ND2316D

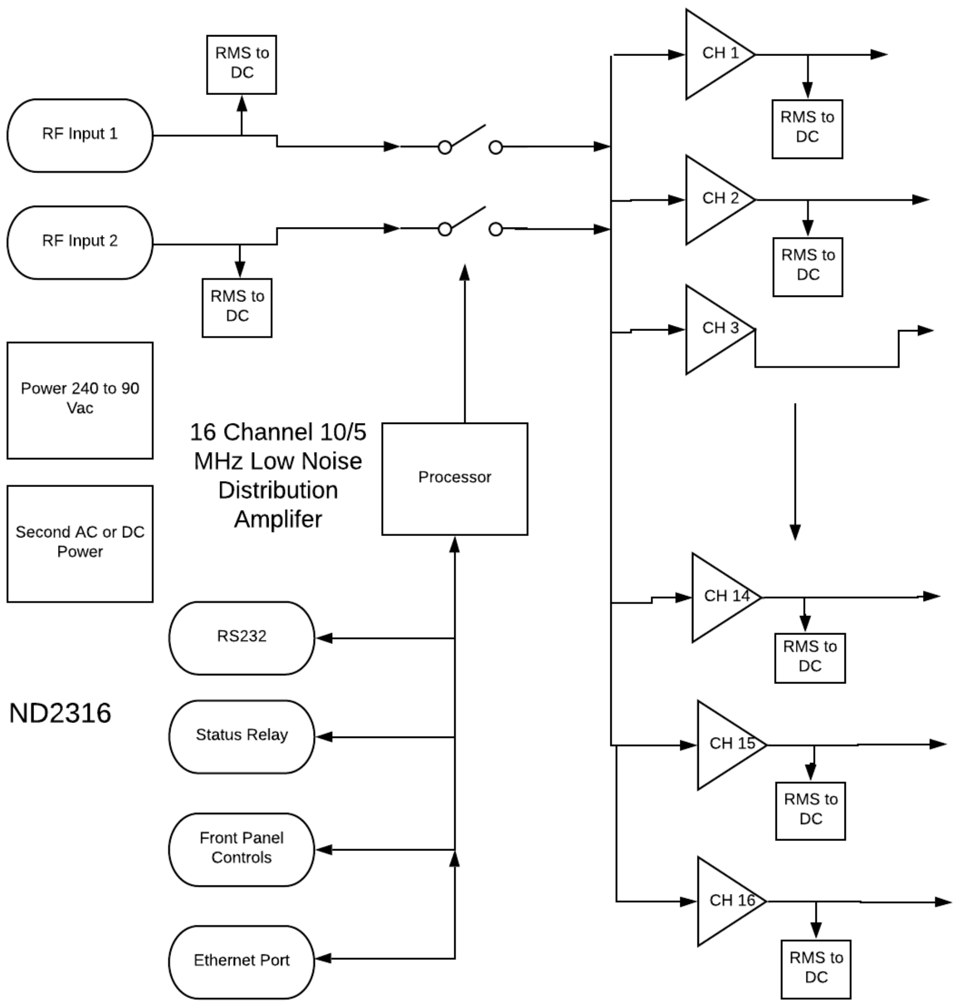
16 Channel Distribution Amplifier w/SNMP

Contents

1.0 Summary

The ND2316D is a ten channel wide bandwidth distribution amplifier. While primarily used for 10 MHz reference distribution, it has a functional bandwidth from 100kHz to 12 MHz but is filtered for the lowest phase noise 10MHz signal.

The amplifier is a low phase noise design to preserve the integrity of the reference signal. All outputs are transient and fault-protected. The unit is set up with ten outputs and dual inputs A and B. Gain is factory set for 0 dB.



The amplifier can also be optionally redundantly powered. The redundancy feature adds a second power supply which may be AC or DC. The dual input design monitors the input signals and selects the active signal or the prioritized signal. Each output channel is monitored against a defined set of thresholds. If a fault is detected, monitoring will report the fault serially,

The unit features extensive reporting via the rear panel RS232 port - equipment status, output voltage on each channel and redundancy status. By being able to monitor the output voltage, the user can detect cabling issues that cause an impedance change and replace cabling before it completely fails. Reporting is also easily accessible via the front panel display.

SNMP is also available for remote monitoring and control. Appendix D details the capability and features.

Nominal power is global AC power but a DC power option can be ordered that acts as the back-up power supply. Nominally 24 Vdc, this port is used for power when AC power fails. Switching between power sources is automatic and there is no transient power outage at the equipment level. The primary power supply is followed by low noise linear converter assemblies.

2.0 Controls and Indicators – Front Panel

This section describes the functionality of the front panel controls and indicators. Two buttons above the status LEDs provide navigation through the menus.

In general, the NEXT button advances through the menus to the next screen, while the SELECT button chooses between the available values on a menu.

Menus that allow selectable adjustments are the Input Threshold, Alert Threshold, and the Attenuation setting. To adjust these values from the front panel, hold down both buttons for two seconds, until the value begins to flash. To leave the menu with the new value, hold down both buttons until the value is solid.

Screen Saver: After 1 hour, the OLED display will turn off, unless activated by a fault condition, or by a user input, such as pressing the NEXT or SELECT buttons.

2.1 Channel Status

The channel status can be determined by reading the actual RMS value on the output of each stage. This is compared to a threshold limit that is set by the user as a percentage variation from a saved value. The default variation value is set at ±25% percent from the current state of the amplifier and is user-programmable in 5% increments from ±10% to ±60%.

The range of acceptable channel amplitude can be narrowed around a connected balanced line, so that a channel status below the alert threshold indicates a shorted line, while a channel status above the alert threshold window indicates a potential disconnected cable.

The threshold value at which a channel alert is triggered can be programmed on the alert threshold screen, or programmed via the RS232 port. Once set, the unit would continue to monitor each channel and a deviation beyond the set limits would be reported as a failure on the front panel and via RS232.

The channel status feature can quickly detect a cabling failure. Any change in the load impedance will change the output voltage with respect to the divider formed by the output impedance of the amplifier and the load impedance. Failing cables and connectors can be detected early.

The current threshold limits are displayed in addition to the actual measured value. These values reflect the percentage threshold defined in the alert threshold settings. If the output value is too low to give a valid reading, the display will read “LOW.”

The status is displayed on the front panel and is accessible over the RS232 serial bus via DB9. Channel statuses can be cycled into view or can remain on a single channel. This feature can be accessed via the NEXT button, by advancing to the channel status screen. To cycle through channels in sequence, press the SELECT button.

2.2 Status LEDs

There are three status LEDs which provide a quick indication of valid unit operation.

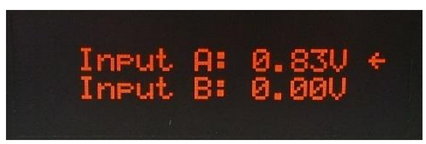
Alert LED: The alert LED will illuminate flashing red to indicate an input failure or a power supply failure. The alert LED will ***not*** flash red if any valid input signal is present.

Oven LED (OCXO option only): The oven LED will illuminate red to indicate an oven failure.

Fault LED: The fault LED will illuminate flashing red to indicate a channel fault, when any single channel is outside the user-defined threshold.

2.3 Input Status

The status of either input (A or B) can be monitored from the input status screen. The input values a displayed in Vrms. When an input is selected, an arrow appears next to the value indicating that the source on that input is relayed to the output channels.



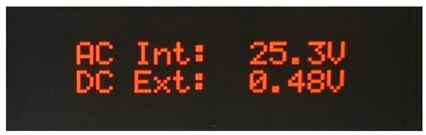
If no input is present, or the input selection priority does not have an input value which is above the input threshold, the alert LED flashes red, and the screen indicates “Connect Source.” The error is also noted in the fifth field of the $GPNVS string, with the following values:

0 = At least one valid input is available and is relayed to the channel outputs.
1 = Input A is selected and is below the input threshold.
2 = Input B is selected and is below the input threshold.

