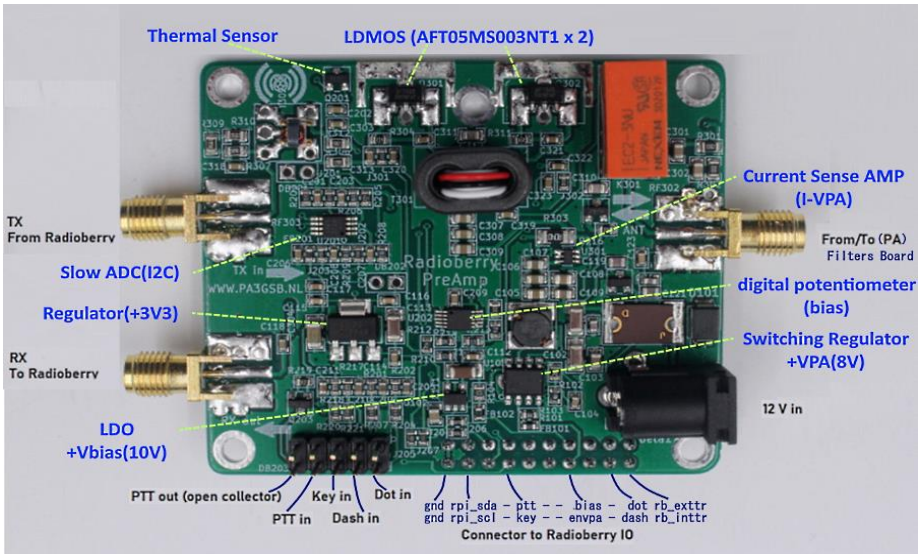
Radioberry Pre-Amp measurements

1 Overall system configuration

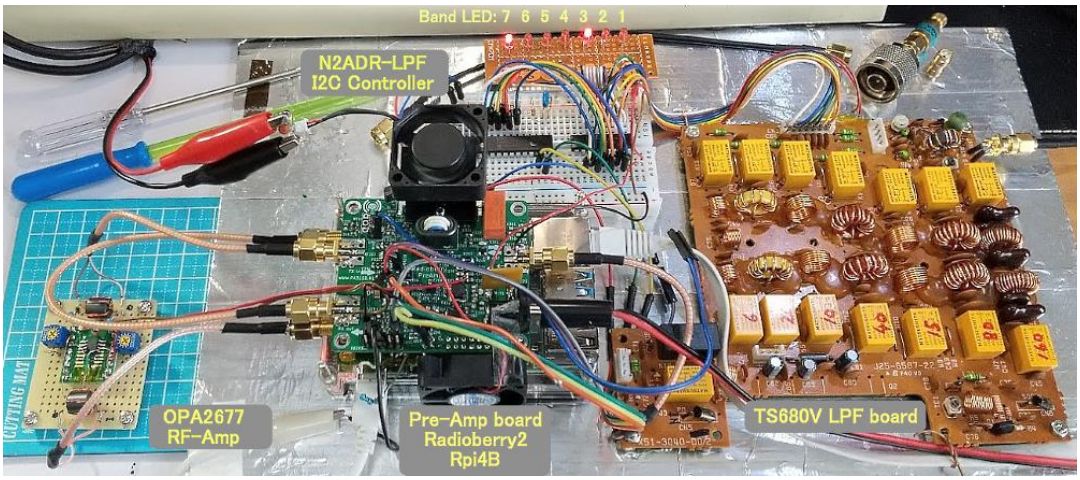
Radioberry preamp board [Fig.1]

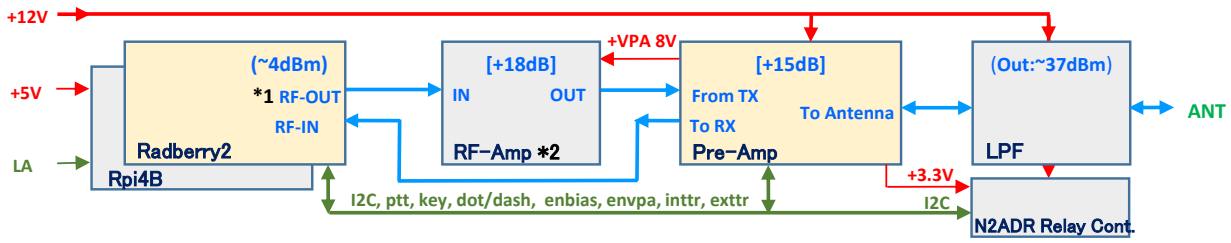
https://github.com/pa3gsb/Radioberry-2.x/wiki/Radioberry-preamp
https://groups.google.com/g/radioberry/c/WQc_afuvViI



Note:
ADC has two reserved channels.
Possible to connect fwd and rev power for SWR.

Components of the measurement. [Fig.2]





Note:

*1 RF-OUT: Changed using AD9866-TxDAC(52pin:IOUT_P+, 51pin:IOUT_P-) to avoid AD9866-IAMP generated nonharmonic spurs. (see modify figure.5)

fspurs = nFs±mFtx Fs=76.8MHz(=38.4Mhz*2)

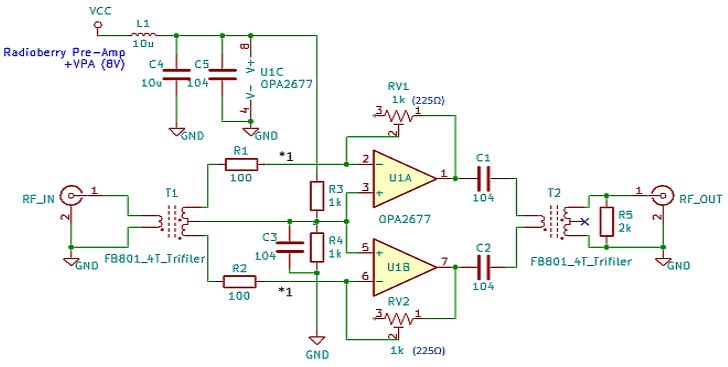
12m and 10m are likely to be a problem , and cannot be removed by LPF.

