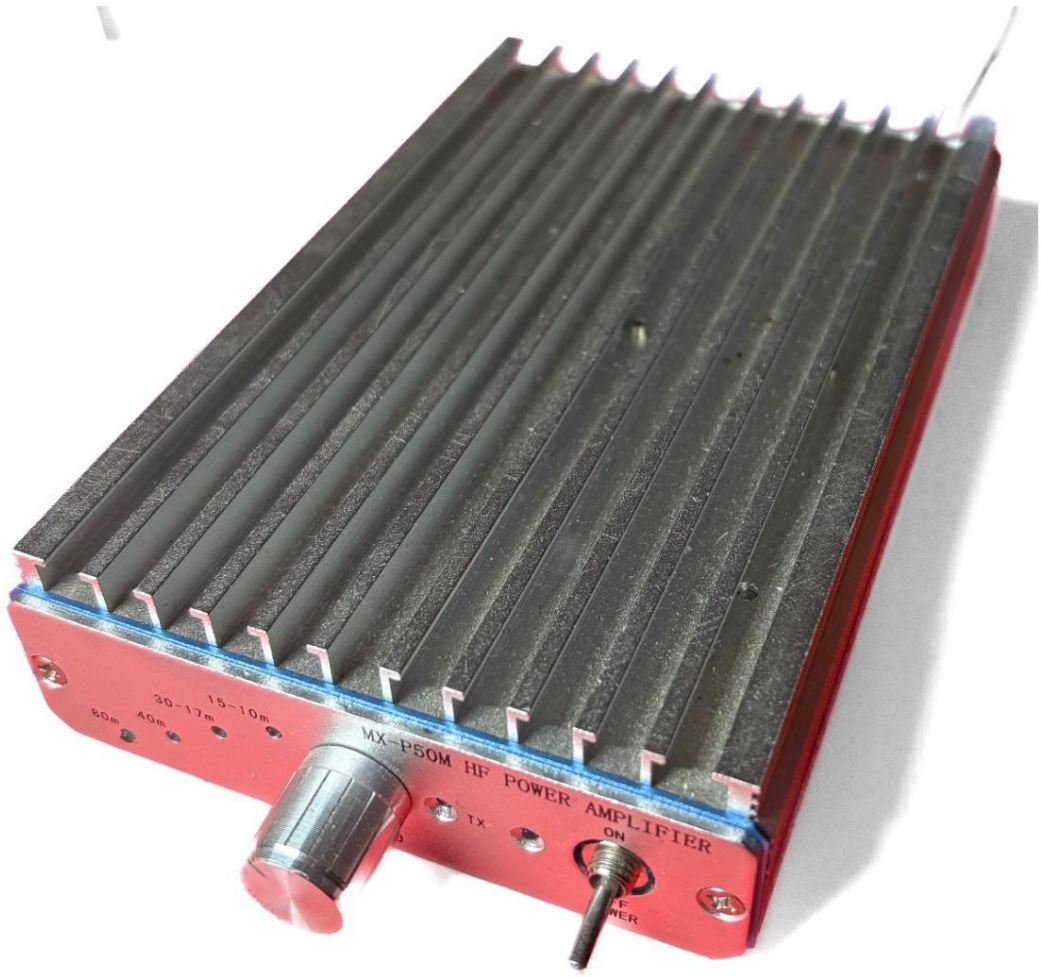
MEASUREMENTS AND RENOVATION THE KW POWER STAGE MX-P50M AFTER BG4IGX



Email: info@dl2sba.com

Location: \\DS1522\ham\Manuals\BG4IGX MP-P50M PA\DL2SBA\MX-P50M_DL2SBA.20260602.docx

CONTENTS

Change log

Initial	**Chapter Description Date** 2026-05-15 All
creation 2026-06-02 “Old” on page 35 Addition regarding control of the	
pre-voltage by the S/E switching	

INTRODUCTION

In this document I have summarized the measurement results for the “China-QRP-PA” MX-P50M.

I bought my power amplifier in like-new condition from a German ham radio operator. The power amplifier will henceforth be referred to as ***DL2SBA.*** designated.

Thomas, DM1TBE, also has a power amplifier of this type, which I have measured. His power amplifier will be referred to below as...
Designated ***DM1TBE .***

Furthermore, the conversion process for switching between transmit and receive modes is described here.

MEASURING INSTRUMENTS

The following measuring devices were used.

Device	type
power supply	MANSON KPS-6602 32V/30A
Millivolt-meter	R&S URV 5
Measuring head	R&S URV 5-Z4 100V / 200W
Control transmitter	ICOM IC-7051
DC measuring device	FLUKE 289
Insertion attenuation element 40dB Weinschel	58-40-33 40dB
10dB insertion loss element for Mini-Circuits	UNAT-10+
Performance completion	Radial R404507 2W
Spectrum analyzer	SIGLENT SSA 3021X 9kHz-3GHz
2-tone generator	WAV file created with AUDT 1078Hz + 1508Hz
VNA	SV4401A 50kHz – 4.4GHz
oscilloscope	RIGOL MSO2072A 2CH 70MHz 2GS/s

Table 1 - Measuring instruments used

MEASUREMENT SETUP POWER MEASUREMENT

Control transmitter ÿ MX-P50M ÿ Measuring head ÿ Insertion attenuator 40dB ÿ Power termination

GENERAL MEASUREMENTS

Condition	Measurement
Power amplifier completely switched off	0mA @ 13.8V DC
Power amplifier in standby mode	20mA @ 13.8V DC
PTT control current before modification	37mA@ 13.8V DC
PTT control current after modification	1.5mA@ 13.8V DC
PTT control voltage	13.8V DC
quiescent current of the power amplifier	approx. 510mA @ 13.8V DC

Table 2 - General Measurements

The power consumption of the final stage with 5W drive power and a 2-tone signal in SSB mode is as follows:

Frequency in MHz, Output power in W, Current in A, Power in W, Efficiency in %				
3,625	38.37	5.00	69.00 56	
7,100	36.31	4.95	68.31	53
10,116	36.73	4.87	67.21	55
14,100	36.31	4.88	67.34	54
18,100	37.15	4.39	60.58	61
21,150	37.67	4.53	62.51	60
24,930	35.08	4.66	64.31	55
28,250	30.90	4.85	66.93	48

Table 3 – Power consumption with 5W control

[1] In my IC-705, the percentage power output corresponds very well to the actual power output.

80M / 3.625MHZ

Performance measurement

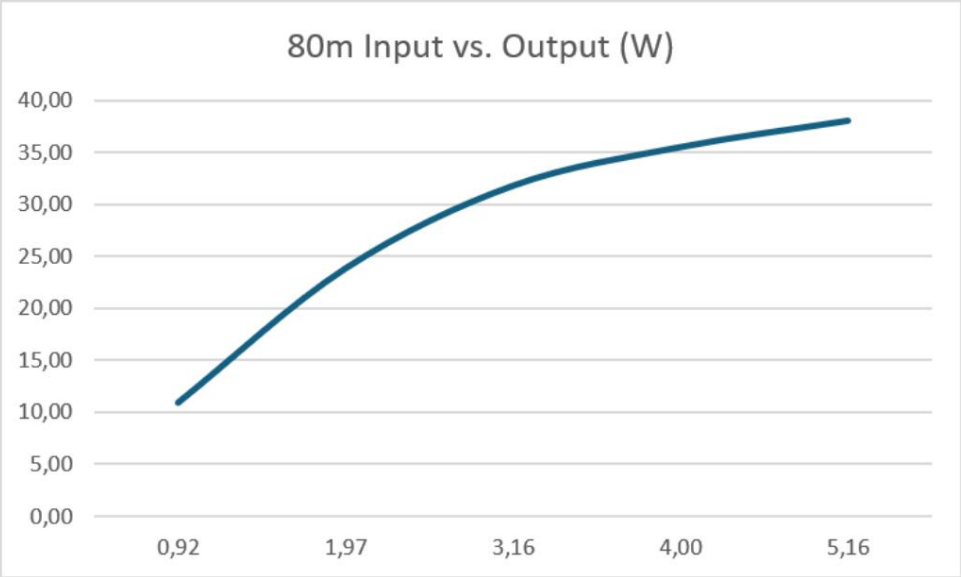


Figure 1 - Input vs. output power 80m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.1	41.3	1.03	13.43	11.1
32.8	44.0	1.91	25.23	11.2
34.6	45.0	2.89	31.92	10.4
35.7	45.4	3.73	34.99	9.7
36.9	45.8	4.93	38.37	8.9

Table 4 - Input vs. Output Power 80m

40M / 7,100MHZ

Performance measurement

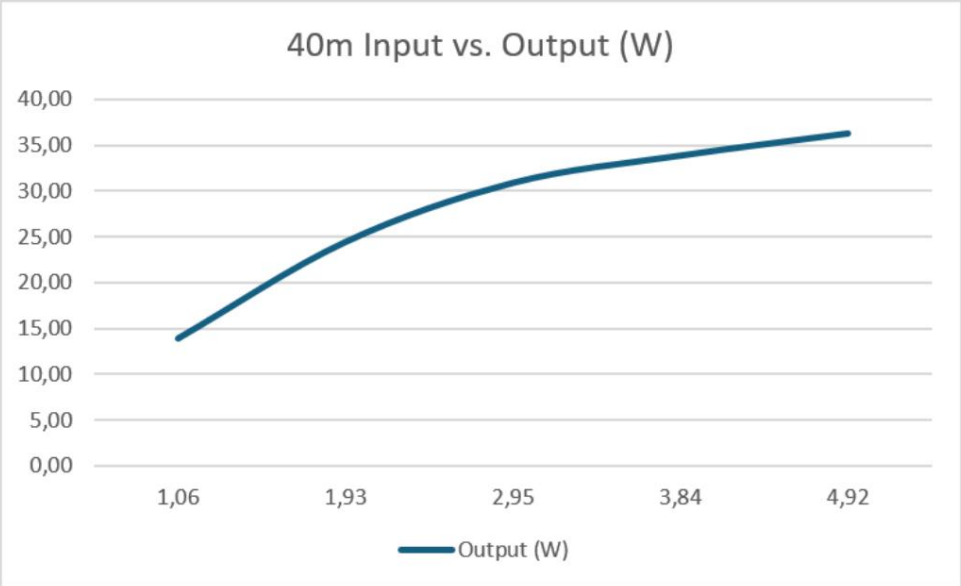


Figure 2 - Input vs. output power 40m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.3	41.4	1.06	13.87	11.2
32.9	43.9	1.93	24.43	11.0
34.7	44.9	2.95	30.90	10.2
35.8	45.3	3.84	33.88	9.5
36.9	45.6	4.92	36.31	8.7

Table 5 - Input vs. Output Power 40m

Measurement of harmonics

MEASUREMENT SETUP

Control transmitter ÿ MX-P50M ÿ Measuring head ÿ Insertion attenuator 40dB ÿ Insertion attenuator 10dB ÿ

Spectrum analyzer

OVERVIEW

frequency in MHz	tax payment in W	tax payment in dBm	Ground wave in dBm	Groundwave in W	3rd OW in dBm	Suppression in dB	5th OW in dBm	oppression in dB
7.1	1.07	30.3	40.7	11.7	-11.0	51.7	-4.4	45.1
7.1	1.94	32.9	43.2	20.9	-16.8	60.0	-1.2	44.4
7.1	2.96	34.7	44.2	26.2	-10.3	54.5	1.0	43.2
7.1	3.85	35.9	44.6	28.8	-14.9	59.5	2.6	42.0
7.1	4.94	36.9	44.9	30.8	-13.9	58.8	3.7	41.2

Table 6 - Harmonic Suppression DL2SBA

frequency in MHz	tax payment in W	tax payment in dBm	Groundwave in dBm	Ground wave in W	3rd OWin dBm	Suppression in dBm	5th OW in dBm	oppression in dBm
7.1	1.07	30.3	41.8	15.0	-17.3	59.1	-7.1	48.8
7.1	1.94	32.9	43.7	23.6	-15.8	59.5	-3.6	47.4
7.1	2.96	34.7	44.6	28.5	-14.0	58.6	-1.4	46.0
7.1	3.85	35.9	44.9	30.6	-13.8	58.7	-0.3	45.1
7.1	4.94	36.9	45.1	32.1	-13.4	58.5	0.6	44.4

Table 7 - Harmonic Suppression DM1TBE

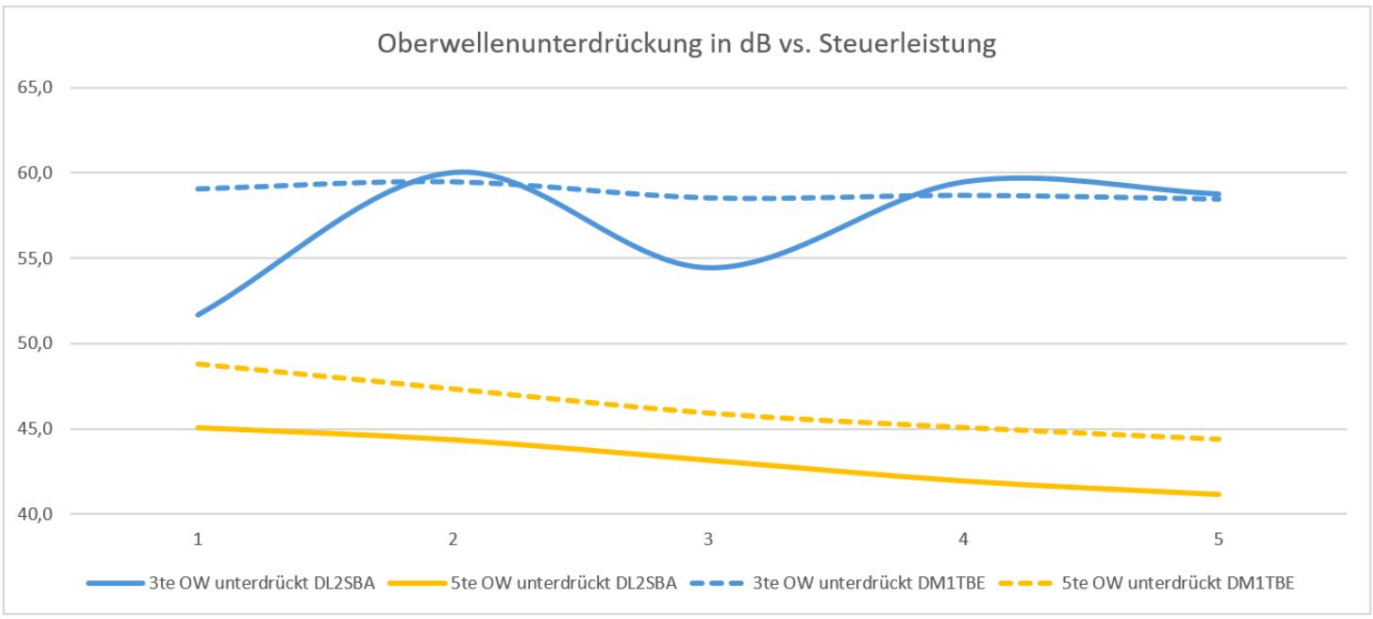


Figure 3 – Harmonic suppression DL2SBA vs. DM1TBE [2]

[2] The higher the value, the better the suppression.

