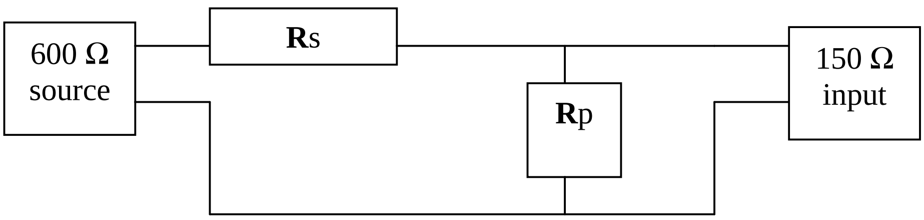
{interphone.doc}

WHITE PAPER

# INTERPHONE SYSTEM IMPEDANCE MATCHING

This white paper covers the problems encountered modifying the C-141 interphone system (IP). The main issues are matching a 600 Ω output (radio) to a 150 Ω input (IP) and getting the correct volume. This is generally done using a "pad" – which is a series and a parallel resistor. (See the schematics on the following pages.) On the C-141 the parallel resistor is generally 150 Ω for reasons that are not clear.




$Z_t = R_s + R_p(150)/(R_p + 150) = R_s + 75\ \Omega$ {where $R_p = 150\ \Omega$ }

If $Z_s = 600\ \Omega = R_s + 75\ \Omega$, then $R_s = 525\ \Omega$

Therefore, the 525 Ω allows the source to "see" a matched impedance if the parallel resistor is 150 Ω. Note that the interphone (IP) voltage is Vo(75/600) = Vo(1/8). The resistor pad reduces the voltage and current at the IP – which seems appropriate if we assume that a 600 Ω source operates at a higher voltage than a 150 Ω source would. Choosing $R_s = 525\ \Omega$ is a good starting point {when $R_p = 150\ \Omega$} based on experience & on the fact that the source sees a matched load while the IP sees a safe voltage/current.

