GAI-TRONICS® CORPORATION
A HUBBELL COMPANY

Model 670-801-EX and 670-801-UL SmartSeries Amplifiers

for CENELEC Zone 1 and UL Div. 1

Confidentiality Notice

This manual is provided solely as an operational, installation, and maintenance guide and contains sensitive business and technical information that is confidential and proprietary to GAI-Tronics. GAI-Tronics retains all intellectual property and other rights in or to the information contained herein, and such information may only be used in connection with the operation of your GAI-Tronics product or system. This manual may not be disclosed in any form, in whole or in part, directly or indirectly, to any third party.

Introduction

The assembly described in this manual is an explosion-proof enclosure and intelligent speaker amplifier designed to be installed in hazardous areas where combustible gases exist or may exist. The extra thick cast aluminum enclosure, while not gas tight, is designed to withstand repeated internal explosions without expelling gases hot enough to ignite the external atmosphere. This is accomplished through the use of a precision-machined enclosure opening flame path that cools the exiting gases to a temperature below the flash point of the external, explosive atmosphere.

How to Use the Assembly/Model

Application

The hazardous area SmartSeries amplifier is designed to provide clear communications even in high noise areas where explosive atmospheres exist or may exist.

The Model 670-801-EX is BASEEFA approved to CENELEC Standards Ex dib for Zone 1, Group IIC T5.

The Model 670-801-UL is approved by Underwriters Laboratories for:

- Class 1, Div. 1, Groups C and D
- Class II, Div. 1, Groups E, F, and G
- Class III, Div. 1

The intelligent SmartSeries amplifier is designed for use on the GAI-Tronics single party or multi-party system cable. It includes micro-controllers that are programmed to:

- Receive and send data messages on the system cable
- Measure ambient noise and adjust speaker level
- Monitor and control optional external equipment

Hardware Configuration

The exterior view of the cast aluminum explosion-proof enclosure is shown in Figure 1 below:
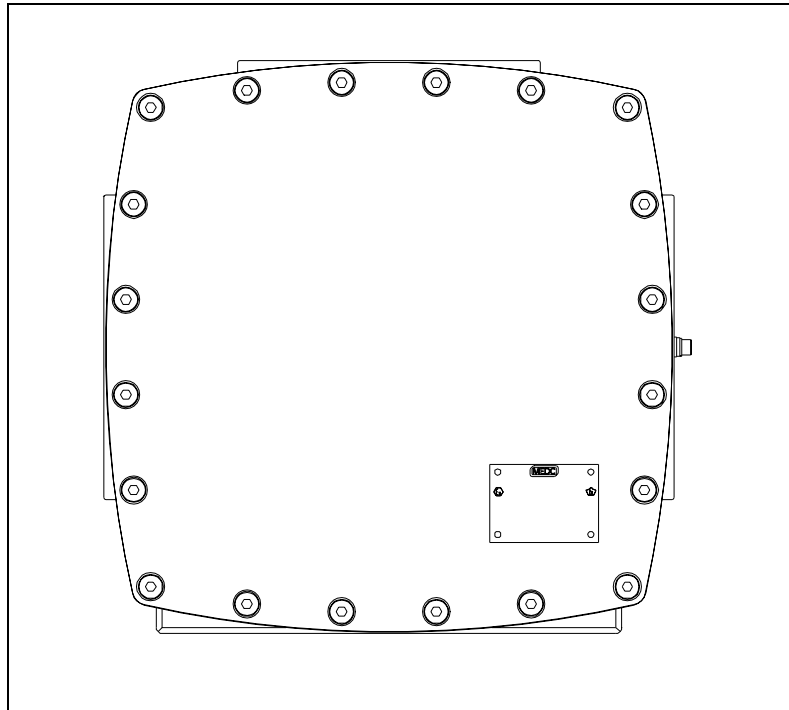

Figure 1. Model 670-801-EX/UL SmartSeries Amplifier

External

The enclosure and cover are fabricated from thick aluminum castings. The cover and the enclosure mate at machined rims to form the flame path seal. The cover is secured to the enclosure with bolts around the perimeter. The enclosure entries are as follows:

The Model 670-801-EX cable gland entries are shown in Figure 2:

