

Consultix CellWizard™ MRX-Pro CW Receiver

User Manual





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Building 57, Zone 2, District 6, El-Teseen St.,11835, New Cairo City, Cairo, Egypt.
☎ +20 225647370 info@consultix-egypt.com

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Introduction

Overview

CellWizard™ MRX-Pro CW receiver is very compact, wideband, battery-operated receivers covering all cellular and public safety bands from 200 MHz to 3.9 GHz. The receiver is combined with WALKVIEW™ data collection software to automatically test & scan signal levels at high sample rates that comply with 40-λ Criteria. The test results including RSSI levels & location information are displayed on the software and can be archived or exported into radio planning software tools.

The CellWizard™ MRX-Pro along with the WalkView™ App allows you to conduct all the measurements, geo-tag or map them to the floor plan then export them to your radio design software of choice

Key Features

- Portable Handheld Receiver
- Multi-Channel Scanning up to 10 Channels
- Two RF input ports
- 40-λ lee Criteria Support 600 samples/second
- -120 dBm Sensitivity
- -35 dBc Adjacent Channel Rejection



Safety Compliances & Precautions

In order to avoid damage to your receiver and to ensure efficient operation of your test receiver, please make sure to follow the following recommendations and best practices:

- A. To avoid hazard or damage, only use original accessories with the receiver.
- B. Don't touch the antenna during operation as it may alter the radiation pattern.
- C. Do not operate in Wet/Very Damp Conditions.
- D. Do not operate near **flammable** or explosive materials.
- E. If you suspect there is damage to this product, have it inspected only by **authorized** service personnel or service centers.
- F. It is recommended to use **Port 2** when working in the band from **3000 to 3900 MHz**
- G. For best accuracy, either use the device in the stand-alone **battery operation** or while it is **fully charged** (and being connected to the charger).
I.E. if you have extended mission and you will use it while it's connected to the charger, wait until the **charging LED** is switched off.

Getting Started

Package contents

Please unpack and inspect the shipping package to make sure that you have received all the parts without damage; the shipping package is shown in **table 1**.





<p>Receiver</p>	
<p>12 VDC Power Adapter</p>	
<p>Documentation CD</p>	
<p>USB mini-B Cable</p>	

Table 1: MRX-Pro Receiver Packing List

For any issue regarding the shipment package, please contact your nearest Consultix distributor or contact us directly at support@consultixwireless.com

CellWizard MRX-Pro Front Panel

Figure 1 depicts the MRX-Pro receiver panels



Figure 1 MRX-Pro Interface Panel

Technical Background

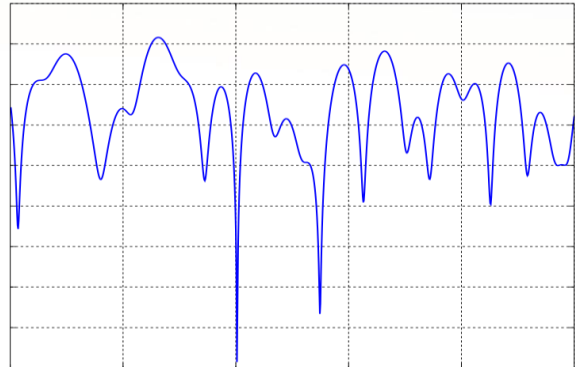
Consultix MRX-Pro captures and samples at 600 Samples/Second which is more than enough to satisfy Lee's Criteria (Minimum 36 samples/distance of 40 Lambda) for any practical frequency and vehicle speed Combination in single channel mode. In this document, we will outline the sampling & averaging mechanism of Consultix WalkView™ SW along with CellWizard™ CW Receiver

Lee Criteria Theory

Fading is a natural phenomenon that causes variations in received signal level, fading occurs due to changes in the transmission channel or propagation paths.

