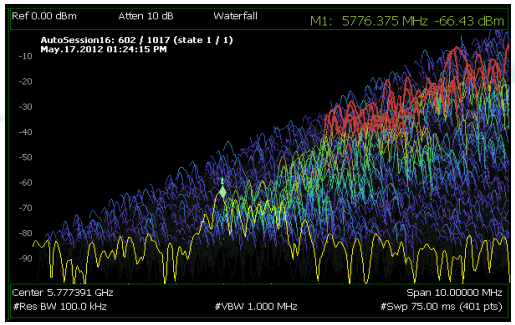
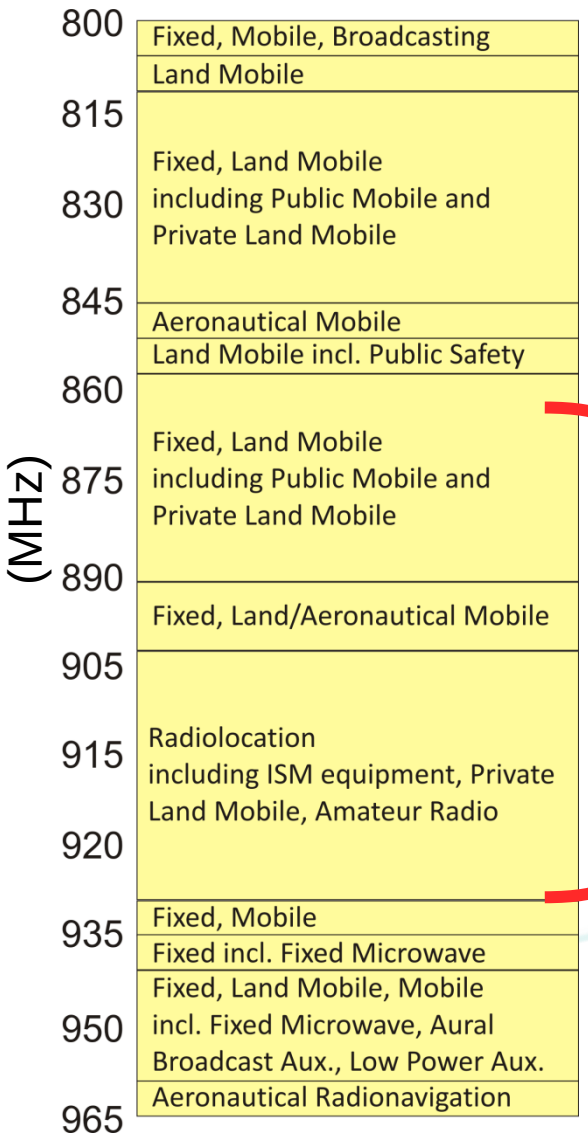
Part 3: Techniques to trouble-shoot Interference in the Field

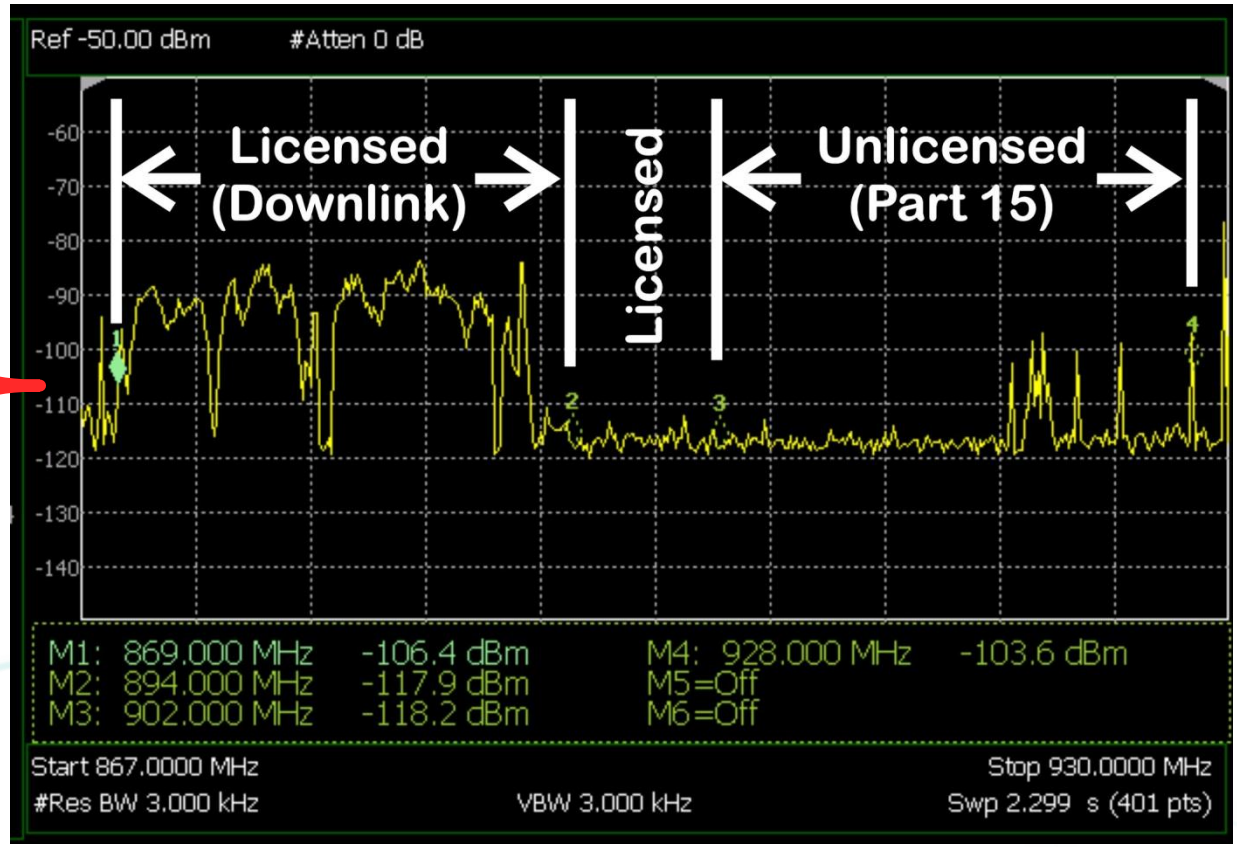
1. Review radio interference classifications and spectrum use
2. Describe key interference classifications and explain their importance
3. Discuss equipment and antenna requirements
4. Demonstrate spectrum analyzer best practices for identifying radio interference
5. Conclusions



Licensed and Unlicensed Spectrum



Licensed : Protected against harmful interference
Unlicensed : Expected amount of interference (Part 15 Rules)



Intentional, Unintentional, Incidental Radiators

Intentional radiators

Active transmitters

- Broadcast radio and television
- Cellular
- Satellite
- Radar
- Mobile radio
- WLAN
- Cordless phones

