

## Bluetooth

Wikipedia:

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz<sup>[2]</sup>) from fixed and mobile devices, and building personal area networks (PANs)

*Contrast with the term **Tootooch**, which is a native term for “Thunderbird”, also the name of my boat.*

### Introduction

I recently upgraded the panel on my Harmon Rocket II to add a second SkyView EFIS. I had already made provisions in the electrical system to support this, so that part of the job was easy. I also added a pair of panel jacks: one to support audio (music and cell phone) and the other to support data (RS-232 serial streams from the SkyView EFIS).

This page describes the way I added stereo audio, cell phone and Bluetooth to my panel.



### The Old Panel

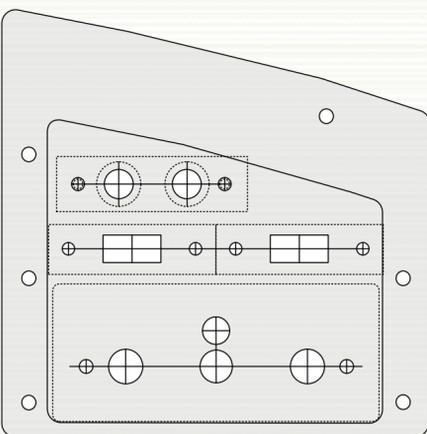
The old panel had a single EFIS, plus two 3” round blanks for future expansion. The iPhone and Trutrak EFIS shown in the drawing were never installed. On the bottom right of the panel was a 15 pin DSub connector which I used for various audio interfaces and access to serial ports.



### The New Panel

I reused the old panel and made a cutout for the SkyView D700 EFIS. In order to keep the intercom on the panel, I had to install a pedestal mount compass on the glare shield. A panel overlay was fabricated that held the intercom, two USB ports for the EFIS systems and a pair of jacks— an audio jack and a data jack.

I was happy that I didn’t have to make an entirely new panel, or change any wiring except for adding the two audio jacks and a pre-made USB cable on the panel overlay, and a power jack for the pedestal mount compass lighting. Since the compass is mounted to the glare shield, I found it more convenient to get power feed from the panel rather than run a longer wire forward.



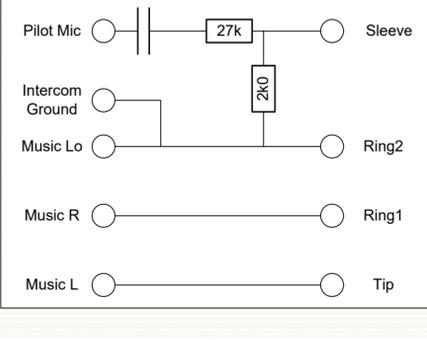
### The Audio Jack

The audio jack was purchased from Digi-Key, part #CP5-43502PM-ND. This is a 4-wire jack, capable of connecting to iPhones, iPads or iPods with a compatible cable.

Stereo music needs three wires... left and right audio and a ground. Cell phones need a 4th wire for the microphone circuit. The way the jack is wired, either a 3-wire cable (music only) or a 4-wire cable (+mic audio) works fine.

For older (mono) cell phones, an adapter cable is required to convert from a 3-wire 2.5mm audio jack on the phone to the 4-wire stereo 3.5mm audio jack on the panel.

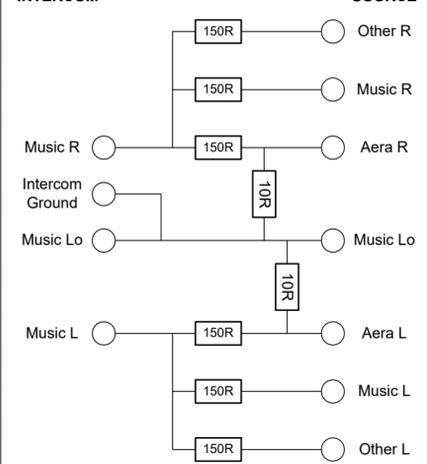
To eliminate ground loops, the jack must be insulated from the aluminum panel. I fabricated a plastic bezel to achieve this and mounted the bezel to the panel.



### Wiring the Jack

My PS Engineering PM-3000 intercom has a stereo music input that can directly connect to the audio jack.

All of the magic required to make a cell phone work with a regular intercom is contained in three little components... two resistors and a capacitor. The capacitor blocks the DC bias from the pilot’s microphone circuit and the two resistors attenuate the signal to be more compatible with the cell phone requirements.



### Passive Mixer

Unfortunately (or fortunately) I have a second music source on the panel... a Garmin Aera 500 that plays MP3 songs!

