VAL AVIONICS LTD

# NAV 2000

**ULTRA-THIN NAVIGATION RECEIVER**

# Installation and Operator's Manual

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# 1 SECTION I - GENERAL INFORMATION

## 1.1 INTRODUCTION

Thank you for purchacing our NAV 2000 *Navigation Receiver*. Here at Val Avionics Ltd., our core design philosophy is based on the ease of installation and use. The NAV 2000 represents a new direction and continued improvement of our product line. The NAV 2000 contains continuing improvements from the INS 429,based on the feedback of customers. The NAV 2000 is a continuation of our *Ultra-thin* series, designed with new and exciting features.

That design philosophy translates into the ease of installation and simple operation the makes the NAV 2000 a navigation solution for a wide variety of aircraft panels, from the Homebuilt through light twins. The NAV 2000 satisfies the need for compact, fully intergraded, quality navigational aid that can be counted on to provide years of reliable service.

Before installing and /or using your new NAV 2000 please read this manual completely. This will ensure proper installation and familiarize you with all of the features your new NAV 2000 has to offer.

## 1.2 SCOPE

This manual will provide detailed information about the installation and operation of the NAV 2000 *Navigation Receiver*. It will also provide equipment limitation information and instructions for continued airworthiness.

## 1.3 EQUIPMENT DESCRIPTION

The NAV 2000 has been designed for simplicity. It is straight forward to install and operate. Using state of the art technology Val Avionics Ltd. has created a navigation receiver that will provide the pilot with simple, easy to interpret navigation information for in-route VOR navigation and ILS Approaches.

The NAV 2000 also has an enhanced display that features both active and standby frequency displays.

The unit's controls have been designed for simple user interface. The concentric knobs on the left side of the unit select the Volume output level with push button access to frequently used frequencies. The concentric knobs on the right side of the unit select the desired standby frequency and a push of the button swaps the active and standby freqencies.

The NAV 2000 has two internal receivers. The VOR/LOC receiver operating from 108.00 MHz to 117.95 MHz and the Glide Slope receiver which operates from 329.15 MHz to 335.0 MHz.

## 1.4 SPECIFICATIONS

**Table 1: Specifications**

| SPECIFICATIONS | CHARACTERISTICS |
|---|---|
| Environmental | RTCA/DO160D |
| VOR | RTCA/DO-196 |
| Localizer | RTCA/DO-195 |
| Glide slope | RTCA/DO-192 |
| | |
| Physical Dimensions: | |
| Height | 1.0 inches (2.54 cm) |
| Width | 6.25 inches (15.88 cm) |
| Depth | 9.0 inches (22.86 cm) |
| | |
| Weight: | 3.00 pounds (1.36 kg) |
| | |
| Mounting: | Panel mounted, no shock mounting required |
| | |
| Temperature Range: | -30 to +55 Celsius with short time operations at +70 Celsius |
| Power Requirements: | |
| Voltage | 10.0 to 30.0 VDC |
| Current | 0.50 Amp @ 14V, 0.30 Amp @ 28V |
| | |
| Receiver: | |
| VHF Frequency (VOR/LOC) | 108.00 to 117.95 MHz |
| Sensitivity | 2 µV to provide 50% Standard Deflection |
| Channel Spacing (VOR/LOC) | 50 KHz |
| UHF Frequency (Glide slope) | 329.15 to 335.0 MHz |
| Sensitivity | 20 µV to provide 50% Standard Deflection |
| Channel Spacing (Glide slope) | 150 KHz |
| | |
| External Outputs: | |
| Audio Output | 10mv into a 600 ohm load |
| CDI Left/Right | 150mv into 1K Load |
| CDI Up/Down | 150mv into 1K Load |
| CDI Glide slope Flag | 250mv into 1K Load |
| CDI VOR/LOC Flag | 250mv into 1K Load |
| Composite Output | 500mv into 1K Load |
| | |
| Manufacturer's Model Number | **NAV 2000** |
| Part Number | VPN 0800120-1 |
| FCC ID | EZNNAV2000 |

## 1.5 EQUIPMENT SUPPLIED

**Table 2: Equipment Supplied**

| PART NUMBER | QTY | DESCRIPTION |
|---|---|---|
| **0800120** | 1 | NAV 2000 NAVIGATION SYSTEM |
| **0651020** | 1 | INSTALLATION KIT |

## 1.6 EQUIPMENT REQUIRED BUT NOT SUPPLIED

**Table 3: Equipment Not Supplied**

| QTY | DESCRIPTION | PART NUMBER |
|---|---|---|
| 1 | Interconnect Wire Harness | VPN 0751020 or field fabricated |
| 1 | Headphone Jack | Switchcraft P/N 11 (Ref VPN 550017) |
| 1 | Circuit Breaker 2 amp | Potter & Brumsfield W58-2 or equivalant |
| 1 | Contact Crimping Tool w/ Positioning Tool | AMP P/N 601966-1<br>AMP P/N 601699-5 |

## 1.7 LICENSE REQUIREMENTS

None

# 2 SECTION II - INSTALLATION

## 2.1 GENERAL INFORMATION

### 2.1.1 Scope

This section of the manual will provide the needed information to successfully complete the installation of your new NAV 2000 *Navigation Receiver*. Please read this section completely before proceeding with the installation process. Although the NAV 2000 installation procedures are designed with the do-it-yourself in mind, we at Val Avionics Ltd. strongly suggest that you seek the advice of a qualified avionics installation facility before beginning this or any other installation project. Qualified avionics installation technicians can offer good advice as to time-tested installation practices and techniques that can save you many hours of time and frustration.

## 2.2 UNPACKING AND INSPECTION

Use care when unpacking the equipment. Inspect the unit and supplied parts for visual signs of damage during shipment. Examine the unit for loose screws, dents, broken buttons and other signs of damage that may have occurred during shipment. Verify the contents of the container with the list in section 1.5. If any damaged or missing parts are discovered during the inspection save the shipping material and contact the freight carrier to file a claim. If it is suspected that parts were omitted from the container please feel free to contact Val Avionics Ltd., to acquire the missing items.

## 2.3 EQUIPMENT INSTALLATION PROCEDURES

### 2.3.1 Cooling Requirements

Forced air cooling is not required for the NAV 2000 *Navigation Receiver*. However, when planning the location for mounting, ensure adequate spacing from heat producing sources such as heating or defrosting ducts.

