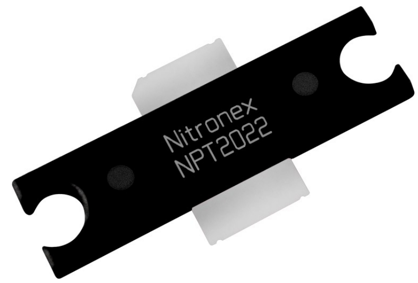
# NPT2022

## Gallium Nitride 48V, 100W, DC-2 GHz HEMT

**Built using the SIGANTIC® process - A proprietary GaN-on-Silicon technology**

### Features

- Suitable for linear and saturated applications
- Tunable from DC-2 GHz
- 48V Operation
- Industry Standard Plastic Package
- High Drain Efficiency (>60%)




### Applications

- Defense Communications
- Land Mobile Radio
- Avionics
- Wireless Infrastructure
- ISM Applications
- VHF/UHF/L-Band Radar

**DC-2 GHz**
**100W**
**GaN HEMT**

RoHS

### Product Description

The NPT2022 GaN HEMT is a wideband transistor optimized for DC-2 GHz operation. This device has been designed for saturated and linear operation with output power levels to 100W (50 dBm) in an industry standard plastic package with a bolt down flange.

**RF Specifications (CW, 900 MHz):** $V_{DS}$ = 48V, $I_{DQ}$ = 600mA, $T_C$= 25°C

| Symbol | Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| $G_{SS}$ | Small-signal Gain | - | 19 | - | dB |
| $P_{SAT}$ | Saturated Output Power | - | 50.5 | - | dBm |
| $\eta_{SAT}$ | Efficiency at Saturated Output Power | - | 64 | - | % |
| $G_P$ | Gain at $P_{OUT}$ = 100W | - | 17 | - | dB |
| $\eta$ | Drain Efficiency at $P_{OUT}$ = 100W | - | 60 | - | % |
| $V_{DS}$ | Drain Voltage | - | 48 | - | V |
| $\Psi$ | Ruggedness: Output Mismatch, all phase angles | VSWR = 10:1, No Device Damage | | | |

## DC Specifications: $T_C$ = 25°C

| Symbol | Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **Off Characteristics** | | | | | |
| $I_{DLK}$ | Drain-Source Leakage Current ($V_{GS}$=-8V, $V_{DS}$=160V) | - | - | 24 | mA |
| $I_{GLK}$ | Gate-Source Leakage Current ($V_{GS}$=-8V, $V_{DS}$=0V) | - | - | 12 | mA |
| **On Characteristics** | | | | | |
| $V_T$ | Gate Threshold Voltage ($V_{DS}$=48V, $I_D$=24mA) | -2.5 | -1.5 | -0.5 | V |
| $V_{GSQ}$ | Gate Quiescent Voltage ($V_{DS}$=48V, $I_D$=600mA) | -2.1 | -1.2 | -0.3 | V |
| $R_{ON}$ | On Resistance ($V_{DS}$=2V, $I_D$=180mA) | - | 0.2 | - | Ω |
| $I_{D, MAX}$ | Maximum Drain Current ($V_{DS}$=7V pulsed, 300μS pulse width, 0.2% Duty Cycle) | - | 14 | - | A |

## Thermal Resistance Specification:

| Symbol | Parameter | Typ | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance (Junction-to-Case), $T_J$ = 200 °C | 1.3 | °C/W |

Junction Temperature ($T_J$) measured using IR Microscopy, Case Temperature ($T_C$) measured using a thermocouple embedded in heatsink.

## Absolute Maximum Ratings: Not simultaneous, $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Max | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 160 | V |
| $V_{GS}$ | Gate-Source Voltage | -10 to 3 | V |
| $I_G$ | Gate Current | 48 | mA |
| $P_T$ | Total Device Power Dissipation (Derated above 25°C) | 134 | W |
| $T_{STG}$ | Storage Temperature Range | -65 to 150 | °C |
| $T_J$ | Operating Junction Temperature | 200 | °C |
| HBM | Human Body Model ESD Rating (per JESD22-A114) | Class 1B | |
| MSL | Moisture sensitivity level (per IPC/JEDEC J-STD-020) | MSL-3 | |

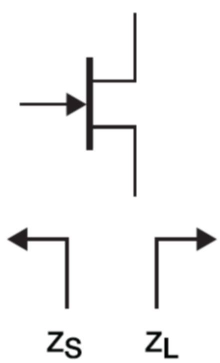
## Load-Pull Data, Reference Plane at Device Leads

