CatchAll

CatchAll™ Ultrafast Wideband Receiver

Overview

The CatchAll receiver is a sophisticated measurement tool for the verification and optimisation of wireless networks, such as TETRA, Tetrapol and GSM.

Unlike conventional scanning receivers the CatchAll receiver uses an instantaneous sampling technique to yield a detailed picture of the radio frequency activity over a wide frequency band. This, in combination with the positional information from the integrated GPS receiver and wheel-pulse inputs makes the CatchAll receiver a powerful network analysis tool.

Furthermore, the CatchAll receiver can be upgraded in the field to support new features, as and when they become available.

The CatchAll receiver is controlled by a laptop PC via a universal serial bus (USB) link. It is supplied complete with all the software needed to control the receiver, capture data, replay the data for subsequent analysis and to post-process the data for export to a geographical information systems, such as MapInfo Professional®.

No Scan List Required

Conventional scanning receivers operate by tuning a narrowband receiver to each carrier frequency in turn to measure the signal strength on a selected list of carriers. This re-tuning typically limits the rate at which channels can be scanned to less than 100 channels per second, and if fast fading is averaged, to less than five channels per second. This means that the scan list must be chosen carefully, and it may be necessary to update this list during a measurement run.

Furthermore, if it becomes apparent that measurements are required on additional frequencies that were not included in the initial scan list, then new measurement runs will be required.

MAC Ltd's CatchAll receiver uses a wideband receiver and a state-of-the-art analogue-to-digital converter (ADC) to capture an instantaneous bandwidth of up to 20 MHz.
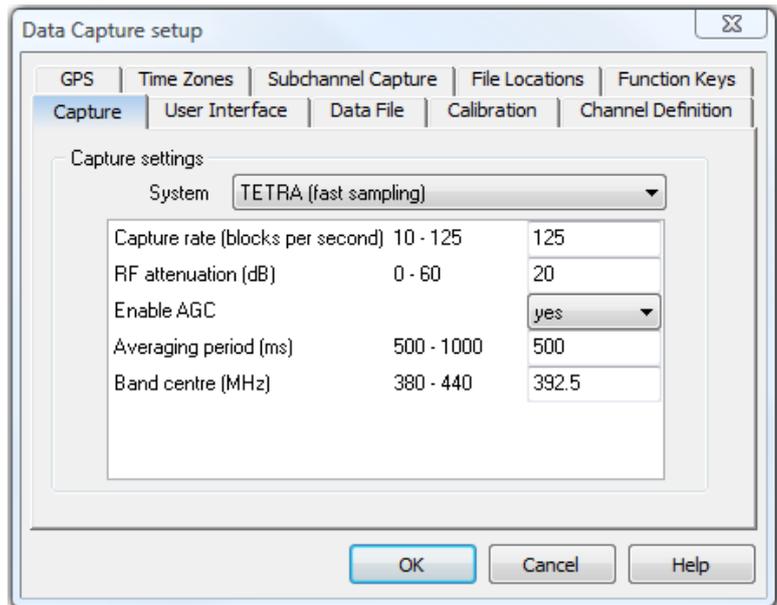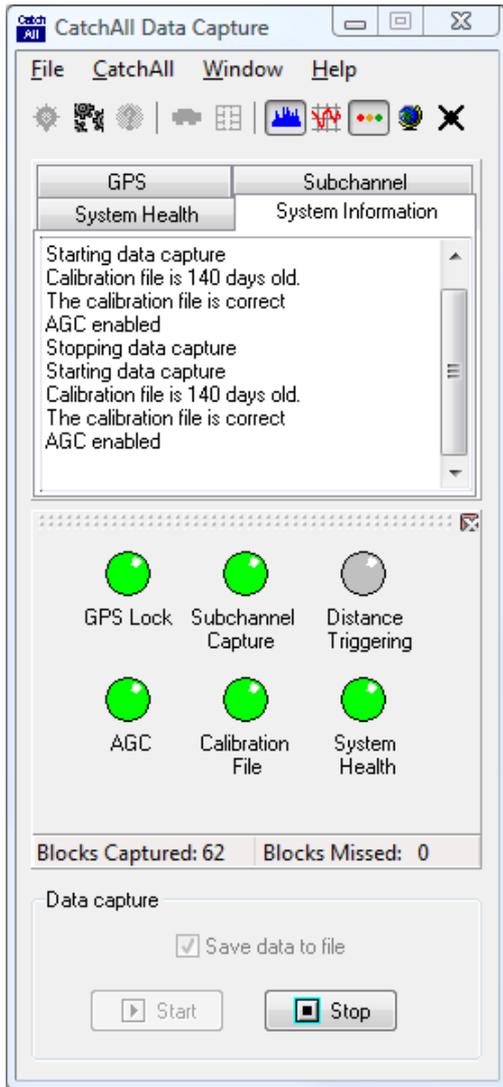
The CatchAll receiver

Depending upon the mode of operation, this band can be scanned up to 200 times per second, and with this scanning rate the CatchAll receiver can accommodate an effective scan list size of 200 TETRA or 400 Tetrapol carriers, thereby eliminating the need to carefully design the scan list prior to each measurement run and also removing any requirement to update the scan list during a measurement run.

