APPLICATION NOTE

MITSUBISHI ELECTRIC
Silicon RF Power Semiconductors

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Date : 27th May 2011
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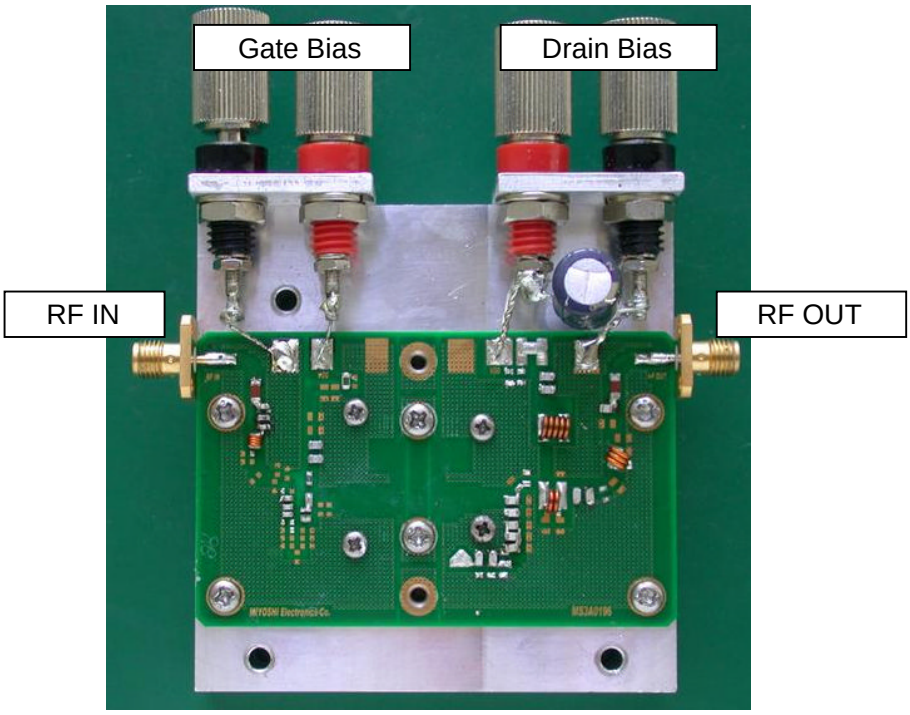
(Taking charge of Silicon RF by
MIYOSHI Electronics)

SUBJECT: RD35HUF2 single-stage amplifier with f=135-175MHz evaluation board

Features:

- The evaluation board for RD35HUF2
- Frequency: 135-175MHz
- Typical input power: 3W
- Typical output power: 40W
- Quiescent current: 500mA
- Operating current: approx. 5A
- Surface-mounted RF power amplifier structure



PCB L=75mm W=46mm

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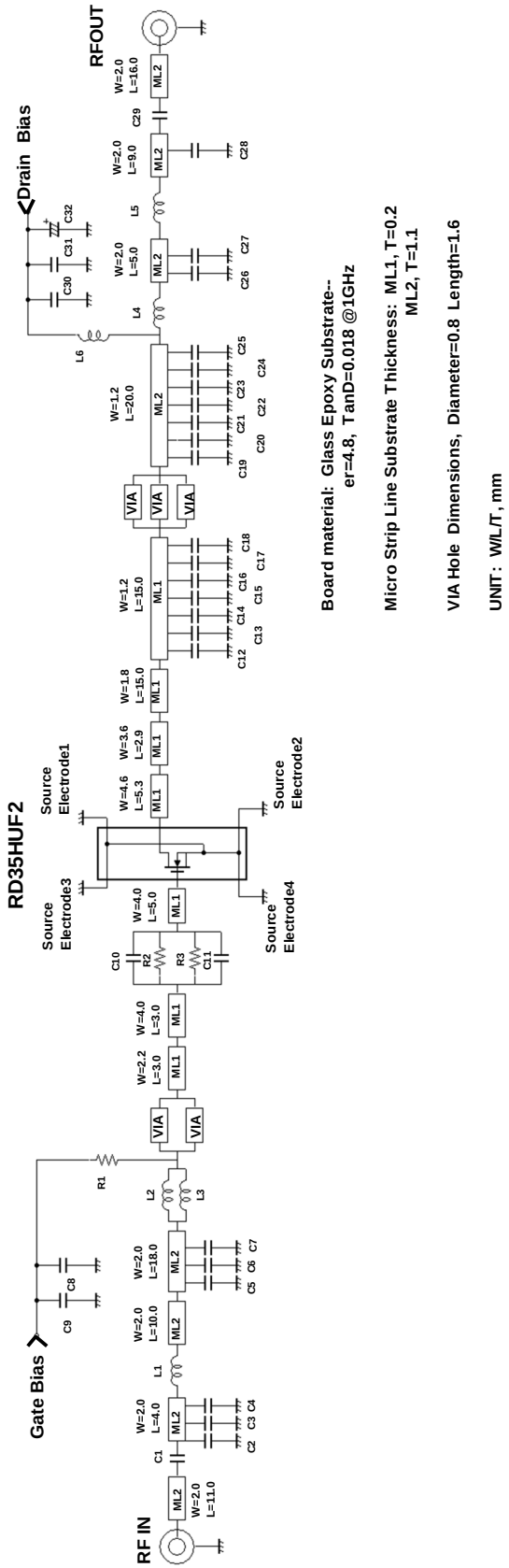
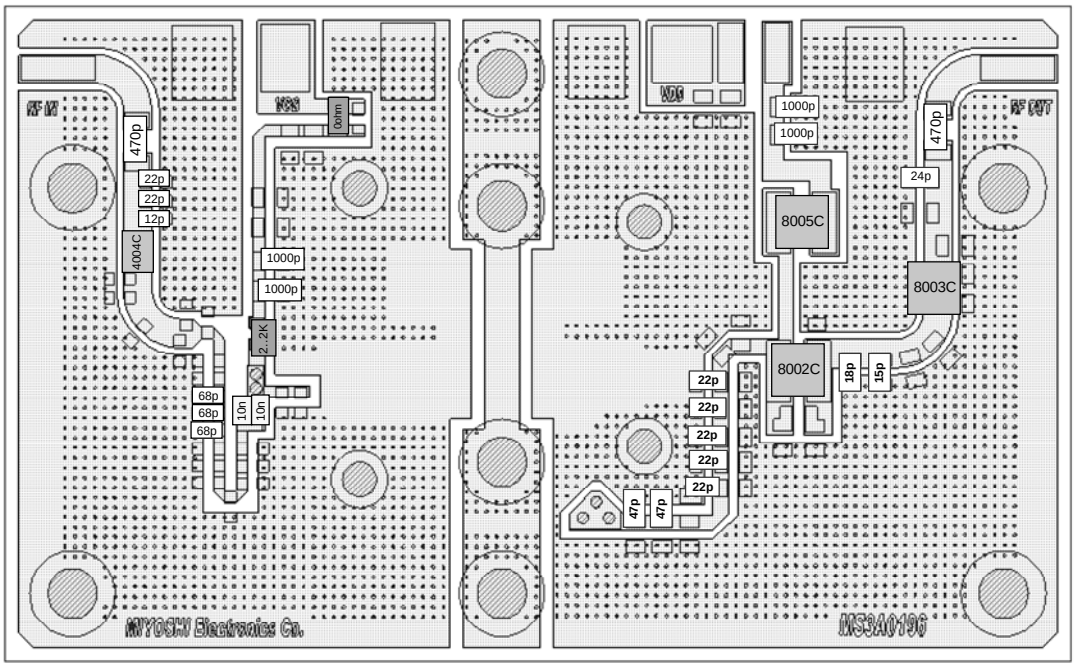
1. Equivalent Circuitry