Unintentional radiators

Use RF but not for radio transmission

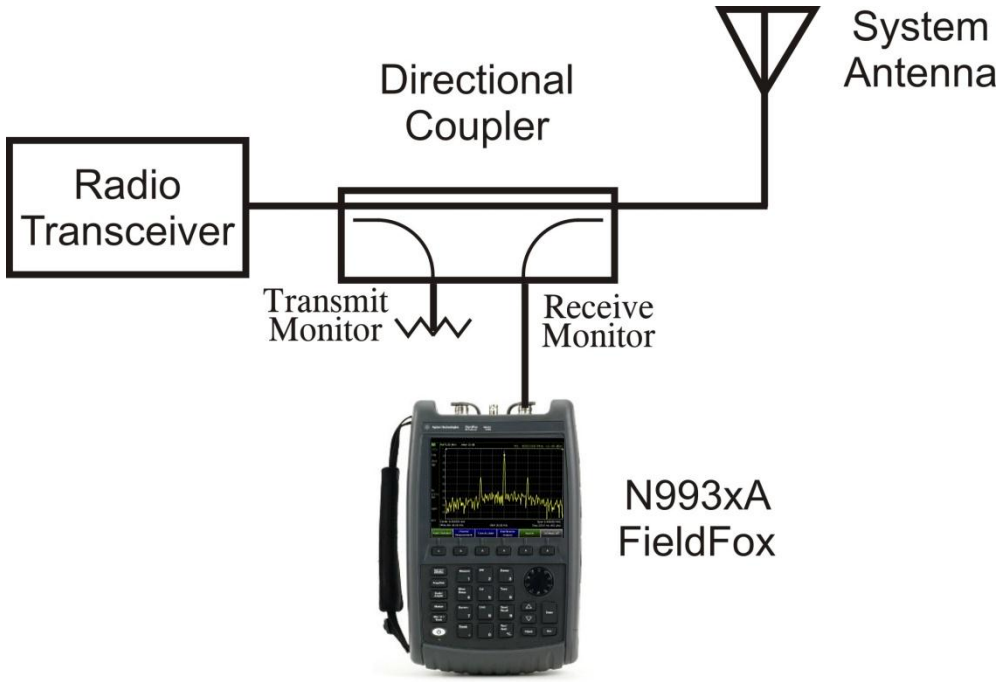
- Microwave ovens
- Radio receiver
- Industrial heaters
- MRI equipment

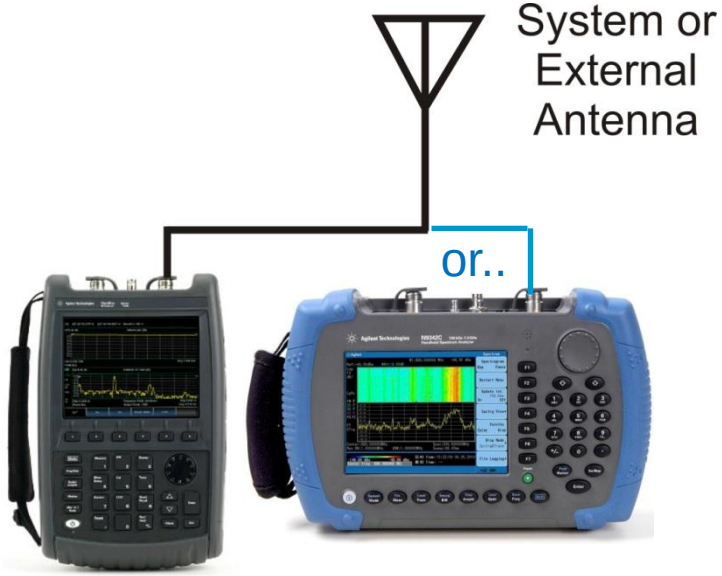
Incidental radiators

Do not use RF

- Switching power supplies
- Clock and control signals
- Ignition motors
- Fluorescent lighting

Measurement Configurations





N993xA spectrum analyzer

N991xA spec/VNA combo

3GHz to 20GHz Spectrum Analyzers – Industry's Best Value

No fans or vents for a completely sealed instrument + 3-year standard warranty

Bright, auto-adjusting anti-reflective display and backlit keys for easy viewing in darkness or direct sunlight

Built-in tracking generator and one-button measurements of channel power, OBW, ACHP, and spectrum emission mask

Automated measurements via TaskPlanner, coverage test, interference analysis, band clearance, and spectrum monitoring record & playback

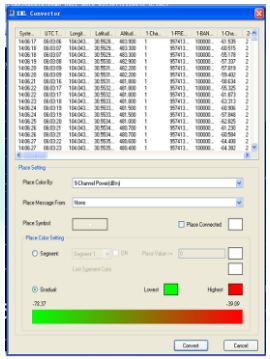
One-button measurements for AM/FM/ASK/FSK modulation analysis and time-gated measurements

