

**SECTION 27 51 19  
MASKING NOISE SYSTEM**

**Division 27.51.19**

**Sound Masking Systems**

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NOTE TO SPECIFIER

Lencore n.FORM® - Networked Sound Masking, Paging and Audio System (As Part of the Mass Notification System)

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Masking noise system for [Project Name] including products, performance criteria, testing, and installation of the system.

1.02 RELATED SECTIONS

- A. Division 00
- B. Division 01
- C. Division 02
- D. Division 16
- E. Division 27
- F. Division 28

1.03 SUMMARY

- A. This specification includes all components required for a networked based Sound Masking System including but not limited to digital signal processors, noise generators, paging interfaces, amplifiers, loudspeakers, the associated wiring, controls, supervised signals and lines, and components to generate, amplify, distribute and reproduce stabilized background sound masking. This includes the above as it relates to the extension of the mass notification system.

1.04 REFERENCES

- A. ASTM E1374-06 – Standard Guide for Open Office Acoustics and Applicable ASTM Standards
- B. ASTM E1573-09 – Standard Test Method for Evaluating Masking Sound in Open Office Using A-Weighted and One-Third Octave Band Sound Pressure Levels
- C. ASTM E1130-08 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index
- D. ASTM E1041-85 – Standard Guide for Measurement of Masking Sound in Open Offices.
- E. ANSI S1.4 American National Standard Specification for Sound Level Meters

- F. ANSI S1.6 American National Standard Specification for Preferred Frequencies and Band Numbers for Acoustical Measurements
- G. ANSI S1.11 American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters
- H. ANSI 709.1 / ISO / IEC standards for open platform.
- I. UL 2043 Approved for use in air handling spaces
- J. UL 2572 Standard for Mass Notification Systems
- K. UL 60065 Approved for use as Audio/Video Equipment
- L. UL 1480 Approved for use as speakers for use in fire alarm, emergency, and commercial and professional use
- M. NFPA 101 Life Safety Code
- N. NFPA 72 Fire Alarm and Signaling Code
- O. ADA American Disabilities Act

#### 1.05 APPROVALS

- A. The system shall have proper listing and/ or approval from the following Nationally Recognized Testing Laboratories (NRTL):
  - 1. UL – Underwriters Laboratories, Inc.
  - 2. ULC – Underwriters Laboratories Canada
  - 3. ETL – Intertek

#### 1.06 PERFORMANCE AND DESIGN REQUIREMENTS

- A. System Architecture
  - 1. The system shall be of a networked decentralized architecture with addressable masking devices distributed throughout the installation area.
  - 2. The system will be tied to the Fire Alarm Control Panel (FACP) in the event of a fire emergency with the purpose of being shut down for safety notification purposes.
- B. Sound Masking Performance
  - 1. The system shall use digital signal processing (DSP) technology for masking sound generation and output adjustment of masking signals.
  - 2. The masking sound shall be generated via a truly-random, non-deterministic digital process with no repeat cycle within a 24 hour period.
  - 3. The system shall include and meet the following requirements:
    - a. A single control unit/panel (SMCP) capable of addressing the entire system. Multiple control units are not acceptable.
    - b. Contain an integrated sound masking digital signal processors (DSP's) system that utilizes an open platform network technology that meets open control standards, with web appliances, browser interfaces, infrared remote controls and internet access capable.
    - c. Capable of separately and independently configuring zones for sound masking via the network zoned through its singular central control.
    - d. Sound Masking System Shutdown through interface with the Fire Alarm Control Panel (FACP) as described in Section 28 31 00 (Fire Alarm and Detection Systems, meeting a minimum of UL standard 2572)
    - e. The control system must be capable of using RS232 for intelligent building integration.
    - f. Must meet ANSI 709.1 / ISO / IEC standards for open platform.
    - g. The system must meet the US Army Corp.'s Unified Facilities Guide Specifications, UFGS 25 10 10, "Utilities Monitoring and Control System" and UFGS 23 09 23, "Direct Digital Control for HVAC and Other Local Building Controls".

- h. Must be a multi-drop network system; point to point systems are unacceptable. No Exceptions.
  - i. The system must be capable of being tuned through a network or a hand-held remote or keypad switches.
  - j. The system must be capable of performing a complete diagnostics of its entire functions including diagnostics of the network, hubs, nodes, routers, DSP, relays, memory, circuitry, amplifiers and power. The system must be capable of reporting entire settings for each zone indicating at a minimum the volume, contour, equalization, diagnostics, and zones and channel groupings. The system shall also be capable of performing diagnostics and remote administration via a standard web browser.
  - k. The system must be capable of naming network nodes, channels, zones, and external audio sources via its integrated Graphical User Interface
  - l. Include 30 band parametric or 30 band third-octave equalizer compatible via DSP.
  - m. The sound masking system must not have speakers that are less than 4" diameter or greater than 6-1/2" diameter to ensure delivery of a broad frequency spectrum.
  - n. The line interfacing with the Fire Alarm Control Panel (FACP) and Sound Masking Control Panel (SMCP) must be monitored as defined by UL 2572.
4. The system shall provide a programmable function to gradually ramp up the masking volume at a predetermined scheduled.

