

# Emerging EMC Threats

## Radio Society of Great Britain



Advancing amateur radio since 1913

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**Dr John Rogers, M0JAV**



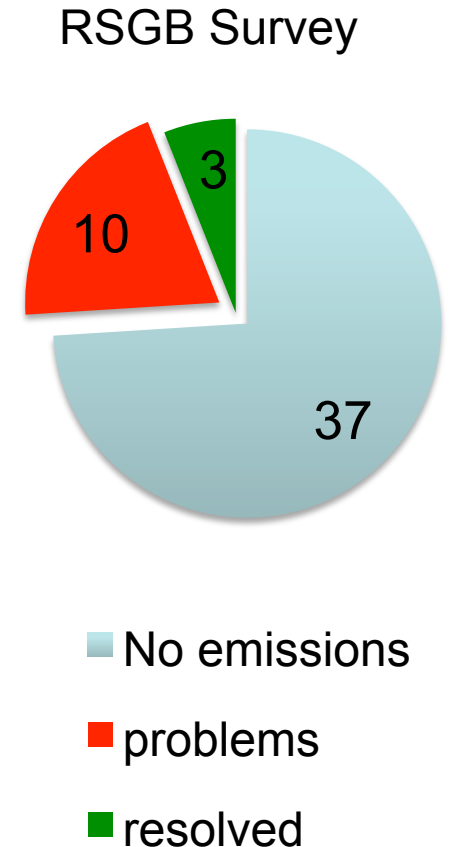
# What do we mean by “Emerging Threats” ?

- Green Energy
  - Solar PV
  - Wind Farms
  - LED Lighting
- Communications – Broadband
  - xDSL
  - PLT
- Others
  - SMPSU's USB chargers
  - Wireless Charging – next investigation

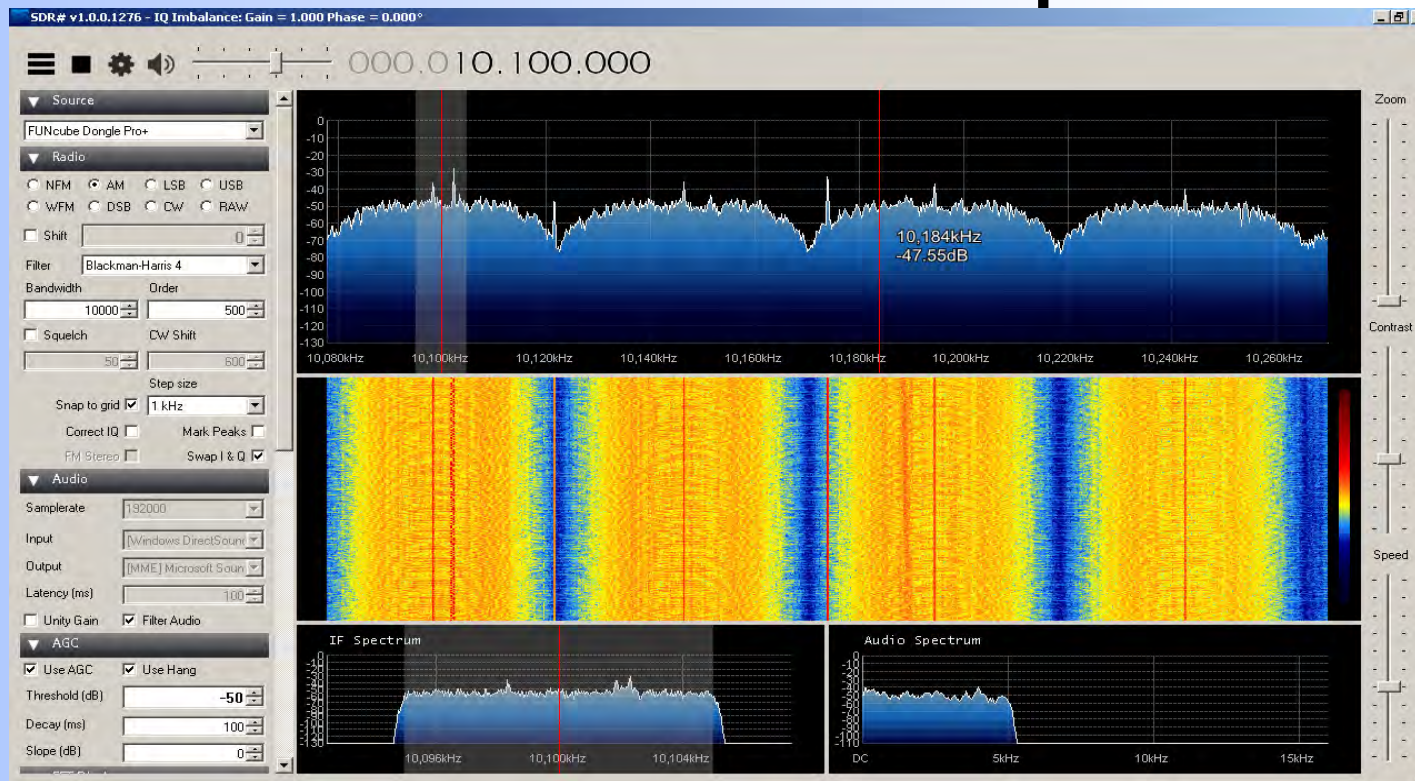


# Solar PV Characteristics

- Cause / Reports
  - Grid-tied Inverter converts DC from panels to AC (synchronous to Grid)
  - Optimisers (switching DC-DC converters) may be fitted to individual panels
- Spectra / Sounds
  - Typically peaks at intervals of ~50 kHz modulated with 100Hz buzz
  - Some recent solar PV systems appear to use Dithered Clocks which spread inverter harmonics over a wider bandwidth