Li-Ion battery <4 hours with stand-by mode

Selectable 20 channels channel scanner

Time Chart

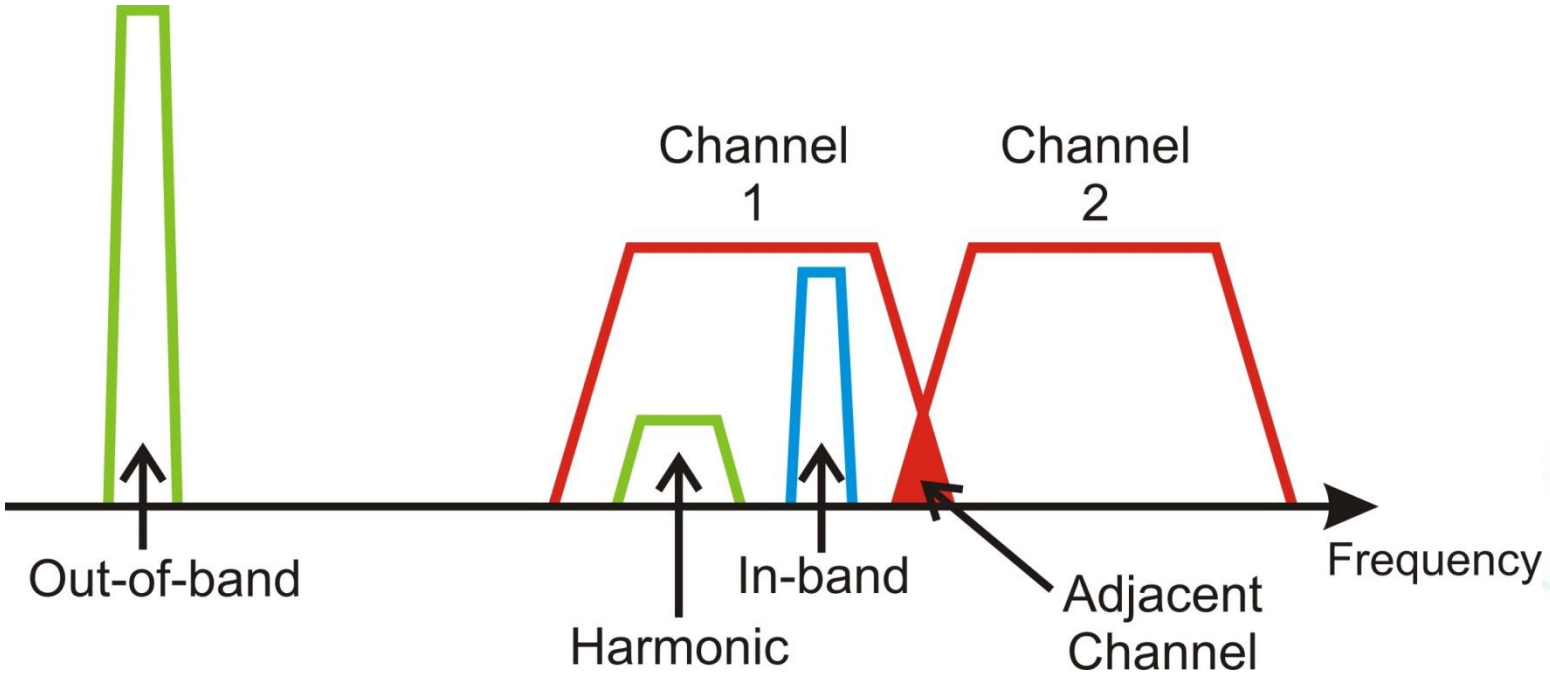
Built-in GPS + coverage mapping



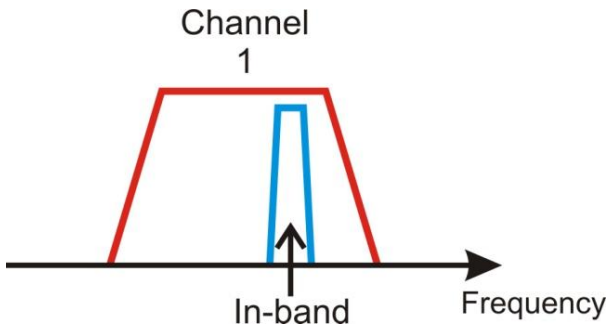
Measurement dbase

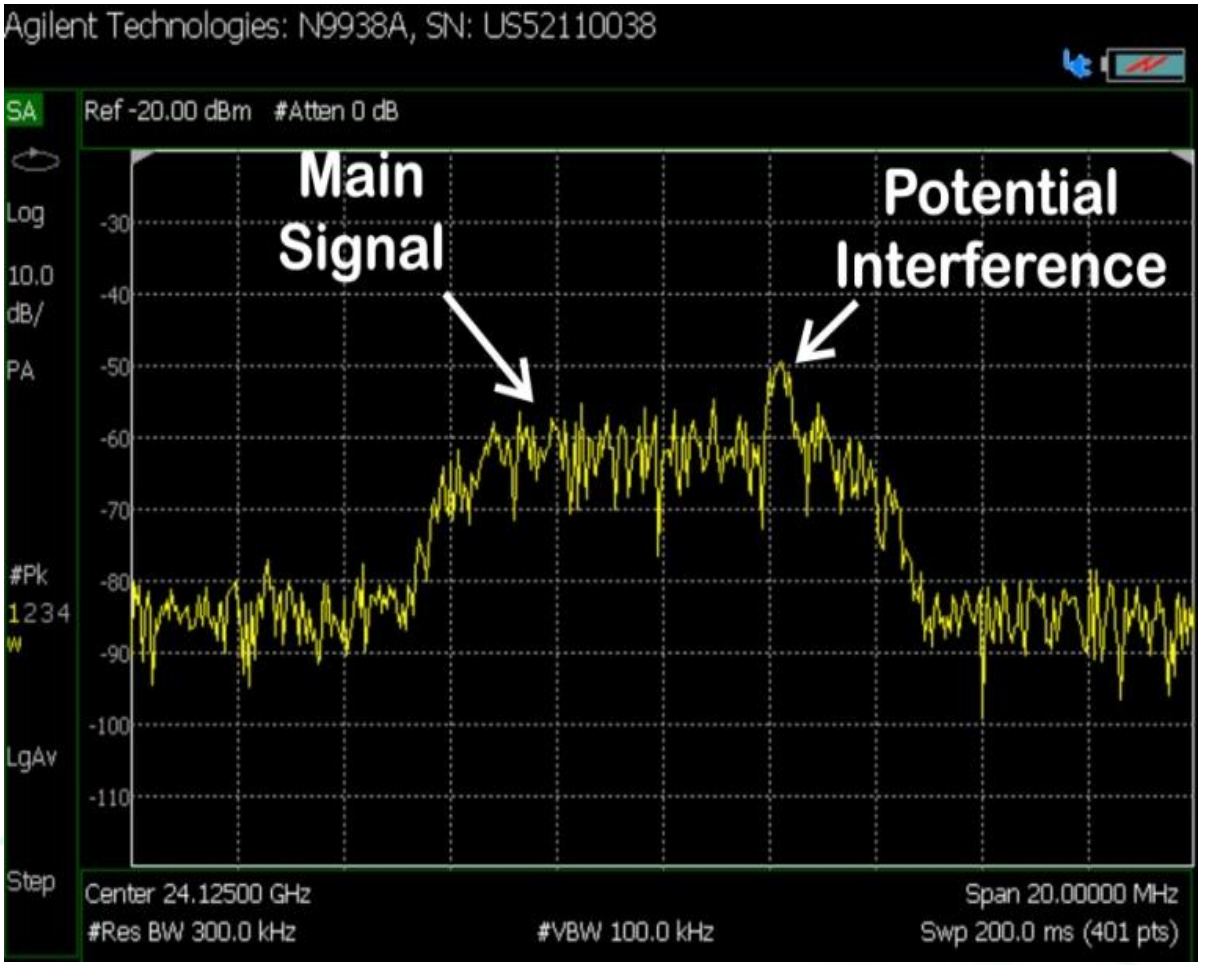
Interference Classifications

- In-band interference
- Co-channel interference
- Out-of-band interference
- Adjacent channel interference
- Uplink interference
- Downlink interference