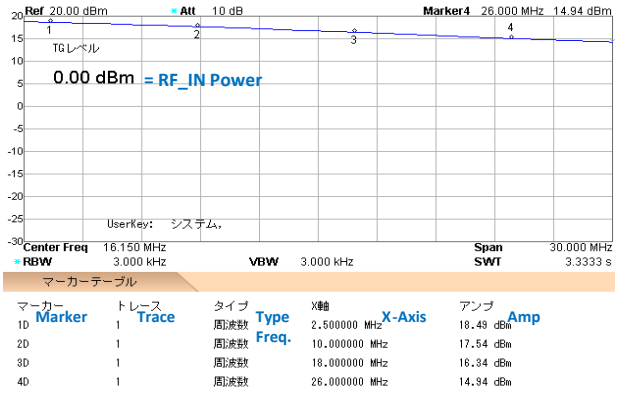
- 24.9MHz spur : 29.1MHz (=2*76.8-5*24.9)
- 28.1MHz spur : 13.1MHz (=2*76.8-5*28.1)

*2 RF-OUT drops when TxDAC is used (about -11dB), so RF-Amp was inserted.
The disadvantage of RF-Amp is that it generates harmonics spurs. Because RB2 RF-OUT is so clean.

(Another way to solve this problem is to insert a BPF instead of an RF-Amp. and don't need to modify RB2 to pull out TxDAC pins.)

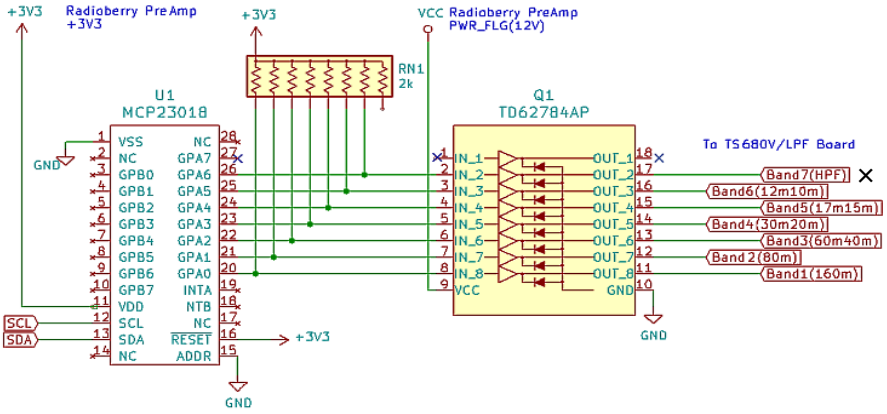
following is the OPA2677 RF-Amp circuit. [Fig.3]
Gain can be varied with RV1,RV2. The measurement was done at 225Ω.





Note *1: I plan to change the signal to + input as in the HL2 circuit. To Improve Frequency

I made a prototype relay control circuit for the TS680-LPF board. [Fig.4]
Following the same circuit of the N2ADR-Filter board. And switching the band-filter by changing the frequency.*2



Note: *2

Auto Filter Switching

SDR Win10	TX	RX
PowerSDR	○	○
Quisk	○	○
SparkSDR	○	×
SDRConsole	△	×

○: Works by changing a frequency
△: Only in the Ham-band
×: Not working

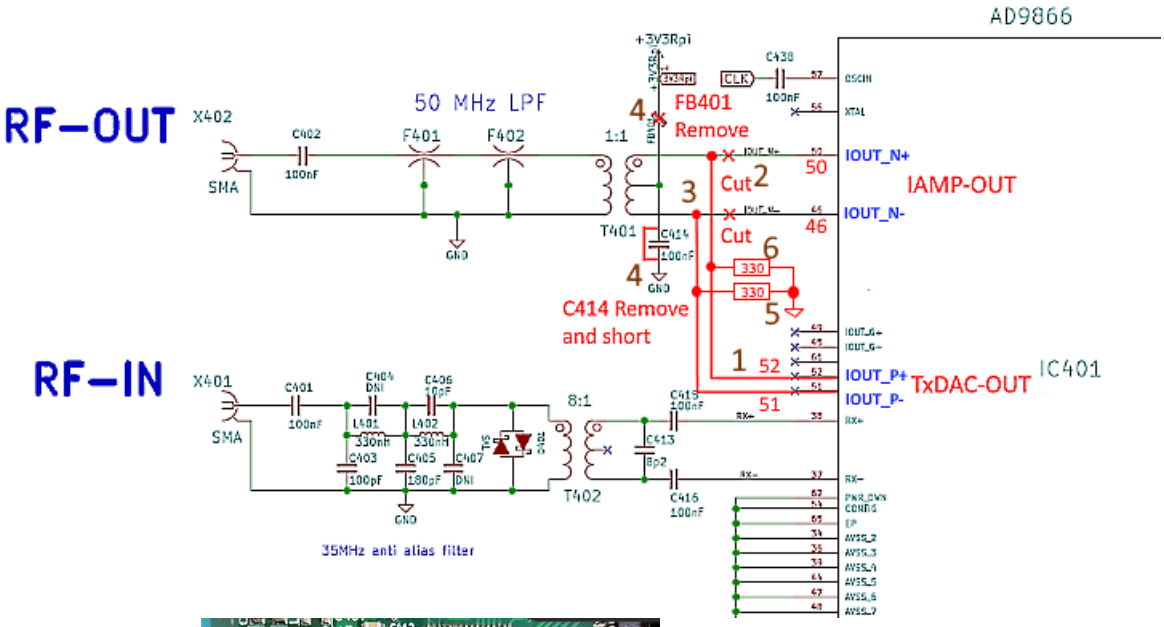
Modified the radioberry firmware bellow.
(1) changed "filters.h": for using MCP23018 (cause I had a mcp23018)
(2) changed "radioberry.c": Temperature to switch PA OFF 60C (The temperature over 50C due to my poor heat radiation.)

