AR201249

ART2k0FE, 165 to 235 Mhz

v0.3 — 9 April 2021

Application Report

Document information	
Status	Company public
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Abstract	Measurement results of a Symmetric Ultra Wideband Doherty design with ART2k0FE for 165 to 235 Mhz

1. Revision History

Table 1: Report revisions

Revision	Date	Description	Author
0.3	20210409	Final version	Walter Sneijers

2. Contents

3. List of figures

4. List of tables

5. General description

This report presents the measurement results of the Symmetric Ultra Wideband Doherty demo AR201249. The device ART2k0FE used can deliver **225Wavg** DVB-T at 50V, in **A**dvanced **R**ugged **T**echnology (LDMOS) in a SOT539 package. The ART2k0 device can work at supply voltages up to 65V, in this application the standard supply voltage of 50V was used.
The ART2k0 upper section is used as Main amplifier, the lower section as Peak amplifier. The power ratio is 1:1 which provides optimum bandwidth. The presented demo was designed for the frequency band 165 to 235 Mhz (a relative bandwidth of 35%). The Doherty amplifier is built on TC350 pcb material. The output transformer is split in 2 sections: a 9:1 transformer with 11ohm coaxial cable and a 2.25:1 transformer with 25ohm coaxial cable.
The demo was designed for 185Wavg for best linearity and max. 225Wavg for best power/efficiency.

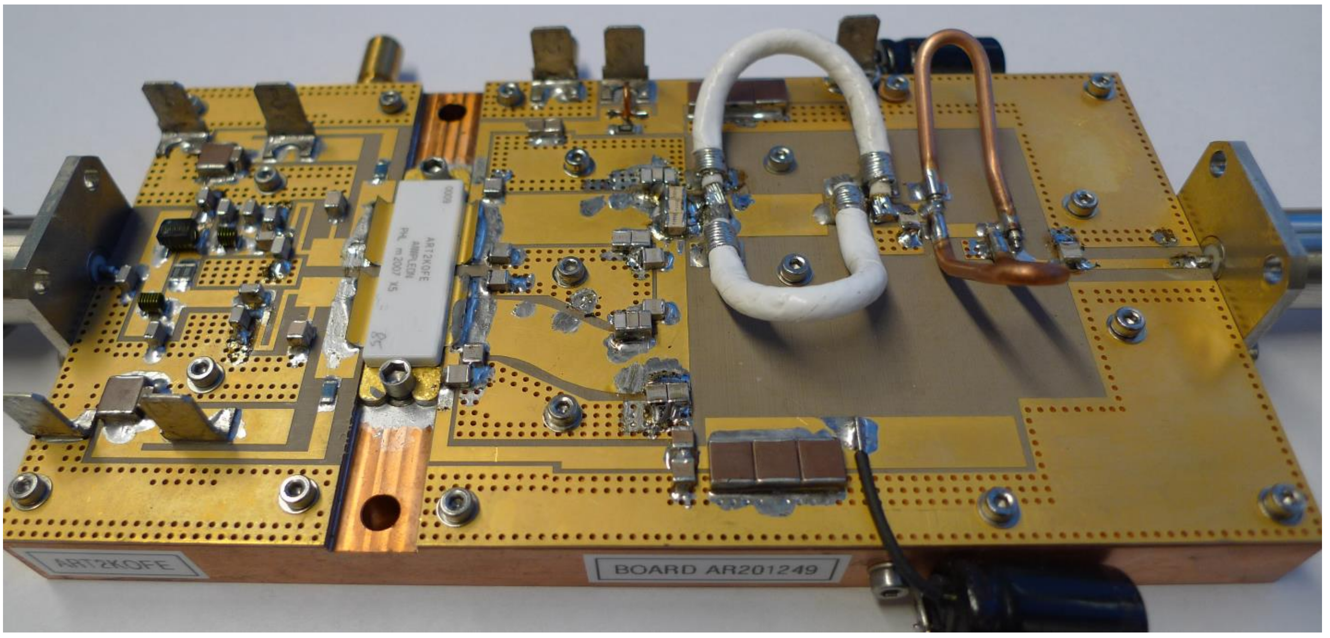

Figure 1 AR201249, 165-235Mhz demo board

6. Biasing and practical aspects

The efficiencies presented are based on the currents of the drain feeds only.
I.e. the biasing currents for the gate circuitry have not been included.
The biasing is as follows:

V_{DD_MAIN}	=	50V
V_{DD_PEAK}	=	50V
V_{GS_MAIN}	=	approx. 2V, leading to an I_{DQ_MAIN} = 200 - 600mA
V_{GS_PEAK}	=	0.7V (range 0.3 – 1 V, can vary dependent on frequency and device)

Main amplifier = upper section
Peak amplifier = lower section

The application is built on a standard copper heatsink and is water cooled. The actual design can be made on a smaller heatsink.
In the present application board the transistor is soldered and PCB's are bolted down. The best RF performance is achieved with a soldered transistor. Under the pcb (the area under the coupling capacitors C18 – 20) thermal compound is used to lower the component/pcb temperature. Another option (best) is to solder the (output) pcb.

Demo board designs:
AR201183 = prototype, 165-235 Mhz board (not final layout, layout version v1)
AR201249 = reference, 165-235 Mhz board (final layout, version v3)
AR201268 = 1st reproduction, 165-235 Mhz board (final layout, version v3)
AR201274 = 2nd reproduction, 165-235 Mhz board (final layout, version v3)
AR201278 = 3rd reproduction, 165-235 Mhz board (final layout, version v3)

Note:
1. The final PCB layout (version v3) is available (dxf files : ART2k0_50V_pcb_input _TC350_30mil_v3, ART2k0_50V_output_TC350_30mil_v3).

7. Performance Summary

Table 2: Performance summary, in band 165-235Mhz

Parameter	Condition-1	Condition-2	Unit	Pulsed CW	DVB-T
Power		Idq_m=0.6A Vgs_p=0.7V	W		185-225
Gain		Idq_m=0.6A Vgs_p=0.7V	dB		>18.5
Drain Efficiency		Idq_m=0.6A Vgs_p=0.7V	%		>45
P_{6dB}	100µs/10%	Idq_m=0.6A Vgs_p=0.7V	W	>1200	-
PAR output signal	CCDF0.01% 185Wavg	Idq_m=0.6A Vgs_p=0.7V	dB		> 7.5
PAR output signal	CCDF0.01% 225Wavg	Idq_m=0.6A Vgs_p=0.7V	dB		> 7
PAR output signal -c	Pre-corrected[1,2] CCDF0.01% 185Wavg	Idq_m=0.6A Vgs_p=0.7V	dB		> 8.5
PAR output signal -c	Pre-corrected[1,2] CCDF0.01% 225Wavg	Idq_m=0.6A Vgs_p=0.7V	dB		> 7.5
Shoulder distance[1,2,3]	185Wavg	Idq_m=0.6A Vgs_p=0.7V	dBc		< -40
	225Wavg	Idq_m=0.6A Vgs_p=0.7V	dBc		< -38
MER[1,2,3]	185Wavg	Idq_m=0.6A Vgs_p=0.7V	dBc		> 38
	225Wavg	Idq_m=0.6A Vgs_p=0.7V	dBc		> 35

Note 1: Input PAR DVB-T signal 9.5dB @ CCDF0.01%

Note 2: Pre-distorter: ProTelevision PT3000

Note 3: Shoulder distance ±4.3Mhz

The amplifier can deliver 185 - 225W average DVB-T power or pulsed CW 1200W (P6dB) over the whole bandwidth 165 - 235Mhz. Average power is dependent on linearity requirements.
All RF measurements were performed with a 300Mhz LPF coupled towards the power meter. This avoids harmonic content in the measured output power.
Note that the amplifier will not isolate mismatch impedances in the harmonic band.
PAR (ccdf) and shoulder measurements were done with R&S FSV spectrum analyser,
MER measurements were done with R&S ETL TV analyser.

Pre-correction:

The pre-corrected measurements were performed with a ProTelevision PT3000 exciter.
Idq/Vgs_p/Vdd settings can be optimised for each channel. Note that some VHF channels need more correction on AM-AM (and AM-PM) distortion, which can be influenced by Vgs_p.

Trade-off:

Vgs_p(eak) has a significant impact on efficiency. Best trade-off between (peak) power and efficiency was achieved at a Vgs_p of 0.7V. Different transistor batches can result in different Vgs settings dependent on transistor Vgs_threshold level.
In chapter 8.4-8.5 (pre-corrrected measurements) the optimum Vgs_p/channel is given for best trade-off (efficiency – linearity – gain): the lower channels need a Vgs_p ≈ 0.5V, where the higher channels need a Vgs_th ≈0.7V.
Idq_m can be varied between 0.2A and 0.6A, a lower Idq will result in slightly more peak power.
See also chapter 8.2.

8. Performance Details

The amplifier was measured with a DVB-T 8K signal (8Mhz signal bandwidth) and with a Pulsed CW signal. Normally, Vgs_peak is fixed at 0.7V and Idq_main at 0.6A. The measured freq range is 160 – 240Mhz.

