FCC test part 47ch
2.1515b and d
Occupied bandwidth and Carrier Frequency for 243MHz

Test Notes and Deviations: The DME beacon has a SMA 50 OHM output that feeds a remote antenna with internal impedance matching network at the end of a 3 ft cable. For convenience and repeatability of measurements the antenna A output connector is directly connected to the test equipment through a 26 db attenuator network to protect the spectrum analyzer during the 5 watt 406 MHz bursts.

The Carrier frequency is read by using the Spectrum analyzers peak marker frequency counter function at a very narrow resolution bandwidth and narrow span to obtain the necessary accuracy directly off the analyzer rather than the FCC generator substitution method.

Sweep times are kept below 30 seconds rather than 100 seconds as required in some FCC tests to prevent display gaps caused during the 406 burst modulation that occurs every 50 seconds or so.

The scope is used to monitor swept audio tone and 406 burst modulation to determine when to acquire data after the burst.

1. Set equipment as shown in figure 1.
2. Activate beacon.
3. Set spectrum analyzer up as follows:
   a) Center Frequency : 243 MHz
   b) IF bandwidth (resolution bandwidth) : 10KHz
   c) Video bandwidth: 3MHz
   d) Scan width: 200 HZ total (20hz /div)
   e) Amplitude scale: 10db/div
   f) Sweep speed: 1sec (100ms/ div) continuous

4. Adjust the amplitude scale level till the modulation covers the screen near full scale like shown in figure 2.
5. Go to trace peak hold after the beacon's 406 burst for 30 seconds to "fill in" the trace and obtain the lowest peak carrier level. Then go to single sweep mode to freeze the display.
6. Turn on marker peak search and adjust marker to the center as shown in figure 2.
7. Record the marker value in dbm. (this measured at –7.50dbm in figure 2)
8. Calculate the mean power reference level by adding the modulation duty cycle derating contribution as follows:
   Peak level + modulation factor from paragraph 2.1513 in db = mean reference level
   -7.50 dbm + $(10 \log_{10} (0.38561))$db = -11.638 dbm

9. Set spectrum analyzer up as follows:
   a) Center Frequency : 243 MHz
   b) IF bandwidth (resolution bandwidth) : 100Hz
   c) Video bandwidth: 3MHz
   d) Scan width: 200 KHz total (20 Khz /div)
   e) Amplitude scale: 10db/div

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f) Sweep speed: 100sec (10s/ div) continuous
g) Trace peak hold: ON

10. Allow the spectrum analyzer to "fill in" the trace for about 10 minutes to collect the highest value sideband data.
11. Go to single sweep mode and let the sweep complete.
12. Turn on marker peak search and adjust marker to the highest peak as shown in figure 3
13. Record the modulation center marker value in dbm. (this measured at –13.33dbm in figure 3)
14. Calculate the mean power reference correction to the modulation center marker value as follows:

    Mean reference level - modulation center marker value = mean carrier reference correction
    -11.638 dbm – (–13.33bm) = 1.692 db

15. Set marker delta mode on the spectrum analyzer and move the marker delta to +12.5 Khz to the right of the peak reference as shown in figure 4 and adjust to the highest peak between +12.5 and +25 Khz. Note: the marker value rounds to the nearest 0.3 Khz at this frequency span range so the marker was moved to the highest peak near +12.5 KHz which was found at +12.3 Khz.
16. Record the modulation marker value in db. (this measured at –26.17db in figure 4)
17. Calculate the sideband to mean reference level by adding the reference correction as follows:

    Mean carrier reference correction – (sideband to peak value)= sideband to below mean carrier value.
    1.692 db - (-26.17 dB) = **27.86 db below mean carrier value.**

    This passes the requirement of 25 db below the mean carrier level at 50% bandwidth from carrier (+/-12.5Khz).