$V_{DS}$=48V, $I_{DQ}$=600mA, $T_C$=25°C unless otherwise noted

### Optimum Source and Load Impedances:

(CW Drain Efficiency and Output Power Tradeoff Impedance)

| Frequency (MHz) | $Z_S$ (Ω) | $Z_L$ (Ω) | $P_{SAT}$ (W) | $G_{SS}$ (dB) | Drain Efficiency @ $P_{SAT}$ (%) |
|---|---|---|---|---|---|
| 500 | 1.3 + j0.2 | 5.8 + j2.0 | 152 | 26 | 71 |
| 900 | 1.1 - j2.2 | 5.0 + j1.9 | 139 | 22 | 70 |
| 1800 | 1.3 - j6.9 | 3.2 - j2.5 | 133 | 17 | 66 |
| 2000 | 1.4 - j7.6 | 2.3 - j3.5 | 119 | 16 | 66 |



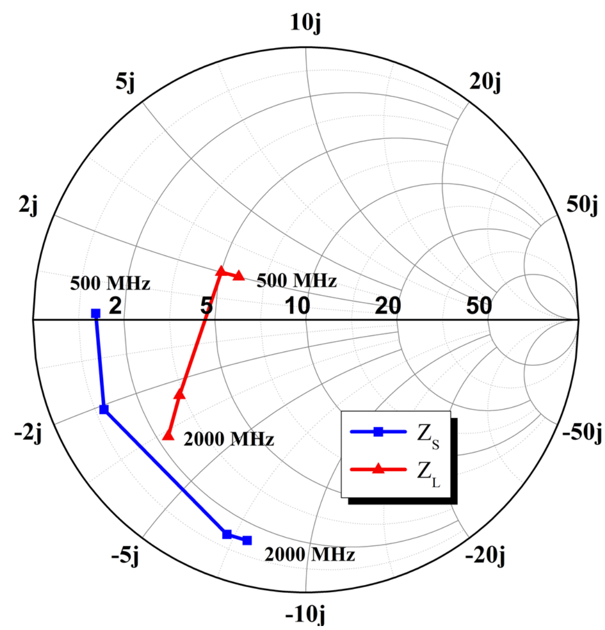




**Figure 1:** CW Power/Drain Efficiency Tradeoff Impedances, $Z_O$=10Ω

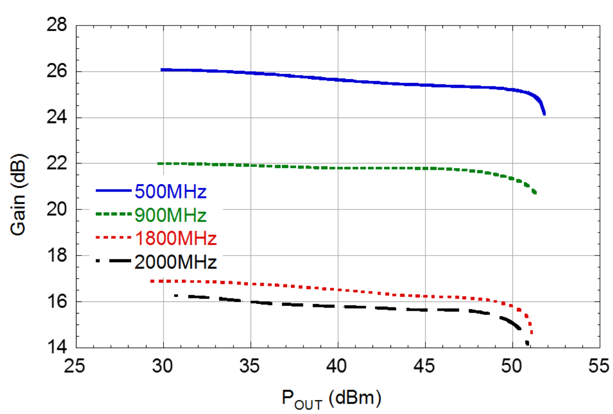



**Figure 2:** Gain vs. $P_{OUT}$

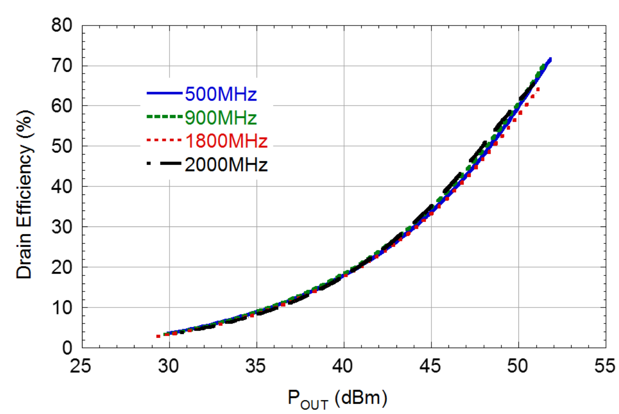



**Figure 3:** Efficiency vs. $P_{OUT}$

## 900 MHz Narrowband Circuit

(CW, $V_{DS}$=48V, $I_{DQ}$=600mA, $T_C$=25°C, unless otherwise noted)

