APPLICATION NOTE

MITSUBISHI ELECTRIC
Silicon RF Power Semiconductors

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SUBJECT: RD07MUS2B TETRA single-stage amplifier at f=800-870MHz,Vdd=3.6V

SUMMARY:

This application note shows the TETRA data .

- Sample history :
  RD07MUS2B: Lot number "086ZE-G", Sample No. "118"

- Evaluate conditions :
  @ f=800MHz, 820MHz, 840MHz, 860MHz, 870MHz, Vdd=3.6V, Idq=250mA
  π/4DQPSK, Filter (α=0.35), Symbol rate=18ksps, Band Width=18kHz

- Results :
  Page 2. shows the summary data.
  Page 3. shows the Pout characteristics.
  Page 4. shows the Pin characteristics.
  Page 5-9. shows the Pin, Pout characteristics data.
  Page 10. shows the Frequency characteristics.
  Page 11. shows the Frequency characteristics data.
  Page 12. shows the equivalent circuit.

1. Summary

@Vdd=3.6V, Idq=250mA (Vgg=1.48V)

f (MHz)	@ Po=1W (Pin ; control)						@ Po=2W (Pin ; control)						P1dB (dBm)
	ACP_1L * (dBc)	ACP_1H * (dBc)	Pin (W)	Idd (A)	ηd (%)	Gp (dB)	ACP_1L * (dBc)	ACP_1H * (dBc)	Pin (W)	Idd (A)	ηd (%)	Gp (dB)	
800	-37.2	-35.9	0.05	0.84	33.0	13.3	-26.1	-26.7	0.15	1.27	43.6	11.2	31.5
820	-38.5	-37.2	0.04	0.85	32.6	13.7	-26.7	-26.6	0.13	1.28	43.4	11.8	31.3
840	-35.4	-34.3	0.05	0.85	32.6	13.4	-26.4	-26.0	0.14	1.26	43.7	11.6	31.5
860	-36.5	-35.8	0.05	0.84	33.3	12.8	-26.6	-26.2	0.16	1.23	45.0	10.9	31.6
870	-35.2	-34.5	0.06	0.83	33.7	12.2	-25.3	-24.9	0.20	1.22	45.9	10.0	31.5

* 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)

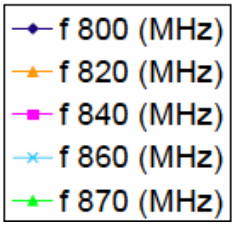
Setting ; Spectrum Analyzer

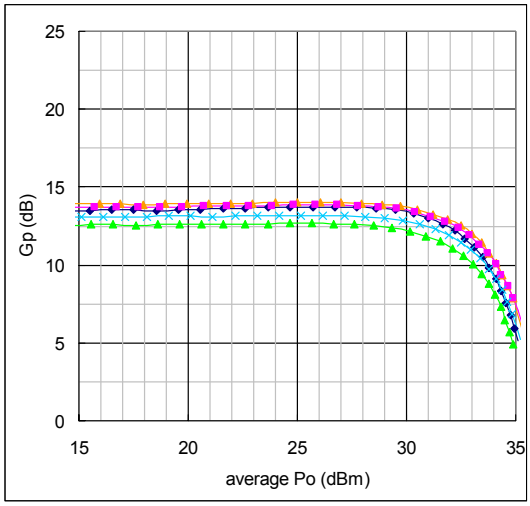
Resolution BW ; 300Hz, Video BW ; 3kHz, Sweep Time ; 1.5s,
Channel Spacing=25kHz (Band Width=18kHz),
Detector ; RMS, Average sweep count "8"

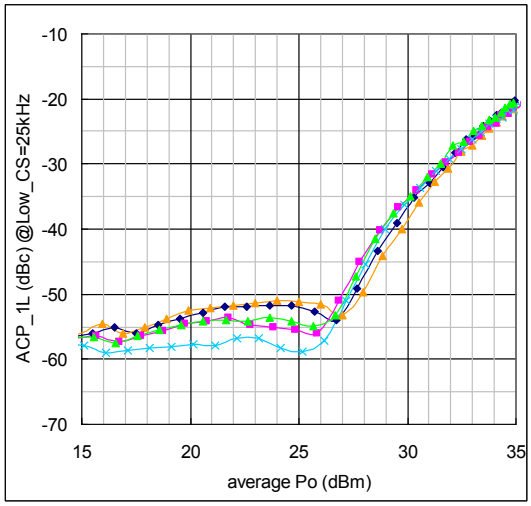
2. RF characteristics

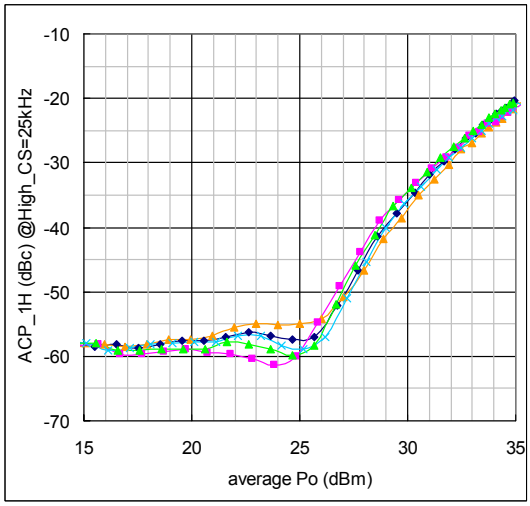
2-1. Pout vs.

