Getting started on 10 GHz

Release 5

Overview

This Powerpoint is explaining my first steps in the *choice of a 10 GHz transverter* found on the market. On the side it gives some hit and kinks about :

*-The locator grid squares reached within a 2 month period with **only 1W** !!!*
-How to make the FT-817nd compatible (best TRx choice associated with transverters)
-Prime-focus and offset dishes – solving the 0° elevation
-Monoband and multiband feedhorns
-A final overview about setups of some well known french hams

Abstract 1/2

1- 10 GHz beacons, SCPs and QSOs from JN18gr

2- 10 GHz SSB-Electronic transverter (<1995)

3- 10 GHz DB6NT transverter

- Version 1:
  - -schematics & practical
  - - LO frequency drift
- Versions 2 and 3 : Rx Nf and principally LO stability improvements

4- Indoor, then outdoor operations with a single 49 cm Procom dish

5- FT-817nd modifications

- Positive voltage added on Tx mode to the 144 MHz coaxial cable for PTT purposes
- S-meter desensibilisation

6- Prime-focus & offset dish gain comparaison

7- Offset dish mounting problems

8- IK1GEX 5.7 / 10 GHz double horn

- S11 and isolation measures between both bands

9- SQG 10 GHz horn

- Adjusting and S11 measures

10- Visiosat SATTV horn

Abstract 2/2

11- Improvement ideas of actual personal setup

12- Antenna settings of well known french « hyper » dXers

13- Aknowledgements

1- 10 GHz beacons and QSOs with 1W

10 GHz beacons

French 10 GHz beacon list							
				La Crau		F6BVA	Puissance : 1000 Watts PIRE Antenne : Parabole Orientation : Nord Ouest
10368.053	F5XBD	JN18JS	77	Favières	10368.073 MHz		ssance : 60 Watts enne : Fentes
10368.108	F1XAP	IN88HL	22	Plougonver	326	F1LHC	Puissance : 10 Watts Antenne : Fentes
10368.282	F5ZPS	IN94QT	33	Talence	83	F6CBC	Puissance : 20/800 Watts Antenne : Cornet Orientation : Nord Est / Sud Est
10368.825	F1XAU	JN27IH	21	Sombernon	516	F1MPE	Puissance : 13 Watts Antenne : Fentes
10368.842	F5ZTR	JN09WI	60	Beauvais	10368.840 MHz - 325°		Watts es
10368.850	F1BDB	JN33KQ	06	Doublier	1200	F1BDB	
10368.859	F1DLT	JN27UR	70	La Roche		F1DLT	Puissance : 15 Watts Antenne : Cornet Orientation : Nord Ouest
10368.863	F5XAD	JN12LL	66	Pic Neulos	1100	F2SF	Puissance : 2 Watts Antenne : Fentes
10368.865	F1XAI	JN07WV	45	Orléans	10368.862 MHz - 207°		Watts es
10368.884	F1XAE	JN24PE	84	Mont Ventoux	1910	F1AAM	Puissance : 5 Watts
10369.900	F5XAY	JN06wd	23	X X X X X	888 ou 892 MHz - 199° piaule		
10369.919	F5ZWM	JN05VE	19	Sainte Fortunade	10368.883 MHz - 188° coupure porteuse		
10368.928	F1URI	JN35FU	73	via Mont Blanc	1660	F1URI	Puissance : 2200 Watts Antenne : Parabole Orientation : >JN35KT
10368.950	F5ZTT	JN14EB	81	Lacapelle	10368.948 MHz		ssance : 10 Watts enne : Fentes
10368.983	F5ZWZ	JN23XE	83	Grand Cap	780	F6BVA	Puissance : 10 Watts Antenne : Fentes En cours de réalisation
10368.994	F5XBG	JN26KT	71	Chalon		F6FAT	Puissance : 5 Watts Antenne : Fentes

Constantly

50% time

Occasionally (RS)

→*10368.836 MHz*

8 nov de retour

=F1XAI + 29 kHz

HB9EME/b 10368.866 MHz

HB9G/b 10368.855 MHz

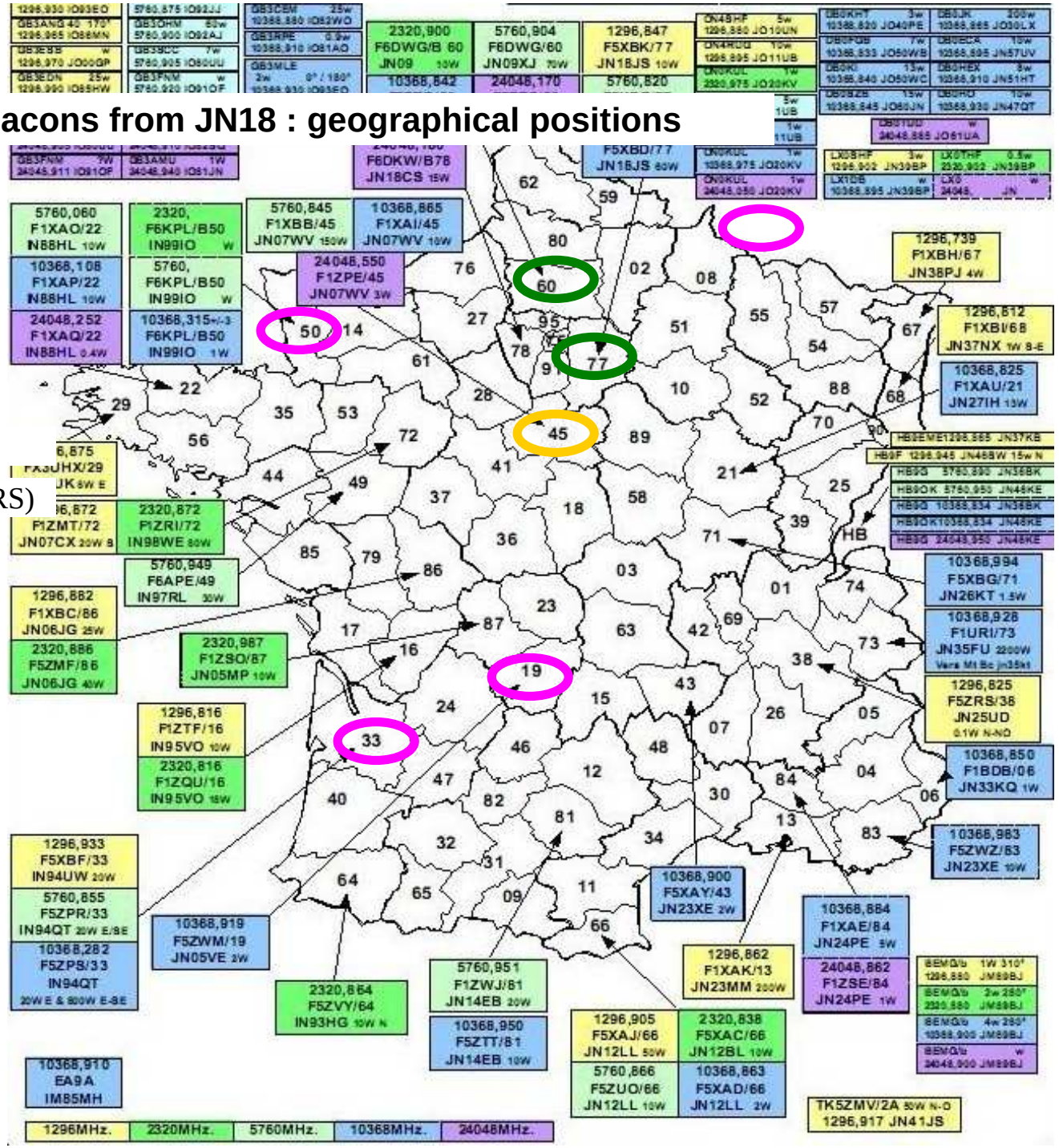
10 GHz rXed beacons from JN18 : geographical positions

Constantly

50% time

Occasionally (RS)

HB9G/b
10368.855 MHz

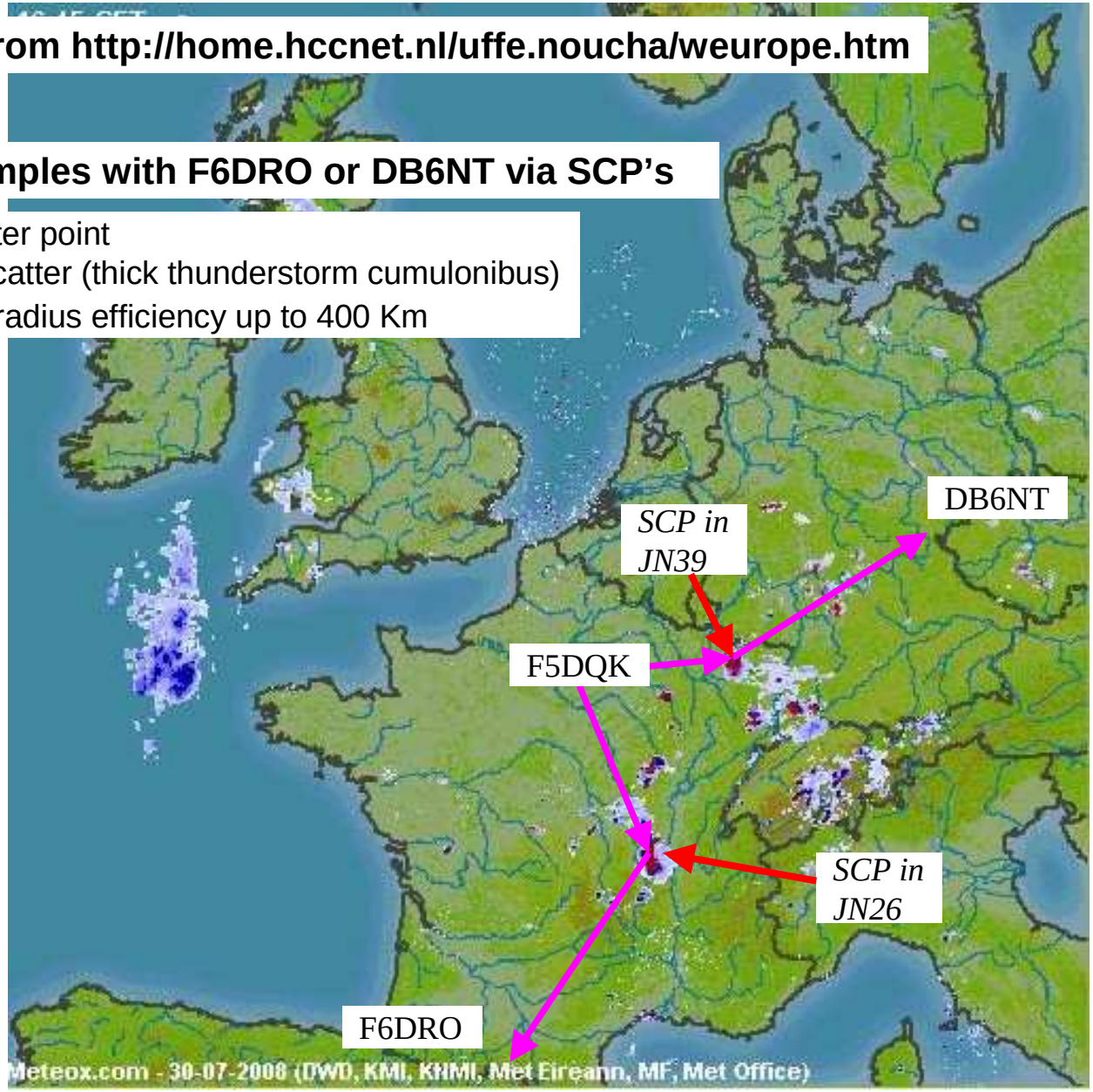


10 GHz SCPs for RS

RS map from http://home.hccnet.nl/uffe.noucha/weurope.htm

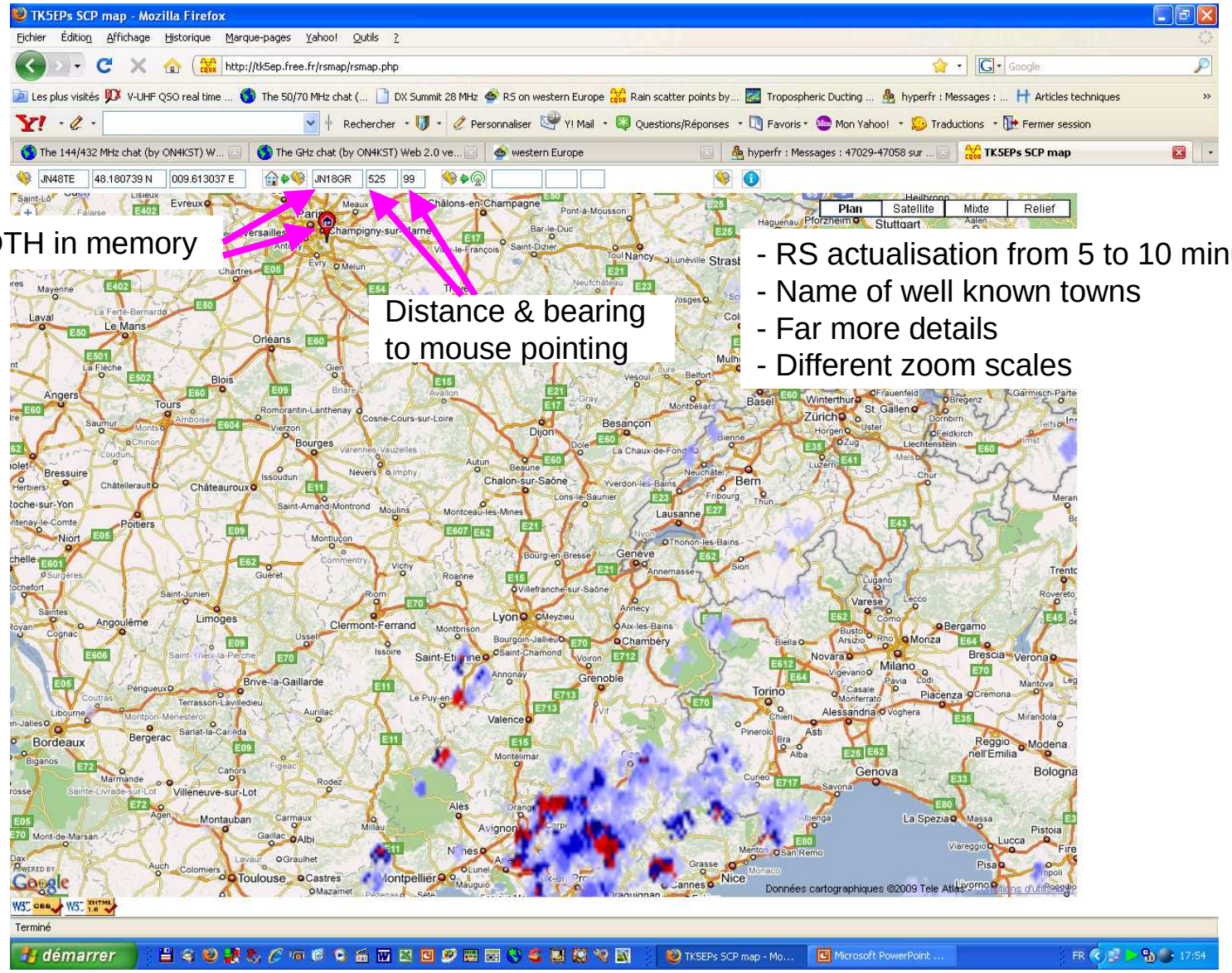
QSO examples with F6DRO or DB6NT via SCP's

SCP = scatter point
RS = rain scatter (thick thunderstorm cumulonibus)
Good SCP radius efficiency up to 400 Km



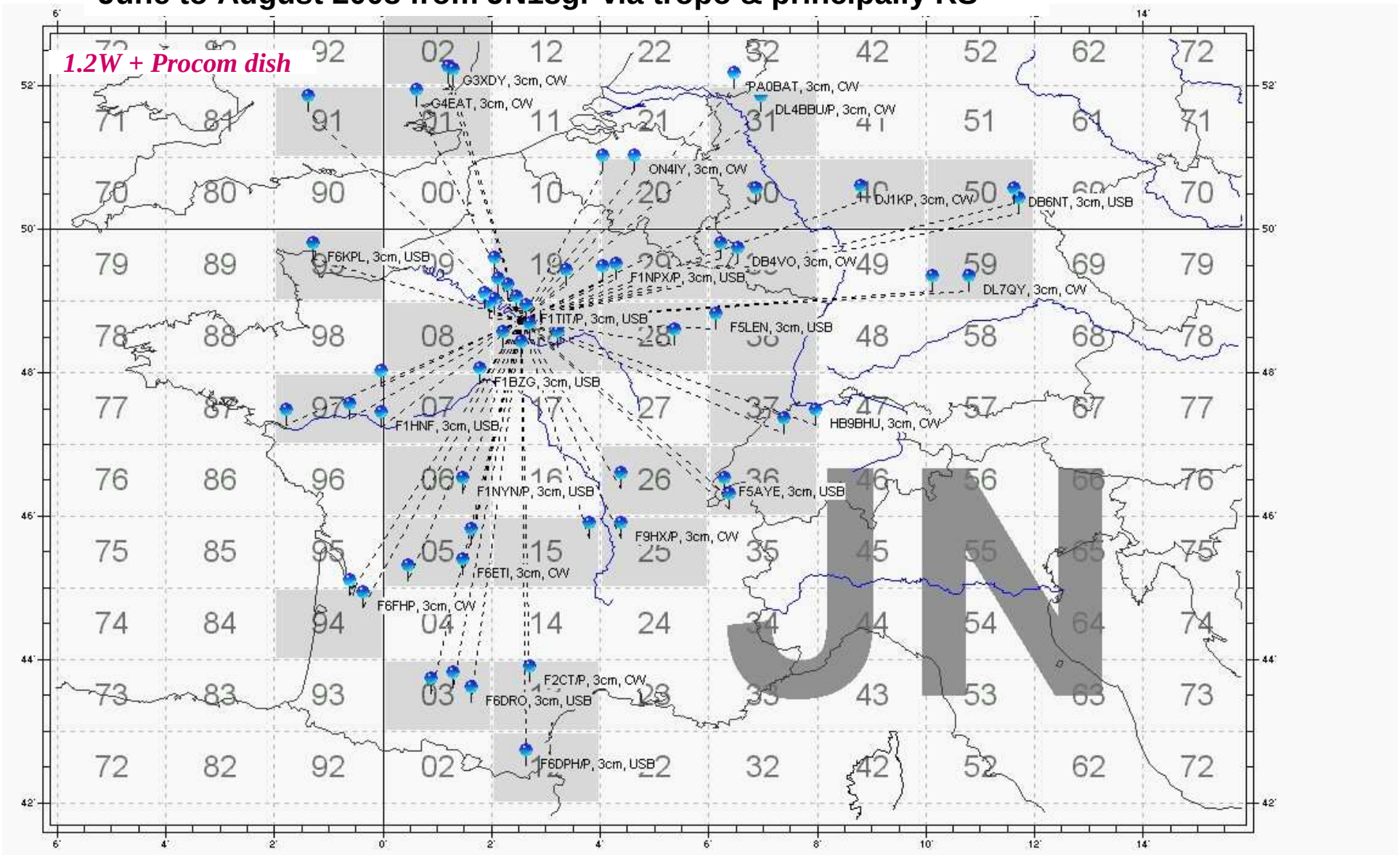
10 GHz SCPs for RS

New : RS map from http://tk5ep.free.fr/rsmap/rsmap.php



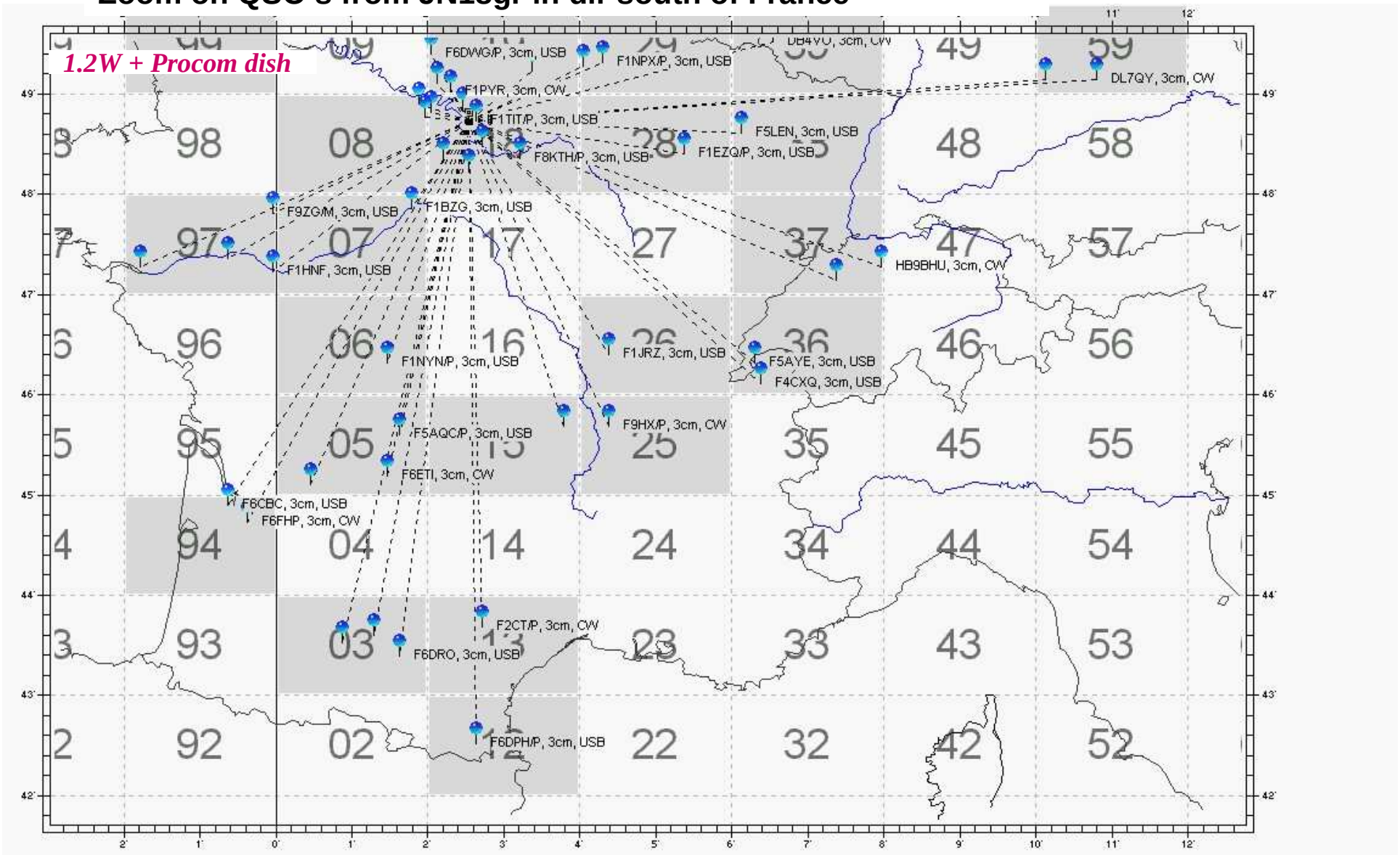
10 GHz QSO's

June to August 2008 from JN18gr via tropo & principally RS



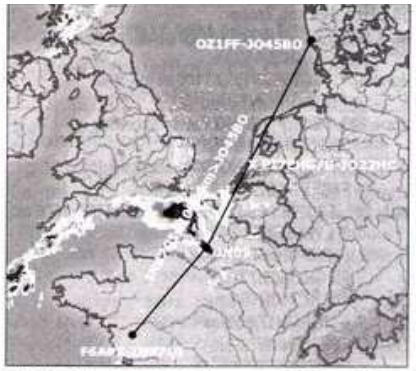
10 GHz QSO's

Zoom on QSO's from JN18gr in dir south of France

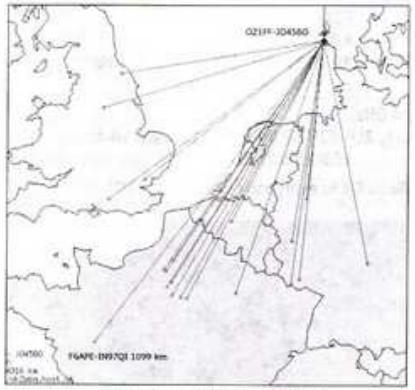


10 GHz QSO's

May 25th 2009 RS report from OZ1FF in the DUBUS revue



Path of the 1099km Rainscatter QSO on 3cm



RS QSOs on 3cm by OZ1FF

F2CT: *Many and very interesting RS qsos since April with some Dx and records up to 1093 km on 6 and 3 cm. On 24 GHz some unilateral tests up to 600 km let us to think that long distance qsos are possible with very strong storms and very high clouds of ice.*

Here is the report from Kjeld OZ1FF:
Hello Guy, your prediction in DUBUS 2/2009 that RS QSOs in the 1000 km range would be reached was right. On May 25 2009 at 07:43z **I worked F6APE on 10 GHz RS, IN97QI over 1099 km from JO45BO for a new RS world record.** The old RS WR was 1008 km and held by AF1T/W4DEX. The scatter point was located over JN09 about 800 km away and could be reached with the help of super refraction over the North Sea indicated by the reception of PI7EHG/B in JO22HC. Exchanged reports was 51S in both directions. A sound clip is at: www.oz1ff.dk/Pages/News/News.htm.
F6APE rig: DB6NT xverter, 60 cm dish/6 W and here: DB6NT xverter, 65 cm offset dish 25 m ASL/3,5W. The RS/TR lasted until the early evening making 10 GHz RS QSOs with 10 different F-stations possible (F6APE, F6DKW, F6DWG, F5DQK, F4BUC/P, F6ACA, F1ISM, F1PYR/P, F1NXP/P, F5PEJ/P). Before ending I worked F6DWG also on 5,7 GHz RS, 804 km and 1. F to OZ on this band. 20 TR/RS QSOs with an average of 750 km and 6 new squares. Really an exciting day. Now off for the record on 24 GHz! :-)
Vy 73 de OZ1FF - Kjeld

