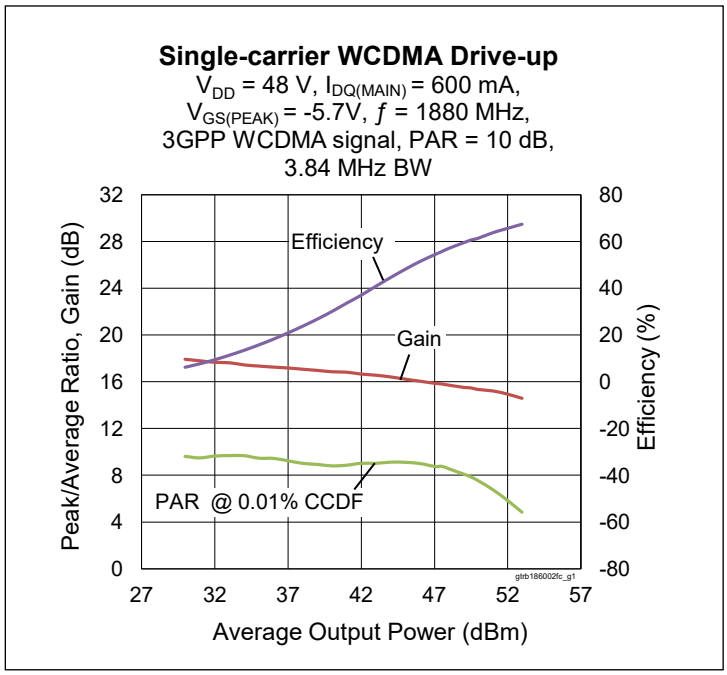
GTRB186002FC

Thermally-Enhanced High Power RF GaN on SiC Amplifier, 500 W, 48 V, 1805 – 1880 MHz

Description

The GTRB186002FC is a 500-watt (P_{3dB}) GaN on SiC HEMT D-mode amplifier designed for use in multi-standard cellular power amplifier applications. It features high efficiency, and a thermally-enhanced package with earless flange.

GTRB186002FC
Package H-37248C-4



Features

- GaN on SiC HEMT technology
- Typical Pulsed CW performance, 1880 MHz, 48 V, 10 µs pulse width, 10% duty cycle, combined outputs
  - Output power at P_{3dB} = 500 W
  - Efficiency at P_{3dB} = 68%
- Human Body Model Class 1B (per ANSI/ESDA/JEDEC JS-001)
- Pb-free and RoHS compliant

Typical RF Performance

Single-carrier WCDMA Specifications (tested in the Doherty production test circuit, LTA/GTRB186002FC-V1, 1805–1880 MHz)
V_{DD} = 48 V, I_{DQ} = 600 mA, P_{OUT} = 81 W avg, $V_{GS(peak)}$ = V_{GS} at $I_{DQ(peak)}$ = 600 mA - 2.5 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)
1805 MHz	49.1	16.1	59.9	-27.2	-26.9	8.2
1842 MHz	49.1	15.9	60.3	-29.3	-29.2	8.3
1880 MHz	49.1	15.5	59.7	-31.9	-31.7	8

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

RoHS compliant

DC Characteristics

Characteristics	Conditions	Symbol	Min	Typ	Max	Unit
Drain-source Breakdown Voltage (main)	V_{GS} = –8 V, I_D = 10 mA	$V_{(BR)DSS}$	150	—	—	V
(peak)	V_{GS} = –8 V, I_D = 10 mA	$V_{(BR)DSS}$	150	—	—	V
Drain-source Leakage Current (main)	V_{GS} = –8 V, V_{DS} = 10 V	I_{DSS}	—	—	4.4	mA
(peak)	V_{GS} = –8 V, V_{DS} = 10 V	I_{DSS}	—	—	8.8	mA
Gate-Source Leakage Current (main)	V_{GS} = –8 V, V_{DD} = 50 V	I_{GSX}	—	—	–7.0	mA
(peak)	V_{GS} = –8 V, V_{DD} = 50 V	I_{GSX}	—	—	–15.0	mA
Gate Threshold Voltage (main)	V_{DS} = 10 V, I_D = 25 mA	$V_{GS(th)}$	–3.8	–3.05	–2.3	V
(peak)	V_{DS} = 10 V, I_D = 50 mA	$V_{GS(th)}$	–3.8	–3.05	–2.3	V