There are two types of fading:

- Slow fading (also called large scale fading or terrain based fading) which is due to path-loss and shadowing effects. This is the parameter that we're ultimately looking to characterize here.
- Fast fading (or Rayleigh fading) which causes rapid (hence fast) variations of the received signal strength over short distance and short time periods (this is the component that we seek to filter out in order to accurately measure the path loss)



To avoid the effects of fast fading, William C. Lee proposed a method for obtaining the local mean values of the received signal along a route, this method has since been recommended and adopted by ITU and CEPT among others. It is based on an averaging process (commonly referred to as 40 Lambda averaging) applied to the envelope of the received signal.

Simply put, a number of samples (N) collected along the route over a certain distance (L) are all averaged together to produce a single point. The number of samples (N) and the distance (L) are essential parameters to ensure that the averaged value:

- Filters out fast fading effects
- Remain, representative of the real signal / within acceptable error limits

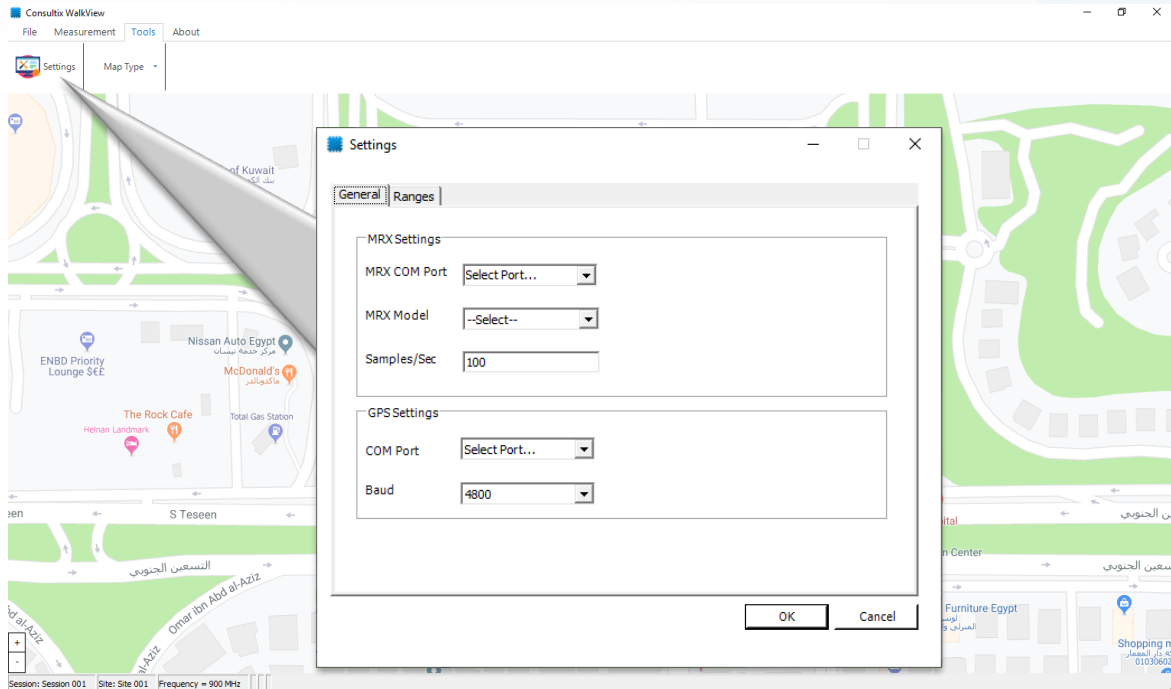
Lee obtained the values of the parameters as follows:

- Distance $L = 40 \times \text{Wavelengths (40 Lambdas)}$
- $N = 36-50$ points

In other words, in order to remove the effects of fast fading in compliance with Lee's criteria your receiver must be capable of collecting a minimum of 36-50 points in the time, it takes the test car to cover a distance of 40 lambdas. Then, all the samples belonging to this 40 lambda distance are averaged together to produce a single point.

Device Configuration

1. Connect the MRX-Pro receiver with a Mini USB-B cable
2. Click on the desktop shortcut Consultix WalkView
3. Connect the GPS receiver
4. Navigate to the **Tools** menu and press **Settings** menu



5. Under **General** submenu adjust the following:
 - a- Select MRX-Pro COM Port according to your computer device manager
 - b- Select the hardware model to be MRX-Pro
 - c- Set device sampling speed to any value between 100 to 600 Samples/Second according to your operating frequency and driving speed
Note: the sampling speed should be calculated carefully to match Lee criteria. you may set this value to 250 Sample/Second, this will comply with Lee criteria with a car speed up to 90Kmph and up to 3GHz
 - d- Select GPS COM port and Baud Rate
Note: that WalkView is compatible with GPS receivers operating with NMEA standard only.

