FCC test part 47ch87.139h
Spurious Emissions referenced to the Output Carrier Frequencies of 406.028 MHz
KTF406-ELT

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 beacon spectrum analyzer direct connection method to locate spurious signals is far more revealing then the radiated emission method requiring dipole antenna re-tuning over the 30 to 1000 MHz band. This is the case because the spectrum analyzer provides the equivalent ideal 50-ohm antenna load to the beacon over the whole 30 to 1000MHZ band. The DME antenna provides a low VSWR load only at the required beacon output frequencies. At other frequencies the antenna would reflect most of the energy back to the beacon and not radiate it into free space. Because of this fact any actual field emission testing would reveal fewer spurious emissions than the direct connection method used below.

Sweep times are kept below 50milli 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 the burst is occurring.

1. Set equipment as shown in figure 1.
2. Activate beacon.
3. Set spectrum analyzer up as follows:
   a) Start Frequency : 350 MHz
   b) Stop Frequency : 2.6 GHz
   c) IF bandwidth (resolution bandwidth) : 1 MHz
   d) Video bandwidth: 1 MHz
   e) Amplitude scale: 10db/div
   f) Sweep speed: 50msec (5ms/ 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 for at least 60 seconds to “fill in” the trace and obtain the highest peak carrier and spurious levels Then go to single sweep mode to freeze the display.
6. Turn on marker peak search and adjust marker to the peak of the 406.028 MHz carrier as shown in figure 2.
7. Record the 406.028 MHz carrier marker value in dBm. (this measured at +8.67dbm in figure 2)
8. Adjust marker to the peak of the 812.056 MHz harmonic spurious as shown in figure 3.
9. Record the 812.056 MHz harmonic spurious marker value in dBm. (this measured at –33.67dbm in figure 3)
10. Adjust marker to the peak of the 1218.084 MHz harmonic spurious as shown in figure 4.
11. Record the 1218.084 MHz harmonic spurious marker value in dBm. (this measured at –35.83dbm in figure 4)
12. Adjust marker to the peak of the 1624.112 MHz harmonic spurious as shown in figure 5.
13. Record the 1624.112 MHz harmonic spurious marker value in dBm. (this measured at –39.33dbm in figure 5)
14. Adjust marker to the peak of the 2030.14 MHz harmonic spurious as shown in figure 6.

15. Record the 2030.14 MHz harmonic spurious marker value in dBm. (this measured at –39.00 dBm in figure 6)
16. Verify the 406.028 MHz related harmonics spurious levels are below the 406.028 MHz carrier by at least 30 dB. To do this subtract the 812.056 MHz spur from the 406.028 MHz carrier as follows:

    406.028 MHz carrier level in dBm - 812.056 MHz spurious level dBm = $dB_{spur812}$

    +8.67 dBm - (-33.67) dB = 42.34 $dB_{spur812Mhz}$

    This passes the spurious requirement of 30 dB below the 406.028 MHz carrier level as per the 87.139h at the beyond the 100 % bandwidth point from the carrier (+/-20 kHz).

17. Verify the next 406.028 MHz related harmonics spurious levels are below the 406.028 MHz carrier by at least 30 dB. To do this subtract the 1218.084 MHz spur from the 406.028 MHz carrier as follows:

    406.028 MHz carrier level in dBm - 1218.084 MHz spurious level dBm = $dB_{spur1218}$

    +8.67 dBm - (-35.83) dB = 44.5 $dB_{spur1218Mhz}$

    This passes the spurious requirement of 30 dB below the 406.028 MHz carrier level as per the 87.139h at the beyond the 100 % bandwidth point from the carrier (+/-20 kHz).

18. Verify the next 406.028 MHz related harmonics spurious levels are below the 406.028 MHz carrier by at least 30 dB. To do this subtract the 1624.112 MHz spur from the 406.028 MHz carrier as follows:

    406.028 MHz carrier level in dBm - 1624.112 MHz spurious level dBm = dBspur1624

    +8.67 dBm - (-39.33) dB = 48 $dB_{spur1624Mhz}$

    This passes the spurious requirement of 30 dB below the 406.028 MHz carrier level as per the 87.139h at the beyond the 100 % bandwidth point from the carrier (+/-20 kHz).

