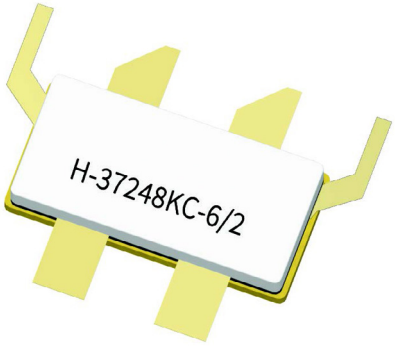
GTRB384608FC

Thermally-Enhanced High Power RF GaN on SiC HEMT
400 W, 48 V, 3300 – 3800 MHz

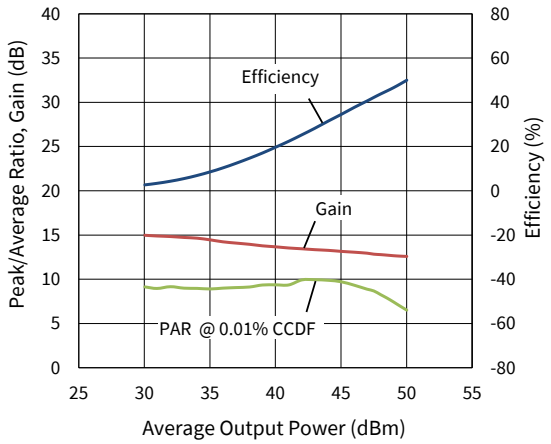


Package Type: H-37248KC-6/2

Description

The GTRB384608FC is a 400-watt (P_{3dB}) GaN on SiC high electron mobility transistor (HEMT) designed for use in multi-standard cellular power amplifier applications. It features high efficiency, and a thermally-enhanced package with earless flange.

Single-carrier WCDMA Drive-up
V_{DD} = 48 V, $I_{DQ(Main)}$ = 1000 mA, $V_{GS(Peak)}$ = –4.5 V,
f = 3700 MHz, 3GPP WCDMA signal, PAR = 10 dB,
3.84 MHz BW



Features

- GaN on SiC HEMT technology
- Typical pulsed CW performance, 3500 MHz, 48 V, 10 µs pulse width, 10% duty cycle, combined outputs
  - Output Power at P_{3dB} = 400 W
  - Efficiency at P_{3dB} = 69%
- Human Body Model Class 1C (per ANSI/ESDA/JEDEC JS-001)
- Pb-free and RoHS compliant

Typical RF Characteristics

Single-carrier WCDMA Specifications (tested in the Doherty evaluation board for 3300 to 3700 MHz)
V_{DD} = 48 V, I_{DQ} = 1000 mA, P_{OUT} = 47.5 dBm, $V_{GS(PEAK)}$ = –4.5 V, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

	P_{OUT} (dBM)	Gain (dB)	Efficiency (%)	ACPR+ (dBc)	ACPR– (dBc)	OPAR (dB)
3300 MHz	47.5	12.2	43.2	-29.4	-29.7	8.7
3400 MHz	47.5	13.4	41.4	-30.5	-30.7	9.0
3500 MHz	47.5	14.0	43.2	-33.6	-34.2	8.7
3600 MHz	47.5	13.6	42.7	-38.7	-39.3	8.7
3700 MHz	47.5	13.1	43.0	-39.8	-40.4	8.7

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

RoHS compliant

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 (main)	I_{DSS}	—	—	3.7	mA	V_{GS} = –8 V, V_{DS} = 10 V
Drain-source Leakage Current (peak)				6.3		
Gate-source Leakage Current (main)	I_{GSX}	—	—	–5.9		V_{GS} = –8 V, V_{DD} = 50 V
Gate-source Leakage Current (peak)				–12.3		
Gate Threshold Voltage (main)	$V_{GS(th)}$	–3.8	–3.1	–2.3	V	V_{DS} = 10 V, I_D = 21 mA
Gate Threshold Voltage (peak)						V_{DS} = 10 V, I_D = 36 mA

Recommended Operating Voltages

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Drain Operating Voltage	V_{DD}	0	—	50	V	
Gate Quiescent Voltage	$V_{GS(Q)}$	–3.5	–2.75	–2.0		V_{DS} =48 V, I_D = 1000 mA

Absolute 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	20	mA
Gate Current (peak)		36	
Drain Current (main)	I_D	7.85	A
Drain Current (peak)		13.5	
Junction Temperature	T_J	275	°C
Storage Temperature Range	T_{STG}	–65 to +150	

1. 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.
2. Product's qualification were performed at 225 °C. Operation at T_J (275 °C) reduces median time to failure.