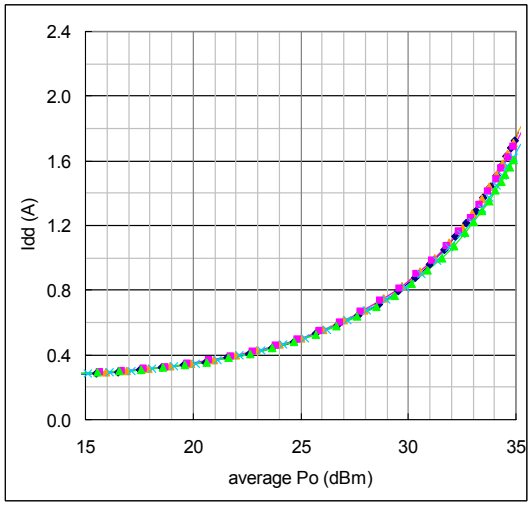
@ Vdd=3.6V, Idq=250mA, f=800MHz, 820MHz, 840MHz, 860MHz, 870MHz

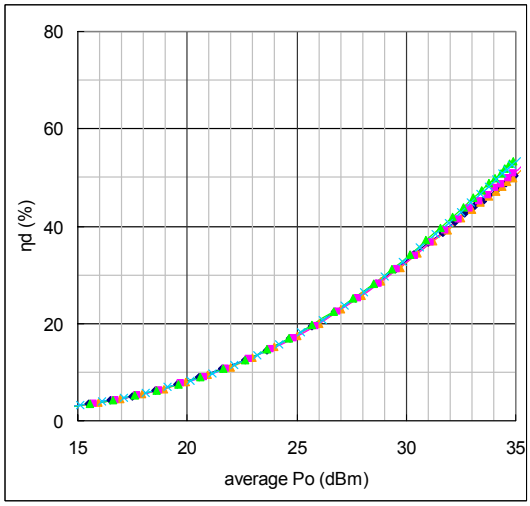






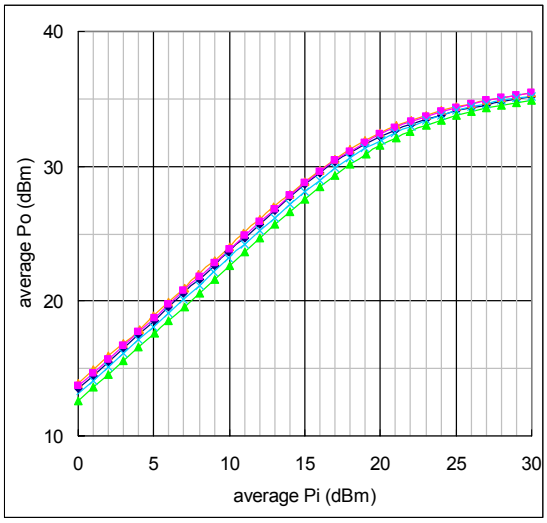


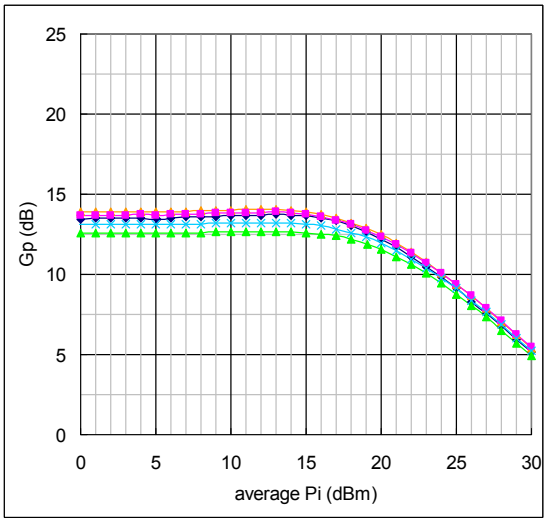


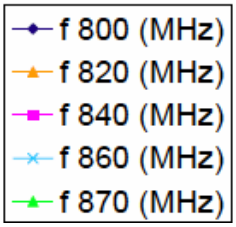


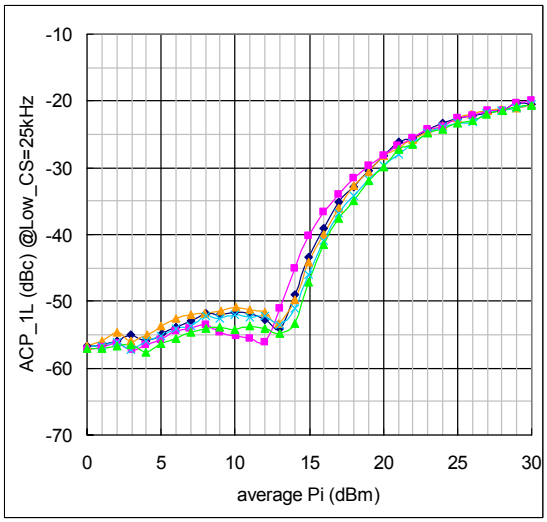
