LPR
Measurement Procedure

Section 15.256

KDB Publication 890966

New Rules

- Provides for LPRs
  - Inside or outside a tank, pointing down
  - 5.925-7.250, 24.05-29.00, 75-85 GHz
  - Minimum bandwidth 50 MHz
  - Fundamental emission limits EIRP
    - 1 MHz & 50 MHz bandwidth
  - Maximum antenna beamwidths
    - 12 degrees for 5.925-7.250 & 24.05-29.00 GHz
    - 8 degrees for 75-85 GHz
  - Maximum side lobe gain > 60 degrees

Measurement Procedure

- KDB Publication 890966
- Fundamental measurements
  - Radiated
    - Far field, boresighted
  - Conducted
  - Harmonic mixer or downconverter required for high frequencies
  - Harmonic mixer
    - Fundamental BW < 2 x IF frequency
  - Downconverter
    - Fundamental BW <= downconverter BW

Measurement Procedure

- Fundamental bandwidth
  - Peak detector, 1 MHz RBW, 3 MHz VBW
  - Activate any frequency sweep for FMCW
  - Select “Max Hold”
  - Multiple sweeps until amplitude stabilizes
  - Measure 10 dB bandwidth

Measurement Procedure
Pulsed Transmitters

- Fundamental emission average power measurement
  - Radiated
    - Boresight LPR and test antenna.
  - Conducted
    - Connect to antenna port of LPR
  - Measure with power averaging (RMS) detector and 1 MHz RBW.

Measurement Procedure
Pulsed Transmitters

- Determine F.S. or conducted power
  - Radiated
    - Calculate F.S. using amplifier gain, antenna factor, conversion loss, etc.

      or
    - Signal substitution.
  - Conducted
    - Calculate conducted power from measurement using attenuation, conversion loss, cable loss, etc.

      or
    - Signal substitution

Measurement Procedure

Signal Substitution Method

- Substitute signal generator for test ant
- Adjust signal generator to reference level on spectrum analyzer
- Calculate field strength

$$F.S. = P + 107 + AF$$

where:

F.S. is field strength in dBuV/m
P is substitution power in dBm
AF is antenna factor of test antenna

Measurement Procedure
Pulsed Transmitters

- Fundamental emission peak power measurement
  - Measure with peak detector and 50 MHz RBW
    - If 50 MHz RBW not available, measure with narrower RBW less than or greater than the PRF by a factor of 3 but no less than 1 MHz
    - Calculate the maximum signal in 50 MHz with the applicable correction factor shown below:
    - 20 Log (50/RBW) dB for PRF<RBW/3
    - 20 Log (50/PRF) dB for PRF >3*RBW
    - RBW and PRF in MHz.

Measurement Procedure

- Calculate EIRP
  - Radiated
    - EIRP = F.S. – 104.8 + 20 Log D
      where F.S is field strength at far field distance D
  - Conducted
    - EIRP = conducted power + antenna gain dBi.

Measurement Procedure
FMCW Transmitters

- TR 14-1007 attachment to KDB Publication 890966
- Set analyzer span >= signal span
- Peak detector
- Measure peak amplitude
  - Stop signal sweep at maximum amplitude
  - Record value in appropriate RBW

or

(cont)

Measurement Procedure
FMCW Transmitters

- Measure peak amplitude (cont)
  - Calculate dwell time Td = Ts / ΔF
    - Ts = signal sweep time in seconds
    - ΔF =signal sweep freq span in MHz
  - Calculate minimum RBW
    - RBW (Hz) = square root ($10 \times 10^6 / T_d$)
  - Perform multiple scans in “Max Hold” or long time scan
  - Record maximum peak amplitude

Measurement Procedure
FMCW Transmitters

- Determine average
  - Calculate average factor
    - Average factor = T_d / cycle time
      - cycle time is the total time for a complete cycle of signal including retrace and any other latency times
    - Calculate average by multiplying peak amplitude by average factor
- Calculate EIRP

