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## PAC45A

**Special Mission Audio Controller System  
with MultiTalker® and IntelliVox®**



Document P/N 200-045-1000

Revision 21, February 2023

Audio Control System with Intercom  
**System Installation and Operation Manual**  
FAA - TSO C139a

Patented under one or more of the following;  
**No. 4,941,187; 5,903,227; 6,160,496 and 6,493,450, 7,391,877**

**In certified aircraft, warranty is not valid unless this product is installed by an  
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Revision History

Rev	Date	Change
New	Jan. 2019	Initial Draft Manual
1	January 2019	After Internal Review
2	March 2019	Release for publication
3	June 2019	Release after TSOA
4	July 2019	Update Model Number
5	August 2019	Add Music Mute control. Correct CTL45A thumbscrew part number
6	October 2019	Added information on DIP switch and improved wiring diagrams
7	January 2020	Added detail on speaker outputs
8	February 2020	Added interface support for EFIS
9	March 2020	Corrected Blacklight Adjustments §2.5.4
10	April 2020	Added "standard" Alert audio, Inverted control head P/N -40XX & -45XX
11	May 2020	Added TX-I Functionality, S/N CH45A1061 and up
12	November 2020	Updated Connector Shells
13	December 2020	Corrected wiring option pinouts §9, added FOD Cover information.
14	February 2021	Clarification of Intercom Mode, §3.6.2, 3.6.3.
15	March 2021	Clarification of CTL45A settings §2.7.13
16	June 2021	Added option for a Push On/Push Off switched in CTL45A control head
17	September 2021	Corrections to Appendix B wiring diagram
18	December 2021	Correction to §3.5, Navaid selection/location
19	November 2022	Update Dimmer adjustment (§2.5.4, S/N CH45A1208 and above)
20	December 2022	Add dual HUB capability
21	February 2023	Revised FOD covers

## Section I – GENERAL INFORMATION

### 1.1 INTRODUCTION

The PAC45A represents a revolutionary step in cockpit audio control and intercommunications utility. MultiTalker®, using licensed U.S. Air Force patented technology, provides True Dimensional Sound, helping pilots to more easily discern from simultaneous radio receptions.

#### 1.1.1 Limitations

This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval. Refer to Advisory Circular 20-41A for information on TSO installation approval.

Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

### 1.2 SCOPE

This manual provides installation and operation instructions for the PS Engineering PAC45A-series of Audio Selector Panel/Intercom Systems. This includes the following units:

Model Number	Description	PS Engineering Part Number
HUB45A	Remote-mounted Audio Hub for analog I/O and processing	050-045-1001
CTL45A	Panel Mounted Control Head for Flight Crew and TFO Push-Pull Knobs	050-045-200X
CTL45A	Panel Mounted Control Head for Flight Crew and TFO, Push-Push knobs	050-245-200X
CTL45A	Panel Mounted Control Head for Flight Crew and TFO -Inverted	050-045-250X
CTL45A	Panel Mounted Control Head for Flight Crew and TFO -Push-Push knobs, Inverted	050-245-25XX
CTL45A-NVG	Panel Mounted Control Head for Flight Crew and TFO, Night Vision Compatible	050-045-400X
CTL45A-NVG	Panel Mounted Control Head for Flight Crew and TFO, Night Vision Compatible	050-245-400X
CTL45A-NVG	Panel Mounted Control Head for Flight Crew and TFO, Night Vision Compatible -Inverted	050-045-450X
CTL45A-NVG	Panel Mounted Control Head for Flight Crew and TFO, Inverted, Night Vision Compatible -Inverted	050-245-45XX

### 1.3 EQUIPMENT DESCRIPTION

The PAC45A is a state-of-the-art audio isolation amplifier and audio selector that contains an automatic voice activated (VOX) intercom system. It can switch up to eight transceivers (COM 1 to 8) and eight navigation receivers (AUX 1 to 8) that can be configured as desired.

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There are up to five unswitched inputs, available for traffic or EGPWS, autopilot disconnect, and/or radar altimeter warning.

In addition to a radio master volume, the individual volume controls select the receiver audio source provided to the headphones when selected to the "out" position.

A nine-station voice activated (VOX) intercom is included in the PAC45A. This system has PS Engineering's patented *IntelliVox*® circuitry that eliminates manual adjustments. The intercom system incorporates pilot isolate, all and crew modes, a stereo music input with "SoftMute™".

In the PAC45A, a Bluetooth® wireless interface is available for wireless telephone and music connection.

Up to nine programmable alerts can be triggered by external sources to provide additional capability.

## 1.4 APPROVAL BASIS FAA TSO

**FAA TSO** The PAC45A-series Audio Selector Panels are FAA authorized under TSO C139A (Audio Amplifiers), ED-14C/DO-160G (*Environmental Conditions and Test Procedures for Airborne Equipment*), ED12B/DO-178C, Level C (*Software Considerations for Airborne Equipment*) and ED- 18/DO-214A (*Audio Systems Characteristics and Minimum Operational Performance Standards for Aircraft Audio Systems*).

### 1.1.2 Limitations

This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval.

Refer to Advisory Circular 20-41A for information on TSO installation approval.

Operation is subject to the following conditions:

This device may not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

## 1.5 SPECIFICATIONS

TSO COMPLIANCE	
<i>Audio Selector/Intercom:</i>	FAA TSO-C139A
APPLICABLE DOCUMENTS:	RTCA/DO-214A RTCA/DO-160G RTCA/DO-178C
<i>Temperature Range:</i>	HUB45A Operating: -45° C to +70°C Short Term Operating: -45° C to +70°C Survival: -55° C to +85°C
	CTL45A -20° C to +70°C -40° C to +70°C -55° C to +85°C
<i>Altitude:</i>	Up to 55,000 feet in a non-pressurized area of the cockpit.
DIMENSIONS:	CTL45A: Height: 1.88 in. (4.78cm) Width: 4.90 in. (12.45 cm) Depth behind panel: 2.35 in. (5.97) HUB45A: Height: 1.9" Width: 5.88 w/mounting flanges, Length 7.22", 12" w/ all connectors. See Figure 5-6
UNIT WEIGHT	
HUB45A	2.0 lbs. (.91 kg)
CTL45A	1.0. (.45 kg)
POWER REQUIREMENTS:	
<i>Voltage:</i>	18 to 33 VDC
<i>Maximum Current:</i>	HUB45A 1.5 Amp (Externally protected by a 5 Amp circuit breaker.) CTL45A 500 mA (Externally protected by a 1 Amp circuit breaker)
<i>Typical Current</i>	750 mA
<i>Alert Power</i>	<20 mA
<i>Lighting</i>	< 5mA

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<b>Audio Selector Specifications</b>	
<i>Audio selector panel input impedance:</i>	510 Ω
<i>Input Isolation:</i>	-60 dB (min.)
<i>Switched Receiver Inputs:</i>	16 (COM 1– COM 8, AUX 1- 8)
<i>Unswitched Inputs:</i>	5
<i>Transmitter Selections:</i>	8 (COM 1, 2, 3, 4, 5, 6, 7, 8)
<i>Headphone Impedance:</i>	150 – 600 Ω <i>or</i> 8 Ω
<i>Headphone Output:</i>	200 mW into 150Ω or 8Ω headset, no clipping <.5% THD typical
<i>Microphone Impedance:</i>	150 - 600 Ω
<i>PA Output, Cockpit speaker output</i>	10W @4 Ω
<b>Intercom Specifications</b>	
<i>Intercom Positions:</i>	Up to 9 places (with individual <i>IntelliVox</i> ® circuits)
<i>Distortion:</i>	<1% THD @ 200 mW into 150Ω
<i>Mic Freq. Response, ±3 dB:</i>	300 Hz - 6000 Hz
<i>Music Inputs:</i>	1 (Stereo) plus Bluetooth
<i>Music Muting:</i>	>-30 dB "Soft Mute" when Com or intercom active.

## 1.6 EQUIPMENT SUPPLIED

The following units comprise the PAC45A System:

Model	Description	Part Number
HUB45A	Remote-mounted Audio Hub for analog I/O and processing	050-045-1001
CTL45A	Control Head for pilot or copilot positions	050-045-200X
CTL45A	Control Head for pilot or copilot positions – Inverted	050-045-250X
CTL45A-NVG	NVG Panel-mounted Control Head for pilot and copilot positions	050-045-400X
CTL45A-NVG	NVG Panel-mounted Control Head for pilot and copilot positions – Inverted	050-045-450X
CTL45A	Control Head for pilot or copilot positions *Push-Push Knobs*	050-245-200X
CTL45A	Control Head for pilot or copilot positions – Inverted *Push-Push Knobs*	050-245-250X
CTL45A-NVG	NVG Panel-mounted Control Head for pilot and copilot positions *Push-Push Knobs*	050-245-400X
CTL45A-NVG	NVG Panel-mounted Control Head for pilot and copilot positions – Inverted *Push-Push Knobs*	050-245-450X

PAC45A Installation Kit: 250-045-0811

<b>Male Connector Kit 250-045-8377 (P452, P454)</b>				
Part Number	Description	MFR	MFR PN	Quantity
625-015-1503	Connector Back shell DB26 pin	Harting	09-70-015-0343	1
625-037-3703	Connector Back shell DB62 pin	Harting	09-67-037-0343	1
425-026-5601	Male Sub-D Connector Shell DB26 pin	Harting	95-62-005-601	1
425-062-8177	Male Sub-D Connector Shell DB62 pin	Harting	95-64-005-601	1
425-044-2043	Hi-density Male Pins	AMP	204370-2	88

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<b>Female Connector Kit 250-045-8477 J451, J453)</b>				
<b>Part Number</b>	<b>Description</b>	<b>MFR</b>	<b>MFR PN</b>	<b>Quantity</b>
625-015-1503	Connector Back shell DB26 pin	Harting	09-70-015-0343	1
625-037-3703	Connector Back shell DB62 pin	Harting	09-67-037-0343	1
425-026-1800	Female Sub-D Connector Shell DB26 pin	Nor comp	180-026-273L000	1
425-062-4701	Female Sub- D Connector Shell DB62 pin	Harting	99-56-400-4701	1
425-030-7354	Hi-density Female Pins	Amphenol	M39029/57-354	88

<b>9-Pin Connector Kit 250-045-0019 (P455)</b>				
<b>Part Number</b>	<b>Description</b>	<b>MFR</b>	<b>MFR PN</b>	<b>Quantity</b>
625-009-9034	Connector Back shell DB9 pin	Harting	09-67-009-0343	1
425-009-0777	Male Sub-D Connector Shell DB9 pin	Amphenol	L777-RR-E-09-P	9
425-020-5089	Standard Density Male Pins	Deutsch	M39029/64-369	9

<b>CTL45A 9-Pin Female Connector Kit 250-543-0100 (J455)</b>				
<b>Part Number</b>	<b>Description</b>	<b>MFR</b>	<b>MFR PN</b>	<b>Quantity</b>
625-009-9209	Connector Back shell DB9	Harting	09-67-009-0343	1
425-009-7709	Connector Sub- D Female Shell DB9	Amphenol	L177-RR-E-09-S	1
425-020-5090	Standard density female pins	Deutsch	M39029/63-368	9

External Bluetooth Antenna

<b>Part Number</b>	<b>Description</b>	<b>MFR</b>	<b>MFR PN</b>	<b>Quantity</b>
300-045-1351	Bluetooth Coaxial Cable SMA ST BH JK to ST Plug RG 174/U 36	Amphenol	135110-02-36"	1
510-045-9602	Panel-Mounted Bluetooth Antenna	Taoglas	GW.26.0112.HT	1

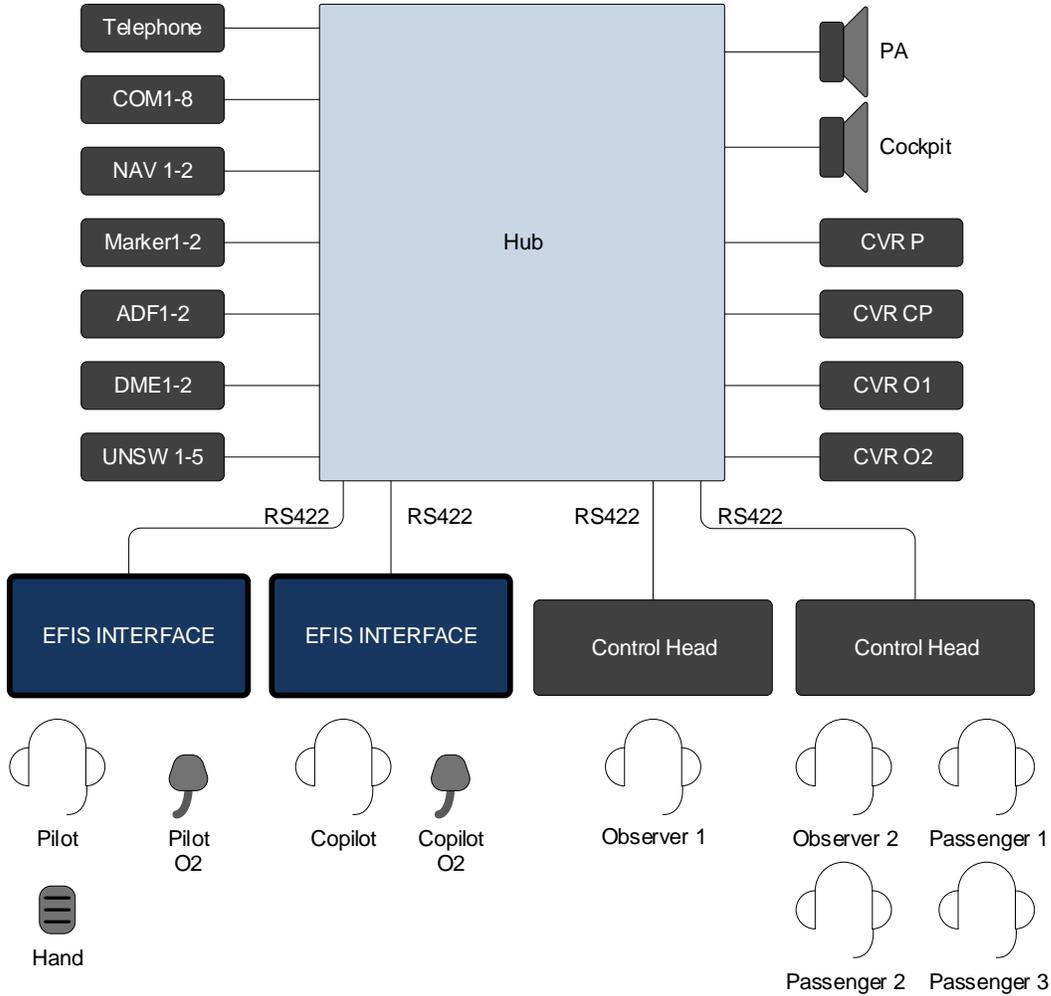
**EQUIPMENT REQUIRED BUT NOT SUPPLIED**

- a. Circuit Breakers: 1 ea.; 5 amp PULL TYPE REQUIRED for HUB45R, 1 A for CTL45As
- b. Optional Circuit Breakers: 1 ea.; 1 amp PULL TYPE REQUIRED for PAC45A aural alerts, 1 ea. 1 A for failsafe power
- c. Stereo Headphone Jacks (as Required)
- d. Microphone Jacks (as Required)
- e. Stereo Headphones, as required
- f. Microphones, as required
- g. Interconnect Wiring Harness

## 1.8 Configuration

The PAC45A System is comprised of a single PAC45A HUB (HUB45AR) and up to four CTL45A Control Head “building blocks” to facilitate flexibility as well as simplicity. . If additional control heads are required, [contact@PS-Engineering.com](mailto:contact@PS-Engineering.com) or +1-865-988-9800 for more details on expanding to a dual system supporting up to eight CTL45As.

**Figure 1-1 Baseline configuration**



## 1.9 LICENSE REQUIREMENTS

None

## **Section II - INSTALLATION**

### **2.1 GENERAL INFORMATION**

#### **2.1.1 SCOPE**

This section provides detailed installation and interconnection instructions for the PS Engineering PAC45A Audio Selector Panel/Intercom.

Please read this manual carefully before beginning any installation to prevent damage and post-installation problems.

Installation of this equipment requires special tools, test equipment (refer to §2.12.1) and installer knowledge as required by 14 CFR 65.81 (b).

#### **2.1.2 Certification Requirements**

##### **NOTE**

The PAC45A requires specialized knowledge and tools for an effective installation. An appropriately rated Certified Aircraft Repair Station **must** install this equipment in accordance with applicable regulations. PS Engineering, Incorporated warranty is not valid unless the equipment is installed by an authorized PS Engineering, Incorporated dealer.

Failure to follow any of the installation instructions, or installation by a non-certified individual or agency will void the warranty and may result in an **unairworthy** installation.

This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval. Refer to AC 20-41A for information regarding Substitute TSO Aircraft Equipment.

### **2.2 Unpacking and Preliminary Inspection**

Use care when unpacking the equipment. Inspect the units and parts supplied for visible signs of shipping damage. Examine the unit for loose or broken buttons, bent knobs, etc. Verify the correct quantity of components supplied with the list in §1.6. If any claim is to be made, save the shipping material, and contact the freight carrier. Do NOT return units damaged in shipping to PS Engineering. If the unit or accessories show any sign of external shipping damage, contact PS Engineering to arrange for a replacement. Under no circumstances attempt to install a damaged unit in an aircraft. Equipment returned to PS Engineering for any other reason should be shipped in the original PS Engineering packaging, or other UPS approved packaging.

### **2.3 Equipment Installation Procedures**

#### **2.3.1 Cooling Requirements**

Forced air-cooling of the PAC45A is not required. However, the units should be kept away from heat producing sources (i.e., defrost or heater ducts, dropping resistors, heat producing avionics) without adequate cooling air provided.

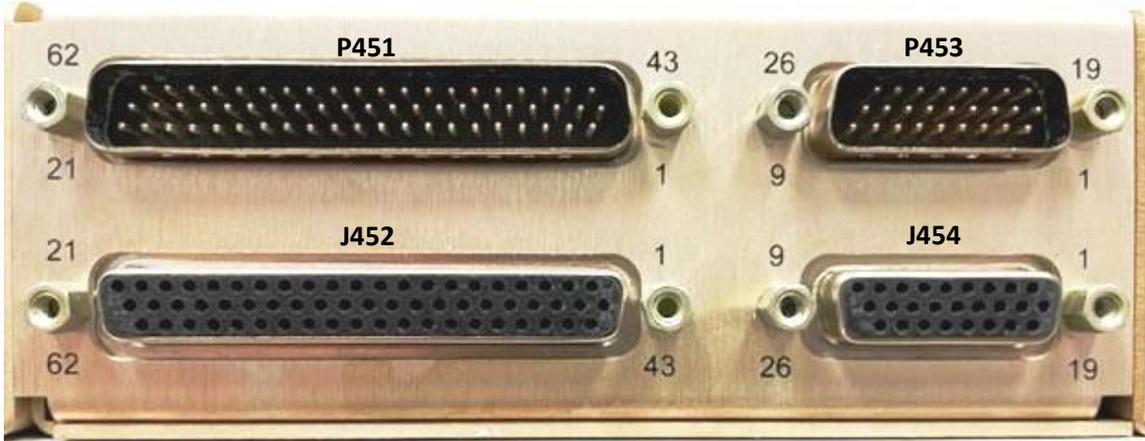
#### **2.3.2 Mounting Requirements**

The HUB45A must be rigidly mounted to the aircraft structure in an avionics-rated location. The CTL45A is designed for Dzus-rail mounting within view and reach of the flightcrew position(s). Installation must comply with FAA Advisory Circular AC 43.13-2B, or other FAA-approved aircraft technical data. The unit may be mounted in any area where adequate clearance for the unit and associated wiring bundle exist.

To prevent noise, avoid installing units close to high current devices or systems with high-voltage pulse type outputs, such as DME or transponders. Avoid running the interconnecting bundles near any high current wires.

### 2.3.3 Audio controller connector assembly

The HUB45A LRU connectors mate with two 62-pin, and two 26-pin connectors. One of each gender. The connectors are a sub-miniature crimp-type and require the use of a hand crimp tool, from table below (or equiv.).



**Figure 2-1 - PAC45A Connector Layout**

Ensure that proper strain relief and chafing precautions are made during wiring and installation.

Manufacturer	Crimping Tool	Positioner	Extraction tool
AMP	601966-1	601966-6	91067-1
Daniels	AFM8	K42	M24308-1
ITT-Cannon	995-0001-584	995-0001-739	91067-1

**Table 2-1 Connector Pin crimping tools**

*NOTE: DO NOT overtighten the thumbscrews into the mating connector. Do not exceed 0.3 ft lbs. (0.4 Nm) torque on any connector hardware, or damage may result.*

## 2.4 Cable Harness Wiring

Referring to the appropriate Appendix, assemble a wiring harness as required for the installation. All wires must be MIL-SPEC in accordance with current regulations. Two- and three-conductor shielded wire must be used where indicated and be MIL-C-27500 or equivalent specification. Proper stripping, shielding and soldering technique must always be used. It is imperative that correct wire be used.

Refer to FAA Advisory Circular 43.13-2B for more information. Failure to use correct techniques may result in improper operation, electrical noise, or unit failure. Damage caused by improper installation will void the PS Engineering warranty.

See Appendix C and D for intercom connection configurations. It is critical to the proper operation of this system to have this connector wiring made in accordance with these diagrams. Use 2- and 3-conductor, MIL-spec cable as shown. Connect the shields at the audio controller end only, and tie to the audio low inputs as shown.

### 2.4.1 Electrical Noise

Due to the variety and the high power of radio equipment often found in today's aircraft, there is a potential for both radiated and conducted noise interference.