18. Set marker delta mode on the spectrum analyzer and move the marker delta to +25 Khz to the right of the peak reference as shown in figure 5 and adjust to the highest peak at or beyond +25 Khz.
19. Record the modulation marker value in db. (this measured at –33.00db in figure 5)
20. Calculate the sideband to mean reference level by adding the reference correction as follows:

    Mean carrier reference correction – (sideband to peak value)= sideband to below mean carrier value.
    1.692 db - (-33.00 dB) = **34.69 db below mean carrier value.**

    This passes the requirement of 30 db below the mean carrier level at 100% bandwidth from carrier (+/-25Khz).

21. Set marker delta mode on the spectrum analyzer and move the marker delta to -12.5 Khz to the left of the peak reference as shown in figure 6 and adjust to the highest peak between -12.5 and -25 Khz. Note: the marker value rounds to the nearest 0.3 Khz at this frequency span range so the marker was moved to the highest peak near -12.5 KHz which was found at -12.3 Khz.
22. Record the modulation marker value in db. (this measured at –25.34db in figure 6)
23. Calculate the sideband to mean reference level by adding the reference correction as follows:

    Mean carrier reference correction – (sideband to peak value)= sideband to below mean carrier value.
    1.692 db - (-25.34 dB) = **27.03 db below mean carrier value.**

    This passes the requirement of 25 db below the mean carrier level at 50% bandwidth from carrier (+/-12.5Khz).

21. Set marker delta mode on the spectrum analyzer and move the marker delta to -25 Khz to the left of the peak reference as shown in figure 7 and adjust to the highest peak at or beyond -25 Khz.
22. Record the modulation marker value in db. (this measured at –32.67db in figure 7)
23. Calculate the sideband to mean reference level by adding the reference correction as follows:

    Mean carrier reference correction – (sideband to peak value)= sideband to below mean carrier value.
    1.692 dB - (-32.67dB) = **34.36 db below mean carrier value.**
    This passes the requirement of 30 db below the mean carrier level at 100% bandwidth from carrier (25Khz).

24. Set up spectrum analyzer for 3 db bandwidth and carrier frequency as follows:
    g) Center Frequency : 243 MHz (re-center for actual carrier frequency as required)
    h) IF bandwidth (resolution bandwidth) : 30Hz
    i) Video bandwidth: 3MHz
    j) Scan width: 200 HZ total (20hz /div)
    k) Amplitude scale: 5db/div
    l) Sweep speed: 30sec (3s/ div) continuous
    m) Frequency counter function ON

25. Adjust the amplitude scale level and center frequency till the modulation covers the screen near full scale like shown in figure 8.
26. Go to trace peak hold and single sweep mode after the beacon's 406 burst for one 30 second sweep to "fill in" the trace as shown in figure 8.
27. Turn on marker peak search to locate the highest peak and carrier frequency as shown in figure 8.
28. Record the frequency counter value in the upper right hand corner of figure 8. (this measured at **243.002243MHz** in figure 8)

    This passes the RTCA DO-183 (Paragraph 2.2.2.1) frequency carrier accuracy and FCC requirement of +/- 0.005% (+/- 12KHZ) under room temperature environmental conditions.

    In the DME beacon FAA test report Y3-03-0726 , the data extracted for +55 degree C high temp 50 life test attachment AH is as follows :
    Lowest Frequency Recorded at +55 : 243.0016 MHZ
    Highest frequency recorded at +55: 243.0031 MHZ

    In the DME beacon FAA test report Y3-03-0726 , the data extracted for –20 degree C low temp 50 life test attachment AG is as follows :
    Lowest Frequency Recorded at -20 : 243.0045 MHZ
    Highest frequency recorded at -20: 243.0053 MHZ

    This passes the RTCA DO-183 (Paragraph 2.2.2.1) frequency carrier accuracy and FCC requirement of +/- 0.005% (+/- 12 KHZ) under all temperature environmental conditions.

