LATNEX®

User Manual

SPA-50K (50KHz - 960MHz)

SPA-3G (15MHz - 2700 MHz)

SPA-6G (15MHz - 2700MHz and 4850MHz - 6100MHz)

SMA Left Port

Internal Battery Power Switch

SMA Right Port

LCD Screen

Keyboard

Mini-USB 2.0 Connector
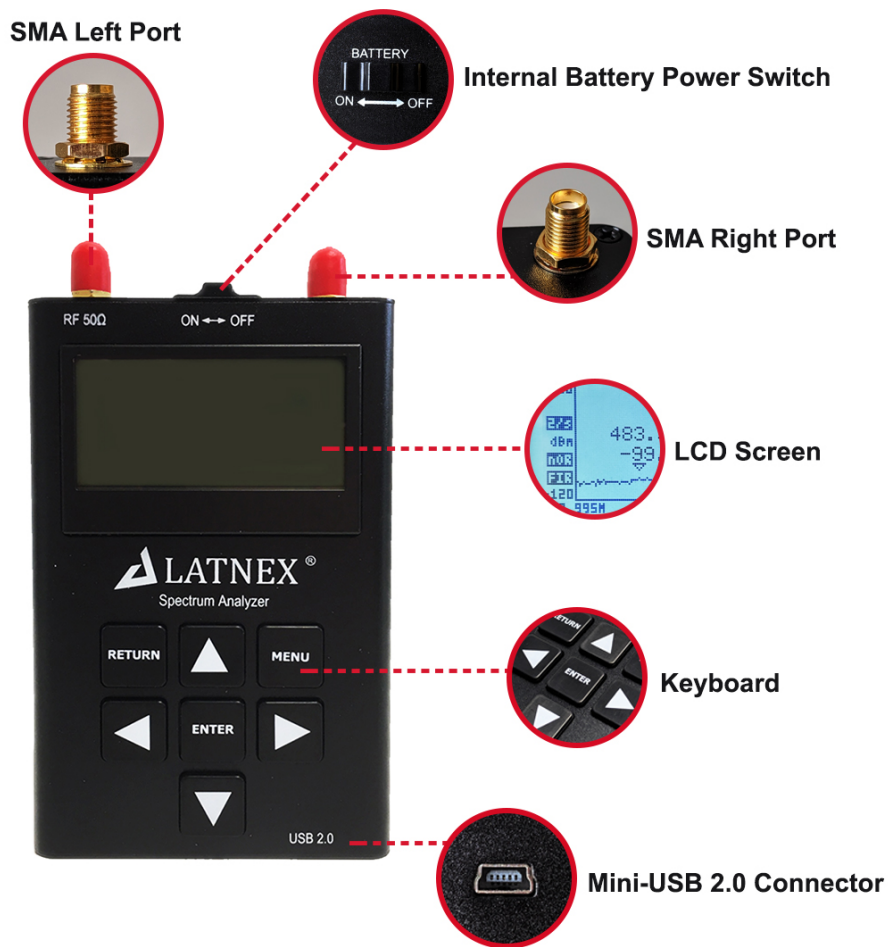
SPA-3G or SPA-6G Models

The LATNEX Spectrum Analyzer SPA-3G or SPA-6G includes 7 functional buttons in the front side. The unit also includes 2 RF connector 50 ohm impedance standard SMA format.

SPA-50K Model

The LATNEX Spectrum Analyzer SPA-50K includes 9 functional buttons in the front side, including context sensitive HELP and easy preset handling with SET button, and a silicone rubber protector. The unit also includes one RF connector 50 ohm impedance standard SMA format.

 Important: The internal battery power switch must be in the ON position for the battery to charge when the USB cable is connected. The internal battery will not charge when the power switch is in the OFF position. The unit will automatically start running on USB power when a compatible mini-USB cable is connected.

Spectrum Analyzer mode - Main Screen

Upon start, LATNEX Spectrum Analyzer goes to Spectrum Analyzer mode automatically.

The X axis represents frequency in MHZ and Y axis display actual received power in dBm or dBuV (selectable). In this example above, the frequency span goes from 2390 MHz to 2450 MHz (that is a 60MHz range), and the visual amplitude goes from -1 dBm to -110 dBm.

Configuration settings such as amplitude reference and frequency span are preserved between sessions, stored in internal FLASH memory.

The main screen automatically displays a small marker with a triangle shape. This will indicate the peak amplitude found in the current frequency span, being the first text line the frequency in MHZ and the second line the amplitude at that particular point.

The main screen has a number of additional indicators:
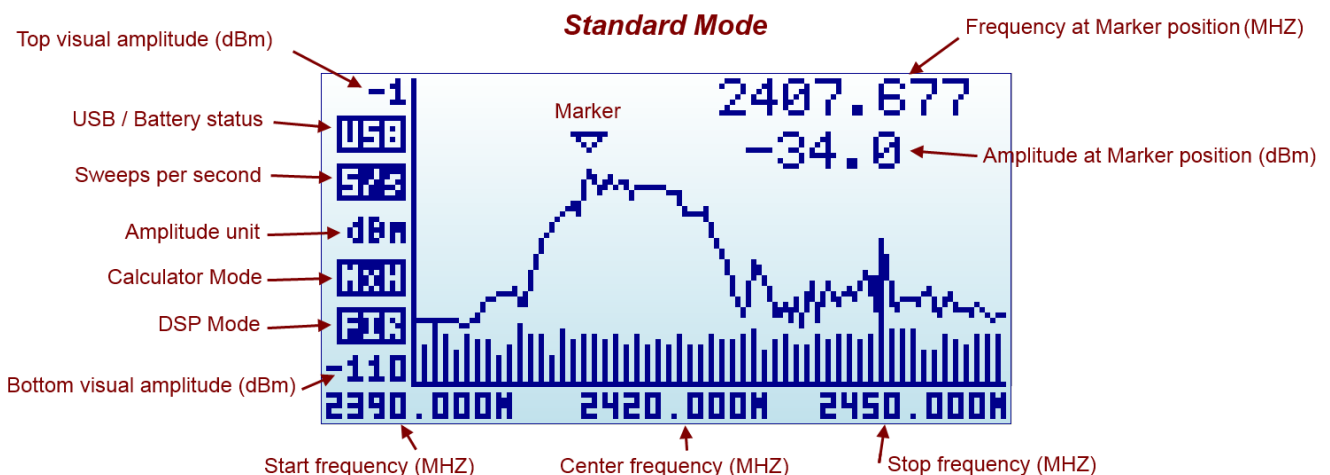
The available indicators are:

