Manfred Ploetz DL7YC

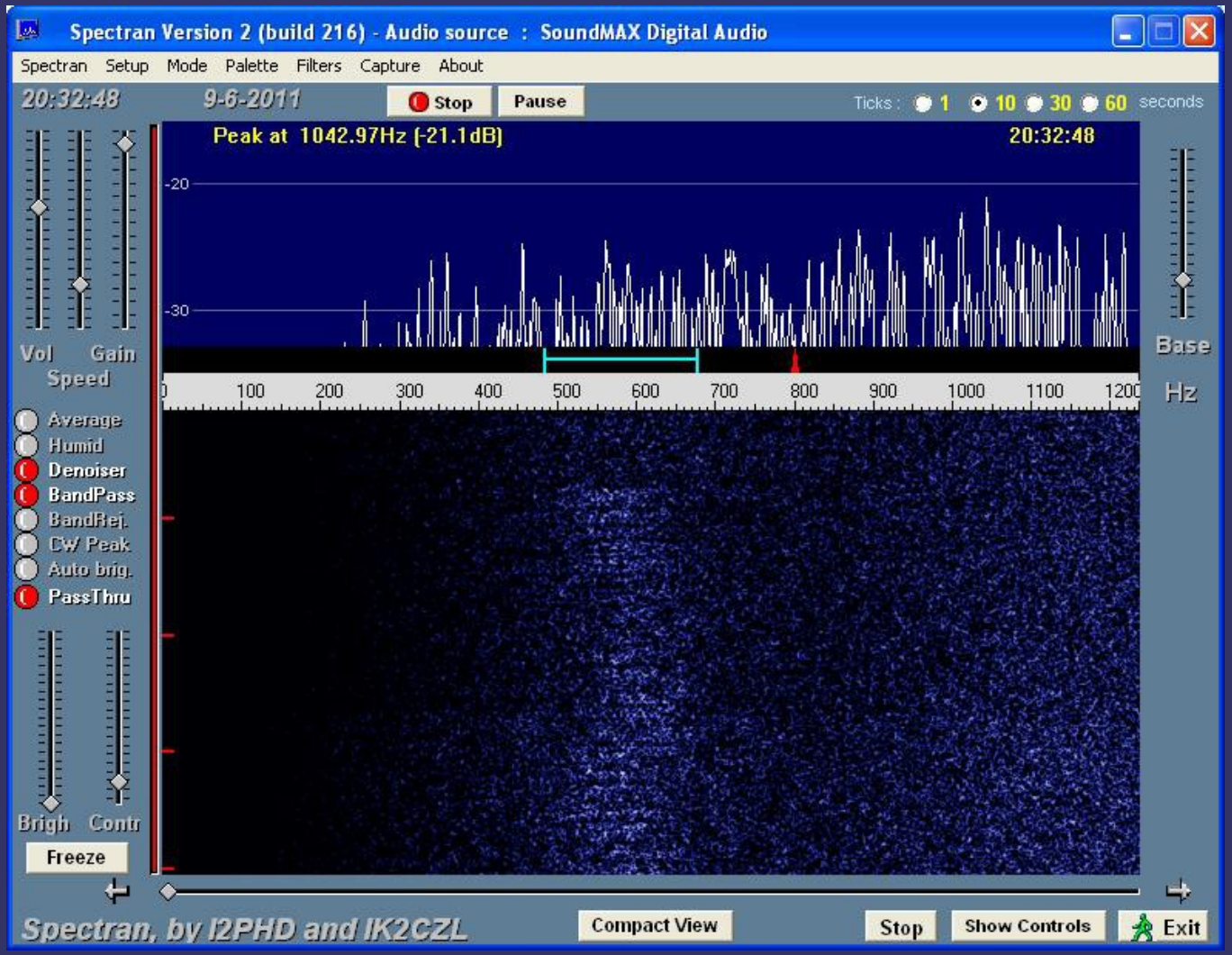
TWTA modifications

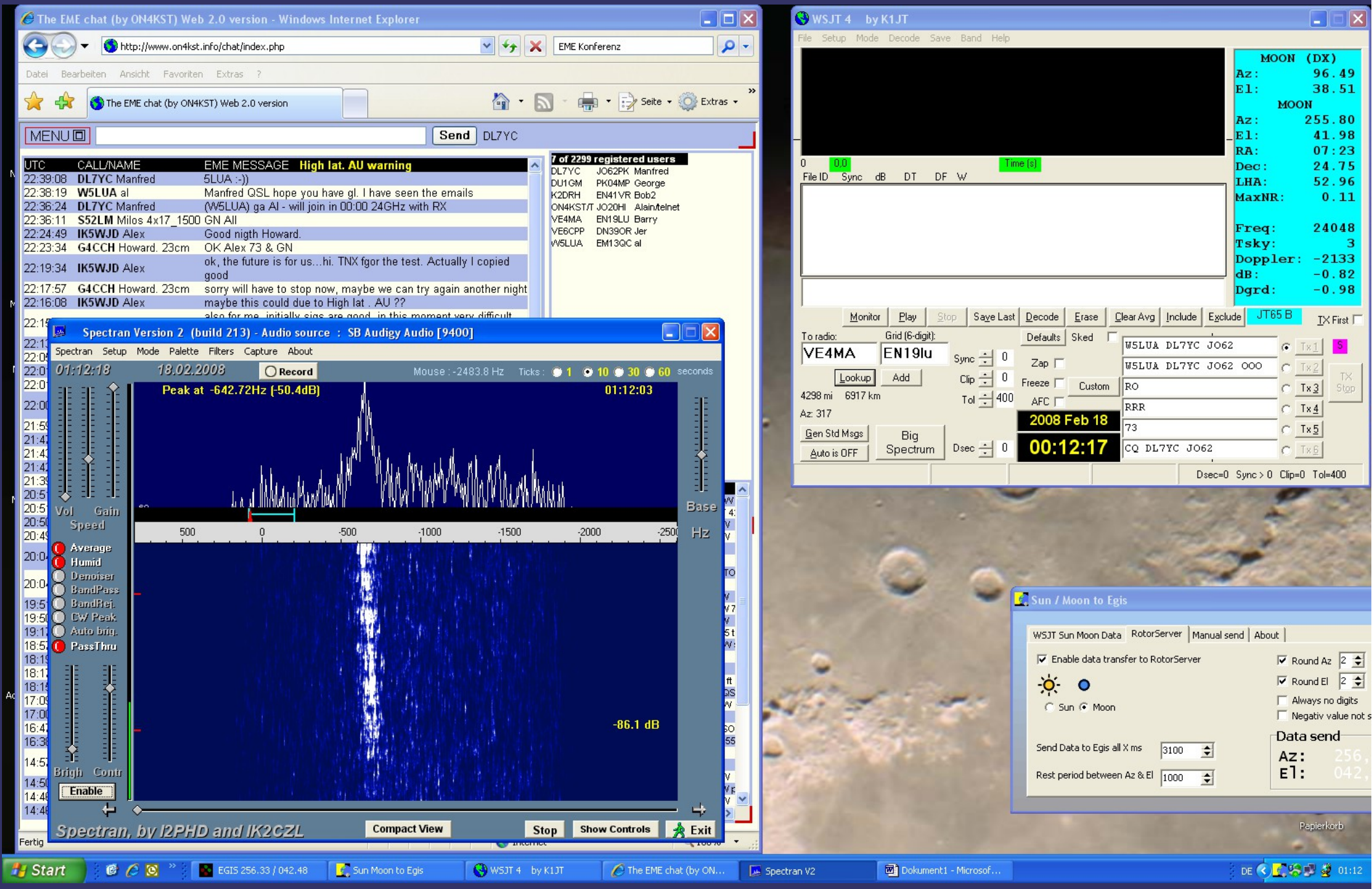
A rocky road ?

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





This is the 529 CW-signal (R OOO) 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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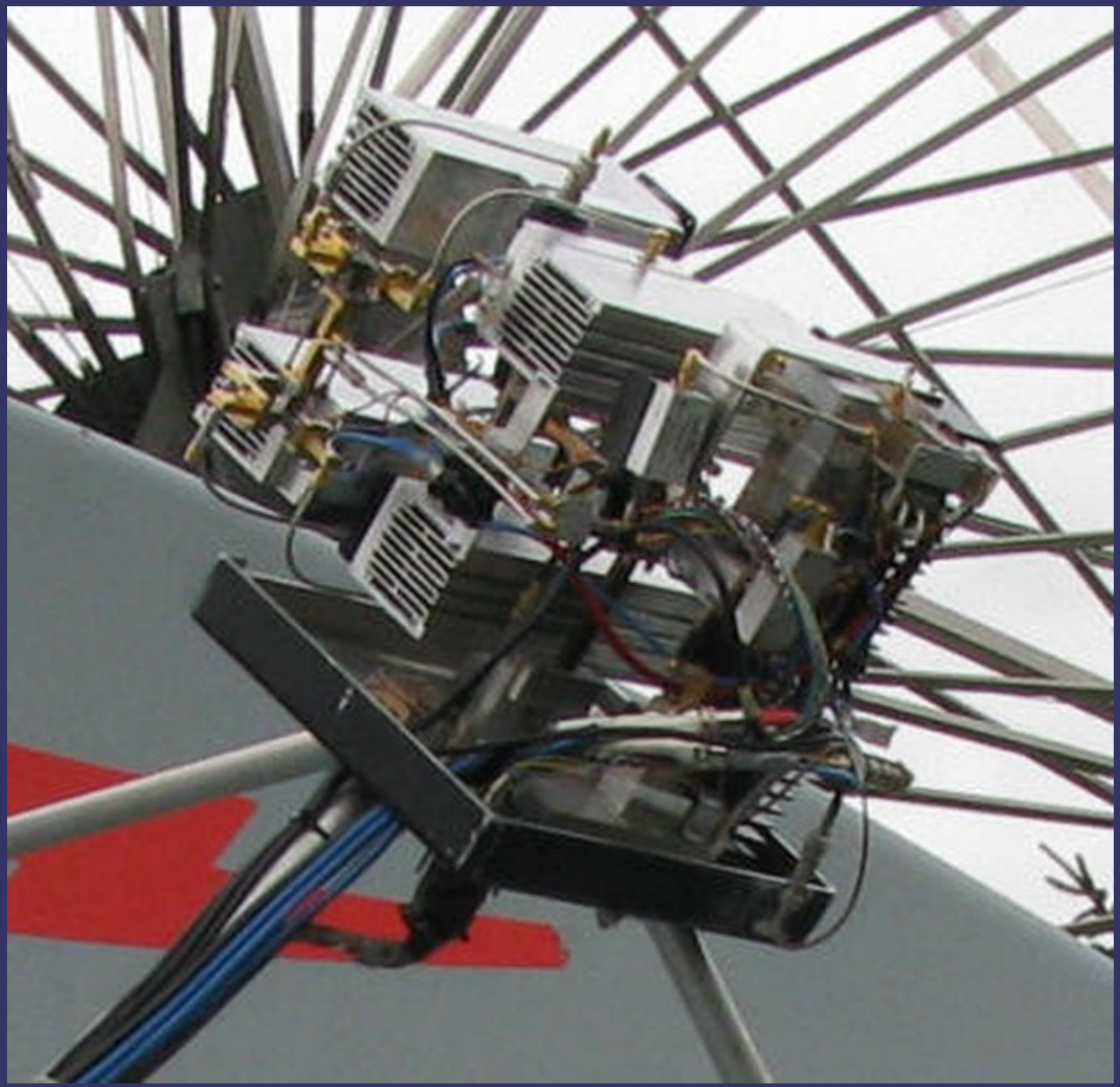
4 x 10 Watt SSPA at LX1DB



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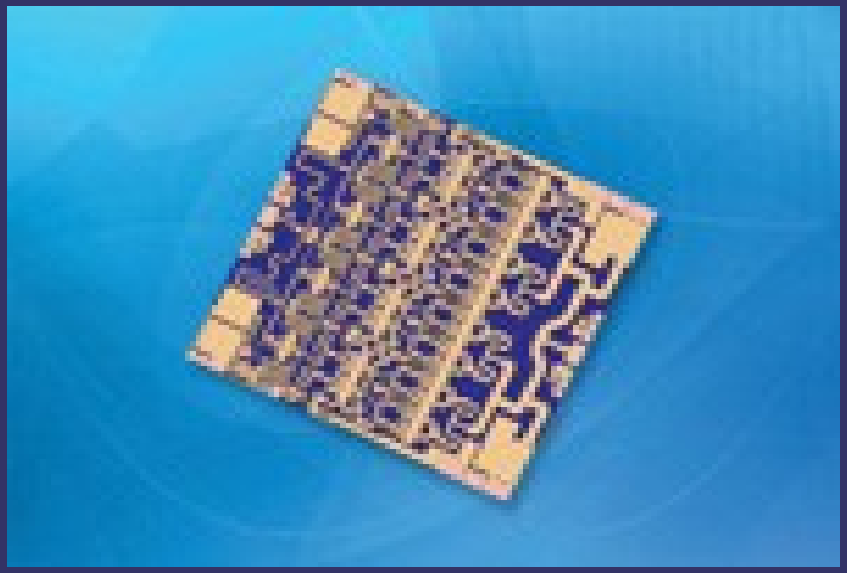
TriQuint TGA 4906

- 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: Vd = 6 V, Idq = 1.6 A,
Vg = -0.75 V typical
Technology: 3MI 0.15 um Power pHEMT
Chip dimensions: 2.98 x 2.90 x 0.05 mm

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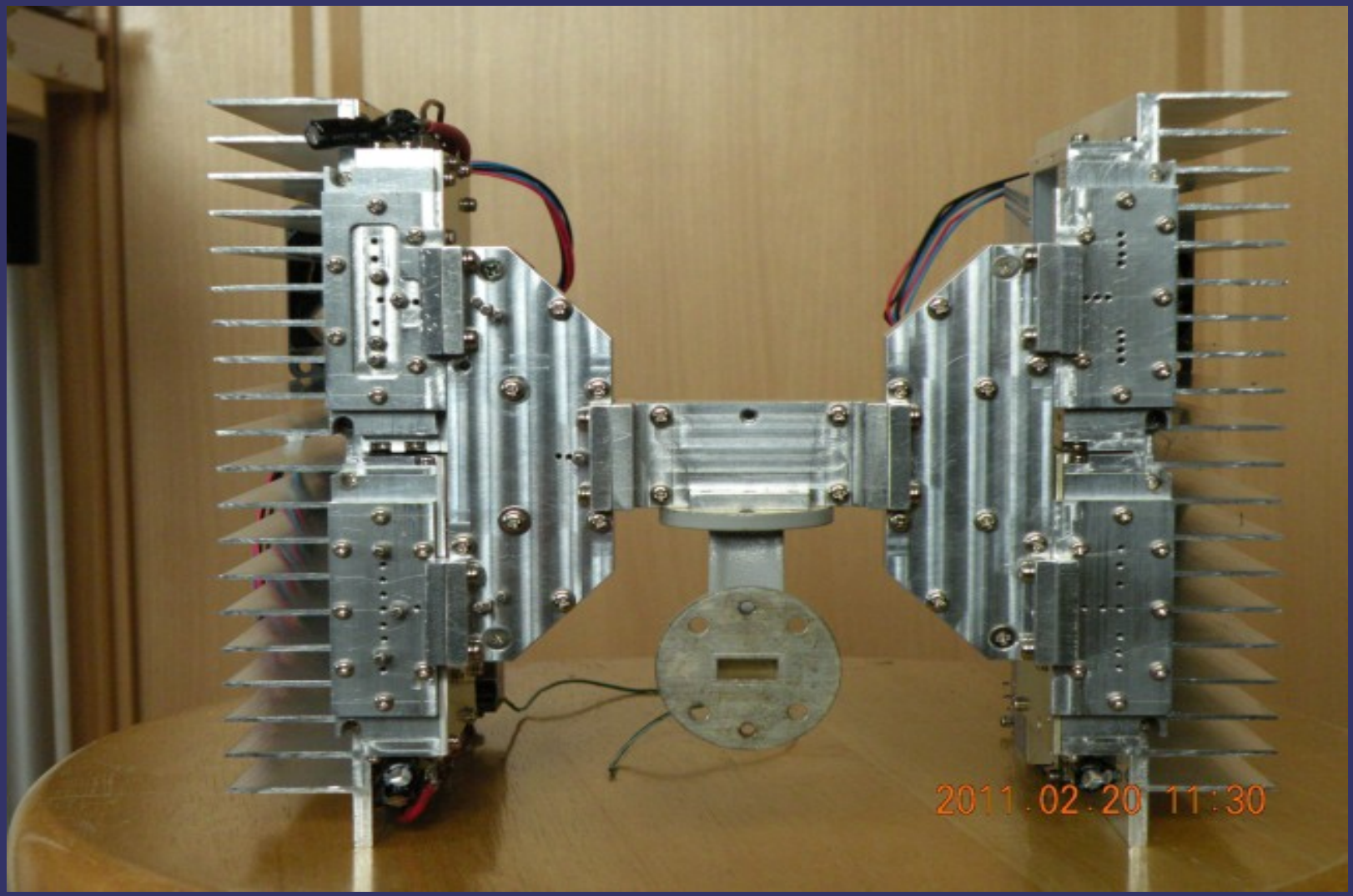
- Former AM TV 12GHz transmitters

  RW 1127 surplus available

24 GHz Power Combiner JA6CZD



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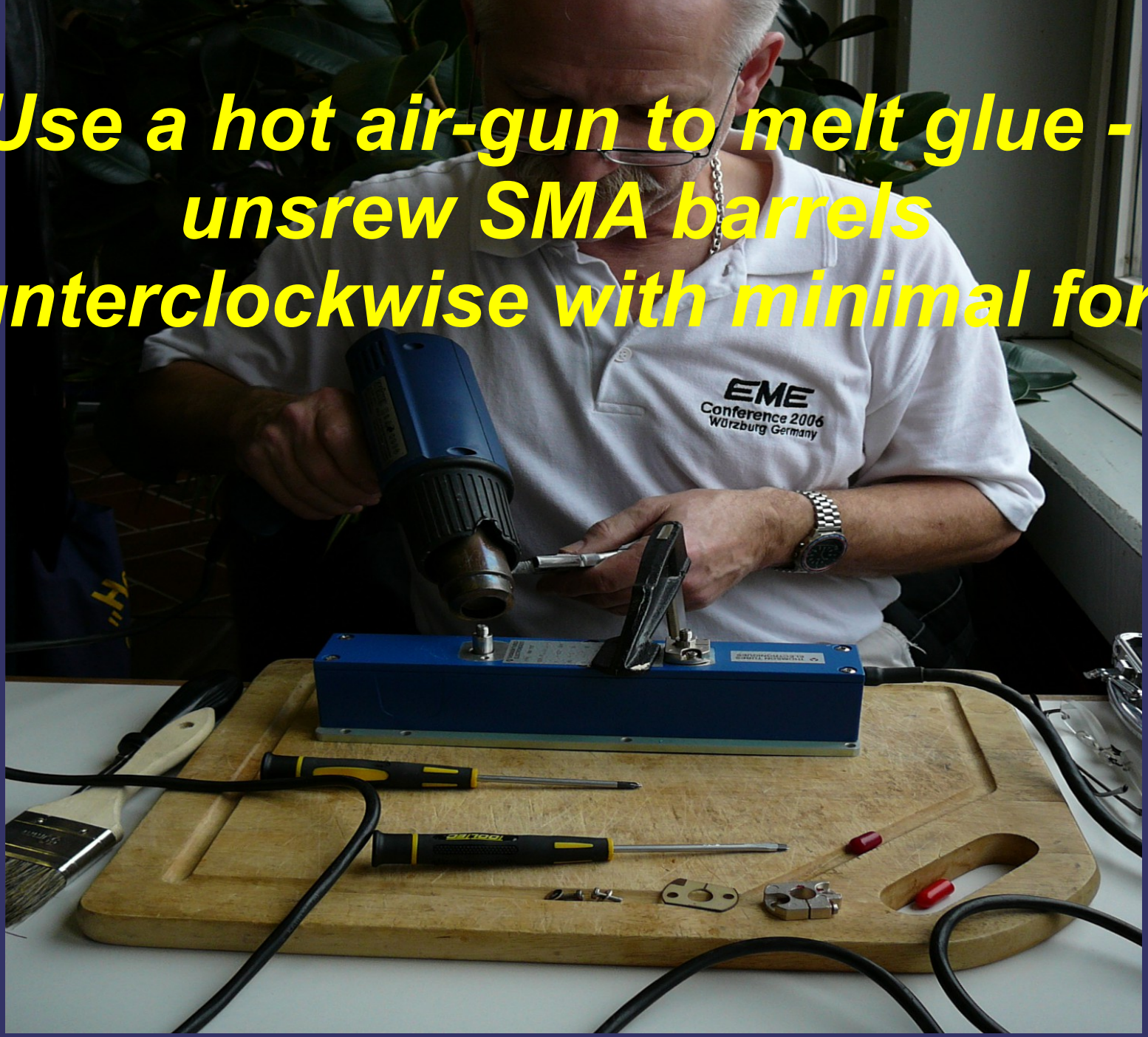
- **Former 12GHz AM TV-transmitters RW1127 + RWN PSU`s surplus available**

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 ?