29. Turn on marker delta peak search and move the delta marker to the right to the closest value of – 3.00 as shown in figure 9.
30. Record the marker delta frequency positive value in HZ. (this measured at 21 HZ in figure 9)
31. Turn on marker delta peak search and move the delta marker to the left to the closest value of – 3.00 as shown in figure 10.
32. Record the marker delta frequency negative value in HZ. (this measured at -19 HZ in figure 10)
33. Calculate the 3db bandwidth by subtracting the left value from the right value

3db positive frequency value – 3db negative frequency value = 3db bandwidth.
21 Hz - (-19 Hz) = 40Hz bandwidth

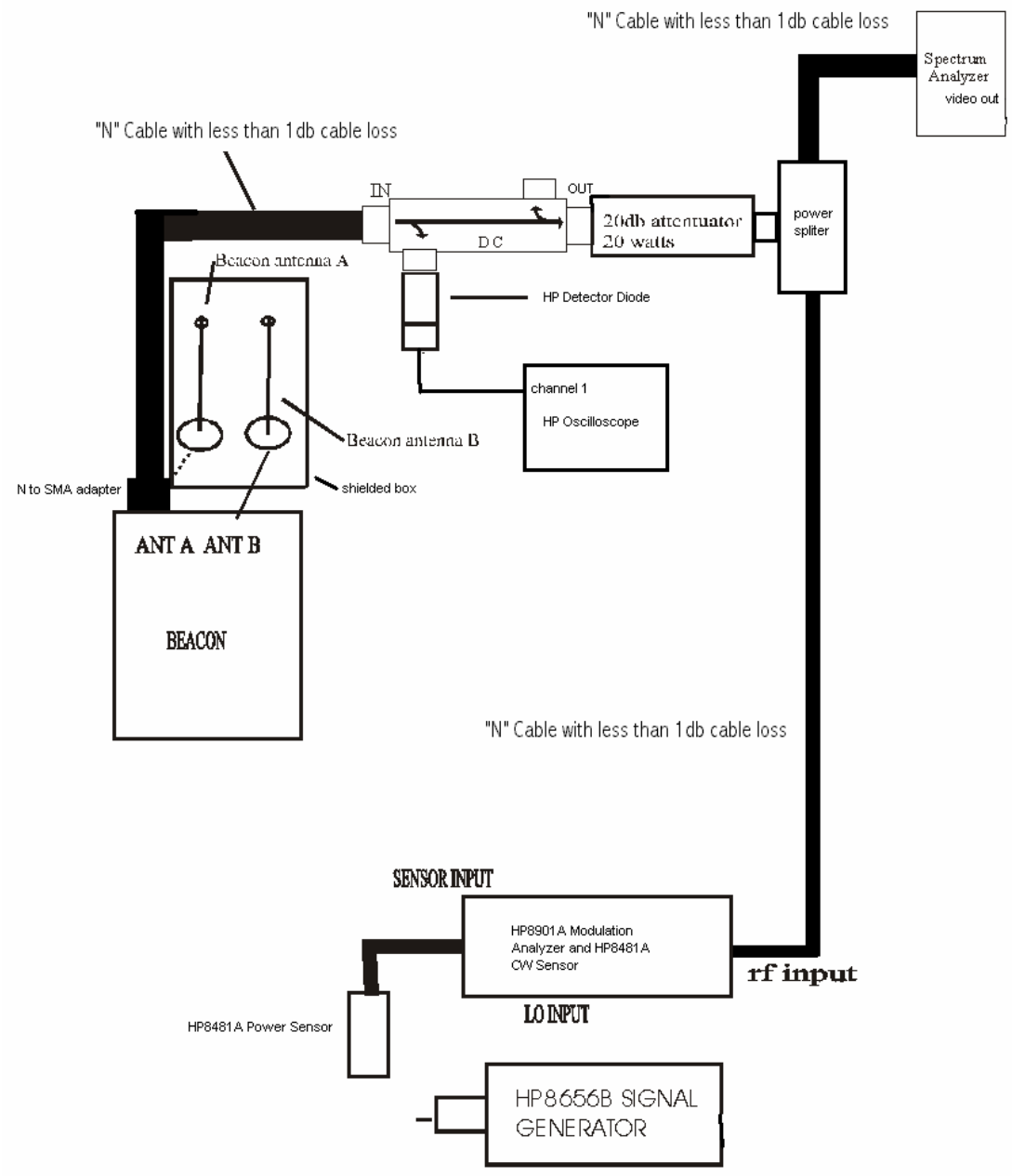
"N" Cable with less than 1db cable loss
Spectrum Analyzer video out
"N" Cable with less than 1db cable loss
IN
OUT
DC
20db attenuator 20 watts
power spliter
Beacon antenna A
HP Detector Diode
channel 1
HP Oscilloscope
Beacon antenna B
N to SMA adapter
shielded box
ANT A ANT B
BEACON
"N" Cable with less than 1db cable loss
SENSOR INPUT
HP8901A Modulation Analyzer and HP8481A CW Sensor
rf input
LO INPUT
HP8481A Power Sensor
HP8656B SIGNAL GENERATOR