Thermal Characteristics

Parameter	Symbol	Value	Unit	Conditions
Thermal Resistance (main)	$R_{\theta JC}$	1.5	°C/W	T_{CASE} = 85°C, P_{DISS} = 91 W DC
Thermal Resistance (peak)		1.0		T_{CASE} = 85°C, P_{DISS} = 146 W DC

RF Characteristics

Single-carrier WCDMA Specifications (tested in the Doherty production test fixture)
V_{DD} = 48 V, I_{DQ} = 220 mA, P_{OUT} = 56.2 W, $V_{GS(PEAK)}$ = –4.1 V, f = 3800 MHz, 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Gain	G_{ps}	11	12.5	—	dB
Drain Efficiency	η_D	34	43	—	%
Adjacent Channel Power Ratio	ACPR	—	–29	–20	dBc
Output PAR @ 0.01% CCDF	OPAR	6.2	8	—	dB

Ordering Information

Type and Version	Order Code	Package Type	Shipping
GTRB384608FC V1 R0	GTRB384608FC-V1-R0	H-37248KC-6/2	Tape & Reel, 50 pcs
GTRB384608FC V1 R2	GTRB384608FC-V1-R2	H-37248KC-6/2	Tape & Reel, 250 pcs

Typical Performance (data taken in the Doherty LTA/GTRB384608FC-E4 evaluation board)

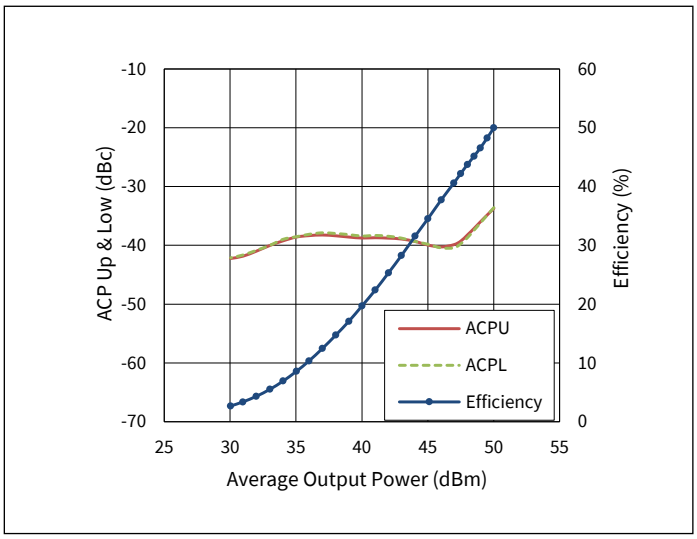


Figure 1. Single-carrier WCDMA Drive-up

V_{DD} = 48 V, $I_{DQ(Main)}$ = 1000 mA, $V_{GS(Peak)}$ = -4.5 V, f = 3700 MHz, 3GPP WCDMA signal, PAR = 10 dB, BW = 3.84 MHz

