APPLICATION NOTE

MITSUBISHI ELECTRIC
Silicon RF Power Semiconductors

Document No. AN-900-045

Date : 28th Oct. 2011
Prepared : S.Nakatsuka
Confirmed : S.Kametani
(Taking charge of Silicon RF by MIYOSHI Electronics)

SUBJECT:

RD01MUS1,RD07MUS2B TETRA 2stage amplifier RF characteristics data (f=800-870MHz)

SUMMARY:

Sample history:

* (Driver) RD01MUS1 : Lot No. ”PB1”
* (Final) RD07MUS2B : Lot No. ”086ZE-G”

Evaluating conditions:

@ f=800MHz and 835MHz and 870MHz, Vdd=7.2V,
Vgg=3.5V [Idq=350mA (RD01MUS1 ; 100mA, RD07MUS2B ; 250mA)
π/4DQPSK, Filter (α=0.35), Symbol rate=18ksps, Band Width=18kHz

Results:

1. Summary

@Vdd=7.2V, Vgg=3.5V [Idq=350mA (RD01MUS1;100mA, RD07MUS2B;250mA)]

f (MHz)	@ Po=3W (Pin ; control)				
	ACP_1L * (dBc)	ACP_1H * (dBc)	Idd (A)	ηd (%)	Gp (dB)
800	-39.7	-38.9	1.10	37.7	27.8
835	-39.2	-38.6	1.07	39.1	29.0
870	-33.7	-32.4	1.02	40.9	31.2

* ACP_1L ; ACP Low @Channel Spacing = 25kHz
ACP_1H ; ACP High @Channel Spacing = 25kHz

Conditions

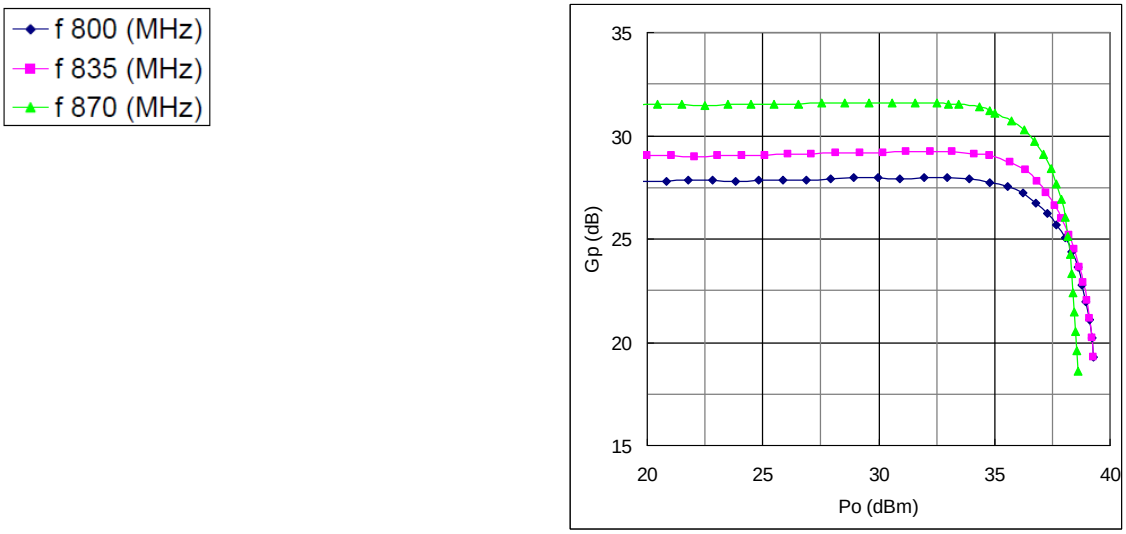
@ Modulation type ; π/4DQPSK, Filter (α=0.35, Current filter response ; Root cosine),
Band Width=18kHz, Symbol rate=18ksps, PRBS9 (PN9)