#### C. System Control

1. The control panel component shall provide controls for:
  - a. Networked device addressing
  - b. IP setup for controller
  - c. Administration for User profiles
    - 1) Controller must be able to capture and report all changes any user makes to the system
    - 2) Must have admin and user profiles uniquely password protected
  - d. System must be able to work with third party controllers
  - e. System must be able to work with BACnet or Modbus systems
  - f. System must be capable of setup and configuration for:
    - 1) Initialization
    - 2) Harvesting and uploading all settings
    - 3) Masking volume and contour adjustment
    - 4) Masking equalizer adjustment
    - 5) Audio Source equalizer adjustment
    - 6) Labeling all nodes, channels, zones, and custom EQ settings
    - 7) System independent zoning for masking.
    - 8) System independent zoning for paging.
    - 9) System independent zoning for audio input.
    - 10) Masking timer programming
    - 11) Security functions
    - 12) System diagnostics and monitoring
    - 13) Graphical User Interface address books for multiple buildings on a campus
    - 14) Interfacing with the Fire Alarm Control Panel (FACP)
2. The controller shall allow for system control for the entire building or buildings by providing operation of multiple system components from a single central location.

3. The system shall provide lockouts preventing simultaneous adjustment of the system from multiple users.
4. The system shall defer control to the Fire Alarm Control Panel (FACP) in the event of a fire emergency for muting the masking through the Sound Masking Shutdown Sequence.

D. Network Device Discovery

1. The system shall identify all networked masking devices via an automatic addressing process such that devices that are numbered in sequence based on their location in the network on each floor.
2. Each identified masking device must have an LCD screen display in addition to labels for ID of the device. LCD screen must work with network controller to ensure proper display of ID. LCD screen must work in real time to display any changes
3. Each Masking device must have an LCD display that displays error messages.
4. System should leverage analytic software, working in real time, to manage and monitor system performance

E. Scheduler

1. The control components shall provide an integrated masking timer function that includes:
  - a. Automatic masking volume adjustments according to custom user-programmed schedules
  - b. The ability to digitally assign any group of masking zones to a selected timer zone
  - c. Calendar-based operation
  - d. Automatic and user-defined daylight savings adjustment

F. Zoning

1. The networked masking devices shall be zone capable for masking, paging, and external audio.
2. Zoning of networked masking devices shall be performed digitally.
3. Assignments to each type of zone shall be independent of each other.
4. The networked masking devices shall be capable of individual rezoning without rewiring.
5. Each zone must be capable of holding, at a minimum of up to 10 programmable zone assignments.

G. Cabling

1. Cabling shall be via a single Category-based cable assembly providing, control signals for connections between:
  - a. a control panel component and a networked masking device
  - b. networked masking devices
  - c. Nodes and speakers and from speaker to speaker connections.
2. Monitored and Supervised Line meeting UL2572
  - a. Connection to Fire Alarm Control Panel (FACP) from a single Sound Masking Control Panel (SMCP)
3. Power for the system shall be run on a separate dedicated cable.
4. The system shall use cabling rated for air-handling plenums.
5. Cabling connections shall be made using connectors with positive locking mechanisms.

- 6. Any and all cables must be non-proprietary off the shelf cables. Single source cables are unacceptable

H. Diagnostic

- 1. Upon initial configuration, the system shall:
  - a. Automatically detect the number and type of networked devices connected
  - b. Verify that each networked device is communicating other devices on the network.
  - c. Verify that each networked device is initialized.
  - d. Identify networked devices that are not communicating.
  - e. Verify the integrity of the system design

1.07 DESCRIPTION OF THE SYSTEM

- A. The system provides a broad band (65 Hz – 20 kHz) background noise in open plan and partitioned work areas.
- B. When used in conjunction with the proper ceiling and partition constructions, the system allows a certain level of privacy between work areas by limiting speech intelligibility. The system also reduces the disturbing effects of noise caused by other common office activities (keyboards, printers, etc.).
- C. The octave band sound pressure level spectrum shall be as follows:

| Octave Band (Hz.)          | 200  | 250 | 315  | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 |
|----------------------------|------|-----|------|-----|-----|-----|-----|------|------|------|------|
| Level (dB) Open Areas      | +2.5 | +3  | +2   | +1  | 0   | -1  | -2  | -3   | -4   | -5   | -6   |
| Level (dB) Enclosed Office | +2   | +2  | +1.5 | +1  | 0   | -1  | -2  | -3   | -4.5 | -5   | -6   |

- D. The spectrum shall have relative 1/3 octave band levels which form a smooth spectrum within the constraint of the above octave band values and are within 2 dB in the 400 Hz to 2000 Hz bands and to within a slowly increasing limit for higher and lower bands to a maximum variance of 6 dB in the 63 Hz and 8000 Hz bands.
- E. The nominal sound level in dBA for each area shall be as follows:

| Area                       | Sound Level dBA |
|----------------------------|-----------------|
| Conference Rooms           | 42              |
| Enclosed Offices           | 44              |
| Semi-enclosed Workstations | 45              |
| Open Office Areas          | 47              |

- F. The background noise level shall exhibit temporal uniformity; the short-term time-average level of each 1/3 octave band over any selected 2 second interval shall vary no more than 3 dB with respect to the long-term average.
- G. In open areas and larger enclosed spaces, the overall sound level produced should have spacial uniformity of no more than  $\pm 1$  dB between any two sound generating units.

