



**GAI-TRONICS LIMITED**  
A Hubbell Company



**elemec**  
*Systems*

**DOCUMENT TITLE : ELEMEC *plus* PUBLIC ADDRESS AND  
GENERAL ALARM (PA/GA) SYSTEM  
SPECIFICATION**

**PROJECT :**

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## 1. GENERAL

This specification describes the minimum requirements for the design, manufacture and application of the Public Address and General Alarm (PA/GA) System. The PA/GA application is a critical system with respect to personnel safety and shall, during an emergency situation, be fully operational to allow safe evacuation of the facility, therefore a field proven design shall be provided. The ELEMEC *plus* System architecture and operation exceeds the requirements for a reliable, life safety PA/GA system.

The PA/GA System shall be fully compliant to this specification.

The ELEMEC *plus* System shall distribute alarm tones, pre-recorded messages, emergency voice messages and routine voice messages to all or selected areas of the facility, in a reliable and safe manner, by the use of loudspeakers. In areas with a high ambient noise level, flashing lights shall complement voice messages and audible alarms

Alarms shall be initiated either manually from any one of the dedicated access panels or automatically from the Fire and Gas Detection System or Emergency Shutdown System main panel via dedicated hardwired interfaces between the two systems. Voice messages shall be generated either from the microphones at dedicated access panels or from telephones in the facility.

### 1.1. SCOPE

The purpose of this specification is to ensure consistency in selection, design and application of the Public Address and Alarm System. This specification defines the requirements of the Public Address System equipment utilised, to allow broadcasts of speech and alarms. Minimum hardware and application software requirements of these systems are defined.

All labour, materials, equipment and services necessary and required to furnish and install a complete and operating Public Address and Alarm system are provided. Any material not specifically mentioned in this specification or shown on the applicable drawings, but required for proper performance and operation shall be included.

### 1.2. SCOPE OF WORK

PA/GA system, including controls (central and remote), access stations, amplifiers, loudspeakers, wiring and all specified and/or required appurtenances and accessories.

### 1.3. REFERENCES

The following categories list the standard bodies referenced in the design of the system:

#### A. Alarm Systems

- International Electro-technical Commission (IEC)
- UKOOA Guidelines for Telecommunications Systems
- International Maritime Organisation (IMO) SOLAS
- DNV Safety Principles and Arrangements
- B. Equipment for use in Hazardous Locations
  - Comite European de Normalisation Electro-technique (CENELEC)
  - International Electro-technical Commission (IEC)
  - IEC 79 Electrical apparatus for explosive gas atmosphere
  - IEC 331 Fire resisting characteristics of electric cables
  - IEC 529 Classification of degrees of protection provided by enclosures
  - IEC 801 Electromagnetic compatibility for industrial-process measurement and control equipment
- C. Equipment Safety
  - Comite European de Normalisation Electro-technique (CENELEC)
  - CE Mark
  - International Electro-technical Commission (IEC)

#### **1.4. SUBMITTALS**

Based on customer detailed requirements the following shall be supplied:

- A. Equipment general arrangement drawings.
- B. Equipment termination drawings.
- C. Certificates of conformity.
- D. Catalogue data on all furnished standard equipment, including, but not limited to: -
  1. Central equipment and all internal modules and devices.
  2. Access panels.
  3. Field access panels.
  4. Loudspeakers.
  5. Beacons.
- E. Technical manuals which contain mounting details and dimensions, installation and connection instructions, operating and maintenance instructions, spare parts list and equipment specifications.
- F. As-built equipment drawings after construction.

### **1.5. QUALITY ASSURANCE**

- A. All work shall be performed in accordance with this specification, applicable drawings and the best modern practices in design, manufacture and fabrication.
- B. The system equipment manufacturer shall be ISO 9001 registered for the design, manufacture, contract installation management and service of industrial communication and emergency notification systems. The system manufacturer shall be an experienced firm having 10 years documented experience in the manufacture of similar systems currently demonstrating satisfactory service.
- C. The system equipment manufacturer shall have in effect at all times a quality system which shall fully satisfy all the elements of ISO 9001-1987, "Quality Systems-Model for Quality Assurance in Design/Development, Production, Installation and Servicing" and ISO 9004-1987, "Quality Management and Quality System Elements- Guidelines". The quality system shall provide for the planned and systematic control of all quality-related activities performed during design. Implementation of the system shall be in accordance with the system equipment manufacturer's Quality Manual. The Quality system shall clearly establish the authority and responsibility of those responsible for the quality system. Persons performing quality functions shall have sufficient and well-defined authority to enforce quality requirements, initiate, identify, recommend and provide solutions to quality problems and verify the effectiveness of the corrective action.

