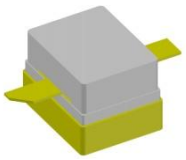
GaN Power Transistors RT12028P

Product Features

- Up to 6GHz
- 28W Saturated Power @ 48V, 2.6GHz
- 60% Drain Efficiency @ Psat, 2.6GHz
- 29% Drain Efficiency @ 38dBm, 2.6GHz

Applications

- WiMAX, LTE, WCDMA, GSM
- Multi-Band, Multi-Mode
- Multi-Carrier
- High Efficiency, Doherty Amplifier



Package Type : NS-CS01

Typical Single-Carrier LTE Performance (V_{DS}= +48V, T_C=25℃, 50Ω)

Frequency [MHz]	Peak Power		Average Power*1			
	Power [W]	Drain Efficiency [%]	Power [W]	Gain [dB]	Drain Efficiency [%]	ACLR [dBc]
2505.0	32.1	60.3	6.3	17.4	29.1	-37.5
2595.0	32.0	59.5	6.3	17.6	29.7	-37.1
2685.0	31.5	60.7	6.3	17.7	31.9	-35.3

Note

*1 Measured in the RT12028P test board amplifier circuit, under LTE 10MHz, PAR 7.5dB @0.01% probability on CCDF.

Absolute Maximum Ratings

Rating	Symbol	Value	Unit	Condition
Drain to Source Voltage	V_{DSS}	150	V	Tc=25℃
Gate to Source Voltage	V_{GS}	-10, +2	V	Tc=25℃
Operating Voltage	V_{DD}	52	V_{DC}	-
Maximum Forward Gate Current	I_{GMAX}	4	mA	Tc=25℃
Maximum Drain Current[*1]	I_{DMAX}	1.5	A	Tc=25℃
Power Dissipation	P_{DISS}	18	W	Tc=85℃
Storage Temperature	T_{STG}	-65, +150	℃	-
Case Operating Temperature	T_C	-40, +150	℃	-
Operating Junction Temperature[*2]	T_J	225	℃	-
Soldering Temperature[*3]	T_S	245	℃	-

Note

*1 Current Limit for long term, reliable operation.

*2 Continuous use at maximum temperature will affect MTTF.

*3 Refer to the Application Note(AN-002) on soldering - "Solder Condition for RFHIC's GaN Device"

Thermal Characteristics

Rating	Symbol	Value	Unit	Condition
Thermal Resistance, Junction to Case	$R_{\theta JC}$	7.61 *1	℃/W	Tc=85℃

Note

*1 Measured for the RT12028P at dissipation power of 18.4W.

Electrical Characteristics (T_C=25℃ unless otherwise noted)

Characteristics	Conditions	Symbol	Min	Typ	Max	Unit
DC Characteristics[*1]						
Gate Threshold Voltage	**V_{DS} = 10V** **I_D = 3.6mA**	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V_{DC}
Gate Quiescent Voltage	**V_{DS} = 48V** **I_D = 100mA**	$V_{GS(Q)}$	-	-2.6	-	V_{DC}
Saturated Drain Current[*2]	**V_{DS} = 6V** **V_{GS} = 2V**	I_{DS}	2.9	3.5	-	A
Drain-Source Breakdown Voltage	**V_{GS} = -8V** **I_D = 3.6mA**	V_{BR}	150	-	-	V
Gate Leakage Current	**V_{GS} = -8V** **V_{DS} = 120V**	I_{GLKG}	-0.79	-	-	mA
Drain Leakage Current	**V_{GS} = -8V** **V_{DS} = 120V**	I_{DLKG}	-	-	1.44	mA
RF Characteristics (Fc=2595MHz unless otherwise noted)						
Saturated Output Power[*3,6]	**V_{DS} = 48V** **I_{DQ} = 100mA**	P_{SAT}	-	28	-	W
Pulsed Drain Efficiency[*3]	**V_{DS} = 48V** **I_{DQ} = 100mA** **P_{OUT} = P_{SAT} Pulsed**	η	55	60	-	%
Modulated Gain[*4]	**V_{DS} = 48V** **I_{DQ} = 100mA** **P_{OUT} = 38dBm**	G_{BR}	16.0	17.5	-	dB
LTE Linearity[*4]	**V_{DS} = 48V** **I_{DQ} = 100mA** **P_{OUT} = 38dBm**	ACLR	-	-35.0	-32.0	dBc
Modulated Drain Efficiency[*4]	**V_{DS} = 48V** **I_{DQ} = 100mA** **P_{OUT} = 38dBm**	η	27.0	29.0	-	%
Output Mismatch Stress[*3, 5]	**V_{DS} = 48V** **I_{DQ} = 100mA** **P_{OUT} = P_{SAT} Pulsed**	VSWR	-	-	10:1	ψ

Note

*1 Measured on wafer prior to packaging.

*2 Scaled from PCM data.

*3 Pulse width 100μsec, Duty Cycle 10%.

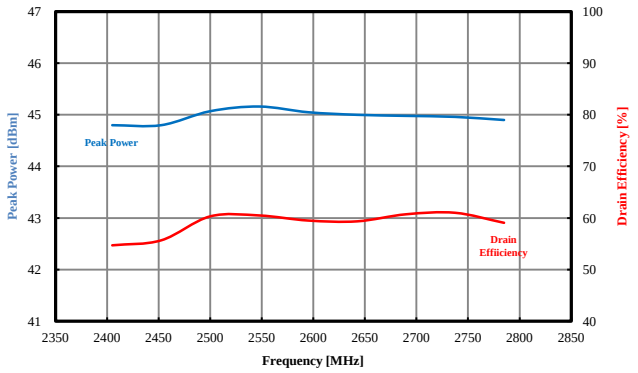
*4 Measured in the RT12028P-2600MHz test board amplifier circuit, under LTE 10MHz, PAR7.5dB @0.01% probability on CCDF.