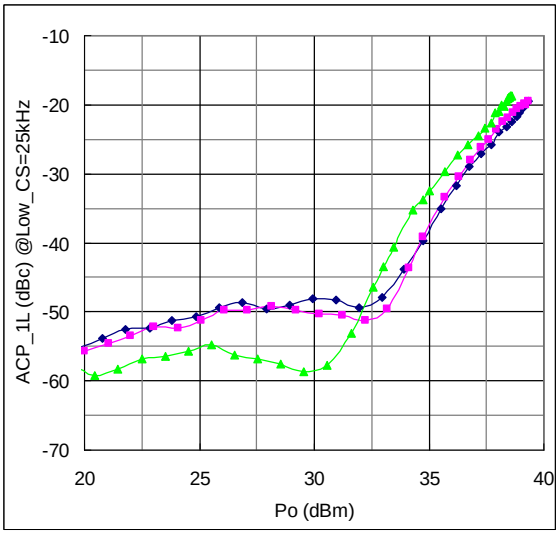
Setting ; Spectrum Analyzer

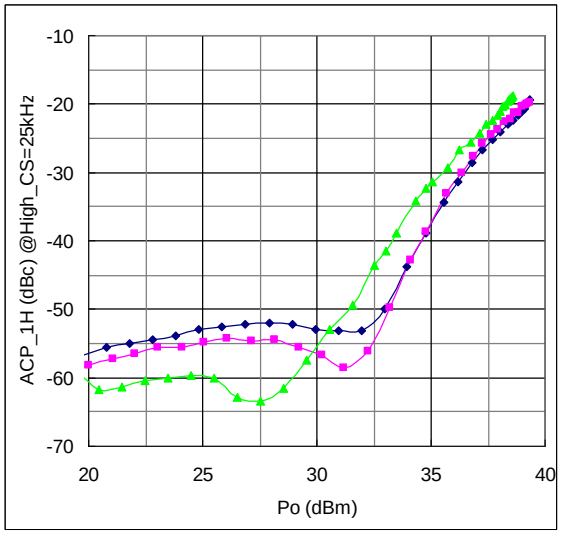
Resolution BW ; 300Hz, Video BW ; 3kHz, Sweep Time ; 1.5s,
Channel Spacing=25kHz (Band Width=18kHz),
Detector ; RMS, Average sweep count “8”

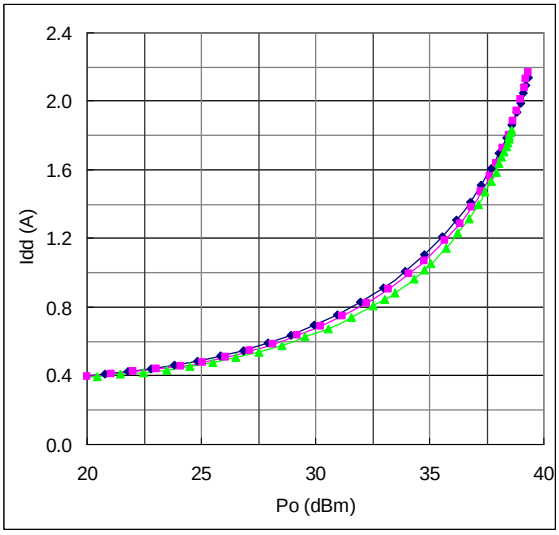
2.RF characteristics

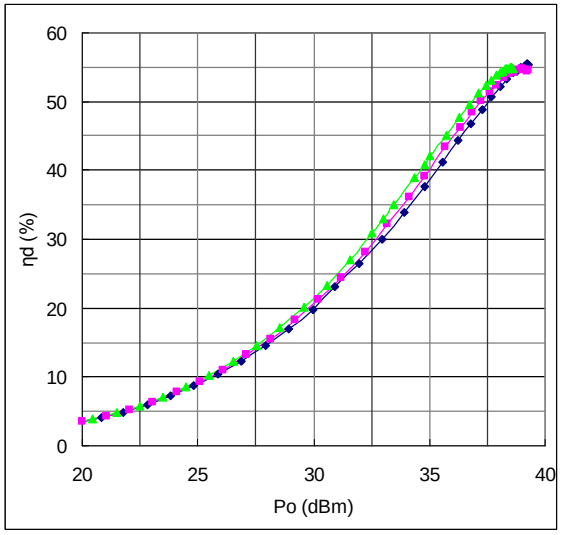
2-1. Pout vs. @ Vdd=7.2V, Vgg=3.5V (Idq=350mA), f=800MHz, 835MHz, 870MHz