On the base: Three M25 entries, two fitted with plugs; and one M16 entry.
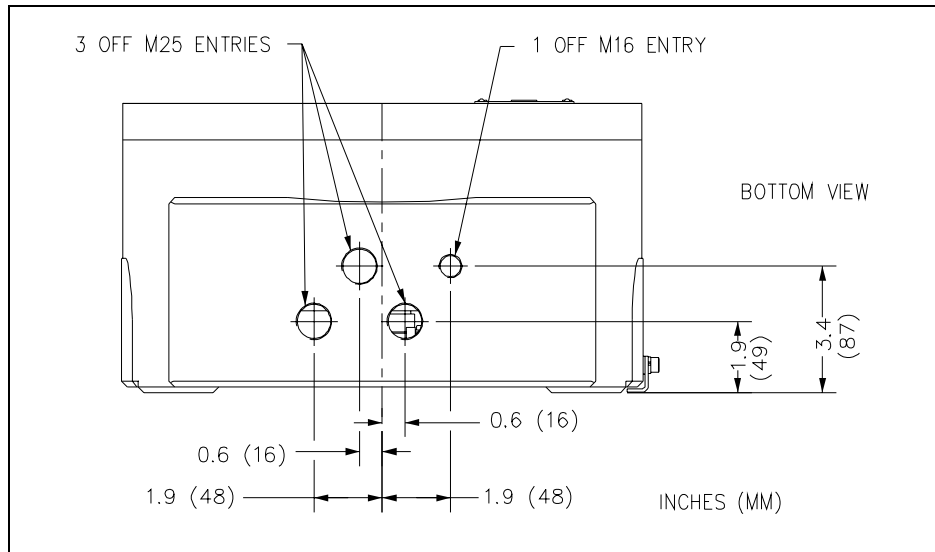

Figure 2. Model 670-801-EX Cable Gland Entries

The Model 670-801-UL conduit entries are shown in Figure 3:

On the top: One 1½-inch NPT entry fitted with a plug, and one ¾-inch NPT entry.
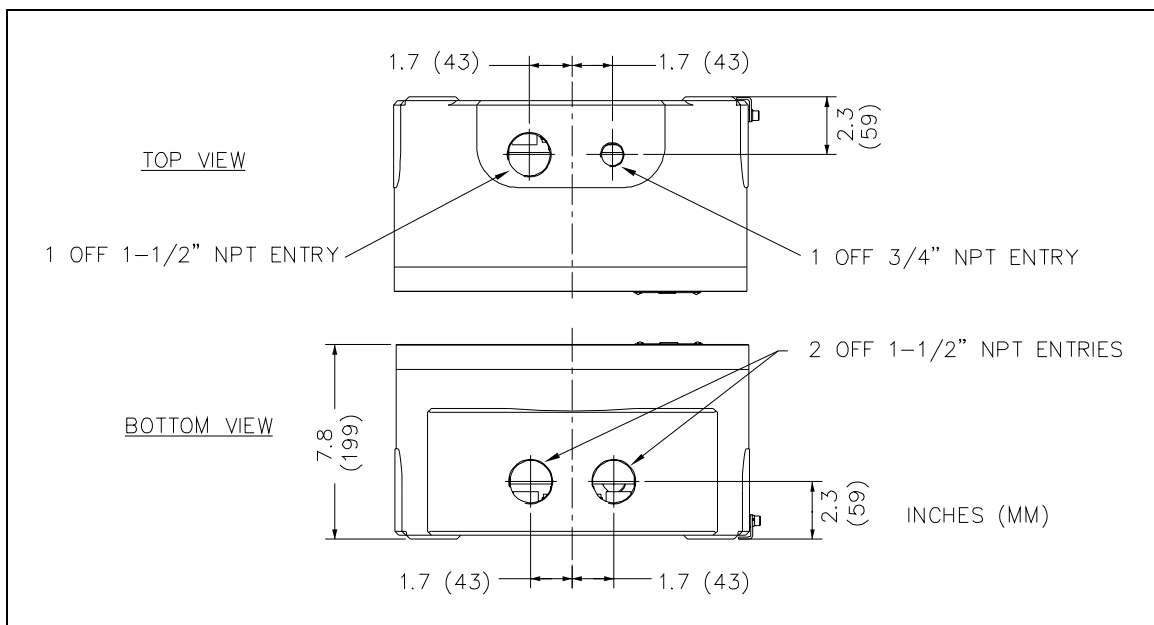On the base: Two threaded 1½-inch NPT entries (one fitted with plug).

Figure 3. Model 670-801-UL Top and Bottom Views

NOTE: Ensure any unused openings are sealed with proper fittings per local standards.

Internal

The SmartSeries amplifier contains the following components:

- Chassis

- Bias Power Supply sub-assembly fixed to the front panel

- Speaker transformer fixed at the top of the chassis

- Base-16 printed circuit board assembly (PCBA) with a plug at the top, pointing to the rear

