

# MGL Avionics

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



**User and Installation manual**

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## **Note**

This document details operation of the Razor NAV/COM control head for COM operations only as first released. The N16 navigation receiver functionality will be added to this manual with release of the N16 navigation receiver. The Firmware in the Razor head will require updating should navigation functionality be desired and the N16 navigation receiver is present. Please view the section on firmware updates at the end of this document. You will require a PC with a RS232 serial port to perform the update. The update can also be performed by your MGL Avionics distributor.

## **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**

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. If you have only a V16 connected, select one of the COM protocols.

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.

## **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.

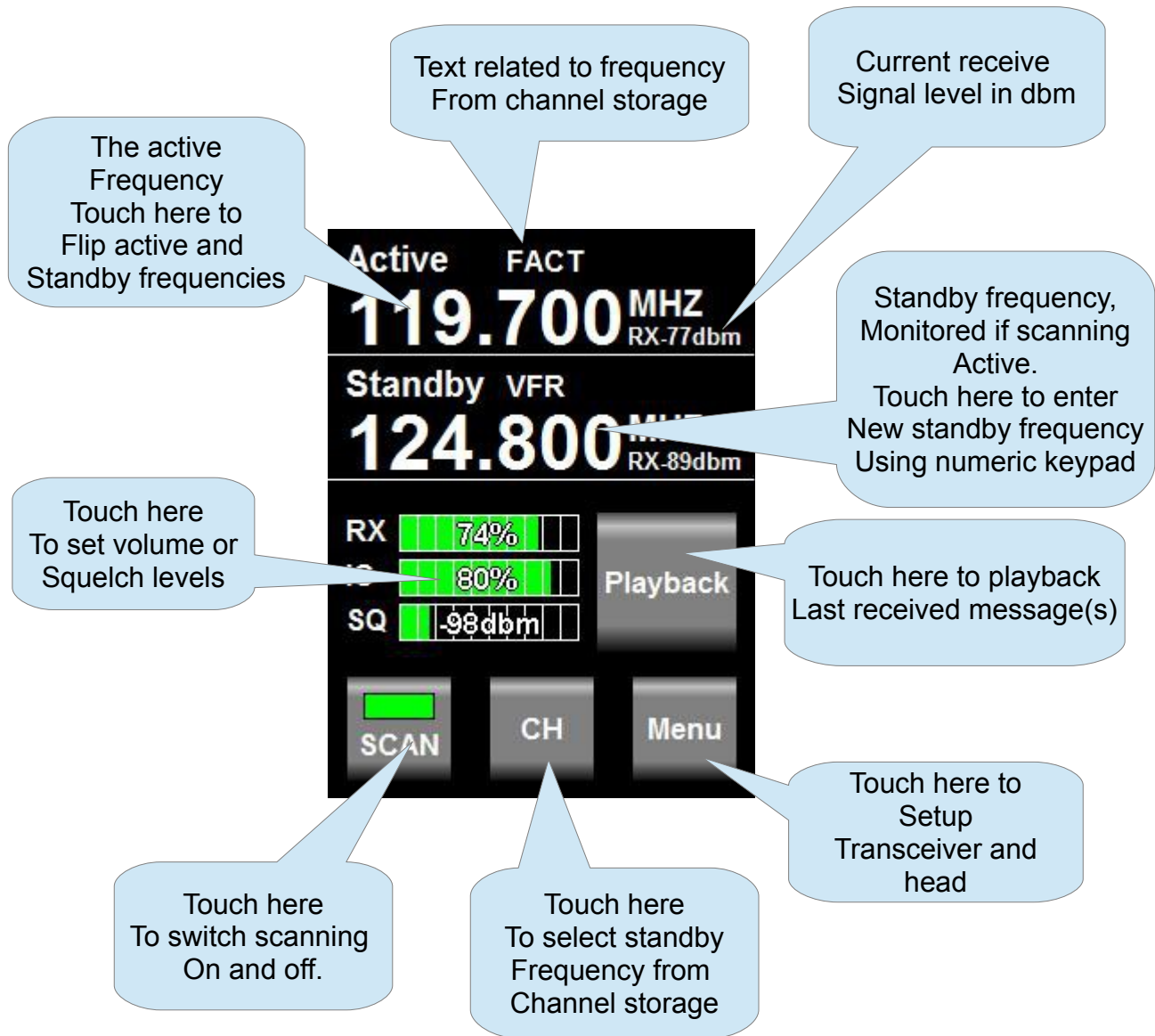
### ***Touch screen***

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.

