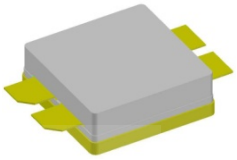
GaN Power Transistors IE21056WD

Product Features

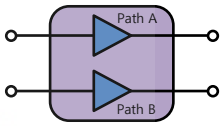
- 2110~2170MHz
- 56W Saturated Power @ 48V
- 54% Drain Efficiency @ 40dBm
- Internally Matched
- Symmetrical Doherty GaN HEMT

Applications

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



Package Type : RF12001DKR3



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

Frequency [MHz]	Peak Power	Average Power*1			
	Power [W]	Power [W]	Gain [dB]	Drain Efficiency [%]	ACLR [dBc]
2115.0	67.3	10	17.2	54.8	-24.9
2140.0	61.7	10	17.2	54.8	-25.3
2165.0	60.3	10	17.7	56.3	-24.3

Note

*1 Measured in the IE21056WD Doherty 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}	-
Storage Temperature	T_{STG}	-65, +150	℃	-
Case Operating Temperature	T_C	-40, +150	℃	30 seconds
Operating Junction Temperature*1	T_J	225	℃	-
Soldering Temperature*2	T_S	245	℃	-

Note

*1 Continuous use at maximum temperature will affect MTTF.

*2 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	$R_{\theta JC}$	7.45 *1	℃/W	Tc=85℃

Note

*1 Measured for the IE21056WD at dissipation power of 18.8W.

Electrical Characteristics (T_C=25℃ unless otherwise noted)

Characteristics	Conditions	Symbol	Min	Typ	Max	Unit
DC Characteristics - Path A (Carrier)[*1]						
Maximum Forward Gate Current	**Tc= 25℃**	I_{GMAX}	-	-	4.0	mA
Maximum Drain Current[*2]	**Tc= 25℃**	I_{DMAX}	-	-	1.5	A
Power Dissipation	**Tc= 85℃**	P_{DMAX}	-	-	18.8	W
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**	$V_{GS(Q)}$	-	-2.7	-	V_{DC}
Drain-Source Breakdown Voltage	**V_{GS} = -8V** **I_D = 3.6mA**	V_{BR}	150	-	-	V
Saturated Drain Current[*3]	**V_{DS} = 6V** **V_{GS} = 2V**	I_{DS}	2.9	3.5	-	A
Gate Leakage Current	**V_{GS} = -8V** **V_{DS} = 120V**	I_{GLKG}	-0.8	-	-	mA
Drain Leakage Current	**V_{GS} = -8V** **V_{DS} = 120V**	I_{DLKG}	-	-	1.4	mA
DC Characteristics - Path B (Peaking)[*1]						
Maximum Forward Gate Current	**Tc= 25℃**	I_{GMAX}	-	-	4.0	mA
Maximum Drain Current[*2]	**Tc= 25℃**	I_{DMAX}	-	-	1.5	A
Power Dissipation	**Tc= 85℃**	P_{DMAX}	-	-	18.8	W
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**	$V_{GS(Q)}$	-	-2.7	-	V_{DC}
Drain-Source Breakdown Voltage	**V_{GS} = -8V** **I_D = 3.6mA**	V_{BR}	150	-	-	V
Saturated Drain Current[*3]	**V_{DS} = 6V** **V_{GS} = 2V**	I_{DS}	2.9	3.5	-	A
Gate Leakage Current	**V_{GS} = -8V** **V_{DS} = 120V**	I_{GLKG}	-0.8	-	-	mA
Drain Leakage Current	**V_{GS} = -8V** **V_{DS} = 120V**	I_{DLKG}	-	-	1.4	mA

Note

*1 Measured on wafer prior to packaging.

*2 Current Limit for long term, reliable operation.

*3 Scaled from PCM data.

Characteristics	Conditions	Symbol	Min	Typ	Max	Unit
RF Characteristics (Fc=2140MHz unless otherwise noted)						
Saturated Output Power *1,4	**V_{DS} = 48V**	P_{SAT}	-	56.0	-	W
	I_{DQ} = 100mA					
Modulated Gain *2	**V_{DS} = 48V**	G_{BR}	16.0	17.0	-	dB
	I_{DQ} = 100mA					
	P_{OUT} = 40dBm					
LTE Linearity *2	**V_{DS} = 48V**	ACLR	-	-24.0	-21.0	dBc
	I_{DQ} = 100mA					
	P_{OUT} = 40dBm					
Modulated Drain Efficiency *2	**V_{DS} = 48V**	η	50.0	54.0	-	%
	I_{DQ} = 100mA					
	P_{OUT} = 40dBm					
Output Mismatch Stress *1, 3	**V_{DS} = 48V**	VSWR	-	-	10:1	ψ
	I_{DQ} = 100mA					
	P_{OUT} = P_{SAT} Pulsed					

Note

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

*2 Measured in the IE21056WD Doherty test board amplifier circuit, under LTE 10MHz, PAR7.5dB @0.01% probability on CCDF.

