

*Manfred Ploetz DL7YC*

# TWTA modifications

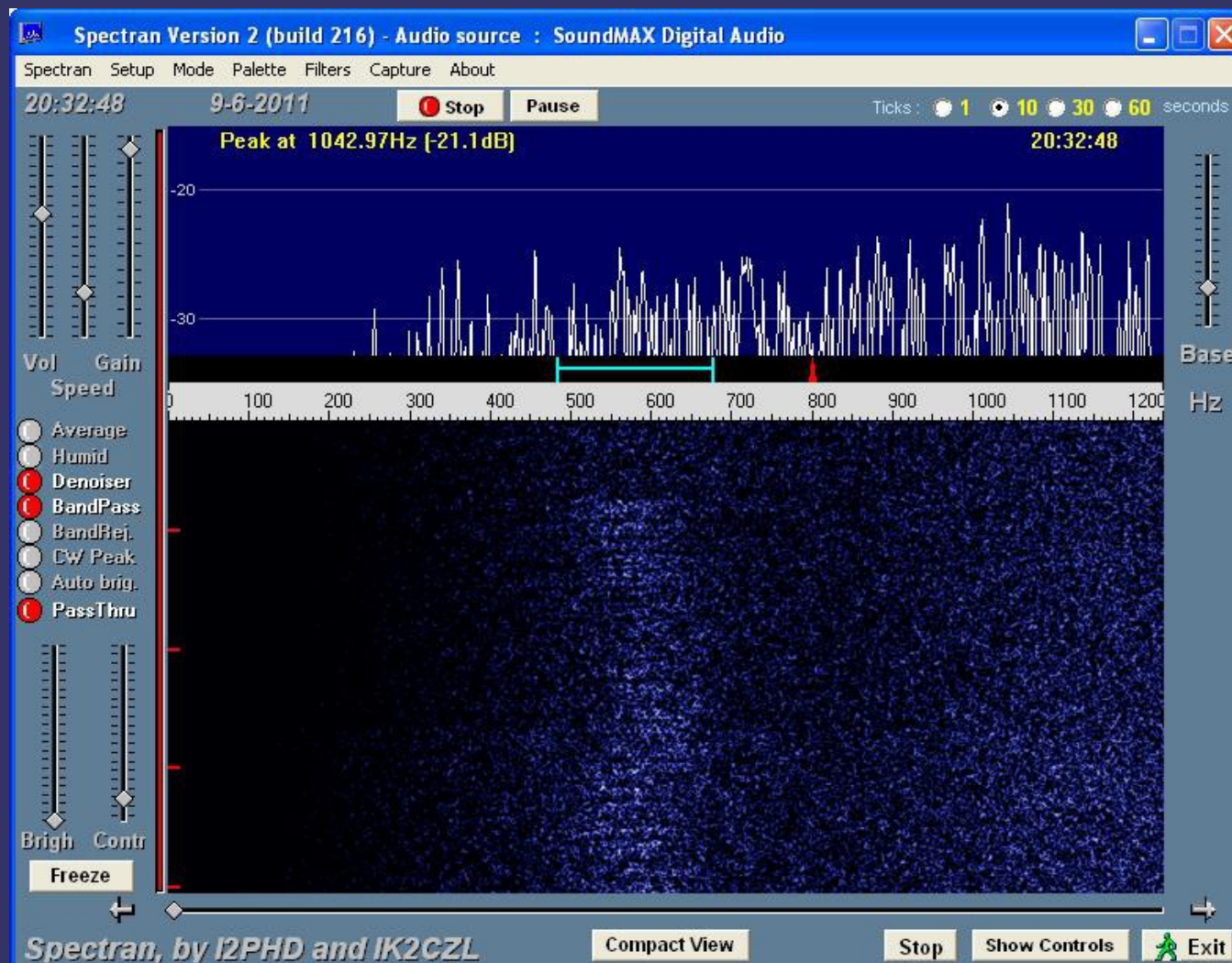
A rocky road ?

# *What are the reasons for 24GHz TWTA modifications ?*

- ⇒ **Echoes too quiet or inaudible**
- ⇒ Commercial SSPA's too expensive
- ⇒ Single MMIC's available having not enough total power
- ⇒ Combining Medium Power SSPA's with Magic-T's is very difficult
- ⇒ Former AM TV 12GHz transmitters  
RW 1127 surplus available



# Marginal echo example @ 24 GHz



The EME chat (by ON4KST) Web 2.0 version - Windows Internet Explorer

http://www.on4kst.info/chat/index.php

EME Konferenz

DATEI Bearbeiten Ansicht Favoriten Extras ?

The EME chat (by ON4KST) Web 2.0 version

MENU Send DL7YC

UTC	CALL/NAME	EME MESSAGE
22:39:08	DL7YC Manfred	5LUA :))
22:38:19	W5LUA al	Manfred QSL hope you have gl. I have seen the emails
22:36:24	DL7YC Manfred	(W5LUA) ga AI - will join in 00:00 24GHz with RX
22:36:11	S52LM Milos 4x17_1500	GN All
22:24:49	IK5WJD Alex	Good nigh Howard.
22:23:34	G4CCH Howard. 23cm	OK Alex 73 & GN
22:19:34	IK5WJD Alex	ok, the future is for us...hi. TNX fgor the test. Actually I copied good
22:17:57	G4CCH Howard. 23cm	sorry will have to stop now, maybe we can try again another night
22:16:08	IK5WJD Alex	maybe this could due to High lat. AU ??
22:15:18	IK5WJD Alex	also for me - initially sigs are good - in this moment very difficult

7 of 2299 registered users

DL7YC	JO62PK	Manfred
DU1GM	PK04MP	George
K2DRH	EN41VR	Bob2
ON4KST/T	JO20HI	Alainetnet
VE4MA	EN19LU	Barry
VE6CPP	DN39OR	Jer
W5LUA	EM13QC	al

Spectran Version 2 (build 213) - Audio source : SB Audigy Audio [9400]

Spectran Setup Mode Palette Filters Capture About

01:12:18 18.02.2008 Record Mouse : -2483.8 Hz Ticks : 1 10 30 60 seconds

Peak at -642.72Hz [-50.4dB]

01:12:03

Vol Gain Base

Speed

Average Humid Denoiser BandPass BandRet. CW Peak Auto brig. PassThru

Brigh Contr

Enable

-86.1 dB

500 0 -500 -1000 -1500 -2000 -2500 Hz

Spectran, by I2PHD and IK2CZL

Compact View Stop Show Controls Exit

WSJT 4 by K1JT

File Setup Mode Decode Save Band Help

MOON (DX)

Az: 96.49

El: 38.51

MOON

Az: 255.80

El: 41.98

RA: 07:23

Dec: 24.75

LHA: 52.96

MaxNR: 0.11

Freq: 24048

Tsky: 3

Doppler: -2133

dB: -0.82

Dgrd: -0.98

0 0.0 Time (s)

File ID Sync dB DT DF W

Monitor Play Stop Save Last Decode Erase Clear Avg Include Exclude JT65 B TX First

To radio: Grid (6-digit): Defaults Sked

VE4MA EN19lu Sync 0 Zap

4298 mi 6917 km Clip 0 Freeze Custom

Az: 317 Tol 400 AFC

2008 Feb 18

00:12:17

W5LUA DL7YC JO62 Tx1

W5LUA DL7YC JO62 000 Tx2

RO Tx3

RRR Tx4

73 Tx5

CQ DL7YC JO62 Tx6

Dsec=0 Sync > 0 Clip=0 Tol=400

Sun / Moon to Egis

WSJT Sun Moon Data RotorServer Manual send About

☒ Enable data transfer to RotorServer

☒ Round Az 2

☒ Round El 2

☐ Always no digits

☐ Negative value not s

Send Data to Egis all X ms 3100

Rest period between Az & El 1000

Data send

AZ: 256

El: 042

Papierkorb

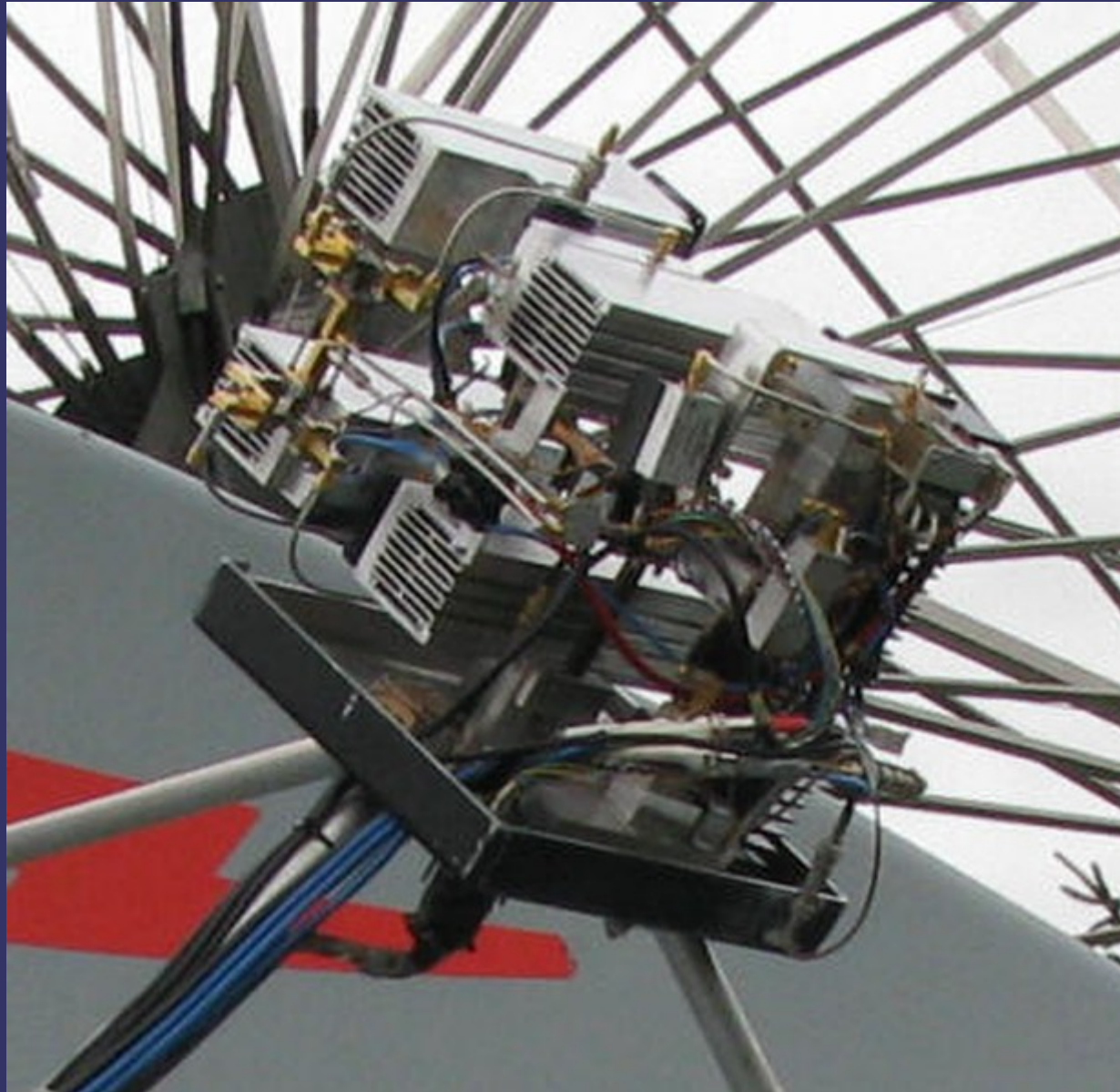
This is the 529 CW-signal (R 000) from W5LUA in a QSO with VE4MA at 17.2.08.  
 Received with a 2.4m segment dish (f/D 0.33), feed system is a 8mm round wave guide, preamp  
 DB6NT LNA243 RX2 with 1.05dB NF @ -5deg. C. sun noise 10.42dB / moonnoise 1.05 dB

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# ***4 x 10 Watt SSPA at LX1DB***

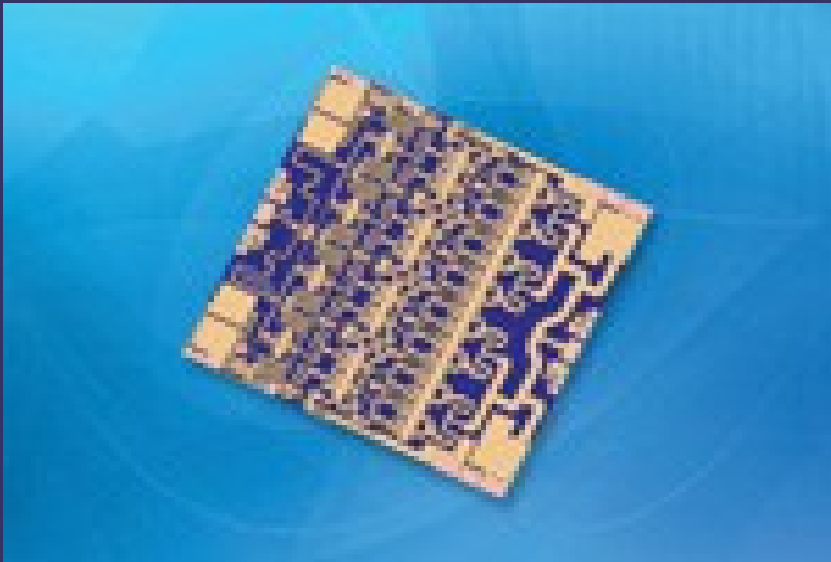


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# *TriQuint TGA 4906*

## ➞ 4 Watt Ka Band High Power Amplifier



### Key Features

Frequency range: 28 to 31 GHz

36 dBm nominal Psat

Gain: 24 dB

Return loss: -8 dB

Bias:  $V_d = 6\text{ V}$ ,  $I_{dq} = 1.6\text{ A}$ ,

$V_g = -0.75\text{ V}$  typical

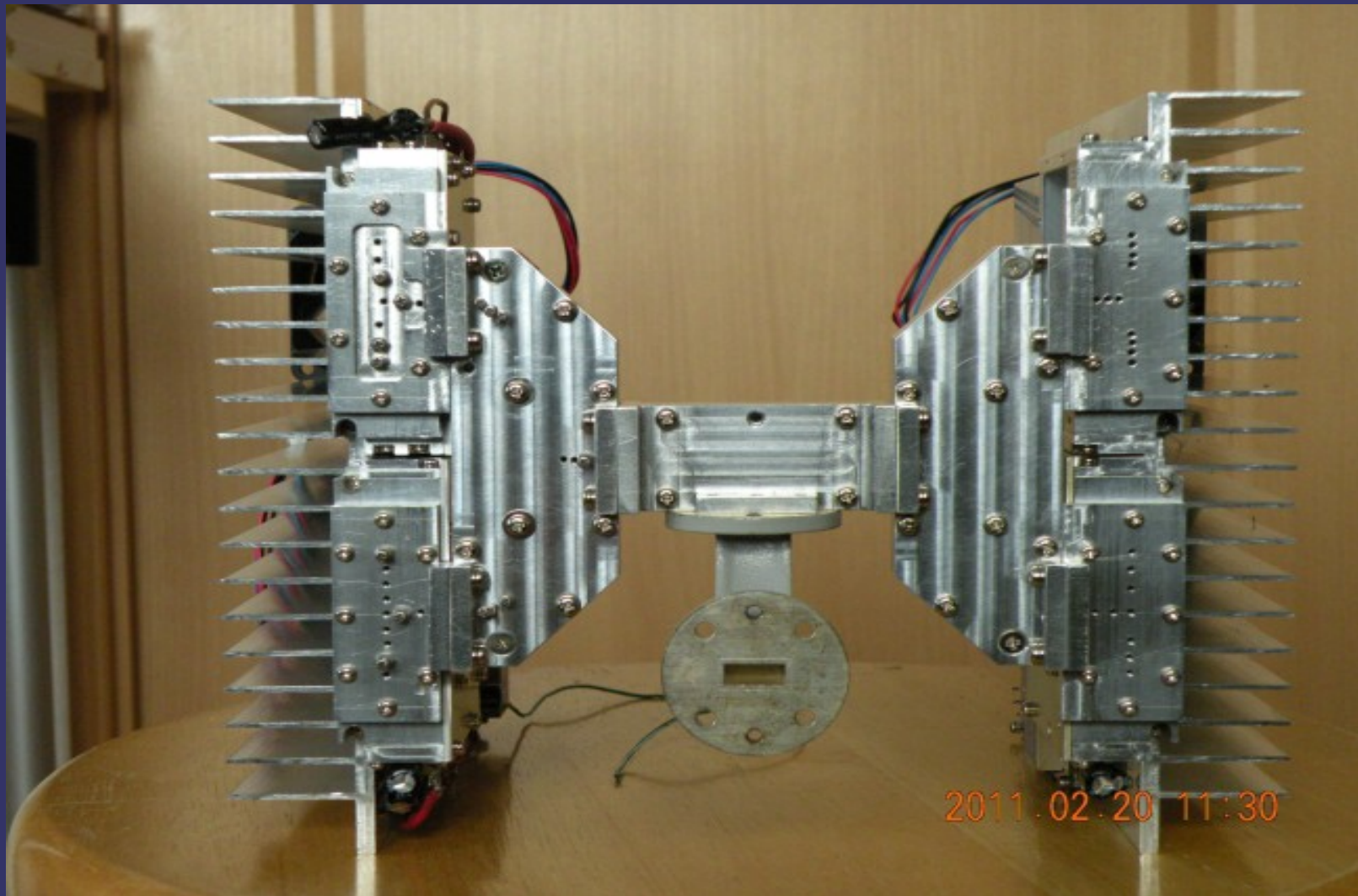
Technology: 3MI 0.15  $\mu\text{m}$  Power pHEMT

Chip dimensions: 2.98 x 2.90 x 0.05 mm

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# *24 GHz Power Combiner JA6CZD*





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- ⇒ **Former 12GHz AM TV-transmitters RW1127 + RWN PSU`s surplus available**

