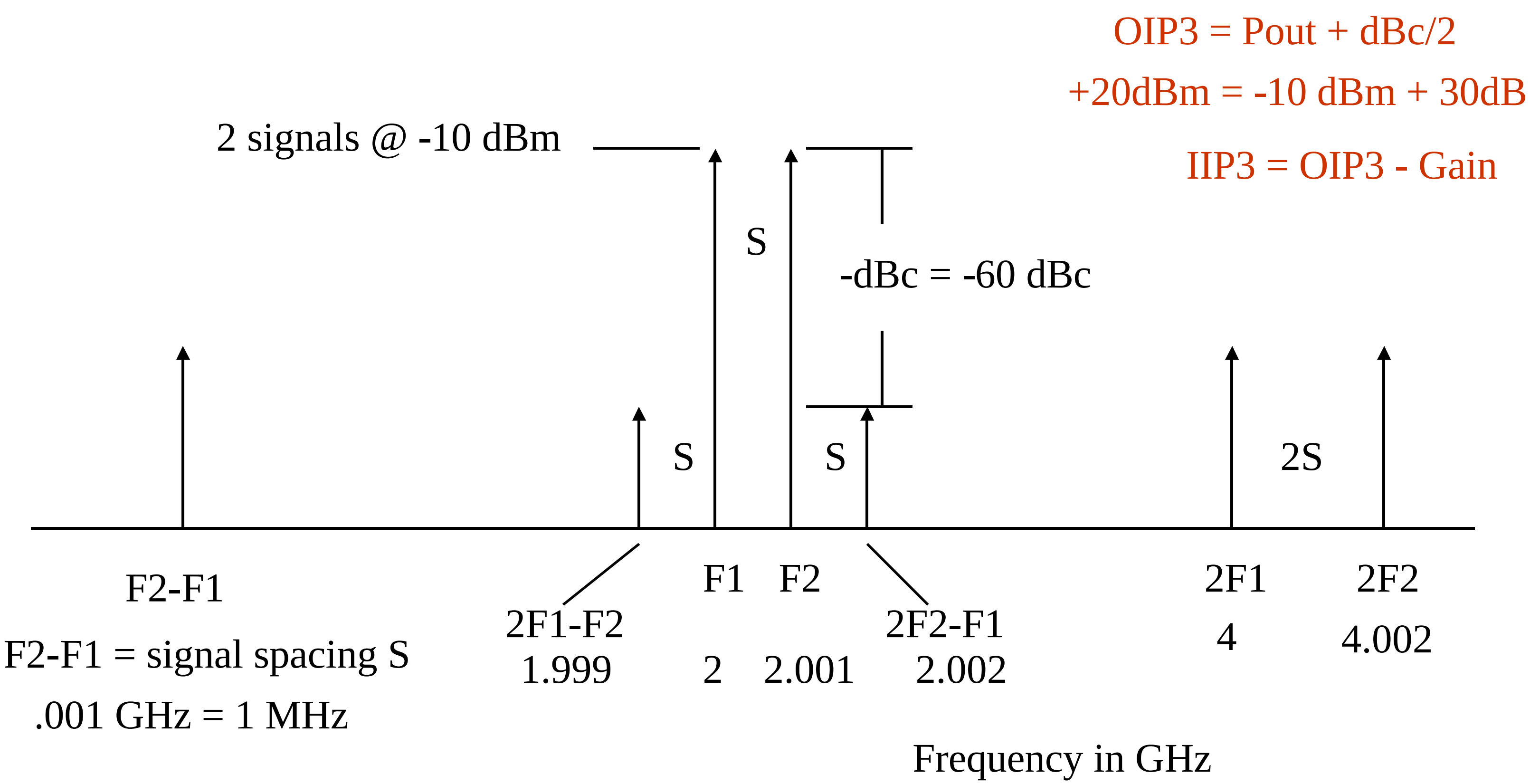