Reports from F2CT:

5,7 GHz > 600 km, Tropo
May 31st, F2CT/P IN92PX 1600 m asl, wkd:
- F9ZG/P/JN36/652 km

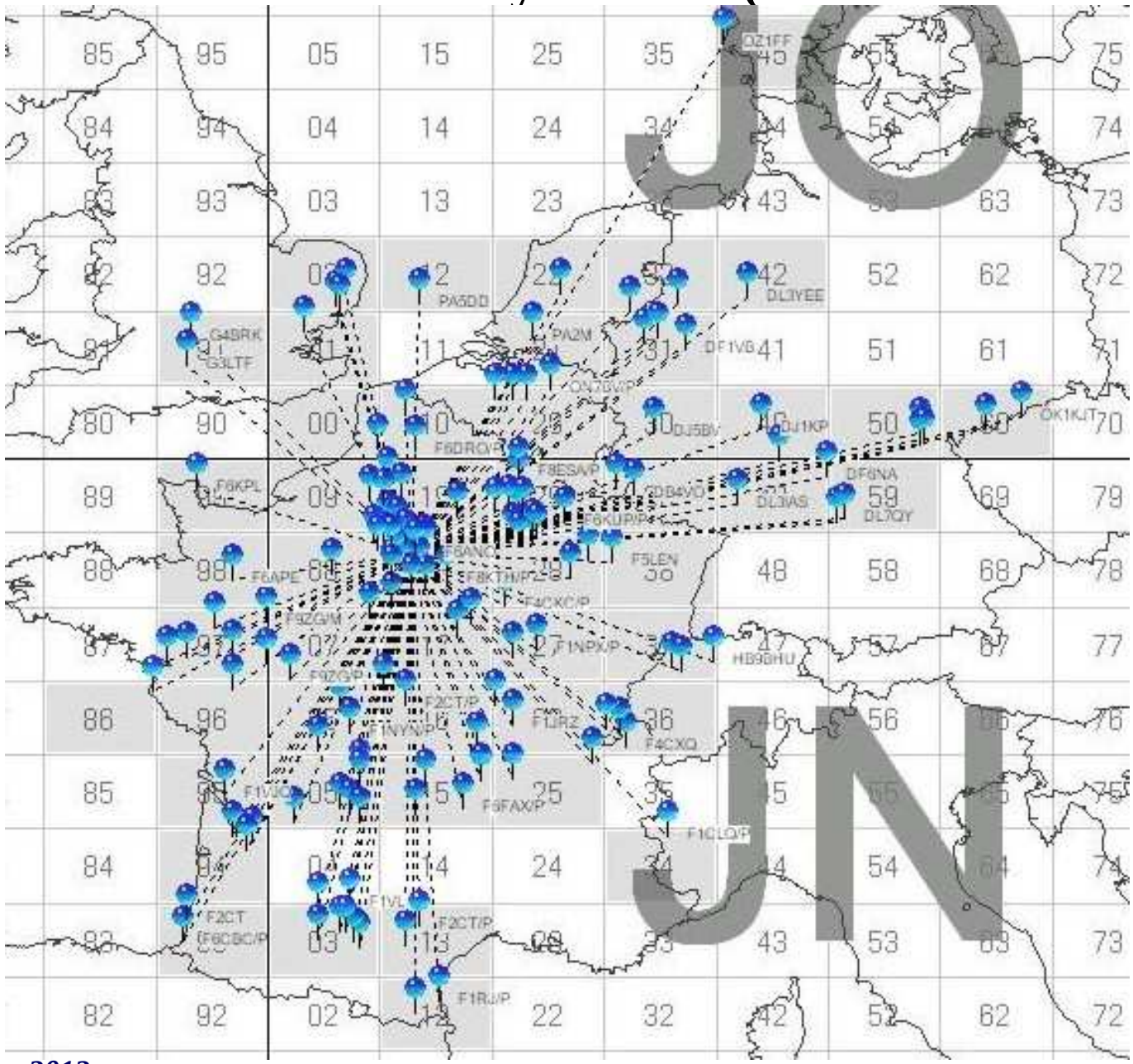
June 20th, F2CT/P IN93HG 930 m asl, wkd:
- F6DWG/P/JN19/729 km

July 16th, F2CT/P IN93HG 930 m asl, wkd:
- F4CKC/P/JN26/653 km

July 26th F2CT/P F6AJW/P F6CBC/P IN92PX 1600m:
- F5LWX/P/IN78/644 km
- F6DWG/P/JN19/744km
- F5IGK/JN09/727km
- F4CKC/P/JN19/715km
- F1JGP/JN17/600km
- F6KPL/IN99/738km

August 1st F2CT/P IN93HG 930 m asl, wkd:
- F4CKC/P/JN27/635 km

Whole 10 GHz owerview year 2010 (1W + Procom dish)



10 GHz transverter overview

On 10 GHz, not many hams are manufacturing transverters on industrial scale.

-Before year 1995 the only choice was the 10 GHz SSB-Electronic transverter Kits. The number of total « on shelf » ready assemblies were really limited.

-After year 1997, DB6NT did really democratise the SHF transverter world. Not only on 23 cm but up to 24 GHz and above.

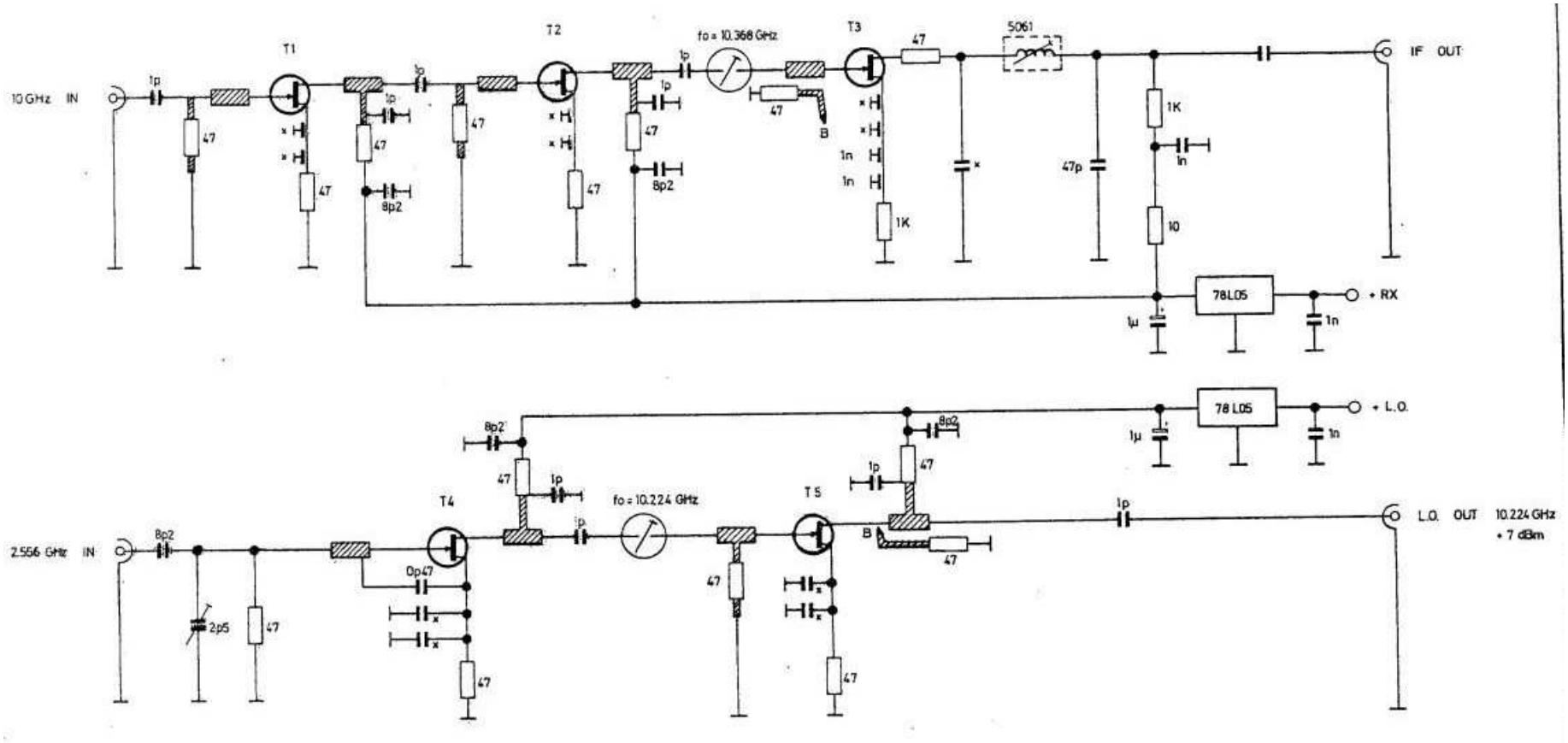
-In 2008 the 3rd generation with a 106.5 MHz self Quarz oscillating LO is replaced by a ocxo (oven oscillator) locked to a 10 or 100 MHz ultra high precision oscillator (eventually also GPS referenced).

2- 10 GHz SSB-Electronic (1988)

- 2 separate Rx and Tx mixers boxes
- 2.556 GHz separate LO with 106.5 MHz quarz
- Pout > +20 dBm or 100 mW (option 1 = 200 mW)
- Nf<2.5 dB
- Need of 2 coaxial relays on both RF and IF sides

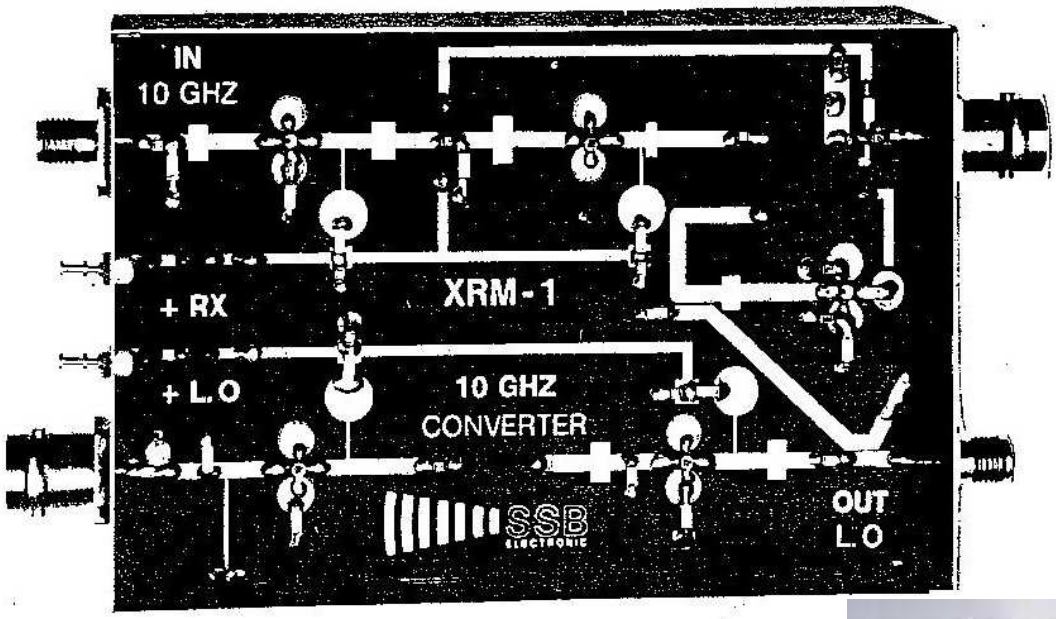
10 GHz SSB-Electronic Transverter

Rx converter scheme



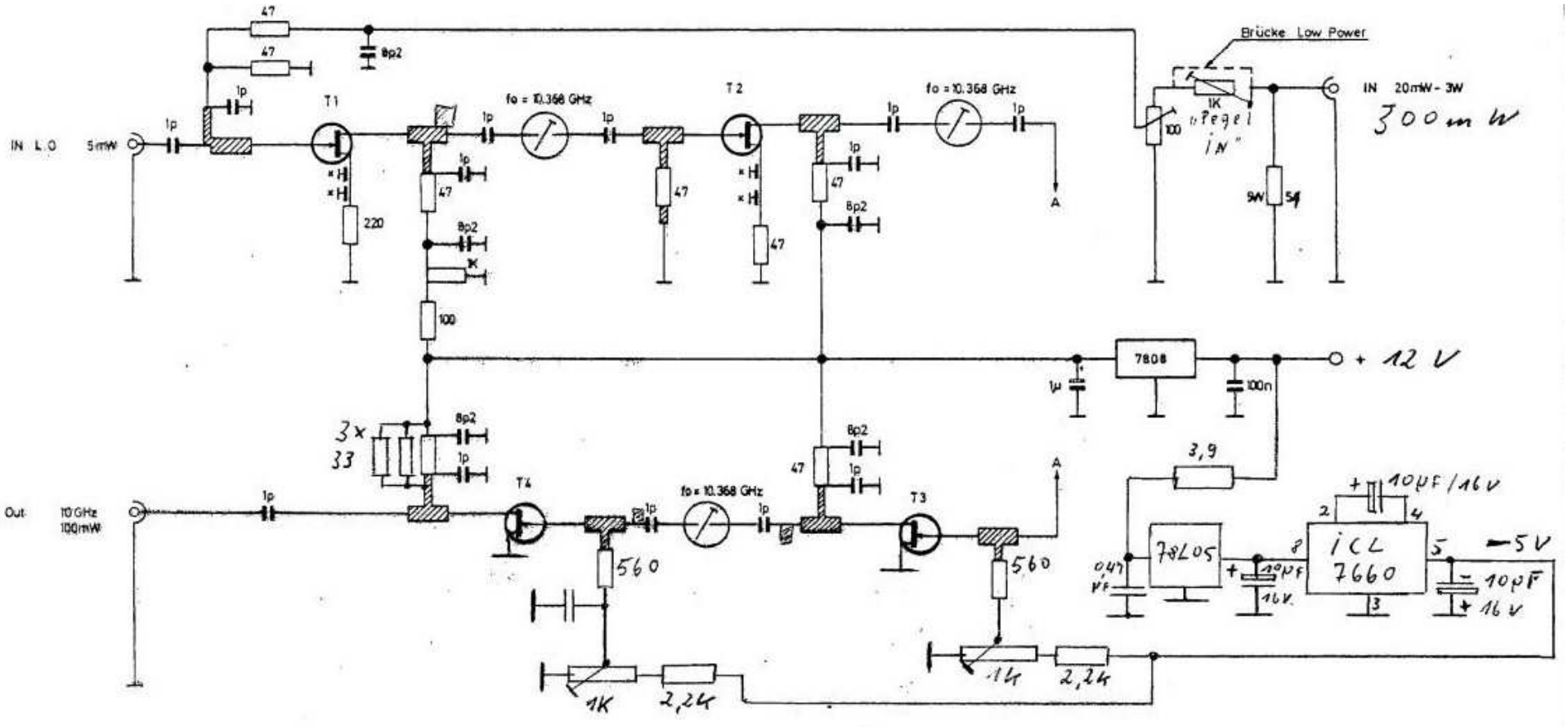
10 GHz SSB-Electronic Transverter

Rx converter layout



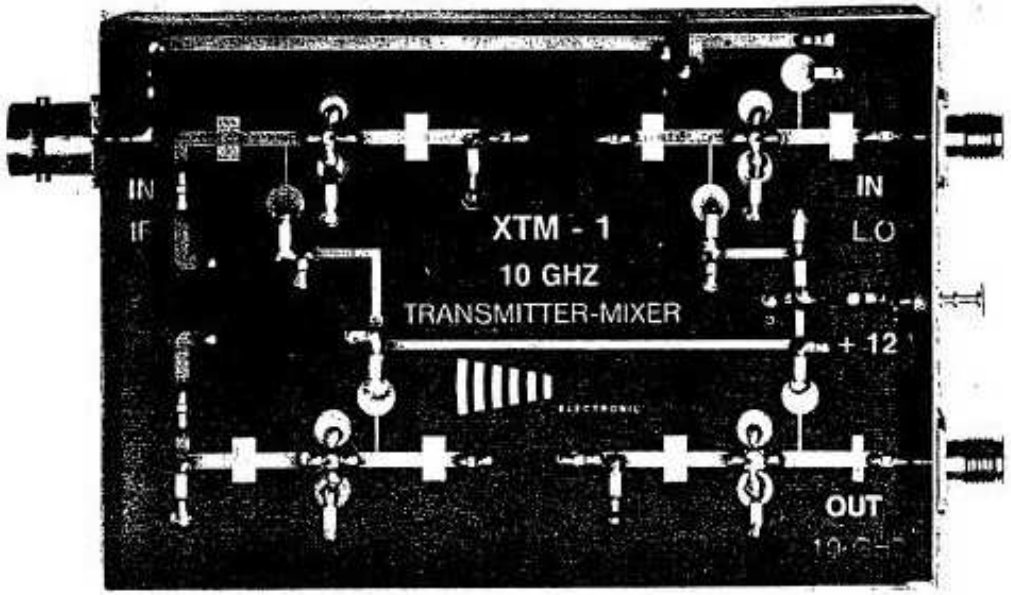
10 GHz SSB-Electronic Transverter

Tx converter scheme



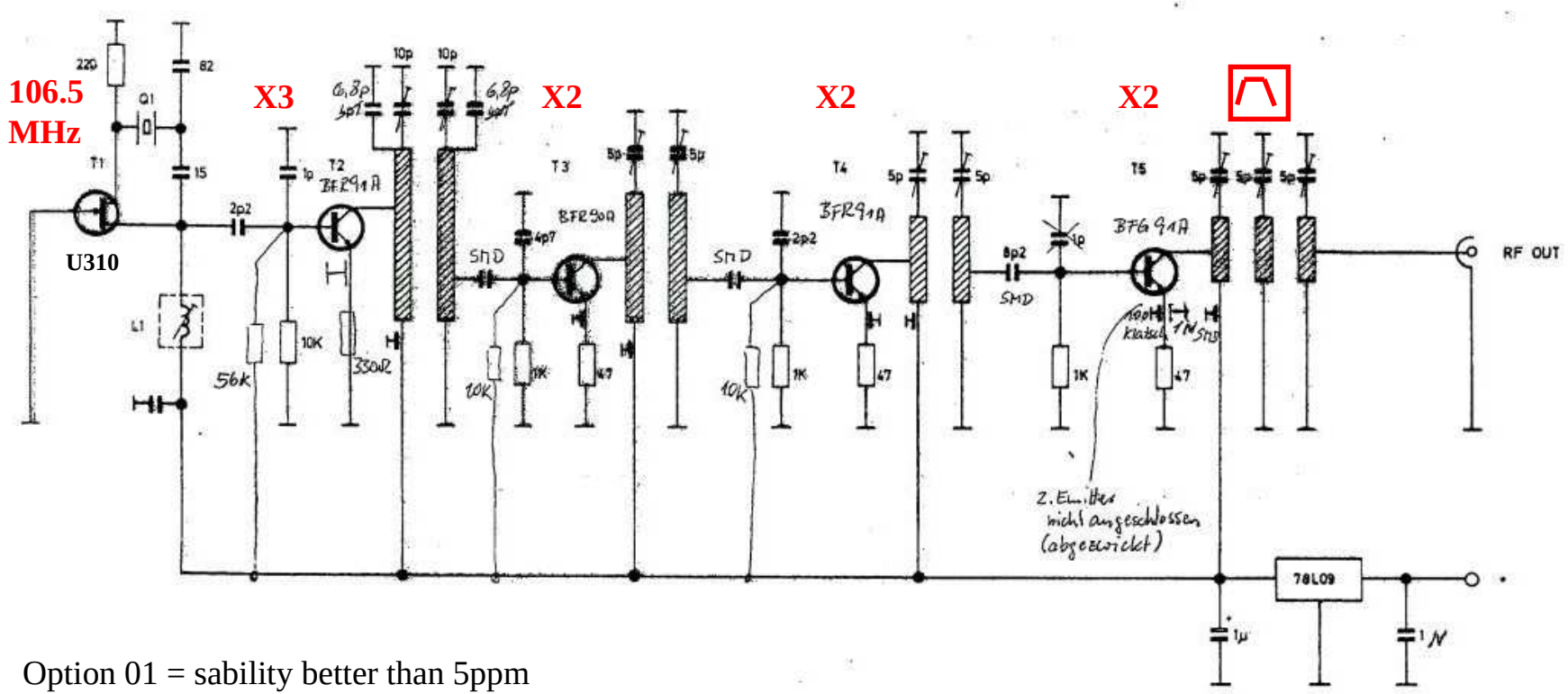
10 GHz SSB-Electronic Transverter

Tx converter layout

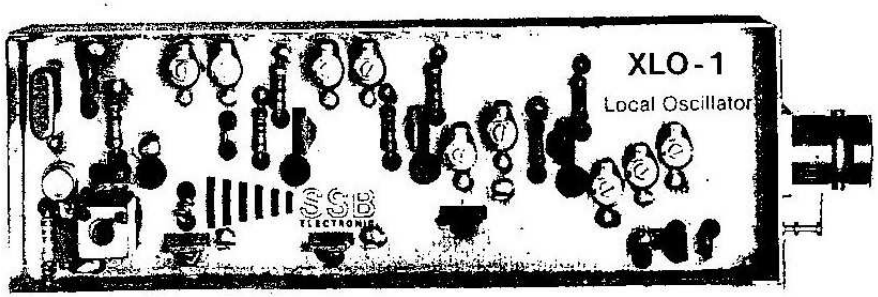


10 GHz SSB-Electronic Transverter

2.556 GHz XLO-1/01 local oscillator

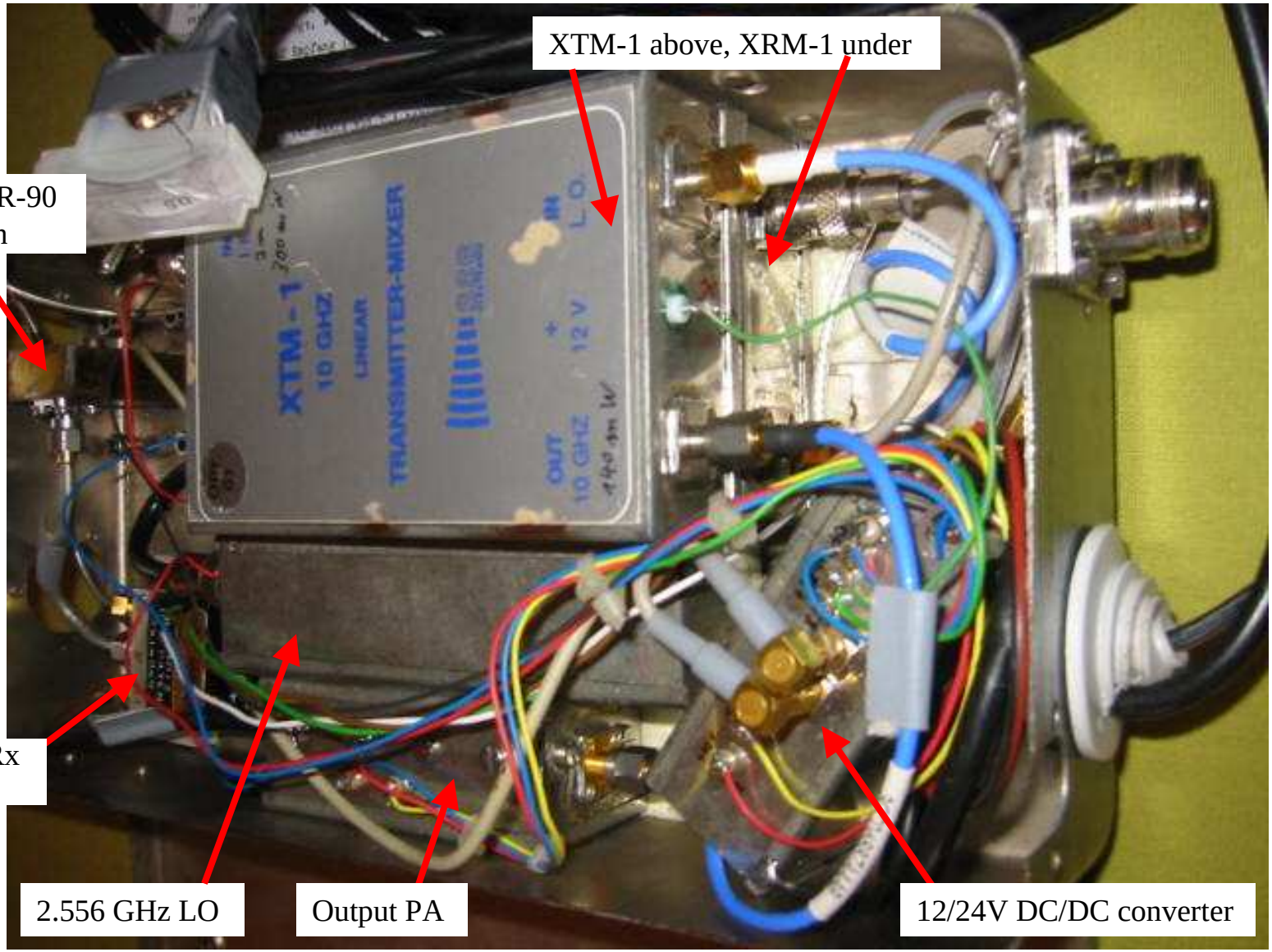


Option 01 = sability better than 5ppm



10 GHz SSB-Electronic Transverter

A boxed transverter (sold for 290€ in Weinheim)



