



**SPECTRADYNAMICS, INC.**



**LOW NOISE FREQUENCY SYNTHESIZER  
LNFS-400  
OPERATING MANUAL**

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## Description



The LNFS-400 is a versatile low noise synthesizer with an output frequency range of 1 MHz to 400 MHz. The synthesizer has a low-noise internal time base that can be phase-locked to an external 10 MHz signal for long-term stability. The synthesizer can be used as a frequency source for instrumentation, microwave synthesis, phase noise characterization, radar and telecommunication clock systems.

The synthesizer has 32-bit frequency resolution with 14-bit phase resolution. One sine wave output is provided on the front panel. All instrument functions and settings are displayed and controlled via the front panel LCD touch screen. Remote control of the instrument is possible through RS-232 communications.

The LNFS-400 has FSK, and PSK modulation capabilities. The LNFS-400 comes in a stand-alone 2U rack mount enclosure.

# Safety and Preparation for Use



## **CAUTION!**

Voltages capable of causing injury or death are present in this instrument. Use extreme caution whenever the instrument cover is removed.

## **Line Voltage**

This instrument can be setup to operate on 110-120 or 220-240 VAC and a line frequency of 50 to 60 Hz. **The setup voltage for this LNFS-400 is specified on page 6.** For conversion to a different line voltage please contact SDI.

## **Fuse**

A 2.0 Ampere 250V slow-blow fuse is used for 100-120 VAC operation.  
A 1.0 Ampere 250V slow-blow fuse is used for 220-240 VAC operation.  
Only replace fuses with the same type and specifications.

## **Line Cord**

The LNFS-400 has a detachable, three wire power cord for connection to a grounded power source. The enclosure of the unit is directly connected to the outlet ground to protect against electrical shock. Always use an outlet with a protective ground and do not disable this safety mechanism.

## **Service**

Do not attempt to service or adjust the instrument unless another person, capable of providing first aid or resuscitation, is present.

## **Operation**

To operate the unit, locate the AC power entry connector on the rear panel and connect the power cable. When power is applied to the unit, a green LED located on the front panel, labeled "ON", should light up.

## **Important!!!**

The LNFS-400 is a frequency synthesizer and may be locked to an external reference for higher stability. The external reference provided should be at 10 MHz +/- 0.1 Hz with a level of +10 to +15 dBm. On startup the external reference tuning is disabled by default. To use the external reference, the external PLL must be activated using the PLL Screen.

## The Front Panel



**ON** The LED is on when power is applied to unit and the unit is operating properly.

**DATA** The LED is on when data is being sent or received via the RS-232 port.

**STATUS** The LED is on when an error has occurred. View the instrument status via the PLL Screen. The LED will turn off once the error condition is corrected or no longer present and the PLL status has been checked. If the LNFS-400 is under RS-232 control use the \*SRE to determine the error condition and the \*CLS command to clear the status register and turn off the STATUS LED.

**RS-232** DB-9 connector for serial communications. This is a dumb terminal RS-232 port. A null modem adapter is not required.

**DISPLAY** The LCD display and touch screen is used to control the LNFS-400 in local control mode.

### REFERENCE INPUTS

**Ext Ref** SMA input for the external 10 MHz reference. This input port has an impedance of 50 ohms. The external reference provided should be at 10 MHz +/- 0.1 Hz with a level of +10 to +15 dBm.

**Signal LED** The 10 MHz signal LED will turn on when the PLL is enabled for locking to an External Reference and a 10 MHz reference signal is present.

**PLL LED** The PLL lock LED will turn on when the LNFS-400 is phase locked to an external reference.

**Trig In** Not Used

**Aux 1** SMA input for an external modulation input. This input port has an impedance of 1 k $\Omega$ . The modulation signal should conform to TTL specifications and must not exceed +5.5 VDC. The voltage at this input must never be negative or the synthesizer will be damaged and warranty voided.

## The Front Panel



### OUTPUTS

**Out 1** SMA output providing the sine-wave output signal of the synthesizer. This output signal has a maximum level of +15 dBm.

## The Back Panel



### AC POWER ENTRY MODULE

The LNFS-400 is configured to operate on:

100-120 VAC

220-240 VAC





## RS-232 Communication Port

The LNFS-400 functions are accessed through the RS-232 port located on the front panel. A standard serial cable with a DB-9 connector can be used to interface to the LNFS-400. The user can input commands using a simple dumb terminal program on a remote computer or more sophisticated control can be used with software such as Labview.

