re-discover radio

FlexRadio Systems®
Software Defined Radios

FlexRadio Overview
Software Defined Radios

November 2014

FlexRadio Systems

What is *Software Defined*?

- Modulation using software, changeable YES
- Digital Signal Processing in software YES
- Control Surface Reconfigurable YES
- Can add new feature with new control YES
- Radio controlled by software YES

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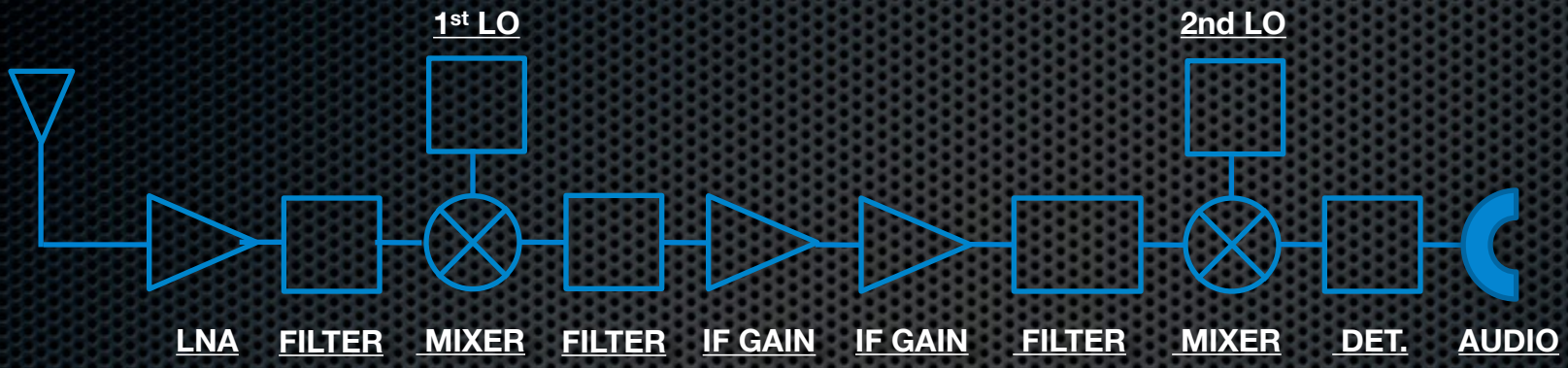
Radio RF/IF Architectures

- Multi-conversion a.k.a. superheterodyne
  - Your car radio, your TV, any older scanner you have
  - Most every Kenwood, Icom, Ten-Tec, Elecraft and Yaesu on the market today
- Direct Conversion
  - FLEX-5000, FLEX-3000, FLEX1500, Elecraft KX3
- Direct Sampling a.k.a wideband
  - FLEX-6000, HPSDR, ANAN-100

Multi-Stage HW Receiver Chain



Legacy HW/DSP Receiver Chain

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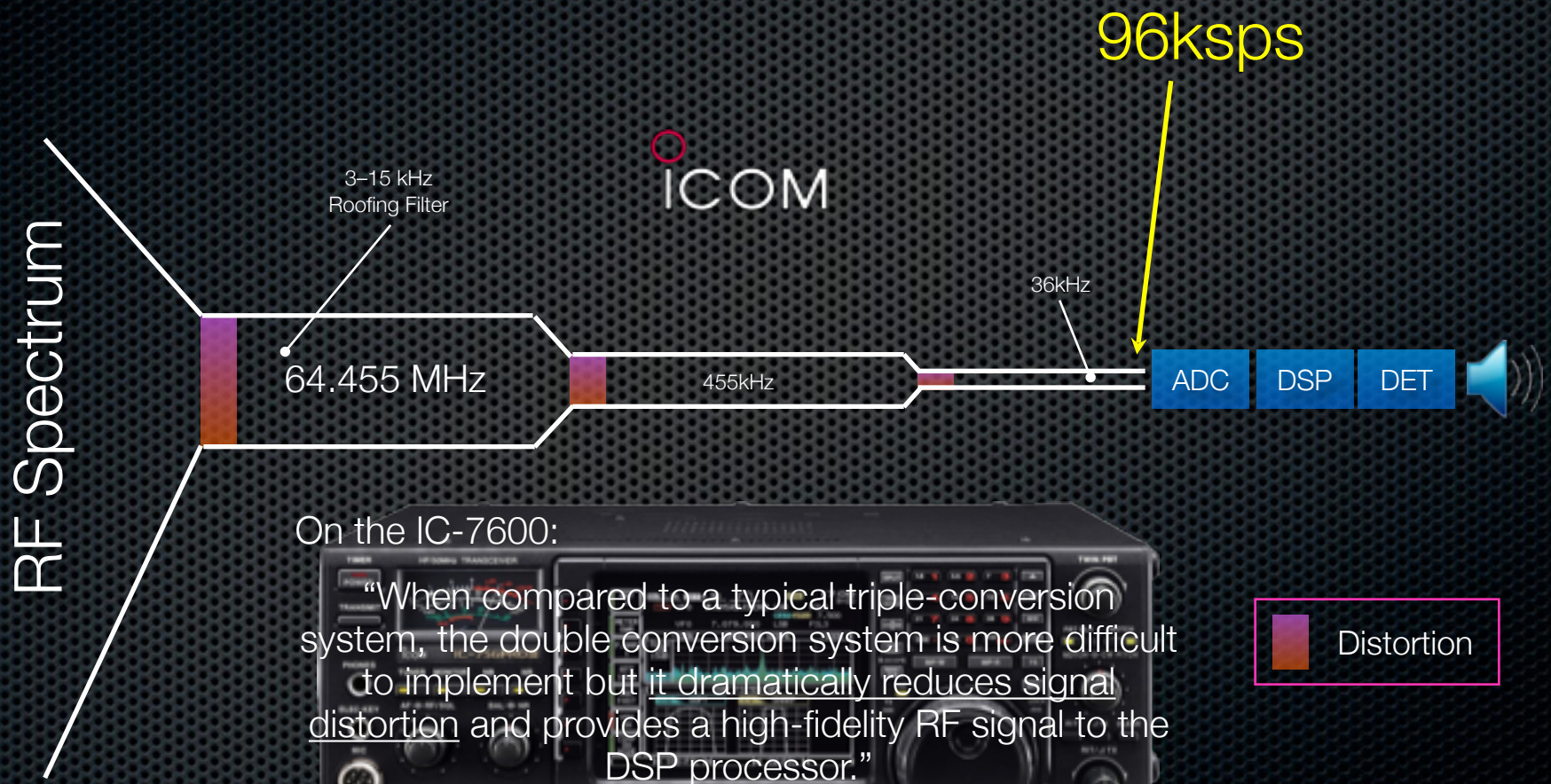
Multi-Conversion



On the IC-7600:

"When compared to a typical triple-conversion system, the double conversion system is more difficult to implement but it dramatically reduces signal distortion and provides a high-fidelity RF signal to the DSP processor."