Recommended Operating Conditions

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Operating Voltage		V_{DD}	0	—	50	V
Gate Quiescent Voltage (main)	V_{DS} = 48 V, I_D = 600 mA	$V_{GS(Q)}$	–3.5	–2.8	–2.0	V

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-source Voltage	V_{DSS}	125	V
Gate-source Voltage	V_{GS}	–10 to +2	V
Operating Voltage	V_{DD}	55	V
Gate Current (main)	I_G	25	mA
(peak)	I_G	50	mA
Drain Current (main)	I_D	9.5	A
(peak)	I_D	19	A
Junction Temperature	T_J	275	°C
Storage Temperature Range	T_{STG}	–65 to +150	°C

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

Characteristics	Symbol	Value	Unit
Thermal Resistance (main, T_{CASE} = 85 °C, P_{DISS} = 100 W DC)	$R_{\theta JC}$	1.4	°C/W
(peak, T_{CASE} = 85 °C, P_{DISS} = 143 W DC)	$R_{\theta JC}$	1.0	°C/W

RF Characteristics

Single-carrier WCDMA Specifications (tested in the Doherty production test fixture, LTA/GTRB186002FC-V1)

V_{DD} = 48 V, I_{DQ} = 600 mA, P_{OUT} = 81.2 W avg, $V_{GS(peak)}$ = V_{GS} at $I_{DQ(peak)}$ = 600 mA - 2.5 V, f = 1880 MHz, 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

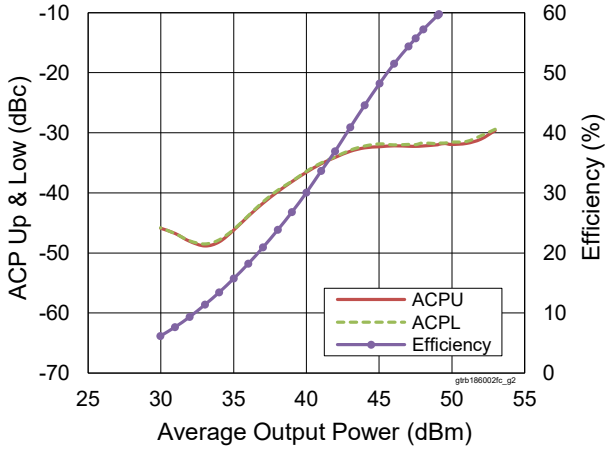
Characteristics	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	14.7	15.7	—	dB
Drain Efficiency	ηD	50	54	—	%
Adjacent Channel Power Ratio	ACPR	—	–31.2	–27.5	dBc
Output PAR @ 0.01% CCDF	OPAR	7.3	7.9	—	dB

Ordering Information

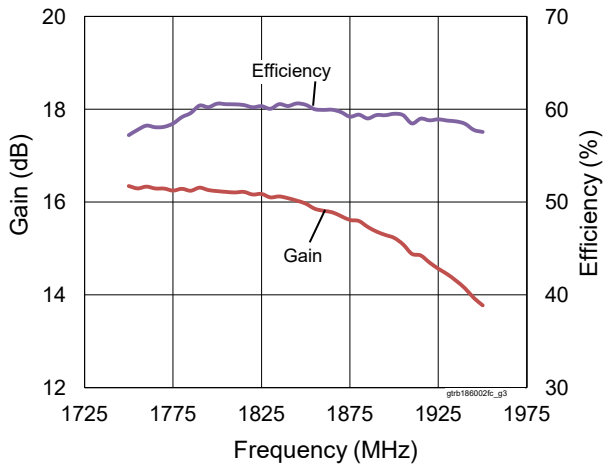
Type and Version	Order Code	Package	Shipping
GTRB186002FC V1 R0	GTRB186002FC-V1-R0	H-37248C-4	Tape & Reel, 50 pcs
GTRB186002FC V1 R2	GTRB186002FC-V1-R2	H-37248C-4	Tape & Reel, 250 pcs

Typical Performance (data taken in the Doherty evaluation board, LTA/GTRB186002FC-V1)