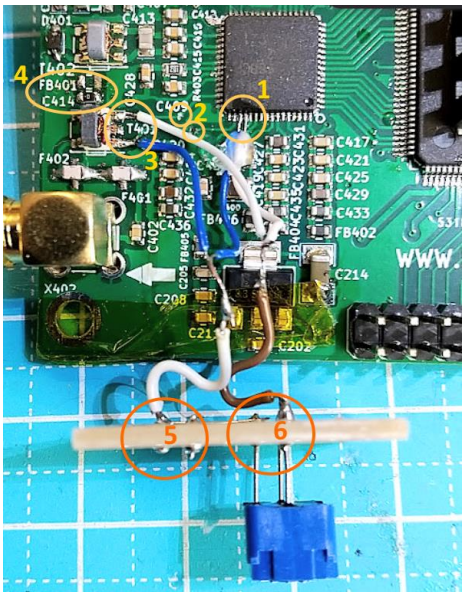
```
pi@raspberrypi:~/tmp/device_driver/firmware $ diff filters.h_org filters.h
137c137,138
<                       ldata[0] = 0x09;
---
>       //              ldata[0] = 0x09;    // mcp23008  gpio : 0x09
>                       ldata[0] = 0x12;    // mcp23018  gpioa: 0x12
364c365
<               fprintf(stderr, "N2ADR filter board interface found and initialized \n");
---
>               fprintf(stderr, "N2ADR(MCP23018) filter board interface found and initialized \n");

pi@raspberrypi:~/tmp/device_driver/firmware $ diff radioberry.c_org radioberry.c
478c478
<       // temperature == (((T*.01)+.5)/3.26)*4096   if pa temperature > 50C (=1256) switch pa off! (pa_temp_ok)
---
>       // temperature == (((T*.01)+.5)/3.26)*4096   if pa temperature > 60C (=1382) switch pa off! (pa_temp_ok)
483,484c483,484
<               if (pa_temp_ok && (pa_temp >= 1256)) {
<                       fprintf(stderr, "ALERT: temperature of PA is higher than 50°C; PA will be switched off! \n");
---
>               if (pa_temp_ok && (pa_temp >= 1382)) {
>                       fprintf(stderr, "ALERT: temperature of PA is higher than 60°C; PA will be switched off! \n");
488c488
<               if (!pa_temp_ok && (pa_temp < 1256)) measured_temp_ok_count++;
---
>               if (!pa_temp_ok && (pa_temp < 1382)) measured_temp_ok_count++;
```

Modifying the circuit. [Fig.5]

Thanks for the modification idea! To Steve G6ALU
https://groups.google.com/g/radioberry/c/rUA8bocApNg
・Removing C414 and FB401, replacing C414 with a short.
・Cutting track from pin 46 and 50 and linking to pins 51 and 52.





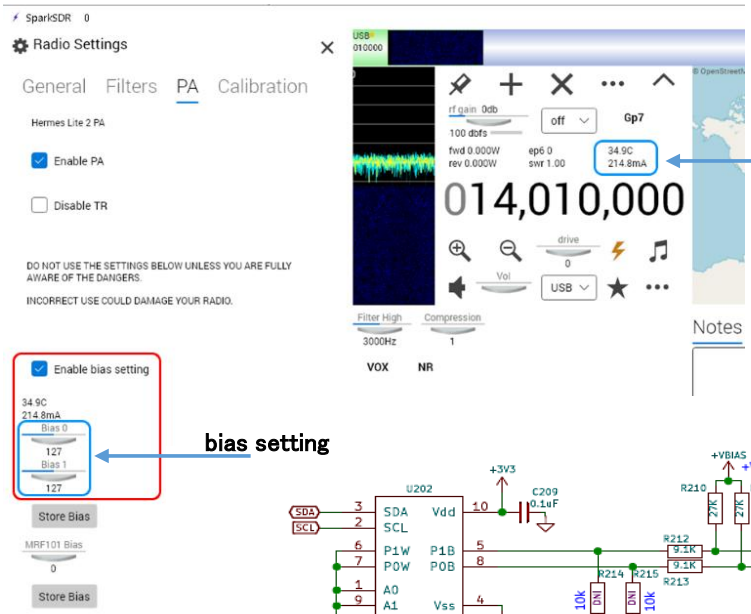
Note: #5,#6

#5,#6: 330Ω is preliminary.
The resistor value was chosen to reduce the output level drop.
see:
https://www.qsl.net/in3otd/ham_radio/Hermes-Lite/TX_out.html

Radioberry2 Software used following: Thanks to Johan PA3GSB
・Radioberry V2.0 Build version: 2021.04.25 (gateware version 73-0., driver version 0.9)
https://github.com/pa3gsb/Radioberry-2.x/releases/ (released on 16 Feb, developement release)
https://github.com/pa3gsb/Radioberry-2.x/tree/master/SBC/rpi-4/device_driver/firmware/ (committed on 11 May, small improvement)