19. Verify the next 406.028 MHz related harmonics spurious levels are below the 406.028 MHz carrier by at least 30 dB. To do this subtract the 2030.14 MHz spur from the 406.028 MHz carrier as follows:

    406.028 MHz carrier level in dBm - 2030.14 MHz spurious level dBm = $dB_{spur2030Mhz}$

    +8.67 dBm - (-39.00) dB = 47.67$dB_{spur2030Mhz}$

    This passes the spurious requirement of 30 dB below the 406.028 MHz carrier level as per the 87.139h at the beyond the 100 % bandwidth point from the carrier (+/-20 kHz).

20. Verify no **other non-harmonically related spurious signal** appears above the -39.13 dBm level between 350 MHz and 2600 MHz. Since **none can be found** that appears bigger than the harmonically related spurious found at the -39.33 dBm level, the beacon does not broadcast any unwanted non-harmonic signals at least 48 dB below the carrier.

    This passes the spurious requirement of 30 dB below 406 MHz carrier level as per the 87.139h at the beyond the 100 % bandwidth point from the carrier (+/-20 kHz).

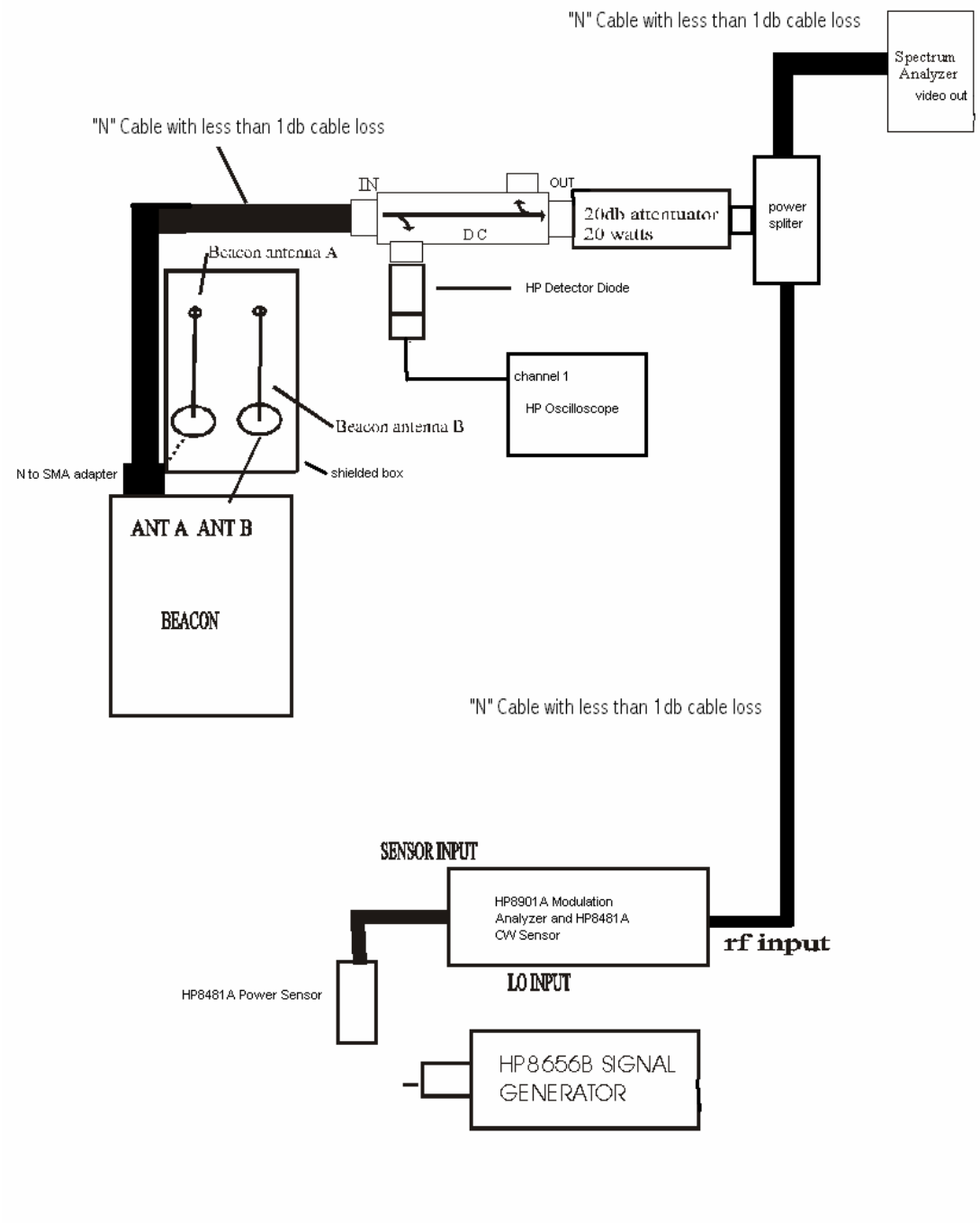
"N" Cable with less than 1db cable loss
Spectrum Analyzer video out
"N" Cable with less than 1db cable loss
IN
OUT
DC
20db attenuator 20 watts
power spliter
Beacon antenna A
HP Detector Diode
channel 1
HP Oscilloscope
Beacon antenna B
N to SMA adapter
shielded box
ANT A ANT B
BEACON
"N" Cable with less 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