For details on the status strings, see section 5.0 Programmer’s Guide.

2.4 Power Supply Status

The power supply status screen provides DC voltage values of the two available power supply sources. The 90-250V AC input is internally connected to an internal 24V AC-DC convertor which powers the internal supplies with 24V. This is diode-connected with the external 24V DC input, which can be used in addition to, or in place of, the AC input.



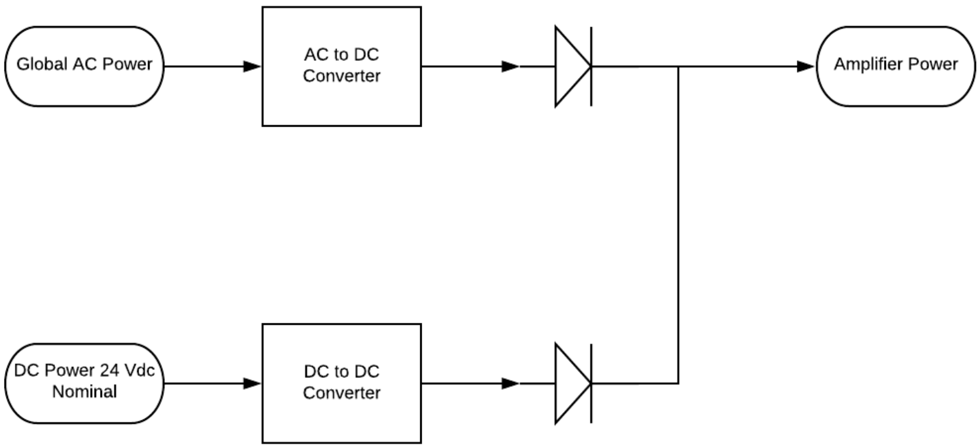
The values of both DC supplies are measured internally to validate connections. The measured values of the AC/DC convertor and the DC input are reported in the third and fourth fields of the second $GPNVS status string.

For details on the status strings, see section 5.0 Programmer's Guide.

In addition to direct value measurements, each redundant system has a power supply status byte which is reported in the third $GPNVS status string, in the seventh and eighth fields respectively.

Any measurement of the power supply which results in an alert condition will be reported in the power supply status byte.

0x80 = External AC not connected.
0x40 = External DC not connected.



Redundant power supplies operate on either the AC input or DC input, and function independently. All functionality and reporting for an individual power supply and amplifier is independent of its redundant copy.

2.6 Alert Threshold

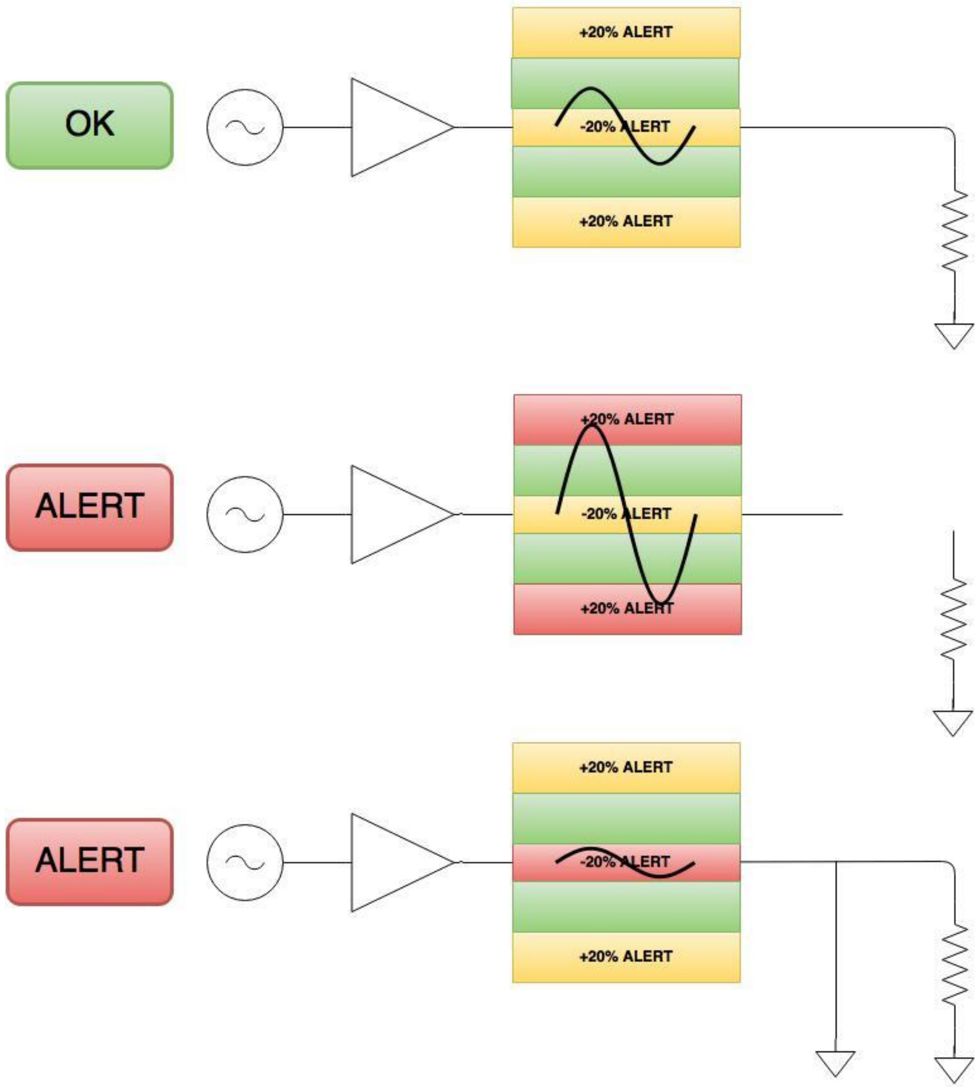
The alert threshold screen allows the user to adjust the tolerance from the reference voltage which, if exceeded in either direction, the output channels will report a fault status. The default threshold value is set at ±25% percent from the current state of the amplifier, and is user-programmable in 5% increments, from ±10% to ±60%.

Each channel has a reference voltage which can be set, all at once, by latching the channel's current value in the latch channel average screen. Each channel's reference voltage can be set individually by writing the value serially with the $SET command. After saving the current configuration on a channel, any subsequent deviation on that channel which exceeds the alert threshold percentage will trigger an alert.

Steps to ensure correct alert configuration:

1. Connect source input(s) to channel A and/or B.
2. Connect distribution cabling to channels 1 through 16.
3. Set alert threshold to desired range.
4. Save current channel voltages with the latch channel values screen.
5. Save current settings on the save configuration screen.

Note: Alert threshold can be different for Input A and Input B, allowing for variation in the input source. To accommodate both inputs, set alert threshold for Input A and Input B.



The alert threshold can be optimized so that a channel short or an impedance change will cause an alert.

Example:

The output of channel 1 is connected to a high impedance input and reports 1.25Vrms at the output. The output of channel 2 is connected to a 50 Ohm terminated input, and reports 0.90Vrms at the output.

Input A is connected to a ~0.95V 10MHz source.

Alert threshold for input A is set to +/-20%.

The current state is saved in the save configuration screen.

The Channel 1 alert will report when:

- The Channel 1 output is higher than 1.50Vrms
- The Channel 1 output is lower than 1.00Vrms
-

The Channel 2 Alert will report when:

- The Channel 2 output is higher than 1.08Vrms
- The Channel 2 output is lower than 0.72Vrms

Pressing the SELECT button toggles the view between the A and B input alert threshold settings.

To adjust the alert threshold from the front panel, hold the NEXT and SELECT buttons down simultaneously for two seconds. The percentage value will begin flashing. To increase the value, press the SELECT button. To decrease the value, press the NEXT button.

