

APPLICATION NOTE

Document NO. AN-UHF-072-C
Date : 6th Feb. 2006
Rev.date : 30th Jul. 2010
Prepared : H.Komatsu, H.Ukita
K.Osaki, Y.Tanaka
Confirmed : S.Kametani
(Taking charge of Silicon RF by
MIYOSHI Electronics)

SUBJECT: RD09MUP2 single-stage amplifier RF performance at f=400-527MHz, Vdd=7.2V

SUMMARY:

This application note shows the RF wide-band characteristics data (Frequency characteristics, Pin vs. Pout characteristics, Pout vs. Vdd characteristics) at f=400 to 527MHz.

- Sample history:

RD09MUP2: Lot number "103AB-G"

- Evaluate conditions:

@f=400MHz : Vdd=7.2V, Pin=1W, Idq=1A (Vgg adj.)

@f=470MHz : Vdd=7.2V, Pin=1W, Idq=1A (Vgg adj.)

@f=527MHz : Vdd=7.2V, Pin=1W, Idq=1A (Vgg adj.)

- Results:

Page 2 shows the Output Power, Drain Efficiency vs. Frequency data.

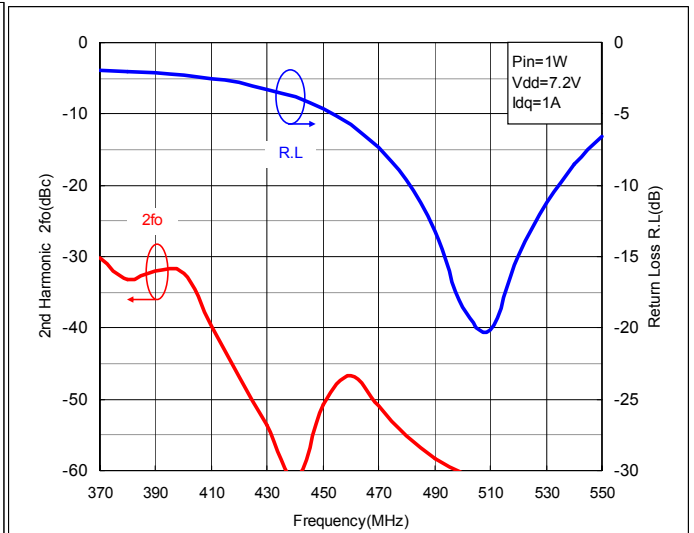
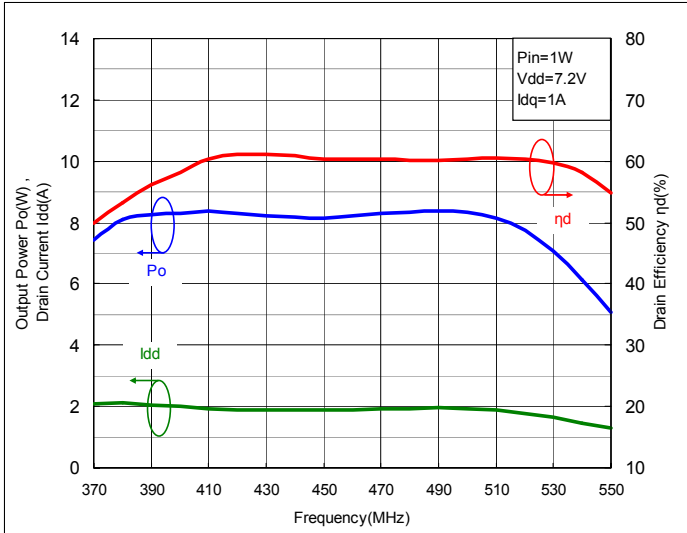
Page 3-5 shows the Output Power, Power Gain, Drain Efficiency vs. Input Power data.

Page 6-8 shows the Output Power, Drain Current, Drain Efficiency vs. Drain Voltage data.

Page 9 shows the Equivalent Circuit and schematic for test fixture.

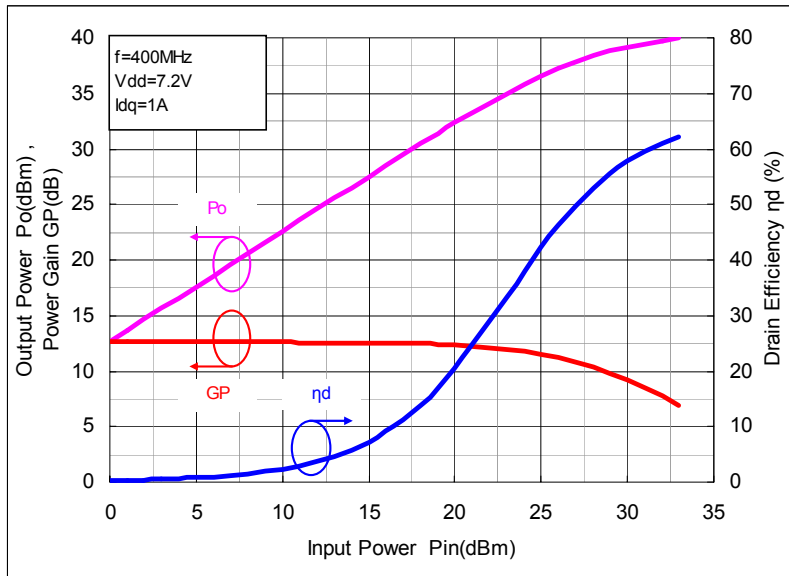
RD09MUP2 Output Power, Drain Efficiency vs. Frequency

