MITSUBISHI ELECTRIC

< Silicon RF Power MOS FET (Discrete) >

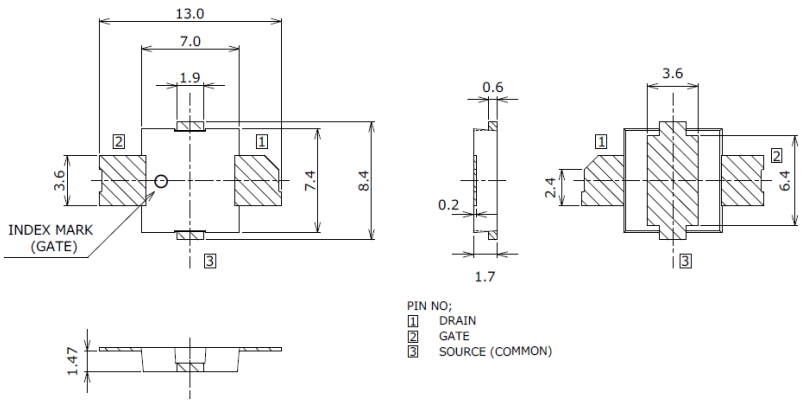
RD35HUP2

RoHS Compliance,Silicon MOSFET Power Transistor, 175MHz, 530MHz, 35W, 12.5V

DESCRIPTION

RD35HUP2 is a MOS FET type transistor specifically designed for VHF/UHF RF power amplifiers applications.

OUTLINE DRAWING



FEATURES

1. Supply with Tape and Reel. 500 Units per Reel
2. Employing Mold Package
3. High Power and High Efficiency
   Pout=35Wtyp, Drain Effi.=70.0%typ
   @ Vds=12.5V Idq=0.5A Pin=3.0W f=175MHz
   Pout=35Wtyp, Drain Effi.=64.0%typ
   @ Vds=12.5V Idq=0.5A Pin=3.0W f=530MHz
4. Integrated gate protection diode.

APPLICATION

For output stage of high power amplifiers in VHF/UHF-band mobile radio sets.

RoHS COMPLIANT

RD35HUP2 is EU RoHS compliant.

RD35HUP2

RoHS Compliance,Silicon MOSFET Power Transistor, 175MHz, 530MHz, 35W, 12.5V

ABSOLUTE MAXIMUM RATINGS (Tc=25°C UNLESS OTHERWISE NOTED)

SYMBOL	PARAMETER	CONDITIONS	RATINGS	UNIT
VDSS	Drain to Source Voltage	Vgs=0V	40	V
VGSS	Gate to Source Voltage	Vds=0V	-5/+10	V
Pch	Channel Dissipation	Tc=25°C	166	W
Pin	Input Power	Zg=Zl=50Ω	6	W
ID	Drain Current	-	10	A
Tch	Channel Temperature	-	175	°C
Tstg	Storage Temperature	-	-40 to +175	°C

Note: Above parameters are guaranteed independently.

ELECTRICAL CHARACTERISTICS (Tc=25°C, UNLESS OTHERWISE NOTED)

SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			MIN	TYP.	MAX.	
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=37V, V_{GS}=0V	-	-	150	μA
I_{GSS}	Gate to Source Leak Current	V_{GS}=10V, V_{DS}=0V	-	-	2.5	μA
V_{TH}	Gate Threshold Voltage	V_{DS}=12V, I_{DS}=1mA	1.6	2.0	2.4	V
Pout	Output Power	f=530MHz*1,V_{DS}=12.5V,	-	35	-	W
ηD	Drain Efficiency	P_{in}=3.0W, Idq=0.5A	-	55	-	%
VSWRT1*2	Load VSWR Tolerance	Load VSWR=65:1(All Phase), V_{DS}=16.3V ,P_{in}=1W(Zg/Zl=50Ω) f=135MHz*1, Idq=0.5A	No destroy			-
VSWRT2	Load VSWR Tolerance	Load VSWR=20:1(All Phase), V_{DS}=16.3V increased after P_{out} adjusted to 40W(Zg/Zl=50Ω) by P_{in}(under f=135MHz*1, V_{DS}=12.5V and Idq=0.5A)	No destroy			-

Note: Above parameters, ratings, limits and conditions are subject to change.

*1 In Mitsubishi VHF Evaluation Board

*2 Random sampling (22pcs/ Lot)

TEMPERATURE CHARACTERISTICS (Tc=25°C UNLESS OTHERWISE NOTED)

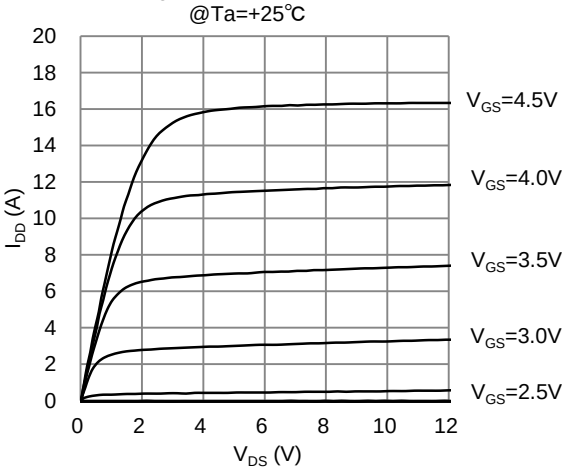
SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			MIN	TYP.	MAX	
Rth j-c	Thermal Resistance	Junction to Case	-	0.33	0.9	°C/W

Note: Above characteristics is a Sampling test. (22pcs / Lot)

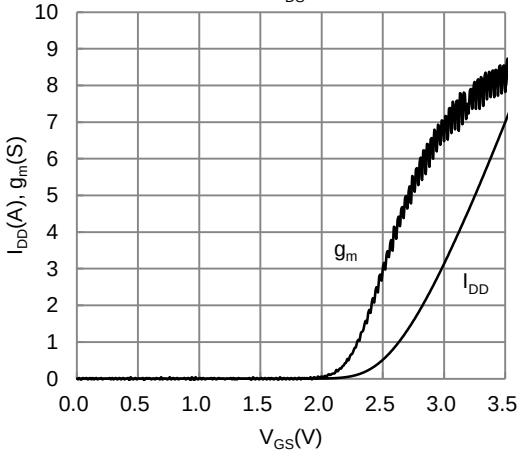
TYPICAL DC CHARACTERISTICS

(These are only typical curves and devices are not necessarily guaranteed at these curves.)

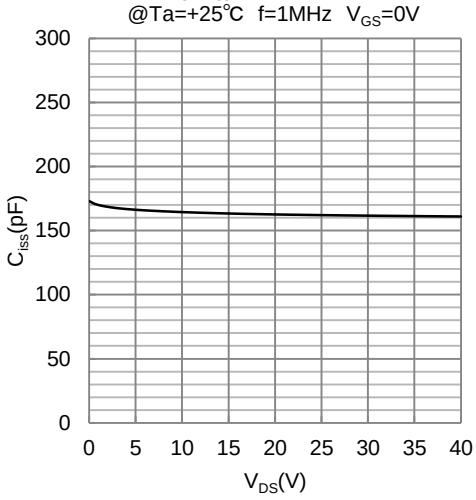
V_{DS}-I_{DD} Characteristics
@Ta=+25℃



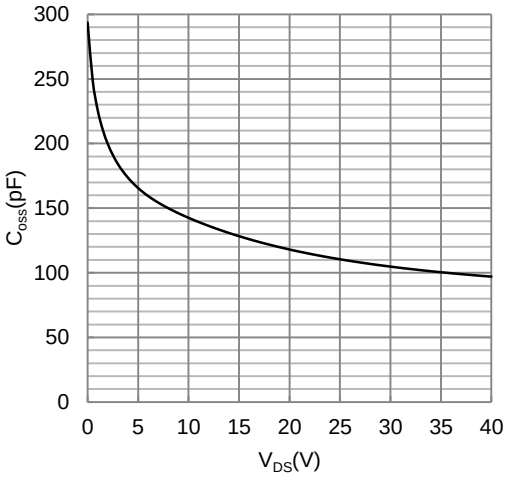
V_{GS}-I_{DD} Characteristics
@Ta=+25℃ V_{DS}=12.5V