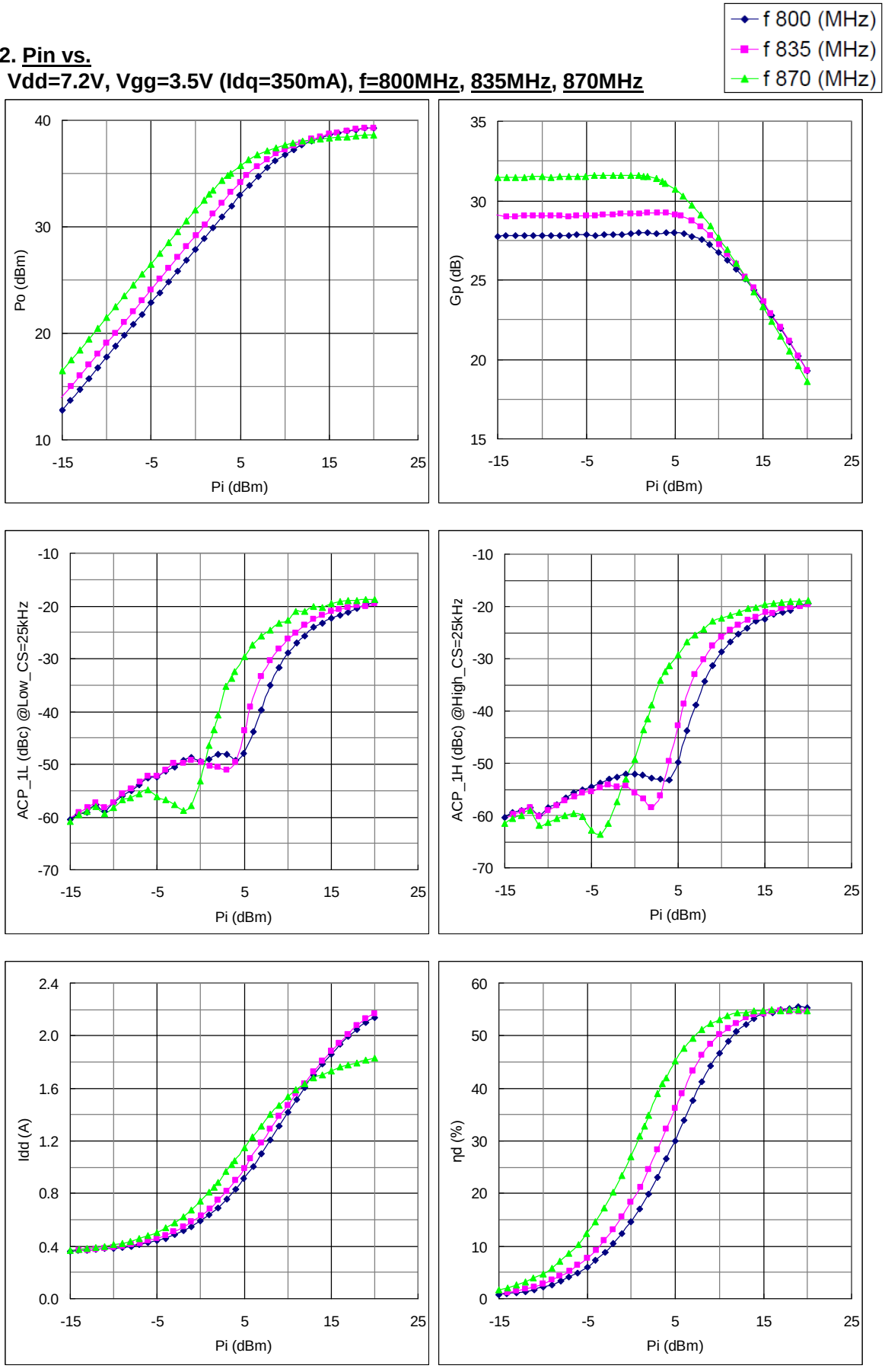








2-2. Pin vs.
@ Vdd=7.2V, Vgg=3.5V (Idq=350mA), f=800MHz, 835MHz, 870MHz



3. RF characteristics data

3-1. @ **f=800MHz,** Vdd=7.2V, Vgg=3.5V (Idq=350mA)

