

< Silicon RF Power MOS FET (Discrete) >

RD35HUF2

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

DESCRIPTION

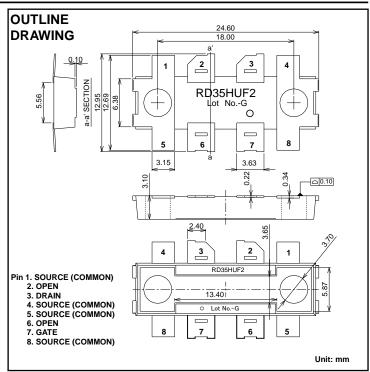
RD35HUF2 is MOS FET type transistor specifically designed for VHF/UHF RF power amplifiers applications.

FEATURES

- 1. Supply with Tape and Reel. 500 Units per Reel.
- 2. Employing Mold Package
- 3. High Power and High Efficiency
- Pout=43Wtyp, Drain Effi.=60%typ
- @ Vds=12.5V Idg=0.5A Pin=3.0W f=530MHz Pout=45Wtyp, Drain Effi.=72%typ
- @ Vds=12.5V Idq=1.0A Pin=3.0W f=175MHz
- 4. Integrated gate protection diode

APPLICATION

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



RoHS COMPLIANT

RD35HUF2 is a RoHS compliant product.

This product includes the lead in high melting temperature type solders.

However, it is applicable to the following exceptions of RoHS Directions.

1. Lead in high melting temperature type solders. (i.e. tin-lead solders alloys containing more than 85% lead.)

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

| | 1 | | | |
|---------|-------------------------|------------------|-------------|------|
| 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=ZI=50Ω | 6 | W |
| ID | Drain Current | - | 10 | А |
| Tch | Channel Temperature | - | 175 | °C |
| Tstg | Storage Temperature | - | -40 to +175 | °C |
| Rth j-c | Thermal Resistance | Junction to Case | 0.9 | °C/W |

Note: Above parameters are guaranteed independently.

* Theoretical value in case of mounted on infinite heat sink.

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

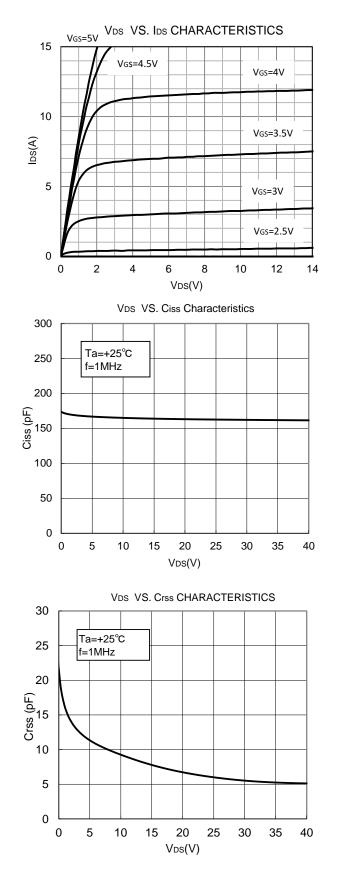
| SYMBOL | PARAMETER | CONDITIONS | LIMITS | | | UNIT |
|----------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------|-----|------|------|
| STIVIDOL FARAIVIETER | | CONDITIONS | MIN | TYP | MAX. | |
| IDSS* | Zero Gate Voltage Drain Current | VDS=37V, VGS=0V | - | - | 150 | μA |
| IGSS* | Gate to Source Leak Current | VGS=10V, VDS=0V | | - | 2.5 | μA |
| VTH* | Gate Threshold Voltage | VDS=12V, IDS=1mA | 1.6 | 2.0 | 2.4 | V |
| Pout1 | Output Power | f=530MHz*,VDs=12.5V, | - | 43 | - | W |
| ηD1 | Drain Efficiency | Pin=3.0W, Idq=500mA | - | 60 | - | % |
| Pout2 | Output Power | f=175MHz**,VDs=12.5V, | - | 45 | - | W |
| ηD2 | Drain Efficiency | Pin=3.0W, Idq=500mA | - | 72 | - | % |
| VSWRT | Load VSWR Tolerance | All phase, VDS=16.3V increased after Pout adjusted to 40W(Zg/Zl=50Ω) by Pin(under f=135MHz**, VDS=12.5V and Idq=500mA) | | - | - | VSWR |

