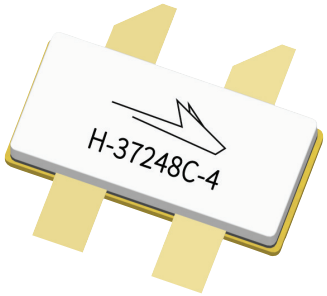
GTRA412852FC

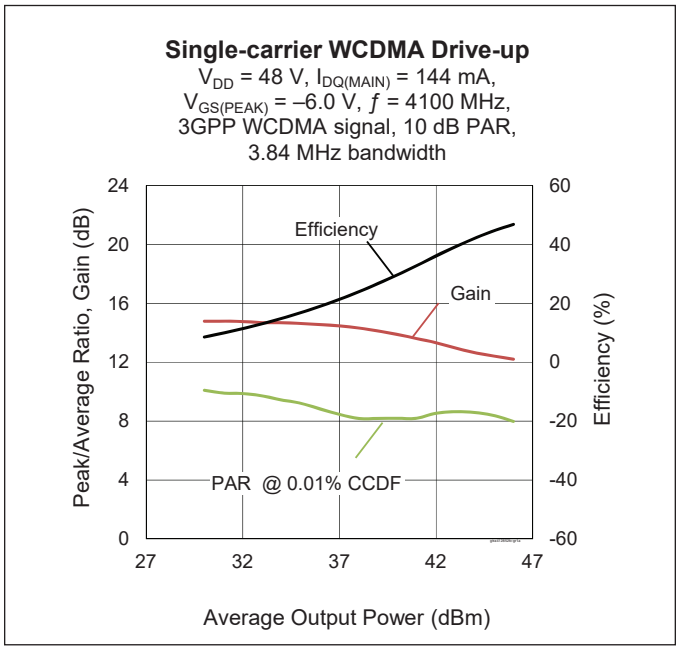
Thermally-Enhanced High Power RF GaN on SiC HEMT
235 W, 48 V, 3700 – 4100 MHz



Package Types: H-37248C-4

Description

The GTRA412852FC is a 235-watt (P_{3dB}) GaN on SiC high electron mobility transistor (HEMT) 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.



Features

- GaN on SiC HEMT technology
- Input and output matched
- Typical pulsed CW performance, 4100 MHz, 48 V, 10 µs pulse width, 100 µs PP
  - Output power at P_{3dB} = 235 W
  - Gain = 10 dB
  - Efficiency = 45%
- Capable of handling 10:1 VSWR @48 V, 30 W (WCDMA) output power
- Human Body Model Class 1A (per ANSI/ESDA/JEDEC JS-001)
- Low thermal resistance
- Pb-free and RoHS compliant

RF Characteristics

Single-carrier WCDMA Specifications (tested in Wolfspeed Doherty production test fixture)
V_{DD} = 48 V, I_{DQ} = 144 mA, POUT = 30 W avg, $V_{GS(PEAK)}$ = –6 V, f = 4100 MHz, 3GPP, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Gain	G_{ps}	10	11.5	—	dB
Drain Efficiency	η_D	34.5	39	—	%
Adjacent Channel Power Ratio	ACPR	—	–29	–24	dBc
Output PAR @ 0.01% CCDF	OPAR	7	8	—	dB

Note:
All published data at T_{CASE} = 25°C unless otherwise indicated
ESD: Electrostatic discharge sensitive device—observe handling precautions!

RoHS compliant

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DC Characteristics

Characteristic	Symbol	Min.	Typ.	Max.	Unit	Conditions
Drain-source Breakdown Voltage (main)	$V_{BR(DSS)}$	150	—	—	V	V_{GS} = -8 V, I_D = 10 mA
Drain-source Breakdown Voltage (peak)						
Drain-source Leakage Current	I_{DSS}	—	—	3	mA	V_{GS} = -8 V, V_{DS} = 10 mA
Gate Threshold Voltage (main)	$V_{GS(th)}$	–3.8	–3	–2.3	V	V_{DS} = 10 V, I_D = 14.4 mA
Gate Threshold Voltage (peak)						V_{DS} = 10 V, I_D = 21.6 mA

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Operating Voltage	V_{DD}	0	—	50	V	
Gate Quiescent Voltage	$V_{GS(Q)}$	-3.4	–3.0	-2.6		V_{DS} =48 V, I_D = 140 mA

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-source Voltage	V_{DSS}	125	V
Gate-source Voltage	V_{GS}	–10 to +2	
Operating Voltage	V_{DD}	55	
Gate Current (main)	I_G	14.4	mA
Gate Current (peak)		21.6	
Drain Current (main)	I_D	5.4	A
Drain Current (peak)		8.1	
Junction Temperature	T_J	225	°C
Storage Temperature Range	T_{STG}	–65 to +150	

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_{DD}) specified above.