Figure 1

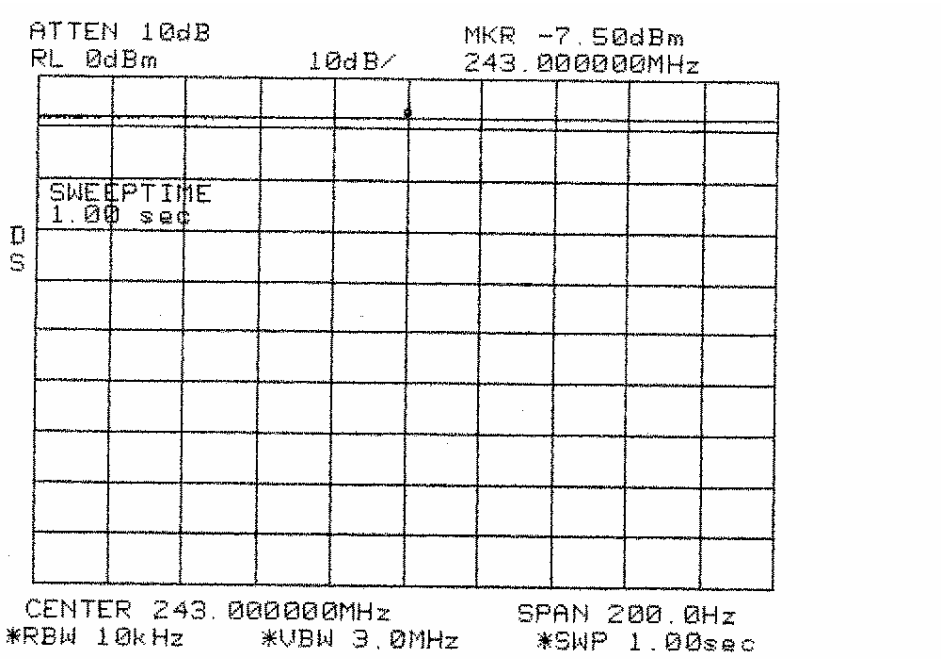

Figure 2

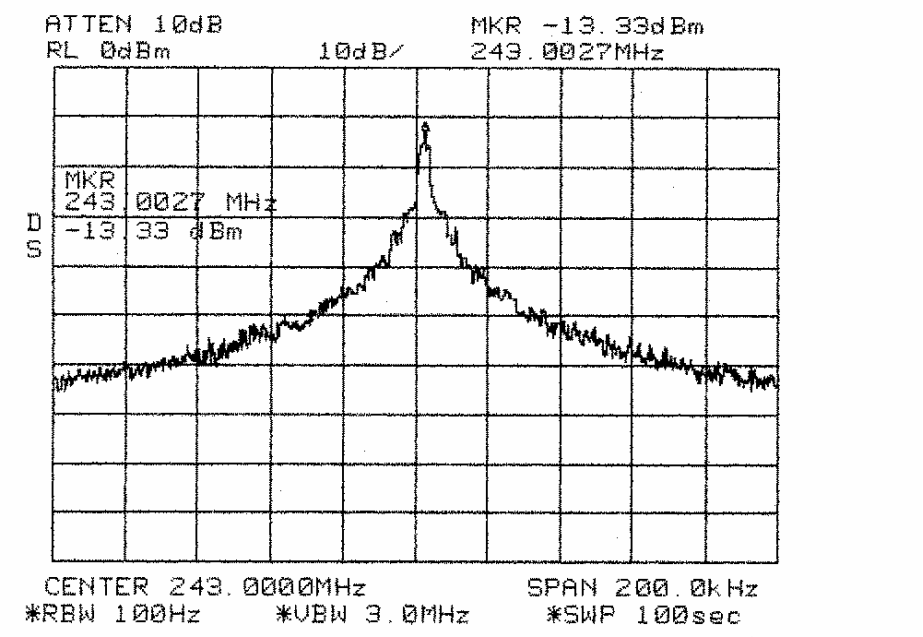

Figure 3