### **1.6. REGULATORY REQUIREMENTS**

- A. The PA/GA system shall be designed and installed in complete conformance designated by the customer requirements.
- B. All hazardous locations shall be equipped with certified equipment. Equipment certification shall be through recognised testing laboratories. Equipment shall be labelled according to the appropriate regulations.

## 2. SYSTEM DESCRIPTION

### 2.1. ARCHITECTURE

The PA/GA system shall be divided into one or more zones (up to a maximum of 8 zones) which can be accessed independently for announcement or alarm broadcasts. Zones can be designated as to function, such as: “work areas” or “accommodations”. Physically, loudspeakers or beacon circuits shall support zones where one or more circuits can be partitioned into a zone. Each loudspeaker or beacon circuit shall be connected to the central equipment for amplification and control/monitor functions.

Paging announcements shall be broadcast through loudspeakers installed in the various areas and locations throughout the facility. The system shall allow calls between it and any existing public address system. The system shall be modular in design and shall be easily expandable.

The area coverage will be such that calls will be clearly audible in the paged operating areas and their surrounding space.

Final distribution of loudspeakers over the zones will be determined during detailed design. Each zone shall be split into loops, where each loop is physically connected to a different amplifier. This configuration ensures that a loss of a single amplifier does not adversely affect paging broadcasts within a zone. The distribution of loudspeakers will be related to area configuration and other operational objectives. Cable distribution throughout the plant area will be designed such that all loops relevant to the same zone are laid up separately following different paths, in order to ensure that cable cuts or shorts will cause a minimum effect on the zone broadcast.

Suitable speech amplifiers shall drive the loudspeaker lines. The system shall provide facilities for automatic insertion of a hot standby amplifier(s) in the event of a single/multiple amplifier failure.

Access panels shall support operator voice announcement and alarm control operations. Announcements are classified as “routine” or “emergency”, where an emergency announcement shall take precedence over all other audio broadcasts. The system shall be expandable to provide inputs for up to 16 fully fitted microphone panels. Announcements shall be pre-configured to broadcast in designated zones. A zone selection feature shall enable users to direct routine announcements to selected zones. Alarm operations shall initiate the broadcast of alarm tones or pre-recorded messages to pre-configured designated zones. Access panels shall be connected to the central equipment and accorded an access priority for announcements. Alarms shall be accorded a broadcast priority that gives the most critical alarm precedence.

Each access panel shall be able to: -

- Address a call to one or multiple zones. (maximum 8)

- Address a call to one or multiple groups of zones, by activating the selected groups of zones.
- Transmit a general call to the whole area activating all zones simultaneously. The speech messages shall be announced by an automatically generated pre-announcement attention signal.

The access panels shall be interlocked to prevent interference on the call in progress for the same zone or group of zones from lower priority panels. In addition, all audio signals to be broadcast shall be able to be configured with different levels of priority in order to allow each signal to override the others where appropriate and where specified in accordance with specific site requirements.

The central equipment shall support external interfaces for telephone or other audio source interconnection for routine broadcast to designated zones. A digital storage and replay feature shall eliminate any acoustic feedback between audio source and nearby loudspeaker. Each external interface shall be accorded an access priority for announcements.

Additional interfaces shall support connectivity to external alarm or monitor systems to facilitate the remote control of alarm operations. Alarms shall be accorded a broadcast priority that gives the most critical alarm precedence.

It shall be possible to initiate a routine paging broadcasts via authorised telephones. In normal operation the user will ring into the system, record a message and then trigger its playback over related zones. Automatic repeating of the message can be configured. DTMF tones are used to control the recording and playback of the messages.

If the access to the PA System is denied due to priority configuration, the PA System shall return a busy signal to the telephone caller.

The plant radio sets equipped with DTMF keypad shall be interfaced with the plant telephone PABX, and consequently they shall be allowed to access the PA system in the same manner as the telephones.