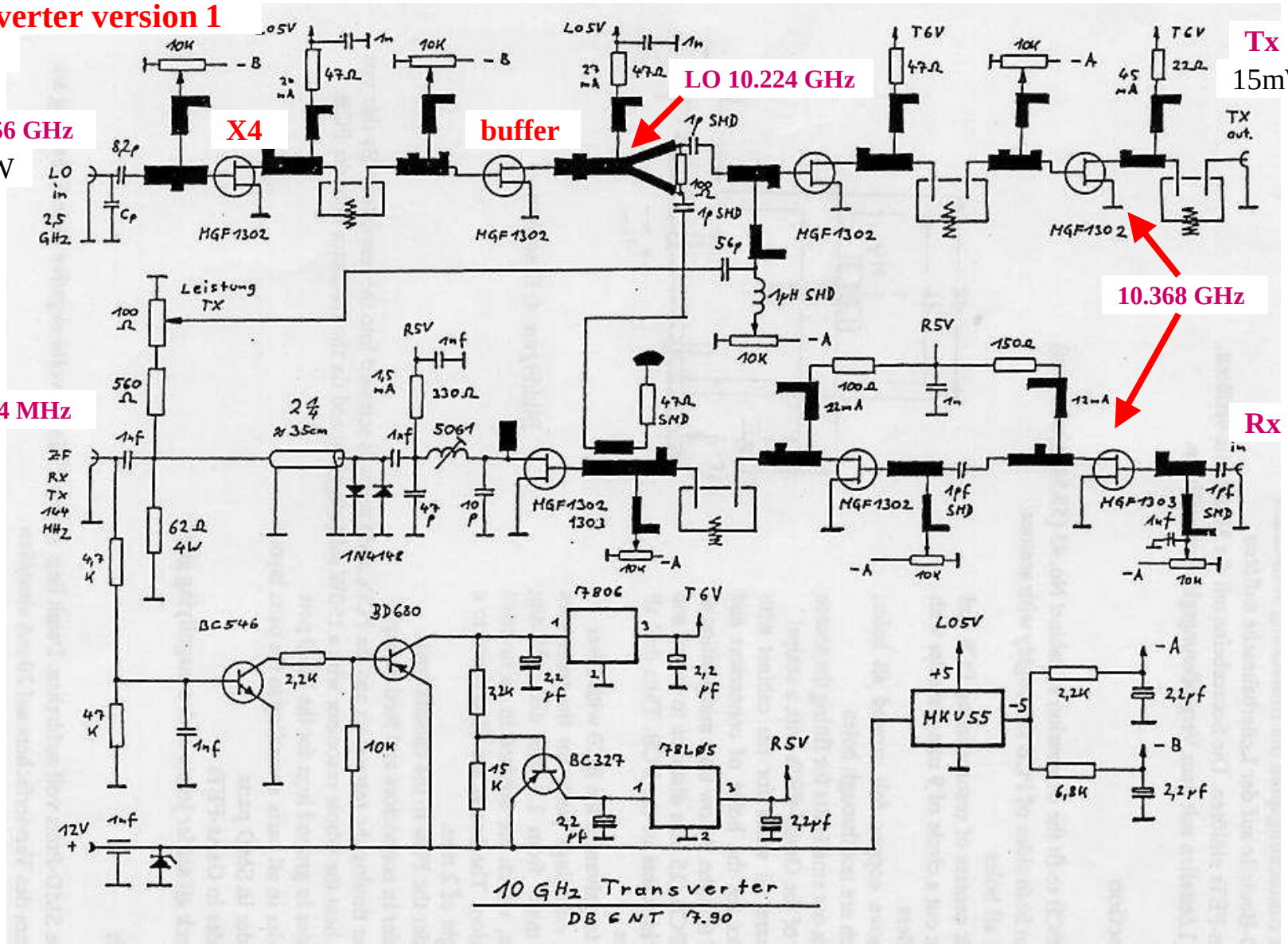
3a- 10 GHz DB6NT transverter vers 1

- Rx and Tx in « all in one » box
- same 2.556 GHz self oscillating LO with 106.5 MHz quarz
-PTT : only positive Voltage applied on 144 MHz coax
- Pout = +7 dBm or 5 mW

That was my choice

10 GHz DB6NT Transverter

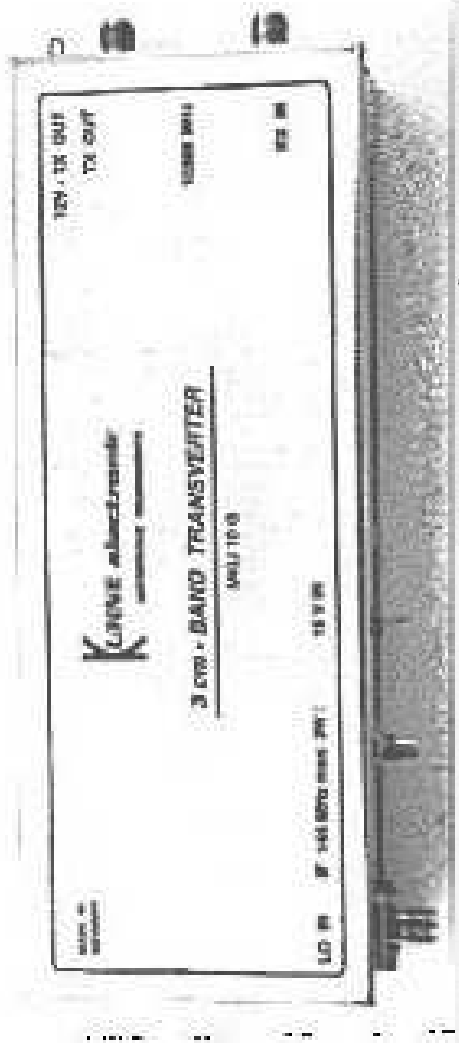
Transverter version 1
(1991)

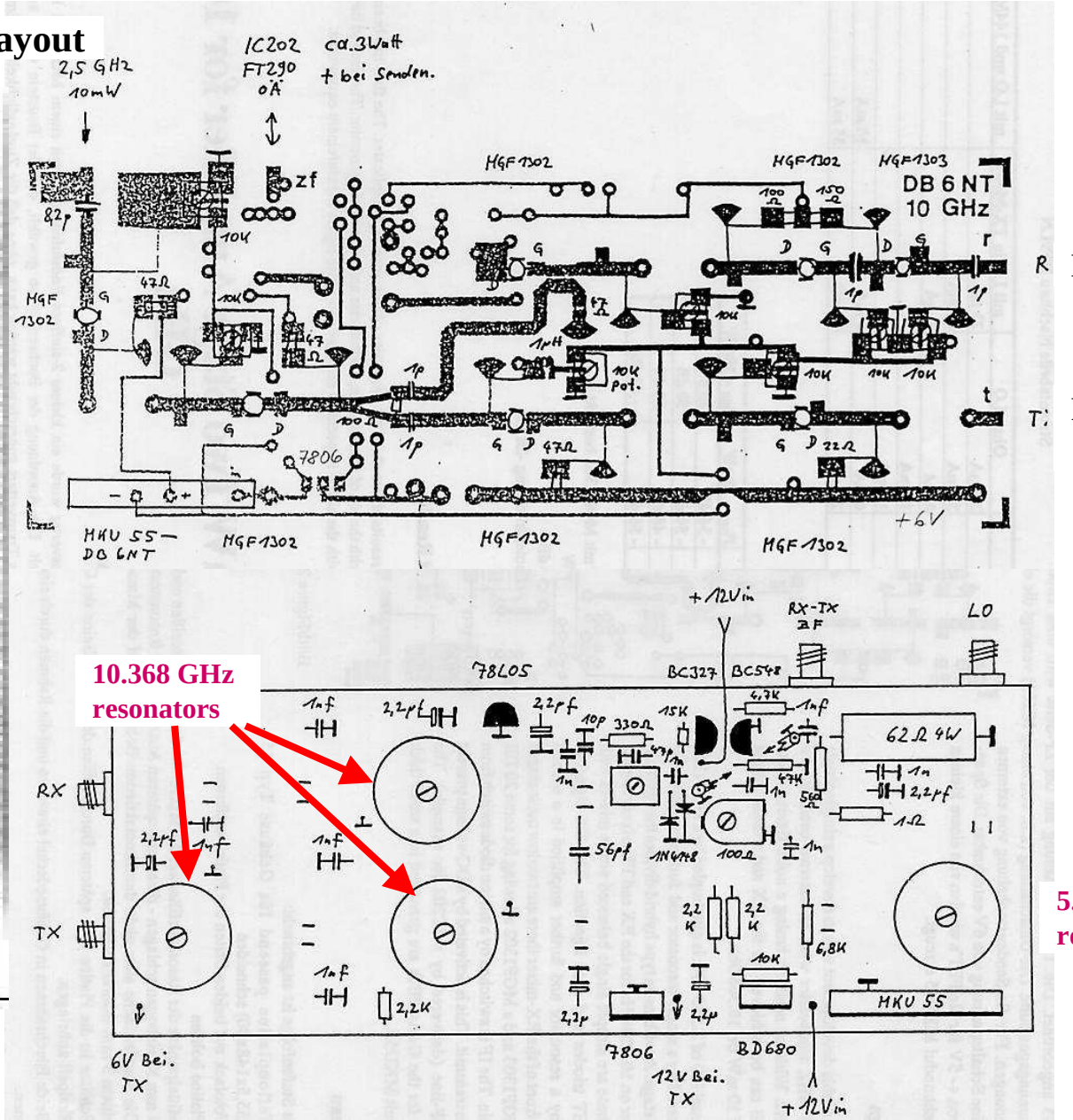


V1 : Pout 10 à 15mW, NF=3dB

10 GHz DB6NT Transverter

Transverter version 1 layout



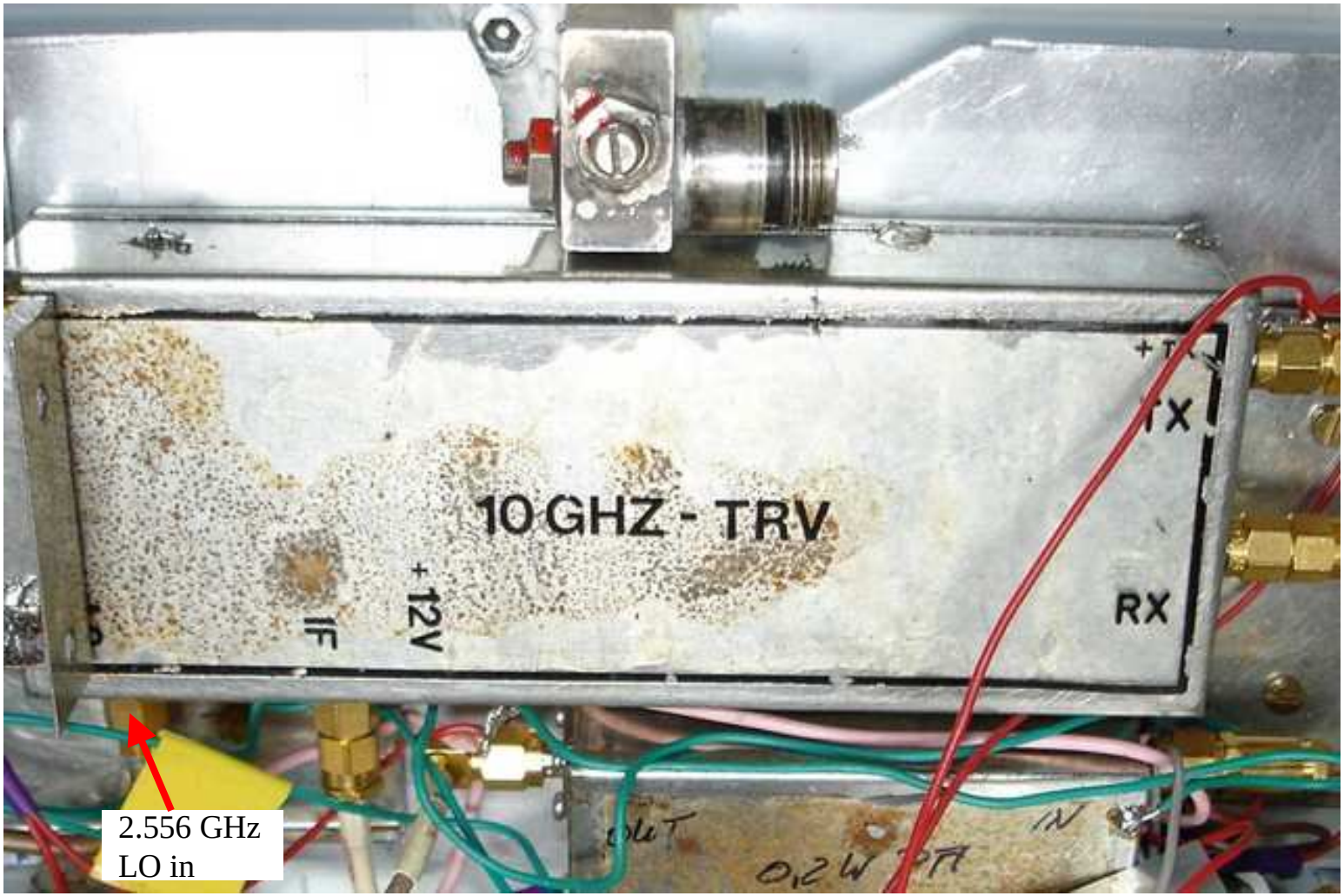


R NF=3dB

T Pout
10 à 15mW

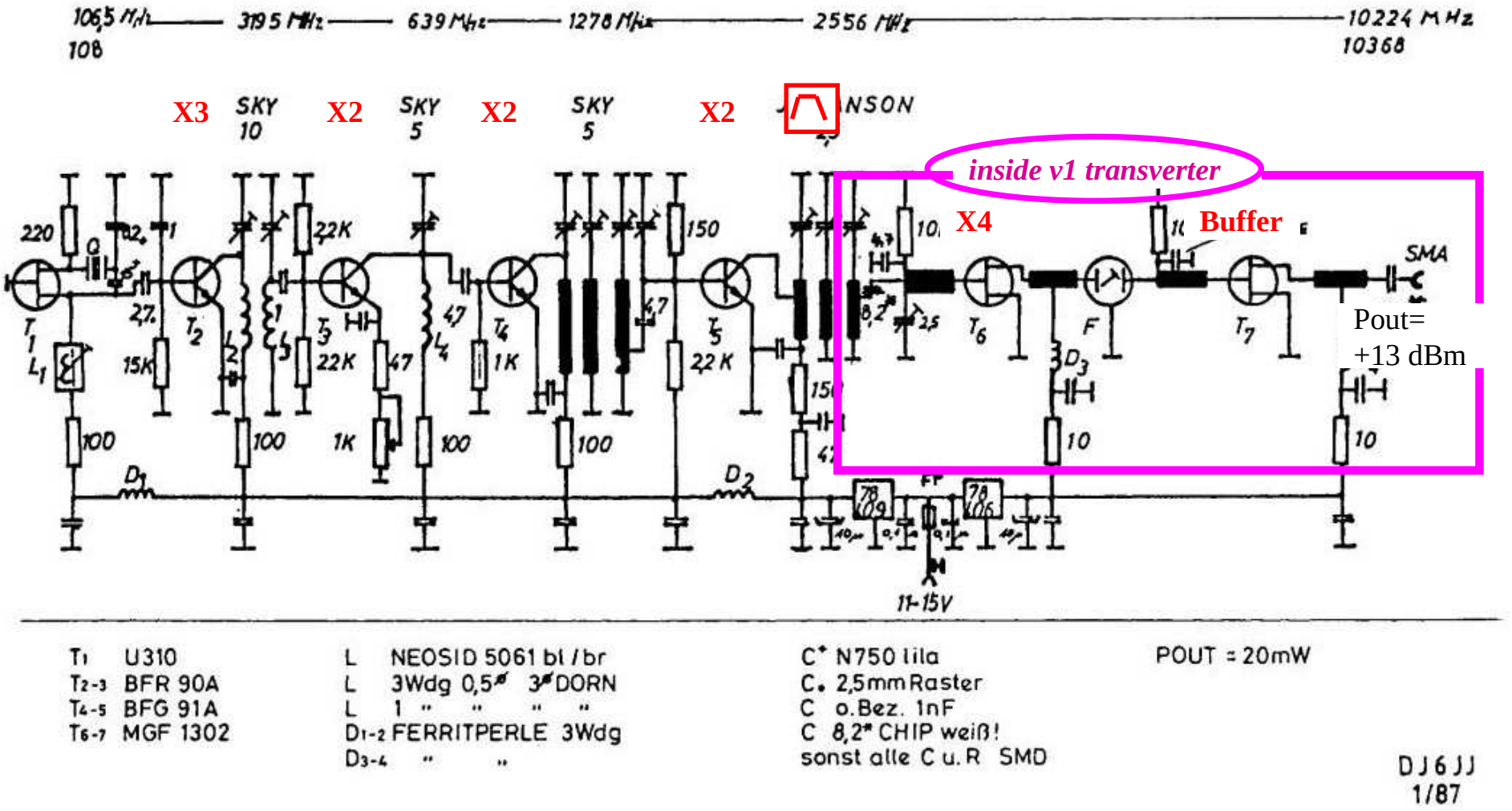
10 GHz DB6NT Transverter

Transverter version 1 hardware



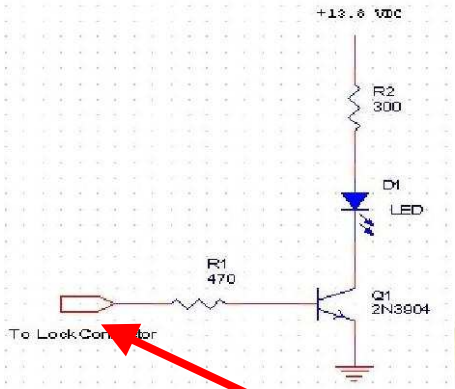
10 GHz DB6NT Transverter

Outside 2.556 GHz MKU25 LO with 106.5 MHz quarz (x96 multiplier)

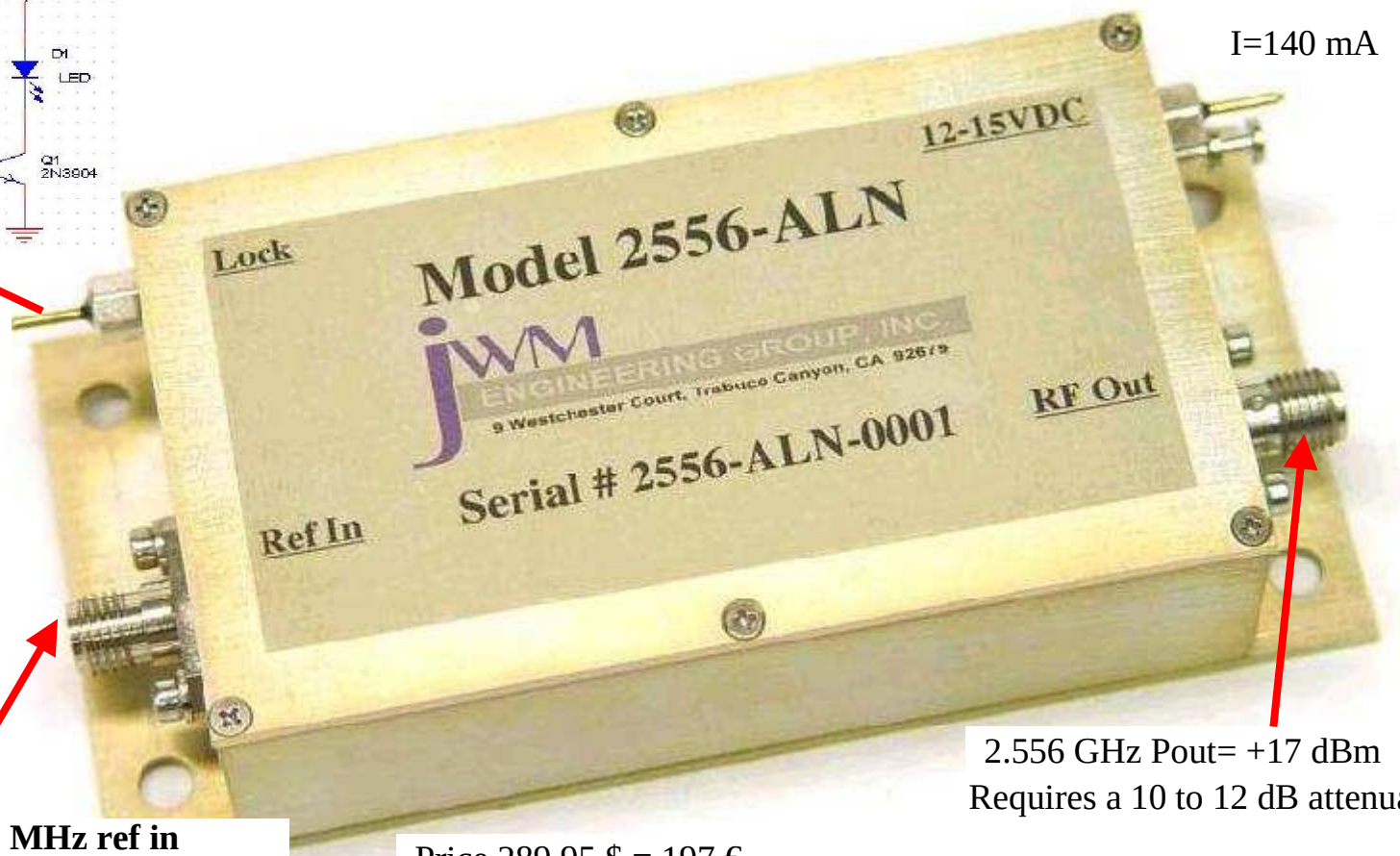


10 GHz DB6NT Transverter

1st alternative to constant LO drift with temperature: JWM Model 2556-ALN phase locked oscillator. with 10 MHz external disciplined LO



Ext lockin output



I=140 mA

2.556 GHz Pout= +17 dBm
Requires a 10 to 12 dB attenuator

10 or 100 MHz ref in
(OCXO, Rubidium or GPS ref)

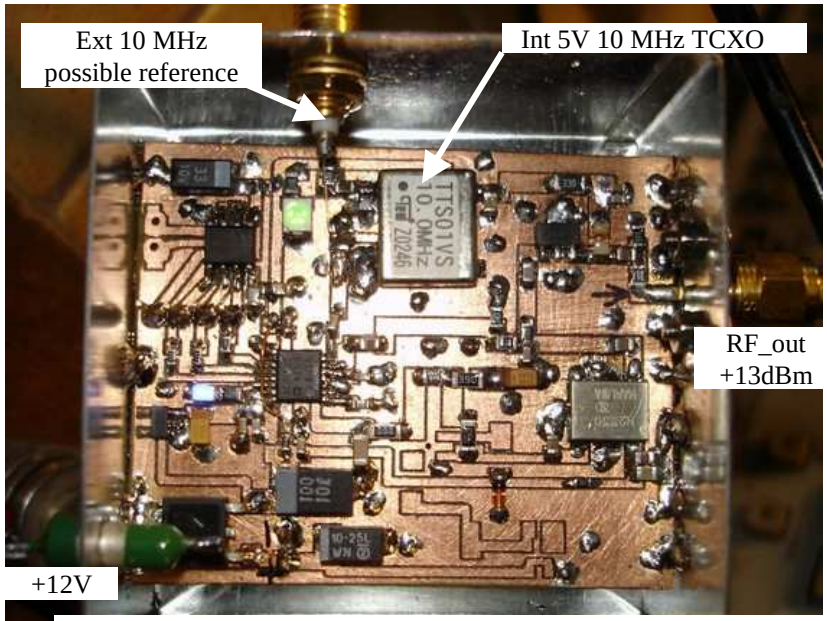
Price 289.95 $ = 197 €

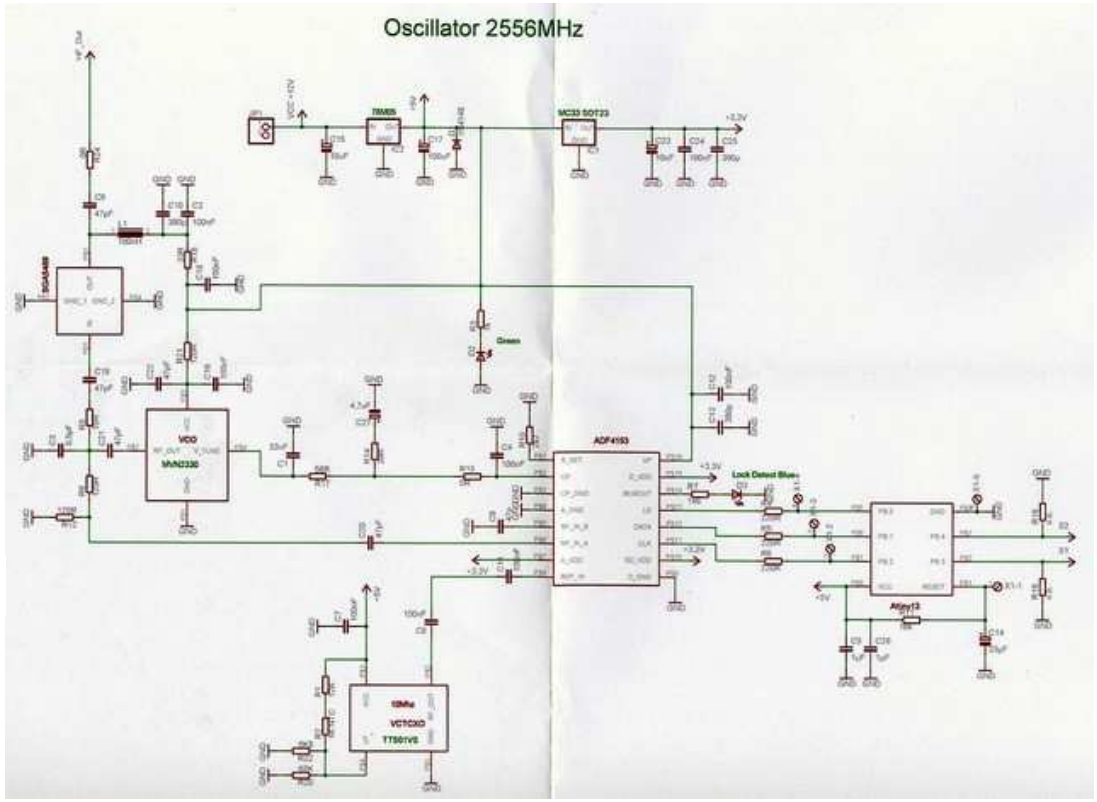
http://www.jwmeng.com/model2556ALN.html

10 GHz DB6NT Transverter

2nd cheaper alternative to constant LO drift with temperature: the 2556 MHz DF9NP phase locked oscillator with 10 MHz internal or external locked LO

