NAME OF TEST: Adjacent Channel Coupled Power
Dataradio G3 Modem at 128000 bps 16FSK

RULE PART NUMBER: 90.543(a) and (b), 27.53(d)(1)(2)

MINIMUM STANDARD: Wideband 150kHz mobile transmitter ACCP requirements:

Offset from Center requency (kHz)	Measurement Bandwidth (kHz)	Maximum ACCP Relative (dBc)	Maximum ACCP Absolute (dBm)
100....	50	-40	Not Specified
200...	50	-50	-35
300...	50	-50	-35
400...	50	-50	-35
600 to 1000.....	30(swept)	-60	-45
1000 to receive band	30(swept)	-70	-55
in the receive band	30(swept)	-100	-75

UNIT UNDER TEST Prototype 700 MHz

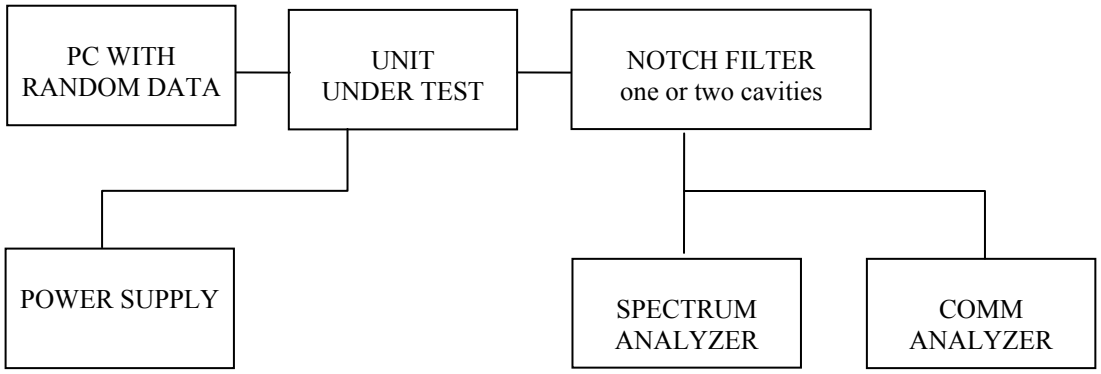
TEST RESULTS: Meets minimum standard (see test data on the following pages)

TEST CONDITIONS: 90.543(b) was the standard procedure followed through the test. The HP 8563E instrument has Channel Power over BW measurement built-in software. Standard Test Conditions, 25 C.

TEST EQUIPMENT: Notch filter, characteristic supplied
DC Power Supply , Astron Model VS-20M
IFR COM-120B
Spectrum Analyzer, Model HP8563E
HP Benchlink -software for plot captures.

PERFORMED BY: Constantin Pintilei DATE: 01/28/03

TEST SET-UP:



NAME OF TEST: Adjacent Channel Coupled Power (Continued)
Dataradio G3 Modem at 128000 bps 16FSK

TX Data Test Pattern:

The transmit "test data" pattern command produces a 2047 bit pseudo-random pattern. This pattern is generated by the internal software using the polynomial $X^{11}+X^{9}+1$ form and a 12-bit shift register. Initial value of the register is 111111111110 (FFE hex). The 2047 bit sequence is repeated thereafter as long is necessary to complete the test duration . This pattern is applied to the DSP processor data input for encoding and pulse shaping as described above.

Explanations for the 50kHz wideband mobile transmitter

As per 90.531(c) there are two band segments that are designated for use with wideband emissions. Each of these wideband segments is divided into 120 channels having a channel size of 50 kHz. Further down in the part 90.531(d)(2) is stated that two or three contiguous wideband (50 kHz) channels may be used in combination as 100 kHz or 150 kHz channels, respectively. Meantime, the specifications for ACCP addresses directly only the 150kHz mobile transmitter ACCP requirements with no explicit reference to 50kHz or 100kHz mobile transmitter ACCP requirements.

For the test purposes the specifications available were interpreted such that the 150 kHz transmitter specifications were considered as applicable to 3 contiguous 50kHz channels which of which has each its own 50 kHz transmitter. Subsequently the rule was applied for the 50kHz transmitter when transmitting on any of the 3-combined channels. Adjacent channel coupled power has also been measured is each of the 50kHz channels immediately adjacent to the non-aggregated 50k in use.