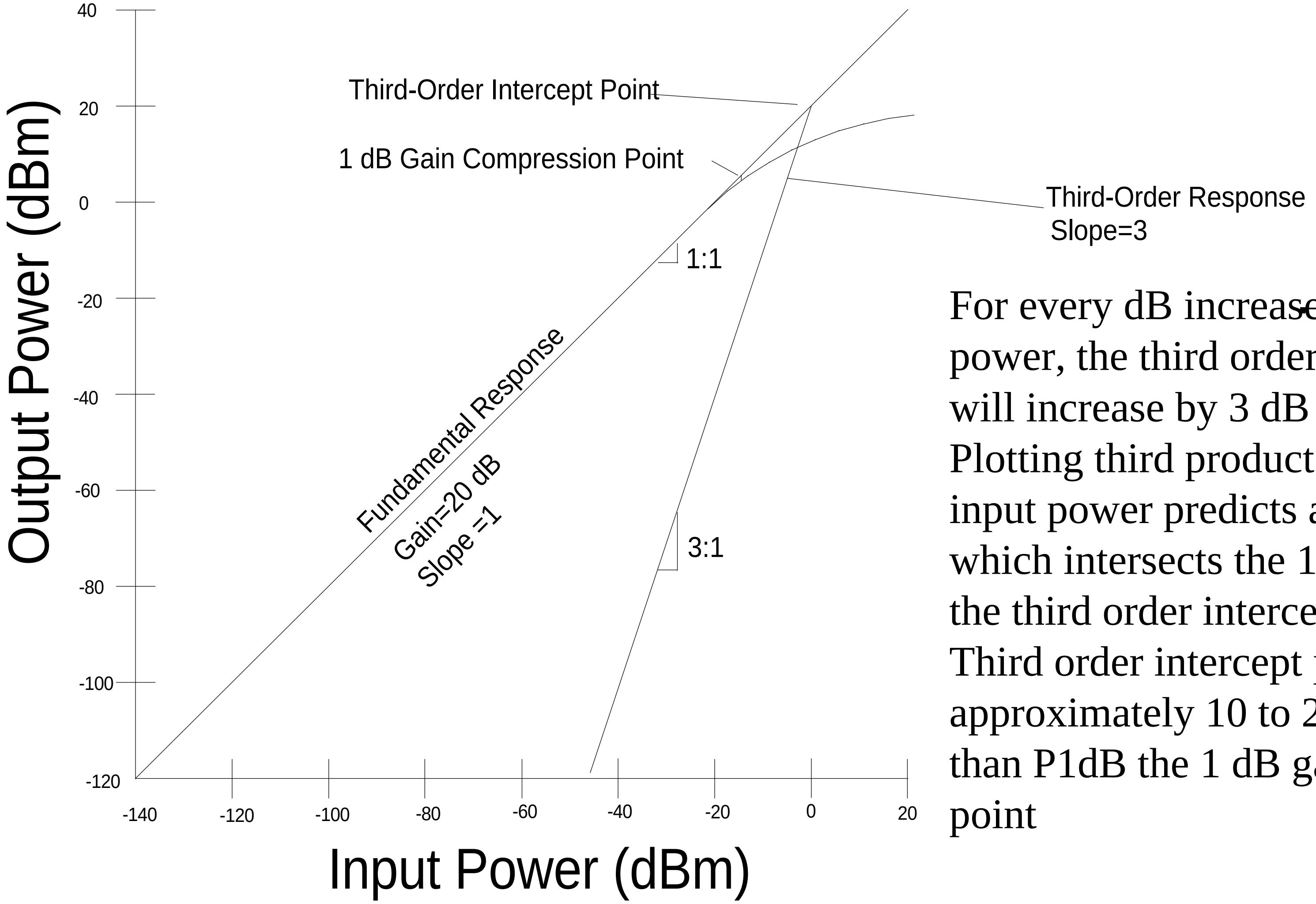
Third Order Intercept Measurements