(@ f=400 – 527MHz, Pin=1W, Vdd=7.2V, Idq=1A)



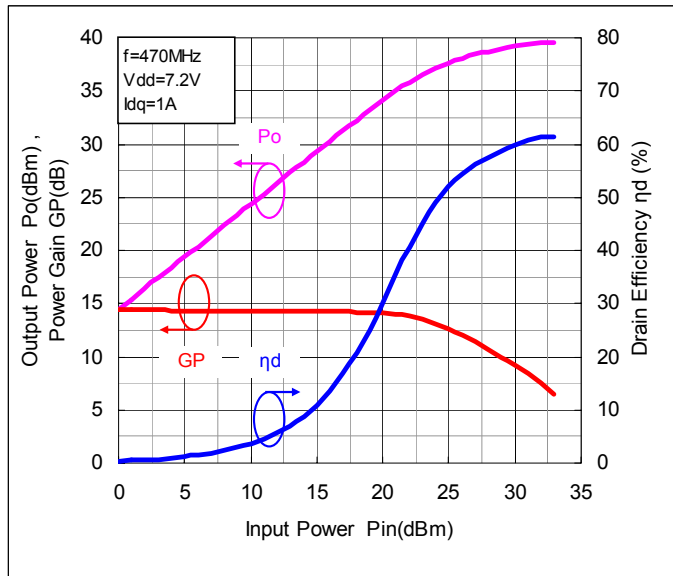
Freq. (MHz)	Vgg (V)	Output Power (dBm) : (W)	Gp (dB)	Idd (A)	η_d (%)	Return Loss (dB)	2fo (dBc)	3fo (dBc)
370	2.4	38.7 : 7.4	8.7	2.08	50.0	-1.9	-30.2	<-60
380	2.4	39.1 : 8.1	9.1	2.12	53.3	-2.0	-33.2	<-60
390	2.4	39.2 : 8.2	9.1	2.05	56.1	-2.1	-32.0	<-60
400	2.4	39.2 : 8.3	9.2	1.99	58.1	-2.3	-32.3	<-60
410	2.4	39.2 : 8.4	9.2	1.94	60.2	-2.5	-39.8	<-60
420	2.4	39.2 : 8.3	9.2	1.90	61.1	-2.8	-46.8	<-60
430	2.4	39.1 : 8.2	9.1	1.88	61.1	-3.2	-53.7	<-60
440	2.4	39.1 : 8.2	9.1	1.87	60.9	-3.8	<-60	<-60
450	2.4	39.1 : 8.1	9.1	1.88	60.3	-4.6	-50.7	<-60
460	2.4	39.2 : 8.2	9.2	1.91	60.3	-5.7	-46.7	<-60
470	2.4	39.2 : 8.3	9.2	1.93	60.3	-7.3	-50.8	<-60
480	2.4	39.2 : 8.4	9.2	1.94	60.1	-9.6	-55.2	<-60
490	2.4	39.2 : 8.4	9.2	1.95	60.2	-13.2	-58.3	<-60
500	2.4	39.2 : 8.3	9.2	1.93	60.3	-18.5	<-60	<-60
510	2.4	39.1 : 8.1	9.1	1.88	60.5	-20.1	<-60	<-60
520	2.4	38.9 : 7.7	8.9	1.79	60.4	-15.0	<-60	<-60
530	2.4	38.5 : 7.1	8.5	1.65	59.8	-11.2	<-60	<-60
540	2.4	37.9 : 6.1	7.9	1.47	58.1	-8.5	<-60	<-60
550	2.4	37.0 : 5.1	7.0	1.29	54.8	-6.6	<-60	<-60

RD09MUP2 Output Power, Power Gain, Drain Efficiency vs. Input Power
 (@ f=400MHz, Vdd=7.2V, Idq=1A)



