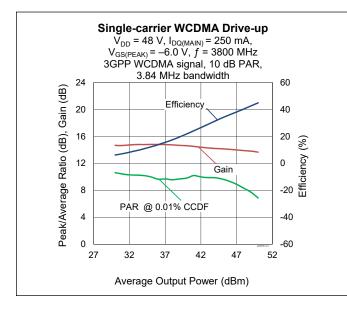


# GTRA384802FC

Thermally-Enhanced High Power RF GaN on SiC Amplifier, 400 W, 48 V, 3600 – 3800 MHz

#### Description

The GTRA384802FC is a 400-watt ( $P_{3dB}$ ) GaN on SiC HEMT D-mode amplifier for use in multi-standard cellular power amplifier applications. It features input and output matching, high efficiency, and a thermally-enhanced package with earless flange.





Package Types: H-37248C-4 PN: GTRA384802FC

#### Features

- GaN on SiC HEMT technology
- Asymmetric Doherty design
  Main: P<sub>3dB</sub> = 200 W typ
  Peak: P<sub>3dB</sub> = 280 W typ
- Typical pulsed CW performance, 3800 MHz, 48 V, combined outputs, Doherty @ P<sub>3dB</sub>, 10 μs, 10% duty cycle
- Output power = 400 W
- Drain efficiency = 62%
- Gain = 12 dB
- Capable of handling 10:1 VSWR at 48 V, 63 W (WCDMA)output power
- Human Body Model Class 1B (per ANSI/ESDA/ JEDEC JS-001)
- Pb-free and RoHS compliant

## **RF Characteristics**

#### Single-carrier WCDMA Specifications (tested in the Doherty test fixture)

 $V_{DD}$  = 48 V,  $I_{DQ}$  = 250 mA,  $P_{OUT}$  = 63 W avg,  $V_{GS(PEAK)}$  = -6 V, f = 3800 MHz, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

Characteristic	Symbol	Min.	Тур.	Max.	Unit
Gain	G <sub>ps</sub>	12	13	_	dB
Drain Efficiency	η <sub>D</sub>	38.5	42	_	%
Adjacent Channel Power Ratio	ACPR	_	-33	-29	dBc
Output PAR @ 0.01% CCDF	OPAR	7.3	7.8	_	dB

Note:

ESD: Electrostatic discharge sensitive device—observe handling precautions!



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All published data at  $T_{CASE}$  = 25°C unless otherwise indicated



#### **DC Characteristics**

Characteristic	Symbol	Min.	Тур.	Max.	Unit	Conditions
Drain-source Breakdown Voltage (main)		150				
Drain-source Breakdown Voltage (peak)	V <sub>BR(DSS)</sub>	150	_	—	V	$V_{GS} = -8 V, I_{D} = 10 mA$
Drain-source Leakage Current	I <sub>DSS</sub>	_	_	5	mA	$V_{GS} = -8 V, V_{DS} = 10 V$
Gate Threshold Voltage (main)						$V_{\rm DS} = 10 \text{ V}, \text{ I}_{\rm D} = 25 \text{ mA}$
Gate Threshold Voltage (peak)	V <sub>GS(th)</sub>	-3.8	-3.0	-2.3	V	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 36 mA

## **Recommended Operating Voltages**

Parameter	Symbol	Min.	Тур.	Max.	Unit	Conditions
Drain Operating Voltage	V <sub>DD</sub>	0	_	50		
Gate Quiescent Voltage	V <sub>GS(Q)</sub>	-3.9	-2.9	-2.0	V	$V_{\rm DS}$ =48 V, I <sub>D</sub> = 250 mA

#### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit	
Drain-source Voltage	V <sub>DSS</sub>	125		
Gate-source Voltage	V <sub>GS</sub>	-10 to +2	V	
Operating Voltage	V <sub>DD</sub>	55		
Gate Current (main)		25.2		
Gate Current (peak)	I <sub>G</sub>	36	mA	
Drain Current (main)		9.5		
Drain Current (peak)	Ι <sub>D</sub>	13.5	A	
Junction Temperature	Tj	225	°C	
Storage Temperature Range	T <sub>STG</sub>	-65 to +150	°C	

Operation above the maximum values listed here may cause permanent damage. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the component. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. For reliable continuous operation, the device should be operated within the operating voltage range (V<sub>DD</sub>) specified above.