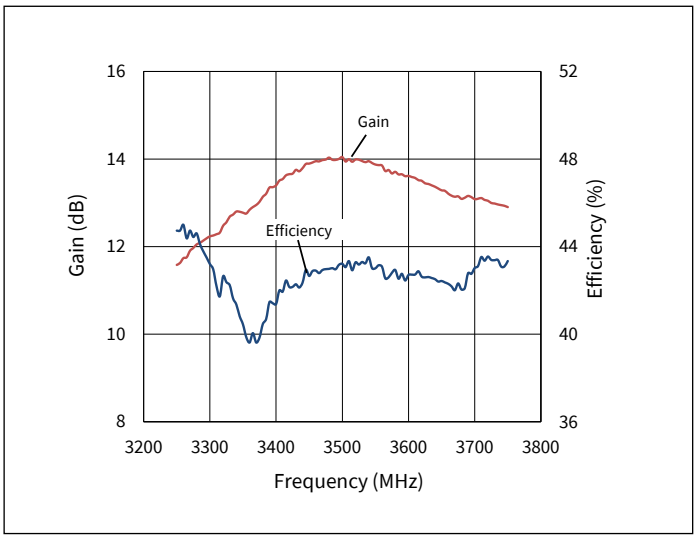


Figure 2. Single-carrier WCDMA Broadband

V_{DD} = 48 V, $I_{DQ(Main)}$ = 1000 mA, $V_{GS(Peak)}$ = -4.5 V, P_{OUT} = 47.5 dBm, 3GPP WCDMA signal, PAR = 10 dB

Typical Performance (cont.)

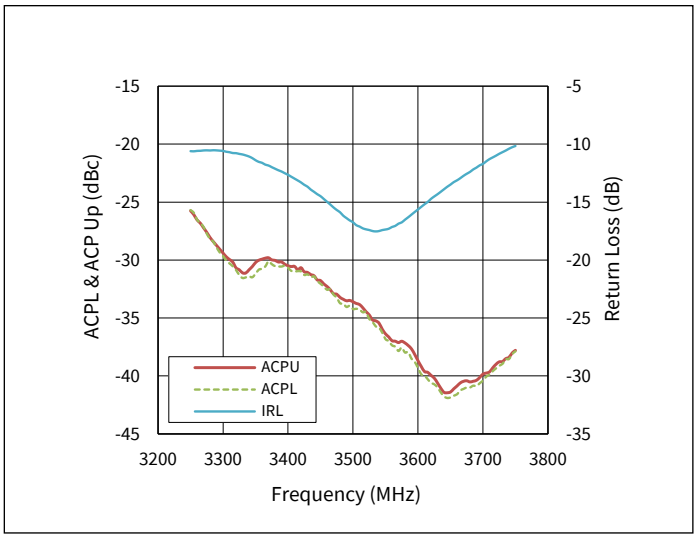


Figure 3. Single-carrier WCDMA Broadband

V_{DD} = 48 V, $I_{DQ(Main)}$ = 1000 mA, $V_{GS(Peak)}$ = -4.5 V,
P_{OUT} = 47.5dBm, 3GPP WCDMA signal, PAR = 10 dB

