

Software Defined Radio

ON7UF



Software Defined Radio

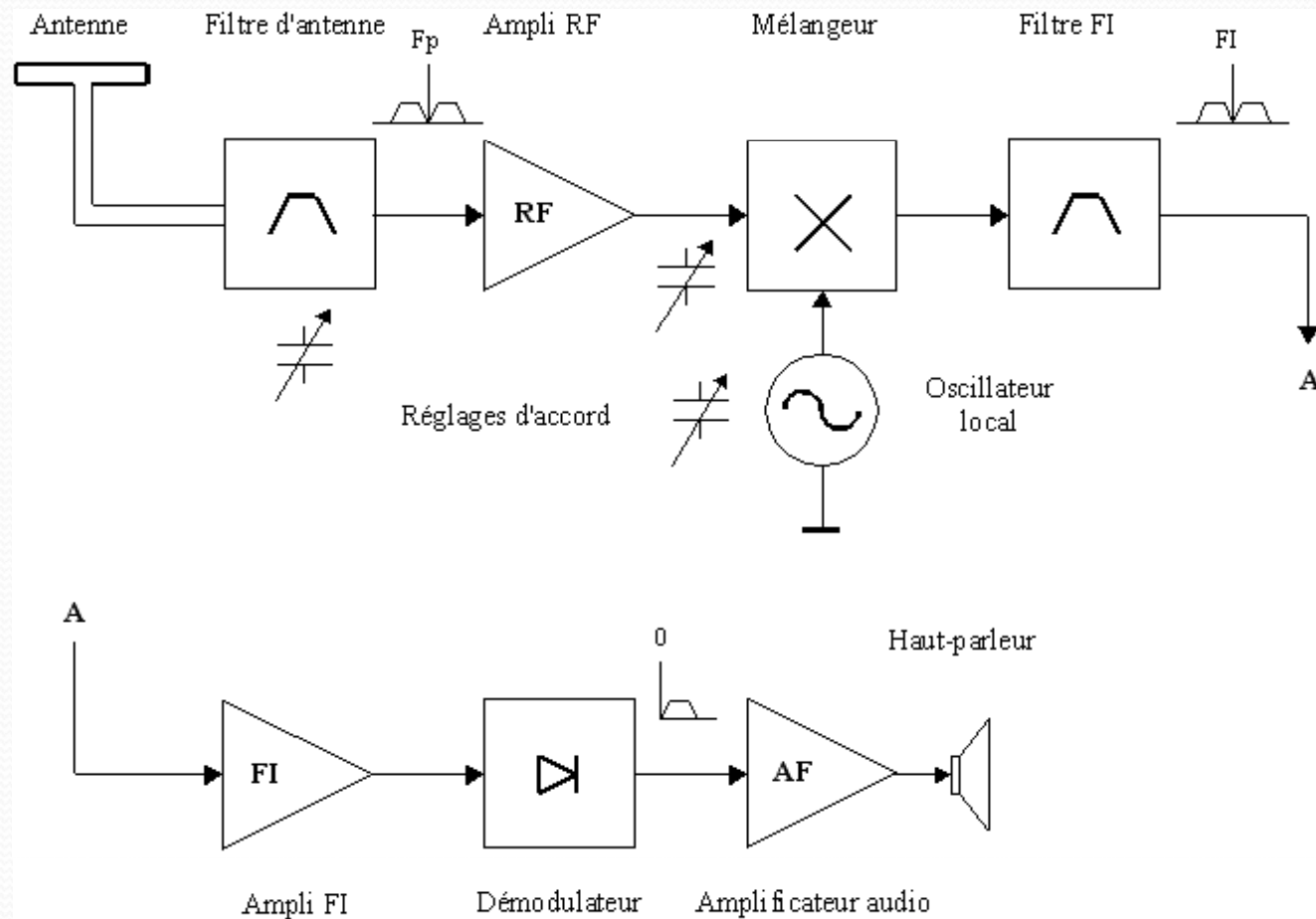
- Wat is dat?
- Hoe werkt dat?
- Wat kan ik daarmee doen?



Een beetje geschiedenis

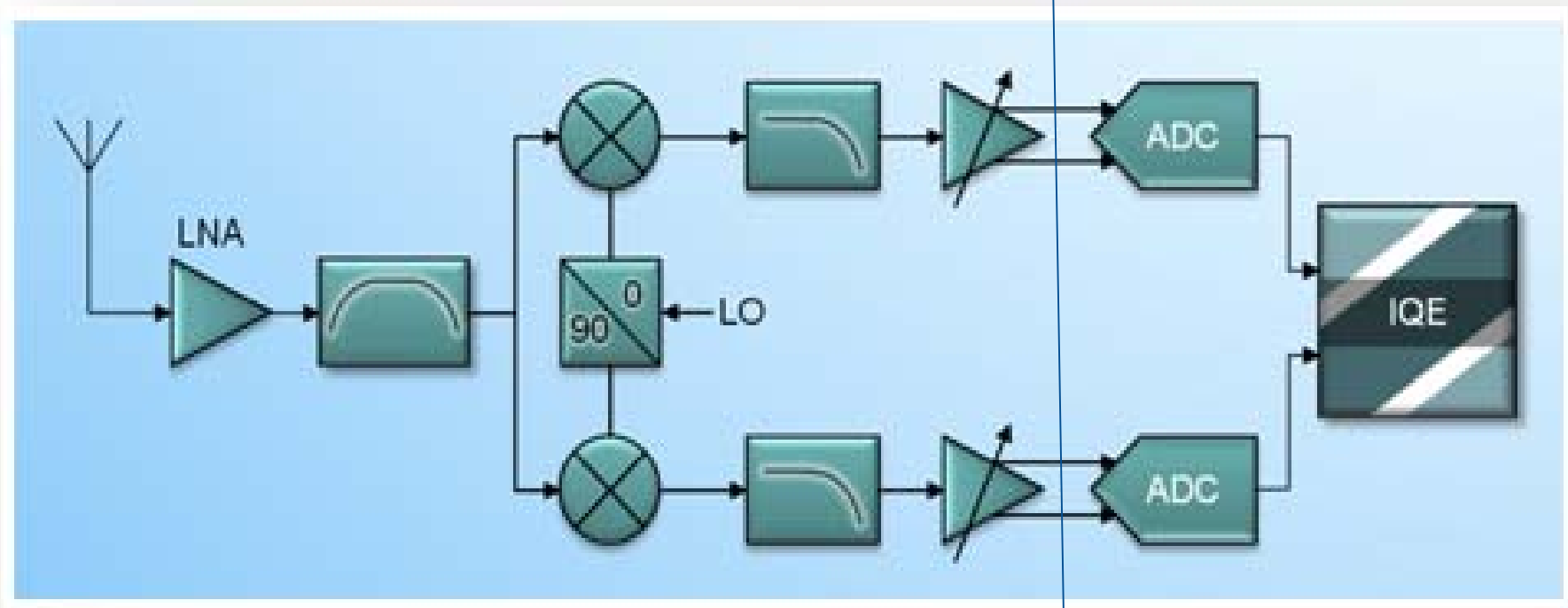
- Eerste Digital Radio dateert van 1970 (California)
- Eerste Software Defined Radio in 1984 (Texas – E-Systems nu Raytheon).
- Eerste gebruik in GSM technologie in 1991
- SPEAKeasy project: radio voor US Airforce (2Mhz tot 2Ghz + gemakkelijk demoduleren van verschillende modulatie vormen, landmacht, luchtmacht enz...)
- GNU Radio: bibliotheek SDR software modules in C++ en Python
- HPSDR: High Performance SDR (backplane)
- WebSDR: Pieter Tjerk De Boer (Univ Twente) toegang via webbrowser tot verschillende SDR ontvangers verspreid over geheel de wereld.
- RTL 2832 Realtek quadratuur decoder DVB-T
- Toekomst: SDR + Software Defined Antenna => Cognitive Radio