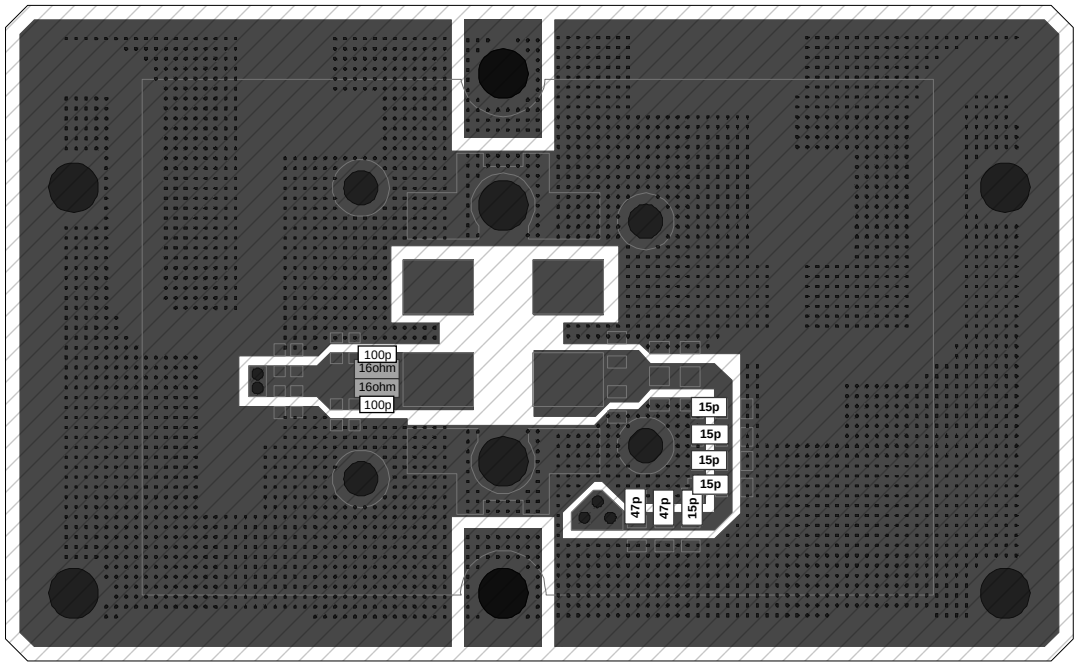
2. PCB Layout

BOARD OUTLINE: 75.0*46.0(mm)

TOP VIEW (Layer 1)

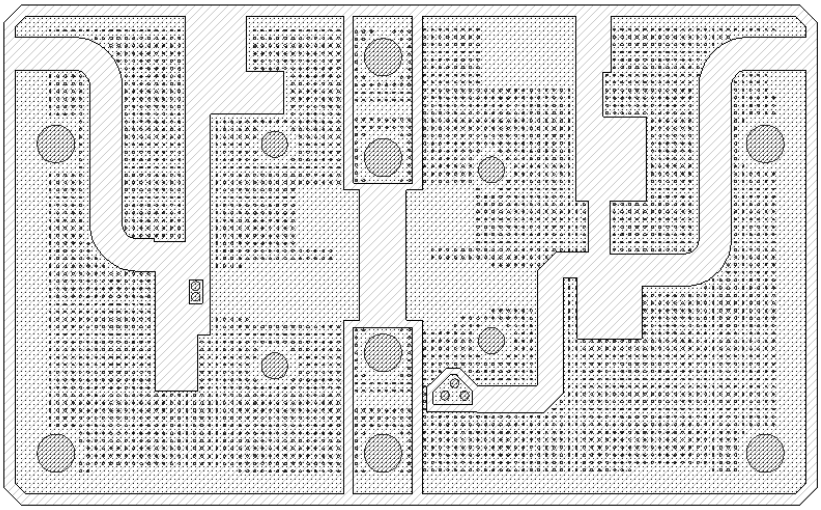


BOTTOM VIEW (Layer 4), Perspective through Top View

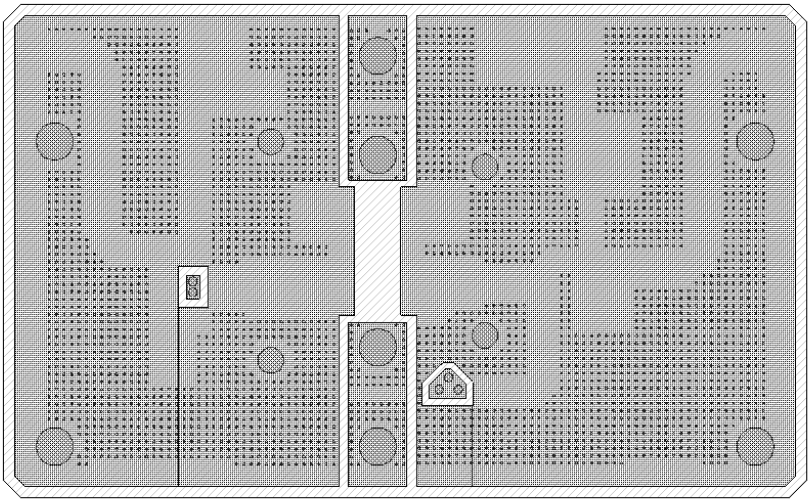


BOARD OUTLINE: 75.0*46.0(mm)

Internal Layer (Layer 2) , Perspective Through Top View

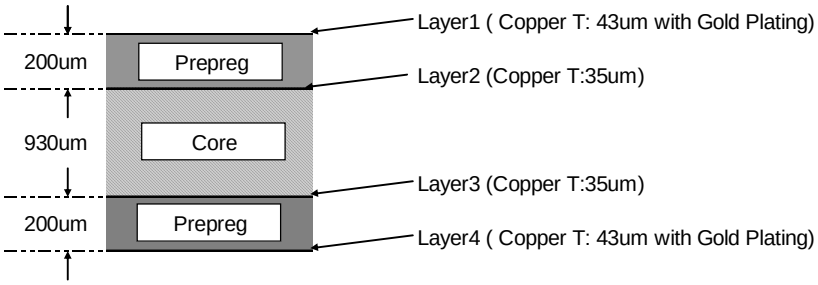


Internal Layer (Layer 3) , Perspective Through Top View



Substrate Condition

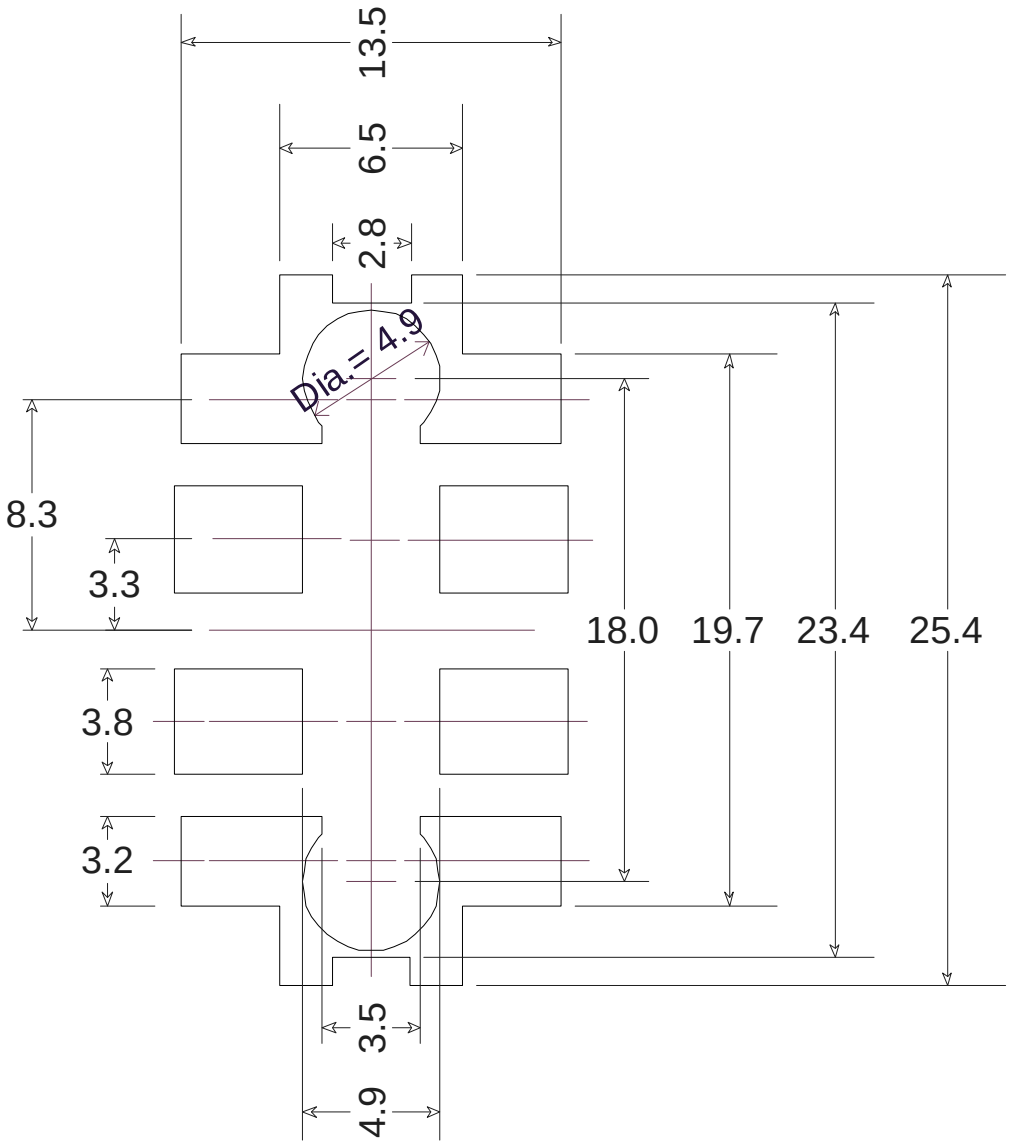
Nomial Total Completed Thickness (included resist coating): 1.6mm



Er: 4.7 @ 1GHz
TanD: 0.018 @ 1GHz

Material: MCL-E-679G(R), Hitachi Chemical Co.