Thermal Characteristics – T_{CASE} = 85°C, V_{DD} = 48 V

Characteristic	Symbol	Value	Unit	Conditions
Thermal Resistance (main)	$R_{\theta JC}$	2.2	°C/W	P_{DISS} = 63 W DC
Thermal Resistance (peak)		1.7		P_{DISS} = 84 W DC

Ordering Information

Type and Version	Order Code	Package	Shipping
GTRA412852FC V1 R0	GTRA412852FC-V1-R0	H-37248C-4, earless flange	Tape & Reel, 50 pcs
GTRA412852FC V1 R2	GTRA412852FC-V1-R2	H-37248C-4, earless flange	Tape & Reel, 250 pcs

Typical RF Performance, 3800 – 4100 MHz (data taken in a Wolfspeed production test fixture)

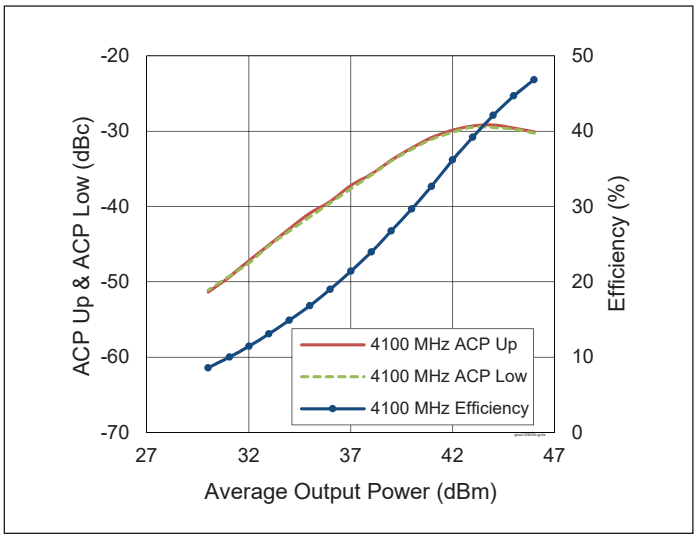


Figure 1. Single-carrier WCDMA Drive-up

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –6.0 V, f = 4100 MHz,
3GPP WCDMA signal, 10 dB PAR,
3.84 MHz bandwidth

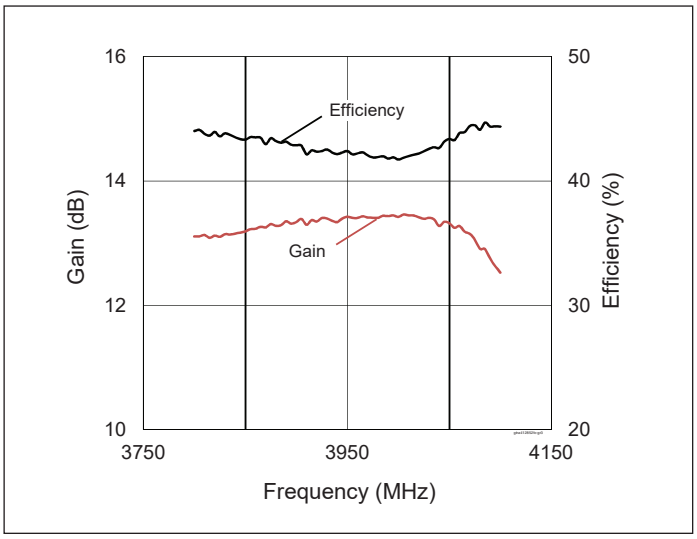


Figure 2. Single-carrier WCDMA Broadband Performance

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –6.0V, P_{OUT} = 44.8 dBm,
3GPP WCDMA signal, 10 dB PAR

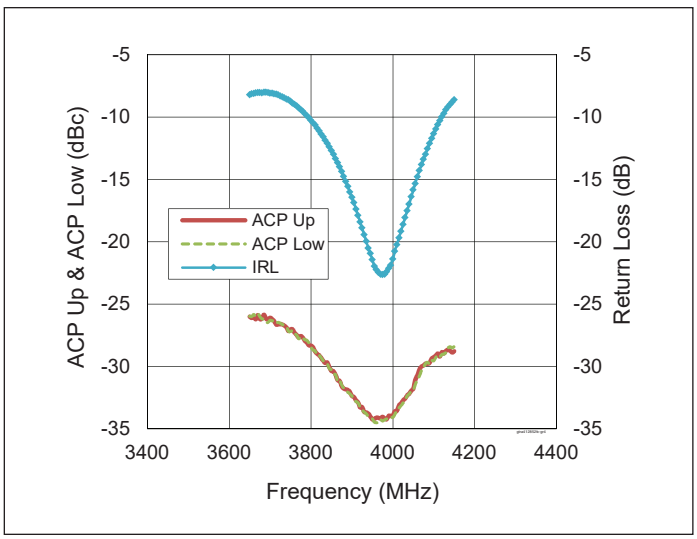


Figure 3. Single-carrier WCDMA Broadband Performance

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –6.0 V, P_{OUT} = 44.8 dBm,
3GPP WCDMA signal, 10 dB PAR

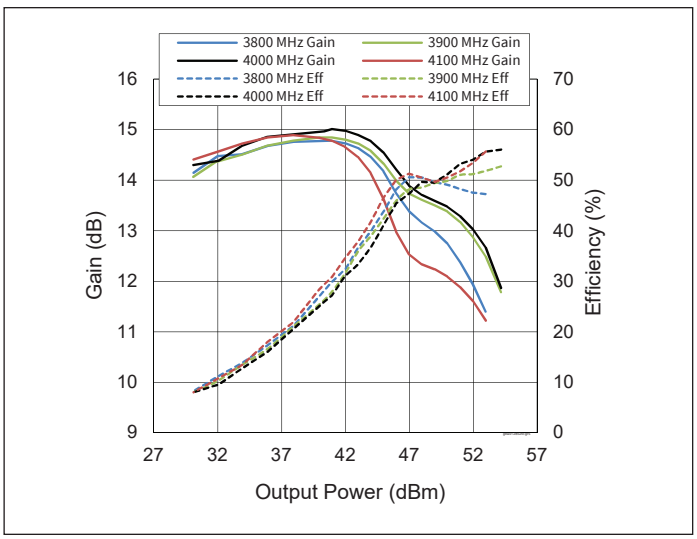


Figure 4. Pulsed CW Performance

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –6.0V

Typical RF Performance, 3800 – 4100 MHz (cont.)