2-2. Pin vs.

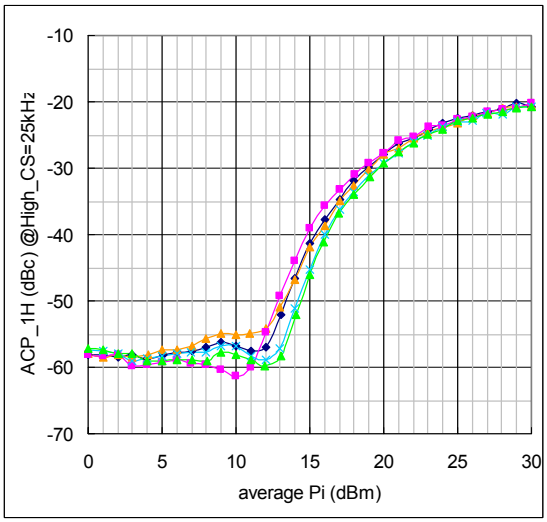
@ Vdd=3.6V, Idq=250mA, f=800MHz, 820MHz, 840MHz, 860MHz, 870MHz

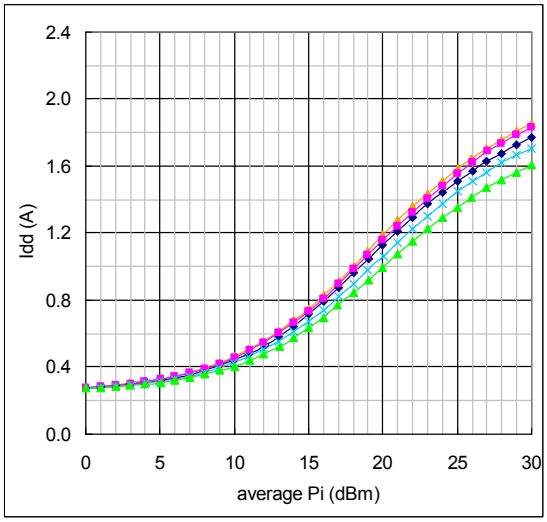


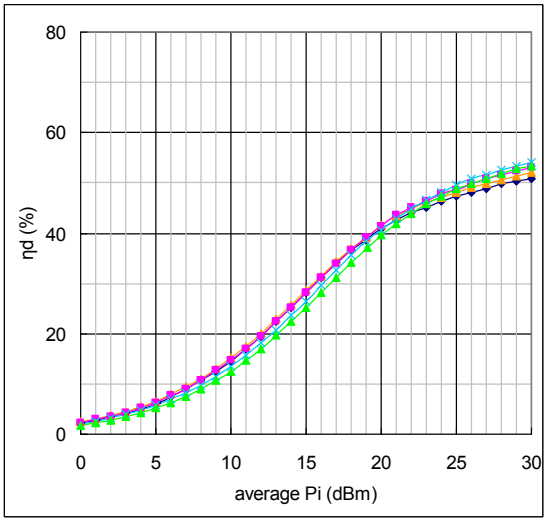












3. Pin, Pout characteristics data.

3-1. @ **f=800MHz,** Vdd=3.6V, Idq=250mA (Vgg=1.48V)