3. Standard Land Pattern Dimensions



UNIT: mm

4. Component List and Standard Deliverable

- Component List

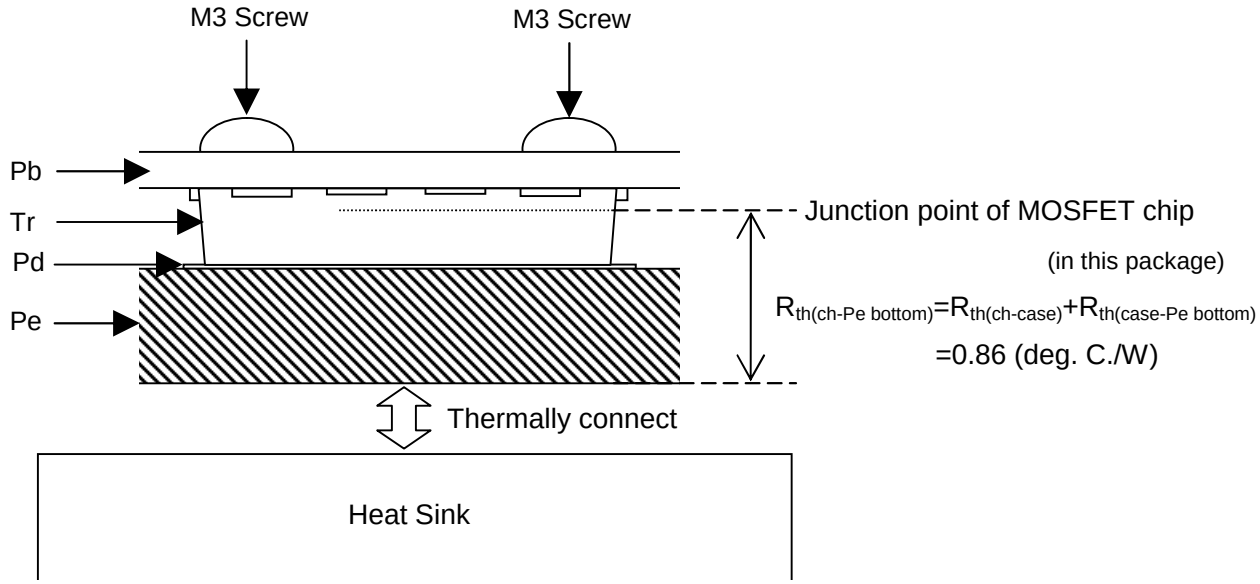
No.	Description	P/N	Qty	Manufacturer
Tr	MOSFET	RD35HUF2	1	Mitsubishi Electric Corporation
C 1	470 pF 3216 200V	GRM31M2C2D471JY21B	1	MURATA MANUFACTURING CO.
C 2	22 pF 1608 Hi-Q 50V	GQM1882C1H220JB01	1	MURATA MANUFACTURING CO.
C 3	22 pF 1608 Hi-Q 50V	GQM1882C1H220JB01	1	MURATA MANUFACTURING CO.
C 4	12 pF 1608 Hi-Q 50V	GQM1882C1H120JB01	1	MURATA MANUFACTURING CO.
C 5	68 pF 1608 Hi-Q 50V	GQM1882C1H680JB01	1	MURATA MANUFACTURING CO.
C 6	68 pF 1608 Hi-Q 50V	GQM1882C1H680JB01	1	MURATA MANUFACTURING CO.
C 7	68 pF 1608 Hi-Q 50V	GQM1882C1H680JB01	1	MURATA MANUFACTURING CO.
C 8	1000 pF 2012 50V	GRM2162C1H102JA01B	1	MURATA MANUFACTURING CO.
C 9	1000 pF 2012 50V	GRM2162C1H102JA01B	1	MURATA MANUFACTURING CO.
C 10	100 pF 1608 Hi-Q 50V	GQM1882C1H101JB01	1	MURATA MANUFACTURING CO.
C 11	100 pF 1608 Hi-Q 50V	GQM1882C1H101JB01	1	MURATA MANUFACTURING CO.
C 12	15 pF 2012 Hi-Q 100V	GQM2192C2A150JB01	1	MURATA MANUFACTURING CO.
C 13	15 pF 2012 Hi-Q 100V	GQM2192C2A150JB01	1	MURATA MANUFACTURING CO.
C 14	15 pF 2012 Hi-Q 100V	GQM2192C2A150JB01	1	MURATA MANUFACTURING CO.
C 15	15 pF 2012 Hi-Q 100V	GQM2192C2A150JB01	1	MURATA MANUFACTURING CO.
C 16	15 pF 2012 Hi-Q 100V	GQM2192C2A150JB01	1	MURATA MANUFACTURING CO.
C 17	47 pF 2012 Hi-Q 50V	GQM2192C1H470JB01	1	MURATA MANUFACTURING CO.
C 18	47 pF 2012 Hi-Q 50V	GQM2192C1H470JB01	1	MURATA MANUFACTURING CO.
C 19	47 pF 2012 Hi-Q 50V	GQM2192C1H470JB01	1	MURATA MANUFACTURING CO.
C 20	47 pF 2012 Hi-Q 50V	GQM2192C1H470JB01	1	MURATA MANUFACTURING CO.
C 21	22 pF 2012 Hi-Q 50V	GQM2192C1H220JB01	1	MURATA MANUFACTURING CO.
C 22	22 pF 2012 Hi-Q 50V	GQM2192C1H220JB01	1	MURATA MANUFACTURING CO.
C 23	22 pF 2012 Hi-Q 50V	GQM2192C1H220JB01	1	MURATA MANUFACTURING CO.
C 24	22 pF 2012 Hi-Q 50V	GQM2192C1H220JB01	1	MURATA MANUFACTURING CO.
C 25	22 pF 2012 Hi-Q 50V	GQM2192C1H220JB01	1	MURATA MANUFACTURING CO.
C 26	18 pF 2012 Hi-Q 100V	GQM2192C2A180JB01	1	MURATA MANUFACTURING CO.
C 27	15 pF 2012 Hi-Q 100V	GQM2192C2A150JB01	1	MURATA MANUFACTURING CO.
C 28	24 pF 2012 Hi-Q 50V	GQM2192C1H240JB01	1	MURATA MANUFACTURING CO.
C 29	470 pF 3216 200V	GRM31M2C2D471JY21B	1	MURATA MANUFACTURING CO.
C 30	1000 pF 2012 100V	GRM2162C2A102JA01B	1	MURATA MANUFACTURING CO.
C 31	1000 pF 2012 100V	GRM2162C2A102JA01B	1	MURATA MANUFACTURING CO.
C 32	220 uF 35V	EEUFC1V221	1	Panasonic Corporation
L 1	17 nH * Diameter: Wire=0.4mm Inside=1.6mm T/N of coils=4		1	YC CORPORATION Co.,Ltd.
L 2	10 nH 1608	LQG18HN10NJ00	1	MURATA MANUFACTURING CO.
L 3	10 nH 1608	LQG18HN10NJ00	1	MURATA MANUFACTURING CO.
L 4	8 nH * Diameter: Wire=0.8mm Inside=2.2mm T/N of coils=2		1	YC CORPORATION Co.,Ltd.
L 5	12 nH * Diameter: Wire=0.8mm Inside=2.2mm T/N of coils=3		1	YC CORPORATION Co.,Ltd.
L 6	25 nH * Diameter: Wire=0.8mm Inside=2.2mm T/N of coils=5		1	YC CORPORATION Co.,Ltd.
R 1	2.2k ohm 1608	RPC05T222J	1	TAIYOSHA ELECTRIC CO.
R 2	16 ohm 2012	RPC10T160J	1	TAIYOSHA ELECTRIC CO.
R 3	16 ohm 2012	RPC10T160J	1	TAIYOSHA ELECTRIC CO.
Pb	PCB	MS3A0196	1	Homebuilt
Rc	SMA female connector	PAF-S00-002	2	GIGALANE Corporation
Bc 1	Bias connector red color	TM-605R	2	MSK Corporation
Bc 2	Bias connector black color	TM-605B	2	MSK Corporation
Pe	Aluminum pedestal		1	Homebuilt
Pd	Thermal Silicon Compound	G746	-	Shin-Etsu Chemical Co.,Ltd
Sbc	Support of bias connectors		2	Homebuilt
	Conductiong wire		4	Homebuilt
	Screw M3		10	-
	Screw M2.6		4	-
	Screw M2		4	-