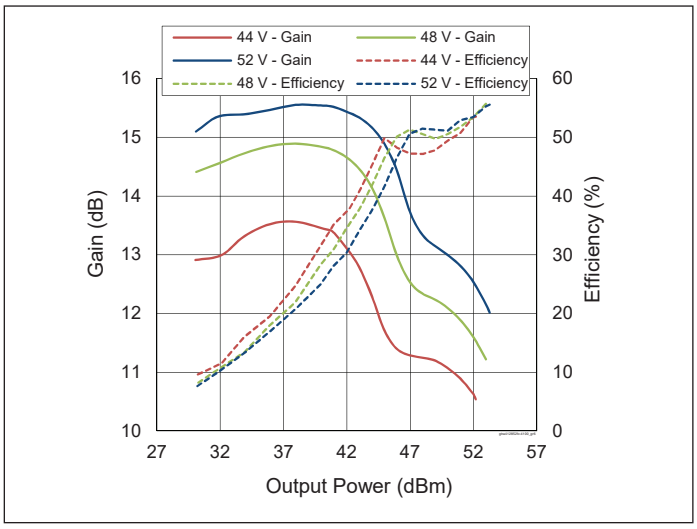


Figure 9. Pulsed CW Performance at Various V_{DD}

$I_{DQ(MAIN)}$ = 144 mA, $V_{GS(PEAK)}$ = –6.0V,
f = 4100 MHz

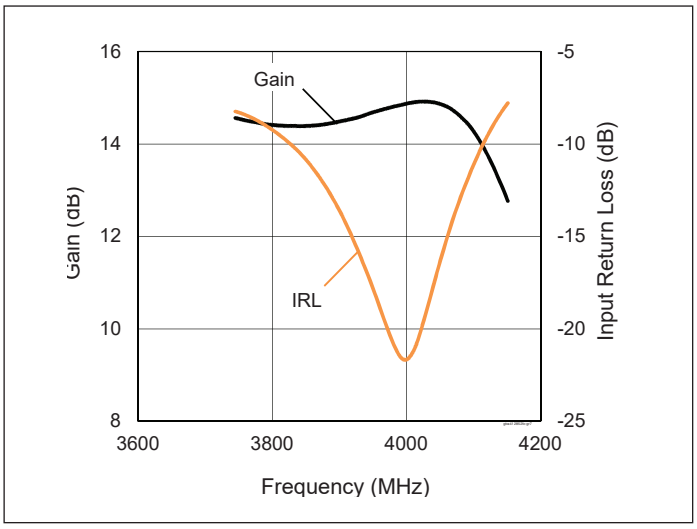


Figure 10. CW Performance Small Signal Gain & Input Return Loss

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = -6.0 V

Load Pull Performance

Main Side – pulsed CW signal: 10 µsec pulse width, 10% duty cycle, 48 V, 144 mA, class AB

		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Zs [Ω]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]
3800	8.3 – j8.8	5.6– j1.3	17.8	51.53	142	55.3	6.9 – j3.3	18.8	51.05	127	64.9
3900	8.0 – j11.2	4.9 – j1.8	17.1	51.42	139	53.6	8.7 – j2.7	18.9	50.06	101	62.8
4000	6.6 – j13.4	3.2 – j2.8	15.9	51.50	141	52.7	8.6 – j2.7	17.6	49.54	90	65.3
4100	5.8 – j15.9	3.4 – j3.5	15.9	51.45	140	55.8	7.4 – j1.6	17.3	49.63	92	64.7