Configuration

The MRX-Pro receives these configurations from the WalkView software before session start

- Operating Frequency
- Sampling rate
- No f channels
- Operating port for each channel

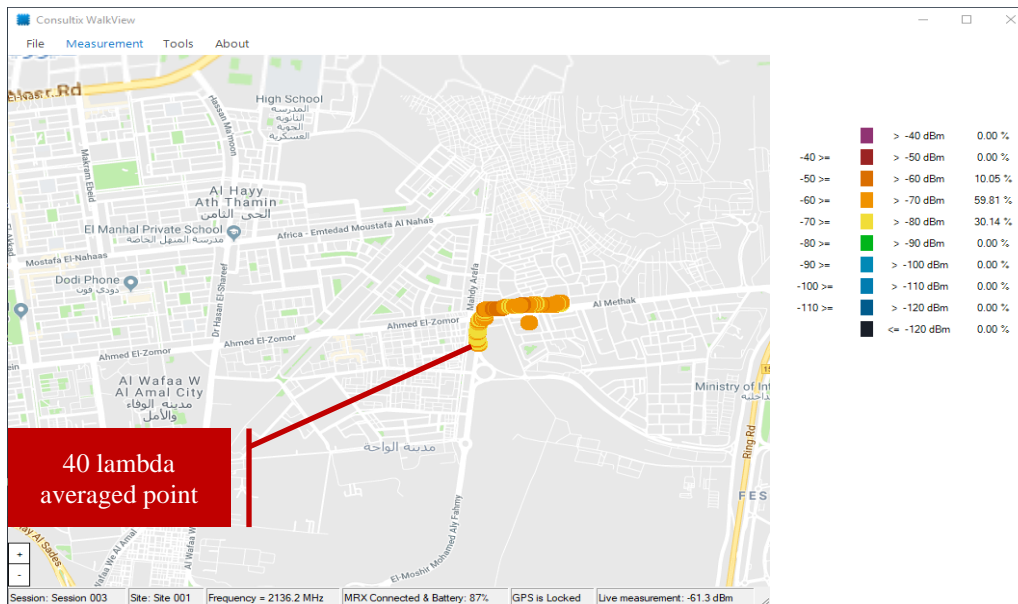
The MRX includes high speed core that can duel between all configured channels while conserving the configured sampling rate, configured sampling rate is divided equally on selected channels, i.e. when the MRX is working with 600 samples/second on two channels then every channel will be sampled with 300 samples/second.

Steps of Operation

Once Consultix CellWizard receiver is commanded by the WalkView application to start operation, the receiver autonomously collects and sends samples to the software. All collected samples are stored along with GPS coordinates and timestamp in a raw data file. If the car stopped moving (Speed = 0) anytime, the SW would command the receiver to stop measurements, this guarantee that your raw data file size is not filled with static useless measurements.

According to Lee Criteria, every 40 wavelengths, WalkView SW plots one point on the map with the average of all samples collected within this distance and stores the original (raw) RF samples to the raw datafile.

RAW data files are saved automatically to the Android device, while the user still can export average points plotted on the map to an average data file with different file format such as a CSV format, ASSET format, or Planet format.



