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

GTRB384608FC
Rev. V1

Features

- GaN on SiC 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 RoHS* Compliant

Applications

- Cellular Power

Description

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

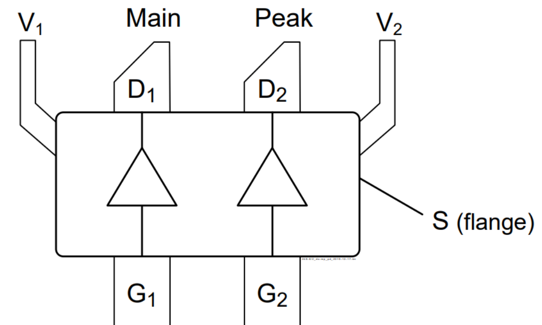
Typical RF Performance

Single-Carrier WCDMA Specifications[1]
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

Frequency	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

1. Measurements taken with device tested in the Doherty evaluation board.

Functional Schematic



Pin Configuration

Pin #	Function
D1	Drain Device 1 (main)
D2	Drain Device 2 (peak)
G1	Gate Device 1 (main)
G2	Gate Device 2 (peak)
V1	Drain Video Decoupling 1, no DC Bias
V2	Drain Video Decoupling 2, no DC Bias
S	Source Flange

Ordering Information

Part Number	Package
GTRB384608FC-V1-R0	50 piece reel
GTRB384608FC-V1-R2	250 piece reel
LTA/GTRB384608FC-E4	Doherty Evaluation Board

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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RF Characteristics

Single-Carrier WCDMA Specifications[2]

V_{DD} = 48 V, I_{DQ} = 220 mA, P_{OUT} = 56.2 dBm, $V_{GS(PEAK)}$ = -4.1 V, *f* = 3800 MHz, 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

Parameter	Units	Min.	Typ.	Max.
Gain	dB	11	12.5	—-
Drain Efficiency	%	34	43	—
Adjacent Channel Power Ratio (ACPR)	dBc	—	-29	-20
Output PAR @ 0.01% CCDF	dB	6.2	8	—

2. Measurements taken with device tested in the Doherty Production Test Fixture.

DC Characteristics

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain-Source Breakdown Voltage (main)	V_{GS} = -8 V, I_D = 10 mA	V	150	—	—
Drain-Source Breakdown Voltage (peak)	V_{GS} = -8 V, I_D = 10 mA	V	150	—	—
Drain-Source Leakage Current (main)	V_{GS} = -8 V, V_{DD} = 10 V	mA	—	—	3.7
Drain-Source Leakage Current (peak)	V_{GS} = -8 V, V_{DD} = 10 V	mA	—	—	6.3
Gate-Source Leakage Current (main)	V_{GS} = -8 V, V_{DD} = 50 V	mA	—	—	-5.9
Gate-Source Leakage Current (peak)	V_{GS} = -8 V, V_{DD} = 50 V	mA	—	—	-12.3
Gate Threshold Voltage (main)	V_{DD} = 10 V, I_D = 21 mA	V	-3.8	-3.1	-2.3
Gate Threshold Voltage (peak)	V_{DD} = 10 V, I_D = 36 mA	V	-3.8	-3.1	-2.3

Recommended Operating Voltages

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain Operating Voltage	—-	V	0	—	50
Gate Quiescent Voltage	V_{DS} = 48 V, I_D = 1000 mA	V	-3.5	-2.75	-2.0

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Absolute Maximum Ratings[3,4]

Parameter	Value
Drain-Source Voltage	125 V
Gate-Source Voltage	-10 V to +2 V
Operating Voltage	55 V
Gate Current (main)	20 mA
Gate Current (peak)	36 mA
Drain Current (main)	7.85 A
Gate Current (peak)	13.5 A
Junction Temperature	275°C
Storage Temperature Range	-65°C to +150°C

3. 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 specified above.
4. Product's qualification were performed at 225°C. Operation at T_J (275°C) reduces median time to failure.