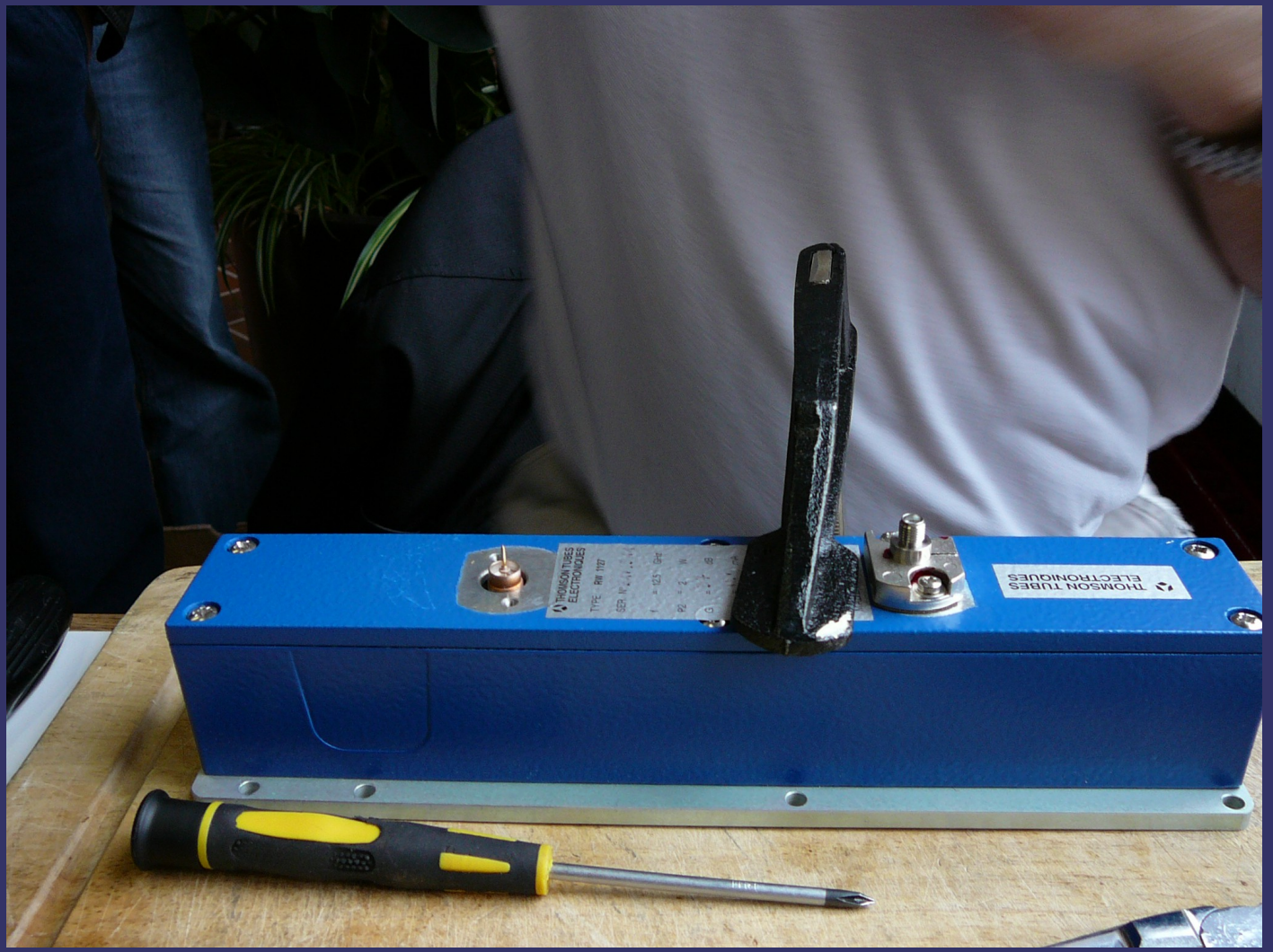


Use a hot air-gun to melt glue - unsrew SMA barrels counterclockwise with minimal force


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 remoce the discs – the tube has „broadband“ capability now

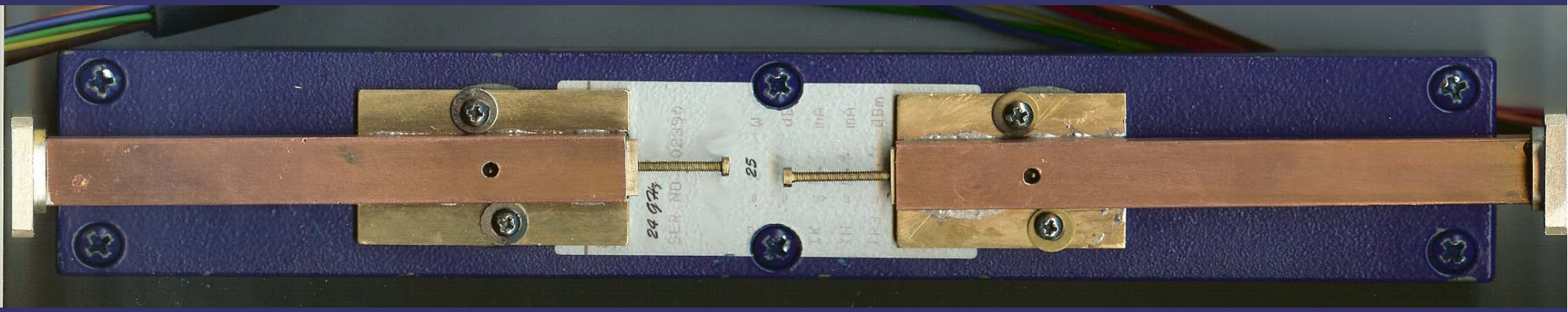


Fragile Helix connector ready – never try to cut the center pin !!

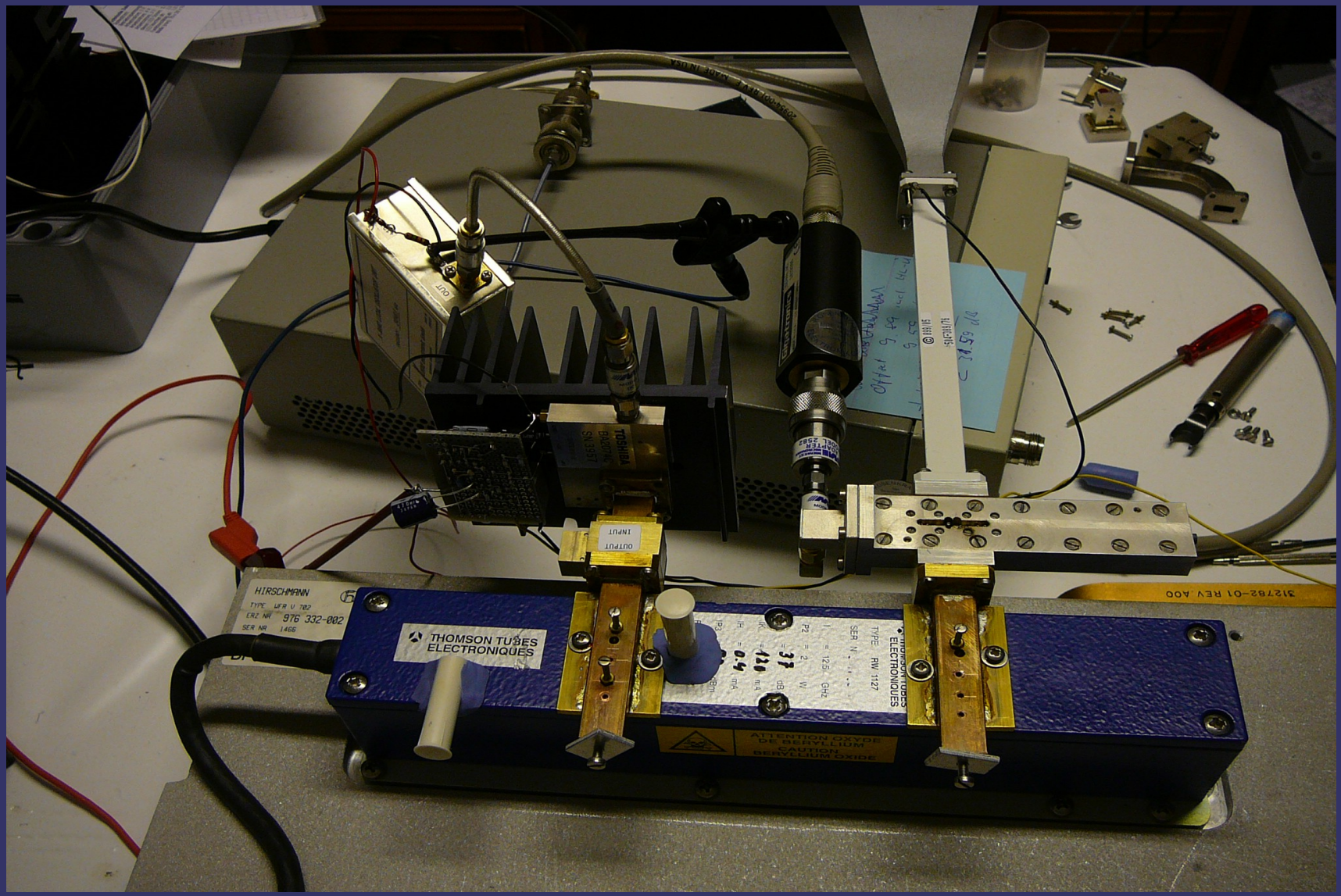
***NOW* you need something like that:**

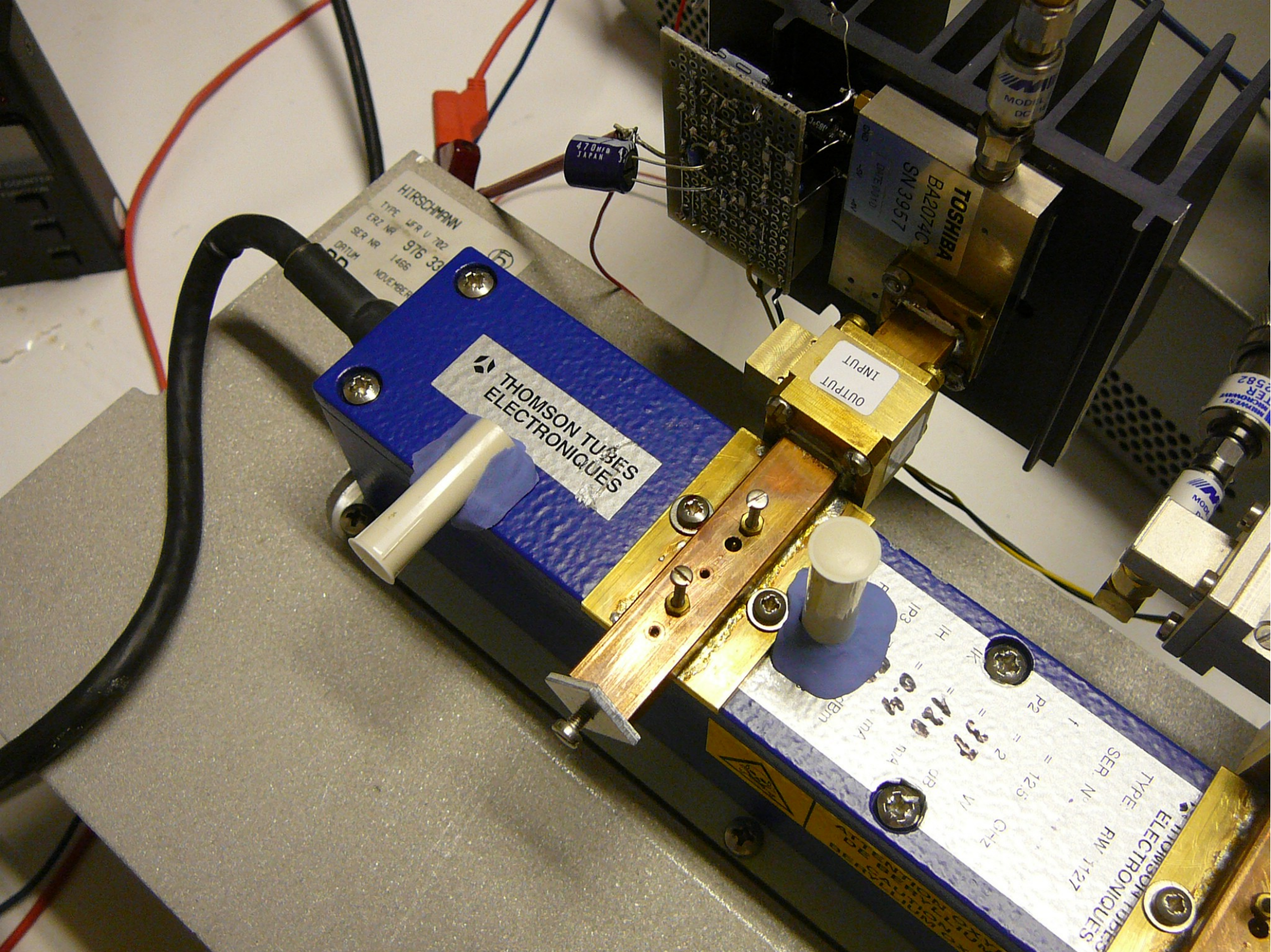
Baseplate with 8mm precision hole to contact Helix coax