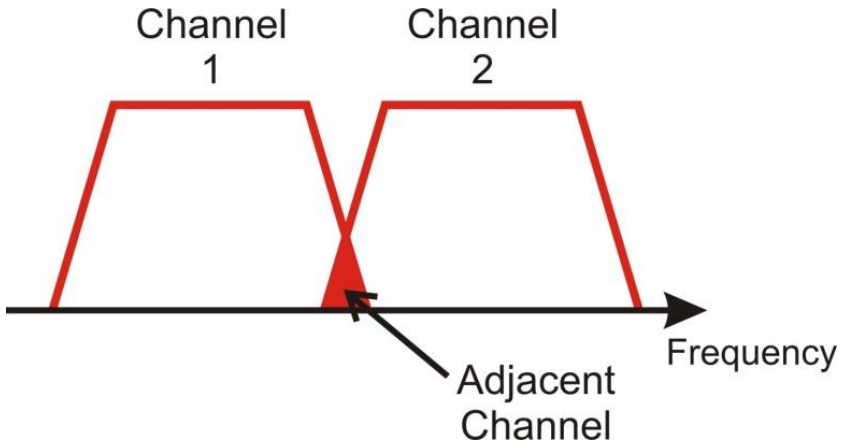
In-Band and Co-Channel Interference



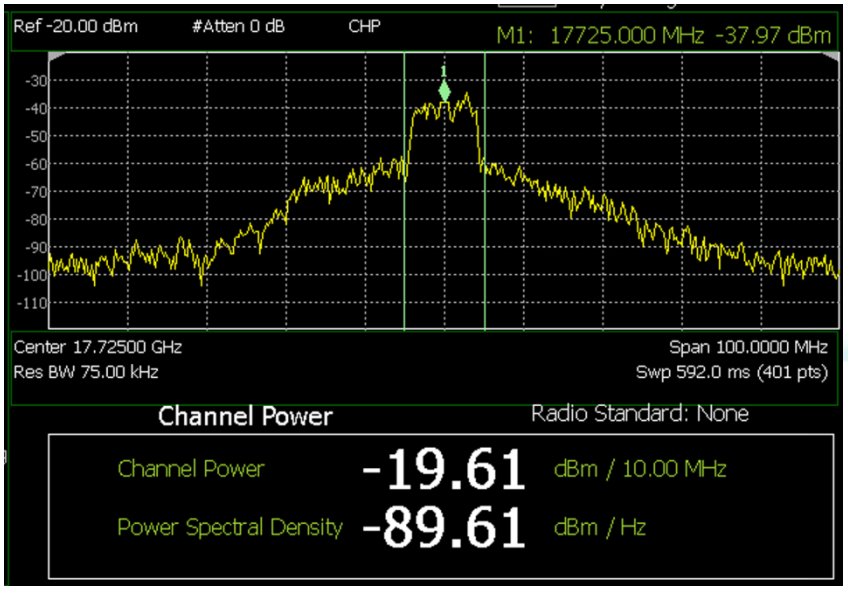


Demo – In-band interference measurements

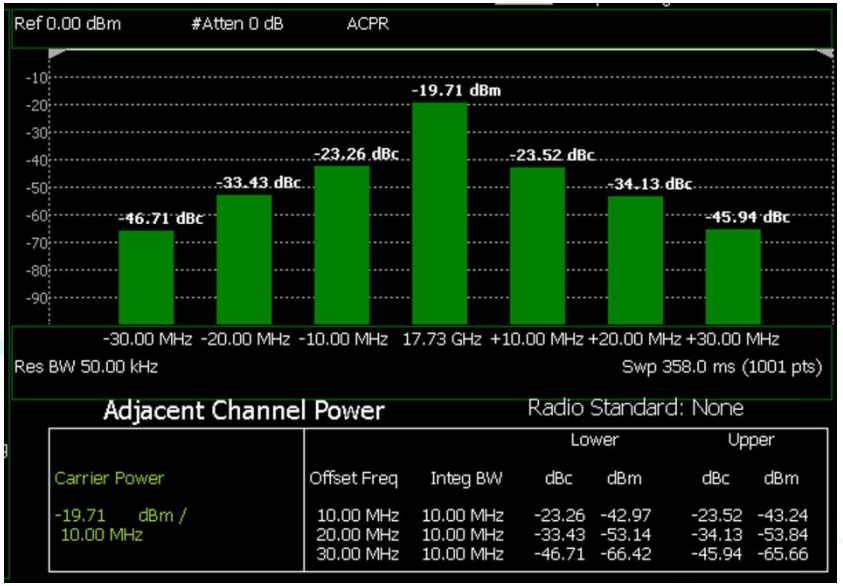
Adjacent Channel Interference



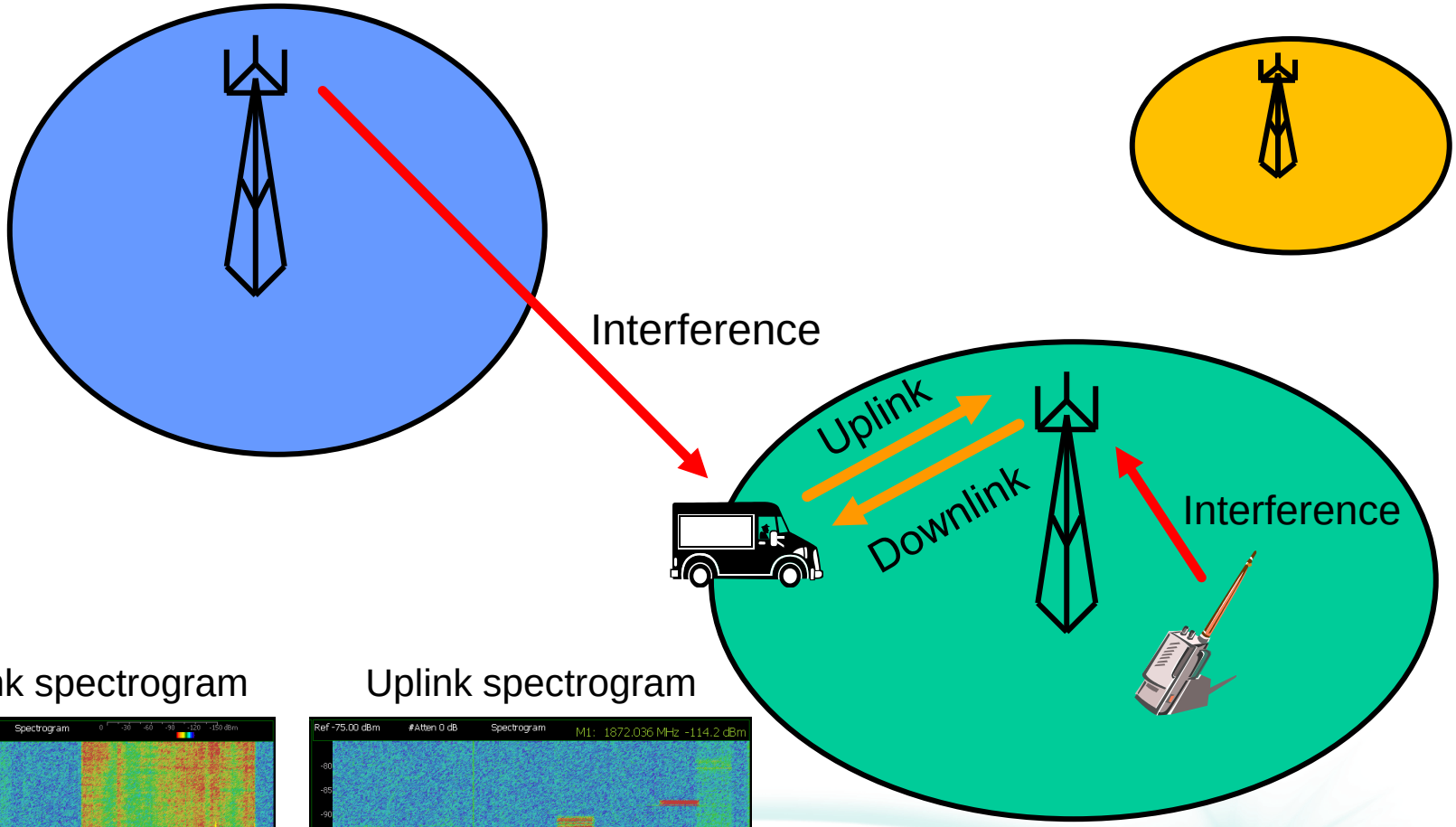
Channel power



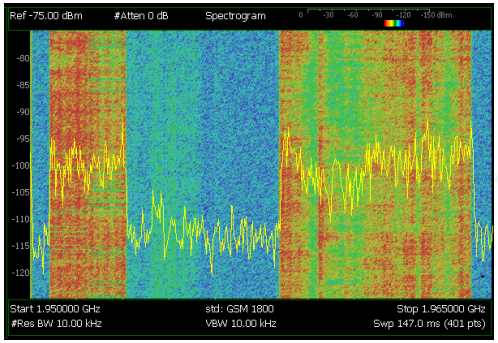
Adjacent channel power



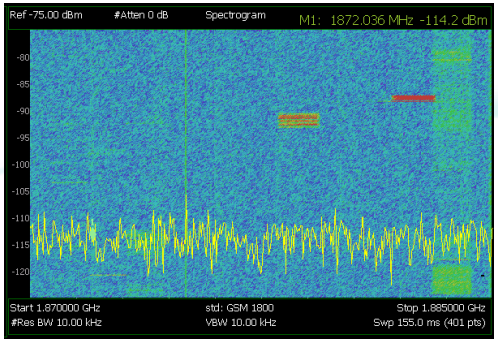
Downlink and Uplink Interference



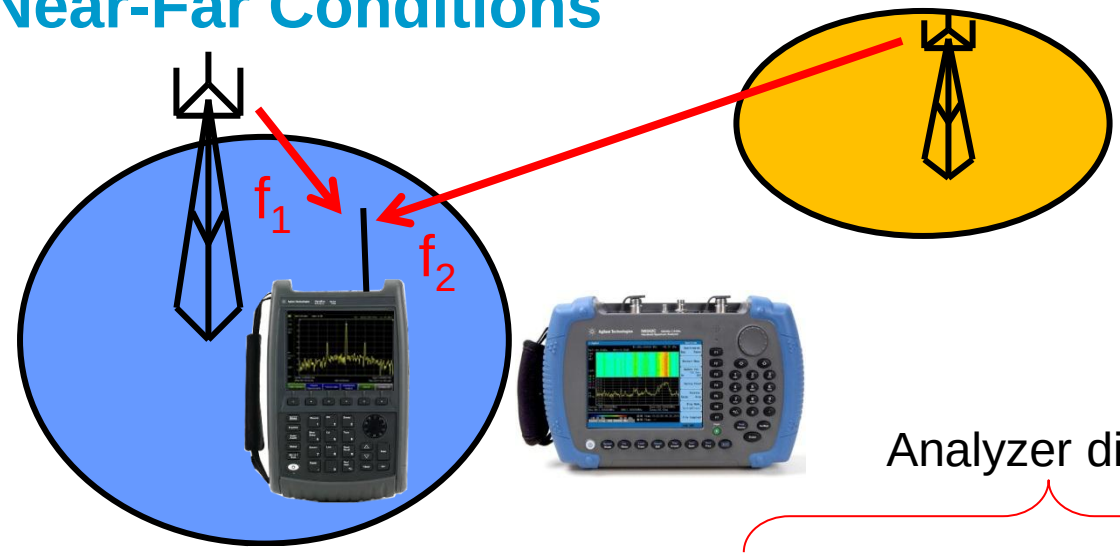