- **USB / battery status**: this indicator will display USB[1] when a valid 5V USB connection is available. This will be true even if the connection is through a wall wart charger, so it does not actually means a data connection but a power bus connection. Alternatively, a battery icon with charge level indicator will display when the Spectrum Analyzer unit power switch is set to ON. If both connections are enabled, then USB and Battery will alternate and, in this case, the battery will be charging.
- **Sweeps per second**: this is an approximate value of the number of full screen sweeps happening every second. In the example above, there are 5 sweeps per second or, in equivalent terms, one sweep every 200ms.
- **Calculator mode**: this indicator may have different values as specified by the Calculator mode in the frequency menu. Please check the section Frequency Menu in page 15.
- **DSP mode**: this indicator shows the actual value being used by the Analyzer. The *DSP:Auto* is the recommended setting in the Frequency Menu. The spectrum analyzer will select the best possible option as per below:
    - **FST**: Fast mode. This is the standard mode available in all models.
    - **FIR**: Filter mode. This is available in the 15-2700MHZ and Plus modules only, and is the recommended one for those models.
- **Marker**: There are different operational modes for the marker, see Configuration Menu in page 21.

The analyzer screen can be turned into advanced mode using the [Return] key:
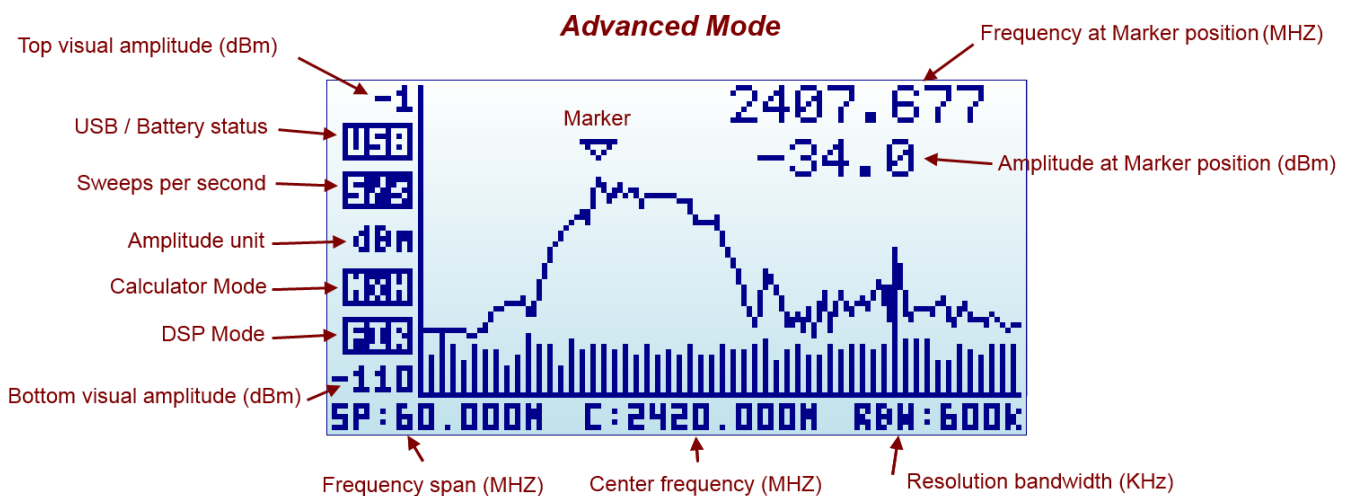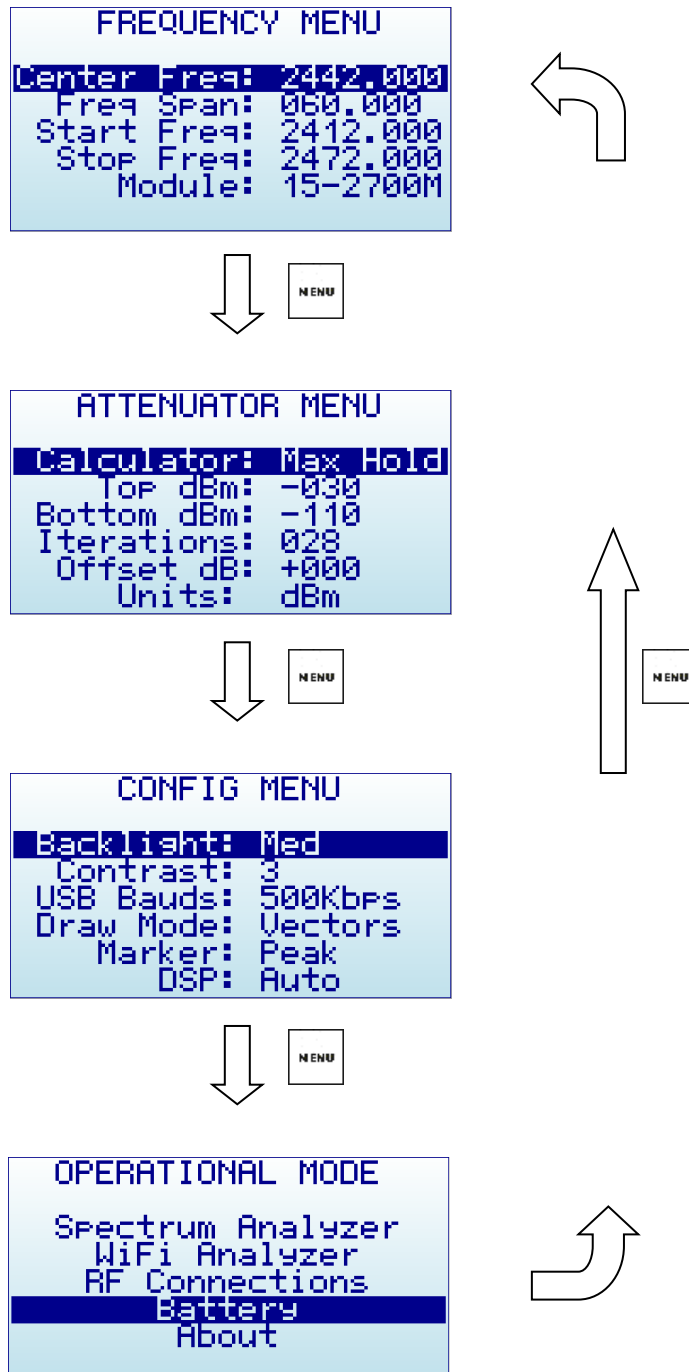