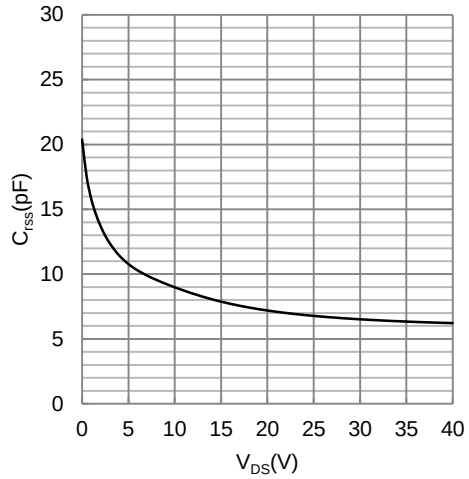
V_{DS}-C_{iss} Characteristics
@Ta=+25℃ f=1MHz V_{GS}=0V



V_{DS}-C_{oss} Characteristics
@Ta=+25℃ f=1MHz

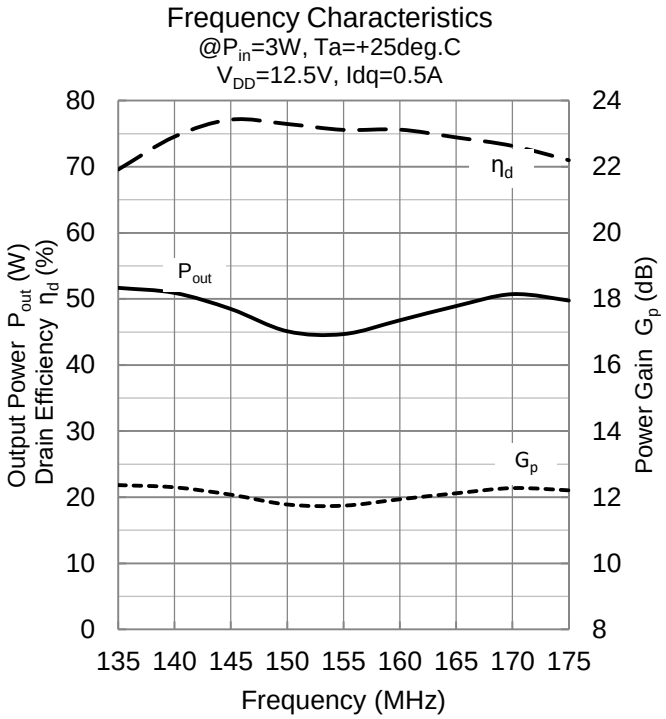


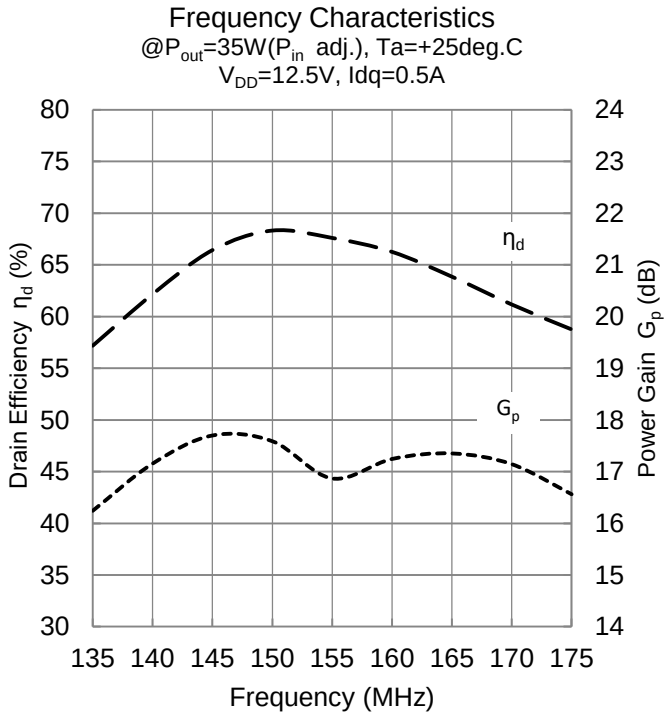
V_{DS}-C_{rss} Characteristics
@Ta=+25℃ f=1MHz



TYPICAL RF CHARACTERISTICS (Frequency vs P_{out} ,ηd , Gp)

(These are only typical curves and devices are not necessarily guaranteed at these curves.)

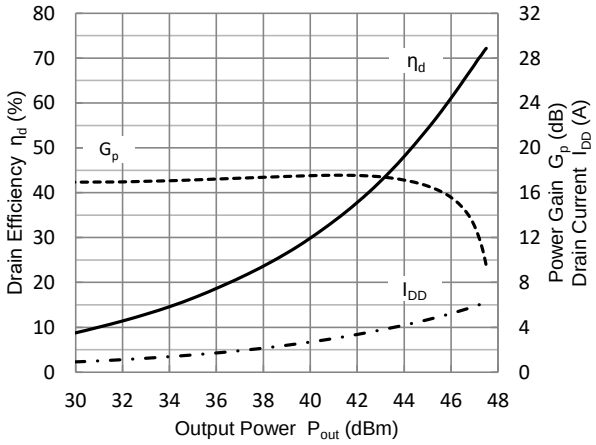




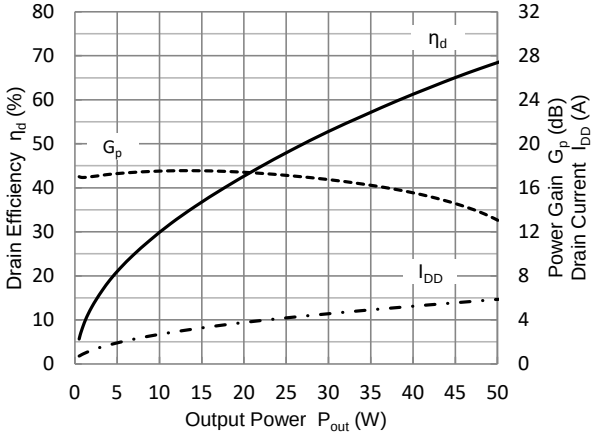
TYPICAL RF CHARACTERISTICS (Pout vs Gp , ηd , I_{DD})

(These are only typical curves and devices are not necessarily guaranteed at these curves.)

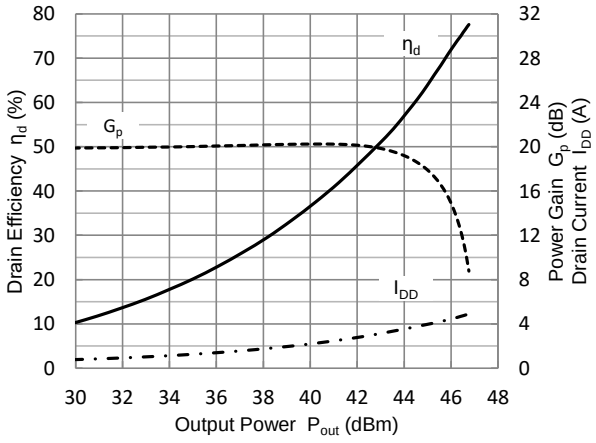
P_{out} Characteristics
@f=135MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



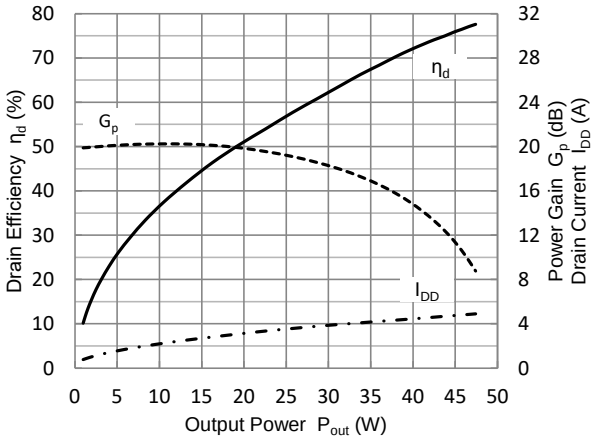
P_{out} Characteristics
@f=135MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



