

## Intercommunications System Aircraft Wiring Guidelines

### Introduction

For proper operation and maximum performance, an aircraft Intercommunications System (ICS) needs to be correctly wired, terminated, shielded and grounded. For those not familiar with these techniques, basic guidelines are covered. This can also help when upgrading aircraft systems or troubleshooting aircraft problems.

### Aircraft Audio System

Aircraft audio systems are designed to allow multiple Communication Control Units (CCU) to talk to each other, and to transmit and monitor the aircraft radio transceivers and receivers. To accomplish this any audio line needed for that CCU is connected to every other CCU that needs that functionality. The “party line” system allows anyone connected to that line to use it. Each input is high impedance, and each output can drive the terminated load. Typical systems are wired to allow the pilot and copilot full control and monitoring, but limit crew to only interphone and monitoring. Aircraft interconnects determine the capabilities and functionality for each operator. Minimum installations may have only a pilot and copilot CCU. Large installations can have eight or more stations.

### Audio terminations

Aircraft are electrically noisy environment. If all the high impedance audio lines were connected, noise pickup would be high. Lowering the impedance lowers the susceptibility of the audio to external noise. The audio termination also provides a fixed reference load for design of the amplifiers needed to drive the line, and minimizes volume level changes with differing numbers of CCU’s. However, **only one termination is used per line.**

### Where to terminate?

Termination should be either on the aircraft, or if available, the pilot and / or copilot CCU internal resistors can be used. Again, only terminate each line at one point. Andrea’s commercial helicopter CCU’s have internal terminations available (Table 1). Andrea’s military CCU’s have no built in terminations and instead are terminated in the aircraft. Wiring to the termination point or junction box should be shielded.

Note: Many Andrea CCU’s have pinouts labeled with “ICS load” or “RCVR1 load” etc. Don’t be fooled by this. There is no association with any audio path internally, they are just individual load resistors and can be used for any signal, not just their named signal

### Types of Audio signals

The three main types of audio signals in an ICS are:

1. Interphone audio – Each CCU is a receiver and transmitter over the same wires. (Fig 1)
2. Receiver Audio – Each radio receiver drives any CCU wired to that radio. (Fig 2)
3. Transmitter Audio – In order to transmit using an aircraft radio, the CCU must connect audio (Fig. 3) and a transmit control signal (Fig. 4).

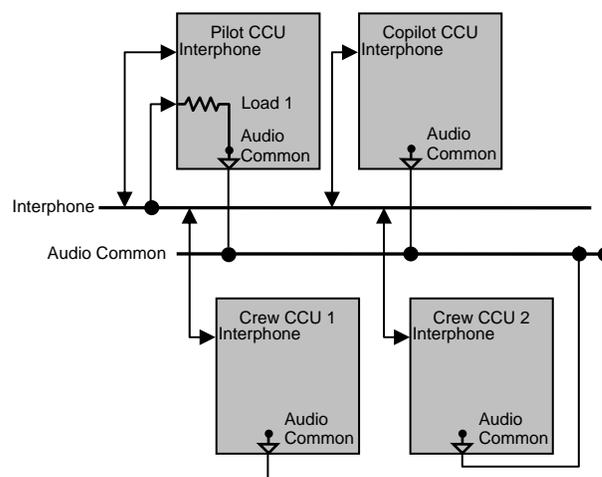


Figure 1 – Interphone audio

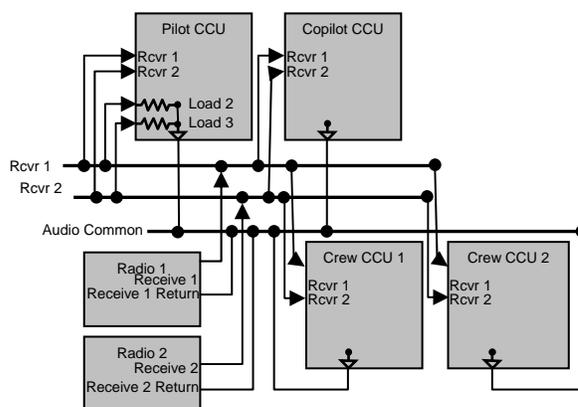


Figure 2 – Radio Receive Audio

### Common termination resistor values

Commercial helicopters typically use 600 Ohm terminations for most receiver and Interphone signals, with 80 to 150 Ohms for transmitter audio. Military aircraft (1950’s and

up) typically use 150 Ohm termination resistors for audio signals.

The built in termination resistors of Andrea ICS's are listed in Table 1.