How are the third order products produced?



Plotting Third Order Response



For every dB increase in input power, the third order products will increase by 3 dB

Plotting third products versus input power predicts a 3:1 response which intersects the 1:1 response at the third order intercept point

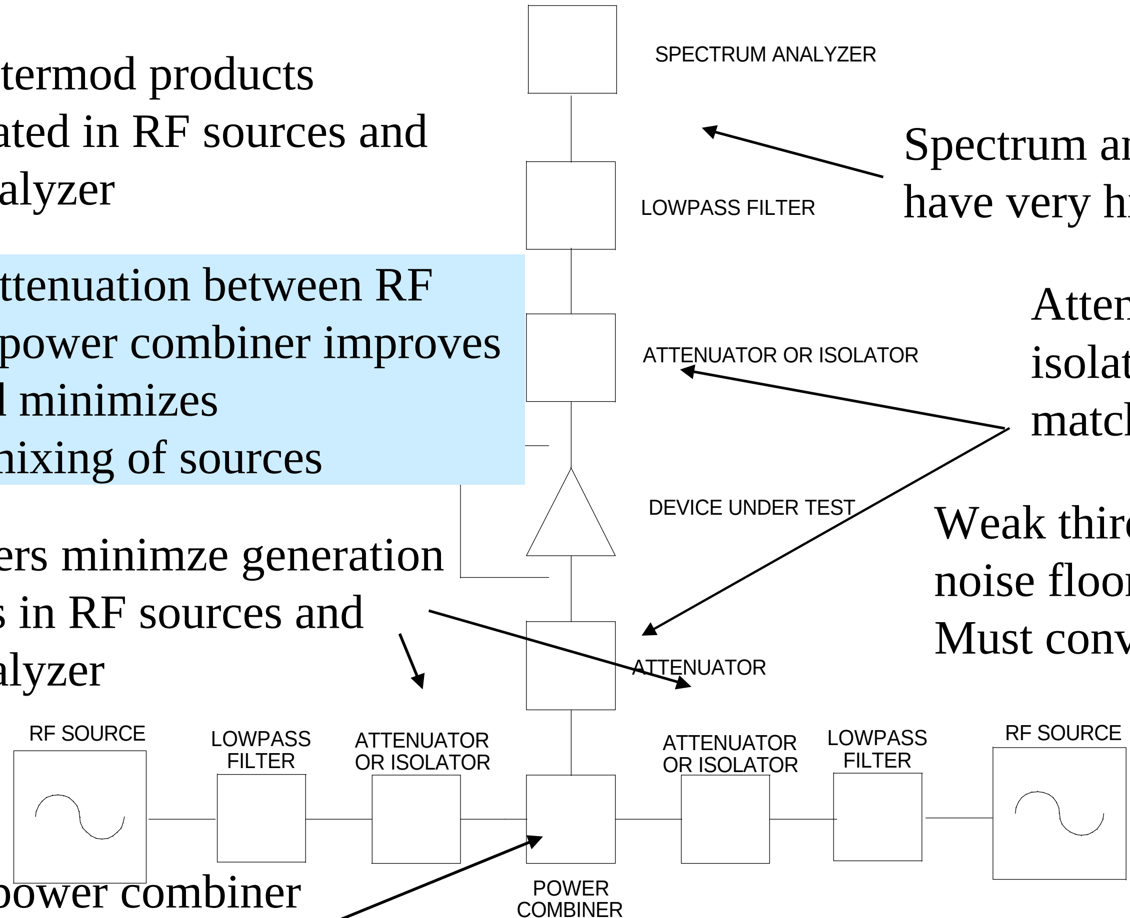
Third order intercept point will be approximately 10 to 20 dB higher than P1dB the 1 dB gain compression point

Intercept Point Measurements

Minimize intermod products being generated in RF sources and spectrum analyzer

Additional attenuation between RF sources and power combiner improves isolation and minimizes interaction/mixing of sources

Lowpass filters minimze generation of harmonics in RF sources and spectrum analyzer



