

Northern Airborne Technology Ltd.

Installation Bulletin

Products Affected: ALL Audio Controllers (AA90/95/AMS40/41/42/43/44, etc.)

AA90 Series Manual: Bulletin Section	No Warranty Action Required.	Parts avail. at no charge direct from NAT.		Date Issued: Mar. 3 /90
Subject: ICS Tie Line Operation				

COBHAM

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Overview:

NAT's audio controllers have the ability to send ICS/intercom audio (only) between units to allow larger systems to be assembled with common or split ICS loops. This is accomplished by connecting a shielded line between units called the ICS TIE LINE. This line is bi-directional, and ICS audio leaves and enters the controller via this line. There are several important considerations regarding the use of this line, and these are discussed in this installation bulletin.

Product Changes:

Effective serial number 1919 on single channel controllers, and serial number 1110 on dual channel controllers (March 31, 1988), two internal adjustments were added to these units to simplify the use of the ICS tie line. These controls are an ICS TIE adjustment (sets the output series resistance), and an ICS GAIN adjustment. These changes were made to improve operation of AA90/AMS40 series units in multiple box installations, and equalize ICS levels.

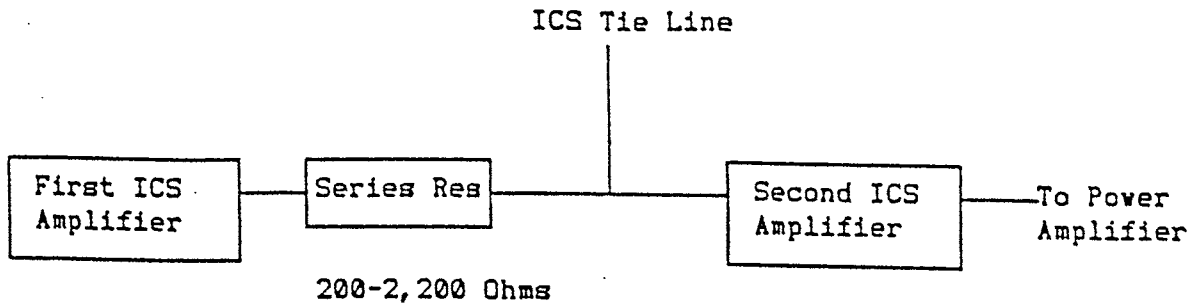
Other devices also have ICS TIE lines, such as the AA38 ICS LOOP unit, and the AA80 InterVOX unit. They must also be carefully considered when a larger system is implemented, to prevent ICS imbalance between units. These units have no internal adjustment, and the controllers must be balanced to them for optimum use.

Early boxes manufactured by NAT (prior to the serial numbers shown) have a smaller series element (200 ohms), and a fixed ICS gain factor. When mixed with newer units which have a much larger series element (2.2K) they will exhibit severe ICS gain imbalance from unit to unit (although they will be balanced with a single unit). To cross-connect old and new boxes, or to correctly connect new boxes, and provide the best ICS operation is the subject of this installation bulletin.

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Theory:

The ICS TIE node is implemented by the following circuit, shown below:



If boxes of the same type (old or new) are connected together, the series element represents the effective load to ground (reflected back into the first ICS amplifier output), and it thus follows that between each unit, a voltage divider is formed by these elements, effectively cutting the ICS voltage output exactly in half, compared to a single unit. Three units connected will result in 1/3 of the normal voltage, four units gives 1/4 of the normal voltage.

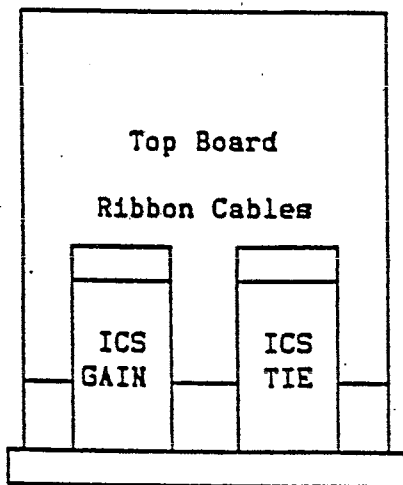
With old boxes, this resistance is 200 ohms, with new boxes, this resistance is 2,200 ohms. If old and new boxes are connected together, the output of the new box will be cut to only a TENTH of its normal value, and the old box will output almost its normal value, the result will be a severe mismatch of ICS levels, and very low ICS volume in the new box. This drives installation crews crazy, as the box will work perfectly by itself, and on the bench, but will not work correctly when cross-connected.

