PAC45D

Special Mission Audio Controller System with MultiTalker® and IntelliVOX®

Document P/N 200-045-0100

Rev. 11, December 2023

Audio Control System with MultiTalker® Technology
High-fidelity Stereo 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 Authorized PS Engineering dealer.

Table of Contents

Rev	Date	Change
New	January 2020	Release of PAC45D/CTL45D
1	April 2020	Update for production
2	April 2020	Include default Aural Alert audio
3	April 2020	Added description of CTL45M Operation §3.9
4	June 2020	Added HRTF/Sidetone notes, position information to wiring diagram, changed conn. hoods to metal.
5	December 2020	Added MOD 7 to Factory Options §2.4.12
6	October 2021	Improve backward compatibility
7	February 2022	Clarify steps for backlight adjustment, §2.5.2.1
8	April 2022	Add additional configuration switches, correct Pin Assignment table
9	October 2022	Update dimmer adjustments to improve NVG Day/Night performance §2.5.2 (S/N BHD054 and above)
10	February 2023	Added dual audio system configuration (MOD #10)
11	December 2023	Added LRU P/N with External Bluetooth antenna

Section I – GENERAL INFORMATION

1.1 INTRODUCTION

The PAC45D represents an evolutionary 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. Our patented *IntelliVOX®* design, programmable MultiTalker® and alert configurations, marks this panel as the next level of audio control. The unit is designed for outstanding ergonomics and visually defined mode annunciation and selection.

Before installing and/or using this product, please read this manual completely. This will ensure that you will take full advantage of all the advanced features in the PAC45D.

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 detailed installation and operation instructions for the PS Engineering PAC45D-series of Audio Selector Panel/Intercom Systems. This includes the following units:

Model number	Description	PS Engineering Part Number	NVIS Compatible Part Number
PAC45D	Panel-mounted Audio Control System with dual CVR outputs, includes integrated control head and Audio Hub, with standard bezel label, includes install kit 250-045-0100, qty. 2, 26 pin connectors.	050-045-0005	050-045-6005
PAC45D	Panel-mounted Audio Control System with single CVR and speaker out, includes integrated control head and Audio Hub, with standard bezel label, includes install kit 250-045-0100, qty. 2, 26 pin connectors.	050-045-0006	050-045-6006
HUB45D	Remote-mounted Audio Hub for analog I/O and processing with dual CVR	050-045-0101	N/A
HUB45D	Remote-mounted Audio Hub for analog I/O and processing with single CVR and speaker out	050-045-0103	N/A
HUB45D	Remote-mounted Audio Hub for analog I/O and processing with dual CVR & external Bluetooth antenna	050-045-0106	N/A

Model number	Description	PS Engineering Part Number	NVIS Compatible Part Number
HUB45D	Remote-mounted Audio Hub for analog I/O and processing with single CVR and speaker out	050-045-0106	N/A
CTL45D	Dual control head with individual transmit switches for pilot and copilot.	050-345-XXXX	050-346-XXXX
CTL45M	Panel-mounted Control Head for Mission Personnel	050-045-50XX*	050-045-80XX*

Item	Description	Part Number
PAC45D Optional Install Kit	For installs that are not replacing "third party" audio controllers, includes 50 & 37 pin connectors/hardware.	250-945-0500
Label45	Customizable bezel label program	575-345-XXXX
*The exact CTL45 part number depends upon the nomenclature applied to the bezel label. Consult PS Engineering for specific LRU part number.		

1.3   EQUIPMENT DESCRIPTION

The PAC45D is a state-of-the-art audio isolation amplifier and audio selector that contains an automatic voice activated (VOX) intercom system. It can switch five transceivers (Com 1 - 5) and six receivers (Nav 1, Nav 2, MKR, and two additional inputs that can be individually labeled, for use with ADF, DME, AUX, etc.).

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

A wired input is available for Satellite or Cellular telephone.

In addition, three alerts can be triggered by external sources to provide additional capability. The individual volume controls select the receiver audio source provided to the headphones when selected.

An eight-station voice activated (VOX) intercom is included in the PAC45D. 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 PAC45D, a Bluetooth® wireless interface is available for wireless telephone and music connection.

Figure 1-1 CTL45D

1.4   APPROVAL BASIS FAA TSO

FAA TSO The PAC45D-series Audio Selector Panels is FAA authorized under TSO C139A (Audio Amplifiers). ED-14C/DO-160G (*Environmental Conditions and Test Procedures for Airborne Equipment*), ED12B/DO-178C, Level D (*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		
Audio Selector/Intercom:	FAA TSO-C139A	
APPLICABLE DOCUMENTS:	RTCA/DO-214A RTCA/DO-160G RTCA/DO-178C	
ENVIRONMENTAL Qualifications:	A1D1BABSXXXXXXZBABZATTMA3J33XXA	
Temperature Range:	HUB45	CTL45
Operating:	-45° C to +55°C	-20°C to +55°C
Short Term Operating:	-45° C to +71°C	-40° C to +70°C
Survival:	-55° C to +85°C	-55° C to +85°C
Altitude:	Up to 55,000 feet in a non-pressurized area of the cockpit.	
DIMENSIONS:	Height: 1.9 in. (4.8 cm) Width: 5.75 in. (14.6 cm) Depth behind panel (PAC45D): 7.38 in. (18.75 cm) including connectors	
UNIT WEIGHT PAC45D HUB45D CTL45D	2.0 lb. (0.90 kg) 1.0. (.45 kg) 1.0. (.45 kg)	
POWER REQUIREMENTS:		
Voltage:	18 to 33 VDC	
Maximum Current: *Typical* *Alert Power* *Lighting*	0.5 Amp (Externally protected by a 1 Amp circuit breaker.) PAC45D (Hub + CTL mated): 500mA HUB45D only 350 mA 10 mA CTL45D only: 150 mA < 5mA	

Audio Selector Specifications	
Audio selector panel input impedance:	510 Ω
Input Isolation:	-60 dB (min.)
Switched Receiver Inputs:	11 (COM 1– COM 5, TEL, NAV 1, NAV 2, Marker, ADF, DME)(Can be relabled as desired)
Unswitched Inputs:	4
Transmitter Selections:	6 (COM 1, COM 2, COM 3, COM 4, COM 5, plus Telephone) (Can be relabled as desired)
Headphone Impedance:	150 – 1000 Ω
Headphone Output:	200 mW into 150Ω each side (left and right) headset, no clipping <.5% THD typical
Speaker Output (-0006 & -0103 only)	3 V$_{rms}$ Maximum
Microphone Impedance:	150 - 600 Ω
PA Output	1 Vrms into 500Ω
Bluetooth Radio	Class 3, FCC ID QOQWT32i
Intercom Specifications	
Intercom Positions:	Up to 8 places (with individual *Intelli*VOX® circuits)
Music Inputs:	1 (Stereo) plus Bluetooth
Music Muting:	>-30 dB "Soft Mute" when Com or intercom active.
Distortion:	<1% THD @ 200 mW into 150Ω
Mic Freq. Response, 3 dB:	300 Hz - 6000 Hz
Stereo Music Freq. Response, 3 dB:	20 Hz – 16 kHz

1.6   EQUIPMENT SUPPLIED

The following units comprise the PAC45D System:

Model	Description	Standard Part Number	NVIS Compatible Part Number
PAC45D	Single Panel-mounted System (HUB45 and CTL45D)	050-045-000X	050-045-600X
Or			
HUB45D	Remote-mounted Audio Hub for analog I/O and processing	050-045-010X	N/A
CTL45D	Panel-mounted Control Head for Pilot and Copilot	050-345-XXXX*	050-346-XXXX*
CTL45M	Panel-mounted Control Head for Mission Personnel	050-045-5000*	050-045-8000*

. *The part numbers shown are for "Standard" bezel label nomenclature. Custom bezel nomenclature is available, using the custom configuration program at:http://www.ps-engineering.com/PAC45D_custom_legend.shtml

PAC45 Standard Installation Kit 250-945-0750 (37 & 50 Pin)

Description	PSE Part Number	Qty.	Manufacturer	MFR Part Number
50 pin connector hood	625-050-0967	1	Amphenol	17E-1728-1
37 pin connector hood	625-0037-3703	1	Amphenol	17E-1727-1
Standard Density Female Sockets	425-020-5090	50	Deutsch	M39029/63-368
50 Pin Female Conn, Housing	425-050-0967	1	Harting	09670504701
37 Pin Female Kit Connector w/Pins	425-037-1757	1	TE Connectivity	1757820-9

PAC45D System Retrofit Installation Kit: 250-945-0200 (Included with PAC45D)

Description	PS E Part Number	Quantity	Manufacturer	MFR Part Number
DB26 Female Connector HD	425-026-1800	2	NorComp	180-026-273L000
Socket contact 22-28 AWG	425-030-7354	52	Amphenol	M39029/57-354
D-sub Slider Lock Post	475-045-6514	4	Tyco Electronics	5206514-6
15/26 pin connector hood	625-015-1503	2	Harting	09670150343

PAC45D System *Optional* Installation Kit: 250-945-0750

Description	PS E Part Number	Quantity	Manufacturer	MFR Part Number
50 Pin Connector hood	625-050-0967	1	Harting	09670500343
37 Pin Conn hood	625-037-3703	1	Harting	09670370343
D-sub 50 Pin Housing Female	425-050-0967	1		
D-sub 37 Pin w/ Female Pins	425-037-1757	1		
Socket contact 22-28 AWG	425-020-5090	50		
D-sub Slider Lock Post	475-045-6514	2	Tyco Electronics	5206514-6

Remote HUB45D System Retrofit Installation Kit: 250-945-0200 (Included with HUB45D)

Description	PS E Part Number	Quantity	Manufacturer	MFR Part Number
9-Pin Male D-Sub Housing	425-009-0777	1	Amphenol	L777-RR-E-09-P
D-Sub male pins	425-020-5089	9	Deutsch	M39029/64-369
9-Pin D-Sub Female Housing	425-009-7709	1	Amphenol	L777-RR-E-09-S
D-Sub Female sockets	425-020-5090	9	Deutsch	M39029/64-368
Connector Hood DB9	625-009-9034	1	Harting	09670090348
DB26 Female Connector HD	425-026-1800	2	NorComp	180-026-273L000
Socket contact 22-28 AWG	425-030-7354	52	Amphenol	M39029/57-354
D-sub Slider Lock Post	475-045-6514	4	Tyco Electronics	5206514-6
15/26 pin connector hood	625-015-1503	2	Harting	09670150343

CTL45D Installation Kit 250-043-0200 (Included with CTL45D)

Description	PS E Part Number	Qty.	Manufacturer	MFR Part Number
Connector Metal Hood DB9	625-009-9034	1	Harting	09670090348
Connector Female Shell DB9	425-009-7709	1	Amphenol	L777-RR-E-09-S
Standard Density Female Pins	425-020-5090	9	Deutsch	M39029/64-368

Supplied with HUB45D

Description	PS E Part Number	Qty	Manufactuer	MFR Part Number
SMA Plug RG-174/U 36- BT Antenna Cable	300-045-1351	1	Amphenol	135110-02-36.00
Antenna Bluetooth 2.4GHz Right Angle	510-045-9602	1	Taoglas	GW.26.0112.HT

EQUIPMENT REQUIRED BUT NOT SUPPLIED
a. Circuit Breakers: 1 ea.; 1 amp PULL TYPE REQUIRED for PAC45D,0.5 A for CTL45s
b. Optional Circuit Breaker: 0.5 ea.; 1 amp PULL TYPE REQUIRED for PAC45D aural alerts
c. Headphone Jacks (**Stereo**, as Required)
d. Microphone Jacks (as Required)
e. Headphones, 150 Ω (**Stereo**), as required
f. Microphones, as required
g. Interconnect Wiring

1.8   Configurations

The PAC45D System is comprised of three "building blocks" to facilitate flexibility as well as simplicity.

The simplest, single audio controller system is a PAC45D where the audio hub is attached to the control head.
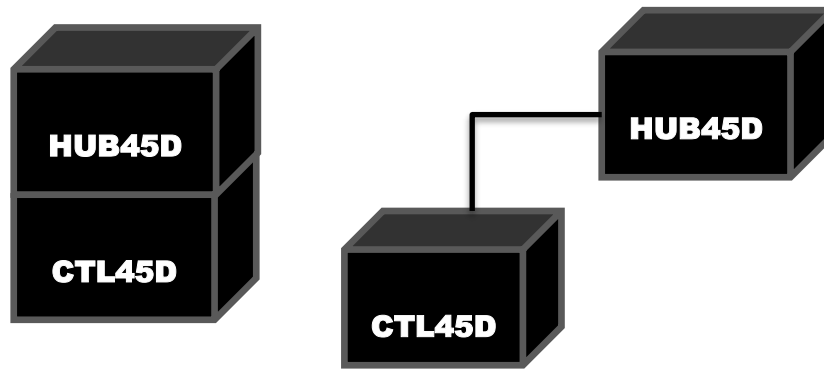
or

Figure 1-2 Single panel configuration
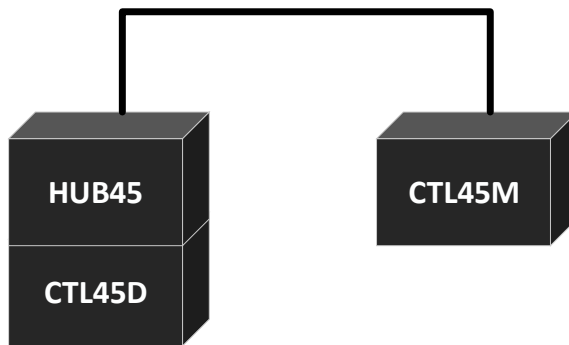
or
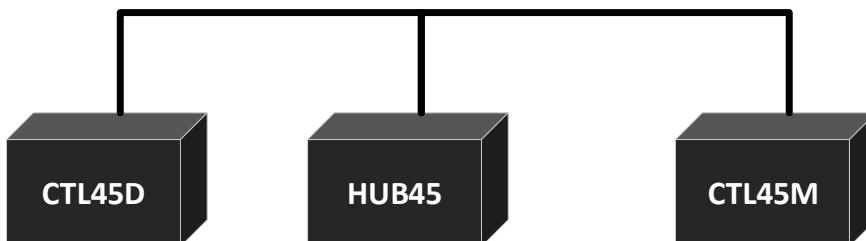
Figure 1-3 PAC45D with a Mission Observer Control Head

1.9   LICENSE REQUIREMENTS

None

PAC45D Bluetooth™ Radio approval:

- FCC ID: QOQWT32I
- Industry Canada ID: 5123A-BGTWT32I
- CE EMC Directive 89/336/EEC as amended by Directives 92/31/EEC and 93/68/EEC

NOTE

Unauthorized use of unapproved cellular telephone devices in aircraft is subject to FCC enforce-ment action, which may include a $10,000 fine per incident.