*5 Measured in the RT12028P-2600MHz test board amplifier circuit. No damage at all phase angles.

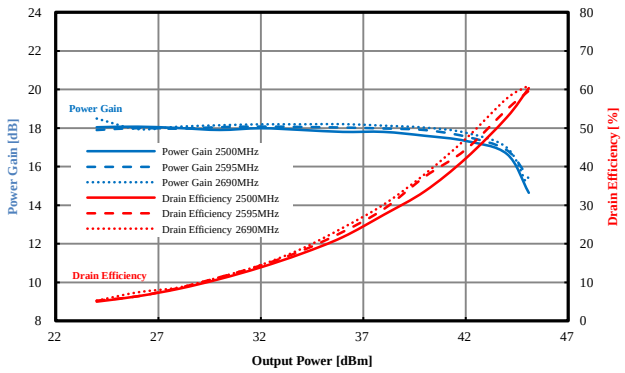
*6 Psat is defined as ΔPout/ΔPin<0.1, where ΔPin is increased input power, ΔPout is increased output power.

Typical Pulsed Signal Performance (Tc=25℃, Measured in the RT12028P-2600MHz test board amplifier circuit)

Peak Power, Drain Efficiency vs. Frequency



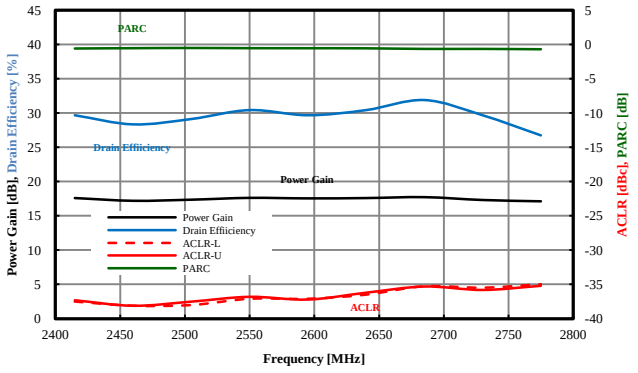
Pulsed Power Gain, Drain Efficiency vs. Output Power



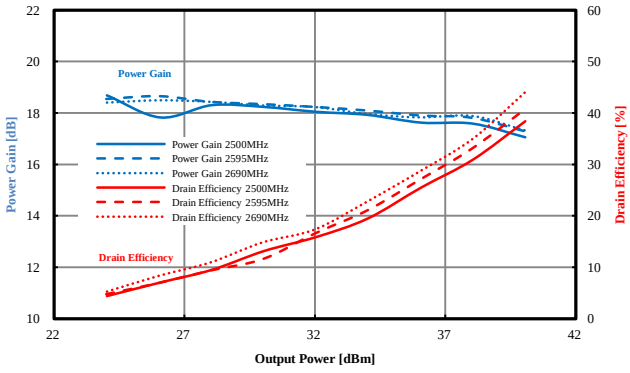
V_{DS} = 48V, I_{DQ} = 100mA, Pulse Width = 100μsec, Duty Cycle = 10%

Typical LTE Signal Performance (Tc=25℃, Measured in the RT12028P-2600MHz test board amplifier circuit)

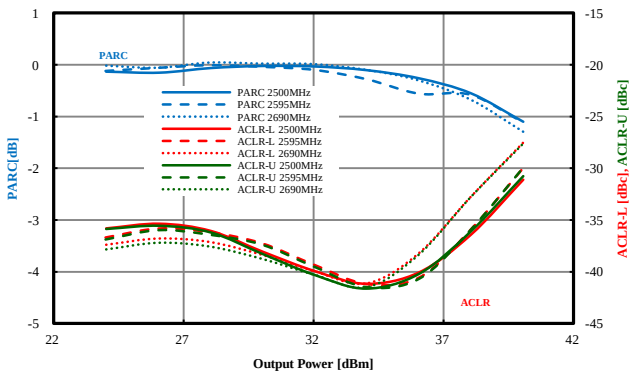
LTE Power Gain, Drain Efficiency, ACLR, PARC vs. Frequency



Power Gain, Drain Efficiency vs. Output Power



PARC, ACLR vs. Output Power

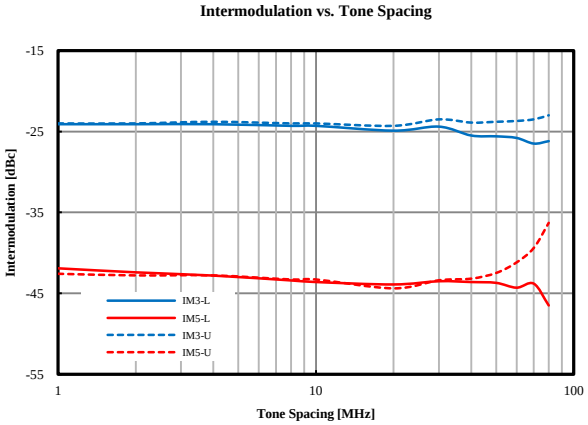


P_{AVG} = 38dBm, V_{DS} = 48V, I_{DQ} = 100mA

LTE 10MHz BW, PAPR=7.5dB @ 0.01% Probability on CCDF

Typical 2-tone Intermodulation Imbalance Performance

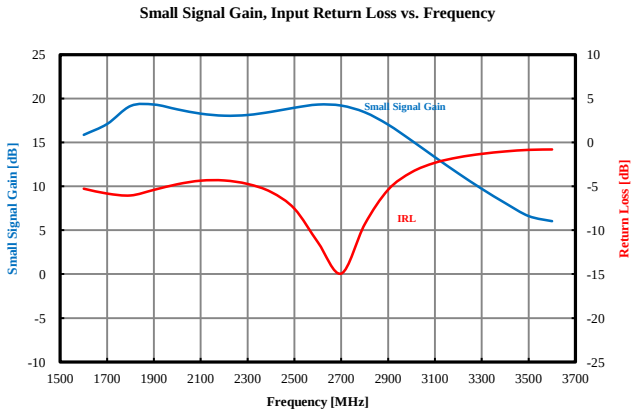
(Tc=25℃, Measured in the RT12028P-2600MHz test board amplifier circuit)