Test results 31W (maximum power, 90.534(a)):

Reference power in the main channel, (90.534(b)(1))
Settings:150kHz Channel Bandwidth

channel 180, 800.025MHz 12.0 dBm
channel 179, 799.975MHz 12.1 dBm
channel 181, 800.075MHz 11.7 dBm
Total RF power is 31W⇔ 45dBm, this makes the total attenuation of about 33dB. In the set-up the notch filter shows 32.1 to 34.1 dB attenuation values, over 150kHz bandwidth the average is 32.95dB

Power Level at frequency offsets <600kHz (90.534(b)(2))
Settings: 1 cavity notch filter, 50kHz Channel bandwidth
RBW=300Hz, Video BW=3kHz, Span=1MHz , Sweep = Detector mode: sample
Display resolution (600 display buckets)= 1665Hz ,
Reference level +9dBm, 50kHz channel noise=-75.5dBm

UUT in center channel of the 150kHz 3-contiguous 50 kHz channels 179, 180, 181.
Channel 180, frequency 800.02500 kHz

frequency Offset	-400	-300	-200	-100	0	100	200	300	400
Channel Power read	-70.4	-70.1	-63.6	-61.3	***12.0***	-62.9	-68.1	-70.2	-69.8
Notch correction factor	21.5	23.5	27	31	***33***	31	27	23.5	21.5
Absolute channel power (dBm) (read value +notch)	-48.9	-46.6	-36.6	-30.3	***45.0***	-31.9	-41.1	-46.7	-48.3
ACCP (difference)	-93.9	-91.6	-81.6	-75.3	NA	-76.9	-86.1	-91.7	-93.3

UUT in left (179) channel of the 150kHz 3-contiguous 50 kHz channels 179, 180, 181.
Channel 179, frequency 799.975000 MHz

frequency Offset to the center channel	-400	-300	-200	-100	0	100	200	300	400
frequency Offset to the unit channel	-350	-250	-150	-50	+50	+150	+250	+350	+450
Channel Power read	-69.2	-64.7	-62.8	-32.0	***12.1***	-66.6	-70.2	-71.6	-70.4
Notch correction factor	21.5	23.5	27	31	***33***	31	27	23.5	21.5
Absolute channel power (dBm) (read value +notch)	-47.7	-41.2	-35.8	-1.0	***45.1***	-35.6	-43.2	-48.1	-48.9
ACCP (difference)	-92.8	-86.3	-79.9	-44.1	NA	-80.7	-88.3	-93.2	-94.0

UUT in right(181) channel of the 150kHz 3-contiguous 50 kHz channels 179, 180, 181.
Channel 181, frequency 800.075000 MHz

frequency Offset to the center channel	-400	-300	-200	-100	0	100	200	300	400
frequency Offset to the unit channel	-450	-350	-250	-150	-50	+50	+150	+250	+350
Channel Power read	-69.8	-70.3	-64.4	-61.8	***11.7***	-32.8	-68.1	-70.2	-69.8
Notch correction factor	21.5	23.5	27	31	***33***	31	27	23.5	21.5
Absolute channel power (dBm) (read value +notch)	-48.3	-47.8	-37.4	-30.8	***44.7***	-1.8	-41.1	-46.7	-48.3
ACCP (difference)	-93.0	-92.5	-82.1	-75.5	NA	-46.5	-85.8	-91.4	-93.0

50 kHz channel (non-aggregated) adjacent channel coupled power.
Channel 180, frequency 800.025000 MHz .All power readings on 50kHz channel