* Inductor of Rolling Coil measurement condition : f=100MHz

- **Standard Deliverable**

TYPE1	**Evaluation Board assembled with all the component including the option**
TYPE2	**PCB (raw board)**

5. Thermal Design of Heat Sink



$Tch_{(delta)}$=(Pout/Efficiency-Pout+Pin) x $R_{th(ch\text{-}Pe\ bottom)}$=(35W/50%-35W+3) x 0.86=32.7 (deg. C.)

Also, operating Tj("$Tj_{(op)}$")=140 (deg. C.), in case of RD series that $Tch_{(max)}$=175 (deg. C.)

Therefore $T_{Pe\ bottom\text{-}air}$ as delta temperature between Pe bottom and ambient 60 deg. C.* is

$T_{Pe\ bottom\text{-}air}$="$Tj_{(op)}$" - $Tch_{(delta)}$ - $Ta_{(60deg.C.)}$=140-32.7-60=47.3 (deg. C.)

*: an instance assuming high temperature of standard ambient conditions is 60 deg. C.

In terms of long-term reliability, "$Tj_{(op)}$" has to be kept less than 140 deg. C. i.e. $T_{Pe\ bottom\text{-}air}$ has to be less than 47.3 deg. C..

The thermal resistance of the heat sink to border it:

$Rth_{(Pe\ bottom\text{-}air)}$=$T_{Pe\ bottom\text{-}air}$/(Pout/Efficiency-Pout+Pin)=47.3/(35W/50%-35W+3)=1.2 (deg. C./W)

Therefore

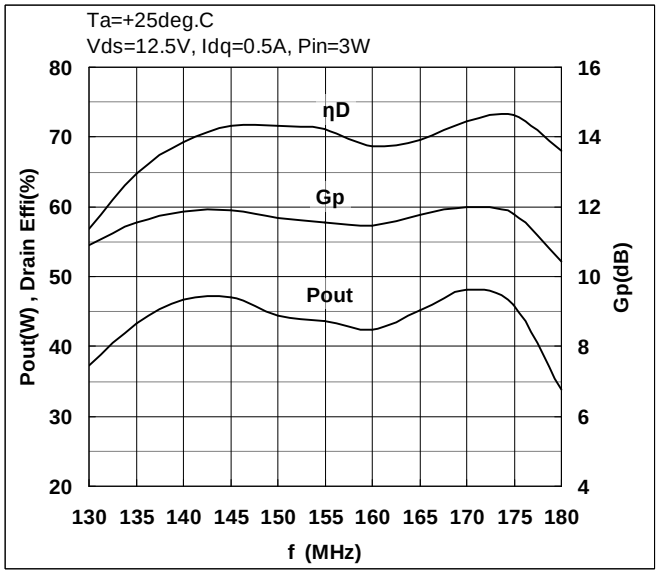
it is preferable that the thermal resistance of the heat sink is much smaller than 1.2 deg. C./W.

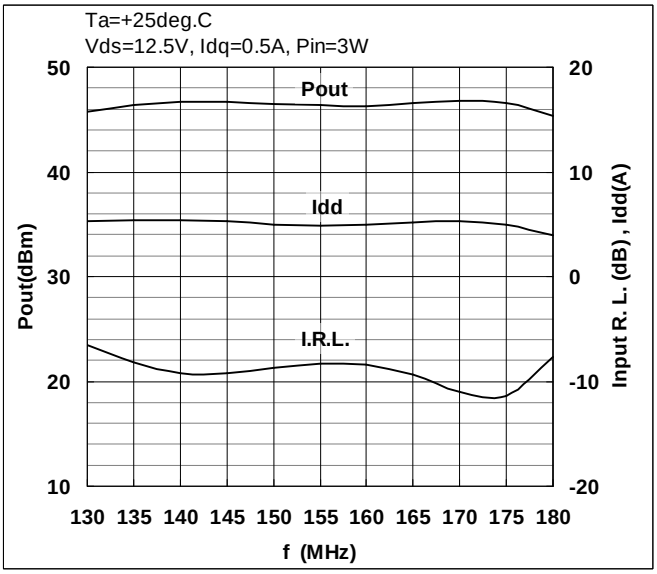
For assembly method including relevant precaution, refer to AN-GEN-070

6. Typical RF Characteristics

6-1. Frequency vs.

OUTPUT POWER, POWER GAIN, DRAIN EFFICIENCY, DRAIN CURRENT and INPUT RETURN LOSS



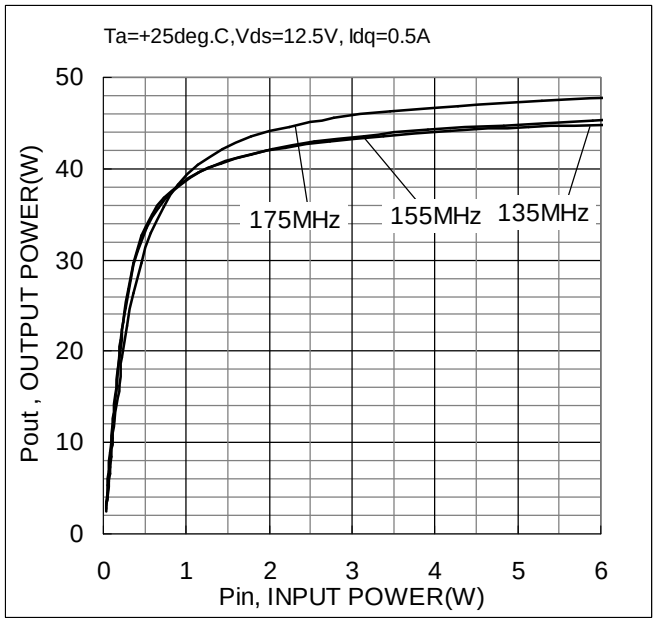


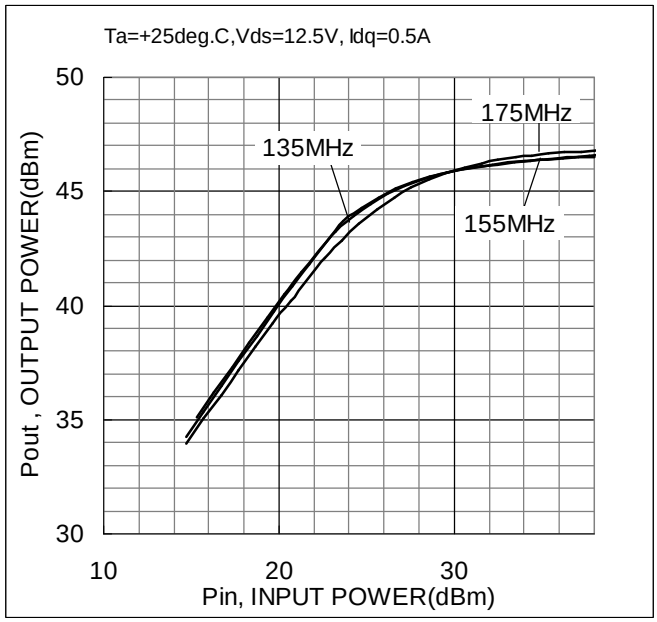
Ta=+25deg. C., Vds=12.5V, Idq=0.5A, Pin=3.0W