**Table 1 – Internal terminations available**

Andrea CCU	600 Ohm	150 Ohm
A301-6[ ]	5	2
A301-6WCR	5	0
A301-61[ ]	5	0
A301-412[ ]	6	0

Caution: Although any CCU could be used to terminate an audio line, in practice only the pilot and/or copilot units are used. If a crew unit is used, since they are “non-critical” that unit may be removed at some point in the life of the aircraft. Without a terminated line, noise and level problems will arise “mysteriously”

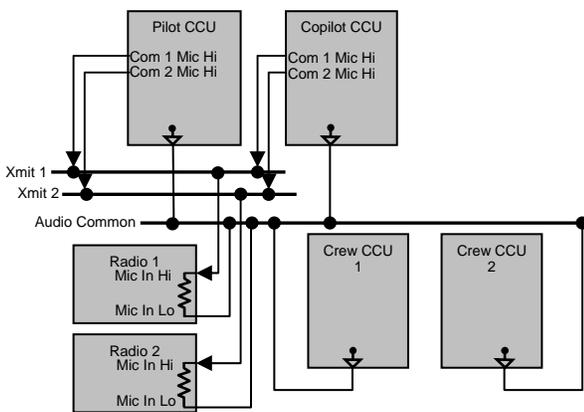


Figure 3 – Transmitter Audio

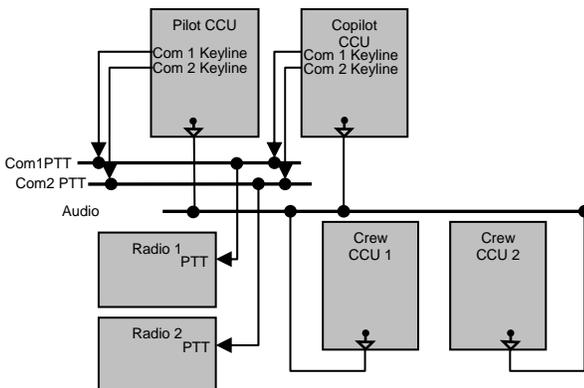


Figure 4 – Transmitter Control

### Transmitter Audio and Control

Each aircraft installation's wiring will determine which CCU stations can transmit. Figures 3 and 4 shows an installation where only the pilot and copilot stations are wired for transmitter audio and control. If the radio transmit audio input has a built-in termination resistor (as shown in figure 3) you will not need to add one externally. Most radio transmitter PTT (Push-To-Talk) inputs are active low, so a “wire-OR” configuration allows any connected CCU to activate transmit when it pulls the PTT line low.

### Audio common and aircraft ground

Care must be taken in separation of grounds. The “audio common” must be kept separate from the aircraft ground in all places throughout the aircraft except a single connection. Failure to do so will result in ground loops. Noise often plagues aircraft that have audio systems upgrades or changes that result in additional audio common and aircraft ground connections. The audio common wiring must be shielded just like any other audio signal.

Good practice is to run a separate shielded audio common from each audio system component to a well-shielded junction box where a single ground connection is made.

### Wire harness types and gauges

For most applications, all audio wiring should be 24 gauge shielded or shielded twisted pair. Power wiring should be 22 gauge or better.

### Aircraft wire bundles

To minimize noise pickup and interference keep all audio wiring away from 400 Hz power. +28VDC power and power return for each unit should be via twisted pair or better yet shielded twisted pair. The power return ground connection to aircraft structure should be as close to the single point audio common ground as possible.

### Headset connections

A critical connection is the headset microphone, particularly with a low level dynamic mics. Shielded twisted pair is a must for all headset connections, both microphone and earphone.

### Definitions

Terminology for the aircraft audio system varies somewhat, so for purposes of this application note the following:

- CCU – Communications Control Unit
- ICS - Intercommunications System, or Intercommunication Station.
- ISC – Intercommunication System Control
- Interphone – the local intercom on the aircraft. All CCU's will be connected to the main interphone line. Everyone can talk and listen to everyone else. Some aircraft have additional Interphone lines to allow separate communication.

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**Further Information**

1. See our website [www.andreasytems.com](http://www.andreasytems.com) for information and spec sheets.
2. Operator Manuals are available for the Andrea CCU's in Table 1. Our website has purchase information.

**Andrea Systems Background Information**

Andrea Systems LLC, located in Farmingdale, Long Island, New York was originally part of Andrea Radio Corporation, then part of Andrea Electronics Corporation. Andrea Systems LLC as separate company was created in April of 2003. For over seventy years, Andrea has provided high quality, state-of-the-art communications technologies for

both military and commercial applications. We are a leader in the manufacturing of audio amplifiers and intercom systems for aircraft including:

- Bell Helicopter AH-1, 205, 212, 412
- Boeing B-52, CH-47, DC-6, FA-18, KC-135
- Cessna T-37 Trainer
- Fairchild Republic A-10
- General Dynamics F-111
- Lockheed Martin C-5A, C-130, F-16, F-117, P3, U2
- Northrop Grumman F-14
- Sikorsky Aircraft UH-60, SH-60, EH-60
- And many other military/commercial applications.

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