Compared with a normal 106.5 MHz PLVCXO, when locked with a 10 MHz OCXO it has a 24 times better stability versus temperature





Either both locking possibilities were tried specifically with this PLL :

- internal TXCO : perfect for portable operation

Or

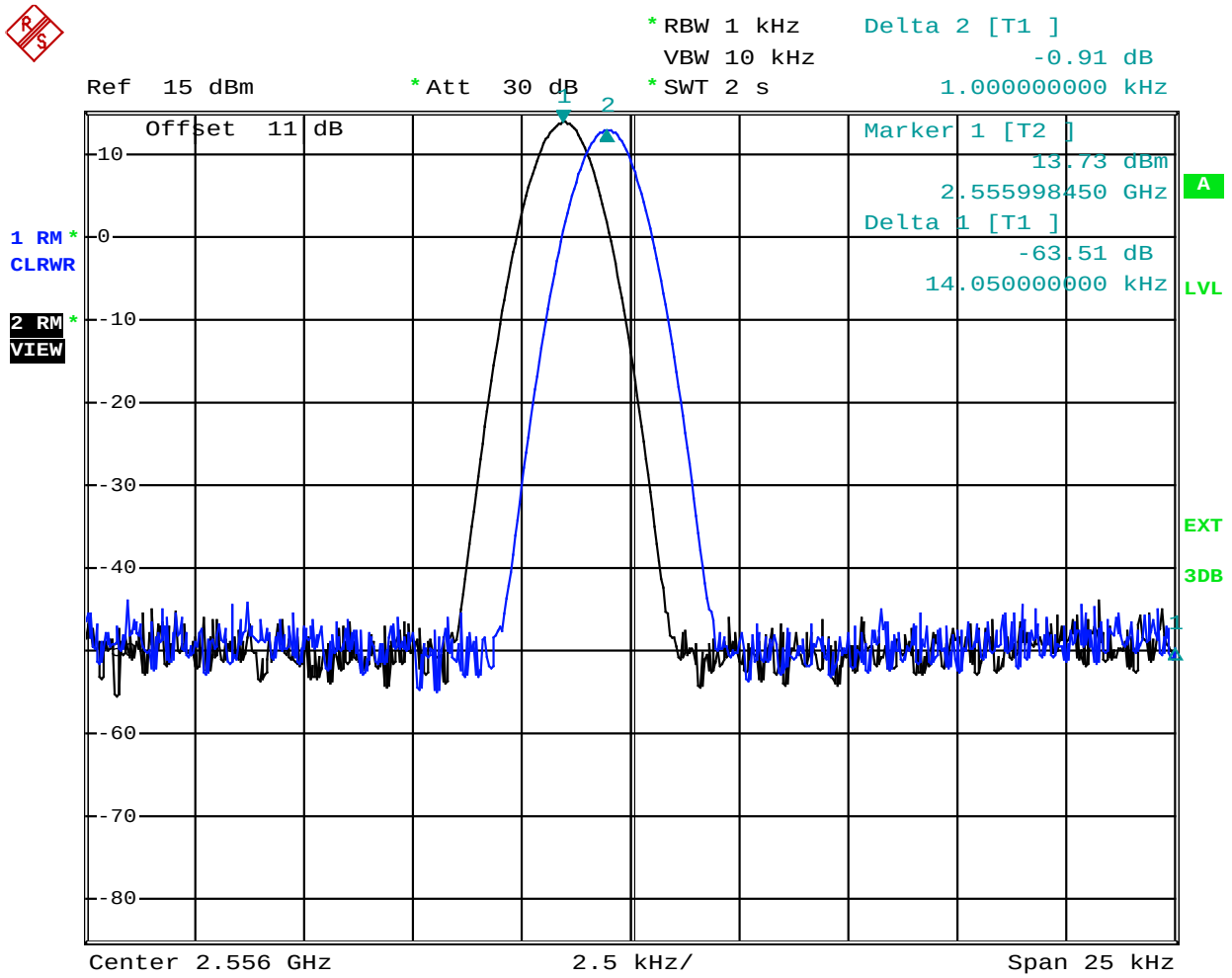
- external OXCO or GPSDO : perfect for indoor beacon monitoring

Never connect both 10 MHz outputs together !

More infos ? Dleupold at t-online.de

10 GHz DB6NT Transverter

DF9NP's meases with internal TXCO



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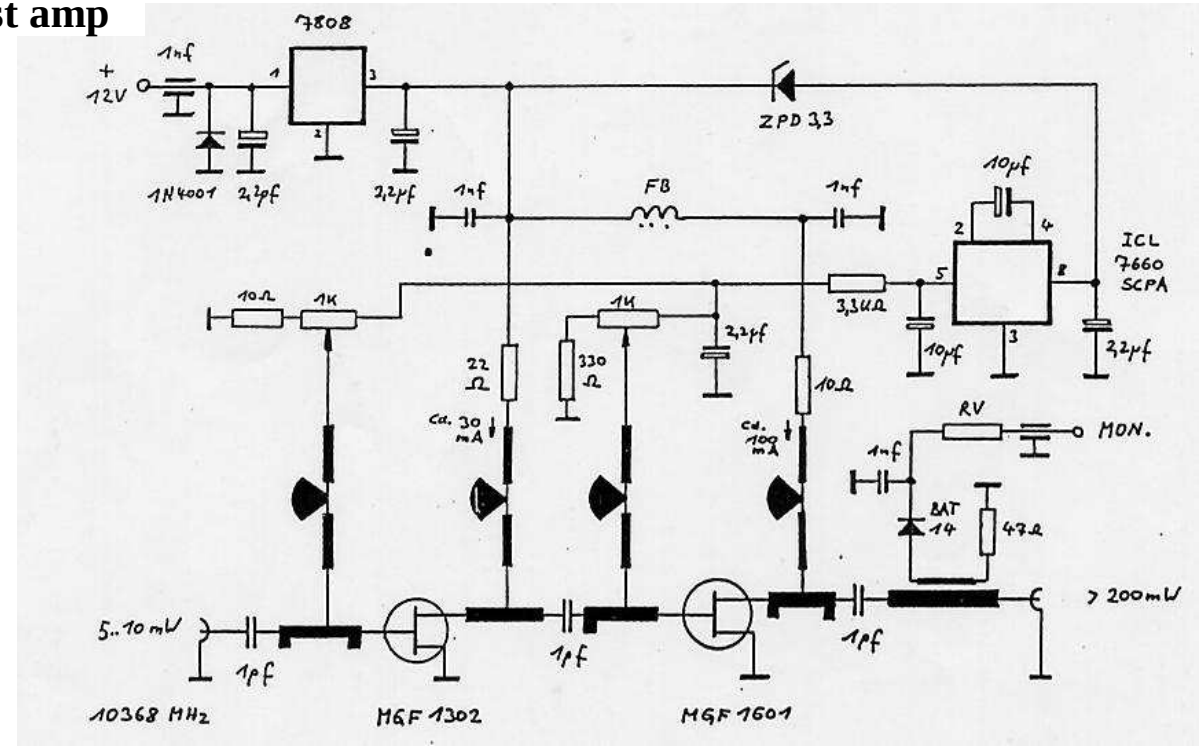
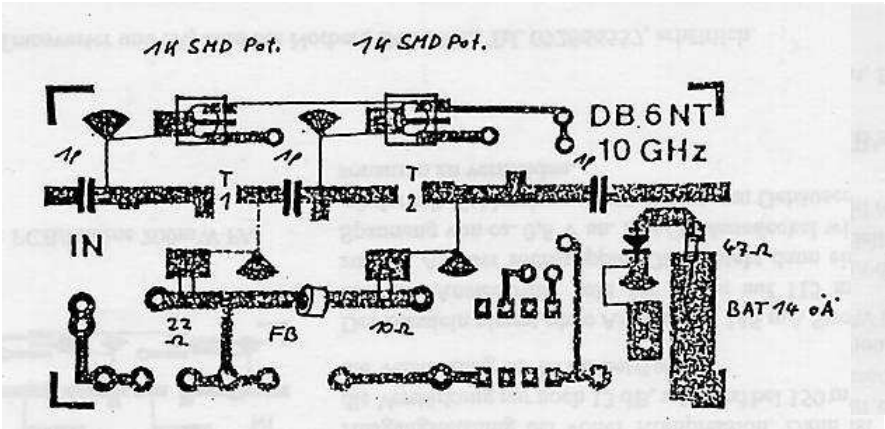
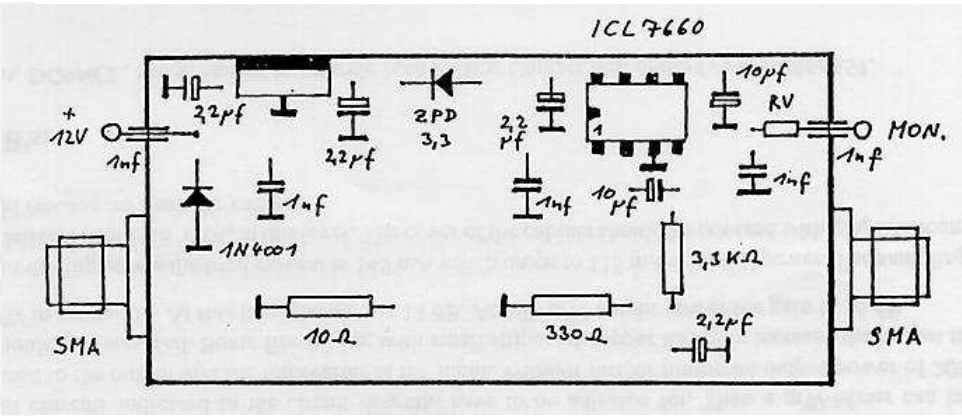
10 GHz DB6NT Transverter

5 to 200 mW first amp

16 dB gain

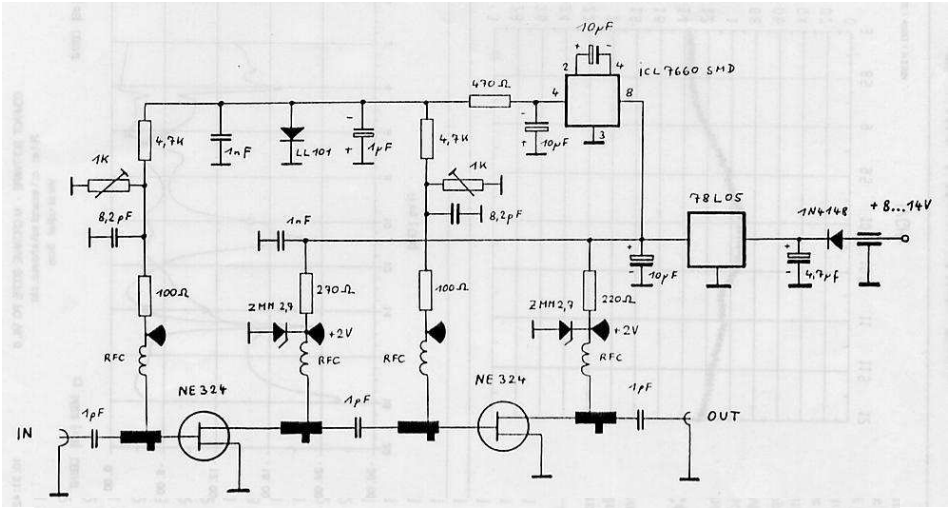


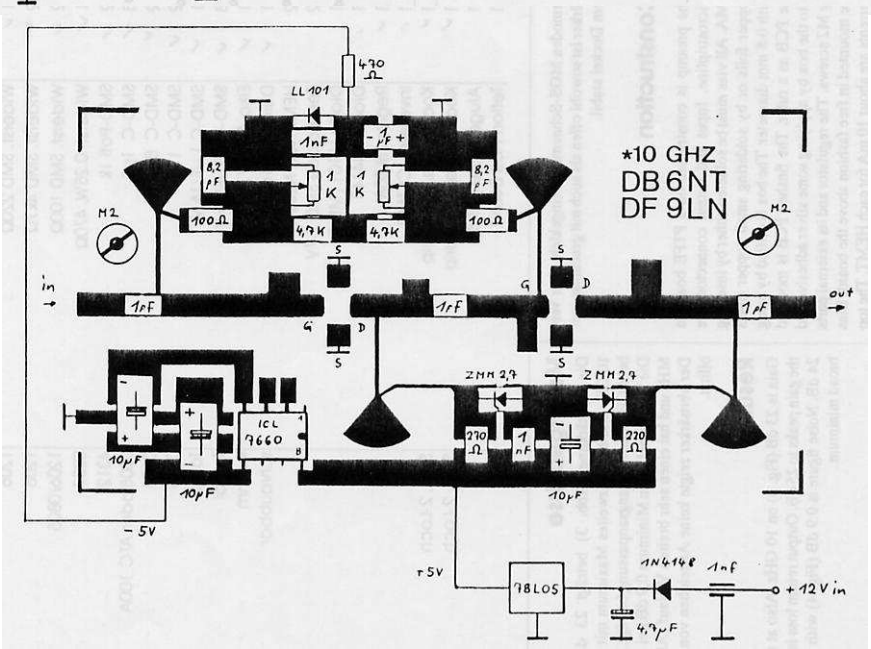




10 GHz DB6NT Transverter

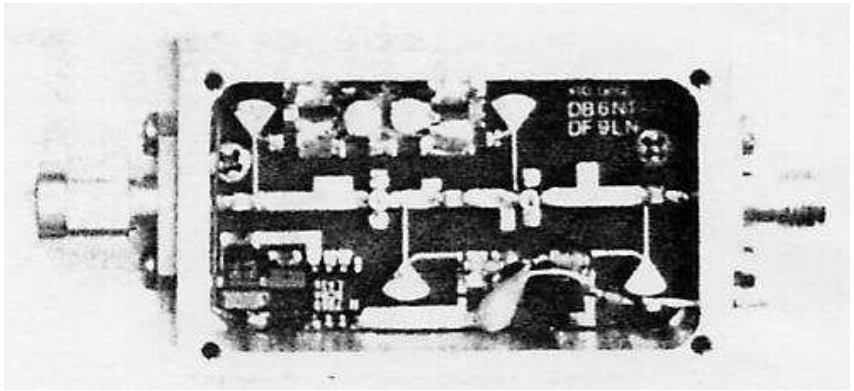
HEMT Nf=1 dB, gain=24 dB DG1VL preamp





Measured

22.8 / 1.15 dB à 10.37 GHz

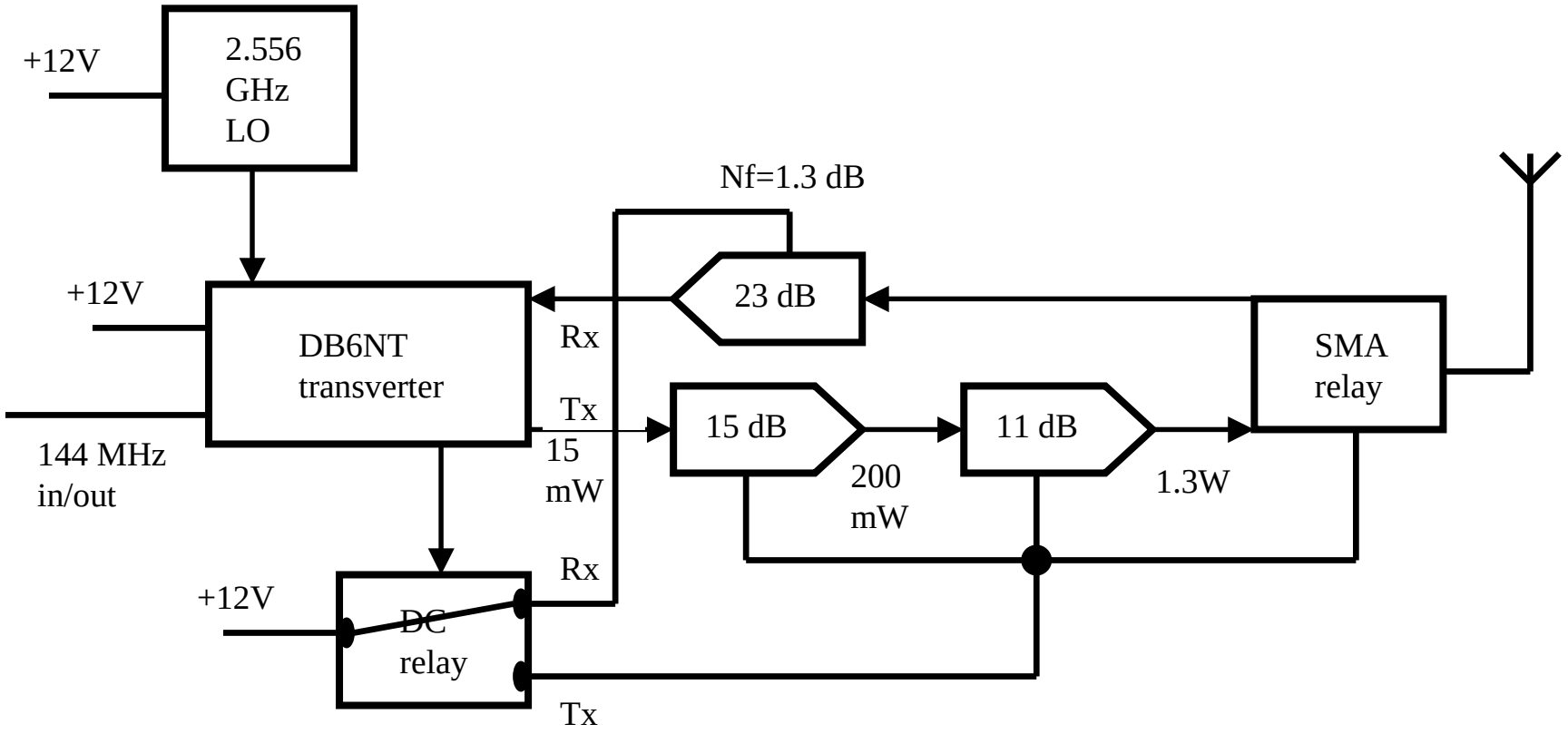


10 GHz DB6NT Transverter

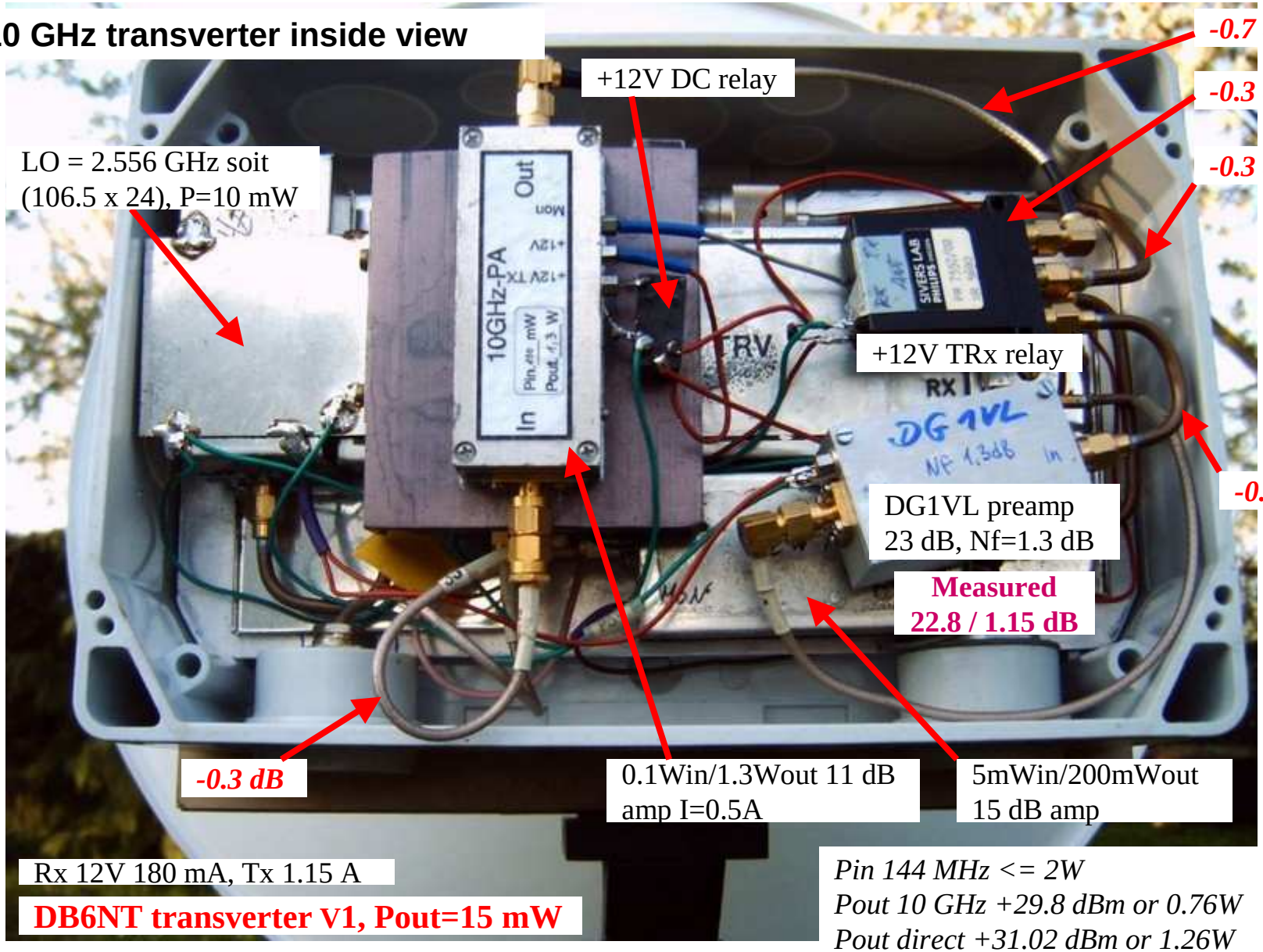
DG1VL HEMT preamp, gain=24 dB, Nf=1.3 dB

10 GHz DB6NT Transverter

Principle of my assembly



10 GHz DB6NT Transverter



10 GHz DB6NT Transverter

10 GHz DB6NT Transverter

10 GHz transverter : DC and RF measures

Oscillator drift after ½hour heating compared to F5 XBD/b 77 frequency

Température (°C)	10°	15°	20°	25°	30°
Drift compared to F5XBD/77 frequency (kHz)	?	?	+10	0	-10

ΔF = 2 kHz/°C

DC measures with V=12V and short DC cables

- Rx 180 mA
- Tx, 1.15A

DC measures after 25M DC of 2x1.5 mm2 cable in tX mode

ΔV = - 0.52V

RF measures

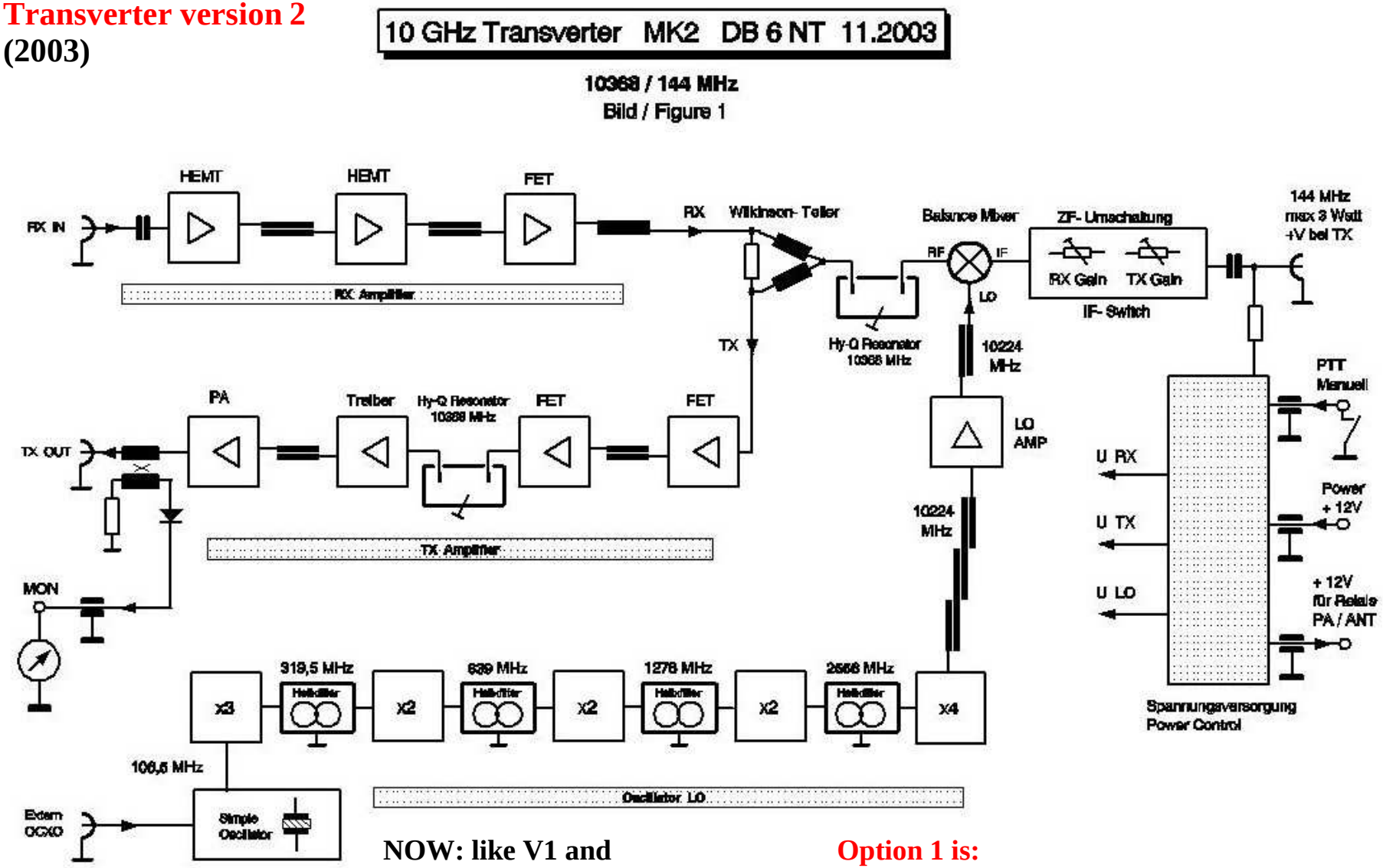
Pin 144 MHz <= 2W
Pout before guide transition +31.02 dBm or 1.26W