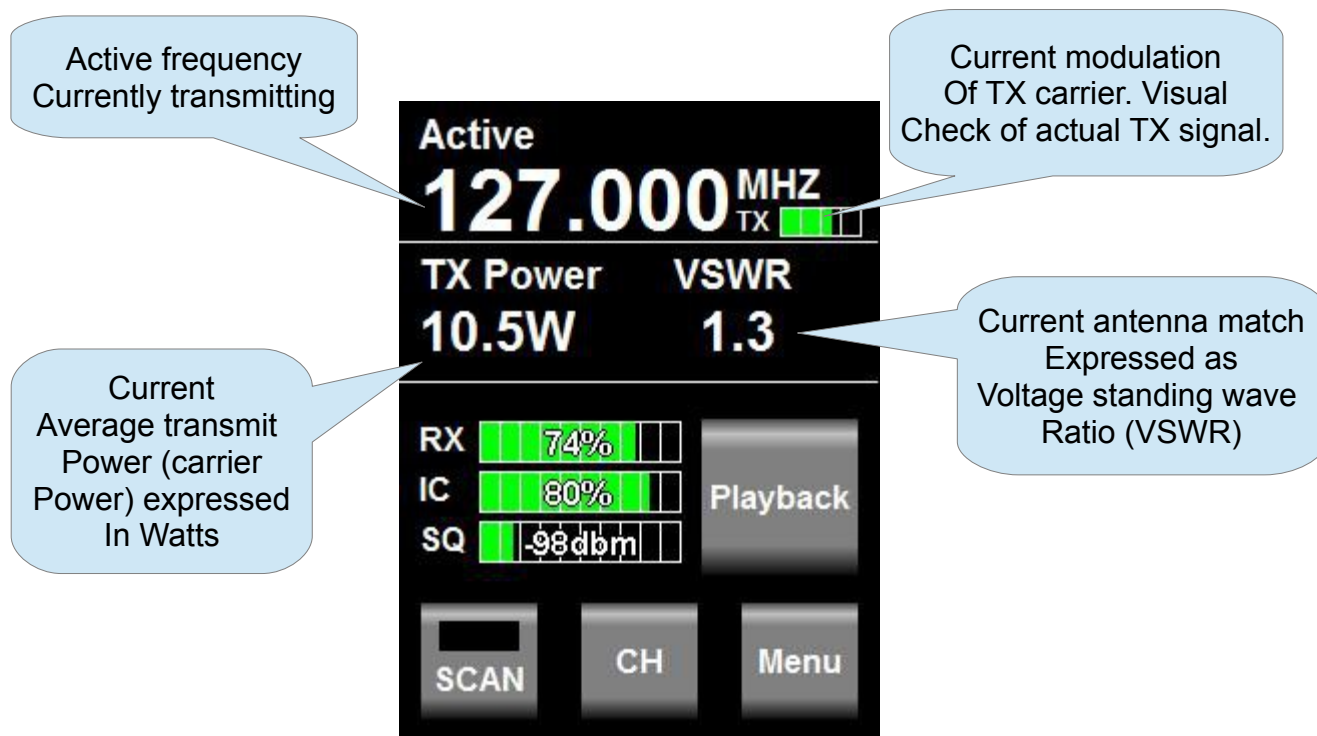
Internal channel storage can be edited via the Menu -> head setup.

