Interference and Direction Analyzer IDA 2

Technical Note TN102

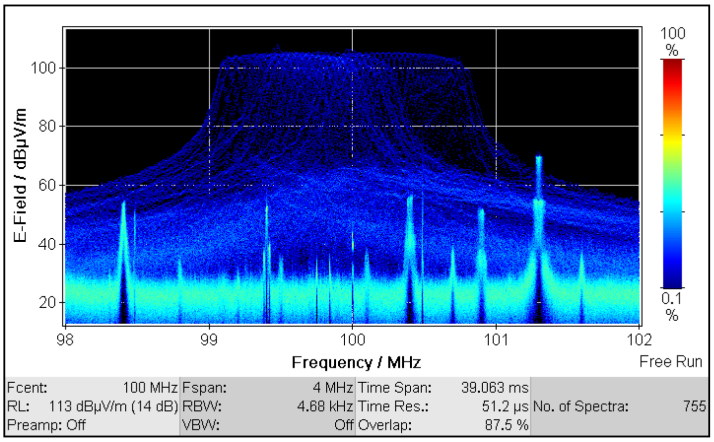
Clock radio disrupts VHF reception

Interference and Direction Analyzer IDA 2 even nails down small interferers

“Alarm clock in Berghof paralyzes air traffic control” was the headline of the “Ruhrnachrichten” newspaper on 11th October 2013, and the same incident was reported on in the local news from Dortmund on WDR TV. Although interference from clock radios is not usually as spectacular and far reaching as that, it occurs much more often than you might think, a fact confirmed by the German Federal Network Agency (Bundesnetz-agentur).

It happens in Pfullingen near Reutlingen, too. VHF reception in part of the Grosse Heerstrasse is disrupted, mainly affecting the broadcasts of SWR3 and Deutschlandradio Kultur around the 100 MHz frequency band. It cannot be due to shadowing by the three-storey apartment block, because radio coverage in the area is excellent. The interference is also limited to a small area, so not worth calling out the Federal Network Agency for; it’s just maybe an interesting case for employees of Narda Safety Test Solutions GmbH who regularly notice the impairment on their way to work.

First of all, they use the IDA 2 to measure the spectrum on the site. It shows the stable FM radio channels and a transient variable frequency interferer.

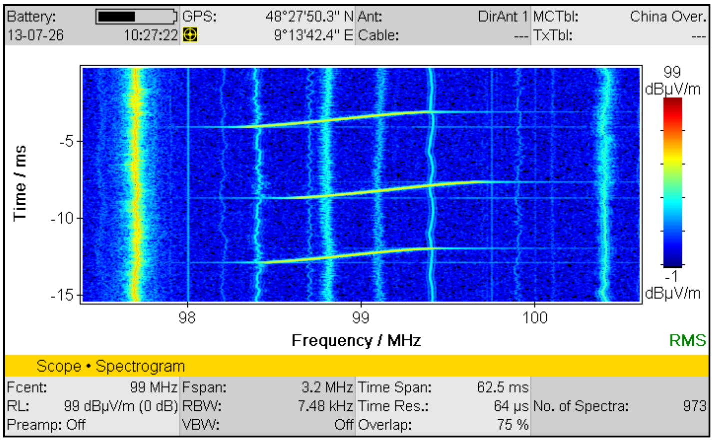


The Persistence Spectrum display “remembers” transient events.

The following spectral lines are stable:
– SWR3 (Hornisgrinde 98.4 MHz),
– Deutschlandradio Kultur (Tübingen 99.4 MHz),
– Radio Regenbogen (Hornisgrinde 100.4 MHz) and
– Hit-Radio Antenne 1 (Stuttgart/Frauenkopf 101.3 MHz).

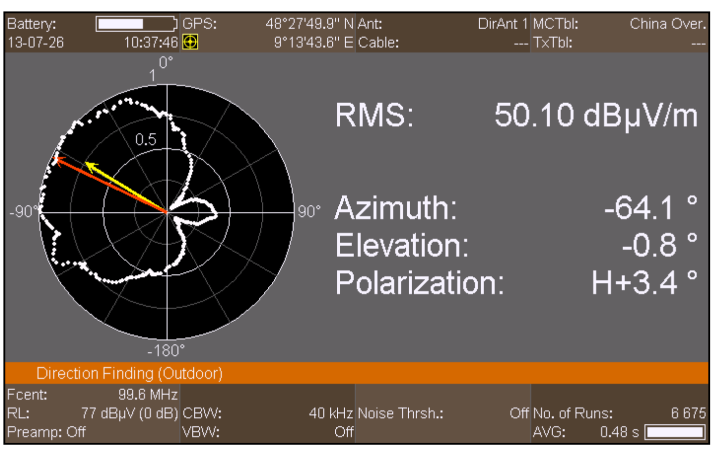
There is sporadic variable frequency interference between about 99 and 101 MHz.