# Solar PV Spectra



Broad band emissions up to 40dB above typical background noise level on 10.1 – 10.15 MHz band

- Mitigation
  - DC cables should be run as closely spaced pairs
  - Clip-on ferrites may be required on DC cables
  - May be necessary to change inverter or optimisers





# Wind Farms

- Some wind farms radiate QRM at up to S9 + 30 dB across the 1.81 - 2MHz band
- Pulse modulated with relatively low duty cycle but peak field strengths of over 40dB( $\mu\text{V}/\text{m}$ ) at a distance of 3km.
- Only seen so far on wind farms that are built on low-lying fen land, 1 - 2 metres above mean sea level



# Noise near Althorpe windfarm





# Windfarm noise G3VBS



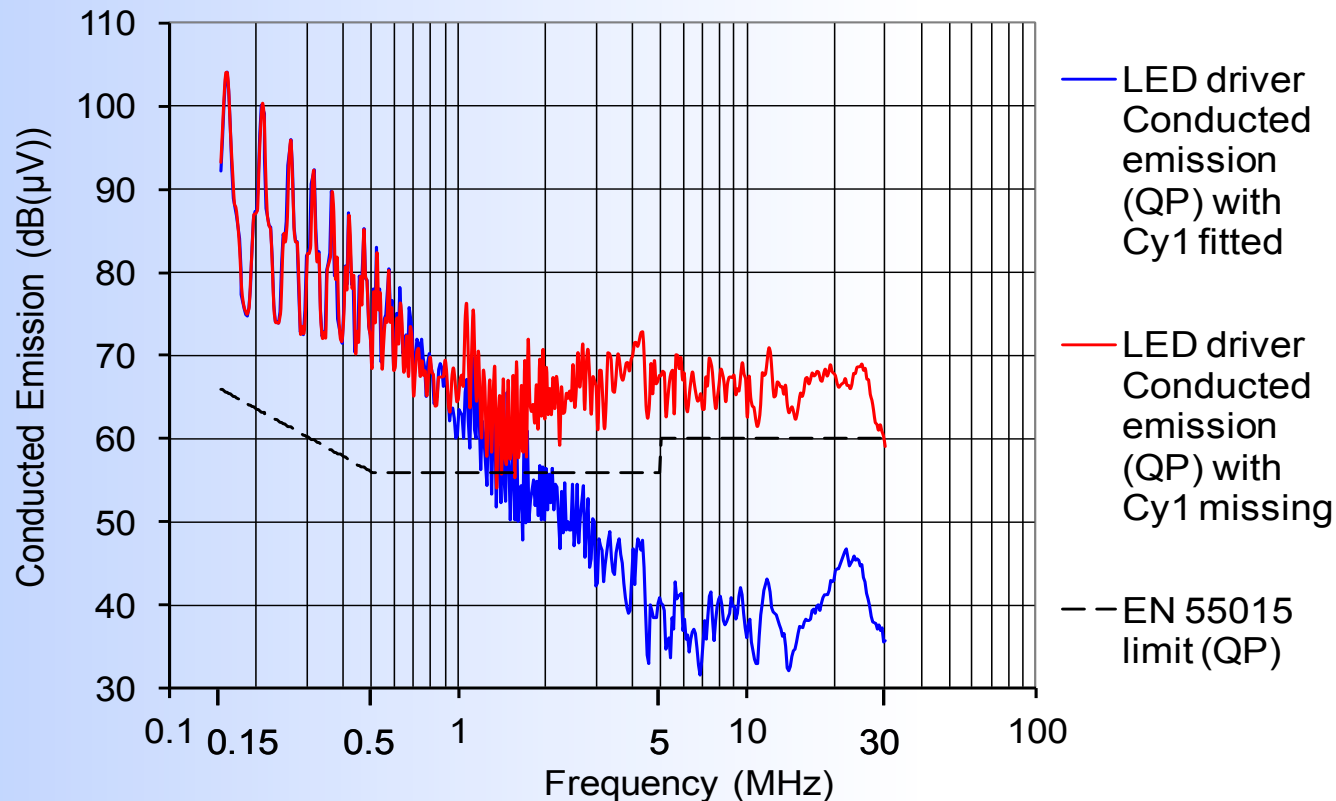


# Noise near Windfarm Goole





# LED Lighting

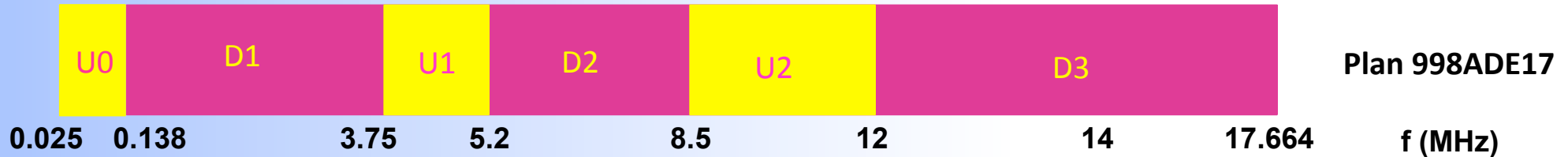


- Some LED drivers fail conducted emission limits below 1 – 2 MHz by up to 40 dB (red and blue traces)
- Missing Class 'Y' capacitors can increase emissions at 3 – 30 MHz by up to 25 dB (red trace)



# FTTC based VDSL2

- Usage of up/downstream bands depends on distance from cabinet - attenuation increases with frequency