FCC Regulation 47 CFR § 22.925 *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 air-craft leaves the ground, all cellular telephones on board that aircraft must be turned off.

PS Engineering, Inc. does not endorse using unapproved cellular telephone equipment in flight, and takes no responsibility for the user's action.

PS Engineering does not guarantee compatibility with personal cellular telephones.

Section II - INSTALLATION

2.1 GENERAL INFORMATION

2.1.1 SCOPE

This section provides detailed installation and interconnection instructions for the PS Engineering PAC45D 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 PAC45D 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 PAC45D 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 PAC45D must be rigidly mounted to the instrument panel of the aircraft structure, within view and reach of the pilot position(s). The PAC45D/CTL45D is designed for Dzus-rail mounting. 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 the unit 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 LRU connectors mate with one 50-pin, one 37-pin, and two 26-pin connectors in the PAC45D. The connectors are a sub-miniature crimp-type, and require the use a hand crimp tool, from table below (or equiv.).
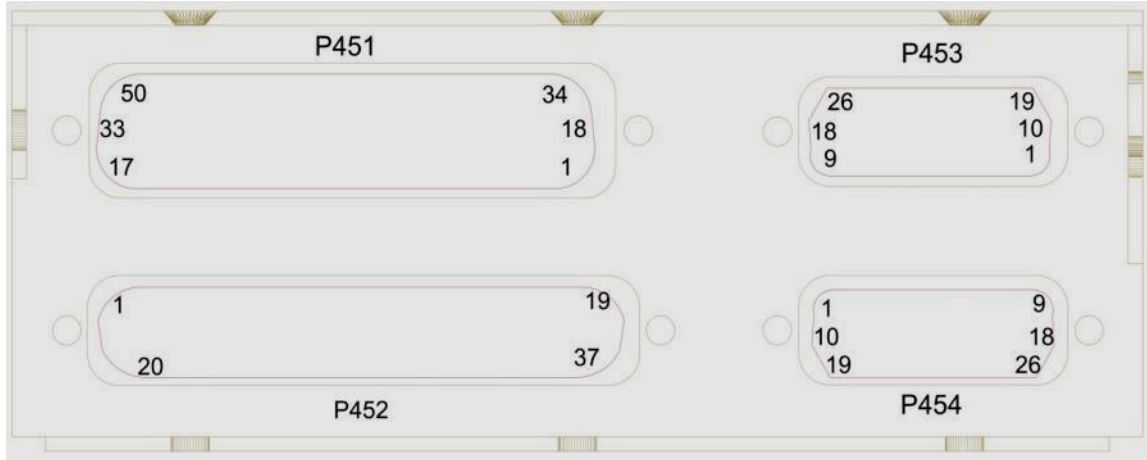
Figure 2-1 - PAC45D Connector Layout

NOTE: The 50-pin and 37-pin connectors are pin-compatible with most NAT AMS-series and Jupiter JA95-series audio controllers. Refer to the connector pin maps to confirm compatibility.
The two 26-pin connectors are used to give the PAC45D systems added capability.
The PAC45D LRU Hub can be remote mounted, and connections to control head(s) CTL45.
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

2.3.4 Thumbscrew and Slide Lock (AMS compliant) connector assembly

Existing installation may utilize slide-locking mechanisms on their connectors. PS Engineering has included slide lock posts with the 26-pin connector kits for your convenience.
You can remove the 5mm hex standoffs from the 37 and 50-pin connectors and replace with the 5mm post to keep the existing connectors. Picture below shows slide lock post installed.

PS Engineering recommends that Loctite #425 be added to any thumbscrew that is removed and reinstalled. Loctite #425 is added to the thumbscrew threads at the factory.

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 be used at all times. 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 PAC45D 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 PAC45D 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 very important that you use

insulated washers to isolate the ground return path from the airframe to **all** headphone and microphone jacks.

2.4.1.1   Music Input and Noise
PAC45D units utilize a differential ground input to help prevent noise from entering the audio system. This feature is usually transparent to the installer; however, it is important that the appropriate music signal and ground connections are made directly to the dedicated music signal and ground inputs on the PAC45D. The power for IFE and audio controller should be a common bus.

NOISE NOTE

Adding a high-performance audio control system, particularly in conjunction with high-performance active noise canceling headsets, cannot improve on older avionics that were designed for cabin-speaker use. PS Engineering makes no claim that the audio controller will provide a noise-free audio quality under all installation conditions, particularly with older avionics.

2.4.2   Compatibility with AMS44

The PAC45D is pin compatible with the NAT AMS44.

2.4.3   Power
The PAC45D is compatible with 28 Volt DC systems. A one (1) Amp circuit breaker is required for all installations. Power and ground wires should be #22AWG connect power to
J451 Pin 17. Connect airframe ground to P451 Pin 34 only.
Power consumption is as follows:
At 28V:
- Hub + Control Head: 500 mA
- Control head Only: 150 mA
- Hub Only: 350 mA
- Alert audio power: 10mA

At minimum input voltage (18V):
- Hub + Control Head: 750mA
- Control head Only: 200mA
- Hub Only: 500mA

Lighting input: <5mA
CAUTION: Do not connect or disconnect (HOT SWAP) any components with power applied, this will damage the units

2.4.3.1   Alert power
The PAC45D 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 16.
When power to P451-16 is present, the message will play three times or until the remote acknowledge is selected.

MOD 9 alert power input will be pin 18 on P453 connector.

2.4.4 Audio controller interface

The PAC45D is designed to interface with standard aircraft avionics and presents a 510 Ω 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.

2.4.4.1 Navaid wiring and selection

The PAC45D has NAV 1, NAV 2, and three additional auxiliary navaid inputs for ADF, etc. The three auxiliary audio inputs on P452 pins 9, 10 and 11 will be presented with the audio control is selected.

2.4.4.2 Additional transmit position or passenger 6 (P451-6, 23, 40)

The PAC45D system can support six passenger intercom stations, in addition to the pilot and co-pilot. The input to the PAC45D P451 6, 23, 40 can be used as an additional transmit position, or a hand microphone, or as passenger 6, with transmit capability on the selected radio.
This microphone transmitter follows the last control head selection.
Passenger 2 (Observer 2) can use this hand mic as a transmit seat.

Function	Pilot	Copilot	Observer Transmit Seat 1	Observer Transmit Seat 2
Mic PTT Key	P451-7	P451-8	P453-9	P451-6
Mic Audio Hi	P451-24	P454-25	P451-26	P451-23
Mic Audio Lo	P451-41	P454-42	P451-43	P451-40
ICS PTT	P451-9	P454-10	P453-4	P454-3
Phones Left Audio Hi	P452-18	P454-17	P451-30	P451-31
Phones Right Audio Hi	P454-11	P454-10	P453-13	P453-14
Phones Low	P452-37	P451-36	P451-47	P451-48

2.4.4.3 Passenger 5 and 6

Passenger 6 is an intercom station input on P454-16 wrt 25.
The headphone outputs for passenger 5 and 6 are paralleled from passenger 1 and passenger 2.

NOTE: Do not parallel headphones to passenger 3 or 4.

2.4.4.4 AMS44 Intercom Tie Line (PAC45D Pins 16 & 35 of P452)

The PAC45D does not support the ICS tie lines (AMS44 J102 16 & 35). A PS Engineering Expansion unit must be used, P/N 11645R. Pins 16 & 35 are open on the PAC45D at P452.

2.4.4.5 Installation with Monaural Headsets

Not recommended, because the benefit of MultiTalker is lost. However, if desired, the PAC45D can be installed monaurally by using the LEFT audio connections only (left side contains Fail-Safe audio). Do NOT short left and right headphone outputs together.

NOTE: Mono headsets that short the tip and ring (i.e. older models) may introduce audio distortion when used. Modern, stereo headsets are recommended in all positions.

2.4.5 Transmit Interlock

Some communications transceivers use a transmit-interlock system. To fully utilize the multi-user, transmit capability, this function must be disabled. Consult the radio manufacturer's installation manual.

2.4.6 Backlighting

Control of the unit backlighting is through the aircraft avionics dimmer Connect P452 Pins 19 to the aircraft dimmer bus. All control heads dimming is control by the HUB. The audio controller can be configured for either 5VDC or 28V dimmer installations. The default setting is 28V from the factory. The ratio of white to green indicator intensity is adjustable, see §2.5.2.1.

Mode	Operation (Serial # BHD054 and above)
Night Mode and Day Mode	**Night Mode**: Dimmer pot (above trip level) adjusts brightness from minimum to full brightness as set by programming pots. **Day Mode**: Below trip level sets brightness to full brightness as set by programming pots (separate settings from Night Mode settings).
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.

2.4.7 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 Ω inputs can be used for altimeter DH audio, GPS waypoint audio, autopilot disconnect tones, 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 Input	Input Pins	Hear in Fail Safe	Hear in Crew Headset	Adjustable at installation
1	P452 - 13 WRT 32	Yes	Yes	Yes
2	P452 - 1 WRT 20	No	Yes	Yes
3	P454 - 14 WRT 23	No	Yes	Yes
4	P454 - 13 WRT 22	No	Yes	Yes

Table 2-2 Unswitched inputs

2.4.8 Cockpit Voice Recorder

The PAC45D audio controller contains a Cockpit Voice Recorder output for the pilot and copilot (PAC45D, -0005 and HUB45R -0101 only).

Pilot CVR output is P454-12; Copilot CVR output is P454-2, both with respect to CVR low, P454 21

A single pilot CVR output is available on PAC45D with a cockpit speaker output (PAC45D, -0006 and HUB45R -0103 only).

The CVR output is consistent with RTCA DO-214A §1.5.7.

The copilot CVR output can be modified to remove intercom audio if desired by the user. This makes it incompatible with regulations where an official CVR is required, but desirable for other applications. See §2.4.11.7

2.4.9   Audio Alerts

The PAC45D contains an independent audio alerting system that will play up to three alert audio messages. These messages are spoken words "ALERT", "MASTER CAUTION" and an audio chime. The alert system has a power input that will keep the systems operable if the PAC45D systems power source is removed. Alert audio is provided in Fail-safe when power is on P453-18.

Alert Trigger Input	Audio	Input Pins
1	"MASTER CAUTION"	P454 – 4
2	"ALERT"	P454 – 5
3	CHIME	P454 – 6
Alert Power		P453 – 18
Remote Acknowledge		P454 – 9

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. See §2.5.3 for configuration options.

Alerts with <u>edge</u> triggers will play three times or until the front panel Acknowledge button (ACK) is pressed (or the remote ACK P454-9 grounded).

Alerts with <u>level</u> trigger will play three times or until the front panel Acknowledge button (ACK) is pressed (or the remote ACK P454-9 grounded), or the input level reverts.

When power is applied to the alerts and not the PAC45D audio controller, it will play the message three times or until the remote acknowledge is selected.

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

2.4.9.1   External Alert Acknowledge Switch (J454-9)

A momentary SPST switch, installed between J454-9 and ground, can act the same as the crew Control Head ACK button. If J454-9 is connected directly to aircraft ground, all alerts will be played one time after trigger, and stop.

2.4.10   Remote ICS mode control

When a momentary, normally open, push-button switch is connected between pin P454-18 and ground, it will change the intercom mode on the Pilot's PAC45D.

2.4.11   Wired Telephone/Satellite Communication input

The PAC45D can accommodate a wired cell phone interface on P454 Pins 17, 26 and 7.

Both Bluetooth and wired Telephone and 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.

2.4.12   Music Input

NOTE
Use the <u>low-level</u> 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.

2.4.13 Bluetooth Antenna

The HUB45D has an external Bluetooth antenna connector (P/N 050-045-0106 & -0107, S/N CBD074 and above). If the HUB45D is mounted close to the cockpit, Bluetooth antenna (P/N 510-045-9602) can be mounted directly to the unit. If the HUB45R is more than 3 meters from the cockpit, or isolated from the cockpit by structure, we recommend installing the antenna closer to the cockpit, using the 6-foot coax cable (P/N 300-045-1351), included in the installation kit.