Downlink spectrogram



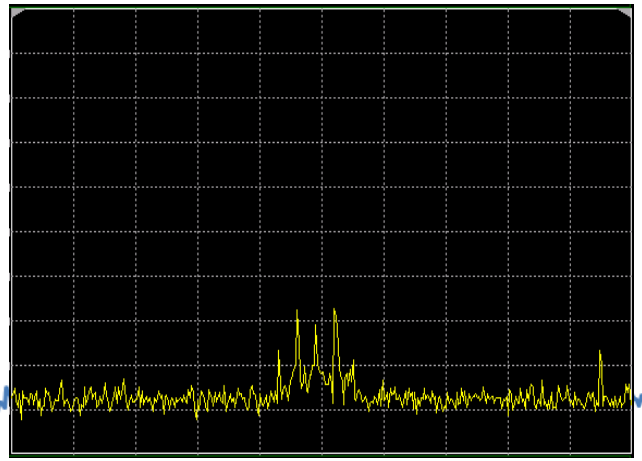
Uplink spectrogram



Near-Far Conditions



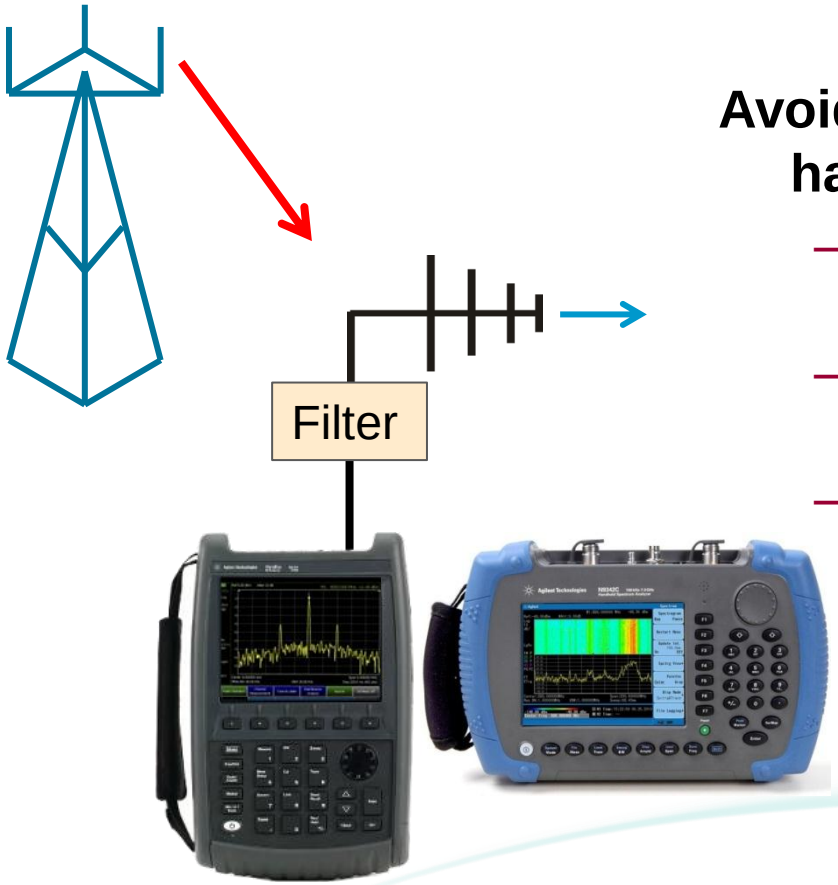
Analyzer display



Potential overload of analyzer's front-end

All signals enter analyzer's front-end

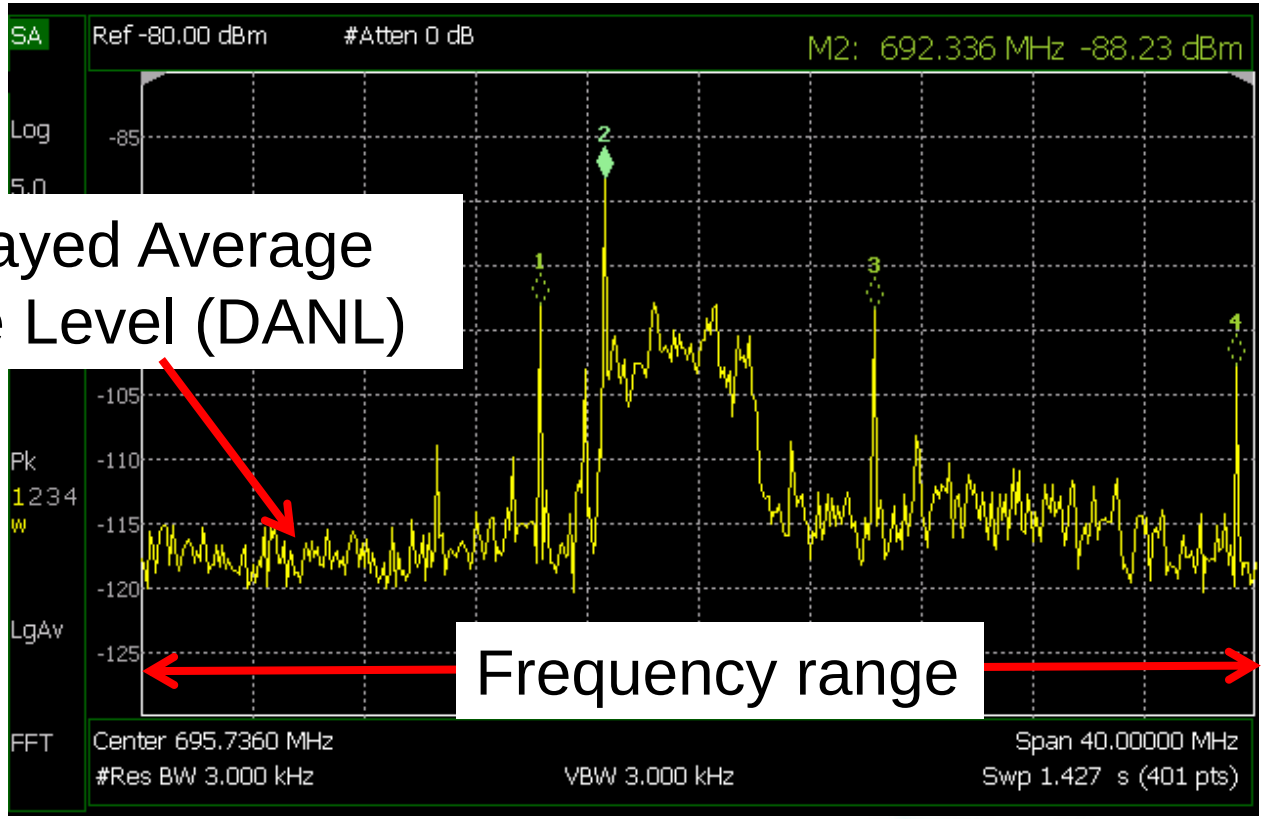
Techniques to Avoid Analyzer Overload



Avoid saturation and overload of the handheld analyzer

- Connect with bandpass filter to filter out strong signals