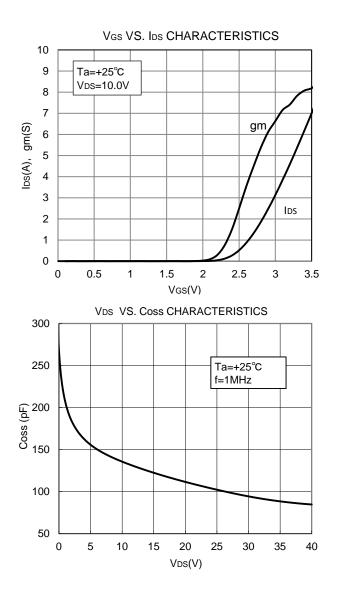
Note: Above parameters, ratings, limits and conditions are subject to change.

* In Mitsubishi UHF Evaluation Board ** In Mitsubishi VHF Evaluation Board

TYPICAL CHARACTERISTICS

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

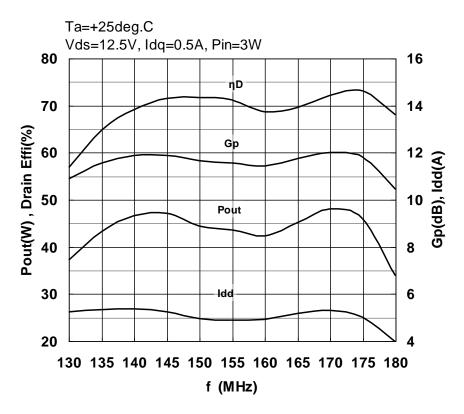




VHF-band TYPICAL CHARACTERISTICS

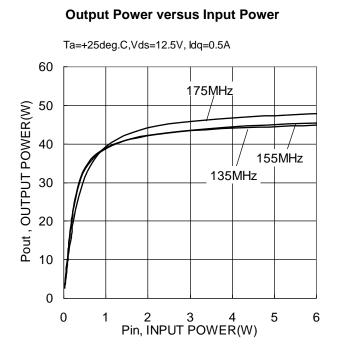
(These are only typical curves and devices are not necessarily guaranteed at these curves.)