In addition to this change, new boxes also incorporate an ICS GAIN control, which allows the signal to be restored to its previous level when cross-connected. To set this control correctly, however, you must know how many boxes are connected together in a given ship.

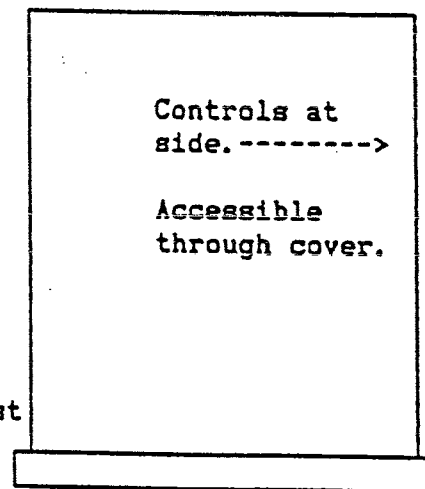
Control Locations:

Single Channel Controllers

Dual Channel Controllers



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Pots are UNDER
Cables. Remove
top cover to adjust



Practical Techniques:ALL NEW BOXES IN THE SAME INSTALLATION

In a system comprised of all new boxes, installation is very simple. All boxes now come from the factory with the series element (ICS TIE) control set to a total resistance of 2.2K. If you are unsure of this setting, measure the resistance of the pot and the series resistor with an ohmmeter, with the cover removed. All units should be set to 2.2K.

Boxes are NOW normally set in the factory for multiple installation (external ICS tie load of 2.2K) and the ICS GAIN control adjusted for a headset output of 250mW into a 600 Ohm load. This adjustment is done with the front panel ICS LEVEL control turned fully clockwise. If these units are operated alone the ICS gain may be slightly high, and result in clipping before full rotation of the front panel ICS LEVEL control. If this is objectionable, or if other interference is picked up on the ICS tie line (the symptom will be that the spurious signals track the position of the front panel ICS LEVEL control), simply adjust the internal ICS GAIN control for an acceptable lower level.

To balance units, you can apply a 1KHz tone (0.25Vrms, capacitively coupled via at least a 1uF non-polarized capacitor) to any microphone jack, and measure the headset output with a wattmeter (150 or 600 ohms). You should adjust the ICS GAIN pot in each unit to give the same output (with the front panel ICS level control set to the same position), regardless of which box the simulated microphone is connected to. FOR FORESTRY INSTALLATIONS, SET THIS LEVEL TO 100mW. An acceptable alternative with no equipment may be to switch headsets attached to different boxes while talking on the ICS circuit, and adjust for equal sounding levels (not precise).

If you experience side-to-side level problems, it is most likely an imbalance in the ICS TIE pot setting (series element), which is causing different ratios of the ICS signal to be sent to each side. Check again that this is set to 2.2K at each box (measure both the pot and the fixed resistor), before continuing. There may also be a gross difference in the setting of the ICS GAIN pot on differing units. You may also have an existing older box and new box mixed together.

The ICS TIE pot is normally set to 2.2K Ohms at all times when used in an all new system, unless a small adjustment is required for balancing. DO NOT USE THIS ADJUSTMENT TO TRY AND EQUALIZE LEVELS, AS IT WILL FORCE AN IMBALANCE BETWEEN BOXES THAT CANNOT BE CORRECTED BY OTHER ADJUSTMENTS.

OLD AND NEW BOXES IN THE SAME INSTALLATION

In a system comprised of mixed boxes, installation can become more complex, as you must first identify which boxes are of which type. All new boxes come from the factory with the series element (ICS TIE) control set to 2.2K Ohms, but you can make this into a 200 ohm series element simply by rotating the control to its MINIMUM setting. This will make the new box behave as if it were an old unit, and will prevent ICS imbalance between units. Unfortunately, excessive loading on the ICS TIE line may now increase distortion and reduce available ICS level if more than two old style boxes are connected together.

Old units have no ICS GAIN adjustment, so only the new units can be adjusted, to give equalized performance. To balance units, you can apply a 1KHz tone (0.25Vrms, capacitively coupled via at least a 1uF non-polarized capacitor) to any microphone jack, and measure the headset output with a wattmeter (150 or 600 ohms). You should adjust the ICS GAIN pot in each new unit to give the same output (with the front panel ICS level control set to the same position), regardless of which box the simulated microphone is connected to. An acceptable alternative may be to switch headsets attached to different boxes while talking on the ICS circuit, and adjust for equal sounding levels (not as precise). You will not be able to deliver full ICS performance in this type of system unless some modifications are made as detailed below.

