



FIELD MANUAL · VOLUME 23

Heard. Placed. Held.

The room is tuned once.
Place the speakers before the drywall closes.

PREPARED FOR

Operators · Project Managers · Designers · Integrators · Owner's Reps

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MANIFESTO

The wire is pulled once. Run the home-run before the drywall closes.

Vol 23 governs the complete specification of luxury residential whole-house audio for Restrepo Innovations projects in Franklin Lakes, New Jersey. The scope covers thirteen coordinated disciplines: source platforms, matrix amplifiers, in-ceiling and in-wall speakers, subwoofers and bass management, speaker placement geometry, DSP and room correction, zone topology and rack sizing, keypads and control, streaming services and library, speaker wire and wiring standards, pre-wire discipline, codes and standards, and without written direction. Every speaker location is pre-wired with its own dedicated home run before the drywall board is hung. The bracket is set, the service loop is coiled, and the wire is labeled before any rocker or taper enters the space. The speaker is heard once correctly or not at all. Platform, amplifier, and zone topology are resolved at design development — not at commissioning. The distribution closet is sized before framing. The wire gauge is confirmed against run length before the spool is cut. This is the discipline that separates a finished residential audio system from a collection of components installed in sequence.

SCOPE

Residential-only. Applies to new luxury residential distributed audio construction and major renovations within Restrepo Innovations projects in the NJ/NY metro corridor. Governing codes: NEC 2023 Articles 640, 725, 800; NEC 640.6 wiring methods for audio systems; NEC 725.136 Class 2/3 separation; NEC 725.51 conduit fill; NEC Article 800 plenum communications circuits; CEDIA RP-22 v1.2 (2023) immersive audio design recommended practice; ANSI/CEA-2010-A subwoofer measurement; IEC 60268-5/19 electroacoustics; NJ UCC NJAC 5:23; AES67 network audio interoperability. Spare hardware at ≥5% of installed equipment value is delivered and labeled at every project closeout per Restrepo policy. The manifesto: the wire is pulled once. Run the home-run before the drywall closes.

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PART 1

Sources & Amplification

Sections 01–02 — Source Platforms, Matrix Amplifiers

Source Platforms

PART I — SOURCES & AMPLIFICATION

A residential whole-house audio system is built on a single source platform. Selecting Sonos S2, Crestron DM NAX, Savant IP Audio, Control4 Triad, or Bluesound BluOS as the streaming backbone is a commitment made at design development — not at commissioning. Mixing two primary platforms in the same residence creates credential conflicts, competing control apps, scene management duplication, and service call complexity that compound at every visit. Choose one platform. Size it for the zone count and amplifier budget. Document the choice in the project specification before rough-in begins. AES67 and Dante interoperability notes appear where platforms can bridge; bridge capability does not make mixed-platform design appropriate.

THE FOUR PARTS OF THIS VOLUME

Part	Sections	Primary Disciplines
I — Sources & Amplification	01–02	Source platforms (Sonos S2, Crestron DM NAX, Savant, Control4 Triad, JBL Synthesis, Lyngdorf); matrix amplifiers (Crestron AMP-X300, Sonance DSP 8-130 MkIII, NAD CI 8-150 / CI 16-60); 70% load mandate; NEC 640 Class 2 wiring; thermal and rack discipline
II — Speakers & Placement	03–05	In-ceiling and in-wall speakers (Sonance Reference R1/R2, VP series, JBL Synthesis SCL-3, B&W; CCM7.5 S2, Revel C763, Paradigm CI Elite); subwoofers and bass management (Sonance SR2, JBL SSW-1, Paradigm Defiance, REL S/812); speaker placement geometry by room type
III — Control & Streaming	06–09	DSP and room correction (Dirac Live, ARC Genesis, RoomPerfect, SonARC); zone topology and rack sizing (hub-and-spoke mandate, Cat6A, managed switch, PoE); keypads, control, and voice (Lutron RA3/HWQXSX, Crestron Horizon, Savant Pro, Control4 SR-260, AirPlay 2, voice caveats); streaming services and library (Apple Music, Tidal, Qobuz, Roon, NAS)
IV — Wiring & Closeout	10–13	Speaker wire and wiring standards (AWG table, CL3/CMP, NEC 640.6/725.136, Liberty/West Penn/Belden brands); pre-wire discipline (home-run mandate, service loop, Z##-ROOM-CL-A labeling, bracket install); codes and standards (NEC 640, 725, 800, CEDIA RP-22, ANSI/CEA-2010-A, NJ UCC, IEC 60268); without written direction

SONOS S2 PLATFORM

The Sonos S2 platform is the most widely integrated streaming layer in luxury residential distributed audio. The S2 app is required for all current hardware; the legacy S1 app supports pre-2020 hardware only and does not receive new features. Sonos uses a local-network-first architecture: streams are buffered on each device, coordination managed via the S2 app or a third-party control system driver (Crestron IP, Control4 SDDP, Savant IP, Lutron via dedicated Pico remote). Cloud dependency is limited

to authentication and streaming service handshakes.

Model / Part Number	Power / Type	Key Spec	Integration Notes
Sonos Port PORT1US1BLK · \$499	Network streamer no amplification	DAC + RCA line-out Digital coax out 12V trigger RCA line-in	IP/TCP and RS-232 drivers for Crestron, Control4, Savant, Lutron; replaces discontinued Sonos Connect; no HDMI ARC; no native AES67
Sonos Amp Gen 2 AMP1US1BLK · \$699	125W/ch @ 8Ω Class D	HDMI eARC/ARC RCA sub pre-out 1U rack-mount Custom banana jacks	One Amp per stereo zone; Crestron IP driver; Lutron RadioRA 3 / HWQSX; Control4 SDDP; Savant IP; stack multiples for multi-zone deployments
Sonos Amp Multi (2026 product)	125W/ch @ 8Ω 8 ch / 4 zones GaN PFFB	Wi-Fi 6 Gigabit Ethernet USB audio < 5.5W idle	4 simultaneous streams; reduced rack footprint for 4-zone deployments; AirPlay 2, Spotify Connect; designed for professional installation
Sonos Era 300 (spatial audio zones)	6 × Class D Self-powered	Wi-Fi 6, BT 5.3 USB-C line-in Dolby Atmos	Music rooms, libraries, high-ceiling primary zones where passive in-ceiling is not appropriate; not a replacement for an engineered passive system

CRESTRON DM NAX PLATFORM

DM NAX (Network AV Audio-over-IP) is Crestron's Audio-over-IP platform built on the AES67 standard with Crestron proprietary extensions. A single DM NAX system supports up to 32 DM NAX devices and up to 256 audio output zones. DM NAX devices are natively interoperable with Dante via AES67 compatibility mode enabled through Dante Controller software. Full DSP capabilities including matrix mixing, PEQ, shelving, high/low-pass filtering, and time alignment are available on all outputs. The Crestron Sonnex product line reached end-of-sale May 28, 2021; DM NAX is the replacement path for all new projects.

Device / Part Number	Form Factor	Audio Capability	Control
DM-NAX-AMP-X300 Amplifier	1U half-rack Surface or rack	4×75W Lo-Z @ 4/8Ω; or 2×150W bridged; or 1×300W bridged; 70V/100V Hi-Z; full DSP matrix mixing; S/N 113 dB; THD+N < 0.1%; freq response 20 Hz–20 kHz ±0.5 dB	SIMPL Windows, C#, RESTful API, Crestron Home; DHCP auto-discovery; AES67 secondary stream; NEC 640 Class 2 Lo-Z
DM-NAX-2XLRI-1G XLR Input Wall Plate	Single-gang PoE 802.3af	2 × XLR balanced in; mic gain to 60 dB; +48V phantom power; full EQ per channel ±20 dB; S/N 111 dB; THD+N 0.005%	SIMPL Windows, C#, RESTful API, web interface; 5W PoE

DM-NAX-AUD-IO Analog I/O Interface	US box or rack PoE 802.3af; 5W	Stereo analog in/out; balanced/unbalanced line-level; S/N 110 dB (line); 113 dB (digital); THD+N 0.005%; full AES67 + Dante AES67 interop mode	SIMPL, C#, RESTful API; Dante interop via AES67 mode
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SAVANT, CONTROL4 TRIAD, JBL SYNTHESIS, AND LYNKDORF PLATFORMS

Platform	Key Hardware	Zones / Power	Notes
Savant IP Audio	IP Audio 125 (PAV-SIPA125SM-10) Pro Audio 4 (SMA-5000) MOTU-AVB switch	IP Audio 125: 4 amplified zones @ 125W/ch @ 8Ω + 2 pre-out; up to 3 units linked via AVB switch for 18 zones total; Pro Audio 4: 4 zones @ 50W/ch, passive cooling, 2 RS-232	AVB over Ethernet; Savant Music (MirageOS) built in; native Savant Pro App control; requires pairing with Savant Smart Host
Control4 Triad	Triad One (TS-SAMP1-100) · \$700 Triad 8-Zone (AMP-8D-150) T4 touchscreens	Triad One: 1 zone, 100W/ch @ 4Ω, 24-bit/192 kHz, 10-band PEQ; Triad 8-Zone: 8 zones, 50W/ch @ 8Ω (all ch driven), ICEpower, 5-band PEQ, 1U	Triad One: 2–4 second encoding delay on analog inputs — do not specify as sole source where lip sync matters; Control4 SDDP; programmed via Composer Pro (dealer-only)
JBL Synthesis SDP-58	16-channel AV preamplifier Dolby Atmos / DTS:X / Auro-3D	16×XLR balanced outputs (10V RMS max); Dirac Live with Bass Control; Dante networking all 16 ch on single Cat5e/Cat6; Roon Ready; AirPlay 2; Spotify Connect; TIDAL Connect	Theater-overflow to whole-house: pre-amp outputs feed distributed zone amps; specify when estate has both theater and distributed audio
Lyngdorf MP-50 / MP-60 2.1	16-channel multichannel processor RoomPerfect correction AES/EBU + HDMI	MP-50: 16×XLR (5V RMS max); MP-60: 16×XLR (8V RMS max); HDMI 2.1 (MP-60); 4K120/8K30; VRR; Dolby Vision; Roon Ready; AirPlay; Tidal Connect; Spotify Connect	MP-60 2.1 is current flagship; for estates where theater and whole-house share one processor, pre-amp outputs feed distributed zone amplifiers

FIELD RULE**One platform per home. Choose before rough-in.**

Every distributed audio platform carries its own app, credential, driver, and scene-management model. A Sonos zone and a Savant zone in the same residence require two apps, two control paths, and two service relationships at every future call. The platform selection is binding once the distribution closet is framed. Document the platform choice, amplifier count, and zone assignments in the project specification and obtain client sign-off before rough-in begins.