When the desired value is reached, press the NEXT and SELECT button simultaneously to leave the settings mode.

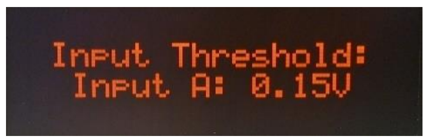
The alert threshold settings can be modified via the RS232 serial port with the $FLTTHRA and $FLTTHRB commands.

For details on the alert threshold, see section 5.0 Programmer's Guide.

2.7 Input Threshold

The input threshold screen allows the user to monitor and set the threshold at which the input is regarded as invalid or faulted.

The input threshold value is the absolute voltage (user programmable between 0.1Vrms and 1Vrms) below which the input fault will occur, and the auto input select will consider the signal invalid. The default minimum value is set to 0.3Vrms.



Pressing the SELECT button toggles the view between the A and B input threshold settings.

To adjust the input threshold from the front panel, hold the NEXT and SELECT buttons down simultaneously for two seconds. The percentage value will begin flashing. To increase the value, press the SELECT button. To decrease the value, press the NEXT button.

When the desired value is reached, press the NEXT and SELECT button simultaneously to leave the settings mode.

The input threshold settings can be modified via the RS232 serial port with the $INPTHRA and $ INPTHRB commands.

For details on the input threshold, see section 5.0 Programmer’s Guide.

2.8 Input Select

The input select screen allows the user to monitor and select the input priority for inputs A and B. Pressing the SELECT button with advance through the following settings:

- Input A Select
- Input B Select
- Auto Select (Priority A)
- Auto Select (Priority B)

Example: Input select is set to Auto(A). Input A threshold is set to 0.5Vrms. Input B threshold is set to 0.5Vrms.

Input A	***Input B***	***Selection***
0.90V	*0.4V*	***A***
0.90V	*No Connection*	***A***
No Connection	*0.6V*	***B***
0.4V	*0.6V*	***B***
No Connection	*No Connection*	***Last Selected***

The default setting is Auto (A). Input A select and Input B select will select only A or B respectively.

Input select priority can also be programmed via the RS232 port with the $INP command:

- $INP=0: Input A Select
- $INP=1: Input B Select
- $INP=2: Auto Select (Priority A)
- $INP=3: Auto Select (Priority B)

For details on the input priority programming, see section 5.0 Programmer's Guide.

2.9 Latch Channel Values

The latch channel values screen allows the user to save the current channel output values for use as the reference value for alert settings.

A channel alert is triggered when a channel output voltage exceeds or falls below a percentage of the reference value. This reference value is 1.10Vrms as a default, but can be set by the user.

There are two ways to set the reference voltage. The RS232 serial port allows for setting an individual channel's reference voltage with the $SET command. The user can also use the latch channel values to take a snapshot of all current outputs, and use these as the reference values.

All channel reference values are with respect to the active Input (A or B). If Input A and input B are both present, this allows for setting references on both inputs to accommodate variation in amplitude between the two inputs.

2.9 Save Configuration

The save configuration screen allows the user to save the current settings for alert threshold, input threshold, attenuation, input select, reference voltage and any other settings that have been modified via the RS232 port.

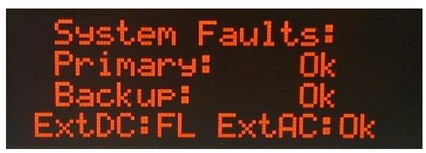
To save the current settings, press the SELECT button twice.

The save configuration action is equivalent to the $SAVEFL command on the serial port.

2.10 Fault Status

The fault status screen allows a quick overview of any channel faults from the front panel. The total fault count is listed, as well as a visual flashing indication of any channels that are beyond the threshold values.

Press SELECT to advance to the system fault screen.



The system fault screen indicates any failures in the primary system or the redundant backup system. All internal power supplies are monitored (24V, +8V, -8V, 5V) on both the primary and backup systems. A failure on one of these supplies will be indicated with a “PS FAIL” fail warning for either system. A communication failure would be indicated by a “Com FAIL” indicator. Either of these fault statuses will result in the change of the primary to the backup system. The individual statuses of the internal power supplies are also available via the RS232 serial port.

The presence of a valid DC input voltage is indicated on this screen, as well as a valid AC power input. If either of these supplies are not present, a “FL” indication will be shown next to the appropriate input.

2.11 Power Switch

The rear panel power switch controls AC power input to the unit. If the optional DC input is provided with 24V, or a valid DC supply, the unit will operate. If the unit is powered with the DC Option, the rear panel switch does not remove DC power.

The AC and DC input option provides a redundant and automatic backup source in the case of failure of either input.

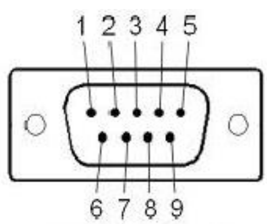
2.12 RS232 DB9 Port

The front panel RS232 port allows convenient setup of the unit in addition to the rear panel RS232 which may be connected to a more permanent instrumentation setup.

The front panel RS232 port will respond to the same commands as the rear panel, and any changes made will be reported on both serial ports. To receive the status strings on the front panel port, the command $ACTFRP=1 is input.

See complete list of functionality in the Programmer's Guide Section 5.0. The default Baudrate for the front panel serial port is 115200 baud, 8 bits, 1 stop bit, no parity.

RS232 Serial Port: Front Panel Pin Connections



Male DB-9

Pin	Function	I/O
1	NC	
2	Command Port TX	O
3	Command Port RX	I
4	NC	
5	GND	GND
6	NC	
7	NC	
8	NC	
9	NC	

RS232 programming functionality is described in detail in Section 5.0.

3.0 Rear Panel

3.1 Channel Outputs - BNC

There are ten outputs across the left hand side of the rear panel. They are labeled 1 through 10. Nominally the outputs are 50 Ohm impedance.

3.2 Status LEDs

There is an LED to the right of each BNC. A continuous green indication is for normal operation. Flashing green channel indicates that the channel has been detected to be in an out-of-tolerance state that can be caused by the RMS value being above or below the specified tolerance.

3.3 Signal Input A/B

Signal input. Standard impedance is 50 ohms. Maximum signal input is 1.5 Vrms. By default, Auto(A) priority is selected, meaning Signal A is considered primary, and B is used if A is detected as being out of tolerance. The user can change the Signal Input priority via the Front Panel Input Select screen, or via RS232, based on a need for, or the presence of, a particular source.

3.4 24VDC Input

The DC input connector is a 3 pin Amphenol circular connector, P/N DL3102A10SL-3P. The mating connector is available as P/N DL3106A10SL-3S.
The default DC input voltage is 24Vdc. Custom voltage ranges can be provided from -60Vdc to +60Vdc.

Pin A goes to the most negative voltage of the DC source. For a 24V source input this would be the ground or return output from the DC source.

Pin B goes to the most positive DC voltage of the DC source. For a 24V source input this would be the positive output from the DC source.

Pin C goes to the Earth ground of the DC source.

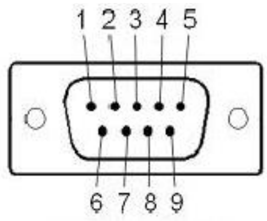
3.5 AC Input

The AC input accepts 90-250Vac, 50-60Hz. IEC 320-C14 Compliant.

3.6 RS232 DB-9

An RS232 port is provided for local setup, and status monitoring. The embedded processor provides status strings, as well as command responses.