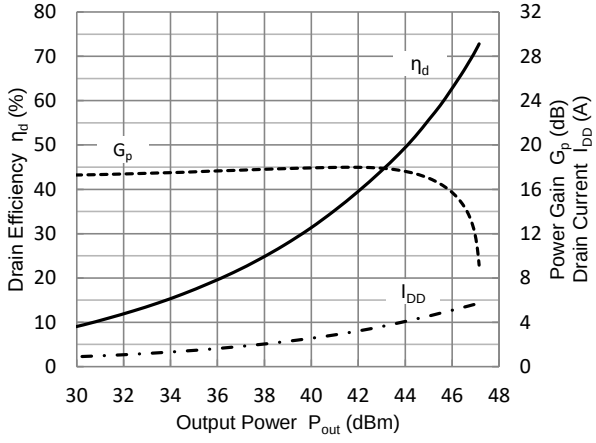
P_{out} Characteristics
@f=155MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



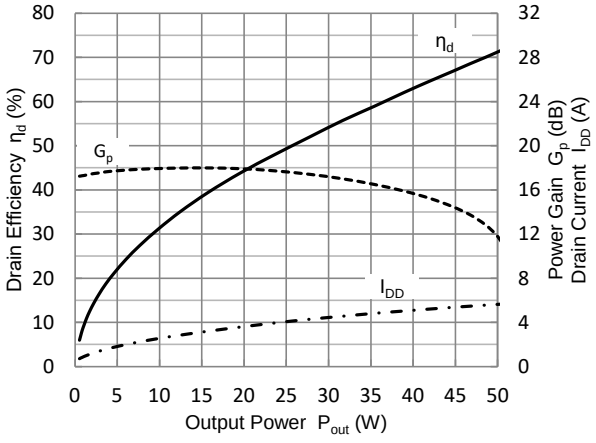
P_{out} Characteristics
@f=155MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



P_{out} Characteristics
@f=175MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



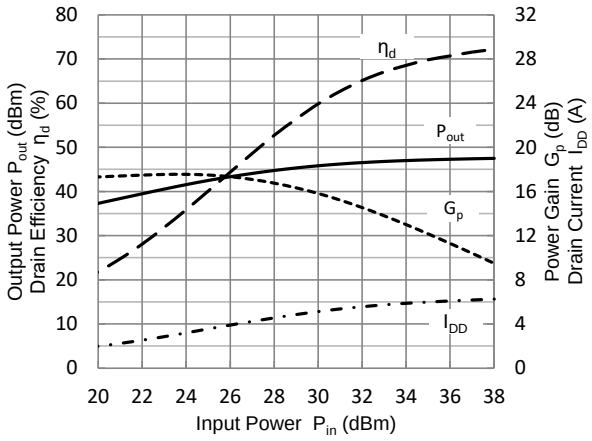
P_{out} Characteristics
@f=175MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



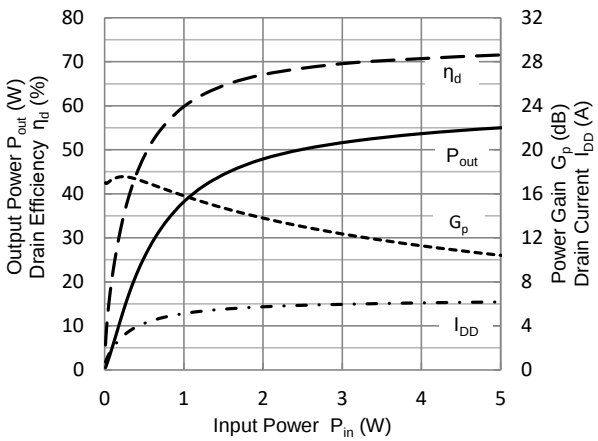
TYPICAL RF CHARACTERISTICS (Pin vs Pout Gp, ηd, I_{DD})

(These are only typical curves and devices are not necessarily guaranteed at these curves.)

P_{in} Characteristics
@f=135MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



P_{in} Characteristics
@f=135MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



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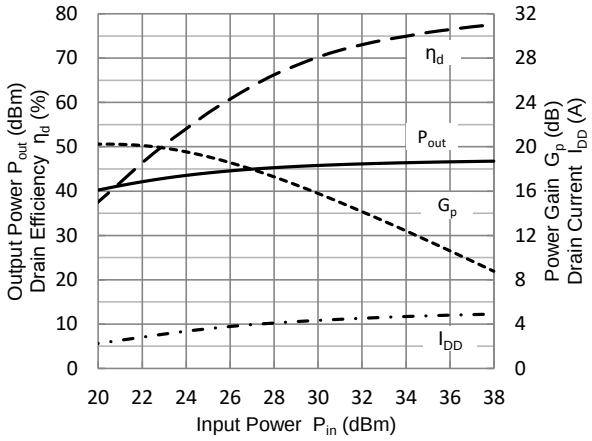
@f=155MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



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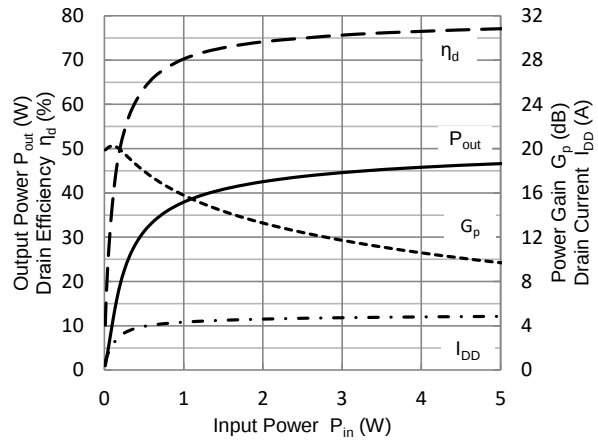

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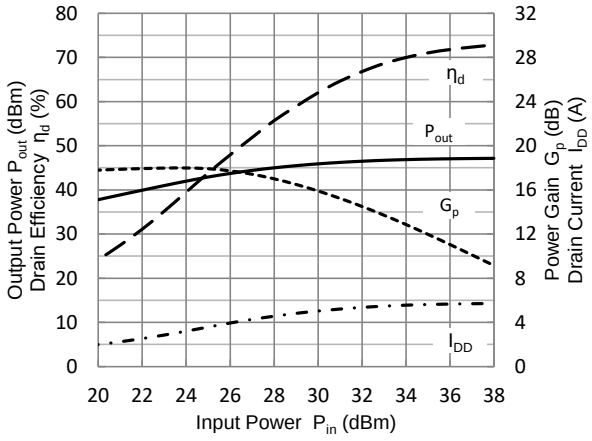
@f=175MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



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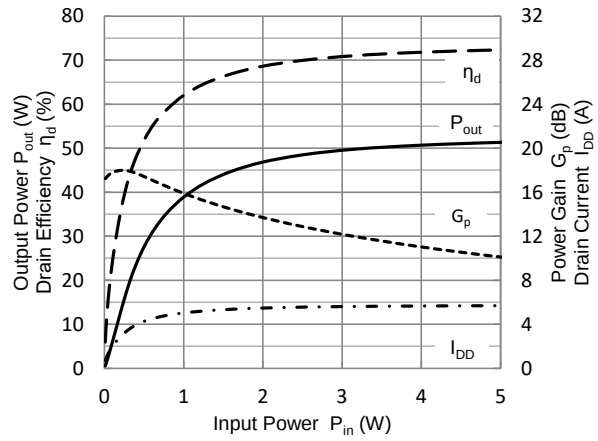
@f=175MHz, V_{DD}=12.5V, Idq=0.5A, Ta=+25deg.C