- Do not point the directional antenna towards the transmitter
- Turn off preamplifier and increase attenuation (if the sensitivity allows)

Key Analyzer Specifications

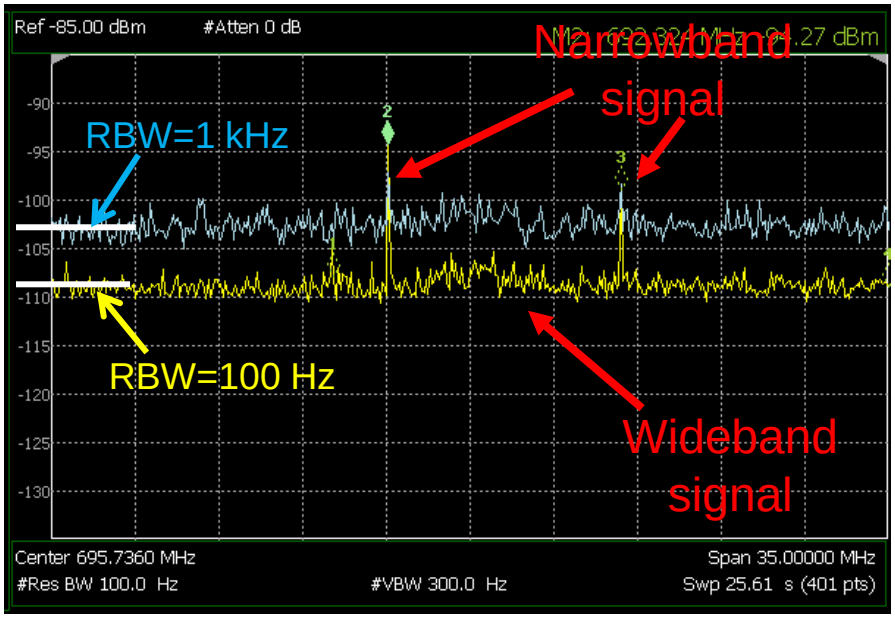


Also,

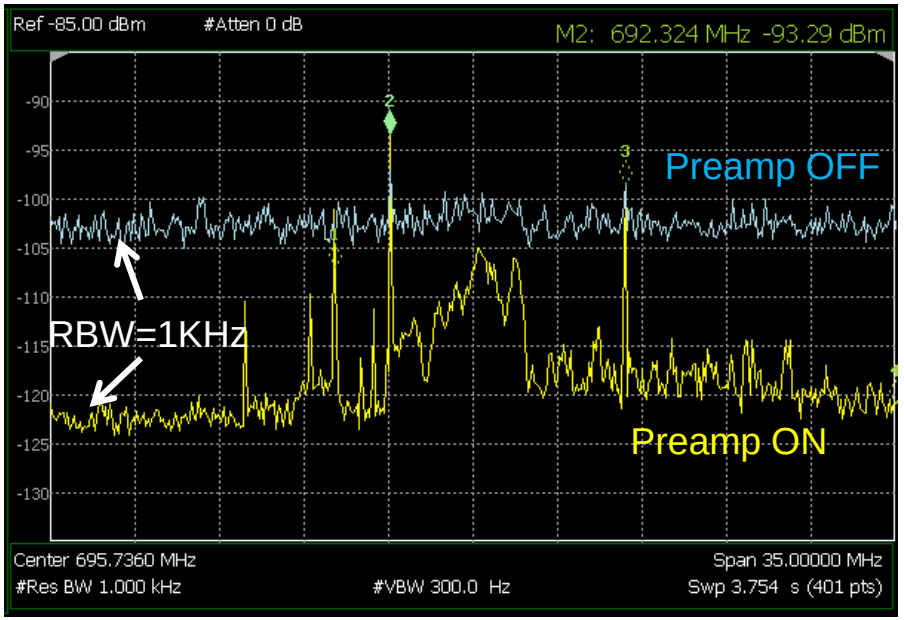
- RBW filter
- Preamplifier
- Third order intercept
- Phase noise
- Spurious

RBW and Preamplifier

Lower RBW improves DANL



Preamp ON



Reducing RBW:

Narrow-band signals (BW < RBW) → Same signal level, lower DANL (*improve SNR*)

