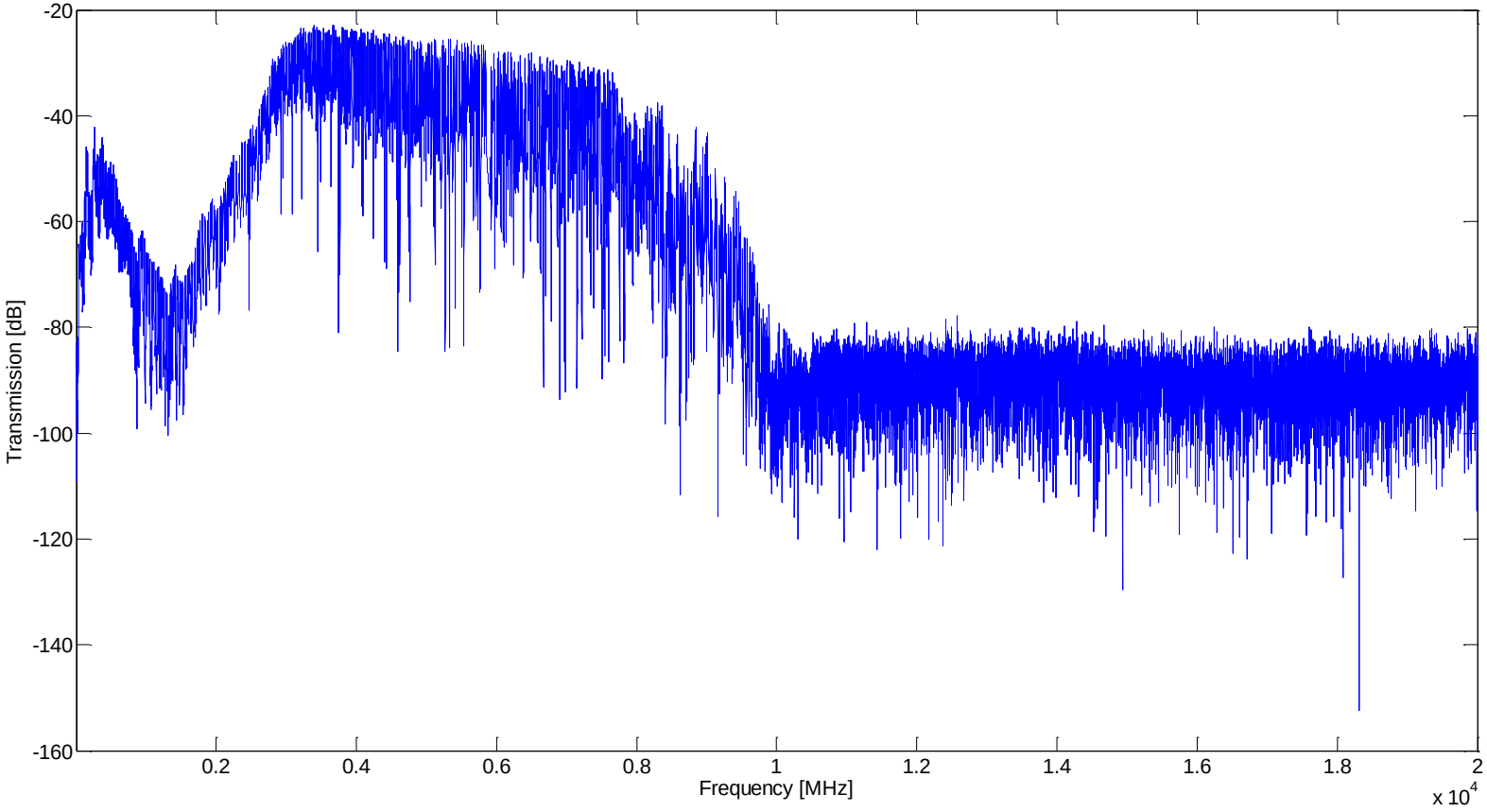
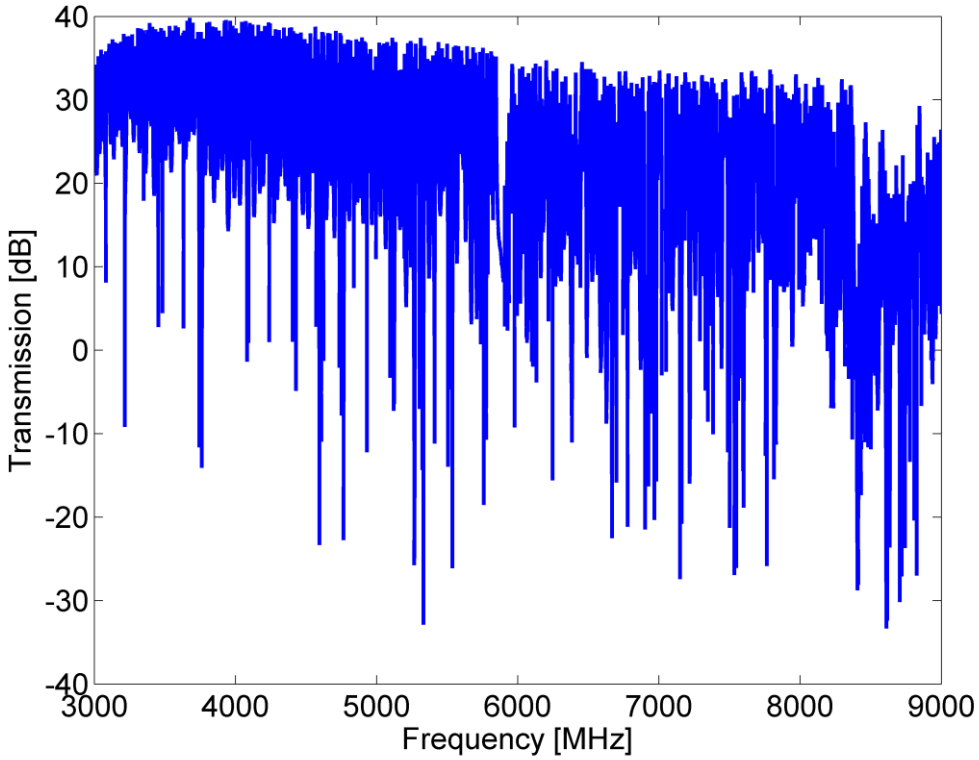
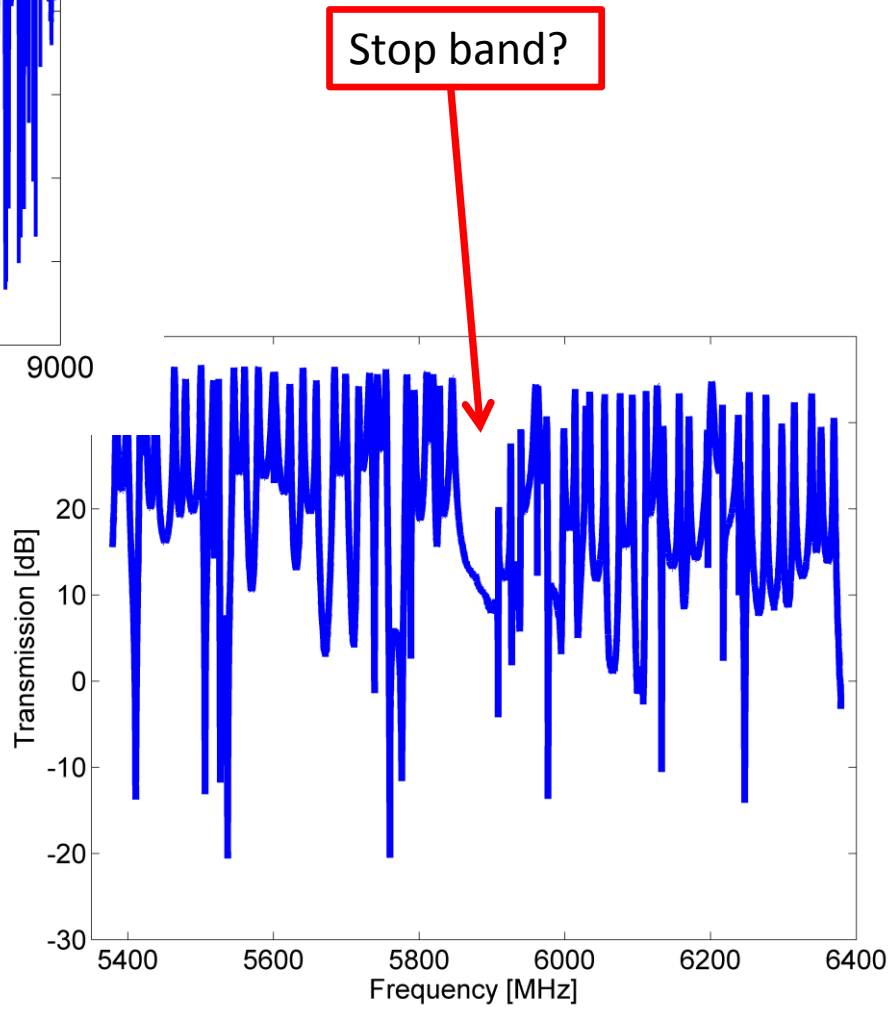
# Summary of WSi traveling-wave paramp measurements