— Icom America website

Distortion

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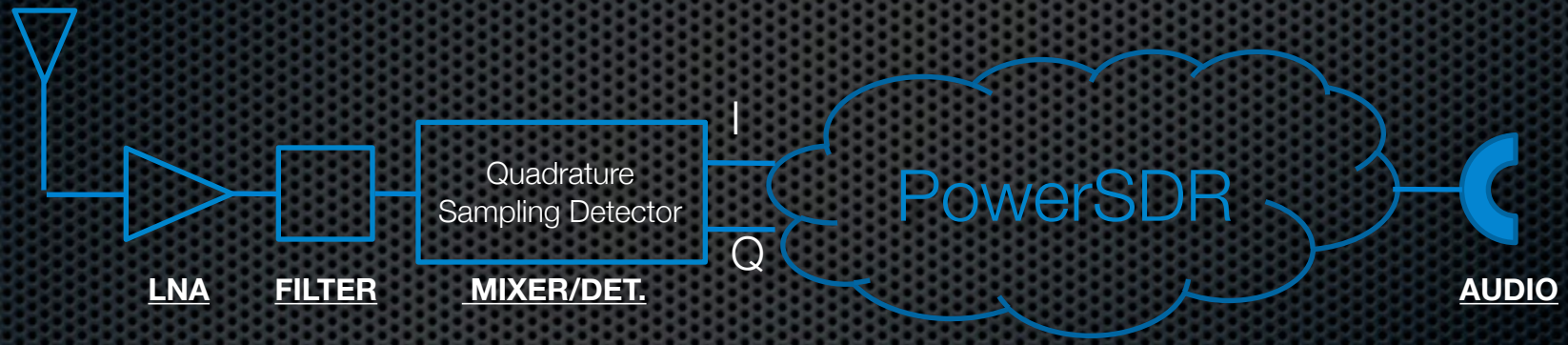
Multi-Conversion
The good and bad

- + Adjacent band signal rejection: operate in harsh signal conditions
- + Common, well-accepted design: works well
- – Only signals in the final IF can be tuned
- – Distortion introduced in each stage of filtering and mixing
- – Limited view of spectrum
- – For best filtering, requires expensive crystal filters (multiple)

“QSD” Direct Conversion Chain



Direct Conversion

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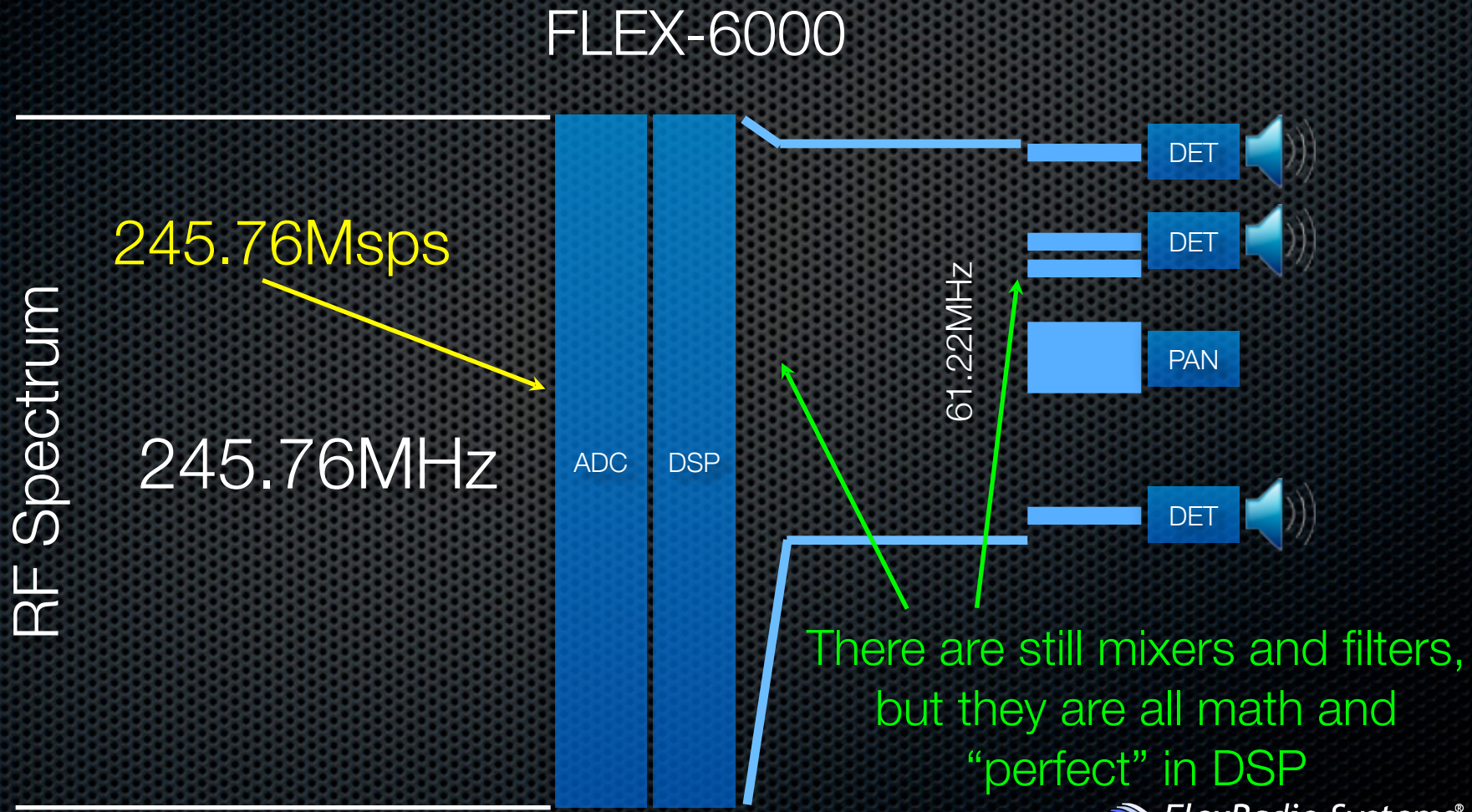
Direct Conversion
The good and not-so-good

- \+ Distortion minimized with only one mixer:
  clear signal — sounds better, less fatigue (less in-band distortion)
- \+ Can show 192kHz of realtime spectrum:
  wide panadapter view
- \+ Low power, high dynamic range:
  interference mitigation
- – Image rejection difficult (balanced IQ mixer, WBIR)
- – Better, but still limited view of spectrum