Note the frequency axis indicators changes at the bottom.

[1] USB refers to Universal Serial Bus, the standard connectivity bus in all modern computers. Our fellow HAM users should not confuse this with Upper Side Band communication, even though uses the same mnemonic.

Using menus

There are several menus in the SPA Spectrum Analyzer. They are organized on different screens, which you can iterate through by using the [Menu] key. If you click [Menu] button multiple times, you will visit every one of them:

```
FREQUENCY MENU

Center Freq: 2442.000
  Freq Span: 060.000
 Start Freq: 2412.000
  Stop Freq: 2472.000
     Module: 15-2700M
```

[MENU]

```
ATTENUATOR MENU

Calculator: Max Hold
   Top dBm: -030
Bottom dBm: -110
Iterations: 028
 Offset dB: +000
     Units: dBm
```

[MENU]

[MENU]

```
CONFIG MENU

 Backlight: Med
  Contrast: 3
 USB Bauds: 500Kbps
 Draw Mode: Vectors
    Marker: Peak
       DSP: Auto
```

[MENU]

```
OPERATIONAL MODE

Spectrum Analyzer
  WiFi Analyzer
  RF Connections
     Battery
      About
```

Optionally, you can use the [Left] and [Right] keys to go from one screen to another.

You can exit from a menu anytime by using the [Return] key.

The first time you click on [Menu] button, Frequency Menu will open. This may change as we will see later, so every time you click on [Menu] from Spectrum Analyzer main screen, you actually re-open the last menu you were working with. In this way you save time by not having to navigate through all the menus to go the same place you were before.

Operational Mode menu

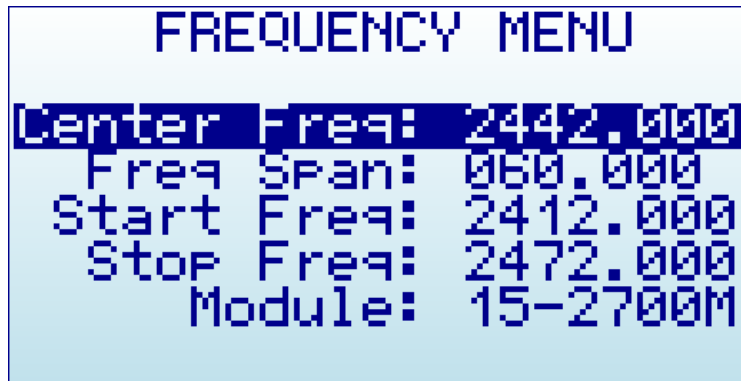The menu display different functional modes available in your Analyzer.

Use [Up] and [Down] arrow keys to select the desired mode and click on [Enter] to activate it immediately.

- **Spectrum Analyzer** mode is the default mode, available in all LATNEX SPA models

- **WiFi Analyzer** is available om the SPA-6G and SPA-3G Modules

- **RF Connections** enumerates the installed RF modules and how each one is connected to each SMA RF port. This example below shows a standard SPA-3G with a 240-960MHz connection on the left port, and 15-2700MHz on the right port. Click on any key to get out of this screen.
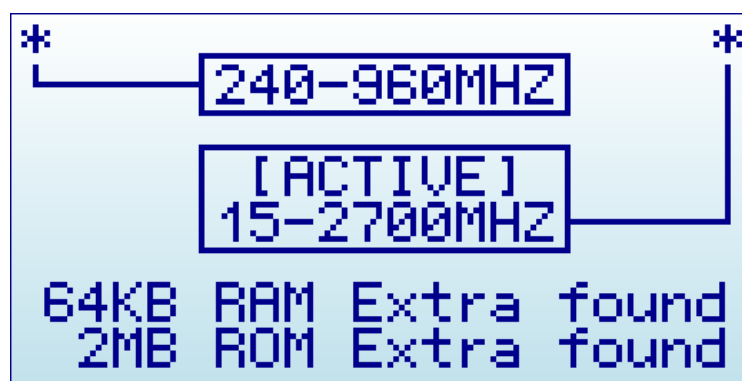
- **Battery** includes details on internal battery charge level, and assist you on charging the unit when connected to USB. For more details read section *Charging the internal battery* in page 27.