SDR Software used following.: for Win10 PC, Thanks to all developers!
・PowerSDR OpenHPSDR mRX PS v3.5.0(HL2)
・SDRConsole v3.0.27
・Quisk 4.1.83
・SparkSDR 2.0.6.6

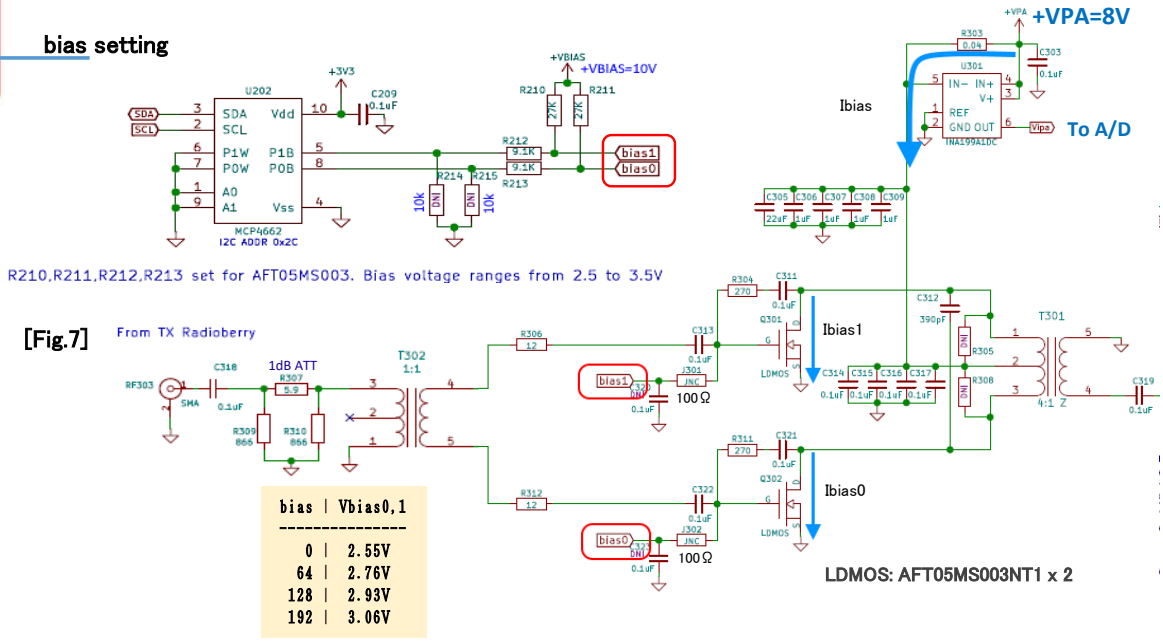
2 Radioberry Pre-Amp "I-bias vs bias-setting"



[Fig.6]
bias-setting: by SparkSDR_2.0.6.6
TX Mode:USB (No Audio Input)

Temperature and
bias (+VPA) current measurement

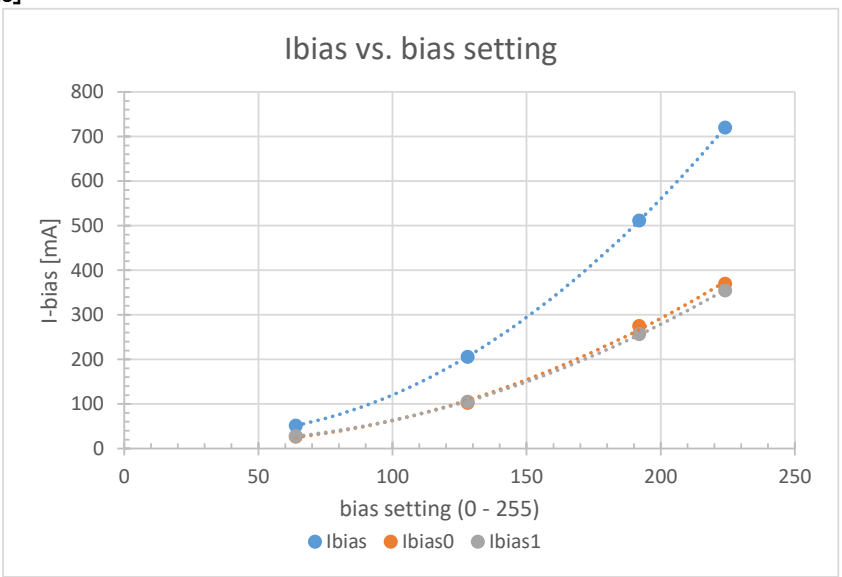
bias setting



[Fig.7]

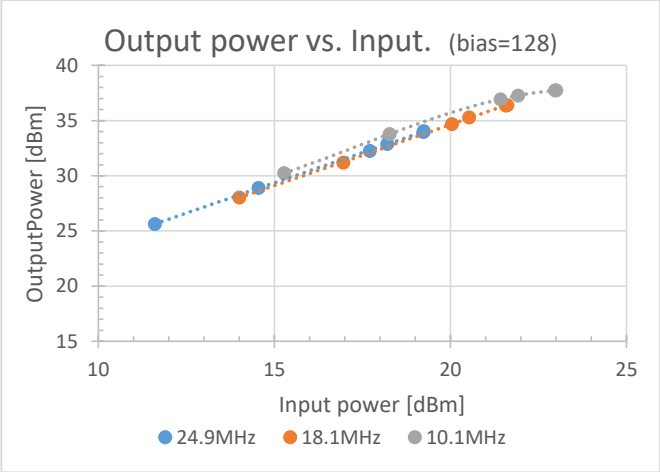
bias	Vbias0,1
0	2.55V
64	2.76V
128	2.93V
192	3.06V