The PAC45A power supply is specifically designed to reduce conducted electrical noise on the aircraft power bus by at least 50dB. Although this is a large amount of attenuation, it may not eliminate all noise, particularly if the amplitude of noise is very high. Shielding can reduce or prevent radiated noise (i.e., beacon, electric

gyros, switching power supplies, etc.) However, installation combinations can occur where interference is possible. The PAC45A was designed in an RFI hardened chassis and has internal Electromagnetic Interference (EMI) filters on all inputs and outputs.

Ground loop noise occurs when there are two or more ground paths for the same signal (i.e., airframe and ground return wire). Large cyclic loads such as strobes, inverters, etc., can inject noise signals onto the airframe that are detected by the audio system. Follow the wiring diagram very carefully to help ensure a minimum of ground loop potential. Use only Mil Spec shielded wires (MIL-C-275000, or better). Under no circumstances, combine a microphone and headphone wiring into the same shielded bundle. Always use a 2- or 3-conductor, shield wire as shown on the installation-wiring diagram.

The shields can be daisy-chained together, and then connected to the ground.

Radiated signals can be a factor when low-level microphone signals are "bundled" with current carrying power wires. Keep these cables physically separated. It is particularly important that you use insulated washers to isolate the ground return path from the airframe to **all** headphone and microphone jacks.

#### **2.4.2 Power**

The PAC45A is compatible with 28 Volt DC systems. A five (5) Amp circuit breaker is required for all installations. Power and ground wires should be #22AWG connect power to P451 Pin 42. Connect airframe ground to P451 Pin 20 and 21 only.

Power consumption is as follows:

At 28V:

- Control head Only: 400 mA
- Hub Only: 750 mA
- Alert audio power: 20mA

At minimum input voltage (20V):

- Control head: 600mA
- Hub Only: 950mA

Lighting input: <5mA

- HUB45A ONLY circuit breaker should be not less than 3 amps
- HUB45A & CTL45L (only 1 CTL45L) should be not less than 4 amps
- CTL45A ONLY breaker should be not less than 1 amp for one unit
- CTL45A ONLY breaker should be not less than 2 amp for two units
- CTL45A ONLY breaker should be not less than 3 amp for three units
- Typically, one CTL45A is powered by the HUB45AR, but if desired, four can be powered from a 4A CTL45A ONLY breaker.

**CAUTION: Do not connect or disconnect (HOT SWAP) any components with power applied, this may damage the units**

##### 2.4.2.1 Alert power, P451 Pin 41,

The PAC45A has an independent alert system with the ability to play alerts even when the audio controller is powered off. To take full advantage of this isolation a separate one (1) Amp circuit breaker is required. Power should be #22AWG connect power to P451 Pin 41.

When power to P451-42 is present, the message will play three times or until the remote acknowledge is selected.

##### 2.4.2.2 Failsafe Power P451 Pin 62 and O<sub>2</sub> Enable P453 Pin 26

When connected to the aircraft bus, it allows for the use of Oxygen microphones in failsafe, when the O<sub>2</sub> microphone discrete, J453 Pin 26 is grounded.

### 2.4.3 Audio controller interface

The PAC45A is designed to interface with standard aircraft avionics and presents a 510  $\Omega$  receiver impedance. For best results, a twisted-shielded cable is recommended from the avionics audio source to the audio controller, with the shield grounded at the audio controller end.

Some avionics do not provide a separate audio low and may introduce additional electrical noise into the system. For best results, connect the audio low from the audio controller to the radio ground, using one conductor of the twisted-shielded cable.

#### 2.4.3.1 Front Panel Nomenclature and Audio Inputs

Due to the PAC45A flexibility with label nomenclature (custom labels) the naming of the inputs and respective control locations can change. See Appendix B – Radio Interconnect Wiring, and §2.8, Pin Assignments for the Switch Positions associated with the respective inputs.

NOTE: Navaid selection is as follows:

- Aux 1, 3, 4, and 5, controlled via AUX 1 knob (NAV 1, Switch Position 9).
- Aux 2, 6, 7 and 8 controlled via AUX 2 knob (NAV 2, Switch Position 10).

#### 2.4.3.2 Installation with Monaural Headsets

**Not recommended**, because the benefit of MultiTalker® is lost.

*However, if desired, the PAC45A can be installed monaurally by using **the right and left outputs together**. However, the HUB45A DIP switches must be set for Mono configuration. See §2.5.3.*

**NOTE These companies adapt monaural helmets and headsets to stereo:**

Lightspeed Avionics Phone: 800-332-2421 <a href="http://www.lightspeedaviation.com">www.lightspeedaviation.com</a>	Acousticom Phone: 574-293-0534 <a href="http://www.acousticom.com">www.acousticom.com</a>	FLIGHTHELMET.COM Phone: (800) 531-4898 <a href="http://www.FlightHelmet.com">www.FlightHelmet.com</a>	Headsets Inc. Phone: 800-876-3374 <a href="http://www.headsetsinc.com">www.headsetsinc.com</a>
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### 2.4.4 Backlighting

Control of the unit backlighting is through the aircraft avionics dimmer through a single connection to the HUB45A. A serial message is sent to the control heads to adjust the dimming.

If dimmer input is not connected, then the backlighting for the CTL45A text will be at the lowest illumination. If you would like to have optimum adjustment for lighting it is recommended to wire the dimmer input or to connect the dimmer input to 28VDC. If adjustments are required, adjust the white & green LEDs with the potentiometer settings. Review Section 2.5.4 for white & green adjustments.

For lighting control, connect J452-22, wrt J452-1 to aircraft dimmer.

Backlight voltages of 5 VDC, 14 VDC and 28 VDC are configurable. See [§2.5.4](#).

### 2.4.5 Unswitched inputs

These inputs are presented to the pilot and copilot regardless of the audio configuration and will always mute the crew entertainment inputs. These 510 $\Omega$  inputs can be used for altimeter DH audio, TAWS audio, TCAS audio or any other critical audio signal.

Unswitched #1 is always presented to the crew headphones and is available to the pilot in fail-safe (off) mode. Unswitched 2 is presented to the copilot in fail-safe. In some installations, an internal sneak audio path may present COM 1 audio in copilot headset and speaker in fail-safe

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Unswitched Input	Input Pins	Hear in Fail Safe	Hear in Headset
1	P452 - 55 WRT 15	Pilot	Pilot & Copilot
2	P452 - 35 WRT 16	Copilot	Copilot
3	P452 - 56 WRT 17	No	Pilot & Copilot
4	P452 - 36 WRT 18	No	Pilot & Copilot
5	P452 -57 WRT 19	No	Pilot & Copilot

**Table 2-2 Unswitched inputs**

**2.4.6 Cockpit Voice Recorder**

The PAC45A audio controller contains independent Cockpit Voice Recorder outputs for the pilot, copilot, and observer positions. The CVR output is consistent with RTCA DO-214A §1.5.7.

Pilot CVR output is J452-60; Copilot CVR output is P452-61, Observer 1 CVR output P452-39, and Observer 2 P452-40, all with respect to any available audio low on J452.

NOTE: Observer 1 and Observer 2 CVR outputs are dual purpose and mutually exclusive with Copilot speaker output and Observer speaker outputs.

See §2.7.14 for information on selecting low-level speaker or CVR outputs.

**2.4.7 Speaker Outputs**

The HUB45A is capable of providing three separate speaker outputs, plus Public Address. However, two are dual purpose and mutually exclusive with copilot and observer CVR outputs.

Cockpit Speaker, P452-41 a 4Ω, 10W output, with the radio audio selected by the *Pilot's* CTL45A Control Panel.

When enabled, P452-40 is a low-level speaker output with the radio audio selected on the *Copilot's* CTL45A Control Panel.

When enabled, P452-39 is a low-level speaker output with the radio audio selected on the *Observer 1* CTL45A Control Panel.

Low Level audio can be amplified to 4Ω, 10W speaker output with a PS Engineering model PSA210, Dual Channel speaker amplifier, P/N 050-230-0000, contact PS Engineering for pricing. See §2.7.14 for information on selecting CVR or low-level speaker outputs.

### 2.4.8 Audio Alerts

The PAC45A contains an independent audio alerting systems that will play up to 9 messages that can be stored by the user (see §3.11.1). Factory stored default audio is shown below.

**NOTE:**

**THESE MESSAGES ARE STRICTLY SUPPLEMENTAL AND OPTIONAL AND SHALL NOT REPLACE ANY EXISTING ALERTS IN THE AIRCRAFT.**

**IT IS THE INSTALLERS' RESPONSIBILITY TO DETERMINE IF THIS ALTERATION IS MAJOR OR MINOR AND PROVIDE APPROPRIATE DOCUMENTATION (FORM 337, SUPPLEMENTS, ETC.)**

The alert system has a power input (P451-41) that will keep the systems operable if the PAC45A systems power source is removed. Alert audio is provided in Fail-safe when power is on P451-62.

Alert Input	Input Pins	Alert Audio
1	P453 – 10	“Master Caution”
2	P453 – 11	“Alert”
3	P453 – 12	Chime
4	P453 – 13	1000 Hz tone
5	P453 – 14	Doorbell Chime
6	P453 – 19	Ring Tone
7	P453 – 20	“Timer at Zero”
8	P453 – 21	“Intercom Call”
9	P453 – 22	“ Check Engine Instruments”
Alert Power	P451 – 41	
Remote Acknowledge	P453 – 23	

The alert triggers can be configured to be Active High (>4.5 VDC) or Active Low (<0.5 VDC), and trigger at the leading-edge transition or by the voltage level. Active Low inputs should be less than 100 Ω when on and more than 10 kΩ when off. See §2.5.3 for configuration options.

Alerts with edge triggers will play continuously until the Acknowledge button (ACK) is pressed (remote ACK P454-23 grounded).

Alerts with level trigger will play continuously until the Acknowledge button (ACK) is pressed (remote ACK P454-23 grounded), or the input level reverts.

When power is applied to the alerts and not the PAC45A audio controller, it will play the message continuously until the remote acknowledge is selected.

The volume level of the alerts is adjustable with potentiometer 13 on the side of the HUB45A (See §2.7.2)

Audio alerts are inhibited for the first 30 seconds after the HUB is powered up to reduce nuisance triggers.

### 2.4.9 CTL45A wiring

The PAC45A supports up to 4 CTL45A control heads. Three can be connected to the rear connectors, and the fourth to J455. For convenience, either the pilot or observer #2 can be connected to J454 (See §2.7.14).

### 2.4.10 Dual HUB45AR Installation (SW Code BDQAD & above)

Dual HUB systems can be configured to divide the communications duties among up to eight control heads (four on each system) that can be for aircrew and tactical users.

These will be completely independent systems, such that the ISO/ALL/CREW switches operate independently, and the two systems can be isolated from each other. Adding a “CALL button is recommended, with a SPST switch between J452-46 and ground on each HUB45AR.

For an audio tie-line, only 2 wires are needed to connect the HUBs, J452-25 on each HUB45AR connects to P452-26 on the other HUB45AR, with a twisted shielded pair. This is intercom audio only, no radio or unswitched. See §2.7.4 for switch settings.

## 2.5 Discrete inputs

### 2.5.1 Remote ICS mode control. (J452-45)

When a momentary, normally open, push-button switch is connected between pin J452-45 and ground, it will change the intercom mode on the Pilot's PAC45A.

### 2.5.1 OXY (P453-26)

Activates the Oxygen Mask microphone inputs if configured.

### 2.5.2 Receive Mute (J452-44)

When J452-44 is grounded through a remote switch, **all** receive audio is muted. If this switch remains closed for more than 30 seconds (i.e., a stuck switch), the received audio will return to normal

### 2.5.3 Remote Alert Acknowledge and Alert Programming (P453-23)

A momentary switch connected to P453-23 serves as a remote Alert Acknowledge switch and **must** be used to program the Audio Alerts. We recommend installing provisions for this switch if audio alerts are ever used.

### 2.5.4 Backlight voltage and adjustment

The white (text) and green (indication) lighting can be adjusted independently.

See [§2.7.2](#) for locations.

Adjustment Pot #14 changes the Green LED brightness intensity

Adjustment Pot #15 changes the White LED brightness intensity

See Set switches 47 & 48 ON for dimmer 28V

Set switch 47 – **OFF** & 48- **ON** for 14V dimmer

Set switches 47 & 48 OFF for 5VDC dimmer

See [§2.7.3](#) for locations

By default, adjustments to Pot #13 will change the minimum trip point for the dimmer input to full bright. The pot permits adjustment from 0V to nominal dimmer voltage (28V or 5V depending on configuration).

#### 2.5.4.1 Backlight Adjustment, (HUB45A with Serial Number CH45A1208 and above)

Mode	Operation
Night Mode and Day Mode	<p><b>Night Mode:</b> Dimmer pot (above trip level) adjusts brightness from minimum to full brightness as set by programming pots.</p> <p><b>Day Mode:</b> Below trip level sets brightness to full brightness as set by programming pots (separate settings from Night Mode settings).</p>
Night Mode Only	Dimmer pot (trip level adjusted to zero) adjusts brightness from minimum to full brightness as set by programming pots.
Day Mode Only	No dimmer pot connected, sets brightness to full brightness as set by programming pots.

To setup the dimming values:

1. Long press (>1 second) HRTF and ACK buttons.

2. One chime is heard in Pilot's headset. You can now set Green (#14) and White (#15) adjustment pots for Night Mode.
3. Long press HRTF and ACK buttons again.
4. Two chimes are heard. You can now set Green and White adjustment pots for Day Mode.
5. Long press HRTF and ACK buttons again.
6. Three chimes are heard. This exits the dimmer setup mode. Green and White Adjustment pots are inactive when not in setup mode.
7. Trip level pot (#13) can be adjusted any time before or after Green/White dimmer setup. This pot is inactive during Green/White dimmer setup mode, otherwise it is always active.

Other things to note:

1. Night mode sets the Maximum brightness level for the external dimming control pot when it is above the trip threshold.
2. Day mode sets the brightness level for the external dimming control pot when it is below the trip threshold.
3. During Green/White setup, the external dimmer brightness control pot is inactive.
4. During Green/White setup, Green/White adjustments are adjusting the Maximum level that can be set by the external dimmer brightness control pot during normal operation.
5. Once dimmer setup mode is entered it will automatically exit the mode and play 3 Chimes after 60 seconds of inactivity, where activity is defined as a long press of dual HRTF and ACK buttons, or movement of either the Green or White adjustment pots.

## **2.6 Wired Telephone/Satellite Communication input**

The PAC45A can accommodate a wired cell phone interface on J452 Pins 58, 59, and 38. Both Bluetooth and wired Telephone can be accommodated, however, only ONE can be active at a time. Low impedance satellite phones might require a tactical radio adapter, PS Engineering P/N 12100.

### **2.6.1 Music Input**

**NOTE**

Use the low-level output of any additional Music device to connect to the audio controller. Maximum signal level is **3 VAC** p-p. **DO NOT** use a speaker-level output; this will cause internal damage in the audio controller.

**CAUTION**

Local oscillators and internal signals from Music equipment can cause undesired interference with other aircraft systems. Before takeoff, operate the entertainment devices to determine if there is any adverse effect within the aircraft systems. If any unusual operation is noted in flight, immediately switch off the entertainment devices.

All additional entertainment devices must be switched off for both takeoff and landing.

## **2.7 User Adjustments**

The HUB45A is factory set for typical installation. However, several installation adjustments are available. No computer is required.

### **2.7.1 Unswitched Audio Level**

Unswitched inputs one through five are installation adjustable through the side of the HUB45A unit.

### **2.7.2 Adjustments**

On the side of the PAC45A/HUB45A are 15 field adjustment potentiometers. **These are ALL 30-turn pots.** Remove any FOD protective covers as necessary from the adjustments.

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CP/OBSVR Speaker & Satcom Volume

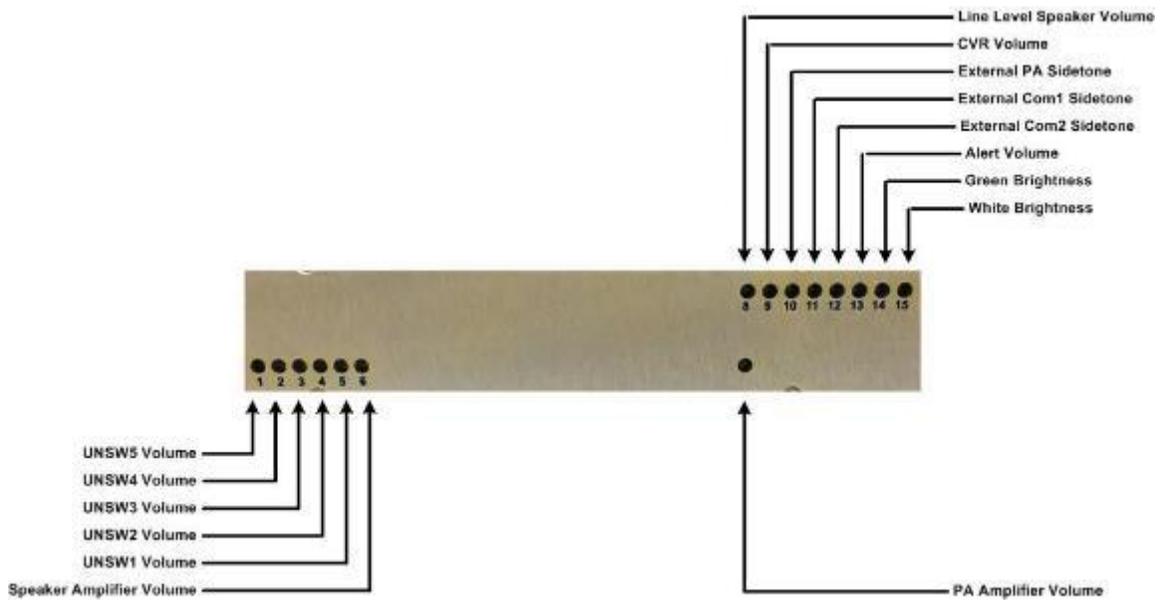
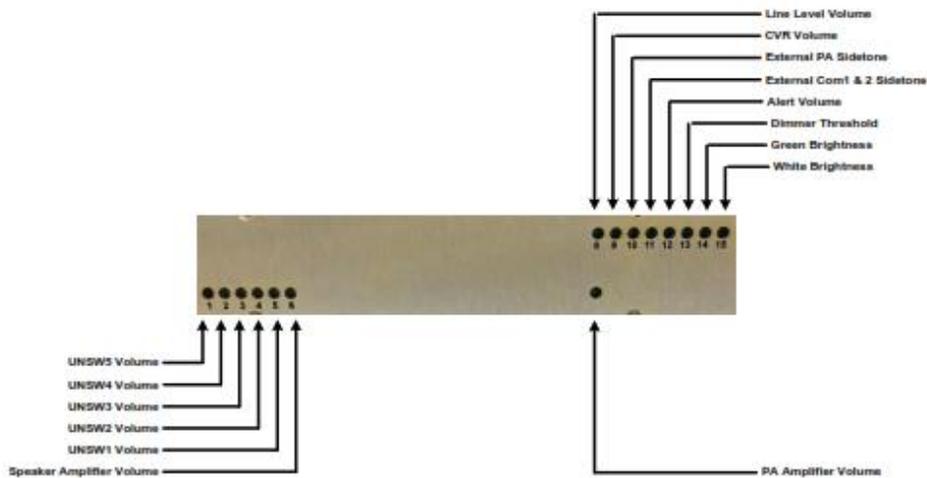


Figure 2-2 Adjustment locations ( Config. ACJAB and below)

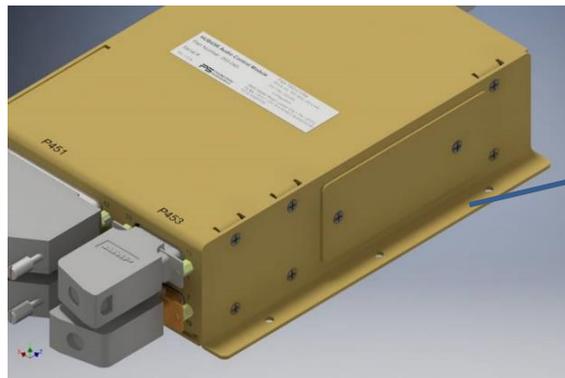


**Figure 2-3 Adjustment locations (Config. ACLAB and above)**

1. Unswitched input 5 volume (J452-57)
2. Unswitched input 4 volume (J452-36)
3. Unswitched input 3 volume(J452-56)
4. Unswitched input 2 volume(J452-35)
5. Unswitched input 1 volume (J452-55)
6. Speaker Amplifier Volume (J452-41)
7. PA Amplifier Volume (J452-42)
8. Copilot and observer speaker output (if configured) and satcom telephone output volume (J452-38)
9. Cockpit Voice Recorder Volume (J452-60, 61)
10. External PA Sidetone (J452-37)
11. External COM 1 Sidetone (J452-33) or  
External COM 1 (J452-33) and COM 2 Sidetone (J452-34) (Configuration ACLAB and above)
12. External COM 2 Sidetone (J452-34) or  
Alert volume (adjusts the level of the internal audio alerts and annunciations generated by the HUB45A)(Configuration ACLAB and above)
13. Alert volume (adjusts the level of the internal audio alerts and annunciations generated by the HUB45A) or  
Dimmer threshold (the minimum voltage when the lights go full bright, “day” mode)  
(Configuration ACLAB and above).
14. Green backlight level, see §2.5.3
15. White backlight level

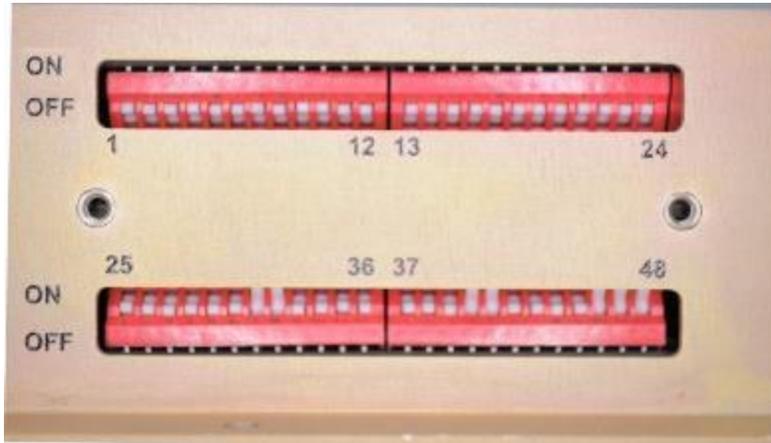
### 2.7.3 Logic Switch Options

The unit has switches accessible through the side of the HUB45A to set specific functions.