Direct Sampling Converter Chain

Direct Sampling



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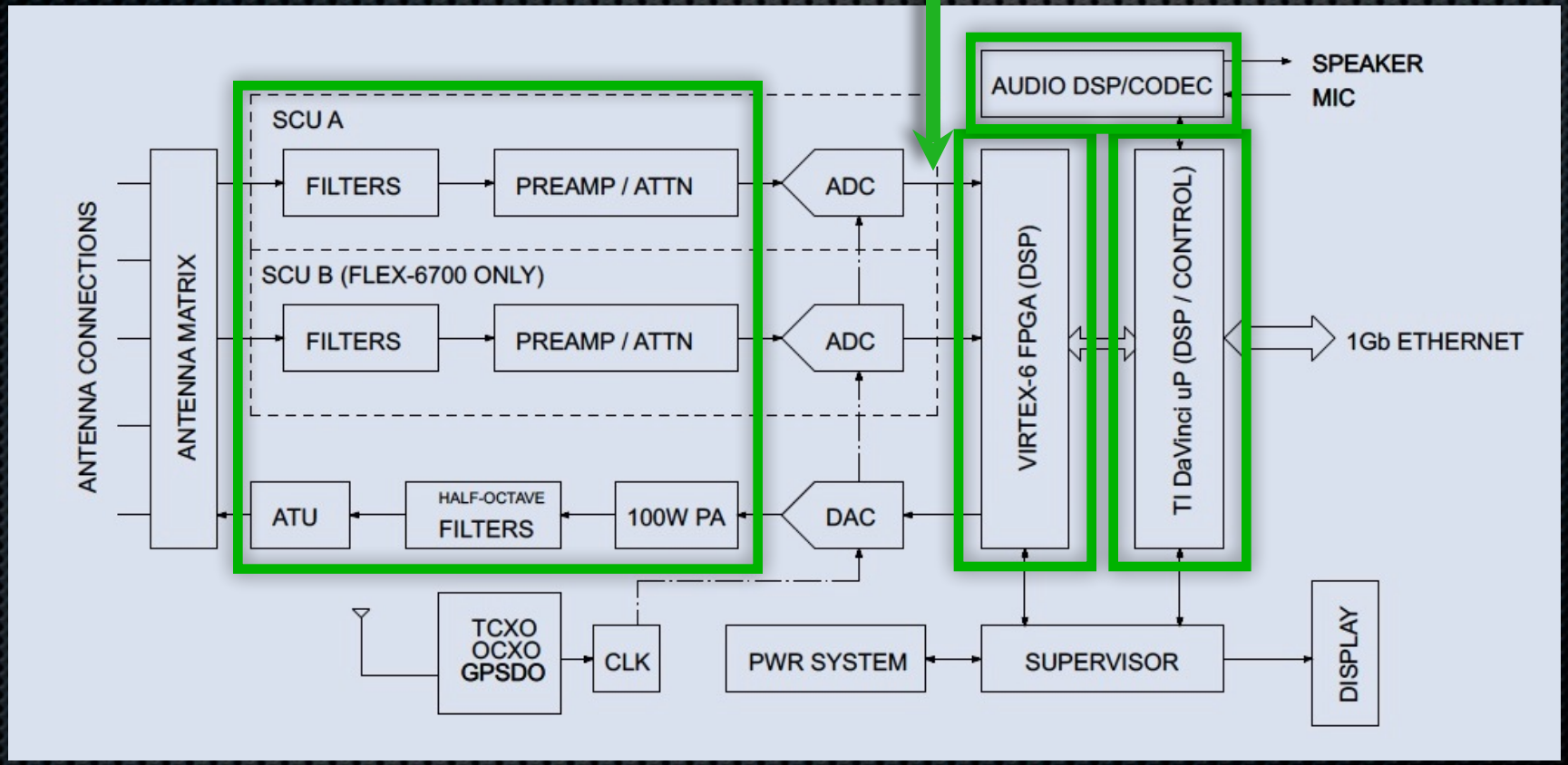
Direct Sampling Benefits

- + Distortion minimized (ADC @ antenna): best signal clarity
- + n-Receivers, n-Panadapters and varying widths see more bands, more receivers
- + Extremely high dynamic range: operate in worst conditions
- + Extreme flexibility through reprogrammability (*ultimate* SDR): future benefits
- – Technically challenging to design

Third Generation SDR

7.9Gbps + 1Gbps



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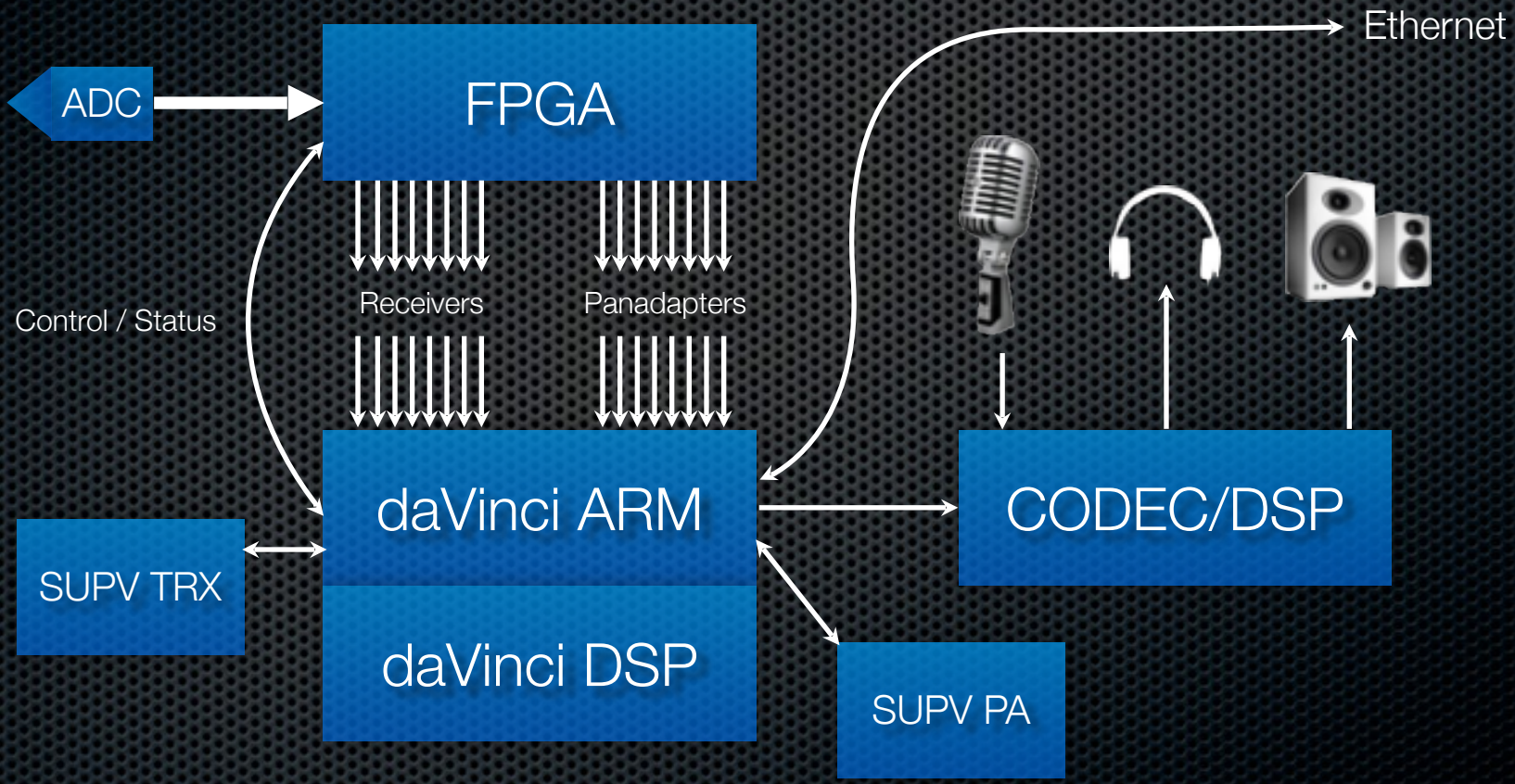
FLEX-6000 Architecture