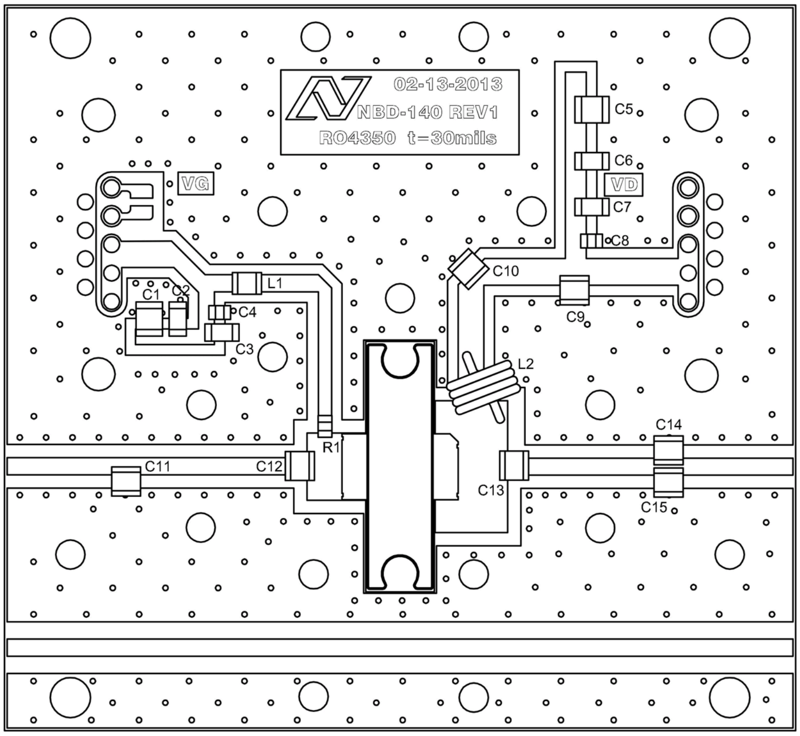



**Figure 4:** Component Placement of 900 MHz Narrowband Circuit for NPT2022

| Reference | Value | Manufacturer | Part Number |
|---|---|---|---|
| C1, C5 | 1µF | AVX | 1210C105KAT2A |
| C2, C6 | 0.1µF | Kemet | C1206C104K1RACTU |
| C3, C7 | 0.01µF | AVX | 12061C103KAT2A |
| C4, C8 | 1000pF | Kemet | C0805C102K1RACTU |
| C9 | 10pF | ATC | ATC800B100B |
| C10 | 33pF | ATC | ATC800B330B |
| C11 | 15pF | ATC | ATC800B150B |
| C12 | 6.8pF | ATC | ATC800B6R8B |
| C13 | 18pF | ATC | ATC800B180B |
| C14 | 0.8pF | ATC | ATC800B0R8B |
| C15 | 8.2pF | ATC | ATC800B8R2B |
| R1 | 10Ω | Panasonic | ERJ-2RKF10R0X |
| L1 | 19.4nH | Coilcraft | 0806SQ-19NJL |
| L2 | ~44nH | 20 AWG Cu Wire | 4 turn, 5mm ID |
| PCB | RO4350, $\varepsilon_r$=3.5, 0.030" | Rogers | Nitronex NBD-140r2 |

# Typical Performance in 900 MHz Narrowband Circuit

(CW, $V_{DS}$=48V, $I_{DQ}$=600mA, f=900MHz, $T_C$=25°C, unless otherwise noted)