Pin		Po		Gp	Idd	ηd	ACP_1L*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
-15.0	0.000	12.7	0.02	27.7	0.36	0.7	-61	-60
-14.1	0.000	13.7	0.02	27.8	0.37	0.9	-60	-59
-13.0	0.000	14.7	0.03	27.8	0.37	1.1	-59	-59
-12.0	0.000	15.8	0.04	27.8	0.37	1.4	-58	-58
-11.0	0.000	16.8	0.05	27.8	0.38	1.7	-59	-60
-10.0	0.000	17.8	0.06	27.8	0.39	2.2	-57	-59
-9.0	0.000	18.8	0.08	27.8	0.39	2.7	-56	-58
-8.0	0.000	19.8	0.10	27.8	0.40	3.3	-55	-57
-7.0	0.000	20.8	0.12	27.8	0.41	4.1	-54	-56
-6.1	0.000	21.8	0.15	27.8	0.42	4.9	-53	-55
-5.0	0.000	22.8	0.19	27.8	0.44	6.0	-52	-55
-4.0	0.000	23.8	0.24	27.8	0.46	7.3	-51	-54
-3.0	0.001	24.8	0.31	27.8	0.49	8.7	-51	-53
-2.0	0.001	25.9	0.39	27.9	0.51	10.4	-49	-53
-1.0	0.001	26.9	0.49	27.9	0.55	12.3	-49	-52
0.0	0.001	27.9	0.62	27.9	0.59	14.6	-50	-52
1.0	0.001	28.9	0.78	28.0	0.64	17.0	-49	-52
2.0	0.002	30.0	0.99	28.0	0.69	19.8	-48	-53
3.0	0.002	30.9	1.24	27.9	0.76	23.1	-48	-53
4.0	0.003	32.0	1.58	28.0	0.83	26.5	-49	-53
5.0	0.003	33.0	1.98	28.0	0.91	30.0	-48	-50
6.0	0.004	33.9	2.46	27.9	1.01	34.0	-44	-44
7.0	0.005	34.8	3.00	27.8	1.10	37.7	-40	-39
8.0	0.006	35.5	3.59	27.5	1.21	41.2	-35	-34
9.0	0.008	36.2	4.18	27.2	1.31	44.3	-32	-31
10.0	0.010	36.8	4.76	26.8	1.41	46.7	-29	-29
11.0	0.013	37.3	5.32	26.3	1.51	48.9	-27	-27
12.0	0.016	37.7	5.87	25.7	1.61	50.8	-26	-25
13.0	0.020	38.0	6.38	25.1	1.70	52.2	-24	-24
14.0	0.025	38.4	6.86	24.4	1.79	53.3	-23	-23
15.0	0.032	38.6	7.25	23.6	1.86	54.1	-22	-22
16.0	0.040	38.8	7.59	22.8	1.94	54.5	-22	-22
17.0	0.050	39.0	7.87	22.0	1.99	54.9	-21	-21
18.0	0.063	39.1	8.13	21.1	2.05	55.2	-20	-21
19.0	0.080	39.2	8.38	20.2	2.10	55.4	-20	-20
20.0	0.100	39.3	8.52	19.3	2.14	55.3	-19	-19

*ACP_1L ; ACP Low @Channel Spacing = 25kHz
ACP_1H ; ACP High @Channel Spacing = 25kHz

3-2. @ **f=835MHz,** Vdd=7.2V, Vgg=3.5V (Idq=350mA)