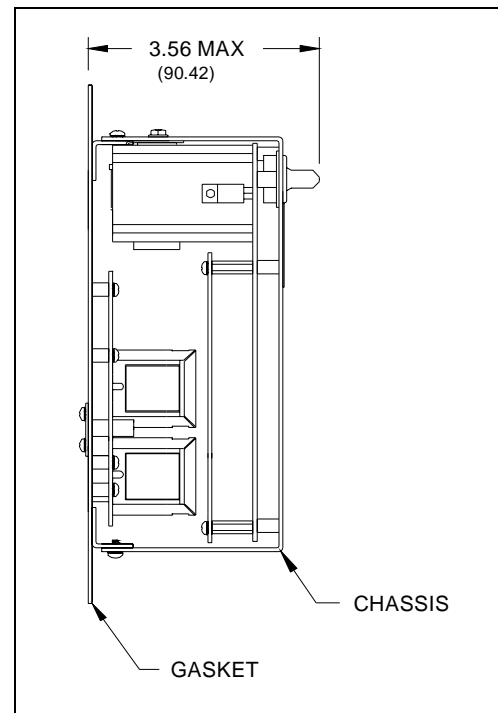- FSK Modem PCBA fixed to the Base-16 PCBA

Figure 4. SmartSeries Amplifier-Side View

Block Diagram
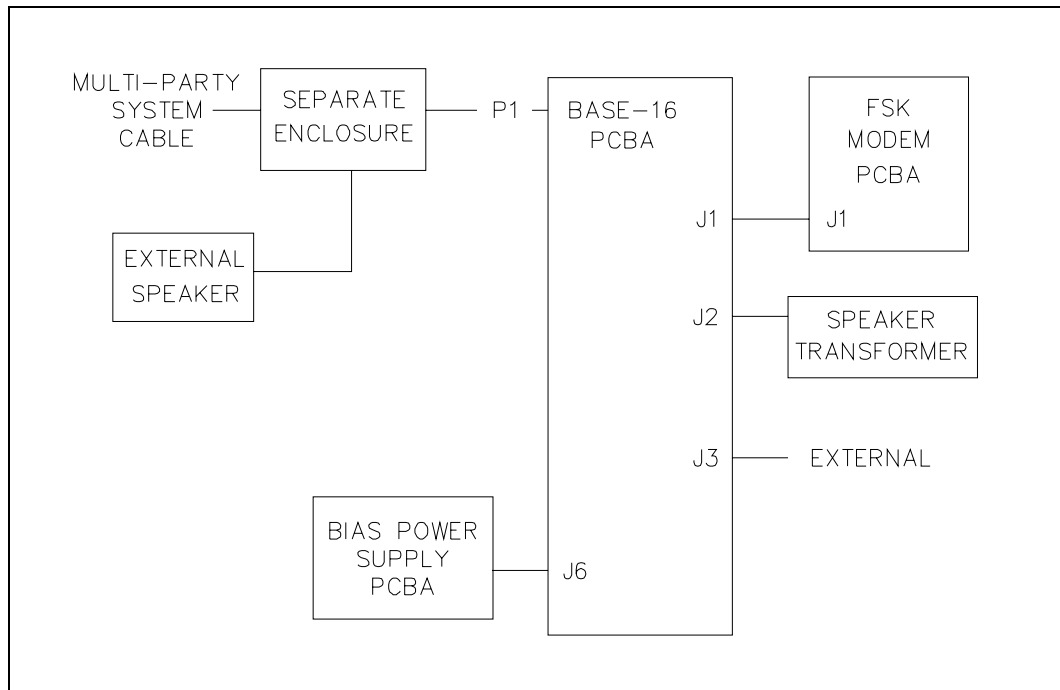
Figure 5. Model 670-801 Block Diagram

As shown on Figure 5, P1 is the 16-pin male connector located on the back of the Base-16 PCBA. It plugs into the socket located inside the cast aluminum enclosure. The socket provides connection to the multi-party cable containing the page/party lines and ac power.

The Base-16 PCBA conducts ac power to the Bias Power Supply PCBA through connector J6 and receives +5 V dc and +/-15 V dc in return. The Base-16 PCBA uses the bias supplies and also passes them (as well as control, monitoring, and line signals) to the FSK Modem PCBA via J1, a 24-pin stacking connector. Connector J2 on the Base-16 PCBA connects the speaker transformer for the station's external speaker, and J3 connects optional external devices.

Interfaces

The unit interfaces to the multi-party cable and to the external loudspeaker, and auxiliary devices via P1, a 16-pin connector.

Pin No.	Function	Description	Pin No.	Function	Description
1	PL_L1	Party line (L1)	9	PL_L2	Party line (L2)
2	PG_L1	Page line (L1)	10	PG_L2	Page line (L2)
3	MT_L1	Mute (L1)	11	MT_L2	Mute (L2)
4	AUX0IN*	Auxiliary input (0)	12	AUX1IN*	Auxiliary input (1)
5	SPKR_8	Speaker (8-ohm)	13	EGND	Earth ground
6	SPKR_16	Speaker (16-ohm)	14	SPKR_C	Speaker (common)
7	N/C	No connection	15	N/C	No connection
8	AC_N	AC neutral	16	AC_H	AC hot

The P1 connections for the multi-party cable are separated from the speaker connections within the enclosure.