SPECIFICATION**AES67 and Dante interoperability — for multi-platform edge cases only.**

AES67 (IEEE 1588 v2 PTP, RTP over IP, 48/96 kHz, 16–32-bit) is the interoperability standard across Crestron DM NAX, Dante (Audinate), Q-SYS, and JBL Synthesis (Dante-native). DM NAX enables AES67 mode natively; Dante devices enable it via Dante Controller software. When mixing AES67 and Dante on the same network, configure Dante AES67 mode and match the AES67 multicast address. This capability is documented for edge cases where a JBL Synthesis SDP-58 or similar Dante-native processor must coexist with a DM NAX zone system on a large estate — it is not a license for mixed-platform design on a standard single-family residential project.

NOTE**Crestron Sonnex is end-of-sale. Do not specify for new projects.**

Crestron announced end-of-sale for the Sonnex product line on April 30, 2021, effective May 28, 2021. Legacy Sonnex hardware currently in the field (SWAMPIE-8, SWE-8, SAT-70V/100V-2, S-EXT1-S KIT) is supported until respective end-of-support dates. The replacement path for all new Restrepo projects is the DM NAX platform: DM-NAX-AMP-X300, DM-NAX-AUD-IO, DM-NAX-2XLRI-1G. Contact Crestron True Blue Support (1-888-CRESTRON) for migration guidance on existing Sonnex accounts.

SOURCES

[Sonos Amp product page](#) [Crestron DM-NAX-AMP-X300 product page](#) [Crestron DM NAX AES67 documentation](#) [Crestron Sonnex End-of-Sale notice](#) [Savant IP Audio 125 QRG](#) [JBL Synthesis SDP-58 product page](#) [Lyngdorf MP-60 2.1 product page](#)

§ 02

Matrix Amplifiers

PART I — SOURCES & AMPLIFICATION

The matrix amplifier is the heart of the distribution closet. It converts the source platform’s audio output into amplified zone feeds for every passive speaker run in the residence. Amplifier selection is governed by three non-negotiable parameters: channel count against zone count, impedance stability at minimum load, and thermal management within the rack enclosure. No matrix amplifier on a Restrepo project is driven above 70% of its rated channel count at minimum impedance — documented as the 70% load mandate. NEC Article 640.6 governs wiring methods; at $\leq 25V$ and $\leq 100W$ per zone, Class 2 wiring methods under NEC Article 725 apply. For 70V and 100V Hi-Z distributed systems, Class 3 wiring applies.

MATRIX AMPLIFIER COMPARISON

Amplifier	Zones / Power	DSP	NEC 640 / Thermal	Best Fit
Crestron DM-NAX-AMP-X300	4 Lo-Z zones 4x75W @ 4/8Ω Or 2x150W bridged Or 1x300W bridged 70V/100V Hi-Z	Matrix mixing any input to any output; full PEQ, shelving, HPF/LPF, time alignment; S/N 113 dB; THD+N < 0.1%	Lo-Z @ $\leq 25V/\leq 100W$ = Class 2; Hi-Z = Class 3; no fan; auto-mute on fault; over-current, over-temp, DC offset protection	Crestron DM NAX deployments; Hi-Z 70V systems; up to 256 zones via DM NAX system
Sonance DSP 8-130 MkIII (SKU 93538)	8 zones 130W/ch @ 8Ω 145W/ch @ 4Ω 300W bridged/pair 24-bit/96 kHz	SonARC v2: 10-band PEQ per zone; hundreds of Sonance-matched EQ presets; IP, IR, 12V trigger; Crestron, Savant, Control4 drivers	Class 2 Lo-Z residential; fanless Class D; 93% efficiency; 1U full rack; accepts 12 AWG at Phoenix terminals	6–8 zone residential; Sonos or Bluesound platform; structured media panel or rack

Sonance DSP 2-150 MkIII (SKU 93542)	2 zones 150W/ch @ 8Ω 224W/ch @ 4Ω 473W bridged mono @ 8Ω	SonARC v2; 10-band PEQ; bridgeable; fanless Class D; 1U half-rack; signal-sensing	Class 2; fanless; terminal blocks accept 12 AWG; high-power primary zone amp	Master suite, great room, music room where 150W/ch is required; in-wall sub drive (bridged)
NAD CI 8-150 DSP	8 zones 150W/ch @ 8Ω (all ch) 180W/ch @ 4Ω 280W bridged @ 8Ω 0.02% THD	Browser-based DSP; per-zone gain, EQ, delay; 4 RCA pairs + 2 global bus + optical + coaxial inputs; S/N 90 dB; HybridDigital NCore; 4Ω stable throughout	2U; active fan (rack ventilation required); universal AC; 12V trigger; Ethernet LAN; IP control; Class 2 @ ≤25V/≤100W	8-zone luxury re sidential; primary zone po werhous e; Roon or Blueso und integ ration
NAD CI 16-60 DSP	16 zones 60W/ch @ 8Ω (all 16 ch) 140W bridged @ 8Ω/pair Hypex UcD	Browser-based DSP; loop-through inputs for source daisy-chain across multiple amps; Eco Mode; 5W standby; 3W network standby	2U; 12 AWG Phoenix terminals; 12V trigger; IR in/out; universal AC; Class 2; NEC 640; \$2,499 MSRP	12-16 zone estate; ambient zone coverage (< 65 dB SPL bath rooms, hallways, closets); estate se condary zones

FIELD RULE**70% load mandate. Document the load calculation in the closeout file.**

No matrix amplifier on a Restrepo project is driven beyond 70% of its rated channel count at minimum impedance. An 8-zone amplifier driving 4Ω loads on all zones simultaneously must be rated for 4Ω on all channels driven; derate accordingly when paralleling speakers or using volume controls that present complex impedance to the output stage. Calculate the total impedance presented to each zone output. Document the load calculation in the project closeout file. If the calculation shows any zone below the amplifier's minimum rated impedance, add an impedance-matching volume control or reconfigure the zone.

SPECIFICATION**NEC 640.6 and NEC 725 — Class 2 for Lo-Z residential; Class 3 for 70V.**

NEC Article 640.6 specifies that audio system wiring methods comply with Articles 725 and 800. For residential audio operating at $\leq 25V$ and $\leq 100W$ per zone (all Lo-Z matrix amp outputs to passive speakers), Class 2 wiring methods under NEC 725, Part III apply — meaning CL2-rated or CL3-rated in-wall speaker cable is required in all wall and ceiling cavities. For 70V and 100V distributed speaker systems (Hi-Z), Class 3 wiring applies. NEC 725.136 mandates separation of Class 2/3 conductors from line voltage: minimum 2 inches in a shared enclosure (with approved barrier) or 6 inches minimum if unenclosed and not in conduit.

BEST PRACTICE**Sonance DSP 8-130 MkIII as the Restrepo standard for 6-8 zone residential.**

The Sonance DSP 8-130 MkIII combines 8 independent 130W/ch amplified zones, the SonARC v2 10-band parametric EQ with hundreds of Sonance-matched presets, fanless Class D operation at 93% efficiency, and published Crestron/Savant/Control4 drivers in a single 1U full-rack unit. No fan means no ventilation constraint in a structured media panel. Specify the DSP 2-150 MkIII alongside it for the master suite or music room where the 150W/ch power class and 473W bridged capability are needed.

NOTE**NAD CI 8-150 DSP requires active cooling. Plan rack ventilation at specification.**

The NAD CI 8-150 DSP includes three side-mounted cooling fans. Specifying it in an enclosed structured media panel without dedicated ventilation will cause thermal shutdown. Plan the rack enclosure with at least one ventilation panel or specify an enclosed rack with a fan tray kit before the closeout package. The NAD CI 16-60 DSP uses the Hypex UcD output stage, which is highly load-invariant and extremely low distortion in the audible range — appropriate for 12-16 ambient zones where the per-zone power class of 60W/ch at 8Ω is sufficient.



SOURCES

[Sonance DSP 8-130 MkIII product page](#) [Sonance DSP 2-150 MkIII product page](#) [NAD CI 8-150 DSP — Crutchfield](#) [NAD CI 16-60 DSP launch — The Absolute Sound](#) [Crestron DM-NAX-AMP-X300](#)

PART 2

Speakers & Placement

Sections 03–05 — In-Ceiling and In-Wall Speakers, Subwoofers and Bass Management, Speaker P

§ 03

In-Ceiling and In-Wall Speakers

PART II — SPEAKERS & PLACEMENT

Speaker selection in luxury residential audio is a commitment made before the framing inspection. The bracket is set before the board goes up. The back-can is installed before the drywall is hung. The service loop is coiled in the cavity before the rocker arrives. Every in-ceiling and in-wall speaker on a Restrepo project is specified by model number, bracket type, and zone assignment in the AV design package before the rough-in begins. Speaker families are organized here by tier and application: Sonance Visual Performance for standard residential ambient zones, Sonance Reference R1/R2 and JBL Synthesis SCL-3 for LCR and primary listening, B&W; CCM7.5 S2 and Revel C763 for premium 2-way in-ceiling, and Paradigm CI Elite for high-sensitivity primary zones.

