MGL Avionics

A16 Aviation Audio Panel and Razor Intercom control head

User and Installation manual

Table of Contents

FCC Statement

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.
FCC ID: **A8TBM62S2**

NOTE: THE GRANTEE IS NOT RESPONSIBLE FOR ANY CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

General

This manual documents the installation and use of the A16 audio panel system. Please note that operation of the audio panel is done via a connected control system such as an EFIS or dedicated audio panel control panel or control head.

User interface varies by type of connected system. Please refer to documentation for the connected equipment for details.

This manual describes available settings through the connected equipment in a generic way that is applicable to all types.

Document history

8 November 2019, first release.

Description

The A16 audio panel is a split module consisting out of the audio panel system body and optional external control. External control can take the form of one or more panel mount control heads and/or control by an EFIS system.

The A16 audio panel provides the following functions:

a) Six independent microphone channels, each with own VOX and sensitivity settings to allow mixed headsets. Channels can be grouped into Pilot and Passenger groups.

b) Support for two COM radios, each with audio input and output and individual PTT control. Level control for all audio signals. Two independent Pilot and PAX PTT inputs provided. PTT inputs dedicated to Pilot and PAX microphone circuits.

c) Support for two NAV radio audio inputs with individual level control.

d) Two independent auxiliary audio inputs with individual level control.

e) Wired stereo music input with level control – may be reassigned as two further AUX channels.

f) Auxiliary audio output (Typical use for cockpit voice recorders etc).

e) Bluetooth mobile phone support to make and receive calls. Optional wired inputs for call and hangup buttons.

f) Bluetooth stereo music streaming support.

g) Ability to connect to two Bluetooth devices simultaneously. Ability to automatically reconnected to the last two connected Bluetooth devices on startup (This depends on the Bluetooth device itself – it must allow a device initiated connection).

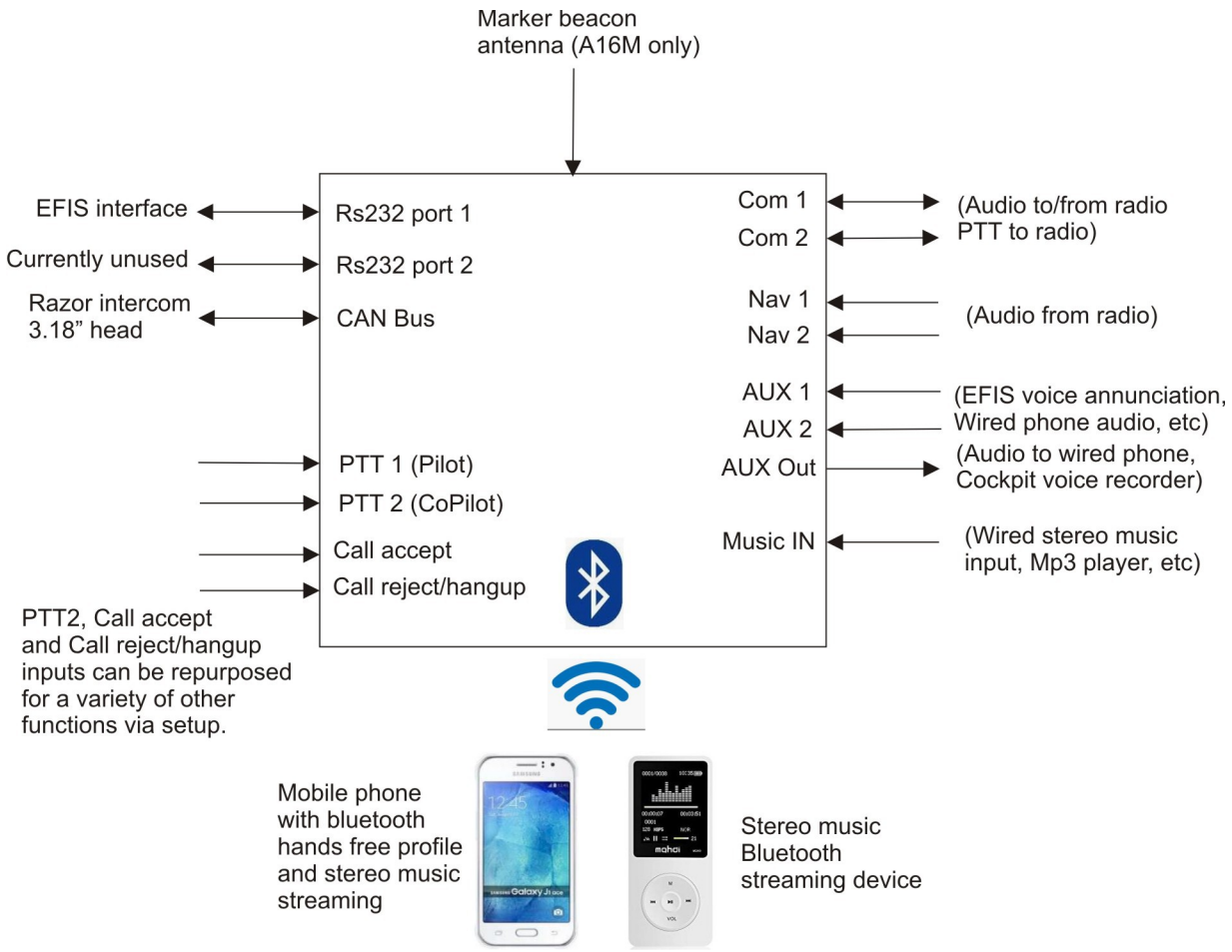
h) Dual circuit, stereo Pilot and PAX headset outputs.

I) Firmware updates via Bluetooth connection (requires PC or Laptop computer with Bluetooth running Windows 7 or later).

J) Firmware update of connected Razor control head via A16 Firmware updates.

k) Communications/Control interfaces: Two RS232 ports, One CAN bus, Bluetooth SPP profile support.

l) Built in cockpit voice recorder (CVR). This device records in an “endless tape” fashion all microphone circuits as well as both COM radio inputs. It records about 35 minutes worth of audio. It only records active audio, not any silence so silence periods do not use up recording time. Recording may be played back as a block via all headset outputs or it can be extracted in digital form via the RS232 port 1 using the supplied application from MGL Avionics.



Audio grounds

In order to reduce the potential for unintended audio noise on audio wiring all audio input circuits are based on differential grounding. This means audio inputs are not connected to the A16 power supply grounds but are instead connected to their own audio inputs. This allows the elimination of common mode noise as the A16 will only process differential signals.

For this purpose input grounds are grouped as follows:

1) All Microphones share a common ground.
2) All COM radios share a common audio ground
3) All NAV radios share a common audio ground
4) Wired music input has its own private ground
5) Both Auxiliary inputs each have their own private grounds.

All audio outputs are on a single shared ground but with multiple provided connections: On the audio connector side two pins are available for audio output ground while on the power connector a single audio output ground is provided for the auxiliary output.

In order to take full advantage of the differential input signal support both the signal wire and the related ground wire must have the same noise profile in amplitude and time. In other words, both connections have exactly the same unwanted signal. This is refereed to as the common signal. The wanted signal is the difference between the signal and ground wires. This is called the differential signal. The A16's audio inputs are designed to favor the differential signal and reject the common signal.

It is recommended to route audio signals using shielded cables. The practice of using wire shields as convenient ground connections is specifically discouraged. This creates ground loops which are receivers for audio noise and makes it impossible to take advantage of the A16's noise rejecting inputs.

The correct method to wire an audio input is to include the signal and ground as two connections inside a shielded cable. The shield in turn connects to an independent ground. This way the signal and signal ground will contain the same unwanted signal (noise) and this can now be rejected by the A16.

There are various options as to what ground to use for the shields and it is not critical. Suitable grounds are any of the A16's Audio output ground pins or a ground at the source of the signal.

Never connect the audio cable shield at both ends of the connection. You must only connect it on one end. This way it is not possible for any DC current or signal to flow via the shield.

Audio wiring from A16 to COM microphone input

This wired connection, in most cases will require special attention in order to prevent RF related issues such as feedback during active TX.

A potential problem exists due to the required audio ground connection between A16 audio panel and the COM radio. This may create a ground loop causing potentially significant issues depending on the level of RF energy received by your aircraft's wiring during transmit. This type of problem is typically worse on composite aircraft compared to metal skinned aircraft.

In order to eliminate this problem the A16 provides several avenues of solutions. These are listed here in order of preference and effectiveness:

1) Fit a 600 ohm line matching audio transformer between A16 and COM radio microphone input. MGL Avionics provides suitable high quality transformer modules. The transformer should be fitted as close to the COM radio as possible (minimizing the wiring length between transformer and COM radio). The transformer provides two advantages: It completely eliminates the ground loop and provides a very effective RF signal block (RF signals cannot pass through the transformer).

   This solution is also recommended if your COM radio requires a DC load to detect a connected microphone.

   This connection is particularly recommended if your COM radio and A16 intercom are not sharing the same power supply ground or the grounds between the two devices are not electrically identical or contain A/C interfering signals that are not common to both devices. Should either of these conditions exist it is recommended to use a second transformer on the COM audio output to the A16 audio panel COM input. This will prevent any ground potential related issues and provide the highest possible audio

quality under these conditions. Note that it may also require the use of a small low power relay to activate the PTT on the COM radio – the relay may be driven by the A16 PTT output (please do not forget a reverse biased “snubber” diode in parallel to the relay coil as otherwise the A16 may be damaged by the back-EMF of the coil when it deenergizes).

2) Use a two core shielded cable from A16 to COM radio and wire a 47ohm resistor between COM radio microphone input and COM radio microphone input to ground.

   The shield must be connected at the COM radio signal ground connection OR at the A16 audio output ground connection (Never both). One of the internal shielded cores shall be used to connect A16 audio ground to microphone ground of the COM radio while the remaining shielded core will connect the A16 COM output to the microphone input of the COM radio. The 47 ohm resistor should be connected at the COM radio.

   Background: The 47 ohm resistor provides a very low impedance to interfering RF signals, reducing the RF signal voltage at the microphone input. The A16 has a very wide range output signal adjustment via a 1KOhm series output resistor. So it can easily produce signals large enough to cater for the 20:1 loss in signal amplitude.

   The 47 ohm resistor from microphone input to ground will also provide a DC path which some radios require to detect a microphone.

3) The same as option 2 can be used if you have a COM radio that requires connection of a dynamic microphone. In this case the resistor value should be dropped to 4.7ohm.

If your COM radio provides this (most do), reduce the microphone input sensitivity adjustment to minimum. This also reduces the reaction of the COM radio to any interfering signals. The A16 on the other hand provides a wide range of output signal amplitude adjustment. So the idea is “make the COM radio as insensitive as possible” and then compensate by increasing the output signal of the A16. This provides an easy method to increase the “signal to noise ratio”.

If you are using a MGL Avionics V16 COM radio, please use the Pilot MIC input and Pilot PTT input of the V16, leave the PAX inputs unconnected.

If you are using the supplied Bourns 5001 audio isolation transformer (recommended), the settings are as follows: On the V16 set the Pilot MIC Gain to 0.00db. On the A16 adjust the COM output level to maximum (or near maximum). Select the COM input level to about 1/3 and the V16 RX and IC levels to about ½ of maximum.

For a direct, non isolated connection:

Using the V16 setup menu – please adjust both Pilot and PAX MIC Gain to -12.00db (the lowest setting). On the A16 – adjust the COM output level to about the 2/3 setting and the COM input level to about 1/3. It is recommended to use the V16 VOX system at a fixed level of “1” (do not use the bypass setting). You will be using the VOX functions of the A16 – so leave the V16 at “1” which is just enough to switch the intercom in the V16 off when not it use. It is advisable to wire a 100 ohm resistor (carbon type, not wound) between microphone input and microphone ground on the V16 connector in order to lower the signal apparent impedance and increase resistance to interference.

Audio signal flow during transmit

The A16 provides two selectable audio signal flows during active transmit. This is selected in the Intercom setup menu of the A16 under “Miscellaneous”.

The “normal” option is: “COM sidetone from COM audio in”.

With this option selected audio flow is: Microphone → A16 → COM radio → A16 → headset.

The alternative is: “COM sidetone Intercom loop back”.

With this option selected you have two flows at the same time:

Microphone → A16 → COM radio

Microphone → A16 → Headset

Note that these settings are independent for COM1 and COM2 radios.

The first option will typically allow you to listen to your outgoing transmission and also help identifying issues such as RF feedback (howling, hollow “bathroom” sound etc). The second option can be used if your radio does not provide audio feedback during transmission.

Dual circuit intercom

The A16 provides two independent stereo output channels. These are refered as Pilot and PAX circuit.

Microphone input ONE is always assigned to the Pilot circuit.
Microphone input TWO may be assigned to the Pilot or PAX circuit.
Microphones THREE to SIX are always assigned to the PAX circuit.

Each audio source may be assigned to either circuit or both. In addition most sources may be assigned to either the left or right audio channel or both. For example: You may assign COM1 to the left channel and COM2 to the right channel if desired.

The two circuits may be operated independent or joined.