3b- 10 GHz DB6NT transverter vers 2

- Totally indoor 10.224 GHz LO with 106.5 MHz quarz
- PTT : positive voltage on 2M coax and « normal » ground
- External 106.5 MHz LO input for far better stability
- Pout = +23 dBm or 200 mW

10 GHz DB6NT Transverter

Transverter version 2
(2003)

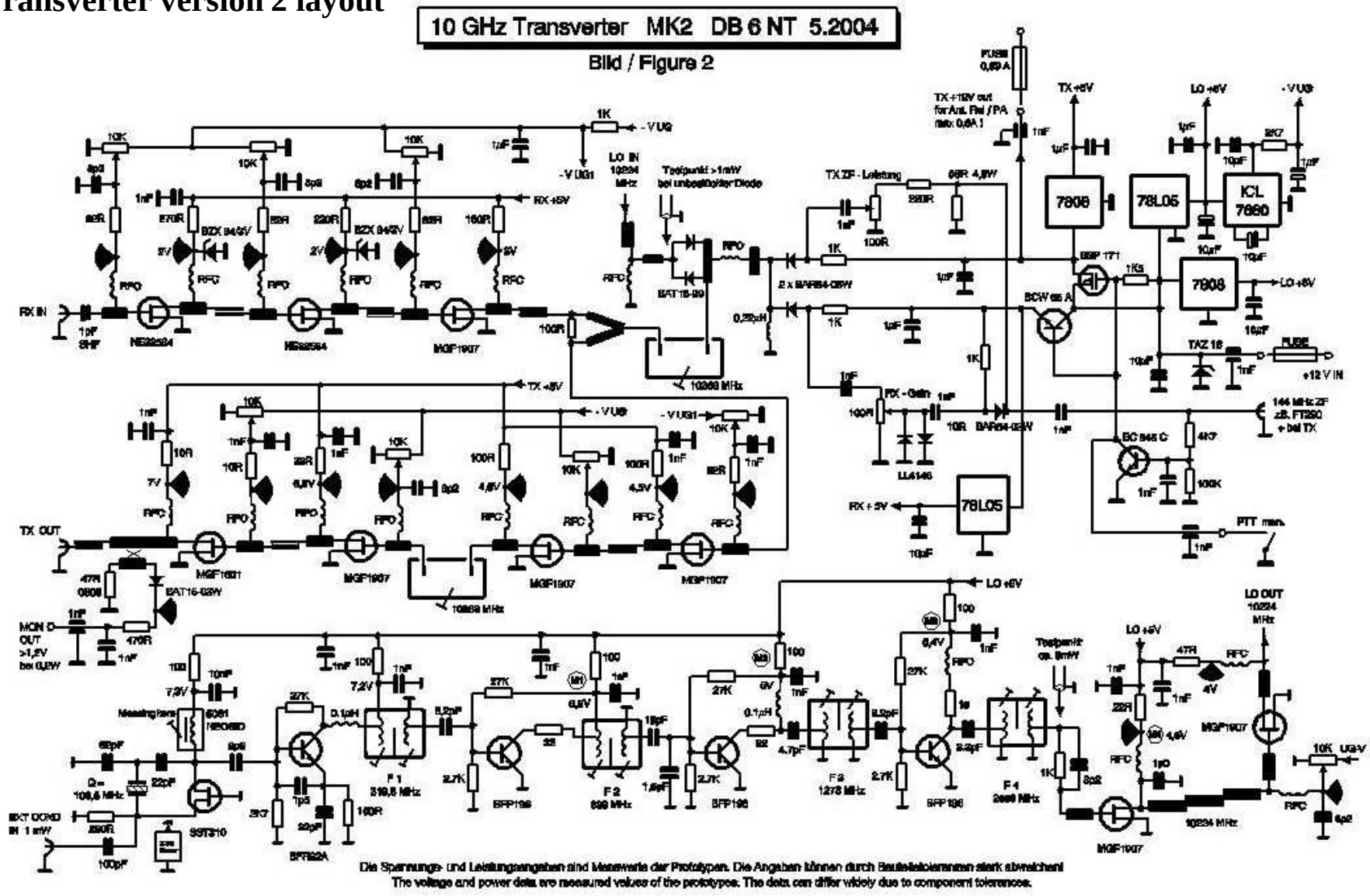


NOW: like V1 and
-Pout=200 mW, nF=1.2 dB
-LO totally on same board

Option 1 is:
-106.5 MHz external ocxo fitting a subsidiary SMA connector

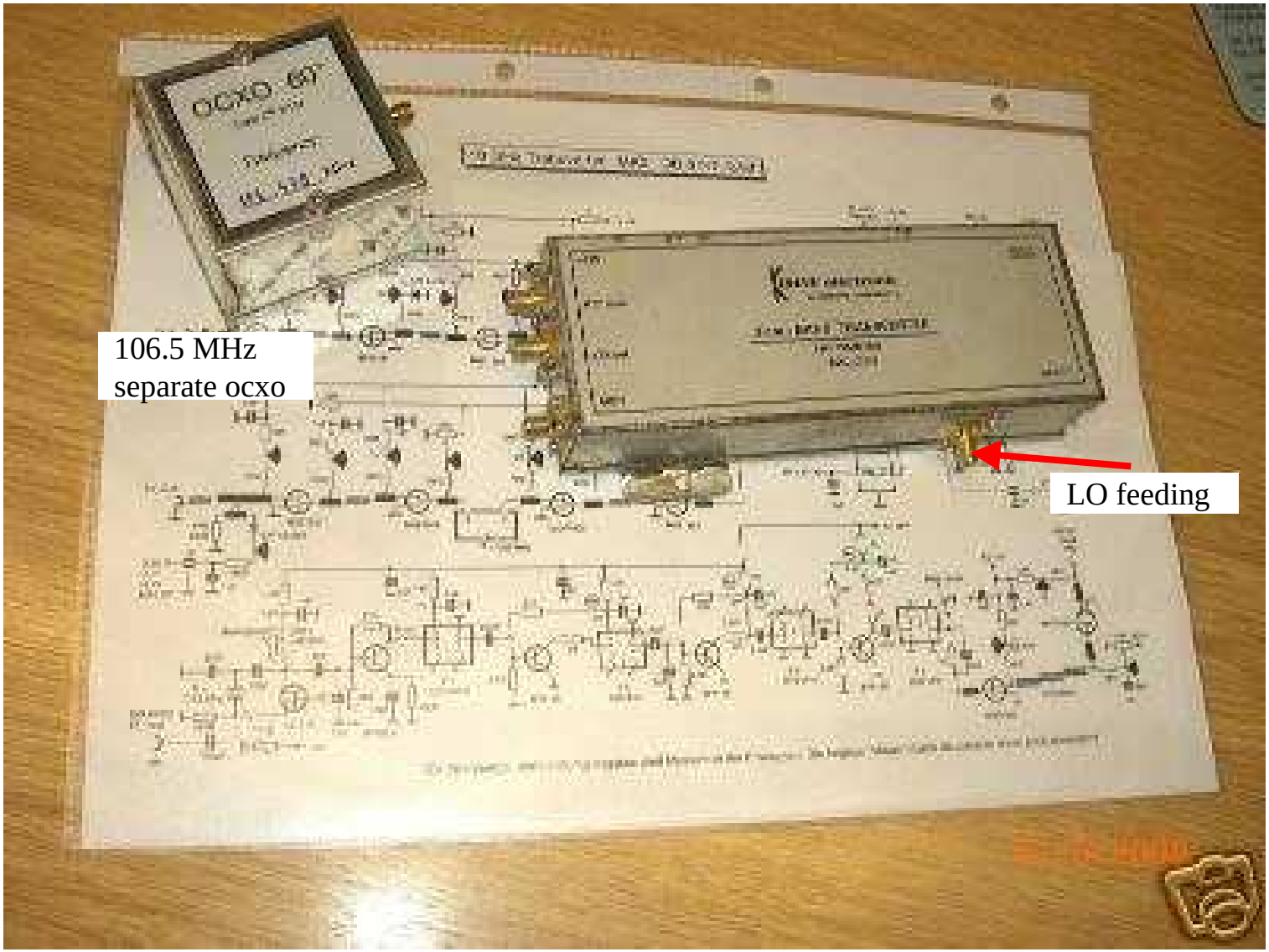
10 GHz DB6NT Transverter

Transverter version 2 layout



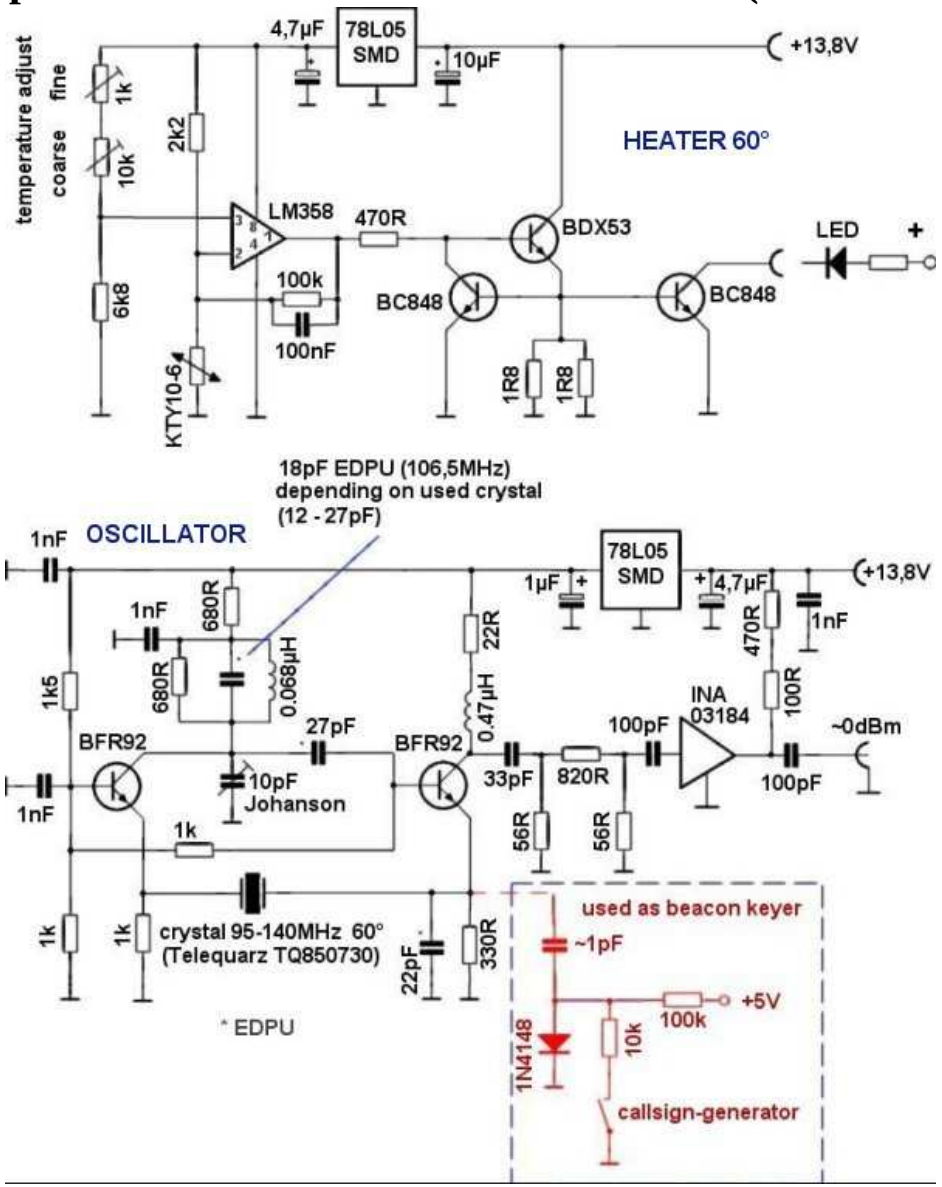
10 GHz DB6NT Transverter

Transverter version 2 hardware



10 GHz DB6NT Transverter

Transverter version 2 : optional 106.5 MHz 60°C ocxo schematic (Eisch-Kafka)

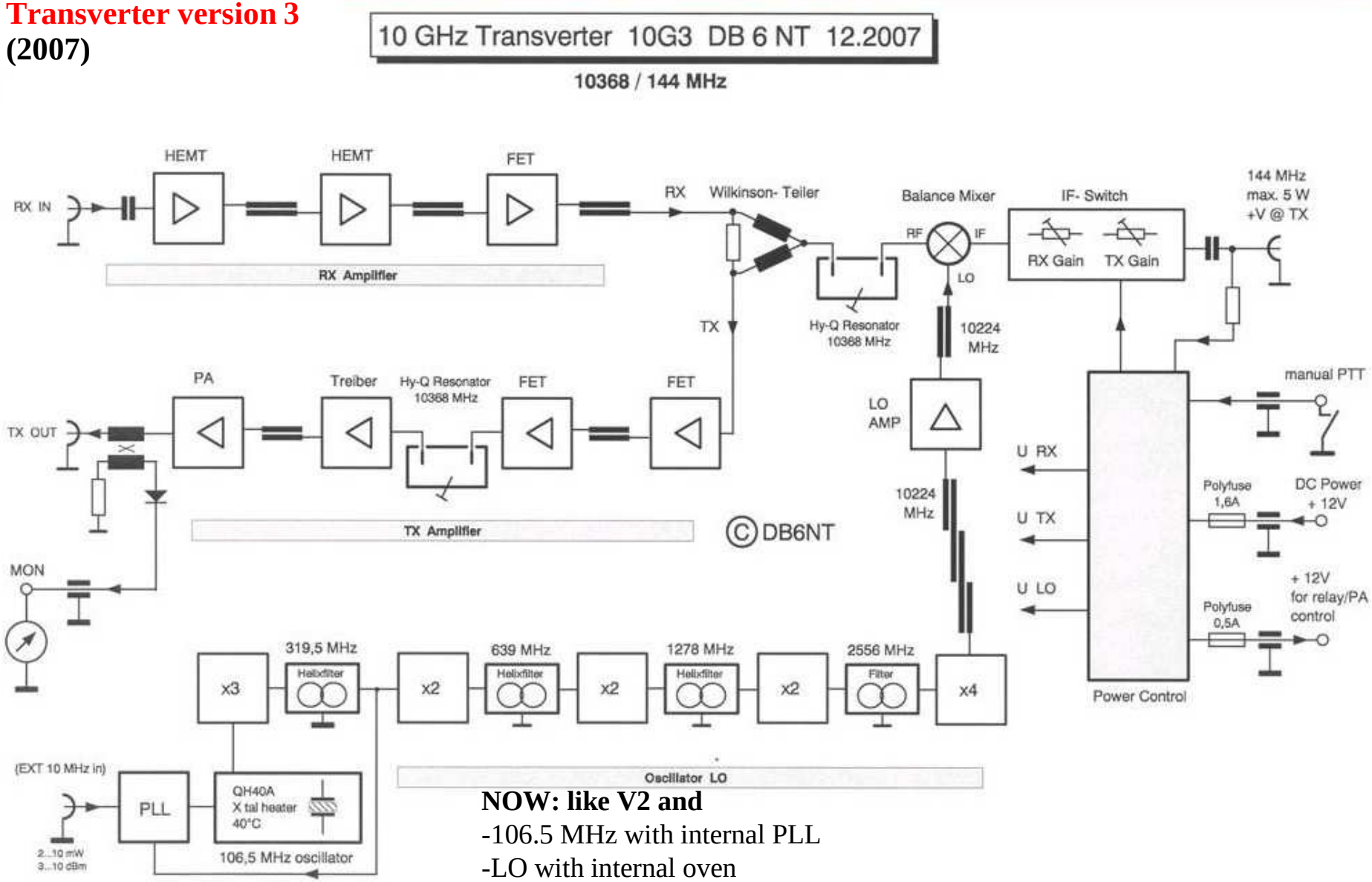


3c- 10 GHz DB6NT transverter vers 3

-LO=106.5 MHz ocxo at 40°C
-External 10 MHz ref input for rock stability (ocxo, rubidium or GPS)
-Rx Nf improvement

10 GHz DB6NT Transverter

Transverter version 3
(2007)

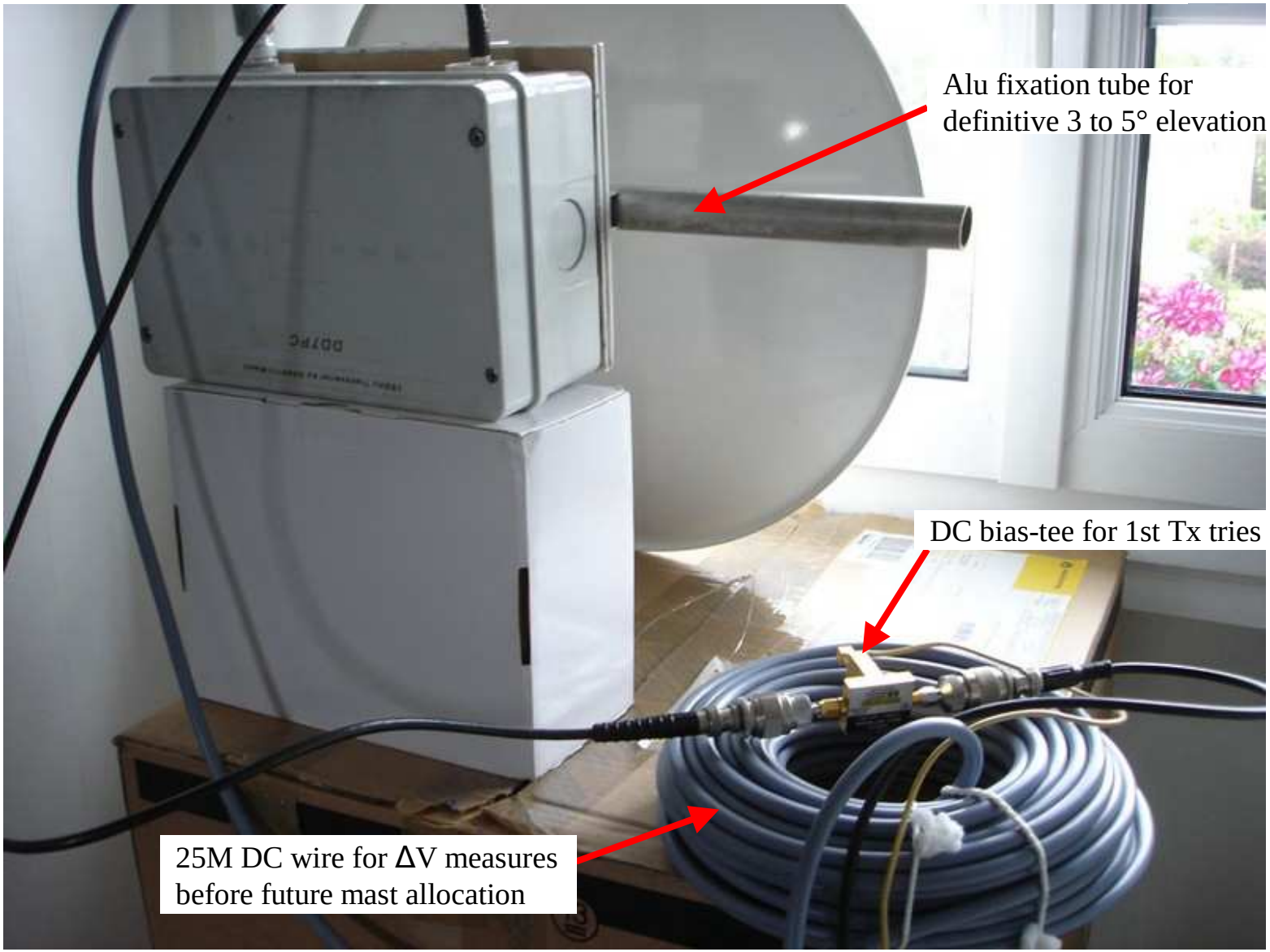


NOW: like V2 and
-106.5 MHz with internal PLL
-LO with internal oven
-Ext 10 MHz ref input for frequency stability like the GPS

4- 10 GHz indoor & outdoor tryings

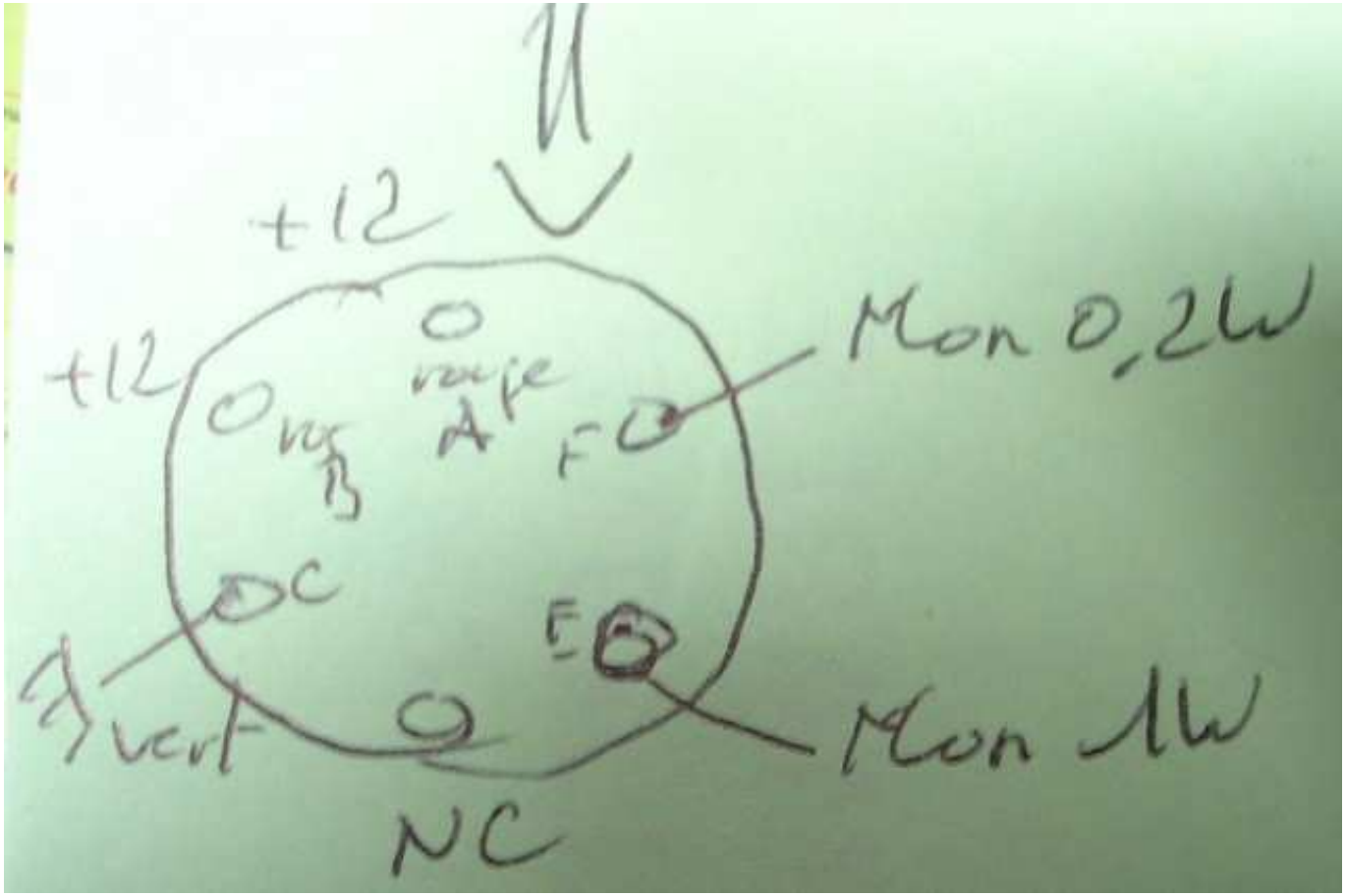
10 GHz DB6NT Transverter

First RS tryings with open window in the shack room



10 GHz DB6NT Transverter

Transverter DC pinning

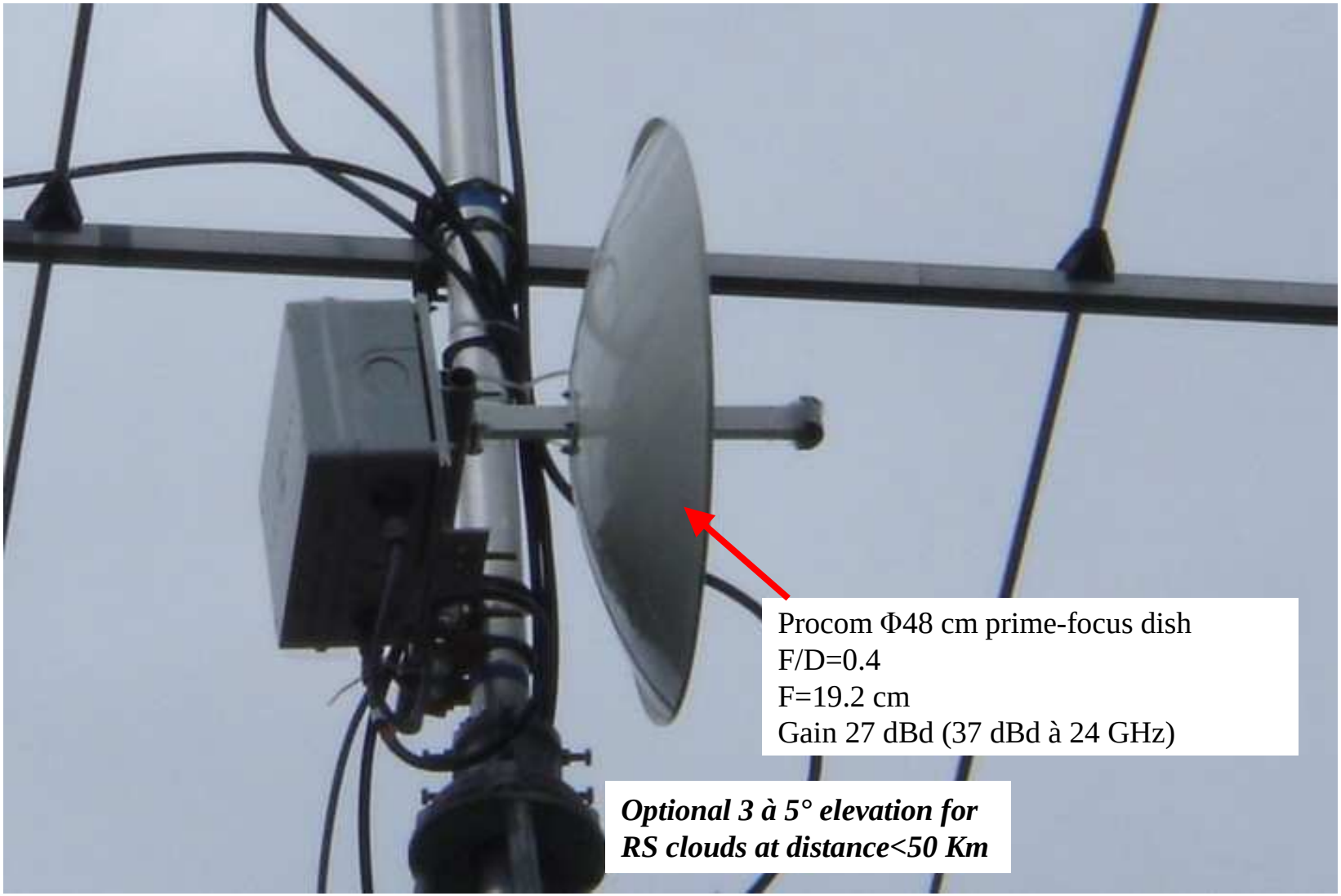


10 GHz DB6NT Transverter

Summer configuration « complement »

10 GHz DB6NT Transverter

Zoom on 10 GHz ensemble



10 GHz DB6NT Transverter

Procom dish : grasshopper breeding inside its waveguide !