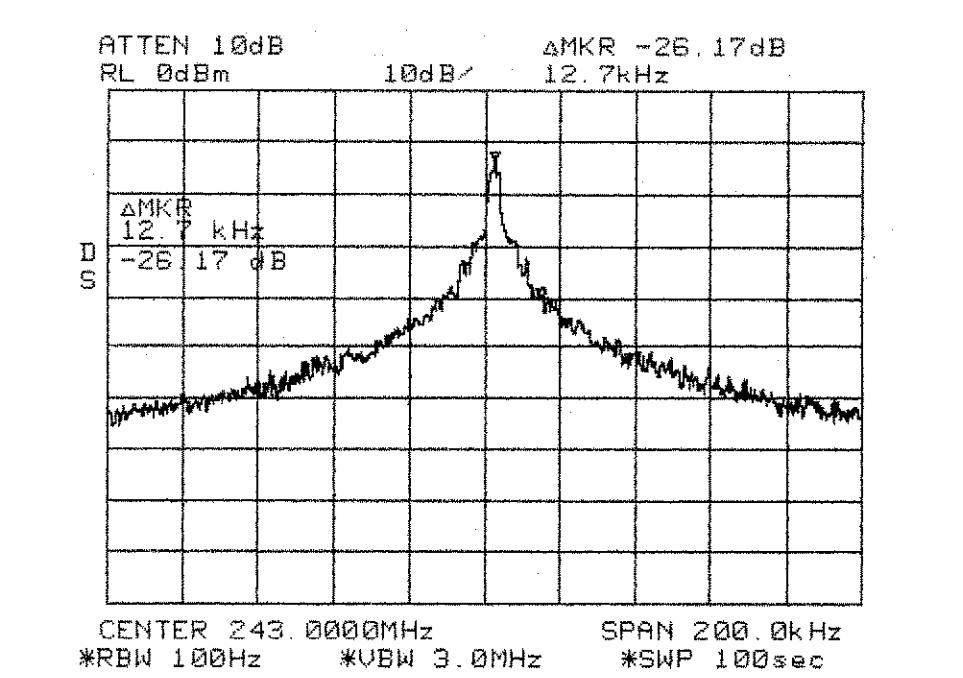

Figure 4

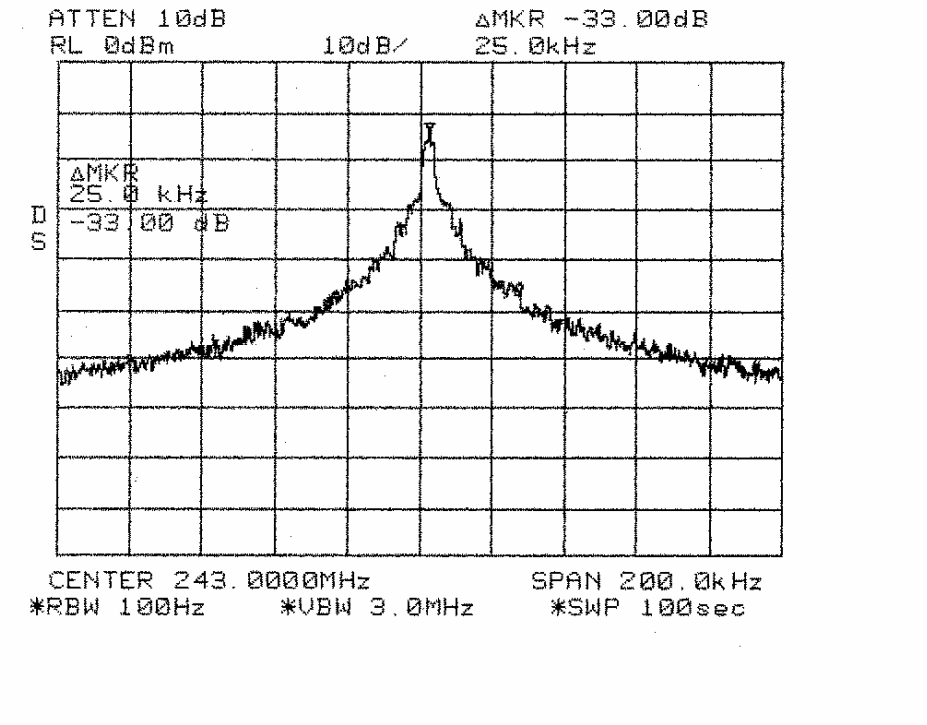

Figure 5

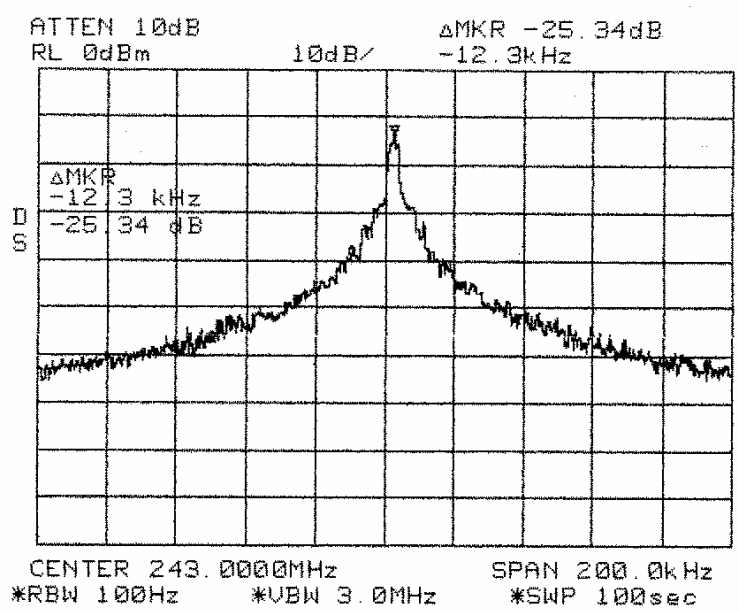