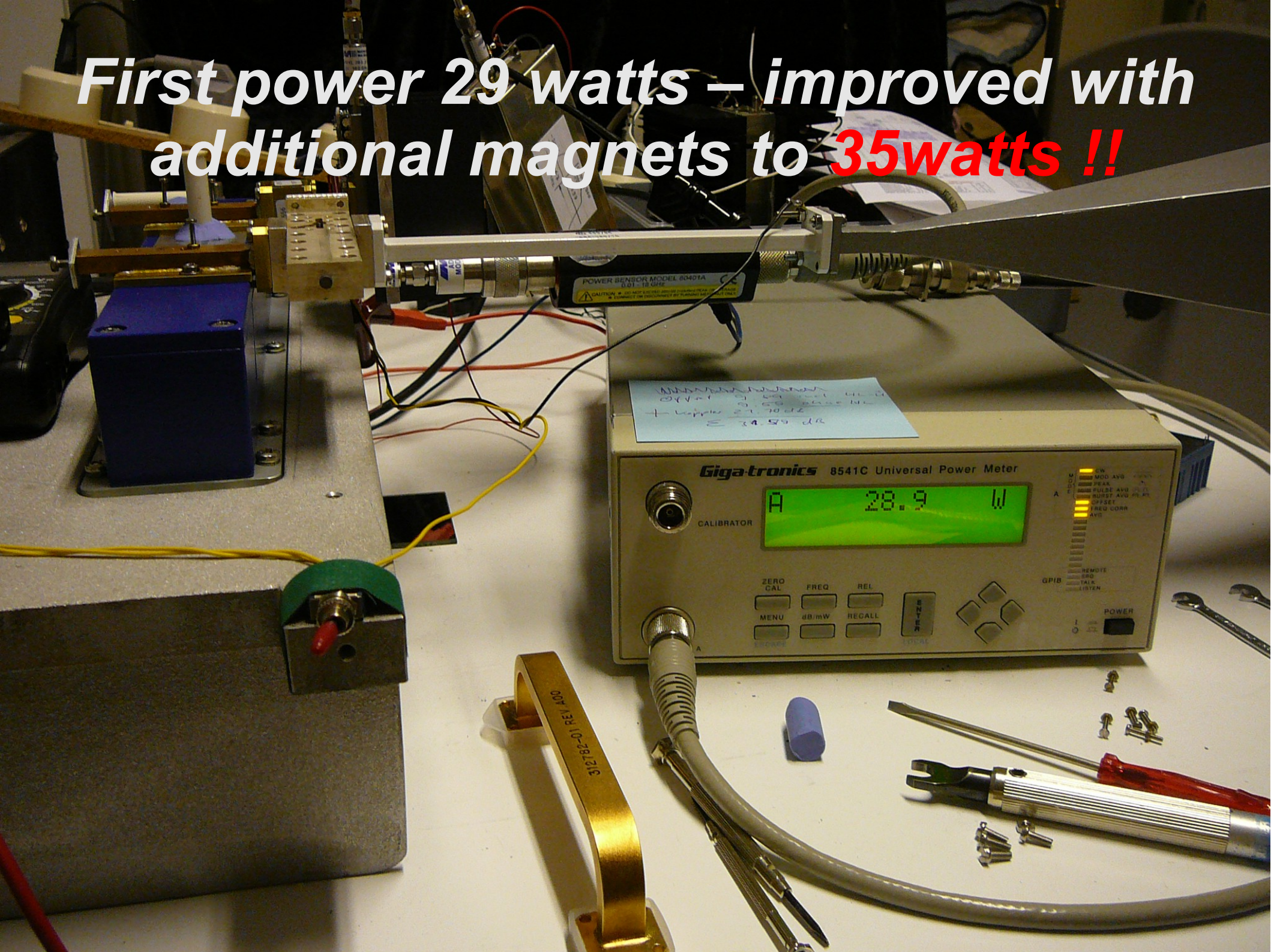
G4NNS version with sliding short



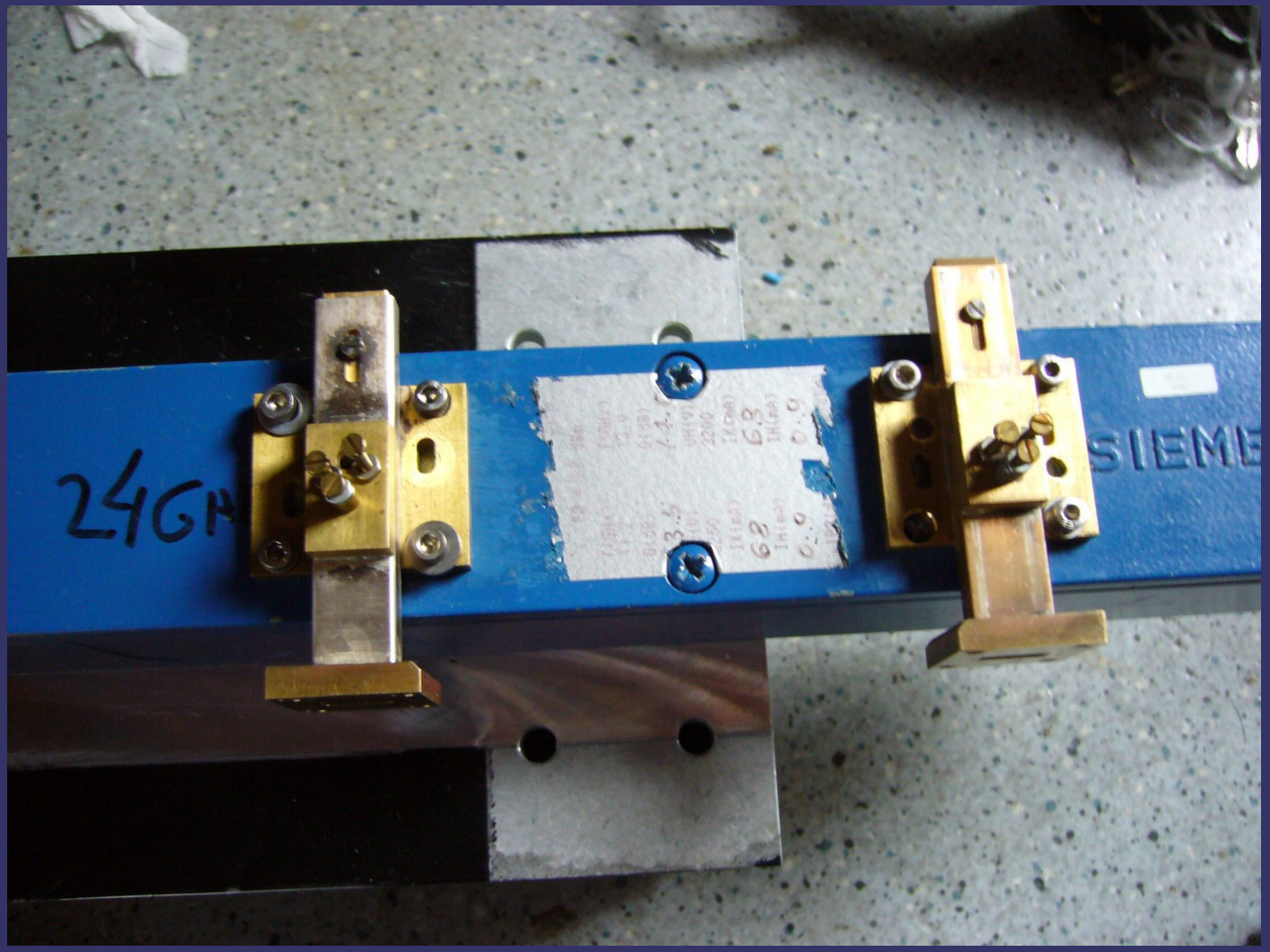
DL7YC first solution in 2008



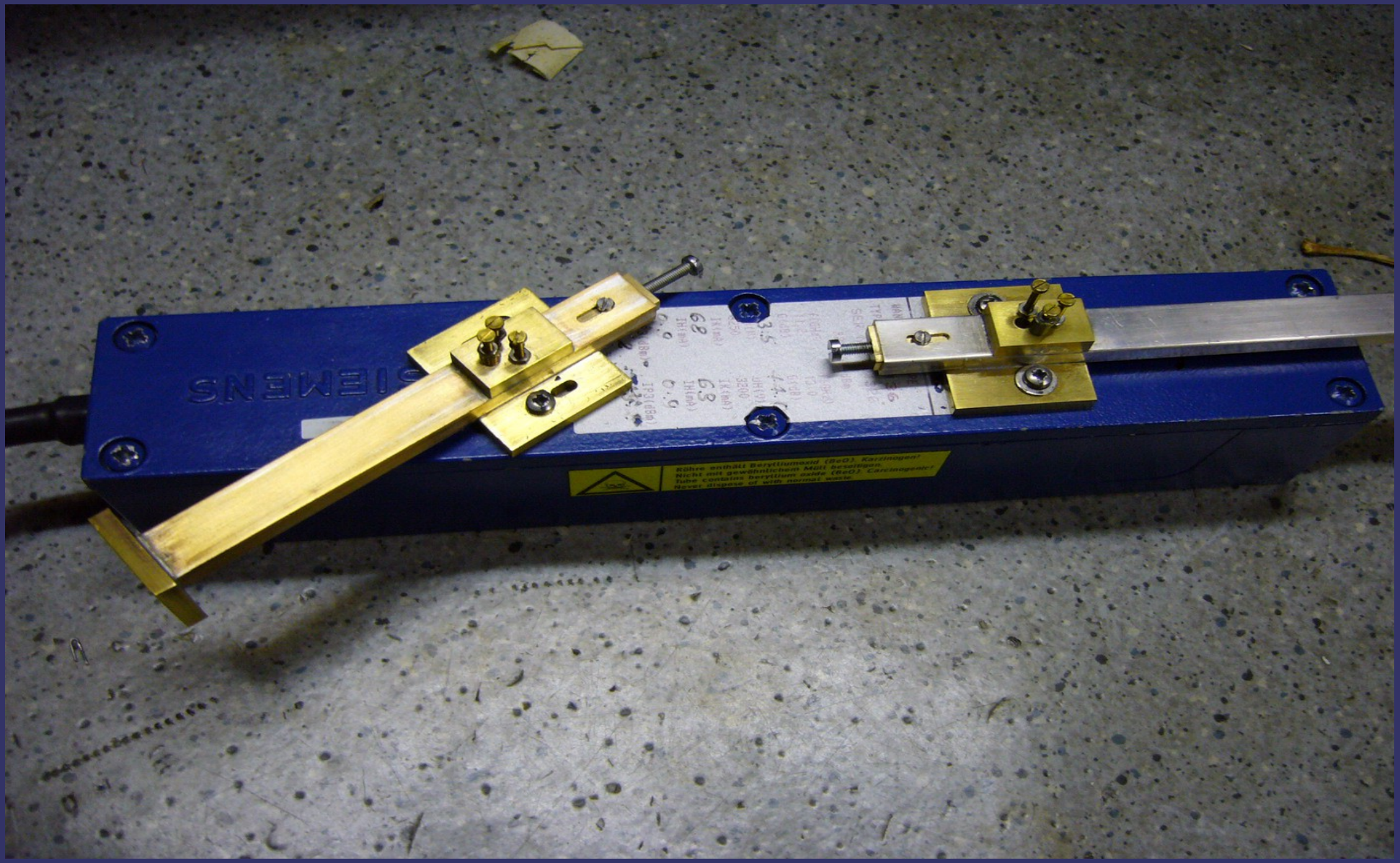

HIRSCHMANN
TOSHIBA
SN 39357
OUTPUT
INPUT
THOMSON TUBES
ELECTRONIQUES


First power 29 watts – improved with additional magnets to 35watts !!
Giga-tronics 8541C Universal Power Meter
A 28.9 W
CALIBRATOR
ZERO CAL
FREQ
REL
MENU
dB/mW
RECALL
ENTER
POWER
GPIB
POWER SENSOR MODEL 8401A

Another different solution for the 24GHz TWTA adaption



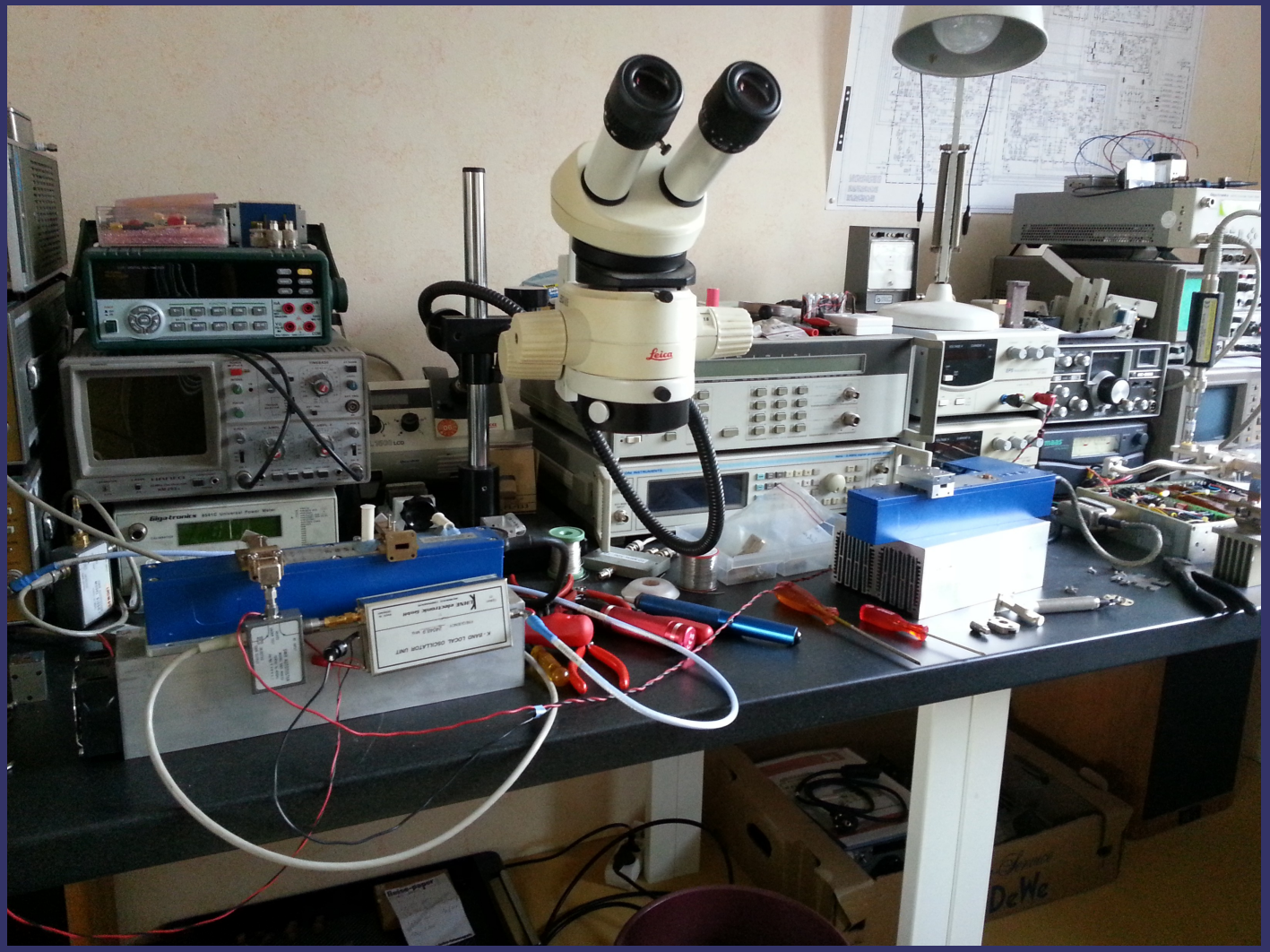
Next Helix / WR-42 transition



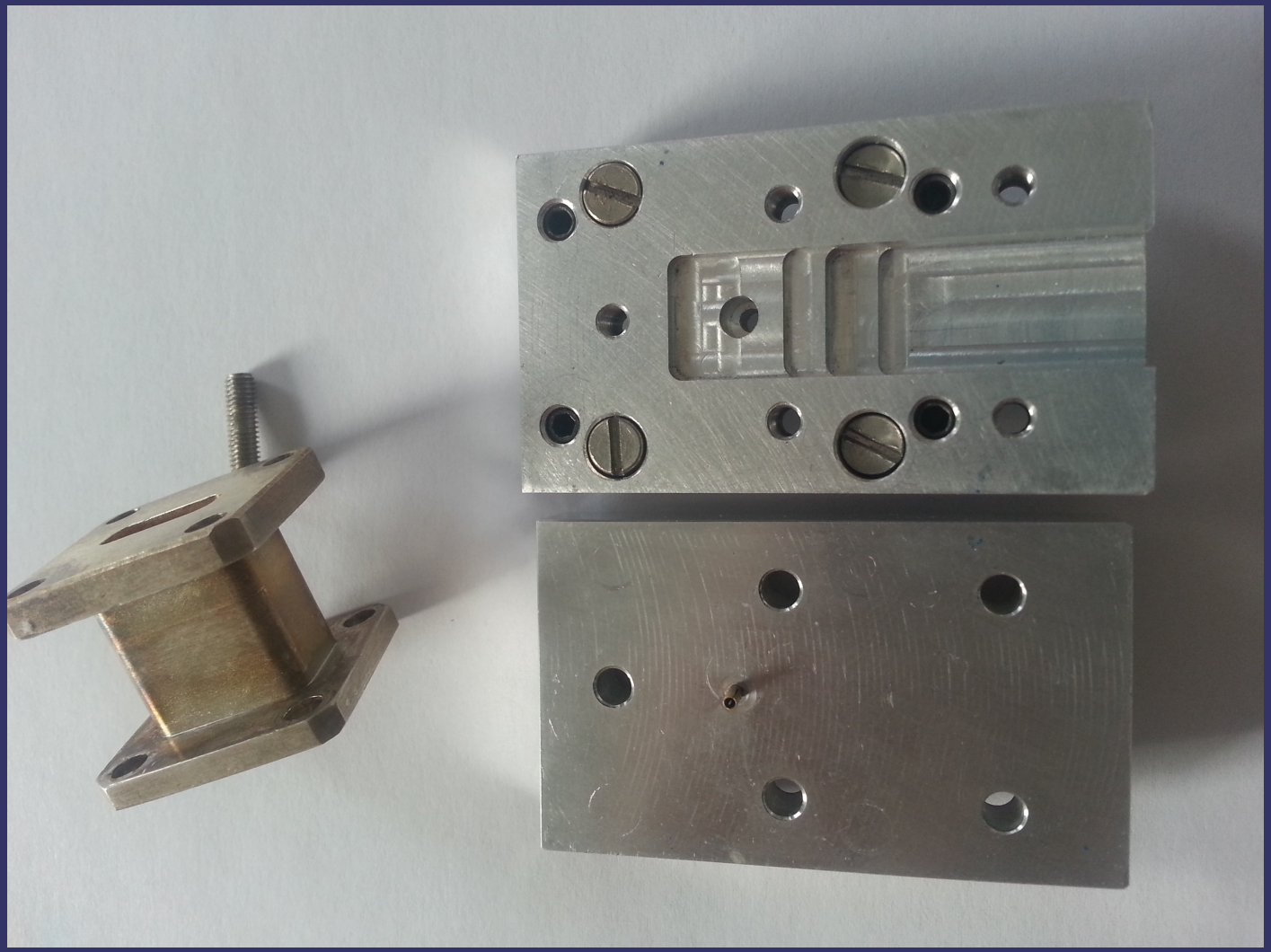
40 watts a realistic value ?

- I was not comfortable with this solution, because the center pin of Helix-coax system seems to be to long pertruding 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“ lenght with unknown Zo, unpredicted effects reduced Power again
- Search for different ways.....

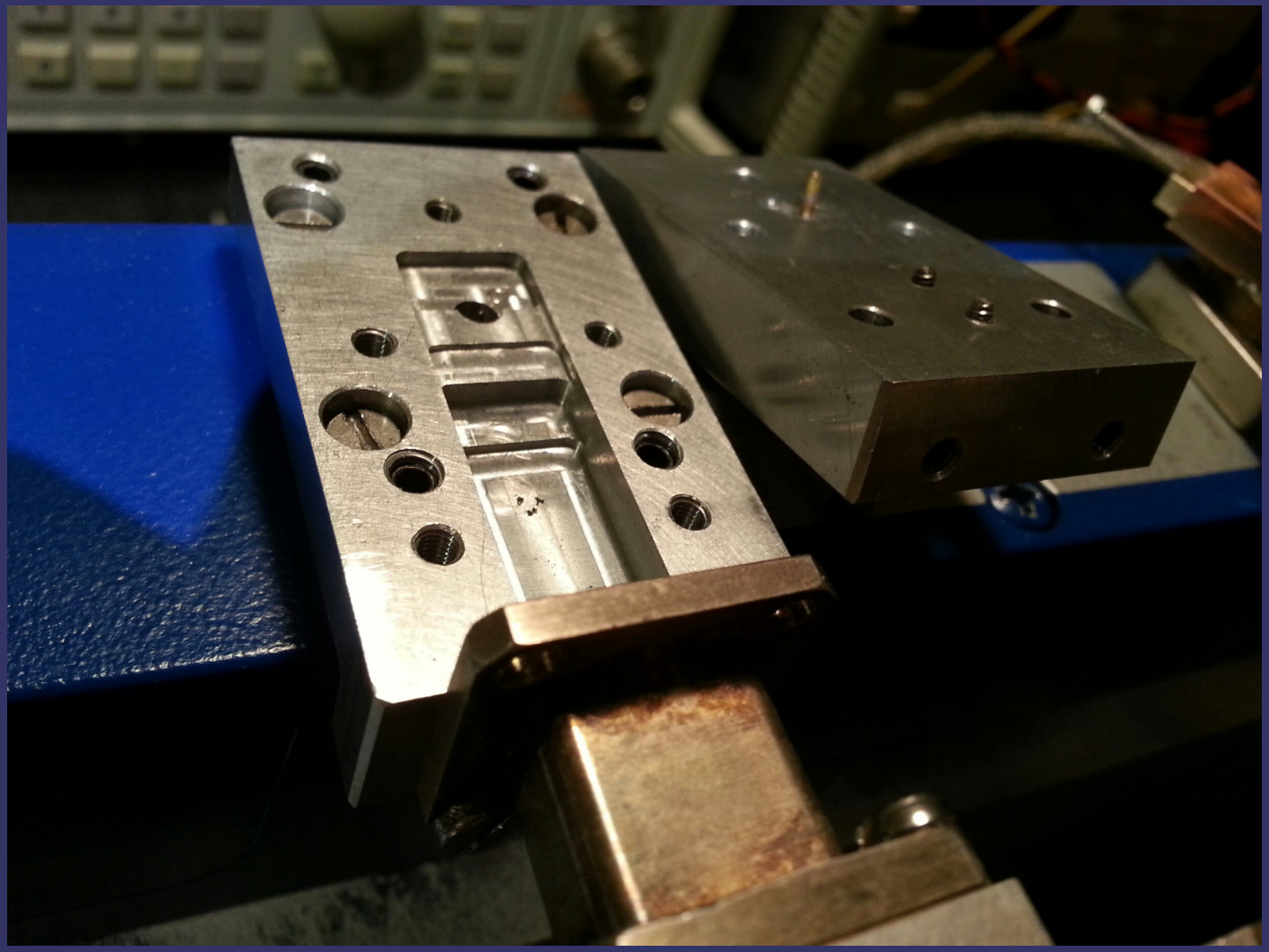
DL7YC lab -several TWTA`s on bench



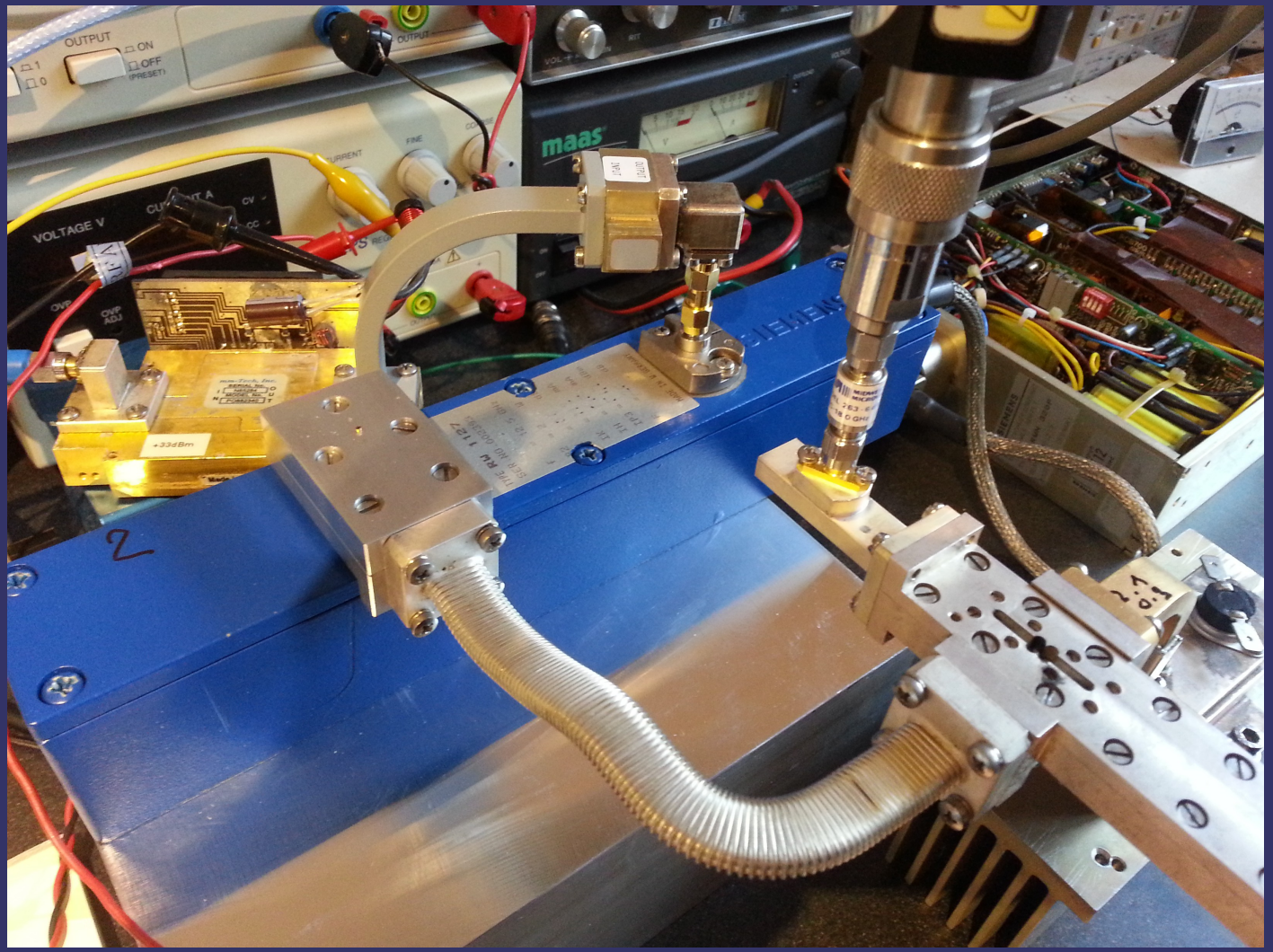
Milled Helix/WR-42transition by DC0LB (center pin contact WG)