On the front panel above the RS-232 connector there are three LEDs. The power LED labeled ON should be lit when power is applied. The second LED labeled DATA will light up only when data is being received or sent on the RS-232 port. This LED can be used to verify that the unit is communicating. The third LED is labeled status and is a hardware representation of the internal status flag. The status LED is on whenever an error has occurred. The user must query the unit to determine the source of error and then clear the error flag. When the error flag is cleared the LED will turn off.

## Port Settings

On power-up the RS-232 port settings are:  
Baud rate 9600 8 Bits 1 Stop Bit No Parity.

Hardware handshaking is not used. The DB-9 connector pin-out is described below.

<u>Pin</u>	<u>Function</u>
1	NC
2	Data out
3	Data in
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC



## Mechanical Tuning

Mechanical frequency tuning is available to adjust the frequency of the internal LNFS-400 oscillator. **Only fully qualified service personnel should perform this procedure.** Frequency adjustments should be made with the unit having been powered on for at least 2 hours. **Caution must be taken to avoid shorting or accidentally touching a line voltage point.**

1. To adjust the frequency of the oscillator, remove the top cover of the LNFS-400. The oscillator module is located at the right side of the instrument. The tuning access for the 10 MHz oscillator is on the top side of the oscillator enclosure. A hermetic cover screw must be removed with a screwdriver to gain access to the tuning screw. A small flat blade tuning tool is needed to make the adjustment.
2. Connect the external 10 MHz reference to the input labeled Ext Ref. Make sure that the reference signal level is between +10 dBm and +15 dBm. Program the LNFS-400 to lock to the external frequency reference.
3. Enter the PLL screen to view the RF power levels and control voltages. The internal oscillator power level should be  $12 \pm 2$  dBm. The reference signal power level should be between 10 dBm and 15 dBm. If the LNFS-400 is phase locked to the external reference the LOCK voltage will be greater than 0.2 V. Adjust the mechanical tuning screw of the oscillator to achieve a lock condition. Continue adjusting the mechanical tuning screw until the PLL voltage displayed is at 0 volts. At this point the internal lock indicator LED should be on, the LOCK voltage should be greater than 0.2 V and the PLL voltage should be at  $0.0 \pm 0.2$  V.
4. Replace the hermetic cover when done adjusting the frequency of the oscillator. Replace the top cover of the LNFS-400.

**Note: The LNFS-400 should be turned on for 2 hours prior to any mechanical frequency adjustment.**

# Specifications



PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Phase Resolution		-	0.022	-	degrees
Phase offset range		-	+/- 360	-	degrees
Amplitude Resolution		-	1.0	-	dB
Frequency Resolution		-	0.233	-	Hz
Frequency Tuning Range		-	1E6 – 400 E6	-	Hz
Mech. Tuning Range		-	+/-1 E-6	-	-
Int. Oscillator Aging	After 30 days of operation	-	1 E-6	-	Per year
Max Sine Output Level	50 Ohm Load, Accuracy +/-2dB	+14	+15	+16	dBm
Output Isolation		-	60	-	dB
Phase Noise $\mathcal{L}(f)$	10 Hz	-	-130	-125	dBc/Hz
10 MHz Output, +13dBm	100 Hz	-	-135	-130	
	1 kHz	-	-135	-130	
	>10 kHz	-	-145	-140	
Allan Deviation $\sigma_y(\tau)$	f = 5E6				
Locked to ext reference	1 s	-	2.0 E-12	4.0 E-12	
	10 s	-	3.0 E-13	4.0 E-13	
	100 s	-	3.0 E-14	5.0E-14	
Allan Deviation $\sigma_y(\tau)$	f = 10E6				
Locked to ext reference	1 s	-	2.0 E-12	3.0 E-13	
	10 s	-	3.0 E-13	4.0 E-13	
	100 s	-	3.0 E-14	5.0E-14	
Spurious	+13 dBm Output Level	-65	-50	-45	dBc
Harmonics	+13 dBm Output Level	-60	-40	-30	dBc

External Reference      10.0 MHz  $\pm$  2.0 E-8      +10 dBm to +15 dBm  
 DC Tuning Voltage      +/- 5VDC  
 External Trigger      400ns min. pulse width      TTL Compatible Levels  
 AC Power      110–120/ 220–240VAC      see page 6.

Rack-mount Enclosure  
 Size: 3.5" X 19" X 17"  
 Weight: 29 lbs

## Main Screen



**Main Screen** The main screen displays the current frequency and phase and amplitude of the LNFS-400. The soft keys at the bottom of the screen display the five main functions that are available.

