# GRF4042

*Released*

## LNA w/Bypass & Guerrilla Armor™: 0.4 to 2.7 GHz


## Features

Reference: 5V/70mA/1.9 GHz

- Bypass + Guerrilla Armor™
- EVB NF: 1.0 dB
- Gain: 16.0 dB
- Bypass Gain: -1.5 dB
- OIP3: 36.3 dBm
- OP1dB: 22.0 dBm

- High Off-State Isolation: >30 dB
- Flexible Bias Voltage and Current
- Internally Matched to 50 Ω
- Process: GaAs pHEMT

## Applications

- Cellular Repeaters and Signal Boosters
- Cellular Infrastructure
- WLAN, ZigBee®/Bluetooth®
- First Stage LNA
- General Purpose Bypass Amplifier

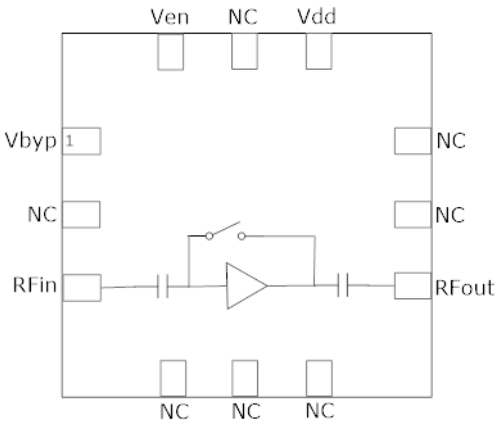
## Product Description

GRF4042 is a low noise amplifier (LNA) with low loss bypass designed for high performance applications up to 2.7 GHz. Guerrilla Armor™ technology provides exceptional off-state isolation in the presence of high RF input signal levels in LNA disabled mode.

With integrated matching, the device achieves outstanding noise figure (NF), high gain and high linearity over 400-2700 MHz using as few as three external components. The data sheet also provides narrow band matches covering 700-960 MHz and 1710-2170 MHz for applications needing enhanced return loss.

The LNA is operated from a single positive supply of 1.8 to 5.0 V with a selectable IDDQ range of 15 to 90 mA.

Consult with the GRF applications engineering team for custom tuning/evaluation board data and device s-parameters.




2.0 mm x 2.0 mm QFN-12

## Absolute Ratings:

| Parameter | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 0 | 6.0 | V |
| RF Input Power CW: (Load VSWR < 2:1; $V_D$: 5.0 volts) | $P_{IN\ MAX}$ | | 20 | dBm |
| Operating Temperature (Package Heat Sink) | $T_{AMB}$ | -40 | 105 | °C |
| Maximum Channel Temperature (MTTF > 10^6 Hours) | $T_{MAX}$ | | 170 | °C |
| Maximum Dissipated Power | $P_{DISS\ MAX}$ | | 500 | mW |
| **Electrostatic Discharge:** | | | | |
| Charged Device Model: | CDM | 1500 | | V |
| Human Body Model: | HBM | 250 | | V |
| **Storage:** | | | | |
| Storage Temperature | $T_{STG}$ | -65 | 150 | °C |
| Moisture Sensitivity Level | MSL | | 1 | -- |

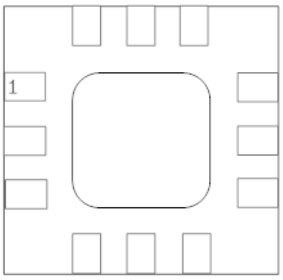
**Caution!** ESD Sensitive Device

Exceeding Absolute Maximum Rating conditions may cause permanent damage to the device.

**Note: For manufacturing information, see the Guerrilla-RF.com website for the following document located on the GRF4042 landing page: Manufacturing Note—MN-001 Product Tape and Reel, Solderability and Package Outline Specification.**

Link to manufacturing note:

## Pin Out (Top View)




## Pin Assignments:

| Pin | Name | Description | Note |
|---|---|---|---|
| 1 | $V_{BYPASS}$ | Low Insertion Loss Bypass | See control logic truth table |
| 2 | NC | No Connect or Ground | No internal connection to die |
| 3 | RF_In | RF Input | Internally DC blocked. Note: Do not apply DC voltage > 0.5 volts. |
| 4 | NC | No Connect or Ground | No internal connection to die |
| 5 | NC | No Connect or Ground | No internal connection to die |
| 6 | NC | No Connect or Ground | No internal connection to die |
| 7 | RF_Out | RF Output | Internally DC blocked. Note: Do not apply DC voltage > 0.5 volts. |
| 8 | NC | No Connect or Ground | No internal connection to die |
| 9 | NC | No Connect or Ground | No internal connection to die |
| 10 | $V_{DD}$ | Supply Voltage Input | Provide device Vdd via external bias inductor |
| 11 | NC | No Connect or Ground | No internal connection to die |
| 12 | $V_{ENABLE}$ | Enable Voltage Input | See control logic truth table. External resistor in series to set Iddq |
| PKG BASE | Gnd | Ground | Provides DC and RF ground for LNA, as well as thermal heat sink. Recommend multiple 8 mil vias beneath the package for optimal RF and thermal performance. Refer to evaluation board top layer graphic on schematic page. |

## Control Logic Truth Table:

| Mode | Description | Vdd | $V_{ENABLE}$ | $V_{BYPASS}$ |
|---|---|---|---|---|
| High Gain | High LNA Gain | >= 1.8 | 1 | 0 |
| Bypass | High Linearity Bypass | >= 1.8 | 0 | 1 |
| Disabled Mode (Guerrilla Armor™) | LNA Powered Down | >= 1.8 | 0 | 0 |
| Logic Level “0” | Logic Low | >= 1.8 | 0.0V to 0.2V | 0.0V to 0.2V |
| Logic Level “1” | Logic High | >= 1.8 | 1.5V to $V_{DD}$ | 1.5V to $V_{DD}$ |

## Nominal Operating Parameters:

| Parameter | Symbol | Specification | | | Unit | Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| **High Gain Mode** | | | | | | $V_{DD}$ = 4.3 V; Temp: +25C |
| Test Frequency | $F_{TEST}$ | | 1900 | | MHz | |
| Gain | S21 | 15.0 | 16.0 | | dB | |
| Noise Figure (De-embedded) | NF | | 0.9 | 1.1 | dB | |
| Output 1dB Compression Point | 0P1dB | 18.5 | 19.5 | | dBm | |
| Output Third Order Intercept Point | 0IP3 | | 30.0 | | dBm | |
| Supply Current | $I_{DD}$ | | 40 | | mA | |
| Enable Current | $I_{ENABLE}$ | | 1.5 | | mA | |
| **Bypass Mode** | | | | | | $V_{DD}$: 4.3 V; $V_{ENABLE}$: Low; $V_{BYPASS}$: High |
| Gain | S(2,1) | -2.5 | -1.5 | | dB | |
| Output 1dB Compression Point | 0P1dB | 15.0 | 19.0 | | dBm | |
| Output Third Order Intercept Point | 0IP3 | | 45.0 | | dBm | |
| **Disabled Mode (Guerrilla Armor™)** | | | | | | $V_{DD}$ = 4.3 V, $V_{ENABLE}$: Low; $V_{BYPASS}$: Low |
| Gain | S(2,1) | | -35.0 | | dB | |
| Leakage Current | $I_{LEAKAGE}$ | | 600 | 1000 | uA | VDD = 4.3 V; $V_{ENABLE}$: 0.0 V; $V_{BYPASS}$: 0.0V |
| **Thermal Data** | | | | | | |
| Thermal Resistance (Infra-Red Scan) | $\Theta jc$ | | 132 | | °C/W | |
| Channel Temperature @ +85 C reference (Package heat sink) | $T_{CHANNEL}$ | | 108 (See note) | | °C | $V_{DD}$: 4.3 V; $I_{DDQ}$: 40 mA; No RF; Dissipated Power: 172 mW |

Note: MTTF >10^6 hours for $T_{CHANNEL}$ < =170 degrees C.

## GRF4042 Evaluation Board Performance Summary Table (Standard Broadband Match):

| Tune (MHz) | Reference Freq. (MHz) | Gain (dB) | Eval Board NF (dB) | OP1dB (dBm) | OIP3 (dBm) | Bias Condition (V/mA) |
|---|---|---|---|---|---|---|
| 700—2700 | 700 | 21.7 | 1.20 | 21.6 | 35.3 | 5.0/70 |
| 700—2700 | 1700 | 16.4 | 0.89 | 22.4 | 36.4 | 5.0/70 |
| 700—2700 | 1950 | 15.3 | 0.98 | 22.0 | 36.3 | 5.0/70 |
| 700—2700 | 2700 | 12.8 | 1.10 | 21.4 | 36.1 | 5.0/70 |