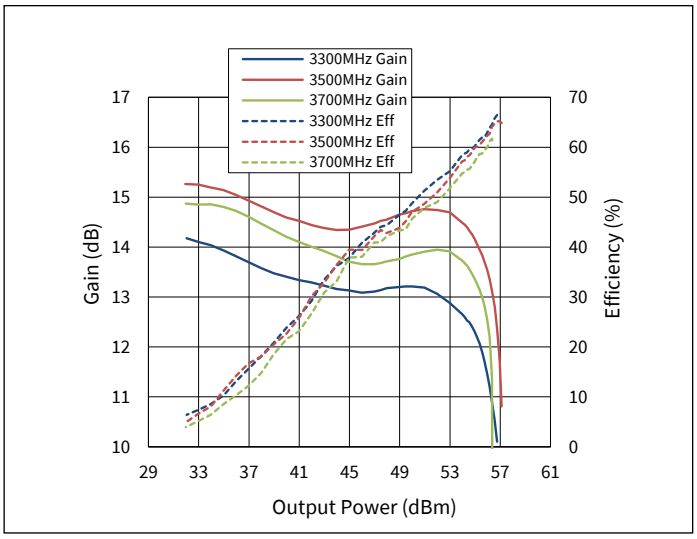


Figure 4. Pulsed CW Performance

V_{DD} = 48 V, $I_{DQ(Main)}$ = 1000 mA, $V_{GS(Peak)}$ = -4.5 V

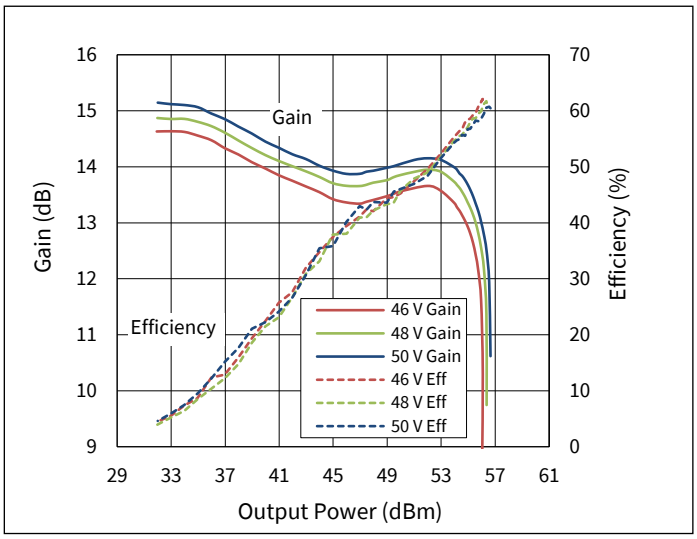


Figure 5. Pulsed CW Performance at various V_{DD}

$I_{DQ(MAIN)}$=1000 mA, $V_{GS(Peak)}$ = -4.5 V,
f = 3700 MHz

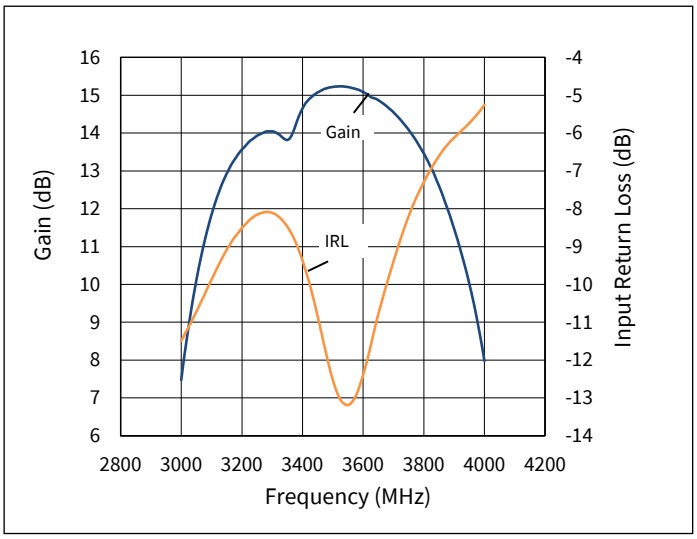


Figure 6. Small Signal CW Gain & Input Return Loss

V_{DD} = 48 V, $I_{DQ(Main)}$ = 1000 mA,
$V_{GS(Peak)}$ = -4.5 V

Load Pull Performance

Main side load pull performance – pulsed CW signal: 10 µsec, 10% duty cycle, 48 V, I_{DQ} = 250 mA , class AB