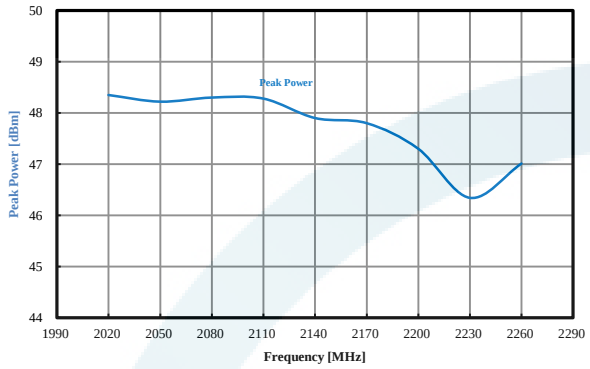
*3 Measured in the IE21056WD Doherty test board amplifier circuit. No damage at all phase angles.

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

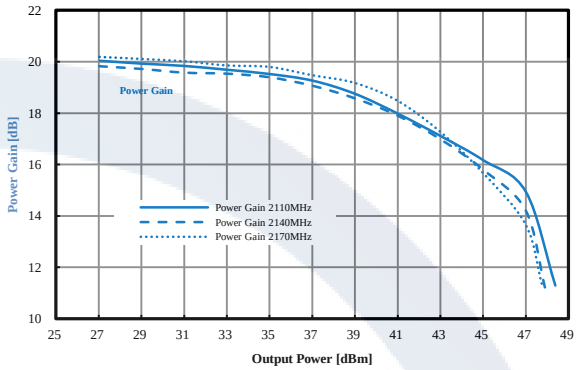
www.rfhic.com

Typical Pulsed Signal Performance (Tc=25℃, Measured in the IE21056WD test board amplifier circuit)

Peak Power vs. Frequency



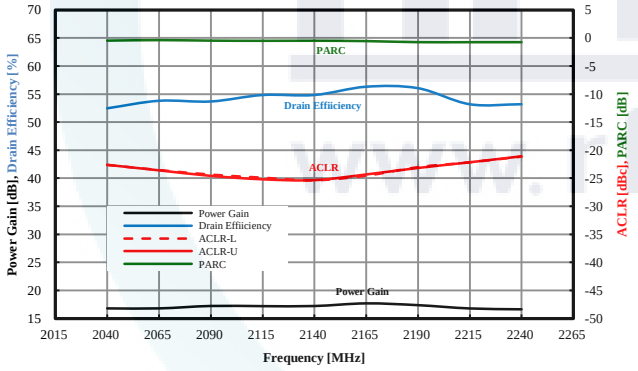
Pulsed Power Gain vs. Output Power



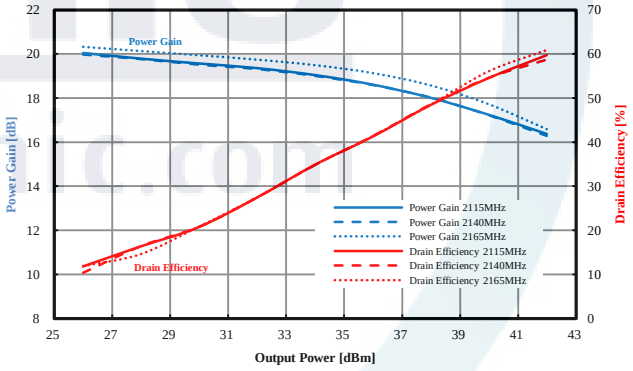
V_{DS} = 48V, $I_{DQ(C)}$ = 100mA, $V_{GS(P)}$=-4.4V, Pulse Width = 100µsec, Duty Cycle = 10%

Typical LTE Signal Performance (Tc=25℃, Measured in the IE21056WD test board amplifier circuit)