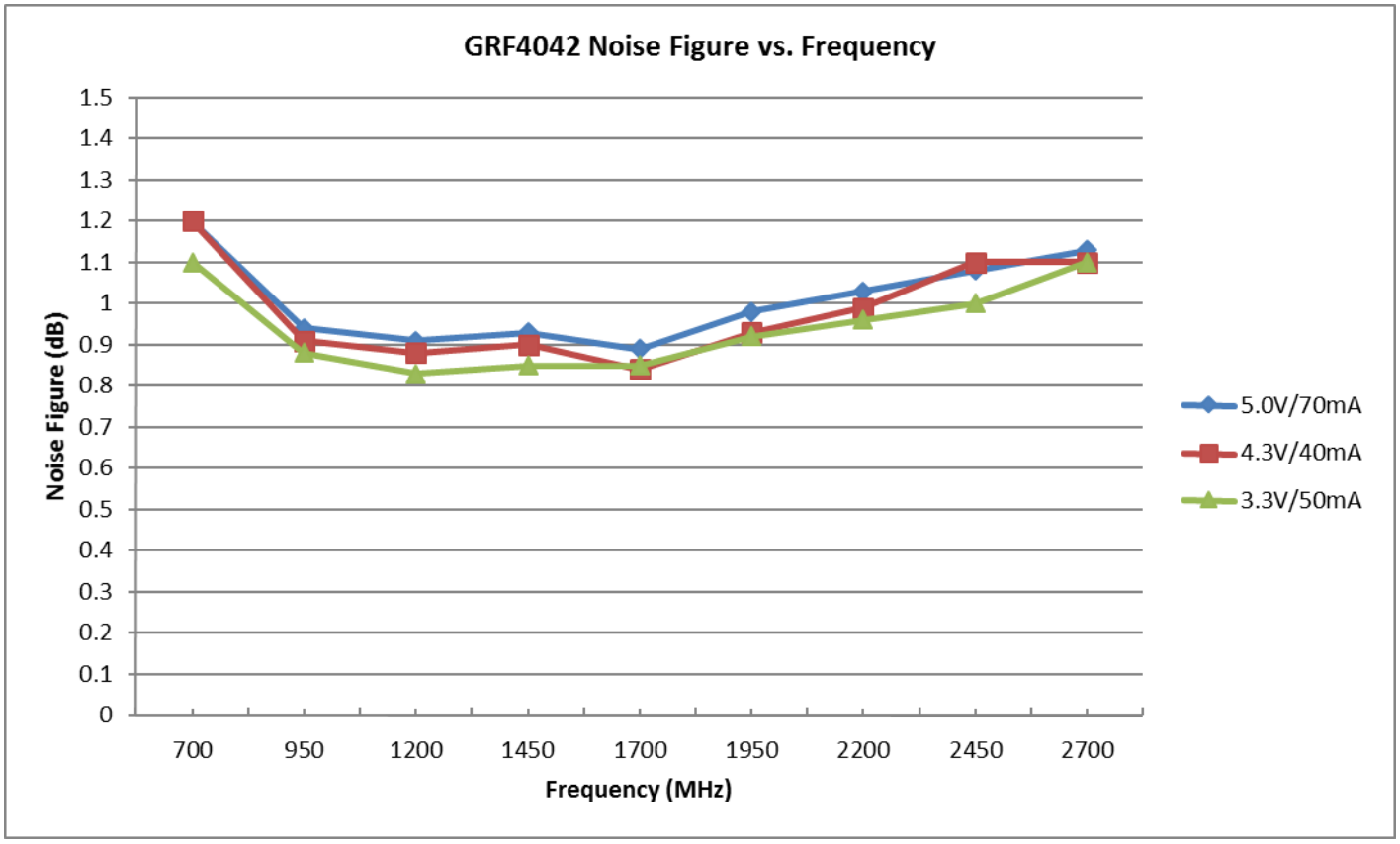
## Band-Specific Data with Low/High Band Tunes (Gain Mode; Bias: 4.3V/40 mA)

| Freq. (MHz) | Gain (dB) | NF (dB) | IP1dB (dBm) | OP1dB (dBm) | IIP3 (dBm) | OIP3 (dBm) | Tuning |
|---|---|---|---|---|---|---|---|
| 707 | 19.8 | 1.2 | -0.5 | 19.8 | 7.3 | 28.7 | 700 - 960 MHz |
| 737 | 20.0 | 1.1 | -0.3 | 20.0 | 7.6 | 28.9 | 700 - 960 MHz |
| 751 | 20.1 | 1.1 | -0.2 | 20.1 | 7.8 | 29.0 | 700 - 960 MHz |
| 782 | 19.9 | 1.0 | 0.0 | 19.9 | 7.7 | 28.6 | 700 - 960 MHz |
| 836 | 20.3 | 0.95 | 0.4 | 20.3 | 8.2 | 29.2 | 700 - 960 MHz |
| 881 | 20.2 | 0.90 | 0.8 | 20.2 | 8.5 | 28.9 | 700 - 960 MHz |
| 1732 | 16.7 | 1.1 | 5.1 | 20.8 | 13.1 | 29.8 | 1710 – 2170 MHz |
| 1880 | 16.0 | 1.1 | 5.2 | 20.3 | 13.4 | 29.4 | 1710 – 2170 MHz |
| 1960 | 15.5 | 1.0 | 6.0 | 20.6 | 14.5 | 30.0 | 1710 – 2170 MHz |
| 2132 | 15.0 | 1.0 | 6.6 | 20.6 | 15.4 | 30.3 | 1710 – 2170 MHz |

## Band-Specific Data with Low/High Band Tunes (Bypass Mode; VDD: 4.3V)

| Freq. (MHz) | Gain (dB) | NF (dB) | IP1dB (dBm) | OP1dB (dBm) | IIP3 (dBm) | OIP3 (dBm) | Tuning |
|---|---|---|---|---|---|---|---|
| 707 | -1.5 | 1.5 | 25.8 | 23.3 | 48.1 | 46.6 | 700 - 960 MHz |
| 737 | -1.2 | 1.2 | 25.8 | 23.6 | 47.9 | 46.7 | 700 - 960 MHz |
| 751 | -1.1 | 1.1 | 25.8 | 23.7 | 47.5 | 46.4 | 700 - 960 MHz |
| 782 | -1.2 | 1.2 | 25.7 | 23.5 | 48.0 | 46.8 | 700 - 960 MHz |
| 836 | -1.1 | 1.1 | 25.6 | 23.5 | 48.0 | 46.9 | 700 - 960 MHz |
| 881 | -1.1 | 1.1 | 25.8 | 23.7 | 47.9 | 46.8 | 700 - 960 MHz |
| 1732 | -1.5 | 1.5 | 24.2 | 21.7 | 47.5 | 46.0 | 1710 – 2170 MHz |
| 1880 | -1.3 | 1.3 | 23.8 | 21.5 | 47.0 | 45.7 | 1710 – 2170 MHz |
| 1960 | -1.2 | 1.2 | 23.4 | 21.2 | 47.4 | 46.2 | 1710 – 2170 MHz |
| 2132 | -1.3 | 1.3 | 23.1 | 20.8 | 47.5 | 46.2 | 1710 – 2170 MHz |

## GRF4042 Evaluation Board Performance (Standard Broadband Match):



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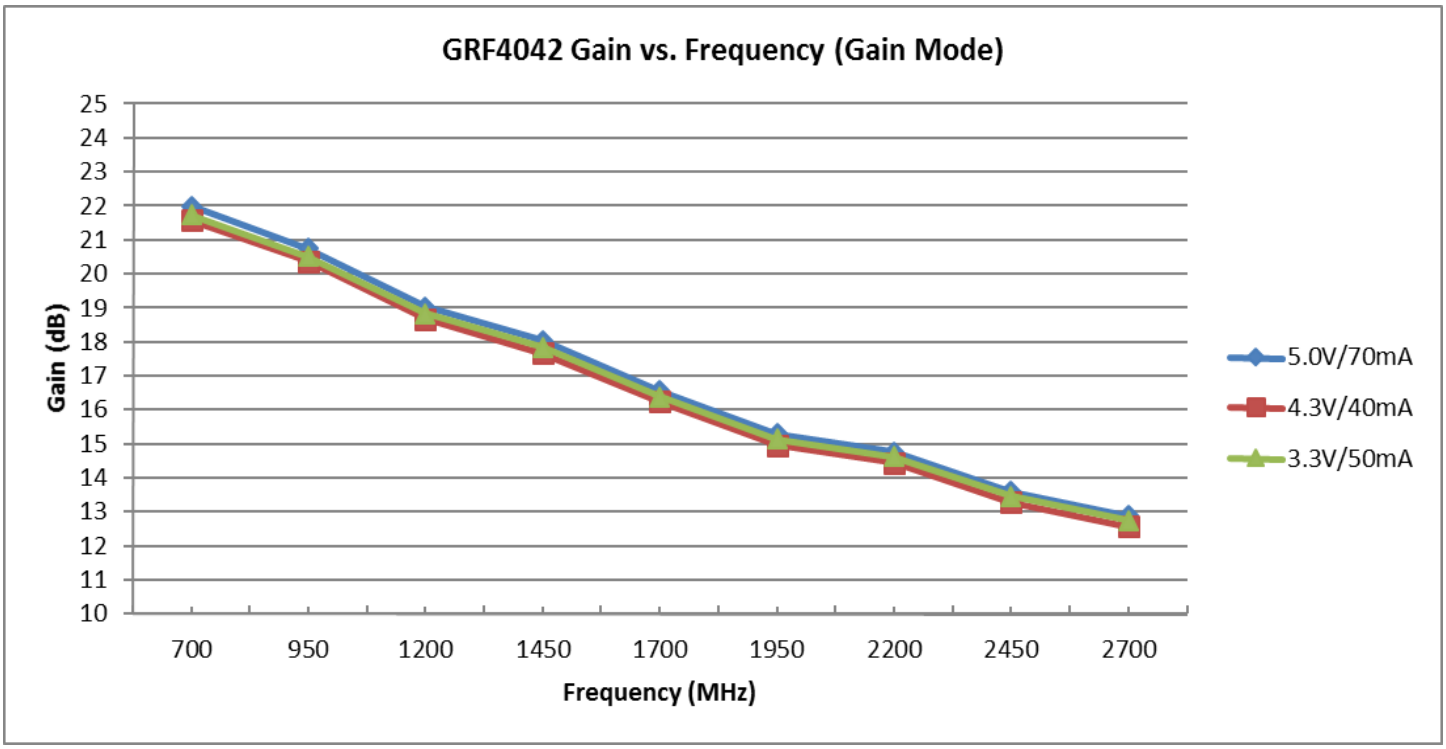