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



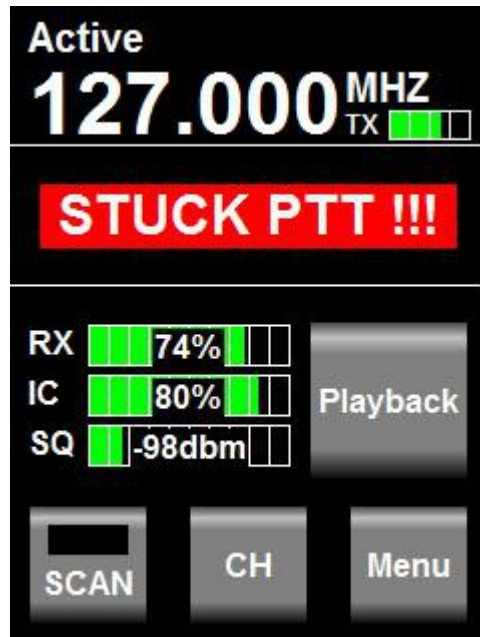
Notes: TX power and VSWR are only shown during TX if "Show TX Info" is selected in Menu -> Head. If not selected, the standby frequency will be shown in this field.

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.



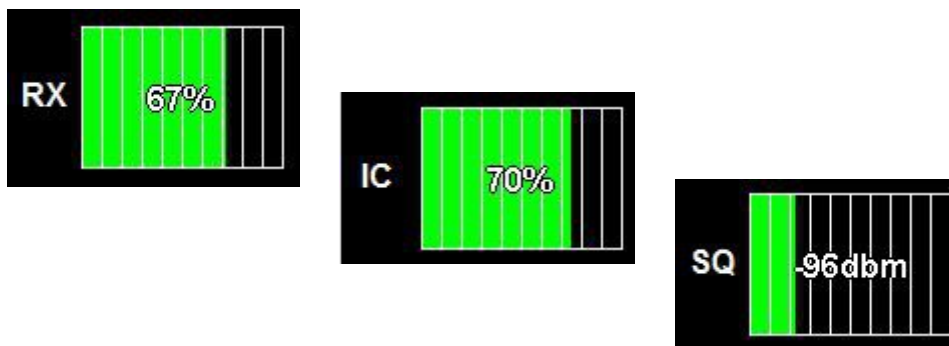
## Adjusting volumes and squelch

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.

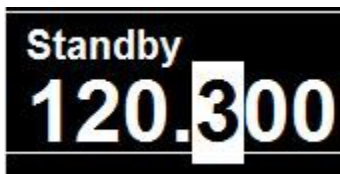
### *Using the rotary control*

"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.

## Using the channel list

Touch the "CH" button on the display.



which results in:

1	119.700	FACT
2	124.800	VFR
3	118.000	
4	118.000	
5	118.000	

Touch or drag  
The slider with your  
Finger to rapidly  
Move through 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.