FLEX-6000 Family Highlights

- Up to 8 full performance Slice receivers in one radio!
- >100dB 2-tone 3rdOrder Dynamic range
- IP3 > +45dB
- Unimaginable Digital Signal Processing Power
- Designed for Networked Operations
- New SmartSDR™ Technology and User Client Interface

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FLEX-6700 HF/6M Transceiver

- Dual Spectral Capture Units
  - Optimal Signal combining
  - Beam Steering, Null Forming, Diversity
- Up to 8 full performance Slice receivers in one radio!
- >105dB 2-tone 3rdOrder Dynamic range
- IP3 > +45dB
- 10KHz to 72MHz + 135 to 165MHz reception
- Low Power 144MHz output (+10dBm nom.)
- 100W PA with built in Antenna Tuner
- Ethernet Interface - Network Ready!

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FLEX-6700

Ultimate Performance SDR

- Serious single-op
- Monitor multiple bands on multiple antennas
- Diversity Platform
- Adds 2m operation

FLEX-6500 HF/6M Transceiver

- Up to 4 full performance Slice receivers in one radio!
- Contest-Grade Amateur Preselector Filters
- Ethernet Interface - Network Ready Hardware
- IP3 > +45dB
- >105dB 2-tone 3rdOrder Dynamic range
- 10KHz to 72MHz reception
- 100W PA with built in Antenna Tuner

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FLEX-6500

Advanced Performance SDR

- Multi-multi or DXpedition
- Monitor several bands at once
- Half-octave transmit filters for MARS, SHARES, etc.
- Preselectors
- ESSB
- Transverter Common or Split

FLEX-6300 HF/6M Transceiver

- Up to 2 full performance Slice receivers
- >105dB 2-tone 3rdOrder Dynamic range
- IP3 > +45dB
- 10KHz to 54MHz reception
- Ethernet Interface - Network Ready
- Low Power 144MHz output (+10dBm nom.)
- 100W PA
- Optional Antenna Tuner

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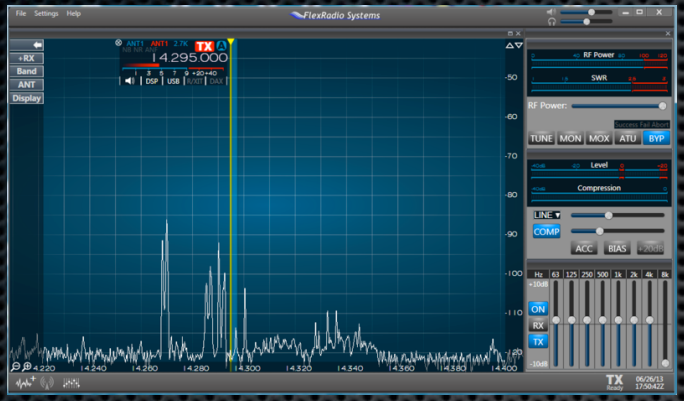
FLEX-6300

High Performance SDR

- Budget conscious single-antenna operator
- Monitor two bands at once
- Direct Sampling
- Transverter Common

Spectrum Display BW



1[illegible]MHz
<500kbps

1[illegible]MHz
77[illegible]Mbps

1[illegible]:1
Bandwidth
Difference

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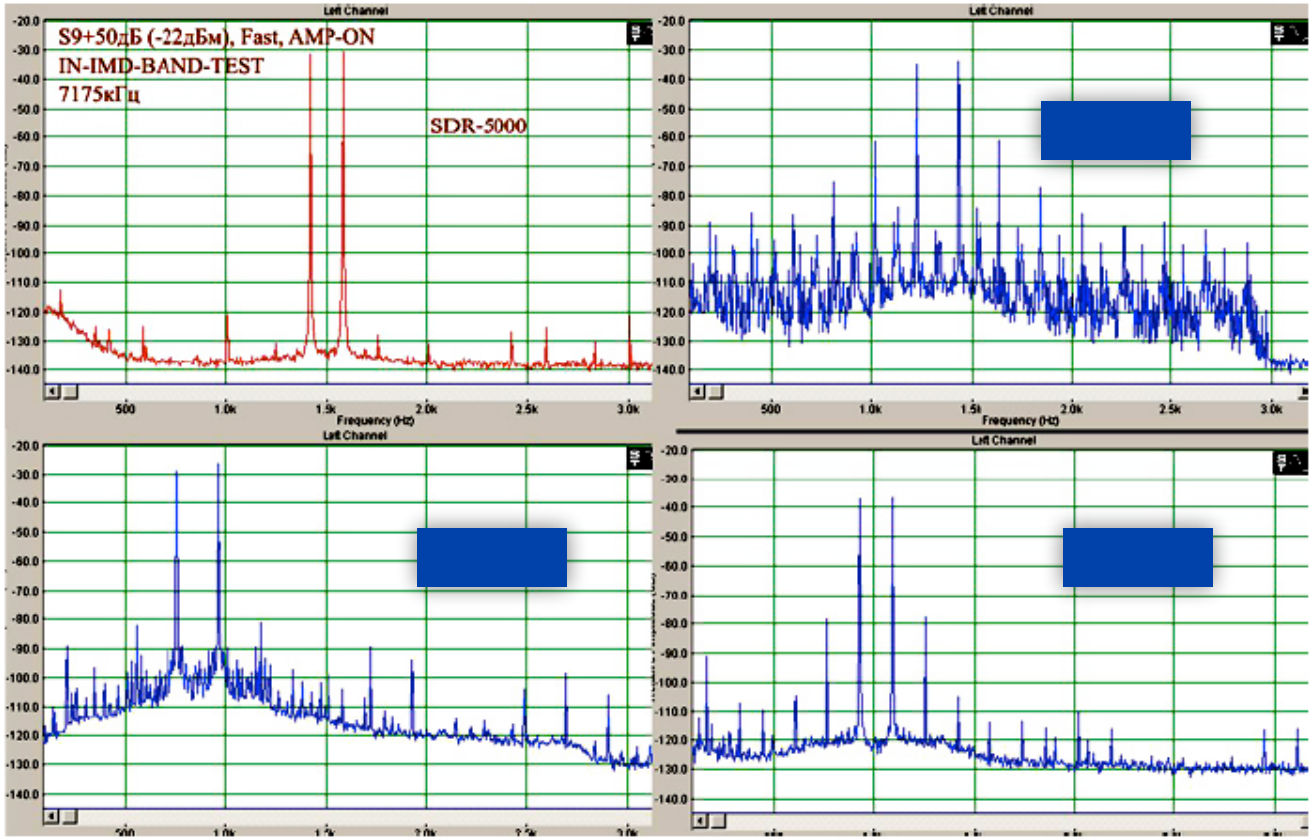
Sherwood Engineering