SONANCE VISUAL PERFORMANCE (VP) SERIES — STANDARD RESIDENTIAL AMBIENT

Model	Driver	Sensitivity	Power Handling	Best Use / Install Notes
VP62R In-Ceiling	6.5" polypropylene woofer 1" cloth dome tweeter Pivoting 13°	89 dB 2.83V/1m 8Ω nominal	5–125W	Bathroom, closet, guest bedroom, small office — ambient zones; confirm ceiling depth ≥4.5" before framing; mark center on stud with chalk
VP82R In-Ceiling	8" textured PP woofer 1" aluminum dome tweeter Ferrofluid-cooled, pivoting Acoustic back chamber	90 dB 2.83V/1m 8Ω nominal; 6Ω min	5–125W Cutout: 10-1/8" Depth: 5-7/8"	Kitchen, great room, dining room, hallway — primary ambient zones; ceiling height 8–10 ft ideal; square grille adapter available
VP86R In-Ceiling	8" Carbon Fiber/Rohacell woofer 4" CF/Rohacell midrange (pivoting) 1" ceramic dome tweeter Ferrofluid-cooled	91 dB 2.83V/1m 8Ω nominal; 6Ω min	5–150W Cutout: 10-1/8" Depth: 5-7/8"	Primary listening zones (master suite, great room, library); ceiling 9–12 ft; tweeter level switch –3 dB / flat / +3 dB

SONANCE REFERENCE SERIES — LCR AND PREMIUM IN-WALL

The Sonance Reference Series is the premium in-wall LCR and surround system for theater-quality reproduction in residential environments. Carbon fiber / Rohacell laminated driver cones — the same material family used in high-end two-channel loudspeakers — deliver low coloration and controlled dispersion from a standard stud-bay installation.

Model	Configuration	Key Specs	Cutout / Install Notes
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Reference R1 (SKU 93344) \$1,350 each	3-way in-wall 1" ceramic dome tweeter (Ferrofluid) 5.25" CF/Rohacell midrange 2 × 5.25" CF/Rohacell woofers	Sensitivity: 90 dB (2.83V/1m) Impedance: 8Ω nom; 6Ω min Freq response: 70 Hz–30 kHz ±3 dB Power: 5–150W	Cutout: 7-1/2" W × 20-1/2" H Overall: 8-7/8" W × 21-3/4" H × 3-7/8" D Specify before drywall; bracket required
Reference R2 (SKU 93346) \$2,700 each	3-way in-wall 1" ceramic dome tweeter (Ferrofluid) 5.25" CF/Rohacell midrange 4 × 5.25" CF/Rohacell woofers	Sensitivity: 92 dB (2.83V/1m) Impedance: 6Ω nom; 4Ω min Freq response: 70 Hz–30 kHz ±3 dB Power: 5–200W	Cutout: 7-1/2" W × 33-1/2" H Fits standard stud bay vertically 34-7/8" height — confirm stud bay clearance before order Requires structural coordination

JBL SYNTHESIS SCL-3, B&W; CCM7.5 S2, REVEL C763, AND PARADIGM CI ELITE

Model	Type	Key Specs	Install Notes
JBL Synthesis SCL-3	2-way in-wall/in-ceiling Dual 5.25" cast-frame AA Matrix woofers 1" 2409H annular ring Teonex driver HDI constant directivity horn	Sensitivity: 91 dB (2.83V/1m) Impedance: 6Ω nom Max power: 300W RMS Freq: 65 Hz–33 kHz (–6 dB) Cutout: 14.2" × 14.2" Depth: 5.8"	Sealed wood back-box is a structural component — not optional; install back-box before drywall; secure to adjacent framing, not drywall alone; bi-wire/bi-amp capable; 5-way binding posts
B&W; CCM7.5 S2 In-Ceiling	2-way in-ceiling 6" Aramid Fibre woofer 1" Nautilus tube-loaded soft dome tweeter	Sensitivity: 88 dB (2.83V/1m) Impedance: 8Ω nom; 6.5Ω min Freq: 54 Hz–28 kHz (–6 dB) Amplifier power: 25–150W Frame width: 14" Cutout: 332mm (13.1") Depth: 184mm	No reservoir box required for CCM series; CWM7.5 S2 in-wall requires 385mm reservoir box before drywall; 60mm CWM depth — verify stud-bay clearance
Revel C763 In-Ceiling	2-way in-ceiling 6.5" MCC cone; cast-aluminum frame 1" aluminum dome; swiveling; integrated waveguide 3-position HF level control	Sensitivity: 88 dB (2.83V/1m) Impedance: 8Ω nom Amplifier power: 10–140W Cutout: 8" (203mm) Depth: 4-25/32"	Round and square zero-bezel magnetic grilles included; boundary compensation switch for wall-proximity placement; spring-post terminals accept 10 AWG bare wire or banana plugs
Paradigm CI Elite E80-R v2 In-Ceiling	2-way in-ceiling 8" AL-MAG woofer; ART surround 1" AL-MAC tweeter with PPA Lens 3rd-order crossover @ 2.0 kHz Advanced SHOCK-MOUNT, CARBON-X Baffle	Sensitivity: 93 dB room / 89 dB anechoic Impedance: 8Ω compatible Freq: ±3 dB, 60 Hz–22 kHz Amplifier: 15–160W Cutout: 9-3/16" Depth: 3-7/8"	AL-MAC tweeter requires no break-in period; E80-IW v2 in-wall version: 11-9/16" × 8-1/16" cutout; power: 15–180W; depth 3-3/8"; coordinate with framing

INSPECTION STANDARD**Bracket discipline — install before board, not after.**

Every in-ceiling and in-wall speaker bracket, back-can, or mounting ring on a Restrepo project is installed before drywall application. Confirm: (1) bracket centered on the mark established in the framing plan; (2) bracket plumb and level in the ceiling or wall plane; (3) wire pulled through the bracket opening with service loop secured; (4) model number spec sheet taped inside the back-can for future reference; (5) center of speaker marked on framing with chalk so the rocker preserves location. The JBL SCL-3 sealed wood back-box is fastened to adjacent framing — never to drywall alone. The Sonance R2 requires structural coordination for the 34-7/8" stud-bay height before the framing package is finalized.

BEST PRACTICE**Sonance VP86R for primary ambient zones; R1/R2 for LCR and music rooms.**

The VP86R carbon fiber / Rohacell midrange delivers noticeably lower coloration than the polypropylene-cone VP82R at the same physical footprint and cutout diameter. For great rooms, libraries, and master suites where the client expects music-quality reproduction from in-ceiling speakers, specify the VP86R at the same ceiling depth as the VP82R — no additional framing coordination. Reserve the Reference R1 and R2 for in-wall LCR positions in media rooms and dedicated music rooms where the stud-bay depth and structural pre-planning are confirmed before the framing package is signed.

SOURCES

[Sonance Visual Performance Series](#) [Sonance Reference R2 product page](#) [JBL Synthesis SCL-3 product page](#) [B&W; CCM7.5 S2 product page](#) [Revel C763](#) — [Crutchfield Paradigm CI Elite E80-R v2](#)

Subwoofers and Bass Management

PART II — SPEAKERS & PLACEMENT

Subwoofer placement in whole-house audio is governed by the same room acoustic principles as theater subwoofers but with fewer architectural resources. Primary decisions: in-wall versus in-ceiling versus discrete placement; single versus multiple subwoofer configuration; room boundary optimization. For new construction primary listening zones, in-wall back-can subwoofers are specified before drywall. For retrofit or secondary zones, discrete floor-standing subwoofers are placed against the wall midpoint. All subwoofer specification is confirmed before the framing package is signed on new construction. Effective bass management requires high-pass filtering the main channels, crossover alignment, time alignment, and level matching as a signed protocol at commissioning.

SUBWOOFER SELECTION TABLE

Model	Configuration	Key Specs	Application
JBL Synthesis SSW-1	Dual 15" passive in-room Bass reflex; dual Slipstream ports @ 18 Hz 1" MDF with internal bracing	Recommended power: 5,000W RMS total Impedance: 8Ω per woofer Sensitivity: 90 dB/1W/1m Freq: 15 Hz–400 Hz (–6 dB) Dims: 53.5"H × 24"W × 22"D; 350.5 lbs	Dedicated media room or music room with structural floor support and custom millwork; requires structural engineering review; not appropriate for standard residential rooms without floor loading analysis
Paradigm Defiance X10 \$1,199.99 Defiance X12 \$1,499.99 Defiance X15 \$1,999.99	10"/12"/15" ported ART surround; carbon-loaded PP cone Class D amplifier Built-in Anthem ARC (app-controlled)	X10: 29 Hz–240 Hz ±3 dB; 24 Hz DIN X12: 20 Hz–230 Hz ±3 dB; 15 Hz DIN X15: 18 Hz–240 Hz ±3 dB; 14 Hz DIN Variable LPF 30–120 Hz; phase 0–180°	Great room, kitchen supplement, ambient zone; app-based ARC calibration for quick integration; cosmetically acceptable in residential millwork alcoves
REL Acoustics S/812 \$2,999 each	12" front-firing active + 12" down-firing passive radiator NextGen 5 Class D; 800W RMS Neutrik Speakon high-level input	Low freq extension: –6 dB @ 19 Hz Inputs: high-level Speakon; low-level RCA; LFE RCA/XLR Dims: 17"W × 17.5"H × 20"D; 75 lbs REL AirShip II optional wireless	Primary music rooms — music-first subwoofer; high-level Speakon input preserves sonic character of main amplifier; ideal with Revel C763 or VP86R zones; specify in pairs for asymmetric room correction

SVS SB-3000 (sealed) SVS PB-3000 (ported)	13" SVS 3000 Series driver Sledge STA-800D2; 800W RMS (2,500W peak) Class D; MOSFET output stage SVS app; 3 EQ presets	SB-3000: 18–270 Hz ± 3 dB; sealed PB-3000: 16–260 Hz ± 3 dB; ported SB-3000 dims: compact footprint; rear-mounted amp PB-3000 dims: 21.9"H $\times$ 18.3"W $\times$ 26"D; 82 lbs	Retrofit zones; SVS app (56-bit DSP, 3-band PEQ, room gain compensation); SB-3000 for music-focused sealed performance; PB-3000 for maximum low-frequency extension
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BASS MANAGEMENT PROTOCOL

Step	Parameter	Standard Setting	Notes
1	High-pass filter on main channels	80 Hz HPF for VP82R/VP86R in standard ceiling 100 Hz HPF for VP62R in small rooms	Set per-zone HPF at or above speaker's -3 dB low-frequency point; removes bass from main channels to prevent excursion in small drivers
2	Subwoofer crossover (LPF)	80 Hz typical 60 Hz for music rooms with extended main speakers	Set sub LPF to match or slightly overlap main channel HPF; ensures seamless handoff; avoid large gaps or excessive overlap
3	Time alignment	Measure speaker-to-sub propagation delay; apply digital delay to mains or sub	Phase-align at crossover frequency; measure with RTA microphone at primary position; DSP delay control available in Sonance SonARC, NAD browser DSP, Dirac Live
4	Level matching	-0.5 dB to ± 0.5 dB at primary position Pink noise at -20 dBFS reference	Use calibrated SPL meter at primary listening position; match main and subwoofer levels to ± 0.5 dB; document final settings in commissioning record

NOTE

NEC 725 daisy-chain note for dual subwoofer configurations.