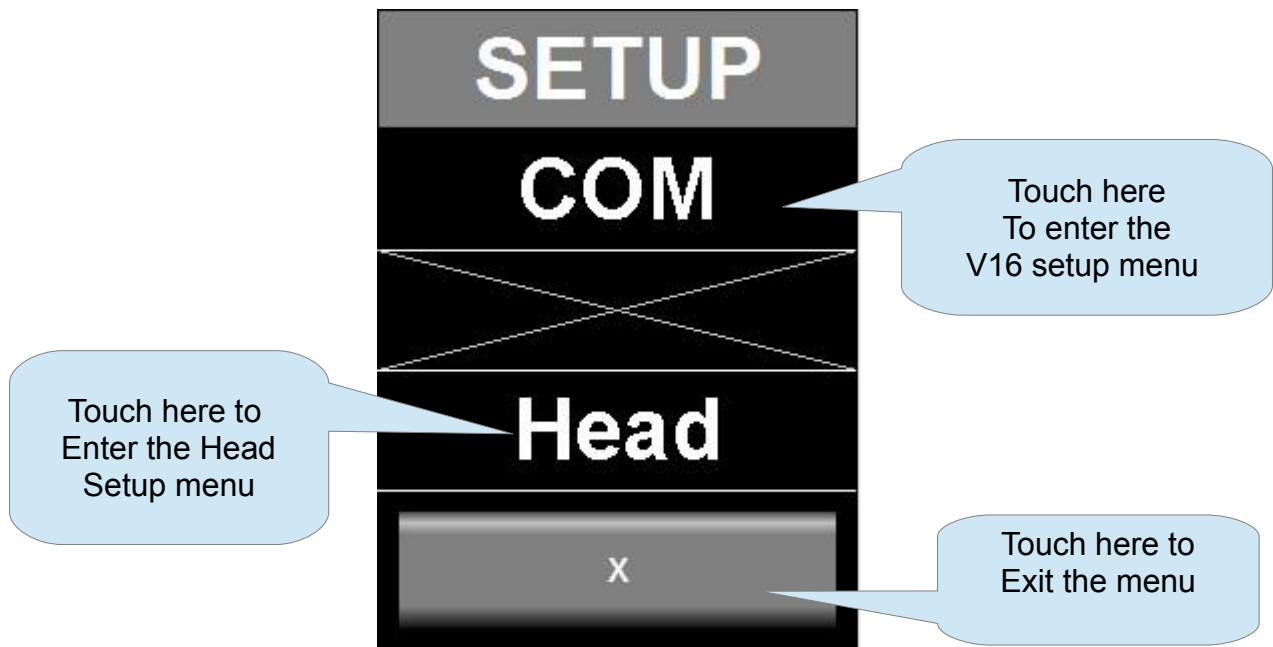
You can edit the contents of the channel list in the Menu -> Head -> Edit channels.

## The Menu

Touch the menu button to enter the menu.



With results in:

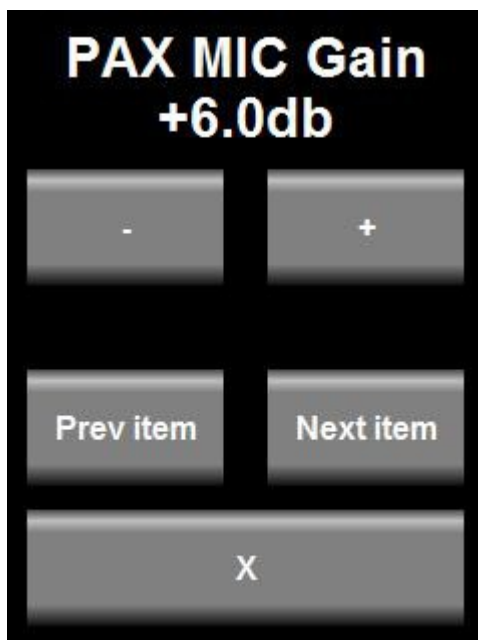


Notes: If no V16 transceiver is connected, "COM device not available" will be displayed over the "COM" field and you cannot enter the COM setup menu.