Data from UR5LAM on 4 Transceivers



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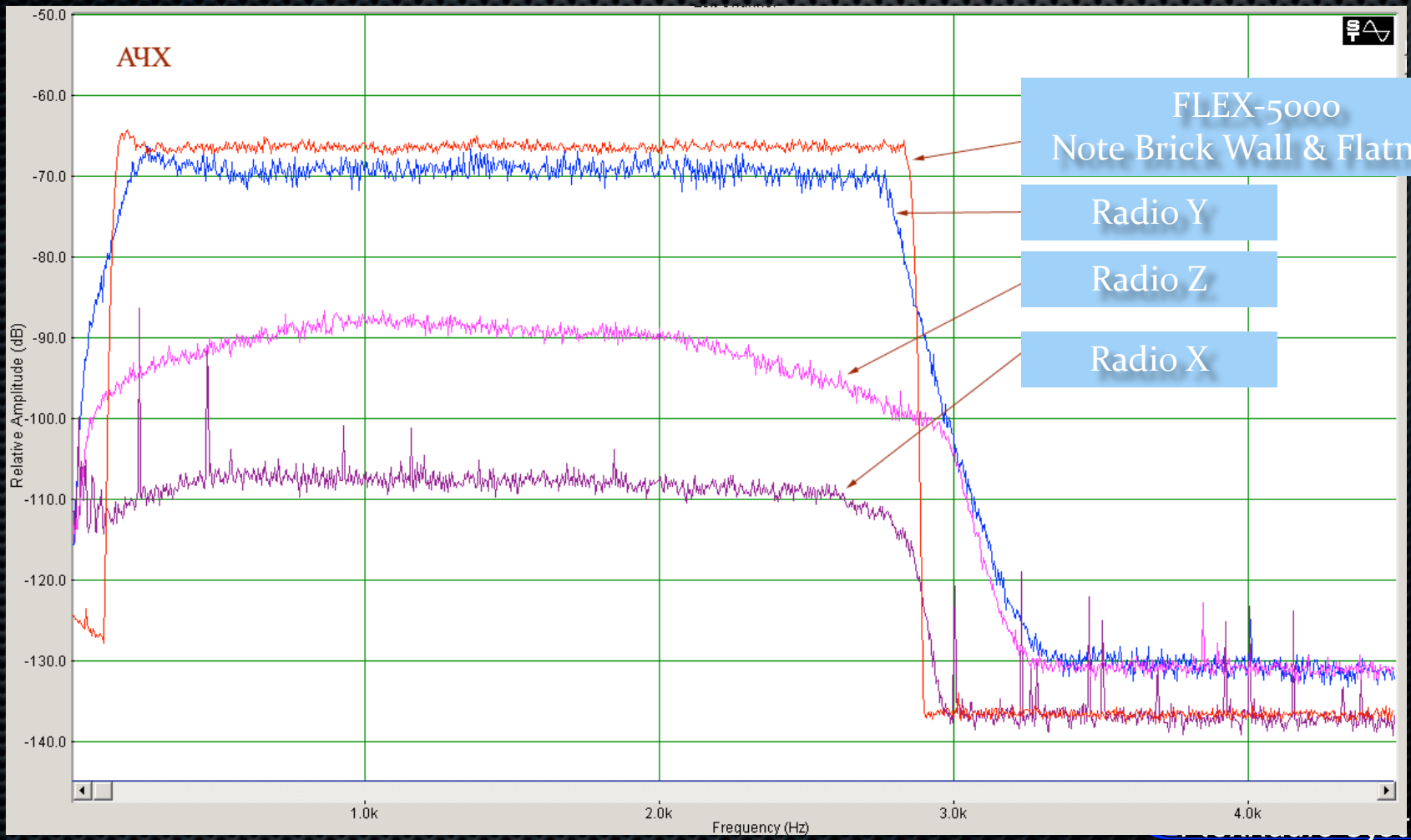
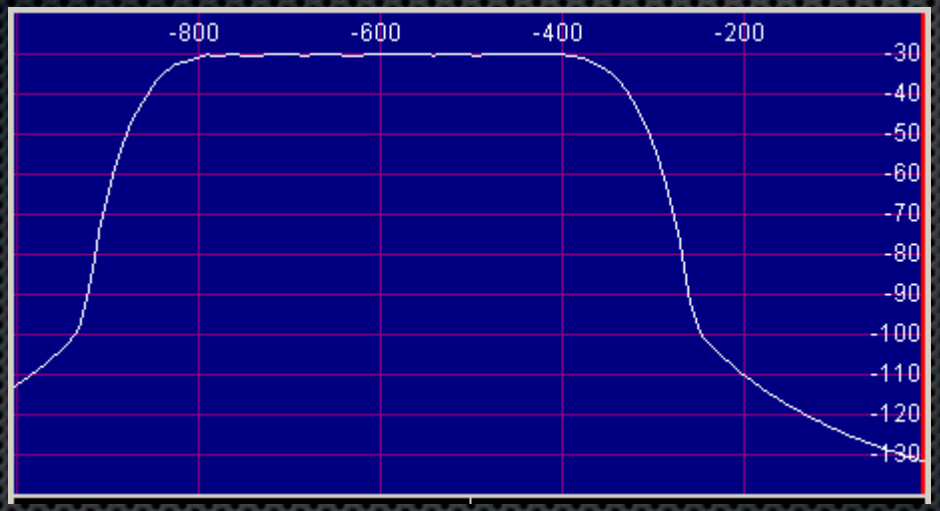
Filter Shape Factor



500 Hz Brick Wall Filter



6dB Bandwidth 487 Hz, 60dB Bandwidth 660 Hz, Shape Factor ~1.35

4096 Bin FFT and 2048 Tap Filter

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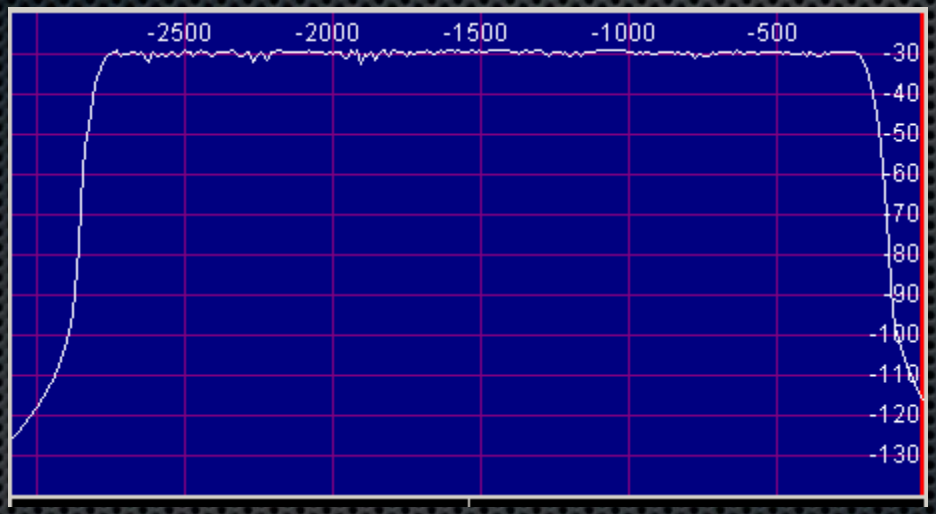
2.8KHz SSB Filter Spectrum