When daisy-chaining two subwoofer amplifiers (e.g., two SVS units in an asymmetrical room), NEC Article 725, Section 725.136 requires separation of Class 2 power-limited audio wiring from line voltage by at least 6 inches minimum (2 inches if inside conduit or separated by a fixed barrier). Ensure each subwoofer feeds from an independent Class 2 circuit; do not parallel subwoofer amplifiers without proper line-level splitting to prevent ground loops and impedance mismatch at the amplifier output stage.

FIELD RULE**Bass management is signed at commissioning, not set at punch-list.**

Bass management — high-pass filter frequencies, subwoofer crossover, time alignment, and level matching — is a four-step protocol executed with a calibrated measurement microphone at commissioning. It is not a volume knob adjustment performed at punch-list walk. Document the final filter settings, crossover frequency, and subwoofer level in the commissioning record. Sign the record with the integrator and client representative before system is handed over.

SOURCES

[JBL Synthesis SSW-1 product page](#) [Paradigm Defiance X10 product page](#) [REL S/812 — Scott Walker Audio](#) [SVS SB-3000 product page](#)

§ 05

Speaker Placement Geometry

PART II — SPEAKERS & PLACEMENT

Speaker placement is determined before the framing inspection. The audio design package specifies every speaker location by room, ceiling height, and distance from boundaries before the structural walk occurs. Universal geometry rules define minimum and maximum spacings. Room-by-room guidance applies those rules to the specific acoustic character and use case of each space. Placement decisions cannot be deferred to the drywall phase.

UNIVERSAL GEOMETRY RULES

Rule	Ambient Listening (≤70 dB SPL)	Primary Listening (≤85 dB SPL)
Speaker pair density	One in-ceiling stereo pair per 100 sq ft of room area	One in-ceiling stereo pair per 60 sq ft; or one high-sensitivity speaker per 80 sq ft with tweeter aimed at seating
Pair spacing	7–8 ft between speakers in a stereo pair configuration	5–6 ft for smaller high-ceiling rooms; adjust to preserve stereo image at primary seat
Wall boundary clearance	Minimum 18 inches from any wall boundary	18 inches minimum; if closer, apply boundary compensation switch (Revel C763/C563) or low-shelf cut –2 to –3 dB below 200 Hz in zone DSP
Tweeter pivot aim	Aim tweeter toward primary listening area or walking path (corridors)	Cross tweeters to converge at seated listening height at primary seat; never leave pivoting tweeters aimed straight down in offset-seating rooms

ROOM-BY-ROOM PLACEMENT GUIDANCE

Room Type	Speaker Specification	Subwoofer	Zone DSP
Formal Living Room	One stereo pair of 8" in-ceiling (VP82R, Paradigm E80-R, or Revel C763) per seating area; ceiling height 8–10 ft ideal; min distance from primary sofa 7–9 ft	REL S/812 on floor in corner; high-level Speakon input from main amp	Full PEQ + Dirac Live or SonARC preset; boundary compensation if speakers placed ≤18" from wall
Great Room / Open Plan	Two stereo pairs minimum for open spaces > 600 sq ft; consider separate zones at kitchen island and main seating group (different volume levels, same source); VP82R or VP86R	Paradigm Defiance X12 or X15 at wall midpoint	RoomPerfect (Lyngdorf) preferred for open-plan variable-position listening; Dirac Live (NAD) acceptable

Kitchen	One stereo pair of 6.5" in-ceiling (VP62R or Revel C563); avoid placement directly over range hood (heat) or exhaust fan (vibration coupling)	Not required for kitchen-only zones	Basic gain trim; 100 Hz HPF for VP62R
Master Suite	Bedroom: one stereo pair 6.5"–8"; aim tweeter toward head of bed; limit volume max to 70% of amplifier output in programming; Master Bath: VP62R; moisture-resistant grilles; IC-rated back-can for insulated ceiling	None in master bath; optional discrete for bedroom if music room function overlaps	PEQ per zone; volume ceiling programmed in controller
Media Room / Theater Spillover	LCR in-wall: Sonance R1/R2, JBL Synthesis SCL-3, or Triad Gold InWall; surround and height per CEDIA RP-22 v1.2 placement angles	JBL SSW-1 (primary theater) or Paradigm Defiance X15; front-wall between main L/R speakers	Full room correction; signed Dirac Live or ARC Genesis protocol
Library / Home Office	Preferred: in-wall bookshelf configuration (Sonance R1, B&W; CWM7.5) at ear level seated; alternative: B&W; CCM7.5 S2 in-ceiling; library shelving with books is excellent natural diffusion	REL S/812 if audiophile-level music listening is specified by client	Full PEQ; note treatment from shelving reduces need for aggressive correction
Gym	One or two stereo pairs of 8" in-ceiling; high sensitivity (≥ 90 dB) preferred; dedicated zone amplification — never share with quiet-zone (bedroom) circuits	Not specified unless music room function overlaps with gym	Gain trim; no room correction required for gym-only zones

BEST PRACTICE**Tweeter aim is set at pre-wire, confirmed at speaker installation.**

Pivoting-tweeter in-ceiling speakers (Sonance VP series, Paradigm CI Elite, B&W; CCM series) have a limited pivot range — typically $\pm 15^\circ$ from center. For a speaker placed off-center from the primary seating position, confirm that the required aim angle is within the tweeter's physical pivot range before committing to the speaker location. Mark the intended tweeter aim direction on the back-can at pre-wire with a permanent marker so the installation technician sets the pivot correctly before the speaker is pushed into the ceiling.

NOTE**Outdoor zone interface — reference Volume 20 for all landscape audio.**

At the indoor/outdoor zone boundary, install an outdoor-rated keypad (Lutron Maestro WR or equivalent) at the patio entry point for convenient volume access. Run the home run for outdoor zones from the distribution closet in 3/4" minimum EMT or Schedule 40 PVC conduit through the exterior slab or wall; terminate at junction box at patio equipment location. Volume 20 of the Restrepo Field Standards Library governs all outdoor and landscape audio specifications. This section covers the indoor/outdoor handoff only.

SOURCES

[CEDIA RP-22 v1.2 Immersive Audio Design Recommended Practice \(PDF\)](#) [Sonance Visual Performance Series Paradigm CI Elite E80-R v2](#)

PART 3

Control & Streaming

Sections 06–09 — DSP and Room Correction, Zone Topology and Rack Sizing, Keypads · Control ·

§ 06

DSP and Room Correction

PART III — CONTROL & STREAMING

Room correction is the most consequential post-installation process in whole-house audio. No amount of quality hardware compensates for an uncalibrated installation. DSP and room correction are not optional enhancements on a Restrepo project — they are part of the commissioning protocol. The correction session is documented, the filters are saved, and the record is signed by the integrator and client representative before system handover. Four correction platforms are used across the Restrepo product ecosystem: Dirac Live, Anthem ARC Genesis, Lyngdorf RoomPerfect, and Sonance SonARC. Each is appropriate for a specific amplifier and zone architecture.

ROOM CORRECTION PLATFORM COMPARISON

Platform	Implementation Partners	Algorithm Type	Protocol	Notes
Dirac Live (with Bass Control)	NAD CI 580, CI 720 v2 (licensed add-on) JBL Synthesis SDP-58 (included, not add-on)	Time-domain + frequency-domain Target curve matching Multi-position measurement Group delay correction	Minimum 9 measurement positions for whole-house zones; minimum 3 for small ambient zones; Harman house curve target (+5 dB @ 20 Hz rolling to 0 dB @ 1 kHz) for music-primary rooms	Dirac Live with Bass Control extends optimization to subwoofer integration frequency; individual corrections per sub in multi-sub configurations; licensed add-on for NAD CI series; included in SDP-58

Anthem ARC Genesis	Anthem MRX-1140 Paradigm Defiance X subwoofers (built-in, app-controlled)	Frequency-domain 4 storable calibration profiles Precision calibration microphone Web UI for remote configuration	32-bit / 768 kHz DAC in MRX-1140 ensures correction at reference fidelity; web UI for remote management; Defiance X series: ARC via smartphone app (Micro USB firmware port)	4 storable profiles useful for different listening positions; redesigned calibration microphone in MRX-1140 8K revision
Lyngdorf RoomPerfect	Lyngdorf MP-50 Lyngdorf MP-60 2.1	Full-room time and frequency domain 8–10 measurement positions distributed throughout room 32 adjustable voicings with ≤ 8 filters per voicing	Measure at multiple positions including floor, seated, and standing heights; generates global correction that improves performance throughout the room, not only at one seat	Global correction is specifically advantageous in open-plan spaces (great rooms, kitchens with islands) where listening position varies; multiple voicings stored and recalled per listening mode

Sonance SonARC v2	Sonance DSP 2-150 MkIII Sonance DSP 8-130 MkIII	10-band parametric EQ per zone Hundreds of speaker-matched Sonance presets Custom PEQ capability	IP (Ethernet), IR, and 12V trigger (3–30V; Bang & Olufsen compatible); Crestron, Control4, and Savant drivers published; pull-down preset menus for Sonance speakers	SonARC presets eliminate manual EQ tuning when pairing Sonance amplifiers with Sonance speakers; custom 10-band PEQ available for non-Sonance speaker pairings
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FIELD RULE

Room correction session is a signed commissioning deliverable.