De klassieke ontvanger

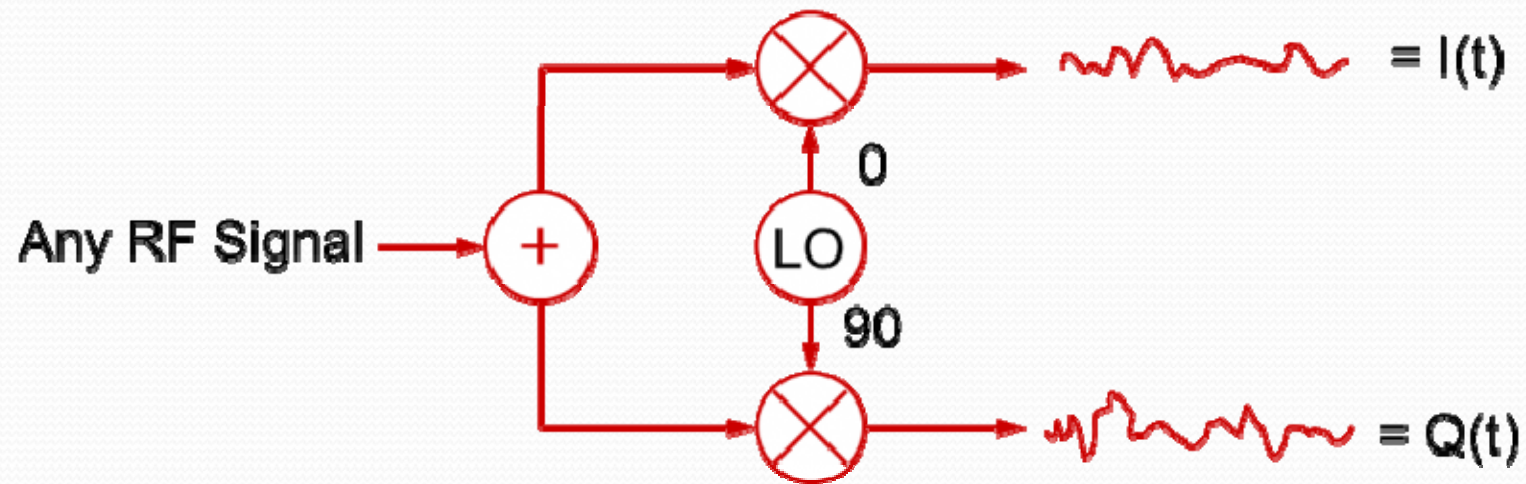


De SDR ontvanger

Computer
Embedded system



I / Q demodulation



De Dan Tayloe (N7VE) I/Q detector

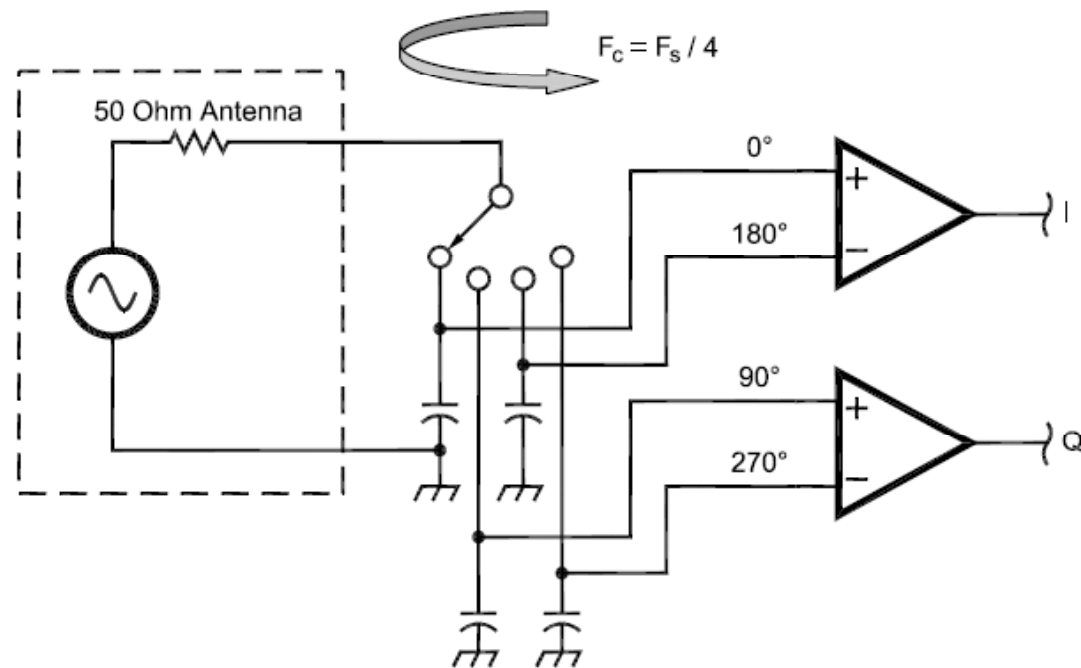
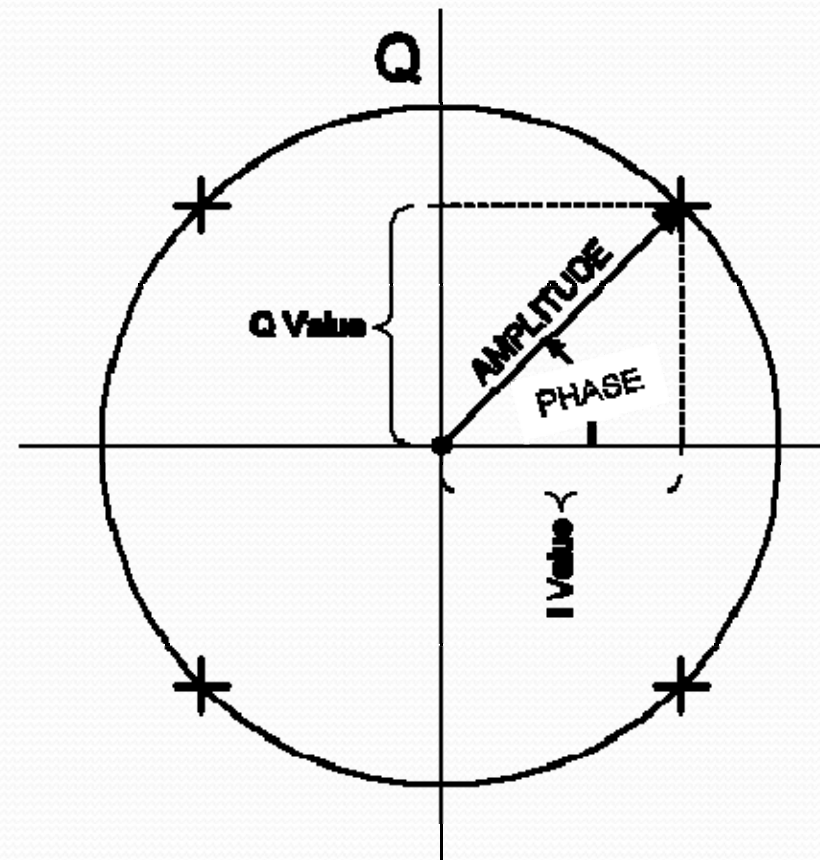
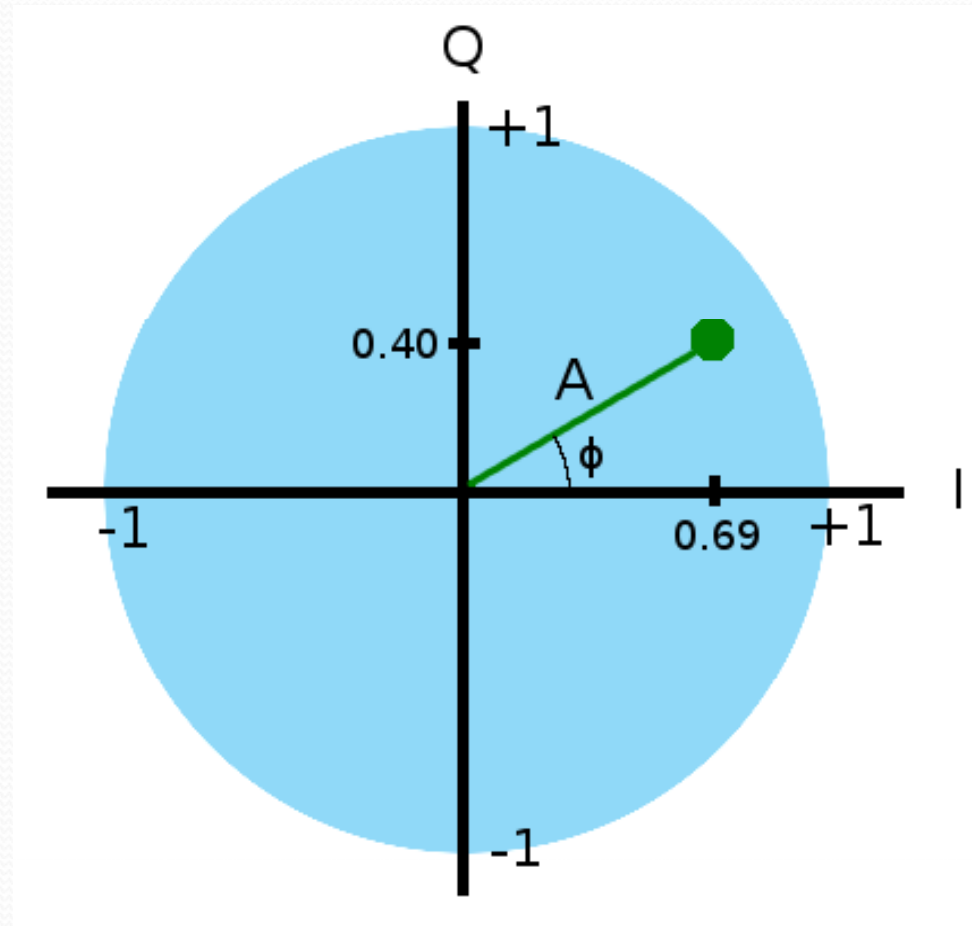