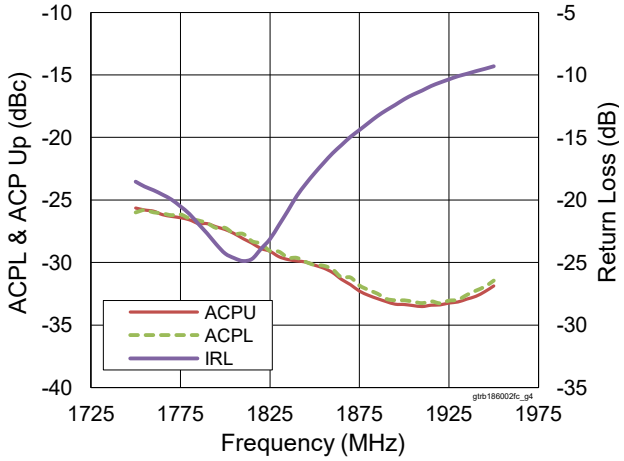
Single-carrier WCDMA Drive-up
V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 600 mA,
$V_{GS(PEAK)}$ = -5.7V, f = 1880 MHz,
3GPP WCDMA signal, PAR = 10 dB,
BW = 3.84 MHz



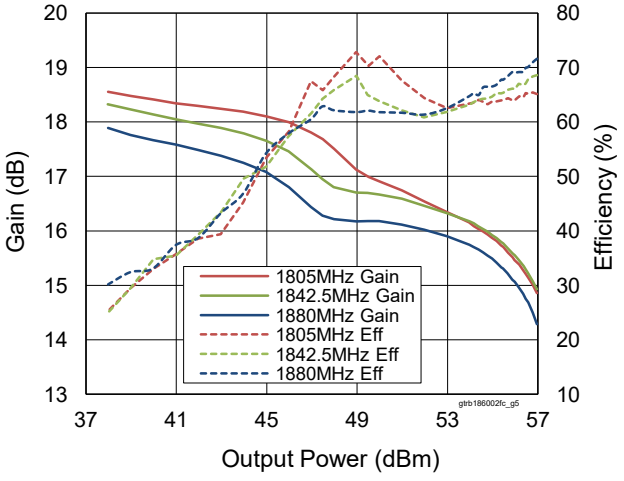
Single-carrier WCDMA Broadband Performance
V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 600 mA,
$V_{GS(PEAK)}$ = -5.7 V, P_{OUT} = 49.1 dBm,
3GPP WCDMA signal, PAR = 10 dB



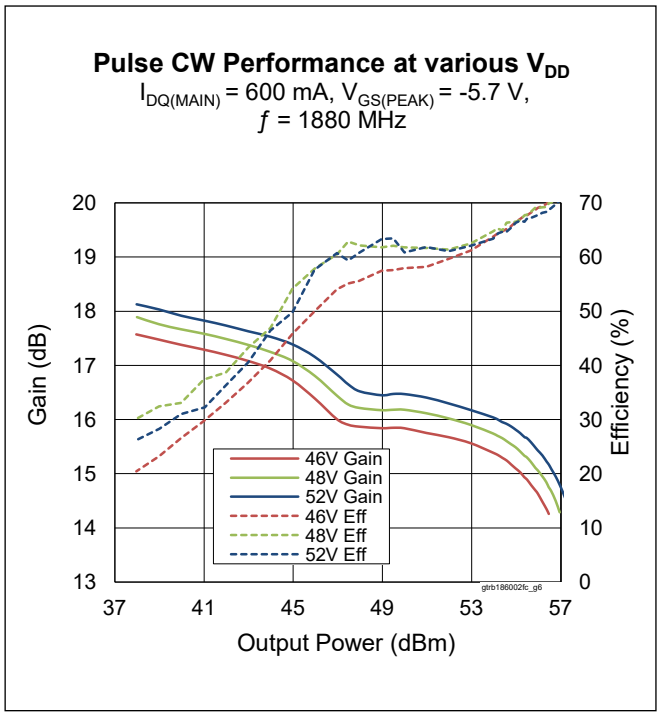
Single-carrier WCDMA Broadband Performance
V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 600 mA,
$V_{GS(PEAK)}$ =-5.7 V, P_{OUT} =49.1 dBm,
3GPP WCDMA signal, PAR = 10 dB

