LPT-3000 Remote User’s Guide

(LPT-3000R)

LP Technologies
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Chapter 1. Specifications

1. Product Specifications

- Frequency

  Range : 9 kHz to 3.0 GHz

  Resolution : minimum 1 Hz

  Span Range : 100 Hz / div to 300 MHz / div

    Selection of 1, 2, 5 steps (automatic), ZERO Span,

    FULL Span (9 kHz to 3.0 GHz)

  Frequency Selection : Start, Stop, Center, Span set-up

  Span Accuracy : ±3 % of the Indicated Span Width

  Readout Accuracy : ≤±(Indicated frequency × Reference frequency accuracy + Span ×

    Span accuracy + 50% of RBW)

  Phase Noise : ≤−90 dBc/Hz @10 kHz offset

- Amplitude

  Range : +20 dBm ~ −105 dBm ; +20 dBm ~ −135 dBm(Pre Amp On)

  Avg. Noise Level (1 kHz RBW, 10 Hz VBW)

    ≤−105 dBm, ≤−135 dBm(Pre Amp On) : 150 kHz ~ 1 GHz ;

    ≤−100 dBm, ≤−130 dBm(Pre Amp On) : 1 GHz ~ 2.4 GHz, 50 kHz ~ 150 kHz ;
\[ \leq -95 \text{ dBm}, \leq -120 \text{ dBm(Pre Amp On)} : 2.4 \text{ GHz} \sim 3 \text{ GHz} ; \]

Amplitude Unit : dBm, dBmV, dBuV

Display Scale Linearity

\[ \leq \pm 1.5 \text{ dB} / 70 \text{ dB (10 dB / div)}, \leq \pm 1.5 \text{ dB} / 40 \text{ dB (5 dB / div)} \]

\[ \leq \pm 0.5 \text{ dB} / 8 \text{ dB (1 dB / div)}, \leq \pm 0.5 \text{ dB} / 16 \text{ dB (2 dB / div)} \]

Frequency Response (0 dB attenuation) : \(-3.5 \text{ dB} \sim 1.5 \text{ dB (100 kHz} \sim 10 \text{ MHz}) \]

\[ \pm 1.5 \text{ dB (10 MHz} \sim 3 \text{ GHz)} \]

Reference Level

Range : +20 dBm \sim -90 dBm

Resolution : 0.1 dB step

Accuracy : \pm 1.5 dB

Second Harmonic Distortion : \leq -60 \text{ dBc, } -40 \text{ dBm input}

Intermodulation Distortion : \leq -70 \text{ dBc, } -40 \text{ dBm input}

Residual Spurious : \leq -85 \text{ dBm (Input terminated, 0 dB attenuation)}

Other Input Spurious : \leq -60 \text{ dBc, } -30 \text{ dBm input}

Resolution Bandwidth

Selections : 1 \text{ kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz, 9 kHz, 120 kHz}

Accuracy : \pm 20 \%

Selectivity : 60 dB / 3 dB ratio < 15 : 1

\[ 60 \text{ dB} / 6 \text{ dB ratio} < 12 : 1 \text{ (9 kHz, 120 kHz)} \]

Switching Error : \leq \pm 1.0 \text{ dB (1 kHz Reference RBW)}
Video Bandwidth : 10 Hz to 3 MHz in 1-3-10 step

- Sweep
  Time : 100 ms to 1000 sec, 40 ms to 1000 sec (zero span)
  Accuracy : ≤±20 %

- Storage
  Setup Storage : 20

- Screen Display
  Type : PC or Notebook
  Display Resolution : 640 (H) × 480 (V) active display area
  Marker Mode : Peak search, Delta marker, Peak Hold, Min Hold

- Input
  RF Input Connector : N-type Female, 50 Ω nominal
  VSWR : 150 kHz to 3.0 GHz, VSWR < 1.5 : 1 (with 0 dBm Ref Level)
  Maximum Input Level : 0 Vdc, +20 dBm

- Standard Frequency (10 MHz, Ref.)
  Temperature Stability : ±0.5 ppm
  Aging : ±0.5 ppm / Year
- Interface

   RS-232C : Null Modem Remote Control

   Ethernet 10-Base-T Ethernet : supports Internet remote control

- General Specifications

   Size : 350 (width) × 195 (height) × 375 (length) mm

   Weight : 10 kg

   Warming-up Time : More than 20 minutes for precise measurement

   Power

   Supply Electrical Power : 100-240 VAC at 50 / 60Hz

   Consumption Power : 80 watts maximum (when an option is not built in)

   Operating Temperature : 0 ℃ to 40 ℃

   Temperature for Storage : −20 ℃ to 70 ℃
Chapter 2. Preparation for Use

1. Initial Inspection

Please inspect the box contents and make sure all listed items are included. Keep the shipping box and all packing materials until the inspection of the LPT Spectrum Analyzer is complete.