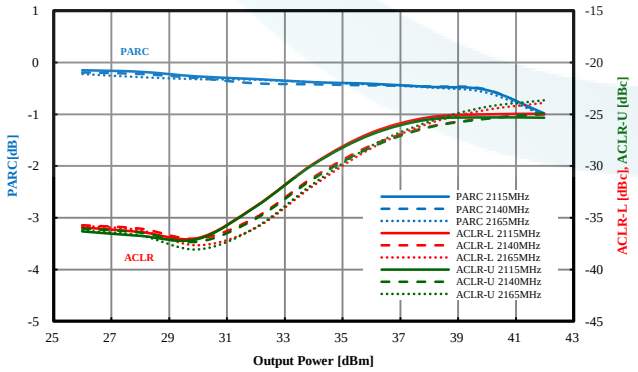
LTE Power Gain, Drain Efficiency, ACLR, PARC vs. Frequency



Power Gain, Drain Efficiency vs. Output Power



PARC, ACLR vs. Output Power

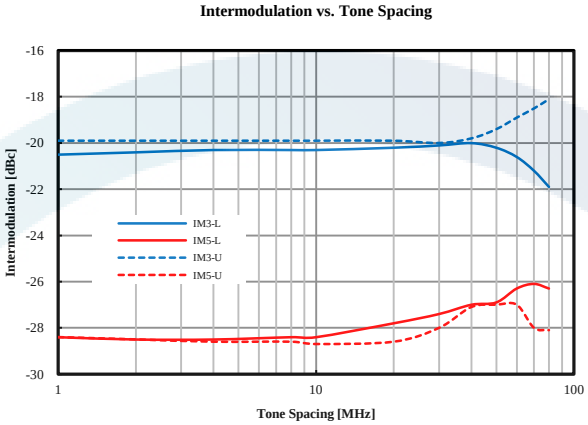


P_{AVG} = 40dBm, V_{DS} = 48V, $I_{DQ(C)}$ = 100mA, $V_{GS(P)}$ = -4.4V

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

Typical 2-tone Intermodulation Imbalance Performance

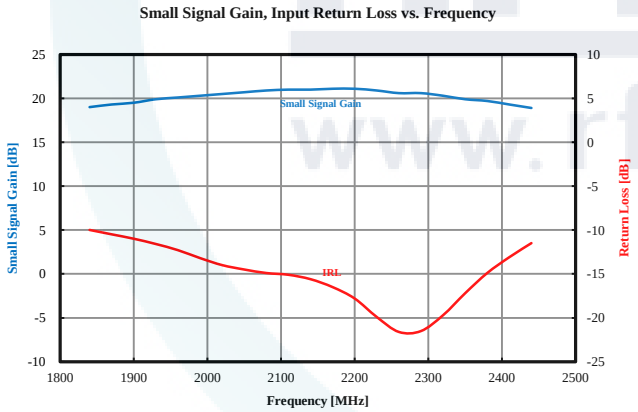
(Tc=25℃, Measured in the IE21056WD Doherty test board amplifier circuit)