# Wide spectrum scans

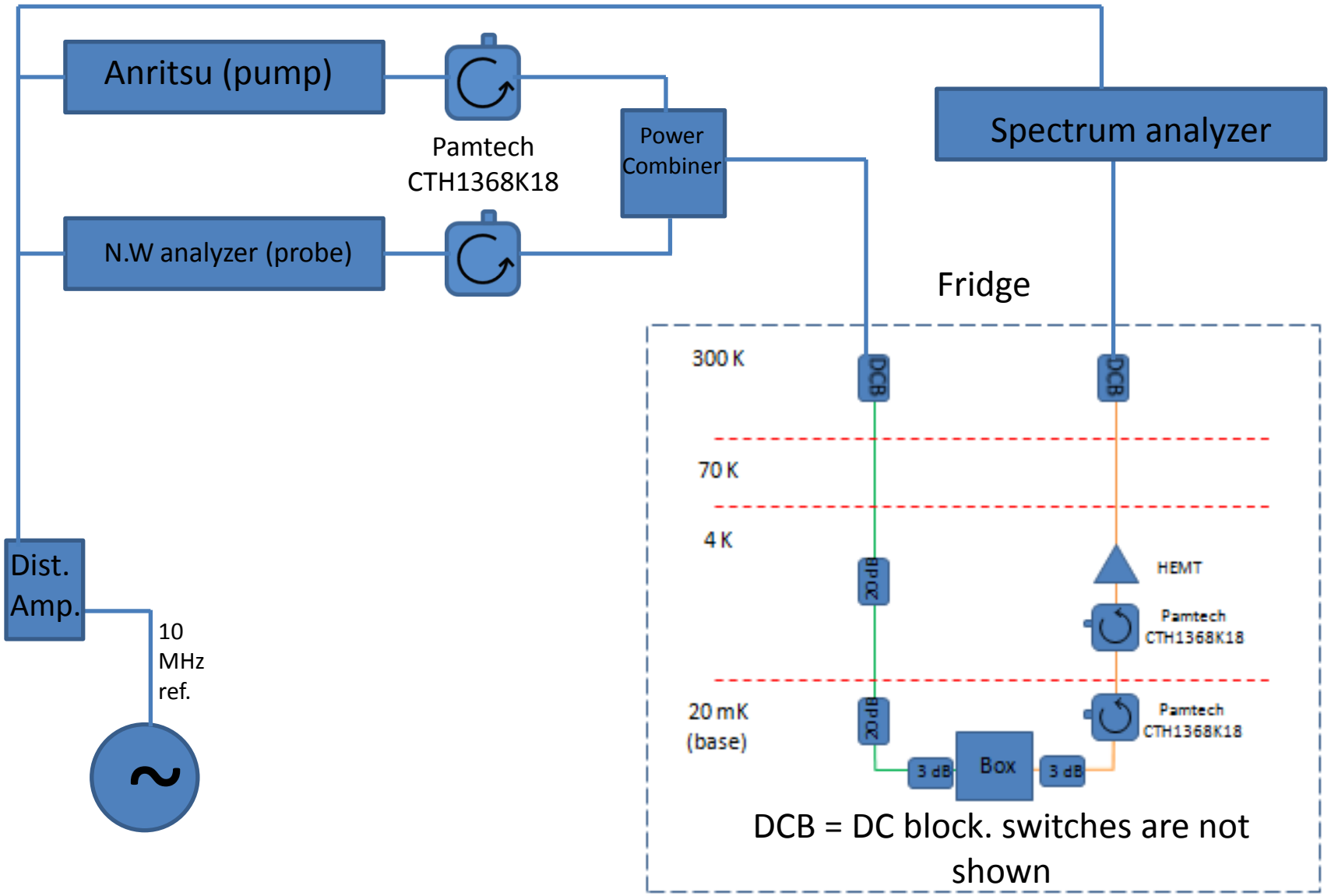



(HEMT only, input passes through circulator and combiner)

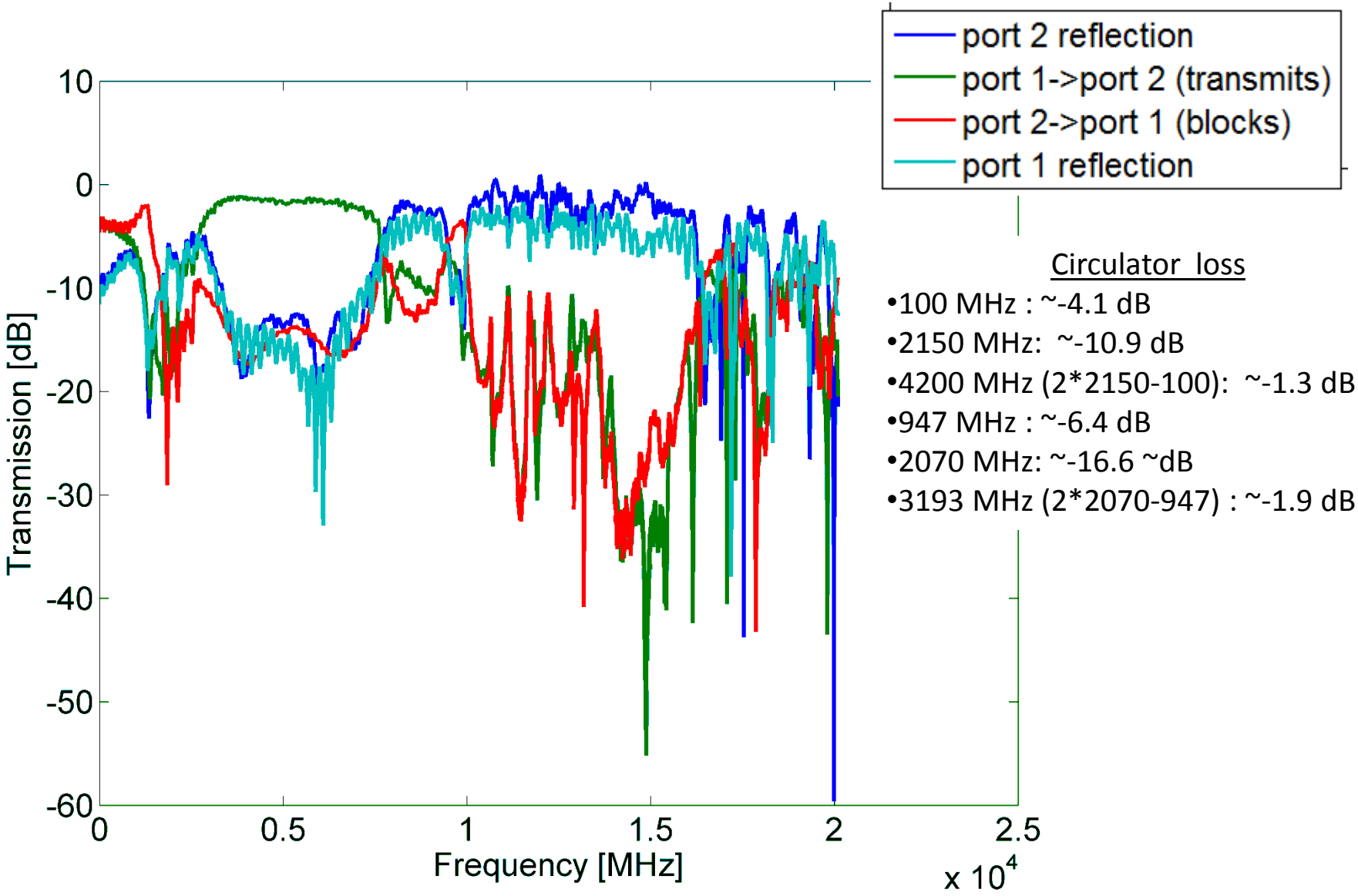

40
30
20
10
0
-10
-20
-30
-40
Transmission [dB]
3000
4000
5000
6000
7000
8000
9000
Frequency [MHz]


Stop band?
20
10
0
-10
-20
-30
Transmission [dB]
5400
5600
5800
6000
6200
6400
Frequency [MHz]

