## Features

- GaN on SiC Technology
- Pulsed CW Performance, 2200 MHz, 48 V, 10 μs Pulse Width, 10% Duty Cycle, Combined Outputs
- Output Power @ $P_{3dB}$ = 400 W
- Efficiency @ $P_{3dB}$ = 65%
- Human Body Model Class 1C (per ANSI/ESDA/ JEDEC JS-001)
- Pb-free and RoHS* Compliant
- Thermally Enhanced Package

## Applications

- Cellular 5G Infrastructure

## Description

The MAPC-C22440 is a 400 W (P3dB) GaN on SiC HEMT amplifier designed for use in multi-standard cellular power applications. It features high efficiency, and a thermally-enhanced package with earless flange.

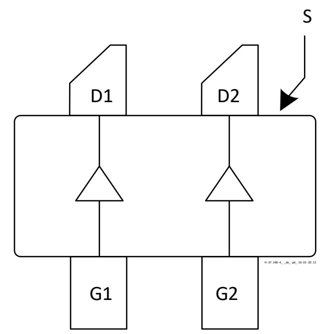
## Typical RF Performance

**Single-Carrier WCDMA Specifications[1]:**
$V_{DD}$ = 48 V, $I_{DQ}$ = 750 mA, $V_{GS(PEAK)}$ = -5.15 V,
$T_C$ = 25°C, Channel Bandwidth = 3.84 MHz,
Peak/Average = 10 dB @ 0.01% CCDF

| Parameter | Frequency (MHz) | Units | Typical |
|---|---|---|---|
| Output Power | 2100<br>2155<br>2200 | dBm | 47.6<br>47.6<br>47.6 |
| Gain | 2100<br>2155<br>2200 | dB | 16.6<br>16.8<br>16.9 |
| Efficiency | 2100<br>2155<br>2200 | % | 58.8<br>57.3<br>57.7 |
| ACPR+ | 2100<br>2155<br>2200 | dBc | -28.6<br>-30.3<br>-31.2 |
| ACPR- | 2100<br>2155<br>2200 | dBc | -28.7<br>-29.9<br>-30.8 |
| OPAR | 2100<br>2155<br>2200 | dB | 8.4<br>8.8<br>8.8 |

1. Measurements taken on 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) |
| S | Source (flange) |

## Ordering Information

| Part Number | Package |
|---|---|
| MAPC-C22440-BS000 | Bulk Quantity |
| MAPC-C22440-BSTR1 | Tape and Reel |

* 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, $I_{DQ}$ = 750 mA, $P_{OUT}$ = 47.6 dBm, $V_{GS(PEAK)}$ = $V_{GS}$ @ $I_{DQ(PEAK)}$ = 300 mA, -2.4 V, $T_C$ = 25°C, *f* = 2200 MHz, 3GPP Signal, Channel Bandwidth = 3.84 MHz, Peak/Average = 10 dB @ 0.01% CCDF

| Parameter | Units | Min. | Typ. | Max. |
|---|---|---|---|---|
| Gain | dB | 14.0 | 15.5 | — |
| Drain Efficiency | % | 52 | 55 | — |
| Adjacent Channel Power Ratio | dBc | — | -28.8 | -26.0 |
| Output PAR @ 0.01% CCDF | dB | 7.8 | 8.3 | — |

2. Measurements taken in Doherty Production Test Fixture.

## DC Characteristics

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $V_{GS}$ = -8 V, $I_D$ = 10 mA<br>Main, Peak | V | 150 | — | — |
| Drain-Source Leakage Current | $V_{GS}$ = -8 V, $V_{DS}$ = 10 V<br>Main<br>Peak | mA | — | — | 3.1<br>6.3 |
| Gate-Source Leakage Current | $V_{GS}$ = -8 V, $V_{DD}$ = 50 V<br>Main<br>Peak | mA | — | — | -5<br>-10 |
| Gate Threshold Voltage | $V_{DS}$ = 10 V, $I_D$ = 18 mA, Main<br>$V_{DS}$ = 10 V, $I_D$ = 36 mA, Peak | V | -3.8 | -3.05 | -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, $I_D$ = 750 mA | V | -3.5 | -2.75 | -2.0 |