RS232 Serial Port: Rear Panel Pin Connections

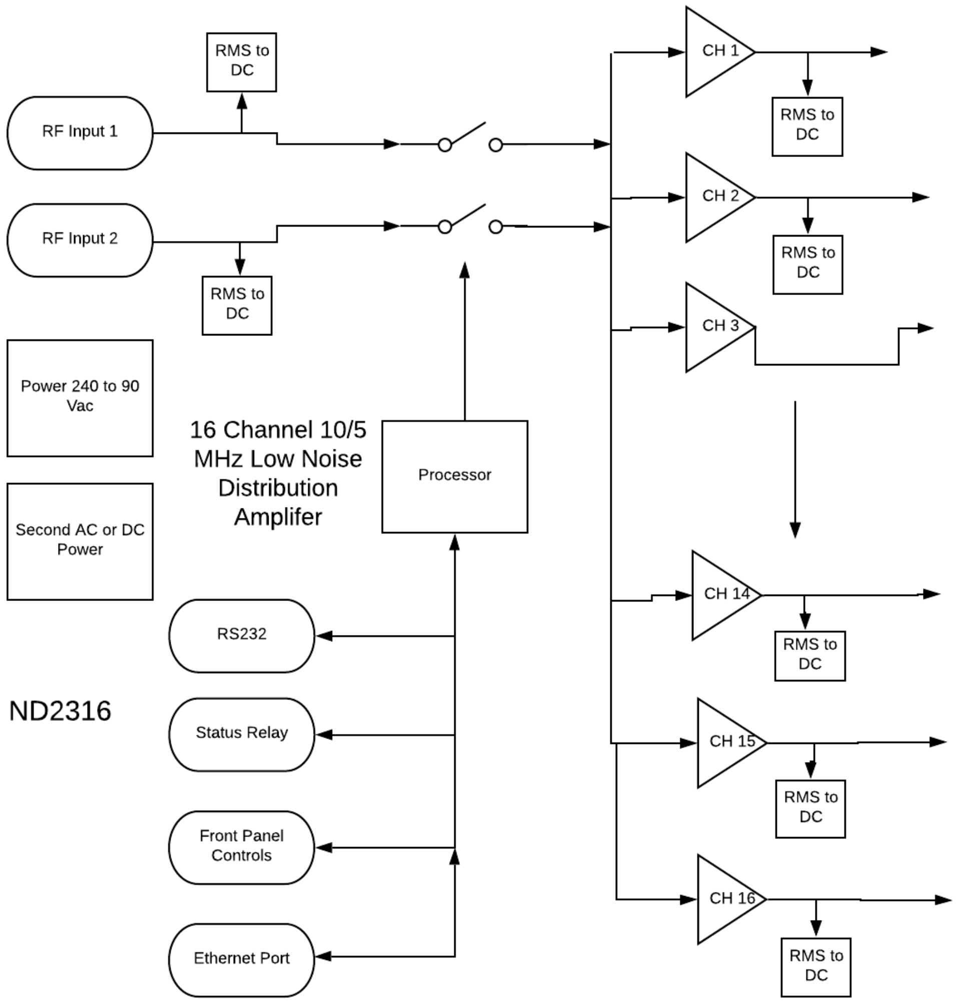


Male DB-9

Pin	Function	I/O
1	NC	
2	Command Port TX	O
3	Command Port RX	I
4	NC	
5	GND	GND
6	NC	
7	NC	
8	NC	
9	NC	

The default settings for the rear panel RS232 port are 115200 baud, 8 bits, 1 stop bit, no parity.

4.0 Functional Description



4.1 Bandwidth

20 KHz to 10MHz. Gain flatness is ±2dB. The amplifier is available with output drive to DC. Though the unit operates well across wide bandwidth, filtering and design have been optimized to reduce phase noise at 10 MHz.

4.2 Phase Noise

Low phase noise contribution is achieved through careful PCB design, component selection and minimization of power supply noise. Below is a typical phase noise performance for a 10 MHz reference application:

Phase Noise L(f) in dBc/Hz

Trace	Notes	DUT Freq	Input Freq	Input Amplitude	dBc/Hz at 10 kHz	RMS Noise (degs)	RMS Jitter	Duration	Acquired
PCB172 c1 New Board R80 (Unsaved)		10.000 MHz	10.000 MHz	12.5 dBm	−146.1	3.00E−4	8.3E−14 s	5m 0s	300 pts

4.3 Outputs

Each output is fault and electrostatic discharge protected. Each output is independent, and any output can be faulted for an indefinite period of time with no permanent damage. Each output is connected to a monitor circuit that detects a local fault on the output. The fault status is indicated on the front panel. The fault status and the protection on each output facilitates installation to help prevent damage. A channel fault will not activate an “ALERT” state and the status relay will not be opened.

The nominal application is for a 10 MHz sine wave output in the range of 1 Vrms.

4.4 Built-in Test

There are numerous power supplies in the design to meet special needs and noise reduction. All power supply voltages are monitored and can be accessed via RS232. In addition, all current channel statuses, or Vrms values, can be monitored, as well as power supply health.

4.5 Power Supplies

The unit is designed to accept power in the range of 90 to 264Vac, 50 to 60 Hz. This allows global application. The design is such that no action need be taken to operate from global power types. This feature avoids installation damage that occurs in designs that require an input power switch mode be used.

There is an EMI filter between the internal power supply and the available power being used. This filter minimizes the electrical noise from entering the circuitry and negatively impacting noise performance.

Also, in most applications, the equipment that surrounds this unit is sensitive and the filter also reduces noise that could impact the performance of other equipment.

If the optional DC Power Option is installed, the unit can be powered from nominal 24 Vdc. The output of the DC to DC converter is effectively diode OR'd with the AC supply and the DC power supply becomes the prime when the AC power fails.

5.0 Programming Guide (RS232 Port: Front and Rear)

The ND2310D can accept user commands which will provide specific fault detection performance which may be customized by the user. The settings can be saved in non-volatile flash memory.

If the user makes one or more changes which are intended to be kept between power-off cycles, the command "$SAVEFLASH*51 <CR><LF>" will update flash to reflect all current settings.

Table 1 shows a complete list of input commands and descriptions. In general, a command may be input without "=" or an additional value, and the unit will respond with the current setting's value. If the input is not understood, the microcontroller will return the value "$?*3F<CR><LF>"

NOTE: All commands should be prefixed with "$", and followed by <cr><lf>. Checksum can be enabled which requires the command to be followed by an asterisk and a two digit hex value.

Example: $<*COMMAND*>*XX<cr><lf>.

The checksum can be required for all input commands, and the requirement for a checksum can be enabled or disabled (default setting is disabled). The checksum method is the two-hexadecimal character representation of an XOR of all characters in the sentence between, but not including, the $ and the * character.

Example: $NVS1=1*76

Note: Commands are general purpose and references to channels above the unit channel count are to treated as examples.

5.1 RS232 Commands

Setting	Command	Response	Description
RS232 REAR PANEL BAUD RATE	$BAUDNV	$BAUDNV=<current Baud Rate>	Query Baud Rate on rear panel RS232. (Default = 115200). Front Panel is 115200 baud.
	$BAUDNV=38400		Assign Baud rate to Rear Panel RS232 port. Default is 115200. Available baudrates are 9600, 19200, 38400, 57600, 115200, 230400. Note: Front panel baud rate is set to 115200.
INPUT PRIORITY SELECT	$INP	$INP=<current INPUT priority>	Query or set the Input Priority Setting to A, B, or AUTO (A) or AUTO (B). 0 = Select Input A 1= Select Input B 2 = Auto Select (Prioritize Input A) (Default) 3 = Auto Select (Prioritize Input B)
	$INP=2		
CHANNEL FAULT THRESHOLD FACTOR	$FLTTHRA $FLTTHRB	$FLTTHR<n>=<current Channel Fault threshold factor (from 0.05 to 0.95)>	Query or set the ratio at which the Channel output monitors report a fault. For example, if the FLTTHRA is set to "0.15", the Channel Fault Word will report an error if the measured value is greater or less than ±15% of its target value, when sourced from Input A. Number format must be in the form <n.nn>
	$FLTTHRA=0.15		
INPUT LOW THRESHOLD VALUE (V)	$INPTHRA $INPTHRB	$INPTHR<n>=<current InputThreshold (from 0.05V to 1.00V)>	Query or set the absolute voltage at which the Input monitor reports a llow input fault. For example, if the THR is set to "0.3", the Channel Fault Byte will report an error if the measured Vpp is lower than 0.3V.
	$INPTHRA=0.20		