### DISPLAYS

**Frequency** The frequency is displayed in units of Hertz (Hz).

**Phase** The phase is displayed in units of degrees (deg).

**Amplitude** The amplitude is displayed in units of dBm, Vrms or Vpp.

### MENU

**FREQ** Change frequency command. The FREQ key will bring up the Frequency Screen.

**PHASE** Change phase command. The PHASE key will bring up the Phase Screen.

**AMPL** Change amplitude command. The AMPL key will bring up the Amplitude Screen.

**SET** Change instrument settings. The SET key will bring up the Settings Screen.

**SYNTH1** Selects synthesizer module one. On instruments with additional synthesizer modules this button will change the active synthesizer module.

# Number Entry Screen



**Number Screen** The number entry screen is used to make numeric entries.

## DISPLAYS

The current setting will be displayed across the top of the screen. The new entry is displayed in a number entry box.

## SPECIAL KEYS

<b>Hz</b>	Enter number in Hertz.
<b>kHz</b>	Enter number in kiloHertz.
<b>MHz</b>	Enter number in MegaHertz.
<b>deg</b>	Enter number in degrees.
<b>dBm</b>	Enter number in dBm.
<b>Vrms</b>	Enter number in Volts RMS.
<b>Vpp</b>	Enter number in Volts peak-to-peak.
<b>BK</b>	Backspace.
<b>ENTER</b>	Enter new number and exit number menu.
<b>ESC</b>	Exit number menu discarding changes.
<b>0-9</b>	Numbers zero through nine.
<b>.</b>	Decimal point.
<b>-</b>	Negative sign.

# Frequency Screen



**Frequency Screen** The frequency screen displays the frequency of the selected synthesizer module in the LNFS-400. Use the Main Screen to change the selected synthesizer module.

## DISPLAYS

**Frequency** The frequency is displayed in units of Hertz.

## MENU

**SET** Enter new frequency. The SET key will bring up the Number Screen. The maximum frequency is 400 MHz. The frequency resolution is 0.233 Hz.

**STEP** Enter a frequency step size. The STEP key will bring up the Number Screen. The maximum step size is 400 MHz. Frequency step resolution is 0.233 Hz.

**UP** Increase the frequency by the frequency step size.

**DOWN** Decrease the frequency by the frequency step size.

**EXIT** Exit to previous screen.

## Phase Screen



**Phase Screen** The phase screen displays the phase of the selected synthesizer module in the LNFS-400. Use the Main Screen to change the selected synthesizer module.

### DISPLAYS

**Phase** The phase is displayed in units of degrees.

### MENU

**SET** Enter the new phase. The SET key will bring up the Number Screen. The phase entered cannot exceed +/- 360 degrees. The phase change is instantaneous. The phase resolution is 0.022 degrees.

**STEP** Enter a phase step size. The STEP key will bring up the Number Screen. The phase step size cannot exceed 360 degrees. The phase step resolution is 0.022 degrees.

**UP** Increase the phase by the phase step size.

**DOWN** Decrease the phase by the phase step size.

**EXIT** Exit to previous screen.

# Amplitude Screen



**Amplitude Screen** The amplitude screen displays the amplitude of the selected synthesizer module in the LNFS-400. Use the Main Screen to change the selected synthesizer module.

## DISPLAYS

**Amplitude** The amplitude is displayed in units of dBm, Vrms or Vpp.

## MENU

**SET** Enter the new amplitude. The SET key will bring up the Number Screen. The amplitude entered cannot exceed +15 dBm, 1.45 Vrms, or 4.0 Vpp. The amplitude units are selected when entering the desired value.

**STEP** Enter an amplitude step size. The STEP key will bring up the Number Screen. The amplitude step size cannot exceed 25 dB, 1.45 Vrms or 4.0 Vpp. The amplitude resolution is 1 dBm, 0.05 Vrms and 0.1 Vpp.

**UP** Increase the amplitude by the amplitude step size.

**DOWN** Decrease the amplitude by the amplitude step size.

**EXIT** Exit to previous screen.



# Settings Screen



**Settings Screen** The settings screen is used to access, view and edit instrument options.

## MENU

- MOD** Setup Modulation options.
- FM** Setup Frequency Modulation.
- PM** Setup Phase Modulation.
- INST** Instrument setup and information. The INST key will bring up the Instrument Screen.
- EXIT** Exit to previous screen.