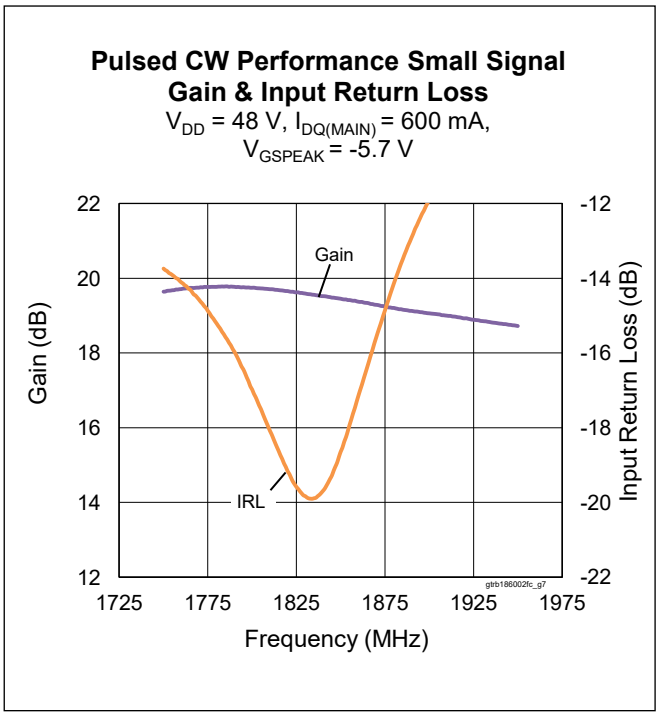


Pulse CW Performance
V_{DD} = 48 V, $I_{DQ(MAIN)}$ = 600 mA,
$V_{GS(PEAK)}$ = -5.7 V



Typical Performance (cont.)





Load Pull Performance

Main Side Load Pull Performance – Pulsed CW signal – 160 µsec, 10% duty cycle, 48 V, I_{DQ} = 200 mA, class AB

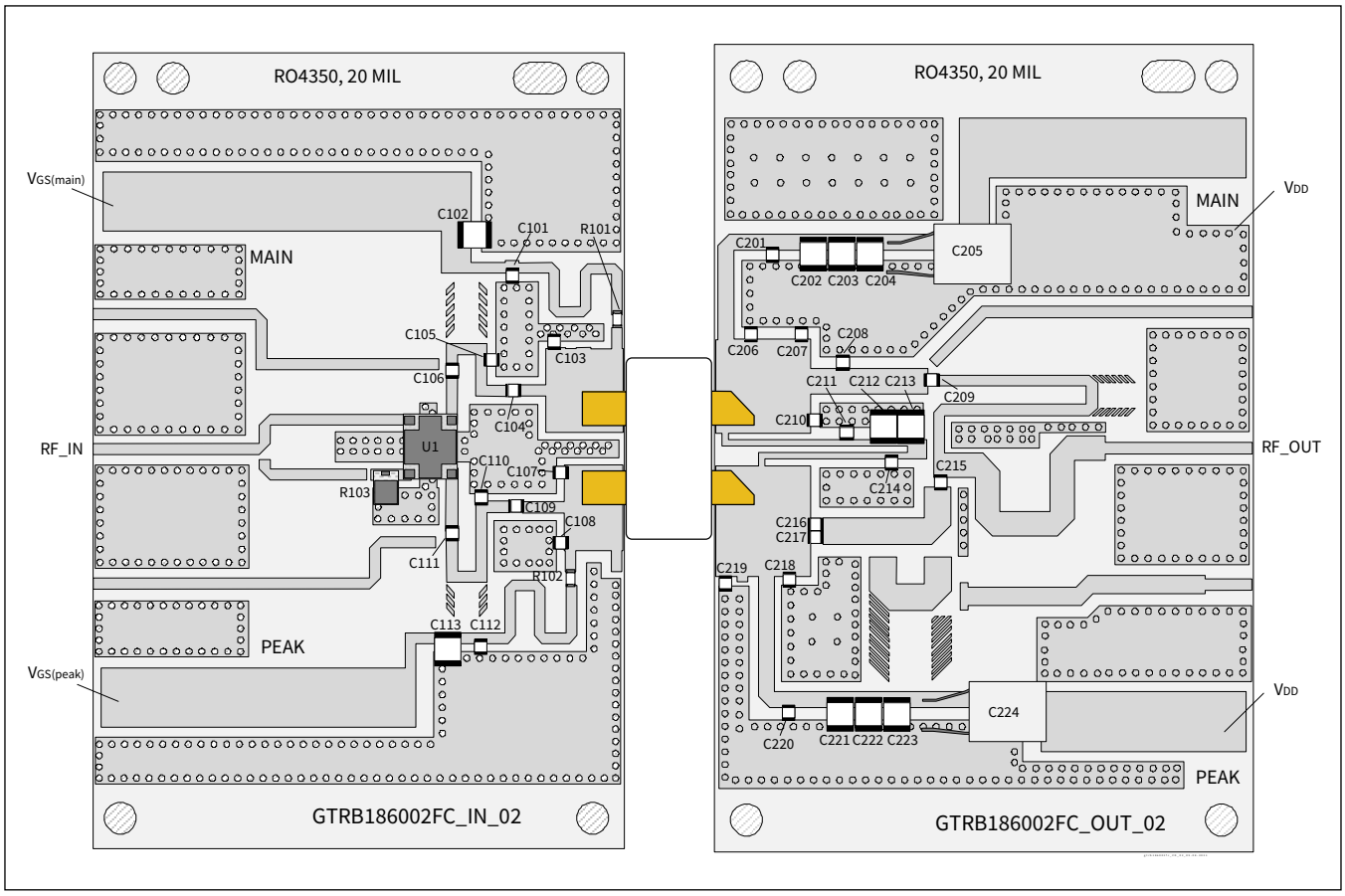
		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Zs [Ω]	Zl [Ω]	Gain [dB]	P_{3dB} [dBm]	P_{3dB} [W]	ηD [%]	Zl [Ω]	Gain [dB]	P_{3dB} [dBm]	P_{3dB} [W]	ηD [%]
1805	3.6-j8.49	3.26-j3.42	17.73	54.95	312.61	75.19	2.48-j0.96	19.66	53.54	225.94	88.13
1840	3.5-j8.7	2.46-j3.04	18.07	55.04	319.15	75.22	2.89-j0.98	19.7	53.41	219.28	87.95
1880	4.1-j9.89	2.84-j3.36	18.19	54.94	311.89	76.75	2.73-j1.39	19.87	53.49	223.36	88.9