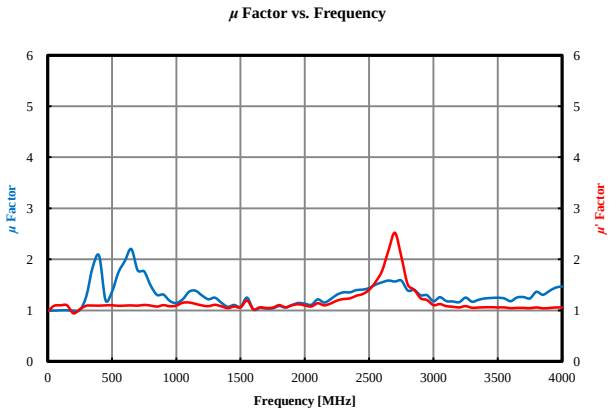


2-tone Power = 42.5dBm, V_{DS} = 48V, I_{DQ} = 100mA

Typical Small Signal Performance

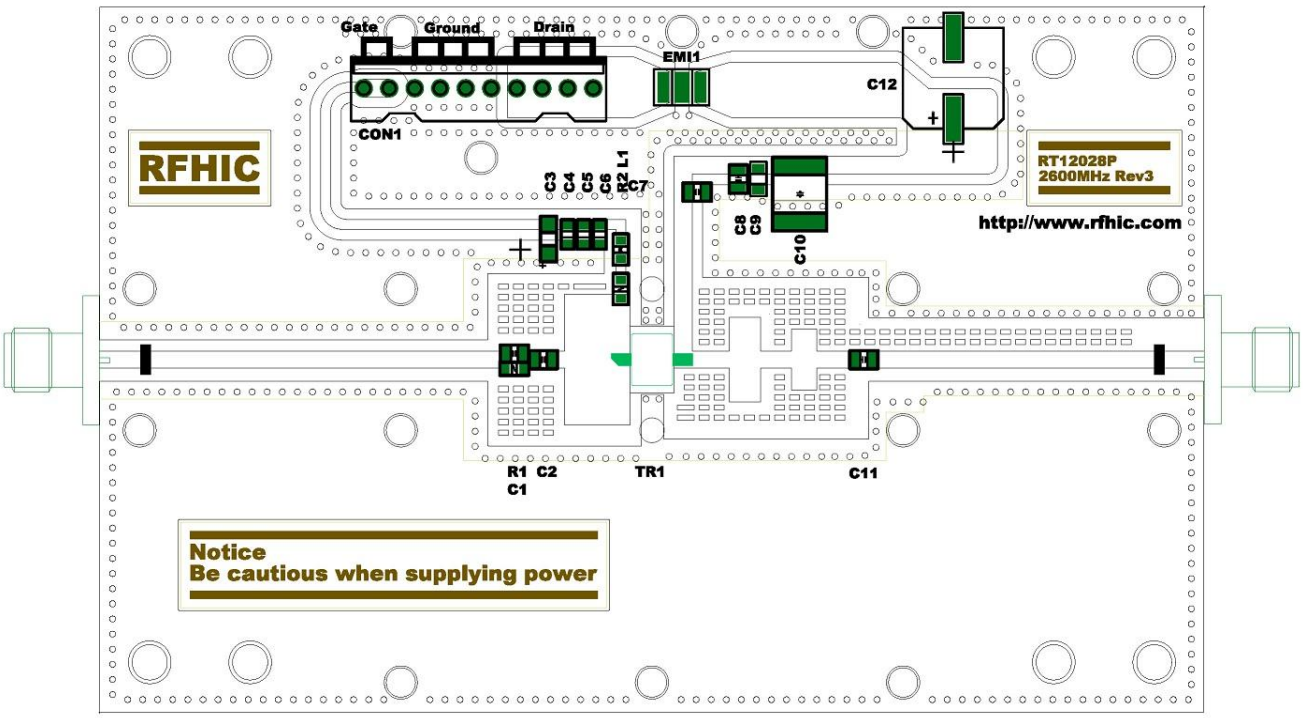
(Tc=25℃, Measured in the RT12028P-2600MHz test board amplifier circuit)





P_{IN} = 0dBm, V_{DS} = 48V, I_{DQ} = 100mA

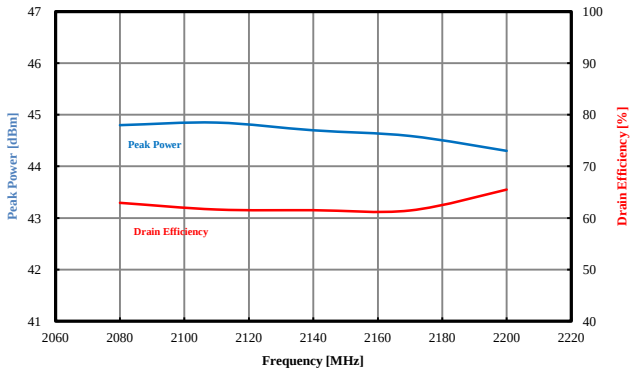
Test Board Component Layout(2600MHz)