Setting	Command	Response	Description
SET INDIVIDUAL CHANNEL REFERENCE VOLTAGE	$SET<nn>=n.nn $SET01=1.00 $SET02=1.00 $SET03=1.00 . . . $SET15=1.00	$SET<nn>=nn.nn	Set or query the Reference Voltage for a perticular channel with respect to the active input. Use in combination with the Channel Fault Threshold Factor to define Alert on an individual Channel. Reference Voltages are set with respect to the active input, allowing for variation in amplitude between Input A and Input B. *Example: Set Channel 4 to Alert if it is beyond +/-20% of 0.90Vrms when relayed to Input A:* $INP=A<CR><LF> $SET04=0.90<CR><LF> $FLTTHRA=0.20<CR><LF> (To set all channel Reference values to their current average amplitude, use the Latch Average Channel Values command.)
LATCH AVERAGE CHANNEL VALUES	$LATCHAVG	$LATCHAVG=<currently Selected input>	Latches the current Channel Vrms measurement averages into memory as the average value to set the Channel Fault Threshold for each channel. Latches in all outputs with respect to the active input. Example: Response of "LATCHAVG=A" indicates input A is active, and the channel fault thresholds for Input A will now measure against the current output values. Use this command during setup, after cabling, to take a snapshot of the nominal system state.
NVS1 OUTPUT	$NVS1	$NVS1=<current RMC output frequency>	Query NVS1 String output Frequency. (Default = 1)
	$NVS1=1		Change NVS1 String output Frequency in seconds. (0-60)
NVS2 OUTPUT	$NVS2	$NVS2=<current RMC output frequency>	Query NVS2 String output Frequency. (Default = 1)
	$NVS2=1		Change NVS2 String output Frequency in seconds. (0-60)
NVS3 OUTPUT	$NVS3	$NVS3=<current RMC output frequency>	Query NVS3 String output Frequency. (Default = 1)
	$NVS3=1		Change NVS3 String output Frequency in seconds. (0-60)
REQUIRE CHECKSUM	$CSUM $CSUM=1	$CSUM=<current CSUM>	Query or set mandatory checksum on all incoming STATUS port communication. 1 = Enabled, 0 = Disabled. Default = 0.

Setting	Command	Response	Description
CAL FACTORS	$CAL<n>=nn.nn	$CAL<n>=nn.nn	Query or set Cal Factors for specific ADC conversions. See list of Cal Factors numbered for appropriate measurement parameters. These settings should only be changed by an authorized technician.
	$CAL1=11.10		
SAVE ALL CAL FACTORS TO FLASH MEMORY	$SAVECAL	$SAVED CAL. $SAVE CAL FAILED.	This command will translate all Calibration Factors to flash string and write. Data is then read back for verification, and result reported. This will update Cal Factors in flash to the current Cal Settings.
STATUS OUTPUT	$STAT<n>	<$GPNVS,1....>	Query NVS<n> String. Useful for status output on demand when user does not require regular string output.
	$STAT1		Outputs current $GPNVS,1 string on demand.
	$STAT2	<$GPNVS,2....>	Outputs current $GPNVS,2 string on demand.
	$STAT3	<$GPNVS,3....>	Outputs current $GPNVS,3 string on demand.
ACTIVATE FRONT PANEL STATUS STRINGS	$ACTFRP=1	$ACTFRP=n	Set Front Panel RS232 to automatically output $GPNVS strings. 1 = Enable, 0 = Disable (Default)
	$ACTFRP=0		
SAVE ALL VALUES TO FLASH MEMORY	$SAVEFLASH	$SAVED TO FLASH. $FLASH SAVE FAILED.	This command will translate all current variables to flash string and write. Data is then read back for verification, and result reported.
RESET ALL TO DEFAULT	$RESETALL	$RESET FLASH VARIABLES.	Resets all user settings to default values and overwrites flash memory with defaults.
INVALID INPUT		$?	Command not recognized.

5.2 Status String ($GPNVS,1) Channel Measurements

$GPNVS	1	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn
1	2	3	4	5	6	7	8	9

n.nn	n.nn	n.nn	*	XX
10	11	12		13

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	1
3.	Channel 1 Vrms	0.00 – 3.30 [V]
4.	Channel 2 Vrms	0.00 – 3.30 [V]
5.	Channel 3 Vrms	0.00 – 3.30 [V]
6.	Channel 4 Vrms	0.00 – 3.30 [V]
7.	Channel 5 Vrms	0.00 – 3.30 [V]
8.	Channel 6 Vrms	0.00 – 3.30 [V]
9.	Channel 7 Vrms	0.00 – 3.30 [V]
10.	Channel 8 Vrms	0.00 – 3.30 [V]
11.	Channel 9 Vrms	0.00 – 3.30 [V]
12.	Channel 10 Vrms	0.00 – 3.30 [V]
13.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,1,1.19,1.19,1.19,1.18,1.20,1.21,1.19,1.21,1.20,1.08 *40

5.3 Status String ($GPNVS,2) Power Supply Measurements

$GPNVS	2	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	nn	nn	±nnC	*	XX
1	2	3	4	5	6	7	8	9	10	11	12		13

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	2
3.	24V AC/DC Internal	0.00 to 36.0 [V]
4.	24V DC Input	0.00 to 36.0 [V]
5.	8V PS (-)	0.00 to 12.0 [V]
6.	8V PS (+)	0.00 to 12.0 [V]
7.	5V PS	0.00 to 12.0 [V]
8.	Input A Vrms	0.00 to 1.30 [V]
9.	Input B Vrms	0.00 to 1.30 [V]
10.	Potentiometer Value	1 to 63
11.	Fan PWM %	0 to 90
12.	Temperature	-40 to 120 [C]
13.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:

$GPNVS,2,25.3,0.09,8.19,7.89,4.99,0.86,0.00,45,00,+26C*30

This example string shows that DC power supply is not present, and input B is not present.

5.4 Status String ($GPNVS,3) Status Bytes

$GPNVS	3	0	A	0	0x0000	0x00	0x00	0x00	0	0x0000	0x0000	0x0000	*	XX
1	2	3	4	5	6	7	8	9	10	11	12	13		14

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	2
3.	Active PCB Assembly	0 or 1
4.	Active Input	A or B
5.	Input Error	0 = Ok, 1 = A Error, 2 = B error
6.	Channel Status Word	0x0000 to 0x7FFF
7.	Primary PS Status	0x00 to 0xFF
8.	Secondary PS Status	0x00 to 0xFF
9.	Active PCB Status	0x00 to 0xFF
10.	Checksum Status	00 to 999
11.	Channel Fault Bin	0x0000 to 0x7FFF
12.	Primary PCB Amp Status	0x0000 to 0x7FFF
13.	Backup PCB Amp Status	0x0000 to 0x7FFF
14.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,3,0,A,0,0x0000,0x40,0x40,0x00,00,0x0000,0x0000,0x0000*66

See Status Byte Table for details.