Spectrum analyzer should have very high dynamic range

Attenuators and/or isolators improve match to DUT

Weak third order products near noise floor are actually (S+N)/N. Must convert to S/N

Isolation of power combiner minimizes interaction of RF sources

Measure IP3 of test system by bypassing DUT

Intercept Point Measurements

Converting (S+N)/N to S/N

$$\frac{S + N}{N} = \frac{S}{N} + 1$$

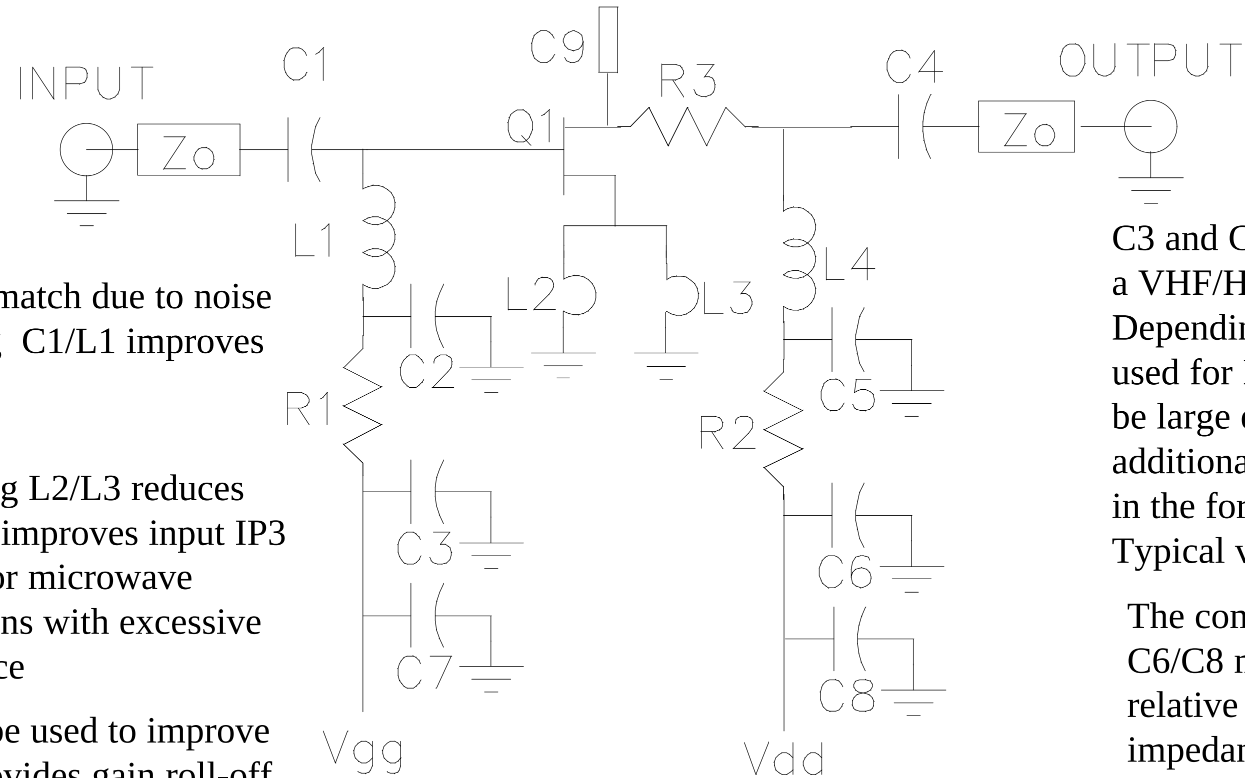
Therefore $$\frac{S}{N} = \frac{S + N}{N} - 1$$

Convert dBs to ratios, then substitute in equations

(S+N)/N	S/N
20 dB	19.96 dB
10 dB	9.54 dB
7 dB	6.03 dB
5 dB	3.35 dB
3 dB	-0.02 dB
2 dB	-2.33 dB
1 dB	-5.87 dB