I made a passive audio mixer to combine music from the jack and music from the Aera. The Jack was wired to the Music R and Music L inputs on the mixer and the Aera on the other inputs. The only gotcha was that the Aera audio should be terminated with 10 ohm resistors to greatly reduce the audio noise introduced by the Garmin cable which runs the audio lines next to serial data lines without shielding.

This concept can be extended, but two or three sources is about the limit before the signal levels drop too far to get sufficient volume in the headphones. In fact, I later added the third set of inputs to another audio jack buried behind the panel for the Bluetooth adapter to reside, out of sight.



### Bluetooth—Music Only

I purchased a Bluetooth music adapter for \$8.00, including shipping from a local supplier. I also ordered a slightly different one from China for \$4.00, but it will take a long time to get here.

The happy accident is that my USB ports are next to the audio jack, so all I needed to do was plug it in to the panel, pair my iPad and I had tunes!

Quality is so-so with almost no bass and there is a fair amount of electrical noise, probably caused by the noisy USB ground. Not an in-flight problem with all that engine noise and aviation headsets, but a separate USB power supply would be beneficial in reducing the noise. \*\* Update, I fabricated a separately regulated power supply for the Bluetooth module USB port, which eliminated the noise. I located this quiet USB power receptacle behind the panel\*\*.

This adapter is only for music, so a cell phone will still need a cable... for now.

There is no need for this adapter to be panel mounted. I later buried it behind the panel, connected to a ‘quiet’ USB power receptacle and wired to the audio system using another 4-wire jack and the “Other” inputs on the passive mixer.

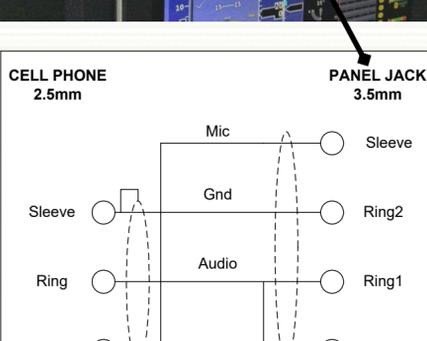


### Cell Phones

I fabricated an adapter cable by purchasing a 2.5mm 3-wire cable assembly with a jack on one end and bare wires on the other. I soldered a 4-wire 3.5mm plug according the diagram. Cable is Digi-Key 839-1031-ND. Plug is CP-35401SP-ND.

This allows my old LG flip-phone to be used in the cockpit. Since I wear a helmet in my Rocket, this is very convenient for filing flight plans.

Eventually I found a good Bluetooth music/phone adapter, so the cable was eliminated.



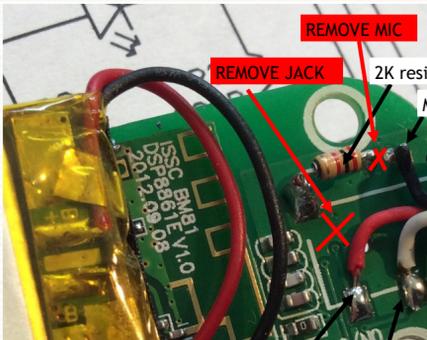
### Bluetooth—Cell Phone and Music

Further research led me to a commercial Bluetooth hands-free adapter. With some modifications, this device proved to work fine for music and cell phone operation, including iPhones. The hands-free adapter has an audio return channel from a built in microphone. The trick is to wire the microphone and 3-wire jack and solder a 4-wire cable into position (Digikey 839-1034-ND). Along with a single resistor, this provides the complete cell-music Bluetooth solution.

This adapter has controls for a music player or phone built into the case, however, everything can be controlled from the source devices directly, so it’s possible to bury the adapter behind the panel.

The default power-on volume level may be a bit low. If this is the case, attach the adapter in an accessible location inside the cockpit so that its volume may be easily adjusted.

A benefit of the adapter shown is that it supports multiple devices. It’s possible to wirelessly connect both a music player (iPod, iPad) and a cell phone. In this case, the cell phone takes priority when being used, automatically muting the audio from the other device and restoring it when the call is complete.



### Cable Wiring

The black wire connects to one of the mic inputs on the Bluetooth board. The other mic input is connected ground with a 2K ohm resistor. The red wire connects to the tip, the white wire to the ring1 and the green wire plus the cable shield connects to ring2. The colors are arbitrary as long as the plug is correctly wired to match.

The Bluetooth adapter uses an internal battery for portable applications. It is not necessary for permanent installations and may be removed.

The tie-wrap assists in stress relief for the cable when reassembled.

### Summary

This document provides information necessary to provide both cell phone and stereo music in the cockpit with wired connections, wireless connections, or both using readily available Bluetooth music or hands-free adapters.

