

# MGL Avionics

## Razor 3.1/8" control head for V16 aviation band transceiver and N16 VHF navigation receiver

\*) from firmware version 010322 support for A14/A16 intercom



## User and Installation manual

Active  
**127.000** MHz

Standby  
**119.300** MHz

RX 64%  
IC 67%  
SQ -96dbm

Playback

SCAN    CH    Menu

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## Note

This document details operation of the Razor NAV/COM control head for COM, NAV and NAVCOM operations. This document is valid for Razor firmware 010322.

Razor devices prior to this can be updated to this version via RS232 using a freely downloadable application from the MGL Avionics website. Versions prior to this only support COM operation.

## General

This manual documents the installation and use of the MGL Avionics Razor NAV/COM 3.1/8" control head.

The Razor NAV/COM control head is designed to interface to a MGL Avionics V16 VHF airband transceiver and/or a MGL Avionics N16 VHF Navigation receiver.

## Document history

01 March 2022

Added support for A14/A16 intercom system

21 February 2018

Added NAV and NAVCOM functionality

14 November 2017, first release.

## Description

The Razor control head consists of a body designed to fit a standard 3.1/8" instrument cutout. The Razor is designed for panel front mounting.

The Razor features a 3.2" portrait mode color TFT touch screen with a wide viewing angle. A Rotary control is provided. Display light intensity may be adjusted to fixed values or set automatically based on ambient light levels.

The Razor interfaces to a V16 and or N16 using a two wire CAN bus. Two RS232 ports are provided. RS232 port 1 may be used as interface to third party systems implementing industry standard communication protocols. The same port may also be used to upload firmware updates to the Razor using a PC application provided by MGL Avionics. RS232 port 2 is reserved for special applications and is not currently used.

Two analog voltage inputs are provided. Input one may be used together with a switch to implement a stick mounted last reception recall for the V16 transceiver. Input two may be used to implement a selection of one, two or three button frequency or channel selection switches.

## **Multiple control heads**

There are no limitations to the number of control heads installed in parallel.

Control head types can be mixed, for example you may mix Razor 3.1/8" heads with Vega you2.14" heads. Heads require no specific configuration for multiple head operation. Simply connect them in parallel on the CAN bus.

## **Interface with MGL EFIS systems**

Heads are not connected in any way to a MGL Avionics EFIS system.

Should you wish to operate an MGL EFIS with a V16 and/or N16, the MGL EFIS connects directly to the V16 via an EFIS RS232 port. In case of a V16 and N16 combination, the N16 is connected to the V16 via CAN bus and the V16 RS232 port provides both V16 and N16 data to the EFIS. In case of a single N16 receiver, connect the RS232 port 1 of the N16 to the RS232 port of the EFIS.

Note that the CAN bus between heads, V16 and N16 is a private CAN bus. It must not be connected to an EFIS CAN bus or any other can bus in your aircraft.

You may operate heads and EFIS connection at the same time.

## **Interface with non-MGL EFIS systems**

Using any Razor or Vega head, RS232 port 1 implements a industry standard, Garmin compatible protocol. As there are several protocol types please select the desired variant in the head setup menu.

Note: If you have both V16 and N16 connected via CAN bus to your head, you can select a NAV/COM protocol such as SL30 or GNC255. If you have only a V16 connected, select one of the COM protocols such as SL40, GTR200, GTR225.

It is possible to connect only a N16. In this case select a NAV/COM protocol. The protocol will include the COM parts but these will not be functional – for example if you were to set a COM frequency this will not work and the head will return a fixed frequency set to 118.000Mhz.

The protocols are implemented fully including various forms of frequency lists and tables depending on the chosen protocol which can be used with compatible GPS receivers. Note: Generally, EFIS systems do not download frequency lists but set individual frequencies from their databases.

## **Multiple V16/N16 systems**

Should you wish to use multiple V16 and/or N16 systems, please wire each system with a separate CAN bus.

## V16 COM radio interface – operation



### ***Rotary control***

This is used to enter a new standby frequency, flip active and standby frequency, switch scanning on and off and select the 121.5Mhz emergency channel. The Rotary control is also used to select from preset channel lists and can be used for many of the menu and setup functions. It is also used to set volume and squelch levels.

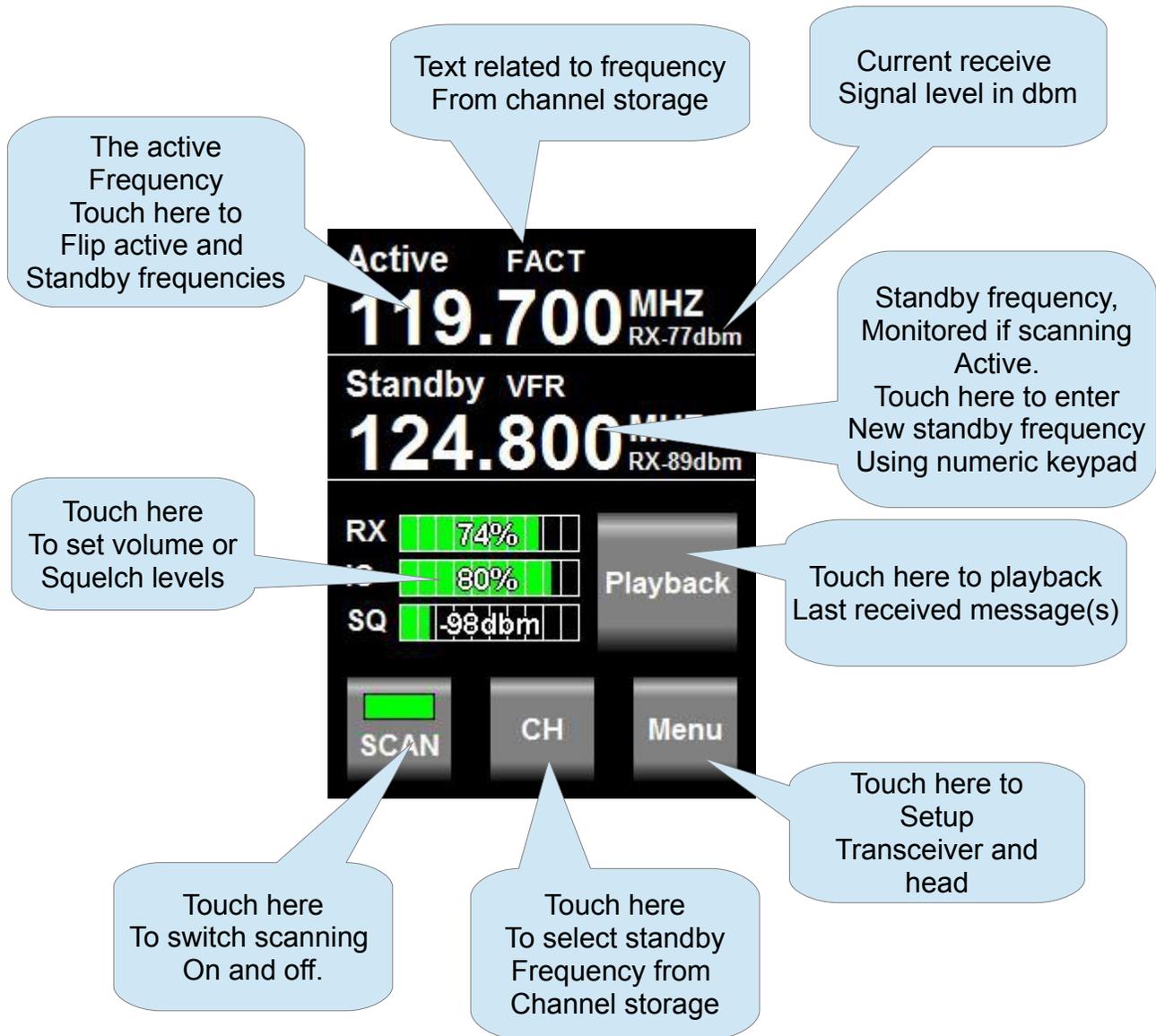
### ***Touch screen***

The touch screen duplicates many of the rotary control functions and is also extensively used with the menu system.

### ***Ambient light sensor***

The display brightness can be adjusted either in fixed steps (using the menu) or it can be set to automatically adjust depending on the amount of ambient light measured at the sensor.

## Main display - receive



Notes: Frequency display flashes when signal received above squelch level. Signal strength readout in dbm only visible when signal above squelch level.

Internal channel storage can be edited via the Menu -> head setup.

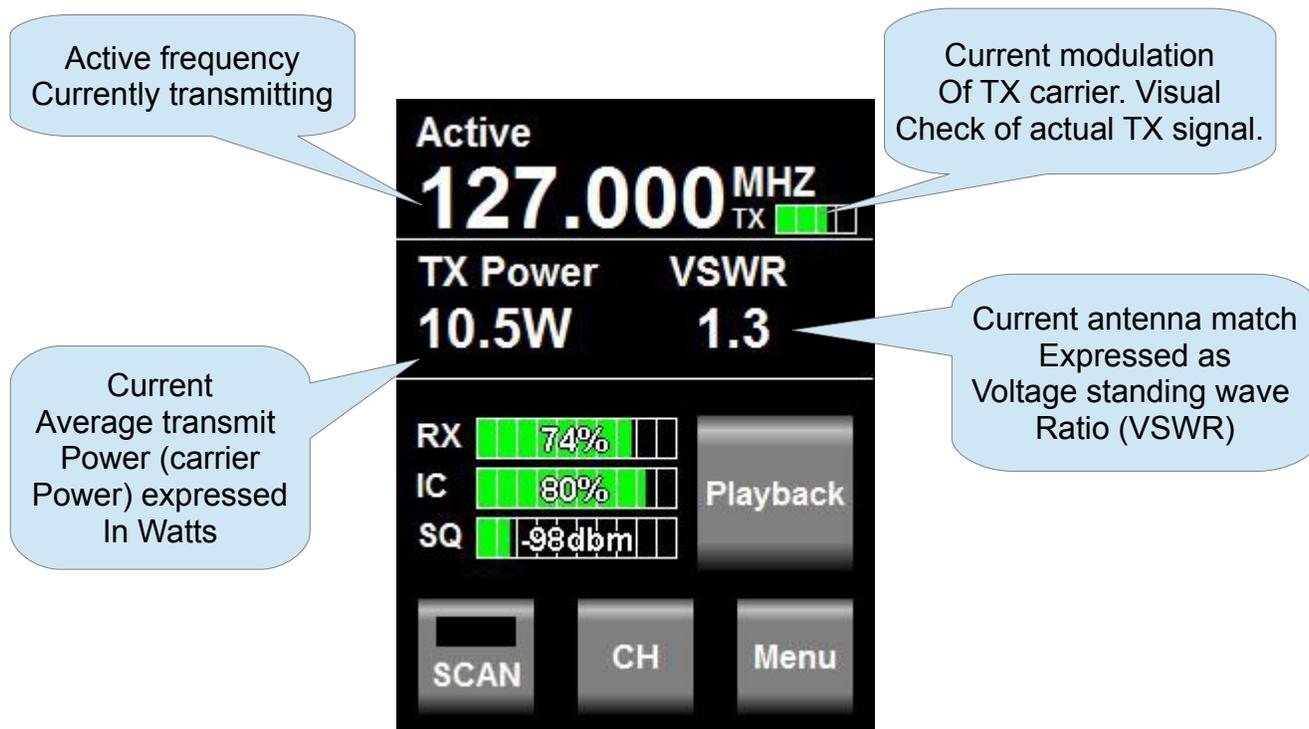
Further channel storage options available via downloaded channel lists from external equipment depending on protocols selected and availability of such functionality on external equipment such as EFIS systems.

