

APPLICATION NOTE

Document NO. AN-VHF-047-A

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SUBJECT: RD07MUS2B single-stage amplifier RF performance at $f=135\text{-}175\text{ MHz}$, $V_{dd}=7.2\text{V}$

SUMMARY:

This application note shows the RF wide band characteristics data

(Frequency characteristics, Pout vs. Pin characteristics) at 135 to 175 MHz band.

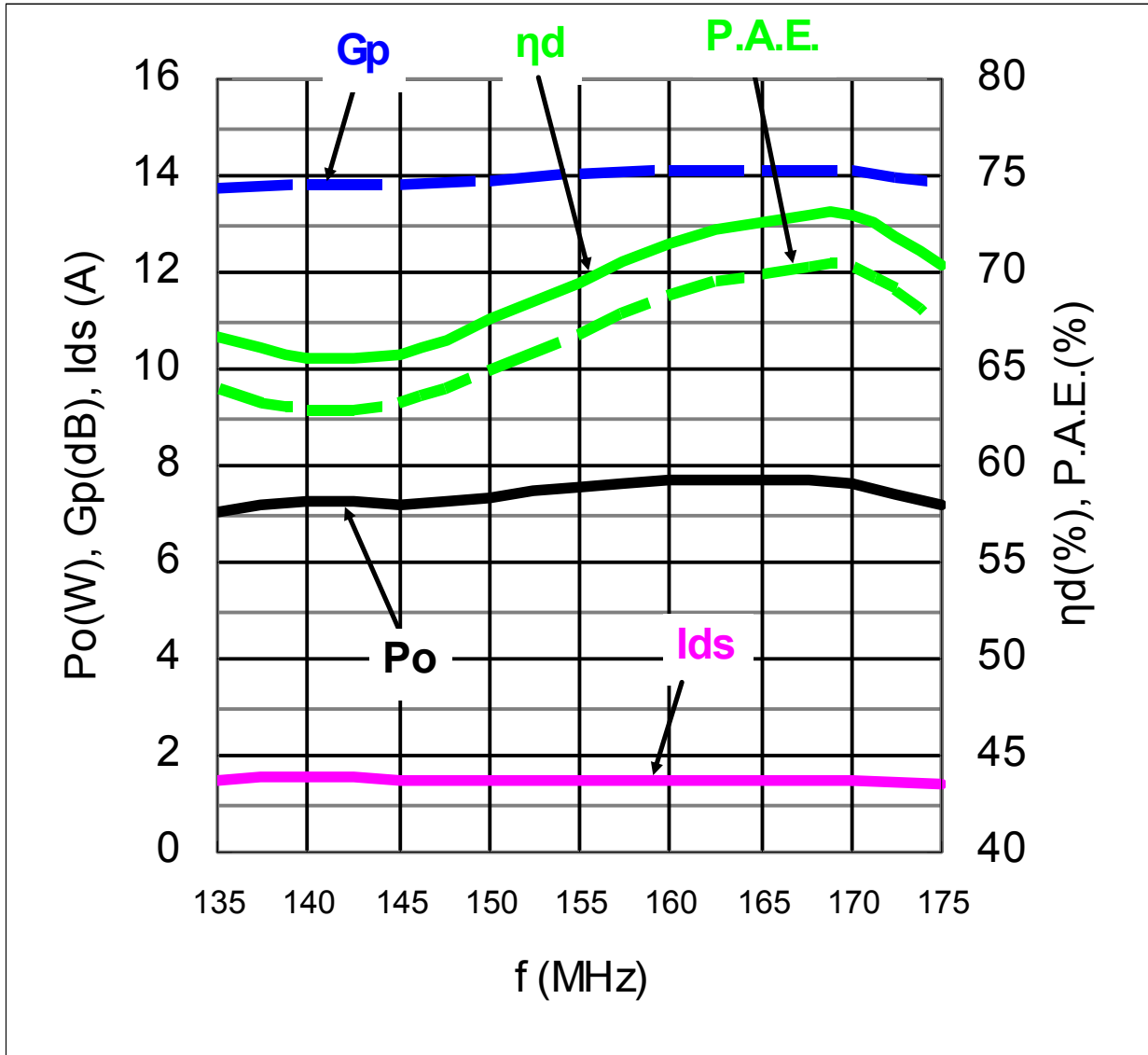
- Sample history :
RD07MUS2B: Lot number "083YH-G"