# Frequency Modulation Screen



**FM Screen**      The frequency modulation screen is used to select frequency modulation options.

## **MENU**

**FSK**            Select Frequency Shift Keying.

**EXIT**            Exit to previous menu.

# Phase Modulation Screen



**PM Screen**      The phase modulation screen is used to access, view and edit phase shift keying modulation options.

## DISPLAYS

**Phase 1**      First output phase setting in degrees.

**Phase 2**      Second output phase setting in degrees.

## MENU

**PHAS1**      Enter or edit phase 1 setting.

**PHAS2**      Enter or edit phase 2 setting.

**UP/DOWN**    Toggle between phase 1 and phase 2.

**EXIT**      Exit to previous menu.

### **Uses Hardware Trigger Input.**

Phase shift between phase 1 and phase 2 of the synthesizer occurs on each rising edge of a TTL level signal on the external trigger input. **The modulation will be on as long as there is an external trigger signal.**

# Frequency Shift Keying Screen



**FSK Screen**      The frequency shift keying screen is used to access, view and edit frequency shift keying modulation options.

## DISPLAYS

**F1**              First output frequency setting in Hz.

**F2**              Second output frequency setting in Hz.

## MENU

**F1**              Enter or edit frequency 1 setting.

**F2**              Enter or edit frequency 2 setting.

**UP/DOWN**      Toggle between frequency 1 and frequency 2.

**EXIT**            Exit to previous menu.

### **Uses Hardware Trigger Input.**

Frequency shift between frequency 1 and frequency 2 of the synthesizer occurs on each rising edge of a TTL level signal on the external trigger input. **The modulation will be on as long as there is an external trigger signal.**



**Instrument Screen** The instrument screen is used to view or instrument configuration settings.

## MENU

**COMM** Set serial communications options and RS-232 remote control configuration.

**DISP** Change the brightness of the LCD display.

**UP** Increase the value.

**DOWN** Decrease the value.

**EXIT** Exit to previous screen.

**TIME** Set the instrument date and time.

**PLL** Set external reference or DC tuning options and view phase-lock-loop control voltages and levels. The PLL key brings up the PLL screen.

**EXIT** Exit to previous screen.

## Communications Screen



**Communications Screen** The communications screen displays the current RS-232 serial port settings. The soft keys at the bottom of the screen are used to set new RS-232 settings, initiate RS-232 control of the instrument or test the serial port connection. The RS-232 port is setup to be controlled by a dumb terminal. A null modem adapter is not needed and should not be used. Hardware handshaking is not used. For additional pin-out information please refer to the RS232 port section on page 7 of this manual.

### DISPLAYS

Current baud rate setting.

### MENU

- |              |  |
|--------------|--|
| <b>REM</b>   | Enter remote RS-232 control mode.  |
| <b>BAUD</b>  | Toggle through available baud rates.<br><b>9600</b> , 19200, 38400, 57600, 115200, 14400, 28800  |
| <b>LOCAL</b> | Return to local control and terminate remote RS-232 control session.<br><b>(This button appears only in remote RS-232 control mode).</b> |
| <b>EXIT</b>  | Exit to previous screen.   |



**PLL Screen** The PLL screen is used to view the current PLL voltages and RF power levels. Use this function to clear the status register and turn off the status LED. The status LED will turn off only if the error condition has been resolved.

## DISPLAYS

- OSC** The power level of the internal oscillator. This level should be  $+12\text{dBm} \pm 1 \text{ dB}$ .
- REF** The power level of the external reference. This level should be between  $+10 \text{ dBm}$  and  $+15 \text{ dBm}$  for proper operation. This value will display only in external reference mode.
- LOCK** The lock indicator voltage. A voltage greater than  $0.2 \text{ V}$  indicates that the LNFS-400 is phase locked to the external reference. This value will display only in external reference mode.
- PLL** The tuning port voltage on the LNFS-400 internal oscillator. This value will display only in external reference mode. For proper operation the tuning port voltage is  $\pm 5.0 \text{ V}$ . If the voltage displayed is within  $0.5 \text{ V}$  of these limits the internal oscillator may need to be mechanically tuned. Please refer to the mechanical tuning section on page 8 of this manual for more information.

## MENU

- EXT** Turns on the phase lock loop and enables locking to an external  $10 \text{ MHz}$  reference. The external reference should have a level of  $+10$  to  $+15 \text{ dBm}$ .
- INT** Turns off the phase lock loop and enables DC tuning of the internal  $10 \text{ MHz}$  reference. The external DC voltage should be less than  $\pm 5\text{VDC}$ .
- Exit** Exit to previous screen.