Integrated test equipment shall be incorporated into the central equipment to identify faults on the external loudspeaker loops.

## **2.2. EQUIPMENT CHARACTERISTICS**

The system shall provide facilities for the control and management of a high integrity Public Address and Alarm System specially designed for industrial environments where advanced technology coupled with very high system availability is demanded.

The materials used shall have characteristics suitable for the installation site and for the service required. The equipment shall be fully solid state type, multi-microprocessor based and programmable.

The system shall be software program controlled to enable easy system configuration and self- diagnostics, as well as future software upgrade.

Configuration of the system shall be achieved by software for maximum flexibility. A user friendly set-up and checking routine shall provide system management and programming through LCD displays and Personal Computers, which enables an operator using a system controller to implement quick commissioning and fault finding functions. The use of these methods shall allow adjustments to be easily made after the system is installed without resulting in modifications to the system wiring.

The access panels shall be microprocessor based and connected to the central control cabinets using three individually twisted and shielded pairs.

Facilities to indicate the status of the main system units shall be provided. Such indications shall show any faulty unit for easy replacement.

The system shall be provided with standard serial interface RS 232 for local or remote access for supervision and maintenance activities (such as diagnostics with a mimic panel, status and logging of events).

## **2.3. CENTRAL EQUIPMENT**

The central equipment shall comprise a single 42U X 19" cabinet. The cabinet shall house all amplification, control and monitoring equipment necessary for the reliable operation of the PA/GA system. An additional amplifier cabinet can be accommodated where greater broadcast power is a requirement. External connections shall be provided for loudspeaker and beacon circuits and external interfaces shall be supported within the central equipment cabinet. The central equipment shall support integral facilities to test the system and provide status information to facilitate repair or replacement of possible failed circuits.

Cable entry to the central equipment cabinet will be via top and/or bottom gland plates, which will be provided less drilling.

## **2.4. MAIN SYSTEM FEATURES**

### **A. Configuration of Alarm Tones and Priorities**

Alarm tones and priorities shall be configured to each customer's requirement so that particular tones are generated under different conditions. Higher priority alarms shall be programmed to override those of a lower priority. The customer shall specify alarm tone frequencies, types, durations, external contact specifications and alarm conditions during the detail design phase.

### **B. Configuration of Announcement Priorities**

Announcements from different sources shall be configured to override others.

### **C. Pre-Announcement Tones**

Single chime or double chime as pre-announcement tones shall be generated under software control, with the possibility to associate these different chimes to different sources and activation types. For example, typically a single chime

precedes a routine announcement and a double chime precedes a telephone access.

#### **D. Zone Selection of Announcement and Alarms**

Real time and pre-recorded voice messages and Emergency Alarm signals may be diverted to pre-determined groups of amplifiers/loudspeakers. The access priority regime will determine which announcement has priority of access and is broadcast. The configurations of groups of zones shall be changed via software without the need to alter wiring of audio inputs or the speaker loops.

#### **E. Gain Control of Alarms and Announcements**

Alarms and announcements shall be individually configurable to different volume levels to allow for clearly audible emergency broadcasts. An alarm in progress can be attenuated (up to 12 dB) or fully muted while an emergency broadcast is made and then increased back to its original level afterwards.

#### **F. Pre-recorded Digital Tones and Important Messages**

The microprocessor shall control the generation of alarm tones, as well as pre-recorded chimes and digital speech messages. The system shall be provided with alarm and test tones, as well as the facility for bilingual or multilingual pre-recorded announcements

Emergency notification alarms can be broadcast manually or automatically. Each alarm is fully configurable and initiated by either a direct command from an access panel or by contact closures from within other system equipment. (Such as fire and gas detection systems) in accordance with the customers requirements. Pre-recorded messages of up to 256 seconds in length can be initiated manually from any operator access panel. For security reasons it shall only be possible to re-program either the important message or the alarm tones by removing the controller unit lid and replacing the storage device (EPROM).

#### **G. System Recovery**

The control unit incorporates a hardwired watchdog circuit. This circuit must be continually refreshed from the microcontroller to prevent it from generating a hardware reset. The circuit also monitors the power supply to generate resets if brown-outs occur. The 'crash mode' relays are also controlled by this circuit to ensure that they revert to fault condition if the processor stops running.

