PRAESENSA

Public Address and Voice Alarm System



en Installation manual

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1 Important product information

1.1 Safety information

1. Read and keep these safety instructions. Follow all instructions and heed all warnings.
2. Download the latest version of the applicable installation manual from www.boschsecurity.com for installation instructions.



Information
Refer to the Installation Manual for instructions.

3. Follow all installation instructions and observe the following alert signs:



Notice! Containing additional information. Usually, not observing a notice does not result in damage to the equipment or personal injuries.



Caution! The equipment or the property can be damaged, or persons can be injured if the alert is not observed.



Warning! Risk of electric shock.

4. System installation and servicing by qualified personnel only, in accordance with applicable local codes. No user-serviceable parts inside.
5. System installation for emergency sound (except for call stations and call station extensions) in a Restricted Access Area only. Children may not get access to the system.
6. For rack-mounting of system devices, make sure that the equipment rack is of suitable quality to support the weight of the devices. Use caution when moving a rack to avoid injury from tip over.
7. The apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus.



Warning! To reduce the risk of fire and electric shock, do not expose this apparatus to rain or moisture.

8. Mains powered equipment shall be connected to a mains power outlet socket with a protective earthing connection. An external, readily operable, mains plug or all-pole mains switch shall be installed.
9. Only replace the mains fuse of an apparatus with a fuse of the same type.
10. The protective ground connection of an apparatus shall be connected to protective ground before the apparatus is connected to a power supply.
11. Amplifier outputs marked with ⚠ may carry audio output voltages up to 120 V_{RMS}. Touching uninsulated terminals or wiring may result in an unpleasant sensation.
    Amplifier outputs marked with ⚠ or ϟ may carry audio output voltages above 120 V_{RMS}. It requires a skilled person to strip and connect the loudspeaker wires in such a way that the naked conductors are inaccessible.
12. The system may receive power from multiple mains power outlet sockets and backup batteries.



Warning! To prevent a shock hazard disconnect all power sources prior to system installation.

13. Only use recommended batteries and observe polarity. Risk of explosion if an incorrect type of battery is used.

14. Fiber optical converters use invisible laser radiation. To prevent injury, avoid eye exposure to the beam.
15. Devices for vertical (wall) mounting supporting a user interface for operation shall only be mounted below 2 m height.
16. Devices installed above 2 m height may cause injury when falling down. Preventive measures must be taken.
17. To prevent hearing damage do not listen at high volume levels for long periods.
18. An apparatus may use a lithium coin battery. Keep away from children. If ingested, high risk of chemical burn hazard. Seek medical attention immediately.

1.2 Disposal instructions



Old electrical and electronic appliances.
Electrical or electronic devices that are no longer serviceable must be collected separately and sent for environmentally compatible recycling (in accordance with the European Waste Electrical and Electronic Equipment Directive).
To dispose of old electrical or electronic devices, you should use the return and collection systems put in place in the country concerned.

1.3 Class A Notice for FCC and ICES 003

applies to U.S.A. and Canadian models only

Business Equipment
For commercial or professional use
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC and Canadian ICES-003 requirements. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense. Intentional or unintentional changes or modifications not expressly approved by the party responsible for compliance shall not be made. Any such changes or modifications may void the user’s authority to operate the equipment.

2 About this manual

The purpose of this installation manual is to provide all required information needed for the installation and interconnection of the Bosch PRAESENSA products. It will guide new installers step-by-step and serves as a reference for experienced installers.

- Unless required for the installation of the products, this manual does not describe software installation, configuration and operating/user instructions. Refer to *Related documentation, page 11*.
- This manual, or an update, in pdf format is available as download from www.boschsecurity.com > PRAESENSA product section > System overview > Documents tab.

Refer to the following sections before and during installation and maintenance of your system:

- **Chapter 1**: *Important product information, page 8* - contains important instructions and safeguards, which you should read before installing or operating your system.
- **Chapter 2**: *About this manual, page 10* - gives information on the intended audience, training, available documentation and explains how to use this manual.
- **Chapter 3**: *System introduction, page 14* - provides a high-level introduction description of the PRAESENSA Public Address and Voice Alarm System. A brief product description and overview is included.
- **Chapter 4**: *General installation procedures and instructions, page 19* - describes considerations for rack building, cable selection and network design.
- **Chapter 5**: *System composition, page 36* - describes considerations and methods for system composition, battery calculation and heat loss.
- **Chapter 6:** *From installation to configuration, page 50* - describes procedures and instructions on how to prepare a PRAESENSA system for configuration.
- **Chapter 7-16**: Products - detailed introduction of each product (category), including functionality, installation and connection instructions and technical specifications.
- **Chapter 17**: *Application notes, page 179* - provides notes on challenging installation and system requirements.
- **Chapter 18**: *Troubleshooting, page 184* - explains where to find troubleshooting information, and provides a list of known issues and their solutions.
- **Chapter 19**: *Maintenance and service, page 186* - provides useful information for maintaining and using your system.
- **Chapter 20**: *EN 54-16 / EN 54-4 compliance, page 191* - gives installation and configuration directions for compliance to EN 54-16 and EN 54-4.
- **Chapter 21**: *ISO 7240-16 / ISO 7240-4 compliance, page 196* - gives installation and configuration directions for compliance to ISO 7240-16 and ISO 7240-4.
- **Chapter 22**: *DNV-GL type approval, page 200* - gives installation and configuration directions on vessels for compliance to DNV-GL.
- **Chapter 23**: *Architects' and engineers' specifications, page 204* - provides A&E specification details on system and product level.
- **Chapter 24**: *Support and academy, page 209* - provides (technical) support and training information.

2.1 Intended audience

This installation manual is intended for everyone who is authorized to install PRAESENSA and related products.

2.2 Training

Participation in the Bosch PRAESENSA product and system training is highly recommended before installing and configuring a PRAESENSA system. The Bosch Security Academy offers classroom training sessions as well as online tutorials on www.boschsecurity.com > Support > Training.

2.3 Related documentation

The Bosch PRAESENSA technical documentation is set up in a modular way addressing different stakeholders.

	Installer	System integrator	Operator
Quick installation guide (QIG). Basic step-by-step installations instructions.	X	-	-
Installation manual. Detailed system and product descriptions and installation instructions.	X	X	-
Configuration manual. Detailed instructions for configuration, diagnosis and operation.	X	X	X

Notice!
Retain all documentation supplied with the products for future reference.
Visit www.boschsecurity.com > PRAESENSA product section.

2.3.1 Other related documentation

- Commercial brochures
- Architects' & Engineers' specifications (included in the product datasheet)
- Release notes
- Datasheets
- Application notes
- Other PRAESENSA hardware and software related documentation.

Visit www.boschsecurity.com > PRAESENSA product section > System controller > Downloads > Literature.

2.4 Listing of open source components

An up to date listing of open source licensed software which may accompany a PRAESENSA device is stored inside the device and can be downloaded as a zip-file. Download instructions are in the Quick Installation Guide (QIG) of the device. This list is also available from www.boschsecurity.com/xc/en/oss/.

Each of the components listed may be redistributed under the terms of their respective open source licenses. Notwithstanding any of the terms in the license agreement you may have with Bosch, the terms of such open source license(s) may be applicable to your use of the listed software.

To the extent permitted by applicable law, Bosch and its suppliers make no representations or warranties, express or implied, statutory or otherwise, with regard to the list or its accuracy or completeness, or with respect to any results to be obtained from use or distribution of the list. By using or distributing the list, you agree that in no event shall Bosch be held liable for any special, direct, indirect or consequential damages or any other damages whatsoever resulting from any use or distribution of this list.

2.5 Copyright notice

Unless otherwise indicated, this publication is the copyright of www.boschsecurity.com. All rights are reserved.

2.6 Trademarks

Throughout this document trademark names may have been used. Rather than put a trademark symbol in every occurrence of a trademark name, Bosch Security Systems states that the names are used only in an editorial fashion and to the benefit of the trademark owner with no intention of infringement of the trademark.

2.7 Notice of liability

While every effort has been taken to ensure the accuracy of this document, neither Bosch Security Systems nor any of its official representatives shall have any liability to any person or entity with respect to any liability, loss or damage caused or alleged to be caused directly or indirectly by the information contained in this document.

Bosch Security Systems reserves the right to make changes to features and specifications at any time without prior notification in the interest of ongoing product development and improvement.

2.8 Document history

Release date	Documentation version	Reason
2019-11	V1.00	1st edition
2020-07	V1.10	Chapters updated: 1.1, 1.2, 1.3, 2, 2.4, 2.8, 3.1, 3.2, 4.5.2, 5.4.3, 7.2, 7.5, 7.6.3, 7.7, 7.8, 8, 8.4, 8.5.3, 8.5.4, 8.5.5, 8.6, 8.7, 9.4, 9.5.3, 9.5.4, 9.5.5, 9.6, 9.7, 10.6, 10.7, 11.4, 11.5.3, 11.5.4, 11.5.5, 11.5.6, 11.6, 11.7,12.4, 12.5.7, 12.6, 12.7, 13.2, 13.4, 13,6, 13.7, 14.5, 14.5.1, 14.6, 15.5, 16.6, 16.7, 20.3. Chapter titles updated: 7-16. Chapters added: 4.7, 21, 22, 23, 24.

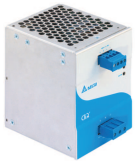
3 System introduction

With PRAESENSA, Bosch has set a new standard in Public Address and Voice Alarm systems. With all system elements being IP-connected and using state-of-the-art technologies, this system combines cost efficiency and audio quality with ease of installation, integration and use. IP-connectivity and amplifier power partitioning enable new levels of scalability and adaptability, and combined with local backup power facilities this makes PRAESENSA equally suited to both centralized and decentralized topologies. PRAESENSA uses only a few different but very flexible system devices, each with unique capabilities, to create sound systems of all sizes for an extremely wide range of applications. PRAESENSA fits to an office with background music in the reception area and some occasional calls, as well as to an international airport with many simultaneous (automated) announcements for flight information, and carefully selected music programs in lounges, restaurants and bars. In all cases, it can be installed to operate also as a certified voice alarm system for mass notification and evacuation. System functions are defined and configured in software and system capabilities can be enhanced via software upgrades. PRAESENSA: one system, endless options.

3.1 Product overview

The following table gives an overview of the available PRAESENSA products. A detailed product description is given by using the link in the "product name" column.

Order number	Product view	Product name
PRA-SCL		*System controller (SCL, SCM, SCS), page 56*
PRA-AD604		*Amplifier, 600W 4-channel (AD604), page 67*
PRA-AD608		*Amplifier, 600W 8-channel (AD608), page 84*
PRA-EOL		*End-of-line device (EOL), page 100*
PRA-MPS3		*Multifunction power supply, large (MPS3), page 106*

Order number	Product view	Product name
PRA-CSLD		*LCD call station (CSLD, CSLW), page 132*
PRA-CSLW		*LCD call station (CSLD, CSLW), page 132*
PRA-CSE		*Call station extension (CSE), page 147*
PRA-ES8P2S		*Ethernet switch (ES8P2S), page 157*
PRA-SFPSX and PRA-SFPLX		*Fiber transceiver (SFPLX, SFPSX), page 166*
PRA-PSM24 and PRA-PSM48		*Power supply module (PSM24, PSM48), page 171*

Refer to

- *Amplifier, 600W 8-channel (AD608), page 84*
- *Amplifier, 600W 4-channel (AD604), page 67*
- *End-of-line device (EOL), page 100*
- *Multifunction power supply, large (MPS3), page 106*
- *LCD call station (CSLD, CSLW), page 132*
- *Call station extension (CSE), page 147*
- *System controller (SCL, SCM, SCS), page 56*
- *Ethernet switch (ES8P2S), page 157*
- *Fiber transceiver (SFPLX, SFPSX), page 166*
- *Power supply module (PSM24, PSM48), page 171*

3.2 High level system characteristics

Secure IP-infrastructure

- PRAESENSA is a networked sound system in which all system elements are connected to OMNEO. Built upon multiple technologies, including IP and open public standards, OMNEO supports AES67 and Audinate's Dante for audio communication and AES70 for system control, with additional network security implemented using AES128 and TLS, offering real-time authentication and audio encryption on IP as protection against malicious attacks.
- OMNEO offers a mature, professional-grade media networking solution that provides interoperability, unique features for easier installation, better performance, and greater scalability than any other IP offering on the market.

Effective power utilization

- PRAESENSA multi-channel power amplifiers have the unique capability of power partitioning, the total power budget of the amplifier can be freely shared across the output channels.
- The class-D amplifier channels operate at high power supply voltages for direct drive 70 V or 100 V outputs without the need for output transformers that would limit the maximum output power of a channel. This also improves efficiency and audio performance and lowers the weight and size of the amplifier. Galvanic isolation of the amplifier outputs, as required by EN 54-16 and other emergency sound standards, is provided by isolated DC/DC converters and the isolated Ethernet connections. The amplifier channels have a load independent, flat frequency response that accept loudspeaker loads between zero and full load. Each channel serves a separate zone or part of a zone.
- The total amount of output power is defined by the redundant power supply and the heatsink, and because both are shared between the amplifier channels, it doesn't matter how many loudspeakers are connected to each channel, as long as the total combined load does not exceed the maximum of 600 W for the whole amplifier and a load > 300 W is not connected to any other channel than channel 1. A spare amplifier channel is also included to take over a failing channel, a very cost- and space-effective redundancy measure because this spare channel uses the same redundant power supply and heatsink too.
- The flexibility of variable output power for each channel makes it possible to utilize most of the available amplifier power. Traditional multi-channel amplifiers have a fixed maximum output power per channel. If a channel is not fully loaded, or even not used, the remaining power capability of that channel cannot be claimed by one of the other channels. PRAESENSA systems typically only need half the amount of amplifier power compared to systems with traditional fixed maximum power amplifiers, saving on space, energy and cost.

Highest system availability

- PRAESENSA offers the highest system availability due to conservative derating of all components, supervision of all critical signal paths and functions, and built-in redundancy of all critical system elements.

  PRAESENSA devices have high margins for safety and temperature stability. This is illustrated by the fact that PRAESENSA devices are quite unique in that they may be operated at altitudes of up to 5000 m (16404 ft), an important requirement in Peru, Chile, India, China and other countries. At this altitude the air is less dense and the cooling capacity of air is decreased, making heat removal less effective. Also, the

dielectric properties of air change with altitude, decreasing its insulator capabilities. PRAESENSA uses effective heat sinking and significantly increased creepage and clearance distances to maintain safety ratings.
- Dual redundant system controller option for highest system availability in mission-critical applications.
- All system devices use dual Ethernet ports, supporting RSTP, to recover automatically from a broken network link.
- The multifunction power supply offers battery backup facilities to be insensitive to mains failures.
- Amplifiers have an integrated spare amplifier channel to take over from a failing channel automatically. They also have double power supplies built in, working in tandem to minimize stress on components, while each one is capable of supplying full power to the amplifier if one section would fail.
- The amplifiers have two loudspeaker outputs per channel, group A and B, separately supervised and protected, to support connection of interleaving loudspeaker strings in the same zone, so a shorted or interrupted loudspeaker line will not mute that zone completely.

Optimized user experience
- The PRAESENSA call stations provide a combination of a large touch screen LCD with mechanical buttons and LED indicators. Access to system functions and areas can be configured per call station, to provide exactly the functions the operator needs, not more, not less. The user interface has been developed in cooperation with real users and addresses their needs, but also their discomforts when making calls to zones they can't see or hear, or adjusting the volume of background music in these areas.
- Functions are easily selected from the touch screen, and zones are easily selected via keypad keys with LEDs giving immediate feedback on the actual status of that zone. After starting a call, the screen shows the operator the progress of the call, indicating when to speak after a start tone or automatic introduction message has finished, and showing whether the call was successfully completed in all destinations.

Fully-featured as standard
- PRAESENSA is an advanced system for Public Address and Voice Alarm purposes. The system consists of a limited range of hardware devices in combination with software to create the required functions. Because the hardware devices are very complete and flexible to use, only a few different devices are sufficient to create a system. For instance, all call stations and amplifiers have a built-in DSP for sound processing, the amplifiers have flexible output power per channel and a built-in spare channel, the power supply has a built-in battery charger, and so on. No need for separate add-ons.
- System functions are software based and regularly updates become available to extend the set of capabilities.

Scalable and flexible
- PRAESENSA is an extremely scalable and flexible system. All devices are network connected and offer loop-through connectivity for easy system expansion and RSTP to create a fail-safe network loop. System devices can be decentralized and their redundant loop wiring often allows for cheap non fire-resistant network cables to be used.
- PRAESENSA uses dynamic channel allocation. Because devices do not use static routing, amplifiers and call stations do not have a permanent audio connection to the system controller. That approach would limit the number of devices, since an 8-channel amplifier would at least need 8 connections, 100 amplifiers would need 800 connections to be independent. Instead, PRAESENSA uses dynamic OMNEO connections that are generated

on the fly when needed and freed up after use. Dynamic streams occupy the least bandwidth; if there is no audio transport going on, the channels are simply not there. Furthermore, this is a scalable solution compared to static channels, which are limited to the number of interconnections that can be handled by the device that contains the audio matrix. All OMNEO audio streams are set up as multicast, directly from the source (the transmitting device, such as a call station) to the destinations (the receiving devices, such as amplifier channels). This connection is setup by the system controller using OCA (AES70). The audio matrix is in the network itself, not in a single unit. In this way, there is no real limitation on the number of source and destination devices. The only limitation is on the number of simultaneous (different) audio streams, which is above 100 and more than enough for even the busiest applications.

- Multifunction power supplies have an integrated battery charger for single 12 V battery based backup power, facilitating easy system decentralization. Amplifiers can be placed closer to the loudspeakers, reducing loudspeaker cabling costs, which is especially advantageous in case of expensive fire-resistant loudspeaker cables.
- DSP power is available in all call stations and amplifiers, so DSP power grows with every device added to the system.
- Every zone has its own amplifier channel for dedicated audio content. Users can make personal music and volume selections, while announcement levels are not affected and loudspeaker line supervision is not impaired. The amplifier’s built-in DSP allows the sound in each zone to be adjusted to the needs and taste of the audience in that area.
- The complexities of traditional system planning make little room for error or last-minute changes. With PRAESENSA however, flexibility is built-in, allowing for an agile and adaptive approach to planning. PRAESENSA allows for future changes to the areas covered by the system, with minimal or no equipment changes. Thus, initial planning is less sensitive to later small changes, which could impact profitability.

4 General installation procedures and instructions

This section provides mounting and installation instructions common to all PRAESENSA devices. It provides installation methods commonly encountered in industrial and commercial applications and should be used in conjunction with the engineer's installation specifications and all applicable codes.



Caution!
All work activities necessary for the installation, connection and commissioning are to be carried out by electrically skilled persons only.

4.1 Location of racks and enclosures

The Bosch PRAESENSA VACIE (Voice Alarm Control and Indicating Equipment) system is designed to provide an emergency announcement and public address system in accordance with the requirements of international standards. The PRAESENSA VACIE includes control and indicator equipment, multi-channel amplifiers, multifunction power supplies, network infrastructure and optional emergency call stations.
In order to ensure that the standards compliance of the PRAESENSA VACIE is not compromised, the PRAESENSA devices, the interconnections to the Fire Detection System, network infrastructure, loudspeakers and loudspeaker wiring must be installed in accordance with the provisions of applicable standards and the directions provided in this Bosch PRAESENSA installation manual.
The Bosch PRAESENSA VACIE must be installed and commissioned by those who have completed the appropriate training courses conducted by Bosch Security Systems. Once the installation and commissioning process is complete, access to the VACIE is restricted to authorized personnel only, in accordance with the access levels indicated in the following table.



Caution!
Also in case the PRAESENSA system is not being used as VACIE and the corresponding access restrictions are not applicable, the system controller, amplifiers and power supplies (19"-equipment) should be installed in a Restricted Access Area only. Especially children may not get access to this equipment.



Caution!
The system shall not be installed near water or heat sources.



Caution!
System power supplies shall be connected to a mains power outlet socket with a protective earthing connection. An external, readily operable, mains plug or all pole mains switch shall be installed.

Level	Authorized operations	Authorized persons	Access restrictions
Level 1	– Accessibility to all mandatory visible and audible indications – System operation for business calls and background music	Members of the general public	Unrestricted, such as – Desktop call station in public area – Wall-mounted background music control panels in public zone
Level 2	– Level 1 operations – System operation in the: – Quiescent condition – Voice alarm condition – Fault warning condition – Disabled condition – Test condition	Persons with specific responsibility for safety, competent and authorized to operate the system	Restricted by a special procedure, such as – Operator panel mounted in an enclosure with lockable door
Level 3	– Level 2 operations – Re-configuration of site-specific data – System maintenance	Persons with specific responsibility for system maintenance, competent and authorized	Restricted by a special procedure, differing from that for access level 2, such as – Configuration program with password protection – System is mounted in a 19”-rack with lockable doors
Level 4	– Level 3 operations – System repair – Perform firmware alterations, thereby changing the basic mode of operation	Persons with specific responsibility for system repair, competent and authorized by the manufacturer	Restricted by special means, not part of the VACIE, such as – Dedicated firmware upgrade program with password protection – Dedicated tools

The PRAESENSA VACIE, consisting of PRAESENSA devices and associated support devices and optional batteries, is typically housed in one or more free-standing or wall-mounted rack cabinets. These cabinets can be at one central location or decentralized, servicing a larger area. PRAESENSA end-of-line devices, used for loudspeaker line supervision are mounted at appropriate locations, in accordance with the directions provided in this manual.
To ensure correct operation, the installer needs to ascertain that access level requirements are met. To maintain standards compliance, installers must follow the Bosch installer guidelines.

To achieve the specified access level 2:

– Access to the emergency microphone is restricted by mounting the microphone in a lockable enclosure or control room.

To achieve the specified access level 3:

– The cabinets must be located in lockable rooms, or a cabinet construction with lockable doors must limit access to rear terminals and wiring of equipment.
– Access to end-of-line supervision devices and loudspeaker wiring terminals requires the use of tools.

4.2 Unpacking products

The products should be unpacked and handled with care. If an item appears to be damaged, notify the shipper immediately. If any items are missing, notify your Bosch representative. The original packaging is the safest container in which to transport products and can also be used to return products for service, if necessary.

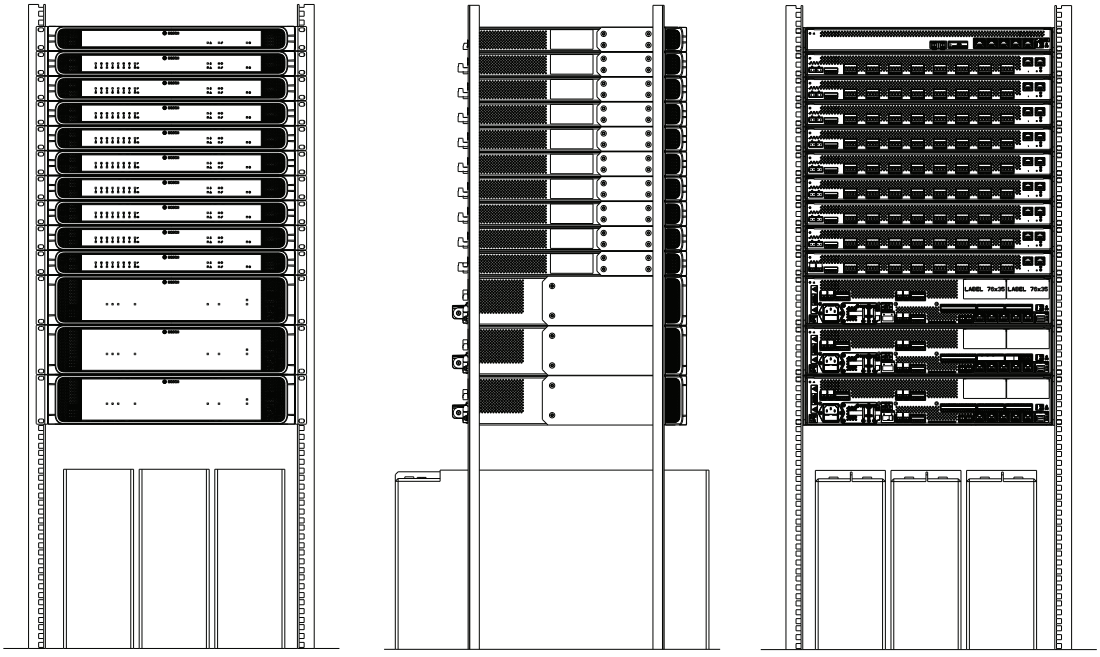
4.3 Equipment racks and cabinets

All PRAESENSA equipment housings are of robust construction and meet at least classification IP30 of EN60529:1992 as amended by EN60529:1991/A1:2000. Racks with a swing frame give better access to wiring. Racks without rear stands provide more space for batteries.

4.4 Mounting the 19"-rack devices

Common installation materials and tools are sufficient to install PRAESENSA products. Each product comes with a set of product specific installation accessories and a quick installation guide (QIG).
Make sure the 19"-equipment rack is of suitable quality to support the weight of the device(s). All PRAESENSA equipment can be located anywhere in the equipment rack. For ease of wiring, it is however advisable to mount devices in the following order (top to bottom):

– System controller (top)
– Amplifiers
– Multifunction power supplies
– Batteries (bottom)



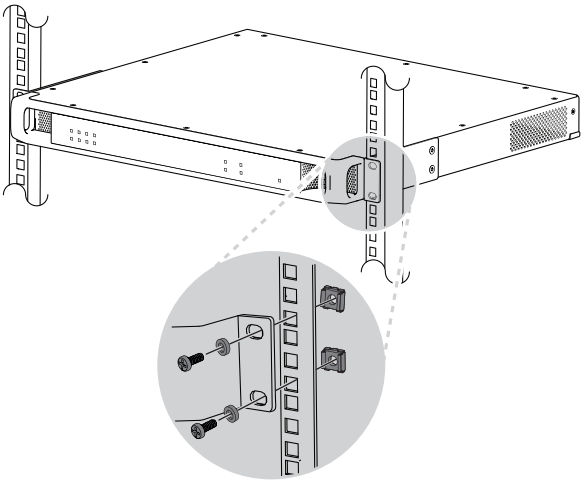
As long as the equipment rack is well ventilated, all devices can be stacked with no extra space between them. Make sure the temperature inside the rack cannot exceed +50 °C (+122 °F).

- Mounting brackets are used to mount the device in 19”-equipment racks.
- Ventilation inlets should be kept free of obstacles and dust. Fans are controlling the airflow based on internal temperature. Airflow is from the front to the rear and sides.
- Integrated handles make it easy to maneuver the device, without adding to the installation depth.
- Sliding feet prevent making scratches on the surface the device is positioned on.
- Product labels are on the side or rear of each device.

Notice!

Make pictures of the product labels and make sure the hostnames and MAC-addresses are readable, or make a list of all hostnames and MAC-addresses of the devices before mounting them in the rack. This information is needed for configuration later. After mounting, access to the product labels with this information might be difficult, especially for devices that have their labels on the side.

The mechanical construction of all 19"-devices is rigid enough to mount the devices using only the holes in the mounting brackets to secure them in the rack. It is however considered good practice to mount support rails if the system is installed in a moving environment.



The PRAESENSA 19”-devices are equipped with (removable) mounting brackets for mounting in a 19”-rack. Use four caged nuts, nylon cup washers and pan head bolts for mounting. Common sizes for bolts and nuts for rack mounting are M6, M8, 10-32 or 12-24.

Caution!

The rack must be grounded to a safety ground. All PRAESENSA 19”-devices have a chassis ground screw on the rear panel, which can be used for a wire connection to the rack frame. Use a thick, multi-strand wire (>2.5 mm^2) with wire eyelets and washers for a solid connection. This connection is mandatory for the PRA-AD604 and PRA-AD608 as a reference for ground-short detection and because of high internal voltages, but may improve immunity to electrostatic discharges (ESD) for all devices.

4.5 Cable requirements

To ensure safety and system reliability, different types of cabling are required for cabling inside the racks that house PRAESENSA devices, and for cabling between racks and to ancillary items such as loudspeakers.

4.5.1 Precautions

Prior to installation

Confirm the following:

- The cable selected is proper for the application, taking into account all applicable local, state, provincial, and national codes.
- The cable has not been damaged in transit or storage.

During cable installation

The following factors must be considered:

- Do not exceed the fill capacity of raceways and cable trays.
- Use grommets to protect cables when passing through metal studs or anything that can possibly cause damage.
- Obey bending rules of cables and maximum pull force.
- Be sure to firestop all cables that penetrate a firewall.
- Use plenum rated cable where it is mandated.
- Use fire resistant cable when it is mandated.

4.5.2 Cable type recommendations

Mains cable

– Use the supplied mains cable that came with the multifunction power supply or an equivalent.

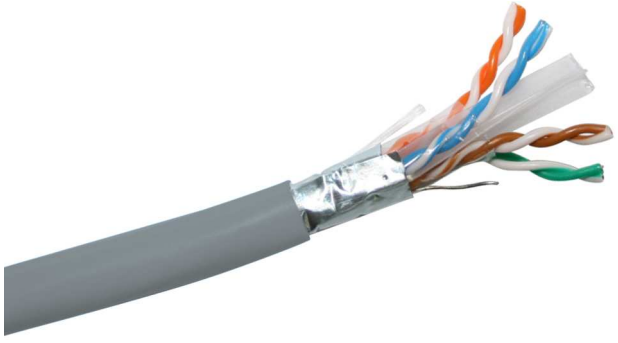
Loudspeaker cable

– When selecting cables and wire gauge take into account the length and loudspeaker load to avoid excessive power loss. Make sure that the signal level at the end of the loudspeaker line has not dropped with more than 2 dB (this is approximately 20%), as this will also affect proper operation of the end-of-line device.
  The table shows the required wire size for copper wires, to keep the loss at the end of the loudspeaker line below 2 dB, when all the load is at the end of the cable. In practice the load will be more distributed and then the attenuation will be less than 2 dB. Round up the actual load power and cable length to the next number in the table.
  Copper clad aluminum (CCA) wires are cheaper but have a higher resistance than copper for the same diameter. When using CCA cables, take the next bigger wire size from the table. **Examples:**
  – A 150 W loudspeaker load on a loudspeaker line of 480 m in a 100 V system. Round up to table values 200 W and 500 m. This requires 1.5 mm^2 copper wires or 2.5 mm^2 CCA wires.
  – A 150 W loudspeaker load on a 1200 ft loudspeaker line in a 70 V system. Round up to table values 150 W and 1312 ft. This requires AWG 14 copper wires or AWG 12 CCA wires.
– When selecting cables and wire gauge take into account the maximum loudspeaker cable capacitance specified for the amplifier.
– When end-of-line supervision is used, take into account the maximum loudspeaker cable capacitance specified for the end-of-line device.
– For compliance to UL 62368-1 all loudspeaker wiring must be Class 2 (CL2); this requirement does not apply for compliance to EN/IEC 62368-1.

Conversion									
mm^2	0.5	0.75	1	1.5	2.5	4	6	10	16
AWG	20	18	17	16	14	12	10	8	6

Cable length		Minimum wire cross section [mm²]								
[m]	[ft]									
1000	3280	0.5	0.75	1.5	4	6	6	10	10	16
900	2952	0.5	0.75	1.5	2.5	4	6	10	10	10
800	2624	0.5	0.75	1.5	2.5	4	6	6	10	10
700	2296	0.5	0.5	1	2.5	4	4	6	6	10
600	1968	0.5	0.5	1	2.5	2.5	4	6	6	10
500	1640	0.5	0.5	0.75	1.5	2.5	4	4	6	6
400	1312	0.5	0.5	0.75	1.5	2.5	2.5	4	4	6
300	984	0.5	0.5	0.5	1	1.5	2.5	2.5	2.5	4
250	820	0.5	0.5	0.5	0.75	1.5	1.5	2.5	2.5	4
200	656	0.5	0.5	0.5	0.75	1	1.5	1.5	2.5	4
150	492	0.5	0.5	0.5	0.5	0.75	1	1.5	1.5	2.5
100	328	0.5	0.5	0.5	0.5	0.5	0.75	0.75	1	1.5
50	164	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75
[W]	@100 V	20	50	100	200	300	400	500	600	-
[W]	@70 V	10	25	50	100	150	200	250	300	400
Loudspeaker power at end-of-line										

Ethernet copper cable



Notice!

In order to comply with the strict rules regarding compliance to high energy voltage surges on the Ethernet connections it is mandatory to use shielded twisted pair cabling (F/UTP), not ordinary unshielded twisted pair cabling (UTP). F/UTP denotes foiled/unshielded twisted pair and consists of four unshielded twisted pairs encased in an overall foil shield. This is not to be confused with an S/FTP (screened / foiled twisted pair) cable which has four individually shielded twisted pairs encased in an overall braided shield.

- All PRAESENSA devices are designed to be used with Gigabit transmission (1000BASE-T), so be sure to use shielded CAT5e or higher network cables. You can use shielded CAT6 and CAT7 cables as necessary. According to their specifications, CAT5e or higher cables can transmit data up to 100 m, but the actual potential transmission distance varies depending on factors such as the cable and termination quality and the environment in which the cable is used. In case of doubt use a cable checker to see whether the cable conforms to CAT5e (TIA/EIA-568-B). Furthermore, cables can be categorized into solid core cables and stranded cables according to the structure of the conductors within the cables. In a solid core cable each of the eight conductors consists of a single copper wire, while in a stranded cable each conductor consists of stranded multiple copper wires. Solid core cables have better transmission performance over long distances than stranded cables. Stranded cables are more flexible and easier to handle than solid core cables. Therefore, in general, solid core cables are suited for installations, while stranded cables are suited for short patch links inside racks.
- Make only gradual bends in the cable where necessary to maintain the minimum bend radius of 4 times the cable diameter. Never allow the cable to be sharply bent, twisted, or kinked at any time. This can cause permanent damage to the geometry of the cable and cause transmission failures.
- Dress the cables neatly with cable ties, using low to moderate pressure.

Ethernet glass fiber cable

- Use single mode or multi-mode glass fiber that fits the SFP transceiver.
- The length of the fiber must not exceed the maximum as specified for the SFP transceiver, also considering the fiber diameter.
- Keep all food and beverages out of the work area. If fiber particles are ingested they can cause internal hemorrhaging.
- Wear disposable aprons to minimize fiber particles on your clothing. Fiber particles on your clothing can later get into food, drinks, and/or be ingested by other means.
- Always wear safety glasses with side shields and protective gloves. Treat fiber optic splinters the same as you would treat glass splinters.
- Never look directly into the end of fiber cables until you are positive that there is no light source at the other end. An SX fiber 850 nm light source is hardly visible, an LX fiber 1310 nm light source is not visible at all.
- Do not touch your eyes while working with fiber optic systems until your hands have been thoroughly washed.
- Put all cut fiber pieces in a properly marked container for disposal.
- Thoroughly clean your work area when you are done.

4.6 Network requirements and considerations

PRAESENSA uses technologies built on top of standard Ethernet networks and the performance of PRAESENSA is heavily reliant on the network configured underneath it. As a result, the underlying network needs to be configured correctly. If the network is not functioning properly, the audio equipment will not function properly either. Because all PRAESENSA devices have integrated Ethernet switches, a system can be set up without being dependent on third party network infrastructure. In many situations, however, PRAESENSA may have to share the network with other services, especially on existing network infrastructure. Although most Gigabit networking equipment will adequately support PRAESENSA, certain configurations that may be present in an enterprise network could cause issues. In any case it is appropriate to consult the IT department when planning and configuring a PRAESENSA network, taking the following network considerations into account.

4.6.1 Network topology

PRAESENSA offers great flexibility to position its networked devices across the premises. This allows for a conventional centralized system topology, with most of the equipment in a central 19”-rack in a technical room. But it is as easy to position equipment in smaller clusters on different locations in order to keep loudspeaker lines short, saving on cost and reducing power losses in the loudspeaker cabling. This is especially beneficial when expensive fire-resistant cables must be used. Because all system elements are network connected and can be powered from a multifunction power supply with local battery backup power, a decentralized system topology is easier than ever before. Call stations, positioned at operator locations, are also network connected and even powered over Ethernet.

4.6.2 Network connector ports

The system controller has five external RJ45 network ports and acts as the root switch for the network, supporting multiple loops.
The multifunction power supply has five external RJ45 network ports and one socket for a Small Form-factor Pluggable (SFP) transceiver module for a single mode or multi-mode optical fiber connection, to facilitate long distance connections between decentralized clusters of devices. Two of the RJ45 network ports provide Power over Ethernet (PoE) to power a connected call station.
Each call station has two RJ45 network connectors, each capable of taking PoE-power, to connect to one or two different power supplies, to allow for fail-safe redundancy. Because of PoE, connecting call stations in a loop-through fashion is only possible with a PoE power source in between, e.g. a midspan PoE power adapter.

4.6.3 Audio content and device control

PRAESENSA uses OMNEO network technology. OMNEO is an architectural approach to connecting devices that need to exchange information such as audio content or device control. Built upon multiple technologies, including IP and open public standards, OMNEO supports the technologies of today such as Audinate’s Dante while adopting the standards of tomorrow, such as AES67 and AES70. OMNEO offers a professional-grade media networking solution that provides interoperability, unique features for easier installation, better performance and greater scalability than any other IP offering on the market.
Using standard Ethernet networking, media products that integrate OMNEO can be assembled into small, medium and large networks that exchange studio-quality synchronized multichannel audio and share common control systems. OMNEO’s media transport technology is based on Audinate’s Dante, a high performance standards-based, routable IP-media transport system. OMNEO’s system control technology is AES70, also known as Open Control Architecture (OCA), an open public standard for control and monitoring of professional media network environments. OMNEO devices are fully compatible with AES67 and AES70, without losing any functionality.

4.6.4 Network security

The OMNEO network technology includes two types of security:
– Control security, using encryption and authentication of the TCP (OCA) control data.
– Audio security, using encryption and authentication of the audio streams.

Control security is realized via Transport Layer Security (TLS). This mechanism requires a TCP-link and a Pre-Shared Key (PSK). The PSK has to be present on a device before it is possible to start a secure connection with that device. OMNEO uses the Diffie-Hellman key exchange method to allow two parties that have no prior knowledge of each other to jointly establish a shared secret key over an insecure channel. This key can then be used to encrypt

subsequent communications. This solution comes with a short period of vulnerability when the factory default key is changed to a system-specific key. At that moment attackers can learn the system key by eavesdropping the Diffie-Hellman key exchange during the connection setup with the factory default key. Preferably, this part of the setup should be done on a closed network. The PSK is stored persistently in the device. To change the PSK later, the key must be known. When the key is lost and/or devices are transferred from one system to another system, a manual reset switch allows a device to be reset to its factory default. This requires physical access to the device.
The Cipher suite used by OMNEO is TLS_DHE_PSK_WITH_AES_128_CBC_SHA. This means:
– Encryption 128 AES.
– Authentication and data integrity HMAC-SHA-1.
Audio security uses a proprietary implementation of a standards based algorithm for encryption and authentication. The main reason for this is the required low latency, it only adds 0.1 ms additional sample delay for encoding plus decoding. It uses 128 AES encryption in Cipher Feedback Mode (CFB) for self-synchronization, even when the audio stream is received much later than when it was started, or when some samples are lost during reception. Only six audio samples (125 us @ 48 kHz sample rate) are sufficient to re-synchronize.
For authentication the algorithm uses Cipher-based Mandatory Access Control, CMAC. This adds eight bits to each 24-bit audio sample, resulting in 32-bit samples.
The audio security algorithm uses a Pre-Shared Key that has to be equal for the transmitter and receiver. The key is volatilely stored on the device and is lost after a power cycle, so it must be redistributed via a secure control connection. A random key is defined every time an audio connection is created, so each audio link has a different key.

Other security measures in PRAESENSA are:
– The system controller stores passwords and exchanges passwords with the Open Interface / API clients using the SHA-2 Secure Hash Algorithm (version SHA-256).
– Configuration and message backup is possible over an authenticated secure connection (HTTPS) based on Transport Layer Security (TLS1.2).

4.6.5 Network speed and bandwidth usage

PRAESENSA uses the OMNEO protocol for audio and control, with all audio streams based on 48 kHz sample rate and 24-bit sample size. Because of encryption for security, 32-bits per sample are used. By default the receiver latency is set to 10 ms as a compromise between latency and network efficiency. This combination of parameters causes a bandwidth usage of 2.44 Mbps per (multicast) channel in the whole subnet it is used in. Control traffic will add another 1 to 20 Mbps, depending on system size and activities.
A Gb Ethernet network is needed for OMNEO. This is not necessarily a bandwidth requirement of multiple concurrent audio channels. Even if only a few audio channels are in use, a Gb network backbone is needed to support the Precision Time Protocol (PTP) for synchronization of all audio devices (IEEE 1588 and IEC 61588). Packet arrival jitter is a critical parameter, which is the variation in latency between the reception of multiple Ethernet messages from the same source. Because of this, Ethernet packet switching must be done in hardware, as software switches will introduce too much jitter. PRAESENSA devices are pre-configured to use Quality of Service (QoS) prioritization for OMNEO, with carefully selected parameters. Other switches need to be configured with the proper settings for OMNEO.

4.6.6 System size limits

OMNEO always uses synchronized play-out times to make sure every receiver produces the audio at exactly the same moment (with an accuracy of 1 us). The maximum distance between two networked devices on the network depends on the configured latency of the receivers. By default PRAESENSA uses a receiver latency setting of 10 ms, which allows for a maximum distance between two devices in the same subnet of 500 km. The OMNEO technology allows for a maximum receiver latency of 20 ms, which is sufficient to cover a distance of 3000 km between devices (not yet supported by PRAESENSA).
If the distance between a transmitter and a receiver is too long for the configured receiver latency, then the audio samples arrive at the receiver later than the instructed play-out time. Then the samples cannot be used anymore, resulting in no audio.
The **maximum number** of PRAESENSA network devices in a single subnet of a system is **250** devices. For smooth and fast operation of the system it is recommended to limit the system size to **150** devices.

4.6.7 Network switches

All networked PRAESENSA devices have a built in Ethernet switch with at least two Ethernet ports on RJ45, supporting Rapid Spanning Tree Protocol (RSTP). Because of the integrated switches, stacked devices can be looped through conveniently with short cables. For RSTP-support, cable loops are allowed in the network, creating redundant connections for automatic network recovery when a connection would fail. This is an important consideration for emergency sound systems. No conventional star-wiring is needed, although it is possible. A PRAESENSA network can be expanded easily by inserting more devices in the loop or chain.
Not all Ethernet switches can be used for PRAESENSA (or any other system that is based on Audio over IP). As part of the PRAESENSA product range a pre-configured, managed, multi-port Ethernet switch is available for more connection flexibility. This switch is also included in the PRAESENSA certification for EN54-16 and other standards.
In case other switches or routers are to be used, consider the following important requirements:

- The switch must be a Gb-switch with packet switching performed in hardware; software switches will introduce too much jitter.
- The MAC-address table must have a capacity of >1000 addresses, to prevent that the switch starts broadcasting unicast packets because it runs out of space.
- The switch must support Quality of Service (QoS), with strict priority, through differentiated services (DiffServ) on all ports, to ensure that PTP-synchronization and audio packets get priority over control packets.
- Do not use Energy Efficient Ethernet (EEE) for PRAESENSA because this breaks the PTP synchronization, resulting in poor audio synchronization performance and occasional dropouts. EEE is a technology that reduces switch power consumption during periods of low network traffic. It is also known as ‘Green Ethernet’ and IEEE 802.3az.
  The PRAESENSA system controller and multifunction power supply have integrated switches, but when additional switches are needed, it is recommended to use PRAESENSA managed switches. Otherwise, do not use unmanaged Ethernet switches that support the EEE function, since EEE operation cannot be disabled in these switches. For managed switches, ensure that they allow EEE to be disabled and make sure that EEE is disabled on all ports used for PRAESENSA audio traffic.
  Guidelines for selecting switches are found on the Audinate website at the following link: https://www.audinate.com/resources/networks-switches

- Because PRAESENSA uses the Rapid Spanning Tree Protocol (RSTP) for network connection redundancy, the switch must support RSTP (IEEE 802.1D-2004) with the ability to change the following parameters, which must be set to the following (not default) values: Hello_time = 9 s, Forwarding_delay = 30 s, Max_age = 22 s.
  Make sure that **not more than 21** devices are between the root bridge and any other device. The 22nd and further devices will not communicate anymore. This means that a loop of 43 devices may work fine, but when the loop breaks, all devices after the 21st device are lost.
- The switch must support the Link Layer Discovery Protocol (LLDP, IEEE 802.1AB) and LLDP must be enabled. LLDP is a vendor-neutral configuration exchange protocol for Layer 2 discovery based on the IEEE 802.1ab standard. This protocol allows a device to advertise information such as its identity or capabilities to its neighbor. PRAESENSA uses LLDP for network supervision. The Docent network diagnose tool also requires LLDP.
- PRAESENSA uses Internet Group Management Protocol (IGMP), the communication protocol responsible for communication between the end devices (hosts) and the switch or router. It is used for dynamic multicasting between one source and a selected group of destinations by establishing multicast group memberships.
  For switches that offer the possibility of IGMP snooping, it is strongly recommended to disable this feature. Performance limitations of the switch while snooping many simultaneous IGMP messages may cause some messages to be dropped, resulting in no multicast audio being present on the requesting port. Especially when using daisy-chained devices this will be a problem.

4.6.8 Setting up connections

The PRAESENSA system controller manages all dynamic OMNEO channels between PRAESENSA devices. The software program OMNEO Control is not needed to set up OMNEO channels.
To set up static Dante channels from Dante sources to the PRAESENSA system controller, use Dante Controller from Audinate. These static channels will be persistent, i.e. are automatically restored after the Dante source has been switched off and on again.

4.6.9 Network redundancy

Dante supports so-called glitch-free audio redundancy. This is a failover protection mechanism ensuring audio is resistant to network failure. To achieve glitch-free audio redundancy an entirely redundant network structure is required, doubling the network and the installed network components, with dual Ethernet connections on separate subnets. However, to have glitch-free redundant audio, you cannot conveniently daisy-chain units across the subnet. Audio is sent and received on all the connections, eliminating the possibility of connections to other devices in a chain. If one connection is lost, the audio stream is still received through the second connection, meaning no audio information is lost.
An important restriction of this mechanism is that it only works for audio; the transmission of control information is not redundant! Therefore, in the event of failover, audio continues to play, but settings cannot be changed until the primary link has been repaired. This makes glitch-free audio redundancy unsuitable for PRAESENSA, that continuously uses control information between devices for monitoring and call processing.
PRAESENSA uses RSTP to create redundancy. This is not glitch-free, audio will be muted for a short period of time until the network has recovered from a broken link, but it works for both audio and control data. Also, it allows for loop-through connections, so devices can be daisy-chained.

For static Dante audio input streams, the PRAESENSA system controller does support glitch-free audio redundancy. This is possible because these Dante sources are not controlled by the system controller. To use this feature, the primary network must be connected to one of the ports 1 to 4 of the system controller, the secondary network must be connected to port 5. The Dante connections must be set up using Dante Controller software.



Notice!
1000BASE-T Ethernet connections use all four wire pairs in a standard CAT5e cable (or better), while 100BASE-TX uses only two pairs. Most Ethernet switches have a feature that a 1000BASE-T port falls back to 100BASE-TX when a connected cable has a fault of some sort in any of its eight wires. In a system that is using RSTP for cable redundancy, it is important that this fallback feature is disabled, because a 100 Mbps connection is still considered a valid connection and RSTP will not replace it by an alternative high speed 1 Gbps-link. All PRAESENSA devices have this fallback mechanism disabled to allow RSTP to work properly.

4.6.10 IP-addressing

An Internet Protocol (IP) address is a unique address which identifies hardware over the network such as a computer, server, system controller, switch, call station or amplifier. It allows a device to communicate with other devices over an IP-based network such as the LAN or WAN. There are multiple possibilities for assigning an IP-address to a device: Link-Local, DHCP and manual (static) assignment:

- **Link-Local** addresses are automatically assigned by the individual devices in cases where no static IP-addressing is assigned and a DHCP-server is not found (IPv4LL). Addressing is based on the MAC-address of the device. Link-Local addressing can be recognized by an IP-address within the range of 169.254.0.0/16 (169.254.0.1 - 169.254.255.254) with subnet-mask 255.255.0.0. Do not use 255.255.255.0 as subnet-mask! This Link-Local addressing is also known as Automatic Private IP-Addressing (APIPA-addressing). The Link-Local addressing scheme manages fixed IP-addresses in the same range, as the devices automatically check availability of the IP-address to ensure devices that do not support IPv4LL can operate in the same subnet. IPv4LL addressing only supports a single subnet; this IP-address range is not routable, so will be dropped by a router.
- **Dynamic Host Configuration Protocol** (DHCP) is a technology used to assign IP-addresses and other related configuration information (such as subnet mask and default gateway) automatically to each device on a network. This is achieved by using a device that contains a DCHP-server, a feature frequently found in devices such as routers or an ARNI. As long as all devices are within the same subnet, IPv4LL is the preferred way of address assignment. When using DHCP, make sure the DHCP-server is powerful enough, because all devices will request an address immediately after the system switches on.
- **Manually assigned IP-addresses**, also known as static or fixed IP-addressing, are only recommended if there is a good understanding of the network administration and assigned IP-addressing schemes already in place on the network. This is critical for preventing collisions and invalid or duplicate IP-addresses on the network. It is mandatory to enter a valid IP-address and subnet mask, while it is optional to enter a default gateway and DNS-server address. The default gateway is mandatory when data goes outside the local area network (LAN) and the DNS-server is mandatory when an ARNI is used within the system. If there is a DHCP-server active, in addition to using fixed IP-addresses, it is recommended to exclude the fixed IP-addresses from the DHCP-address range. Currently PRAESENSA does not support manually assigned IP-addresses.

Additional information:

– Some devices have **multiple IP-addresses**. This refers to devices that contain multiple Network Interface Cards (NICs) or to the protocols they are using. Examples are the system controller and the call station, which contain a controller IP-address and an audio IP-address.
– **Managed switches** need a valid IP-address to change the configuration.

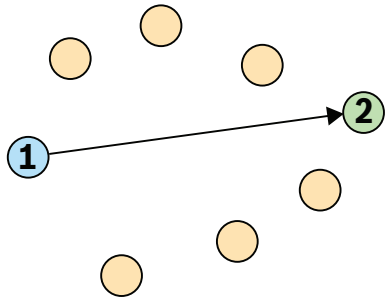
Notice!
When a DHCP-server is added to an existing PRAESENSA network in which the devices already have a Link-Local IP-address, then these devices will query a new IP-address from the DHCP-server and get a new address assigned. This results in temporary network disconnects. When a DHCP-server is removed from an existing PRAESENSA network, initially all devices will continue to work with their assigned IP-addresses. However, when the lease time expires, they will revert back to a Link-Local IP-address. Since every device will do this at a different moment, this will lead to system instability for a prolonged time. It is better to switch off the power to the system, remove the DHCP-server and switch the system on again.

Caution!
When part of a PRAESENSA system is powered down, including the DHCP-server, while the rest of the system remains in operation, then, upon restart of the DHCP-server, some DHCP-servers may assign an IP-address to a restarting PRAESENSA device that is already in use by one of the devices in operation. This will result in unexpected behavior of the system and requires a power cycle of the whole system, to renew all IP-addresses. Also the DHCP-server function of the PRA-ES8P2S switch is suffering from this behavior; therefore this function is disabled by default and it is advised not to enable and use it.