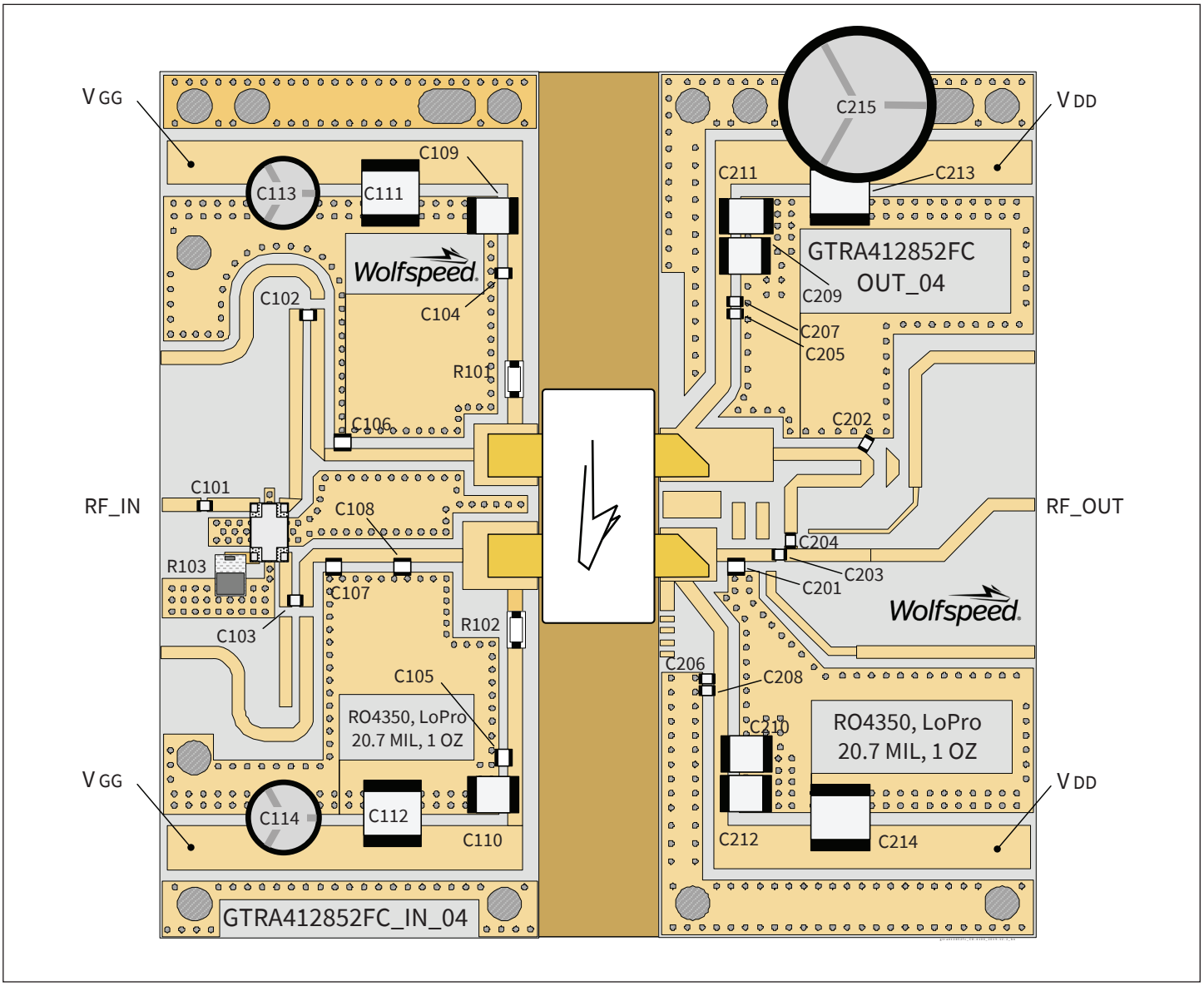
Peak Side – pulsed CW signal: 10 µsec pulse width, 10% duty cycle, 48 V, 216 mA, class AB

		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Zs [Ω]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]
3800	10.4 – j13.6	5.8 – j12.6	14.5	53.30	214	50.4	4 – j9.2	16.3	52.08	161	60.2
3900	9.4 – j15.7	7.2 – j9.1	14.4	53.20	214	55.6	4.7 – j7.5	15.1	52.13	163	62.1
4000	8.2 – j17.2	5.6 – j12	14.3	53.50	224	53.9	4 – j8.8	15.3	52.15	164	62.2
4100	6.4 – j18.2	5.5 – j12.8	14.3	53.10	204	55.4	4.5 – j11.2	14.8	52.30	170	59.5

Evaluation Board, 3800 – 4100 MHz

Evaluation Board Part Number	LTA/GTRA41285FC-V1
PCB Information	Rogers 4350, LoPro® 0.526mm [0.0207"] thick, 1 oz. copper, ε_r = 3.55

Find Gerber files for this test fixture on the Wolfspeed Web site at www.wolfspeed.com/RF



Reference circuit assembly diagram (not to scale)

Evaluation Board, 3800 – 4100 MHz (cont.)

Components Information

Component	Description	Manufacturer	P/N
Input			
C101, C102, C103, C104, C105	Capacitor, 8.2 pF	ATC	ATC800A8R2CT250X
C106	Capacitor, 0.6 pF	ATC	ATC800A0R6CT250XT
C107	Capacitor, 0.1 pF	ATC	ATC800A0R1BT250XT
C108	Capacitor, 1.0 pF	ATC	ATC800A1R0CT250XT
C109, C110	Capacitor, 1 µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C111, C112	Capacitor, 10 µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C113, C114	Capacitor, 100 µF, 35 V	Panasonic Electronic Components	EEE-FT1V101AP
R101, R102	Resistor, 5.6 ohms	Panasonic Electronic Components	ERJ-8RQJ5R6V
R103	Resistor, 50 ohms	Anaren	C8A50Z4A
U1	Hybrid coupler	Anaren	X3C35F1-03S
Output			
C201	Capacitor, 0.2 pF	ATC	ATC800A0R2BT250XT
C202	Capacitor, 0.3 pF	ATC	ATC800A0R3CT250XT
C203, C204, C205, C206	Capacitor, 8.2 pF	ATC	ATC800A8R2CT250X
C207, C208	Capacitor, 0.001 µF, 100 V	Murata Electronics	GRM188R72A102KA01D
C209, C210	Capacitor, 2.2 µF, 100 V	TDK Corporation	C4532X7R2A225K230KA
C211, C212	Capacitor, 1 µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C213, C214	Capacitor, 10 µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C215	Capacitor, 220 µF	Panasonic Electronic Components	ECA-2AHG221

Typical RF Performance, 3700 – 3900 MHz (data taken in a Wolfspeed test fixture)