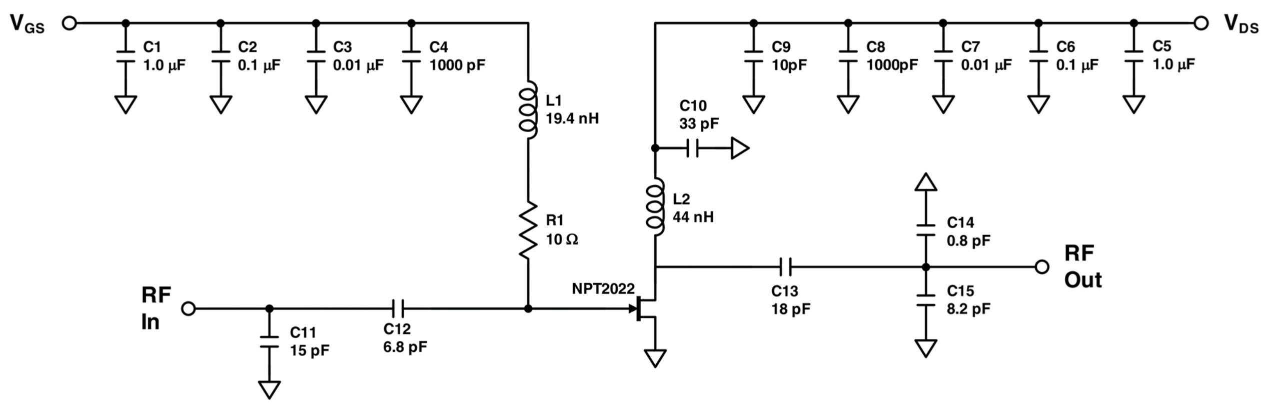



**Figure 5.** Electrical Schematic of 900 MHz Narrowband Circuit for NPT2022
(For RF Tuning details see Component Placement Diagram Figure 4)

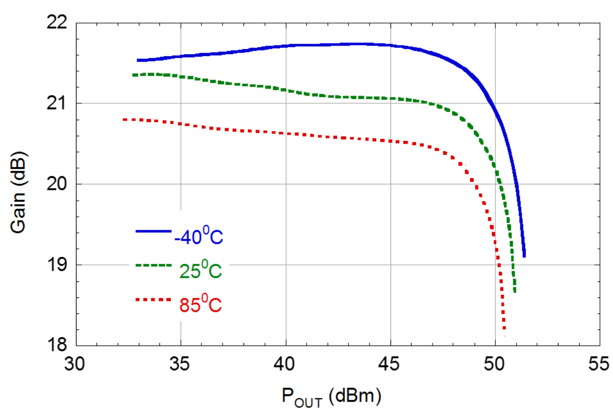



**Figure 6:** Gain vs. $P_{OUT}$

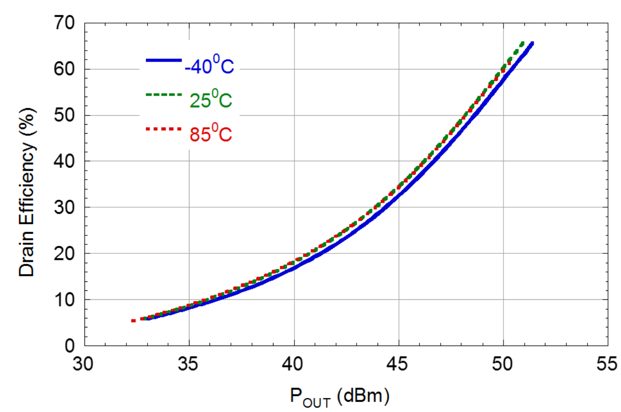



**Figure 7:** Drain Efficiency vs. $P_{OUT}$

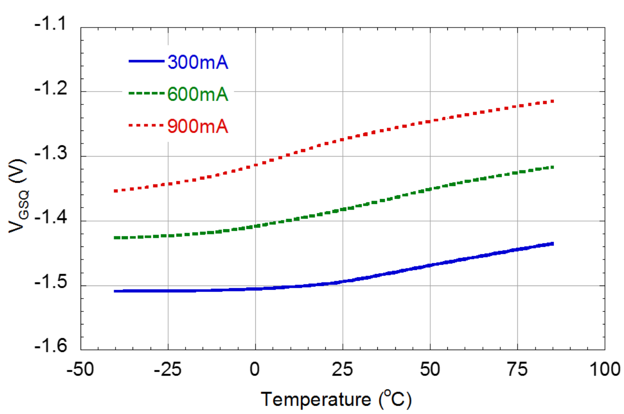



**Figure 8:** Quiescent $V_{GS}$ vs. Temperature

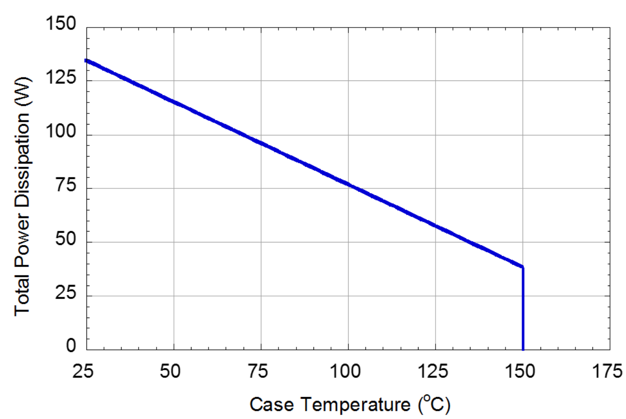



**Figure 9:** Power De-rating Curve
($T_J$ = 200°C, $T_C$ > 25°C)

## Typical Performance in 900 MHz Narrowband Circuit

(CW, $V_{DS}$=48V, $I_{DQ}$=600mA, f=900MHz, $T_C$=25°C, unless otherwise noted)