Frequency Menu


```
FREQUENCY MENU
Center Freq: 2442.000
  Freq Span: 060.000
 Start Freq: 2412.000
  Stop Freq: 2472.000
     Module: 15-2700M
```

- **Center Freq**: Center frequency in MHZ
- **Freq Span**: Frequency span (or range) to display on screen in MHZ
- **Start Freq**: Lower frequency range to display on screen in MHZ
- **Stop Freq**: Higher frequency range to display on screen in MHZ
- **Module**: Active selected RF module. When an expansion module is installed, click [Enter] key to enable the module you need.

The selected frequency band to display can be specified in two different but complementary ways:
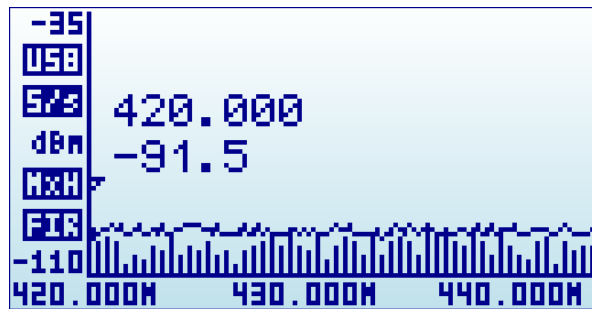
- **Center/Span**: This is the traditional Spectrum Analyzer format all engineers are used to. You basically select the Center frequency at which the band will be displayed, and then a Frequency Span.
- **Start/Stop**: This alternative mode is very useful to select frequency range between two frequencies of interest, with no need to manually calculate the Center or the Span.

The valid values for Frequency and Span are defined based on LATNEX SPA model and operational mode.
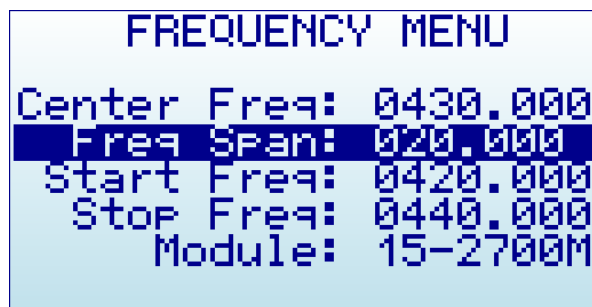
As you edit Center/Span or Start/Stop, the other values are updated accordingly, so feel free to use the method you prefer. In general, you will use Center/Span more frequently when you know the frequency you want to look at, and probably Start/Stop when you just want to look at a larger span to see what is happening in a specific range.

To navigate through the menu, just use [Up] and [Down] keys to go to the option you want, then click on [Enter] to edit that option, [Left] or [Right] to go to the digit you want to change, and [Enter] to confirm or [Return] to cancel.
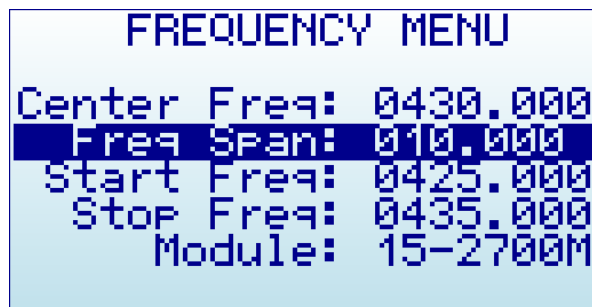
As an example, a center frequency of 430MHz with a 20MHz span:

```
-35
USB
S/s    420.000
dBm    -91.5
MxH
FIR
-110
420.000M    430.000M    440.000M
```

A click on [Menu] button will open the Frequency Menu:

```
FREQUENCY MENU

Center Freq: 0430.000
Freq Span: 020.000
Start Freq: 0420.000
Stop Freq: 0440.000
Module: 15-2700M
```

Selecting a span of 10MHz, the Start/Stop frequency changes accordingly:

```
FREQUENCY MENU

Center Freq: 0430.000
Freq Span: 010.000
Start Freq: 0425.000
Stop Freq: 0435.000
Module: 15-2700M
```

A click on [Return] button will close the menu and go back to Spectrum Analyzer main screen.

```
-35
USB
S/s
dBm    426.071
MxH    -100.0
FIR      ▽
-110
425.000M    430.000M    435.000M
```

Note: While SPA Spectrum Analyzer screen is enabled, the [Left] and [Right] buttons can be used to increase or decrease the Start/Stop frequency, virtually moving the visible spectrum to the left or the right 25% on every key press. This is helpful in order to offset the visual range without need to specify a new numeric range.

Analyzer screen in Advanced Mode

Alternatively, there is a simpler way to increase and decrease frequency span while keeping the center frequency. As this is a usual workflow, the LATNEX Spectrum Analyzer screen enables the [Return] key to switch between standard visualization mode and advanced mode.

In this screen above, the frequency reading at the bottom changed from Start/Center/Stop frequency to Span/Center/RBW. When this mode is enabled, a key press on [Left] or [Right] button will increase or decrease to double and half frequency span respectively.

As an example, to increase the span from 10MHz to 20MHz, a single click to the [Left] button is enough, no need to go back to the Frequency Menu.

Advanced: Understanding RBW

The advanced mode displays the currently selected RBW (Resolution Band Width). This is an important concept for advanced users.

The RBW references the internal filter used to discriminate the bandwidth of each sweep step. In the frequency spectrum analyzer, each measurement dot represents a range of frequencies, and there are exactly 112 steps on each sweep. As an example, in a 10MHz span, each of the 112 measurement steps represents 10MHz/112=0.089MHz or, in other words, 89KHz[2].