- Evaluate conditions :
RD07MUS2B @ $f=135\text{ to }175\text{ MHz}$: $V_{ds}=7.2\text{V}$, $I_{dq}=250\text{mA}$ (V_{gs} adjust)

- Results :
Page 2. shows the typical RF characteristics (Frequency characteristics) data.
Page 3-6. shows the typical RF characteristics (Pout vs. Pin characteristics) data.
Page 7-9. shows the typical RF characteristics (Pout vs. V_{gg} characteristics) data.
Page 10. shows the equivalent circuit.

RD07MUS2B single-stage amplifier Frequency characteristics

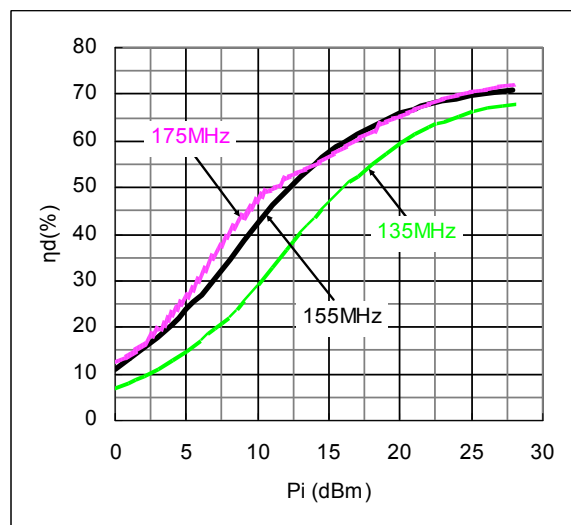
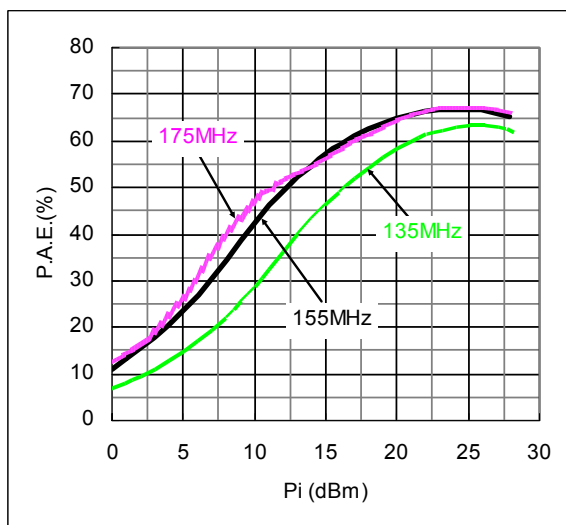
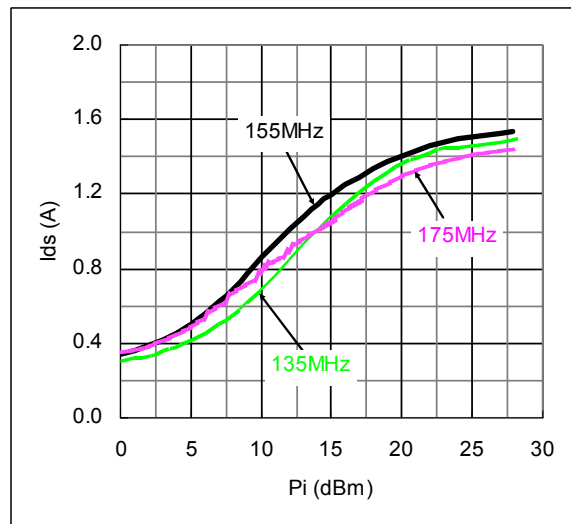
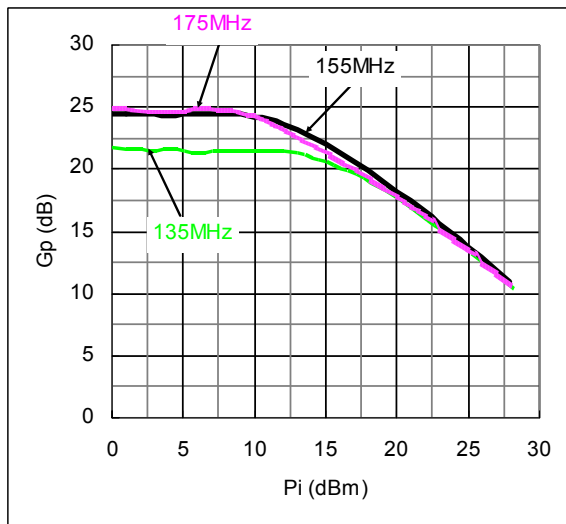
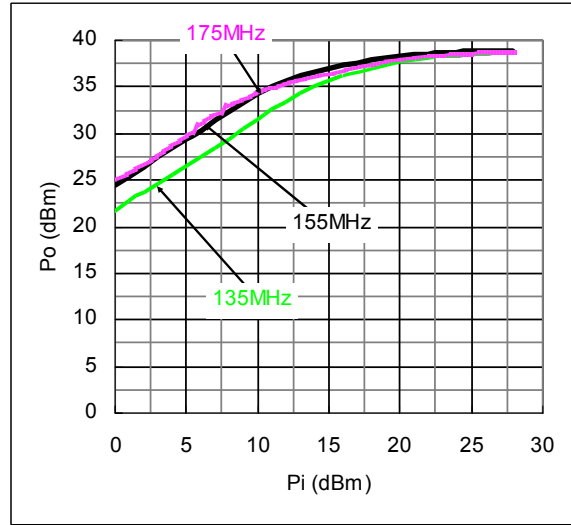
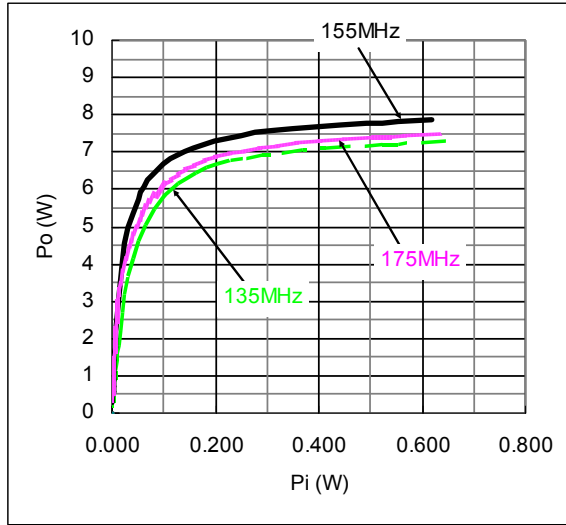
@ Vdd=7.2V, Idq=250mA, **Pi=0.3W** (24.77dBm)



