APPLICATION NOTE

MITSUBISHI ELECTRIC
Silicon RF Power Semiconductors

Document NO. AN-UHF-127
Date : 31st May. 2011
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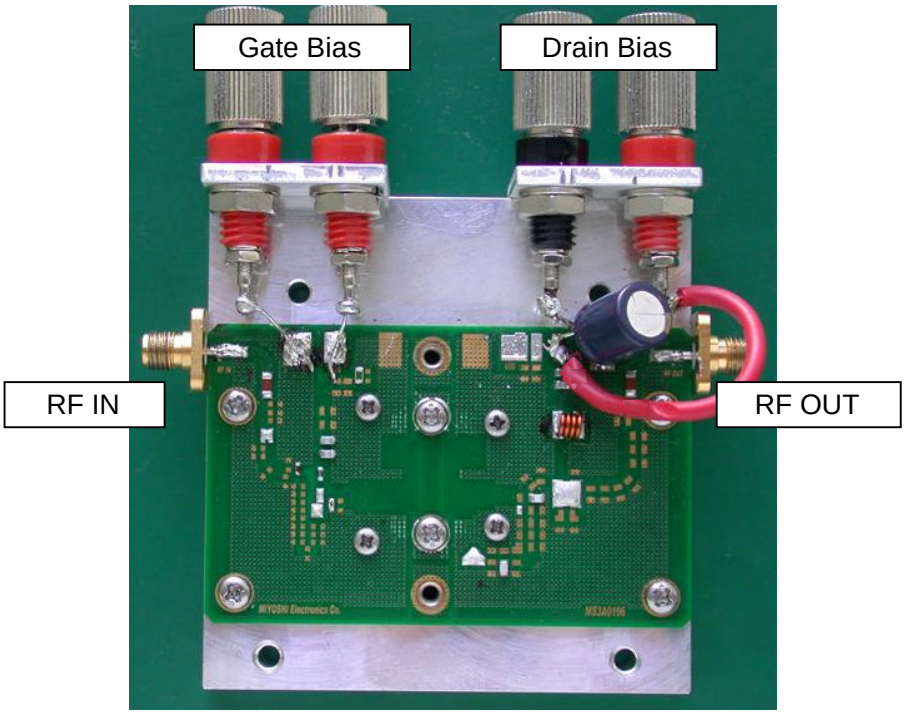
(Taking charge of Silicon RF by
MIYOSHI Electronics)

SUBJECT: RD35HUF2 single-stage amplifier with f=380-430MHz evaluation board

Features:

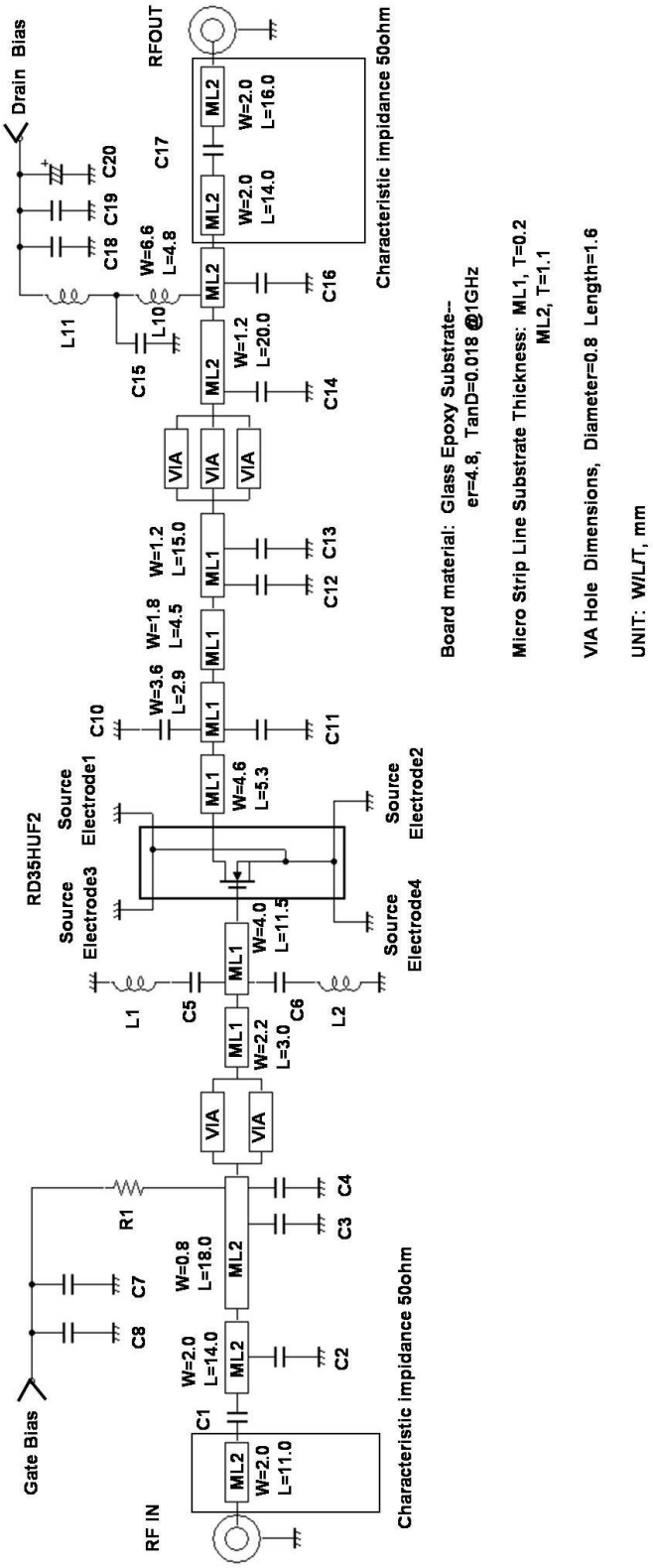
- The evaluation board for RD35HUF2
- Frequency: 380-430MHz
- Typical input power: 3W
- Typical output power: 46W
- Typical adjacent channel power ratio*: -42.5dBc @ output power=17.7W (42.5dBm)
  *: Modulation: π/4 DQPSK, 18kbps, α=0.35, Channel-Band-Width=18 kHz, Channel-Spacing=25 kHz
- Quiescent current: 700mA
- Operating current: 6.4A @output power=46W
- 3.5A @ output power=17.7W (42.5dBm)
- Surface-mounted RF power amplifier structure