4.6.11 Transmission methods

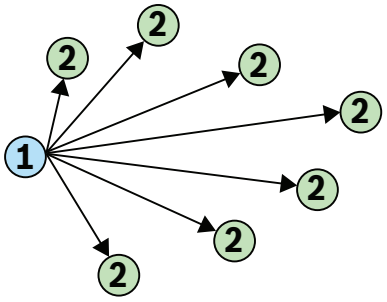
IP-communication takes place using the following transmission methods:

– **Unicast** is used for **one-to-one**, also known as **point-to-point**, transmission with one sender and one receiver. A switch detects which port a unicast IP-address is connected to and only forward packets to this port.



1 Sender
2 Receiver

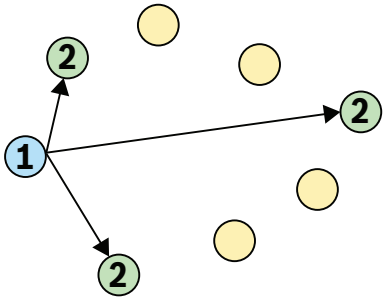
– **Broadcast** is used for **one-to-all** transmission with one sender and multiple receivers. With broadcast, the packets are sent to all devices in the subnet or VLAN. The data is then processed by the devices that need it, but ignored by others that do not. However, the bandwidth on the link is still utilized by sending this information.



1 Sender

2 Receiver

– **Multicast** is used for **one-to-many** transmission with just one sender and multiple receivers. Multicast differs from broadcast in that packets are sent only to the devices and ports that are interested in the data. This means that multicast traffic can make much more efficient use of available network bandwidth, but may also require the use of IGMP for management. Without IGMP, multicast traffic behaves as broadcast traffic.



1 Sender

2 Receiver

Although OMNEO supports unicast and multicast for audio streams, PRAESENSA uses multicast transmission for all dynamic OMNEO audio channels. An audio stream of a call station can be received by multiple amplifiers to play out in connected zones. Even during an announcement it is possible to add zones to that call by subscribing the appropriate amplifiers to the already existing multicast stream.
Exchange of control information is done one-to-one and uses a unicast transmission link.
Dante audio streams can be configured as unicast or multicast stream, depending on the number of receivers (destinations).

4.7 Security precautions

PRAESENSA is an IP-connected, networked Public Address and Voice Alarm system. In order to ensure that the intended functions of the system are not compromised, special attention and measures are required during installation and operation to avoid tampering of the system. Many of such measures are provided in the PRAESENSA configuration manual and installation manual, related to the products and the activities described. This section provides an overview of precautions to be taken, related to network security and access to the system.

– Follow the installation instructions with respect to the location of equipment and the permitted access levels. See section 4.1 of the PRAESENSA installation manual. Make sure that critical* call stations and operator panels that are configured for alarm functions only have restricted access using a special procedure, such as being mounted in an enclosure with lockable door or by configuration of user authentication on the device**.
  * Call stations, that address very large areas, are considered as critical.
  ** Availability of the user authentication function is to be announced.

- It is highly recommended to operate PRAESENSA on its own dedicated network, not mixed with other equipment for other purposes. Other equipment may be accessible by unauthorized people, causing a security risk. This is especially true if the network is connected to the Internet.
- It is highly recommended that unused ports of network switches are locked or disabled to avoid the possibility that equipment is connected that may compromise the system. This is also the case for PRAESENSA call stations that are connected via a single network cable. Make sure that the connector cover of the device is in place and properly fixed, to avoid that the second network socket is accessible. Other PRAESENSA equipment should be installed in an area that is only accessible by authorized people to avoid tampering.
- PRAESENSA uses secure OMNEO for its network connections, using encryption and authentication for all control and audio data exchange, but the system controller allows the configuration of unsecure Dante or AES67 audio connections as an extension of the system, both as inputs and as outputs. These Dante/AES67 connections are not authenticated and not encrypted and form a security risk, as no precautions are taken against malicious or accidental attacks via their network interfaces. For highest security, these Dante/AES67 devices should not be used as part of the PRAESENSA system. If such inputs or outputs need to be used, use unicast connections only. Only Dante devices should be used that support Device Lock. Device Lock allows you to lock and unlock supported Dante devices using a 4-digit PIN (Personal Identification Number). Make sure that the devices are locked when in normal operation. Dante Controller is needed to set the PIN and setup the connections. Alternatively use Dante Domain Manager.
- For security reasons, by default the PRA-ES8P2S Ethernet switch is not accessible from the Internet. When the default (special link-local) IP-address is changed to an address outside the link-local range (169.254.x.x/16), then also the default (published) password must be changed. But even for applications on a closed local network, for highest security the password may still be changed. See section 14.5 of the PRAESENSA installation manual.
- The PRA-ES8P2S network switch supports SNMP. By convention, most SNMPv1-v2c equipment ships from the factory with a read-only community string set to "public". This also applies to the PRA-ES8P2S. For security reasons SNMP should be disabled. If SNMP must be enabled, for example to use the Bosch Network analysis tool OMN-DOCENT, use SNMPv3. SNMPv3 provides much better security with authentication and privacy. Select the authentication level SHA and encryption via AES. To configure the switch accordingly, see section 14.5 of the PRAESENSA installation manual.
- The system controller webserver uses secure HTTPS with SSL. The web server in the system controller uses a self-signed security certificate. When you access the server via https, you will see a Secure Connection Failed error or warning dialog indicating that the certificate was signed by an unknown authority. This is expected and to avoid this message in the future you have to create an exception in the browser.
- Make sure that new user accounts for system configuration access use sufficiently long and complex passwords. The user name must have between 5 and 64 characters. The password must have between 4 and 64 characters.
- The PRAESENSA system controller provides an Open Interface for external control. Access via this interface requires the same user accounts as for system configuration access. In addition, the system controller generates a certificate to setup the TLS (secure) connection between the system controller and the Open Interface client.

Download the certificate and open/install/save (depending on browser type) the crt-file. Activate the certificate on the client PC. See section 7.2 of the PRAESENSA configuration manual.

– System access to the devices of this system is secured via the OMNEO security user name and passphrase of the system. The system uses a self-generated user name and long passphrase. This can be changed in the configuration. The user name must have between 5 and 32 characters and the passphrase must have 8 to 64 characters. To update the firmware of the devices, the firmware upload tool requires this security user name and passphrase to get access.
– In case a PC for event logs is used (PRAESENSA logging server and viewer), make sure that the PC is not accessible by unauthorized persons.

5 System composition

For large sound systems it may not be immediately clear how many amplifiers are needed, and which model, to connect the loudspeaker loads in all zones. Also, how many power supplies are needed for these amplifiers, the system controller, call stations and other system components, and what the backup battery size should be for the multifunction power supplies.

5.1 Constant voltage systems

Public address audio installations often require large numbers of loudspeakers to be powered from a single amplifier. Using traditional low impedance loudspeakers (4-16 ohm), like used in consumer audio installations, would make it very difficult to connect all these loudspeakers, especially when not all loudspeakers have the same power rating. Simple parallel connection of all loudspeakers would create a very low impedance load that the amplifier most likely cannot drive. Connecting the loudspeakers in a series-parallel fashion (e.g. 4 parallel strings, each with 4 loudspeakers in series) keeps the overall load impedance the same as for an individual loudspeaker, but all loudspeakers will get the same amount of power, even when small and large loudspeakers are mixed, for instance because some loudspeakers need to be louder than others. Also wiring the loudspeakers would be difficult and error prone.

Solution

There is a very simple and elegant solution to this problem: constant voltage systems. A constant voltage system is a system that uses a standardized maximum signal level for amplifiers and loudspeakers. Most frequently used are 70 V systems (in USA) and 100 V systems (rest of the world).

- A 100 V amplifier is capable of delivering 100 VRMS sine wave power (equal to 282 Vpeak-to-peak) before clipping.
- A 100 V loudspeaker is designed to deliver its specified maximum output level with a 100 V input signal.
- A 30 W loudspeaker takes 30 W at 100 V and a 6 W loudspeaker takes 6 W at 100 V.

Now all loudspeakers belonging to the same group can simply be connected in parallel with perfect power distribution and no risk of overloading some loudspeakers. The total loudspeaker load of such a set of parallel connected loudspeakers is just the sum of all individual loads. Of course, the amplifier must be capable to deliver at least that amount of power.

Loudspeakers for constant voltage usage have a much higher impedance than the typical 8 ohm of a consumer loudspeaker, because an 8 ohm loudspeaker would dissipate 1250 W when driven by a 100 V signal. A 10 W loudspeaker for 100 V usage has an impedance of 1 kohm. The loudspeaker voice coil cannot be made with such long and thin wire to achieve that high impedance. Instead, a normal loudspeaker is used with an impedance of around 8 ohm, combined with an input transformer to convert the 100 V input to e.g. 9 V output, just enough for 10 W into 8 ohm. Using a 100 V distribution line to drive the loudspeakers requires much lower currents to transfer the same amount of power. That means that thinner wires can be used to connect the loudspeakers and also the cable losses are much lower. This is very important when long loudspeaker lines are to be used, such as often required for public address systems, covering large areas. Loudspeakers for the same zone are then connected in a daisy chain, to make it possible to supervise the whole line with a single end-of-line device. Star wiring of loudspeakers should be avoided, as it often uses much more loudspeaker cable and cannot be supervised easily.

Traditionally the power amplifiers also use transformers to convert the relatively low maximum output voltage of the amplifier to the standardized 100 V distribution level. The size and weight of these transformers scale with their power handling capabilities and determine to a large extend the size and weight of the whole amplifier. PRAESENSA amplifiers, however, use high power supply voltages to create a 100 V (or 70 V) output signal without the use of output transformers. This does not only saves weight but also improves the audio quality, as transformers operate within a limited frequency range and may suffer from core saturation at very low frequencies. Another big benefit is that the output power of an amplifier channel is not limited anymore by the size of its output transformer, an important pre-condition for flexible power allocation across output channels for multi-channel amplifiers.

5.2 Amplifier selection

The flexibility of the PRAESENSA multi-channel power amplifiers makes it possible to cover most demands with just a few different models, the PRA-AD604 and PRA-AD608. Both models have a power budget of 600 W in total, to power the loads for 4 or 8 channels. Because the channels can be loaded with any amount of loudspeaker load within the 600 W budget of the whole amplifier, only the average channel load determines which amplifier fits best to the load. The PRA-AD608 is capable to drive 600 W of load into 8 zones, so it fits best when the average zone size is 600/8 = 75 W, or less. The PRA-AD604 fits best when the average zone size is 600/4 = 150 W, or more. When the average zone size of a large system is between 75 W and 150 W, then a mix of PRA-AD604 and PRA-AD608 amplifiers is needed.

To determine quickly the minimum amount and type of amplifiers that are needed for a project, use the following rules:

1. Check how many locations are needed for equipment clusters to be installed (technical rooms). System decentralization into clusters is often needed because of the size of the area that needs to be covered by the system. Decentralization of equipment is a good way to minimize the amount of loudspeaker cabling by positioning the amplifiers closer to the connected loudspeakers in each zone. Often clusters are located per fire zone, each covering multiple separately addressable smaller zones, to mitigate the requirement of fire resistant loudspeaker cabling.
   - The next steps for calculation must be executed for each cluster separately.
2. Count the number of zones for this cluster. Zones with a loudspeaker load > 600 W need to be split into sub-zones with a maximum load < 600 W each, because they require more than one amplifier. Then count the subzones instead of the original large zone.
   - Example: Cluster A serves 52 (sub-)zones, each needing its own amplifier channel.
3. Add up the loudspeaker loads of all zones to get the total loudspeaker load. For loudspeakers that are tapped down to get the required sound pressure level (and not more), use the tapped down power setting in the summation. Often a project asks for a margin on the power for later expansion, then count that margin in.
   - Example: The total loudspeaker load for cluster A is 4300 W and 20% margin is needed. Then the total load for calculation is 4300x1.2 = 5160 W.
4. Based on the number of zones at least a certain number of amplifiers is needed to have enough channels to drive each zone separately. Because the PRA-AD608 has the most channels (8), divide the number of zones by 8 and round up.
   - Example: Cluster A has 52 zones, so at least 52/8 = 6.5 amplifiers are needed, that means at least 7 whole amplifiers.

5. Based on the loudspeaker load, including margin, at least a certain number of amplifiers is needed to have enough power available to drive the total load. Because all amplifiers are 600 W capable, divide the total load by 600 W and round up.
   – Example: Cluster A needs 5160 W, so at least 5160/600 = 8.6 amplifiers are needed, that means at least 9 whole amplifiers.
6. Some large loudspeaker zones may need more than 300 W each. These zones cannot be connected to the same amplifier because then the total power would become > 600 W. These zones need at least their own amplifier, although smaller zones may be added to other channels of that amplifier. Count the number of such large zones.
   – Example: Of the 52 zones in cluster A there are 5 with a load of around 400 W, so at least 5 amplifiers are needed already for these zones.
7. The required number of amplifiers is now the biggest number that came out of steps 4, 5 and 6. That number represents the deciding factor for this cluster.
   – Example: Based on channel count 7 amplifiers are needed, based on total loudspeaker load 9 amplifiers are needed and based on large zones at least 5 amplifiers are needed. That means that 9 amplifiers are needed because loudspeaker load is the deciding factor here.
8. To know what type of amplifiers is needed, it is important to consider the average number of channels per amplifier that is needed for this cluster. When it is < 4, then the cluster can use 4-channel amplifiers all over. When it is > 8, then all amplifiers must be 8-channel. When it is between 4 and 8 channels per amplifier, a mix of both models is needed, based on interpolation.
   – Example: Cluster A needs 52 channels for 52 zones and uses at least 9 amplifiers. This is 52/9 = 5.78 channels per amplifier, which is between 4 and 8. Then the number of 8-channel amplifiers can be calculated via interpolation: 9x(5.78-4)/4 = 4, meaning that cluster A needs 4 pieces of PRA-AD608, so the other 9-4 = 5 amplifiers can be PRA-AD604.
9. Now the minimum number of amplifiers is known and, if no other requirements exist, this number is sufficient as a basis for further system design, even without knowing what the actual load of each zone is. Because of other requirements more amplifiers may be needed, e.g. when certain groups of zones must be connected to the same amplifier; then it may not be possible to optimize the load assignment across all amplifiers.
   Also when the cluster has many relatively big zones and very few small zones, it may happen that another amplifier is needed because the remaining power budget of each of the amplifiers is not enough to accept the load of another big zone, although the sum of all the remaining budgets of all amplifiers is more than enough for that big zone. It may help to split up such a zone in smaller sub-zones.

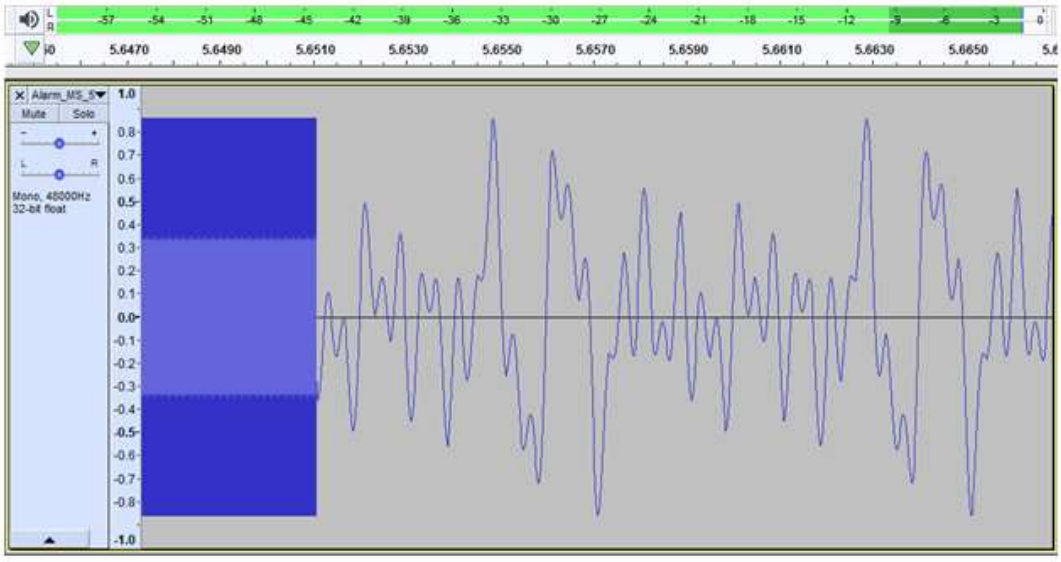
5.3 Amplifier power and crest factor

The PRA-AD604 and PRA-AD608 amplifiers are designed for a maximum loudspeaker load of 600 W. Of course the amount of power that is actually delivered to the loudspeakers depends on the audio signal being amplified. A full scale sinewave signal with an RMS (Root Mean Square) voltage of 100 V into a resistive loudspeaker load of 16.7 ohm would cause 600 W of power to be delivered to that load. For this RMS output voltage of 100 V, the peak output voltage is 141 V. For a sine wave, the RMS voltage is 3 dB lower than its peak voltage. This can also be expressed as that a sine wave has a crest factor of 3 dB, because by definition the crest factor of a signal is the ratio of its peak level to its RMS level. A square wave signal has a crest factor of 0 dB because its peak level and its RMS level is the same. Pink noise has a crest factor of 12 dB and a typical STIPA test signal has a crest factor of 13 dB. The crest factor of voice signals is approximately 12 dB. That is, the peaks of speech are about 12 dB more intense than the average values. This is caused by natural damping of the human vocal tract due to the nasal cavity, soft cheeks, soft tongue, lips, et cetera. Musical instruments, however, are not so well damped. Hard walled horns and stiff resonator chambers all yield a physical musical signal with much higher crest factors. Typical crest factors for musical instruments are on the order of 18 to 20 dB. That is, with musical instruments, peaks tend to be sharper than for speech. On the other hand, for recorded music the crest factor is often lowered by mixing of multiple instruments and additional sound processing in order to get a more even output level, where soft signals don’t disappear in the ambient noise and loud fragments are not disturbingly loud.

It is sufficient that an amplifier can drive its loudspeaker load to the maximum level only during peaks; its long term (average) power capability can be much lower. It is generally accepted that a continuous output power of 1/8 of the maximum sinewave power is sufficient for most types of music and speech. The PRA-AD604 and PRA-AD608 amplifiers have more margin and can deliver a continuous RMS output power of 1/4 of the maximum sine wave power, which is 150 W for a 600 W amplifier. For short periods of time (bursts) the maximum output power is 600 W. This additional margin is used to play continuous alarm tones at a relatively high level. An even higher level would not be very useful because PRAESENSA is a Voice Alarm system, and the loudness of an alarm tone should not be significantly higher than the loudness of the voice signal, otherwise the voice signal would be perceived as softer and not very clear.

PRAESENSA uses digital signal processing and transport. The maximum peak voltage of 141 V at an amplifier channel output corresponds to a digital signal level of 0 dBFS (dB Full Scale). The RMS level of a full scale sinewave is 3 dB lower, so -3 dBFS, corresponding to an RMS voltage of 100 V. In the 70 V mode all voltage levels are 3 dB lower for the same digital signal level in dBFS. In order to keep the RMS power at 150 W for a 600 W loudspeaker load, the RMS signal level must be 6 dB lower. This means that the RMS level of the digital signal should not be more than -9 dBFS. Peaks can be as high as 0 dBFS. The PRAESENSA amplifiers have an integrated RMS power limiter that reduces the signal level to all channels when the combined output power of all channels together exceeds 150 W for a too long time.

PRAESENSA has a library of attention tones, alarm tones and test tones, formatted as wav-files. These tones all have an RMS level at or below -9 dBFS. For custom made tones this should not be different. For instance, one of the multi-sine alarm tones in the audio editing program Audacity may look like this:



The peaks are at -1.3 dBFS (= 0.86 of full scale) and the RMS level is at -9.4 dBFS (= 0.34 of full scale). Both these levels are also visible in the level bar at the top.

5.4 Battery calculation

The PRAESENSA system includes multifunction power supplies, like the PRA-MPS3, to power other PRAESENSA devices from the mains, but also from a battery in case of mains failures. PRAESENSA encourages to use a distributed system approach, in order to minimize expensive (fire resistant) loudspeaker cabling, therefore each multifunction power supply uses its own battery. There is no large battery set that supplies power to a centralized system on one location.

5.4.1 Topology

Each PRA-MPS3 multifunction power supply has the capability to power up to three amplifiers via 48 VDC, one system controller (or other device) via 24 VDC and one Call station via PoE. A single 12 V battery is charged by the multifunction power supply to which it is connected. This battery serves as a backup power source during mains failures. A large system with dozens of amplifiers will contain many PRA-MPS3 devices, each having its own battery. This means that the required capacity of each battery must be calculated separately for the PRA-MPS3 it is connected to, taking the load into account that is served by this specific PRA-MPS3.
For the devices that are powered from a PRA-MPS3, it is important to notice that the power consumption of each device may vary depending on operation modes and how it is connected. When the power consumption has been calculated or measured, the corresponding battery current draw (in case of a mains failure) can be calculated or measured. The power taken from the battery will always be slightly higher than the power that is consumed by the device, because of additional losses in the DC/DC converters inside the PRA-MPS3 that convert the battery voltage to 48 VDC and 24 VDC.

5.4.2 Operating conditions

PRA-SCL

The power consumption of the PRA-SCL is relatively small, stable and hardly affected by system activities. It is powered from the 24 VDC output of the PRA-MPS3. Only the number of active Ethernet ports increases the power consumption. At least one port will be in use, but often more ports are active. In case of a connection to a PC for logging and to two independent loops for linking to other PRAESENSA devices, all five ports will be in use.

PRA-CSLD | PRA-CSLW | PRA-CSE

The power consumption of the PRA-CSLD and PRA-CSLW is the same. Again, the power consumption consists of a fixed part with an increment per active Ethernet port. Power is supplied via PoE to one or both ports. Power is taken from the port that has the highest PoE voltage. This means that if a call station is powered from two different PoE sources, like two different PRA-MPS3 power supplies for additional redundancy, because of tolerances all of the power may be taken from one of the power supplies. Only upon disconnection of that Ethernet cable, the call station will take power from the other power supply. Even if both PoE voltages are the same, using one short cable and one long cable may result in that most of the power is taken via the shortest cable because then the voltage drop across the wire resistance of each cable is equal.

Connecting PRA-CSE extensions to the call station will increase its power consumption slightly, the increment depends on the number of LEDs that are on, but on average that contribution is very limited because selections are only active during calls.

When a call station is configured for emergency purposes it may happen that a fault or failure occurs and the buzzer of the call station is activated as an audible fault alarm. This is only the case for emergency call stations, but the power consumption of the buzzer must then be taken into account because the fault may not be acknowledged and then the buzzer continues.

PRA-AD604 | PRA-AD608

The PRA-AD604 and PRA-AD608 amplifiers are designed for low power consumption, especially when powered from a battery, by incorporating different modes of operation. When the amplifier is running on mains power and there is no audio signal present, it is operating in idle mode on a reduced power supply voltage to keep the idle power consumption relatively low. When an audio signal is present for one or more of the audio channels, then the power supply voltage increases to the normal operating voltage to be able to drive loudspeaker lines up to 100 VRMS. This increases the idle losses in the amplifier channels. Of course, when the amplifier provides full output power to the loudspeakers, the power consumption increases significantly. Full output power means a continuous output power of 150 W into a 600 W loudspeaker load. Because typical speech and music signals have a crest factor of more than 9 dB, the RMS power remains below 150 W while the burst output power is 600 W.

When the mains voltage on the PRA-MPS3 fails, it switches to the battery to take power from. The PRA-MPS3 notifies the amplifier of this and when the amplifier doesn't have to make announcements of high enough priority, it will go into sleep mode or snooze mode and notifies the PRA-MPS3 to switch off the 48 VDC power section to this amplifier. The amplifier then operates directly from the battery via the lifeline interconnection. In sleep mode the power consumption is lowest but there is no amplifier and loudspeaker line supervision active. When supervision has been enabled for this amplifier, the amplifier will go into snooze mode, which is a combination of being in sleep mode for most of the time, but waking up into idle mode to perform a supervision cycle for a few seconds every 90 seconds. The average power consumption in snooze mode is somewhat larger than in sleep mode. When a call is being made or a tone played to one or more of the channels, the amplifier immediately requests the PRA-MPS3 to switch on the 48 VDC power supply again and the amplifier will operate from the normal supply voltage. The power consumption of the active amplifier will then vary between the value for low power (small signal audio or small loudspeaker load) and full power (audio in full load at maximum level).

In all modes, the power consumption of the active Ethernet ports must be taken into account. Because the PRA-AD608 has nine amplifier channels, while the PRA-AD604 has five channels, the power consumption of the PRA-AD608 is slightly higher than of the PRA-AD604.

PRA-ES8P2S

This Ethernet switch has dual redundant 24 to 48 V DC-inputs. In case no battery backup is required, it can be powered from a PRA-PSM24 or PRA-PSM48 power supply. In case the switch is used in a Voice Alarm system, compliant to EN54-16, the switch must be powered from an EN54-4 certified power supply, like the PRA-MPS3.

When the switch is powered by the PRA-MPS3 multifunction power supply, it must be connected to one of the 48 V outputs, normally intended for the amplifiers. Use both A and B outputs for connection redundancy. The 24 V output of the PRA-MPS3 is not powerful enough for this switch. The 48 V output that is powering the switch should not be used to also power an amplifier. Especially when the switch is serving multiple PoE powered devices as PSE (Power Sourcing Equipment), its power consumption can raise to 140 W. The remaining power capacity of the 48 V supply is not sufficient anymore for an amplifier under various load conditions.

The lifeline that belongs to the powering 48 V output is not used, so the 48 V output will not be disabled as would be for amplifiers in sleep/snooze mode to save power. It is also essential that the 48 V for the switch is not disabled at any time. In case of mains failure the switch will be powered from the battery, connected to the multifunction power supply.

The power consumption of the switch is highly dependent on the number of ports that are in use and whether these ports provide PoE power to connected devices. Next to the power consumption of the switch itself and the power consumption of the active ports, the PoE loads of all ports together (expressed in watt) multiplied by 0.1 gives the approximate additional load of the battery (expressed in ampere). Please note that a call station that is connected to this switch and powered via PoE from this switch will load the battery slightly more than when the same call station would have been directly powered from a PoE port of the PRA-MPS3, because the switch in between has some 20% additional losses.

PRA-MPS3

The power consumption of the PRA-MPS3 itself is mainly determined by its network interface and the number of active Ethernet ports (RJ45 or SFP). For the battery capacity calculation, the power loss of the DC/DC converters to supply power to all connected devices is already taken into account in the power taken from the battery by these devices. The power consumption of the relays of the control outputs is insignificant.

5.4.3 Power consumption

The following table gives an overview of the power demand of the PRAESENSA devices for the different operating conditions.

Device	Device elements	Power consumption [W]	Power from battery [W]	Current from battery [A]
PRA-SCL	System controller	3.9	4.2	0.35
	+ per active RJ45 port	0.4	0.5	0.04
PRA-CSLD / PRA-CSLW	Call station	4.2	5.0	0.42
	+ per active RJ45 port	0.5	0.6	0.05
	+ per extension PRA-CSE	0.1	0.1	0.01
	+ with alarm option	1.2	1.5	0.12
PRA-AD604	Amplifier (sleep)	6.0	6.0	0.50
	Amplifier (snooze)	8.0	8.5	0.71
	Amplifier (active, idle)	32	39	3.25
	Amplifier (active, low power)	52	64	5.33
	Amplifier (active, full power)	230	250	20.83
	+ per active RJ45 port	0.4	0.4	0.03
PRA-AD608	Amplifier (sleep)	6.0	6.0	0.50
	Amplifier (snooze)	8.4	9.2	0.77
	Amplifier (active, idle)	38	48	4.00
	Amplifier (active, low power)	70	88	7.33
	Amplifier (active, full power)	250	274	22.83
	+ per active RJ45 port	0.4	0.4	0.03
PRA-ES8P2S	Ethernet switch	7.0	8.4	0.70
	+ per active RJ45 port	0.4	0.5	0.04
	+ per active SFP port	0.7	0.8	0.07
	+ PoE load	load	1.2 x load	0.1 x load
PRA-MPS3	Multifunction power supply	5.2	5.2	0.43
	+ per active RJ45 port	0.4	0.4	0.03
	+ per active SFP port	0.7	0.7	0.06

5.4.4 Accurate battery size calculation

The size or capacity of the battery for each cluster of devices, consisting of a PRA-MPS3, up to three amplifiers and optionally a system controller and a call station, can be calculated by using the current taken from the battery for each device element, as shown in the previous section.

Of importance is for how long the system must be able to operate on the battery. Most emergency sound systems are specified to run on battery for 24 hours in quiescent mode and then subsequently for 30 minutes doing (voice) alarms.

System example

Consider a voice alarm system that consists of the devices as shown in the next table.

Device	Device elements	Current taken from battery [A]	Time in quiescent mode [h]	Time in alarm mode [h]	Current x time [Ah]
PRA-SCL	System controller	0.35	24	0.5	8.58
	+ per active RJ45 port (2)	2 x 0.04	24	0.5	1.96
PRA-CSLD	Call station	0.42	24	0.5	10.29
	+ per active RJ45 port (2)	2 x 0.05	24	0.5	2.45
	+ per extension PRA-CSE (3)	3 x 0.01	24	0.5	0.73
	+ with alarm option	0.12	24	0.5	2.94
PRA-AD604	Amplifier (sleep)	0.50	-	-	-
	Amplifier (snooze)	0.71	24	-	17.04
	Amplifier (active, idle)	3.25	-	-	-
	Amplifier (active, low power)	5.33	-	-	-
	Amplifier (active, full power)	20.83	-	0.5	10.41
	+ per active RJ45 port (2)	2 x 0.03	24	0.5	1.47
PRA-AD608	Amplifier (sleep)	0.50	-	-	-
	Amplifier (snooze)	0.77	24	-	18.48
	Amplifier (active, idle)	4.00	-	-	-
	Amplifier (active, low power)	7.33	-	-	-
	Amplifier (active, full power)	22.83	-	0.5	11.41
	+ per active RJ45 port (2)	2 x 0.03	24	0.5	1.47
PRA-AD608	Amplifier (sleep)	0.50	-	-	-
	Amplifier (snooze)	0.77	24	-	18.48
	Amplifier (active, idle)	4.00	-	-	-
	Amplifier (active, low power)	7.33	-	-	-
	Amplifier (active, full power)	22.83	-	0.5	11.41
	+ per active RJ45 port (2)	2 x 0.03	24	0.5	1.47
PRA-MPS3	Multifunction power supply	0.43	24	0.5	10.53
	+ per active RJ45 port (2)	2 x 0.03	24	0.5	1.47
	+ per active SFP port	0.06	-	-	-
Total calculated battery capacity [Ah]					**130.59**
Required battery capacity (30% oversized) [Ah]					**170**

All devices are connected in a single loop, which means that all devices have two ports in active use for loop-through cabling. The PRA-CSLD is used as emergency call station and has three extensions connected. Because this is a voice alarm system, supervision is enabled. Furthermore the system is specified to run from a battery for 24 hours in quiescent mode and 30 minutes in alarm mode.

Manufacturers specify the capacity of a lead-acid battery at a specified discharge rate. Typically the specified (nominal) battery capacity is based on fully discharging the battery in 20 hours with a constant (nominal) current. If the battery is discharged at a faster rate, the delivered capacity is less, and if the battery is discharged at a slower rate the delivered capacity is more. This effect is described by Peukert's law. Without going into detail, this law describes an exponential relationship between the discharge current and the delivered capacity over a specified range of discharge currents. For flooded lead-acid batteries this effect is very significant, for VRLA batteries this effect is much smaller but certainly not negligible.
Consider a PRAESENSA system with a battery capacity that is sufficient for 24 h operation in quiescent mode, followed by 0.5 h operation in alarm mode. In quiescent mode the discharge current will be around half of the nominal current and a typical VRLA battery then has an effective capacity of 110% of the nominal capacity. But during alarm mode the discharge current can be up to ten times higher than the nominal discharge current and the effective battery capacity then reduces to 75% of the nominal capacity. The consequence of this is that the required nominal battery capacity should be around 20% higher than calculated without taking Peukert's law into account.
Because another 10% additional battery capacity is needed to compensate for aging and low temperature operation, the battery must be oversized by approximately 30%.

5.4.5 Quick battery size calculation

A very simple and quick way to calculate the required battery capacity is to add up the Ah-values from the table below. This includes 30% battery oversize and it doesn't matter whether the amplifiers are 4-channel or 8-channel amplifiers, how many channels are in use or what the loudspeaker load is, nor how many call station extensions are used, whether it is used to make alarm calls or not, nor how many Ethernet ports are used. These details have only a relatively small impact on the ultimate battery capacity needed and the Ah-values are rounded up to include them all.

Device	**Battery requirement**	
	24 h quiescent + 0.5 h alarm	30 h quiescent + 0.5 h alarm
System controller	17 Ah	21 Ah
Call station with extensions	21 Ah	26 Ah
Amplifier	40 Ah	47 Ah
Multifunction power supply	21 Ah	25 Ah

According to this simple table, the system described in the previous section would get a backup battery of 17 + 21 + 40 + 40 + 40 + 21 Ah = 179 Ah when used for 24 h in quiescent condition and 30 minutes in alarm condition. The accurate calculation resulted in 170 Ah. The additional benefit of this approach is that relatively small system changes, such as adding load to an amplifier, can easily be made without changing the already installed battery capacity.

The minimum installed battery capacity should be 100 Ah to have a sufficiently low internal impedance of the battery to accommodate peak current draw from connected amplifiers. The maximum installed battery capacity is 230 Ah to be able to charge the battery within the permitted time according to EN 54-4 or similar standards.
The maximum current draw from the battery would be approximately 70 A in alarm mode without taking the losses of the battery cables, battery internal resistance, fuse and connections into account. With the supplied battery cables and fuse, and assuming that the internal resistance of the battery is 3.5 mohm, the total series resistance is approximately 6 mohm. The 70 A current creates a loss of 0.42 V across this resistance, so the 12 V would drop to 11.58 V, making the supply voltage of the system, approximately 4% lower. Because all PRAESENSA devices use DC/DC converters that take the required power regardless of small deviations of the supply voltage, the 4% lower voltage is compensated by drawing 4% more current, so approximately 73 A. Because of this, the voltage drops a bit more and the current increases a bit more again. This shows the high importance of keeping the series resistance of the battery connections as low as possible. In quiescent conditions the current from the battery is hardly 4 A, worst case, so the cable losses are low (<0.1 W), but at maximum output power, the battery cable losses go up to 30 W, causing the cables to warm up. Also see section *Battery and fuse, page 111*.

5.4.6 Uninterruptable power supply size calculation

An alternative for the use of the multifunction power supply with built-in battery charger and converter, is to use the PRA-PSM48 to power PRAESENSA. This solution is not compliant to EN 54 and ISO 7240, but still useful for non-certified solutions. In this case the system controller PRA-SCL and Ethernet switch PRA-ES8P2S can be powered from a PRA-PSM48 power supply module. The PRA-CSLD and PRA-CSLW can be powered via PoE from the PRA-ES8P2S. The amplifiers PRA-AD604 and PRA-AD608 can also be powered from a PRA-PSM48, not more than one amplifier per power supply. Also with this setup it is possible to have battery backup power by using an uninterruptable power supply (UPS) to provide uninterruptable mains power to the PRA-PSM48 power supply modules.

The required capacity of the UPS can be calculated in the same way as for the backup battery of the multifunction power supply. Because the efficiency of the PRA-PSM48 power supply modules is comparable to the efficiency of the DC/DC converters in the multifunction power supply, take the data from the column “Power from battery [W]” in the table of *Power consumption, page 43*. This is also the approximate amount of mains power that is taken by the PRA-PSM48 , when it is powering the connected device or devices in the mode or configuration that is specified in this table. To calculate the required battery capacity or energy storage, the power consumption must be multiplied by the time that the devices are powered in a specific mode, similar to what was done for the accurate battery size calculation in *Accurate battery size calculation, page 44*. However, in this case the amplifiers cannot run in snooze mode, but will run in idle mode while not being active. The snooze mode is only available in combination with the multifunction power supply. In idle mode the power consumption of the amplifiers is considerably higher than in snooze mode and this will have an impact on the required backup power capacity of the UPS.

As an example, consider a voice alarm system that consists of the devices in the table below. This small system has a system controller, one call station and three amplifiers; furthermore, it has an Ethernet switch to connect and power the call station via PoE, because this system doesn’t have a multifunction power supply. This system can be powered from four PRA-PSM48

power supply modules, one for each amplifier and one for the system controller and switch. The PoE load of the switch is not counted in the table as this power is already taken into account for the call station, the power is in fact passed through the switch.
For the required UPS capacity, the calculation is based on 24 h operation in quiescent mode, which is in this case the idle mode of the amplifiers, and 0.5 h operation in alarm mode for which the full power consumption of the amplifiers is taken. It is clear that most of the UPS capacity is needed to keep the system alive during the 24 h in quiescent mode, the energy consumption during the much shorter alarm mode is less. If this system would use the PRA-MPS3 multifunction power supply, the amplifiers would be able to run in snooze mode during these 24 h and the total energy consumption and associated battery size would be much lower.
This system requires a UPS that can deliver at least 4.3 kWh of energy. Also, the UPS must be capable of providing at least 823 W of instantaneous power, so a 1 kW UPS, with 5 kWh of energy stored in batteries seems to be a good choice. It depends on how the aging of the batteries and Peukert’s law has been taken into account by the manufacturer of the UPS, whether this 5 kWh capacity is really sufficient or that 6 kWh would be a better choice.

Device	Device elements	Power taken from mains [W]	Time in quiescent mode [h]	Time in alarm mode [h]	Power x time [Wh]	Maximum power [W]
PRA-SCL	System controller	4.2	24	0.5	103	4.2
	+ per active port (2)	2 x 0.5	24	0.5	25	2 x 0.5
PRA-CSLD	Call station	5.0	24	0.5	123	5.0
	+ per active port (2)	2 x 0.6	24	0.5	29	2 x 0.6
	+ per extension PRA-CSE (3)	3 x 0.1	24	0.5	7	3 x 0.1
	+ with alarm option	1.5	24	0.5	37	1.5
PRA-ES8P2S	Ethernet switch	8.4	24	0.5	206	8.4
	+ per active RJ45 port (2)	2 x 0.5	24	0.5	25	2 x 0.5
	+ per active SFP port	1.2	-	-	-	-
	+ PoE load	PRA-CSLD	-	-	-	-
PRA-AD604	Amplifier (active, idle)	39	24	-	936	-
	Amplifier (active, low power)	64	-	-	-	-
	Amplifier (active, full power)	250	-	0.5	125	250
	+ per active port (2)	2 x 0.4	24	0.5	20	2 x 0.4
PRA-AD608	Amplifier (active, idle)	48	24	-	1152	-
	Amplifier (active, low power)	88	-	-	-	-
	Amplifier (active, full power)	274	-	0.5	137	274
	+ per active port (2)	2 x 0.4	24	0.5	20	2 x 0.4
PRA-AD608	Amplifier (active, idle)	48	24	-	1152	-
	Amplifier (active, low power)	88	-	-	-	-
	Amplifier (active, full power)	274	-	0.5	137	274
	+ per active port (2)	2 x 0.4	24	0.5	20	2 x 0.4
Minimum required backup power capacity of UPS [Wh]					**4254**	
Minimum output power capability of UPS [W]						**823**

5.5 Heat loss calculation

To be able to calculate the required cooling capacity of a cooling system for a technical room with equipment to stay within temperature limits of the equipment, the heat production must be known and the maximum ambient temperature that the equipment is allowed to operate in. The maximum ambient operating temperature of PRAESENSA rack-mounted devices is 50 °C (122 °F). The generated heat is the energy that is dissipated and released as heat by the equipment in the room. Energy is power multiplied by time, so the longer a certain amount of power is dissipated in the room the more heat is generated. The amount of energy is expressed in joule, calories or BTU, British Thermal Units. The amount of power is expressed in watt. By definition 1 joule = 1 watt x 1 second. Furthermore: 1 kJ = 1.055 BTU = 4.184 kcal. The PRAESENSA system controller just dissipates some power that is taken from the power supply. This power turns into heat. The same is true for the call stations, but they are typically placed outside the technical room and do not contribute to heat production in the room. PRAESENSA power amplifiers dissipate some power that is taken from the power supply, but when announcements are made or music is played through the system, the output power of the amplifiers is dissipated in the loudspeakers and the cabling to the loudspeakers. Because the loudspeakers and most of the cabling is not in the technical room with the equipment, this

part should not be taken into account for the heat generation. Only the difference between the power that is taken from the power supply and the output power to the loudspeakers is actually dissipated as loss in the amplifier and contributes to the heat production.
When the PRAESENSA system is powered via multifunction power supplies (PRA-MPS3), also some power is dissipated in the AC/DC power converters that convert power from the mains to DC voltages for the connected devices. The amplifiers and the power supplies are the only devices that contribute significantly to the heat production, the contribution of other PRAESENSA devices is negligible. It is easiest to incorporate the losses of the power supplies into the power dissipation data of the amplifiers. Because the normal situation is that the system is running from mains power, this is the operational mode to consider for heat calculations. During operation from a battery, the system switches to a power saving mode (sleep mode or snooze mode), on average resulting in less heat.
The table below then shows the heat loss related data for the amplifiers, in different operating modes.

Device	Mode	Dissipated power [W]	Heat loss [kJ/h]	Heat loss [BTU/h]	Heat loss [kcal/h]
PRA-AD604	Amplifier (active, idle)	39	140	133	34
	Amplifier (active, low power)	64	230	218	55
	Amplifier (active, full power)	100	360	341	86
PRA-AD608	Amplifier (active, idle)	48	173	164	41
	Amplifier (active, low power)	88	317	300	76
	Amplifier (active, full power)	124	446	423	107

This data can be further simplified by assuming that in most systems the amplifiers are used for background music and occasional calls, that full power alarm tones have a relatively short duration (less than an hour) and that the heat production of the PRA-AD604 and PRA-AD608 is not so different. Then the following rounded numbers are sufficient for heat loss calculation. Just count the number of amplifiers in the rack or room for which the heat production must be calculated and use the data from the table below.

	Dissipated power [W]	Heat loss [kJ/h]	Heat loss [BTU/h]	Heat loss [kcal/h]
Per amplifier	100	360	340	90

When amplifiers are powered from a PRA-PSM48 power supply, also the heat loss of that power supply can be ignored, because it is already included in the heat loss of the connected amplifier.

6 From installation to configuration

To configure the system, an Ethernet connection is required between the configuration PC and the system controller. Then access the device's webserver through its URL using a browser. For general and detailed system configuration instructions, see the PRAESENSA configuration manual.

6.1 MAC-addresses and hostname

All OMNEO connected PRAESENSA devices use one or two MAC-addresses and have a device hostname; the system controller also has a control hostname to get access to its webserver. The MAC-addresses are in the Bosch Security Systems vendor range 00:1c:44:xx:xx:xx or in the Audinate vendor range 00:1d:c1:xx:xx:xx. In many corporate networks the MAC-addresses of networked devices need to be entered in a table in the DHCP-server, to allow access. For that purpose the MAC-addresses of each PRAESENSA device are printed on the product label:

- The system controller has two MAC-addresses and two hostnames. The device MAC-address and the Control MAC-address (C-MAC) are both in the Bosch Security Systems vendor range. The device hostname, of for example the PRA-SCL, is derived from the MAC-address: PRASCL-xxxxxx.local, with xxxxxx being the last 6 hexadecimal digits (3 octets) of the MAC-address. The domain name label 'local' is used as a pseudo-top-level domain for hostnames in local area networks that can be resolved via the Multicast DNS name resolution protocol. It is possible to ping a system controller via this name (for example: PRASCL-xxxxxx.local. The system composition webpage does not show the .local extension; this is implicit. The control hostname is the same as the device hostname, but with a postfix -ctrl. So, it becomes for example: PRASCL-xxxxxx-ctrl.local. To get access to the webserver, of for example, the PRA-SCL, this address is used as URL (Uniform Resource Locator). This address is also used for the Open Interface.
- The PRA-AD604 and PRA-AD608 only have a MAC-address in the Bosch Security Systems vendor range. Their hostname is PRAAD604-xxxxxx.local or PRAAD608-xxxxxx.local.
- The PRA-MPS3 only has a MAC-address in the Audinate vendor range. The hostname is: PRAMPS3-xxxxxx.local.
- The PRA-CSLD and PRA-CSLW have two MAC-addresses, but only one hostname. Its device MAC-address in the Audinate vendor range and its C-MAC address is in the Bosch Security Systems vendor range. The device hostname is derived from the device MAC-address: PRACSLD-xxxxxx.local or PRACSLW-xxxxxx.local.
- The PRA-CSE and PRA-EOL do not have a MAC-address, nor hostname.

Remarks:

- The program OMNEO Control only shows device hostnames, not the control hostname of a system controller.
- The configuration webpages show device hostnames without .local domain extension. It does not show control hostnames, neither the one of its own web server, nor from other system controllers.
- Both MAC-addresses of the system controller and call station are on the same printed circuit board (PCB), so in case of PCB exchange both MAC-addresses will change and also the derived host name(s).
- The Firmware upload tool (FWUT) addresses the devices via their device hostname.
- The configuration of all devices is described in the PRAESENSA configuration manual.

6.2 Connecting the system controller

Perform the following steps to get access to the PRAESENSA system controller:

1. Install the Firmware Upload Tool on the PC, then automatically also the Bosch DNS-SD Service is installed. This service is needed to access PRAESENSA devices via their hostname instead of the IP-address.
2. Connect a network cable between the Ethernet network port of the PC and connect to one of Ethernet ports of the PRAESENSA system controller, or to a network port of another native PRAESENSA device that is connected to the same network, such as the PRA-AD60x amplifiers, PRA-MPSx multifunction power supplies or PRA-CSLx call stations.



Notice!
Do not connect the configuration PC to a port of any other device on the same network, such as the (Advantech) PRA-ES8P2S Ethernet switch or any other Ethernet switch.

3. When a DHCP-server is present on the network the PRAESENSA devices will already have an IP-address, otherwise a Link-Local address will be assigned.
4. Some PC settings of (corporate) PCs may prohibit automatic Link Local addressing for the PC. Then this must be done manually. For Windows 10 the procedure is as follows:
   - Click Internet settings in the taskbar, then go to Network & Internet settings.
   - Select Wi-Fi and switch off Wi-Fi.
   - Select Ethernet, then go to Change adapter options.
   - Double click Ethernet and select Properties.
   - Check Internet Protocol Version 4 (TCP/IPv4), then select Properties.
   - Select Use the following IP-address and enter 169.254.1.1 with mask 255.255.0.0. This is a Link-Local address.
5. Open a browser on the PC, e.g. Firefox. Make sure no proxy is used. To disable using a proxy, do as follows:
   - Select Open menu, then select Options.
   - Select Network proxy, then select Settings.
   - Select No proxy.
6. If for example the PRA-SCL system controller is connected, type https://prascl-xxxxxx-ctrl.local in URL-bar. Read xxxxxx from the product label, e.g. https://prascl-0b484c-ctrl.local.



Notice!
The system controller webserver uses secure HTTPS with SSL. The web server in the system controller uses a self-signed security certificate. When you access the server via https, you will see a Secure Connection Failed error or warning dialog indicating that the certificate was signed by an unknown authority. This is expected and to avoid this message in the future you have to create an exception in the browser.

See the PRAESENSA configuration manual for configuration of the system.

6.3 Network connections to devices

Except for some accessories, PRAESENSA devices must be connected to the OMNEO network in order to become part of the PA/VA system. Depending on the size of the system, there are different ways to do that.

6.3.1 Star topology

In this topology, the system controller is the central point and other devices are connected directly to one of the ports of the system controller. But, because the system controller has five ports, the system can only be very small. No call station can be connected because the system controller does not have ports that supply PoE.
Many wired home networks are wired like this with one central multi-port switch as central point. However, for a sound system this is not very useful.

6.3.2 Tree topology

A tree or ‘combined star’ topology is effectively an interconnection of multiple star networks. In modern networks this is the most used topology. In this topology the connection of devices depend on the connection of other devices in the network.
All PRAESENSA networked devices have a built-in Ethernet switch and at least two ports. Because of this, devices can easily be connected to a switch port of another device. Devices are then cascaded or looped through.
The system controller is still the central point of the network. A multifunction power supply is connected to one port of the system controller. A call station can be connected to a port of the multifunction power supply that provides PoE. An amplifier can be connected to another port of the system controller, but also to one of the ports of the multifunction power supply. Another amplifier can be connected to the first amplifier, and so on.
For every three amplifiers, a multifunction power supply is needed, which has a multi-port switch built in. So the connection possibilities grow with the system size. Not all devices need to be looped through in a single long string of devices, but parallel paths (branches) of shorter strings are possible. The use of branches reduces the risk that a failing connection of a devices close to the root of the tree disconnects all other devices. Still a single connection failure may cause more than one device to become disconnected from the system controller. And even though an amplifier might be connected to a call station, when both get disconnected from the system controller, the audio connection between the call station and the amplifier gets lost. The system controller is needed to set up and supervise the connections.

6.3.3 Ring topology

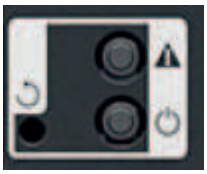
A next step in improving the connectivity of the devices is to use a ring topology. In this topology the devices are connected in one or more rings or closed loops. Normal Ethernet networks do not allow a topology with more than one physical path between two endpoints (e.g. multiple connections between two network switches or two ports on the same switch connected to each other). The loop creates broadcast storms as broadcasts and multicasts are forwarded by switches out of every port. The switch or switches will repeatedly rebroadcast the broadcast messages, flooding the network.
A physical topology that contains switching or bridge loops is attractive for redundancy reasons, yet a switched network must not have loops. The solution is to allow physical loops, but create a loop-free logical topology using a protocol that disables redundant connections until they are needed because another connection failed. RSTP is such a protocol and all

PRAESENSA networked devices support RSTP. Connecting and disconnecting redundant loops take some time to be processed in the network and as a result active audio connections will be muted during that time.
The system controller is still the central point, it is the so-called root bridge. Amplifiers can be looped through and a ring of amplifiers can then be connected between two ports of the system controller. In the same way a number of multifunction power supplies can be looped through and a ring of these devices can be connected between the two other ports. Call stations can be connected to a multifunction power supply via a double connection to two PoE ports, or even to two different multifunction power supplies. This is the recommended way of connecting PRAESENSA devices and mandatory for PA/VA systems that need to be compliant to voice alarm standards.