Touching playback plays back last received message. If pressed again while message is playing back - advances to next older message. If playback allowed to finish, next playback

requests starts from latest message again. Playback may also be activated via a remote switch.

Channel based frequency selection may be operated via remote switches. This can be configured to operate in various modes and number of switches.

## Main display - transmit



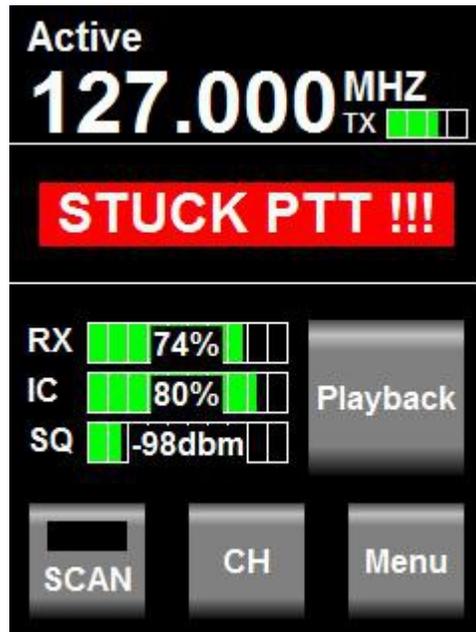
Notes: TX power and VSWR are only shown during TX if "Show TX Info" is selected in Menu -> Head. If not selected, the standby frequency will be shown in this field.

Current modulation is derived from actual demodulation of the outgoing TX carrier wave and is a true reflection of modulation of the carrier.

Transmit power is a true RF forward power measurement using a directional coupler at the antenna connector. Typical readings are around 10W (or 5W if low power TX mode selected). Power readings can vary depending on tuned frequency, antenna match at that frequency, internal temperature of the transmitter (if exceeding high levels) or power supply voltage if below 13.8V DC during transmit.

VSWR reading is taken from a directional coupler at the antenna connector which looks into the transmitter harmonics filter as termination. Due to variable impedance at this location the VSWR reading may differ slightly from that of a similar meter inserted at the antenna but nevertheless is a good indication of antenna match. A good antenna match would give readings below 1.5 at any frequency. Readings above 2.0 should be investigated and may indicate a badly tuned or unsuitable antenna. Transmitting into a 50 ohm RF dummy load produces a perfect match and a reading of 1.0.

## Messages



Messages requiring alerts alternate with the standby frequency field. The following messages may be displayed:

### **STUCK PTT !!!**

This displays when transmission has been active for 35 seconds. The V16 conforms to the requirements of DO-207. After 35 seconds the V16 reverts back to receive mode even if the PTT remains active. Releasing PTT resets the 35 second timer and a new transmission may commence.

### **V16 FAULT**

This displays if the internal self diagnostics of the V16 transceiver has detected an internal fault that may cause incorrect operation. Please make arrangements to have your V16 transceiver checked and if required, repaired by a qualified service lab.

### **Antenna !**

This message will be displayed in case of a very bad antenna match during transmit. If this message appears transmit power will have been reduced automatically to prevent destruction of the transmitter.

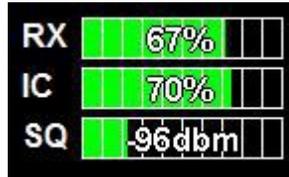
Please check your antenna and antenna cable as well as connectors for shorts or open circuits. If this happens with an antenna that was previously operating fine, check connectivity to the antenna ground plane and check for corrosion.

For new installations, please ensure that your antenna has a properly configured ground plane of sufficient size.

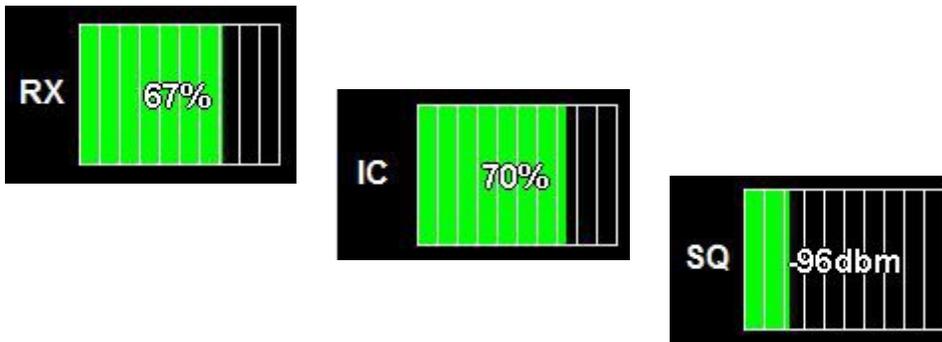
## Adjusting volumes and squelch

The V16 features independent receive and intercom volume controls plus a semi-automatic receiver squelch.

To adjust any of these settings, touch the field showing the current values:



This results in:



Tap to alternate between the three settings. While the setting is shown using a large bargraph, use the rotary control to adjust the setting.

Notes:

Typical volume settings for aviation headsets (2 x 600 ohms impedance) tends to be in the region of 60-70%. If the V16 is connected to an intercom system you may prefer much lower levels to avoid over driving the intercom inputs.

Receiver squelch is adjusted in steps of about 1 dbm from just under -100 to -70. Typical settings tend to be in the range of -95dbm. You should adjust to a setting that just cancels the receiver noise if there is no reception of a sufficiently strong signal.

Avoid too high squelch settings – this will make your receiver insensitive to weak signals, unless this is your intention.

Be aware that higher than normal squelch settings may indicate interference from on-board electrical systems – typically these would be frequency dependent. Good and proper installation of your V16 can help to minimize such effects. Pay particular attention to a good antenna match using the on-board VSWR meter and also of the location of antenna cable and antenna itself with respect to on-board interferers. Distance minimizes interference !

The V16 squelch is on the semi-automatic type. This combines the positive elements of a fully automatic squelch with the control of a manual squelch. When you adjust the squelch or when

the V16 powers up squelch is set to your set level. However, the V16 is allowed to adjust starting at this value for a small amount depending on the received signal so it can track the noise floor which typically changes a bit with location and frequency.

## **Entering a new standby frequency**

### ***Using the numeric keypad***



Touch the standby frequency to activate the numeric keypad.

Entry starts with the 10's of MHZ (you do not need to type the 100's of MHZ). A blinking cursor shows the digit you are changing. Only valid numerics for a given position may be entered. For example, the 10's of MHZ will only accept the numbers "1", "2" or "3".

Use "BS" to move to the last digit entered if you made a mistake.

Use "X" to abandon any entry and return to the normal display without changing the standby frequency.

To complete the entry, either enter all of the digits or touch the frequency display area when you are done.

Notes: Using the numeric keypad allows you to enter 8.33Khz and 25Khz channels regardless of the channel spacing setup in the head setup menu.

### ***Using the rotary control***

"Click" means push the rotary control towards the panel without turning it - you will notice a distinct "click" action.

To enter a new standby frequency - rotate the knob. You will notice the MHZ part of the

frequency highlighted and the numbers changing with your rotations, Clockwise to increase, anti-clockwise to decrease.



When satisfied with your selection and you would like to change the Khz, "Click" the knob.



Change the 100's of KHZ by rotating the knob. When satisfied, "Click" the knob.



Now change the 10's and 1's of the Khz portion by rotating the knob. "Click" when done - you return to the normal display with the new standby frequency.

Notes:

Using the rotary knob you can restrict entry to only use 25Khz channels by selecting "25Khz" channel spacing in the head setup menu.

Using the rotary control to enter only partial frequencies - for example just the MHZ (and leave the KHZ unchanged) - change the MHZ as needed and "click" twice or simply leave the display as is - it will automatically time out after a few seconds and accept the new frequency.

"Click" the knob without first turning it will flip main and standby frequencies.

This means to rapidly enter a new standby frequency and flip it into active, enter the new frequency and then simply "click" once more.

Note: The behavior of the khz selection using the rotary control is dependent on the Rotary rollover or Rotary clamp selection in the head setup menu.

## Using the channel list

Touch the "CH" button on the display.



which results in:

The diagram shows a channel list interface with five entries. The first entry is highlighted. A vertical slider is on the left, and a button labeled 'X' is at the bottom. Callouts provide instructions and information about the interface.

Channel	Frequency	Text
1	119.700	FACT
2	124.800	VFR
3	118.000	
4	118.000	
5	118.000	

Callouts:

- Touch or drag The slider with your Finger to rapidly Move though the list
- The highlighted Field will be selected If you "click" the Rotary control
- The highlighted field Moves if you Rotate the rotary control
- You may define Up to 100 channels
- Touch here to Exit without Selecting a New frequency
- Channels not yet Defined show as 118,000Mhz with No text added

Note: you can also drag the channel list using your finger and select a frequency by touching a frequency entry.

You can edit the contents of the channel list in the Menu -> Head -> Edit channels.

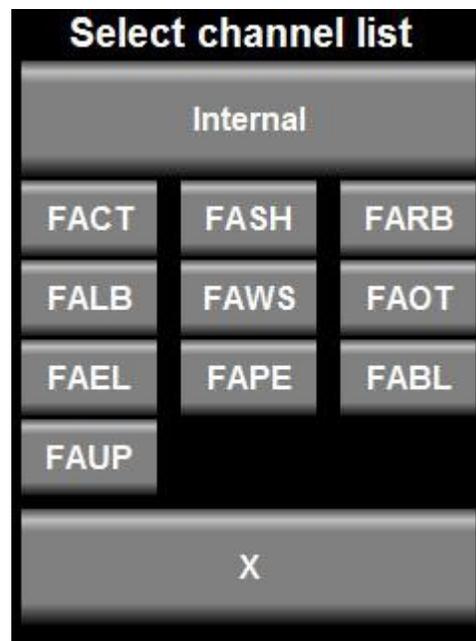
## ***Frequency lists downloaded from external devices***

### **COM lists**

If at least one frequency list downloaded from an external source is available then your channel selection button is bracketed <CH>.