If joined, all microphone signals will be audible on both Pilot and PAX circuits. This means Pilots and PAX may communicate with each other. All other sources however will remain at their assignments. For example you may exclude music source from being audible on the Pilot circuit and COM radios may not be audible on PAX circuits.

If separate, each circuit operates independent.

PTT behavior

The A16 provides two PTT inputs. PTT1 is dedicated to the Pilot circuit and PTT2 is dedicated to the PAX circuit.

Two PTT outputs are available. PTT1 output 1 is dedicated to COM1 and PTT2 output is dedicated to COM2.

It is possible to wire both PTT1 and PTT2 in parallel to a single PTT switch if this is desired.

If PPT1 is held active, only voice from the pilot circuit will be routed to the currently selected COM radio for TX.
If PTT2 is held active, only voice from the PAX circuit will be routed to the currently selected

COM radio for TX.

If both PTT1 and PTT2 are held active then both pilot and PAX circuit will be routed to the currently selected COM radio for TX.

Note: Only microphone signals will be routed to the COM radios. No other audio sources can be routed to the COM radios. This includes including phone calls.

Only one COM radio can be selected for TX.

Marker beacon receiver

The A16M variant implements a 75Mhz marker beacon receiver. The marker beacon antenna is connected to pin 1 and 2 of the Power side DB25 connector. The marker beacon receiver can be operated in a reduced sensitivity mode.

Power supply

The A16 audio panel system is designed to be operated on a typical 12V DC aircraft power system. The DC supply must be free of undesired transients and reasonably stable within the acceptable supply voltage range of the A16.

It is possible to operate the A16 on 24/28V DC power supplies as well.

For operation with compromised power sources on aircraft it is advised to consider external power conditioning such as the MGL Avionics AvioGuard isolated power supply.

Digital control interfaces

The A16 audio panel provides two RS232 ports as well as a CAN bus interface.

The CAN bus is typically used with control heads from MGL Avionics.

RS232 port 1 and RS232 port 2 may be used with EFIS systems. Both ports are equivalent and can be used at the same time to two different EFIS systems.

Audio input specifications

Microphone inputs	Gain range 47db	For reference level: At input sensitivity MINIMUM setting: 0.8Vpp with 6db reserve before clipping. At input sensitivity MAXIMUM setting: 10mVpp. At 75% input sensitivity (typical aviation headset setting): 40mVpp. Input impedance 240 ohms A/C. 8V DC microphone bias via 470 ohms.
All other audio inputs	Gain range 47db	For reference level: At input sensitivity MINIMUM setting: 4.0Vpp. At input sensitivity MAXIMUM setting: 100mVpp. Input impedance 250KOhm.

Audio output specifications

Output impedance	8 ohms. Suitable for connection of high impedance headphones.
Output power	0.2W low distortion. Up to 0.5W at 1% distortion.
Maximum voltage swing	5Vpp (1W into 8 ohms) 6.5Vpp into 300 ohms
Typical voltage swing for 600 ohm aviation headsets	1Vpp-2Vpp
Frequency response audio power amplifier	200Hz to 20Khz at 8 ohms load, lower limit decreases with lower loading (100uF output coupling capacitor)
Volume control range	32 steps of 3db each. Total control range = 96db.

Audio filters

Microphone inputs Pilot and PAX	350-2900Hz, Butterworth 4 pole BP
All other inputs	20-8000Hz

Power supply

The A16 is designed to operate from a 12V to 24/28V DC avionics bus. It will operate down to 8VDC. Current draw is dependent on supply voltage and drops as voltage increases (constant power draw).

A16 supply current at 14VDC supply: 120mA typical.
Razor control supply current at 14VDC supply: 120mA typical.

Power supply fusing and protection

The A16 and Razor control has no internal fuses. Both devices must be supplied via suitably protected power sources to avionics standards. It is recommended that provision is made for a maximum of 1A power draw for both devices. Both devices contain capacitors on their power supply inputs. The Razor's capacitors have a neglible value. The A16 has a 1000uF capacitor across its power supply input, however inrush current is limited.

Environmental qualification matrix

The environmental qualification is based on the document DO-160G

Temperature and Altitude	4.0	Equipment Categories B2, C1	
Low temperature ground survival	4.5.1	-50°C	
Low temperature shorttime operating	4.5.1	-30°C	
Low temperature operating	4.5.2	-20°C	
High temperature operating	4.5.4	+55°C	
High temperature shorttime operating	4.5.3	+65°C	
High temperature ground survival	4.5.3	+85°C	
Loss of Cooling	4.5.5	Cooling air not required	Convection cooling or forced air cooling recommended in compromised installations.
Altitude	4.6.1	55,000 feet	
Decompression	4.6.2	8,000 to 55,000 feet in 15 seconds	
Over pressure	4.6.3	-15,000 feet	
Temperature Variation	5.0	Equipment Category B	
Humidity	6.0	Equipment Category A	
Operational Shocks	7.2	Equipment Category B	
Crash Safety	7.3	Equipment Category B Type 5	
Vibration	8.0	Aircraft zone 2; type 3, 4, 5 to category S level M, type 1 (Helicopters) to category U level G	
Explosion	9.0	Equipment identified as Category X	

		– no test required	
Waterproofness	10.0	Equipment identified as Category X – no test required	
Fluids Susceptibility	11.0	Equipment identified as Category X – no test required	
Sand and Dust	12.0	Equipment identified as Category X – no test required	
Fungus	13.0	Equipment identified as Category X – no test required	
Salt Spray	14.0	Equipment identified as Category X – no test required	
Magnetic Effect	15.0	Equipment tested to Category Z, safe distance 20cm	
Power Input	16.0	Equipment Category BXX	
Voltage Spike	17.0	Equipment Category B	
Audio frequency conducted susceptibility	18.0	Equipment Category B	
Induced signal susceptibility	19.0	Equipment Category AC	
Radio frequency susceptibility	20.0	Equipment Category TT	
Radio frequency emission	21.0	Equipment Category B	
Lightning induced transient susceptibility	22.0	Equipment identified as Category B2G2L2 – no test required	
Lightning direct effects	23.0	Equipment identified as Category X – no test required	
Icing	24.0	Equipment identified as Category X – no test required	
Electrostatic Discharge	25.0	Equipment identified as Category X – no test required	
Fire, Flammability	26.0	Equipment identified as Category C	

Notes: Power input tests chapter 16. The A16 easily complies with all required criteria. The A16 has a limitation related to power supply voltage rise time which falls well outside of any required performance standards. Voltage rises from 0 to about 2.0V at any rate and then the rise time to about 3.6V is very slow (in the region of greater than about 0.5 seconds) the A16 will enter self protection mode which will only be released when voltage drops again below 2.0V. In this mode the internal processor will lock itself and its integrated memories out for protection against damage by pre-start brownout conditions. This limitation does not apply if the A16 is already up and running and voltage dips not lower than 2.0V before rising again slowly as the critical startup time does not apply in this case due to a secondary brownout detection being active at this time.

The processor, should it enter self protection mode, will release this mode on the next power cycle provided voltage ramp up is faster than the maximum time of 0.5 seconds in the mentioned voltage range.

This limitation however is unlikely to affect any real world applications and is mentioned only for completeness sake.

The A16 is designed not to commence operation until supply voltage reaches about 7V on startup regardless of the above condition.

The above measures have been included to prevent any internal hardware damage due to unusual supply voltage conditions during low to very low voltage conditions.

A16 Connector pinout, Power side

1	Marker beacon antenna. 50 ohms impedance @ 75Mhz.
2	Market beacon antenna ground (coax cable shield)
3	CAN-H Communications interface to a compatible MGL control head
4	CAN-L As above
5	RS232 RX 1 Communications interface to an MGL EFIS system
6	RS232 TX 1 As above
7	RS232 RX 2 Not used, do not connect
8	RS232 TX 2 Not used, do not connect
9	Ground for RS232 / Audio out ground
10	Auxiliary audio output
11	Music input left channel
12	Music input ground
13	Audio input right channel
14	Phone call accept button
15	Phone call reject/hangup button
16	Ground for buttons / System ground

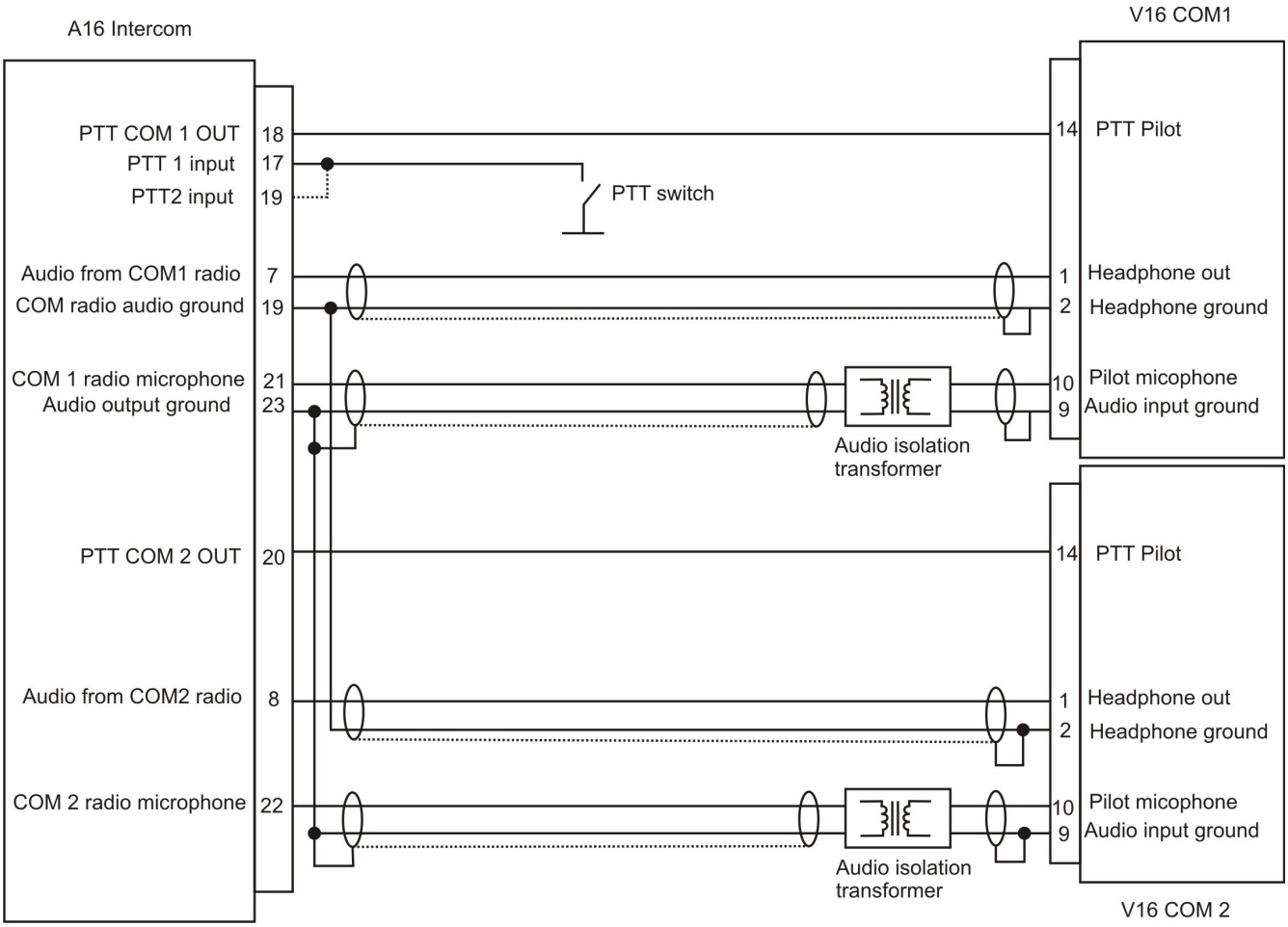
17	PTT 1 input (Pilot PTT button)
18	PTT 1 Output to COM1 radio
19	PTT 2 input (Copilot PTT button). Note: This input can assigned to other functions.
20	PTT 2 Output to COM2 radio
21	Not internally connected
22	Power supply ground
23	Power supply ground (connected internally to pin 22)
24	+12V to +28V DC power supply input
25	+12V to +28V DC power supply input (connected internally to pin 24)

A16 Connector pinout, Audio side

1	Microphone 1 input
2	Microphone 2 input
3	Microphone 3 input
4	Microphone 4 input
5	Microphone 5 input
6	Microphone 6 input
7	Audio from COM1 radio
8	Audio from COM2 radio
9	Audio from NAV1 radio
10	Audio from NAV2 radio
11	Audio output ground
12	Pilot audio out left channel
13	Pilot audio out right channel
14	Microphone common ground
15	Auxiliary 1 audio input
16	Auxiliary 1 audio input ground
17	Auxiliary 2 audio input
18	Auxiliary 2 audio input ground
19	COM radio audio ground
20	NAV radio audio ground
21	COM 1 radio microphone input
22	COM 2 radio microphone input
23	Audio output ground