IC-705 5W WITHOUT PA

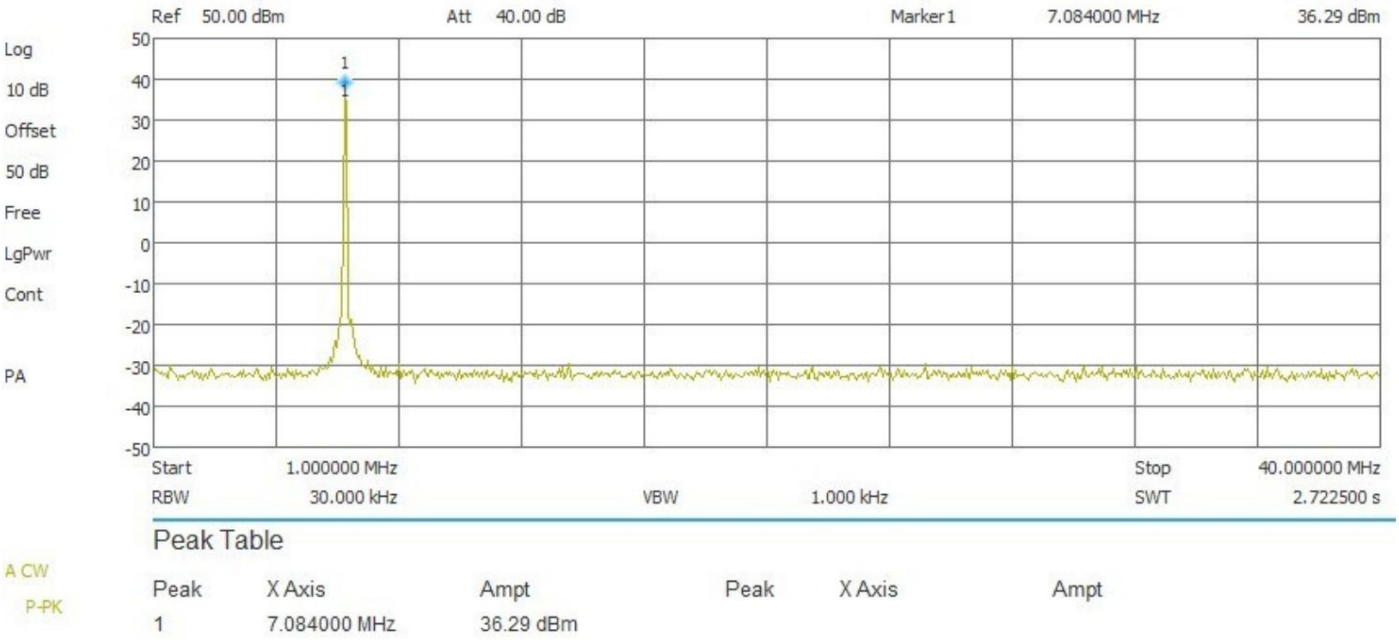


Figure 4 – Harmonics 40m at 5W of the IC-705

PA control power 1W

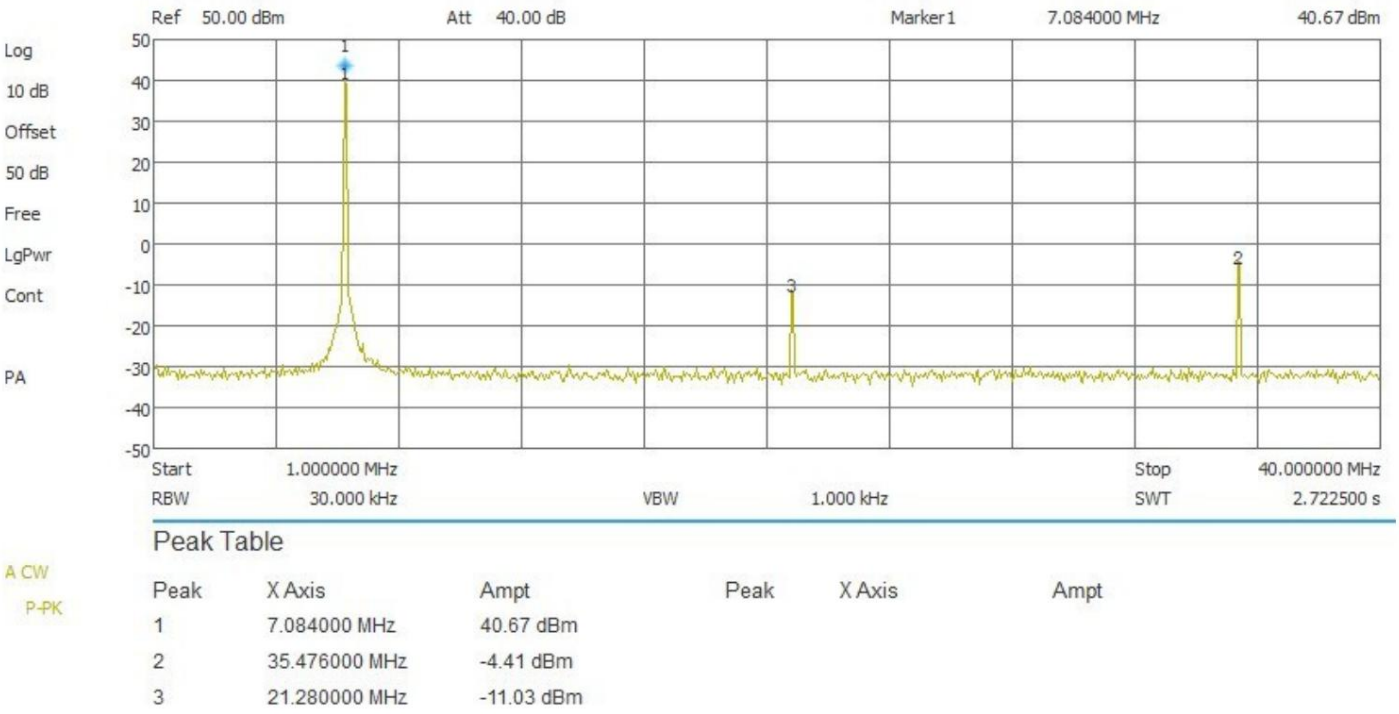


Figure 5 – Harmonics 40m at 1W control power

PA control power 2W

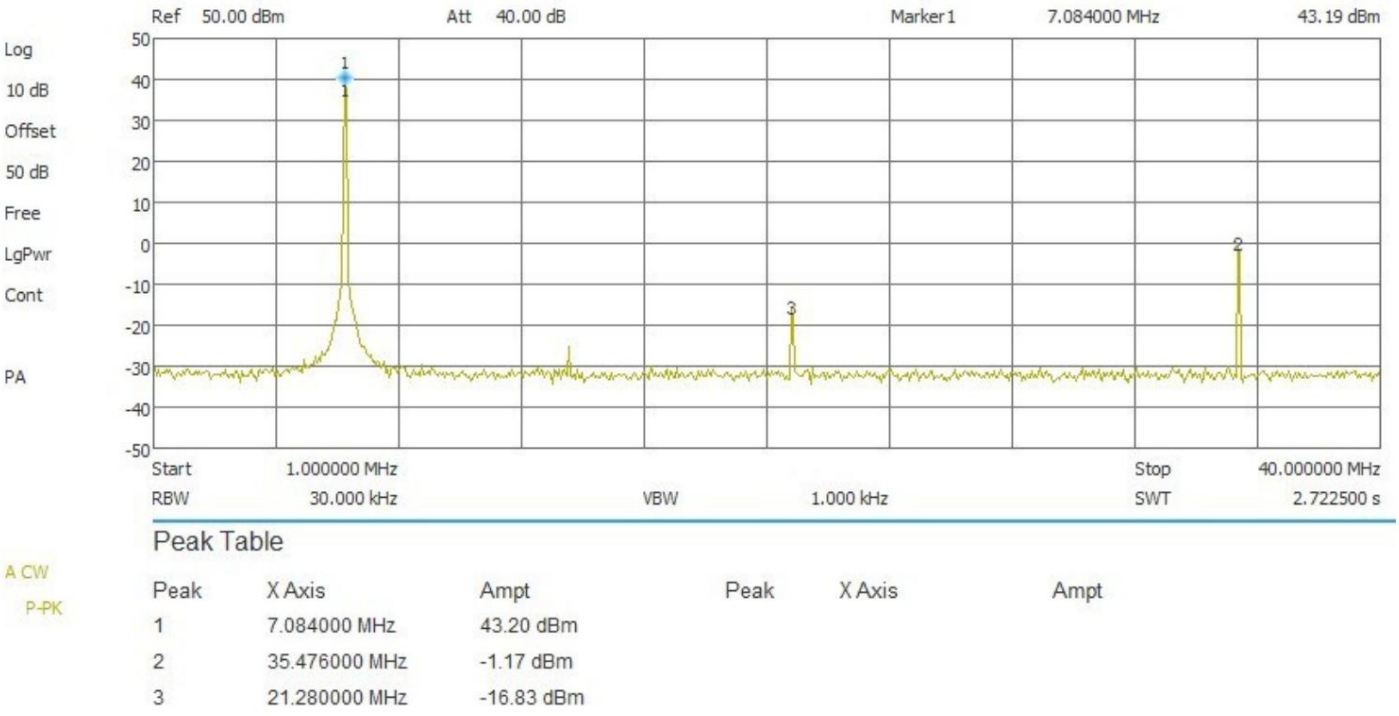


Figure 6 – Harmonics 40m at 2W control power

PA control power 3W

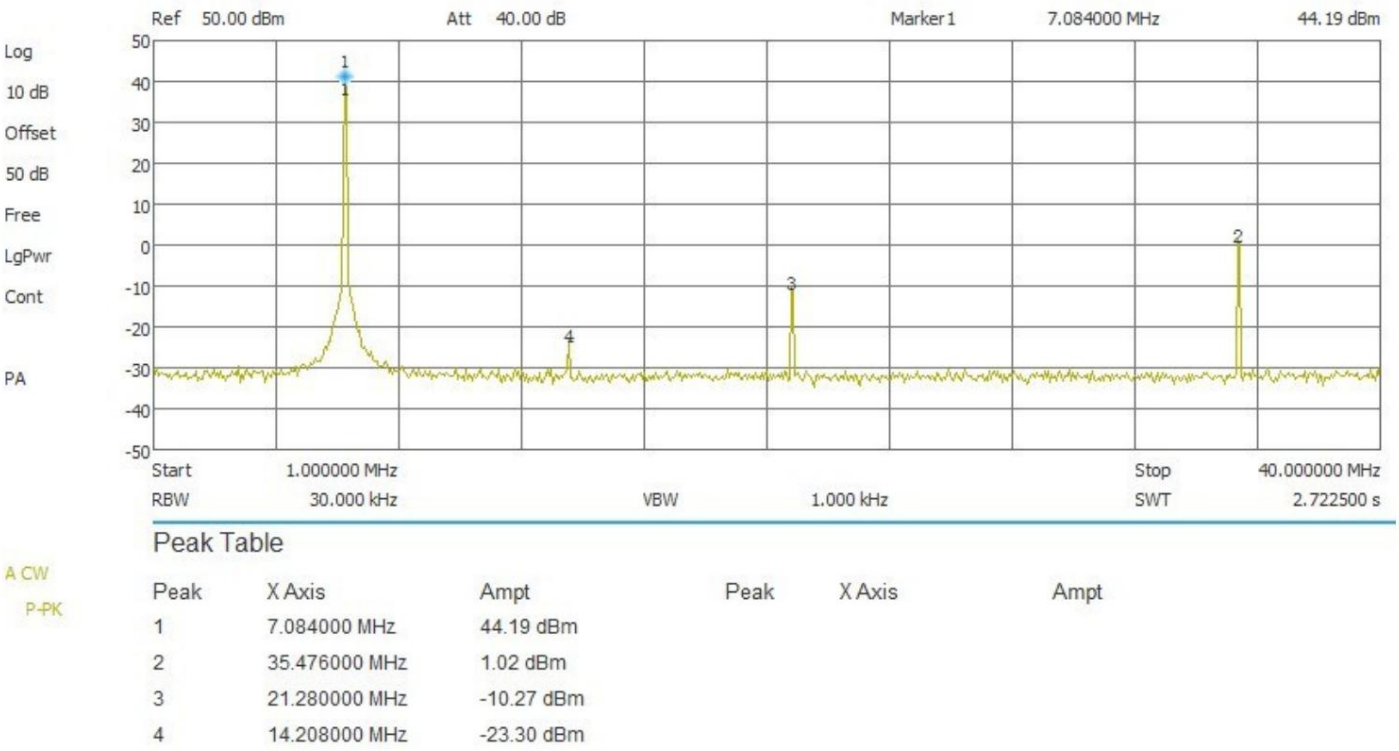
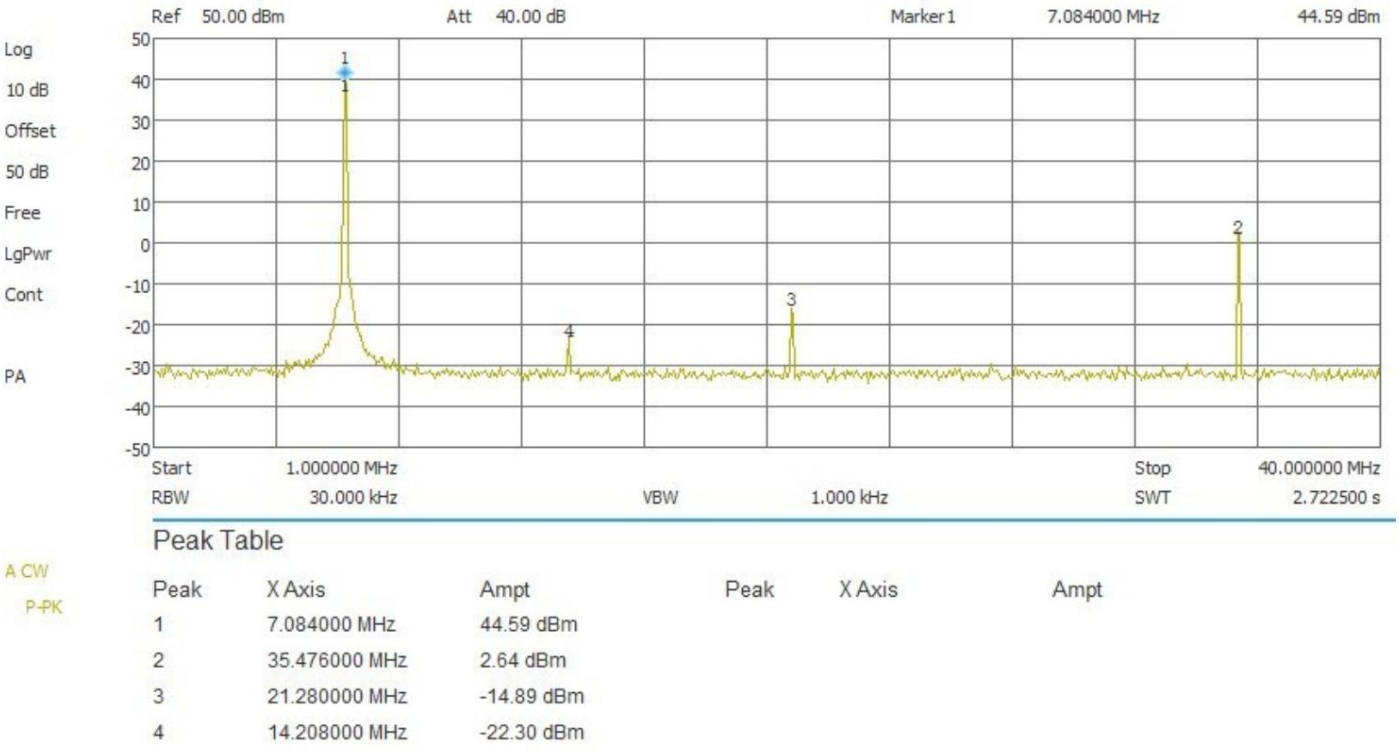