Frequency Characteristics @f=135 to 175MHz

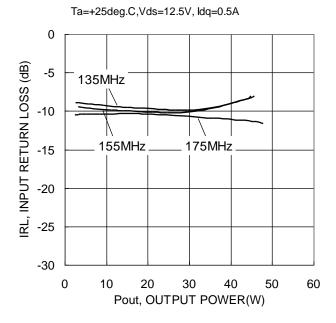


VHF-band TYPICAL CHARACTERISTICS

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

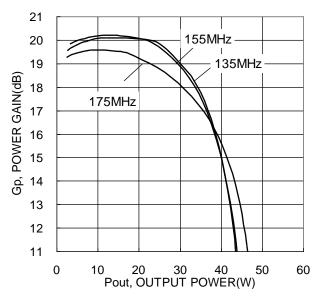


Input Return Loss versus Output Power



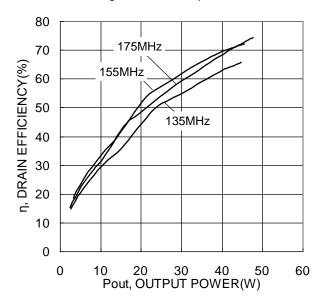
Gain versus Output Power

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



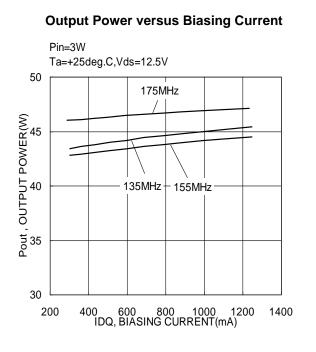
Drain Efficiency versus Output Power

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

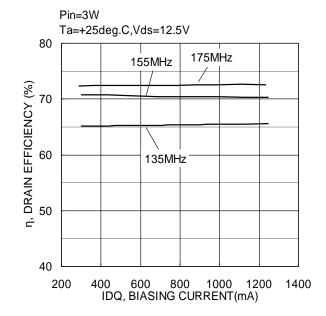


VHF-band TYPICAL CHARACTERISTICS

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

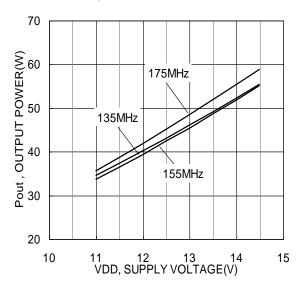


Drain Efficiency versus Biasing Current



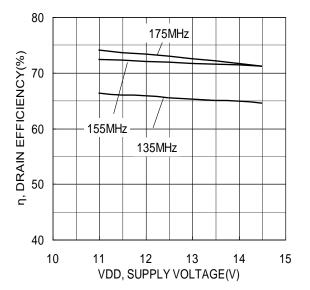
Output Power versus Supply Voltage

Pin=3W Ta=+25deg.C, Idq=0.5A



Drain Efficiency versus Supply Voltage

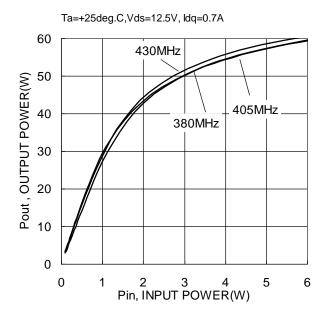
Pin=3W Ta=+25deg.C, Idq=0.5A



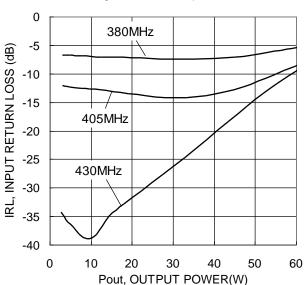
UHF-band, 380 - 430MHz, TYPICAL CHARACTERISTICS

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

Output Power versus Input Power



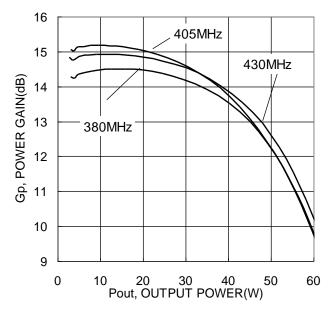
Input Return Loss versus Output Power



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

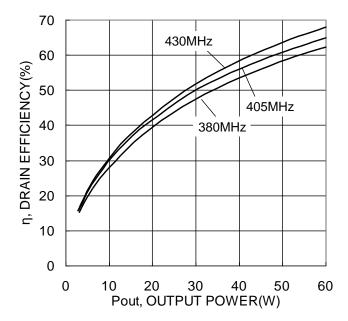
Gain versus Output Power

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



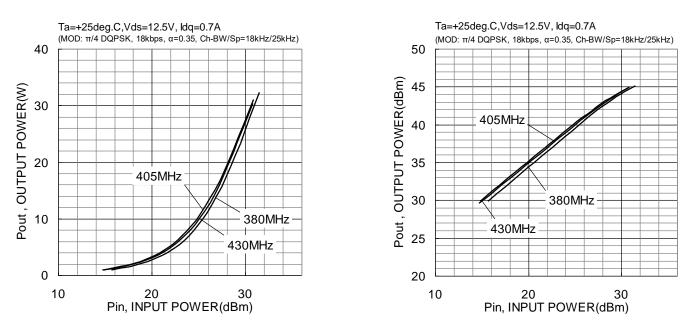
Drain Efficiency versus Output Power

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



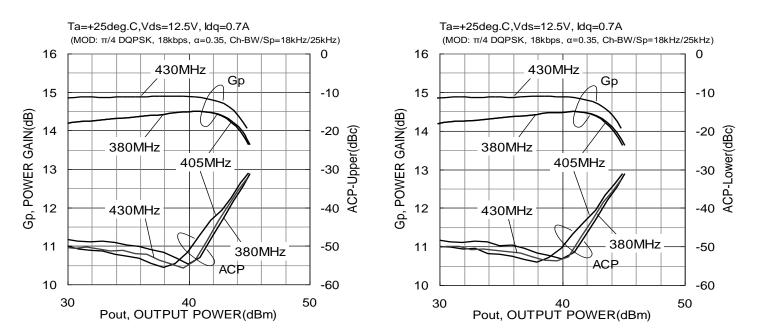
UHF-band, 380 - 430MHz, TYPICAL CHARACTERISTICS