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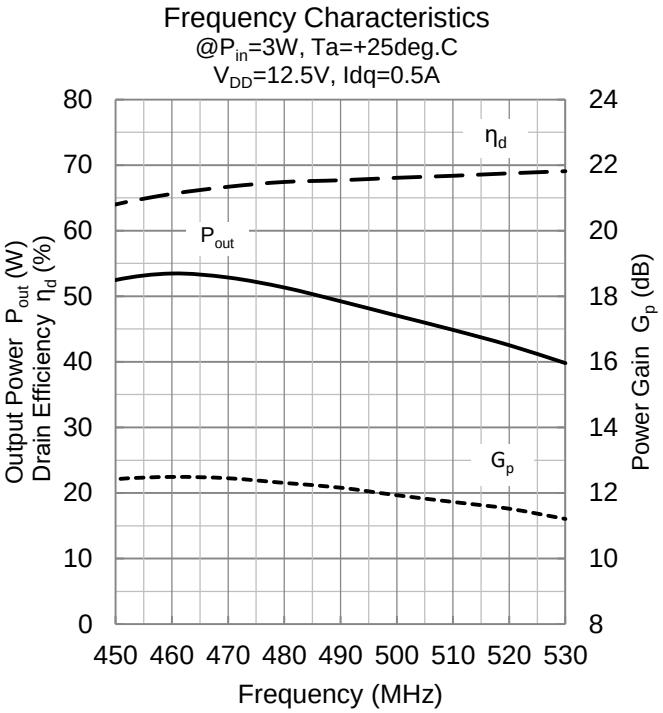

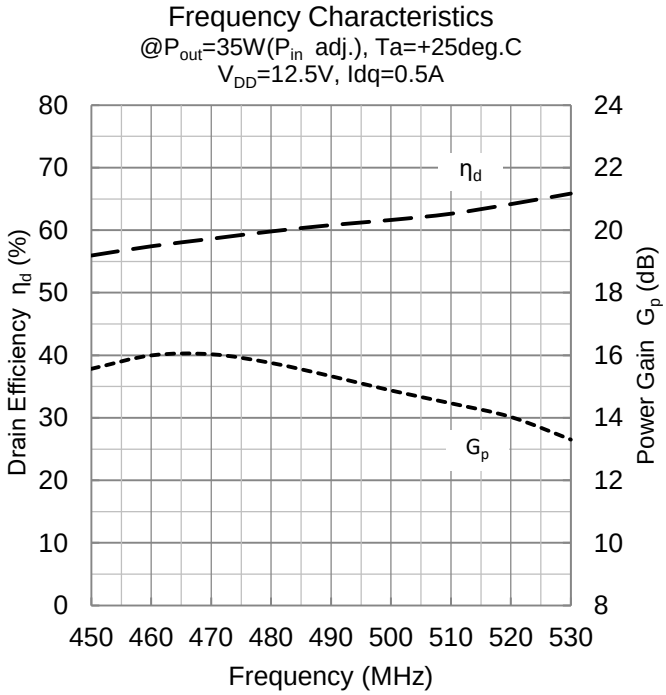

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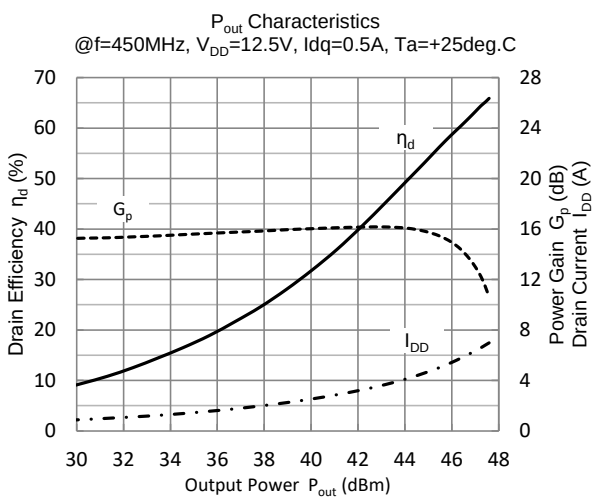

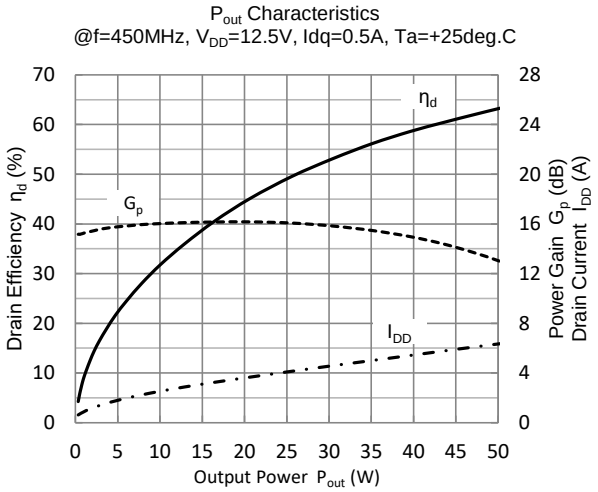

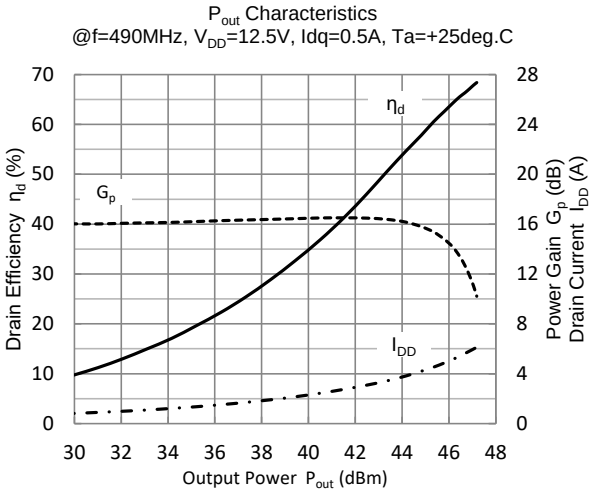

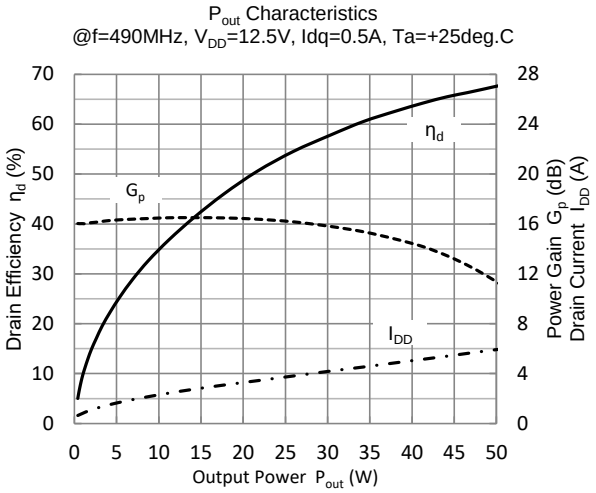

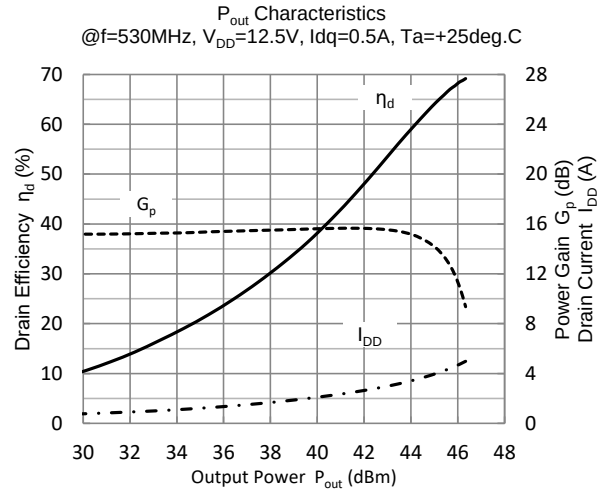

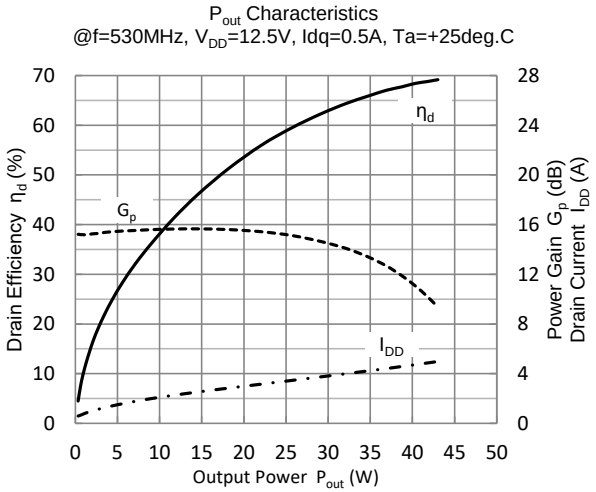

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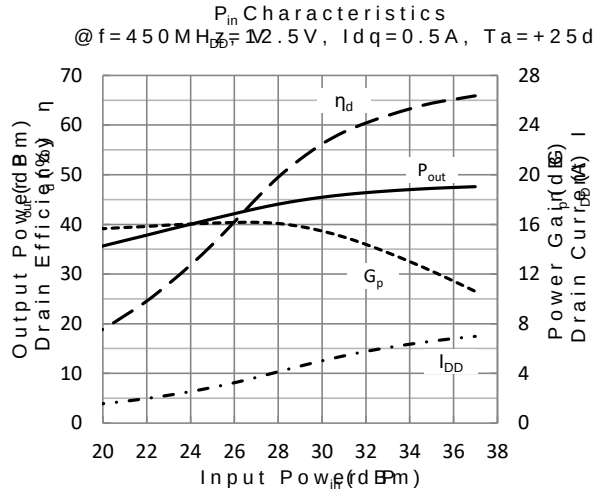