# Pump-probe setup



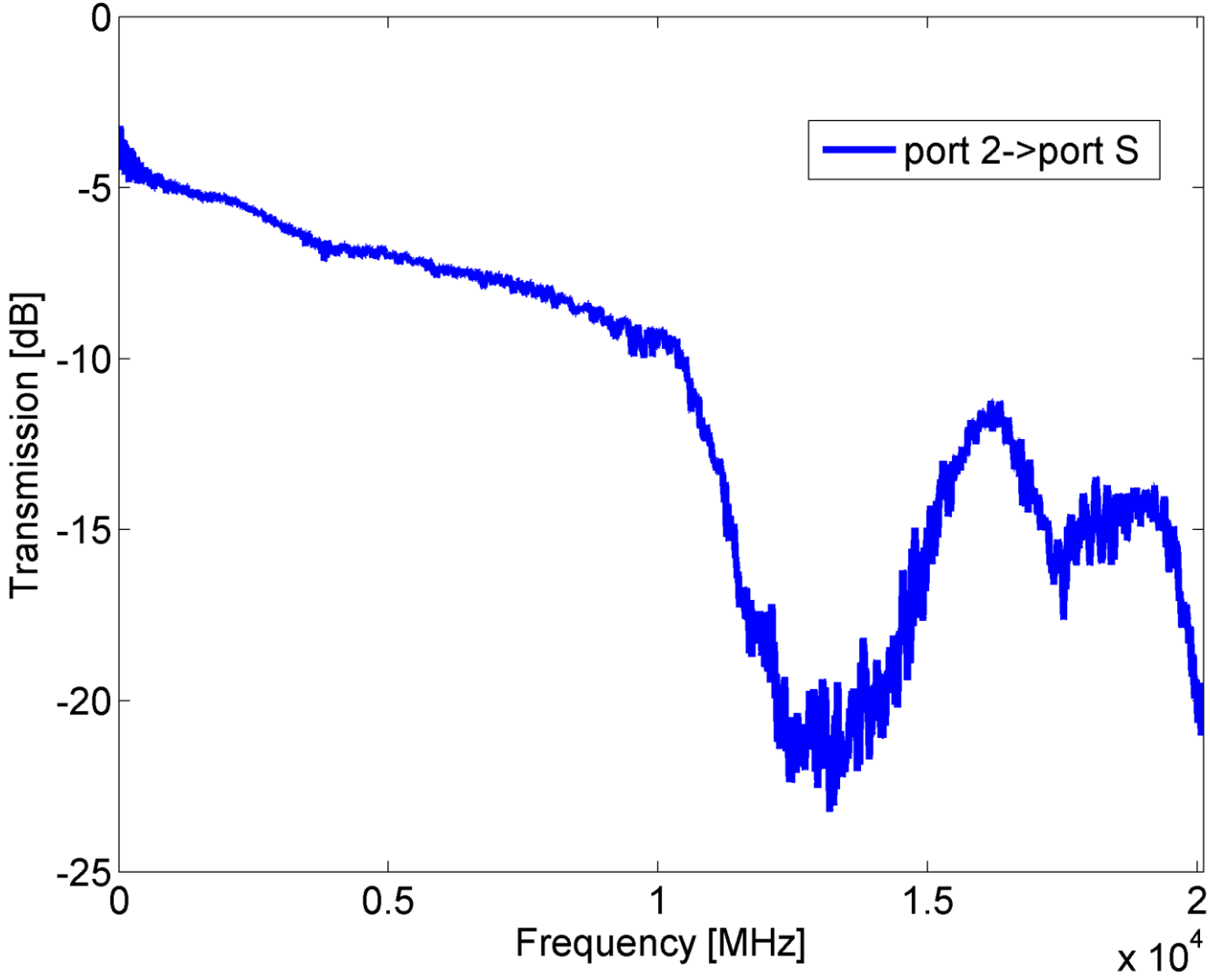
# Circulator response




Circulator loss

- 100 MHz : ~-4.1 dB
- 2150 MHz: ~-10.9 dB
- 4200 MHz (2*2150-100): ~-1.3 dB
- 947 MHz : ~-6.4 dB
- 2070 MHz: ~-16.6 ~dB
- 3193 MHz (2*2070-947) : ~-1.9 dB

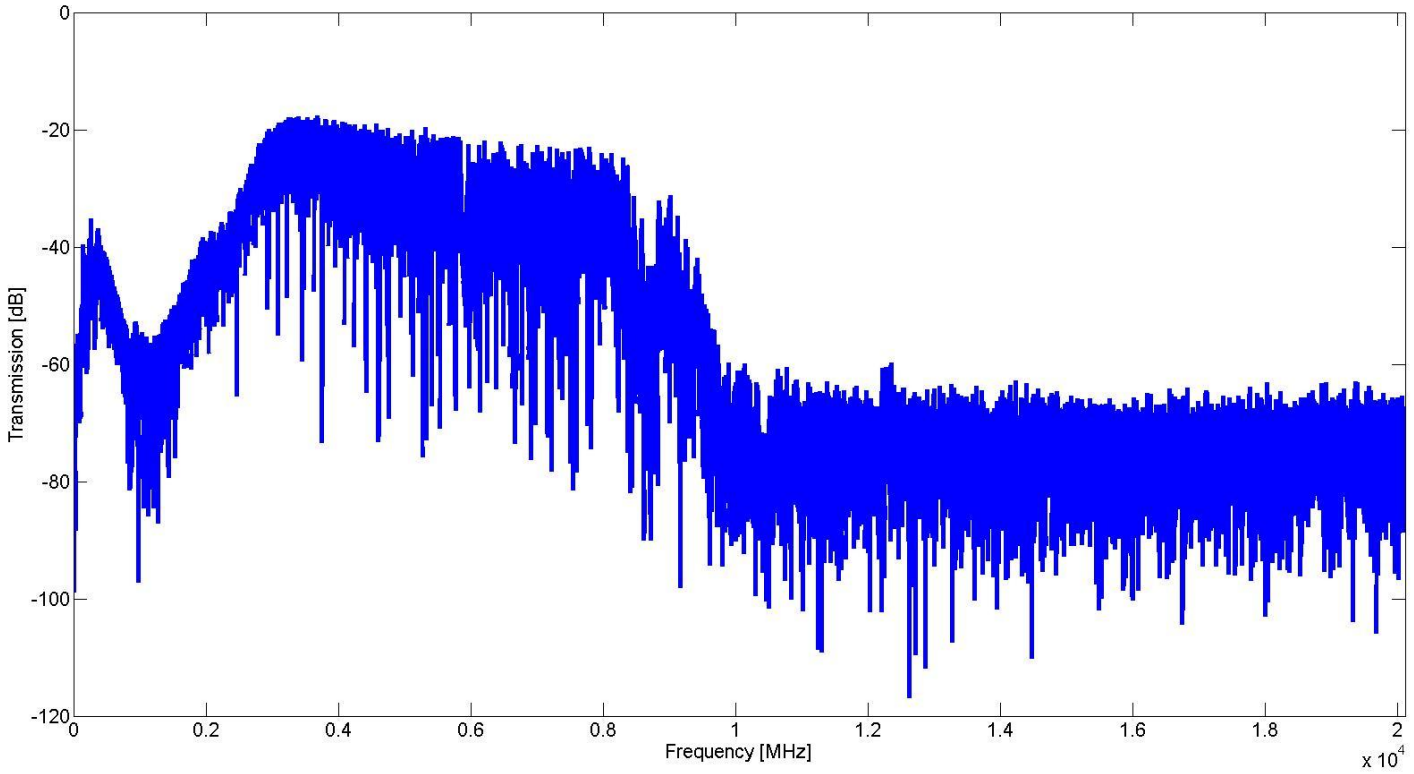
# Combiner




Combliner loss

- 100 MHz : ~-3.8 dB
- 2150 MHz: ~-5.3 dB
- 4200 MHz (2*2150-100): ~-6.8 dB
- 947 MHz : ~-4.9 dB
- 2070 MHz: ~-5.4 ~dB
- 3193 MHz (2*2070-947) : ~-6.2 dB