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



Output Power versus Input Power, Digital Modulation

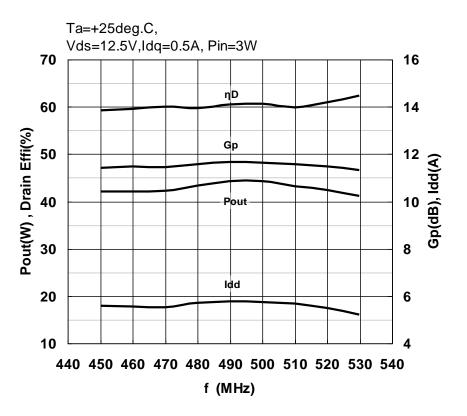
Gain and Adjacent Channel Power Ratio versus Output Power, Digital Modulation



UHF-band, 450 - 530MHz, TYPICAL CHARACTERISTICS

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

Frequency Characteristics @f=450 to 530MHz



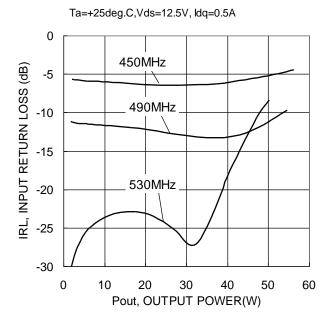
UHF-band, 450 - 530MHz, TYPICAL CHARACTERISTICS

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

Ta=+25deg.C,Vds=12.5V, Idq=0.5A 60 490MHz 50 Pout, OUTPUT POWER(W) 40 530MHz 450MHz 30 20 10 0 0 1 5 6 2 3 4 Pin, INPUT POWER(W)