#### **Thermal Characteristics**

Parameter	Symbol Value		Unit	Conditions
Thermal Resistance (main)	-	1.6	00.000	T <sub>CASE</sub> = 70°C, 95 W DC , 48 V
Thermal Resistance (peak)	R <sub>θJC</sub>	1.1	°C/W	T <sub>CASE</sub> = 70°C, 141 W DC, 48 V

#### **Ordering Information**

Type and Version	Order Code	Package Description	Shipping
GTRA384802FC V1 R0	GTRA384802FC-V1-R0	H-37248C-4, earless flange	Tape & Reel, 50 pcs
GTRA384802FC V1 R2	GTRA384802FC-V1-R2	H-37248C-4, earless flange	Tape & Reel, 250 pcs

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# GTRA384802FC



#### **Typical Performance** (data taken in a the production test fixture)

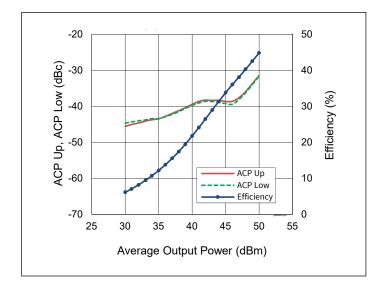
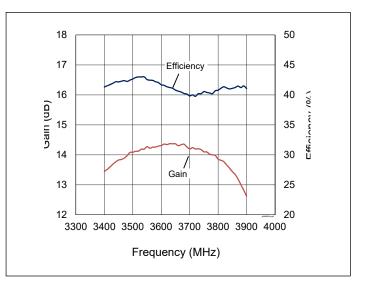


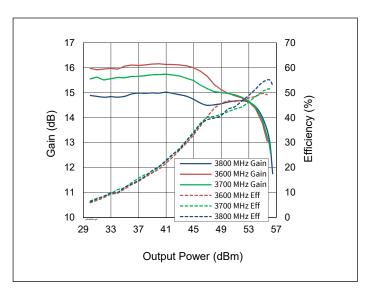
Figure 1. Single-carrier WCDMA Drive-up

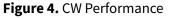
 $V_{DD}$  = 48 V,  $I_{DQ(MAIN)}$  = 250 mA,  $V_{GS(PEAK)}$  = -6.0V, f = 3800 MHz 3GPP WCDMA signal, 10 dB PAR, 3.84 MHz bandwidth



#### Figure 2. Single-carrier WCDMA Broadband

 $\begin{array}{l} V_{\text{DD}} = 48 \text{ V}, \text{ I}_{\text{DQ(MAIN)}} = 250 \text{ mA}, \\ V_{\text{GS(PEAK)}} = -6.0 \text{V}, \text{ P}_{\text{OUT}} = 48 \text{ dBm} \\ \text{3GPP WCDMA signal, 10 dB PAR} \end{array}$ 





 $V_{DD}$  = 48 V,  $I_{DQ(MAIN)}$  = 250 mA,  $V_{GS(PEAK)}$  = -6.0 V

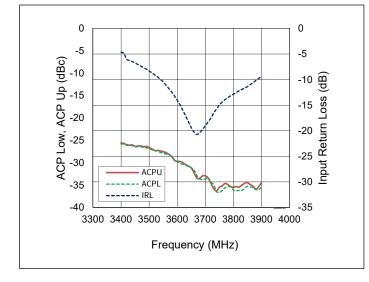


Figure 3. Single-carrier WCDMA Broadband

 $\label{eq:V_DD} \begin{array}{l} V_{\text{DD}} = 48 \text{ V}, \text{ I}_{\text{DQ(MAIN)}} = 250 \text{ mA}, \\ V_{\text{GS(PEAK)}} = -6.0 \text{ V}, \text{ P}_{\text{OUT}} = 48 \text{ dBm} \\ \text{3GPP WCDMA signal, 10 dB PAR} \end{array}$ 

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# Typical Performance (cont.)

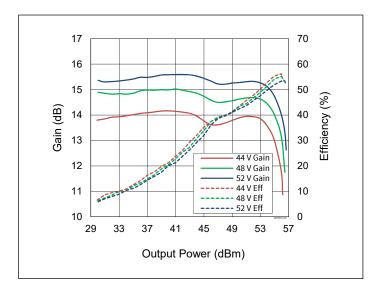
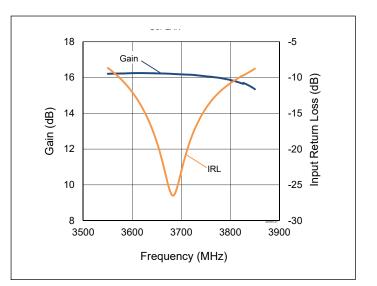