Best to set up power levels such that third order products are at least 10 dB over the noise. However, if high end dynamic range limits power that spectrum analyzer can read without saturation, then be sure to convert (S+N)/N to S/N before calculating -dB/C

LNA Components and The Effect on IP3



R3 provides Q1 stability while reducing IP3 - R3 less than 27 Ω for about a dB reduction in IP3

C3 and C6 normally provide a VHF/HF termination for Q1. Depending on spacing of signals used for IP3 test, values may not be large enough - may necessitate additional low frequency bypassing in the form of C7 and C8. Typical values 0.01 to 0.1 uF.

The combination of C3/C7 and C6/C8 must provide a low impedance relative to Q1 input and output impedance at F2 - F1. May have to add resistance between caps to De-Q.

C7 and C8 also used to minimize power supply noise from modulating the DC on gate and drain

Any mismatch due to noise matching C1/L1 improves input IP3

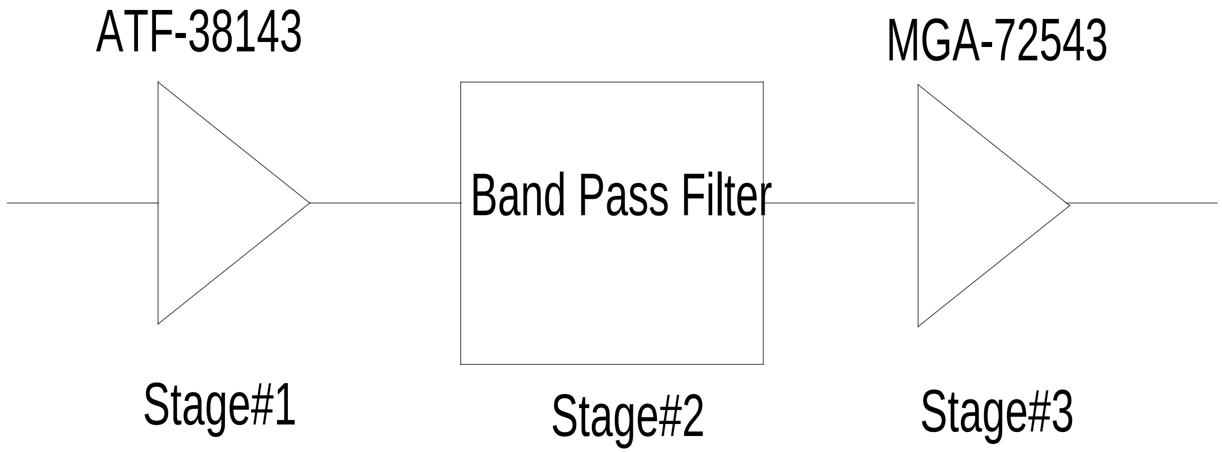
Increasing L2/L3 reduces gain and improves input IP3 -watch for microwave oscillations with excessive inductance

C9 can be used to improve IP3 - provides gain roll-off at 2X F1 or 2X F2?

Printed circuit board losses

Other methods to reduce 2X F1 and 2X F2?

Cascade IP3 Calculation



	Stage#1	Stage#2	Stage#3
OIP3	+21dBm(125.9)	∞ dBm(∞)	+25 dBm(316.2)
Gain	15 dB (31.62)	-3 dB (.5)	15 dB (31.62)

$$\frac{1}{OIP3} = \frac{1}{OIP3_1 \bullet G_2 \bullet G_3} + \frac{1}{OIP3_2 \bullet G_3} + \frac{1}{OIP3_3}$$

$$\frac{1}{OIP3} = \frac{1}{(125.9)(.5)(31.62)} + \frac{1}{(\infty)(31.62)} + \frac{1}{316.2}$$

OIP3 = 273.075 = 24.4 dBm , IIP3 = 24.4 - 33 = -8.6 dBm