Table 2-1 (below) shows all accessories offered with the LPT-3000R Spectrum Analyzer. Please contact LP Technologies Customer Support for any damaged parts, missing items or any other issue that you may need assistance with.

To clean the unit, please use a dry or wet cloth on the surface only. Do not clean the inside of the case.

**WARNING!** To prevent an electric shock, please unplug the power cord from the main power supply on the back of the spectrum analyzer before cleaning.

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Manual CD</td>
<td>Included in the package</td>
</tr>
<tr>
<td>Power Cable (AC Power Cable 3 Holes)</td>
<td>Included in the package</td>
</tr>
</tbody>
</table>

[Table 2-1] Accessories offered with the LPT 3000R Spectrum Analyzer
2. Power Requirements

The LPT 3000R does not need any additional external devices, use only the power cord provided. For more information, see Table 2-2 below.

<table>
<thead>
<tr>
<th>Source Voltage</th>
<th>100 - 120 VAC (50 - 60 Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source Voltage</td>
<td>220 - 240 VAC (50 - 60 Hz)</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Less than 80W</td>
</tr>
</tbody>
</table>

[Table 2-2] Requirements for AC Power

3. Fuse Check

A fuse should be established in the fuse holder located in the upper part of the power switch on the back board. When replacing fuses, if no spare fuses were offered with the unit, the replacement fuse should match the properties listed in the fuse holder (250 VAC, 3.15 A type T5 × 20 mm).

**WARNING !** To prevent the danger of a fire, please use only the recommended fuses. Using a fuse with a different power rating may cause serious damage to the spectrum analyzer.
4. Power Cable

In accordance with International Safety Standards, the LPT 3000R’s power cable uses 3 lines including “Ground”. When connected to a power outlet, the cable grounds a cabinet of the unit.

**WARNING !** Please use a grounded power cable with three lines, or connect the spectrum analyzer to a protective “Ground” line. Operating the unit without following these requirements may put you at risk of an electric shock.

It is also important to check the source voltage because if it exceeds the standard recommended value, the spectrum analyzer might get damaged permanently or catch fire.

5. Environmental Conditions

The LPT-3000R Spectrum Analyzer will operate normally between the temperatures of 0 °C and 40 °C. However, for the best performance, it is important to avoid exposing the unit to the following conditions: severe vibration, high moisture, direct sun rays and areas where the source voltage changes constantly.

**WARNING !** To prevent short-circuits due to condensation. Make sure the spectrum analyzer is fully dry before using it in normal conditions, after storing or using it in low temperature environments for long periods of time.
In order to prevent the inner temperature of the unit from rising, there is a cooling fan on the rear panel. Please, leave at least 10 cm between the back panel and walls or other nearby devices in order to allow proper cooling.

**6. Turning on Power**

Please connect the power cord to the back panel of the LPT-3000R Spectrum Analyzer, before use, and then press the “On” button. Allow the unit to warm up for approximately 10 minutes before measuring.
Chapter 3. Starting

1. Front Panel

[Figure 3-1] Overview of the Front Panel

1. 20x2 character LCD for frequency and span display.

2. USB interface for system update and screenshot memory using flash drive.

3. Rack mount handles convenience storage.

4. Air passages on the front panel for proper ventilation.
After the LPT-3000R Spectrum Analyzer is turned on, “INITIALIZE…” is displayed on the LCD in order to indicate that the setup is in progress. When the normal operation begins, default Frequency and Span set in the equipment are displayed on the LCD.

The USB port is designed to administer firmware installation and upgrades using a USB flash memory stick.

2. Rear Panel

[Figure 3-2] Overview of the Rear Panel

1. RF IN-1, IN-2, IN-3 and IN-4 Port
When Pre Amp/4 : 1 A switching option module is mounted, therefore the LPT-3000R Spectrum Analyzer can connect up to 4 signals on its back panel. Please see the inputs IN-1, IN-2, IN-3 and IN-4 shown in the above figure.