8.1 DVB-T measurement (uncorrected), Pavg=185W, Vgs_p variation

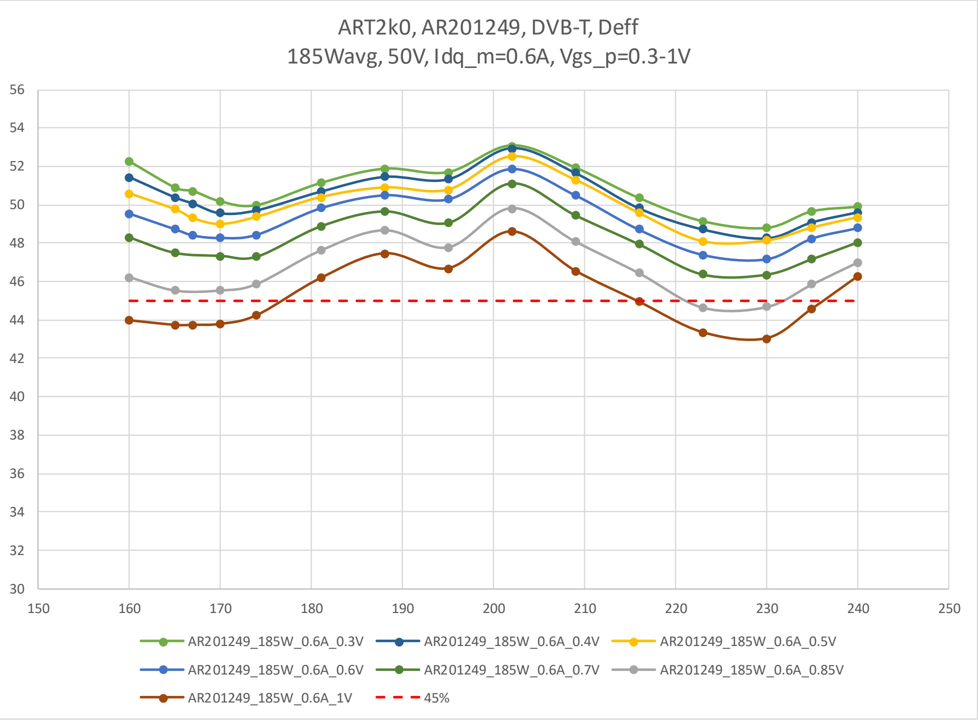

Figure 2 DVB-T, (Drain) efficiency [%] (uncorrected) Vgs_p = 0.3 – 1V

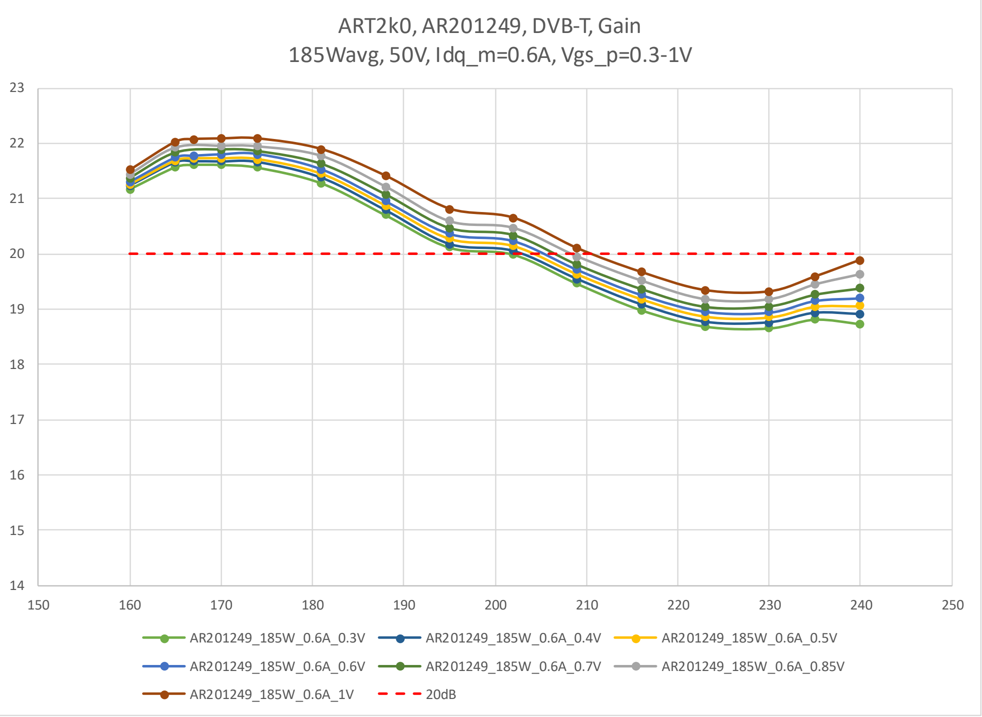

Figure 3 DVB-T, Gain [dB] (uncorrected) Vgs_p = 0.3 – 1V

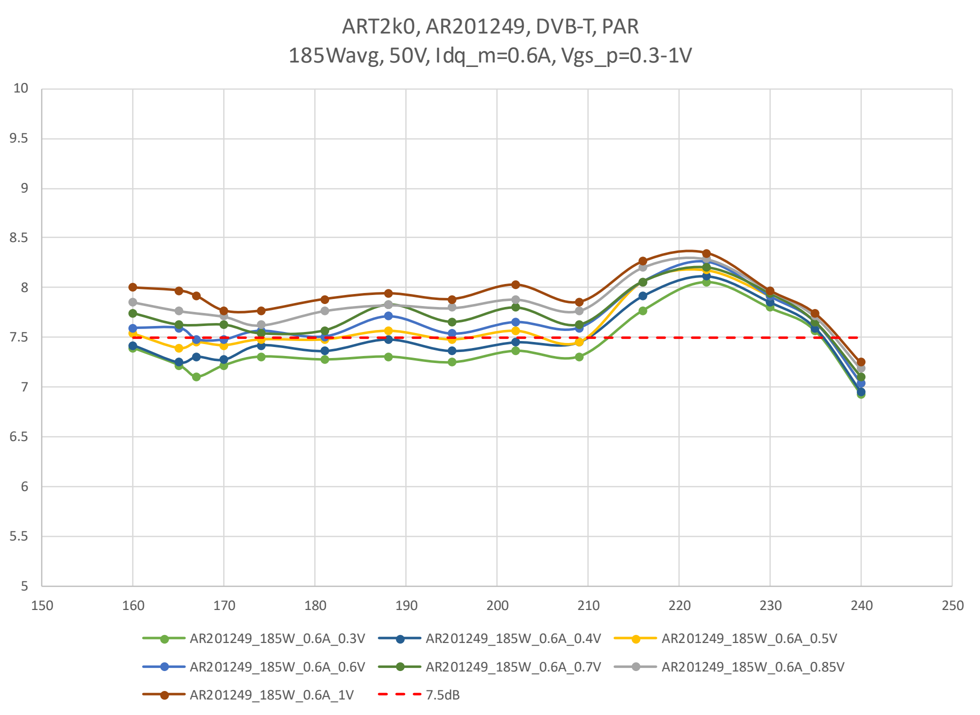

Figure 4 DVB-T, PAR [dB] (uncorrected) Vgs_p = 0.3 – 1V

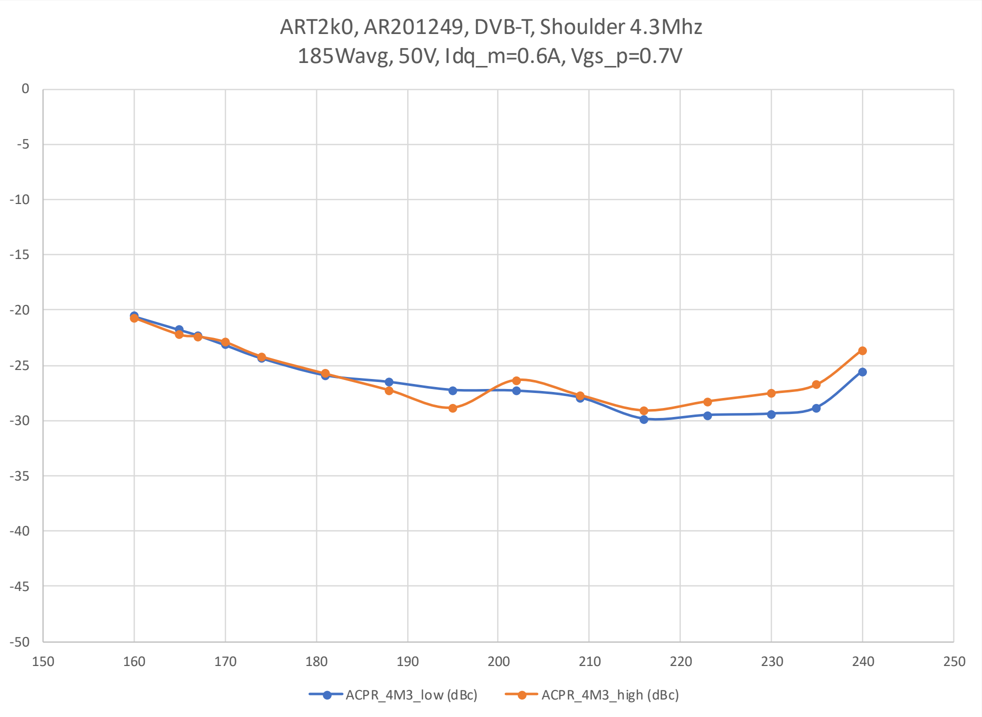

Figure 5 DVB-T, Shoulder [dB] (uncorrected) Vgs_p = 0.7V

8.2 DVB-T measurement (uncorrected), Pavg=185W, Idq variation

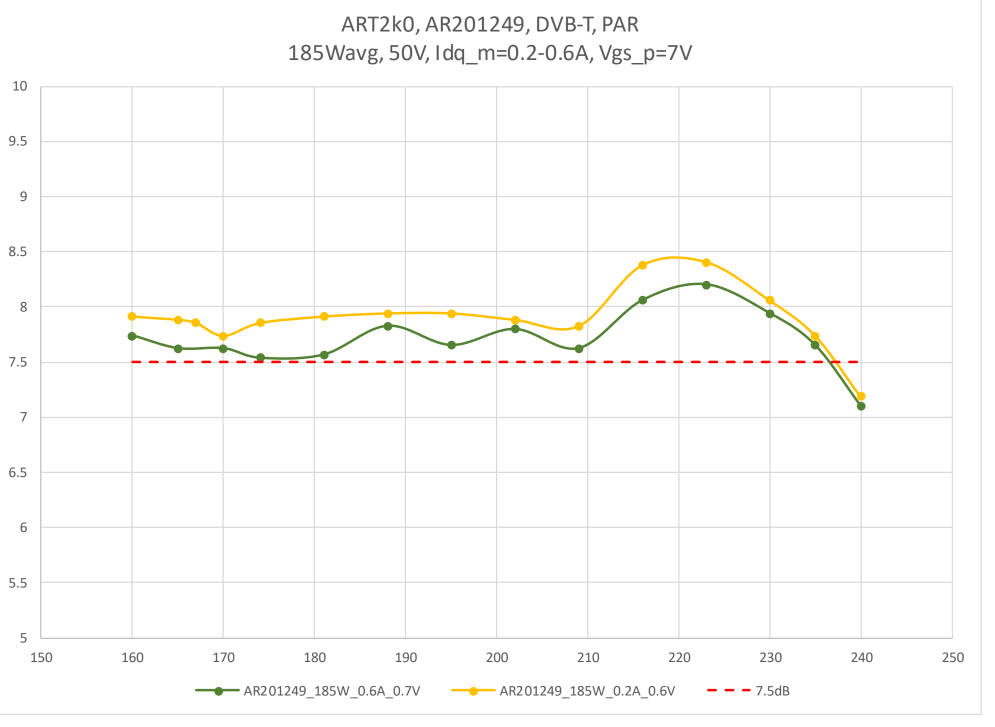

Figure 6 DVB-T, PAR [dB] (uncorrected) Idq = 0.2 – 0.6A

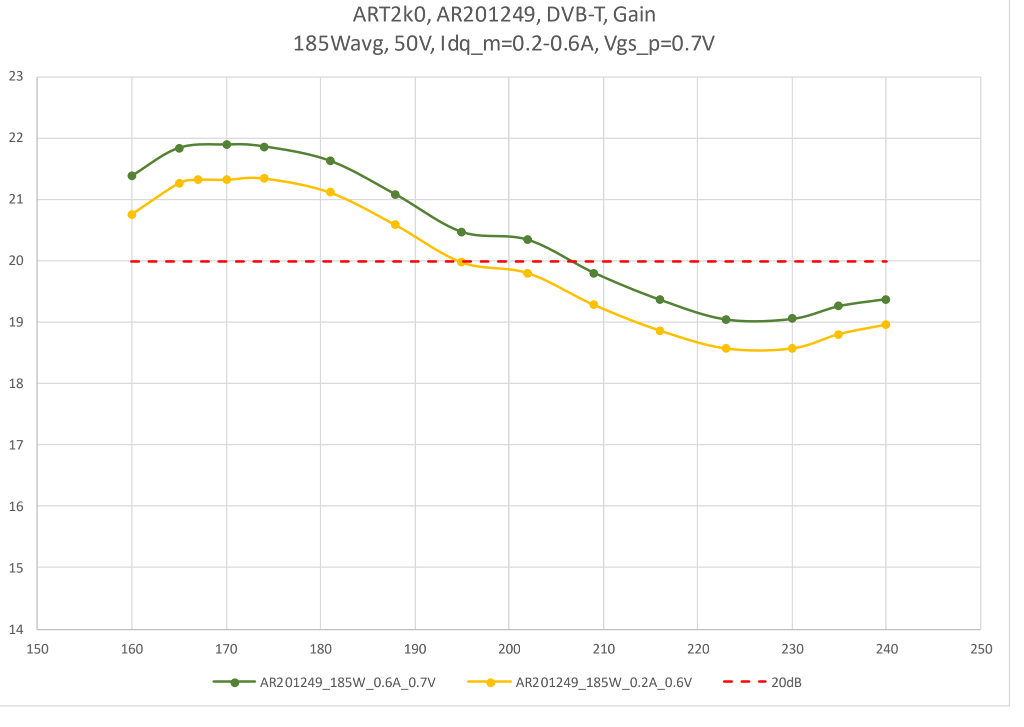

Figure 7 DVB-T, Gain [dB] (uncorrected) Idq = 0.2 – 0.6A

8.3 DVB-T measurement (uncorrected), Pavg =225W

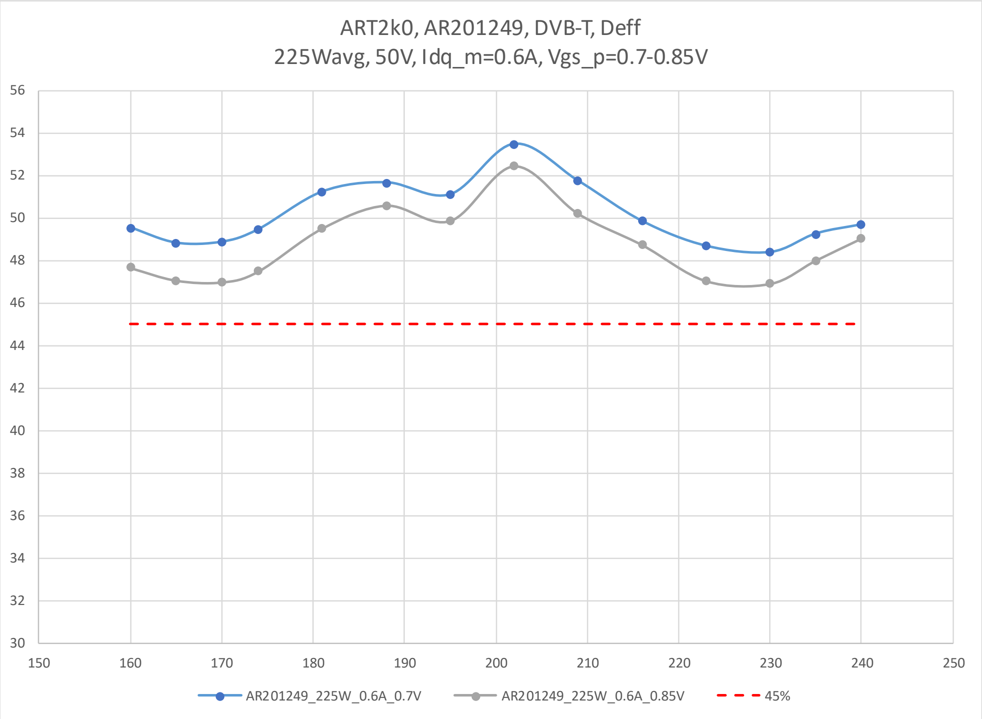

Figure 8 DVB-T, Deff [%] (uncorrected) Vgs_p = 0.7 – 85V

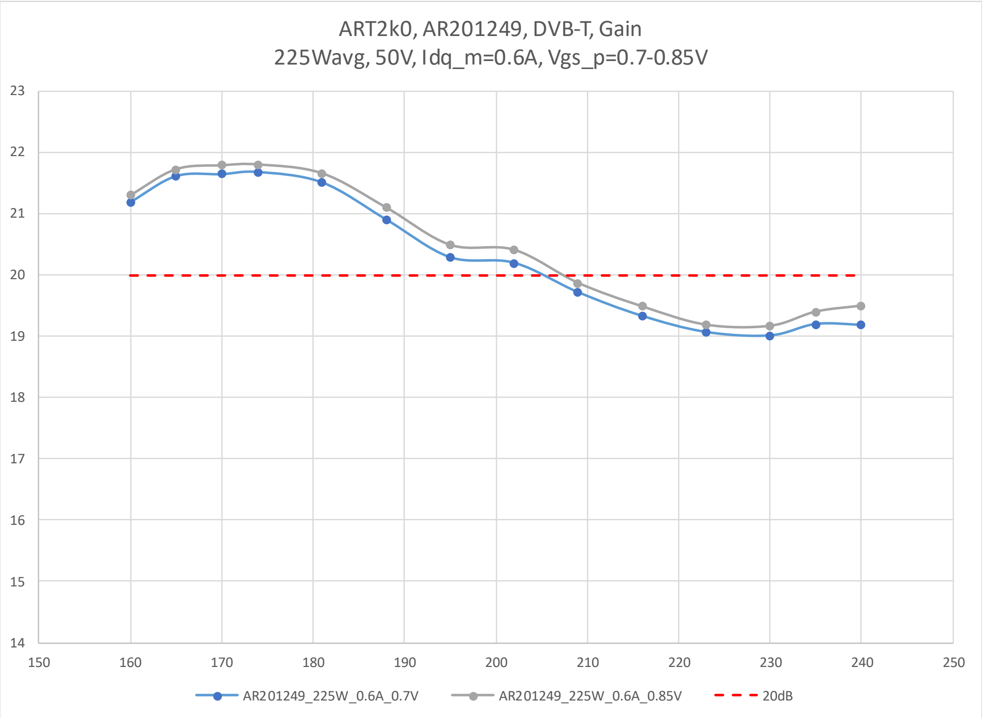

Figure 9 DVB-T, Gain [dB] (uncorrected) Vgs_p = 0.7 – 85V

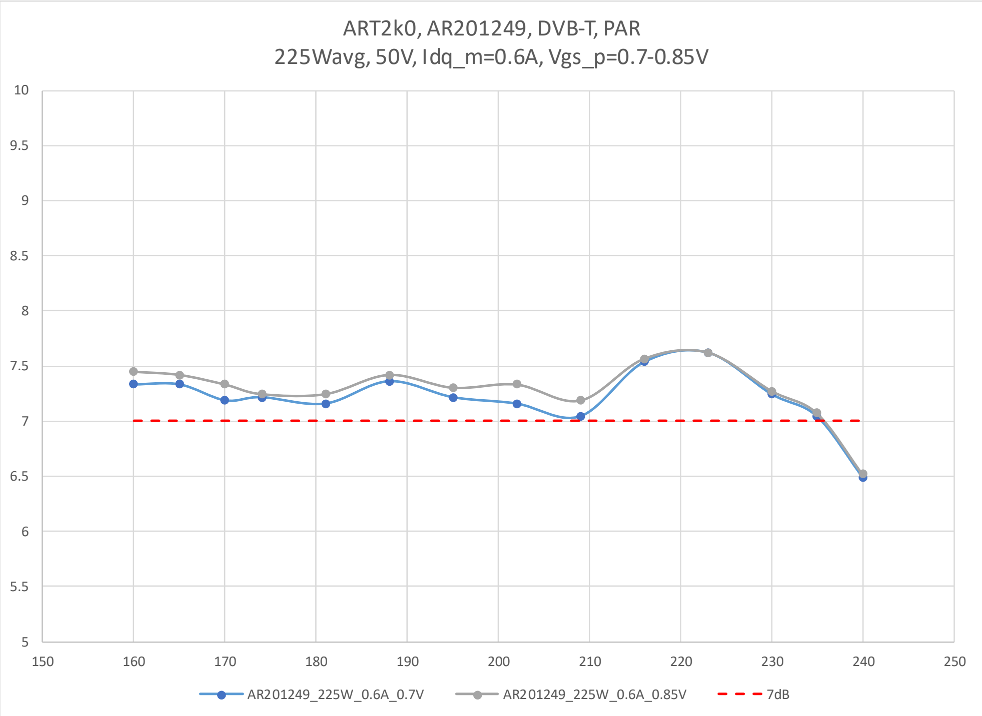

Figure 10 DVB-T, PAR [dB] (uncorrected) Vgs_p = 0.7 – 85V

8.4 DVB-T measurements (corrected), Pavg=185W

Pre-corrected data (ProTelevision PT3000).
The measured freq range is 167 – 230Mhz.
The data of AR201249 and AR201268 (1st reproduction) is given in the tables and compared in the graphs below. Note that the data of AR201249 is recorded with fixed Vgs_p/channel where AR201268 is recorded with optimum Vgs_p settings/channel ! the efficiency of AR201249 can be improved further with a lower Vgs_p @ lower VHF channels.

AR201249, Pavg=185W, corrected measurement ProTelevision PT3000

Freq	V1 (V)	Idq_m	Vgs_peak	Pavg	Id1 (A)	Pout (dBm)	Ppeak (dBm	PAR (dB)_A	Ppeak [W]_	Gain (dB)_A	Eff (%)_AR2	_PAE (%)	Pdc (W)	MER (dB)_A	M3 (dBc)_AR	ACPR4M3 (	ACPR4M3L
167	49.73439	0.6	0.7	**186.1363**	8.017286	52.69831	61.62585	8.927536	1454.068	21.56748	46.68297	46.35757	398.7242	40	-43.1625	-43.1625	-44.7728
170	49.97565	0.6	0.7	**185.8502**	8.030918	52.69163	61.67714	8.985507	1471.343	21.59085	46.30159	45.98059	401.3906	39.1	-42.7239	-42.7239	-43.8235
174	49.75977	0.6	0.7	**183.2682**	7.880237	52.63087	61.44247	8.811594	1393.948	21.60742	46.73728	46.41449	392.1242	40	-44.2691	-44.4483	-44.2691
181	50.00299	0.6	0.7	**186.1131**	7.72595	52.69777	61.27748	8.57971	1341.986	21.43939	48.16875	47.82294	386.3773	40	-43.2374	-44.6423	-43.2374
188	49.79058	0.6	0.7	**185.0137**	7.565767	52.67204	61.51262	8.84058	1416.648	20.88212	49.11079	48.70995	376.7272	40	-41.6384	-43.7073	-41.6384
195	49.7821	0.6	0.7	**186.4262**	7.691176	52.70507	61.37174	8.666667	1371.43	20.23003	48.68536	48.22362	382.9205	38.6	-41.7086	-41.7086	-41.7316
202	49.81314	0.6	0.7	**185.398**	7.365479	52.68105	61.31873	8.637681	1354.793	20.13696	50.52462	50.03506	366.9458	40.3	-44.236	-44.5117	-44.236