# Output chain transmission (n.w analyzer->fridge->box->HEMT->n.w analyzer)

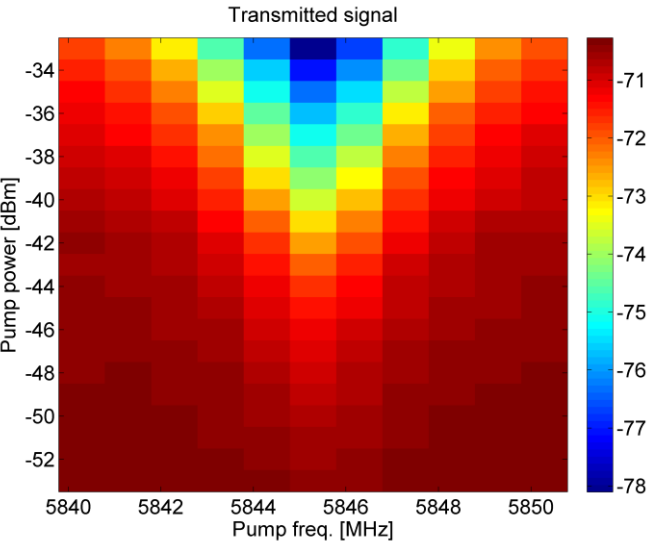


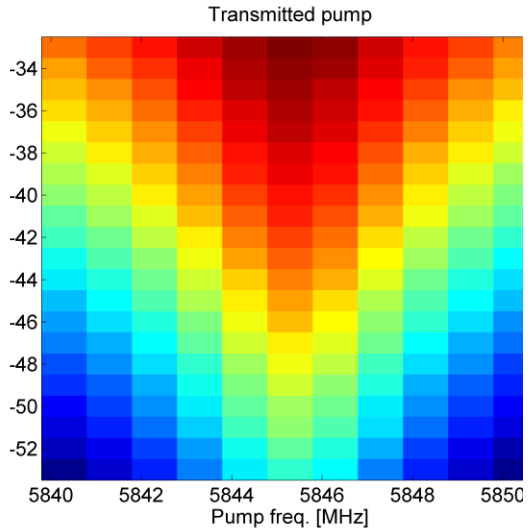

Transmission

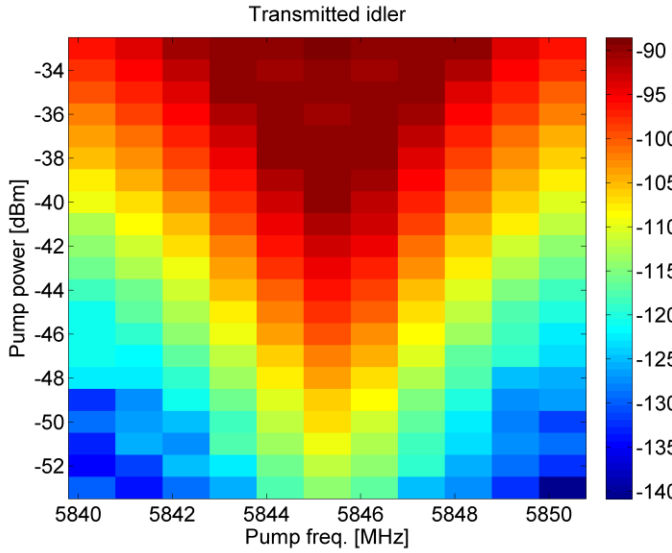
- 100 MHz : ~-59.1 dB
- 2150 MHz: ~-45 dB
- 4200 MHz (2*2150-100): ~-36.9 dB
- 947 MHz : ~-53.3 dB
- 2070 MHz: ~-37.3 ~dB
- 3193 MHz (2*2070-947) : ~-24.7 dB

# Pump-probe experiments: signal @ 5716.7 MHz, -40 dBm from inst. – **HEMT nonlinearity**

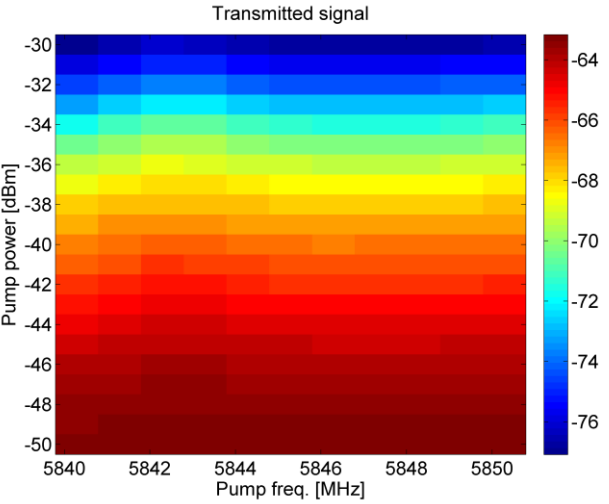
## WITH paramp

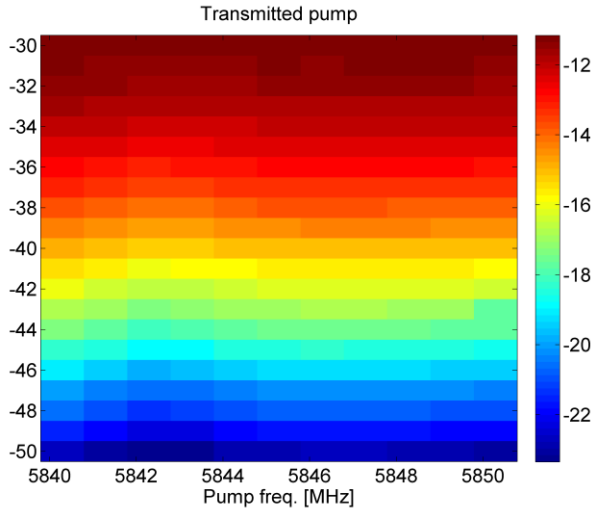


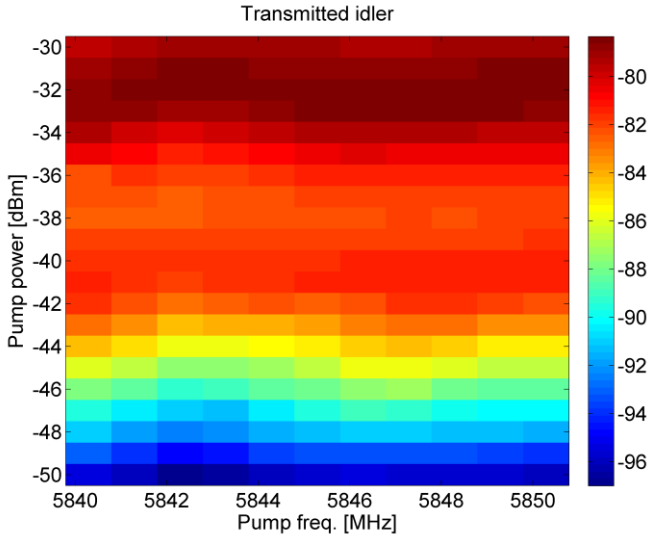




## WITHOUT paramp



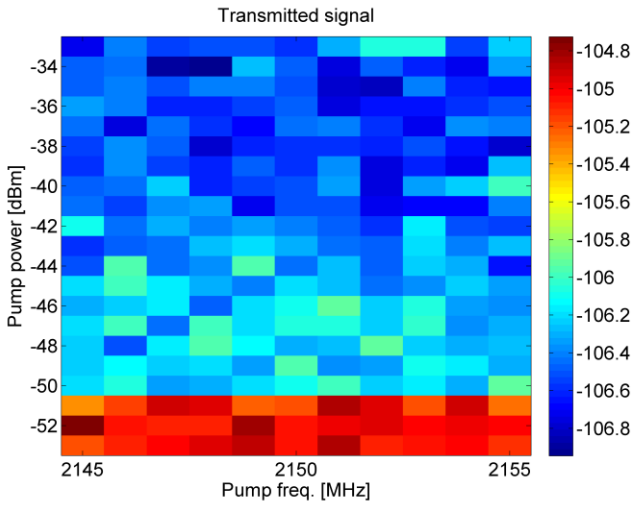



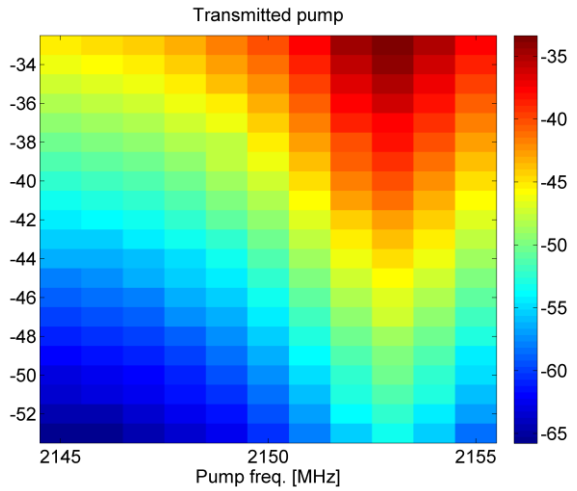



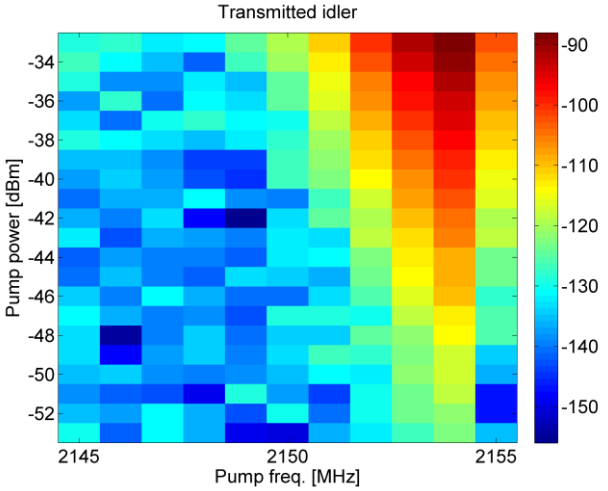

Input: circulator, combiner. Output: 2 circulators + HEMT. Assumed 53 and 50 dB pump attenuation with/without paramp