5.5 Status Byte Key

	Hex Value (OR'd)	Channel ID	Channel Status Word
Channel Status Byte	0x1<<0	Channel 1 Fault	General Channel Fault
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	Channel ID	Channel Fault Bin
Channel Fault Bin	0x1<<0	Channel 1 Fault	External Fault: The ND0100 has completed an internal amplifier gain test and both primary and backup assemblies are functional. The fault is external to the ND0100 (cabling, short, etc) Amp Gain Test for Alert is enabled with $AMP=1 command via RS232
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	Channel ID	Primary PCB Amp Status
Primary PCB Amp Status	0x1<<0	Channel 1 Fault	Internal Fault Primary Assembly: The channel has failed an internal gain test on the primary PCB assembly, and the channel is not functional on the primary board. Amp Gain Test for Alert is enabled with $AMP=1 command via RS232
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	Channel ID	Backup PCB Amp Status
Backup PCB Amp Status	0x1<<0	Channel 1 Fault	Internal Fault Backup Assembly: The channel has failed an internal gain test on the backup PCB assembly, and the channel is not functional on the secondary board. Amp Gain Test for Alert is enabled with $AMP=1 command via RS232
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	**Status Message**
Primary and Secondary Power Supply Status	0x1<<0	8V(-) PS out of range
	0x1<<1	Reserved
	0x1<<2	Reserved
	0x1<<3	8V(+) PS out of range
	0x1<<4	5V PS out of range
	0x1<<5	Communication Failure
	0x1<<6	DC Power not present
	0x1<<7	AC Power not present

	Hex Value (OR'd)	**Status Message**
Active Board Status	0x1<<0	Flash Read Boot Error (Deprecated)
	0x1<<1	Potentiometer Read/Set Fail
	0x1<<2	Reserved
	0x1<<3	Reserved
	0x1<<4	PCB Assembly Input A/B Select Fail
	0x1<<5	Reserved
	0x1<<6	Reserved
	0x1<<7	Reserved

5.6 Calibration Factors

Calibration ID	Description	Default Value
CAL00	24Vdc Input Adjust	11.30
CAL01	AC/DC 24V Adjust	11.10
CAL02	Input A Vrms Adjust	2.85
CAL03	Input B Vrms Adjust	2.72
CAL04	Reserved	0.00
CAL05	Reserved	0.00
CAL06	Channel 0-16 Output Vrms Adjust (Primary Board)	0.83
CAL07	Channel 0-16 Output Vrms Adjust (Secondary Board)	0.81
CAL08	Power Supply 8V(-) Vdc Adjust	10.30
CAL09	Power Supply 8V(+) Vdc Adjust	11.00
CAL10	Power Supply 5V(+) Vdc Adjust	2.00
CAL11	Diode Offset	2.88
CAL12	Reserved	0.00
CAL13	Reserved	0.00
CAL14	Reserved	0.00
CAL15	Reserved	0.00

6.0 Specifications

6.1 Technical Specifications

Linear amplifier bandwidth	20KHz to 15MHz ±2db, 1.5 Vrms max (option to DC available) Bandwidth limited for 10 MHz reference applications. Factory configurable
Impedance	50 Ohm
Channel status, system	channel status, system status - front panel display – serial port
Rear panel connectors	16 output, signal in and system status BNC
Harmonics	< -30db
Serial port	RS232
Phase noise	1 Hz -120 dBc/Hz
	10 Hz -135 dBc/Hz
	100 Hz -150 dBc/Hz
	1000Hz -150 dBc/Hz
AC input	90 to 250 Vac, 50/60Hz, IEC 320-C14
DC input	24V, 2A
Gain	0 dB +-1

6.2 Environmental and Mechanical

Operating temperature	0 to 50°C non-condensing
Storage temperature	-40 to 70°C
Height	1RU (~1.73”)
Width	19.0”
Depth	12.0”
Weight	5.5 lbs.
AC input	90 to 250 Vac, 50/60Hz, less than 10 Watts

7.0 LIMITED HARDWARE WARRANTY

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User Manual **$GPNVS**

Appendix C: $GPNVS Status String Definitions

Contents

1.0 The $GPNVS Serial Status String

Novus products provide, in many cases, serial data output from a standard GNSS receiver matching the NMEA 0183 protocol. This is usually a direct connection to the receiver.

In addition to NMEA, Novus Products which provide an additional RS232 serial port for status monitoring, will be set up to meet the following protocols. These are designed to be standardized across different products, and easy to port and use via serial-to-ethernet connections.

Many products will have some, but not all, of the following strings, if configured for the optional status RS232.

The following products comply with this document:

1. ND0115
2. NR2310-OG
3. NR2315
4. NR2110-O
5. NR2110-OG (Separate Status Port)
6. NR2110-OG (Combined NMEA/Status Port)
7. NR6720
8. NR2304

Note: The NR2110-OG with combined NMEA and Status Port complies with section 2.0 "Combined NMEA/Status RS232"

1.1 Status String ($GPNVS,1) Fault Bytes

$GPNVS	1	hhmmss	mmddyy	A	A	nn	nn	0x0000	0x00	0x00	n	n	*	XX
1	2	3	4	5	6	7	8	9	10	11	12	13		14

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	1
3.	Time (UTC)	hhmmss
4.	Date	mmddyy
5.	GPS 1 Lock (Valid)	"A" = Valid, "V" = Not Valid, "N" = N/A
6.	GPS 2 Lock (Valid)	"A" = Valid, "V" = Not Valid, "N" = N/A
7.	# of Sats in View (1)	Greater of GPS or GNSS count, "N" = N/A
8.	# of Sats in View (2)	Greater of GPS or GNSS count, "N" = N/A
9.	Channel Fault Byte	0x0000 to 0xFFFF (Hex OR'd value)
10.	Power Supply Fault Byte	0x00 to 0xFF (Hex OR'd value)
11.	Error Message Byte	0x00 to 0xFF (Hex OR'd value)
12.	Antenna 1	"0" = Ok, "1" = Error, "N" = N/A
13.	Antenna 2	"0" = Ok, "1" = Error, "N" = N/A
14.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,1,233518,092516,A,A,10,11,0x0000,0x00,0x00,0,0*23

1.2 Status String ($GPNVS,2) Channel Values 1-8

$GPNVS	2	hhmmss	ddmmyy	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	*	XX
1	2	3	4	5	6	7	8	9	10	11	12		13

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	2
3.	Time (UTC)	hhmmss
4.	Date	mmddyy
5.	Channel 1 Vrms	0.00 to 3.30 [V]
6.	Channel 2 Vrms	0.00 to 3.30 [V]
7.	Channel 3 Vrms	0.00 to 3.30 [V]
8.	Channel 4 Vrms	0.00 to 3.30 [V]
9.	Channel 5 Vrms	0.00 to 3.30 [V]
10.	Channel 6 Vrms	0.00 to 3.30 [V]
11.	Channel 7 Vrms	0.00 to 3.30 [V]
12.	Channel 8 Vrms	0.00 to 3.30 [V]
13.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,2,233518,092516,2.56,2.48,2.51,2.60,2.44,2.53, 2.51,2.60*6C

Note: For units with fewer than the number of channels listed, a null value will be present.

1.3 Status String ($GPNVS,3) Power Supply Values

$GPNVS	3	hhmmss	ddmmyy	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n	nn	*	XX
1	2	3	4	5	6	7	8	9	10	11	12	13	14		15

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	3
3.	Time (UTC)	hhmmss
4.	Date	mmddyy
5.	Power Supply 1	-30.0 to 30.0 [V]
6.	Power Supply 2	-30.0 to 30.0 [V]
7.	Power Supply 3	-30.0 to 30.0 [V]
8.	Power Supply 4	-30.0 to 30.0 [V]
9.	Power Supply 5	-30.0 to 30.0 [V]
10.	Power Supply 6	-30.0 to 30.0 [V]
11.	Power Supply 7	-30.0 to 30.0 [V]
12.	Power Supply 8	-30.0 to 30.0 [V]
13.	Built in Test (BIT)	0 = Ok, 1 = Fail
14.	Temperature (C)	-40 to 99
15.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,3,233518,092516,-7.84,7.93,-11.8,12.1,0.00,0.00,0.00,1.92,0,
26*62

Note: Depending on configuration, Power Supply values will be defined differently, and some Power Supply values may not be present.