209	49.79827	0.6	0.7	**185.9598**	7.605576	52.69419	61.12897	8.434783	1296.873	19.58286	49.0915	48.55109	378.8025	38.9	-42.3904	-42.4924	-42.3904
216	49.98144	0.6	0.7	**185.3511**	7.806917	52.67995	61.49155	8.811594	1409.79	19.24677	47.5018	46.93682	390.198	40	-42.2336	-42.3113	-42.2336
223	49.96774	0.6	0.7	**185.2298**	8.061748	52.67711	61.2858	8.608696	1344.561	18.94657	45.97978	45.39376	402.8506	39.6	-42.5896	-42.5896	-43.3574
230	49.95885	0.6	0.7	**186.1702**	8.14655	52.6991	61.04693	8.347826	1272.602	18.88725	45.73704	45.1461	407.0446	38.7	-42.3563	-42.3563	-42.9877

Table 3: AR201249, Pre-corr data 167-230 Pavg=185W,Vgs_p=0.7V

AR201268, corrected measurement ProTelevision PT3000

Freq	V1 (V)	Idq_m	Vgs_peak	Pavg	Id1 (A)	Pout (dBm)	Ppeak (dBm	PAR (dB)_A	Ppeak [W]_	Gain (dB)_A	Eff (%)_AR2	_PAE (%)	Pdc (W)	MER (dB)_A	M3 (dBc)_AR	ACPR4M3 (	ACPR4M3L
167	49.71727	0.6	0.4	186.1937	7.983212	52.69965	61.65617	8.956522	1464.257	21.16723	46.91218	46.55362	396.8984	39.3	-42.7183	-43.4946	-42.7183
170	49.99632	0.6	0.4	185.896	7.869019	52.6927	61.62024	8.927536	1452.19	21.36009	47.24961	46.90415	393.4339	40	-44.0652	-44.7285	-44.0652
174	50.00295	0.6	0.5	184.2434	7.714273	52.65392	61.37856	8.724638	1373.586	21.63354	47.76214	47.43425	385.752	40.5	-44.0685	-44.8352	-44.0685
181	50.0177	0.6	0.5	185.142	7.548638	52.67505	61.42867	8.753623	1389.528	21.38119	49.0366	48.67982	377.5587	40.2	-44.0253	-44.446	-44.0253
188	50.00717	0.6	0.7	186.1379	7.695161	52.69835	61.65487	8.956522	1463.818	20.91277	48.37441	47.98236	384.786	38.6	-40.2966	-43.5123	-40.2966
195	49.98956	0.6	0.7	185.7835	7.775054	52.69007	61.4437	8.753623	1394.342	20.20261	47.79084	47.33472	388.7429	38.7	-41.1778	-41.7051	-41.1778
202	50.0292	0.6	0.7	185.0226	7.326437	52.67225	61.19399	8.521739	1316.433	20.11665	50.48166	49.99022	366.5146	40	-43.4584	-43.4584	-43.7127
209	50.00708	0.6	0.7	185.2466	7.483041	52.6775	61.17026	8.492754	1309.259	19.63634	49.49589	48.9577	374.2665	38.9	-42.2275	-42.2275	-42.6965
216	50.0033	0.6	0.7	185.5167	7.72651	52.68383	61.52441	8.84058	1420.499	19.22968	48.01881	47.44543	386.3417	39.6	-42.207	-42.207	-42.3116
223	49.92037	0.6	0.7	185.8764	7.959877	52.69224	61.56181	8.869565	1432.784	18.91084	46.77113	46.1701	397.4169	40	-43.1293	-43.1293	-43.4146
230	49.94661	0.6	0.7	185.5757	8.044523	52.68521	61.20695	8.521739	1320.368	18.84835	46.17947	45.57745	401.8575	39.8	-42.6889	-42.6889	-43.1098

Table 4: AR201268, Pre-corr data 167-230 Pavg=185W,Vgs_p=0.4-0.7V

The tables show the pre-corrected measurements at 185Wavg. A minimum MER of 38.5dB with a shoulder distance below 40dBc was achieved over the band 167-230Mhz. The *minimum* (drain) efficiency in the band is 45.5%.

The graphs below gives a comparison between AR201249 and AR201268. Note that AR201249 was measured with fixed Vgs_p (=0.7V) and AR201268 was measured with optimum Vgs_p (0.4-0.7V).