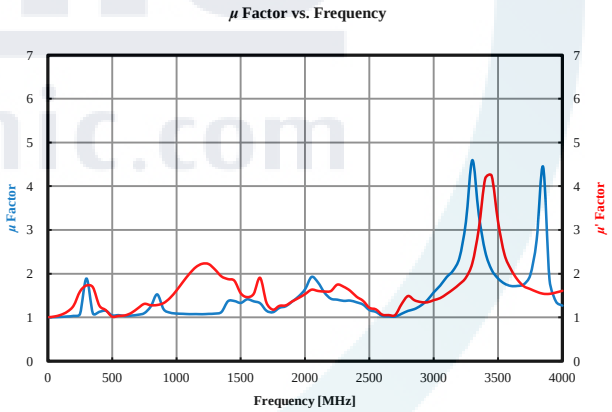


2-tone Power = 40dBm, V_{DS} = 48V, $I_{DQ(C)}$ = 100mA, $V_{GS(P)}$ = -4.4V

Typical Small Signal Performance

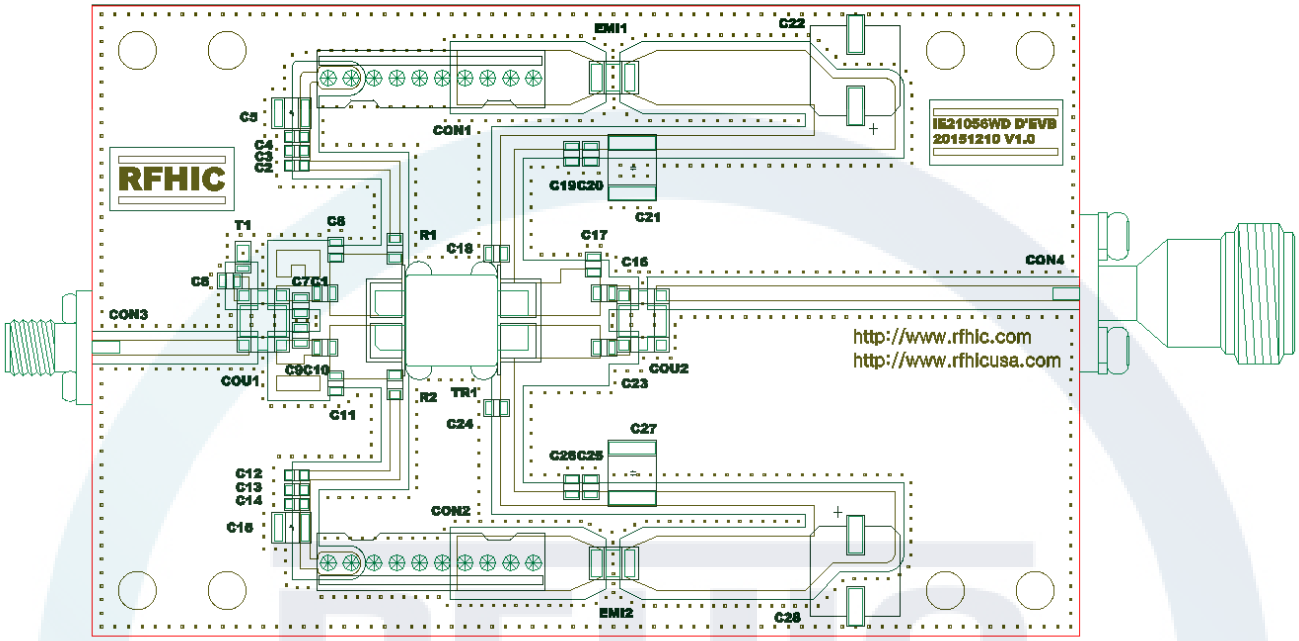
(Tc=25℃, Measured in the IE21056WD Doherty test board amplifier circuit)





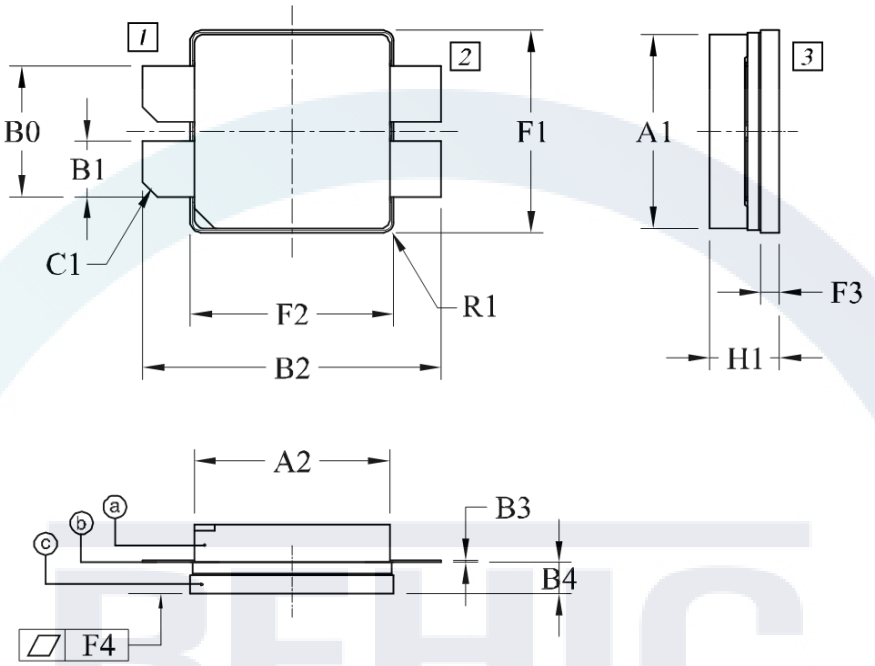
P_{IN} = 0dBm, V_{DS} = 48V, I_{DQ} = 100mA, $V_{GS(P)}$ = -4.4V