### 2.3.2 Mounting Requirements

The NAV 2000 mounting tray should be rigidly mounted in the avionics stack using the hardware provided in the installation kit. Ensure that the mounting location will provide easy access and a clear view of the equipment's front panel from the pilot's position. Ensure that the mounting position will provide adequate clearance between the unit and the associated wire harness and the aircraft controls. Bracing at the rear of the unit should be installed to ensure rigidity in the panel. Consult FAA Advisory Circular AC 43.13-2A for acceptable practices and techniques.

### 2.3.3 Wire Harness Fabrication

Val Avionics Ltd. recommends that a factory fabricated wire harness (VPN 0751020) be used for the installation of the NAV 2000 *Navigation receiver*. Use of the factory fabricated wire harness will ensure proper operation of the NAV 2000, reduction in the occurrence of interfering signals and ground loops, greatly reduced installation time, and provide prolonged trouble-free performance of your new equipment. Contact Val Avionics Ltd. or your local avionics distribution center for NAV 2000 Wire Harness ordering information.

Although strongly recommended, it is not required to use the factory fabricated wire harness when installing the NAV 2000. A wiring harness can be fabricated in the field. Refer to appendix B of this manual for a complete wiring diagram. The NAV 2000 is connected to the aircrafts avionics bus via a 2 AMP circuit breaker. All wires must be 22 AWG MIL-SPEC, unless otherwise noted in accordance with current regulations. Two and three conductor shielded MIL-C-27500 or equivalent wire must be used where indicated. Use AMP Contact Crimping Tool (AMP P/N 601966-1) with Positioning Tool (AMP P/N 601699-5) or equivalent to ensure good quality contacts. Refer to FAA Advisory Circular AC 43.13-2A for acceptable practices and techniques.

### 2.3.4 NAV 2000 Installation

#### 2.3.4.1 Mounting

The NAV 2000 is rigidly mounted in the aircrafts avionics stack. Once a location has been selected, a visual inspection should be made of the area directly behind the panel which will be occupied by the NAV 2000 and harness assembly for obvious obstructions such as heater ducts, control cables, fuel and oil lines or any other obstruction. Pay particular attention to the control yoke assembly. It should be moved to the full limit of travel and verified that sufficient clearance exists prior to beginning installation. Most aircraft instrument panels will already have existing radio mounting cutouts. If the location you have selected requires that a mounting hole be cut, refer to Figure 3: Panel Cut Out on Page 15 for the mounting template. Mark and cut the mounting holes as required.

Position the unit's mounting tray in its upright position, and from the rear of the panel. With the unit held in place, insert the two supplied 6-32 X 1/2" countersunk screws VPN 501053 from the front and tighten as appropriate. The installing agency must fabricate and attach rear support brackets to the aircraft structure behind instrument panel as appropriate to support the rear of the NAV 2000. Then, attach these brackets to the provided attachment points on the rear of the unit with the supplied 6-32 1/4" truss head screws VPN 501063.

#### 2.3.4.2 Antennas

One antenna is required for the NAV 2000 installation. A standard VOR/Localizer/Glide Slope antenna can be used with the unit such as a COMANT CI-157 or equivalent. The most common location for the antenna is on top of the vertical stabilizer. The VOR/Localizer/Glide Slope antenna can be coupled to the unit's NAV-in port directly.

#### 2.3.4.3 Audio

The NAV 2000 has one navigation audio output. Although the audio output levels of the receivers are capable of driving a standard headset directly, it is strongly recommended that these audios be coupled to a quality audio selector panel. For complete details, refer to the interconnect wiring diagrams in Appendix B.

## 2.4 POST INSTALLATION CHECK

### 2.4.1 Operational Check

Refer to section three of this manual. Using a calibrated VOR, Localizer and Glide Slope signals, check all functions of the NAV 2000 for proper operation. Check the operational functions of other equipment installed in the aircraft in accordance with the individual manufacture's operation manuals to insure that no cross interference exists as a result of this installation.

### 2.4.2 Final Inspection

Verify that the wiring is bundled away from all controls and that no part of the installation interferes with the movement of the aircraft controls. Move all of the aircraft controls through their full range of movement while visually verifying that the installation does not mechanically interfere with the control movement. Verify that the wiring harnesses are properly secured to the aircraft structure in accordance with accepted practices as described in AC 43.13 and that adequate strain relief and service loops have been provided. Ensure that there are no kinks or sharp bends in the wire harnesses. Verify that the wire bundles are not exposed to any sharp or abrasive surfaces. Complete log book entries, weight and balance computations and other documentations as required.

## 2.5 LIMITATIONS

There are no known limitations to the operation of the NAV 2000. Instructions for Continued Airworthiness and Return to Service Instructions can be found in Appendix C.

# 3 **SECTION III -** OPERATION

## 3.1 GENERAL INFORMATION

### 3.1.1 Scope

This section will provide detailed operating instructions for your new NAV 2000 Navigation Receiver. Please read this section completely to become familiar with all of the features of the unit.

### 3.1.2 Display Functions

### 3.1.3 User Controls

The user controls consist of two sets of concentric rotary knobs. The set on the left control the volume and select memory functions while set on the right select the standby frequency and toggle between the active and standby. Both sets of knobs contain three parts, the inner knob (the small one) the outer knob (the large one) and a momentary push button (the end of the small knob).

#### 3.1.3.1 Turning the unit on/off

To turn the unit on, momentarily press the left hand inner knob. The unit will go through a short initialization routine at start up and then begin operation at the same settings that were loaded at the last power down. To turn the unit off, press and hold the left inner knob for three seconds.

#### 3.1.3.2 Setting Active and Standby Frequency

The knob functions of the right hand set are as follow; the inner knob will change the standby frequency by KHz or the numbers to the right of the decimal point (108.**15**) in 50kHz (0.05 MHz) increments. The outer knob will change the frequency by MHz or the numbers to the left of the decimal point (**108**.15) in 1 MHz increments. Only the frequency in the standby position will change. The standby frequency is displayed on the right side of the display and is identified by the letter "S" to the left of the frequency (**S**108.15). To load the standby frequency in to the active position, momentarily press on the inner right knob. This will swap the standby frequency with the active frequency. The active frequency is identified by the letter "A" at the left of the frequency display (**A**108.15).

#### 3.1.3.3 Setting a Bearing

The bearing on the unit can be selected through one of three ways: Using a mechanical resolver, through the RS-232 input, or through using the basic nav setting.