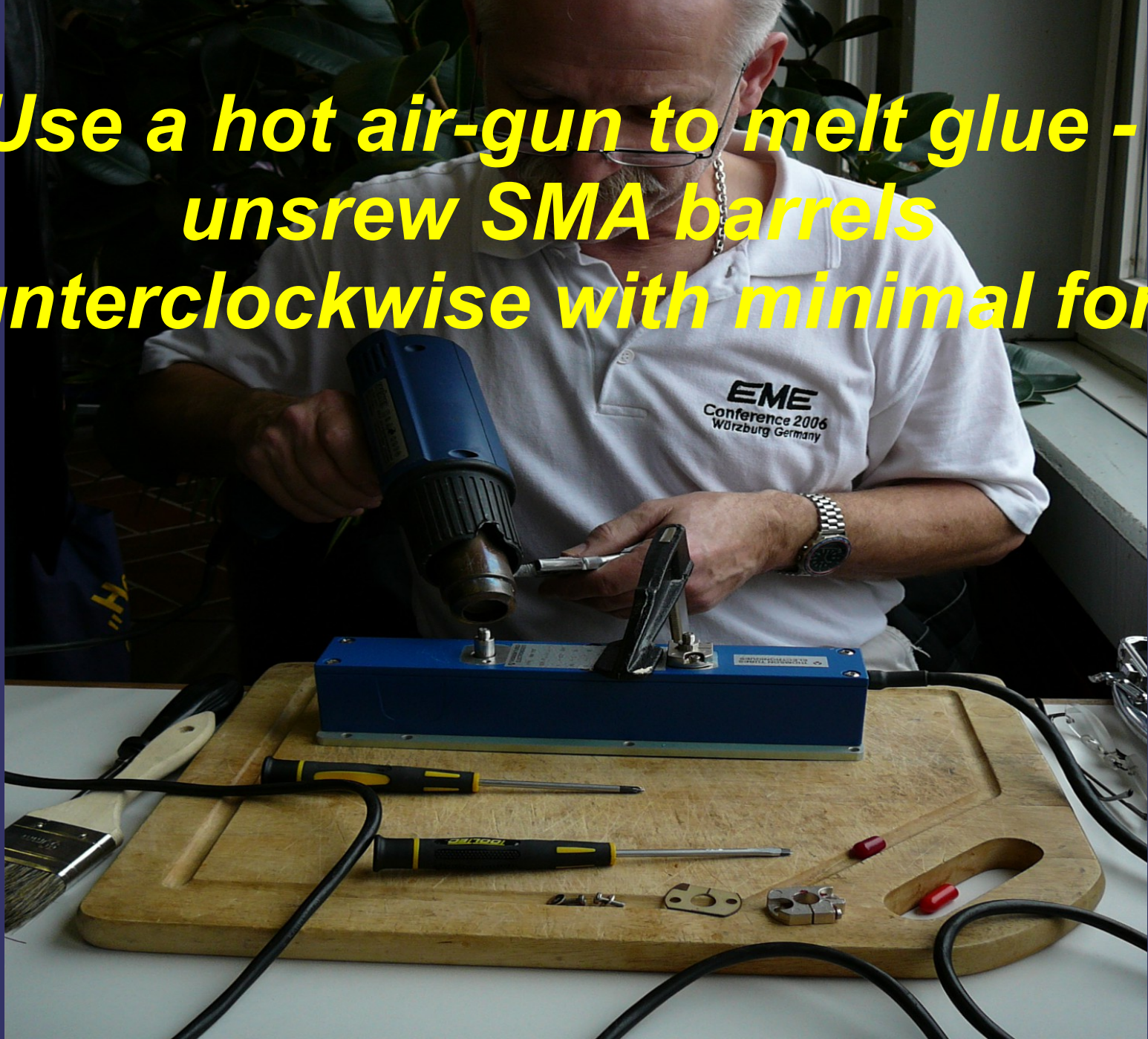


# *Real 24GHz tube advantages ?*

- ⇒ High output power (30-45 watts) possible
- ⇒ Power combiner not necessary
- ⇒ Simple mechanics – very easy to duplicate
- ⇒ Easy and **save** final setup - due to pretuning of transitions and voltages

*How to prepare the tube ?*

***Use a hot air-gun to melt glue -  
unscrew SMA barrels  
counterclockwise with minimal force***





**Carefully remove the SMA barrels -  
heat up again from time to time**

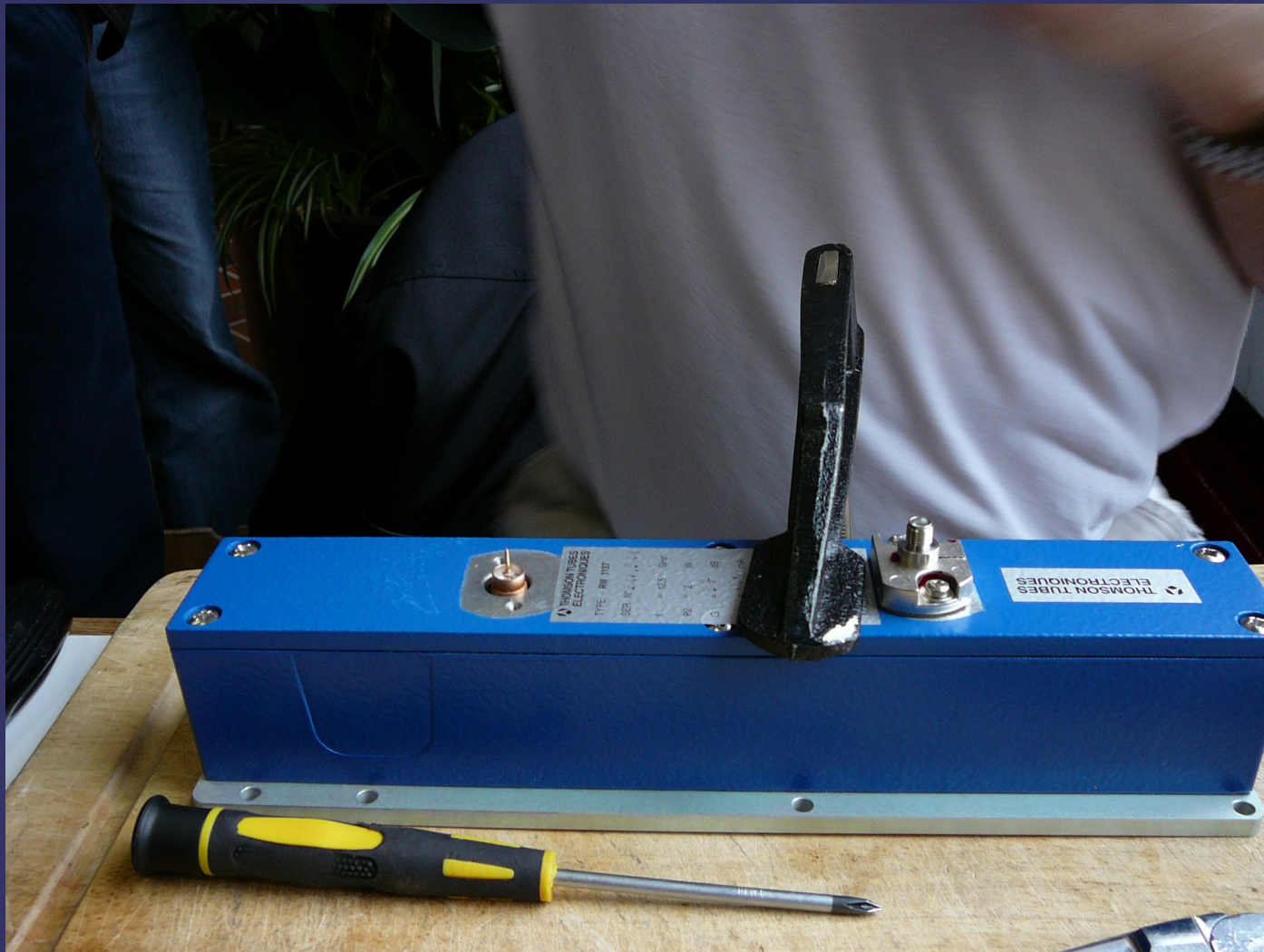




***The two weld spots at the center pin  
should be carefully filed or ground  
away***



***Finally remove the discs – the tube has „broadband“ capability now***





***Fragile Helix connector ready  
– never try to cut the center pin !!***



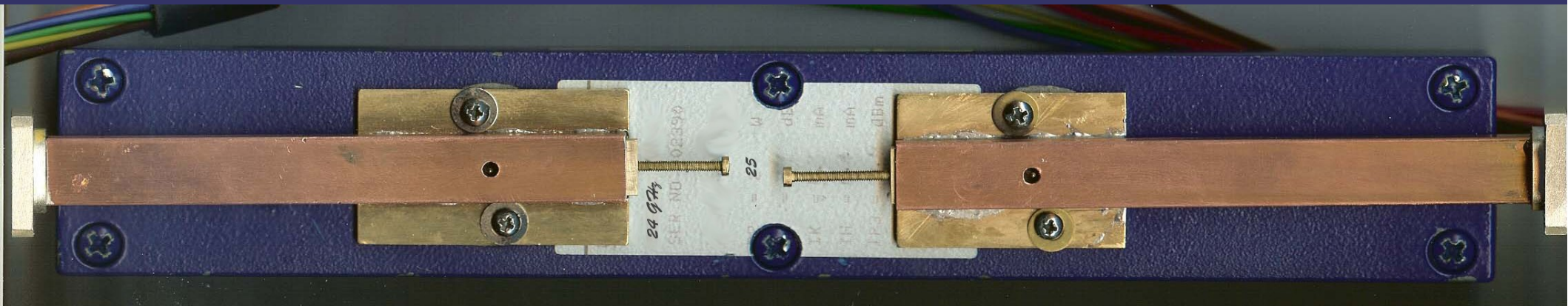
***NOW*** you need something like that:

***Baseplate with 8mm precision hole  
to contact Helix coax***



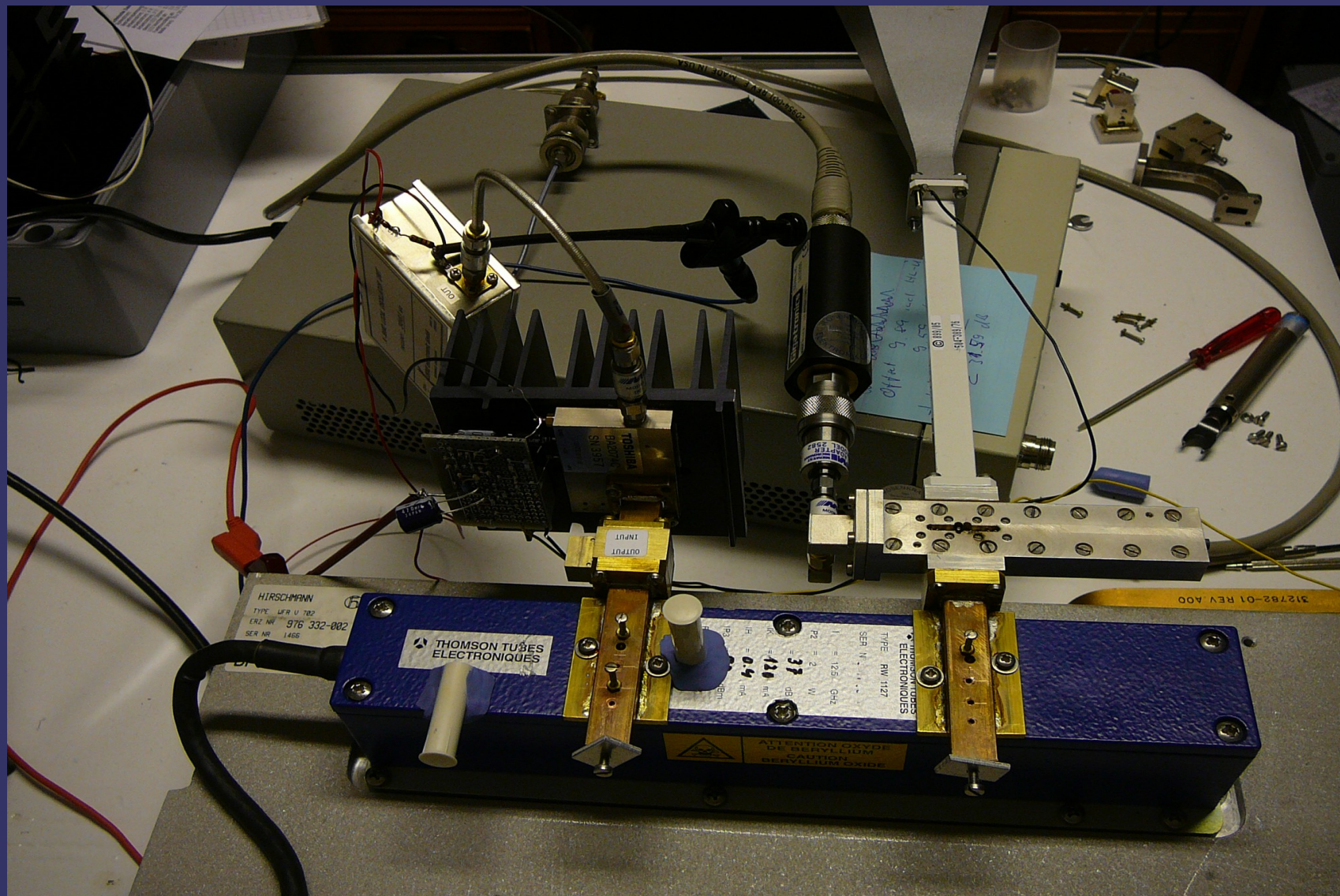


# *G4NNS version with sliding short*

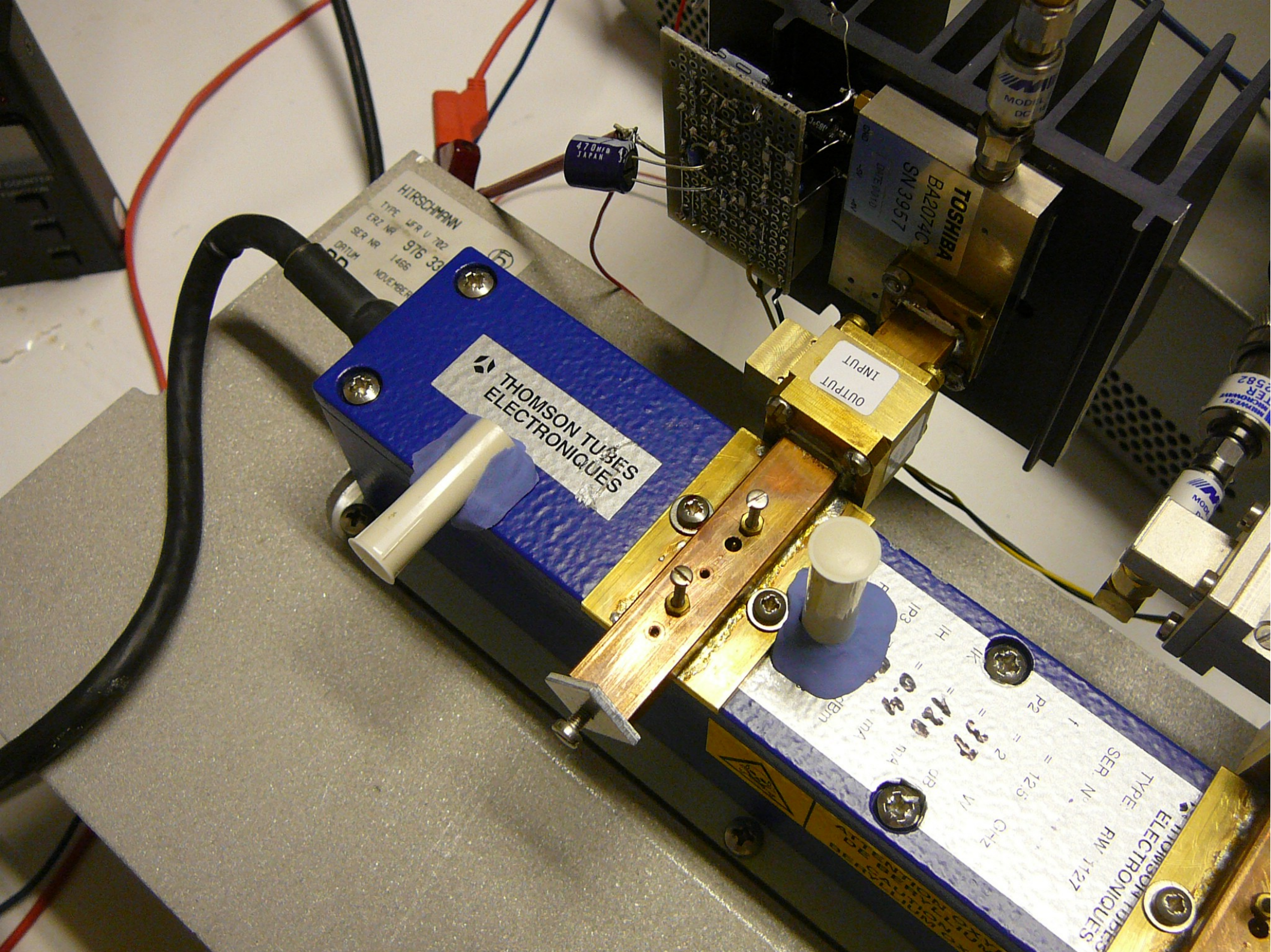




# DL7YC first solution in 2008







HIRSCHMAN

TYPE LFR V 702  
SER. NO. 976 33  
DATE NOVEMBER 1965

THOMSON TUBES  
ELECTRONIQUES

INPUT  
OUTPUT

TOSHIBA  
BA2074C  
SN 3957

470MFD  
JAPAN

TYPE 6X4  
P2 = 12.5  
Q = 4.2  
I = 2  
W = 3.8  
Ib = 1.0  
Ip3 = 0.4  
Ipk = 1.0