Figure 5. CW Performance at various V<sub>DD</sub>  $I_{DQ(MAIN)} = 250 \text{ mA}, V_{GS(PEAK)} = -6.0 \text{V}$ f = 3800 MHz



#### Figure 6. Small Signal CW Gain & Input Return Loss

 $\label{eq:VDD} \begin{array}{l} V_{\text{DD}} = 48 \text{ V}, \text{ I}_{\text{DQ}(\text{MAIN})} = 250 \text{ mA}, \\ V_{\text{GS}(\text{PEAK})} = -6.0 \text{ V} \end{array}$ 

#### Load Pull

Main side load pull performance – pulsed CW signal: 10  $\mu$ sec, 10% duty cycle, 48 V, I<sub>DO</sub> = 250 mA, class AB

		P <sub>3dB</sub>									
	Max Output Power Max Drain Efficiency					Max Output Power					
Freq [MHz]	Ζ <sub>s</sub> [Ω]	Ζ <sub>ι</sub> [Ω]	Gain [dB]	Ρ <sub>ουτ</sub> [dBm]	P <sub>OUT</sub> [W]	Efficiency [%]	Ζ <sub>l</sub> [Ω]	Gain [dB]	Ρ <sub>ουτ</sub> [dBm]	P <sub>OUT</sub> [W]	Efficiency [%]
3600	11.2 – j7.4	10.2 + j0	18.1	54.70	295	31.3	11.7 – j7	17.0	48.70	74	57.5
3700	6.2 – j5.7	9.5 + j0.9	17.6	54.60	288	31.3	7.5 – j15.6	16.0	48.10	65	57.5
3800	4.0 – j7.3	8.4 + j2	17.4	54.60	288	31.2	16 – j24	14.6	47.20	52	55.5

#### Peak side load pull performance – pulsed CW signal: 10 $\mu$ sec, 10% duty cycle, 48 V, I<sub>DO</sub> = 360 mA, class AB

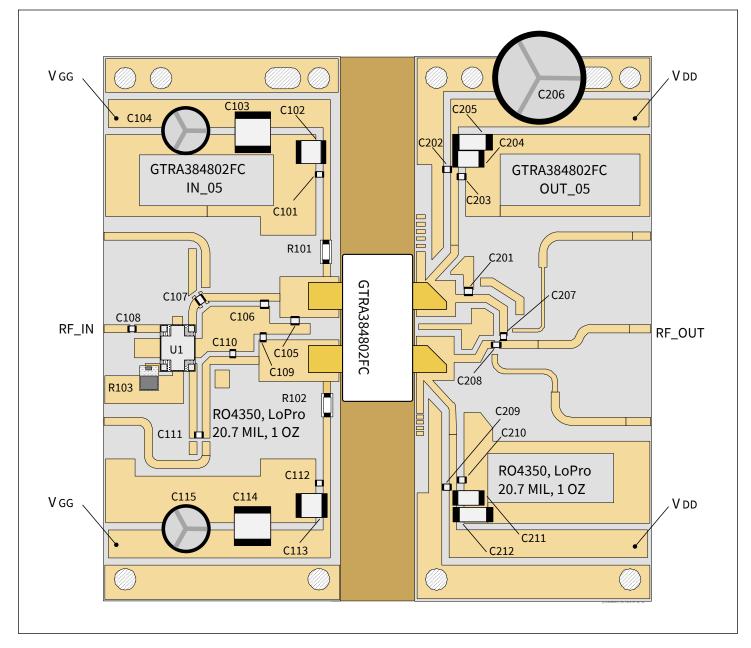
		P <sub>3dB</sub>									
		Max Output Power				Max Drain Efficiency					
Freq [MHz]	$Z_{s}[\Omega]$	Ζ <sub>ι</sub> [Ω]	Gain [dB]	P <sub>out</sub> [dBm]	P <sub>OUT</sub> [W]	Efficiency [%]	Ζ <sub>Ι</sub> [Ω]	Gain [dB]	P <sub>out</sub> [dBm]	P <sub>OUT</sub> [W]	Efficiency [%]
3600	15 - j11.4	3 – j8.5	15.4	55.90	389	57.5	1.5 – j7.3	18.5	54.60	288	67.0
3700	10.8 – j8.8	3 – j8.8	14.9	55.60	363	52.2	3 – j7.1	15.7	55.00	316	61.3
3800	6.7 – j8	3 – j8.8	15.2	55.60	363	56.9	1.6 – j7.6	17.0	53.50	224	61.8