When working with a mechanical resolver, select the desired bearing using the OBS knob.

For more information regarding selecting a bearing using a serial input, please see the owners manual that was included with the driving device.

The Basic Nav setting provides a deviation on the display where the Active frequency normally is placed, allowing for direct selection of the active frequency, and the bearing is set through use of the inner and outer left hand knobs (normally the volume control). In this mode the memory and volume control are unavailable. Please see the system configuration section for more information about this mode.
**NOTE:** When using the Basic Nav functions the unit **MUST** be connected to a CDI for IFR flight the display CDI is for reference only.

#### 3.1.3.4 Changing the Volume

Rotating the inner left rotary encoder controls the receiver's audio volume. "**VOL**" will be displayed in the standby frequency display and the volume level is indicated by the numeric value after "**VOL**" (i.e. "**VOL 15"**). The volume level can be adjusted from **0** to **20** by rotating the left hand large knob. Normal display operation resumes after 5 seconds.

## 3.2 System Configuration

### 3.2.1 Accessing Setup Functions

During startup, press and hold both buttons simultaneously to assess the unit's setup mode; The Active frequency remains on the Left display, while the right display will show Rs I:xxx. To select each individual setting, rotate the left outer knob until the desired configuration setting is displayed. To exit this mode and resume normal operation, press both buttons simultaneously.

The available Configuration settings are as follows:

**Rs I: Resolver Input selection:** This allows selection of the OBS data input.
**Rs T: Resolver Test:** This function shows the current selected OBS from either the mechanical resolver or the Serial port as selected from Rs I.
**RsCl: Resolver Calibration:** Allows for the calibration of a mechanical resolver.
**SrMd: Serial Mode:** Allows for configuration as a standalone unit or slaved to a COM 2000 to fully emulate a Garmin SL-30.
**VORC: VOR Calibrate:** Allows for front panel calbration of the VOR system to the currently displayed frequency.

#### 3.2.1.1 OBS/Resolver Selection (Rs I)

Selecting the OBS input to the unit using the configuration pages has 3 options:

**SER:** Serial input: The unit accepts the OBS over the RS-232 input and changes the deviation outputs accordingly with the inputted data.

**RES:** Mechanical Resolver: The unit uses the analog resolver inputs to determine the OBS and changes the deviation outputs accordingly.

**INT:** Internal OBS: The NAV 2000 changes its display, eliminating the standby frequency and memory access to allow for direct input of the OBS. In this mode, the Volume knob becomes the OBS Control, and frequency input is directly inputted through the frequency knobs (Right Hand inner and outer). The display shows a digital CDI, however this is not to be used for IFR flight. In order to allow for IFR flight, an external CDI/VDI **MUST** be attached to the unit.

#### 3.2.1.2 Resolver Test (Rs T)

The resolver test option has no functions. In this setting, the information following the: represents the currently received data from the mechanical resolver. If the bearing being displayed is incorrect, select the Resolver Calibration setting (RsCl) and calibrate the NAV 2000 to the attached head.

#### 3.2.1.3 Resolver Calibration (RsCl)

The resolver calibration option has two settings, No and Yes. When initially selected, No will be displayed. Calibration of the NAV 2000 to the resolver is as follows:

- Set the Resolver OBS to 150.
- Rotate the inner left knob to "Yes"
- Push the left knob.
- On success, the display will show "Cal"
- If there is an error, the display will show "Err"

If the result of "Err" is received, check your wiring between the mechanical resolver and the NAV 2000

#### 3.2.1.4 Serial Mode (SrMd)

The serial mode configures the RS-232 output to work either as a standalone navigation unit (DIR), or as a slave to the COM 2000 to fully emulate the SL-30 (PAS). This setting has two options, DIR and PAS.

- DIR: Direct serial. The output directly connects to an EFIS or other serial device.
- PAS: Passthru. The output connects to a COM 2000 before connecting to an EFIS or other serial device.

#### 3.2.1.5 VOR Calibration (VORC)

The VOR Calibration setting allows for the user to calibrate the VOR settings and has two settings, No and Yes. When initially selected, No will be displayed. Calibration of the NAV 2000 VOR is as follows.

- Have a VOT or VOR calibration device available.
- Channel the unit to the selected frequency and verify reception (The CDI will unflag)
- If the calibration device has a bearing select, set it to 0.
- Rotate the inner left knob to "Yes".
- Push the left knob.
- After 1 minute, the unit will display either "Cal" indicating a successful calibration or "Err" indicating an error.

If the result of "Err" is received, verify reception of the test frequency and operation of the antenna.

# 4 **SECTION IV -** WARRANTY AND SERVICE

## 4.1 LIMITED WARRANTY

The equipment delivered with this Standard Factory Warranty is manufactured by Val Avionics, Ltd. and is guaranteed against defective materials and workmanship for one year from date of original retail purchase. Any unit found to be defective due to material and workmanship during the warranty period will be repaired or replaced at the sole discretion of Val Avionics Ltd.

Val Avionics, LTD liability under this warranty is limited to servicing, repairing or adjusting any equipment returned prepaid to the Val Avionics' factory by express written or verbal authorization for that purpose and to repair or replace defective parts thereof.

If, upon examination, it is determined that a malfunction has been caused by misuse of the equipment, installation or operation not in accordance with factory instructions, accident or negligent damage, alterations of any manner, and repair by other than the factory, the repairs will not be covered under the warranty. In such cases, an estimate will be submitted for approval before repair is initiated. In most cases, Val avionics, Ltd. will provide 72-hour turn around on its warranty and repair service. We recommend that contact be made with the FACTORY CUSTOMER SERVICE DEPARTMENT prior to any unit return and obtain RETURN AUTHORIZATION AND INSTRUCTIONS. This will provide proper control and expedite service.

Val Avionics, Ltd. reserves the right of continuous product development without obligation to install changes in previously manufactured products.

Installation of Val Avionics, Ltd. products must conform to methods acceptable by the Federal Aviation Administration as described in the appropriate Federal Aviation Regulations (FAR's) and Advisory Circulars (AC's).

To ensure proper warranty registration, type or print clearly the application information on the enclosed PRODUCTS WARRANTY REGISTRATION FORM and return to Val Avionics, Ltd.

## 4.2 SERVICE

Repair service for the NAV 2000 *Navigation Receiver* is available at our manufacturing facility. Units in need of servicing should be returned prepaid to Val Avionics Ltd at the following addresses.