Fig 10—Tayloe detector: The switch rotates at the carrier frequency so that each capacitor samples the signal once each revolution. The 0° and 180° capacitors differentially sum to provide the in-phase (I) signal and the 90° and 270° capacitors sum to provide the quadrature (Q) signal.

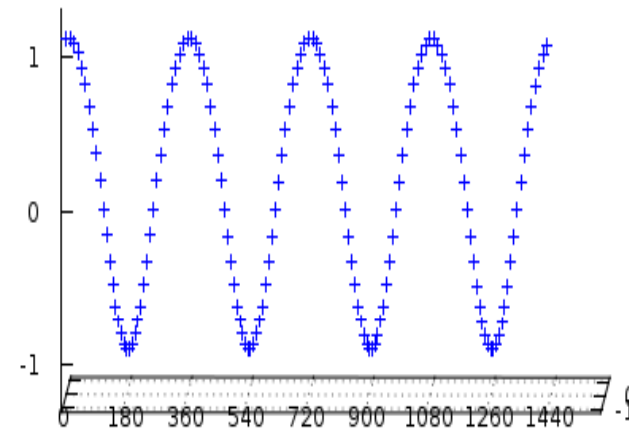
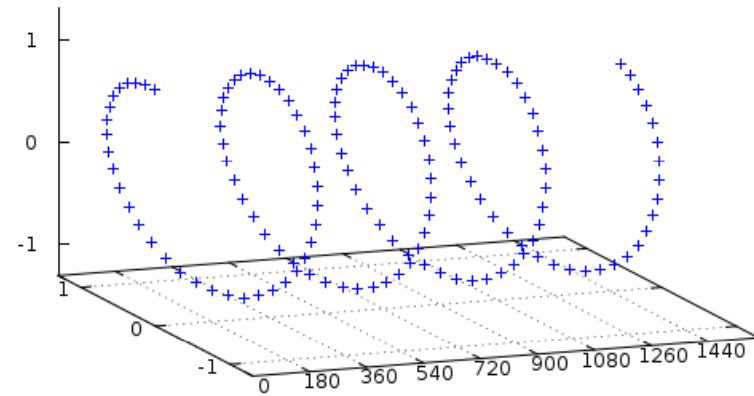
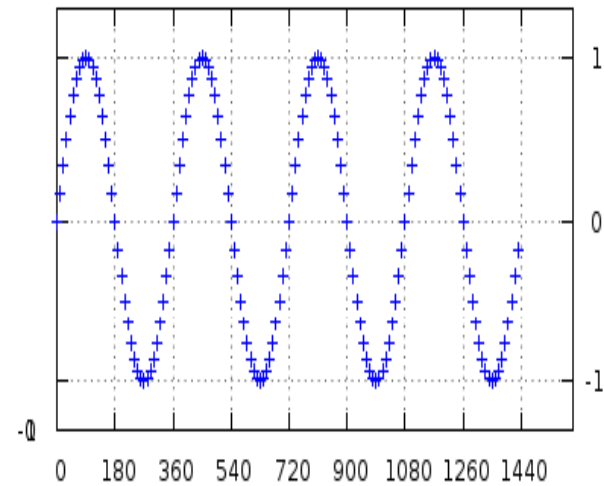
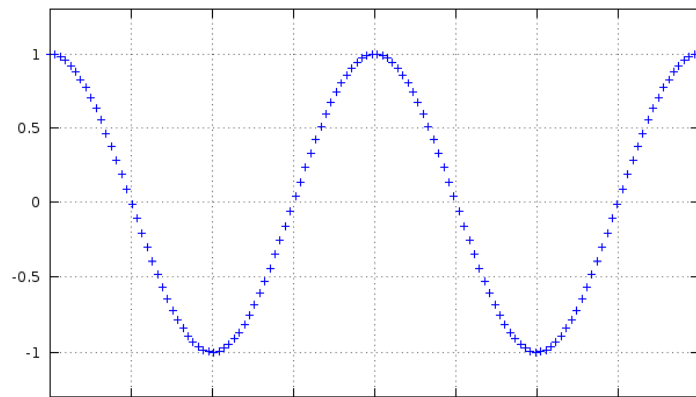
Het I/Q signaal



