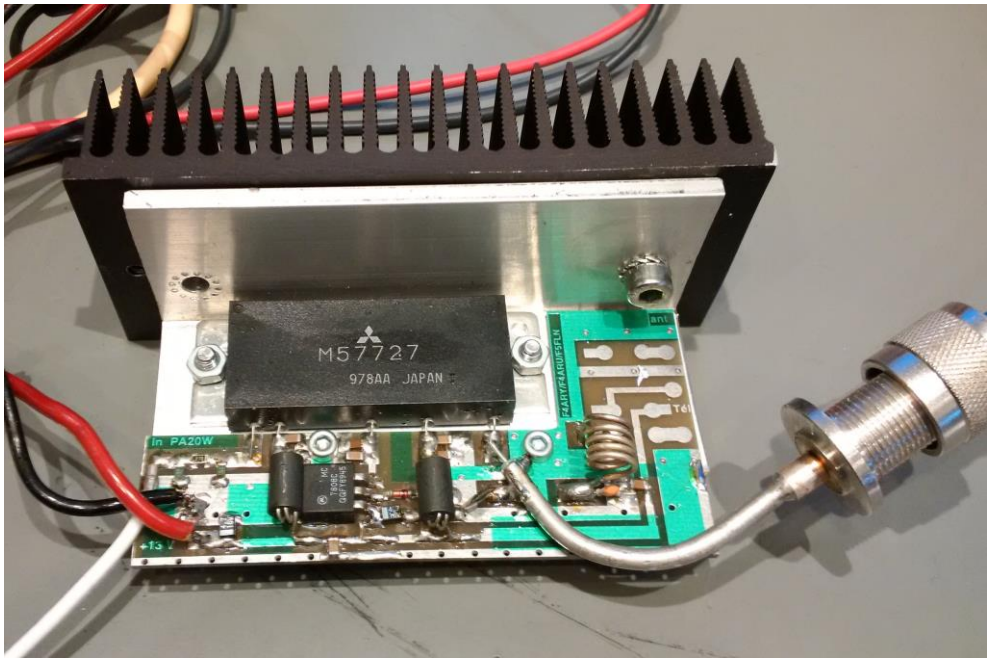
145 MHz 40W power amplifier based on the Hybrid Module Mitsubishi M57727

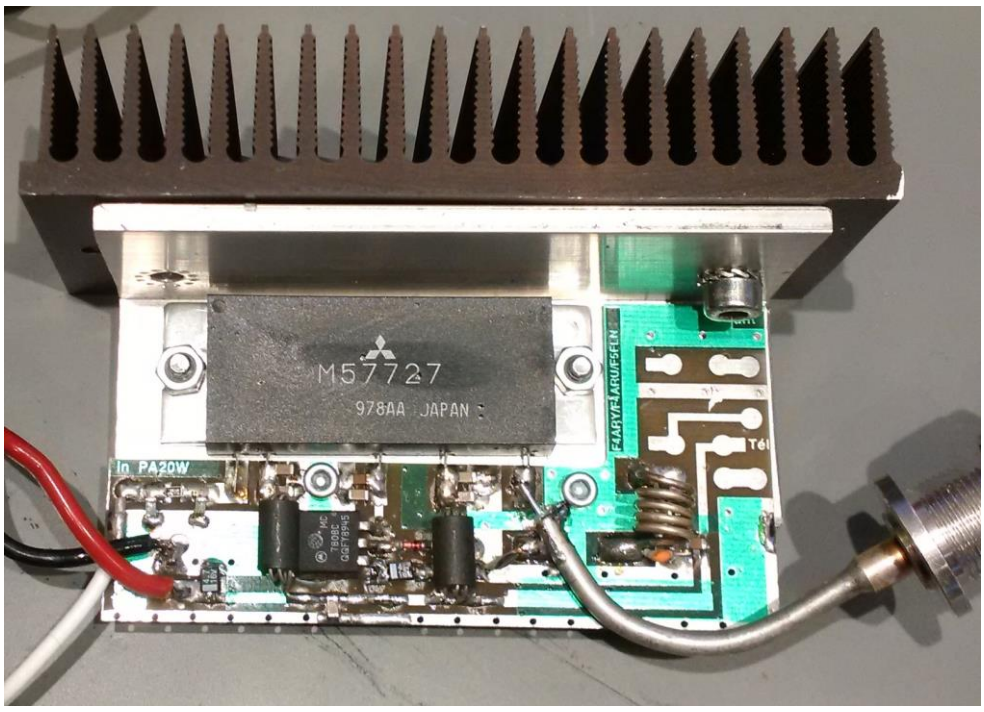
Matthias, DD1US, January 19th 2020, rev 1.0