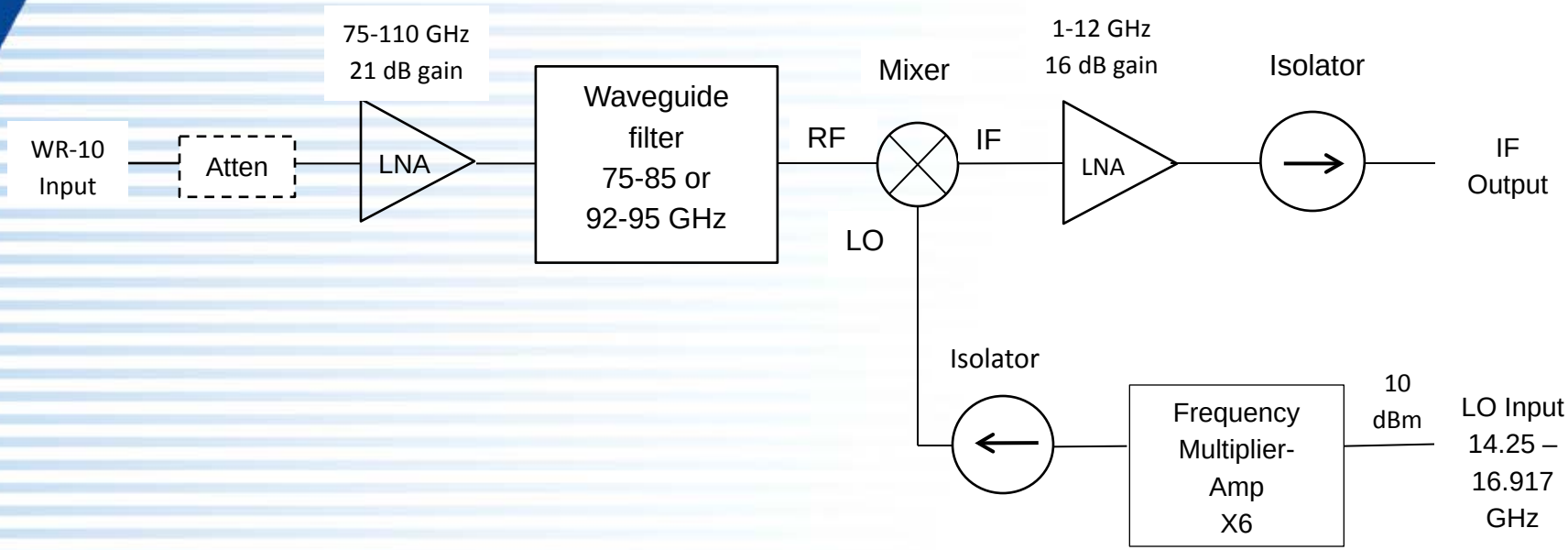
Measurement Procedure
Unwanted Emissions

- Emission limits of 15.209
- Measurement procedure ANSI C63.10
- Harmonic mixers needed for high frequencies