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## Absolute Maximum Ratings[3,4,5]

| Parameter | Absolute Maximum |
|---|---|
| Drain Source Voltage | 125 V |
| Gate Source Voltage | -10 V to +2 V |
| Operating Voltage | 55 V |
| Gate Current<br>Main<br>Peak | <br>18 mA<br>36 mA |
| Drain Current<br>Main<br>Peak | <br>6.75 A<br>13.50 A |
| Junction Temperature | +275°C |
| Storage Temperature | -65°C to +150°C |

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. Product's qualification were performed @ +225°C. Operation @ $T_J$ (+275°C) reduces median time to failure.

## Thermal Characteristics

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Thermal Resistance ($R_{\theta JC}$)<br>Main<br>Peak | $T_C$ = +85°C, 48 V<br>76 W DC<br>136 W DC | °C/W | — | <br>1.8<br>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. 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

## 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 HBM Class 1C devices.



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## 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, $I_{DQ}$ = 100 mA, $T_C$ = 25°C, P3dB, Class AB | | | | |
| | | $Z_{LOAD}$ | Gain (dB) | $P_{3dB}$ (dBm) | $P_{3dB}$ (W) | $\eta_D$ |
| 2110 | 7.2 - j16.2 | 8.1 - j9.0 | 16.88 | 52.83 | 191.9 | 67.2 |
| 2200 | 11.9 - j14.3 | 8.1 - j9.2 | 17.91 | 52.79 | 190.1 | 68.6 |

| Frequency (MHz) | $Z_{SOURCE}$ (Ω) | Maximum Drain Efficiency | | | | |
|---|---|---|---|---|---|---|
| | | $V_{DS}$ = 48 V, $I_{DQ}$ = 360 mA, $T_C$ = 25°C, P3dB, Class AB | | | | |
| | | $Z_{LOAD}$ | Gain (dB) | $P_{3dB}$ (dBm) | $P_{3dB}$ (W) | $\eta_D$ |
| 2110 | 7.2 - j16.2 | 11.3 + j1.3 | 19.61 | 50.39 | 109.4 | 82.0 |
| 2200 | 11.9 - j14.3 | 9.2 - j2.5 | 19.76 | 51.37 | 137.1 | 81.0 |

### Peak Side:

| Frequency (MHz) | $Z_{SOURCE}$ (Ω) | Maximum Output Power | | | | |
|---|---|---|---|---|---|---|
| | | $V_{DS}$ = 48 V, $V_{GS(PEAK)}$ = -3.3 V, $T_C$ = 25°C, P3dB, Class B | | | | |
| | | $Z_{LOAD}$ | Gain (dB) | $P_{3dB}$ (dBm) | $P_{3dB}$ (W) | $\eta_D$ |
| 2110 | 2.0 - j8.8 | 2.5 - j2.9 | 17.52 | 56.45 | 441.6 | 70.2 |
| 2200 | 3.0 - j11.2 | 2.6 - j2.9 | 17.24 | 56.33 | 429.5 | 68.7 |

| Frequency (MHz) | $Z_{SOURCE}$ (Ω) | Maximum Drain Efficiency | | | | |
|---|---|---|---|---|---|---|
| | | $V_{DS}$ = 48 V, $V_{GS(PEAK)}$ = -5 V, $T_C$ = 25°C, P3dB, Class C | | | | |
| | | $Z_{LOAD}$ | Gain (dB) | $P_{3dB}$ (dBm) | $P_{3dB}$ (W) | $\eta_D$ |
| 2110 | 2.0 - j8.8 | 2.2 - j1.2 | 18.68 | 54.91 | 309.7 | 78.2 |
| 2200 | 3.0 - j11.2 | 2.2 - j1.6 | 18.56 | 55.26 | 335.7 | 75.9 |