[Fig.8]

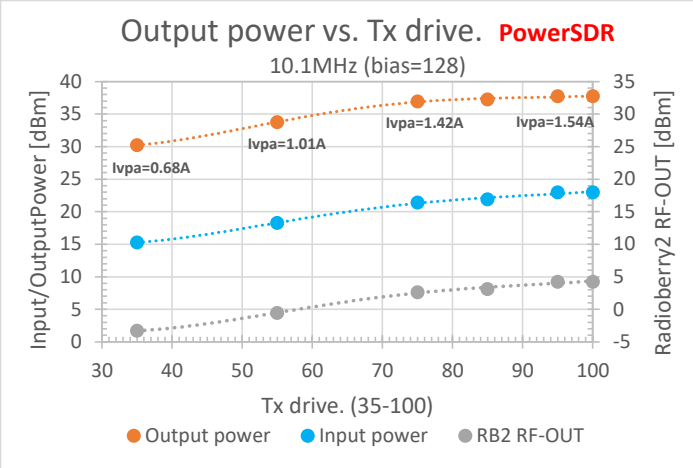


3 Radioberry Pre-Amp “Output power vs. input power”

[Fig.9]

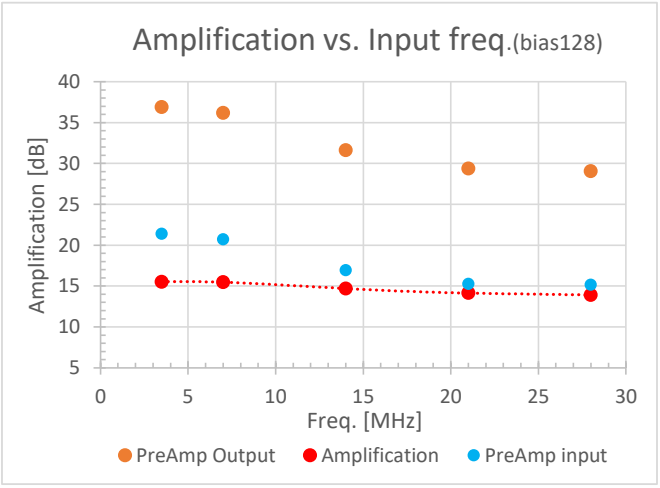


[Fig.10]

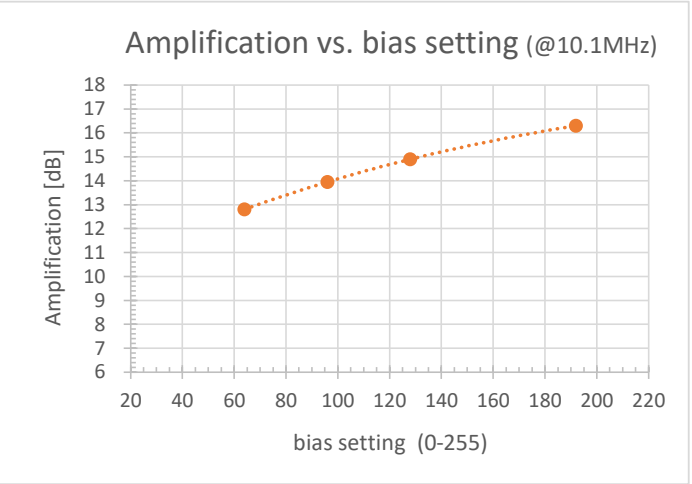


4 Radioberry Pre-Amp “Power amplification vs. input freq./bias setting”

[Fig.11]



[Fig.12]

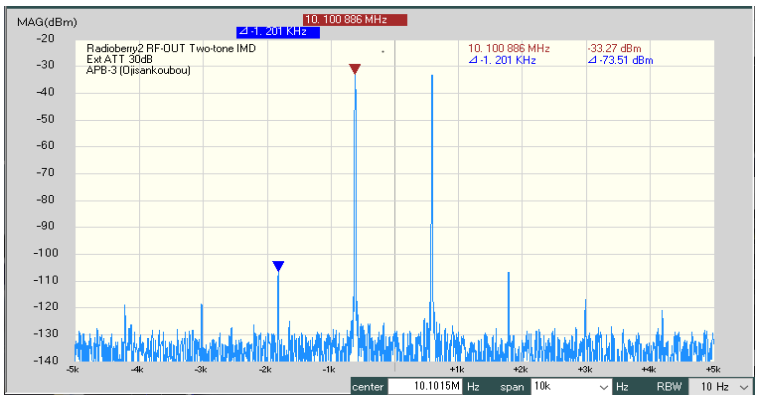


[Fig.13] OpenHPSDR-PowerSDR mRX PS v3.5.0

5 Radioberry Pre-Amp “Two-tone IMD”

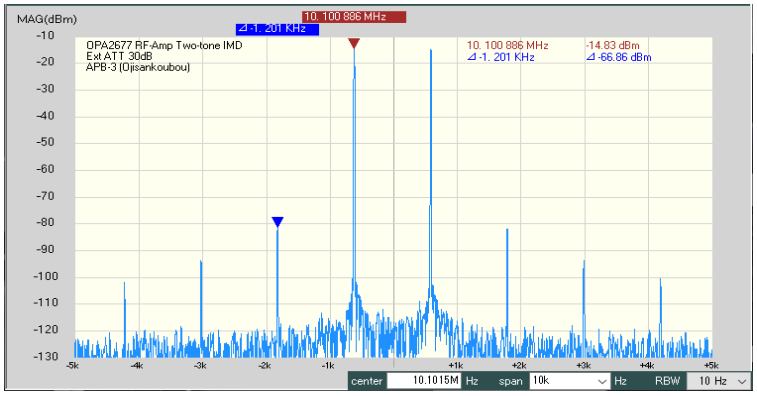
(1) Radioberry2
RF-OUT
-73.5dB

[Fig.14]