#### **H. Power Amplifiers**

Industry standard 300 Watt power amplifiers shall be provided with the following minimum features: low idle current, LCD indicators for output level (V.U), built-in thermal protection, overload and short circuit protection. The short circuit protection shall shut off the power amplifier for a 5-second period, repeating until the fault is rectified. Power amplifiers shall be provided with built-in supply capability from AC mains or 48VDC or 24V DC (250W).

### **I. Network Connection Facility**

Data links between remote units shall be provided through standard serial interface RS 232/RS 485. The maximum distance for RS 485 shall be 1km.

Audio links between remote units shall be provided through individually shielded, twisted pairs. The maximum distance shall be 1 km. For distances greater than 1 km, it shall be necessary to use an alternative transmission system, for example a fibre optic link may be used.

### **J. Multiple Sources of Speech**

Announcements shall be able to be made from a variety of sources, such as engineer test panel, operator access panels, telephones via PABX interface, radio (through the PABX) or digitally recorded messages.

### **K. System Redundancy**

The system is designed for full 100% redundancy of equipment. Each operator access panel is provided with duplicate (A+B) circuitry. To further increase system availability hot standby amplification shall be offered.

System power supplies may be provided such that each control cabinet shall contain a power supply of substantial capacity to provide power to the Controller Unit and Microphone Panels.

### **L. Built-in Self Diagnostics**

Each piece of system equipment shall have a comprehensive built in diagnostic test feature so that at all times the status of the system can be monitored. Faults shall be reported to an operator or engineer via remote or local access panel. Circuit failures shall be reported on the LCD display of the Controller Unit and on the operator's control sets, and reported remotely through dry contacts and/or serial lines. The system monitoring functions shall include: - Management System alarms, power amplifier alarms, power supply alarms, speaker loop alarms and communication alarms between the various system equipment.

### **M. Speaker Loop Monitoring**

The system shall provide the facility for monitoring speaker loop status. Automatic setting procedures shall be able to be programmed in order to check all output line conditions. Speaker loop monitoring shall utilize two-wires, using the same 100V or 70.7V speaker line, which provides real time (or scheduled) trouble-shooting of the individual speaker loops.

The system shall provide facility for detection of speaker line earth leakage and for detection of speaker line impedance deviation, utilising an ultrasonic signal (open or short circuit detection or alteration from the defined typical value).

## 2.5. ACCESS PANELS

Multiple access panel formats shall be supported. Standard formats shall include rack-mount, desktop and bulkhead versions. Each panel type can be offered in safe area or I.S. approved versions for use in Zone 1, Gas Group IIB/C, Temperature Class T4 locations. Custom formats can be provided if packaging deviations do not void unit certifications.

Connection to the Central Equipment shall be via a 3 pair individually screened cable.

Access panels shall support facilities for an operator to execute routine or emergency announcements, and initiate and terminate prioritized alarms. Panels shall provide status information on panel and external operations, and system health. Operator facilities shall be selected from a features list to meet a customer's specific operational requirements.

The unit may be used with a single system or provide galvanic isolated circuits for use with fully redundant A+B systems. The front fascia panel allows user access to: -

- Panel microphone: Fist or gooseneck (safe area or I. S.)
- Panel switches: Up to 30 pushbuttons can be fitted
- Sounder: Confidence beep tone emitted on any pushbutton press (safe area panels only)
- Switch LEDs: Lights to confirm control equipment acceptance of push button press
- Status LEDs: Indicators provided for typical, healthy, fault, alarm actuation, system in use.

## 2.6. DUPLICATION

The system design shall support a complete duplication of critical components, i.e. central equipment, access panels, loudspeakers and beacon components. The desired redundancy format shall be stipulated by the customer requirements.

Critical component redundancy shall support duplication (2N) or hot standby (N+1) formats. Components available for duplicated service shall be, but are not limited to tone generators and pre-recorded audio units. Components available for hot standby shall be, but are not limited to amplifiers and power supplies.

Complete duplication of the PA/GA system shall be of a design such that in the event of a serious failure of the alarm circuits in the primary central equipment cabinet, the secondary cabinet is given control of the power amplifiers and beacon outputs. In case of complete cabinet failure, alarm and emergency announcements shall still be audible in all areas from all microphone panels, but at a reduced volume level.