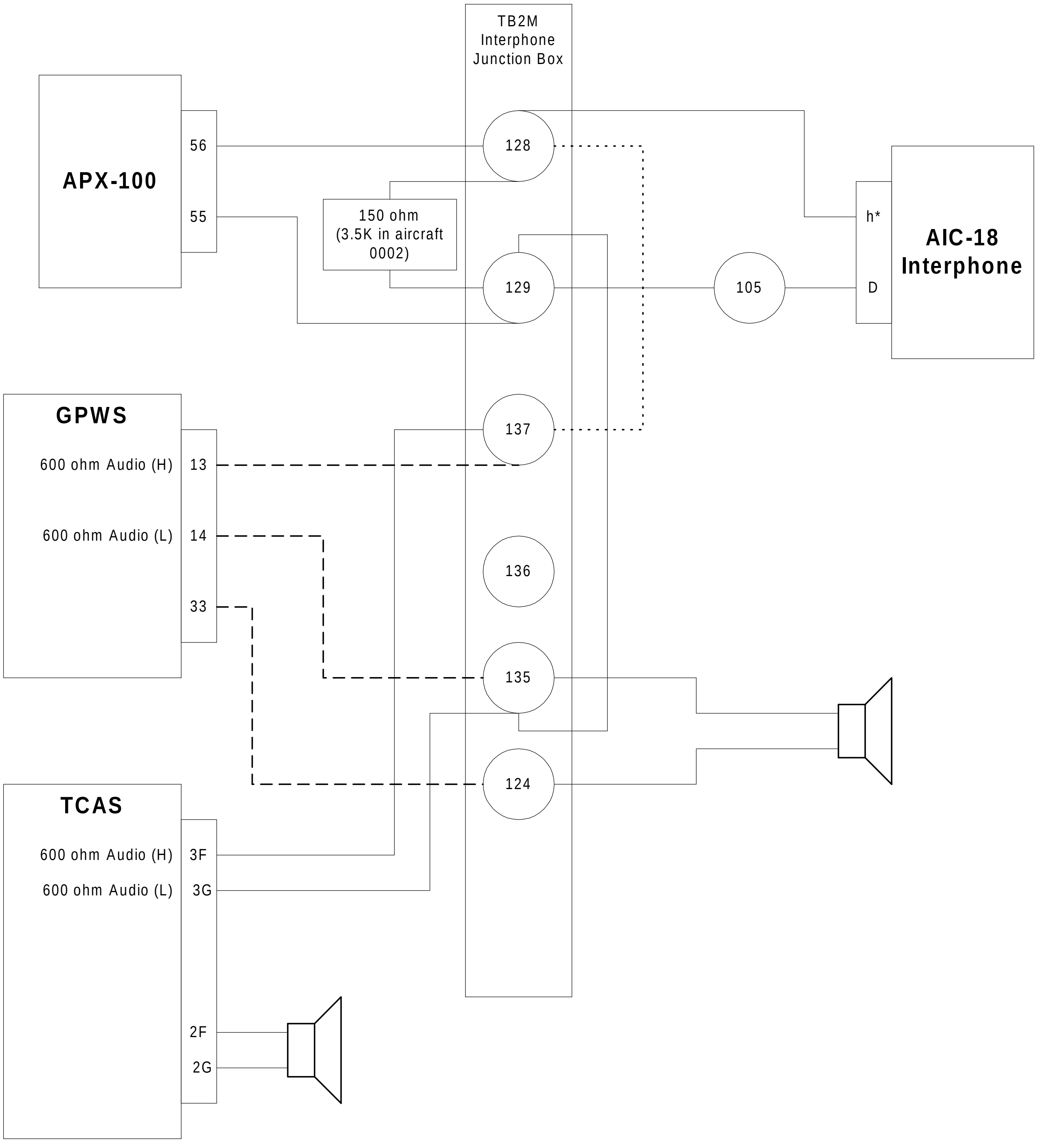
Reducing $R_s$ always increases the power delivered to the IP. This will increase volume provided the IP can make use of the higher voltage/current. Likewise, increasing $R_p$ always increases the power delivered to the IP. This will increase volume provided the IP can make use of the higher voltage/current. Maximum power is delivered to the IP when no resistors are used & the source is straight wired to the IP. A transformer is required to increase power further.

[Note that the most efficient method is to use a 600 Ω/150 Ω audio transformer (see Mil-T-27). The transformer method would deliver ~100% of the power to the IP (at ½ Vo). However, this method has not been used on the C-141.]