The room correction session — microphone placement, measurement positions, target curve selection, filter generation, and final level matching — is executed by the commissioning technician with a calibrated measurement microphone at the primary listening position and surrounding positions. The resulting filter profile is saved to the amplifier or processor. A correction report (screenshots of the before/after frequency response curves) is printed or exported and placed in the project closeout folder. The commissioning record is signed by the integrator and the client representative. The system is not handed over without this signed record.

BEST PRACTICE

Dirac Live with Bass Control for NAD CI + subwoofer configurations.

For projects using NAD CI 8-150 or CI 720 v2 with an integrated subwoofer zone, specify the Dirac Live license add-on. The Bass Control extension applies individual correction filters to each subwoofer in multi-sub configurations — closing the gap between the main speaker high-pass point and the subwoofer low-pass point where most residential rooms have the largest response anomalies. The Harman house curve target is the Restrepo standard for music-primary rooms: approximately +5 dB at 20 Hz rolling off to 0 dB at 1 kHz.



SPECIFICATION**Audyssey MultEQ XT32 — zone amplifier application context.**

Audyssey MultEQ XT32 (8,192-point filters per channel) is AV-receiver-centric and is not applied directly to distributed zone amplifiers (Sonance DSP, NAD CI) — those products use their own DSP platforms. Where a Denon or Marantz receiver is used as a zone processor for a secondary theater or media room feeding an adjacent distributed zone, the MultEQ XT32 calibration improves the source quality before distribution. Specify accordingly in the zone architecture documentation.

SOURCES

[Dirac Live for NAD Anthem MRX-1140 / ARC Genesis product page](#) [Lyngdorf MP-50 product page](#) [Sonance DSP 8-130 MkIII \(SonARC\)](#)

§ 07

Zone Topology and Rack Sizing

PART III — CONTROL & STREAMING

Zone topology defines the physical and logical architecture of audio distribution from the distribution closet to every speaker location in the residence. The Restrepo standard is hub-and-spoke: all speaker home runs terminate at a single distribution closet. No in-wall daisy-chaining. No Y-splitters. No loop connections through volume controls between zones. Hub-and-spoke enables per-zone impedance control, independent volume and DSP management, and reliable fault isolation. Zone count, rack size, network infrastructure, and distribution closet requirements are all defined before framing.

ZONE CLASSIFICATION TABLE

Zone Type	Examples	Amp Power	DSP Requirement
Primary listening	Great room, master suite, library, music room	100–150W/ch @ 8Ω	Full PEQ + room correction (Dirac Live, ARC Genesis, RoomPerfect, or SonARC preset)
Secondary listening	Kitchen, dining room, formal living	50–100W/ch @ 8Ω	PEQ per zone; gain trim; no full room correction required
Ambient	Primary bath, powder room, hallway, closet	25–70W/ch @ 8Ω	Basic gain trim; 100 Hz HPF for 6.5" speakers in small rooms
Utility / value	Mudroom, utility area, guest bath	25–50W/ch @ 8Ω	None required; volume control at keypad sufficient
Outdoor	Patio, pool deck, landscape	Per Volume 20 spec	Per Volume 20 spec; home run from distribution closet in conduit

ZONE COUNT BY PROJECT TIER

House Tier	Zone Count	Primary Equipment	Control Platform
6-Zone (3,000–5,000 sq ft)	2 primary; 4 ambient	1 × Sonance DSP 8-130 MkIII or NAD CI 8-150 DSP; Sonos Port per source room; Sonos Amp (kitchen, great room)	Lutron RadioRA 3 keypads; Control4 EA-1 or Savant Pro Host
8-Zone (5,000–8,000 sq ft)	3 primary; 5 ambient	1 × NAD CI 8-150 DSP; 1 × Sonance DSP 2-150 MkIII (master suite or music room); Roon Nucleus; Sonos Port; Bluesound Node X	Lutron HomeWorks QSX + Crestron Home integration or Control4 EA-3

12-Zone (8,000–15,000 sq ft)	4 primary; 8 ambient	1 × NAD CI 16-60 DSP (16 ch) + NAD CI 8-150 for primary zones; Roon Nucleus+ or ROCK on Intel NUC; multiple Sonos Amps; Bluesound Node X	Crestron Home (PROC3/CP4N) + Lutron HomeWorks QSX; Crestron Horizon keypads; TSW-770 or TSW-1070 touchscreens
16-Zone+ (15,000+ sq ft / Estate)	5+ primary; 10+ ambient	2 × NAD CI 16-60 DSP (32 ch total); 2–3 × Sonance DSP 2-150 MkIII; Savant IP Audio 125 in outbuildings; Roon Nucleus+; JBL SDP-58 or Lyngdorf MP-60	Crestron DMPS3-300-C or MC4 controller; full Crestron Home; 4" and 7" keypads throughout; TSW-1070 in primary gathering rooms

DISTRIBUTION CLOSET AND RACK SIZING

Component	Rack Space	Cooling Requirement
NAD CI 8-150 DSP (1 unit)	2U	1 × rack ventilation panel or enclosed rack with fan kit; active fan in unit
NAD CI 16-60 DSP (1 unit)	2U	Same as CI 8-150; active cooling required in conditioned space or dedicated ventilation
Sonance DSP 8-130 MkIII (1 unit)	1U	No fan required; fanless Class D; can install in structured media panel
Crestron DM-NAX-AMP-X300 (1 unit)	1U half-rack	Rack-mount with half-rack shelf; no fan required; low thermal output
Sonos Amp (per unit)	1U with rack shelf	No fan required; low heat; stacking multiple units acceptable
Rack total (8-zone project, typical)	6U equipment + 2U patch + 1U management	Allow 2U additional thermal clearance between active units; ambient rack temp must remain below 95°F / 35°C

NETWORK INFRASTRUCTURE FOR AUDIO DISTRIBUTION

Infrastructure	Specification	Notes
Cat6A runs	All network audio runs: DM NAX, Savant AVB, Roon endpoints, Sonos	Terminate with RJ-45 Cat6A keystone jacks (Belden REVConnect or equivalent); do not use Cat5e for new construction
Fiber	Runs exceeding 100 m between distribution points; inter-building galvanic isolation	OM3 or OS2 depending on transmission distance and manufacturer requirements; specify fiber between main house and guest house, pool house, or outbuilding
Managed switch	Cisco CBS350 or similar L2 managed switch for DM NAX deployments	Must support IGMP snooping, QoS (DSCP marking for audio traffic), and VLAN segmentation; Savant AVB requires AVB-certified switch (Savant MOTU-AVB or compatible)

PoE budget	DM-NAX-2XLRI-1G and DM-NAX-AUD-IO: PoE IEEE 802.3af Class 0 (12.95W each)	Calculate total PoE budget before finalizing switch specification; include all Crestron DM NAX edge devices, keypads, and access points
AC circuits	1 × dedicated 20A (audio equipment); 1 × dedicated 20A (networking)	Rack-mount power conditioning (Furman or equivalent) with surge protection, EMI filtering, and voltage regulation required on audio circuit

FIELD RULE

Hub-and-spoke. No daisy-chain. No exceptions without written direction.

Daisy-chain speaker wiring — running wire from speaker A to speaker B inside the wall — creates parallel impedance loads the amplifier cannot independently control, prevents per-speaker DSP processing, and eliminates the ability to diagnose individual speaker faults. Every speaker location on a Restrepo project receives its own dedicated, uninterrupted cable home run from the distribution closet to the speaker back-can or wall bracket. Any departure from this topology requires written direction from the Restrepo principal with an explicit load-management plan (see Section 13).

SOURCES

[Russound MCA Series context](#) [NAD CI 720 v2 Roon Ready confirmation](#) [Savant MOTU-AVB 5-Port AVB Switch](#)



§ 08

Keypads, Control, and Voice

PART III — CONTROL & STREAMING

The control layer determines the client experience of a whole-house audio system more than any other specification decision. A correctly placed, correctly programmed wall keypad at every zone entry point is the standard. Touchscreen panels supplement keypads in gathering rooms. Mobile app control is available through the platform’s native app on the client’s existing devices. Voice control is available as a secondary convenience layer — it is not the primary interface on a Restrepo project.

LUTRON CONTROL PLATFORMS

Platform	Tier / Size	Audio Integration	Notes
Lutron RadioRA 3 (RA3)	Mid-tier residential Up to 200 devices per system	Sonos integration via RA3 Sonos driver (single-scene, not toggle programming); audio scene control from Pico remote; without third-party control system, Sonos is limited to dedicated Pico remote	Standard specification for 3,000–8,000 sq ft projects; Crestron, Control4, and Savant can integrate RA3 for full audio + lighting scene coordination
Lutron HomeWorks QSX (HWQSX)	Premium residential 8,000+ sq ft projects Unlimited devices	Native integration with Crestron Home (discovered on same subnet; no license required); HWQSX supports lighting and shading scenes recalled in concert with audio events; scenes programmed in Lutron Designer Software and imported into Crestron Home	Restrepo standard for 8,000+ sq ft tier; individual load control available; Crestron Home Lutron integration: ‘pair and configure’ workflow in Crestron Home UI

CRESTRON, SAVANT, AND CONTROL4 CONTROL INTERFACES

System	Key Hardware	Audio Control Capability	Notes
Crestron Home	Crestron Horizon keypad TSW-570E / TSW-770 / TSW-1070 touchscreens	Native audio pages on all current Crestron Home panels: zone-by-zone source selection, volume sliders, transport controls, now-playing metadata; no custom programming required for basic audio function	Horizon keypad: source selection, volume, play/pause from wall plate; multiple button configurations; standard on 12-zone and larger Restrepo projects
Savant Pro	Savant Pro App (iOS primary) Savant Pro touch panels (iOS hardware) Savant Pro Remote (PRO-BDES01)	All audio scenes, volume levels, and source selections managed through Pro App or Pro panels; Pro Remote for media room contexts	Pro App is the primary client interface; native Savant IP Audio control; requires pairing with Savant Smart Host or Pro Host

Control4	Control4 SR-260 remote T4 Series touchscreens (8" and 10") 1920×1200 capacitive touch	SR-260: source selection, volume, transport (play/pause/skip), programmed keypad actions; RF (ZigBee) to Control4 controller; rechargeable; optional charging station	SR-260 is the standard handheld for media rooms; T4 at 8" and 10" as in-wall and tabletop; in-wall PoE power (802.3af, 13W peak)
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APPLE HOME, AIRPLAY 2, AND VOICE CONTROL

Apple AirPlay 2 is natively integrated into Sonos (S2 app), Bluesound (BluOS), NAD CI series (BluOS), and JBL Synthesis SDP-58. AirPlay 2 allows multi-room audio grouping and synchronized playback across all AirPlay 2 endpoints from the iOS Music app, Apple Music, or any third-party app with AirPlay 2 support. HomeKit speaker support is available for Sonos via the Apple Home app with Siri voice control. Matter speaker control is emerging but not at production spec for whole-house audio distribution at the time of this publication.