- System uses frequencies with acceptable S/N  
=> reducing use of higher bands further from cabinet
- Upstream signals stronger than downstream at user, but upstream power is backed off to minimise crosstalk
- VDSL is active all the time users modem is powered up
- Few reports of VDSL RFI even with coverage of 66%
- Most reported cases are from someone else's VDSL





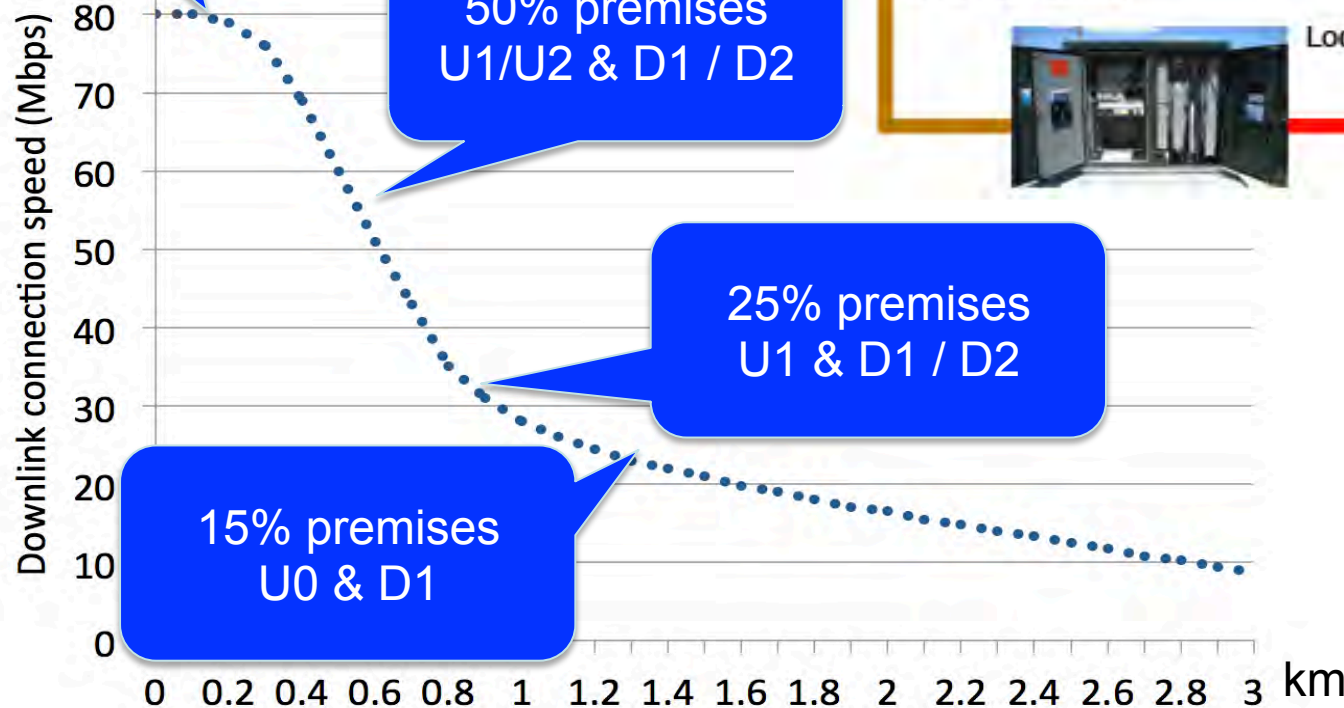
# VDSL2 – distance from cabinet

10% premises  
U1/U2 & D1/D2/D3

50% premises  
U1/U2 & D1 / D2

25% premises  
U1 & D1 / D2

15% premises  
U0 & D1