6.3.4 Hop count

When data passes through (PRAESENSA) network devices between source and destination, a hop occurs for every device that is passed. In PRAESENSA the relevant portion for hop counting is the network path between the root (the system controller) and any possible end point via the shortest path.
This is important because there is maximum to the number of hops that are allowed for proper communication. This has to do with the latency that occurs in every hop and every connection. There is a limit of 22 hops. Devices that are connected after the 22nd hop are lost in the system. Also loops, connected to the system controller, should not contain more than 22 devices. A loop with 43 devices, connected to the system controller, works fine as long as the loop is not interrupted, because the device in the middle of the loop has a hop count of 22 towards the system controller in both directions. All other devices have a smaller hop count. But if one link in the loop fails, this results in two branches being connected to the system controller, and one of them will have more than 22 looped-through devices. Then the devices after the 22nd will be lost. So, always consider the worst case hop count for a device in case a connection would fail. This must be carefully analyzed for larger systems.
The performance of a network will be better if the number of loops is smaller. The RSTP recovery time of the network after a link failure increases when the number of loops is higher. So, the hop count must be balanced against the number of loops.

6.4 Device status and reset



Status

⚠	Device fault present	Yellow	⏻	Power on	Green
	Identification mode / Indicator test	All LEDs blink			

All PRAESENSA 19”-devices have a small section on their rear panel for status monitoring, comprising a:

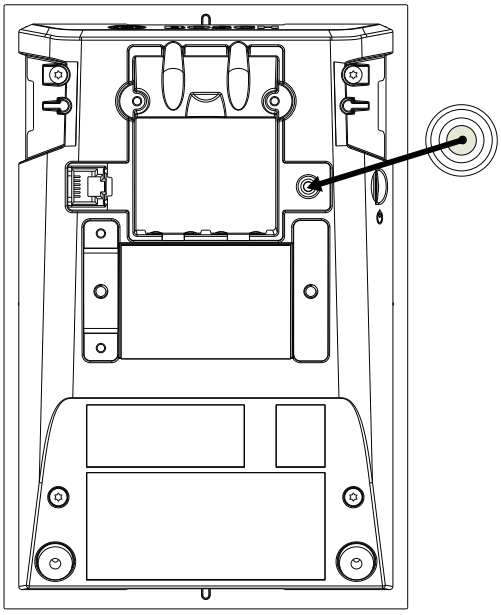
– Green LED to show the device is powered. The green LED will blink when the device is in identification mode during configuration.
– Yellow LED to show that a device fault is present. This may be convenient during installation and servicing.

Reset

↺	Device reset (to factory default)	Button			

A pinhole gives access to the hidden reset switch. This switch resets the device to its factory default settings. It clears the OMNEO pre-shared key (PSK) for secure connections and clears the complete local configuration and reference data.
For the system controller it also clears the complete system configuration, all messages, user authentication information, security certificates, time zone, NTP settings and all event logs!

For the call stations, the reset switch is below the cable cover, as indicated. It functions in the same way as the reset switch of the 19”-devices.



Notice!
This function is only to be used in case a device is removed from one system to become part of another system and is secured by an unknown PSK, that prevents discovery of the device in the new system.

To activate this function:

1. Use a pin or toothpick to press and hold the reset button for more than 10 s. After 10 s the LEDs of the device start flashing.
2. Release the reset button and the device will be reset to the factory default setting.

Indicator test

The reset switch can also be used to do an indicator test for this device.
To activate this function:

1. Use a pin or toothpick to press the reset button briefly. This will start the indicator test (LED test):
   - All LEDs will cycle through their possible color modes.
   - Make sure to release the switch within 10 s, otherwise the device will be **reset** to the factory default!
2. Pressing the reset button again will stop the indicator test.

7 System controller (SCL, SCM, SCS)



7.1 Introduction

The system controller manages all system related functions in a PRAESENSA Public Address and Voice Alarm system. It routes all audio connections between network-connected PRAESENSA audio sources and destinations. It supervises and plays back messages and tones, stored on its flash memory, either scheduled or manually started from a call station or PC. It manages the routing of background music streams, along with business calls and emergency calls, all based on priority level and zone occupancy. It collects all status information of connected system devices, manages the event logs and reports faults.
The system controller is network-connected via OMNEO and DC-powered from a multifunction power supply with integrated battery backup, accommodating both centralized and decentralized system topologies. Connections to other devices in the system are made using the built-in 5-port switch, supporting RSTP. The built-in web server allows for system configuration using a browser.

7.2 Functions

System control and audio routing

- Capability to control a system with up to 250 devices, serving more than 500 zones.
- Native support for switched single-subnet networks, with add-on support for routed multi-subnet topologies.*
- Dynamic allocation of multiple and simultaneous audio channels to save on network bandwidth; audio connections are created when a call or a message is broadcast, and freed up immediately afterwards.
- Secure interconnections using Advanced Encryption Standard (AES128) for audio data and Transport Layer Security (TLS) for control data.
- Receiver for Dante or AES67 audio channels from external sources, with dynamic re-routing to open or secure OMNEO channels.
- Internal storage capacity for messages and tones; up to eight messages can be played back simultaneously.
- Recording facility on SD-card for emergency audio logging and call stacking. The integrated call stacker automatically forwards recorded calls to previously occupied zones.*
- Internal real time clock for scheduled events and event time stamping; support for Network Time Protocol (NTP) with automatic adjustment for Daylight Saving Time (DST).
- Internal system event and fault event log.
- Networked control interface for third party applications.
- Built-in webserver for configuration and file management using a browser.

Sound quality

- Audio-over-IP, using OMNEO, the Bosch high-quality digital audio interface, compatible with Dante and AES67; audio sample rate is 48 kHz with 24-bit sample size.
- Messages and tones are stored as high definition uncompressed wav-files.

Supervision

- Supervision of stored messages and tones.
- Supervision of data integrity of site specific data.
- Internal watchdog timers to detect and recover from processing errors.
- Faults or problems of all system devices are collected, reported and logged.

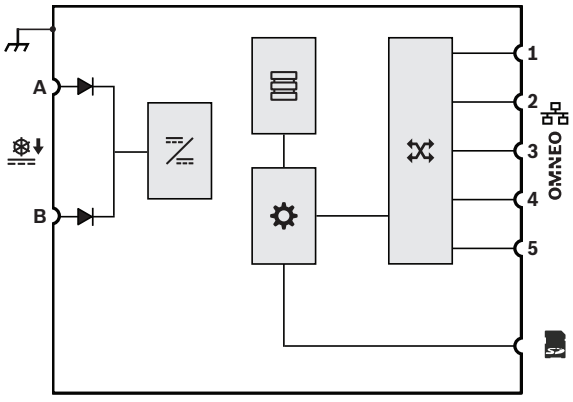
Fault tolerance

- Two system controllers can be configured as a redundant pair.
- Five OMNEO network connection ports, supporting RSTP.
- Dual DC-inputs with polarity reversal protection.

* Availability to be announced.

7.3 Functional diagram

Functional and connection diagram



Internal device functions

Diode

DC to DC converter

Message and tone storage

Controller

OMNEO network switch

7.4 System controller variants

Three system controller variants offer a different maximum number of simultaneous audio streams (for calls, tones, announcements, background music channels), to optimally match system requirements and cost price. OMNEO channel routing is always dynamic and secure, using audio encryption in the transmitting device and decryption in the receiving device. Dante and AES67 channels are always static and not encrypted for easy compatibility between systems of different brands. The PRAESENSA system controller can either encrypt up to eight incoming streams to dynamic secure OMNEO streams, or decrypt up to eight dynamic secure OMNEO streams to outgoing streams, or a mix of both with a maximum of eight. This is sufficient for the PRA-SCM and PRA-SCS. But the PRA-SCL can receive up to 120 Dante or AES67 channels, so 112 of these channels cannot be encrypted but are only converted to open (unencrypted) dynamic OMNEO streams.
OMNEO streams are always dynamic multicast streams, routed from transmitter to one or more receivers. The Dante and AES67 streams are static and received and/or transmitted by the system controller, where they are encrypted, converted or decrypted.

<table>
<tr><th>System controller variant</th><th colspan="2">SCL</th><th>SCM*</th><th>SCS*</th></tr>
<tr><th>Security mode</th><th>Secure</th><th>Open</th><th>Secure</th><th>Secure</th></tr>
<tr><td>Audio routing
(dynamic) OMNEO channels</td><td>Unlimited</td><td>-</td><td>32</td><td>4</td></tr>
<tr><td>Tone/message playback
(dynamic) OMNEO channels</td><td>8</td><td>-</td><td>8</td><td>4</td></tr>
<tr><td>Call recording/stacking*
(dynamic) OMNEO channels</td><td>8</td><td>-</td><td>8</td><td>4</td></tr>
<tr><td>External audio inputs
(static) Dante or AES67 channels</td><td rowspan="2">Pool of 8</td><td>112</td><td rowspan="2">Pool of 8</td><td rowspan="2">Pool of 4</td></tr>
<tr><td>External audio outputs
(static) Dante or AES67 channels</td><td>-</td></tr>
</table>

* Availability to be announced

7.5 Indicators and connections



Front panel indicators

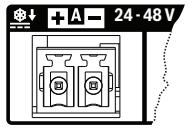
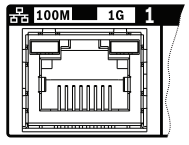
⚠	Device fault present	Yellow	⏻	Power on	Green
🔗	Network link present Network link lost Standby for redundancy	Green Yellow Blue		Identification mode / Indicator test	All LEDs blink



Rear panel indicators and controls

	SD card busy; do not remove	Green		100 Mbps network 1 Gbps network	Yellow Green
⚠	Device fault present	Yellow	⏻	Power on	Green
↺	Device reset (to factory default)	Button		Identification mode / Indicator test	All LEDs blink

Rear panel connections

	Chassis ground			24 to 48 VDC input A-B	
SD	Memory card		OMNEO	Network port 1-5	

7.6 Installation

The device can be connected everywhere within the PRAESENSA system. If required, refer to: *System introduction, page 14*.
The device is designed to be installed in a 19"-rack/cabinet. Refer to: *Mounting the 19"-rack devices, page 21*.

7.6.1 Parts included

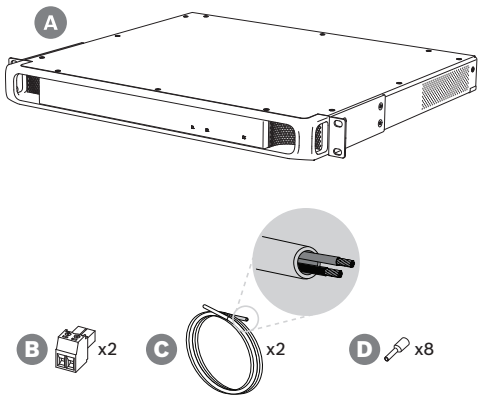
The box contains the following parts:

Quantity	Component
1	System controller
1	Set of 19"-rack mounting brackets (pre-mounted)
1	Set of screw connectors and cables
1	Quick Installation Guide

Quantity	Component
1	Safety information

No tools, SD-card or Ethernet cables are provided with the device.

Parts check and identification



A System controller

B 2-pole screw plug (x2)

C 2-conductor cable (x2)

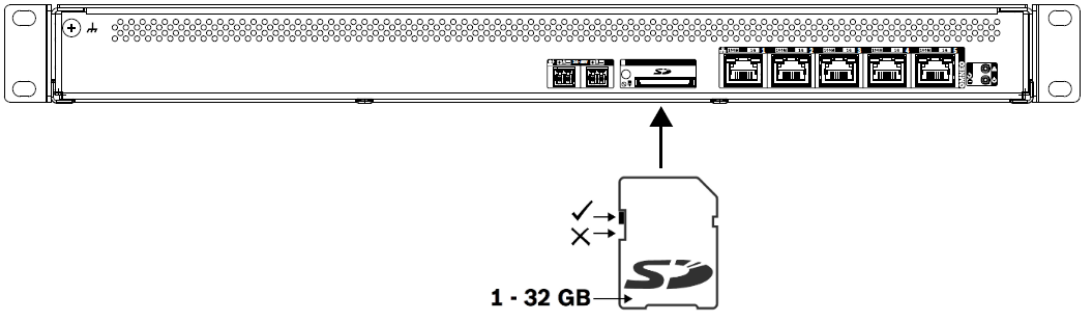
D Wire-end ferrules (x8)

7.6.2 Memory card

The SD memory card is optional and only used for call recording. Messages and tone files are stored in the internal memory.

Notice!
In a live system, do not remove the SD memory card while the system controller is accessing the card; this is indicated by the green busy-indicator.
Removal of the card while busy may corrupt the card's file system.

For IP30 ingress protection compliance, the system controller is delivered with a plastic dummy SD card in the memory card slot. The dummy card must be removed before a real SD memory card can be inserted. If no SD memory card is used, leave the dummy SD card in place.

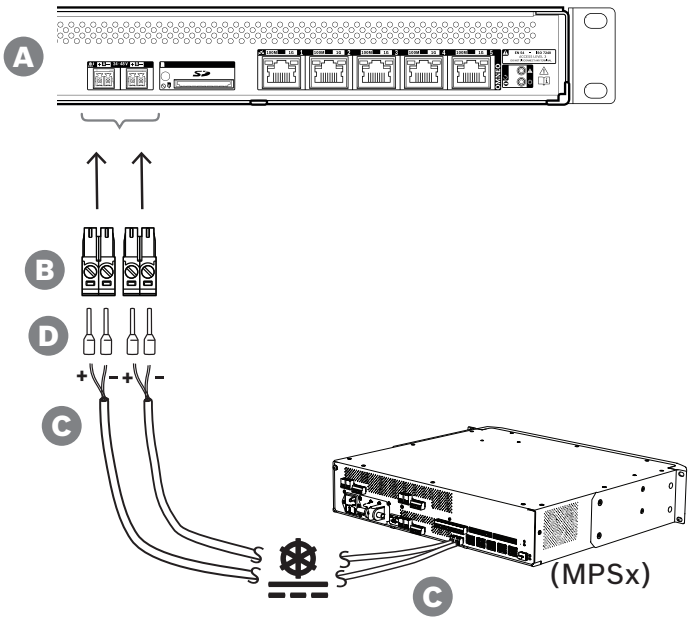


1. Use an SD memory card with a maximum size of 32 GB.
2. Disable write-protection of the card.
3. Insert the SD memory card in the slot.

7.6.3 Power supply

The system controller must be powered from a 24 - 48 V power supply. If the system controller is part of a certified emergency sound system, it must be powered from a PRAESENSA multifunction power supply. In case the system controller and the power supply

are mounted in two different racks, double supply connections must be made. Even if both devices are in the same rack, it is recommended to use double connections for fail-safe redundancy.



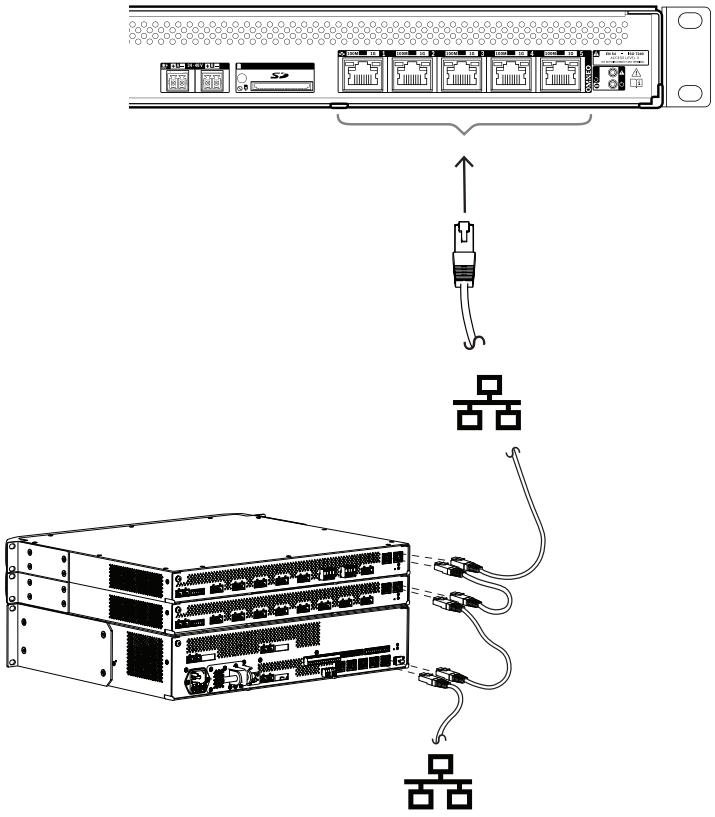
Follow the connection procedure below:

1. Crimp ferrules D onto the ends of the electrical wires of cable C to provide a solid and reliable electrical connection. Use a dedicated crimping tool.
2. Insert each wire into the appropriate slot of the connector B, observing polarity. Wiring color convention: red for + and black for -. Use a flat blade screwdriver to tighten each connection.
3. Insert the cable into the 24 to 48 V input A, cut the cable to length and mount the connector of the powering device to the other end of the cable, again observing polarity. Insert this connector into output A of the powering device (e.g. the 24 V output of the PRA-MPS3).
4. For redundancy, repeat these steps for a second cable to connect output B of the powering device to input B of the system controller.
5. Alternatives:
   - Instead of using the A/B outputs of a PRAESENSA powering device, also two separate power supplies can be used. The maximum current rating of the supply connectors is 8 A; only use a 24 - 48 V power supply that is current limited to < 8 A, also in overload condition.
   - When no power supply redundancy is required, a single power supply can be used.

Notice!
For compliance to EN 50121-4 for railway applications, the power connections to the 24-48 V input may not be longer than 3 m.

7.6.4 Ethernet network

The system controller has five Ethernet connection ports with a built-in Ethernet switch, supporting RSTP. Follow the procedure below to connect the system controller to a network and other system devices.



1. Use shielded Gb-Ethernet cables (preferably CAT6A F/UTP) with RJ45 connectors to connect the system controller to a network.
2. Connect to any of the five switch ports of the system controller.
   - The system controller supports Rapid Spanning Tree Protocol (RSTP) to enable the use of multiple connections simultaneously for cable redundancy, e.g. to daisy-chain devices in a loop, with a maximum of **21** devices in a loop.
   - RSTP can be disabled in the system configuration in case a (corporate) network does not allow for this.
3. Port assignments:
   - For general purpose Public Address systems all ports 1-5 can be used.
   - For Voice Alarm systems use ports 1-4 for (redundant) connections to the Voice Alarm network part, including all other PRAESENSA devices. Use port 5 for auxiliary connections, not related to the Voice Alarm function, like to a background music server.
   - The PRAESENSA system controller can be set up to work on two completely separate networks simultaneously for fail-over redundancy, supporting Dante glitch-free audio switching between both networks for continuous and uninterrupted audio distribution in case of a network failure of one of the networks. In this mode, use ports 1-4 for the primary network (with RSTP) and port 5 for the secondary network.

All PRAESENSA devices are on the primary network, the secondary network is only for network redundancy of Dante devices. Also see section *Network redundancy, page 30*.

– To configure the system, access to the webserver of the system controller is needed, using a web browser and the URL (Uniform Resource Locator) of the system controller. The URL is printed on the product label and for a PRA-SCL it has the following format: https://prascl-xxxxxx-ctrl.local, with xxxxxx being the last 6 hexadecimal digits of the device MAC-address. Configuration of the system and its devices is described in the PRAESENSA configuration manual.

7.6.5 Internal battery

The system controller has an internal lithium coin cell battery, model CR2032 (3 V, 225 mAh), in a battery holder. It is only used to power the internal real time clock (RTC) when the system controller is off. The life-time of the battery is in that case more than 20 years. When the system controller is on, the RTC is powered from the external power supply and the CR2032 battery is not used, making the system insusceptible to spring contact bounce of the battery holder in case of heavy vibrations.

Even when the system time is under control of an NTP server, the battery must not be removed, because it is important to keep the real time clock (RTC) powered during system restarts, keeping event logs in chronological order. Storage of system data does not depend on the presence of the battery.

In case battery replacement is needed:

1. Disconnect all power supply connections to the system controller.
2. Remove the system controller from the mounting rack and remove the top cover.
3. Locate the battery on the main printed circuit board, behind Ethernet port 5.
4. Replace the battery with the same type: CR2032 (3 V, 225 mAh). Observe polarity.
5. Assemble in reverse order.
6. Always comply with local requirements for hazardous waste when disposing the old battery.



Warning!

Keep lithium coin batteries out of the reach of small children; coin cell batteries can be accidentally ingested. If ingested, these batteries may leak harmful contents causing chemical burns, perforation of soft tissue, and in severe cases may cause death. Lithium coin batteries must be removed immediately if swallowed. Seek medical attention immediately.

7.6.6 Reset to factory default

The reset switch resets the device to its factory default settings. This function is only to be used in case a secured device is removed from a system to become part of another system. See *Device status and reset, page 54*.

7.7 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	EN/IEC/CSA/UL 62368-1
Immunity	EN 55024 EN 55103-2 (E1, E2, E3) EN 50130-4
Emissions	EN 55032 EN 61000-6-3 ICES-003 ANSI C63.4 FCC-47 part 15B class A
Environment	EN 50581
Railway applications	EN 50121-4
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
Australia	RCM
Morocco	CMIM
Russian Federation	EAC
United Arabic Emirates	CoC

7.8 Technical data

Electrical

Control	
Audio routing (SCL / SCM / SCS) OMNEO channels	 Unlimited / 32 / 4
Tone/message playback (SCL / SCM / SCS) OMNEO channels	 8 / 8 / 4
External audio inputs and/or outputs (SCL / SCM / SCS) Dante or AES67 channels	 120 / 8 / 4

Logging (internal storage)	
Call events	1000
Fault events	1000
General events	1000

Real Time Clock	
Accuracy (with NTP)	< 1 s/yr off
Accuracy (no NTP)	< 11 min/yr off
Daylight Saving Time (DST)	Automatic
Backup battery	CR2032 Lithium cell
Message/tone storage capacity	
Mono, uncompressed, 48 kHz, 16-bit	90 min
SD card size	1 to 32 GB
System size	
Networked devices	250 (single subnet)
Zones	500
Configuration	Web server/browser

Power transfer	
Power supply input A/B	
Input voltage range	24 to 48 VDC
Input voltage tolerance	20 to 60 VDC
Power consumption (24 V)	
Duty mode	3.9 W
Per active port	0.4 W

Supervision	
Run fault (watchdog reset)	All processors
System integrity	
Fault report time	< 100 s
Site specific data integrity	
Fault report time	< 1 hour
Supervised message storage	90 min
Power supply input A/B	Undervoltage

Network interface	
Ethernet	100BASE-TX, 1000BASE-T
Protocol	TCP/IP
Redundancy	RSTP
Audio/control protocol	OMNEO
Network audio latency	10 ms
Audio data encryption	AES128
Control data security	TLS

Ports	5

Reliability	
MTBF (extrapolated from calculated MTBF of PRA-AD608)	1.000.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -5 to +50 °C (23 to 122 °F) -30 to +70 °C (-22 to 158 °F)
Humidity (non condensing)	5 to 95 %
Air pressure (operating)	560 to 1070 hPa
Altitude (operating)	-500 to +5000 m (-1640 to 16404 ft)
Vibration (operating) Amplitude Acceleration	 < 0.7 mm < 2 G
Bump (transport)	< 10 G

Mechanical

Enclosure	
Dimensions (WxHxD) With mounting brackets Rack unit	 483 x 44 x 400 mm (19 x 1.75 x 15.7 in) 19 in, 1U
Ingress protection	IP30
Case Material Color	 Steel RAL9017
Frame Material Color	 Zamak RAL9022HR

Weight	5.8 kg (12.8 lb)

8 Amplifier, 600W 4-channel (AD604)



8.1 Introduction

This is a flexible and compact multi-channel power amplifier for 100 V or 70 V loudspeaker systems in Public Address and Voice Alarm applications. It fits in centralized system topologies, but also supports decentralized system topologies because of its OMNEO IP-network connection, combined with DC-power from a multifunction power supply.
The output power of each amplifier channel adapts to the connected loudspeaker load, only limited by the total power budget of the whole amplifier. This flexibility, and the integration of a spare amplifier channel, makes it possible to utilize the available power effectively and use less amplifiers for the same loudspeaker load, compared to using traditional amplifiers.
Digital sound processing and control, adjusted to the acoustics and requirements of each zone, allow for better sound quality and speech intelligibility.

8.2 Functions

Efficient 4-channel power amplifier

- Transformerless, galvanically isolated, 70/100 V outputs, with a total loudspeaker output power of 600 W.
- Flexible partitioning of the available output power across all amplifier channels to use it effectively, significantly reducing the amount of required amplifier power in a system.
- Cost and space saving, integrated, independent spare channel for fail-safe redundancy.
- High-efficiency in all operating conditions; dissipation and heat loss is minimized to save on energy and battery capacity for backup power.

Flexibility in loudspeaker topologies

- A/B outputs on every amplifier channel to support redundant loudspeaker wiring topologies. Both outputs are individually supervised and disabled in case of a fault.
- Class A loop wiring possible between the A and B loudspeaker outputs. Dedicated connection facility for an end-of-line device to supervise the complete loop, including the B-output connection.
- Load independent frequency response; the amplifier channels can be used with any loudspeaker load up to the maximum, without any change in audio quality.

Sound quality

- Audio-over-IP, using OMNEO, the Bosch high-quality digital audio interface, compatible with Dante and AES67; audio sample rate is 48 kHz with 24-bit sample size.
- Large signal to noise ratio, wide audio bandwidth and very low distortion and crosstalk.
- Digital signal processing on all amplifier channels, including equalization, limiting and delay, to optimize and tailor the sound in each loudspeaker zone.

Supervision

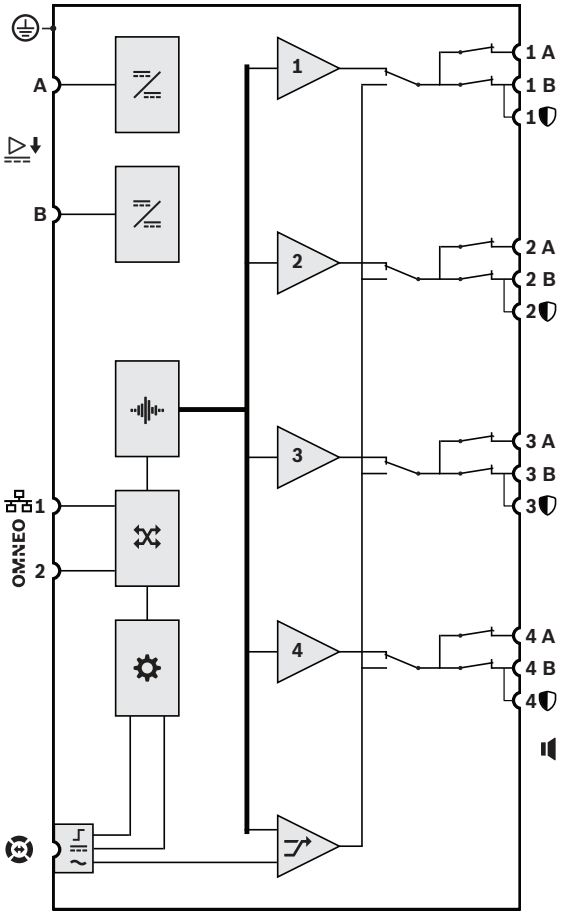
- Supervision of amplifier operation and all of its connections; faults are reported to the system controller and logged.
- Loudspeaker line integrity supervision without interruption of audio, using end-of-line devices (separately available) for best reliability.
- Network link supervision.

Fault tolerance

- Dual OMNEO network connections, supporting Rapid Spanning Tree Protocol (RSTP), for loop-through connections to adjacent devices.
- Dual 48 VDC inputs with polarity reversal protection, each with a full power DC/DC converter, operating in tandem for redundancy.
- Fully independent amplifier channels; the integrated spare channel automatically replaces a failing channel, with due regard of the actual sound processing settings.
- All amplifier channels support two independent loudspeaker groups, A and B, enabling redundant loudspeaker wiring topologies.
- Backup analog audio lifeline input driving the spare amplifier channel to serve all connected loudspeaker zones in case both network connections, or the amplifier network interface, would fail.

8.3 Functional diagram

Functional and connection diagram



Internal device functions

- DC to DC converter
- Audio processing (DSP)
- OMNEO network switch
- Controller
- Lifeline control interface
- Lifeline supply input
- Lifeline audio input
- **1-4** Amplifier channel
- Spare channel

8.4 Indicators and connections



Front panel indicators

	Spare channel substitute 1-4	White		Signal present 1-4 Fault present 1-4	Green Yellow
	Ground fault present	Yellow		Device fault present	Yellow
	Audio lifeline substitute	White		Network link to system controller present Network link lost Amplifier in standby mode	Green Yellow Blue
	Power on	Green		Identification mode / Indicator test	All LEDs blink



Rear panel indicators and controls

	100 Mbps network 1 Gbps network	Yellow Green		Device fault present	Yellow
	Power on	Green		Device reset (to factory default)	Button
	Identification mode / Indicator test	All LEDs blink			

Rear panel connections

	Safety ground			48 VDC input A-B	
	Lifeline interface			Loudspeaker output A-B (1-4) End-of-line device	
OMNEO	Network port 1-2				

8.5 Installation

The device is designed to be installed in a 19"-rack/cabinet. Refer to: *Mounting the 19"-rack devices, page 21*.
The device can be connected everywhere within the PRAESENSA system. If required, refer to: *System introduction, page 14*.

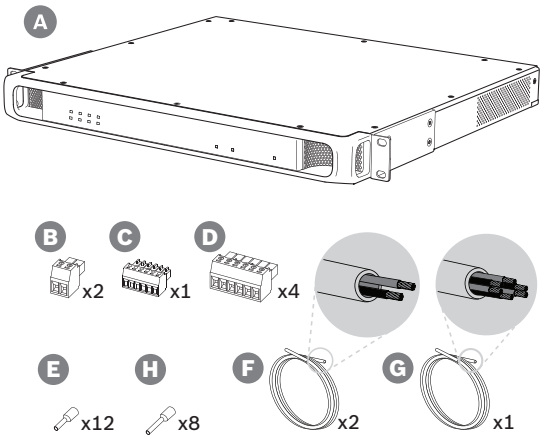
8.5.1 Parts included

The box contains the following parts:

Quantity	Component
1	Amplifier, 600W 4-channel
1	Set of 19"-rack mounting brackets (pre-mounted)
1	Set of screw connectors and cables
1	Quick Installation Guide
1	Safety information

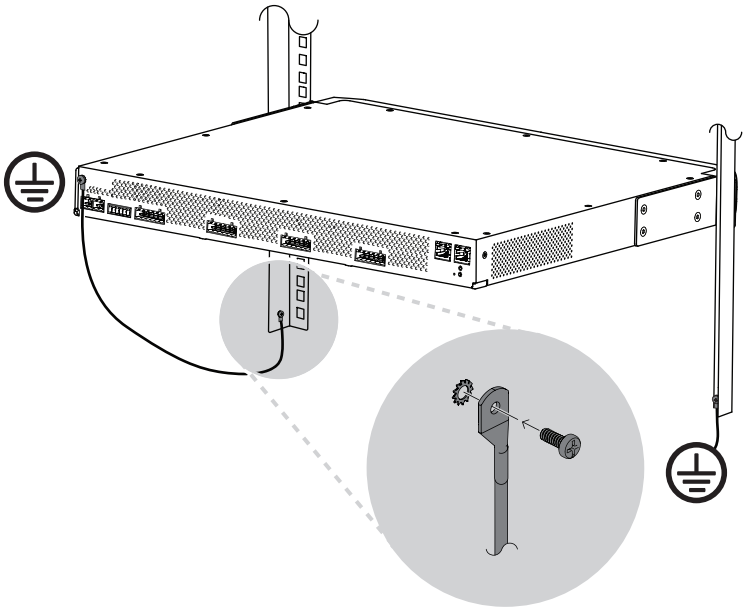
No tools or Ethernet cables are provided with the device.

Parts check and identification



A Amplifier
B 2-pole screw plug (x2)
C 6-pole screw plug (small)
D 6-pole screw plug (large, x4)
E Wire-end ferrules (small, x12)
F 2-conductor cable (x2)
G 6-conductor cable
H Wire-end ferrules (large, x8)

8.5.2 Safety ground



Connecting the chassis ground screw to safety ground is mandatory for the PRAESENSA power amplifiers:

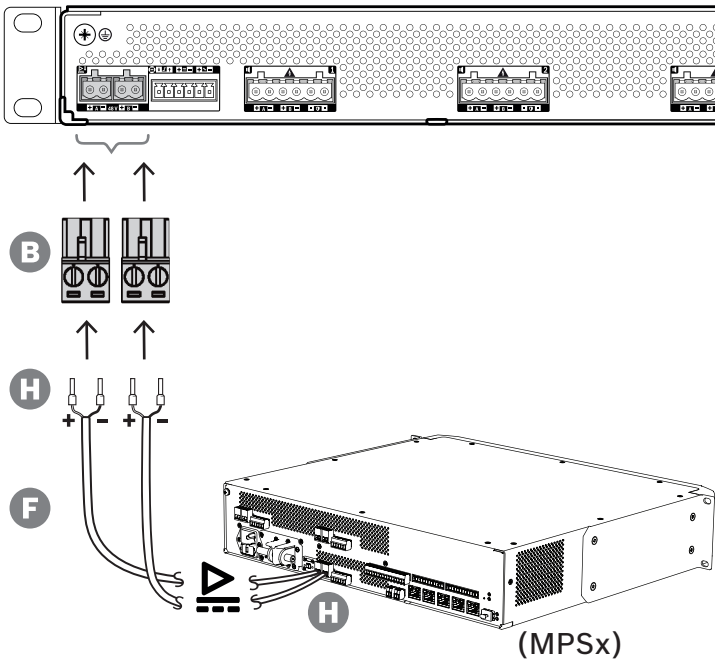
– The safety ground connection is needed for safety because of high internal voltages. All PRAESENSA 19”-devices have a chassis ground screw on the rear panel, which can be used for a wire connection to the rack frame. The rack frame must be grounded to safety ground. This is a conductive path to ground or earth that is designed to protect persons from electrical shock by shunting away any dangerous currents that might occur due to malfunction or accident. Use a thick, multi strand wire (>2.5 mm^2) with wire eyelets and washers for a solid connection.
– The safety ground connection is needed as reference for the ground short detection circuit. Without this connection, the amplifier could be electrically floating and no ground shorts or leakage currents would be detected for loudspeaker lines that touch ground somewhere. The safety ground connection via the mains connection of the multifunction power supply cannot be relied on for this, because the mains cable of this supply could be unplugged and then the amplifier continues to work on the backup battery.



Caution!
The chassis ground screw of an amplifier must be connected to protective ground **before** the amplifier is connected to a power supply.

8.5.3 Power supply

The amplifier must be powered from a 48 V power supply. If the amplifier is used as part of a certified emergency sound system, it must be powered from a PRAESENSA multifunction power supply. In case the amplifier and the power supply are mounted in two different racks, double power supply connections must be made, but even if both devices are in the same rack, it is recommended to use double connections for fail-safe redundancy.



Follow the connection procedure below:

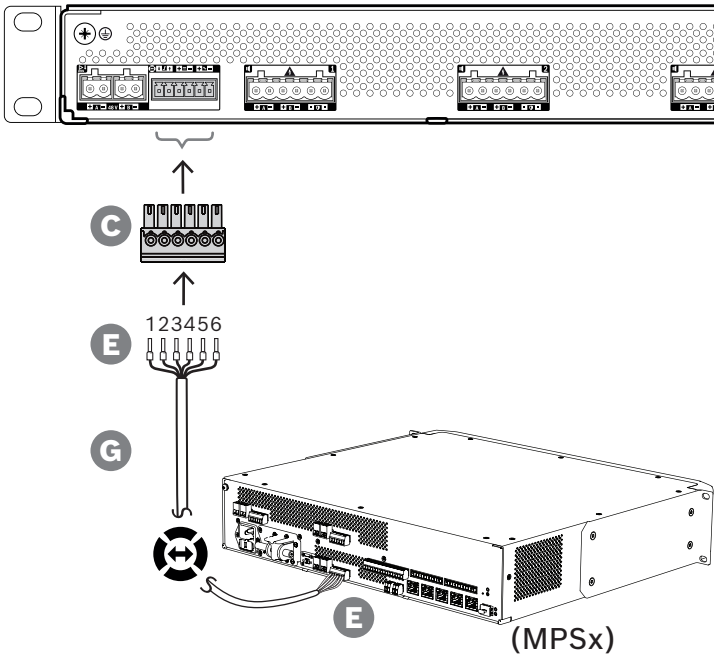
1. Crimp ferrules H onto the ends of the electrical wires of cable F to provide a solid and reliable electrical connection.
   – Use a dedicated crimping tool.
2. Insert each wire into the appropriate slot of the connector B, observing polarity. Wiring color convention: red for + and black for -.
   – Use a flat blade screwdriver to tighten each connection.
3. Insert the cable into the 48 V input A, cut the cable to length and mount the connector of the powering device to the other end of the cable, again observing polarity. Insert this connector into output A of the powering device.
4. For redundancy, repeat these steps for a second cable between output B of the powering device to input B of the amplifier.
5. Alternatives:
   – Instead of using the A/B outputs of a PRAESENSA powering device, also two separate power supplies can be used. The maximum current rating of the supply connectors is 15 A; only use a 48 V power supply that is current limited to < 15 A, also in overload condition.
   – When no power supply redundancy is required, a single power supply can be used; in that case connect the 48 V inputs A and B in parallel to make use of the amplifier's internal dual power converters for fail safe redundancy and to avoid a supply supervision fault event.

8.5.4 Lifeline

The lifeline is an optional cable connection between a PRAESENSA amplifier and a PRAESENSA multifunction power supply. This interconnection serves multiple functions:

- The multifunction power supply provides the audio signal of the highest priority emergency call as a balanced line level analog signal on the lifeline connector (pins 5 and 6). This signal is a backup audio signal for the connected amplifier in case its network interface or both network links would fail. The emergency call will then be distributed to all connected loudspeakers at maximum volume and without equalization or audio delay. The lifeline signal goes straight to the spare amplifier channel to drive all zones in parallel. This line is supervised by the multifunction power supply.
- The multifunction power supply sends information (pin 1) to the connected amplifier about the availability of mains power. In case mains power fails and power is provided from the battery, this signal sets the amplifier in backup power mode to disable all amplifier channels that are not needed to make calls with a priority above the configured priority level for the backup power mode. When no high priority calls are being made via this amplifier, it informs the multifunction power supply (pin 2) to switch off the 48 V converters to minimize battery power consumption even more. The power supplies and the amplifier channels go to snooze mode and wake up every 90 seconds briefly to perform the required supervision actions for timely fault reporting.
- The multifunction power supply provides the battery or charger voltage, in the range of 12 to 18 V, to the amplifier directly (pins 3 and 4) to supply power to the amplifier's network interface while the 48 V power supplies are switched off.

Notice!
When the amplifier is powered from one or two normal 48 V power supplies, that do not have a lifeline interface, the power saving and audio bypass functions are not available. All other amplifier functions are still available.



To create a lifeline connection, follow the procedure below.

1. Crimp ferrules E onto the ends of the electrical wires of cable G to provide a solid and reliable electrical connection.
   - Use a dedicated crimping tool.

2. Insert each wire into the appropriate slot of the connector C. The wiring order is not critical, but use the same order for all lifeline cables in the system to minimize the risk of errors.
   – Use a flat blade screwdriver to tighten each connection.
3. Insert the cable connector into the amplifier's lifeline socket, cut the cable to length and mount a connector of the same type, delivered with the multifunction power supply to the other end of the cable, observing wiring order. Insert this connector into the lifeline socket of the multifunction power supply.

Notice!
The lifeline connection may not be longer than 3 m.

8.5.5 Amplifier outputs

The amplifier provides four output channels and a spare channel that substitutes a failing channel.
The channels have direct drive 70/100 V outputs for low distortion, low crosstalk and a wide audio bandwidth. There are no output transformers that would be a limiting factor for the output power of each channel. Every channel also has a load independent flat frequency response. This combination of features makes it possible to partition the available amplifier power across all channels and utilize that power effectively.
Every channel has a 6-pole connector socket, providing independently switched loudspeaker group A and group B outputs and a separate connection facility for an End-of-Line device for loudspeaker cable supervision (only for Class-A loop, A to B).

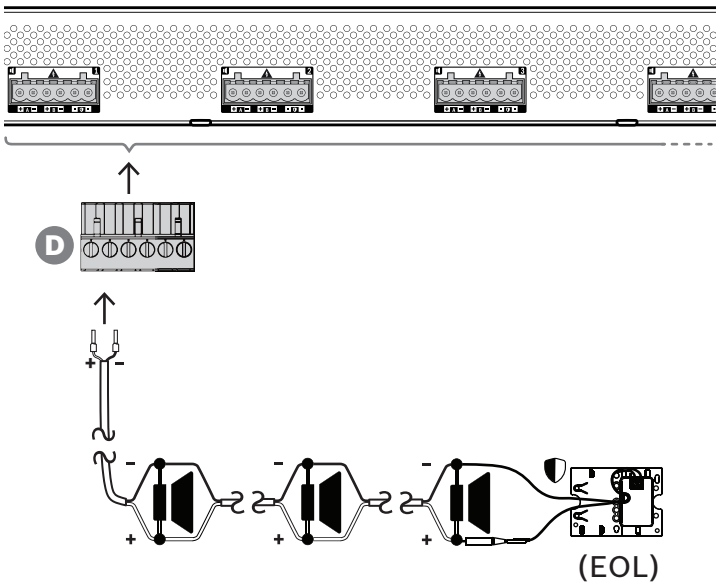
Caution!
For compliance to UL 62368-1 and CAN/CSA C22.2 No. 62368-1 all loudspeaker wiring must be Class 2 wiring (CL2); this requirement does not apply for compliance to EN/IEC 62368-1.

Caution!
Amplifier outputs may carry output voltages up to 100 VRMS. Touching uninsulated terminals or wiring may result in an unpleasant sensation.

Notice!
Only amplifier channel 1 and the spare channel are capable of delivering up to 600 W maximum. All other channels are limited to 300 W maximum. In practice this does not impose any limitation on the flexibility of partitioning the total amplifier power across the channels, because if there is one zone with more than 300 W load, which is connected to channel 1, no other channel can be loaded with more than 300 W anymore without exceeding the total maximum of 600 W.

Three different loudspeaker connection topologies are supported, configurable in the system configuration:

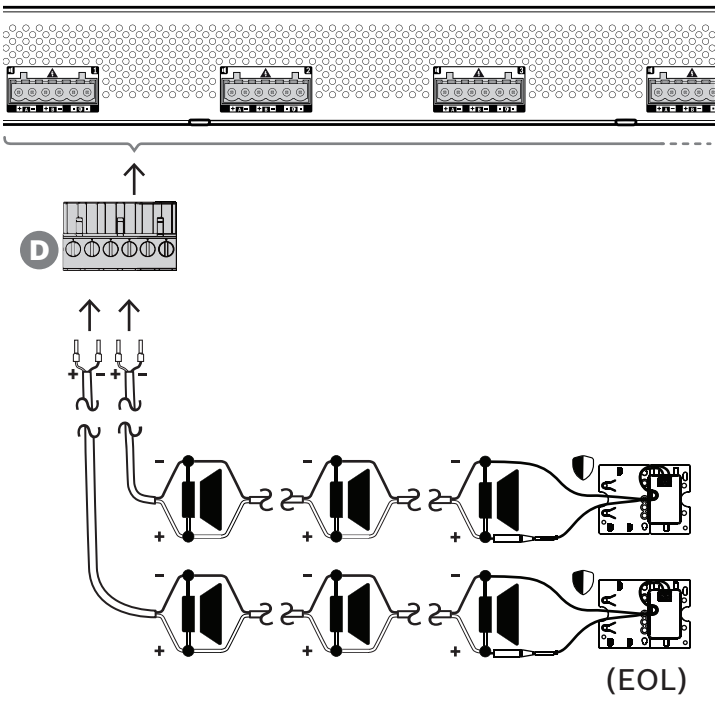
Single line A only



If no loudspeaker line redundancy is needed for a zone, then follow the procedure below to connect the loudspeakers to output A only:

1. Connect all loudspeakers in parallel, observing proper polarity. Select the right wire gauge, taking into account the connected loudspeaker power, the length of cable and the maximum permissible attenuation of the acoustic sound level due to loudspeaker line losses. See also section *Cable type recommendations, page 24* for loudspeaker cable size recommendations.
2. Insert the near end wires of the loudspeaker cable into slots 1 and 2 of connector D, preferably using crimped on wire ferrules that fit to the wire gauge used. Observe polarity.
   – Use a flat blade screwdriver to tighten each connection.
3. If the connected loudspeakers are also intended for emergency sound and loudspeaker line supervision is required, make sure that all loudspeakers are connected in a loop-through fashion and that an end-of-line device is connected to the end of the loudspeaker line for supervision.
   – No cable spurs or branches are allowed, because they will not be supervised.

Dual line (A + B)

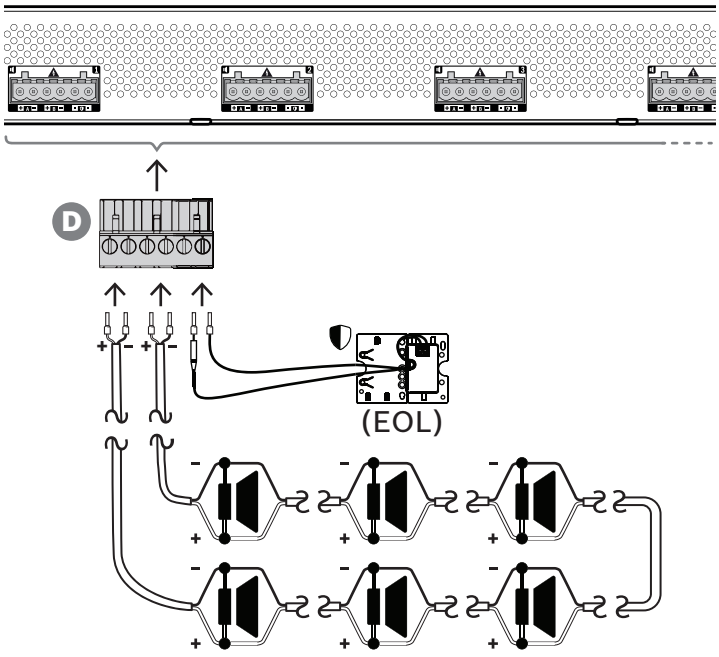


If loudspeaker line redundancy is needed, then follow the procedure below to connect two loudspeaker lines, one to output A and one to output B. Typically the loudspeakers are mounted alternating A, B, A, B, and so on, half the number connected to A, half the number connected to B.

When one loudspeaker line fails this may result in the loss of half the number of loudspeaker and with proper positioning of the loudspeakers the acoustic output level will drop by 3 dBSPL. A loudspeaker line fault will be reported.

1. Connect half of the loudspeakers in parallel in a loop-through fashion to output A. Observe polarity.
   – Follow the same wiring procedure as for using a single line.
2. Connect an end-of-line device to the end of loudspeaker line A.
3. Repeat this procedure for the other half of the loudspeakers and connect them to output B.
4. Connect an end-of-line device to the end of loudspeaker line B. Loudspeaker lines A and B must be separately supervised, each with its own end-of-line device. In case of a short circuit in one of the loudspeaker lines, the amplifier will diagnose the overload condition to find the affected loudspeaker line and switch-off that line, so the other loudspeaker line can continue operation.

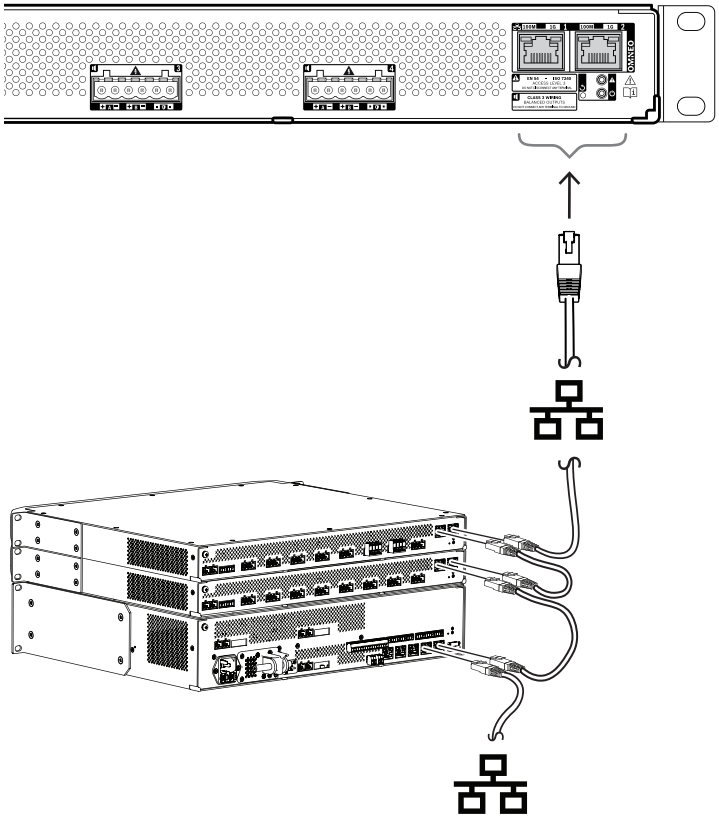
Loop (A to B)



A third loudspeaker connection topology is the so-called Class-A loop, where the loudspeakers are connected in a loop, starting at output A and ending at output B, with the end of the loop being supervised with an end-of-line device.
In normal operation the loop is driven from output A only. In case of an interruption of the loudspeaker line, this will result in the loudspeaker signal not arriving at output B and neither at the end-of-line device. The disconnection of the end-of-line device will be detected at output A, and as a result output B will be activated to drive the loop from the opposite side in an attempt to reach all loudspeakers again. A loudspeaker line fault will be reported.
Follow the procedure below to connect the loudspeakers according to this scheme.

1. Connect all loudspeaker in parallel in a loop-through fashion. Observe equal polarity for all loudspeakers. Connect one side of the loudspeaker cable to output A, observing polarity.
2. Connect the other side of the loudspeaker cable to output B. In this case maintaining the correct polarity is especially important, as reversal on one end will short circuit the amplifier channel, not immediately, but when output B is activated in case of interruption of one conductor.
3. Connect an end-of-line device to the end-of-line connection terminals. These terminals are connected in parallel to output B, internally in the amplifier, to include supervision of the output B connection.

8.5.6 Ethernet network



The amplifier has two Ethernet connection ports with a built-in Ethernet switch, supporting RSTP. Follow the procedure below to connect the amplifier to a network. The network must be set up in such a way that the amplifier can be discovered and reached by the system controller.

1. Use shielded Gb-Ethernet cables (preferably CAT6A F/UTP) with RJ45 connectors to connect the amplifier to the network.
2. Connect one end of the cable to one port of the amplifier.
3. Connect the other side of the cable to another network port in the network. This can be one port of the system controller, a port of a separate switch in the network, but also a port of another PRAESENSA device in the same rack.
4. The second port of the amplifier can be connected to a subsequent PRAESENSA device. The built-in Ethernet switch allows for a loopthrough interconnection between system devices, with a maximum of 21 devices in series.
5. For redundancy a looped through network connection may be connected at both sides to create a loop. RSTP must be enabled in the system.
6. For configuration, the amplifier is identified by its hostname, which is printed on the product label on the side of the device. The format of the hostname is the type number of the device without the dash, followed by a dash and then the last 6 hexadecimal digits of its MAC-address. Configuration is described in the PRAESENSA configuration manual.