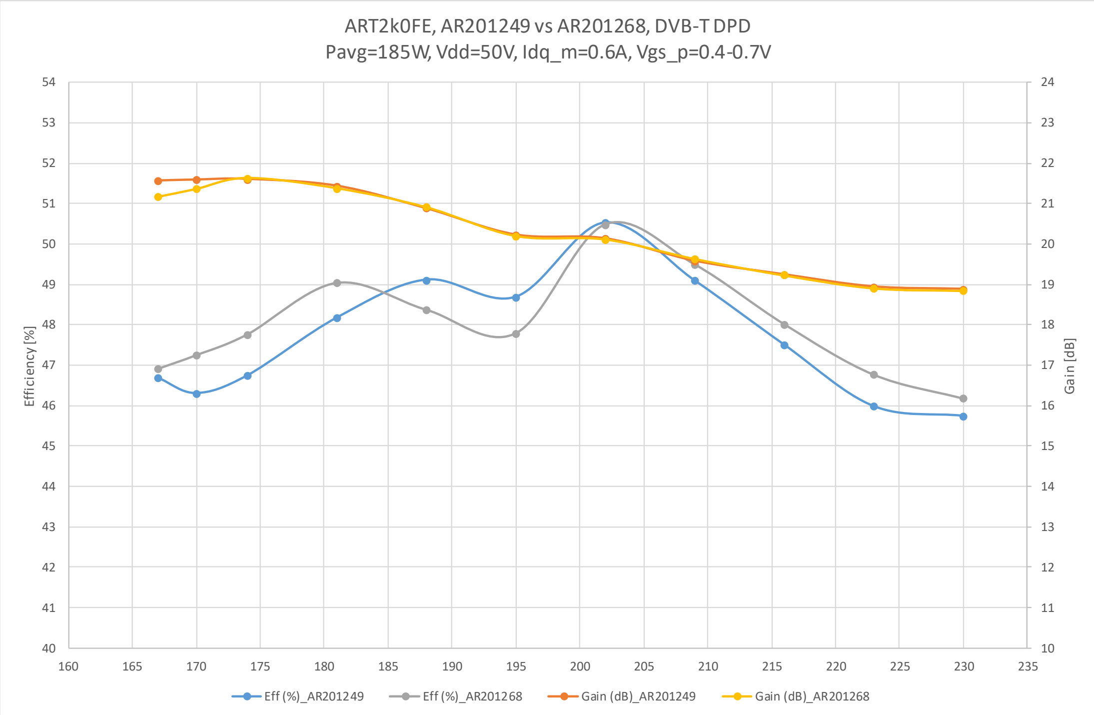

Figure 11 DVB-T, Deff + Gain (corrected) Pavg=185W

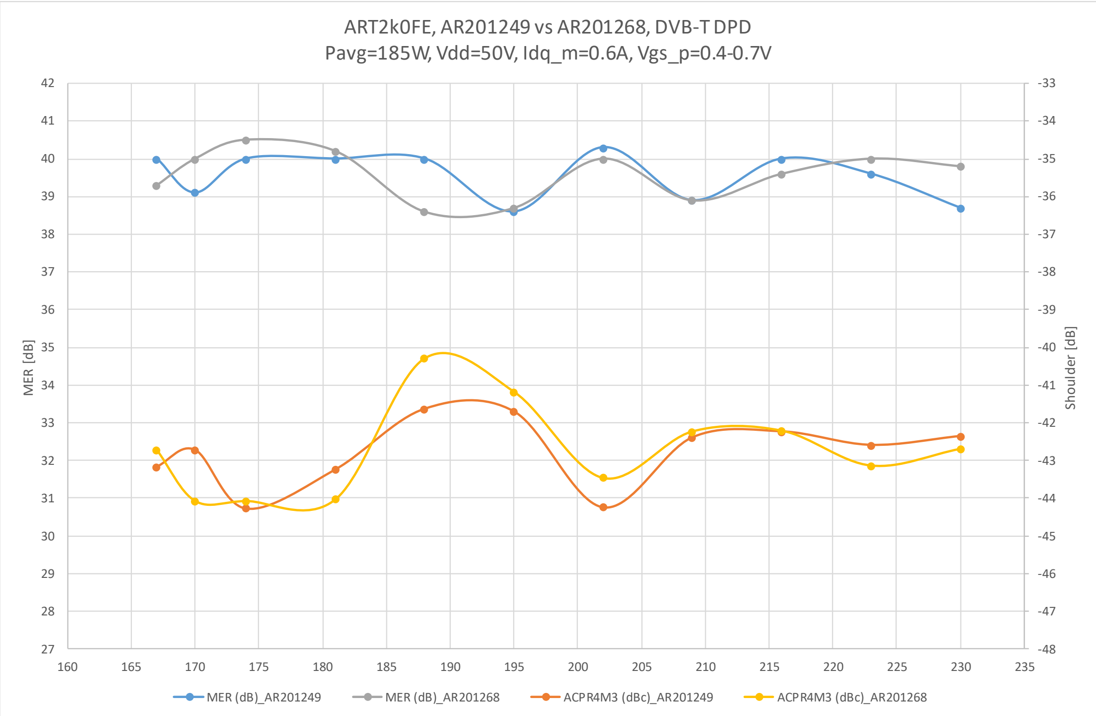

Figure 12 DVB-T, MER + Shoulder (corrected) Pavg=185W

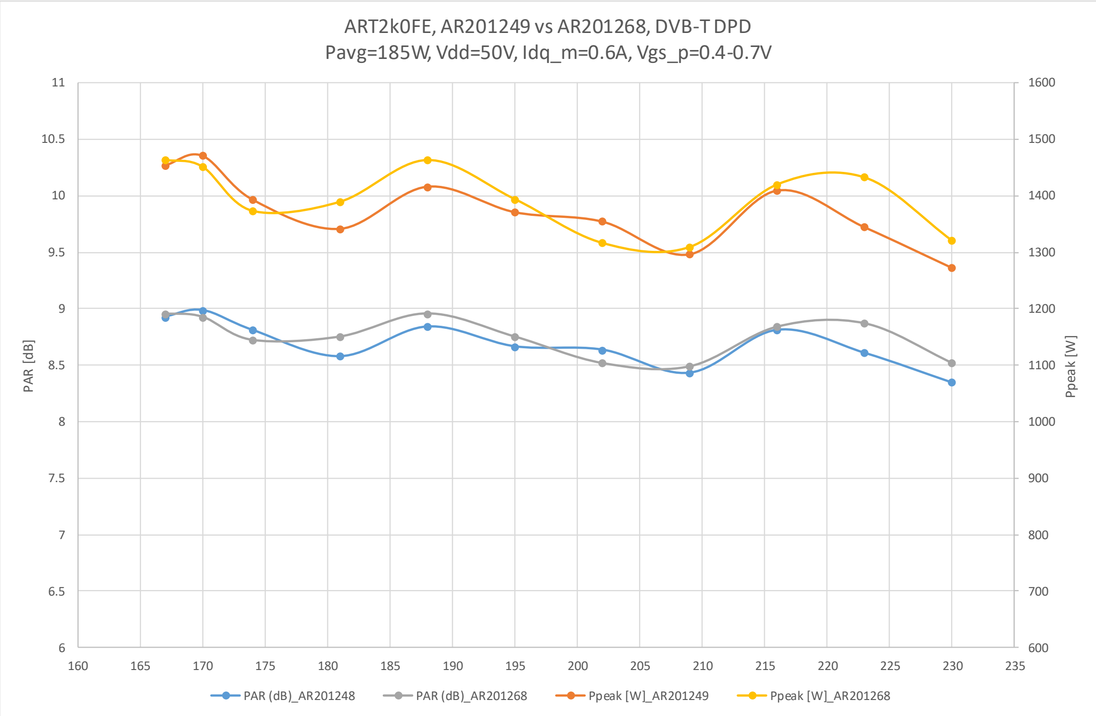

Figure 13 DVB-T, PAR + Ppeak (corrected) Pavg=185W

8.5 DVB-T measurements (corrected), Pavg=225W

AR201249, Pavg =225W, corrected measurement ProTelevision PT3000																	
Freq	V1 (V)	Idq_m	Vgs_peak	Pavg	Id1 (A)	Pout (dBm)	Ppeak (dBn	PAR (dB)_A	Ppeak [W]_	Gain (dB)_A	Eff (%)_AR2	_PAE (%)	Pdc (W)	MER (dB)_A	M3 (dBc)_AR	ACPR4M3 (	ACPR4M3L
167	49.62988	0.6	0.7	**225.6685**	9.415524	53.53471	61.59268	8.057971	1443.006	21.24343	48.29405	47.93135	467.2802	36.2	-39.2731	-39.2731	-39.5388
170	49.86975	0.6	0.7	**225.9784**	9.416302	53.54067	61.71458	8.173913	1484.083	21.26235	48.11911	47.75929	469.6229	36.2	-39.5943	-39.5943	-40.5562
174	49.65076	0.6	0.7	**226.2065**	9.295802	53.54505	61.77694	8.231884	1505.544	21.28456	49.00934	48.64474	461.558	36.7	-40.8542	-40.8542	-41.1973
181	49.90506	0.6	0.7	**225.9899**	8.99286	53.54089	61.48292	7.942029	1406.993	21.14229	50.35202	49.96495	448.8198	36.1	-39.8233	-39.851	-39.8233
188	49.69376	0.6	0.7	**225.2293**	8.832678	53.52625	61.6132	8.086957	1449.842	20.62104	51.31009	50.86536	438.9572	36.4	-40.5226	-40.8003	-40.5226
195	49.68739	0.6	0.7	**225.3658**	8.92876	53.52888	61.47091	7.942029	1403.108	19.95746	50.79346	50.28052	443.6907	35.6	-38.7401	-38.7401	-38.9777
202	49.72314	0.6	0.7	**224.7745**	8.535821	53.51747	61.51747	8	1418.232	19.89952	52.95245	52.41053	424.4837	36.6	-39.8094	-39.8094	-40.0565
209	49.90598	0.6	0.7	**225.1346**	8.810503	53.52442	61.23457	7.710145	1328.791	19.34907	51.19617	50.60142	439.7489	35.2	-37.6638	-37.6638	-38.9982
216	49.88091	0.6	0.7	**225.4302**	9.077238	53.53012	61.38519	7.855072	1375.686	19.15892	49.78783	49.18356	452.7817	36.5	-39.0293	-39.0293	-40.8065
223	49.86501	0.6	0.7	**225.8484**	9.360664	53.53817	61.30629	7.768116	1350.917	18.88096	48.38249	47.75646	466.7978	35.6	-38.9192	-38.9192	-39.807
230	49.86816	0.6	0.7	**223.3418**	9.323573	53.4897	61.0839	7.594203	1283.484	18.80623	48.03257	47.40029	464.9799	34.5	-38.0283	-38.1325	-38.0283

Table 5: AR201249, Pre-corr data 167-230 Pavg=225W,Vgs_p=0.7V

AR201268, corrected measurement ProTelevision PT3000																	
Freq	V1 (V)	Idq_m	Vgs_peak	Pavg	Id1 (A)	Pout (dBm)	Ppeak (dBn	PAR (dB)_A	Ppeak [W]_	Gain (dB)_A	Eff (%)_AR2	_PAE (%)	Pdc (W)	MER (dB)_A	M3 (dBc)_AR	ACPR4M3 (	ACPR4M3L
167	49.61401	0.6	0.4	225.7907	9.378389	53.53706	61.73996	8.202899	1492.78	20.78129	48.52593	48.12057	465.299	36.7	-39.3666	-39.9735	-39.3666
170	49.88368	0.6	0.5	225.682	9.284564	53.53497	61.76685	8.231884	1502.053	21.12604	48.72747	48.35148	463.1515	37.2	-40.4208	-40.5664	-40.4208
174	49.90683	0.6	0.5	224.8666	9.003001	53.51925	61.89606	8.376812	1547.412	21.27828	50.04579	49.67293	449.3217	37.7	-41.7927	-42.0031	-41.7927
181	49.92482	0.6	0.5	225.3595	8.778287	53.52876	61.58673	8.057971	1441.03	21.03691	51.42276	51.01775	438.2486	36.5	-39.648	-39.648	-40.0793
188	49.91017	0.6	0.7	225.5708	8.969971	53.53283	61.73573	8.202899	1491.327	20.62665	50.38842	49.95224	447.6641	36	-39.1304	-40.6019	-39.1304
195	49.88922	0.6	0.7	226.2872	9.095118	53.5466	61.51762	7.971014	1418.278	19.90921	49.86435	49.35517	453.8056	35.9	-38.8148	-39.4142	-38.8148
202	49.93898	0.6	0.7	225.0573	8.510514	53.52293	61.32003	7.797101	1355.199	19.78087	52.95503	52.39807	424.9969	35.7	-38.6744	-38.6744	-39.0807
209	49.91353	0.6	0.7	225.3077	8.722874	53.52776	61.2379	7.710145	1329.813	19.37213	51.74025	51.14237	435.4591	35	-37.501	-37.501	-38.0514
216	49.90262	0.6	0.7	226.5249	9.016924	53.55116	61.52217	7.971014	1419.768	19.09927	50.34377	49.7243	449.9561	36.8	-39.6677	-39.6677	-40.8586
223	49.84307	0.6	0.7	228.4742	9.314992	53.58837	61.5304	7.942029	1422.46	18.83497	49.20327	48.55984	464.3476	36.3	-39.8238	-39.8238	-40.7668
230	49.85252	0.6	0.7	225.7018	9.330762	53.53535	61.27448	7.73913	1341.06	18.75975	48.5155	47.86998	465.216	35.3	-38.419	-38.419	-39.13

Table 6: AR201268, Pre-corr data 167-230 Pavg=225W,Vgs_p=0.4-0.7V

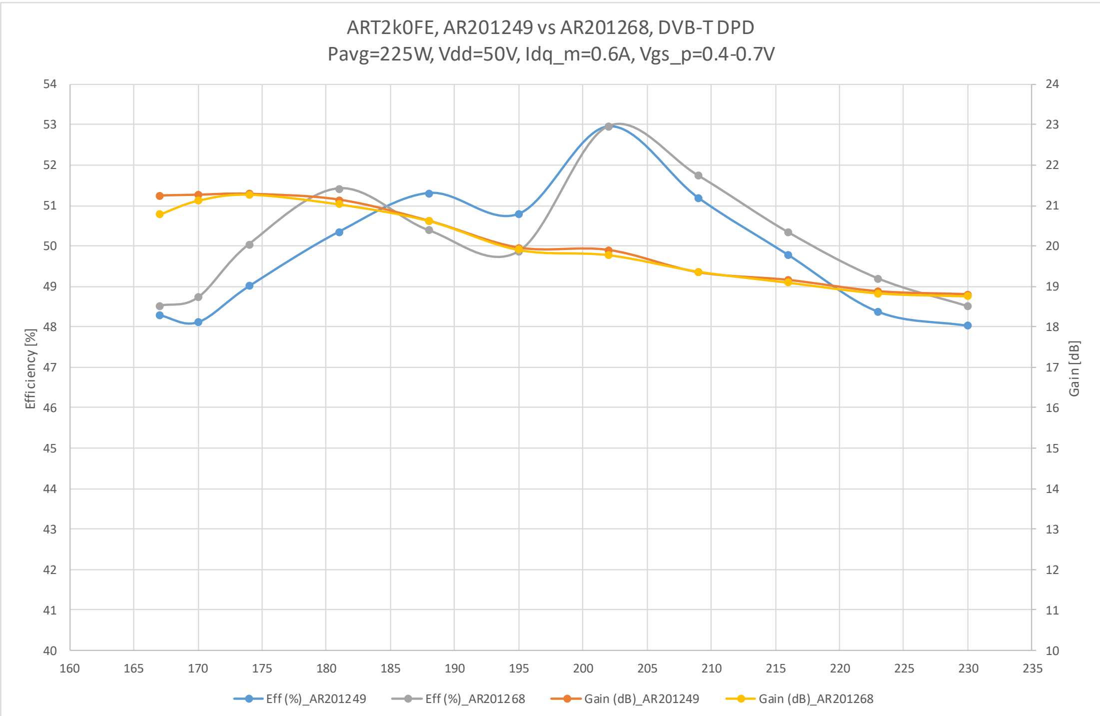

Figure 14 DVB-T, Deff + Gain (corrected) Pavg=225W

The graphs give a comparison between AR201249 and AR201268. Note that AR201249 was measured with fixed Vgs_p (=0.7V) and AR201268 was measured with optimum Vgs_p (0.4-0.7V).