Installation

Before installing SmartSeries equipment, design the system layout taking into consideration personnel safety, operational function and convenience, and power cable length. In general, for 115 V ac systems the total power cable length should not exceed 1 mile (1.6 km), but the length of cable between the stations is not a critical factor.

However, it is a good practice to run a separate power feed to each station located in hazardous areas. With a separate feed, individual stations can be de-energized for service or maintenance without affecting the power supply and operation of the other stations in the hazardous area.

Mounting

NOTE: The mounting surface must be able to support 55 lbs (25 kg).

1. Remove the front panel. Allow the front panel to hang from the rear of the enclosure by means of two retaining straps during installation. The straps serve as personnel safety feature and as a safeguard designed to ensure the front panel flame path is not nicked, dented or otherwise damaged while mounting the enclosure.

2. To maintain the explosion-proof integrity of the enclosure, all mounting hardware is located in non-intrusive mounting holes under the front panel. The suggested mounting height of the station is 54 inches (137cm). Use standard 1/2-inch socket head cap screws or M12 bolts to secure the enclosure to a flat mounting surface. See Figure 6 below for mounting hole dimensions.
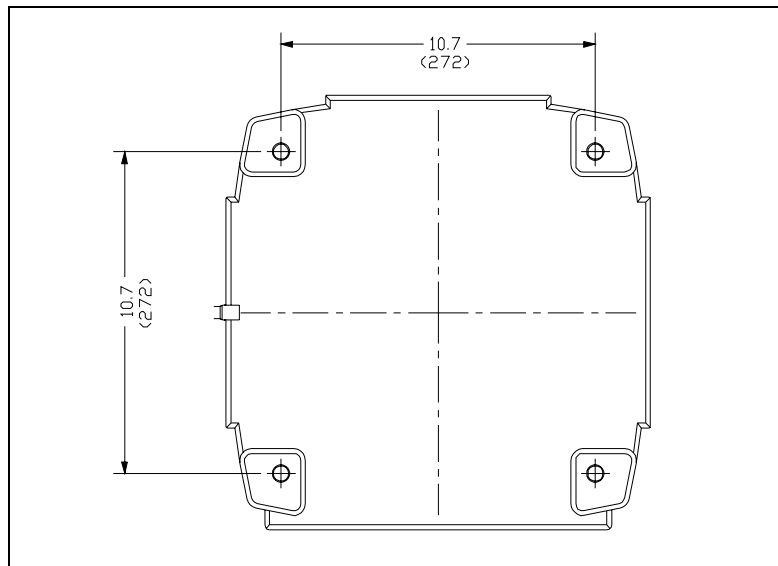
Figure 6. Shows mounting holes with dimensions.

3. After the enclosure is securely mounted, remove the plug-in amplifier:

- Remove the four screws that secure the amplifier to the standoffs, and retain.
- Pull the amplifier straight toward you to disengage the 16-pin connector from the enclosure.
- Set the amplifier aside in a safe place while completing the installation.

NOTE: The following instructions are provided to ensure compliance with the appropriate approval standards. Select the version that applies to the equipment you have purchased based on approval agency jurisdiction.

UL Version

1. Install the conduits for system and speaker cable and make connection to the enclosure. External conduits in Class I, Groups C, and D must have gas seals located not more than 18 inches (457mm) from the amplifier enclosure. External conduits in Class II and Class III areas must also have seals if the conduit is not dust-tight.

2. Feed the wiring through the conduit and into the enclosure.

3. Make connections by following the wire colors as illustrated in Figure 7. The wire colors correspond to GAI-Tronics 60029 and 60038 Series system cable and to 60021 for speaker cable.

4. Connect the wires carefully and completely to the compression terminal block. An improper termination may result in diminished station performance.

5. Install the amplifier by aligning the 16-pin connector to the enclosure socket and pushing straight in. Install the four screws retained previously.

6. Lift the front cover and inspect the gasket and mating machined rims for nicks, scratches, or other damage that could compromise the integrity of the flame path.

7. Secure the front cover in place using the bolts provided. Tighten the bolts alternately with bolts that are diagonally opposite to ensure that the cover is evenly sealed.

NOTE: If acoustical feedback occurs between the speaker associated with the amplifier and the handset on a nearby station, the speaker can be muted by moving the violet wire on the enclosure on TB1 to terminal 7.

EX Version

Follow the mounting instructions described above.

1. Make up cable core ends as required for connection to the terminal blocks in the enclosure base.

2. Dismantle the outer parts of the 25mm Ex 'd' cable gland(s) for the system cable and 16mm Ex 'd' cable gland for the speaker cable and thread them onto the cable(s) in the correct order.

3. Feed the cable end(s) into the enclosure through the gland body or bodies and reassemble the outer gland parts as directed by the manufacturer.