## **2.7. OPTIONAL SYSTEM FEATURES**

### **A. Audio Recording**

The calls originated from telephone or microphone consoles shall be automatically recorded through a suitable digital audio recorder, with a removable storage media. During an incident or emergency, it shall be possible to record voice traffic on the system for future replay. A transformer isolated 600 ohm output is provided for this purpose.

### **B. Alarm Attenuation**

Attenuation of alarms while a broadcast is being made shall be provided. The alarm audio level shall be reduced up to 12 dB from the broadcast level.

### **C. Audio Path Monitoring**

The system shall provide full audio path test from microphone panels to loud speakers with ultrasonic audio signal for true dynamic checks. The ultrasonic test signal shall be a true sinusoidal low distortion signal. The system shall provide signal wire integrity monitoring throughout the internal cabinet wiring and over all access panels to cabinet wiring (open or short circuit, unbalancing for balanced lines and ground leakage).

### **D. Background Music Broadcast**

The system shall be able to provide broadcasts of background music from various music sources such as CD players, cassette recorders or tuners. The Customer shall specify music sources during the detailed design phase.

### **E. Page /Party® Access**

A facility is provided whereby the page line output of a GAI-Tronics Page/Party® system can access the Elemec Plus equipment to make paging broadcasts. Dependent upon the input configuration, either real time or voice storage and replay options are available.

### **F. PABX Access**

A priority telephone interface unit can be installed at each equipment cabinet. Upon receipt of a valid access code (e.g., 333) a confirmation tone is returned to the call originator and the message to be broadcast is recorded. During message playback system "A" has control and sends the announcement via the A/B inter-link to both A and B broadcast amplifiers.

### **G. Auxiliary Warning Beacons**

The system shall provide for auxiliary warning beacon activation or other relay-controlled outputs (up to 16 maximum), for alarm indication and local muting facilities.

### 3. SYSTEM OPERATION

#### 3.1. GENERAL

The PA/GA system shall provide basic functions for:

- **Announcements** The capability to support prioritized one-way voice audio broadcasts to one or more zones from access panels and external audio interfaces.
- **Emergency Notification** The capability to support prioritized alarm responses that include audio and/or visual notification when initiated from access panels or external interfaces.
- **Supervision** The capability to continually monitor all critical audio paths and circuits so that any failure can be brought to the attention of the system operators or maintenance personnel for corrective action.

#### 3.2. PUBLIC ADDRESS ANNOUNCEMENTS

The PA/GA system shall provide one-way voice audio broadcast primarily utilising access panels located throughout the facility in accordance with customer requirements. Additional broadcast services shall be provided through interfaces for telephone or intercom systems as specified by customer requirements. Alarm audio notification shall employ circuitry integral to voice audio broadcast so as to facilitate prioritisation. Access panel, external audio interface and alarm audio sources shall be prioritised by content to allocate access to the most critical broadcast information. Where multiple microphone panels are used, these shall be prioritised in order of importance.

**TABLE 3-1 TYPICAL ANNOUNCEMENT PRIORITISATION**

MESSAGE CONTENT	PRIORITY LEVEL	DEFAULT DESTINATION
Emergency Announcements from Access Panels	1 <sup>st</sup> Priority	All Areas (Programmable) Including accommodation
Alarms	2 <sup>nd</sup> Priority	All Areas (Programmable)
Routine Announcements from Access Panels	3 <sup>rd</sup> Priority	All normally occupied work areas, zone selectable except accommodations
External Announcement (eg PABX)	4 <sup>th</sup> Priority	All Areas, zone selectable

A facility to combine both zone selection and announcement initiation shall be supported. This facility shall allow an operator to select one momentary switch to launch a routine announcement to one pre-configured zone. Zone selection is automatically terminated after an announcement.

Status facilities shall be provided to display system information regarding active or non-active announcement information on access panel indicators. This status serves to sequence equal access announcements.

### **3.3. EMERGENCY NOTIFICATION**

The PA/GA system shall support eight alarms that consist of distinctive tones and/or pre-recorded messages broadcast to predetermined destinations. Visual notification shall be supported for alarms and emergency announcements to supplement audio notification in areas where noise levels typically exceed 85dBA or in accordance with customer requirements. Visual notification shall be through color coded beacons that indicate the severity of the alarm or emergency announcement.