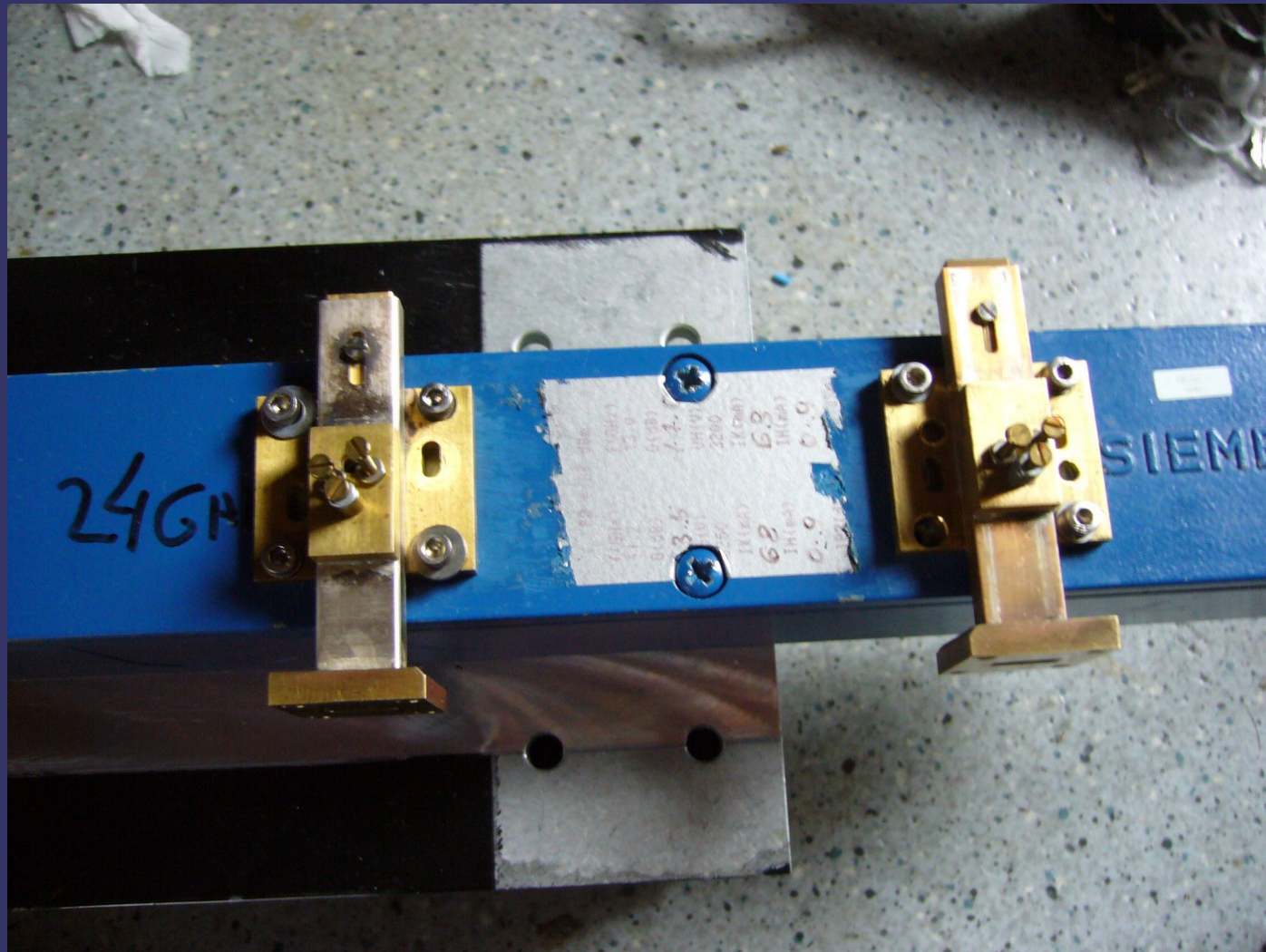
THOMSON TUBES  
ELECTRONIQUES  
TYPE RM 1127  
SER. NO. 1455



*First power 29 watts – improved with additional magnets to **35watts !!***

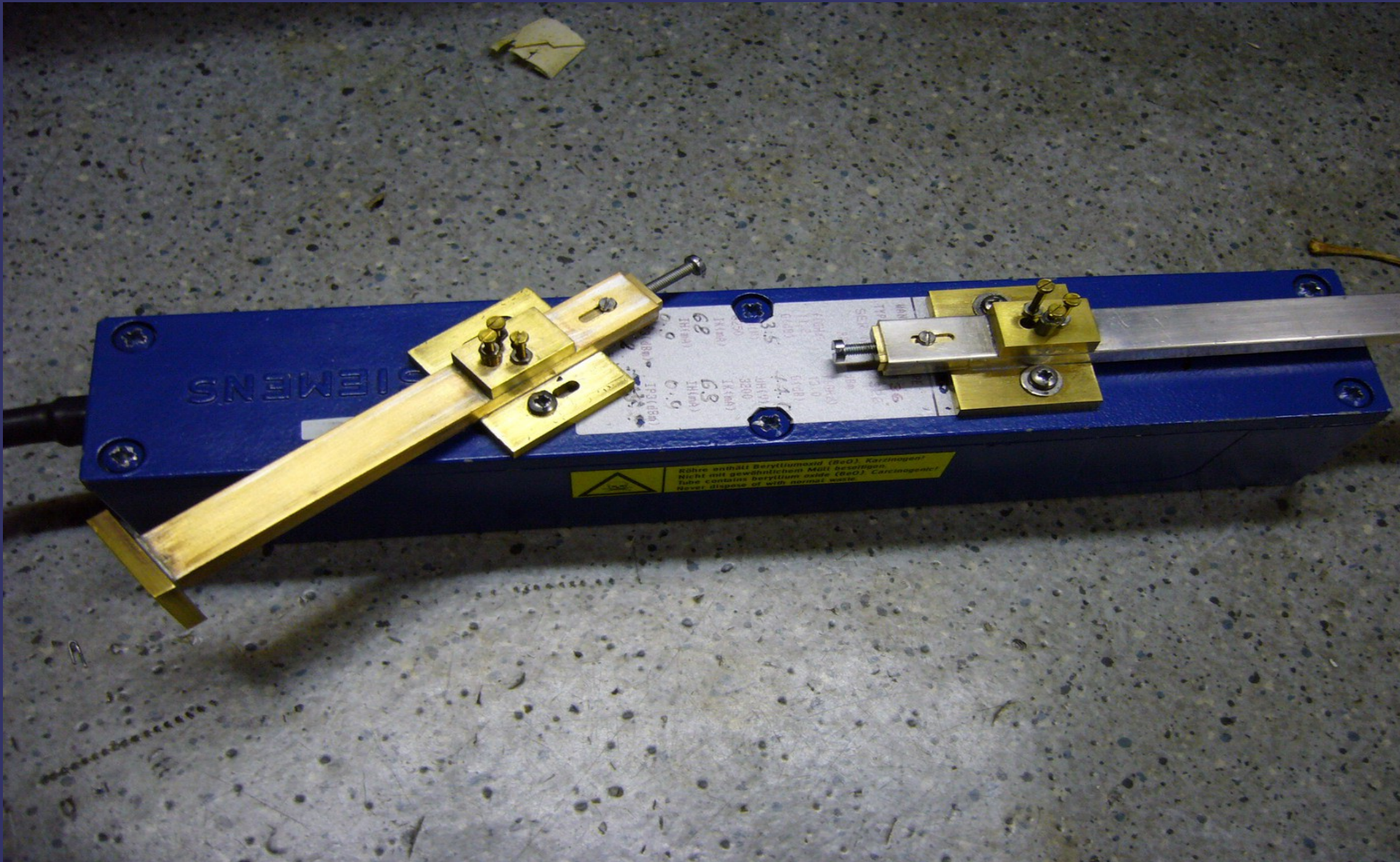


# *Another different solution for the 24GHz TWTA adaption*





## A blue Siemens test fixture, likely for testing electrical components, is shown resting on a grey, speckled surface. The fixture consists of a main blue body with two brass contact arms extending from it. The left arm is angled downwards, while the right arm is horizontal. Both arms are secured with brass blocks and screws. A white label is affixed to the blue body, displaying technical specifications in German and English. A yellow warning label is also visible on the blue body. The Siemens logo is embossed on the left side of the blue body. The background is a grey, speckled surface, possibly a workbench or floor.

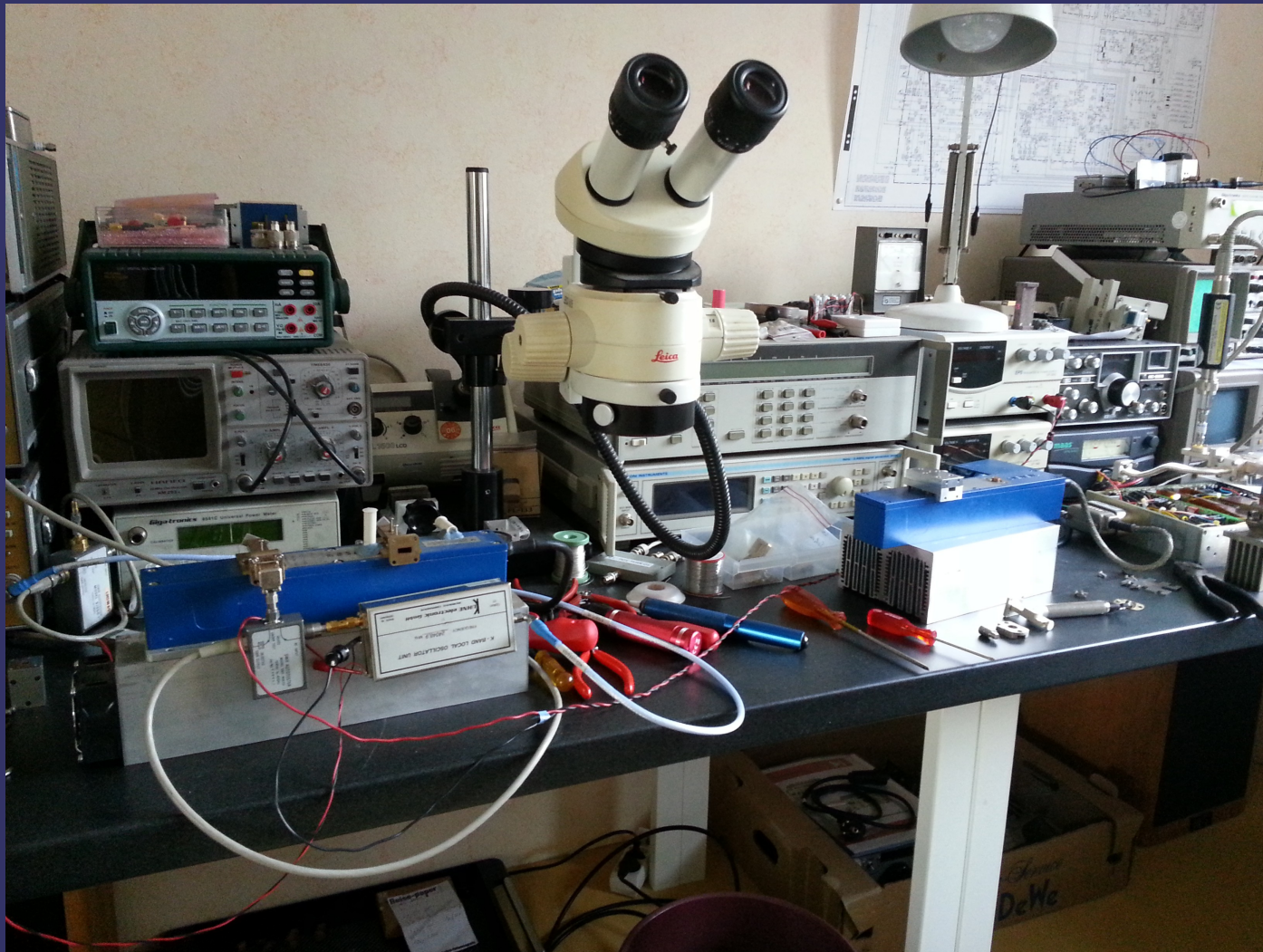




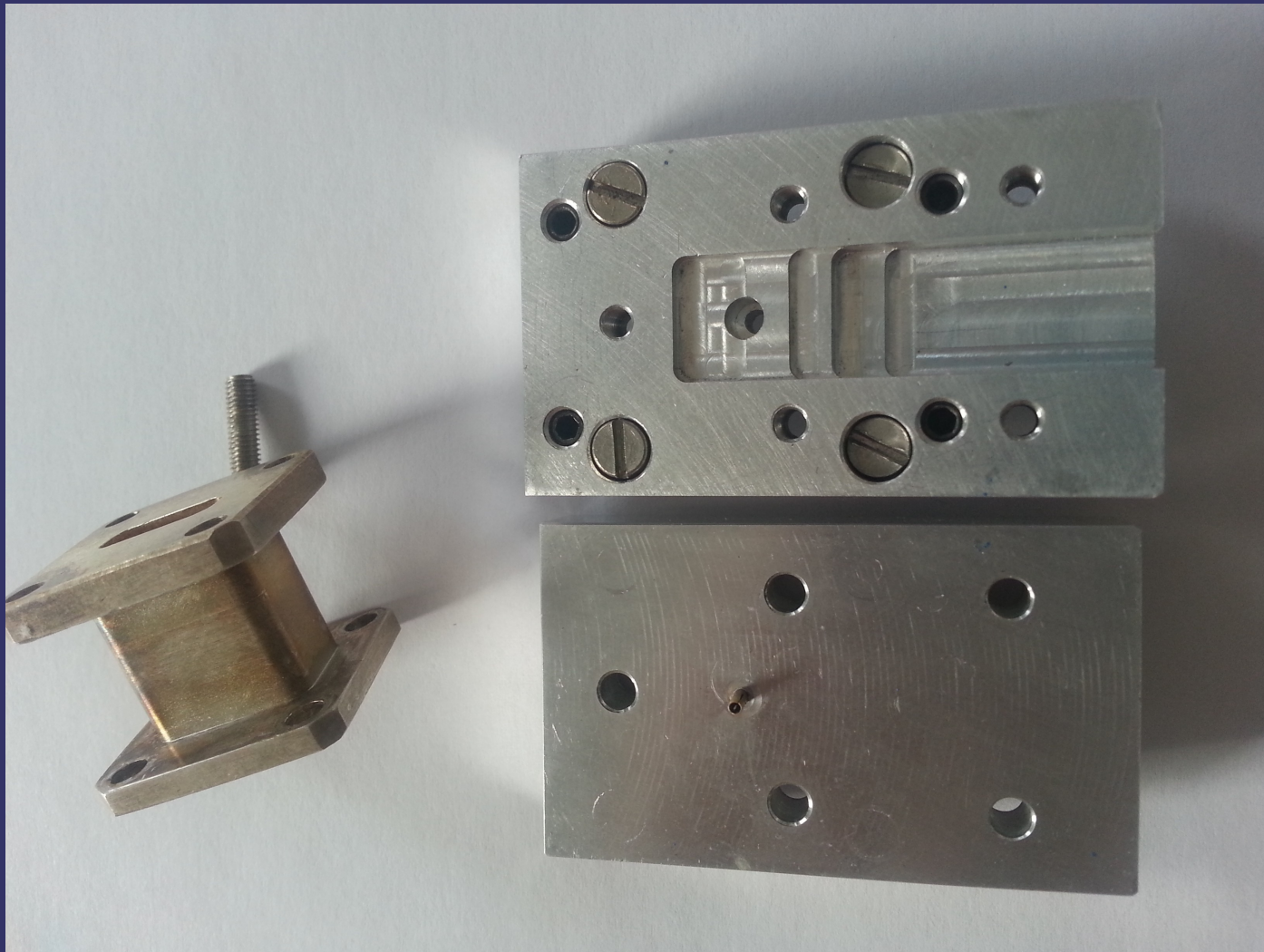
# *40 watts a realistic value ?*

- ➔ I was not comfortable with this solution, because the center pin of Helix-coax system seems to be too long protruding the whole WG
- ➔ Therefore the first trial was to „lift up“ the baseplate to bring the pin just below  $h/2$  WR-42 WG
- ➔ Due to the increased „coaxial“ length with unknown  $Z_0$ , unpredicted effects reduced Power again
- ➔ Search for different ways.....