4. Before tightening of the gland assembly, check that the slack in the cable inside the enclosure is adequate but not excessive.

5. Connect cable cores to terminals following the wire colors as illustrated in Figure 7. The wire colors correspond to GAI-Tronics 60071 and 60072 Series system cable and to 60070 for speaker cable. Connect the wires carefully and completely to the compression terminal block. An improper termination may result in diminished station performance.

6. Install the amplifier by aligning the 16-pin connector to the enclosure socket and pushing straight in. Install the four screws retained previously.

7. Lift the front cover and inspect the gasket and machined rim for nicks, scratches, or other damage that could compromise the integrity of the flame path seal.

8. Secure the front cover in place using the bolts provided. Tighten the bolts alternately with bolts that are diagonally opposite to ensure that the cover is evenly sealed.

NOTE: If acoustical feedback occurs between the speaker associated with the amplifier and the handset on a nearby station, the speaker can be muted by moving the violet wire on the enclosure on TB1 to terminal 7.
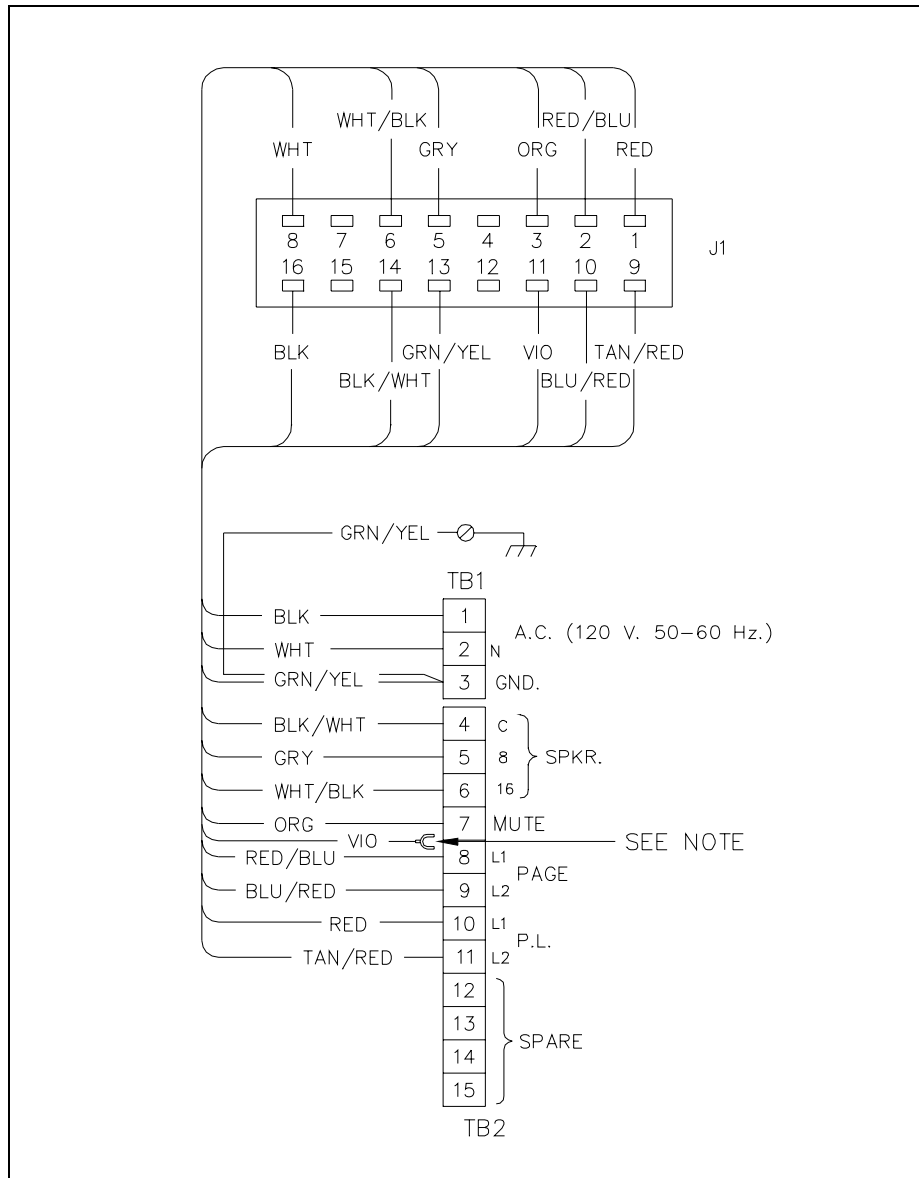
Figure 7. Wiring Detail

Operation

This unit amplifies page audio for broadcast over external speaker(s).

Adjustments

⚠ CAUTION ⚠

It is necessary to open the explosion-proof enclosure to make adjustments. Make adjustments only when the conditions at your facility are such that <u>no</u> explosive atmospheres can be present.