Figure 7 – Harmonics 40m at 3W control power

PA control power 4W



Peak Table

Peak	X Axis	Ampt	Peak	X Axis	Ampt
1	7.084000 MHz	44.59 dBm			
2	35.476000 MHz	2.64 dBm			
3	21.280000 MHz	-14.89 dBm			
4	14.208000 MHz	-22.30 dBm			

Figure 8 – Harmonics 40m at 4W control power

PA control power 5W

Peak Table

Peak	X Axis	Ampt	Peak	X Axis	Ampt
1	7.084000 MHz	44.89 dBm			
2	35.476000 MHz	3.73 dBm			
3	21.280000 MHz	-13.88 dBm			
4	14.208000 MHz	-21.86 dBm			

Figure 9 – Harmonics 40m at 5W control power

30M / 10.116MHZ

Performance measurement

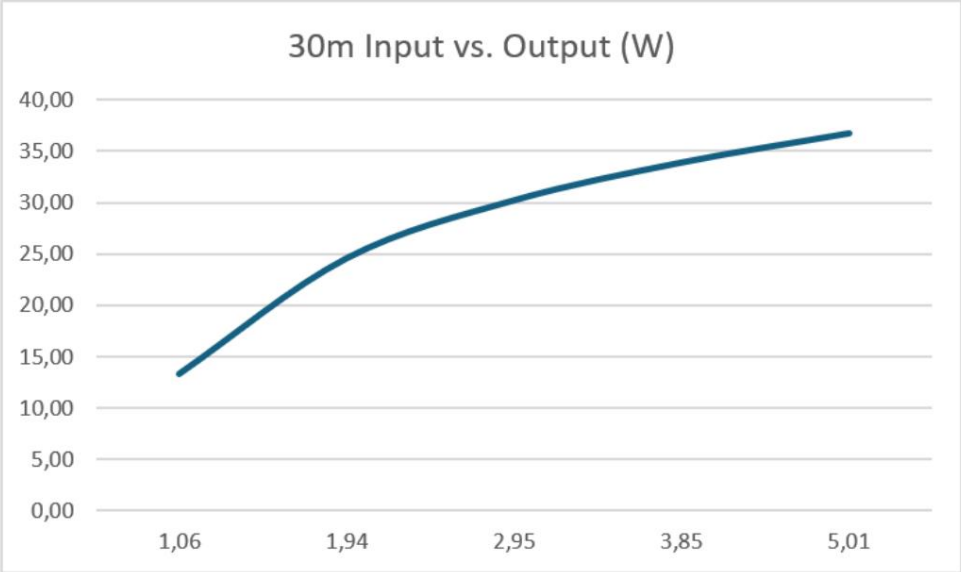


Figure 10 - Input vs. Output Power 30m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.3	41.2	1.06	13.27	11.0
32.9	43.9	1.94	24.55	11.0
34.7	44.8	2.95	30.20	10.1
35.9	45.3	3.85	33.88	9.5
37.0	45.7	5.01	36.73	8.7

Table 8 - Input vs. Output Power 30m

20M / 14,100MHZ

Performance measurement

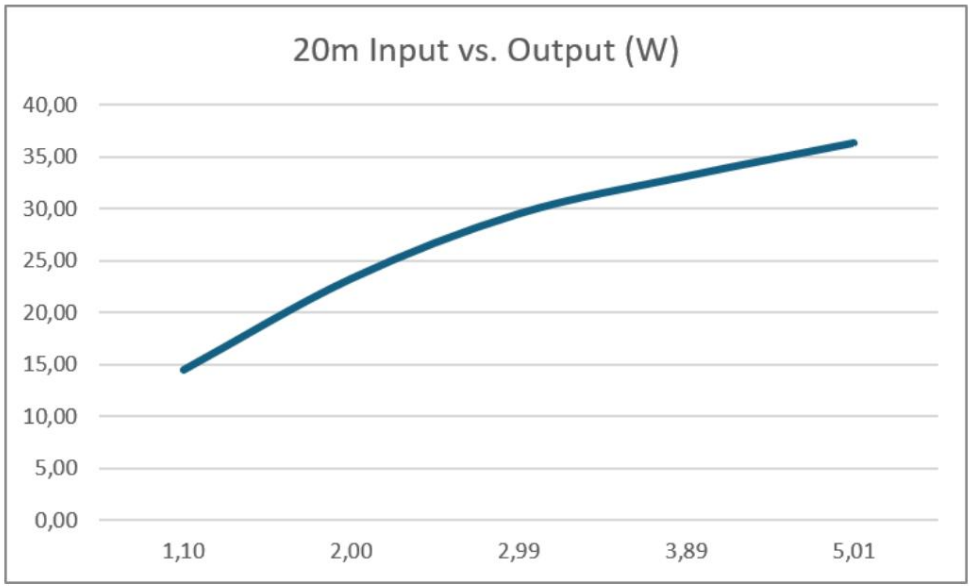


Figure 11 - Input vs. output power 20m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.4	41.6	1.10	14.52	11.2
33.0	43.7	2.00	23.28	10.7
34.8	44.7	2.99	29.51	9.9
35.9	45.2	3.89	33.11	9.3
37.0	45.6	5.01	36.31	8.6

Table 9 - Input vs. Output Power 20m

Measurement IM3

EDITING IN AUDIO TESTER

The transmitter was controlled via a WAV file created with audioTester V3.0. The WAV file's gain was set to 0 dBFS. The two tones at 1078 Hz and 1508 Hz were each generated at -3 dBFS.

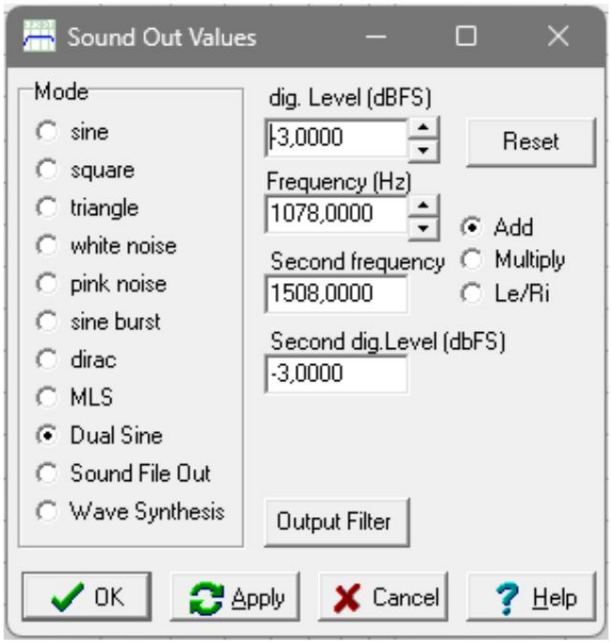


Figure 12 – Setting for the 2-tone AF signal

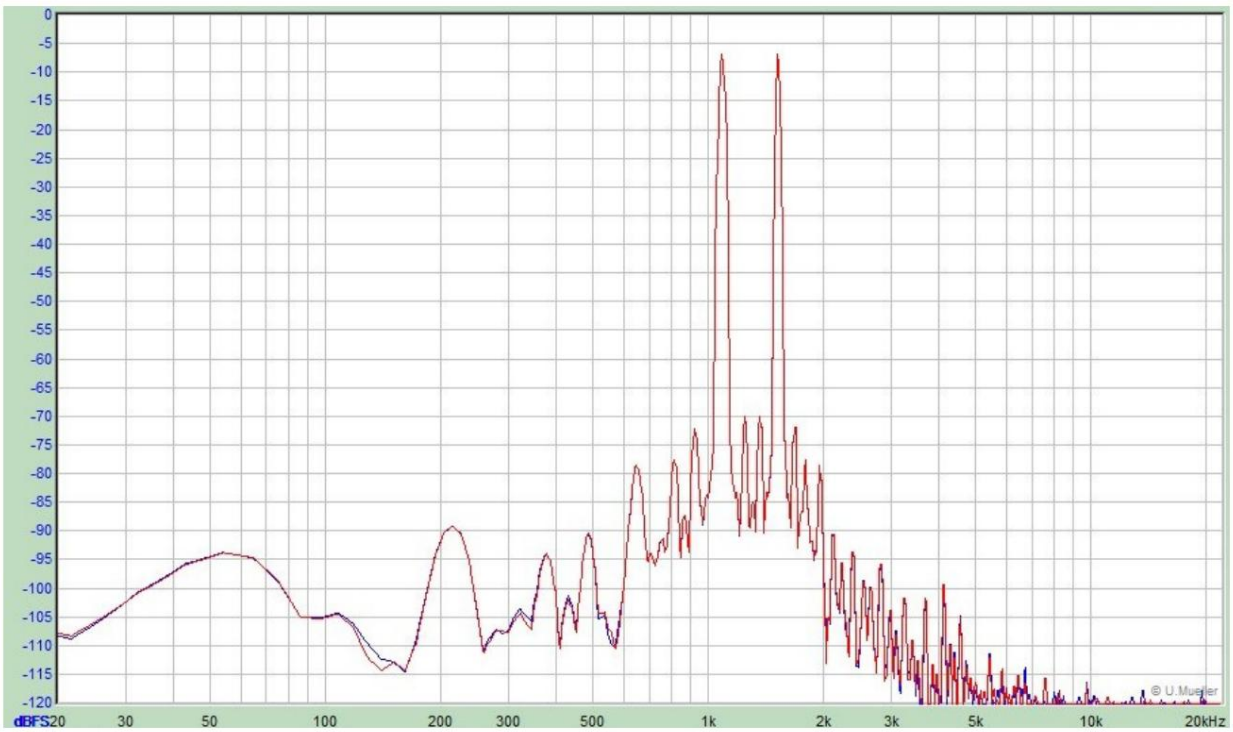


Figure 13 - 2-tone audio signal

EDITING IN AUDACITY

The two-tone signal was recorded via the virtual audio cable in Audacity and processed there as an 8kHz mono PCM signal.

exported:

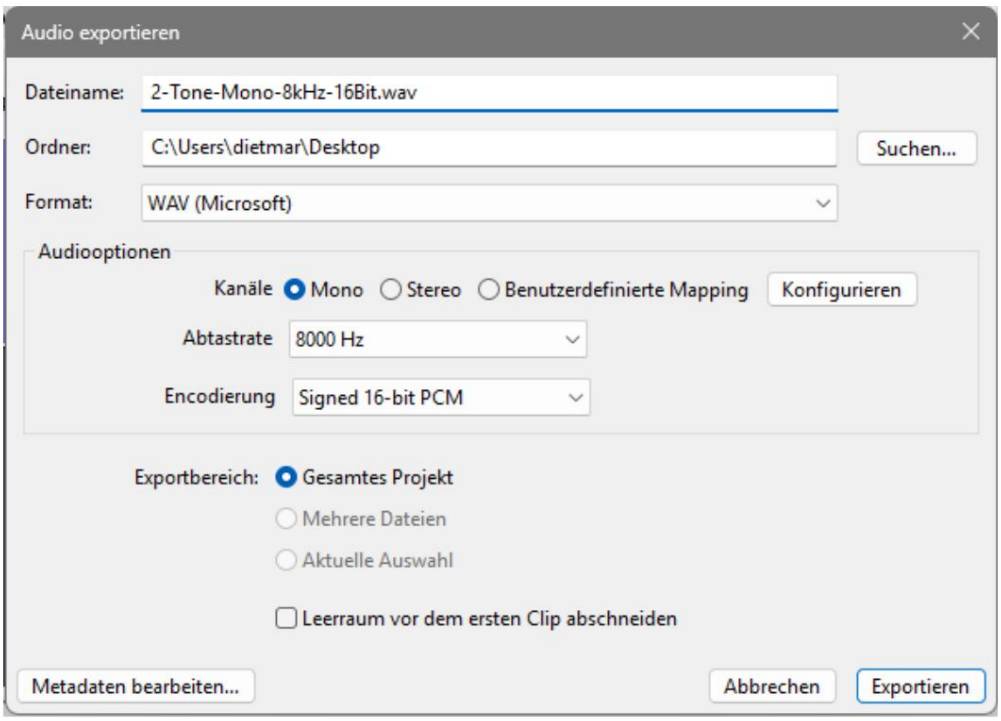


Figure 14 – Export of the signal to Audacity

This format is necessary so that the IC-705 can later play this WAV file.

USE ON THE IC-705

The file must be copied to the SD card in the **\IC-705\VoiceTX** directory of the IC-705. The filename must

selected according to the pattern shown below.

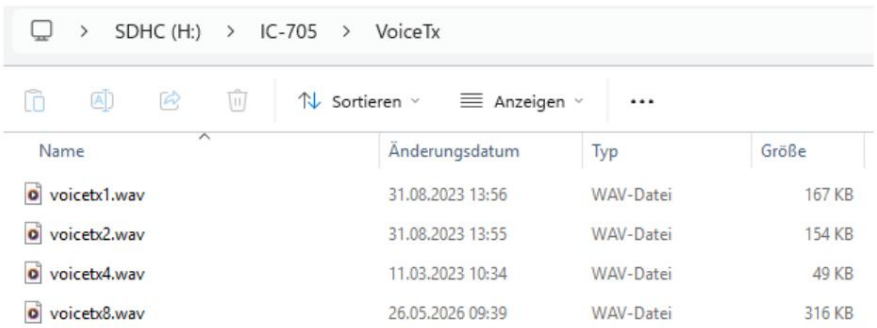


Figure 15 – Destination directory for transmit memory on the IC-705

I named the file **voicetx8.wav** so that it can be sent as a **T8** memory file via the **VOICE menu .**

Figure 16 – Emitting a voice memory in the IC-705

To enable repeatable measurements, I adjusted the following parameters.

parameter	Standard value when measuring	
ALC	9	-
Compressor	0	5
bass	0	-2
Treble	0	+3
Mic Gain	70	50
TX level	50	50
TX bandwidth	300Hz - 2700Hz	300Hz - 2700Hz

Table 10 – IC-705 settings for IM3 measurements

TABLE LABELS

The meaning of the columns in the following tables is as follows:

Area	Split	Meaning
dBm	PEP	Output power of IC-705 measured in PEAK mode of the URV5
dBm	C1	Carrier power at 1078Hz
dBm	IM31	Carrier power at 648Hz[3]
dBm	C2	Carrier power 1508Hz
dBm	IM32	Carrier power at 1938Hz[4]
dBm	ÿ C1 IM31	Intermodulation spacing IM3 of the carrier at 1078 Hz
dBm	ÿ C2 IM32	Intermodulation spacing IM3 of the carrier at 1508 Hz
W	PEP	Total PEP power
W	P1	Carrier power at 1078Hz
W	P2	Carrier power at 1508Hz
W	Pavr	Sum of P1 and P2
W	Pepp	Peak performance calculated from Pavr