Pin		Po		Gp	Idd	ηd	ACP_1L*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
-15.1	0.000	14.0	0.03	29.1	0.37	0.9	-60	-61
-14.0	0.000	15.0	0.03	29.0	0.37	1.2	-59	-60
-13.0	0.000	16.0	0.04	29.0	0.37	1.5	-58	-59
-12.0	0.000	17.0	0.05	29.0	0.38	1.9	-57	-59
-11.0	0.000	18.0	0.06	29.0	0.38	2.3	-58	-60
-10.0	0.000	19.0	0.08	29.0	0.39	2.9	-57	-59
-9.0	0.000	20.0	0.10	29.0	0.40	3.5	-56	-58
-8.0	0.000	21.0	0.13	29.1	0.41	4.3	-55	-57
-7.0	0.000	22.0	0.16	29.0	0.42	5.2	-53	-57
-6.0	0.000	23.0	0.20	29.1	0.44	6.3	-52	-56
-5.0	0.000	24.1	0.26	29.1	0.46	7.7	-52	-56
-4.0	0.000	25.1	0.32	29.1	0.48	9.3	-51	-55
-3.0	0.000	26.1	0.41	29.1	0.51	11.1	-50	-54
-2.0	0.001	27.1	0.51	29.1	0.54	13.1	-50	-55
-1.0	0.001	28.2	0.65	29.2	0.58	15.5	-49	-54
0.0	0.001	29.2	0.83	29.2	0.63	18.3	-50	-56
1.1	0.001	30.2	1.05	29.2	0.69	21.2	-50	-57
2.0	0.002	31.2	1.32	29.2	0.75	24.5	-51	-59
3.0	0.002	32.2	1.67	29.2	0.82	28.2	-51	-56
4.0	0.003	33.2	2.09	29.2	0.90	32.2	-50	-50
5.0	0.003	34.1	2.58	29.1	0.99	36.1	-44	-43
5.7	0.004	34.8	3.00	29.0	1.07	39.1	-39	-39
7.0	0.005	35.7	3.70	28.7	1.19	43.3	-33	-33
8.0	0.006	36.3	4.29	28.3	1.29	46.2	-30	-30
9.0	0.008	36.8	4.82	27.8	1.38	48.4	-28	-28
10.0	0.010	37.3	5.31	27.2	1.47	50.2	-26	-26
11.0	0.013	37.6	5.77	26.6	1.56	51.4	-25	-25
11.9	0.016	37.9	6.17	26.0	1.64	52.4	-24	-24
13.0	0.020	38.2	6.64	25.2	1.73	53.5	-23	-23
14.0	0.025	38.5	7.02	24.5	1.80	54.1	-22	-22
15.1	0.032	38.7	7.36	23.6	1.88	54.2	-21	-21
15.9	0.039	38.8	7.63	22.9	1.94	54.6	-21	-21
17.0	0.050	39.0	7.93	22.0	2.01	54.7	-20	-20
18.0	0.063	39.1	8.20	21.2	2.08	54.6	-20	-20
19.0	0.080	39.2	8.37	20.2	2.13	54.5	-20	-20
20.0	0.100	39.3	8.52	19.3	2.17	54.5	-20	-20