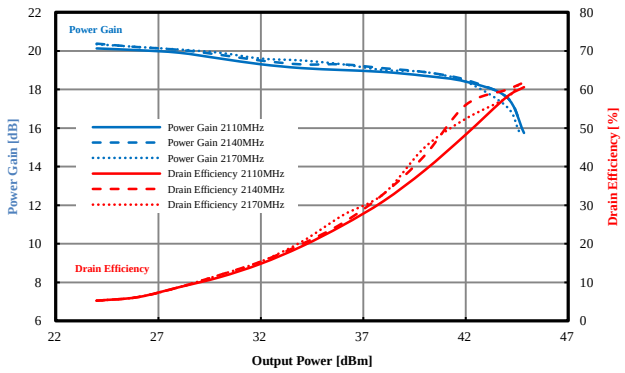
Part	Description	Part Number	Manufacturer
R1	100 ohm Chip Resistor	MCR03EZPJ101	ROHM
R2	100 ohm Chip Resistor	MCR10EZPJ101	ROHM
L1	22nH Wire Wound Inductor	LQW18AN22NG00	MURATA
C1	2.7pF High Q Capacitor	201CHA2R7BSLE	TEMEX
C2, C7, C11	10pF High Q Capacitor	201CHA100JSLE	TEMEX
C3	10uF Polymer Capacitor	TCJA106M016R0200	AVX
C4	10nF Chip Capacitor	GRM188R71H103KA01D	MURATA
C5	1nF Chip Capacitor	GRM188R71H102KA01D	MURATA
C6	10pF Chip Capacitor	GRM1885C1H100JA01D	MURATA
C8	100pF High Q Capacitor	201CHA101JSLE	TEMEX
C9	0.1uF Chip Capacitor	C2012X7R2A104K	TDK
C10	10uF MLCC	RS80R2A106M	MARUWA
C12	33uF Aluminum Capacitor	BDS100VC33MJ10TP	SAMYOUNG
EMI1	EMI FILTER	CTH32R102S20A-TM	MARUWA
CON1	DC Connector	22-04-1101	MOLEX
PCB	εr=3.66 ± 0.05, 0.030” (0.762mm)	RO4350B	ROGERS Corp.
TR1	28W GaN Transistor	RT12028P	RFHIC

Typical Pulsed Signal Performance (Tc=25℃, Measured in the RT12028P-2100MHz test board amplifier circuit)

Peak Power, Drain Efficiency vs. Frequency



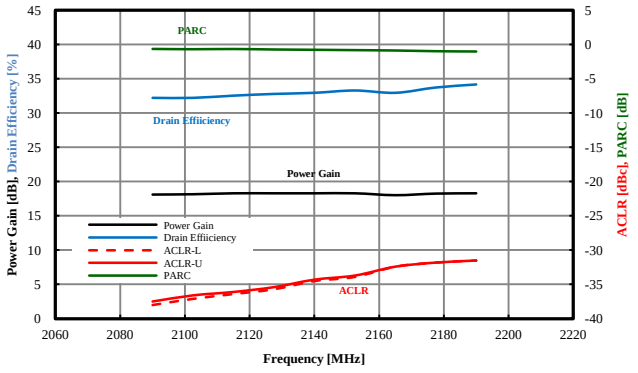
Pulsed Power Gain, Drain Efficiency vs. Output Power



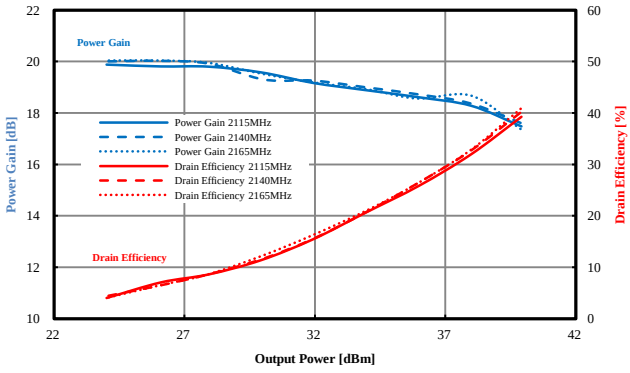
V_{DS} = 48V, I_{DQ} = 100mA, Pulse Width = 100μsec, Duty Cycle = 10%

Typical LTE Signal Performance (Tc=25℃, Measured in the RT12028P-2100MHz test board amplifier circuit)

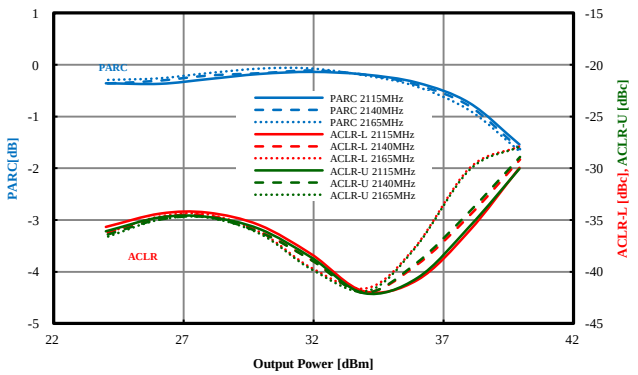
LTE Power Gain, Drain Efficiency, ACLR, PARC vs. Frequency