Peak Side Load Pull Performance – Pulsed CW signal – 160 µsec, 10% duty cycle, 48 V, V_{GSPK} = –5 V, class C

		P_{3dB}									
		Max Output Power					Max Drain Efficiency				
Freq [MHz]	Zs [Ω]	Zl [Ω]	Gain [dB]	P_{3dB} [dBm]	P_{3dB} [W]	ηD [%]	Zl [Ω]	Gain [dB]	P_{3dB} [dBm]	P_{3dB} [W]	ηD [%]
1805	2.13-6.67j	1.67-4.84j	13.92	56.91	490.91	67.06	2.39-3.20j	14.31	55.52	356.45	82.16
1840	2.5-7.79j	1.74-4.90j	14.03	56.84	483.06	70.54	1.81-3.08j	14.43	54.86	306.2	83.08
1880	3.47-9.41j	1.84-5.21j	13.32	56.77	475.34	69.38	1.7-3.32j	13.68	54.44	277.97	80.08

Reference circuit, 1805 – 1880 MHz

DUT	GTRB186002FC-V1
Test Fixture Part No.	LTA/GTRB186002FC-V1
PCB	Rogers 4350, 0.508 mm [0.020”] thick, 2 oz. copper, ε_r = 3.66



Reference circuit assembly diagram (not to scale)

Reference circuit (cont.)