Freq.	Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.
(MHz)	(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)
130	2.65	34.8	3.0	45.7	37.3	10.9	5.24	52.2	56.8	-6.6
135	2.65	34.8	3.0	46.4	43.3	11.6	5.34	60.3	64.8	-8.2
140	2.65	34.8	3.0	46.7	46.7	11.9	5.39	64.7	69.2	-9.2
145	2.65	34.8	3.0	46.7	47.1	11.9	5.25	67.0	71.6	-9.2
150	2.65	34.8	3.0	46.5	44.4	11.7	4.95	66.8	71.6	-8.7
155	2.65	34.8	3.0	46.4	43.6	11.5	4.89	66.2	71.2	-8.3
160	2.65	34.8	3.0	46.3	42.4	11.4	4.93	63.7	68.7	-8.4
165	2.65	34.8	3.0	46.6	45.3	11.8	5.19	65.0	69.6	-9.4
170	2.65	34.8	3.0	46.8	48.1	12.0	5.31	67.7	72.2	-11.0
175	2.65	34.8	3.0	46.6	46.0	11.8	5.03	68.3	73.1	-11.4
180	2.65	34.8	3.1	45.3	33.9	10.4	3.98	61.9	68.0	-7.7

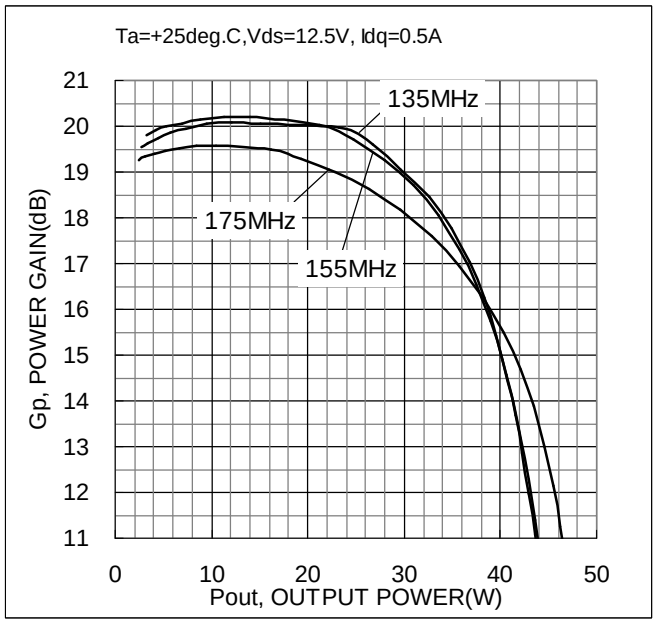
6-2. RF Power vs.