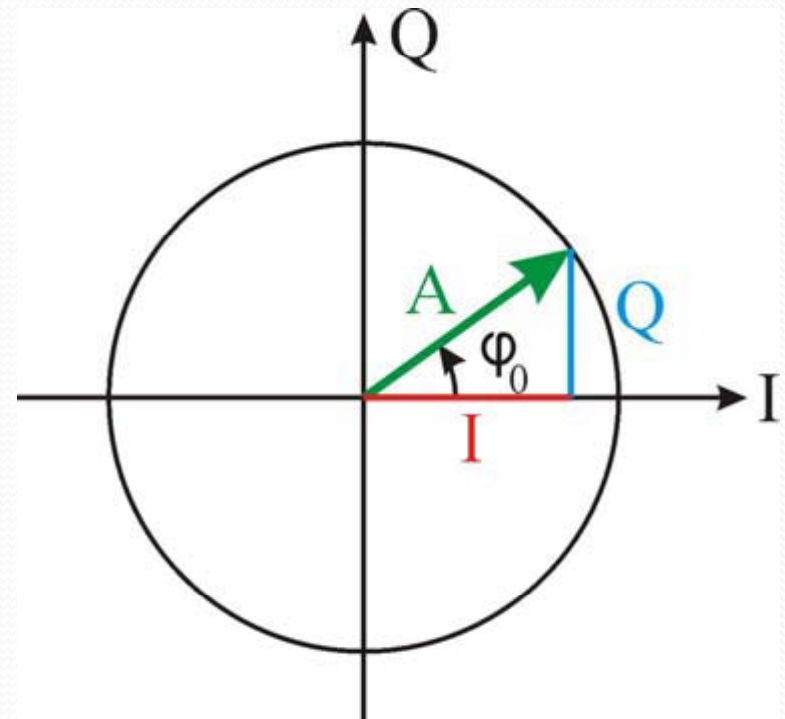
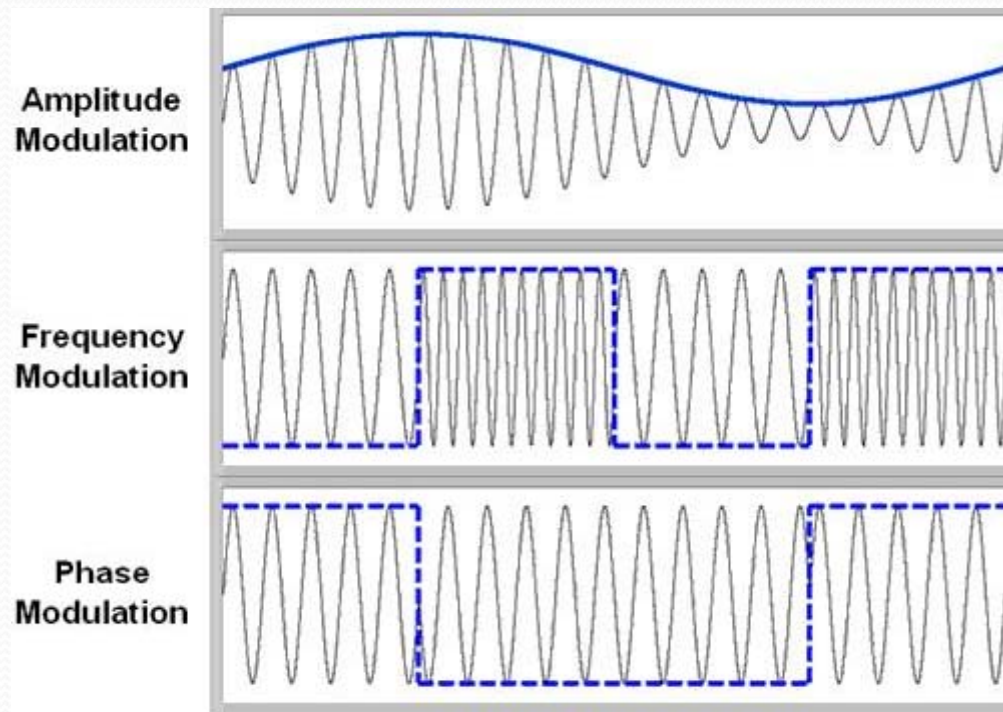
Het I / Q Signaal



Het I / Q signaal in 3D



Verschillende modulaties



Voor de liefhebbers

$$y(t) = A \cdot \sin(\omega t + \varphi_0)$$

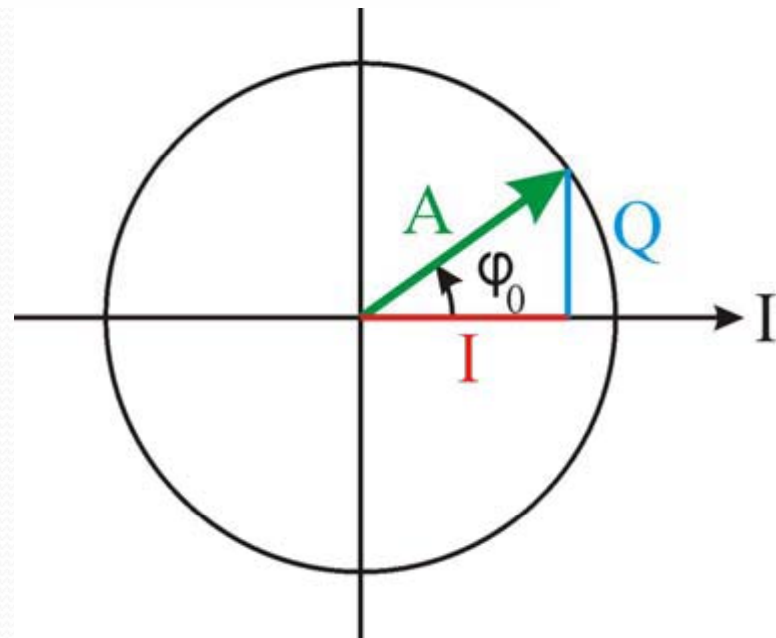
$$y(t) = \underbrace{A \cos \varphi_0}_{=:I} \sin \omega t + \underbrace{A \sin \varphi_0}_{=:Q} \cos \omega t$$

$$I = A \cdot \cos \varphi_0$$

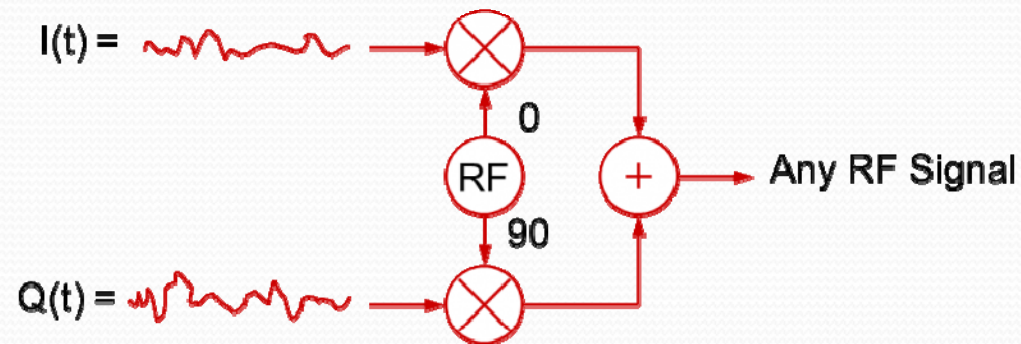
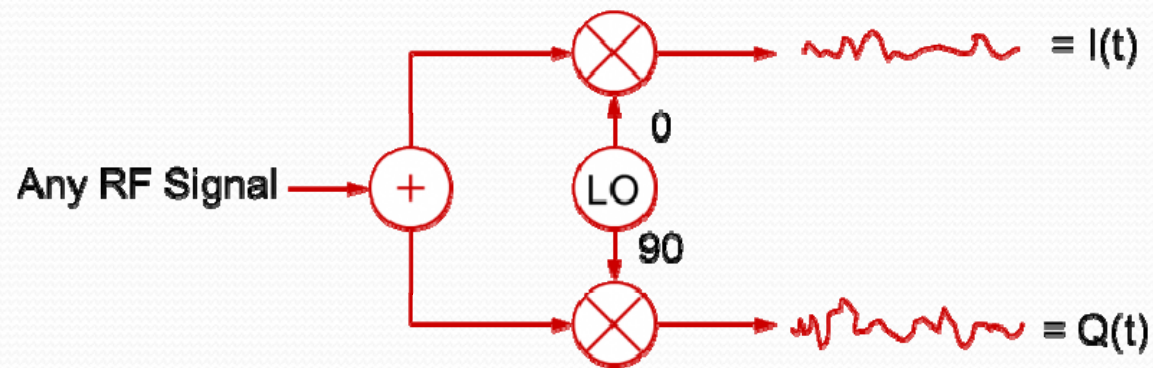
$$Q = A \cdot \sin \varphi_0$$