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Switch functions and positions as shipped from the factory. The color coding denotes similar groups of functionality.

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TOP ROW			BOTTOM ROW		
SWITCH	FUNCTION	POSITION*	SWITCH	FUNCTION	POSITION*
1	FAILSAFE ALERTS TO CREW	ON	25	COPILOT CONTROL HEAD INSTALLED	ON
2	FAILSAFE ALERTS TO OBSERVERS	ON	26	OBSVR 1 CONTROL HEAD INSTALLED	ON
3	ALERTS TO CREW	ON	27	OBSVR 2 CONTROL HEAD INSTALLED	ON
4	ALERTS TO OBSERVERS	ON	28	REVERSIONARY MODE	ON
5	ALERT 1 TRIGGER	EDGE ON, LEVEL OFF	29	TRANSMIT MUTE	OFF
6	ALERT 1 POLARITY	POS ON, NEG OFF	30	STUCK MIC ENABLE	ON
7	ALERT 2 TRIGGER	EDGE ON, LEVEL OFF	31	HIGH MIC SENS	OFF
8	ALERT 2 POLARITY	POS ON, NEG OFF	32	PAX 1 & 2 = O <sub>2</sub> MICS	OFF
9	ALERT 3 TRIGGER	EDGE ON, LEVEL OFF	33	PAX 3 & 4 = OBSVR O <sub>2</sub> MICS	OFF
10	ALERT 3 POLARITY	POS ON, NEG OFF	34	COM 7 COM 8 Audio/COM 1 COM 2 SIDETONE	OFF
11	ALERT 4 TRIGGER	EDGE ON, LEVEL OFF	35	PA SIDETONE	OFF
12	ALERT 4 POLARITY	POS ON, NEG OFF	36	UNSW 1 & 2 SPLIT	OFF
13	ALERT 5 TRIGGER	EDGE ON, LEVEL OFF	37	UNSW OBSVR	ON
14	ALERT 5 POLARITY	POS ON, NEG OFF	38	STEREO OBSVR	ON
15	ALERT 6 TRIGGER	EDGE ON, LEVEL OFF	39	STEREO CREW	ON
16	ALERT 6 POLARITY	POS ON, NEG OFF	40	8 OHM HEADSETS	OFF
17	ALERT 7 TRIGGER	EDGE ON, LEVEL OFF	41	RECEIVER INDICATOR ON	ON
18	ALERT 7 POLARITY	POS ON, NEG OFF	42	MUSIC MUTE	ON
19	ALERT 8 TRIGGER	EDGE ON, LEVEL OFF	43	COPILOT MUSIC ENABLE	ON
20	ALERT 8 POLARITY	POS ON, NEG OFF	44	OBSERVER 1 MUSIC ENABLE	ON
21	ALERT 9 TRIGGER	EDGE ON, LEVEL OFF	45**	OBSERVER 2 MUSIC ENABLE **	ON
22	ALERT 9 POLARITY	POS ON, NEG OFF	46	ALERTS ON SPEAKER	ON
23	RESERVED	OFF	47	DIMMER 28V	ON
24	RESERVED	OFF	48	DIMMER 28V	ON

**2.7.4 Logic Switch Details**

SWITCH NUMBER	FUNCTION	ON	OFF
1	FAILSAFE ALERTS TO CREW	PILOT AND COPILOT HEAR ALERTS IN FAILSAFE MODE	NO ALERT AUDIO IN FAILSAFE (RADIOS ONLY)
2	FAILSAFE ALERTS TO OBSERVER	OBSERVER STATIONS HEAR ALERTS IN FAILSAFE MODE	NO AUDIO IN FAILSAFE
3	ALERTS TO CREW	PILOT AND COPILOT HEAR ALERT AUDIO	PILOT AND COPILOT <b>DO NOT</b> HEAR ALERT AUDIO
4	ALERTS TO OBSERVERS	OBSERVER STATIONS HEAR ALERT AUDIO	OBSERVER STATIONS <b>DO NOT</b> HEAR ALERT AUDIO
5, 7, 9, 11, 13, 15, 17, 19, 21	ALERT TRIGGER	EDGE TRIGGERED	LEVEL TRIGGERED
6, 8, 10, 12, 14, 16, 18, 20, 22	ALERT POLARITY	ACTIVE HI TRIGGER (5 TO 28 VDC)	ACTIVE LOW TRIGGER (GROUND)
23, 24	RESERVED	DO NOT TOUCH	MUST BE OFF
25	COPILOT CONTROL HEAD INSTALLED	COPILOT CONTROL HEAD IN USE	NO COPILOT CONTROL HEAD
26	OBSVR 1 CONTROL HEAD INSTALLED	OBSERVER 1 CONTROL HEAD IN USE	NO OBSERVER CONTROL HEAD
27	OBSVR 2 CONTROL HEAD INSTALLED	OBSERVER 2 CONTROL HEAD IN USE	NO OBSERVER 2 CONTROL HEAD
28	REVERSIONARY MODE SEE §2.7.4.1	USER STATIONS "REVERT" TO OTHER CONTROL HEADS WHEN FAILED	USER STATIONS IN FAILSAFE WHEN FAILED
29	TRANSMIT MUTE	COM RECEIVE AUDIO MUTES FOR ALL HEADSETS TRANSMITTING WHEN ANY TX PTT IS PRESSED. COM TX IS STILL HEARD (PREVENTS SQUEALING ON CLOSE FREQS)	SELECTED COM AUDIO IS HEARD DURING TRANSMIT
30	STUCK MIC ENABLE	IGNORES PTT IF GROUNDED FOR MORE THAN 35 SEC.	NO STUCK MIC TIMEOUT
31	MICROPHONE SENSITIVITY	REDUCED MIC SENSITIVITY FOR LOUD COCKPITS	NORMAL MIC SENSITIVITY
32	PASSENGER 1, 2 OR CREW OXYGEN MIC	P453-15 BECOMES PILOT O <sub>2</sub> MIC P453-16 BECOMES COPILOT O <sub>2</sub> MIC	P453-15 BECOMES PASS 1 MIC P453-16 BECOMES PASS 2 MIC
33	PASSENGER 1, 2 OR OBSERVER OXYGEN MIC	P453-17 BECOMES OBSVR 1 O <sub>2</sub> MIC P453-18 BECOMES OBSVR 2 O <sub>2</sub> MIC	P453-17 BECOMES PASS 3 MIC P453-18 BECOMES PASS 4 MIC
34	COM 7 & COM 8 AUDIO OR COM 1 & COM 2 SIDETONE	J452-33 IS COM 1 SIDETONE INPUT J452-34 IS COM 2 SIDETONE	J452-33 IS COM 7 AUDIO INPUT

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SWITCH NUMBER	FUNCTION	ON	OFF
			J452-34 IS COM 8 AUDIO INPUT
35	PA SIDETONE	SIDETONE FROM EXTERNAL PA IS ACTIVE	LOCAL SIDETONE FOR EXTERNAL PA
36	UNSWITCHED 1 & 2 SPLIT	UNSWITCHED #1 IS NOT PROVIDED TO COPILOT UNSWITCHED #2 IS NOT PROVIDED TO PILOT	UNSWITCHED #1 AND 2 PROVIDED TO BOTH CREWMEMBERS
37	UNSWITCHED TO OBSERVER	UNSWITCHED AUDIO PROVIDED TO OBSERVER POSITIONS	NO UNSWITCHED AUDIO AT OBSERVER POSITIONS
38	STEREO OBSERVER	OBSERVER POSITIONS ARE STEREO (LEFT & RIGHT CHANNELS ACTIVE)	OBSERVER POSITIONS ARE MONO (LEFT OUTPUT)
39	STEREO CREW	CREW POSITIONS ARE STEREO (LEFT & RIGHT CHANNELS ACTIVE)	CREW POSITIONS ARE MONO (LEFT OUTPUT)
40	8Ω HEADSETS	AUDIO OUTPUTS COMPATIBLE WITH LOW IMPEDANCE HEADPHONES	AUDIO OUTPUTS COMPATIBLE WITH HIGH IMPEDANCE (150Ω TO 300Ω) HEADPHONES
41	RECEIVER INDICATION	INDICATOR BLINKS WHEN AUDIO SIGNAL IS PRESENT ON A SELECTED RECEIVER	NO RECEIVER INDICATION
42	MUSIC MUTE	MUSIC WILL MUTE WHEN RADIO OR INTERCOM IS ACTIVE	MUSIC MUTES ONLY WHEN RADIO IS ACTIVE
43	COPILOT MUSIC ENABLE	COPILOT POSITION CAN HEAR MUSIC	COPILOT POSITION WILL NEVER HEAR MUSIC
44	OBSERVER 1 MUSIC ENABLE	OBSERVER 1 POSITION CAN HEAR MUSIC	OBSERVER 1 WILL NEVER HEAR MUSIC
45**	OBSERVER 2 MUSIC ENABLE	OBSERVER 2 POSITION CAN HEAR MUSIC	OBSERVER 2 WILL NEVER HEAR MUSIC
46	ALERTS ON SPEAKER	AURAL ALERT AUDIO IS PRESENTED ON COCKPIT SPEAKER	AURAL ALERT AUDIO IS <b>NOT</b> PRESENTED ON COCKPIT SPEAKER
47	BACKLIGHT VOLTAGE	ON FOR 28VDC	OFF FOR 14 OR 5 VDC
48	BACKLIGHT VOLTAGE	ON FOR 28 OR 14 VDC	OFF FOR 5 VDC

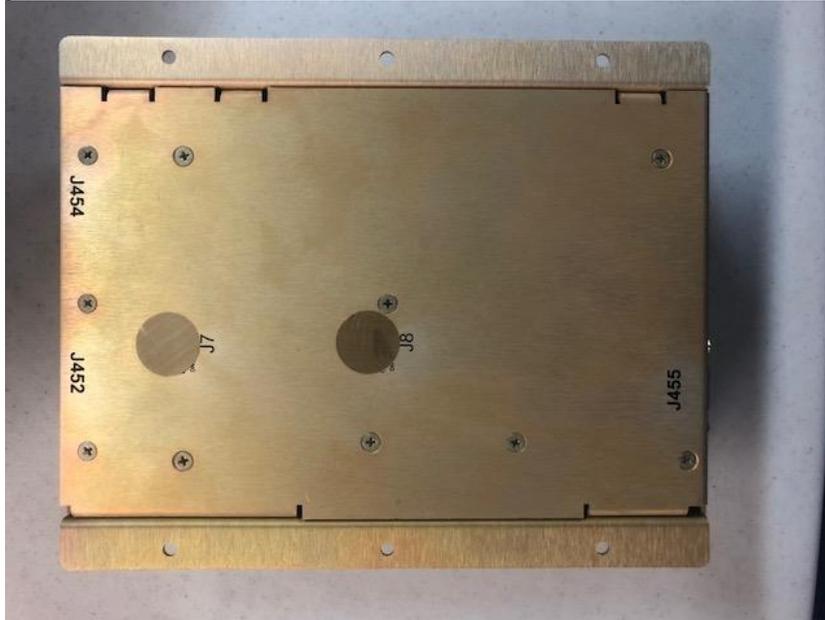
**\*\*If Switch 45 is ON, in a DUAL installation, music (Bluetooth or wired) will be passed between both hubs. We recommend leaving SW 45 OFF. This will eliminate music for the OBS2 and Passengers' headsets. Pilot copilot & OBS 1 will still have music.**

**2.7.4.1 HUB45R Bottom Logic Switches**

In the PAC45A System, the DIP switches located on the bottom of the HUB45 is configured from the factory:

Position	1	2	3	4	5	6
<b>Switch</b>						
<b>J7</b>	ON	ON	ON	OFF	OFF	OFF
<b>J8</b>	OFF	OFF	OFF	ON	ON	ON

If it is necessary to check or set these switches, remove the foil covers.



**Figure 2-4 - LOGIC SWITCH Locations**



**Figure 2-5 LOGIC SWITCH LOCATIONS HUB45AR**

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J7 SWITCH NUMBER	FUNCTION	ON	OFF
1	UNSWITCHED #5	J452-57 IS UNSWITCHED INPUT 5	J452-57 IS COPILOT HAND MIC INPUT*
2	TEL/MIC	P451-58 IS WIRED TEL INPUT	P452-58 IS OBS #1 HAND MIC*
3	EXPANSION	J452-26 IS PASS 5 MIC INPUT	J452-26 IS EXPANSION INPUT
4	RESERVED	N/A	DEFAULT
5	RESERVED	N/A	DEFAULT
6	EXPANSION	EXPANSION UNIT IN SYSTEM	NO EXPANSION

**\*NOTE\*** An additional switch must be selected to utilize these Hand Mics. Ensure that Switch 58 is in the up position. [See 2.7.14.](#)

J8 SWITCH NUMBER	FUNCTION	ON	OFF
1	RESERVED	DEFAULT	N/A
2	RESERVED	DEFAULT	N/A
3	COPILOT FAILSAFE	COPILOT HEARS NAV 2	NO FAILSAFE NAV AUDIO
4	PILOT FAILSAFE	PILOT HEARS NAV 1	NO FAILSAFE NAV AUDIO
5	COPILOT FAILSAFE	COPILOT HEARS UNSWITCHED 2	NO FAILSAFE UNSWITCHED AUDIO
6	PILOT FAILSAFE	PILOT HEARS UNSWITCHED 1	NO FAILSAFE UNSWITCHED AUDIO

After any necessary adjustments are complete, replace the cover and apply the foil covers, rectangular (575-045-0162) and round (575-998-0050).



## 2.7.5 Fail-Safe Audio and Reversionary Mode

HUB power is pin P451-42, if no power is applied to this pin, the HUB45A goes into Failsafe Mode.

While in Failsafe Mode, you must have bus voltage applied to Alert Power pin P451-41 to hear the nine aural alerts, refer to [Section 3.10](#) for more information.

### 2.7.5.1 Fail-Safe options

When **ON**, Switch 1 allows the crew to have Audio Alerts in Fail-Safe, when the alert subsystem is powered. When Switch 2 is **ON**, the Observer positions will hear the audio alerts in Fail-Safe, when the alert subsystem is powered.

Switches 3 and 4 provide the option for the pilot and copilot (Switch 3), and or observer positions (Switch 4) to hear the Audio Alerts in normal operation.

### 2.7.5.2 Reversionary Mode

When Switch 28 is **ON**, CTL45A Control heads will “revert” to the next higher control head if it is turned off. For example, if the Observer #2 control head is off, Observer 2 will hear what Observer 1 has selected and transmit on the radios Observer 1 has selected. Or, if the copilot’s control head is switched off (fail-safe), the copilot will hear what the pilot has selected and transmit on the radios the pilot has selected.

If Switch 28 is **OFF**, the user just goes into fail-safe, with no ability to change radios and hears the audio associated with that position.

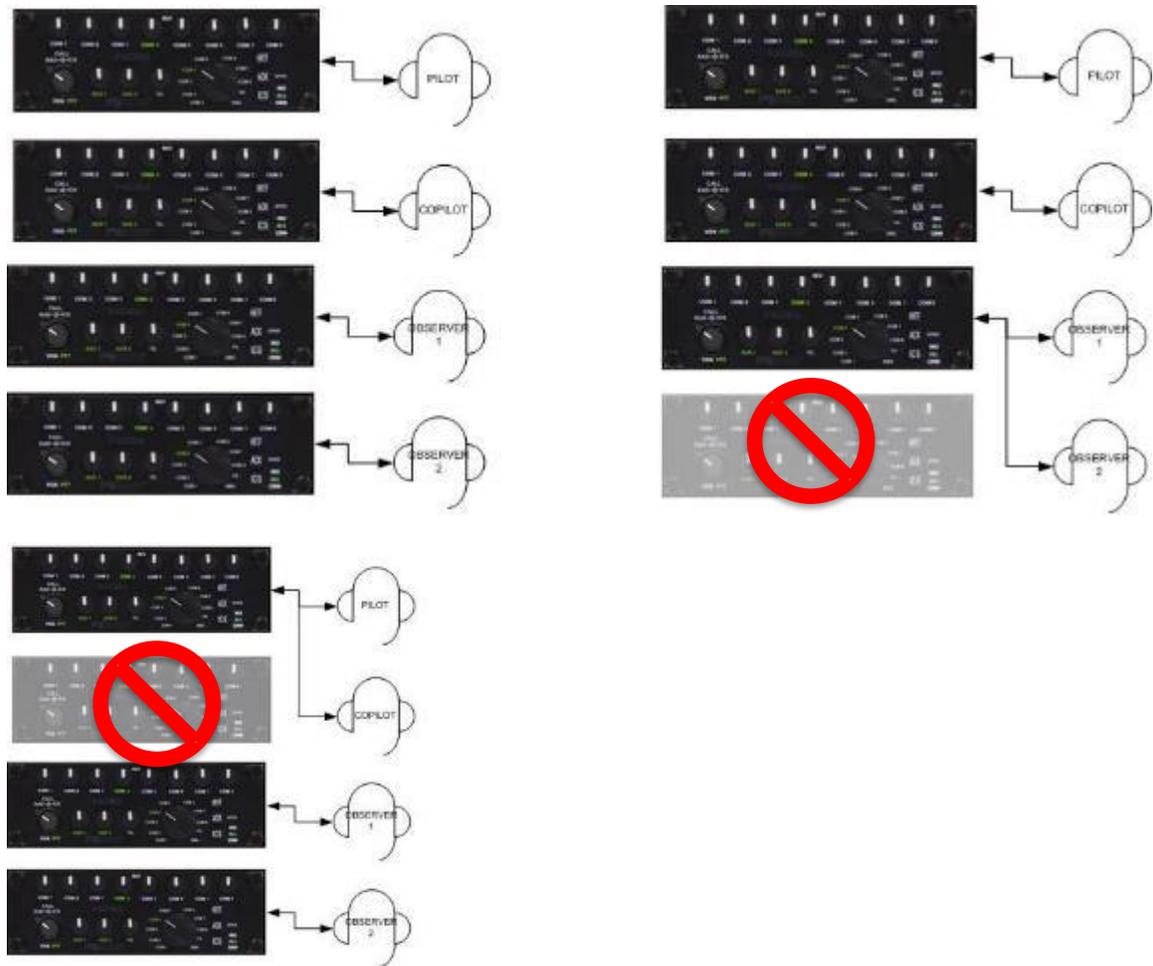


Figure 2-6 Observer 1 in fail-safe and Copilot in fail-safe

## **2.7.6 Microphone settings**

### **2.7.6.1 Transmit Muting**

Switch 29 controls the muting of other receivers when one is transmitting. When Switch 29 is **ON**, other receivers are muted during transmission. This can prevent bleed-over and squealing if they are operating on close frequencies, or the antennas are close together. However, it prevents other crew members from hearing radios they have selected for receiving during transmissions.

Sidetone from the transmitter is still heard when selected.

### **2.7.6.2 Stuck PTT Mic Enable**

When Switch 30 is **ON** the PAC45A will ignore any push-to-talk input that is held low for more than 35 seconds. This function resets if the PTT ground is released. If Switch 30 is **OFF**, a PTT will key the selected radio indefinitely, and rely on the radio's internal stuck mic protection.

### **2.7.6.3 Microphone Trip Level Sensitivity**

If Switch 31 is **ON**, the intercom microphone sensitivity is decreased by 6dB. This makes the intercom more resistant to noisy aircraft environments. PS Engineering recommends trying the PAC45A in normal mode (Switch 31 **OFF**) first, because the IntelliVox® does perform very well in most airplanes and rotorcraft.

### **2.7.6.4 Oxygen Microphones or Passenger Intercom inputs**

P453-15 and P453-16 can be either Passenger 1 and Passenger 2 intercom microphone inputs, or, when Switch **32** is **ON** they will become Pilot and Copilot Oxygen microphone inputs. These are activated when an OXY mode is on.

P453-17 and P453-18 can be either Passenger 3 and Passenger 4 intercom microphone inputs, or, when Switch **33** is **ON** they will become Observer 1 and Observer 2 Oxygen microphone inputs. These are activated when an OXY mode is on.

### **2.7.6.5 Hand Mic Inputs**

Configuration of the dipswitches at J7 and hidden dip switch page 2-19 might be required.

HUB45A supports up to three independent hand microphones.

- Pilot
- Copilot
- OBS1

Hand mics will allow the pilot, copilot & OBS1 to transmit on any transceiver (C1 through C8) selected on the control head.

NOTE: Hand microphones will not transmit on the PA (public address) location, if you are using less than 8 COM ports than you can repurpose one of the transceiver locations as PA mode. contact PS Engineering for this information.

### **2.7.6.6 PA (Public Address) Output**

PA (Public Address) is supported by headsets & oxygen microphones only and will not work with hand microphones. If you have less than 8 com radios, then the PA can be placed at a com location and then it will work with the hand mics.

## **2.7.7 Artificial Transmit Sidetone**

Using the hand mics, the audio system will not have sidetone unless if the radio or PA system provides it. Configuring the HUB45A for artificial sidetone will only work when using the headset or oxygen microphone.