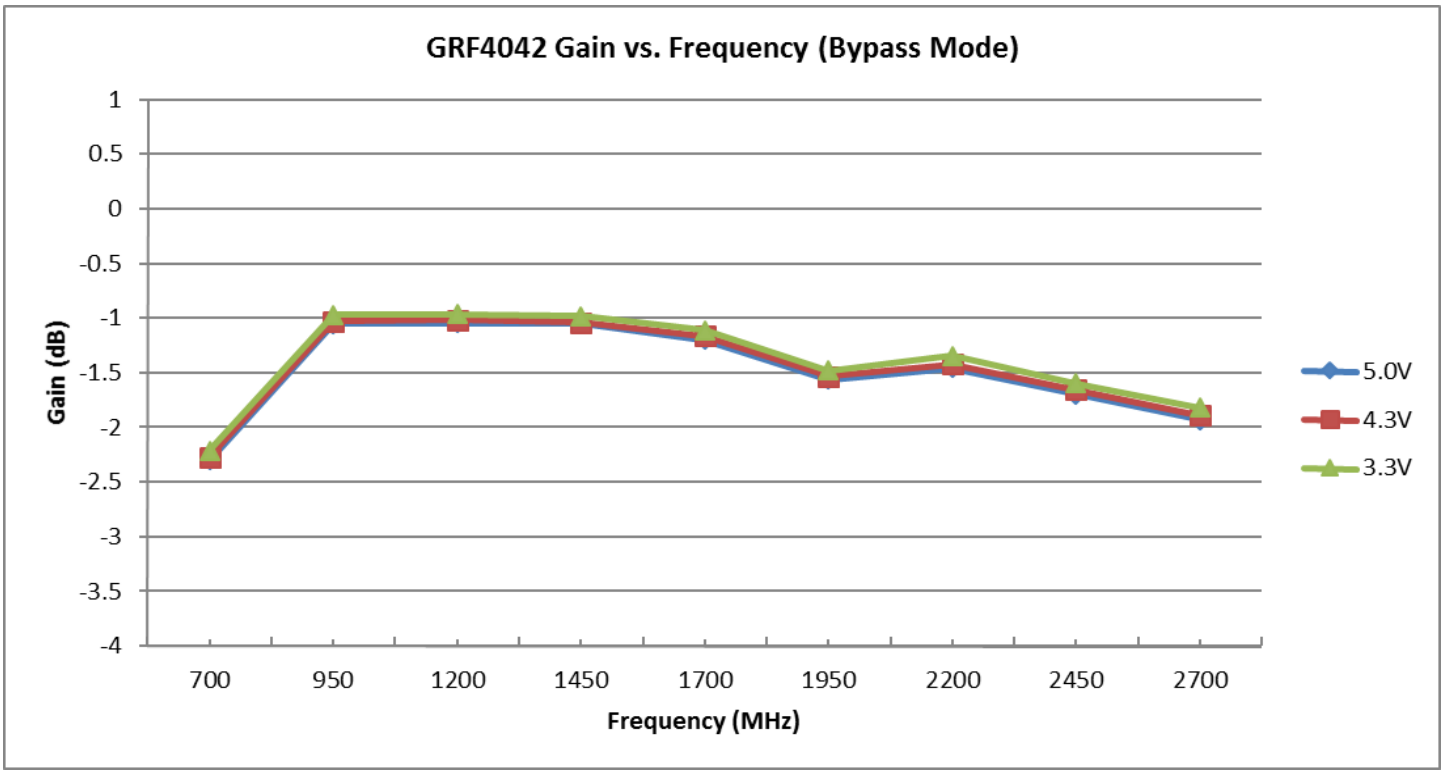

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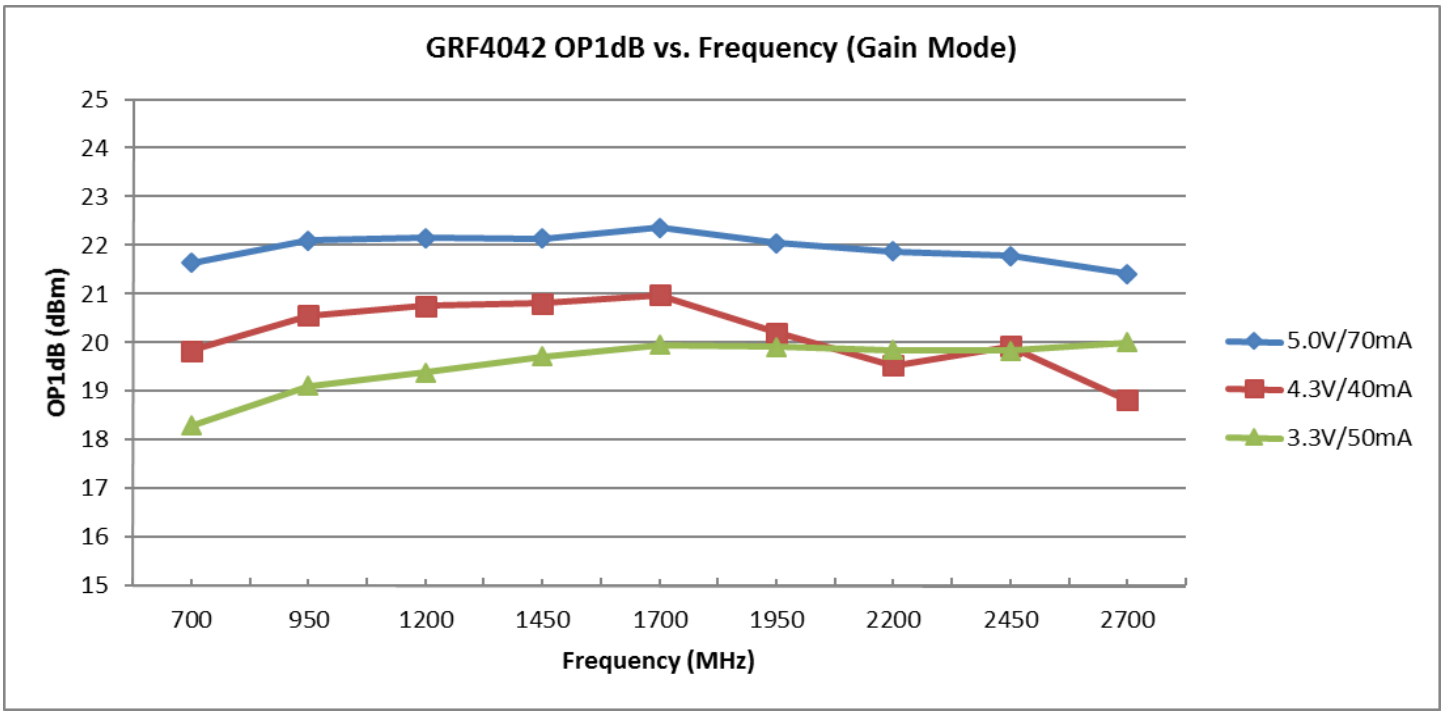