8.5.7 Reset to factory default

The reset switch resets the device to its factory default settings. This function is only to be used in case a secured device is removed from a system to become part of another system.
See *Device status and reset, page 54*.

8.6 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	EN/IEC/CSA/UL 62368-1
Immunity	EN 55024 EN 55103-2 (E1, E2, E3) EN 50130-4
Emissions	EN 55032 EN 61000-6-3 ICES-003 ANSI C63.4 FCC-47 part 15B class A
Environment	EN 50581
Railway applications	EN 50121-4
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
Australia	RCM
Morocco	CMIM
Russian Federation	EAC
United Arabic Emirates	CoC

8.7 Technical data

Electrical

Loudspeaker load	
Maximum loudspeaker load 100 V mode, all channels* 70 V mode, all channels*	 600 W 600 W
Minimum loudspeaker load impedance 100 V mode, all channels* 70 V mode, all channels*	 16.7 ohm 8.3 ohm
Maximum cable capacitance 100 V mode, all channels* 70 V mode, all channels*	 2 uF 2 uF
*All channels combined.	

Amplifier outputs	
Rated output voltage	
100 V mode, 1 kHz, THD <1 %, no load	100 VRMS
70 V mode, 1 kHz, THD <1 %, no load	70 VRMS
Burst / rated power**	
All channels combined	
100 V mode, load 16.7 ohm	600 W / 150 W
70 V mode, load 8.3 ohm	600 W / 150 W
Channel 1	
100 V mode, load 16.7 ohm // 20 nF	600 W / 150 W
70 V mode, load 11.7 ohm // 20 nF	420 W / 105 W
Other channels	
100 V mode, load 33.3 ohm // 20 nF	300 W / 75 W
70 V mode, load 16.7 ohm // 20 nF	300 W / 75 W
Full to no load regulation	
20 Hz to 20 kHz	< 0.2 dB
Frequency response	
Rated power, +0.5 / -3 dB	20 Hz to 20 kHz
Total Harmonic Distortion + Noise (THD+N)	
Rated power, 20 Hz to 20 kHz	< 0.5 %
6 dB below rated power, 20 Hz to 20 kHz	< 0.1 %
Intermodulation Distortion (ID)	
6 dB below rated power, 19+20 kHz, 1:1	< 0.1 %
Signal to Noise Ratio (SNR)	
100 V mode, 20 Hz to 20 kHz	> 110 dBA
70 V mode, 20 Hz to 20 kHz	> 107 dBA
Crosstalk between channels	
100 Hz to 20 kHz	< -84 dBA
DC offset voltage	< 50 mV
Signal processing per channel	
Audio equalization	7-section parametric
Level control	0 to -60 dB, mute
Level control resolution	1 dB
Audio delay	0 to 60 s
Audio delay resolution	1 ms
RMS power limiter	Rated power
Lifeline	
Sensitivity (100 V out)	0 dBV
Mute attenuation	> 80 dB
Signal to Noise Ratio (SNR)	> 90 dBA
**Full voltage swing into maximum loudspeaker load for speech and music program material (crest factor > 9 dB)	

Power transfer	
Power supply input A/B	
Input voltage	48 VDC
Input voltage tolerance	44 to 60 VDC
Power consumption (48 V)	
Sleep mode, no supervision	6.0 W
Snooze mode, supervision active	8.0 W
Active mode, idle	32 W
Active mode, low power	52 W
Active mode, rated power	230 W
Per active port	0.4 W
Heat loss (including power supply)	
Active mode, idle	140 kJ/h (133 Btu/h)
Active mode, low power	230 kJ/h (218 Btu/h)
Active mode, full power	360 kJ/h (341 Btu/h)

Supervision	
End-of-Line detection mode	Pilot tone 25.5 kHz, 3 VRMS
Power supply input A/B	Undervoltage
Ground short detection (loudspeaker lines)	< 50 kohm
Amplifier channel redundancy switching	Internal spare channel
Amplifier channel load	Short circuit
Loudspeaker line redundancy switching	A/B group, Class-A loop
Controller continuity	Watchdog
Temperature	Overheat
Fan	Rotation speed
Network interface	Link presence

Network interface	
Ethernet	100BASE-TX, 1000BASE-T
Protocol	TCP/IP
Redundancy	RSTP
Audio/control protocol	OMNEO
Network audio latency	10 ms
Audio data encryption	AES128
Control data security	TLS

Ports	2

Reliability	
MTBF (extrapolated from calculated MTBF of PRA-AD608)	300.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -5 to +50 °C (23 to 122 °F) -30 to +70 °C (-22 to 158 °F)
Humidity (non condensing)	5 to 95 %
Air pressure (operating)	560 to 1070 hPa
Altitude (operating)	-500 to +5000 m (-1640 to 16404 ft)
Vibration (operating) Amplitude Acceleration	 < 0.7 mm < 2 G
Bump (transport)	< 10 G

Airflow	
Fan airflow	Front to sides/rear
Fan noise Idle condition, 1 m distance Rated power, 1 m distance	 < 30 dBSPLA < 53 dBSPLA

Mechanical

Enclosure	
Dimensions (WxHxD) With mounting brackets Rack unit	 483 x 44 x 400 mm (19 x 1.75 x 15.7 in) 19 in, 1U
Ingress protection	IP30
Case Material Color	 Steel RAL9017
Frame Material Color	 Zamak RAL9022HR

Weight	8.1 kg (17.9 lb)

9 Amplifier, 600W 8-channel (AD608)



9.1 Introduction

This is a flexible and compact multi-channel power amplifier for 100 V or 70 V loudspeaker systems in Public Address and Voice Alarm applications. It fits in centralized system topologies, but also supports decentralized system topologies because of its OMNEO IP-network connection, combined with DC-power from a multifunction power supply.
The output power of each amplifier channel adapts to the connected loudspeaker load, only limited by the total power budget of the whole amplifier. This flexibility, and the integration of a spare amplifier channel, makes it possible to utilize the available power effectively and use less amplifiers for the same loudspeaker load, compared to using traditional amplifiers.
Digital sound processing and control, adjusted to the acoustics and requirements of each zone, allow for better sound quality and speech intelligibility.

9.2 Functions

Efficient 8-channel power amplifier

- Transformerless, galvanically isolated, 70/100 V outputs, with a total loudspeaker output power of 600 W.
- Cost and space saving, integrated, independent spare channel for fail-safe redundancy.
- High-efficiency in all operating conditions; dissipation and heat loss is minimized to save on energy and battery capacity for backup power.
- Flexible partitioning of the available output power across all amplifier channels to use it effectively, significantly reducing the amount of required amplifier power in a system.

Flexibility in loudspeaker topologies

- A/B outputs on every amplifier channel to support redundant loudspeaker wiring topologies. Both outputs are individually supervised and disabled in case of a fault.
- Class A loop wiring possible between the A and B loudspeaker outputs.
- Load independent frequency response; the amplifier channels can be used with any loudspeaker load up to the maximum, without any change in audio quality.

Sound quality

- Audio-over-IP, using OMNEO, the Bosch high-quality digital audio interface, compatible with Dante and AES67; audio sample rate is 48 kHz with 24-bit sample size.
- Large signal to noise ratio, wide audio bandwidth and very low distortion and crosstalk.
- Digital signal processing on all amplifier channels, including equalization, limiting and delay, to optimize and tailor the sound in each loudspeaker zone.

Supervision

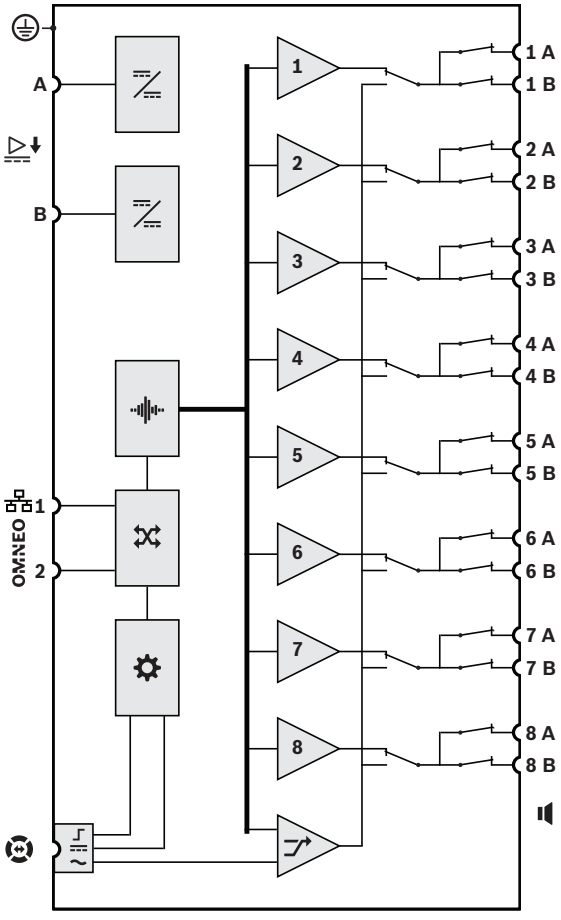
- Supervision of amplifier operation and all of its connections; faults are reported to the system controller and logged.
- Loudspeaker line integrity supervision without interruption of audio, using end-of-line devices (separately available) for best reliability.
- Network link supervision.

Fault tolerance

- Dual OMNEO network connections, supporting Rapid Spanning Tree Protocol (RSTP), for loop-through connections to adjacent devices.
- Dual 48 VDC inputs with polarity reversal protection, each with a full power DC/DC converter, operating in tandem for redundancy.
- Fully independent amplifier channels; the integrated spare channel automatically replaces a failing channel, with due regard of the actual sound processing settings.
- All amplifier channels support two independent loudspeaker groups, A and B, enabling redundant loudspeaker wiring topologies.
- Backup analog audio lifeline input driving the spare amplifier channel to serve all connected loudspeaker zones in case both network connections, or the amplifier network interface, would fail.

9.3 Functional diagram

Functional and connection diagram



Internal device functions

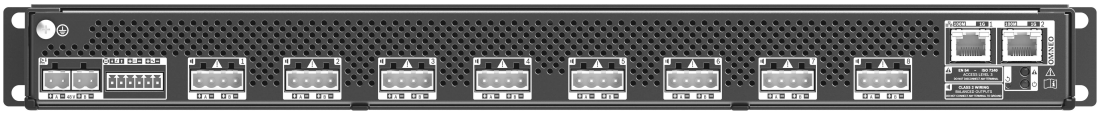
- DC to DC converter
- Audio processing (DSP)
- OMNEO network switch
- Controller
- Lifeline control interface
- Lifeline supply input
- Lifeline audio input
- **1-8** Amplifier channel
- Spare channel

9.4 Indicators and connections



Front panel indicators

	Spare channel substitute 1-8	White		Signal present 1-8 Fault present 1-8	Green Yellow
	Ground fault present	Yellow		Device fault present	Yellow
	Audio lifeline substitute	White		Network link to system controller present Network link lost Amplifier in standby mode	Green Yellow Blue
	Power on	Green		Identification mode / Indicator test	All LEDs blink



Rear panel indicators and controls

	100 Mbps network 1 Gbps network	Yellow Green		Device fault present	Yellow
	Power on	Green		Device reset (to factory default)	Button
	Identification mode / Indicator test	All LEDs blink			

Rear panel connections

	Safety ground			48 VDC input A-B	
	Lifeline interface			Loudspeaker output A-B (1-8)	
OMNEO	Network port 1-2				

9.5 Installation

The device is designed to be installed in a 19"-rack/cabinet. Refer to: *Mounting the 19"-rack devices, page 21*.
The device can be connected everywhere within the PRAESENSA system. If required, refer to: *System introduction, page 14*.

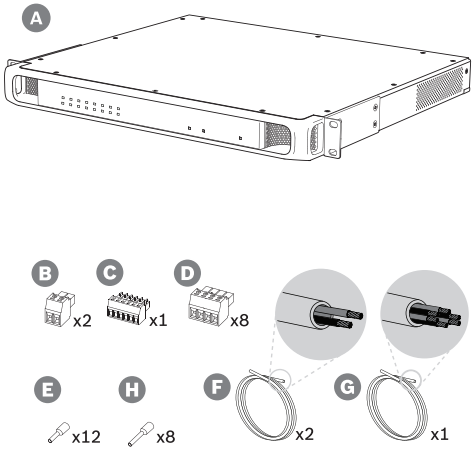
9.5.1 Parts included

The box contains the following parts:

Quantity	Component
1	Amplifier, 600W 8-channel
1	Set of 19"-rack mounting brackets (pre-mounted)
1	Set of screw connectors and cables
1	Quick Installation Guide
1	Safety information

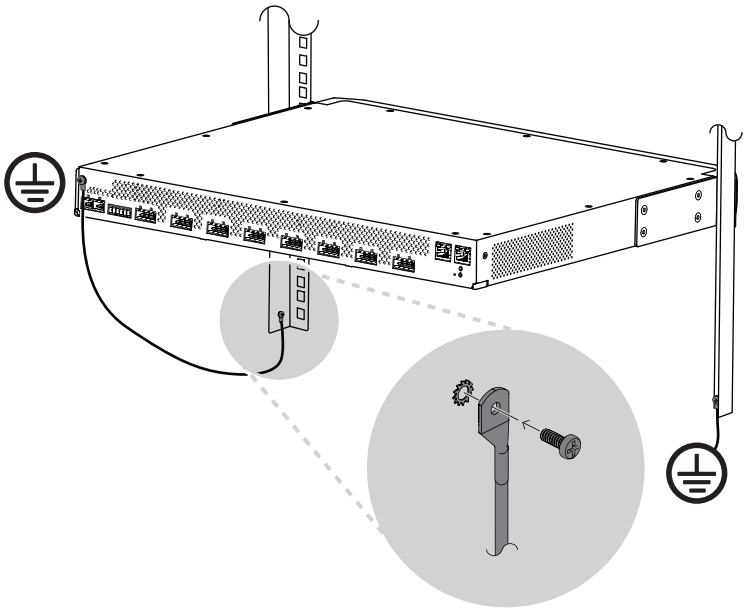
No tools or Ethernet cables are provided with the device.

Parts check and identification



A Amplifier
B 2-pole screw plug (x2)
C 6-pole screw plug (small)
D 4-pole screw plug (large, x8)
E Wire-end ferrules (small, x12)
F 2-conductor cable (x2)
G 6-conductor cable
H Wire-end ferrules (large, x8)

9.5.2 Safety ground



Connecting the chassis ground screw to safety ground is mandatory for the PRAESENSA power amplifiers:

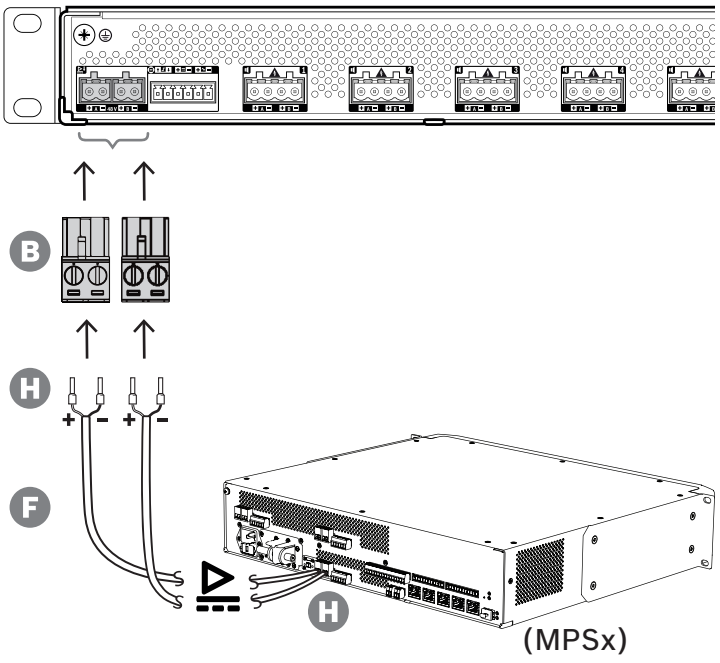
– The safety ground connection is needed for safety because of high internal voltages. All PRAESENSA 19”-devices have a chassis ground screw on the rear panel, which can be used for a wire connection to the rack frame. The rack frame must be grounded to safety ground. This is a conductive path to ground or earth that is designed to protect persons from electrical shock by shunting away any dangerous currents that might occur due to malfunction or accident. Use a thick, multi strand wire (>2.5 mm^2) with wire eyelets and washers for a solid connection.
– The safety ground connection is needed as reference for the ground short detection circuit. Without this connection, the amplifier could be electrically floating and no ground shorts or leakage currents would be detected for loudspeaker lines that touch ground somewhere. The safety ground connection via the mains connection of the multifunction power supply cannot be relied on for this, because the mains cable of this supply could be unplugged and then the amplifier continues to work on the backup battery.



Caution!
The chassis ground screw of an amplifier must be connected to protective ground **before** the amplifier is connected to a power supply.

9.5.3 Power supply

The amplifier must be powered from a 48 V power supply. If the amplifier is used as part of a certified emergency sound system, it must be powered from a PRAESENSA multifunction power supply. In case the amplifier and the power supply are mounted in two different racks, double power supply connections must be made, but even if both devices are in the same rack, it is recommended to use double connections for fail-safe redundancy.



Follow the connection procedure below:

1. Crimp ferrules H onto the ends of the electrical wires of cable F to provide a solid and reliable electrical connection.
   – Use a dedicated crimping tool.
2. Insert each wire into the appropriate slot of the connector B, observing polarity. Wiring color convention: red for + and black for -.
   – Use a flat blade screwdriver to tighten each connection.
3. Insert the cable into the 48 V input A, cut the cable to length and mount the connector of the powering device to the other end of the cable, again observing polarity. Insert this connector into output A of the powering device.
4. For redundancy, repeat these steps for a second cable between output B of the powering device to input B of the amplifier.
5. Alternatives:
   – Instead of using the A/B outputs of a PRAESENSA powering device, also two separate power supplies can be used. The maximum current rating of the supply connectors is 15 A; only use a 48 V power supply that is current limited to < 15 A, also in overload condition.
   – When no power supply redundancy is required, a single power supply can be used; in that case connect the 48 V inputs A and B in parallel to make use of the amplifier's internal dual power converters for fail safe redundancy and to avoid a supply supervision fault event.

9.5.4 Lifeline

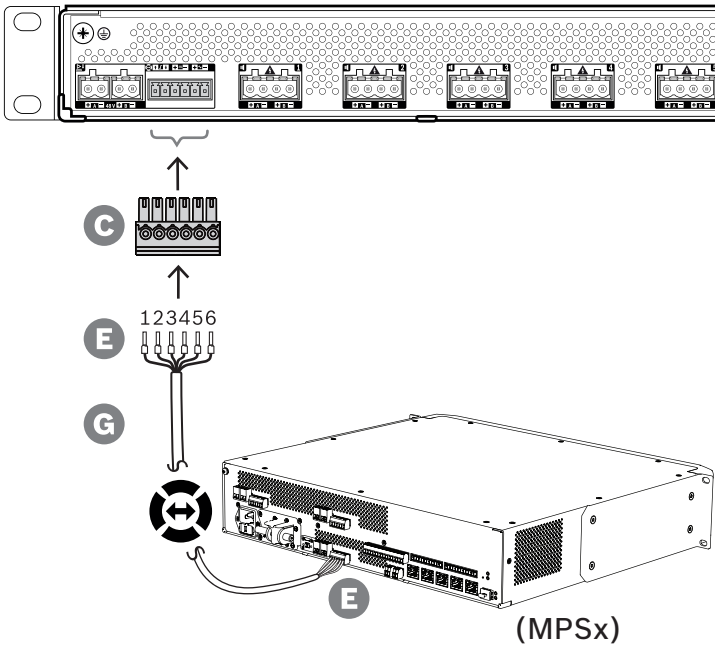
The lifeline is an optional cable connection between a PRAESENSA amplifier and a PRAESENSA multifunction power supply. This interconnection serves multiple functions:

– The multifunction power supply provides the audio signal of the highest priority emergency call as a balanced line level analog signal on the lifeline connector (pins 5 and 6). This signal is a backup audio signal for the connected amplifier in case its network interface or both network links would fail. The emergency call will then be distributed to

all connected loudspeakers at maximum volume and without equalization or audio delay. The lifeline signal goes straight to the spare amplifier channel to drive all zones in parallel. This line is supervised by the multifunction power supply.

– The multifunction power supply sends information (pin 1) to the connected amplifier about the availability of mains power. In case mains power fails and power is provided from the battery, this signal sets the amplifier in backup power mode to disable all amplifier channels that are not needed to make calls with a priority above the configured priority level for the backup power mode. When no high priority calls are being made via this amplifier, it informs the multifunction power supply (pin 2) to switch off the 48 V converters to minimize battery power consumption even more. The power supplies and the amplifier channels go to snooze mode and wake up every 90 seconds briefly to perform the required supervision actions for timely fault reporting.
– The multifunction power supply provides the battery or charger voltage, in the range of 12 to 18 V, to the amplifier directly (pins 3 and 4) to supply power to the amplifier's network interface while the 48 V power supplies are switched off.

Notice!
When the amplifier is powered from one or two normal 48 V power supplies, that do not have a lifeline interface, the power saving and audio bypass functions are not available. All other amplifier functions are still available.



To create a lifeline connection, follow the procedure below.

1. Crimp ferrules E onto the ends of the electrical wires of cable G to provide a solid and reliable electrical connection.
   – Use a dedicated crimping tool.
2. Insert each wire into the appropriate slot of the connector C. The wiring order is not critical, but use the same order for all lifeline cables in the system to minimize the risk of errors.
   – Use a flat blade screwdriver to tighten each connection.

3. Insert the cable connector into the amplifier's lifeline socket, cut the cable to length and mount a connector of the same type, delivered with the multifunction power supply to the other end of the cable, observing wiring order. Insert this connector into the lifeline socket of the multifunction power supply.

Notice!
The lifeline connection may not be longer than 3 m.

9.5.5 Amplifier outputs

The amplifier provides eight output channels and a spare channel that substitutes a failing channel.
The channels have direct drive 70/100 V outputs for low distortion, low crosstalk and a wide audio bandwidth. There are no output transformers that would be a limiting factor for the output power of each channel. Every channel also has a load independent flat frequency response. This combination of features makes it possible to partition the available amplifier power across all channels and utilize that power effectively.
Every channel has a 4-pole connector socket, providing independently switched loudspeaker group A and group B outputs. It supports three different loudspeaker connection topologies, configurable in the system configuration:

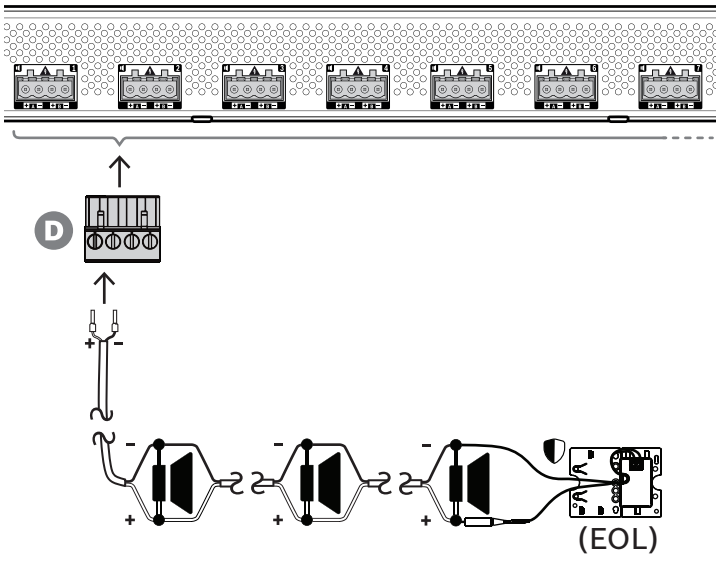
Caution!
For compliance to UL 62368-1 and CAN/CSA C22.2 No. 62368-1 all loudspeaker wiring must be Class 2 wiring (CL2); this requirement does not apply for compliance to EN/IEC 62368-1.

Caution!
Amplifier outputs may carry output voltages up to 100 VRMS. Touching uninsulated terminals or wiring may result in an unpleasant sensation.

Notice!
Only amplifier channel 1 and the spare channel are capable of delivering up to 600 W maximum. All other channels are limited to 300 W maximum. In practice this does not impose any limitation on the flexibility of partitioning the total amplifier power across the channels, because if there is one zone with more than 300 W load, which is connected to channel 1, no other channel can be loaded with more than 300 W anymore without exceeding the total maximum of 600 W.

Three different loudspeaker connection topologies are supported, configurable in the system configuration:

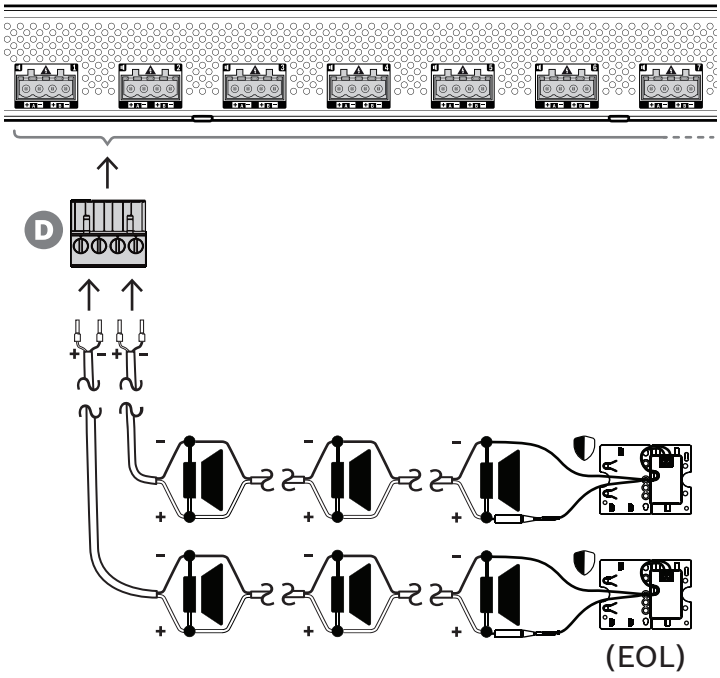
Single line A only



If no loudspeaker line redundancy is needed for a zone, then follow the procedure below to connect the loudspeakers to output A only:

1. Connect all loudspeakers in parallel, observing proper polarity. Select the right wire gauge, taking into account the connected loudspeaker power, the length of cable and the maximum permissible attenuation of the acoustic sound level due to loudspeaker line losses. See also section *Cable type recommendations, page 24* for loudspeaker cable size recommendations.
2. Insert the near end wires of the loudspeaker cable into slots 1 and 2 of connector D, preferably using crimped on wire ferrules that fit to the wire gauge used. Observe polarity.
   – Use a flat blade screwdriver to tighten each connection.
3. If the connected loudspeakers are also intended for emergency sound and loudspeaker line supervision is required, make sure that all loudspeakers are connected in a loop-through fashion and that an end-of-line device is connected to the end of the loudspeaker line for supervision.
   – No cable spurs or branches are allowed, because they will not be supervised.

Dual line (A + B)

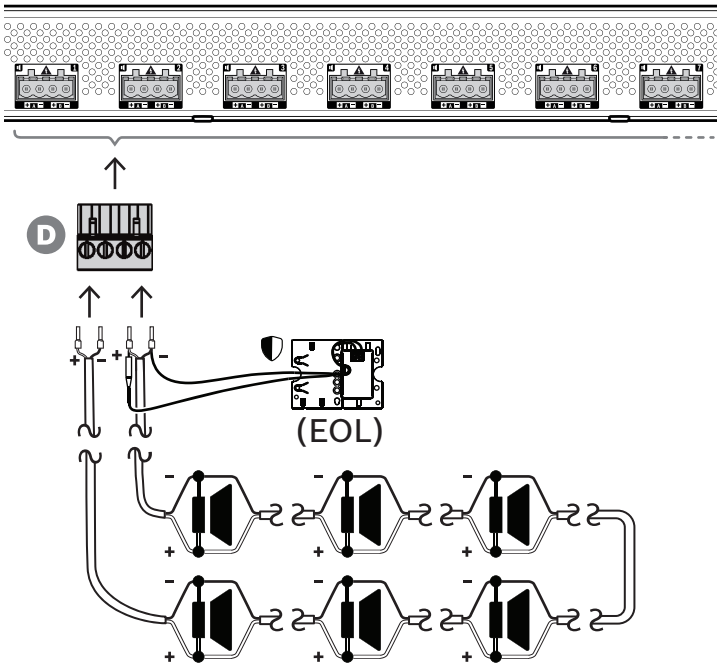


If loudspeaker line redundancy is needed, then follow the procedure below to connect two loudspeaker lines, one to output A and one to output B. Typically the loudspeakers are mounted alternating A, B, A, B, and so on, half the number connected to A, half the number connected to B.

When one loudspeaker line fails this may result in the loss of half the number of loudspeaker and with proper positioning of the loudspeakers the acoustic output level will drop by 3 dBSPL. A loudspeaker line fault will be reported.

1. Connect half of the loudspeakers in parallel in a loop-through fashion to output A. Observe polarity.
   – Follow the same wiring procedure as for using a single line.
2. Connect an end-of-line device to the end of loudspeaker line A.
3. Repeat this procedure for the other half of the loudspeakers and connect them to output B.
4. Connect an end-of-line device to the end of loudspeaker line B. Loudspeaker lines A and B must be separately supervised, each with its own end-of-line device. In case of a short circuit in one of the loudspeaker lines, the amplifier will diagnose the overload condition to find the affected loudspeaker line and switch-off that line, so the other loudspeaker line can continue operation.

Loop (A to B)



A third loudspeaker connection topology is the so-called Class-A loop, where the loudspeakers are connected in a loop, starting at output A and ending at output B, with the end of the loop being supervised with an end-of-line device.
In normal operation the loop is driven from output A only. In case of an interruption of the loudspeaker line, this will result in the loudspeaker signal not arriving at output B and neither at the end-of-line device. The disconnection of the end-of-line device will be detected at output A, and as a result output B will be activated to drive the loop from the opposite side in an attempt to reach all loudspeakers again. A loudspeaker line fault will be reported.

Follow the procedure below to connect the loudspeakers according to this scheme:

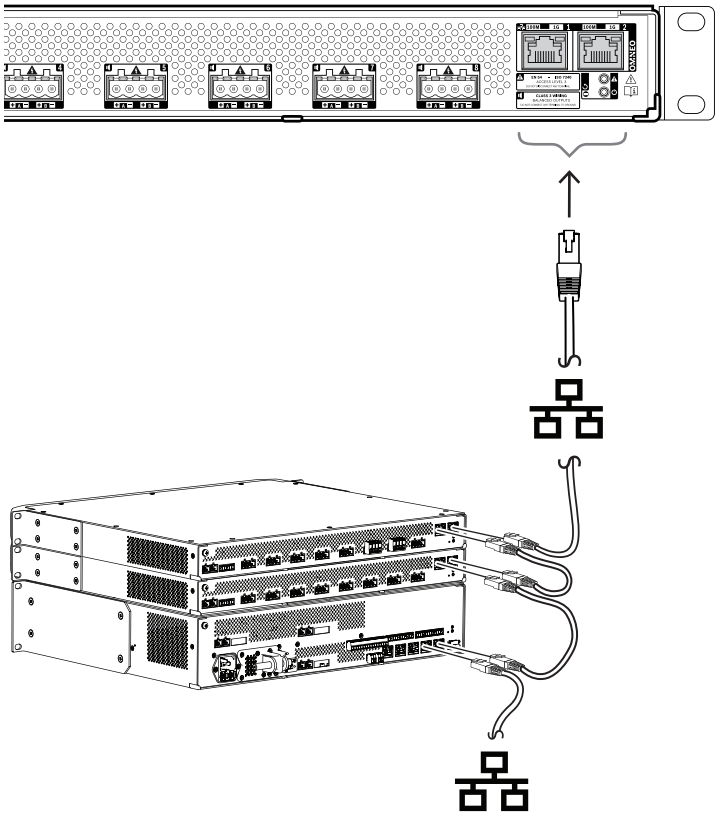
1. Connect all loudspeaker in parallel in a loop-through fashion. Observe equal polarity for all loudspeakers. Connect one side of the loudspeaker cable to output A, observing polarity.
2. Connect the other side of the loudspeaker cable to output B. In this case maintaining the correct polarity is especially important, as reversal on one end will short circuit the amplifier channel, not immediately, but when output B is activated in case of interruption of one conductor.
3. Connect an end-of-line device to output B, in parallel with the loudspeaker cable.

Notice!

Unlike the 4-channel amplifier, the outputs of the 8-channel amplifier use 4-pole connectors without separate terminals for the end-of-line device.
Do not replace the 4-pole plug by two 2-pole plugs for outputs A and B separately, because then it is possible that plug B gets disconnected from the amplifier, while the end-of-line device remains connected to the loudspeaker line and no fault is being reported, until an interruption occurs in the loop. Only then it will appear that the loudspeaker line after the interruption cannot be driven from output B anymore. When the 4-pole plug for outputs A and B combined would get unplugged unintentionally, then both outputs A and B would be disconnected together with the end-of-line device and a fault would be reported immediately.

9.5.6 Ethernet network

The amplifier has two Ethernet connection ports with a built-in Ethernet switch, supporting RSTP. Follow the procedure below to connect the amplifier to a network. The network must be set up in such a way that the amplifier can be discovered and reached by the system controller.



1. Use shielded Gb-Ethernet cables (preferably CAT6A F/UTP) with RJ45 connectors to connect the amplifier to the network.
2. Connect one end of the cable to one port of the amplifier.
3. Connect the other side of the cable to another network port in the network. This can be one port of the system controller, a port of a separate switch in the network, but also a port of another PRAESENSA device in the same rack.
4. The second port of the amplifier can be connected to a subsequent PRAESENSA device. The built-in Ethernet switch allows for a loopthrough interconnection between system devices, with a maximum of 21 devices in series.
5. For redundancy a looped through network connection may be connected at both sides to create a loop. RSTP must be enabled in the system.
6. For configuration, the amplifier is identified by its hostname, which is printed on the product label on the side of the device. The format of the hostname is the type number of the device without the dash, followed by a dash and then the last 6 hexadecimal digits of its MAC-address. Configuration is described in the PRAESENSA configuration manual.

9.5.7 Reset to factory default

The reset switch resets the device to its factory default settings. This function is only to be used in case a secured device is removed from a system to become part of another system.
See *Device status and reset, page 54*.

9.6 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	EN/IEC/CSA/UL 62368-1
Immunity	EN 55024 EN 55103-2 (E1, E2, E3) EN 50130-4
Emissions	EN 55032 EN 61000-6-3 ICES-003 ANSI C63.4 FCC-47 part 15B class A
Environment	EN 50581
Railway applications	EN 50121-4
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
Australia	RCM
Morocco	CMIM
Russian Federation	EAC
United Arabic Emirates	CoC

9.7 Technical data

Electrical

Loudspeaker load	
Maximum loudspeaker load 100 V mode, all channels* 70 V mode, all channels*	 600 W 600 W
Minimum loudspeaker load impedance 100 V mode, all channels* 70 V mode, all channels*	 16.7 ohm 8.3 ohm
Maximum cable capacitance 100 V mode, all channels* 70 V mode, all channels*	 2 uF 2 uF
*All channels combined.	

Amplifier outputs	
Rated output voltage	
100 V mode, 1 kHz, THD <1 %, no load	100 VRMS
70 V mode, 1 kHz, THD <1 %, no load	70 VRMS
Burst / rated power**	
All channels combined	
100 V mode, load 16.7 ohm	600 W / 150 W
70 V mode, load 8.3 ohm	600 W / 150 W
Channel 1	
100 V mode, load 16.7 ohm // 20 nF	600 W / 150 W
70 V mode, load 11.7 ohm // 20 nF	420 W / 105 W
Other channels	
100 V mode, load 33.3 ohm // 20 nF	300 W / 75 W
70 V mode, load 16.7 ohm // 20 nF	300 W / 75 W
Full to no load regulation	
20 Hz to 20 kHz	< 0.2 dB
Frequency response	
Rated power, +0.5 / -3 dB	20 Hz to 20 kHz
Total Harmonic Distortion + Noise (THD+N)	
Rated power, 20 Hz to 20 kHz	< 0.5 %
6 dB below rated power, 20 Hz to 20 kHz	< 0.1 %
Intermodulation Distortion (ID)	
6 dB below rated power, 19+20 kHz, 1:1	< 0.1 %
Signal to Noise Ratio (SNR)	
100 V mode, 20 Hz to 20 kHz	> 110 dBA
70 V mode, 20 Hz to 20 kHz	> 107 dBA
Crosstalk between channels	
100 Hz to 20 kHz	< -84 dBA
DC offset voltage	< 50 mV
Signal processing per channel	
Audio equalization	7-section parametric
Level control	0 to -60 dB, mute
Level control resolution	1 dB
Audio delay	0 to 60 s
Audio delay resolution	1 ms
RMS power limiter	Rated power
Lifeline	
Sensitivity (100 V out)	0 dBV
Mute attenuation	> 80 dB
Signal to Noise Ratio (SNR)	> 90 dBA
**Full voltage swing into maximum loudspeaker load for speech and music program material (crest factor > 9 dB)	

Power transfer	
Power supply input A/B	
Input voltage	48 VDC
Input voltage tolerance	44 to 60 VDC
Power consumption (48 V)	
Sleep mode, no supervision	6.0 W
Snooze mode, supervision active	8.4 W
Active mode, idle	38 W
Active mode, low power	70 W
Active mode, rated power	250 W
Per active port	0.4 W
Heat loss (including power supply)	
Active mode, idle	173 kJ/h (164 Btu/h)
Active mode, low power	317 kJ/h (300 Btu/h)
Active mode, full power	446 kJ/h (423 Btu/h)

Supervision	
End-of-Line detection mode	Pilot tone 25.5 kHz, 3 VRMS
Power supply input A/B	Undervoltage
Ground short detection (loudspeaker lines)	< 50 kohm
Amplifier channel redundancy switching	Internal spare channel
Amplifier channel load	Short circuit
Loudspeaker line redundancy switching	A/B group, Class-A loop
Controller continuity	Watchdog
Temperature	Overheat
Fan	Rotation speed
Network interface	Link presence

Network interface	
Ethernet	100BASE-TX, 1000BASE-T
Protocol	TCP/IP
Redundancy	RSTP
Audio/control protocol	OMNEO
Network audio latency	10 ms
Audio data encryption	AES128
Control data security	TLS

Ports	2

Reliability	
MTBF (calculated according to Telcordia SR-332 Issue 3)	250.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -5 to +50 °C (23 to 122 °F) -30 to +70 °C (-22 to 158 °F)
Humidity (non condensing)	5 to 95 %
Air pressure (operating)	560 to 1070 hPa
Altitude (operating)	-500 to +5000 m (-1640 to 16404 ft)
Vibration (operating) Amplitude Acceleration	 < 0.7 mm < 2 G
Bump (transport)	< 10 G

Airflow	
Fan airflow	Front to sides/rear
Fan noise Idle condition, 1 m distance Rated power, 1 m distance	 < 30 dBSPLA < 53 dBSPLA

Mechanical

Enclosure	
Dimensions (WxHxD) With mounting brackets Rack unit	 483 x 44 x 400 mm (19 x 1.75 x 15.7 in) 19 in, 1U
Ingress protection	IP30
Case Material Color	 Steel RAL9017
Frame Material Color	 Zamak RAL9022HR

Weight	8.8 kg (19.4 lb)

10 End-of-line device (EOL)



10.1 Introduction

This end-of-line device is a reliable solution for loudspeaker line integrity supervision, which is a requirement for emergency sound systems.
It is connected at the end of a loudspeaker line, after the last loudspeaker of a series of looped-through loudspeakers.
It communicates with the PRAESENSA amplifier channel driving that loudspeaker line, to confirm the integrity of the line.
Where impedance measurements may not detect a disconnected loudspeaker, depending on the number of connected loudspeakers and cable type, or report false faults, the end-of-line device provides a superior solution to report the correct status of the loudspeaker line.
The enclosure size is compatible with the mounting provisions in most Bosch loudspeakers for supervision boards or devices. It can also be reduced in size to fit most cable junction boxes.

10.2 Functions

Supervision

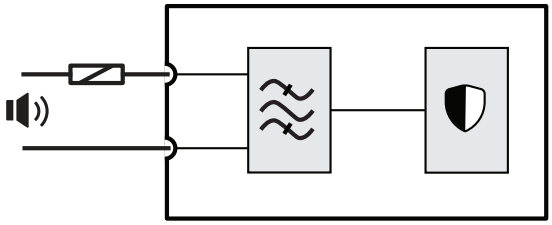
- Reliable supervision of a single loudspeaker line, using loudspeakers connected in a loop-through fashion.
- Operation is based on pilot tone detection from the amplifier with feedback to the amplifier using the loudspeaker line itself. No additional wiring is needed for fault or status reporting.
- The A/B outputs of a PRAESENSA amplifier channel are supervised individually, with separate end-of-line devices.
- To reduce power consumption, PRAESENSA amplifier channels use pilot tone modulation.
- The audibility of the pilot tone is virtually eliminated by using a pilot tone amplitude of only 3 VRMS with a frequency of 25.5 kHz, amply outside the human hearing range, even for young children.

Mounting

- The PRAESENSA end-of-line device is small, lightweight and fits to the mounting provisions in most Bosch loudspeakers for supervision boards (board shape). It comes with push terminal connected flying leads, containing a thermal fuse, for easy connection to the last loudspeaker of a loudspeaker line.
- Part of the mounting plate of the device can be broken off and snapped in place as bottom plate, making the device enclosure IP30 compliant, for use outside a loudspeaker enclosure (box shape). The enclosure contains a wiring strain relief for additional protection.
- Various mounting holes in the enclosure allow for mounting the device in most standard cable junction boxes. In this case the loudspeaker line enters the box via a standard cable gland and is connected using the push terminal.

10.3 Functional diagram

Functional and connection diagram



Internal device functions

- Thermal fuse
- Loudspeaker line
- Bandpass filter
- Supervision receiver/transmitter

10.4 Connections



Device connections

	Loudspeaker line	

10.5 Installation

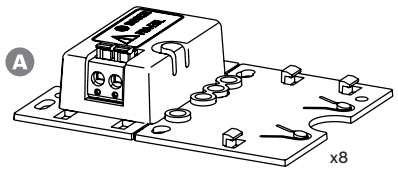
10.5.1 Parts included

The box contains the following parts:

Quantity	Component
8	End of line device
8	Set of connection wires with thermal fuse
1	Quick Installation Guide
1	Safety information

The PRA-EOL can only be ordered in multiples of eight devices, packed in one box.
No tools are provided with the device.

Parts check and identification



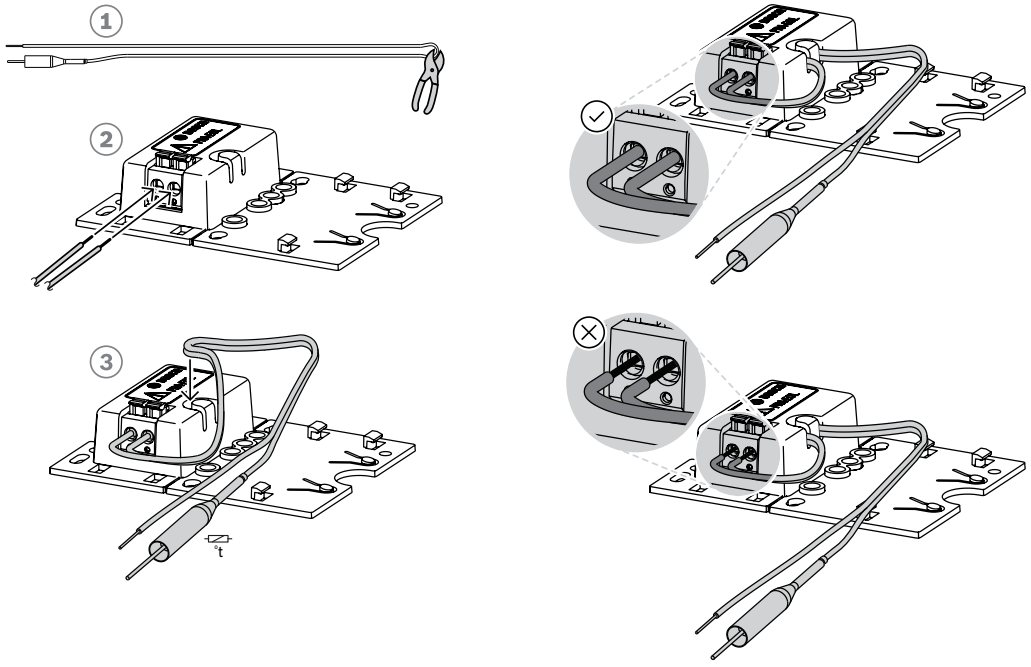


A End-of-line device

B Connection wires with thermal fuse

10.5.2 Wiring

The end-of-line device must be connected to the end of a loudspeaker line, to monitor the full length of the line. All loudspeakers connected to that line must be wired in a loop-through arrangement, without branches. The end-of-line device is then connected to the last loudspeaker using the supplied connection wire.



To do so:

1. Cut (1) the supplied connection wire with the thermal fuse in two halves.
2. Connect the two wires to the 100 V or 70 V loop-through connection of the loudspeaker, with the thermal fuse at the loudspeaker side:
   - This is the primary side of the loudspeaker transformer.
   - The polarity is not important for the end-of--line device, but it is good practice to connect the wire with the thermal fuse to the positive loudspeaker terminal.
   - The thermal fuse is to disconnect the end-of-line device and its wires from the loudspeaker line in case of fire. This prevents that the loudspeaker line might be shorted in case the wire insulation melts.
3. Cut the wires (2) to the required length for connection to the end-of-line device, feeding the wires through the strain relief slot (3) in the plastic housing:
   - The end-of-line device uses a 2-pole push wire connector.
   - The stripped wire ends must be inserted into the connector completely, up to the insulation, to prevent that the wires can be touched.

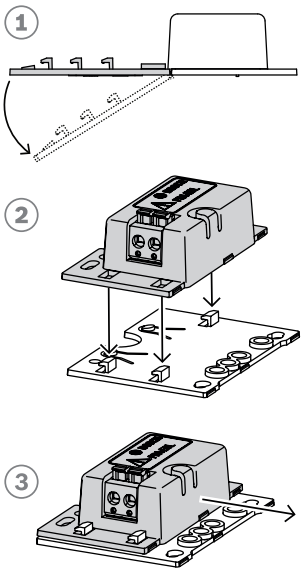
10.5.3 Mounting

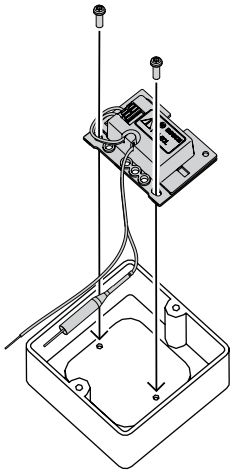
Most Bosch loudspeakers have a provision to mount the end-of-line device as a flat panel using the holes in the mounting plate.

Caution!
When PRA-EOL devices are mounted at a height above 2 m from the ground, special care should be taken to avoid that a device falls and may hurt a person.

Caution!
For compliance to NFPA 70 and CSA C22.1, the device must be mounted in a junction box.

Part of the mounting plate of the end-of-line device can be broken off (1) and snapped in place as bottom plate (2+3). Then the device can be mounted outside the loudspeaker cabinet or inside a cable junction box.





Notice!
When selecting cables and wire gauge for loudspeaker connections, take into account the length and loudspeaker load to avoid excessive power loss. Make sure that the signal level at the end of the loudspeaker line has not dropped with more than 2 dB (this is approximately 20%), as this will also affect proper operation of the end-of-line device. Also see section *Cable type recommendations, page 24*.

Notice!
The PRA-EOL shows up on a loudspeaker line as a mostly capacitive load of 30 nF, representing a reactive load of 1.7 W when measured with an impedance meter at 1 kHz. The device will not dissipate this amount of power as it is reactive.

10.6 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	EN/IEC/CSA/UL 62368-1
Immunity	EN 55103-2 (E1, E2, E3) EN 50130-4
Emissions	EN 55032 EN 61000-6-3 ICES-003 ANSI C63.4 FCC-47 part 15B class A
Environment	EN 50581
Plenum rating	UL 2043
Railway applications	EN 50121-4
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
United Arabic Emirates	CoC

10.7 Technical data

Electrical

Control	
Pilot tone detection Frequency Level	 25.5 kHz 1.5 - 3 VRMS
Amplifier load	< 100 mW
Loudspeaker cable Maximum length Maximum capacitance Operating temperature	 1000 m 80 nF -20 to +50 °C (-4 to 122 °F)
Maximum input voltage	100 VRMS
Fault detection	Line shorted, line interrupted
Fault reporting	By amplifier

Reliability	
MTBF (extrapolated from calculated MTBF of PRA-AD608)	5.000.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -5 to +50 °C (23 to 122 °F) -30 to +70 °C (-22 to 158 °F)
Humidity (non condensing)	5 to 95 %
Air pressure (operating)	560 to 1070 hPa
Altitude (operating)	-500 to +5000 m (-1640 to 16404 ft)
Vibration (operating) Amplitude Acceleration	 < 0.7 mm < 2 G
Bump (transport)	< 10 G

Mechanical

Enclosure	
Dimensions (WxHxD) Board shape Box shape	 78 x 60 x 16 mm (3.1 x 2.4 x 0.6 in) 45 x 60 x 18 mm (1.8 x 2.4 x 0.7 in)
Ingress protection	IP30
Case Material Color	 Plastic RAL3000
Weight	25 g (0.055 lb)

11 Multifunction power supply, large (MPS3)



11.1 Introduction

This compact device combines multiple support functions to power and serve other PRAESENSA system devices.
It can be used in a centralized system, but it is an enabler for decentralized system topologies with several smaller racks or cabinets located across the premises, to reduce loudspeaker cabling costs significantly.
It provides DC-power supply to connected amplifiers and peripherals from the mains, with a standards compliant charger for a single 12 V backup battery, saving on installation and battery maintenance costs.
The integrated 6-port Ethernet switch, with glass fiber support, facilitates easy interconnection of decentralized clusters of devices.
Configurable, supervised control inputs and voltage-free control outputs are available as interface to external equipment. Its OMNEO interface for control and fault reporting also provides an analog audio backup lifeline for the connected amplifiers.

11.2 Functions

Independent mains power supplies

- Three fully independent 48 VDC power supplies for up to three amplifiers.
- One 24 VDC output for a system controller or auxiliary device.
- All power supply outputs have double connectors for A/B dual redundant wiring to the connected loads.
- A fault condition on one of the outputs does not affect any of the other outputs.
- Universal mains input with power factor correction to maximize the amount of power that can be taken from a single phase power distribution network.

Backup battery solution

- Integrated charger for a 12 V VRLA (Valve Regulated Lead-Acid) battery, with a capacity up to 230 Ah for standards compliant charging and energy storage.
- The battery life time for servicing is maximized by using a single 12 V battery that has all six battery cells at the same temperature and all cells using the same electrolyte. This prevents unequal charging and consequently overcharging of series connected batteries, which is the main cause of premature battery aging.
- Three fully independent battery to 48 VDC power converters for up to three amplifiers.
- Flexible, pre-terminated battery cabling of fixed length included, with fuse and battery temperature sensor, for fast battery connection and predictive cabling resistance.
- Accurate battery impedance measurement to monitor aging of the battery and supervision of battery connections.