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

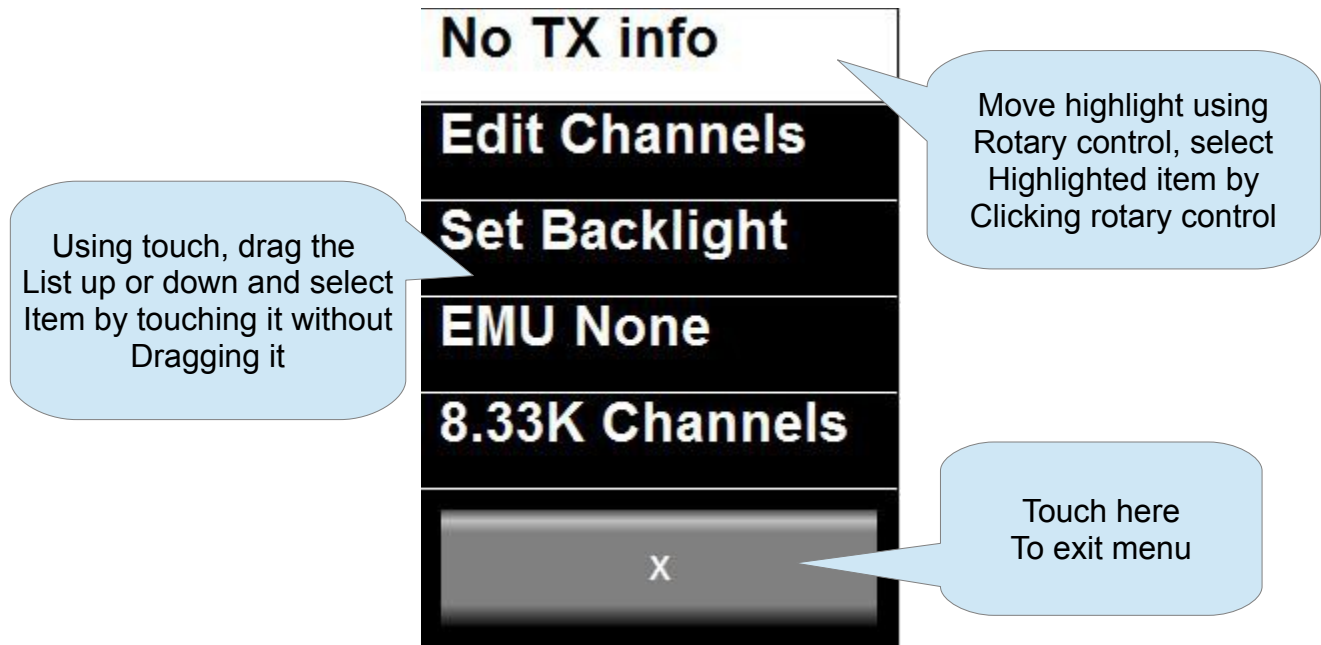


With COM setup selected you will be presented with items to set similar to the above. Depending on the setup item type you can adjust a value using a slider or buttons as appropriate,

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.

### Edit channels

Select this to enter the channel list editor

### 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)

## **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.

## **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) Input A1 used for frequency flip. A2 not used
- 3) Input A1 used for combined channel select and frequency flip A2 not used
- 4) As (3) but A2 used to decrease channel pointer
- 5) 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.

## **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.

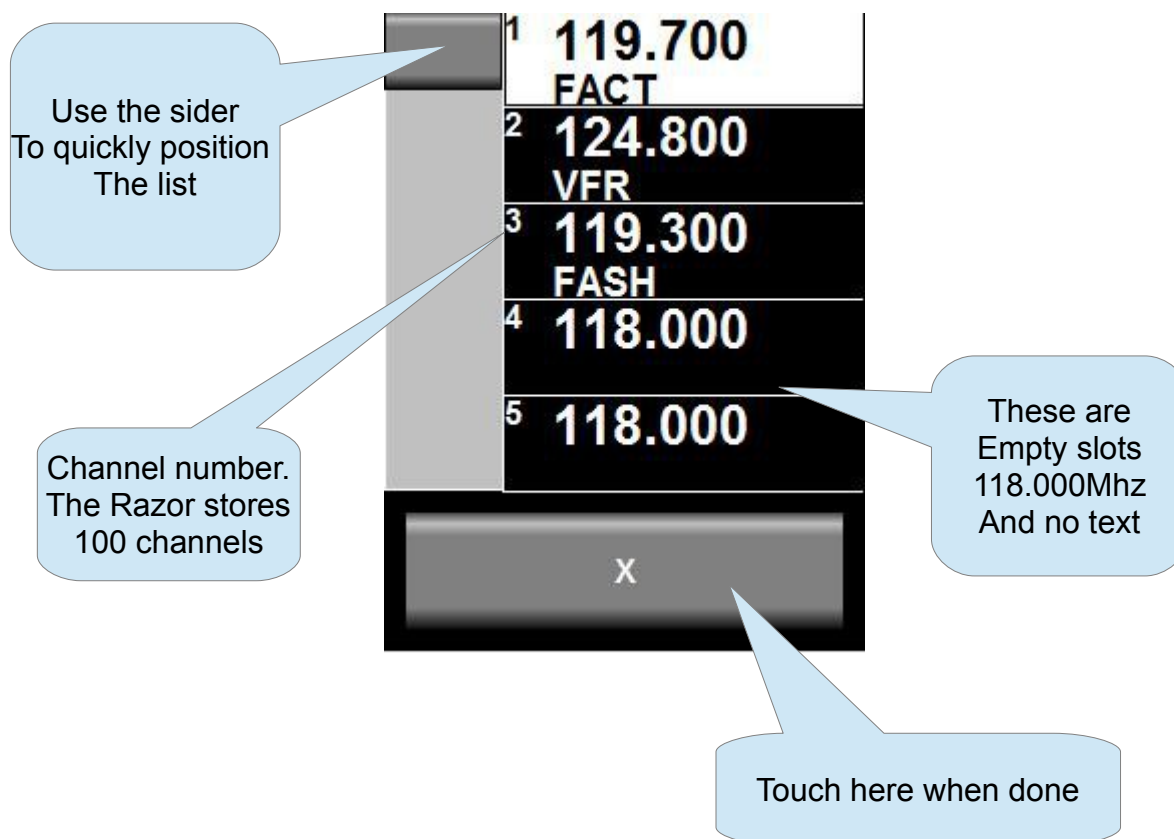
The Application will not allow you to proceed with uploading the new firmware which takes a few minutes.