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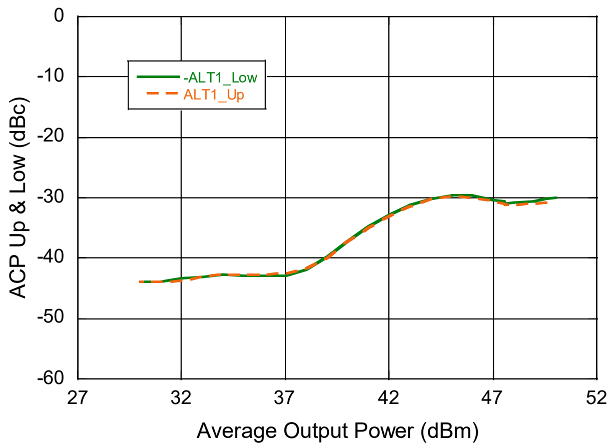
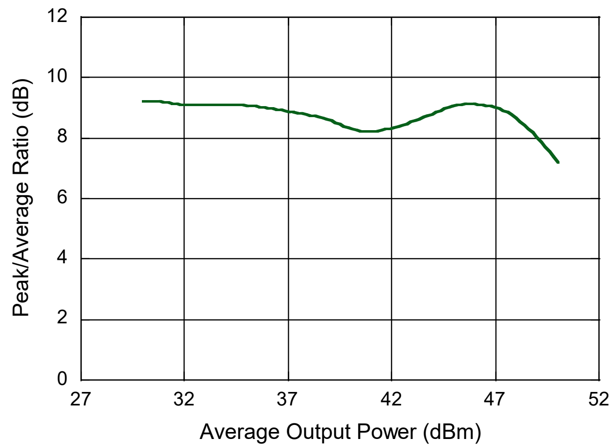
## Typical Performance Curves: Data taken in Evaluation Board
## Single-Carrier WCDMA Drive-up @ 2200 MHz