# Pump-probe experiments, pump & signal outside HEMT range: signal @ 100 MHz, -40 dBm from inst.

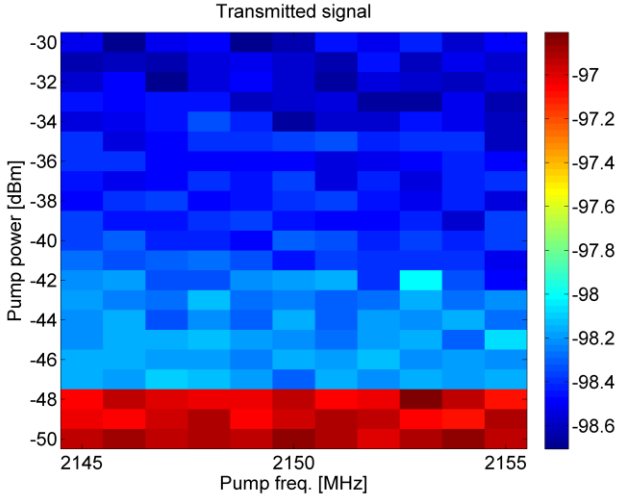
## WITH paramp

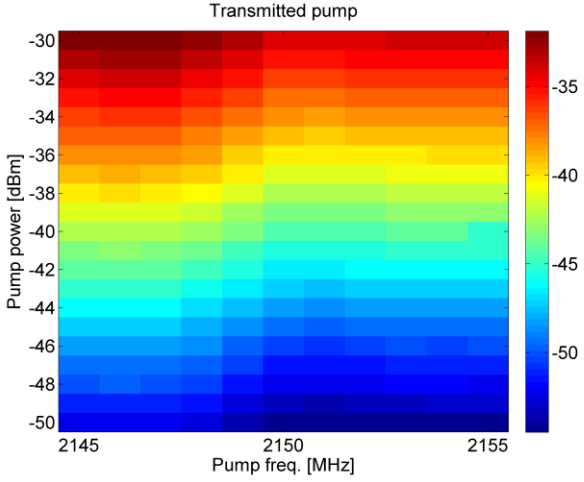


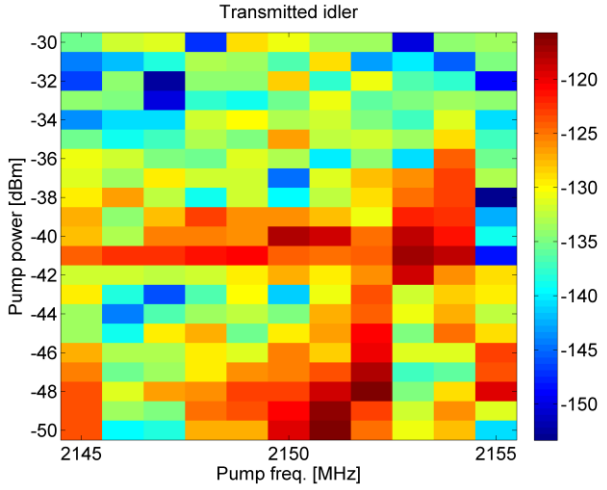




## WITHOUT paramp



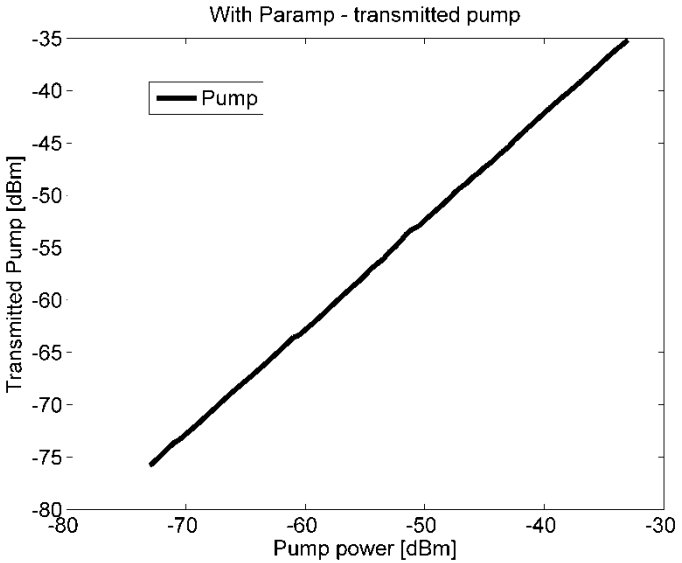



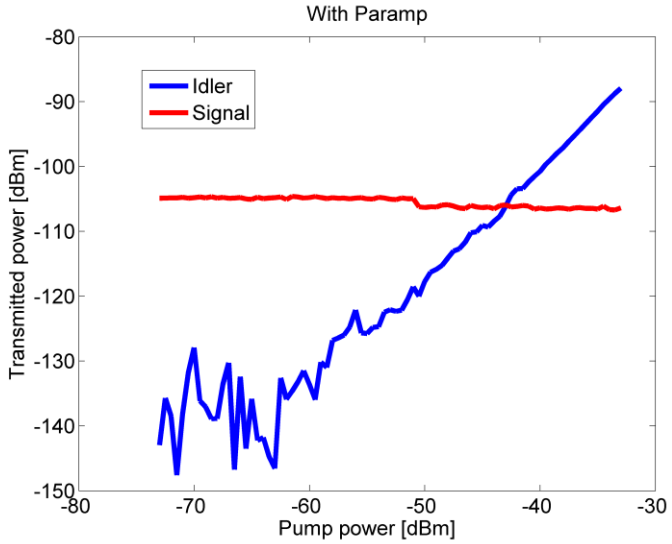




Input: circulator, combiner. Output: 2 circulators + HEMT. Assumed 53 and 50 dB pump attenuation with/without paramp

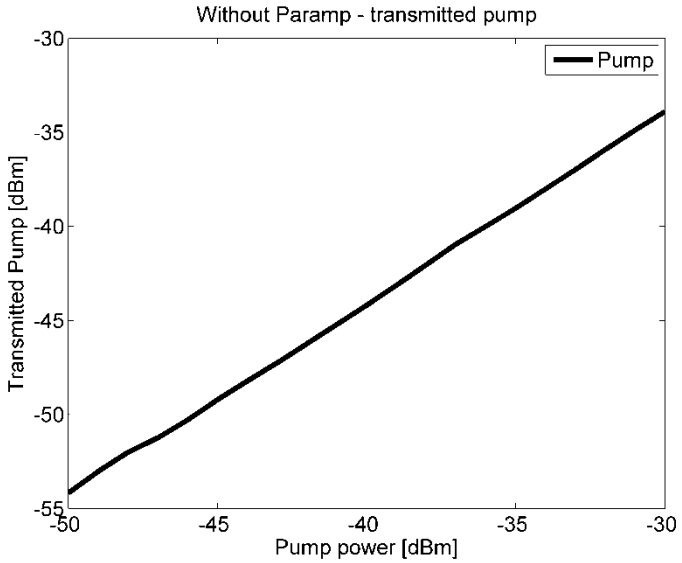
# Pump-probe experiments, pump & signal outside HEMT range: signal @ 100 MHz, -40 dBm from inst.

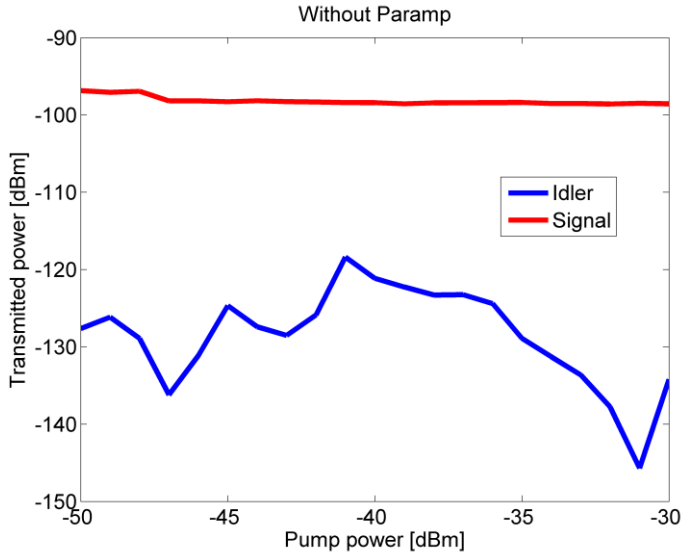
## WITH paramp




## WITHOUT paramp

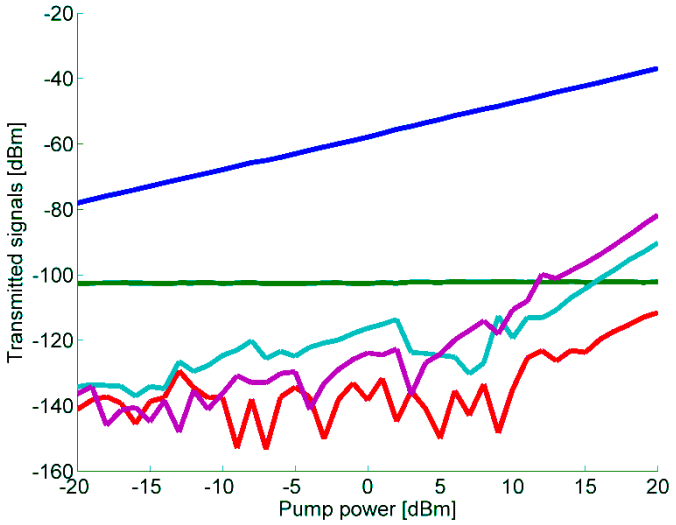


- Turning HEMT off requires a strong signal to overcome the noise, no idler/signal gain was seen.
- Changed signal freq. to be more reasonable (shorter wave length)