Power Gain, Drain Efficiency vs. Output Power



PARC, ACLR vs. Output Power

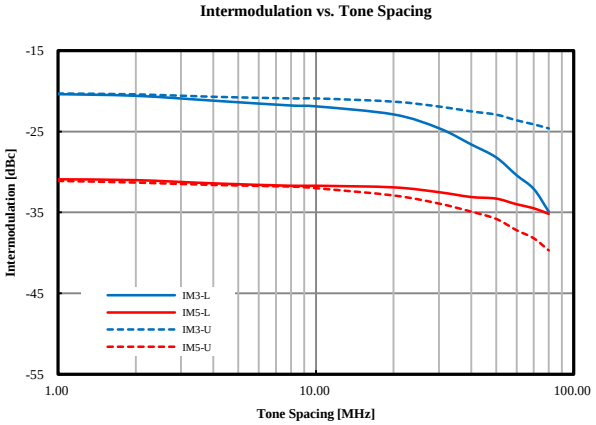


P_{AVG} = 38dBm, V_{DS} = 48V, I_{DQ} = 100mA

LTE 10MHz BW, PAPR=7.5dB @ 0.01% Probability on CCDF

Typical 2-tone Intermodulation Imbalance Performance

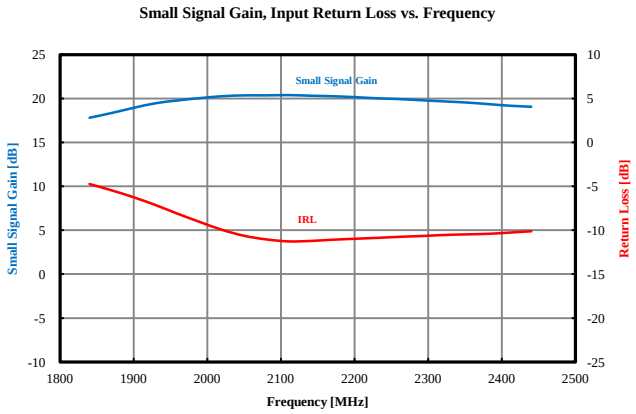
(Tc=25℃, Measured in the RT12028P-2100MHz test board amplifier circuit)

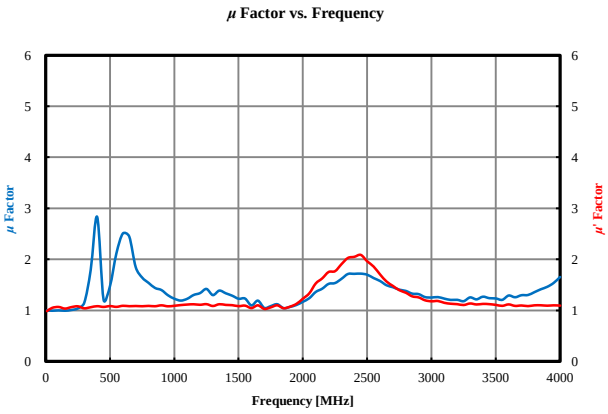


2-tone Power = 42.5dBm, V_{DS} = 48V, I_{DQ} = 100mA

Typical Small Signal Performance

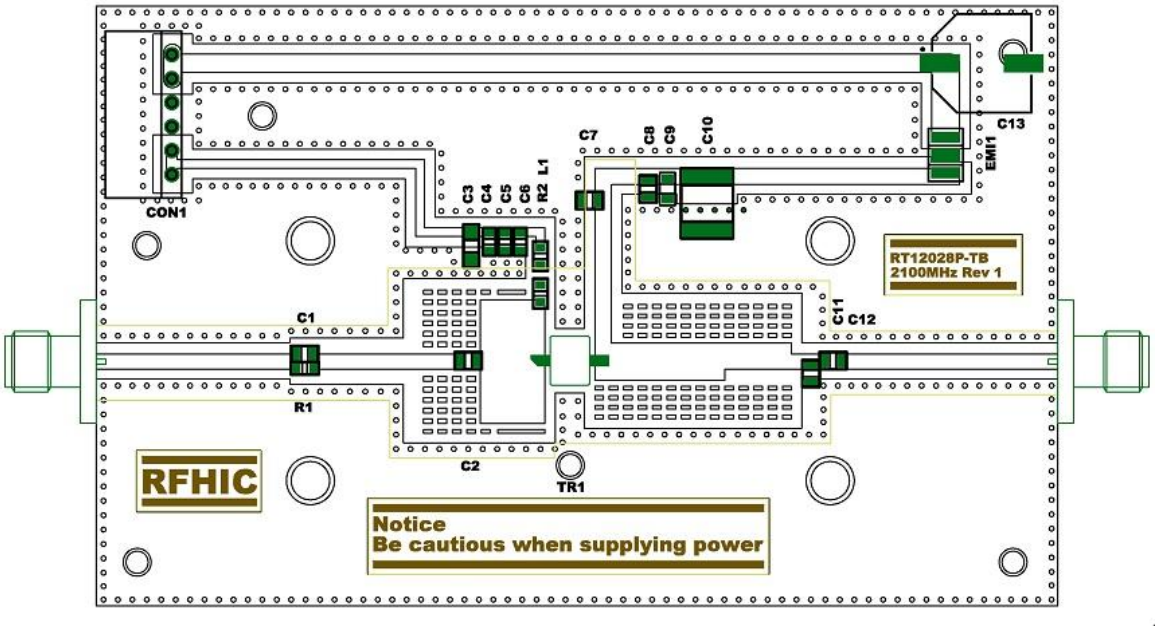
(Tc=25℃, Measured in the RT12028P-2100MHz test board amplifier circuit)