2.4.14 Functional Options

There are several optional features in the PAC45D system that are configured by PS Engineering based on customer responses to a questionnaire. The status of these modification options is shown on a Modification Identifier tag on the PAC45D. (**PAC45D s/n BHD047 and below**).
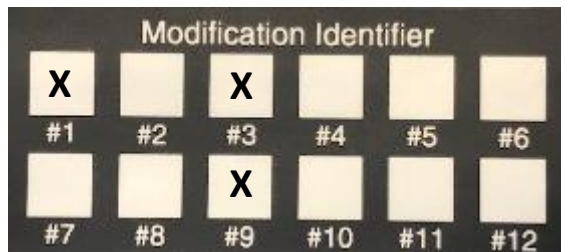
For PAC45D S/N BHD048 and above, the status is shown by the DIP switch position.

2.4.14.1 Intercom Active during PTT press (-TXI) (**MOD #1**)
When this option is used, the intercom audio is NOT muted when a crewmember is transmitting on the radio. Ideal for tactical operations where air to ground and inter aircraft communication occur simultaneously.

2.4.14.2 Receive Activity Indicator (-RXI) (**MOD #2**)
PAC45D systems have an optional Receive Activity Indicator that flashes the selected receiver indicator when a signal is present on that receiver.

2.4.14.3 Reversionary Mode (**MOD #3**)
This option is applied normally and may be requested to be disabled. When enabled, if any control head is shut off (EMG mode), those users will revert to the flight crew's CTL45D and hear the radio and intercom audio selected by the copilot.
If the Reversionary Mode is NOT applied, when a CTL45 is switched to EMG, those users will hear nothing.

2.4.14.4 Unswitched Audio present in passenger audio **(MOD #7)**
When MOD 7 is present, the direct/unswitched audio is provided to the passenger intercom audio as well as the crew. This is useful if the passengers need to hear the unswitched audio for tactical reasons.

2.4.14.5 AMS44 MOD 9 **(MOD #9 Factory Only)**
Mod 9 to the AMS44 systems allowed for the addition of a 5th intercom station. This is not compatible with PAC45D internal alert system.

2.4.14.6 Dual systems configuration (MOD#10)
Specially configured HUB45s can be interfaced to create a dual systems with up to 4 control heads. , 5 coms or 4 coms + 1 sat phone. The audio tie line connects P454 pin 7 on one HUB45 P454 pin 17 on the other HUB45. If isolation is desired install a switch in the tie-line (See Fig. 5). NOTE: This uses the wired TEL port, so this system can't be used with a wired telephone. See §3.12.5 for operational details.
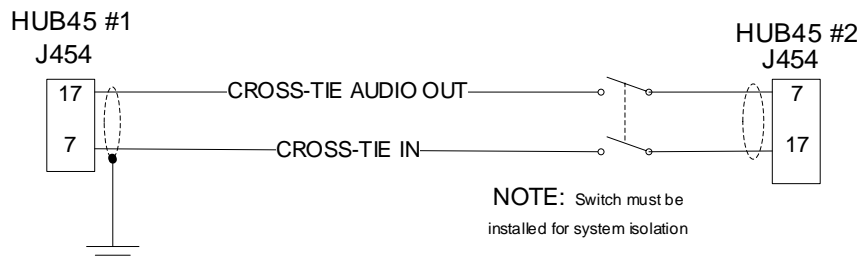
Figure 2 – Dual HUB45 Interface

2.4.14.7 Special Recorder Out (MOD #11)
Applies to HUB45 P/N 050-045-0102, S/N JBH01370 and above. This removes intercom audio from copilot's SPR/CVR output (J454 Pin 2 and Pin 21). The audio present on this line will follow the last control head installed, whether it's a single, dual or three control head system.
Example: When a TFO control head is installed, the tactical radios selected will be present on this recorder output. This output can be wired to a Churchill Navigation / SHOTOVER camera system as an example.
Setting switch 6, (internal dipswitch) Recorder Output Function, MOD 11. See §2.4.7.
   1. Power off the HUB45.

2. Set the Recorder Out switch (Switch #6) up.
3. Power on the HUB45.
4. Hold down the **ICS** button on the *pilot's* control head for 3 seconds or until you hear the "beep", this will program the special mode.
5. Power off the HUB45 and set the Recorder Out (Switch #6) to down.
6. Test the function.

NOTE: This function is incompatible with a pilot low-level speaker output.

2.4.14.8 **Internal DIP Switch configuration (S/N MH01267 and above)**

There are eight switches accessible through the side of theHUB45 unit that provide field configurability of the functions listed above in [§2.4.11](). In a clean bench environment, carefully remove the side plate closest to the 9-Pin connector by removing eight #4-40 x 3/16 Philip screws and star washers.

Place the switch in the UP position to select the functions below.

Switch #	Mod #	Description	Function Active
1	1	TXI- Intercom stays active during radio PTT presses	UP
2	2	RXI- Comm Text flashes when audio is active	UP
3	3	Reversionary Mode	UP
4	4	RESERVED	KEEP DOWN
5	5	Artificial Transmit Sidetone	UP
6	6	Recorder Out Select (S/N JHB01370 & higher)	KEEP DOWN UNLESS ACTIVATING FUNCTION
7	7	Passengers hears unswitched input	UP
8	8	Passengers will not hear aircraft radios in any ICS mode	UP
	9	AMS44 Configuration, for PAC45D only	
	10	Dual HUB Installation (Special Build)	
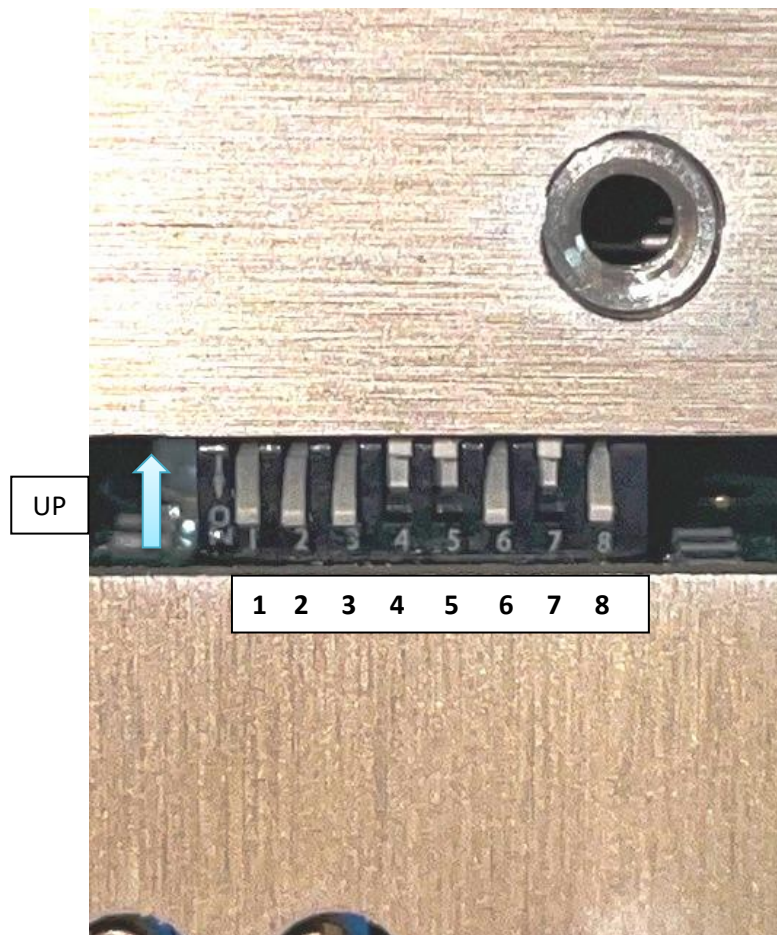
After setting the required switched, re-install the side plate. PS Engineering recommends adding a small amount of Locktite 425 to the screws.

2.4.15   Cockpit Speaker Output (PAC45D 050-045-0006 and HUB45R 050-045-0103 only)

A low-level output is available to drive a separate speaker amplifier (such as PSA210) and contains received audio. This output is P454 Pin 2.

2.5 User Adjustments

The PAC45D is factory set for typical installation. However, several installation adjustments are available. No computer is required.

2.5.1   Unswitched Audio Level

Unswitched inputs one through four are installation adjustable through the side of the PAC45D unit.

2.5.2   Adjustment Pots

On the side of the PAC45D/HUB45D are six adjustment potentiometers.
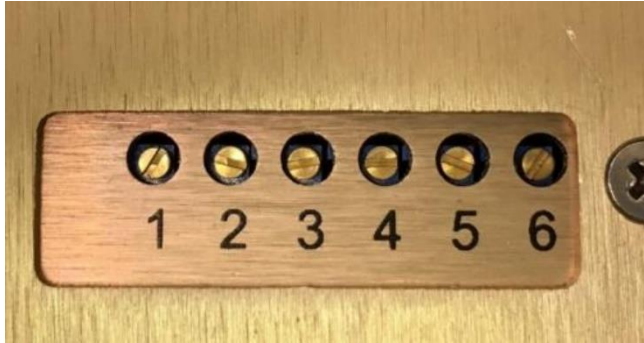
**Figure 2-3— Adjustment potentiometers (*NOTE these are all 30-Turn
pots, and may require 10-15 turns to notice any change*)**

Alert volume (adjusts the level of the internal audio alerts and annunciations generated by the PAC45D)
1. White & Green text backlight level adjust (see §2.5.2.1)
2. Unswitched input 1 volume
3. Unswitched input 2 volume
4. Unswitched input 3 volume
5. Unswitched input 4 volume

2.5.2.1   Green and White lighting adjustment

Units with Configuration **BBGAA** and above, the dimming has been modified to set a minimum level:
*   By default, adjustments to the pot 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).
*   The following steps must be taken in this specific order.
1. Enter programing mode with a long press (3 seconds) of TEL and ACK on pilot panel which will cause the #2 potentiometer to adjust the green level. When in this mode the green LEDs will get brighter or dimmer.
2. Another long press (3 seconds) of TEL and ACK on pilot panel will adjust the white level
3. Another long press (3 seconds) of TEL and ACK will exit programming mode

4. Also, ACK can be pressed at any time to exit (if you want to adjust green but not white for example)

Finally, adjust the dimmer trip level. Even if adjusted prior to the green/white adjustment, it will have to be readjusted because the #2 potentiometer has moved.

2.5.2.2 Units with serial number **BHD054** and above (Day/Night Mode):

Mode	Operation
Night Mode and Day Mode	**Night Mode**: Dimmer pot (above trip level) adjusts brightness from minimum to full brightness as set by programming pots. **Day Mode**: Below trip level sets brightness to full brightness as set by programming pots (separate settings from Night Mode settings).
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.

1. Long Press (3 seconds) TEL/ACK, a single Chime (indicates programming Green LEDs), adjust pot to set Night Mode Green level.
2. Long Press (3 seconds) TEL/ACK, a double Chime (indicates programming White LEDs), adjust pot to set Night Mode White level.
3. Long Press (3 seconds) TEL/ACK, a single Chime (indicates programming Green LEDs), adjust pot to set Day Mode Green level.
4. Long Press (3 seconds) TEL/ACK, a double Chime (indicates programming White LEDs), adjust pot to set Day Mode White level.
5. Long Press (3 seconds) TEL/ACK, a triple Chime (indicates programming Trip Level), adjust pot to set trip level.

2.5.3   Logic Switch Options

The PAC45D has several switches accessible through the side of the HUB45 to set specific functions

Power must be cycled after selections are completed.

Switch going towards the number is "UP" Switch going away from the number is "DOWN"

Switch #	Description	SWITCH UP	SWITCH DOWN
1	Alert Trigger #1 Logic	Active Low (Ground)	Active High (Voltage)
2	Alert Trigger #2 Logic	Active Low (Ground)	Active High (Voltage)
3	Alert Trigger #3 Logic	Active Low (Ground)	Active High (Voltage)
4	Alert Trigger #1 Type	Level Trigger	Edge Trigger
5	Alert Trigger #2 Type	Level Trigger	Edge Trigger
6	Alert Trigger #3 Type	Level Trigger	Edge Trigger
7	Dimmer Voltage	5 Volt Dimmer Input	28 Volt Dimmer Input
8	High Aircraft Noise Sensitivity	Standard Microphone Sensitivity	High Noise Microphone Sensitivity
9	Passengers' HRTF Selection	Disabled	Enable
10	Offside Com audio active	Coms are heard	Coms are not heard
11	Copilot Control Head Installed	No	Yes
12	Observer Control Head Installed	No	Yes

2.5.3.1   Alert Trigger Logic (1 – 3)
Switches 1-3 set alert logic. DOWN for active high, UP for active low.
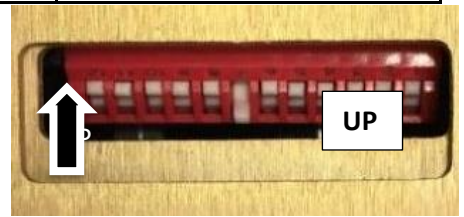
2.5.3.2   Alert Trigger Type (Switches 4 – 6)
Switches 4-6 set alert type. UP for level triggered, DOWN for edge triggered.
As shown: Alert 1 Edge Triggered, Alerts 2-3 Level Triggered (default from factory)

2.5.3.3   Back light dimmer voltage (Switch 7)
Switch 7 sets dimmer mode. UP for 5V, DOWN for 28V
As shown: 28V dimmer (default from factory).