Tapping the CH button will bring up a list selection display:



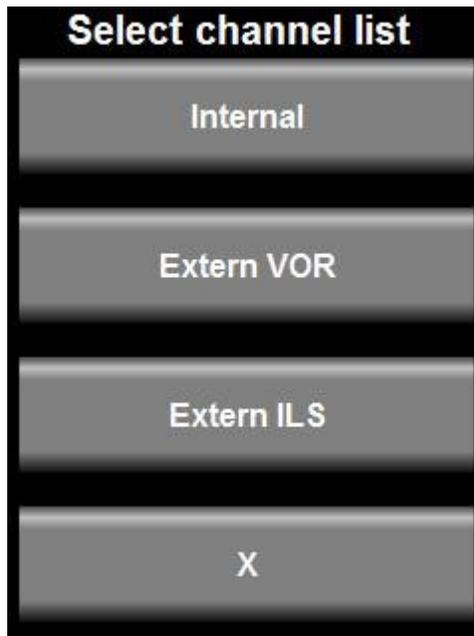
Each external list is identified by an airport ID (as downloaded from the external device). Select the desired list or choose the internal list. You can then proceed to choose an entry from that list.

A selected frequency will be inserted into your standby frequency.

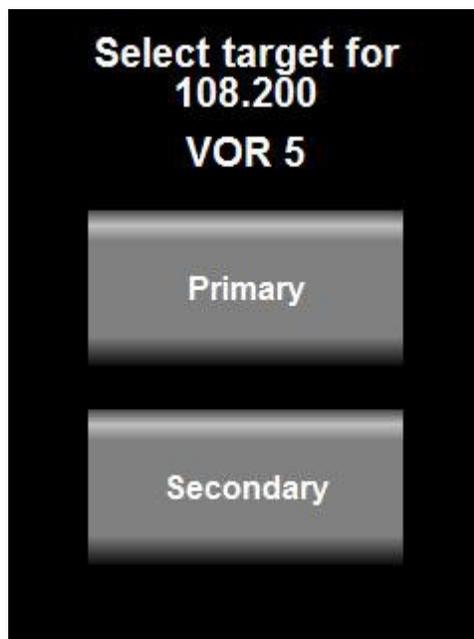
## NAV lists

If your Razor is selected as a NAV head then you will be given the choice of either a VOR or ILS (or both) list – provided either of these has been downloaded from an external device.

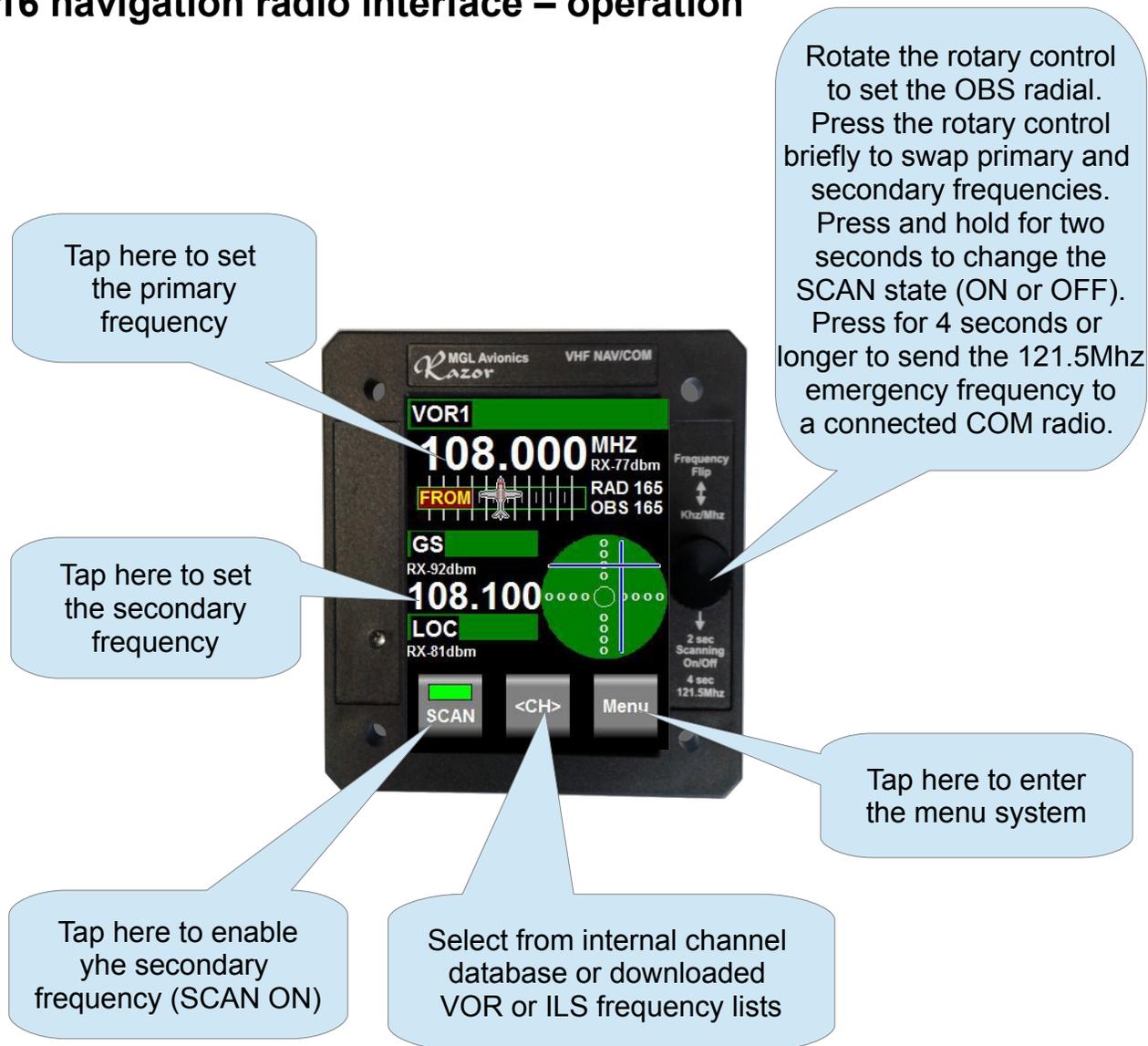
After you choose a frequency from either list or the internal list you will be asked if you would like to select that frequency to the primary or secondary NAV frequency.



Once you have chosen channel from the chosen list you will be asked to indicate the target for the new frequency. Choose primary or secondary. Note: This choice applies only to NAV frequencies. COM frequencies are always sent to the COM standby channel.



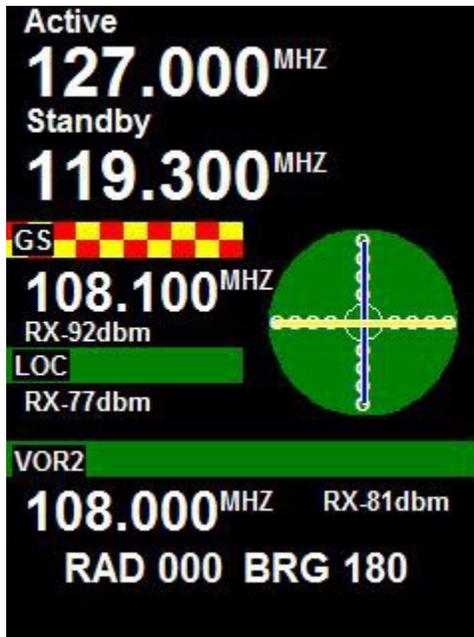
## N16 navigation radio interface – operation



Tap anywhere on a VOR section of the display (except the frequency) to change to the VOR control menu which allows you to set the RX volume, RX squelch as well as Audio and ID enables.

Tap anywhere on a ILS section of the display (except the frequency) to change to the ILS control menu which allows you to set the RX volume, RX squelch as well as Audio and ID enables. It also allows you to change to localizer backcourse navigation which is indicated by the letters "BC" on the needles display.

## Typical navigation displays



NAVCOM display. In this mode the COM is shown at the top section of the display and the NAV section occupies the bottom section.

We see the active and standby COM frequencies and any descriptors (if available). During RX, signal strengths are shown. Any fault or attention messages will flash in red in this section.

The NAV section shows the primary frequency tuned to an ILS localizer frequency. The paired glide slope is flagged and receiving a signal at -92dbm while the localizer is unflagged at a signal level of -77dbm. The needles show we are on glide slope and tracking the localizer.

The secondary NAV frequency is tuned to a VOR station and is receiving at -81dbm. The station is unflagged and we are showing a radial of 000 degrees (FROM) and a bearing (TO) of 180 degrees. Since this is a VOR on the

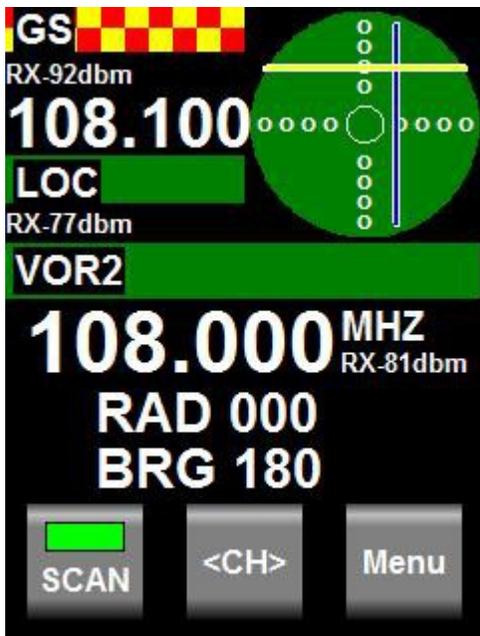
secondary channel there is no CDI.

Tapping the COM section of the display changes the display to COM mode. This allows you control the COM device.

Similar, tapping the NAV section of the display changes the display to NAV mode. This allows you control the NAV device.

If no activity is detected for 6 seconds the Razor reverts back to the NAVCOM display.

While the NAVCOM display is showing the rotary control can be used to adjust the OBS bearing if the primary NAV frequency is tuned to a VOR station.