- H. The system should interface with the Fire Alarm Control Panel (FACP) so that in the event of a fire emergency the sound masking may be muted or turned off in accordance with the Sound Masking Shutdown Sequence. The system must have the ability to assist in creating a safer, more intelligible environment in a life safety situation.

#### 1.08 SCOPE

- A. The terms Masking Noise System Design-Builder or Design-Builder refer to the organization that will provide and install the masking noise system.
- B. The Masking Noise System Design-Builder is required to furnish all components of the system, install them in the building within space provided by others, to make the system operational, to demonstrate by appropriate test data that the completed system and all components meet the performance specifications.
- C. It is the obligation and responsibility of the Design-Builder to obtain and be totally familiar with the drawings and details for the masking noise system. As indicated on these drawings, the Design-Builder shall furnish and install the following:
  - 1. All wiring and cabling.
  - 2. All masking noise equipment and materials according to the layout as described in the performance specifications.
  - 3. All supporting brackets necessary for the suspension of loudspeakers as described in the performance specifications, including speaker seismic bracing as building code necessary.
- D. This performance specification indicates the basic components and equipment items. Minimum quantities of mounting, terminating, matching and connecting elements are reflected in the system design; additional units required to meet system requirements including the labor to install them, shall also be supplied by the Design-Builder. Design-Builder shall furnish and install all equipment, solid state devices, power supplies, transformers, matching networks, signal indicators, controls, mounting brackets, painting, devices, and other materials even though not specifically mentioned herein, which are necessary for the proper integration of the system, so that the system shall perform the functions listed herein in compliance with all the specified requirements.
- E. In general, the performance specifications outline the basic functions and equipment parameters that are required for each system. It is recognized that each bidding Design-Builder will desire to perform all final engineering based on their proposed equipment.
- F. All assembly and sub-assembly fabrication, construction, wiring, etc., is to be performed in the Design-Builder's shop. All assemblies and sub-assemblies shall be thoroughly tested and made to operate perfectly in the Design-Builder's shop prior to delivery to the job site.
- G. The general and special conditions of the contract and these performance specifications shall be binding upon the Design-Builder and all employees directly or indirectly by him/her.

#### 1.09 DESIGN-BUILDER QUALIFICATIONS

- A. The work specified under this section shall be accomplished by a specialty Design-Builder experienced in the design, fabrication, installation, checkout, and warranty contract management of systems such as is described in this section. This specialty Design-Builder shall have complete responsibility for the system described herein, and

shall be the single contact point for the Architect, Consultant, Fire Protection Engineer (FPE) and/or the Owner with respect to all work specified herein as required by the channel.

- B. The Design-Builder will coordinate with the Fire Protection Engineer in order to assemble / connect the sound masking system to the Fire Alarm Control Panel (FACP). It is the responsibility of the Design-Builder to provide the connection but NOT make the connection. It is the responsibility of the installation company of the FACP to make the connection with the FACP and then, in conjunction with the Design-Builder, test the system.
- C. The prospective Design-Builder shall submit as a part of its bid submittal, a detailed brochure describing its capabilities in terms of facilities, personnel, experience background examples of similar installations (at least two projects within the past two years), distribution arrangements with manufacturers, and financial capability (includes satisfaction of the project bonding requirements). This submittal must justify in the judgment of the Consultant and the Architect, that the Design-Builder is capable of the necessary business and technical arrangements for this installation and the pursuant warranty service.
- D. The Design-Builder must have on his staff a qualified project engineer. This person shall:
  - 1. Have at least five years' experience with similar electronic specialty systems, or other educational experience background as approved by the Architect and Consultant.
  - 2. Observe at all times a good working relation with the Architect's representatives, and shall also cooperate with engineers and technicians who will later be charged with the operation and maintenance of the system.
  - 3. Provide all technical liaison between the Design-Builder, the Architect, the General Contractor, Fire Protection Engineer (FPE), and the Consultant. This shall include participation in meetings and conferences. He will be required to be present at the job site for final inspection, to approve the operating and maintenance manuals, and to provide the specified instruction of designated members of the Owner's staff.
  - 4. Be responsible for the supervision of all technical work which is part of the contract. This supervision includes the following:
    - a. Preparation of all construction drawings from information within the performance specifications. He shall approve and sign all shop drawings.
    - b. Supervision of shop fabrication and field installation work to assure conformance with the performance specifications, and the approved shop drawings to assure workmanship of the highest quality. He shall oversee the testing of all assemblies and sub-assemblies prior to delivery to the job site.
    - c. Take a leading role in the specified testing of the completed installation to assure himself for the Design-Builder that all performance specifications are met. Work with and assist the Consultant in his final testing for approval and acceptance of the system.
- E. In the absence of a qualified staff engineer, the Design-Builder may retain a consulting engineer to supplement the capacity of the organization. This engineer shall have the qualifications and perform the functions previously listed.
- F. Design-Builder must be factory qualified and certified to install the products listed in this performance specification.

#### 1.10 PROJECT ENGINEER'S RESPONSIBILITIES

- A. Obtain and be totally familiar with all drawings that have a bearing on the location and installation of electronic equipment, loudspeakers, or any special components.