2.5.3.4   Microphone Sensitivity (Switch 8)
Switch 8 sets mic sensitivity. UP for low noise (standard), DOWN for high noise environment.
As shown: High noise

2.5.3.5   Passenger Head Related Transfer Function (HRTF) Disable (Switch 9)
Switch 9 enables HRTF mode for passengers. UP disabled, DOWN enabled.
Disable *only* if headsets are monaural.
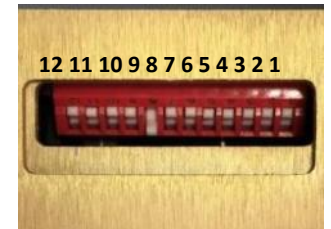
2.5.3.6   Offside com audio active during transmit – (Switch 10)
When this switch is in the "UP" position, the receive audio on other radios is not muted when one crew member transmits on the radio. This allows other crewmembers to listen to other radios while one trasmits. (shipped from factory in this mode. Serial Number DH01069 and above).
NOTE: This may result in crosstalk if multiple radios are tuned to close frequencies.

2.5.3.7 Copilot Control Head (Switch 11)
Must be in **DOWN** position for PAC45D.

2.5.3.8 Mission/Observer Control head (Switch 12)
Switch 12 indicates that a CTL45M is installed as an Observer/Mission control head. UP for CTL45M not installed, DOWN for observer/mission position control head present. As shown: Observer Control Head in System

2.6 PAC45D Pin assignments

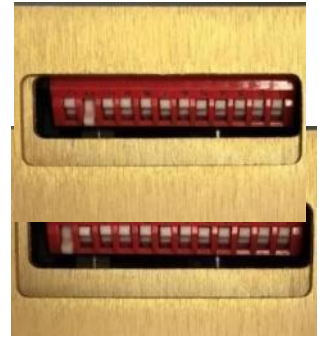| P451		P452		
Pin	FUNCTION	PIN	FUNCTION	
1	COM2 KEY [2]	1	UNSWITCHED AUDIO 2	
2	COM1 KEY [1]	2	COM 2 AUDIO HI [2]	
3	COM5 KEY [3]	3	COM 1 AUDIO HI [1]	
4	COM3KEY [4]	4	COM 5 AUDIO HI [3]	
5	COM4 KEY [5]	5	COM 3 AUDIO HI [4]	
6	OBSERVER	6	COM 4 AUDIO HI [5]	
7	PILOT MIC PTT	7	NAV 1 AUDIO HI [6]	
8	COPILOT MIC PTT	8	NAV 2 AUDIO HI [7]	
9	PILOT ICS PTT	9	ADF 1 AUDIO HI*[8]	
10	COPILOT ICS PTT	10	ADF2 AUDIO HI*[8]	
11	**PAX 4 MIC AUD**	11	DME AUDIO HI **[9]**	
12	**GROUND**	12	MKR AUDIO HI [10]	
13	**PA KEY**	13	UNSWITCHED AUDIO 1	
14	PA MIC OUTPUT HI	14	MUSIC LEFT HI	
15	PA MIC LO	15	MUSIC RIGHT HI	
16	**OBS 2 PHONES (LEFT)]**	16	NO CONNECTION	
17	AIRCRAFT POWER (+28 VDC)	17	COPILOT PHONES (L) HI	
18	COM2 MIC AUD	18	PILOT PHONES (L) HI	
19	COM 1 MIC AUD	19	28 V LIGHTS	
20	COM 5 MIC AUD	20	UNSWITCHED AUDIO 2 LO	
21	COM 3 MIC AUD	21	COM 2 AUDIO LO	
22	COM 4 MIC AUD	22	COM 1 AUDIO LO	
23	OBS 2 MIC AUD	23	COM 5 AUDIO LO	
24	PILOT MIC AUD IN	24	COM 3AUDIO LO	
25	COPILOT MIC AUD IN	25	COM 4 AUDIO LO	
26	OBS 1 MIC AUD	26	NAV 1 AUDIO LO	
27	PASS 2 MIC AUD	27	NAV 2 AUDIO LO	
28	PAX 3 MIC AUDIO	28	ADF 1 AUDIO LO	
29	PAX 1MIC AUDIO	29	ADF 2 AUDIO LO	
30	OBSERVER 1 & 2 HP OUT (L)	30	DME AUDIO LO	
31	PAX 4 & 4 HP OUT (L)	31	MKR AUDIO LO	
32	PAX 1 HP OUT (L)	32	UNSWITCHED AUDIO 1	
33	PAX 2 HP OUT (L)	33	MUSIC LEFT LO	
34	AIRCRAFT GND	34	MUSIC RIGHT LO	
35	COM 2 MIC LO	35	NO CONNECTION	
36	COM 1 MIC LO	36	COPILOT PHONES LO	
37	COM 5 MIC LO	37	PILOT PHONES LO	
38	COM 3 MIC LO			
39	COM 4 MIC LO			
40	OBS 2 MIC LO			
41	PILOT MIC LO			
42	COPILOT MIC LO			
43	OBS 1 MIC LO			
44	PAX 2 MIC LO			
45	PAX 3 MIC LO			
46	PAX 1 MIC LO			
47	OBS 1 PHONE LO			
48	PAX 3 & 4 PHONE LO			
49	PAX 1 PHONE LO			
50	PAX 2 PHONE LO			

*Audio presented on same switch. Numbers in brackets [1] indicate the associated front panel switch location See Appendix B – Radio Wiring.

P453		P454	
1	NC	1	PA KEY (SEE APPX C NOTE 2 & 3)
2	NC	2	COPILOT CVR/Low Level SPR out (-0103 only)
3	OBS 2 ICS PTT	3	PAX 4 ICS PTT
4	OBS 1 ICS PTT	4	**ALERT 1**
5	PAX2 ICS PTT	5	**ALERT 2**
6	PAX3 ICS PTT	6	**ALERT 3**
7	PAX 1 ICS PTT	7	TEL MIC AUD
8	NC	8	SWAP
9	OBS 1 MIC PTT	9	ACKNOWLEDGE
10	SERIAL TX3 -	10	COPILOT HP RT
11	NC	11	PILOT HP RT
12	NC	12	PILOT CVR OUT
13	OBS 1 & 2 HP RT	13	UNSW 4 AUD IN
14	PAX 3 & 4HP RT	14	UNSW 3 AUD IN
15	PAX 1 HP RT	15	NC
16	PAX 2 HP RT	16	**NC**
17	NC	17	TEL AUD IN
18	ALERT POWER	18	REMOTE ISO
19	SERIAL TX3+	19	COPILOT HP LOW
20	SERIAL RX3-	20	PILOT HP LOW
21	SERIAL RX3+	21	CVR LOW
22	NC	22	UNSW 4 AUD LOW
23	OBS 1 & 2 HP LOW	23	UNSW 3 AUD LOW
24	SERIAL 3 LOW	24	NC
25	PAX HP LOW	25	NC
26	NC	26	TEL AUD LOW

Table 2-3: PAC45D Pin Assignments

Connections in [brackets] indicate changes required when replacing an AMS44 with Mod 9.
NOTE: Serial TX 3 for Mission Observer Control Head.

2.7 Wiring Checkout

After wiring is complete, verify power is ONLY on pin 16 & 17 of J451 and airframe ground on pin 34. 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

2.8   Operational Checkout

2.8.1   Required Test Equipment

In order to return an aircraft to service after installation of the PAC45D, 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.

2.8.2   Audio controller Test

> **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.
> Use of a Stereo headset is **required** to obtain full effect of MultiTalker processing.

1. Apply power to the aircraft and avionics.
    If the system does not power up, verify the GREEN Power LED visible in the HUB45 by the DIP switches is on. Peel back the foil sticker to view.
2. Plug **stereo** headsets into the pilot, copilot, and occupied passenger positions, or monaural if not using HRTF feature.
3. Verify fail-safe operation by receiving and transmitting on com 1 from the pilot position, with the audio controller power off /EMG mode. The Com audio will be present in one ear cup only if stereo headset and both ear cups if using monaural headsets.
4. Switch on the unit by turning the XMT select knob to the full CCW position (COM 1).
5. Check intercom operation.
6. Verify that the COM 1 legend in both the XMT and RCV change to green. Verify that transmit **indicator is not flashing green**... If the LED is flashing green, <u>stop testing</u> and troubleshoot the microphone PTT installation. If for any reason the transmit PTTs are stuck, then they will disconnect after 35 seconds.
7. Verify proper transmit and receive operation from the copilot position, noting that the copilot PTT switch allows proper transmission on the selected transceiver. Verify that the Xmt legend flashes green when the copilot is transmitting.
8. Rotate the XMT knob to the next transceiver position and verify the indicators change to track the selection, and Com 2 receiver is heard.
9. Repeat for remaining transceivers.
10. Verify proper operation of all receiver sources by selecting them using the appropriate knob.
11. Verify proper Intercom system operation in the **ALL, ISO** and **CREW** modes (see Table 3-1).
12. 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.

2.8.3   Bluetooth Checkout

Verify that the PAC45D will "pair" with a Bluetooth device, and interface with cellular phone and Music source. See <u>§ 3.7.2</u> for more information.

If PAC45D is not connecting, resetting the Bluetooth memory might be required. Hold down TEL & ICS buttons for 3 seconds until there is a chime in pilot headset. You will also need to "Forget Device" on the phone.

2.8.3.1   TEL Checkout

Pair the PAC45D 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 press the TEL button on the audio controller panel.

2.9   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.

Section III OPERATION

3.1   SCOPE

This section provides detailed operating instructions for the PS Engineering PAC45D Audio Selector Panel/Intercom Systems. Please read it carefully before using the equipment so that you can take full advantage of its capabilities.

This section is divided into sections covering the basic operating areas of the PAC45D systems. They are Communications Transceiver Selection, Audio Selector, Intercom, and special functions, including the Bluetooth® functionality in the PAC45D.

Note: The nomenclature may vary between user configurations. Pilot and copilot ides can be reversed.
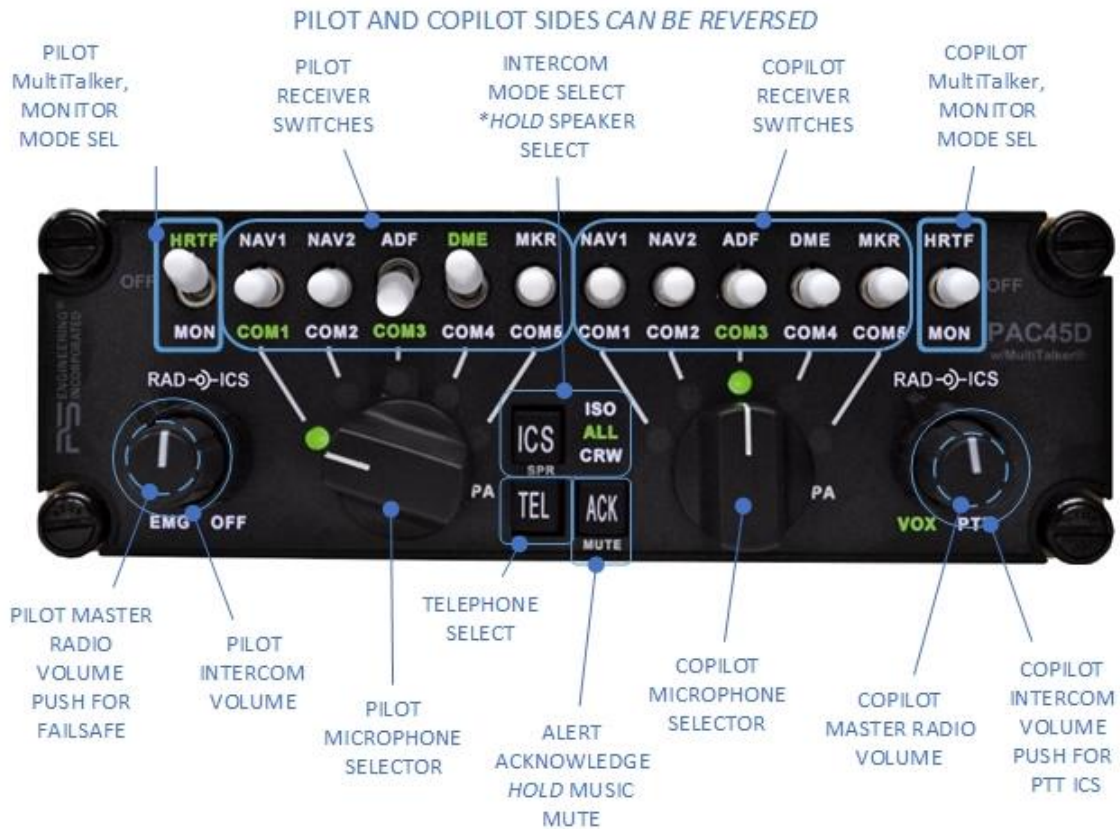
Figure 3-1 PAC45D Operating Controls

3.2   Power and Fail Safe

Unit power is controlled by pushing on/pushing off of the pilot side volume control knob. In the "EMG" or off condition, 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. NAV1 audio is also provided to the pilot in the other ear of a stereo headset.

Any time power is removed or turned off; the audio selector will revert to fail-safe mode. If fail-safe audio is present in both ears of a stereo headset, or completely absent, verify that a stereo headset is used and is selected for stereo mode.