1.4 Status String ($GPNVS,4) Channel Values 9-16

$GPNVS	4	hhmmss	ddmmyy	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	*	XX
1	2	3	4	5	6	7	8	9	10	11	12		13

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	4
3.	Time (UTC)	hhmmss
4.	Date	mmddyy
5.	Channel 9 Vrms	0.00 to 3.30 [V]
6.	Channel 10 Vrms	0.00 to 3.30 [V]
7.	Channel 11 Vrms	0.00 to 3.30 [V]
8.	Channel 12 Vrms	0.00 to 3.30 [V]
9.	Channel 13 Vrms	0.00 to 3.30 [V]
10.	Channel 14 Vrms	0.00 to 3.30 [V]
11.	Channel 15 Vrms	0.00 to 3.30 [V]
12.	Channel 16 Vrms	0.00 to 3.30 [V]
13.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,4,233518,092516,2.56,2.48,2.51,2.60,2.44,2.53,2.51,2.60*6A

Note: For units with fewer than the number of channels listed, a null value will be present.

1.5 Status String ($GPNVS,5) Sensors

$GPNVS	5	hhmmss	ddmmyy	nnn	nn	±nn	*	XX
1	2	3	4	5	6	7		8

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	5
3.	Time (UTC)	hhmmss
4.	Date	mmddyy
5.	Potentiometer	Hex Value 000 to FFF
6.	Fan PWM %	0 to 90
7.	Temperature	-40 to 99 [C]
8.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,5,233518,092516,45,00,25*70

1.6 Status String ($GPNVS,6) Status Bytes

There are two different Status Strings; one for everything except the NR2304 and one for the NR2304.

1.6.1 Status String ($GPNVS,6) Status Bytes; Standard

$GPNVS	6	0	A	0	0x0000	0x00	0x00	0x00	0	0x0000	0x0000	0x0000	*	XX
1	2	3	4	5	6	7	8	9	10	11	12	13		14

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	6
3.	Active PCB Assembly	0 or 1
4.	GNSS Lock	A = Locked, V = Unlocked
5.	Input Error	0 = Ok, 1 = A Error, 2 = B error
6.	Channel Status Word	0x0000 to 0xFFFF
7.	Primary PS Status	0x00 to 0xFF
8.	Secondary PS Status	0x00 to 0xFF
9.	Active PCB Status	0x00 to 0xFF
10.	Checksum Status	00 to 999
11.	Channel Fault Bin	0x0000 to 0xFFFF
12.	Primary PCB Amp Status	0x0000 to 0xFFFF
13.	Backup PCB Amp Status	0x0000 to 0xFFFF
14.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,6,0,A,0,0x0000,0x40,0x40,0x00,00,0x0000,0x0000,0x0000*63

See Status Byte Table for details.

1.6.2 Status String ($GPNVS,6) Status Bytes; Rubidium

$GPNVS	6	nnn	0x0000	nnn	0/1	*	XX
1	2	3	4	5	6		7

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	6
3.	Heat Sink Temperature	0-255
4.	Heater Current Voltage	0x0000-0x0136
5.	Measured Voltage in Heater	0-255
6.	Rb Locked	0 = Unlocked 1= Locked
7.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,9,136,0x002A,90,1*7E

1.7 Status String ($GPNVS,7) Status Bytes

$GPNVS	7	nnnnnn	nnnnnn	A	nn	0x00	0	0	0	nnnnnn	n.nn	n.nn	*	XX
1	2	3	4	5	6	7	8	9	10	11	12	13		14

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	7
3.	Time	hhmmss
4.	Date	mmddyy
5.	GPS Lock	“A” = Valid, “V” = Not Valid
6.	# of Sats in View (1)	Greater of GPS or GNSS count, “N” = N/A
7.	Error Byte	0x00 to 0xFF
8.	Freq Diff	±999 (last count, clock cycles)
9.	PPS Diff	±999 (last count, clock cycles)
10.	Freq Correction Slice	±999 (DAC bits, per second)
11.	DAC Value	Integer Representation, n x 1/(2^20)
12.	Power Supply	Vdc
13.	Power Supply	Vdc
14.	NMEA Checksum	*XX (xor’d value of bytes between $ and *)

Example:
$GPNVS,7,161505,081617,A,12,0x00,-1,-2,0,505610,+5.05,-4.66*58

1.8 Event String ($GPNVS,8) Event Status

$GPNVS	8	0	0	0	0	0	0	0	nnnnnn	0	*	XX
1	2	3	4	5	6	7	8	9	10	11		12

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	8
3.	Discipline Counter	0 = Off, 1 = Disciplined to Synthetic PPS
4.	User Enabled	0 = Off, 1 = On
5.	Event Enabled (System)	0 = Events Disabled, 1 = Events Enabled
6.	GPS Lock Achieved	0 = No Lock, 2 = Locked or previously locked
7.	Event Index	0-512, Current count of events in RAM
8.	Event Errors (RAM)	0
9.	Event Index	0-512, Current count of events in Flash
10.	Event Errors (Flash)	0
11.	Event Time Alignmet	2 = LS applied, 1 = GPS, 0 = RTC
12.	Estimated Accuracy	0-999999 [ns]
13.	Edge Detect Direction	0 = Falling Edge, 1 = Rising Edge
14.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,8,1,1,1,2,0,0,2,000005,0*60

1.9 Status String ($GPNVS,9) Frequency Measurement

The frequency measurement string has two versions, one standard version, and one for the NR6720.

1.9.1 Standard Frequency Measurement String

$GPNVS	9	hhmmss	ddmmyy	(n)nnnnnnn.nnn	nnn	(-)nn	*	XX
1	2	3	4	5	6	7		8

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	9
3.	Time (UTC)	hhmmss
4.	Date	mmddyy
5.	Measured Frequency	9999900.000 to 10000100.000
6.	Frequency Alert Range	0 – 240 (units of 0.0083 Hz)
7.	Temperature	-40 to 99 [C]
8.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,9,233518,092516,10000000.003,240,25*70

1.9.2 NR6720-HS Frequency Measurement String

$GPNVS	9	nnnnnnn.nnn	n.nnnnn	nnnnnnnn.nn	0	±n.nn	±n.nn	*	XX
1	2	3	4	5	6	7	8		9

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	9
3.	Frequency (Loop Period)	10000000.000
4.	DAC Voltage (Double)	2.00000
5.	Frequency (per second)	10000000.0
6.	Loop Period	0-99
7.	Antenna Current Mon	0.00 to 3.30V
8.	Sine Output RMS	0.00 to 3.30V
9.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,9,+10000000.003,+1.97493,+10000000.0,15,+1.03,+1.30*4A

1.10 PPS Alignment String ($GPNVS,10) PPS Status

$GPNVS	10	0	0	0	±n	±n	n	n	n.n	n	n	n	0	±n	n.n	n	*	XX
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	10
3.	PPS Stability Enabled	0 = Off, 1 = On
4.	PPS Disciplining to GPS	0 = Off, 1 = Actively Synchronized
5.	PPS Output Type	0 = Synthetic PPS, 1 = GPS PPS
6.	PPS Difference	±250 [ns]
7.	PPS Avg Difference	±250 [ns]
8.	PPS Avg Count	1-20
9.	PPS Synch Threshold	1-250
10.	PPS pull Cal Factor	0.1 to 10.0
11.	PPS active Time Cal Factor	0 to 9
12.	Frequency Variance	0-9999 (clock cycles per Loop period)
13.	Frequency Var Threshold	0-100 (clock cycles per Loop period)
14.	PPS Stabile Mode Post-Warm up	0 = Off, 1 = On
15.	PPS Slope Indicator	±250 (clock cycles per second)
16.	PPS Slope Cal Factor	0.1 to 10.0
17.	PPS Slope Distance	14 to 60 (seconds)
18.	NMEA Checksum	*XX (xor’d value of bytes between $ and *)