6dB Bandwidth 2587 Hz, 60dB Bandwidth 2756
Shape Factor ~1.06, 2048 Tap Filter

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250Hz CW Filter

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Minimum Discernable Signal vs. Mother Nature & Man

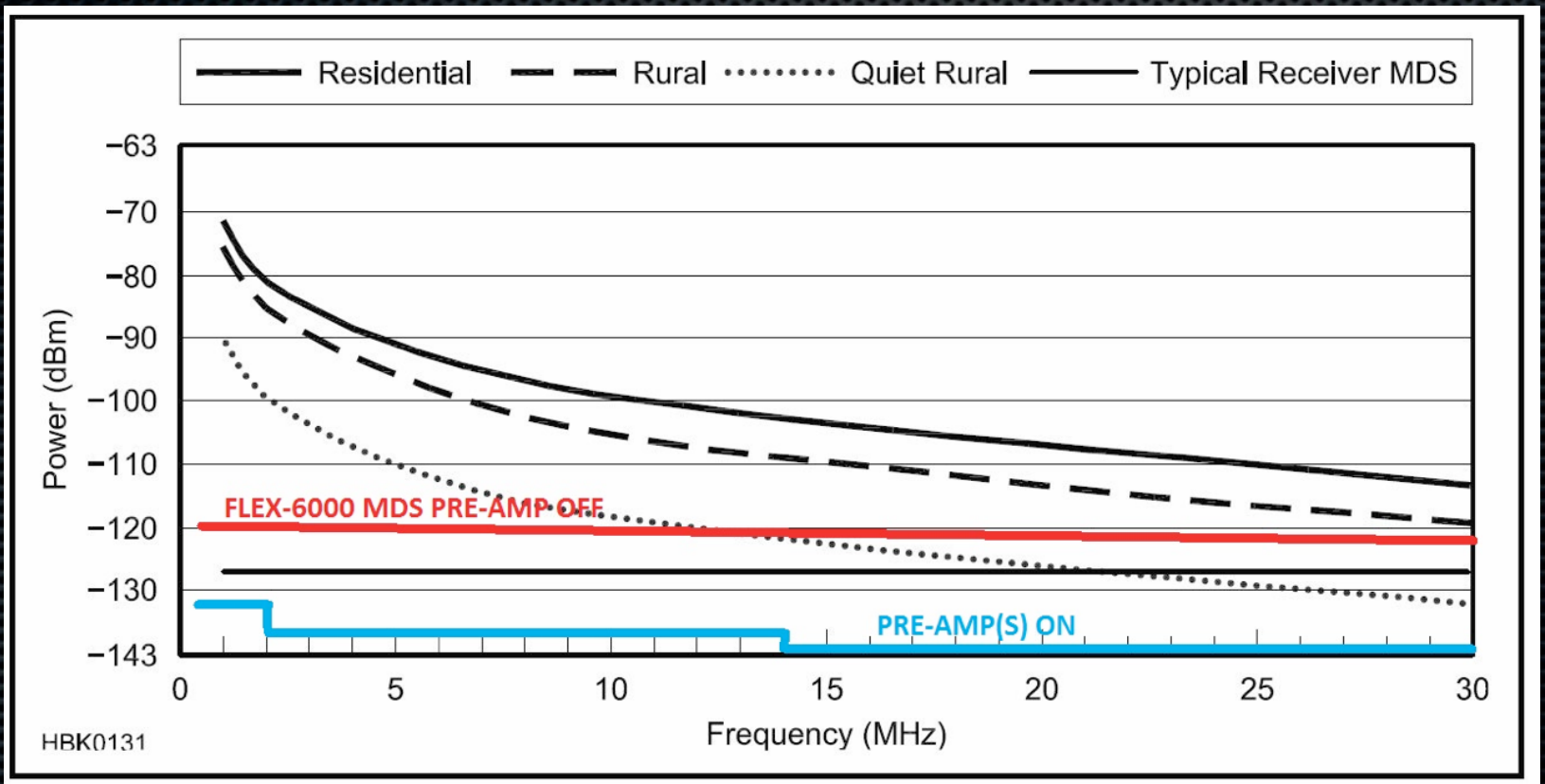
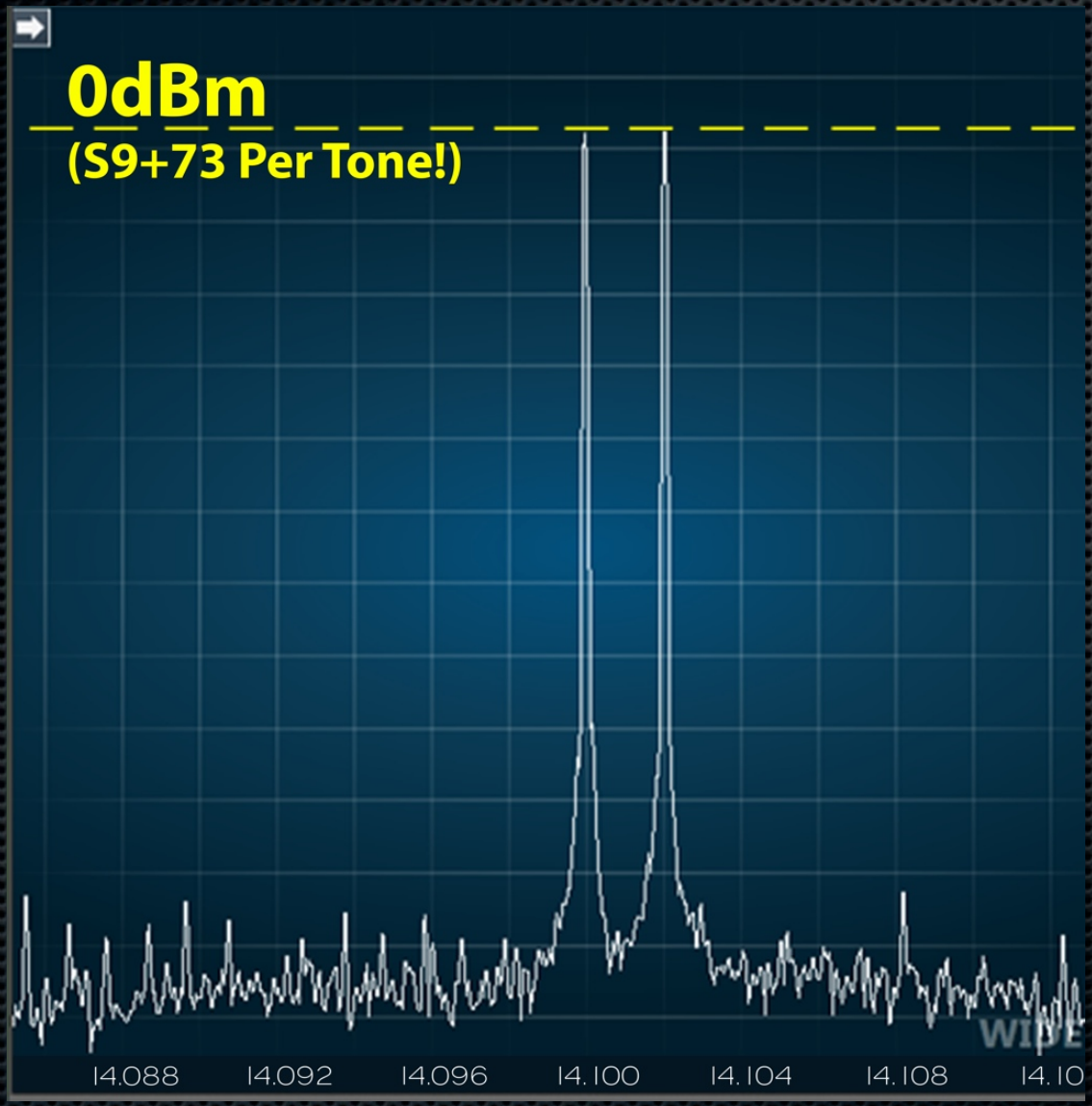