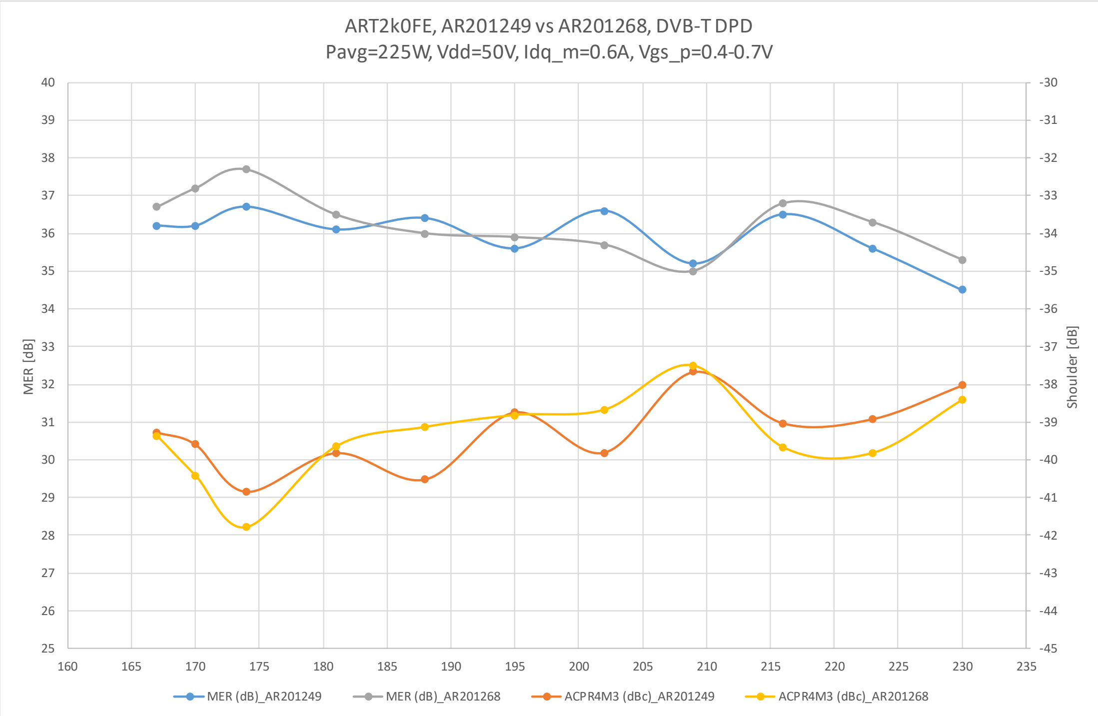

Figure 15 DVB-T, MER + Shoulder (corrected) Pavg=225W

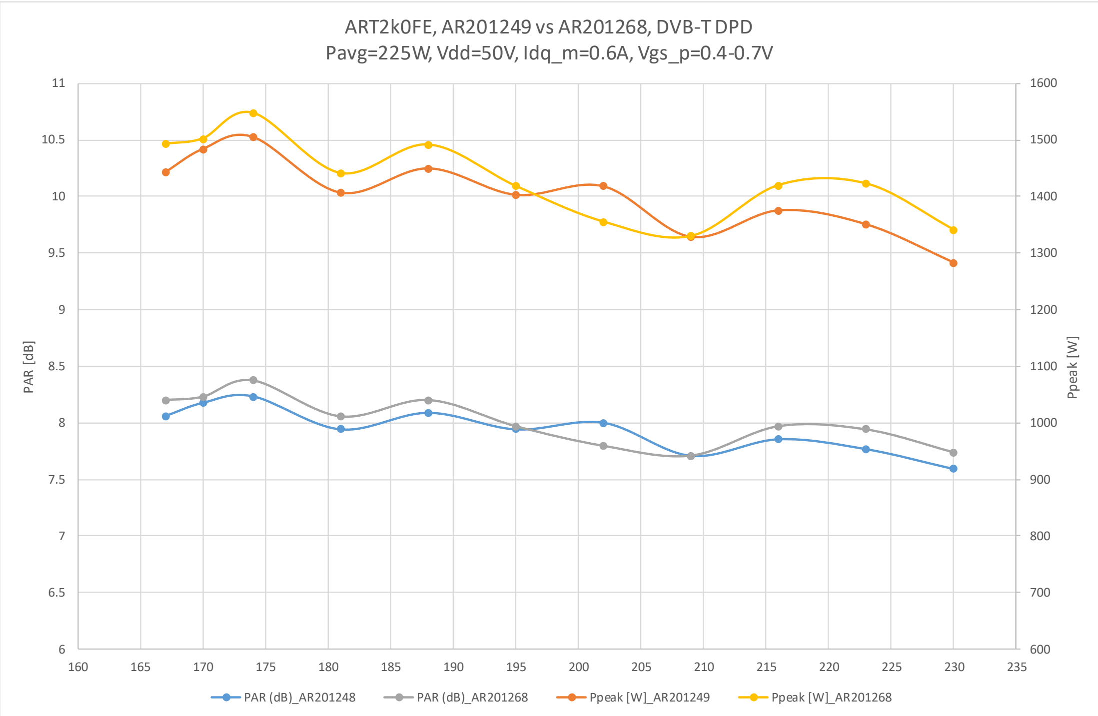

Figure 16 DVB-T, PAR + Ppeak (corrected) Pavg=225W

8.6 Thermal measurement (IR)

The temperature of the most critical components (coupling capacitor C18 – C20) is recorded during the DPD measurements.
IR scans at 230 and 170Mhz:

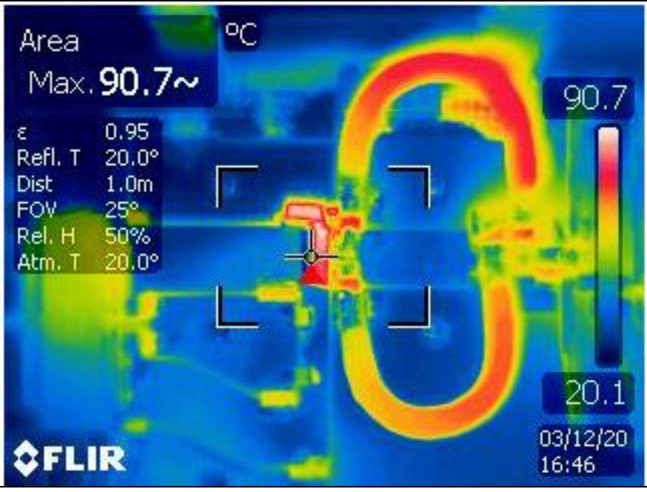	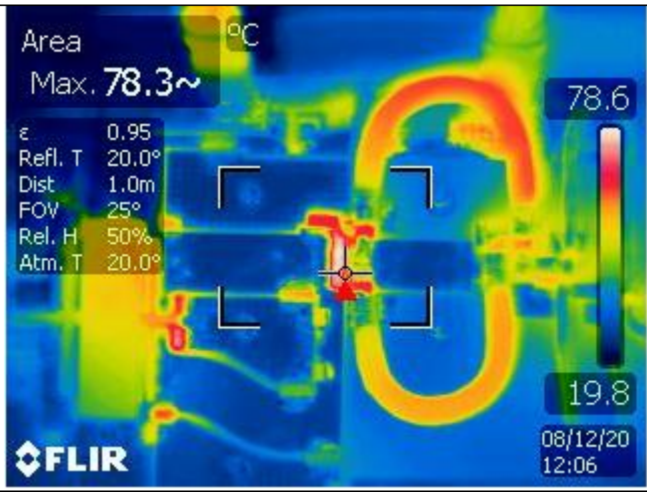
AR201268 Pavg=225W, Freq = 230Mhz	AR201268 Pavg=225W, Freq = 170Mhz

Table 7: IR scans output pcb

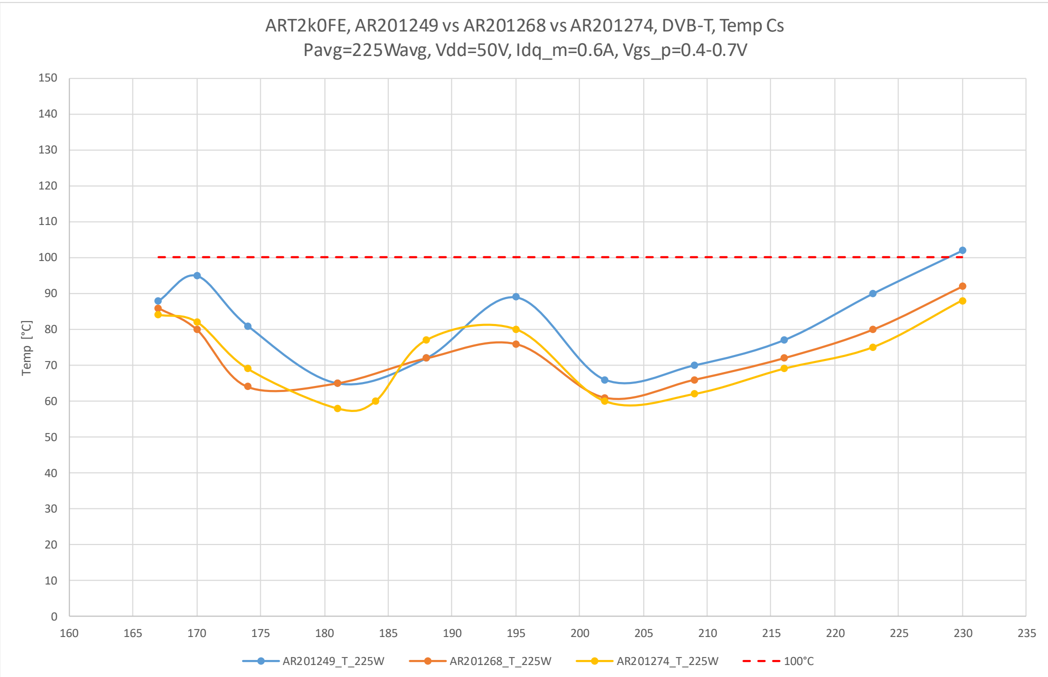

Figure 17 AR2012XX Temperature of C18-20 @225Wavg DVB-T

The temperature was measured over the full freq range at 225Wavg. The maximum was reached at 230Mhz and is approx. 90°. The temperature of AR201268/AR201274 was approx. 10° lower than AR201249 due to:

- better thermal compound spread under the pcb in area of C18-20 (note also the screw holes to press down the pcb in this area).
- slightly more distance between C7 and C18-20, therefore a better solder joint of these capacitors.

Note: the temperature of C18-20 can be decreased further if the pcb is soldered.
A different (higher) Vgs_p can lead to an increase of the C18-20 temperature, especially at the lower VHF channels (below 180Mhz).

8.7 Pulsed CW measurements over frequency

Pulse condition: 100µs/10%. P6dB gives the best indication of the peak power capability.

Required P6dB for 185Wavg DVBT (to achieve a MER of 40dB) is approx. 1200W.