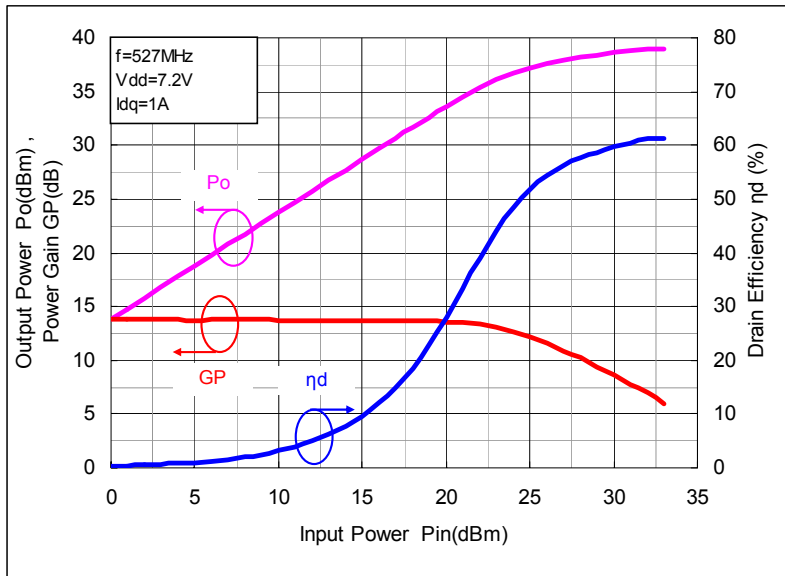
Vgg (V)	Pin (dBm)	Pin (W)	Output Power (dBm)	Output Power (W)	Gp (dB)	Idd (A)	ηd (%)	Return Loss (dB)	2fo (dBc)	3fo (dBc)
2.4	0.0	0.00	12.7	0.0	12.7	1.03	0.2	-2.8	<-60	<-60
2.4	1.0	0.00	13.6	0.0	12.6	1.03	0.3	-2.8	<-60	<-60
2.4	2.0	0.00	14.6	0.0	12.6	1.04	0.4	-2.8	<-60	<-60
2.4	3.0	0.00	15.6	0.0	12.6	1.04	0.5	-2.8	<-60	<-60
2.4	4.0	0.00	16.6	0.0	12.6	1.04	0.6	-2.8	-50.0	<-60
2.4	5.0	0.00	17.6	0.1	12.6	1.04	0.8	-2.8	-49.3	<-60
2.4	6.0	0.00	18.6	0.1	12.6	1.04	1.0	-2.8	-49.7	<-60
2.4	7.0	0.01	19.6	0.1	12.6	1.04	1.2	-2.8	-48.7	<-60
2.4	8.0	0.01	20.6	0.1	12.6	1.04	1.5	-2.8	-48.8	<-60
2.4	9.0	0.01	21.6	0.1	12.6	1.05	1.9	-2.8	-48.0	<-60
2.4	10.0	0.01	22.6	0.2	12.6	1.05	2.4	-2.8	-46.8	<-60
2.4	11.0	0.01	23.6	0.2	12.6	1.05	3.0	-2.8	-46.3	<-60
2.4	12.0	0.02	24.6	0.3	12.6	1.05	3.8	-2.8	-44.8	<-60
2.4	13.0	0.02	25.6	0.4	12.6	1.06	4.7	-2.8	-44.3	<-60
2.4	14.0	0.03	26.5	0.5	12.5	1.06	5.9	-2.8	-43.5	<-60
2.4	15.0	0.03	27.5	0.6	12.5	1.07	7.3	-2.8	-42.3	<-60
2.4	16.0	0.04	28.5	0.7	12.5	1.08	9.2	-2.7	-41.2	<-60
2.4	17.0	0.05	29.5	0.9	12.5	1.09	11.3	-2.7	-40.0	<-60
2.4	18.0	0.06	30.5	1.1	12.5	1.11	13.9	-2.7	-39.0	<-60
2.4	19.0	0.08	31.4	1.4	12.4	1.13	17.0	-2.7	-37.7	<-60
2.4	20.0	0.10	32.3	1.7	12.3	1.16	20.5	-2.7	-36.3	<-60
2.4	21.0	0.13	33.3	2.1	12.3	1.20	24.6	-2.7	-34.8	<-60
2.4	22.0	0.16	34.2	2.6	12.2	1.25	29.1	-2.7	-33.5	<-60
2.4	23.0	0.20	35.0	3.2	12.0	1.31	33.5	-2.7	-32.3	<-60
2.4	24.0	0.25	35.8	3.8	11.8	1.40	37.9	-2.6	-31.8	<-60
2.4	25.0	0.32	36.6	4.5	11.6	1.49	42.2	-2.6	-32.0	<-60
2.4	26.0	0.40	37.3	5.3	11.3	1.60	46.3	-2.6	-32.7	<-60
2.4	27.0	0.50	37.9	6.1	10.9	1.70	49.8	-2.5	-33.2	<-60
2.4	28.0	0.63	38.4	6.9	10.4	1.81	52.9	-2.4	-33.5	<-60
2.4	29.0	0.79	38.8	7.6	9.8	1.90	55.5	-2.4	-33.0	<-60
2.4	30.0	1.00	39.2	8.3	9.2	1.99	57.7	-2.3	-32.3	<-60
2.4	31.0	1.26	39.5	8.9	8.5	2.07	59.5	-2.2	-31.5	<-60
2.4	32.0	1.59	39.7	9.4	7.7	2.14	60.9	-2.1	-30.5	<-60
2.4	33.0	2.00	39.9	9.9	6.9	2.20	62.2	-2.0	-29.8	<-60

RD09MUP2 Output Power, Power Gain, Drain Efficiency vs. Input Power
 (@ f=470MHz, Vdd=7.2V, Idq=1A)