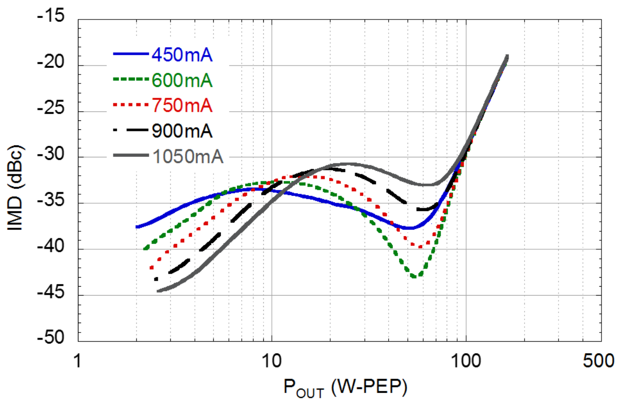



**Figure 10:** 2-Tone IMD3 vs. $P_{OUT}$ vs. $I_{DQ}$
(1MHz Tone Spacing)

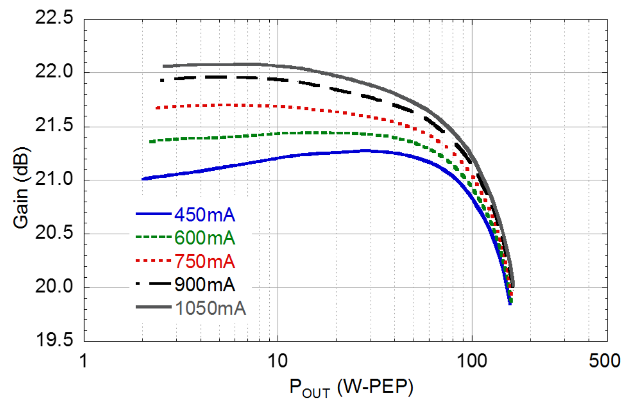



**Figure 11:** 2-Tone Gain vs. $P_{OUT}$ vs. $I_{DQ}$
(1MHz Tone Spacing)

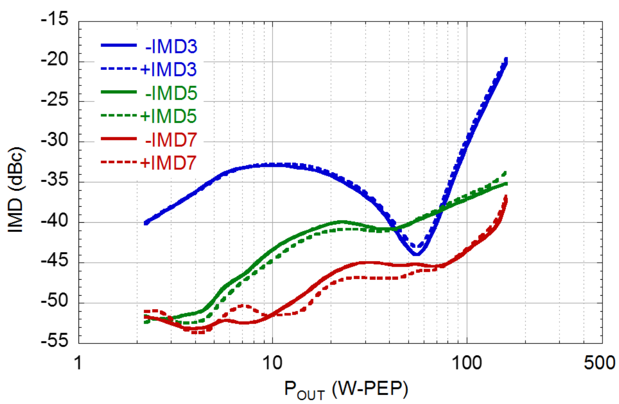



**Figure 12:** 2-Tone IMD vs. $P_{OUT}$
(1MHz Tone Spacing)

# 130-940 MHz Broadband Circuit

(CW, $V_{DS}$=48V, $I_{DQ}$=600mA, $T_C$=25°C, unless otherwise noted)