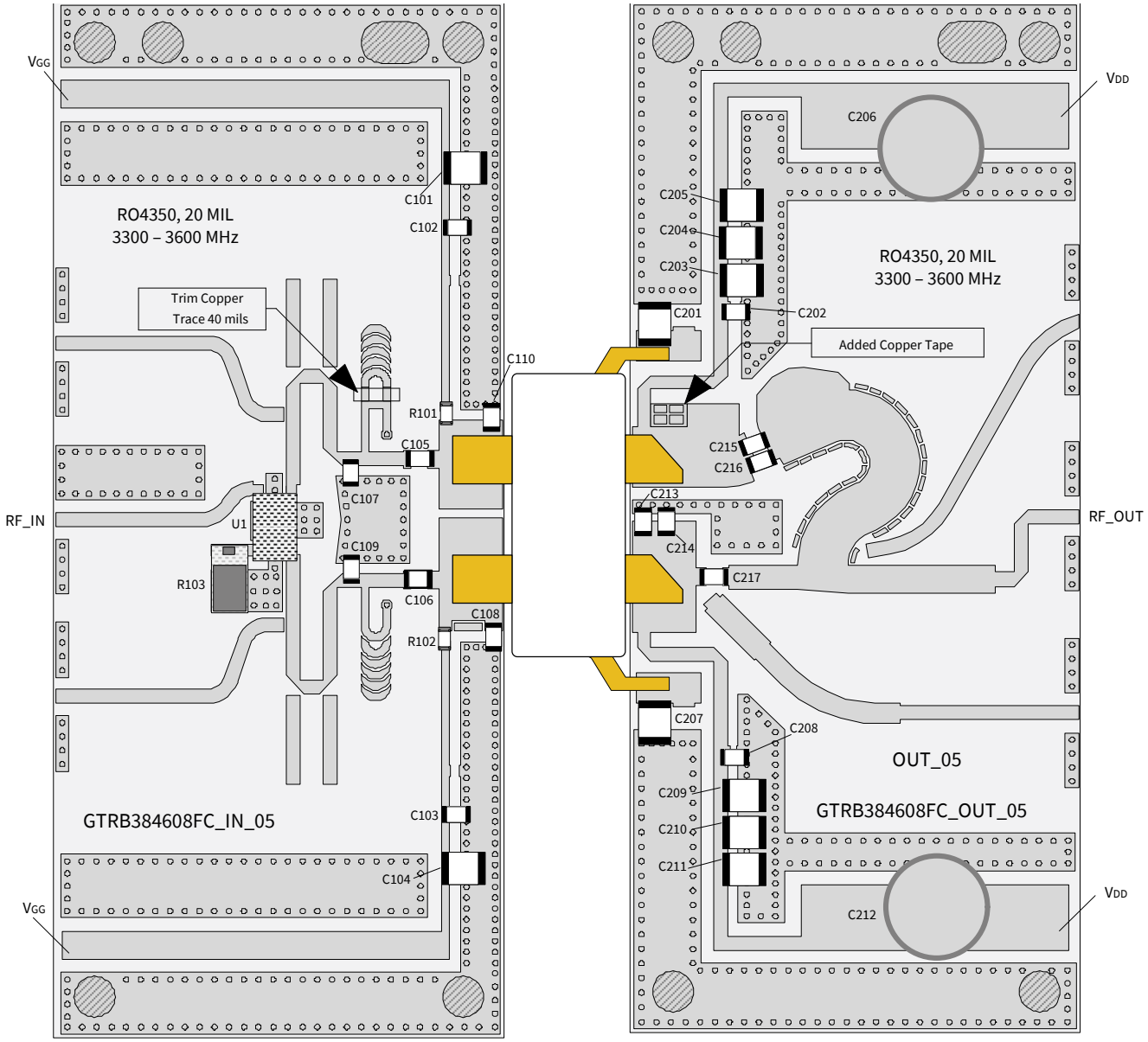
		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Z_s [Ω]	Z_l [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	ηD [%]	Z_l [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	ηD [%]
3300	2.83 - j12.74	7.48 - j16.65	12.32	53.77	238.232	55.2	13.71 - j12.54	13.82	52.76	188.799	63.1
3400	3.6 - j16.40	6.66 -j13.90	13.04	53.90	245.471	56.5	17.82 - j4.71	15.52	51.71	148.252	64.7
3500	4.30 - j14.25	9.12 - j16.22	13.02	53.81	240.436	57.5	18.2 - j7.37	14.68	52.25	167.88	65.5
3600	4.87 - j16.91	7.95 -j13.67	13.43	53.72	235.505	56.9	11.36 - j6.76	15.16	52.31	170.216	64.7
3700	6.03 - j16.98	8.02 - 14.28	13.36	53.57	227.51	55.2	10.01 - j6.09	15.31	51.95	156.675	64.7
3800	7.18-j16.05	11.02-j19.99	13.25	53.63	230.67	54.5	11.5-j10.51	15.17	52.43	174.98	64.0