Components Information

Component	Description	Manufacturer	P/N
Input			
C101, C104, C106, C108	Capacitor, 15 pF	ATC	ATC600F150JT250XT
C102, C109	Capacitor, 100 V, 10 µF	Murata Electronics	GRM32EC72A106KE05L
C103	Capacitor, 1.8 pF	ATC	ATC600F1R8BT250XT
C105	Capacitor, 1.5 pF	ATC	ATC600F1R5BT250XT
C107	Capacitor, 2.7 pF	ATC	ATC600F2R7BT250XT
R101, R102	Resistor, 9.1 ohms	Panasonic Electronic Components	ERJ-3GEYJ9R1V
R103	Resistor, 50 ohms	Richardson	C8A50Z4B
U1	Hybrid Coupler	Anaren	X3C19P1-03S
Output			
C201, C210, C212, C215, C216, C221	Capacitor, 15 pF	ATC	ATC600F150JT250XT
C202, C203, C204, C213, C214, C222, C223, C224	Capacitor, 100 V, 10 µF	Murata Electronics	GRM32EC72A106KE05L
C205, C225	Capacitor, 100 V, 470 µF	Panasonic Electronic Components	ECA-2AHG471B
C206	Capacitor, 1.6 pF	ATC	ATC600F1R6BT250XT
C207, C211	Capacitor, 1 pF	ATC	ATC600F1R0BT250XT
C208	Capacitor, 0.5 pF	ATC	ATC600F0R5BT250XT
C209	Capacitor, 1.5 pF	ATC	ATC600F1R5BT250XT
C217, C218	Capacitor, 6.2 pF	ATC	ATC600F6R2BT250XT
C219	Capacitor, 2 pF	ATC	ATC600F2R0BT250XT
C220	Capacitor, 2.4 pF	ATC	ATC600F2R4BT250XT

RF Characteristics (Not tested in production, characterized in application circuit, LTA/GTRB186002FC-E2)

Single-carrier WCDMA Specifications

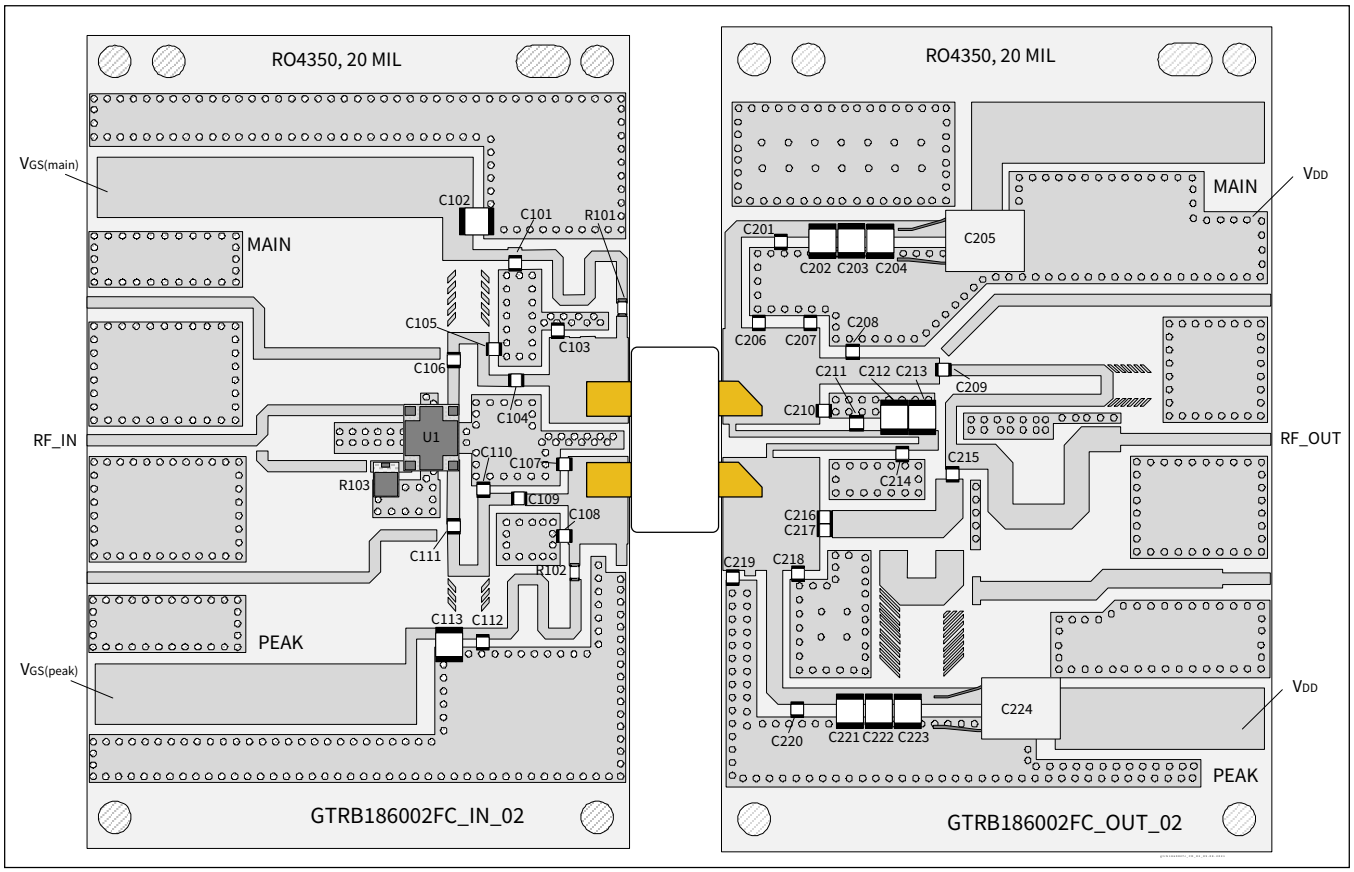
V_{DD} = 51 V, I_{DQ} = 400 mA, P_{OUT} = 115 W, $V_{GS(peak)}$ = V_{GS} at $I_{DQ(peak)}$ = 400 mA - 2.4 V, f = 1880 MHz, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