Each alarm may be initiated through an access panel or external voltage free contact interface. The standard manual format for alarm operations from an access panel shall be through switches for each alarm activation. The external interface shall support configurable normally open or normally closed, maintained or momentary voltage-free contacts for each automatic alarm activation.

Audio notification shall be prioritised to assure the broadcast of the most critical alarms as identified in Section 3.2. Customization of the system design can provide for additional alarms.

Status facilities may be provided to display system information regarding active or non-active alarm information on access panel indicators. This status serves to provide a visual interpretation to access panel operators.

### **3.4. SUPERVISION**

The central equipment shall incorporate configurable automatic monitoring facilities. These facilities shall be selected during system design in accordance with the customer requirements.

The standard set of monitoring facilities shall interrogate:

- Controller unit with built-in message/tone generator.
- Power amplifiers.
- Loudspeaker loops.
- Digital communication paths between the various system equipment.

The interrogation of supplemental circuits shall be supported as required.

The standard system design shall ensure that all critical audio paths and operation of the PA/GA system are continuously monitored so faults are immediately identified. The Controller Unit located in the central equipment cabinet shall assist

in fault location and diagnosis during a failure condition. Voltage free relay contacts shall be provided to enunciate equipment failure conditions to external systems. Facilities shall be provided to display system information regarding health or fault information on access panel indicators.

### **3.5. PAGING PRIORITIES**

Paging priorities can be assigned for each page audio source and can be altered through software programming.

### **3.6. PLANT TELEPHONE ACCESS**

The following steps are completed to make an all zone page announcement from a plant telephone:

- Dial the “PA Access” number – the system will auto-answer if the line is not already engaged; otherwise a busy notification will be returned.
- As an alternative it is possible to provide zone selection from PABX access by keying the appropriate zone once a seize condition has been registered.
- Make announcement – then through the use of the page delay feature to eliminate feedback, the system broadcasts the user’s voice to all zones if no other higher or equal priority broadcast is active.

Access to plant telephones or radios are similar except for the number dialled.

**Note:** *Based on the project specification, the approach for radio access assumes that DTMF keypad equipped hand-held radios are employed, and interfaced with the plant telephone PABX, and consequently allowed to access the PA system in the same manner as the telephones.*

## 4. PRODUCTS AND MATERIALS

### 4.1. CENTRAL EQUIPMENT

The central equipment shall consist of:

- Single board Controller Unit with integral fault monitoring circuitry
- Audio Power Amplifiers
- Power Supplies

#### 4.1.1. System Cabinet

The control sub-system, amplifiers and their ancillary devices shall be housed in a 19" standard rack mounted 42U system cabinet with all control, power circuits and necessary amplifiers.

Wiring from the modules shall be via ribbon cables and via screw terminals. Connections external to the control rack shall also be made via screw terminals. All wiring shall be clearly identified by numbered sleeves and terminal markers where appropriate.

Cabinet(s) shall contain all panels that are part of the central system equipment. Cabinets shall have front glazed and plain rear access doors. Panel(s) shall be removable from the front, and disconnected from the rear before removing. The cable entries shall be via top or bottom gland plates sealed.

Low power signals among cabinets shall be extended with interconnecting cables connected via IDC terminals. All the connectors shall be mechanically lockable.

**Cooling fans external to the power amplifiers, shall not be used.**

Terminal strips shall be provided at each side of the cabinet(s) for external circuit's connection. All terminals shall be progressively numbered. Terminals shall have adequate size for accepting cables with up to 2.5mm<sup>2</sup> cross section. Dirty and clean earth bars shall also be provided to earth all the metallic parts of the cabinet(s) and incoming field cables.

Unless otherwise specified in the requisition, or agreed by the principal, the color-coding of wires shall be as follows:

Power	Positive Negative Live Neutral	RED BLACK BROWN LIGHT BLUE	
	Low Level Input signals Low Level Output signals	TBA	TBA
	100V Power Output Signals	GREY/ORANGE	
	Safety earth Signal earth	GREEN/YELLOW GREEN	

## **4.1.2. Basic Components**

### **4.1.2.1 Controller Unit**

The control unit provides the heart of the PAGAs system controlling audio routing from access panels, alarm generation, contacts inputs and outputs, power amplifier control, and visual-audible indication of system status.

For ease of rack wiring all connections to the unit are made via ribbon cables.