Recently I bought a power amplifier at a Ham Radio flea-market. It is based on a hybrid module M57727 from Mitsubishi. Based on the low price I assumed that the module itself is defective but that I could use the PCB and heatsink and mount other modules with the same pinout on to it.

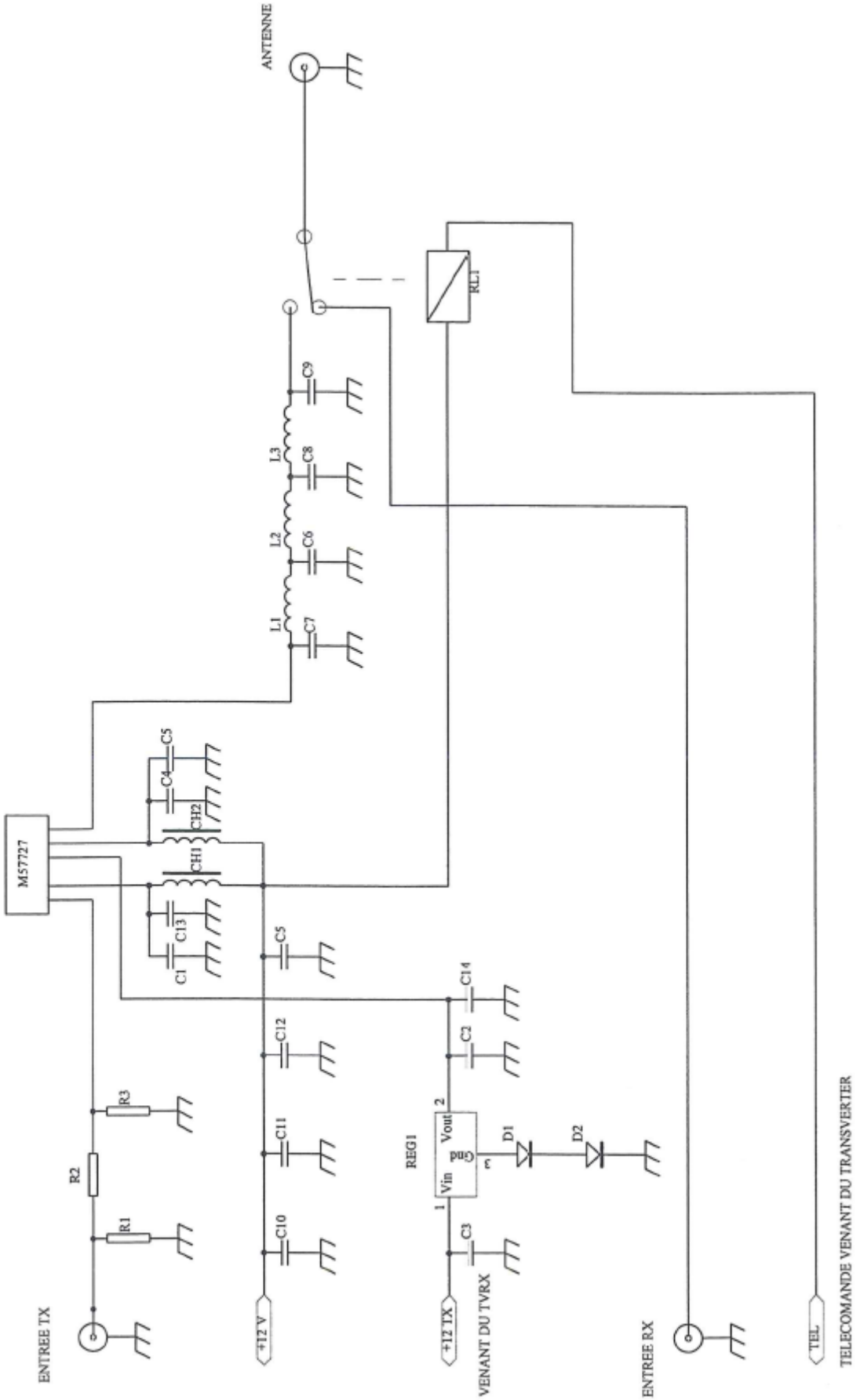
The PCB seems to be cut out from a larger PCB and has some callsigns printed on it. Based on this I was able to identify the PCB being part of a 144 MHz linear transverter with an IF frequency of 28 MHz. It was published in 1999 by F5FLN, F4ARU and F4ARY in the French journal Reunion THF Francaise Cj99.