Fig 19.37 — Typical noise levels versus frequency for various environments. (Man-made noise in a 500-Hz bandwidth, from Rec. ITU-R P.372.7, *Radio Noise*)

High Dynamic Range



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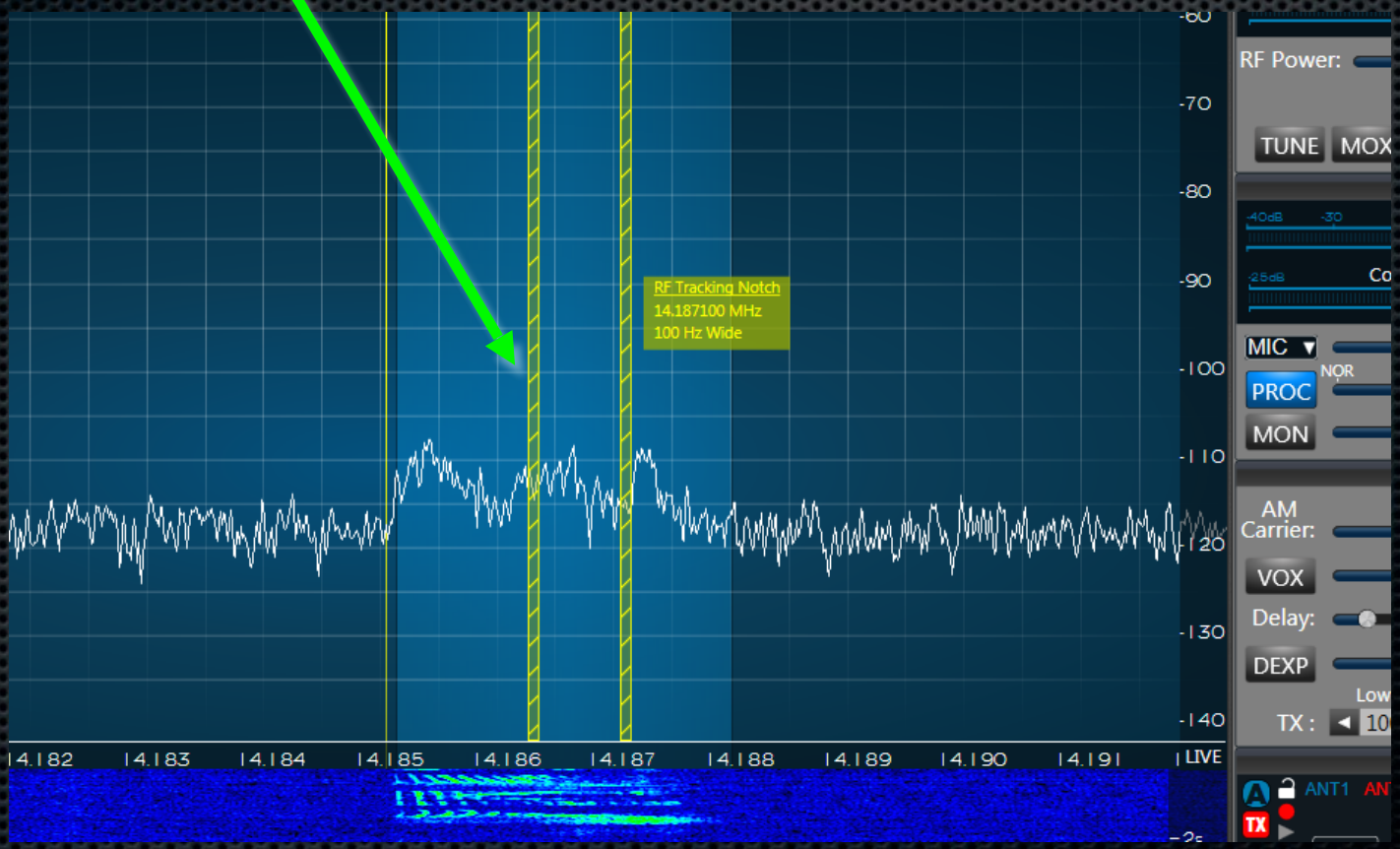
RF Tracking Notch Filters

Add a notch with a single mouse click!