### **2.7.7.1 COM 1 & COM 2 Sidetone or COM 7 & 8 Audio**

The PAC45A system is capable of supporting up to 9 communications radios. However, COM 7 & COM 8 and artificial sidetone are mutually exclusive because the same inputs are used. See § 2.7.7.1.

### 2.7.7.2 Public Address Sidetone

When Switch 35 is **ON**, the audio input from J452-37 is active when the PTT is pressed in Public Address mode as an input from an external PA Amplifier. When Switch 35 is **OFF**, the PAC45A creates a local sidetone for public address. NOTE: Configuring the HUB45A for artificial sidetone will only work when using the headset or oxygen microphone

## 2.7.8 Unswitched Audio

### 2.7.8.1 Splitting Unswitched 1 and 2 between Pilot and Copilot

Unswitched Input #1 (J452-55) and Unswitched #2 (J452-35) can be split between the pilot and copilot, if desired. If Switch 36 is "**ON**" the pilot will hear unswitched 1, and never hear unswitched 2, while the copilot will hear unswitched 2, and never hear unswitched 1.

### 2.7.8.2 Observer Unswitched Audio

When Switch 37 is **ON**, the observer positions will receive the unswitched audio. When Switch 37 is **OFF**, the observer positions will NOT hear unswitched audio. This mode selection depends upon the role of the mission observers in the operation of the aircraft.

## 2.7.9 Headphone Options

### 2.7.9.1 Stereo or Mono

When Switch 38 is **ON**, the observer 1 and 2 positions will receive stereo audio (P451-37 left ear, P451-58, Right ear).

When Switch 38 is **OFF**, the observer 1 and 2 positions will receive monaural audio (P451-37), which is useful if only monaural headphones will be used.

When Switch 39 is **ON**, the Pilot and Copilot positions will receive stereo audio (P451-35 pilot's left ear, P451-56, Right ear, P451-35 copilot's left ear, P451-57, Right ear).

When Switch 38 is **OFF**, crew positions will receive monaural audio (P451-35 and 36, respectively), which is useful if only monaural headphones will be used.

NOTE: The MultiTalker® Head Related Transfer Function will not function in a mono headset.

### 2.7.9.2 Low Impedance (8Ω)

When Switch 40 is **ON**, the PAC45A audio output is optimized for a low-impedance headphone output of about 8Ω.

When Switch 40 is **OFF**, the PAC45A audio output is optimized for a standard civil aviation headphone impedance headphone output of about 150-300Ω.

## 2.7.10 Receive Signal Indicator

When Switch 41 is **ON**, the receive indicator of the selected receiver will blink when an audio signal is on that input. This is useful for locating the source of a received signal when many are active.

When Switch 41 is **OFF**, there is no received signal indication.

## 2.7.11 Music Functions

The PAC45A has several options for music presented to pilot and crew.

Regardless of the position of Switches 43, 44, or 45, the Pilot will always hear music, if present, and Switch 42 controls the muting behavior.

### 2.7.11.1 Music Mute

When Switch 42 is **ON**, any music playing will mute when intercom or radio communication is active.

When Switch 42 is **OFF**, the music will NOT mute when **intercom** audio is present. It will mute for any **radio** activity.

#### 2.7.11.2 Copilot Music Enable

When Switch 43 is **ON**, the copilot position will hear music that is present

When Switch 43 is **OFF**, the copilot position will never hear music in the system.

#### 2.7.11.3 Observer Music Enable

When Switch 44 is **ON**, the observer 1 position will hear music that is present

When Switch 44 is **OFF**, the observer 1 position will never hear music in the system.

When Switch 45 is **ON**, the observer 2 position will hear music that is present

When Switch 45 is **OFF**, the observer 2 position will never hear music in the system.

### 2.7.12 Speaker Alert Audio

When Switch 46 is **ON**, the internal audio alert audio messages will be presented to the cockpit speaker.

When Switch 46 is **OFF**, the internal audio alert audio messages never be heard over the cockpit speaker.

### 2.7.13 Backlight Dimmer Voltage

Switches 47 and 48 control the backlight dimming input expected for the purpose of adjusting the curve.

For 28 VDC backlighting both Switches 47 and 48 are **ON**.

For 14 VDC backlighting, Switch 47 is **OFF** and 48 is **ON**.

For 5 VDC backlighting, both Switches 47 and 48 are **OFF**

### 2.7.14 Other Shared Functions

Some functions are set by switches not easily accessible to the installer.

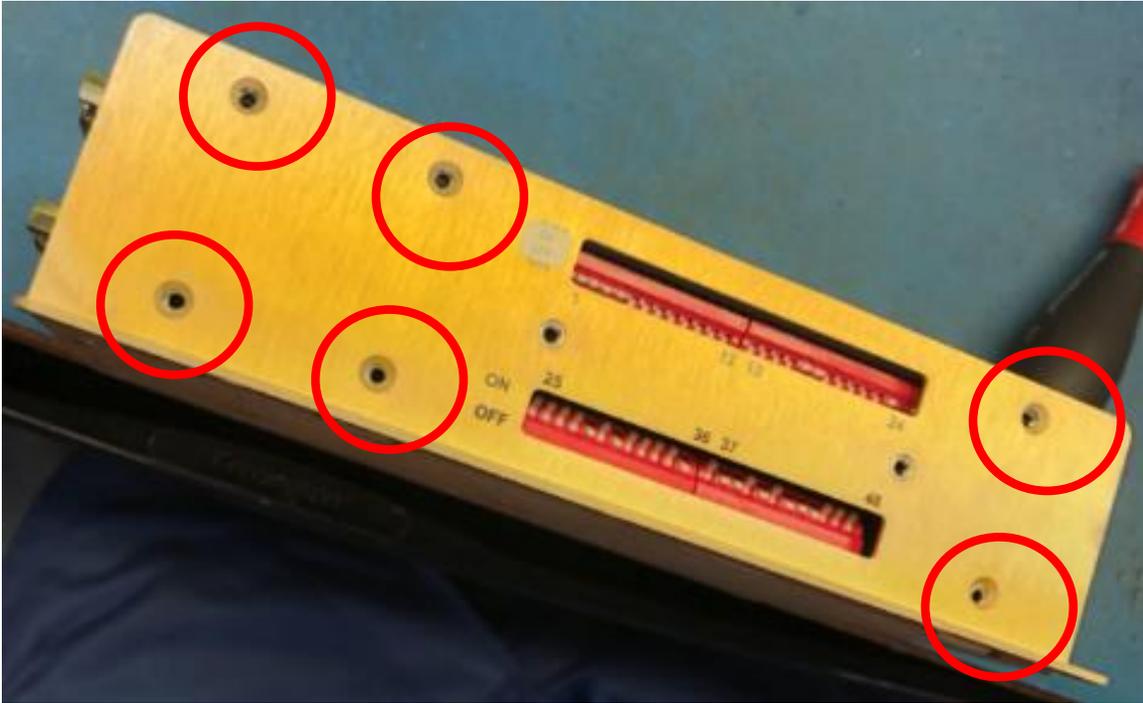
These include:

- Observer 1 CVR or Observer 1 Speaker output (J452-39)
- Observer 2 CVR or Copilot Speaker output (J452-40)
- J455 function as Observer 2 or Pilot Control Head port (Shipped as Observer 2, pilot on J454)
- Hand Mic enable for Copilot (J452-57) and Observer 1 (J452-58) (eliminate Unswitched 5 input and wired telephone input).
- TX-I: Keeps intercom active during radio transmissions so in-aircraft conversations can continue when a crew member is communicating out of the aircraft.
- Artificial Sidetone feature so whomever is transmitting can still hear themselves and other headsets will hear if they are selected/receiving the same transceiver.

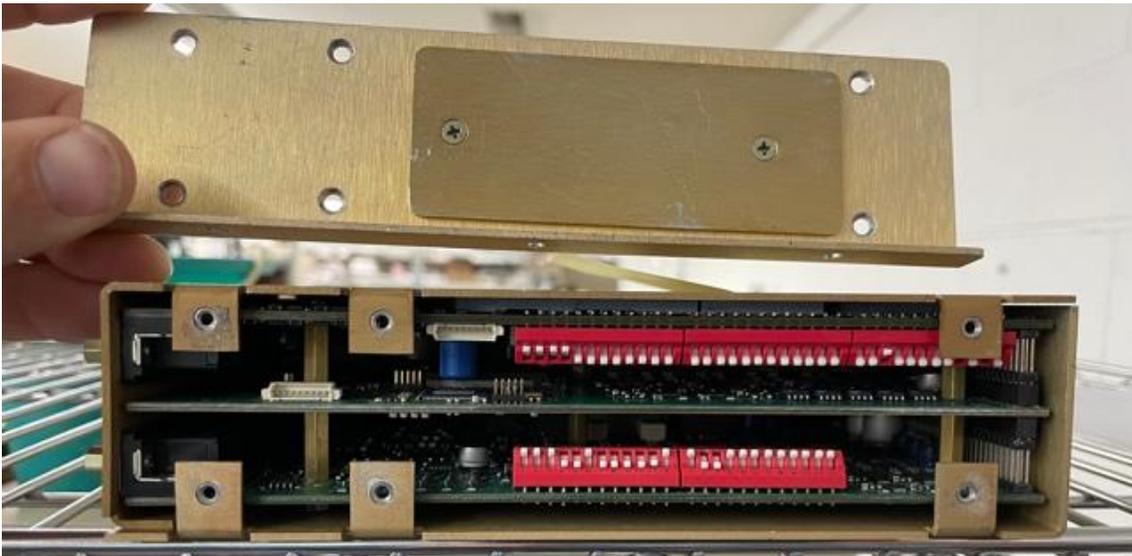
These switches are accessible by removing the side plate of the HUB45A using the following procedure:

**NOTE: THIS PROCESS SHALL ONLY BE PERFORMED IN A CLIMATE AND FOD CONTROLLED ENVIRONMENT, BY AN AUTHORIZED PS ENGINEERING INSTALLER.**

1. Remove qty. 6 #4-40 c 3/16" Countersunk screws (p/n 475-442-2001) from side with DIP switches.



2. Remove side panel to expose additional DIP switches

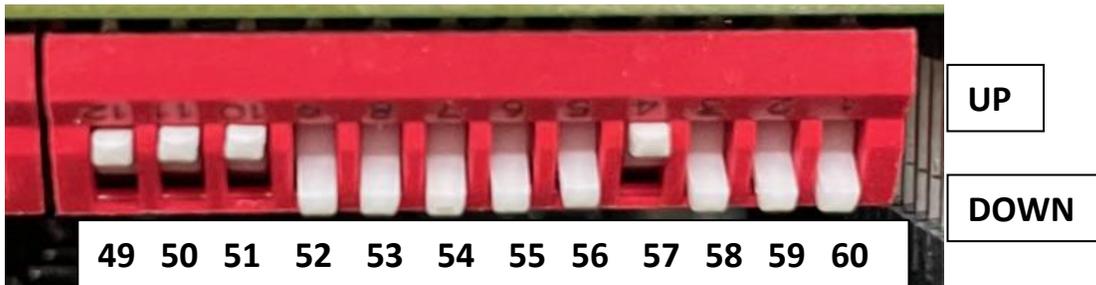


3. Identify additional DIP switch bank

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4. Select options as needed.



SWITCH NUMBER	FUNCTION	ON (UP)	OFF (DOWN)
		<b>BOLD IS FACTORY DEFAULT</b>	
49	ALERTS ENABLE	<b>UP (ON) AUDIO ALERTS ENABLED</b>	AUDIO ALERTS DISABLED
50	RECORD AUDIO ALERTS	RECORD AUDIO	<b>NO AUDIO RECORDING</b>
51	BT ENABLE	<b>BLUETOOTH MODULE ENABLED</b>	NO BLUETOOTH FUNCTIONS
52	PASS 4 = CREW 3	<b>PASSENGER 4</b>	3 <sup>RD</sup> CREW POSITION
53	J452-39: OBS1 CVR OR OBS1 SPR	<b>OBS1 CVR ON J452-39</b>	OBSERVER 1 SPEAKER ON J452-39
54	J452-40: OBS2 CVR OR COPILOT SPR	OBSERVER 2 CVR OUTPUT ON J452-40	<b>COPILOT SPEAKER OUTPUT ON J452-40</b>
55	ARTIFICIAL COM RADIO SIDETONE	<b>ARTIFICIAL SIDETONE PRODUCED</b>	SIDETONE OFF (SIDETONE FROM RADIO)
56	PSE EXPANSION INSTALLED	<b>EXPANSION ENABLED</b>	<b>EXPANSION DISABLED</b>
57	HUB DB9 J455 = OBS2 CTL45A OR PILOT CTL45A	<b>OBSERVER #2 CTL45A CONNECTED TO J455</b>	PILOT CTL45A CONNECTED TO J455
58	HAND MIC ENABLE FOR COPILOT & OBS1 OR SWAP MODE	<b>HAND MIC ACTIVE</b>	COM SWAP MODE ENABLED
59	TXI ENABLE	<b>INTERCOM ACTIVE DURING RADIO PTT</b>	INTERCOM MUTED DURING PTT
60	RESERVED	DO NOT TOUCH	<b>DEFAULT POSITION</b>

5. After settings are confirmed, reinstall the side plate by reversing the disassembly procedure.
6. Test and verify all changed settings.
7. Perform an installed system test in accordance with Section 2.10.

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## 2.8 PAC45A Pin assignments

P451		J452	
Pin	Description	Pin	Description
1	Ground	1	Lighting Common
2	Ground	2	Music Ground
3	Ground	3	Ground
4	Ground	4	Ground
5	Ground	5	Ground
6	Ground	6	Ground
7	Ground	7	Ground
8	Ground	8	Ground
9	Ground	9	Ground
10	Ground	10	Ground
11	Ground	11	Ground
12	Ground	12	Ground
13	Ground	13	Ground
14	Ground	14	Ground
15	Ground	15	Ground
16	Ground	16	Ground
17	Ground	17	Ground
18	Ground	18	Ground
19	Ground	19	Ground
20	Aircraft Ground	20	Speaker Ground
21	Aircraft Ground	21	PA Ground
22	Pilot Hand Mic	22	Lighting In
23	Pilot Mic	23	Music Left
24	Copilot Mic	24	Expansion Power Out
25	Observer 1 Mic	25	Expansion Out
26	Observer 2 Mic	26	Passenger 5 or Expansion In
27	COM1 Mic [1]	27	COM1 Audio Hi [1]
28	COM2 Mic [2]	28	COM2 Audio Hi [2]
29	COM3 Mic [3]	29	COM3 Audio Hi [3]
30	COM4 Mic [4]	30	COM4 Audio Hi [4]
31	COM5 Mic [5]	31	COM5 Audio Hi [5]
32	COM6 Mic [6]	32	COM6 Audio Hi [6]
33	COM7 Mic [7]	33	COM7 Audio Hi [7] or COM1 Sidetone
34	COM8 Mic [8]	34	COM8 Audio Hi [8] or COM2 Sidetone
35	Pilot Left/Mono Headset	35	UNSW2
36	Copilot Left/Mono Headset	36	UNSW4
37	Observer 1 Left/Mono Headset	37	PA Sidetone
38	Passenger 1, Observer 2 Left, Mono Headset	38	Telephone Mic Hi
39	Passenger 2,3 Left/Mono Headset	39	CVR Observer 1 or Observer 1 Speaker Output
40	Passenger 4,5 Left/Mono Headset	40	CVR Observer 2 or Copilot Speaker Output
41	Alert Power	41	Speaker Pilot
42	Aircraft Power	42	PA Out
43	Pilot Hand TX PTT	43	Music Right
44	Pilot TX PTT	44	Radio Mute
45	Copilot TX PTT	45	Pilot ICS
46	Observer 1 TX PTT	46	External Cabin Call
47	Observer 2 TX PTT	47	NAV1 Audio Hi [9]
48	COM1 Key [1]	48	NAV2 Audio Hi [10]
49	COM2 Key [2]	49	AUX3 Audio Hi [9]
50	COM3 Key [3]	50	AUX4 Audio Hi [9]
51	COM4 Key [4]	51	AUX5 Audio Hi [9]
52	COM5 Key [5]	52	AUX6 Audio Hi [10]
53	COM6 Key [6]	53	AUX7 Audio Hi [10]
54	COM7 Key [7]	54	AUX8 Audio Hi [10]
55	COM8 Key [8]	55	UNSW1
56	Pilot Right Headset	56	UNSW3
57	Copilot Right Headset	57	UNSW5 or Copilot Hand Mic Audio Hi
58	Observer 1 Right Headset	58	HEADPHONE AUDIO HI or Observer 1 Hand Mic Audio Hi
59	Passenger 1, Observer 2 Right Headset	59	Telephone Key
60	Passenger 2,3 Right Headset	60	CVR Pilot
61	Passenger 4,5 Right Headset	61	CVR Copilot
62	O <sub>2</sub> Mic Failsafe Power	62	PA Key

**Numbers in brackets [1] indicate the associated front panel bezel location. See Appendix B Radio Wiring.**

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P453		J454	
Pin	Description	Pin	Description
1	Ground	1	TX- Pilot <u>or</u> Observer 2
2	Ground	2	TX+ Pilot <u>or</u> Observer 2
3	Ground	3	RX- Pilot <u>or</u> Observer 2
4	Ground	4	RX+ Pilot <u>or</u> Observer 2
5	Ground	5	Ground
6	Ground	6	Ground
7	Ground	7	Ground
8	Ground	8	Ground
9	Ground	9	Ground
10	Alert 1	10	TX- Observer 1
11	Alert 2	11	TX+ Observer 1
12	Alert 3	12	RX- Observer 1
13	Alert 4	13	RX+ Observer 1
14	Alert 5	14	Passenger 5 ICS PTT
15	Passenger 1 Mic Hi <u>or</u> pilot O <sub>2</sub> Mic	15	Passenger 4 ICS PTT
16	Passenger 2 Mic Hi <u>or</u> Copilot O <sub>2</sub> Mic	16	Passenger 3 ICS PTT
17	Passenger 3 Mic <u>or</u> Observer 1 O <sub>2</sub> Mic	17	Passenger 2 ICS PTT
18	Passenger 4 Mic <u>or</u> Observer 2 O <sub>2</sub> Mic	18	Passenger 1 ICS PTT
19	Alert 6	19	TX- Copilot
20	Alert 7	20	TX+ Copilot
21	Alert 8	21	RX- Copilot
22	Alert 9	22	RX+ Copilot
23	Alert Ack and message programming	23	Observer 2 ICS PTT
24	No Connect	24	Observer 1 ICS PTT
25	Pilot Com Swap	25	Copilot ICS PTT
26	Oxygen Mask Enable	26	Pilot ICS PTT

J455 (HUB45A)		P455 (CTL45A)	
Pin	Description	Pin	Description
1	RX-	1	TX-
2	RX+	2	TX+
3	TX-	3	RX-
4	TX+	4	RX+
5	Ground	5	Common
6	No Connect	6	No Connect
7	CTL Power out	7	Aircraft Power
8	Aircraft Ground	8	Aircraft Ground
9	Open	9	Open

See §2.7 for shared functions (OR)

**Table 2-3: PAC45A Pin Assignments**

## 2.9 Wiring Checkout

After wiring is complete, verify power is ONLY on pins 41, 42 & 62 of J451 and airframe ground on pins 20 & 21. Failure to do so will cause serious internal damage and void PS Engineering's warranty.

**CAUTION: Do not connect or disconnect (HOT SWAP) any components with power applied, this will damage the units**

## **2.10 Operational Checkout**

### **2.10.1 Required Test Equipment**

In order to return an aircraft to service after installation of the PAC45A, the installer must have access to headset(s) and be able to establish 2-way communications on appropriate radios.

Equivalent test equipment is acceptable as long as the testing requirements can be met.

Due to the configurable nature of the PAC45A, control head nomenclature may differ than illustrations.

Some PAC45A systems are intended for integration with other manufacturer's EFIS. Contact system integrator for operation details.

### **2.10.2 Audio Controller Test (CTL45A)**

#### **NOTE**

The *IntelliVox*® is designed for ambient noise levels of 80 dB or above. Therefore, some clipping may occur in a quiet cabin, such as without the engine running, in a hangar. This is normal.

1. Apply power to the aircraft and avionics.
2. Verify fail-safe operation by receiving and transmitting on COM 1 from the pilot position, with the audio controller power off /EMG mode (XMT Selector fully CW).
3. Switch on the unit by turning the XMT select knob to the full CCW position (COM 1).
4. Verify that the COM 1 legend in both the XMT and RCV change to green. Verify that the transmit **indicator is not flashing green**. . . If the LED is flashing green, stop testing and troubleshoot the microphone PTT installation. If for any reason the transmit PTTs are stuck, then they will disconnect after 35 seconds.
5. Verify proper transmit and receive operation from the pilot position, noting that the copilot PTT switch allows proper transmission on the selected transceiver. Verify that the Selected XMIT legend flashes green when transmitting.
6. Rotate the XMT knob to the COM 2 transceiver position and verify the indicators change to track the selection, and COM 2 receiver is heard.
7. Repeat for any other installed communications radios (up to 8 total).
8. Verify proper operation of all receiver sources (NAV 1, NAV 2, and AUX 3 through 8) by selecting them by pulling the appropriate knob to the out position. Turn the knob and verify that the audio level changes.
  - NOTE: Navaid selection is as follows:
    - Aux 1, 3, 4, and 5, controlled via AUX 1 knob (NAV 1, Switch Position 9).
    - Aux 2, 6, 7 and 8 controlled via AUX 2 knob (NAV 2, Switch Position 10).
9. With several sources selected, verify that the volume level of the radios in the headset is controlled by the INNER concentric knob.
10. If configured for Oxygen mask mics, activate the remote OXY switch; verify that the microphone audio source is the Oxygen Masks.
11. Verify proper crew Intercom system operation in the **ALL**, **ISO** and **CREW** modes.
12. With the intercom in ISO or CREW mode, activate the CABIN CALL external switch or by pressing the observers "ACK" button on the front of the observer control head. This will be the request from observer stations to speak with the crew intercom stations. Observe that the "CALL" text illuminates on all control heads, the crew ICS button will flash, and a chime is heard in all headsets.