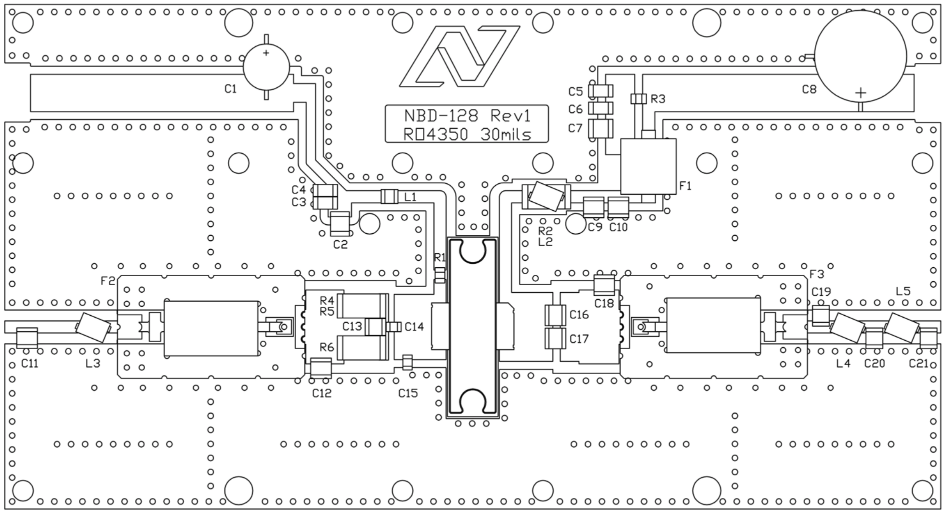



**Figure 13:** Component Placement of 130-940 MHz Broadband Circuit for NPT2022

| Reference | Value | Manufacturer | Part Number |
|---|---|---|---|
| C1 | 150µF | Nichicon | UPW1C151MED |
| C2, C7 | 1µF | AVX | 1210C105KAT2A |
| C3, C6 | 0.1µF | Kemet | C1206C104K1RACTU |
| C4, C5 | 0.01µF | AVX | 12061C103KAT2A |
| C8 | 270µF | United Chemi-Con | ELXY 630ELL271MK25S |
| C9 | 18pF | ATC | ATC100B180 |
| C10 | 1000pF | ATC | ATC100B102 |
| C11 | 1.5pF | ATC | ATC100B1R5 |
| C12 | 5.6pF | ATC | ATC100B5R6 |
| C13 | 15pF | ATC | ATC100B150 |
| C14 | 220pF | ATC | 600F221FT |
| C15 | 12pF | ATC | 600F120FT |
| C16, C17 | 82pF | ATC | ATC100B820 |
| C18 | 4.7pF | ATC | ATC100B4R7 |
| C19 | 2.4pF | ATC | ATC100B2R4 |
| C20 | 3.9pF | ATC | ATC100B3R9 |
| C21 | 1.0pF | ATC | ATC100B1R0 |
| R1 | 49.9Ω | Panasonic | ERJ-6ENF49R9V |
| R2 | 470Ω | Panasonic | ERJ-1TNF4700U |
| R3 | 0.33Ω | Panasonic | ERJ-6RQFR33V |
| R4, R5, R6 | 24.9Ω | Panasonic | ERJ-1TNF24R9U |
| F1 | Material 73 | Fair-Rite | 2673000801 |
| F2, F3 | 4:1 Transformer | Anaren | XMT031B5012 |
| L1 | 25nH | Coilcraft | 0908SQ-25NJL |
| L2, L4 | 8nH | Coilcraft | A03TJL |
| L3, L5 | 5nH | Coilcraft | A02TJL |
| PCB | RO4350, $\varepsilon_r$=3.5, 0.020” | Rogers | Nitronex NBD-128r1 |

# Typical Performance in 130-940 MHz Broadband Circuit

(CW, $V_{DS}$=48V, $I_{DQ}$=600mA, $T_C$=25°C, unless otherwise noted)

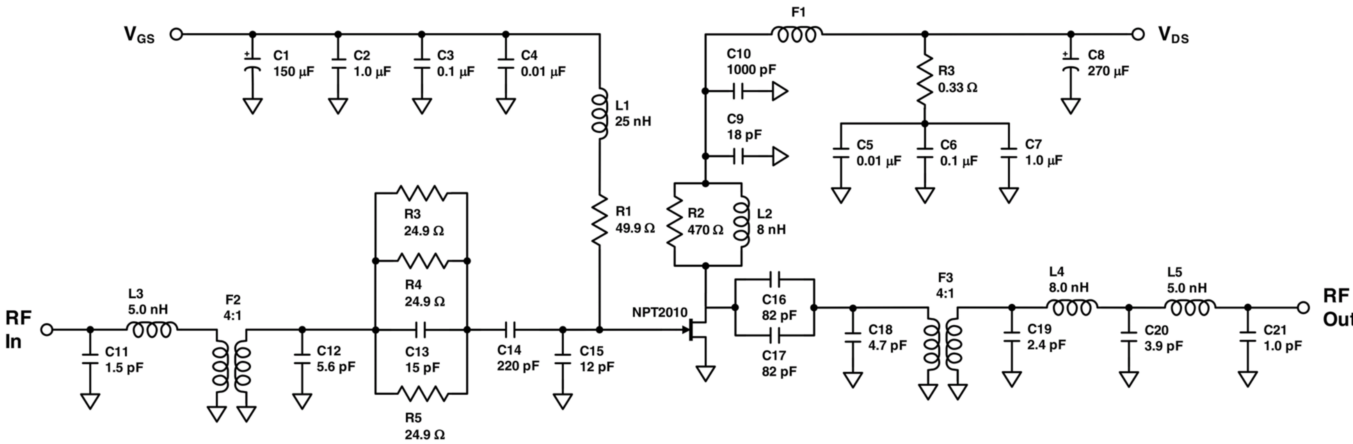



**Figure 14.** Electrical Schematic of 130-940 MHz Broadband Circuit for NPT2022
(For RF Tuning details see Component Placement Diagram Figure 13)