# ASCII Command Set



The LNFS-400 command set is used to control all synthesizer functions. The characters sent to the LNFS-400 must be upper case ASCII characters.

<u>Command Summary</u>	<u>Description</u>	<u>Page</u>
AMPL [ampl][aunits]	Set amplitude in dBm, Vrms or Vpp	24
AMPL?	Query amplitude	24
BAUD [baud]	Change baud rate	25
BAUD?	Query baud setting	25
DATE [mo/day/yr]	Change date	26
DATE?	Query date	26
FMFSK [f1][f2]	Set frequency shift parameters	27
FMFSK?	Query frequency shift parameters	27
FSK [fskcmd]	Start/stop frequency shift keying	28
FREQ [freq]	Change frequency setting	29
FREQ?	Query frequency setting	29
HELP	Basic help on ASCII command set	30
LOCL	Return to local control	31
PHAS [phase]	Set synthesizer phase	32
PHAS?	Query synthesizer phase	32
PLL [pllcmd]	Set Int/Ext frequency reference	33
PLL?	Query phase lock loop status	34
PMPSK [p1][p2]	Set phase shift keying parameters	35
PMPSK?	Query phase shift keying parameters	35
PSK [pskcmd]	Enable/disable phase shift keying	36
TEMP?	Query instrument temperature	37
TIME [hr:min:sec]	Change instrument time of day	38
TIME?	Query time of day	38
*RST	Reset synthesizer	39
*SRE	Get status byte	40
*CLS	Clear status byte	40



## ASCII Command Set



<u>Command Arguments</u>	<u>Description</u>
ampl	Amplitude entered in units indicated by aunit {max +15 dBm}
aunits	Amplitude units {1 – dBm, 2 – Vrms, 3 – Vpp}
baud	Serial port baud rate. The default is 9600.
mo	Month {1 – 12}
day	Day {1 – 31}
year	Year {1900 – 2100}
f1	Start frequency in Hz {1 – 400 MHz}
f2	Stop frequency in Hz {f1 – 400 MHz}
df	Step frequency in Hz {0.233Hz –( f1-f2)}
fskcmd	Frequency shift keying command {1– set f1, 2 – set f2}
freq	Frequency in Hz {1 – 400 MHz}
phase	Phase in degrees {+/- 360}
pllcmd	PLL command {0 – DC Tuning, 1 – Lock to Ext 10 MHz}
p1	First phase setting in degrees {+/-360}
p2	Second phase setting in degrees {+/-360}
pskcmd	Phase shift command {1 – set p1, 2 – set p2}
hr	Hour {0 – 23}
min	Minute {0 – 59}
sec	Second {0 – 59}

# AMPL, AMPL?



**AMPL** sets the synthesizer amplitude.

**AMPL [ampl][aunits]<cr>**

AMPL has 2 parameters and is executed following the carriage return <cr>

**ampl** amplitude in desired unit specified by aunits  
**aunits** amplitude units desired

**valid values:**

<b>ampl</b>	<b>aunits</b>	<b>units</b>
-9 to +16	1	dBm
0.05 to 1.45	2	Vrms
0.1 to 4.0	3	Vpp

**Example: AMPL 13.0 1<cr>**

Sets the amplitude to 13.0 dBm. <cr> is a carriage return.

**AMPL?** Queries the synthesizer amplitude setting.

**AMPL?<cr>**

AMPL? is executed following the carriage return <cr>

The results of the query are in the following format.

**AMPL? [ampl][units]<cr>**

**Example: AMPL?<cr>**

Queries the amplitude setting of the synthesizer. <cr> is a carriage return.  
The function will return:

**AMPL? 13.0 dBm<cr>**

## BAUD, BAUD?



**BAUD** changes the baud rate of the synthesizer.

**BAUD [baud]<cr>**

BAUD has 1 parameter and is executed following the carriage return <cr>

**baud            baudrate valid values are:**

110	150	300	600	1200
2400	4800	<b>9600</b>	14400	19200
28800	38400	57600	115200	

**Example:    BAUD 9600<cr>**

Sets the baudrate of the synthesizer to 9600. <cr> is a carriage return.

**BAUD?** Queries the synthesizer baudrate.

**BAUD?<cr>**

BAUD? is executed following the carriage return <cr>

The results of the query are in the following format.