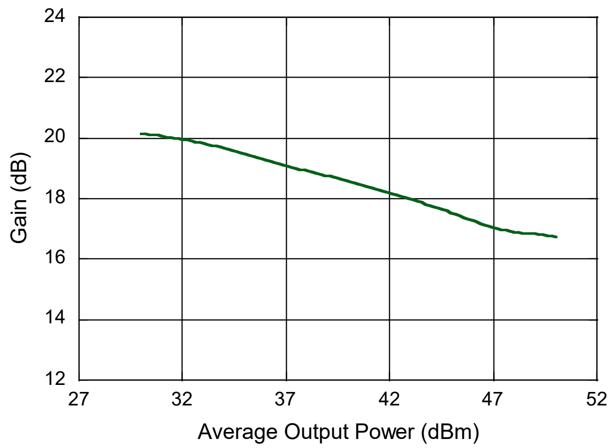
*ACP Up & Low Vs. Output Power*



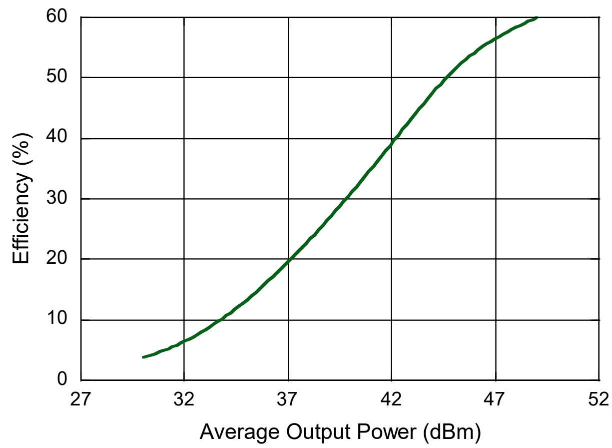

*PAR @ 0.01% CCDF Vs. Output Power*




*Gain Vs. Output Power*




*Efficiency Vs. Output Power*



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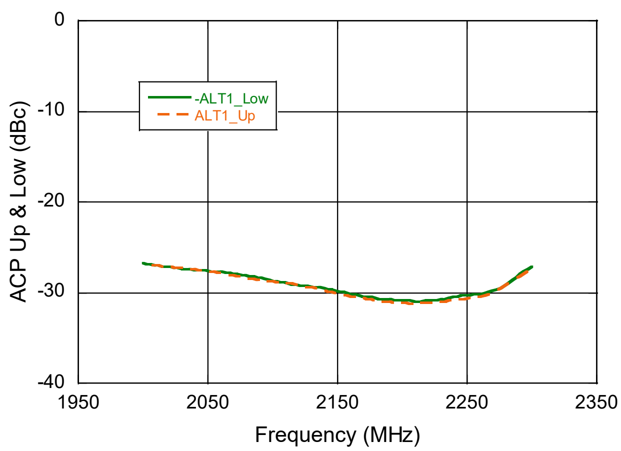
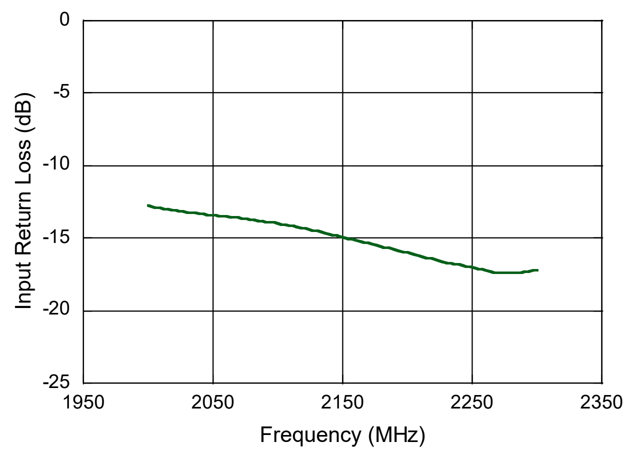
## Typical Performance Curves: Data taken in Evaluation Board
## Single-Carrier WCDMA Broadband Performance