Thermal Characteristics

Parameter	Test Conditions	Units	Value
Thermal resistance (main)	T_{CASE} = 85°C, P_{DISS} = 91 W DC	°C/W	1.5
Thermal resistance (peak)	T_{CASE} = 85°C, P_{DISS} = 146 W DC	°C/W	1.0

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. Bia 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

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Load Pull Performance: Pulsed CW Signal: 10 μs, 10% Duty Cycle
Main Side:

Frequency (MHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 48 V, I_{DQ} = 250 mA, T_C = 25°C, P3dB, Class AB				
		Z_{LOAD} (Ω)	Gain (dB)	P_{3dB} (dBm)	P_{3dB} (W)	η_D (%)
3300	2.83 - j12.74	7.48 - j16.65	12.32	53.77	238.232	55.2
3400	3.6 - j16.40	6.66 - j13.90	13.04	53.90	245.471	56.5
3500	4.30 - j14.25	9.12 - j16.22	13.02	53.81	240.436	57.5
3600	4.87 - j16.91	7.95 - j13.67	13.43	53.72	235.505	56.9
3700	6.03 - j16.98	8.02 - j14.28	13.36	53.57	227.57	55.2
3800	7.18 - j16.05	11.02 - j19.99	13.25	53.63	230.67	54.5

Frequency (MHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 48 V, I_{DQ} = 250 mA, T_C = 25°C, P3dB, Class AB				
		Z_{LOAD} (Ω)	Gain (dB)	P_{3dB} (dBm)	P_{3dB} (W)	η_D (%)
3300	2.83 - j12.74	13.71 - j12.54	13.82	52.76	188.799	63.1
3400	3.6 - j16.40	17.82 - j4.71	15.52	51.71	148.252	64.7
3500	4.30 - j14.25	18.2 - j7.37	14.68	52.25	167.88	65.5
3600	4.87 - j16.91	11.36—j6.76	15.16	52.31	170.216	64.7
3700	6.03 - j16.98	10.01 - j6.09	15.31	51.95	156.675	64.7
3800	7.18 - j16.05	11.5 - j10.51	15.17	54.43	174.98	64.0

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Load Pull Performance: Pulsed CW Signal: 10 µs, 10% Duty Cycle
Peak Side:

Frequency (MHz)	Z_{SOURCE} (Ω)	Maximum Output Power V_{DS} = 48 V, I_{DQ} = 250 mA, T_C = 25°C, P3dB, Class AB				
		Z_{LOAD} (Ω)	Gain (dB)	P_{3dB} (dBm)	P_{3dB} (W)	η_D (%)
3300	1.82 - j14.1	4.24 - j8.44	14.19	55.28	337.29	64.4
3400	2.41 - j15.09	3.37 - j110.02	13.71	55.73	374.11	58.5
3500	2.91 - j15.76	3.45 - j10.22	14.23	55.73	374.11	59.2
3600	3.87 - j16.41	3.34 - j10.49	14.3	55.45	350.75	56.0
3700	5.18 - j15.79	3.32 - j11.29	14.25	55.21	331.89	53.5
3800	6.02 - j13.37	3.62 - j12.08	14.3	55.15	327.34	54.6

Frequency (MHz)	Z_{SOURCE} (Ω)	Maximum Drain Efficiency V_{DS} = 48 V, I_{DQ} = 250 mA, T_C = 25°C, P3dB, Class AB				
		Z_{LOAD} (Ω)	Gain (dB)	P_{3dB} (dBm)	P_{3dB} (W)	η_D (%)
3300	1.82 - j14.1	6.61 - j6.99	15.64	54.00	251.19	68.5
3400	2.41 - j15.09	8.39 - j3.94	16.18	52.58	181.13	69.4
3500	2.91 - j15.76	5.52 - j6.73	16.23	53.89	244.91	67.8
3600	3.87 - j16.41	5.33 - j6.84	16.62	53.55	226.46	66.3
3700	5.18 - j15.79	4.0 - j5.9	17.46	52.33	171.00	66.50
3800	6.02 - j13.37	4.48 - j8.67	16.49	53.58	228.03	64.00

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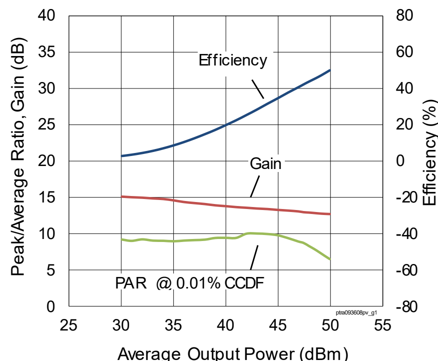
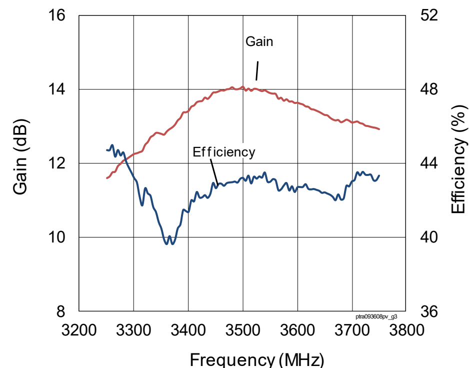
Typical Performance (data taken in the Doherty LTA/GTRB384608FC-E4 board)