Figure 6

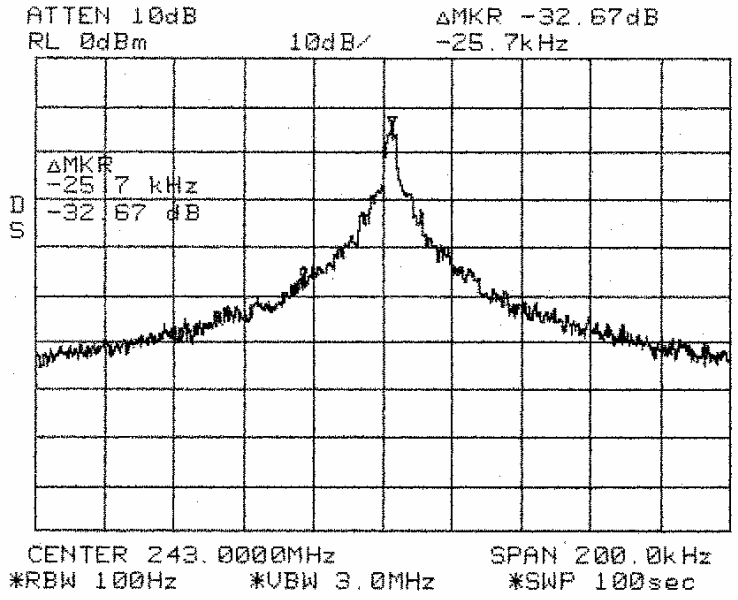

Figure 7

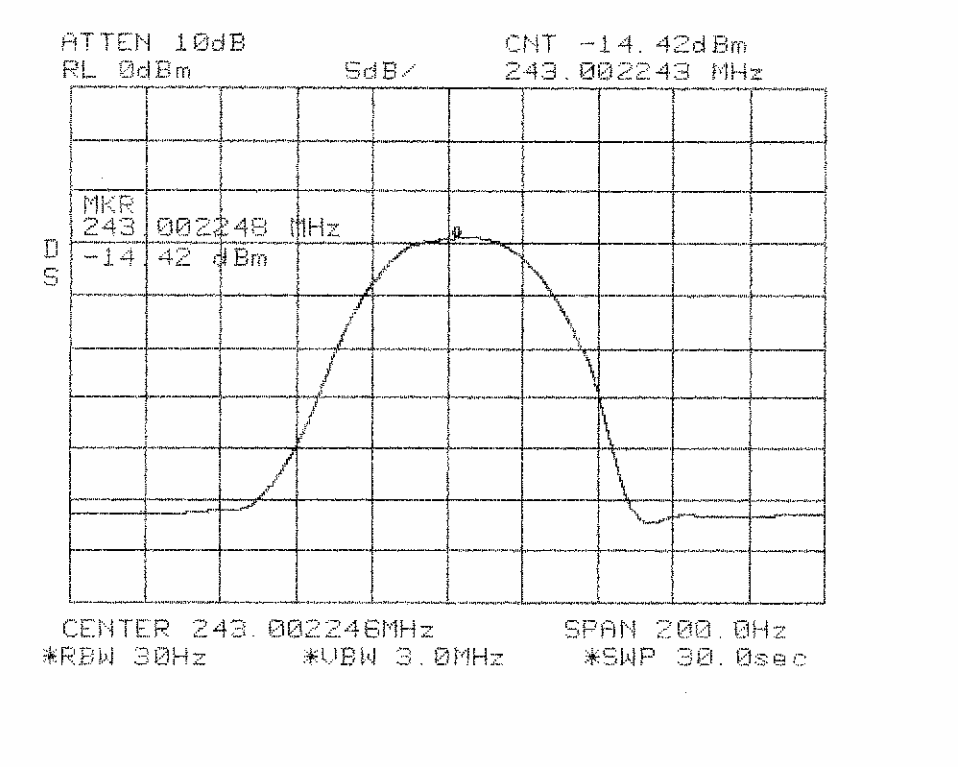

Figure 8