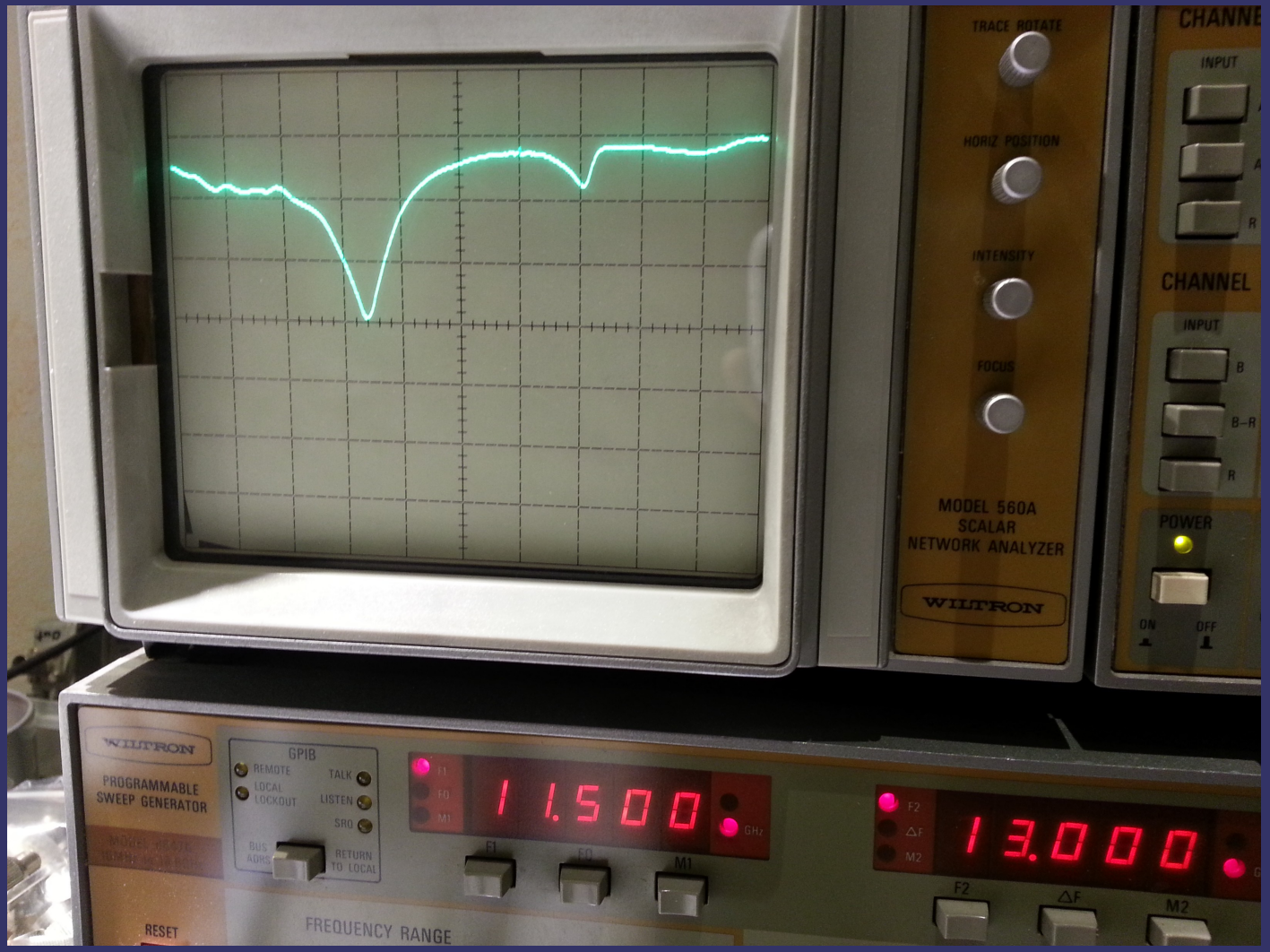
Due to „bad“ ground contact worse results regarding output power



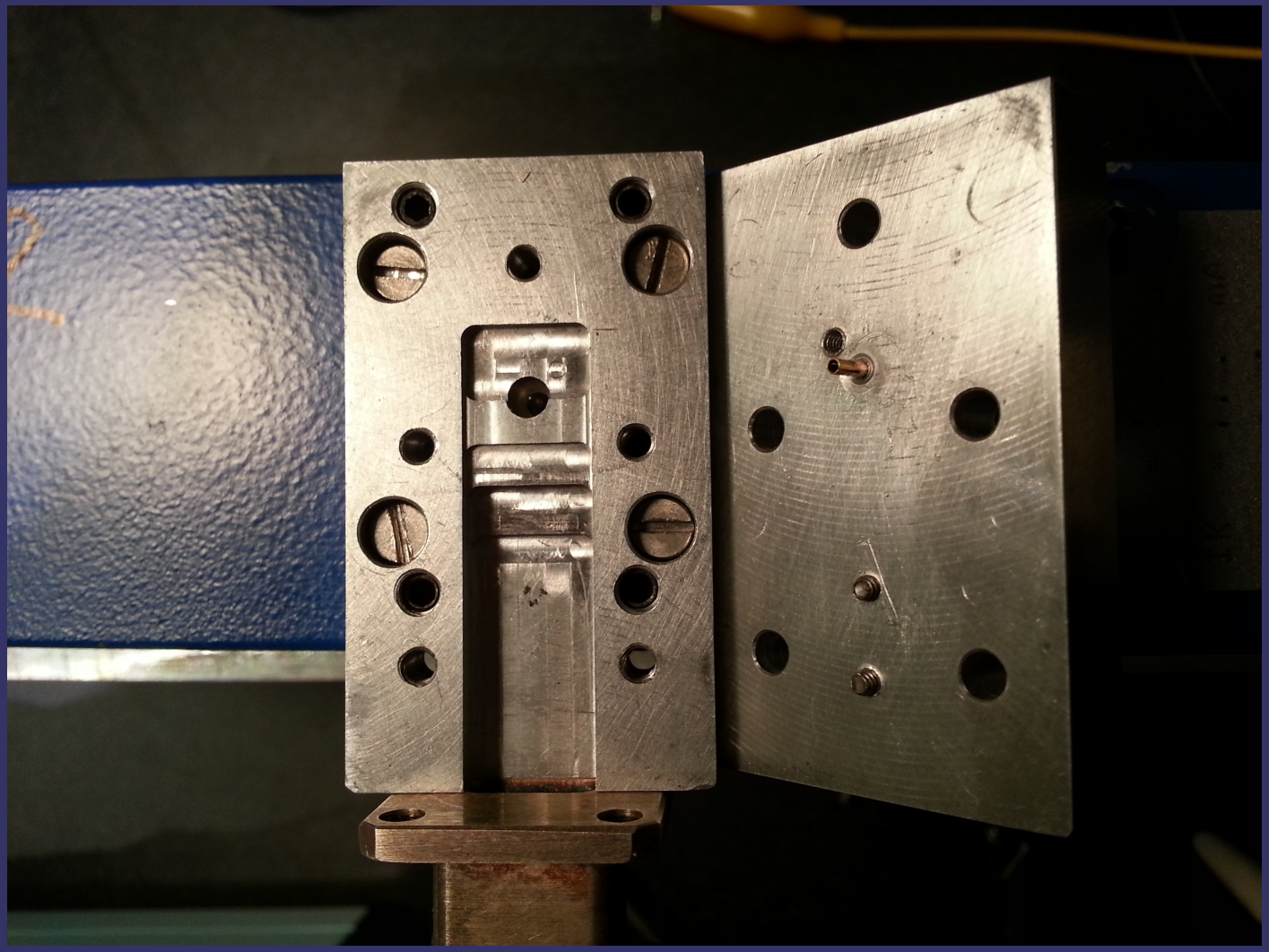
2 Watts input – DC0LB transition @ output



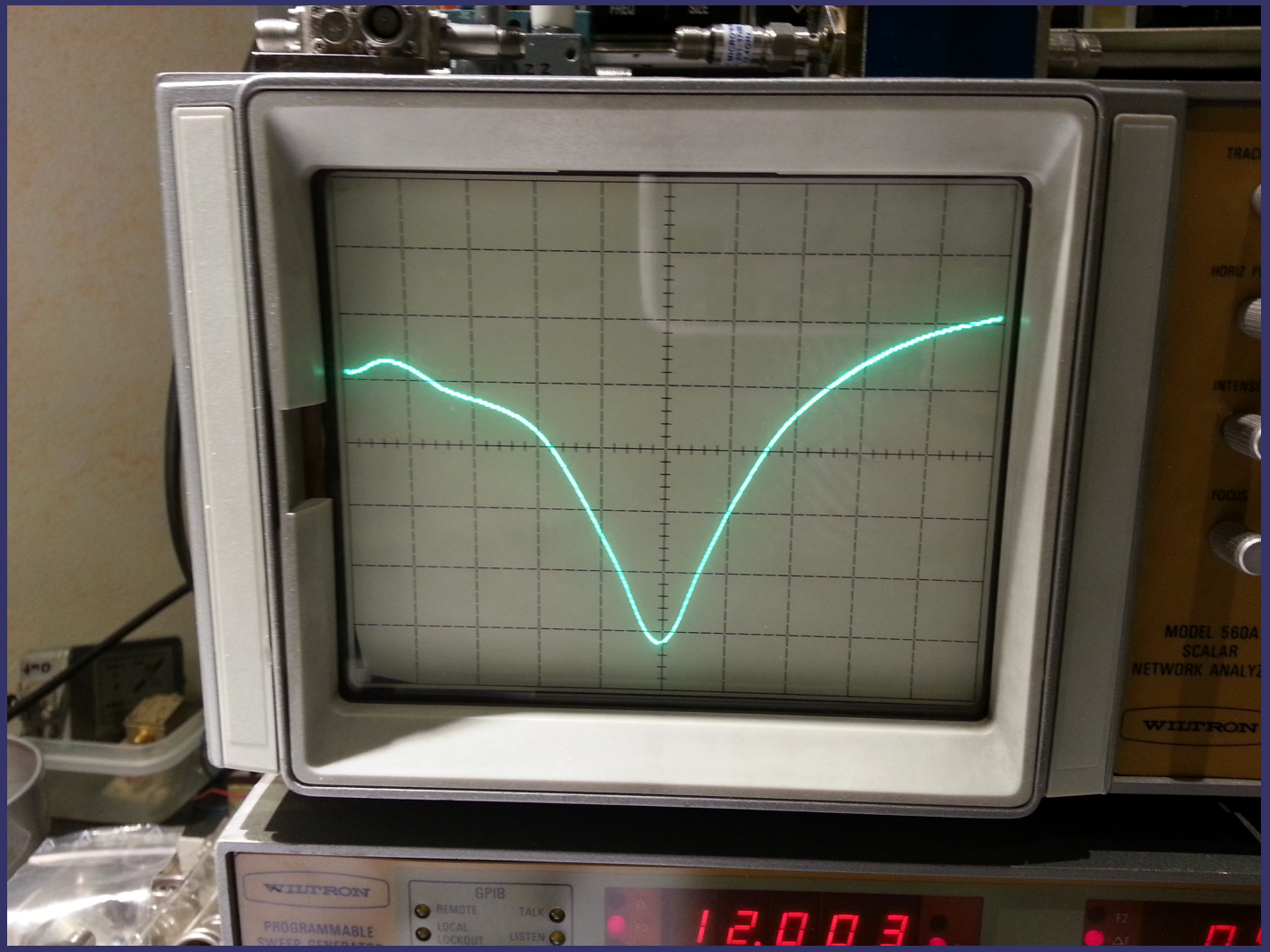
Before tuning (23-26GHz)



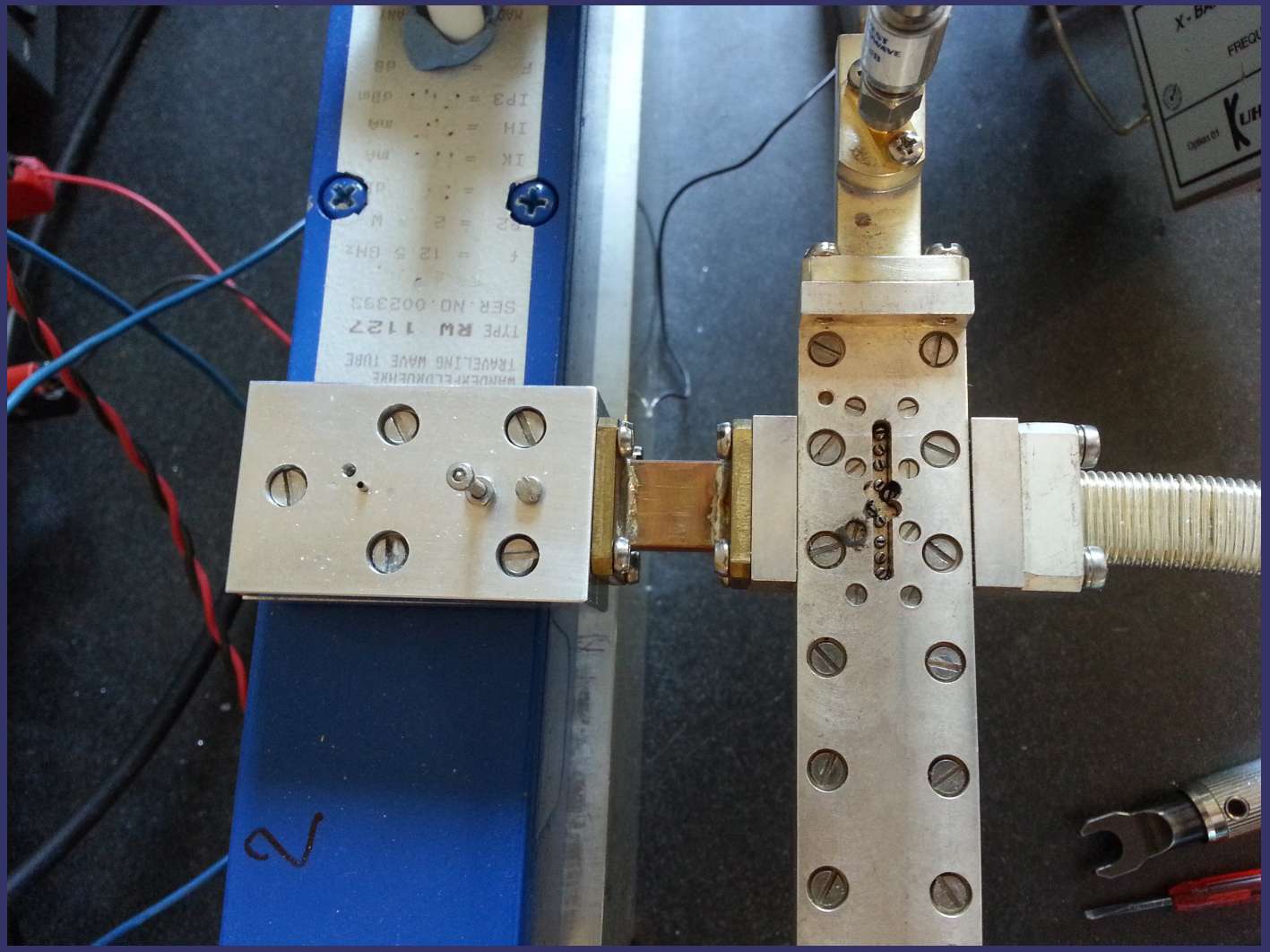
DC0LB -resonant chamber and taper



After tuning (24028 +/- 250MHz)