10 GHz DB6NT Transverter

Procom dish : Penny-feed protection with plumber special teflon

Pictures made by F6ETI

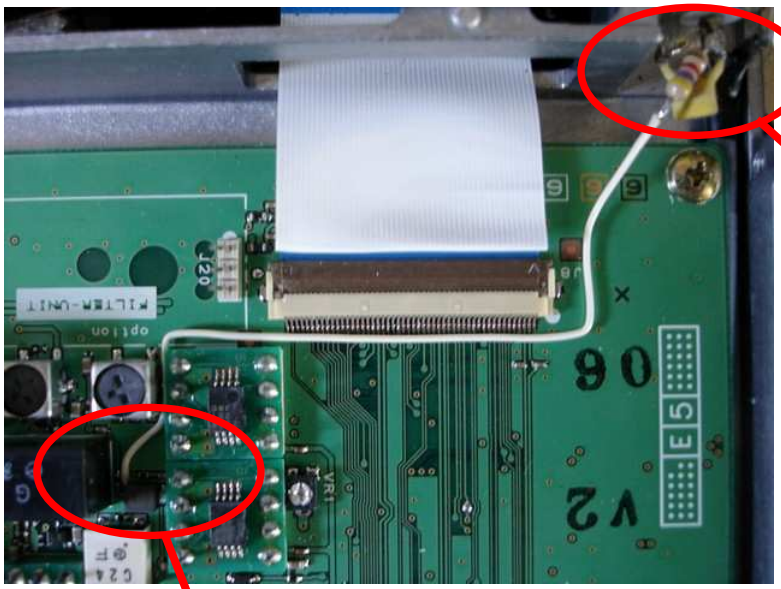
5- FT-817nd mods for Tx purposes

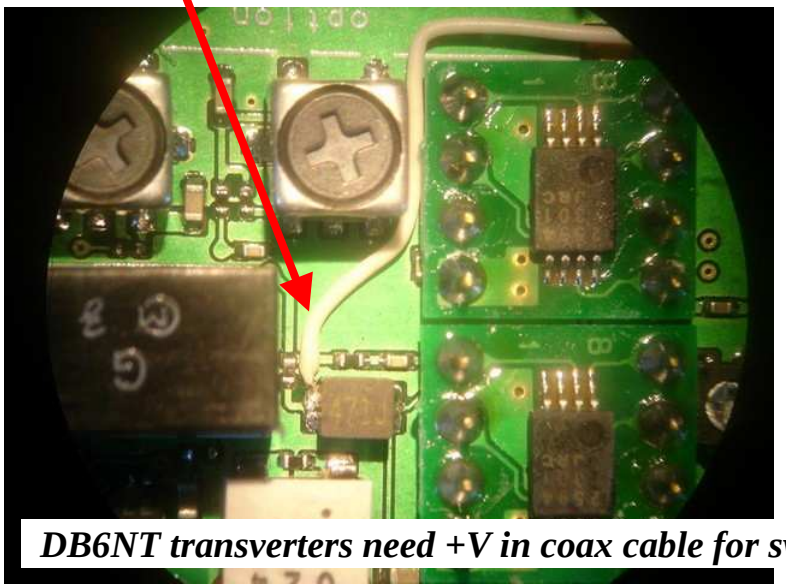
Best TRx choice because fully compatible with the tranverter options of:
-the Ham Radio Deluxe logbook
-FT-817 commander (also from HB9DRV)

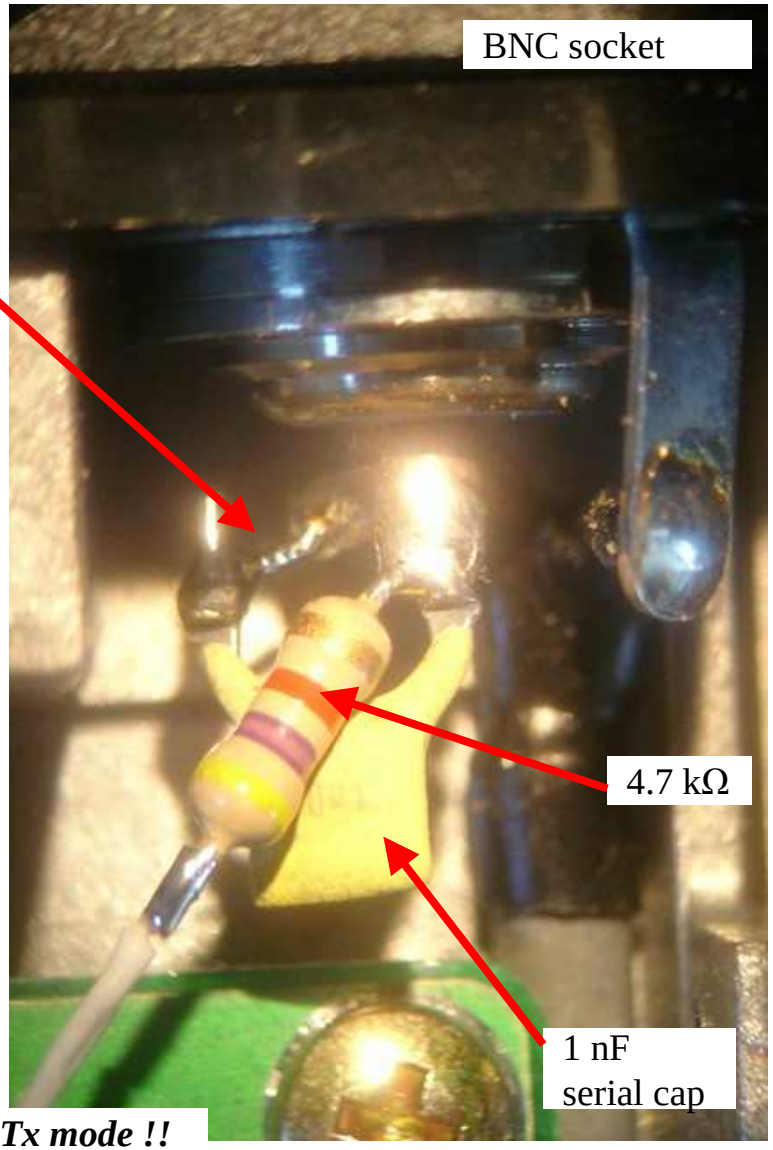
Target : positive voltage in the 144 MHz coaxial while tXing

FT-817nd mods with +12V in coax while tXing

FT-817nd mod for DC addition in coax while Txing (upper side) or « reversal PPT »







DB6NT transverters need +V in coax cable for switching in Tx mode !!

FT-817nd mods with +12V in coax while tXing

FT-817nd desensibilisation procedure

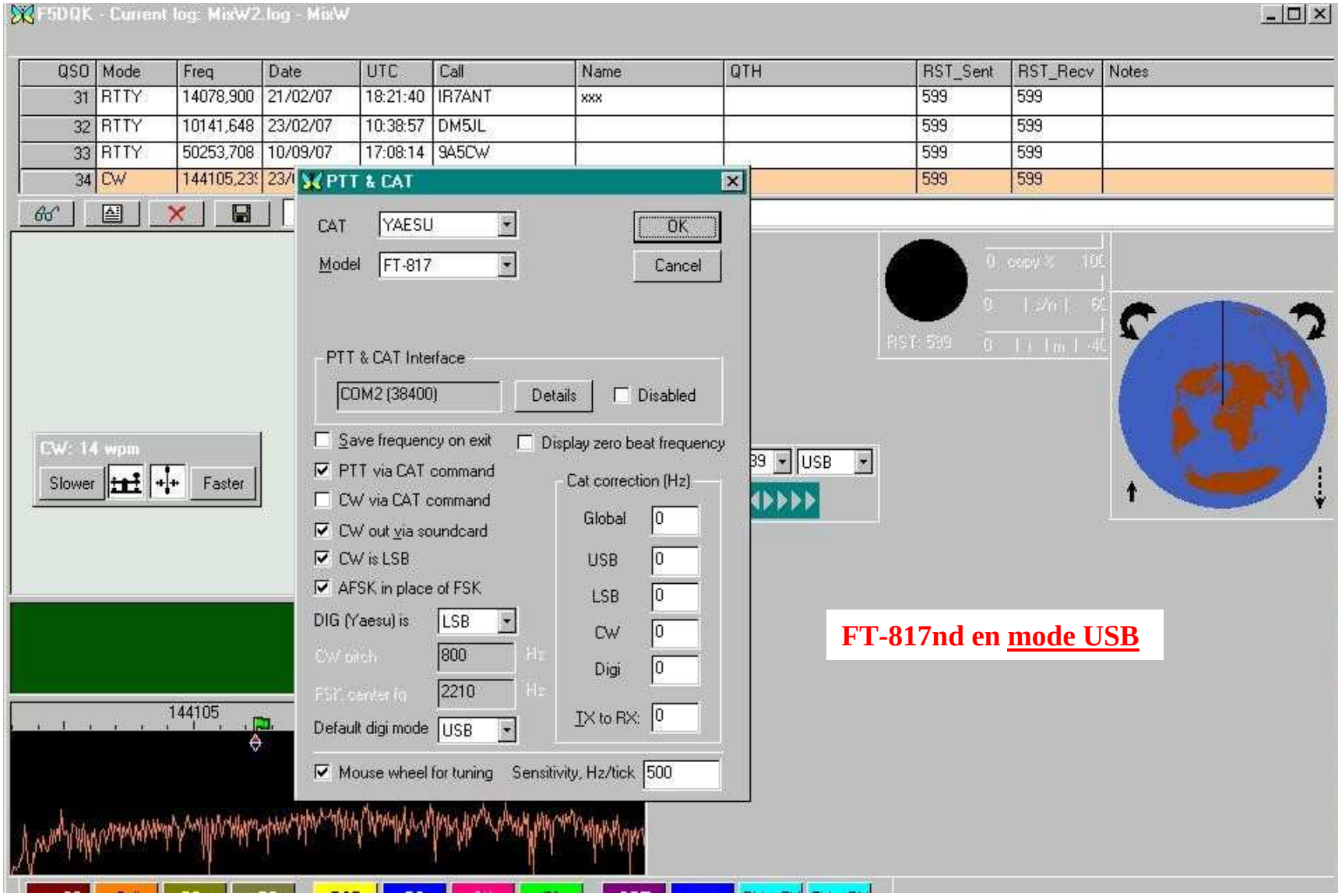
With only noise, the S-meter drops down from S8 to S1 to the 144 MHz Rx

-TX OFF
- appuyer simultanément sur A, B et C et conserver les 3 BP enfoncés
- mettre en marche →le 817 envoie une série de bips et passe en mode config
- sélecteur à gauche pour faire défiler les menus
- choisir **menu 5 VHF RXG** (gain Réception en VHF) valeur initiale=128
- descendre à la **valeur 56** → S1 de QRM ce qui ne saturera plus le FT-817nd
- presser le bouton F pendant plus d'une seconde

Attenuation reached after decreasing S8 to S1 in the 144 MHz IF line : roughly 14 dB

FT-817nd mods with +12V in coax while tXing

FT-817nd automatic CW associated to MixW2 : configuration



6- 10 GHz prime / offset dish comparaison

Prime-focus and offset dish comparaison

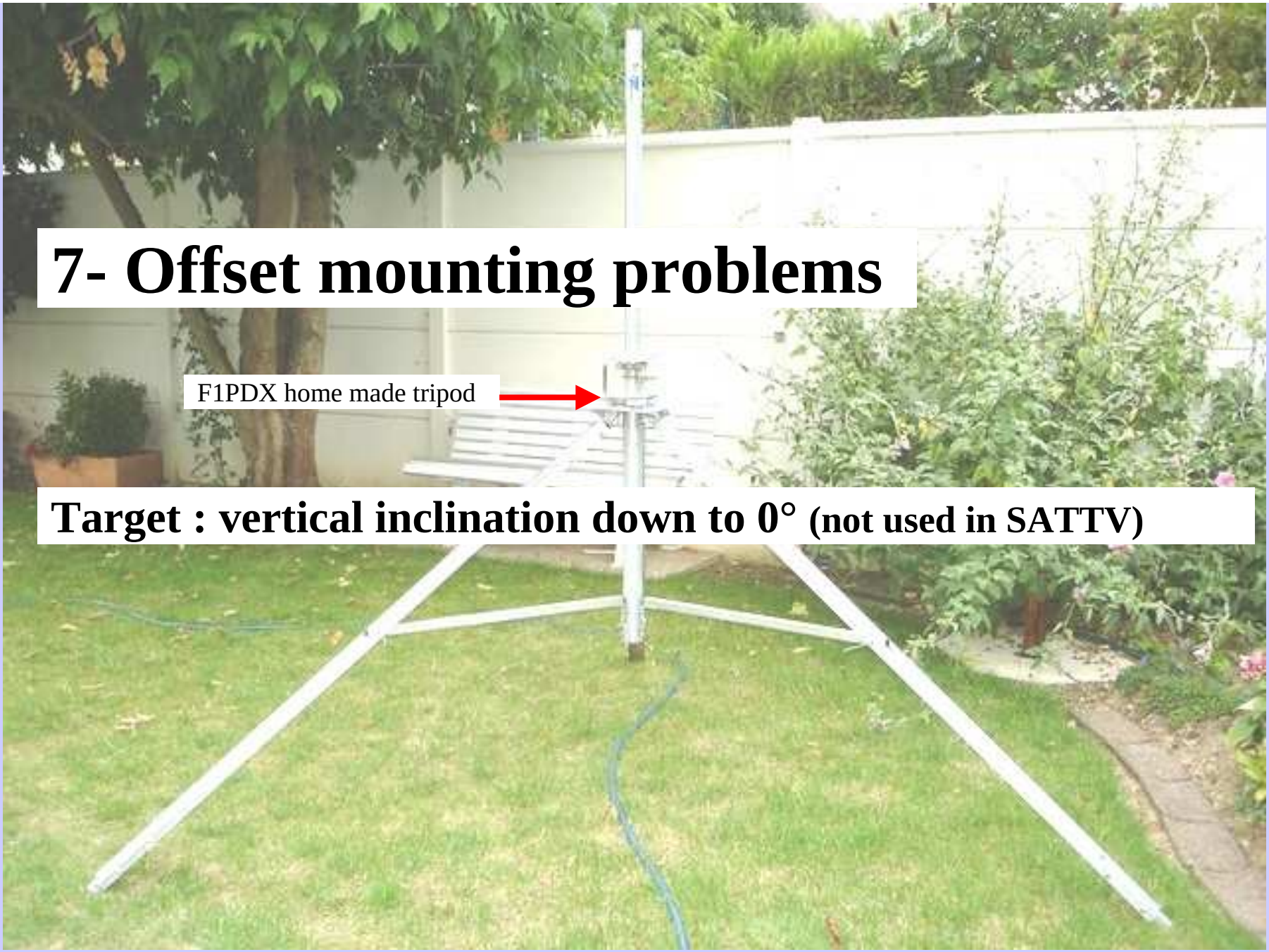
Gain comparaison of prime-focus and offset dishes

Dish	**Heigth (cm)**	Width (cm)	Depth (cm)	Gain (dB)
Procom Prime-focus	49	49	na	32 calculated
Worldsat offset	80	73	6.4	36.1
Echostar offset	131	121	11.5	40.5

At same dims <100 cm, the *offset* gives far better results

That's the best way to both improve Rx and Tx by a minimum of 3 to 4 dB

7- Offset mounting problems

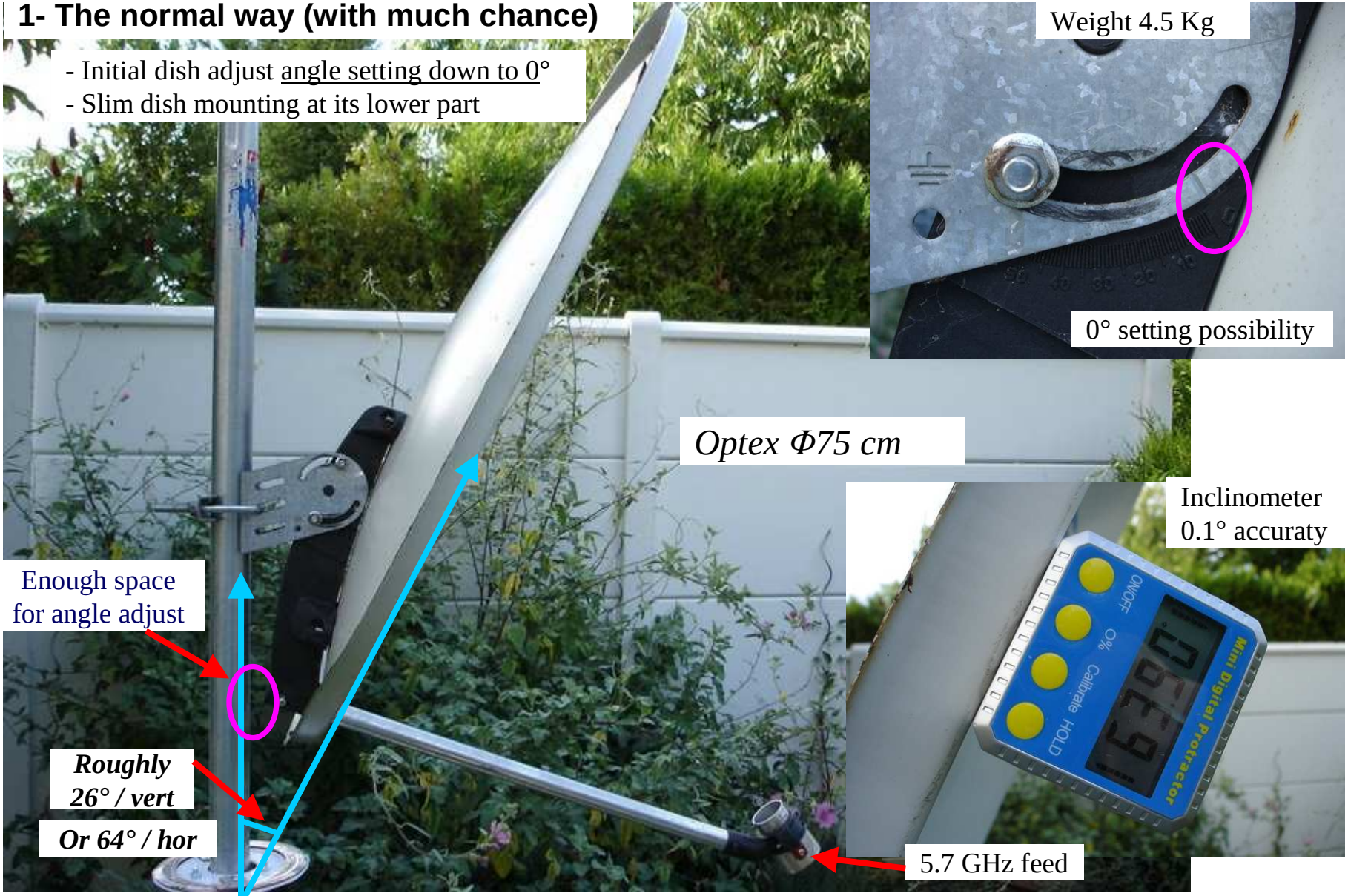


Target : vertical inclination down to 0° (not used in SATTV)

Solving offset dishes 0° elevation

1- The normal way (with much chance)

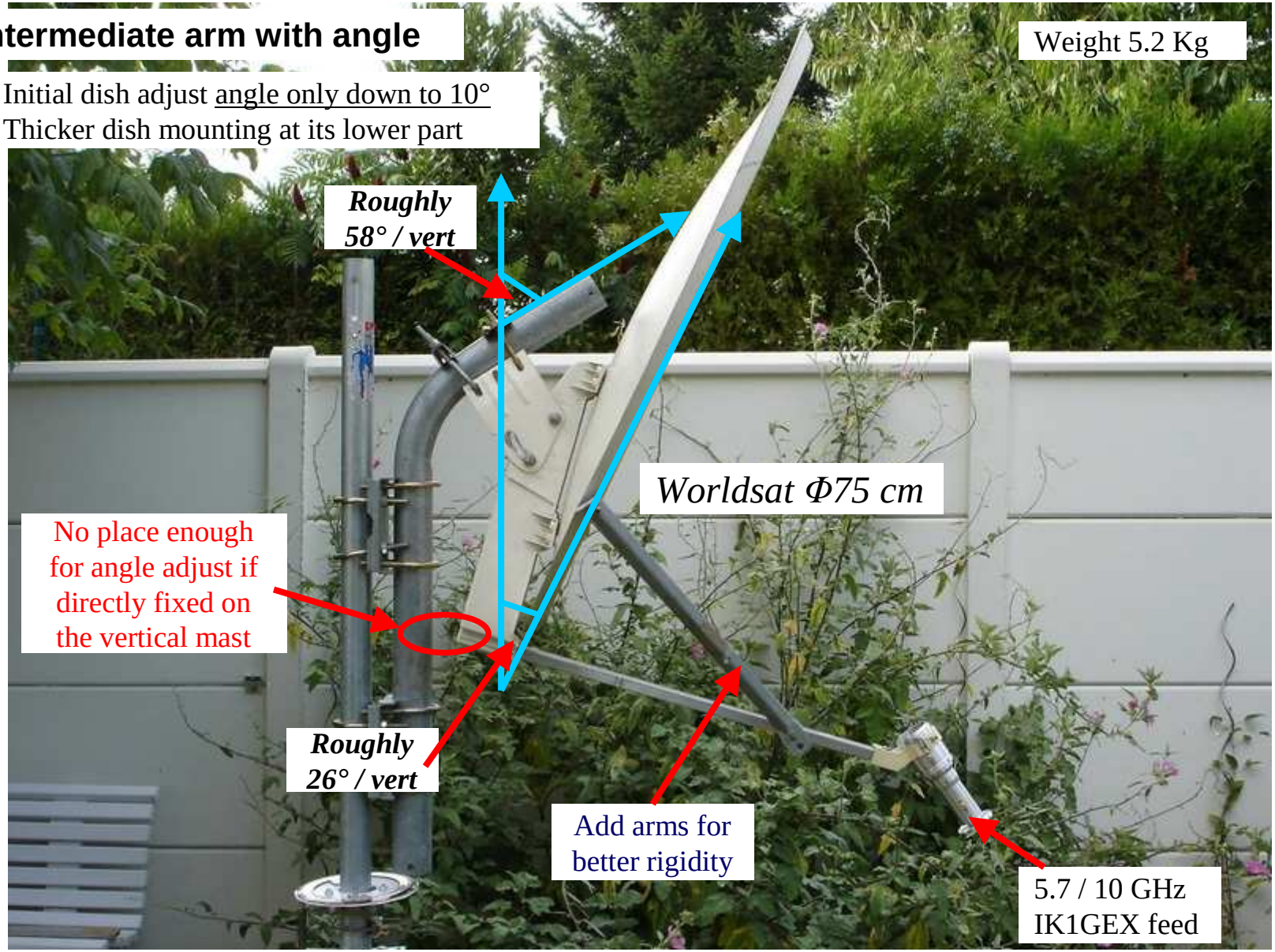
- Initial dish adjust angle setting down to 0°
- Slim dish mounting at its lower part