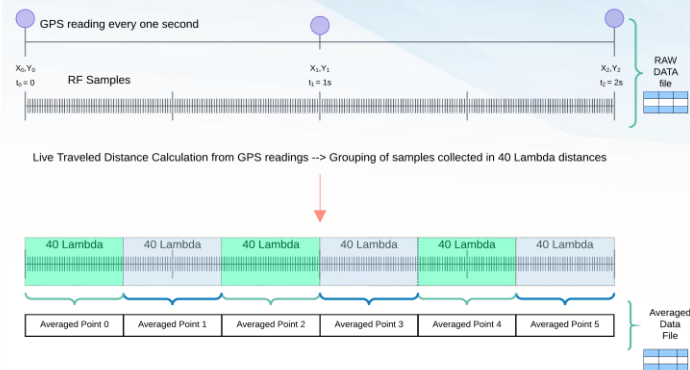
Averaged data file



RAW data file

WalkView™ Averaging Process

The GPS Receiver reports the location every 1 second, then the application records RF samples with GPS Readings and stores it in the raw data file, the WalkView™ SW performs live distance calculation from the GPS readings then groups the collected RF samples into blocks corresponding to 40 lambda distances



The block size and number of samples in each block, will vary depending on the sampling rate and driving speed, also number of blocks vary with the distance traveled during every GPS report, Samples corresponding to each 40 Lambda distance is then averaged to one point then presented as one point on the map, Optionally the user can export presented points to averaged data file

Examples

Assuming a CW drive test with the following configuration,

RX Frequency = 2140 MHz

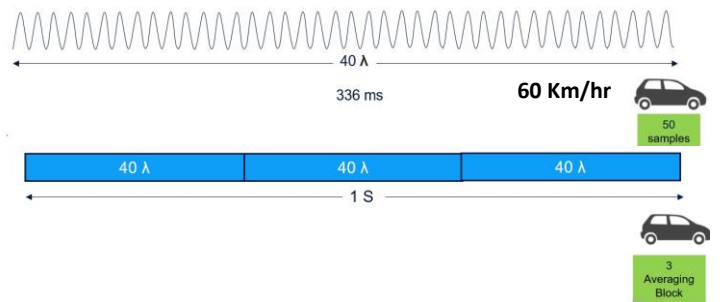
Lambda = 14 cm

40 Lambda = 5.6m

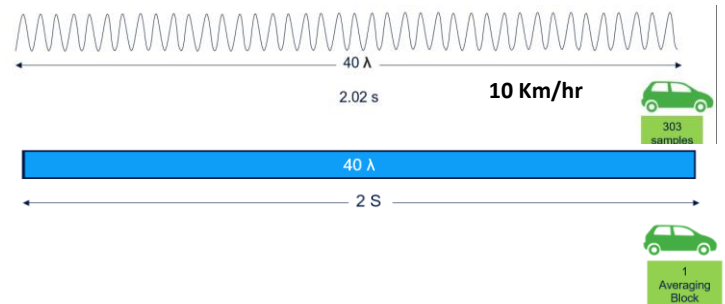
RF Sampling Rate = 150 samples/second

Ex. 1: with a car speed of 60 Km/hr, the car will finish a distance of 40 lambda (5.6 m) in 336 ms and WalkView™ SW gets 50 samples.

The application then will have 3 x (40 lambda) blocks between every 2 GPS reports (1 second). Samples corresponding to each block will be averaged and presented as one point on the map - this is done assuming a constant velocity during the one second GPS reporting interval.



Ex. 2: with a car speed of 10 Km/hr, the car will finish a distance of 40 lambda (5.6 m) in 2.02 s and WalkView™ SW gets 303 samples, this happens after 2 GPS reports, and after this period the WalkView™ SW will average all samples corresponding to this block (2.02 seconds and 303 samples) as one point presented on the map



Guidelines for CW Measurement Surveys

- Inaccurate measurements → inaccurate calibration → inaccurate model
- The area under test must be scanned against interference exists
- Selected frequency must have a clearance of 400kHz from radio interference
- Measurement surveys should be obtained for distances up to 10km (or until the noise floor of the receiver has been reached).
- Equal number of samples should be conducted near as well as far from the transmitter
- CW measurement surveys should be well documented with a 'Station Measurement Form' (position, antenna height, transmit power, gains and losses)



Further Help

- For any support inquiry, kindly contact:

Support: support@consultixwireless.com

Or contact our distributor covering your region (check www.consultixwireless.com)

- For any information about prices, specifications, future developments, recommendations, customizations, or general question, kindly contact:

Sales: sales@consultixwireless.com



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☎ +20 225647370 info@consultix-egypt.com