DC0LB – tuned for optimized RL

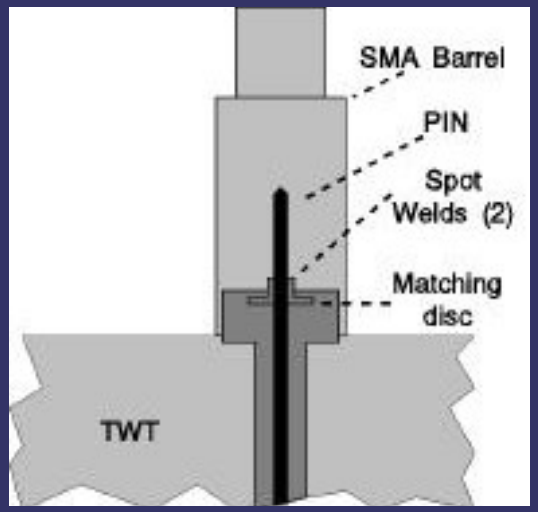


Rember the thread below the 8mm part of the Helix coaxial system

Next solution was an idea from Italien microwaver

I3OPW

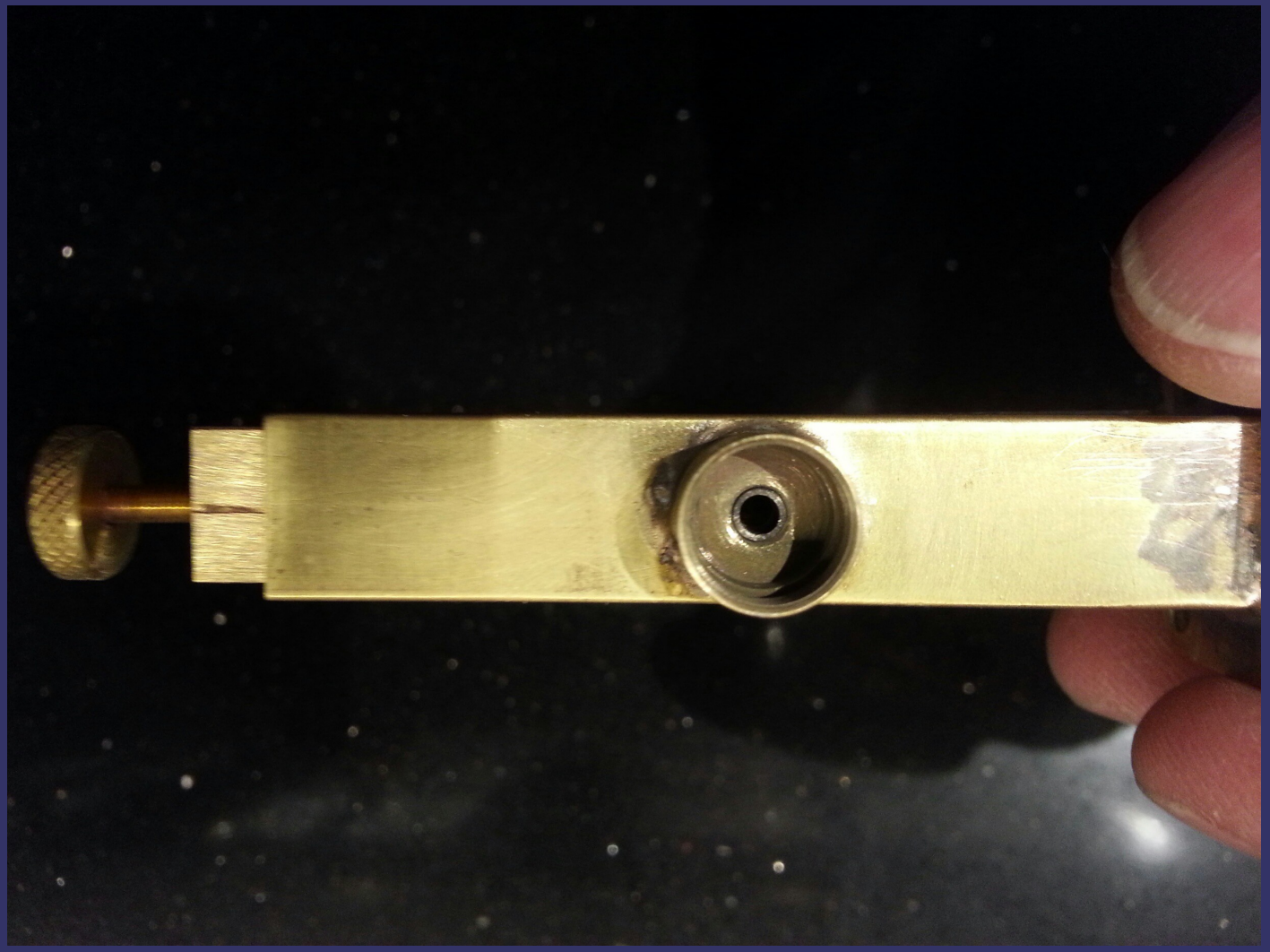
Detail of the SMA / Helix system



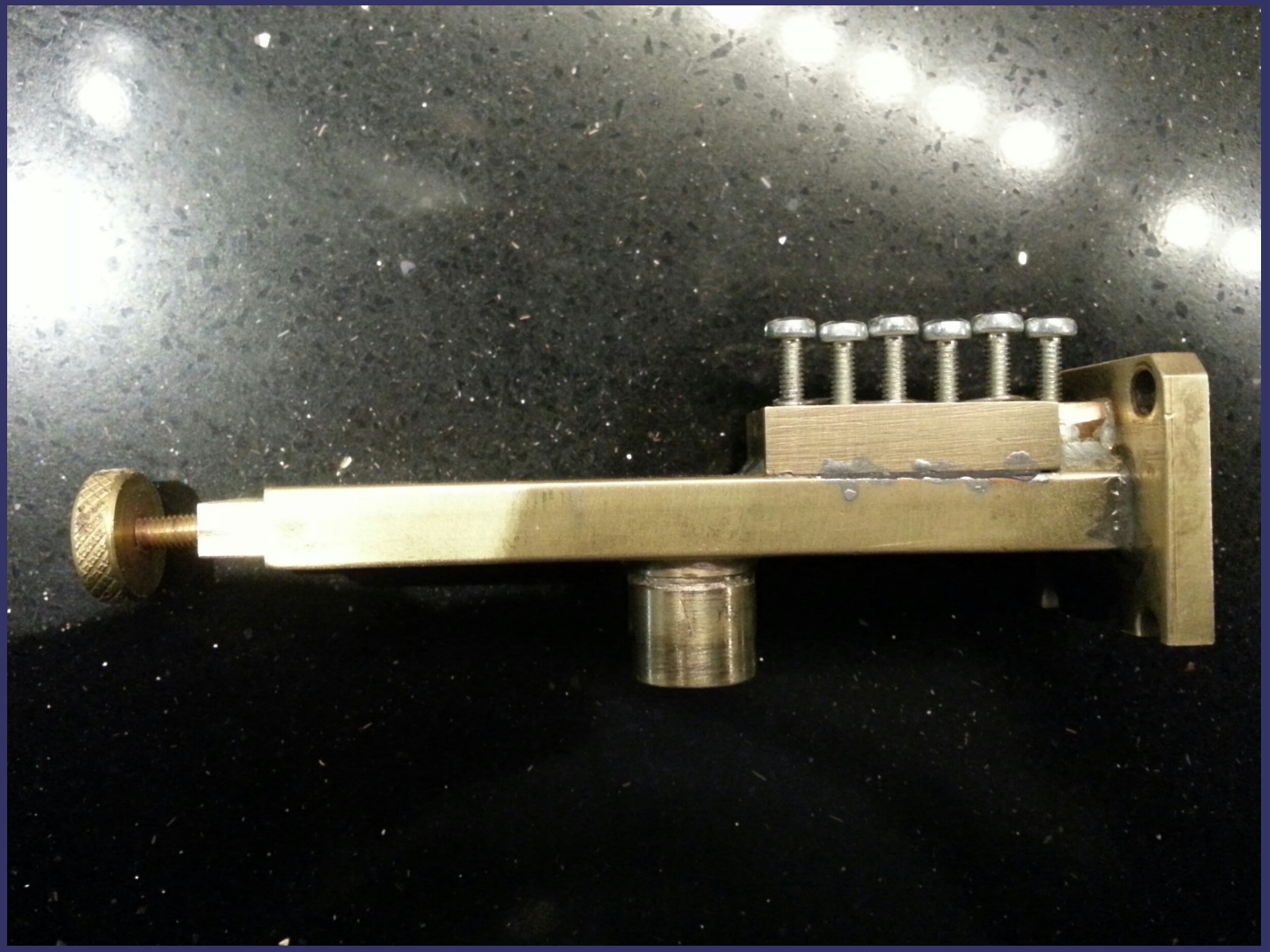
SMA barrels – prepared by I3OPW

WR-42 WG`s ready to solder barrels

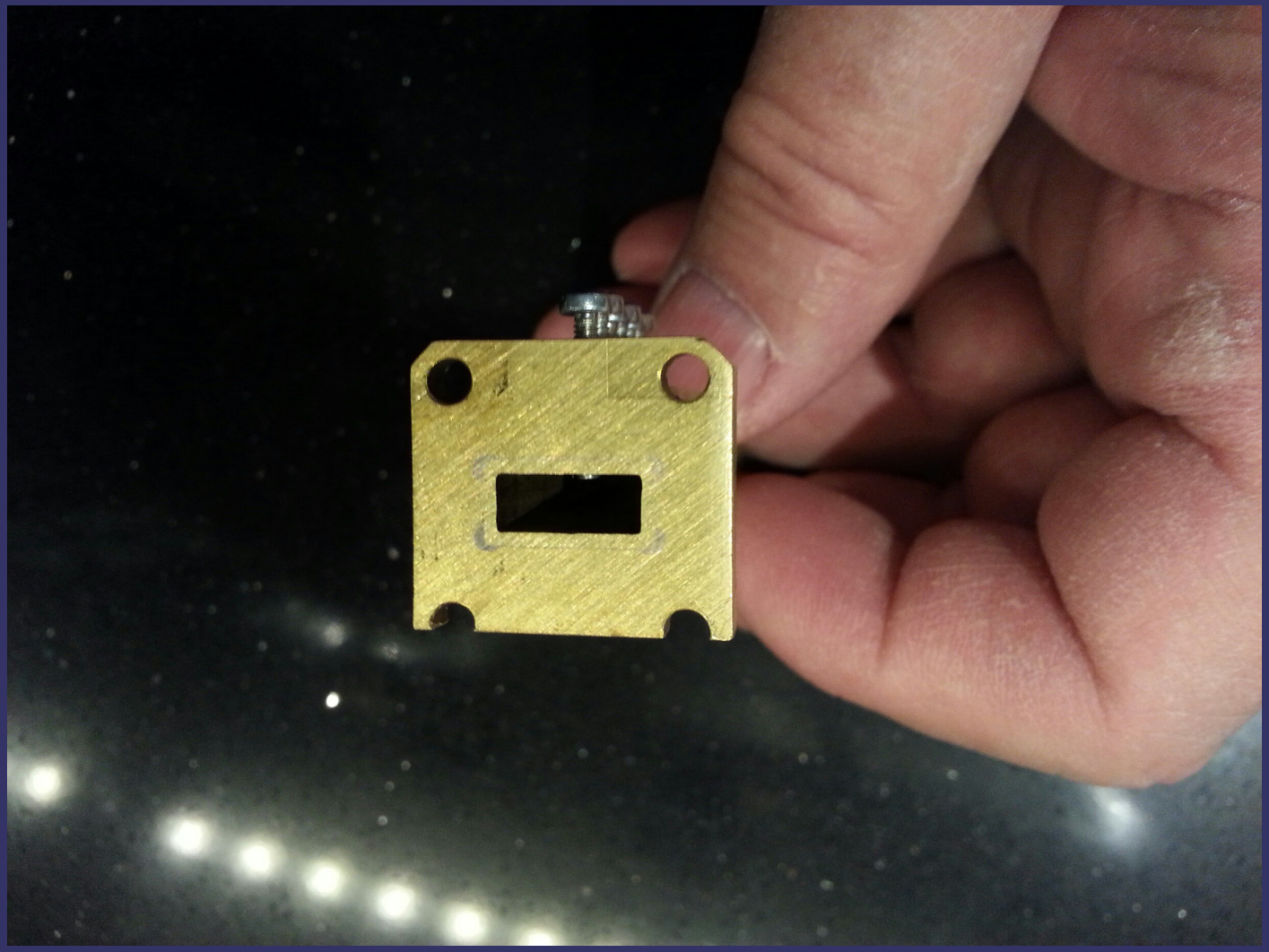
Modified barrel soldered into WG



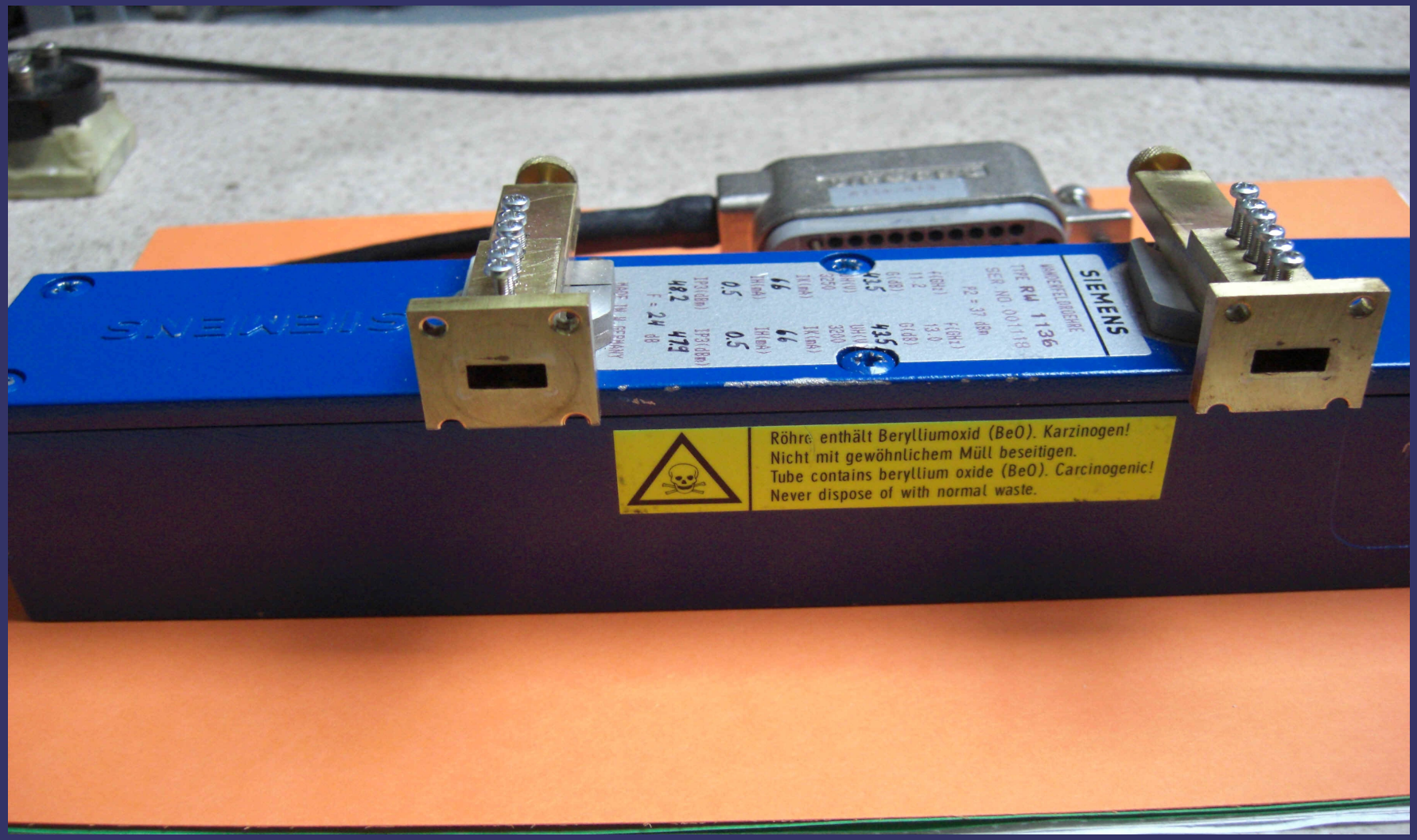
I3OPW`s solution ready to use



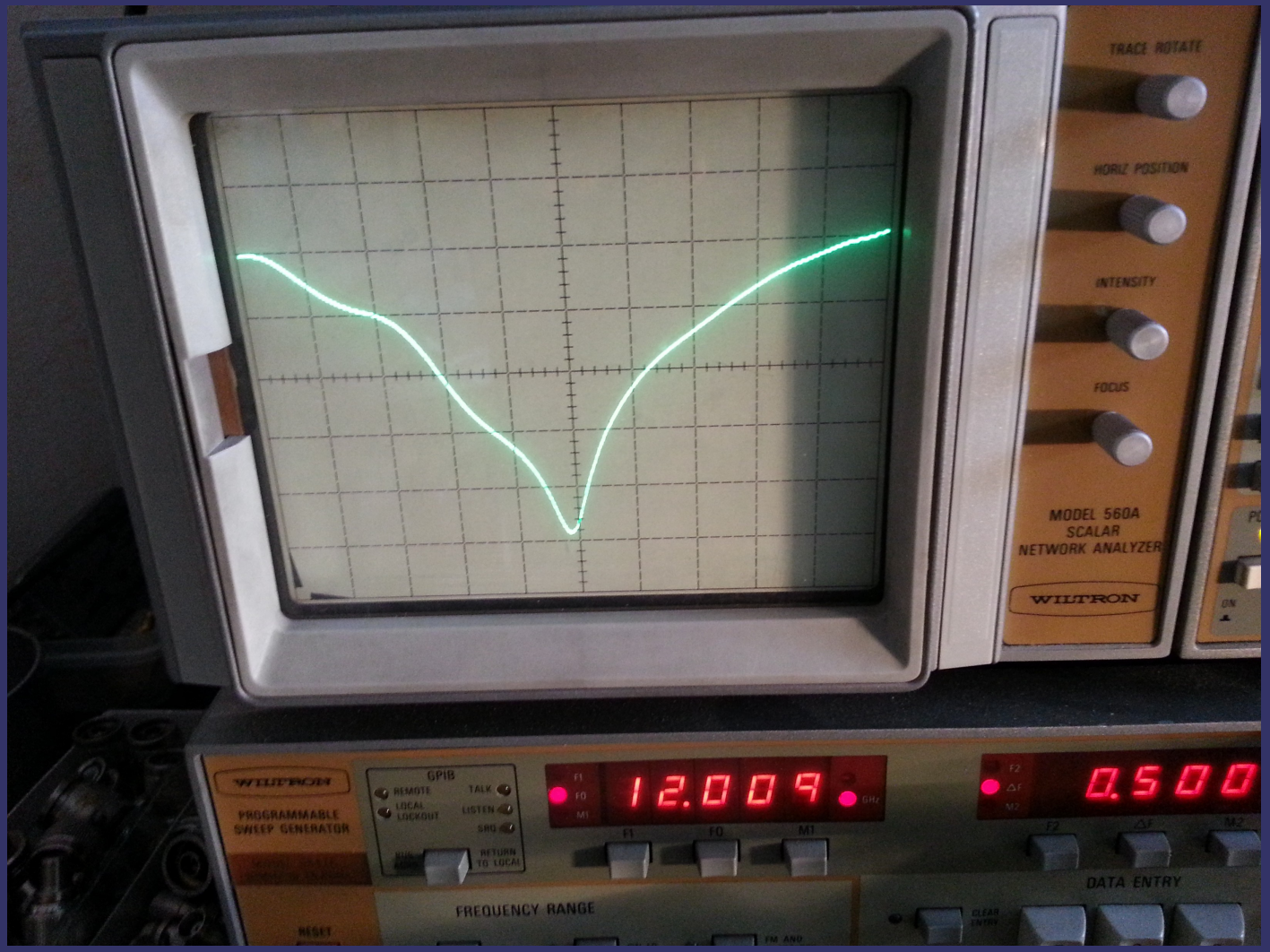
Flange „cut“ - now WG can be turned overhead the tubes body to adjust Return Loss



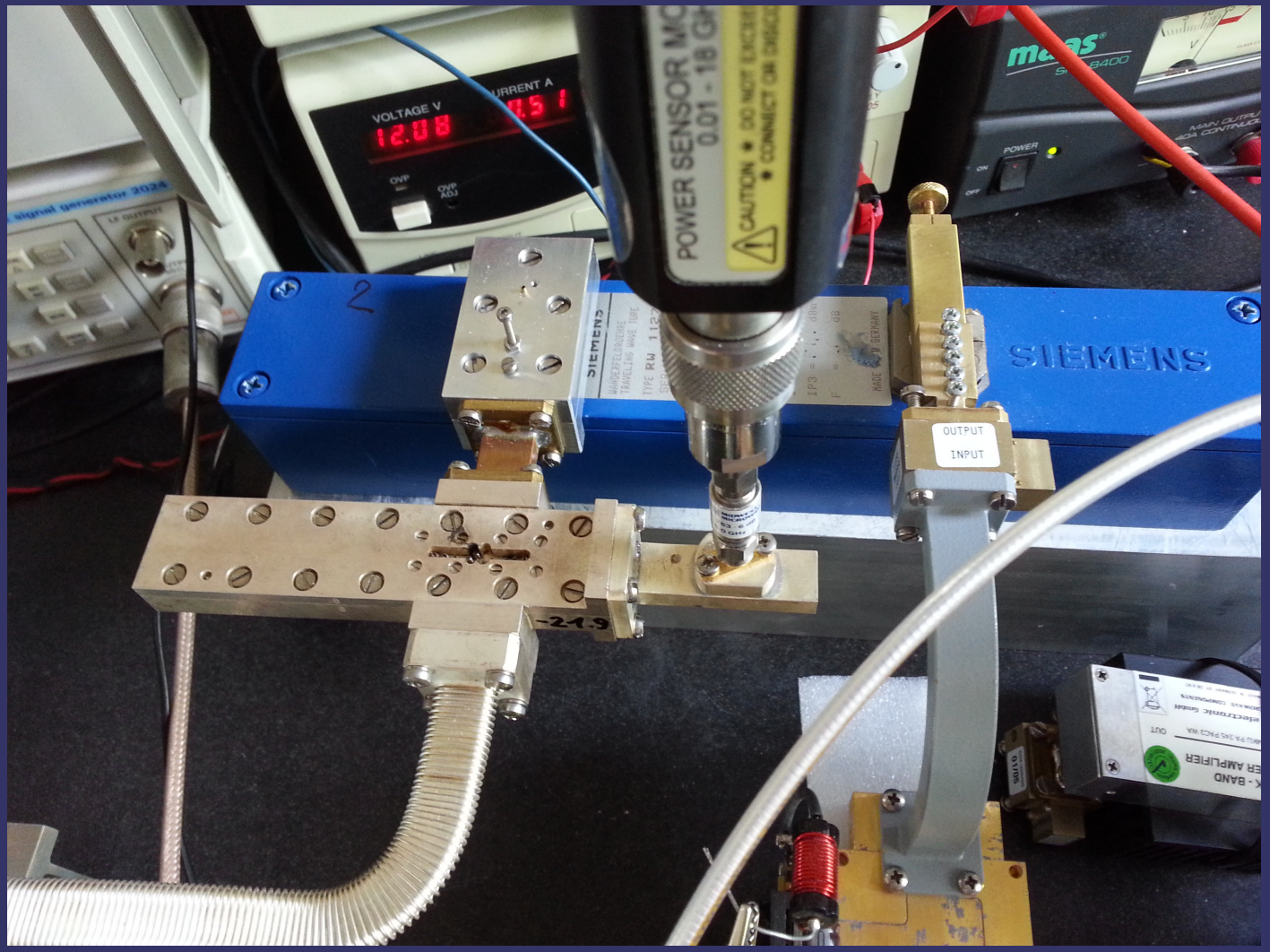
I3OPW`s solution – mounted at Input and Output – tuned best RL