#### 1.11 SCHEDULE OF WORK AND SUBMITTALS

- A. All submittals shall be in accordance with the general conditions.
- B. All shop drawings shall be submitted in DWG format, all data sheets shall be submitted in PDF format. Equipment data sheets shall be identified with device IDs that reference drawings and equipment used.
- C. Accompanying the bid proposal the prospective Design-Builder shall submit the following for approval:
  - 1. A preliminary listing of proposed major components, in the order and format listed in the products section of these performance specifications, along with the manufacturer's detailed technical data sheets. Advertising literature shall not be accepted.
- D. Shop drawings shall be submitted, in DWG format, for approval on all items that require assembly by the Design-Builder, including, but not limited to:
  - 1. Head/End Rack panel layouts.
  - 2. Loudspeaker enclosures.
  - 3. Supporting brackets for the suspension and/or support of loudspeaker enclosure and equipment enclosure.
  - 4. Wiring and installation diagrams showing quantity and location of system components and related cabling and accessories.
- E. Test results shall be submitted for approval of the following, as specified herein:
  - 1. Performance tests on completed component sub-assemblies.
  - 2. Performance tests on the complete system assemblies.
- F. Layouts shall be submitted for approval on the following:
  - 1. Loudspeaker system locations.
  - 2. Plenum mounted networked masking noise components.
  - 3. Equipment rack layouts.
  - 4. Connection between the rack headend and the Fire Alarm Control Panel.
- G. Within the scheduled amount of days after the receipt of the Notice to Proceed, the Design-Builder shall submit for approval a complete components list, in the order and format in the contract documents. For proposed substitutions to components listed in this performance specification, manufacturer's independent test data to demonstrate performance specification compliance shall be provided.
- H. Within scheduled amount of days after the receipt of the Notice to Proceed, the Design-Builder shall submit for approval a complete and final list of all components that are to be furnished, in the same order and format as the specifications, with conforming manufacturers' independent test data for each specified item. A brochure and photograph (unless included in the brochure) of each item shall also be furnished.

#### 1.12 QUALITY ASSURANCE

- A. All equipment and associated hardware shall be fabricated and installed in accordance with the manufacturer's specified recommendations.
- B. Unless otherwise stated, all electrical and electronic equipment shall be products of



established manufacturers with a minimum of 10 years manufacturing sound masking systems. They shall be the latest model or type offered which meet the applicable specifications at the time of the submittal.

- C. Quality of workmanship and fabrication of all equipment and components which are custom fabricated shall be comparable to that of professional audio equipment as produced by specialized manufacturers of electronic apparatus. Only skilled craftsmen of the profession required shall be utilized for all aspects of the fabrication and installation of the system.
- D. All materials and products shall be new and of the finest quality. No used materials shall be installed.
- E. System Design to be performed by an approved manufacturer representative.
- F. System shall be designed so that individual speaker or component failure will have no impact on the balance of the system
- G. System adjustment to be completed by an approved manufacturer representative or trained contractor.
- H. All system components for sound masking must carry a minimum of a 10 year warranty. Warranty statements must be submitted prior to notice to proceed.

#### 1.13 REGULATORY TESTING AND CERTIFICATIONS

- A. The relevant system components shall conform to:
- B.
  - 1. Safety and Electrical
    - a. Shall be UL 6500 – Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial and Similar General Use. Products shall be labelled accordingly.
  - 2. Air-Handling Plenum Installation
    - a. Shall be UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; 1996. Products shall be labeled accordingly.
  - 3. Plenum Rated Cabling
    - a. Shall be CSA CMP 75C FT6. Products shall be labelled accordingly.
  - 4. Electromagnetic Interference (EMI)
    - a. Shall be FCC – Part 15, Subpart B, Class A – Unintentional Radiators.
  - 5. Heavy Metals
    - a. Shall be RoHS – Restriction of Hazardous Substances.
  - 6. Low Voltage Power Supplies
    - a. Shall be UL1310, Standard for Class 2 Power Units. Products shall be labeled accordingly.
  - 7. Shall be UL 2572 Standard for Mass Notification Systems
- C. DELIVERY, STORAGE AND HANDLING
  - 1. Protect from moisture during shipping, storage and handling.
  - 2. Deliver in manufacturer's original unopened and undamaged packages with manufacturer's labels legible and intact.
  - 3. Inspect manufacturer's packages upon receipt.

#### 1.14 WARRANTIES - ALL EQUIPMENT

- A. At project closeout, provide to Owner or Owners Representative an executed copy of the

manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

- B. The Sound Masking system shall be warranted to be free from defects in materials, workmanship, and performance for a minimum of 1 year from date of installation.