Vds (V)	f (MHz)	Po (W)	Po (dBm)	Gp (dB)	Ids (A)	ηd (%)	P.A.E. (%)
7.2	135	7.04	38.5	13.7	1.47	66.7	63.9
	140	7.24	38.6	13.8	1.54	65.5	62.7
	145	7.19	38.6	13.8	1.52	65.8	63.1
	150	7.33	38.7	13.9	1.51	67.5	64.7
	155	7.52	38.8	14.0	1.50	69.4	66.7
	160	7.67	38.8	14.1	1.49	71.4	68.6
	165	7.70	38.9	14.1	1.47	72.6	69.8
	170	7.62	38.8	14.0	1.45	73.0	70.2
	175	7.15	38.5	13.8	1.41	70.4	67.4

RD07MUS2B single-stage amplifier Pout vs. Pin characteristics

@ Vdd=7.2V, Idq=250mA, f=135MHz, 155MHz, 175MHz



RD07MUS2B single-stage amplifier Pout vs. Pin characteristics data

@ f=135MHz, Idq=250mA

Vds (V)	Pi (W)	Pi (dBm)	Po (W)	Po (dBm)	Gp (dB)	I _{ds} (A)	η _d (%)	P.A.E. (%)
7.29	0.001	0.0	0.15	21.7	21.7	0.30	6.7	6.6
7.29	0.001	1.0	0.18	22.7	21.6	0.32	8.0	7.9
7.29	0.002	2.1	0.23	23.7	21.6	0.34	9.5	9.5
7.29	0.002	3.1	0.29	24.6	21.5	0.36	11.0	11.0
7.29	0.003	4.0	0.36	25.6	21.5	0.38	13.0	12.9
7.28	0.003	5.1	0.45	26.5	21.4	0.42	14.9	14.8
7.28	0.004	6.1	0.56	27.5	21.4	0.45	17.0	16.9
7.27	0.005	7.1	0.71	28.5	21.4	0.50	19.6	19.4
7.27	0.006	8.1	0.89	29.5	21.4	0.55	22.1	22.0
7.27	0.008	9.0	1.13	30.5	21.5	0.61	25.4	25.2
7.26	0.010	10.1	1.41	31.5	21.4	0.68	28.6	28.4
7.25	0.013	11.0	1.79	32.5	21.5	0.76	32.6	32.4
7.25	0.016	12.0	2.21	33.4	21.4	0.84	36.2	36.0
7.24	0.020	13.0	2.69	34.3	21.3	0.93	40.1	39.8
7.23	0.025	14.0	3.15	35.0	21.0	1.00	43.4	43.0
7.22	0.032	15.0	3.63	35.6	20.6	1.08	46.6	46.2
7.22	0.040	16.0	4.10	36.1	20.1	1.15	49.5	49.0
7.22	0.051	17.0	4.58	36.6	19.6	1.21	52.4	51.8
7.21	0.064	18.1	5.04	37.0	19.0	1.27	55.1	54.4
7.21	0.081	19.1	5.45	37.4	18.3	1.32	57.3	56.5
7.20	0.102	20.1	5.84	37.7	17.6	1.36	59.5	58.5
7.20	0.129	21.1	6.17	37.9	16.8	1.40	61.4	60.1
7.20	0.163	22.1	6.46	38.1	16.0	1.43	62.9	61.3
7.20	0.206	23.1	6.69	38.3	15.1	1.45	64.3	62.3
7.20	0.260	24.1	6.85	38.4	14.2	1.45	65.4	62.9
7.20	0.328	25.2	6.98	38.4	13.3	1.46	66.4	63.2
7.20	0.414	26.2	7.10	38.5	12.4	1.47	67.1	63.2
7.20	0.521	27.2	7.22	38.6	11.4	1.48	67.7	62.8
7.20	0.660	28.2	7.32	38.6	10.4	1.50	68.0	61.9

@ f=155MHz, Idq=250mA

Vds (V)	Pi (W)	Pi (dBm)	Po (W)	Po (dBm)	Gp (dB)	I _{ds} (A)	η _d (%)	P.A.E. (%)
7.32	0.001	0.0	0.28	24.4	24.4	0.34	11.1	11.0
7.31	0.001	1.0	0.35	25.4	24.4	0.36	13.2	13.1
7.31	0.002	2.0	0.44	26.4	24.4	0.39	15.4	15.4
7.31	0.002	3.0	0.55	27.4	24.4	0.42	17.9	17.8
7.31	0.003	4.0	0.69	28.4	24.4	0.46	20.6	20.5
7.30	0.003	5.0	0.88	29.4	24.4	0.51	23.7	23.7
7.30	0.004	6.0	1.10	30.4	24.4	0.56	26.9	26.8
7.29	0.005	7.0	1.40	31.5	24.5	0.62	30.9	30.8
7.28	0.006	8.0	1.75	32.4	24.4	0.70	34.5	34.4
7.28	0.008	9.0	2.19	33.4	24.4	0.77	38.8	38.6
7.27	0.010	10.0	2.65	34.2	24.2	0.86	42.5	42.3
7.26	0.013	11.0	3.16	35.0	24.0	0.94	46.3	46.1
7.25	0.016	12.0	3.64	35.6	23.6	1.02	49.4	49.2
7.24	0.020	13.0	4.11	36.1	23.1	1.08	52.5	52.2
7.24	0.025	14.0	4.56	36.6	22.6	1.14	55.0	54.7
7.23	0.032	15.0	4.98	37.0	22.0	1.20	57.5	57.1
7.23	0.040	16.0	5.37	37.3	21.3	1.25	59.5	59.1
7.23	0.050	17.0	5.74	37.6	20.6	1.29	61.4	60.9
7.22	0.063	18.0	6.07	37.8	19.8	1.33	63.0	62.4
7.22	0.079	19.0	6.38	38.0	19.1	1.37	64.5	63.7
7.21	0.099	20.0	6.67	38.2	18.3	1.40	65.8	64.9
7.21	0.125	21.0	6.90	38.4	17.4	1.43	66.8	65.6
7.21	0.157	22.0	7.12	38.5	16.6	1.46	67.7	66.3
7.20	0.197	22.9	7.29	38.6	15.7	1.48	68.5	66.6
7.20	0.248	23.9	7.44	38.7	14.8	1.49	69.2	66.9
7.20	0.312	24.9	7.56	38.8	13.8	1.51	69.6	66.8
7.20	0.392	25.9	7.68	38.9	12.9	1.52	70.1	66.5
7.20	0.493	26.9	7.77	38.9	12.0	1.53	70.5	66.0
7.20	0.620	27.9	7.84	38.9	11.0	1.54	70.8	65.2