Ethernet switch

- Six OMNEO network ports, supporting Rapid Spanning Tree Protocol (RSTP), for loop-through connections to adjacent devices:
  - Five ports are for copper connection on RJ45, two of them provide Power over Ethernet (PoE) to supply power to connected call stations or other devices.
  - One port provides an SFP-cage for Small Form-factor Pluggable transceivers for single or multi-mode glass fiber connections.

General purpose control inputs and outputs

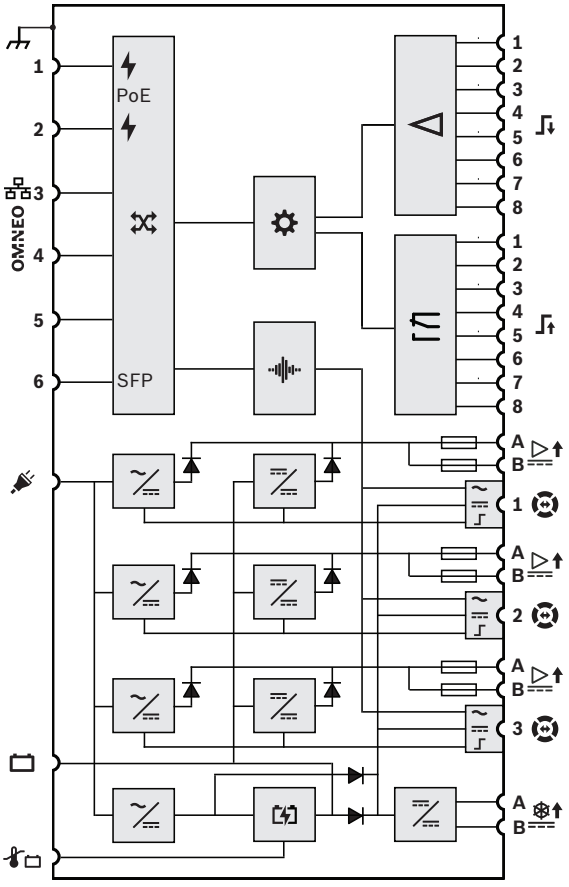
- Eight control inputs to receive signals from external systems with configurable connection supervision.
- Eight voltage free single pole, double throw (SPDT) relay contacts to activate external devices.
- Control input and output functions are software configurable.

Fault tolerance and supervision

- Supervision of mains, battery and device operation and all connections; faults are reported to the system controller and logged.
- Automatic battery backup takeover from mains in case of mains failures.
- Multi-port network interface with RSTP-support for recovery from a failing network connection.
- Supervised audio lifeline to connected amplifiers, as backup for a failing amplifier network interface.

11.3 Functional diagram

Functional and connection diagram



Internal device functions

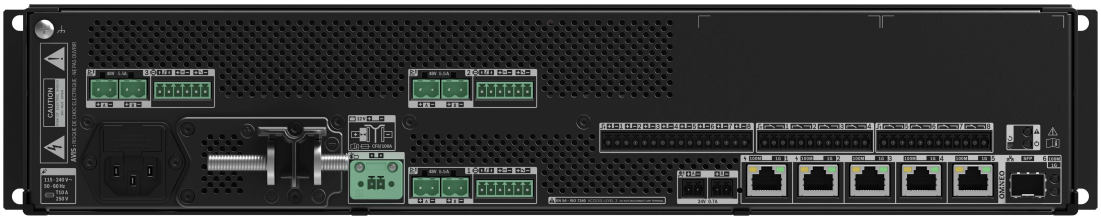
- Power over Ethernet power source
- OMNEO network switch
- **SFP** Socket for SFP module
- Controller
- Audio processing (DSP)
- Mains to DC converter
- DC to DC converter
- Battery charger
- Control input processor
- Control output relay
- Lifeline audio output
- Lifeline supply output
- Lifeline control interface
- Diode
- Fuse

11.4 Indicators and connections



Front panel indicators

	48 VDC amplifier power supply A-B (1-3) Power on Fault	 Green Yellow		24 VDC auxiliary power supply A-B Power on Fault	 Green Yellow
	Device fault present	Yellow		Network link to system controller present Network link lost	 Green Yellow
	Battery status Full (float charging) Charging (bulk or absorption charging) Fault	 Green Green blinking Yellow		Mains present Mains fault	Green Yellow
	Identification mode / Indicator test	All LEDs blink			

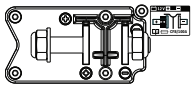
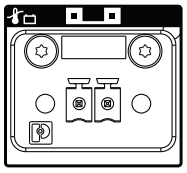
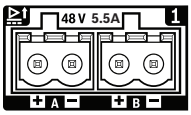
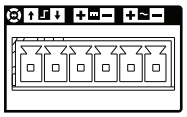
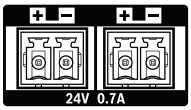
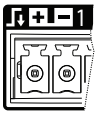
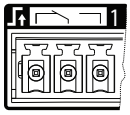
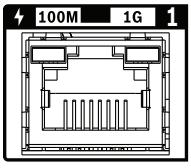
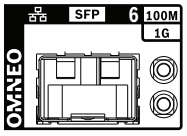


Rear panel indicators and controls

	100 Mbps network 1 Gbps network	Yellow Green		Device fault present	Yellow
	Power on	Green		Device reset (to factory default)	Button
	Identification mode / Indicator test	All LEDs blink			

Rear panel connections

	Chassis ground			Mains input with fuse	

	Battery 12 VDC (⎓)			Battery temperature sensor	
	48 VDC output A-B (1-3, to amplifier 1-3)			Lifeline control/audio/ supply interface (1-3, to amplifier 1-3)	
	24 VDC output A-B (to system controller)				
	Control input 1-8			Control output 1-8	
OMNEO	Network port 1-5 (port 1 and 2 with PoE)			Network port 6 (SFP)	

11.5 Installation

The device is designed to be installed in a 19"-rack/cabinet. Refer to: *Mounting the 19"-rack devices, page 21*.
The device can be connected everywhere within the PRAESENSA system. If required, refer to: *System introduction, page 14*.

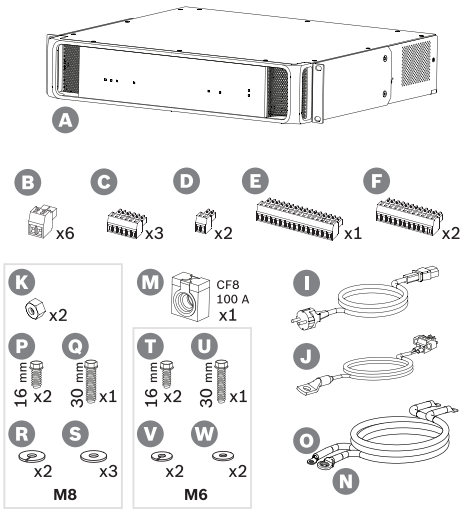
11.5.1 Parts included

The box contains the following parts:

Quantity	Component
1	Multifunction power supply
1	Set of 19"-rack mounting brackets (pre-mounted)
1	Set of screw connectors
1	Battery connection set (wiring, fuse, temperature sensor)
1	Mains power cord
1	Quick Installation Guide
1	Safety information

No tools or Ethernet cables are provided with the device.

Parts check and identification



A Multifunction power supply

B 2-pole screw plug (x6)

C 6-pole screw plug (small, x3)

D 2-pole screw plug (small, x2)

E 16-pole screw plug (small)

F 12-pole screw plug (small, x2)

I Mains power cord

J Temperature sensor assembly

K Nut M8 (x2)

M Battery fuse CF8 100 A

N Positive battery cable (red)

O Negative battery cable (black)

P Bolt M8 (short, x2)

Q Bolt M8 (long)

R Spring washer M8 (x2)

S Washer M8 (x3)

T Bolt M6 (short, x2)

U Bolt M6 (long)

V Spring washer M6 (x2)

W Washer M6 (x2)

11.5.2 Battery and fuse

The multifunction power supply needs an external 12 V VRLA (Valve Regulated Lead Acid) battery as backup power source. It uses internal DC/DC converters to convert the battery voltage to the required supply voltages for the connected PRAESENSA devices. A 100 A fuse (model CF8) (M) must be used in series with the positive (red) cable (N) of the battery. It is recommended to mount the fuse at the battery side (see chapter below), immediately at the positive battery terminal. Alternatively the fuse can be mounted at the power supply side (see chapter below), when local standards require so. Never use two fuses, one on each side, because this would increase the series resistance of the cable assembly and the high peak currents of a system in emergency mode would result in voltage dips that could limit the maximum available output power to the loudspeakers. The connected battery must have a capacity of 100 to 230 Ah. The actual required capacity depends on many variables, see *Battery calculation, page 40* for calculation guidelines. The device is delivered with cables with crimp eyelet terminals (N + O) and it is recommended to use these full length cables. Although a shorter cable is better, it requires heavy tools to shorten a cable and fix new eyelet terminals.

The temperature sensing assembly (J) is used to sense the temperature of the battery for best performance. The temperature of the negative battery terminal is a good representation of the internal battery temperature. Temperature sensing is an important requirement to set the

correct charging threshold voltages to fully charge the battery without overcharging. When the temperature sensor is not mounted correctly, the battery lifetime may be considerably reduced. When the sensor is not connected, the battery charger will be switched off. Only use the temperature sensor assembly that is delivered with the device.



Notice!
For compliancy to EN 54-4 and ISO 7240-4, the battery shall
- be rechargeable;
- be suitable to be maintained in a fully charged state;
- be constructed for stationary use;
- be marked with the type designation and date of manufacture;
- be of the sealed type;
- be mounted in in accordance with the manufacturer's data.

A properly marked and mounted VRLA (Valve Regulated Lead Acid) battery of 12 V fulfils these requirements. SLA (Sealed Lead Acid) and VRLA are different acronyms for the same battery. This battery type is maintenance-free, leak-proof and position insensitive. Batteries of this kind have a safety vent to release gas in case of excessive internal pressure build up. AGM (Absorbed Glass Mat) refers to a specific type of SLA or VRLA and can be used also.



Caution!
1. The battery must be electrically floating. Never connect any battery terminal to ground. The battery terminals must be wired individually to the battery connection terminals of the PRA-MPS3.
2. A battery may not be connected to more than one PRA-MPS3, this means that it cannot be shared by multiple power supplies.
3. Risk of explosion if an incorrect type of battery is used.



Notice!
1. To prevent damage to the battery always check the depth of the threaded insert of the terminals before tightening the bolts. If needed, use shorter bolts.
2. Make sure that all connections are tightened with the correct torque. Not only to prevent damage, but also to keep the contact resistances as low as possible. It is good practice to keep the red and black battery cables together and aligned for most of their length, using cable ties or heat shrink sleeves. This reduces cable inductance and improves the accuracy of the battery impedance measurement because the battery impedance is measured using an AC current. The inductance of the cables is very low and may seem insignificant, but the impedance of the battery and the resistance of the cables, cable connections and the fuse are also very low and all these elements are in series and measured together.
3. It is not allowed to connect any external load to the battery directly, as this will disturb the charging process.

Battery and charging stages

The charger of the multifunction power supply is a 3-stage charger. This is a processor-controlled charger that offers maximum safety and ease of use, while preserving best performance and battery lifetime. Recharging a battery is a three stage process:

– **Stage 1 (bulk charge)**: In this stage the battery is charged with a constant current, the nominal charging current of 8.5 A. The applied voltage increases over time to keep this current flowing while the battery charges. The actual voltage also depends on the internal resistance of the battery and the connection cable resistance. This stage will recharge batteries that are severely drained. There is no risk of overcharging in this stage because

the battery hasn't reached full yet. The charger measures the battery voltage and, in combination with the actual temperature, decides on the state of charge of the battery. At a certain voltage, corresponding to a state of charge of the battery of 70-80%, the charger will enter the absorption stage. The battery status LED blinks green while in stage 1.

- **Stage 2 (absorption charge)**: In this stage the charger maintains a steady voltage, while the charging current declines. The lower current going into the battery safely brings up the charge on the battery without overheating it. This stage takes more time as the charging current is lower. The current continuously declines until the battery almost reaches full capacity. Then the charger will enter the float stage. The battery status LED still blinks green while in stage 2.
- **Stage 3 (float charge)**: The float stage charges the battery to full and maintains the 100% state of charge. The voltage will decrease and stays at a steady voltage of around 13.5 V (the exact value adapts to the temperature), which is the maximum voltage a 12 V VRLA battery can hold. The current will also decrease to the point of trickle charging. It's essentially the float stage where there is charge going into the battery at all times, but only at a safe rate to ensure a full state of charge and nothing more. The charger does not turn off at this point. It is important that the battery is at 100% state of charge to utilize its full capacity when the PRAESENSA system needs to operate on backup battery, but this state of charge is also the healthiest regarding battery lifetime. In this stage 3, the battery status LED is steady green.

Battery lifetime is maximized by using a single 12 V battery, that has all six battery cells at the same temperature and all cells using the same electrolyte. All cell voltages will be substantially equal and the switch-over to the next charging state is well-defined. Series connected batteries without battery balancing circuits will not stabilize to the exactly same voltage, while the switch-over to the next charging state is determined by the summed voltages of the distinctive batteries. This causes non-optimum charging and consequently overcharging of one or more of the series connected batteries, which is the main cause of premature battery aging.

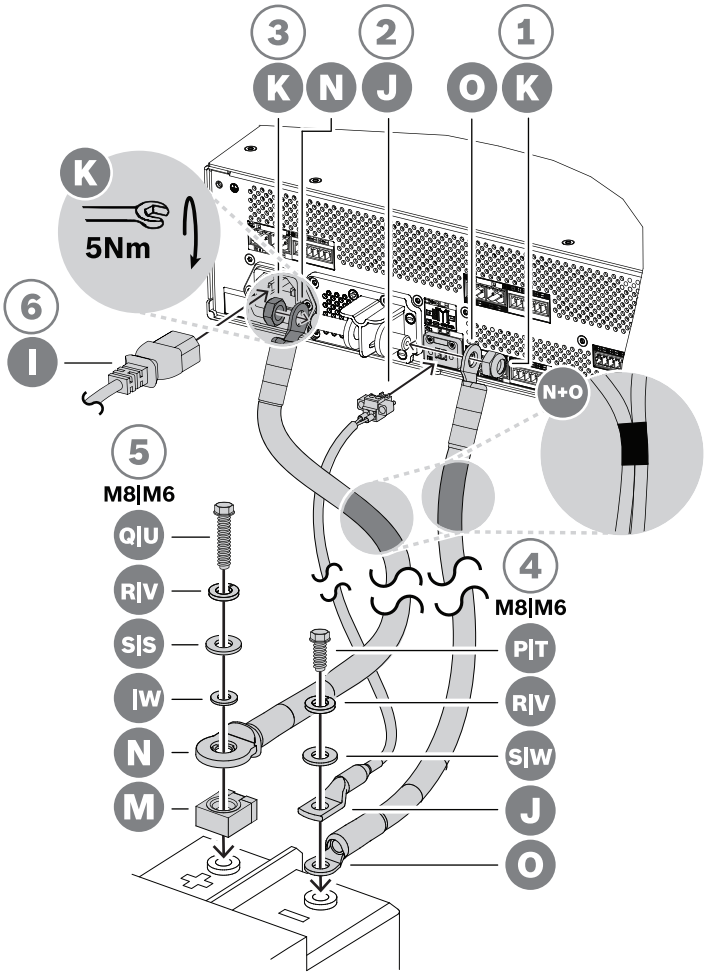
Battery fault reporting

The battery is monitored continuously to prevent damage to the battery and to make sure that it is available in good state as a backup power source to the system in case of mains power failures. When a backup power source is not needed, it is allowed to not connect a battery to the multifunction power supply. In that case make sure that supervision of the battery is disabled in the configuration of the device to avoid that a battery missing fault is reported by the system.

When a battery is in fact connected, but the battery supervision is disabled in the configuration, then the battery will still be charged and used when mains power fails. In order to prevent damage to the battery, also battery supervision still continues in the background and even most battery faults will be reported as usual (voltage too high, voltage too low, battery short circuit, temperature too high, leakage current too high, temperature sensor missing). Only the results of the battery impedance measurements are suppressed. This mode could be useful for special situations (not compliant to EN 54-16 and EN 54-4), where a relatively small backup battery is used, to avoid that a fault is reported that the battery impedance is too high. Make sure that this battery can handle a charging current of 8.5 A and the maximum current draw of the load, see section *Accurate battery size calculation, page 44*.

Fuse at battery side

Putting the fuse (M) at the positive battery terminal, follow the connection procedure below.

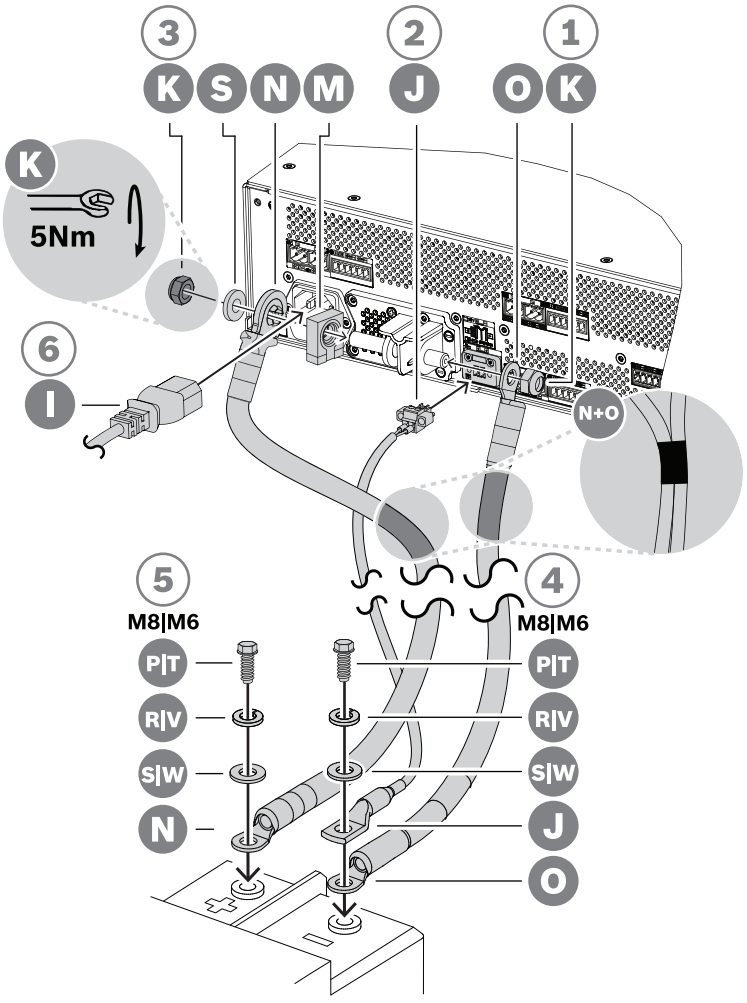


1. Take the black battery cable (O) and fix one side to the short negative battery connection terminal of the power supply, using an M8 self-locking nut (K). Tighten with torque 5 Nm.
   - When the black (O) and red (N) battery cables are fixed to each other, make sure that the isolated fuse eyelet on the red cable (N) is at the **battery side**, otherwise reverse the complete cable set.
2. Take the red battery cable (N) and fix the non-isolated eyelet to the long positive battery connection terminal, using the other M8 self-locking nut (K). Tighten with torque 5 Nm.
3. Insert the connector of the battery temperature sensor assembly (J) into the temperature sensor connector socket of the power supply.
4. Connect the open end of the black cable (O) to the negative battery terminal, with the eyelet of the temperature sensor (J) on top.
   - Depending on the type of battery and its terminals, use a short M8 bolt (P), spring washer (R) and washer (S), or short M6 bolt (T), spring washer (V) and washer (W).
   - M8 and M6 are the most common screw terminal types for VRLA batteries in PA/VA applications. Check the battery specification for the optimum tightening torque.
5. Put the fuse (M) on top of the positive battery terminal, then put the open end of the red cable (N) with the metal side of the isolated eyelet on top of the fuse and fix this set to the battery terminal with a long bolt, spring washer and washer (M8: Q, R, S / M6: U, V, W).

– Tighten with the correct torque, according to the battery specification. The eyelet isolation of cable (N) is needed to prevent that the fuse is being shorted by the bolt (Q or U).

Fuse at power supply side

Putting the fuse (M) at the positive battery terminal of the power supply, follow the connection procedure below.



1. Take the black battery cable (O) and fix one side to the short negative battery connection terminal of the power supply, using an M8 self-locking nut (K). Tighten with torque 5 Nm.
   – When the black (O) and red (N) battery cables are fixed to each other, make sure that the isolated fuse eyelet on the red cable (N) is at the **power supply** side, otherwise reverse the complete cable set.
2. Put the fuse (M) on the long positive battery connection terminal of the power supply, followed by the isolated eyelet of the red cable (N), with the metal side of the eyelet against the fuse, then followed by a washer (S). Fix this set using the other M8 self-locking nut (K). Tighten with torque 5 Nm.
   – The eyelet isolation of cable (N) is needed to prevent that the fuse (M) is being shorted by the threaded end terminal.
3. Insert the connector of the battery temperature sensor assembly (J) into the temperature sensor connector socket of the power supply.

4. Connect the open end of the black cable (O) to the negative battery terminal, with the eyelet of the temperature sensor (J) on top. Depending on the type of battery and its terminals, use a short M8 bolt (P), spring washer (R) and washer (S), or short M6 bolt (T), spring washer (V) and washer (W).
   – M8 and M6 are the most common screw terminal types for VRLA batteries in PA/VA applications. Check the battery specification for the optimum tightening torque.
5. Connect the open end of the red cable (N) to the positive battery terminal using a short bolt, spring washer and washer (M8: P, R, S / M6: T, V, W). Tighten with the correct torque, according to the battery specification.

Using a circuit breaker

Instead of using the 100 A CF8 fuse (M) that is delivered with the unit, it is possible to use a thermal or electro-magnetic circuit breaker. The circuit breaker can also serve to manually disconnect the battery from the PRA-MPS3. This could be convenient to power off a system for making modifications after installation of the battery. It is important to make sure that the breaking capacity of the circuit breaker is bigger than the short-circuit current of the installed battery. The short-circuit current of typical batteries for the PRA-MPS3 is 2 to 6 kA. Circuit breakers for 100 A for DC are available with a breaking capacity of 10 kA, both for panel mounting and for DIN-rail mounting.

The internal resistance of a 100 A circuit breaker is about the same as for the 100 A CF8 fuse (M), less than 1 mohm, so the impedance measurement of the battery circuit, which is a requirement of the voice alarm standards, is not affected. Do not use multiple fuses or circuit breakers in series or double-pole circuit breakers, as this will increase the impedance of the battery circuit and may generate a premature battery fault.



Battery cables

Battery cables are packed with the PRA-MPS3. These are heavy duty red (N) and black (O) cables of 120 cm length, with a cross section of 35 mm^2 (approximately AWG 2) and with crimp eyelet terminals attached. The wire resistance of each cable is approximately 0.7 mohm (together 1.4 mohm). It is important to keep the resistance of the battery circuit very low for the 12 V battery to be able to supply large (peak) currents without much voltage drop to the DC/DC converters for the amplifiers. For that reason only a single fuse with a resistance of 0.5 to 1 mohm is allowed. The supplied 100 A CF8 fuse (M) has a cold resistance of 0.6 mohm. The battery itself has an internal resistance that depends on the capacity of the battery. A new, charged 200 Ah battery (VRLA) of 12 V has an internal resistance of approximately 3 mohm.

When the supplied battery cables cannot be used, it is possible to use alternative cables, as long as the total wire resistance remains below 2 mohm, and the lower it is, the better. That value is for a PRA-MPS3 with three amplifiers connected, each loaded with 600 W of loudspeakers. But even when less amplifiers are connected or less loudspeaker load is connected, it is still good to select a cable type and length that fits to a maximum configuration. Then, amplifiers and load can be added later without having to change battery cables.

For installation, it is very convenient when the cables are very flexible. In the metal industries, welding cables are used that are hard wearing and flexible, and designed to transmit high currents between the welding generator and electrodes. These cables are sometimes identified by codes H01N2-D for flexible cables and H01N2-E for very flexible cables, in accordance with EN 50525-2-81. Useful sizes are 10, 16, 25, 35 and 50 mm^2 and AWG sizes 6 to 1. Welding cables are available with red and black colored insulation and ideal for making the connections between the PRA-MPS3 and the battery. Especially in racks, where the equipment is mounted in a swing frame, flexibility of the cables is important.

Wire gauge [AWG]	Wire cross section [mm^2]	Wire resistance [mohm/m]	Maximum length per wire [cm]
	10	1.95	50
6	(13.3)	1.47	60
	16	1.22	70
5	(16.8)	1.16	80
4	(21.1)	0.92	100
	25	0.78	120
3	(26.7)	0.73	130
2	(33.6)	0.58	170
	35	0.55	180
1	(42.4)	0.46	210
	50	0.39	250

11.5.3 Mains power connection

1. Check that the mains (AC) power supply meets the nominal input rating of the PRA-MPS3.
   - The voltage that can be applied is any of the nominal power supply voltages in the range of 115 VAC to 240 VAC. The frequency is 50 Hz or 60 Hz.
2. Use the supplied power cord (I) to connect to the mains line.
   - If the supplied power cord cannot be used due to the plug shape, have a qualified engineer replace it with an appropriate power cord of length 3 m or less.
   - The PRA-MPS3 uses an IEC 60320 - C14 appliance inlet; the mains cord must have a matching C13 connector.
   - The PRA-MPS3 has no power switch.



Notice!
The power cord with a plug can be used to disconnect the PRA-MPS3 from the mains. Connect the plug to an easily accessible power outlet so that the plug can be removed from the outlet at any time. Be sure to allow enough space around the power outlet.

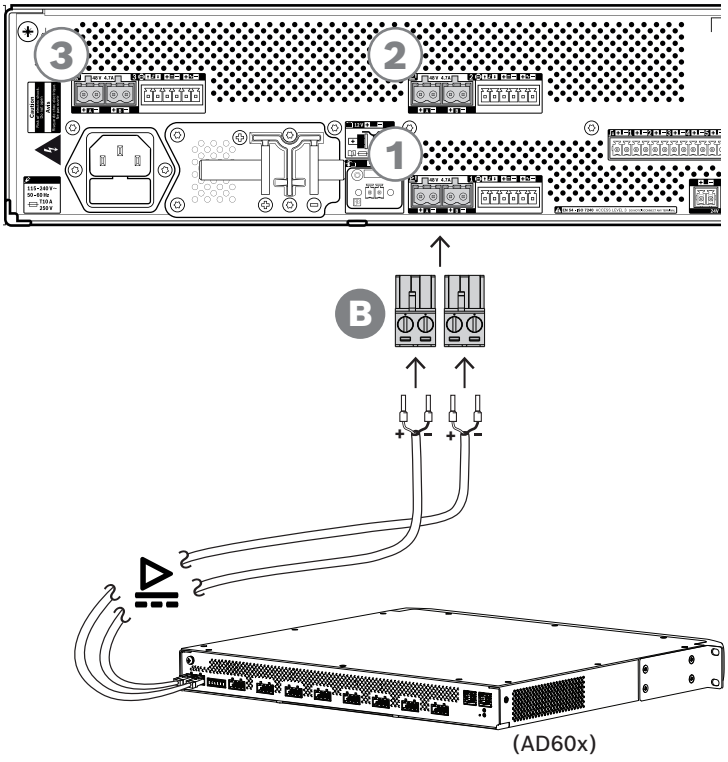
3. The mains inlet has a built-in fuse T10AH 250V.
   - The T-characteristic of this 10 A fuse refers to how rapidly it responds to various current overloads. This is a slow-acting fuse (Time-lag) that has additional thermal inertia, designed to tolerate normal initial or start-up overload pulses.
   - The H-characteristic of this 10 A fuse refers to being a High breaking fuse type.

– Because the fuse is only connected in line with one of the mains conductors (L or N), never use the fuse as a means to interrupt the mains in case of service. Pull out the C13-connector of the power cord to disconnect the mains.

Caution!
Only replace with a fuse of the same type, certified for IEC 60217 or UL 248.

11.5.4 Amplifier power supply

The multifunction power supply has three independent 48 VDC outputs to supply power to three PRAESENSA 600 W power amplifiers. Each output has dual A/B connectors for connection and cable redundancy. This is especially useful when the amplifiers and the power supply are not in the same rack and the power supply cable is accessible or vulnerable. It is recommended to always use both connections.



Connection procedure

1. The power supply interconnection wiring and ferrules are delivered with the amplifier.
   – The power supply terminal plugs (B) are delivered with the multifunction power supply.
2. Follow the power supply cable assembly instructions as provided for the amplifiers.
   – Observe polarity.
3. Insert the power supply terminal plugs of the interconnection cables into the A/B sockets of one of the three 48 VDC outputs.
   – It is good practice to connect output A of the power supply to input A of the amplifier and the same for B. Cross coupling is allowed, but may be confusing in case of fault finding.

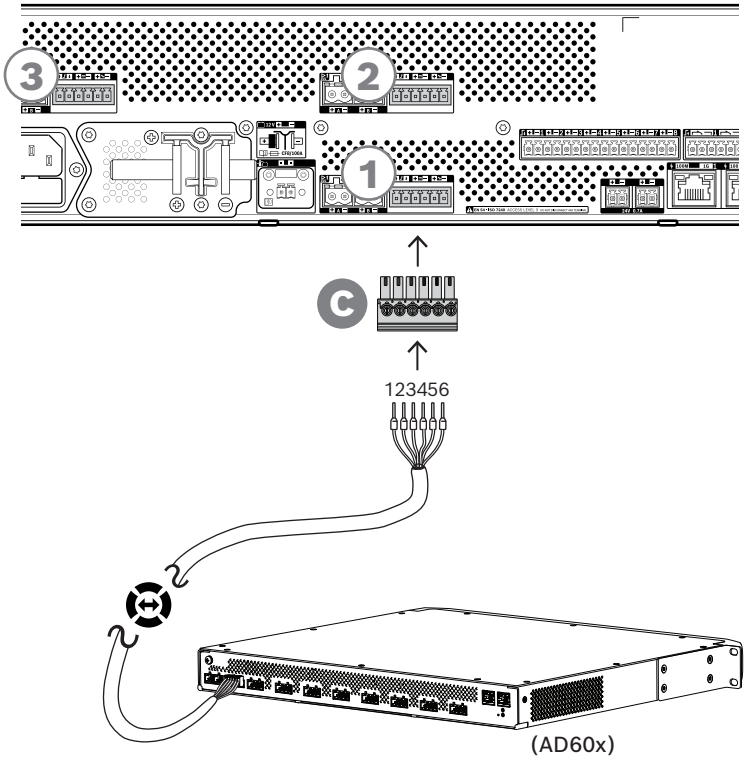
Caution!

For compliance to UL 62368-1 and CAN/CSA C22.2 No. 62368-1 the power supply wiring must be Class 1 wiring (CL1); this requirement does not apply for compliance to EN/IEC 62368-1.

11.5.5 Lifeline

The lifeline is an optional cable connection between a PRAESENSA amplifier and a PRAESENSA multifunction power supply. This interconnections serves multiple functions:

- The multifunction power supply provides the audio signal of the highest priority emergency call as a balanced line level analog signal on the lifeline connector (pins 5 and 6). This signal is a backup audio signal for the connected amplifier in case its network interface or both network links would fail. The emergency call will then be distributed to all connected loudspeakers at maximum volume and without equalization or audio delay. The lifeline signal goes straight to the spare amplifier channel to drive all zones in parallel. This line is supervised by the multifunction power supply.
- The multifunction power supply sends information (pin 1) to the connected amplifier about the availability of mains power. In case mains power fails and power is provided from the battery, this signal sets the amplifier in backup power mode to disable all amplifier channels that are not needed to make calls with a priority above the configured priority level for the backup power mode. When no high priority calls are being made via this amplifier, it informs the multifunction power supply (pin 2) to switch off the 48 V converters to minimize battery power consumption even more. The power supplies and the amplifier channels go to snooze mode and wake up every 90 seconds briefly to perform the required supervision actions for timely fault reporting.
- The multifunction power supply provides the battery or charger voltage, in the range of 12 to 18 V, to the amplifier directly (pins 3 and 4) to supply power to the amplifier's network interface while the 48 V power supplies are switched off.



To complete the lifeline interconnection follow the procedure below:

1. The 6-pole cable and connector for the amplifier are delivered with the amplifier. For lifeline assembly instructions, refer to the following sections: *Lifeline, page 73* and/or *Lifeline, page 89*.
2. The 6-pole connector (C) for the multifunction power supply is delivered with the power supply.
3. Mount the connector (C) to the cable, following the same wire order as for the amplifier side, the cable should be reversible.
4. Insert the connector (C) into the lifeline socket of the multifunction power supply, using the socket next to the 48 V outputs that go to the same amplifier.



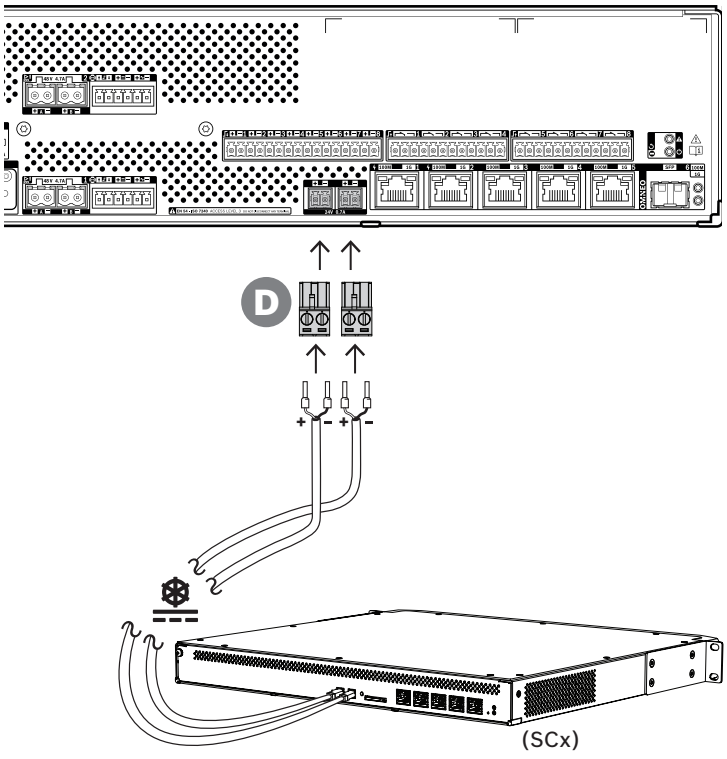
Caution!
For compliance to UL 62368-1 and CAN/CSA C22.2 No. 62368-1 the lifeline wiring must be Class 1 wiring (CL1); this requirement does not apply for compliance to EN/IEC 62368-1.



Notice!
Each pair of 48 V outputs A/B and the lifeline next to it belong to each other and are always connected to the same amplifier. Keep the cables together to avoid errors that could result in no sound in case of emergencies.

11.5.6 Power supply connection to system controller

The multifunction power supply has one 24 VDC output to supply power to a PRAESENSA system controller or to power an auxiliary device like an Ethernet switch. The output has dual A/B connectors for connection and cable redundancy. This is especially useful when the system controller and the power supply are not in the same rack and the power supply cable is accessible or vulnerable. It is recommended to always use both connections.



Connection procedure:

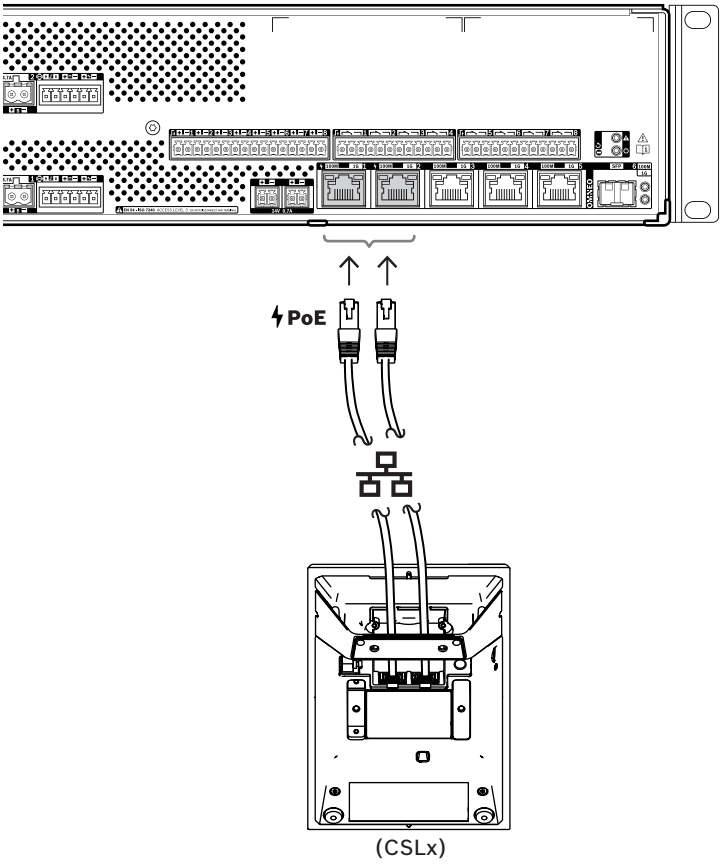
1. The power supply interconnection wiring and ferrules are delivered with the system controller. The power supply terminal plugs (D) are delivered with the multifunction power supply.
2. Follow the power supply cable assembly instructions as provided for the system controller.
   – Observe polarity.
3. Insert the power supply terminal plugs (D) of the interconnection cables into the A/B sockets of the 24 VDC output.
   – It is good practice to connect output A of the power supply to input A of the amplifier and the same for B. Cross coupling is allowed, but may be confusing in case of fault finding.

Caution!
For compliance to UL 62368-1 and CAN/CSA C22.2 No. 62368-1 the power supply wiring must be Class 1 wiring (CL1); this requirement does not apply for compliance to EN/IEC 62368-1.

Notice!
The power connections from the 24 V output may not be longer than 3 m.

11.5.7 Power over Ethernet

The multifunction power supply has an integrated Ethernet switch with 6 external ports. Ports 1 and 2 provide Power over Ethernet (PoE), next to OMNEO and other Ethernet data, present on the network. These ports can be used to connect one or two call stations, or other devices that are powered via PoE. Each port is capable of providing enough power for a call station with four extensions, which is the maximum. A PRAESENSA call station has two Ethernet ports and can be connected with two cables for fail safe cable redundancy. It is also possible to connect a call station to two separate multifunction power supplies for additional protection against failure of its Ethernet switch. Ports 3 to 5 cannot be used for PoE powering.



(CSLx)

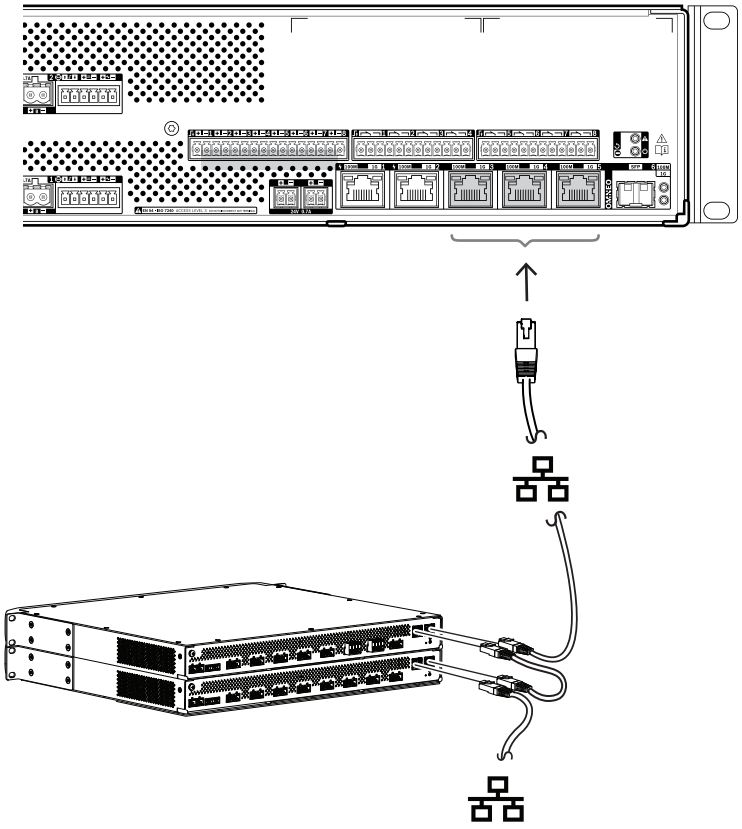
PoE devices can simply be connected using shielded Gb-Ethernet cables (preferably CAT6A F/UTP) with RJ45 connectors. All PRAESENSA devices support Rapid Spanning Tree Protocol (RSTP) to enable the use of multiple connections simultaneously for cable redundancy, e.g. to daisy-chain devices in a loop, with a maximum of 21 devices in a loop.

11.5.8 Ethernet network

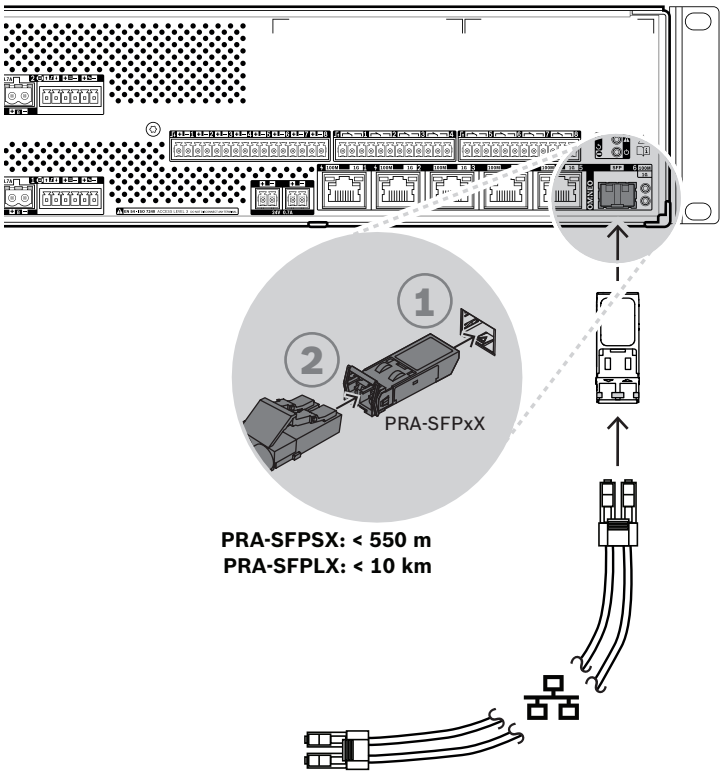
The multifunction power supply has six Ethernet connection ports with a built-in Ethernet switch, supporting RSTP. Follow the procedure below to connect the device to a network and other system devices.

The network must be set up in such a way that the multifunction power supply can be discovered and reached by the system controller.

Configuration of the multifunction power supply is done via the system controller. For configuration, the device is identified by its hostname, which is printed on the product label on the rear side of the device. The format of the hostname is the type number of the device without the dash, followed by a dash and then the last 6 hexadecimal digits of its MAC-address. Configuration is described in the PRAESENSA configuration manual.



1. Connect at least one of the ports to the network, so that it can be discovered by the system controller to make it part of the system.
2. The other ports can be used for a loop-through connection to a next device. Devices can just be daisy-chained or be connected in a loop, in which case the system can recover from a broken link.
3. The availability of a multi-port switch makes the multifunction power supply an ideal device for decentralized system clusters that are interconnected to create a large system. One or more of these multifunction power supplies in cluster can be easily interconnected to other clusters, while the remaining ports are used to connect loops of other devices in that cluster.
4. Port 6 is an SFP socket for a Small Form-factor Pluggable module. This allows for a long distance connection using glass fiber to the next cluster. In case two glass fiber connections are needed, e.g. to make the devices in the cluster part of a long distance fiber ring, at least two fiber ports are needed from two multifunction power supplies, or from a stand-alone network switch with two SFP sockets, or a combination of these.



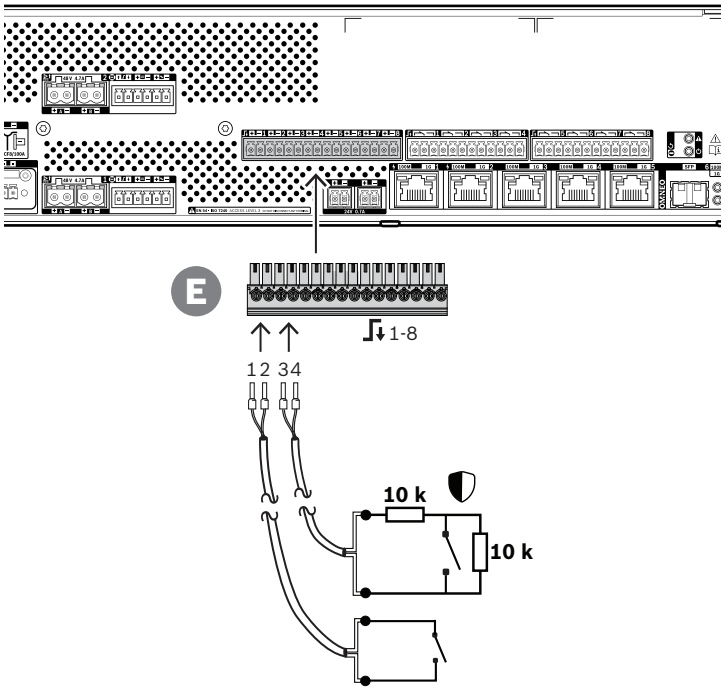
Caution!
Risk of eye injury. When inspecting a connector, ensure that light sources are off. The light source in fiber optic cables may cause eye injury. SX and LX fiber connections use invisible IR light.

11.5.9 Control inputs

The multifunction power supply provides eight control inputs on a 16-pole connector. The control inputs can be configured independently for various actions, with activation on closing a contact or opening a contact, and with or without interconnection supervision. See the PRAESENSA configuration manual for all options.

In case no interconnection supervision is configured, just use a switch or a relay output from another system for activation.

If a control input is used for activation of emergency calls, interconnection supervision is needed to generate a fault warning in case of an open or shorted circuit. In that case two resistors with value 10 kohm (0.25 W) must be connected between the cable and the switch. The resistors are connected in such a way that the control input sees 20 kohm for an open contact and 10 kohm for a closed contact. In case of a cable interruption, the control input sees a very high resistance. In case of a cable short-circuit, the control input sees a very low resistance. A very high or very low resistance will be interpreted as a fault condition.



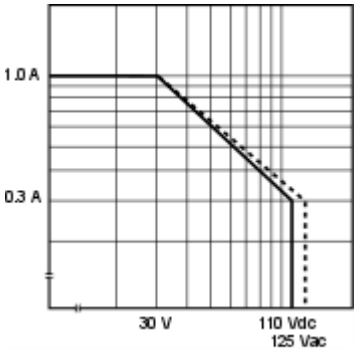
Connection procedure, with and without supervision

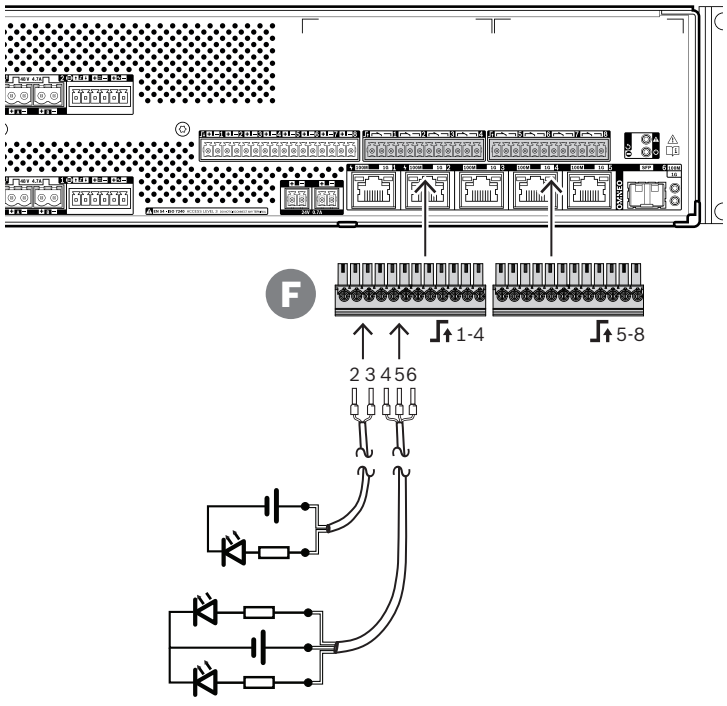
1. Use a 2-wire cable, proper for the installation, and the 16-pole terminal plug (E) delivered with the device.
2. Insert the near end wires of the cable into the appropriate slots of terminal plug (E), preferably using crimped on wire ferrules that fit to the wire gauge used.
   – Use a flat blade screw driver to tighten each connection.
3. **No supervision**: connect the other side of the cable to the activation switch or voltage free relay contact.
4. **With supervision**: connect the other side of the cable to the combination of activation switch and two 10 kohm supervision resistors. One resistor is in series with the switch and one resistor is in parallel with the switch.

Notice!
Do not use any terminal in common with other control input terminals.

11.5.10 Control outputs

The multifunction power supply provides eight control outputs on two 12-pole connectors. The control outputs use an SPDT (Single Pole Double Throw) relay for each output, providing an NC (Normally Closed) and an NO (Normally Open) contact. The control outputs can be configured independently for various actions. Make sure not to exceed the maximum contact rating. Refer to the “Control output contact rating” graphic below.





Connection procedure:

1. Use a 2-wire or 3-wire cable, proper for the installation and application, and one of the 12-pole terminal plugs delivered with the device.
2. Insert the near end wires of the cable into the appropriate slots of terminal plug (F), preferably using crimped on wire ferrules that fit to the wire gauge used.
   – Use a flat blade screw driver to tighten each connection.
3. Connect the other side of the cable to the application to be activated.

11.5.11 Reset to factory default

The reset switch resets the device to its factory default settings. This function is only to be used in case a secured device is removed from a system to become part of another system.
See *Device status and reset, page 54*.