The power controls all audio selector panel functions and intercom.

3.3 Communications Transmit (XMT) Selection

The PAC45D has two rotary control knobs to select communications transceiver functions for pilot and copilot. To select a transceiver for transmit; turn the knob to select the desired radio from the five available.

The radio is automatically selected to receive incoming radio calls when the XMT is selected. With a PAC45D, you will never transmit on a radio that you are not receiving. The selected audio is indicated by both knob position and the green LED indicator.

3.4 COM Audio Selector

The communications receiver audio sources are controlled by toggle switches on the pilot and copilot side of the CTL45D. These are shared with the navigational receiver audio (up position). Communication audio from another radio, not selected for transmit, can be heard by flipping the associated RCV switch, which will place it in the down position. The selected audio is indicated by both knob position and the green nomenclature text.

3.4.1.1 Received Audio Master Volume Control

The Radio Master Control Volume (small inner knob labeled RAD) controls all received audio sources. It does not affect intercom or music volume. It should be normally set for should always be at MAX volume. You will always hear the audio from the selected transceiver, even if the is turned all the way down on the audio controller because it cannot turn the selected receive audio all the way off.

> NOTE: IF ARTIFICIAL SIDETONE IS ENABLED, RADIO SIDETONE WILL BE AFFECTED BY ICS VOLUME CONTROL (OUTER KNOB).

3.4.2 MultiTalker® 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 six communications transceivers.

NOTE: YOU MUST USE STEREO HEADSETS, IN STEREO MODE FOR THIS FEATURE.

This adjustment allows the five 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.

3.4.3 HRTF On /Off

Placing the HRTF switch in the "up" position activates the PAC45D MultiTalker® spatial function in 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. Transmit sidetone may be adversely affected with HRTF on in mono headsets.

3.4.4   Audio Location

The pilot section of the panel controls the locations for the five communications receive audio locations. Press and hold the TEL button for three (3) seconds on the audio panel until the TEL button and all COM nomenclature start blinking green. Set the pilot mic selector to the COM to be adjusted.

Then rotate the RAD 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. Re-

Figure 3-2 Spatial Audio Locations and Voice Annunciations

ceived audio shall then be presented from that location. Rotate the pilot mic selector to the next radio to be adjusted and repeat until all locations have been set as desired.

Press the TEL button again to exit the mode. The audio controller will remember locations through power cycles.

3.4.5   Receiver Activity Indication (-RXI)

PAC45D systems have a Receive Activity Indicator that flashes the *selected* receiver indicator when a signal is present on that receiver. This allows the user to spot an active radio, even if the volume is turned down. This function is set at the factory at the installer's request and can be changed *only* at the factory.

3.4.6   Monitor Mode

With the toggle switch in the "down" position, the PAC45D is in Monitor Mode. In this mode, the audio from the COM radio that is selected for transmit will mute the other COM audio when it is active. For example, if COM 1 is selected to transmit to ATC, but COM 2 is receiving weather information; the ATC will mute the audio from the weather while ATC is transmitting. In Monitor mode, the RCV COM indicator will blink every few seconds as a status indication.

3.4.7   Navaid Selection

Navigation receivers are selected in the same manner as the communication receiver, select the toggle switch to the UP position.

3.4.8   Telephone control

The button connects the audio controller to either a Bluetooth-enabled cell phone or a wired cellular/satellite phone.

The TEL button behaves as follows:
- If TEL is "white" then an incoming call MUST be answered with the TEL button.
- If TEL is "green" then an incoming call MUST be answered with the Phone.
- If TEL is "green" and you are on an active call then pressing TEL disconnects the call.
- Active calls can also be disconnected from the phone at any time.

NOTE: When TEL is active, the intercom is routed to the telephone. If no telephone is present, no intercom will be heard if TEL is on.

3.4.9   Speaker Control (PAC45D 050-045-0006, HUB45R 050-045-0103 only)

If equipped, the SPR label will be on the unit below the ICS button. Press and hold the ICS button to toggle the output ON/OFF. When the speaker output is "ON", all alerts, unswitched inputs and all switched inputs selected by the pilot will be present. Intercom, telephone and music will never be present.

When the speaker output is "OFF", only alerts and unswitched inputs will be present

3.5 Intercom Operation (8)

3.5.1   *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.

For optimum microphone performance, PS Engineering recommends installation of a Microphone Muff Kit from Oregon Aero (1-800-888-6910). This will not only optimize VOX performance, but will improve the overall clarity of *all* your communications.

Manufacturer	Model	Mic Muff™ Part Number
Bose	Dynamic	90010
	Electret	90015
	M87 Dynamic	90020
David Clark	H10-30	90010
	H10-20, H10-40	90015
	H10-13.4	90015
Lightspeed	All	90015
Peltor	7003	90010
	7004	90015
Pilot	11-20 & 11-90	90015
Sennheiser		90015
Telex	Airman 750, Echelon	90015
	AIR3000	90010

Table 3-1 Mic Muff ™ Part Numbers

3.5.2   Push to talk intercom (PTT ICS)

Pressing the copilot's intercom volume knob (ICS VOL) will place the system (all headsets) 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 buttons for each position be used to speak on the intercom.

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

3.5.3   Intercom Volume Control

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

In the PAC45D, the pilot volume control adjusts the pilot's intercom volume. The copilot's knob adjusts the copilot, and any connected passengers.

3.5.3.1   Monaural headsets

The pilot and copilot positions work with stereo or mono headsets. However, MultiTalker will not be presented correctly unless stereo headsets are used, and oriented correctly on the head, left and right.

NOTE: For the full effect of MultiTalker Dimensional Sound, stereo headsets *must be used*, and the left/right orientation observed.

Some *passenger* headsets are connected in parallel. Therefore, if a monaural headset is plugged in to a PAC45D Stereo installation, one channel may be shorted. Although no damage to the unit will occur, all passengers with stereo headsets will not hear one channel, unless they switch to the "MONO" mode on their headset.

NOTE: Mono headsets that short the tip and ring (i.e. older models) will introduce some audio distortion when used. Modern, stereo headsets are recommended in all positions.

3.5.4   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 top to bottom, then bottom to top as: ISO, ALL, CRW, ALL. A green indicator shows which mode is currently active.

ISO: The pilot is isolated from the intercom and is connected only to the aircraft radio system. He will hear the aircraft radio reception (and sidetone during radio transmissions). Copilot will have radios, intercom and music. Passengers will have intercom and music.

ALL: All parties will hear the aircraft radio, intercom and music. 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 (CRW): Pilot and copilot are connected on one intercom channel and have exclusive access to the aircraft radios.

3.5.4.1 Remote ICS Mode Control (P454 connector pin 18)

An optional external switch can act as a remote intercom mode selector. Pressing the switch will increment the intercom mode selector from ISO-ALL-CRW-ALL, etc. each time the button is pressed.

3.6 Bluetooth® connection

The PAC45D has an internal Bluetooth module (FCC ID: QOQWT32I), no external boxes 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 PAC45D has been "paired" with your Bluetooth device, the TEL distribution will act as described in § 3.7.2.

3.6.1 Pairing and unpairing Bluetooth devices

The PAC45D can be paired with up to eight individual devices, but will only connect to one at a time. When that number is exceeded, the PAC45D 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 PAC45D, 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 TEL and ICS buttons for more than three (>3) seconds. Then "forget" the PAC45 from your device, and pair again.

3.6.2 Bluetooth® Telephone Mode

The PAC45D 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."

To answer an incoming call, or initiate a call from the PAC45D, select the TEL volume control to the out position.

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 PAC45D 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.

NOTE
PS Engineering does not guarantee compatibility with personal cellular telephones.

3.6.2.1 Bluetooth Reset

To reset the Bluetooth module, clearing out the connected devices, press TEL and ICS for more than three seconds. Then "Forget" the PAC45 on your mobile device, and pair again from the beginning.

3.6.3 Music Muting Control

The PAC45D 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 ACK button for three (3) seconds will turn the music muting on/off.

When in mute off mode, the intercom, radio & PTT will <u>not</u> 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.

3.7 Wired Satcom/Cell Phone input

The PAC45D can accommodate a wired telephone input as well as a Bluetooth connection. This operates the same as the Bluetooth Telephone (see §3.7.2).

3.8 Alert Audio

The PAC45D incorporates an independent alert audio system that can store three 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 CTL45D control panel is pushed, or the trigger input returns to normal. Edge-triggered alerts will play 3 times or until ACK is pushed, whichever occur first.
The PAC45D system incorporates three audio alerts. Chime , "Alert", and "Master Caution" (spoken words).

3.9 Observer Control head Operation (CTL45M)

The PAC45D can be paired with a CTL45M Mission Observer (TFO) control panel.

Figure 3-3 CTL45M Control Head for Mission Observers

3.9.1.1   Power On/Off
The rotary transmit selector controls power to the CTL45M, and it is on in any position except off. Turning the witch fully clockwise places the CTL45M in the off mode. Users of this control head will not have any audio from any source in the OFF position.

3.9.1.2 Transmit Selection

To select a transceiver for transmit; turn the knob to select the desired radio from the five available.

The radio is automatically selected to receive incoming radio calls when the XMT is selected. With a PAC45D, 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.

3.9.1.3 Com Receive Audio Selection

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.

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 completely.

3.9.1.4 HRTF On/Off

Pressing the HRTF button toggles the PAC45 MultiTalker spatial function on in stereo headsets connected to the user's CTL45M Control Head, (receiver sources distributed) or off (receiver audio sources neutral).
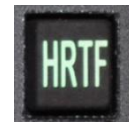
3.9.1.5 Navaid Selection

Navigation receivers are selected in the same manner as the communication receiver by setting the knob associated with the desired navigational aid to the out position, and rotate to adjust the receiver volume.

3.9.1.6 Volume Controls

The Intercom and Radio Master volume controls operate the same manner as the CTL45D for pilot and copilot. The intercom volume control knob (outer knob) adjusts the loudness of the intercom for the intercom stations(s) connected to the audio controller panel. It has no effect on selected radio levels, or music input levels.

3.9.1.7 Telephone

To answer an incoming call, or initiate a call from the PAC45D Observer Control Head, select the TEL volume control to the out position. This is the same switch for either Bluetooth or Satellite phone connection.

3.9.1.8 Intercom

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 available intercom modes ISO and ALL. A green indicator shows which mode is currently active.

Iso: The users on this panel are isolated from the intercom and is connected only to the aircraft radios they have selected. They will hear the aircraft radio reception (and sidetone during radio transmissions). The crew will have radios, intercom and music in their location.

ALL: All parties will hear the aircraft radio, intercom, and music. 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.

3.9.1.9   Music Muting

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

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.

3.10 Soft Key Button Functions

The PAC45 System has some secondary functions using the mode select buttons. A long press is three (3) seconds.

Long Press button	Action
ICS	Speaker On/Off
ACK	Music Mute On/Off
TEL	HRTF Setup
TEL + ICS	Bluetooth® Reset
TEL + ACK	Green Backlight Dimming & Lighting setup

3.11 Dual Audio HUB45 Intercom Operation (MOD #10 Units Only)

This section describes the intercom modes in a dual hub system. For clarity, we will designate one system (HUB45#1) as flight crew, and the other (HUB45 #2) mission operators.

- ALL – When BOTH systems are in ALL intercom mode, all intercom stations will have radio and intercom audio.

Figure 4 - Dual HUB, ALL Mode

- CREW – When the Flightcrew systems are in CREW mode, the Pilot and Copilot are isolated from the rest of the aircraft.
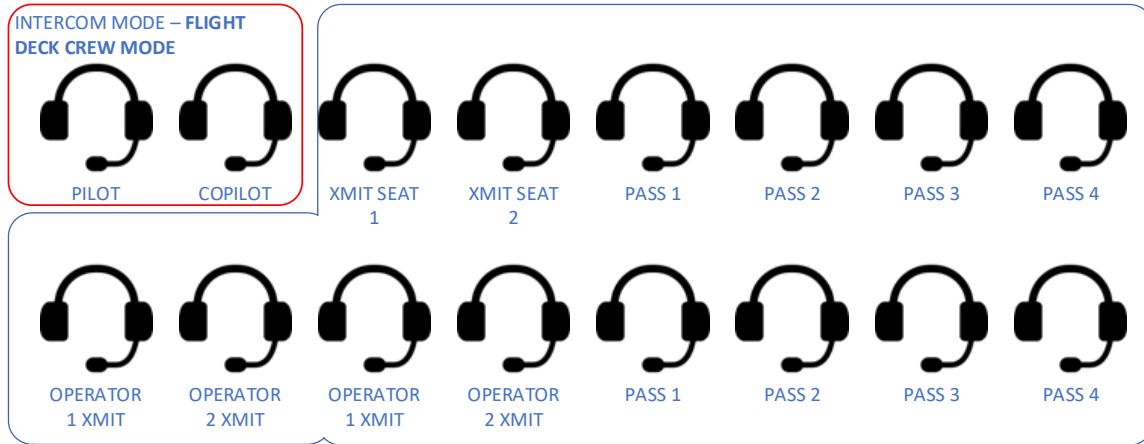
Figure 5 - Dual HUB, Flight CREW Mode
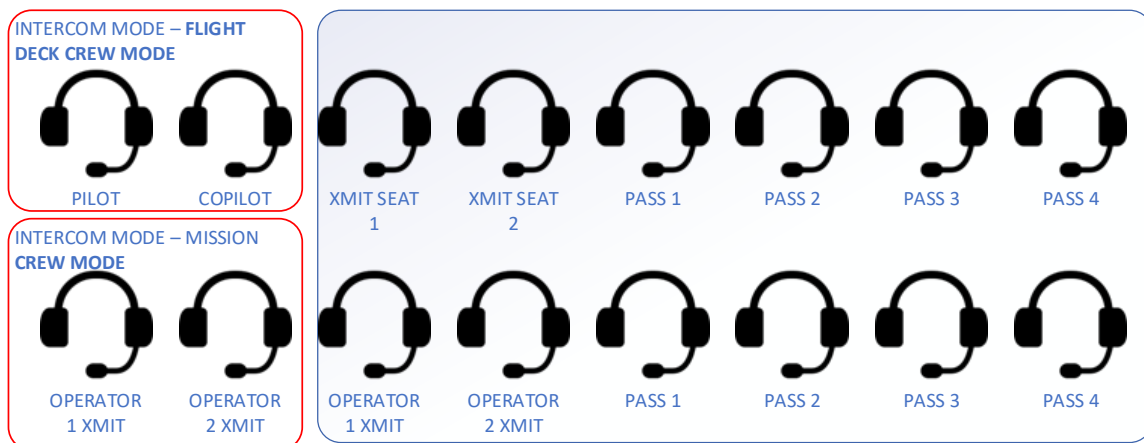
Figure 6 – Both systems in CREW Mode