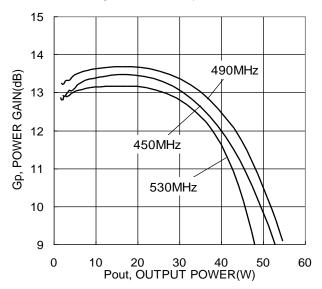
Output Power versus Input Power

Input Return Loss versus Output Power

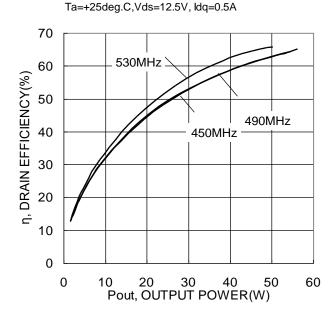


Gain versus Output Power

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



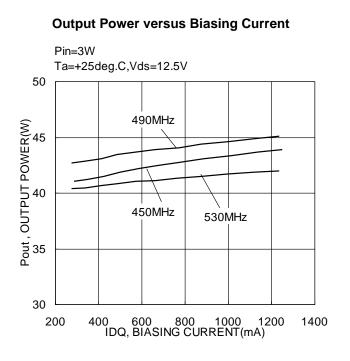
Drain Efficiency versus Output Power



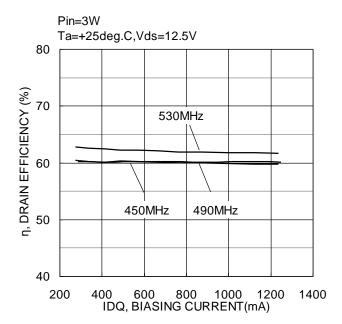
Publication Date : Nov. 2018

UHF-band, 450 - 530MHz, TYPICAL CHARACTERISTICS

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

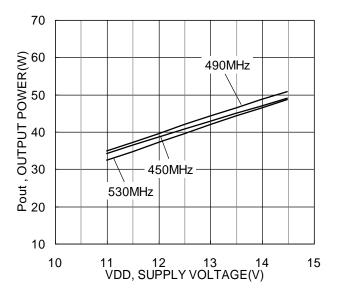


Drain Efficiency versus Biasing Current



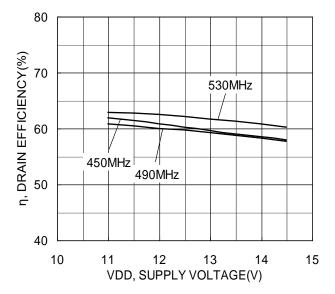
Output Power versus Supply Voltage

Pin=3W Ta=+25deg.C, Idq=0.5A

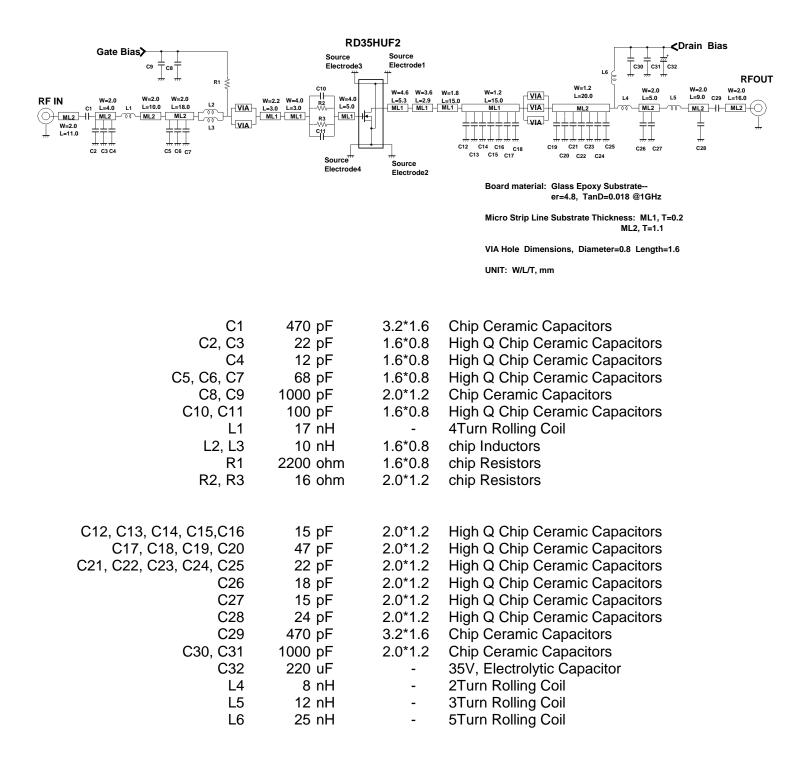


Drain Efficiency versus Supply Voltage

Pin=3W Ta=+25deg.C, Idq=0.5A

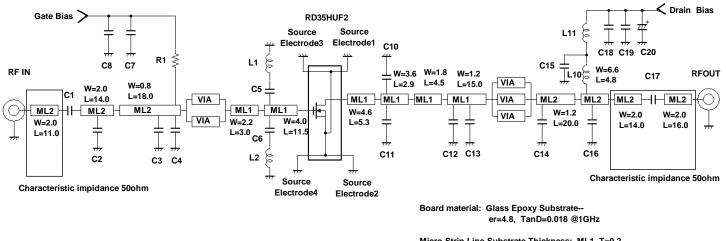


EQUIVALENT CIRCUITRY for VHF EVALUATION BOARD (f=135 - 175MHz)



For more information regarding this evaluation board, refer to APPLICATION NOTE "AN-VHF-048"

EQUIVALENT CIRCUITRY for UHF EVALUATION BOARD (f=380 - 430MHz)



Micro Strip Line Substrate Thickness: ML1, T=0.2 ML2, T=1.1

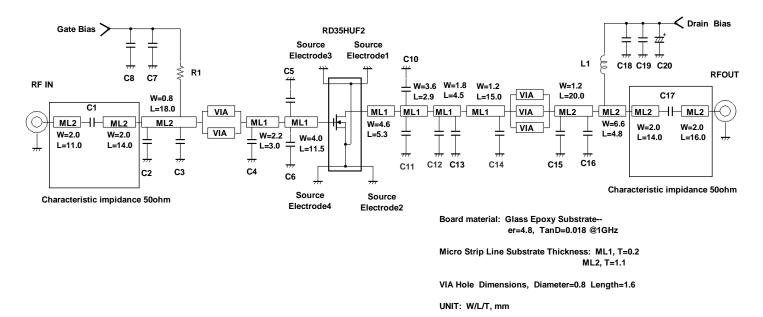
VIA Hole Dimensions, Diameter=0.8 Length=1.6