Pin		Po		Gp	Idd	ηd	ACP_1L*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
0.0	0.001	13.5	0.02	13.5	0.28	2.3	-57	-58
1.0	0.001	14.5	0.03	13.5	0.28	2.8	-57	-58
2.0	0.002	15.5	0.04	13.5	0.29	3.4	-56	-58
3.0	0.002	16.5	0.04	13.5	0.30	4.2	-55	-58
4.0	0.003	17.5	0.06	13.5	0.31	5.1	-56	-59
5.1	0.003	18.5	0.07	13.5	0.32	6.2	-55	-58
6.0	0.004	19.5	0.09	13.5	0.34	7.5	-54	-58
7.0	0.005	20.6	0.11	13.6	0.36	8.9	-53	-58
8.0	0.006	21.6	0.14	13.6	0.38	10.6	-52	-57
9.0	0.008	22.6	0.18	13.6	0.41	12.5	-52	-56
10.0	0.010	23.7	0.23	13.7	0.44	14.6	-52	-57
11.0	0.013	24.7	0.29	13.7	0.48	16.9	-52	-57
12.0	0.016	25.7	0.37	13.7	0.53	19.5	-53	-57
13.0	0.020	26.7	0.47	13.7	0.59	22.4	-54	-52
14.0	0.025	27.7	0.59	13.7	0.65	25.3	-49	-47
15.0	0.032	28.6	0.73	13.6	0.72	28.3	-43	-41
16.0	0.040	29.5	0.89	13.5	0.79	31.2	-39	-38
17.0	0.050	30.3	1.08	13.3	0.88	34.0	-35	-35
18.0	0.063	31.0	1.26	13.0	0.96	36.6	-33	-32
19.0	0.080	31.7	1.47	12.7	1.05	38.7	-31	-30
20.0	0.100	32.2	1.66	12.2	1.13	40.9	-28	-28
21.0	0.126	32.7	1.86	11.7	1.21	42.5	-26	-26
22.0	0.159	33.1	2.05	11.1	1.29	44.0	-26	-25
23.0	0.200	33.5	2.24	10.5	1.37	45.2	-24	-24
24.0	0.251	33.8	2.40	9.8	1.44	46.3	-23	-23
25.0	0.317	34.1	2.58	9.1	1.51	47.3	-22	-23
26.0	0.401	34.3	2.72	8.3	1.57	48.1	-22	-22
27.0	0.502	34.6	2.86	7.6	1.63	48.9	-22	-21
28.0	0.631	34.8	3.01	6.8	1.68	49.8	-21	-21
29.0	0.796	34.9	3.12	5.9	1.72	50.4	-20	-20
30.0	1.001	35.1	3.26	5.1	1.78	50.9	-21	-21

*ACP_1L ; ACP Low @Channel Spacing = 25kHz

ACP_1H ; ACP High @Channel Spacing = 25kHz

3-2. @ **f=820MHz,** Vdd=3.6V, Idq=250mA (Vgg=1.48V)

Pin		Po		Gp	Idd	ηd	ACP_1V*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
0.0	0.001	13.9	0.02	13.9	0.28	2.4	-57	-58
1.0	0.001	14.9	0.03	13.9	0.29	3.0	-56	-58
2.0	0.002	15.9	0.04	13.9	0.29	3.7	-55	-58
3.0	0.002	16.9	0.05	13.9	0.30	4.5	-56	-58
4.0	0.003	17.9	0.06	13.9	0.32	5.5	-55	-58
5.0	0.003	18.9	0.08	13.9	0.33	6.6	-54	-57
6.0	0.004	19.9	0.10	13.9	0.35	7.9	-52	-57
7.0	0.005	20.9	0.12	13.9	0.37	9.4	-52	-57
8.0	0.006	22.0	0.16	14.0	0.39	11.1	-52	-56
9.0	0.008	23.0	0.20	14.0	0.43	12.9	-51	-55
10.0	0.010	24.0	0.25	14.0	0.46	15.1	-51	-55
11.0	0.013	25.0	0.32	14.1	0.51	17.5	-51	-55
12.0	0.016	26.0	0.40	14.0	0.56	20.0	-52	-54
13.0	0.020	27.0	0.50	14.0	0.61	22.8	-53	-51
14.0	0.025	28.0	0.63	13.9	0.68	25.6	-50	-47
15.0	0.032	28.9	0.77	13.9	0.75	28.6	-44	-42
16.0	0.040	29.7	0.94	13.8	0.83	31.5	-40	-39
17.0	0.050	30.5	1.13	13.5	0.91	34.3	-36	-35
18.0	0.063	31.2	1.33	13.2	1.00	36.9	-33	-33
19.0	0.079	31.9	1.54	12.9	1.09	39.2	-31	-30
20.0	0.100	32.5	1.78	12.5	1.19	41.6	-28	-28
21.0	0.126	33.0	1.99	12.0	1.28	43.3	-27	-27
22.0	0.159	33.4	2.20	11.4	1.36	44.9	-26	-25
23.0	0.200	33.8	2.38	10.8	1.44	46.0	-25	-25
24.0	0.252	34.1	2.58	10.1	1.51	47.2	-24	-24
25.0	0.318	34.4	2.74	9.4	1.59	48.0	-23	-23
26.0	0.397	34.6	2.90	8.6	1.64	49.2	-22	-22
27.0	0.501	34.9	3.07	7.9	1.71	49.8	-21	-22
28.0	0.633	35.1	3.20	7.0	1.76	50.7	-21	-21
29.0	0.797	35.2	3.35	6.2	1.81	51.4	-21	-21
30.0	1.003	35.4	3.47	5.4	1.85	52.0	-21	-21