RD07MUS2B single-stage amplifier RF performance at f=135-175MHz,Vdd=7.2V

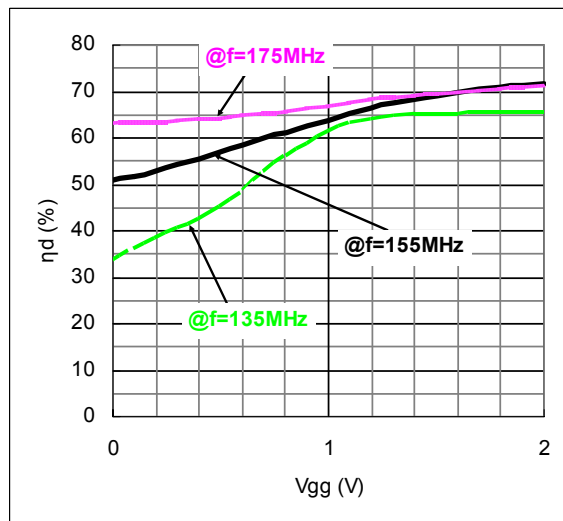
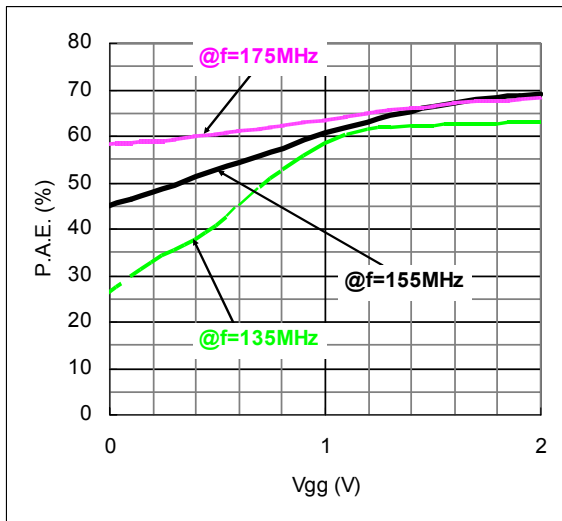
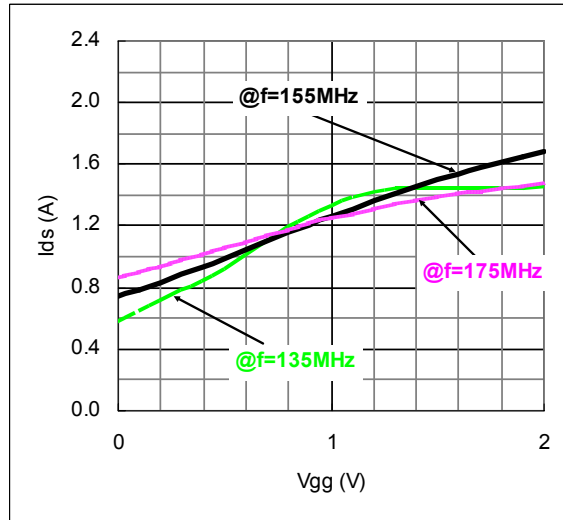
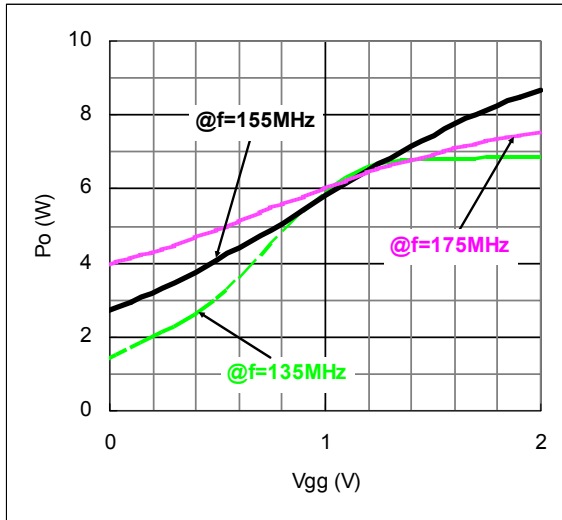
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@ f=175MHz, Idq=250mA