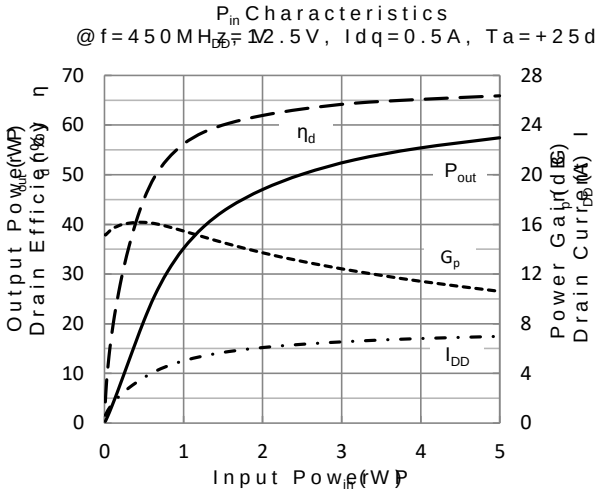

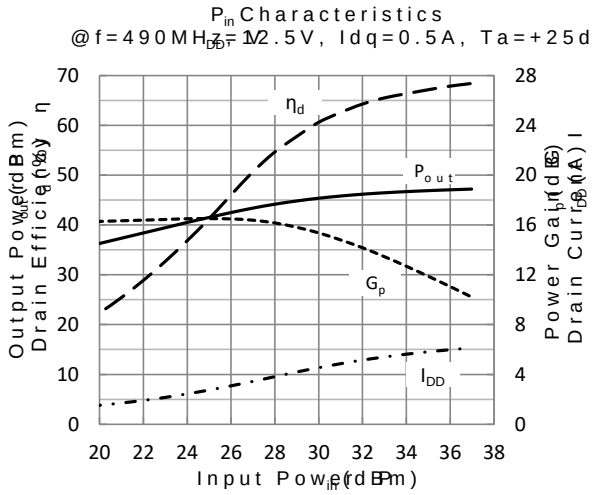

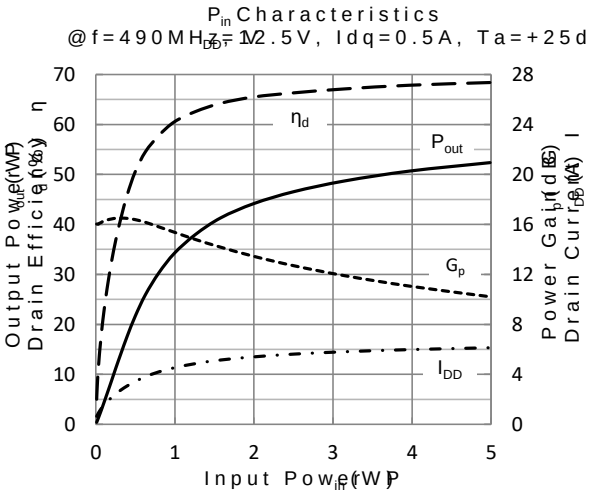

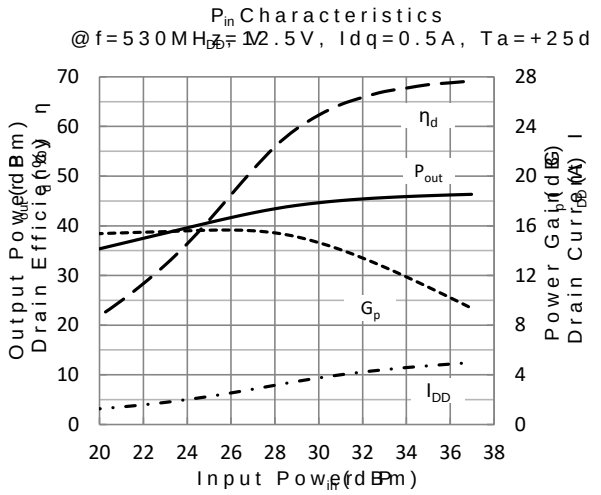

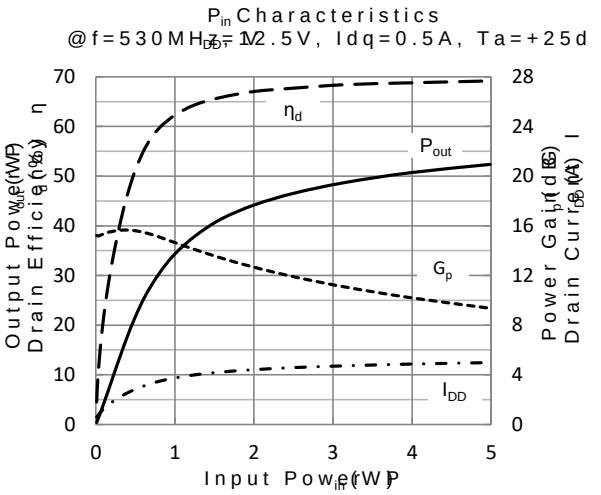

TYPICAL RF CHARACTERISTICS (P_{out} vs ACP ,ηd , Gp)

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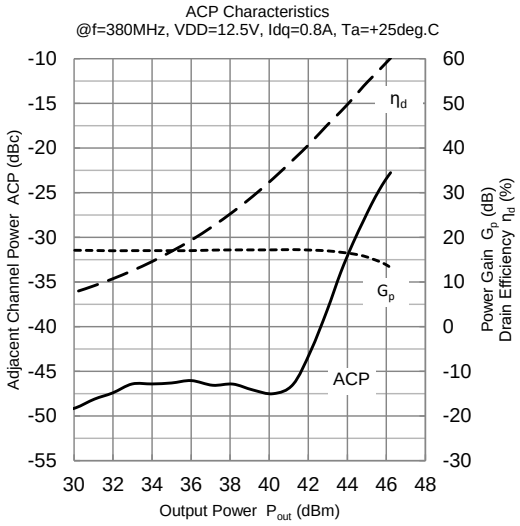
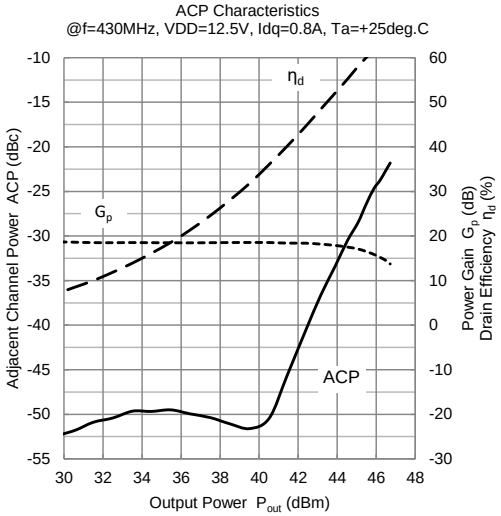