24	PAX audio out left channel
25	PAX audio out right channel

Typical connection diagrams

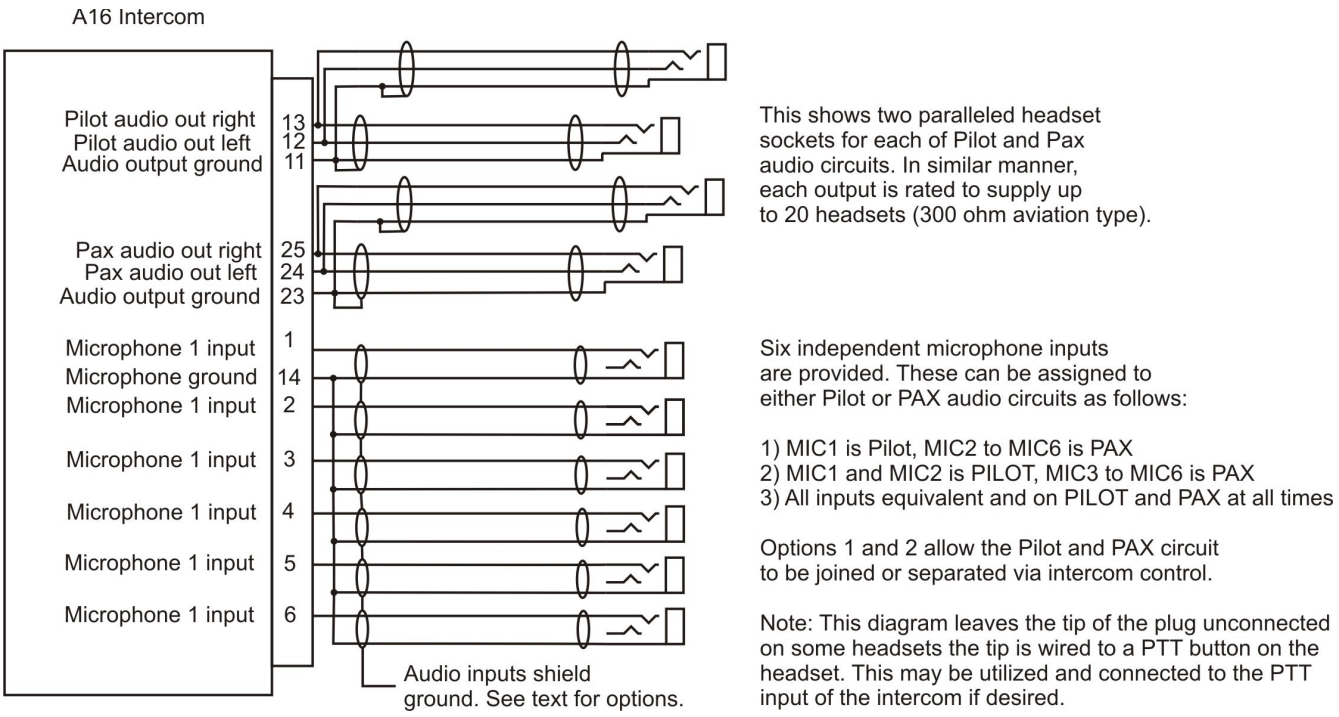


This diagram shows typical connection to two COM radios using the MGL Avionics V16 as example. Note that the microphone input on the radio side is connected via an audio isolation transformer. This is highly recommended as it prevents the creation of a ground loop (the ground connection between radio output and audio input ground on the A16 is a signal connection and not connected to ground on the A16 side so no ground loop can be formed here.

The audio transformer performs a secondary task of providing a very effective block for RF signals preventing RF feedback issues. RF feedback can otherwise become troublesome as typically a large network of wiring connects to the A16 intercom providing a receive path for RF signals that can couple into the radio's microphone input and cause a feedback loop. The A16, as packaged, contains two specially selected audio transformers for this purpose. These are chosen for their excellent RF blocking performance. They should be wired as shown in the diagram – the wired connection between the radio and the transformer should be kept very short. If short, it is not required to use shielded cable for this side.

Note that all shielded cable only connects the shield at one end. This way no signal travels on the shield itself.

Note that the COM radio audio ground (pin 19 on the A16) is not an electrical ground. This is a signal input forming part of the noise canceling system. Do not use this connection as grounding point for a shield.



When wiring headset sockets please ensure that the sockets are isolated from any metal panels and isolated from each other. Headset and microphone grounds must not be shared. You must not route microphone signal wires and headset signal wires in the same shielded cable unless the signals are also shielded from each other. It is otherwise possible to create an unintentional audio feedback path from headset to microphone via capacitive and inductive coupling between the wires. This can cause howling at higher volume levels.

Please never use shields as signal conductors. Shields must be connected to an electrical ground point or dedicated audio ground.

Never use noise canceling audio signal grounds on the A16 as shield ground points.

Audio noise canceling grounds on the A16 are:

COM Ground, pin 19.
NAV Ground, pin 20.
AUX1 Ground, pin 16.
AUX2 Ground, pin 18.
MUSIC ground, pin 13 (also AUX3 and AUX4 ground).

Ground points that are referenced to ground and that may be used as shield grounds for their respective signals:

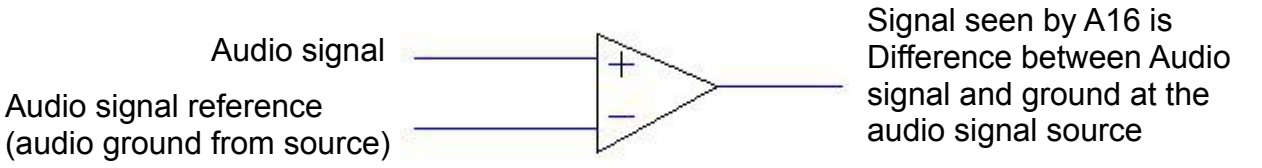
MIC ground, pin 14.

Audio out ground pins 11 and 23.
System Ground, pin 12.
Antenna Ground, pin 2.
Audio out ground, pin 9.

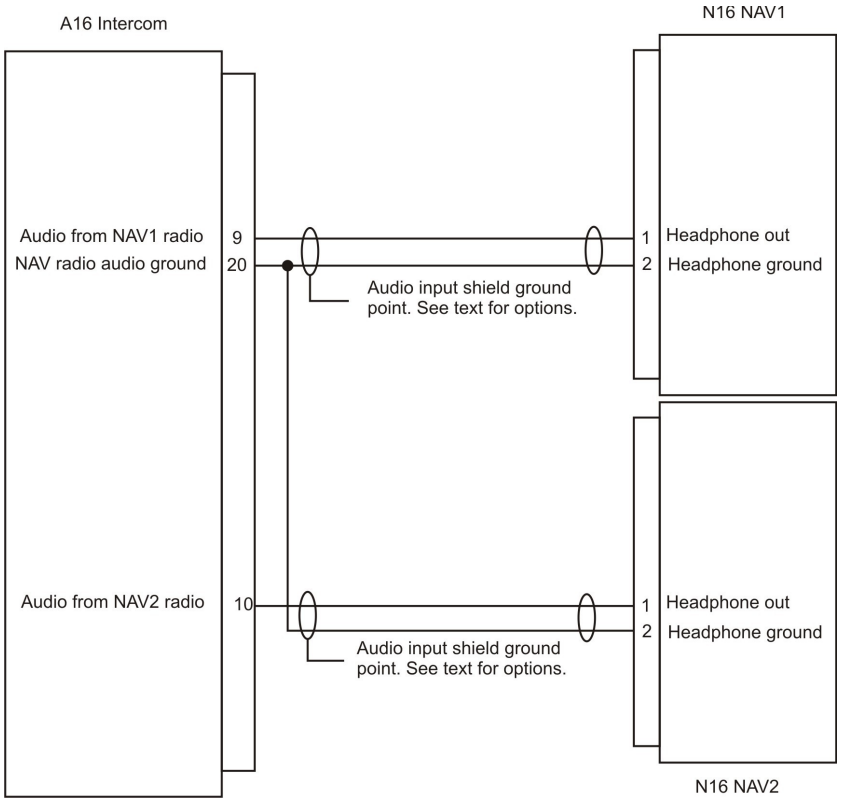
Noise canceling inputs – how they work

Normally, an audio input “sees” the signal as the voltage difference between its input and the electrical ground of its own circuit. Should the audio source have a slightly different ground are there is noise that is different at the source ground compared to the A16 ground then this difference will add to the signal.

To prevent this from happening the A16 employs a number of virtual ground points that feed into a differential amplifier that only sees the difference between the two signals. One of the signals is the normal audio signal from the source and the other is the ground at the source. The A16 thus sees the signal as it is created at the source and any differences between source and A16 ground are canceled.



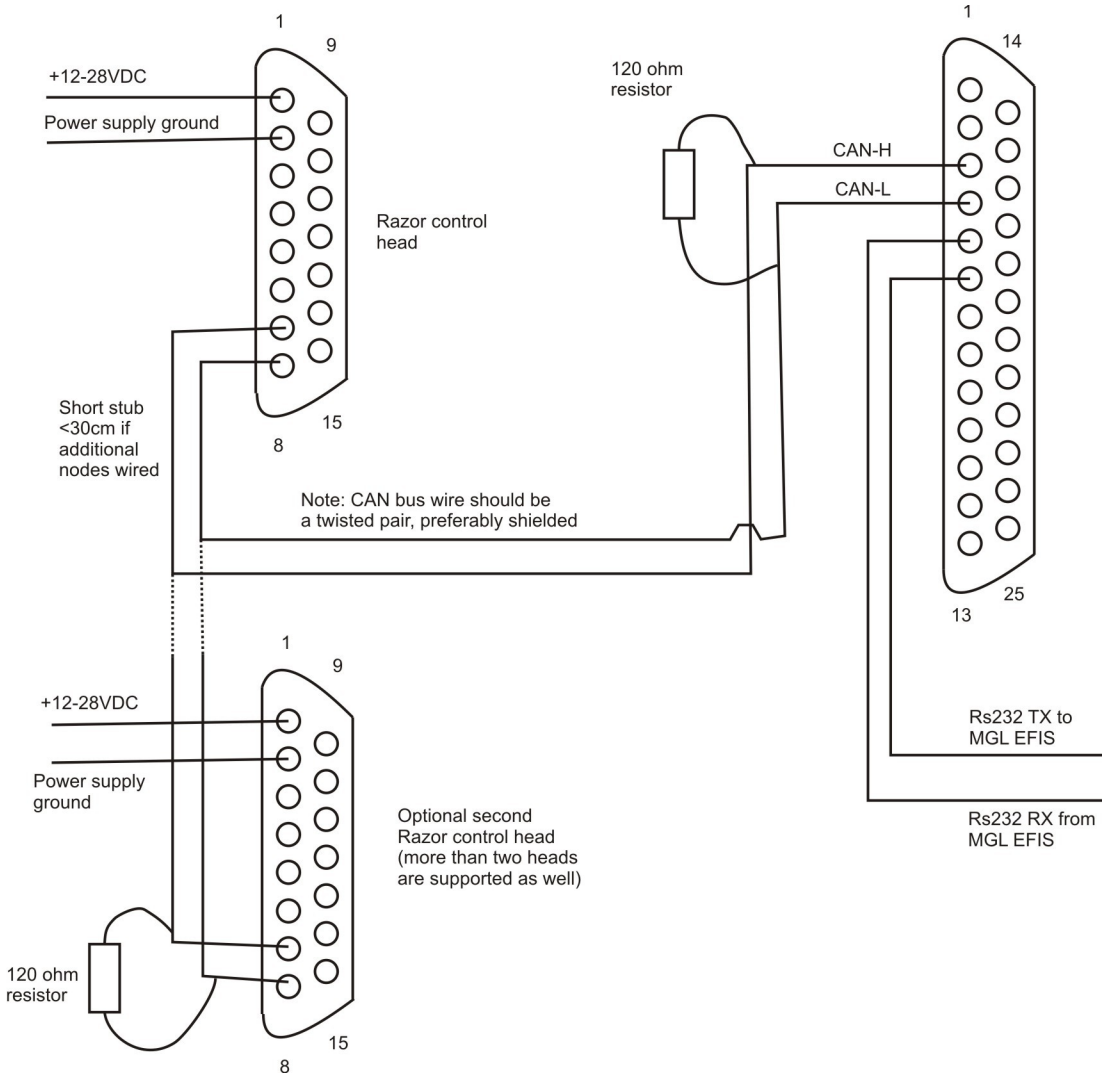
In cases were this is not needed, please connect the relevant signal ground on the A16 to any A16 audio output ground or the MIC ground (pin 14).



Example connection of two NAV radios.

Control heads and options

The A16 module must be connected to at least one controller. A controller is typically a Razor head (more than one may be connected) or an EFIS system.