*ACP_1L ; ACP Low @Channel Spacing = 25kHz

ACP_1H ; ACP High @Channel Spacing = 25kHz

3-3. @ **f=840MHz,** Vdd=3.6V, Idq=250mA (Vgg=1.48V)

Pin		Po		Gp	Idd	ηd	ACP_1L*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
0.0	0.001	13.7	0.02	13.7	0.28	2.3	-57	-58
1.0	0.001	14.7	0.03	13.7	0.28	2.9	-57	-58
2.0	0.002	15.7	0.04	13.7	0.29	3.5	-56	-58
3.0	0.002	16.7	0.05	13.7	0.30	4.3	-57	-60
4.0	0.002	17.7	0.06	13.7	0.31	5.2	-56	-60
5.0	0.003	18.7	0.07	13.7	0.33	6.3	-56	-59
6.0	0.004	19.7	0.09	13.7	0.34	7.6	-55	-59
7.0	0.005	20.7	0.12	13.8	0.36	9.1	-54	-59
8.0	0.006	21.8	0.15	13.8	0.39	10.7	-54	-60
9.0	0.008	22.8	0.19	13.8	0.42	12.6	-55	-60
10.0	0.010	23.8	0.24	13.8	0.46	14.7	-55	-61
11.0	0.013	24.8	0.31	13.8	0.50	17.0	-56	-60
12.0	0.016	25.9	0.39	13.9	0.55	19.5	-56	-55
13.0	0.020	26.9	0.48	13.9	0.60	22.3	-51	-49
14.0	0.025	27.8	0.60	13.8	0.67	25.1	-45	-44
15.0	0.032	28.7	0.74	13.7	0.74	28.1	-40	-39
16.0	0.040	29.6	0.91	13.6	0.81	31.1	-37	-36
17.0	0.050	30.4	1.10	13.4	0.90	33.9	-34	-33
18.0	0.063	31.1	1.29	13.1	0.98	36.5	-32	-31
19.0	0.079	31.8	1.50	12.8	1.07	39.1	-30	-29
20.0	0.100	32.4	1.73	12.4	1.16	41.3	-28	-28
21.0	0.126	32.9	1.95	11.9	1.24	43.5	-27	-26
22.0	0.159	33.3	2.15	11.3	1.33	45.1	-26	-25
23.0	0.200	33.7	2.36	10.7	1.41	46.4	-24	-24
24.0	0.252	34.1	2.56	10.1	1.48	47.9	-24	-24
25.0	0.317	34.4	2.72	9.3	1.55	48.6	-23	-23
26.0	0.398	34.6	2.91	8.6	1.62	49.8	-22	-22
27.0	0.502	34.9	3.09	7.9	1.69	50.8	-21	-21
28.0	0.633	35.1	3.23	7.1	1.74	51.5	-21	-21
29.0	0.794	35.3	3.37	6.3	1.79	52.4	-20	-21
30.0	1.003	35.5	3.51	5.4	1.83	53.0	-20	-20

*ACP_1L ; ACP Low @Channel Spacing = 25kHz

ACP_1H ; ACP High @Channel Spacing = 25kHz

3-4. @ **f=860MHz,** Vdd=3.6V, Idq=250mA (Vgg=1.48V)

Pin		Po		Gp	Idd	ηd	ACP_1V*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
0.0	0.001	13.1	0.02	13.1	0.27	2.1	-57	-57
1.0	0.001	14.1	0.03	13.1	0.28	2.6	-57	-58
2.0	0.002	15.1	0.03	13.1	0.29	3.2	-56	-58
3.0	0.002	16.1	0.04	13.1	0.29	3.9	-57	-59
4.0	0.003	17.1	0.05	13.1	0.30	4.7	-56	-59
5.0	0.003	18.1	0.06	13.1	0.31	5.7	-55	-58
6.0	0.004	19.1	0.08	13.1	0.33	6.9	-54	-58
7.0	0.005	20.1	0.10	13.2	0.35	8.3	-54	-58
8.0	0.006	21.1	0.13	13.1	0.37	9.8	-52	-58
9.0	0.008	22.2	0.16	13.2	0.40	11.5	-53	-57
10.0	0.010	23.2	0.21	13.2	0.43	13.5	-52	-57
11.0	0.013	24.2	0.26	13.2	0.46	15.7	-52	-58
12.0	0.016	25.2	0.33	13.2	0.51	18.2	-52	-59
13.0	0.020	26.2	0.42	13.2	0.56	20.8	-54	-57
14.0	0.025	27.2	0.52	13.2	0.61	23.6	-51	-51
15.0	0.032	28.1	0.64	13.1	0.67	26.5	-46	-45
16.0	0.040	29.0	0.79	13.0	0.74	29.6	-41	-40
17.0	0.050	29.9	0.97	12.8	0.82	32.7	-37	-36
18.0	0.063	30.6	1.15	12.6	0.90	35.6	-34	-34
19.0	0.079	31.3	1.36	12.3	0.98	38.3	-32	-31
20.0	0.100	31.9	1.56	11.9	1.06	40.7	-30	-29
21.0	0.126	32.5	1.77	11.5	1.15	42.9	-28	-28
22.0	0.159	33.0	1.98	11.0	1.23	45.0	-26	-26
23.0	0.200	33.4	2.19	10.4	1.30	46.6	-25	-25
24.0	0.251	33.8	2.38	9.8	1.38	48.1	-24	-24
25.0	0.318	34.1	2.58	9.1	1.45	49.5	-23	-23
26.0	0.399	34.4	2.75	8.4	1.51	50.7	-23	-23
27.0	0.499	34.6	2.90	7.6	1.56	51.5	-22	-22
28.0	0.633	34.9	3.06	6.8	1.62	52.5	-22	-22
29.0	0.797	35.0	3.20	6.0	1.66	53.4	-21	-21
30.0	0.995	35.2	3.31	5.2	1.71	54.0	-21	-21