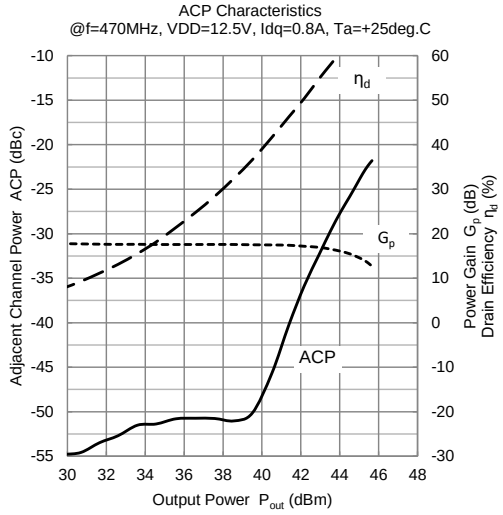
Modulation: TETRA

π/4DQPSK, Root Nyquist Filter (α=0.35),

Symbol rate=18ksps,

Band Width=18kHz, Cannel Spacing=25KHz





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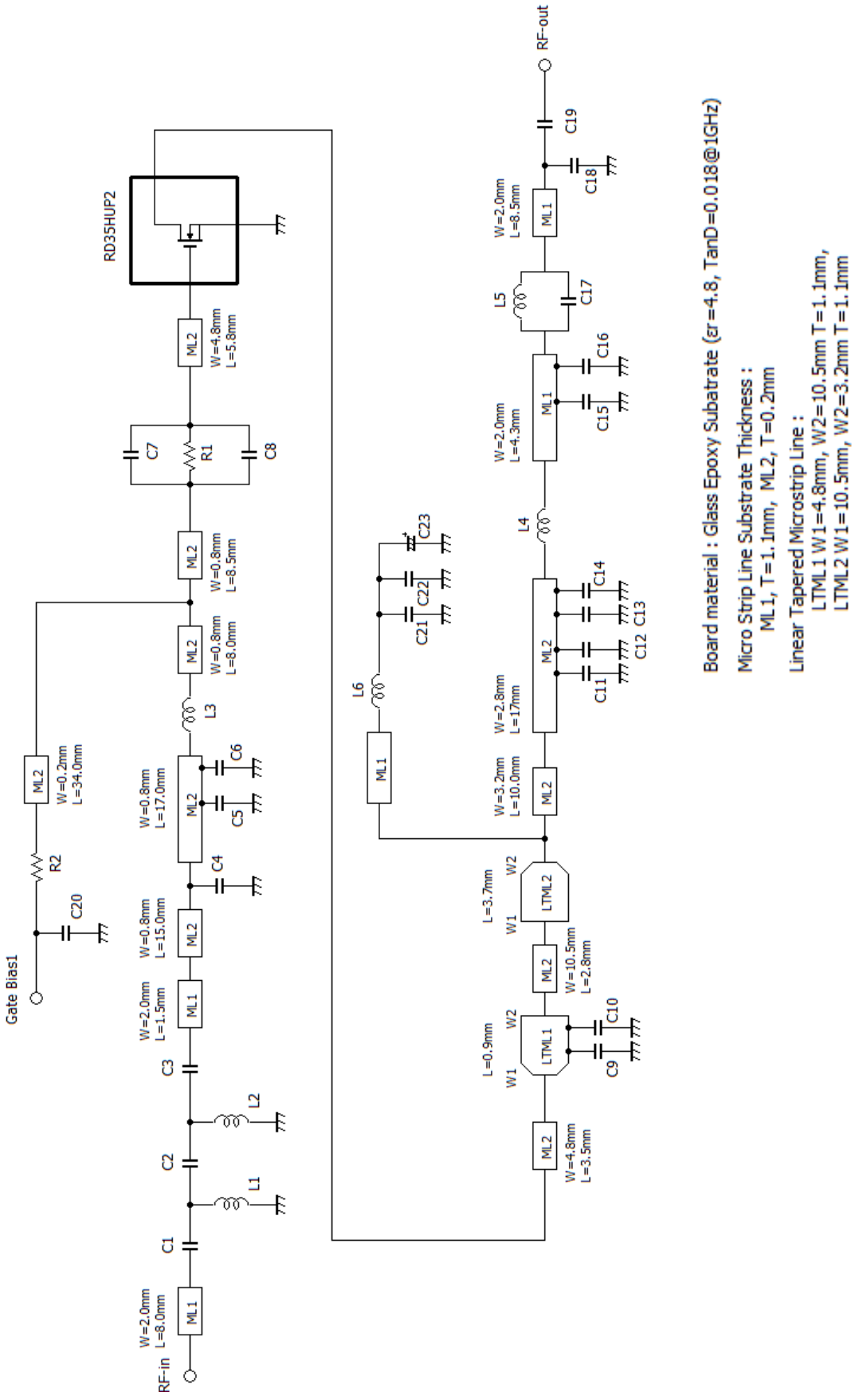
EQUIVALENT CIRCUITRY for UHF Circuit for f=135-175MHz



RD35HUP2

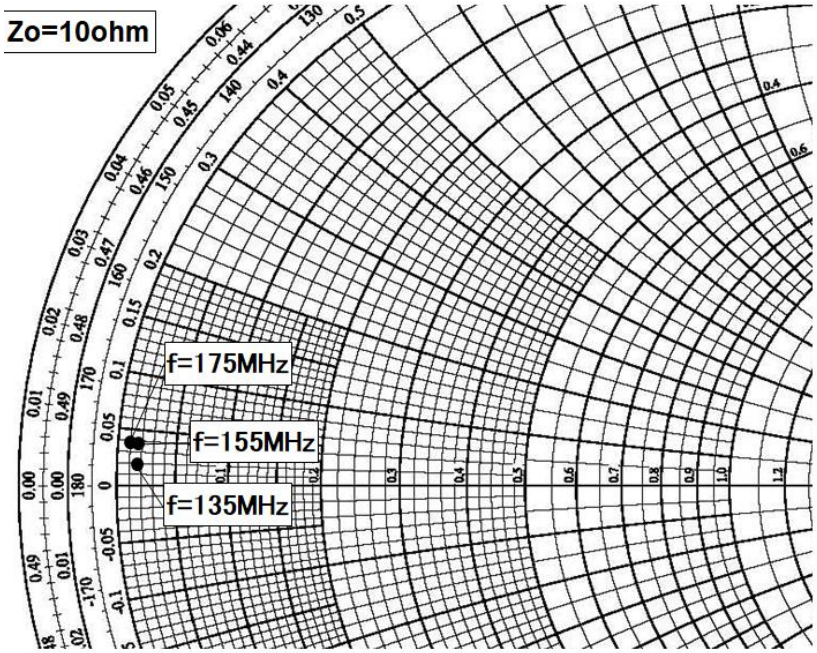
RoHS Compliance,Silicon MOSFET Power Transistor, 175MHz, 530MHz, 35W, 12.5V