Verify that switching the intercom (ICS button) into ALL mode on either crew control head will cancel the CABIN CALL function or if no action is done then it will cancel in 15 seconds.
13. Verify that the volume level of the intercom is controlled by the inner concentric volume knob.

14. Verify that the audio selector panel system does not adversely affect any other aircraft system by systematically switching the unit on and off, while monitoring the other avionics and electrical equipment on the aircraft.
15. Repeat for the other aircraft crew stations.

### **2.10.3 Bluetooth Checkout**

Verify that the PAC45A will “pair” with a Bluetooth device, and interface with cellular phone and Music source. See § 3.7.2 for more information.

If PAC45A is not connecting, resetting the Bluetooth memory might be required. Hold down HRTF & ICS buttons for 3 seconds until there is a chime in the pilot headset.

#### **2.10.3.1 Bluetooth TEL Checkout**

Pair the PAC45A with a Bluetooth telephone device. Verify that the pilot headset is connected to the cellular telephone system (if installed). The telephone function will allow any person heard by the pilot on the intercom, also heard on the telephone.

To make or receive a phone call, you must pull the TEL knob on the audio controller panel.

### **2.11 Final Inspection**

Verify that the wiring is bundled away from all controls and no part of the installation interferes with aircraft control operation. Move all controls through their full range while examining the installation to see that no mechanical interference exists. Verify that the cables are secured to the aircraft structure in accordance with good practices, with adequate strain relief. Ensure that there are no kinks or sharp bends in the cables and coaxial cables. Verify that the cables are not exposed to any sharp edges or rough surfaces, and that all contact points are protected from abrasion.

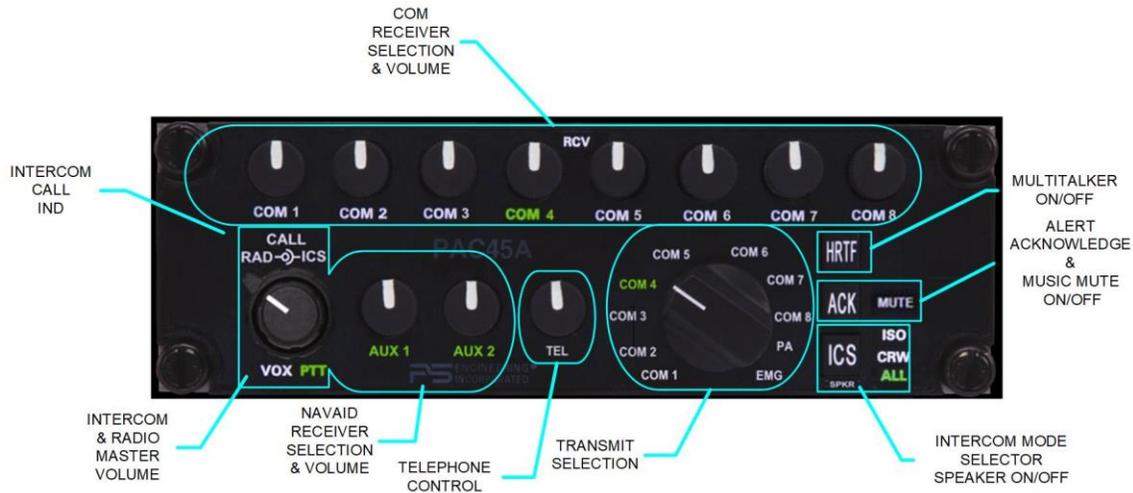
Complete documentation that may be required, such as a logbook entry, weight and balance computation and FAA Form 337. Sample text for FAA Form 337, and instructions for continuing airworthiness can be found in Appendix F. Return completed warranty registration application to PS Engineering, or complete online at [www.ps-engineering.com](http://www.ps-engineering.com).

## Section III OPERATION

### 3.1 SCOPE

This section provides basic operating instructions for the PS Engineering PAC45A, Audio Selector Panel/Intercom Systems. Please read it carefully before using the equipment so that you can take full advantage of its capabilities.

Note: Because of the flexibility to customize the PAC45A systems nomenclature, the appearance and naming conventions may differ from those shown below.



**Figure 3-1 PAC45A Typical Operating Controls**



**Figure 3-2 Typical PAC45A Inverted Controls**

### 3.2 Power and Fail Safe

Unit power is controlled by the transmitter (XMT) rotary selector knob. In the "EMG" or OFF (fully clockwise) position, the pilot headset is connected directly to COM 1 as well as alerts and unswitched input #1. This allows communication capability regardless of unit condition.

The power controls all audio selector panel functions, and intercom.

### 3.2.1 Fail Safe Audio Distribution

Here is the audio present for each station in Fail Safe:

Station	Audio Present in Fail Safe		
Pilot – Left ear (tip)	COM 1	NAV 1 <sup>[1]</sup>	Unswitched 1*
Pilot Right ear (ring)	Alert Audio <sup>[2]</sup>		
Copilot – Left ear (tip)	COM 1 <sup>[1]</sup>	NAV 2 <sup>[1]</sup>	Unswitched 2
Copilot– Right ear (ring)	Alert Audio <sup>[2]</sup>		
Observer– Right ear (ring)	Alert Audio <sup>[3]</sup>		
<sup>[1]</sup> Configured by J8 switch	<sup>[2]</sup> Configured by SW1	<sup>[3]</sup> Configured by SW2	

### 3.3 Communications Transmit (XMT) Selection

The PAC45A has a rotary control knob to select communications transceiver functions. To select a transceiver for transmit; turn the knob to select the desired radio from the eight available.

The radio is automatically selected to receive incoming radio calls when the XMT is selected. With a PAC45A, you will *never* transmit on a radio that you are not receiving. The selected audio is indicated by both knob position and the green text.

Pilot Com Swap (P453 pin 25) switch is available if all eight transceivers are present and configured. If less than eight comms then pilot comm swap is not possible.

### 3.4 COM Audio Selector and Volume Control

The communications receiver audio sources are controlled by a combination pull-on-push-off switch/volume control. Communication audio from another radio, not selected for transmit, can be heard by pulling the associated RCV switch, which will place it in the OUT position. The selected audio is indicated by both knob position and the green nomenclature text.

The Radio Master Control Volume (small inner knob labeled RAD) should always be at MAX volume.

The volume controls for the individual radios are the normal way of changing respective radio volumes. The RAD volume control is to allow an easy way to reduce all radio volumes temporarily to assist in intercommunications (intercom).

The recommended practice for volume controls is:

1. Headset volume controls – all the way up
2. Master radio volume (if applicable) – all the way up
3. Intercom volume – noon
4. Individual comm selection/volume – 1 o'clock (unity gain)
5. Set Radio volumes to comfortable levels, no higher than 80%



If your control head has a **master radio volume**, turn it full clockwise. This master volume is just an attenuator, and not designed to give additional amplification. It should be used for the purpose of turning down all radios at the same time for training or communicating. Once finished, turn the master volume to max (CW) and leave it there.

Then, turn all switched audio knobs to the one o'clock positions and leave them there.



Finally, go to the specific radio/switch audio source (GTN750/KX155A, etc.) and adjust to slightly above comfortable listening level and leave it there. Now you should never have to adjust the source volume again. If you want the radios to be louder simply adjust the knob on the PAC45A control head.



You will always hear the audio from the selected transceiver; even if the selected com audio is turned all the way down on the audio controller because it cannot turn off the selected receive audio all the way.

### 3.4.1 Multi-Talker® Head Related Transfer Function (HRTF)

Communication receiver audio signals are presented to the DSP and processed to “appear” in a different location to the crew. “MultiTalker” (US Patent #7,391,877) specifies up to nine locations. This helps the crew to better comprehend speech by locating it in a manner more easily differentiated by the human brain.

Intercom and other audio are not spatially processed, only the eight communications transceivers.

**NOTE: You must use stereo headsets, in stereo mode for this feature.**

This adjustment allows the eight Spatial Audio inputs to be “relocated” on any of nine (9) pre-defined “Head Related Transfer Function” (HTRF) locations.

MultiTalker® places the communications receiver audio in one of nine apparent locations in the crew’s headset. This has been scientifically shown to allow the brain to focus on multiple conversations and improve comprehension for the listener.



### 3.4.2 HRTF On /Off

Activating the HRTF toggles the PAC45A MultiTalker® spatial function in a stereo headset, (receiver sources distributed) or off (receiver audio sources neutral).



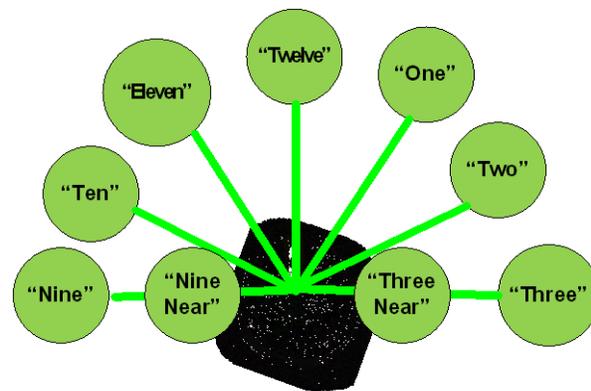
HRTF **REQUIRES** Stereo Headsets. If monaural headsets are used, the received audio will sound “distant” or somewhat distorted.

### 3.4.3 Audio Location

The pilot controller can adjust the locations for the eight receive audio locations. Press and hold the HRTF button for > 1 second on the pilot’s panel until the HRTF button and all COM nomenclature start blinking green.

Rotate the COM receive volume knob, so the pointer indicates the approximate location of the desired location. A voice announcement will accompany the knob rotation with the clock positions. Received audio shall then be presented from that location. Repeat for other communication radios as desired.

Press the HRTF button again to exit the mode. The audio controller will remember the last state through power cycles.



**Figure 3-3 Spatial Audio Locations and Voice Annunciations**

**NOTE: IF** the HUB45A is *configured* for Mono operation (SW 38 -Observers and/or SW39- Crew OFF) the HRTF function will not work, and the HRTF button will not turn green.

### 3.5 Navaid Selection

Navigation receivers are selected in the same manner as the communication receiver, pull on/push off the knob associated with the desired navigational aid, and rotate to adjust the receiver volume.

There are three navaid controls, and up to eight navaid inputs available. Selection is:

- Aux 1, Aux 3, Aux 4, and Aux 5 are controlled via AUX 1 knob (NAV 1).
- Aux 2, , Aux 6, Aux 7, and Aux 8 are controlled via AUX 2 knob (NAV 2).



#### 3.5.1 OXY (P453-26)

Activates the Oxygen Mask microphone inputs if configured.

#### 3.5.2 Receive Mute (J452-44)

When J452-44 is grounded through a remote switch, **all** receive audio is muted. If this switch remains closed for more than 30 seconds (i.e. a stuck switch), the received audio will return to normal

### 3.6 Intercom Operation (8)

#### 3.6.1 IntelliVox® Intercom VOX-Squelch

No adjustment of the *IntelliVox*® squelch control is necessary. Through individual signal processors, the ambient noise appearing in all microphones is constantly being sampled. Non-voice signals are blocked. When someone speaks, only their microphone circuit opens, placing their voice on the intercom.

The system is designed to block continuous tones; therefore, people humming or whistling in monotone may be blocked after a few moments.

For consistent performance, any headset microphone **must** be placed within ¼-inch of your lips, preferably against them. (ref: *RTCA/DO-214, 1.3.1.1 (a)*).

#### NOTE

It is also a good idea to keep the microphone out of a direct wind path. Moving your head through a vent air stream may cause the *IntelliVox*® to open momentarily. This is normal.

The *IntelliVox*® is designed to work with normal aircraft cabin noise levels (70 dB and above). It loves airplane noise! Therefore, it may not recognize speech and clip syllables in a quiet cabin, such as in the hangar, or without the engine running. This is normal.

#### 3.6.1.1 PTT-ICS

Pressing the intercom volume knob (ICS VOL) will place the user assigned to that control head into the Push-to-talk (PTT for Intercom use) mode. This will disable the voice activation (VOX) and require that the external push to talk intercom button for the position used to speak on the intercom.

Push the knob again and the user toggles back to voice activation. The mode is shown by the green indication in the text.



#### 3.6.2 Intercom Volume Control

The outer concentric volume control knob adjusts the loudness of the intercom for the intercom station(s) connected to the audio controller panel. It has no effect on selected radio levels, or music input levels.

#### 3.6.3 Intercom Modes

The “ICS” pushbutton switch on the panel provides the selection of the intercom modes

The intercom mode defaults to “ALL” at power up. Then the button cycles through the intercom modes, from bottom to top, then top to bottom: ALL CRW ISO, CRW. A green indicator shows which mode is currently active.

**ISO:** Each control head has their own ISOLATE selection. The control head is isolated from the intercom stations and is connected only to the aircraft radios that are selected system. They will hear the aircraft radio reception (and sidetone during radio transmissions).

**ALL:** Each control head has their own ALL selection. When in the ALL mode, all parties will hear the aircraft radio, intercom and music. The pilot or copilot control head will decide when the system will be in the ALL mode by pressing their ICS switch. During any radio or intercom communications, the music volume automatically decreases. The music volume increases gradually back to the original level after communications have been completed.

**CREW:** Pilot and copilot are connected on one intercom channel and have exclusive access to the aircraft radios. The pilot or copilot control head will decide when the system will be in the ALL mode by pressing their ICS switch. The observers can communicate with each other and passengers in ALL or Crew mode or select ISO mode.



### 3.6.3.1 Intercom Operation with 4 CTL45A

The PAC45A was designed for the special mission market (forestry, law enforcement, EMS, etc.) with the ability to allow controls heads to remove themselves and pull in other intercom stations during working/high communication special mission operations as needed. This was our goal and design purpose of the intercom states and is very practical to this environment.

Pilot and copilot have priority commands over the Observer 1 & Observer 2 in regard to the intercom states. The intercom system reacts to whomever initially selects the intercom mode, meaning if the OBS 1 or OBS 2 selects ALL to CRW then it will move all control heads to that location. If the pilot selects ALL to CRW, it does the same, but now the OBS 1 and OBS 2 can never select ALL mode again until the pilot or copilot forces the change.

If four control heads are used, the following rules apply:

- System defaults to ALL at power up.
- The pilot, copilot, and Observer 1 can select ISO and be removed from the intercom.
- If the 4<sup>th</sup> control head (Observer #2) selects ISO, that position will be connected to any passengers, but disconnected from the pilot, copilot, and Observer 1.
- Any control head can select CRW, and place all panels in Crew mode, unless the pilot and copilot are in ISO, and they will remain in ISO.
- Either pilot or copilot panel can select ALL and add everybody to the intercom.
- The Observer 1 and Observer 2 panels can leave and return to ALL, unless a pilot or copilot has selected ISO or CREW.

The observer/mission personnel can isolate their audio feed from the crew by pressing the ICS button. When the CTL45A is in ISO mode, the observer/passengers will have intercom among themselves, and be able to use the selected radios.

If the observer personnel would like to CABIN CALL the crew intercom stations. On the observer control head (CTL45A), pressing “ACK” button will activate an ICS call light and a chime in the crew headsets and crew control head.

### 3.6.3.2 PAC45A Intercom State Rules

The following charts show the intercom mode state rules with four CTL45A control heads, for pilot, copilot, OBS1 & OBS2.

At the top of each section, it states these button presses below. For explanation we will use “Pilot ICS States”

1. On initial power up, all control heads in ALL mode.
2. Pilot presses ICS button, all control heads to CRW mode.
3. Pilot presses ICS button, Pilot to ISO, while all other control heads to ALL mode.
4. Pilot pressed ICS button, all control heads to CRW mode

This is consistent on the CTL45A control heads, so the pilot (and any other control head) can select all steps 1 through 4 as above.

**Additional Notes:**

1. Pilot & Copilot can force all control heads to ALL mode, regardless of ICS selections are on the OBS1 & OBS2 control head.
2. When all control heads are in the ALL mode, any control head can force all locations to CRW mode.
3. **All four** control heads can select ISO mode at the same time.
4. If pilot & copilot are in ISO mode, then the OBS 1 & OBS 2 can only select ISO or CRW
5. If pilot & copilot are in CRW mode, then the OBS 1 & OBS 2 can only select ISO or CRW

While the pilot & copilot are in either ISO or CRW mode then the OBS 1 and OBS 2 have the “cabin call” feature, either by pressing external CALL switch or pressing the ACK button on their control head.

### PAC45A INTERCOM STATE RULES

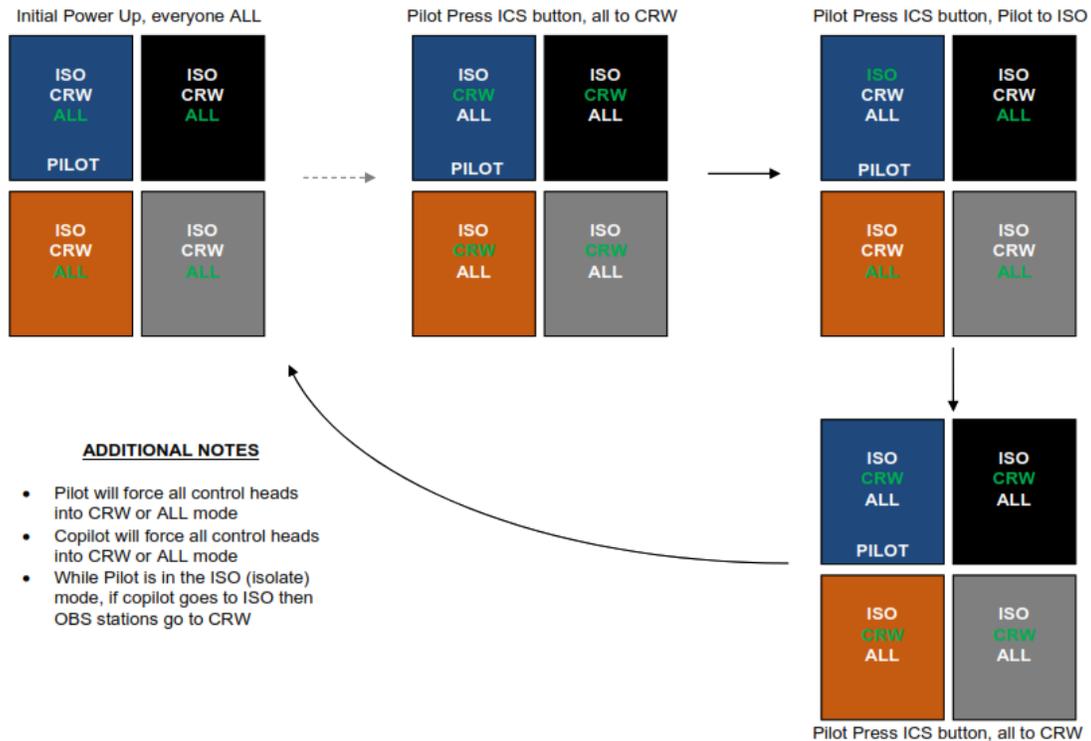
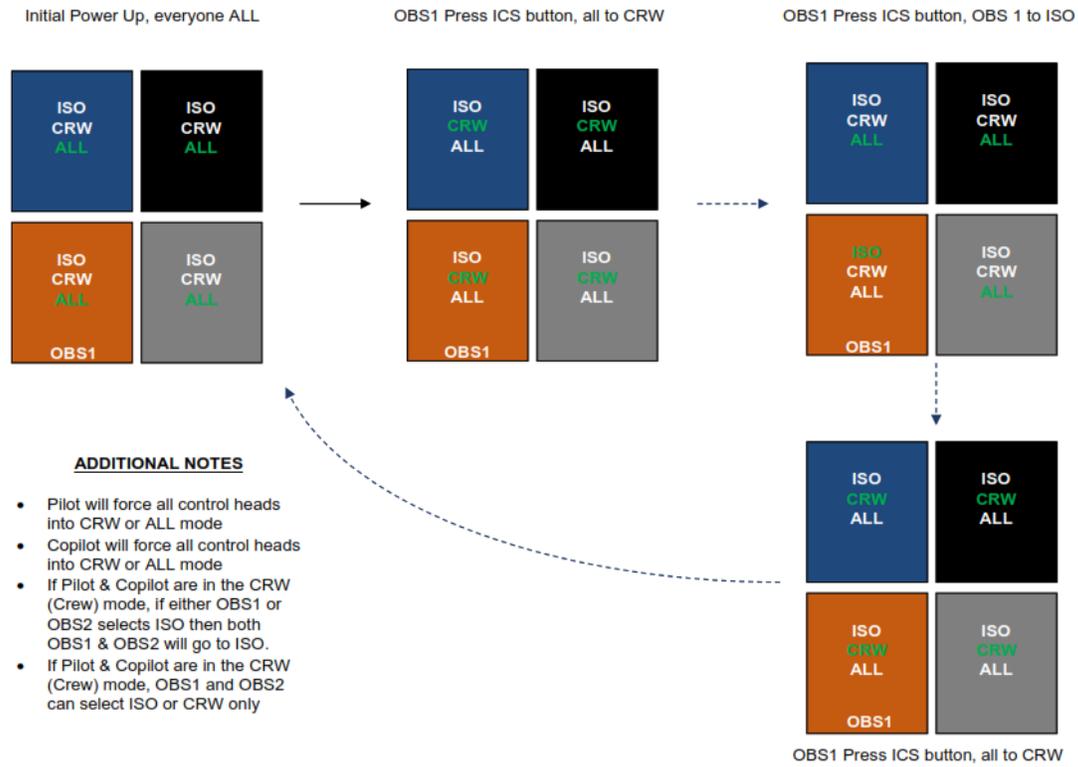
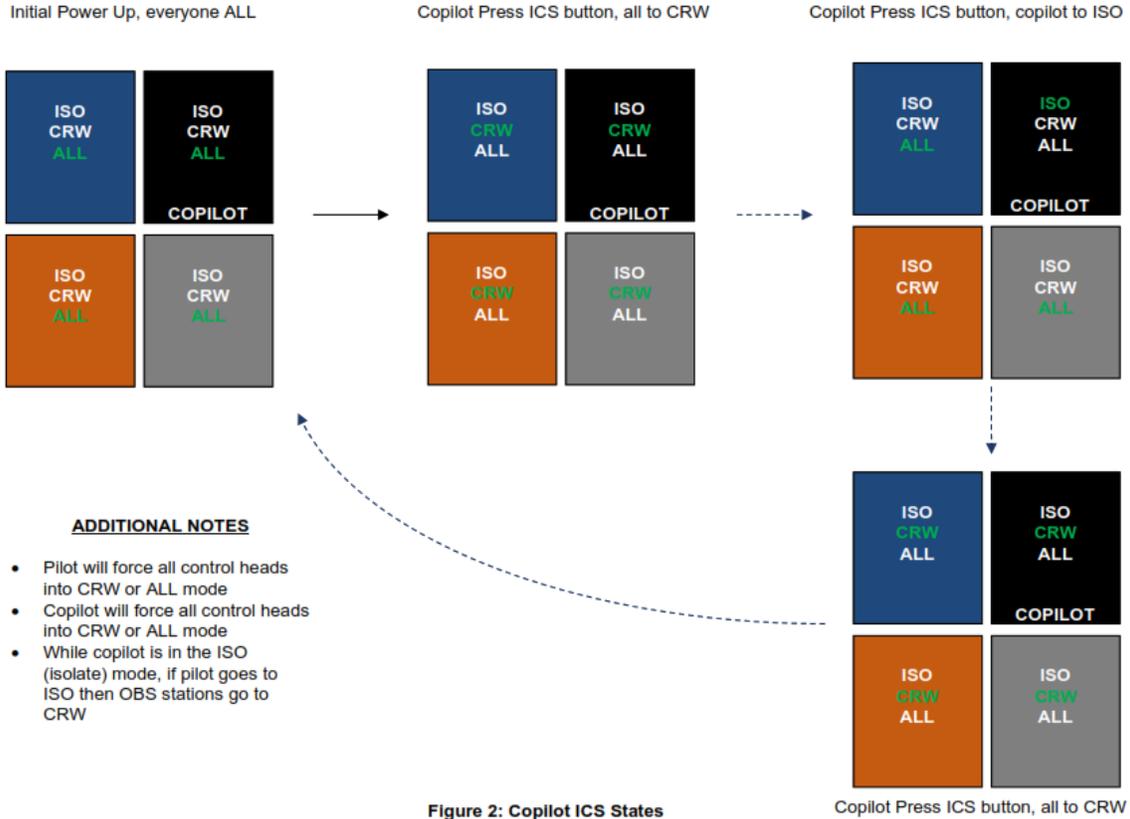