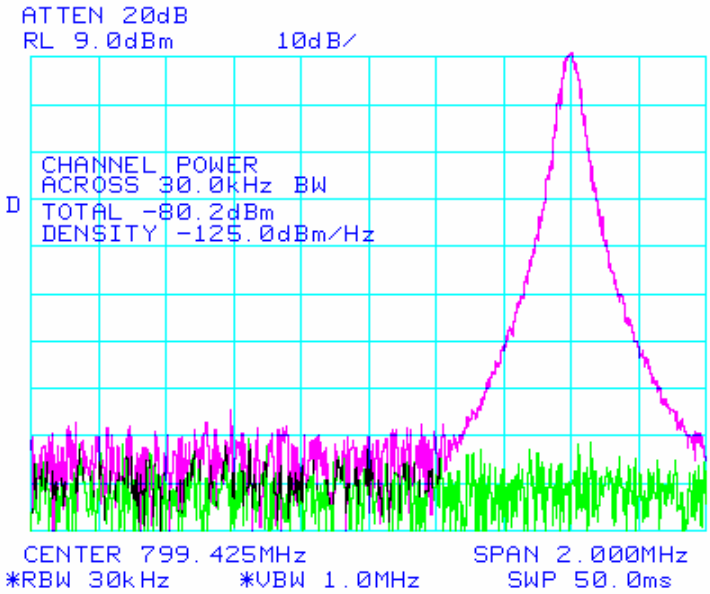
frequency Offset to the center channel	-200	-150	-100	-50	0	+50	+100	+150	+200
Channel Power read	-63.6	-61.9	-61.3	-32.0	***12.0***	-32.6	-63.9	-66.6	-68.1
Notch correction factor	27	29	31	33.8	***34.1***	33.2	31	29	27
Absolute channel power (dBm) (read value+correction)	-36.6	-32.9	-30.3	+1.8	***46.1***	+0.6	-32.9	-37.6	-41.1
ACCP (difference)	-82.7	-79.0	-76.4	-44.3	NA	-45.5	-79.0	-83.7	-85.2

Power Levels at frequency offsets >600kHz (90.534(b)(3)

- **frequency offsets between 600kHz and 1000 kHz**

Settings
Notch filter: 1cavity, 2MHz span picture, attenuation for 600kHz-1MHz offsets between 13dB and 17dB.
Spectrum analyzer: RBW=30kHz, Span=2MHz, Display resolution (601 display buckets)= 20kHz Detector mode: sample; Instrument's noise floor for 9dBm reference level –83.5dBm/30kHz (density noise =128.1dBm/Hz), instrument's noise floor including the notch attenuation: -100.5dBm/30kHz

Test data:
The capture below has data trace (red) vs noise trace (green). Data spectrum was swept for the 30kHz channel power at frequency offsets between 600kHz and 1MHz.



All the power channel read was below –75dBm/30kHz , after the correction of the 17dB (worst case) inserted by the notch filter the absolute channel coupled power was found lower than –58dBm
The value required for maximum absolute ACCP =–45dBm/30kHz bandwidth. >-58dBm
The value required for maximum relative ACCP = -60dBc >103dBc

- **frequency offsets between 1MHz and 6MHz**

Settings
Notch filter: 1cavity, attenuation for 1MHz-6MHz offsets between 4dB and 13dB.
Spectrum analyzer: RBW=30kHz, Span=600kHz, Display resolution (601 display buckets)= 1kHz Detector mode: sample; Instrument's noise floor for 9dBm reference level –83.5dBm/30kHz (density noise =128.1dBm/Hz), instrument's noise floor including the notch attenuation: -96.5dBm/30kHz
All the power channel read was below –75dBm/30kHz , after the correction of the 13dB (worst case) inserted by the notch filter the absolute channel coupled power was found lower than –62dBm
The value required for maximum absolute ACCP =–55dBm/30kHz bandwidth. >-62dBm
The value required for maximum relative ACCP = -70dBc >107dBc (+45dBm carrier)