**BAUD? [baud]<cr>**

**Example:    BAUD?<cr>**

Queries the baudrate setting of the synthesizer. <cr> is a carriage return.  
The function will return:

**BAUD? 9600<cr>**

## DATE, DATE?



**DATE** changes the date setting of the instrument.

**DATE [month/day/year]<cr>**

DATE has 3 parameters and is executed following the carriage return <cr>

<b>mo</b>	<b>month valid values are 1 - 12.</b>
<b>day</b>	<b>day valid values are 1 - 31.</b>
<b>year</b>	<b>year valid values are 1900 – 2100.</b>

**Example: DATE 02/02/2001<cr>**

Sets the date of the instrument to February 2, 2001. <cr> is a carriage return.

**DATE?** queries the instrument date setting.

**DATE?<cr>**

DATE? is executed following a carriage return.

The results of the query are in the following format.

**DATE? [mo/day/year]<cr>**

**Example: DATE?<cr>**

Queries the date setting of the instrument. <cr> is a carriage return.  
The function will return:

**DATE? 02/02/2001<cr>**

## FMFSK, FMFSK?



**FMFSK** is used to set the frequency shift keying parameters.

**FMFSK [f1] [f2]<cr>**

FMFSK has two parameters and is executed following the carriage return <cr>

**f1** start or first frequency in Hz, valid range is 1 MHz to 400.0 MHz.

**f2** stop or second frequency in Hz, valid range is f1 to 400 MHz.

**Example: FMFSK 1000000.0 10000000.0<cr>**

This command will set the first frequency to be 1 MHz and the second frequency to be 10 MHz. <cr> is a carriage return.

**FMFSK?** queries the instrument frequency shift keying settings.

**FMFSK?<cr>**

FMFSK? is executed following a carriage return.

The results of the query are in the following format.

**FMFSK? [f1] [f2]<cr>**

**Example: FMFSK?<cr>**

Queries the instrument frequency shift keying settings. <cr> is a carriage return.

The function will return:

**FMFSK? 1000000.0 10000000.0<cr>**

# FSK



**FSK** enables or disables the frequency shift keying. When frequency shift keying is enabled a rising edge on the external trigger will toggle the frequency from f1 to f2 or vice-versa. A software trigger will do the same. Use the TRIG command to issue a software trigger.

**FSK [askcmd]<cr>**

FSK has 1 parameter and is executed following the carriage return <cr>

**fskcmd frequency shift command:**

- 1 – set frequency to f1**
- 2 – set frequency to f2**

**Example: FSK 1<cr>**

Selects f1.<cr> is a carriage return.

## FREQ, FREQ?



**FREQ** is used to set the synthesizer frequency.

**FREQ [freq] <cr>**

FREQ has one parameter and is executed following the carriage return <cr>

**freq** range (1 to 400 MHz) resolution is 0.233Hz.

**Example: FREQ 10.0e6<cr>**

The frequency of the LNFS-400 will be set to 10 MHz. <cr> is a carriage return.

**FREQ?** queries the instrument frequency setting.

**FREQ?<cr>**

FREQ? is executed following a carriage return.

The results of the query are in the following format.

**FREQ? [freq]<cr>**

**Example: FREQ?<cr>**

Queries the frequency setting of the instrument. <cr> is a carriage return.  
The function will return:

**FREQ? 10000000.01 Hz<cr>>**

# HELP



**HELP** is used to display basic help on the ASCII command set.

**HELP**<cr>

HELP is executed following the carriage return <cr>

**Example:**   **HELP**<cr>



**LOCL**



---

**LOCL** turns off the RS-232 communications and returns control to the LCD screen and keypad on the instrument.

**LOCL<cr>**

LOCL is executed following the carriage return <cr>

## PHAS, PHAS?



**PHAS** changes the phase of the synthesizer.

**PHAS [phase]<cr>**

PHAS has one parameter and is executed following the carriage return <cr>

**phase** value is in degrees, the range is 0 to +/- 360, and the resolution is 0.022 deg.

**Example: PHAS 36<cr>**

Sets the output phase of the LNFS-400 to +36 degrees from the phase = 0 condition. Note that if **phase** = 360 deg and we issue a **PHAS 360<cr>** command the output phase will not change because the synthesizer output is already at 360 deg.

**PHAS?** queries the instrument phase.

**PHAS?<cr>**

PHAS? is executed following a carriage return.

The results of the query are in the following format.

**PHAS? [phase]<cr>**

**Example: PHAS?<cr>**

Queries the phase of the instrument. <cr> is a carriage return.  
The function will return:

**PHAS? 36 deg<cr>**

# PLL



**PLL** is used to select the frequency reference for the synthesizer. The phase locked loop can be enabled to allow locking of the synthesizer to an externally provided 10 MHz reference. DC tuning of the internal 10 MHz reference is selected when the PLL is turned off.