11.6 Approvals

Emergency standard certifications	
Europe	EN 54-16 EN 54-4
International	ISO 7240-16 ISO 7240-4

Regulatory areas	
Safety	EN/IEC/CSA/UL 62368-1
Immunity	EN 55024 EN 55103-2 (E1, E2, E3) EN 50130-4
Emissions	EN 55032 EN 61000-3-2 EN 61000-3-3 EN 61000-6-3 ICES-003 ANSI C63.4 FCC-47 part 15B class A
Environment	EN 50581
Railway applications	EN 50121-4
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
Australia	RCM
Morocco	CMIM
Russian Federation	EAC
United Arabic Emirates	CoC

11.7 Technical data

Electrical

Power transfer	
Mains power supply input	
Input voltage range	115 to 240 VRMS
Input voltage tolerance	102 to 264 VRMS
Frequency range	50 to 60 Hz
Inrush current	< 20 A
Power factor (PF)	0.9 to 1.0
Leakage current to safety ground	< 0.75 mA (120 V), < 1.5 mA (240 V)
Battery power supply input	
Nominal DC input voltage	12.6 V
DC input voltage tolerance	9 to 15 V
Maximum current	90 A
Under-voltage protection	< 9 V
Battery charger	
Nominal charging current	8.5 A
Nominal float voltage	13.5 V
Float voltage control	-21.9 mV/°C
Temperature sensor NTC	10 kohm / β = 3984 K
Charging temperature range	-15 to 50 °C
48 VDC outputs (1-3)	
Nominal DC output voltage	48 V
Maximum continuous current	5.5 A
Maximum peak current	7.0 A
24 VDC output	
Nominal DC output voltage	24 V
Maximum continuous current	0.7 A
Maximum peak current	0.9 A
Lifeline DC outputs (1-3)	
Nominal DC output voltage	18 V
Maximum continuous current	0.7 A
Maximum peak current	1.0 A
Power over Ethernet (PoE 1-2)	
Nominal DC output voltage	48 V
Standard	IEE 802.3af (mode B)
Maximum PD load	12.95 W
Power consumption	
Mains powered	
Active mode, all outputs loaded	<1000 W
Battery powered	
Unloaded	5.2 W

Power transfer	
Active mode, all outputs loaded	<1000 W
Per active port	0.4 W
Per active SFP port	0.7 W
Lifeline / power save interface	
Audio level (100 V / 70 V mode)	0 dBV / -6 dBV
Frequency response (+0 / -3 dB)	200 Hz to 15 kHz
Signal to Noise Ratio (SNR)	90 dBA

Information related to EN 54-4:1997, ISO 7240-4:2017 and AS 7240.4:2018	
Maximum battery capacity	230 Ah
Lowest discharge voltage	9 V
Continuous output current (I max. a / I max. b / I min.)	
48 VDC outputs (1-3)	5.5 A / 5.5 A / 0 A
24 VDC output	0.7 A / 0.7 A / 0 A
PoE output (1-2)	0.3 A / 0.3 A / 0 A
Lifeline DC outputs (1-3)	0.7 A / 0.7 A / 0 A
Continuous output power (P max. a / P max. b / P min.)	
48 VDC outputs (1-3)	264 W / 264 W / 0 W
24 VDC output	16.8 W / 16.8 W / 0 W
PoE output (1-2)	15.4 W / 15.4 W / 0 W
Lifeline DC outputs (1-3)	12.6 W / 12.6 W / 0 W
Output voltage range	
48 VDC outputs (1-3)	46 to 50 V
24 VDC output	23 to 25 V
PoE output (1-2)	44 to 57 V
Lifeline DC outputs (1-3)	9 to 18 V
Maximum impedance of battery circuit	
230 Ah battery	7.1 mohm
180 Ah battery	8.6 mohm
140 Ah battery	9.8 mohm
100 Ah battery	11.0 mohm

Control interface	
Control input contacts (1-8)	
Principle	Contact closure
Galvanic isolation	No
Supervision	Resistance measurement
Contact closed	8 to 12 kohm
Contact open	18 to 22 kohm
Cable fault detection	<2.5 kohm / >50 kohm
Minimum hold time	100 ms
Maximum voltage to ground	24 V

Control interface	
Control output contacts (1-8) Principle Galvanic isolation Maximum contact voltage Maximum contact current Maximum voltage to ground	 Contact switch over (Relay SPDT) Yes 110 VDC, 125 VAC 1 A 500 V

Supervision	
Battery	Disconnect Short circuit Charging state Impedance
Power supplies	Converter voltages Output voltages
Lifeline connection	Impedance
Control input connections	Open / short
Temperature	Per section
Fan	Rotation speed
Controller continuity	Watchdog
Network interface	Link presence

Network interface	
Ethernet Protocol Redundancy	100BASE-TX, 1000BASE-T TCP/IP RSTP
Audio/control protocol Network audio latency Audio data encryption Control data security	OMNEO 10 ms AES128 TLS

Ports	
RJ45	5 (2 with PoE)
SFP	1

Reliability	
MTBF (extrapolated from calculated MTBF of PRA-AD608)	350.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -5 to +50 °C (23 to 122 °F) -30 to +70 °C (-22 to 158 °F)
Humidity (non condensing)	5 to 95 %
Air pressure (operating)	560 to 1070 hPa
Altitude (operating)	-500 to +5000 m (-1640 to 16404 ft)
Vibration (operating) Amplitude Acceleration	 < 0.7 mm < 2 G
Bump (transport)	< 10 G

Airflow	
Fan airflow	Front to sides/rear
Fan noise Idle condition, 1 m distance Rated power, 1 m distance	 < 30 dBSPLA < 53 dBSPLA

Mechanical

Enclosure	
Dimensions (WxHxD) With mounting brackets Rack unit	 483 x 88 x 400 mm (19 x 3.5 x 15.7 in) 19 in, 2U
Ingress protection	IP30
Case Material Color	 Steel RAL9017
Frame Material Color	 Zamak RAL9022HR
Weight	11.8 kg (26 lb)

12 LCD call station (CSLD, CSLW)



PRA-CSLD



PRA-CSLW

12.1 Introduction

This call station for use in PRAESENSA Public Address and Voice Alarm systems is easy to install and intuitive to operate because of its touch screen LCD, providing clear user feedback about setting up a call and monitoring its progress, or controlling back ground music.
The call station allows for positioning without much effort, because it only requires a connection to an OMNEO IP-network with Power over Ethernet (PoE) for communication and power supply combined.
It can be configured for use as business call station, but also as emergency call station.
The stylish design incorporates a supervised microphone, an internal monitor loudspeaker and a socket to insert a local audio source for background music.
The 4.3" high-resolution full-color capacitive touch screen gives the operator optimum control and feedback at all times.
Every call station must have at least one PRA-CSE call station extension for zone selection, with a maximum of four extensions.

12.2 Functions

IP-network connection

- Direct connection to the IP-network. One shielded CAT5e cable is sufficient for Power over Ethernet, audio and control.
- For dual redundancy of network and power connection, a second shielded CAT5e cable can be connected.
- Integrated network switch with two OMNEO ports allows for loop-through connections to adjacent devices (at least one must provide PoE). Rapid Spanning Tree Protocol (RSTP) is supported to enable recovery from failing network links.

Business operation

- Full color 4.3" capacitive touch screen with intuitive function menu navigation provides guidance and feedback during the process of live announcements, pre-recorded messages and music control. Successful broadcast of announcements/messages and changes to the background music settings are clearly indicated.
- Built-in monitor loudspeaker with volume control.
- Local audio line input (with stereo to mono conversion) for connecting an external audio source. The audio channel will be available on the network and can be played in any loudspeaker zone.
- Connection of up to four PRA-CSE extensions, each with twelve buttons. The buttons can be configured for various functions, but they are especially useful for zone selection, giving a clear overview of accessible zones and the LED indicators for each button show the status of the respective zone (like being selected, occupied or at fault).
- If the call station is not used for a while, it will switch to sleep mode to save energy. It will immediately wake up when the screen, or a button, is touched.

Only valid for the PRA-CSLD

- Press-to-talk button gives tactile feedback and is recessed to prevent accidental use.

Only valid for the PRA-CSLW

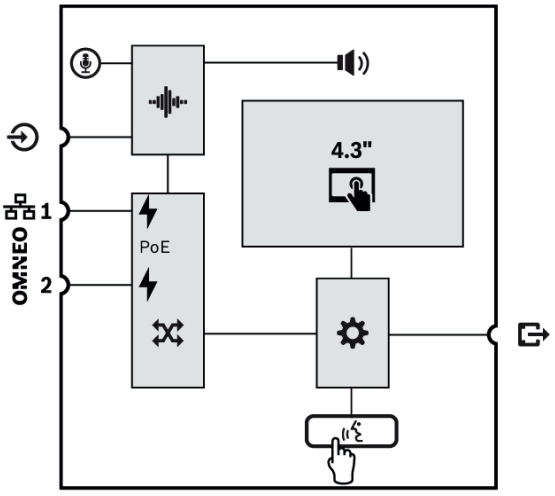
- Press-to-talk switch on hand-held microphone.

Emergency operation

- The call station fully complies to the standards for voice alarm applications when the firemen's user interface is configured and at least one PRA-CSE is connected to it.
- All critical alarm functions are accessible via buttons for operators wearing gloves. The 4.3" screen gives feedback on the system status.
- Each of the two RJ45 network connectors accept PoE to power the call station. This provides fail-safe network connection redundancy, as one connection is sufficient for full operation.
- Supervision of all critical elements; the audio path is supervised, as well as the communication to the network.

12.3 Functional diagram

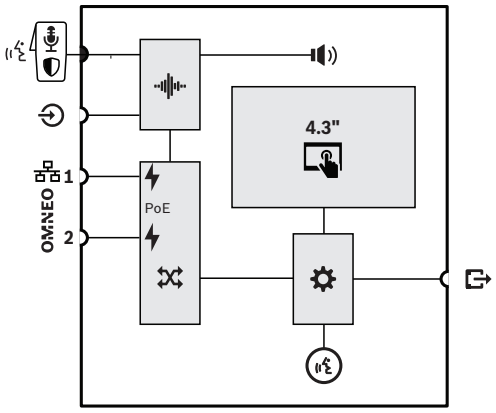
Functional and connection diagram



PRA-CSLD

Internal device functions

- Fixed microphone on a flexible stem
- Internal monitor loudspeaker
- Audio processing (DSP)
- Power over Ethernet
- OMNEO network switch
- Controller
- Press-To-Talk button



PRA-CSLW

Fixed hand-held microphone with Press-To-Talk or Start/Stop switch

Call status LED ring

12.4 Indicators and connections



PRA-CSLD PRA-CSLW

Top-side indicators

	Power on Device in identification mode	Green Green blinking		System fault present	Yellow
	PRA-CSLD Status business call Microphone active Chime/message active Status emergency call Microphone active Alarm tone/message active	 Green Green blinking Red Red blinking		4.3" full-color capacitive touch screen	LCD

	PRA-CSLW Status business call Microphone active Chime/message active Status emergency call Microphone active Alarm tone/message active	 Green Green blinking Red Red blinking		Identification mode / Indicator test	All LED's blink

The brightness adjustment of the LEDs and LCD backlight is only supported on devices with HW version 01/01 and higher.

Top-side controls

	Press-To-Talk	Button		4.3" full-color capacitive touch screen	LCD
	Fixed hand-held Press-To-Talk	Microphone Switch			



Bottom-side indicators and controls

	100 Mbps network 1-2 1 Gbps network1-2	Yellow Green		Device reset (to factory default)	Button

Bottom-side and side interconnections

OMNEO	Network port 1-2 (PoE PD)			Local source audio line input	
	PRA-CSE interconnection				

12.5 Installation

The call station is designed to be installed on a desktop (PRA-CSLD) or on a wall (PRA-CSLW) and in combination with one or more call station extensions (PRA-CSE). The following installation instructions apply to both products.

Notice!
In case of flush mounting, the rear or bottom must be vented. It is used as a heatsink.

12.5.1 Parts included

The box contains the following parts:

PRA-CSLD

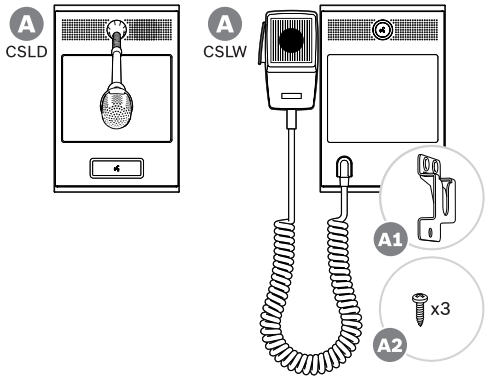
Quantity	Component
1	Desktop LCD call station
1	Bracket (attached to bottom)
1	Connector cover (attached to bottom)
1	Quick Installation Guide
1	Safety information

PRA-CSLW

Quantity	Component
1	Wallmount LCD call station
1	Bracket (attached to bottom)
1	Connector cover (attached to bottom)
1	Microphone clip
1	Quick Installation Guide
1	Safety information

No tools or Ethernet cables are provided with the device.

Parts check and identification



A Desktop/wallmount LCD call station

A1 Hand-held microphone clip

A2 Microphone clip connection screws

12.5.2 Interconnection call station / extension

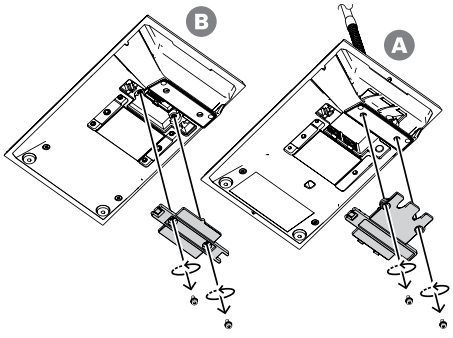
Every call station must have at least one PRA-CSE call station extension for zone selection, with a maximum of four extensions.
A call station (A) will automatically assign a connected extension (B) to itself and number the extensions in succession. Manual addressing is not needed and not possible. The system will supervise that a configured extension remains connected to its call station.
Refer to: *Extension connected to a call station, page 150*.

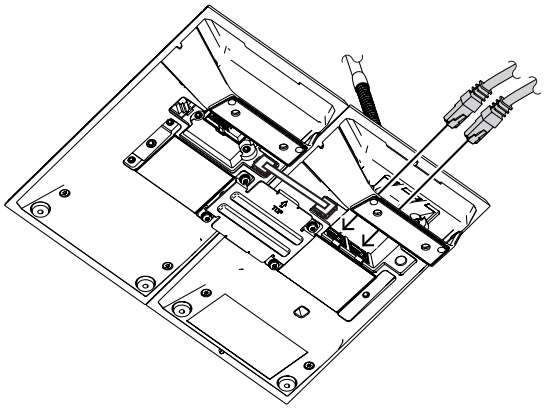
12.5.3 Power over Ethernet

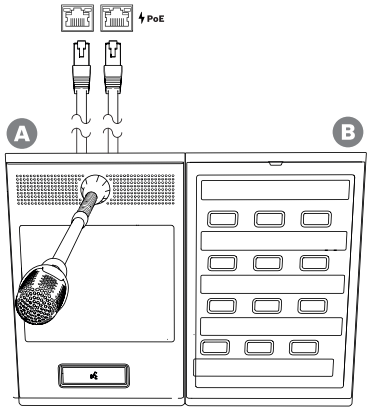
The call station has two Ethernet connection ports with a built-in Ethernet switch, supporting RSTP. The call station is an PoE Powered Device (PD). It provides the correct signature and classification to power sourcing equipment (PSE), so that a PSE sources the right amount of power to a PD over the Ethernet cables. Although it is sufficient to provide PoE power to only one port, both Ethernet ports take PoE power for cable redundancy and supply redundancy. For best availability it is advised to connect each port to a different, independent PSE, such as a PRA-MPS3 multifunction power supply (ports 1 and 2) or a PRA-ES8P2S Ethernet switch (ports 1-8). In case one of the connections fail, or one of the PSE sources fail, the operation of the call station is not affected. With both connections to the same PSE, there is still connection redundancy but no PSE redundancy.
The ports of the call station can be looped through to another PRAESENSA device, but at least one port must be connected to a PSE to power the call station and its extensions. With only one port connected to a PSE, there is no connection redundancy.
The call station ports cannot source PoE power to subsequent devices, such as another call station.

To connect the call station, follow the procedure below:

1. Remove the cable cover at the bottom of the call station using a TX10 screwdriver.
   – Get access to the two screws via the holes in the table stand bracket.
2. Use one or two shielded Gb-Ethernet cables (preferably CAT6A F/UTP) with RJ45 connectors to connect the call station to a PSE port, with PoE enabled.
3. Put back the cable cover with the two TX10 screws.





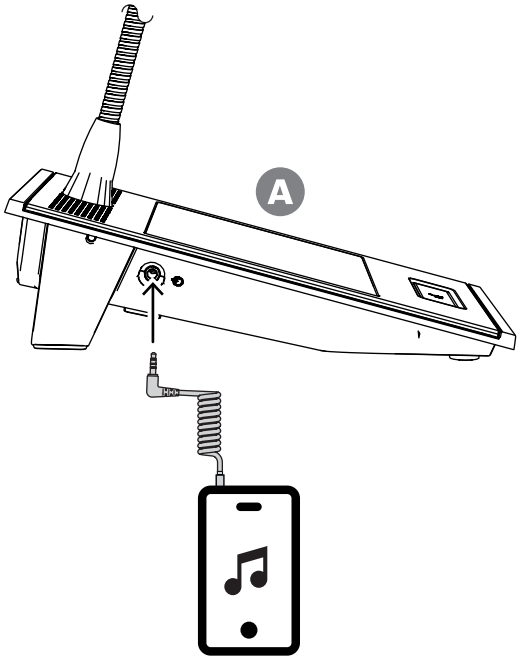


12.5.4 Ethernet network

The network must be set up in such a way that the call station can be discovered and reached by the system controller. Configuration of the call station and its extensions is done via the system controller. For configuration, the call station is identified by its hostname, which is printed on the product label on the bottom of the device. The format of the hostname is the type number of the device without the dash, followed by a dash and then the last 6 hexadecimal digits of its MAC-address.
Configuration is described in the PRAESENSA configuration manual.

12.5.5 Line input

On the left side of the call station is a 3.5 mm stereo socket. This is an input for a background music source, such as a dedicated audio player, smartphone or PC. The stereo signal is converted to mono for further distribution in the system. This input needs to be configured in the system for this function, to link it to a background music channel that is available for playback in one or more system zones. This input is not supervised, unplugging the cable to the audio player will not be reported as a fault.



Notice!

When music is played from a PC that is connected to a grounded mains supply, there is a risk of hum being inserted into the music input of the call station. This is caused by unequal ground potentials of the different mains supplies. Use a cable with integrated transformers for ground loop isolation to prevent such hum. See picture below of an example ground loop isolator cable.



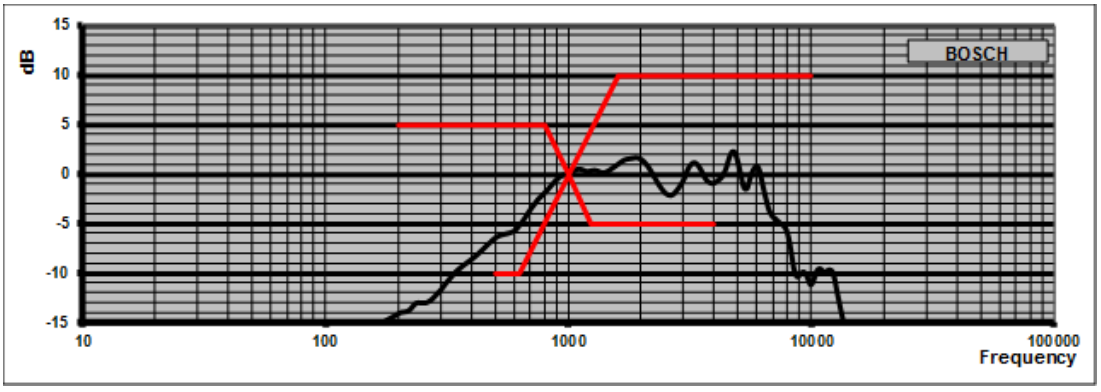
Notice!

For compliance to DNV GL type approval, the line input must not be used. By connecting a cable to this input the radiated emission of the device would exceed the limit for the maritime radio band.

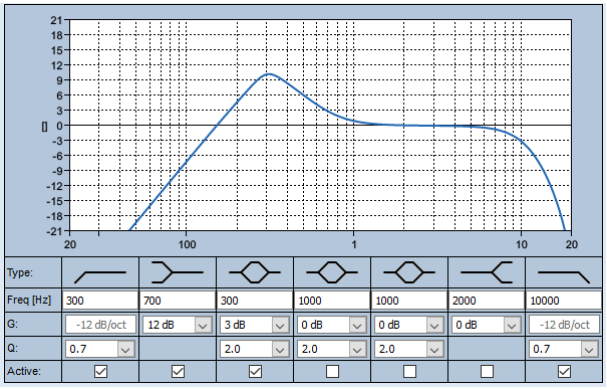
12.5.6 Call station microphone frequency response

PRA-CSLW (Hand-held)

The typical frequency response of the PRA-CSLW call station microphone is shown in the next diagram (black), together with the boundaries according to EN 54-16, clause 13.12.3 (red). The frequency response has been measured at a distance of 10 cm (4 in) with 1/6th octave smoothing. It rolls off rapidly below 1 kHz to cancel environmental noise. But this might result in a lack of body of the voice sound.

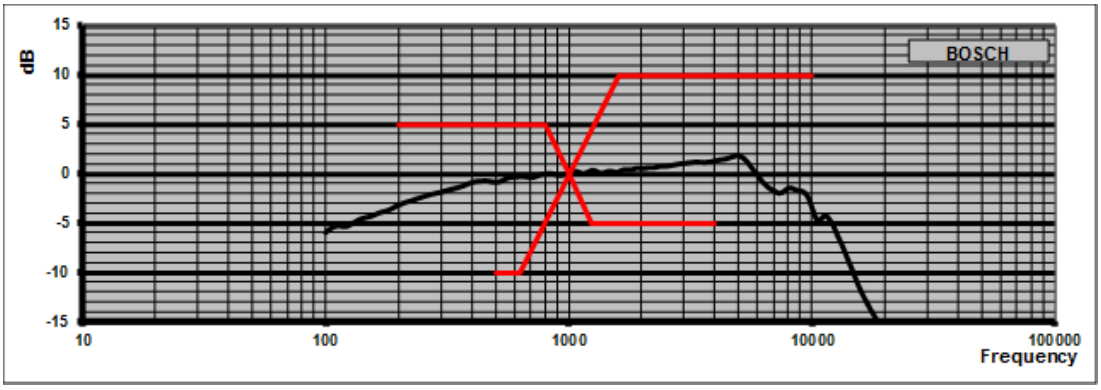


In environments that are not extremely noisy, the sound can be improved by applying parametric equalization on this call station, lifting the frequency band between 300 Hz and 1 kHz as shown in the next diagram. This makes the frequency response more flat between 300 Hz and 6 kHz. A low-cut filter below 300 Hz helps to improve speech intelligibility. See the PRAESENSA configuration manual for details on how to get to the audio options in the configuration.



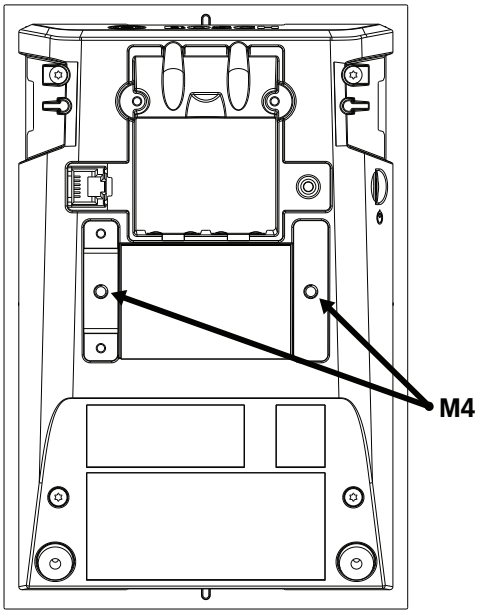
PRA-CSLD

The typical frequency response of the PRA-CSLD call station microphone is shown in the next diagram (black), together with the boundaries according to EN 54-16, clause 13.12.3 (red). The frequency response has been measured at a distance of 20 cm (8 in) with 1/6th octave smoothing.



12.5.7 Mounting

The call station and call station extension enclosures have two rear M4-threaded inserts of 5 mm depth to facilitate fixing the devices to a plate for horizontal or vertical mounting on a desktop or against a wall. Use M4 bolts (metric 4 mm thread), having a length of the thickness of the mounting plate or bar plus an additional 4-5 mm. Or use M4 extension bolts (hexagonal spacer) to create more distance between the device and the mounting plate.

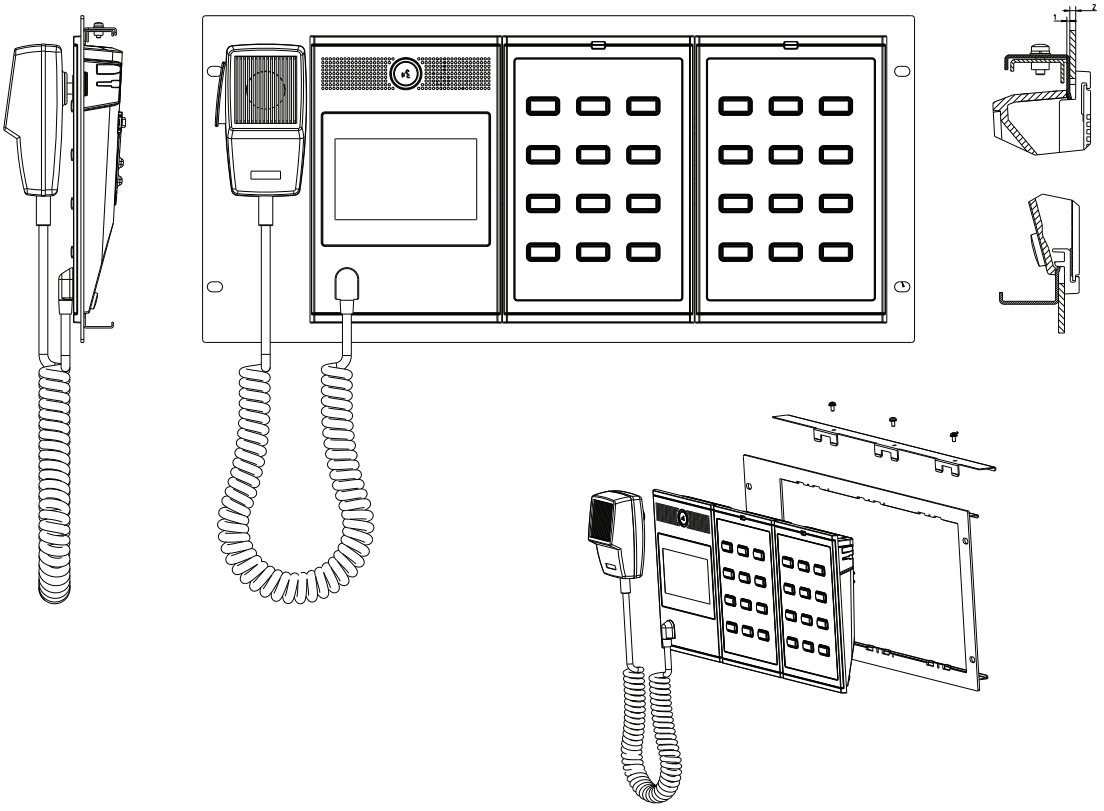


For mounting against a wall, the mounting plate must be firmly attached to the wall using screws and wall plugs. For stone walls use screws of 4 mm diameter and 40 mm length with matching plugs; for hollow walls use hollow wall or dry wall anchors with matching screws, approximately 5 mm diameter and 50 mm length.

For flush mounting, the call station and extension can be sunk into a rectangular cavity of 182 mm x 120 mm. Center distance is 130 mm between the cavities of call station and extensions. On the front and rear sides, just below the rim of the top cover, are adapter slots (size 50 mm x 3 mm, depth 3 mm) to accept a lip for positioning. These slots can also be used for fixing the call station and extensions.

The desktop stand of the call station and extensions can be removed. Insert a Torx T10 screwdriver into the slot of the stand, just below the rim of the top cover, and use it as a pry bar to pry off the desktop stand on one side, and then on the other side. Be careful not to damage the rim of the top cover; use a piece of metal (for instance a metal ruler) between the rim and the screwdriver. Considerable force is needed. The stand can also be replaced by pushing it back until it snaps in place.

The next illustration shows an example of a PRA-CSLW call station with two extensions PRA-CSE, flush-mounted on a 19 in panel of 5U height. The devices are fixed on the panel by clamping strips, behind the panel, that go into the adapter slots. In this case the M4 inserts are not used and the desktop stands are removed.



Caution!
The call station and its extensions are suitable for vertical mounting below 2m height.

12.5.8 Reset to factory default

The reset switch resets the device to its factory default settings. This function is only to be used in case a secured device is removed from a system to become part of another system. See *Device status and reset, page 54*.

12.6 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	EN/IEC/CSA/UL 62368-1
Immunity	EN 55024 EN 55103-2 (E1, E2, E3) EN 50130-4
Emissions	EN 55032 EN 61000-6-3 ICES-003 ANSI C63.4 FCC-47 part 15B class A
Environment	EN 50581
Railway applications	EN 50121-4
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
Australia	RCM
Morocco	CMIM
Russian Federation	EAC
United Arabic Emirates	CoC

12.7 Technical data

Electrical

Microphone (PRA-CSLD)	
Nominal acoustic input level (configurable)	80 to 100 dBSPL
Maximum acoustic input level	120 dBSPL
Signal to Noise Ratio (SNR)	> 70 dBA
Directivity	Unidirectional
Frequency response (+3 / -6 dB)	100 Hz to 14 kHz

Microphone (PRA-CSLW)	
Nominal acoustic input level (configurable)	85 to 105 dBSPL
Maximum acoustic input level	120 dBSPL
Signal to Noise Ratio (SNR)	> 73 dBA

Microphone (PRA-CSLW)	
Directivity	Unidirectional
Frequency response (+3 / -6 dB)	 500 Hz to 8 kHz (noise cancelling)

Display	
Size	4.3"
Touch screen	Capacitive
Color depth	24-bit
Resolution	480 x 272 px
Brightness	300 cd/m^2

Monitor loudspeaker	
Maximum sound pressure level, at 1 m	75 dBSPL
Volume control	Mute, -40 dB to 0 dB
Frequency range (-10 dB)	400 Hz to 10 kHz

Line input	
Signal to Noise Ratio (SNR)	> 96 dBA
Total Harmonic Distortion + Noise (THD+N)	< 0.1 %

Power transfer	
Power over Ethernet (PoE 1-2) Nominal DC input voltage Standard	 48 V IEEE 802.3af (mode B)
Power consumption Call station (general use) Call station (alarm use) Per call station extension (indicators off / on)	 4.2 W 5.4 W 0.1 W / 1.0 W
Input voltage tolerance	37 to 57 VDC

Supervision (PRA-CSLD)	
Supervision Microphone Audio path Controller continuity PoE (1-2)	 Current Pilot tone Watchdog Voltage

Supervision (PRA-CSLW)	
Supervision Microphone Audio path	 Impedance Pilot tone

Supervision (PRA-CSLW)	
Press-to-talk switch Controller continuity PoE (1-2)	Impedance Watchdog Voltage

Network interface	
Ethernet Protocol Redundancy	100BASE-TX, 1000BASE-T TCP/IP RSTP
Audio/control protocol Network audio latency Audio data encryption Control data security	OMNEO 10 ms AES128 TLS

Ports	2

Reliability	
MTBF (extrapolated from calculated MTBF of PRA-AD608)	1.000.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -5 to +50 °C (23 to 122 °F) -30 to +70 °C (-22 to 158 °F)
Humidity (non-condensing)	5 to 95 %
Air pressure (operating)	560 to 1070 hPa
Altitude (operating)	-500 to +5000 m (-1640 to 16404 ft)
Vibration (operating) Amplitude Acceleration	 < 0.35 mm < 5 G
Bump (transport)	< 10 G

Mechanical

Enclosure (PRA-CSLD)	
Dimensions (WxHxD) Excluding microphone	 130 x 62 x 189 mm (5.12 x 2.44 x 7.44 in)
Ingress protection	IP30

Enclosure (PRA-CSLD)	
Base Material Color	 Zamak RAL9017
Panel Material Color	 Plastic RAL9017 RAL9022HR
Weight	0.9 kg (1.98 lb)

Enclosure (PRA-CSLW)	
Dimensions (WxHxD)	130 x 62 x 189 mm (5.12 x 2.44 x 7.44 in)
Ingress protection	IP30
Base Material Color	 Zamak RAL9017
Panel Material Color	 Plastic RAL9017 RAL9022HR
Weight	1.0 kg (2.21 lb)

13 Call station extension (CSE)



13.1 Introduction

This keypad extension is used in combination with PRAESENSA call stations to make selections for business and alarm calls.
One device adds twelve configurable buttons with light ring. Each button has two additional indicators for user feedback, related to the configured functionality of that button.
Up to four PRA-CSE can be connected to one call station. Using extension keypads for zone selection allows all zones to be accessible and visible at the same time. It shows a complete status overview of selected and occupied zones or zones with faults.
The extension keypad is delivered with a metal coupling plate and patch cable to link it to a call station or other extension keypad.
The front cover can be easily removed to insert labels with up to three lines of text per button and a header section on top.

13.2 Functions

Business operation

– Connection of up to four PRA-CSE extensions, each with twelve buttons. The buttons can be configured for various functions, but they are especially useful for zone selection, giving a clear overview of accessible zones and the LED indicators for each button show the status of the respective zone (like being selected, occupied or at fault).

Emergency operation

– The call station extension complies to the standards for voice alarm applications, when the firemen's user interface is configured for the call station and at least one PRA-CSE is connected to it.
– All critical alarm functions are accessible via buttons for operators wearing gloves.
– All indicators of the extension take part in the indicator test function of the connected call station.

Connection

– Reliable, locked, single cable interconnection between call station and extension and between extensions.
– Robust metal coupling plate.
– All extensions are automatically addressed, from left to right.
– All assembling can be done with one standard Torx TX10 screwdriver.

Labeling

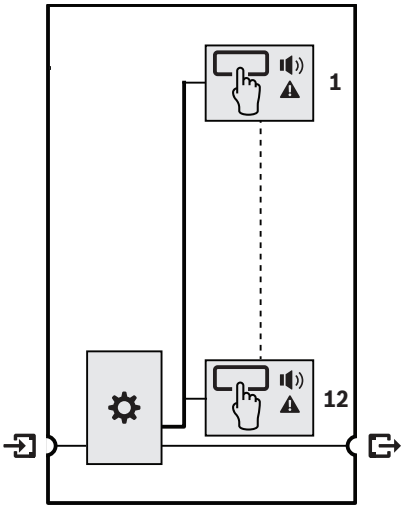
– Removable front cover for easy labeling with space for three lines of text per button.

Button cap

– Three button caps are included to prevent unintended activation of critical buttons.

13.3 Functional diagram

Functional and connection diagram



Internal device functions

Controller

Zone status indicator

Zone fault indicator

13.4 Indicators and connections



Top-side indicators

	Selection button LED ring (1-12) Selected	White		Active (1-12) Evacuation call Business call Music	 Red Blue Green
	Zone fault present (1-12)	Yellow			

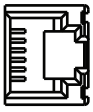
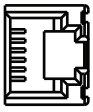
The brightness adjustment of the LEDs is only supported on devices with HW version 01/01 and higher.

Top-side controls

▭	Selection (1-12)	Button			

Bottom-side interconnections



⇥	Connection to next extension (RJ12)		⇤	Connection to call station or previous extension (RJ12)	

13.5 Installation

The PRA-CSE is used in combination with a PRA-CSLD and PRA-CSLW call station.

Refer to

– *LCD call station (CSLD, CSLW), page 132*

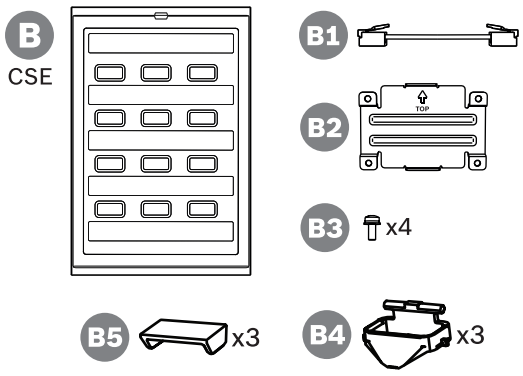
13.5.1 Parts included

The box contains the following parts:

Quantity	Component
1	Call station extension
1	Bracket (attached to bottom)
1	Metal coupling plate + 4 screws
1	RJ12 interconnection cable
1	Button cap (x3)
1	Quick Installation Guide
1	Safety information

No tools or Ethernet cables are provided with the device.

Parts check and identification



B Call station extension
B1 Patch cable
B2 Coupling plate
B3 Screw torx TX10 (x4)
B4 Button light ring (x3)
B5 Button cap (x3)

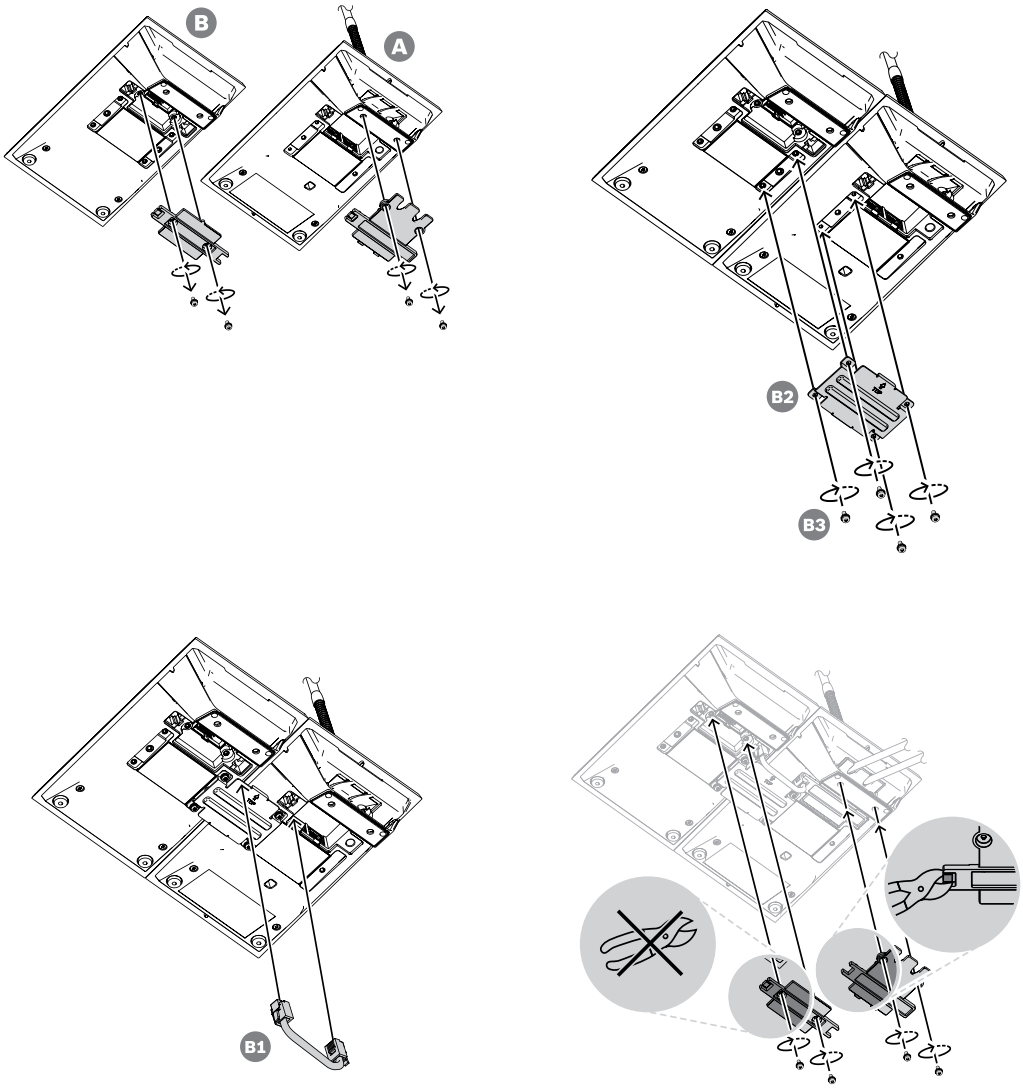
13.5.2 Extension connected to a call station

Every call station must have at least one PRA-CSE call station extension for zone selection, with a maximum of four extensions.
A call station (A) will automatically assign a connected extension (B) to itself and number the extensions in succession. Manual addressing is not needed and not possible. The system will supervise that a configured extension remains connected to its call station.
The extension that is mounted immediately next to the call station is the first extension in the configuration. All extensions communicate with their call station via a short loop-through cable with RJ12-connectors. The same connection provides power to the extensions. Extensions cannot be used without call station.

To mount and connect a call station extension, follow the procedure below:

1. Remove the cable covers at the bottom of the call station and the extension using a TX10 screwdriver.
   – For the call station, get access to the two screws via the holes in the table stand bracket.
2. Mount the coupling plate between the call station and the first extension, using four M3 screws with TX10 head.
   – Mounting plate and screws are included with the extension.
   – An extension can only be mounted to a call station on its right hand side (looking from above).
3. Connect the short RJ12-cable between the call station and the (first) extension.
   – This cable reversible and can be used in either direction. The RJ12-cable is included with the extension.
4. When the call station is not yet connected to the network, use one or two shielded Gb-Ethernet cables (CAT5e or better) with RJ45 connectors to connect the call station to a PSE port, with PoE enabled.
5. Cut off the small break-off part of the cable cover of the call station to make space for the RJ12-cable to pass through.
   – This break-off part covered the RJ12-socket when it was not used.
6. Put back both cable covers, each with its two TX10 screws.
   – The cable covers prevent that the RJ12-cable can be pulled out. For the call station, the cable cover also prevents access to the Reset switch.

Follow the same procedure for mounting an additional extension to an already mounted extension.

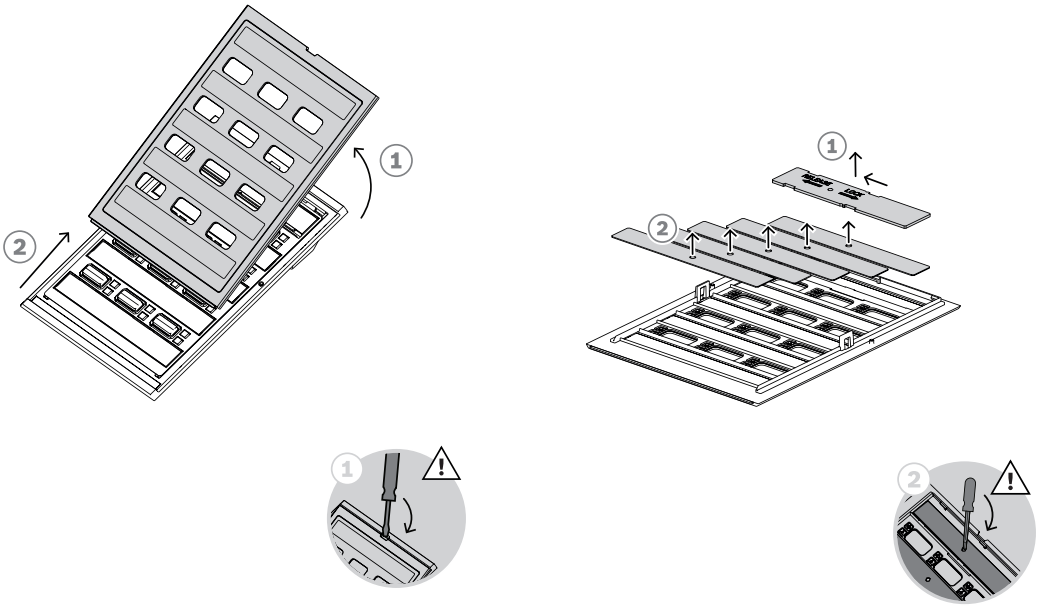


13.5.3 Labeling

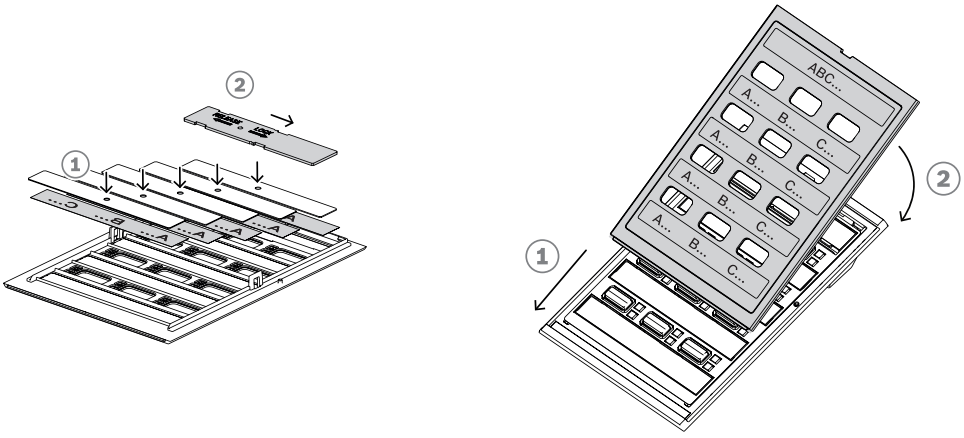
The call station extension has provisions to label the keys with custom texts and/or symbols, but also the extension itself can be labeled.

To add or change labels follow the procedure below:

1. The extension top cover is fixed in place with magnets. Use a screwdriver or tweezers in the slot of the extension cover plate to lift up the top cover.
2. Slide the cover upwards to remove it.
3. Turn the cover upside down. Gently push a screwdriver of tweezers into the hole in the metal top side label holder. Slide the label holder to the left to unlock and then up to remove.
   – This label holder is for the title label of the extension. It is made of metal and is also used to fix the top cover magnetically to the body of the enclosure.
4. Gently push a screwdriver or tweezers into the holes of the plastic label holders for the keys and lift them up to remove.
5. Type in the texts for the title label and the key labels using the available template. Then print on paper and cut to size.



6. Place the labels upside down in the label slots and put the label holders back in place. Slide the metal top side label holder to the right to lock it in place.
7. Mount the cover back on the extension body by first sliding the bottom side into the body, then tilt down until it snaps into place.

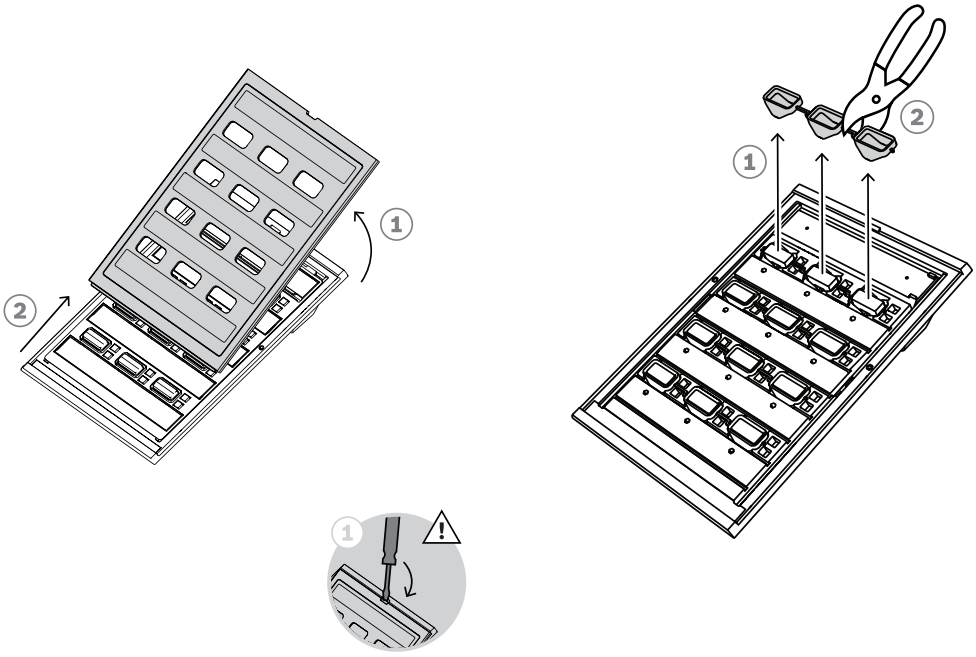


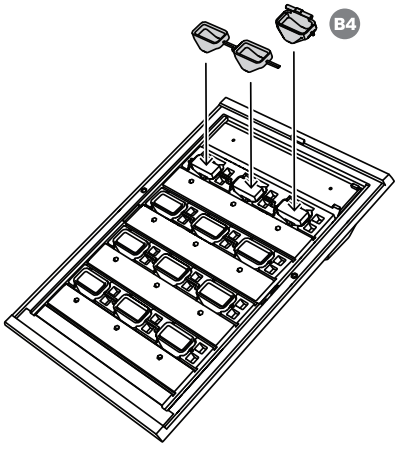
13.5.4 Mounting a button cap

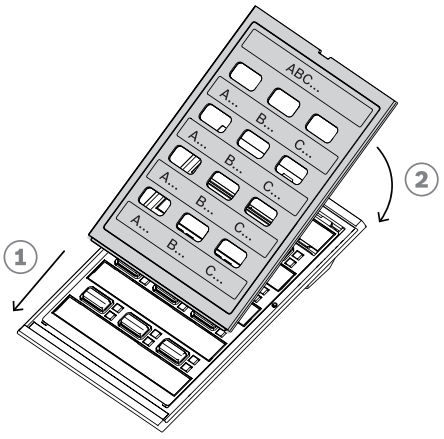
The call station extension has provisions to add a cap over one or more buttons, as a safeguard against accidental activation. Each PRA-CSE is delivered with a set of three caps, each consisting of a white light ring with pivot pins and a red cap with a hinge.

To mount a button cap, follow the procedure below:

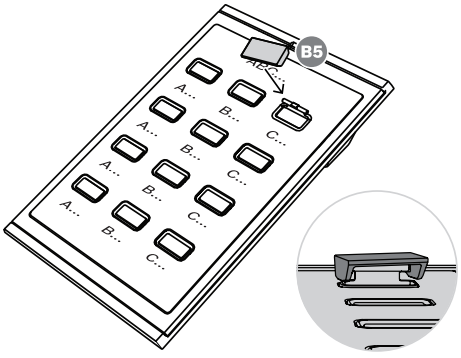
1. The extension top cover is fixed in place with magnets. Use a screwdriver or tweezers in the slot of the extension cover plate to lift up the top cover.
2. Slide the cover upwards to remove it and get access to the buttons.
3. Translucent light rings are placed in rows of three around the buttons. Use tweezers to lift and remove the row for the button that should get a cap.
4. Remove the original light ring by cutting the plastic bridges to the adjacent light rings. Leave part of the plastic bridges in place around each light ring for better orientation when it is put back in place.
5. Insert one of the new light rings with pivot pins in the slot around the button that should get a cap. The pivot pins must be on top.
6. Then place the original light rings back around the remaining buttons.
7. Mount the cover back on the extension body by first sliding the bottom side into the body, then tilt down until it snaps into place.