# *DL7YC lab -several TWTA's on bench*

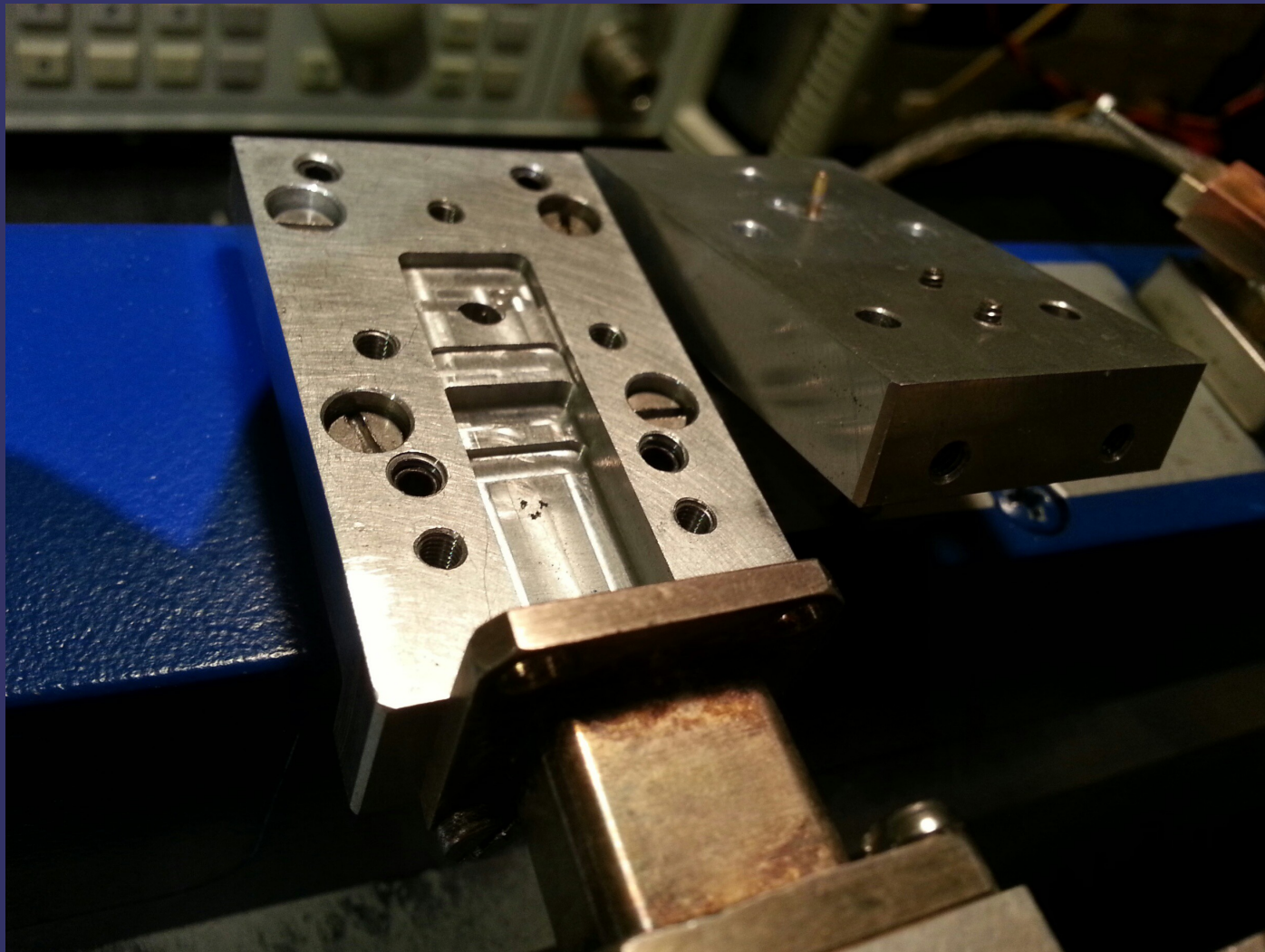


# ***Milled Helix/WR-42 transition by DC0LB (center pin contact WG)***

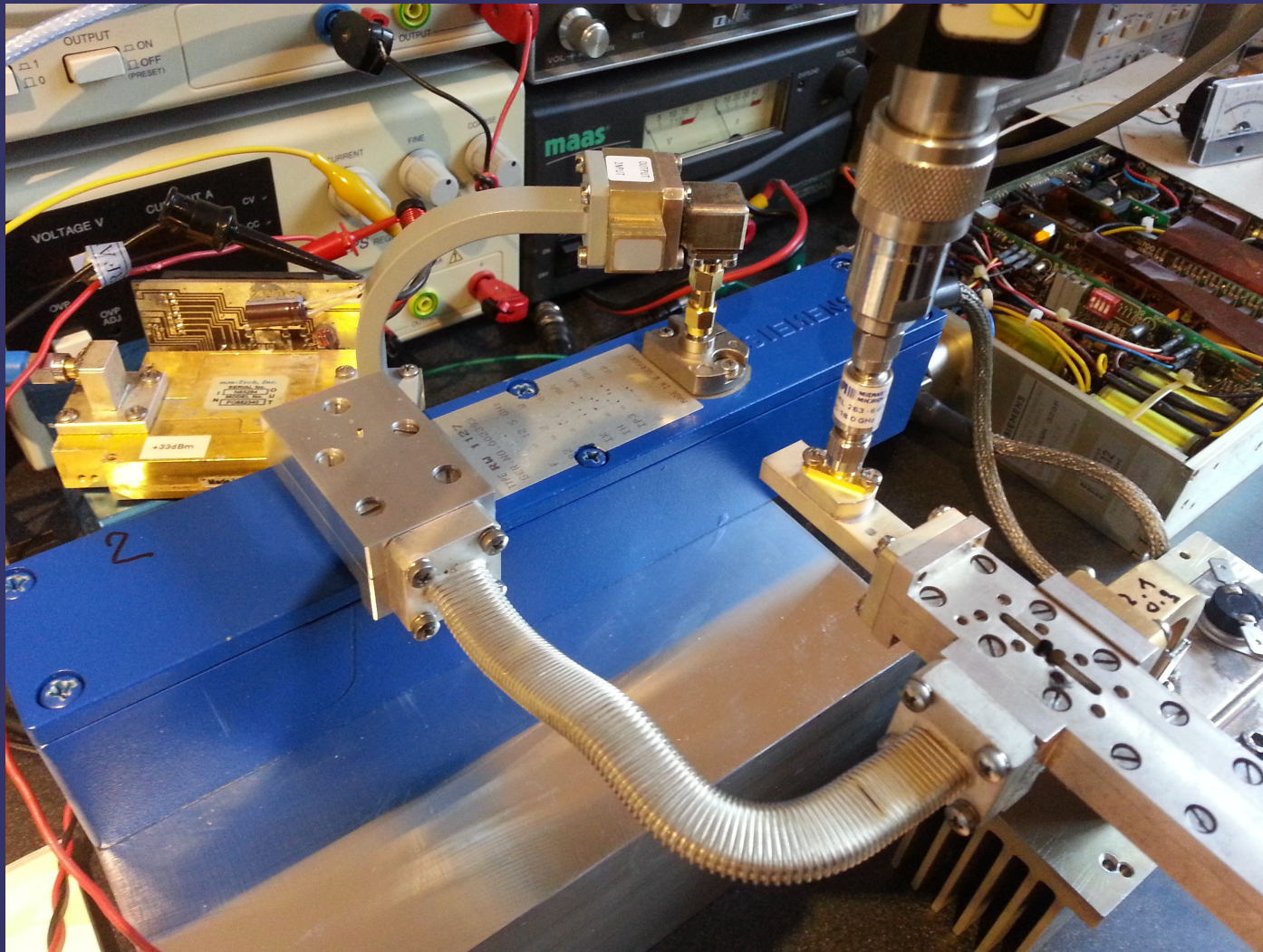




***Due to „bad“ ground contact worse results regarding output power***

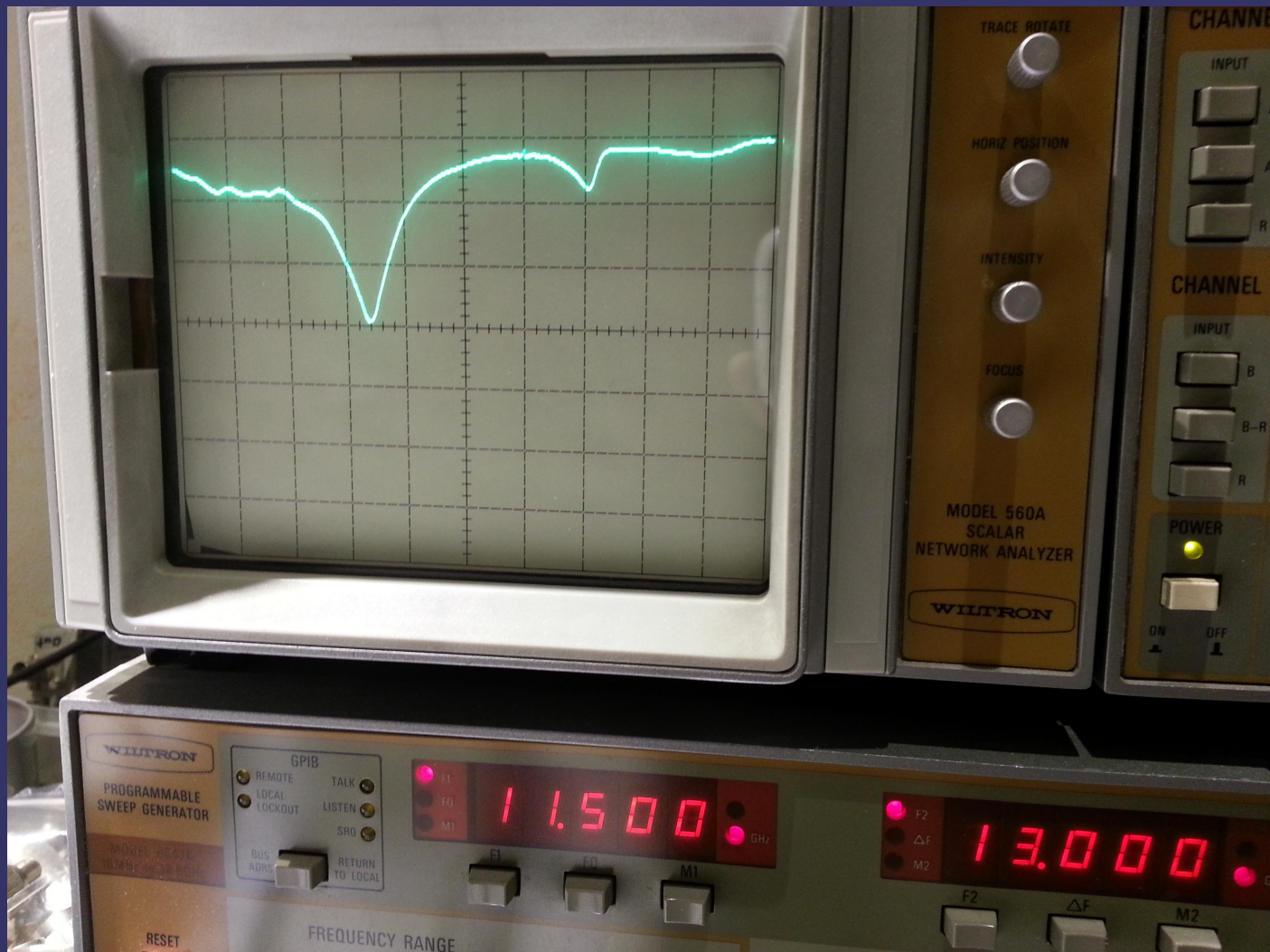


# *2 Watts input – DC0LB transition @ output*

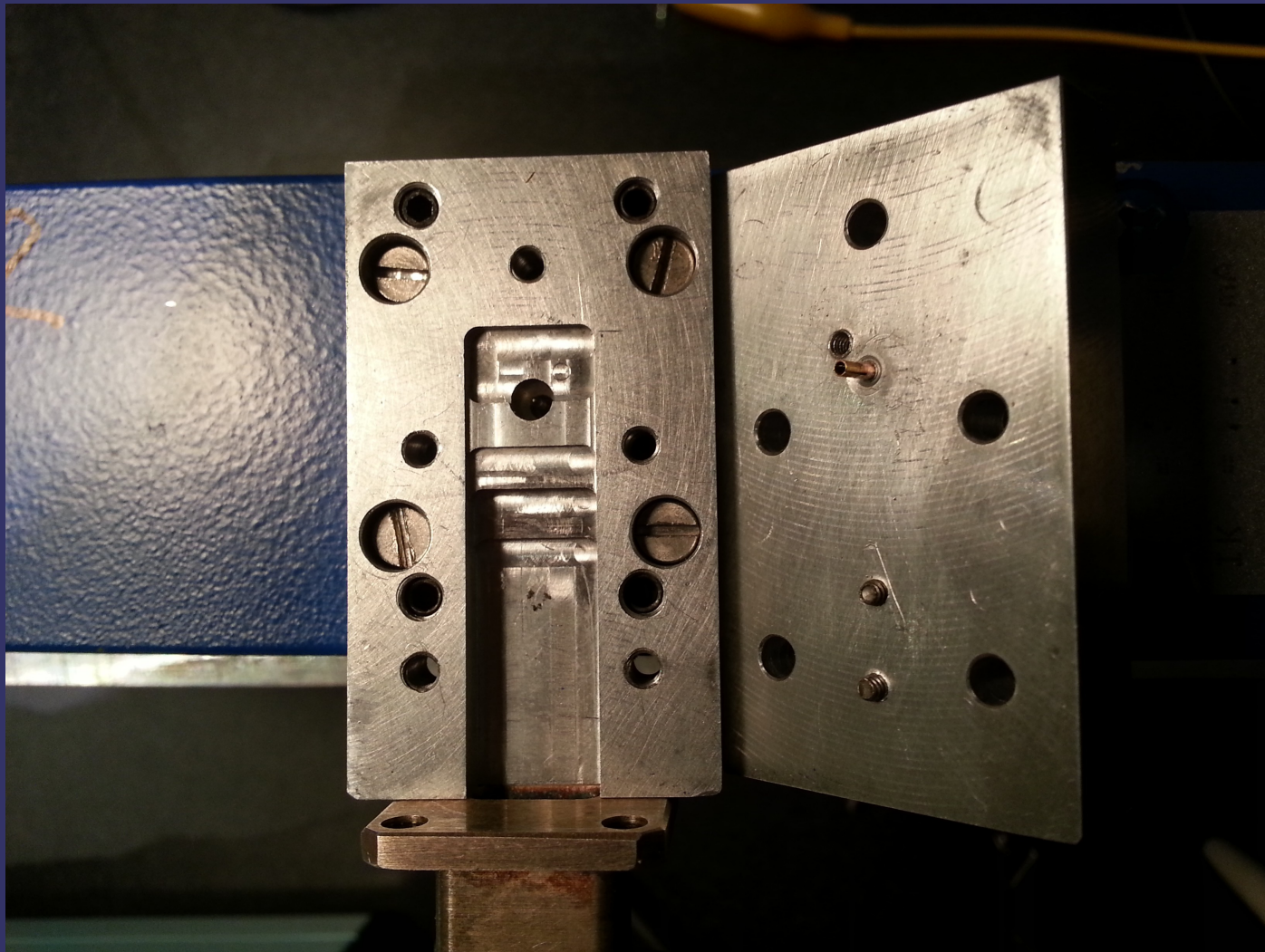




# *Before tuning (23-26GHz)*

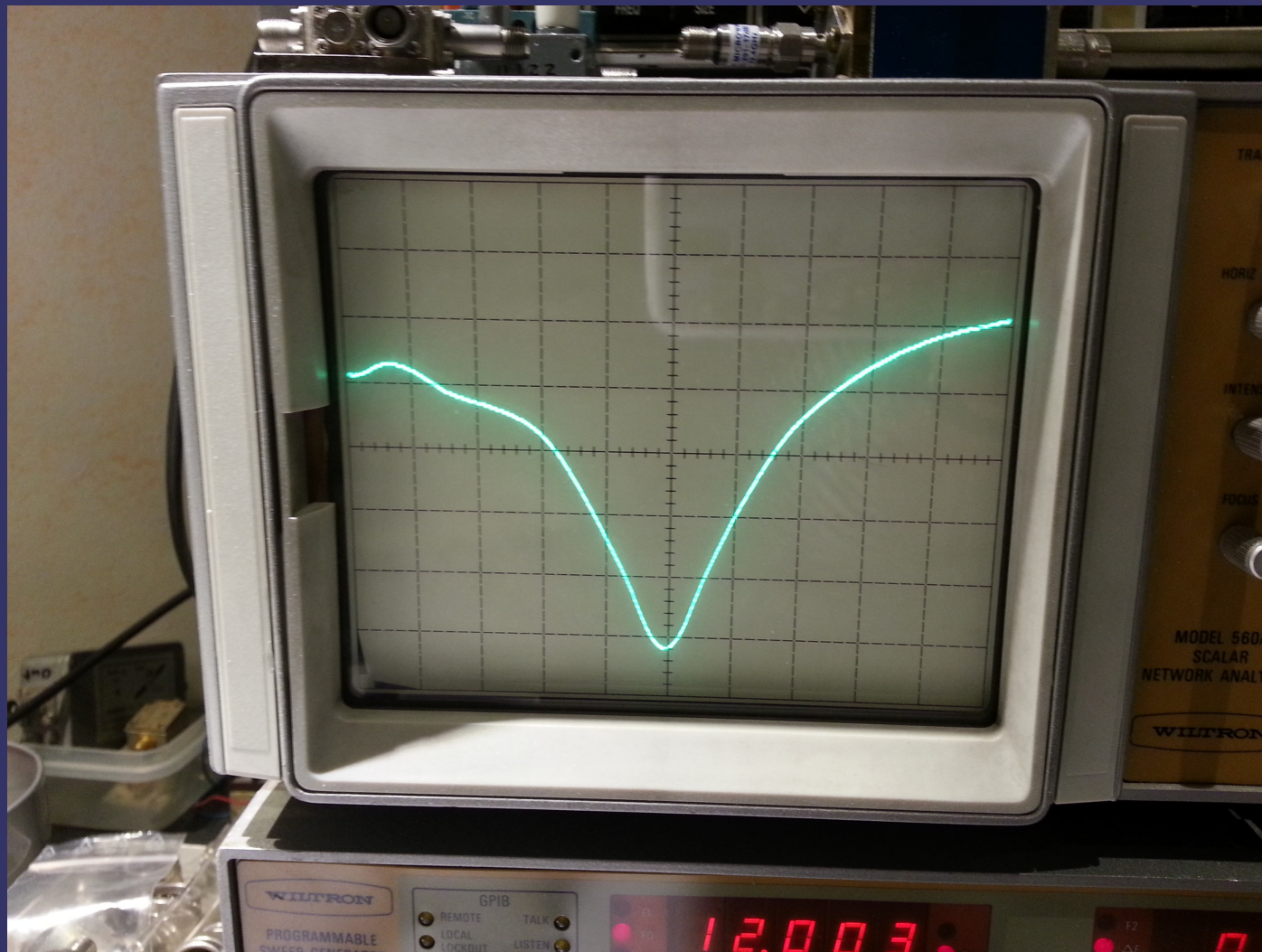


# *DC0LB -resonant chamber and taper*



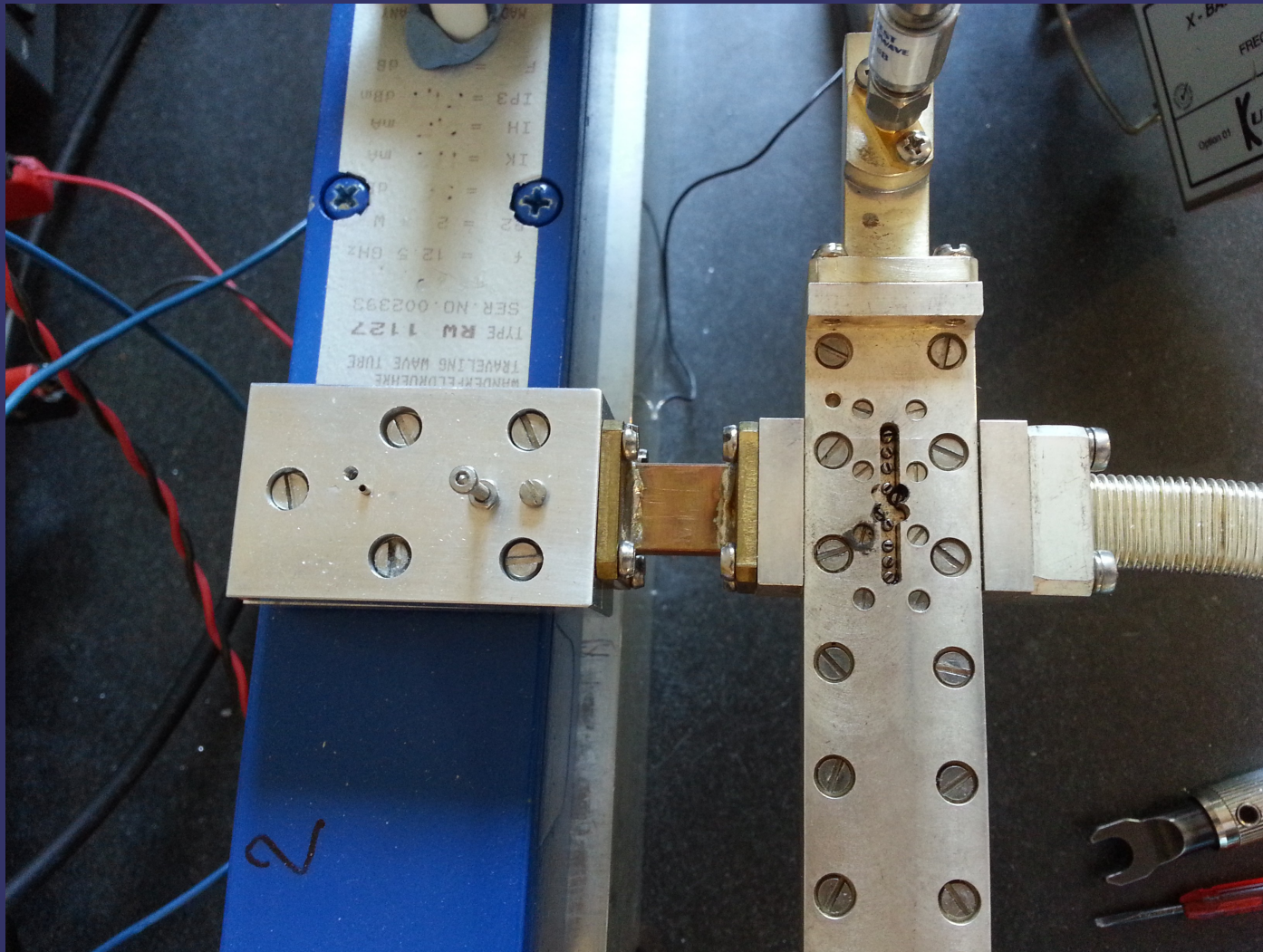