COMPONENT LIST

Parts Type \ No.	Description			P/N	Manufacturer
Capasitor	C1	43pF	2012 Hi-Q	GQM2195C2E430JB12	MURATA MANUFACTURING CO.
	C2	15pF	2012 Hi-Q	GQM2195C2E150JB12	MURATA MANUFACTURING CO.
	C3	43pF	2012 Hi-Q	GQM2195C2E430JB12	MURATA MANUFACTURING CO.
	C4	24pF	1608 Hi-Q	GQM1882C1H240JB01	MURATA MANUFACTURING CO.
	C5	15pF	1608 Hi-Q	GQM1882C1H150JB01	MURATA MANUFACTURING CO.
	C6	24pF	1608 Hi-Q	GQM1882C1H240JB01	MURATA MANUFACTURING CO.
	C7	100pF	2012 Hi-Q	GQM2195C2E101JB12	MURATA MANUFACTURING CO.
	C8	100pF	2012 Hi-Q	GQM2195C2E101JB12	MURATA MANUFACTURING CO.
	C9	30pF	2012 Hi-Q	GQM2195C2E300JB12	MURATA MANUFACTURING CO.
	C10	24pF	2012 Hi-Q	GQM2195C2E240JB12	MURATA MANUFACTURING CO.
	C11	100pF	2012 Hi-Q	GQM2195C2E101JB12	MURATA MANUFACTURING CO.
	C12	100pF	2012 Hi-Q	GQM2195C2E101JB12	MURATA MANUFACTURING CO.
	C13	100pF	2012 Hi-Q	GQM2195C2E101JB12	MURATA MANUFACTURING CO.
	C14	20pF	2012 Hi-Q	GQM2195C2E200JB12	MURATA MANUFACTURING CO.
	C15	36pF	2012 Hi-Q	GQM2195C2E360JB12	MURATA MANUFACTURING CO.
	C16	30pF	2012 Hi-Q	GQM2195C2E300JB12	MURATA MANUFACTURING CO.
	C17	24pF	2012 Hi-Q	GQM2195C2E240JB12	MURATA MANUFACTURING CO.
	C18	6.2pF	2012 Hi-Q	GQM2195C2E6R2DB12	MURATA MANUFACTURING CO.
	C19	390pF	3216	GRM31A5C2H391JW01	MURATA MANUFACTURING CO.
	C20	1000pF	2012	GRM216B11H102KA01	MURATA MANUFACTURING CO.
	C21	1000pF	2012	GRM216B11H102KA01	MURATA MANUFACTURING CO.
	C22	0.22μF	2012	GRM21BB31H224KA88	MURATA MANUFACTURING CO.
	C23	220μF	-	EEUFC1V221	Panasonic Corporation
Register	R1	2.2Ω	2012	RPC10T2R2J	TAIYOSHA ELECTRIC CO.
	R2	4700Ω	1608	RPC05T472J	TAIYOSHA ELECTRIC CO.
Inductor	L1	39nH	1608	LQW18AN39NJ00	MURATA MANUFACTURING CO.
	L2	39nH	1608	LQW18AN39NJ00	MURATA MANUFACTURING CO.
	L3	13nH	1608	LQW18AN13NJ00	MURATA MANUFACTURING CO.
	L4	12nH Enameled wire 3Turns, Diameter:0.80mm, φ2.2mm(the out side diameter)		8003C	YC Corporation Co.,Ltd.
	L5	12nH Enameled wire 3Turns, Diameter:0.80mm, φ2.2mm(the out side diameter)		8003C	YC Corporation Co.,Ltd.
	L6	25nH Enameled wire 5Turns, Diameter:0.80mm, φ2.2mm(the out side diameter)		8005C	YC Corporation Co.,Ltd.

Input / Output Impedance VS. Frequency Characteristics

Zout*(f=135MHz, 155MHz, 175MHz)

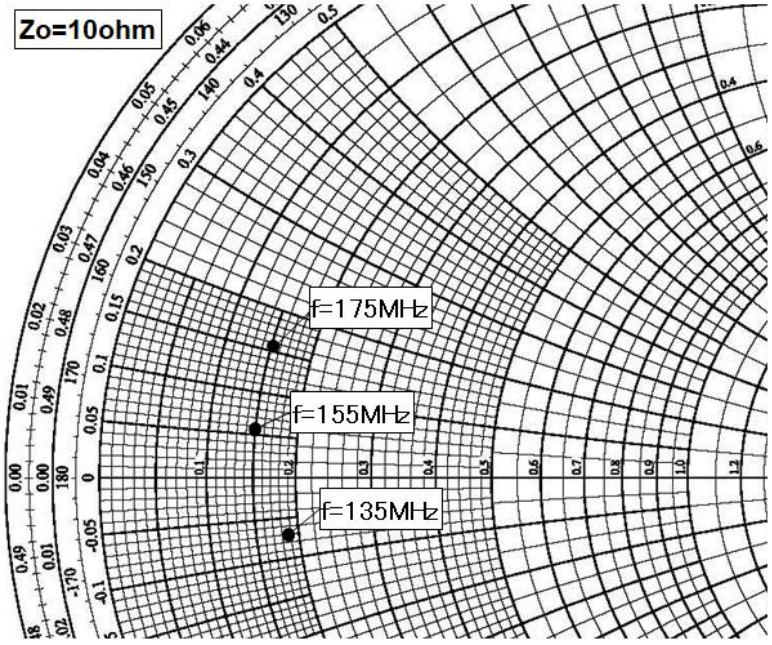


@Pin=3W, Vds=12.5V,
Idq=0.5A

f (MHz)	Zout* (ohm)
135	0.27-j0.12
155	0.36-j0.15
175	0.24-j0.15

Zout*: Complex conjugate of output impedance

Zin*(f=135MHz, 155MHz, 175MHz)



@Pin=3W, Vds=12.5V,
Idq= 0.5A

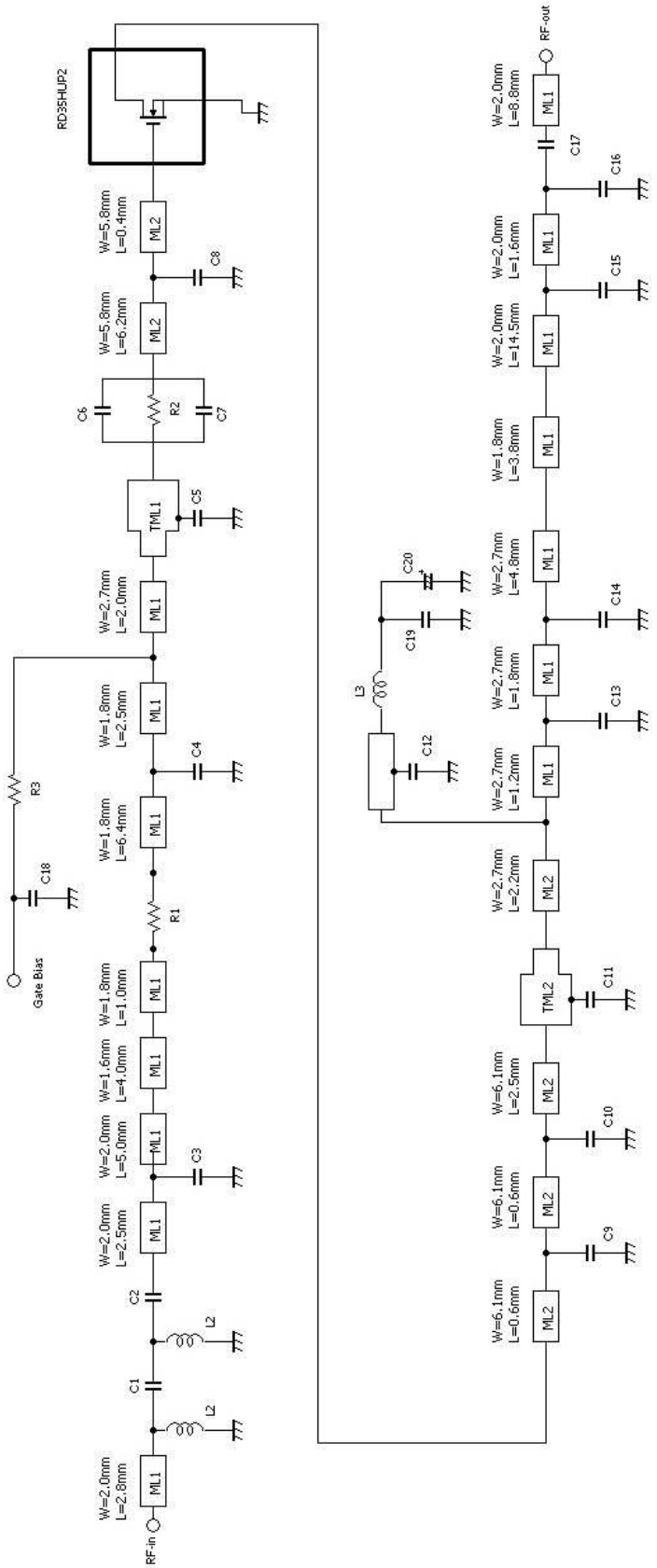
f (MHz)	Zin* (ohm)
135	1.85-j0.80
155	1.51+j0.56
175	1.52+j1.55

Zin*: Complex conjugate of input impedance

RD35HUP2

RoHS Compliance,Silicon MOSFET Power Transistor, 175MHz, 530MHz, 35W, 12.5V

EQUIVALENT CIRCUITRY for UHF Circuit for f=450-530MHz



Note:
Evaluation board materials
Glass-Epoxy substrate (Er=4.8,t=1.6mm,TanD=0.015@1.0GHz)