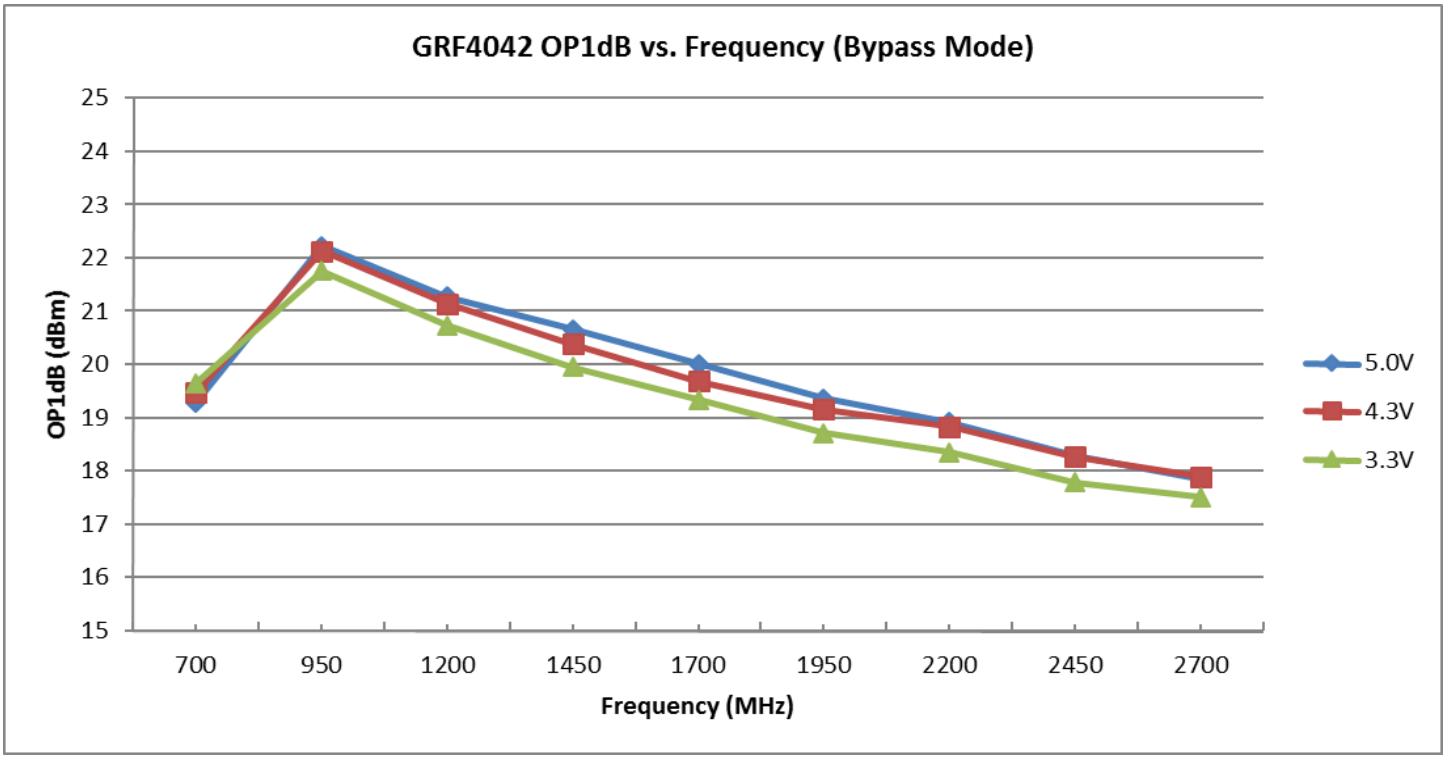

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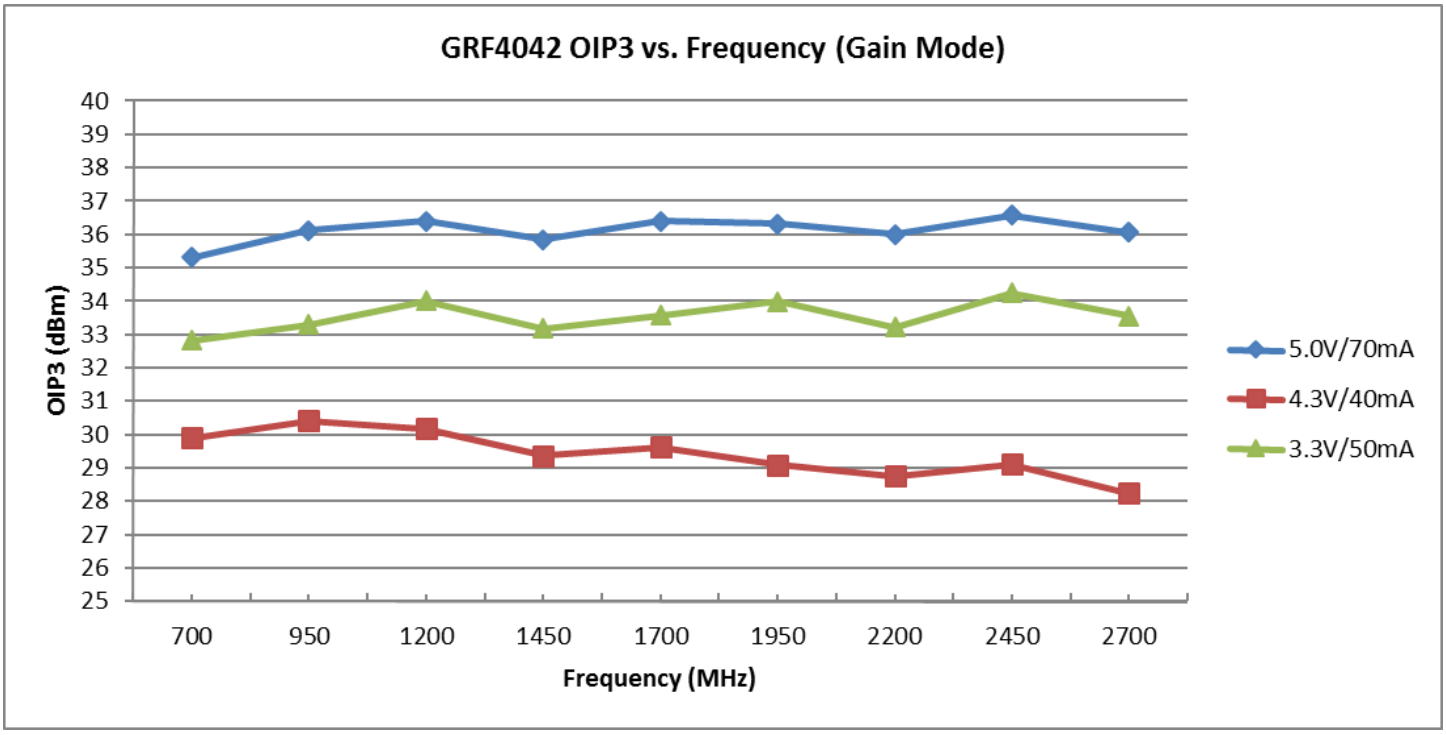
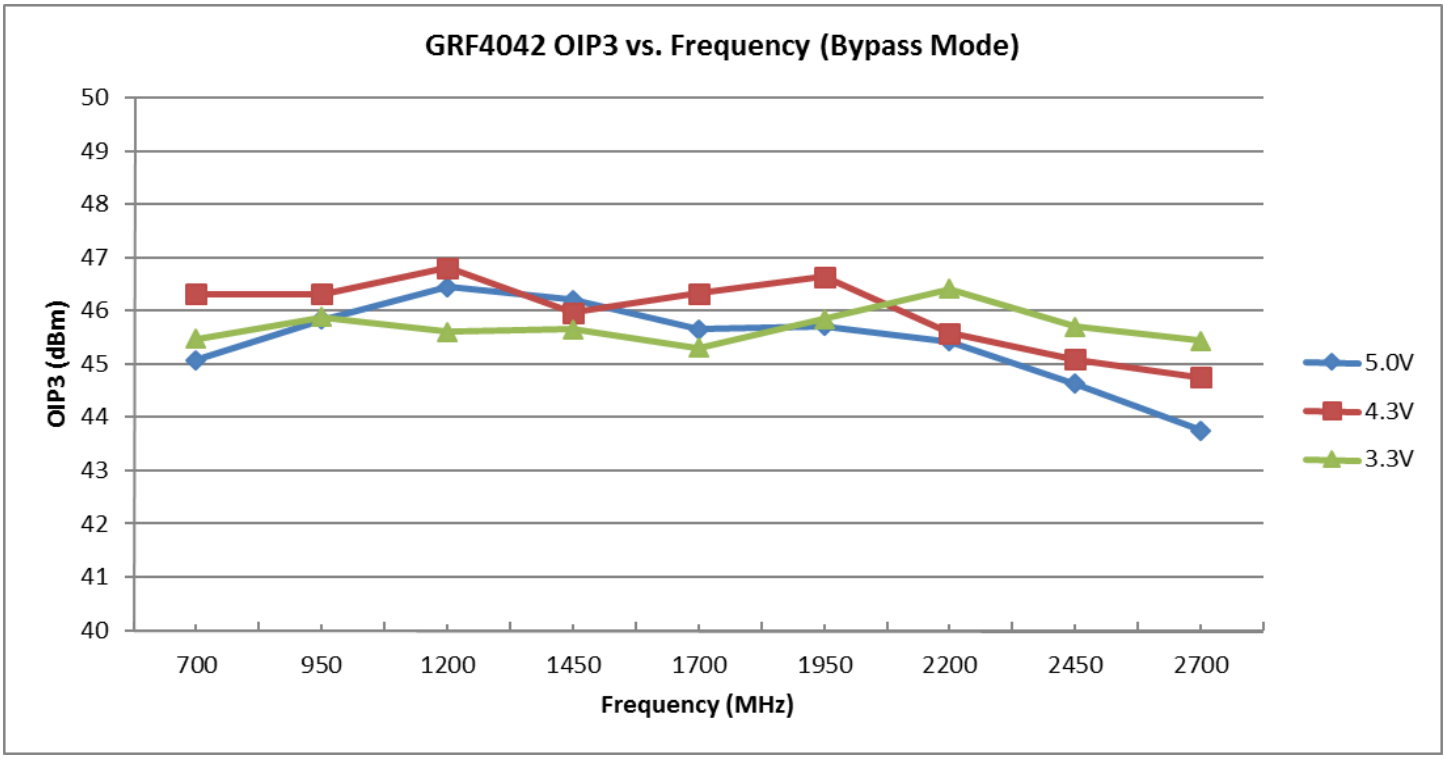
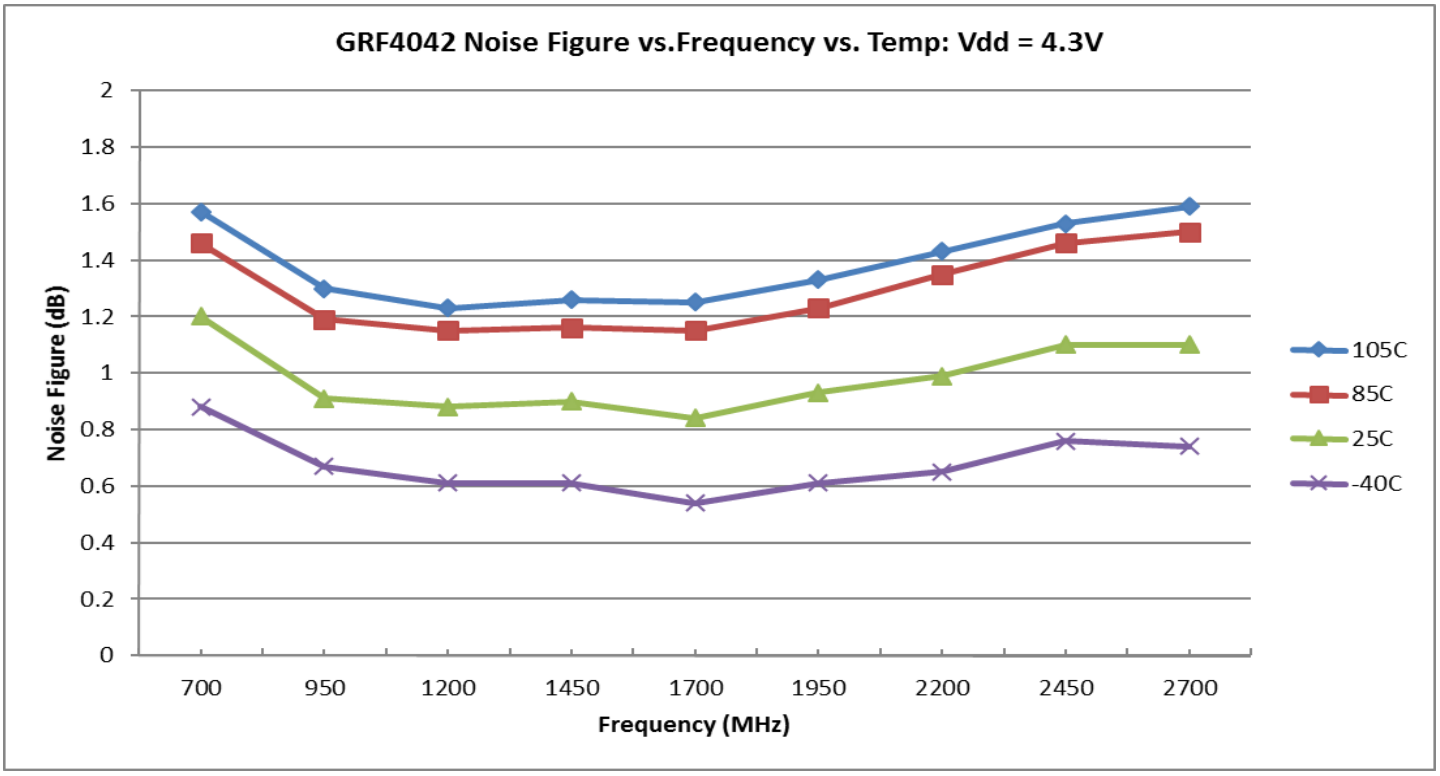
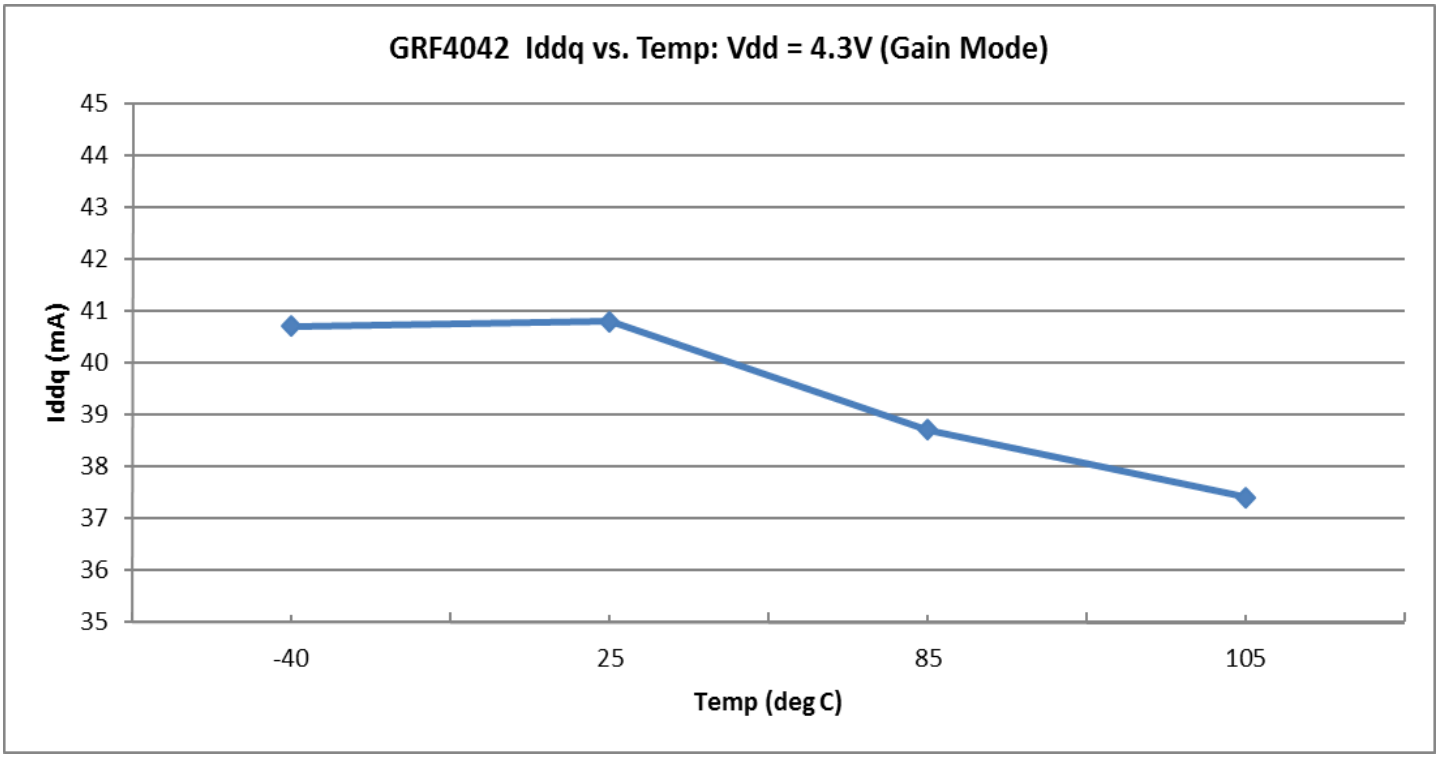