DO NOT

Do not specify standalone smart speakers as primary whole-house audio control.

Amazon Alexa multi-room and Google Nest audio function as secondary convenience layers only — not primary interfaces on Restrepo projects. Alexa voice recognition introduces 1–2 second latency inappropriate for a refined listening experience, and the presence of Amazon microphone hardware in the space is inconsistent with a luxury residential tone. Google Nest carries similar caveats. Specify wall-mounted keypads (Lutron, Crestron Horizon) as the primary control interface. Voice control is available as a secondary convenience layer through the client’s existing devices (iPhone, iPad) using Siri to AirPlay 2 endpoints — no dedicated microphone device installed in the room is required.

BEST PRACTICE

Lutron HomeWorks QSX + Crestron Home as the Restrepo standard for 8,000+ sq ft.

The HomeWorks QSX + Crestron Home combination delivers integrated lighting, shading, and audio scene coordination from a single control plane without custom Crestron SIMPL Windows programming. Crestron Home discovers the HWQSX processor on the same subnet and exposes individual Lutron loads, groups, and scenes natively in the Crestron Home UI. Audio scenes programmed in Crestron Home recall Lutron lighting presets, zone source assignments, and volume levels simultaneously. This is the most efficient commissioning path for large residential projects and the most intuitive client experience.

SPECIFICATION**Two Cat6A home-runs to every keypad location, minimum.**

Two Cat6A home-runs land at every keypad backbox — Cat A active, Cat B coiled and labeled SPARE. The second Cat is the difference between a wall-open touchscreen upgrade later and a faceplate swap. Every keypad location (Lutron Sunnata, Crestron Horizon, or equivalent) receives two dedicated Cat6A home-runs from the distribution closet regardless of whether the current keypad requires only four-conductor low-voltage. Any keypad location may later be converted to a touchscreen or IP-based device; the second Cat6A home-run eliminates the wall-open rework that conversion would otherwise require.

SOURCES

[Lutron RadioRA 3 product page](#) [Crestron Home — Lutron HomeWorks QSX integration docs](#) [Crestron Home + Lutron integration — Residential Systems Control4 SR-260 product page](#) — [Snap One](#)

§ 09

Streaming Services and Library

PART III — CONTROL & STREAMING

The streaming layer is the most client-visible part of the audio system after the physical speakers. Platform selection (Section 1) determines which services are natively available. This section documents service quality tiers, integration paths, and local library architecture for Restrepo residential projects. Hi-res audio — 24-bit / 96 kHz and above — is achievable on every platform specified in this volume. The integration path determines where the decoding occurs.

STREAMING SERVICE QUALITY TIERS

Service	Max Quality	Protocol	Monthly Cost	Integration Notes
Apple Music	24-bit / 192 kHz ALAC lossless	AirPlay 2	\$10.99/mo individual No hi-res upcharge	AirPlay 2 protocol supports up to 24-bit / 48 kHz streaming; for full 24/192, audio decoded on source device (iPhone/iPad) before streaming; Sonos S2, Bluesound BluOS, NAD CI series all support AirPlay 2
Tidal HiFi Plus	24-bit / 192 kHz Hi-Res FLAC MQA up to 24-bit/192 kHz 360 Reality Audio	Tidal Connect	\$19.99/mo Tidal HiFi: \$10.99/mo (CD quality only)	Tidal Connect natively supported by Lyngdorf MP-50/MP-60, JBL Synthesis SDP-58, and Bluesound BluOS; Crestron and Savant require Roon or Bluesound endpoint in the chain
Qobuz Studio	24-bit / 192 kHz FLAC lossless	Qobuz streaming protocol	Studio Solo: \$12.99/mo Sublime: \$21.99/mo	Available via Roon (as streaming source), Bluesound BluOS, and NAD CI series; not natively available on Crestron or Savant without a Roon or Bluesound endpoint
Spotify	320 kbps Ogg Vorbis (lossy)	Spotify Connect	Individual plan varies	No lossless option; Spotify Connect is the standard integration across all platforms (Sonos, Bluesound, NAD, JBL Synthesis, Lyngdorf, Crestron)
Roon (library + streaming)	Up to 24-bit / 192 kHz via Roon Ready endpoints	RAAT (Roon Advanced Audio Transport)	Roon: \$14.99/mo or \$829.99 lifetime Separate from streaming service cost	Roon Ready: Bluesound Node X, NAD CI 580/720 v2 (BluOS), JBL Synthesis SDP-58, Lyngdorf MP-50/MP-60; Sonos is AirPlay 2 endpoint in Roon (not native Roon Ready)

ROON ARCHITECTURE AND LOCAL LIBRARY

Component	Function	Specification	Notes
Roon Nucleus	Dedicated Roon Core appliance	Rack-mountable; Ethernet; USB and HDMI outputs; storage via USB or NAS share	Managed via Roon remote app (iOS, Android, Mac, Windows); for residences with up to 10 Roon Ready endpoints
Roon Nucleus+	Higher-performance Core; larger libraries; more zones	Same form factor as Nucleus; higher CPU for DSP-heavy configurations	Recommended for estates with 10+ Roon Ready endpoints or large local libraries (> 100,000 tracks)
ROCK on Intel NUC	Roon Operating System on NUC hardware; cost-effective alternative	Roon OS installed on Intel NUC hardware; fan-cooled; rack-mountable with NUC tray	Restrepo value-tier alternative to dedicated Nucleus appliance; confirm Intel NUC model compatibility on Roon website before purchasing
Synology DS923+ NAS	Local music library storage	NAS share pointed to by Roon Core via SMB or NFS; Plex Media Server available as independent DLNA/UPnP audio server	Restrepo standard for local library; specify with minimum 2 × 4 TB NAS drives in RAID 1 for redundancy

NOTE**Spotify Connect is the integration standard for Spotify on all platforms.**

Spotify does not currently offer a lossless streaming tier. Spotify Connect is supported by virtually all current streaming endpoints (Sonos, Bluesound, NAD, JBL Synthesis, Lyngdorf). For clients who use Spotify as a primary service, confirm that the specified platform includes Spotify Connect support before the system is commissioned. Clients who want hi-res audio should be directed to Apple Music, Tidal HiFi Plus, or Qobuz, and a Roon Core should be specified if local library management and multi-service browsing are priorities.

BEST PRACTICE**Roon Nucleus+ + Synology NAS as the Restrepo standard for 8-zone and larger.**

The Roon Nucleus+ provides a dedicated, always-on Roon Core that manages streaming services (Tidal, Qobuz), local NAS library, and all Roon Ready endpoints simultaneously without depending on a client's laptop or desktop computer. Pair it with a Synology DS923+ NAS in RAID 1 for local library redundancy. For 6-zone projects where client has no local library, the standard Nucleus suffices. Specify Roon only when the system includes at least one native Roon Ready endpoint (NAD CI 580/720 v2, Bluesound Node X, JBL Synthesis SDP-58, or Lyngdorf MP-50/MP-60).

SOURCES

[Roon — How Roon Works](#) [NAD CI 720 v2 Roon Ready confirmation](#) [Apple Music vs Tidal — Mediaio Roon complete guide](#) — [Moon Audio](#)

PART 4

Wiring & Closeout

Sections 10–13 — Speaker Wire and Wiring Standards, Pre-Wire Discipline, Codes and Standards, V

§ 10

Speaker Wire and Wiring Standards

PART IV — WIRING & CLOSEOUT

Speaker wire selection is governed by three variables: run length from amplifier terminal to speaker terminal, speaker impedance, and NEC wiring classification for in-wall and in-ceiling use. Wire resistance must not exceed 5% of speaker impedance for the total run (both conductors). For an 8Ω speaker with a 75-foot run: 12 AWG copper (1.59Ω per 1,000 ft per conductor) yields $75 \times 2 \times 1.59 / 1,000 = 0.24\Omega = 3.0\%$ of 8Ω. Acceptable. All in-wall and in-ceiling speaker wire must be CL2 or CL3 rated per NEC Article 725. In plenum return-air spaces, CMP-rated wire (CL2P or CL3P) is required. Lamp cord, zip cord, and unrated speaker wire are never used in wall or ceiling cavities.