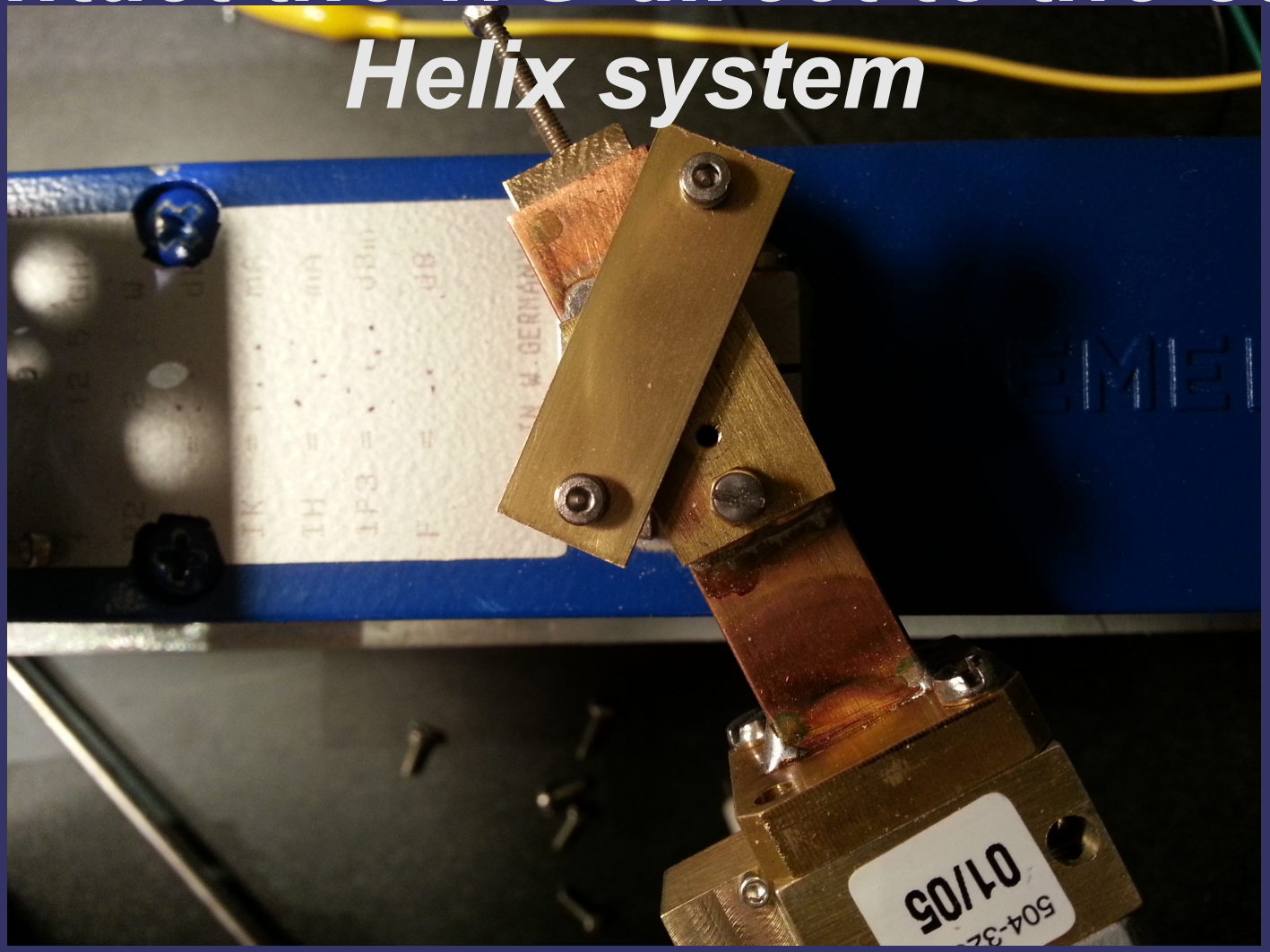
Very good RL results – but ground currents have to „pass“ thread



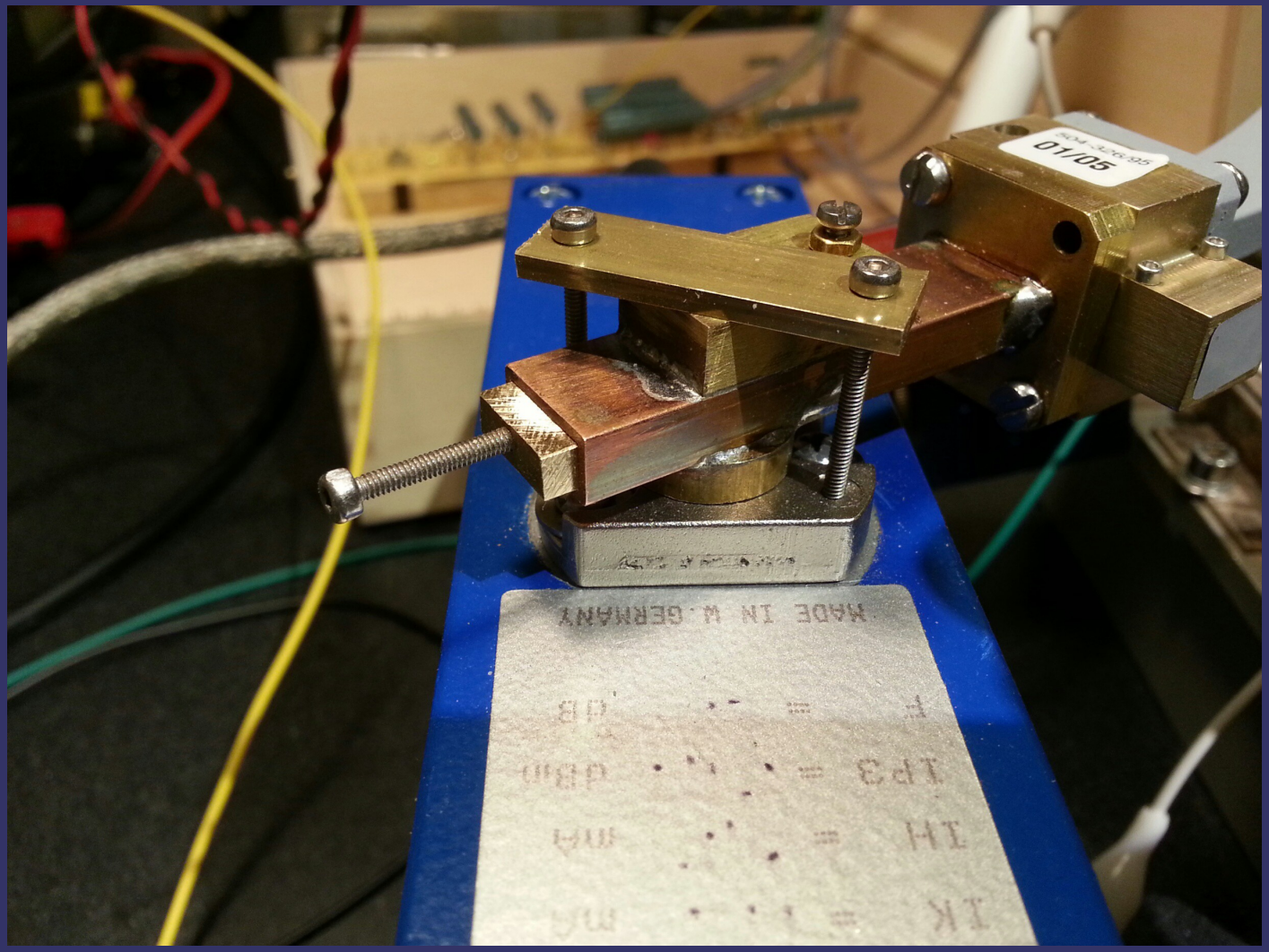
Input: I3OPW - Output DC0LB



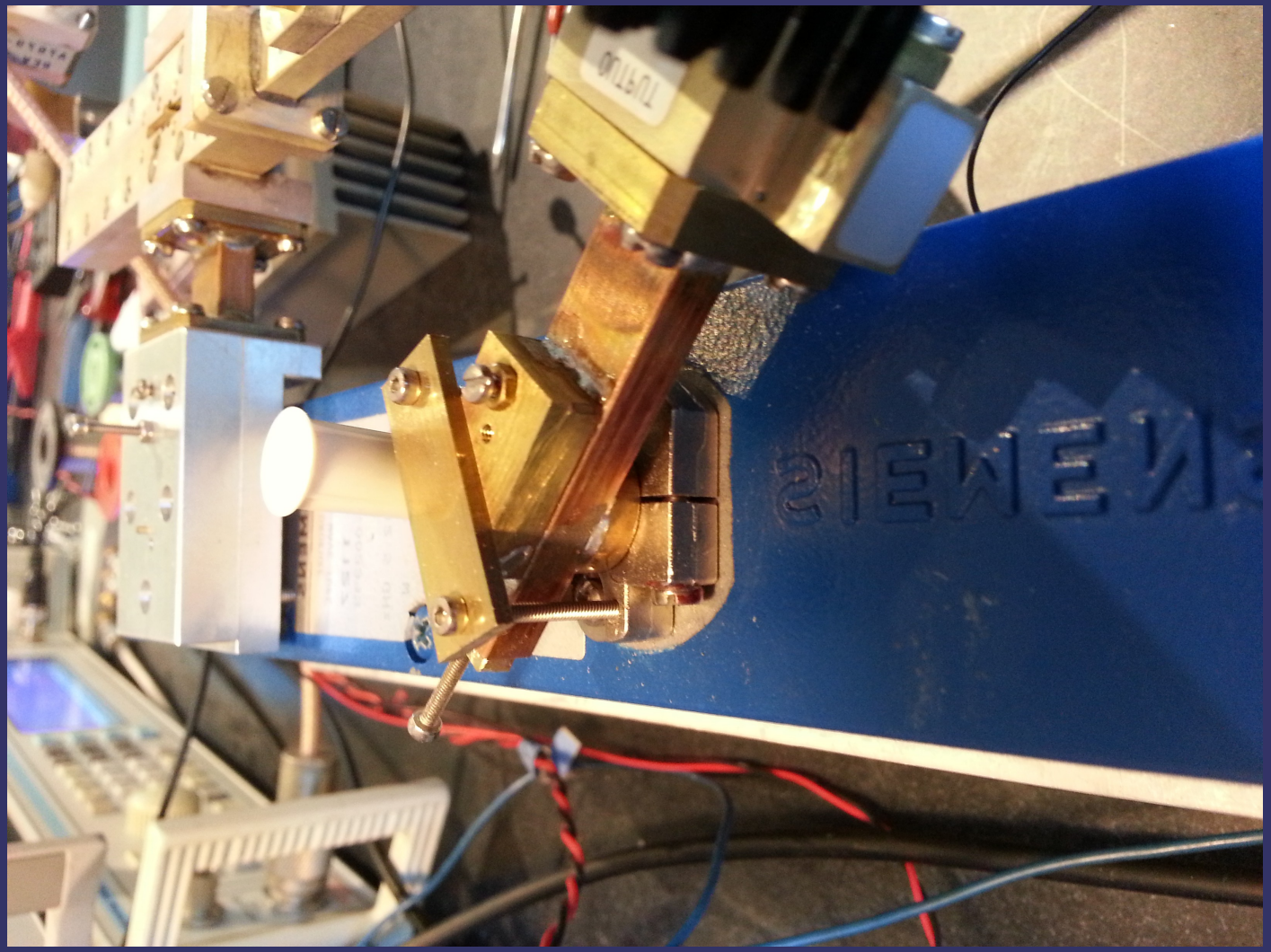
Knowing now the ground path problem, a „vertical force“ construction was design to contact the WG direct to the outher Helix system



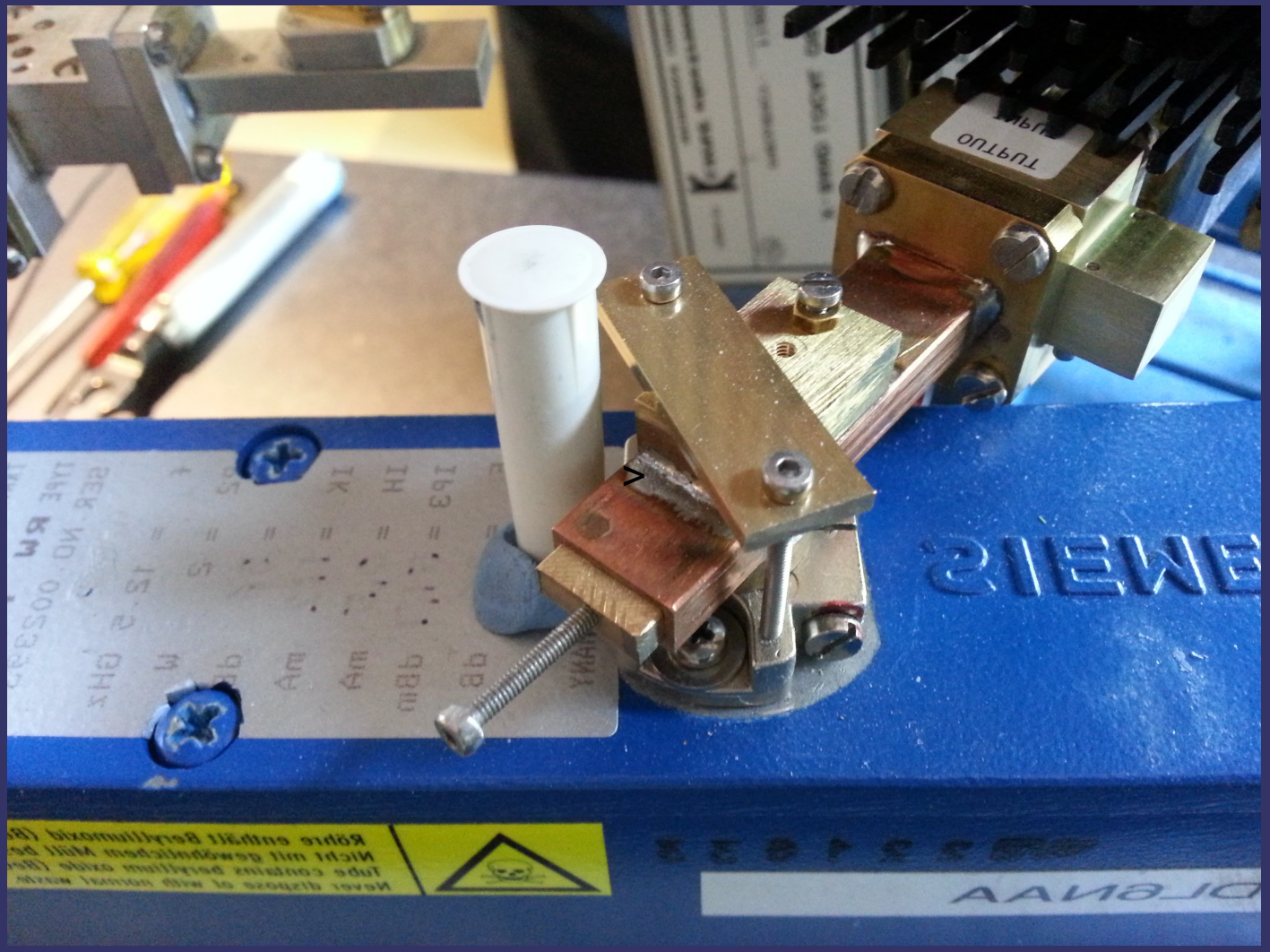
Sideview of the ground path improved construction