Vds (V)	Pi (W)	Pi (dBm)	Po (W)	Po (dBm)	Gp (dB)	I _{ds} (A)	η _d (%)	P.A.E. (%)
7.30	0.001	0.2	0.32	25.0	24.8	0.35	12.5	12.4
7.30	0.001	1.5	0.41	26.1	24.7	0.37	15.2	15.2
7.30	0.002	2.6	0.52	27.2	24.6	0.39	18.1	18.0
7.29	0.002	3.5	0.64	28.1	24.6	0.43	20.5	20.4
7.29	0.003	4.6	0.83	29.2	24.7	0.46	24.9	24.8
7.29	0.004	5.5	1.04	30.2	24.7	0.51	28.0	27.9
7.28	0.004	6.3	1.32	31.2	24.9	0.56	32.3	32.2
7.28	0.006	7.4	1.67	32.2	24.8	0.62	37.2	37.1
7.27	0.007	8.3	2.04	33.1	24.8	0.68	41.3	41.1
7.27	0.009	9.5	2.45	33.9	24.3	0.74	45.4	45.3
7.26	0.011	10.3	2.81	34.5	24.2	0.80	48.1	48.0
7.26	0.014	11.5	3.15	35.0	23.5	0.86	50.5	50.3
7.25	0.017	12.3	3.47	35.4	23.1	0.92	52.3	52.0
7.25	0.022	13.4	3.81	35.8	22.4	0.97	54.0	53.6
7.24	0.027	14.4	4.11	36.1	21.7	1.03	55.4	55.0
7.24	0.034	15.3	4.45	36.5	21.1	1.08	57.2	56.7
7.23	0.042	16.3	4.79	36.8	20.5	1.13	58.9	58.3
7.23	0.053	17.2	5.17	37.1	19.9	1.18	60.8	60.2
7.22	0.066	18.2	5.49	37.4	19.2	1.22	62.3	61.6
7.22	0.082	19.1	5.82	37.6	18.5	1.26	63.9	63.0
7.22	0.103	20.1	6.13	37.9	17.7	1.30	65.4	64.3
7.21	0.129	21.1	6.40	38.1	17.0	1.33	66.8	65.5
7.21	0.162	22.1	6.65	38.2	16.1	1.36	68.0	66.3
7.21	0.203	23.1	6.85	38.4	15.3	1.38	69.0	66.9
7.21	0.255	24.1	7.02	38.5	14.4	1.40	69.8	67.2
7.21	0.321	25.1	7.17	38.6	13.5	1.41	70.5	67.3
7.21	0.403	26.1	7.29	38.6	12.6	1.42	71.0	67.1
7.20	0.505	27.0	7.40	38.7	11.7	1.43	71.6	66.7
7.20	0.636	28.0	7.49	38.7	10.7	1.44	72.1	66.0

RD07MUS2B single-stage amplifier Pout vs. Vgg characteristics

@ Vdd=7.2V, Pi=0.3W (=24.77dBm), **f=135MHz, 155MHz, 175MHz**



RD07MUS2B single-stage amplifier Pout vs. Vgg characteristics data

@ f=135MHz, Pin=0.3W (=24.77dBm)