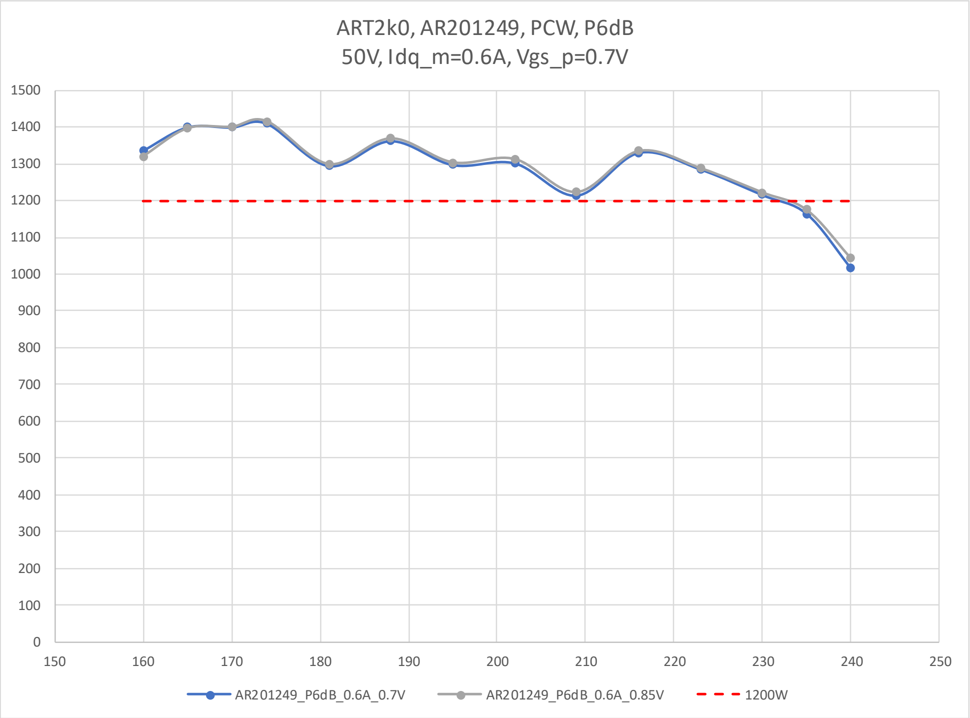

Figure 18 Pulsed CW, P6dB [W] Vgs_p=0.7-0.85V

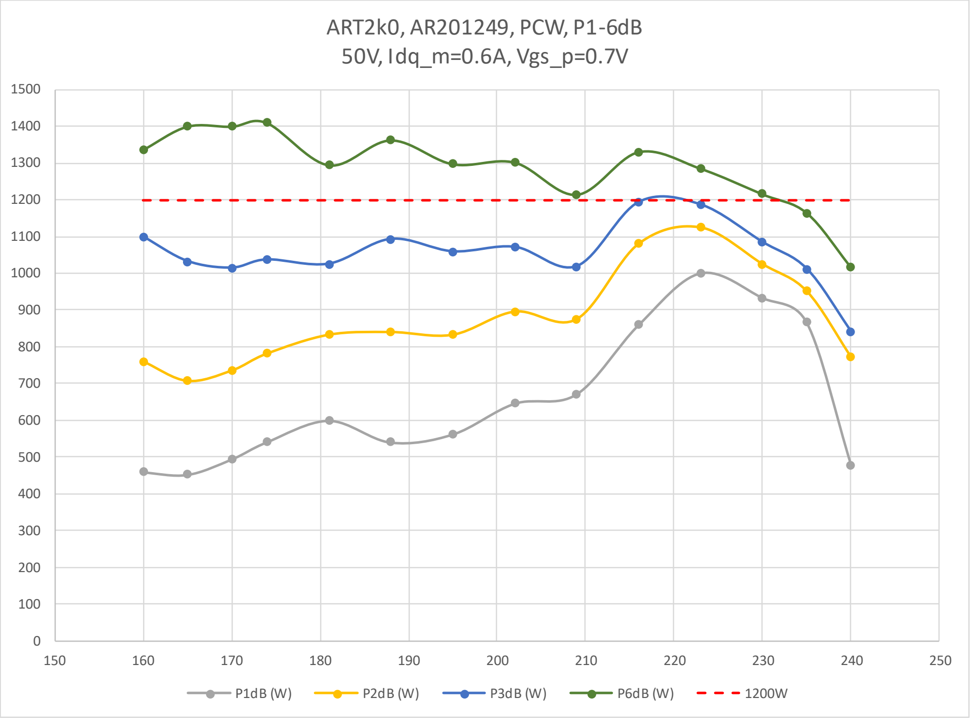

Figure 19 Pulsed CW, P1-6dB [W] Vgs_p=0.7V

8.8 Pulsed CW power sweeps

Pulse condition: 100µs/10%.

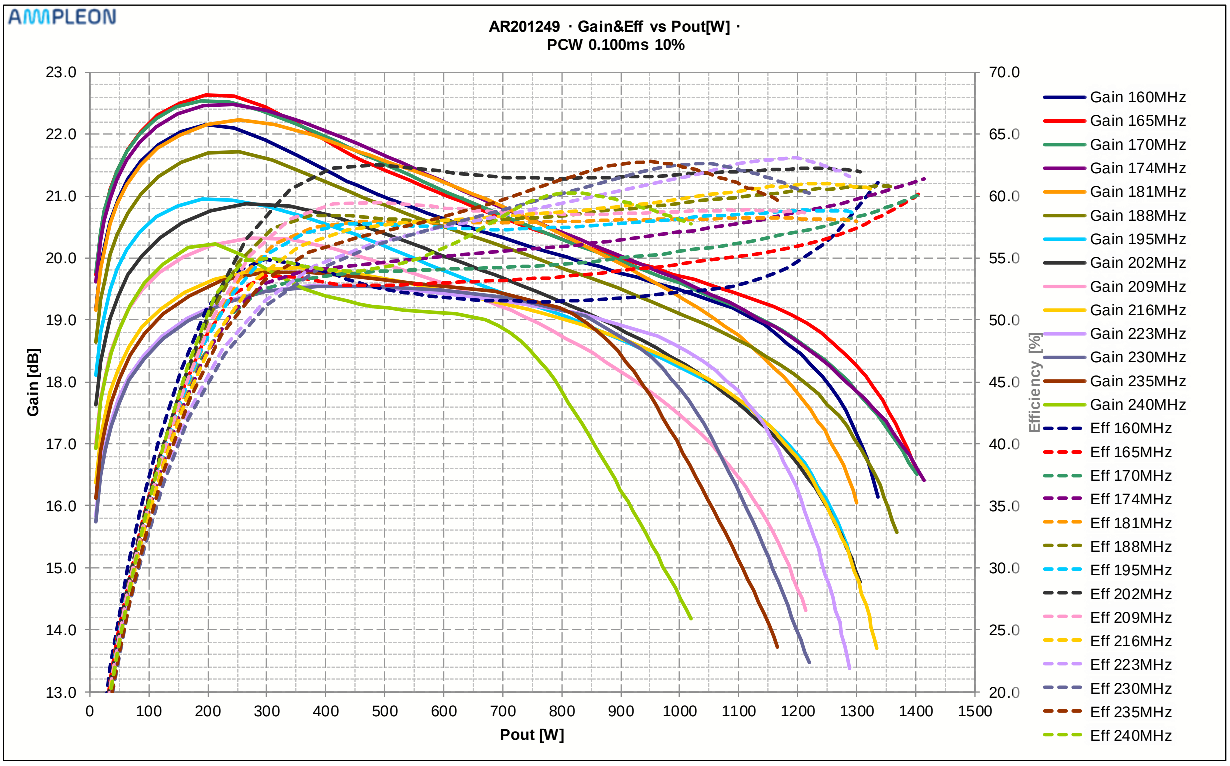

Figure 20 Pulsed CW, Gain [dB] + Deff [%] as function of Pout [W] Vdd=50V, Idq_m=0.6A, Vgs_p=0.7V

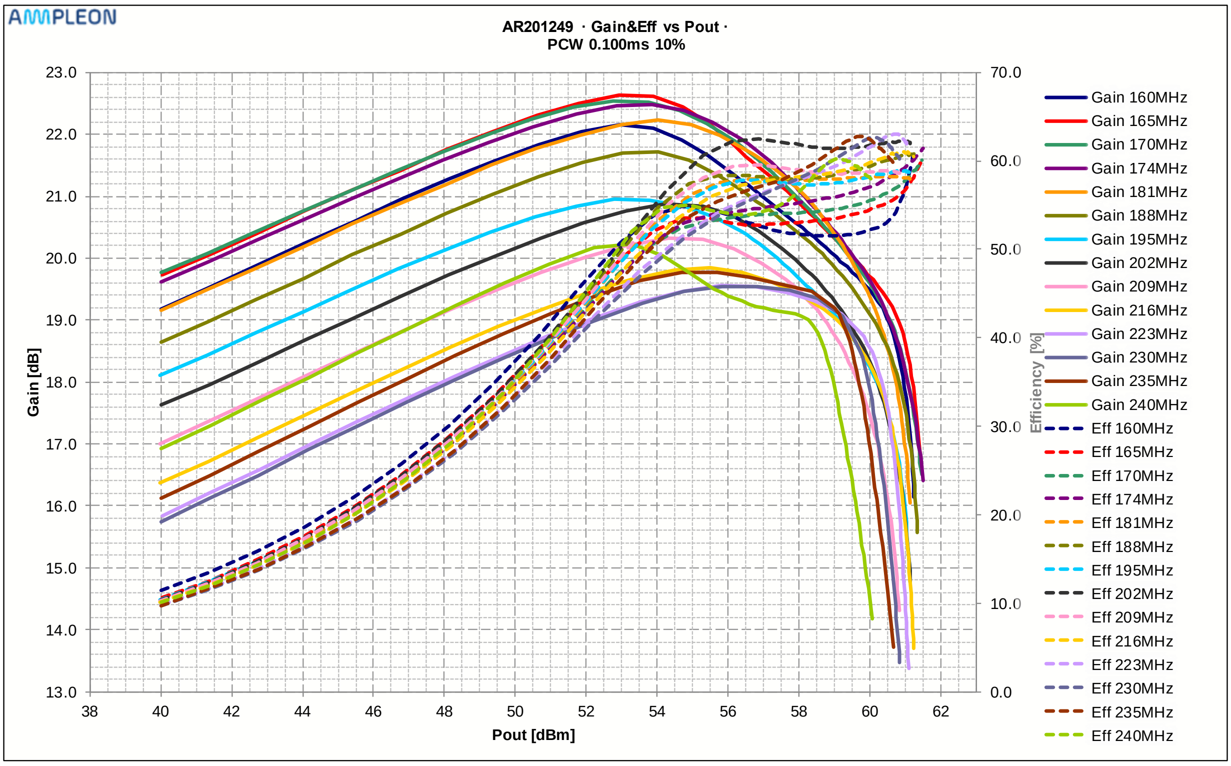

Figure 21 Pulsed CW, Gain [dB] + Deff [%] as function of Pout [dBm] Vdd=50V, Idq_m=0.6A, Vgs_p=0.7V

8.9 Assembly spread

The performance of the reference demo AR201249 and the 1st / 2nd / 3rd reproduction AR201268 / AR201274 / AR201278 for DVB-T (uncorrected) Deff and Pulsed CW peak power are given below (Vgs_p = 0.7V)