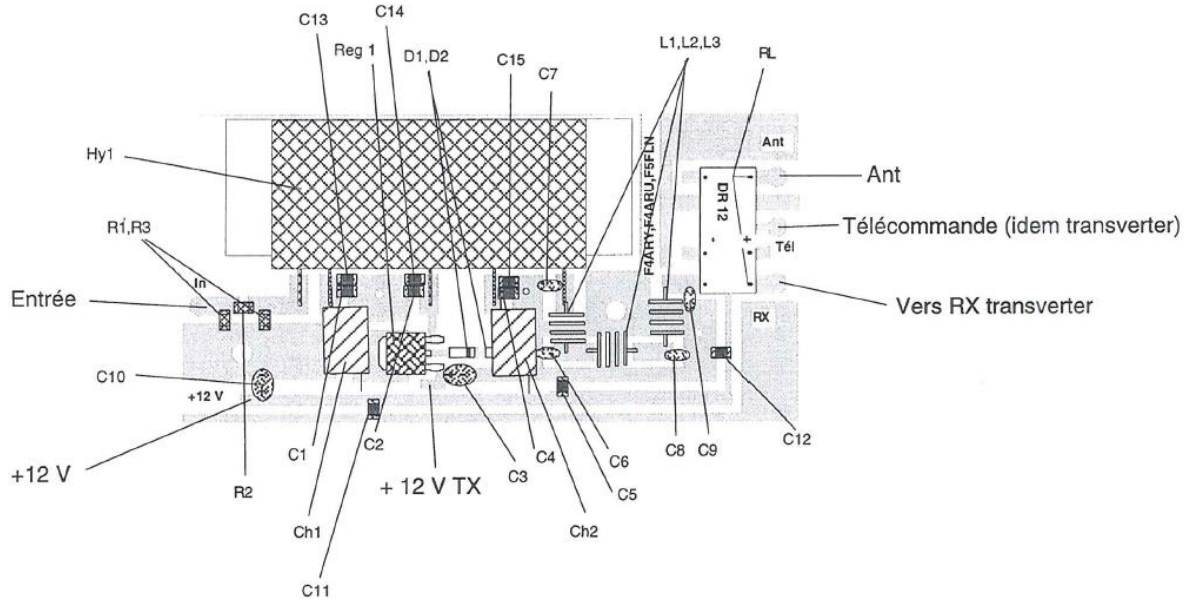
Here are pictures of the power amplifier:





Here is the information I found in the Journal Cj99:





NOMENCLATURE AMPLI 20W				
N°	REPERE	DESIGNATION	FOURNISSEUR	OBSERVATIONS
1	C1	1nF	CHOLET	CMS
2	C2	1nF	CHOLET	CMS
3	C3	4,7µF 25V	CHOLET	CMS
4	C4	1nF	CHOLET	CMS
5	C5	100nF	CHOLET	CMS
6	C6	39pF	CHOLET	CAPA NPO céramique
7	C7	18pF	CHOLET	CAPA NPO céramique
8	C8	39pF	CHOLET	CAPA NPO céramique
9	C9	18pF	CHOLET	CAPA NPO céramique
10	C10	4,7µF 25V	CHOLET	CMS
11	C11	100nF	CHOLET	CMS
12	C12	100nF	CHOLET	CMS
13	C13	100nF	CHOLET	CMS
14	C14	100nF	CHOLET	CMS
15	C15	100nF	CHOLET	CMS
16				
17	L1	5 TOURS	10/10 AG	Ø 6
18	L2	5 TOURS	10/10 AG	Ø 6
19	L3	5 TOURS	10/10 AG	Ø 6
20	CH1	VK200	CHOLET	
21	CH2	VK200	CHOLET	
22	R1	150Ω	CHOLET	CMS
23	R2	27Ω	CHOLET	CMS
24	R3	150Ω	CHOLET	CMS
25	REG1	78M08	CHOLET	CMS
26	D1	PMLL4153	CHOLET	1N4148 CMS
27	D2	PMLL4153	CHOLET	1N4148 CMS
28	HY1	M57527	CHOLET	
29	RL	DR12	CHOLET	

When I got from the flea-market I started refurbish the amplifier in order to be able to test it. The output filter was not assembled and I decided to test the power amplifier module without any external output matching.

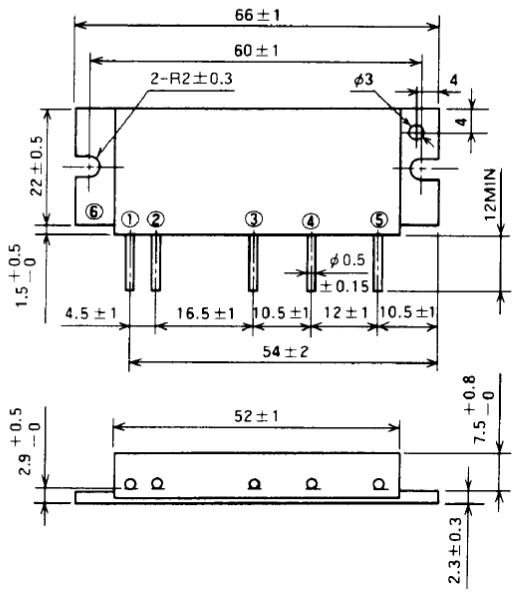
Based on the datasheet of the M57727 module this amplifier should be capable to deliver up 37W on 145 MHz. The supply voltages are V1=12.5V, V2=9V and V3=12.5V.

Here is a copy of the datasheet:

M57727

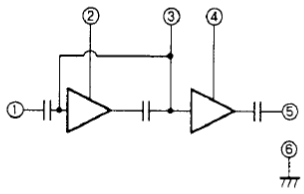
144-148MHz, 12.5V, 37W, SSB MOBILE RADIO

OUTLINE DRAWING Dimensions in mm



H3

BLOCK DIAGRAM



PIN :
①Pin : RF INPUT
②Vcc1 : 1st. DC SUPPLY
③VBB : BASE BIAS SUPPLY
④Vcc2 : 2nd. DC SUPPLY
⑤Po : RF OUTPUT
⑥GND : FIN

ABSOLUTE MAXIMUM RATINGS (Tc = 25℃ unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		17	V
V_{BB}	Base bias		10	V
I_{CC}	Total current		10	A
$P_{in(max)}$	Input power	$Z_G = Z_L = 50\ \Omega$	0.5	W
$P_{o(max)}$	Output power	$Z_G = Z_L = 50\ \Omega$	40	W
$T_{C(OP)}$	Operation case temperature		− 30 to 110	℃
T_{stg}	Storage temperature		− 40 to 110	℃

Note. Above parameters are guaranteed independently.

ELECTRICAL CHARACTERISTICS (Tc = 25℃ unless otherwise noted)

Symbol	Parameter	Test conditions	Limits		Unit
			Min	Max	
f	Frequency range	P_{in} = 0.3W V_{CC} = 12.5V V_{BB} = 9V $Z_G = Z_L = 50\ \Omega$	144	148	MHz
Po	Output power		37		W
η_T	Total efficiency		50		%
2fo	2nd. harmonic			− 25	dBc
3fo	3rd. harmonic			− 30	dBc
ρ_{in}	Input VSWR			2.2	−
−	Load VSWR tolerance	V_{CC} = 15.2V, V_{BB} = 9V Po = 30W (P_{in} : controlled) Load VSWR≧20:1 (All phase), 5sec. $Z_G = 50\ \Omega$	No degradation or destroy		−

Note. Above parameters, ratings, limits and conditions are subject to change.