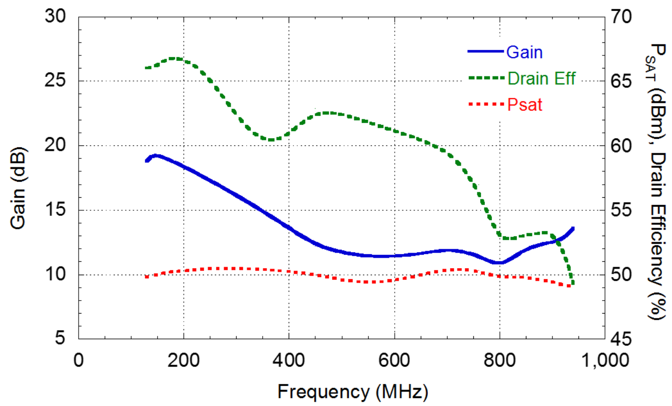



**Figure 15:** Performance vs. Frequency at ($P_{OUT}$ = $P_{SAT}$)

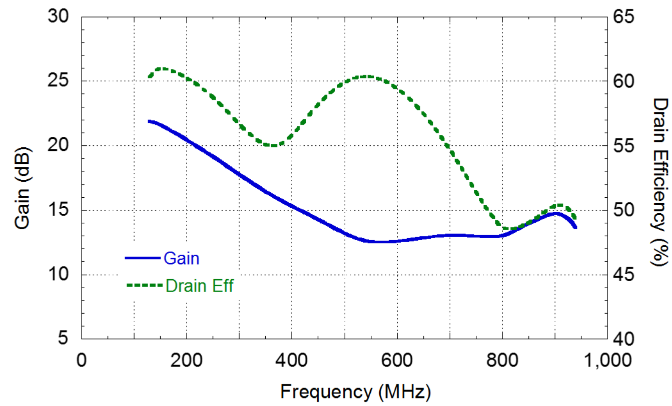



**Figure 16:** Performance vs. Frequency ($P_{OUT}$ = 49dBm)

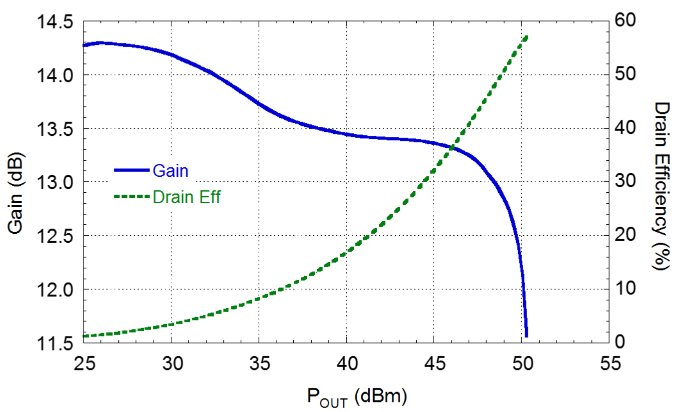



**Figure 17:** Performance vs. $P_{OUT}$ (f = 760MHz)

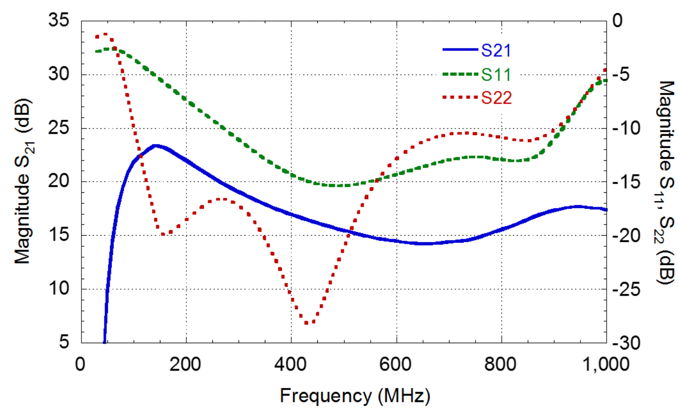



**Figure 18:** Small Signal s-parameters vs. Frequency

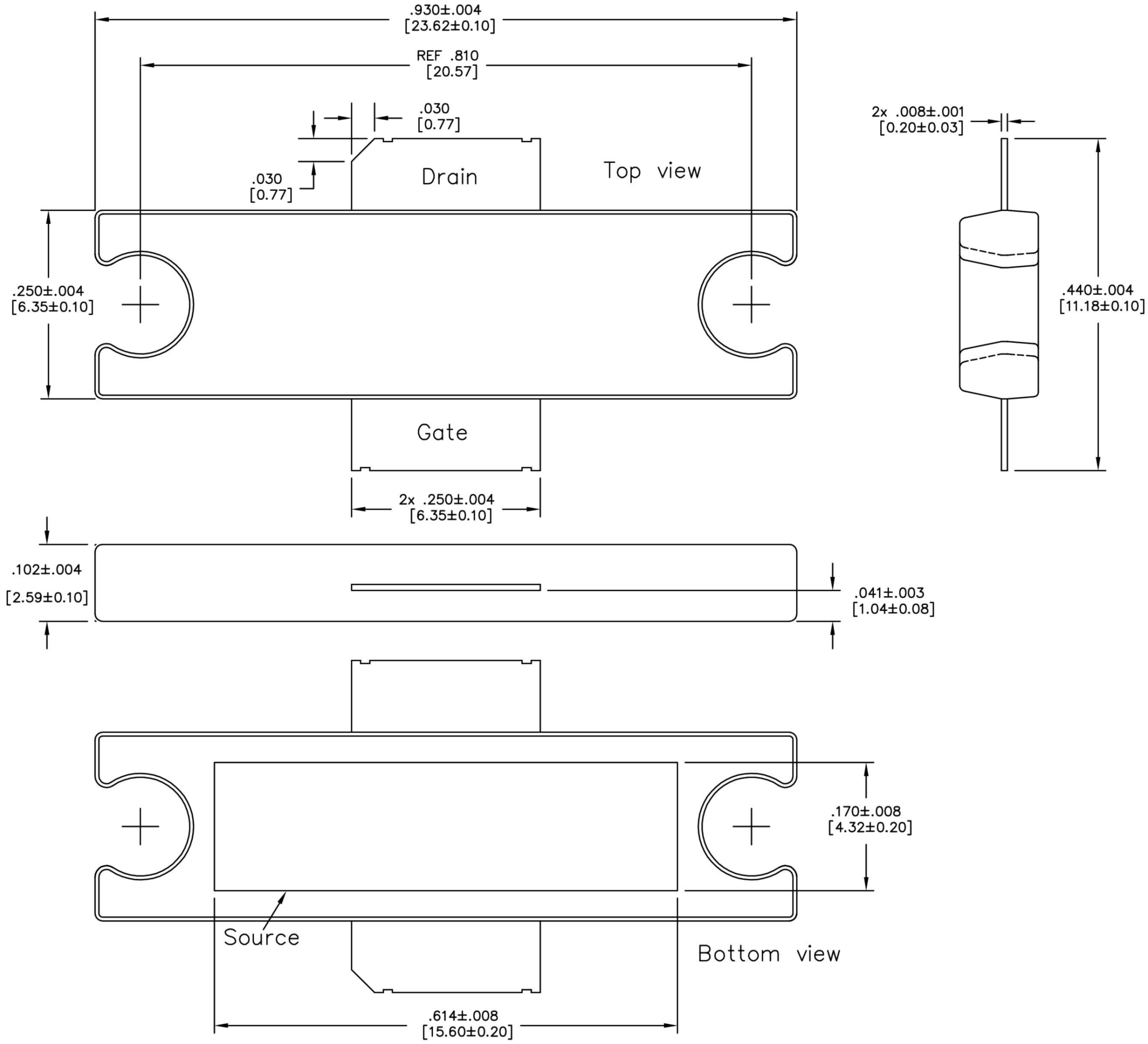



**Figure 19 -** TO272-2 Bolt-Down Plastic Package Dimensions (all dimensions in inches [millimeters])

| Function |
| --- |
| Gate — RF Input |
| Drain — RF Output (Cut lead) |
| Source — Ground (Flange) |

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## Additional Information

**This part is lead-free and is compliant with the RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).**

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