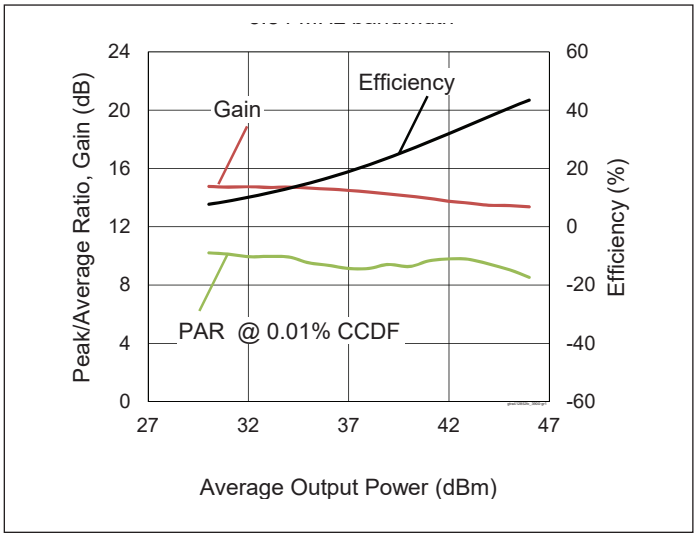


Figure 11. Single-carrier WCDMA Drive-up

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –5.5 V, f = 3900 MHz,
3GPP WCDMA signal, 10 dB PAR,
3.84 MHz bandwidth

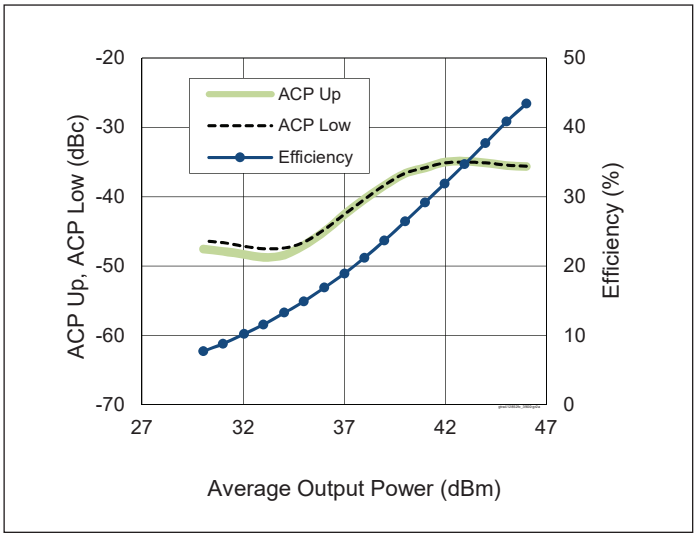


Figure 12. Single-carrier WCDMA Drive-up

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –5.5 V, f = 3900 MHz,
3GPP WCDMA signal, 10 dB PAR,
3.84 MHz bandwidth

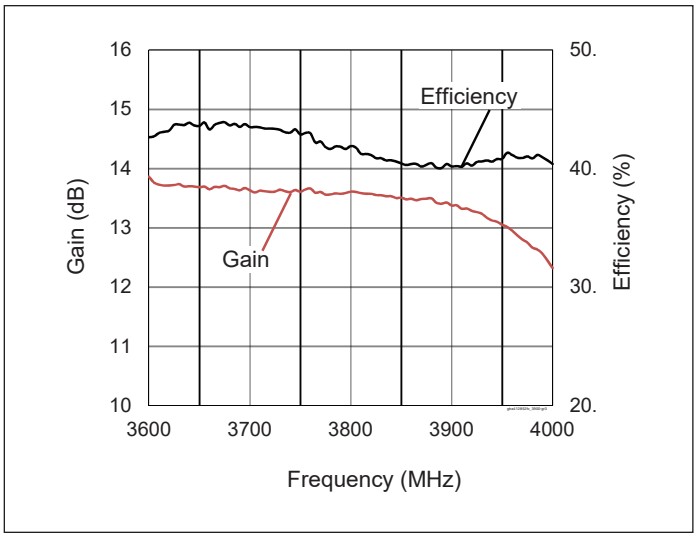


Figure 13. Single-carrier WCDMA Broadband

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –5.5V, P_{OUT} = 44.8 dBm,
3GPP WCDMA signal, 10 dB PAR

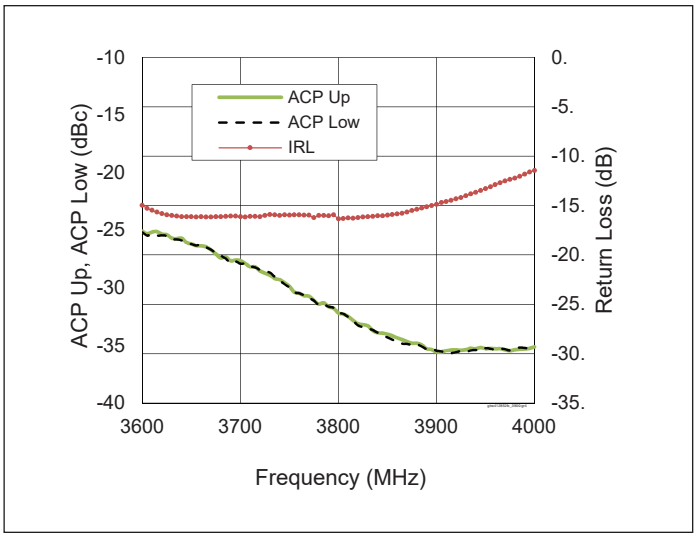


Figure 14. Single-carrier WCDMA Broadband

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = –5.5 V, P_{OUT} = 44.8 dBm,
3GPP WCDMA signal, 10 dB PAR

Typical RF Performance, 3700 – 3900 MHz (cont.)