When the flight crew control head is in Isolate, the pilot is separated from the rest of the air-craft.
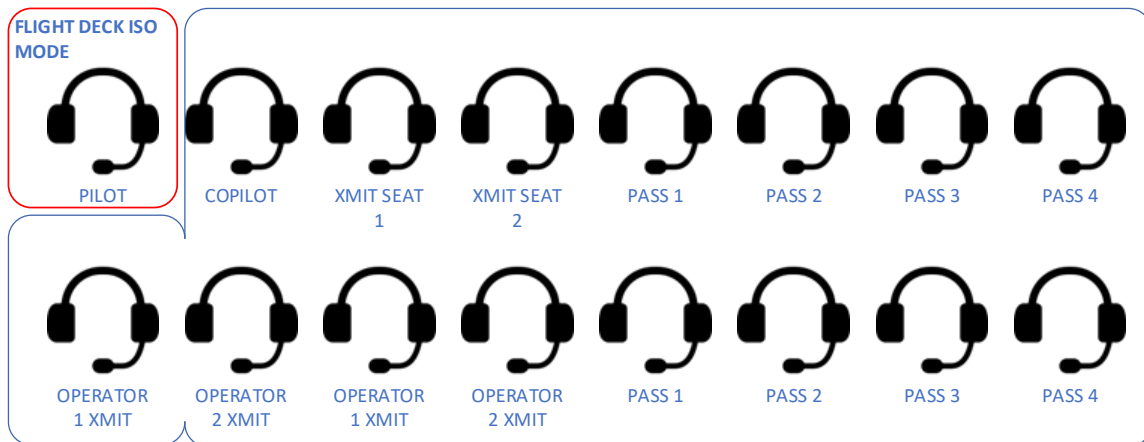
Figure 7 – Flight Crew Pilot ISO mode

FLIGHT DECK ISO MODE

PILOT

COPILOT

XMIT SEAT 1

XMIT SEAT 2

PASS 1

PASS 2

PASS 3

PASS 4

MISSION ISO MODE

OPERATOR 1 XMIT

OPERATOR 2 XMIT

OPERATOR 1 XMIT

OPERATOR 2 XMIT

PASS 1

PASS 2

PASS 3

PASS 4

Figure 8 – Both systems placed into ISOLATE 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 <u>date of sale</u>. During the first **twelve (12) months** of the two-year warranty period, PS Engineering, Inc., at its option, <u>will send a replacement unit</u> at our expense if the unit should be determined to be defective after consultation with a 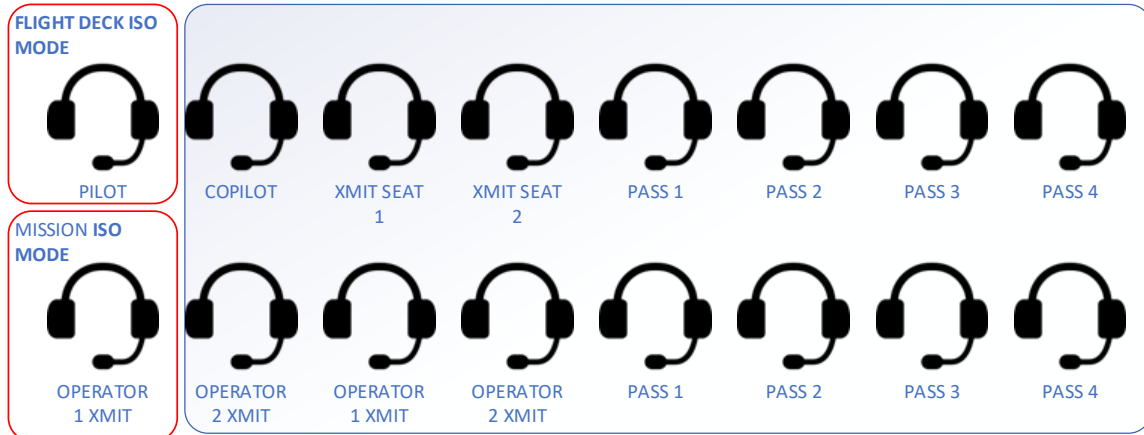factory technician. For the remaining **twelve (12) months** of the two-year warranty period, PS Engineering, Inc., at its option, <u>will send a similar replacement unit</u> at the customers' expense if the unit should be determined to be defective after consultation with an authorized PS Engineering dealer.

<u>All transportation charges for returning the defective units are the responsibility of the purchaser</u>. 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 rights to make modifications or improvements to the product without obligation to perform like modifications or improvements to previously manufactured products.

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 – PAC45D Installation Drawings
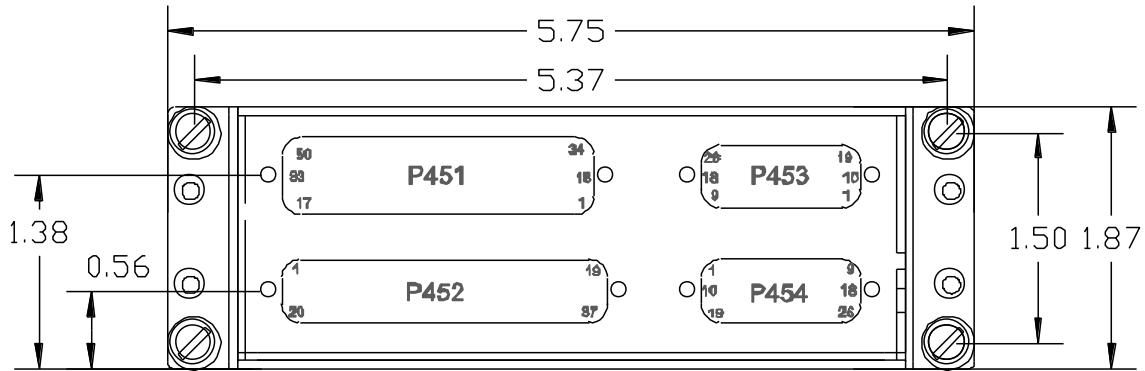
Figure 5-1 – PAC45D Rear/Connector View (not to scale)
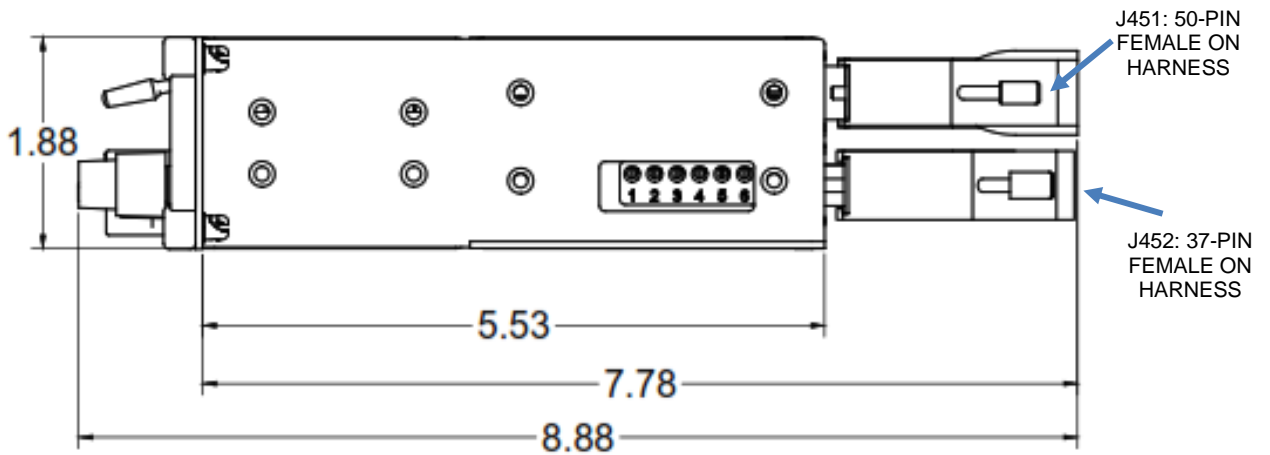
Figure 5-2 – PAC45D Side View
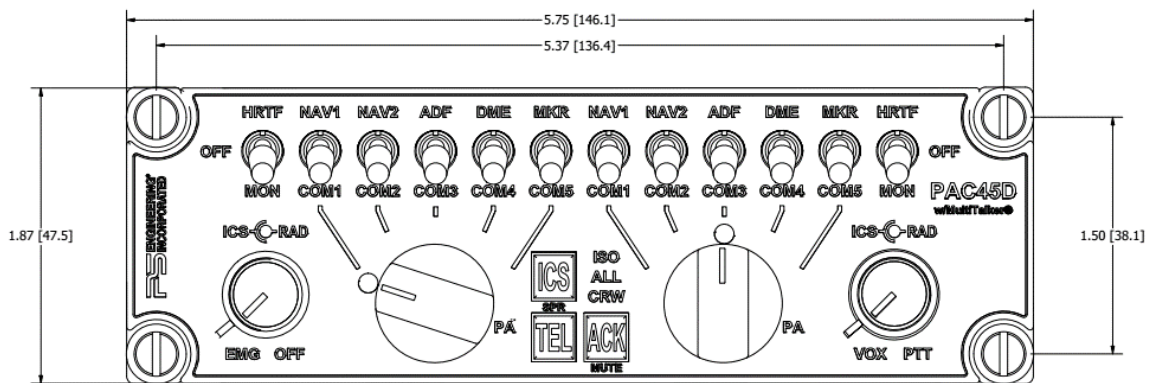
Figure 5-3 - PAC45D/CTL45D Front View