Peak side load pull performance – pulsed CW signal: 10 µsec, 10% duty cycle, 48 V, I_{DQ} = 220 mA, class AB

		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Z_s [Ω]	Z_l [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	ηD [%]	Z_l [Ω]	Gain [dB]	P_{OUT} [dBm]	P_{OUT} [W]	ηD [%]
3300	1.82-j14.1	4.24-j8.44	14.19	55.28	337.29	64.4	6.61-j6.99	15.64	54.00	251.19	68.5
3400	2.41-j15.09	3.37-j10.02	13.71	55.73	374.11	58.5	8.39-j3.94	16.18	52.58	181.13	69.4
3500	2.91-j15.76	3.45-j10.22	14.23	55.73	374.11	59.2	5.52-j6.73	16.23	53.89	244.91	67.8
3600	3.87-j16.41	3.34-j10.49	14.3	55.45	350.75	56.0	5.33-j6.84	16.62	53.55	226.46	66.3
3700	5.18-j15.79	3.32-j11.29	14.25	55.21	331.89	53.5	4-j5.9	17.46	52.33	171	66.5
3800	6.02-j13.37	3.62-j12.08	14.3	55.15	327.34	54.6	4.48-j8.67	16.49	53.58	228.03	64.0

Evaluation Board, 3300 – 3800 MHz

Evaluation Board Part Number	LTA/GTRB384608FC-E7
PCB Information	Rogers 4350, 0.508 mm [0.020”] thick, 2 oz. copper, ε_r = 3.66



Reference circuit assembly diagram (not to scale)

Components Information

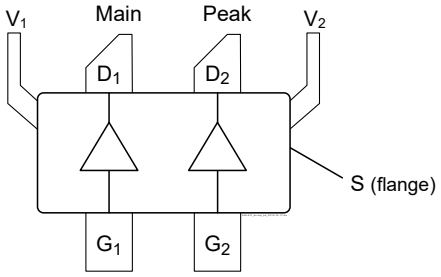
Component	Description	Manufacturer	P/N
Input			
C101, C102, C103, C106	Capacitor, 0.6 pF	ATC	ATC600S0R6AT250XT
C104	Capacitor, 0.8 pF	ATC	ATC600S0R8AT250XT
C105	Capacitor, 0.4 pF	ATC	ATC600S0R4AT250XT
C107, C108,	Capacitor, 3 pF	ATC	ATC600S3R0AT250XT
C109, C110	Capacitor, 1 µF, 100 V	Murata	GRM21BC72A105KE01L
C111, C112	Capacitor, 1 µF, 100 V	Murata	GCJ31CR72A105KA01
R101, R102	Resistor, 10 ohms	Panasonic Electronic Components	ERJ-3GEYJ100V
R103	Resistor, 50 ohms	Richardson	C8A50Z4B
U1	Hybrid Coupler	Anaren	X3C35P1-03S
Output			
C201, C206	Capacitor, 3 pF	ATC	ATC600S3R0AT250XT
C202, C203	Capacitor, 3 pF	ATC	ATC600F3R0BT250XT
C204	Capacitor, 0.6 pF	ATC	ATC600S0R6AT250XT
C205	Capacitor, 5.6 pF	ATC	ATC600F5R6BT250XT
C207, C208, C209, C210, C211, C212, C213, C214	Capacitor, 4.7 µF, 100 V	Murata	GRM31CC72A475KE11L
C215, C216	Capacitor, 220 µF, 100 V	Panasonic Electronic Components	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)



Lead connections for GTRB384608FC

Pin	Description
D1	Drain Device 1 (Main)
D2	Drain Device 2 (Peak)
G1	Gate Device 1 (Main)
G2	Gate Device 2 (Peak)
V1	Drain video decoupling, no DC bias
V2	Drain video decoupling, no DC bias