*ACP_1L ; ACP Low @Channel Spacing = 25kHz

ACP_1H ; ACP High @Channel Spacing = 25kHz

3-5. @ **f=870MHz,** Vdd=3.6V, Idq=250mA (Vgg=1.48V)

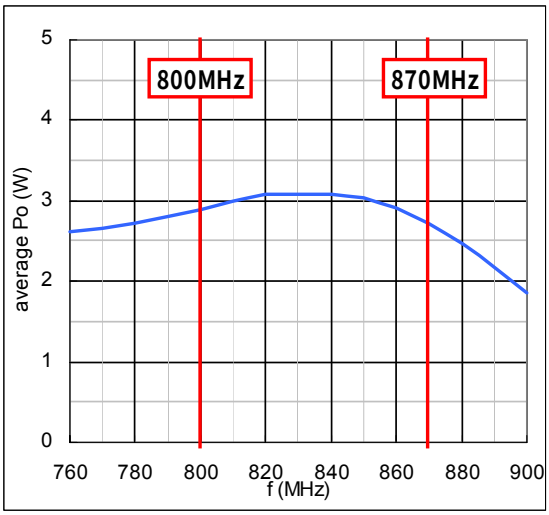
Pin		Po		Gp	Idd	ηd	ACP_1L*	ACP_1H*
(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(dBc)	(dBc)
0.0	0.001	12.6	0.02	12.6	0.27	1.8	-57	-57
1.0	0.001	13.6	0.02	12.6	0.28	2.3	-57	-57
2.0	0.002	14.6	0.03	12.6	0.28	2.8	-57	-58
3.0	0.002	15.6	0.04	12.6	0.29	3.5	-57	-58
4.0	0.003	16.6	0.05	12.6	0.30	4.2	-58	-59
5.0	0.003	17.6	0.06	12.6	0.31	5.1	-56	-59
6.0	0.004	18.6	0.07	12.6	0.32	6.3	-56	-59
7.0	0.005	19.6	0.09	12.6	0.34	7.5	-55	-59
8.0	0.006	20.6	0.12	12.6	0.36	9.0	-54	-59
9.0	0.008	21.6	0.15	12.6	0.38	10.6	-54	-58
10.0	0.010	22.6	0.18	12.6	0.41	12.5	-54	-58
11.0	0.013	23.7	0.23	12.7	0.44	14.7	-54	-59
12.0	0.016	24.7	0.29	12.7	0.48	17.0	-54	-60
13.0	0.020	25.7	0.37	12.7	0.53	19.6	-55	-58
14.0	0.025	26.7	0.46	12.6	0.58	22.4	-53	-52
15.0	0.032	27.6	0.58	12.6	0.63	25.2	-47	-46
16.0	0.040	28.5	0.71	12.5	0.70	28.2	-41	-41
17.0	0.050	29.4	0.86	12.4	0.77	31.1	-38	-37
18.0	0.063	30.2	1.04	12.2	0.84	34.2	-35	-34
19.0	0.080	30.9	1.23	11.9	0.92	37.1	-32	-31
20.0	0.100	31.5	1.43	11.5	1.00	39.7	-30	-29
21.0	0.126	32.1	1.63	11.1	1.08	42.0	-27	-28
22.0	0.158	32.6	1.83	10.6	1.16	43.8	-27	-26
23.0	0.200	33.0	2.02	10.0	1.22	45.7	-25	-25
24.0	0.252	33.4	2.20	9.4	1.29	47.3	-24	-24
25.0	0.316	33.8	2.38	8.8	1.35	48.8	-23	-23
26.0	0.397	34.1	2.55	8.1	1.42	49.9	-23	-22
27.0	0.500	34.3	2.70	7.3	1.47	51.0	-22	-22
28.0	0.633	34.5	2.83	6.5	1.52	51.9	-21	-21
29.0	0.799	34.7	2.97	5.7	1.56	52.9	-21	-21
30.0	0.999	34.9	3.10	4.9	1.61	53.4	-21	-21