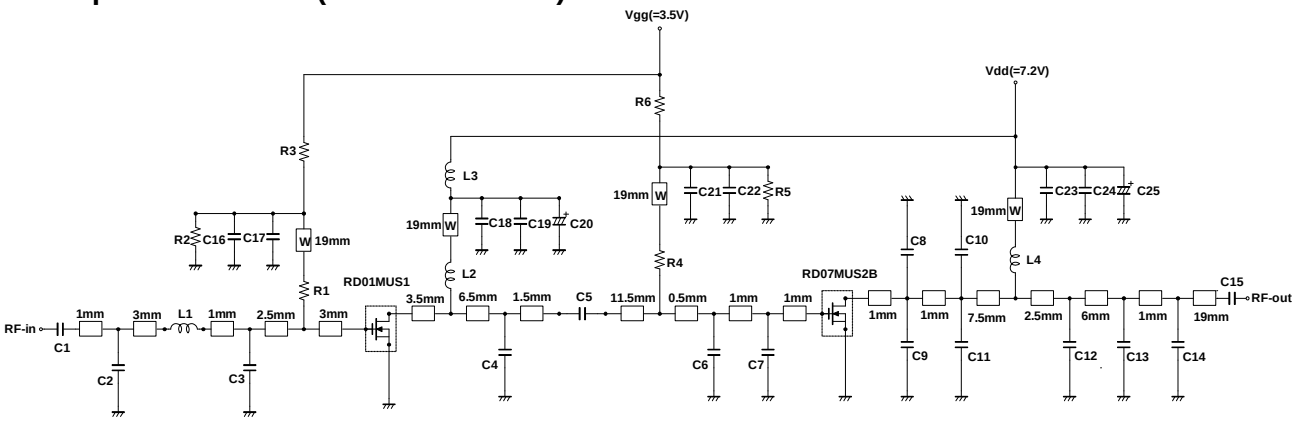
*ACP_1L ; ACP Low @Channel Spacing = 25kHz
ACP_1H ; ACP High @Channel Spacing = 25kHz

3-3. @ **f=870MHz,** Vdd=7.2V, Vgg=3.5V (Idq=350mA)

Pin		Po		Gp	Idd	ηd	ACP_1L*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
-15.0	0.000	16.5	0.04	31.5	0.37	1.7	-61	-62
-14.0	0.000	17.5	0.06	31.5	0.38	2.0	-60	-61
-13.0	0.000	18.4	0.07	31.5	0.38	2.5	-59	-60
-12.0	0.000	19.5	0.09	31.5	0.39	3.1	-58	-59
-11.1	0.000	20.5	0.11	31.5	0.40	3.9	-59	-62
-10.0	0.000	21.5	0.14	31.5	0.41	4.8	-58	-61
-9.0	0.000	22.5	0.18	31.5	0.42	5.8	-57	-61
-8.0	0.000	23.5	0.22	31.5	0.44	7.1	-56	-60
-7.0	0.000	24.5	0.28	31.5	0.46	8.6	-56	-60
-6.0	0.000	25.5	0.36	31.5	0.48	10.3	-55	-60
-5.0	0.000	26.5	0.45	31.5	0.51	12.3	-56	-63
-4.0	0.000	27.5	0.57	31.6	0.54	14.6	-57	-64
-3.0	0.000	28.6	0.72	31.6	0.58	17.2	-58	-62
-2.0	0.001	29.6	0.91	31.6	0.63	20.2	-59	-57
-1.0	0.001	30.6	1.14	31.6	0.68	23.4	-58	-53
0.0	0.001	31.6	1.44	31.6	0.74	27.1	-53	-49
1.0	0.001	32.5	1.80	31.6	0.81	30.9	-47	-44
1.5	0.001	33.0	2.00	31.5	0.85	32.9	-43	-42
2.0	0.002	33.5	2.22	31.5	0.88	35.0	-41	-39
3.0	0.002	34.3	2.71	31.4	0.97	38.9	-35	-34
3.6	0.002	34.8	3.00	31.2	1.02	40.9	-34	-32
3.9	0.002	35.0	3.18	31.1	1.05	42.0	-33	-31
5.0	0.003	35.7	3.72	30.7	1.14	45.2	-30	-29
6.0	0.004	36.3	4.23	30.3	1.23	47.7	-27	-27
7.0	0.005	36.7	4.69	29.7	1.32	49.5	-26	-26
8.0	0.006	37.1	5.16	29.1	1.40	51.2	-25	-24
9.0	0.008	37.4	5.53	28.4	1.47	52.3	-23	-23
10.0	0.010	37.7	5.87	27.7	1.54	53.1	-23	-22
11.0	0.013	37.9	6.16	26.9	1.59	53.9	-21	-22
12.0	0.016	38.0	6.38	26.0	1.63	54.3	-21	-21
13.0	0.020	38.2	6.57	25.1	1.68	54.3	-20	-20
14.0	0.025	38.3	6.71	24.3	1.71	54.7	-20	-20
15.0	0.032	38.4	6.84	23.4	1.74	54.7	-20	-20
16.0	0.040	38.4	6.95	22.4	1.76	54.9	-19	-19
17.0	0.050	38.5	7.03	21.5	1.78	54.8	-19	-19
18.0	0.063	38.5	7.09	20.5	1.80	54.9	-19	-19
19.0	0.079	38.6	7.19	19.6	1.82	54.9	-19	-19
20.0	0.100	38.6	7.23	18.6	1.83	54.8	-19	-19

