Application Note

Spectrum Analysis using MHX-920/921/2420/2421

Revision:

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Spectrum Analysis using MHX-920/921/2420/2421

1   Overview

This application note describes how to use modems MHX920/921/2420/2421 for spectrum analysis. Our modems provide several AT-commands which are very useful for troubleshooting and analyzing the performance of the radio system:

- ATg
- ATG
- ATN

2   Spectrum Analysis Supporting Commands

2.1. ATg and ATG

Issuing the command ATg <enter>, causes the MHX 920/921/2420/2421 to perform a sweep of the entire operating spectrum, giving a signal strength read-out in dBm for each channel as shown below:

```
ATg
      Noise level, '*'- mean value, '.'- max value
ch 1  -122dBm  *.
ch 2  -123dBm  *
ch 3  -122dBm  *.
ch 4  -121dBm  *
ch 5  -123dBm  *
ch 6  -122dBm  *
ch 7  -122dBm  *
ch 8  -122dBm  *
ch 9  -118dBm  *................................
ch 10 -123dBm  *
ch 11 -122dBm  *
ch 12 -121dBm  *.....................
ch 13 -122dBm  *.....................
ch 14 -122dBm  *
ch 15 -122dBm  *
ch 16 -114dBm  *.............................................
ch 17 -115dBm  *.....................
ch 18 -105dBm  *****…


ch 86 -123dBm  *
ch 87 -123dBm  *
ch 88 -121dBm  *.........
ch 89 -124dBm  *
ch 90 -123dBm  *
ch 91 -123dBm  *

OK
```

Figure 1. Spectrum Analysis using ATg command

Note:

Example shows the Spectrum Analysis representation for MHX-920 and the default link rate (S103=2). Other modems have different number of channels and channel spaces.

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Spectrum Analysis using MHX-920/921/2420/2421

Issuing the command ATG <enter>, causes the MHX 920/921/2420/2421 to perform a sweep of the entire operating spectrum, giving a signal strength read-out in dBm for each channel as shown below:

```
ATG
      Noise level, '*'- mean value
ch 1  -122dBm  *
ch 2  -122dBm  *
ch 3  -122dBm  *
ch 4  -122dBm  *
ch 5  -122dBm  *
ch 6  -122dBm  *
ch 7  -122dBm  *
ch 8  -122dBm  *
ch 9  -122dBm  *
ch 10  -122dBm  *
ch 11  -121dBm  *
ch 12  -121dBm  *
ch 13  -122dBm  *
ch 14  -121dBm  *
ch 15  -121dBm  *
ch 16  -121dBm  *
ch 17  -116dBm  *
ch 18  -122dBm  *


ch 86  -123dBm  *
ch 87  -123dBm  *
ch 88  -123dBm  *
ch 89  -123dBm  *
ch 90  -123dBm  *
ch 91  -122dBm  *

OK
```

Figure 2. Spectrum Analysis using ATG command

Note:
Example shows the Spectrum Analysis representation for MHX-920 and the default link rate. Other modems have different number of channels and channel spaces.

The difference between ATg and ATG is that ATg averages on 256 samples while ATG averages on 16,384 samples. Whereas, the ATg command is useful for the rapidly changeable radio environment, the ATG command is useful for the stable radio environment. Modem scans all channels starting from the first channel to the last channel. Total number of channels and channel space are defined by the modem's model and selected link rate. For example, for MHX-920 and selected link rates (S103) 0-3 the channel space is 280 kHz and the total number of available channels is 91. Therefore, to calculate the frequency of channel n:

Freq channel n = 902.4+ ((n-1) x 0.280) MHz.

The signal level represented graphically is limited from -110 dBm to -53 dBm with 1 dBm increment. The value indicates current mean value of signal level. The "*" is the graphical showing of same value if the value is greater than -110 and less than -53. If the value is less than -110, only a "*" is displayed. The dots show the historical peak signal on the channel.

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How to interpret the displays (examples) shown in Figure 1:
ch 6   -No signal was measured on this channel;
ch 10   -Mean signal level: -(110-5 (asterisks)) = -105dBm. Peak signal level: -(110-5 (asterisks) -3 (dots)) = -102dBm

2.2. ATN

The N – Spectrum analyzer is designed for an advanced Spectrum Analysis. It doesn't use fixed channels, channel spaces and averaging time is changeable. The Advanced Spectrum Analyzer feature provides for a very detailed analysis of a particular area of the radio frequency spectrum within which the MHX920/921/2420/2421 operate. The specific parameters: start (of scan) and stop frequencies, along with step (increment) size and dwell (on frequency) time are user-definable.