$$A = \sqrt{I^2 + Q^2}$$

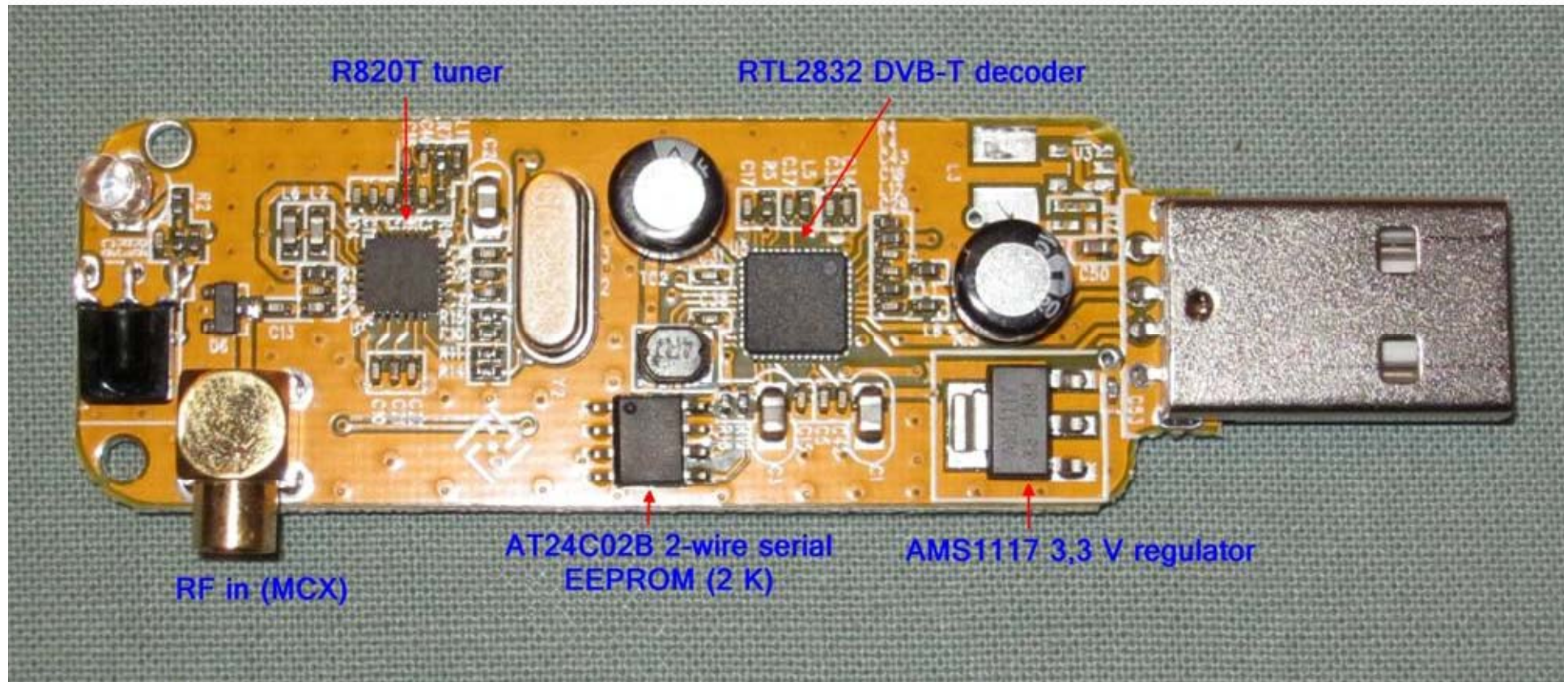
$$\varphi_0 = \operatorname{atan} \left(\frac{Q}{I} \right)$$



