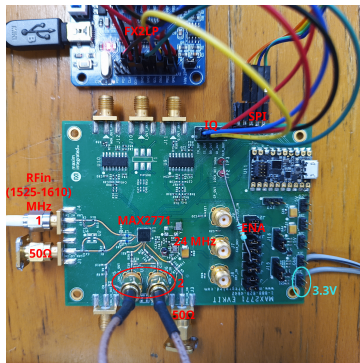


Efficient USB communication under GNU/Linux for a wideband L-band (GNSS) SDR receiver: getting familiar with the MAX2771

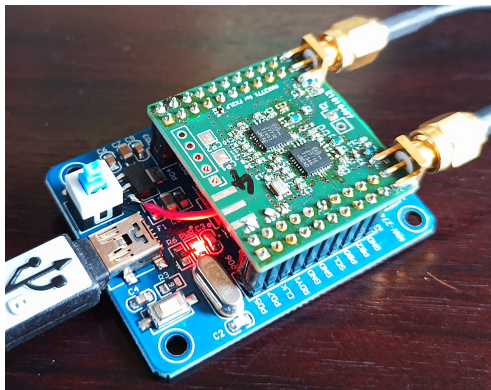
J.-M Friedt

FEMTO-ST Time & Frequency, Besançon, France

From



to



January 12, 2026

Reading pocket_dump output with GNU Octave & Numpy

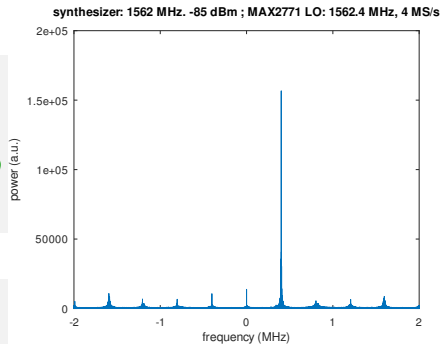
Output of pocket_dump -t 4 /tmp/1.bin /dev/null:

GNU Octave:

```
fs=4; % sampling rate (MHz)
N=1e5; % number of samples
fr=linspace(-fs/2,fs/2-fs/N,N);
f=fopen('/tmp/1.bin'); % file descriptor
d=fread(f,2*N,'int8'); % read 2N samples (8 bit int)
d=d(1:2:end)+j*d(2:2:end); % interleaved IQ to complex
plot(fr,abs(fftshift(fft(d))))
```

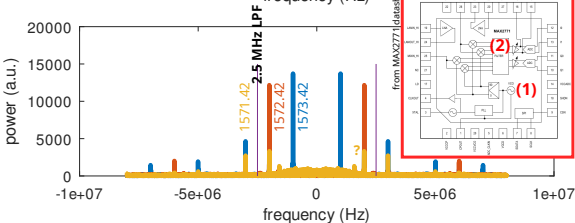
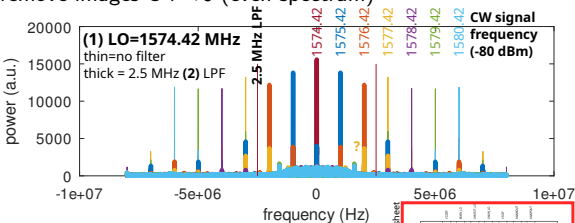
Numpy:

```
import numpy as np
from matplotlib import pyplot as plt
fs=4 # sampling rate (MHz)
N=int(1e5) # number of samples
fr=np.linspace(-fs/2,fs/2-fs/N,N)
with open('/tmp/1.bin','rb') as f:
    d=np.fromfile(f,dtype=np.int8,count=2*N)
d=d[0::2]+1j*d[1::2]
plt.plot(fr,np.abs(np.fft.fftshift(np.fft.fft(d))))
plt.show()
```

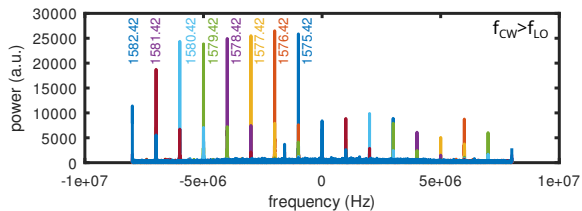
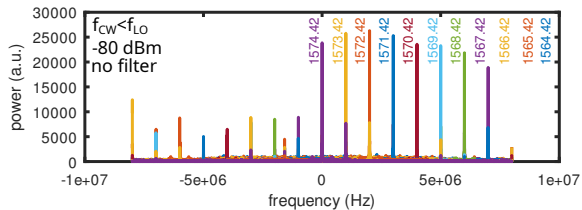


MAX2771 internal architecture: tests with continuous wave (CW) signals

Real output (I only), will require IF and software transposition to remove images @ $f < 0$ (even spectrum)



Complex output (IQ $\Rightarrow$ non-even spectrum)