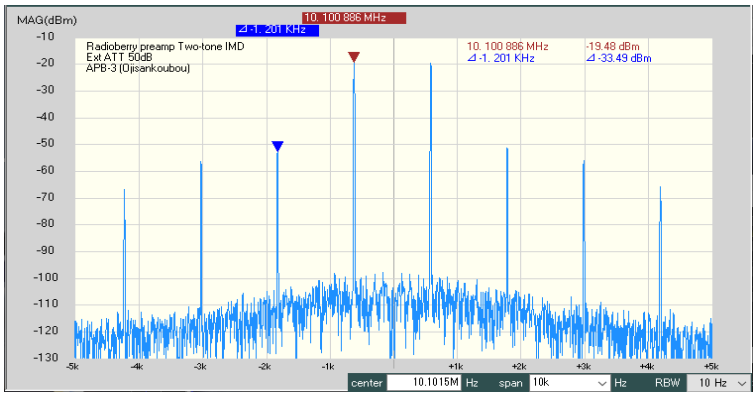
(2) RF-Amp OUT
-66.8dB

[Fig.15]



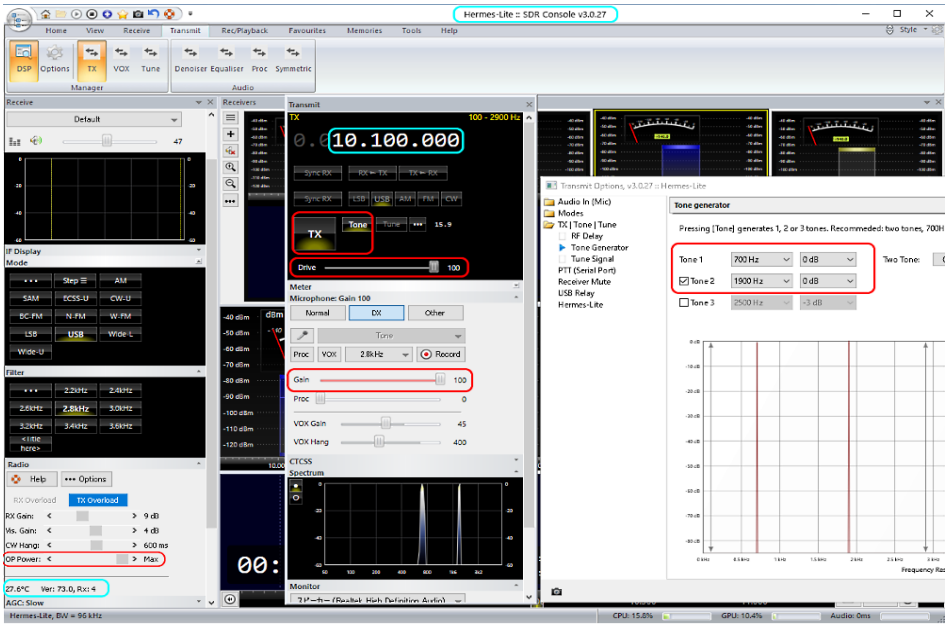
(3) Radioberry
Pre-Amp OUT
-33.4dB

[Fig.16]



SDRConsole v3.0.27
Two-tone setting
700Hz 0dB
1900Hz 0dB

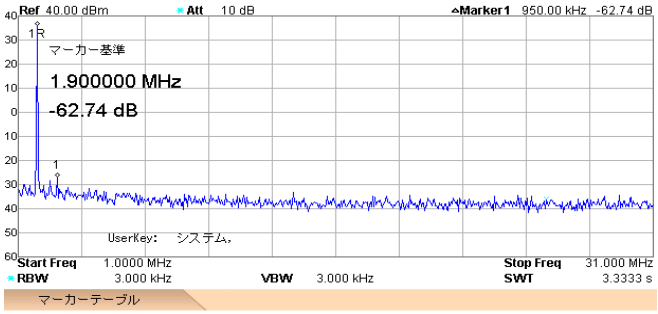
[Fig.17]



6 “Output Spectrum” (PowerSDR, for reference)

[Fig.18]

(1) 160m

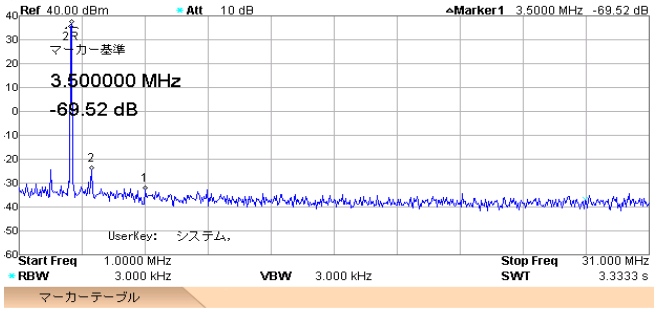


マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	1.900000 MHz	35.77 dBm
1D	1	周波数	950.00 kHz	-62.74 dB