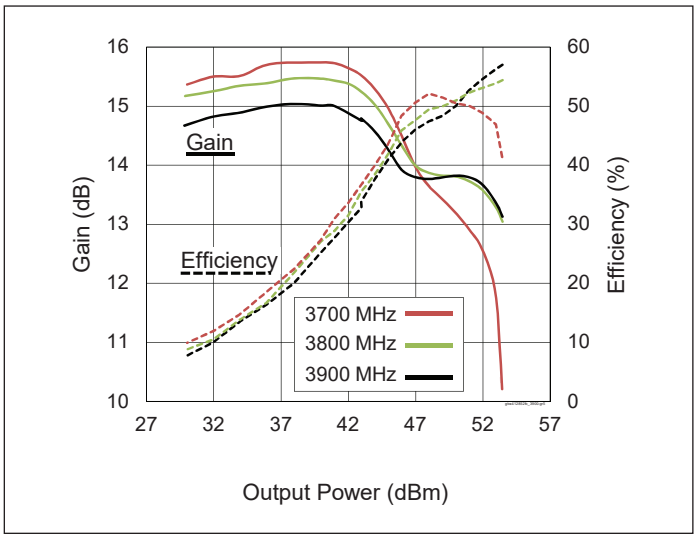


Figure 15. Pulsed CW Performance at 48 V_{DD}

$I_{DQ(MAIN)}$ = 144 mA, $V_{GS(PEAK)}$ = –5.5 V

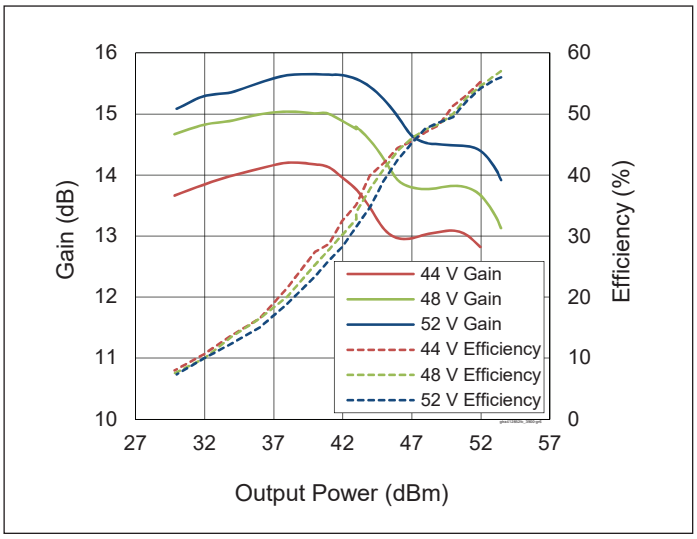


Figure 16. Pulsed CW Performance at Various V_{DD}

$I_{DQ(MAIN)}$ = 144 mA, $V_{GS(PEAK)}$ = –5.5V,
f = 3900 MHz

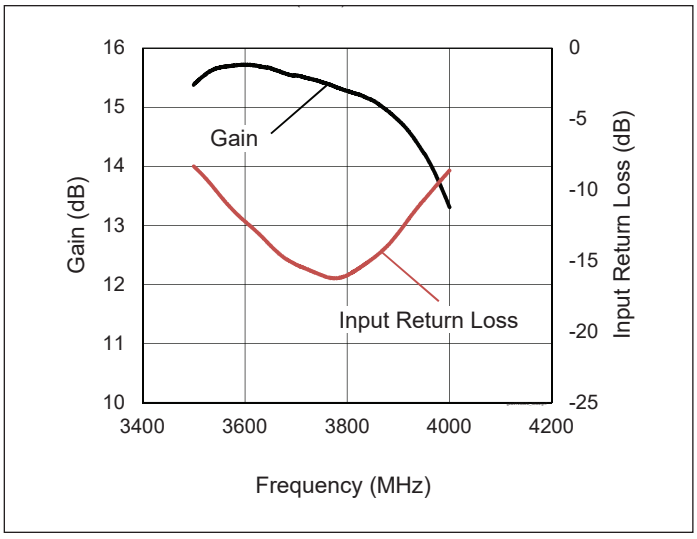


Figure 17. CW Performance Small Signal Gain & Input Return Loss

V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 144 mA,
$V_{GS(PEAK)}$ = --5.5 V

Load Pull

Main Side – pulsed CW signal: 10 µsec pulse width, 10% duty cycle, 48 V, 144 mA, class AB

		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Zs [Ω]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]
3700	11.1 – j5.7	6.4 – j1.67	18.53	51.74	149	59.0	8.9 – j7.2	19.2	49.85	97	64.5
3800	8.3 – j8.8	5.6 – j1.3	17.8	51.53	142	55.3	6.9 – j3.3	18.8	51.05	127	64.9
3900	8.0 – j11.2	4.9 – j1.8	17.1	51.42	139	53.6	8.7 – j2.7	18.9	50.06	101	62.8