Solving offset dishes 0° elevation

2- Intermediate arm with angle

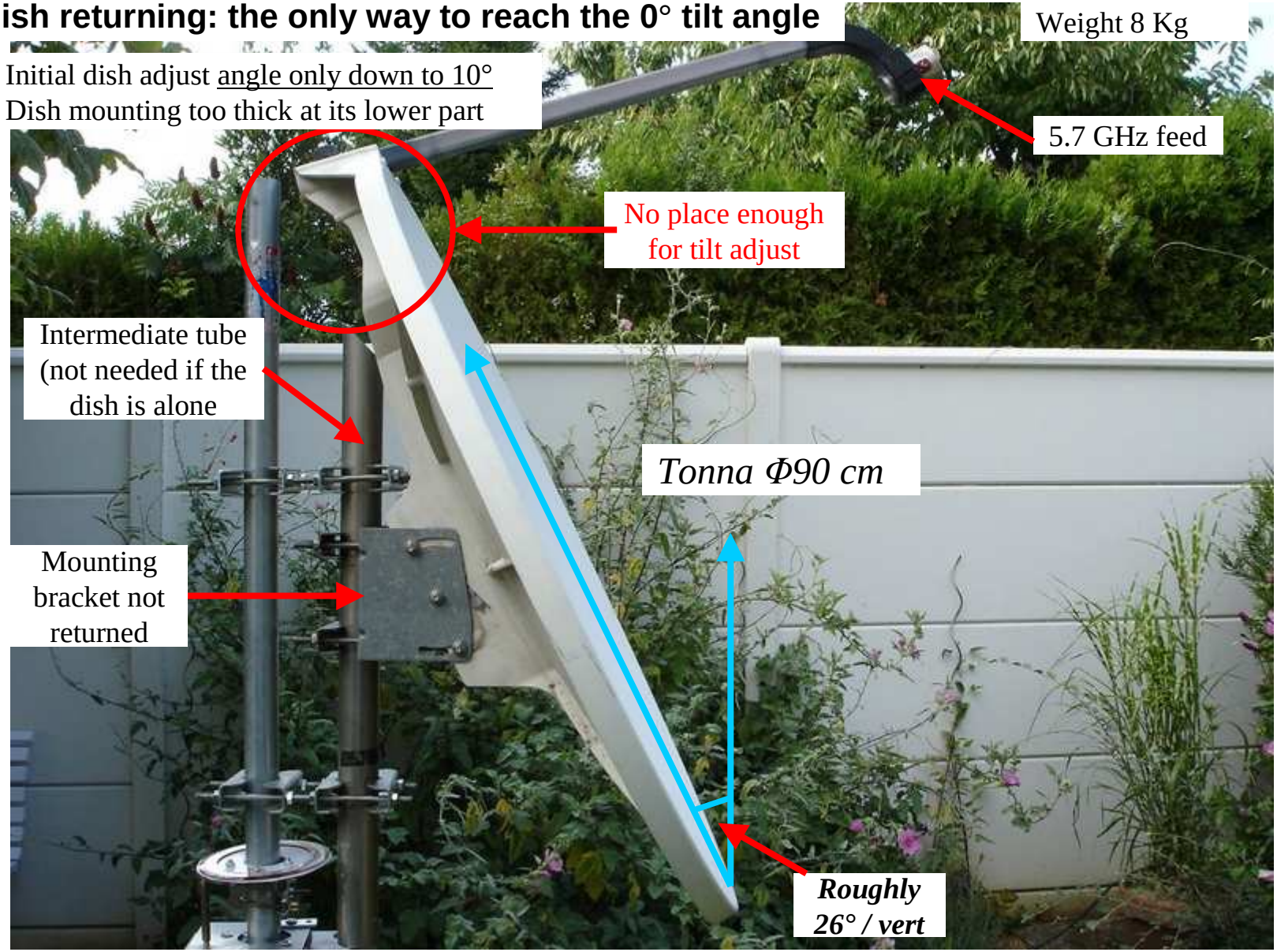
- Initial dish adjust angle only down to 10°
- Thicker dish mounting at its lower part



Solving offset dishes 0° elevation

3- Dish returning: the only way to reach the 0° tilt angle

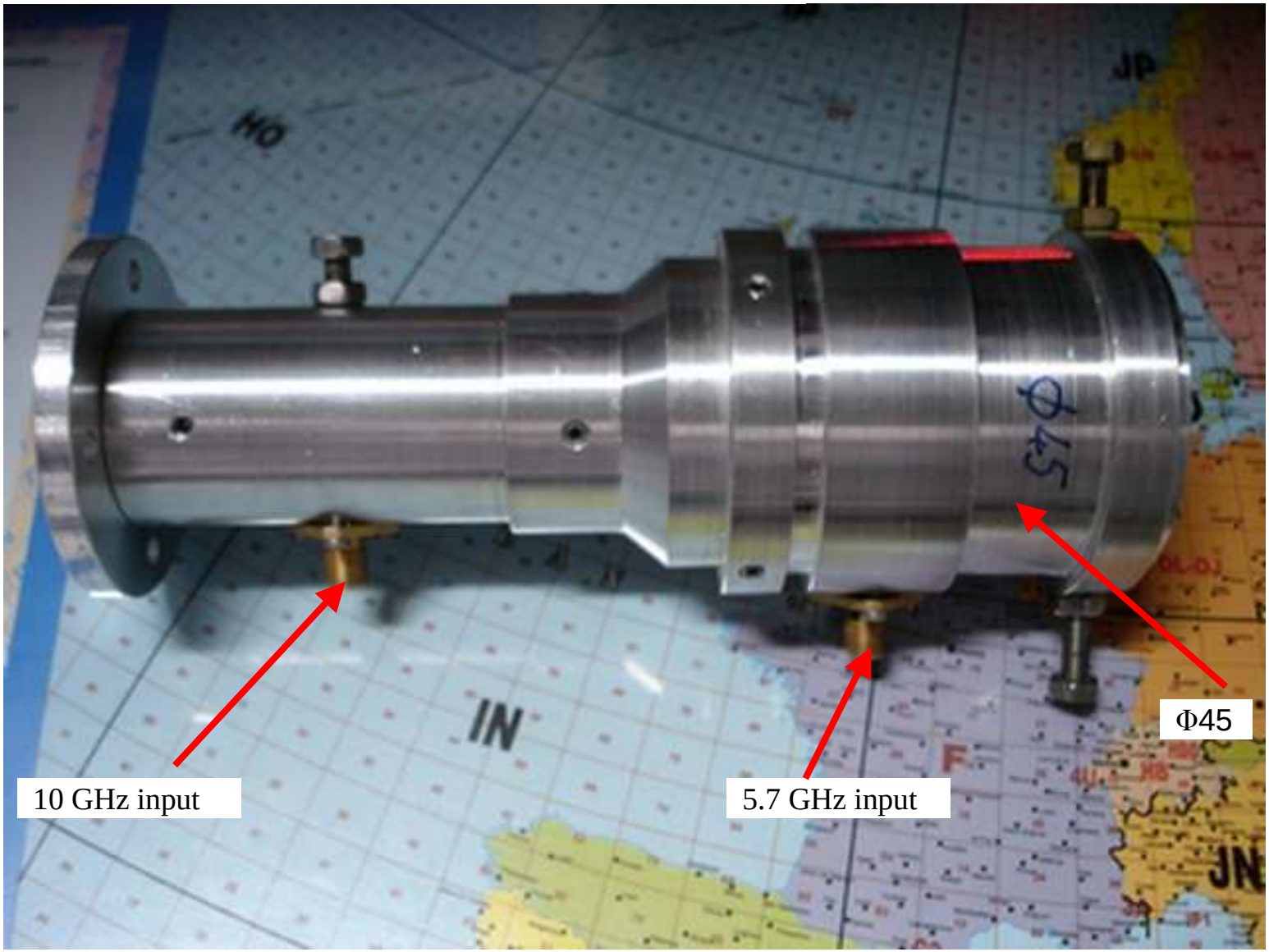
- Initial dish adjust angle only down to 10°
- Dish mounting too thick at its lower part



8- 10 and 5.7 GHz IK1GEX double horn

IK1GEX 5.7 & 10 GHz double Horn

Double 5.7 and 10.4 GHz horn

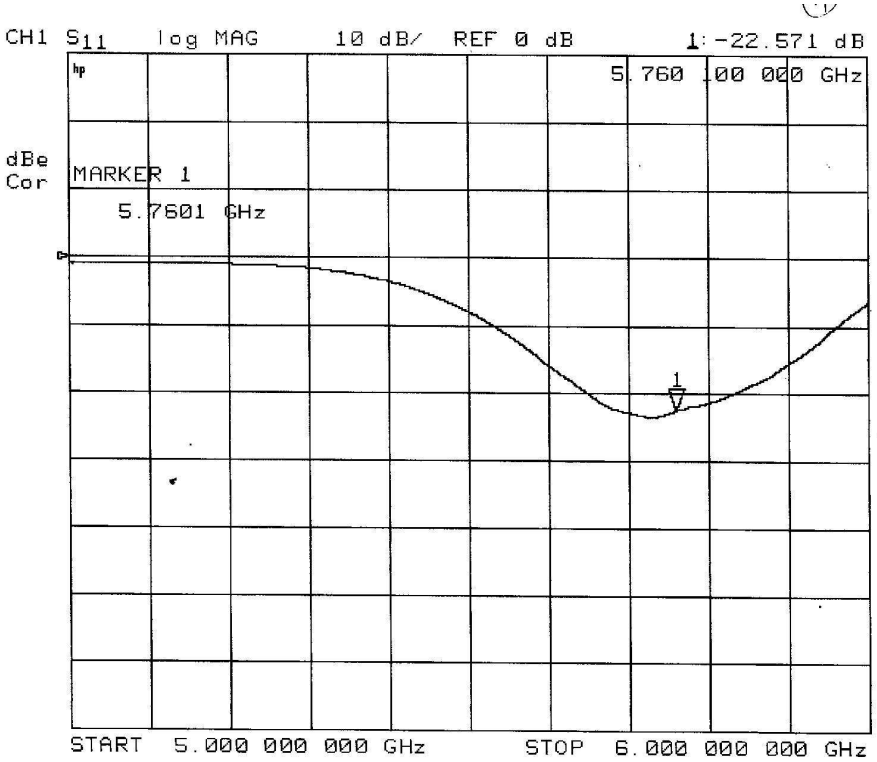


IK1GEX 5.7 & 10 GHz double Horn

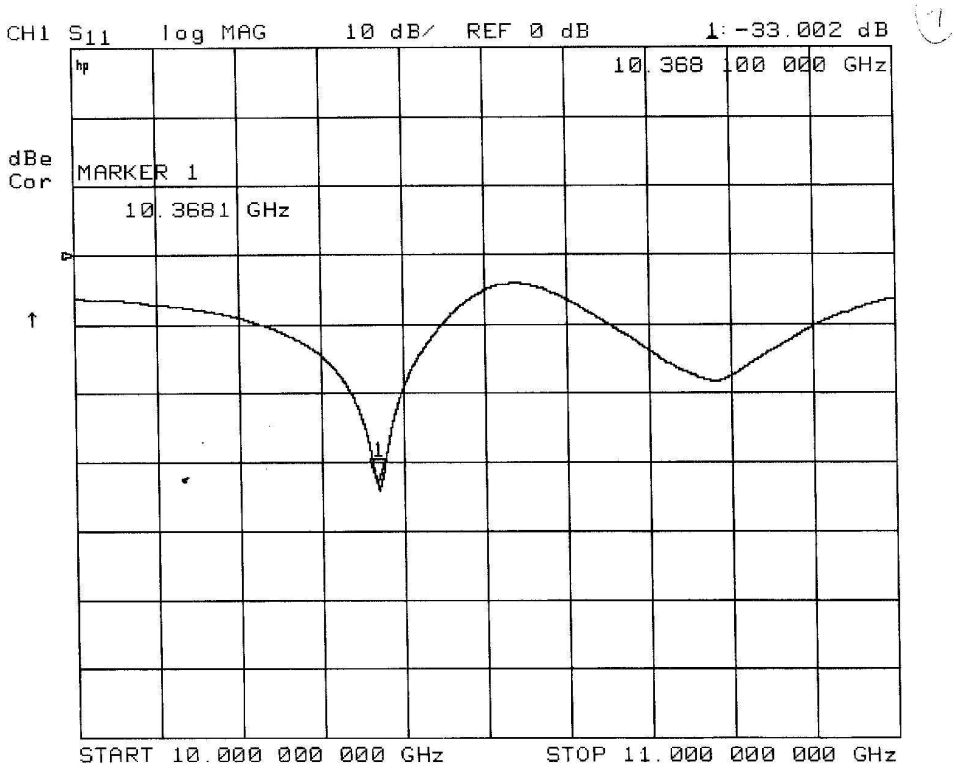
S11 specs on both bands given by IK1GEX

Optimized for dishes with 0.55 < F/D < 0.75 (principally offset designs)
NB: prime-focus dishes have 0.3 < F/D < 0.55

5.7 GHz

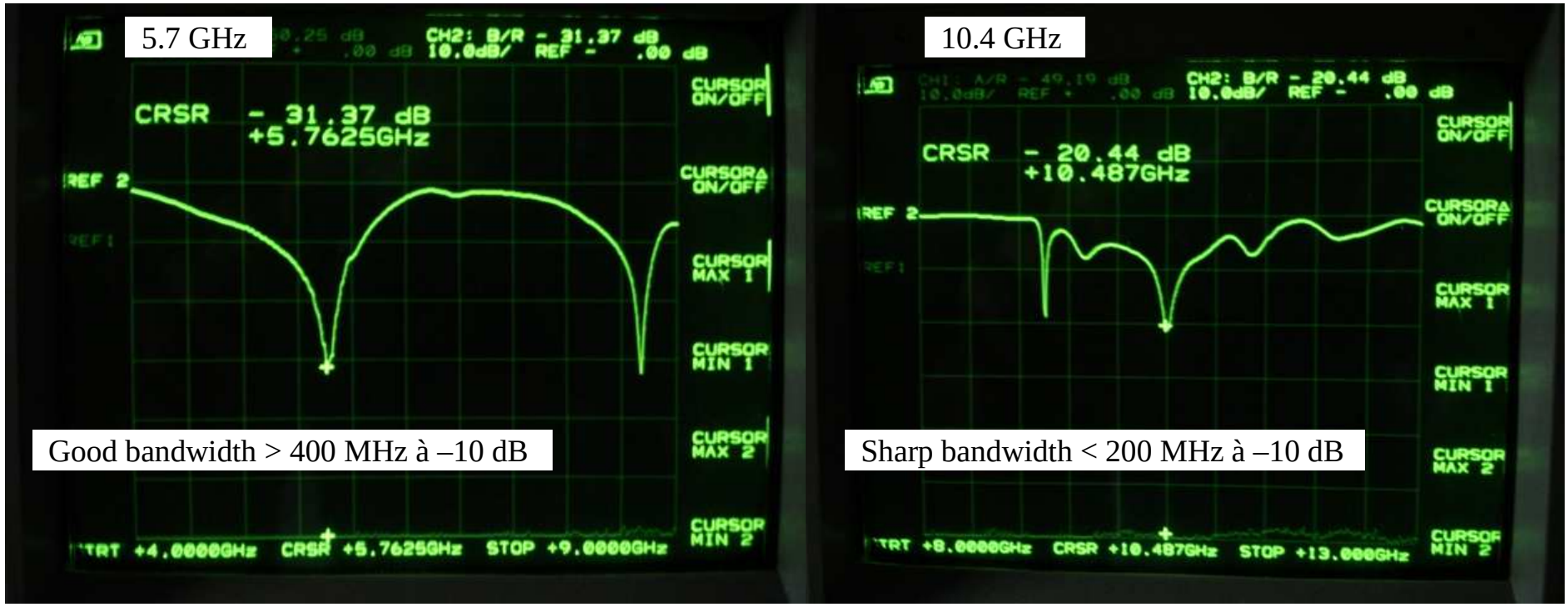


10.4 GHz



IK1GEX 5.7 & 10 GHz double Horn

S11 measured here on both bands



Scalar analyser HP 8757a + sweep HP 8350b 10 MHz – 20 GHz

IK1GEX 5.7 & 10 GHz double Horn

10 to 5.7 GHz isolation

5.7 to 10 GHz isolation

Target : double 5.7 & 10 GHz feeding on one same 80 cm offset dish

Cure : far better isolation must be done on the 5.7 GHz Rx part

NB: in opposite side of a coax cable, the guide acts like a **HIGHPASS filter !!**

10 GHz feeding – measures on 5.7 GHz SMA input

IK1GEX 5.7 & 10 GHz double Horn

Compromise of different phase center positions on each band

-Dixit F6DRO, the gain on each band cannot be optimised because the phasing center on every band is at 2 different locations.
-So a monoband horn has more the preference
-Discussion to be continued

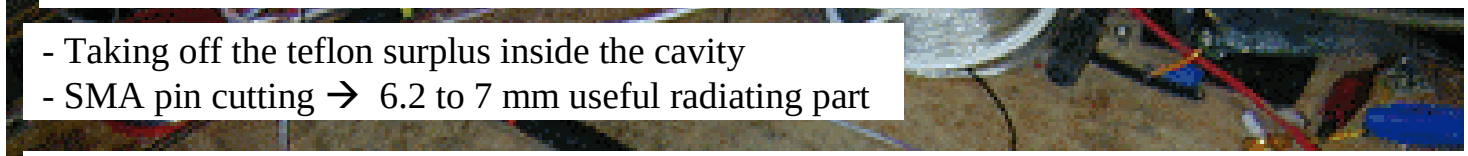
9- 10 GHz SQG horn

Absolutely perfect for offset dishes

Max yield for offset dishes with f/d = 0.85

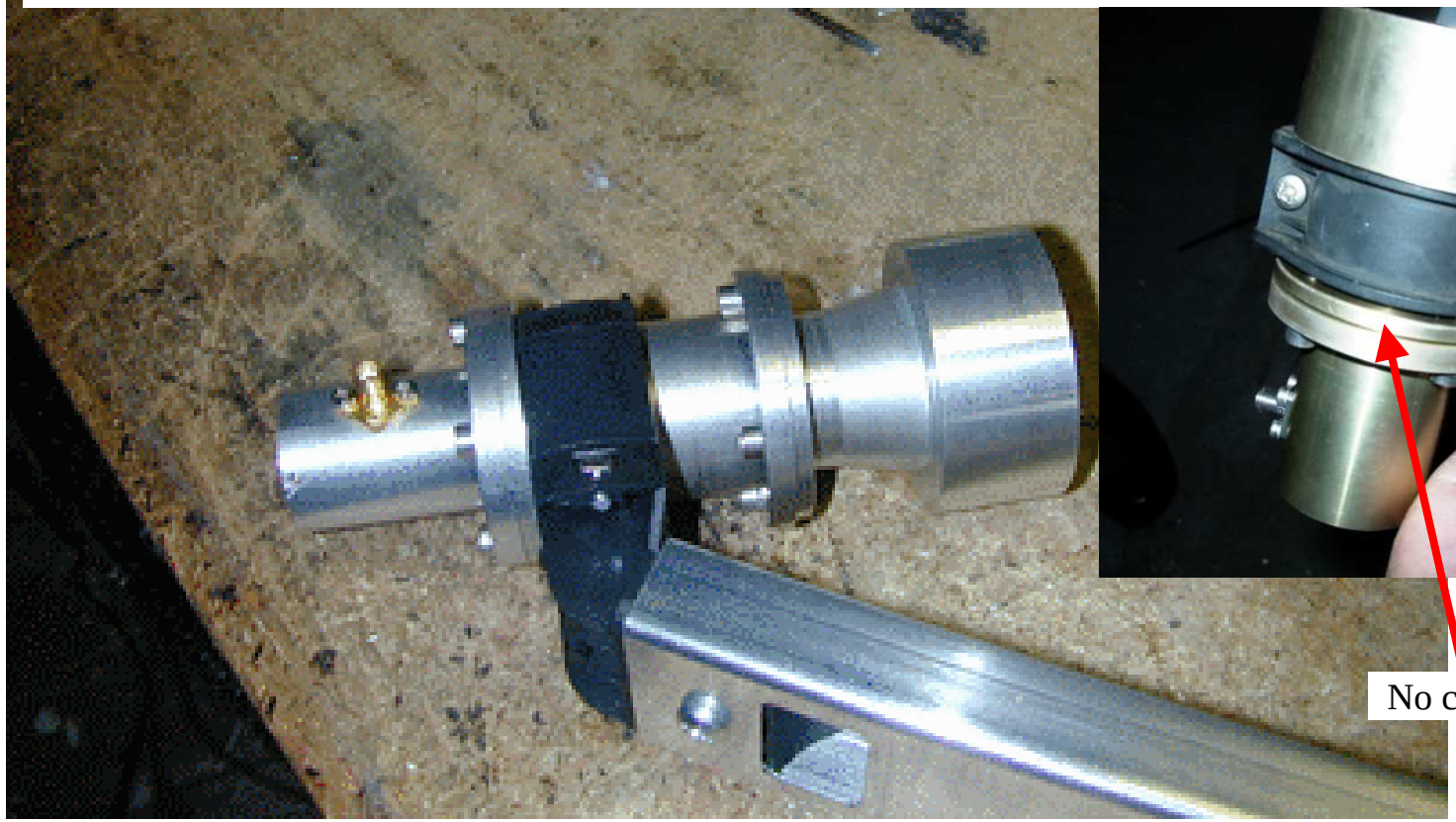
SQG 10 GHz Horn

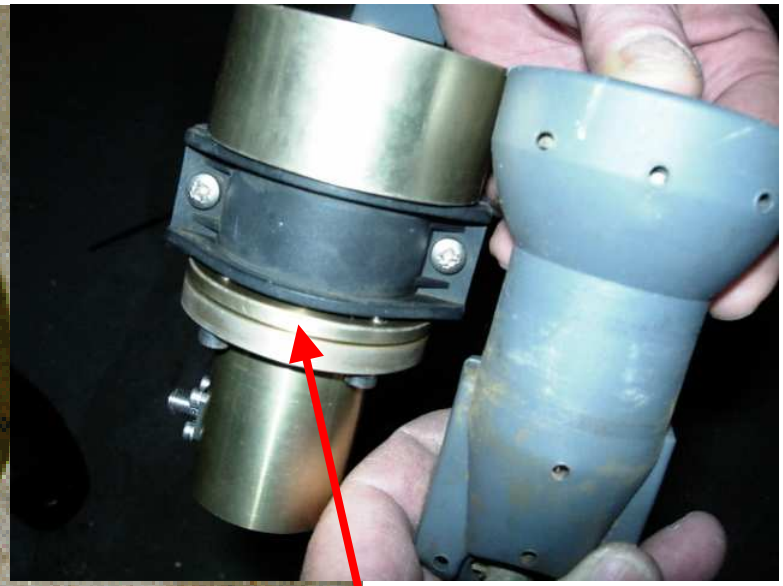
Horn preparing



- Taking off the teflon surplus inside the cavity
- SMA pin cutting → 6.2 to 7 mm useful radiating part

- OZ8AFC Palle from Silverfox Technology Danemark sells it with the reference 10 GHz feedhorn for offset dish
- F4DRU did make the last grouped order





No central fixing part here

SQG 10 GHz Horn

S11 measures

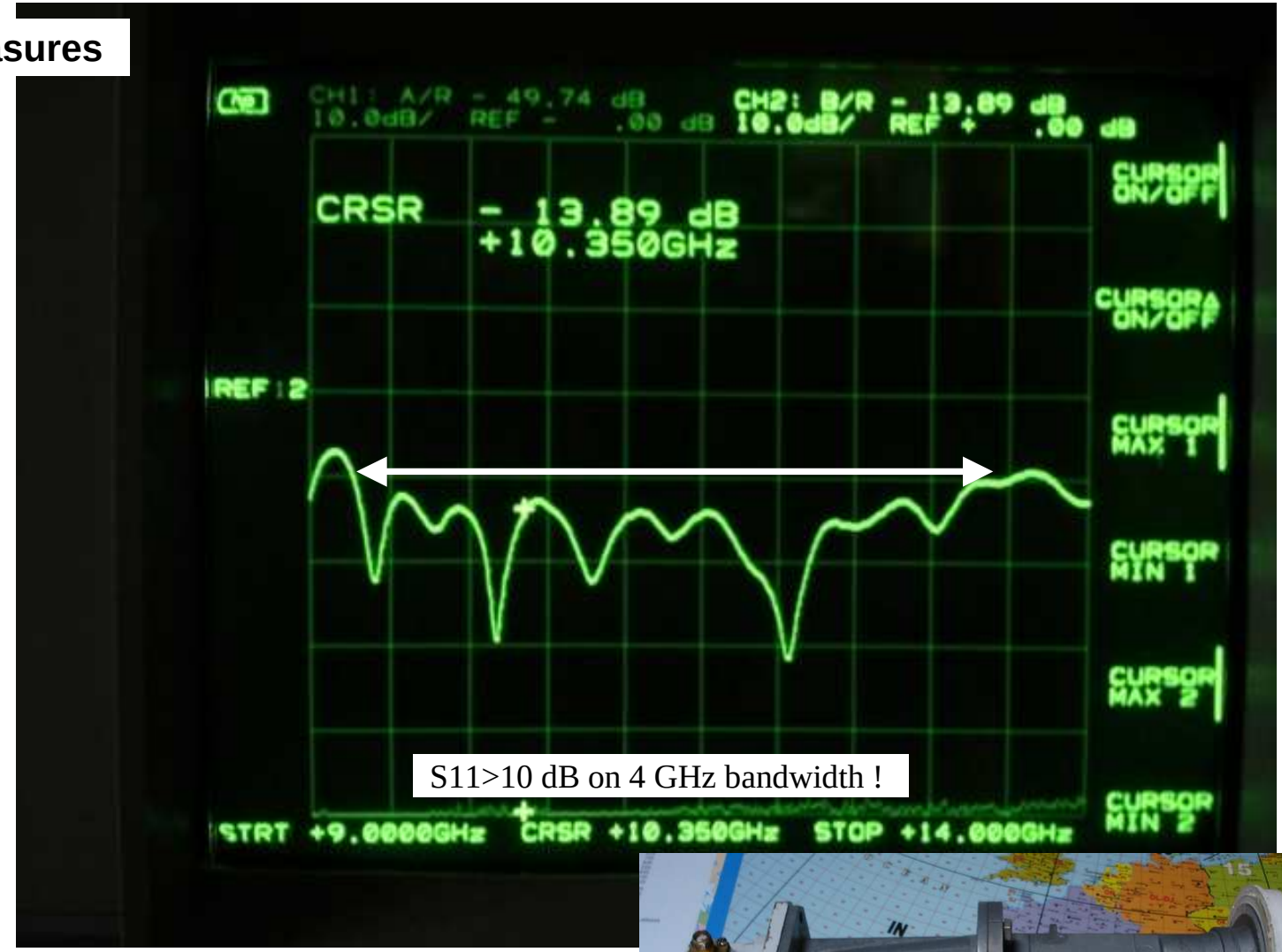
S11>20 dB on 1 GHz bandwidth !

10- Visiosat SATTV horn

For comparaison with the precedent horns

Visiosat SATTV Horn

S11 measures



S11>10 dB on 4 GHz bandwidth !