PCB L=75mm W=46mm

Contents

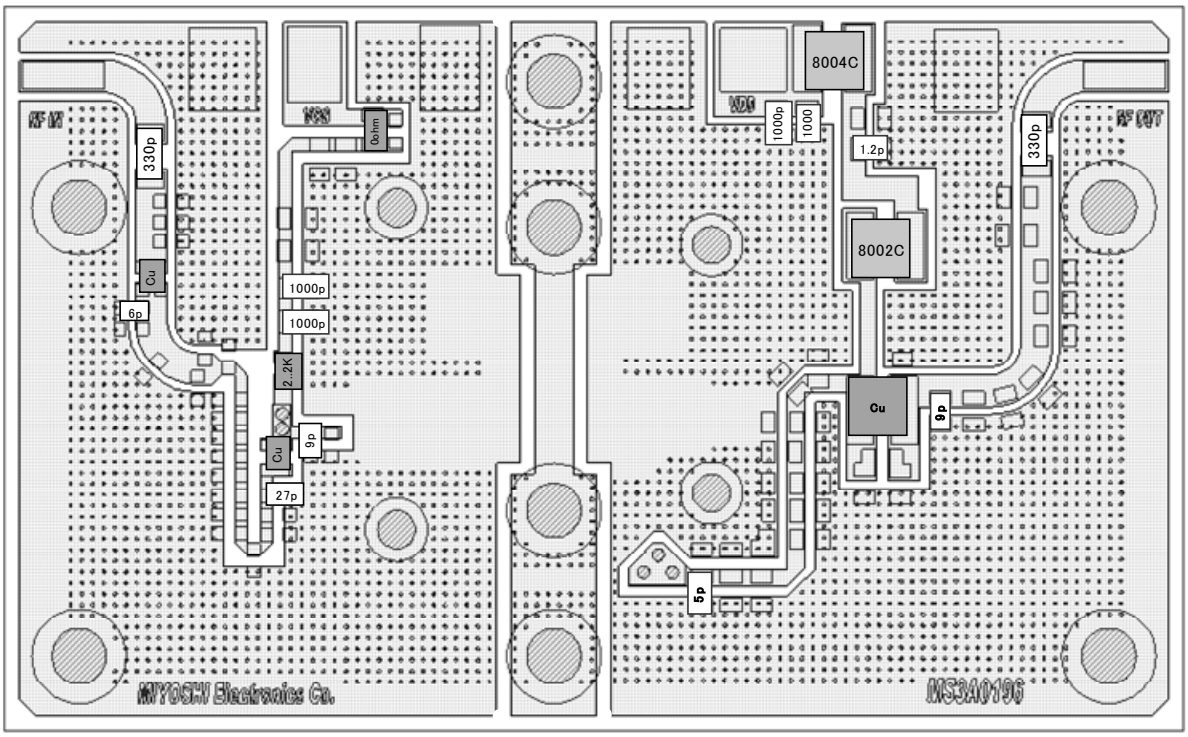
1. Equivalent Circuitry



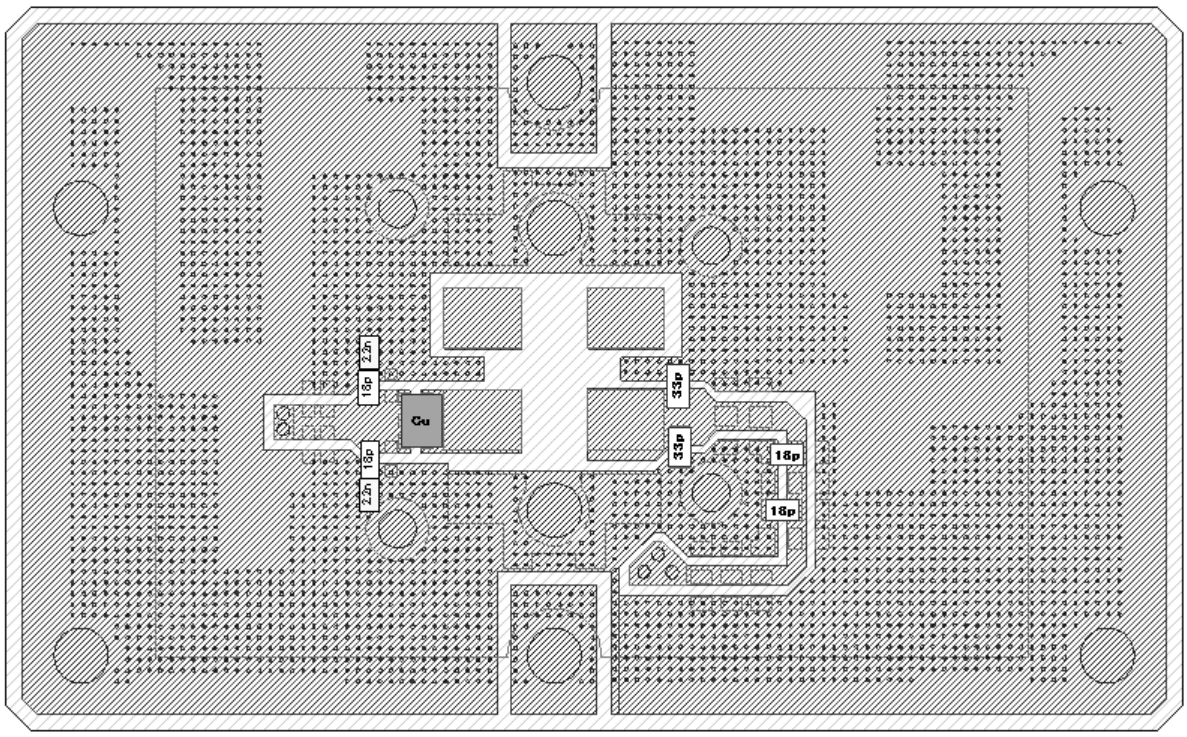
2. PCB Layout

BOARD OUTLINE: 75.0*46.0(mm)

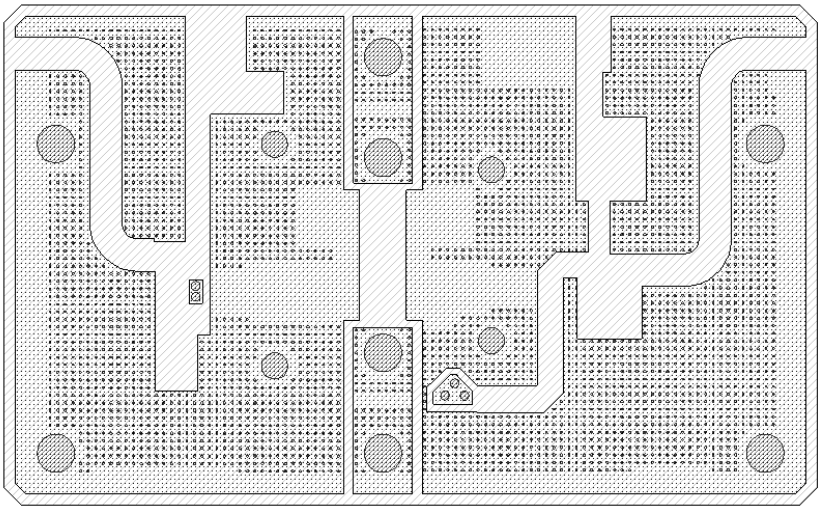
TOP VIEW (Layer 1)



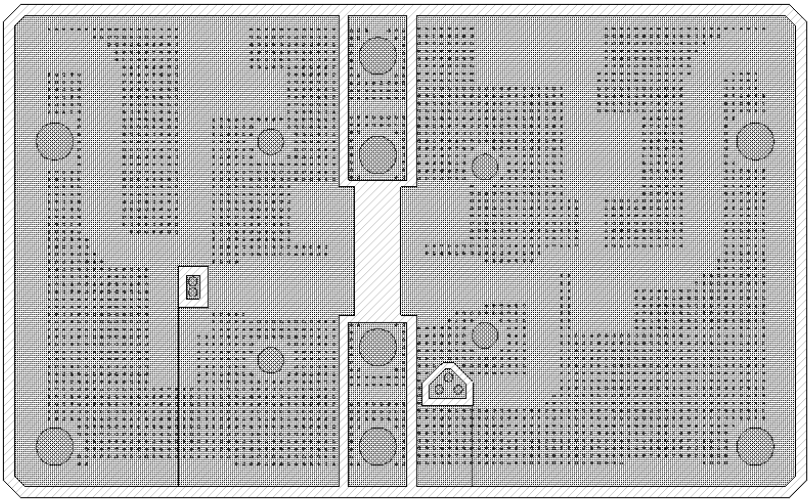
BOTTOM VIEW (Layer 4), Perspective through Top View



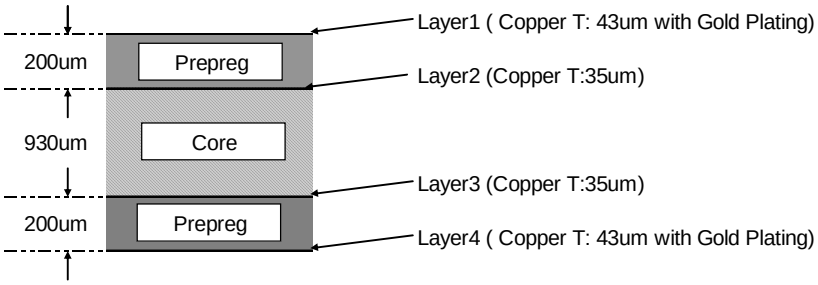
BOARD OUTLINE: 75.0*46.0(mm)
Internal Layer (Layer 2) , Perspective Through Top View