Characteristics	Symbol	Min[1]	Typ	Max[1]	Unit
Gain	G_{ps}	14.8	15.8	—	dB
Adjacent Channel Power Ratio	ACPR	—	–29.5	–25.8	dB
Drain Efficiency	ηD	50	56	—	%
Output PAR @ 0.01% CCDF	OPAR	7.3	7.95	—	dB

Notes:
[1] Minimum and maximum specifications are derived by applying the statistical spread from typical production data measured in a production fixture to the typical data as measured in the applications circuit.

Application circuit, 1805 – 1880 MHz

DUT	GTRB186002FC-V1
Test Fixture Part No.	LTA/GTRB186002FC-E2
PCB	Rogers 4350, 0.508 mm [0.020”] thick, 2 oz. copper, ε_r = 3.66



Reference circuit assembly diagram (not to scale)

Application circuit (cont.)

Components Information

Component	Description	Manufacturer	P/N
Input			
C101, C104, C106, C109, C111, C112	Capacitor, 15 pF	ATC	ATC600F150JT250XT
C102, C113	Capacitor, 100 V, 10 µF	Murata Electronics	GRM32EC72A106KE05L
C103, C105, C107	Capacitor, 1.5 pF	ATC	ATC600F1R5BT250XT
C108	Capacitor, 2.4 pF	ATC	ATC600F2R4BT250XT
C110	Capacitor, 0.2 pF	ATC	ATC600F0R2BT250XT
R101, R102	Resistor, 9.1 ohms	Panasonic Electronic Components	ERJ-3GEYJ9R1V
R103	Resistor, 50 ohms	Richardson	C8A50Z4B
U1	Hybrid Coupler	Anaren	X3C19P1-03S
Output			
C201, C209, C211, C214, C215, C220	Capacitor, 15 pF	ATC	ATC600F150JT250XT
C202, C203, C204, C212, C213, C221, C222, C223	Capacitor, 100 V, 10 µF	Murata Electronics	GRM32EC72A106KE05L
C205, C224	Capacitor, 100 V, 470 µF	Panasonic Electronic Components	ECA-2AHG471B
C206	Capacitor, 1.6 pF	ATC	ATC600F1R6BT250XT
C207, C210	Capacitor, 1 pF	ATC	ATC600F1R0BT250XT
C208	Capacitor, 1.5 pF	ATC	ATC600F1R5BT250XT
C216, C217	Capacitor, 6.2 pF	ATC	ATC600F6R2BT250XT
C218	Capacitor, 2 pF	ATC	ATC600F2R0BT250XT
C219	Capacitor, 2.2 pF	ATC	ATC600F2R2BT250XT

Bias Sequencing

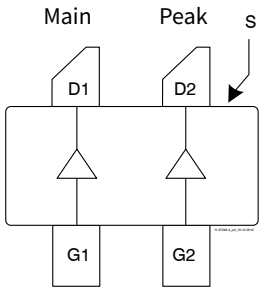
Bias ON

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)