Existing copper supply  
from local cabinet



Local green cabinet

Telephone exchange



New fibre optic link

Normally no  
problem when  
underground  
cables used for  
final drop

Think Broadband



# U1 @ QTH M0JAV 1km from cabinet

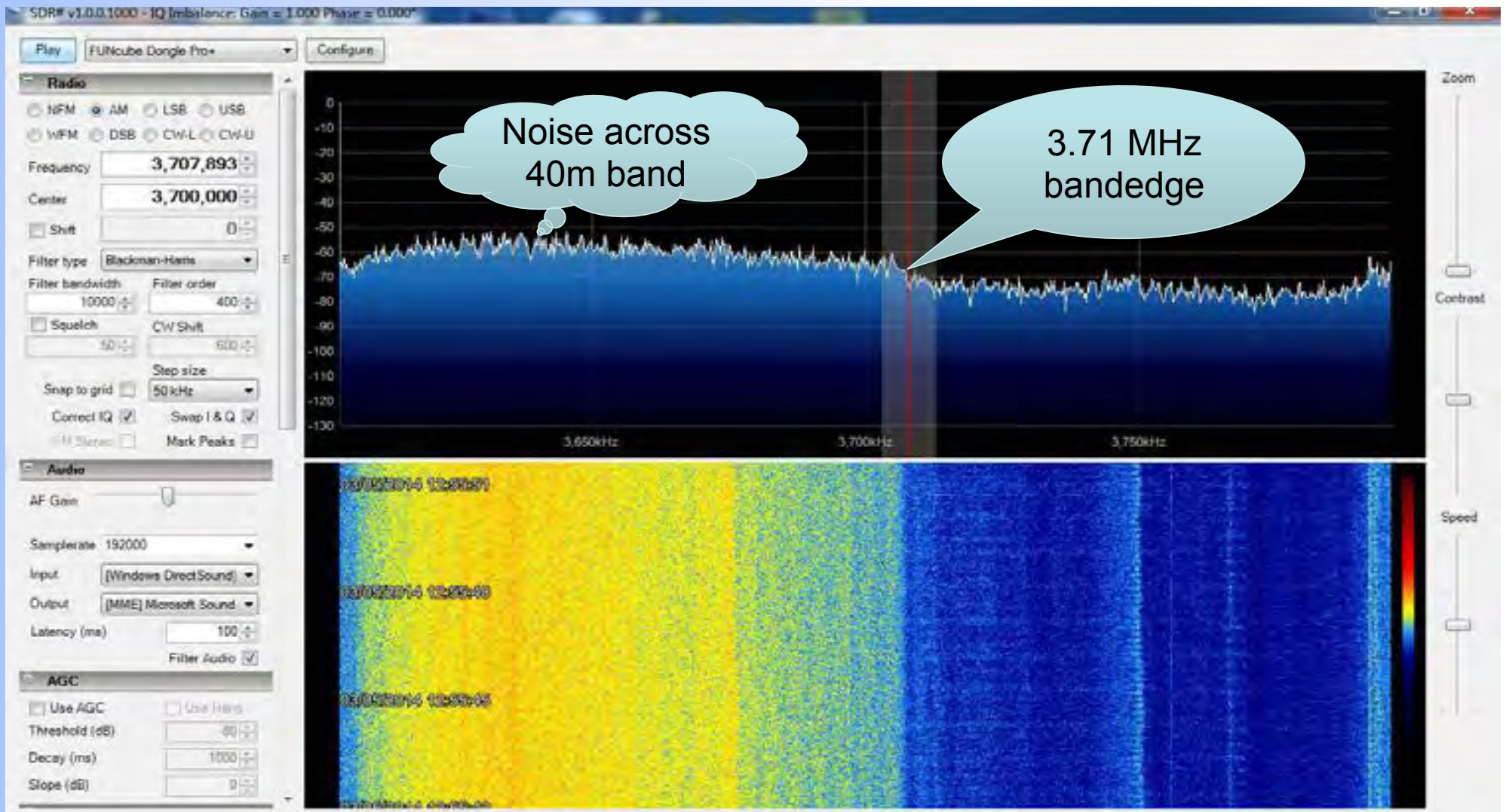




# U2 @ QTH G3JWI 500m from cabinet

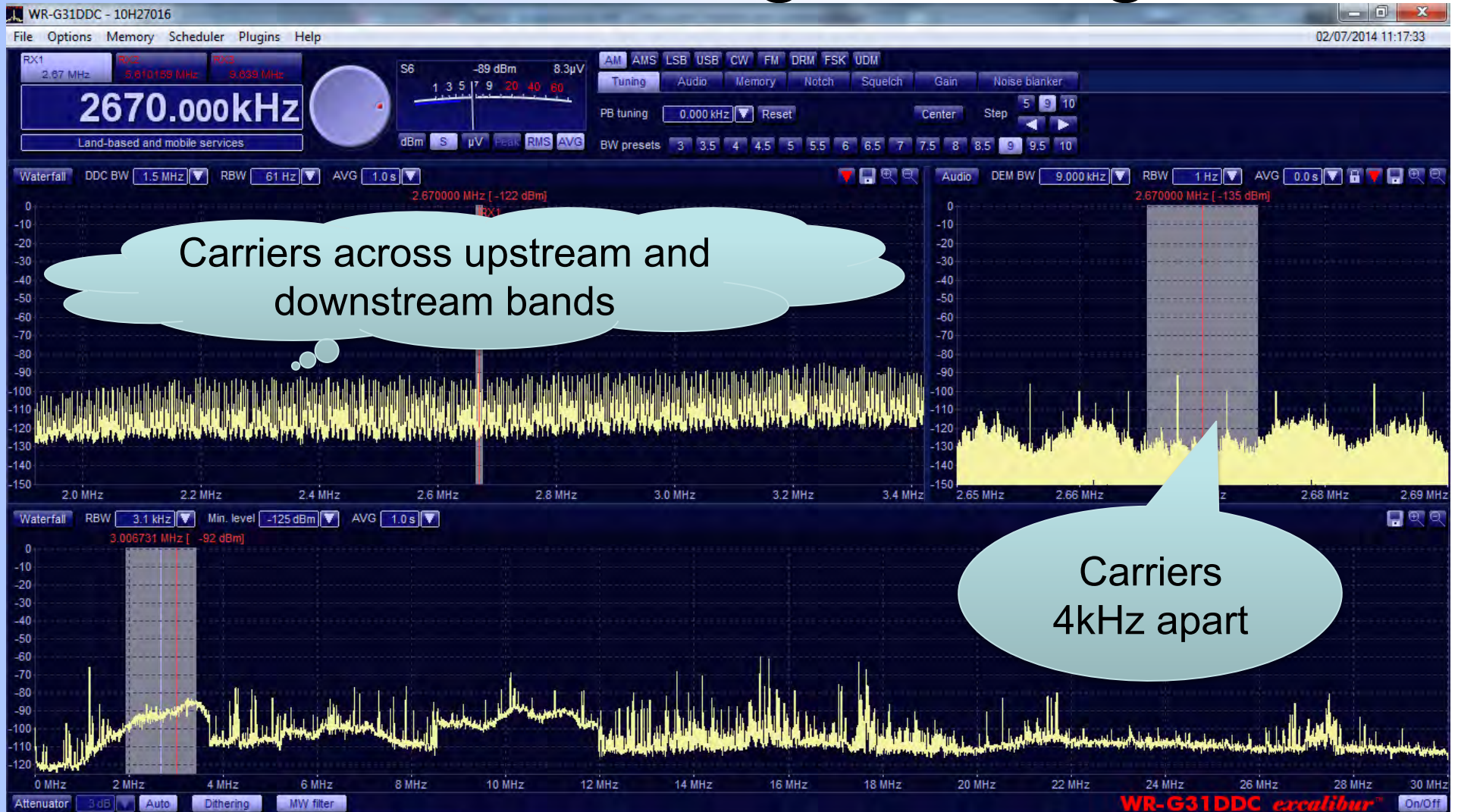


# D1 near Coventry





# VDSL during Training



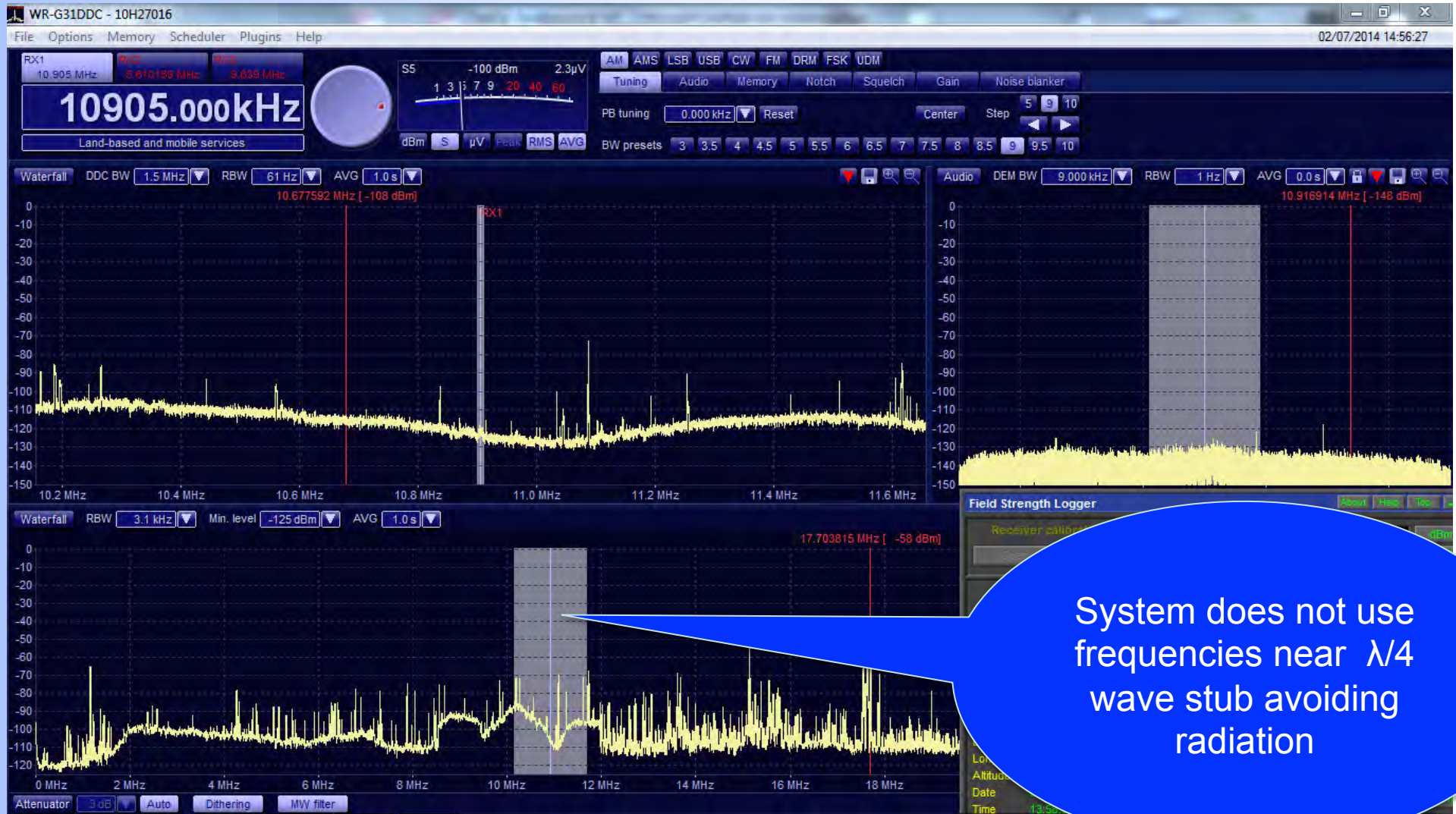


# Transmitting can cause retraining





# Open circuit $\lambda/4$ wave stub on modem line





# Ongoing investigations

- Working with BT to understand the issues better
  - Investigating modes of radiation and variations in near field patterns, including effect of in house extensions
  - Fault conditions can cause lower broadband speeds and increase radiation in all our interests to resolve problems
  - Investigating mitigation for cases suffering interference
  - Trying different common mode filter designs
  - Broadband accelerator can reduce U2 emissions
- Self Install launched may see more mismatches as no centralised splitter and/or distributed microfilters