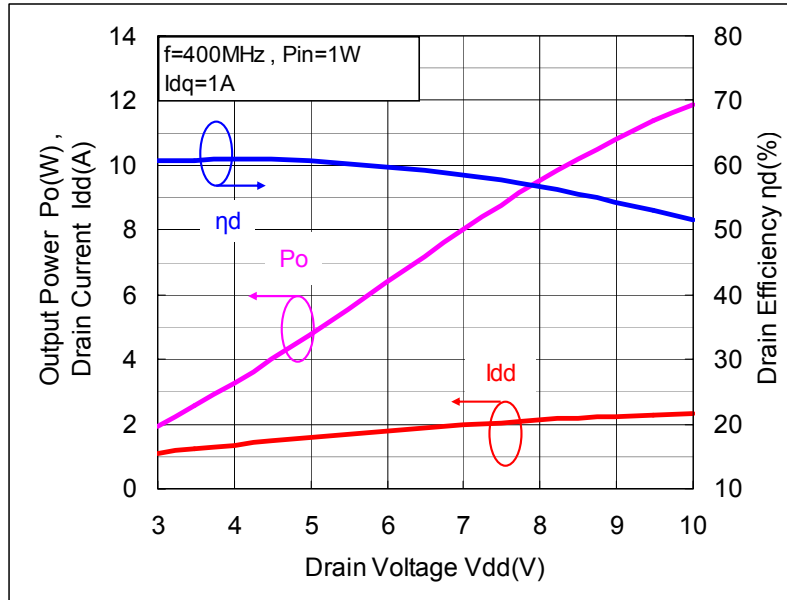
V	Pin (dBm)	Pin (W)	Output Power (dBm)	Output Power (W)	Gp (dB)	Idd (A)	ηd (%)	Return Loss (dB)	2fo (dBc)	3fo (dBc)
2.4	0.0	0.00	14.4	0.0	14.4	1.04	0.4	-8.5	<-60	<-60
2.4	1.0	0.00	15.4	0.0	14.4	1.04	0.5	-9.0	<-60	<-60
2.4	2.0	0.00	16.4	0.0	14.4	1.04	0.6	-9.1	<-60	<-60
2.4	3.0	0.00	17.4	0.1	14.4	1.04	0.7	-9.0	<-60	<-60
2.4	4.0	0.00	18.3	0.1	14.3	1.04	0.9	-8.1	<-60	<-60
2.4	5.0	0.00	19.4	0.1	14.4	1.04	1.1	-8.1	<-60	<-60
2.4	6.0	0.00	20.4	0.1	14.3	1.04	1.4	-8.1	<-60	<-60
2.4	7.0	0.01	21.4	0.1	14.4	1.05	1.8	-8.1	<-60	<-60
2.4	8.0	0.01	22.4	0.2	14.4	1.05	2.3	-8.1	<-60	<-60
2.4	9.0	0.01	23.3	0.2	14.3	1.05	2.9	-8.1	<-60	<-60
2.4	10.0	0.01	24.3	0.3	14.3	1.05	3.6	-8.1	<-60	<-60
2.4	11.0	0.01	25.3	0.3	14.3	1.05	4.5	-8.1	<-60	<-60
2.4	12.0	0.02	26.3	0.4	14.3	1.06	5.6	-8.1	<-60	<-60
2.4	13.0	0.02	27.3	0.5	14.3	1.06	7.0	-8.1	<-60	<-60
2.4	14.0	0.03	28.3	0.7	14.3	1.07	8.8	-8.1	<-60	<-60
2.4	15.0	0.03	29.3	0.8	14.3	1.08	10.9	-8.1	<-60	<-60
2.4	16.0	0.04	30.3	1.1	14.3	1.09	13.6	-8.0	<-60	<-60
2.4	17.0	0.05	31.2	1.3	14.2	1.10	16.8	-8.1	<-60	<-60
2.4	18.0	0.06	32.2	1.7	14.2	1.12	20.7	-8.1	<-60	<-60
2.4	19.0	0.08	33.2	2.1	14.2	1.15	25.1	-8.1	<-60	<-60
2.4	20.0	0.10	34.1	2.6	14.1	1.18	30.1	-8.1	<-60	<-60
2.4	21.0	0.13	35.0	3.2	14.0	1.24	35.5	-8.2	<-60	<-60
2.4	22.0	0.16	35.8	3.8	13.8	1.30	40.5	-8.3	<-60	<-60
2.4	23.0	0.20	36.5	4.5	13.5	1.39	45.2	-8.4	<-60	<-60
2.4	24.0	0.25	37.1	5.2	13.1	1.47	49.0	-8.5	<-60	<-60
2.4	25.0	0.32	37.6	5.8	12.6	1.56	51.9	-8.5	<-60	<-60
2.4	26.0	0.40	38.1	6.4	12.1	1.64	54.3	-8.3	-57.0	<-60
2.4	27.0	0.50	38.4	7.0	11.4	1.72	56.1	-8.1	-54.5	<-60
2.4	28.0	0.63	38.7	7.4	10.7	1.80	57.5	-7.8	-52.7	<-60
2.4	29.0	0.79	39.0	7.9	10.0	1.86	58.7	-7.6	-51.7	<-60
2.4	30.0	1.00	39.2	8.3	9.2	1.93	59.8	-7.3	-50.7	<-60
2.4	31.0	1.26	39.4	8.6	8.4	1.98	60.6	-7.1	-50.2	<-60
2.4	32.0	1.58	39.5	9.0	7.5	2.03	61.5	-6.9	-49.7	<-60
2.4	33.0	2.00	39.5	9.0	6.5	2.03	61.4	-6.9	-49.7	<-60

RD09MUP2 Output Power, Power Gain, Drain Efficiency vs. Input Power
 (@ f=527MHz, Vdd=7.2V, Idq=1A)