## GRF4042 EVB Performance vs. Temp. (Standard Broadband Match):



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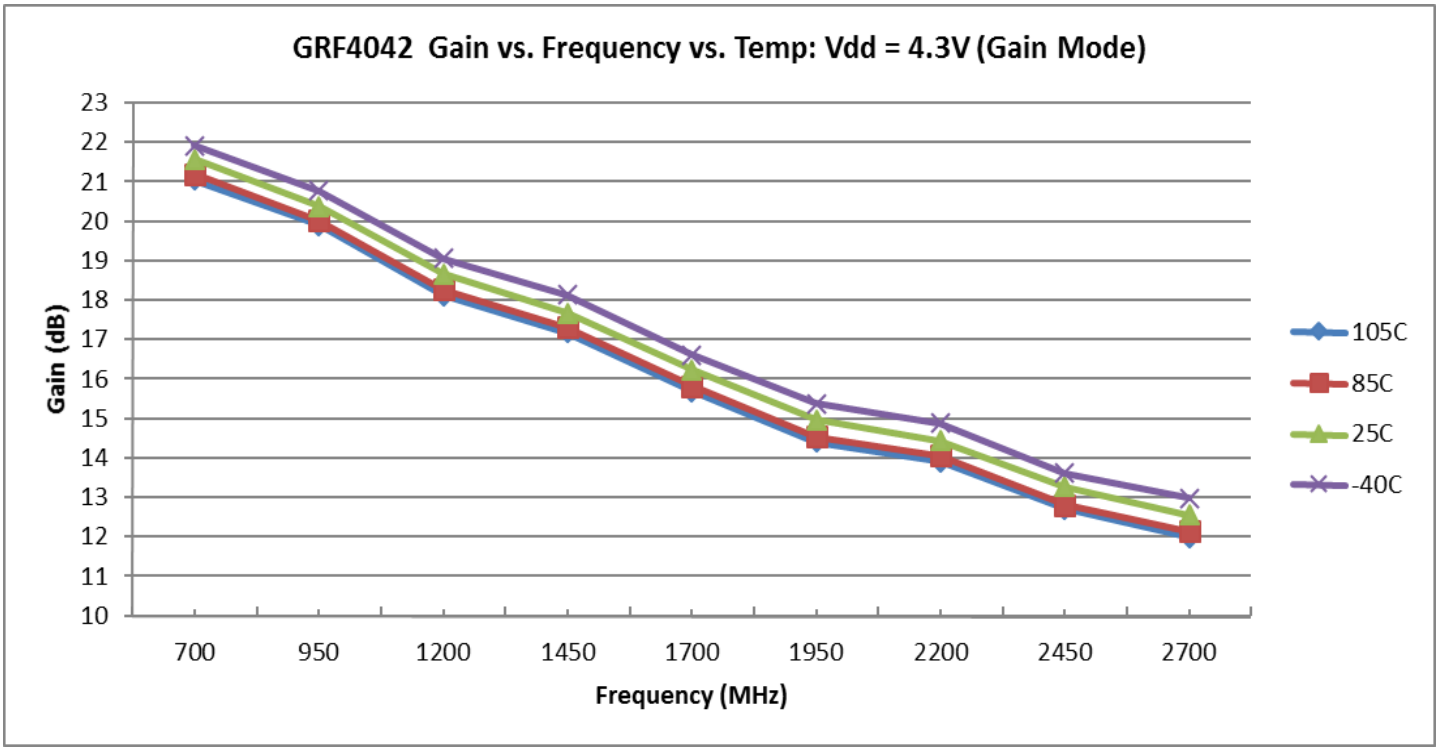