NAV display. Primary frequency is tuned to an ILS localizer and we are receiving at -77dbm. The localizer is unflagged. We are below the glide slope and to the left of the runway centerline.

The GS is being received at -92dbm and is flagged and should be used with caution.

The secondary frequency is tuned to a VOR station that is receiving at -81dbm. We are on the "FROM" radial 000 degrees and "TO" bearing of 180 degrees.

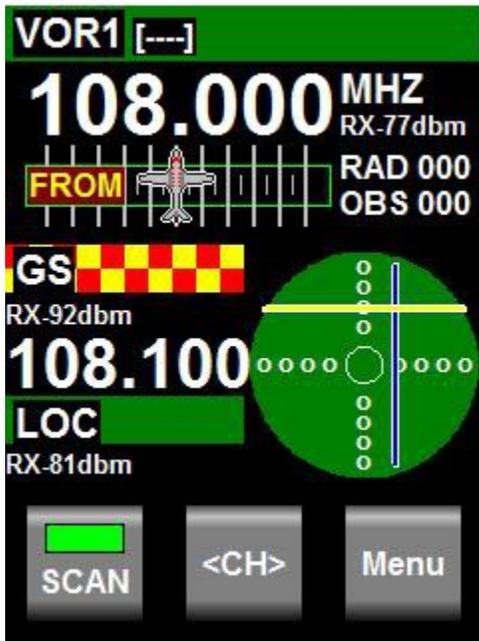
As this is a secondary frequency there is no VOR CDI and we are shown the radial/bearing only. This is used for radial crossing navigation in most cases.

SCAN, CH and Menu buttons work as described in the COM section of this manual.

Note the CH is bracketed: <CH>. This means externally downloaded VOR and/or ILS frequency lists are available.

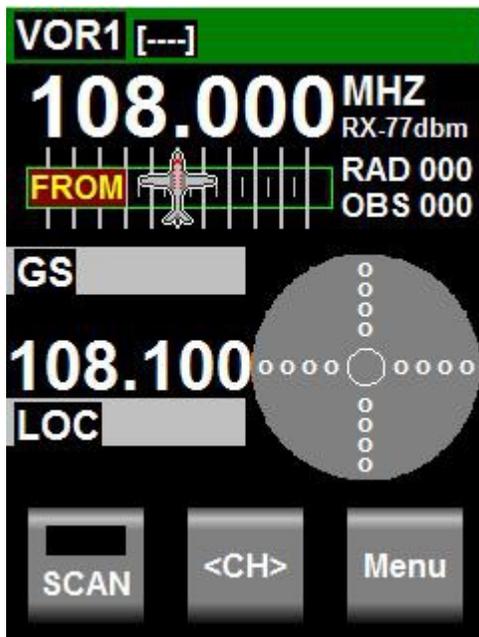
If there are no brackets, it means you can only select from the internal frequency list.

To change either primary or secondary frequencies, simply tap on the frequency.



NAV display. Primary frequency is tuned to a VOR station and receiving at -77dbm. OBS is set to 000 while we are on the FROM radial 000 so the CDI is centered.

The secondary frequency is tuned to a localizer receiving at -81dbm. The paired glide slope is flagged but receiving at -92dbm. We are below the glide slope and to the left of the runway.



NAV display. Same condition as the display on the left but scanning has been disabled.

The secondary frequency is tuned but not operating.

In this mode you can listen to the primary frequency audio if desired.

The secondary frequency section will be grayed out and the SCAN button is not lit.

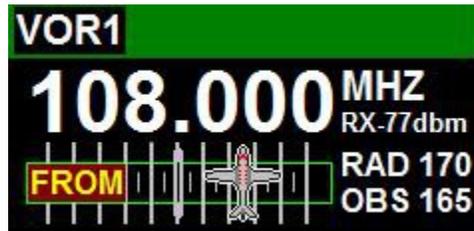
## Adjusting the OBS

For a VOR station tuned as primary you can adjust the OBS for the CDI using the rotary

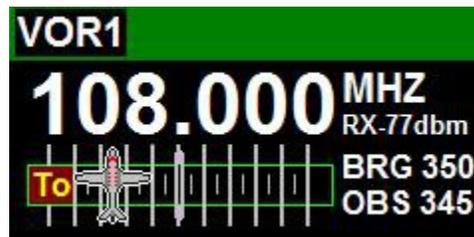
control. The control in this case is speed sensitive – if you turn faster the OBS will change in bigger steps allowing you to set the desired radial very quickly.

The “TO/FROM” flag indicator will change automatically based on the current received radial and the selected OBS.

In order to provide consistency between the CDI and active TO/FROM flag and the numeric angle readout, the readout will show either the radial “RAD” FROM the station or the bearing “BRG” TO the station.



Here we are on radial 170 “from” the station on an OBS of 165 degrees. We should turn left to intercept the course.

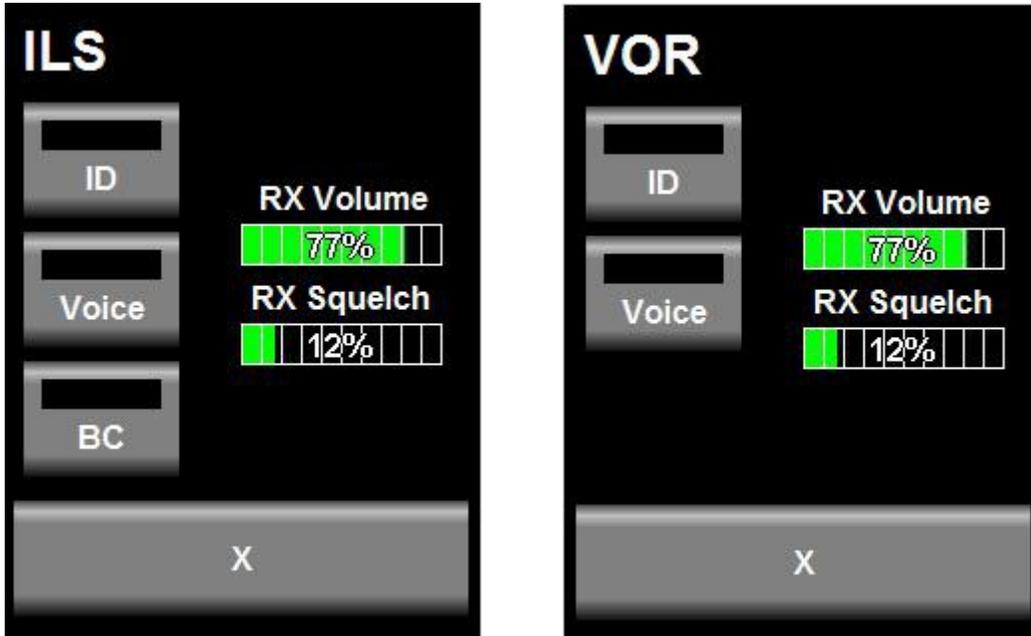


In this case we are heading “to” the station on a bearing of 350 degrees with the OBS set to 345 degrees. We should turn right to intercept the course.

Note: In both cases above, the aircraft is on the VOR radial of 170 degrees. The display uses RAD (radial) to indicate that the OBS is set to a course FROM the station while BRG (bearing) is used to indicate that the OBS is set to a course TO the station.

The choice of either radial or bearing display is thus made by setting the OBS to the appropriate course.

## NAV receiver controls



Tap on a VOR display anywhere except the frequency and you select the VOR control display. Tap on an ILS display anywhere except frequency and you select the ILS control.

Both controls are similar and differ only the back course selection.

ID = Switch the morse ID filter for the audio output. If enabled you will hear the ID.

Voice = Switch the voice band filter for the audio output. If enabled you will hear the voice audio.

You may enable both ID and voice at the same time.

BC = control back course for the localizer.

### Adjusting RX volume

Tap on the RX volume or RX Squelch readout, then use the rotary control to adjust the volume. Note: during the adjustment of volume the receiver squelch will be disabled to aid in adjusting the volume.

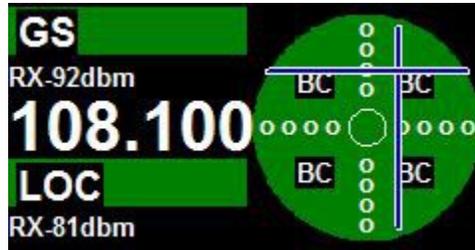
### Adjusting the squelch

Tap on the RX squelch or RX Volume readout, when the larger RX Volume readout appears, tap on it again – it now changes to the larger RX Squelch readout. Now use the rotary control to adjust the receiver squelch. Note: the receiver squelch is of the semi automatic variety. It will use your setting as starting value but is allowed, within limits, to self adjust from there. This allows the receiver to track changes in background noise. The squelch setting only affects the audio output. It does not affect morse station decoding or the function of VOR or

ILS.

## Localizer backcourse

Back course selection is indicated on the ILS needles display using 4 sets of “BC” indicators.



Ensure you are familiar with localizer operation and back course navigation before using the ILS facilities in the Razor. Enabled back course will reverse the localizer needle as you are approaching the localizer “from behind”.

## The NAVCOM mode

The system is configured as “NAVCOM” using one V16 and one N16.

This configuration differs from typical competing NAVCOM solutions in some ways.

- 1) The V16/N16 NAVCOM operates as COM and NAV at the same time. In many cases systems like this can operate either as COM or as NAV but not both at the same time.
- 2) The NAV can operate on two frequencies in “SCAN” mode, sometimes referred to “monitor mode” with other systems. With the N16, both frequencies are equivalent in abilities, the secondary channel is not in any way compromised. It is possible for example to tune to a VOR with CDI on the primary channel and have a fully operational ILS with localizer and glide slope on the secondary channel.
- 3) There are no restrictions on how frequencies are allocated to primary or secondary frequency. You can have two VOR stations on different frequencies or one ILS and one VOR (in any order). You cannot, of course tune to two ILS stations or two VOR stations on the same frequency. Should the same frequency be selected for primary and secondary frequency then SCAN is automatically disabled and the secondary frequency does not operate.

## The audio output

The audio output may be connected to an intercom panel in the usual fashion or may be connected to the AUX input of the V16 transceiver. In this case the AUX input of the N16 can be used as AUX for the V16 (both N16 AUX audio and receiver audio are routed to the V16 AUX input).

The receiver audio is available when SCAN is switched OFF.

Receiver audio is routed via two internal filters – one passes only the 1020Hz ID morse tone,

the second passes only the voice band excluding the 1020 morse tone.