#### 1.15 AIDS TO USE

- A. Upon completion, the Design-Builder shall provide:
  - 1. As-built drawings.
  - 2. Manuals of operation and maintenance literature (3 copies).
  - 3. System geographical layout and block diagram under a plastic cover on the inside of the equipment enclosure front door.
  - 4. Record of final field tests and measurements include final adjustment of system.
- B. Instruction:
  - 1. After the system is totally installed and in proper operating condition as directed, the Design-Builder shall provide instruction sessions as necessary to describe and demonstrate the entire system to the Owner's engineering staff, and those others who will be in charge of or otherwise related to the system operation.
  - 2. The session shall be scheduled by the Owner and shall be held at a time convenient to the Owner, and shall be at least 4 man-hours.
  - 3. The operation manuals described above shall be completed at the time of the instruction session and at this time supplied to the Owner to aid in the system description.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. Insofar as possible, the specifications for all components of the system are written as performance specifications. These performance specifications are intended to promote competition and the development of superior new components for high quality sound systems.
- B. All masking noise equipment shall be UL listed. All equipment installed above ceiling shall be UL listed plenum rated.
- C. All electronic and electrical equipment and components shall be capable of sustained proper operation when supplied from a nominal 120 VAC +/-10%, 60 Hz +/-10% power source. There shall be no exposed, unprotected 120 VAC potential inside or outside any enclosure. All exterior metal surfaces shall be grounded.
- D. All electronic and electrical equipment shall be capable of sustained proper operation within an ambient temperature range of 0 to 40 degrees C.
- E. Unless otherwise stated, all electrical and electronic equipment and components shall be products of established manufacturers. Quality of workmanship and fabrication of all equipment and components, which are custom fabricated, shall be comparable to that of professional audio equipment as produced by specialized manufacturers of electronic apparatus.
- F. Unless otherwise stated, all electronic and electrical equipment shall be designed or adaptable for standard front panel rack mounting.
- G. All manufacturers' stock equipment and component labeling and console designations shall be in English. All systems nomenclature, signage and custom labeling pertaining to

routine system operation shall be on the equipment itself and on descriptive drawings, charts or diagrams.

## 2.02 MASKING NOISE PROCESSOR

- A. A DSP-based masking sound generator.
- B. Shall provide noise generation, equalization and level control for the system.
- C. The system must be capable of global and local level zoning for sound. Local zoning shall be designed in accordance with the space plan for those areas requiring special attention; i.e. patient rooms, exam rooms, reception areas, provider offices, clerical work areas, open areas, patient check in areas, special work areas, executive areas. All zoning must allow both volume and frequency adjustments.
- D. Shall be software configurable and controllable, capable of programming the sound pressure level at predetermined times.
- E. Control Unit:
  - 1. LON or BACNET capable
  - 2. Digital input/output relays
  - 3. TCP IP and RS-232 port
  - 4. Able to control entire building without any additional controllers
  - 5. Able to be browsed using off the shelf software
  - 6. Capable of providing email reports
  - 7. Capable of programming alarms, alarm triggers
  - 8. Capable of creating data logs.
  - 9. Shall be UL 2572 listed by a (Nationally Recognized Testing Laboratory (NRTL)
  - 10. Acceptable Manufacture: Lencore
- F. NOISE GENERATOR: Octave bands from 20Hz to 20KHz
  - 1. Voltage: 48 Volts DC, 60 Hz
  - 2. Contour Adjustments
  - 3. Spectrum adjustment shall meet acoustical preferred curve
  - 4. 1/3 band EQ for entire spectrum (25Hz – 20 KHz). Meets ANSI specification for bands
  - 5. Parametric EQ for entire spectrum (20Hz – 20KHz)
  - 6. Central volume control, contour control and EQ control for zones for sound masking.
  - 7. Central volume control, and EQ control for zones and units for paging and audio.
  - 8. Acceptable Manufacture: Lencore
- G. POWER SUPPLY
  - 1. Output:
    - a. DC VOLTAGE: 48v
    - b. RATED CURRENT: 3.2A
    - c. CURRENT RANGE: 0~3.2A
    - d. RATED POWER: 150/320/500 W
    - e. OUTPUT VOLTAGE ADJ. RANGE: 45.6~52.8V
    - f. LINE REGULATION:  $\pm 0.5\%$
    - g. LOAD REGULATION:  $\pm 0.5\%$
    - h. SETUP, RISE TIME: 600ms, 30ms at full load
    - i. HOLD UP TIME (Typ.): 20ms at full load
  - 2. Input:
    - a. VOLTAGE RANGE: 85~264VAC 120~370VDC
    - b. FREQUENCY RANGE: 47~63Hz

- c. POWER FACTOR (Typ.): PF>0.93/230VAC PF>0.98/115VAC at full load
- d. AC CURRENT (Typ.): 2.5A/115VAC 1.2A/230VAC
- e. INRUSH CURRENT (Typ.): Cold Start 40A/230VAC
- 3. Safety: & EMC
  - a. SAFETY STANDARDS: UL60950-1, TUV EN60950-1 and S-Mark J60950 Approved
  - b. HARMONIC CURRENT: Compliance to EN61000-3-2,-3
  - c. EMS IMMUNITY: Compliance to EN61000-4-2,3,4,5,6,8,11; ENV50204, EN55024
- 4. Environment:
  - a. WORKING HUMIDITY: 20 ~ 90% RH non-condensing
  - b. WORKING TEMP: -10 ~ +60 (Refer to output load derating curve)
  - c. STORAGE TEMP., HUMIDITY: -20 ~ +85 , 10 ~ 95% RH
  - d. TEMP. COEFFICIENT: 0.05%/ (0 ~ 50°C)
  - e. VIBRATION: 10 ~ 500Hz, 2G 10min./1cycle, 60min. each along X, Y, Z axes
- 5. Others:
  - a. MTBF: 191.2K hrs. min. MIL-HDBK-217F (25°C)
  - b. DIMENSION: 7 27/32" x 3 29/32" x 1 15/16"
- 6. Protection:
  - a. OVERLOAD: 105 ~ 150% rated output power
  - b. Protection type : Constant current limiting, recovers automatically after fault condition is removed
  - c. OVER VOLTAGE: 52.8 ~ 64.8V
  - d. OVER TEMPERATURE: 95°C±5°C (TSW1: Detect on Heat sink of Power Transistor)
  - e. Protection type : Shut down o/p voltage, recovers automatically after temperature goes down
- 7. Acceptable Manufacture: Lencore or approved equal