## **PLL [pllcmd] <cr>**

PLL has one parameter and is executed following the carriage return <cr>

**pllcmd**      **0 – pll disabled. DC tuning of internal 10 MHz reference is selected. The tuning voltage is applied to the external reference SMA input. The tuning voltage should not exceed +/-5 VDC. The tuning bandwidth is approximately 1000 Hz and the tuning port impedance is 10 kOhm.**

**1 – pll enabled. Locking to an externally provided 10 MHz signal is enabled. The 10 MHz signal should be applied to the external reference SMA input. The level of the 10 MHz signal should be between +10 dBm to +15 dBm for optimal operation. Locking to signals lower than +9 dBm may be possible, however it is not recommended.**

**Example:    PLL 1<cr>**

PLL is enabled and the synthesizer will lock to an external 10 MHz reference. <cr> is a carriage return.

## PLL?



**PLL?** queries the critical levels and voltages in the main instrument control loop.

**PLL?<cr>**

PLL? is executed following the carriage return <cr>

**OSC**            Power level of the internal oscillator. Valid range +11.0 to +13.0 dBm.

**REF**            Power level of external reference signal. Valid range +10 to +16 dBm.

**LOCK**           Voltage of the lock detector. Valid range is 0.2 to 0.35 V.

**PLL**            Tuning port voltage on the oscillator. Valid range is +/- 5 V.

**Note** that if the tuning port voltage exceeds +/- 5 V the instrument will lose phase-lock to the external reference. This voltage can also be monitored and used to decide when the internal oscillator must be mechanically tuned to adjust for aging.

**Example:    PLL?<cr>**

Queries the critical levels and voltages in the LNFS-400 control loop. <cr> is a carriage return.

The function returns:

**PLL? Osc: 12.0dBm Ref: 15.0dBm Lock: 0.3V PLL: -0.2V**

Note if the pll is disabled only the internal oscillator level will be returned.

**PLL? Osc: 12.0dBm DC Tuning Enabled**

## PMPSK, PMPSK?



**PMPSK** is used to set the phase shift keying parameters.

**PMPSK [p1] [p2]<cr>**

PMPSK has two parameters and is executed following the carriage return <cr>

**p1** first phase in degrees, valid range is +/- 360 degrees.

**p2** second phase, valid range is +/- 360 degrees.

**Example: PMPSK 0.0 180.0<cr>**

The output of the synthesizer will change in phase from 0 degrees to 180 degrees.  
<cr> is a carriage return.

**PMPSK?** queries the phase shift keying parameters.

**PMPSK? <cr>**

PMPSK? executed following a carriage return.

The query returns the phase shift keying parameters.

The results of the query are in the following format.

**PMPSK? [p1] [p2]<cr>**

**Example: PMPSK?<cr>**

Queries the phase shift keying parameters. <cr> is a carriage return.  
The function will return:

**PMPSK? 0.0Deg 180.0Deg<cr>**



**PSK** enables or disables phase shift keying. When phase shift keying is enabled a rising edge on the external trigger will toggle the phase from p1 to p2 or vice-versa. A software trigger will do the same. Use the TRIG command to issue a software trigger.

**PSK [pskcmd]<cr>**

PSK has 1 parameter and is executed following the carriage return <cr>

**pskcmd phase shift command:**

- 1 – set phase to p1**
- 2 – set phase to p2**

**Example: PSK 1<cr>**

Selects phase 1. <cr> is a carriage return.

**TEMP?**



**TEMP?** Queries the system temperature.

**TEMP?<cr>**

TEMP? is executed following a carriage return,

**Example: TEMP?<cr>**

Returns

**TEMP? 40.1C<cr>**

## TIME, TIME?



**TIME** changes the time of day of the instrument.

**TIME [hr:min:sec] <cr>**

TIME has 3 parameters and is executed following the carriage return <cr>

**hr**            **Hour valid range 0 – 23**

**min**          **Minutes valid range 0 – 59**

**sec**          **Seconds valid range 0 – 59**

**Example: TIME 12:01:00<cr>**

Sets the time of day to 12 hours, 1 minute and 0 seconds. <cr> is a carriage return.