Figure 1: Pilot ICS States

**PS Engineering**  
PAC45A Audio Selector Panel and Intercom System  
Installation and Operator's Manual



**PS Engineering**  
**PAC45A Audio Selector Panel and Intercom System**  
**Installation and Operator's Manual**

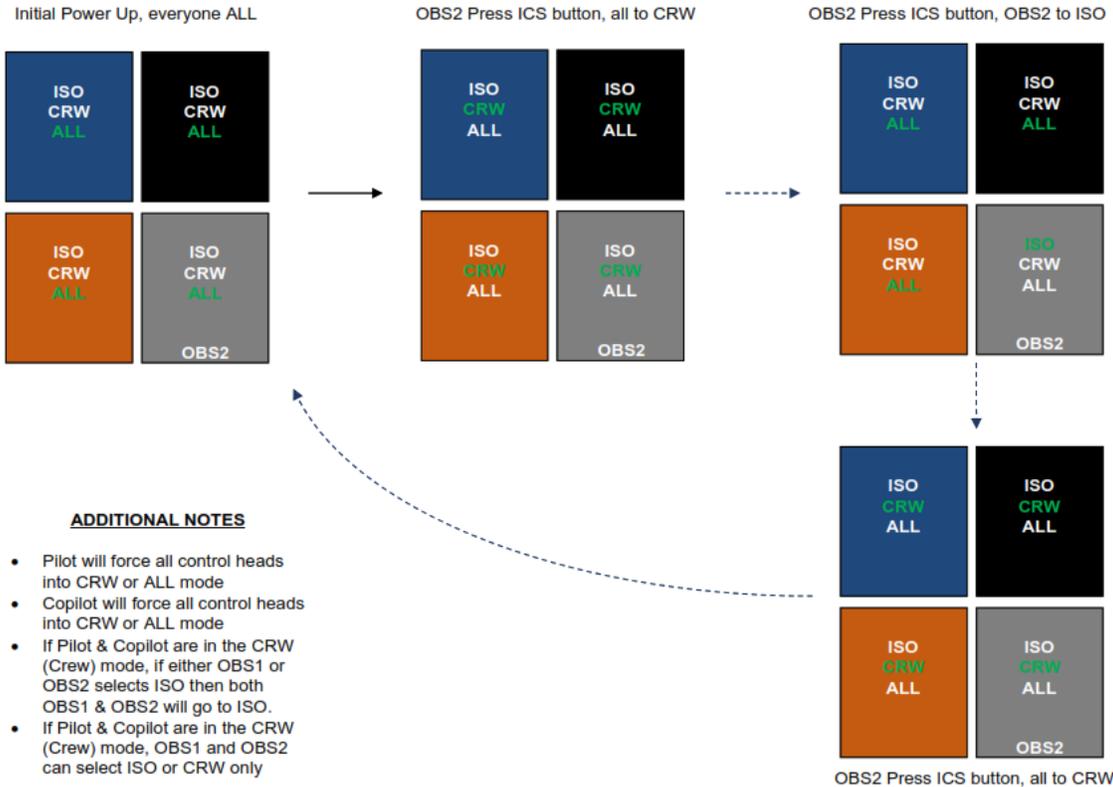


Figure 4: OBS2 ICS States

### 3.7 Speaker operation

To activate the cockpit speaker, press and hold the ICS button for one second. This will place all received audio from that control head (CTL45A) over the cockpit speaker.

### 3.8 Bluetooth® connection

The PAC45A has an internal Bluetooth module (FCC ID: QOQWT32i), no external boxes required, but external antenna will be required. The audio controller is always “discoverable,” so you just need to search for the PAC45 from your Bluetooth-equipped phone or music source. Default access code is not required. Once the PAC45 has been “paired” with your Bluetooth device, the TEL distribution will act as described in § 3.7.2.

Currently, there is no option to change the Bluetooth ID name.

#### 3.8.1 Pairing and unpairing Bluetooth devices

The PAC45A can be paired with up to eight individual devices but will only connect to one at a time. When that number is exceeded, the PAC45A will drop a device to allow the new device to be added.

Once paired, the audio controller should connect automatically.

*Hint, if your devices are not recognized by the PAC45A, you may need to cycle Bluetooth on or off from your device. If that does not help, you may need to reset the Bluetooth module, Press and hold HRTF and ICS buttons for more than three (>3) seconds. Then “forget” the audio controller from your device, and repair.*

### 3.8.2 Bluetooth® Telephone Mode

The PAC45A serves as a full duplex interface for telephone systems such as portable cellular phones with Bluetooth connectivity.

**Warning:**

United States FCC Regulations contained in 47 CFR § 22.925 currently contain prohibition on airborne operation of cellular telephones. "Cellular telephones installed in or carried aboard airplanes, balloons or any other type of aircraft must not be operated while such aircraft are airborne (not touching the ground). When any aircraft leaves the ground, all cellular telephones on board that aircraft must be turned off."

Answering or placing a call is done from the mobile phone. Once connected, the audio is routed through the headset(s) by pulling the TEL knob out. This knob also adjusts the volume of the telephone audio.

For a single CTL45A installation:

In **ALL** intercom mode, all crew and passengers will be heard on the phone when they speak.

In **CREW** mode, the pilot and copilot are connected to the telephone.

In **ISO** intercom mode, when the PAC45A is in the **TEL** mode, the pilot position is in the "Phone Booth." Only the pilot will hear the telephone, and only he will be heard.

For multiple CTL45A installation:

Each users CTL45A controls their access to the telephone audio.

**NOTE**

PS Engineering does not guarantee compatibility with personal cellular telephones.

#### 3.8.2.1 Bluetooth Reset

To reset the Bluetooth module, clearing out the connected devices, press HRTF and ICS for more than three seconds.

#### 3.8.3 Music Muting Control

The PAC45A incorporates PS Engineering's trademark "SoftMute. The SoftMute™ circuit will mute the music whenever there is conversation on the radio or the intercom. When that conversation stops, the music returns to the previous level comfortably, over a second or so.



Holding down the ACK button for three (3) seconds will turn the music muting on/off.

When in mute off mode, the intercom, radio & PTT will not mute the music. The music muting will reset to mute on mode at each power cycle. *Any* control head will switch the muting on or off for *all* users.

### 3.9 Wired Satcom/Cell Phone input

The PAC45A can accommodate wired telephone input as well as a Bluetooth connection. This operates the same as the Bluetooth Telephone ([see §3.7.2](#))

### 3.10 Alert Audio

The PAC45A incorporates an independent alert audio system that can store nine audio messages recorded by the user and played back when triggered by an external source.

Once triggered, the alert audio will continue until the ACK button (front panel or external) on the CTL45A control panel is pushed, or the trigger input returns to normal. During failsafe mode (no HUB or Control Head power), when dedicated Alert power is provided, edge-triggered alerts will play 3 times or until ACK is pushed, whichever occur first.

The PAC45A system can store nine audio alerts, default audio is stored at the factory. These are “Master Caution,” “Alert,” a simple chime, 1000 Hz tone, Doorbell Chime, Ring Tone, “Timer at Zero,” “Intercom Call,” and “ Check Engine Instruments.”

**NOTE:**

**THESE MESSAGES ARE STRICTLY SUPPLEMENTAL AND OPTIONAL AND SHALL NOT REPLACE ANY EXISTING ALERTS IN THE AIRCRAFT.  
IT IS THE INSTALLERS' RESPONSIBILITY TO DETERMINE IF THIS ALTERATION IS MAJOR OR MINOR AND PROVIDE APPROPRIATE DOCUMENTATION (FORM 337, SUPPLEMENTS, ETC.)**

In Failsafe Mode, Alert audio is on the RING (Right channel) of the headsets. If mono headsets are being used, then left ear & right ear wiring must be tied together to hear aural alerts.

### **3.10.1 Storing Alert Audio**

The PAC45A systems can store nine audio alerts. You must record **all nine** when the unit is in audio program mode. You cannot change *only one at a time*. If you wish to replace just one message, we recommend you write down all the messages before starting the procedure.

To record messages from the pilot's headset:

1. Press & Hold “remote acknowledge button” (P453-23 to ground) until a chime is heard in the headset, and then *release* the button.
2. COM1 will blink, to indicate the recording of ALERT #1.
3. Start speaking message.
4. When finished with Alert #1, press the button again.
5. Now COM2 will blink, to indicate the recording of ALERT #2.
6. Speak message.
7. When finished with Alert #2, press the “button”
8. Repeat for messages #3 to #9
9. A chime indicates that recording is now finished.

*NOTE: If the acknowledge button is not pressed to indicate the end of recording, it will record for five seconds, and then advance to next alert. After all time slots are timed out, the PAC45A will exit the alert recording mode.*

## Section IV – Warranty and Service

### 4.1 Warranty

In order for the factory warranty to be valid, the installations in a certified aircraft must be accomplished by an FAA- (or other ICAO agency) certified avionics shop and authorized PS Engineering dealer. If the unit is being installed by a non-certified individual in an experimental aircraft, a factory-made intercom harness must be used for the warranty to be valid.

PS Engineering, Inc. warrants this product to be free from defect in material and workmanship for a period of two (2) years from the date of sale. During the first **twelve (12) months** of the two-year warranty period, PS Engineering, Inc., at its option, will send a replacement unit at our expense if the unit should be determined to be defective after consultation with a factory technician. For the remaining **twelve (12) months** of the two-year warranty period, PS Engineering, Inc., at its option, will send a similar replacement unit at the customers' expense if the unit should be determined to be defective after consultation with an authorized PS Engineering dealer.

All transportation charges for returning the defective units are the responsibility of the purchaser. All domestic transportation charges for returning the exchange or repaired unit to the purchaser will be borne by PS Engineering, Inc. The risk of loss or damage to the product is borne by the party making the shipment, unless the purchaser requests a specific method of shipment. In this case, the purchaser assumes the risk of loss.

This warranty is not transferable. Any implied warranties expire at the expiration date of this warranty. PS Engineering SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. This warranty does not cover a defect that has resulted from improper handling, storage or preservation, or unreasonable use or maintenance as determined by us. This warranty is void if there is any attempt to disassemble this product without factory authorization. This warranty gives you specific legal rights, and you may also have other rights, which may vary from state to state. Some states do not allow the exclusion of limitation of incidental or consequential damages, so the above limitation or exclusions may not apply to you.

All items repaired or replaced under this warranty are warranted for the remainder of the original warranty period. PS Engineering, Inc. reserves the right to make modifications or improvements to the product without obligation to perform like modifications or improvements to previously manufactured products.



Scan here to activate warranty

### 4.2 Factory Service

The units are covered by a two-year limited warranty. See warranty information. Call PS Engineering, Inc. at (865) 988-9800 before you return any unit. This will allow the service technician to provide any other suggestions for identifying the problem and recommend possible solutions.

After discussing the problem with the technician and you obtain a Return Authorization number, ship product to:

PS Engineering, Inc.  
Attn: Service Department  
9800 Martel Rd  
Lenoir City, TN 37772  
(865) 988-9800 FAX (865) 988-6619  
Email: support@ps-engineering.com

**Units that arrive without an RMA number, or telephone number for a responsible contact, will be returned un-repaired. PS Engineering is not responsible for items sent via US Mail.**