2. RF IN/OUT Port

For RF signal entered into RF IN-1 port, the RF IN/OUT port uses internal RF power divider and produces the output. In general, the output is produced with the loss of approximately -6dB. General signals from antenna port are measured as they are entered into RF IN-1 and are produced as outputs through RF IN/OUT port.

3. Ethernet interface

Through the RJ-45 connector, the communication is established between the PC and the LPT-3000R Spectrum analyzer using SA_Comm_TC_R application software.

4. RS-232C Connector

Through the RS-232C connector, the communication is established between the PC and the LPT-3000R Spectrum analyzer using SA_Comm_RS_R application software.

5. Ventilation fan is installed to discharge heat generated inside equipment.

6. AC Power Switch
This switch is used to turn ON and OFF the equipment power.

3. Display

This is a screen shot of the actual communication program display. A description of each item listed is provided below.

[Figure 3-3] Screen Display
1. Program title and version are displayed.

2. Menu
   
   Comm Setup: To set Comm port
   
   Print Widows: To print the screen displayed
   
   Save Window Image: To save the displayed screen as image file
   
   Graph Color Change: To invert colors in grid area where spectrum is displayed
   
   Firmware Update: To update firmware of LPT-3000R
   
   System Info: To display serial number of the unit and version of LPT-3000R installed
   
   Switch name change: To rename the RF switches/ports

3. Displays the active function block.

4. Level per grid is displayed.

5. Starting frequency is displayed.

6. Center frequency is displayed.

7. Stopping frequency is displayed.

8. Currently set values are displayed.
   
   Span, frequency step, RBW, VBW, attenuation and screen scale are displayed.
9. Allows the operator to setup the following parameters: RBW, VBW, attenuation, screen scale, as well as the average function

10. Allows the operator to activate the Pre Amp option module.

11. Allows the operator to turn ON the Marker function.

12. Allows the operator to set frequency channel.

13. Allows the operator to view the memory.

14. Allows the operator input information using the keypad.

15. Allows to operator to activate the following functions: Preset, Peak Search, Max and Min Hold, Reference ON/OFF, Align, Auto-set, Channel Power, DVT Mask, and Status Hold.

4. Measurement Methods

A 80MHz standard signal is generated inside equipment and is used as test signal.
1. Turn ON the AC switch button on the rear panel of the LPT-3000R Spectrum Analyzer. After the power authorization and the initialization processes are completed, the LCD will display the Center Frequency and the Span.

2. Run the Windows program.
   - In case of SA_Comm_RS_R (RS232 connection), select Comm port connected to PC.
   - In case of SA_Comm_TC_R (Ethernet connection), select IP address corresponding to the unit. The default IP address is 192.168.1.244 if it has not been changed manually.

3. Press Ref OFF button to turn ON the internal standard signal of 80MHz. Notice that the button is now highlighted and the caption changes to Ref ON.

4. Set the Frequency.
   Press Cent button on the keypad to activate Center Frequency. The button is now highlighted and the top left hand corner of the screen displays Center Frequency. The values can be entered or changed using the numeric key pad and as well as the up/down button. Using numeric keypad, set the Center Frequency to 80MHz.

5. Set the Span.
Press the Span button on the keypad to activate Span frequency.
The button is now highlighted and the top left hand corner of the screen displays Span Frequency. Using numeric keypad, set the Span Frequency to 50kHz.

6. Set the Amplitude.
Adjust Amplitude level on the screen if the maximum value of signal is not displayed.
Press Ref button to activate Amplitude level function. Ref button is now highlighted and the top left hand corner of the screen displays the Reference level. The highest bar on the grid and is set at 0.0 dBm. When the value of reference level is changed, the Amplitude level of the highest grid line also changes.

7. Set the Marker.
Marker function measures Frequency and Amplitude of signal. Frequency and amplitude of signal can be found by placing x-shaped marker on the maximum value of signal. Press the Mark button to activate marker. When using the Pk Srch button, marker No. 1 will automatically be set at the maximum (highest point of trace). The result of Frequency and Amplitude reading by marker will be displayed in marker window.

Figure 3-4 (below) illustrates the relationship between the Center Frequency and the Reference level. Changing the Center Frequency will result in changing the signal position of the signal on the horizontal line on display screen. Changing the Reference level will result in
changing vertical position of the Signal on the display screen.

When the Span frequency is increased, the range of frequency shown in display also increases horizontally.

[Figure 3-4] Relationship between Frequency and Amplitude
Chapter 4. Program Installation and Start-up

This program allows the operator to view live traces and store data on a PC or Laptop remotely using RS232 or Ethernet connections. This program is made and configured for the Windows environment.