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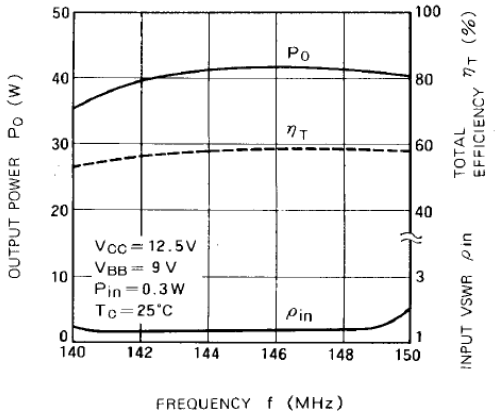
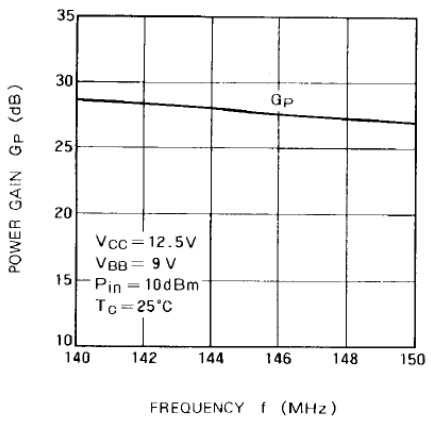
TYPICAL PERFORMANCE DATA

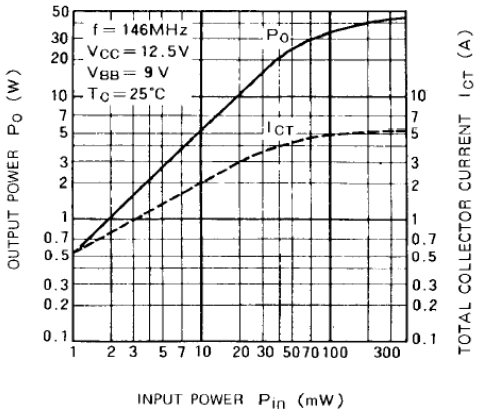
OUTPUT POWER, TOTAL EFFICIENCY, INPUT VSWR VS. FREQUENCY