P_{IN} = 0dBm, V_{DS} = 48V, I_{DQ} = 100mA

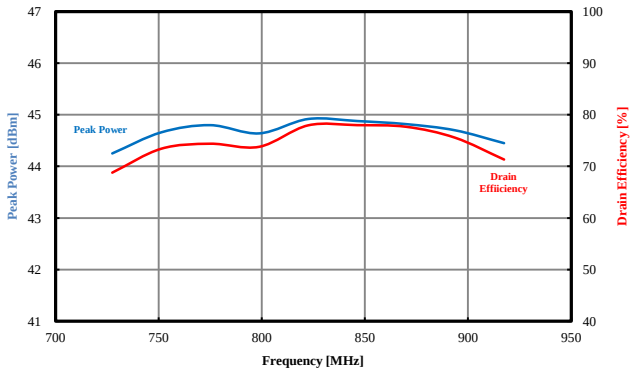
Test Board Component Layout(2100MHz)



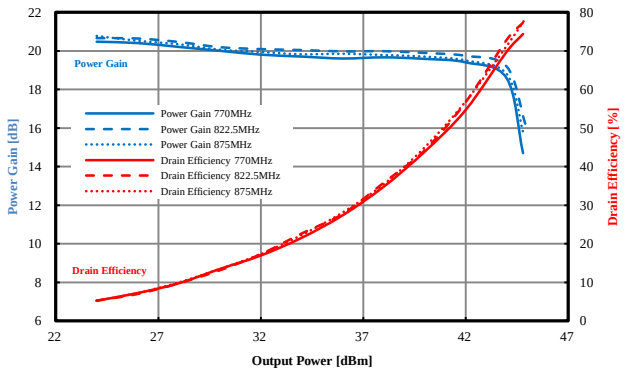
Part	Description	Part Number	Manufacturer
R1	510 ohm Chip Resistor	MCR03EZPJ511	ROHM
R2	100 ohm Chip Resistor	MCR10EZPJ101	ROHM
L1	22nH Wire Wound Inductor	LQW18AN22NG00	MURATA
C1,C2	2pF High Q Capacitor	201CHA2R0BSLE	TEMEX
C3	10uF Polymer Capacitor	TCJA106M016R0200	AVX
C4	1uF Chip Capacitor	GRM188R71H105KA01D	MURATA
C5	1nF Chip Capacitor	GRM188R71H102KA01D	MURATA
C6	10pF Chip Capacitor	GRM1885C1H100JA01D	MURATA
C7,C12	10pF High Q Capacitor	201CHA100JSLE	TEMEX
C8	100pF High Q Capacitor	201CHA101JSLE	TEMEX
C9	0.1uF Chip Capacitor	C2012X7R2A104K	TEMEX
C10	10uF MLCC	RS80R2A106M	MARUWA
C11	1pF High Q Capacitor	201CHA1R0BSLE	TEMEX
C13	33uF Aluminum Capacitor	BDS100VC33MJ10TP	SAMYOUNG
EMI1	EMI FILTER	CTH32R102S20A-TM	MARUWA
CON1	DC Connector	5268-06A	MOLEX
PCB	εr=3.66 ± 0.05, 0.030” (0.762mm)	RO4350B	ROGERS Corp.
TR1	28W GaN Transistor	RT12028P	RFHIC

Typical Pulsed Signal Performance (Tc=25℃, Measured in the RT12028P-800MHz test board amplifier circuit)

Peak Power, Drain Efficiency vs. Frequency



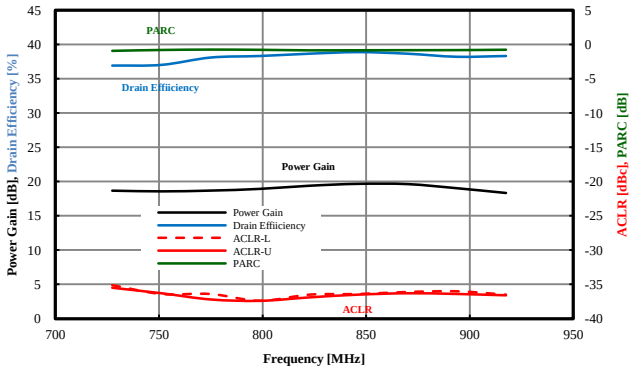
Pulsed Power Gain, Drain Efficiency vs. Output Power



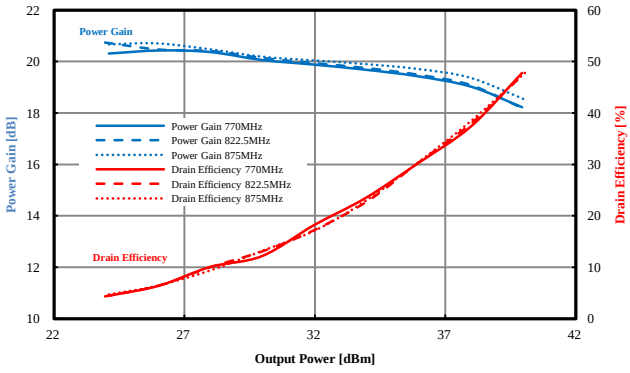
V_{DS} = 48V, I_{DQ} = 100mA, Pulse Width = 100μsec, Duty Cycle = 10%

Typical LTE Signal Performance (Tc=25℃, Measured in the RT12028P-800MHz test board amplifier circuit)