1. NI-VISA Runtime Program Installation

NI-VISA 3.4.1 Runtime is a driver program supplied by National Instrument. It must be properly installed on the computer in order to allow the SA_Comm_RS to run without any problem.

This program is included in the CD supplied with your package.

To install the program:

Execute visa341runtime.exe in the CD.

Continue the installation by clicking OK.
Click Unzip and continue the installation.

Continue the installation by clicking OK.

By clicking Next start the installation of the NI-VISA 3.4.1 Runtime program.
Click Next to continue the installation. To change the default directory path, click on “Browse,” and select your new destination.

Click Next to continue the installation.
Select “I accept the License Agreement(s)” and continue the installation by clicking Next.

Click Next to start the installation.
During the installation, the process is displayed as shown in the above Figure.

Once the installation is completed, the above window appears. The program installation is completed by clicking Finish.
When the program is installed, please restart a computer by clicking Restart.

2. Serial Graphic User Interface Program Installation

This program is also included in the CD supplied with your package.

To install the program:

Execute setup.exe on the CD.

Click Next
In the figure above, if a user wants to change the default directory of SA_Comm_TC program, a user can change this to another directory.

Click Next to start the installation.

During the installation, the process is displayed as above.
After the program has been successfully installed, click Finish.

3. Serial Graphic User Interface Program Execution

When you click Start > Program > SA_Comm_TC, the execution icon is displayed. By clicking the icon, Serial Graphic User Interface Program is executed.

4. Port Setup
Once the Serial Graphic User Interface Program is executed, the main window and RS-232C port setup window will appear at the same time. In the combo box, only available RS-232C ports are shown after a computer searches the available ports. Among the available ports, select a port which is connected to the Spectrum analyzer through cable. Click the Set button to finish the setup.

5. Ethernet Graphic User Interface Program Installation

This program can be installed from CD. The program is installed by double clicking setup.exe in the CD. Below, the figure is displayed after double clicking setup.exe.

After clicking Next, the next display will be followed.
In the figure above, if a user wants to change the default directory of SA_Comm_TC program, a user can change this to another directory.

After clicking Next, installation starts while coping the files.
During the installation, the process is displayed as above.

After the completion of the installation, the above display is followed. The SA_Comm_TC
program installation is completed by clicking Finish.

6. Ethernet Graphic User Interface Program Execution

When you clicks Start > Program > SA_Comm_TC, the execution icon is displayed. By clicking the icon, Spectrum Analyzer TCP/IP interface program is executed.

7. IP Address Setup

Upon the execution of the Ethernet Graphic User Interface program, the main window and IP address setup window are displayed. Please, enter IP address of the LPT-3000R Spectrum Analyzer in the designated field; the default IP address is 192.168.1.244.
The port number is set to 5000.

Note: The IP address of a Spectrum Analyzer that is connected through the Internet should be entered correctly.

Chapter 5. Interface

1. RS-232C Connection with an External Control Device

Connect RS-232C connector (D-Sub 9 pin, female) in rear panel of equipment to RS-232C connector of outside control equipment (personal computer) by using RS-232C cable.

The figure below shows an example of signal connection between LPT-3000R and outside control equipment through RS-232C interface. It illustrates connection with personal computer.

![Figure 5-1: Connection with Personal Computer](image)
The table below shows standard specifications of RS-232C in spectrum analyzer.

<table>
<thead>
<tr>
<th>Item</th>
<th>Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Control through outside control equipment (power on/off key excluded)</td>
</tr>
<tr>
<td>Communication System</td>
<td>Asynchronous, duplex system</td>
</tr>
<tr>
<td>Communication Control System</td>
<td>N/A</td>
</tr>
<tr>
<td>Transmission Speed</td>
<td>115200 bps</td>
</tr>
<tr>
<td>Data Bit</td>
<td>8 bit</td>
</tr>
<tr>
<td>Parity</td>
<td>N/A</td>
</tr>
<tr>
<td>Stop Bit</td>
<td>1 bit</td>
</tr>
<tr>
<td>Connector</td>
<td>D-Sub 9pin, female</td>
</tr>
</tbody>
</table>

[Table 5-1] Specifications of RS-232C

2. TCP/IP Connection with an External Control Device

Communication is possible by connecting RJ-45 connector in rear panel of equipment to RJ-45 connector of outside equipment by using LAN cable.

The table below shows connection between standard, straight-through wiring and cross-over
wiring based on EIA/TIA 568B wiring information. Cross-over cable is used when repetitively connecting hub or for point-to-point connection without LAN hub.