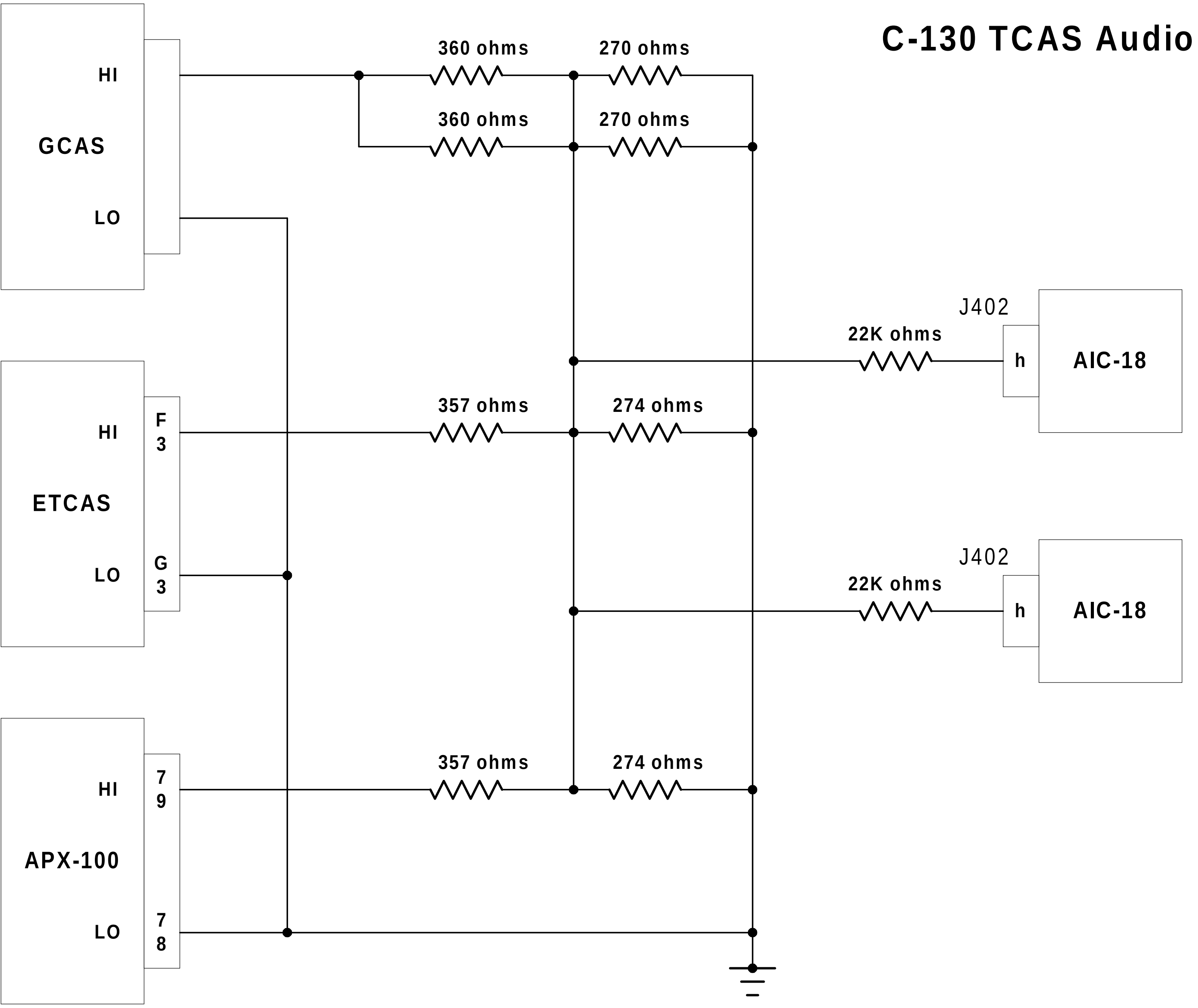
**Procedure for Tuning the Volume:**

In order to tune the volume of the source, the integrator should start with a series resistor of ~525 Ω and increase $R_s$ until the audio volume is equal to a similar audio input that has been in use for some time. It is very difficult to judge the correct volume unless the aircraft is in flight because of engine noise, ear plugs, etc. What sounds good on the ground is probably too low in flight! That is why the volume should be specifically tested/adjusted in flight or made equal to a known good audio or both.

A reasonable range for $R_s$ is 525 - 1000 Ω. The AAR-47 missile warning was changed from 27K to **620 Ω**. The GCAS went from 5600 to **1000 Ω**. Prior to the change, both were nearly inaudible over the headphones if the cockpit speaker was turned off.




# C-141 TCAS/TAWS AUDIO




<u>Additional comments</u>: The choice of 150 Ω for Rp is probably based on the fact that the IP has an input impedance of 150 Ω. This 150 Ω Rp will be in parallel with (600 Ω + Rs). The result is that the IP will always see less than 150 Ω. If Rs = 525 Ω, then the IP will see ~ 132 Ω which sounds pretty good. (In other words, the radio will see 600 & the IP will see just under 150 – which is a pretty good "impedance match".) This allows the source to deliver at its expected load. However, you should adjust from that point to obtain the proper volume. Since this is subjective, louder is generally better – especially for alarms.