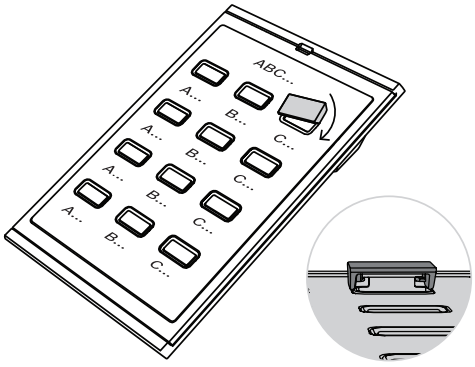


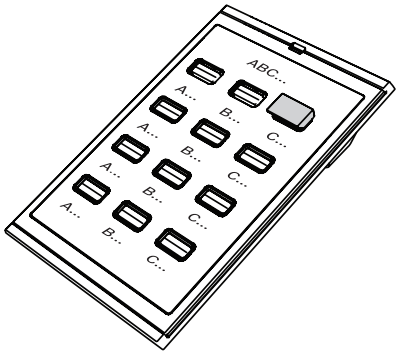




8. The red cap has a hole on one side of the hinge for the left pivot pin, and a slot on the other side of the hinge for the right pivot pin. Rotate the cap 10 degrees, counterclockwise, and slide to the right over the button, so the left pivot pin goes into the hole of the hinge. Then push the right side of the cap down until the right pivot pin snaps into the slot of the hinge. This requires some force.
9. After the cap has snapped into place, the hinge has two stable positions and the cap can be flipped into the open or closed position.







13.6 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	EN/IEC/CSA/UL 62368-1
Immunity	EN 55024 EN 55103-2 (E1, E2, E3) EN 50130-4
Emissions	EN 55032 EN 61000-6-3 ICES-003 ANSI C63.4 FCC-47 part 15B class A
Environment	EN 50581
Railway applications	EN 50121-4
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
Australia	RCM
Morocco	CMIM
Russian Federation	EAC
United Arabic Emirates	CoC

13.7 Technical data

Electrical

Power transfer	
Power supply input Input voltage Input voltage tolerance Power consumption (indicators off / on)	 5 VDC 4.5 to 5.5 VDC 0.1 W / 1.0 W

Supervision	
Interconnection	Link presence
Processor	Watchdog

Reliability	
MTBF (extrapolated from calculated MTBF of PRA-AD608)	2.000.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -5 to +50 °C (23 to 122 °F) -30 to +70 °C (-22 to 158 °F)
Humidity (non-condensing)	5 to 95 %
Air pressure (operating)	560 to 1070 hPa
Altitude (operating)	-500 to +5000 m (-1640 to 16404 ft)
Vibration (operating) Amplitude Acceleration	 < 0.35 mm < 5 G
Bump (transport)	< 10 G

Mechanical

Enclosure	
Dimensions (WxHxD)	130 x 62 x 189 mm (5.12 x 2.44 x 7.44 in)
Ingress protection	IP30
Base Material Color	 Zamak RAL9017
Panel Material Color	 Plastic RAL9017 RAL9022HR
Weight	0.4 kg (0.88 lb)

14 Ethernet switch (ES8P2S)



14.1 Introduction

The PRA-ES8P2S is a compact DIN-rail mounted Ethernet switch with eight Gigabit copper ports, supporting Power over Ethernet (PoE) and two Gigabit SFP combo ports. This Ethernet switch is an OEM switch, made for Bosch by Advantech for use in Bosch Public Address and Voice Alarm systems. It is a preconfigured version of the EKI-7710G-2CPI-AE switch, optimized for PRAESENSA. The PRA-ES8P2S is certified for EN 54-16 in combination with PRAESENSA systems. It can be used in addition to the switch ports of the PRAESENSA system controller and multifunction power supply. This is especially convenient in large systems where more SFP ports are needed for long distance interconnections on glass fiber or more PoE-enabled ports are needed to power PRAESENSA call stations.

14.2 Functions

Intended for PA/VA systems

- Managed industrial Gigabit Ethernet switch with convection cooling and DIN-rail mounting, designed for long term continuous operation.
- Redundant wide range DC power input.
- Protected against overloads and short circuits.
- Comes with pre-installed and pre-configured firmware for quick installation and optimum performance.
- Certified for EN 54-16 in combination with Bosch PRAESENSA systems.

Advanced features

- Managed switch, configurable via web browser, with eight Gigabit copper ports with PoE and two SFP combo ports for PRA-SFPLX single mode and/or PRA-SFPSX multimode fiber transceiver modules.
- Deactivated Energy Efficient Ethernet (EEE) mode on all ports to avoid problems in combination with audio clock synchronization (IEEE 1588) in combination with OMNEO, Dante and AES67.
- Wire speed switching in hardware to avoid variable latency that may cause audio streaming problems.

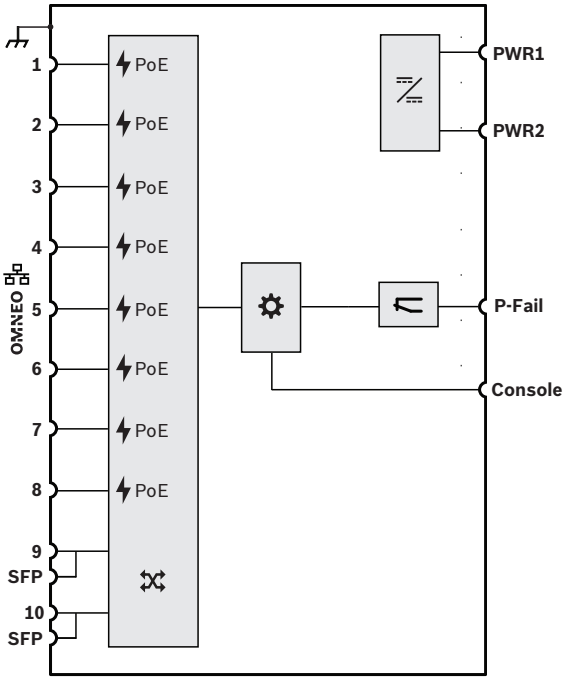
- Full Quality of Service (QoS) through differentiated services (DiffServ) on all ports, compatible with OMNEO Docent diagnostic tool.
- Support for Rapid Spanning Tree Protocol (RSTP) according to IEEE 802.1d to create redundant loops.
- Fault output relay for fault reporting into PA/VA system.
- Large MAC-address table (8k-addresses) for large system broadcasting.
- Support for Simple Network Management Protocol (SNMP) and Link Layer Discovery Protocol (LLDP).
- All copper ports provide PoE (IEEE 802.3 af/at) to power PRAESENSA call stations or other devices.

Fault tolerance

- All ports support RSTP for loop connections to adjacent devices with recovery from a broken link.
- Dual redundant 24 to 48 V DC-inputs.

14.3 Functional diagram

Functional and connection diagram



Internal device functions

Power over Ethernet power source

OMNEO network switch

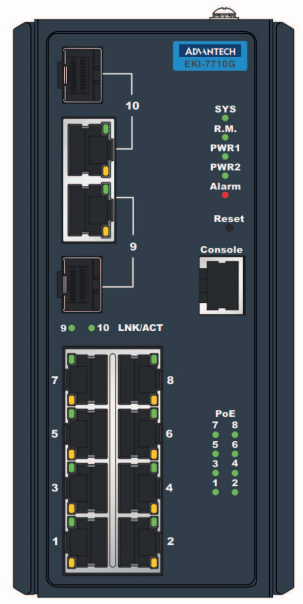
SFP Socket for SFP module

Controller

DC to DC converter

Fault relay

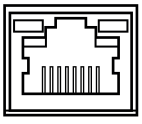
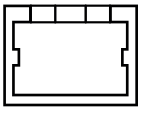
14.4 Indicators and connections

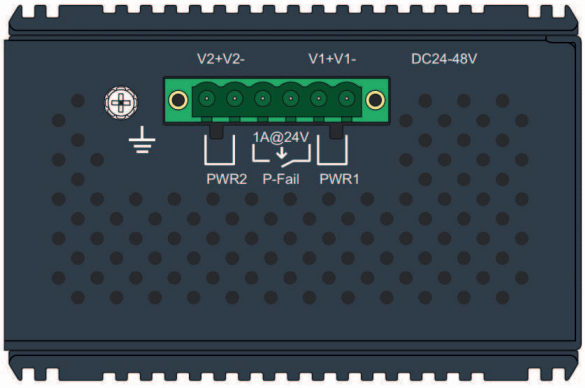


Front panel indicators and controls

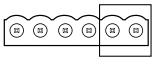
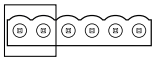
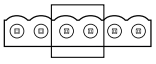
Port 1-10	Link activity	Green	SYS	System is operating normally	Green
Port 1-10	100 Mbps network 1 Gbps network	Yellow Green	R.M.	Active when determining ring master	Green
-	-	-	PWR1	Power on power supply input 1	Green
PoE 1-8	PoE activated	Green	PWR2	Power on power supply input 2	Green
Reset	System soft reset or factory reset	Switch	Alarm	SFP port disconnected or link down	Red

Front panel connections

Port 1-8	Network port 1-8 with PoE		Port 9-10	Network combo port 9-10	
Console	Console serial RS232 cable COM port				



Top panel connections

⏚	Chassis ground	⊕	PWR1	24 to 48 VDC input 1	
PWR2	24 to 48 VDC input 2		P-Fail	Fault relay	

14.5 Installation

The PRA-ES8P2S is a preconfigured version of the Ethernet switch Advantech EKI-7710G-2CPI-AE. Detailed installation and configuration instructions can be downloaded from the manufacturer's website: www.advantech.com.
The switch can be mounted on a DIN-rail or on a wall or panel, using the wall mounting brackets.

Notice!
For security reasons, by default this switch is not accessible from the Internet. When the default (special link-local) IP-address is changed to an address outside the link-local range (169.254.x.x/16), then also the default (published) password must be changed. But even for applications on a closed local network, for highest security the password may still be changed. To do so:
1: Access the switch via its preconfigured IP address, using a browser to setup a secure connection to https://169.254.255.1.
2: The PRA-ES8P2S is factory configured with the following default credentials:
User: Bosch.
Password: mLqAMhQ0GU5NGUK.
3: Log in to this account. This is an account with administrator rights.
4: Change the password and if needed the IP-address, and safe the password for future access.
The IP-address is only used to get access to the switch for configuration, but it is not used during operation. For that reason it is not a problem to have multiple PRA-ES8P2S switches connected on the same network, all with the same (default) IP-address. Only when the configuration is to be changed, each switch must be individually connected to the configuration PC, one at a time, to make the changes.

Notice!
By convention, most SNMPv1-v2c equipment ships from the factory with a read-only community string set to "public". This also applies to the PRA-ES8P2S. The SNMP community string is like a user id or password that allows access to the switch statistics. If the community string is correct, the device responds with the requested information, otherwise the device simply discards the request and does not respond. For security reasons, it is standard practice for network managers to change all the community strings to customized values in the device setup, or SNMP should be disabled.

Notice!
Open Source Software license agreements are accessible as download from the device itself. Access the device via its IP-address (https://169.254.255.1 is the factory default address). No user credentials are needed for this.

Notice!
PRAESENSA supervises the network links between OMNEO devices, but a link between two non-OMNEO devices is not supervised. The PRA-ES8P2S is not a native OMNEO device and a connection between two of these switches is not supervised.

14.5.1 Parts included

The box contains the following parts:

Quantity	Component
1	10-port industrial Ethernet switch
1	Screw connector
2	Wall-mounting bracket
1	DIN-rail mounting bracket and screws
1	Startup manual

No tools or Ethernet cables are provided with the device.

14.5.2 Power supply connection

This Ethernet switch has dual redundant 24 to 48 V DC-inputs. In case no battery backup is required, it can be powered from a PRA-PSM24 or PRA-PSM48 power supply. In case the switch is used in a Voice Alarm system, compliant to EN54-16, the switch must be powered from an EN54-4 certified power supply, like the PRA-MPS3.
When the switch is powered by the PRA-MPS3 multifunction power supply, it must be connected to one of the 48 V outputs, normally intended for the amplifiers. Use both A and B outputs for connection redundancy. The 24 V output of the PRA-MPS3 is not powerful enough for this switch. The 48 V output that is powering the switch should not be used to also power an amplifier. Especially when the switch is serving multiple PoE powered devices as PSE (Power Sourcing Equipment), its power consumption can raise to 140 W. The remaining power capacity of the 48 V supply is not sufficient anymore for an amplifier under various load conditions.
The lifeline that belongs to the powering 48 V output is not used, so the 48 V output will not be disabled as would be for amplifiers in sleep/snooze mode to save power. It is also essential that the 48 V for the switch is not disabled at any time. In case of mains failure the switch will be powered from the battery, connected to the multifunction power supply.

14.5.3 Fault relay connection

The switch has a fault relay output to report faults. This relay can be connected to one of the control inputs of the PRA-MPS3, configured as ‘External fault input’, to transfer switch faults to the PRAESENSA system. This switch does not communicate via OMNEO to the PRAESENSA system controller.

14.6 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	UL 508
Immunity	EN 55024 EN 61000-4-2 EN 61000-4-3 EN 61000-4-4 EN 61000-4-5 EN 61000-4-6 EN 61000-4-8
Emissions	EN 55032 class A EN 61000-6-4 FCC-47 part 15B class A
Environment	EN 50581
Shock	IEC 60068-2-27
Freefall	IEC 60068-2-32
Vibration	IEC 60068-2-6
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
USA/Canada	FCC/c-UL
Korea	KE

14.7 Technical data

Electrical

Power transfer	
Power supply input PWR1-2 Input voltage Input voltage tolerance	 24 to 48 VDC 16.8 to 62.4 VDC

Power transfer	
Power consumption (48 V) Active mode, no PoE Active mode, with PoE	 12 W < 140 W
Power over Ethernet Standard Output power, all ports together Output power, per port (1-8)	 IEEE 802.3 af/at < 120 W < 30 W

Supervision	
Redundant power failure	P-Fail relay / Alarm LED
Port link down	P-Fail relay / Alarm LED
Fiber link down	P-Fail relay / Alarm LED
Device status reporting	SNMP, SMTP

Network interface	
Ethernet Speed Ports 1-8 Ports 9-10	 100BASE-TX 1000BASE-T RJ45 RJ45/SFP combo
Console Standard Port	 RS232 RJ45

Reliability	
MTBF	> 800.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -40 to +75 °C (-40 to 167 °F) -40 to +85 °C (-40 to 185 °F)
Humidity (non condensing)	5 to 95 %

Functional

Switching	
MAC-address table size	8k

Switching	
VLAN Group Arrange	IEEE 802.1Q 256 (VLAN ID1-4094) Port based, Q-in-Q, GVRP
Multicast	IGMP snooping v1/v2/v3, MLD snooping, IGMP immediate leave
Energy Efficient Ethernet	IEEE 802.3az EEE
Redundancy	IEEE 802.1D-STP IEEE 802.1s-MSTP IEEE 802.1w-RSTP

QoS	
Priority queue scheduling	SP, WRR
Class of service (CoS)	IEEE 802.1p, DiffServ (DSCP)
Rate limiting	Ingress, Egress
Link aggregation	IEEE 802.3ad Static, Dynamic (LACP)

Security	
Port security	Static, Dynamic
Authentication	IEEE 802.1X, port based
Storm control	Broadcast, Unknown multicast, Unknown unicast

Management	
DHCP	Client, Server
Access	SNMP v1/v2c/v3, RMON, Telnet, SSH, HTTP(S), CLI
Software upgrade	TFTP, HTTP (dual image)
NTP	SNTP client

Mechanical

Enclosure	
Dimensions (WxHxD)	74 x 152 x 105 mm (2.9 x 6.0 x 4.1 in)
Ingress protection	IP30

Enclosure	
Mounting	TS35 DIN Rail (EN 60715), Wall-mounting
Case	Aluminum
Weight	1.3 kg (2.7 lb)

15 Fiber transceiver (SFPLX, SFPSX)



15.1 Introduction

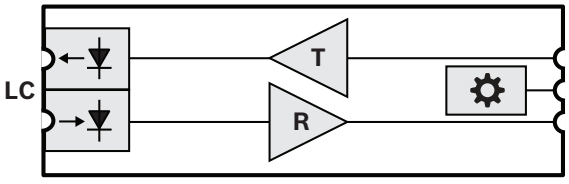
The PRA-SFPSX and PRA-SFPLX are compact SFP fiber transceivers. The PRA-SFPSX is for use with multi-mode fibers, covering distances up to 550 m. The PRA-SFPLX is for use with single mode fibers, covering distances up to 10 km. These are OEM transceivers, made for Bosch by Advantech for use in Bosch Public Address and Voice Alarm systems. An SFP transceiver locks into the SFP socket of the PRAESENSA multifunction power supply and Ethernet switch. It is compliant with IEEE 802.3z Gigabit Ethernet standards for maximum performance, reliability and flexibility. Both transceivers are certified for EN 54-16 in combination with PRAESENSA systems.

15.2 Functions

- Features a duplex LC connector; one connection for transmit and the other for receive.
- Fits and locks into the SFP socket of the PRA-MPSx and PRA-ES8P2S.
- SFP is the popular industry format jointly developed and supported by many network component vendors, providing a connection to different types of optical fiber.
- The PRA-SFPSX supports multi-mode fiber for distances up to 550 m.
- The PRA-SFPLX supports single-mode fiber for distances up to 10 km.
- Wide temperature range for maximum reliability.
- Certified for EN 54-16 in combination with PRAESENSA systems.

15.3 Functional diagram

Functional and connection diagram



Internal device functions

LC Dual lockable transmitter and receiver connector

T Transmitter

R Receiver

Controller

15.4 Installation

The fiber transceiver fits and locks into the SFP socket of the PRA-MPSx and PRA-ES8P2S. The transceiver receives power from the host device.

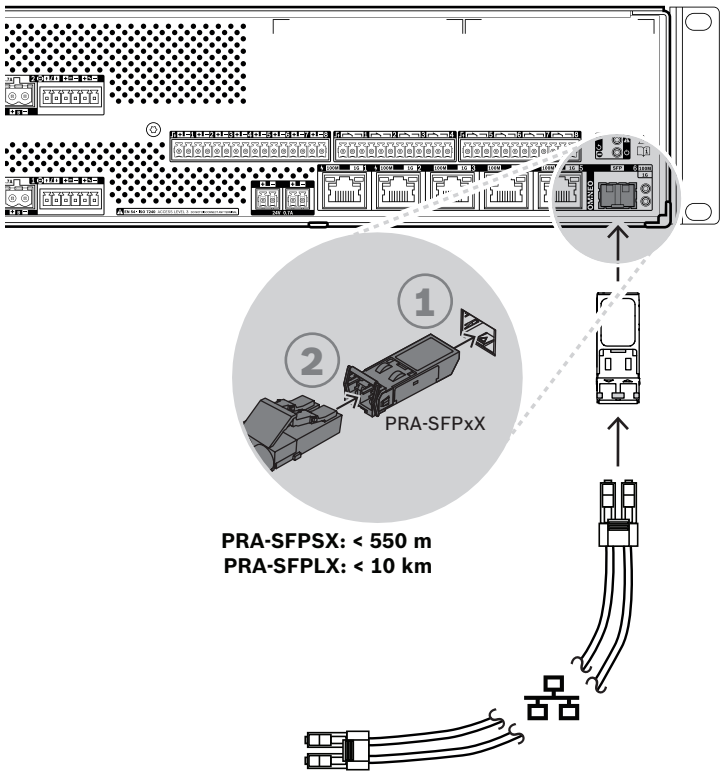


Figure 15.1: PRA-MPSx installation

Caution!
Risk of eye injury. When inspecting a connector, ensure that light sources are off. The light source in fiber optic cables may cause eye injury. SX and LX fiber connections use invisible IR light.

15.4.1 Parts included

The box contains the following parts:

Quantity	Component
1	SFP fiber transceiver

No tools or Ethernet cables are provided with the device.

15.4.2 Application

Fiber transceivers are especially beneficial in environments where high levels of electromagnetic interference (EMI) is a common phenomenon, like industrial plants. This interference can cause data corruption over copper-based Ethernet links. However, data transmitted over fiber optic cable is completely immune to this type of noise, ensuring optimal data transmission across the plant floor.
For short distance transmissions multi-mode fibers can be used using light with a wavelength of 850 nm, while single-mode fibers typically support distances up to 10 km, using light with a wavelength of 1310 nm. Some third party dedicated SFP fiber transceivers can even cover

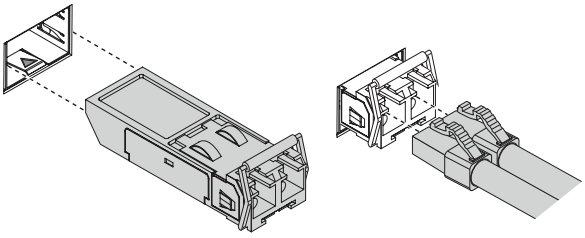
distances up to 40 km, using light with a wavelength of 1550 nm for lowest attenuation of light. However, for EN54-16 compliant PRAESENSA systems only the PRA-SFPLX and PRA-SFPSX are certified for use.
Make sure to use the correct combination of fiber and connector for both sides of the cable, matching the fiber transceivers. A connection between a multi-mode fiber transceiver on one end and a single-mode fiber transceiver on the other end will not work, because the wavelength of the light that is produced by the transmitter does not match the wavelength of the light the receiver is sensitive to.
Fiber optic cables are exceptionally vulnerable. Dust, dirt or tampering might cause physical damage. To avoid physical damage, avoid extreme bends in fiber optic cables when storing them and put dust-caps on the cable ends after disconnection. Also, see subsection *Cable type recommendations, page 24* for safety precautions when working with fiber optic cables.

Notice!
The SFP transceiver is not standardized by any official standards body, but rather is specified by a multi-source agreement (MSA) among competing manufacturers. Some networking equipment manufacturers engage in vendor lock-in practices whereby they deliberately break compatibility with generic SFPs by adding a check in the device's firmware that will enable only the vendor's own modules. As a result, this means that the PRA-SFPLX and PRA-SFPSX may not work in some brands of Ethernet switches.

15.4.3 Transceiver

To install an SFP transceiver, follow the procedure below:

1. An SFP transceiver can be damaged by static electricity. Be sure to observe all standard electrostatic discharge (ESD) precautions, such as wearing an antistatic wrist strap, to avoid damaging the transceiver.
2. Remove the transceiver from its packaging.
3. Position the SFP transceiver with the label facing up. The transceiver can be hot-swapped; there is no need to power-off the host device to install a transceiver.
4. With the handle on the transceiver oriented towards the host device, slide the transceiver into the SFP socket and push until it clicks into place.
5. Verify that the handle on the transceiver is in the position that secures the transceiver and prevents it from being dislodged from the socket.



15.4.4 Fiber cable

To insert a fiber cable with LC connector, follow the procedure below:

1. Verify that the type of cable is appropriate for the SFP transceiver that is installed.
2. The SFP transceiver has two connectors. Each connector connects to a separate fiber strand. One is for receiving data and the other is for transmitting data. When connecting a fiber optic cable to the SFP module, be sure that the receive fiber connector is connected to the transmitter connector on the remote end-node device, and the transmit fiber connector is connected to the receiver connector on the remote node.
3. Remove the dust plugs from the LC fiber cable and save the dust plugs for future use. Then inspect and clean the cable end-face.

4. Remove the dust plugs from the SFP transceiver optical bores. Immediately attach the LC fiber cable to the SFP transceiver.

15.5 Approvals

Emergency standard certifications	
Europe	EN 54-16
International	ISO 7240-16

Regulatory areas	
Safety	Laser Class I IEC 60825-1
Environment	EN 50581
Maritime applications	DNV-GL Type Approval

Conformity declarations	
Europe	CE/CPR
USA/Canada	FCC/c-UL

15.6 Technical data

PRA-SFPSX

Electrical

Interface	
Supply voltage	3.3 V
Power consumption	0.5 W
Speed	IEEE 802.3z 1000BASE-SX
Transmitter power	-4 to -9.5 dBm
Receiver sensitivity	< -18 dBm
Connection	Hot swappable, Locking

Optical

Interface	
Connector type	Dual LC
Wave length	850 nm
Fiber length 50 µm core 62.5 µm core	 < 550 m (1.804 ft) < 220 m (722 ft)
Optical fiber	Multi-mode
Core size	50 µm / 62.5 µm

PRA-SFPLX

Electrical

Interface	
Supply voltage	3.3 V
Power consumption	0.7 W
Speed	IEEE 802.3z 1000BASE-LX
Transmitter power	-3 to -9.5 dBm
Receiver sensitivity	< -20 dBm
Connection	Hot swappable, Locking

Optical

Interface	
Connector type	Dual LC
Wave length	1310 nm
Fiber length	< 10 km (32,821 ft)
Optical fiber	Single-mode
Core size	ITU-T G.652 SMF

PRA-SFPSX and PRA-SFPLX

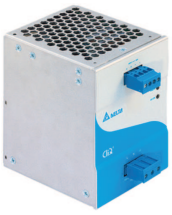
Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -40 to +85 °C (-40 to 185 °F) -40 to +85 °C (-40 to 185 °F)
Humidity (non condensing)	5 to 95 %

Mechanical

Enclosure	
Dimensions (WxHxD)	8.5 x 13.4 x 56.5 mm (0.33 x 0.53 x 2.2 in)
Weight	75 g (0.17 lbs)

16 Power supply module (PSM24, PSM48)



16.1 Introduction

The PRA-PSM24 and PRA-PSM48 are compact DIN-rail mounted power supplies. The PRA-PSM24 delivers 24 V at up to 10 A continuously, while the PRA-PSM48 delivers 48 V at up to 5 A continuously. These power supplies are OEM power supplies, made for Bosch by Delta Power Supply, as a cost effective alternative to the PRAESENSA multifunction power supply PRA-MPS3 in case the additional functions and characteristics of the multifunction power supply are not needed. Also, the PRA-PSM24 and PRA-PSM48 are not certified for EN 54-4 and similar standards.

The PRA-PSM24 can be used to power a PRAESENSA system controller or other devices and utilities that need 24 V.

Because of its ability to deliver high peak currents, the PRA-PSM48 can supply sufficient power to a single fully loaded PRAESENSA 600 W power amplifier. The PRA-PSM48 can also power a PRA-ES8P2S Ethernet switch with all its PoE outputs loaded.

16.2 Functions

Mains power supply

- Universal mains input with power factor correction to maximize the amount of power that can be taken from a single phase power distribution network.
- The mains is supplied via a 3-pole screw plug that requires the module to be installed by professional installers and mounted in a safe place, without user access.

PRA-PSM24

- Compact DIN-rail mounted power supply, delivering 24 V at up to 10 A continuously, for powering various utilities and devices in Public Address systems.
- Adjustable output voltage, 24 to 28 V.
- For fail safe redundancy it is possible to use two 24 V power supplies for one PRAESENSA system controller, one connected to its 24 V input A and the other to input B. In that case, the power supply with the highest voltage will supply the power, the other one is available as backup.

PRA-PSM48

- Compact DIN-rail mounted power supply, delivering 48 V at up to 5 A continuously, for powering one fully loaded PRAESENSA 600 W amplifier. Because the long term effective power consumption of the amplifier is much lower than the short term burst power consumption, related to the crest factor of speech and music, this power supply is sufficiently powerful.
- Adjustable output voltage, 48 to 56 V, of which the range 48 to 50 V can be used because the PRAESENSA power amplifiers are tolerant up to 50 V.
- For fail safe redundancy it is possible to use two 48 V power supplies for one amplifier, one connected to its 48 V input A and the other to input B. In that case the amplifier load will be shared by both power supplies, even if the supply voltages are adjusted to be slightly different.

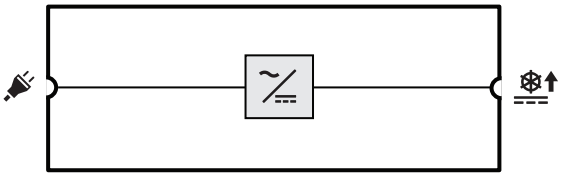
Protections

- Overvoltage protection with automatic recovery.
- Overload protection with automatic recovery.
- Over-temperature protection with automatic recovery.

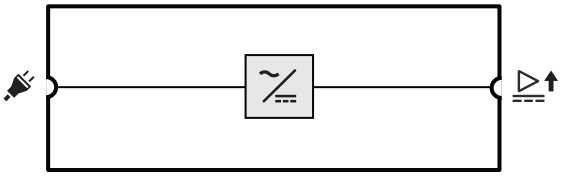
16.3 Functional diagram

Functional and connection diagram

PRA-PSM24



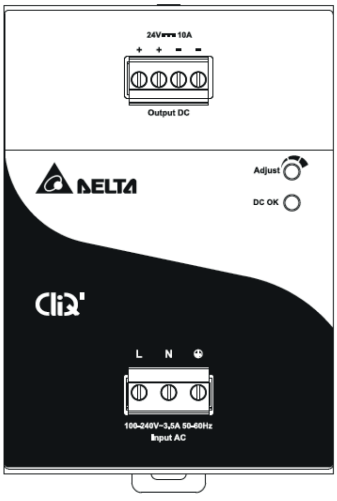
PRA-PSM48



Internal device functions

Mains to DC converter

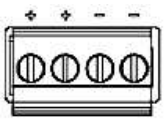
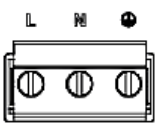
16.4 Indicators and connections



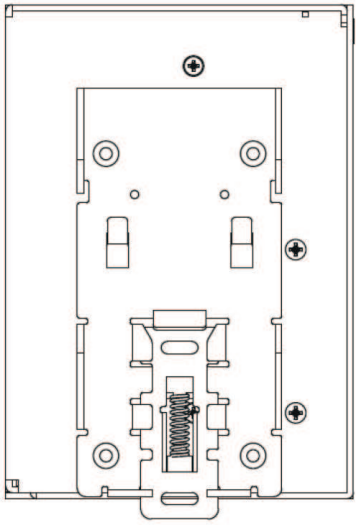
Front panel indicator and control

DC OK	Output voltage present	Green	Adjust	Output voltage adjustment	Rotary control

Front panel connections

	24 VDC or 48 VDC output			Mains input	

Rear view



16.5 Installation

Caution!

These power supplies must be installed and used in a controlled environment.
The PRA-PSM24 and PRA-PSM48 are built-in units and must be installed in a cabinet or room (condensation-free and indoor) that is relatively free of conductive contaminants. The mains power connection of these devices is not touch-protected.

16.5.1 Parts included

The box contains the following parts:

PRA-PSM24

Quantity	Component
1	Power supply module 24 V
1	Set of screw connectors
1	Manufacturer's datasheet

PRA-PSM48

Quantity	Component
1	Power supply module 48 V
1	Set of screw connectors
1	Manufacturer's datasheet

No tools or cables are provided with the devices.

16.5.2 Mounting

The power supply unit can be mounted on a 35 mm DIN-rail in accordance with EN 60715. The device must be installed vertically with the mains power input terminal block down.

Safety precautions:

1. Switch main power off before connecting or disconnecting the device.
2. To guarantee sufficient convection cooling and prevent that the unit goes into thermal protection, it is important to keep a distance of at least 100 mm above the device, 200 mm below the device, as well as a lateral distance of 20 mm to other units.
3. Note that the enclosure of the device can become very hot depending on the ambient temperature and load of the power supply. Risk of burns!
4. Only plug in and unplug connectors when power is turned off.
5. Do not introduce any objects into the unit.
6. Dangerous voltage present for at least 5 minutes after disconnecting all sources of power.

To snap the device on a DIN-rail, follow the procedure below:

1. Tilt the device slightly upwards and put it onto the DIN-rail.
2. Push the device downwards until stopped.
3. Press against the bottom of the front side to lock the device on the rail.
4. Shake the unit slightly to ensure that it is secured.

For dismounting the device:

1. Pull or slide down the latch at the rear side bottom with a screwdriver.
2. Tilt the device upwards.
3. Release the latch, and pull the device from the rail.

16.5.3 Mains connection

The terminal block connector allows for easy and fast wiring.

For connecting the mains power to the power supply, follow the procedure below:

1. Use standard flexible (stranded wire) or solid cables with a cross section of 0.75 to 2.5 mm² (AWG 18 to 14), designed to sustain an operating temperature of 75°C (167°F).
2. For secure and reliable connections, the stripping length should be 7 mm.
3. For safety, ensure that all wires are fully inserted into the connecting terminals. In accordance to EN 60950 / UL 60950, flexible cables require ferrules.
4. Fix the L (Live), N (Neutral) and PE (Protective Earth) connection wires to the input terminal connector to establish the 100 to 240 VAC connection, using a torque of 0.5 Nm.
5. Plug the connector into the power supply.

The unit is protected with an internal fuse (not replaceable) at the L input and the power supply has been tested and approved on 20 A (UL) and 16 A (IEC) branch circuits without an additional protection device. An external protection device is only required if the supplying branch has a current capability greater than this. Thus, if an external protective device is necessary or utilized, a circuit breaker must be used with a minimum value of 4 A (B-characteristic) or 2 A (C-characteristic).



Caution!
The internal fuse must not be replaced by the user. In case of an internal defect, return the unit for inspection.

16.5.4 Output connection

Use the positive (+) and negative (-) screw connections to establish the 24 V (PRA-PSM24) or 48 V (PRA-PSM48) connection. The output voltage can be adjusted upwards to 28 V or 56 V with the front side potentiometer, but for use with PRAESENSA keep the power supply at 24 V or 48 V. The green LED DC OK displays the correct functioning of the output. The device has a short circuit and overload protection and an overvoltage protection.

For connecting the output to a PRAESENSA device, proceed as follows:

1. Use a PRA-PSM24 to power a PRA-SCx system controller or auxiliary device designed for 24 V operation.
2. Use a PRA-PSM48 to power a PRA-AD60x multi-channel amplifier or PRA-ES8P2S Ethernet switch, designed for 48 V operation.
3. Use standard flexible (stranded wire) or solid cables with a cross section of 1.5 to 2.5 mm² (AWG 16 to 14), designed to sustain an operating temperature of 75°C (167°F).
4. For secure and reliable connections, the stripping length should be 7 mm.
5. For safety, ensure that all wires are fully inserted into the connecting terminals. In accordance to EN 60950 / UL 60950, flexible cables require ferrules.
6. Use a torque of 0.5 Nm on the screws to secure the wire connections.
7. For cable redundancy use two cables in parallel (2x2 wires) between the dual output connections of the power supply and the A and B inputs of the loads to be connected.

In the event of a short circuit or overload, the output voltage and current collapses when the overload current exceeds 150% of the maximum output current. The output voltage is then reduced and the power supply enters the hick-up mode until the short circuit or overload has been removed.

16.5.5 Thermal behavior

In the case the ambient temperature exceeds +50°C (for vertical mounting), the load power is to be reduced by 2.5% per degree Celsius increase in temperature. If the load is not reduced, the device will run into thermal protection by switching off; the device will go in hick-up mode and will recover when the ambient temperature is lowered or the load is reduced as far as necessary to keep the device within normal working conditions.

16.6 Approvals

Regulatory areas	
Safety	EN/IEC/CSA/UL 60950-1
Immunity	EN 55024 EN 61000-6-1 EN 61000-6-2
Emissions	EN 55032 EN 55011 CISPR 32 CISPR 11 FCC-47 part 15B class B EN/IEC 61000-3-2, Class A
Environment	EN 50581
Railway applications	EN 50121-4 (PRA-PSM48 only)
Maritime applications	DNV-GL Type Approval (PRA-PSM48 only)

Conformity declarations	
Europe	CE
USA/Canada	FCC/c-UL/CSA
China	CCC
Korea	KE
Australia	RCM
Taiwan	BSMI
Russian Federation	EAC
India	BIS

16.7 Technical data

Electrical

PRA-PSM24

Power transfer	
Mains power supply input	
Input voltage range	100 to 240 VAC
Input voltage tolerance	85 to 264 VAC
Frequency range	50 to 60 Hz

Power transfer	
Inrush current	< 35 A (115 V, 230 V)
Power factor (PF)	0.9 to 1.0
Leakage current to safety ground	< 1 mA (240 V)
24 VDC output	
Nominal DC output voltage	24 V
Output voltage range	24 to 28 V
Maximum continuous current	10 A
Derating	-0.25 A/°C above 50°C
Maximum peak current	15 A
Power consumption	
Active mode, rated power	265 W
Heat loss	
Active mode, rated power	90 kJ/h (85 Btu/h)

PRA-PSM48

Power transfer	
Mains power supply input	
Input voltage range	100 to 240 VAC
Input voltage tolerance	85 to 264 VAC
Frequency range	50 to 60 Hz
Inrush current	< 35 A (115 V, 230 V)
Power factor (PF)	0.9 to 1.0
Leakage current to safety ground	< 1 mA (240 V)
48 VDC output	
Nominal DC output voltage	48 V
Output voltage range	48 to 56 V
Maximum continuous current	5 A
Derating	-0.125 A/°C above 50°C
Maximum peak current	7.5 A
Heat loss	
Active mode, rated power	90 kJ/h (85 Btu/h)

PRA-PSM24 and PRA-PSM48

Protection	
Overvoltage	Automatic recovery
Overload	Automatic recovery
Over-temperature	Automatic recovery

Reliability	
MTBF	> 500.000 h

Environmental

Climatic conditions	
Temperature Operating Storage and transport	 -25 to +80 °C (-13 to 176 °F) -40 to +85 °C (-40 to 185 °F)
Humidity (non condensing)	5 to 95 %
Air pressure	750 to 1070 hPa
Altitude (operating)	0 to 2500 m (0 to 8200 ft)
Vibration (operating) Amplitude Acceleration	 < 0.35 mm < 3 G
Bump (transport)	< 10 G

Airflow	
Cooling	Convection

Mechanical

Enclosure	
Dimensions (WxHxD)	85 x 121 x 124 mm (3.35 x 4.76 x 4.86 in)
Ingress protection	IP20
Mounting rail	TS35 DIN Rail (EN 60715)
Case	Aluminum

PRA-PSM24

Weight	1.10 kg (2.43 lb)

PRA-PSM48

Weight	0.96 kg (2.12 lb)

17 Application notes

Sometimes applications using PRAESENSA have very specific requirements or face special installation challenges. This chapter shows possible solutions to some of them.

17.1 Connecting 100 Mbps-devices

Some Dante devices only have a 100BASE-TX connection, but also many control devices, like a Fire Alarm system, only support a 100BASE-TX connection. This is also the case for the Bosch Smart Safety Link. Devices that have a low speed 100BASE-TX network interface are only allowed at the endpoints of a PRAESENSA network and may not be looped through. But even if such a device is connected as an endpoint, the maximum number of audio channels on the network must be taken into consideration. PRAESENSA uses multicast traffic which is actually broadcast within the subnet to all switch ports. Because every OMNEO channel requires 2.44 Mbps, the number of (multicast) OMNEO audio channels must be **kept below 20**, to not exceed the available network bandwidth.
When **more than 20** simultaneous multicast audio channels are needed on the network, it must be avoided that all this traffic is forwarded to the 100 Mbps link. This is possible by using a switch with IGMP-snooping. The low speed 100 Mbps-devices must then be connected to a port on the switch that runs IGMP-snooping on that port. OMNEO devices may be connected to other ports of that switch, but for these ports IGMP-snooping must be disabled and these ports should **not filter** multicast traffic.



Notice!
It is very important that OMNEO or Dante devices are not connected behind a port that uses IGMP-snooping. See *Network switches, page 29*.



Notice!
Dante devices that are based on the Audinate's Ultimo chip (e.g. Dante AVIO audio network adapters, Atterotech unDIO2X2+) are limited to a 100BASE-TX connection. When such a device is used, the maximum number of simultaneous OMNEO audio channels in PRAESENSA is 20.

17.2 Long range interconnections

Copper CAT-wiring for Ethernet is limited to a distance of 100 m between nodes. Longer distances can be covered by using Gigabit fiber interconnections with SFP transceivers. Some PRAESENSA devices have one or more SFP sockets for this purpose. But call stations need Power over Ethernet (PoE), which cannot be transported on fiber connections. For distances above 100 m there are several possibilities:

– It is possible to use special Ethernet cables that deliver 1 Gbps and PoE+ over 200 m and pull and terminate like a CAT6 cable.
  See Gamechanger cables (http://www.paigedatacom.com/).
– Use one or more Gigabit PoE Ethernet extenders/repeaters. Typically, up to four or five can be daisy chained, each one adding a new stretch of 100 m, up to around 600 m in total. The repeaters themselves are powered from the incoming PoE source and also forward PoE to the connected call station. Multiple repeaters may need a PoE+ power source in order to still have adequate PoE power left for the call station. These extenders do not need mains power.

– Some extenders provide a PoE point-to-point solution of up to 800 m with no mid-cable equipment and no far-end power source, but only for 100BASE-T Ethernet. As an exception to the rule that 1000BASE-T is needed, this may be used for edge devices only, such as a single call station without loop-through connection to other PRAESENSA devices. The maximum number of (multicast) OMNEO audio channels must be kept below 20 in order not to exceed the available network bandwidth. See section *Connecting 100 Mbps-devices, page 179* for more information.
  See Longspan (http://www.veracityglobal.com/).

There are also Ethernet bridges on the market that can cover even longer distances and use CAT, coax or telephone wiring. Although they may have Gigabit Ethernet connections on the end-devices, they do not use 1000BASE-T Ethernet on the long distance interconnections but other (slower) communication links like VDSL. Do **not** use these kind of range extenders for PRAESENSA because they have too much packet arrival jitter and do not support PTP for synchronization of audio devices! For the same reason Wi-Fi or other wireless interfaces cannot be used.

17.3 Compatibility with other network data

Devices that use OMNEO/Dante/AES67 should never be used with active CobraNet devices on the same network to avoid disturbance of clocking data. If this is not possible, then use an additional VLAN to keep CobraNet devices separated.
Make sure jumbo frames are not present on the network, because jumbo frames will increase the packet jitter to an unacceptable level. One packet in a jumbo frame can contain up to 9000 bytes which blocks the network too long for other traffic.

17.4 Static IP-binding

Many applications and devices support making connections via hostnames, so they don't need a fixed or static IP-address to establish a connection. Using hostnames is easier to configure and maintain because it avoids IP-address conflicts and makes hardware replacements more easy. However some applications do not (yet) support hostnames, they need an IP-address to setup a connection.



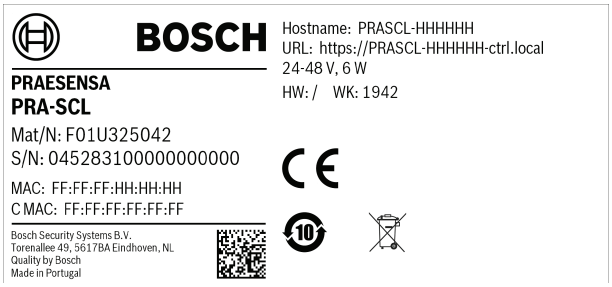
Notice!
The Bosch modular fire panel FPA-5000 is able to control the PRAESENSA system via the Open Interface of the PRAESENSA system controller. This connection is called the Smart Safety Link and it creates an interface between the fire detection system and the voice alarm system. However, the FPA-5000 only supports a static IP-address to establish a connection and the PRAESENSA system controller does not support the configuration of a static IP-address. Solving this problem requires a function called static IP-binding.

Configuring a static IP-address in the system controller is not supported. It is not possible to use the Link Local address of the system controller or an address assigned by a DHCP-server because this address may change after a power cycle or reset. Even when the Ethernet switch with the DHCP-server is able to create a pool of only one IP-address that would always be given to the device connected to a certain port of the switch, this solution would be useless, because the PRAESENSA system controller has two MAC-addresses.
The solution is to use a switch, such as the PRA-ES8P2S, that has a DHCP-server that supports static IP-binding to a MAC-address.

The PRAESENSA system controller has two MAC-addresses:

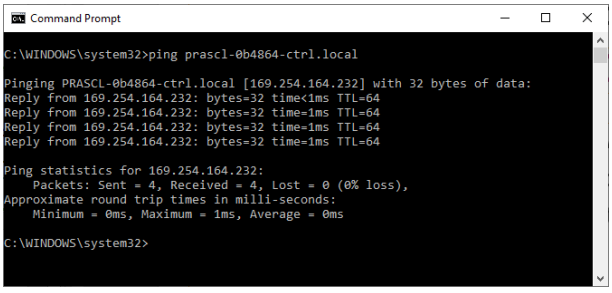
– The device MAC-address. This is the MAC-address, where the device hostname is derived from, using the format ‘PRASCL-xxxxxx’, with xxxxxx being the last six hexadecimal digits of the device MAC-address.
– The control C MAC-address. This is the physical address that is linked to the control hostname, although the control hostname itself is just the device hostname with an extension ‘-ctrl.local’. This ‘PRASCL-xxxxxx-ctrl.local’ is the URL of the webserver in the system controller. The same control hostname is also used for the Open Interface.

Both the MAC and the C MAC addresses are shown on the product label of the system controller. The C MAC-address is the physical address that is needed for IP-binding.

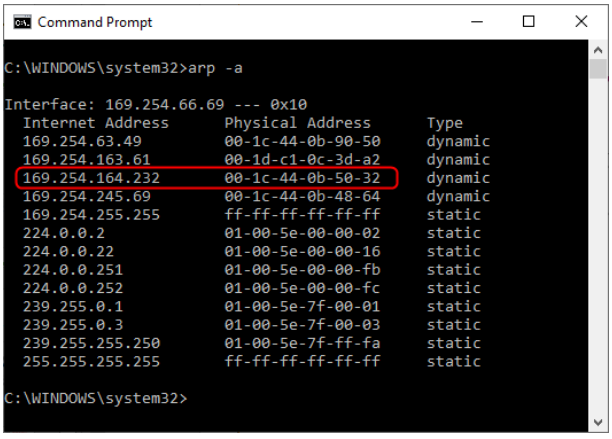


If the product label is inaccessible, then the following steps 1-3 will make the C MAC-address known. If the C MAC-address is already known these steps can be skipped.

1. The device hostname can be learned from the system configuration, in the System composition web page, or from the Firmware upload tool. The control hostname is the device hostname extended with ‘-ctrl.local’.
2. Then ‘ping’ to the control hostname of the system controller from the Windows Command Prompt with a PC that is on the same network as the system controller and has an IP-address in the same range, and supporting DNS-SD.
   – For example, the system controller with control hostname PRASCL-0b4864-ctrl.local appears to have an IP-address 169.254.164.232. Hostnames are case-insensitive.



3. The control C MAC-address that belongs to this IP-address will be added into the ARP (Address Resolution Protocol) table of the PC. Enter the command ‘arp -a’ to look into this table. Look for the IP-address that was found by pinging the control hostname, 169.254.164.232, and check its Physical Address: 00-1c-44-0b-50-32. This is the C MAC-address of this system controller.

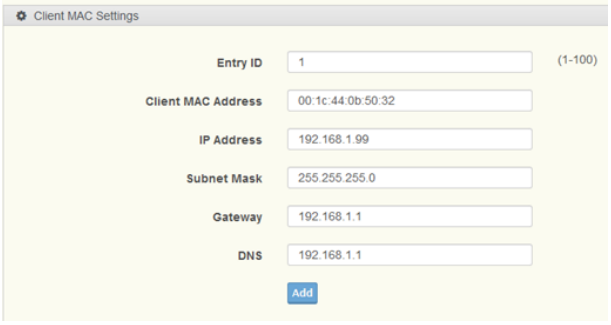


4. Now login to the configuration web page of the Ethernet switch, in this case the PRA-ES8P2S, an OEM variant of the Advantech EKI-7710G. Make sure that it contains firmware that supports client MAC settings, like the firmware file EKI-7710G-2CP-AE-1-01-04.hex. Then enable the DHCP-server in the switch and define the global DHCP-server settings.

Global Information

Information Name	Information Value
Lease time	864000 sec
Low IP Address	192.168.1.100
High IP Address	192.168.1.199
Subnet Mask	255.255.255.0
Gateway	192.168.1.1
DNS	192.168.1.1

5. The next step is to go to the Client MAC Settings in the DHCP section and add the Client MAC-Address. In this example 00:1c:44:0b:50:32 (replacing the dashes for semicolons). Then enter a static IP-address for the PRAESENSA system controller outside the configured DHCP-address range, which is the range between the Low IP Address and the High IP Address of the switch. In this case the IP-address 192.168.1.99 is chosen, just below the DHCP-address range.



6. After a successful entry this will show up as follows:



7. Save the new configuration and reboot the switch and all PRAESENSA equipment. Now the system controller will have a static IP-address for the configuration webpages and the Open Interface: 192.168.1.99. All other PRAESENSA devices will get an IP-address in the

defined DHCP address range. The static IP-address of the system controller will not show up in the Lease Entry table anymore. For confirmation, pinging to the control hostname of the system controller will now show its new static IP-address.

18 Troubleshooting

There are many possible causes for anomalous system behavior. In this section some are presented with maintenance actions focused on finding and solving the cause. In large systems it can be difficult to find the root cause of a problem. In that case it is often helpful to create a minimum size system with only the troubled device and the necessary devices to make it work, using short and proven cables. If the problem is absent, extend the system in steps until the problem shows up again.



Notice!
Experience and analysis of repair shop data has revealed that in most cases system malfunction is not caused by defective devices, but by wiring errors, configuration errors and application errors. Read the product documentation carefully, especially the installation manual, the configuration manual and the release notes. If possible, use the latest software version (available as free download).

- **No system response**
  - **Cause**: RSTP is switched off in the System settings, but there are loops in the network. This may result in a data broadcast storm that takes the entire network down.
  - **Action**: Recovery is only possible by disconnecting redundant loops and power cycle the whole system. It is not possible to leave the loops in the network and enable RSTP, because the system controller cannot be accessed to change the configuration.
- **Some or all devices are disconnected from the system controller**
  - **Cause**: Wrong Pre-Shared Key (PSK) is loaded into one or more of the devices.
  - **Action**: Login to the system controller and verify connected devices. Modify the PSK user name and key to correct the configured PSK. In case the PSK is not available anymore, the concerning devices need to be reset to factory default via the local reset key on the device.
  - **Cause**: Not all devices have the same firmware version uploaded.
  - **Action**: Check via the Firmware Upload Tool whether all devices have the same firmware and upload the correct version.
  - **Cause**: The number of looped through devices (hop count) is more than 21, start counting from the spanning tree root bridge.
  - **Action**: Reduce the number of looped through devices by changing the network topology. Make sure that no 3rd party Ethernet switch is used with default settings, because it will have a higher priority than the PRAESENSA devices or switches and thus take the role of spanning tree root bridge.
  - **Cause**: Failing or unreliable network connections.
  - **Action**: Make sure that the maximum length of an Ethernet link is not exceeded (100 m for copper connections), that no sharp bends are made in the cabling, that the maximum length of fiber connections is not exceeded, that SX and LX fiber converters are not mixed up, that the correct type of fiber is used for the mounted converters.
- **Devices not visible in Firmware Upload Tool**
  - **Cause**: No security user present (PSK user name and key).
  - **Action**: Use secure connection via File menu and add the security user (PSK user name and key). In case the PSK is not available anymore, the concerning devices need to be reset to factory default via the local reset key on the device.

- **Music control not available on a call station**
  - **Cause**: The Music function is not enabled in Device Options of that call station.
  - **Action**: Enable the Music function for that call station. If the music source is connected to that call station, then also configure a BGM channel for the Audio input of that call station in Zone definition > BGM routing.
- **One or more amplifiers are not powered on**
  - **Cause**: The amplifier does not receive power from the multifunction power supply or power supply module.
  - **Action**: Make sure the power supply is powered, that the power supply wiring is connected correctly and that power supply outputs are enabled in the configuration.
- **The system controller is not powered on**
  - **Cause**: The system controller does not receive power from the multifunction power supply or power supply module.
  - **Action**: Make sure the power supply is powered, that the power supply wiring is connected correctly and that power supply outputs are enabled in the configuration.
- **One or more call stations are not powered on**
  - **Cause**: The call station does not receive PoE-power from the multifunction power supply or switch.
  - **Action**: Make sure the power supply or switch is powered and that at least one of the call station Ethernet cables is connected to a port that provides PoE. The second port of the call station will not provide PoE power to a subsequent call station.
- **The yellow fault indicator on one of the devices lights up**
  - **Cause**: There can be many reasons.
  - **Action**: A good way to start is to check the system fault log or the fault menu on the call station for a more detailed fault description.