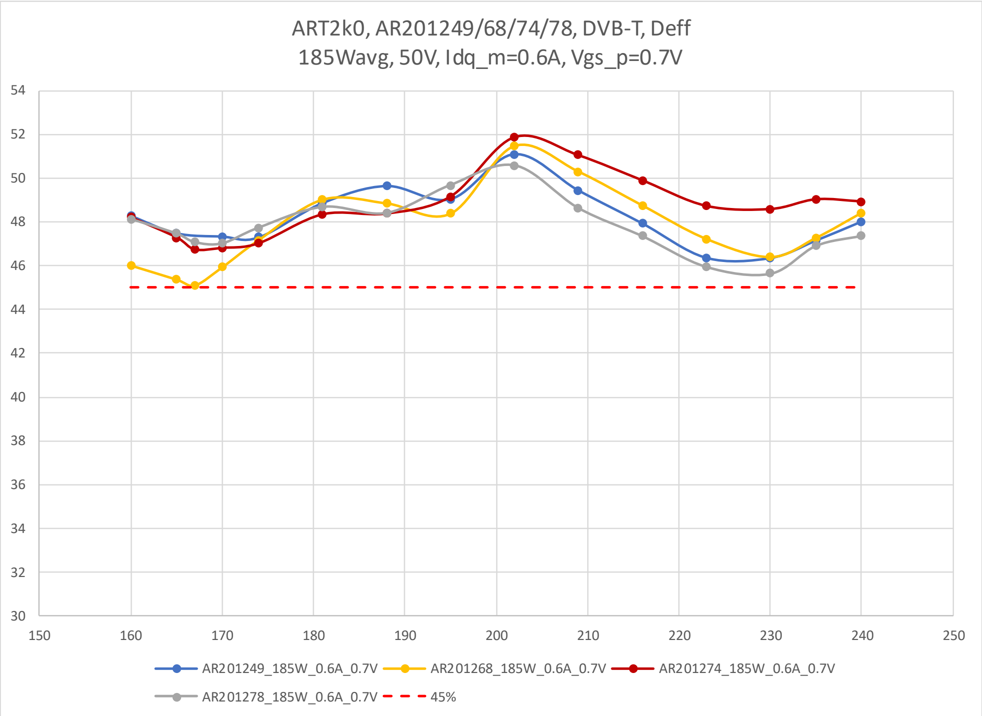

Figure 22 AR201249 vs AR2012XX: Deff DVB-T, Pavg=185W

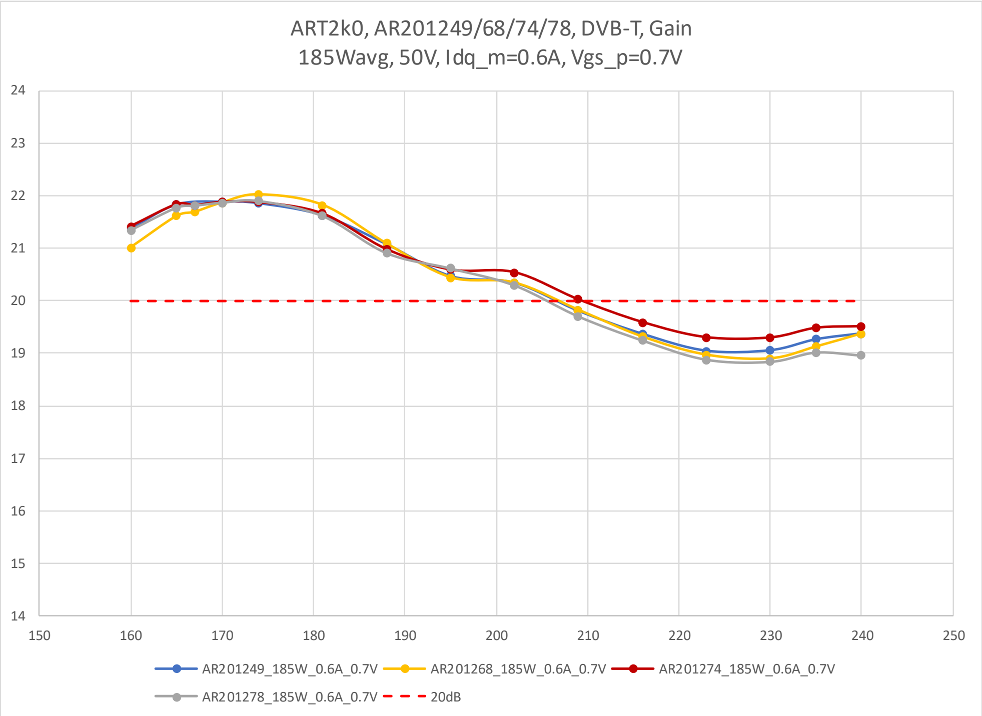

Figure 23 AR201249 vs AR2012XX: Gain DVB-Y, Pavg=185W

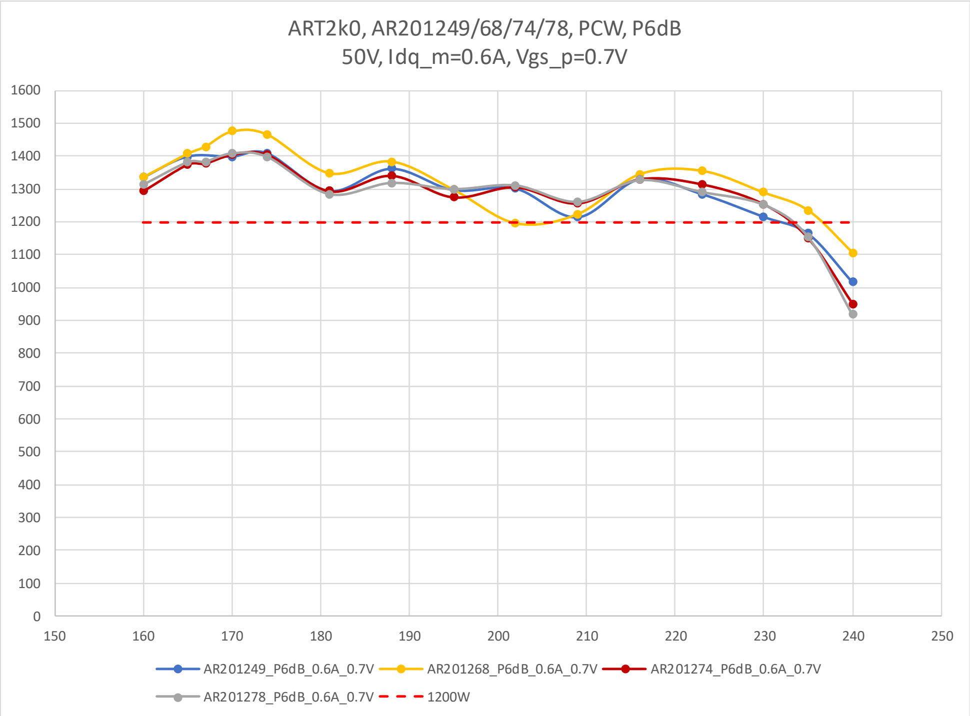

Figure 24 AR201249 vs AR2012XX: Ppeak Pulsed CW

8.10 Tuning Guideline

The following tunings can be done to improve Gain, Deff or Peak power due to assembly/component spread.

Gain: C41+C48:

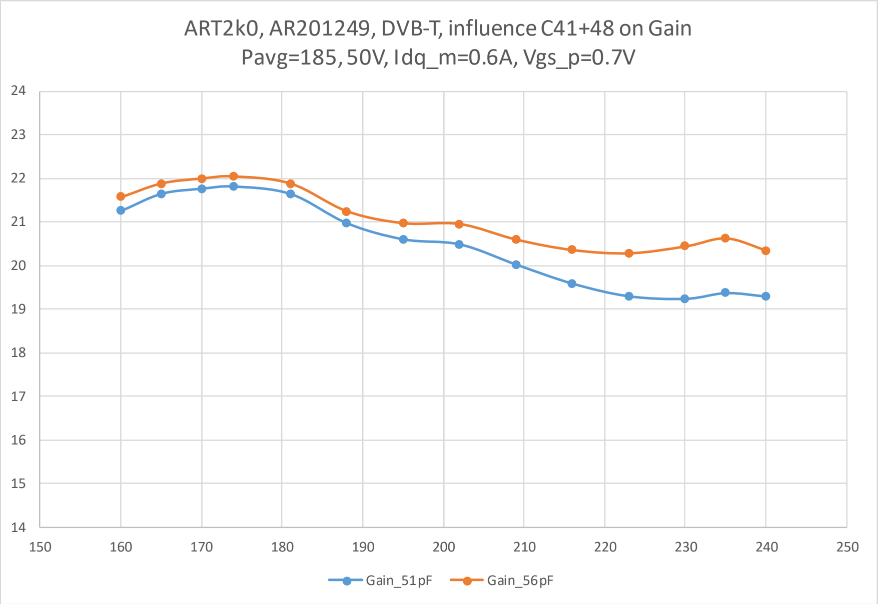

Figure 25 Gain=f(C41,48) AR201249

C41 + C48 should be changed simultaneously to maintain good tracking between Main/Peak amplifier. A value of 56pF improves gain flatness but might be critical for Ppeak at 230Mhz.

Efficiency: influence of C22:

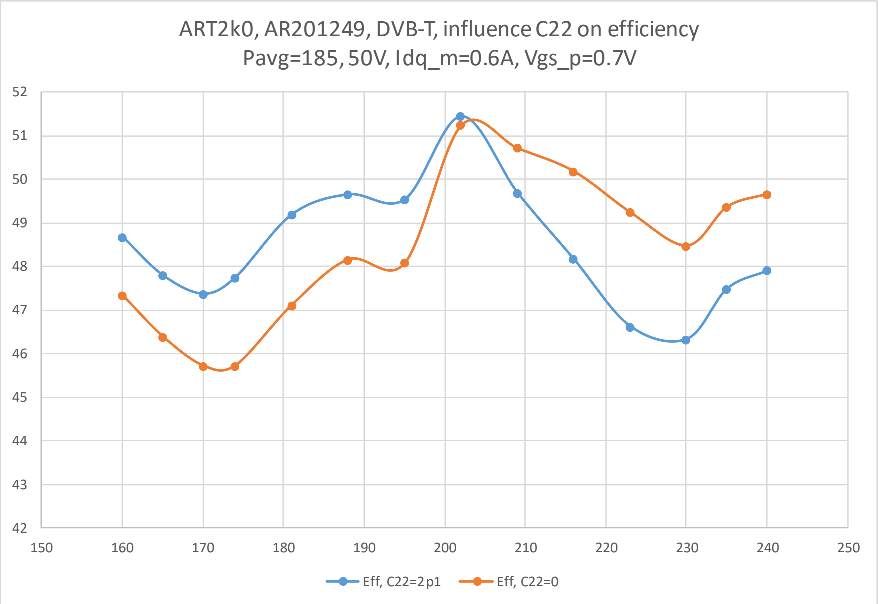

Figure 26 Deff=f(C22) AR201249

PAR:

Influence of C5:

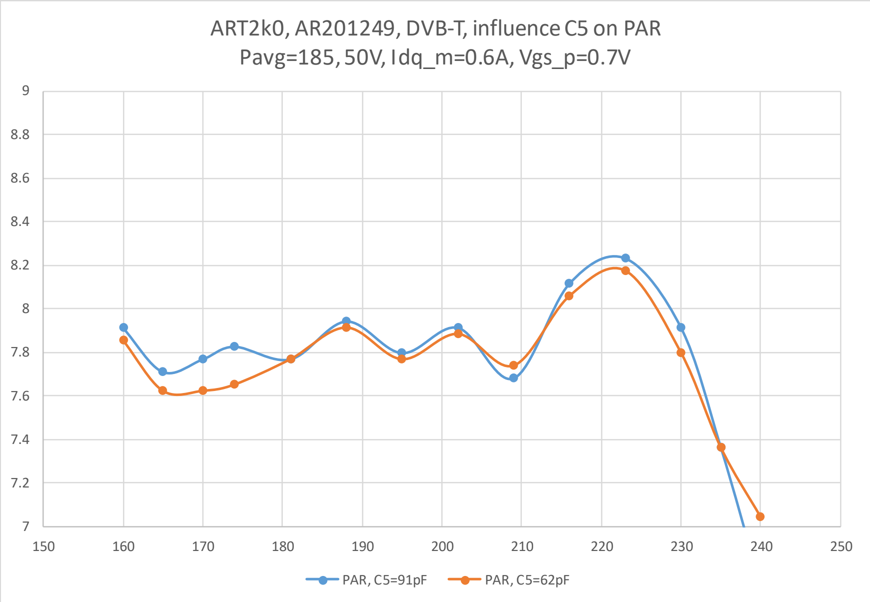

Figure 27 PAR=f(C5) AR201249

A higher C5 leads to a small improvement of PAR above 210Mhz.

Influence of C17:

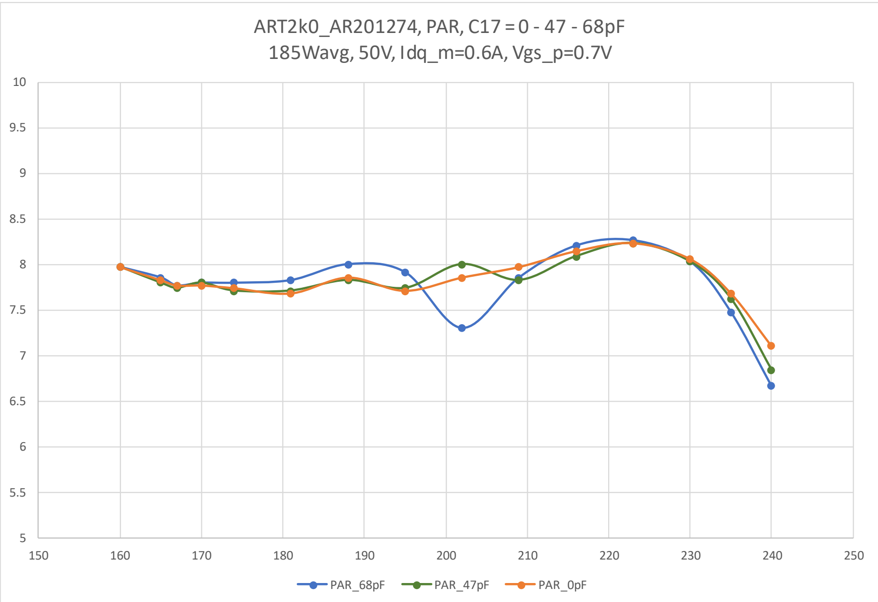

Figure 28 PAR=f(C17) AR201274

C17 has influence on PAR around 200Mhz and above 230Mhz. Nominal value (AR201249) is 68pF but a lower value (47pF) might increase PAR for freqs of 200-210Mhz. Note that a smaller value of C17 will lead to an increase of efficiency below 200Mhz.

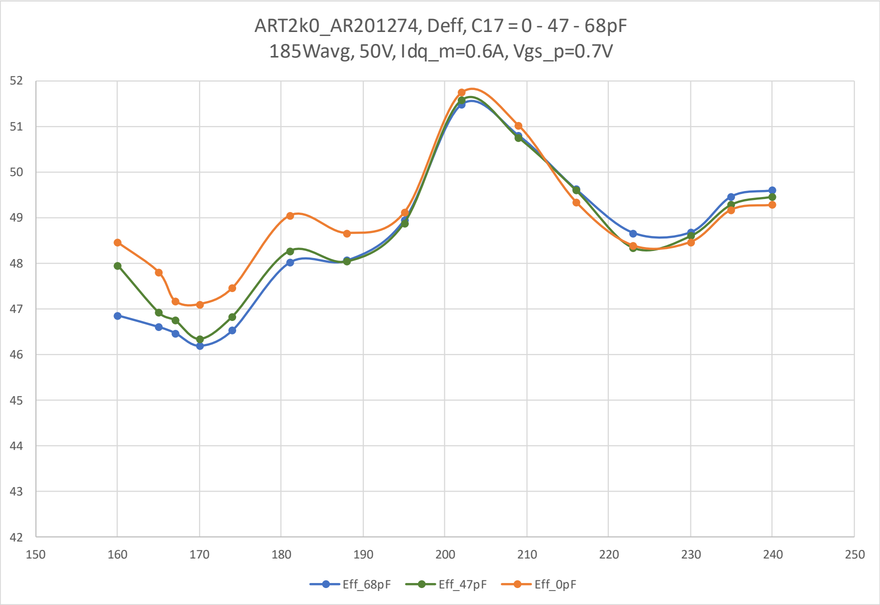

Figure 29 Deff=f(C17) AR201274

Coaxial cable assembly:

1. the coaxial cables should *not* be mounted flat on the pcb (outer conductors are *not* ground), see photo of demo's
2. connection of B1,B2 (TC12 coaxial cable) to C18-20 should be close (approx. 2mm), too much distance may lead to a drop in efficiency.