Example:
$GPNVS,10,1,0,0,+0,+0,2,100,0.5,3,2,10,1,0,1.0*46

1.12 PPS Alignment String ($GPNVS,9) PPS Status

$GPNVS	9	nnn	0x0000	nnn	0/1	*	XX
1	2	3	4	5	6		7

#	Description	Range
8.	Identifier	$GPNVS
9.	String ID	9
10.	Heat Sink Temperature	0-255
11.	Heater Current Voltage	0x0000-0x0136
12.	Measured Voltage in Heater	0-255
13.	Rb Locked	0 = Unlocked 1= Locked
14.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,9,136,0x002A,90,1*7E

1.11 Response String ($GPNVS,R)

$GPNVS	R	n	<response>	*	XX
1	2	3	4		5

#	Description	Range
1.	Identifier	$GPNVS
2.	Response ID	R
3.	Command Success	1 = Success, 0 = Fail
4.	Response	<see example responses>
5.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,R,SET01=1.00*6F

1.12 Discipline Selection String ($GPNVS,13)

$GPNVS,	13,	n,	n,	n,	n,	n,	,	,	*	XX
1	2	3	4	5	6	7	8	9		10

#	Description	Range
1.	Identifier	$GPNVS
2.	String ID	13
3.	Priority Discipline Source	0 = GNSS, 1 = 10MHz input, 2 = Optical input
4.	Current Discipline Source	0 = GNSS, 1 = 10MHz, 2 = Optical, 3 = Holdover
5.	GNSS Lock	0 to 3, 0 = Unlocked, 3 = Fully Locked
6.	RF Present	0 = No RF source, 1 = RF Source found
7.	Opto Present	0 = No Optical source, 1 = Optical Source Found
8.	Loop Lock	1 = Lock, 0 = Loop acquiring lock
9.	Reserved	
10.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,13,0,0,3,0,0,1,*5C

2.0 Combined NMEA/Status RS232

NR2110-OG Combined NMEA?Status Port

2.1 Status String ($GPNVS,1) Fault Bytes

$GPNVS	1	hhmmss	mmddyy	A	nn	0x00	0x00	0x00	*	XX
1	2	3	4	5	6	7	8	9		10

# Description	Range
15. Identifier	$GPNVS
16. String ID	1
17. Time (UTC)	hhmmss
18. Date	mmddyy
19. GPS Lock (Valid)	"A" = Valid, "V" = Not Valid
20. # of Sats in View	Greater of GPS or GNSS count
21. Channel Fault Byte	0x00 to 0x3F (Hex OR'd value)
22. Power Supply Fault Byte	0x00 to 0x1F (Hex OR'd value)
23. Error Message Byte	0x00 to 0x0F (Hex OR'd value)
24. NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,1,233518,092516,A,10,0x00,0x00,0x00*62
Time: 23:35:18; Sep. 25, 2016, GPS locked; 10 Satellites in view; No channel faults; No power supply faults; No error messages.

2.2 Status String ($GPNVS,2) Channel Values

$GPNVS	1	hhmmss	mmddyy	n.nn	n.nn	n.nn	n.nn	n.nn	n.nn	*	XX
1	2	3	4	5	6	7	8	9	10		11

#	Description	Range
14.	Identifier	$GPNVS
15.	String ID	2
16.	Time (UTC)	hhmmss
17.	Date	mmddyy
18.	Channel 1 Vrms	0.00 to 6.60 [V]
19.	Channel 2 Vrms	0.00 to 6.60 [V]
20.	Channel 3 Vrms	0.00 to 6.60 [V]
21.	Channel 4 Vrms	0.00 to 6.60 [V]
22.	Channel 5 Vrms	0.00 to 6.60 [V]
23.	Channel 6 Vrms	0.00 to 6.60 [V]
24.	NMEA Checksum	*XX (xor’d value of bytes between $ and *)

Example:
$GPNVS,2,233518,092516,0.99,1.01,1.06,0.97,1.52,1.54*4E

2.3 Status String ($GPNVS,3) Power Supply Values

$GPNVS	3	hhmmss	mmddyy	n.nn	n.nn	n.nn	n.nn	n.nn	*	XX
1	2	3	4	5	6	7	8	9		10

#	**Description**	**Range**
15.	Identifier	$GPNVS
16.	String ID	2
17.	Time (UTC)	hhmmss
18.	Date	mmddyy
19.	-5Vdc Power Supply(opt)	-30.0 to 30.0 [V]
20.	+5Vdc Power Supply	-30.0 to 30.0 [V]
21.	10kΩ Thermistor(opt)	0.00 to 3.30 [V]
22.	+5Vdc Power Supply(opt)	-30.0 to 30.0 [V]
23.	OCXO Control Voltage	0.00 to 3.30 [V]
24.	NMEA Checksum	*XX (xor'd value of bytes between $ and *)

Example:
$GPNVS,3,233518,092516,-4.84,4.93,1.45,4.90,2.12*42

3.0 Status Byte Key

	Hex Value (OR'd)	Channel ID	Channel Status Word
Channel Status Byte	0x1<<0	Channel 1 Fault	General Channel Fault
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	Channel ID	Channel Fault Bin
Channel Fault Bin	0x1<<0	Channel 1 Fault	External Fault: The ND0100 has completed an internal amplifier gain test and both primary and backup assemblies are functional. The fault is external to the ND0100 (cabling, short, etc) Amp Gain Test for Alert is enabled with $AMP=1 command via RS232
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	Channel ID	Primary PCB Amp Status
Primary PCB Amp Status	0x1<<0	Channel 1 Fault	Internal Fault Primary Assembly: The channel has failed an internal gain test on the primary PCB assembly, and the channel is not functional on the primary board. Amp Gain Test for Alert is enabled with $AMP=1 command via RS232
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	Channel ID	Backup PCB Amp Status
Backup PCB Amp Status	0x1<<0	Channel 1 Fault	Internal Fault Backup Assembly: The channel has failed an internal gain test on the backup PCB assembly, and the channel is not functional on the secondary board. Amp Gain Test for Alert is enabled with $AMP=1 command via RS232
	0x1<<1	Channel 2 Fault	
	0x1<<2	Channel 3 Fault	
	0x1<<3	Channel 4 Fault	
	0x1<<4	Channel 5 Fault	
	0x1<<5	Channel 6 Fault	
	0x1<<6	Channel 7 Fault	
	0x1<<7	Channel 8 Fault	
	0x1<<8	Channel 9 Fault	
	0x1<<9	Channel 10 Fault	
	0x1<<10	Channel 11 Fault	
	0x1<<11	Channel 12 Fault	
	0x1<<12	Channel 13 Fault	
	0x1<<13	Channel 14 Fault	
	0x1<<14	Channel 15 Fault	

	Hex Value (OR'd)	Status Message
Active Board Status	0x1<<0	Flash Read Boot Error (Deprecated)
	0x1<<1	Potentiometer Read/Set Fail
	0x1<<2	Reserved
	0x1<<3	Reserved
	0x1<<4	PCB Assembly Input A/B Select Fail
	0x1<<5	Reserved
	0x1<<6	Reserved
	0x1<<7	Reserved

	Hex Value (OR'd)	Status Message
Primary and Secondary Power Supply Status	0x1<<0	PS 1 Fault
	0x1<<1	PS 2 Fault
	0x1<<2	PS 3 Fault
	0x1<<3	PS 4 Fault
	0x1<<4	PS 5 Fault
	0x1<<5	PS 6 Fault
	0x1<<6	PS 7 Fault
	0x1<<7	PS 8 Fault

	Hex Value (OR'd)	Status Message
Error Status	0x1<<0	FLASH_NOT_FOUND
	0x1<<1	FLASH_NOT_SAVED
	0x1<<2	LOOP_VOLT_ERROR
	0x1<<3	ANTENNA_VOLT_ERROR
	0x1<<4	GPS_FAILURE
	0x1<<5	POTENTIOMETER_ERROR
	0x1<<6	RAM_MEMORY_ERROR
	0x1<<7	Reserved