Depending on your selection using the NAV control, the two signals are then mixed so the deselected item appears suppressed at 20db relative to the other. In other words, the item that is switched “off” is attenuated but not switched off entirely.

If ILS is selected as primary frequency and SCAN is not enabled, you will hear the localizer frequency. If the glide slope frequency has a very low signal level (the signal is flagged) you will hear a brief interruption of the audio once per second. This interruption is 0.066 seconds and does not affect overall audibility of the signal.

Once the glide slope is unflagged this interruption occurs at a rate of 6 times per second as glide slope monitoring rate increases.

If SCAN is enabled, the audio output is muted.

## The morse station decoder

The N16 contains an automatic morse signal decoder. This decoder is active whenever SCAN is disabled. The decoder works for both VOR and Localizer stations.

Stations may send out a morse identification signal at 10 second intervals. Some stations may alternate these with recorded voice identification signals.

When a morse signal is detected the N16 attempts to decode it and sends the result to the Razor head. Up to 4 letters may be contained. These letters will be shown either next to the VOR label or LOC label marked by square brackets. If no code has been detected [----] is shown. If a morse character has been decoded that is not reconized a “?” is substituted.

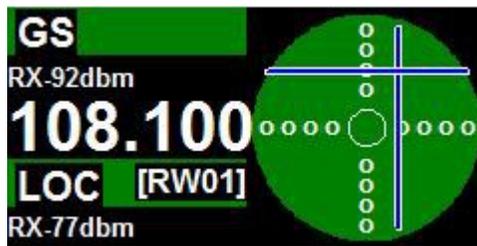
AS there is no way to check for errors in a received morse signal the displayed ID should be viewed with caution. Depending on the success of the decoding, it is possible that only part of the ID is shown or a completely incorrect ID is shown. Always use the displayed ID in conjunction with the tuned frequency readout to verify that the correct station has been tuned to.

With a clean morse signal at the prescribed ICAO rate of 7 words per minute the decoding is 100% error free. Some stations are known to use rates up to 10 words per minute and this can also be handled with equal success.

Errors are the result of weak signals and interference at the 1020Hz morse tone frequency. It is also possible that you happen to tune to a station while it is in the middle of sending its morse code ID. In this case the N16 will only “hear” part of the ID. However in this case the full ID should be available typically 10 seconds later.



Display showing received morse station ID “CTV” on VOR



Display showing received morse station ID “RW01” on localizer

## Channel identification by text

The Razor stores up to 100 used defined channels in its memory (this information is maintained if power is removed). Each channel can be tagged with a text identification describing the channel (up to 11 characters).

In addition, various types of frequency lists and tables can be downloaded to the Razor via the serial interface depending on the chosen protocol emulation.

Some of these have a fixed “type” identification (for example: “Approach”, “Tower”) while others have a text identification of 4 characters or more.

Some lists are designed to act as source for frequency selection while others are merely used as reference – in this case you cannot select a frequency from that list but rather if you enter a frequency contained in the list the Razor will show the text identification.

Tables are used for airports with up to 10 tables available and each table can contain up to 20 frequencies.

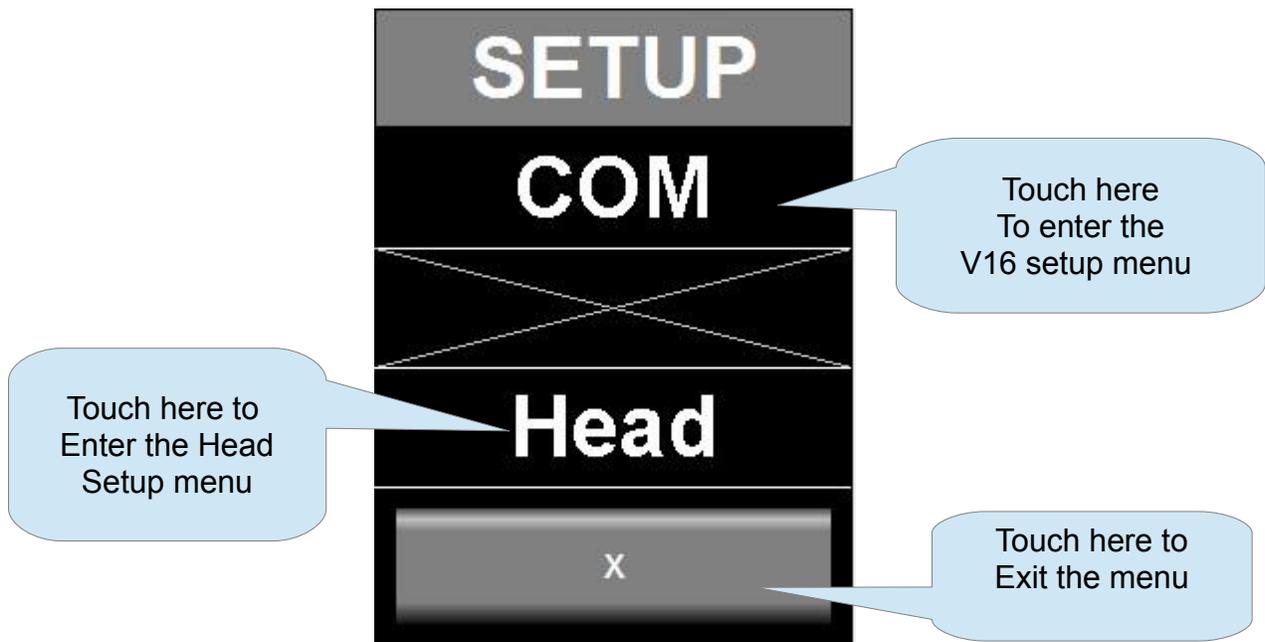
The Razor will first search any downloaded lists for a match before searching its own channel storage. The Razor will search only appropriate lists – for example it will not search VOR or ILS lists if the Razor is set to COM mode.

## The Menu

Touch the menu button to enter the menu.



With results in:

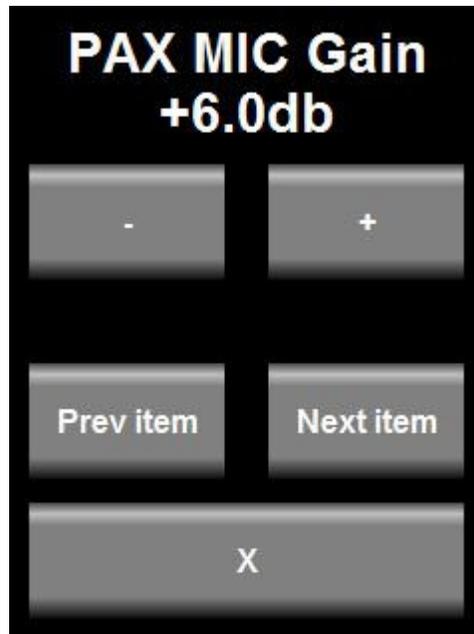


Notes: If no V16 transceiver is connected, "COM device not available" will be displayed over the "COM" field and you cannot enter the COM setup menu.

All of the COM setup items and the text displayed originates from the connected V16 transceiver. Please refer to the V16 transceiver manual for information on the available setups.

The "Head" setup groups all of the setup actions you can perform on the Razor head itself, including editing the channel list.

## ***COM Setup Menu***

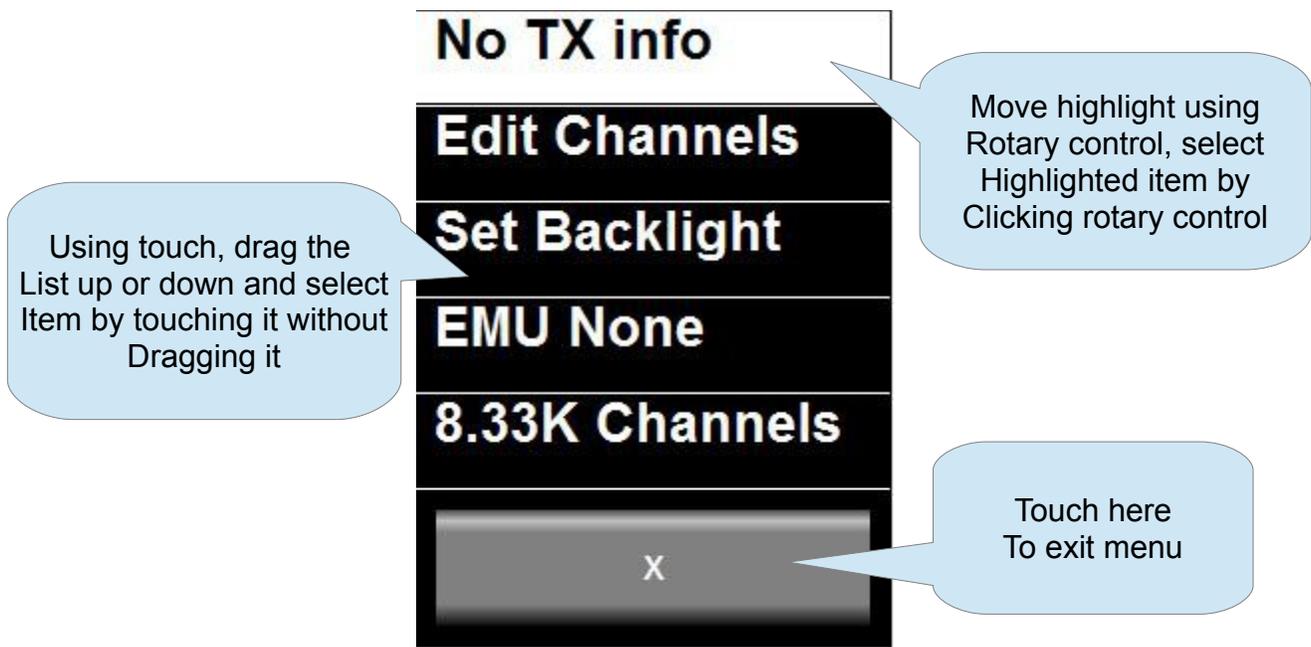


With COM setup selected you will be presented with items to set similar to the above. Depending on the setup item type you can adjust a value using a slider or buttons as appropriate,

You will be presented with one setup item at a time. Choose "Next" or "Prev" item to change the item to edit.

Note: items presented here for setup and the text shown is determined by the V16 transceiver, not the head. If you, for example, update the firmware of the V16 and this update changes or adds to the setup functions, then the Razor will reflect these changes without needing an update itself.

## ***Head Setup Menu***



### **No TX Info/Show TX info**

Change this field between two states to either show TX information (power and VSWR) during TX or not.

### **VHF...**

VHF COM – The head has been selected for fixed COM functionality.