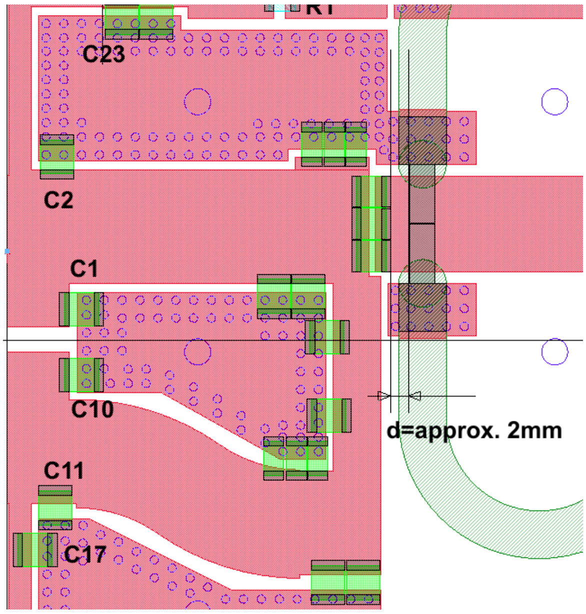

Figure 30 distance TC12 coax to C18-20

9. Hardware

9.1 Board Image

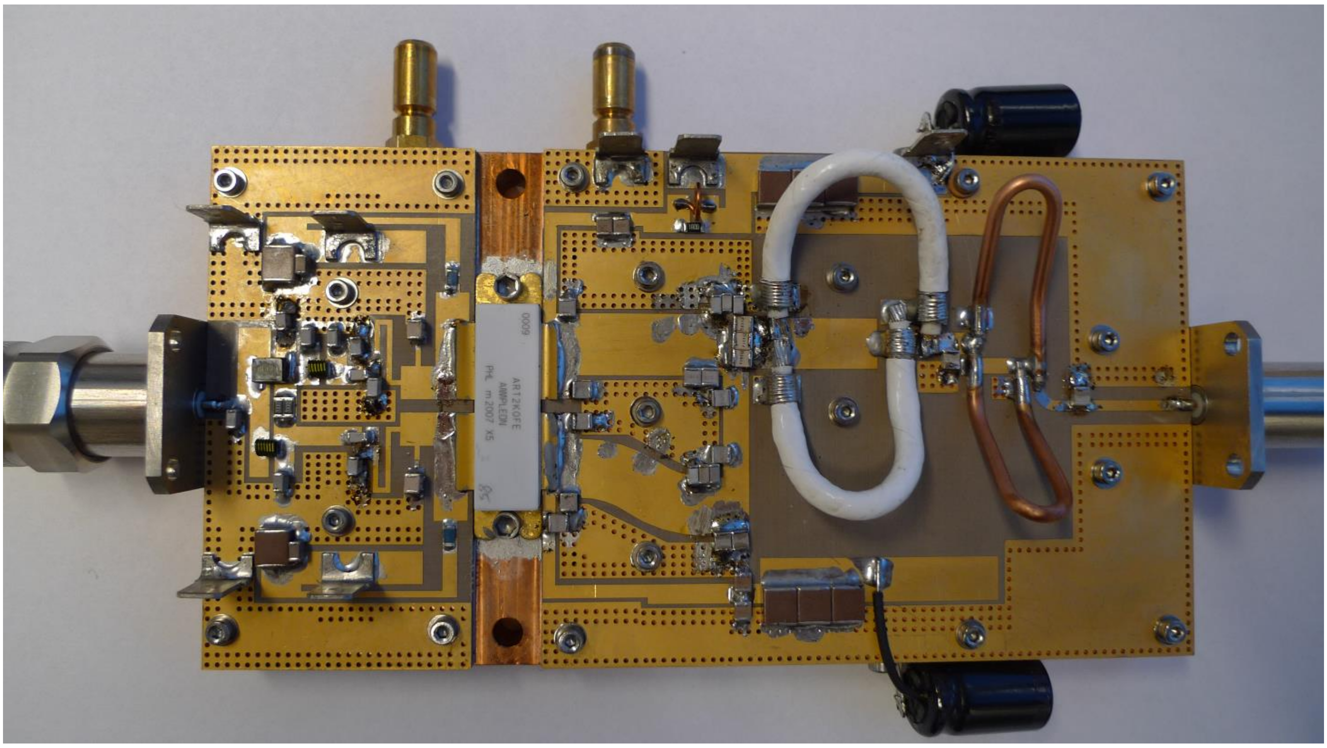

Figure 31 Picture of AR201249, 165-235Mhz demo board (top view)

Total board dimensions: 152 x 80mm

9.2 Copper Layout (version v3)

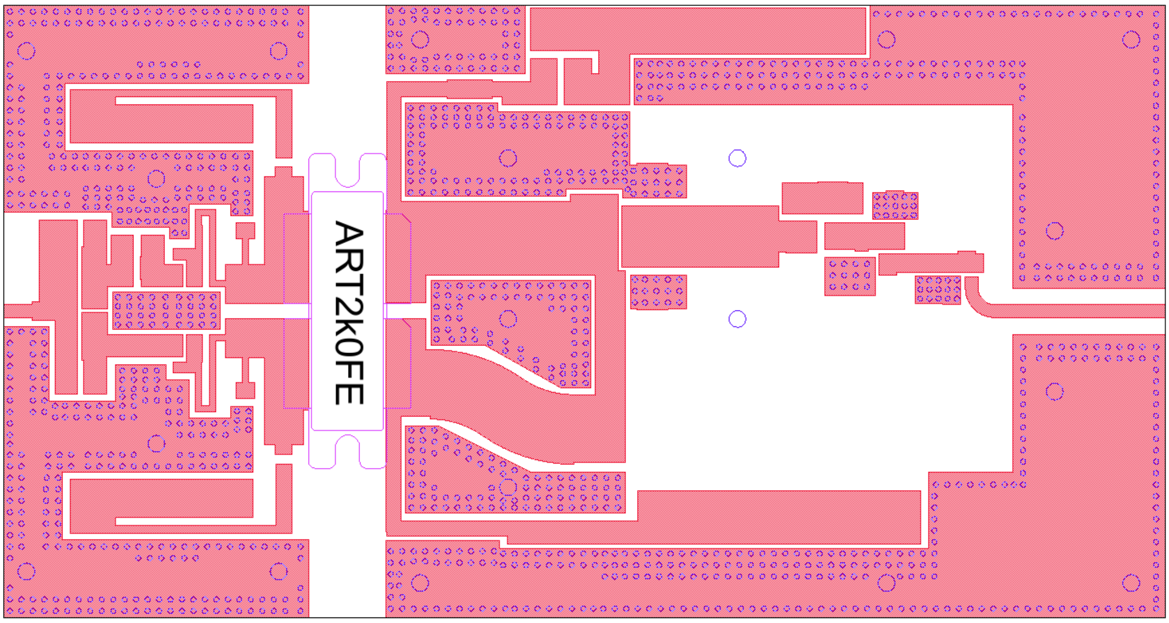

Figure 32 Layout drawing

9.3 Component Mapping

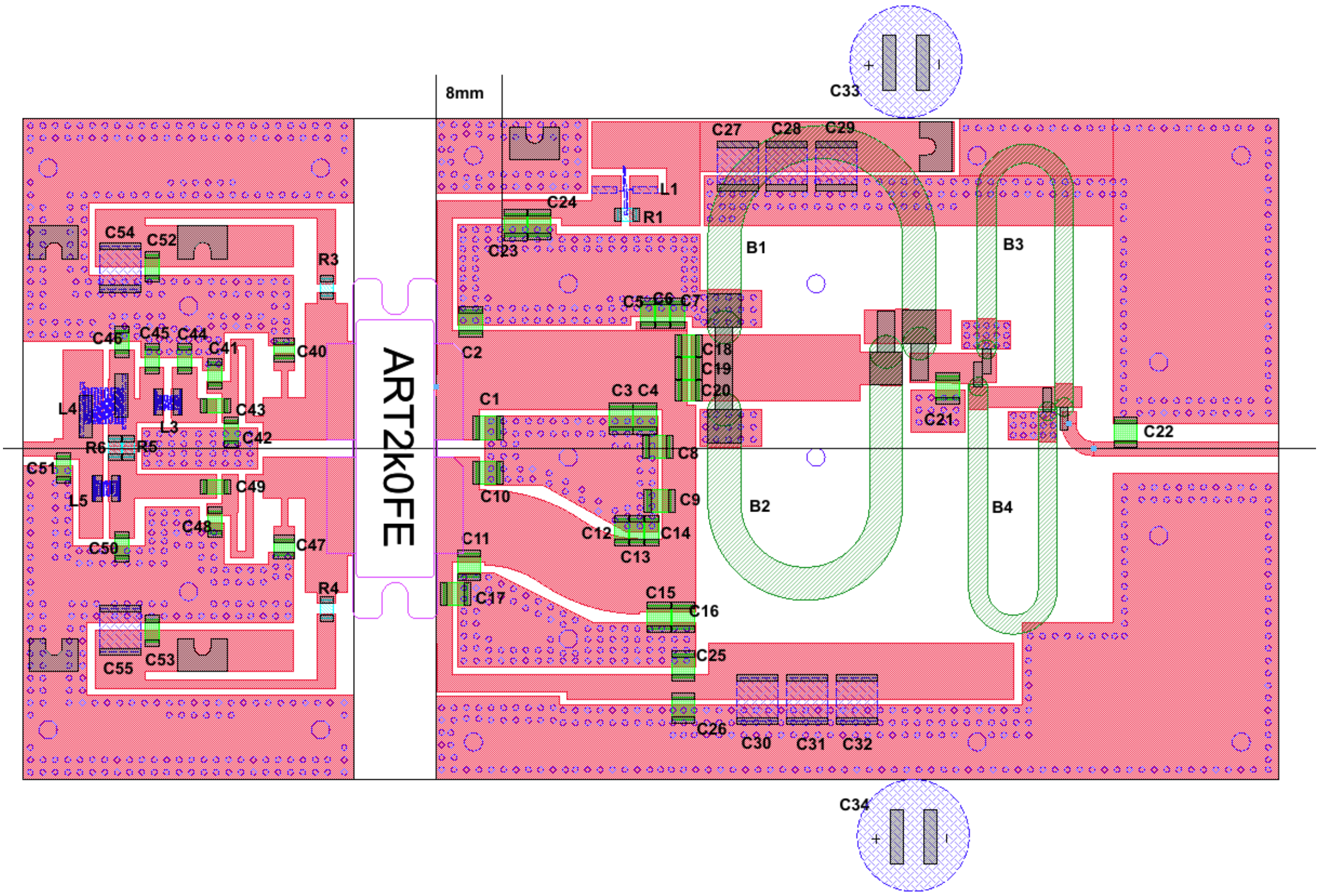

Figure 33 Component drawing

9.4 Bill of materials

Table 8: Bill of Materials

Description	Value	Case	Supplier	Remark
Output				
C1, C2	68pF	ATC800B	ATC	
C3,C4,C5,C6,C7	91pF	ATC800B	ATC	
C8	62pF	ATC800B	ATC	
C9	20pF	ATC800B	ATC	
C10,C11	110pF	ATC800B	ATC	
C12	33pF	ATC800B	TDK	
C13,C14	56pF	ATC800B	ATC	
C15,C16,C17	68pF	ATC800B	ATC	
C18,C19,C20	330pF	ATC100B	ATC	
C21	39pF	ATC800B	ATC	
C22	2.1pF	ATC800B	ATC	
C23,C24,C25,C26	1000pF	ATC800B	ATC	
C27,C28,C29,C30,C31,C32	4.7µF / 100V		TDK	
C33,C34	470µF	ATC800B		
L1				1 turn, 4-5mm diameter
R1	1Ω			
B1,B2	12Ω / 60mm			TC12, flexible coaxial cable
B3,B4	25Ω / 60mm			UT-90C-25, semi rigid coaxial cable
Input				
C40	910pF	ATC100B		
C41,C48	51pF	ATC800B		
C42	1.5pF	ATC800B		
C43	100pF	ATC800B		
C44,C45	15pF	ATC800B		
C46	7.5pF	ATC800B		
C47	1000pF	ATC100B		
C49	160pF	ATC800B		
C50	12pF	ATC800B		
C51	22pF	ATC800B		
C52,C53	1000pF	ATC800B		
C54,C55	4.7µF / 50V		TDK	
R3,R4	5.6Ω	0805		
R5,R6	200Ω	1206		In parallel
L3	39nH	1111SQ_39NJEB	Coilcraft	
L4	68nH	1812SMS_68NGLB	Coilcraft	
L5	47nH	1111SQ_47NJEB	Coilcraft	

9.5 Board material

Table 9: Board specifications

Parameter	Value	thickness	metallisation
Manufacturer	Rogers		
Input pcb	TC350	30 mil	35µ Cu, ground layer full Cu
Output pcb	TC350	30 mil	35µ Cu, ground layer full Cu

Input pcb: 40 x 80 mm, file (dxf) name = ART2k0_50V_pcb_input_TC350_30mil_v3

Output pcb: 102 x 80 mm, file (dxf) name = ART2k0_50V_pcb_output_TC350_30mil_v3

9.6 Device markings

Table 10: Device specifics

Parameter	Value
Manufacturer	Ampleon
Device	ART2k0FE
Marking	M2007-0005
Comments	

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