This assembly includes one control that permits adjustments to be made while the assembly is mounted in its enclosure but with the bolted cover removed. In addition there are several internal controls that are accessible only by removing the assembly from its enclosure.

There is a user adjustment for setting the speaker amplifier gain for the SmartVolume™ feature, which has three components: Minimum Level, Offset Level, and VLC Level. Although they typically require no adjustments, these volume levels can be set with the User Level Adjustment control (labeled USER ADJ). Use a small flat-blade screwdriver with an insulated shaft at least 4 inches long to make adjustments.

To access the USER ADJ control, perform the following steps:

1. Unbolt and remove the front enclosure cover revealing the speaker amplifier.

2. Loosen (do not remove) the two screws that secure the nameplate.

3. Pivot the nameplate counterclockwise, exposing the access hole.

   A guide behind the access hole helps direct the screwdriver to the USER ADJ control.

4. When you are done with the adjustment, pivot the nameplate clockwise into position, then tighten the two screws. Re-install the bolted cover.

Minimum Level

The Minimum Level adjustment sets the minimum output of the speaker amplifier. The amplifier can be set from minimum to full output (12 watts into 8 ohms) in 100 discrete steps, or no output. The factory default is step 20, providing 4 watts.

To adjust the Minimum Level, perform the following steps:

1. Turn USER ADJ fully counterclockwise and wait to hear a single beep over the associated speaker.

   This switches the speaker amplifier into the Minimum Level adjustment mode. If there is an audio signal on the page line when the amplifier enters this mode, you hear it over the associated speaker. Otherwise, you hear an amplifier-generated test tone.

2. Turn USER ADJ clockwise to the desired minimum speaker volume level.

   The amplifier remains in the Minimum Level adjustment mode for as long as USER ADJ is varying. After USER ADJ has remained stable for five seconds, the amplifier returns to its normal operating mode.

Offset Level

The Offset Level adjustment causes the speaker amplifier to maintain a set difference between the ambient level and the speaker output level. The SmartVolume™ feature measures the ambient noise at the associated speaker and adds the Offset Level to set the speaker amplifier gain. This keeps page announcements louder than the ambient noise. The Offset Level can be set from 0 dB (the speaker output level is the same as the ambient level) to 49 dB. A speaker should be set for 6 to 10 dB louder than the ambient noise, so the factory default is 9 dB.

To adjust the Offset Level, perform the following steps:

NOTE: There must be enough ambient noise for the amplifier to sense. The exact level depends upon the speaker type, but it is typically approximately 80 dB.

1. Turn USER ADJ fully clockwise and wait to hear two beeps over the associated speaker.

   This switches the amplifier into the Offset Level adjustment mode. If there is an audio signal on the page line when the amplifier enters this mode, you hear it over the speaker. Otherwise, you hear an amplifier-generated test tone.

2. Turn USER ADJ counterclockwise to the desired speaker volume level.

   The amplifier remains in the Offset Level adjustment mode for as long as USER ADJ is varying. After USER ADJ has remained stable for five seconds, the amplifier returns to its normal operating mode.

VLC Level

The VLC Level adjustment sets the speaker amplifier gain for the Page Priority VLC feature to provide an emergency output level. The amplifier can be set from minimum to full output (12 watts into 8 ohms) in 100 discrete steps, or to no output. The factory default is step 10, but the System VLC Control feature is disabled.

To adjust the VLC Level, perform the following steps:

1. Have an assistant page from a station that forces the amplifier being adjusted into VLC mode.

2. Turn USER ADJ fully counterclockwise and wait to hear two beeps over the amplifier's associated speaker.

   This switches the amplifier into the VLC Level adjustment mode.

3. Turn USER ADJ clockwise to the desired speaker volume level.

The amplifier remains in the VLC Level adjustment mode for as long as USER ADJ is varying. After USER ADJ has remained stable for five seconds, the amplifier returns to its normal operating mode.

Internal Adjustments

This assembly includes additional internal control, the FSK Transmit Level, which affects system performance. Therefore, only qualified GAI-Tronics personnel with the appropriate test equipment should make any adjustments. The function and location are included for information only. Tampering with this control may void your warranty.

FSK Transmit Level

The control labeled XMIT LEVEL adjusts the level of the frequency shift keying (FSK) signal transmitted to the page line.

Maintenance

In order to verify and ensure explosion-proof integrity, perform regular preventive maintenance and inspection checks on the GAI-Tronics explosion-proof stations. The GAI-Tronics Field Service Department can formulate a service contract to suit specific preventive maintenance needs.

⚠ **CAUTION** ⚠

Remove power from the enclosure before performing any maintenance.

Use the following procedures to ensure reliable operation of your equipment:

1. Remove power from the enclosure.

2. Unbolt the cover. Remove the amplifier from the enclosure.

3. Visually check the interior of the enclosure for signs of contamination. Contamination inside the enclosure could mean that the conduit seals or cable gland seals have been compromised.