Package Outline Specifications – Package H-37248KC-6/2

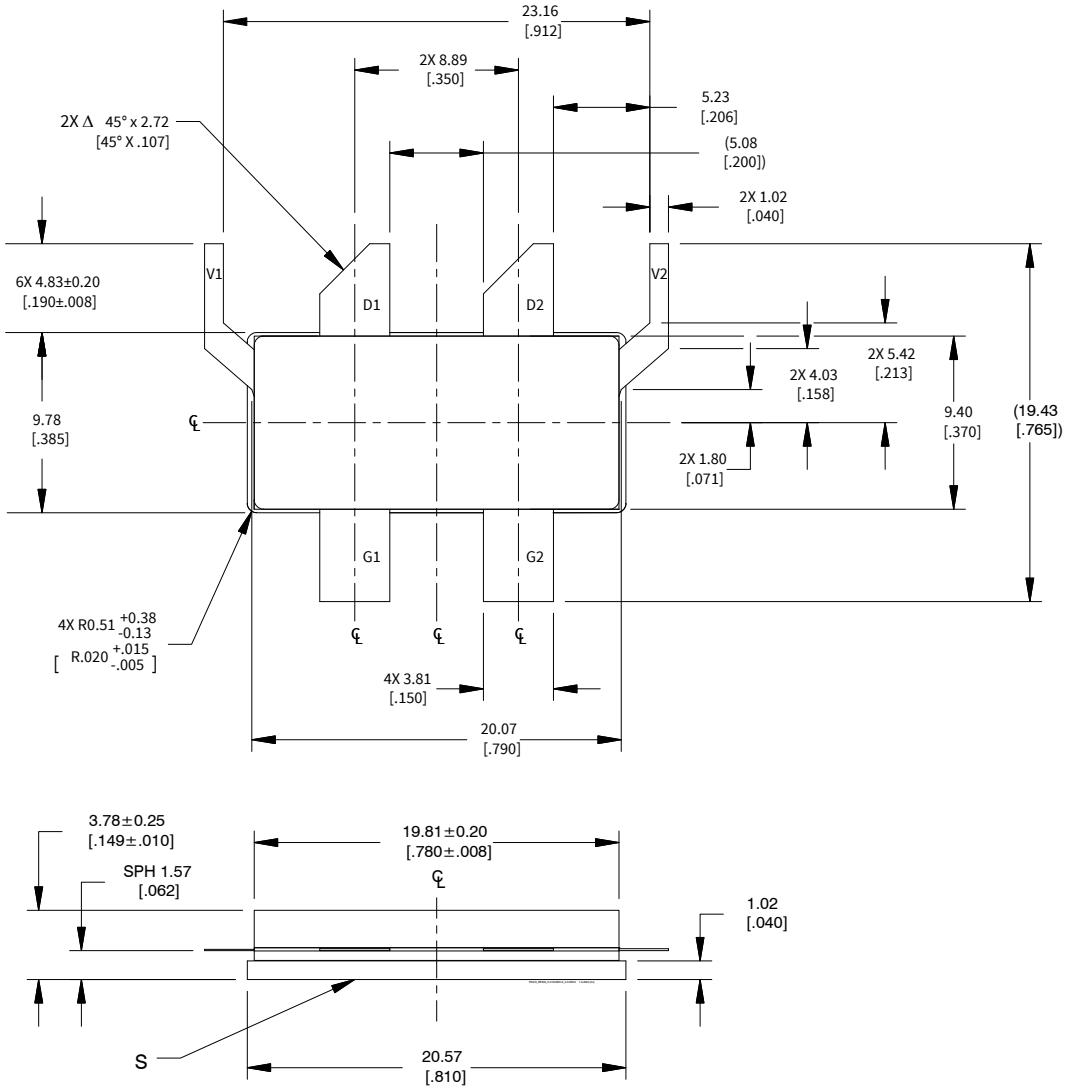


Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994
2. Primary dimensions are mm; alternate dimensions are inches
3. All tolerances ± 0.127 [.005]
4. Pins: D1, D2 – drain, G1, G2 – gate, V1 – drain video decoupling and no DC bias, V2 – TBD, S – source (flange)
5. Lead thickness: 0.127 +0.05/–0.025 [.005 +.002/–.001]
6. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch]

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