**ES1 Ceiling Audio Solution**

ARCHITECTS’ & ENGINEERS’ SPECIFICATIONS

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The ES1 ceiling audio solution shall consist of a Sennheiser TeamConnect Ceiling 2 (TCC2) and Bose Professional ControlSpace EX-440C conference processor, PowerSpace P2600A amplifier, and EdgeMax EM180 in-ceiling loudspeaker. The audio DSP shall control and proxy TCC2 attributes including LED color for mute and unmute LED brightness, output gain, and orientation. The DSP shall proxy HID signaling over USB to and from the video conferencing host device as logic operations for call-active status and privacy mute status to microphone LEDs and shall respond to user adjustments of volume and mute. Video conferencing room solution shall offload acoustic echo cancellation (AEC) processing to conferencing signal processor.

ES1 configuration shall be certified for Google Meet, Microsoft Teams, and Zoom applications.

**Sennheiser TeamConnect Ceiling 2 Ceiling Mounted Microphone Array**

The ceiling-mounted microphone array shall be designed for fixed installation in medium-to-large conference rooms. The microphone array shall fit within the space of a standard 600 mm (2 ft.) ceiling panel and shall be mountable either onto or flush with the ceiling itself. Several mounting accessories shall be available, including a ceiling suspension kit, a ceiling fixation bracket as well as mounting brackets for US size ceiling panels and for 625 mm ceiling panels. Additionally, a VESA adapter shall be available for all standard 100 mm and 200 mm VESA mounting material. The microphone array shall consist of 28 Sennheiser KE 10-237 pre-polarized condenser microphone capsules and shall use beamforming technology that automatically focuses on whoever is speaking in the room. The beam will automatically detect the position of the person speaking and will follow the person around the room at all times. A threshold for the detection shall be adjustable. Live monitoring of the horizontal and vertical angle of the position shall be available in the Sennheiser Control Cockpit control software. The microphone array shall have a Dante™ interface with two RJ-45 sockets (primary and secondary) for digital audio output, supporting both redundant and daisy-chain modes. The microphone array shall also feature a 3-pin terminal for analog audio output, which is compatible with Phoenix Contact MCVW 1.5-3-ST-3.81 connectors. In addition, the microphone array shall have an RJ-45 Ethernet socket for network control and easy configuration and monitoring using the Sennheiser Control Cockpit control software. The RJ-45 Ethernet socket shall also support Power over Ethernet, using the PoE IEEE 802.3af Class 3 standard. 802.1X network configuration shall be possible via SSH protocol. The microphone array shall feature a reset button for restoring the factory settings. The microphone sensitivity shall be 0 dBV/Pa (988 mV/Pa). The maximum sound pressure level shall be 104 dB SPL. The dynamic range shall be 93 dB(A). The microphone dimensions (L × W × H) shall be 590 × 590 × 43 mm (23.2 × 23.2 × 1.7 in), weight shall be 5.67 g (12.5 lb). The operating temperature shall range from 0 °C to +40 °C (+32 °F to +104 °F). The storage temperature shall range from -10 °C to 60 °C (14 °F to 140 °F). The microphone array shall be tested according to UL 2043 rating.

The microphone array shall be the Sennheiser TeamConnect Ceiling 2.

**ControlSpace EX-440C conferencing processor**

The conferencing processor shall have 4 mic/line inputs and 4 balanced output channels for analog audio signals, each independently controllable with removable screw-down and labeled connectors. The DSP shall contain 8 channels of acoustic echo cancellation (AEC), with multiple references, routable to analog and/or Dante inputs. The DSP shall have 16 input and 16 output Dante digital audio channels, and an Ethernet connection for control and programming, integrated VoIP connection for 1 line, PTSN, USB audio and 4 channels of AmpLink on an RJ-45 jack. The audio DSP shall be a 1RU rack mountable chassis and include configurable signal processing, including but not limited to: signal routing and mixing, equalization, filtering, dynamics, delay, conference room router, conference room combining, as well as control, monitoring, and diagnostic tools. The audio DSP shall control and proxy all ControlSpace EX expansion devices and other Dante endpoints. The audio DSP shall be compliant to UL60065 (8th edition), CAN/CSA-C22.2 No.60065 (8th edition), IEC/EN60065 (8th edition); UL62368-1 (2nd edition), CAN/CSA C22.2 No. 62368-1-14 (2nd edition), IEC/EN 62368-1 (2nd edition), UL62368-1 (2nd edition), CAN/CSA C22.2 No. 62368-1-14 (2nd edition), IEC/EN 62368-1 (2nd edition), IEC/EN 60950-1 (2nd edition); EN 55032:2015, EN 61000-3-2:2014, EN 61000-3-3:2013, EN 55035:2017, FCC Part 15B Class A, AS/NZS CISPR 32:2015, ICES-003 Class A, CNS13438, GB/T9254-2008, CISPR13; and have telephone certifications for Australia, Canada, China (NAL) Europe, Hong Kong, India, Japan, Mexico, New Zealand, UAE, USA, and Taiwan.

Warranty shall be 5 years.

The conferencing processor shall be the Bose Professional ControlSpace EX-440C.