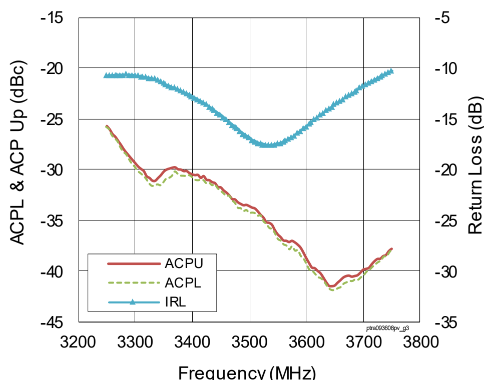
Single-carrier WCDMA Drive-up
V_{DD} = 48 V, $I_{DQ(Main)}$= 1000 mA, $V_{gs(Peak)}$=-4.5V
f = 3700 MHz,
3GPP WCDMA signal, PAR = 10 dB,
3.84 MHz BW



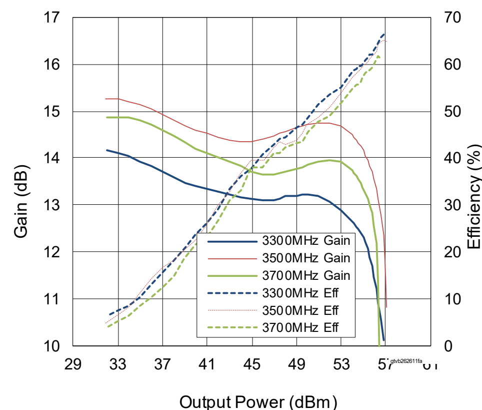
Single-carrier WCDMA BroadbandPerformance
V_{DD} = 48 V, $I_{DQ(Main)}$=1000 mA,
$V_{gs(Peak)}$ =-4.5V, P_{OUT} = 47.5dBm,
3GPP WCDMA signal, PAR = 10 dB



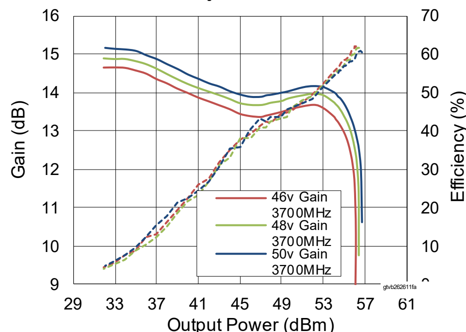
Single-carrier WCDMA BroadbandPerformance
V_{DD} = 48 V, $I_{DQ(Main)}$=1000 mA,
$V_{gs(Peak)}$ = -4.5V, P_{OUT} = 47.5dBm,
3GPP WCDMA signal, PAR = 10 dB



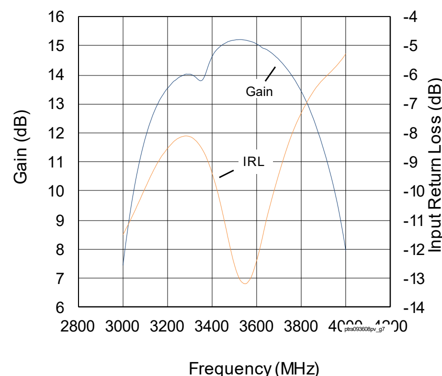
PulsedCW Performance
V_{DD} = 48 V, $I_{DQ(Main)}$=1000 mA, $V_{gs(Peak)}$ =-4.5V



PulsedCW Performance at various V_{DD}
$I_{DQ(MAIN)}$=1000 mA, $V_{gs(peak)}$=-4.5V
f = 3700MHz



CW Performance Small Signal Gain & Input Return Loss
V_{DD} = 48 V, $I_{DQ\ Main}$= 1000mA,
$V_{gs\ Peak}$ = -4.5V



Frequency (MHz)