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>RJ-45 Pin #</th>
<th>Wire Color</th>
<th>Pair #</th>
</tr>
</thead>
<tbody>
<tr>
<td>RX+</td>
<td>1</td>
<td>white/orange</td>
<td>2</td>
</tr>
<tr>
<td>RX-</td>
<td>2</td>
<td>orange</td>
<td></td>
</tr>
<tr>
<td>TX+</td>
<td>3</td>
<td>white/green</td>
<td>3</td>
</tr>
<tr>
<td>TX-</td>
<td>6</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>Not Used</td>
<td>4</td>
<td>blue</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>white/blue</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>white/brown</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>brown</td>
<td></td>
</tr>
</tbody>
</table>

[Table 5-2] Straight-Through Cable (Unshielded-twisted-pair(UTP) cable with RJ-45 connectors)

<table>
<thead>
<tr>
<th>Connector A</th>
<th>Connector B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Name</td>
<td>RJ-45 Pin #</td>
</tr>
<tr>
<td>RX+</td>
<td>1</td>
</tr>
<tr>
<td>RX-</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>----</td>
<td>---</td>
</tr>
<tr>
<td>TX+</td>
<td></td>
</tr>
<tr>
<td>TX-</td>
<td>6</td>
</tr>
<tr>
<td>Not</td>
<td>4</td>
</tr>
<tr>
<td>Used</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

[Table 5-3] Cross-Over Cable (Unshielded-twisted-pair (UTP) cable with RJ-45 connectors)

[Figure 5-2] Cross-Over Patch Cable Wiring (cross-over end)
3. How to change IP Address, Subnet Mask, Gateway

Connect your spectrum analyzer to your computer with a terminal program such as Hyperterminal.

- Terminal program setup

![Terminal program setup](image)

Set up the COM Properties as indicated in Table 5-1

RS-232C Specifications: Control system (no flow control), transmission speed (115200 bps, The device does not support speed other than 115200 bps), Set up Data bit (8 bit), parity bit (NA), Stop bit (1 bit).

- Remote start
Send ‘#’ to a device by using a keyboard on a terminal program.

In order to send ‘#’, click Shift + 3 on a keyboard.

The Spectrum analyzer Terminal Mode Start... on a terminal program console, and prompt(>) appears to be ready to receive command.

- Input command
Input command that a user wants.

If you want to change IP Address or Subnet Mask or Gateway,

> :syst:comm:tcp:address xxx.xxx.xxx.xxx  ex) 192.168.1.244
> :syst:comm:tcp:netmask xxx.xxx.xxx.xxx  ex) 255.255.255.0

If you want to check IP Address or Subnet Mask or Gateway at the present time,

> :syst:comm:tcp:address?
> :syst:comm:tcp:netmask?
> :syst:comm:tcp:gateway?
- Remote termination

In order to terminate under a remote condition,

Type

> :remote_end

Then, there appears Spectrum analyzer Terminal Mode END... on a terminal console, and the remote condition is terminated.
Chapter 6. Menu and Operations

1. Pull down Menu

- Comm Setup

Comm Setup sets communication connection of program. In case of SA_Comm_RS_R, the program for RS-232C, it activates RS-232C comm. Port setting window. For SA_Comm_TC_R, the program for TCP/IP, it activates IP address setting window.

- Print Windows

Prints the screen displayed.

- Save Windows Image

Saves the screen displayed as image file of JPG format.

- Graph Color Change

This function changes background grid and the wave form to Black and White colors to save ink when printing.
- Firmware Update

Firmware Update allows the user to update firmware on the LPT-3000R Spectrum Analyzer.

- System Info

Displays serial number of the unit and version of LPT-3000R firmware installed.

2. State Setup

- RBW

This button is used to set RBW. For RBW setup, Auto Mode for automatic control according to span frequency and Manual Mode to randomly enter settings are available. Range of setting is 3MHz, 1MHz, 300kHz, 100kHz, 30kHz, 10kHz, 3kHz, 1kHz, 120kHz and 9kHz.

- VBW

This button is used to set VBW. For VBW setup, Auto Mode for automatic control according to VBW/ RBW and Manual Mode to randomly enter settings are available. Range of setting is 3MHz, 1MHz, 300kHz, 100kHz, 30kHz, 10kHz, 3kHz, 1kHz, 300Hz, 100Hz, 30Hz and 10Hz.