If you experience side-to-side level problems, it is most likely an imbalance in the ICS TIE pot setting (series element), which is causing different ratios of the ICS signal to be sent to each side. Check again that this is set to the minimum setting at each box (200 ohms set by the fixed resistor in series with the pot), before continuing. There may also be a gross difference in the setting of the ICS GAIN pot on differing units.

Preferred Modifications

It is possible to improve operation by carrying out some simple modifications to the older units in your system. These can be very simple, such as just changing the internal series resistor in units from 200 to 2.2K Ohms, or can be more complex, such as installing both pots and modifying the 2nd ICS stage to give variable gain. For full details on this option, contact NAT directly for details. We will require the model and serial number of your unit to give you exact instructions. The parts required will be provided by NAT at no charge, if you are a factory authorized dealer or service center. The schematic and parts layout is provided in the service manual for this product.

This modification is strongly recommended over adjusting all boxes to the lower performance level of the older units.

Interconnection Considerations:

The ICS TIE LINE is a low level signal line, with a 0dBm level during ICS operation. Care must be taken to insure that this line is correctly installed, shielded, and terminated, or significant interference may result, degrading system operation. Shielded, twisted pair interconnect can be used with this line to further improve interference rejection.

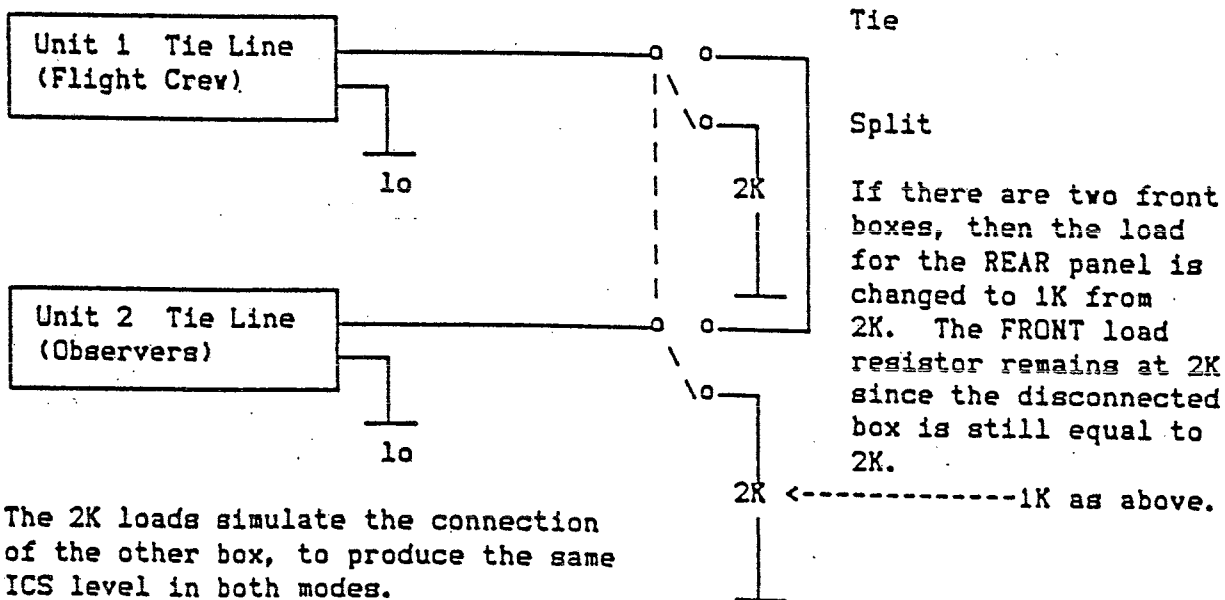
NEVER bundle this line with RF coax lines, inverter or synchro wiring, or any high level signals. Inductive and capacitive coupling through the cable may result in significant interference which can only be corrected by re-routing the cable. Of all the lines in an AA90/AMS40 installation, this is the most sensitive, and should be routed with care. NEVER ground this line external to the controllers.

In difficult installations, you may wish to run this line as a shielded, twisted pair, with the shield grounded at one point, and the hi and lo lines connected through to other units. This provides superior rejection of coupled interference.

Tie/Split Operation:

If it is desired to split the ICS loops via external switches (such as dual or triple installations, etc.), you should observe the following technique. First, adjust the units for acceptable operation with all units connected together (this will be the maximum gain setting for the system). When the units are split (ie., the tie line is opened between units), load each line with a resistor equivalent to the disconnected load (2K per box). THIS WILL PREVENT SUDDEN SHIFTS IN LEVEL WHEN CHANGING FROM THE TIE TO SPLIT MODES.