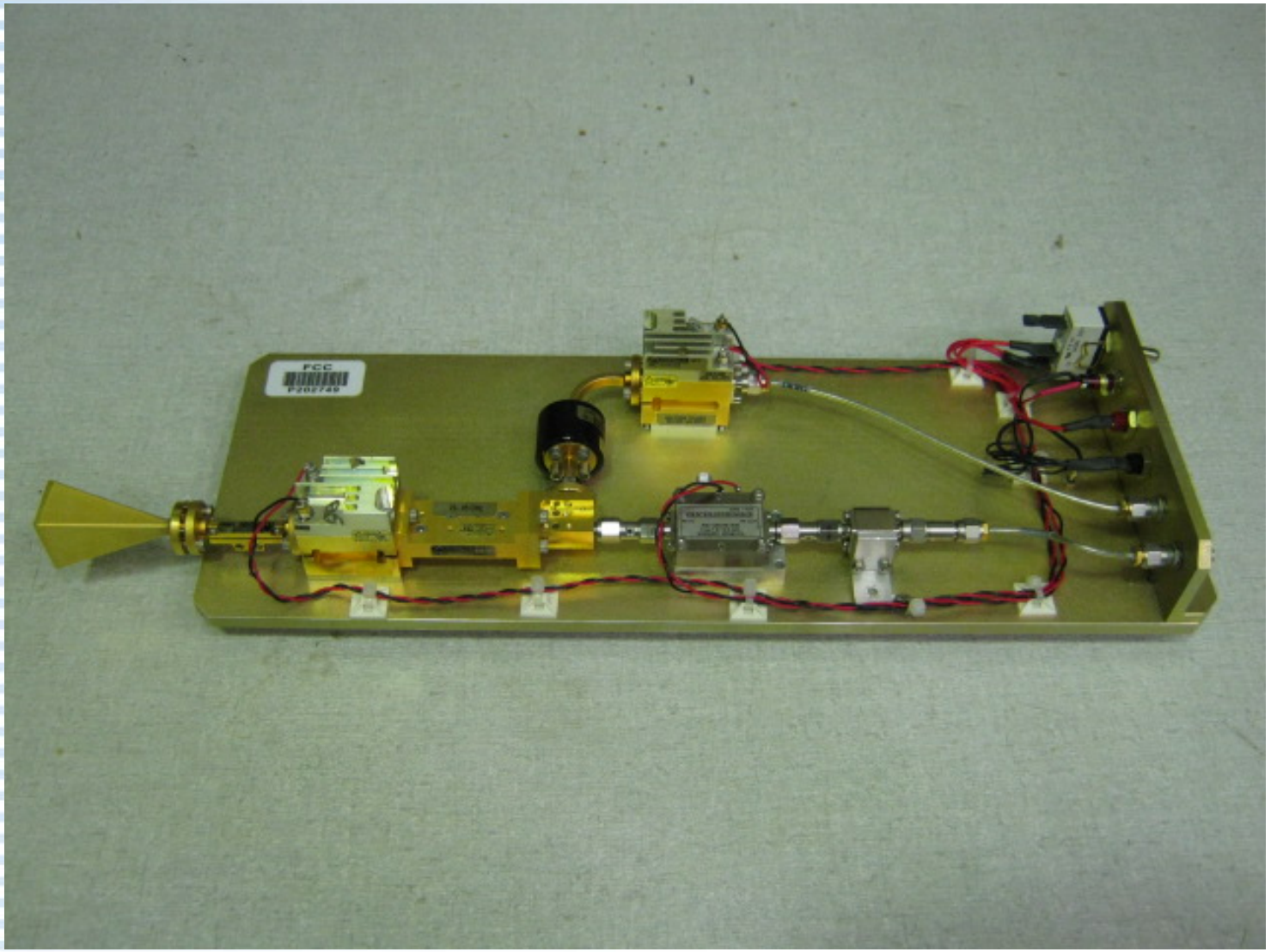
End
Part 1

Addendum

- Downconverter
  - Downconverts from 75-85 GHz and 92-95 GHz range to 1 to 12 GHz range
  - Lower conversion loss, wider bandwidth & less image problem than harmonic mixer



W-Band Downconverter



Addendum (cont)

- FMCW peak measurement
  - Stop sweep if possible
    - Must stop at maximum frequency
    - Maximum signal amplitude when stopped must be at least as high as when sweeping.
  - Measurement when sweeping
    - Fig. A-1 single scan
    - Figs. A-2, A-3 multiple scans, max hold
    - Fig. A-4 100 sec scan, 1 MHz, 300 kHz & 100 kHz RBW