Val Avionics
2950 Pringle Road S.E.
Salem, OR 97302

# 5 **Appendix A** – INSTALLATION DRAWINGS AND CONNECTOR LAYOUT

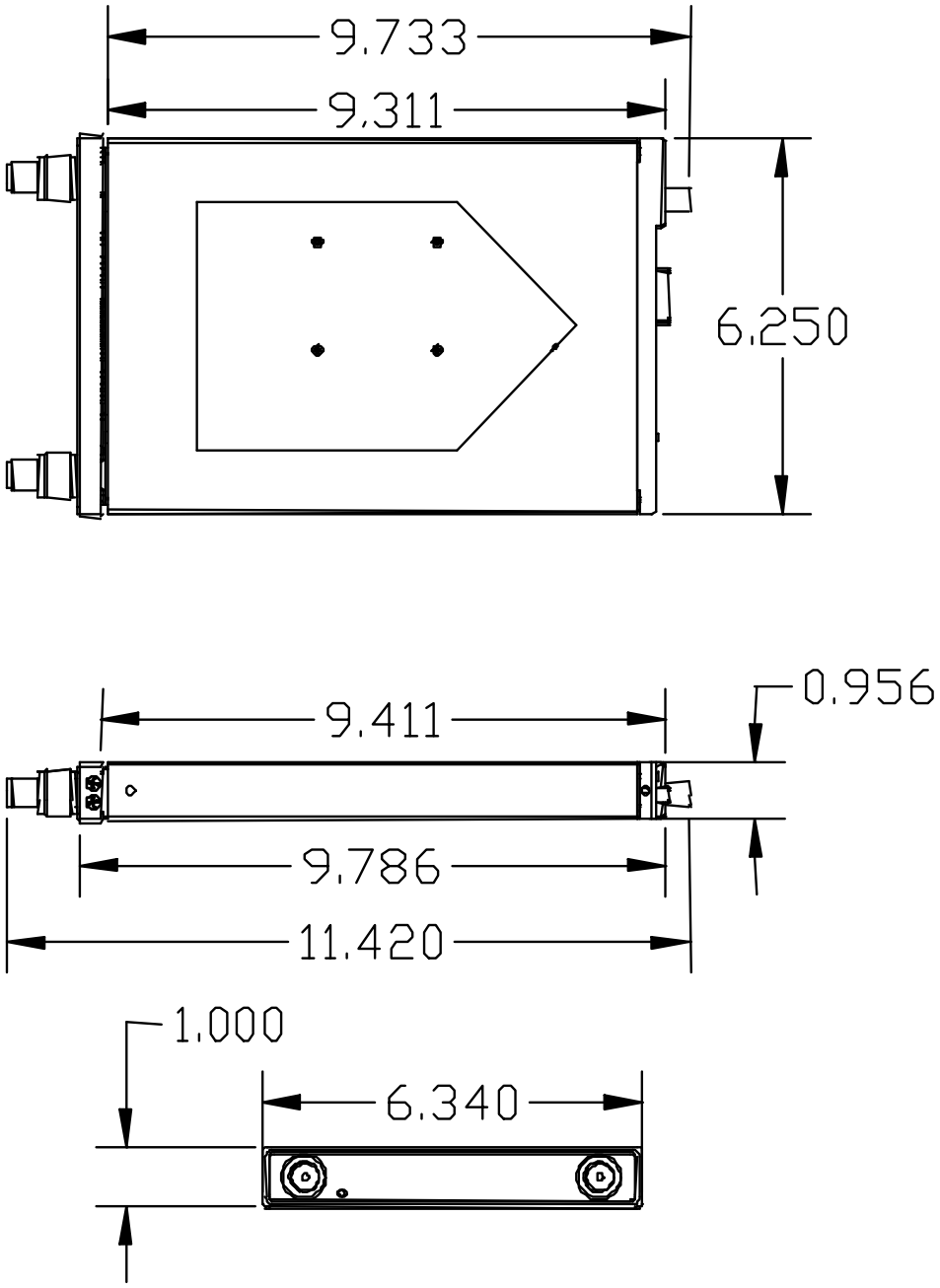



**Figure 1: Physical Dimensions**

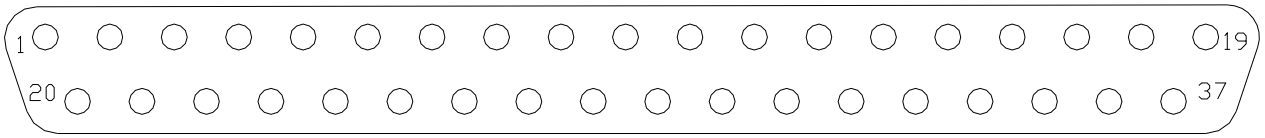
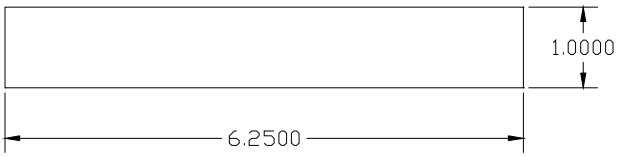



**Figure 2: P1 Connector Pin Out**




(Drawing Not to Scale)