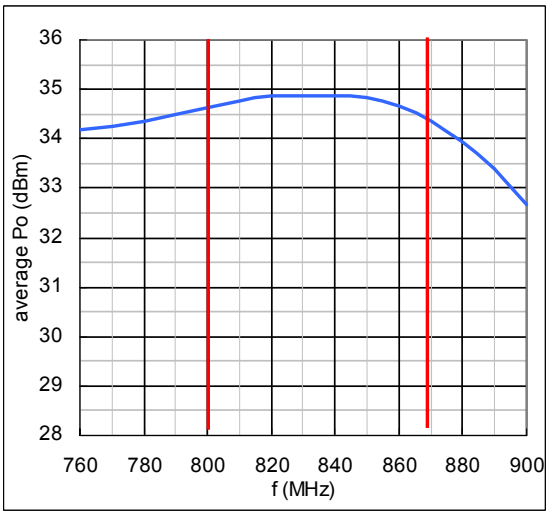
*ACP_1L ; ACP Low @Channel Spacing = 25kHz

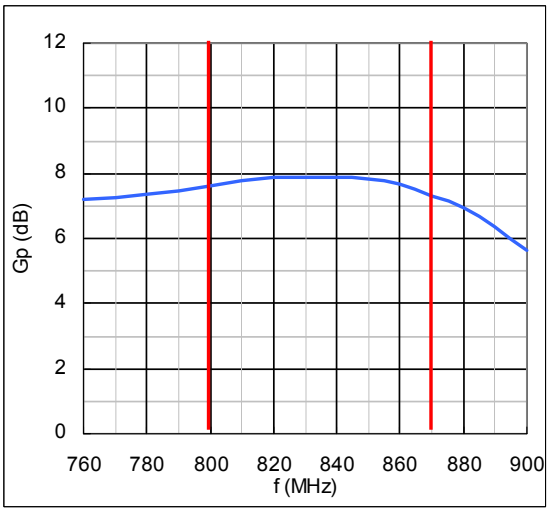
ACP_1H ; ACP High @Channel Spacing = 25kHz

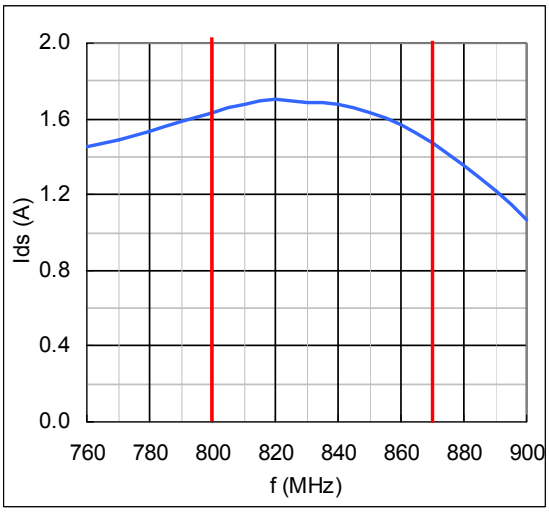
4. Frequency characteristics

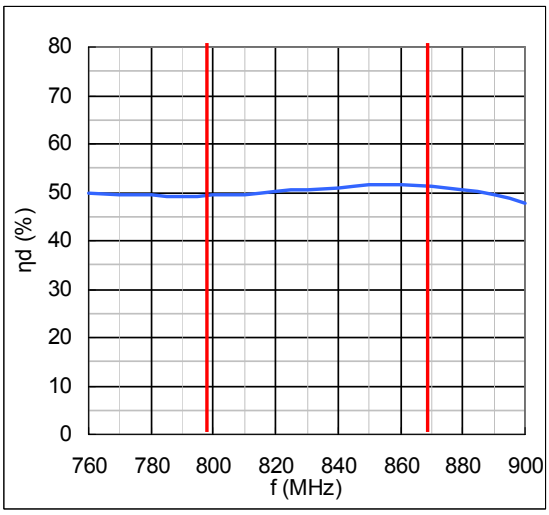
@Vdd=3.6V, Idq=250mA, Pin=0.5W (=26.99dBm)