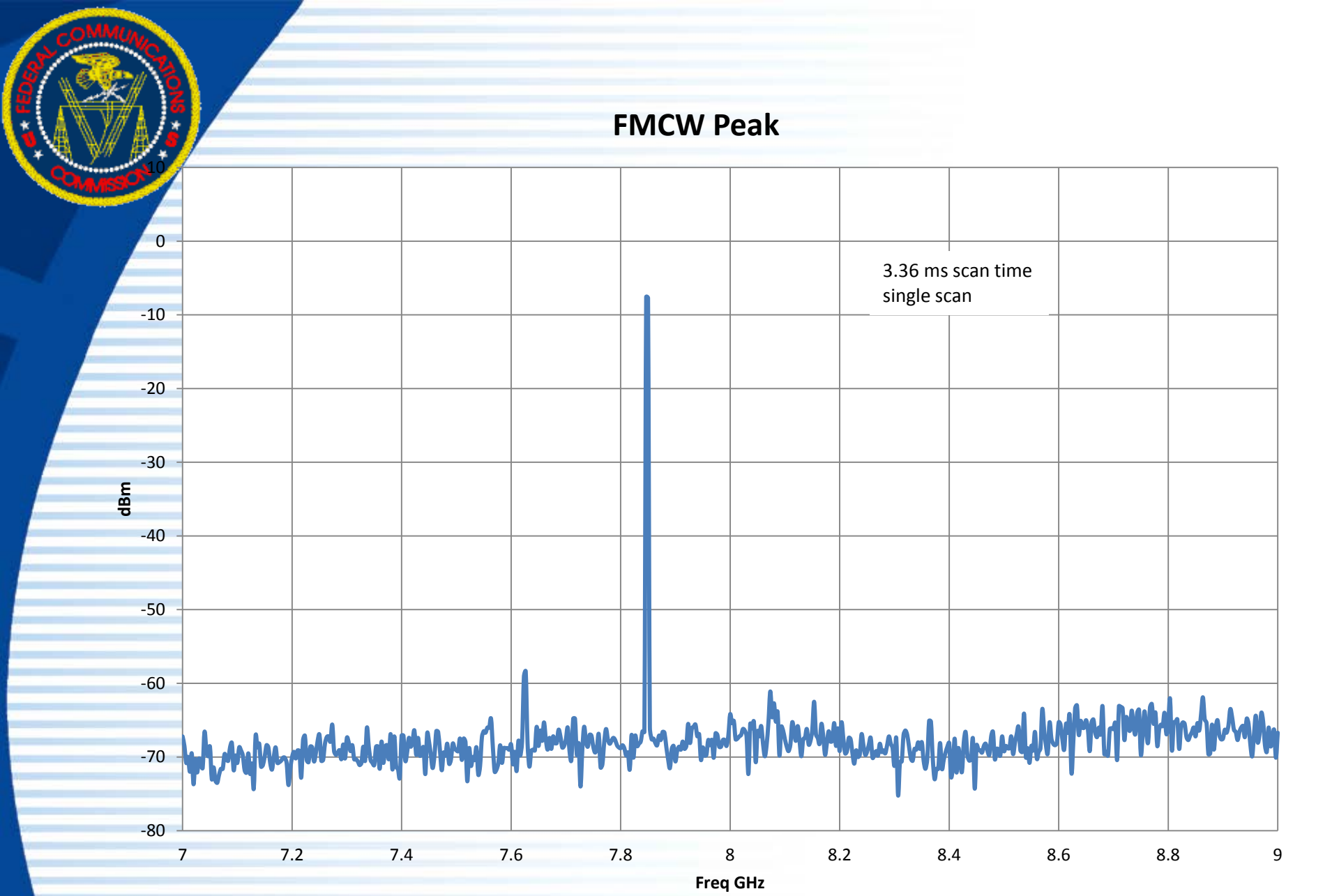


Figure A-1 Single scan

FMCW Peak