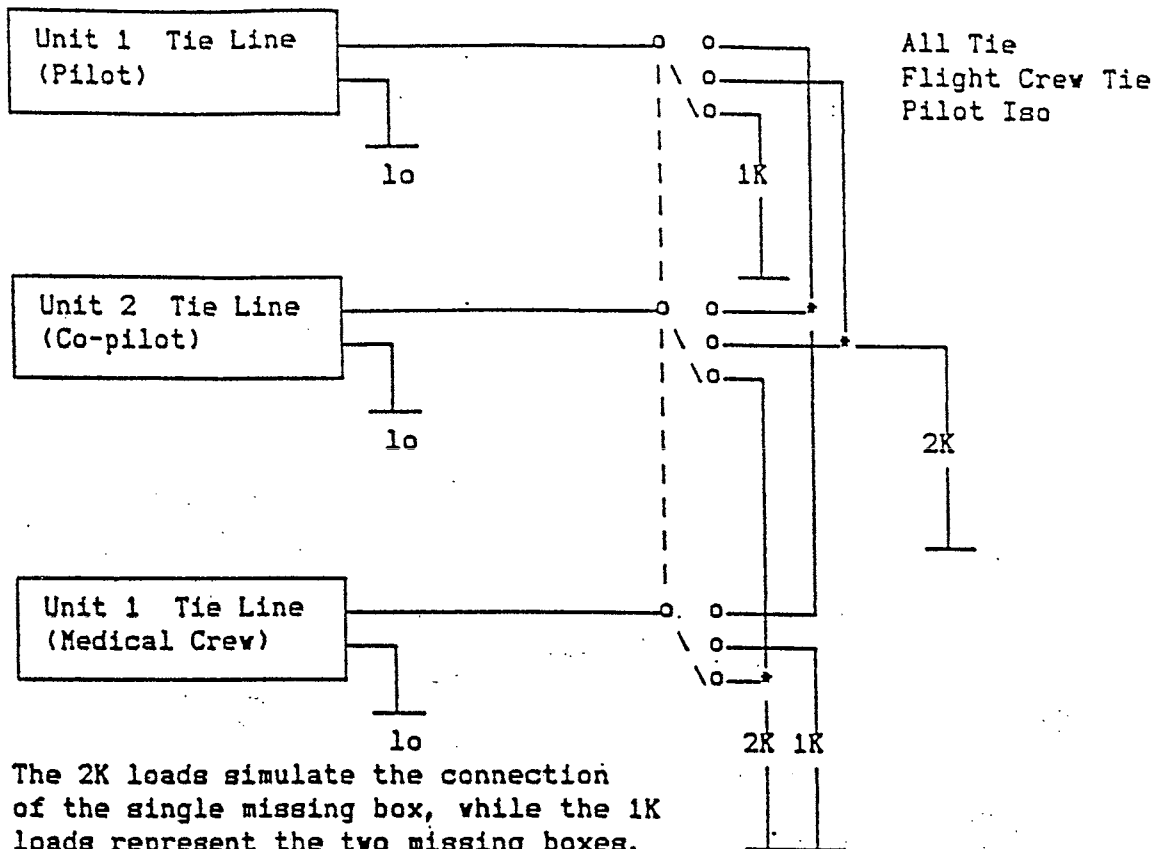
An example is given for two different interconnects. First, two boxes, which are operated together and split.



The 2K loads simulate the connection of the other box, to produce the same ICS level in both modes.

The ICS TIE low connection is NOT grounded externally, it is shown as a common for simplicity only.

Three station interconnect with multiple ICS loops:



The 2K loads simulate the connection of the single missing box, while the 1K loads represent the two missing boxes, to provide equal ICS levels in all modes.

Note that these connections require "NEW" style boxes, with an internal ICS GAIN adjustment, and 2K loads.

Bench Test Considerations:

To easily set up the ICS TIE adjustments on the bench using the TS-AA fixture, use the following technique. First, note that the monitor jack has a switch position marked pin 16; this is the ICS TIE LINE. Connect the desired load impedance (wattmeter, etc.) to the jack and select this monitor point. You can easily simulate a 1K, 2K or other load, and make your ICS GAIN ADJUSTMENT.

If a microphone simulator is used (0.25Vrms) on an ICS mic input, you can set the gain adjustment to give the maximum value (100mW for forestry) before clipping at full rotation of the front panel ICS level control, or other desired reference point. You should mark the covers of the units with the ICS settings for clarity in the field later.

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