- Atten
Input attenuation value is set in the unit to 10dB. The input attenuator of LPT-3000R decreases the power level of the input signal being fed into input mixer. When the Auto Mode is selected, the appropriate input attenuation value is automatically set in accordance with the reference level currently set. Range of attenuation to be set with manual mode is 0dB, 10dB, 20dB, 30dB, 40dB and 50dB.

- **Avg**

This button is used to turn on or off average function.

- **Scale**

Scale button is used to set log unit in relations to vertical grid zone of display graph. Range of scale values can be changed as 1dB, 2dB, 5dB, 10dB and 20dB per vertical grid zone.

### 3. Memory Setup

![Memory Setup](image)

The Memory function allows the user to save the current settings of LPT-3000R in a memory location between 0 and 20. Any settings saved can be fetched or retrieved by selecting the appropriate memory location.
- Save

Characters in combo box are changed to Memory 0-save when combo box is located at Memory 0 and Save button is pressed. This indicates that the setup value has been saved in Memory 0. When saving setup value again in the memory where Save is displayed, the previously saved contents are erased and the newly saved contents are saved in memory.

- Load

When selecting memory where setup value is saved and pressing Load button, the setup value saved in memory replaces the current setup value. No change occurs when loading memory with no setup value saved, in other words, Save is not displayed in combo box.

4. Keypad Setup

- Center Frequency Setup Function

This function is used to set center frequency. The button is highlighted when activated and the top left hand corner of the screen displays Center Frequency. The values can be entered or changed using the numeric key pad and as well as the up/ down button. Level of changes
made by Up/Down button is determined by step frequency.

- Span Frequency Setup Function
This function is used to set Span Frequency. The button is highlighted when this function is activated and the top left hand corner of the screen displays Span Frequency. Level of made by pressing the Up/Down buttons can be set in steps of 1, 2 and 5.

- Reference Level Setup Function
This function is used to change reference level. Ref button is highlighted when is function is activated and the top left hand corner of the screen displays the Reference level. Changes can be made by using Up/Down buttons in 10 db steps.

- Step Setup Function
This function changes step value operated by Up/Down step button. Button color is changed when pressing Step button and step value change can be administered. Changes can be made by using numeric keypad.

- Integ BW Setup Function
This function is used to set Integ BW. The button is highlighted when this function is activated and the Integ BW change can be set. Integ BW can be changed using the Up/Down step button or the numeric keypad. This function needs to be activated only when measuring channel power.
5. One-button Setup

- Preset

This button resets all settings to factory default. For status of preset setup, refer to the table below for preset conditions.

<table>
<thead>
<tr>
<th>Amplitude Unit</th>
<th>dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display and Grid Display</td>
<td>On</td>
</tr>
<tr>
<td>Attenuation</td>
<td>30 dB</td>
</tr>
<tr>
<td>Center Frequency</td>
<td>1.5GHz</td>
</tr>
<tr>
<td>Start Frequency</td>
<td>0Hz</td>
</tr>
<tr>
<td>Stop Frequency</td>
<td>3GHz</td>
</tr>
<tr>
<td>CF Step</td>
<td>10% of span frequency</td>
</tr>
<tr>
<td>Log Scale</td>
<td>10dB per zone</td>
</tr>
<tr>
<td>Reference Level</td>
<td>0dBm</td>
</tr>
<tr>
<td>Marker</td>
<td>Off</td>
</tr>
</tbody>
</table>
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<tr>
<th>RBW</th>
<th>3MHz (Auto)</th>
</tr>
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<tbody>
<tr>
<td>VBW</td>
<td>3MHz (Auto)</td>
</tr>
<tr>
<td>Video Average</td>
<td>Off</td>
</tr>
<tr>
<td>Span Frequency</td>
<td>3GHz</td>
</tr>
</tbody>
</table>

[Table 6-1] Preset Conditions

- Pk Srch

This button is used to detect and mark the highest point on the trace. Peak search function operates only for Mark1.

- Ref Off/On

This button is used to turn ON or OFF internal 80 MHz standard signal. When Ref is ON, the LPT-3000R will not display any RF input signal connected to it. This function is used mainly for the unit testing purposes.

- Align

This button is used to align the internal circuits of analyzer to increase accuracy.

- Max H

The Max Hold function displays and continuously updates the highest peak amplitude of signal level.
- Min H

The Min Hold function displays and continuously updates the lowest peak amplitude of signal level.

- Autoset

The Autoset function searches for the RF signal and automatically sets the parameter.