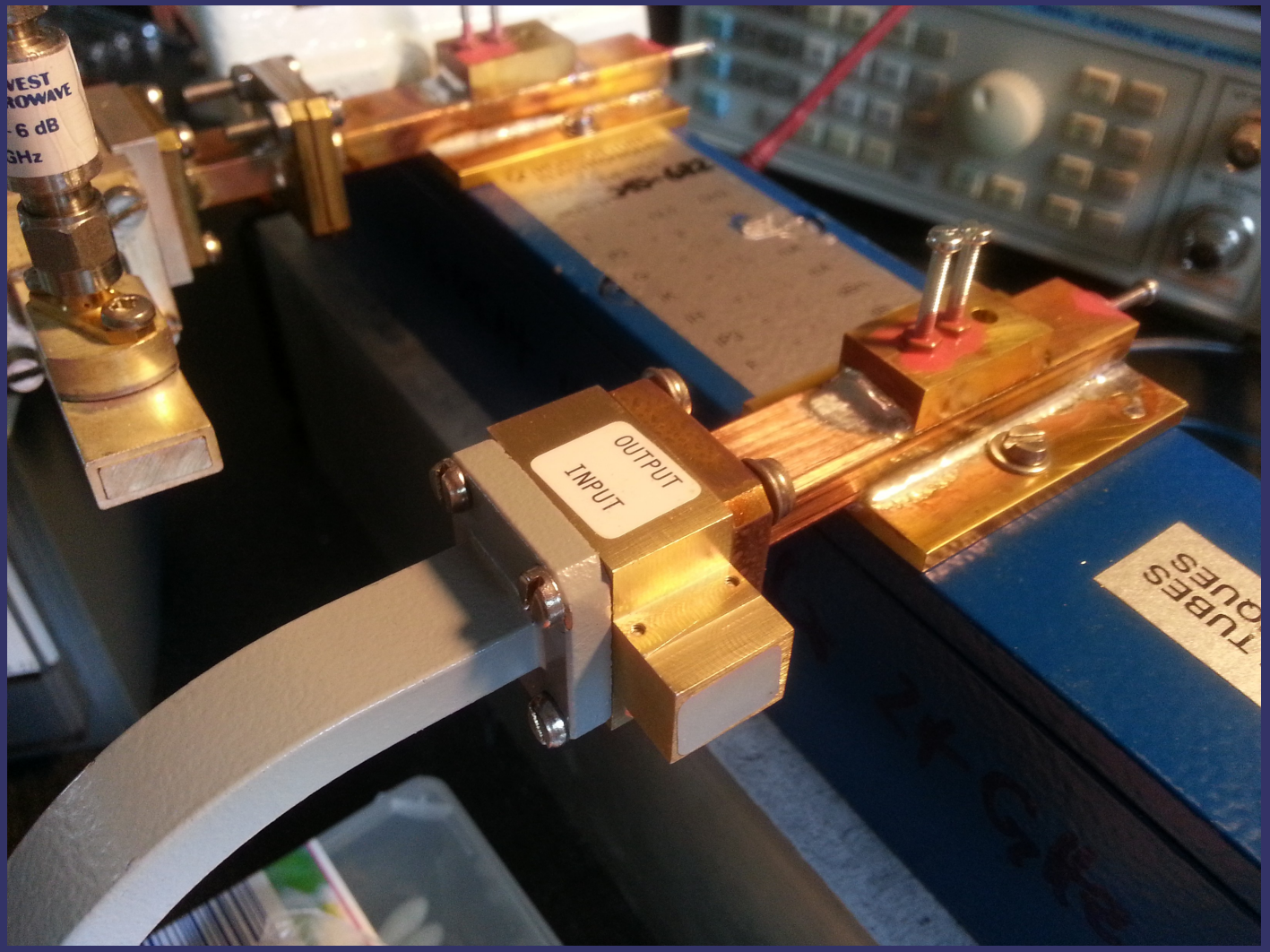
DC0LB`s at output – DL7YC`s at input



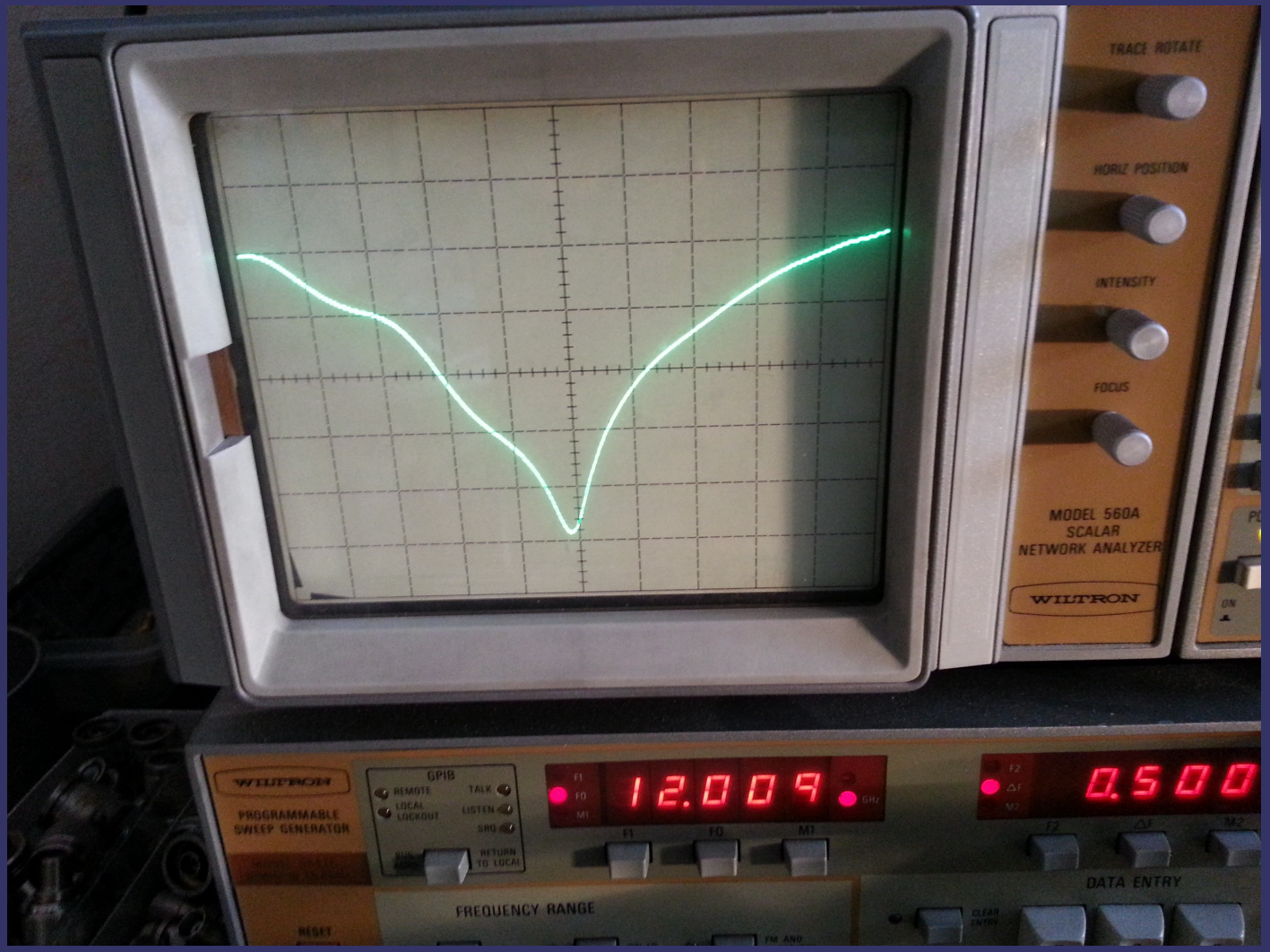
DL7YC`s 3rd attempt to improve the ground contact



Example of DL7YC`s 4th and final solution to improve the ground contact



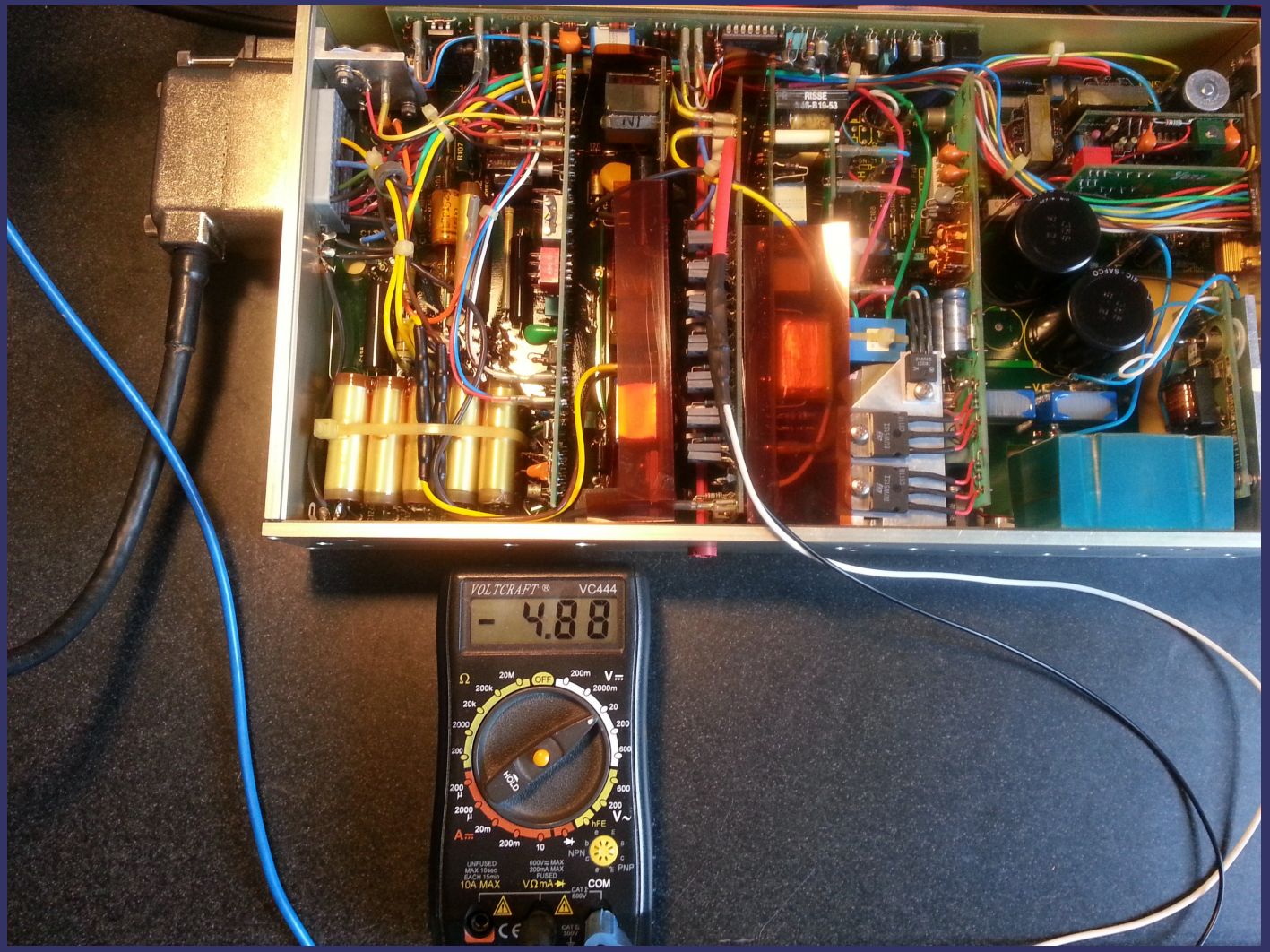
Final RL measurement – 5dB/Div 1GHz sweep



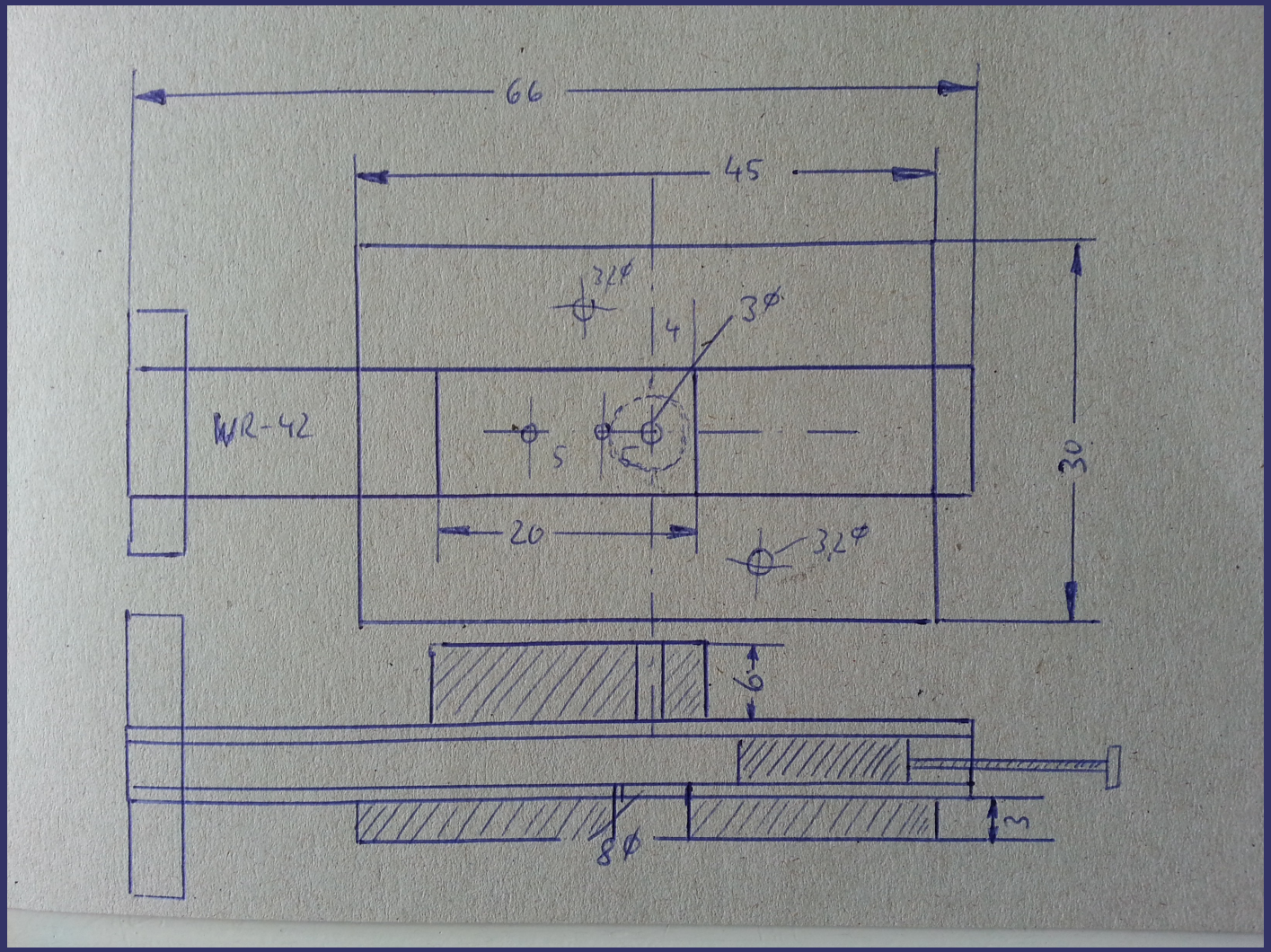
Most important steps for a „perfect“ result:

- 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 basepate 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

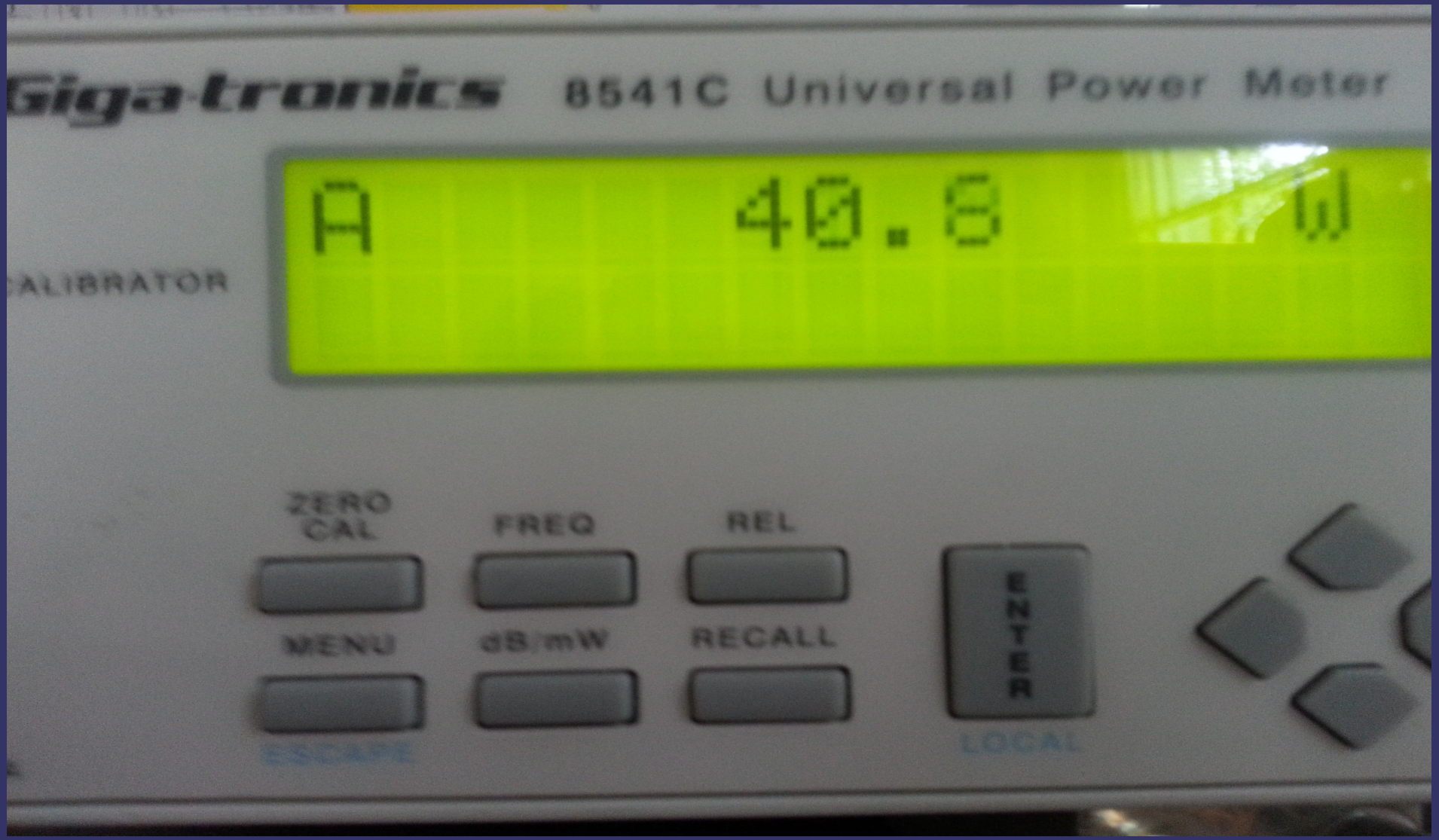


„Quick and Dirty“ drawing of the adapter



Adjust Ik (by G2 voltage) to maximum - observe Ih and keep below 1.5mA

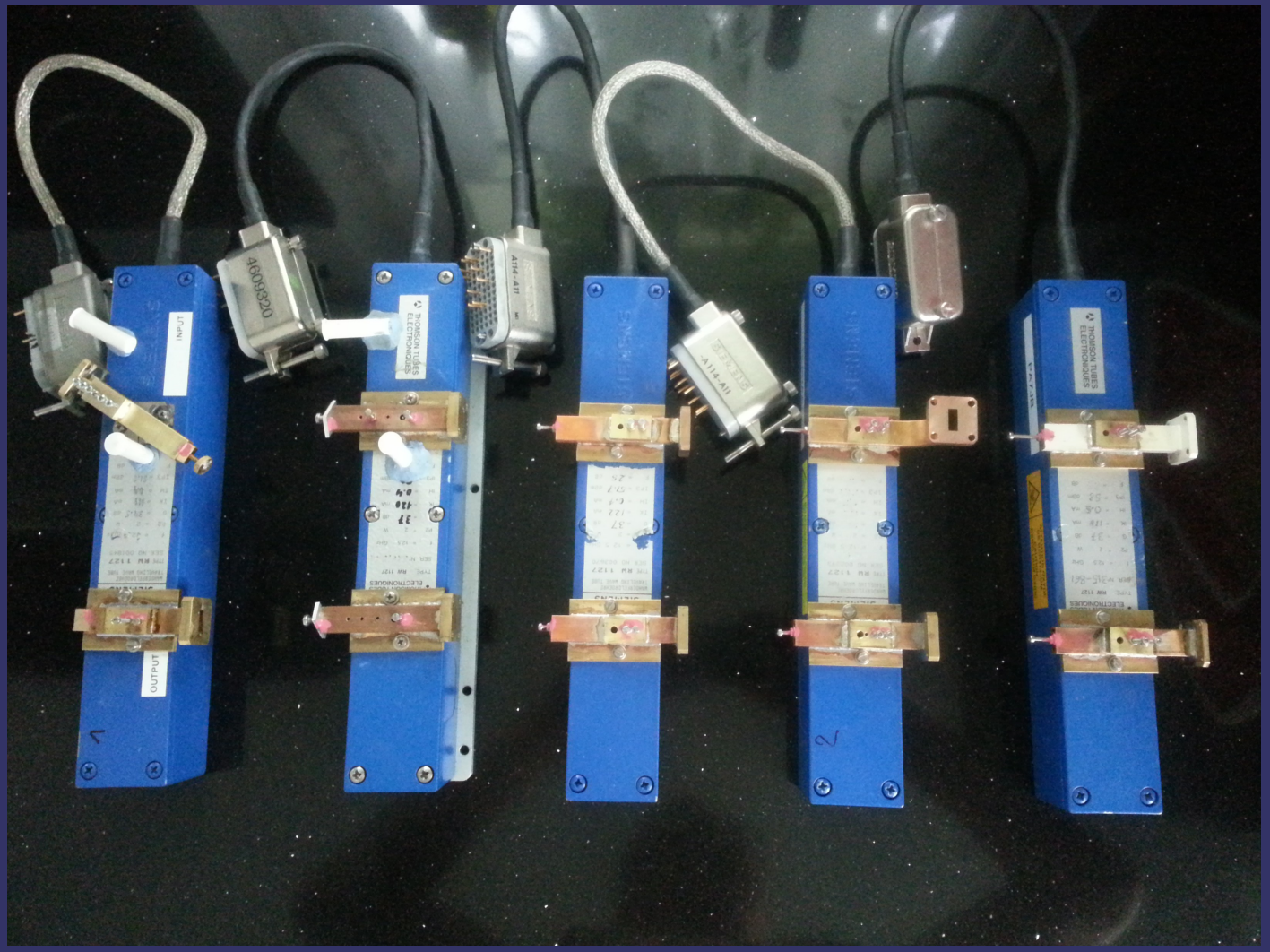
Use CW keying to „adjust“ drive PWR @ 24 GHz