WIRE GAUGE BY RUN LENGTH AND IMPEDANCE

Load Impedance	Run Length	Minimum AWG	Preferred AWG	Notes
8Ω	≤25 ft	16 AWG	14 AWG	Short jumper or same-floor run
8Ω	26–50 ft	14 AWG	14 AWG	Standard residential run
8Ω	51–100 ft	12 AWG	12 AWG	Two-story or long-wing runs
8Ω	> 100 ft	12 AWG	10 AWG	Distribution closet to extreme end-of-run
4Ω	≤25 ft	14 AWG	12 AWG	Low-impedance loads require lower resistance
4Ω	26–50 ft	12 AWG	12 AWG	4Ω load standard residential run
4Ω	> 50 ft	10 AWG	10 AWG	Low-impedance long-run
70V Hi-Z	Any	16 AWG	14 AWG	Hi-Z systems have lower current requirements; NEC Class 3

NEC WIRING CLASSIFICATIONS FOR IN-WALL SPEAKER CABLE

NEC Article / Section	Classification	Requirement
NEC 640.6	Audio System Wiring Methods	Equipment and conductors for audio systems shall comply with NEC Chapter 3 and Articles 725 and 800; for systems ≤25V / ≤100W, Class 2 wiring methods (NEC 725, Part III) apply; for 70V systems, Class 3 wiring applies

NEC 725.136	Class 2 / Class 3 Separation	Class 2/3 wiring must be separated from line voltage conductors: minimum 2 inches in same enclosure (with approved barrier) or 6 inches minimum if unenclosed and not in conduit; Class 2/3 wiring must not occupy same enclosure as line voltage without approved barrier
NEC 725.51	Conduit Fill	Conduit fill calculations per NEC Chapter 9, Table 1 apply when Class 2/3 conductors are run in conduit
NEC Article 800	Plenum Communications	Where audio conductors are in plenum return-air spaces with Cat6A, both must be CMP-rated (Communications Plenum); do not mix CL2 (non-plenum) speaker wire with CMP-rated Cat6A in a plenum ceiling without upgrading speaker wire to CL2P or CL3P

APPROVED WIRE BRANDS — RESTREPO RESIDENTIAL

Product	Gauge / Rating	Application
Liberty 14-2-OFC	14 AWG, 2-conductor Oxygen-free copper CL2/CL3 rated	Standard distribution closet to speaker run; Restrepo default for 8Ω loads, runs ≤50 ft
West Penn 25227B	12 AWG, 2-conductor Unshielded, plenum-rated (CMP)	HVAC-adjacent runs in plenum ceilings; required when speaker wire shares plenum space with CMP-rated Cat6A
Belden 5T00UP	10 AWG, 2-conductor Bare copper, CL2 rated 27.8A per conductor	Long runs (> 75 ft at 8Ω) or 4Ω speaker loads; high-power primary zone amplification runs
Wirepath WP-MAS Series	12 AWG and 14 AWG CL2/CL3 configurations	Restrepo value-tier projects; available in 12 AWG and 14 AWG CL2/CL3; suitable for ambient zone runs at standard residential lengths

TERMINATION METHODS

Method	Applicable Equipment	Standard
Banana plugs (dual, 3/4" spacing)	Sonos Amp custom banana plug jacks	Use dual-banana plugs at 3/4" spacing for Sonos Amp; standard-diameter single banana plugs for NAD, Sonance, Episode binding posts; provides more secure and consistent connection than bare wire in spring-clip terminals
Phoenix-style screw terminals	Sonance DSP amplifiers, Episode amps, NAD CI 8-150, Triad 8-zone amps	Strip 3/8" insulation; insert into terminal and tighten to manufacturer torque spec; accept up to 12 AWG; preferred over spring-clip terminals
Five-way binding posts	JBL Synthesis SCL-3; bi-amp configurations	Use spade lugs (insulated, tinned copper) for all JBL Synthesis speaker connections to ensure reliable contact in high-power applications; accept bare wire, pin, banana, spade

Spring-clip terminals	Revel C763, some lower-tier speakers	Accept bare wire and single banana plugs; minimum acceptable for Restrepo installations; not preferred; do not use when binding posts are available
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FIELD RULE**CL2 or CL3 in every concealed wall and ceiling cavity. No exceptions.**

Lamp cord (SPT-1, SPT-2), zip cord, and unrated speaker wire are never used in wall or ceiling cavities on a Restrepo project. This is not a preference — it is a code requirement under NEC Article 725 and NJ UCC NJAC 5:23. Every in-wall and in-ceiling speaker run is pulled with CL2 or CL3 rated wire. In plenum return-air spaces, CMP-rated wire (CL2P or CL3P) is pulled. Wire rating is verified at the spool label before the run is pulled. A spool photograph is filed in the project closeout folder.

FIELD RULE**Single-color cable standard: black jacket on every low-voltage run.**

Restrepo Innovations specifies black-jacketed cable for every low-voltage run — speaker wire, Cat6A, control, shade, lighting, and security all pull black. Color-by-function schemes are rejected because no trade crew maintains a color assignment consistently past day one; mismatched re-pulls in year three produce a service nightmare that a label discipline prevents and a color scheme does not. A black bundle reads smaller in the wall and in the rack. One jacket color stocked means one color pulled, one color serviced for the life of the home.

SPECIFICATION**Measure actual pull length. Not room dimension, not blueprints.**

Run length for wire gauge selection is measured from amplifier terminal to speaker terminal — the actual pull distance through the building structure, not the room dimension or blueprint distance. Account for routing through walls, over ceiling joists, down partition walls, and through grommets. A 15-foot room may have a 35-foot pull. Measure before cutting. Label the gauge at both ends of every run before drywall.

SOURCES

[Liberty Cable 14-2 product page](#) [Belden 5T00UP product page](#) [West Penn 25227B — Wire and Cable Your Way](#) [NEC Article 640 — Code Book City NEC 725 Class 2/3 — Mike Holt](#)



§ 11

Pre-Wire Discipline

PART IV — WIRING & CLOSEOUT

Pre-wire is the highest-leverage phase of any residential audio installation. Every decision made before the drywall board is hung determines the ceiling of system performance and the floor of future rework cost. Pre-wire discipline on Restrepo projects is non-negotiable: every home run is pulled, labeled, and terminated to the correct back-can or bracket before the framing inspection closes. The pre-wire gate is signed by the GC project manager, low-voltage contractor, and Restrepo AV lead. No drywall is hung over an un-labeled wire.

HOME RUN TOPOLOGY — MANDATORY

Every speaker location receives its own dedicated, uninterrupted cable home run from the distribution closet to the speaker back-can or wall bracket. No in-wall daisy-chain wiring. No Y-splitters at junction boxes. No loop connections between volume controls across zones. Daisy-chain wiring creates parallel impedance loads the amplifier cannot independently control, prevents per-speaker DSP processing, and eliminates the ability to diagnose individual speaker faults without disconnecting multiple runs.

SERVICE LOOP REQUIREMENTS

Location	Service Loop Length	Purpose
At each speaker location (back-can or bracket)	18–24 inches stored in back-can or against bracket, coiled and secured	Allows future speaker replacement without fishing additional wire; 24" loop at ceiling gives 12" of working slack for termination outside the opening
At distribution closet (each home run)	5 feet minimum, coiled and secured in rack enclosure before termination	Allows future amplifier repositioning, re-routing, or zone reassignment without re-pulling wire; coil labeled with zone designation before termination

LABELING PROTOCOL

Label every wire pair at both ends before drywall with zone designation and speaker position. Restrepo standard label format:

Z[zone number]–[room abbreviation]–[speaker position]–[speaker ID]

Example Label	Meaning
Z02-LIV-CL-A	Zone 2, Living Room, Ceiling, Speaker A
Z02-LIV-CL-B	Zone 2, Living Room, Ceiling, Speaker B

Z05-MBA-CL-A	Zone 5, Master Bath, Ceiling, Speaker A
Z08-PAT-CL-A	Zone 8, Patio, Ceiling, Speaker A
Z12-GYM-CL-A	Zone 12, Gym, Ceiling, Speaker A

Use UV-resistant, heat-tolerant wire labels (Brady or equivalent) rated for attic environments (–40°F to 250°F). Labels must remain legible for the life of the installation. Do not use paper labels, tape, or handwritten masking tape — these fail in attic environments within two to three years.

NOTE

All low-voltage cable pulls black. Labeling is the identification system, not jacket color.

Restrepo Innovations mandates black-jacket cable across all low-voltage disciplines — speaker wire, Cat6A, control, shade, and lighting all pull black on every project. Jacket color is not the identification method; the label is. A color-by-function scheme breaks down the first time a re-pull uses a different spool; the label scheme does not break down. Black bundles disappear in the wall cavity and in the rack. Confirm all ordered cable is black-jacketed before the pull crew mobilizes.

PRE-CONSTRUCTION BRACKET INSTALLATION CHECKLIST

Step	Requirement	Notes
1	Bracket centered on mark from framing plan	Establish mark during framing walk; use chalk line; confirm with AV designer before crew mobilizes for pre-wire
2	Bracket plumb and level in ceiling or wall plane	Use level; recheck after any framing modification to adjacent structure
3	Wire pulled through bracket opening; service loop secured	Minimum 18" service loop at bracket location; secure loop with cable tie to bracket before drywall
4	Model number spec sheet taped inside back-can	Facilitates future replacement without accessing closeout documents
5	Center of speaker marked on framing with chalk	Rocker and drywall installer preserve location; mark must be visible from inside the framing, not on drywall face
6	JBL SCL-3 / SCL-4 back-box fastened to adjacent framing	Sealed wood back-box is a structural component of the speaker system; not optional; must be fastened to framing members, not drywall alone

- | | | |
|---|---|---|
| 7 | Sonance Invisible Series stiffening ring positioned | Ring must be installed on back of drywall before hanging or cut and fitted after; rough opening precisely dimensioned per Sonance template; mark center on stud with chalk before board goes up |
|---|---|---|

FIELD RULE**No drywall over an un-labeled wire. The pre-wire gate is signed.**

The pre-wire gate is a signed field document: every home run pulled, coiled, labeled at both ends, and terminated to its bracket or back-can is verified by the AV lead before the drywall crew is released to hang. The GC project manager, low-voltage contractor, and Restrepo AV lead sign the pre-wire gate document. Photographs of labeled wire bundles at the distribution closet and at each bracket location are timestamped and filed in the project closeout folder. Un-labeled wire discovered after drywall is a change order, not a courtesy fix.

SPECIFICATION**Two Cat6A home-runs minimum at every keypad, amplifier, and touchscreen location.**

Every keypad location (Lutron Sunnata, Crestron Horizon, or equivalent), every matrix amplifier location, and every touchscreen location receives two dedicated Cat6A home-runs from the distribution closet — Cat A active, Cat B coiled and labeled SPARE. Label Cat A with the same zone designation as the audio home run serving that room (e.g., Z05-MBA-CAT6A at the master bath keypad location); label Cat B as Z05-MBA-CAT6B-SPARE. Do not share Cat6A runs between keypads and audio distribution on the same pull — they serve different physical endpoints.