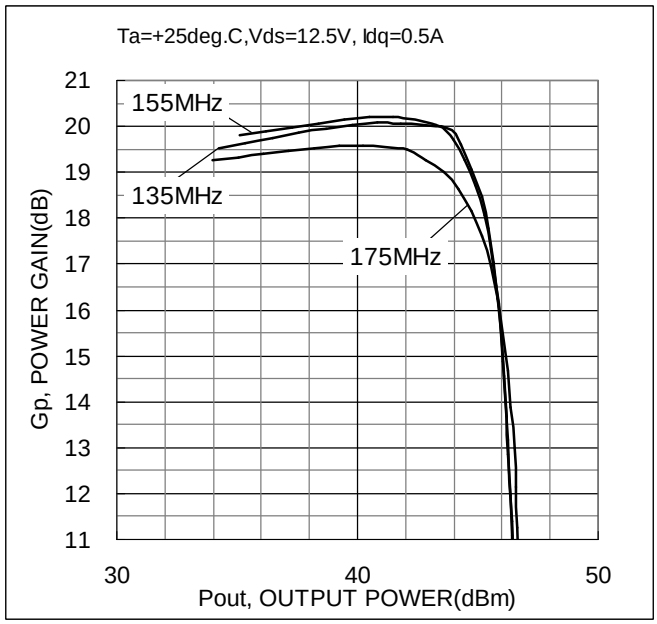
INPUT POWER



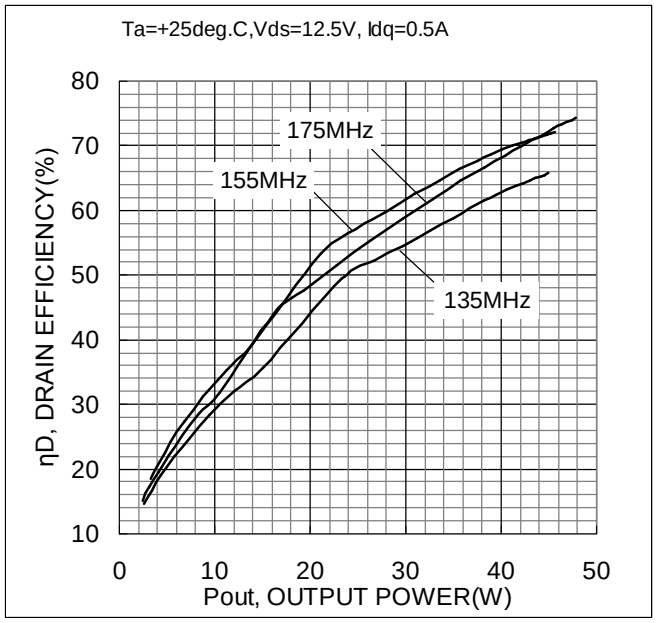


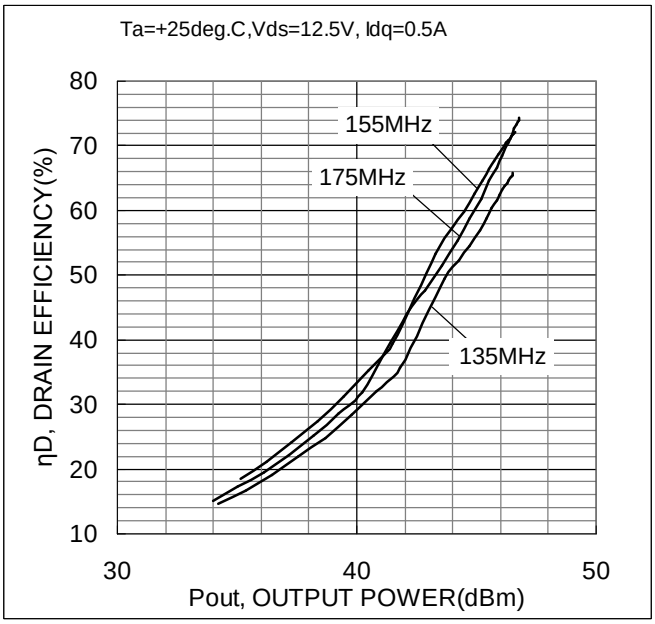
POWER GAIN



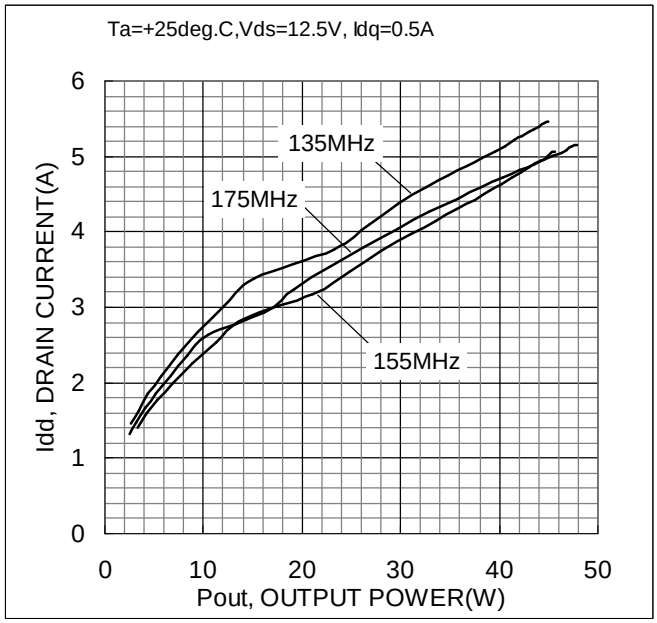


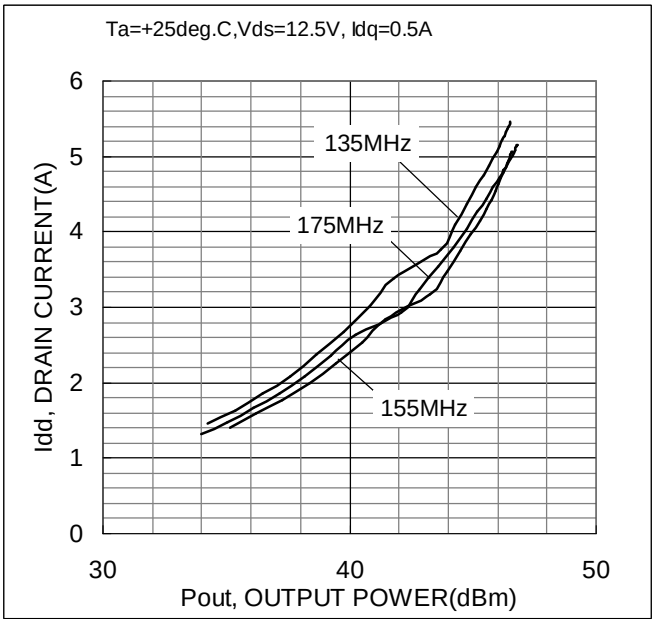
DRAIN EFFICIENCY



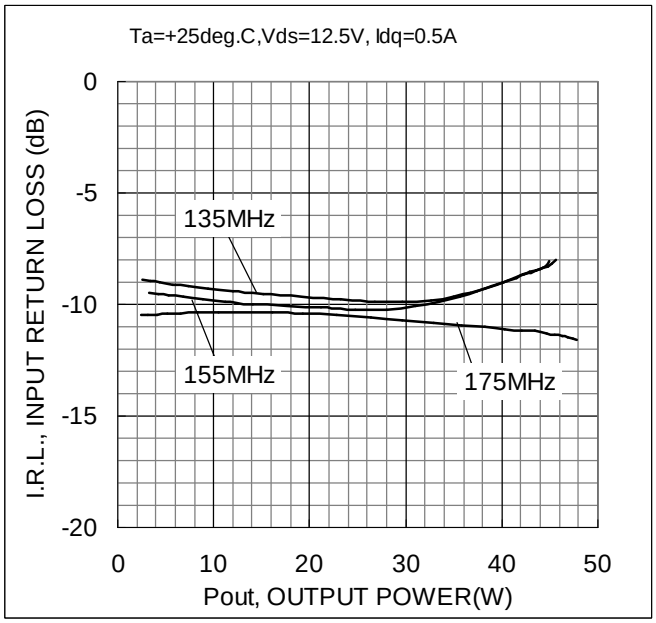


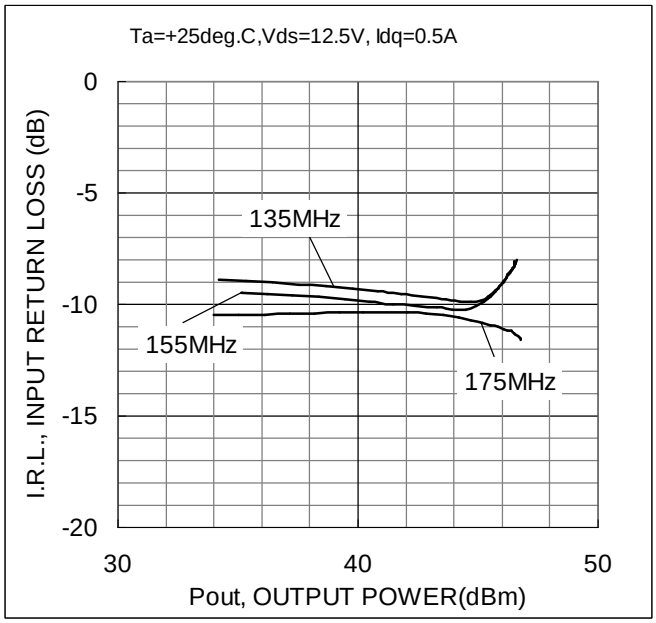
DRAIN CURRENT





INPUT RETURN LOSS





Ta=+25deg. C., Vds=12.5V, Idq=0.5A

135MHz	Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.
	(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)
	2.65	14.7	0.03	34.2	2.7	19.5	1.45	14.5	14.6	-8.9
	2.65	15.7	0.04	35.3	3.4	19.6	1.64	16.5	16.7	-9.0
	2.65	16.7	0.05	36.5	4.4	19.7	1.85	19.0	19.2	-9.0
	2.65	17.7	0.06	37.6	5.7	19.8	2.09	21.6	21.9	-9.1
	2.65	18.7	0.07	38.7	7.4	19.9	2.38	24.5	24.8	-9.2
	2.65	19.7	0.09	39.8	9.5	20.0	2.68	28.0	28.3	-9.3
	2.65	20.7	0.12	40.8	12.0	20.1	3.01	31.6	32.0	-9.4
	2.65	21.7	0.15	41.8	15.1	20.1	3.39	35.4	35.7	-9.5
	2.65	23.7	0.23	43.7	23.3	20.0	3.76	49.0	49.5	-9.8
	2.65	24.7	0.29	44.3	26.8	19.6	4.09	51.8	52.4	-9.9
	2.65	25.7	0.37	44.7	29.7	19.1	4.36	53.8	54.4	-9.9
	2.65	26.7	0.46	45.1	32.6	18.5	4.59	56.1	56.9	-9.8
	2.65	27.6	0.58	45.4	34.9	17.8	4.75	57.9	58.9	-9.7
	2.65	28.6	0.73	45.7	36.8	17.0	4.88	59.1	60.3	-9.5
	2.65	29.6	0.91	45.8	38.3	16.2	4.98	60.1	61.5	-9.3
	2.65	30.6	1.14	46.0	39.5	15.4	5.06	60.6	62.4	-9.1
	2.65	31.5	1.42	46.1	40.6	14.6	5.14	61.0	63.2	-9.0
	2.65	32.5	1.78	46.2	41.5	13.7	5.21	61.0	63.7	-8.8
	2.65	33.4	2.20	46.3	42.3	12.8	5.28	60.8	64.2	-8.7
	2.65	34.4	2.73	46.3	43.0	12.0	5.33	60.5	64.6	-8.6
	2.65	35.3	3.38	46.4	43.6	11.1	5.36	59.9	65.0	-8.5
	2.65	36.2	4.18	46.4	44.1	10.2	5.40	59.1	65.3	-8.4
	2.65	37.1	5.13	46.5	44.5	9.4	5.44	57.9	65.5	-8.3
	2.65	38.0	6.26	46.5	44.9	8.6	5.46	56.6	65.8	-8.1

155MHz

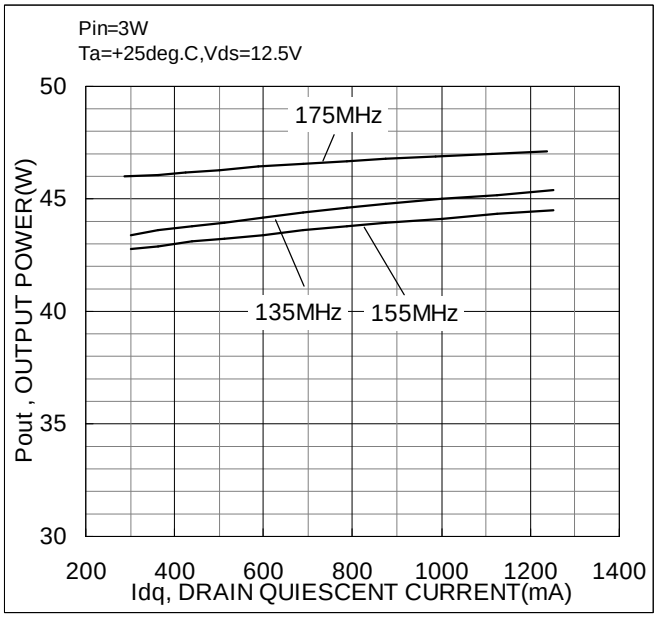
Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.
(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)
2.65	15.3	0.03	35.1	3.3	19.8	1.41	18.2	18.4	-9.5
2.65	16.3	0.04	36.2	4.2	19.9	1.59	20.8	21.1	-9.5
2.65	17.3	0.05	37.3	5.4	20.0	1.78	23.9	24.2	-9.6
2.65	18.3	0.07	38.4	6.9	20.1	2.00	27.2	27.5	-9.7
2.65	19.3	0.09	39.5	8.8	20.2	2.26	30.9	31.2	-9.8
2.65	20.3	0.11	40.5	11.2	20.2	2.54	35.0	35.3	-9.9
2.65	21.3	0.13	41.5	14.0	20.2	2.85	39.0	39.4	-10.0
2.65	23.2	0.21	43.3	21.1	20.0	3.18	52.8	53.3	-10.1
2.65	24.2	0.26	43.9	24.8	19.7	3.48	56.4	57.0	-10.2
2.65	25.2	0.33	44.5	28.0	19.3	3.74	59.1	59.8	-10.2
2.65	26.2	0.42	44.9	31.0	18.7	3.96	61.7	62.5	-10.1
2.65	27.2	0.52	45.3	33.5	18.1	4.15	63.6	64.6	-9.9
2.65	28.2	0.66	45.5	35.7	17.3	4.30	65.1	66.4	-9.6
2.65	29.2	0.83	45.7	37.5	16.5	4.43	66.2	67.7	-9.4
2.65	30.2	1.04	45.9	38.9	15.7	4.54	66.8	68.6	-9.2
2.65	31.2	1.31	46.0	40.2	14.9	4.63	67.3	69.5	-9.0
2.65	32.1	1.64	46.2	41.2	14.0	4.71	67.2	70.0	-8.8
2.65	33.1	2.03	46.2	42.1	13.2	4.79	67.0	70.4	-8.7
2.65	34.0	2.53	46.3	42.9	12.3	4.85	66.6	70.8	-8.5
2.65	35.0	3.15	46.4	43.6	11.4	4.90	66.0	71.2	-8.4
2.65	35.9	3.91	46.5	44.2	10.5	4.95	65.1	71.5	-8.4
2.65	36.8	4.83	46.5	44.8	9.7	5.00	63.9	71.6	-8.3
2.65	37.7	5.91	46.6	45.2	8.8	5.04	62.5	71.8	-8.2
2.65	38.5	7.05	46.6	45.7	8.1	5.06	61.0	72.1	-8.0