*After tuning (24028 +/- 250MHz)*





# ***DC0LB – tuned for optimized RL***



***Remember the thread below the 8mm part of the Helix coaxial system***

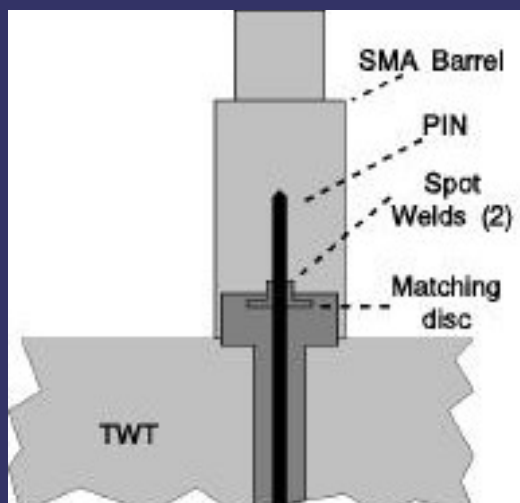




***Next solution was an idea from  
Italien microwaver***

***I30PW***

# *Detail of the SMA / Helix system*





# ***SMA barrels – prepared by I3OPW***

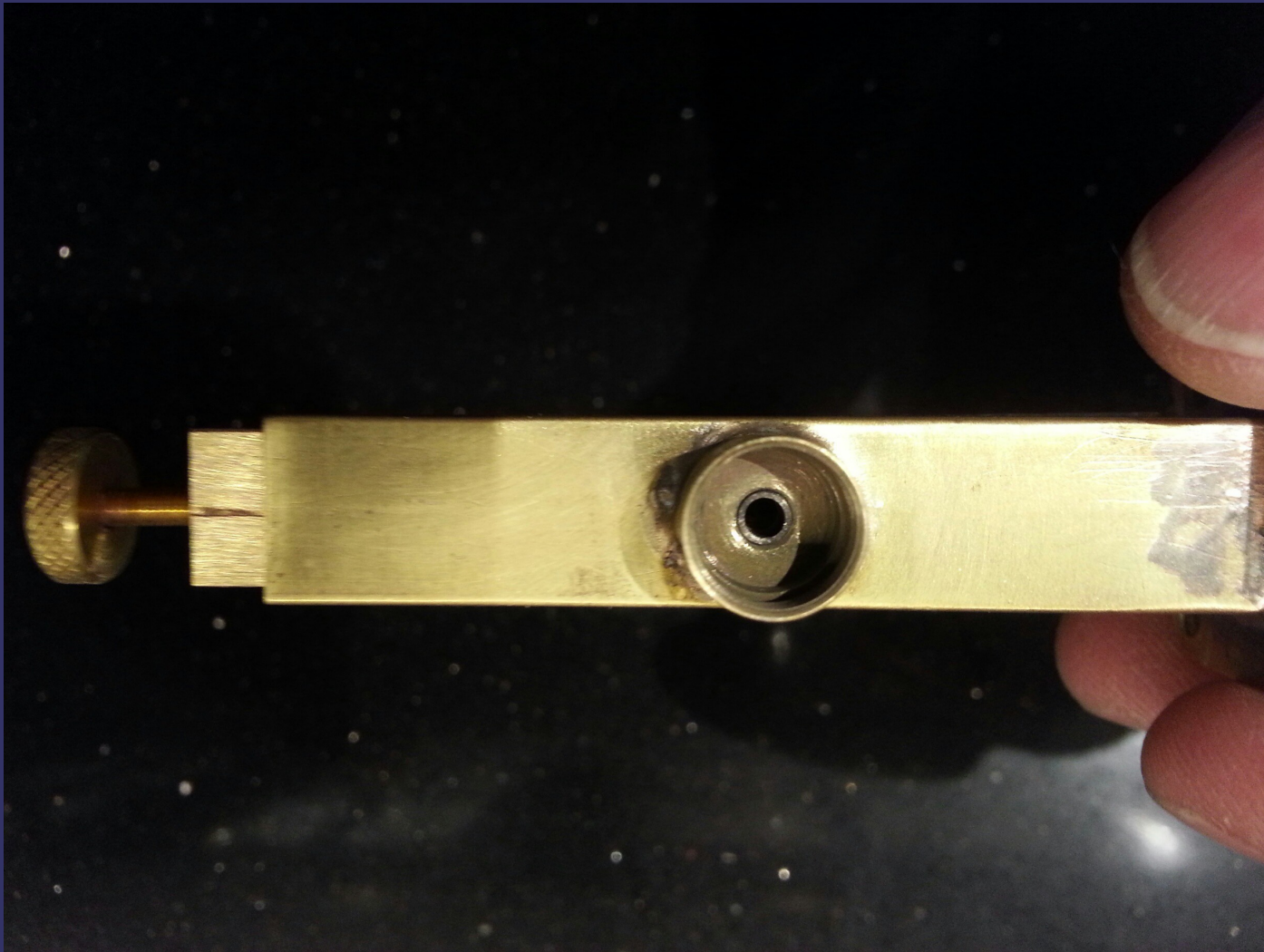


***WR-42 WG`s ready to solder barrels***

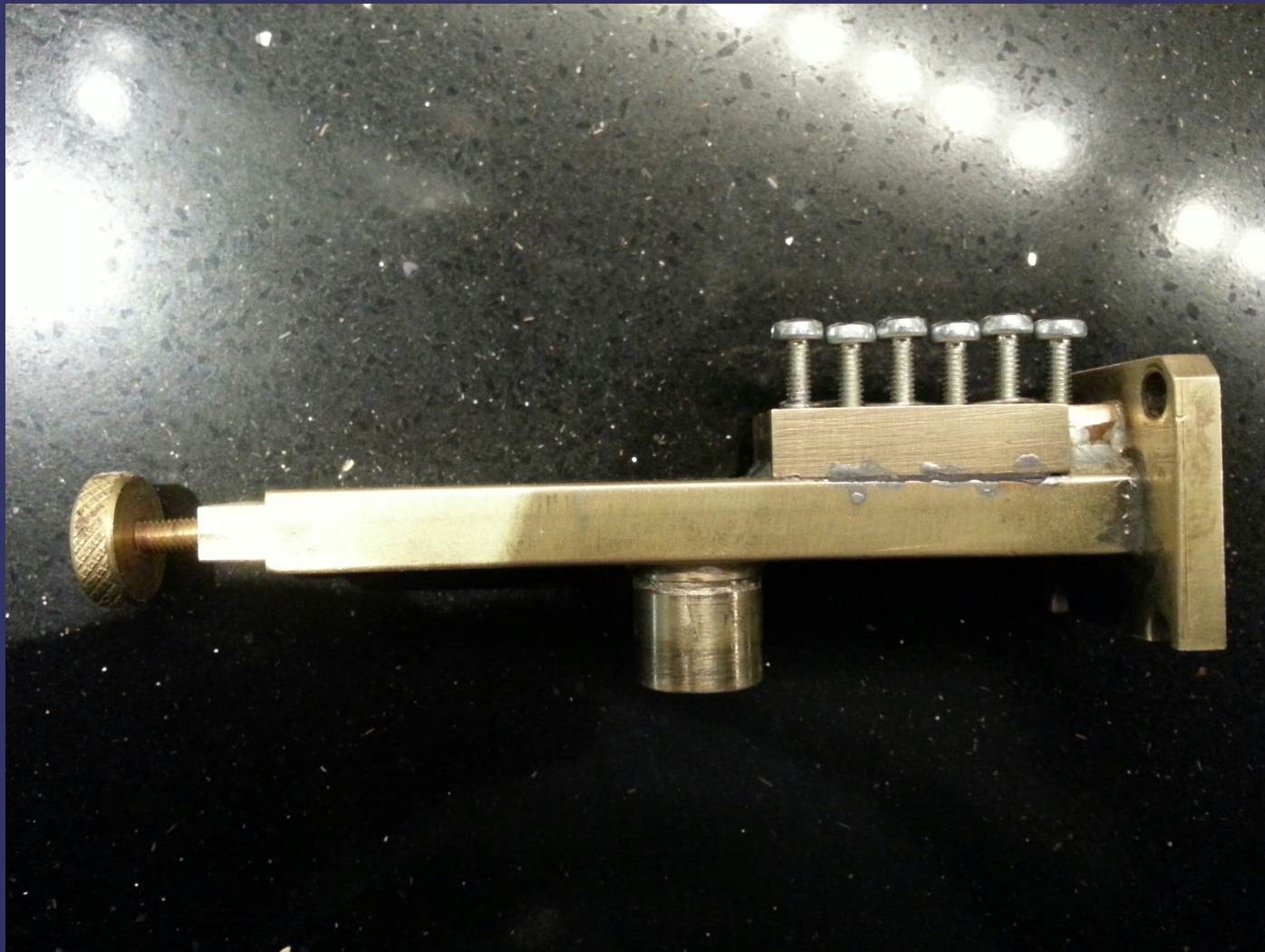




# ***Modified barrel soldered into WG***

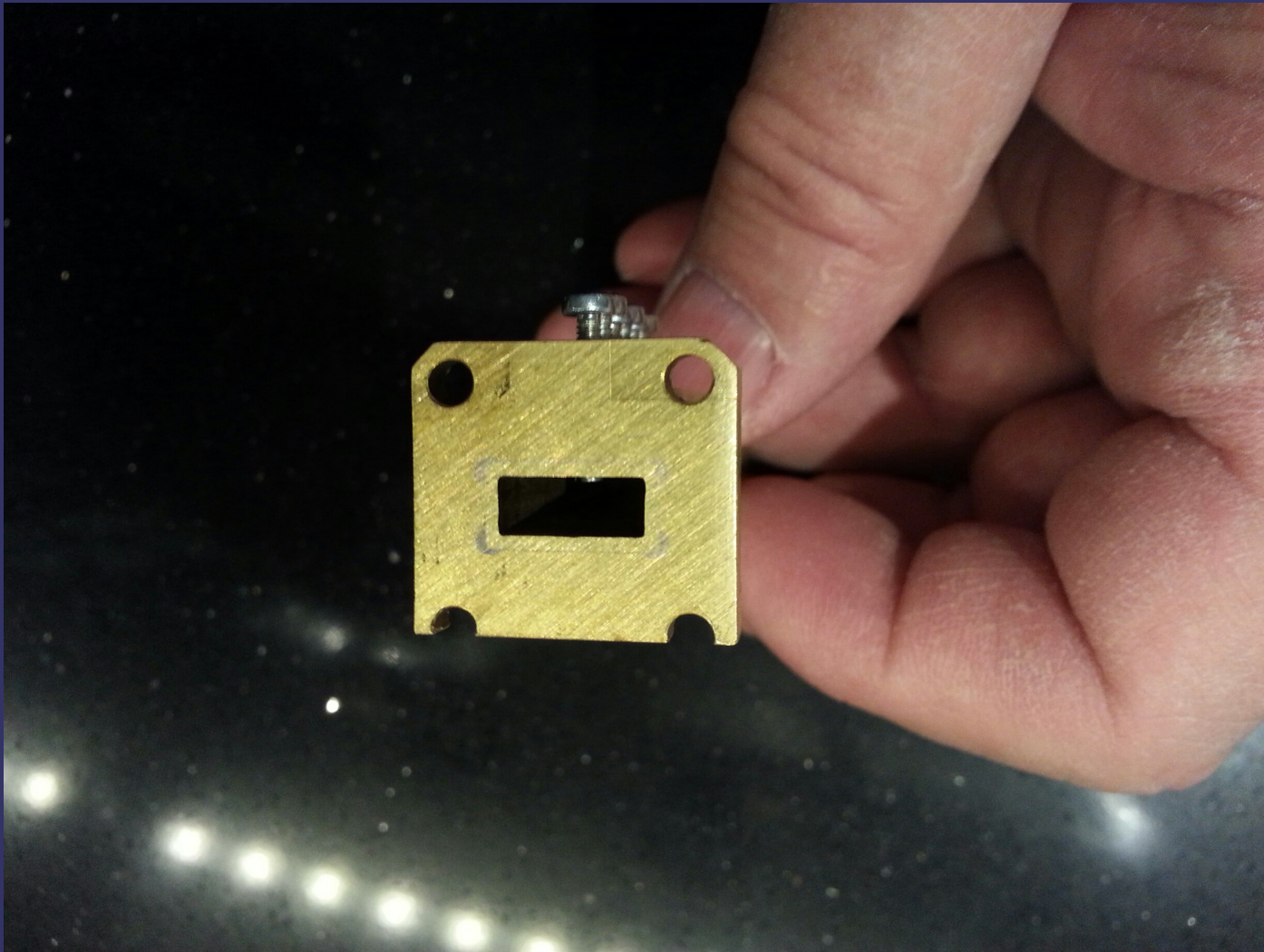


*I30PW's solution ready to use*