Zenden en ontvangen met SDR



SDR USB Dongle



SDR met Up-Converter

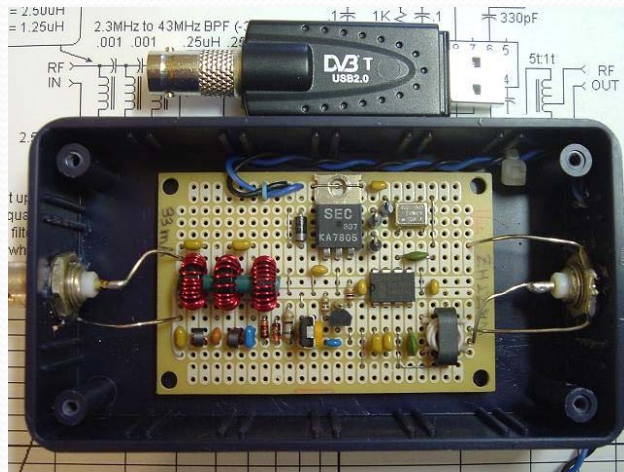
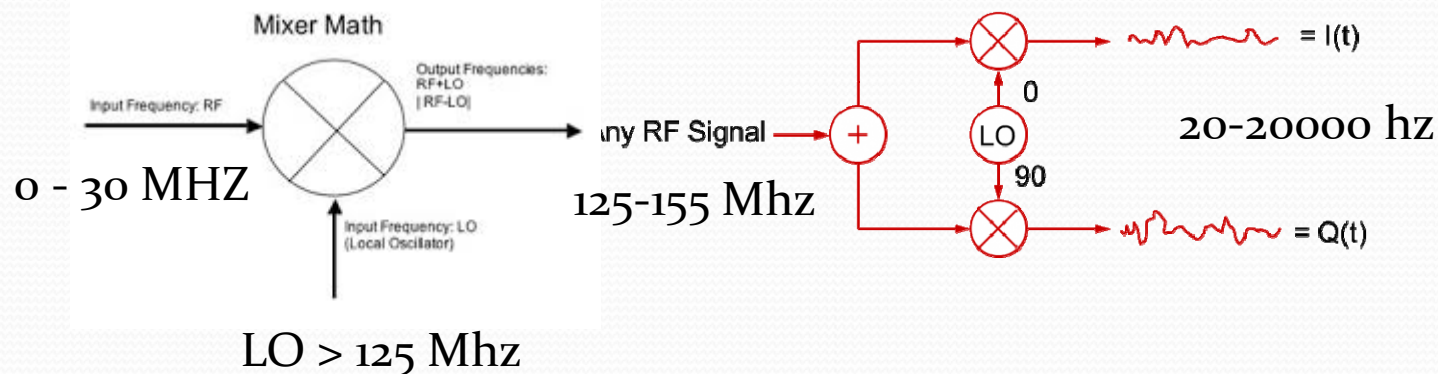
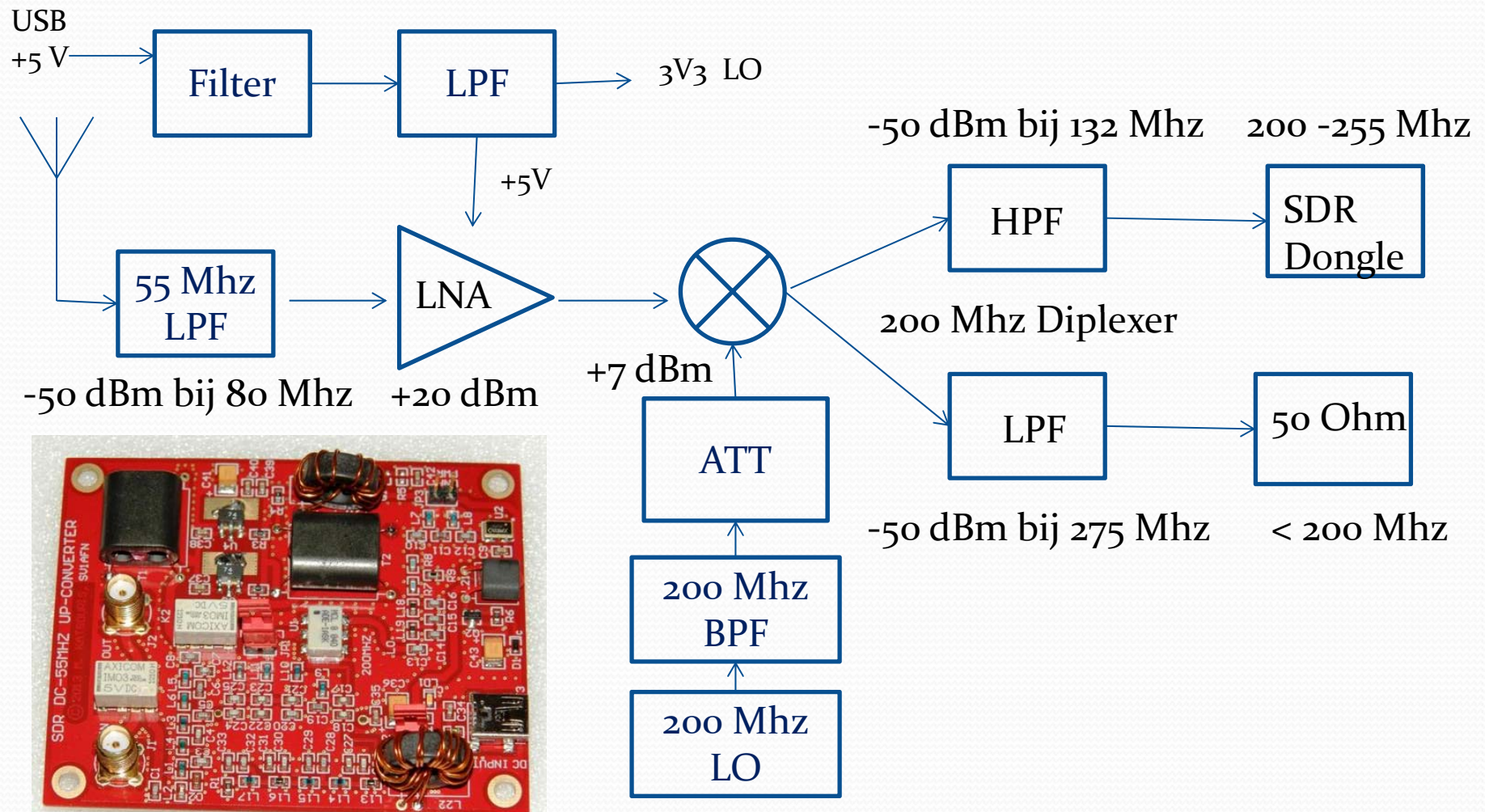