The range of frequencies represented on each sweep step is a level of uncertainty; screen resolution is limited to that RBW. With a resolution of 89KHz on screen (for a 10MHz span), the best accuracy expected is exactly that value. In other words, a frequency reading of 430.100MHz on screen may mean a range of +-44.5KHz each side, as the filter will not discriminate further than that for a 10MHz span.

In addition to that, RBW has an important impact on the sensitivity of the Spectrum Analyzer. The wider the filter bandwidth, the higher the spectral noise and therefore the lower the sensitivity. This is visible by an increasing noise floor as the RBW is larger, and lower noise floor as the RBW is narrower. Based on this, the narrowest RBW would look like the better choice for all measurements but as you get a narrower RBW you also decrease the scan speed notably, due to the slower nature of narrow filter as well as the need to measure more sweep points to cover the full span.
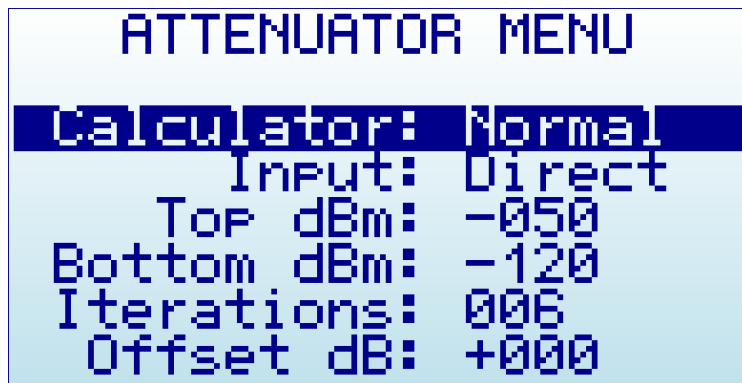
---

[2] Note the actual value used by the device may differ from the value calculated, due to finite tabulated choices.

To put it simple: Selecting the best combination of RBW, scan speed and sensitivity requires significant experience. In most RF Spectrum Analyzers, operator needs to fully understand and select RBW for each measurement, being this one of the most challenging aspects of proper Spectrum Analyzer usage.

Fortunately, this is not the case with the RF analyzer: The design of the internal DSP includes sophisticated internal tables and algorithms to make the best possible choice at all times automatically. No user intervention is required to get the best compromise between scan speed, noise floor and sensitivity every time.

In all cases, the internal RBW can be checked anytime on the advanced screen mode.

Attenuator Menu

```
ATTENUATOR MENU

Calculator: Normal
      Input: Direct
    Top dBm: -050
 Bottom dBm: -120
 Iterations: 006
  Offset dB: +000
```

- **Calculator**: internal DSP calculator mode.
- **Input**: select input stage to enable LNA or Attenuator - *only in PLUS models*
- **Top dBm**: Visual max amplitude on screen.
- **Bottom dBm**: Visual min amplitude on screen.
- **Iterations**: Internal DSP calculator iterations.
- **Offset dB**: external dB attenuation or gain value to compensate for external devices, such as attenuators or amplifiers.
- **Units**: dBm or dBuV. *Note you may need to navigate all the way to the bottom for the menu to show this last option on screen*.

The selected Top and Bottom dBm are visual limits, not real internal limits.

The internal DSP optionally performs advanced calculations in order to configure the analyzer for the required measurement:

- **Calculator** offers multiple modes to display data, to change mode click on [Enter] key:
    - o **Max**: Peak values are used from the last sweep Iterations (see menu option at the bottom). This is the standard mode you will want to use to detect rapidly changing DSS signals or find for worst case channel occupancy.
    - o **Max Hold**: Capture all activity in the band including the Max signal envelope mode with vector graphics and real-time activity with vertical bars. Use this mode anytime you want to detect activity for a long period of time. It is a very powerful mode to detect activity in busy bands such as 2.4 GHz. As this is a cumulative mode, while on Spectrum Analyzer screen you can clear the spectrum anytime with the RETURN button.
    - o **Average**: Arithmetic media average is calculated over the last sweep Iterations. This is the best possible choice to remove unwanted white noise from screen, particularly useful in constant wave (CW) and channel signals display.
    - o **Normal**: No calculation is done, just raw data as result of the realtime sweep.
    - o **Overwrite**: Useful to track unlimited activity in the band. Darker areas will point to high activity signal. You can clear the spectrum anytime with the RETURN button.
- **Iterations**: The number of sweep data iterations to perform calculations on. It goes from 1 to 16. As an example, a value of 5 with Calculator: Average means the DSP will use 5 complete accumulated sweeps to average data.

Note: *Selecting a higher or lower Top dBm value is a very frequent workflow, as you typically want to zoom in or out based on signal power being measured. The handheld Spectrum Analyzer main screen offers two keyboard shortcuts: [Up] and [Down] arrow keys can be used to increase or decrease Top dBm respectively*

by 5dBm each time. This shortcut, together with [Left] and [Right] for moving Center Frequency or Span as described before, are very convenient to make configuration changes real-time with no need to visit the Menu.