Table 11 – Column description IM3 measurements

[3] 1078Hz - (1078Hz + 1508Hz) / 2 = 648Hz

[4] 1508Hz + (1078Hz + 1508Hz) / 2 = 1938Hz

OVERVIEW IC-705 WITHOUT POWER STAGE

	dBm					W		
Frequency PEP C1	IM31 ÿ C1 IM31 C2 0.15		IM32	ÿ C2 IM32 PEP		P1	P2	Pepp
14,200 37.17 31.09 **14,200**	30.94 30.97		-0.01	Pavr 30.98 5.21 1.29 1.25 2.54 5.07				
40.12 34.03	1.46	32.57 33.91	1.28	32.63 10.28 2.53 2.46 4.99 9.98				

Table 12 – IM3 Measurements IC-705 without power stage

Without PA 5W

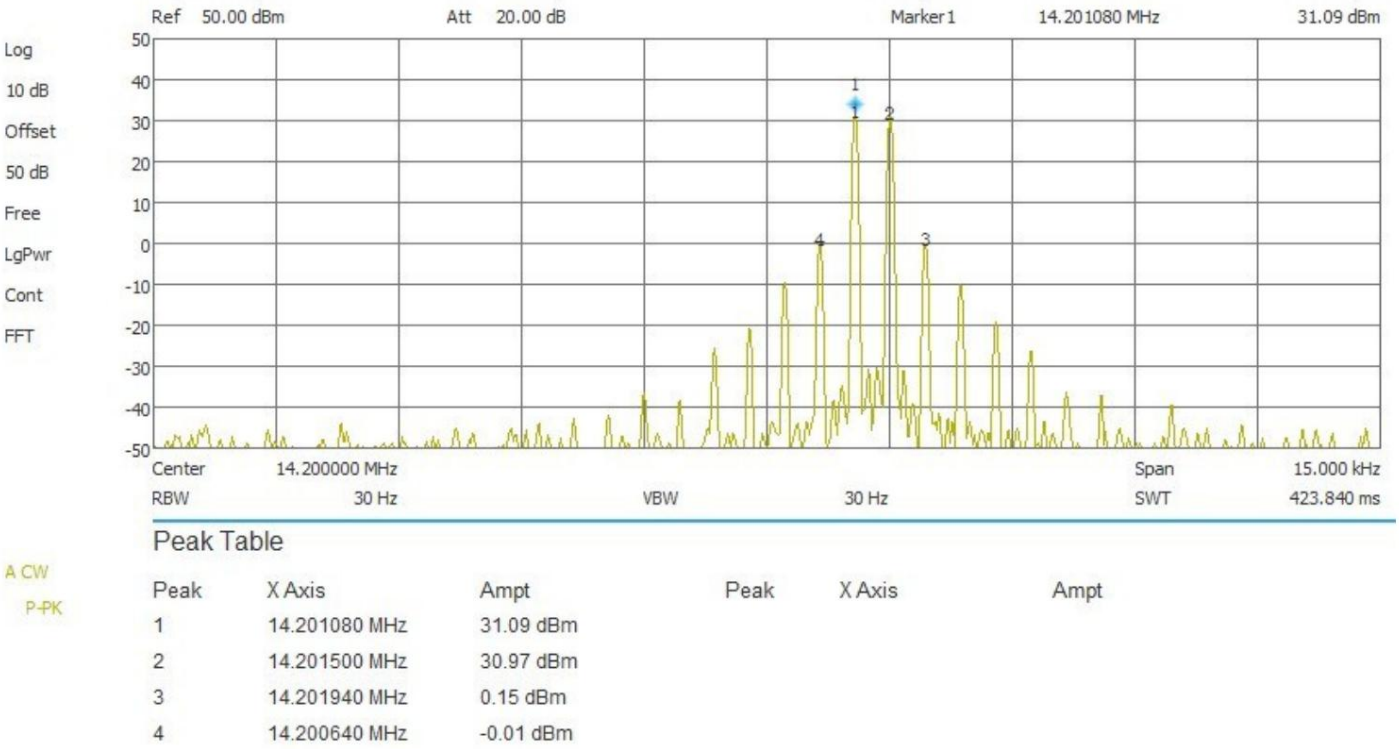


Figure 17 – Spectrum IM3 IC-705 at 5W

Without PA 10W

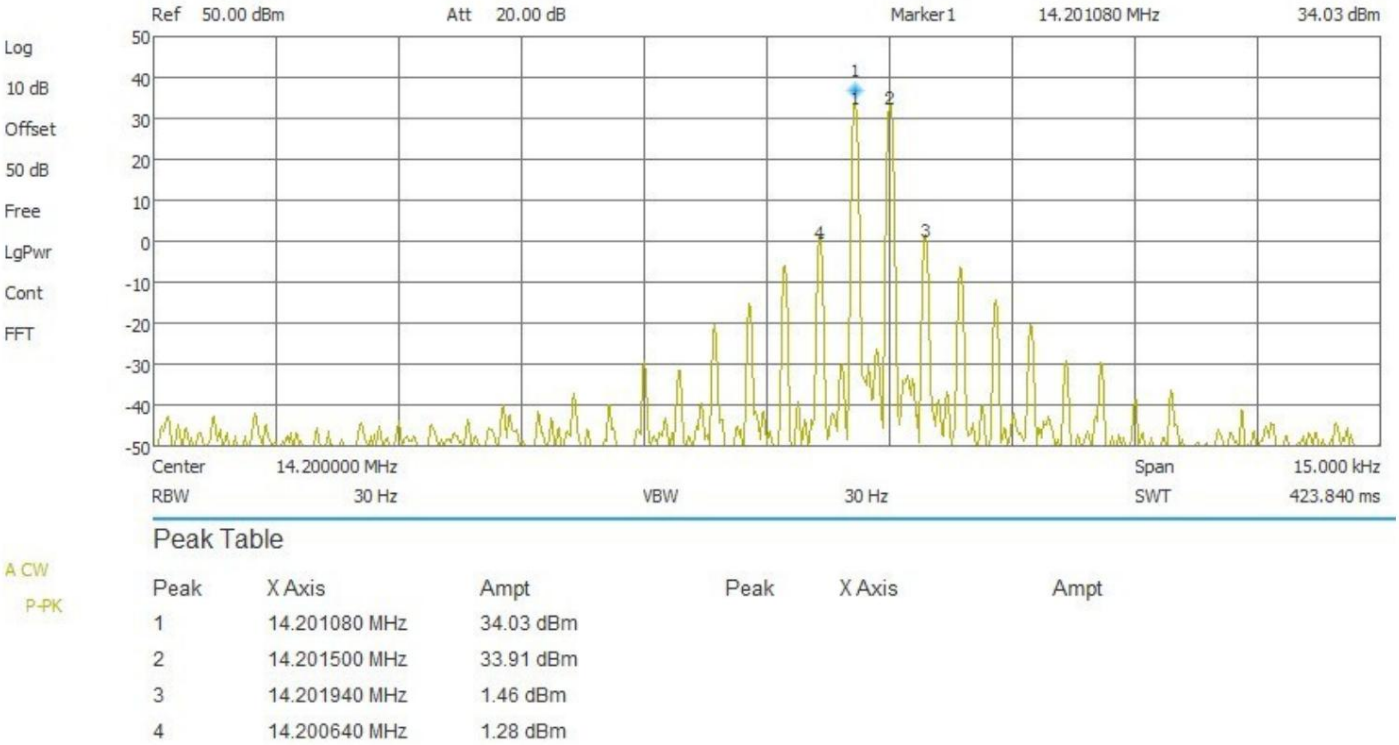


Figure 18 – Spectrum IM3 IC-705 at 10W

OVERVIEW IC-705 WITH POWER STAGE

	dBm					W	
Frequency PWR C1	IM31 ÿ C1 IM31 C2 9.11		IM32 ÿ C2 IM32 PWR P1			P2	Pepp
14,200 41.68 35.37	26.26 35.24		8.68	Pavr 26.56 14.72 3.44 3.34 6.79 13.57			
14,200 43.66 37.75	3.18	34.57 37.61	2.86	26.56 23.23 5.96 5.77 11.72 23.45			
14,200 44.70 39.03	10.82	28.21 38.89	9.05	29.84 29.51 8.00 7.74 15.74 31.49			
14,200 45.15 39.69 **15.50** 14,200		24.19 39.55 14.62		24.93 32.73 9.31 9.02 18.33 36.65			
45.54 40.20 19.23		20.97 40.06 18.81		21.25 35.81 10.47 10.14 20.61 41.22			