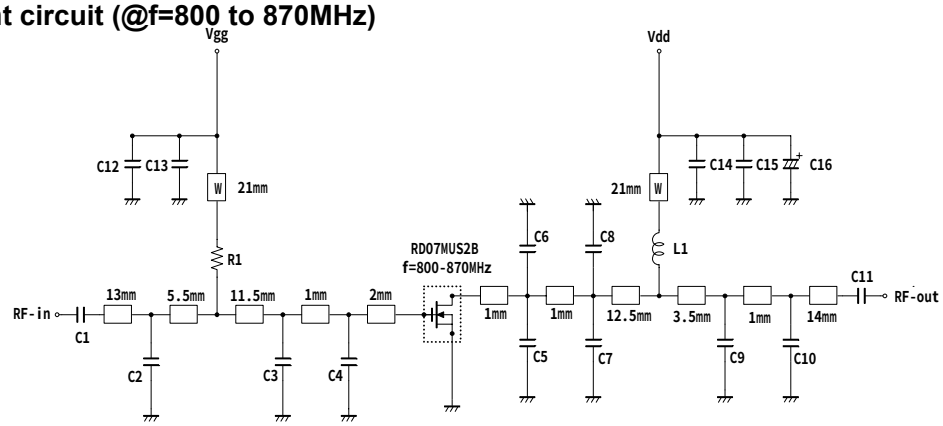


5. Frequency characteristics data

@Vdd=3.6V, Idq=250mA, Pin=0.5W (=26.99dBm)

f (MHz)	Pi (W)	Pi (dBm)	Po (W)	Po (dBm)	Gp (dB)	Ids (A)	ηd (%)	2fo (dBc)	3fo (dBc)
760	0.499	27.0	2.61	34.2	7.2	1.45	50.0	<-50	<-50
770	0.501	27.0	2.66	34.2	7.2	1.49	49.6	-58.2	<-50
780	0.501	27.0	2.72	34.4	7.4	1.53	49.4	-57.2	<-50
790	0.505	27.0	2.81	34.5	7.5	1.58	49.3	-55.8	<-50
800	0.502	27.0	2.89	34.6	7.6	1.63	49.3	-56.6	<-50
810	0.501	27.0	2.99	34.8	7.8	1.67	49.6	-58.8	<-50
820	0.501	27.0	3.07	34.9	7.9	1.70	50.1	-56.7	<-50
830	0.499	27.0	3.07	34.9	7.9	1.69	50.5	-56.5	<-50
840	0.499	27.0	3.08	34.9	7.9	1.68	50.9	<-50	<-50
850	0.501	27.0	3.03	34.8	7.8	1.63	51.6	<-50	<-50
860	0.501	27.0	2.92	34.6	7.6	1.57	51.7	<-50	<-50
870	0.503	27.0	2.71	34.3	7.3	1.47	51.3	<-50	<-50
880	0.501	27.0	2.47	33.9	6.9	1.36	50.7	<-50	<-50
890	0.503	27.0	2.18	33.4	6.4	1.22	49.5	<-50	<-50
900	0.504	27.0	1.85	32.7	5.6	1.07	47.9	<-50	<-50

5. 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	150pF	GRM2162C1H101JA01D	Murata Manufacturing Co., Ltd.
	C2	3pF	GRM2162C1H8R0DZ01D	Murata Manufacturing Co., Ltd.
	C3	7pF	GRM2162C1H8R0DZ01D	Murata Manufacturing Co., Ltd.
	C4	15pF	GRM2162C1H120JZ01D	Murata Manufacturing Co., Ltd.
	C5	10pF	GRM2162C1H560JZ01D	Murata Manufacturing Co., Ltd.
	C6	10pF	GRM2162C1H300JZ01D	Murata Manufacturing Co., Ltd.
	C7	9pF	GRM2162C1H300JZ01D	Murata Manufacturing Co., Ltd.
	C8	9pF	GRM2162C1H160JZ01D	Murata Manufacturing Co., Ltd.
	C9	4pF	GRM2162C1H8R0DZ01D	Murata Manufacturing Co., Ltd.
	C10	4pF	GRM2162C1H101JA01D	Murata Manufacturing Co., Ltd.
	C11	150pF	GRM216R11H223KA01E	Murata Manufacturing Co., Ltd.
	C12	1000pF	GRM188R11H102KA02E	Murata Manufacturing Co., Ltd.
	C13	100pF	GRM2162C1H101JA01D	Murata Manufacturing Co., Ltd.
	C14	100pF	GRM2162C1H101JA01D	Murata Manufacturing Co., Ltd.
	C15	1000pF	GRM188R11H102KA02E	Murata Manufacturing Co., Ltd.
	C16	22μF	H1002	NICHICON CORPORATION
Resistance	R1	4.7K OHM	CR1/10-472JB	Hokuriku Electric Industry Co.,Ltd.
Inductance	L1	37.8nH Enameled wire 7Turns, Diameter:0.23mm,φ1.6mm (the out side diameter)	2307A	YC CORPORATION Co.,Ltd.