**Figure 3: Panel Cut Out**

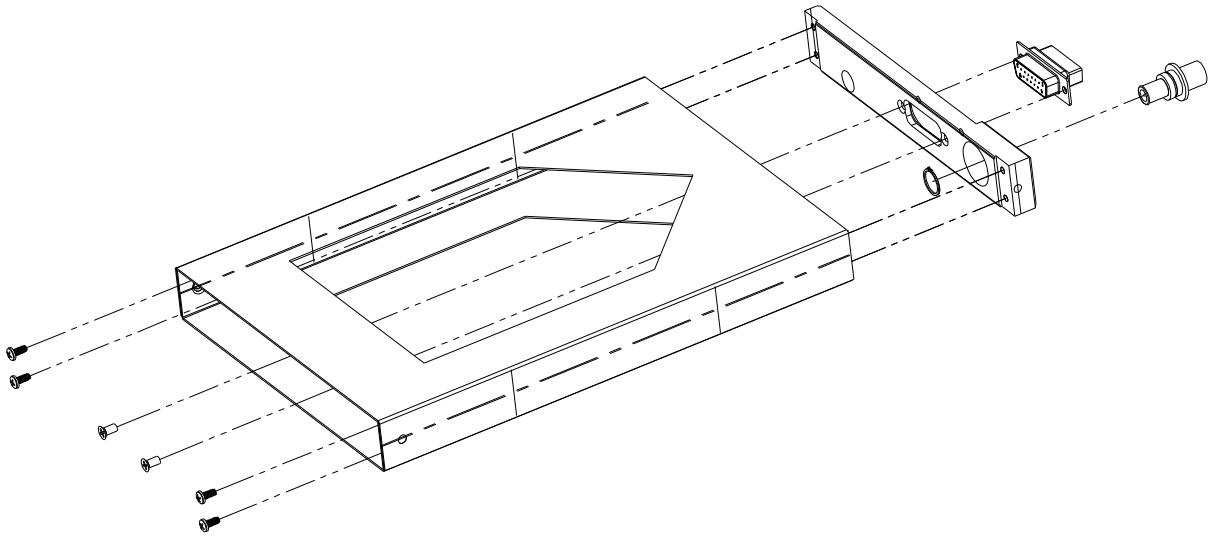


**Figure 4: Mounting Tray Assembly Exploded View**

**Table 4: Rear Connector Pin Functions**

| Pin | Functoin | I/O |
|---|---|---|
| 1 | Main Power | Input |
| 2 | Airframe Ground | |
| 3 | Serial Ground | |
| 4 | RS-232 Input | Input |
| 5 | RS-232 Output | Output |
| 6 | Reserved | |
| 7 | OBS_D (COS) | Input |
| 8 | Reserved | Input |
| 9 | Reserved | |
| 10 | CDI +Flag | Output |
| 11 | + From | Output |
| 12 | + To | Output |
| 13 | CDI +Right | Output |
| 14 | CDI + Left | Output |
| 15 | Backcourse | Output |
| 16 | OBS_F (SINE) | Input |
| 17 | Reserved | |
| 18 | Reserved | |
| 19 | Composite Output | Output |
| 20 | Audio Ground | |
| 21 | Reserved | |
| 22 | Reserved | |
| 23 | Audio Output | Output |
| 24 | OBS_H (Reference) | Output |
| 25 | OBS_C | Output |
| 26 | OBS_E | Input |
| 27 | Reserved | |
| 28 | VDI +Flag | Output |
| 29 | CDI -Flag | Output |
| 30 | VDI +Up | Output |
| 31 | VDI + Down | Output |
| 32 | VDI - Flag | Output |
| 33 | ILS Energize | Output |
| 34 | OBS_G | Output |
| 35 | Reserved | |
| 36 | Reserved | |
| 37 | Ground (composite) | |

# 6 **Appendix B** – WIRING DIAGRAMS

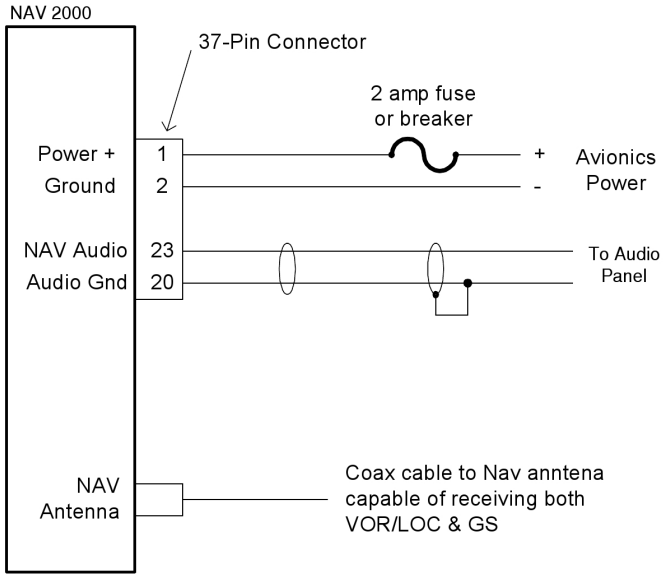



**Figure 5:** NAV 2000 Basic Wiring Diagram

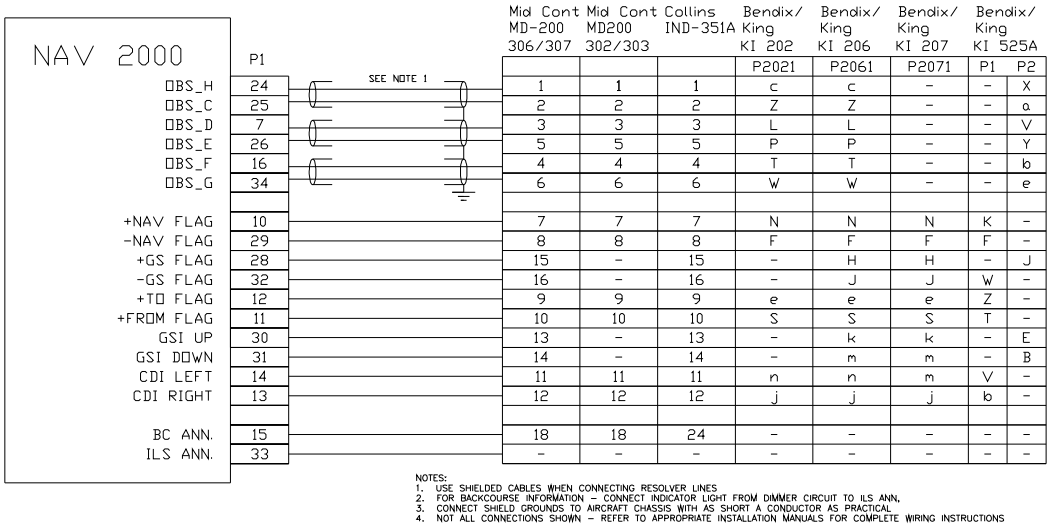



**Figure 6:** NAV 2000 to Nav Indicator

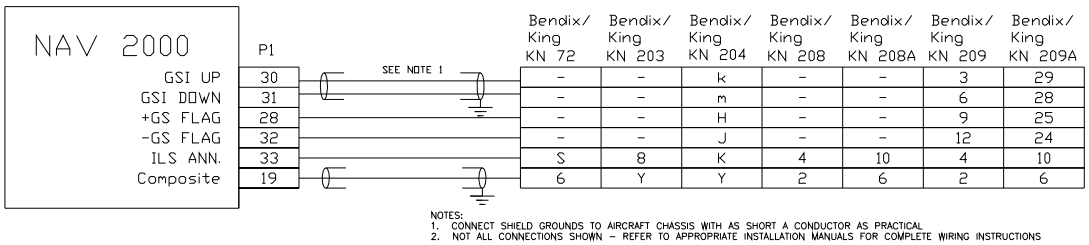



**Figure 7:** NAV 2000 to Nav Converter

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# 7 **Appendix C** – INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

## 7.1 MAINTENANCE INSTRUCTIONS

Maintenance of the NAV 2000 Navigation Receiver is on condition only. **No periodic maintenance is required**. VOR calibration, in accordance with 14 CFR 91.171, is required to be checked every 30 days. If unit is found to be out of calibration, send unit in for service. If the unit is removed for service, upon re-installation perform Post Installation check as described in section 2.4 of this manual.