Pinout for 3.18” Razor Intercom control head

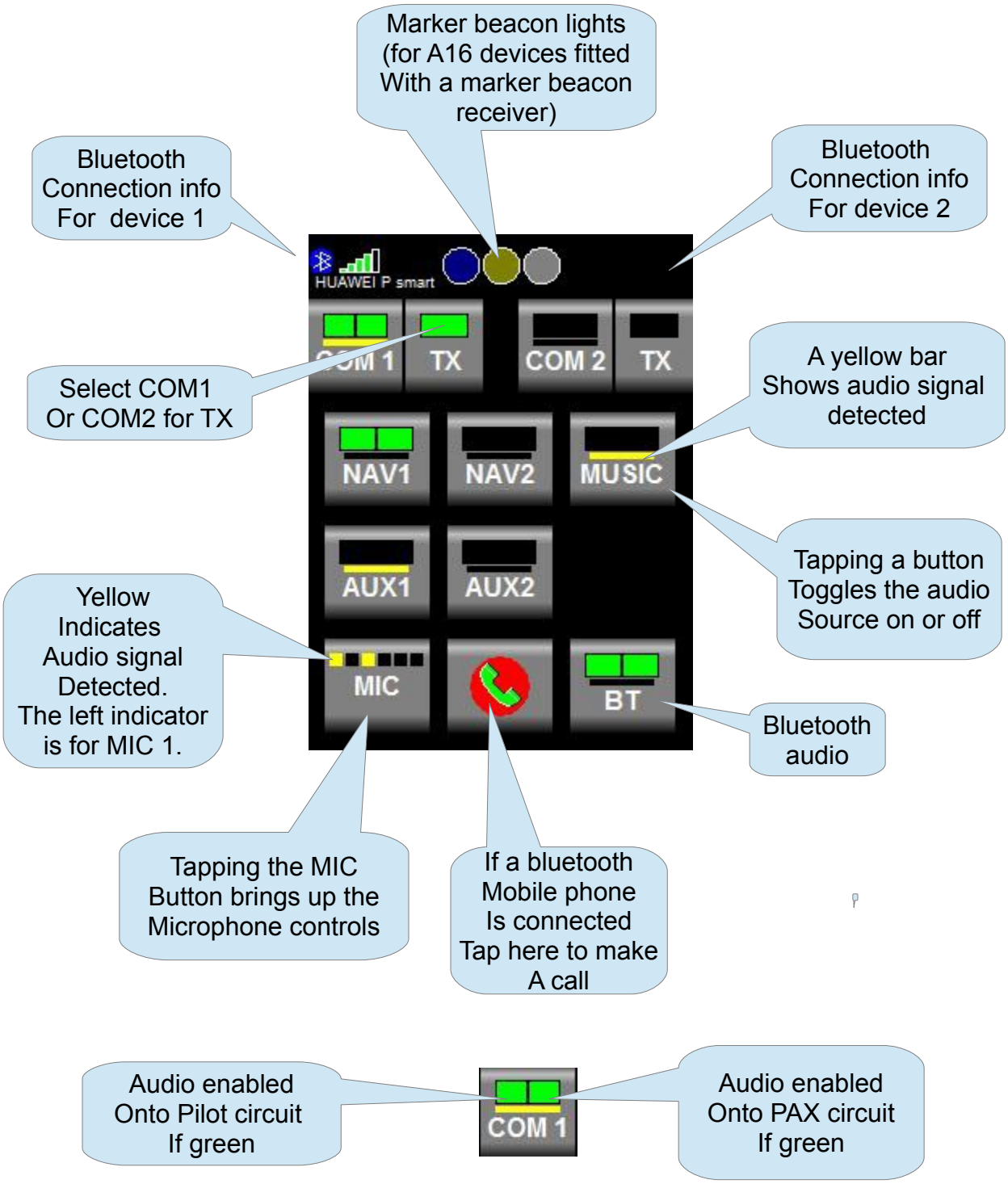
1	Supply +9 to +28VDC
2	Supply ground
3	RS232 RX Port 1
4	RS232 TX Port 1
5	RS232 RX Port 2

6	RS232 TX Port 2
7	CAN H (connect to CAN H on A16)
8	CAN L (connect to CAN L on A16)
9	Ground (Internally connected to pin 2)
10	KeepAlive. Do not connect.
11	A1. Control input. Select desired function in Razor setup menu.
12	A2. Control input. Select desired function in Razor setup menu.
13	Program pin. Do not connect.
14	USB P. Do not connect
15	USB M. Do not connect.

Razor A16 head

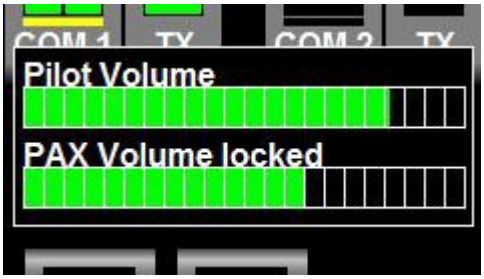
Using the A16 intercom

Regardless of using a Razor control head or an MGL EFIS supporting the A16 the control will be the same as described here:



Setting the volume

Turn the rotary knob to adjust the headset volume. When you turn the knob just one click the volume display activates.



The current volume setting for Pilot and PAX audio output circuits is shown. Both will be shown as “locked” the first time the rotary control is turned after power-up.

Turning the rotary control while the volume is locked with not change the volume. Tap on the desired volume to lock or unlock it.

If both Pilot and PAX volumes are unlocked, rotating the volume knob will adjust both Pilot and PAX volumes at the same time – setting the PAX volume to that of the Pilot.

Audio configuration options:

Each audio input source may be enabled or disabled for display.

Most audio sources can be enabled for output to Pilot left, Pilot right, Pax left and Pax right outputs individually.

Some audio sources such as Bluetooth can be enabled individually for Pilot and Pax (left and right at the same time).

Each audio source can be enabled for the Pilot or Pax circuit or both.

Microphones can be grouped as follows:

MIC1 is Pilot, MIC2 to MIC6 are PAX.

MIC1 and MIC2 is Pilot, MIC3 to MIC6 are PAX.

Microphone groups may be joined or separated at any time by tapping the MIC button.

The wired music input may be reassigned as two additional independent Auxiliary audio input channels.

Audio signal level controls

Each audio input source has an individual level/gain control.

Each audio output (COM 1 and COM 2) has individual output level control.

Pilot and PAX headphone outputs have individual or joined volume controls depending on setup.

Each microphone input has independent level and VOX control.

Bluetooth connectivity

The A16 Intercom system provides the following connectivity:

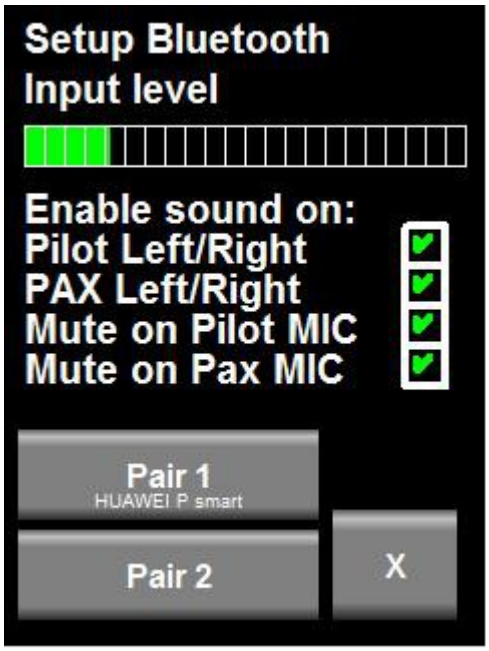
One or two simultaneous Hands Free phone connections or stereo audio music streaming. One SPP data link used for firmware updates.

The A16 will, on power up attempt to reestablish connection to the two most recent devices it has a pairing record for. It maintains a list of the last 8 devices. It will try the most recent devices first before attempting older devices. The search continues until both Bluetooth channels have a device connected.

Bluetooth pairing

Before a bluetooth link can be established, the devices need to be paired. The A16 follows a simple pairing protocol without PIN number security. If it has no pairing records stored it will automatically attempt to pair with any device it finds. If you have a bluetooth enabled mobile phone or device you should automatically be shown a pairing request from the A16 intercom. Accept the request or deny it as you require.

Some devices will not accept automatic requests. In this case you can force a pairing request in the Bluetooth menu.



In the above image Bluetooth device 1 has an active connection to a device named “HUAWEI P smart” Device 2 however is available.

Press “Pair 2” to attempt to pair with a second device. The pairing request will remain active for three minutes.

Note: The order of paired devices shown depends on the “last use” rule. The last known device that the A16 was able to pair with will always pair as device 1 after a restart.

You may adjust the audio input level for your bluetooth connection. It is recommended to keep

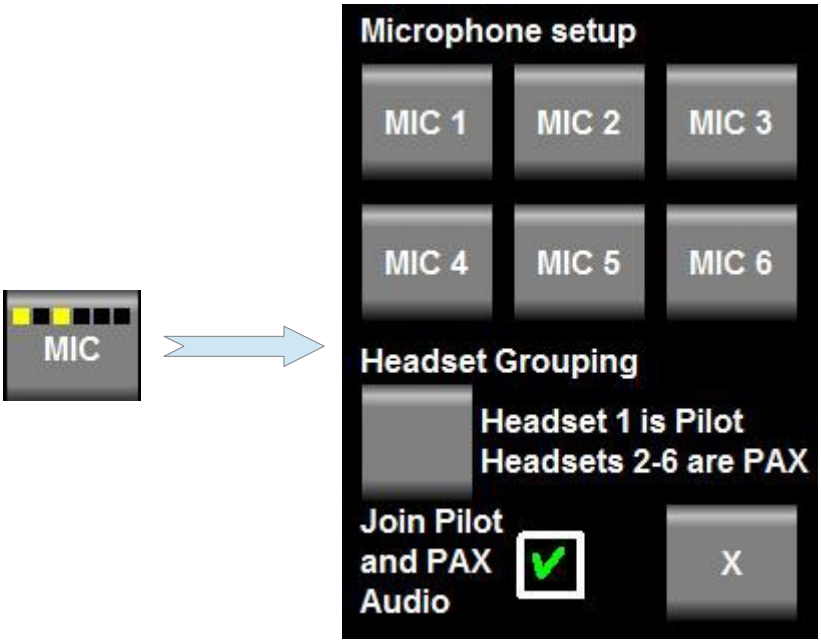
it similar to that shown in this image (fairly low level). Adjust the volume of your bluetooth device fairly high or at maximum. This helps to suppress undesired sound artifacts in the bluetooth system (i.e. audio levels much higher than the undesired artifacts).

You can enable/disable bluetooth sound individually for Pilot or PAX (Note: Left and Right channels are switched as one).

You may also mute the bluetooth signal on microphone activity. Note that this only applies to music streaming sources – phone signals will not be muted.

Setting up microphone inputs

Tap the MIC button to open the Microphone setup screen.



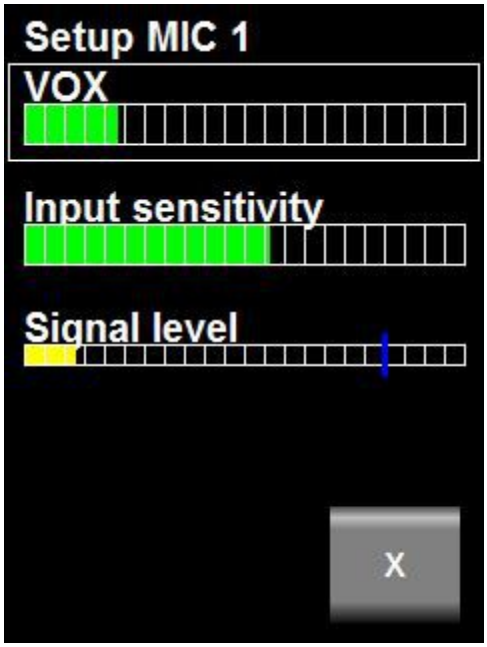
Here you can select the headset grouping (assign which headsets connect to the Pilot audio output and which connect to the PAX audio output).

Note: if you make use of the two independent PTT inputs (PTT1 = Pilot and PTT2 = PAX) this setting also dictates which headset voice will be sent to the selected COM radio during transmit.

Tap on the checkbox to join or separate the PILOT and PAX headsets. If joined the headset grouping has no effect for voice and all microphone sounds are sent to both Pilot and Pax audio outputs.

Note: Even if the headsets are joined, all other audio sources retain their assignments to either Pilot, PAX or both audio outputs as selected in the individual setups.

Tap MIC 1 to MIC 6 to open the setup for that particular microphone channel:



Tap on either the VOX or the Input sensitivity field to move the white rectangle over that field. The field with the white rectangle can be adjusted using your Rotary control.

Adjusting VOX:

This level sets the signal threshold above which the microphone channel opens. It should be set to a level which ensures that the microphone is closed in normal flight so no noise can enter the audio system. It should be set such that if you speak into the microphone with the microphone close to your mouth the microphone channel opens.

Adjusting Input sensitivity:

This setting is usually done once for each channel or when you change headset makes. Headsets tend to have different microphone output levels due to tolerances or microphone types. Observe the signal level as you talk normally into the microhone and adjust such that the Signal level does not exceed the marker to the right during the loudest parts of your voice – but it should get close to it.

Note: Adjusting the input sensitivity will most likely also affect your VOX setting so adjust the VOX to your requirements after you are satisfied with the sensitivity setting.