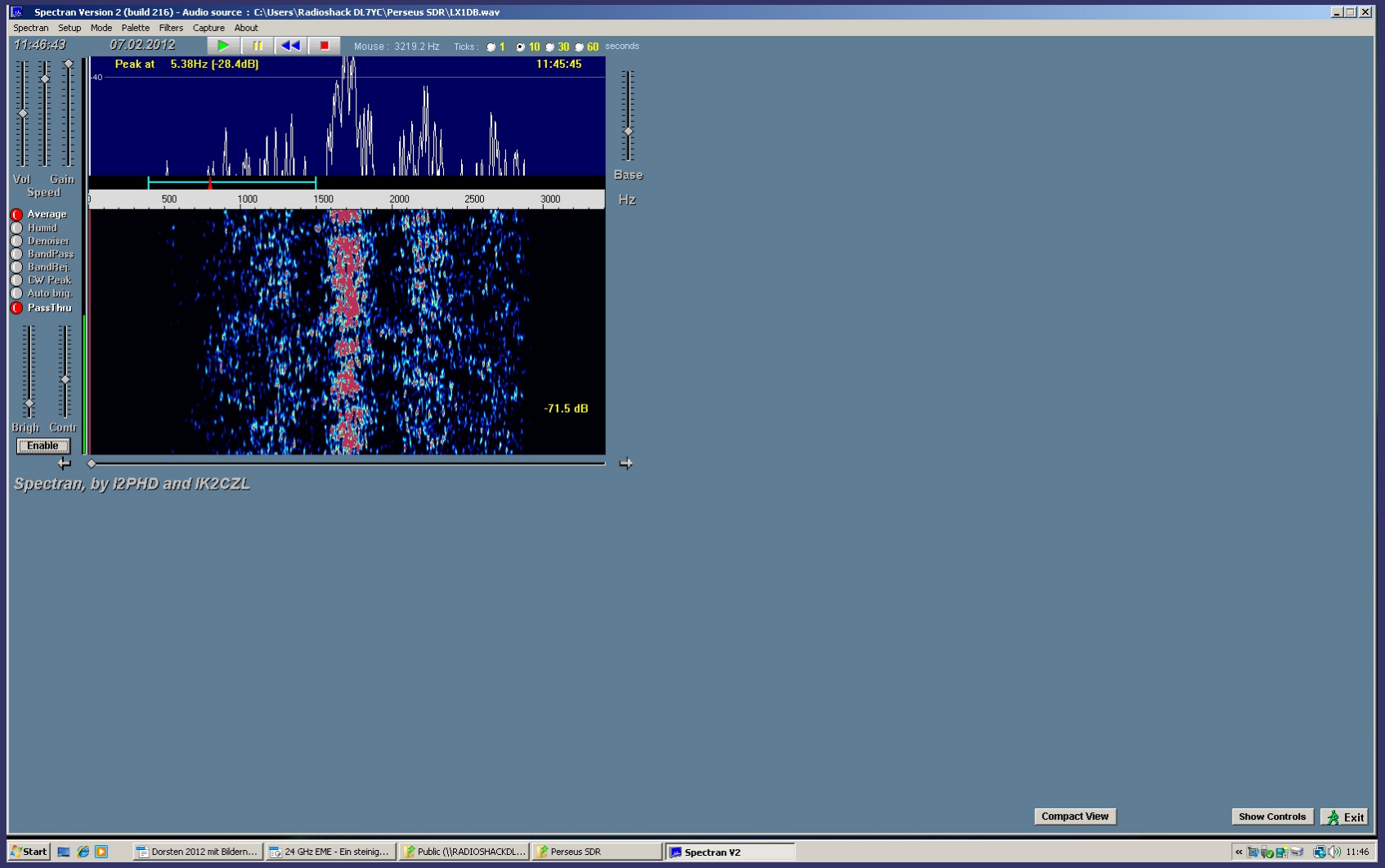
Final conclusions

- **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 !**

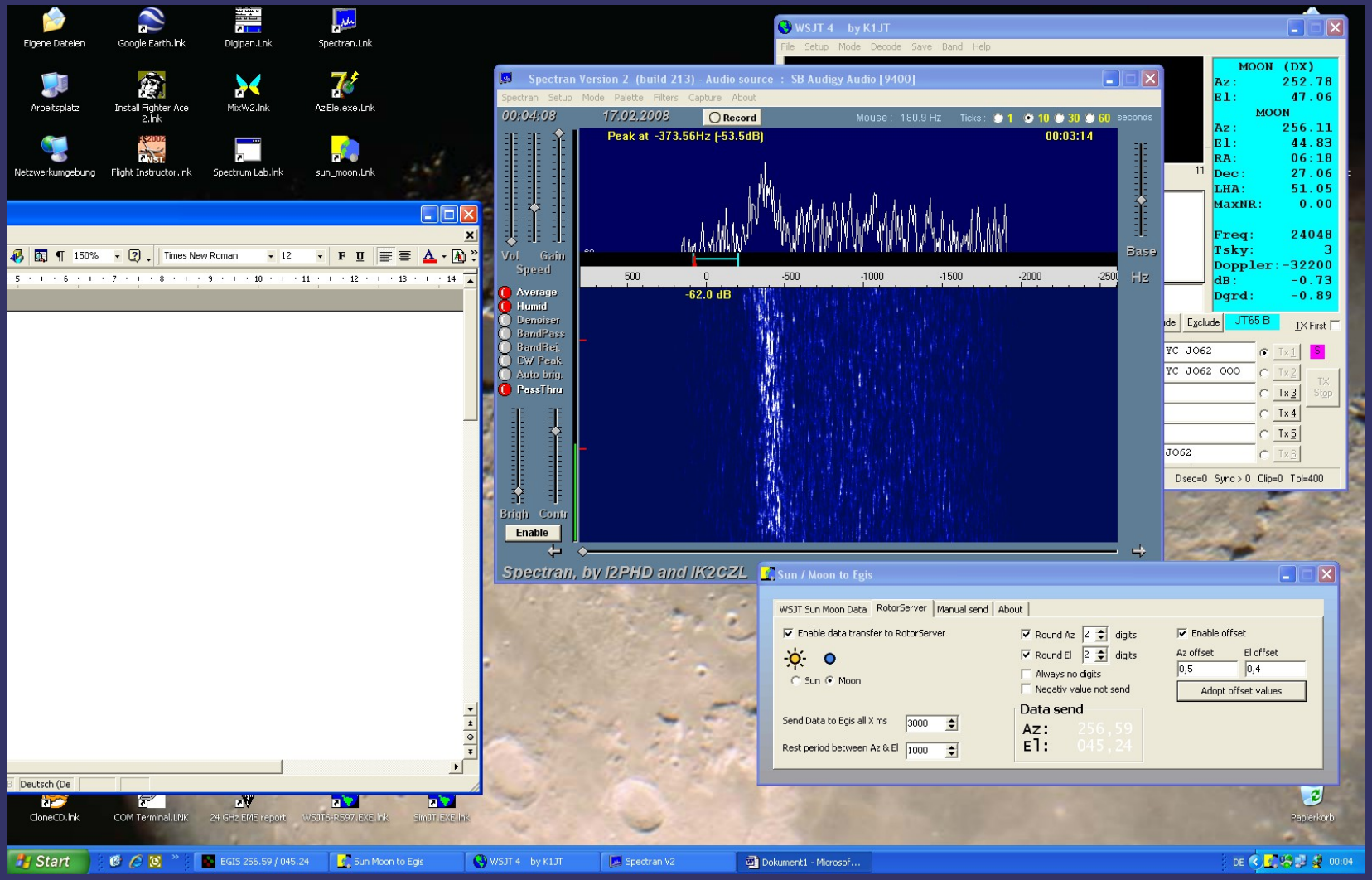
5 of 6 modified tubes – all between 35 and 45 watts peak output



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



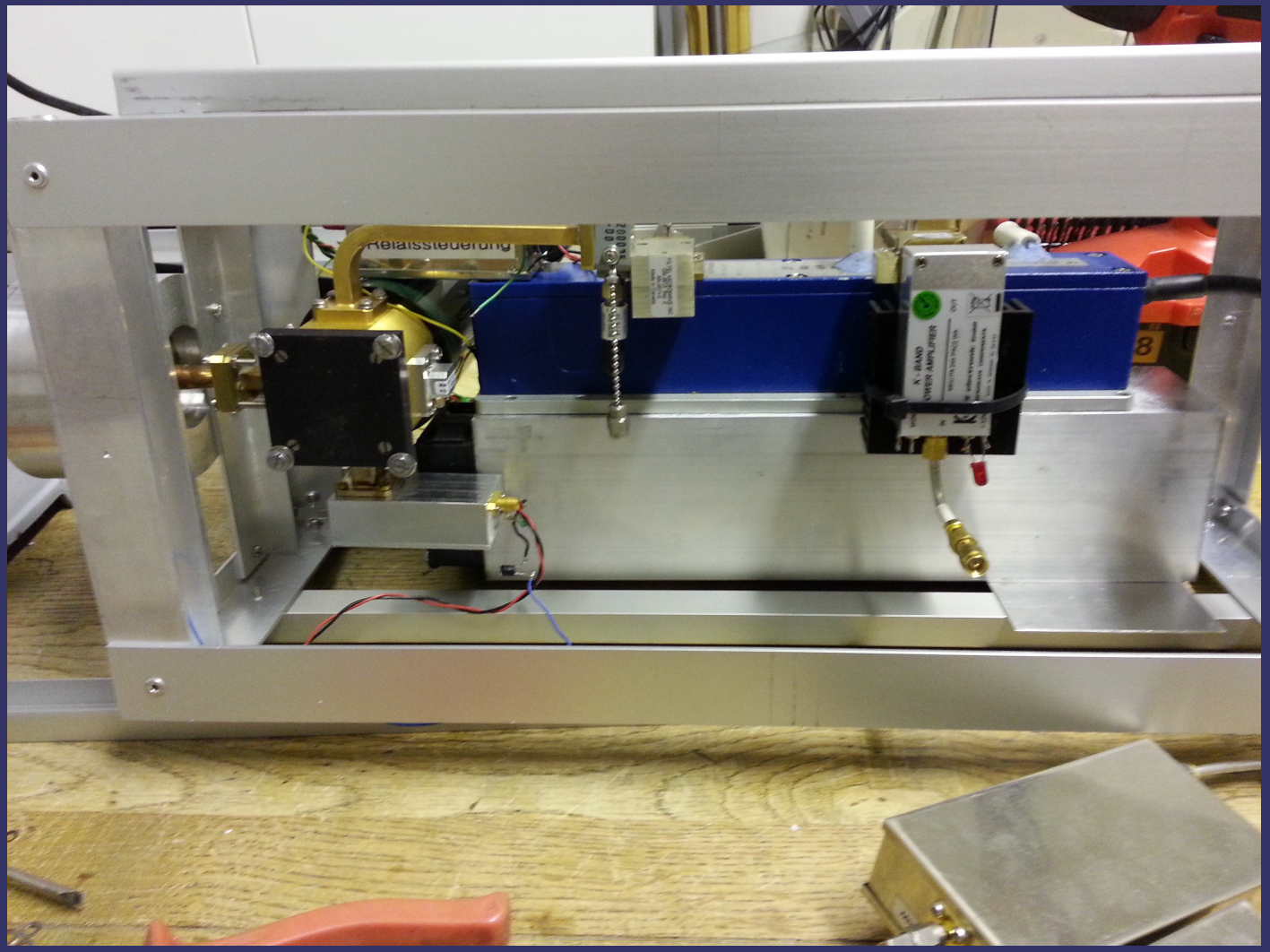
Echo results of modified tubes



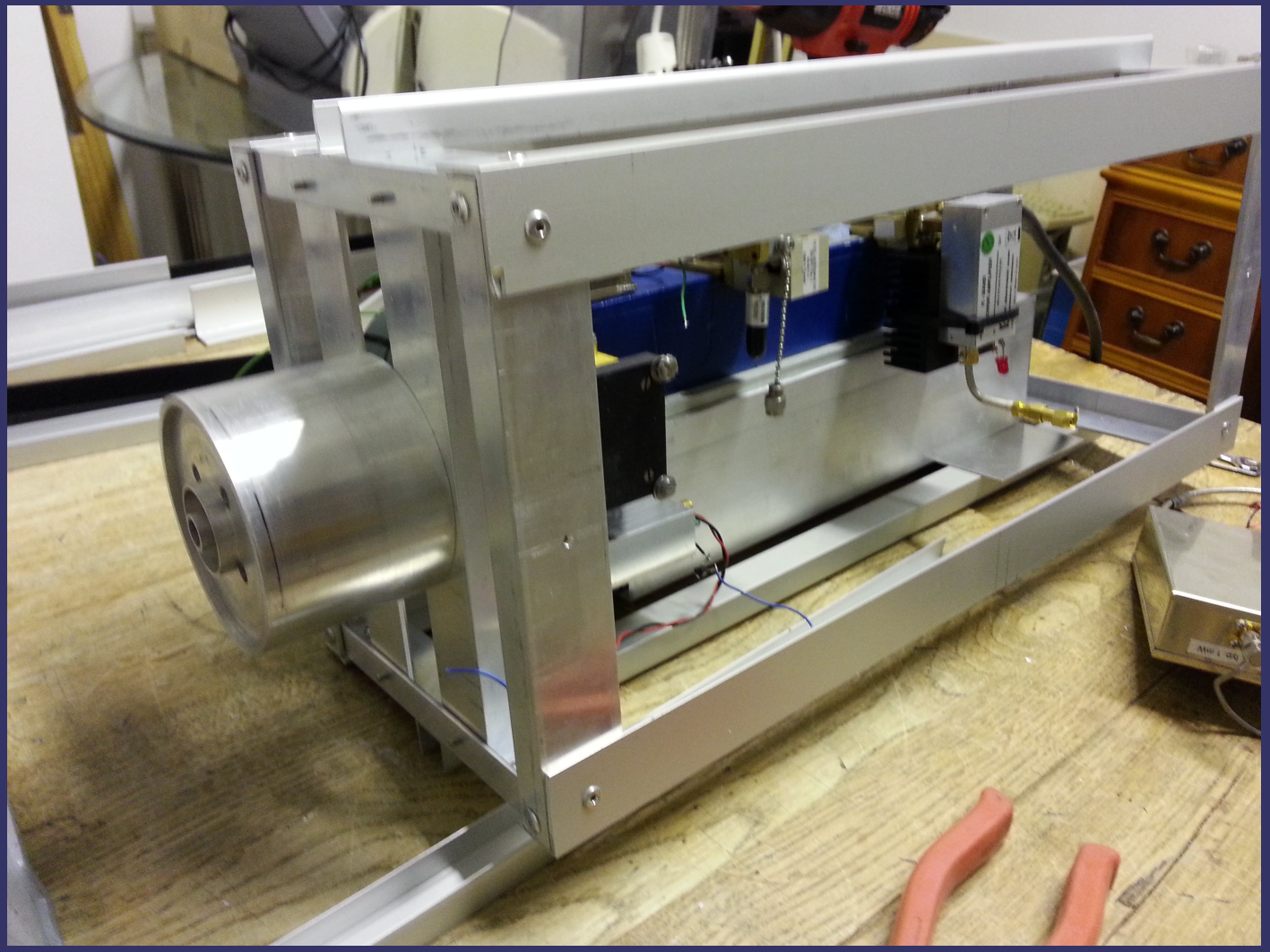
My first 10 GHz trial – TWTA + PSU + transverter: ALL behind the feedhorn

MY

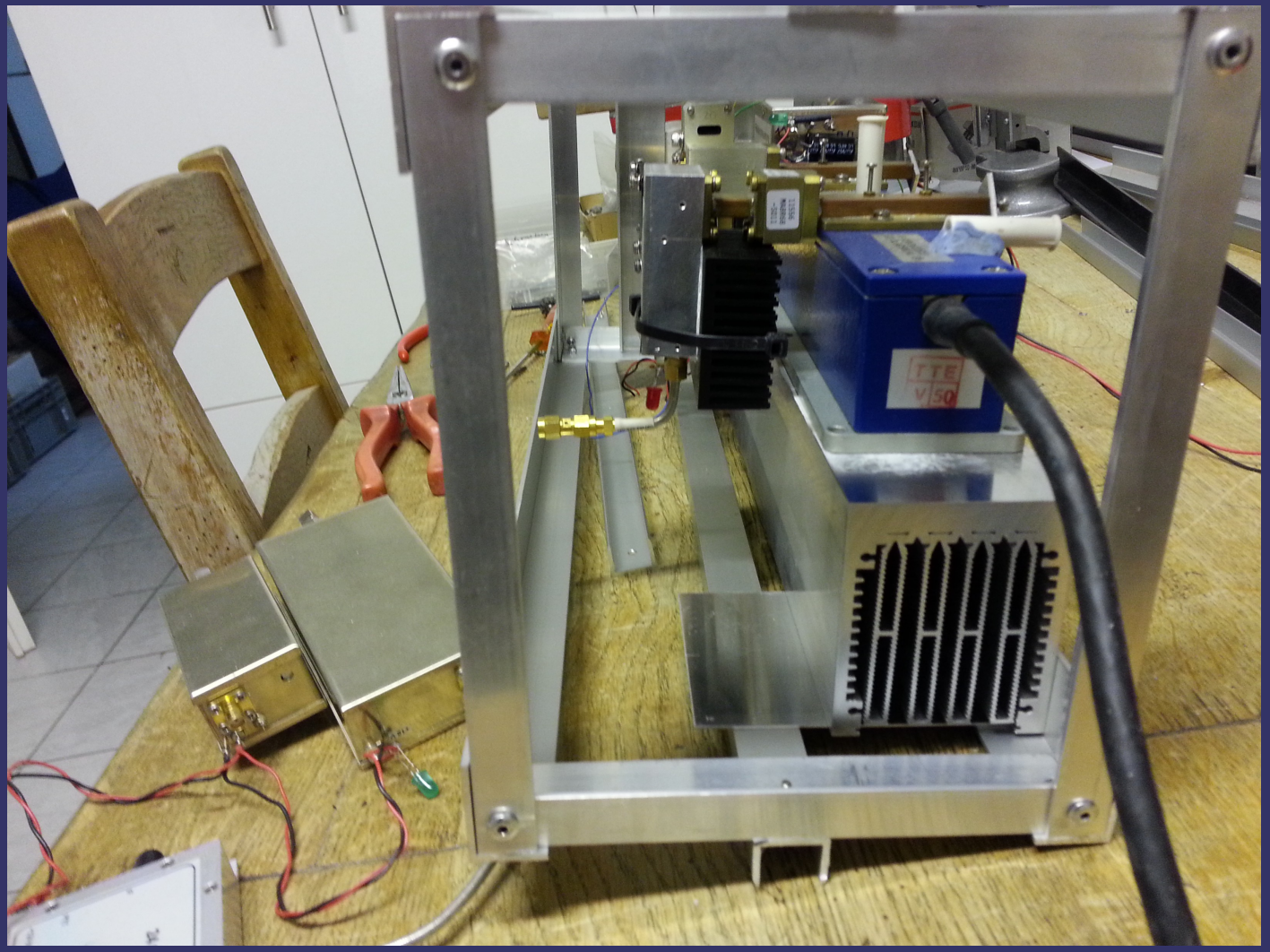
Solution for 24 GHz EME – Feedbox with TWT and WG - switch



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