- **frequency offsets between 1MHz and the uppermost receive frequency**

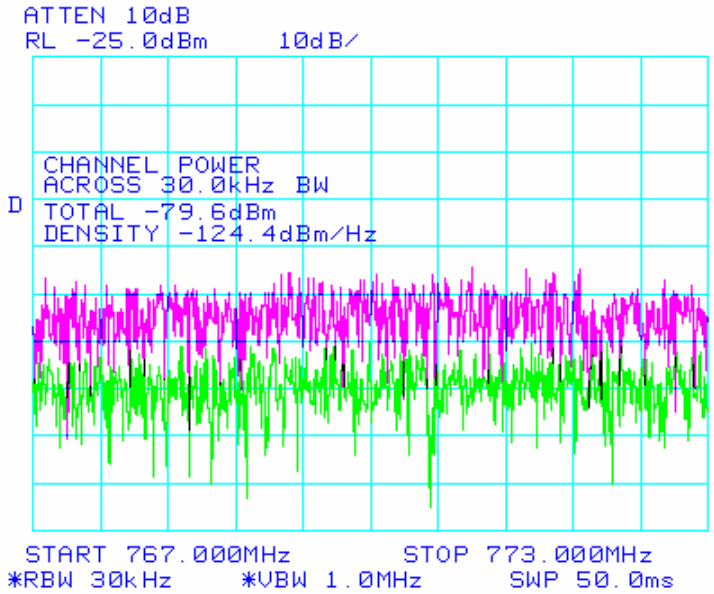
Notch filter: 2cavities, attenuation for 1MHz-8.5MHz offsets(791.5MHz to 799.025MHz) decreases between 33dB and 2dB. Attenuation between 773MHz (uppermost receive band) and 791.5MHz is 2.5dB.
Spectrum analyzer: RBW=30kHz, Span=600kHz, Display resolution (601 display buckets)= 1kHz Detector mode: sample; Instrument's noise floor for -25dBm reference level –101.0dBm/30kHz (density noise =145dBm/Hz)

For the frequencies between 773.0MHz and 791.5MHz the value of the couples power over 30kHz channel read was below -80dBm, its absolute value corrected with the notch attenuation is below –78dBm.
For the frequencies between 791.5 and 799.025 the signal was attenuated by the notch filter below the noise floor of the instrument. The worst case in this frequency band is given by 799.025 MHz, -101dBm noise floor corrected with 33dB attenuation of the notch yields –67dBm absolute value
The value required for maximum absolute ACCP =–55dBm/30kHz bandwidth. >-67dBm
The value required for maximum relative ACCP = -70dBc >112dBc (+45dBm carrier)

- **Coupled Power in receiver channels (764-776 MHz)**

Notch filter: 2cavities, attenuation in receive band 773MHz –767MHz is 2.1dB.
Spectrum analyzer: RBW=30kHz, Span=600kHz, Display resolution (601 display buckets)= 1kHz Detector mode: sample; Instrument's noise floor for 25dBm reference level –-101dBm/30kHz (density noise =145dBm/Hz), instrument's noise floor including the notch attenuation: -99dBm/30kHz

The capture below has data trace (red) vs reference noise trace (green), for the receive bandwidth spectrum, with a power reading for a 30kHz channel in the middle of the receive band.



All the power channel read was below –78.5dBm/30kHz , after the correction of the 2.1dB inserted by the notch filter the absolute channel coupled power was found lower than –76.4dBm
The value required for maximum absolute ACCP =–75dBm/30kHz bandwidth. >-76.4dBm
The value required for maximum relative ACCP = -100dBc >120dBc

Test results 10W (power control at maximum power reduction 90.534(b)(4)

Reference power in the main channel, (90.534(b)(1))
Settings:150kHz Channel Bandwidth
channel 180, 800.025MHz 6.1 dBm
channel 179, 799.975MHz 6.3 dBm
channel 181, 800.075MHz 6.5 dBm

Total RF power is 10W⇔ 40dBm, this makes the total attenuation of about 33dB. In the set-up the notch filter shows 32.1 to 34.1 dB attenuation values, over 150kHz bandwidth the average is 32.95dB

Power Level at frequency offsets <600kHz (90.534(b)(2)
Settings: 1 cavity notch filter, 50kHz Channel bandwidth
RBW=300Hz, Video BW=3kHz, Span=1MHz , Sweep = Detector mode: sample
Display resolution (600 display buckets)= 1665Hz ,
Reference level +3dBm, 50kHz channel noise=-78.5dBm

UUT in center channel of the 150kHz 3-contiguous 50 kHz channels 179, 180, 181.
Channel 180, frequency 800.02500 kHz

frequency Offset	-400	-300	-200	-100	0	100	200	300	400
Channel Power read	-75.3	-74.9	-68.2	-63.3	***6.1***	-63.1	-64.3	-74.9	-75.1
Notch correction factor	21.5	23.5	27	31	***33***	31	27	23.5	21.5
Absolute channel power (dBm) (read value +notch)	-53.8	-51.4	-41.2	-32.3	***39.2***	-32.1	-37.3	-51.4	-53.6
ACCP (difference)	-93.0	-90.6	-80.4	-71.5	NA	-71.3	-69.6	-90.6	-92.8