Internal Layer (Layer 3) , Perspective Through Top View



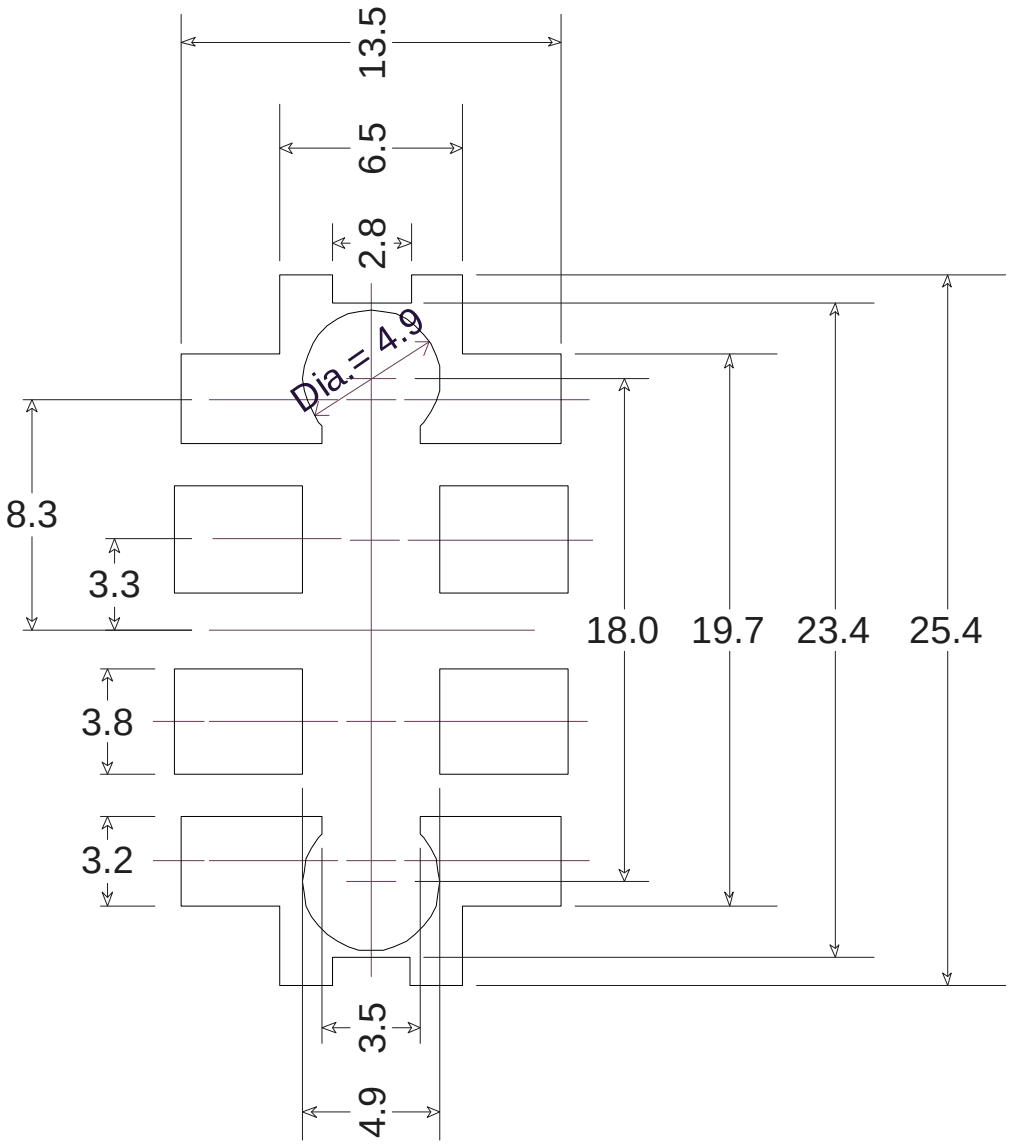
Substrate Condition
Nomial Total Completed Thickness (included resist coating): 1.6mm



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

- Component List

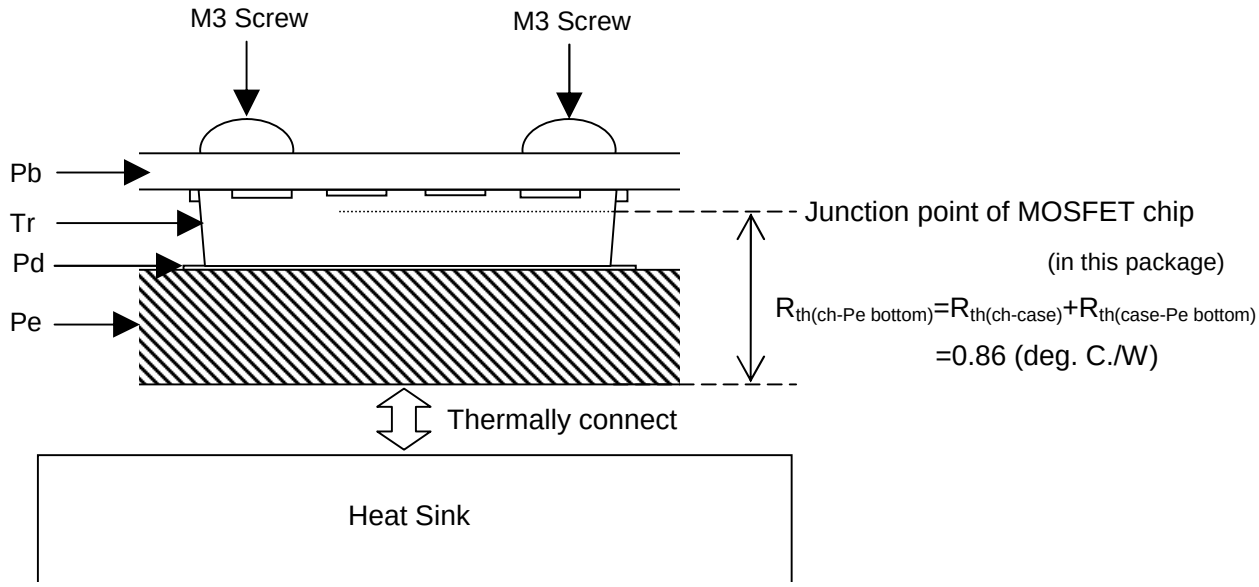
No.	Description	P/N	Qty	Manufacturer
Tr	MOSFET	RD35HUF2	1	Mitsubishi Electric Corporation
C 1	330 pF 3216 200V	GRM31M2C2D331JY21B	1	MURATA MANUFACTURING CO., LTD.
C 2	6 pF 1608 Hi-Q 100V	GQM1882C2A6R0DB01	1	MURATA MANUFACTURING CO., LTD.
C 3	27 pF 1608 Hi-Q 50V	GQM1882C1H270GB01	1	MURATA MANUFACTURING CO., LTD.
C 4	9 pF 1608 Hi-Q 50V	GQM1882C1H9R0DB01	1	MURATA MANUFACTURING CO., LTD.
C 5	18 pF 1608 Hi-Q 50V	GQM1882C1H180JB01	1	MURATA MANUFACTURING CO., LTD.
C 6	18 pF 1608 Hi-Q 50V	GQM1882C1H180JB01	1	MURATA MANUFACTURING CO., LTD.
C 7	1000 pF 2012 50V	GRM2162C1H102JA01B	1	MURATA MANUFACTURING CO., LTD.
C 8	1000 pF 2012 50V	GRM2162C1H102JA01B	1	MURATA MANUFACTURING CO., LTD.
C 10	33 pF 2012 Hi-Q 50V	GQM2192C1H330JB01	1	MURATA MANUFACTURING CO., LTD.
C 11	33 pF 2012 Hi-Q 50V	GQM2192C1H330JB01	1	MURATA MANUFACTURING CO., LTD.
C 12	18 pF 2012 Hi-Q 100V	GQM2192C2A180JB01	1	MURATA MANUFACTURING CO., LTD.
C 13	18 pF 2012 Hi-Q 100V	GQM2192C2A180JB01	1	MURATA MANUFACTURING CO., LTD.
C 14	5 pF 2012 Hi-Q 100V	GQM2192C2A5R0CB01	1	MURATA MANUFACTURING CO., LTD.
C 15	1.2 pF 2012 Hi-Q 100V	GQM2194C2A1R2CB01	1	MURATA MANUFACTURING CO., LTD.
C 16	9 pF 2012 Hi-Q 100V	GQM2192C2A9R0DB01	1	MURATA MANUFACTURING CO., LTD.
C 17	330 pF 3216 200V	GRM31M2C2D331JY21B	1	MURATA MANUFACTURING CO., LTD.
C 18	1000 pF 2012 100V	GRM2162C1H102JA01B	1	MURATA MANUFACTURING CO., LTD.
C 19	1000 pF 2012 100V	GRM2162C1H102JA01B	1	MURATA MANUFACTURING CO., LTD.
C 20	220 uF 35V	EEUFC1V221	1	Panasonic Corp.
L 1	2.2 nH 1608	LQG18HN2N2S00	1	MURATA MANUFACTURING CO., LTD.
L 2	2.2 nH 1608	LQG18HN2N2S00	1	MURATA MANUFACTURING CO., LTD.
L 10	8 nH * Diameter: Wire=0.8mm Inside=2.2mm T/N of coils=2		1	YC CORPORATION Co.,Ltd.
L 11	17 nH * Diameter: Wire=0.8mm Inside=2.2mm T/N of coils=4		1	YC CORPORATION Co.,Ltd.
R 1	2.2k ohm 1608	RPC05T222J	1	TAIYOSHA ELECTRIC CO.,LTD.
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.