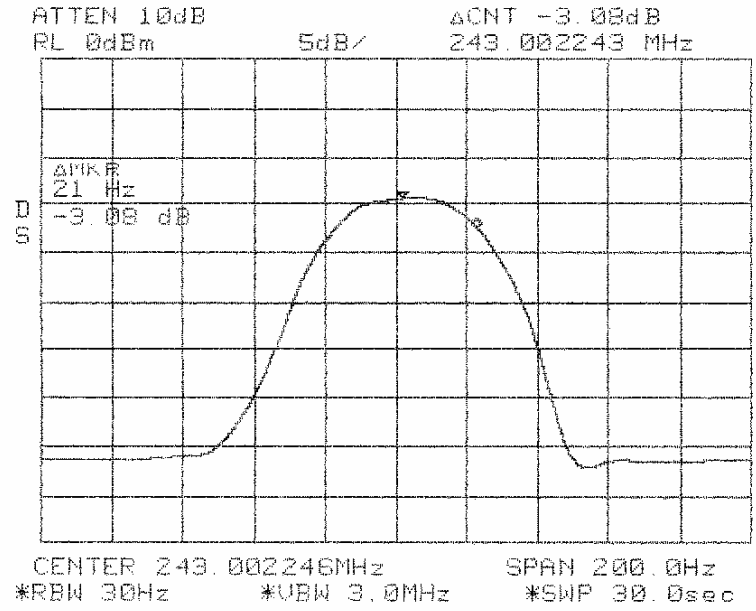

Figure 9

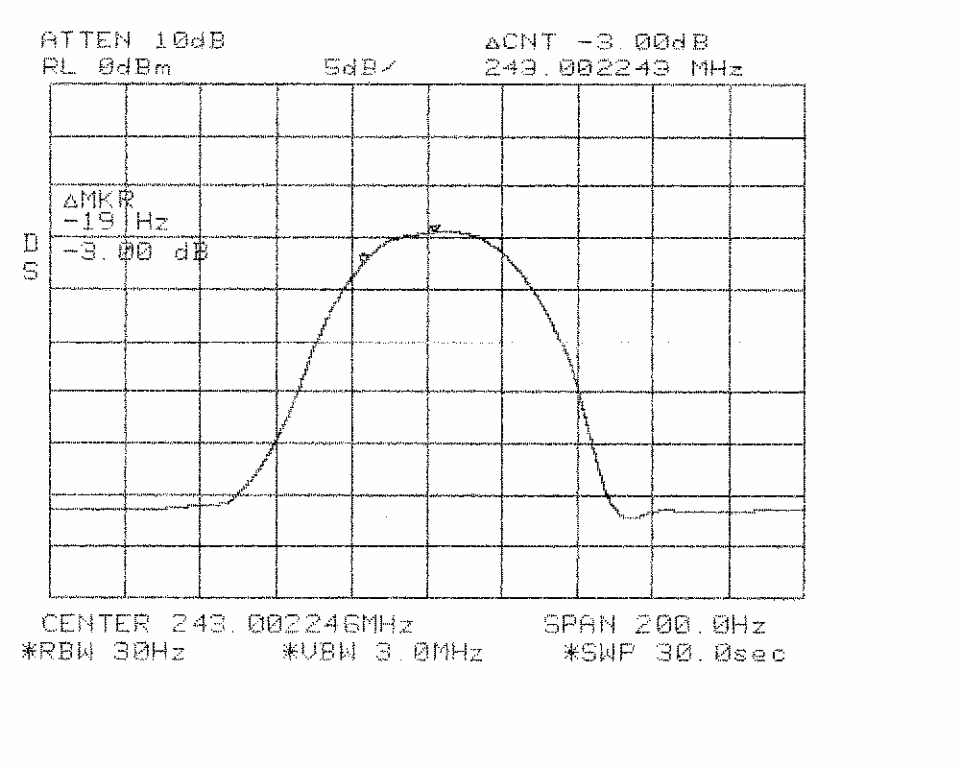
ATTEN 10dB
RL 0dBm
5dB/
ΔCNT -3.00dB
249.002249 MHz
ΔMKR
-19 Hz
-3.00 dB
D
S
CENTER 249.002246MHz
SPAN 200.0Hz
*RBW 30Hz
*VBW 3.0MHz
*SWP 30.0sec

Figure 10