Using Intercoms in Aircraft

Applications Note AN-4
p/n 81334

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BACKGROUND

RST has two voice-actuated intercoms in its line of kit avionics. These are the RST-442 2-channel and the 445 4-channel systems. This applications note will attempt to clarify and expand the "Operations" section of the manual.

PROVIDING POWER

The RST-442/RST-445 intercoms were designed to run up to 40 hours on a 9 volt alkaline cell. (Helpful hint: if you buy your batteries from a store that sells a lot of these they'll be fresher!) Simply clip the battery onto the side of the chassis, snap on the battery connector, and you're ready to go. When you have finished using your intercom don't forget to turn it "OFF" to conserve battery life. If you tire of replacing batteries, but appreciate the completely portable operation they provide, you may wish to consider purchasing a 9 volt NiCad cell and charger. If you don't forget to snap the cell back into its charger after a day's flying, you'll always have a "fresh" battery handy. (By the way, it is actually GOOD for a nickel cadmium battery to be discharged up to a point -- so not to worry if you forget). If you use your intercom frequently, NiCads are less expensive and probably a good investment. Inexpensive zinc carbon cells may work, but they have a high internal impedance and can cause your intercom to oscillate (hum loudly) at high volume settings.

Many aircraft have cigarette lighters, and the 442/445 intercoms have been designed to work directly with BOTH "12 volt" and "24 volt" aircraft power supplies. Before you decide to use your lighter socket as a source of power, you should check to be sure it has been properly fused or connected to an appropriate circuit breaker. It would also be wise to check that, as is normally the case, a POSITIVE voltage has been provided to the center of the lighter jack. (The rim should be at airframe ground). Finally, it is not a bad idea to clean the jack's contacts -- especially if it is old or frequently used. When you insert the 442/445 intercom's cigarette lighter plug into this jack, the intercom's 9 volt battery will be automatically disconnected from the circuit (if fresh, it will normally last for the shelf life of the battery). Though it is not now necessary for intercom operation, retaining the 9 volt cell on the 442/445 provides a "failsafe" power supply to keep your cockpit communication system functioning should aircraft power ever be interrupted.

VOICE-ACTUATED SQUELCH ("VOX")

The VOX circuit in the intercom is intended to cut out background microphone noise until such time as a crew member wishes to say something through the intercom. Then the squelch breaks, turns the amplifiers in the intercom on, and turns them off when the talking stops. The problem with this audio-type squelch (as opposed to the more common RF signal squelch) is that there is no continuous "carrier" or transmitted signal with constant level from which to derive the squelch signal. The squelch signal must be derived from the actual voice modulation to the microphone. While at first this might seem to be a rather easy task, remember that this circuit (with only one adjustment) needs to work in a very noisy environment with widely varying voice levels, in addition to hard and soft voicings of words. Throw in mis-positioned microphones, as well as the very real possibility of microphones with slightly different output levels, and it is a wonder that the VOX can work at all. Some users of the intercom have commented that the squelch is "touchy" or hard to set. We agree. VOX

squelch, to accommodate a tremendous dynamic range of inputs, noise levels and voice levels, is necessarily a rather critical adjustment. There are, however, several procedures that can be used to make the VOX quite usable in the aircraft environment. They are outlined below.

VOX ADJUSTMENT

The "squelch" adjustment on the intercom sets a bias level on the squelch gate amplifier. When the microphone audio level exceeds the squelch bias, the gate snaps open fully and allows audio through the headphones. When microphone level is below the bias level, the gate shuts and no audio gets to the headphone amplifiers. This squelch is an on-off circuit that is antitease; that is, the squelch control cannot be set so that the squelch is only slightly on -- it is an all or nothing proposition.

Also, once the squelch circuit turns on, it stays on for 3-5 seconds before turning off. This allows a pause in the conversation without the intercom audio dropping out. Therefore, before setting the squelch control, all audio inputs must be quiet for AT LEAST 5 seconds to allow the "hang" circuit time to reset.