## Appendix A – PAC45A Installation Drawings

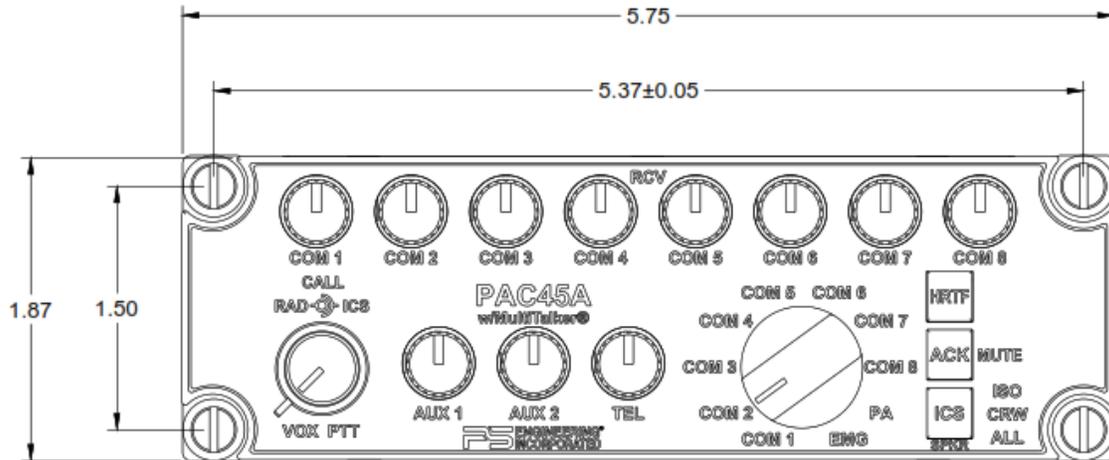


Figure 5-1 - CTL45A Front View

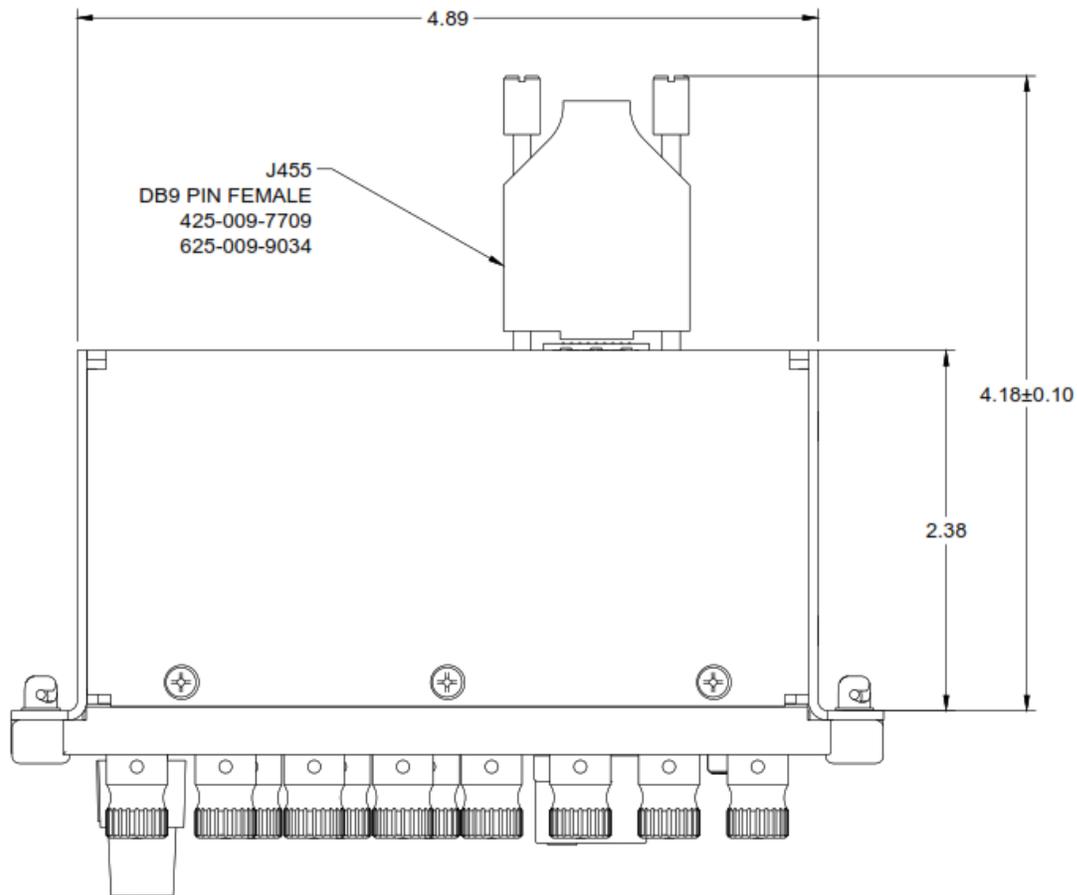


Figure 5-2 CTL45A Top View

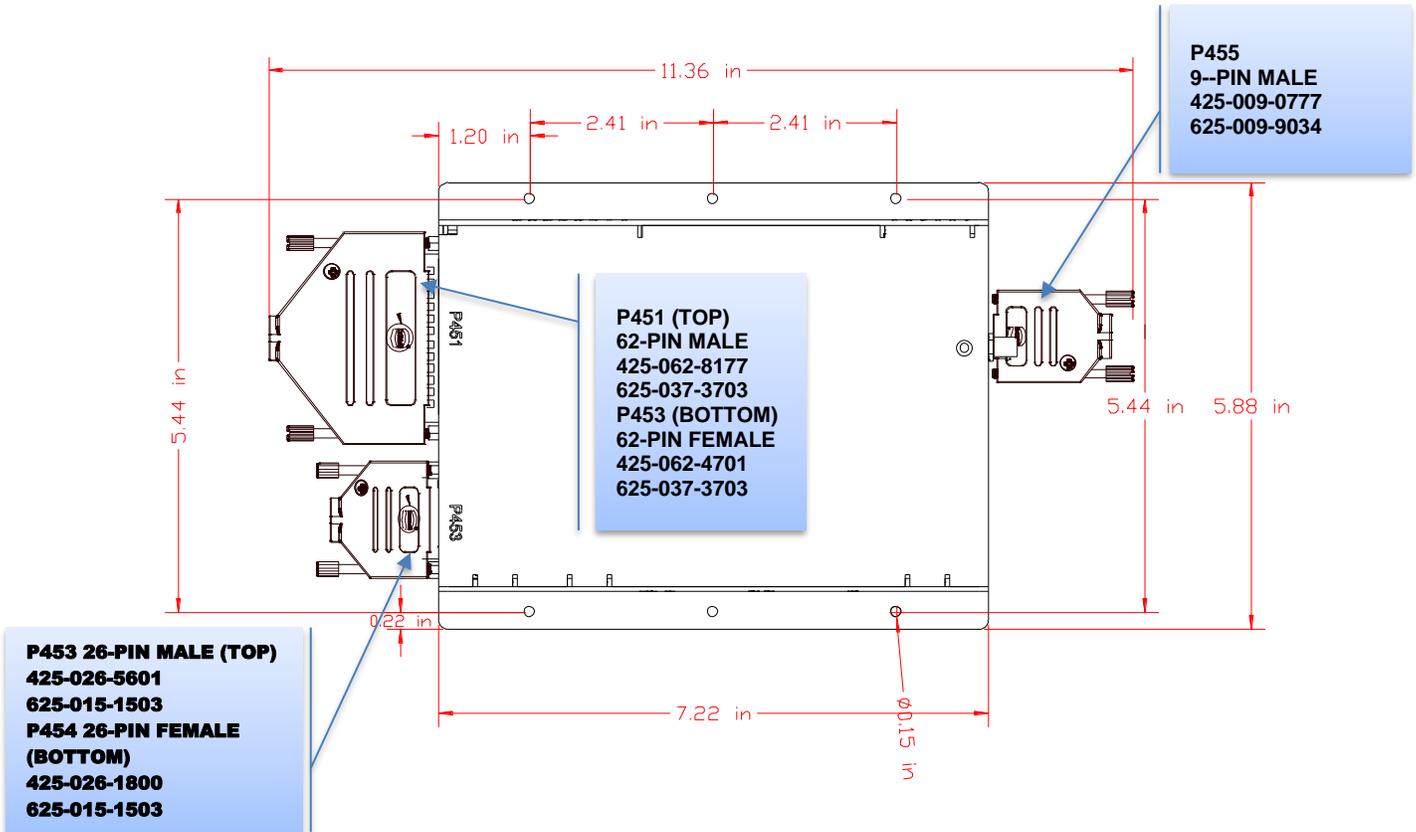


Figure 5-3 - HUB45A Top View

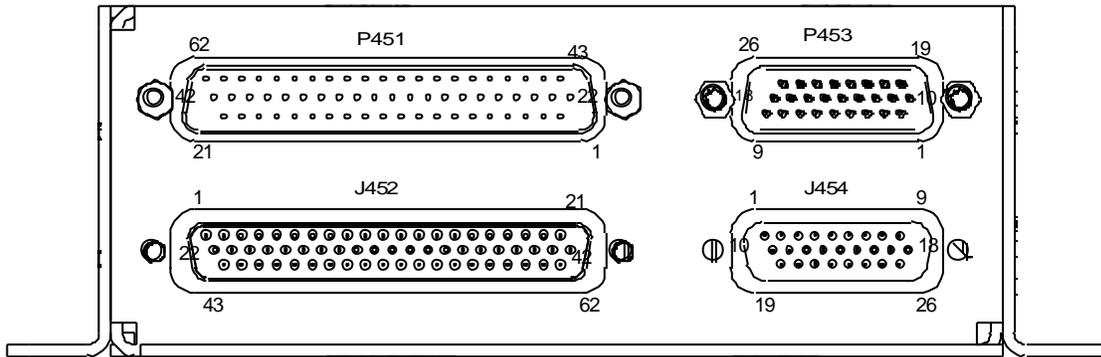
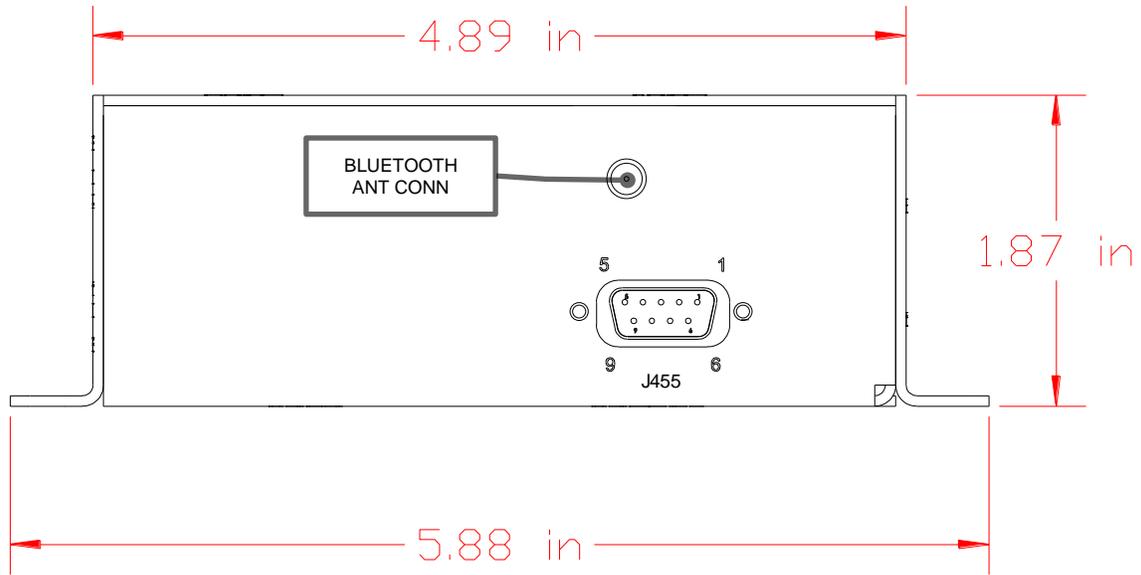
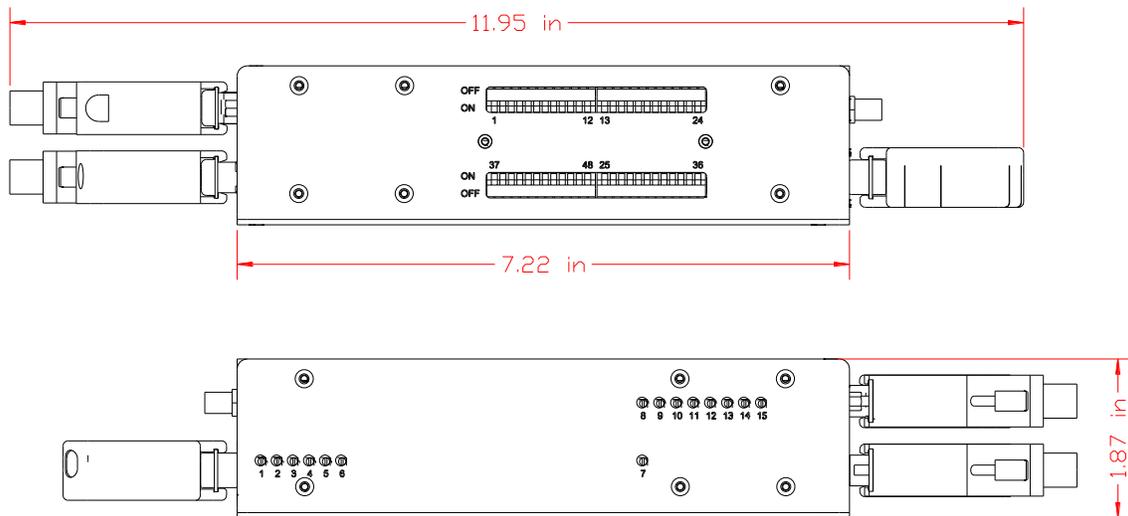


Figure 5-4 - HUB45A Rear Connector View

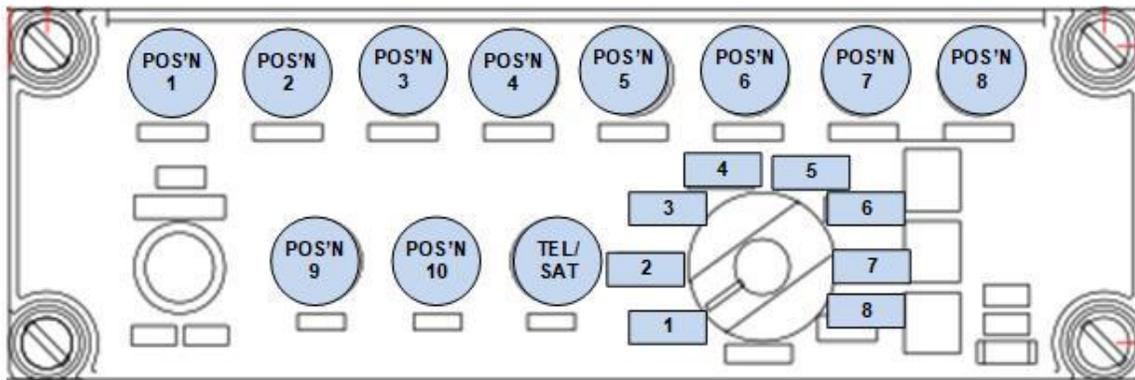
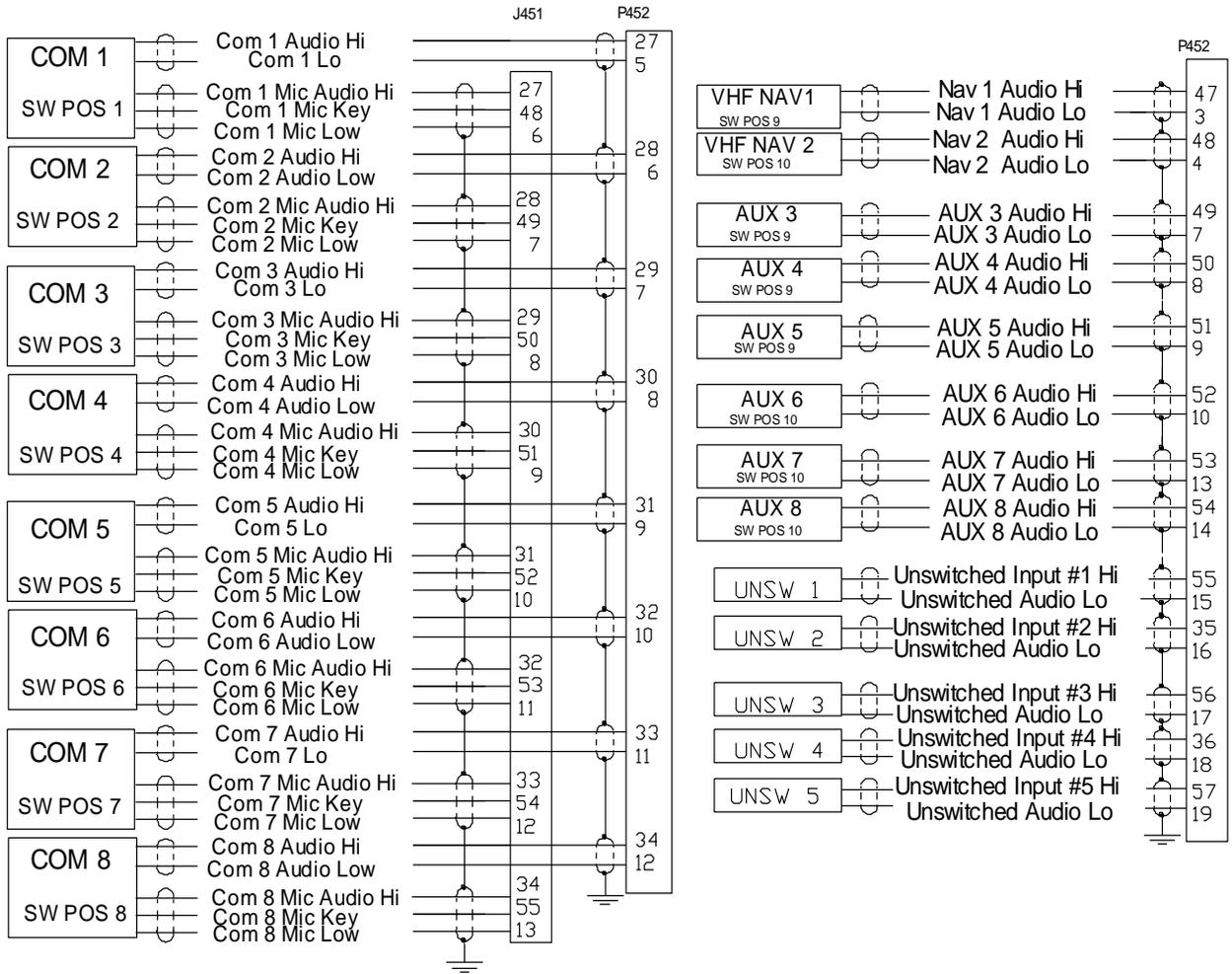


**Figure 5-5 HUB4A5R Front View**



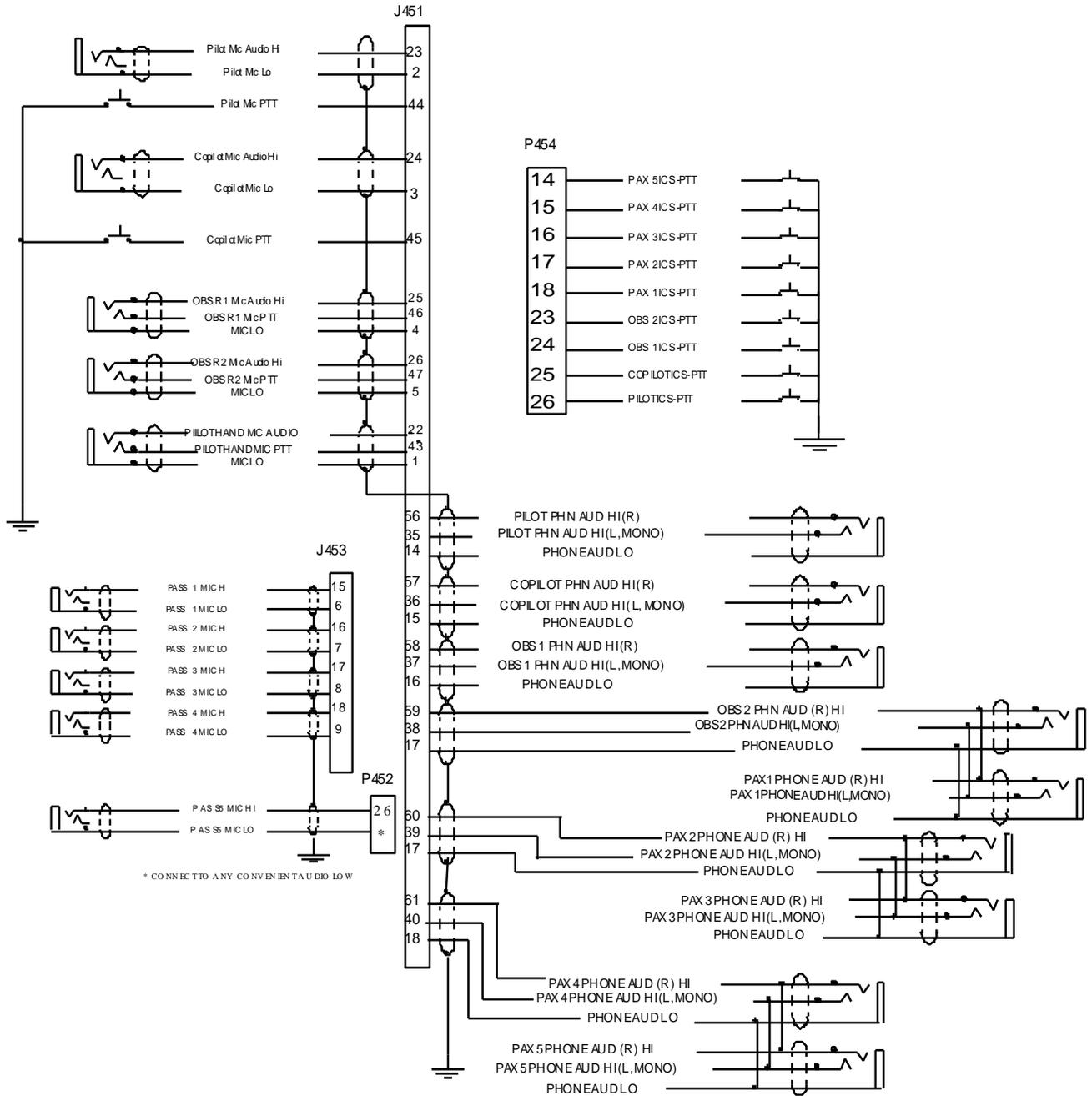
**Figure 5-6 - HUB45A Side Views**

## Appendix B – Radio Interconnect Wiring



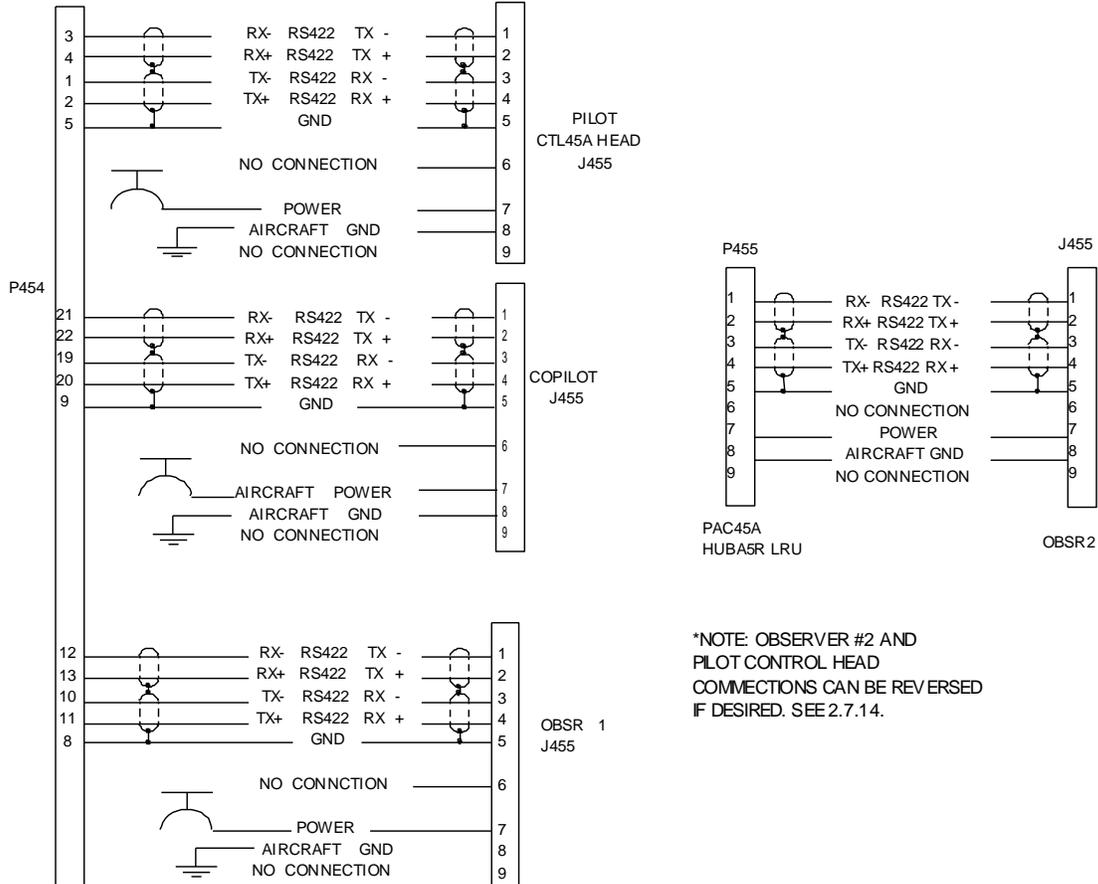
Because of the labeling flexibility on the PAC45A System, the nomenclature on the CTL45 may not match the wiring diagram. Shown here are the switch positions for each of the available inputs.