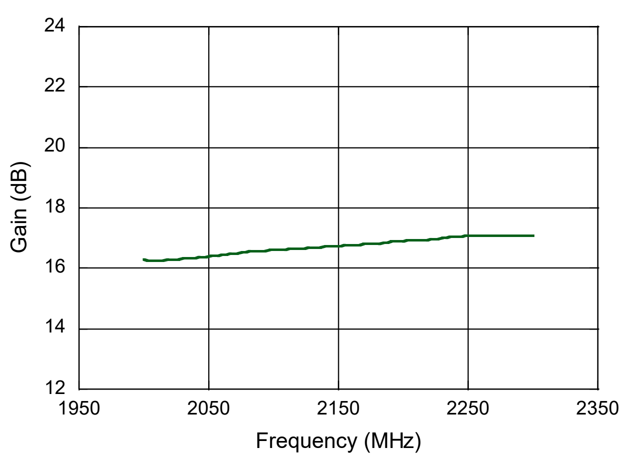
*ACP Up & Low Vs. Frequency*



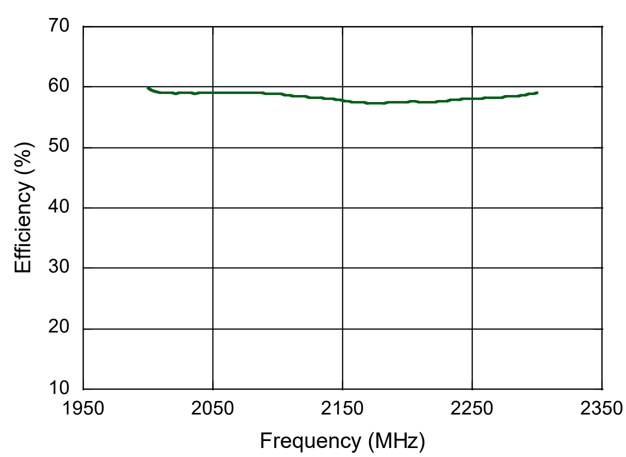

*Input Return Loss Vs. Frequency*




*Gain Vs. Frequency*




*Efficiency Vs. Frequency*







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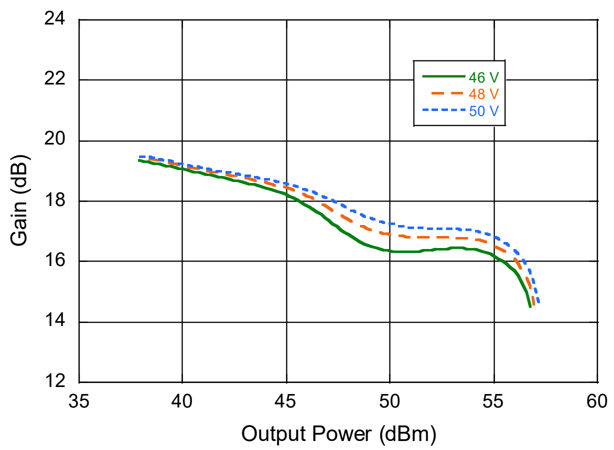
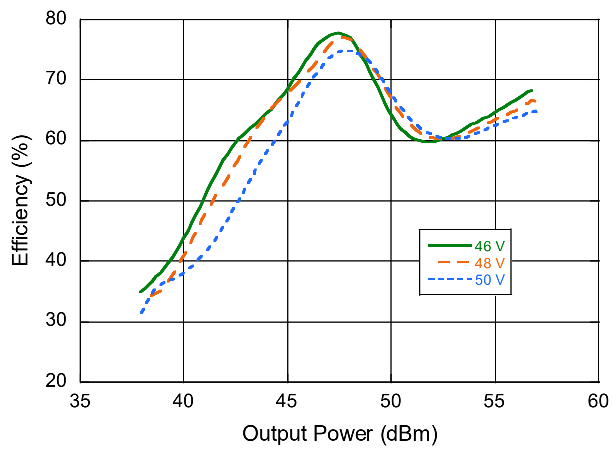
## Typical Performance Curves: Data taken in Evaluation Board
## Pulsed CW Performance

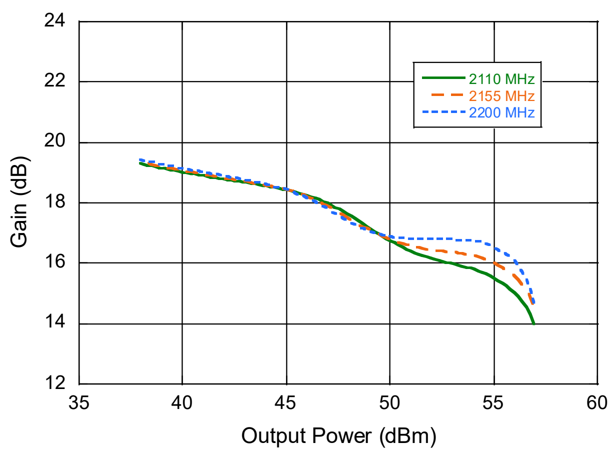
*Gain Vs. Output Power over Voltage @ 2200 MHz*