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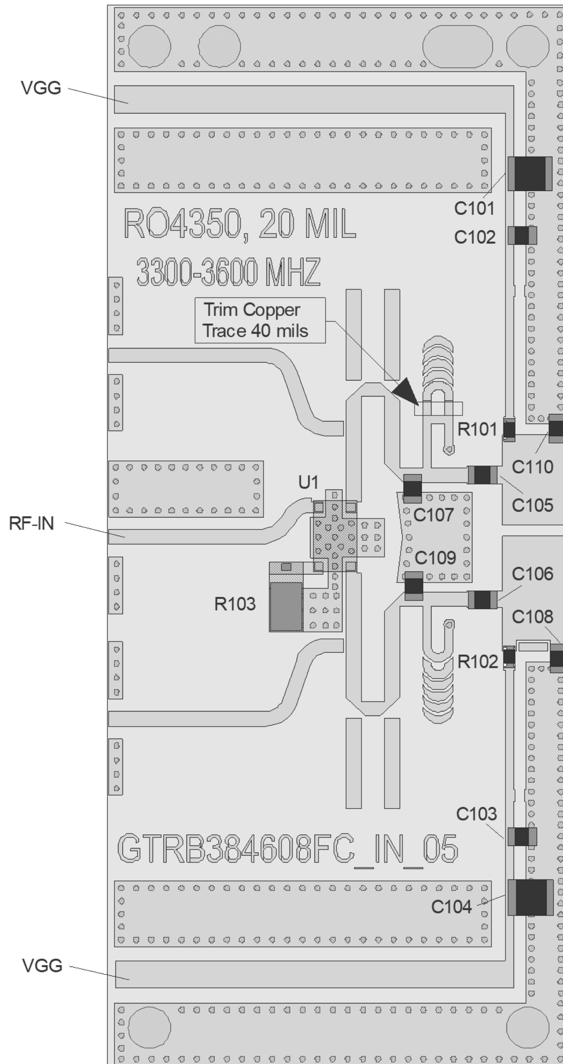
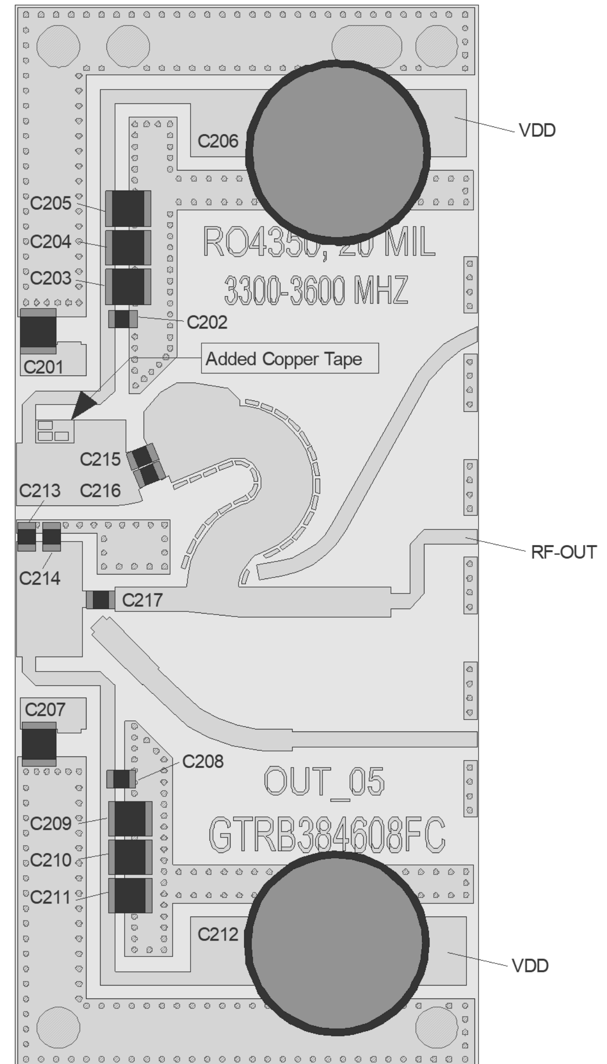
Evaluation Board, 3300 - 3800 MHz (LTA/GTRB384608FC-E4)





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Parts List for Evaluation Board: 3300 - 3800 MHz

INPUT

Component	Description	Manufacturer	P/N
C101, C104	Capacitor, 10 µF, 100 V	Murata	GRM32EC72A106KE05L
C102, C103	Capacitor, 4.7 pF	ATC	ATC600F4R7BT250XT
C105, C106	Capacitor, 5.6 pF	ATC	ATC600F5R6BT250XT
C107, C108, C109	Capacitor, 0.3 pF	ATC	ATC600F0R3BT250XT
C110	Capacitor, 0.2 pF	ATC	ATC600F0R2BT250XT
R101, R102	Resistor, 5.6 ohms	Panasonic	ERJ-3GEYJ5R6V
R103	Resistor. 50 ohms	Anaren	C16A50Z4
U1	Hybrid Coupler	Anaren	X3C35F1-03S