- Channel Power

This function measures Channel Power and Power Spectrum Density within a selected channel bandwidth.

- DTV MASK

This function measures the Shoulder Attenuation used for digital TV measurement.

6. Marker Setup

![Marker Setup Table]
The Marker function allows the user to select any point on the trace and display frequency and level data in real time. The LPT-3000R has a total of 4 markers. Mark1, Mark2, Mark3 and Mark4 can be displayed simultaneously. The Delta values obtained by subtracting Mark1 from Mark2, Mark3 and Mark4 are also displayed.

8. Communication Setup

- RS-232C communication:

![RS-232C communication setup window]

The communication setup window will only display the usable RS-232C ports available. Select the port corresponding to the LPT-3000R Spectrum Analyzer connection and click on the “Set” button. There is no need for the user to make other setups of RS-232C.

- TCP/IP communication:

![TCP/IP communication setup window]
The communication setup window will require a valid IP address to enable the connection.

Please enter the LPT-3000R IP address in the designated field. The default IP address is 192.168.1.244 unless it has been manually changed inside the unit. The port is fixed at 5000.

Press “Set” to complete the set up.

Note: the IP address of an LPT-3000R Spectrum Analyzer connected over the Internet must be entered accurately to allow the connection.

8. Print

The Print function allows the user to print out the current screen.

From pull down menu, select Function > Print Window.... Or, use shortcut of Ctrl + P.

9. Image Save

The Image Save function allows the user to save a copy of the screen displayed as an image in JPG format.

From pull down menu, select Function > Save Window Image. Enter a file name and press the OK button.
10. Graph Color Change Feature

This function changes background grid and the wave form to Black and White colors.
From pull down menu, select Function > Graph Color Change.

11. Firmware Update

The Firmware Update function allows the user to update firmware on the LPT-3000R Spectrum Analyzer.

12. System Info

The System Info function displays serial number of the unit and version of LPT-3000R firmware installed.

13. Switch name change

The Switch name change function allows the user to rename the ports (switches).
Chapter 7. Measurement guide

We will now review a few experiments that will allow an operator to use some of the functions the LPT-3000R Spectrum Analyzer discussed above while taking simple measurements and learning how use the unit.

We will look at:
- Utilization of delta marker ; Comparison of signals
- Utilization of RBW ; Distinction of a small signal
- Measurement of a small signal
- Use of a Pre Amplifier
- Measurement of a Shoulder Attenuation

1. Utilization of Delta Marker ; Comparison of Signals

Using an LPT-3000R, the frequency and amplitude differences between radio, wireless telegraphy, mobile communication device and CATV spectrum signals can be easily compared. Using delta marker function of LPT-3000R, the power difference between two signals can be compared.

- Example of Use (Delta Marker Function)
Power difference between two signals is compared.

- Set a signal generator to a frequency of 10MHz and a level of 0dBm.
- Set the LPT-3000R program as of the following.
  
  Center Frequency - 20MHz, Span Frequency - 50MHz, Reference Level - 0dBm.
- Turn on Average.
- Turn on Marker.
- Using mouse, place Marker1 at 10MHz and Marker2 at 20MHz.
- Frequency and amplitude difference between Marker1 and Marker2 is displayed in marker window located at the bottom of program.

[Figure 7-1] Delta Marker Function
2. Utilization of RBW; Distinction of a Small Signal

To distinguish between two signals of similar frequencies, it is required to consider configuration characteristics and 3dB bandwidth of the analyzer IF (RBW) filter. The configuration characteristics of filter are defined by selectivity, the ratio of 3dB and 60dB bandwidth. If a small signal is located too close to a large signal, the small signal may become blocked by IF (RBW) filter selection.

- Example of Use (IF (RBW) Selection)

Characteristics and measuring method of IF (RBW) can be obtained by measuring two input signals with frequency difference of 200 kHz and amplitude difference.

- Connect the spectrum analyzer as shown in Figure 7-2 to obtain signal with frequency difference of 200kHz. Set the first signal generator as 100MHz and -30dBm.

[Figure 7-2] Setup for Input of Two Signals

- Set Center Frequency and Span Frequency of LPT-3000R communication program
100MHz, and 1MHz/ VBW 100Hz respectively.

① Set the second signal generator as 100.2MHz so that the signal is higher than the first signal by 200kHz. Set signal amplitude as -90dBm (lower than the first signal by 60dB).