## 2.03 LOUDSPEAKER SYSTEMS

- A. Product specifications to meet or exceed:
  - 1. Size: 5 ¼ inch wide dispersion
  - 2. Power Rating: 10 Watts Root Mean Squared (RMS)
  - 3. Frequency Response: 65-12,000 Hz
  - 4. Pressure Sensitivity: SPL - at 1 Watt/m - 90 dB
  - 5. Impedance: 32 Ohms
  - 6. Magnet Weight: 10 oz. (283.5 grams)
  - 7. 1 Watt/m - 86 dB
  - 8. Impedance: 32 Ohms
  - 9. Magnet Weight: At least 10 oz.
  - 10. Shall be UL 1480 Listed
  - 11. Acceptable Manufacture: Lencore

## 2.04 REMOTE CENTRAL VOLUME CONTROL

- A. Generation and integration of multiple random sound masking sources. Channel outputs with three levels of global and independent control.
  - 1. Contour control – At the source using infra-red technology for each independent channel, quad-pod and global control or via a centralized control.
  - 2. Parametric equalization control for one to minimum of 6,400 speakers.
  - 3. 1/3 Band Octave controls – (Same as Parametric controls for groups)
  - 4. Volume control for entire spaces to channels to individual speakers.

## 2.05 PROGRAMABLE AUDIO LEVEL CONTROL:

- A. Standard applications include scheduling, data logging, alarm detection & dispatch, meter reading, analog functions, and type translation. The scheduling application permits events and exceptions to be initiated based on time and date schedules configured by the user. An astronomical position calculator permits scheduling to be done based on the calculated position of the sun. The data logging application collects network activity for use by trending, reporting, and analysis applications. New DIME support enables data log upload to a Web services application to occur through a firewall. The alarming application provides a means to identify, announce, and log alarm conditions. The meter reading application supervises impulse meters and provides suitable conversion values for energy, gas, and water metering. Automatic Sound Power Level Changes: Two system channel changes, four times per day, and capable of different time settings for each day of the week:
1. Programmable attenuation range: -24 to +24 dB (48 dB)
  2. Slide control attenuation range: -24 to +24 dB
  3. Minutes per dB change: User programmable
  4. Acclimation attenuation range: -24 to +24 dB
  5. Acclimate days per dB change: 1 to 5 days
  6. Programmable events: 24 events per day for each zone
- B. Sound Masking, Audio and Paging Shutdown Sequence
1. The FACP shall be connected to the SMCP (Sound Masking Control Panel) utilizing a supervised line and addressable relays, per NFPA 72, to shut down and effectively mute all sound masking, audio and paging systems.
  2. The FACP and associated supervised lines shall meet UL 2572 to ensure that the shutdown mechanism is properly supervised and is reliable and will in no way damage the FACP or SMCP
  3. The FACP and associated relays shall not introduce any noise into the sound masking, audio or paging system.
  4. Muting ambient sound during an emergency is necessary to meet ADA suggested guidelines and NFPA acoustic requirements
  5. Non-UL listed SMCP is not acceptable
  6. Refer to Section 28 31 00
- C. Program Memory: Nonvolatile for one year, minimum, without power. When re-energized after a power outage, control starts at zero level and automatically advances system sound level at same rate used for programmed level changes.
1. Acceptable Manufacture: Lencore

## 2.06 MISCELLANEOUS EQUIPMENT

- A. Wiring and Cables:
1. Use manufacture recommended cable.
  2. Grounding wire shall be in accordance with NEC 800-31 (1984) and NEC 250
  3. All lacing and clamping shall be in the strictest practice. No intermediate splices are permitted.
  4. All connections are to be soldered. No solderless connectors or "wire-nuts" may be used for splicing or connections.
- B. Equipment Racks:
1. Acceptable Product: By other, coordinate with IT
- C. Conduit System:

1. Meet all of the requirements of the metallic conduit system described in the electrical specifications, Division 16.

## 2.07 AIDS TO USE

- A. One Durable Single Line Block Diagram: The drawing for this diagram shall be drawn expressly for the purpose of facilitating the operator's use of the system. No superfluous information such as wire designations, voltages, levels, construction information, etc., shall appear on the drawing. The drawing shall be a simplified block diagram. All pieces of equipment, controls, etc., shall be identified precisely as they are actually designated or engraved. Mount the drawing inside the front of the equipment enclosure panel.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. The following installation requirements shall govern the design, fabrication and installation of the system(s) specified herein. In case of a discrepancy between these overall system standards and the individual equipment item specifications, the latter shall govern.
- B. The equipment specified in this section shall be installed according to standards of good engineering practice and the conditions specified herein.
- C. The equipment enclosure shall be installed according to standards of good human engineering. Equipment installed shall be selected within the criteria of operational simplicity and ease of maintenance.
- D. Workmanship on the installed system shall be of professional quality, best commercial practice and accomplished by persons experienced in the techniques and standards of the particular crafts involved.
- E. The performance specifications describe required performance. The specifications with the contract drawings indicate a general design; it is the intention of the specifications that the Design-Builder will supply from his background of experience and knowledge the necessary supporting details; for example, the values of components in wiring networks, and implementation of specific components into functioning sub-systems.
- F. In general, the drawings show dimensions, positions, and kind of construction and the specifications describe materials, qualities and methods. Any work called for on the drawings and not mentioned in the specifications, or vice-versa, shall be performed as though fully set forth in both. In case, of differences between the drawings and the specifications, the decision of the Consultant shall govern. Work not particularly detailed, marked, or specified, shall be construed to be the same as similar parts or areas that are detailed, marked, or specified.
- G. All equipment items shall be provided and installed to allow fully normal operation in the anticipated ambient temperature range of 60 degree-90 degree F.