Wide-band signals (BW > RBW) → Lower signal level, lower DANL (*same SNR)*

FieldFox *InstAlign*

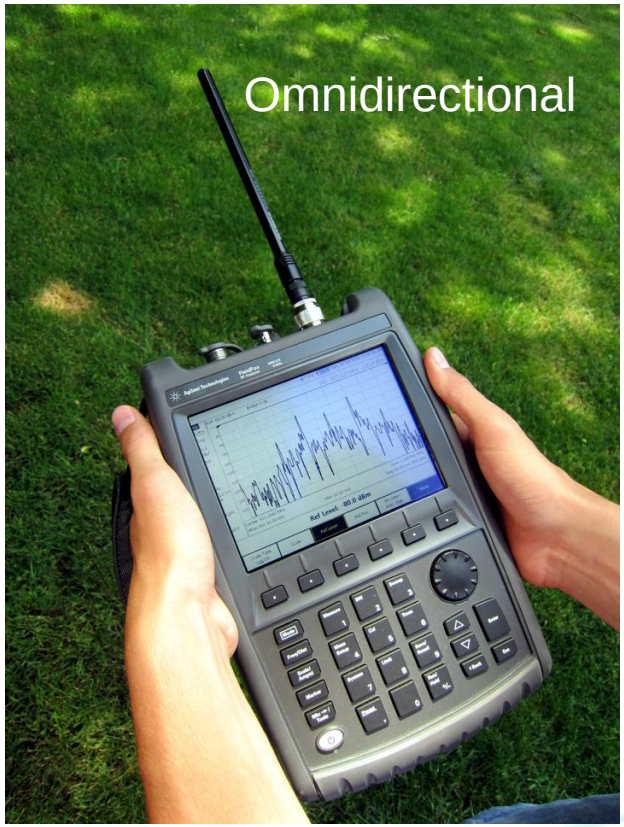
Total amplitude accuracy across frequency and temperature

Frequency range	(23 °C ± 5 °C)	(–10 to +55 °C)
100 kHz to 18 GHz	± 0.35 dB	± 0.50 dB
>18 GHz to 26.5 GHz	± 0.50 dB	± 0.60 dB

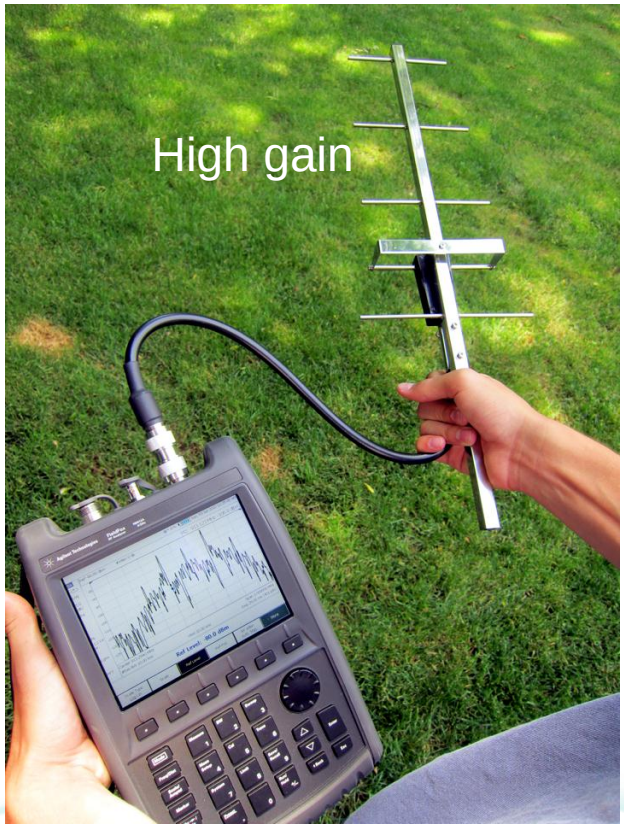
- *Accurate across -10 to +55 º*
- *No warm-up required*