Features

- Ultrafast sampling
- Captures up to 20 MHz instantaneously
- Frequency ranges: 380 - 480 MHz
                      870 - 960 MHz
                      1,805 - 1,880 MHz
- Integrated GPS receiver
- Flexible hardware platform
- Lee Criterion scanning
- Raw data captured for post-processing analysis
- Wheel-pulse input to measure distance travelled without GPS

An intuitive user interface makes the CatchAll receiver straightforward to use

samples provides a "spectrum analyser" type display in real-time and a selected channel signal strength display to provide confidence that the system is operational to prevent accidental data loss.

If the CatchAll receiver is operational but data are not being stored, the spectrum analyser-type information is displayed in red. When the PC is storing the data to its hard disk, the display is coloured green.

When the equipment is driven along a test route with only a driver in the vehicle, an audible "heartbeat" reassures the driver that the equipment is functioning. The heartbeat can be disabled if required.

Spectrum and Selected Channel Displays

The CatchAll receiver requires no user operation while it is gathering data, although the PC collecting the data

Lee Criterion Scanning Feature

The CatchAll receiver is intended for use as part of a drive test system for radio-based networks, especially those constructed in a cellular-type arrangement. When a mobile moves, its receiver will encounter a rapidly changing signal strength due to the changing environment around the receiver. Reflections from

An example of the selected channel signal strength display produced while the CatchAll receiver is capturing data (the relatively flat period was captured while the vehicle was stationary at traffic lights)

Map view showing where data have been captured
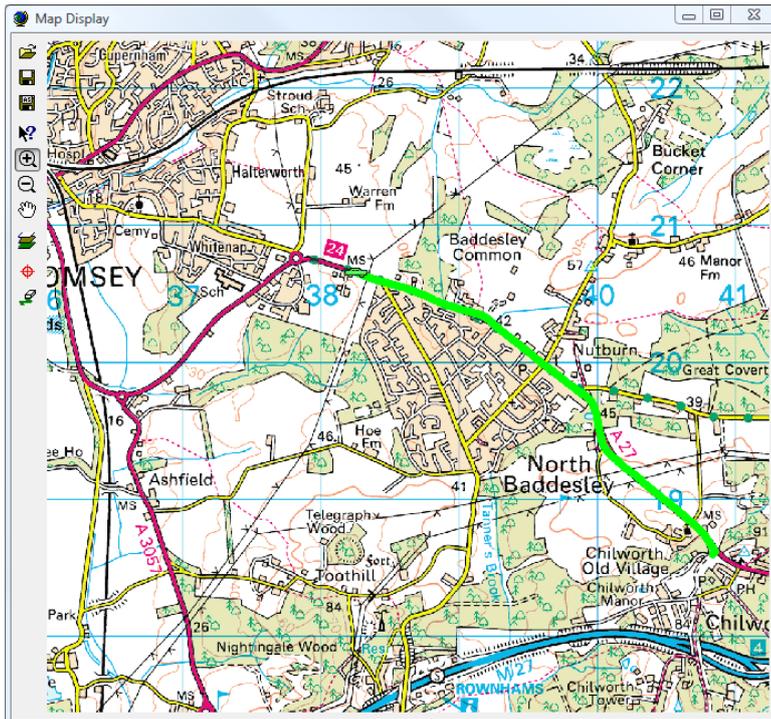
objects between the transmitter and receiver cause multi-path signals, which interfere with and reinforce each other depending upon their relative phase. This is known as fast fading.

To measure the local mean signal strength as the receiver moves requires a certain degree of averaging of the received signal strength measurements. Too short an averaging period would produce rapid and unrepresentative changes in measured signal strength, and too long a period would average out the genuine changes in signal strength that the measurement system is trying to capture.

W. C. Y. Lee[†] determined, and it is widely accepted, that the best averaging distance is between 20 and 40 wavelengths of the signal being measured and that using between 36 and 50 samples in this interval provides for sufficient averaging. This sampling rate is known as the Lee Criterion. For narrowband signals, such as TETRA and Tetrapol, by limiting the instantaneous bandwidth to 5 MHz, the CatchAll is capable of a sampling rate of 125 samples/s. This is sufficient to provide enough samples that the Lee Criterion can be met on all 200 25 kHz carriers, within a contiguous 5 MHz band, whilst the drive test vehicle is travelling at up to 180 kph and is equivalent to a scanning rate of 25,000 channels per second.

For wideband signals such as GSM, the CatchAll can sample the full 20 MHz band 50 times a second, which is sufficient to meet the Lee Criterion at speeds of up to 66 kph at 900 MHz.

[†] *W.C.Y. Lee, Mobile Cellular Telecommunications Systems, McGraw-Hill Book Co., 1989 p. 13—14.*

Software

The data-logging software provides the user interface to the CatchAll receiver. Through the user interface the drive test parameters, such as frequency bands and sampling rate, can be set. During a drive test the data-logging software stores the captured data along with a GPS position and time stamp information for subsequent processing.