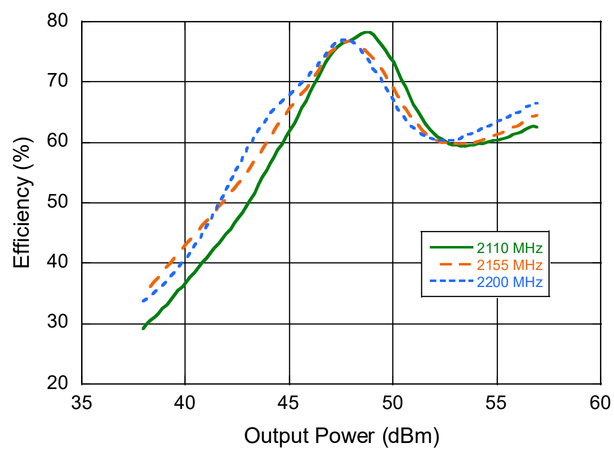

*Efficiency Vs. Output Power over Voltage @ 2200 MHz*



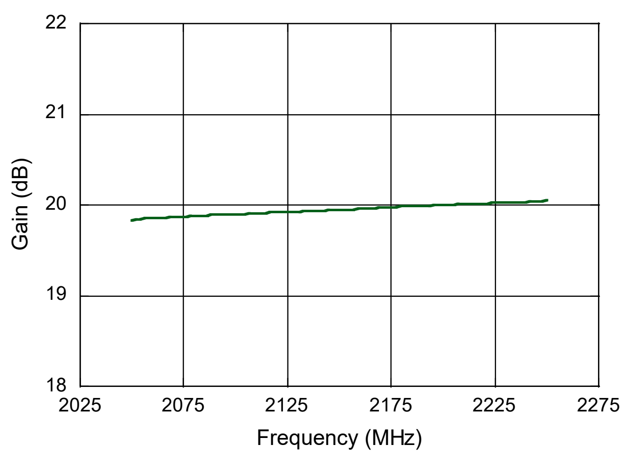

*Gain Vs. Output Power over Frequency @ 2200 MHz*



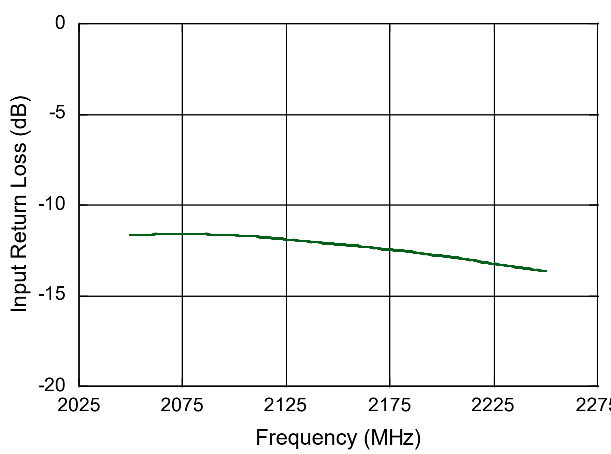

*Efficiency Vs. Output Power over Frequency @ 2200 MHz*




*Gain Vs. Frequency*




*Input Return Loss Vs. Frequency*



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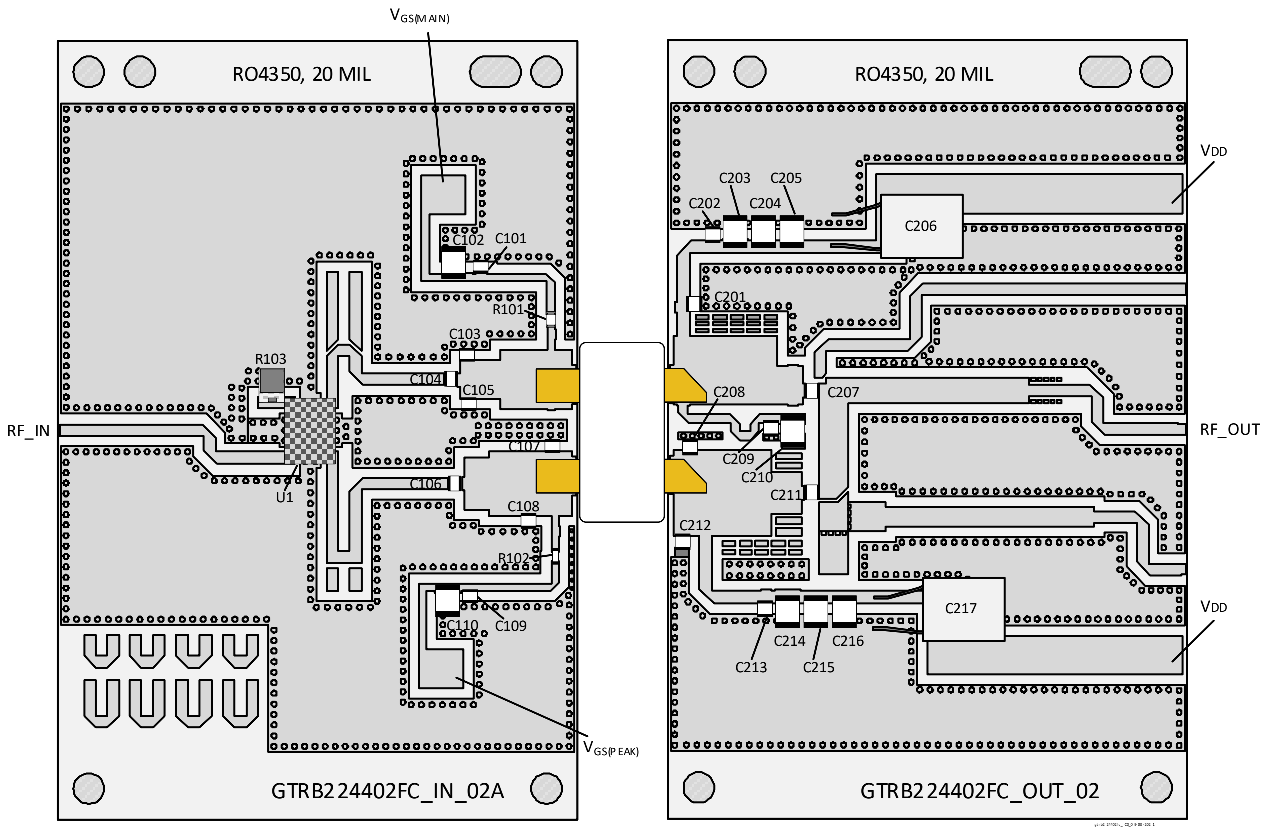
## Evaluation Board: 2110 - 2200 MHz




| Component | Description | Manufacturer | Manufacturer P/N |
|---|---|---|---|
| **Input** | | | |
| C101, C104, C106, C109 | Capacitor, 10 pF | ATC | ATC600F100JT250XT |
| C102, C110 | Capacitor, 100 V, 10 µF | Murata Electronics | GRM32EC72A106KE05L |
| C103 | Capacitor, 1.2 pF | ATC | ATC600F1R2BT250XT |