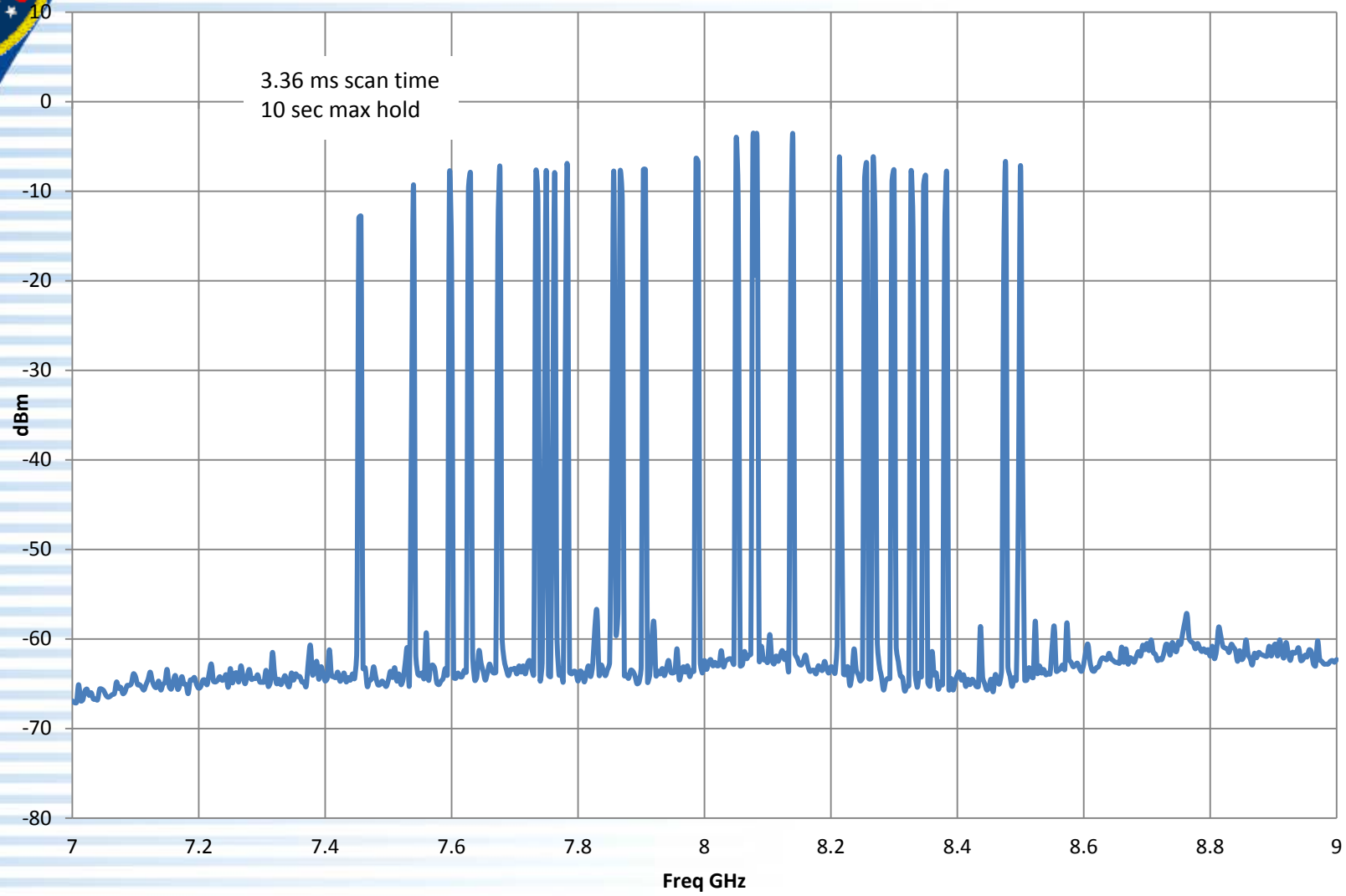


Figure A-2 10 sec max hold

FMCW Peak