FIGURE 2: MIXER MATH



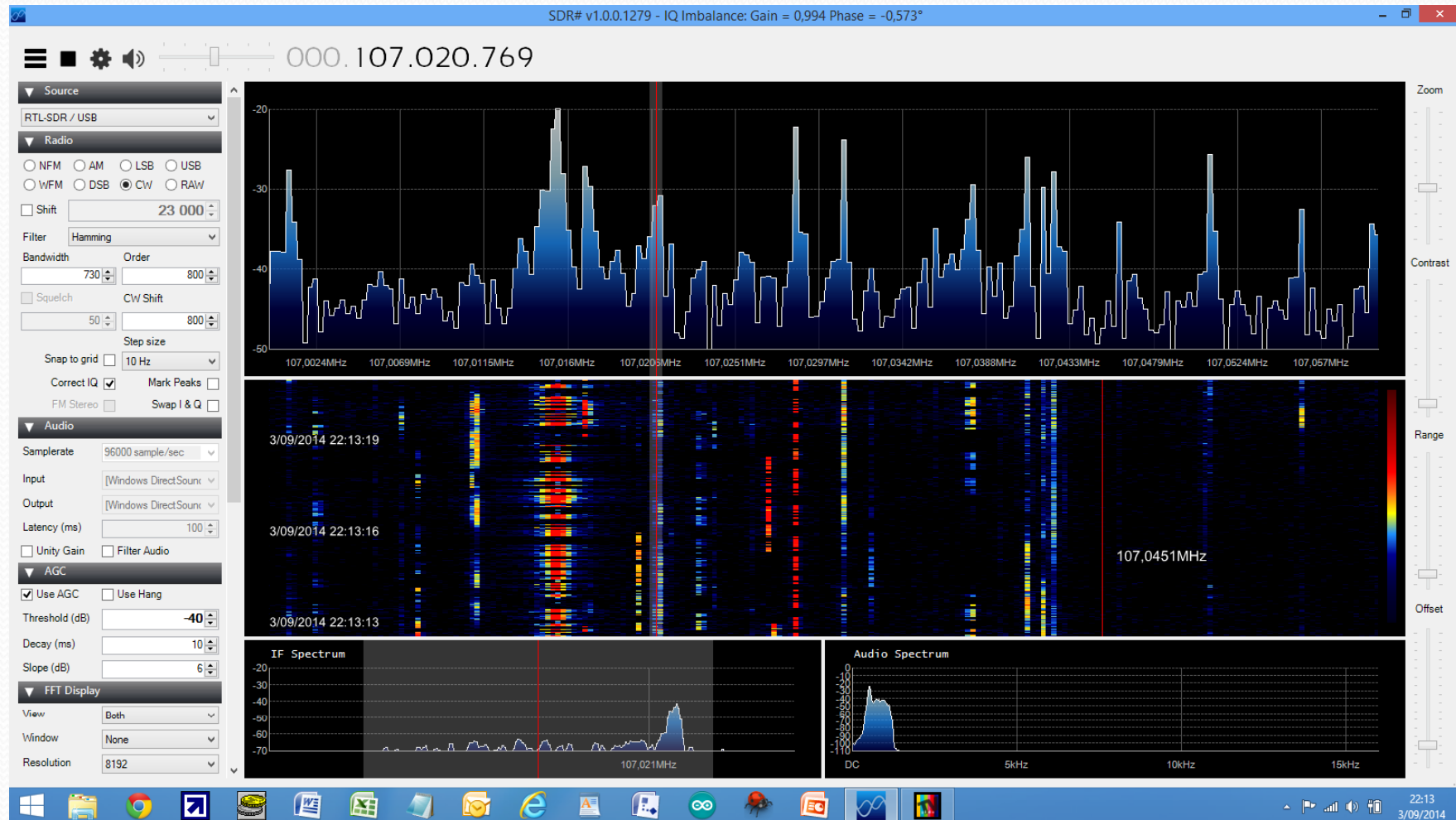
ADC
↓
DSP
↓
DAC
↓
LF

SDR UP-Converter

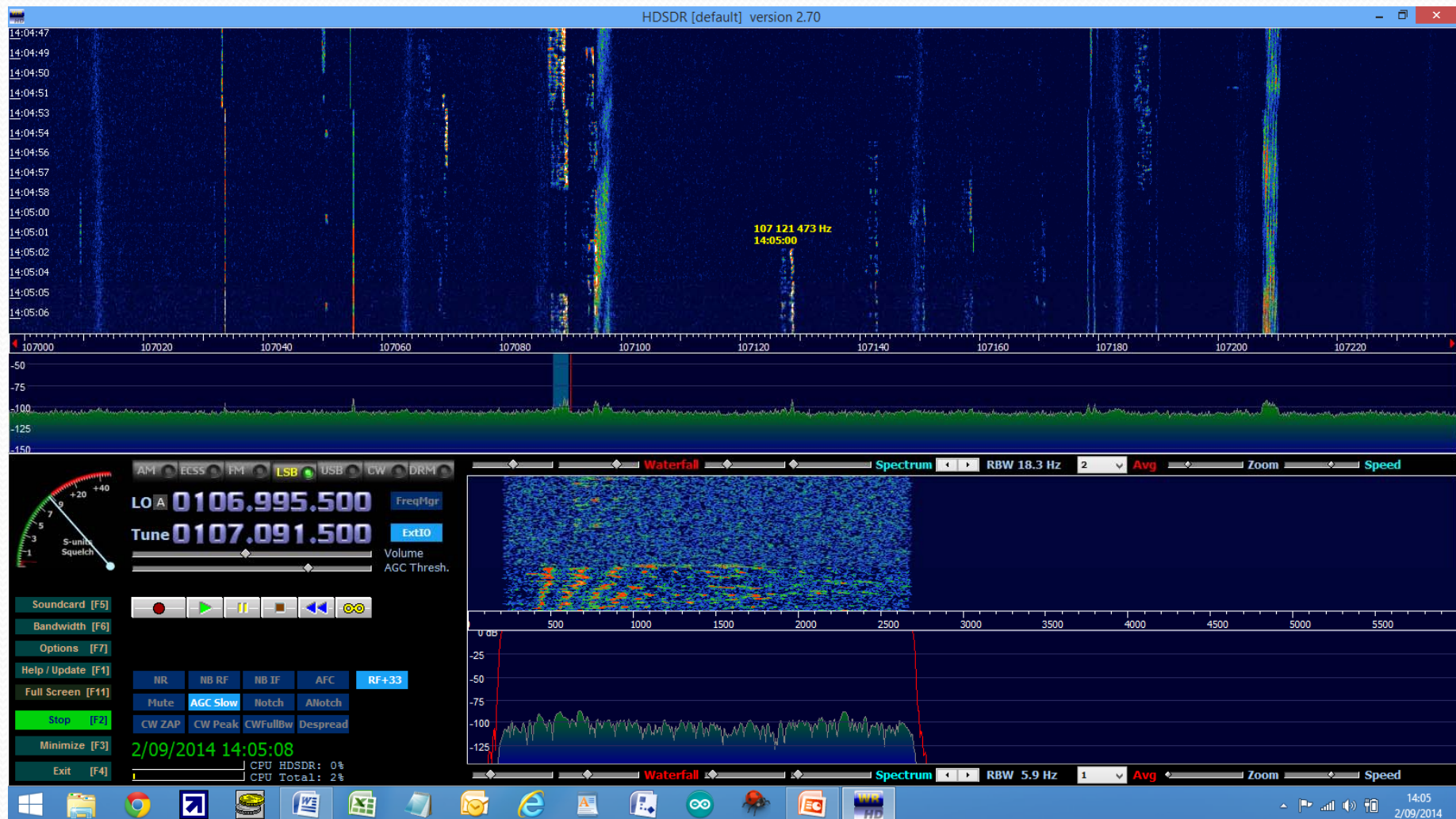


<https://www.sv1afn.com/home.html>

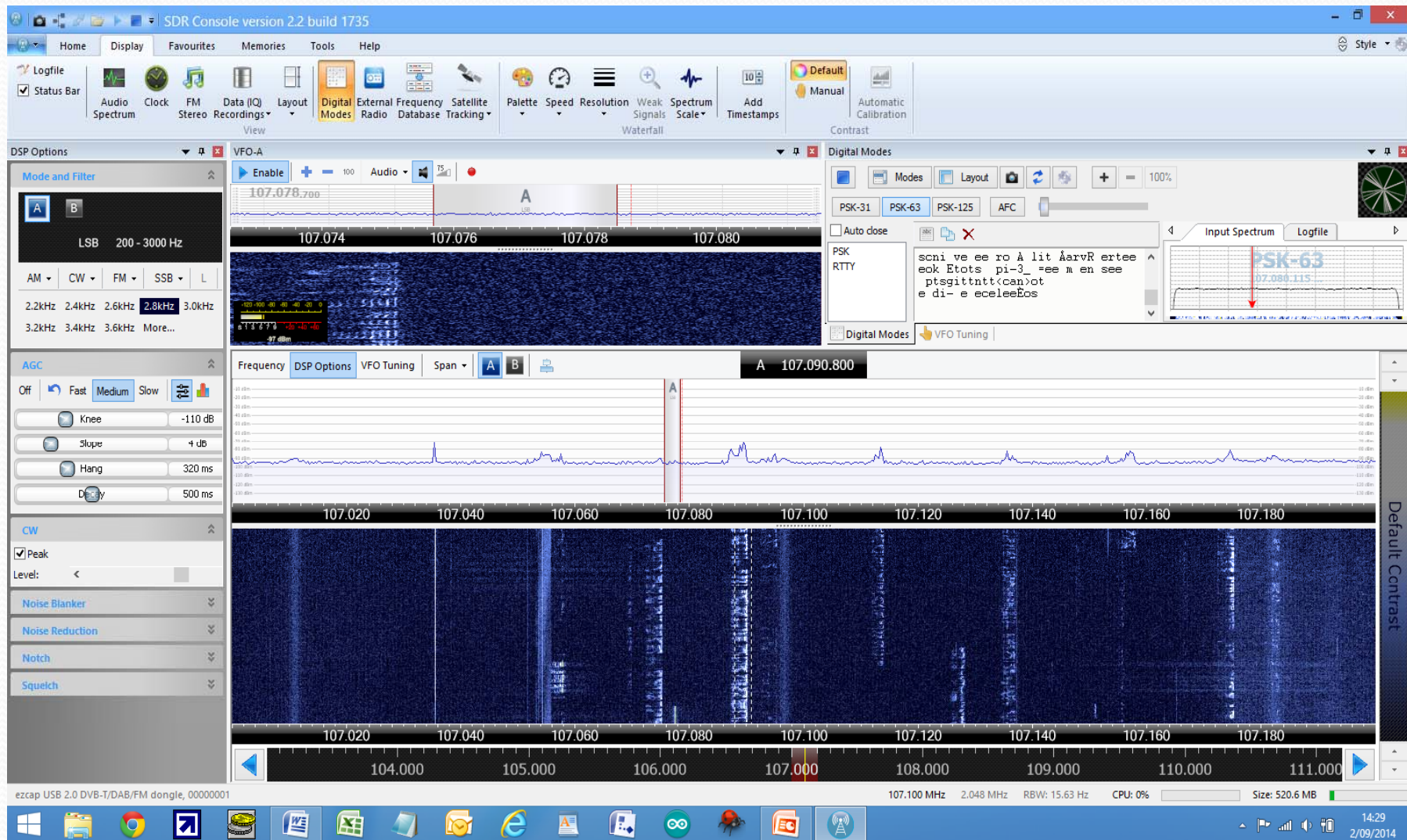
Geen SDR zonder software: C#



Geen SDR zonder Software: HDSDR



SDR software: SDR Console



SDR software: PowerSDR

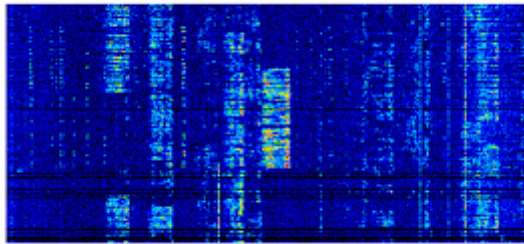


SDR op Smartphone en Tablet

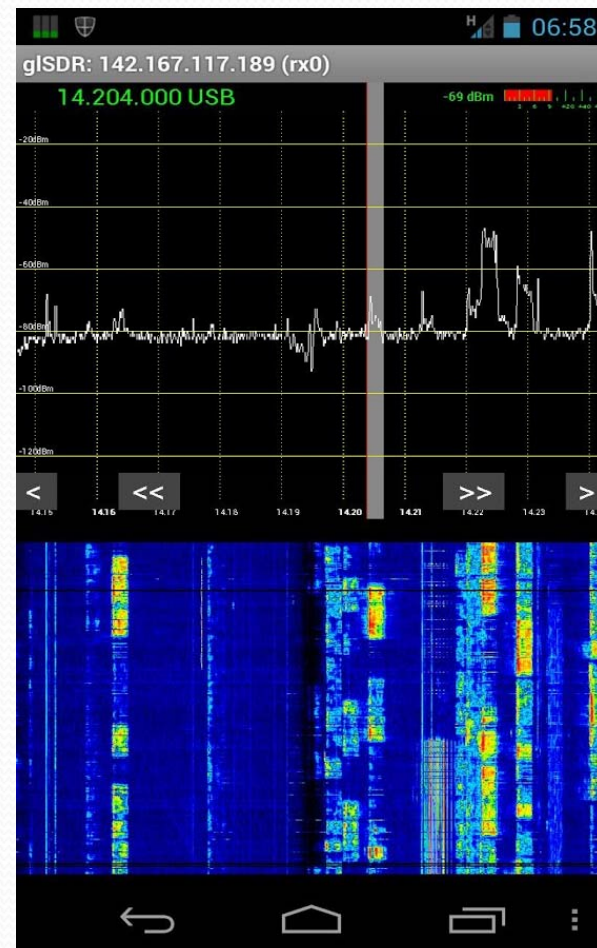
- SDR TOUCH



Web-SDR op Android



gISDR





Voordelen van SDR

- Andere software = andere radio
- Software updates
- Breed frequentiespectrum
- Alle mogelijke + nieuwe modulatievormen
- Zeer goede + nieuwe soort filters (geen “ringing”)
- Betere noise filters
- Betere audio
- Veel minder hardware + gerelateerde problemen
- Gemakkelijk afstemmen: klik op de frequentie
- Radiosignalen worden zichtbaar in 3D
 - Amplitude
 - Frequentie: bandscope
 - Tijd : waterval

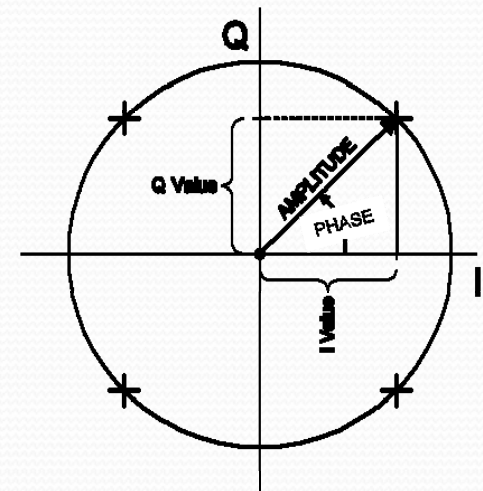
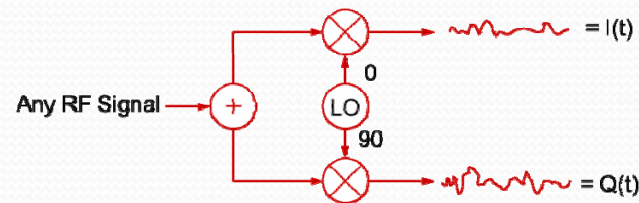
Wat kunnen we allemaal horen (en zien !)