| C105 | Capacitor, 1.0 pF | ATC | ATC600F1R0BT250XT |
| C107, C108 | Capacitor, 0.9 pF | ATC | ATC600F0R9BT250XT |
| R101, R102 | Resistor, 5.6 Ω | Panasonic Electronics | ERJ-8RQJ5R6V |
| R103 | Resistor, 50 Ω | Richardson | C8A50Z4B |
| U1 | Hybrid Coupler | Anaren | X3C21P1-03S |
| **Output** | | | |
| C201 | Capacitor, 0.7 pF | ATC | ATC600F0R7BT250XT |
| C202, C209, C213 | Capacitor, 10 pF | ATC | ATC600R100JT250XT |
| C203, C204, C205, C210, C214, C215, C216 | Capacitor, 100 V, 10 µF | Murata Electronics | GRM32EC72A106KE05L |
| C206, C217 | Capacitor, 220 µF | Panasonic Electronics | ECA-2AHG221 |
| C207 | Capacitor, 6.8 pF | ATC | ATC600F6R8BT250XT |
| C208 | Capacitor, 2.0 pF | ATC | ATC600F2R0BT250XT |
| C211 | Capacitor, 18 pF | ATC | ATC600F180JT250XT |
| C212 | Capacitor, 2.4 pF | ATC | ATC600F2R4BT250XT |