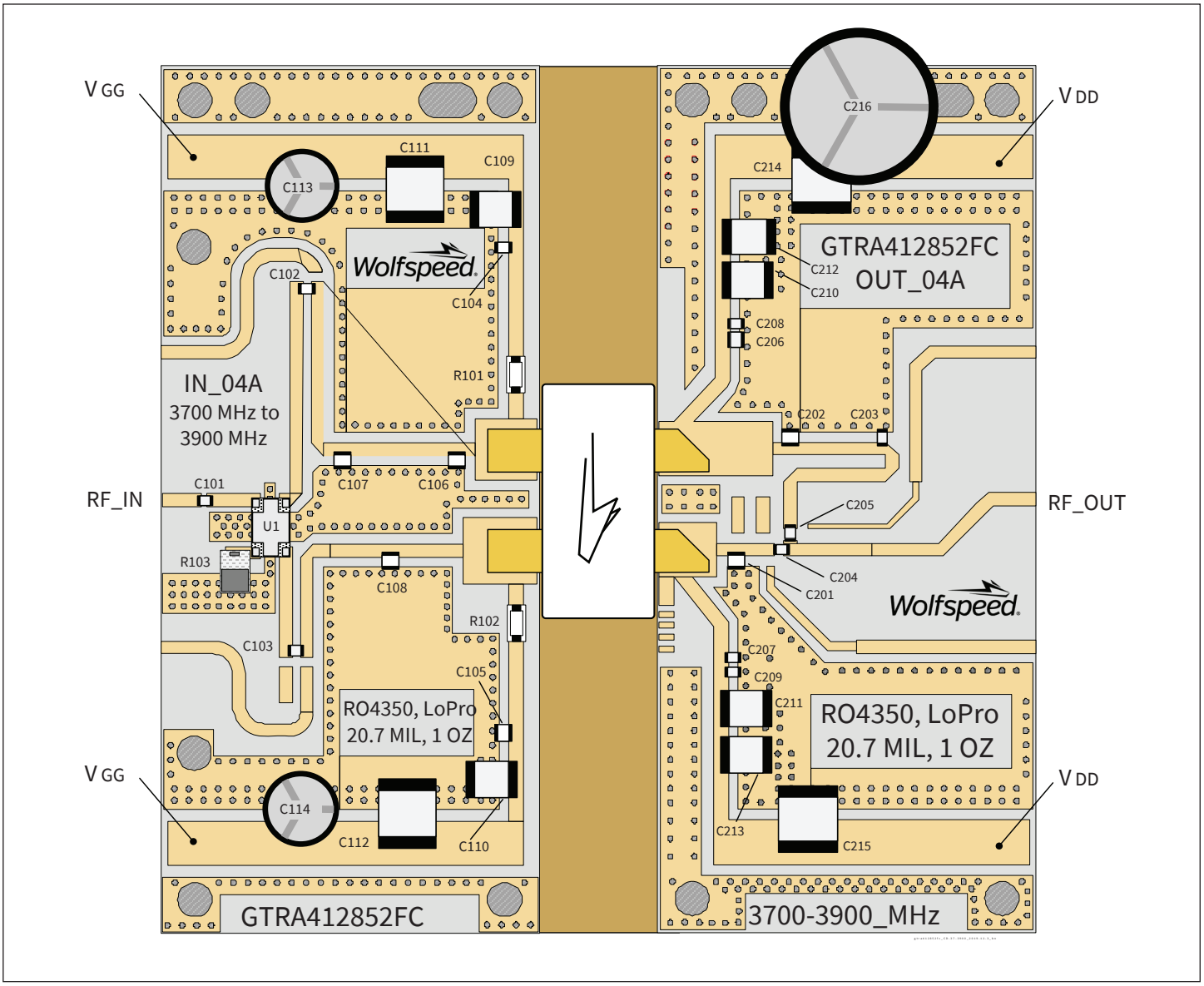
Peak Side – pulsed CW signal: 10 µsec pulse width, 10% duty cycle, 48 V, 216 mA, class AB

		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Zs [Ω]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]	Zl [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	PAE [%]
3700	14.1 – j14	5.0 – j10.5	15.3	53.56	227	55.8	3.6 – j7.6	17.1	52.64	184	67.0
3800	10.4 – j13.6	5.8 – j12.6	14.5	53.30	214	50.4	4.0 – j9.2	16.3	52.08	161	60.2
3900	9.4 – j15.7	7.2 – j9.1	14.4	53.20	214	55.6	4.7 – j7.5	15.1	52.13	163	62.1

Evaluation Board, 3700 – 3900 MHz

Evaluation Board Part Number	LTA/GTRA41285FC-E2
PCB Information	Rogers 4350, LoPro® 0.526mm [0.0207"] thick, 1 oz. copper, ε_r = 3.55

Find Gerber files for this test fixture on the Wolfspeed Web site at www.wolfspeed.com/RF



Reference circuit assembly diagram (not to scale)

Evaluation Board, 3700 – 3900 MHz (cont.)