OUTPUT

Component	Description	Manufacturer	P/N
C201, C203, C204, C205, C207, C209, C210, C211`	Capacitor, 10 µF, 100 V	Murata	GRM32EC72A106KE05L
C202, C208	Capacitor, 4.7 pF	ATC	ATC600F4R7BT250XT
C206, C212	Capacitor, 470 µF, 100V	Cornell Dubillier Electronics (CDE)	SEK471M050ST
C213, C214	Capacitor, 0.4 pF	ATC	ATC800A0R4CT250XT
C215, C216	Capacitor, 6.2 pF	ATC	ATC800A6R2CT250XT
C217	Capacitor, 5.6 pF	ATC	ATC600F5R6BT250XT

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Package Outline Specifications (H-37248KC-6/2)

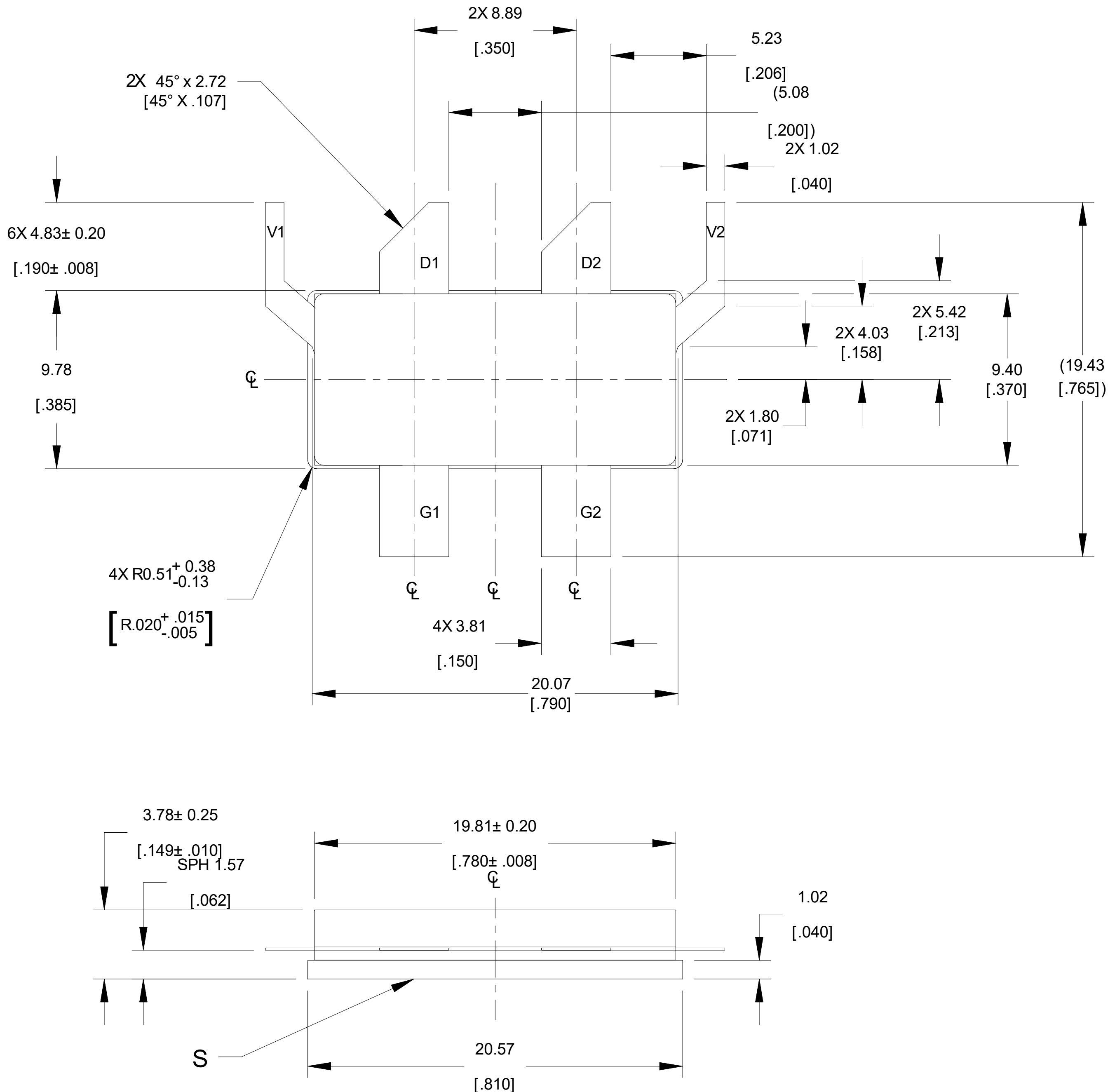

Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994
2. Primary dimensions are mm; alternate dimensions are inches
3. All tolerances ± 0.127 [0.005]
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/-0.25 [.005+.002/-.001]
6. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 micorinch]

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