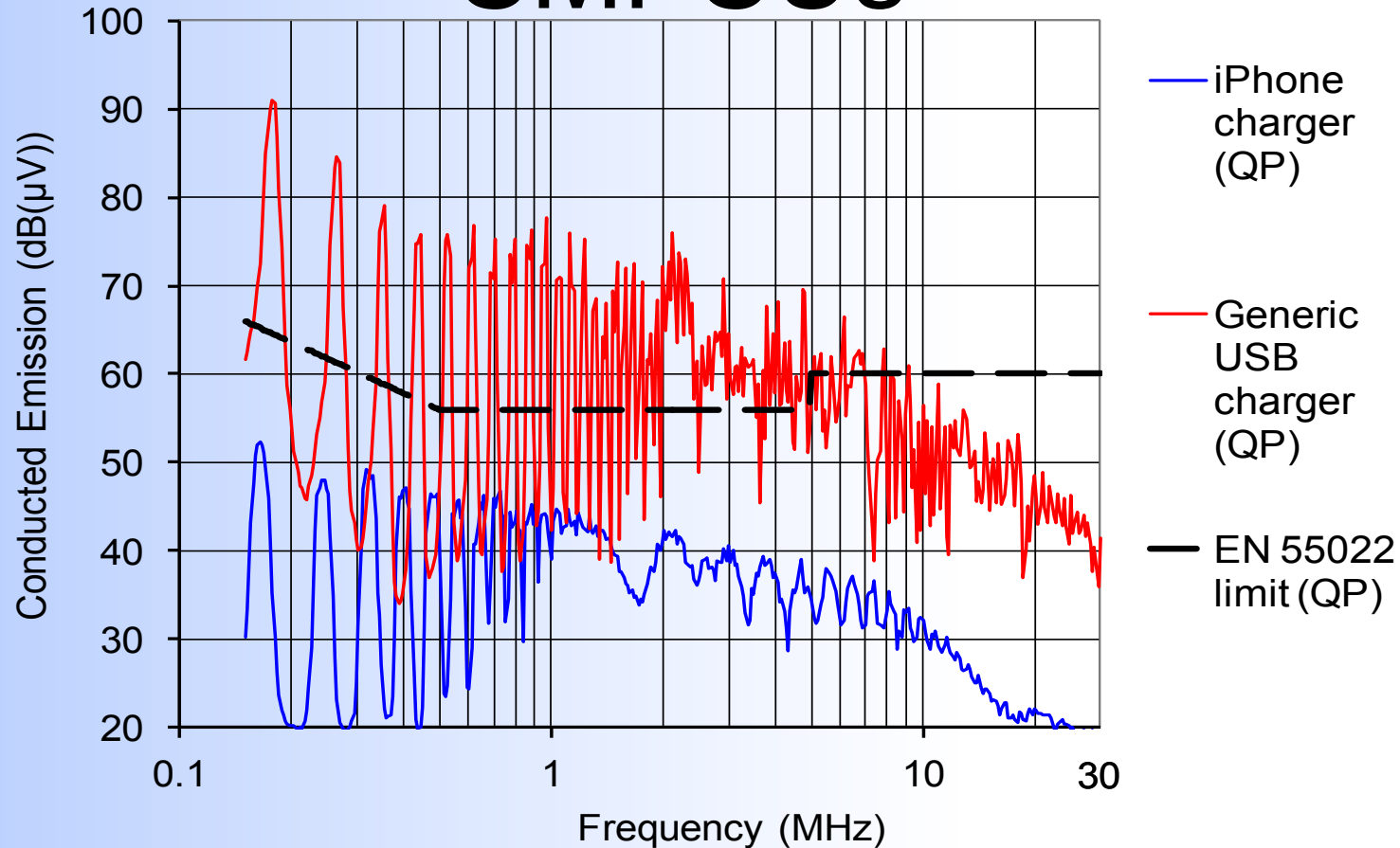


# PLT - update

- EN50561-1 has been adopted but some amateurs are considering legal challenge to the way the standard was set up
- Notches provide some protection for amateur bands but not to our SWL's
- Some evidence that intermods are filling in the notches as we predicted
- As 50561-2 PLA and 50561-3 VHF are being drafted more parties are worried about the levels set in the EN50561-1



# SMPSUs



- Two types of mains USB charger
  - Genuine Apple iPhone charger (blue trace)
  - Generic USB charger model TC038 (red trace)





# How can you help us?

- **COMPLAIN** if you see these problems
- Use the Forum EMC Matters to tell us
  - <http://forums.thersgb.org/index.php?forums/emcmatters/>
  - Collect data / ask for help / share your knowledge
- Volunteer to help with investigations
- **Our aims are**
  - To help people identify the source of interference
  - To collect data to influence standards evolution, lobby suppliers and press regulators for enforcement



# Plasma TV

- Problems may increase as the plasma ages
- Cooperation of the set owner is key as suppliers will only deal with them
- One of our committee has had good success with manufacturers getting problems resolved particularly with Panasonic and Samsung
- Contact Ken Underwood G3SDW directly or via the EMC Matters forum
- Problem will go away as sets go out of production



# How can interferers be found ?

- Use leaflet EMC04 to help diagnosis
- Location of source – portable receiver use a poor antenna to get closer to source
- Record Frequencies - problems observed
- Use different Modes to characterise interference
- Try at different times and in different weather
- We are building examples of characteristics to look for