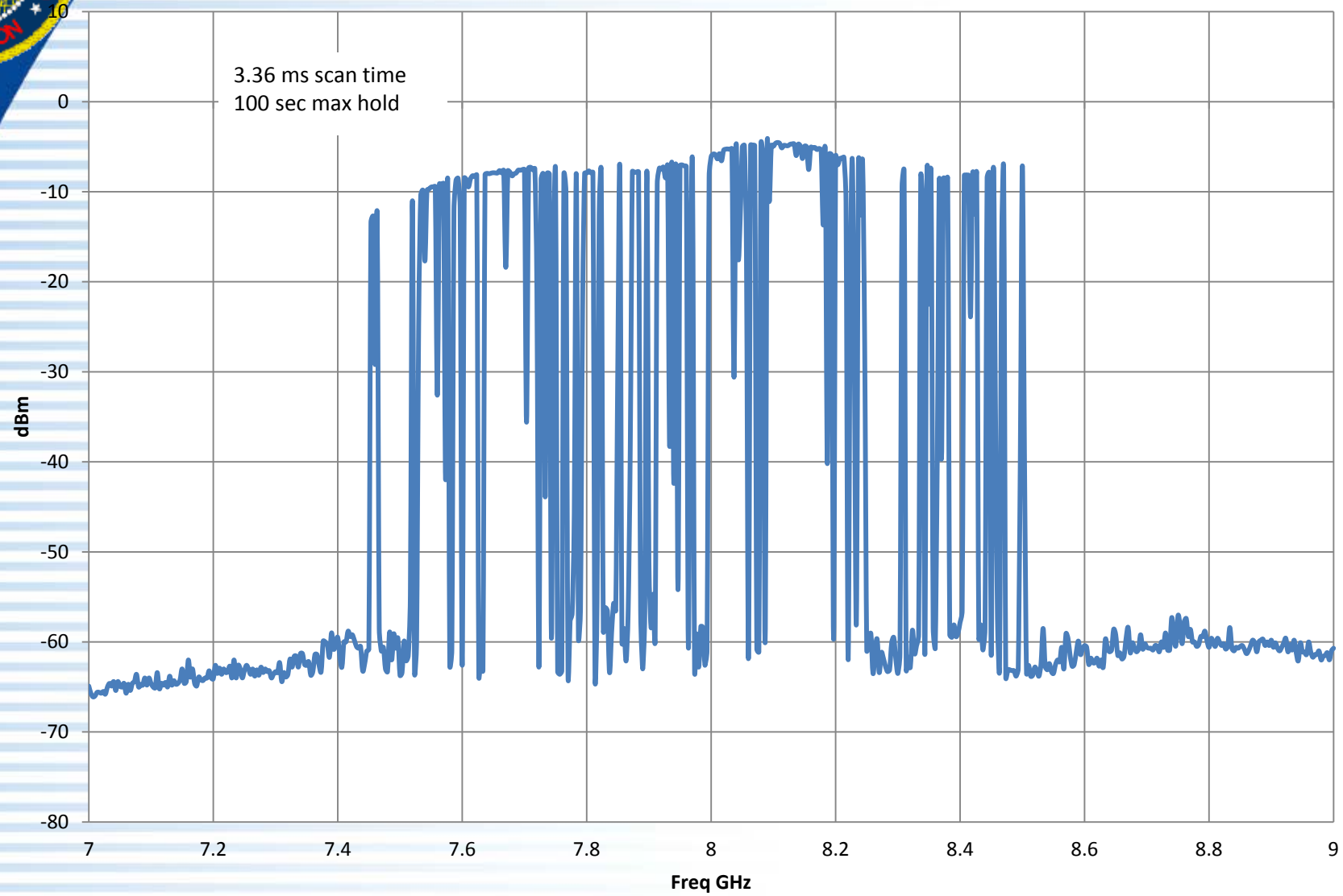


Figure A-3 100 sec max hold