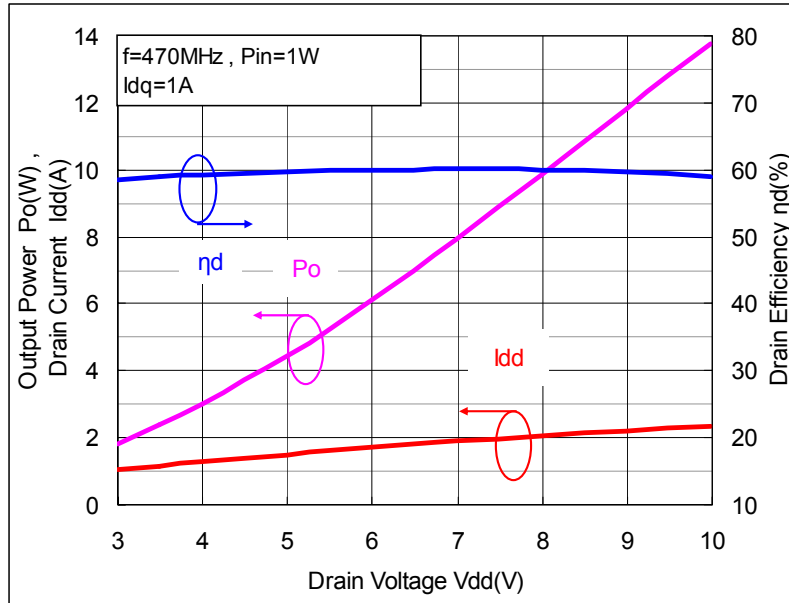
V _{gg} (V)	Pin (dBm)	Pin (W)	Output Power (dBm)	Output Power (W)	G _p (dB)	I _{dd} (A)	η _d (%)	Return Loss (dB)	2f _o (dBc)	3f _o (dBc)
2.4	0.0	0.00	13.8	0.0	13.8	1.03	0.3	-22.0	<-60	<-60
2.4	1.0	0.00	14.8	0.0	13.8	1.04	0.4	-16.0	<-60	<-60
2.4	2.0	0.00	15.8	0.0	13.8	1.04	0.5	-15.9	<-60	<-60
2.4	3.0	0.00	16.8	0.0	13.8	1.04	0.6	-15.8	<-60	<-60
2.4	4.0	0.00	17.8	0.1	13.8	1.04	0.8	-15.6	<-60	<-60
2.4	5.0	0.00	18.7	0.1	13.8	1.04	1.0	-15.4	<-60	<-60
2.4	6.0	0.00	19.8	0.1	13.8	1.04	1.3	-15.5	<-60	<-60
2.4	7.0	0.01	20.8	0.1	13.8	1.04	1.6	-15.5	<-60	<-60
2.4	8.0	0.01	21.8	0.2	13.8	1.05	2.0	-15.4	<-60	<-60
2.4	9.0	0.01	22.8	0.2	13.8	1.05	2.5	-15.4	<-60	<-60
2.4	10.0	0.01	23.7	0.2	13.7	1.05	3.1	-14.8	<-60	<-60
2.4	11.0	0.01	24.7	0.3	13.7	1.05	3.9	-14.5	<-60	<-60
2.4	12.0	0.02	25.7	0.4	13.7	1.05	4.9	-14.5	<-60	<-60
2.4	13.0	0.02	26.7	0.5	13.7	1.06	6.2	-14.5	<-60	<-60
2.4	14.0	0.03	27.7	0.6	13.7	1.06	7.7	-14.5	<-60	<-60
2.4	15.0	0.03	28.7	0.7	13.7	1.07	9.7	-14.5	<-60	<-60
2.4	16.0	0.04	29.7	0.9	13.7	1.07	12.0	-14.5	<-60	<-60
2.4	17.0	0.05	30.7	1.2	13.7	1.08	15.0	-14.5	<-60	<-60
2.4	18.0	0.06	31.7	1.5	13.7	1.10	18.5	-14.6	<-60	<-60
2.4	19.0	0.08	32.6	1.8	13.6	1.12	22.9	-14.6	<-60	<-60
2.4	20.0	0.10	33.6	2.3	13.6	1.14	28.0	-14.7	<-60	<-60
2.4	21.0	0.13	34.5	2.8	13.5	1.17	33.2	-14.9	<-60	<-60
2.4	22.0	0.16	35.3	3.4	13.3	1.22	38.9	-15.0	<-60	<-60
2.4	23.0	0.20	36.1	4.0	13.1	1.27	44.1	-15.3	<-60	<-60
2.4	24.0	0.25	36.7	4.7	12.7	1.34	48.4	-15.7	<-60	<-60
2.4	25.0	0.32	37.2	5.2	12.2	1.40	51.8	-16.0	<-60	<-60
2.4	26.0	0.40	37.6	5.7	11.6	1.46	54.3	-15.9	<-60	<-60
2.4	27.0	0.50	37.9	6.2	10.9	1.53	56.3	-15.3	<-60	<-60
2.4	28.0	0.63	38.2	6.6	10.2	1.59	57.7	-14.4	<-60	<-60
2.4	29.0	0.79	38.4	7.0	9.4	1.65	58.7	-13.4	<-60	<-60
2.4	30.0	1.00	38.6	7.3	8.6	1.70	59.7	-12.3	<-60	<-60
2.4	31.0	1.26	38.8	7.6	7.8	1.74	60.5	-11.2	<-60	<-60
2.4	32.0	1.58	39.0	7.9	7.0	1.79	61.2	-10.2	<-60	<-60
2.4	33.0	2.00	39.0	7.9	6.0	1.79	61.4	-10.1	<-60	<-60

RD09MUP2 Output Power, Drain Current, Drain Efficiency vs. Drain Voltage
 (@ f=400MHz, Pin=1W, Idq=1A)