# 8 Appendix D – RS-232 Instruction Listing

This appendix includes the interface specifications for the RS-232 serial port. The RS-232 port can be used to input active and standby frequencies as well as using an external serial resolver such as an EFIS system. The interface format conforms to NMEA 0183 message format specifications.

## 8.1 Input Commands

The following input command messages are supported:

- Input VOR frequency data from a remote source
- Input Localizer frequency data from a remote source
- Request data output
- Set active VOR/LOC frequency data from a remote source
- Set standby VOR/LOC frequency data from a remote source
- Set Omni-Bering Select (OBS) value from remote source

## 8.2 Output Messages

The NAV 2000 output messages include:

- Reset status
- CDI, GSI, and flags
- Decoded OBS setting
- Radial from active VOR
- Communications Error
- NAV Receiver status
- NAV audio mode
- NAV microcontroller software version

## 8.3 Data Format

The data format for serial communication is:

- Baud rate 9600
- Data bits 8
- Stop bits 1
- Parity none

## 8.4 Default Message Output

At system start when the NAV 2000 is configured to operate in normal mode, the following messages will be configured for output and the specified rates:

- CDI, VDI, and Flags at 10 Hz (high rate)
- Decoded OBS Setting at 10 Hz (high rate)
- Radial from Active VOR at 10 Hz (high rate)
- NAV Receiver status at 1 Hz (low rate)

These default rates can be changed by using the Request Data Output message.

## 8.5 Message Formats

All messages will conform to the NMEA 0183 proprietary message format as follows. All characters will be standard ASCII characters. No binary data characters will be used.

| | |
|---|---|
| "$" | Start of message character, ASCII "$" (024h) |
| "P" | Proprietary message identifier |
| "MRR" | II Morrow company identifier |
| c | Message class identifier. Used to identify a message as either a COMM of VHF NAV message. Those message types, which are also supported by the VAL COM 2000 VHF Transceiver, will use the "C" identifier to allow the NAV 2000 to accept COMM radio commands from existing products. All other messages will use the "V" identifier to indicate that they relate to a VHF NAV receiver. |
| nn | Message identifier, two-digit number in ASCII characters. |
| d…d | Message data characters defined for each message. |
| chksum | Message checksum, including message identifier through data characters. The two-digit checksum is generated by adding all values of valid characters together, ignoring carry (if any). This value is converted into two encoded hex[1] characters (30h-3Fh). |
| <CR> | ASCII carriage return (0Dh) |
| <LF> | ASCII line feed (0Ah) |

The maximum message length, including the start of message character ("$") and the end of message <CR><LF> sequence, is 25 bytes.

This message format is the same as is used in the VAL COM 2000 VHF Transceiver. The NAV 2000 will be able to accept all messages intended for a COM 2000 without generating a serial communications error. It will forward all of those messages.

[1] Encoded Hex: each character consists of 4 bits of data placed in the low order nibble +30h. For example, the 8-bit value of 5Fh would be encoded as two characters with values of 35h and 3Fh, which map to the ASCII characters "5" and "?" respectively.

## 8.6 Message Definitions

**Input Messages**

**REQUEST DATA OUTPUT**

This input is used to request an output message to be sent by the NAV 200.

**Message format:**

"V" .....Message class. This is a VHF NAV message.
"24" .....Message identifier.
ii .....Output identifier of requested message, two ASCII characters.
dd.....Message data, two encoded hex[2] characters (30h-3Fh), used for specific output request. Set to "00" if not needed. These characters are used for such items as selecting a specific EEPROM address to output.
A.....Request type: (ASCII) "0"= output repeatedly at low speed (1 Hz); "H" = output repeatedly at high speed (10 Hz).

| ii | Output | Dd | Data Description | a |
|---|---|---|---|---|
| "20" | Reset Status | "00" | | "0" |
| "21" | CDI, GSI, and Flags | "00" | | "0", "L", "H" |
| "22" | Decoded OBS Setting | "00" | | "0", "L", "H" |
| "23" | Radial from Active VOR | "00" | | "0", "L" |
| "28" | Receiver Status | "00" | | "0" |
| "30" | NAV Microntroller Software Version | "00" | | "0" |
| "32" | ADC Data Output | cc | ADC channel: "00" to "08" | "0" |
| "35" | Comm Transceiver Status | "00" | | "0" |
| "36" | Comm Software Version | "00" | | "0" |

**Table 5 -** Data Output Requests

**Example messages:**

```
$PMRRV242100L<chksm><CR><LF>
```

Request periodic output of CDI, GSI, and related flags at low (1Hz) rate.

```
$PMRRV2432050<chksm><CR><LF>
```

Request a single output of ADC data from channel 5.

**SET ACTIVE VOR/LOC FREQUENCY AND RECEIVER FUNCTION**

This message is used to set the standby VOR or Localizer frequency as well as the receiver operating function. The NAV 2000 can detect if the supplied frequency corresponds to a VOR or a Localizer channel, so this command will work for both types of NAV aids.

[2] Encoded Hex: each character consists of 4 bits of data placed in the low order nibble +30h. For example, the 8-bit value of 5Fh would be encoded as two characters with values of 35h and 3Fh, which map to the ASCII characters "5" and "?" respectively.

**Message format:**

`$PMRV27E4N<chksm><CR><CR><LF>`

This example command would set the active VOR frequency to 117.100 MHz. This can be interpreted by noting that the ASCII 'E' corresponds with 45h, + 30h = 75h, converted to decimal equals 117 for the MHz portion of the command. The kHz portion converts ASCII '4' to 34h, - 30h = 4h, x 25 kHz steps = 100 kHz. This command would also set the receiver function to normal, leaving the standby channel inactive.