The spectrogram shows that the interference occurs about every four milliseconds, and covers a changing frequency band of roughly 2 MHz over a period of almost one millisecond.



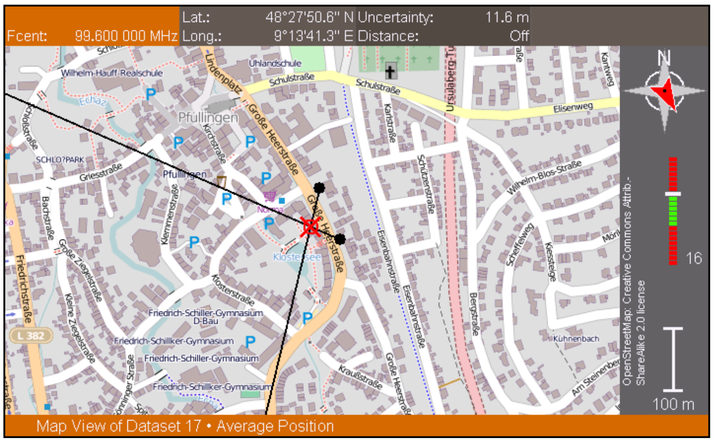
A gapless spectrogram covering 15 ms. The interference appears roughly every 3.8 ms and takes about 0.8 ms to move from a lower to a higher frequency across a variable bandwidth.

To make direction finding more difficult, as well as the transient nature of the interference, the signal is at approximately the same level as the radio signal and disappears completely a bit further away – a sure indication that the source must be in the immediate vicinity. Reflections on buildings are an additional difficulty in the urban environment. For these reasons, initial direction finding is performed from areas on the street that are as open as possible. A frequency within the disrupted range that is not occupied by a radio broadcaster is selected as the measurement frequency, and a narrow measurement bandwidth excludes the adjacent broadcast radio frequencies.



A Horizontal Scan, i.e. taking bearings all round, at a frequency of 99.6 MHz and a bandwidth of 40 kHz. The result is shown as a polar diagram. The red arrow indicates the maximum and hence the suspected direction of the interference source.

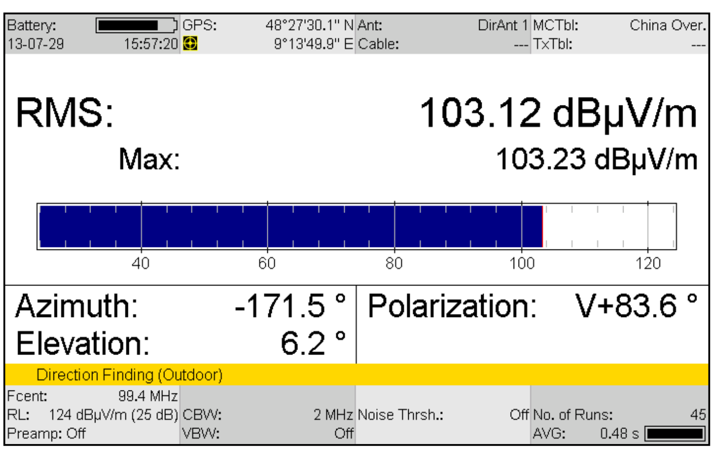
Triangulation from two Horizontal Scans indicates the apartment block on the opposite side of the street; the area can be narrowed down to just a few houses.



Triangulation indicates the likely location of the interference source.

A further bearing taken from the back of the buildings, together with a direct measurement of the interference signal level close to the buildings serves to confirm the result of triangulation. The highest level at the side of the road is definitely in front of one house, but in front of the next door house when measured at the back of the row of buildings.

The next stage involves the cooperation and courtesy of the residents. Measurements in the stairwell of the first suspected building, a three storey block containing six apartments, give more information: The floor and apartment can be determined from taking bearings manually. The residents are ready to help and are appreciative, so the source of the interference can be identified in next to no time: a simple clock radio like one you can find in almost every home.

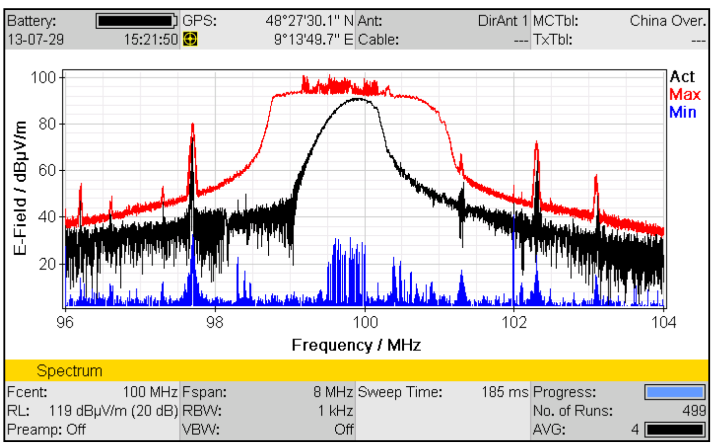


The final meters of direction finding: Looking for the maximum level.