UNIT: W/L/T, mm

| C1 | 330 pF | 3.2*1.6 | Chip Ceramic Capacitors |
|----------|----------|---------|-----------------------------|
| C2 | 6 pF | 1.6*0.8 | High Q Chip Ceramic |
| C3 | 27 pF | 1.6*0.8 | |
| C4 | 9 pF | 1.6*0.8 | High Q Chip Ceramic |
| C5, C6 | 18 pF | 1.6*0.8 | High Q Chip Ceramic |
| C7, C8 | 1000 pF | 2.0*1.2 | Chip Ceramic Capacitors |
| R1 | 2.2 kohm | 1.6*0.8 | |
| L1, L2 | 2.2 nH | 1.6*0.8 | Chip Inductors |
| | | | |
| | | | |
| C10 | 33 pF | 2.0*1.2 | o 1 |
| C11 | 33 pF | 2.0*1.2 | High Q Chip Ceramic |
| C12 | 18 pF | 2.0*1.2 | High Q Chip Ceramic |
| C13 | 18 pF | 2.0*1.2 | High Q Chip Ceramic |
| C14 | 5 pF | 2.0*1.2 | High Q Chip Ceramic |
| C15 | 1.2 pF | 2.0*1.2 | High Q Chip Ceramic |
| C16 | 9 pF | 2.0*1.2 | High Q Chip Ceramic |
| C17 | 100 pF | 3.2*2.5 | High Q Chip Ceramic |
| C18, C19 | 1000 pF | 2.0*1.2 | Chip Ceramic Capacitors |
| C20 | 220 uF | - | 35V, Electrolytic Capacitor |
| L10 | 8 nH | - | 2Turn Rolling Coil |
| L11 | 17 nH | - | 4Turn Rolling Coil |
| | | | |

For more information regarding this evaluation board, refer to APPLICATION NOTE "AN-UHF-127"

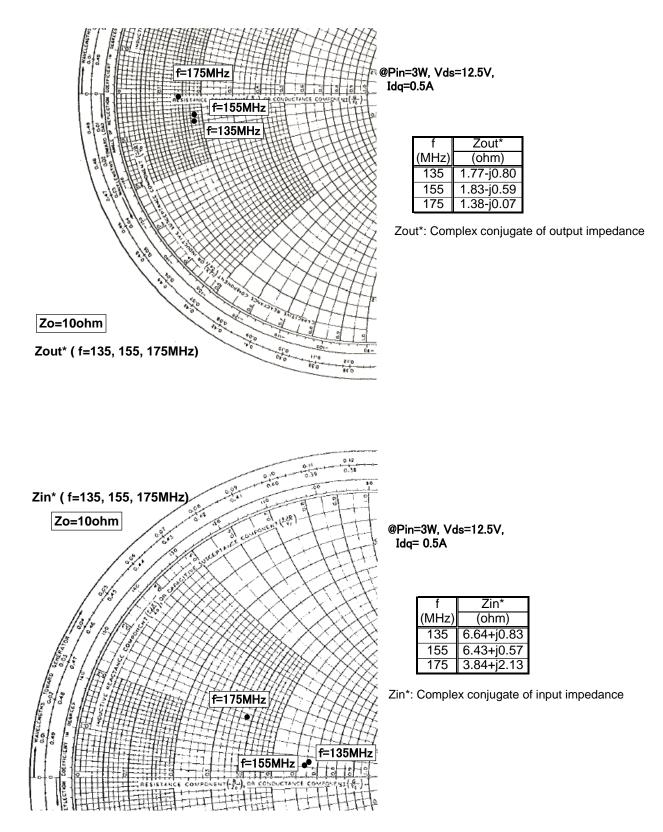
EQUIVALENT CIRCUITRY for UHF EVALUATION BOARD (f=450 - 530MHz)