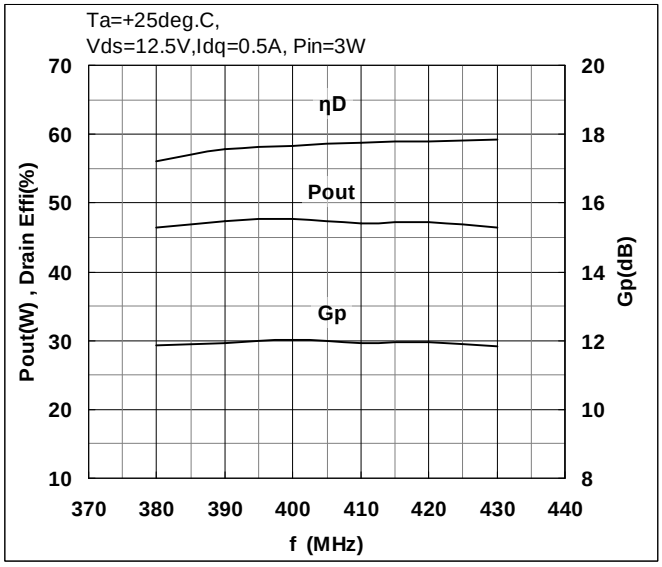
In terms of long-term reliability, "$Tj_{(op)}$" has to be kept less than 140 deg. C. i.e. $T_{Pe\ bottom\text{-}air}$ has to be less than 47.3 deg. C..
The thermal resistance of the heat sink to border it:
$Rth_{(Pe\ bottom\text{-}air)}$=$T_{Pe\ bottom\text{-}air}$/(Pout/Efficiency-Pout+Pin)=47.3/(35W/50%-35W+3)=1.2 (deg. C./W)
Therefore
it is preferable that the thermal resistance of the heat sink is much smaller than 1.2 deg. C./W.

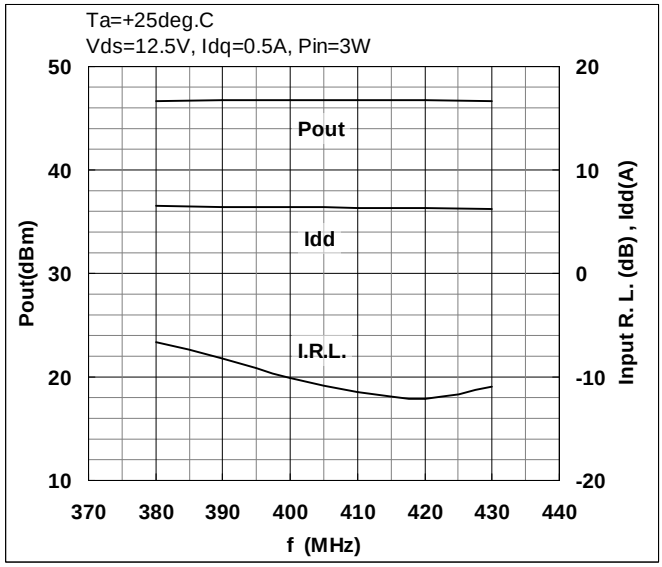
For assembly method including relevant precaution, refer to AN-GEN-070

6.Typical Performance

6-1. Frequency vs.

ADJACENT CHANNEL POWER RATIO, POWER GAIN, DRAIN EFFICIENCY, DRAIN CURRENT, INPUT POWER and INPUT RETURN LOSS





Ta=+25deg. C., Vds=12.5V, Idq=0.7A, Pin=3W

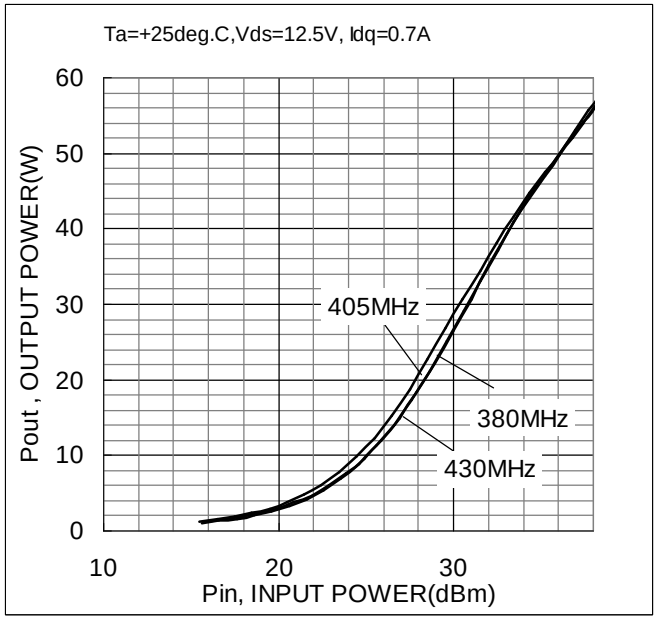
Freq.	Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.
(MHz)	(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)
380	2.80	34.8	3.0	46.7	46.4	11.9	6.53	52.4	56.1	-6.7
390	2.80	34.8	3.0	46.8	47.4	11.9	6.46	54.1	57.8	-8.2
400	2.80	34.8	3.0	46.8	47.7	12.0	6.45	54.6	58.3	-10.1
410	2.80	34.8	3.0	46.7	47.0	11.9	6.30	55.0	58.8	-11.5
420	2.80	34.8	3.0	46.7	47.2	11.9	6.31	55.2	58.9	-12.1
430	2.80	34.8	3.0	46.7	46.4	11.8	6.18	55.4	59.3	-10.9

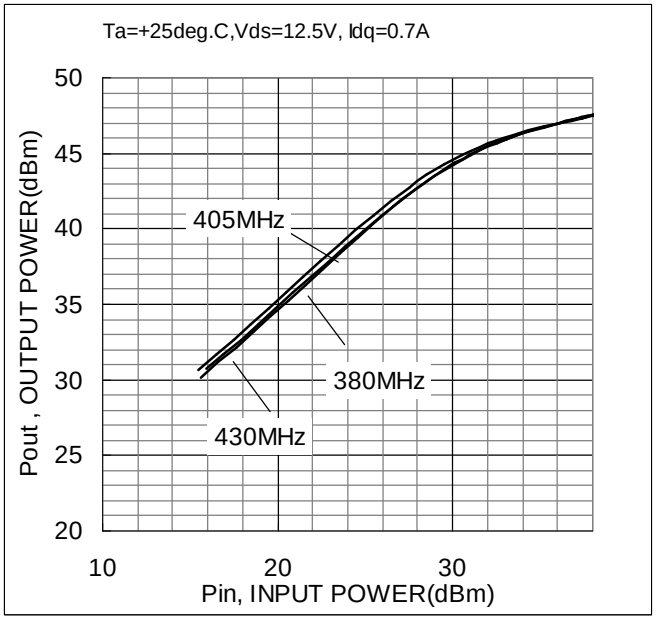
Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

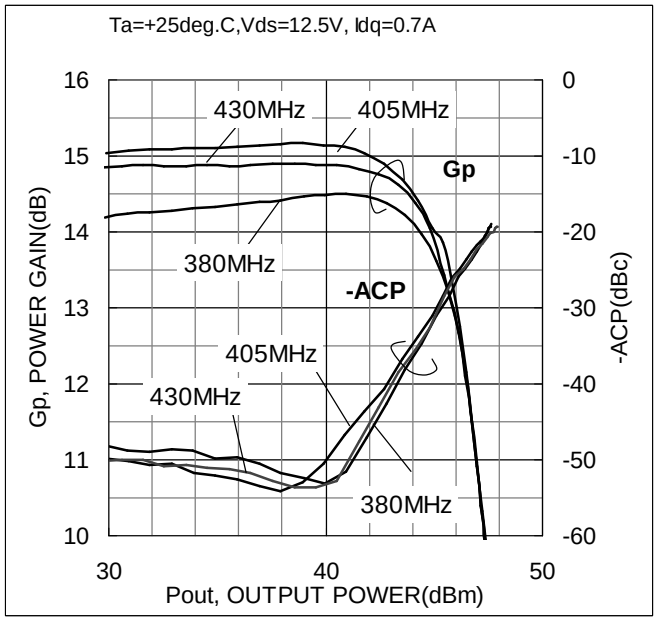
6-2. RF Power vs.