P453 (TOP)
P454 (BOTTOM)
26-PIN FEMALE
425-026-1800
625-015-1503

P451 (TOP)
50-PIN FEMALE
425-050-0967
625-050-0967
P452 (BOTTOM)
37-PIN FEMALE
425-037-1757
625-037-3703

4.89

7.78

5.53

5.37

5.75
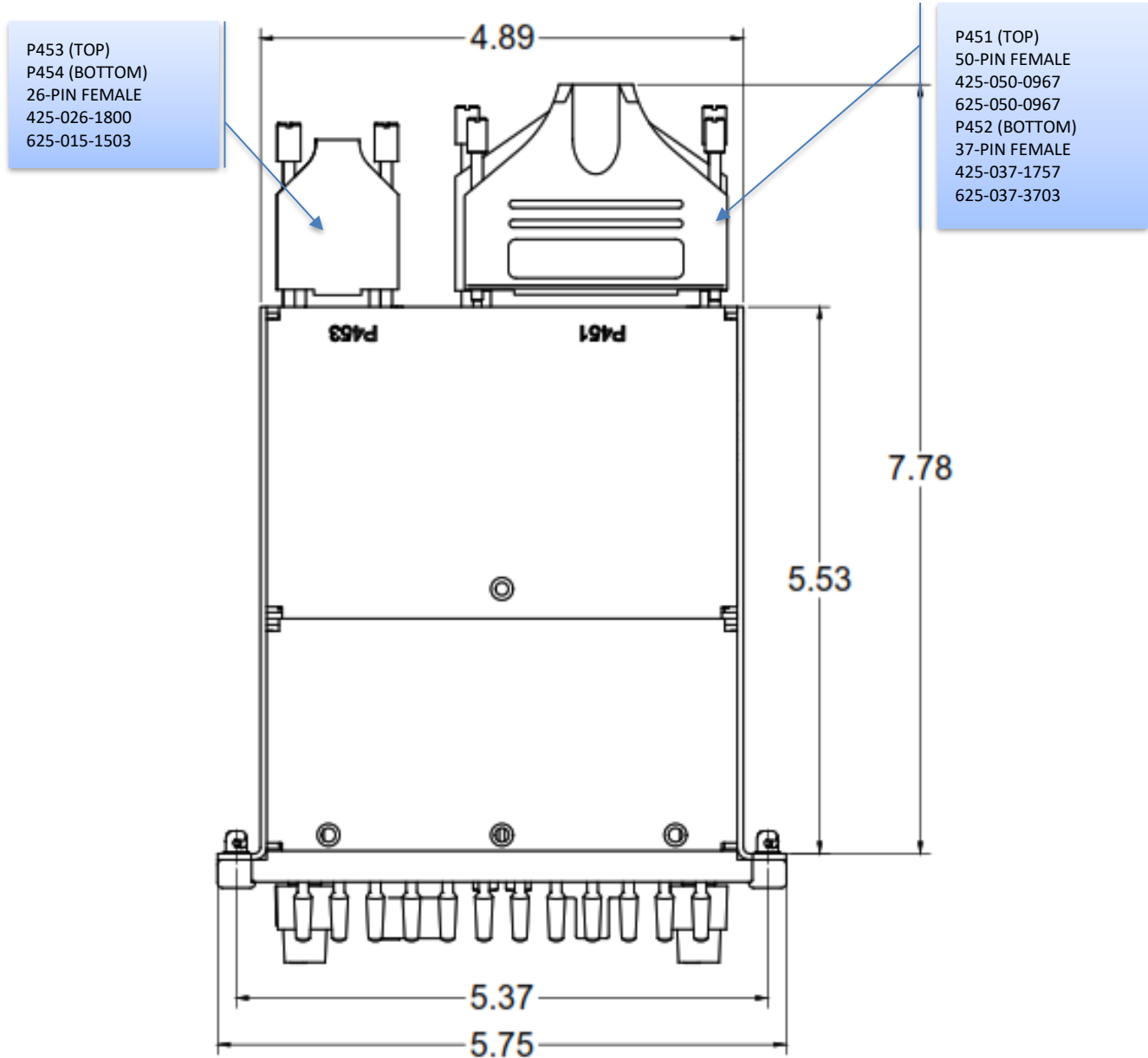
Figure 5-4 PAC45D Overall Top View

4.11

2.38

J455
9-PIN FEMALE
425-009-7709
625-009-9034

5.37

5.75
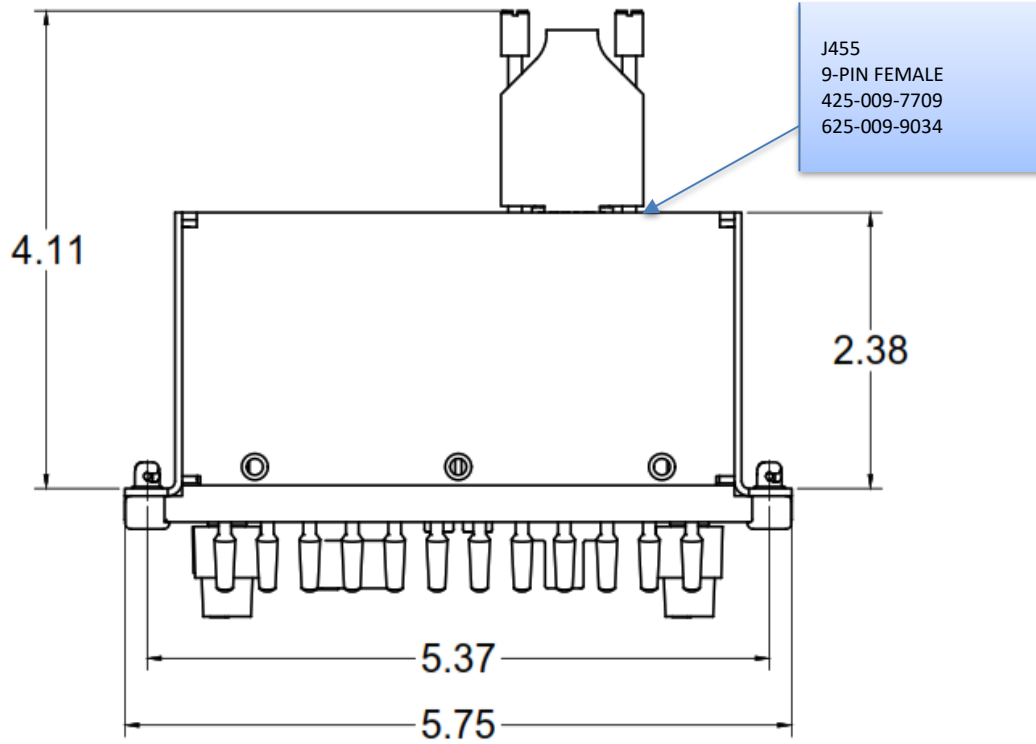
Figure 5-5 CTL45D Top View

4.88

P453 (TOP)
P454 (BOTTOM)
26-PIN FEMALE
425-026-2161
625-015-1503

P451 (TOP)
50-PIN FEMALE
425-050-0967
625-050-0967
P452 (BOTTOM)
37-PIN FEMALE
425-037-1757
625-037-1757

5.37

7.21

2.15 3.15

Ø0.16 in. X 4

P455
9--PIN MALE
425-009-0777
625-009-9034

5.38

5.88
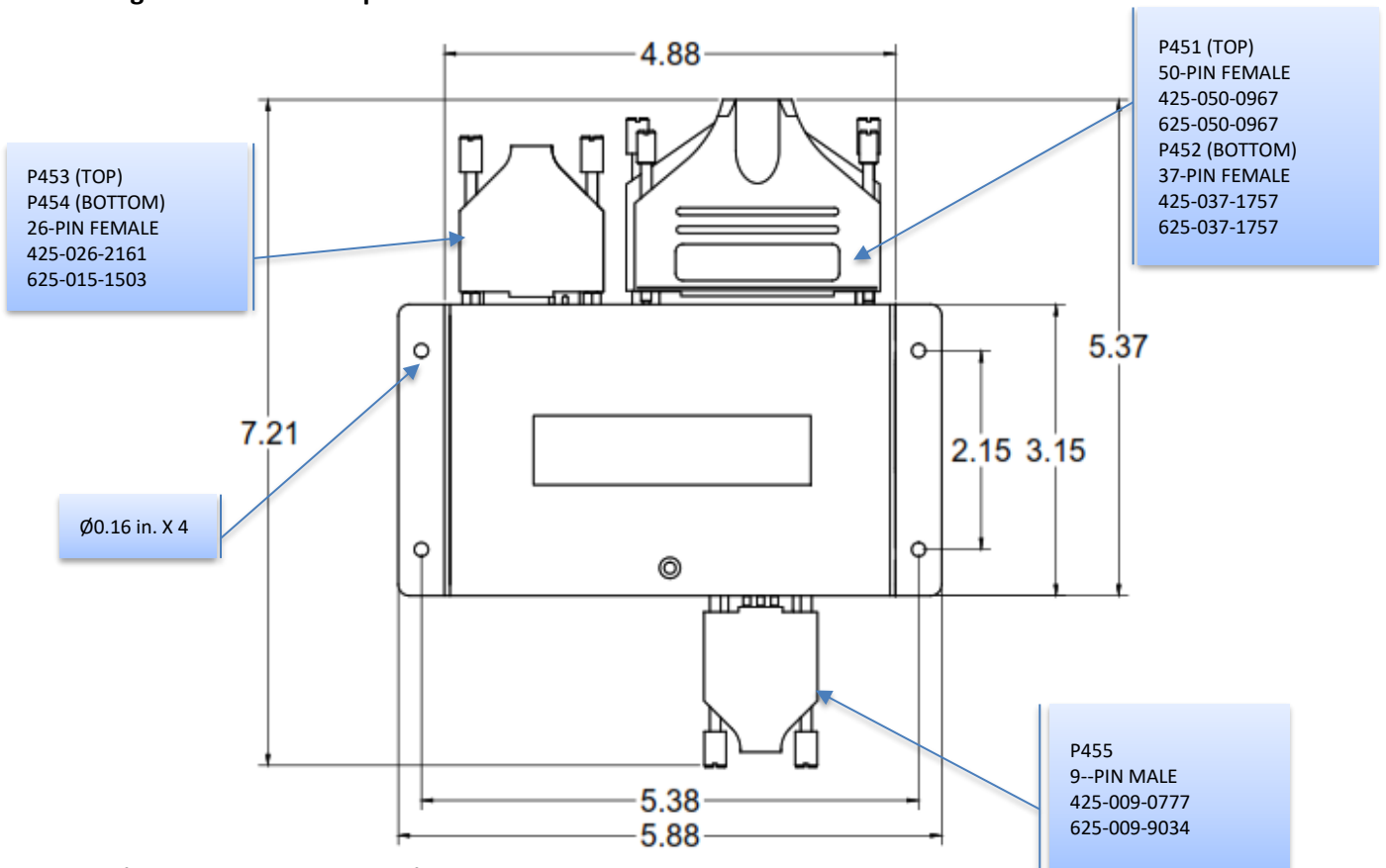
Figure 5-6 HUB45D Top View
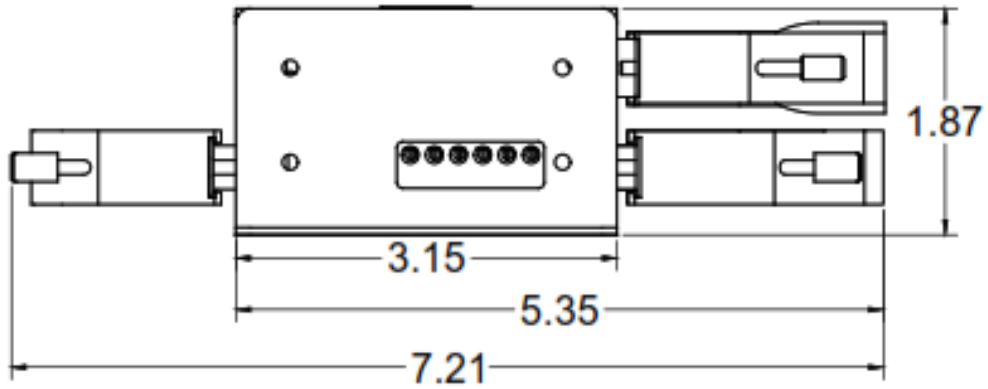
Figure 5-7 - HUB45D Side View

Appendix B – Radio Interconnect Wiring

PAC45D Radio Connections

Pins 16 & 35 are <u>No Connect</u> for P452; PS Engineering does not support AMS44 Tie Line

NOTE: TEXT IN (PARENTHESES) SHOWS AMS44 NOMENCLATURE

NOTE COPILOT CVR IN - 0101 HUB45
COCKPIT SPEAKER IN - 0103 HUB45
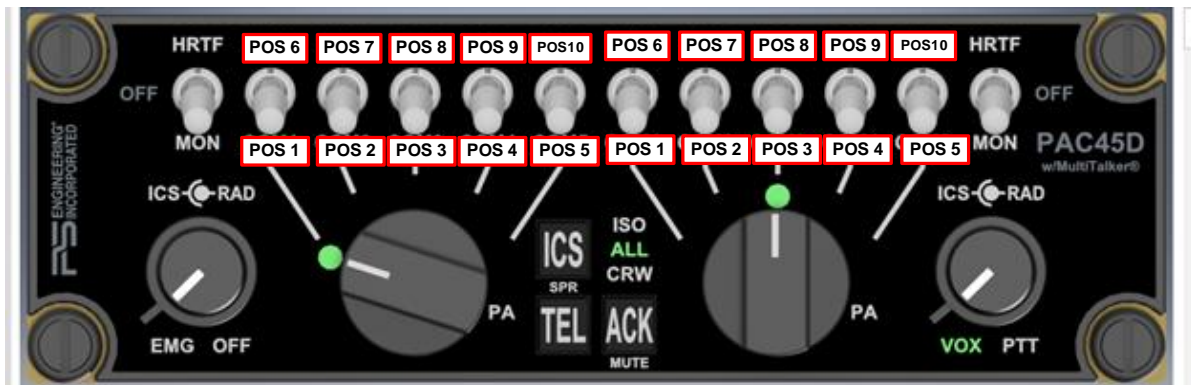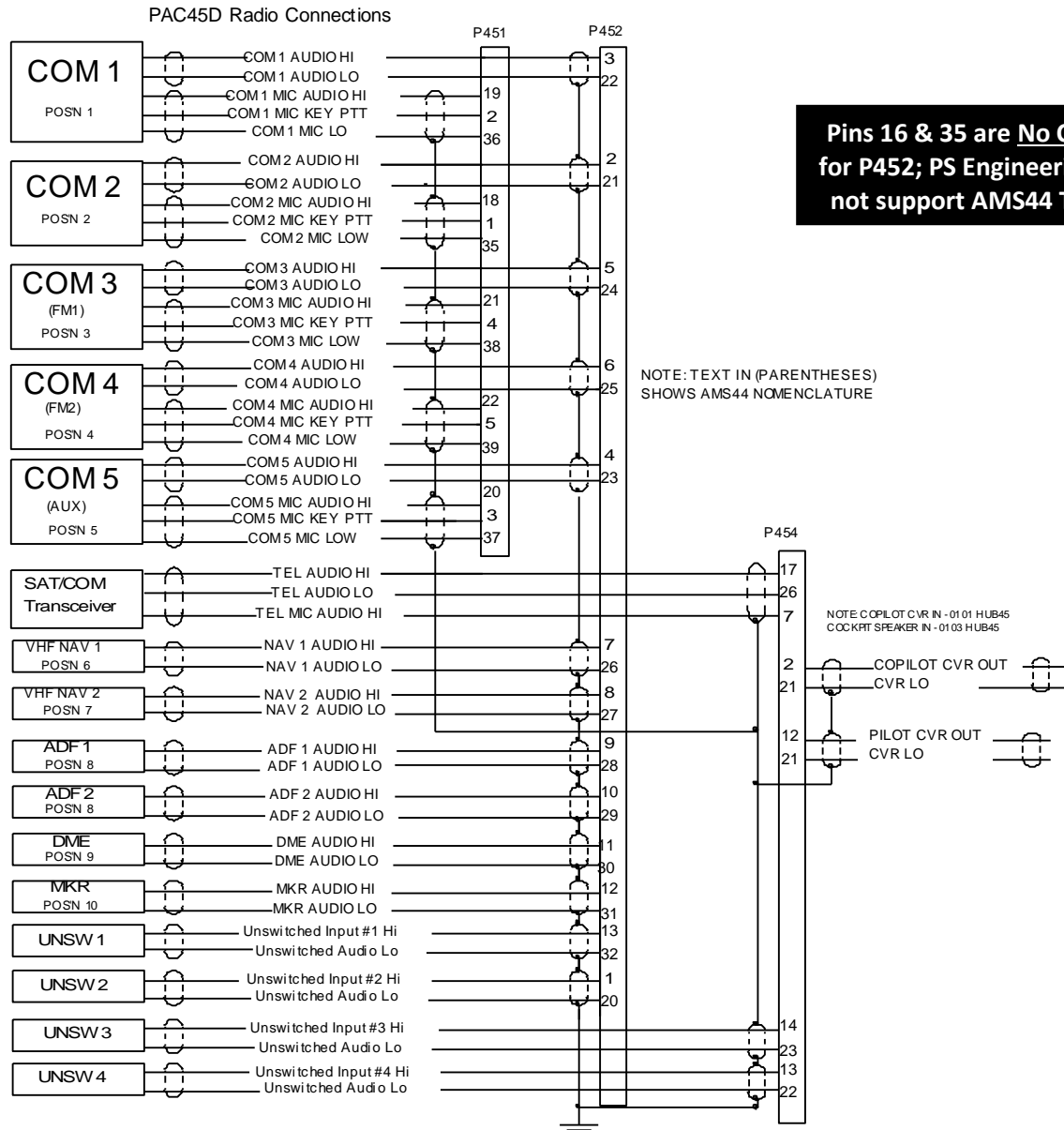
Because of the labeling flexibility on the PAC45D System, the nomenclature on the CTL45D may not match the wiring diagram. Shown here are the switch positions for each of the available inputs.