VHF NAV – The head has been selected for fixed NAV functionality.

VHF NAVCOM – The head displays both COM and NAV and provides control functionality for both COM and NAV systems.

### **Edit channels**

Select this to enter the channel list editor. This is the channel list of up to 100 channels stored in the head itself. It can contain both NAV and COM frequencies.

### **Set Backlight**

Select this to set the display backlight level to a fixed setting or automatic in which case the ambient light sensor is used to set the backlight level.

### **EMU...**

Select which of the following RS232 protocols to emulate for RS232 Port 1.

None: No protocol selected, RS232 port not used.

SL40 (requires V16 connected to this head)

SL30 (requires V16 and N16 Navigation receiver connected to this head)

GTR200 (requires V16 connected to this head)

GTR225 (requires V16 connected to this head)

GNC255 (requires V16 and N16 Navigation receiver connected to this head)

Note: SL30 and GNC225 options can be used with only a N16 connected. In this case the COM related information in the communications protocols is not functional and will contain default values. The COM protocol parts however will still be sent to preserve overall integrity of the communications.

The selected emulation mode is always full operational for COM and NAV (provided a NAVCOM mode is selected). This means, regardless of your selection of the Razor mode as COM or NAV the protocol is not affected. This means for example, even if your Razor is selected as COM only – your RS232 port behaves as NAVCOM if a NAVCOM emulation has been selected.

### **8.33K Channels/25K Channels**

Select if you would like to restrict frequency selection by rotary control to 25Khz channels (8.33Khz includes 25Khz channels).

Note this only affects the rotary control - all other means of frequency selections allow 8.33Khz channels.

NAV channels are always fixed to 50 Khz channel spacing and are not affected by this setting.

### **Inputs...**

This choice selects how to use the two inputs on the D15 connector A1 and A2. Please see the section on remote control for details.

Choices are:

- 1) **Inputs not used**
- 2) **Inp A1 flip** - Input A1 used for frequency flip. A2 not used
- 3) **Inp A1 CHF** - Input A1 used for combined channel select and frequency flip A2 not used
- 4) **Inp A1A2 CHF** - As (3) but A2 used to decrease channel pointer
- 5) **Inp A1A2 CHF/PB** - As (3) but A2 used as playback switch

### **About**

Select this option to display the version number and other details of the firmware currently installed in your Razor head.

## Rotary rollover/clamp

Select how you would like the rotary control to act when setting frequencies. In clamp mode the Khz will not move past 0 or 9 (depending on direction). In rollover mode the next highest digit will increase/decrease as you go past 0 or 9.

## Check ...

This function allows you to store a 6 digit number. It is intended to be used for VOR equipment check recording as required by regulations. You may use this number for example to store a date or reference number.

## Razor head firmware

The firmware in your Razor head can be updated by means of a RS232 connection to a PC. You require the new firmware (download from MGL Avionics website) which comes in the form of an application (exe file) that can execute on a Windows PC. A RS232 serial port on your PC (usually a USB to RS232 converter) is connected to your Razor using RS232 port 1.

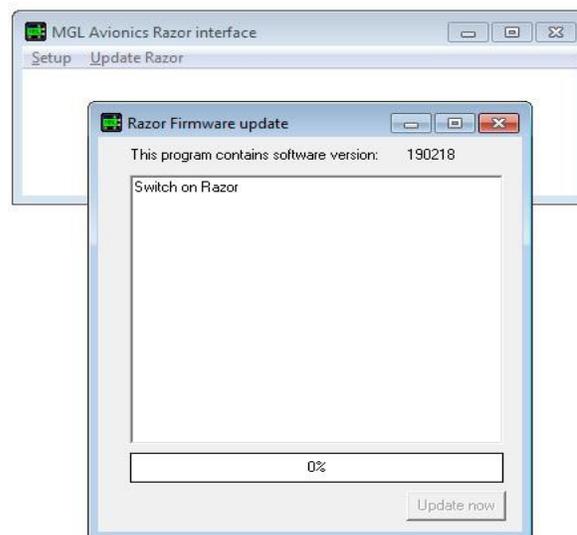
Only RX, TX and ground are the required connections (PC TX to Razor RX and RX RX to Razor TX).

The Razor needs to be powered from a 12V DC source.

With the firmware application running and configured to the correct RS232 port on your PC, switch on the Razor. The application should detect the Razor and the Razor will not show its normal screen but instead show a white screen with some black text.

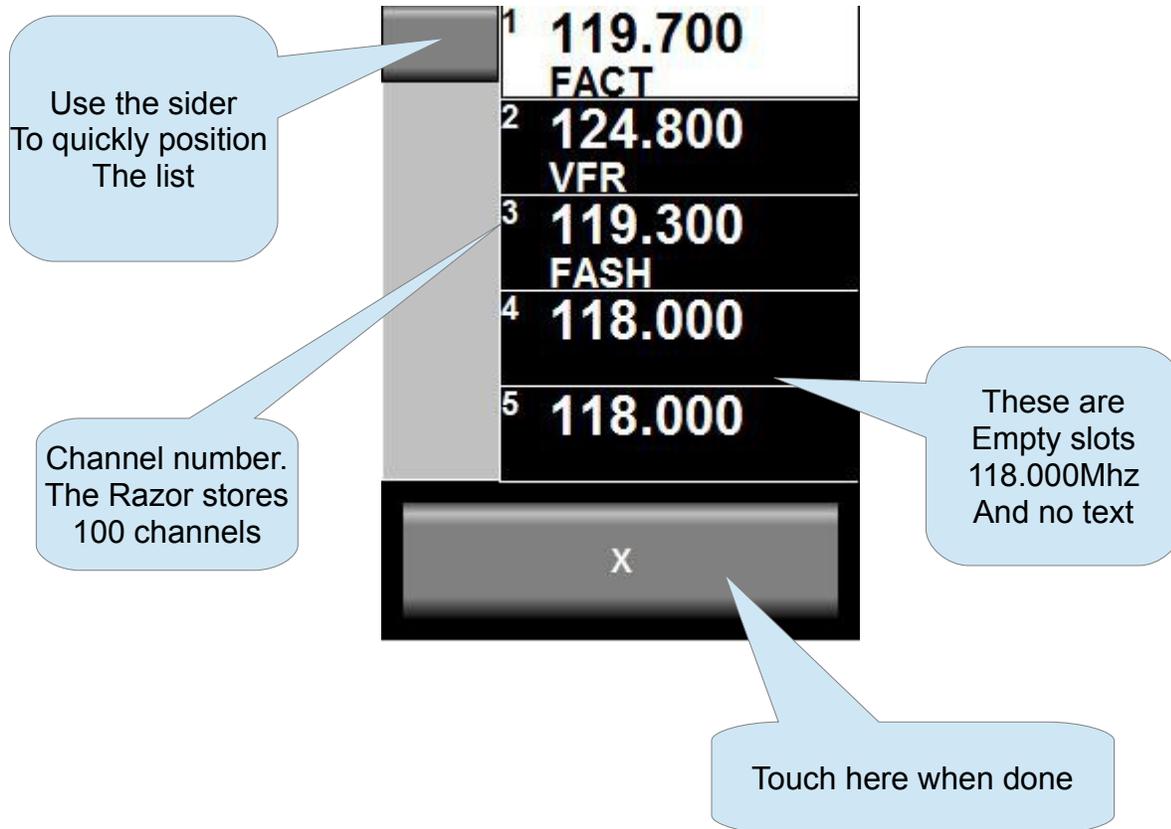
The Application will not allow you to proceed with uploading the new firmware which takes a few minutes.

After this is complete, disconnect the Razor from the PC and restart it by re-applying power to it. It should now start with the new firmware.



## Editing channel memory

Touch Menu, then select or touch “Head”, then select or touch “Edit channels”.



Touch the channel you would like to edit or select it using the rotary control. Turn the rotary control to move the highlighted entry and then click the knob to select the highlighted entry.

You can also drag the list with your finger.

If you plan to use the remote channel select feature using for example stick mounted buttons we would suggest keeping a few empty slots at the beginning of the list for frequencies you might only need for a short time on a particular route. Place frequencies you use often behind these empty entries.

When you select from the channel list using the remote buttons empty slots will be skipped.

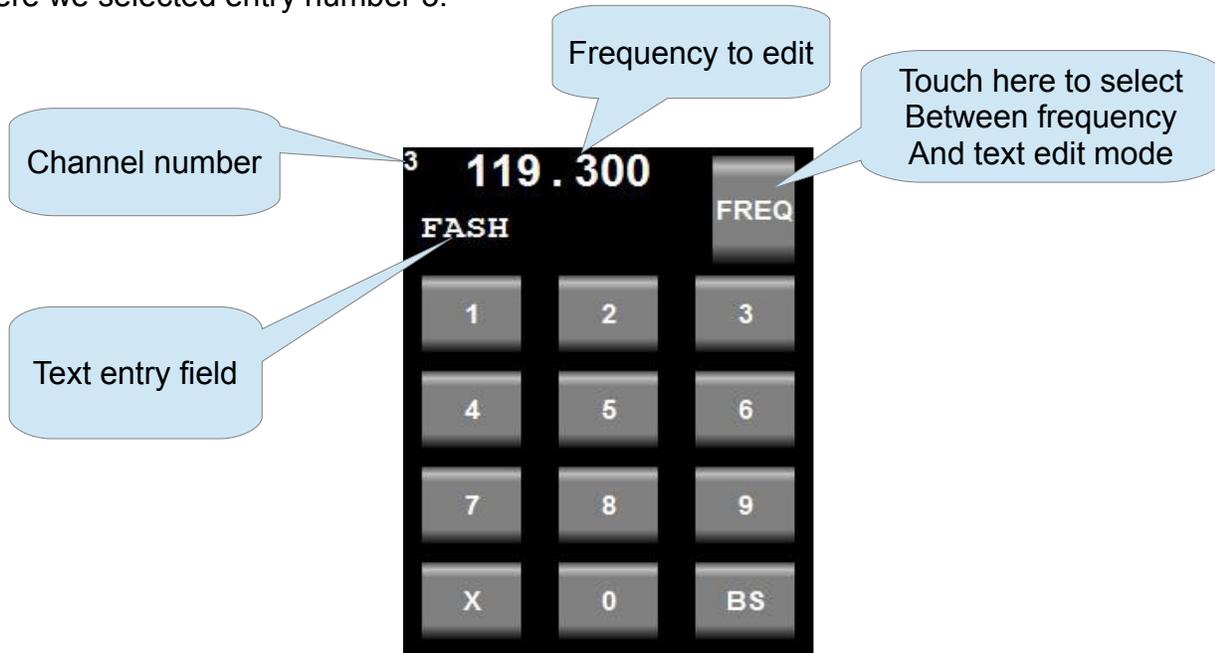
An empty slot is any slot with a frequency of 100.000.