Note: The NAV 2000 will check input frequencies for validity. An RS-232 serial error message output will be generated if the frequency is invalid.

## SET STANDBY VOR/LOC FREQUENCY AND RECEIVER FUNCTION

This message is used to set the standby VOR or Localizer frequency as well as the receiver operating function. The NAV 2000 can detect if the supplied frequency corresponds to a VOR or a Localizer channel, so this command will work for both types of NAV aids.

**Message format:**

"V"……..Message class. This is a VHF NAV message.
"28"……Message identifier.
mk……..Standby VOR/LOC frequency:
m = desired frequency in MHz in hexadecimal, where m = desired frequency – 30h, with desired frequency in range of 108 to 117 MHz.
k = desired frequency in kHz, where k = (desired frequency / 25 kHz) + 30h, desired frequency in range of 000 to 975 kHz in 50 kHz steps, or the even numbers from 30h to 56h.
a…….Receiver function: N = normal, 0 = unchanged.

**Example message:**

`$PMRRV28?PN<chksm><CR><LF>`

This example command would set the standby VOR frequency to 111.800 MHz. This is interpreted by noting that the ASCII '?' corresponds with 3Fh, + 30h = 7Bh, converted to decimal equals 111 for the MHz portion. The kHz portion converts ASCII 'P' to 50h, -30h, -30h yields 20h, x 25 kHz steps = 800 kHz portion. This command would also set the receiver function to normal, so the receiver would receive only the active VOR channel.

**Note:** The NAV 2000 will check input frequencies for validity. An RS-232 serial message output will be generated if the frequency is invalid.

## SET STANDBY COM FREQUENCY AND TRANSRECEIVER FUNCTION

This message is issued to set the standby COM frequency.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"29"..... Message identifier.
Mk..... Standby COM frequency:
m = desired frequency in MHz in hexadecimal, where m = desired frequency - 30h, with desired frequency in range of 118 to 136 MHz, or 162 MHz.
k = desired frequency in kHz, where k = (desired frequency / 25 kHz) + 30h, with desired frequency in range of 000 to 975 kHz in 25 kHz steps.

a……..Transceiver function: N = normal, 0 = unchanged.

**Example message:**

$PMRRV29G4M<chksm><CR><LF>

This example command would set the standby VOR frequency to 119.100 MHz. This is interpreted by noting that the ASCII 'G' corresponds with 47h, + 30h = 77h, converted to decimal equals 119 for the MHz portions. The kHz portion converts ASCII '4' to 34h, - 30h yields 4h x 25 kHz steps = 100 kHz.

**Note:** The COM 2000 will check input frequencies for validity. An RS-232 serial error message output will be generated if the frequency is invalid.

## SET ACTIVE COM FREQUENCY AND TRANSCEIVER FUNCTION

This message is used to set the Active COM frequency as well as he COM transceiver function.

This message is only available in normal mode.

**Message format:**

"V".....Message class. This is a VHF NAV message.
"42".....Message identifier.
mk .....Active COMM frequency:
m = desired frequency in MHz in hexadecimal, where m = desired frequency – 30h, with desired frequency in range of 118 to 136MHz, or 162MHz.
k = desired frequency in kHz, where k = (desired frequency / 25kHz steps.)
a = Transceiver function: N = normal, 0 = unchanged.

**Example message:**

$PMRRV42G4N<chksm><CR><LF>

This example command would set the active VOR frequency to 119.100MHz and place the COMM radio in Normal receive mode. This is interpreted by noting that the ASCII 'G' corresponds with 47h, + 30h = 77h, converted to decimal equals 119 for the MHz portion. The KHz portion converts ASCII '4' to 34h, - 30h yields 4h, x 25KHz steps = 100 kHz.

**Note:** The COM 2000 will check input frequencies for validity. An RS-232 serial error message output will be generated if the frequency is invalid.

## SET NAV OMNI-BEARING SELECT (OBS) VALUE

This message is used to set the OBS value used by the NAV 2000 as the elected radial for computing the course deviation from a VOR. This message will have no effect unless the NAV 2000 is configured to use the internal OBS source, or a serial OBS source.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"34"..... Message identifier.
vvv ..... OBS Value in degrees, ranging from "000" to "359".

**Example message:**

```
$PMRRV34310<chksm><CR><LF>
```

Set the OBS value to 310 degrees.

### COM VOLUME AND SQUELCH CONTROL

This message is used to adjust the volume and squelch levels of the COM unit

**Message format:**

"V" ..... Message class - VHF NAV Message
"71" ..... Message Identifier
"vs" ..... Volume level and Squelch Level:
v = Desired volume level in encoded hexadecimal, where v = desired level + 0x30 with a range between 0 - 20, 0 being muted
s = Desired squelch level in encoded hexadecimal, where s = desired level + 0x30 with a range between 0 - 20, 0 being off

**Example Message:**

$PMRRV71;?<chksum><CR><LF>

This example command would set the volume level at 11 and the squelch at 15.

### COM MIC GAIN AND SIDETONE CONTROL

This message is used to adjust the volume and squelch levels of the COM unit

**Message format:**

"V" ..... Message class - VHF NAV Message
"72" ..... Message Identifier
"ms" ..... Volume level and Squelch Level:
m = Desired mic gain level in encoded hexadecimal, where m = desired level + 0x30 with a range between 1 - 20
s = Desired sidetone level in encoded hexadecimal, where s = desired level + 0x30 with a range between 1 - 20.

**Example Message:**

$PMRRV72;?<chksum><CR><LF>

This example command would set the mic gain level at 11 and the sidetone at 15.

**NAVIGATION VOLUME CONTROL**

This message is used to adjust the volume level of the NAV unit

**Message format:**

"V" ..... Message class - VHF NAV Message
"73" ..... Message Identifier
"v" ..... Volume level:
v = Desired volume level in encoded hexadecimal, where v = desired level + 0x30 with a range between 0 - 20, 0 being muted

**Example Message:**

$PMRRV73;<chksum><CR><LF>

This example command would set the volume level at 11.

# OUTPUT MESSAGES

**RESET STATUS**

This message is sent to indicate to the host that the NAV 2000 is running and ready to accept data on the serial port. It will be sent once upon startup and when requested by the host.

**Message format:**

"V"……..Message class. This is a VHF NAV message.\
"20"……Message identifier.