Included in LATNEX SP-50K Plus models is a selectable input stage with three possible signal paths:
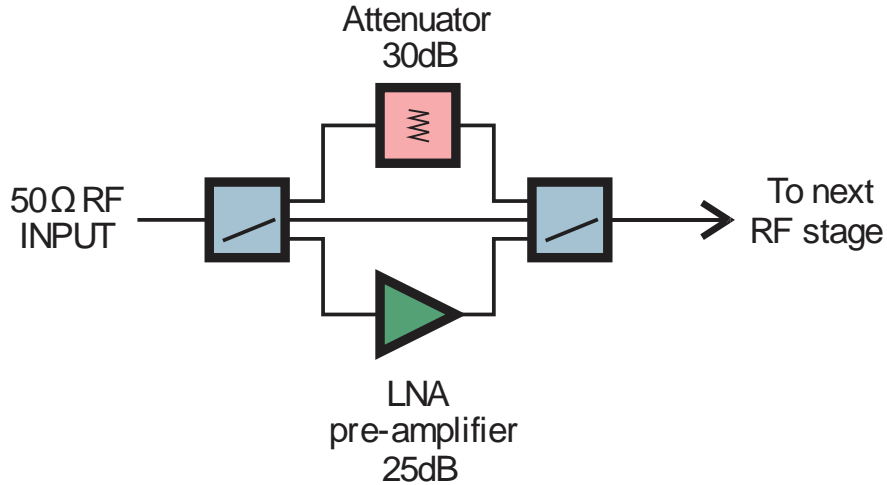
- **Direct**: low loss signal path to standard sensitivity, use for linear measurements up to -25dBm
- **Attenuator**: 30dB nominal wideband attenuator, use for linear measurement up to 0dBm
- **LNA**: low noise wideband preamplifier, use for linear measurements up to -40dBm. Note this option requires more battery power than other modes. When using LNA and an antenna, it is recommended using band pass filters to limit the wideband noise detected, otherwise degraded signal/noise reception may limit or even cancel the benefit of the amplifier.

The selection is defined by using the *Input* option in the *Attenuator Menu*. High performance RF switches drives signal path into the selected option instantly.

Configuration Menu

```
CONFIG MENU

Backlight: Med
 Contrast: 3
USB Bauds: 500Kbps
Draw Mode: Vectors
   Marker: Peak
      DSP: Auto
```

- **Backlight**: Several levels of display backlight. The level of backlight should be the appropriate for each condition, and you may want to limit backlight brightness to preserve battery capacity.
- **Contrast**: There are 10 different display contrast levels to choose from.
- **USB Bauds**: Default is 500Kbps, which is also the recommended setting. In the rare case you experience a problem when connecting with the PC, you may want to change this to 2400bps slower speed. However, this is not recommended as the connection will go really slow, so do this only if there is a good reason to. The port speed in the portable spectrum analyzer and PC Client settings must match to properly establish a connection.
- **Draw mode**: Vectors is the standard mode, and Fill can be specified if additional contrast is required by filling the area behind the signal.
- **Marker**: There are three different modes available for the Marker on the Spectrum Analyzer screen:
   - **Peak**: The marker will automatically detect the peak value on screen.
   - **Manual**: The marker can be manually moved anywhere on screen by using [Left] and [Right] buttons. When this mode is selected, the standard functions to move Center Frequency or Span are disabled.
   - **None**: The marker is not displayed.
- **DSP**: The DSP (Digital Signal Processor) can be configured in different ways in order to select the best possible choice of noise reduction, image rejection and scan speed.
   - **Auto**: This is the recommended option for all users. When Auto mode is enabled, the internal configuration tables will select the best possible algorithm. The Spectrum Analyzer screen will display a FIR (Filter) or FST (Fast) mode to indicate the actual DSP mode being used.
   - **Filter**: This mode is currently functional in the 15-2700MHz module and Plus models only, but other modules may implement it in the future. When Filter mode is enabled, the DSP will scan the spectrum several times in order to reject unwanted spurs and image frequency out of the screen. As result of that, the scan speed is slower than compared with Fast mode.
   - **Fast**: This mode is recommended for advanced users only. When it is selected on the 15-2700MHz or Plus module, the DSP will not process spurs and therefore unwanted signals may display on screen.

Preset Menu

```
PRESET MENU

Identifier: 002
Desc: Preset 2*
      Load
      Save
      Reset
[0907.064 -0912.936]
```

Preset is a convenient facility to store multiple configurations which can be easily recovered.

- **Identifier**: Numerical index of the preset valid from 1-100 (SPA-50K) or 1-30 (SPA-3G, SPA-6G)
- **Description**: Descriptive text up to 12 characters long. An asterisk at the end is automatically added when the preset has actually some data stored. In Plus model, this field is editable and can be changed in the device. In Combo models, this field is read only and can only be updated with the external Preset Manager tool.
- **Load**: Action option to load stored preset values into current configuration, the menu screen is automatically closed
- **Save**: Action option to save current configuration into the selected preset – this option cannot be undone, care should be taken to not overwrite another valid preset
- **Reset**: Action option to remove all values from selected preset and reset to unused state - this option cannot be undone, care should be taken to not reset a valid preset
- **Frequency range**: when an active preset with data stored is selected, the last line of the screen shows the Start/Stop frequency range of the preset, to help on determining the specific preset configuration before using it. This line will be blank when an empty preset is selected.

Easy Preset restore:

This menu has a very convenient shortcut for easy selection and restore of any pre-defined preset:

- **SPA-50K model**: press SET button from any *Analyzer* mode screen. By pressing SET button, this menu becomes active and cursor is preselected in *Load* action option. Pressing SET button inside this menu will iterate through all predefined Presets with valid data one by one. This shortcut is faster than manually changing *Identifier* numbers one by one when you are looking to load a preset.
- **SPA-3G and SPA-6G models**: These models do not have a dedicated SET button, but an equivalent function is available by clicking ENTER button on *Desc:* line, the menu will iterate through all predefined Presets with valid data one by one. This shortcut is faster than manually changing *Identifier* numbers one by one when you are looking to load a preset.

HELP button (SPA-50K model only)

SPA-50K model includes HELP button for easy, intuitive context-sensitive help.