**TIME?** Queries the system time of day.

**TIME?<cr>**

TIME? is executed following a carriage return,

**Example: TIME?<cr>**

Returns

**TIME? 12:01:31<cr>**



## **\*RST**



**\*RST** resets the synthesizer to default power on settings.

**\*RST<cr>**

\*RST is executed following the carriage return <cr>

**Example: \*RST<cr>**

Resets the synthesizer. <cr> is a carriage return.

## \*SRE, \*CLS



**\*SRE** queries the synthesizers for the value of the status register.

**\*SRE<cr>**

\*SRE is executed following a carriage return.

The results of the query are in the following format.

**SRE [status]<cr>**

**status** is an 8-bit value that contains the sum of the error conditions. status is 0 when there are no errors.

External reference error	0x01
Internal oscillator error	0x02
PLL Lock error	0x04
Tuning voltage error	0x08
Invalid parameter	0x10
Invalid command	0x20
Reserved 1	0x40
Reserved 2	0x80

**Example:**   **\*SRE<cr>**   query status  
                  **SRE 10**     the return value indicates that an invalid parameter was sent to the synthesizer.

**\*CLS** clears the status register and turns off the status LED.

**\*CLS<cr>**

\*CLS is executed following a carriage return.



The LNFS-400 needs up to 30 minutes to warm up after power is applied to the unit. After this warm up period the power on LED and the OSC signal LED should be on. On power on the instrument phase locked loop is turned off and the synthesizer has DC tuning enabled. To lock to an external 10 MHz reference. Connect a 10 MHz signal with a level of +10 dBm to +15 dBm to the external reference input SMA on the front panel. Once the external reference is applied the external reference signal LED will turn on. Proceed to enter the PLL screen from the keypad and enable the PLL function by pressing the EXT key in the PLL Screen. The LNFS-400 will automatically lock to the external reference. Once the PLL is locked the PLL lock LED will turn on. The status LED will remain on if an error condition occurs and will stay on until the PLL Screen is invoked and the PLL status is reviewed. NOTE that the PLL can also be enabled in remote control mode.

## **Problems**

### **Unit does not turn on.**

Check power cord, fuses and make sure on/off switch is in on position.

### **Unit does not respond to keypad**

Make sure unit is in local control mode and not in RS-232 mode.

### **External reference signal LED is off**

Check that the external 10 MHz signal is present and that the level is between +10 and +15 dBm.

### **PLL Lock LED is off or blinking**

Check that the external 10 MHz signal is present. Check that the frequency of the external reference is 10.0 MHz +/- 0.1 Hz and that the level is between +10 and +15 dBm. Check that the PLL is enabled.

Check that the LNFS-400 output is present.

Check PLL status using the PLL Screen function.

- OSC level should read +12 dBm +/- 2.0 dB

- REF level should be between +10 dBm and +15 dBm.

- LOCK voltage should be greater than 0.2 V

- PLL voltage should be between +4.5 V and -4.5V

- The unit temperature should not exceed +50C.

If the unit remains unlocked the oscillator may require mechanical tuning. Refer to the Mechanical Tuning section on page 8.



### **OSC signal LED is not on**

Send unit to SpectraDynamics, Inc. for repair.

### **STATUS LED is on**

Activate the PLL Screen and check the PLL status and make sure that the external reference is adequate. If the RS-232 control mode is being used use the \*SRE command to read the status register and the \*CLS command to clear the status register.

### **RS-232 communications failed**

Check that the correct RS-232 cable is being used.

Do not use a null modem adapter.

Check baud rate of the LNFS-400 and set the controller to the same baud rate.

Use the TEST function to test the serial connection.

The DATA LED should flash when data is being received by the LNFS-400.

Make sure that the LNFS-400 is in remote control mode and not in local control mode.

**If any error condition persists please contact technical support.**

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# Warranty



## Warranty

The LNFS-400 is warranted to be free of defects under normal operating conditions, as specified, for one year from date of original shipment from SpectraDynamics, Inc (SDI). SDI's obligation and liability under this warranty is expressly limited to repairing or replacing, at SDI's option, any product not meeting the said specifications. This warranty shall be in effect for one (1) year from the date an LNFS-400 is sold by SDI. SDI makes no other warranty, express or implied, and makes no warranty of the fitness for any particular purpose. SDI's obligation under this warranty shall not include any transportation charges or costs of installation or any liability for direct, indirect, or consequential damages or delay. Any improper use, operation beyond capacity, substitution of parts not approved by SDI, or any alteration or repair by others in such manner as in SDI's reasonable judgment affects the product materially and adversely shall void this warranty. No employee or representative of SDI is authorized to change this warranty in any way or grant any other warranty.