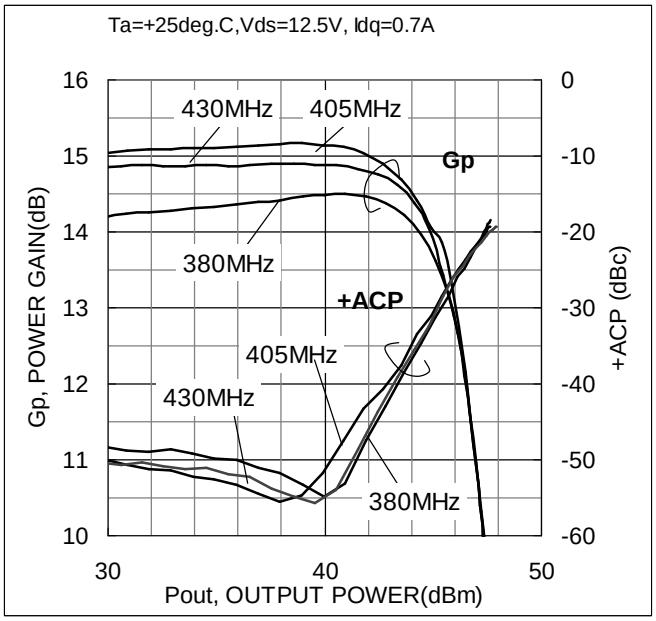
INPUT POWER





POWER GAIN and - /+ ADJACENT CHANNEL POWER

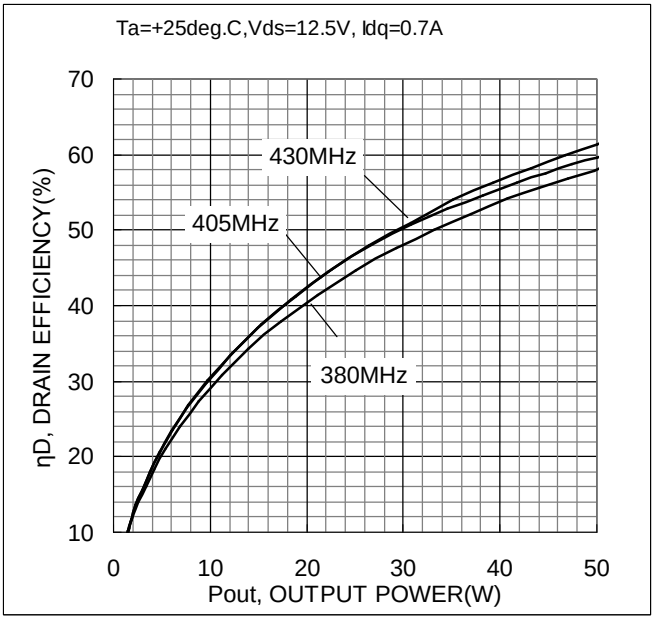


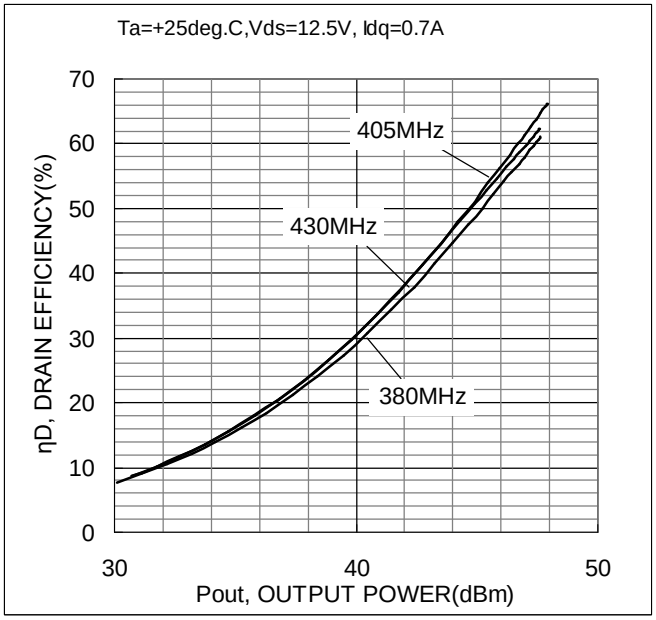


Note: Unless otherwise specified, input signal is setting modulation with the following condition.

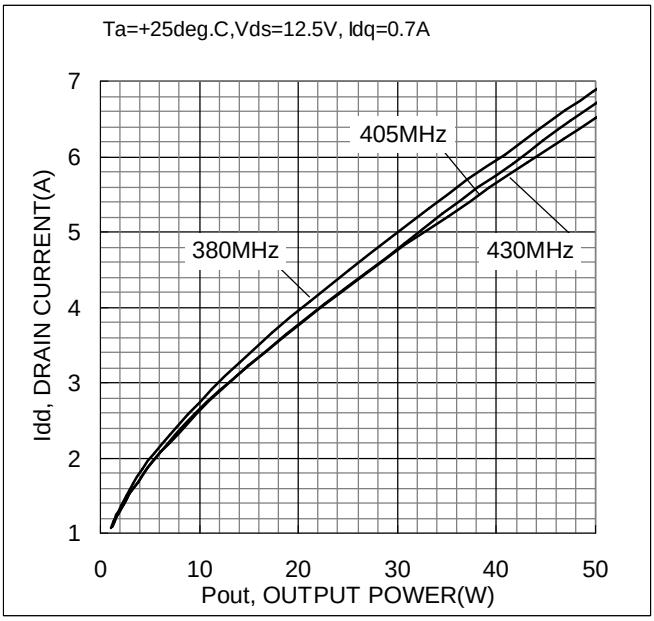
Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