### 3.02 PERMITS

- A. Obtain Necessary permits for installation work.

### 3.03 INSTALLATION

- A. The General Contractor shall be responsible for supplying any conduit, which may be

required to complete the system installation in accordance with the specifications.

1. All requirements for the metallic conduit specified in the electrical specifications and Division 16 shall apply to the work described herein.

B. The Equipment Enclosure Layout and Assembly:

1. The equipment enclosure shall be installed in the equipment room. Install equipment in the enclosure as shown in the drawings.
2. Interconnecting cabling shall be led laterally from each component to the vertical rack member opposite from the AC power strip and then run vertically, remaining as exposed and accessible as possible. Wherever corners in cabling occur a strain relief spiral covering should be used. All cable clamps shall be non-conducting or have soft insulating covers.
3. Great care shall be exercised to keep low level signal lines separated from the AC power lines and high level signal lines. This must be observed in rack layout and mechanical support or passage within the equipment room.
4. All connections of lines at terminal strips shall be mechanically secured and then soldered. No unsoldered connections will be permitted. Where lines approach the enclosure and terminal strips they shall also be mechanically anchored at the enclosure and provided with sufficient slack length to avoid strain, abrasion or wear.
5. The enclosure shall be constructed to easily accommodate interconnecting cables entering from above or below. Approved terminal blocks shall be provided. Other suitable means of terminating or connecting incoming and outgoing cables may be used if approved by the Consultant.

C. Wiring and Cabling:

1. Wiring shall be executed in accordance with the equipment manufacturer's wiring recommendations. Should the Design-Builder desire variations from these requirements, the Design-Builder shall first receive the approval of the Consultant/Engineer.
2. Wiring Method: Install wiring in accordance with all local electrical codes. Conceal cable in accessible ceilings, walls and floors. No exposed cable is allowed.
3. Pulling Cable: Do not exceed manufacturers' recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between normal termination points. Remove and discard cable where damaged during installation and replace it with new cable.
4. Cables shall be grouped and bundled by type and level and routed from source to termination in a uniform manner throughout all equipment housings. Care shall be taken not to break the insulation or deform the cable by harness supports. Cables shall not change relative position in a cable group throughout a cable route.
5. Power distribution wiring shall not be installed adjacent to signal cables. Power distribution cabling shall be on the opposite side from signal wiring in equipment enclosures and shall be uniformly located throughout an installation.
6. Edge protection material ("cat track") shall be installed on the edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edges.
7. Audio and control cable ends shall be neatly formed and shrinkable tubing applied where necessary to secure the insulation against graying or raveling.
8. All conductors, including spare conductors, which are entering or leaving the above listed components, shall be directly terminated on terminal blocks without intermediate splices. All terminals used shall be properly and completely labeled.
9. Cable shields shall be terminated in the same manner as other conductors. The shields of all cables shall be kept well separated from each other and from ground.
10. Installation of cable will be the responsibility of the Design-Builder for the Sound

Masking system. The connection to the Fire Alarm Control Panel (FACP) will be provided by the Design-Builder to the Fire Protection Engineer (FPE). The FPE will be responsible for the physical connection to the FACP.

- D. Plenum Loudspeakers:
1. Mount loudspeakers at locations shown on the approved shop drawing.
  2. Mountings and Loudspeakers shall be concealed above the acoustical ceiling. The loudspeakers shall be suspended from the slab above by chain. Where possible, the bottom, of each speaker shall be located a minimum of 6" to 8" (150 to 200mm) above the acoustical ceiling tile. It is most important that all units hang at a uniform height throughout to insure a uniformity of sound when the system is turned on.
  3. Provide safety cable attached to the deck above at each loudspeaker location.
  4. In the event that the alternate to furnish exposed loudspeaker cables in the ceiling plenum is exercised, locate all cables approximately 12 inches below the metal deck and attach cables by approved J-Hook fasteners. Loudspeaker cables shall not be permitted to lay on ceiling suspension members or the ceiling tile.
- E. Power distribution throughout the system shall be done according to applicable codes:
1. Unless otherwise specified elsewhere, the Design-Builder shall supply and install the appropriate rack mounted power distribution panel, specified elsewhere, in each equipment console/rack/enclosure.
  2. Power cords from individual equipment to power outlet strips shall be shortened to the proper length and neatly dressed into the rack or console. Cradle clamps with removable rubber retainers shall be utilized to secure power cords to the side of the rack supports. Power cords shall not be secured by non-reusable supports.
- F. Labeling:
1. Equipment markings shall present only needed information and be readable from the operator's or service personnel's normal work position. These markings shall be designed to avoid ambiguous interpretation.
  2. All Networked devices must have an LCD screen that works directly with the network in real time displaying the correct node number.
  3. A descriptive title shall be assigned to each piece of equipment. An engraved designation title plate shall be applied to both the front and rear panels of rack-mounted equipment, and to the outside case or enclosure of equipment mounted within a rack. These same titles shall also be indicated on the block diagrams, all wiring drawings, and all installation drawings. Descriptive titles assigned to front panel mounted equipment shall use plain English (example: Power Amplifier #2-1).
  4. All cabling (signal and control) shall be individually identified. Each cable identification shall be a unique number located approximately 1.5 inches from the cable termination connector at both ends of a cable. This cable identification number shall be impressed on a fixed length of white shrinkable tubing with a heat impression stamping machine. The lettering shall be filled with a black filler and covered with a protective coating after shrinking that will not crack, peel or yellow. After installation, these labels shall be covered with clear heat shrinkable tubing. The letters shall be approximately .25 inches in height. These unique numbers shall appear on "as built" documentation to be supplied at the completion of the project. Markers shall be pre-shrunk to the approximate size before installing. Cable markers shall be oriented for ease in viewing before installation.