Channel Power read UUT in right (181) channel of the 150 kHz 3-contiguous 50 kHz channels 179, 180, 181.
Channel 181, frequency 800.075000 MHz

frequency Offset to the center channel	-400	-300	-200	-100	0	100	200	300	400
frequency Offset to the unit channel	-450	-350	-250	-150	-50	+50	+150	+250	+350
Channel Power read	-75.1	-75.1	-68.3	-64.2	***6.5***	-35.3	-68.9	-68.2	-63.3
Notch correction factor	21.5	23.5	27	31	***33***	31	27	23.5	21.5
Absolute channel power (dBm) (read value +notch	-53.6	-51.7	-39.3	-33.2	***39.5***	-4.3	-41.6	-44.7	-41.8
ACCP (difference)	-93.1	-91.2	-78.8	-72.7	NA	-43.8	-81.1	-84.2	-81.3

UUT in left (179) channel of the 150kHz 3-contiguous 50 kHz channels 179, 180, 181.
Channel 179, frequency 799.975000 MHz

frequency Offset to the center channel	-400	-300	-200	-100	0	100	200	300	400
frequency Offset to the unit channel	-350	-250	-150	-50	+50	+150	+250	+350	+450
Channel Power read	-75.3	-74.6	-65.5	-36.1	***6.3***	-69.1	-75.4	-75.1	-75.2
Notch correction factor	21.5	23.5	27	31	***33***	31	27	23.5	21.5
Absolute channel power (dBm) (read value+notch)	-53.8	-51.1	-38.5	-5.1	***39.3***	-38.1	-52.4	-51.6	-53.7
ACCP (difference)	-93.1	-90.4	-77.6	-44.4	NA	-69.9	-71.7	-71.4	-71.5

50 kHz channel (non-aggregated) adjacent channel coupled power.
Channel 180, frequency 800.025000 MHz .All power readings on 50kHz channel

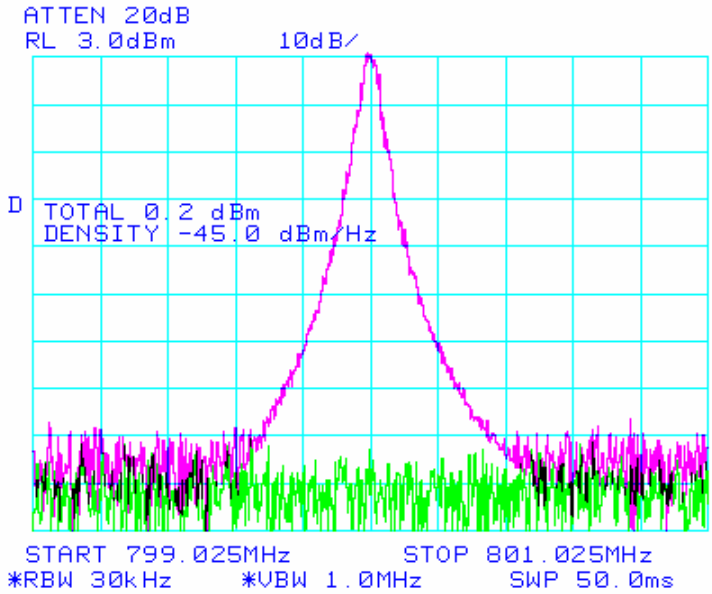
frequency Offset to the center channel	-200	-150	-100	-50	0	+50	+100	+150	+200
Channel Power read	-74.6	-76.9	-71.3	-36.0	***6.5***	-37.1	-69.9	-73.2	-75.1
Notch correction factor	27	29	31	33.8	***34.1***	33.2	31	29	27
Absolute channel power (dBm) (read value+correction)	-36.6	-47.9	-40.3	-2.2	***40.6***	-3.9	-38.9	-34.2	-48.1
ACCP (difference)	-82.7	-79.0	-76.4	-42.8	NA	-44.5	-79.5	-74.8	-88.7

Power Levels at frequency offsets >600kHz (90.534(b)(3)