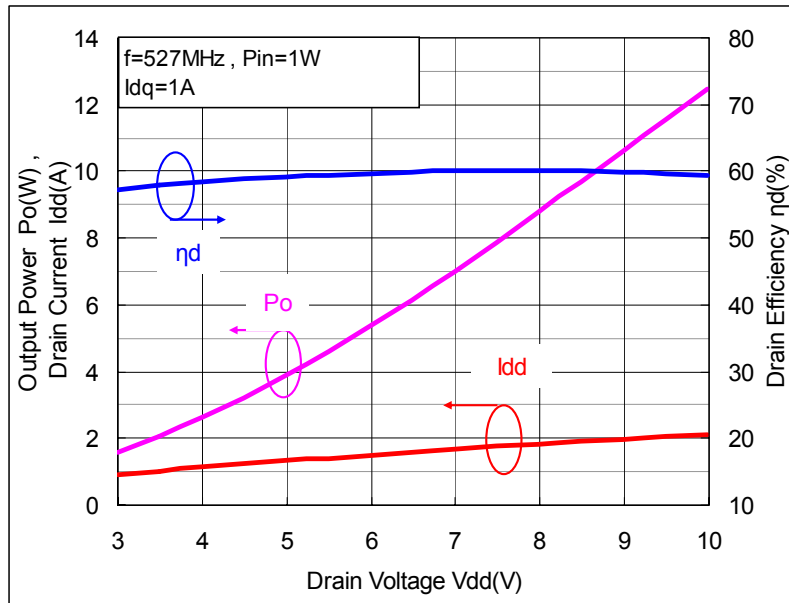
Vdd (V)	Vgg (V)	Output Power (dBm)	Output Power (W)	Idd (A)	ηd (%)	Return Loss (dB)	2fo (dBc)	3fo (dBc)
3.0	2.4	32.9	1.9	1.08	60.6	-1.7	-26.3	<-60
3.5	2.4	34.1	2.6	1.21	60.8	-1.7	-27.2	<-60
4.0	2.4	35.1	3.3	1.34	61.0	-1.8	-27.7	<-60
4.5	2.4	36.0	4.0	1.46	60.9	-1.9	-28.5	<-60
5.0	2.4	36.8	4.7	1.58	60.6	-2.0	-29.3	<-60
5.5	2.4	37.4	5.6	1.69	60.3	-2.1	-30.2	<-60
6.0	2.4	38.0	6.4	1.78	59.8	-2.1	-30.5	<-60
6.5	2.4	38.6	7.2	1.87	59.2	-2.2	-31.5	<-60
7.0	2.4	39.0	8.0	1.96	58.6	-2.3	-32.0	<-60
7.5	2.4	39.4	8.8	2.04	57.7	-2.3	-32.3	<-60
8.0	2.4	39.8	9.5	2.10	56.7	-2.3	-32.5	<-60
8.5	2.4	40.1	10.2	2.17	55.5	-2.4	-32.0	<-60
9.0	2.4	40.3	10.8	2.22	54.3	-2.4	-31.7	<-60
9.5	2.4	40.6	11.4	2.27	53.0	-2.4	-31.2	<-60
10.0	2.4	40.7	11.9	2.31	51.6	-2.5	-30.5	<-60

RD09MUP2 Output Power, Drain Current, Drain Efficiency vs. Drain Voltage
 (@ f=470MHz, Pin=1W, Idq=1A)



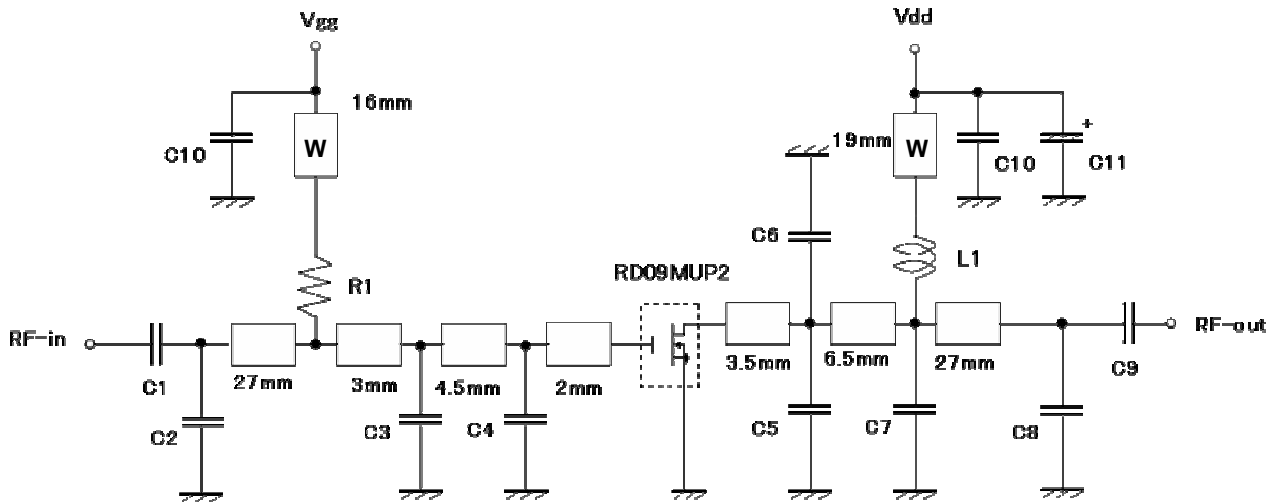
Vdd (V)	Vgg (V)	Output Power (dBm)	Output Power (W)	Idd (A)	ηd (%)	Return Loss (dB)	2fo (dBc)	3fo (dBc)
3.0	2.4	32.6	1.8	1.04	58.6	-5.9	-47.3	<-60
3.5	2.4	33.8	2.4	1.16	58.9	-6.1	-47.5	<-60
4.0	2.4	34.8	3.0	1.28	59.2	-6.3	-47.8	<-60
4.5	2.4	35.7	3.7	1.39	59.5	-6.5	-48.5	<-60
5.0	2.4	36.5	4.4	1.50	59.6	-6.7	-48.8	<-60
5.5	2.4	37.2	5.3	1.61	59.8	-6.8	-49.2	<-60
6.0	2.4	37.9	6.1	1.71	59.9	-7.0	-49.7	<-60
6.5	2.4	38.4	7.0	1.80	60.0	-7.1	-50.0	<-60
7.0	2.4	39.0	7.9	1.89	60.1	-7.3	-50.5	<-60
7.5	2.4	39.5	8.9	1.98	60.1	-7.4	-50.8	<-60
8.0	2.4	39.9	9.8	2.06	60.0	-7.5	-51.5	<-60
8.5	2.4	40.3	10.8	2.14	59.8	-7.6	-52.3	<-60
9.0	2.4	40.7	11.8	2.21	59.6	-7.6	-52.7	<-60
9.5	2.4	41.1	12.8	2.28	59.4	-7.7	-53.5	<-60
10.0	2.4	41.4	13.8	2.35	59.0	-7.7	-53.8	<-60