### 3.04 OVERALL SYSTEM PERFORMANCE REQUIREMENTS AND QUALIFICATIONS



- A. The system shall be validated in at least the following steps. All work is to be fully recorded with a neat copy presented for acceptance by the Consultant and included in the system manual. The costs for all tests shall be borne by the Design-Builder.
  
- B. Tests required: To the greatest extent possible, the Design-Builder should pre-assemble and test all system component subassemblies, including consoles, rack assemblies, interconnections, and system assemblies (excluding, of course, input and output transducers) in his own facility.
  - 1. By Design-Builder at Design-Builder's shop:
    - a. Frequency Response: Overall frequency response of the complete electronic system (un-equalized) shall be 65 - 15,000 Hz +-2 dB. Equalizing circuits shall be temporarily set in the indicated "flat" position. Other equalization devices shall be temporarily removed and replaced with equivalent loss networks.
    - b. Distortion: Total harmonic distortion at full power shall be less than 1.5% for frequencies of 50, 1000, 10,000 and 15,000 Hz.
  
  - 2. Equalization and Other Testing (by the Design-Builder at the job site):
    - a. After all electronic equipment specified herein is fully installed at the job site and the ceiling speakers and ceiling system with all relevant return air sound boots in place are fully installed, the system shall be equalized and acoustically tested by the Design-Builder. The tests shall be performed with the HVAC system and ultrasonic motion detectors, if installed, turned off. The carpeting, work stations, desks, chairs, acoustical wall panels, and all other materials that may influence the acoustical characteristics of the space shall be installed prior to testing.
      - 1) Equalize the complete system in all zones to meet the octave and third-octave sound spectrum requirements in accordance with the Design Criteria.
      - 2) After all zones are equalized, set the sound level, measured in dBA for each zone so that it meets the Design Criteria. If the variation in sound level in a particular zone or area exceeds the nominal value in excess of 2 decibels, adjust individual loudspeakers as required.
      - 3) The time clock shall be set as follows for all zones (verify with Owner):
        - (a) Monday – Friday 7 am to 7 pm: 0 dB
        - (b) Monday – Friday 7 pm to 7 am: - 3 dB
        - (c) Saturday, Sunday: - 3 dB
      - 4) All these tests, and any others that the Design-Builder may wish for his own satisfaction, shall have been performed and successfully achieved before observation is requested for the Consultant. The Consultant may request repetition and demonstration during observation of certain of these tests or other critical tests if problems become apparent. If specifications are met, acceptance of the system after this observation may be expected. If specifications are not met, further observations by the Consultant will be at the Design-Builder's expense.
  
      - 5) .

### 3.05 ACCEPTANCE DOCUMENTATION

- A. Acceptance: Official acceptance of the system covered by this specification will occur

when the Design-Builder receives the following written documents:

1. A letter from the Consultant to the Architect acknowledging Final Acceptance of the system stating compliance with all articles of the specifications.
2. A letter from the Architect to the Design-Builder stating that all related work has been completed to his satisfaction. Until these documents are received, the installation is not formally complete. The official date of acceptance shall be the date of the letter from the Architect to the Design-Builder described above.

### 3.06 INSTRUCTIONS

- A. When all required approval of this portion of the work has been obtained, and a time designated by the Owner, the Design-Builder shall thoroughly demonstrate to the Owner's maintenance personnel the operation and maintenance of all items installed under the work in this section.
- B. The Design-Builder shall supply complete system documentation with the system described herein. A complete instruction manual as provided by the manufacturer containing an operation description, schematic diagrams, parts layout drawings, and parts lists shall be furnished with each component time supplied by the Design-Builder.
- C. In addition to the specified system documentation, the Design-Builder shall supply complete manufacturers instruction manuals (operation and service) for each purchased system component. Each instruction manual shall contain an operational description of the components plus a schematic diagram(s), parts layout, parts list, and maintenance instructions (preventive and corrective). All manuals shall be organized by system and presented in bound volume, one volume for each system. Three copies of each volume shall be provided.
- D. A list of all instruments, including accessories by manufacturer and type number used by the Design-Builder to obtain test data shall be submitted to the Owner with maintenance recommendations for all equipment furnished under this contract.

### 3.07 CLEANING

- A. All debris resulting from the system's installation shall be continuously removed during and after the installation. All equipment shall be thoroughly dusted and cleaned after installation.

- END OF SECTION -