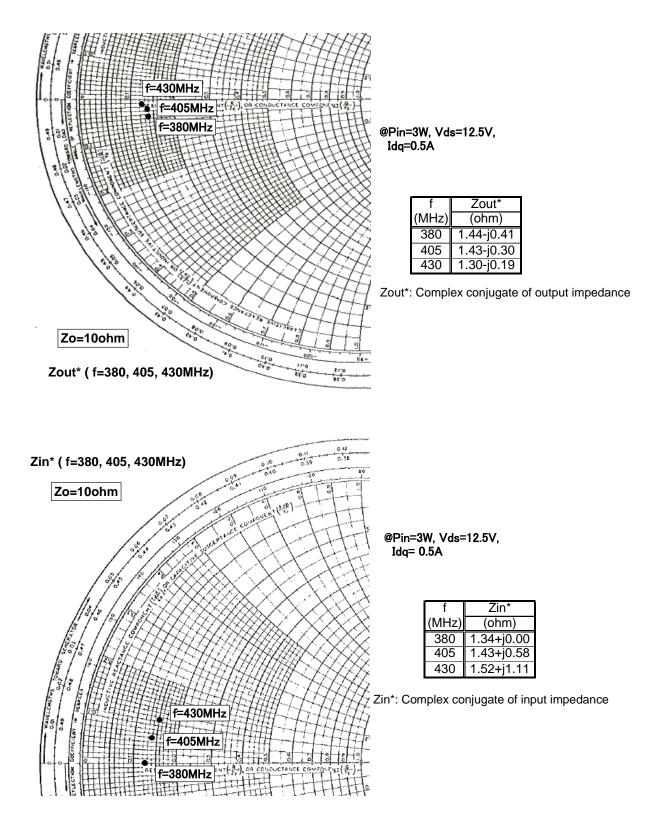
| C1 C2 C3 C4 C5, C6 C7, C8 R1 | 330 pF 6.2 pF 18 pF 9 pF 18 pF 1000 pF 2.2 kohm | 3.2*1.6 1.6*0.8 1.6*0.8 1.6*0.8 1.6*0.8 2.0*1.2 1.6*0.8 | Chip Ceramic Capacitors High Q Chip Ceramic High Q Chip Ceramic High Q Chip Ceramic High Q Chip Ceramic Chip Ceramic Capacitors |
|------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| C10 | 33 pF | 2.0*1.2 | High Q Chip Ceramic |
| | | | |
| C11 | 33 pF | 2.0*1.2 | High Q Chip Ceramic |
| C12 | 2.4 pF | 2.0*1.2 | High Q Chip Ceramic |
| C13 | 12 pF | 2.0*1.2 | High Q Chip Ceramic |
| C14 | 3.3 pF | 2.0*1.2 | High Q Chip Ceramic |
| C15 | 5.1 pF | 2.0*1.2 | High Q Chip Ceramic |
| C16 | 9.1 pF | 2.0*1.2 | High Q Chip Ceramic |
| C17 | 100 pF | 3.2*2.5 | High Q Chip Ceramic |
| C18, C19 | 1000 pF | 2.0*1.2 | Chip Ceramic Capacitors |
| C20 | 220 uF | - | 35V, Electrolytic Capacitor |
| L1 | 29 nH | - | 6Turn Rolling Coil |

For more information regarding this evaluation board, refer to APPLICATION NOTE "AN-UHF-112"