Lead connections for GTRB186002FC

Package Outline Specifications

Package H-37248C-4

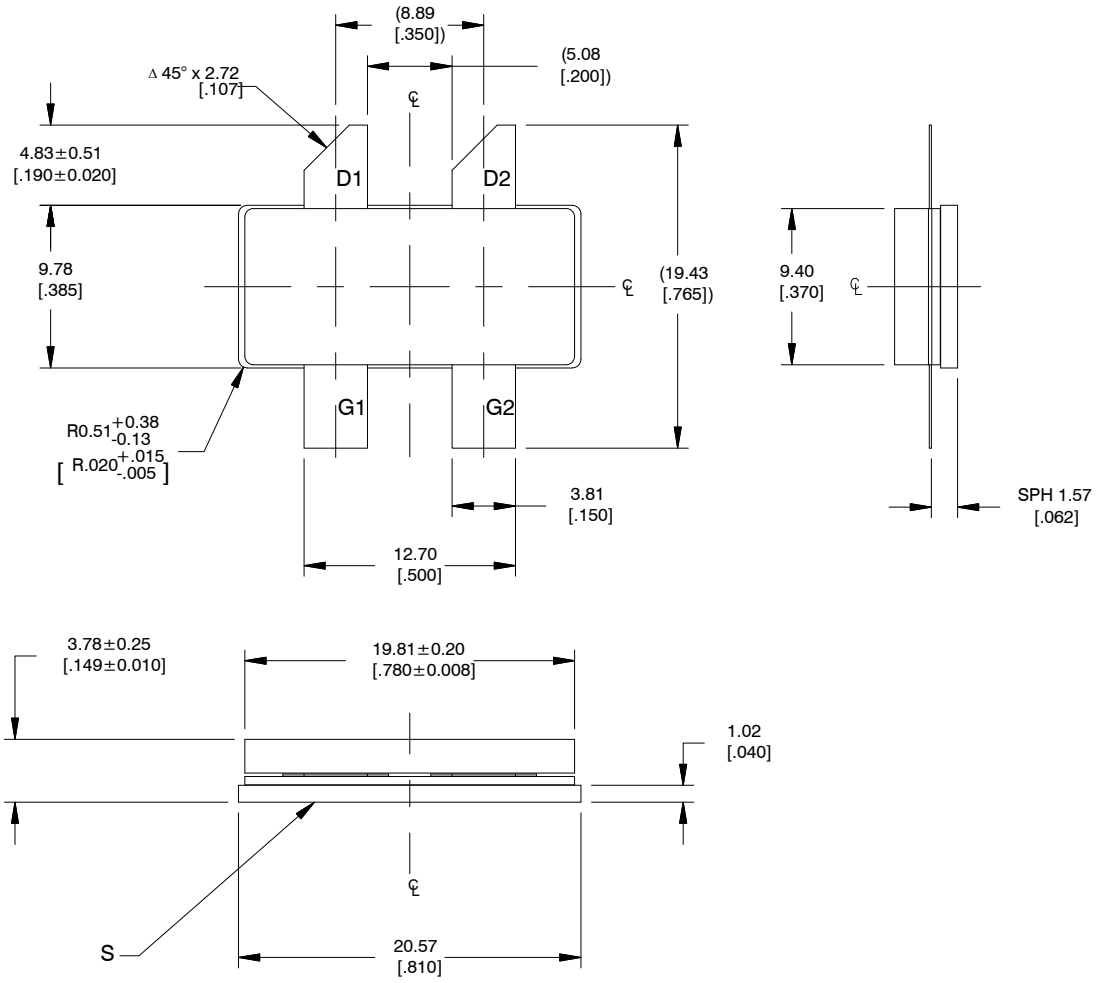


Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994.
2. Primary dimensions are mm. Alternate dimensions are inches.
3. All tolerances ± 0.127 [.005] unless specified otherwise.
4. Pins: D1, D2 – drains; G1, G2 – gates; S – source (flange)
5. Lead thickness: 0.13 ± 0.05 [.005 ± 0.002].
6. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch].

Revision History

Revision	Date	Data Sheet Type	Page	Subjects (major changes since last revision)
01	2020-07-09	Preliminary	All	Proposed specification for new product development
02	2021-04-05	Production	2	Change Junction Temperature, add explanation
03	2021-07-05	Production	All	Data Sheet reflects released product specification
03.1	2021-07-15	Production	All	Data Sheet reflects released product specification, added Typ RF Performance table, Performance graphs and Reference Circuit
03.2	2021-09-09	Production	8, 9	Added 1C specifications for app circuit, added Application Circuit

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