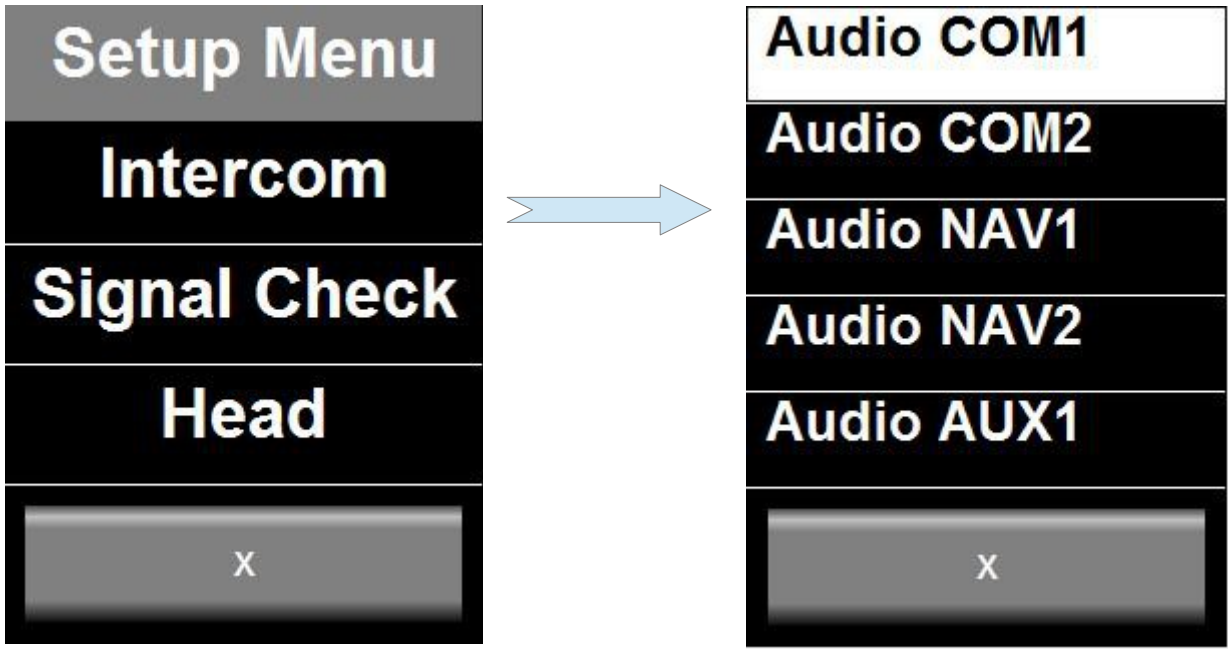
Setup of audio sources

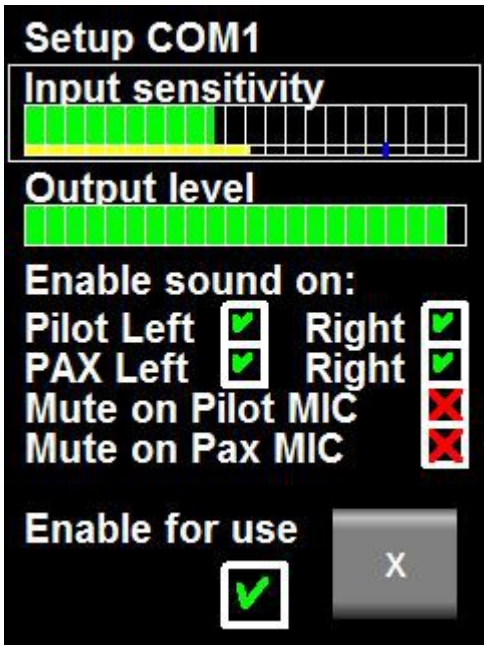
This chapter shows the setups for audio sources COM1, COM2, NAV1, NAV2, AUX1, AUX2 and MUSIC L/R or AUX3 and AUX4.

Setups for these audio sources are accessible via the Menu. To activate the Menu press the Rotary control. The tap “Intercom” and then select the audio source you would like to edit.

You can drag the menu up or down with your finger to show further sources and other options.

You can also use the rotary control. Turn the knob to select the desired entry and push it to select that entry.





Audio sources COM1 and COM2 each have an associated independent audio output – this is connected to the audio input (usually the microphone input) of your COM radio.

You can control the output level over a wide range to suit your COM radio. The recommendation is to use a high a level as possible (reduce the input sensitivity of your COM radio to minimum if it has such a setting). This assists greatly in helping to avoid RF feedback problems (howling, hollow “bathroom” sound, distortion) during TX. Note that it is generally recommended to couple the A16 intercom system to your COM radio's microphone input via a small audio transformer to break potential ground loops and also to provide an effective RF block (see details in the wiring diagrams in this document).

Tap on either the Input sensitivity field or Output level field (in case of COM radios) to move the white rectangle over that field. The field with the white rectangle can be adjusted using your Rotary control.

The Output level field will be missing in case of audio sources that do not have an associated output.

Note that the input sensitivity field has a small audio level bar graph display. This shows the current audio level at that input. Note the small marker at the right of the bar – this is your maximum level. Adjust your input sensitivity such that the loudest parts of the signal does not exceed this level.

You can enable sounds for the selected audio source individually for each headset audio output (Pilot Left, Pilot Right, PAX Left and PAX Right).

Most audio sources allow muting on microphone sound activity. This is typically used for music sources or any other source you would like to mute if a microphone is spoken into.

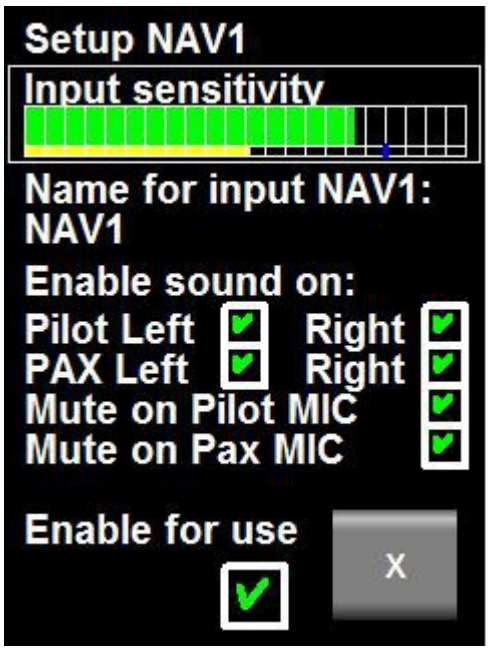
Note that COM radios are excluded from this functionality and it is not possible to enable the mute function for these sources.

Finally a checkbox is provided which allows you to suppress this source if it is not used in your system. In this case the associated button in the main display will not show.

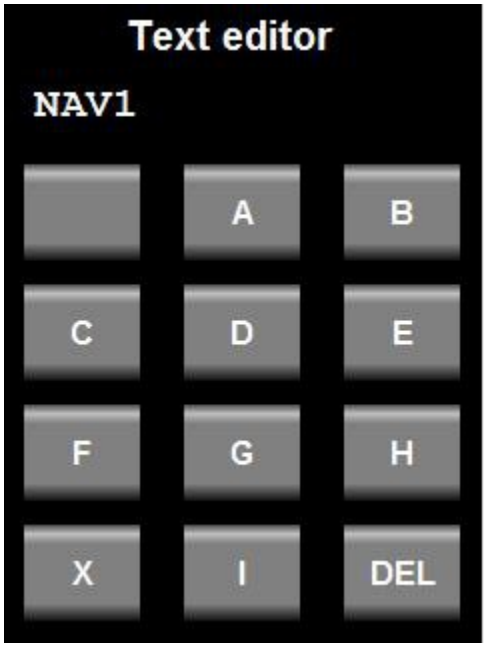
Assigning names to inputs

Inputs NAV1,NAV2,AUX1,AUX2,AUX3,AUX4 and MUSIC may be assigned custom names.

These names are stored in the A16. If you change the names they will become available to other controllers that may be connected to your A16 intercom.

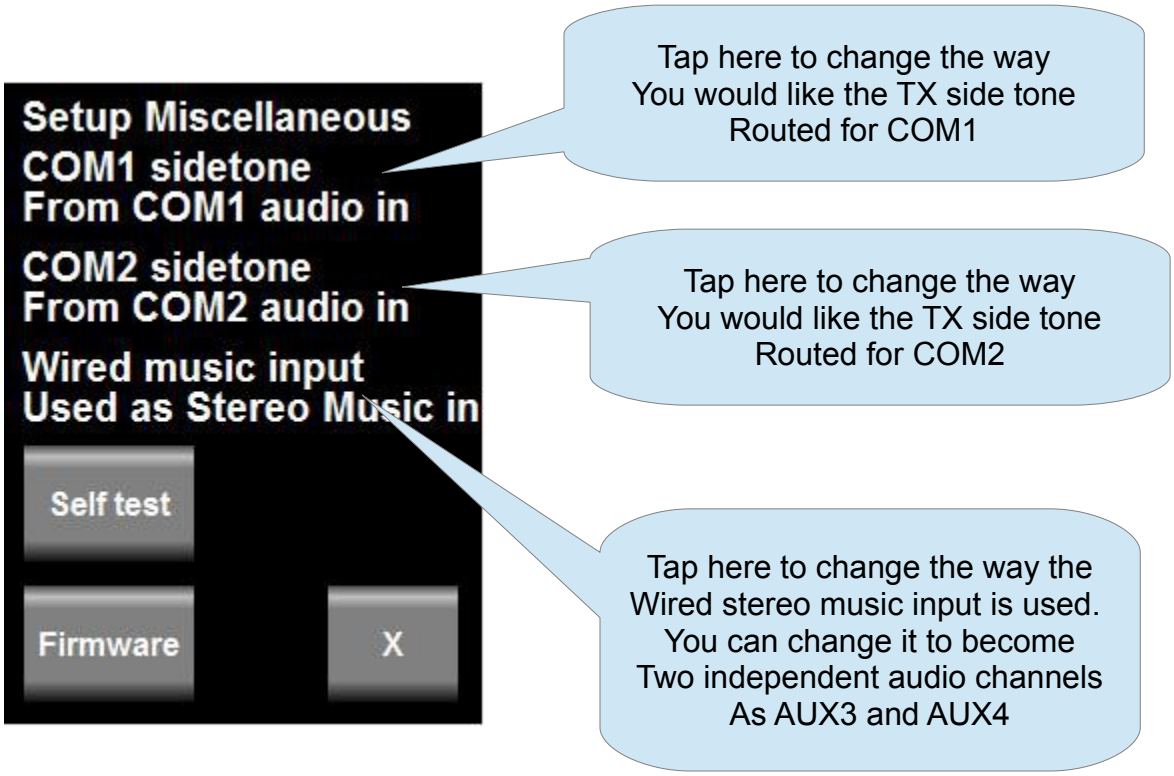


Tap the Name field to activate an editor for the name. You may use up to six characters. Ensure the result fits the available space on the button.



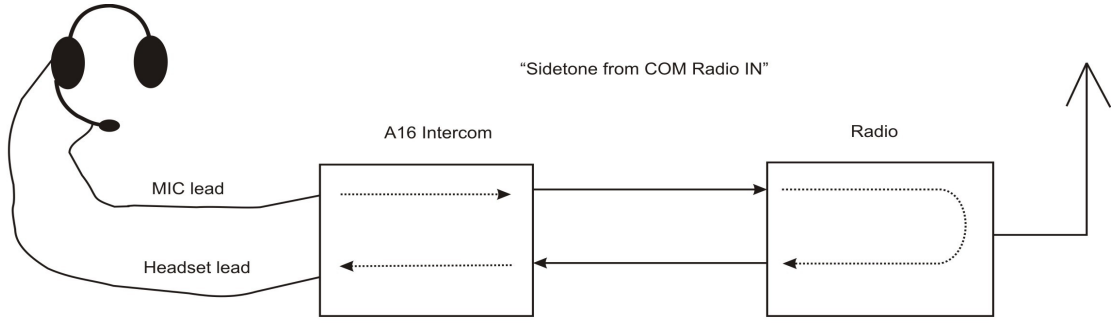
Press the rotary control to switch character selections on the button. DEL deletes the character at the cursor position. Use the rotary control to move the cursor left or right. Press “X” when done.

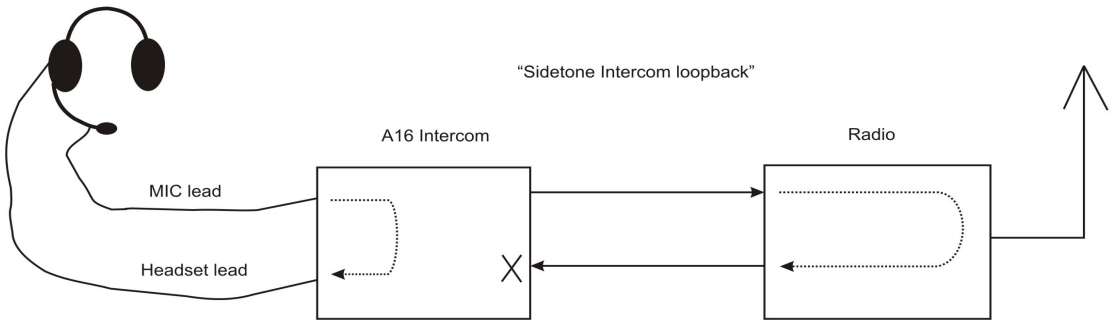
The Intercom Miscellaneous menu



Self test and Firmware buttons are explained in their own chapters.