NOTE**Two Cat6A home-runs at every keypad location is future-proofing, not redundancy.**

Every keypad today that requires only four-conductor low-voltage may become a touchscreen or IP-based device in a future upgrade cycle. The second Cat6A home-run is the difference between opening the wall and swapping the faceplate. Coil Cat B inside the backbox with a minimum 18-inch service loop, label it SPARE, and document it on the sleeve schedule. This run costs minutes during rough-in and eliminates a change order later.

NOTE**Spare hardware ≥5% delivered and labeled at project closeout.**

Per Restrepo policy, spare hardware at not less than 5% of installed equipment value is delivered to the client at project closeout. Spares are labeled with the zone, model number, and installation date. Spare speaker wire (one spool of each gauge used on the project) is stored in the distribution closet. Spare grilles, brackets, and mounting hardware are stored in the client equipment storage location documented in the closeout package.

SOURCES

[Sonance Invisible Series data sheet — Hill Residential JBL Synthesis SCL-3 \(back-box installation context\)](#) [Sonance Reference R2 product page \(bracket spec\)](#)

§ 12

Codes and Standards

PART IV — WIRING & CLOSEOUT

The following codes and standards govern luxury residential distributed audio in New Jersey. They are the floor, not the ceiling. NEC 2023 Articles 640, 725, and 800 are the primary governing codes for wiring methods, classification, and plenum separation. CEDIA RP-22 v1.2 (September 2023) is the current industry standard for audio design in private entertainment spaces. ANSI/CEA-2010-A governs subwoofer measurement comparison. NJ UCC NJAC 5:23 adopts the NEC by reference and governs AHJ enforcement in Bergen County. AES67 governs network audio interoperability where DM NAX, Dante, and similar platforms must coexist.

Code / Standard	Edition / Version	Primary Provisions — Residential Distributed Audio
NEC Article 640 Audio Systems	NEC 2023	640.6: Wiring methods for audio signal processing and reproduction equipment; $\leq 25V$ / $\leq 100W$ = Class 2 (NEC 725); 70V = Class 3; all other = Class 1; 640.9: In-wall speaker runs must be CL2 or CL3 rated; NEC Chapter 6 governs voltage and power limits per amplifier classification
NEC Article 725 Class 2 and Class 3 Circuits	NEC 2023	725.51: Conduit fill calculations apply to Class 2/3 conductors in conduit; 725.136: Class 2/3 wiring must not occupy same enclosure as line voltage without approved barrier; minimum 2" separation in shared raceway; 6" if unenclosed and not in conduit; in-wall cable must be CL2 or CL3 listed
NEC Article 800 Communications Circuits	NEC 2023	Plenum return-air spaces: audio conductors co-located with Cat6A must be CMP-rated; CL2P or CL3P speaker wire required in plenum ceilings; mixing non-plenum CL2 speaker wire with CMP-rated Cat6A in plenum violates NEC 800
CEDIA RP-22 v1.2 Immersive Audio Design	September 2023 (supersedes CEB22)	Performance level tiers L1–L4 for system specification; screen speaker placement angles (44°–60° horizontal for immersive systems); subwoofer placement optimization (front wall, wall midpoints, distributed); target SPL: 105 dB(C) at 2/3 room depth for screen speakers; ambient noise floor and reverberation time targets; freely available at cedia.org
ANSI/CEA-2010-A Subwoofer Measurement	Current edition	Defines measurement protocol for subwoofer maximum output levels; 2-meter ground-plane quasi-anechoic measurement with swept tone bursts; use only CEA-2010 burst output for manufacturer-to-manufacturer comparison; SVS, Paradigm, and REL publish CEA-2010-compliant data
NJ UCC NJAC 5:23 New Jersey Uniform Construction Code	Current adoption (NEC 2023 by reference)	Adopts NEC by reference; follow current NEC edition per local AHJ — confirm before each project; obtain required permits for all new residential wiring; Class 2 audio wiring generally does not require electrical permit in NJ (confirm with AHJ); must be installed by licensed electrician or licensed low-voltage contractor; NJ energy code is IECC-based (not California Title 24)

IEC 60268-5 and IEC 60268-19	Electroacoustics Current edition	IEC 60268-5: loudspeaker measurement (frequency response, sensitivity, power handling); IEC 60268-19: in-wall loudspeaker back-can volume specifications; confirm speaker sensitivity measurements are per IEC 60268-5 or ANSI/CTA-2034, not unverified marketing figures
AES67 Network Audio Interoperability	2013; updated 2018	RTP streams over IP; 48/96 kHz; 16–32-bit; PTP IEEE 1588 v2 synchronization; up to 8 audio channels per stream; DM NAX, Dante, Q-SYS all publish AES67 modes; JBL Synthesis SDP-58 and SDA-2200 support Dante (AES67-compatible in AES67 mode); enable Dante AES67 mode via Dante Controller; configure AES67 multicast address to match

NOTE

Bergen County AHJ confirmation before permit submission.

NJ UCC NJAC 5:23 allows local AHJs to adopt amendments to the referenced NEC edition. Before permit submission on each Bergen County project, confirm: (1) the currently adopted NEC edition with the local AHJ; (2) whether Class 2 audio wiring requires a low-voltage permit in that jurisdiction; (3) whether the local AHJ has any NJ-specific amendments affecting speaker wire or audio equipment installation. Document the AHJ confirmation in the project file before the permit package is submitted.

SOURCES

[NEC Article 640](#) — [Code Book City NEC 725 Class 2/3](#) — [Mike Holt CEDIA RP-22 v1.2 PDF](#) — [cedia.org](#) [NJ UCC](#) — [NJAC 5:23 \(NJ DCA\)](#)



§ 13

Without Written Direction

PART IV — WIRING & CLOSEOUT

The following practices require explicit written approval from the Restrepo principal, the project engineer of record, or the client representative before implementation. None of these practices are undertaken by a field technician unilaterally. Written direction means a signed document in the project file — not a verbal agreement, not a text message, not a site meeting note. The Restrepo standard positions these practices as requiring direction, not as practices that are prohibited by default. With appropriate engineering authorization and documentation, any of the following may be executed on a specific project.

PRACTICES REQUIRING WRITTEN DIRECTION

Practice	Risk Without Written Direction	Written Direction Requirement
BX/MC cable (metal-clad or armored cable) for audio wiring	MC/BX creates a grounding path that can introduce 60 Hz hum into audio circuits via antenna coupling or ground loops; used in commercial audio under NEC 518.4(A) but non-standard for residential speaker runs	Written direction from project engineer; documentation of grounding isolation method and ground-loop mitigation plan in the project closeout file
In-wall daisy-chain speaker wiring (departure from home-run topology)	Parallel impedance loads cannot be independently controlled; per-speaker DSP processing is eliminated; fault diagnosis requires disconnecting multiple runs; impedance loading affects all speakers on the daisy-chain segment	Written direction from Restrepo principal; explicit load-management plan documenting impedance at each tap, power derating for the zone, and DSP compensation strategy; signed by integrator and project engineer
Untested impedance loads beyond 70% of amplifier rating	Driving speaker loads below the amplifier's minimum impedance rating (e.g., 3Ω-nominal loads on a 4Ω-stable amplifier) risks thermal shutdown, protection circuit engagement, or amplifier damage	Written engineering authorization; load calculation on file; no zone impedance lower than 70% of amplifier's stated minimum without written documentation and amplifier manufacturer confirmation

Mixing Class 2 and line voltage in same enclosure without approved barrier	Violates NEC 725.136; creates shock and fire hazard; in the field it is tempting to share a 4-gang box between a duplex outlet and a keypad volume control to minimize patching	Written direction and AHJ approval; enclosure must be listed for mixed-voltage use; approved barrier must be installed and photographed before inspection; document AHJ approval in project permit file
Repurposing existing non-rated wire for speaker runs (unused telephone wire, old speaker wire of unknown rating, repurposed Cat5 runs)	Non-CL2/CL3-rated wire cannot legally serve as speaker cable in a concealed wall location under NEC Article 725 and NJ UCC NJAC 5:23; unknown wire vintage may not meet current fire propagation ratings	Written direction from Restrepo principal; wire rating must be verified by physical label on the wire jacket; rating documentation photographed and filed in project closeout; AHJ confirmation that substitution is acceptable for jurisdiction

FIELD RULE

Written direction means a signed document in the project file.

A field technician who proceeds with any of the above practices on verbal direction alone is exposed to liability for the consequences: ground-loop hum requiring re-wire, amplifier failure from impedance overload, NEC code violation requiring correction at the client's expense, or AHJ rejection of a concealed installation. Written direction is a signed document on project letterhead, filed in the project folder before work begins. A text message or an email from a non-engineer does not constitute written direction under this standard.

BEST PRACTICE

BX/MC audio wiring — when it is appropriate with written direction.

In specific retrofit scenarios where pulling new CL2/CL3 wire would require significant wall demolition, and where the project engineer has evaluated the grounding isolation requirements, BX/MC cable for audio runs may be authorized. The authorization must specify the ground-loop isolation method (Hum-X ground-loop isolator, Jensen Transformer, or similar), the grounding conductor disposition, and the test procedure to confirm hum-free operation before the walls are closed. Document the authorization and the test result in the closeout file.



NOTE**This section governs residential projects only.**

Every provision in Vol 23 is residential-only. NEC Article 518 (places of public assembly) and NEC Article 520 (theaters) are explicitly out of scope. Commercial audio distribution, commercial 70V paging systems, and public address systems are governed by different codes and are not addressed here. NJ UCC NJAC 5:23 governs all residential code enforcement in Bergen County and throughout the Restrepo project territory. Spare hardware at not less than 5% of installed equipment value is delivered and labeled at every project closeout per Restrepo policy. The system is not handed over without the signed commissioning record, the signed pre-wire gate document, and the delivered spare hardware.

SOURCES

[NEC Article 640 — Code Book City NEC 725 Class 2/3 — Mike Holt CEDIA RP-22 v1.2 Recommended Practice PDF — cedia.org](#) [NJ UCC NJAC 5:23 — NJ DCA](#)

FIELD NOTES

Whole-House Audio · Volume 23 · Project: _____ · Date: _____

Lined area for field notes.

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