**Example message:**

$PMRRV20<chksm><CR><LF>

NAV 2000 is running and ready to accept serial input.

**CDI, GSI, AND RELATED FLAGS**

This message outputs the current values of the CDI, GSI, and their related flags. After power up this message will be output at a 10 Hz rate.

**Message format:**

"V" ..... Message class. This is a VHF NAV message.
"21" ..... Message identifier.
cc ..... CDI deflection. An eight-bit value indicating the amount of deflection of the CDI needle, represented as two encoded hex[3] digits. The CDI deflection is a twos complements signed integer in the range of –100 to 100. –100 indicates full left deflection, 0 indicates no deflection, and 100 indicates full right deflection.
gg ..... GSI deflection. An eight-bit value indicating the amount of deflection of the GSI needle, represented as two encoded hex[3] digits. The CDI deflection is a twos complement signed integer in the range of –100 to

[3] Encoded Hex: each character consists of 4 bits of data placed in the low order nibble +30h. For example, the 8-bit value of 5Fh would be encoded as two characters with values of 35h and 3Fh, which map to the ASCII characters "5" and "?" respectively.

100. –100 indicates full deflection upwards, 0 indicates no reflection, and 100 indicates full deflection downwards.

ff..... Flags. Eight bits for HNAV and VNAV related flags, represented as two encoded hex digits.

| | |
|---|---|
| Bit 1 (1sb) | Back Course enable (1 = enabled) |
| Bit 2 | Localizer detect (1 = using localizer) |
| Bit 3 | FROM flag (1 = From)[4] |
| Bit 4 | TO flag (1 = To) |
| Bit 5 | GSI superflag (1 = valid) |
| Bit 6 | GSI valid (1 = valid)\ |
| Bit 7 | NAV superflag (1 = valid) |
| Bit 8 (msb) | NAV valid (1 = valid) |

**Example message:**

`$PMRRV21817??:<chksm><CR><LF>`

This message indicates a full left CDI deflection (-127), a full up GSI deflection (127), both the GSI and NAV flags/superflags are valid, TO flag set, FROM flag not set, using a localizer, with no back course enable.

## DECODED OBS SETTING

This message outputs the current OBS setting, which may be read from an external resolver or from user input to the front panel. After power up this message will be sent at a 10 Hz rate.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"22"..... Message identifier.
v ..... Valid flag. "0" = OBS invalid/not present, "V" = OBS setting is valid.
ddd ..... Three digit OBS setting, in degrees. Values are in the range of "000" to "359".

**Example message:**

`$PMRRV22V170<chksm><CR><LF>`

A valid OBS setting of 170 degrees.

## RADIAL FROM ACTIVE VOR

This message outputs the current bearing from the active VOR station. This message will be output even when a localizer is being tracked by the NAV receiver. In this case, the bearing will be marked as invalid. After power up this message will be sent at a 10 Hz rate.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"23"..... Message identifier.
v ..... Valid flag. "0" = bearing not valid, "V" = bearing is valid.
dddf..... Bearing to a resolution of $1/10^{th}$ of a degree. ddd = three digit bearing in degrees, ranging from "000" to "359". f = $1/10^{th}$ of a degree.

**Example message:**

`$PMRRV23V1654<chksm><CR><LF>`

A valid bearing of 165.4 degrees FROM the active VOR station.

[4] The TO and From flag can not both be 1, indicating that they are both valid. They can both be zero, indicating that neither is valid. This situation will occur whenever the receiver determines that it is within the "cone of confusion" directly over the VOR, or when no signal is being received.

**COMMUNICATIONS ERROR**

This message is used to indicate a communication error.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"27"..... Message identifier.
e ..... Error code: (ASCII)
"0" = input message checksum error.
"1" = unknown message.
"2" = error or mismatch in message data.

**Example message:**

```
$PMRRV271<chksm><CR><LF>
```

Received an unknown message.

**NAV RECEIVER STATUS**

This message is used to output the current status of the NAV receiver. It will be output upon request or whenever the status changes.

**Message format:**

"V"..... Message class. This is a VHF NAV message
"28"..... Message identifier
mk ..... Standby NAV frequency: m = MHz, where m + 30h = desired MHz frequency in the range of 108 to 117 MHz. k= (desired frequency / 25 kHz) + 30h, with desired frequency in range of 000 to 975 kHz in 50 kHz steps.
s..... Status: "N" = Normal mode, "M" = Monitor mode

**Example message:**

```
$PMRRV28E4?PM<chksm><CR><LF>
```

Active NAV frequency is 117.100 MHz, Standby NAV frequency is 111.800 MHz, receiver is in monitor mode.

**NAV MICROCONTROLLER SOFTWARE VERSION**

This message is used to output the version string for the NAV microcontroller software.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"30"..... Message identifier.
vvvv ..... Software version in ASCII
e ..... Engineering version flag:
"R" = Released version.
"E" = Engineering version.

**Example message:**

```
$PMRRV300103E<chksm><CR><LF>
```

NAV Microcontroller software is version 1.03. It is an engineering version.

**COM TRANSCEIVER STATUS**

This message outputs the result of a specific system test.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"35"..... Message identifier.
mk ..... Active frequency: m = MHz, where m = desired MHz frequency – 30h, ranging from 118 to 136 MHz, 162 (i.e., 76h to 88h, A2h); k = (kHz offset / 25 kHz) + 30h, ranging from 000 to 975 kHz steps.
mk ..... Standby frequency: m = MHz, where m = desired MHz frequency – 30h, ranging from 118 to 136 MHz, 162 (i.e., 76h to 88h, A2h); k = (kHz offset / 25 kHz) + 30h, ranging from 000 to 975 kHz steps.
a ..... Transceiver status:
R = Normal receive
T = Transmit enabled
S = Stuck mic
F = Comm failure
s..... Squelch test setting: (ASCII) 0 = automatic; 1 = test

**Example message:**

$PMRRV35G4LFR0<chksm><LF>

Active frequency is 119.100 MHz, the standby frequency is 124.550 MHz, receiver function, squelch is automatic.

**COM SOFTWARE VERSION**

This message is used to output the version string for the VHF COM receiver software.

**Message format:**

"V"..... Message class. This is a VHF NAV message.
"36"..... Message identifier.
vvvv ..... Software version in ASCII

**Example message:**

$PMRRV300103<chksm><CR><LF>

COM software is version 1.03.