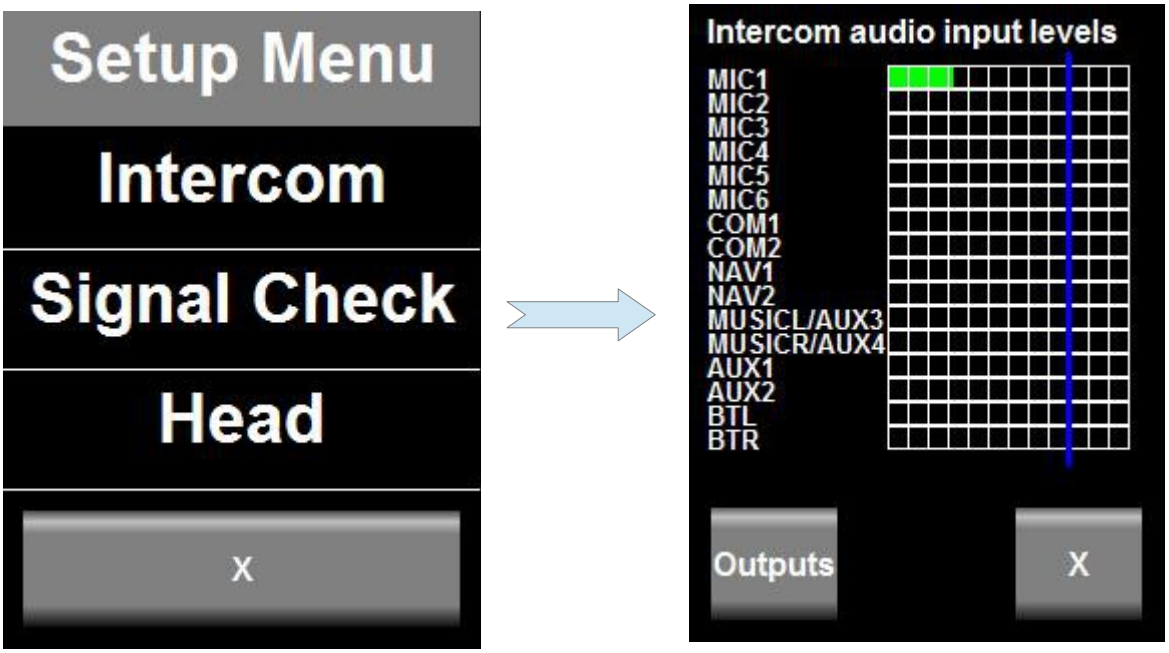
TX Sidetone may be routed in one of two options: Via the radio itself or via internal loopback.





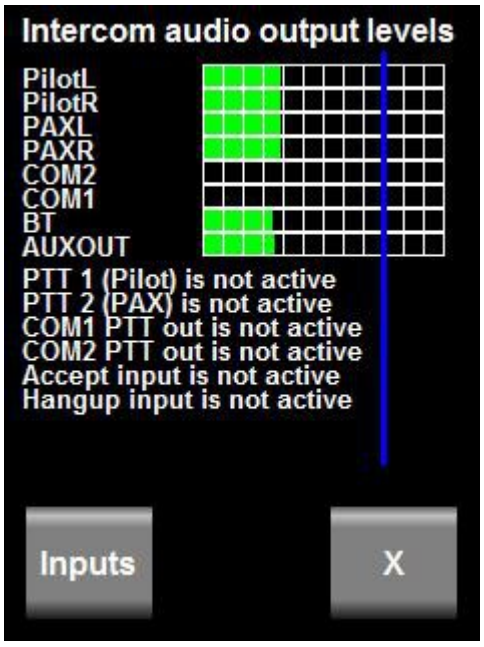
Signal Check

A convenient display of all input and output audio channels signal level is available in the Menu. The output displays also shows the current states of PTT and other digital input and output levels.



The audio input levels show all of the audio input channels. Signals are displayed even if the corresponding channel is disabled. A marker is shown giving the desired maximum signal level. Each audio source has a sensitivity adjustment you can use to achieve this.

Tap on the “Output” button to see the output levels and digital signal states.

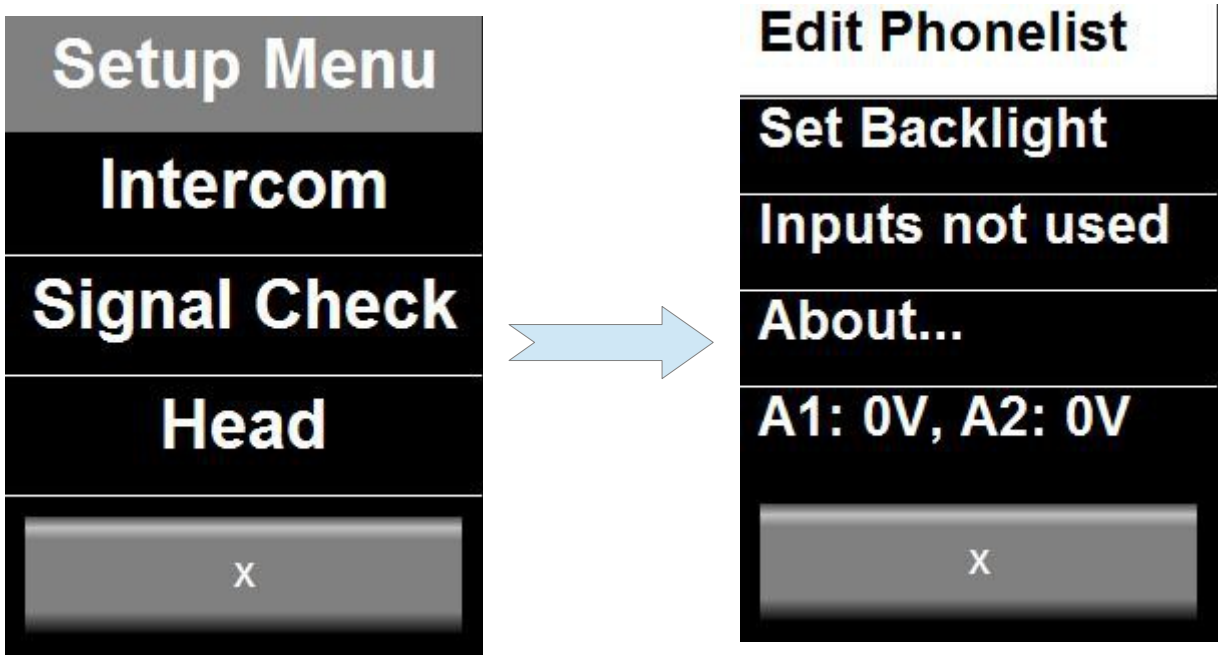


Note: Audio levels here are shown BEFORE any output level adjustment.

COM1 and COM2 will never show a signal at the same time. This is the signal sent to the COM radio selected for TX. The signal is only sent if the PTT is active.

The Head Menu

Access the Head menu buy pressing the rotary knob.



The Head menu refers to functions specifically dedicated to the Razor control head.

Edit phonelist

This function allows you to create a phone list with numbers and text descriptors. This list is separate to the phone book you may have on your mobile device. It's main purpose is to store often used numbers related to flight operations as well as suitable emergency numbers.

Set Backlight

This function allows you to fix the backlight intensity level to a predetermined setting or you can select automatic level adjustment based on the ambient light sensor on the front of your Razor.

Inputs...

Your Razor has two available digital inputs. They are not used with current firmware revisions.

About...

This function shows you the Firmware version installed on the Razor as well as the A16

intercom.

A1/A2...

This entry shows the current voltage levels measured at the two inputs of your Razor. This function has no current use on the Razor.

Making a phone call

You can make a phone call in several ways.

1) You can dial on your mobile device. Any sound will be routed to your A16 intercom via the bluetooth connection.
2) You can tap the phone button on your Razor A16 display. This will bring up the dialer on the Razor. You can enter a number to dial or select a number from your local Razor phone list.
3) You can press a button connected to your A16 “Accept” input. This has the same effect as “2”

The Razor phone dialer. Enter the number via the numeric keypad. Use BS to delete the last number shown if you made a mistake. Tap “X” to cancel the attempt. Tap “List” to select from your local Razor List (you edit the list in the “Head setup menu”).

If you have entered the number and would like to proceed with the call tap the green handset button. Your mobile phone will now dial the number.

Whenever your phone line is active, the phone control popup will show regardless of the underlying screen.

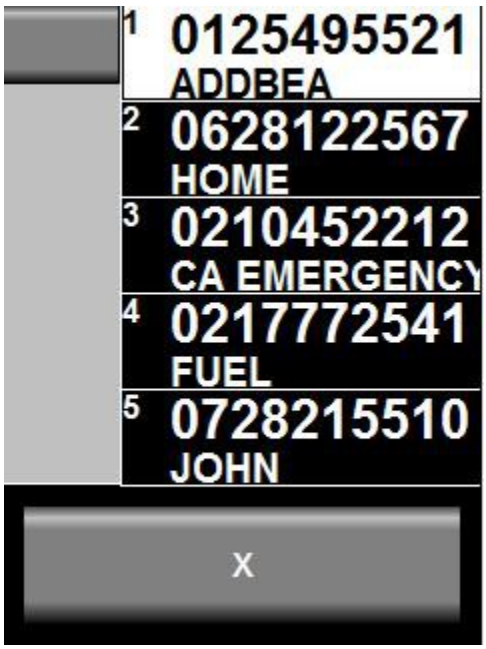
If you originated the call – you can tap “hangup” to end the call. “Accept” in this case has no function.

The corresponding wired input on your A16 labeled “Accept” performs the same function if a button has been wired here.

If you receive an incoming call (not originated by you) the same phone control popup will show. You have the option to Hangup or Accept the call. The corresponding wired inputs on your A16, if used will have the same functionality.

Regardless of the above, if an incoming or outgoing call is terminated by the calling side the phone control popup will close – provided your mobile phone has closed its connection.

The phone list



The phone list is accessed in one of two ways – via the dialer keypad to select an existing number in the list or via the Head menu to edit the list.

Use the slider to the left to quickly scroll through the list – you can also drag it with your finger.

It is advisable to place often used numbers and emergency numbers at the beginning of the list for quick access.

Note: The phone list is stored in your Razor's memory. It works independent of the phone book that may be in your phone. You can still use your phones own facilities to dial out.

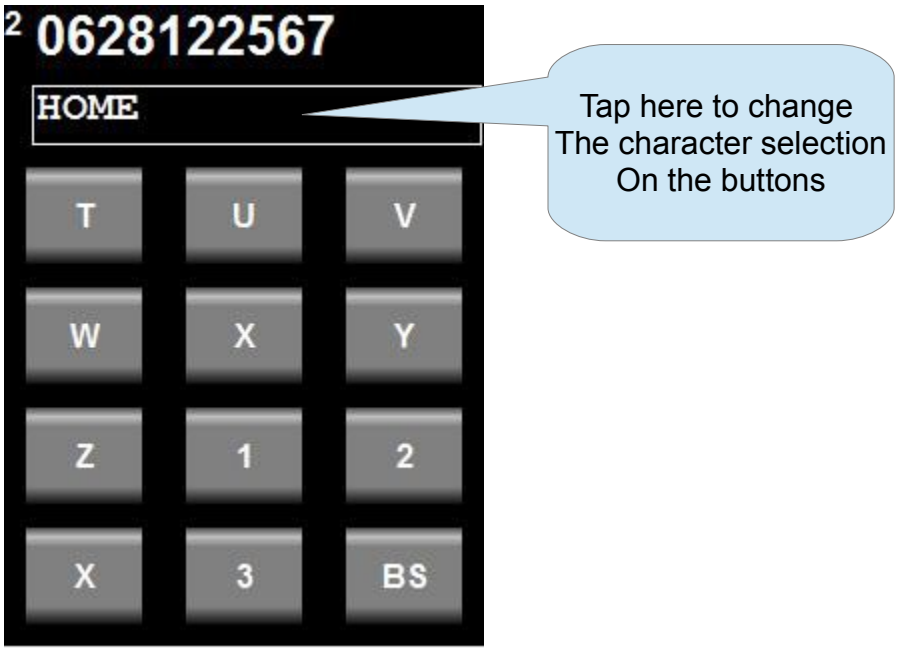
Editing the phone list

Using the “Edit Phonelist” in the menu, select the entry you would like to edit.

You can edit the actual phone number and a text descriptor up to 15 characters.

To change the edit mode between number and text – push the rotary control. This moves a white rectangle over the item to be edited.

To Edit text the same keypad is used but you can select the characters on the buttons. This is done by tapping in the area that shows the text.



BS is used to move the edit position to the left. You can also use the rotary control to change the edit position. The text is always 15 characters long – if required it is filled with spaces.