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.

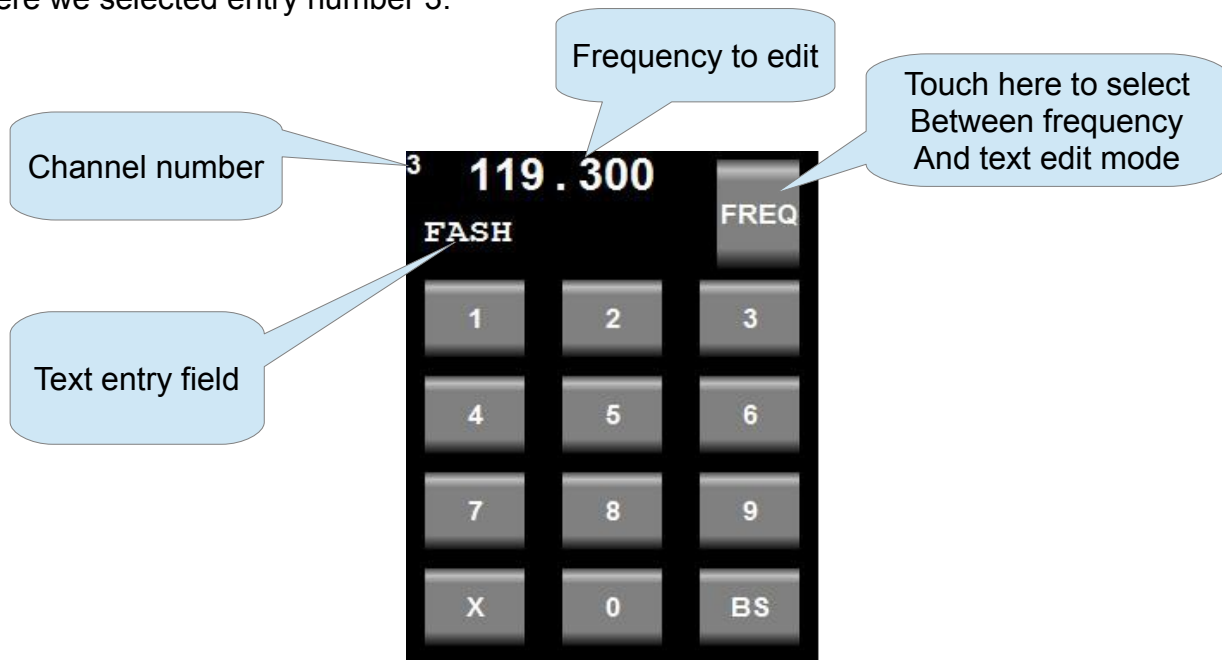
You can also drag the list with your finger.

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 118.000 and no text. Should you require a slot with this frequency, just add some text.