***Flange „cut“ - now WG can be turned  
overhead the tubes body to adjust  
Return Loss***

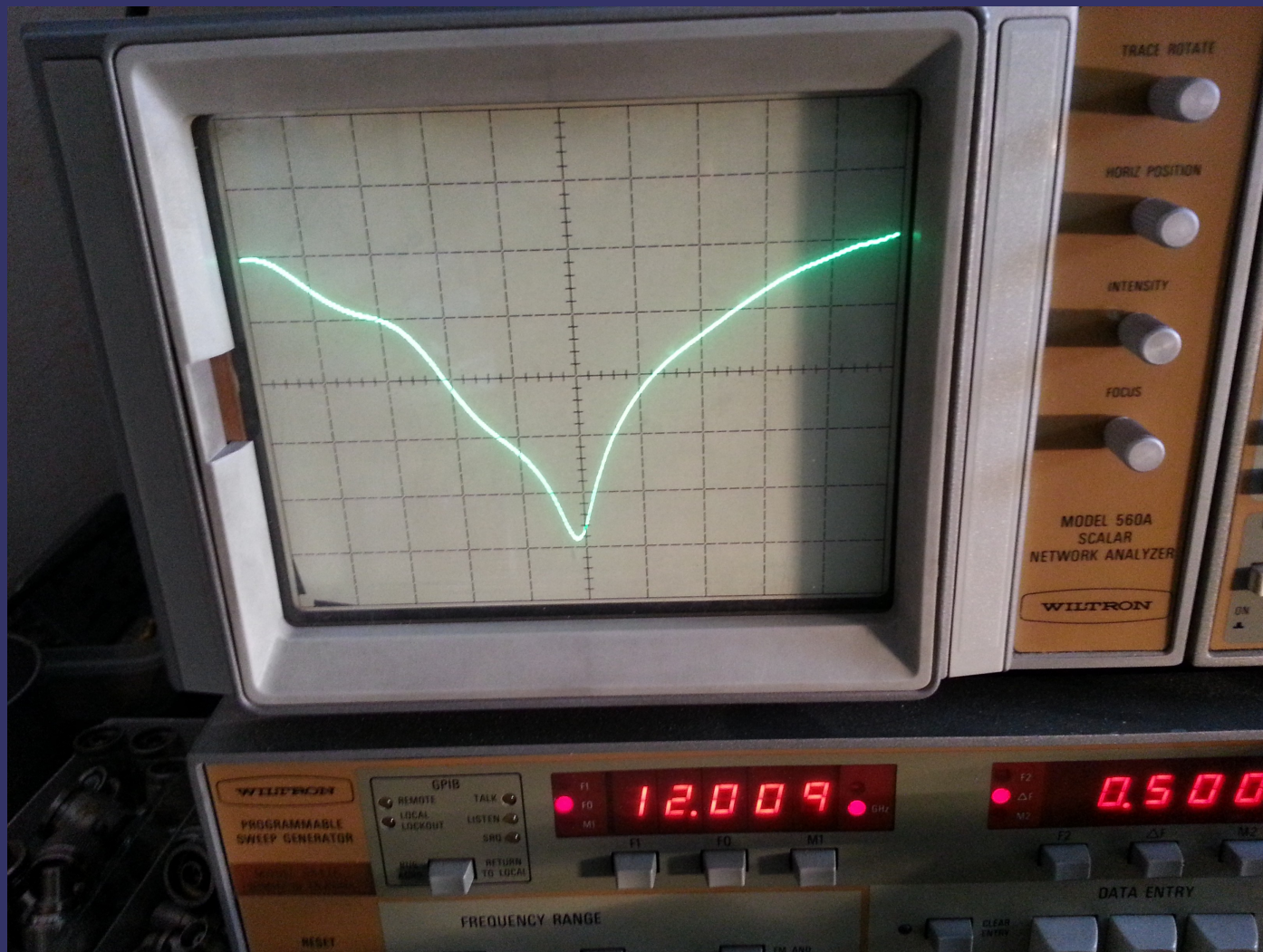


***I3OPW's solution – mounted at Input  
and Output – tuned best RL***



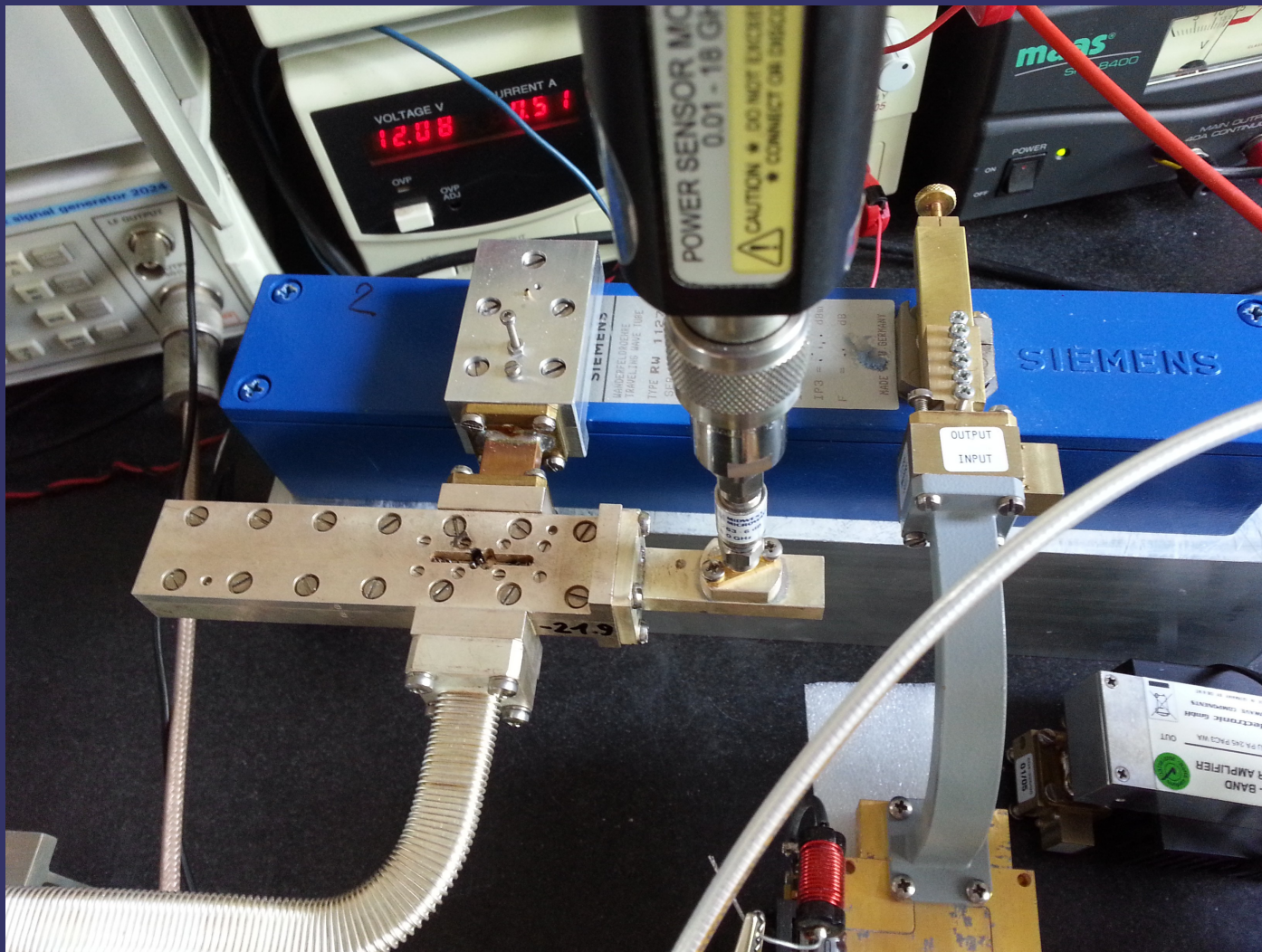


*Very good RL results – but ground currents have to „pass“ thread*



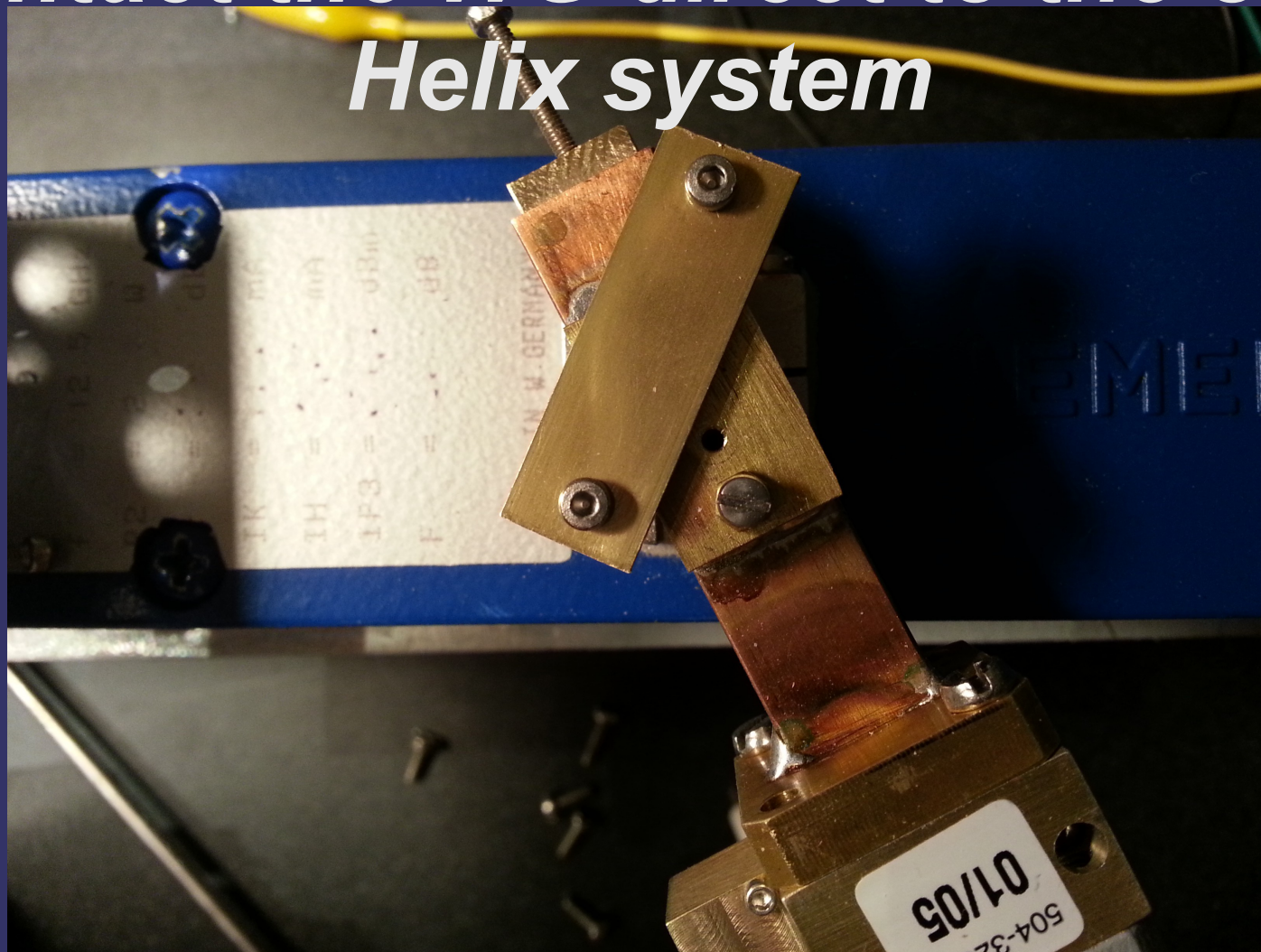


*Input: I30PW - Output DC0LB*

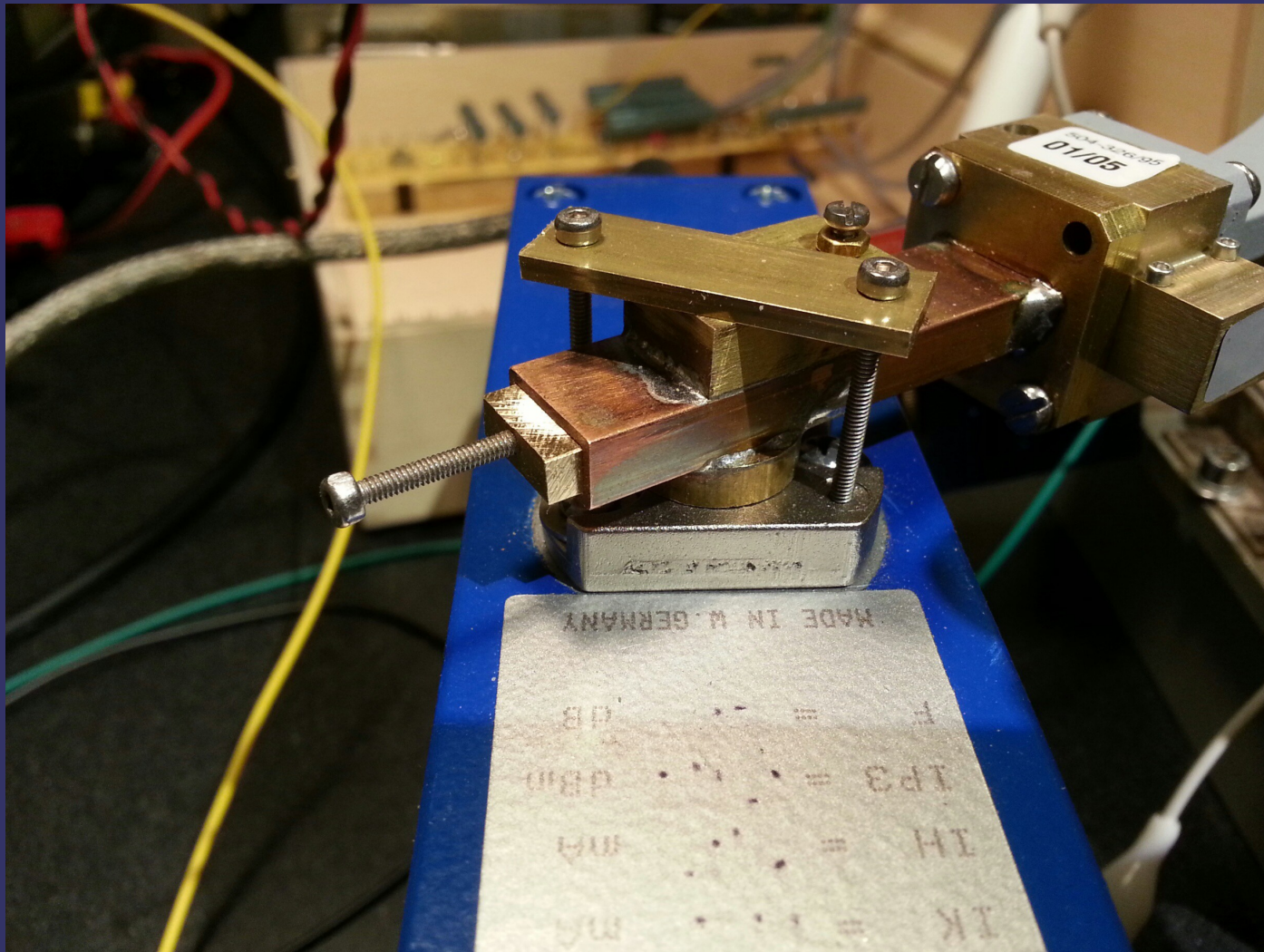




*Knowing now the ground path problem, a „vertical force“ construction was design to contact the WG direct to the outhter Helix system*