RD09MUP2 Output Power, Drain Current, Drain Efficiency vs. Drain Voltage
 (@ f=527MHz, Pin=1W, Idq=1A)



Vdd (V)	Vgg (V)	Output Power (dBm)	Output Power (W)	Idd (A)	ηd (%)	Return Loss (dB)	2fo (dBc)	3fo (dBc)
3.0	2.4	32.0	1.6	0.92	57.3	-7.3	<-60	<-60
3.5	2.4	33.1	2.1	1.02	58.0	-7.7	<-60	<-60
4.0	2.4	34.2	2.6	1.13	58.4	-8.2	<-60	<-60
4.5	2.4	35.1	3.2	1.23	58.8	-8.8	<-60	<-60
5.0	2.4	35.9	3.9	1.32	59.2	-9.3	<-60	<-60
5.5	2.4	36.6	4.6	1.41	59.5	-9.9	<-60	<-60
6.0	2.4	37.3	5.4	1.50	59.7	-10.5	<-60	<-60
6.5	2.4	37.9	6.1	1.59	59.9	-11.2	<-60	<-60
7.0	2.4	38.5	7.0	1.67	60.1	-11.9	<-60	<-60
7.5	2.4	39.0	7.9	1.75	60.2	-12.6	<-60	<-60
8.0	2.4	39.4	8.8	1.83	60.2	-13.3	<-60	<-60
8.5	2.4	39.9	9.7	1.91	60.1	-14.0	<-60	<-60
9.0	2.4	40.3	10.6	1.98	59.9	-14.8	<-60	<-60
9.5	2.4	40.6	11.5	2.04	59.7	-15.5	<-60	<-60
10.0	2.4	41.0	12.5	2.11	59.4	-16.1	<-60	<-60

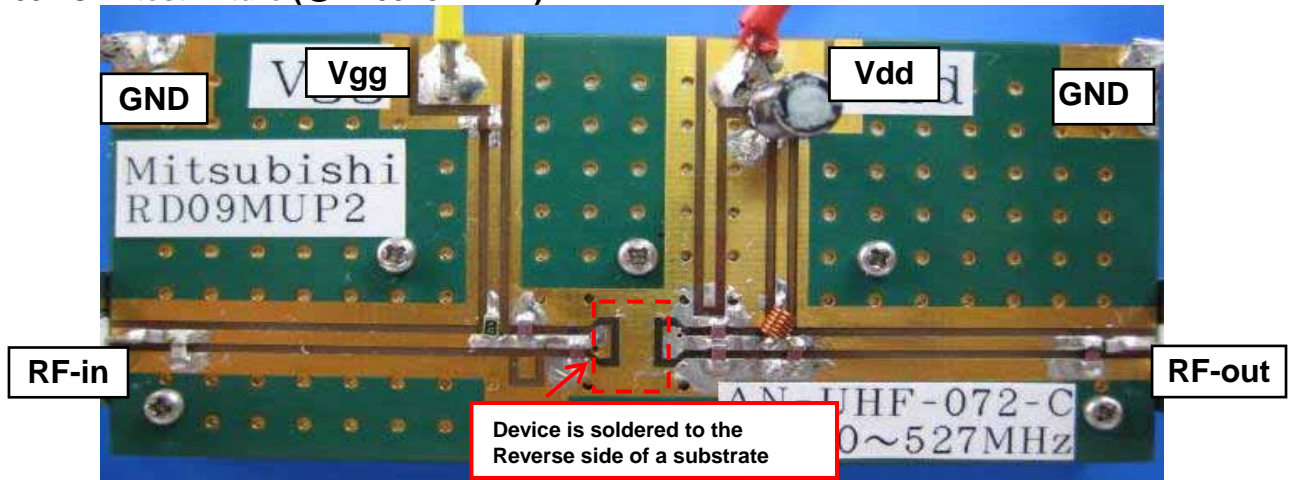
RD09MUP2 Equivalent Circuit (@f=400-527MHz)