- **frequency offsets between 600kHz and 1000 kHz**

Settings 10dB attenuator
RBW=30kHz, Span=2MHz, Display resolution (601 display buckets)= 20kHz Detector mode: sample
Instrument's noise floor for 10dBm reference level –114.5dBm/Hz

Test results for frequency offsets between 600kHz and 1000 kHz over view.
Maximum absolute ACCP =–45dBm/30kHz bandwidth. This equates to a maximum power density of -89.8dBm/Hz, the instrument provides enough dynamic range.
Sample picture



- **frequency offsets between 1MHz and 6MHz**

Settings Notch filter
RBW=30kHz, Span=2MHz, Display resolution (601 display buckets)= 20kHz Detector mode: sample

Maximum absolute ACCP =–55dBm/30kHz bandwidth. This equates to a maximum power density of -99.8dBm/Hz, the instrument provides enough dynamic range.
Test results for frequency offsets up to +/-6MHz

- **frequency offsets between 1MHz and the uppermost receive frequency**

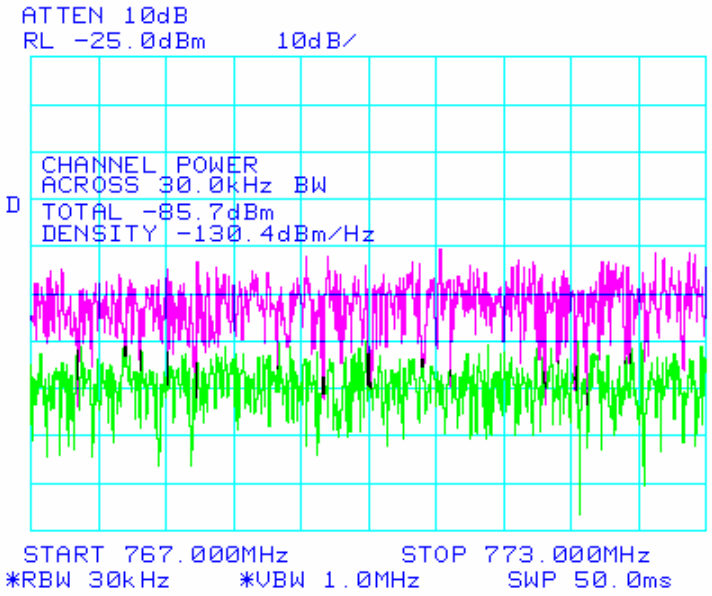
Notch filter: 2cavities, attenuation for 1MHz-8.5MHz offsets(791.5MHz to 799.025MHz) decreases between 33dB and 2dB. Attenuation between 773MHz (uppermost receive band) and 791.5MHz is 2.5dB.
Spectrum analyzer: RBW=30kHz, Span=600kHz, Display resolution (601 display buckets)= 1kHz Detector mode: sample; Instrument's noise floor for -25dBm reference level –101.0dBm/30kHz (density noise =145dBm/Hz)

For the frequencies between 773.0MHz and 791.5MHz the value of the couples power over 30kHz channel read was below -85dBm, its absolute value corrected with the notch attenuation is below –82.5dBm.
For the frequencies between 791.5 and 799.025 the signal was attenuated by the notch filter below the noise floor of the instrument. The worst case in this frequency band is given by 799.025 MHz, -101dBm noise floor corrected with 33dB attenuation of the notch yields –67dBm absolute value
The value required for maximum absolute ACCP =–55dBm/30kHz bandwidth. >-67dBm
The value required for maximum relative ACCP = -70dBc >112dBc (+45dBm carrier)

- **Coupled Power in receiver channels (764-776 MHz)**

Notch filter: 2cavities, attenuation in receive band 773MHz –767MHz is 2.1dB.
Spectrum analyzer: RBW=30kHz, Span=600kHz, Display resolution (601 display buckets)= 1kHz Detector mode: sample; Instrument's noise floor for 25dBm reference level –-101dBm/30kHz (density noise =145dBm/Hz), instrument's noise floor including the notch attenuation: -99dBm/30kHz

The capture below has data trace (red) vs reference noise trace (green), for the receive bandwidth spectrum, with a power reading for a 30kHz channel in the middle of the receive band.