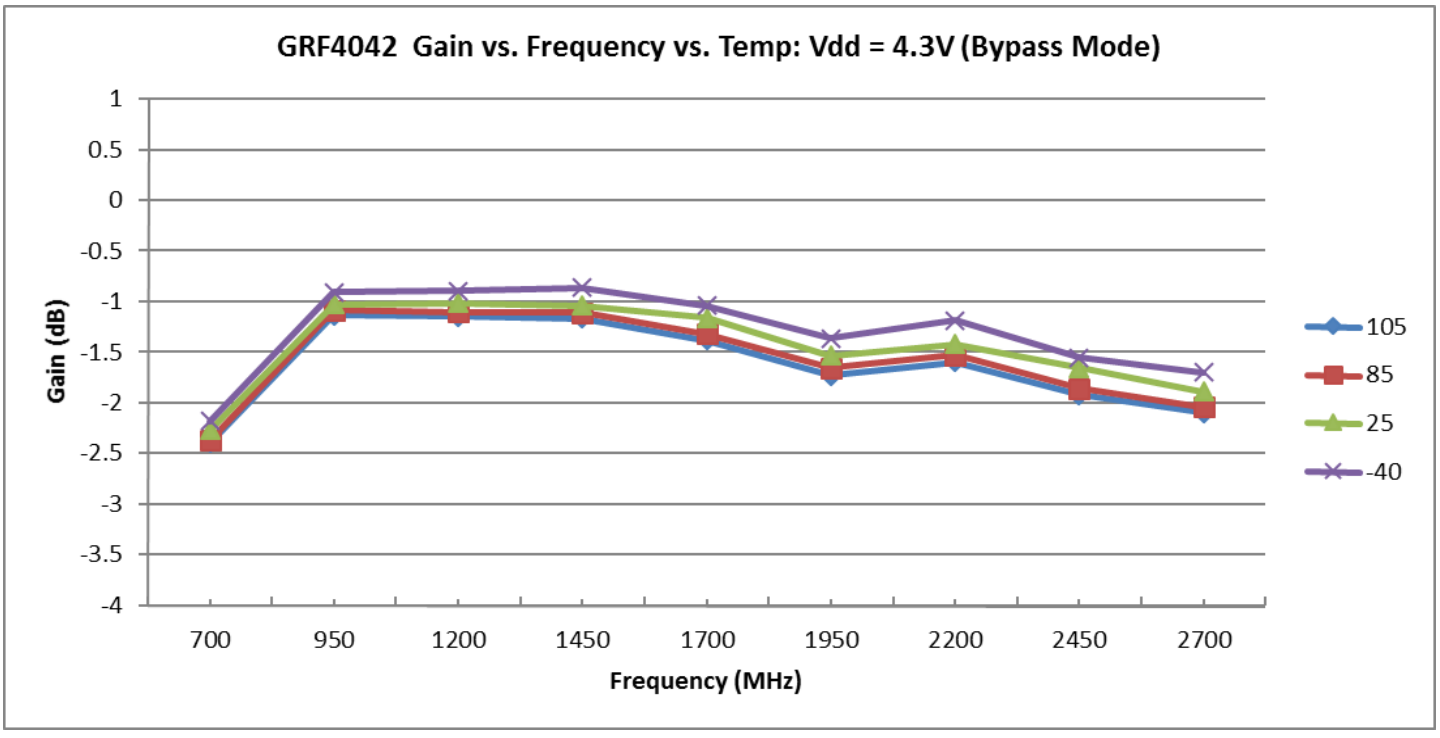

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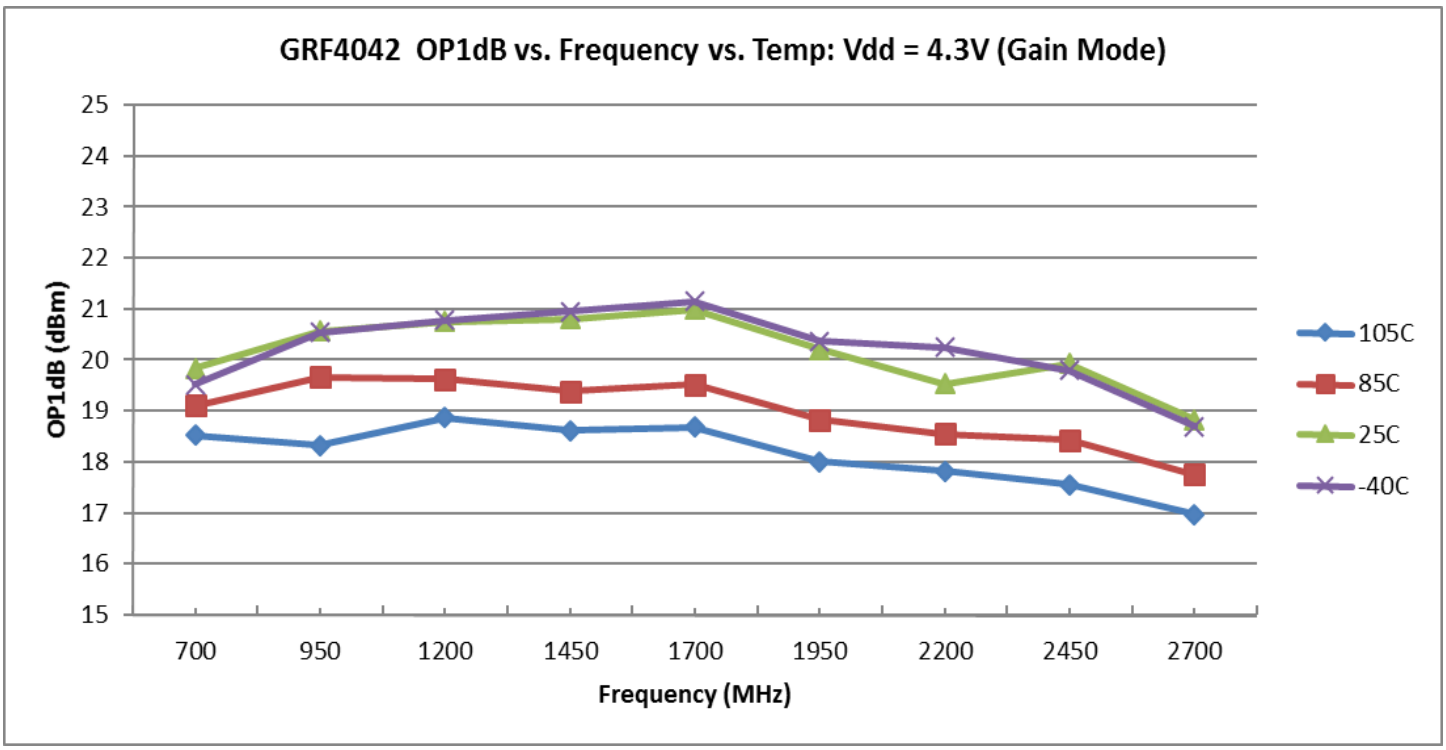