4. Ensure the gasket and hardware are in place and in good condition. Reinstall the amplifier and enclosure cover. Restore power to the unit.

In certain circumstances, it may be necessary to re-terminate some or all of the enclosures in a system. When this is done, strip the wires back to clean copper, and make wire connections to each terminal.

If contaminants from the plant atmosphere have entered the enclosure, clean the interior. Often, a solvent contact cleaner is not strong enough to wash away the buildup. If this occurs, try the following steps:

1. Disconnect power from the enclosure.

2. Disconnect all wires from the terminal strip inside the box.

3. Spray the interior of the enclosure with a heavy-duty, surfactant-type, water-based industrial cleaner. Heavy concentrations of contaminants may be scrubbed with a scrub pad or a soft brush.

4. Rinse the interior of the box with a water spray, and blow out any excess water using compressed air.

5. Apply a coating of water-displacement solution followed by contact cleaner and compressed air.

6. Strip wires back to clean copper before reconnections.

7. Reinstall the amplifier and enclosure cover. Reapply the power.

Troubleshooting

The following suggestions are provided to aid a technician in troubleshooting.

Problem	Solution
Feedback during page of nearby handset station.	Use the muting feature in the amplifier enclosure at the terminal blocks.
Crosstalk	One or more system cable pairs may be improperly terminated. Visually inspect the system cable for accidental crossing of cable pairs or grounds.

Software Configuration

The unit has the following versions of software:

PCBA	Device	Part Number
Base-16 PCBA	U2	50086-014
FSK modem PCBA	U1	49023-030

The SmartSeries Amplifier has software on U2 of the Base-16 PCBA and on U1 of the FSK Modem
PCBA. This software provides the following standard programmable features, accessible from the SST
Configuration screen when the station is in an ADVANCE system:

- Page Priority VLC Mode—determines the condition for setting the speaker amplifier output to the
  User Page Priority VLC (Volume Level Control) Output Level by comparing the incoming page's
  Page Priority Level with the station's Page Priority Level (VLC Page Priority). Default setting:
  disabled.

- Page Trip Level for Speaker Amplifier—the minimum trip level for detecting a page in progress.
  Default setting: 0.44 Vpeak.

- Pass Level for Speaker Amp HC—the minimum expected test tone voltage level for supervision of
  the speaker amplifier. Default setting: 0.2 Vpeak.

- Pass Level for Speaker/Wire HC—the minimum expected ambient level for supervision of the
  speaker wire. Default setting: 35 dB SPL.

- Smart Party Line EOL—enables or disables the station as an end-of-line device for supervision of
  party line 1, for a station configured either as a Smart Handset Dual Party Select device or a Smart
  Handset Party Select device. Default setting: disabled.

- SmartSeries Station RTU Monitored Input Process—selects the input mode for each IDC. Default
  setting: disabled.

- SmartSeries Station RTU Power Relay Process—selects the relay group and zone associated with an
  indicating appliance circuit (IAC). Default setting: disabled.

- Speaker Amplifier Clip Level—the maximum output level of the speaker amplifier. Default setting:
  2.16 Vpeak.

- System VLC Control—enables or disables VLC Mode. Default setting: disabled.

- System VLC Group—the group number for VLC operation. Default setting: 0.

- VLC Page Priority—the station's incoming Page Priority Level. Default setting: 0.

The following standard programmable features are also accessible from the User Level Adjustment
control on the front panel:

- User Minimum Page Output Level (or Minimum Level)—the minimum page output level of the
  speaker amplifier. Default setting: 4 watts.

- User Offset Added to Ambient (or Offset Level)—the amount of gain added to the ambient level so
  that an incoming page is not lost in the noise. Default setting: 9 dB.

- User Page Priority VLC Output Level (or VLC Level)—the page output level of the speaker amplifier
  when the station is in VLC Mode. Default setting: 1 watt.

Specifications

Electrical

Voltage .... 90 to 140 V ac (120 V ac nominal) 50/60 Hz

Power consumed .... Zero/maximum signal (12 watts): 15 VA, 10.5 watts/ 53 VA, 34 watts

Speaker Amplifier

Output.. 12 watts minimum, with nominal supply voltage

Output limiter..2.16 Vpeak (adjustable via configuration)

Voltage Gain ....26 dB maximum, adjustable

Frequency Response...575-4500 Hz, +0/-3 dB ref. to 1 kHz

Distortion ....1% max. THD @ 1 kHz, 12 watts

Input Impedance..50 k-ohms nominal without FSK modem
16 k-ohms nominal with FSK modem

Audio input from line ....1.5 Vrms nominal (depends on distance) from 33 ohm

FSK Modem

FSK output to line ....0.7 Vrms, 2 Vp-p into 33 ohm load

FSK frequency range... 30-33 kHz

SmartVolume™

Dynamic range (low gain) .... 62 to 100 dBA SPL

Frequency characteristics...630 Hz LPF (-6 dB/octave)

Offset (above ambient) User Level Adjust ....0 to 25 dB

Minimum user adjust.. Off; 85 to 125 dBA SPL

Speaker/Wire Monitor

Dynamic range (high gain) ....27 to 65 dB SPL

Frequency characteristics..630 Hz LPF (-6 dB/octave)

Fault setpoint...35 dB SPL (adjustable via configuration)
Note: The measured SPL varies for each speaker type.