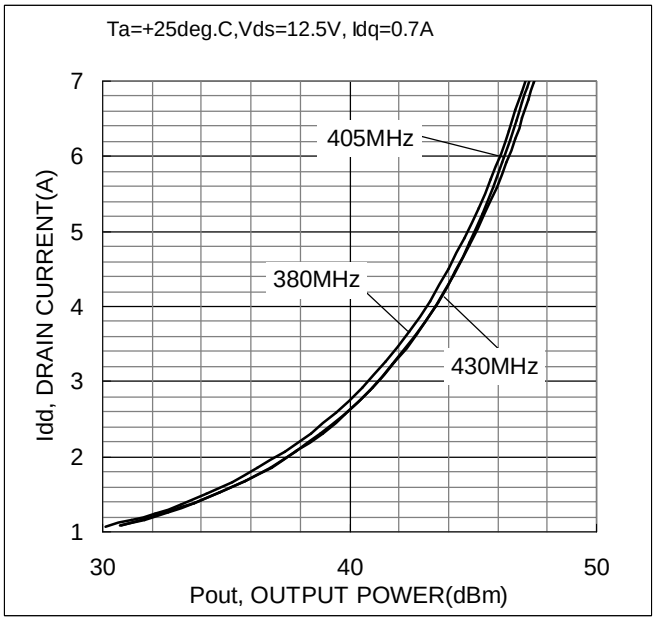
DRAIN EFFICIENCY





DRAIN CURRENT

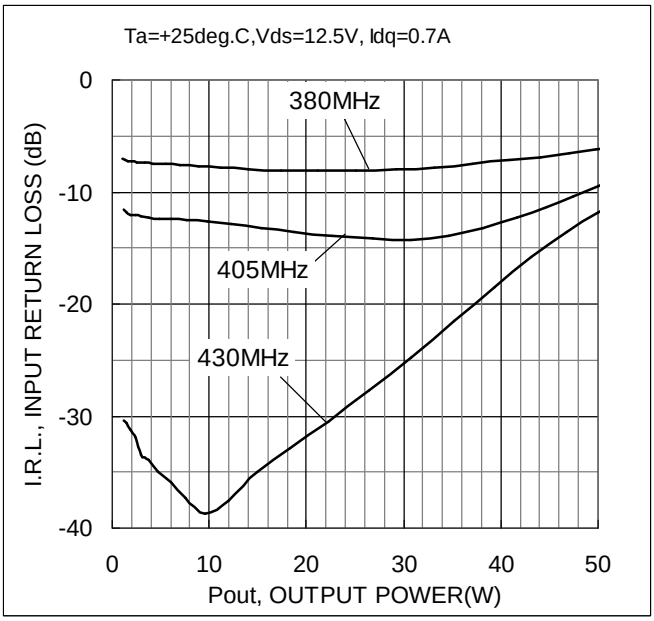


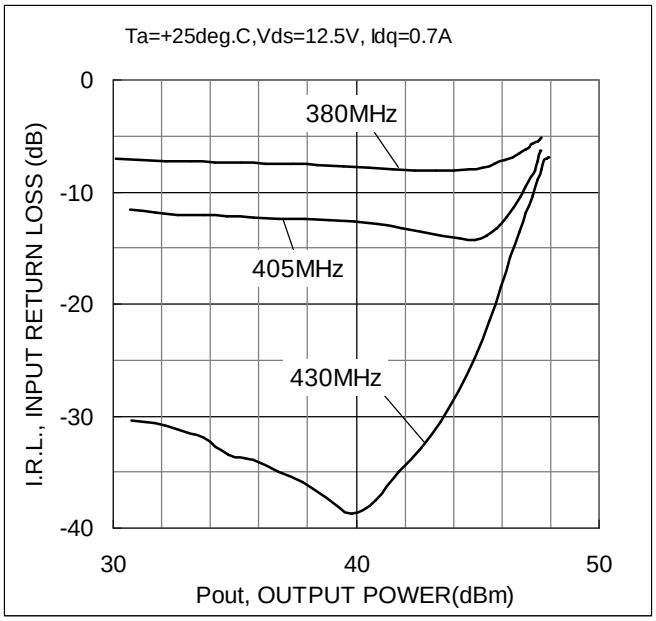


Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

INPUT RETURN LOSS





Ta=+25deg. C., Vds=12.5V, Idq=0.7A

380MHz	Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.	-ACP	+ACP
	(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)	(dBc)	(dBc)
	2.80	15.6	0.04	30.1	1.0	14.2	1.06	7.5	7.7	-7.0	-48.7	-48.8
	2.80	16.6	0.05	31.1	1.3	14.2	1.15	8.7	9.1	-7.1	-48.9	-49.0
	2.80	17.6	0.06	32.1	1.6	14.3	1.25	10.1	10.5	-7.2	-48.6	-48.7
	2.80	18.6	0.07	33.2	2.1	14.3	1.36	11.8	12.2	-7.2	-48.8	-49.1
	2.80	19.6	0.09	34.2	2.6	14.3	1.50	13.5	14.0	-7.3	-49.7	-49.8
	2.80	20.6	0.11	35.3	3.4	14.3	1.66	15.6	16.1	-7.4	-49.7	-50.1
	2.80	21.6	0.14	36.3	4.2	14.4	1.85	17.7	18.3	-7.5	-50.5	-51.0
	2.80	22.6	0.18	37.4	5.5	14.4	2.06	20.5	21.2	-7.5	-51.7	-51.7
	2.80	23.6	0.23	38.4	6.9	14.4	2.31	23.2	24.0	-7.6	-52.4	-53.2
	2.80	24.6	0.29	39.5	8.8	14.5	2.59	26.4	27.3	-7.7	-53.1	-54.8
	2.80	25.6	0.36	40.5	11.2	14.5	2.91	29.7	30.7	-7.8	-51.5	-53.0
	2.80	26.6	0.46	41.5	14.0	14.5	3.26	33.2	34.3	-7.9	-47.0	-47.5
	2.80	27.6	0.58	42.4	17.4	14.5	3.66	36.6	37.9	-8.0	-42.6	-43.0
	2.80	28.6	0.73	43.2	21.1	14.4	4.08	40.0	41.5	-8.1	-38.1	-38.4
	2.80	29.6	0.91	44.0	25.1	14.2	4.50	43.1	44.7	-8.1	-34.7	-34.6
	2.80	30.6	1.14	44.7	29.2	14.0	4.91	45.7	47.6	-8.0	-31.1	-31.2
	2.80	31.6	1.43	45.2	33.2	13.6	5.31	47.8	50.0	-7.8	-28.5	-28.5
	2.80	32.5	1.78	45.7	37.0	13.2	5.69	49.6	52.1	-7.5	-25.9	-25.9
	2.80	33.4	2.21	46.1	40.9	12.7	6.03	51.3	54.2	-7.2	-24.8	-24.8
	2.80	34.3	2.71	46.4	44.0	12.1	6.34	52.1	55.5	-6.9	-23.6	-23.3
	2.80	35.2	3.33	46.7	47.0	11.5	6.61	52.8	56.9	-6.5	-22.6	-21.9
	2.80	36.0	4.02	47.0	49.7	10.9	6.86	53.2	57.9	-6.2	-21.8	-21.2
	2.80	36.8	4.76	47.2	52.1	10.4	7.06	53.6	59.0	-5.9	-20.5	-20.1
	2.80	37.4	5.46	47.3	54.0	10.0	7.23	53.7	59.8	-5.7	-20.1	-19.5
	2.80	37.8	6.09	47.4	55.5	9.6	7.36	53.7	60.3	-5.5	-19.6	-19.0

Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

405MHz

Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.	-ACP	+ACP
(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)	(dBc)	(dBc)
2.80	15.4	0.03	30.7	1.2	15.0	1.09	8.3	8.6	-11.6	-50.1	-50.7
2.80	16.5	0.04	31.7	1.5	15.1	1.16	9.9	10.2	-11.8	-50.7	-51.2
2.80	17.5	0.06	32.7	1.8	15.1	1.26	11.3	11.7	-12.0	-50.5	-51.4
2.80	18.5	0.07	33.7	2.4	15.1	1.39	13.2	13.6	-12.0	-51.8	-52.2
2.80	19.5	0.09	34.7	3.0	15.1	1.53	15.1	15.5	-12.1	-52.0	-52.7
2.80	20.5	0.11	35.8	3.8	15.1	1.68	17.5	18.1	-12.2	-52.5	-53.3
2.80	21.5	0.14	36.8	4.8	15.1	1.86	20.0	20.6	-12.3	-53.4	-54.5
2.80	22.5	0.18	37.8	6.1	15.1	2.08	22.8	23.5	-12.4	-54.1	-55.5
2.80	23.5	0.22	38.9	7.7	15.2	2.31	26.0	26.8	-12.5	-52.9	-54.6
2.80	24.5	0.28	39.9	9.8	15.2	2.60	29.3	30.2	-12.7	-50.5	-51.7
2.80	25.5	0.35	40.9	12.3	15.1	2.91	32.9	33.8	-12.9	-46.8	-47.5
2.80	26.5	0.45	41.9	15.3	15.1	3.26	36.5	37.6	-13.2	-43.6	-43.4
2.80	27.5	0.56	42.7	18.8	15.0	3.64	40.1	41.3	-13.5	-40.6	-40.8
2.80	28.5	0.71	43.6	22.7	14.9	4.05	43.4	44.8	-13.9	-36.8	-37.5
2.80	29.5	0.90	44.3	26.8	14.7	4.46	46.5	48.1	-14.2	-33.8	-33.5
2.80	30.5	1.13	44.9	30.7	14.4	4.85	48.9	50.7	-14.2	-31.1	-31.0
2.80	31.5	1.42	45.4	34.6	14.1	5.24	50.6	52.8	-13.9	-28.5	-28.5
2.80	32.5	1.77	45.8	38.1	13.3	5.59	52.1	54.6	-13.2	-26.1	-26.4
2.80	33.4	2.21	46.2	41.7	12.8	5.91	53.4	56.4	-12.3	-24.8	-24.8
2.80	34.4	2.73	46.5	44.7	12.1	6.21	54.1	57.6	-11.3	-23.6	-23.6
2.80	35.2	3.35	46.8	47.5	11.5	6.48	54.5	58.7	-10.4	-22.6	-22.6
2.80	36.1	4.06	47.0	50.0	10.9	6.71	54.8	59.6	-9.5	-21.8	-21.8
2.80	36.8	4.76	47.2	52.3	10.4	6.91	55.0	60.5	-8.7	-21.2	-21.0
2.80	37.4	5.51	47.3	54.1	9.9	7.08	54.9	61.2	-8.0	-20.7	-20.5
2.80	37.9	6.16	47.4	55.6	9.6	7.20	54.9	61.7	-7.3	-20.0	-20.0