Micro strip line substrate thickness

ML1, TML1: t=1.3mm
ML2, TML2 : t=0.2mm

Via hole diamensions
Diameter=0.8mm, Length=1.5mm

RD35HUP2

RoHS Compliance,Silicon MOSFET Power Transistor, 175MHz, 530MHz, 35W, 12.5V

COMPONENT LIST

Parts Type	Symbol	Description			Type name	Vender
Capasitor	C 1	6.8 pF	2012	Hi-Q	GQM2195C2E6R8DB12	Murata Manufacturing Co.,Ltd
	C 2	16 pF	2012	Hi-Q	GQM2195C2E160JB12	Murata Manufacturing Co.,Ltd
	C 3	8.2 pF	1608	Hi-Q	GQM1882C1H8R2DB01	Murata Manufacturing Co.,Ltd
	C 4	6.2 pF	1608	Hi-Q	GQM1882C2A6R2DB01	Murata Manufacturing Co.,Ltd
	C 5	33 pF	1608	Hi-Q	GQM1882C1H330JB01	Murata Manufacturing Co.,Ltd
	C 6	130 pF	2012		GRM2162C2A131JA01	Murata Manufacturing Co.,Ltd
	C 7	130 pF	2012		GRM2162C2A131JA01	Murata Manufacturing Co.,Ltd
	C 8	51 pF	1608	Hi-Q	GQM1882C1H510JB01	Murata Manufacturing Co.,Ltd
	C 9	30 pF	2012	Hi-Q	GQM2195C2E300JB12	Murata Manufacturing Co.,Ltd
	C 10	33 pF	2012	Hi-Q	GQM2195C2E330JB12	Murata Manufacturing Co.,Ltd
	C 11	5.1 pF	2012	Hi-Q	GQM2195C2E5R1DB12	Murata Manufacturing Co.,Ltd
	C 12	2.7 pF	2012	Hi-Q	GQM2195C2E2R7CB12	Murata Manufacturing Co.,Ltd
	C 13	10 pF	2012	Hi-Q	GQM2195C2E100JB12	Murata Manufacturing Co.,Ltd
	C 14	10 pF	2012	Hi-Q	GQM2195C2E100JB12	Murata Manufacturing Co.,Ltd
	C 15	4.7 pF	2012	Hi-Q	GQM2195C2E4R7CB12	Murata Manufacturing Co.,Ltd
	C 16	4.7 pF	2012	Hi-Q	GQM2195C2E4R7CB12	Murata Manufacturing Co.,Ltd
	C 17	62 pF	2012	Hi-Q	GQM2195C2E620JB12	Murata Manufacturing Co.,Ltd
	C 18	1000 pF	1608		GRM188R61H102KA01	Murata Manufacturing Co.,Ltd
	C 19	100000 pF	2012		GRM21BB11H104KA01	Murata Manufacturing Co.,Ltd
	C 20	220 μF			EEUFC1V221	Panasonic Corporation
Register	R 1	0 Ω			RPC05T0R0J	Taiyosha Electiric Co.,Ltd
	R 2	2.2 Ω			RPC10T2R2J	Taiyosha Electiric Co.,Ltd
	R 3	2.2 kΩ			RPC05T222J	Taiyosha Electiric Co.,Ltd
Inductor	L 1	39 nH	1608		LQW18AN39NJ00	Murata Manufacturing Co.,Ltd
	L 2	18 nH	1608		LQW18AN18NJ10	Murata Manufacturing Co.,Ltd
	L 3	17nH Enameled wire 4Turns, Diameter,0.8mm, φ2.2mm(inside diameter)			8004C	YC Corporation Co.,Ltd

Recommended device usage as power amplifier

(1) Mitsubishi recommends a structure mounted like Figure 1 for this device used in the power amplifier.
Please fix the source of device backside directly on heat sink by solder.
(If heat dissipation is insufficient, there is a possibility that the destruction caused by heat is generated.)

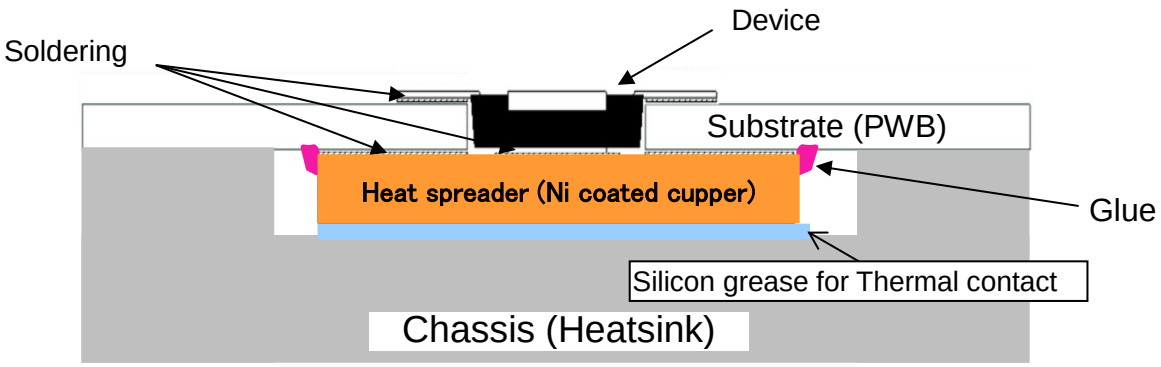


Fig.1

ATTENTION:

1.High Temperature ; This product might have a heat generation while operation,Please take notice that have a possibility to receive a burn to touch the operating product directly or touch the product until cold after switch off. At the near the product,do not place the combustible material that have possibilities to arise the fire

2.Generation of High Frequency Power ; This product generate a high frequency power. Please take notice that do not leakage the unnecessary electric wave and use this products without cause damage for human and property per normal operation.

3.Before use; Before use the product,Please design the equipment in consideration of the risk for human and electric wave obstacle for equipment.

PRECAUTIONS FOR THE USE OF MITSUBISHI SILICON RF POWER DEVICES:

1. The specifications of mention are not guarantee values in this data sheet. Please confirm additional details regarding operation of these products from the formal specification sheet. For copies of the formal specification sheets, please contact one of our sales offices.

2.RA series products (RF power amplifier modules) and RD series products (RF power transistors) are designed for consumer mobile communication terminals and were not specifically designed for use in other applications.
In particular, while these products are highly reliable for their designed purpose, they are not manufactured under a quality assurance testing protocol that is sufficient to guarantee the level of reliability typically deemed necessary for critical communications elements and In the application, which is base station applications and fixed station applications that operate with long term continuous transmission and a higher on-off frequency during transmitting, please consider the derating, the redundancy system, appropriate setting of the maintain period and others as needed. For the reliability report which is described about predicted operating life time of Mitsubishi Silicon RF Products , please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor.

3. RD series products use MOSFET semiconductor technology. They are sensitive to ESD voltage therefore appropriate ESD precautions are required.

4. In the case of use in below than recommended frequency, there is possibility to occur that the device is deteriorated or destroyed due to the RF-swing exceed the breakdown voltage.

5. In order to maximize reliability of the equipment, it is better to keep the devices temperature low. It is recommended to utilize a sufficient sized heat-sink in conjunction with other cooling methods as needed (fan, etc.) to keep the channel temperature for RD series products lower than 120deg/C(in case of Tchmax=150deg/C) ,140deg/C(in case of Tchmax=175deg/C) under standard conditions.

6. Do not use the device at the exceeded the maximum rating condition. In case of plastic molded devices, the exceeded maximum rating condition may cause blowout, smoldering or catch fire of the molding resin due to extreme short current flow between the drain and the source of the device. These results causes in fire or injury.

7. For specific precautions regarding assembly of these products into the equipment, please refer to the supplementary items in the specification sheet.

8. Warranty for the product is void if the products protective cap (lid) is removed or if the product is modified in any way from it's original form.

9. For additional "Safety first" in your circuit design and notes regarding the materials, please refer the last page of this data sheet.

10. Please avoid use in the place where water or organic solvents can adhere directly to the product and the environments with the possibility of caustic gas, dust, salinity, etc. Reliability could be markedly decreased and also there is a possibility failures could result causing a serious accident. Likewise, there is a possibility of causing a serious accident if used in an explosive gas environment. Please allow for adequate safety margin in your designs.

11. Please refer to the additional precautions in the formal specification sheet.

Keep safety first in your circuit designs!

Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

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