FMCW Peak

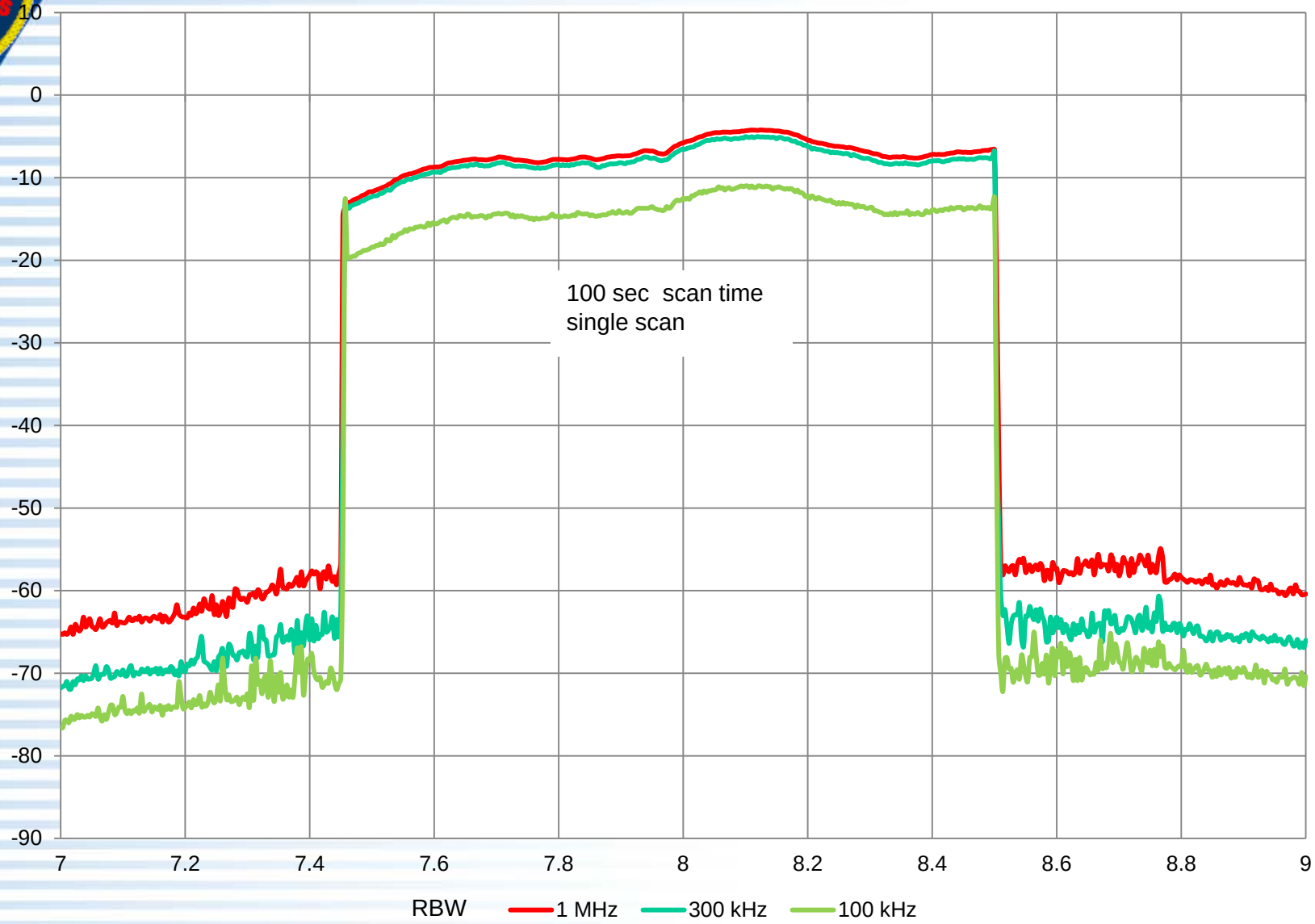


Figure A-4 100 sec single scan