All the power channel read was below –82.3dBm/30kHz , after the correction of the 2.1dB inserted by the notch filter the absolute channel coupled power was found lower than –80.2dBm
The value required for maximum absolute ACCP =–75dBm/30kHz bandwidth. >-80.2dBm
The value required for maximum relative ACCP = -100dBc >120dBc

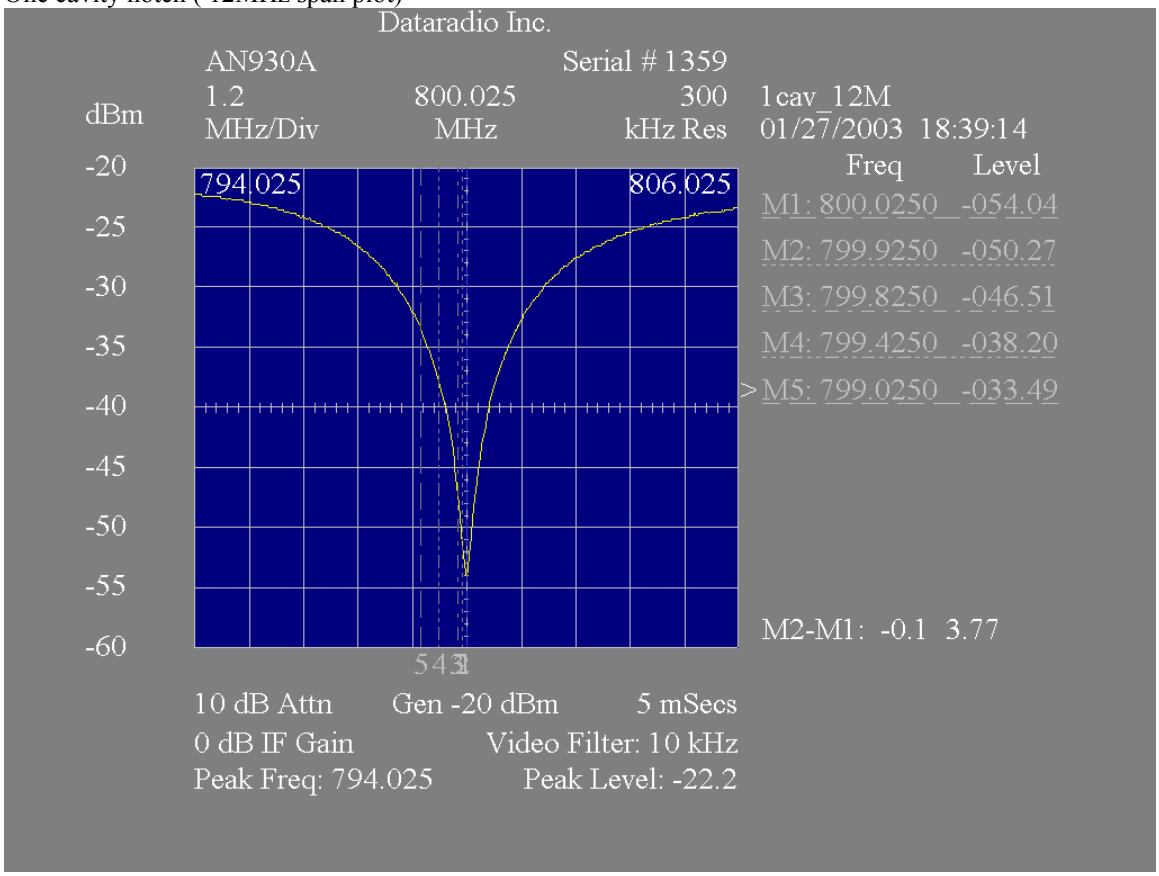
General settings of the instrument

In the chapter 2, page 125 of the HP 8365 user manual the following 4 recommendations apply for power measurement functions in order to achieve RMS detection of all the applicable measurement cells (display buckets):

- detection mode must be sample
- video bandwidth should be at least 10x the RBW
- the RBW must not exceed 100kHz
- video averaging and other display functions must be OFF

Notch filter characteristic.

One cavity notch (12MHz span plot)



Two cavities notch (1000kHz frequency offset and in the receive band)