Following is the format for the ATN command in the AT-command Mode:
<div align="center">ATN Fstart Fstop S D[Enter]</div>

where
     Fstart   - start frequency in MHz (including 0-6 decimal places)
     Fstop   - stop frequency in MHz (including 0-6 decimal places)
     S   - step increment in kHz (from 1-1000)
     D   - dwell time in ms (from 1-1000)
Example:
ATN 902.4 927.6 50 100
Note: Be sure to enter spaces as shown in the format detailed above.

```
ATN 902.4 927.6 50 100
902.400 -122dBm *
902.450 -122dBm *
902.500 -123dBm *
902.550 -123dBm *
902.600 -123dBm *
902.650 -122dBm *
902.700 -123dBm *
902.750 -123dBm *
902.800 -122dBm *
902.850 -121dBm *
902.900 -123dBm *


927.300 -123dBm *
927.350 -123dBm *
927.400 -122dBm *
927.450 -122dBm *
927.500 -123dBm *
927.550 -123dBm *
927.600 -122dBm *
OK
```

Figure 3. Spectrum Analysis using ATN command

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3 Spectrum Analysis using "RadioNetwork" software

The Windows-based software "RadioNetwork" implements Diagnostics Protocol. The "RadioNetwork" allows users of our modems:
- to build wireless network topology;
- to get diagnostics information on-line;
- to get modem settings on-line;
- to update modem's settings on-line;
- to do spectrum analysis;
- hard firmware local upgrade;
- soft firmware local upgrade;
- remote firmware upgrade.

Spectrum analysis could be done only locally. User should connect his computer to the modem's data connector using standard "Strait-Trough" cable. User needs to select a proper COM port and set up all communication related parameters: baud rate, data format and hardware handshaking. Communication port's settings must match modem's settings. Run the software "RadioNetwork". Click the icon "Spectrum" on the main window control bar.
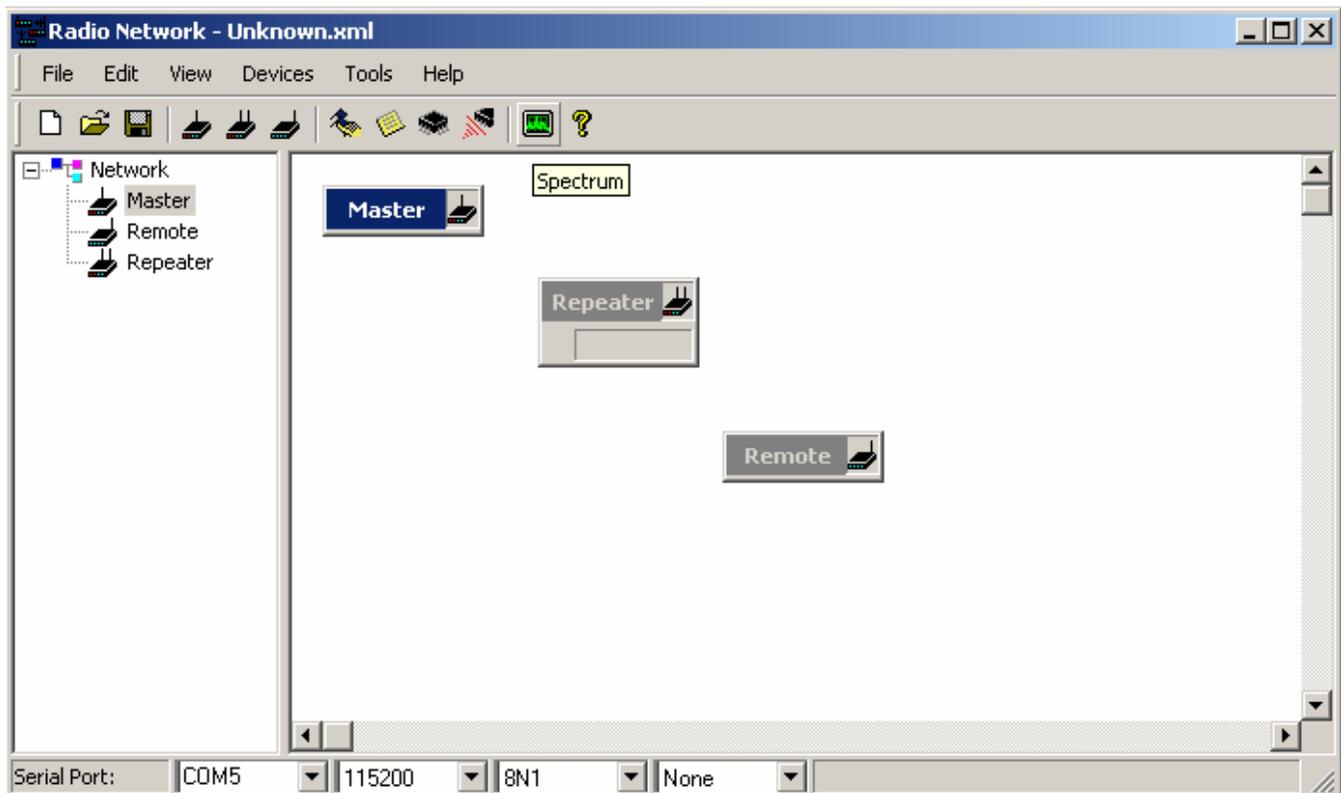
Figure 4. Main window