11- Improvement ideas

Improvement ideas of my setup

-**Better antenna yield** : substitution of the 48 cm prime-focus by a 80 cm offset dish (especially for tropo conditions) → directly better yield of 3 to 4 dB for both Rx & Tx modes

-**Better LO stabilisation** : substitution of the 2.556 GHz LO with a high stability OCXO, rubidium or GPS reference

-**Output amplifier** Pout increase up to 3 - 5 Watts output

Max error expected on a 10.224 GHz LO 0.2 x 96 = 19.2 Hz
No more temperature depending

12V 10 MHz OCXO
Pout=+6.8 dBm

24V 10 MHz
rubidium OCXO

12- 10 GHz setup of some french dXers

Also great thanks to all of them for their given help

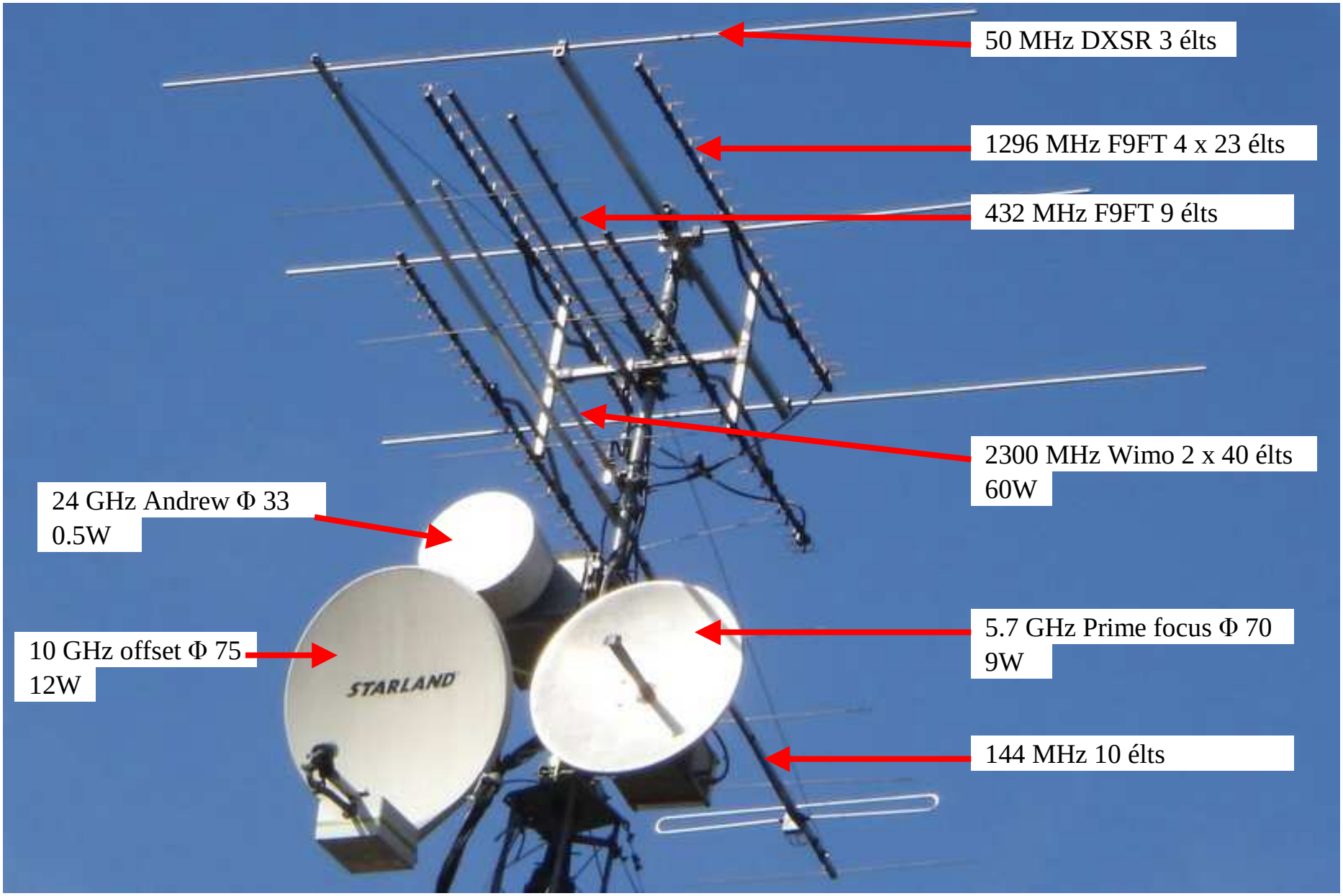
F4DRU/p setup

F4AJS/p setup

F1BZG/45 setup

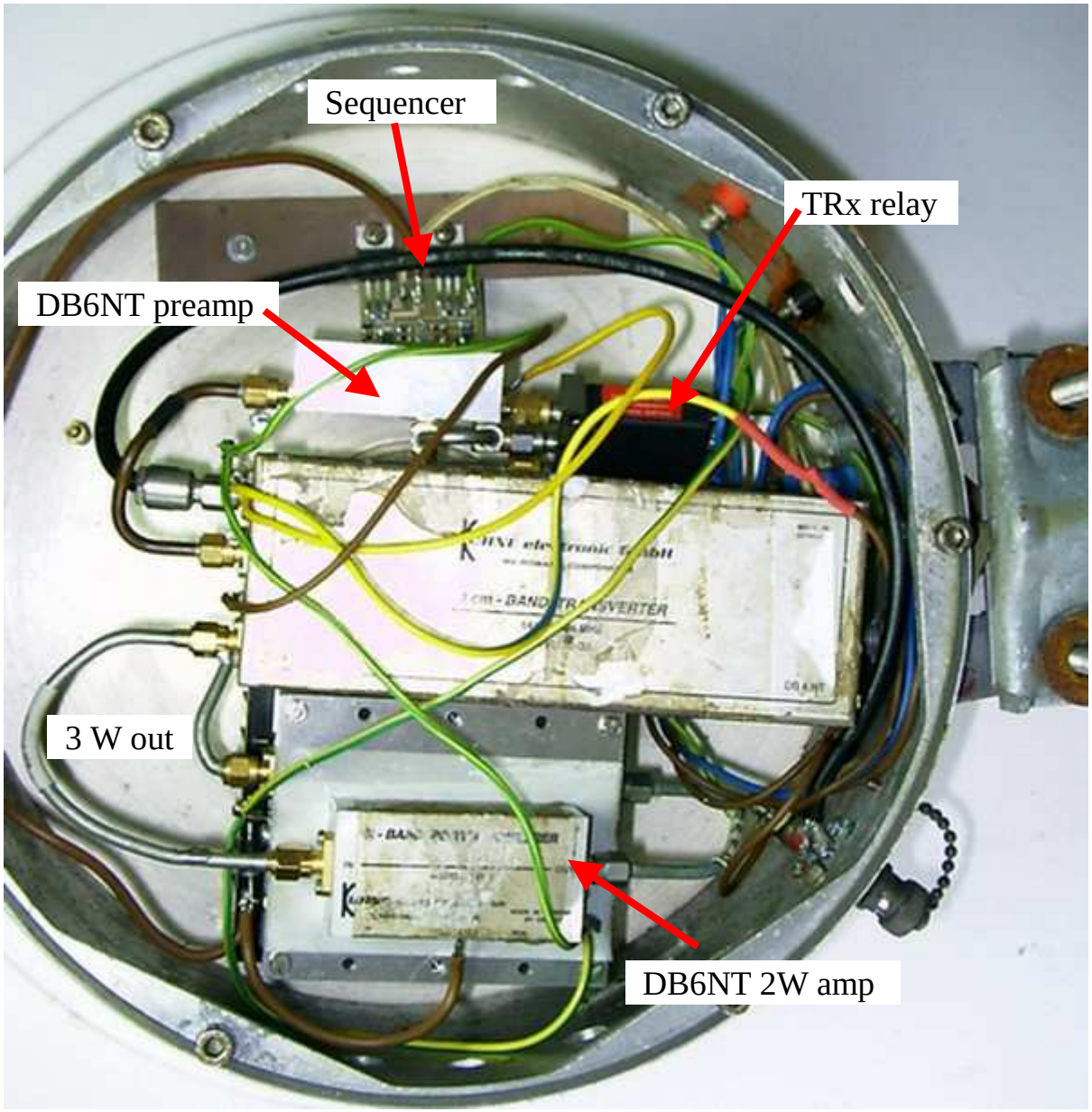
HB9AFO/p setup

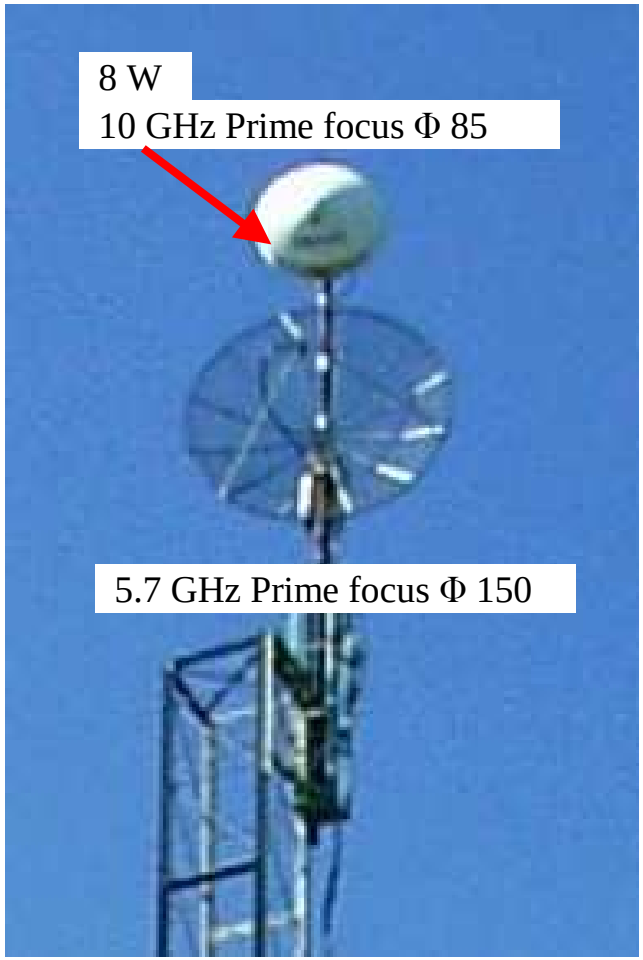
F5HRY setup


50 MHz DXSR 3 élts
1296 MHz F9FT 4 x 23 élts
432 MHz F9FT 9 élts
2300 MHz Wimo 2 x 40 élts
60W
24 GHz Andrew Φ 33
0.5W
10 GHz offset Φ 75
12W
5.7 GHz Prime focus Φ 70
9W
144 MHz 10 élts
STARLAND

F6APE setup

F8BRK setup


Sequencer
TRx relay
DB6NT preamp
3 W out
DB6NT 2W amp


8 W
10 GHz Prime focus Φ 85
5.7 GHz Prime focus Φ 150

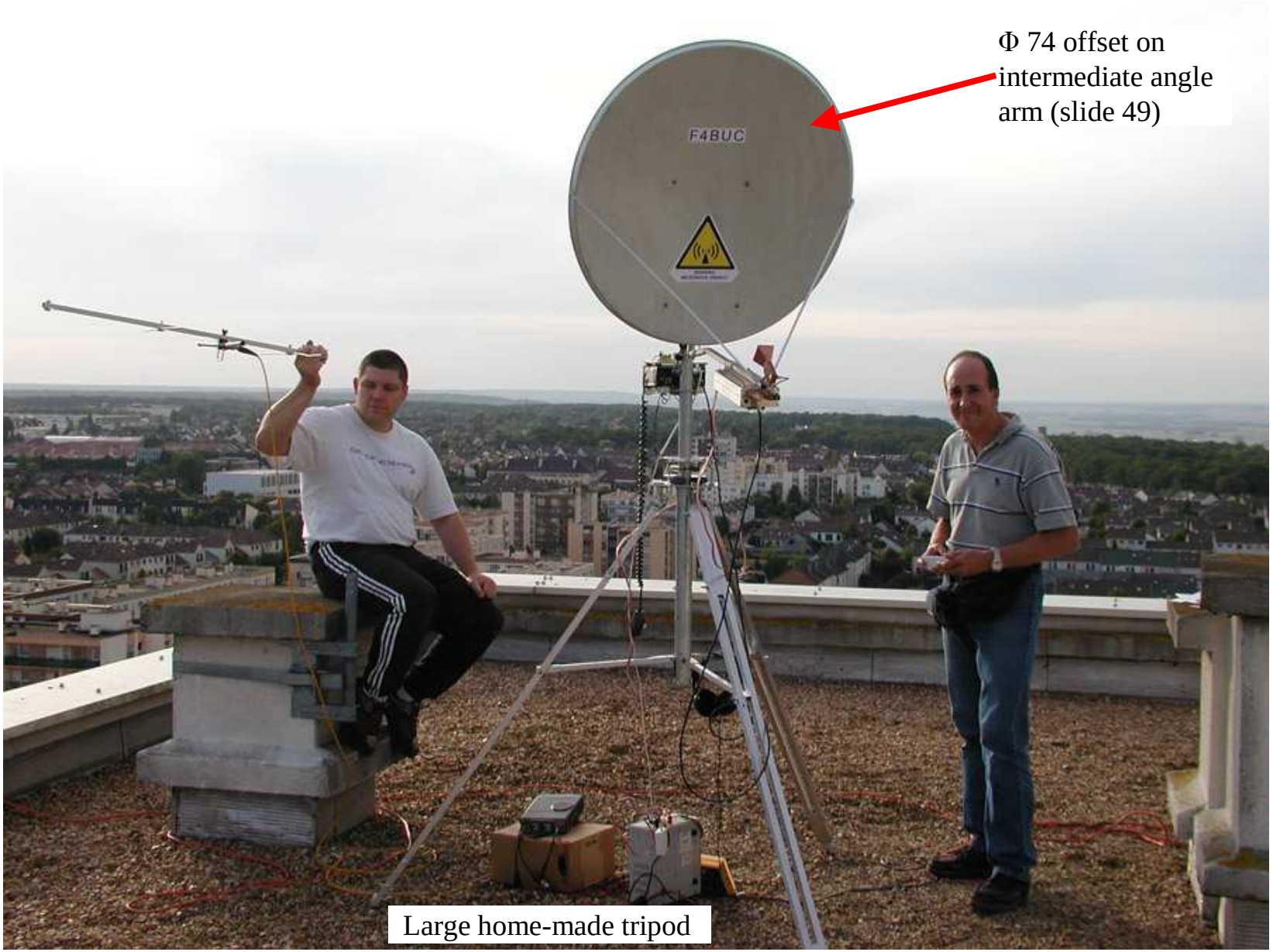
F2CT/p setup

10W à 10 GHz & offset Φ 1.20

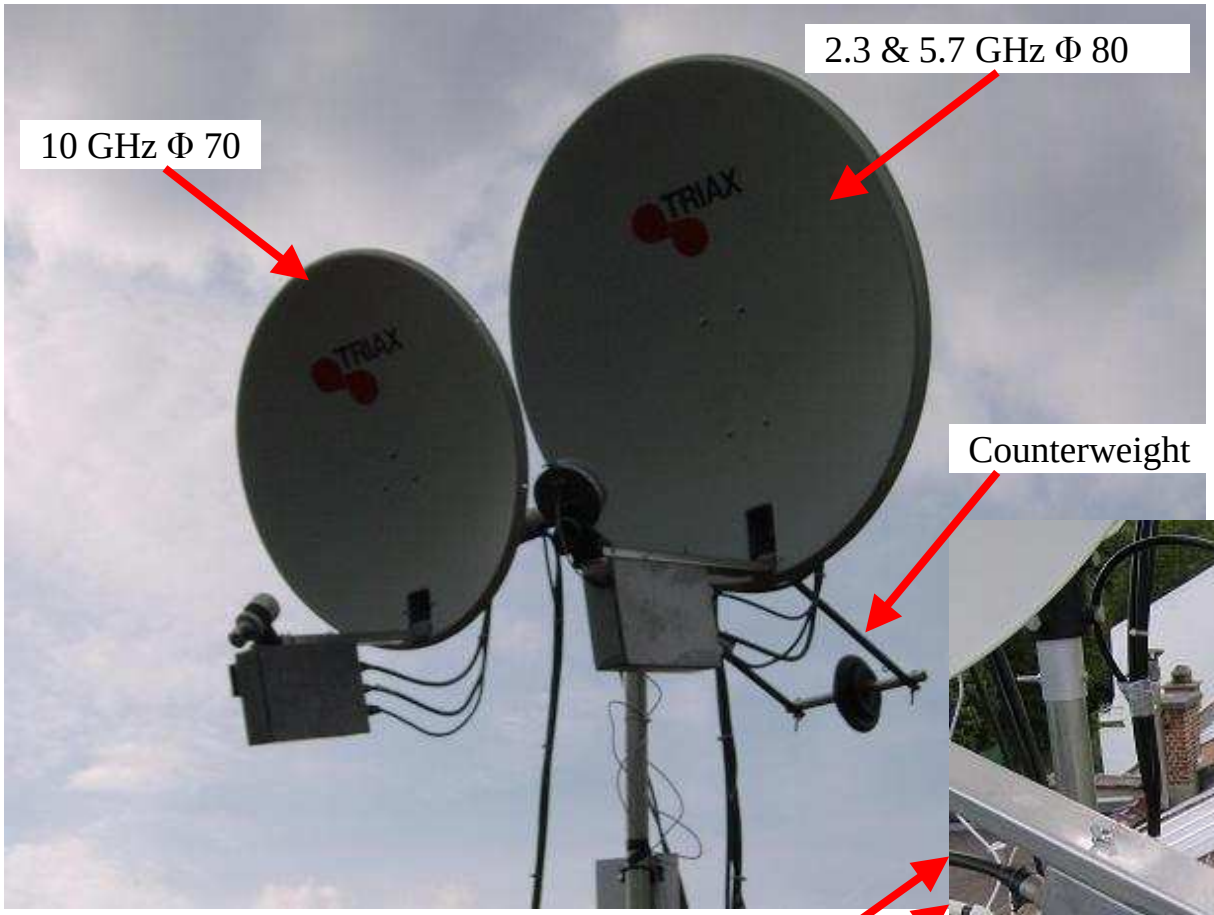
F6ETI setup

5.7 / 10 GHz IK1GEX feed on prime focus Φ 90

F4BUC & F1PDX/p setup

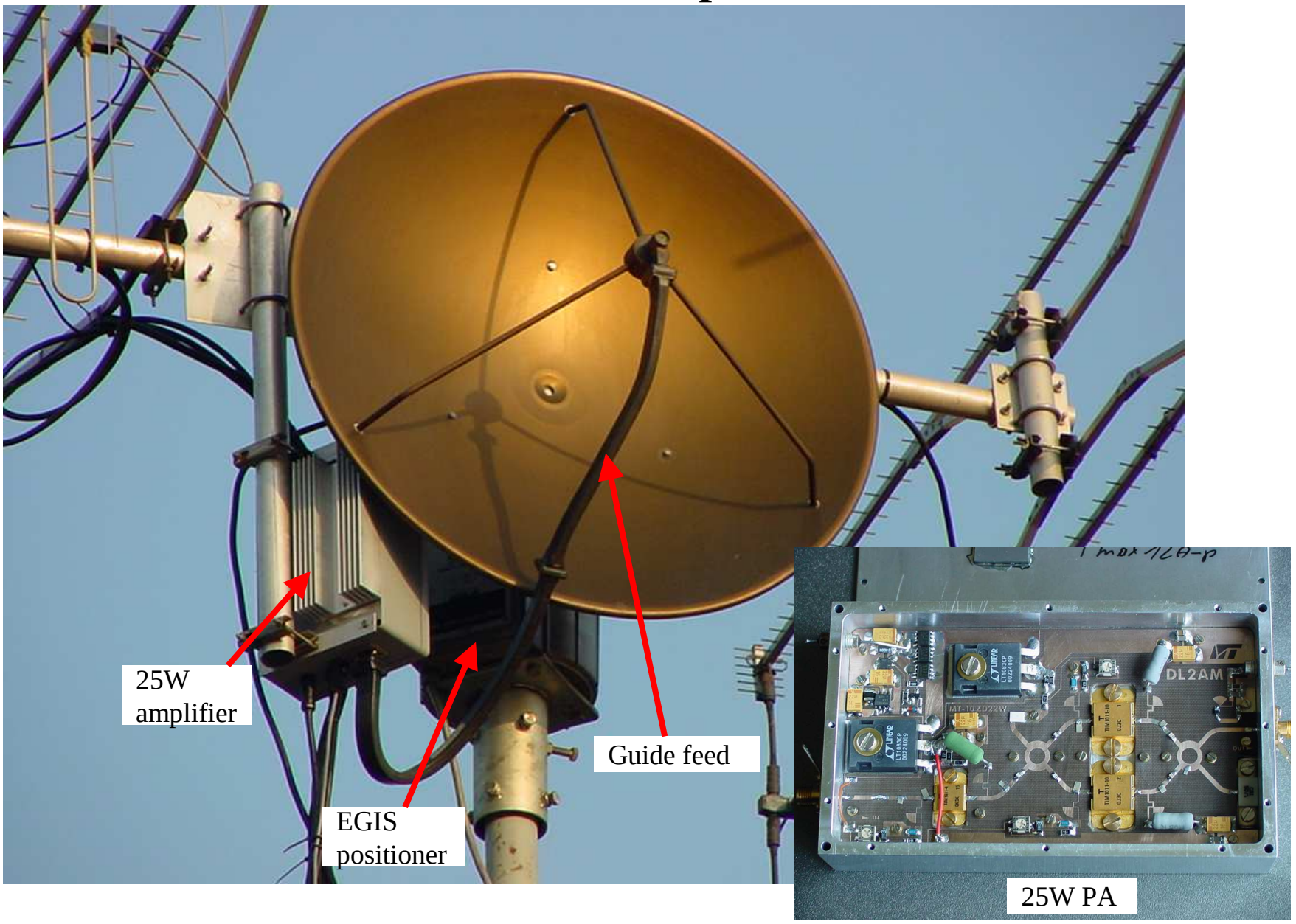


ON5TA setup

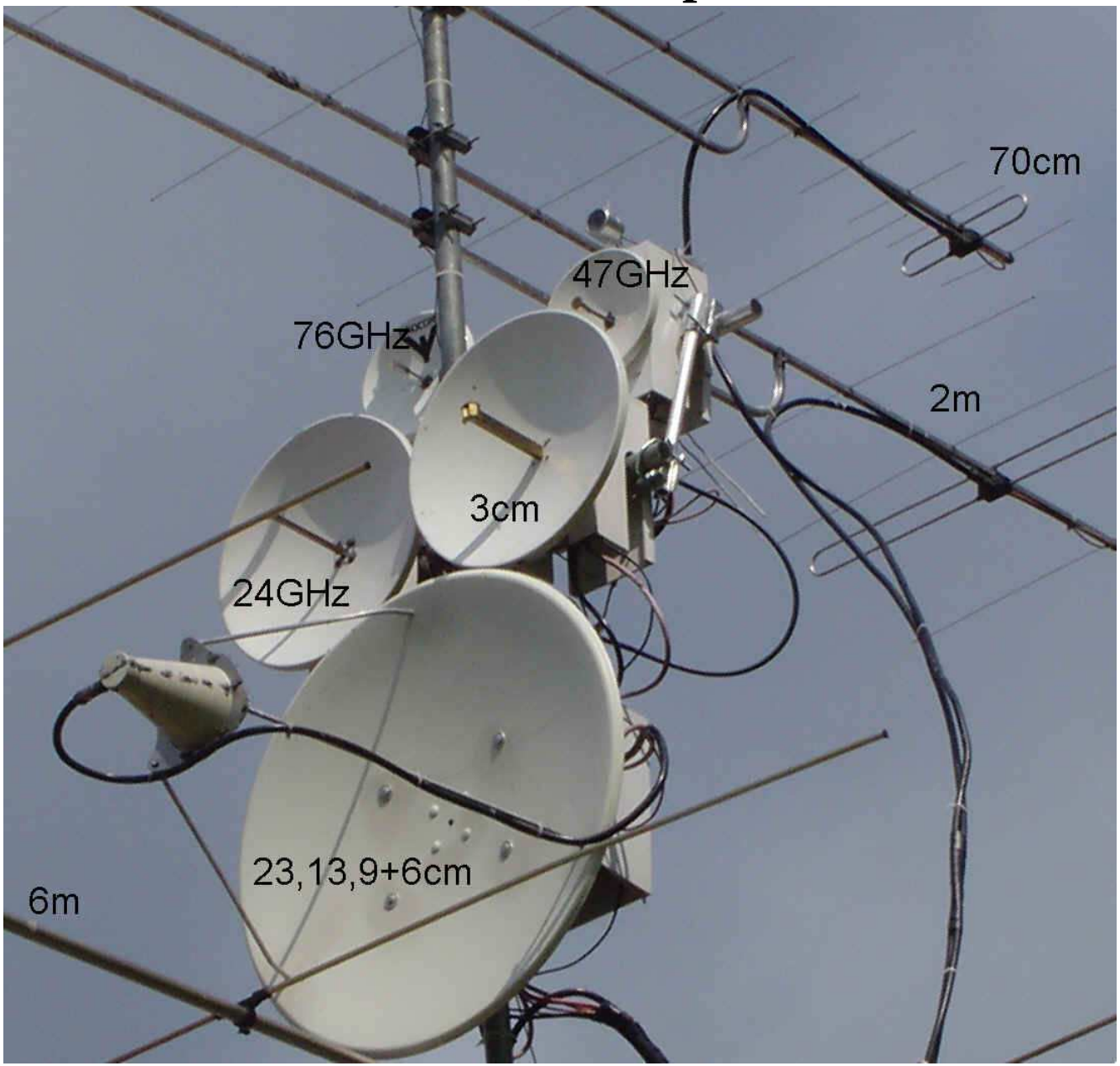


- 144 MHz feed
- OCXO locking
- 12V DC feed

DF6NA setup



DL7QY setup



13- Aknowledgements

To the whole french « hyper ham » world, also to DD7PC and especially F1PDX for his great help.