## Appendix C – Intercom Interconnect Wiring



## Appendix D – Control Head Interconnect Wiring

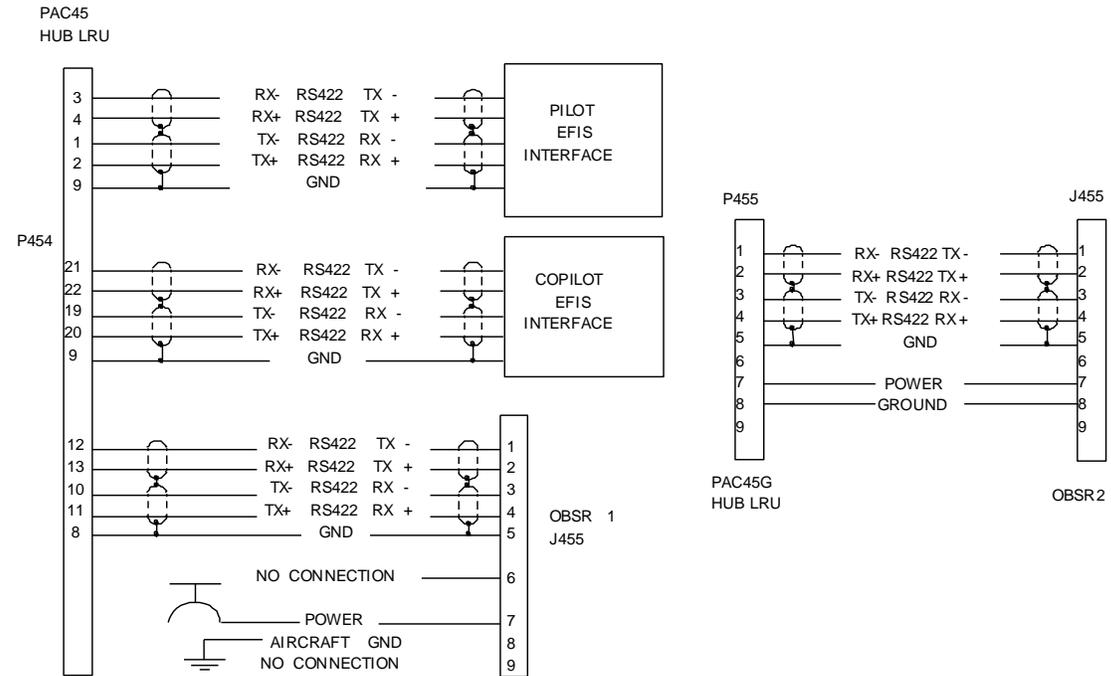
PAC45  
 HUB45R LRU



**\*NOTE: OBSERVER #2 AND  
 PILOT CONTROL HEAD  
 CONNECTIONS CAN BE REVERSED  
 IF DESIRED. SEE 2.7.14.**

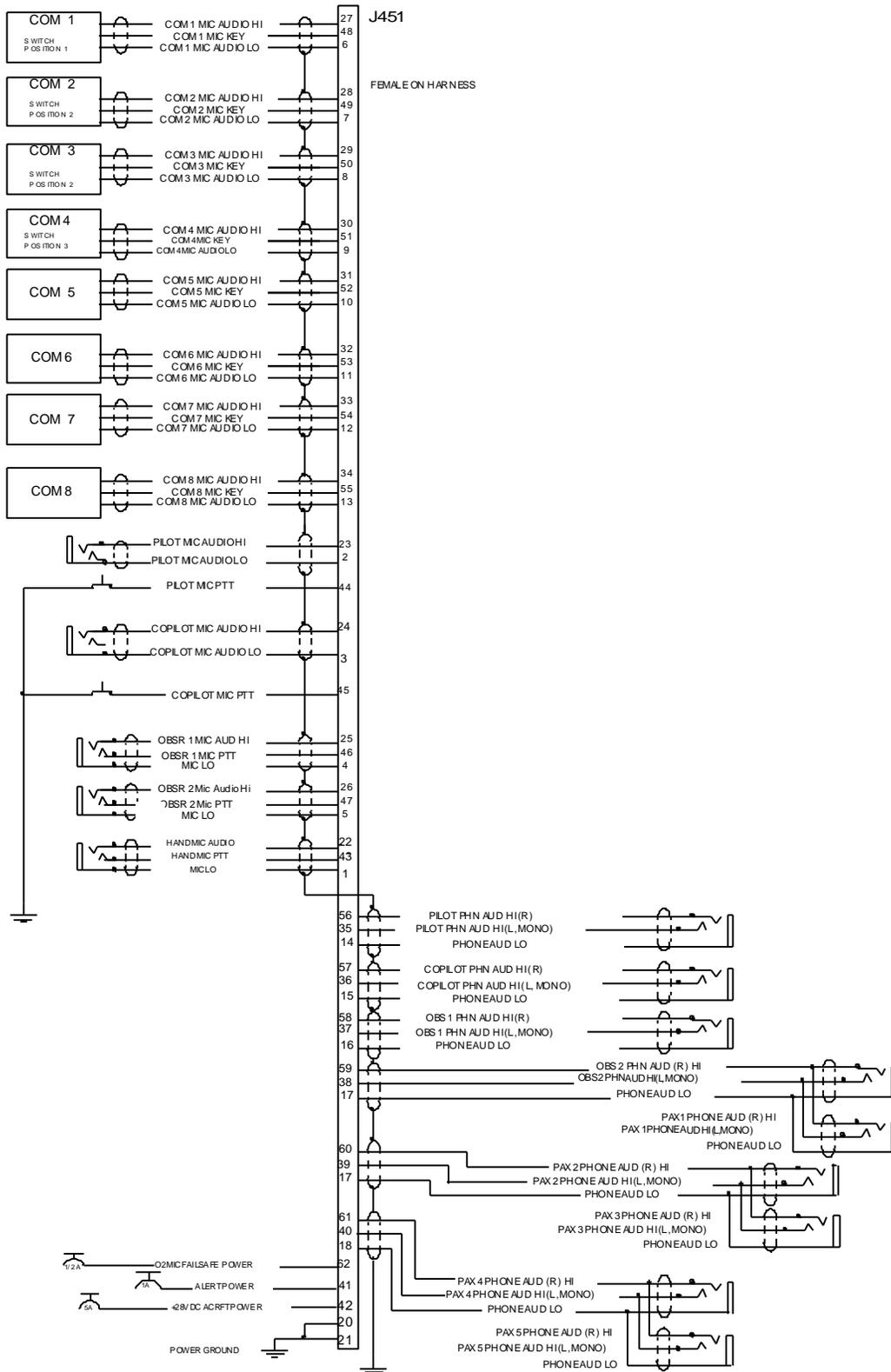
**PS Engineering**  
**PAC45A Audio Selector Panel and Intercom System**  
**Installation and Operator's Manual**

**8.1.1 EFIS Interface**

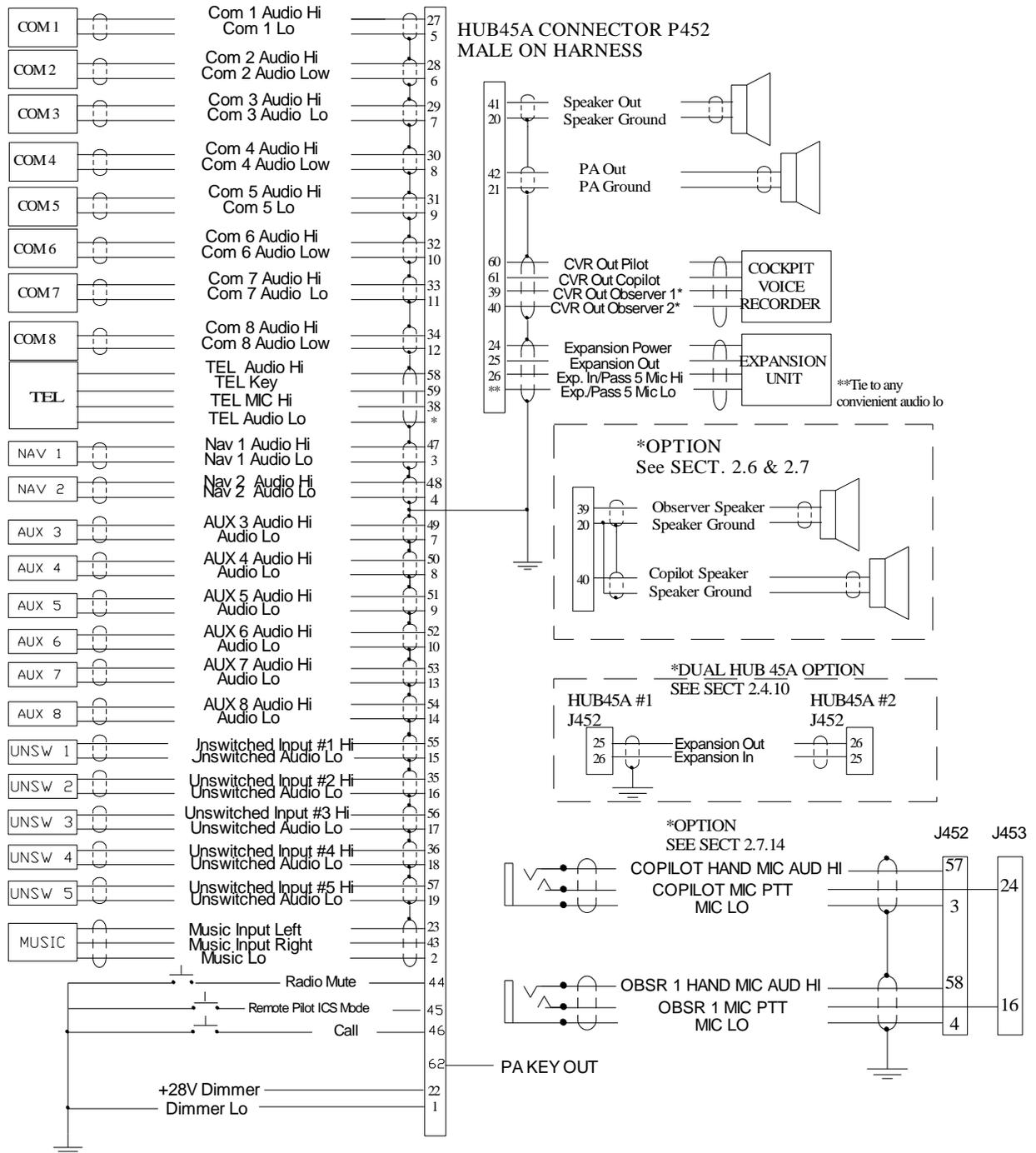


## Appendix E, Unit Connector Wiring Reference

### 9.1 J451 Connections

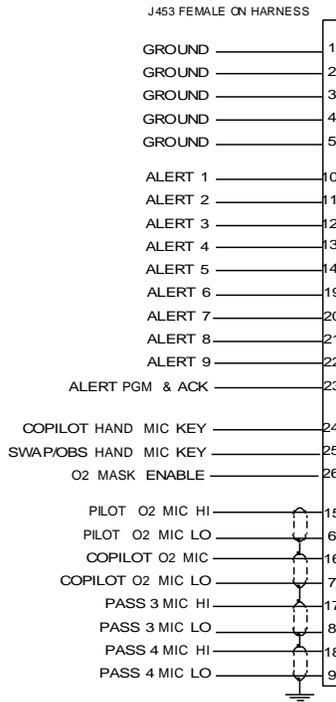


## 9.2 J452 Connections

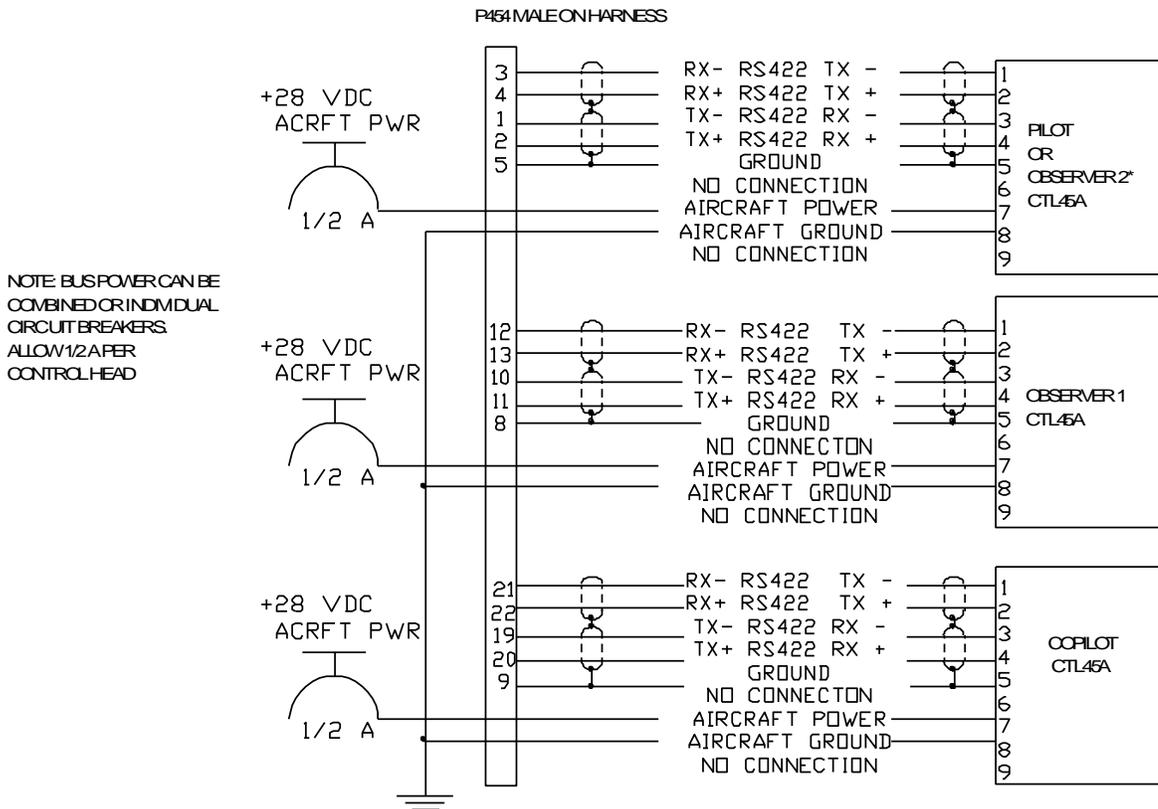


**NOTE:** Pins marked as AUDIO LO are the same audio ground and can be used interchangeably as convenient. There are 21 possible Audio Lo signals and 17 available Audio Lo connections, paralleling is permitted.

### 9.3 J453 Connections



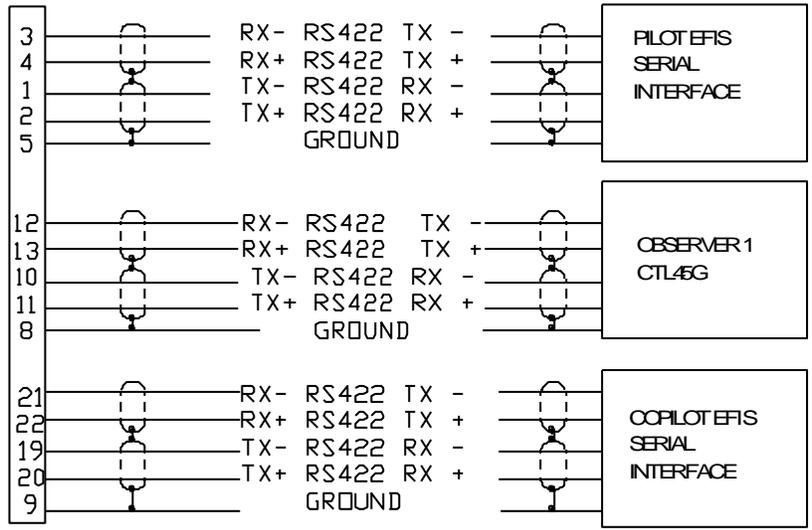
### 9.4 J454 Connections



\* PILOT AND OBSVR #2 CONNECTIONS CAN BE REVERSED. SEE SECT. 2.7.1

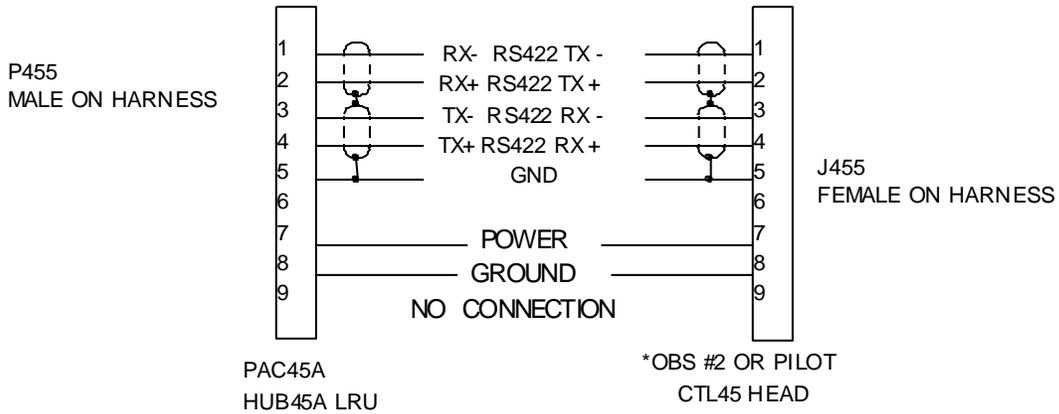
**9.4.1 EFIS Interface**

P454 MALE ON HARNESS



\* PILOT AND OBSVR #2  
CONNECTIONS CAN BE  
REVERSED. SEE SECT. 2.

**9.5 J455 Connections**



\* PILOT AND OBSVR #2  
CONNECTIONS CAN BE REVERSED.  
SEE SECT. 2.7.14.

## Appendix F – Instructions for FAA Form 337 and continuing airworthiness

### 10.1 Instructions for FAA Form 337, Audio controllers

One method of airworthiness approval is through an FAA Form 337, *Major Repair and Alteration (Airframe, Powerplant, Propeller, or Appliance)* In the case of the PAC45A, you may use the following text as a guide.

Installed audio selector and 6-place intercom, PS Engineering PAC45A, part number 050-045-(XXXX) in ( location ) at station   . Installed per *AC43.13-2, Chapter 2, paragraph 23* (Instrument Panel Mounting). Installed per PS Engineering *Installation Operators Manual* p/n 200-045-(XXXX), revision ( ), dated ( ).

These units are FAA-Approved under TSO C139A for audio amplifiers, and meets environmental qualifications outlined in RTCA DO-160G as appropriate or this aircraft.

Interface to existing aircraft radios in accordance with installation manual and in compliance with practices listed in *AC43.13-2, Chapter 2*. All wires are Mil-Spec 22759 or 27500. Connection to aircraft dimmer bus is                     . Power is supplied to the unit through a 3A circuit breaker (type and part number), and total electrical load does not exceed     % of the electrical system capacity with the PAC45A added.

Aircraft equipment list, weights and balance amended. Compass compensation checked. A copy of the operation instructions, contained in PS Engineering document 202-045-(XXXX), revision ( ), dated ( ), is placed in the aircraft records. All work accomplished listed on Work Order                     

### 10.2 Instructions for Continuing Airworthiness, Audio System

Sample ICA Checklist for PS Engineering PAC45A Audio System:

Section	Item	Information
1	Introduction	Installation of audio control panel with intercommunications system, with integrated audio alert system.
2	Description	Installation as described in manufacturer's installation manual referenced on installation documentation (FAA Form 337, etc.), including interface with other avionics audio as required.
3	Controls	See installation and operator's guide referenced on installation documentation.
4	Servicing	None Required
5	Maintenance Instructions	On Condition, no special instructions
6	Troubleshooting	In the event of a unit problem, place the unit into "off," "fail-safe" and/or "emergency" mode. This allows pilot communications using COM 1, and unswitched audio for critical alerts, copilot communications on VHF. Follow checkout instructions in the installation manual referenced on the FAA Form 337. For a specific unit fault, contact the manufacturer at (865) 988-9800 for special instructions.
7	Removal and replacement information	<u>Removal:</u> The CTL45A is attached to the aircraft using ¼-turn Dzus fasteners. To release, insert a slotted screwdriver into the head and turn counterclockwise. Release the wiring connectors by sliding the latches on the retaining standoff. The HUB45A is attached to the aircraft using four #6 screws on the flanges. <u>Installation:</u> Reverse the connector installation process. Place the unit against the Dzus rail and with the slotted screwdriver push gently and turn ¼-turn to secure.
8	Diagrams	Not applicable
9	Special Inspection Requirements	Not Applicable
10	Protective Treatments	Not Applicable
11	Structural Data	Not Applicable
12	Special Tools	None
13	Not Applicable	Not Applicable
14	Recommended Overhaul Periods	None
15	Airworthiness Limitations	Not Applicable
16	Revision	To be determined by installer

## Appendix G – RTCA DO160G Environmental Qualification Form

### 11.1 Model Number PAC45A Audio Selector Panel/Intercom Remote Hub

Part Number: 050-045-()

FAA TSO Number: C139a,

Manufacturer: PS Engineering Incorporated 9800 Martel Road Lenoir City TN 37772

Conditions	Section	Conducted Tests
Temperature and Altitude	4.0	Equipment tested to CAT D2
Low Temperature	4.5.1	-45°C Low Operating
	4.5.2	-55° C Survival,
	4.5.4	-45°C Low Short-Term Operating
High Temperature	4.6.1	+85°C Survival,
	4.6.2	+55°C High Operating
	4.6.3	+70°C High Short Time Operating
In-flight Loss of Cooling		Not Applicable, no cooling required
Altitude		50,000' unpressurized (D2)
Decompression		Not Applicable
Overpressure		Not Applicable
Temperature variation	5.2	Equipment tested to Category B
Humidity	6.0	Equipment tested to Category A
Shock	7.0	Equipment tested to Category B Standard operational shock and crash safety
Vibration	8.0	Equipment tested to Category SM, SB, U2FF1, Helicopter Random
Explosion	9.0	Category X, not tested
Waterproofness	10.0	Category X, not tested
Fluids Susceptibility	11.0	Category X, not tested
Sand and Dust	12.0	Category X, not tested
Fungus	13.0	Category X, not tested
Salt Spray	14.0	Category X, not tested
Magnetic Effect	15.0	Equipment tested to Category Z
Power input	16.0	Equipment tested to Category Z (28V)
Voltage Spike	17.0	Equipment tested to Category A (600V)
Audio Frequency Susceptibility	18.0	Equipment tested to Category Z
Induced Frequency Susceptibility	19.0	Equipment tested to Category ZC
Radio Frequency Susceptibility	20.0	Equipment tested to Category T
Radio Frequency Emission	21.0	Equipment tested to Category B
Lightning Induced Transient Susceptibility	22.0	Equipment tested to Category A3J33
Lightning Direct Effects	23.0	Category X, not tested
Icing	24.0	Category X, not tested
ESD	25.0	Category A

## 11.2 Model Number CTL45A, Audio Selector Control Panel

Part Number: 050-045-(20, -40XX)

FAA TSO Number: C139a

Manufacturer: PS Engineering Incorporated 9800 Martel Road Lenoir City TN 37772

Conditions	Section	Conducted Tests
Temperature and Altitude	4.0	Equipment tested to CAT D1
Low Temperature	4.5.1	-20°C Low Operating
	4.5.2	-55° C Survival,
	4.5.4	-40°C Low Short-Term Operating
High Temperature	4.6.1	+85°C Survival,
	4.6.2	+55°C High Operating
	4.6.3	+70°C High Short Time Operating
In-flight Loss of Cooling		Not Applicable, no cooling required
Altitude		50,000' unpressurized (D2)
Decompression		Not Applicable
Overpressure		Not Applicable
Temperature variation	5.2	Equipment tested to Category B
Humidity	6.0	Equipment tested to Category B (Severe)
Shock	7.0	Equipment tested to Category B Standard operational shock and crash safety
Vibration	8.0	Equipment tested to SM, SB, U2FF1, Helicopter Random
Explosion	9.0	Category X, not tested
Waterproofness	10.0	Category X, not tested
Fluids Susceptibility	11.0	Category X, not tested
Sand and Dust	12.0	Category X, not tested
Fungus	13.0	Category X, not tested
Salt Spray	14.0	Category X, not tested
Magnetic Effect	15.0	Equipment tested to Category Z
Power input	16.0	Equipment tested to Category Z (28V)
Voltage Spike	17.0	Equipment tested to Category A (600V)
Audio Frequency Susceptibility	18.0	Equipment tested to Category Z
Induced Frequency Susceptibility	19.0	Equipment tested to Category ZC
Radio Frequency Susceptibility	20.0	Equipment tested to Category T
Radio Frequency Emission	21.0	Equipment tested to Category B
Lightning Induced Transient Susceptibility	22.0	Equipment tested to Category A3J33
Lightning Direct Effects	23.0	Category X, not tested
Icing	24.0	Category X, not tested
ESD	25.0	Category A