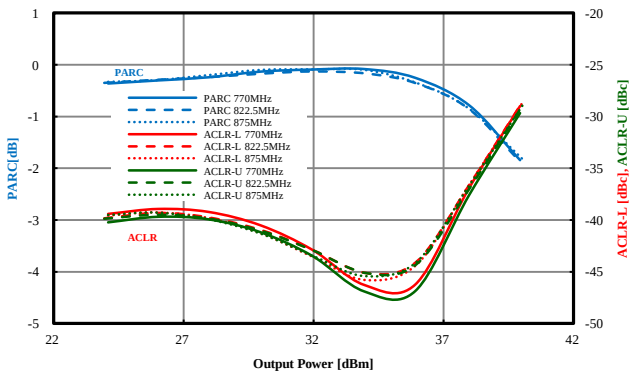
LTE Power Gain, Drain Efficiency, ACLR, PARC vs. Frequency



Power Gain, Drain Efficiency vs. Output Power



PARC, ACLR vs. Output Power

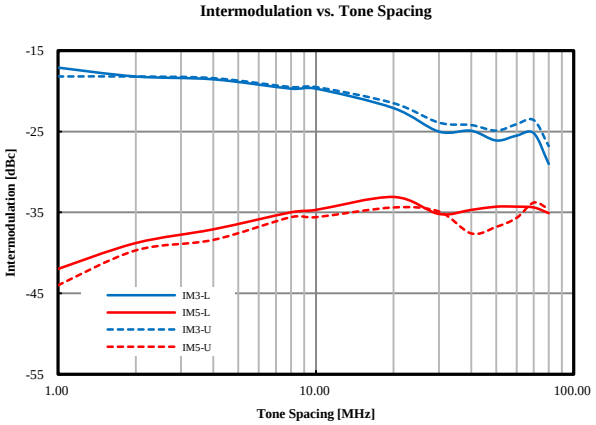


P_{AVG} = 38dBm, V_{DS} = 48V, I_{DQ} = 100mA

LTE 10MHz BW, PAPR=7.5dB @ 0.01% Probability on CCDF

Typical 2-tone Intermodulation Imbalance Performance

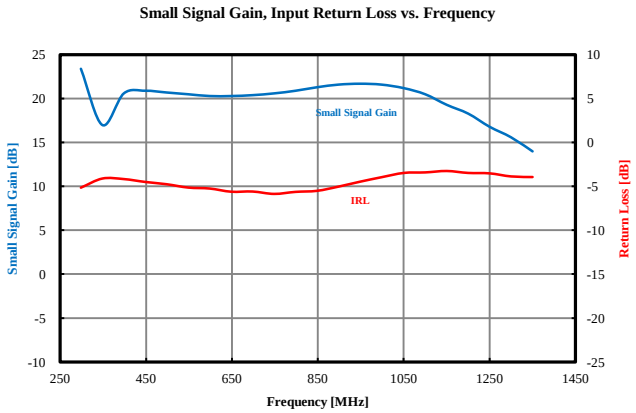
(Tc=25℃, Measured in the RT12028P-800MHz test board amplifier circuit)

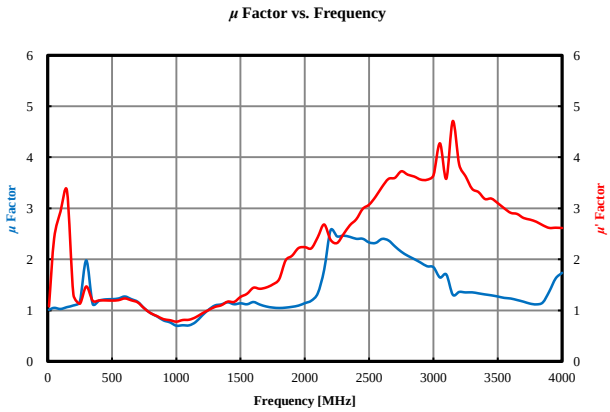


2-tone Power = 42.5dBm, V_{DS} = 48V, I_{DQ} = 100mA

Typical Small Signal Performance

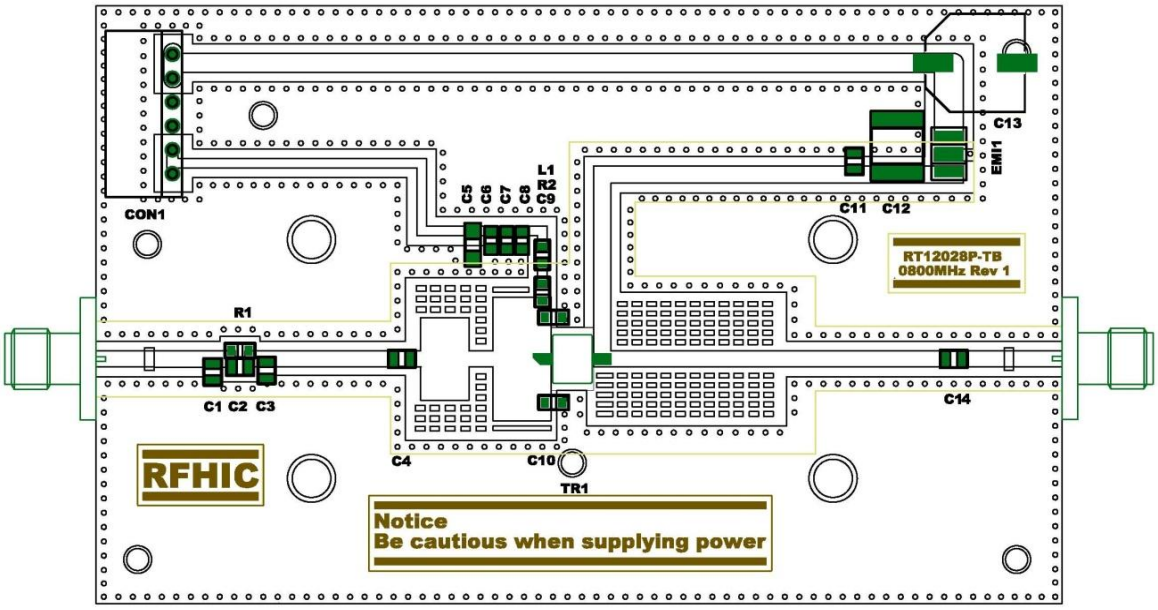
(Tc=25℃, Measured in the RT12028P-800MHz test board amplifier circuit)