Table 13 – IM3 Measurements IC-705 with Power Amplifier

Control power 1W

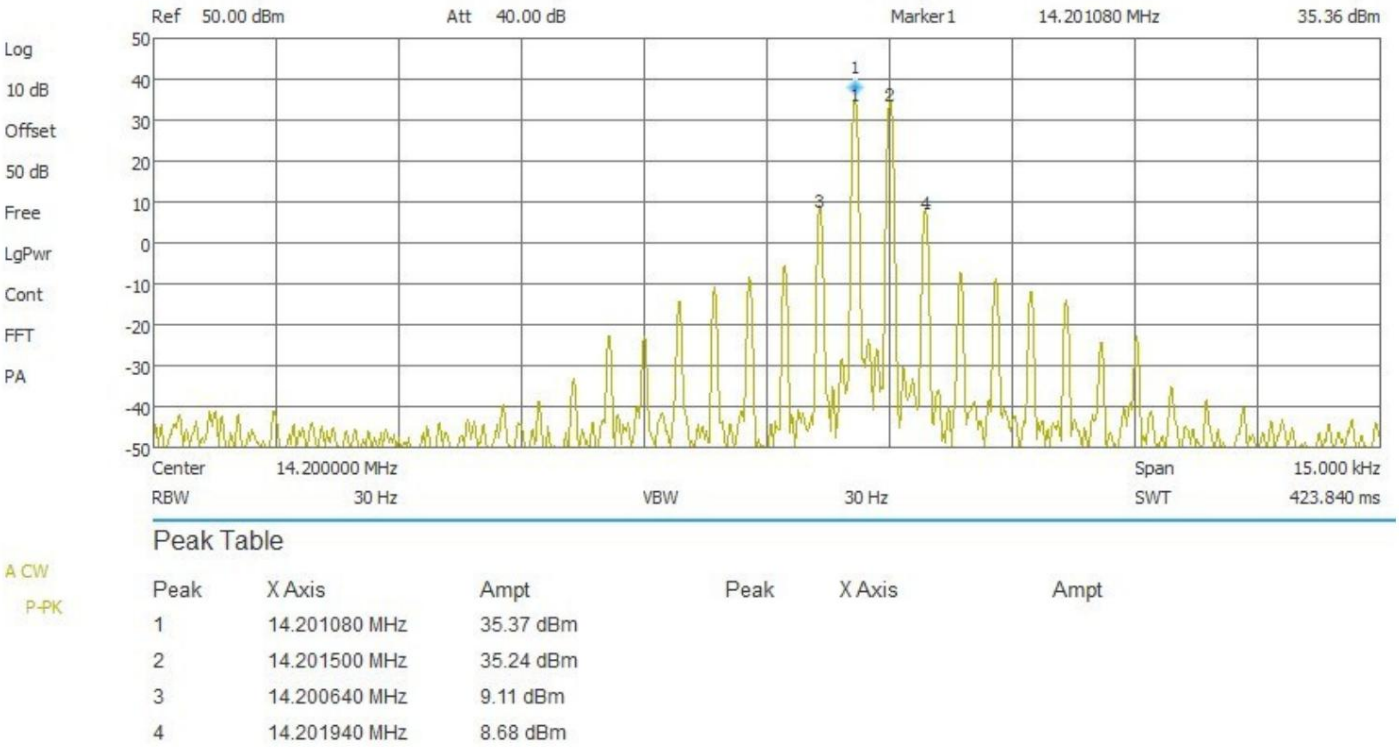


Figure 19 – Spectrum IM3 PA at 1W control power

Control power 2W

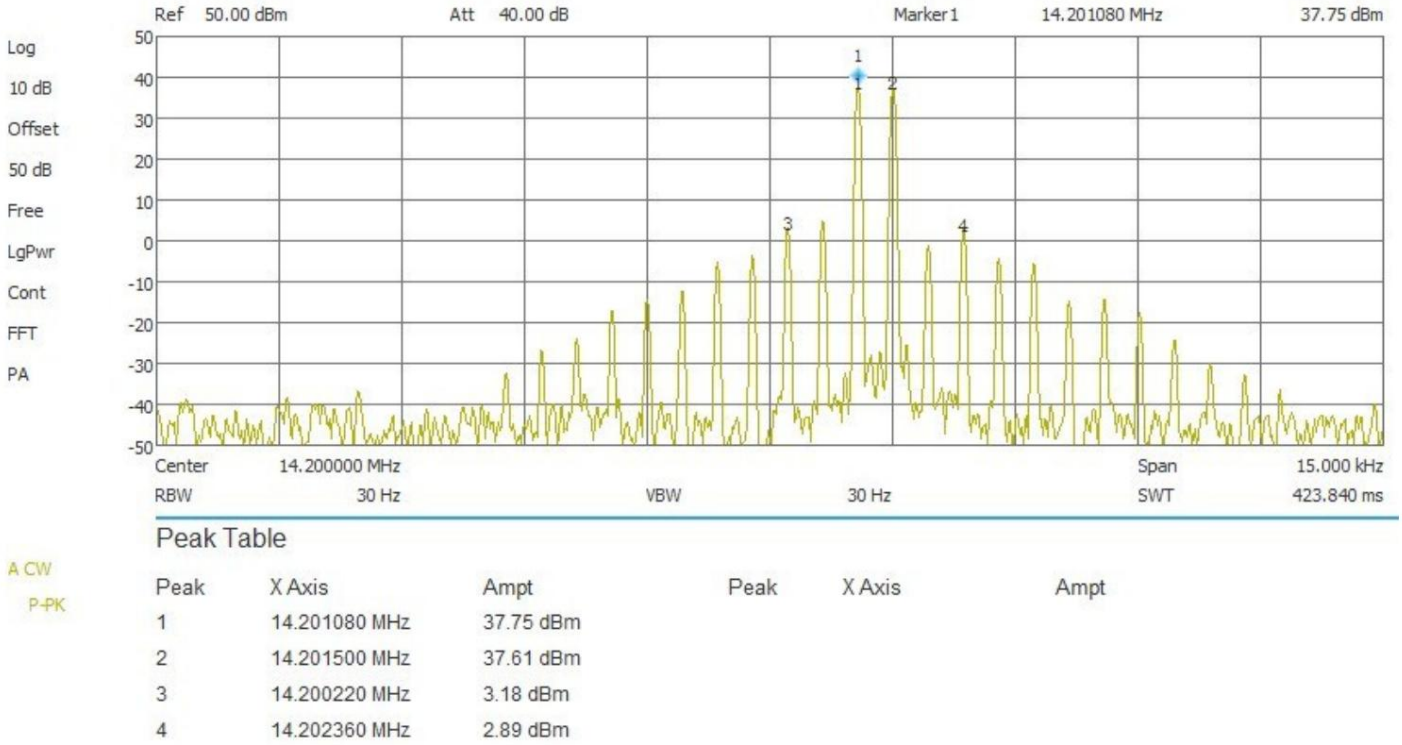


Figure 20 – Spectrum IM3 PA at 2W control power

Control power 3W

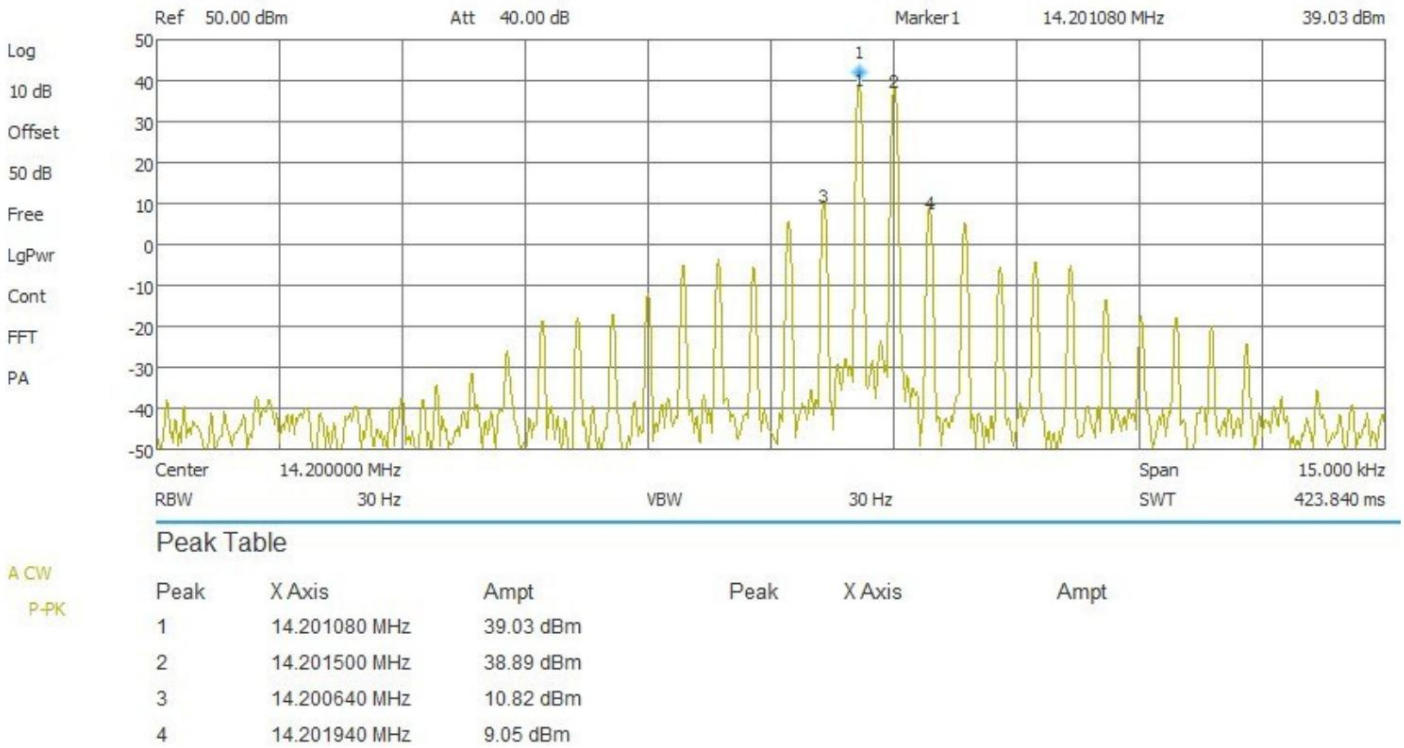


Figure 21 – Spectrum IM3 PA at 3W control power

Control power 4W

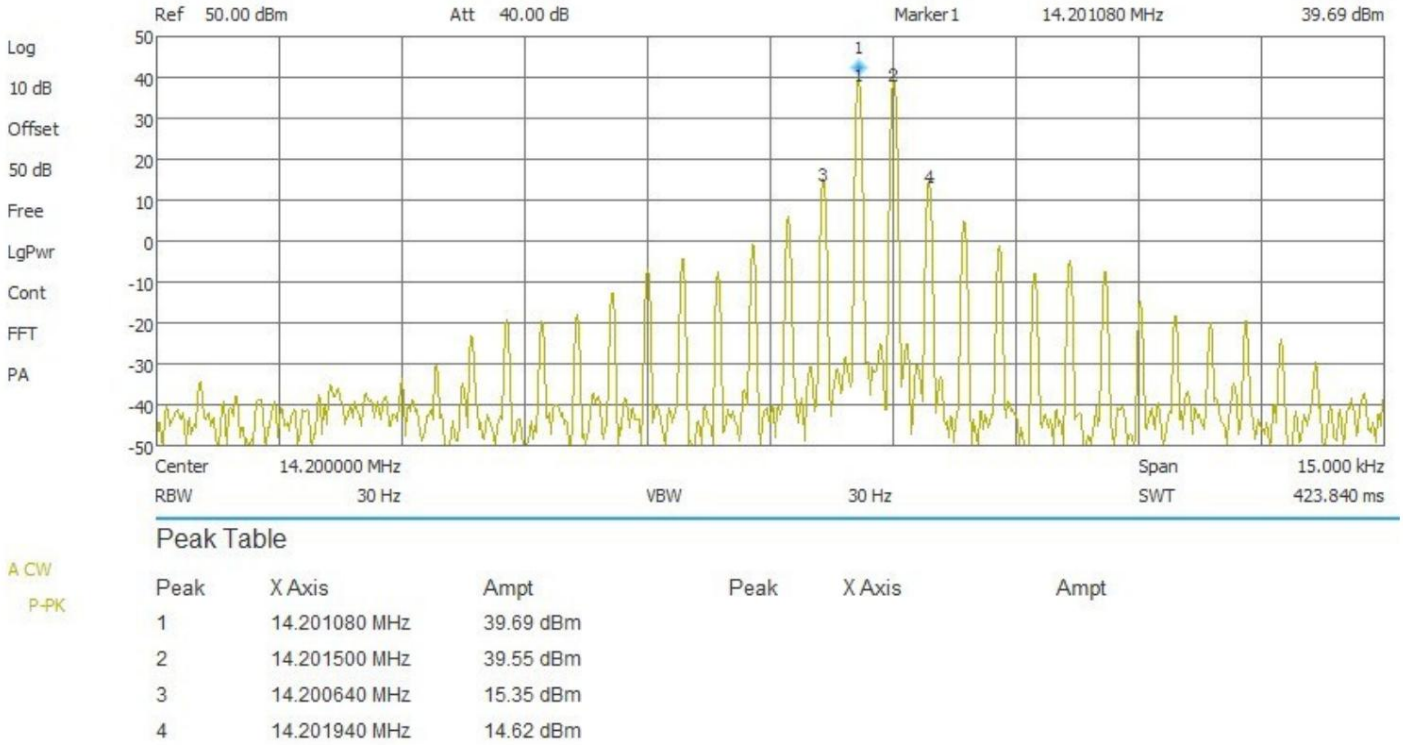


Figure 22 – Spectrum IM3 PA at 4W control power

Control power 5W

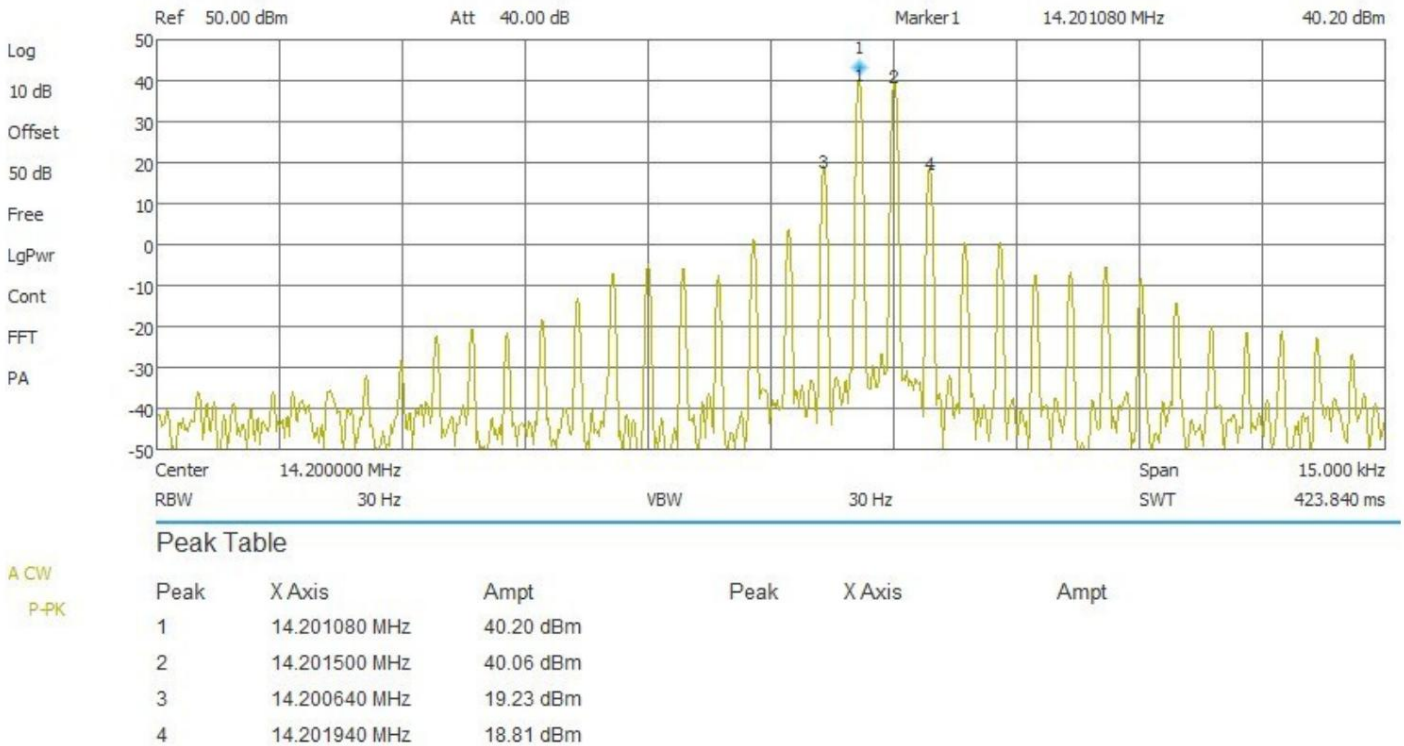


Figure 23 – Spectrum IM3 PA at 5W control power

17M / 18,100MHZ

Performance measurement

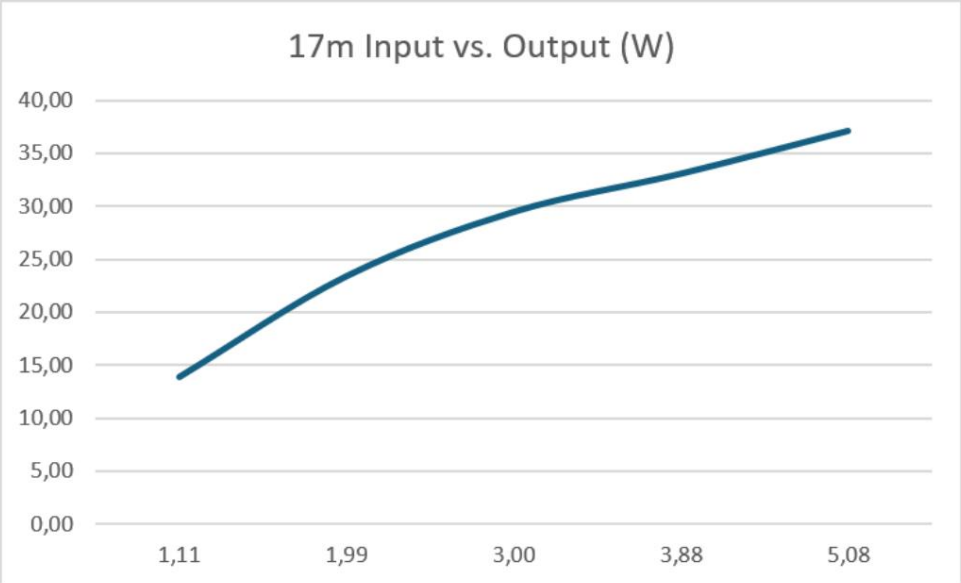


Figure 24 - Input vs. Output Power 17m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.5	41.4	1.11	13.93	11.0
33.0	43.7	1.99	23.44	10.7
34.8	44.7	3.00	29.51	9.9
35.9	45.2	3.88	33.11	9.3
37.1	45.7	5.08	37.15	8.6

Table 14 - Input vs. Output Power 17m

15M / 21,150MHZ

Performance measurement

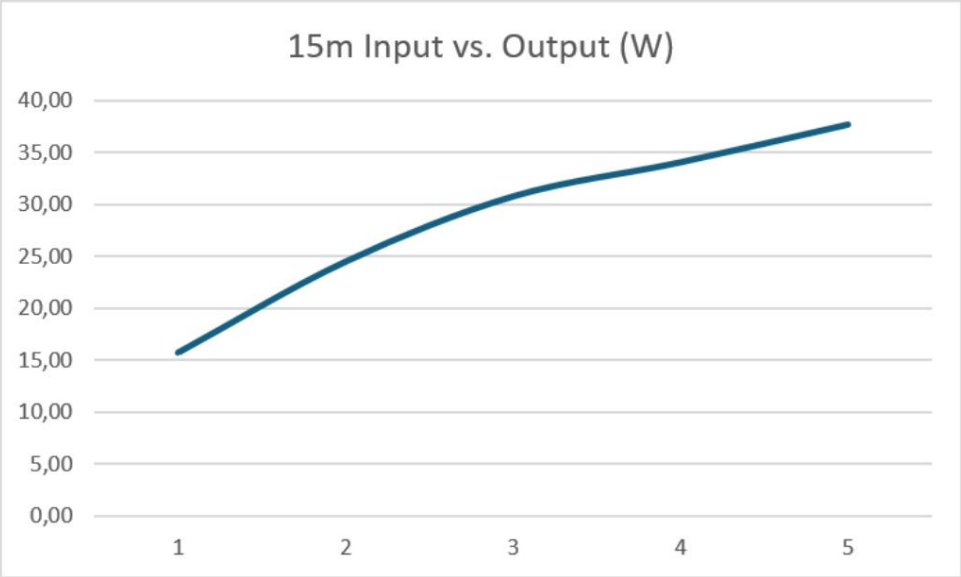


Figure 25 - Input vs. Output Power 15m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.6	42.0	1.14	15.74	11.4
33.1	43.9	2.02	24.49	10.8
34.8	44.9	3.05	30.76	10.0
36.0	45.3	3.94	34.04	9.4
37.1	45.8	5.16	37.67	8.6

Table 15 - Input vs. Output Power 15m

12M / 24.930MHZ

Performance measurement

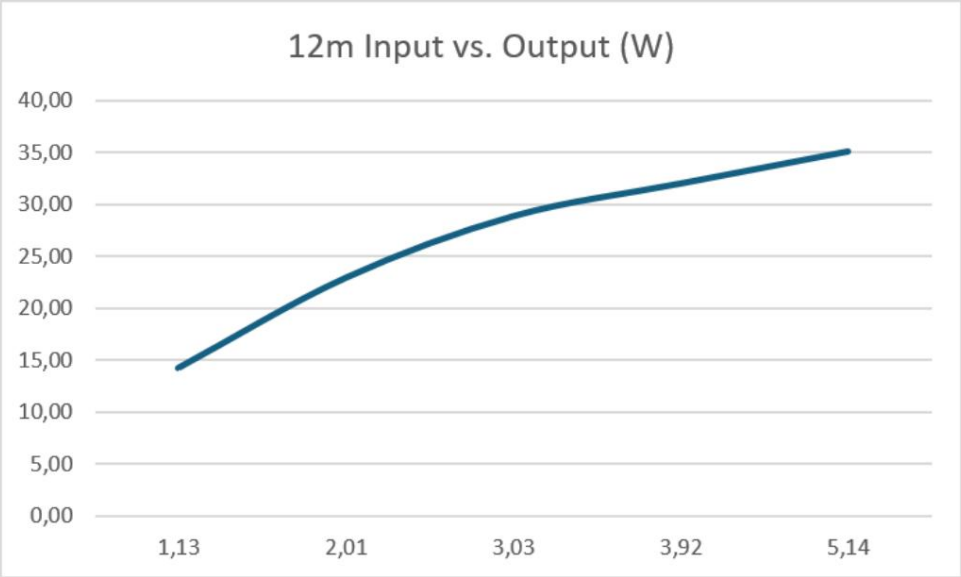


Figure 26 - Input vs. Output Power 12m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.5	41.5	1.13	14.22	11.0
33.0	43.6	2.01	22.91	10.6
34.8	44.6	3.03	28.84	9.8
35.9	45.1	3.92	31.99	9.1
37.1	45.5	5.14	35.08	8.3