Test Board Component Layout



Part	Description	Part Number	Manufacturer
R1, R2	10ohm Chip Resistor	MCR03EZPJ100	ROHM
C1, C10, C16, C18, C19, C23, C24, C26	10pF High Q Capacitor	201CHA100JSLE	TEMEX
C2, C12	10pF Chip Capacitor	GRM1885C1H100JA01D	MURATA
C3, C13	1nF Chip Capacitor	GRM188R71H102KA01D	MURATA
C4, C14	100nF Chip Capacitor	GRM188R71C104KA01D	MURATA
C5, C15	47uF Polymer Capacitor	TCJB476M010R0070	AVX
C6	0.5pF High Q Capacitor	201CHA0R5BSLE	TEMEX
C7, C8, C11	-	-	-
C9	1.2pF High Q Capacitor	201CHA1R2BSLE	TEMEX
C16, C23	10pF High Q Capacitor	UQCAVA100JATME	AVX
C17	0.3pF High Q Capacitor	201CHA0R3BSLE	TEMEX
C20, C25	100pF High Q Capacitor	201CHA101JSLE	TEMEX
C21, C27	22uF MLCC	RS80R2A226M-TPNT	MARUWA
C22, C28	33uF Aluminum Capacitor	BDS100VC33MJ10TP	SAMYOUNG
T1	50 ohm Power Resistor	S1206N	RN2
COU1	Asymmetric Coupler	CMX21Q05	RN2
COU2	Doherty Combiner	CXH21Q	RN2
EMI1, EMI2	1000pF EMI Filter	CTH32R102S20A-TM	MARUWA
CON1, CON2	DC Connector	LW0640-10	HANLIM
CON3	RF Connector	SMA-4Hole	ANY
CON4	RF Connector	KCN8043110070	ANY
PCB	εr=3.66 ± 0.05, 0.030” (0.762mm)	RO4350B	ROGERS
TR	56W GaN Transistor	IE21056WD	RFHIC

Package Dimensions (Type:RF12001DKR3)



Pin Description	
Pin No	Function
1	Path A Gate
2	Path B Gate
3	Path A Drain

ⓐ- Lid
ⓑ- Lead Frame
ⓒ- Flange

Dim.	INCH			MILLIMETER		
	MIN	TYP	MAX	MIN	TYP	MAX
A1	.379	.384	.389	9.63	9.76	9.89
A2	.379	.384	.389	9.63	9.76	9.89
B0	.253	.258	.263	6.43	6.56	6.69
B1	.104	.109	.115	2.65	2.78	2.91
B2	.567	.587	.606	14.4	14.9	15.4
B3	.003	.005	.007	0.08	0.13	0.18
B4	.057	.062	.067	1.45	1.57	1.7
C1 (Chamfer)	.024	.030	.035	0.62	0.75	0.88
F1	.395	.400	.405	10.03	10.16	10.29
F2	.395	.400	.405	10.03	10.16	10.29
F3	.031	.036	.041	0.79	0.92	1.05
F4	-	.001	-	-	0.03	-
H1	.115	.137	.158	2.92	3.47	4.02
R1 (Radius)	.016	.020	.024	0.4	0.5	0.6

Revision History

Part Number	Release Date	Version	Description	Data Sheet Status
IE21056WD	March, 2016	1.0	Modified Electrical Characteristics	-

RFHIC Corporation reserves the right to make changes to any products herein or to discontinue any product at any time without notice. While product specifications have been thoroughly examined for reliability, RFHIC Corporation strongly recommends buyers to verify that the information they are using is accurate before ordering. RFHIC Corporation does not assume any liability for the suitability of its products for any particular purpose, and disclaims any and all liability, including without limitation consequential or incidental damages.
RFHIC products are not intended for use in life support equipment or application where malfunction of the product can be expected to result in personal injury or death. Buyer uses or sells such products for any such unintended or unauthorized application, buyer shall indemnify, protect and hold RFHIC Corporation and its directors, officers, stockholders, employees, representatives and distributors harmless against any and all claims arising out of such unauthorized use.
Sales, inquiries and support should be directed to the local authorized geographic distributor for RFHIC Corporation. For customers in the US, please contact the US Sales Team at +1-919-677-8780. For all other inquiries, please contact the International Sales Team at 82-31-8069-3036 or Korean Domestic Sales Team 82-31-8069-3034.