Marker Trace Type Freq. X-Axis Amp

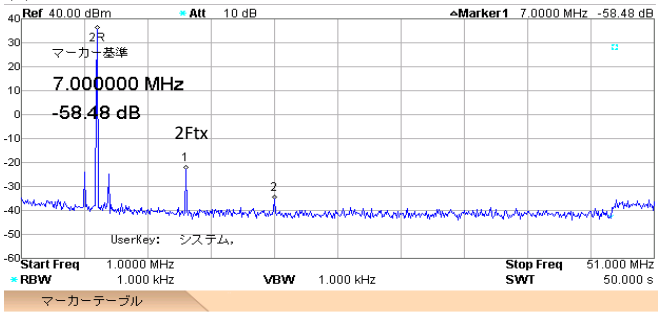
(2) 80m



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	3.500000 MHz	36.41 dBm
1D	1	周波数	3.5000 MHz	-69.52 dB
2R	1	周波数	3.450000 MHz	34.62 dBm
2D	1	周波数	1.0000 MHz	-59.36 dB

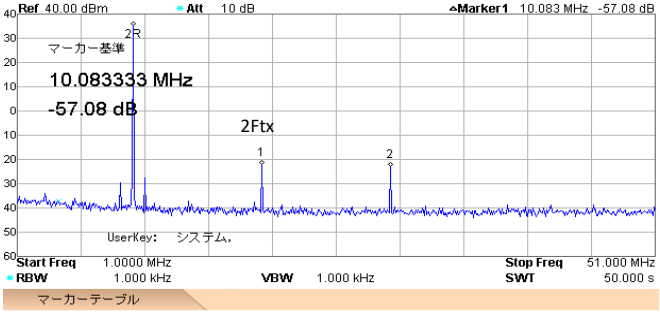
(3) 40m −58.4dB@2ftx (TS680_LPF: −20dB@14MHz, −38dB@28MHz)



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	7.000000 MHz	35.46 dBm
1D	1	周波数	7.0000 MHz	-58.48 dB
2R	1	周波数	7.000000 MHz	35.46 dBm
2D	1	周波数	14.000 MHz	-70.77 dB

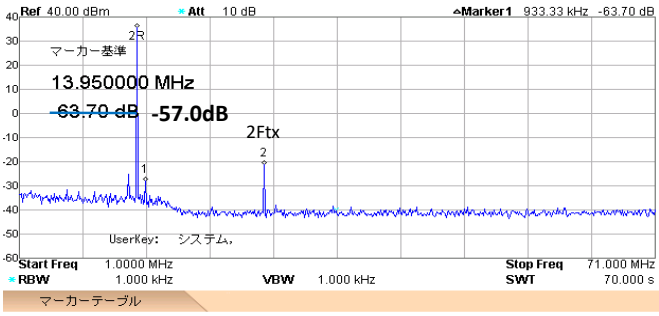
(4) 30m −57.0dB@2ftx (TS680_LPF: −14dB@20MHz, −33dB@30MHz)



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	10.083333 MHz	34.98 dBm
1D	1	周波数	10.083 MHz	-57.08 dB
2R	1	周波数	10.083333 MHz	34.98 dBm
2D	1	周波数	20.166 MHz	-57.91 dB

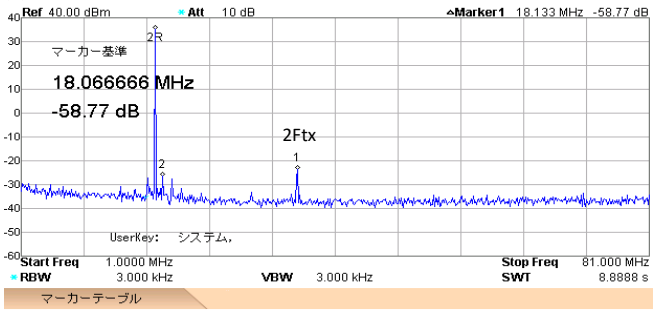
(5) 20m −57.0dB@2ftx (TS680_LPF: −32dB@28MHz, −43dB@42MHz)



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	13.950000 MHz	35.55 dBm
1D	1	周波数	933.33 kHz	-63.70 dB
2R	1	周波数	13.950000 MHz	35.55 dBm
2D	1	周波数	14.000 MHz	-57.03 dB

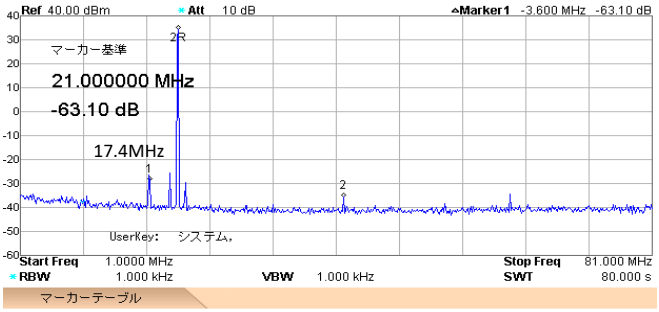
(6) 17m −58.7dB@2ftx (TS680_LPF: −21dB@36MHz, −50dB@52MHz)



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	18.066666 MHz	34.95 dBm
1D	1	周波数	18.133 MHz	-58.77 dB
2R	1	周波数	18.066666 MHz	34.95 dBm
2D	1	周波数	933.33 kHz	-61.53 dB

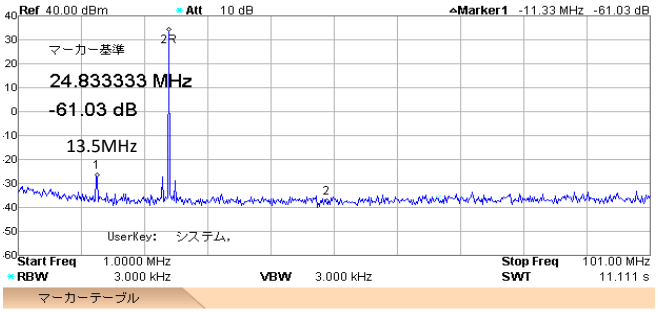
(7) 15m −63.1dB@17.4MHz (=Fosc-Ftx =38.4MHz-21.0MHz)