Table 16 - Input vs. Output Power 12m

10M / 28,250MHZ

Performance measurement

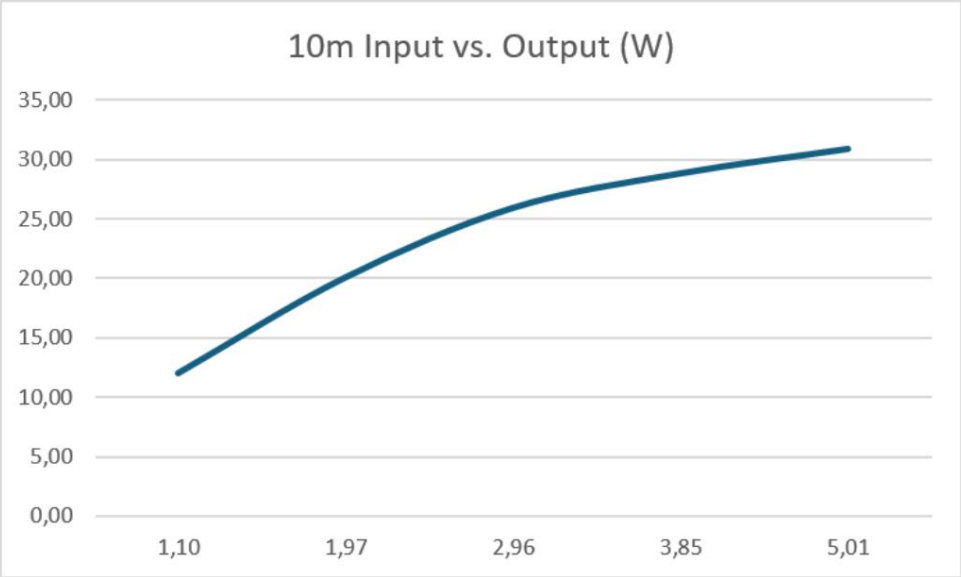


Figure 27 - Input vs. Output Power 10m

PA in (dBm)	PA out (dBm)	PA in (W)	PA out (W)	Power amplification (dB)
30.4	40.8	1.10	12.02	10.4
32.9	43.0	1.97	20.09	10.1
34.7	44.1	2.96	25.94	9.4
35.9	44.6	3.85	28.84	8.7
37.0	44.9	5.01	30.90	7.9

Table 17 - Input vs. Output Power 10m

PERFORMANCE HISTORY

As seen in previous chapters, the power gain of the output stage decreases with increasing input power on each band. The diagram shows the difference in power gain in dB for a 1W input and
5W.

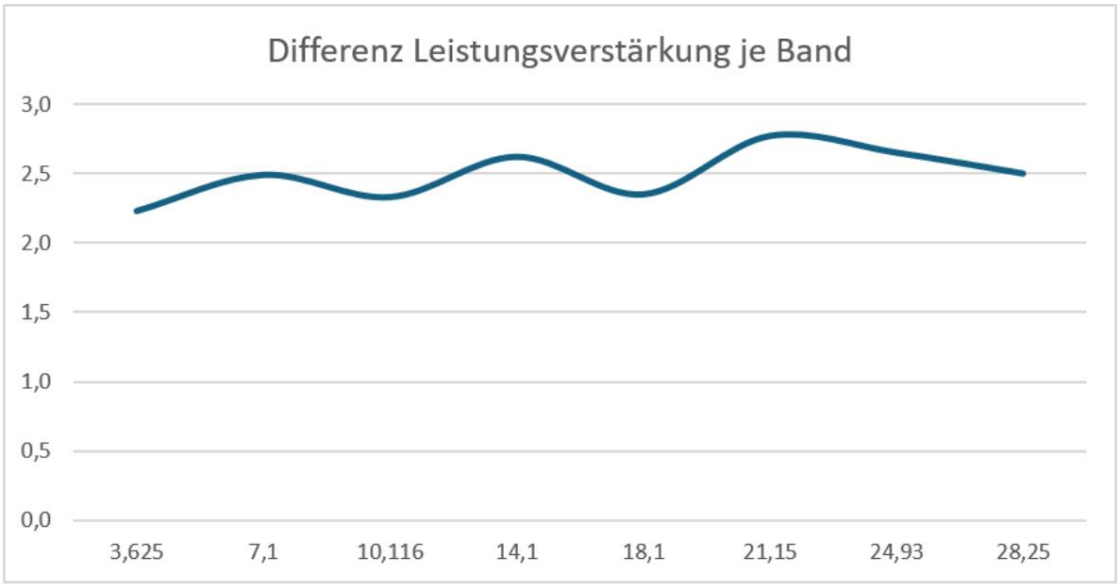


Figure 28 – Gain curve

INPUT ADJUSTMENT

The following describes the input adaptation of the power amplifier depending on the bandpass filter setting.

The final stage has the following positions for the output low-pass filters:

- 80m
- 40m
- 30m – 17m
- 15m – 10m

Measurement setup

The VNA is connected directly to the input of the power amplifier. For the measurements, the appropriate bandpass filter is then switched on and the power amplifier is driven via the PTT line of the PA.

VNA ÿ Power amplifier ÿ Measuring head ÿ Insertion attenuator 40dB ÿ Power termination

The measurement setup has the following adjustments between 50kHz and 30MHz:

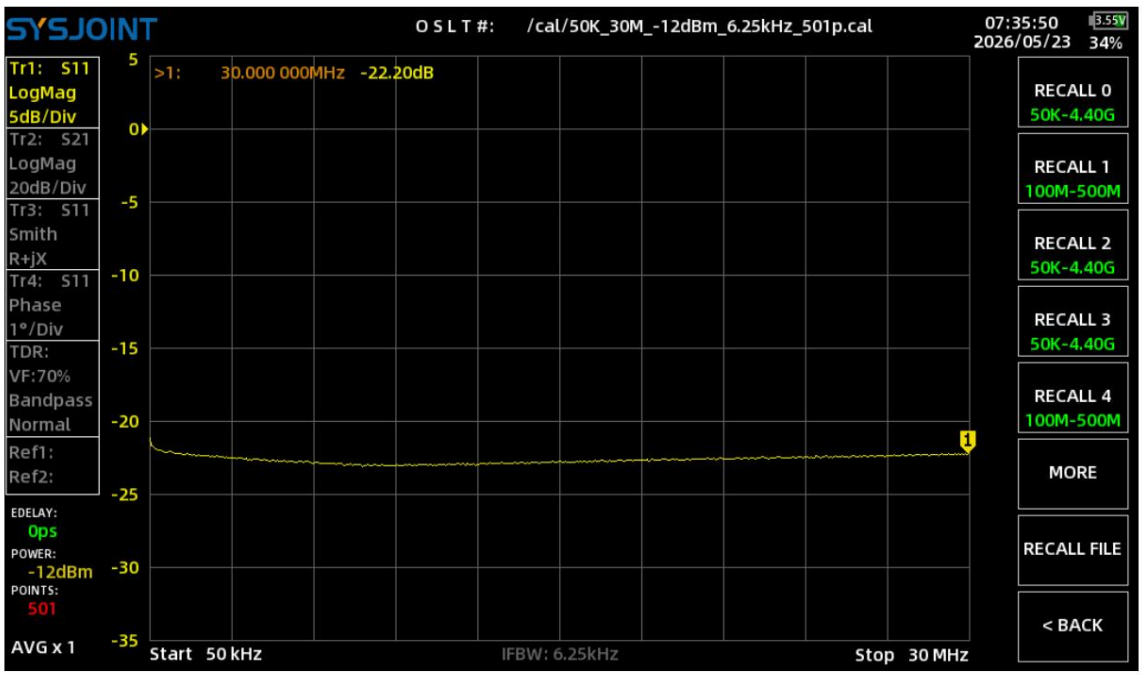


Figure 29 - Input adaptation Measurement setup

Overview

The input matching of the power amplifier was determined using the VNA.

Band switch RL (dB) Frequency (MHz) SWR x : 1			
80m	-17.46	3.584	1.31
40m	-17.14	7.058	1.32
30m - 17m -	17.70	10.173	1.30
30m - 17m -	18.30	14.126	1.28
30m - 17m -	18.58	18.079	1.27
15m - 10m	-20.18	21.194	1.22
15m - 10m	-19.48	24.129	1.24
15m - 10m	-19.80	28.262	1.23

Table 18 – Input matching vs. frequency

The matching improves with increasing operating frequency – with very low SWR fluctuations.