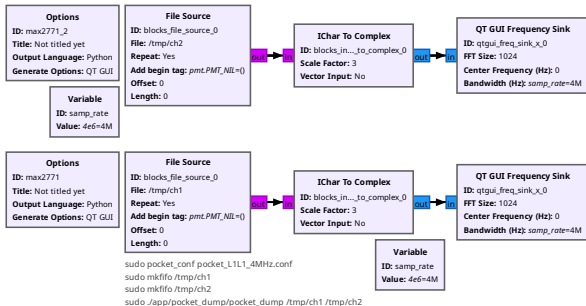


FCEN = 107 # IF filter center frequency: (128-FCEN)/2*{0.195|0.66|0.355} MHz
FBW = 1 # IF filter BW (0:2.5MHz,1:8.7MHz,2:4.2MHz,3:23.4MHz,4:36MHz,7:16.4MHz)
F3OR5 = 1 # Filter order selection (0:5th,1:3rd)
FCENX = 0 # Polyphase filter selection (0:lowpass,1:bandpass)
FGAIN = 1 # IF filter gain setting (0:-6dB,1:normal)
IQEN = 0 # I and Q channel enable (0:I-CH-only,1:I/Q-CH)

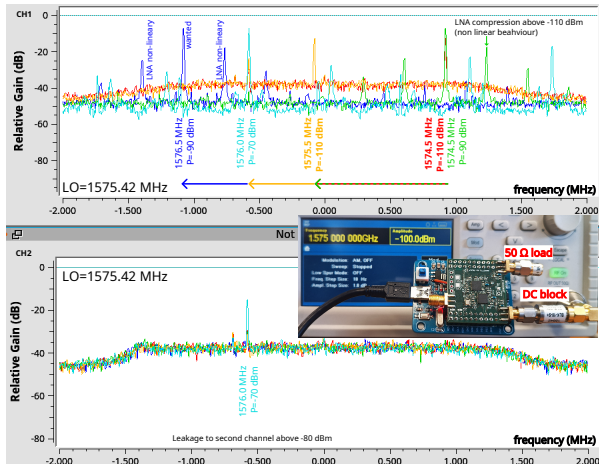
from PocketSDR pocket_conf

Link with GNU Radio

- ▶ PocketSDR app/pocket_dump/pocket_dump allows for streaming to files.
- ▶ Link to GNU Radio through named pipes (mkfifo) ¹ ...
- ▶ ... requires though two GNU Radio scripts, one for each pipe/file $\Rightarrow$ dynamic display of spectra for analyzing the MAX2771 behaviour.
- ▶ PocketSDR can address multiple MAX2771-based boards (app/pocket_scan/pocket_scan ²)



Datasheet: In-Band Mixer Input Referred 1dB Compression Point = -85 dBm after 18 dB LNA gain



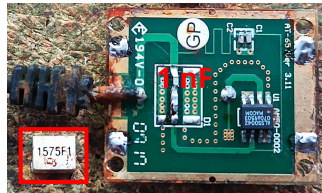
¹B.W. Kernighan, *AT&T Archives: The UNIX Operating System* (1982) @ <https://www.youtube.com/watch?v=tc4ROCJYbm0> (6'00" "the notion of pipelining is the fundamental contribution of the system...") & D. Ritchie @ 11'51" & 17'17" "input/output redirection"

Sidenote exploration: Iridium reception

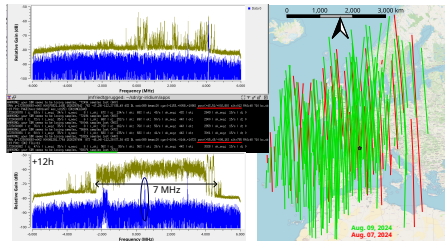
- ▶ LEO (780 km) satellite constellation broadcasting in the upper L-band, J. Bloom, *Eccentric Orbits: The Iridium Story – How a Single Man Saved the World's Largest Satellite Constellation From Fiery Destruction*, Grove Press (1998)
- ▶ signal well above thermal noise ...
- ▶ ... but (BPSK/QPSK) does not benefit from correlation to increase number of bits
- ▶ GPS L1 active patch antenna whose bandpass filter was replaced with a capacitor
- ▶ Fractional PLL of MAX2771: $RDIV \in [0:1023]$, $NDIV \leq 546$ ($f_{LO} = 1638 > 1622$ MHz) and $FDIV \in [36 - 32767]$,

$$\text{for } f_{LO} = \frac{f_{Xtal}}{RDIV} \times \left(NDIV + \frac{FDIV}{2^{20}} \right) \text{ with } f_{Xtal} = 24 \text{ MHz}$$

Settings: $f_{IF} = 6.5$ MHz, $f_s = 24$ MS/s ; MAX2771 spectrum around 1622 MHz



Flight history for aircraft - G-HFHX									
AIRCRAFT	Embraer Praetor 600	TYPE CODE	E550	MODE S	407AE1				
AIRLINE	Flexjet		/ LXJ	SERIAL NUMBER (MSN)					
OPERATOR	Flexjet Europe		/ FLJ	AGE					
DATE	FROM	TO	FLIGHT	FLIGHT TIME	STD	ATD	STA	STATUS	
07 Aug 2024	Rome (CIA)	Milan (LIN)	(FLJ61H)	0:47	1:30 PM	1:54 PM	2:23 PM	Landed 2:41 PM	



2024-08-07T14:02:03 [hdr: 0339010100000001] Dir:DL Mode:2 REG:F-GXLI ACK:7 Label:?? (Demand mode) bID:F
 2024-08-07T14:42:12 Dir:DL Mode:2 REG:GFHFX ACK:8 Label:?? (Demand mode) bID:Z

Result: ACARS message³ from a plane between Rome and Milan (Italy), beyond the horizon from Besançon (France)

³<https://thebaldgeek.github.io/Iridium.html>