# Pump-probe experiments, pump & signal outside HEMT range: signal @ 947 MHz, 40 dBm from inst. pump @ 2070 MHz.

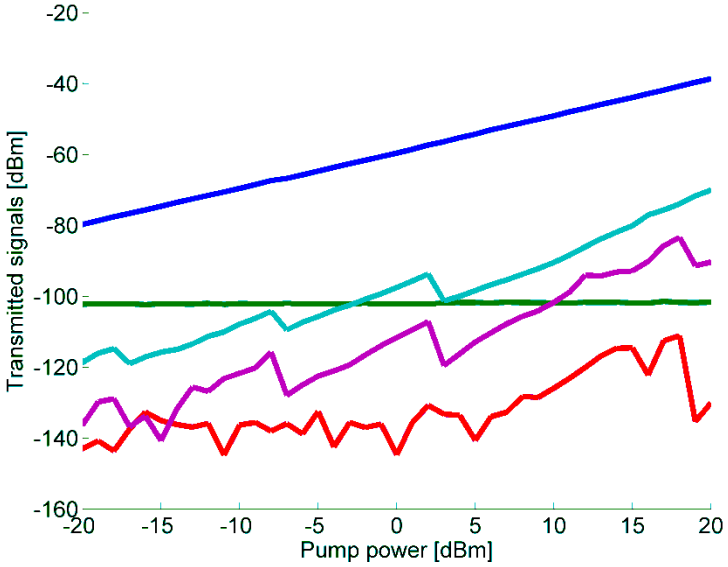
WITH paramp

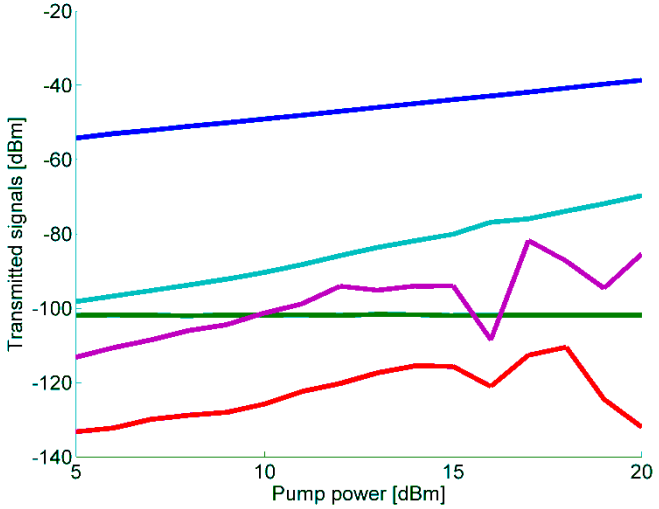



Pump
Signal
Idler
Pump 2nd harmonic
Pump 3rd harmonic

Idler!
3rd harmonic larger than 2nd

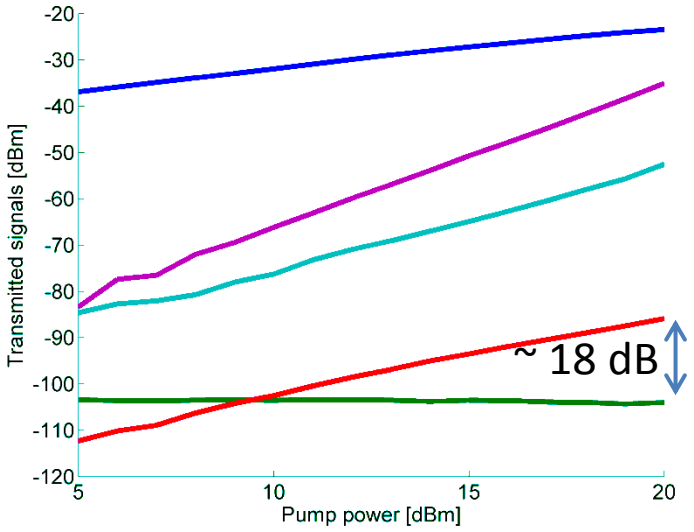
WITHOUT paramp

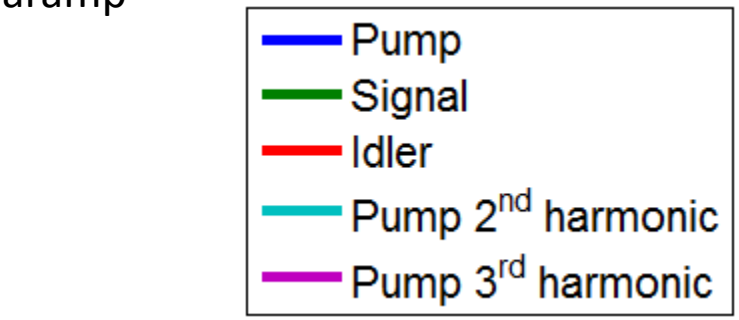


Same as above but removing the circulator @ pump (Anritsu) input – **more pump power**

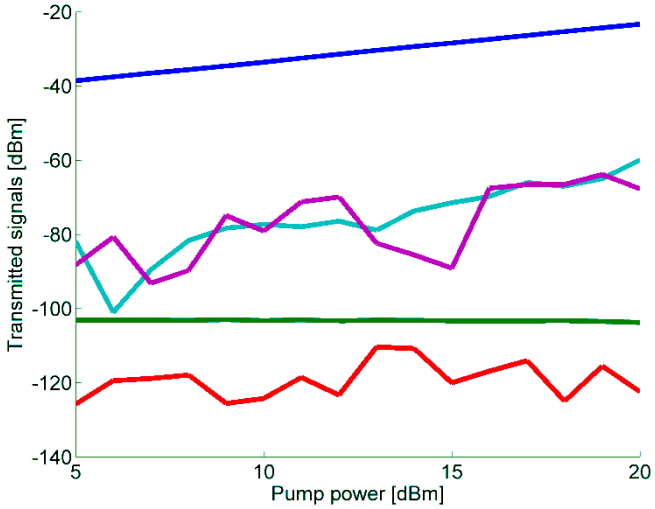
WITH paramp

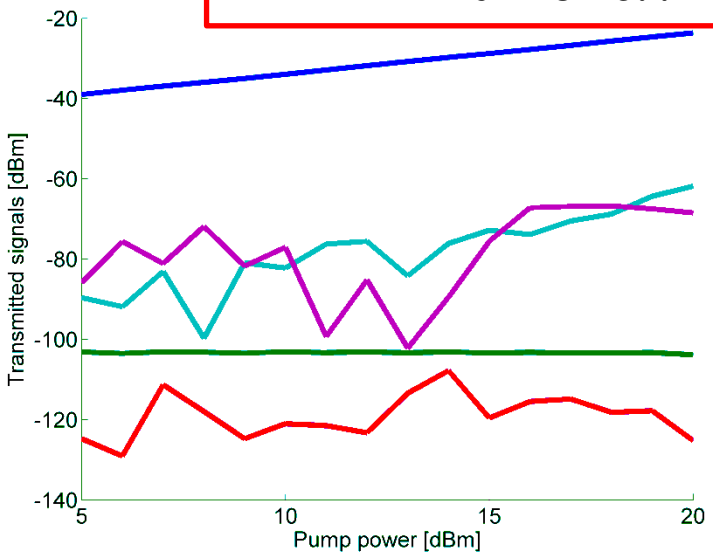


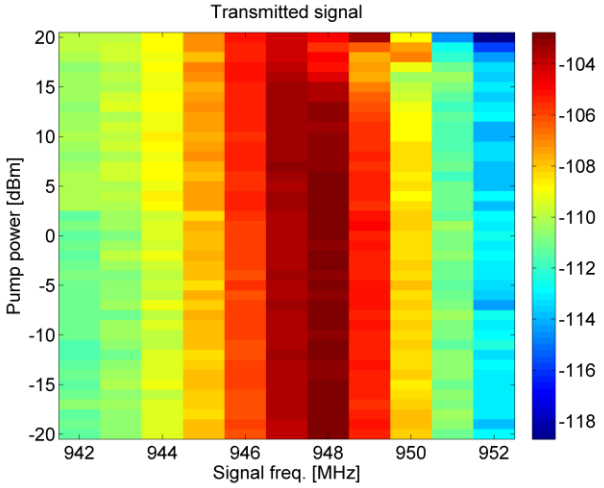

**But:** idler's gain from the output chain > ~28.6 dB from signal gain!
→ @ box output idler/signal~-11 dB.
Do we lose gain for pump 3rd harmonic??