Vgg (V)	Idq (A)	Po (W)	Po (dBm)	Ids (A)	η_d (%)	P.A.E. (%)
0.0	0	1.31	31.2	0.56	32.8	25.3
0.1	0	1.70	32.3	0.65	36.3	30.0
0.2	0	2.00	33.0	0.72	38.6	32.8
0.3	0	2.30	33.6	0.78	40.6	35.3
0.4	0	2.59	34.1	0.85	42.6	37.6
0.5	0	3.01	34.8	0.92	45.4	40.9
0.6	0	3.56	35.5	1.01	48.9	44.8
0.7	0	4.17	36.2	1.10	52.7	48.9
0.8	0	4.82	36.8	1.19	56.3	52.8
0.9	0	5.38	37.3	1.27	59.0	55.7
1.0	0	5.90	37.7	1.33	61.6	58.4
1.1	0	6.31	38.0	1.38	63.2	60.2
1.2	0.01	6.58	38.2	1.42	64.3	61.4
1.3	0.04	6.75	38.3	1.45	64.9	62.0
1.4	0.14	6.80	38.3	1.45	65.1	62.3
1.5	0.36	6.82	38.3	1.45	65.3	62.4
1.6	0.71	6.83	38.3	1.45	65.4	62.6
1.7	1.14	6.84	38.4	1.45	65.6	62.7
1.8	1.57	6.85	38.4	1.45	65.7	62.8
1.9	1.99	6.86	38.4	1.45	65.8	62.9
2.0	2.37	6.89	38.4	1.46	65.8	62.9

RD07MUS2B single-stage amplifier RF performance at f=135-175MHz,Vdd=7.2V

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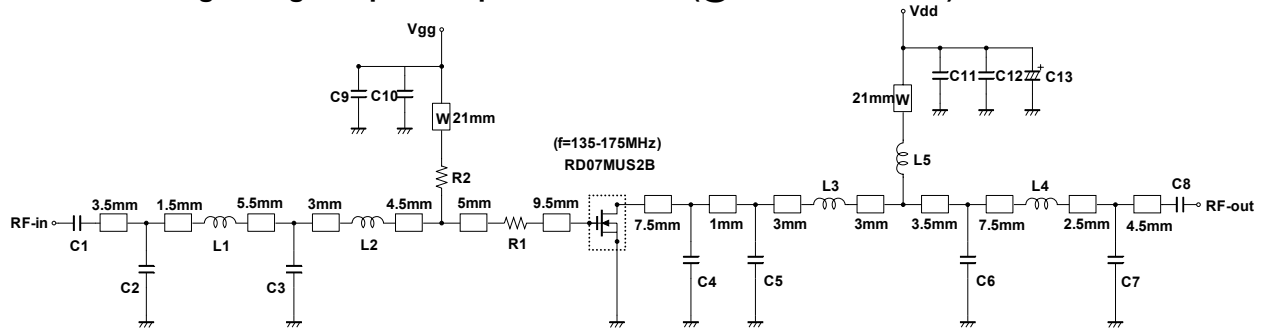
@ f=155MHz, Pin=0.3W (=24.77dBm)

Vgg (V)	Idq (A)	Po (W)	Po (dBm)	Ids (A)	η_d (%)	P.A.E. (%)
0.0	0	2.63	34.2	0.73	50.4	44.7
0.1	0	2.92	34.7	0.78	51.8	46.5
0.2	0	3.17	35.0	0.83	53.0	48.0
0.3	0	3.45	35.4	0.88	54.3	49.6
0.4	0	3.74	35.7	0.94	55.6	51.2
0.5	0	4.07	36.1	0.99	57.0	52.8
0.6	0	4.39	36.4	1.05	58.4	54.4
0.7	0	4.74	36.8	1.10	59.8	56.0
0.8	0	5.09	37.1	1.16	61.2	57.5
0.9	0	5.45	37.4	1.21	62.6	59.1
1.0	0	5.81	37.6	1.26	63.9	60.6
1.1	0	6.16	37.9	1.31	65.2	62.0
1.2	0.01	6.50	38.1	1.36	66.3	63.2
1.3	0.04	6.84	38.4	1.41	67.4	64.4
1.4	0.14	7.17	38.6	1.46	68.3	65.4
1.5	0.36	7.46	38.7	1.50	69.2	66.4
1.6	0.71	7.76	38.9	1.54	69.9	67.2
1.7	1.14	8.01	39.0	1.58	70.5	67.8
1.8	1.57	8.24	39.2	1.61	71.0	68.4
1.9	1.99	8.48	39.3	1.65	71.3	68.8
2.0	2.37	8.68	39.4	1.68	71.6	69.2

@ f=175MHz, Pin=0.3W (=24.77dBm)