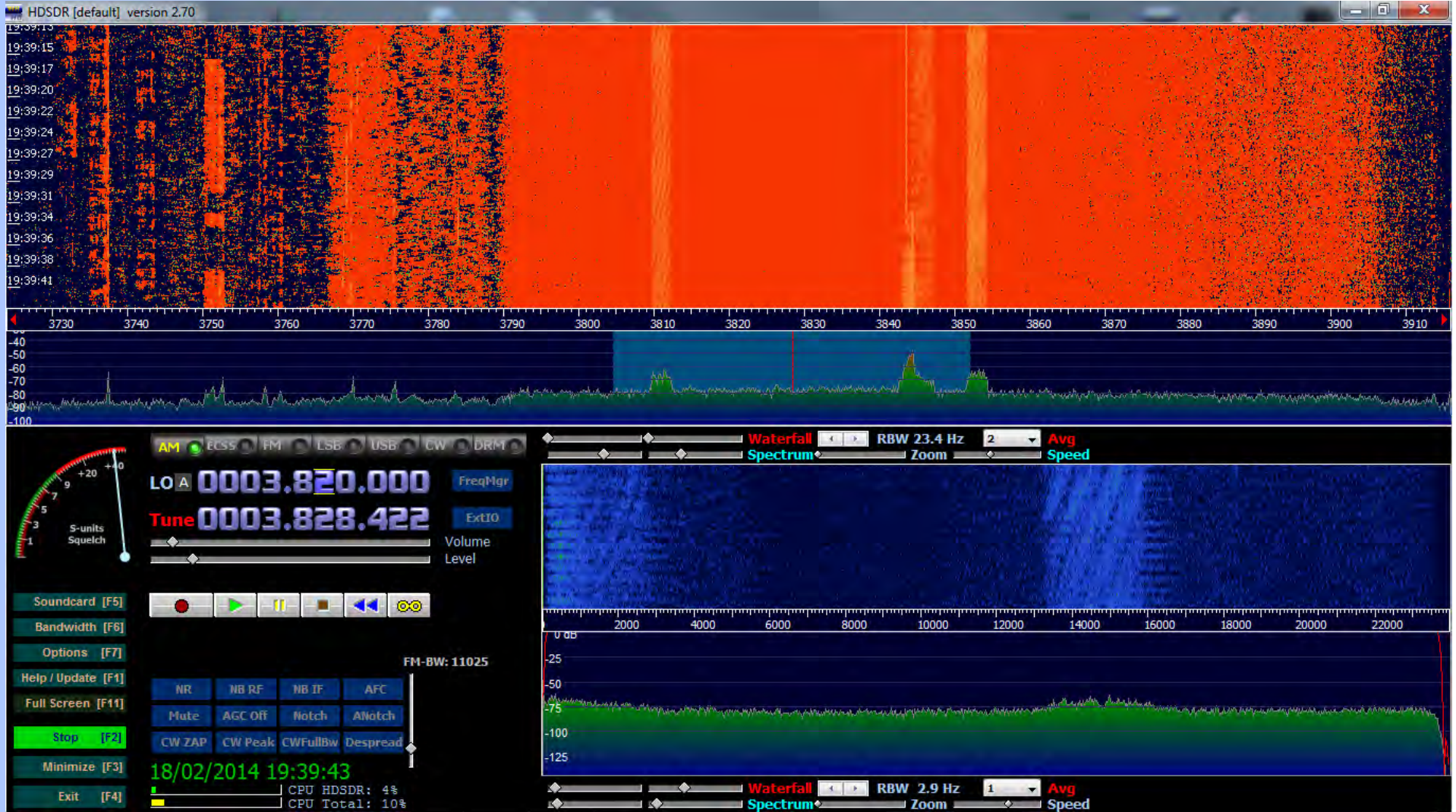


# Tools to use

- Portable / mobile receiver / am radio
- Transceiver or Comms Receiver
- Narrowband SDR (<200kHz) eg funcube dongle
- Spectrum Analyser or Wideband SDR (>1MHz)
- Choice of Antenna
  - Normal antennas tell if a problem
  - Loops sensitive and portable
  - Small active dipoles allow polarisation check
  - Current loops when safe to use