The unit is microprocessor controlled with a hardware fallback circuit, which is capable of alarm generation and emergency speech in the event of processor failure.

Three PCBs are used within the unit – one main PCB containing all the audio routing and microprocessor components, a front panel PCB containing the LCD, LEDs, and switches, and a rear PCB for the ribbon cable connectors.

The software is designed to be as flexible as possible by making extensive use of configurable options to meet customer needs. The system is configured via an RS232 port with appropriate software.

The system is designed for use in safety critical installations and as such contains several high integrity features.

- Emergency fall back operation
- Dual system A/B inter-link for operational status checking
- Fully duplicated A/B operation
- Hardware watchdog circuitry
- Hot standby amplification
- Fault-event logging

### **4.1.3. Power Amplifier**

The power amplifiers support speaker loops. Each amplifier produces 300W RMS from a 0dB, 600 ohm-input signal. The line output is 100 or 70V with a frequency response of 100 to 18,000 Hz and with less than 1% THD. The power amplifier shall be capable of operation from 115/230 VAC or 48 VDC or 24VDC (250W) with a supply tolerance of  $\pm 10\%$  and shall be capable of operating in an ambient temperature ranging from  $-10^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ . Separate Amplifier power supplies and separate fan cooling shall not be used. Power consumption at full power is 500W and quiescent power consumption is 25W. The amplifier is monitored for fuse failure, overtemperature, overload, and output short circuit. Alarm levels shall be capable of being broadcast at full line output level continuously.

The power amplifier shall provide the following features:

- On/Off Switch
- Internal overload and shutdown protection
- Temperature controlled, cross flow forced cooling
- Soft-start power up (AC mains), preventing initial current surges
- Comprehensive front panel status LCD display indicating:
  - a) High Temperature operation
  - b) Output Overload
  - c) Power On
  - d) Internal DC Fuse Failure
  - e) LCD output level bar graph
  - f) Tri-state LED fault indication
  - g) Zone allocation
  - h) Amplifier Enable/Disable
  - i) Amplifier Shutdown

The unit shall be composed of a welded steel tray with vented lid. Connections shall be supplied for audio and supply input, line output and standby line input. The unit shall be 19" rack mountable with 2U height.

The supply and line voltages shall be selected in accordance with customer requirements.

#### **4.1.4. Power Supply**

The power supply shall operate from 110 – 240 VAC ( $\pm 10\%$ ) 50/60 Hz, in a temperature ranging from  $-10^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ . Power consumption at full power is 150VA max. The power supply shall be protected against short circuit on each output.

#### **4.1.5. Interfaces**

The central cabinet shall provide customised interfaces in accordance to customer requirements. These interfaces support, but are not limited to, the following applications:

- Telephone Announcement - Supports telephone dial-in announcement facility; will incorporate feedback elimination.
- Facility Control System - Supports alarm inputs and status reporting for an external system, up to a maximum of 16 inputs.
- Fire and Gas Emergency - Supports alarm inputs and status reporting for an external system, up to a maximum of 16 inputs.

Interfaces that support announcement facilities employ access panel and central equipment cards to inject and control audio for subsequent broadcast to pre-configured areas. Typically these interfaces are at a lower priority than access panel or system alarm announcements.

Connection to external systems shall be through contact inputs and outputs. The inputs (up to 16 max) typically are implemented through a normally open relay contact wherein the external system energises the relay for the normal state. A de-energised or open circuit condition on the line triggers the alarm response. Outputs are also supported by relays wherein either state can be supplied to the external system. The outputs typically are used to provide PA/GA system status information.

## **4.2. FIELD EQUIPMENT**

The field equipment shall consist of:

- Access Panels
- Loudspeakers
- Auxiliary Warning Beacons
- UPS
- Auxiliary external equipment.

### **4.2.1. Access Panels**

Access panels shall be custom designed to support system specific announcement and alarm operations in accordance with customer requirements. While each panel is unique in terms of configuration up to 30 pushbuttons, the design shall incorporate standard components and packaging formats. Connection between each panel and the central equipment cabinets shall be through 3 pair individually screened/shielded conductor cable.

### **4.2.2. Loudspeakers**

The loudspeakers shall be indoor, weatherproof for all outdoor locations, and/or explosion proof type (if required), depending upon the location in which they will be installed.