You may enter both COM as well as NAV frequencies. Should you choose from the channel list in operation, you will be presented with either COM or NAV frequencies depending on the current mode the Razor is operating in.

You may use up to 100 channels.

## Editing a channel

Here we selected entry number 3:

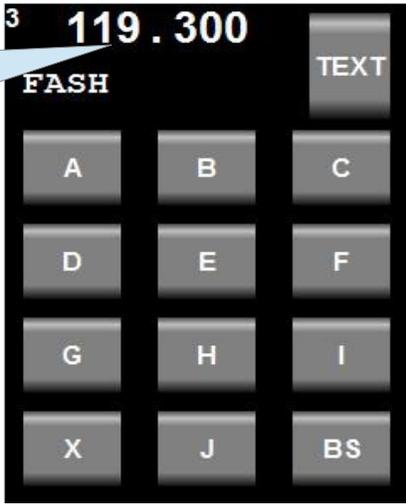


In frequency edit mode, use the numeric keypad to enter your frequency or use the rotary control in the same manner as if you would be selecting a new standby frequency.

[BS] – move to the previous digit

[X] – exit channel edit

In text entry Mode, touch in this Area to select a Group of characters On the keypad



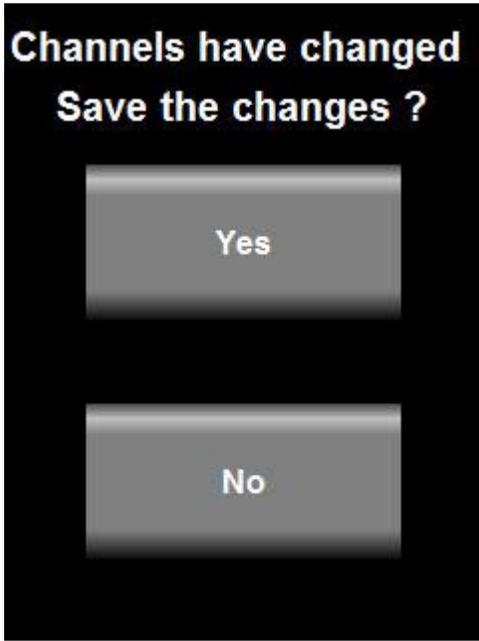
In text edit mode you edit a single character at a time. The character blinks with a cursor. You can change this character using the keypad or by turning the rotary control. To select which group of characters to show on the keypad – touch the area where the frequency and text is shown. “Clicking” the rotary control moves to the next character. Selecting a character from the keypad also advances to the next character. The maximum length of the text entry is 11 characters.

[BS] – move to the previous character

[X] – exit channel edit

Clearing a channel to “empty” status: Select the desired channel and then press and hold down the rotary control for four seconds until the channel clears.

If you changed any channels during your edit session and exit the function you will be shown a confirmation dialog:



If you select “No” and changes you made will not be saved and the channels revert back to the state they were in before you entered the “Edit channels” function.

If you select “Yes” the channels will be saved and remembered next time you power on the Razor.

Note: Channels are saved on the Razor head, not the V16 transceiver or N16 receiver.

### ***Remote channel lists***

Depending on the chosen protocol and capability of external systems channel list(s) can be downloaded to the Razor. These lists are typically short and contain the list of frequencies for one airport. There can be multiple such lists.

If one or multiple multiple external lists are available, you will be shown a selection of these lists to choose from when selecting the channel button.

Note: External list functionality has been added to the Razor for the sake of completeness as this is included in some of the external protocols.

Most modern EFIS systems maintain their own lists and only send currently desired active/standby frequencies to the transceiver.

## Environmental qualification matrix

The environmental qualification is based on the document DO-160G and is identical to that of the V16 transceiver.

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 short time 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	
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	
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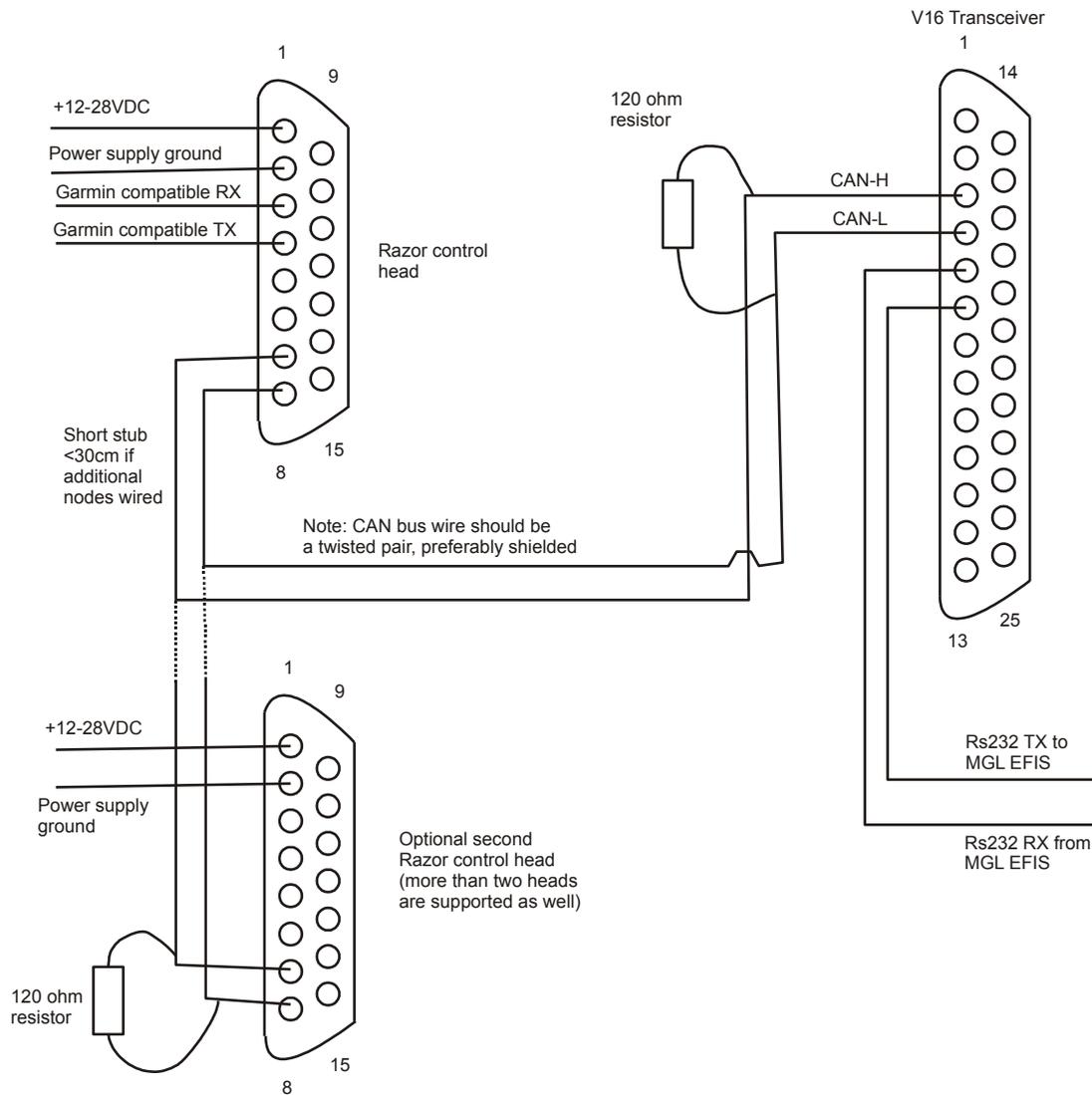
## Typical connection diagrams

This diagram shows the connection of one or two heads to a V16 transceiver. Note that audio, PTT and other transceiver related wiring is not shown for clarity.

At minimum you only need 4 wires to connect to a Razor head – power supply, ground and the two CAN bus wires.

Should you want the Razor head to emulate a Garmin compatible protocol for use with third party EFIS systems you can also wire RS232 port 1 as shown. Note that if the third party EFIS and the Razor/V16 are supplied by the same power source (common in an aircraft) there is usually no need for a ground connection between the two devices. Shielded cable, with the shield connected on one side to ground is advised to minimize interference.

You may use pin 9 as ground for shielding purposes (both RS232 as well as CAN bus).



Note that termination resistors (shown here as 2 x 120 ohms) are mandatory. Place one of each onto each end of the bus. Never more than two resistors.

In most installations where the length of the CAN bus does not exceed 3 meters or 10 ft, it is permissible to use a single 100 ohm resistor at any location on the bus without ill effect.

## Remote control

The Razor provides two pins on the D15 connector that can be used to remotely control selection of the standby frequency and frequency “flip”.

These pins are marked A1 and A2. Your options are:

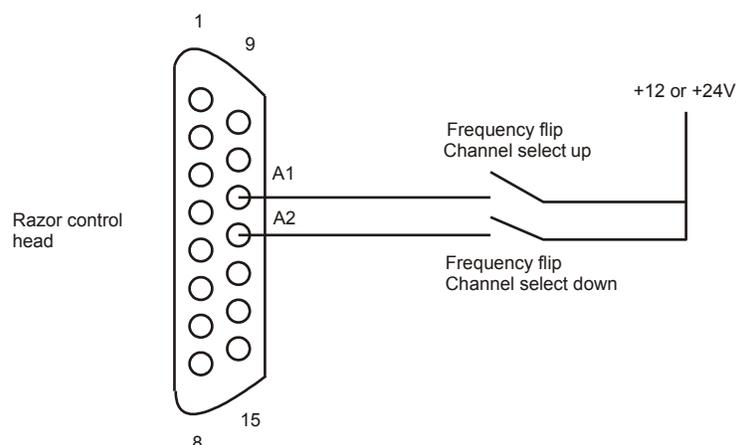
- 1) Do not use these pins
- 2) Use only A1 as “Main/standby frequency flip”
- 3) Use only A1 as “Frequency selection from channel storage” and “Main/standby

frequency flip”. This mode uses the duration of an external button push to select the function. Standby frequencies are picked from Channel memory in ascending order by using short duration switch closures. A switch closure duration of 1 second flips main and standby frequency. The channel pointer resets to the first channel entry if the switch has not been closed for 4 seconds.