**PowerSpace P2600A versatile power amplifier**

The amplifier shall employ Class-D amplification together with a digital signal processing architecture running at 48 kHz/24-bit. The amplifier shall incorporate a switch-mode power supply allowing normal operation from AC outlets ranging from 100–264 V at 50/60 Hz. The amplifier shall have an IEC 320-C14 electrical power inlet and shall be equipped with a removable power supply cord. A power switch shall be located on the front panel. The product shall include protection from shorted loads and general overheating. The amplifier’s physical size shall be 1RU in height by 1RU in width and be capable of rack mounting. The product shall have venting with two fans, variable front-to-back airflow. Each output channel shall have output attenuation controls. The amplifier shall have two 600 W output channels with a frequency response of 20 Hz to 20 kHz (±1 dB) when driving low-impedance (4–8 Ω) systems, and a frequency response of 50 Hz to 20 kHz when driving 70/100 V distributed audio systems. The amplifier shall have THD+N at rated power less than 0.04%. Output connections shall be made via a 4-pin terminal block connector.

The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB below rated power at 1 kHz. The amplifier shall incorporate 2 line-level inputs. The nominal input sensitivity shall be 4 dBu for balanced line-level inputs (6-pin Euroblock connector). The amplifier can also accept up to two AmpLink audio inputs (two RJ-45 connectors, Input and Thru). Five LEDs shall be visible on the front panel: one Power (white) for power indication, (blinking white) for standby indication, (red) for fault indication, and (blinking red) for thermal fault indication; per-channel Signal (green) to indicate input signal presence, (amber) to indicate within 3 dB of input clipping, and (red) to indicate input clipping; per-channel Limit (amber) when an output is limiting, (red) for fault indication, and (blinking red) when outputs are muted. The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier.

The amplifier chassis shall be constructed of painted steel. The dimensions of the amplifier shall allow for 19-inch (483 mm) EIA-standard rack mounting. The amplifier shall be 44 mm (1.7 in) in height, 483 mm (19.0 in) in width and 420 mm (16.5 in) in depth. The amplifier shall weigh 6.2 kg (13.7 lb).

The amplifier is UL/cUL Listed according to UL60065 (8th edition), UL62368-1, CAN/CSA C22.2 No. 60065-16 and CAN/CSA C22.2 No 62368-1-14; The amplifier complies with CE requirements per EN62368-1:2014 and is CB Certified according to IEC60065:2014 and IEC62368-1:2014, including all group and national differences. This model also complies with FCC Part 15B Class A, ICES-003 Class A, EN55032:2012, EN55035, CISPR 13: Ed. 5.0 (2009-06), requirements.

Warranty shall be 5 years.

The amplifier shall be the Bose Professional PowerSpace P2600A versatile power amplifier.

**EdgeMax EM180 in-ceiling premium loudspeaker**

The 2-way, full-range loudspeaker shall contain a single 1.3-inch voice coil mid-high-frequency compression driver firing through a PhaseGuide device and a single 8-inch cone transducer. The loudspeaker shall contain a passive crossover network with a 1000 Hz crossover point.

The 2-way, full-range loudspeaker shall meet the following performance specifications: On-axis system frequency response shall be 45 Hz to 20 kHz (-10 dB) with the use of recommended active equalization. The loudspeaker sensitivity shall be 96 dB SPL in a quarter-space (wall-loaded) environment with recommended active EQ with 1 W input at 1 meter. The long-term power handling rating shall be 150 W (AES test methodology using IEC system noise, 2-hour duration). Maximum continuous output shall be 115 dB SPL and the maximum peak output shall be 121 dB SPL, both in quarter-space (wall-loaded) environment with recommended active EQ. The nominal coverage pattern shall be 180° horizontal and 75° vertical (0° to 75° referenced to wall). The loudspeaker is designed to be mounted near wall-ceiling boundaries, eliminating the need for center-of-ceiling downward-firing loudspeakers.

The loudspeaker shall be constructed of an engineered-plastics front baffle with an integrated steel formed enclosure. The loudspeaker shall be plenum rated for use in air handling spaces and in compliance with the following safety standards: UL1480A, UL2043. The transducers shall be located behind a perforated steel grille with a powder-coated finish that is magnetically attached. The finish of the grille shall be white (paintable), and a black grille accessory is available for purchase. Input connectors shall be a Euroblock 6-pin connector with loop-through, located on the front baffle. The loudspeaker shall have a nominal rated impedance of 8 ohms and shall be wired in parallel with a line voltage matching (stepdown) transformer with a level selector appropriate for output taps of 2.5, 5, 10, 20, 40 and 80 W and bypass (8 ohms). The loudspeaker input connections shall allow for direct connection to 70-volt, 100-volt, or low-impedance amplifiers. Loudspeaker backcan dimensions shall be 345 × 345 mm (13.6 × 13.6 in, length by width) with a 236 mm (9.3 in) backcan depth and net weight shall be 10.1 kg (22.2 lb) with grille. Outward front grille dimensions shall be 390 × 390 mm (15.4 × 15.4 in).

The loudspeaker shall be the Bose Professional EdgeMax EM180 in-ceiling premium loudspeaker.