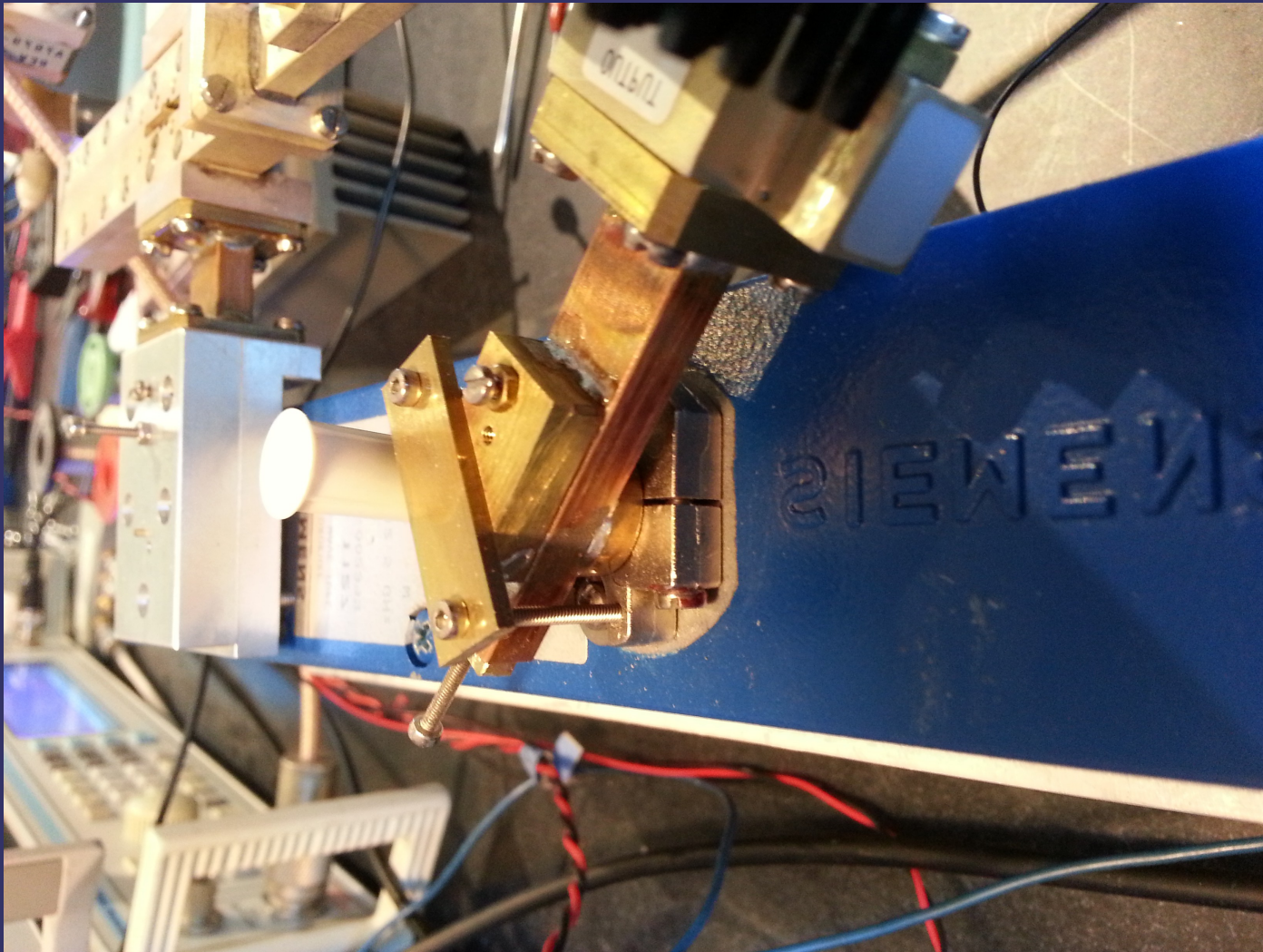


# *Sideview of the ground path improved construction*

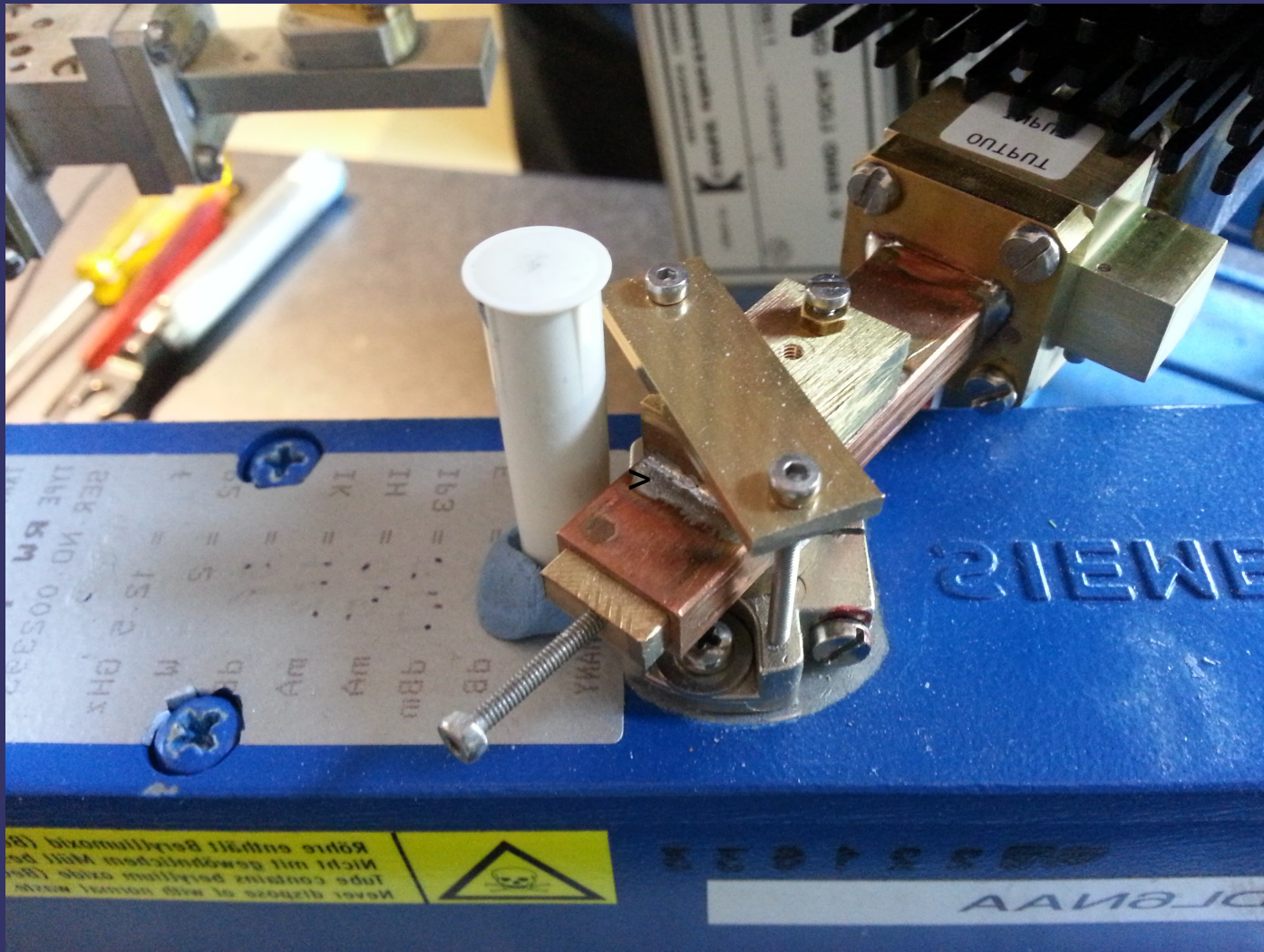




*DC0LB`s at output – DL7YC`s at  
input*

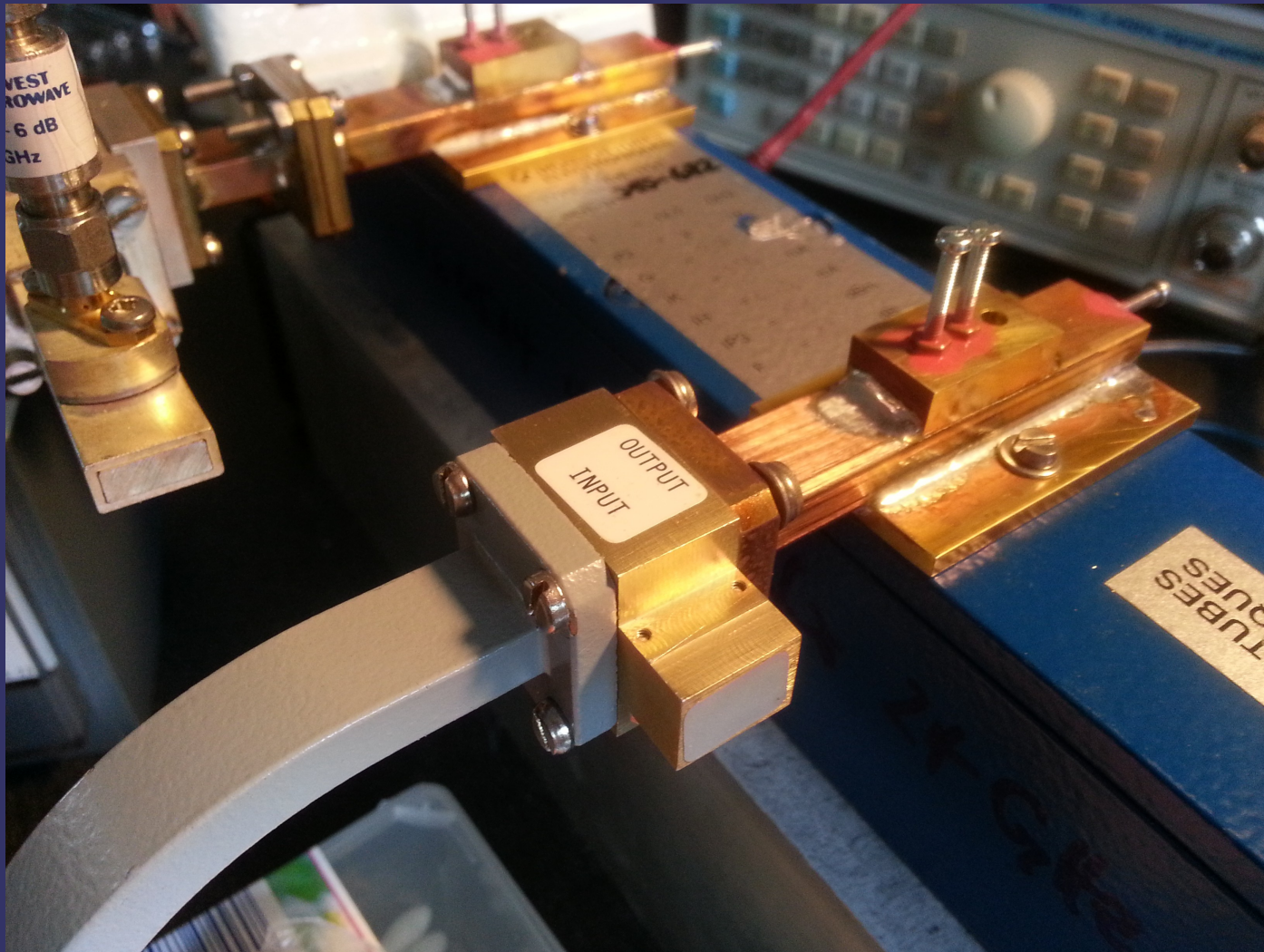


# *DL7YC's 3<sup>rd</sup> attempt to improve the ground contact*

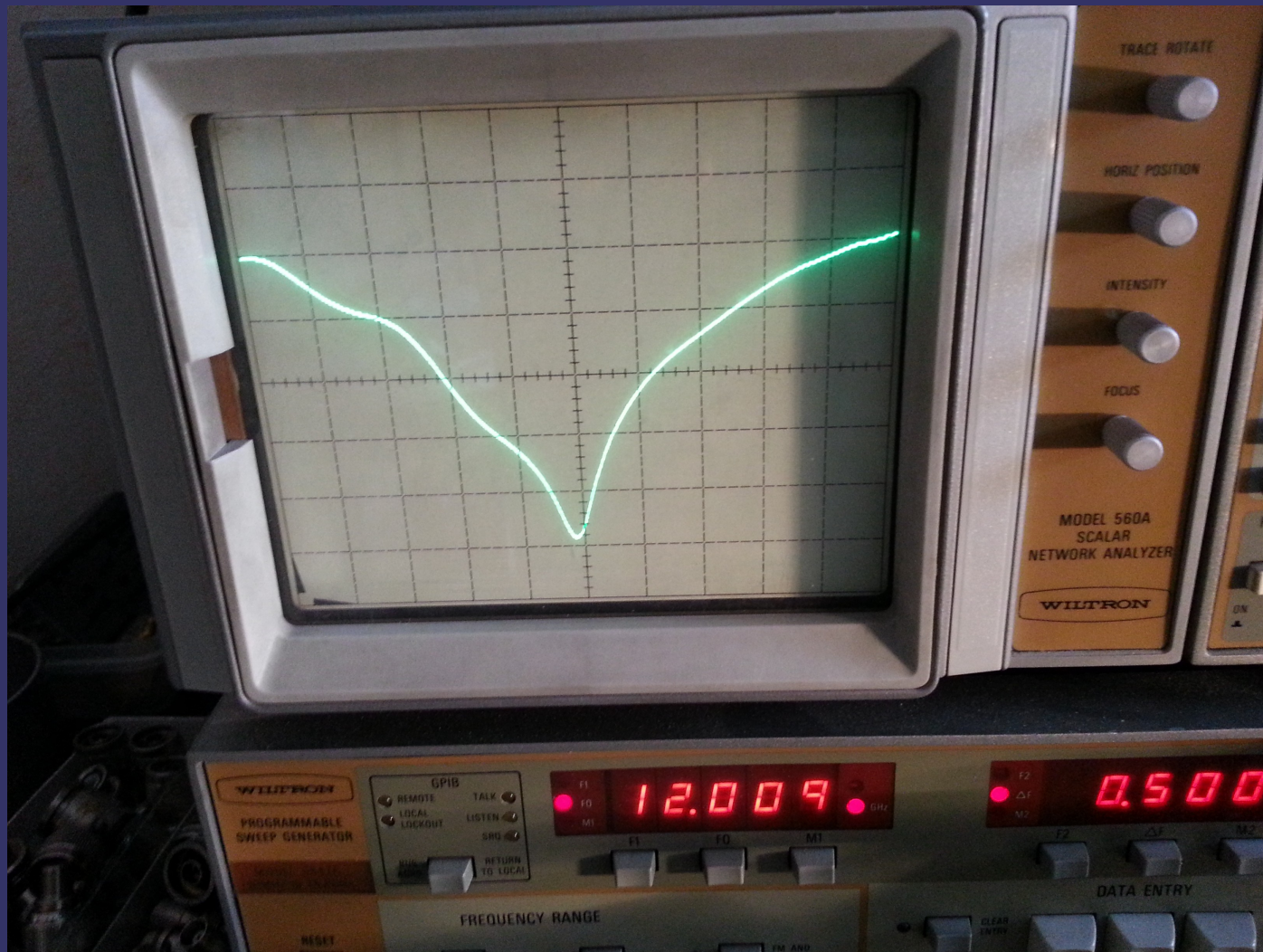




# *Example of DL7YC's 4th and final solution to improve the ground contact*



# *Final RL measurement – 5dB/Div 1GHz sweep*

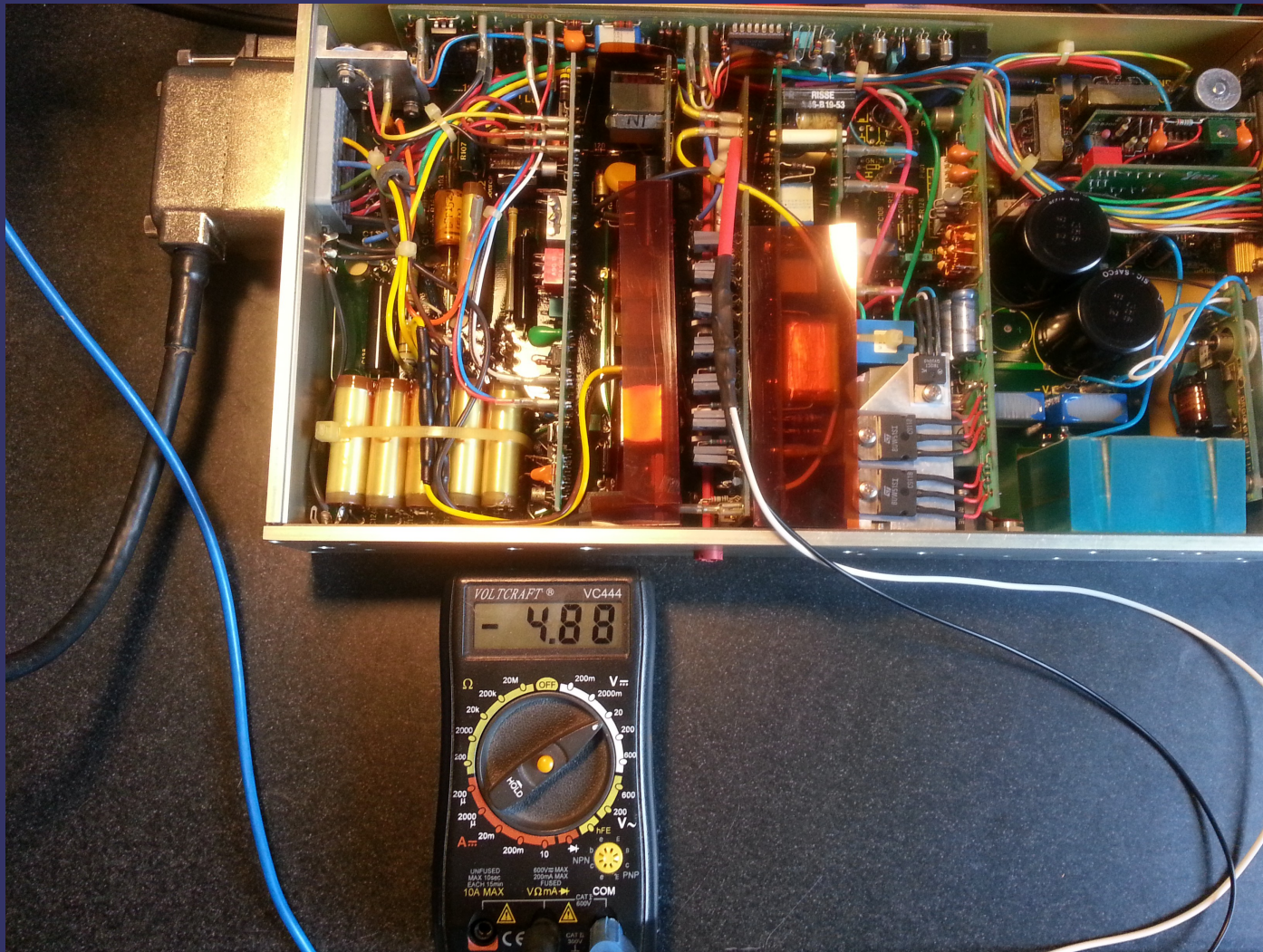




# ***Most important steps for a „perfect“ result:***

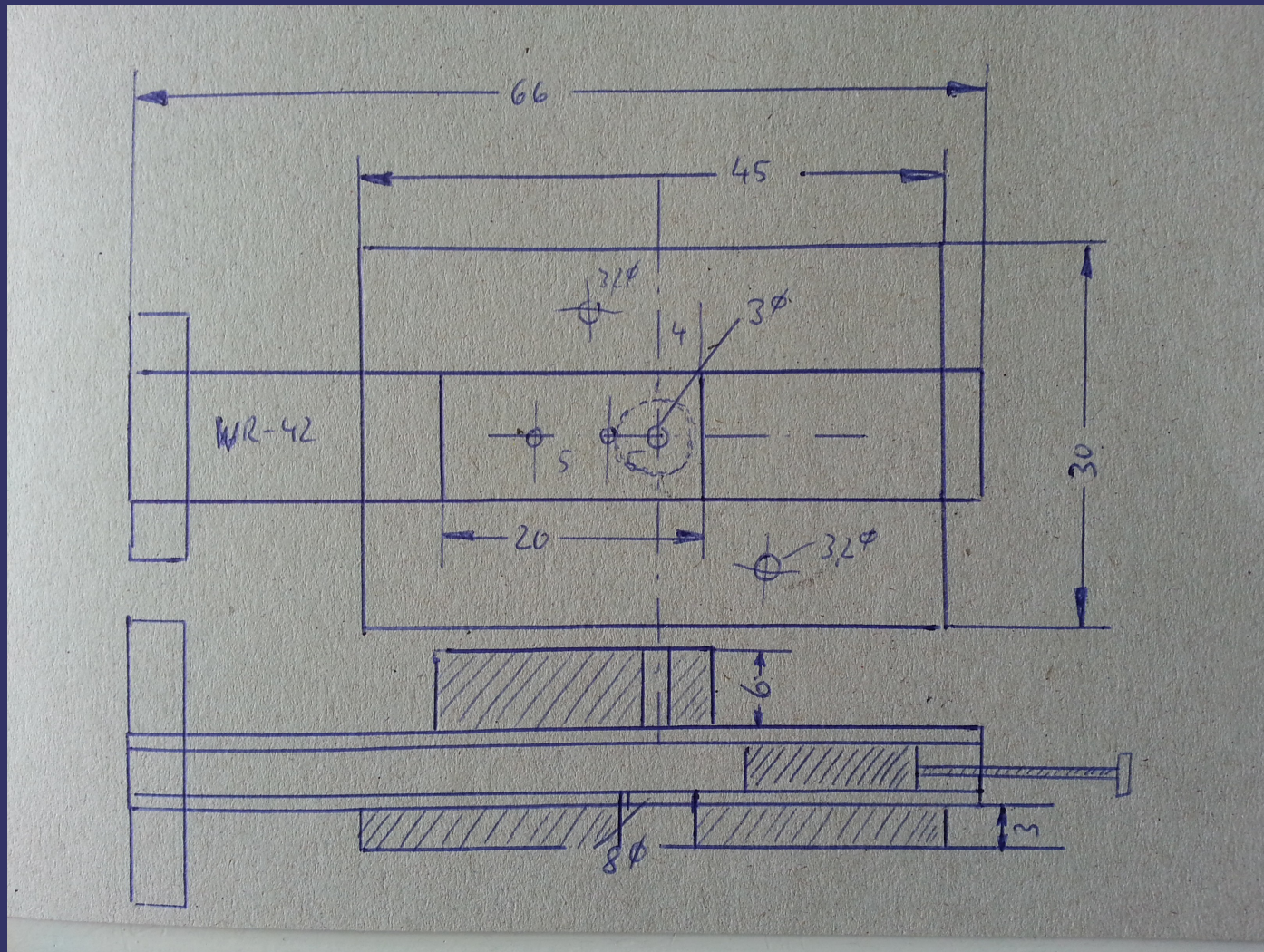
- ➡ 1. Modify 10 GHz pretested tubes only
- ➡ 2. Disconnect C1 current monitor in RWN 320 PSU by removing the yellow wire from helixboard
- ➡ 3. Adjust Helix voltage to +/- 4.88 kV
- ➡ 4. Drill the 8mm hole in WG baseplate carefully  
– finally use a reamer to get a VERY tight connection between baseplate and the Helix coaxial contact
- ➡ 5. Preadjust WG-transition RL with 24 GHz VNA