The HELP text can be displayed in all functional screens, effectively complementing this User Manual with handy information, always available with a simple click.
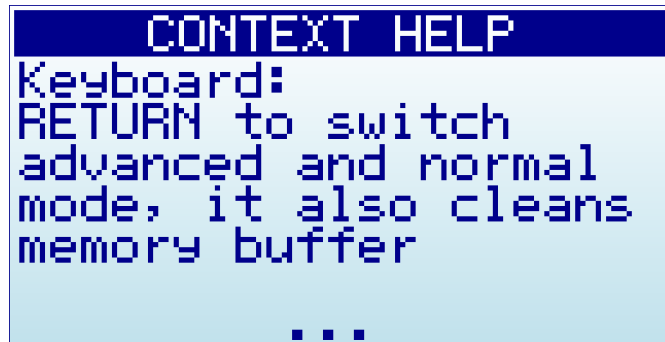
Use the following keys to interact with Help screen:

- **Scroll text up and down**: The bottom of screen shows "..." when additional text is available for scroll. Use UP and DOWN arrow key buttons to scroll text one line at a time, or LEFT and RIGHT arrow key buttons to scroll text full page at a time.
- **Help on Help**: This special screen offers description of how to interact with Help screen itself. Use HELP button within a Help screen to activate *Help on Help*.
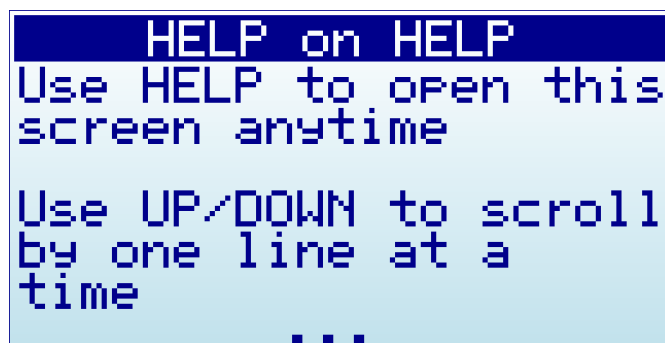
- **Close help screen**: use RETURN or ENTER key, both will close the help screen and return to previous device state.

IMPORTANT

You must have connected a 50 ohm antenna or RF load before you switch your transmitter ON.

If you switch the transmitter ON without a proper antenna, you may damage the RF module of your SPA Spectrum Analyzer, as the power amplifier will not have a load to feed. Think of the equivalent to an audio amplifier running at full power with no speakers connected: you are likely damaging the power transistors.

You can use any kind of RF 50 ohm load, including a dummy load, a coaxial with a 50 ohm termination, etc. If you use a load different than 50 ohm, the reflected wave may also damage the power amplifier.

Except you need full power for a range test, we suggest always use the lowest power level to minimize battery consumption and EMI radiation. Note local regulations must be observed, so double check you are not radiating a tone with power or frequency that may interfere with other equipment.

SPA Spectrum Analyzer internal battery

The internal battery is a high capacity Lithium-ion polymer 1000mAh. This is the same battery technology used in cell phones and modern laptops and tablet computers.

The power switch is a *true hard switch* connecting the battery in ON position, fully isolating the battery in the OFF position. As the battery is fully disconnected in the OFF position, you can keep your RF Spectrum analyzer stored for months and the battery will keep the charge intact, as opposed to cell phones or laptops which typically implement a *soft switch* which slowly discharge the battery by drawing a microamperes continuously from it. This doesn't happen in your LATNEX hand-held RF analyzer device.

Note there is actually a self-discharge effect in the battery but it is so negligible that you can store your device for a year or more and a battery will not be depleted.

<div style="background-color: yellow;">

<u>IMPORTANT</u>

Never charge your device unattended or in any place where there is a risk of fire.

Never store the SPA Spectrum Analyzer in a place where temperature may go beyond 50ºC (122F).
A car can heat up incredibly quickly in the *sun*, especially in the summer, and damage or reduce the lifetime of your battery if stored in such an environment.

If your battery doesn't seem to hold a charge or work properly, or if the unit gets hot when charging, switch the power button OFF immediately and review and/or replace your battery.

Never use any of the LATNEX Spectrum Analyzer models with a damaged battery or with a Lithium Ion battery different than the one officially supplied by technical service, which includes a
protection circuit for safety. Contact EMR Shielding Solutions if you have any question on any matter related with your battery or if you need a replacement.

</div>

Charging the internal battery

To charge the internal battery, plug it in to a powered USB port or USB wall-wart charger via the USB mini socket. For the internal charger to access the battery, you must set the power switch to ON position, otherwise the device will be running from USB but will not use or charge the internal battery.

The RF signal analyzer may draw up to 500mA according to USB standard, and may take up to 3hs max to charge a fully discharged battery in normal conditions. We recommend the first time to be charged for up to 8hs.

www.latnex.com/spa
www.emrss.com/latnex-analyzers
Toll-free number 1(855)267-2582
info@latnex.com
17

It is ok having the battery connected forever to the USB port, the internal charger will stop and start the charge when needed.

If your USB port is unpowered it may not be capable of delivering more than 100mA; the battery may not be charged at all. If you have no other option available than a 100mA USB port, set the LCD backlight to OFF in the OPTIONS MENU and keep charging for as long as needed (it may take up to 24hs in these conditions so you should use a powered USB port whenever possible).

Using the Battery dedicated screen

In latest firmware versions, you can use the specific Battery menu option for better battery charge control. Note: As long as the USB is connected and the power switch is in the ON position, the battery will charge. However, you can get additional information when using the Battery specific menu.