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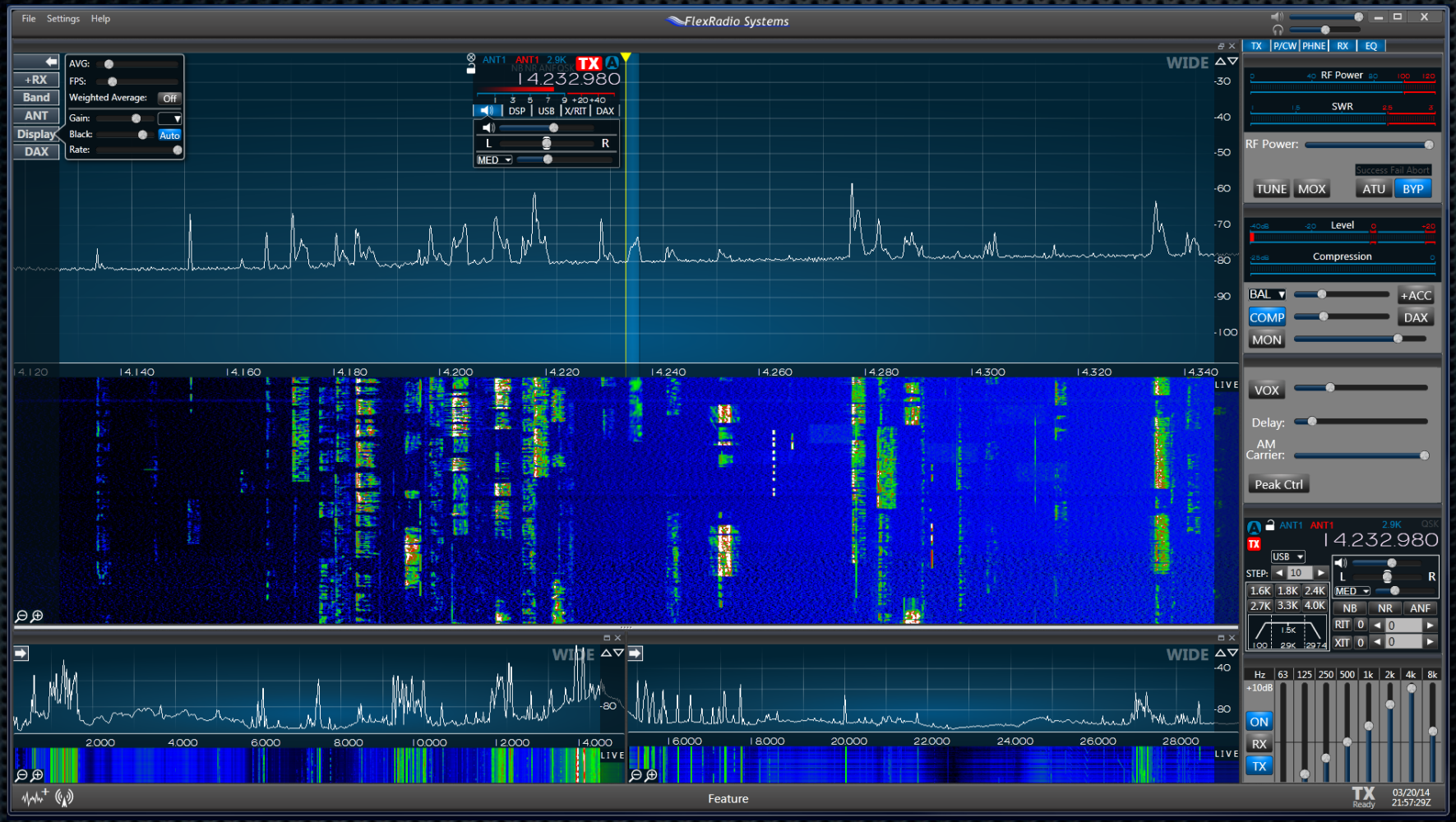
Waterfall plus Bandscope



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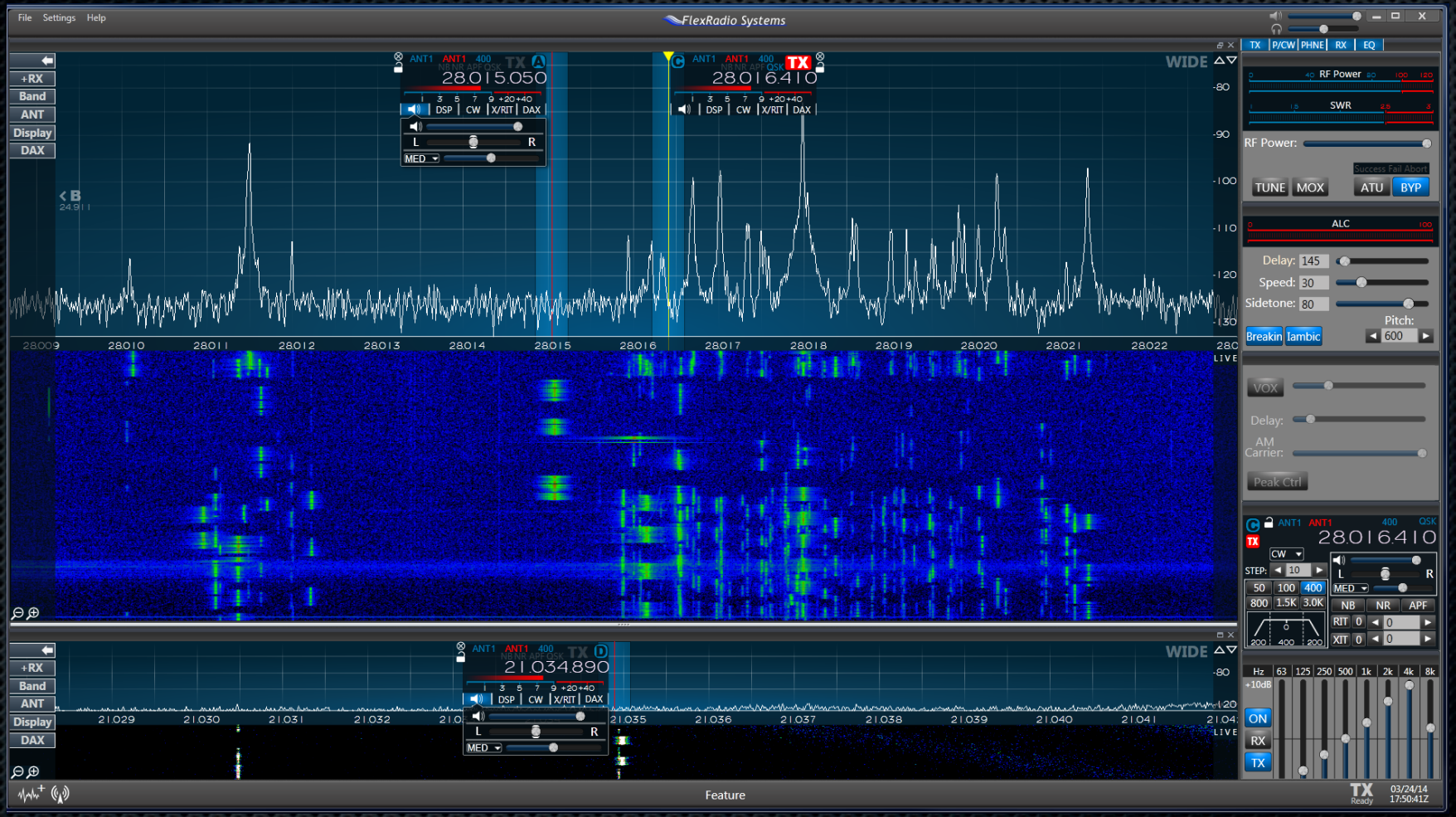
TX6G - 10m UP UP EU EU!



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Possibilities —

What could you do with:

- Four, six, or eight receivers or panadapters
- The ability to directly decode and display digital modes
- Ethernet connectivity to talk to the world
- The ability to combine receivers in disparate locations
- The ability to transmit locally and listen to yourself remotely
- Access to remote databases on the Internet
- A radio appliance that can be connected via Ethernet to any computer

Questions?

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