The nominal power is intended as the power of a sinusoidal signal continuously applied without damage. All speakers of the same type shall have the same rated power and shall be adjusted to provide the required coverage.

The secondary winding of the loudspeaker transformer shall be tapped so that the loudspeakers will absorb from the line 100%, or a smaller percentage of its power, according to the tap used.

### **4.2.3. Auxiliary Warning Beacons**

Proprietary Xenon beacons shall be employed with either indoor, weather-proof outdoor and or explosion proof type (if required) depending upon the location in which they will be installed. High output power 10-joule units are preferred.

#### **4.2.4. Uninterruptible Power Supply**

The system will be powered from an Uninterruptible Power System at 220 V, single phase, 50 Hz. Range of UPS voltage deviations are limited to  $\pm 2\%$ ; bypass source deviations may be up to  $\pm 10\%$ .

The UPS shall be able to feed the entire equipment load and allow 20% future growth. It shall be fitted with the suitable optical indication of correct working condition.

#### **4.2.5. Auxiliary External Equipment**

Auxiliary external equipment could include a PABX, Page/Party® Interface, or other similar equipment.

## 5. EXECUTION

### 5.1. INSTALLATION

- A. Locate and install components as indicated on the applicable drawings and in accordance with the manufacturer's recommendations. Access panels shall be mounted with sufficient clearance for observation and testing. All junction boxes shall be clearly marked for easy identification. All wiring shall be in conduit or other approved means. All devices, conduit, junction boxes, etc. shall be securely hung and fastened with appropriate fittings to ensure positive grounding throughout the entire system.
- B. All wiring shall be checked and tested to ensure that there are no grounds, opens or shorts, on all the control, power and audio conductors.
- C. The equipment manufacturer shall provide technical guidance during and/or following construction to perform a checkout of the system. At such time, a factory-trained technician shall apply system power and make all necessary adjustments and instruct operating and maintenance personnel on the proper use and care of the system.

### 5.2. ELECTRICAL PROTECTION

All field mounted electrical equipment shall be of the weatherproof type IP65 and/or of explosion-proof type Ex d certified to CENELEC/IEC for hazardous area classified Zone 1, IIB or IIC, T4, IP65 as required.

### 5.3. ENVIRONMENTAL CONDITIONS

The equipment shall, in all respects, be suitable for operation in service conditions typical of the facility environment.

The following parameters further define the environmental conditions:

Indoor Conditions:

Ambient temperature :	25 °C, ± 2 °C
Humidity :	40% to 60%
Pressurization:	6.5 mm WG min.

Outdoor conditions:

Air temperature:	min/max. 5 / 50 °C
Relative humidity:	min/ max. 6 / 100%
Rain:	min/max. 0 / 100 mm per year
Maximum:	wind velocity :160 Km/hr
Altitude not exceeding:	m AMSL

#### **5.4. TESTING**

- A. The installed system shall be performance tested in accordance with the manufacturer's recommendations and in accordance with the applicable requirements. Tests shall demonstrate the proper operation of all components, interlocks, etc.
- B. The Owner and Engineer reserve the right to witness the tests and approve all portions of the system prior to acceptance.

#### **5.5. COMMISSIONING AND TRAINING**

The System Equipment Manufacturer shall perform on-site commissioning and start-up of all system components in order to provide a fully functional system.

The System Equipment Manufacturer shall provide a training course on site for Customer's personnel on the operation and maintenance of the system as follows:

Operation:	1 day
Maintenance and programming	2 days

The System Equipment Manufacturer shall provide any and all special test equipment required for system check-out/start-up and/or training functions.

#### **5.6. WARRANTY**

- A. The Installer shall warrant all equipment and systems for a period of one-year following shipment.
- B. The manufacturer shall offer an annual test and maintenance agreement, consisting of the following:
  1. Regularly and systematically examine, test and adjust all system components.



2. Submit test reports, which certify that all components have been tested and that the system is in proper working order and functions in accordance with this specification.

### **5.7. MEAN TIME TO REPAIR (MTTR)**

The design and construction of the Public Address and General Alarm system shall ensure high reliability and availability. The Public Address and General Alarm system shall employ modular constructional techniques in its design, allowing a first line maintenance philosophy of module replacement to be implemented. The average module replacement time for the system is less than 1 hour as long as the correct spares holding is maintained as recommended by the manufacturer.