With this type of circuit, a difference in ambient (i.e. cockpit) noise level will necessitate a change in squelch control position. The trick is to set the squelch control twice -- once during taxi and again when you apply full takeoff power. The thing to remember is that the squelch bias is used to JUST overcome the background noise of the microphones, and also remember that a noise-cancelling microphone can only cancel a portion of the noise -- not all of it. And don't forget to WAIT 5 seconds before saying anything.

MICROPHONE ADJUSTMENT

If there is any one item which will make the intercom play either perfectly or poorly, it is the mechanical adjustment of the microphone element. The microphone must be positioned DIRECTLY in front of the user's mouth -- NOT off to one side, NOT at the corner, but right square in the middle of the mouth. If the microphone is on an aluminum-tube boom, the boom should be bent to fit. If the microphone is on a swivel, it should be adjusted so that the microphone element is in front of the mouth when the headset is in the operational position on the user. As to the distance between lips and mike -- if you can't pucker your lips and touch the case, it isn't close enough.

All this comes about because of the use of noise-cancelling microphones. Not that noise-cancelling is bad -- far from it, it is a great aid to intelligibility in communications with an aircraft microphone. The problem comes when your voice does not enter the microphone directly, from the front -- the microphone thinks your golden baritone is "noise" and promptly proceeds to cancel out this perceived "noise". The end result is exactly what the designer intended -- noise cancelling and no microphone output. The only correct way to use a noise-cancelling microphone is to talk DIRECTLY into the FRONT of the microphone element.

MIXING MICROPHONES

We have two basic microphone types in aviation -- carbon and amplified dynamic. Carbon has been with us since pre-WWII. We know a lot about them -- not all good. We know carbon is noisy, unreliable, prone to moisture damage, poor in fidelity -- and cheap. Dynamics are great -- and expensive. Not only that, but carbons have a tendency to have lower and lower output over time and use, while dynamics' output pretty much stays put. For this reason, when new, carbons may appear to have a higher output than a dynamic. As the years go by, carbons drop and drop in amplitude until (at some point) they are equal in amplitude to a dynamic, then continue their drop to a lower level. To try and balance a carbon against a dynamic requires a bit of continuous juggling. The problem is this: The 442/445 were designed to use microphones that are equal in output, and there is no room on the board for an individual microphone gain for each input. However, it is certainly

possible for individual owners to hand-select individual microphone gain resistors to equalize the microphone gains. In the RST-442 these are R11 and R12, while for the RST-445 the resistors are R11, R12, R13 and R14. The value of these resistors may be decreased to as low as 33K ohm (to increase gain) or may be increased above 1 megohm (to decrease gain). The best practice is to decrease the gain of louder microphones until all microphones have equal gain.

Many dynamic microphones have an adjustment either contained inside one earcup or in a small box attached to the cord (see manufacturer's literature for details). If this adjustment is set too high, it may cause distorted audio in your 442 or 445 intercom (particularly apparent at low volume settings). If this is the case, simply return the headset adjustment to midrange in accordance with the headset manufacturer's instructions.

ABOUT PTT SWITCHES

Some push-to-transmit switches are designed only for use with headsets and radios and leave the microphone audio line (this is the "ring" portion of the microphone plug) connected to the radio even when the radio is not transmitting. Since some radios ground (disable) the microphone audio in receive mode, this type of PTT switch is unsuitable for use with an intercom system. If you already HAVE PTT switches in the aircraft you may wish to try them with your intercom. If, however, you find that you lose intercom function (microphones are weak, distorted, or dead) when you plug the Option 1 "PILOT ICS" AND "COPILOT ICS" plugs into the COM radio via these PTT switches you will need to either 1) change to a model switch which opens the audio line when not transmitting or 2) consult your local radio shop and have a relay installed to achieve the same effect.