19 Maintenance and service

The PRAESENSA system requires minimum maintenance. To keep the system in good condition, see the following sections.

19.1 Preventive maintenance

Cleaning

Wipe clean only with a dry or damp cloth.



Notice!

Do not use alcohol, ammonia or petroleum solvents or abrasive cleaners to clean the devices.

Depending on the pollution degree in the operating environment, check at regular intervals that the air inlets for ventilation on the front side of the rack mount devices are not obstructed by dust. Use a dry cloth or a vacuum cleaner to remove dust.

Operate devices within specifications

When designing the PRAESENSA system, Bosch largely avoided using wear parts. The parts subject to wear and tear are dimensioned to last longer than the lifetime of the products when they are operated normally. Operate the devices within their specifications.

Relays and fans are electromechanical components and are subject to natural wear. The relays in the amplifiers are used for spare channel switching and loudspeaker group A and B switching in case of failures. During normal operation the relays are hardly ever switched and the relays have a very long lifetime. The fans in the amplifiers and multifunction power supplies are temperature controlled and run on low speed most of the time, minimizing wear.

Battery replacement

The system controller has an internal lithium coin cell battery, model CR2032 (3 V, 225 mAh), in a battery holder. It is only used to power the internal real time clock (RTC) when the system controller is off. The life-time of the battery is in that case more than 20 years. When the system controller is on, the RTC is powered from the external power supply and the CR2032 battery is not used, making the system insusceptible to spring contact bounce of the battery holder in case of heavy vibrations.

See also *Internal battery, page 63*.

Software updates

Bosch continually works on improving and developing the software. Regularly check whether there is a new version of the software that provides additional benefits. Information and software downloads are available on the Bosch PRAESENSA product pages on the internet (www.boschsecurity.com).

Regular maintenance

Regularly (e.g. twice per year, or following local legislation) check the correct operation of the complete system, especially when the system is used as voice alarm system only without regular announcements or background music in the zones.

- Check for changes in room occupation, requiring different sound settings or loudspeaker positioning.
- Check for changes of the environmental conditions and update the system if needed.
- Use the Diagnose section of the configuration webpages to:

- Check the amplifier load conditions for any changes compared to the previous measurement. A new load measurement will result in audible test tones in the zones under test. Preferably do the measurement when the zones are not occupied or announce upcoming tests to the occupants.
- Check the battery impedance of all connected batteries for any change compared to the previous measurement. This allows for timely detection of battery aging.

19.2 Corrective maintenance

In case of fault reports, a qualified technician should perform:
- Fault analysis;
- Elimination of the part that causes the failure;
- Replacement of the part;
- Test of the associated functions.

19.3 Device replacement

In case one of the PRAESENSA devices in a system needs to be replaced, it is important to follow a strict sequence of actions to minimize down-time of the system or part of the system. The required actions differ per type of product.

19.3.1 System controller

To replace a defective system controller PRA-SCx in a running system proceed as follows:

Prepare the new system controller

1. Unpack the new system controller.
2. Supply power to the new system controller using any available 24 VDC power supply (e.g. a PRA-PSM24 or a PRA-MPSx with an unused 24 V output).
3. Connect a (laptop) PC to the new system controller.
4. Start the PRAESENSA Firmware Upgrade Tool (FWUT) and upgrade the new system controller to the required firmware version; this is the same version as the system is running in which this system controller will be used.
   - See the PRAESENSA configuration manual.
5. If the original configuration backup file and the message files are available on the installation PC, including the security keys, upload the system configuration backup file and the individual message files to the new system controller.
   - See the PRAESENSA configuration manual.

Exchange the system controller

1. Disconnect all cables from the original system controller.
2. Remove the original system controller from the rack and put the new system controller in the rack.
3. Connect all cables to the new system controller.
4. Connect the PC to the system, either to a spare port of the system controller or to one of the PRA-MPSx.
5. Depending on the availability of a backup configuration:
   - In case the backup from the old system was uploaded to the new system controller, update the configuration with the correct hostname of the new system controller.
   - In case no backup was available, start a new system configuration as described in the PRAESENSA configuration manual.
6. Restart the application on the new system controller.
7. Perform a system test.
8. Make a backup of the new configuration and store on a safe location.

19.3.2 Amplifier

To replace a defective amplifier PRA-AD60x in a running system proceed as follows:

Prepare the new amplifier

1. Unpack the new amplifier (same model as the one to be replaced).
2. Supply power to the new amplifier using any available 48 VDC supply (e.g. a PRA-PSM48 or a PRA-MPSx with an unused 48 V output).
3. Connect a (laptop) PC to the new amplifier.
4. Start the PRAESENSA Firmware Upgrade Tool (FWUT) and upgrade the new amplifier to the required firmware version; this is the same version as the original amplifier was using.
   - See the PRAESENSA configuration manual.

Exchange the amplifier

1. Disconnect all cables from the original amplifier:
   - First disconnect the lifeline connector. There is no audio signal on the lifeline input.
   - Then disconnect the Ethernet cables. The network link is lost, so the disconnected lifeline input is activated.
2. Then disconnect the 48 VDC connectors. There is no audio signal, so the supply current is low, reducing arc flashes.
   - Finally disconnect the audio outputs; make sure the loudspeaker cables are labeled correctly.
3. Remove the original amplifier from the rack and put the new amplifier in the rack.
4. Connect all cables to the new amplifier:
   - First connect the lifeline, Ethernet and loudspeaker cables; make sure the loudspeaker cables are connected to the appropriate channel outputs. The amplifier is in sleep mode.
   - Then connect the 48 VDC connectors. The DC/DC converters are disabled, but the inrush current to charge the input capacitors may still cause a spark.
5. Connect the PC to the system, either to a spare port of the system controller or to one of the PRA-MPSx.
6. Go to the System composition web page and click Rediscover to discover the new amplifier. The amplifier is now discovered but not yet assigned.
7. The location of the original amplifier is still present and shows the hostname of the original amplifier.
8. Select under hostname the new hostname of the new amplifier.
9. Press the Submit button on the System definition page to add the new amplifier to the configuration.
10. Press Save and restart to store and activate the new configuration.
11. Acknowledge and reset the faults in the system. If faults associated to the amplifier can be acknowledged and reset, this means that the connection and configuration is correct.
12. The new amplifier is now operational. There is no need for measuring the connected output loads again in Diagnose > Amplifier loads, because the system controller pushes the values of the original amplifier to the new amplifier.
13. Perform a test by making calls to the zones associated with the new amplifier and check the audio presence.
14. Make a backup of the new configuration and store on a safe location.

19.3.3 Multifunction power supply

To replace a defective multifunction power supply PRA-MPSx in a running system proceed as follows:

Prepare the new multifunction power supply

1. Unpack the new multifunction power supply (same model as the one to be replaced).
2. Supply mains power to the new device.
3. Connect a (laptop) PC to the new multifunction power supply.
4. Start the PRAESENSA Firmware Upgrade Tool (FWUT) and upgrade the device to the required firmware version; this is the same version as the original device was using.
   - See the PRAESENSA configuration manual.

Exchange the multifunction power supply

1. Disconnect all cables from the original device:
   - First disconnect the NTC temperature sensor. This will stop charging the battery.
   - Then disconnect the battery cables, the negative terminal first, followed by the positive terminal. Be careful not to short circuit the battery.
   - Disconnect all control input and control output connectors.
   - Disconnect all Ethernet cables.
   - Then disconnect the mains cable. All connected amplifiers will turn off and a connected system controller too, unless it is redundantly powered from another power supply.
   - Finally disconnect the 48 V cables to the amplifiers and the 24 V cables to other devices (if any).
   - If present, remove the FSP fiber transceiver from the original device for re-use.
2. Remove the original multifunction power supply from the rack and put the new device in the rack.
3. Connect all cables to the new device:
   - First connect the 48 V from the amplifiers and the 24 V cables (if any).
   - Then connect the mains cable. The amplifiers and other devices (if any) will be powered.
   - Finally connect the other cables: battery cables, temperature sensor, control inputs and outputs, Ethernet cables.
   - If it was present, insert the SFP fiber transceiver and connect the optical fibers.
4. Connect the PC to the system, either to a spare port of the system controller or to one of the PRA-MPSx.
5. Go to the System composition web page and click Rediscover to discover the new multifunction power supply. The multifunction power supply is now discovered but not yet assigned.
6. The location of the original multifunction power supply is still present and shows the hostname of the original device.
7. Select under hostname the new hostname of the new multifunction power supply.
8. Press the Submit button on the System definition page to add the device to the configuration.
9. Press Save and restart to store and activate the new configuration.
10. Acknowledge and reset the faults in the system. If faults associated to the multifunction power supply can be acknowledged and reset, this means that the connection and configuration is correct.
11. The new multifunction power supply is now operational.
12. Perform a test by making calls to the zones associated to amplifiers powered from the new multifunctional power supply and check the audio presence.

13. Make a backup of the new configuration and store on a safe location.

19.3.4 Call station

To replace a defective call station in a running system proceed as follows:

Prepare the new call station

1. Unpack the new call station (same model as the one to be replaced).
2. Supply power to the call station by connecting it to a switch with PoE or a midspan adapter.
3. Connect a (laptop) PC to the switch or midspan adapter.
4. Start the PRAESENSA Firmware Upgrade Tool (FWUT) and upgrade the new the new call station to the required firmware version; this is the same version as the original call station was using.
   – See the PRAESENSA configuration manual.

Exchange the call station

1. Disconnect the Ethernet cables from the original call station.
2. Disconnect the bracket and the first loop-through cable to the call station extensions.
3. Connect the call station extensions to the new call station and mount the bracket.
4. Connect the Ethernet cables to the new call station.
5. Connect the PC to the system, either to a spare port of the system controller or to one of the PRA-MPSx.
6. Go to the System composition web page and click Rediscover to discover the new call station. The call station is now discovered but not yet assigned.
7. The location of the original call station is still present and shows the hostname of the original call station.
8. Select under hostname the new hostname of the new call station.
9. Press the Submit button on the System definition page to add the new call station to the configuration.
10. Press Save and restart to store and activate the new configuration.
11. Acknowledge and reset the faults in the system. If faults associated to the call station can be acknowledged and reset, this means that the connection and configuration is correct.
12. The new call station is now operational.
13. Perform a test by making some calls and check the audio presence.
14. Make a backup of the new configuration and store on a safe location.

20 EN 54-16 / EN 54-4 compliance

Compliance to the standards EN 54-16 and EN 54-4 requires certain installation and configuration directions to be adhered to.

20.1 Introduction

The Bosch PRAESENSA system is designed to operate as a VACIE (Voice Alarm Control and Indicating Equipment), providing emergency announcement functions in accordance with the requirements of international standards, while also providing functions for business announcement and background music.
The PRAESENSA VACIE includes one or more system controllers, multi-channel amplifiers, desktop and wall mount emergency call stations, uninterruptable power supplies and network switches.
Installers of the PRAESENSA VACIE shall review and understand the architecture and the installation and configuration processes of PRAESENSA in order to build up the PRAESENSA VACIE in compliance with EN 54-16 and EN 54-4. This information is available in the PRAESENSA installation manual, with focus on the hardware, and the PRAESENSA configuration manual, with focus on the software.

20.2 Checklist

The EN 54-16 / EN 54-4 compliance checklist gives installation and configuration directions for compliance to these standards. Each section of the checklist must be approved after installation for compliance (Y/N-field).

EN 54-16 / EN 54-4 compliance checklist	
System architecture and compliance	Y/N:
PRAESENSA is a networked sound system in which all system elements are connected via OMNEO, the secure Bosch network protocol for audio and control on Ethernet. A system comprises several system elements, or devices. Some devices are intended for business operation only; they can be part of the PRAESENSA system, but should not be used for VACIE-functions in compliance to EN 54-16 and EN 54-4. The Certificate of Constancy of Performance, **0560-CPR-182190000**, issued by the Notified Body, applies to the construction product PRAESENSA VACIE, in compliance with Regulation 305/2011/EU of the European Parliament and of the Council of 9 March 2011, the Construction Products Regulation or CPR. All devices that are listed in this Certificate of Constancy of Performance can be used in the VACIE. As per December 2019, these are: PRA-SCL, PRA-AD604, PRA-AD608, PRA-EOL, PRA-MPS3, PRA-CSLD, PRA-CSLW, PRA-CSE, PRA-ES8P2S, PRA-SFPSX, PRA-SFPLX. – Understand the purpose of each device element and its function in the system. See section *System introduction, page 14*. – Familiarize with the requirement clauses of the EN 54-16 and EN 54-4 standards. The following optional functions, with requirements, are included in PRAESENSA: – Audible warning (7.3) – Phased evacuation (7.5) – Manual silencing of the voice alarm condition (7.6.2) – Manual reset of the voice alarm condition (7.7.2) – Voice alarm condition output (7.9) – Indication of faults related to the transmission path to the CIE (8.3)	

EN 54-16 / EN 54-4 compliance checklist	
– Indication of faults related to voice alarm zones (8.4) – Voice alarm manual control (10) – Interface to external control device(s) (11) – Emergency microphone(s) (12) – Redundant power amplifiers (13.14) The following optional functions, with requirements, are not included in PRAESENSA: – Delay(s) to entering the voice alarm condition (7.4) – Output to fire alarm devices (7.8) – Disabled condition (9)	
Installation and location	Y/N:
The Bosch PRAESENSA VACIE must be installed and commissioned by those who have completed the appropriate training courses conducted by Bosch Security Systems. Once the installation and commissioning process is complete, access to the VACIE is restricted to authorized personnel only. – Install equipment on locations in accordance with the access levels and provide appropriate access restrictions. See section *Location of racks and enclosures, page 19*. – Make sure the location of the installation has sufficient ventilation to remove the generated heat of the equipment. See section *Mounting the 19"-rack devices, page 21*. For standards compliance of the PRAESENSA VACIE, the devices, the interconnections to the Fire Detection System, network infrastructure, loudspeakers and loudspeaker wiring must be installed in accordance with the provisions of applicable standards and the directions provided in the Bosch PRAESENSA installation manual. – Use compliant equipment racks and cabinets only. See section *Equipment racks and cabinets, page 21*. – Obey the cabling requirements and recommendations. See section *Cable requirements, page 23*. Dual redundant interconnections must be used between system elements in separate cabinets or racks; within a rack it is recommended to use dual redundant interconnections. – Use the A and B power supply connections of all devices.	
Network	Y/N:
Use a separate Ethernet network for PRAESENSA, not shared with other services, and do not use other network switches than the PRA-ES8P2S. – Respect the maximum system size. See section *System size limits, page 29*. – Do not deviate from recommended network switch settings and loop length. See section *Network switches, page 29*. – Use shielded network cabling. See section *Cable requirements, page 23*. – Connect networked devices in a loop, with RSTP enabled. In case continuous event logging (beyond the possibilities and capacity provided by the system controller) is required, a logging PC must be installed on the PRAESENSA network. In that case the logging PC is considered as a basic element of the system.	
Ethernet switch	Y/N:
The VACIE can use additional Ethernet switches for flexibility of the system connection topology.	

EN 54-16 / EN 54-4 compliance checklist	
– Do not use other switches than the PRA-ES8P2S. See section *Ethernet switch (ES8P2S), page 157*. – Do not use other fiber transceivers than the PRA-SFPLX and PRA-SFPSX. See section *Fiber transceiver (SFPLX, SFPSX), page 166*. – When a PRA-ES8P2S is used, its fault output contact must be connected to a PRAESENSA control input, configured as 'External fault input'. See section *Fault relay connection, page 162*. – The PRA-ES8P2S must be powered from a 48 V output of a PRA-MPS3 with battery backup. See section *Power supply connection, page 161*.	
Emergency call station	Y/N:
The call stations PRA-CSLD or PRA-CSLW must be used in combination with one or more PRA-CSE call station extensions. Such a composed call station provides visible (LEDs, LCD) and audible (buzzer) indicators to unambiguously indicate the quiescent condition, the voice alarm condition and the fault warning condition with indications of the recognized faults. The system is capable of being simultaneously in the voice alarm condition and in the fault warning condition. The optional disabled condition is not supported. – To indicate the voice alarm condition and the fault warning condition, configure the call station as an emergency call station. – Install an emergency call station in accordance with access level 2 and provide appropriate access restrictions. See section *Location of racks and enclosures, page 19*. – The emergency call station must be network-connected in a loop with PoE power supply on both network connections. See section *Power over Ethernet, page 137*. – Emergency call definitions must have a preconfigured priority in the emergency priority range 224 - 255. Higher priorities overrule lower priorities in case of resource or destination conflicts. In case of the same priority the first call gets priority, but for priority 255 the last call gets priority. – If the VACIE uses multiple emergency call stations, the priorities between them must be arranged via the call definitions in the configuration. At any time only one microphone will be active in any zone. – To silence an audible warning manually, the emergency call station must be configured with buttons to acknowledge and reset the fault alarm and voice alarm condition.	
Amplifier	Y/N:
The PRAESENSA power amplifiers have a built-in spare amplifier channel that takes over from a failing channel automatically. – Amplifier supervision must be enabled in the configuration. The amplifier to loudspeaker cabling must be supervised. – Use a PRA-EOL end-of-line device for each loudspeaker line to detect interrupted or shorted loudspeaker lines. See section *End-of-line device (EOL), page 100*. – In case of A-group and B-group wiring for a zone, use an end-of-line device for each group. See sections *Amplifier outputs, page 75* and *Amplifier outputs, page 91*.	
Multifunction power supply	Y/N:
PRAESENSA uses multifunctional power supplies to provide power to the system devices. – Only use the PRA-MPS3 power supply with battery backup. See section *Multifunction power supply, large (MPS3), page 106*.	

EN 54-16 / EN 54-4 compliance checklist	
– Make sure the battery size is sufficient for the required backup and alarm time during mains failures; use the calculation directions. See section *Battery calculation, page 40*. – Use a 12 V VRLA battery of capacity 100 - 230 Ah, marked with the type designation and date of manufacture; use the supplied battery cables or similar for proper battery impedance measurement. See section *Battery and fuse, page 111*. – Use the lifeline interconnections between the multifunction power supply and the connected amplifiers to enable the snooze mode for sufficient backup and alarm time. See section *Lifeline, page 119*.	
VACIE control inputs and outputs	Y/N:
The PRA-MPS3 provides control inputs and outputs. The control inputs can be used as voice alarm inputs from the fire detection equipment, the Control and Indicating Equipment (CIE). – Control input connections for alarm purposes must be supervised, using end-of-line resistors, to detect a cable short or interruption and prevent that this is perceived as a state change. See section *Control inputs, page 125*. – Emergency call definitions that are triggered from a control input must have a preconfigured priority in the emergency priority range 224 - 255. Higher priorities overrule lower priorities in case of resource or destination conflicts. In case of the same priority the first call gets priority, but for priority 255 the last call gets priority. – To silence an audible warning from the CIE, control inputs must be configured for the function to acknowledge and reset the fault alarm and voice alarm condition. – PRAESENSA control outputs are floating relay contacts without the ability to supervise the control output connections. The control outputs should not be used as outputs to fire alarm devices. Use control outputs of the CIE for that purpose. See section *Control outputs, page 126*.	
Open interface	Y/N:
Next to control inputs and outputs and control via a call station with extensions, the PRAESENSA VACIE supports a TCP/IP based Open Interface with connection supervision for interfacing to external control device(s) such as standardized user interfaces required by local regulations. This interface only allows for access to level 1 and level 2 functions. Mandatory functions of the VACIE are not overridden. – An uncertified PC, connected via the Open Interface, shall not be used as the sole user interface to put the VACIE in the voice alarm condition. – The Open Interface is only allowed to be used as interface between a CIE and the VACIE in case of the Smart Safety Link between the Bosch FPA 5000 CIE and the Bosch PRAESENSA VACIE. – The Open Interface is allowed to be used with a PC on the same network for event logging purposes, including the possibility to acknowledge and/or reset the fault alarm condition and the voice alarm condition.	
Rack label	Y/N:
The proper functioning of the VACIE in accordance with EN 54-16 is the joint responsibility of the manufacturer of the system elements and the installer. The system elements and documentation for installation and configuration are reviewed, tested and certified for compliance by a Notified Body. The installer is responsible for the correct design, installation, interconnection, configuration and maintenance of the system for compliance to EN 54-16 and EN 54-4.	

EN 54-16 / EN 54-4 compliance checklist
– After installation and configuration of the PRAESENSA system, all sections of this checklist must have been positively approved. Then the VACIE rack label that is delivered with the PRAESENSA system controller must be affixed to the door of the rack containing the system controller.

Refer to

- *System introduction, page 14*
- *Location of racks and enclosures, page 19*
- *Mounting the 19"-rack devices, page 21*
- *Equipment racks and cabinets, page 21*
- *Cable requirements, page 23*
- *System size limits, page 29*
- *Network switches, page 29*
- *Multifunction power supply, large (MPS3), page 106*
- *Battery calculation, page 40*
- *Battery and fuse, page 111*
- *Lifeline, page 119*
- *End-of-line device (EOL), page 100*
- *Amplifier outputs, page 75*
- *Amplifier outputs, page 91*
- *Ethernet switch (ES8P2S), page 157*
- *Fiber transceiver (SFPLX, SFPSX), page 166*
- *Fault relay connection, page 162*
- *Power supply connection, page 161*
- *Control inputs, page 125*
- *Control outputs, page 126*
- *Power over Ethernet, page 137*

20.3 Rack label



21 ISO 7240-16 / ISO 7240-4 compliance

Compliance to the standards ISO 7240-16 and ISO 7240-4 requires certain installation and configuration directions to be adhered to.

21.1 Introduction

The Bosch PRAESENSA system is designed to operate as a VACIE (Voice Alarm Control and Indicating Equipment) or s.s.c.i.e. (sound system control and indicating equipment), providing emergency announcement functions in accordance with the requirements of international standards, while also providing functions for business announcement and background music. Because the standards ISO 7240-16 and ISO 7240-4 are very similar to the standards EN 54-16 and EN 54-4 respectively, only the additional requirements are listed in this chapter.

Installers of the PRAESENSA s.s.c.i.e. shall review and understand the architecture and the installation and configuration processes of PRAESENSA in order to build up the PRAESENSA VACIE in compliance with ISO 7240-16 and ISO 7240-4. This information is available in the PRAESENSA installation manual, with focus on the hardware, and the PRAESENSA configuration manual, with focus on the software.

21.2 Checklist

The installer must use the checklist for EN 54-16 / EN 54-4 (see chapter *EN 54-16 / EN 54-4 compliance, page 191*) before proceeding with this checklist for ISO 7240-16 / ISO 7240-4. The checklist for EN 54-16 / EN 54-4 compliance and this supplementary checklist for ISO 7240-16 / ISO 7240-4 combined provide the installation and configuration directions for compliance to ISO 7240-16 / ISO 7240-4. Each section of the checklist must be approved after installation for compliance (Y/N-field).

ISO 7240-16 / ISO 7240-4 compliance checklist (supplementary to the EN54-16 / EN 54-4 checklist)	
System compliance	Y/N:
ISO 7240-16:2007 specifies the requirements, test methods and performance criteria for sound system control and indicating equipment (s.s.c.i.e.) for use in buildings and structures as part of a sound system for emergency purposes (s.s.e.p.) as defined in ISO 7240-1. The s.s.c.i.e. is primarily intended to broadcast information for the protection of lives within one or more specified areas in an emergency, to effect a rapid and orderly mobilization of occupants in an indoor or outdoor area. ISO 7240-4:2017 specifies requirements, test methods and performance criteria for power supply equipment (PSE) for use in fire detection and alarm systems installed in buildings. PRAESENSA is a networked sound system in which all system elements are connected via OMNEO, the secure Bosch network protocol for audio and control on Ethernet. A system comprises several system elements, or devices. Some devices are intended for business operation only; they can be part of the PRAESENSA system, but should not be used for s.s.c.i.e.-functions.	

ISO 7240-16 / ISO 7240-4 compliance checklist (supplementary to the EN54-16 / EN 54-4 checklist)	
The PRAESENSA sound system control and indicating equipment (s.s.c.i.e.) has been tested by a Notified Body. As per May 2020, to be in compliance to ISO 7240-16:2007 and ISO 7240-4:2017, a PRAESENSA system may use the following devices: PRA-SCL, PRA-AD604, PRA-AD608, PRA-EOL, PRA-MPS3, PRA-CSLD, PRA-CSLW, PRA-CSE, PRA-ES8P2S, PRA-SFPSX and PRA-SFPLX. – Understand the purpose of each device element and its function in the system. See section *System introduction, page 14*. – Familiarize with the requirement clauses of the ISO 7240-16 and ISO 7240-4 standards. The following optional functions, with requirements, are included in PRAESENSA: – Alert signal (7.2) – Audible warning (7.5) – Phased evacuation (7.7) – Silencing of the voice-alarm condition with a manual control (7.8.2) – Reset of the voice-alarm condition with a manual control (7.9.2) – Voice alarm condition output signal (7.11) – Faults related to the transmission path to the emergency detection system (8.2.6.1) – Faults related to emergency loudspeaker zones (8.2.6.2) – Manual mode control (11) – Indication of emergency-loudspeaker zones in the fault-warning condition (11.3) – Interface to external control device(s) (12) – Emergency microphone (13) – Microphone priority (13.2) – Microphone emergency-loudspeaker-zone control (13.3) – Redundant power amplifiers (14.14) The following optional functions, with requirements, are not included in PRAESENSA: – Delay to entering the voice alarm condition (7.6) – Output to alarm devices (7.10) – Disabled condition (9) – Disablement-condition output (9.4) – Test condition (10) – Indication of emergency-loudspeaker zones in the disabled condition (11.4)	
Alert and evacuate signals	Y/N:
Select and configure an alert signal that is in compliance with ISO 7731 from the set of available signals that PRAESENSA offers or have such a signal created as a wav-file. The preferred signal and required sound pressure level depend on the actual application, as the parameters of the danger signal (signal level, frequency spectrum, temporal pattern, etc.) shall be designed to stand out from all other sounds in the reception area and shall be distinctly different from any other signals. The sound pressure level shall be at least 65 dBA at any position in the signal reception area, while being at least 15 dB above A-weighted ambient noise, but it may not exceed 118 dBA. The danger signal shall include frequency components between 500 Hz and 2500 Hz. Pulsating danger signals are preferred to signals that are constant in time, while the repetition frequencies shall be in the range from 0.5 Hz to 4 Hz. Examples of compliant multi-sinewave tones that are available for PRAESENSA are:	

ISO 7240-16 / ISO 7240-4 compliance checklist (supplementary to the EN54-16 / EN 54-4 checklist)	
– Alarm_MS_1200-500Hz_100%_10x1s.wav – Alarm_MS_970+630Hz_100%_10x(0.5+0.5)s.wav The evacuate signal shall include the tone signal and pre-recorded voice messages, as specified in ISO 8201. PRAESENSA offers dedicated ISO 8201 compliant evacuate signals, that have the temporal pattern as described by ISO 8201. Examples of compliant multi-sinewave tones that are available for PRAESENSA are: – Alarm_MS_800-970Hz_38%_3x(0.5+0.5)s+1s.wav – Alarm_MS_970Hz_38%_3x(0.5+0.5)s+1s.wav Make sure that the sound pressure level of the evacuate signal is at least 65 dBA, or 75 dBA if the signal is intended to arouse sleeping occupants. ISO 8201 does not specify pre-recorded voice messages, but PRAESENSA offers the possibility to store and select custom voice messages to satisfy specific mandated requirements. Configure a call definition to set up a sequence of tones and messages with repetition options and to assign such a call to a button or input contact to commence. Where a voice signal is used as part of the alert signal, the alert signal shall precede the first pre-recorded voice message for 3 s to 10 s. This can be accomplished by configuring an appropriate, ISO 7731 compliant, alert signal as start tone in the PRAESENSA call definition. Successive alert signals and messages shall then continue until either automatically or manually changed or silenced. This can be accomplished by configuring the appropriate alert signal and voice message as sequential messages in the PRAESENSA call definition with infinite repetitions. The voice message(s) and alert tone(s) must be short enough to make sure that the interval between successive messages does not exceed 30 s and silence periods do not exceed 10 s. Where an alert signal is used as part of an automatic evacuation plan, it should precede the evacuate signal and may include voice messages. Use separate call definitions for the alert and evacuate signals, with or without voice messages, and make sure that the evacuation call has a higher priority than the alert call, addressing the same zones. Upon starting the evacuation call, the alert call is automatically stopped, or interrupted when the alert call is configured to return after being overruled. See also **Phased evacuation** in this checklist.	
Fault warning	Y/N:
To indicate the fault warning condition, use one or more output contacts (on the PRA-MPS3) and configure them as Fault alarm buzzer, Fault alarm indicator and/or System fault indicator. These contacts have fail-safe behavior: when de-energized, the contacts of these outputs are closed (activated).	
Audible warning	Y/N:
The audible warning shall be silenced automatically when the s.s.c.i.e. is reset from the voice alarm condition. PRAESENSA silences the audible warning signal upon acknowledge of the voice alarm condition. Combine the acknowledge and reset into a single action in the configuration to make the acknowledge implicit upon resetting the voice alarm condition.	
Phased evacuation	Y/N:
Phased evacuation can be accomplished in various ways with PRAESENSA: – By phased triggering of input contacts (configured for the function Make announcement) by the c.i.e. that start separate alarm calls to different zones. Such calls can also be started via the Open Interface.	

ISO 7240-16 / ISO 7240-4 compliance checklist (supplementary to the EN54-16 / EN 54-4 checklist)	
– By phased triggering of the same call for different zones; subsequent triggers after the first one will extend the running call with additional zones. Configure the input contact to Start phased announcement. This has the advantage that only one instance of a message player is occupied, regardless of the number of zones or zone groups that are added later. A (phased) call can be overruled manually by starting a call with a higher priority. The lower priority call must be configured (in its call definition) to continue after an interruption in order to resume automatically.	
Rack label	Y/N:
The proper functioning of the s.s.c.i.e. in accordance with ISO 7240-16 is the joint responsibility of the manufacturer of the system elements and the installer. The system elements and documentation for installation and configuration are reviewed, tested and certified for compliance by a Notified Body. The installer is responsible for the correct design, installation, interconnection, configuration and maintenance of the system for compliance to ISO 7240-16 and ISO 7240-4. After installation and configuration of the PRAESENSA system, all sections of this checklist must have been positively approved. Then the s.s.c.i.e. rack label that is delivered with the PRAESENSA system controller must be affixed to the door of the rack containing the system controller.	

Refer to

– *EN 54-16 / EN 54-4 compliance, page 191*
– *System introduction, page 14*

21.3 Rack label



22 DNV-GL type approval

DNV-GL type approval for PRAESENSA systems installed on vessels requires certain installation and configuration directions to be adhered to.

22.1 Introduction

The Bosch PRAESENSA system is designed to operate as a PA/GA (Public Address/General Alarm) system, providing emergency announcement functions in accordance with the requirements of international standards, while also providing functions for business announcement and background music.

The PRAESENSA PA/GA system includes system controllers, multi-channel amplifiers, desktop and wall mount emergency call stations, uninterruptable power supplies and network switches.
Installers of the PRAESENSA PA/GA system shall review and understand the architecture and the installation and configuration processes of PRAESENSA in order to build up the system in compliance with DNV-GL type approval requirements. This information is available in the PRAESENSA installation manual, with focus on the hardware, and the PRAESENSA configuration manual, with focus on the software.

22.2 Checklist

In this checklist specific issues that require special attention from the installers when installing a PRAESENSA PA/GA system are described. Each section of the checklist must be approved after installation for compliance (Y/N-field).

DNV-GL PA/GA compliance checklist	
System compliance	Y/N:
PRAESENSA is a networked sound system in which all system elements are connected via OMNEO, the secure Bosch network protocol for audio and control on Ethernet. A system comprises several system elements, or devices. The Type Approval Certificate TAA00002RC, issued by DNV-GL, certifies that PRAESENSA is found to comply with: – DNV GL rules for classification - Ships, offshore units, and high speed and light craft – IMO Res. A.694(17) General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids – IMO A.1021(26) Code on alerts and indicators (2009) – LSA Code VII 7.2 – IMO MSC/Circ. 808 Recommendation on performance standards for public address systems on passenger ships, including cabling (2017) Products approved by this certificate are accepted for installation on all vessels classed by DNV-GL. The PRAESENSA Public Address and General Alarm system can be installed as either: – PA system only – GA system only – Integrated PA and GA system The PRAESENSA system may be used on cargo ships, passenger vessels, high-speed and light craft and mobile offshore units for compliance with the following codes/rules/regulations: – SOLAS	

DNV-GL PA/GA compliance checklist	
– HSC Code – MODU Code – DNV-GL Statutory Interpretations [July 2015] PRAESENSA PA/GA installations that are used for GA-functions shall only use products that are listed in the PRAESENSA Type Approval Certificate TAA00002RC. In case extension of the PRAESENSA system requires other equipment, the following restrictions apply: – The equipment must be approved by Bosch Security Systems for use with PRAESENSA – The equipment must have DNV-GL Type Approval	
Location	Y/N:
The following location requirements for installation must be taken into account: – The PRAESENSA equipment can be installed in one of the main area locations on board in accordance with the Class Guideline DNVGL-CG-0339 and the location class of each product, as indicated on the DNV-GL certificate. – Call stations with functions for activation of emergency PA and GA are to be installed in locations with controlled access. – To prevent acoustic feedback (‘howling’), do not mount a zone loudspeaker close to a call station when that loudspeaker may receive calls from that call station. Because a PRAESENSA call station has a built-in monitor loudspeaker (that is switched off while the microphone is open) there is also no need for an overhead zone loudspeaker. – The following safe distance to the standard magnetic compass must be considered for the PRA-CSLD, PRA-CSLW and PRA-CSE: > 85 cm (> 34 in). – The following safe distance to the steering magnetic compass must be considered for the PRA-CSLD, PRA-CSLW and PRA-CSE: > 55 cm (> 22 in). – Other PRAESENSA products are not to be positioned in the vicinity of a magnetic compass.	
Installation	Y/N:
The following installation restrictions apply: – When separate PA and GA systems are installed, no single fault tolerance is required as the combination of both systems provides redundancy. – For a system used for PA on passenger vessels or used for integrated PA and GA on any vessel, essential parts of the system shall be duplicated (A+B systems). Various duplications are possible with PRAESENSA, like system controller redundancy, double network connections, A/B loudspeaker cabling and power supplies with battery backup facilities. Other duplications are already integrated in PRAESENSA, like spare amplifier channels and redundant power converters. Information about duplication of essential parts of a system is available in the PRAESENSA installation manual. – When used for passenger vessels, the A+B systems are to be installed in separate fire zones. – When used for cargo vessels, the system may be installed on one location, but it must be installed with single fault tolerance. – When used for a combined PA/GA system, as a minimum two independent speaker runs A and B are required with interleaved loudspeakers, or the loudspeakers must be connected in closed loop between zone group outputs A and B. – For ongoing announcements during a switchover from the duty system controller to the backup system controller the following should be taken into account:	

DNV-GL PA/GA compliance checklist	
– Automated GA emergency alarm activation should always be done via PRAESENSA control inputs (contact closure) to ensure that the GA emergency alarm continues after switchover. It is not allowed to activate GA emergency alarms from a call station. – For manual emergency PA announcements (using the PTT button on a call station or panel), it is accepted that the announcement is terminated after a switchover and must be reinitiated by the user. – A call station capable of issuing GA and emergency PA shall be connected to both system controllers (duty and backup). This is automatically achieved by connecting all PRAESENSA devices in the same subnet of the network and configuring both system controllers as a redundant pair. – The following power management options are allowed: – Connection to a mains and emergency source of power are handled by an Uninterruptable Power Supply (UPS) outside the PRAESENSA system. – Connection to a mains source of power is handled by PRA-MPS3 devices, that have a battery connected of sufficient capacity. – Output contacts shall be used to override local muting or local volume controls (at or near the speakers) during a GA and emergency PA announcement. See *Control outputs, page 126* section of this manual. – Emergency PA shall have a priority higher than GA, otherwise it is not possible to have an emergency PA announcement when GA is already running. General (business) PA should have a priority that is lower than GA and emergency PA. – Any call station that is not used for emergency PA activation shall have a lower priority than GA. – Call stations with functions for activation of emergency PA and GA shall be provided with means to avoid unintended use. Each configured button of a PRA-CSE call station extension for such a call station must have a clear descriptive label to identify its function. To protect buttons from being pushed accidentally, a button cap must be mounted on each button that can activate an emergency function. See sections *Labeling, page 151* and *Mounting a button cap, page 153* of this manual. – In order to reset a GA emergency alarm as a default single button action, a combined Acknowledge/Reset action must be configured for that button to prevent that two buttons need to be pressed separately. In addition, by selecting Reset aborts active emergency calls for that button, the reset action will not be blocked by emergency calls that are still active.	
Cabling	Y/N:
Cables and wiring serving internal communications or signals should, as far as practicable, be routed clear of galleys, laundries, machinery spaces of category A and their casings, and other high fire risk areas unless serving those spaces. Where possible, all such cables should be run in such a manner so as to preclude that they are being rendered unserviceable by heating of the bulkheads that may be caused by a fire in an adjacent space. All areas of each fire zone should be served by at least two dedicated loudspeaker runs sufficiently separated throughout their length.	

DNV-GL PA/GA compliance checklist
Using loop wiring with entry into a fire compartment from two different sides, often the use of fire resistant cables can be evaded. But in case fire resistant cables are specified within the system design, these cables are available on the market with DNV-GL Type Approval, for loudspeaker and power cabling, as well as for short distance CAT6A network cabling and for longer distance glass optical fiber cabling.

Refer to

- *Control outputs, page 126*
- *Labeling, page 151*
- *Mounting a button cap, page 153*

23 Architects' and engineers' specifications

This chapter provides the architects' and engineers' specifications of the PRAESENSA system and the individual devices.

23.1 System

Architects' and engineers' specifications - PRAESENSA system

The Public Address and Voice Alarm System shall be fully IP-network based. All system devices such as system controller, amplifiers and call stations shall communicate via IP, using an Audio over IP (AoIP) protocol that supports AES67 for audio and using AES70 for control, with encryption and authentication to prevent unauthorized access, misuse and modification of data. The audio part shall support Layer 3 connections via routers between subnets with latency of less than 10 ms and synchronized outputs. The control data part shall be guaranteed by Transmission Control Protocol (TCP) Layer 4. The system shall support >100 simultaneous channels for music routing and making calls, using an uncompressed, high-definition digital audio format with 24-bit sample size and 48 kHz sample rate. A system based on a single system controller shall support at least 200 system devices and 500 zones.

System functionality shall be defined in software, allowing for regular updates for functional and/or security improvements. The system software shall run on the system controller with additional firmware on other system devices for device-related functions. Upload and installation of new firmware into the system devices shall be secure. System configuration shall be possible using a standard web browser, connected to the embedded webserver in the system controller, using HTTPS (HTTP Secure) communication. It shall support multiple access levels with associated access rights. After completion of the system configuration, no connection to a PC shall be required for operation. It shall be possible to connect a backup system controller for dual redundancy with automatic fail-over. The system software shall support the discovery and assignment of all system devices in a system and the individual configuration of each device. The system software shall support configurable call definitions for user calls and related actions that can be assigned to virtual and/or real control inputs and call station buttons. A call definition shall define the following: priority, start and end tones with volume setting, an audio input for live speech insertion with volume setting, a message or sequence of messages with a number of repetitions and volume setting, maximum call duration and optional automatic scheduling with duration and interval. The system software shall permit uploading of individual wav-files for messages and tones to the system controller, with integrity supervision of stored wav-files. It shall support zone definition and zone grouping with amplifier channel to zone assignment. The system software shall configure and control all device inputs and outputs in the system, including audio processing functions, operation modes, assigned functions and connections and the supervision thereof. The system shall include diagnosis and logging software, supporting different modes of inquiry, including call events and fault events. It shall be possible to view fault events, collected by the system controller, on a call station screen, including the fault status of connected third party equipment. It shall be possible to acknowledge and reset faults and alarm states, and to log these actions.

The system devices shall be certified for EN 54 and ISO 7240, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The system shall be a Bosch PRAESENSA system.

23.2 System controller (SCL, SCM, SCS)

Architects' and engineers' specifications

The IP-networked system controller shall be designed exclusively for use with Bosch PRAESENSA systems. The system controller shall dynamically assign network audio channels for audio routing between system devices across multiple subnets. It shall support >100 simultaneous High Definition audio channels (24-bit, 48 kHz) for music routing and making calls, with encryption and authentication to protect against eavesdropping and hacking. It shall be capable of receiving Dante and AES67 audio streams. The system controller shall provide an interface for control data and multi-channel digital audio over OMNEO using an integrated 5-port Ethernet switch for redundant network connections, supporting RSTP and loop-through cabling. The system controller shall have dual power supply inputs and power supplies. The system controller shall manage all devices in the system to provide the configured system functions. It shall incorporate a supervised storage for message and tone files with networked playback of up to eight streams simultaneously. It shall keep an internal log of fault events and call events. The system controller shall provide a secure TCP/IP open interface for remote control and diagnostics. The system controller shall provide front-panel LED indications for the status of power supplies and the presence of faults in the system and provide additional software monitoring and fault reporting features. The system controller shall be rack mountable (1U). It shall be possible to connect a backup system controller for dual redundancy with automatic fail-over. The system controller shall be certified for EN 54-16 and ISO 7240-16, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The system controller shall be a Bosch PRA-SCL.

23.3 Amplifier, 600W 4-channel (AD604)

Architects' and engineers' specifications

The IP-networked 4-channel amplifier shall be designed exclusively for use with Bosch PRAESENSA systems. The amplifier shall adapt the maximum output power of each amplifier channel to its connected loudspeaker load, with free assignable output power per channel for a total maximum of 600 watt per amplifier, supporting 70 V or 100 V operation with direct drive capability and outputs that are galvanically insulated from ground. The amplifier shall have a built-in independent spare amplifier channel for automatic failover. The amplifier shall provide an interface for control data and multi-channel digital audio over OMNEO using dual Ethernet ports for redundant network connection, supporting RSTP and loop-through cabling, with automatic failover to an analog lifeline input. The amplifier shall have dual power supply inputs and power supplies. All amplifier channels shall have independent A/B zone outputs with support for class-A loudspeaker loops. All amplifier channels shall supervise the integrity of connected loudspeaker lines without interruption of audio distribution. The amplifier shall provide front-panel LED status indications for the network link, ground fault, power supplies and audio channels, and provide additional software monitoring and fault reporting features. The amplifier shall be rack mountable (1U) and feature software-configurable signal processing including level control, parametric equalization, limiting and delay for each channel. The amplifier shall be certified for EN 54-16 and ISO 7240-16, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The amplifier shall be a Bosch PRA-AD604.

23.4 Amplifier, 600W 8-channel (AD608)

Architects' and engineers' specifications

The IP-networked 8-channel amplifier shall be designed exclusively for use with Bosch PRAESENSA systems. The amplifier shall adapt the maximum output power of each amplifier channel to its connected loudspeaker load, with free assignable output power per channel for a total maximum of 600 watt per amplifier, supporting 70 V or 100 V operation with direct drive capability and outputs that are galvanically insulated from ground. The amplifier shall have a built-in independent spare amplifier channel for automatic failover. The amplifier shall provide an interface for control data and multi-channel digital audio over OMNEO using dual Ethernet ports for redundant network connection, supporting RSTP and loop-through cabling, with automatic failover to an analog lifeline input. The amplifier shall have dual power supply inputs and power supplies. All amplifier channels shall have independent A/B zone outputs with support for class-A loudspeaker loops. All amplifier channels shall supervise the integrity of connected loudspeaker lines without interruption of audio distribution. The amplifier shall provide front-panel LED status indications for the network link, ground fault, power supplies and audio channels, and provide additional software monitoring and fault reporting features. The amplifier shall be rack mountable (1U) and feature software-configurable signal processing including level control, parametric equalization, limiting and delay for each channel. The amplifier shall be certified for EN 54-16 and ISO 7240-16, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The amplifier shall be a Bosch PRA-AD608.

23.5 End-of-line device (EOL)

Architects' and engineers' specifications

The end-of-line device shall be designed exclusively for use with Bosch PRAESENSA systems. The end-of-line device shall only require a connection with the end of the loudspeaker line to supervise its integrity. Supervision reliability shall not depend on the number of connected loudspeakers. Supervision shall be inaudible and not interrupt audio content. The end-of-line device shall be certified for EN 54-16 and ISO 7240-16, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The end-of-line device shall be a Bosch PRA-EOL.

23.6 Multifunction power supply, large (MPS3)

Architects' and engineers' specifications

The IP-networked multifunction power supply shall be designed exclusively for use with Bosch PRAESENSA systems. The multifunction power supply shall contain four independent mains power supplies with power factor correction and dual output connection facilities to power up to three 600 W amplifiers and to power a system controller and two call stations. The multifunction power supply shall have an integrated battery charger for a connected battery, and independent converters to use the battery as a backup power source for all connected loads in case of mains failures. Failover to the backup battery shall be without interruption of output power. It shall use a single 12 V VRLA backup battery to eliminate the need for battery balancing, while maximizing battery lifetime and power density. The multifunction power supply shall have eight general purpose control inputs with connection supervision and eight voltage free control outputs. The multifunction power supply shall provide an interface for control data and to receive a backup audio channel over OMNEO using an integrated 6-port Ethernet switch for redundant network connections, supporting RSTP and loop-through cabling. Two ports shall have PoE to provide redundant power to a call station. The backup audio channel shall be available as analog lifeline to connected amplifiers. The multifunction

power supply shall provide front-panel LED indications for status of the power supply sections, mains and battery, network link and fault presence, and provide additional software monitoring and fault reporting features. The multifunction power supply shall be rack mountable (2U). The multifunction power supply shall be certified for EN 54-4 and ISO 7240-4, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The multifunction power supply shall be a Bosch PRA-MPS3.

23.7 LCD call station (CSLD, CSLW)

Architects' and engineers' specifications

The IP-networked desktop call station shall be designed exclusively for use with Bosch PRAESENSA systems. The desktop call station shall provide an interface for control data and multi-channel digital audio over OMNEO using dual Ethernet ports for redundant network connection, supporting RSTP and loop-through cabling. It shall receive Power over Ethernet (PoE) via either one or both network connections. The desktop call station shall provide a backlit full-color capacitive touch panel LCD as user interface for business and evacuation purposes. The desktop call station shall accept up to four optional extensions, each offering 12 configurable buttons for zone selection and other purposes. It shall provide control and routing of live speech calls, stored messages and music with volume control per zone. The desktop call station shall have a gooseneck cardioid microphone for live calls and a 3.5 mm jack line level input for background music, and provide software-configurable signal processing including sensitivity control, parametric equalization and limiting. The desktop call station shall be certified for EN 54-16 and ISO 7240-16, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The desktop call station shall be a Bosch PRA-CSLD.

Architects' and engineers' specifications

The IP-networked wallmount call station shall be designed exclusively for use with Bosch PRAESENSA systems. The wallmount call station shall provide an interface for control data and multi-channel digital audio over OMNEO using dual Ethernet ports for redundant network connection, supporting RSTP and loop-through cabling. It shall receive Power over Ethernet (PoE) via either one or both network connections. The wallmount call station shall provide a backlit full-color capacitive touch panel LCD as user interface for business and evacuation purposes. The wallmount call station shall accept up to four optional call station extensions, each offering 12 configurable buttons for zone selection and other purposes. It shall provide control and routing of live speech calls, stored messages and music with volume control per zone. The wallmount call station shall have a hand-held omnidirectional microphone for live calls and a 3.5 mm jack line level input for background music, and provide software-configurable signal processing including sensitivity control, parametric equalization and limiting. The wallmount call station shall be certified for EN 54-16 and ISO 7240-16, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The wallmount call station shall be a Bosch PRA-CSLW.

23.8 Call station extension (CSE)

Architects' and engineers' specifications

The call station extension shall be designed exclusively for use with Bosch PRAESENSA systems. The call station extension shall offer electrical and mechanical connection facilities for use with a desktop or wallmount call station. It shall provide 12 configurable buttons for zone selection and other purposes. Each button has tactile feedback and a light ring activation indicator, complemented with a set of multi-color LEDs for function related status indications. The call station extension shall have a removable front cover to put language independent

button labels behind the front cover. The call station extension shall be certified for EN 54-16 and ISO 7240-16, marked for CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The call station extension shall be a Bosch PRA-CSE.

23.9 Ethernet switch (ES8P2S)

Architects' and engineers' specifications

The Ethernet switch shall be a managed 10-port Gigabit switch with eight ports providing PoE and two ports providing SFP sockets for glass fiber transceivers. The switch shall have dual redundant, wide range DC power supply inputs for 24 to 48 V. It shall supervise its DC power supply inputs and port links, and have a fault relay output for fault reporting. The Ethernet switch shall be DIN rail mountable with convection cooling. It shall be certified for EN 54-16 in combination with Bosch PRAESENSA systems for public address and voice alarm purposes. The switch shall be marked for UL and CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The Ethernet switch shall be a Bosch PRA-ES8P2S.

23.10 Fiber transceiver (SFPLX, SFPSX)

Architects' and engineers' specifications

The LX fiber transceiver shall be a wide temperature Small Form-factor Pluggable (SFP) for use with single-mode fiber and IR light with a wavelength of 1310 nm, to cover glass fiber link lengths of up to 10 km. It shall be certified for EN 54-16 in combination with Bosch PRAESENSA systems for public address and voice alarm purposes. The transceiver shall be marked for UL and CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The LX-transceiver shall be a Bosch PRA-SFPLX.

Architects' and engineers' specifications

The SX fiber transceiver shall be a wide temperature Small Form-factor Pluggable (SFP) for use with multi-mode fiber and IR light with a wavelength of 850 nm, to cover glass fiber link lengths of up to 550 m. It shall be certified for EN 54-16 in combination with Bosch PRAESENSA systems for public address and voice alarm purposes. The transceiver shall be marked for UL and CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The SX-transceiver shall be a Bosch PRA-SFPSX.

23.11 Power supply module (PSM24, PSM48)

Architects' and engineers' specifications

The 24 V power supply module shall contain a mains input with power factor correction and a 24 V output. Output current capability shall be 10 A continuous and 15 A peak. It shall be approved to power Bosch PRAESENSA and PAVIRO equipment. The power supply shall be DIN-rail mountable with passive cooling. The power supply shall be marked for UL and CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The power supply module shall be a Bosch PRA-PSM24.

Architects' and engineers' specifications

The 48 V power supply module shall contain a mains input with power factor correction and a 48 V output. Output current capability shall be 5 A continuous and 7.5 A peak. It shall be approved to power one 600 W Bosch PRAESENSA amplifier. The power supply shall be DIN-rail mountable with convection cooling. The power supply shall be marked for UL and CE and be compliant with the RoHS directive. Warranty shall be three years minimum. The power supply module shall be a Bosch PRA-PSM48.

24 Support and academy

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