Appendix C – Intercom Interconnect Wiring

Pins 16 & 35 are <u>No Connect</u> for P452; PS Engineering does not support AMS44 Tie Line

Appendix D – Control Head Interconnect Wiring

J455

P455

1	RX- RS422 TX -	1
2	RX+ RS422 TX +	2
3	TX- RS422 RX -	3
4	TX+ RS422 RX +	4
5	GND	5
6	NO CONNECTION	6
7	POWER	7
8	AIRCRAFT GND	8
9	NO CONNECTION	9

PAC45
HUB LRU

PILOT/COPILOT
CTL45D HEAD

PAC45
HUB LRU

OBSR
P455

J453

20	RX- RS422 TX -	1
21	RX+ RS422 TX +	2
10	TX- RS422 RX -	3
19	TX+ RS422 RX +	4
24	GND	5
	NO CONNECTION	6
	AIRCRAFT POWER	7
	AIRCRAFT GND	8
	NO CONNECTION	9

+28V ACRFT POWER

0.5 Amp

OBSERVER
CTL45M HEAD
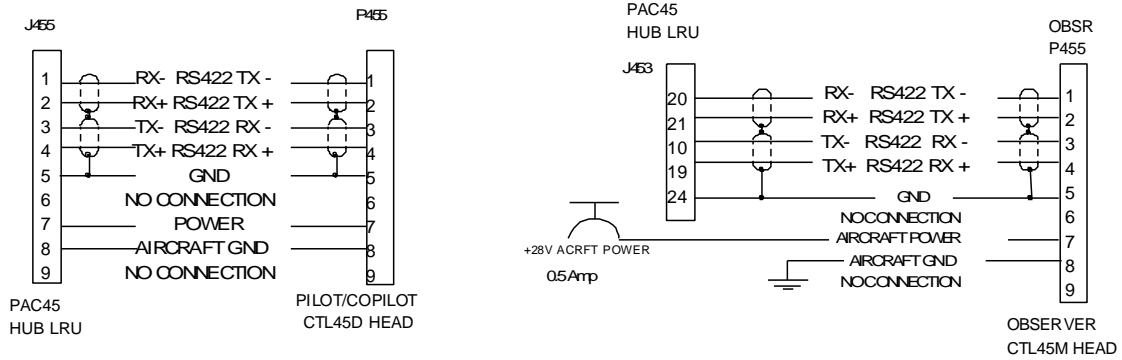
Appendix E, Unit Connector Wiring Reference

9.1   *J451 Connections*

PAC45D Connectors, J451

NOTE: TEXT IN (PARENTHESES)
SHOWS AMS44 NOMENCLATURE

9.2 J452 Connections

PAC45 Connector, J452

P452

COM 1	Com 1 Audio Hi — 3
	Com 1 Lo — 22
COM 2	Com 2 Audio Hi — 2
	Com 2 Audio Lo — 21
COM 3 (FM1)	Com 3 Audio Hi — 5
	Com 3 Audio Lo — 24
COM 4 (FM2)	Com 4 Audio Hi — 6
	Com 4 Audio Lo — 25
COM 5 (AUX)	Com 5 Audio Hi — 4
	Com 5 Audio Lo — 23
VHF NAV 1	Nav 1 Audio Hi — 7
	Nav 1 Audio Lo — 26
VHF NAV 2	Nav 2 Audio Hi — 8
	Nav 2 Audio Lo — 27
ADF 1	ADF 1 Audio Hi — 9
	ADF 1 Audio Lo — 28
ADF 2	ADF 2 Audio Hi — 10
	ADF 2 Audio Lo — 29
DME	DME Audio Hi — 11
	DME Audio Lo — 30
MKR	MKR Audio Hi — 12
	MKR Audio Lo — 31
UNSW 1	Unswitched Input #1 Hi — 13
	Unswitched Audio Lo — 32
UNSW 2	Unswitched Input #2 Hi — 1
	Unswitched Audio Lo — 20

Pins 16 & 35 are No Connect for P452; PS Engineering does not support AMS44 Tie Line

18 — PIL PHN (L) — Pilot Phones Jack
37 — PIL PHN Lo

17 — COPIL PHN (L) — Copilot Phones Jack
36 — COPIL PHN Lo

Music Source	Music (Left) — 14
	Music (L) Lo — 33
	Music (Right) — 15
	Music (R) Lo — 34
	+28VDC Dimmer — 19

9.3   J453 Connections

PAC45D Connectors, J453

CONNECT TO AIRCRAFT POWER
THROUGH CIRCUIT PROTECTION
EACH CTL45 DRAWS 150 mA

P453

Pin	Signal
10	SERIAL TX-
19	SERIAL TX +
20	SERIAL TX+
21	SERIAL RX-
	GROUND
	ACFT POWER

CTL45
Obsver

Pin	Signal	Jack
13	OBS 1 PHN (R)	OBS 1 Phones Jack
24	OBS 1 PHN LO	
	OBS 2 PHN (R)	OBS 2 Phones Jack
	OBS 2 PHN LO	
15	PAX 1 PHN (R)	PAX 1 Phones Jack
25	PAX 1 PHN LO	
16	PAX 2 PHN (R)	PAX 2 Phones Jack
	PAX 2 PHN LO	
14	PAX 3 PHN (R)	PAX 3 Phones Jack
	PAX 3 PHN LO	
	PAX 4 PHN (R)	PAX 4 Phones Jack
	PAX 4 PHN LO	

Pin	Signal
4	OBS 1 ICS-PTT
3	OBS 2 ICS-PTT
7	PAX 1 ICS-PTT
5	PAX 2 ICS-PTT
6	PAX 3 ICS-PTT
9	OBS 1 Radio-PTT

9.4   *J454 Connections*

J454 Connections with Pilot & Copilot CVR Output (050-045-0005 and 050-045-0101)
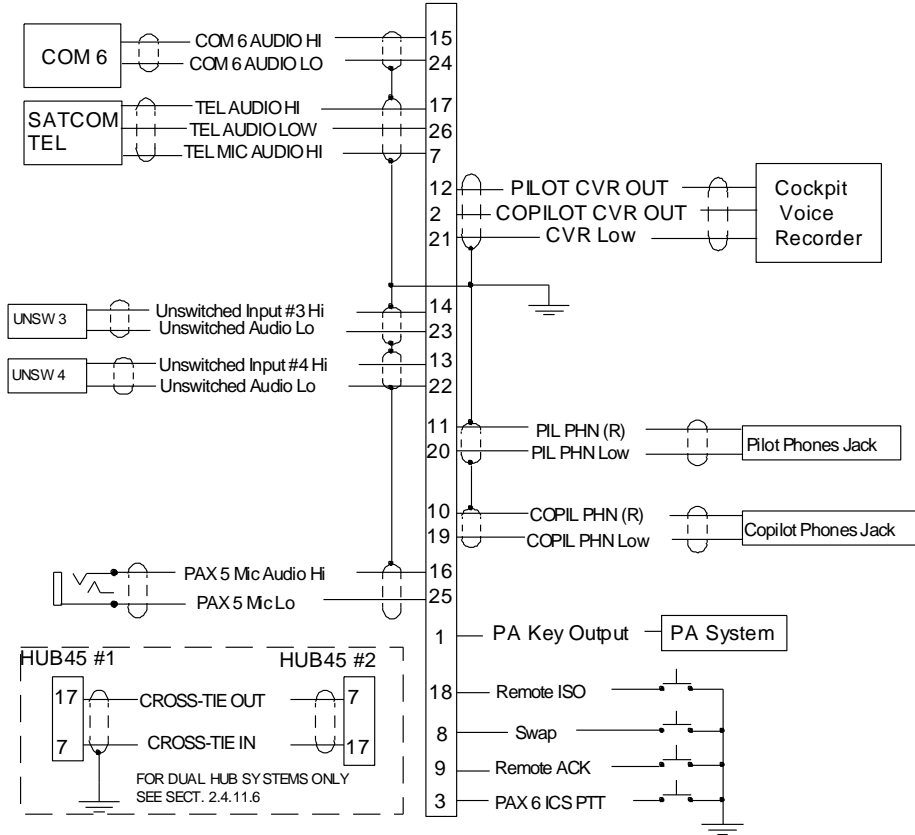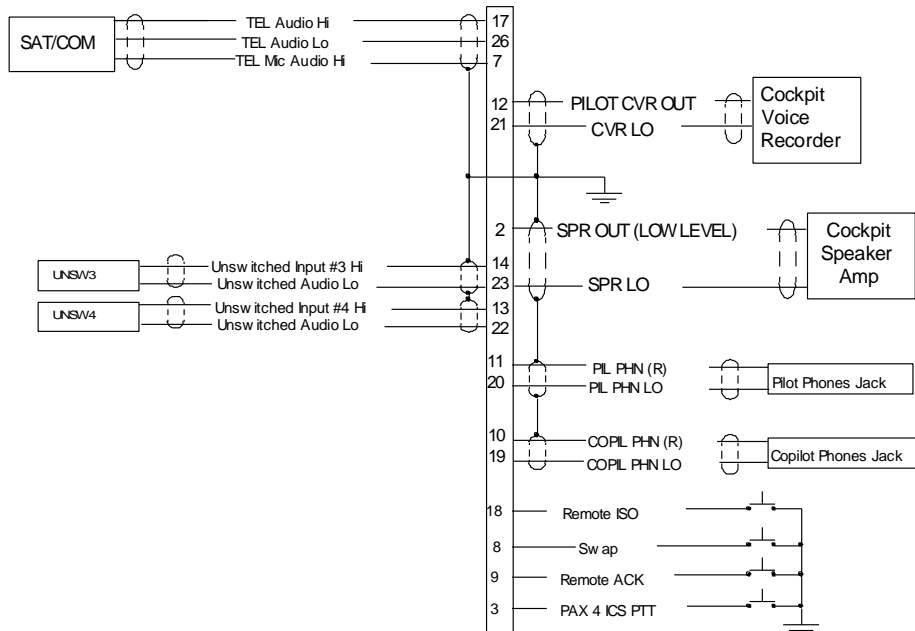

J454 Connections with Single CVR and Speaker Output (050-045-0006 and 050-045-0103)

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 PAC45D, you may use the following text as a guide.

Installed audio selector and 6-place intercom, PS Engineering PAC45D, 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 #A circuit breaker (type and part number), and total electrical load does not exceed ____% of the electrical system capacity with the PAC45D added.

Aircraft equipment list, weights and balance amended. Compass compensation checked. A copy of the operation instructions, contained in PS Engineering document 202-045-( ), 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 PAC45D 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 COM 2, pilot navigation audio 1 if stereo headsets are used,. 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	Removal: The PAC45D/CTL45 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 from the retaining standoff. The HUB45R is attached to the aircraft using four #6 screws on the flanges. Installation: 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 PAC45D Audio Selector Panel/Intercom Remote Hub

Part Number: 050-045-(0005, 0006, 6005, 6006)
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	-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 CTL45D, Audio Selector Control Panel

Part Number: 050-345-(XXXX), 050-346-(XXXX) NVG
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		
Altitude		Not Applicable, no cooling required
Decompression		50,000' unpressurized (D2)
Overpressure		Not Applicable
		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