Vgg (V)	Idq (A)	Po (W)	Po (dBm)	Ids (A)	η_d (%)	P.A.E. (%)
0.0	0	3.90	35.9	0.86	63.2	58.3
0.1	0	4.11	36.1	0.90	63.3	58.7
0.2	0	4.28	36.3	0.94	63.4	59.0
0.3	0	4.47	36.5	0.98	63.7	59.4
0.4	0	4.68	36.7	1.02	64.0	59.9
0.5	0	4.90	36.9	1.06	64.3	60.4
0.6	0	5.12	37.1	1.10	64.8	61.0
0.7	0	5.34	37.3	1.14	65.3	61.6
0.8	0	5.58	37.5	1.18	65.8	62.3
0.9	0	5.79	37.6	1.21	66.3	62.9
1.0	0	6.00	37.8	1.25	66.9	63.6
1.1	0	6.22	37.9	1.28	67.6	64.3
1.2	0.01	6.44	38.1	1.31	68.1	65.0
1.3	0.04	6.63	38.2	1.34	68.7	65.6
1.4	0.14	6.79	38.3	1.36	69.2	66.1
1.5	0.36	6.93	38.4	1.39	69.6	66.6
1.6	0.71	7.10	38.5	1.41	70.0	67.0
1.7	1.14	7.23	38.6	1.43	70.4	67.4
1.8	1.57	7.34	38.7	1.44	70.6	67.7
1.9	1.99	7.45	38.7	1.46	70.9	68.1
2.0	2.37	7.56	38.8	1.48	71.1	68.3

RD07MUS2B single-stage amplifier equivalent circuit (@f=135 to 175MHz)



Note: Board material- Glass-Epoxy Substrate
 Micro strip line width=1.3mm/50OHM,er:4.8,t=0.8mm
 W: Line width=1.0mm

Parts Type	Value	Type name	Vender	
Capacitor	C1	100pF	GRM2162C1H101GD01E	Murata Manufacturing Co., Ltd.
	C2	56pF	GRM2162C1H560GD01E	Murata Manufacturing Co., Ltd.
	C3	43pF	GRM2162C1H430GD01E	Murata Manufacturing Co., Ltd.
	C4	22pF	GRM2162C1H220GD01E	Murata Manufacturing Co., Ltd.
	C5	22pF	GRM2162C1H220GD01E	Murata Manufacturing Co., Ltd.
	C6	100pF	GRM2162C1H101GD01E	Murata Manufacturing Co., Ltd.
	C7	20pF	GRM2162C1H200GD01E	Murata Manufacturing Co., Ltd.
	C8	100pF	GRM2162C1H101GD01E	Murata Manufacturing Co., Ltd.
	C9	22000pF	GRM216R11H223KA01E	Murata Manufacturing Co., Ltd.
	C10	1000pF	GRM216R11H102KA01E	Murata Manufacturing Co., Ltd.
	C11	1000pF	GRM216R11H102KA01E	Murata Manufacturing Co., Ltd.
	C12	22000pF	GRM216R11H223KA01E	Murata Manufacturing Co., Ltd.
	C13	22µF	A0603	NICHICON CORPORATION
Resistance	R1	2.2 OHM	RPC10T2R2J	TAIYOSHA ELECTRIC Co.,Ltd.
	R2	4.7K OHM	CR1/10-472JB	Hokuriku Electric Industry Co.,Ltd.
Inductance	L1	6.6nH Enameled wire 2Turns, Diameter:0.23mm,φ1.66mm (the out side diameter)	2302S	Yoneda Processing Place Co.,Ltd.
	L2	10.8nH Enameled wire 4Turns, Diameter:0.43mm,φ1.66mm (the out side diameter)	4804A	Yoneda Processing Place Co.,Ltd.
	L3	6.6nH Enameled wire 2Turns, Diameter:0.43mm,φ1.66mm (the out side diameter)	2302S	Yoneda Processing Place Co.,Ltd.
	L4	31.0nH Enameled wire 6Turns, Diameter:0.23mm,φ1.66mm (the out side diameter)	2306C	Yoneda Processing Place Co.,Ltd.
	L5	31.0nH Enameled wire 6Turns, Diameter:0.23mm,φ1.66mm (the out side diameter)	2306C	Yoneda Processing Place Co.,Ltd.