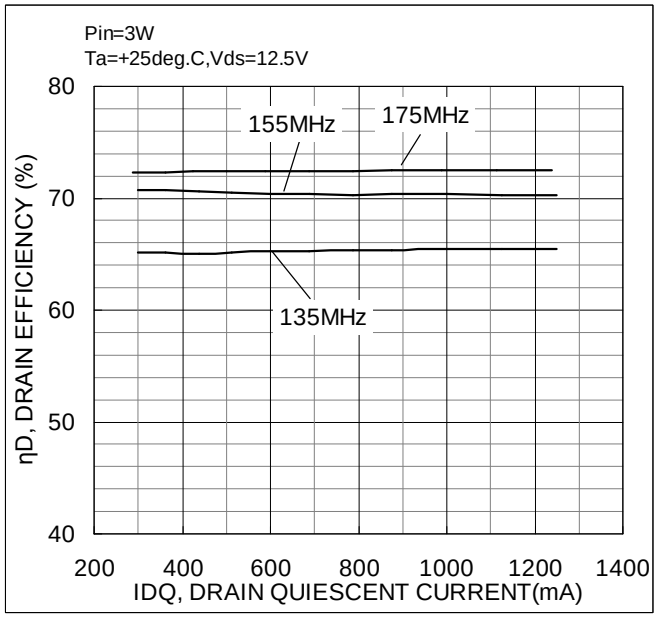
175MHz

Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.
(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)
2.65	14.7	0.03	34.0	2.5	19.3	1.33	14.9	15.0	-10.5
2.65	15.7	0.04	35.0	3.2	19.3	1.48	17.1	17.3	-10.5
2.65	16.7	0.05	36.1	4.1	19.4	1.66	19.4	19.6	-10.5
2.65	17.7	0.06	37.1	5.2	19.5	1.86	22.0	22.2	-10.4
2.65	18.7	0.07	38.2	6.6	19.5	2.09	25.0	25.3	-10.4
2.65	19.7	0.09	39.2	8.4	19.6	2.35	28.2	28.6	-10.4
2.65	20.7	0.12	40.2	10.5	19.6	2.64	31.6	31.9	-10.4
2.65	22.6	0.18	42.1	16.2	19.5	2.94	43.5	44.0	-10.3
2.65	23.6	0.23	42.9	19.3	19.3	3.24	47.1	47.6	-10.4
2.65	24.6	0.29	43.6	22.8	19.0	3.54	50.8	51.5	-10.5
2.65	25.6	0.36	44.2	26.3	18.6	3.80	54.6	55.4	-10.6
2.65	26.6	0.45	44.7	29.7	18.2	4.04	57.9	58.8	-10.7
2.65	27.6	0.57	45.2	32.9	17.6	4.26	60.7	61.7	-10.8
2.65	28.6	0.72	45.5	35.8	17.0	4.44	63.2	64.5	-10.9
2.65	29.6	0.91	45.8	38.2	16.3	4.59	65.1	66.7	-11.0
2.65	30.6	1.14	46.1	40.4	15.5	4.71	66.6	68.5	-11.1
2.65	31.6	1.43	46.2	42.1	14.7	4.81	67.5	69.9	-11.2
2.65	32.5	1.78	46.4	43.5	13.9	4.89	68.3	71.2	-11.2
2.65	33.5	2.24	46.5	44.6	13.0	4.96	68.3	71.9	-11.3
2.65	34.4	2.79	46.6	45.5	12.1	5.01	68.2	72.6	-11.3
2.65	35.4	3.46	46.7	46.2	11.3	5.05	67.8	73.3	-11.4
2.65	36.3	4.28	46.7	46.9	10.4	5.09	67.0	73.7	-11.5
2.65	37.2	5.29	46.8	47.4	9.5	5.13	65.7	74.0	-11.5
2.65	38.1	6.48	46.8	47.9	8.7	5.15	64.3	74.3	-11.6

6-3. Drain Quiescent Current vs.

OUTPUT POWER and DRAIN EFFICIENCY





Ta=+25deg. C., Vds=12.5V, Pin=3.0W

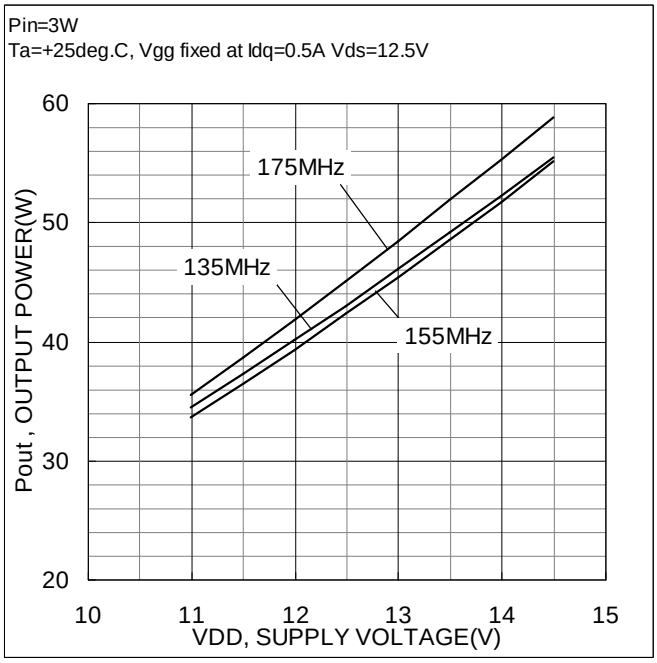
135MHz	Vgg	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
	(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
	2.63	300	34.8	3.0	46.4	43.4	5.25	65.1	60.6	11.6	-8.8
	2.65	363	34.8	3.0	46.4	43.6	5.28	65.1	60.6	11.6	-8.9
	2.68	438	34.8	3.0	46.4	43.8	5.30	65.1	60.6	11.6	-8.9
	2.70	513	34.8	3.0	46.4	44.0	5.31	65.2	60.7	11.6	-8.9
	2.73	600	34.8	3.0	46.5	44.2	5.34	65.2	60.7	11.6	-8.9
	2.75	688	34.8	3.0	46.5	44.4	5.36	65.2	60.8	11.7	-8.9
	2.78	788	34.8	3.0	46.5	44.6	5.38	65.4	60.9	11.7	-8.9
	2.80	875	34.8	3.0	46.5	44.8	5.40	65.3	60.9	11.7	-8.9
	2.82	1000	34.8	3.0	46.5	45.0	5.41	65.5	61.1	11.7	-8.9
	2.85	1125	34.8	3.0	46.6	45.2	5.44	65.5	61.1	11.8	-8.9
	2.88	1250	34.8	3.0	46.6	45.4	5.46	65.5	61.1	11.8	-8.9