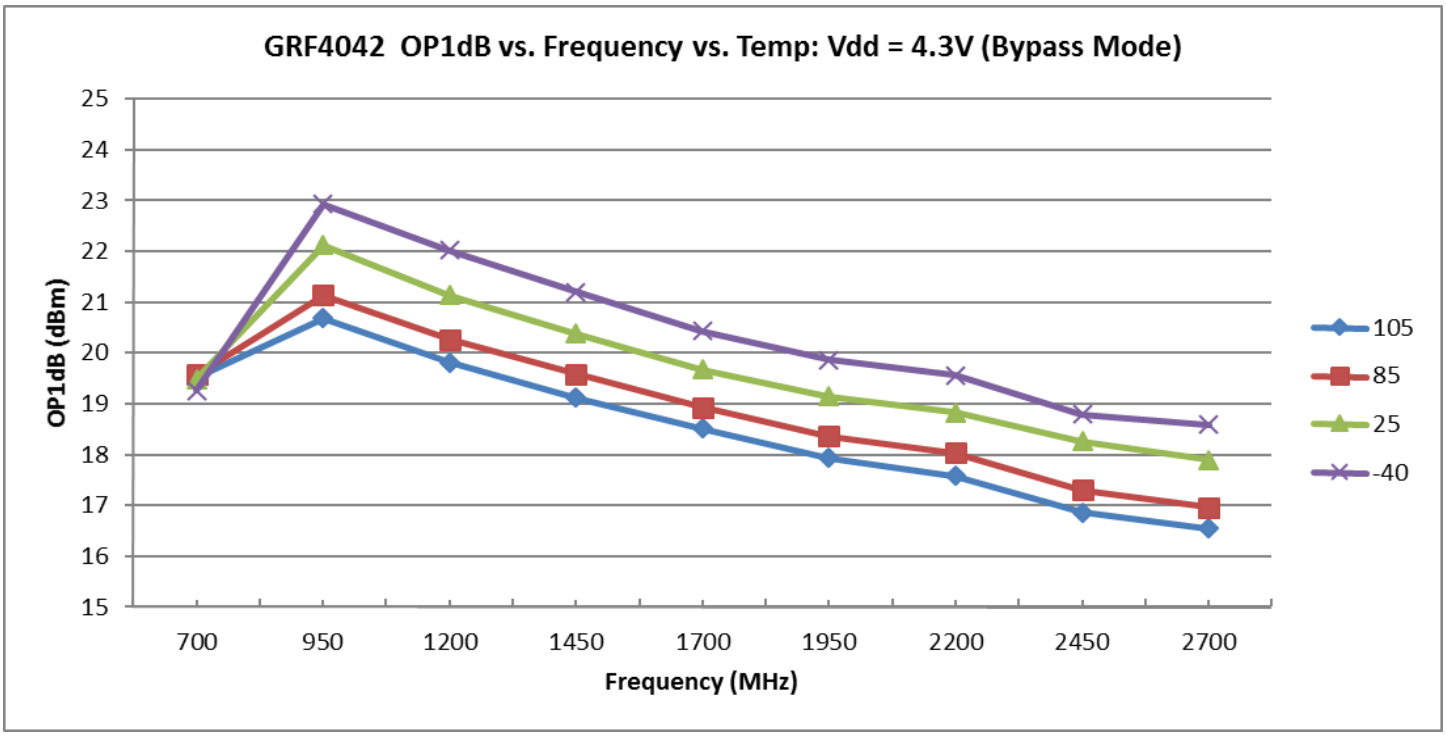

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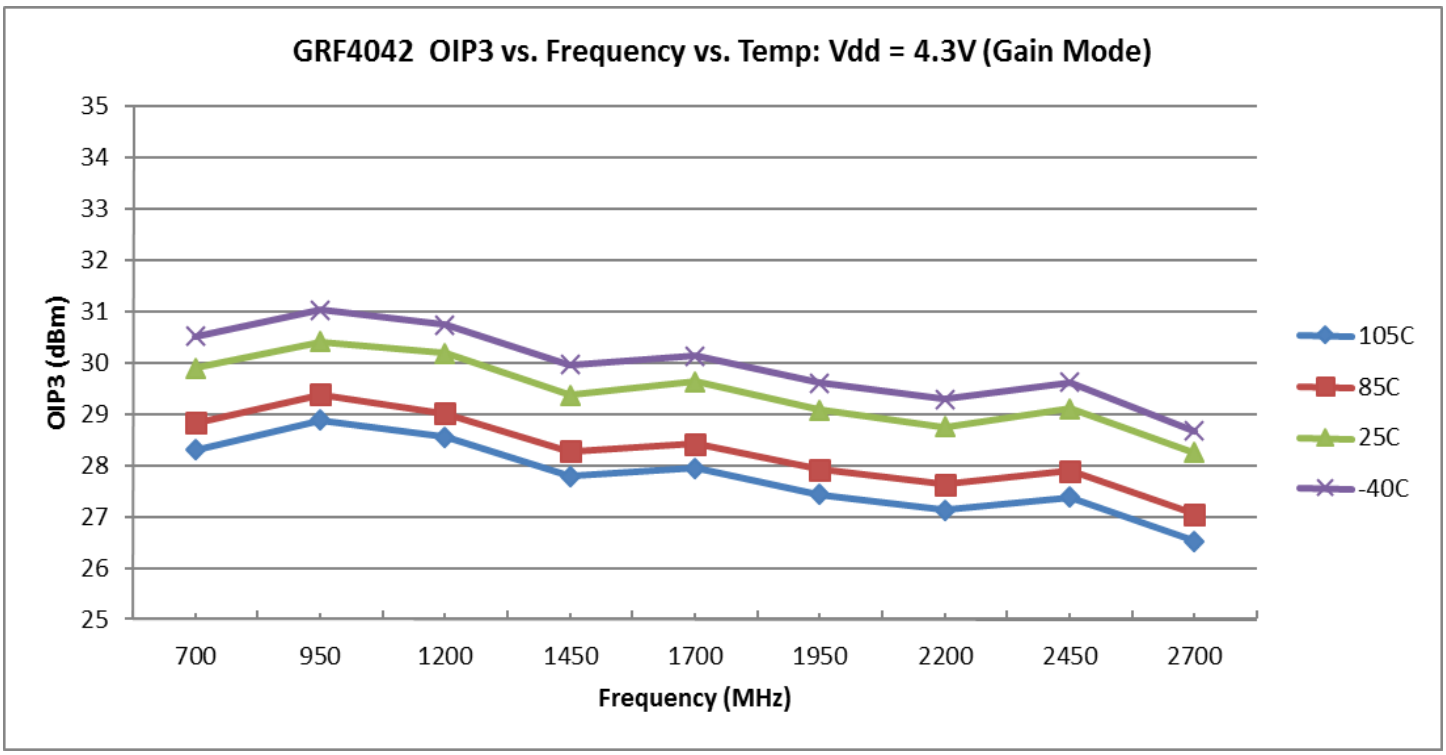
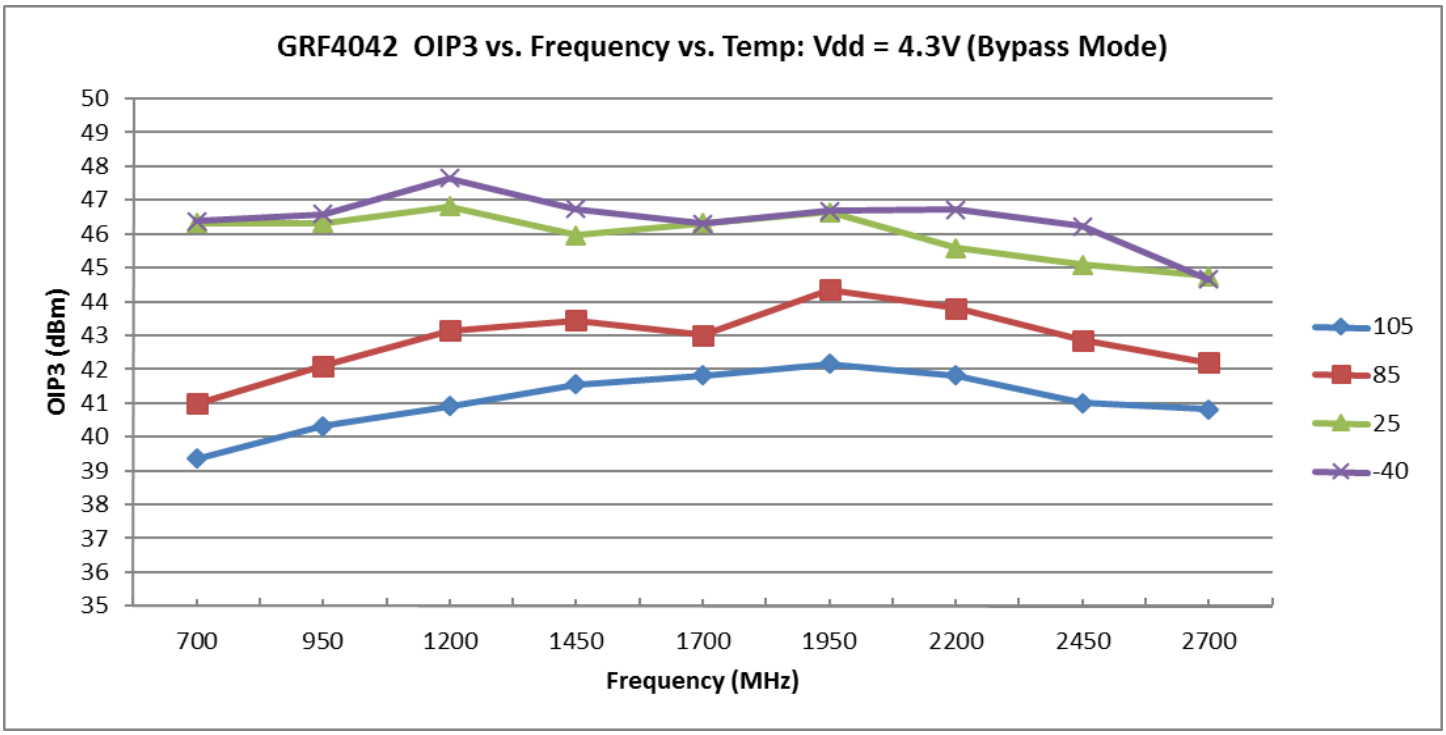
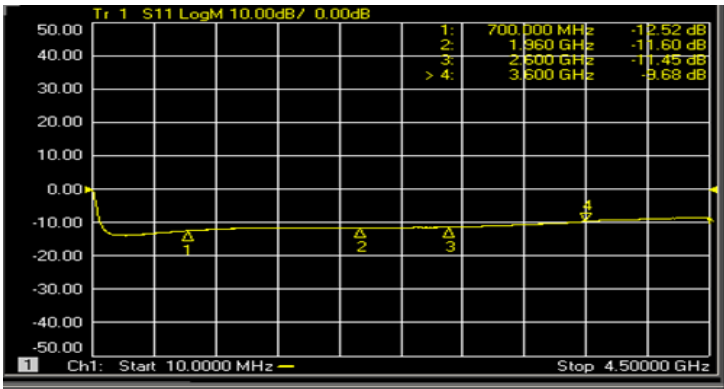
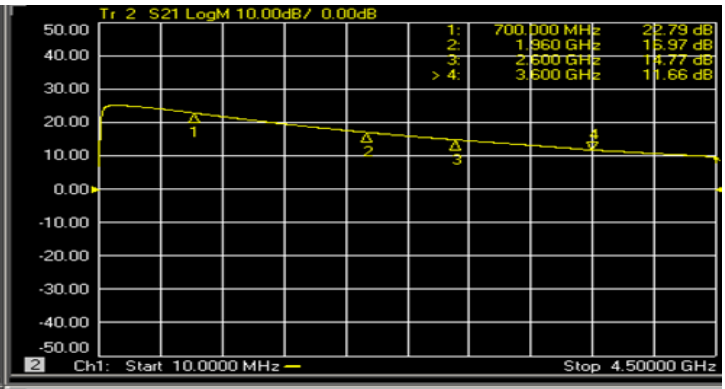
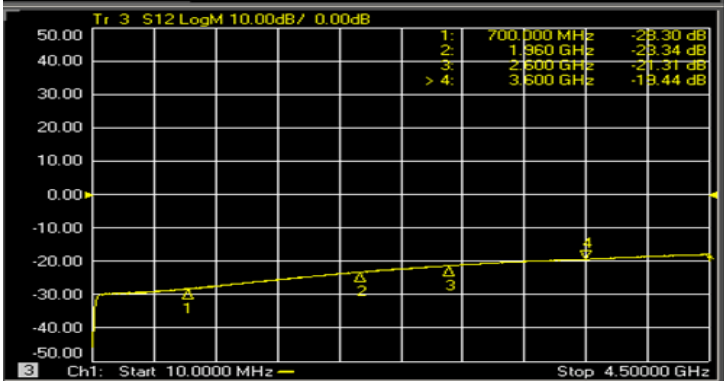


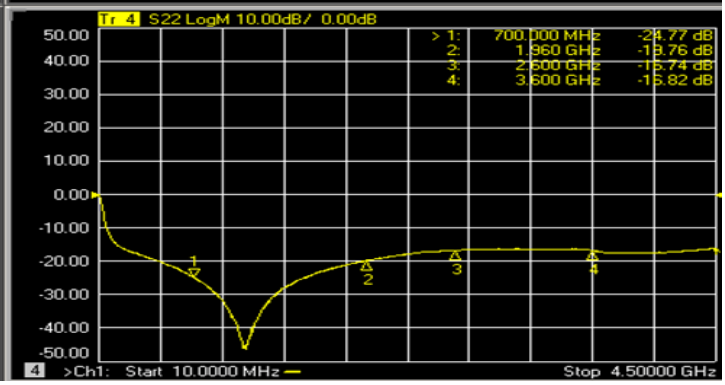



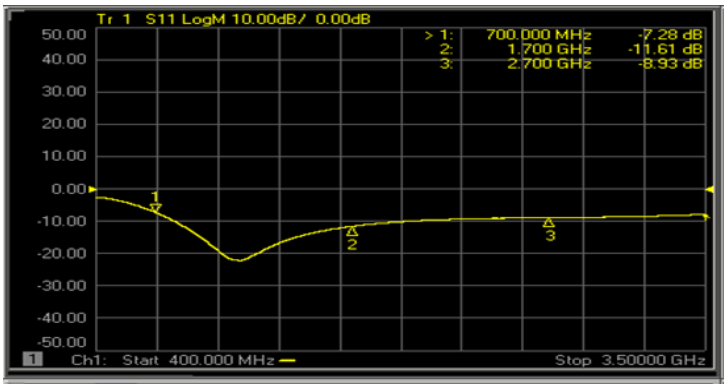
## GRF4042 EVB S-Parameters (4.3V/40 mA): (Standard Broadband Match)