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	21.000000 MHz	34.16 dBm
1D	1	周波数	-3.600 MHz	-63.10 dB
2R	1	周波数	21.000000 MHz	34.16 dBm
2D	1	周波数	20.933 MHz	-69.97 dB

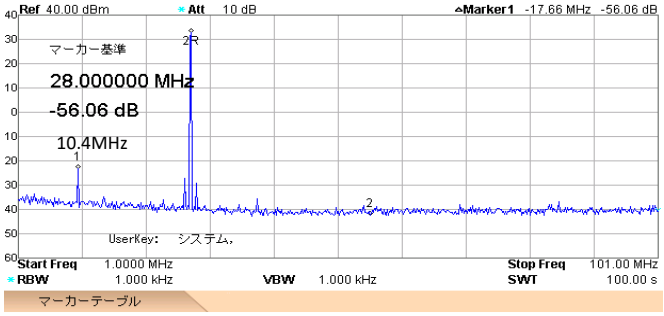
(8) 12m −61.0dB@13.5MHz (=Fosc-Ftx =38.4MHz-24.9MHz)



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	24.833333 MHz	33.55 dBm
1D	1	周波数	-11.33 MHz	-61.03 dB
2R	1	周波数	24.833333 MHz	33.55 dBm
2D	1	周波数	25.000 MHz	-71.56 dB

(9) 10m　-56dB@10.4MHz (= Fosc-Ftx = 38.4MHz-28.0MHz)



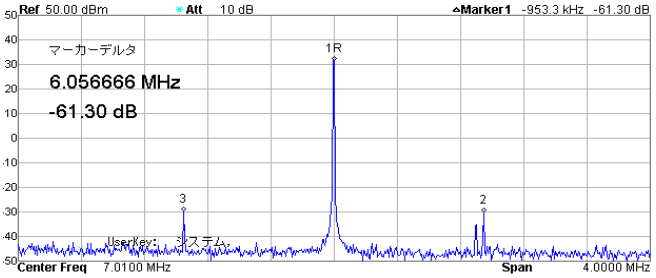
マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	28.000000 MHz	32.51 dBm
1D	1	周波数	-17.66 MHz	-56.06 dB
2R	1	周波数	28.000000 MHz	32.51 dBm
2D	1	周波数	28.000 MHz	-75.17 dB

"Spurious at Ftx ±960 kHz" (SDRConsole Quisk, for reference)

In PowerSDR, a spurious signal of about -60 dB was observed at Ftx ±960 kHz .
This Spurs. was also observed in SDRConsole and Quisk. And the level is decrease when increase a power. (!?)
However, it was not observed with APB-3. (at Radioberry RF-OUT)
I'm not sure what's causing this spurious.

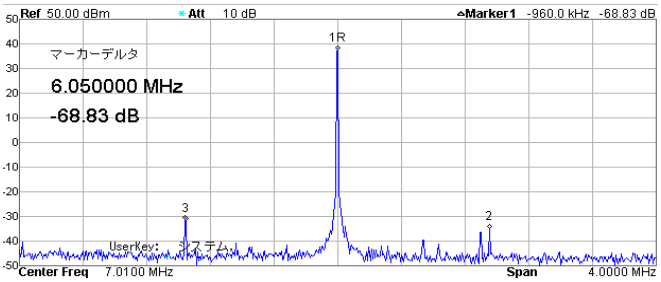
[Fig.19a] Quisk 31.6dBm@7MHz Spurs.= -61.3dB



マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	7.010000 MHz	31.53 dBm
1D	1	周波数	-953.3 kHz	-61.30 dB
2D	1	周波数	7.956666 MHz	-30.23 dBm
3D	1	周波数	6.056666 MHz	-29.77 dBm

[Fig.19b] Quisk 37.2dBm@7MHz Spurs.= -68.8dB

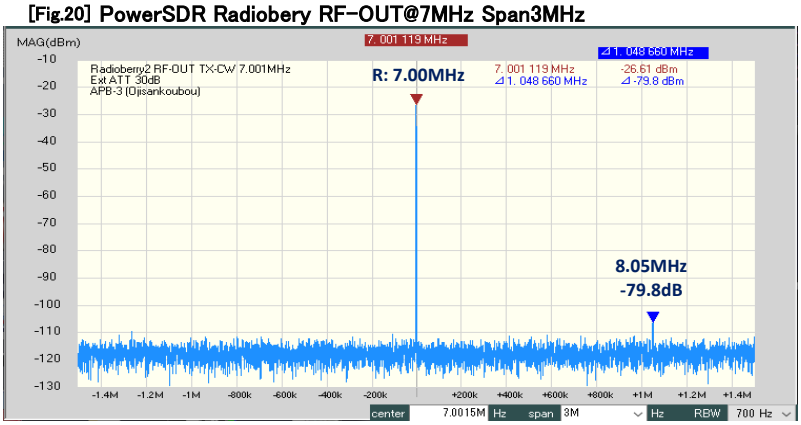


マーカーテーブル

マーカー	トレース	タイプ	X軸	アンプ
1R	1	周波数	7.010000 MHz	37.27 dBm
1D	1	周波数	-960.0 kHz	-68.83 dB
2D	1	周波数	7.963333 MHz	-34.89 dBm
3D	1	周波数	6.056666 MHz	-31.86 dBm

Equipment: DSA815 (RIGOL)

[Fig.20] PowerSDR Radiobery RF-OUT@7MHz Span3MHz



Equipment: APB-3 (Ojisankoubou)

04 July 2021 jg1twp