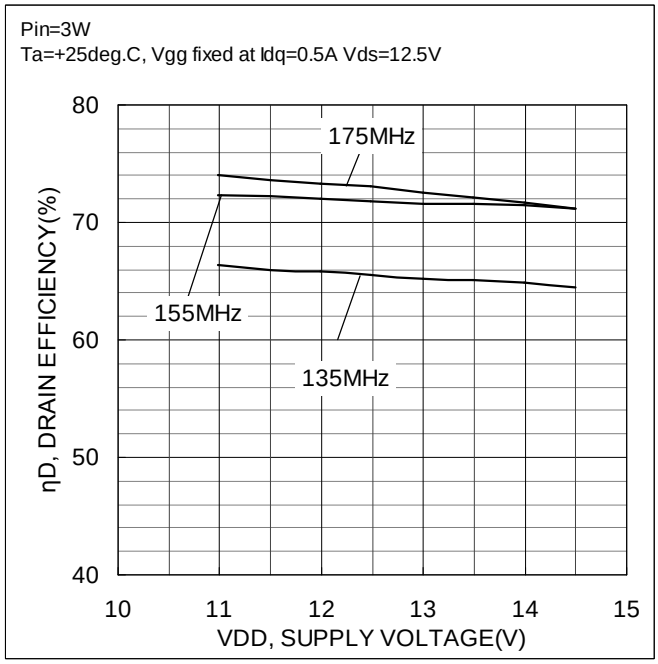
155MHz	Vgg	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
	(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
	2.63	300	34.8	3.0	46.3	42.8	4.79	70.7	65.7	11.5	-8.4
	2.65	363	34.8	3.0	46.3	42.9	4.80	70.7	65.8	11.5	-8.4
	2.68	438	34.8	3.0	46.3	43.1	4.83	70.6	65.7	11.5	-8.4
	2.70	513	34.8	3.0	46.4	43.2	4.85	70.5	65.6	11.6	-8.4
	2.73	600	34.8	3.0	46.4	43.4	4.88	70.4	65.6	11.6	-8.4
	2.75	688	34.8	3.0	46.4	43.6	4.90	70.4	65.5	11.6	-8.5
	2.78	788	34.8	3.0	46.4	43.8	4.93	70.3	65.5	11.6	-8.5
	2.80	875	34.8	3.0	46.4	43.9	4.94	70.4	65.6	11.6	-8.5
	2.82	1000	34.8	3.0	46.4	44.1	4.96	70.4	65.6	11.7	-8.5
	2.85	1125	34.8	3.0	46.5	44.3	4.99	70.3	65.5	11.7	-8.5
	2.88	1250	34.8	3.0	46.5	44.5	5.01	70.2	65.5	11.7	-8.5

175MHz	Vgg	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
	(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
	2.63	288	34.8	3.0	46.6	46.0	5.04	72.3	67.5	11.8	-11.4
	2.65	363	34.8	3.0	46.6	46.1	5.04	72.3	67.6	11.8	-11.4
	2.68	425	34.8	3.0	46.6	46.2	5.05	72.4	67.6	11.8	-11.4
	2.70	500	34.8	3.0	46.7	46.3	5.06	72.3	67.6	11.8	-11.4
	2.73	588	34.8	3.0	46.7	46.4	5.08	72.4	67.7	11.9	-11.4
	2.75	688	34.8	3.0	46.7	46.5	5.09	72.4	67.7	11.9	-11.4
	2.78	788	34.8	3.0	46.7	46.7	5.10	72.4	67.7	11.9	-11.4
	2.80	875	34.8	3.0	46.7	46.8	5.10	72.5	67.8	11.9	-11.4
	2.82	988	34.8	3.0	46.7	46.9	5.11	72.5	67.9	11.9	-11.4
	2.85	1113	34.8	3.0	46.7	47.0	5.13	72.6	67.9	11.9	-11.4
	2.88	1238	34.8	3.0	46.7	47.1	5.14	72.5	67.9	11.9	-11.4

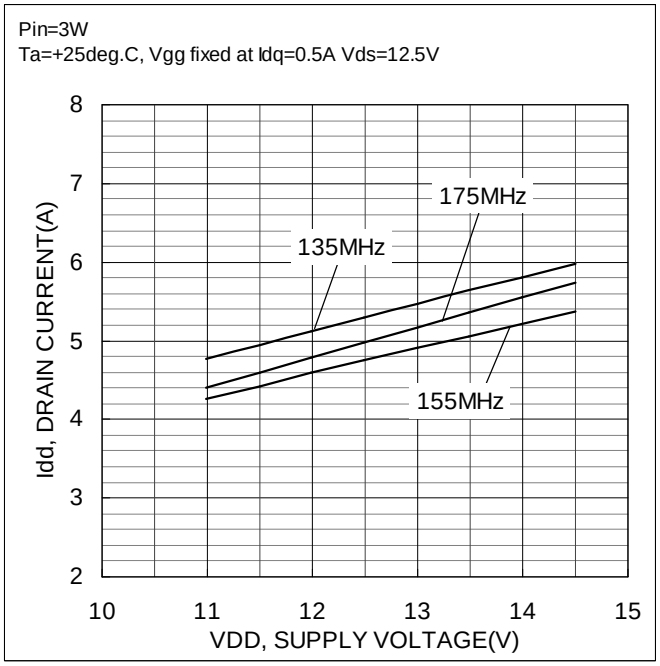
6-4. DC Power Supply vs.

OUTPUT POWER and DRAIN EFFICIENCY





DRAIN CURRENT



Ta=+25deg. C., Pin=3.0W

135MHz	Vgg	Vdd	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
	(V)	(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
	2.69	10.99	438	34.8	3.0	45.4	34.5	4.76	66.4	60.6	10.6	-8.7
	2.69	11.5	463	34.8	3.0	45.7	37.3	4.95	66.0	60.7	10.9	-8.8
	2.69	11.99	475	34.8	3.0	46.0	40.2	5.13	65.8	60.9	11.2	-8.8
	2.69	12.49	475	34.8	3.0	46.3	43.0	5.30	65.5	60.9	11.5	-8.8
	2.69	13	488	34.8	3.0	46.6	46.1	5.48	65.2	61.0	11.8	-8.9
	2.69	13.49	500	34.8	3.0	46.9	49.1	5.64	65.1	61.1	12.1	-8.9
	2.69	13.99	513	34.8	3.0	47.2	52.2	5.80	64.9	61.1	12.4	-8.9
	2.69	14.5	525	34.8	3.0	47.4	55.5	5.98	64.5	61.0	12.6	-9.0

155MHz	Vgg	Vdd	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
	(V)	(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
	2.70	10.99	463	34.8	3.0	45.3	33.7	4.26	72.4	65.9	10.5	-8.4
	2.70	11.5	475	34.8	3.0	45.6	36.5	4.43	72.2	66.3	10.8	-8.4
	2.70	11.99	488	34.8	3.0	46.0	39.4	4.59	72.0	66.5	11.2	-8.5
	2.70	12.49	500	34.8	3.0	46.3	42.3	4.75	71.9	66.7	11.5	-8.5
	2.70	13	513	34.8	3.0	46.6	45.4	4.91	71.6	66.9	11.8	-8.5
	2.70	13.49	513	34.8	3.0	46.9	48.6	5.06	71.6	67.1	12.1	-8.6
	2.70	13.99	525	34.8	3.0	47.1	51.8	5.21	71.4	67.3	12.3	-8.6
	2.70	14.5	538	34.8	3.0	47.4	55.1	5.38	71.2	67.3	12.6	-8.7

175MHz	Vgg	Vdd	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
	(V)	(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
	2.70	10.99	463	34.8	3.0	45.5	35.6	4.40	74.0	67.7	10.7	-11.5
	2.70	11.5	475	34.8	3.0	45.9	38.7	4.60	73.6	67.8	11.1	-11.4
	2.70	11.99	488	34.8	3.0	46.2	41.8	4.79	73.3	68.0	11.4	-11.4
	2.70	12.49	488	34.8	3.0	46.5	45.1	4.98	73.0	68.1	11.7	-11.4
	2.70	13	500	34.8	3.0	46.9	48.5	5.18	72.5	68.0	12.0	-11.4
	2.70	13.49	513	34.8	3.0	47.1	51.9	5.36	72.2	68.0	12.3	-11.3
	2.70	13.99	525	34.8	3.0	47.4	55.3	5.55	71.7	67.8	12.6	-11.3
	2.70	14.5	538	34.8	3.0	47.7	58.8	5.74	71.2	67.6	12.9	-11.3