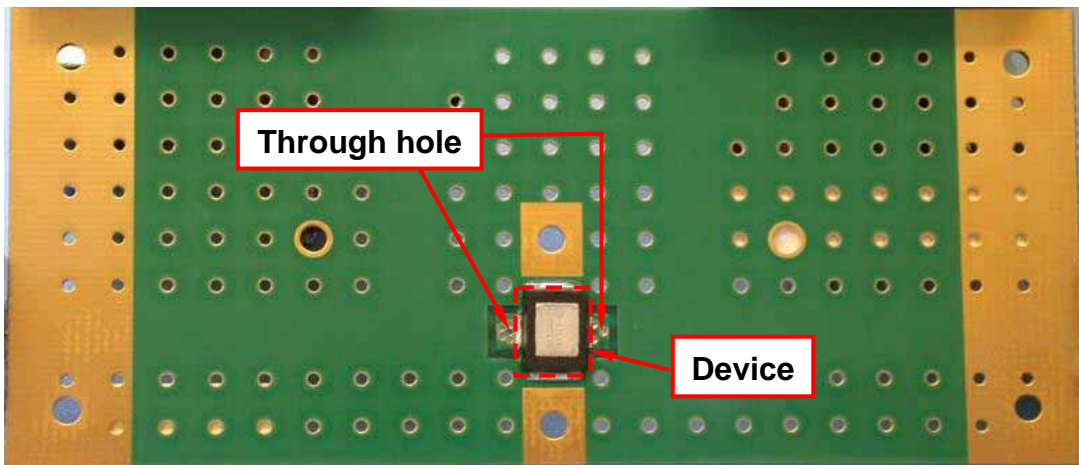
Note: Board material – Glass-Epoxy Substrate. Microstrip line width=1.3mm/50 OHM, er:4.8, t=0.8mm. W: Line width=1.0mm.

Parts Type		Value	Type name	Vender
Capacitor	C1	330pF	GRM2162C1H331JA01D	Murata Manufacturing Co.,Ltd.
	C2	5pF	GRM2162C1H5R0CD01D	Murata Manufacturing Co.,Ltd.
	C3	33pF	GRM2162C1H330JZ01D	Murata Manufacturing Co.,Ltd.
	C4	33pF	GRM2162C1H330JZ01D	Murata Manufacturing Co.,Ltd.
	C5	24pF	GRM2162C1H240JZ01D	Murata Manufacturing Co.,Ltd.
	C6	30pF	GRM2162C1H300JZ01D	Murata Manufacturing Co.,Ltd.
	C7	20pF	GRM2162C1H200JZ01D	Murata Manufacturing Co.,Ltd.
	C8	11pF	GRM2162C1H110JZ01D	Murata Manufacturing Co.,Ltd.
	C9	330pF	GRM2162C1H331JA01D	Murata Manufacturing Co.,Ltd.
	C10	4700pF	GRM216R11H472KA01D	Murata Manufacturing Co.,Ltd.
	C11	4700pF	GRM216R11H472KA01D	Murata Manufacturing Co.,Ltd.
	C12	22μF	UVZ1H220MDD	NICHICON CORPORATION
Resistance	R1	4.7K OHM	CR20-472JB	Hokuriku Electric Industry Co.,Ltd.
	L1	43.7nH Enameled wire 6Turns, Diameter:0.43mm,φ2.46mm(the out side diameter)	4006A	yc corporation Co.,Ltd.

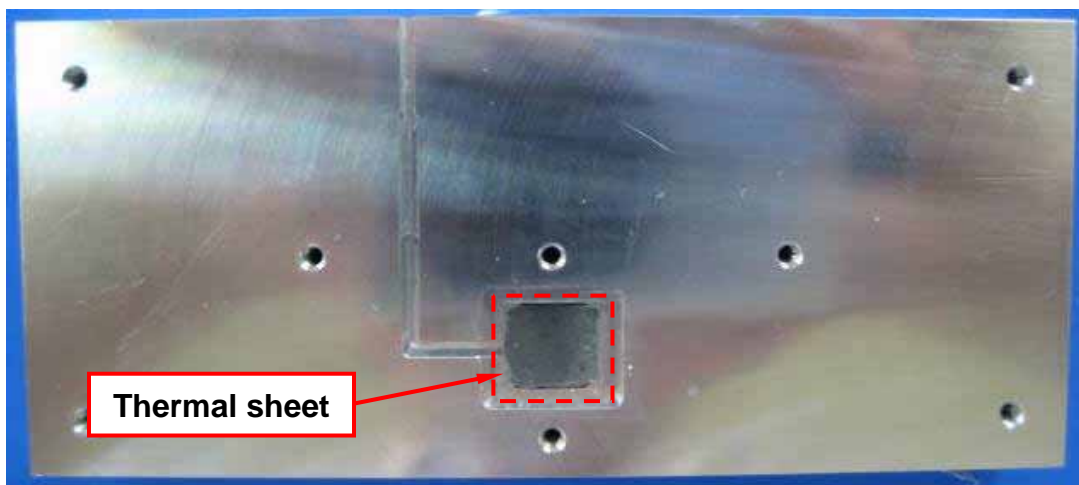
RD09MUP2 test fixture (@ $f=400\text{-}527\text{MHz}$)



Front side View



Reverse side View



Heat sink View