Antenna Configurations

Antenna connected directly



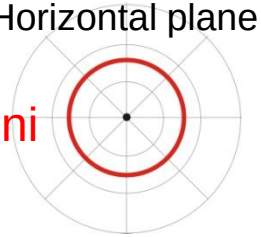
Antenna cabled to analyzer



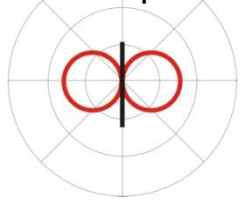
Antenna patterns

Horizontal plane

Omni

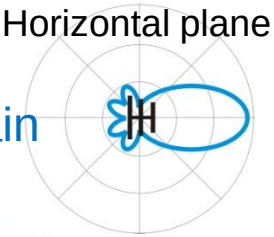


Vertical plane

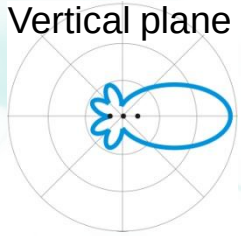


Horizontal plane

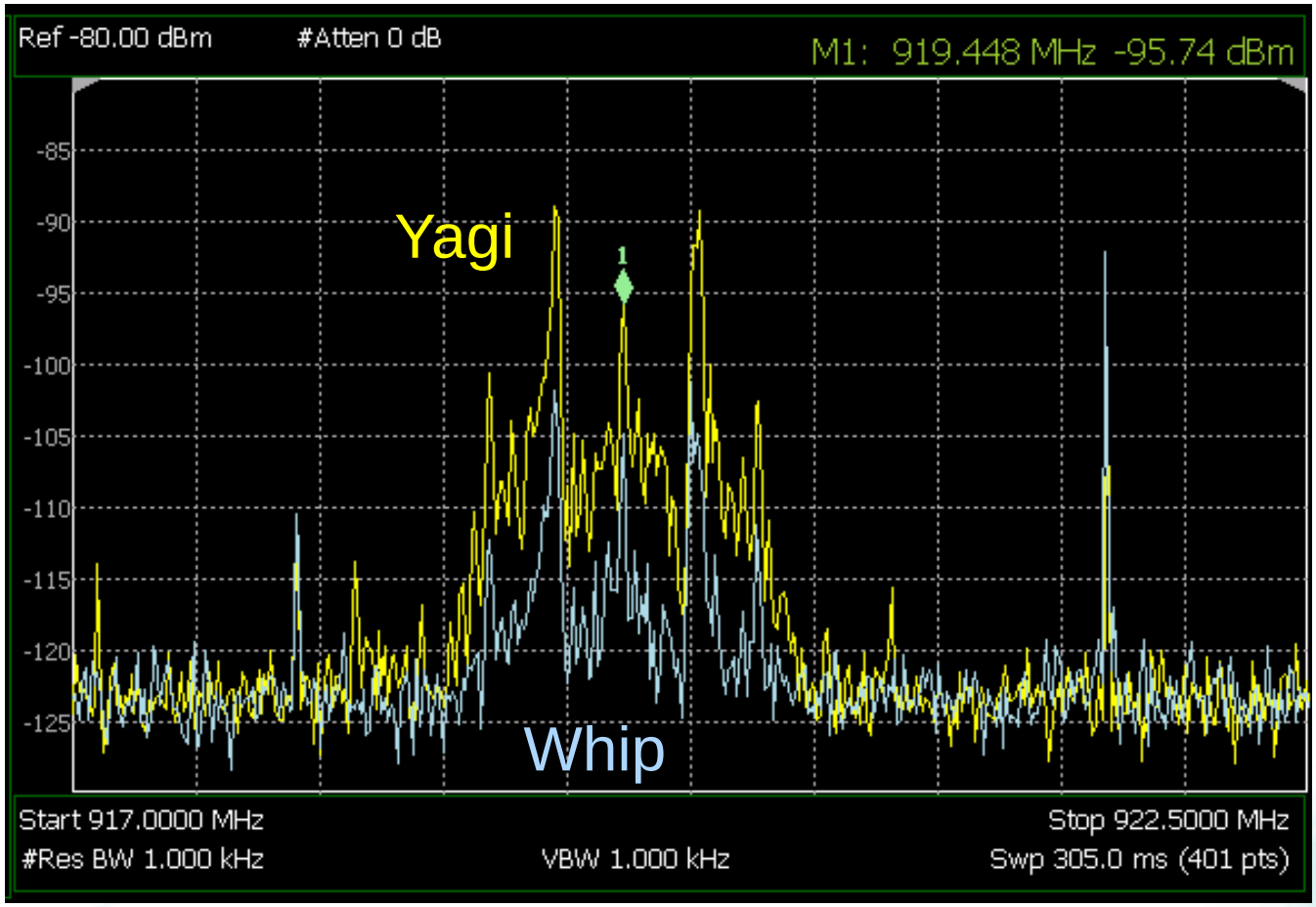
High gain



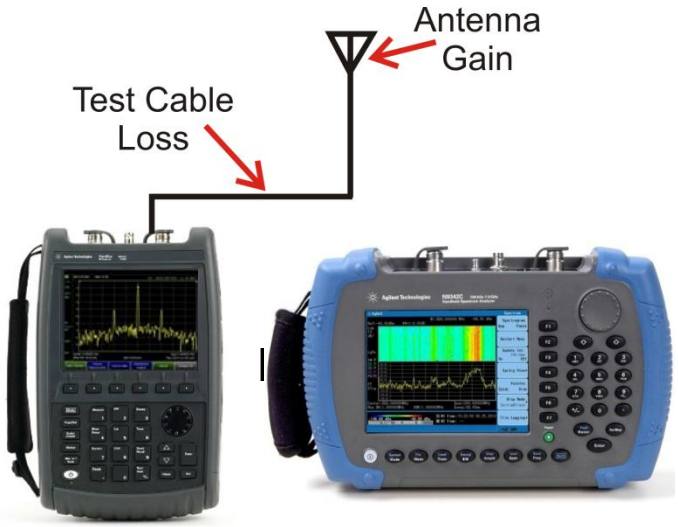
Vertical plane



High Gain versus Omnidirectional Antenna Types



Amplitude Correction and Field Strength



Field strength units

dBm ⟷ dBµV/m

Amplitude correction = antenna gain - cable loss

Correction factors editor

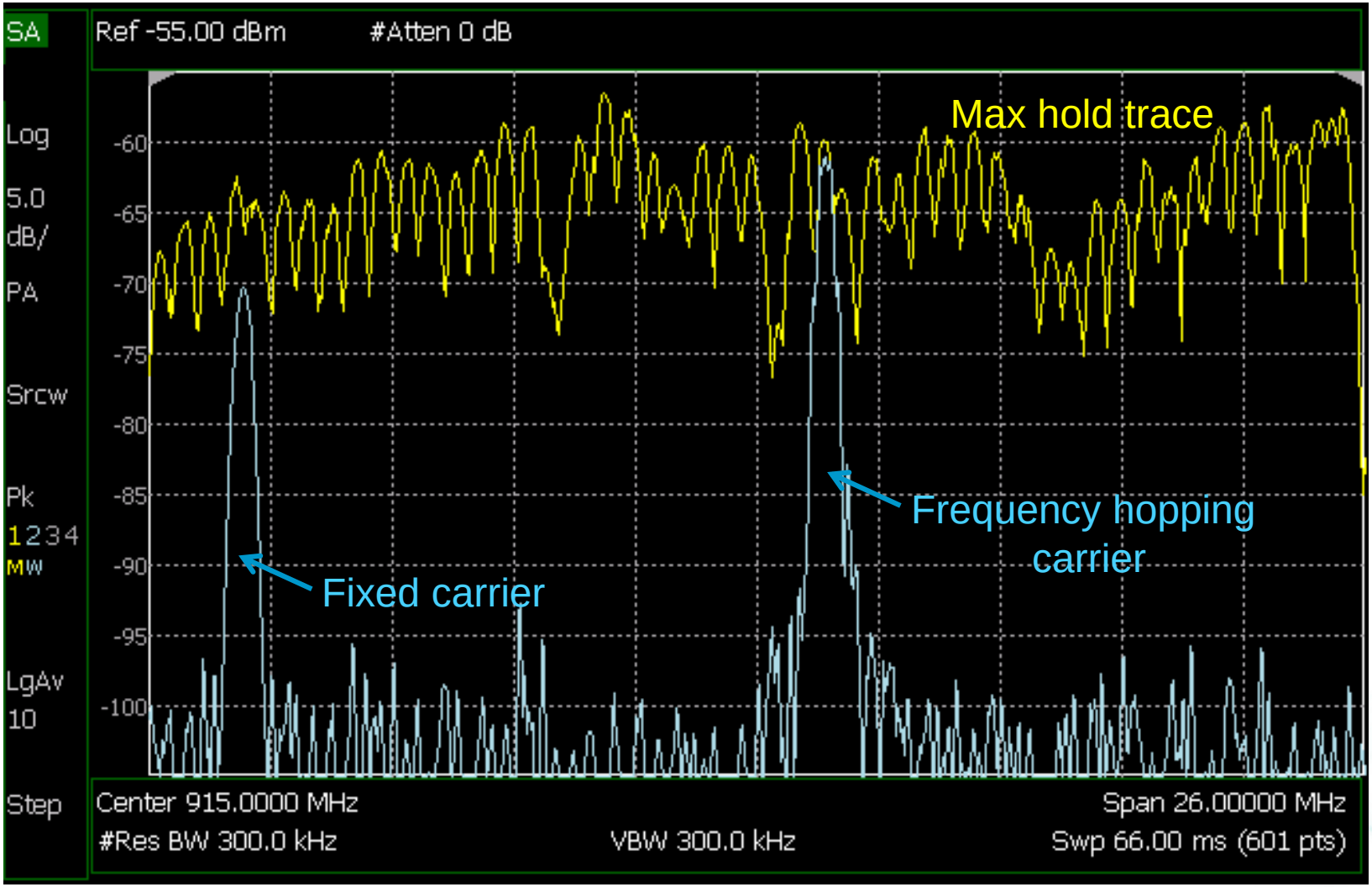
Use knob. Press [Edit] to make changes. Press [Done] to exit.

Setting	Value
Header	
Description	Correction Factors for 11966P
Correction Units	
Antenna Unit	dBuV/m
Freq Interpolation	LIN
Setting	**Value**
Frequency	Gain Factor
26.000000 MHz	20.000
30.000000 MHz	17.500
40.000000 MHz	13.500

Corrections .csv

	A	B
1	Amplitude Correction	
2	N9311-504	
3		
4	N9912A	MY50492472
5	Frequency Unit	MHZ
6	Antenna Unit	dBuV/m
7	Frequency Interpolation	LIN
8		
9	[DATA]	
10	26	20
11	30	17.5
12	40	13.5

Clear/Write and Max Hold Display Modes



Conclusions

- Reviewed radio interference classifications and spectrum use
- Discussed why interference analysis is important
- Discussed equipment and antenna requirements
- Reviewed spectrum analyzer settings for high accuracy
- Reviewed FieldFox display modes for identifying radio interference

Additional Information

www.agilent.com/find/FieldFox or /find/HSA

- **Application note series**
  - Interference analysis, cable and antenna analysis, calibration and alignment, time domain, power measurements, and data correlation
- **Product literature**
  - Family brochure, technical overviews, data sheet, configuration guide, tri-fold photo card
- **Product introduction and demo videos**

Agilent webcasts and YouTube training videos

- Interference analysis, cable and antenna analysis, power measurements and more…

End of part 3