Input / Output Impedance VS. Frequency Characteristics

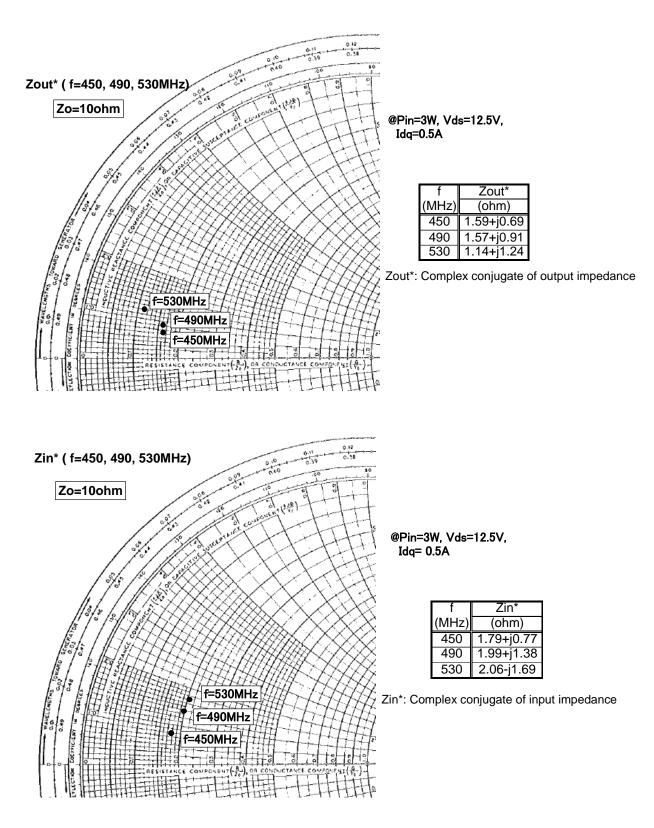


Input / Output Impedance VS. Frequency Characteristics



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

Input / Output Impedance VS. Frequency Characteristics



Small Signal Parameter of RD35HUF2

Bias Condition: Vds=12.5V, Idq=0.5A

| Freq. | S11 | | S21 | | S12 | | \$22 | |
|-------|-------|--------|-------|-------|-------|-------|-------|--------|
| (MHz) | (mag) | (ang) | (mag) | (ang) | (mag) | (ang) | (mag) | (ang) |
| 100 | 0.882 | -174.5 | 5.155 | 69.4 | 0.009 | -14.8 | 0.847 | -174.4 |
| 135 | 0.894 | -175.2 | 3.631 | 61.8 | 0.008 | -20.1 | 0.864 | -174.4 |
| 150 | 0.899 | -175.4 | 3.188 | 58.9 | 0.008 | -21.6 | 0.871 | -174.4 |
| 175 | 0.907 | -175.8 | 2.619 | 54.4 | 0.007 | -24.8 | 0.884 | -174.5 |
| 200 | 0.915 | -176.2 | 2.187 | 50.1 | 0.007 | -26.5 | 0.896 | -174.8 |
| 250 | 0.929 | -177.1 | 1.594 | 42.8 | 0.005 | -28.7 | 0.916 | -175.4 |
| 300 | 0.940 | -178.0 | 1.205 | 36.9 | 0.004 | -27.8 | 0.931 | -176.2 |
| 350 | 0.948 | -179.0 | 0.944 | 31.6 | 0.003 | -20.1 | 0.942 | -177.1 |
| 400 | 0.955 | -179.9 | 0.755 | 27.2 | 0.003 | -5.7 | 0.950 | -177.9 |
| 450 | 0.960 | 179.3 | 0.616 | 23.7 | 0.002 | 16.0 | 0.954 | -178.7 |
| 500 | 0.964 | 178.4 | 0.514 | 20.4 | 0.002 | 34.8 | 0.957 | -179.4 |
| 550 | 0.967 | 177.5 | 0.433 | 17.7 | 0.003 | 54.5 | 0.959 | 179.9 |
| 600 | 0.970 | 176.6 | 0.375 | 15.4 | 0.003 | 63.4 | 0.962 | 179.4 |
| 650 | 0.971 | 175.7 | 0.322 | 12.8 | 0.004 | 68.9 | 0.966 | 178.7 |
| 700 | 0.974 | 174.9 | 0.284 | 11.0 | 0.005 | 72.8 | 0.969 | 178.1 |
| 750 | 0.974 | 173.9 | 0.252 | 10.1 | 0.005 | 75.5 | 0.973 | 177.3 |
| 800 | 0.976 | 173.0 | 0.228 | 7.7 | 0.006 | 76.5 | 0.974 | 176.5 |
| 850 | 0.976 | 172.0 | 0.203 | 6.0 | 0.007 | 77.5 | 0.977 | 175.6 |
| 900 | 0.977 | 171.0 | 0.185 | 6.5 | 0.008 | 78.7 | 0.977 | 174.7 |
| 950 | 0.978 | 170.0 | 0.164 | 3.6 | 0.009 | 77.5 | 0.978 | 173.9 |
| 1000 | 0.979 | 168.9 | 0.151 | 2.5 | 0.010 | 76.8 | 0.978 | 173.0 |
| 1050 | 0.979 | 167.8 | 0.139 | 0.7 | 0.011 | 76.1 | 0.979 | 172.1 |
| 1100 | 0.979 | 166.7 | 0.130 | -0.1 | 0.011 | 75.9 | 0.980 | 171.0 |

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

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.

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

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

Main Revision for this Edition

| No | Dete | Revision | | | | | |
|-----|------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| INO | Date | Pages | Points | | | | |
| 1 | May 2011 | - | Initial Release | | | | |
| 2 | 2011.10.14 | 1-21 | The product name was changed. Before it corrects it Silicon RF Power Semiconductors > PRECAUTION FOR THE USE OF MITSUBISHI SILICON RF POWER AMPLIFIER DEVICES: 2. The content of the above-mentioned item is changed. Before it corrects it RA series products (RF power amplifier modules) 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. Examples of critical communications elements would include transmitters for base station applications and fixed station applications that operate with long term continuous transmission and a higher on-off frequency during transmitting, especially for systems that may have a high impact to society. | | | | |
| 3 | 2016.9.28 | 3 | DC,容量データを新ファブウエハ品にチェンジ | | | | |
| | | 14 | S パラデータを新ファブウエハ品にチェンジ | | | | |
| | | 20 | 注意事項の追加 | | | | |
| 4 | 2018.11.13 | 1-20 | New | | | | |