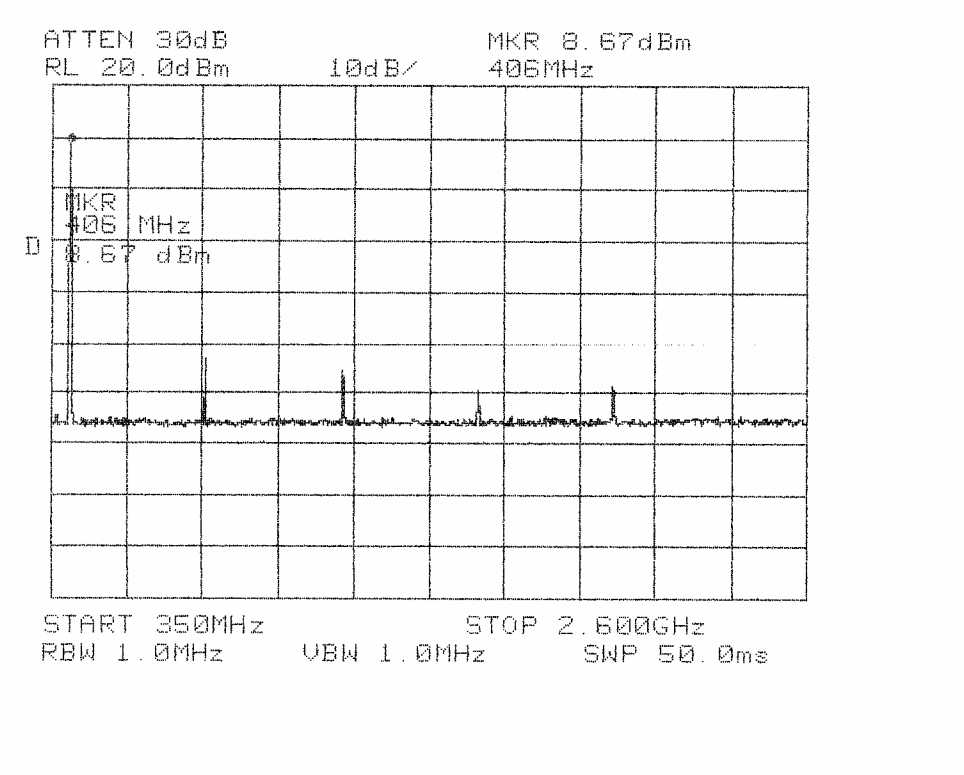

Figure 2

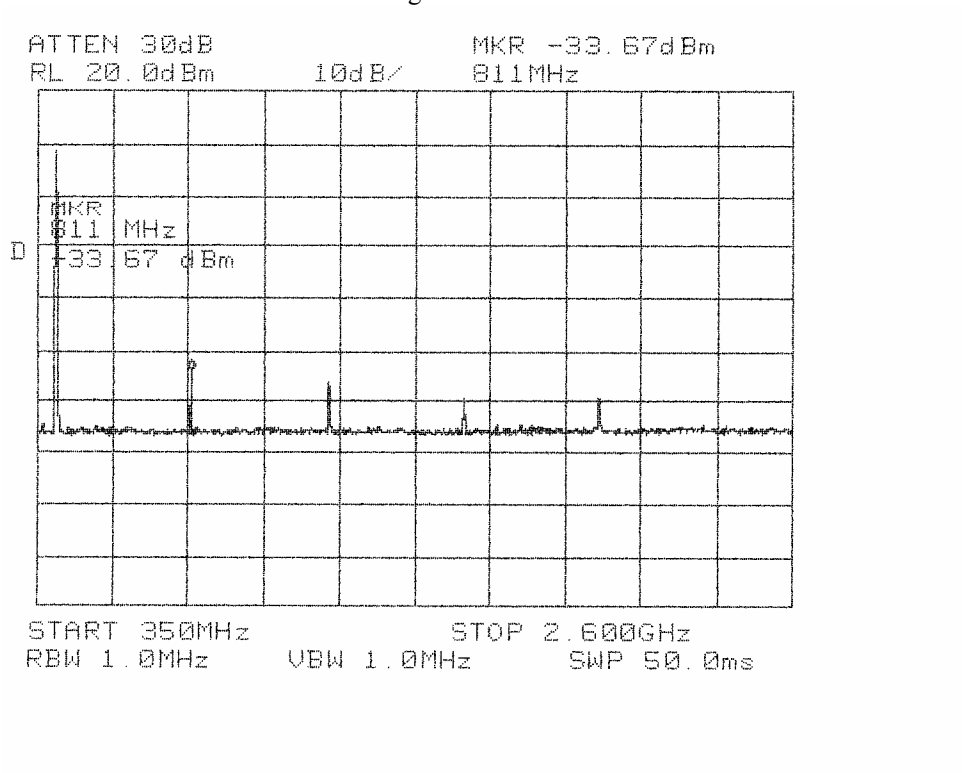

Figure 3

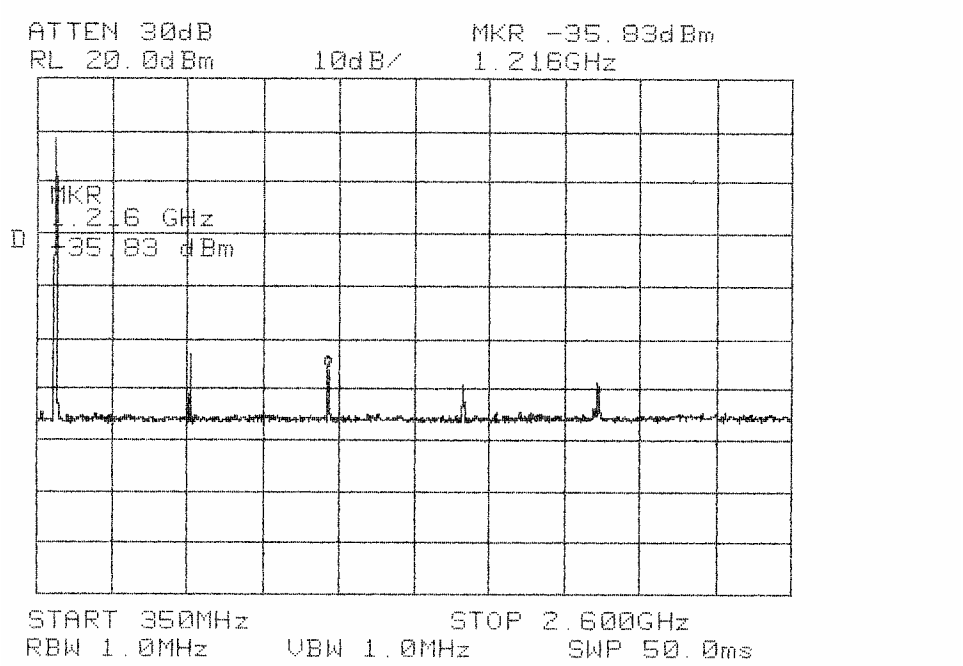