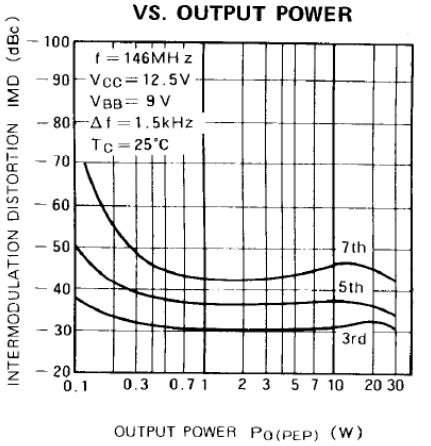
POWER GAIN VS. FREQUENCY



OUTPUT POWER, TOTAL COLLECTOR CURRENT VS. INPUT POWER



INTERMODULATION DISTORTION VS. OUTPUT POWER

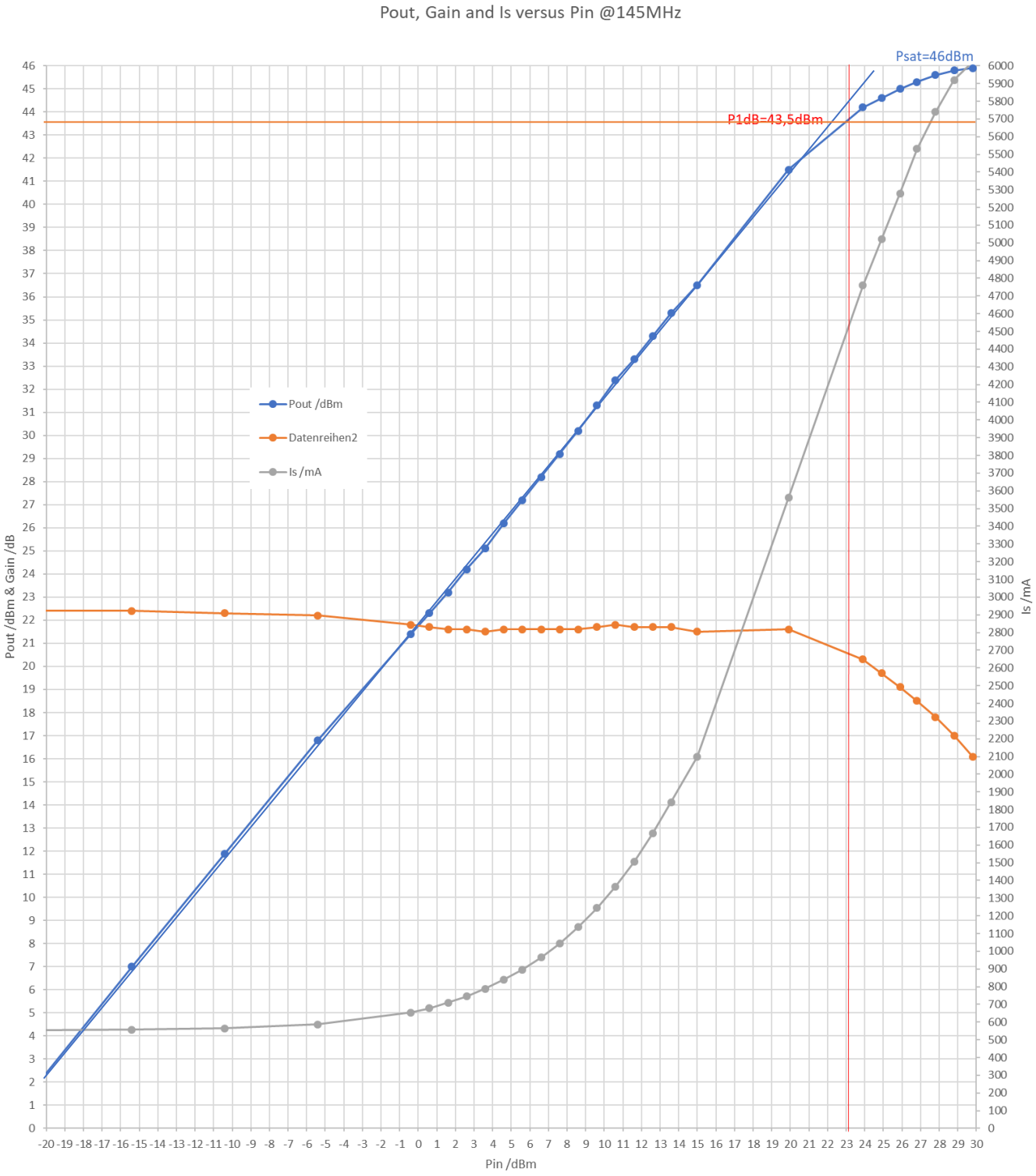


I measured the output power as a function of the drive level. I operated the PA at a supply voltage of 12.5V. The quiescent current is 540mA.

The small signal gain is 22.4dB dropping to a value of 21.7dB over a wide input power range before hitting the P1dB which is +43.5dBm or 22W. The drain efficiency at P1dB is approx..35%. Increasing the input power further and driving the amplifier into saturation increases the drain efficiency up to 52.6% at an output power of 46dBm or 40W.

I was surprised that the hybrid module seems to be perfectly ok meeting the specifications from Mitsubishi spot on.

Here are the measurement results:



I am always grateful to get feedback and will be happy to answer questions.

Please direct them to the Email address which you will find below.

Best regards

Matthias DD1US

Email: DD1US@AMSAT.ORG Homepage: http://www.dd1us.de