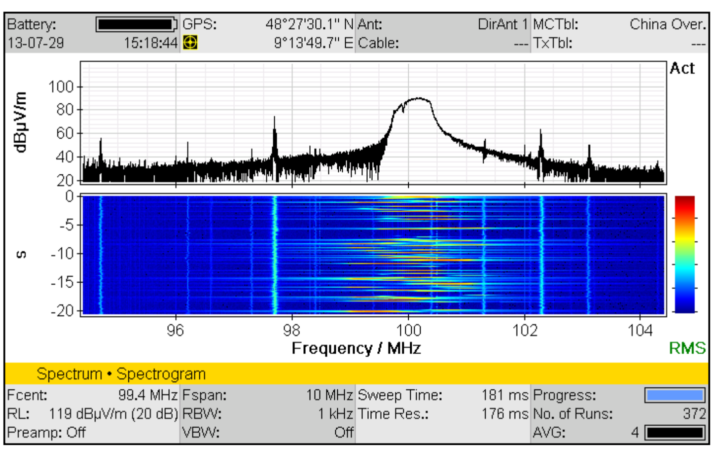
Finding does not mean eliminating. The somewhat unconventional solution here: The Narda employees provide the owners with a new clock radio and take the defective one with them to examine as an object of interest – but this time in the screened laboratory, of course.

The actual cause turns out to be the defective phase locked loop (PLL) in the VHF receiver of the clock radio, which sweeps through a wide frequency range, causing interference in the reception of several radio transmitters in the vicinity. Many clock radios are still used for the clock or alarm function even though the radio receiver is defective and apparently "dead", so the device can often interfere with other radio services for a long time without being discovered.

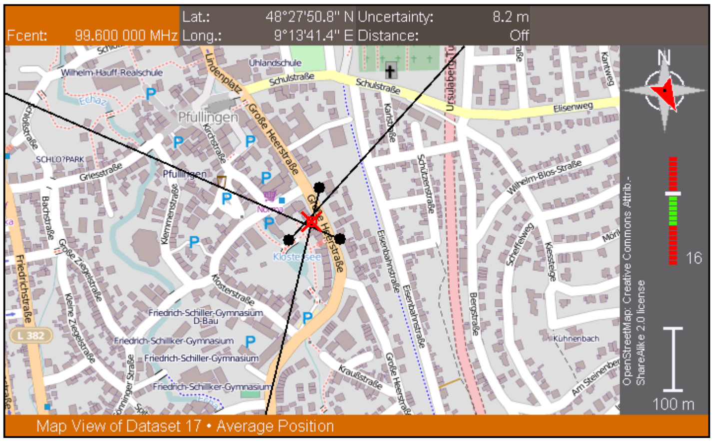
Further measurement results



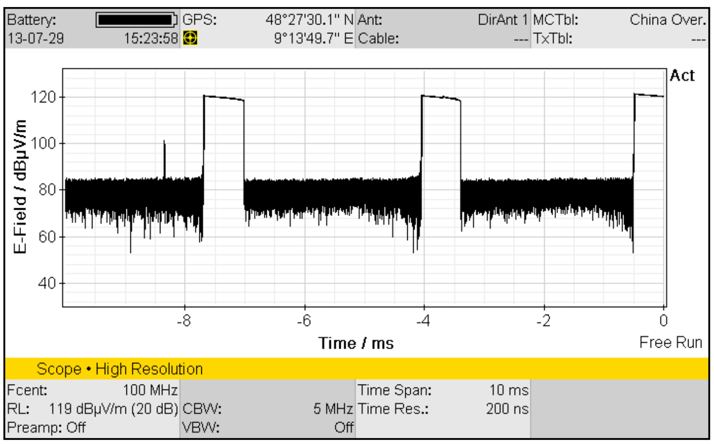
Spectrum mode. The type of interference becomes clear when you display the actual, maximum and minimum levels.



A single spectrum (above) taken from the spectrogram (below). The time characteristic can be followed by retrieving the individual spectrums one after the other.



A third bearing taken from behind the building helps to confirm the result.



Direct examination of the defective device. Scope mode shows the time characteristic of the interference signal level exactly.

Narda Safety Test Solutions GmbH
Sandwiesenstrasse 7
72793 Pfullingen, Germany
Phone: +49 7121-97 32-0
Fax: +49 7121-97 32-790
E-Mail: support.narda-de@L-3com.com
www.narda-sts.de

Narda Safety Test Solutions
435 Moreland Road
Hauppauge, NY 11788, USA
Phone: +1 631 231-1700
Fax: +1 631 231-1711
E-Mail: NardaSTS@L-3COM.com
www.narda-sts.us

Narda Safety Test Solutions Srl
Via Leonardo da Vinci, 21/23
20090 Segrate (Milano) - Italy
Phone: +39 02 269987 1
Fax: +39 02 269987 00
E-mail: nardait.support@L-3Com.com
www.narda-sts.it