Figure 4

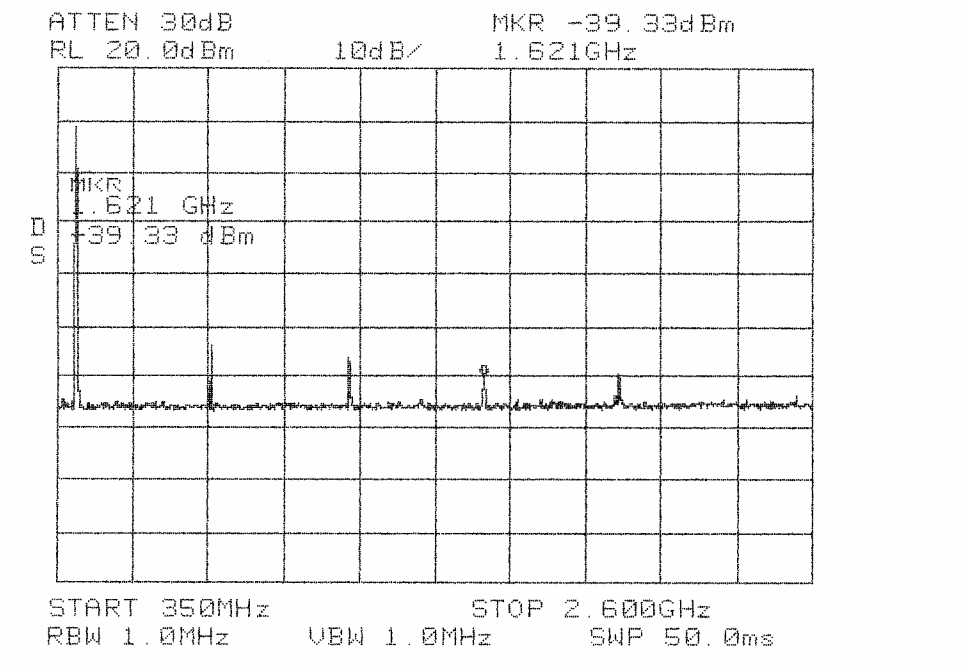

Figure 5

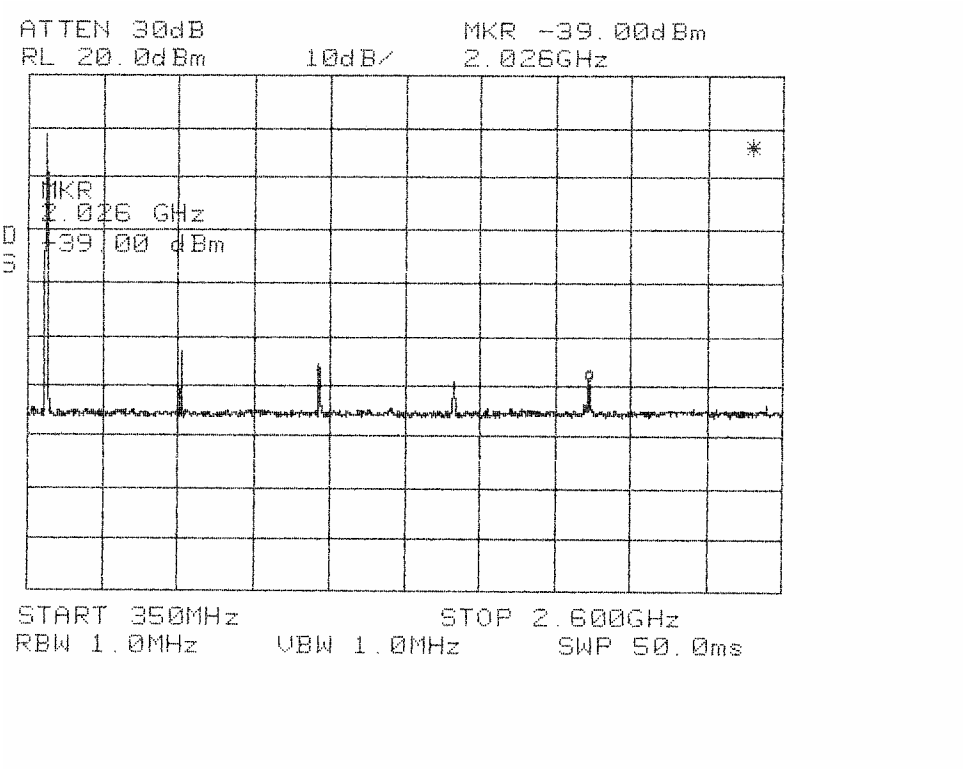
ATTEN 30dB
RL 20.0dBm
10dB/
MKR -39.00dBm
2.026GHz
MKR
2.026 GHz
-39.00 dBm
START 350MHz
STOP 2.600GHz
RBW 1.0MHz
VBW 1.0MHz
SWP 50.0ms

Figure 6