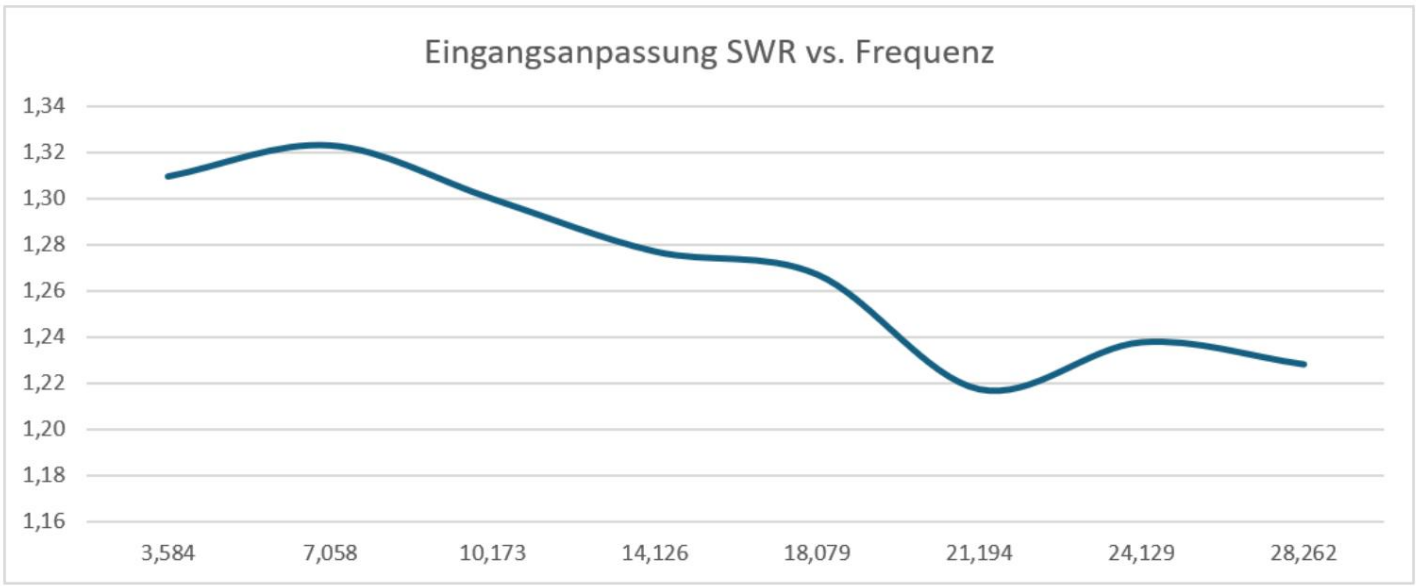


Figure 30 – Input matching SWR vs. frequency

Adjustment 80m

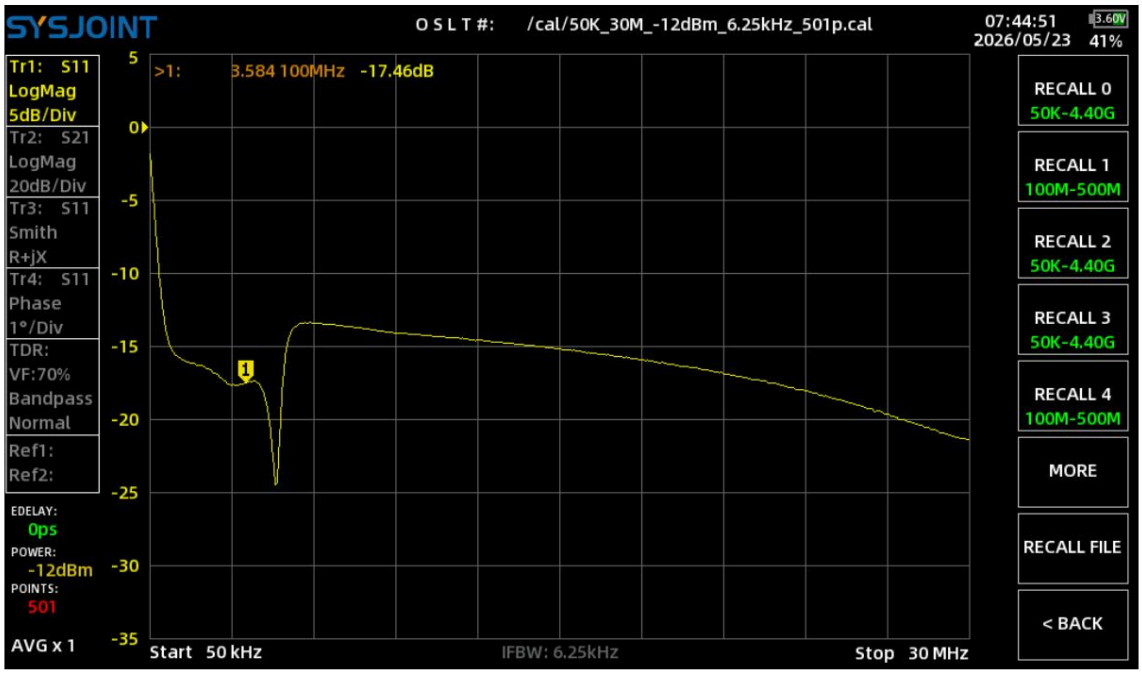


Figure 31 - Input matching 80m

Adjustment 40m

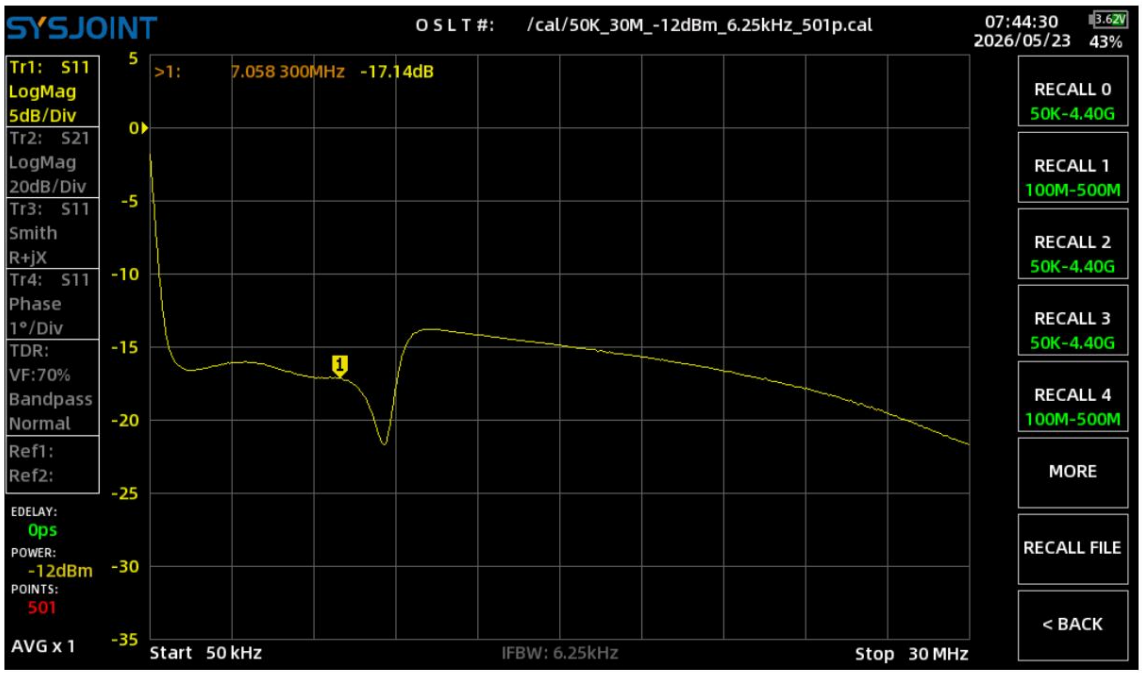


Figure 32 - Input matching 40m

Adjustment 30m to 17m

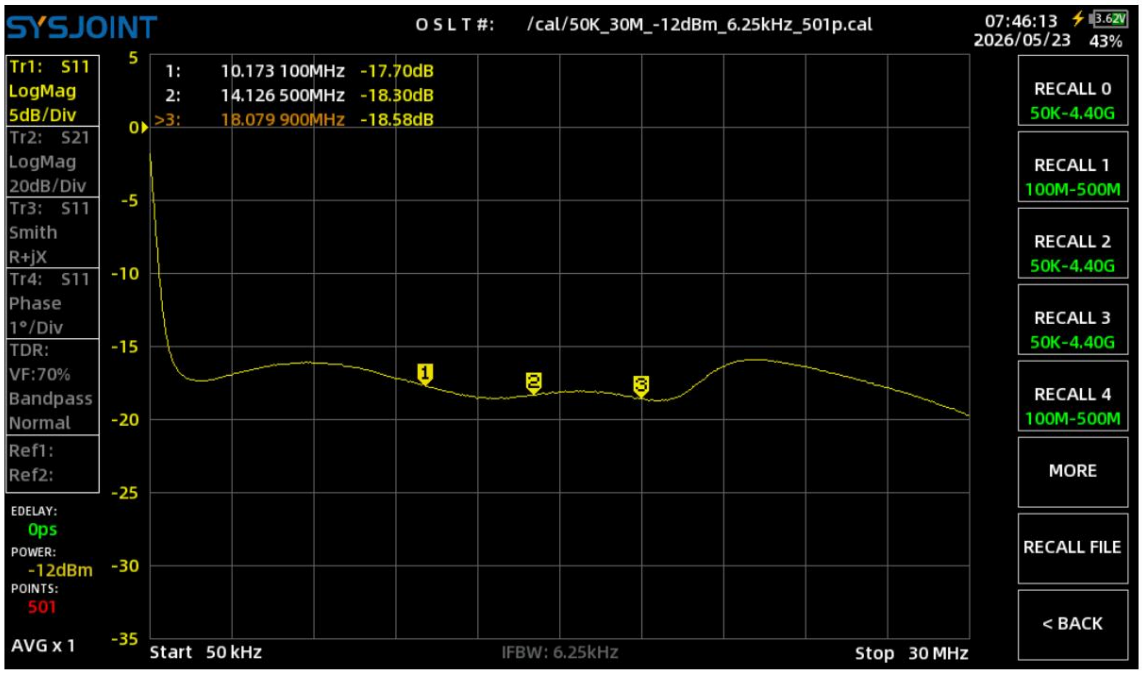


Figure 33 - Input matching 30m - 17m

Adjustment 15m – 10m

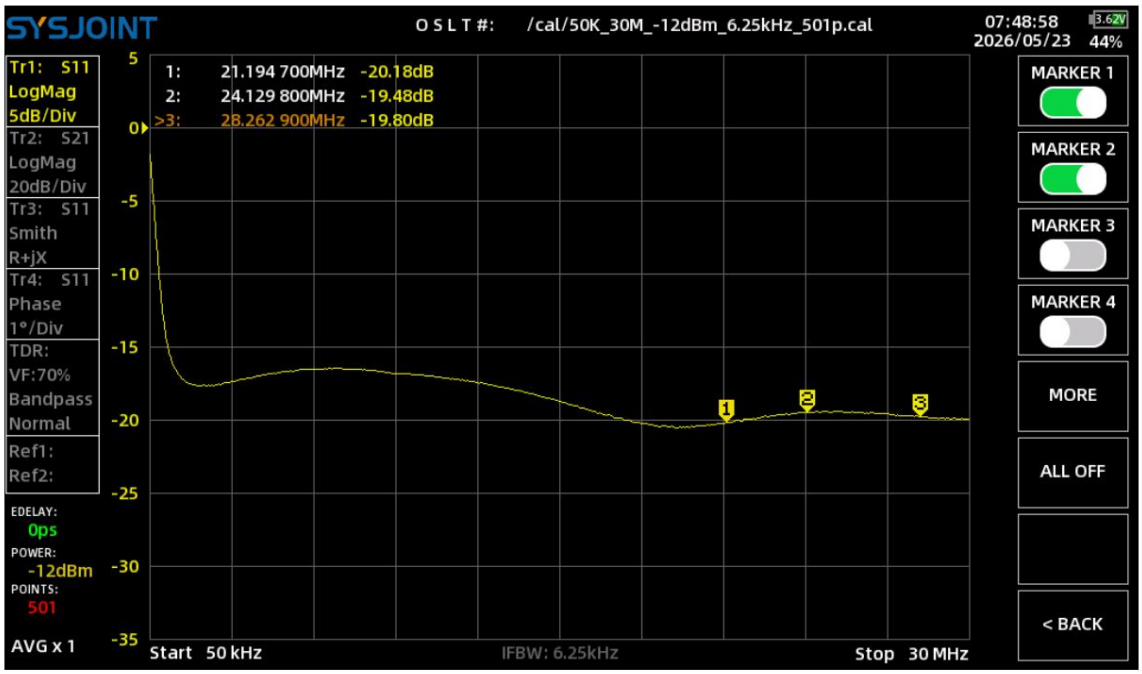


Figure 34 - Input matching 15m - 10m

MEASUREMENT IN CW OPERATING MODE

It is interesting to see whether the first CW signal is distorted by the final stage.

To enable repeatable measurements, I adjusted the following parameters.

parameter	Value at measurement
Dot-dash ratio	1:1:3
Rise Time	4ms
speed	40WPM

Table 19 – IC-705 settings for measuring transmit/receive switching

The transmitter was keyed using the dot paddle of the internal keyer.

For the measurement, the probe line was measured on channel 1 and the RF output of the power amplifier on channel 2.

Key-down measurement and maximum transmit power

The measurement is performed using a 2-channel oscilloscope, with the probe connected to channel 1 (yellow) and the RF signal to channel 2 (green).
The output is connected.

The delay between key-down and the application of full transmission power is approximately [value] with and without an active power amplifier.
11.5ms.

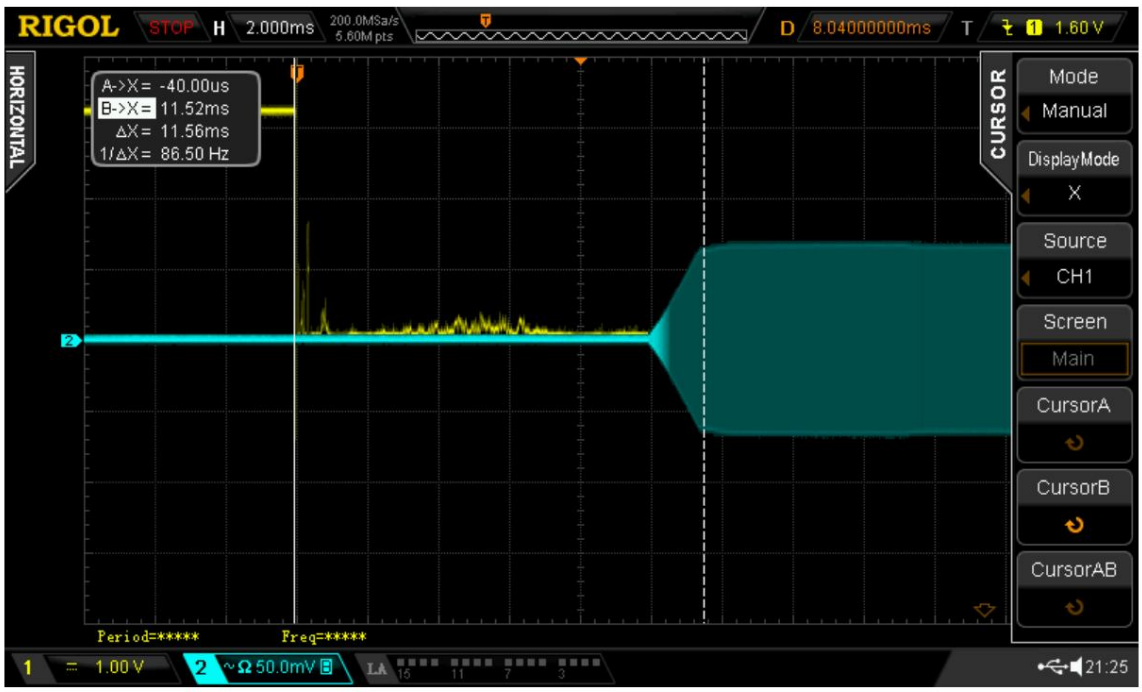


Figure 35 - Duty cycle IC-705

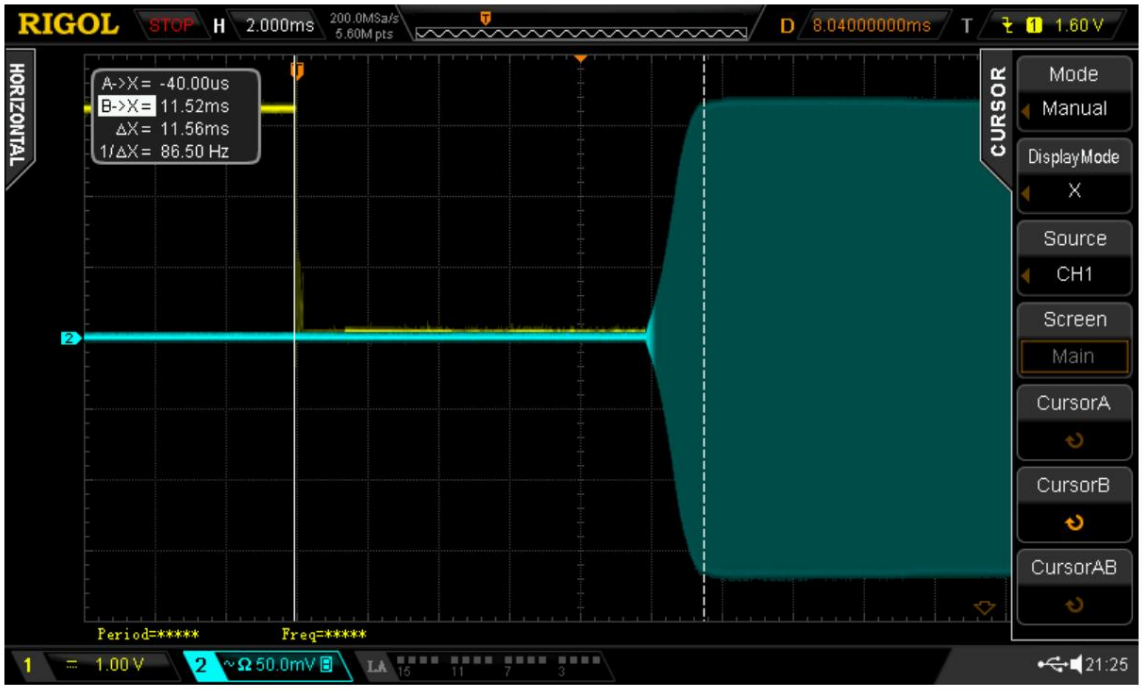


Figure 36 - Duty cycle IC-705 + output stage

Measurement of shortening, first point

A slight shortening of the character length occurs at a rate of 40 BPM. The first dot lasts approximately 23 ms in terms of heart rate; subsequent dots...

are approximately 26ms long.