430MHz

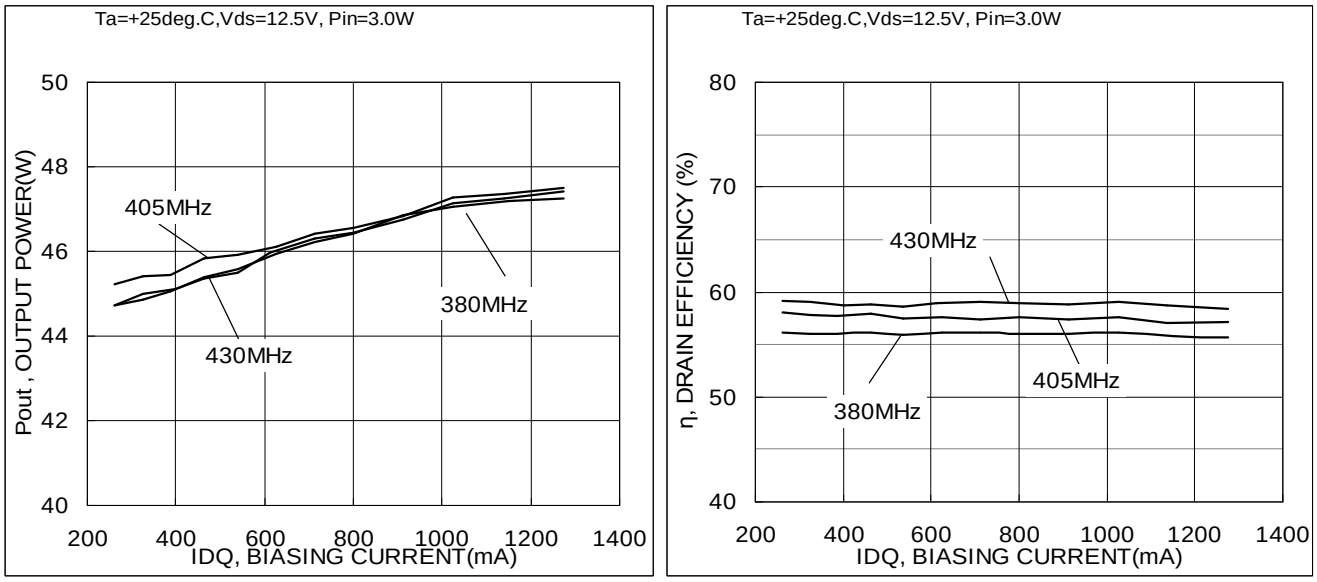
Vgg	Pin		Pout		Gp	ID(RF)	ηadd	ηD	I.R.L.	-ACP	+ACP
(V)	(dBm)	(W)	(dBm)	(W)	(dB)	(A)	(%)	(%)	(dB)	(dBc)	(dBc)
2.80	15.9	0.04	30.7	1.2	14.8	1.09	8.4	8.7	-30.4	-49.9	-50.7
2.80	16.9	0.05	31.7	1.5	14.8	1.18	9.8	10.2	-30.6	-50.0	-50.3
2.80	17.9	0.06	32.7	1.9	14.8	1.28	11.3	11.7	-31.2	-50.8	-50.8
2.80	18.9	0.08	33.7	2.4	14.8	1.39	13.2	13.6	-31.9	-50.6	-51.2
2.80	19.9	0.10	34.7	3.0	14.8	1.53	15.1	15.6	-33.5	-51.1	-51.1
2.80	20.9	0.12	35.8	3.8	14.9	1.68	17.4	18.0	-33.9	-51.3	-51.9
2.80	21.9	0.15	36.8	4.8	14.9	1.86	19.8	20.5	-35.0	-51.7	-52.2
2.80	22.9	0.19	37.8	6.0	14.9	2.06	22.6	23.3	-35.9	-52.8	-53.7
2.80	23.9	0.24	38.8	7.6	14.9	2.30	25.6	26.4	-37.3	-53.6	-54.8
2.80	24.9	0.31	39.8	9.6	14.9	2.58	28.8	29.8	-37.9	-53.6	-55.7
2.80	25.9	0.39	40.8	12.0	14.9	2.89	32.3	33.3	-37.6	-52.7	-53.9
2.80	26.9	0.49	41.7	15.0	14.8	3.23	35.9	37.1	-35.0	-47.6	-48.6
2.80	27.9	0.62	42.6	18.4	14.7	3.60	39.5	40.9	-32.9	-43.1	-43.6
2.80	28.9	0.78	43.5	22.2	14.5	4.00	42.9	44.5	-30.5	-38.4	-39.1
2.80	30.0	1.00	44.2	26.5	14.2	4.41	46.2	48.0	-27.7	-35.5	-35.5
2.80	31.0	1.26	44.9	30.8	13.9	4.83	48.9	51.0	-24.8	-32.6	-32.4
2.80	32.0	1.60	45.5	35.2	13.4	5.21	51.5	54.0	-21.5	-28.5	-28.5
2.80	33.1	2.02	45.9	39.3	12.9	5.59	53.4	56.3	-18.5	-25.9	-25.9
2.80	34.1	2.54	46.4	43.2	12.3	5.93	54.9	58.3	-15.8	-24.8	-24.5
2.80	35.1	3.20	46.7	46.8	11.6	6.24	55.9	60.0	-13.6	-23.6	-23.2
2.80	36.0	4.00	47.0	50.0	11.0	6.51	56.5	61.4	-11.8	-22.3	-22.1
2.80	36.9	4.93	47.3	53.1	10.3	6.76	57.0	62.8	-10.4	-21.6	-21.5
2.80	37.7	5.91	47.5	55.6	9.7	6.98	57.0	63.8	-8.9	-20.8	-20.5
2.80	38.4	6.88	47.6	57.7	9.2	7.14	57.0	64.7	-8.0	-20.2	-20.0
2.80	38.9	7.80	47.7	59.4	8.8	7.28	56.7	65.3	-7.1	-20.0	-19.7

Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

6-3. Drain Quiescent Current vs.

OUTPUT POWER and DRAIN EFFICIENCY



Ta=+25deg. C., Vds=12.5V, Pin=3W

380MHz	Vgg	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
	(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
	2.48	263	34.8	3.0	46.5	44.7	6.25	56.2	52.4	11.7	-6.59
	2.50	325	34.8	3.0	46.5	44.9	6.29	56.0	52.2	11.7	-6.61
	2.53	388	34.8	3.0	46.5	45.1	6.31	56.0	52.3	11.8	-6.63
	2.55	463	34.8	3.0	46.6	45.4	6.35	56.1	52.4	11.8	-6.62
	2.58	538	34.8	3.0	46.6	45.6	6.40	55.9	52.2	11.8	-6.66
	2.60	625	34.8	3.0	46.6	45.9	6.43	56.1	52.5	11.9	-6.68
	2.63	713	34.8	3.0	46.6	46.2	6.46	56.1	52.5	11.9	-6.69
	2.65	800	34.8	3.0	46.7	46.4	6.50	56.1	52.4	11.9	-6.69
	2.68	913	34.8	3.0	46.7	46.9	6.58	56.0	52.3	11.9	-6.70
	2.70	1025	34.8	3.0	46.7	47.1	6.59	56.1	52.5	11.9	-6.73
	2.73	1150	34.8	3.0	46.7	47.2	6.64	55.8	52.3	12.0	-6.74
	2.75	1275	34.8	3.0	46.7	47.3	6.66	55.7	52.2	12.0	-6.77

Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

405MHz

Vgg	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
2.47	263	34.8	3.0	46.6	45.2	6.11	58.1	54.2	11.7	-10.47
2.50	325	34.8	3.0	46.6	45.4	6.16	57.8	54.0	11.8	-10.49
2.53	388	34.8	3.0	46.6	45.5	6.19	57.7	53.8	11.8	-10.57
2.55	463	34.8	3.0	46.6	45.8	6.21	57.9	54.1	11.8	-10.56
2.58	538	34.8	3.0	46.6	45.9	6.26	57.5	53.8	11.8	-10.60
2.60	625	34.8	3.0	46.6	46.1	6.29	57.5	53.8	11.8	-10.65
2.63	713	34.8	3.0	46.7	46.4	6.35	57.4	53.7	11.9	-10.63
2.65	800	34.8	3.0	46.7	46.6	6.35	57.6	53.8	11.9	-10.71
2.68	913	34.8	3.0	46.7	46.8	6.41	57.3	53.6	11.9	-10.76
2.70	1025	34.8	3.0	46.7	47.3	6.45	57.6	53.9	11.9	-10.78
2.73	1138	34.8	3.0	46.8	47.4	6.51	57.1	53.4	12.0	-10.75
2.75	1275	34.8	3.0	46.8	47.5	6.53	57.2	53.5	12.0	-10.88