Components Information

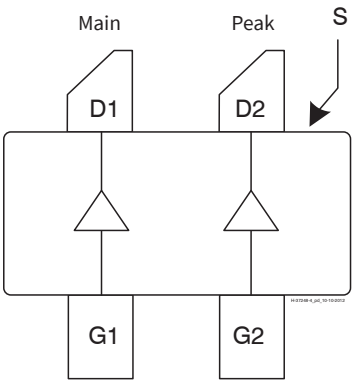
Component	Description	Manufacturer	P/N
Input			
C101, C102, C103, C104, C105	Capacitor, 8.2 pF	ATC	ATC800A8R2CT250X
C106, C107	Capacitor, 0.3 pF	ATC	ATC800A0R3CT250XT
C108	Capacitor, 0.6 pF	ATC	ATC800A0R6BT250XT
C109	Capacitor, 1.0 pF	ATC	ATC800A1R0CT250XT
C109, C110	Capacitor, 1 µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C111, C112	Capacitor, 10 µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C113, C114	Capacitor, 100 µF, 35 V	Panasonic – ECG	EEE-FT1V101AP
R101, R102	Resistor, 5.6 ohms	Panasonic – ECG	ERJ-8RQJ5R6V
R103	Resistor, 50 ohms	Anaren	C8A50Z4A
U1	Hybrid coupler	Anaren	X3C35F1-03S
Output			
C201, C202	Capacitor, 0.2 pF	ATC	ATC800A0R2BT250XT
C203	Capacitor, 0.3 pF	ATC	ATC800A0R3CT250XT
C204, C205, C206, C207	Capacitor, 8.2 pF	ATC	ATC800A8R2CT250X
C208, C209	Capacitor, 0.001 µF, 100 V	Murata Electronics	GRM188R72A102KA01D
C210, C211	Capacitor, 1 µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C212, C213	Capacitor, 2.2 µF, 100 V	TDK Corporation	C4532X7R2A225K230KA
C214, C215	Capacitor, 10µF, 100 V	TDK Corporation	C5750X7S2A106M230KB
C216	Capacitor, 220 µF	Panasonic – ECG	ECA-2AHG221

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

Bias OFF
1. Turn RF off
2. Apply pinch-off voltage to the gate
3. Turn-off drain voltage
4. Turn-off gate voltage

Pinout Diagram (top view)



Pin	Description
D1	Drain Device 1 (main)
D2	Drain Device 2 (peak)
G1	Gate Device 1 (main)
G2	Gate Device 2 (peak)
S	Source (flange)

Package Outline Specifications – Package H-37248C-4

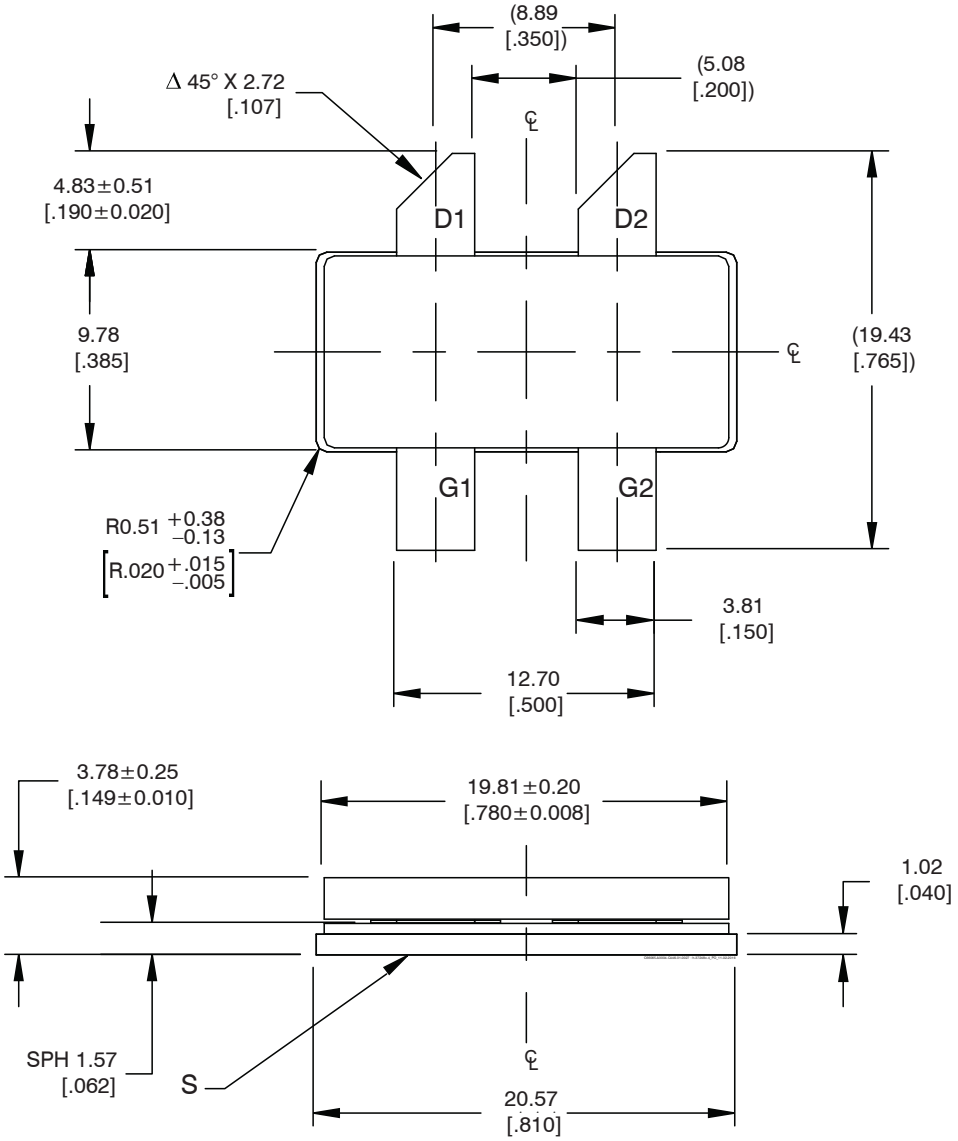


Diagram Notes—unless otherwise specified:

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 ± 0.05 [0.005 ± 0.002]
6. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch]

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