Cockpit voice recorder (CVR)

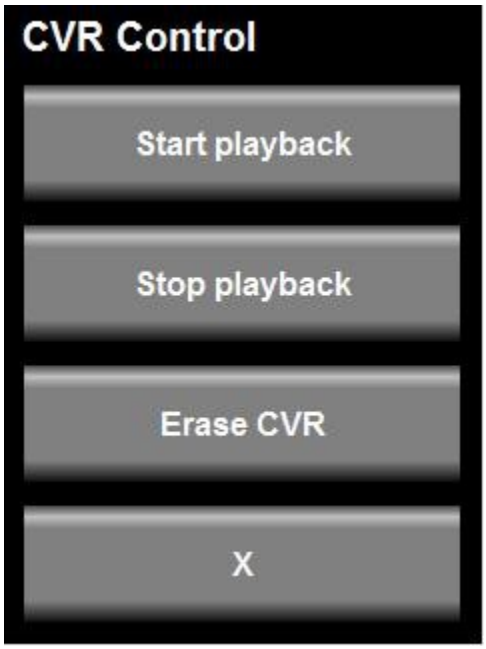
The A16 contains an “always on” cockpit voice recorder. This recorder records all active audio on all microphone and COM radio inputs.

It records the last 35 minutes of audio in an “endless tape” fashion. Silence is not recorded, only active audio such as incoming radio transmissions and microphone VOX “open”.

In order for the CVR to work as expected, please ensure that all microphone VOX settings will close the microphones when sound level is below voice level.

Also ensure that all COM radios have their RX squelch correctly set so there is silence when there is no signal.

To read out the stored audio use the CVR entry in the intercom menu.



Playback starts at the oldest recording (usually 35 minutes of active audio ago) and continues until stopped or all audio has been played back.

The playback sound is available on all Pilot and PAX audio output circuits.

In addition a Windows application is available from MGL Avionics that can connect via RS232 port 1 and download the audio in digital form.

Note: The recording is always active unless you are in playback mode. Should you want to obtain the recording for a particular purpose please switch off all audio sources so nothing is recorded that may overwrite the information you are interested in. Be careful disconnecting audio sources as unterminated inputs may be sensitive to noise and start a recording. Generally this is not an issue if connected devices are not switched on. Headset microphones should be unplugged.

The recording may be erased. Note this takes about 3.5 minutes. A notification will display when this has completed.

Electrical state interfaces

PTT inputs

PTT inputs are realized as active low digital inputs with internal 2200 ohm pull up resistor to 3.3 Volts feeding the base of a transistor via a 10.000 ohm resistor. Open circuit voltage is approximately 3V. PTT is activated when the voltage is pulled by an external device such as a switch below about 0.8V.

It is common to connect a PTT switch to ground. The switch is closed when PTT is active.

The PTT input has a RF filter consisting of a ferrite beed feeding into a grounded capacitor.

Accept and Hangup inputs

Internal 2200 ohm pullup resistor to 3V. Active state is if pulled below 0.8V. Normally a switch is used to ground to activate the input.

RS232 and CAN bus communication protocols

The protocols used to communicate with the A16 are available to third party developers that would like to integrate the A16 into their systems.

Please contact MGL Avionics (info@MGLAvionics.co.za) to obtain the latest protocol documentation or visit the website www.MGLAvionics.co.za and find the product page listing the A16 audio panel.

Certifications

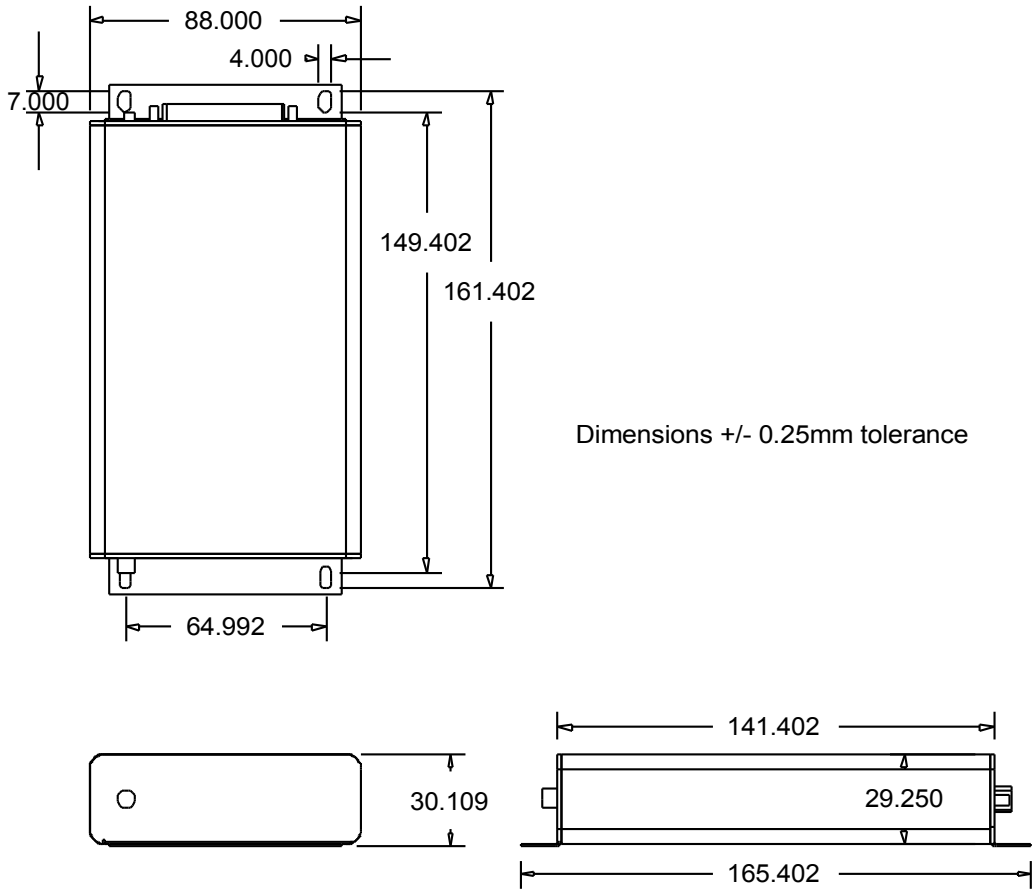
The A16 contains a Bluetooth transceiver Class 2 at +2dbm maximum TX power.

TABLE A-1: EUROPEAN COMPLIANCE TESTING (BM62SPKS1MC2/BM62SPKA1MC2)

Certification	Standards	Article	Laboratory	Report Number	Date
Safety	EN 60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013	[3.1(a)]	TUV, Rheinland, Taiwan	10055923 001	2016-04-20
Health	EN 300 328 V1.9.1 EN 62479:2010			10055775 001 (BDR/EDR)	2016-05-05
				10055772 001(BLE)	
EMC	EN 301 489-1 V1.9.2 EN 301 489-17 V2.2.1	[3.1(b)]		10055205 001 (BM62SPKS1MC2)	2016-05-19
				10055207 001 (BM62SPKA1MC2)	
	EN 301 489-1 V2.1.1 EN 301 489-1 V2.2.0 EN 301 489-17 V3.1.1 EN 301 489-17 V3.2.0			10055205 002 (BM62SPKS1MC2)	2017-05-26
				10055207 002 (BM62SPKA1MC2)	
Radio	EN 300 328 V1.9.1	(3.2)		10055775 001 (BDR/EDR)	2016-05-05
				10055772 001 (BLE)	
	EN 300 328 V2.1.1			10055775 002 (BDR/EDR)	2017-05-26
				10055772 002 (BLE)	

• BT SIG/QDID: 110148
• United States/FCC ID: A8TBM62S2
• Canada/ISED
- IC: 12246A-BM62S2
- HVIN: BM62SPKS1MC2
• Europe/CE
• Japan/MIC: 005-101204
• Korea/KCC: MSIP-CRM-mcp-BM62SPKS1MC2
• Taiwan/NCC No: CCAN16LP0270T5
• China/SRRC: CMIIT ID: 2016DJ2656
• Brazil/ANATEL: 00633-17-03464

Mechanical dimensions



Materials

Body: Aluminum extrusion
Flanges: Stainless Steel, 1mm, Fasteners Stainless Steel.
Labels: Vinyl

Dealing with common audio signal issues

An intercom such as the A16 concentrates potentially many audio sources via distributed wires to a central point and from there to a COM radio microphone input.

This presents a potential problem if during transmission the area containing the wiring (including headsets) is exposed to a strong RF field. As COM radios use AM modulation the strength of the field is directly related to the amplitude of the modulating audio signal. If this RF signal is allowed to enter the microphone input of the COM radio and it is very strong it will setup a feed back path that is very similar to a microphone held too close to a speaker on a stage. COM radios tend to have built in RF filters for this purpose but in case of a very strong or concentrated RF signal these filters can be overwhelmed.

As COM radios become more powerful this issue becomes worse. In most cases an aircraft constructed with a metal skin is much less as risk compared to an aircraft constructed with other materials.

In many cases shielding audio cables, which is generally a requirement, does not help much with RF contamination as the grounds themselves are contaminated with RF signals and this can even couple into the signal wires via the shields. Common solutions involve lowing impedance using low value resistors (100-500 ohms), small value capacitors (typically up to 1nF ceramic disk) or ferrite beads which help to reduce RF on the conductors.

In our experience, by far, the best solutions involve a specially selected audio isolation transformer, selected for its core material and physical separation of its primary and secondary winding. MGL Avionics provides a pair of these transformers with each A16 and further transformers may be purchased if needed.

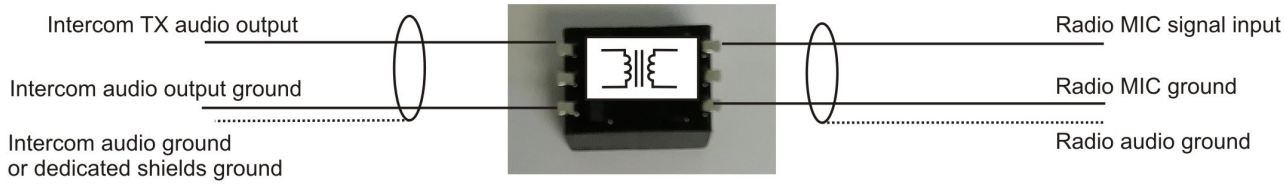
In most cases only two transformers are needed, one for each COM radio. These are wired as DC isolation transformer which has the added benefit of avoiding a troublesome DC ground loop.

This transformer is also very useful as DC coupled RF block with common mode choke properties for other applications. The most useful of these in the avionics context is in the microphone cable to an aviation headset. The headset requires a DC connection to the radio as the radio will supply current to the microphone amplifier in the headset.

The following diagram shows how to use the transformer for either application. It is small in size and if installed inline should be protected with a short piece of heat shrink or plastic sleeving.

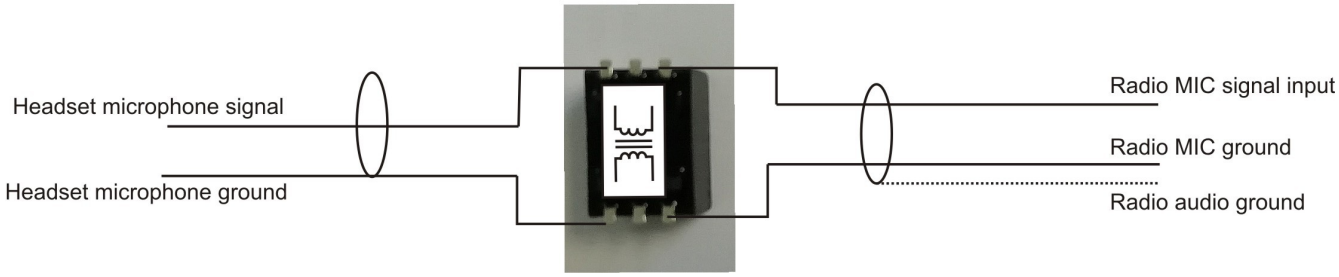
Note: In some cases an RF field during TX can be so strong that the microphone amplifier in the headset itself demodulates the signal and creates the feedback loop. In this case any downstream measures have no effect. The only possible solution, apart from modifications to the headset, is to move your antenna further away (the field strength drops rapidly with distance) or to find a more robust headset.

Using the 5001 audio transformer as DC isolator and RF block



Note: Shields on Radio side not needed if wires kept very short.