*Remove Collector 1 protection*  
*- adjust Helix voltage to **4.88 kV***





# „Quick and Dirty“ drawing of the adapter



***Adjust  $I_k$  (by G2 voltage) to maximum  
- observe  $I_h$  and keep below 1.5mA***





*Use CW keying to „adjust“ drive  
PWR @ 24 GHz*

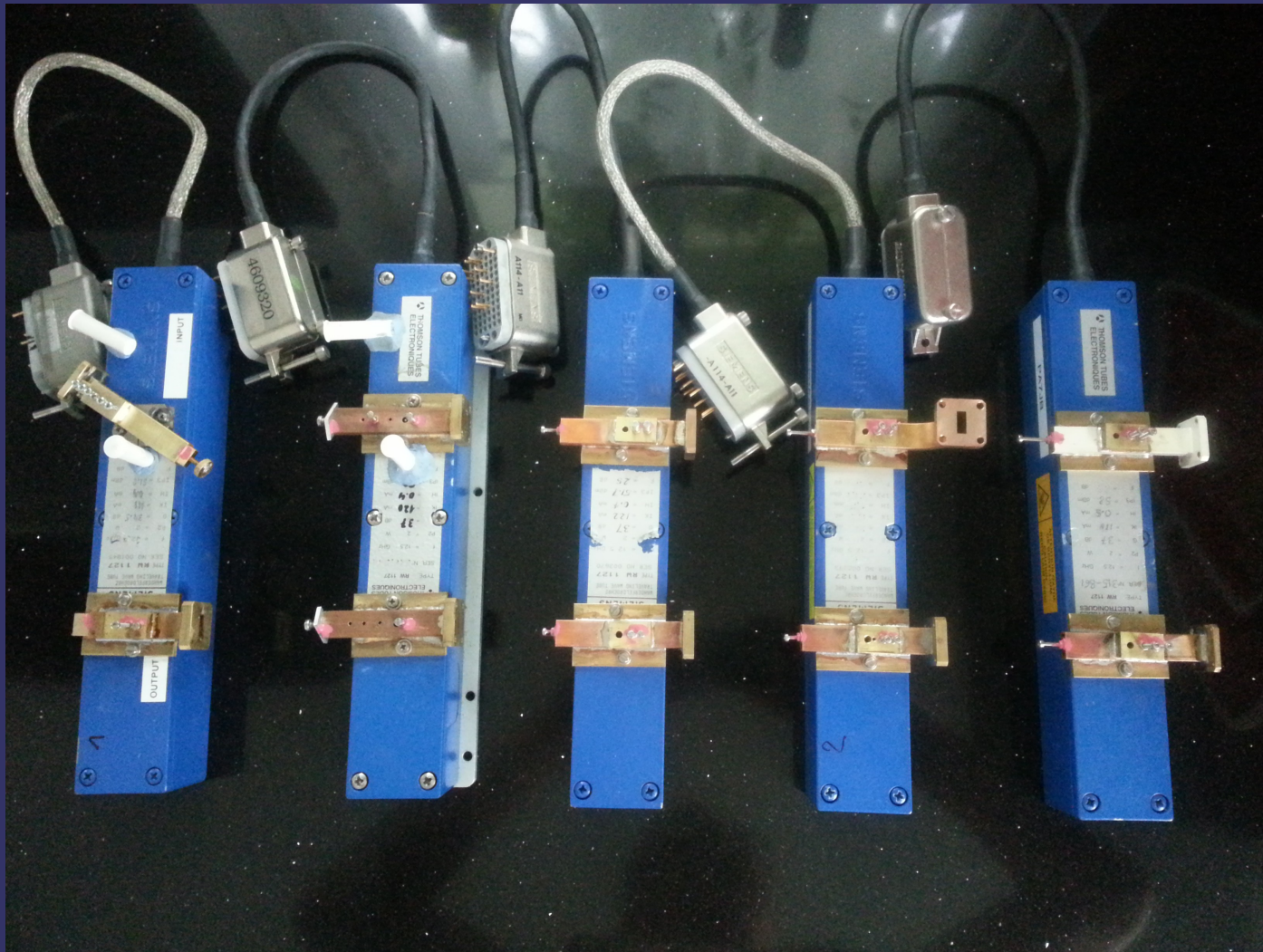


## *Final conclusions*

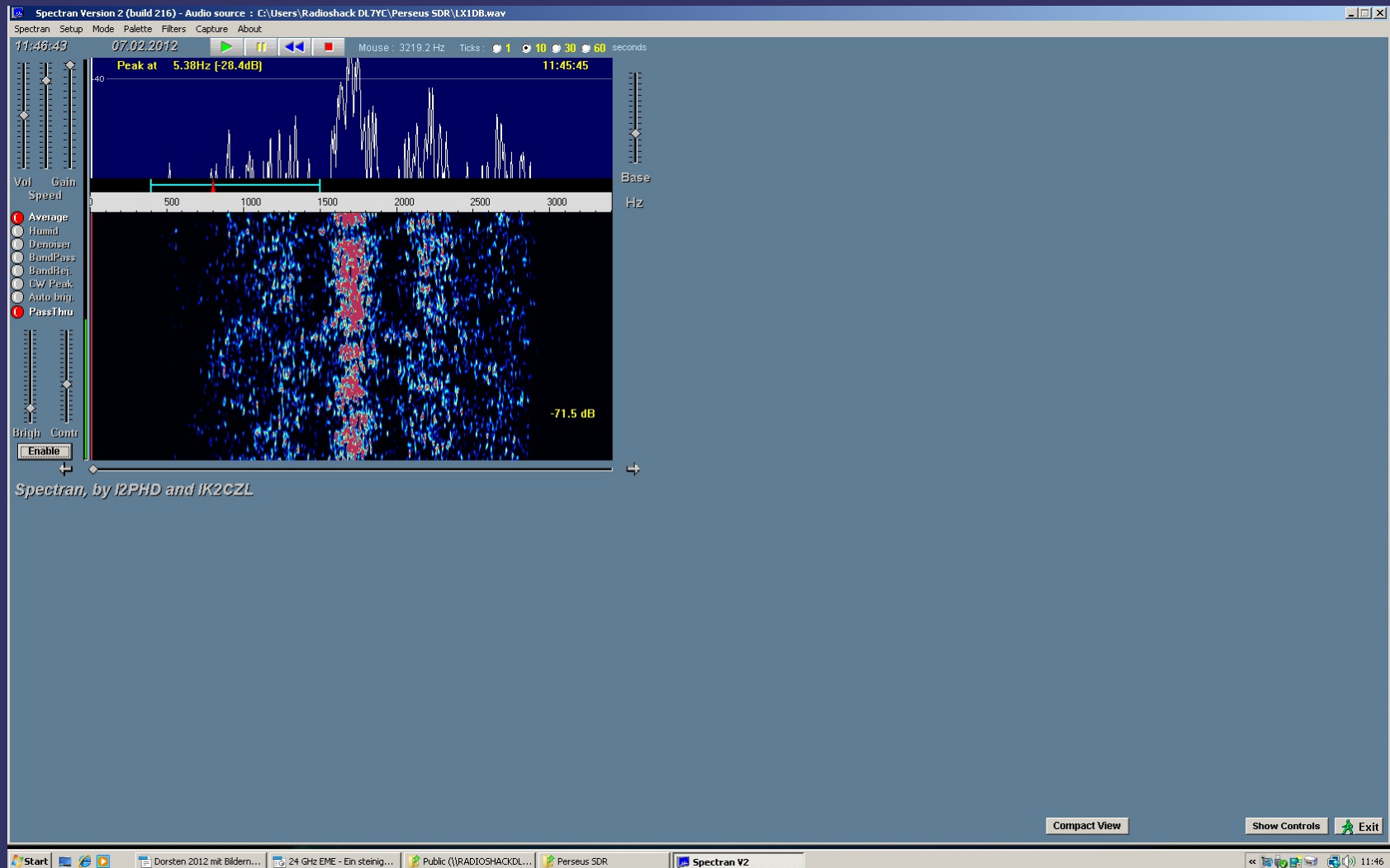
- ➔ **Again:** Carefully open the lower side WG-hole to 8mm using **a 8H reamer !!!!!** (try some tests before)
- ➔ Use lubricant and minimal force to „mount“ and connect the baseplate overhead the Helix coaxial system
- ➔ Pretune to best RL both Input and Output
- ➔ Use forced cooling and short „carrier periods“ for adjustments only !! **CW is OK !**



*5 of 6 modified tubes – all between  
35 and 45 watts peak output*

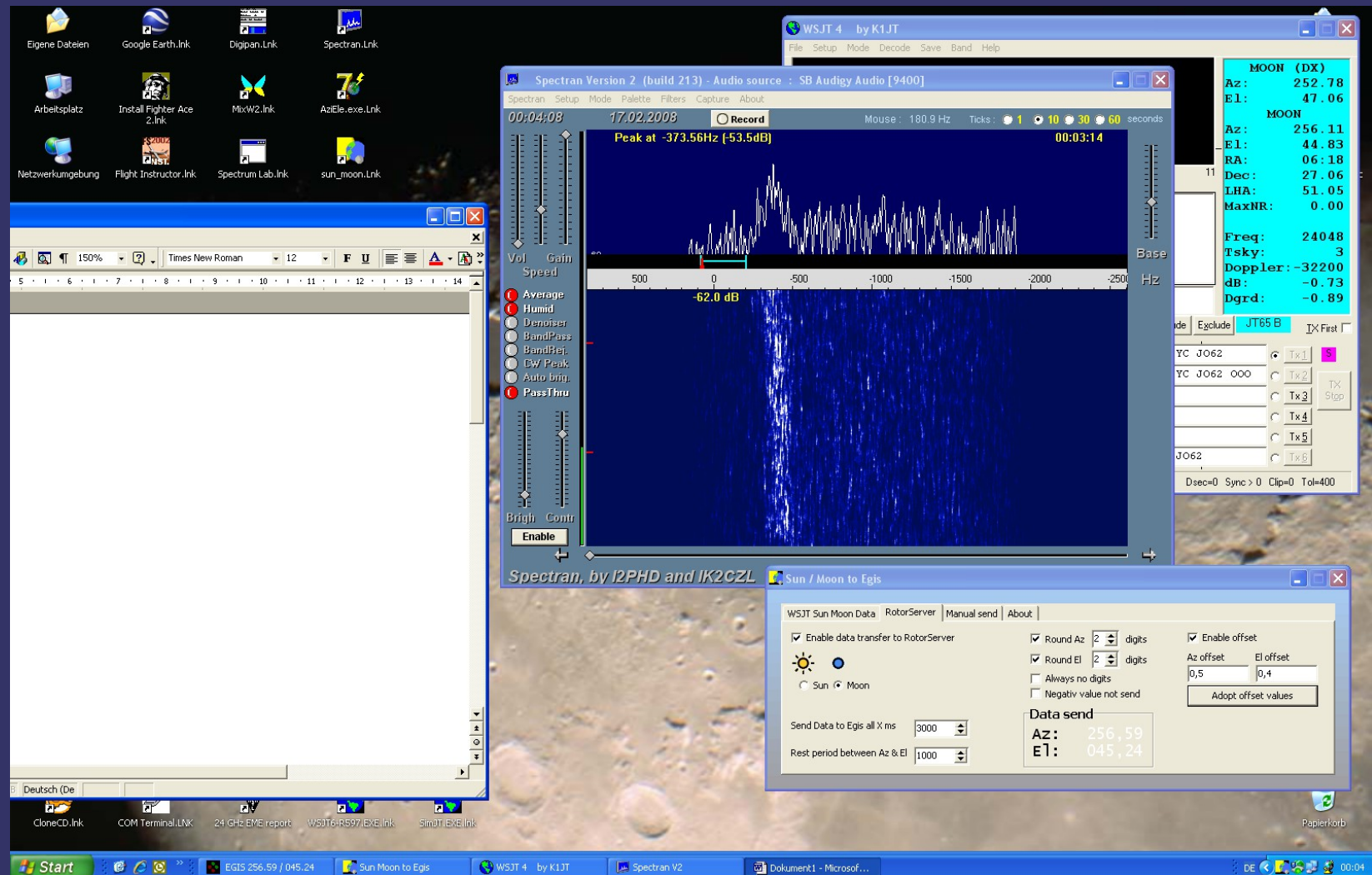


# *Echos results - now with 40 watts measured at the WG-switch output*





# Echo results of modified tubes

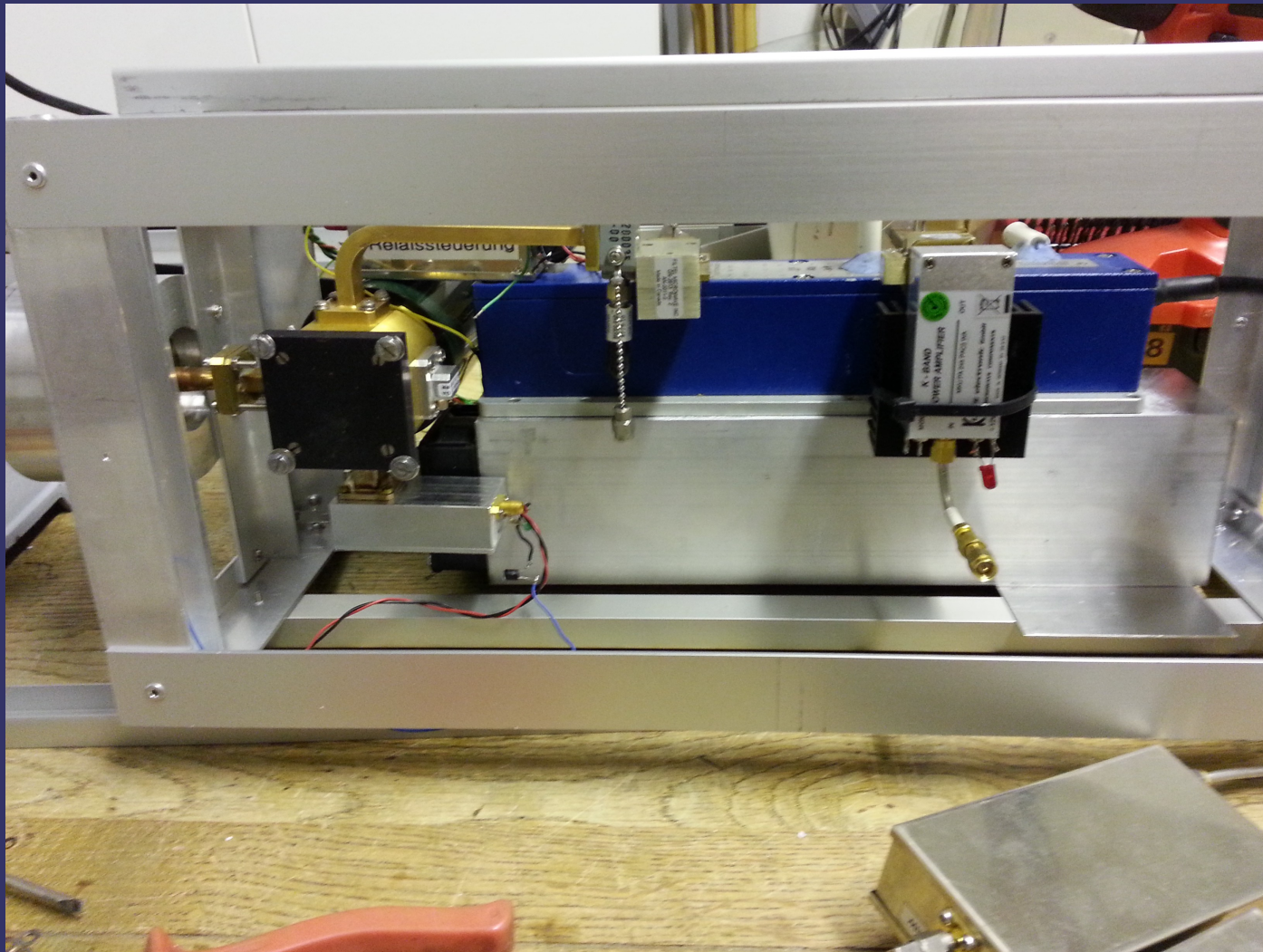


*My first **10 GHz** trial – TWTA + PSU +  
transverter: ALL behind the feedhorn*

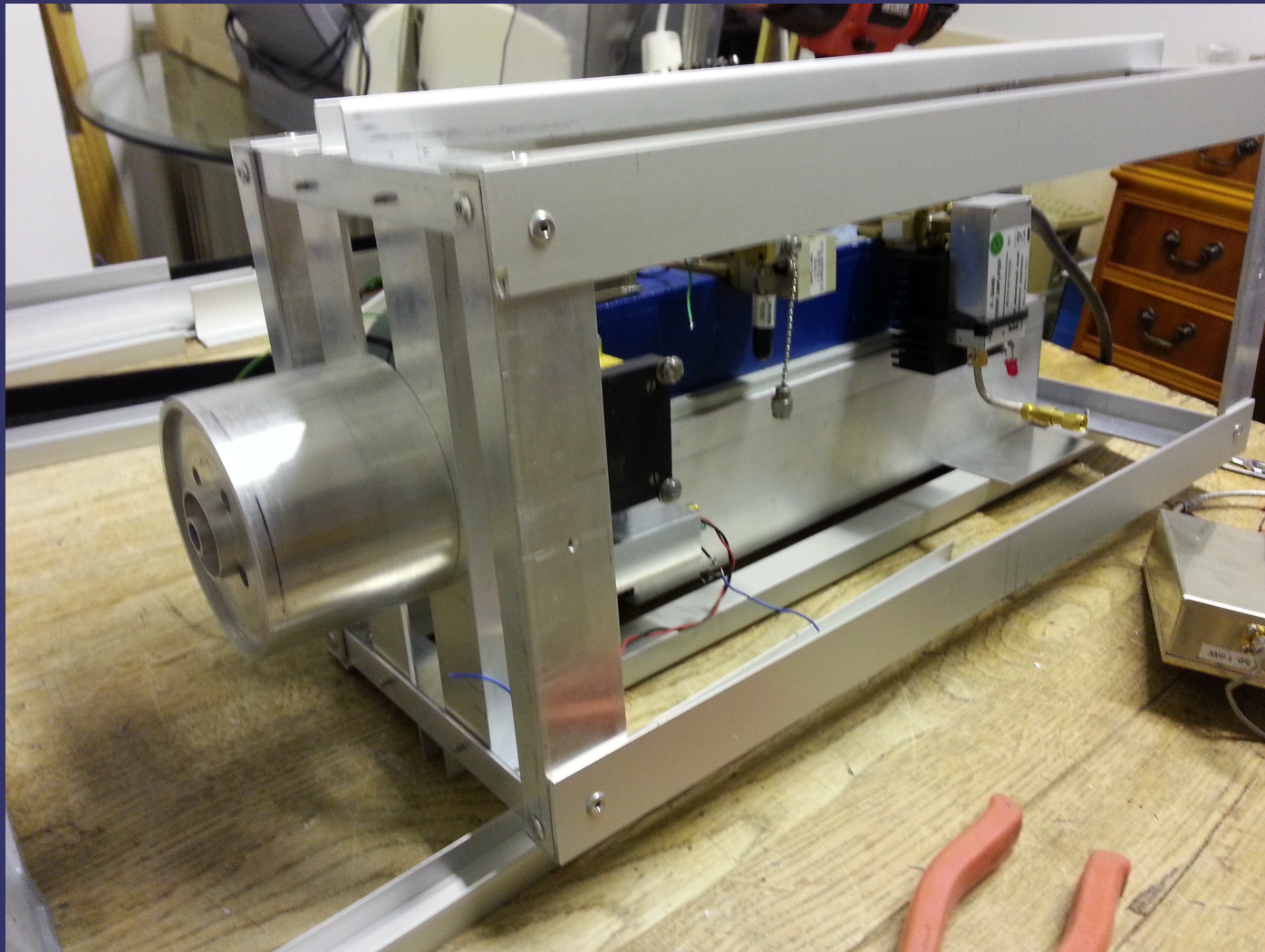




# ***Solution for 24 GHz EME – Feedbox with TWT and WG - switch***

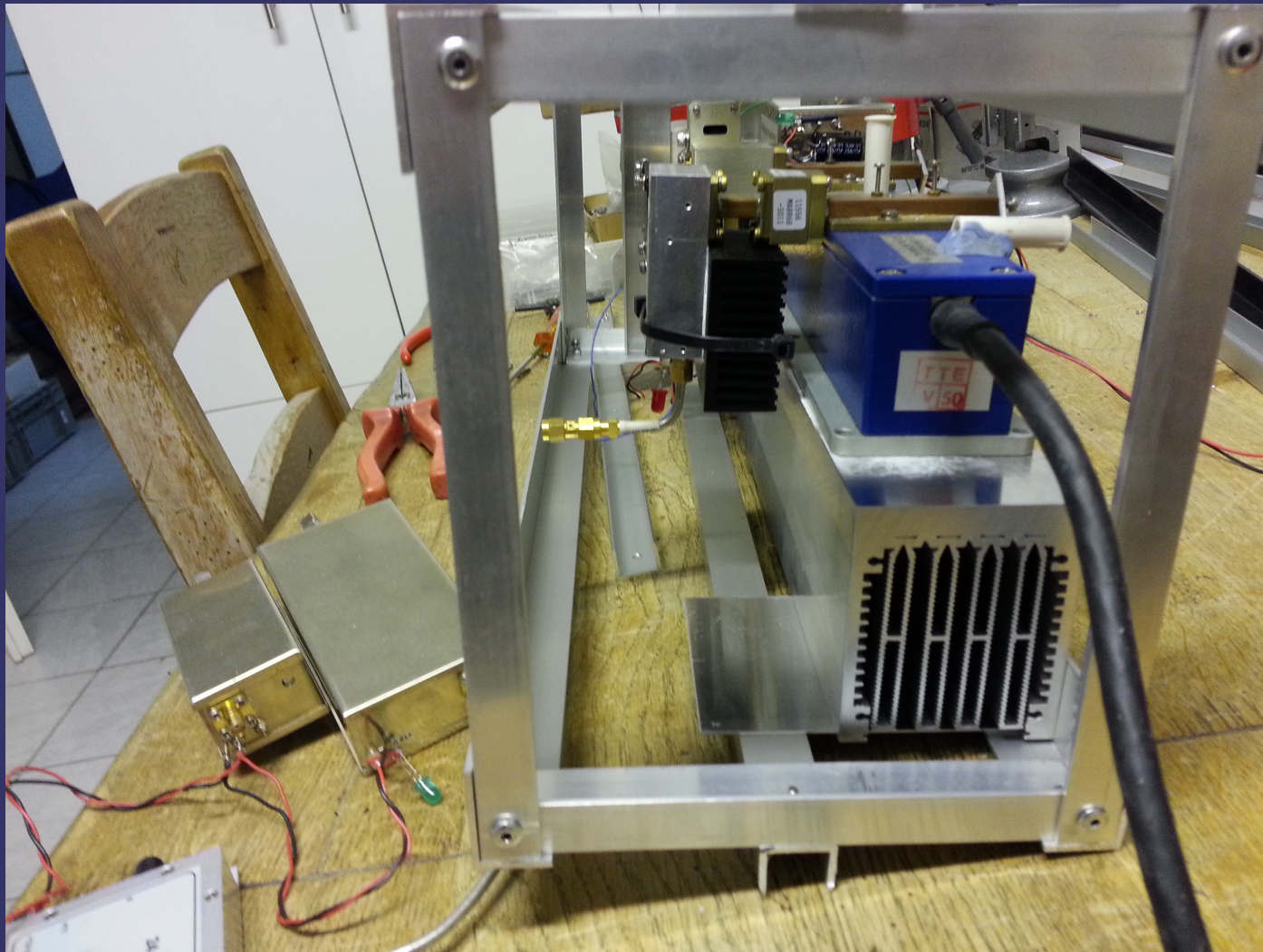


# *Improved 24 GHz trial - feed direct in front of the cage*





# *24 GHz EME cage again – special heatsink, RW 1127 tube, driver amp*



*Any questions ?*

**Thanks for your attention**