430MHz

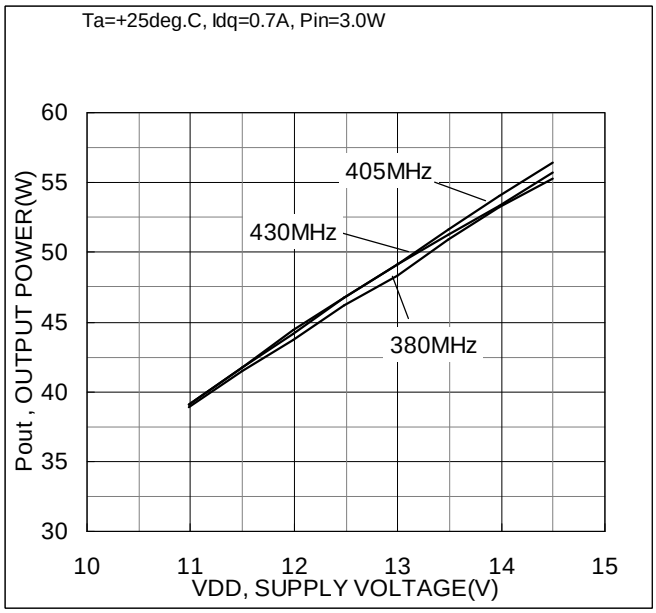
Vgg	Idq	Pin		Pout		Idd	ηD	ηadd	Gain	I.R.L.
(V)	(mA)	(dBm)	(W)	(dBm)	(W)	(A)	(%)	(%)	(dB)	(dB)
2.47	263	34.8	3.0	46.5	44.7	5.93	59.2	55.2	11.7	-10.77
2.50	325	34.8	3.0	46.5	45.0	5.98	59.1	55.1	11.7	-10.78
2.53	400	34.8	3.0	46.5	45.1	6.03	58.7	54.8	11.7	-10.80
2.55	463	34.8	3.1	46.6	45.4	6.05	58.8	54.9	11.7	-10.86
2.58	538	34.8	3.0	46.6	45.5	6.09	58.6	54.8	11.8	-10.94
2.60	613	34.8	3.0	46.6	46.0	6.13	58.9	55.0	11.8	-10.87
2.63	713	34.8	3.0	46.7	46.3	6.15	59.1	55.2	11.8	-10.93
2.65	800	34.8	3.0	46.7	46.5	6.19	58.9	55.1	11.9	-11.04
2.68	913	34.8	3.0	46.7	46.8	6.24	58.8	55.0	11.9	-11.05
2.70	1025	34.8	3.0	46.7	47.1	6.26	59.1	55.3	11.9	-11.04
2.73	1138	34.8	3.0	46.7	47.2	6.31	58.7	55.0	11.9	-11.07
2.75	1275	34.8	3.0	46.8	47.4	6.38	58.4	54.6	11.9	-11.08

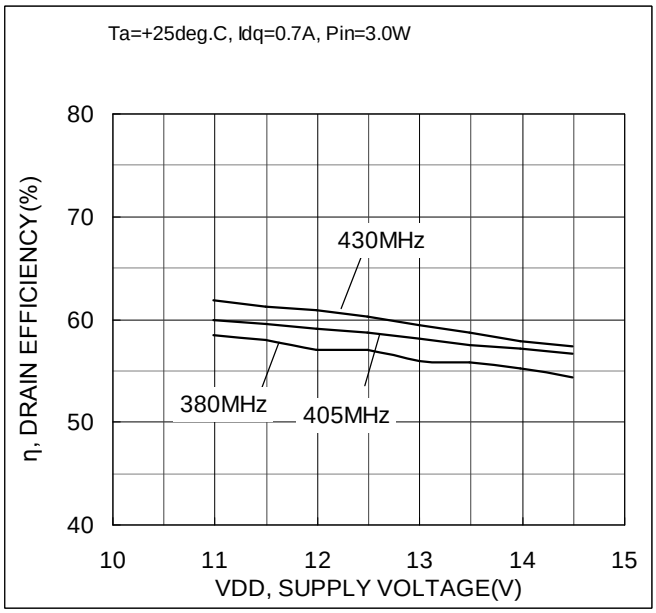
Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

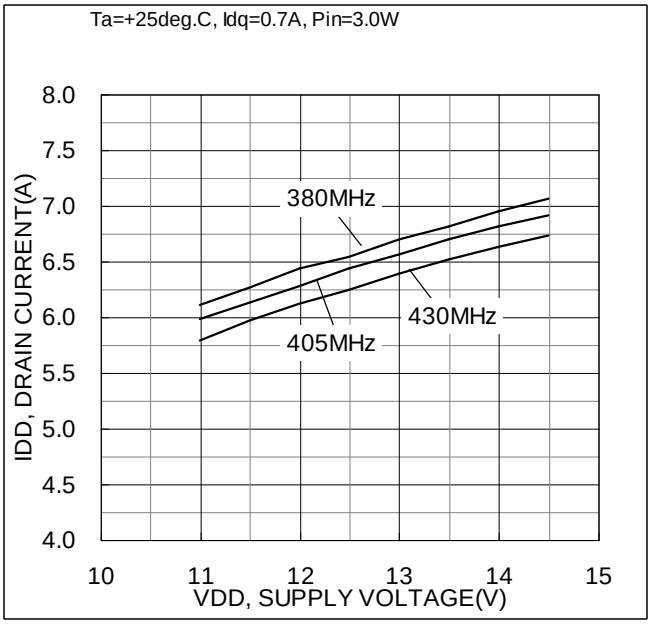
6-4. DC Power Supply vs.

OUTPUT POWER and DRAIN EFFICIENCY





DRAIN CURRENT



Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz

Ta=+25deg. C., Pin=3W

380MHz

Vgg (V)	Vdd (V)	Idq (mA)	Pin (dBm)	Pin (W)	Pout (dBm)	Pout (W)	Idd (A)	ηD (%)	ηadd (%)	Gain (dB)	I.R.L. (dB)
2.62	11.0	613	34.8	3.0	45.9	38.9	6.11	58.5	54.0	11.1	-6.2
2.62	11.5	650	34.8	3.0	46.2	41.4	6.28	58.0	53.7	11.4	-6.3
2.62	12.0	663	34.8	3.0	46.4	43.7	6.44	57.1	53.2	11.6	-6.4
2.62	12.5	688	34.8	3.0	46.7	46.2	6.55	57.0	53.3	11.9	-6.6
2.62	13.0	700	34.8	3.0	46.8	48.3	6.70	56.0	52.5	12.1	-6.7
2.62	13.5	725	34.8	3.0	47.1	50.9	6.81	55.9	52.6	12.3	-6.9
2.62	14.0	738	34.8	3.0	47.3	53.3	6.95	55.2	52.1	12.5	-7.0
2.62	14.5	750	34.8	3.0	47.4	55.3	7.06	54.4	51.5	12.6	-7.1

405MHz

Vgg (V)	Vdd (V)	Idq (mA)	Pin (dBm)	Pin (W)	Pout (dBm)	Pout (W)	Idd (A)	ηD (%)	ηadd (%)	Gain (dB)	I.R.L. (dB)
2.62	11.0	638	34.8	3.0	45.9	39.1	5.99	60.0	55.3	11.1	-9.5
2.62	11.5	663	34.8	3.0	46.2	41.7	6.14	59.6	55.3	11.4	-9.8
2.62	12.0	675	34.8	3.0	46.5	44.2	6.29	59.1	55.1	11.6	-10.1
2.62	12.5	688	34.8	3.0	46.7	46.8	6.44	58.7	54.9	11.9	-10.4
2.62	13.0	700	34.8	3.0	46.9	49.2	6.56	58.1	54.6	12.1	-10.8
2.62	13.5	725	34.8	3.0	47.1	51.6	6.70	57.6	54.2	12.3	-11.1
2.62	14.0	738	34.8	3.0	47.3	54.0	6.81	57.1	53.9	12.5	-11.4
2.62	14.5	750	34.8	3.0	47.5	56.5	6.93	56.7	53.7	12.7	-11.6

430MHz

Vgg (V)	Vdd (V)	Idq (mA)	Pin (dBm)	Pin (W)	Pout (dBm)	Pout (W)	Idd (A)	ηD (%)	ηadd (%)	Gain (dB)	I.R.L. (dB)
2.62	11.0	613	34.8	3.0	45.9	39.1	5.80	61.8	57.0	11.1	-9.4
2.62	11.5	638	34.8	3.0	46.2	41.8	5.98	61.3	56.8	11.4	-9.8
2.62	12.0	663	34.8	3.0	46.5	44.4	6.13	60.9	56.8	11.6	-10.3
2.62	12.5	675	34.8	3.0	46.7	46.7	6.25	60.4	56.4	11.9	-10.7
2.62	13.0	688	34.8	3.0	46.9	49.1	6.40	59.5	55.8	12.1	-11.1
2.62	13.5	713	34.8	3.0	47.1	51.3	6.53	58.8	55.3	12.3	-11.5
2.62	14.0	725	34.8	3.0	47.3	53.3	6.64	57.9	54.6	12.5	-11.9
2.62	14.5	738	34.8	3.0	47.5	55.7	6.74	57.5	54.3	12.7	-12.3

Note: Unless otherwise specified, input signal is setting modulation with the following condition.

Modulation; π/4DPQSK, 18kbps, α=0.35, Channel-Band-Width=18KHz, Channel-Spacing=25KHz