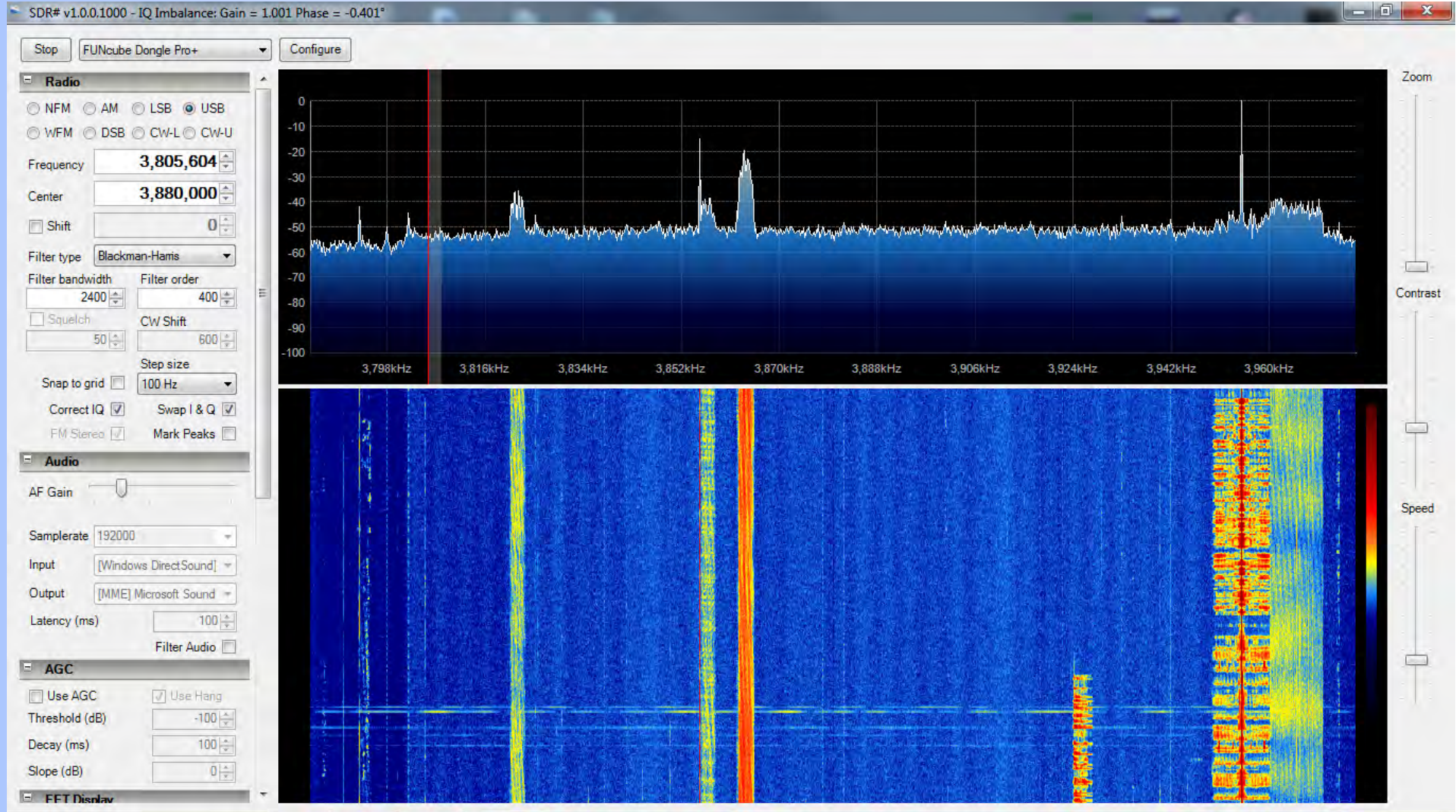


# KX3 with HDSDR



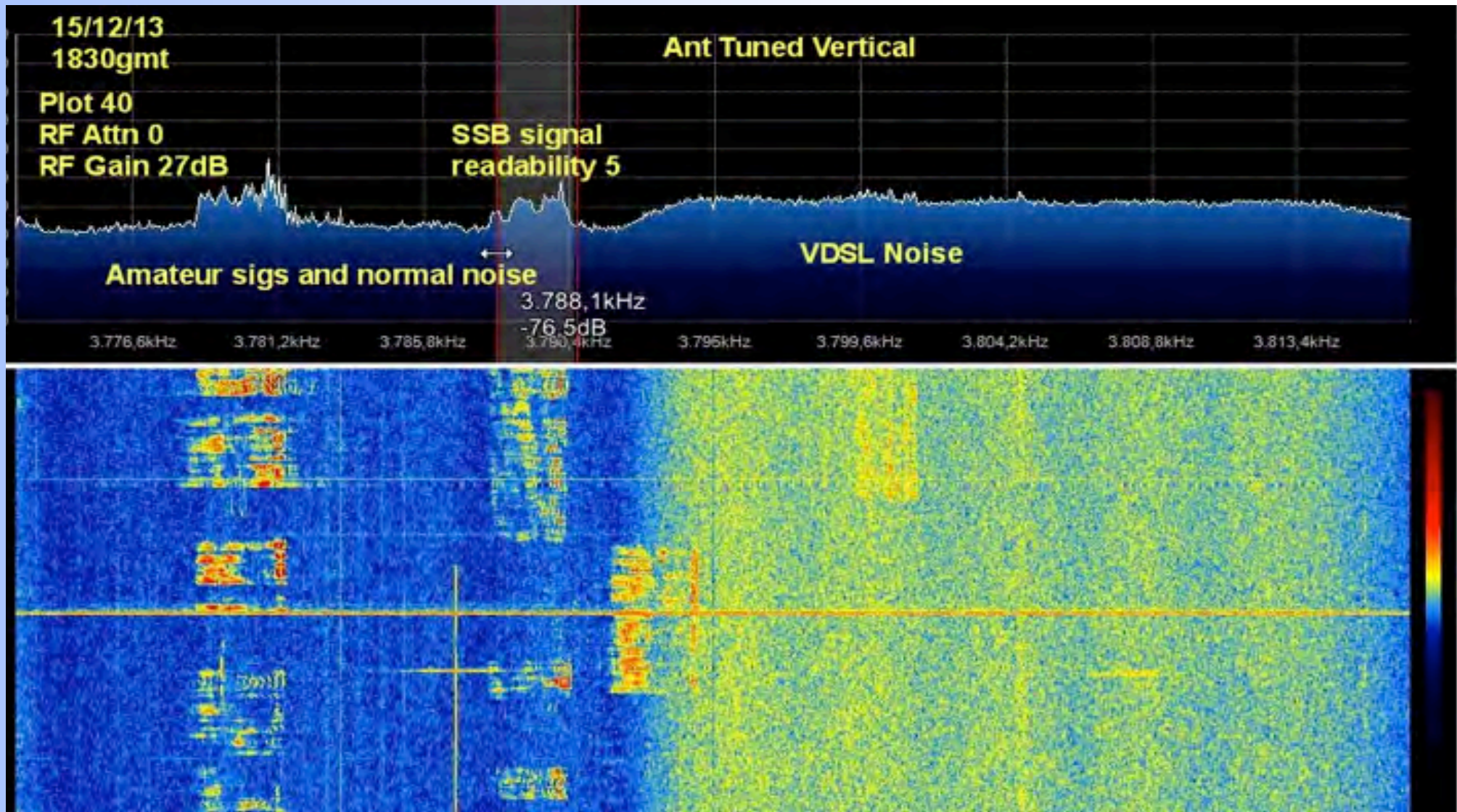


# Funcube dongle Pro+ SDR Sharp





# Softrock ensemble SDRSHARP





# Winradio SDR 30MHz spectrum