- Meteoorscatterstations: Dourbes 49,970 MHz, IRIS AstroLab, Zillebeke (Ieper) 49,990 MHz
- 6m amateurband 50-52 MHz
- 4m amateurband: 70,200 – 70,400
- Analoge FM broadcast band: 87-108 MHz
- Vliegtuigband 108-137 MHz: communicatie in AM vanuit de cockpit, ACARS (Aircraft Communications Addressing and Reporting System) een digitaal communicatiesysteem tussen vliegtuig en grondstations, VOR-bakens (zoals AFI = Affligem, NIK = Sint-Niklaas)
- Weersatellieten: 137-138 MHz
- 2m amateurband: 144-146 MHz
- 70cm amateurband: 430-440 MHz
- PMR446 (Personal Mobile Radio): 446 MHz
- 1090 MHz: ADS-B (Automatic Dependent Surveillance-Broadcast) vliegtuigdata
- 1240-1300 MHz: 23cm amateurband

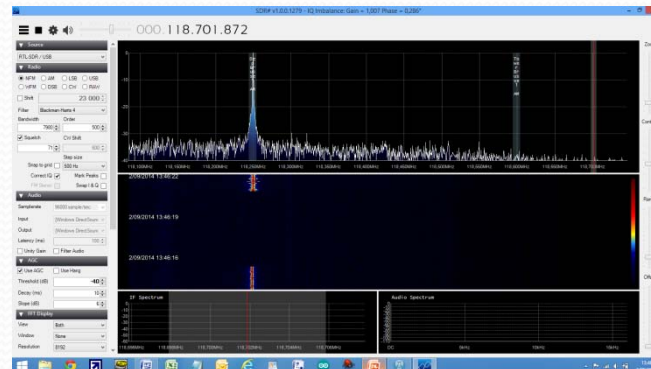


**GEEN SDR
ZONDER
EEN GOEDE
ANTENNE !**

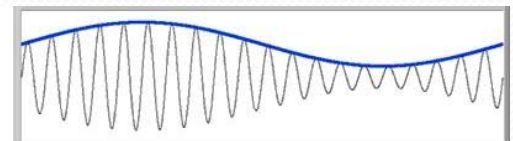
Software Defined Radio ?????



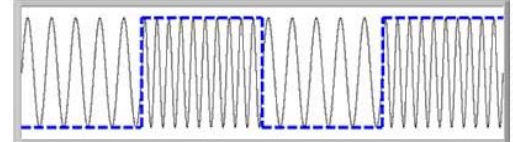
Q & A



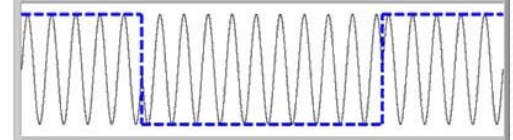
Amplitude Modulation



Frequency Modulation



Phase Modulation





**DANK VOOR UW
AANDACHT**

VEEL PLEZIER MET SDR

73 DE ON7UF