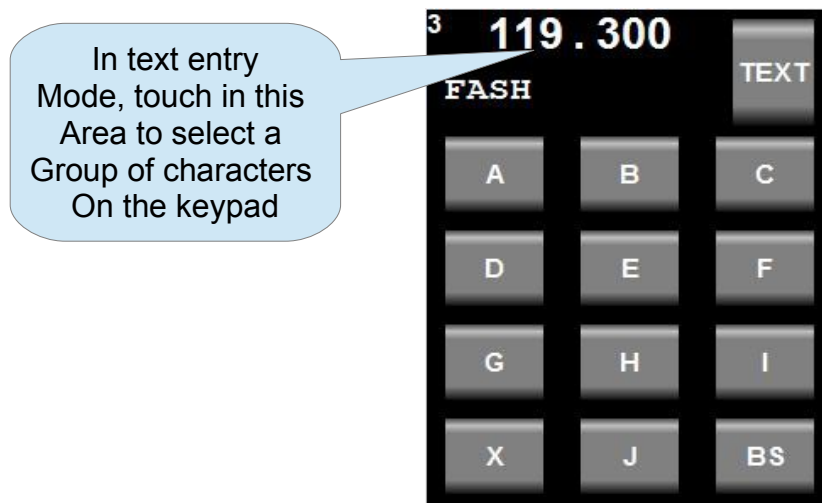
Here we selected entry number 3:



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

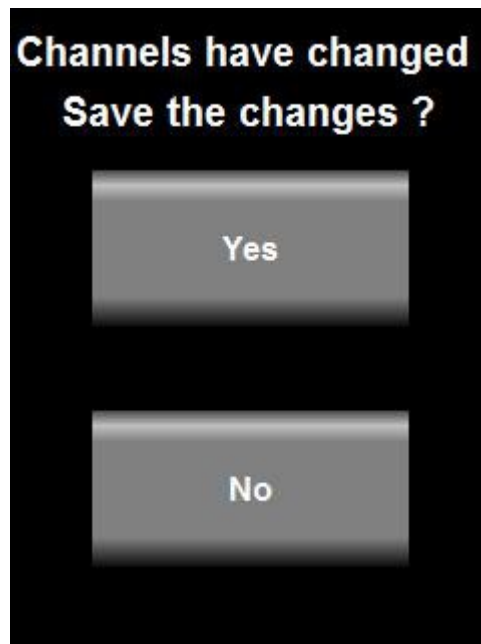


In text edit mode you edit a single character at a time. The character blinks with a cursor. You can change this character using the keypad or by turning the rotary control. To select which group of characters to show on the keypad – touch the area where the frequency and text is shown. “Clicking” the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

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.

### ***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 at least one external list is available – it will be used instead of the internal list. If multiple external lists are available, you will be shown a selection of these lists to choose from.