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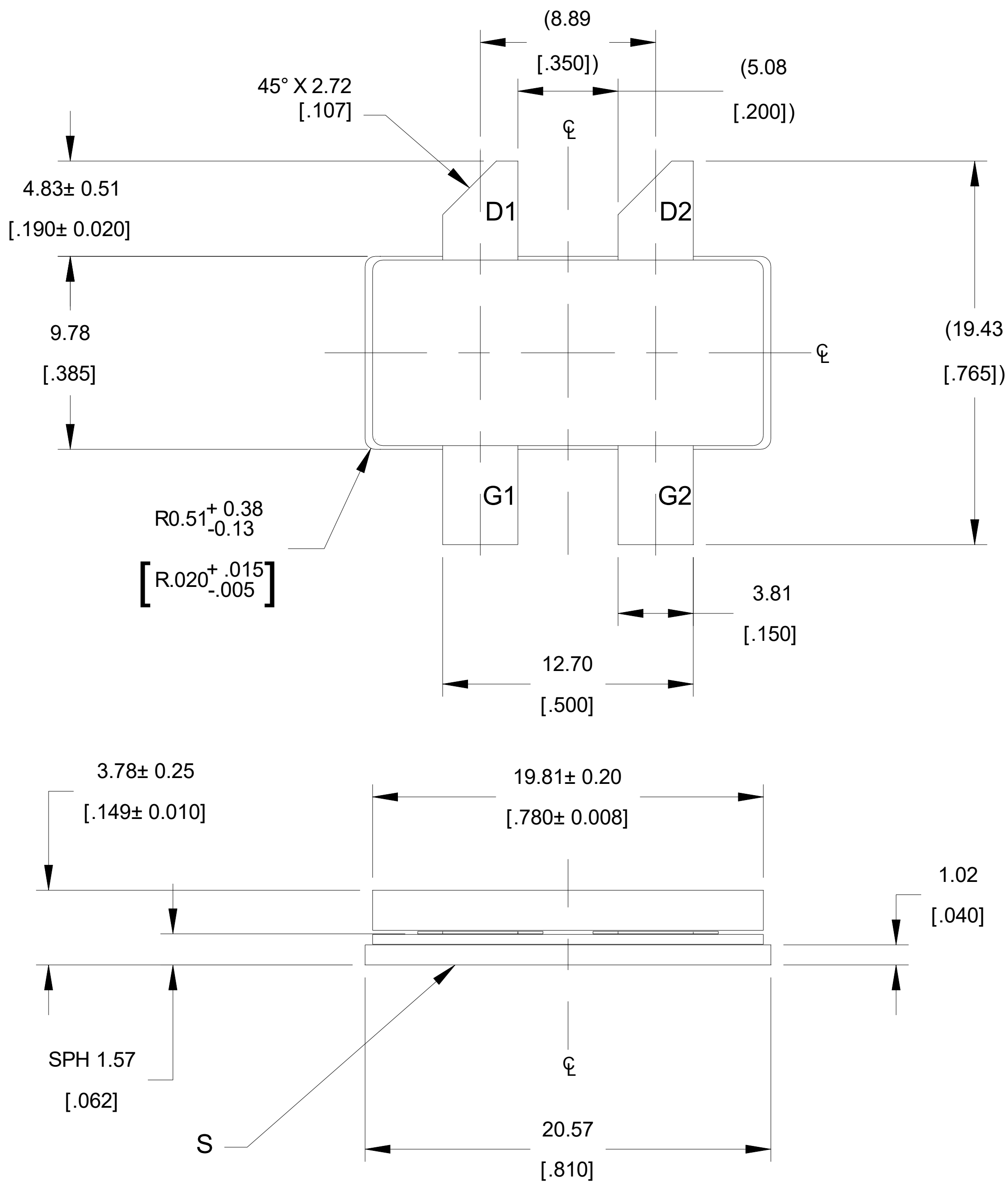
## Lead-Free Outline Drawing H-37248C-4




Interpret dimensions and tolerances per ASME Y14.5M-1994
Primary dimensions are mm; alternate dimensions are inches
All tolerances ± 0.127 [0.005]
Lead thickness: 0.13 ± 0.05 mm [0.005 ± 0.002 inch]
Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch]



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