The post-processing software analyses the captured data to extract signal strength information for all signals measured during the drive test. Since the amount of data collected may be very large, flexible data filtering is provided so that only data about the signals of interest are exported. The exported data files are in a text format, suitable for subsequent analysis by tools such as MapInfo Professional® or Microsoft® Excel®.

Future enhancements will extend the range of post-processing analysis.

Optional Features

The reconfigurable nature of the CatchAll receiver permits software upgrades to be added easily by the end user. As new functions are designed or refined, upgrades can be supplied electronically for

Post-processed data in comma-separated variable (.csv) text format, suitable for import into many applications

During data capture the attached PC displays a "spectrum analyser" like display, with the advantage of labels identifying specific signal peaks with channel numbers or other transmitter identification
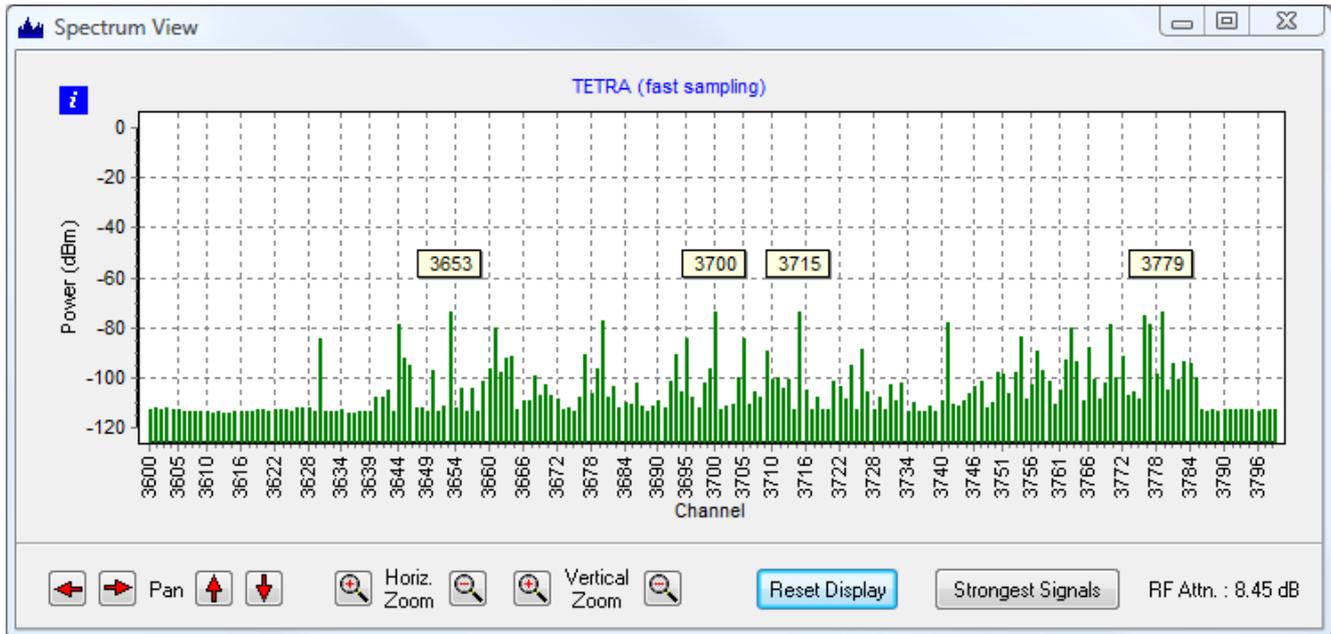
installation via the PC interface. (Some new functions may require additional hardware modules.)

Decoding the control channel is a function that has been the preserve of TETRA mobile units. However, now it can be accomplished with an upgrade option to the CatchAll receiver. With this option the control channels of TETRA base stations within range are decoded to provide more information about the received signal. In addition, the option also provides calculated values of the carrier-to-interference ratio (C/I) and indicates the quality of the downlink by monitoring the Access Assignment Channel (AACH) success rate. Other parameters are also decoded directly from the control channel.

A complementary product designed to provide extensive diagnostic capability using the above information is MAC Ltd's TRAMPS™ TETRA measurement solution. TRAMPS consists of post-processing and data viewing software that enables the intuitive manipulation and display of quality of service (QoS) and RSSI information superimposed on a map of the drive-test route.

Both CatchAll and TRAMPS are now in service in a number of TETRA regions worldwide.

Technical Specification

Frequency ranges	380 MHz to 480 MHz 870 MHz to 960 MHz 1805 MHz to 1880 MHz
Instantaneous scan bandwidth (BW)	20 MHz or 5 MHz
Resolution BW (RBW)	12.5 kHz to 200 kHz
Sampling rate (12.5 kHz RBW) (200 kHz RBW)	≤125 samples/s ≤50 samples/s
RSSI accuracy	±1 dB
Input 1 dB compression point	-15 dBm
Dynamic range (25 kHz BW)	>100 dB
Noise floor (25 kHz BW) better than	-120 dBm
Operating temp range	0ºC to +50ºC
Power consumption	15 W
Supply voltage	12 V
Wheel pulse input Pulse level Pulse rate	 3 V to 6 V Up to 20 kHz

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