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	

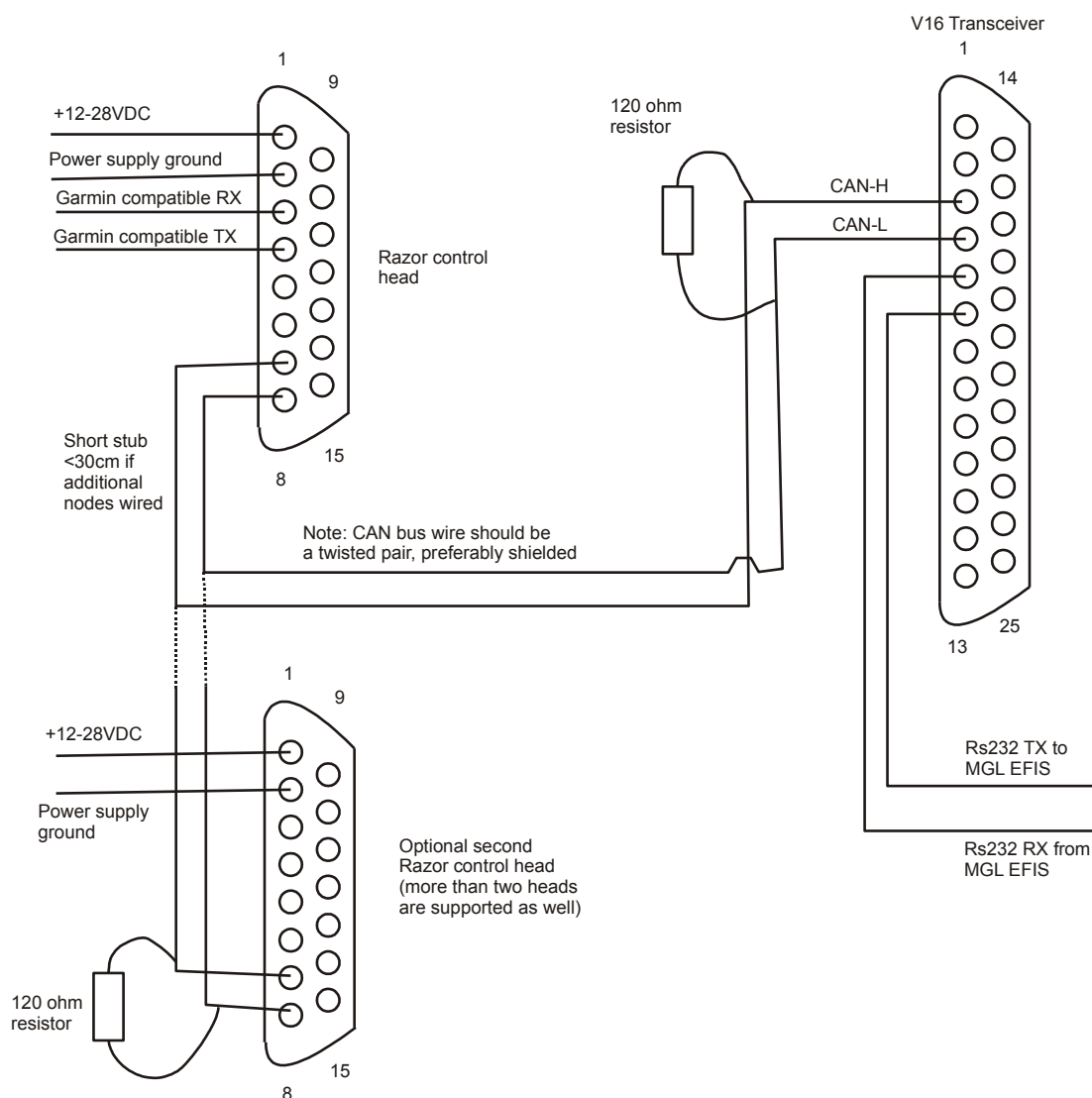
## Typical connection diagrams

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

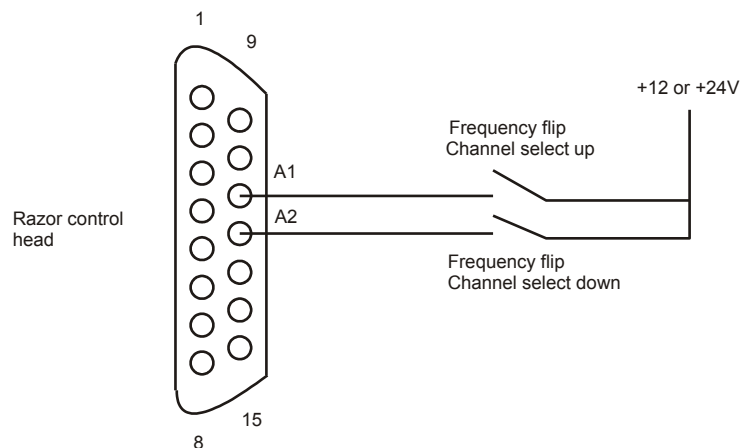
The Razor provides two pins on the D15 connector that can be used to remotely control selection of the standby frequency and frequency “flip”.

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 top 800nits.
Touch screen	Projected capacitive
Housing	Designed to front mount into standard 3.1/8" instrument panel hole.



# Dimensions

Dimensions are in mm