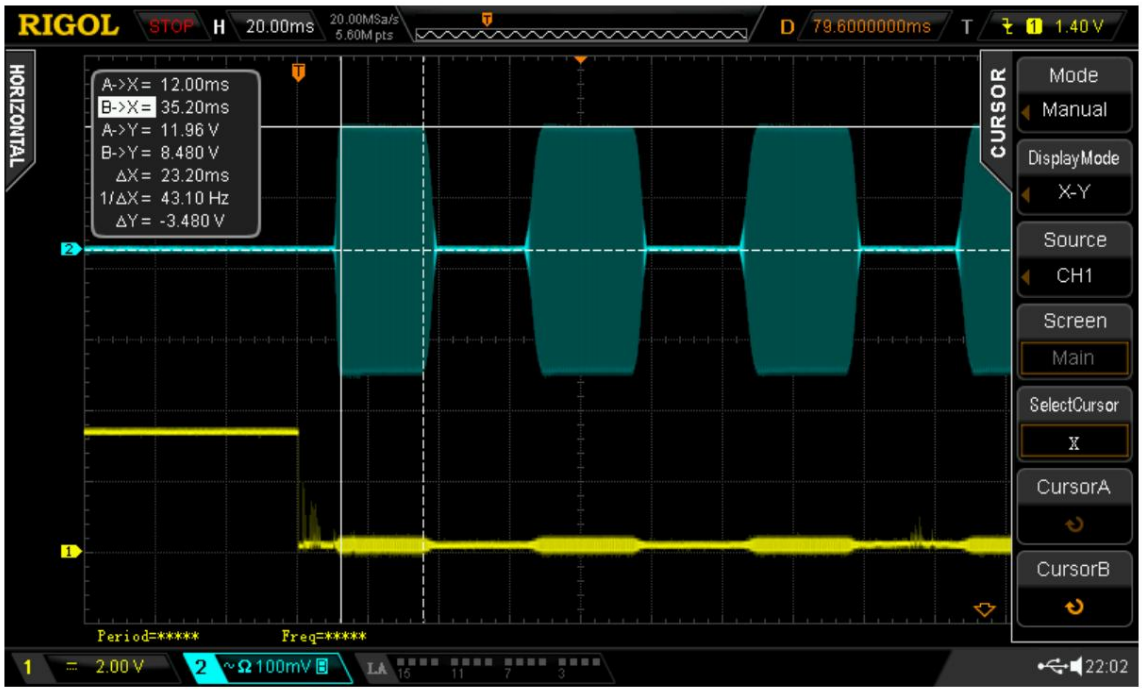


Figure 37 – Length of the 1st point IC-705

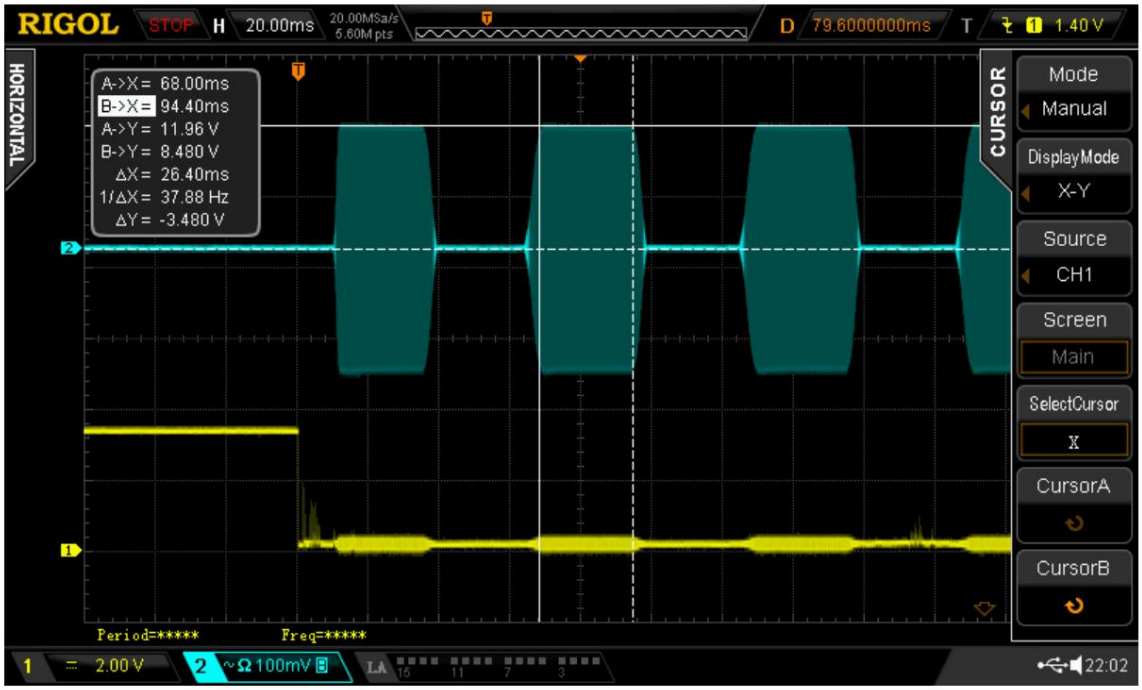


Figure 38 – Length of the 1st point IC-705 + final stage

The shortening of the first point is triggered by the IC-705. There is no degradation due to the activation of the final stage.

The shortening of the first point should not be noticeable to the ear.

TRANSMIT/RECEIVE SWITCHING CONVERSION

The following describes the modification of the control system for the transmit/receive switching of the power amplifier.

Old

The PTT line (TX in the circuit diagram) of the MX-P50M directly controls the two relays K1 / K2 of the transmit/receive switching.
to.

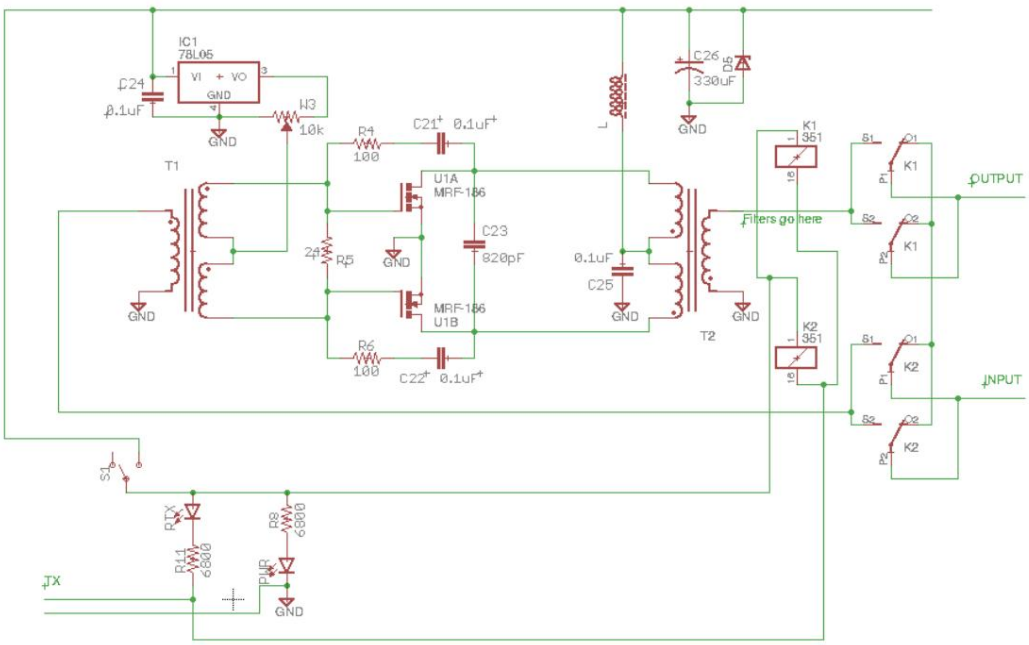


Figure 39 – Incomplete circuit diagram of the output stage

This requires a control current of approximately 37mA. This current is unlikely to pose a problem for most transceivers.
This poses a problem.

However, what is problematic is that the back EMF of the relays generates a high voltage when they drop out – this will certainly lead to problems with FET/transistor PTT outputs of the transceivers without appropriate protection measures.
in the transceiver.

Why the manufacturer saved on three components worth <€0.10 is a mystery to me.

Note: June 2, 2026

The circuit diagram above is missing the control circuit for the bias voltage generation. The voltage regulator 78L05 only receives its supply voltage via one of the S/E relays when transmitting. This ensures that the output stage's quiescent current only flows during transmission. Presumably, a contact of K2 is used for this control.
This is used because one contact of the relay is sufficient for the maximum input power.

Furthermore, the circuit diagram is missing the absolutely necessary decoupling capacitor at the output of the 78L05. Whether this is possibly installed on the underside of the circuit board cannot be determined without completely disassembling the power amplifier.

New

To solve the problem described above, various articles on the internet suggest a simple solution.

Driver stage proposed with a PNP transistor:

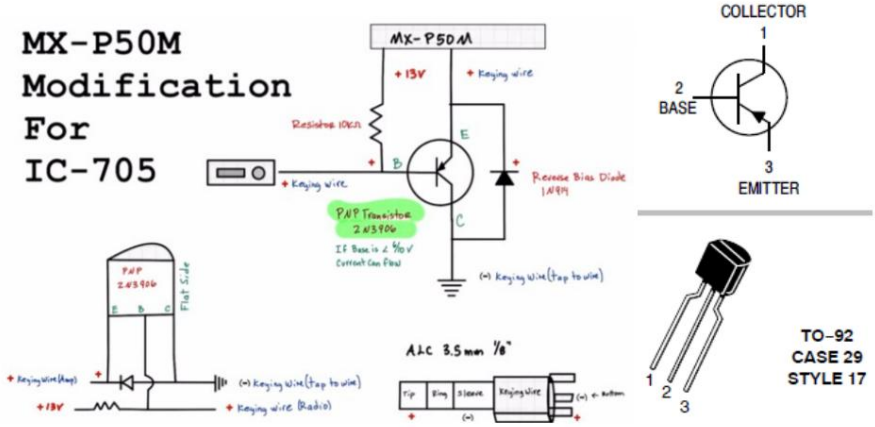


Figure 40 – Driver Stage 5

Due to component availability, I used a BC307C transistor. Note that the pinout is different. I used a 1N4148 diode.

The circuit can be built very compactly without a printed circuit board.

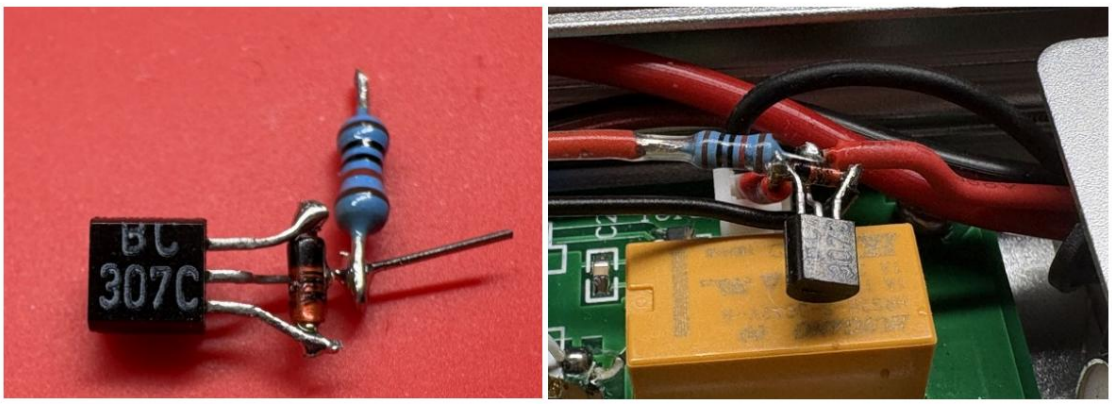


Figure 41 - Key Circuit

[5] https://www.youtube.com/watch?v=wtj93Rj_zk8

It is inserted into the PTT line of the final stage and also receives the operating voltage (switched via the Power amplifier switch) and ground via extra leads:

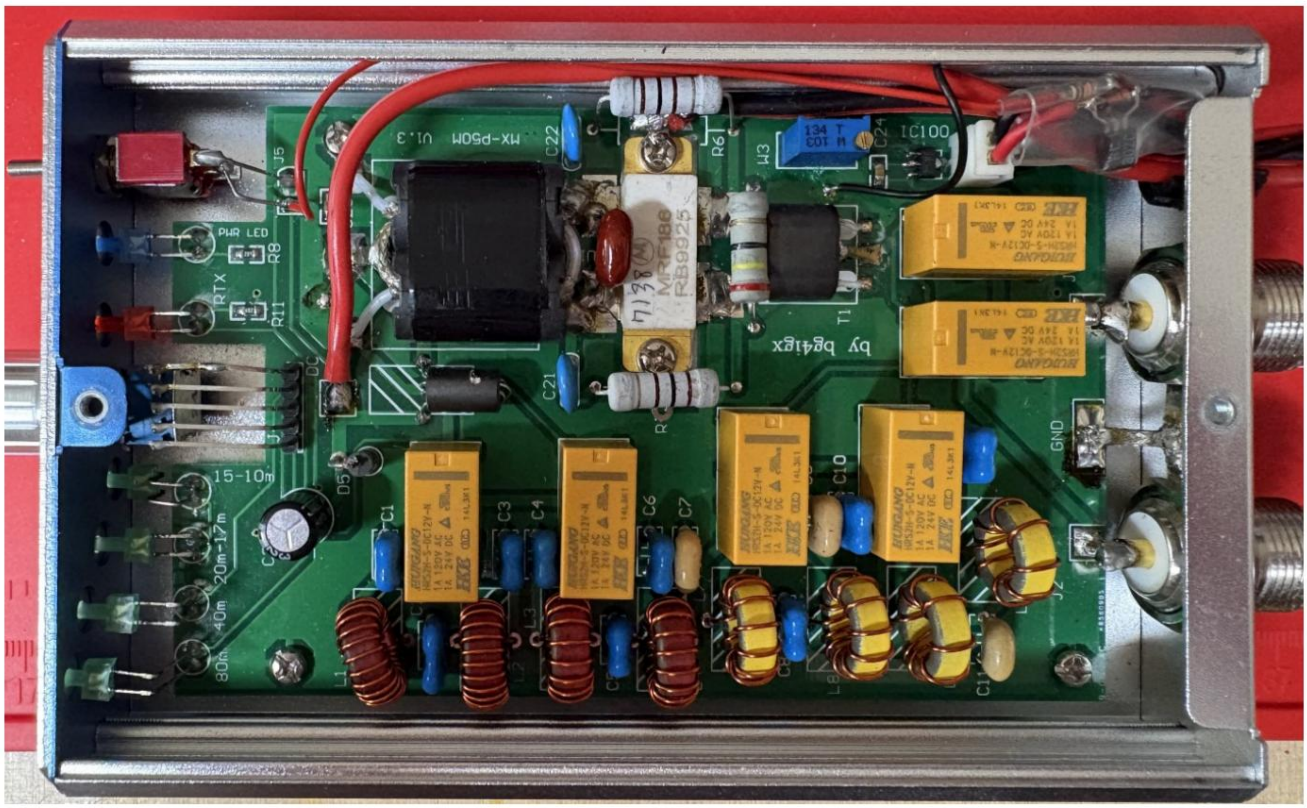


Figure 42 - Installation in power amplifier

SUMMARY

The measurements shown demonstrate good performance of the power amplifier considering the complexity of the amplifier and the current price of approximately €250,- when shipped from China[6]. The power amplifier cannot be purchased in Germany because it has CE marking. The identification is missing. However, searches in the relevant amateur radio forums should yield results relatively quickly. lead.

The power amplifier provides between 38W on 80m (+8dB) and on the shortwave bands with a drive power of 5W. 31W (7.9dB) over 10m is sufficient for a noticeable increase in the transmitted signal. At 13.8VDC, the current draw ranges from 5.0A at 80m to 4.3A at 18m, resulting in an average efficiency of 55%.

The suppression of the 3rd harmonic, measured as an example at 7MHz, is at least 51.7dB. The suppression of the 5th harmonic... Harmonic at least 41.2 dB. However, larger variations between individual units are likely to occur, as shown in *Table 6. Harmonic suppression DL2SBA* is shown on page 8 and *Table 7 - harmonic suppression DM1TBE* is shown on page 8.

Using the output stage with an IC-705 (at a drive power of 5W) reduces the measured IM3 value of the IC-705 from 30.98dB to 21.25dB at an output power of 35.81W in the 20m band.

The input matching of the power amplifier is good for the shortwave bands and lies between 1.22:1 and 1.22:1 in the SWR range. 1.32:1.

The final stage should also be well suited for use in CW mode, as the shortening of the first character is only a few milliseconds.

[6] However, there are also sellers from China who charge over €500 for this.

LEFT

The following online sources helped me with this:

- https://www.youtube.com/watch?v=k8dwJMOdEMI
- https://www.youtube.com/watch?v=wtj93Rj_zk8
- https://dk9jc.de/blog/equipment/66-mx-p50m-50w-hf-power-amplifier-fuer-ft-817
- https://www.dj5am.de/ic705strg.html
- https://www.carnut.info/IC-705/IC-705_PTT-Interface/V2.0_BOM_and_SCH/
- https://oshpark.com/shared_projects/mcmzPLEv
- https://dc4ku.com/.cm4all/uproc.php/0/Sender%2C%20Messtechnik/Praxis_der-IM-Measurement_on_transmitters_using_the_IC7300_as_an_example.pdf?cdp=a&_=1970db261d1
- https://www.audiotester.de/
- https://vac.muzychenko.net/en/
- https://www.audacityteam.org/

LIST OF ILLUSTRATIONS

LIST OF TABLES