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#### Evaluation Board, 3600 - 3800 MHz

Evaluation Board Part Number	LTA/GTRA384802FC-V1
PCB Information	Rogers 4350, LoPro <sup>®</sup> , 0.526mm [0.0207"] thick, 1 oz. copper, ε <sub>r</sub> = 3.55



Reference circuit assembly diagram (not to scale)

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# **Components Information**

Component	Description	Manufacturer	P/N
Input			
C101, C107, C108, C111, C112	Capacitor, 10 pF	ATC	ATC800A100JT250XT
C102, C113	Capacitor, 1 µF	TDK Corporation	C4532X7R2A105M230KA
C103, C114	Capacitor, 10 μF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C104, C115	Capacitor, 100 μF, 35 V	Panasonic Electronic Components	EEE-FT1V101AP
C105, C110	Capacitor, 1.2 pF	ATC	ATC800A1R2CT250XT
C106	Capacitor, 1.7 pF	ATC	ATC800A1R7CT250XT
C109	Capacitor, 0.5 pF	ATC	ATC800A0R5CT250XT
R101, R102	Resistor, 5.6 ohms	Panasonic Electronic Components	ERJ-8RQJ5R6V
R103	Resistor, 50 ohms	Anaren	C8A50Z4A
U1	Hybrid coupler	Anaren	XC3500P-03S
Output			
C201	Capacitor, 0.2 pF	ATC	ATC800A0R2CT250XT
C202, C209	Capacitor, 1000 pF, 100 V	Murata Electronics North America	GRM188R72A102KA01D
C203, C207, C208, C210	Capacitor, 10 pF	ATC	ATC800A100JT250XT
C204, C211	Capacitor, 1 µF	TDK Corporation	C4532X7R2A105M230KA
C205, C212	Capacitor, 10 μF	TDK Corporation	C5750X7S2A106M230KB
C206	Capacitor, 220 μF	Panasonic Electronic Components	ECA-2AHG221

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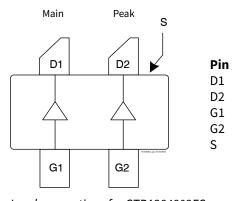
# **Bias Sequencing**

#### **Bias ON**

- 1. Ensure RF is turned off
- 2. Apply pinch-off voltage of –5 V to the gate
- 3. Apply nominal drain voltage
- 4. Bias gate to desired quiescent drain current
- 5. Apply RF

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# Pinout Diagram (top view)



#### Description

Drain Device 1 (Main) Drain Device 2 (Peak) Gate Device 1 (Main) Gate Device 2 (Peak) Source (flange)

**Bias OFF** 

1. Turn RF off

3. Turn-off drain voltage

4. Turn-off gate voltage

2. Apply pinch-off voltage to the gate

Lead connections for GTRA384802FC



#### Package Outline Specifications – Package H-37248C-4

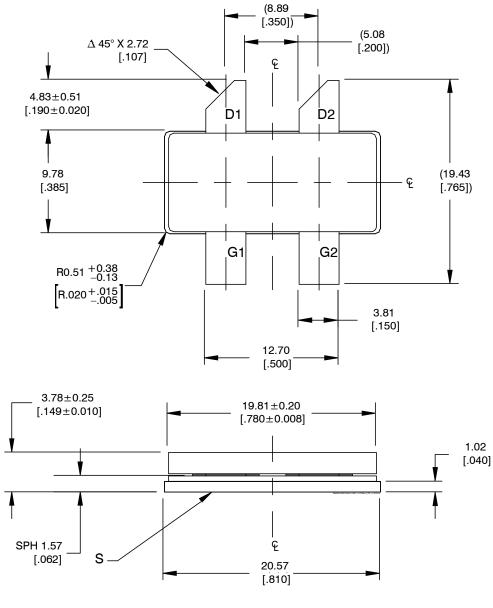


Diagram Notes-unless otherwise specified:

- 1. Interpret dimensions and tolerances per ASME Y14.5M-1994
- 2. Primary dimensions are mm, alternate dimensions are inches
- 3. All tolerances ± 0.127 [0.005]
- 4. Pins: D1, D2 drain, G1, G2 gate, S source (flange)
- 5. Lead thickness:  $0.13 \pm 0.05 [0.005 \pm 0.002]$
- 6. Gold plating thickness:  $1.14 \pm 0.38$  micron [45 ± 15 microinch]

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