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If user clicks on the button "SCAN", computer will start communicating with a modem. If the COM port's setting match the modem's settings and negation is completed successfully, the "RadioNetwork" program will put modem off-line (AT-command menu). The ATg command is used to get data from a modem. User will see the picture shown in Figure 5. He can clear the chart or stop the spectrum data updating.
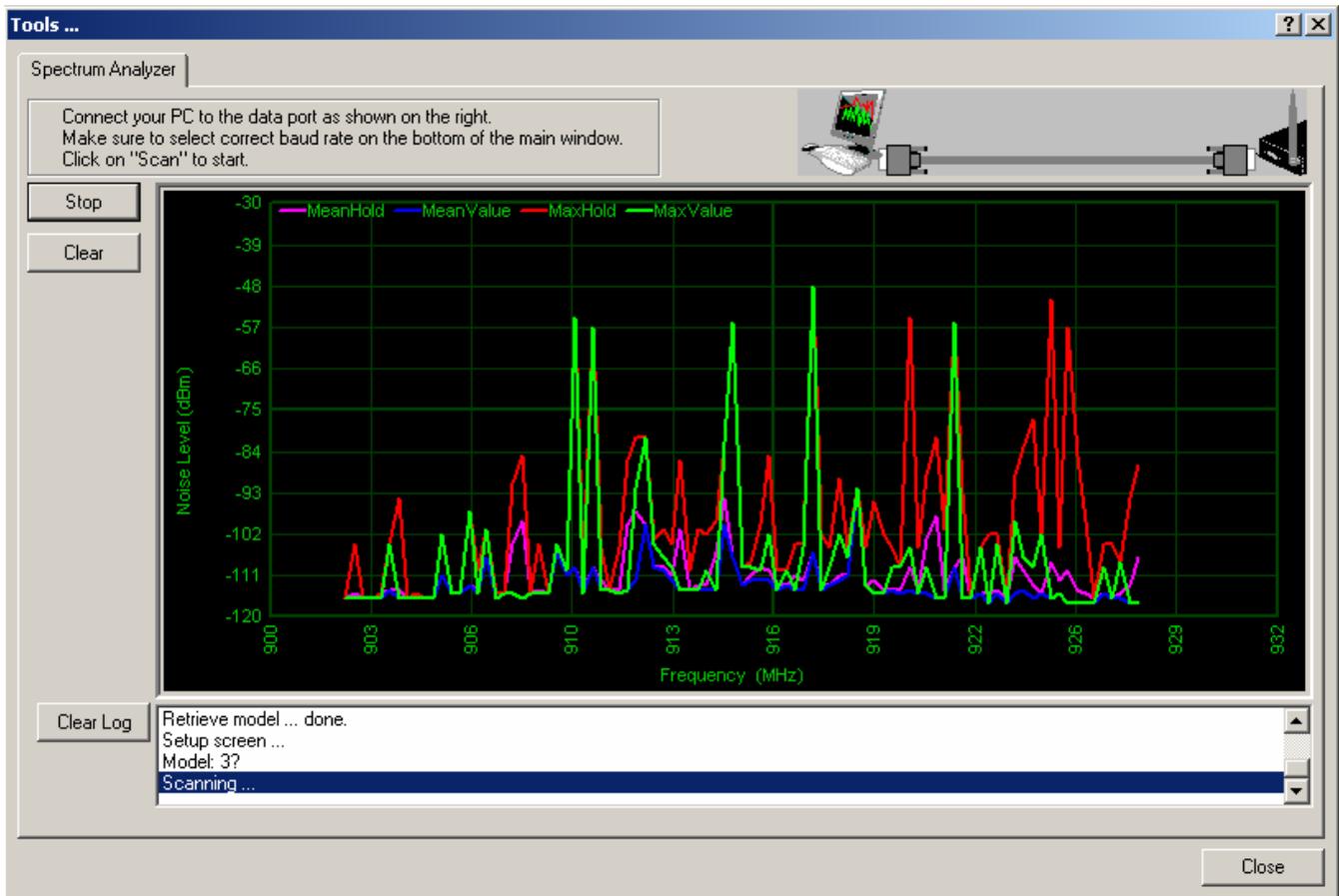
Figure 5. Spectrum Analysis Window

The RSSI value is represented in dBm (Y-axis) and frequency is represented in MHz (X-axis). The RSSI value -122dBm is a zero point for modem. Spectrum analysis starts at the channel 1 (902.4 MHz) and stops at the channel 127 (927.6 MHz) for the MHX-920.
The mean RSSI value is drown by blue line and the mean hold RSSI – by pink-blue lines. The maximum RSSI value is represented by green line and the maximum hold RSSI – by red line.
When the spectrum analysis is completed, user should close the "RadioNetwork" program; disconnect the serial cable from a modem and power cycle a modem.