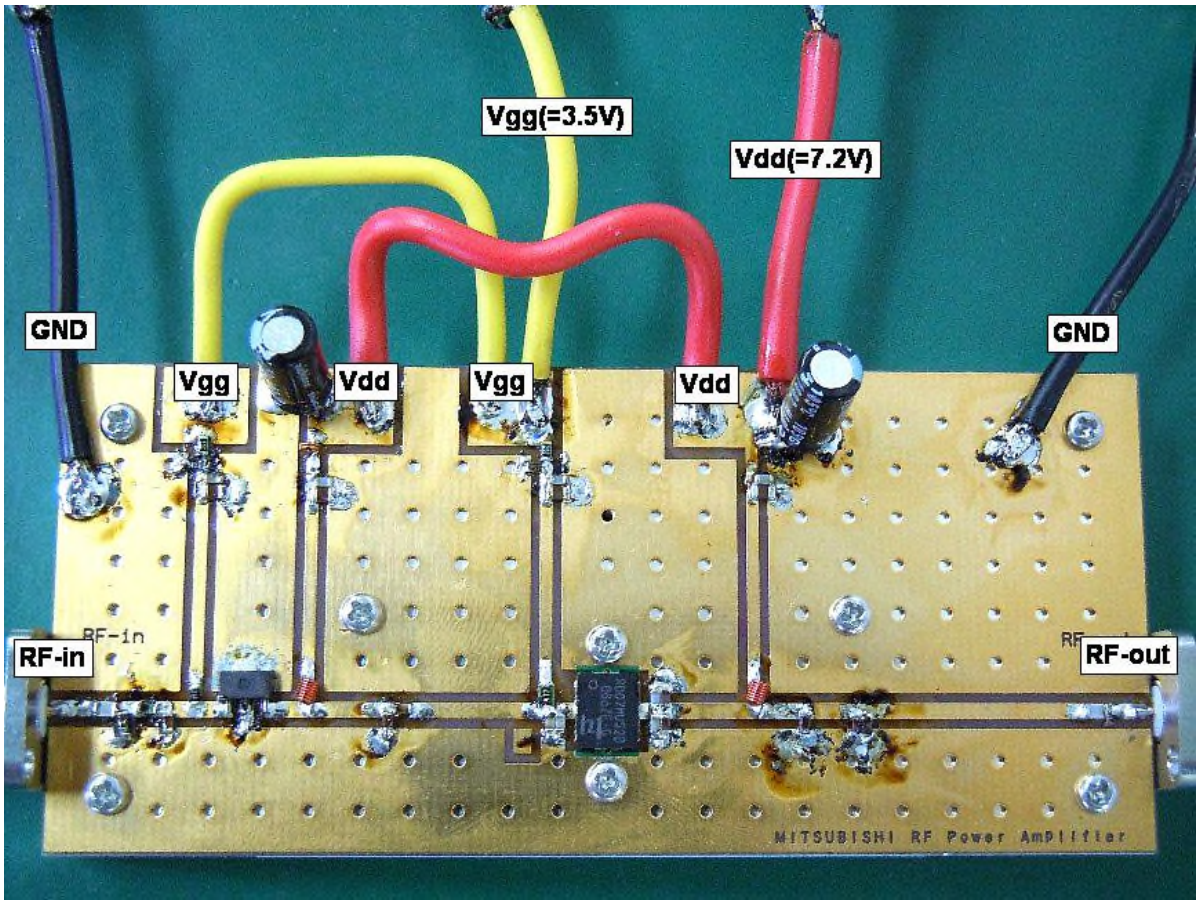
*ACP_1L ; ACP Low @Channel Spacing = 25kHz
ACP_1H ; ACP High @Channel Spacing = 25kHz