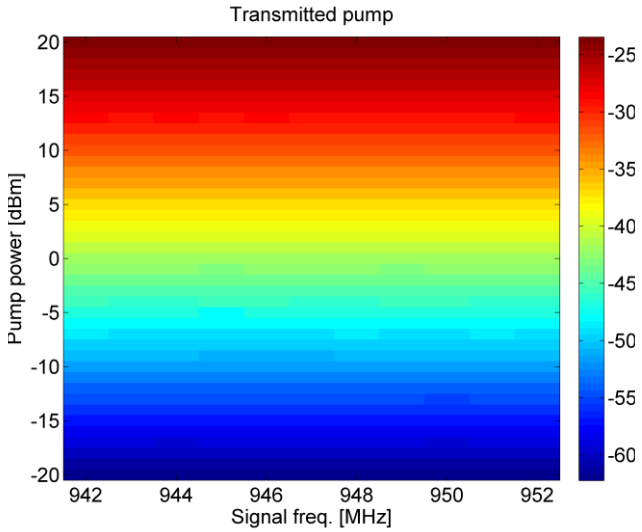
WITHOUT paramp

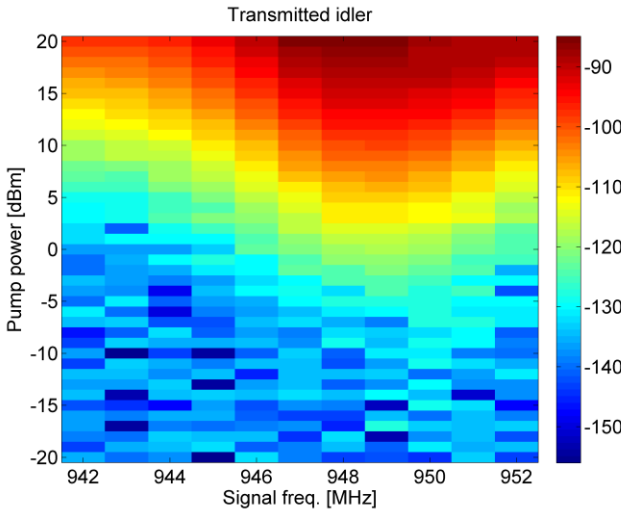


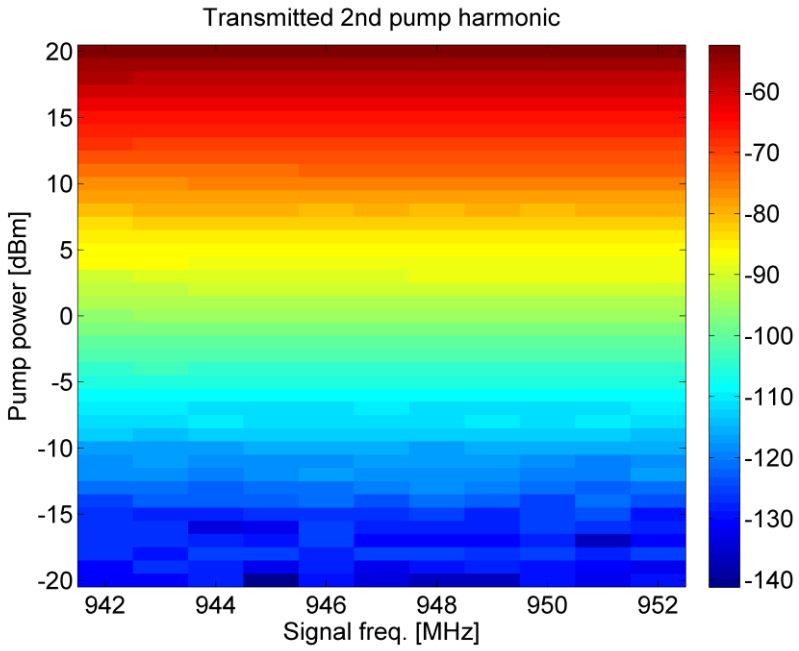



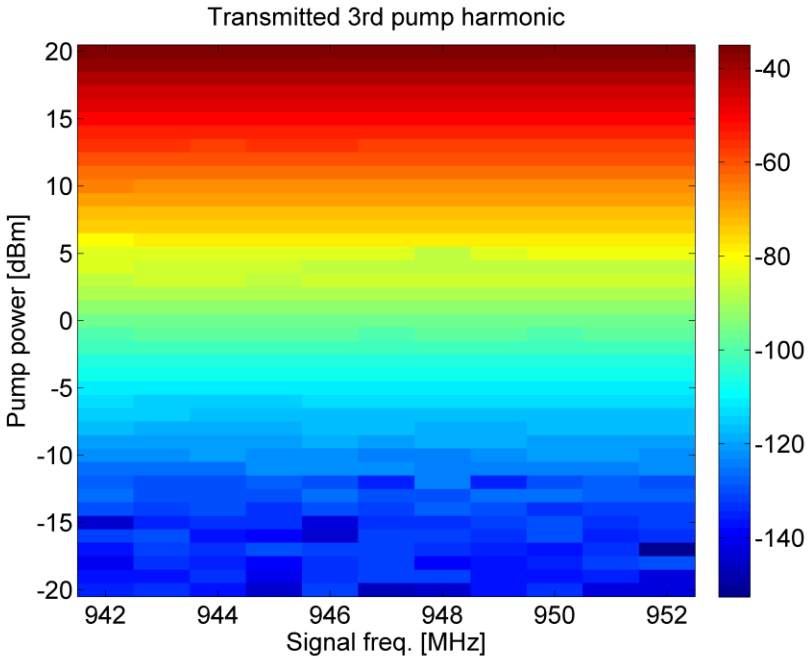
# Scanning signal frequency



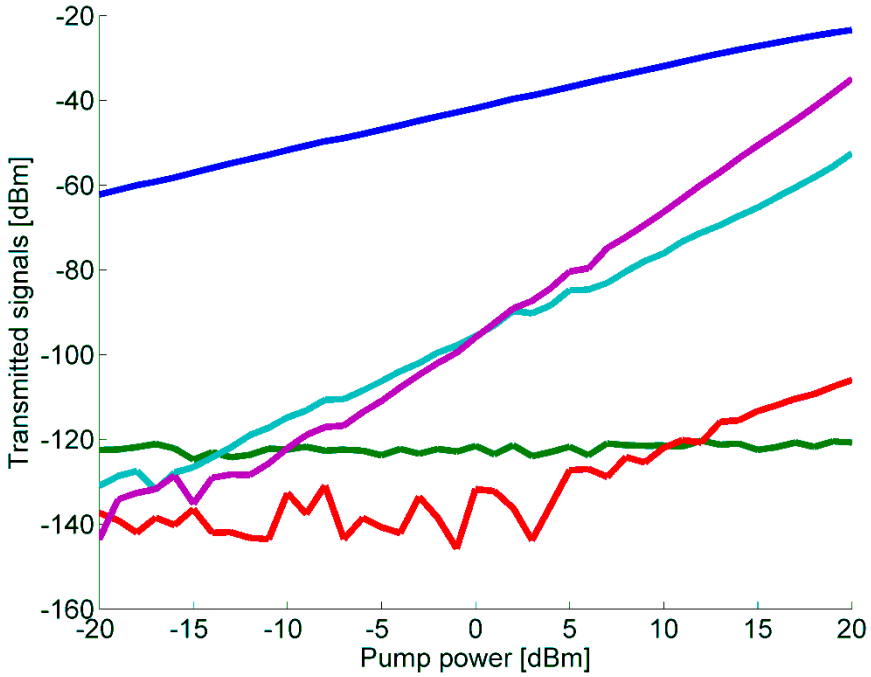



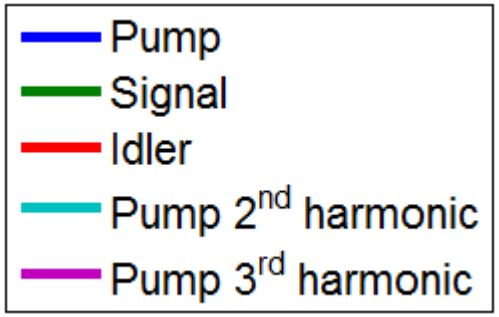



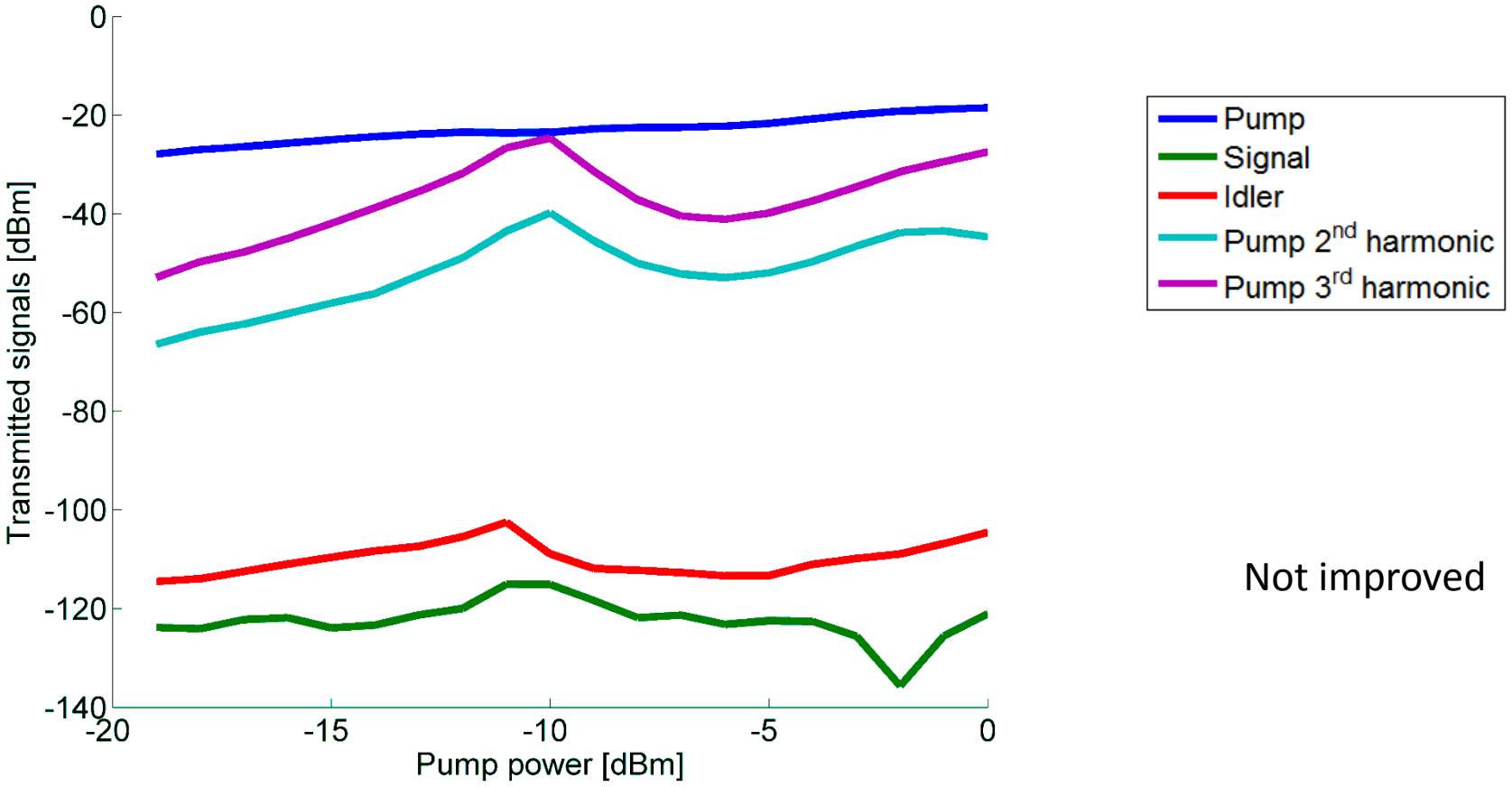