Inside this INTERNAL BATTERY charger screen, it is easier to realize if the battery is being charged. In this case below, it clearly indicates the power switch is not in the ON position and, therefore, battery is not being charged.
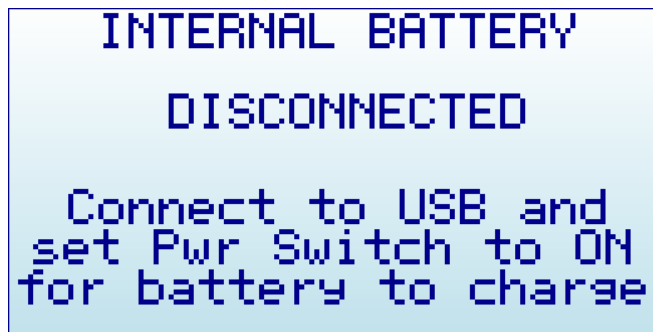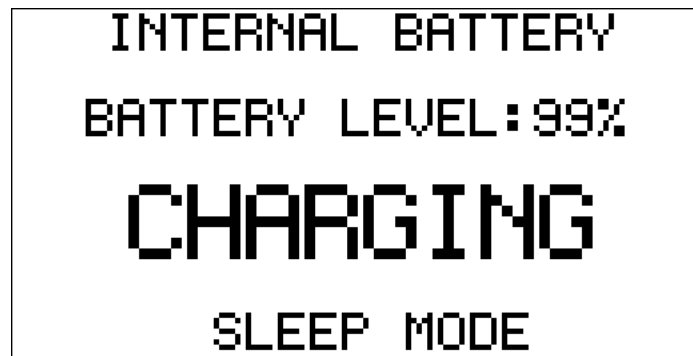

As soon as the power switch is set to the correct position, the screen will display correct charging status.
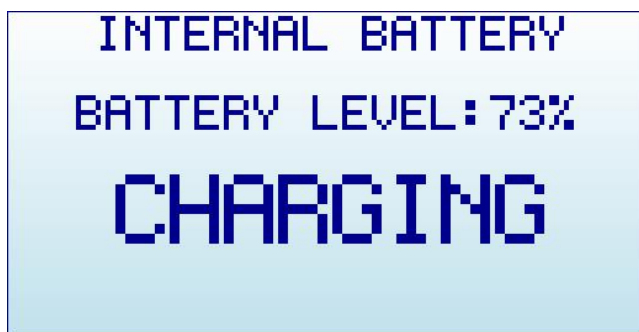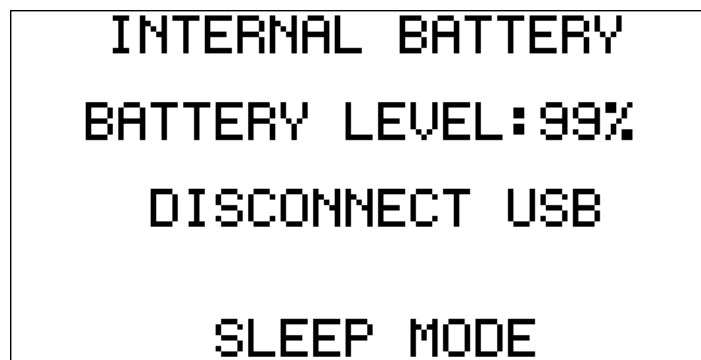

At this point you can close this screen pressing ENTER or RETURN. If you keep it active for more than 15 seconds, it automatically sets the device in SLEEP MODE - all internal circuits and LCD backlight go off, except for charging and minimal CPU monitoring - This is the recommended procedure to charge the device

overnight. Note: for the sake of clarity, below black/white screen images are depicted when LCD backlight is OFF.

```
┌─────────────────────────────────┐
│    INTERNAL BATTERY             │
│                                 │
│   BATTERY LEVEL:99%             │
│                                 │
│     CHARGING                    │
│                                 │
│      SLEEP MODE                 │
└─────────────────────────────────┘
```

In this mode you can stop charging whenever the device reaches 99% or 100%, which may take up to 2 or 3 hours under normal condition and depending on initial battery charge level. When the charging algorithm detects the battery fully charged and a minimum of 2hs connected, it will suggest disconnecting the USB cable.

```
┌─────────────────────────────────┐
│    INTERNAL BATTERY             │
│                                 │
│   BATTERY LEVEL:99%             │
│                                 │
│    DISCONNECT USB               │
│                                 │
│      SLEEP MODE                 │
└─────────────────────────────────┘
```

Calibrating the battery capacity

The INTERNAL BATTERY screen, at this point, can re-calibrate the available battery power level. This is a useful feature to adjust what reference voltage the internal charger considers 100% capacity. This reference is subject to change over time as the internal battery reduces total capacity over many charge cycles. As a reference, 500 charge cycles will typically reduce the total battery capacity about 30% - in order for this new capacity to be consistent with the battery icon on screen, you can easily recalibrate after the charge process completed.

In the previous example screen, if the battery charge remains at 99% (or any other level) after the internal charger timer completes 3hs charge process, it will keep asking to DISCONNECT USB.

By doing so, the firmware adjust for a few seconds the new charge level and save in internal ROM for future use.

```
INTERNAL BATTERY

CALIBRATING


SLEEP MODE
```

After the device recalibrates the internal battery charge reference level, it will automatically restart and you should see the Battery icon (on Spectrum Analyzer screen) showing full charge.

Charging a fully depleted battery

The firmware includes a protection mechanism to shutdown everything if the battery goes too low, in the range of 3.3V or less. However, this state will still keep drawing about 1mA from the battery. If you keep the power switch to ON forever the battery will be depleted but limited to a safe 3V level where battery protection circuitry will reduce the leakage to about 50uA.

In any case, the internal battery charger will take care of the battery conditions once it gets powered back from the USB and will charge the battery using an internal efficient algorithm. For that to work properly when the battery was fully depleted, you should use the Battery menu option as described.

Automatic idle mode with battery charge

As described in previous section, you should enable the Battery screen and keep it charging for the device to automatically set internal circuits to Sleep for overnight charge.

Note: A more limited, equivalent functionality was available in old firmware versions prior to v1.16 in the About screen, it has now moved to the new Battery screen. The About screen no longer sets the device to sleep.