Recommended environment .... Greater than 50 dB SPL

Mechanical

Dimensions .... 14.4 H × 14.4 W × 7.83 D inches (367 × 367 × 199 mm) overall

Enclosure material..LM25TF, Epoxy

Internal controls ....Line level

Environmental

Operating and storage temperature range ....-4º F to +151º F (-20º C to +66º C)

Humidity.. 95% non-condensing

Replacement Parts

Model Number	Description
751-801	Amplifier
12555-001	FSK PCBA Kit
12557-001	Base-16 PCBA Kit
12558-001	Bias Power Supply PCBA Kit
12530-001	Transformer/Connector Subassembly

Reference Material

Reference to Assembly/Model Drawings

Published by	Title	GAI-Tronics Ref. No.
GAI-Tronics	SmartSeries Amplifier Enclosure Outline drawing	222-143
GAI-Tronics	SmartSeries Plug-in Amplifier Outline drawing	71846

Warranty

Equipment. GAI-Tronics warrants for a period of one (1) year from the date of shipment, that any GAI-Tronics equipment supplied hereunder shall be free of defects in material and workmanship, shall comply with the then-current product specifications and product literature, and if applicable, shall be fit for the purpose specified in the agreed-upon quotation or proposal document. If (a) Seller's goods prove to be defective in workmanship and/or material under normal and proper usage, or unfit for the purpose specified and agreed upon, and (b) Buyer's claim is made within the warranty period set forth above, Buyer may return such goods to GAI-Tronics' nearest depot repair facility, freight prepaid, at which time they will be repaired or replaced, at Seller's option, without charge to Buyer. Repair or replacement shall be Buyer's sole and exclusive remedy. The warranty period on any repaired or replacement equipment shall be the greater of the ninety (90) day repair warranty or one (1) year from the date the original equipment was shipped. In no event shall GAI-Tronics warranty obligations with respect to equipment exceed 100% of the total cost of the equipment supplied hereunder. Buyer may also be entitled to the manufacturer's warranty on any third-party goods supplied by GAI-Tronics hereunder. The applicability of any such third-party warranty will be determined by GAI-Tronics.

Services. Any services GAI-Tronics provides hereunder, whether directly or through subcontractors, shall be performed in accordance with the standard of care with which such services are normally provided in the industry. If the services fail to meet the applicable industry standard, GAI-Tronics will re-perform such services at no cost to buyer to correct said deficiency to Company's satisfaction provided any and all issues are identified prior to the demobilization of the Contractor's personnel from the work site. Re-performance of services shall be Buyer's sole and exclusive remedy, and in no event shall GAI-Tronics warranty obligations with respect to services exceed 100% of the total cost of the services provided hereunder.

Warranty Periods. Every claim by Buyer alleging a defect in the goods and/or services provided hereunder shall be deemed waived unless such claim is made in writing within the applicable warranty periods as set forth above. Provided, however, that if the defect complained of is latent and not discoverable within the above warranty periods, every claim arising on account of such latent defect shall be deemed waived unless it is made in writing within a reasonable time after such latent defect is or should have been discovered by Buyer.

Limitations / Exclusions. The warranties herein shall not apply to, and GAI-Tronics shall not be responsible for, any damage to the goods or failure of the services supplied hereunder, to the extent caused by Buyer's neglect, failure to follow operational and maintenance procedures provided with the equipment, or the use of technicians not specifically authorized by GAI-Tronics to maintain or service the equipment. THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE IN LIEU OF AND EXCLUDE ALL OTHER WARRANTIES AND REMEDIES, WHETHER EXPRESS OR IMPLIED BY OPERATION OF LAW OR OTHERWISE, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Return Policy

If the equipment requires service, contact your Regional Service Center for a return authorization number (RA#). Equipment should be shipped prepaid to GAI-Tronics with a return authorization number and a purchase order number. If the equipment is under warranty, repairs or a replacement will be made in accordance with the warranty policy set forth above. Please include a written explanation of all defects to assist our technicians in their troubleshooting efforts.

Call 800-492-1212 (inside the USA) or 610-777-1374 (outside the USA) for help identifying the Regional Service Center closest to you.

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