# Weak signal (-60 dBm)



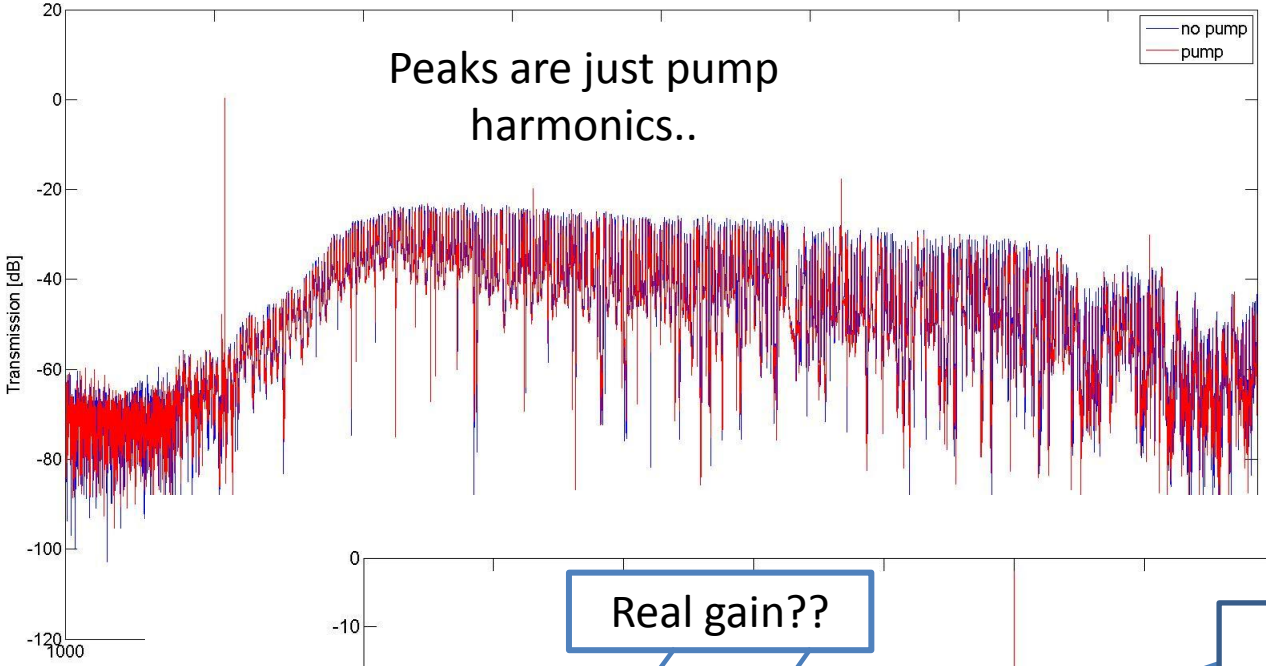

Not improved

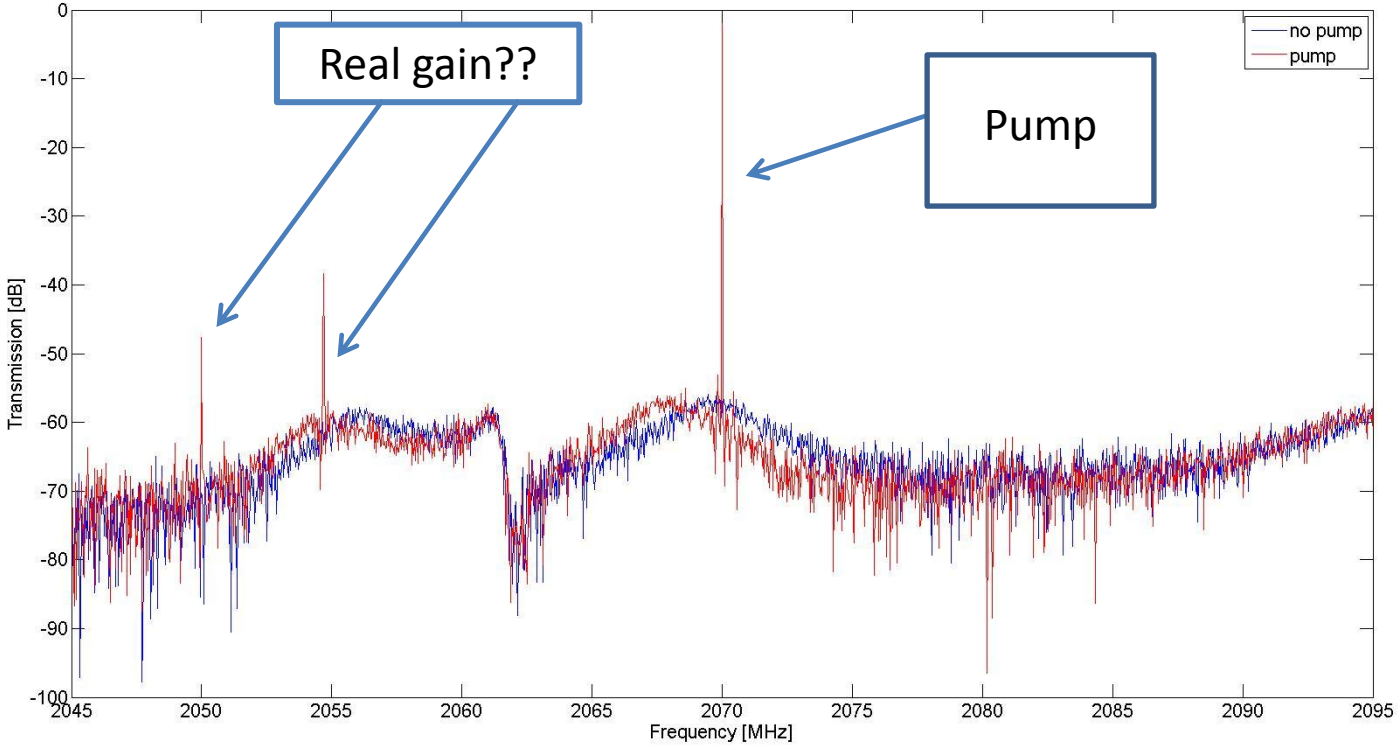
# Added external amplification to pump (~30 dB, ZVE-3W-83+ )




Not improved

# Wide scans (Pump = 20 dBm @ 2070 MHz), scanning signal frequency



Putting the pump @ 1/3*(stop band freq.) → no gain is observed