① When using RBW 10kHz filter with selectivity of 15 : 1 or less, bandwidth of filter becomes 150kHz or less at the point of 60dB. Also, half value of resolving power bandwidth (75kHz or less) becomes smaller than frequency difference. Therefore, input signals can be distinguished.

① When using RBW 30kHz filter, 60dB bandwidth becomes 450kHz or less. Half value of bandwidth (225kHz) is wider than frequency difference (200kHz). Therefore, signals are almost undistinguishable.

① When using RBW 100kHz filter, signal with drop of 200kHz is located within the band of RBW 100kHz. Therefore, signals cannot be distinguished at all. As such, signals can be distinguished by adjusting RBW.
[Figure 7-3] Signal Resolution where RBW is 10kHz

[Figure 7-4] Signal Resolution where RBW is 30kHz
3. Measurement of a Small Signal

The small signal measuring capacity of LPT-3000R is restricted by the internally generated noise level of LPT-3000R. Small signals with low power level may become blocked by LPT-3000R noise level to be invisible. For sensitivity of small signal measurement, equipment setup is the most important element. Setup status places influence on internal noise level of LPT-3000R.

RBW setup places the most significant impact on internal noise level of LPT-3000R and input
terminal attenuator influences level of signals measured. Ultimately, S/N ratio (signal to noise ratio) must be set high to be able to accurately measure small signals (RBW, Atten ➔ Set relatively low). A number of examples to measure small signals are listed below. In case it is still difficult to distinguish between small signals and noise after RBW and attenuator setup, visibility can be improved by using bandwidth reduction and video average function. Video bandwidth reduction and average function is used to average the irregularly generated noise.

- Example of Use (Input Terminal Attenuator Setup)
In case signal is very close to noise level, reduce input terminal attenuator to 0dB and downwardly adjust reference level to maximize, therefore measure signal output.

- Connect a signal generator to RF INPUT of LPT-3000R.
- Set Frequency of signal generator as 100 MHz and Amplitude as -90 dBm.
- Set Center Frequency to 100 MHz.
- Set Span Frequency to 1 MHz.
- Set Reference level to -30 dBm.
- Execute trace averaging.
- Using Atten combo box, set attenuation as 10dB.
- For better measurement, set attenuator as 0dB or Atten as Auto. Attenuator of 0dB more clearly displays signal.
[Figure 7-6] 0dB Attenuation Rate Setup

[Figure 7-7] 10dB Attenuation Rate Setup
- Example of Use (RBW Selection)

Small signals can be measured when lowering noise level of LPT-3000R by reducing RBW.

- Set the frequency of signal generator as 100MHz and amplitude as -90dBm.
- Set Center Frequency to 100MHz.
- Set Span Frequency to 1MHz.
- Set Reference level to -30 dBm.
- Execute trace averaging.
- Reduce RBW in LPT-3000R communication program. Small signal is more clearly displayed because noise level has been reduced.

[Figure 7-8] RBW 10kHz Signal
- Example of Use (VBW Reduction)

Setting the video filter with small value is useful for measuring noise or very small signal. The video filter passes through low frequency zone. In case it is difficult to visually distinguish between a signal near noise level and noise, irregular random noise can be reduced and the signal can be clearly visible by making video filter smaller. Sweep time increases when video bandwidth decreases.

Measure level of small signal by using video bandwidth function.
- Set frequency of the signal generator as 100 MHz and amplitude as -90 dBm.
- Set Center Frequency to 100 MHz.
- Set Span Frequency to 1 MHz.
- Set Reference level to -30dBm.
- Reduce VBW in LPT-3000R communication program.

Noise level becomes smaller to produce a clearer signal. This improves signal level measurement.

[Figure 7-10] VBW 10kHz Signal
[Figure 7-11] VBW 3kHz Signal
4. Use of a Pre Amplifier

The small signal measuring capacity of LPT-3000R can be improved by pre-amplifier in addition to the method described in Section 7-4.

- Set frequency of the signal generator as 100 MHz and amplitude as -80 dBm.
- Set Center Frequency to 100 MHz.
- Set Span Frequency to 1MHz.
Set the Reference level to -30dBm.

[Figure 7-14] Pre Amplifier Turned Off

Set pre-amplifier as ON.
Set reference level to -60dBm.

Noise level is lowered by approximately 30dB.
5. Measurement of Shoulder Attenuation

LPT-3000R is equipped with a Shoulder Attenuation Measuring function to satisfy the 8VSB/ATSC standard.

![Shoulder Attenuation Measurement](image)

[Figure 7-17] Shoulder Attenuation Measurement