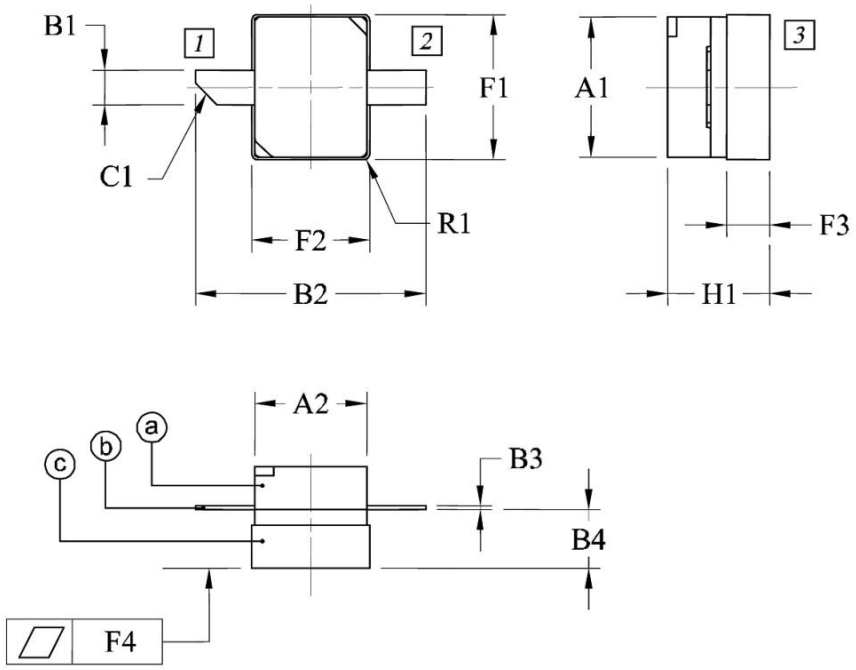
P_{IN} = 0dBm, V_{DS} = 48V, I_{DQ} = 100mA

Test Board Component Layout(800MHz)



Part	Description	Part Number	Manufacturer
R1	10 ohm Chip Resistor	MCR03EZPJ100	ROHM
R2	100 ohm Chip Resistor	MCR10EZPJ101	ROHM
L1	22nH Wire Wound Inductor	LQW18AN22NG00	MURATA
C1	2.2pF High Q Capacitor	201CHA2R2BSLE	TEMEX
C2	5.6pF High Q Capacitor	201CHA5R6BSLE	TEMEX
C3	3.3pF High Q Capacitor	201CHA3R3BSLE	TEMEX
C4	39pF High Q Capacitor	201CHA390JSLE	TEMEX
C5	10uF Polymer Capacitor	TCJA106M016R0200	AVX
C6	10nF Chip Capacitor	GRM188R71H103KA01D	MURATA
C7	1nF Chip Capacitor	GRM188R71H102KA01D	MURATA
C8	10pF Chip Capacitor	GRM1885C1H100JA01D	MURATA
C9,C10	1.5pF High Q Capacitor	201CHA1R5BSLE	TEMEX
C11	100pF High Q Capacitor	201CHA101JSLE	TEMEX
C12	10uF MLCC	RS80R2A106M	MARUWA
C13	33uF Aluminum Capacitor	BDS100VC33MJ10TP	SAMYOUNG
C14	12pF High Q Capacitor	201CHA120JSLE	TEMEX
EMI1	EMI FILTER	CTH32R102S20A-TM	MARUWA
CON1	DC Connector	5268-06A	MOLEX
PCB	εr=3.66 ± 0.05, 0.030" (0.762mm)	RO4350B	ROGERS Corp.
TR1	28W GaN Transistor	RT12028P	RFHIC

Package Dimensions (Type:NS-CS01)



Pin Description	
Pin No	**Function**
1	Gate
2	Drain
3	Source

ⓐ- Lid
ⓑ- Lead Frame
ⓒ- Flange

Dim.	INCH			MILLIMETER		
	MIN	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**
A1	.189	.193	.197	4.80	4.90	5.00
A2	.150	.154	.157	3.80	3.90	4.00
B1	.042	.047	.052	1.07	1.20	1.33
B2	.295	.315	.335	7.50	8.00	8.50
B3	.004	.005	.007	0.10	0.13	0.18
B4	.076	.081	.086	1.93	2.05	2.18
C1 (Chamfer)	.026	.030	.033	0.65	0.75	0.85
F1	.196	.201	.206	4.97	5.10	5.23
F2	.156	.161	.167	3.97	4.10	4.23
F3	.054	.059	.064	1.37	1.50	1.63
F4	-	.001	-	-	0.03	-
H1	.132	.144	.152	3.35	3.65	3.85
L1	-	-	-	-	-	-
L2	-	-	-	-	-	-
R1 (Radius)	.004	.008	.012	0.10	0.20	0.30

Revision History

Part Number	Release Date	Version	Description	Data Sheet Status
RT12028P	September, 2016	1.2	Modification of electrical characteristics	-
RT12028P	October, 2013	1.1	Modification of electrical characteristics	-
RT12028P	October, 2013	1.0	Initial release of datasheet	-