4. Equivalent circuit (f=800 to 870MHz)



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	GRM2162C1H101JA01D	Murata Manufacturing Co., Ltd.
	C2	3pF	GRM1882C1H3R0CZ01D	Murata Manufacturing Co., Ltd.
	C3	9pF	GRM1882C1H9R0DZ01D	Murata Manufacturing Co., Ltd.
	C4	6pF	GRM1882C1H6R0DZ01D	Murata Manufacturing Co., Ltd.
	C5	15pF	GRM1882C1H150JA01D	Murata Manufacturing Co., Ltd.
	C6	10pF	GRM1882C1H100JA01D	Murata Manufacturing Co., Ltd.
	C7	12pF	GRM1882C1H120JA01D	Murata Manufacturing Co., Ltd.
	C8	10pF	GRM1882C1H100JA01D	Murata Manufacturing Co., Ltd.
	C9	10pF	GRM1882C1H100JA01D	Murata Manufacturing Co., Ltd.
	C10	8pF	GRM1882C1H8R0DZ01D	Murata Manufacturing Co., Ltd.
	C11	8pF	GRM1882C1H8R0DZ01D	Murata Manufacturing Co., Ltd.
	C12	4pF	GRM1882C1H4R0CZ01D	Murata Manufacturing Co., Ltd.
	C13	3pF	GRM1882C1H3R0CZ01D	Murata Manufacturing Co., Ltd.
	C14	1pF	GRM1882C1H1R0CZ01D	Murata Manufacturing Co., Ltd.
	C15	100pF	GRM2162C1H101JA01D	Murata Manufacturing Co., Ltd.
	C16	22000pF	GRM216R11H223KA01E	Murata Manufacturing Co., Ltd.
	C17	1000pF	GRM188R11H102KA01E	Murata Manufacturing Co., Ltd.
	C18	22000pF	GRM216R11H223KA01E	Murata Manufacturing Co., Ltd.
	C19	1000pF	GRM188R11H102KA01E	Murata Manufacturing Co., Ltd.
	C20	22μF	A0603	NICHICON CORPORATION
	C21	22000pF	GRM216R11H223KA01E	Murata Manufacturing Co., Ltd.
	C22	1000pF	GRM188R11H102KA01E	Murata Manufacturing Co., Ltd.
	C23	22000pF	GRM216R11H223KA01E	Murata Manufacturing Co., Ltd.
	C24	1000pF	GRM188R11H102KA01E	Murata Manufacturing Co., Ltd.
	C25	22μF	A0603	NICHICON CORPORATION
Resistance	R1	1.8K OHM	RPC05-182	Taiyosha Electric Co.,Ltd.
	R2	56K OHM	RPC05-563	Taiyosha Electric Co.,Ltd.
	R3	20K OHM	RPC05-203	Taiyosha Electric Co.,Ltd.
	R4	4.7K OHM	CR1/10-472JB	Hokuriku Electric Industry Co.,Ltd.
	R5	15K OHM	RPC05-153	Taiyosha Electric Co.,Ltd.
	R6	20K OHM	RPC05-203	Taiyosha Electric Co.,Ltd.
Inductance	L1	8.2nH(Chip Inductor)	LQG11A8N2S00	Murata Manufacturing Co., Ltd.
	L2	37.8nH Enameled wire 7Turns, Diameter:0.23mm,φ1.6mm (the out side diameter)	2307A	Yoneda Processing Place Co.,Ltd.
	L3	6.6nH Enameled wire 2Turns, Diameter:0.23mm,φ1.66mm (the out side diameter)	2302S	Yoneda Processing Place Co.,Ltd.
	L4	37.8nH Enameled wire 7Turns, Diameter:0.23mm,φ1.6mm (the out side diameter)	2307A	Yoneda Processing Place Co.,Ltd.


Vgg(=3.5V)
Vdd(=7.2V)
GND
Vgg
Vdd
Vgg
Vdd
GND
RF-in
RF-in
RF-out
MITSUBISHI RF Power Amplifier