Using the 5001 audio transformer as common mode choke and RF block

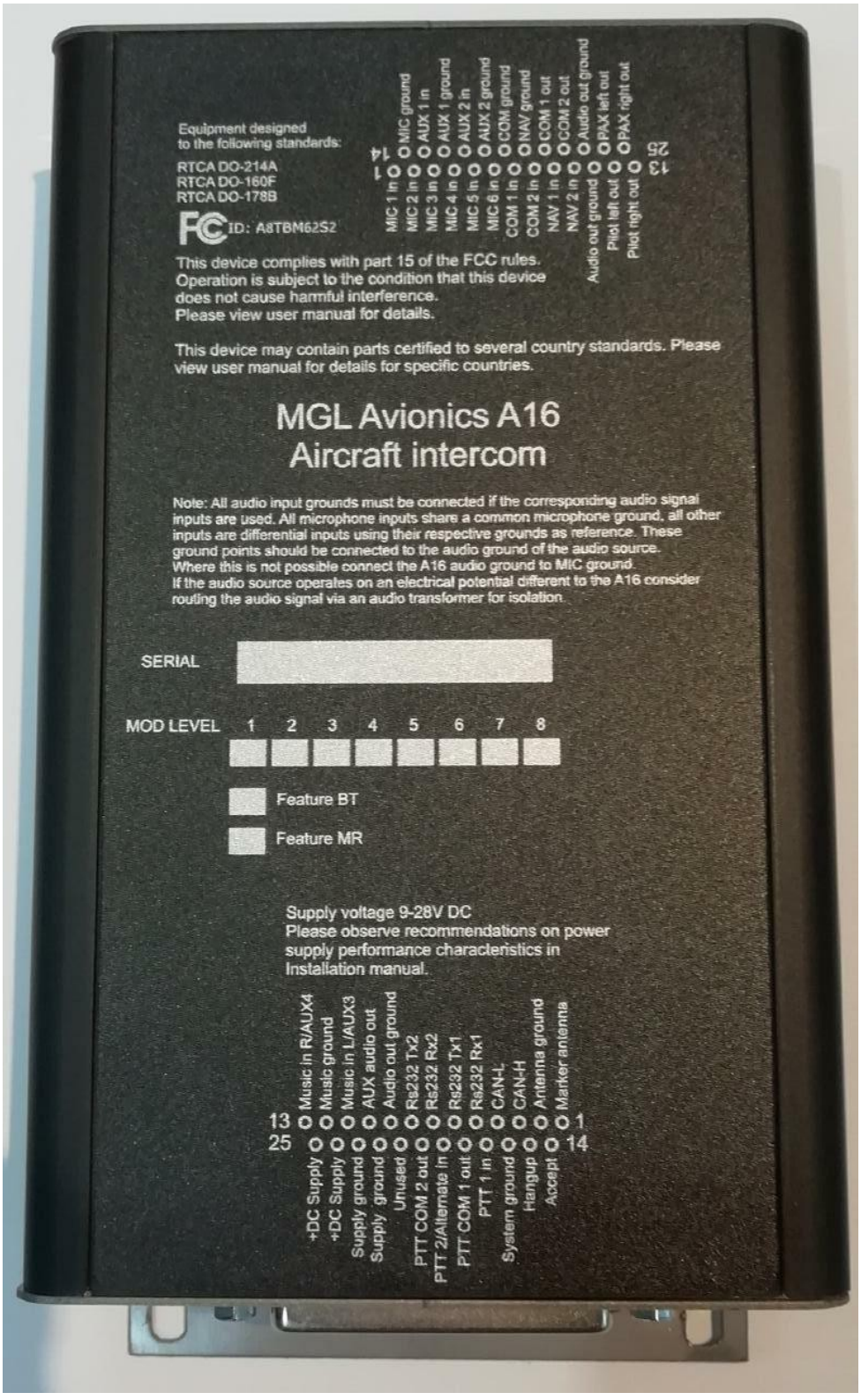


The above image shows two ways of using the 5001 transformer. The top illustration can generally be used for any audio feed to and from the A16 intercom system if needed.The illustration below is an effective solution for headset microphone feeds which require DC coupling.

Images

Rear connector and Bluetooth antenna

Rear label detail


Equipment designed
to the following standards:
RTCA DO-214A
RTCA DO-160F
RTCA DO-178B
FC ID: A8TBM62S2
This device complies with part 15 of the FCC rules.
Operation is subject to the condition that this device
does not cause harmful interference.
Please view user manual for details.
This device may contain parts certified to several country standards. Please view user manual for details for specific countries.
MGL Avionics A16
Aircraft intercom
Note: All audio input grounds must be connected if the corresponding audio signal inputs are used. All microphone inputs share a common microphone ground, all other inputs are differential inputs using their respective grounds as reference. These ground points should be connected to the audio ground of the audio source.
Where this is not possible connect the A16 audio ground to MIC ground.
If the audio source operates on an electrical potential different to the A16 consider routing the audio signal via an audio transformer for isolation.
SERIAL
MOD LEVEL 1 2 3 4 5 6 7 8
Feature BT
Feature MR
Supply voltage 9-28V DC
Please observe recommendations on power supply performance characteristics in Installation manual.
14 MIC ground
AUX 1 in
AUX 1 ground
AUX 2 in
AUX 2 ground
COM ground
NAV ground
COM 1 out
COM 2 out
Audio out ground
PAX left out
PAX right out
25
1 MIC 1 in
MIC 2 in
MIC 3 in
MIC 4 in
MIC 5 in
MIC 6 in
COM 1 in
COM 2 in
NAV 1 in
NAV 2 in
Audio out ground
Pilot left out
Pilot right out
13
13 Music in R/AUX4
Music ground
Music in L/AUX3
AUX audio out
Audio out ground
Rs232 Tx2
Rs232 Rx2
Rs232 Tx1
Rs232 Rx1
CAN-L
CAN-H
Antenna ground
Marker antenna
1
25 +DC Supply
+DC Supply
Supply ground
Supply ground
Unused
PTT COM 2 out
PTT 2/Alternate in
PTT COM 1 out
PTT 1 in
System ground
Hangup
Accept
14

Top view

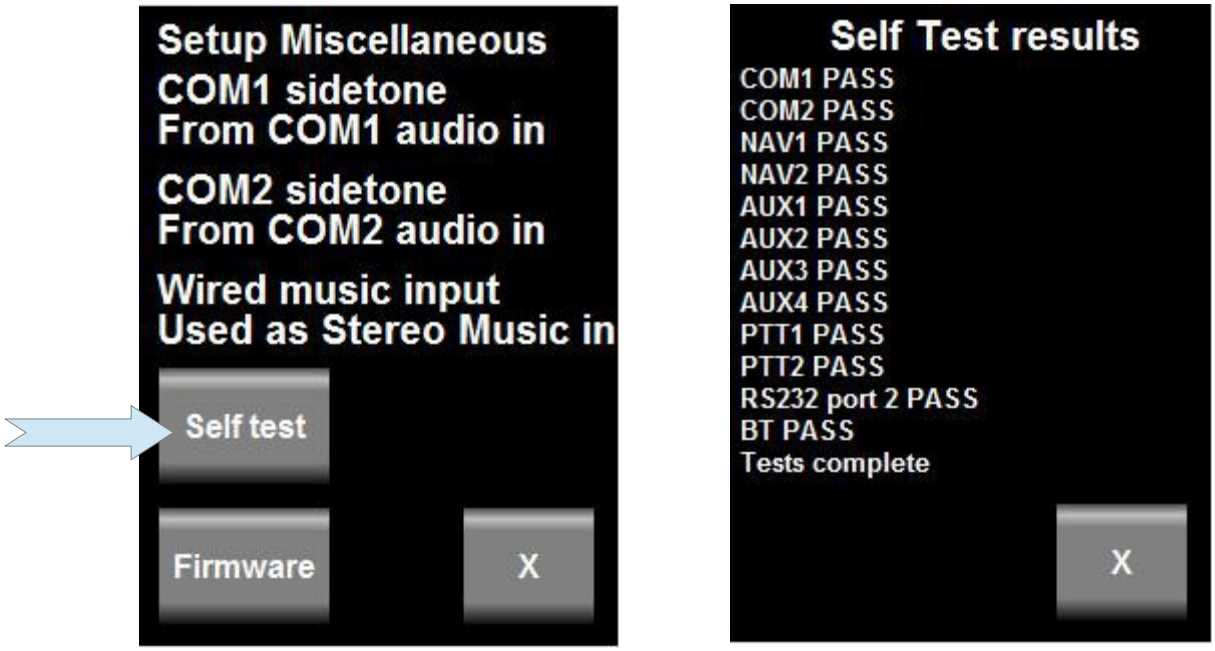
Self test facility

The A16 contains a built in self test. This test requires two DB25 male connectors wired as shown in the diagram below.

This test creates an audio signal generator and routes a signal via all available outputs to all available inputs in a sequence. In addition it tests the PTT inputs and outputs as well as Call accept and hangup button inputs. RS232 port 2 is tested via a loop back from TX to RX. Further information is presented showing the online status of the four internal CODEC chips and the bluetooth module.

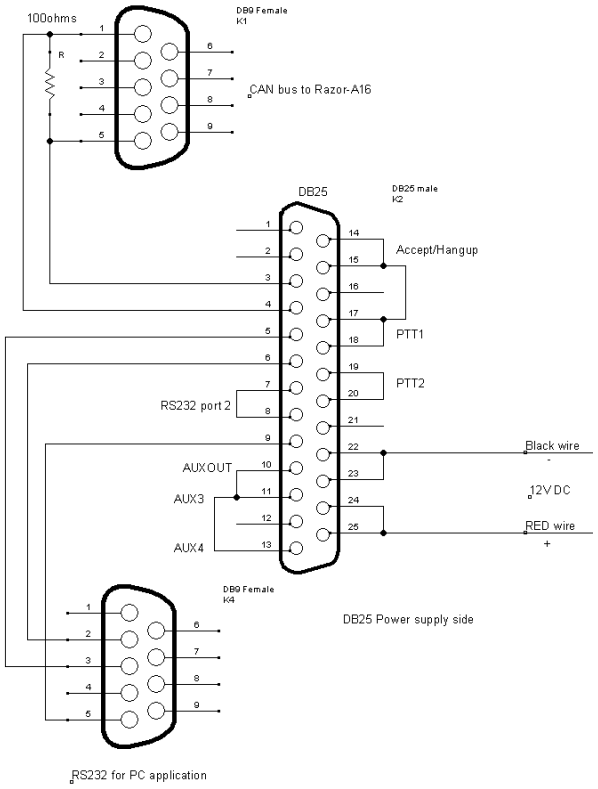
Note: By plugging in the self test connectors a strong feedback loop is created between audio outputs and inputs. This results in oscillation. This is not a problem for the test however. Once you start the test, the A16 is reconfigured for the duration of the test to avoid the feedback loops.

The test can be started using the function provided in the Miscellaneous menu.

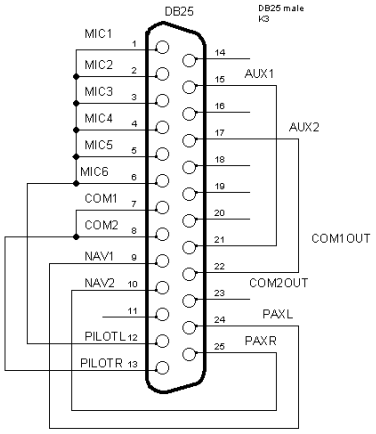


CODEC test results are displayed as a hexadecimal number. If all CODECS are online the value is 0F

If PTT 1 or 2 fails a hexadecimal number is displayed allowing determination of the failure.



DB25 Power supply side



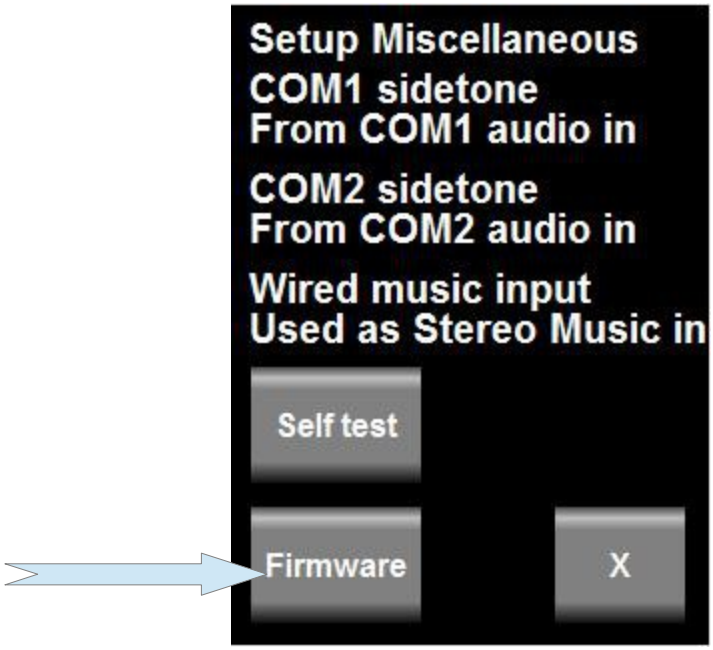
DB25 Microphone side

Title: A16 Aircraft Intercom Self test wiring		
Author:		
File: C:\Docs\A16\Self test.dsn		Document
Revision: 1.0	Date:	Sheets: 1 of 1

Razor Firmware updates

Firmware updates are performed on both the A16 Intercom and the A16 Razor control (if used).

The Firmware for the A16 Intercom includes the matching Firmware for the A16 Razor. Once you have updated the Firmware of the A16 either via Bluetooth or via RS232 port 1 using the supplied application from MGL Avionics you can then update the Razor which can extract its new Firmware via the CAN bus connection from the A16 Intercom.



Simply tap the Firmware button. New firmware will be downloaded from the A16. This process takes about a minute and a progress window is shown. When done you are prompted to restart the Razor. During the restart the boot loader will check if the new firmware differs from that already installed and if it does will perform a check to make sure it is not corrupted in any way. If OK it will then replace the existing firmware and the Razor will start with the new Firmware. You can check the Firmware number in the “Head” setup menu.

The Firmware replacement process takes a few seconds after restart. Should it be interrupted it will restart on the next power cycle.