- 4) Use A1 and A2. In this case A1 works as described in (3). A2 is used to decrease the channel frequency pointer but can also be used to flip main and standby frequency in the same manner as (3).
- 5) Use A1 as described in (3). Use A2 as last message(s) playback button.

Please select the desired mode of remote control in the Head setup menu.

Notes: The switch(es) are wired from the A1 and A2 pins to a +12V or +24V source as shown in the diagram below.



### ***Pinout for 3.18” Razor and 2.25” Vega transceiver 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 transceiver and NAV radio)
8	CAN L (connect to CAN L on transceiver and NAV radio)
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.

## Specifications

Power supply	+7VDC to +28VDC
Current consumption	At maximum backlight, 13.8VDC, 100mA At minimum backlight, 13.8VDC, 80mA Note: current reduces with increasing voltage, power remains constant.
Power supply rise time	Maximum 100mS to 5V
Weight	TBA
Display	240x320 pixel TFT color 16 bits. Brightness up to 800nits.
Touch screen	Projected capacitive
Housing	Designed to front mount into standard 3.1/8" instrument panel hole.

# Dimensions

Dimensions are in mm





## Garmin protocol limitations

As part of the setup you can select your Razor to emulate various Garmin protocols used for both COM and NAVCOM systems.

The protocols are generally fully implemented but there are some differences. For example there are some protocol items that are related specifically to Garmin systems such as diagnostics information mostly intended for workshops or firmware version information.

Version information has been implemented as a dummy as it is not compatible with the way MGL firmware versions operate.

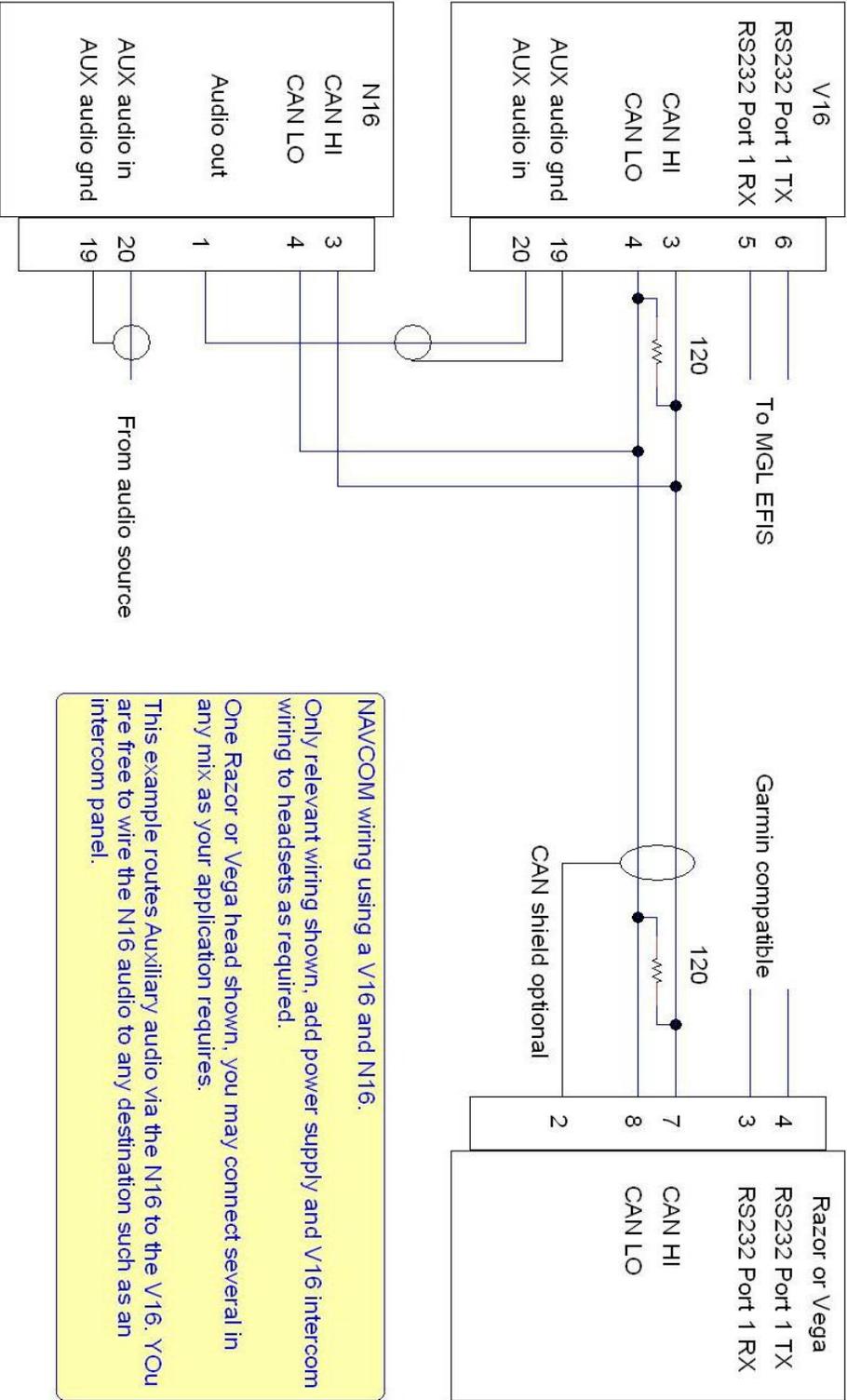
A limitation exists with respect to the CDI. The Garmin NAVCOM protocol only makes provision for a single CDI which is either from the localizer or a VOR. The MGL N16 however is able to track a VOR and a localizer as well as glideslope all at the same time so it has two valid CDI indicators (one being the localizer needle).

**The Razor will use the CDI from the primary frequency as CDI for the Garmin protocol.**

This limitation does not exist for the MGL protocol applicable for direct RS232 connection of the N16 to a MGL EFIS system or routed via a V16 RS232 port.

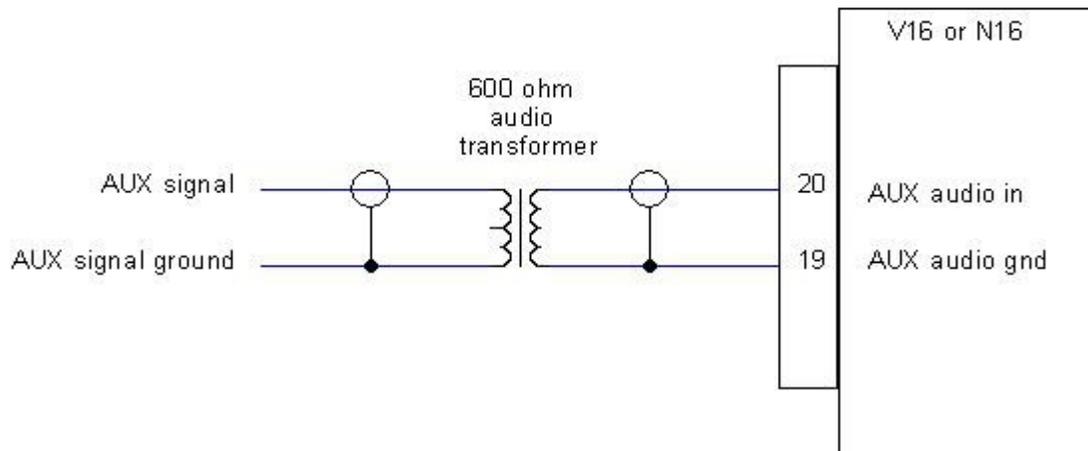


# NAVCOM device using V16 and N16



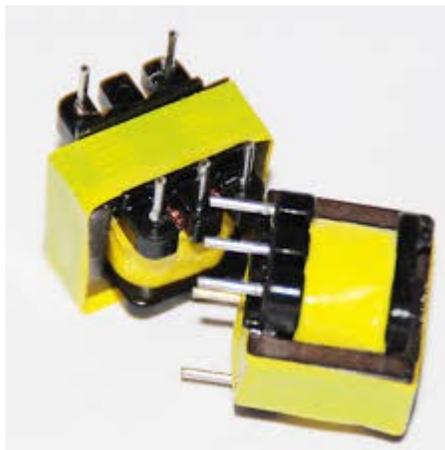
NAVCOM wiring using a V16 and N16.  
 Only relevant wiring shown, add power supply and V16 intercom wiring to headsets as required.  
 One Razor or Vega head shown, you may connect several in any mix as your application requires.  
 This example routes Auxiliary audio via the N16 to the V16. YOU are free to wire the N16 audio to any destination such as an intercom panel.

## Using audio transformer on the AUX input



Depending on your desired audio source it may be advisable to electrically isolate the source from the V16 (or N16). This could be due to the need to prevent ground loops or if the source is at a different electrical potential. Sometimes connecting a source may induce undesired noise into the audio due to electrically contaminated grounds.

Using a small 600 ohm audio transformer can be a useful device to provide isolation and separate the source and destination grounds. Often, one side of a transformer like this has a center tap (indicated on the drawing above). This can be used to create a step up transformer (usually a 1:2 ratio) in order to increase the signal amplitude, should that be necessary.



Example of a typical audio transformer with center tap. Ensure you use one with the correct impedance ratio between primary and secondary windings. A 2:1 transformer would have 600 ohms on one side and 2 x 300 ohms on the other.

These transformers are available in a large variety of form factors as well as special high quality shielded types. In our experience, simple unshielded transformers work very well.

## Using the Razor V16 with an A14/A16 intercom system

From firmware version 010322 of the Razor V16 control head includes the complete Razor A16 control head firmware.

It is possible to switch the operation of the head into either V16 or A16 mode at any time using one of two methods:

- a) By tapping on the menu heading after entering the menu. Note that on the V16 you tap the Menu button on the display to enter the Menu while on the A16 you press the rotary control to enter the menu.
- b) By use of a toggle switch connected to input A1 on the rear of the Razor V16 control and configuration of that input for this function. Note that the selection of functions for the A1 and A2 inputs remains in the V16 mode of operation.

The Razor must be connected to the A16 and V16 (and if used, the N16) via CAN bus. No other device must be connected to this bus – it is private between the above devices. Never connect this CAN bus to an EFIS CAN bus as it can affect operation of all connected devices negatively.

Note: The updated firmware is available on the MGL Avionics website under the Firmware tab → RF devices firmware.

Note: Both A14 and A16 intercom systems may be operated by the upgraded firmware.

For details of operating the Razor A16, please view the A16 manual downloadable from the MGL Avionics website under the A16 product page.

**Important: If you have the Razor A16 (not the Razor V16) - it is NOT possible to update the Razor A16 with the code described here as the Razor A16 cannot be updated via the RS232 port.**