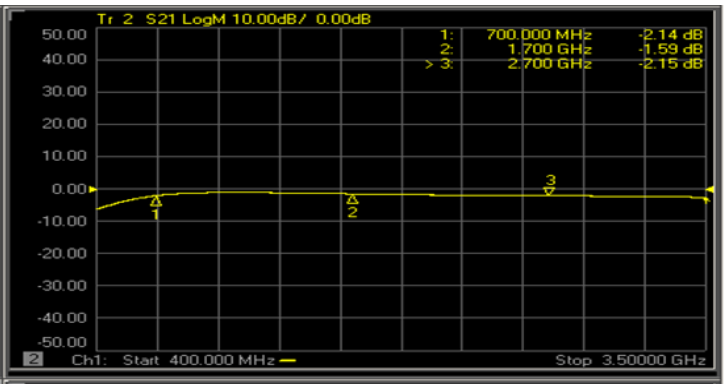


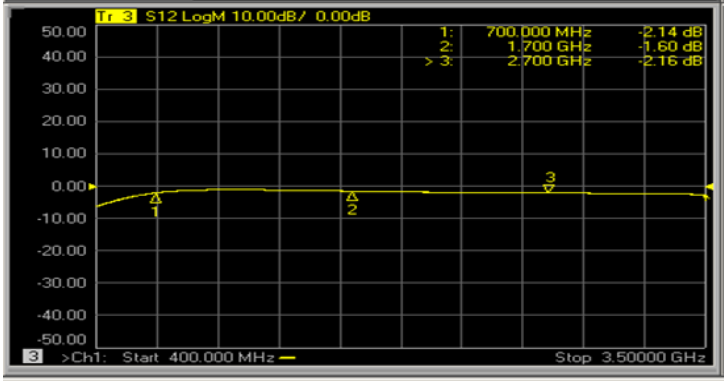



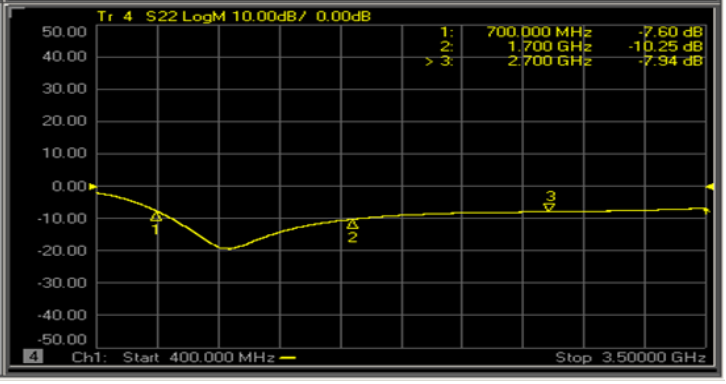



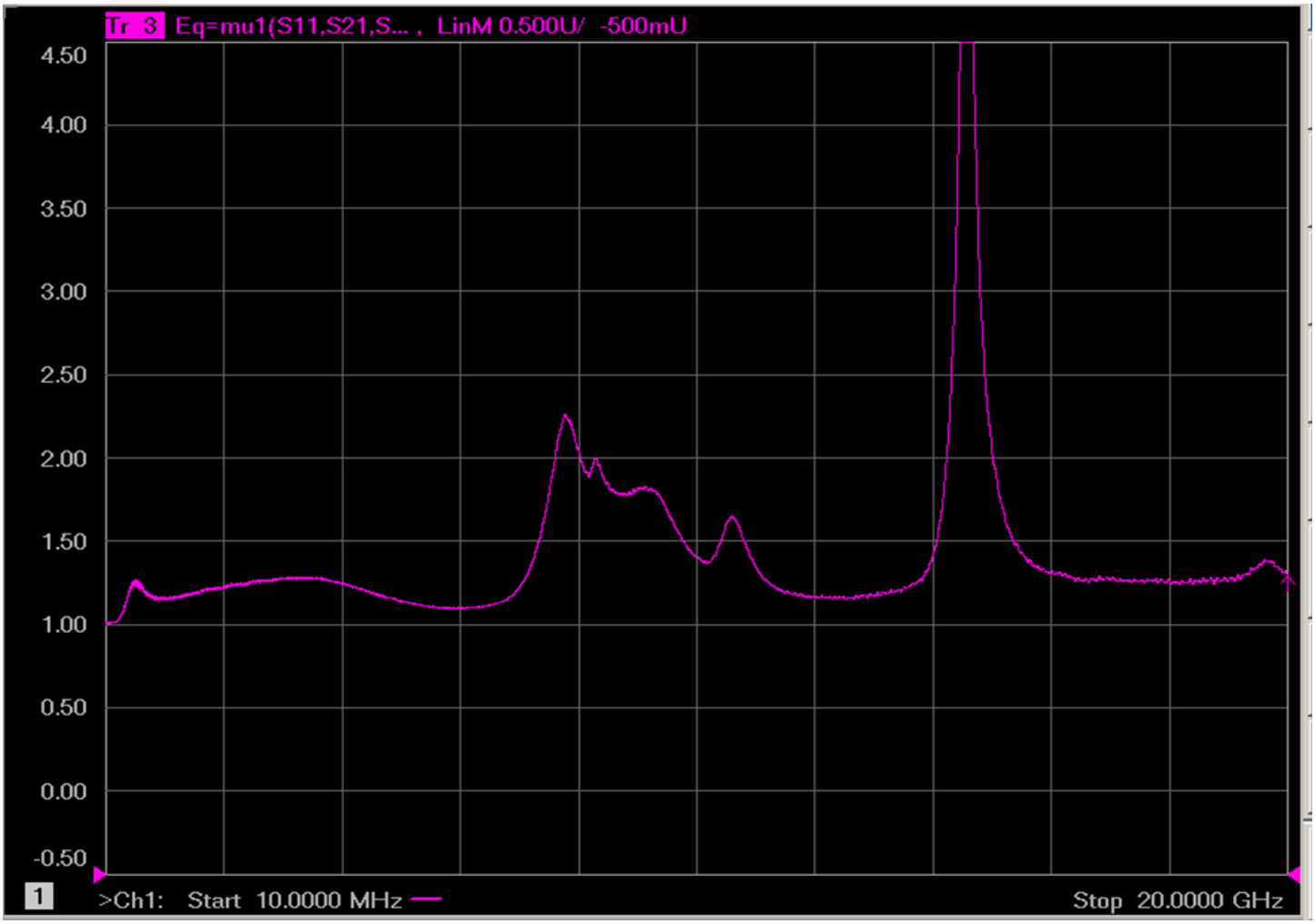



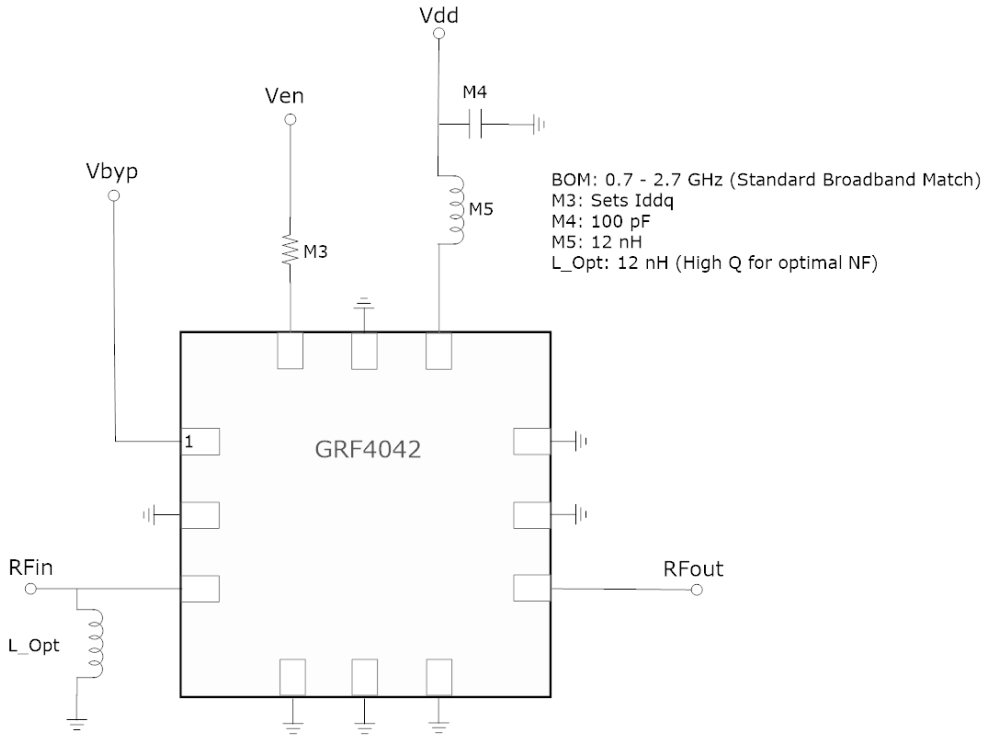



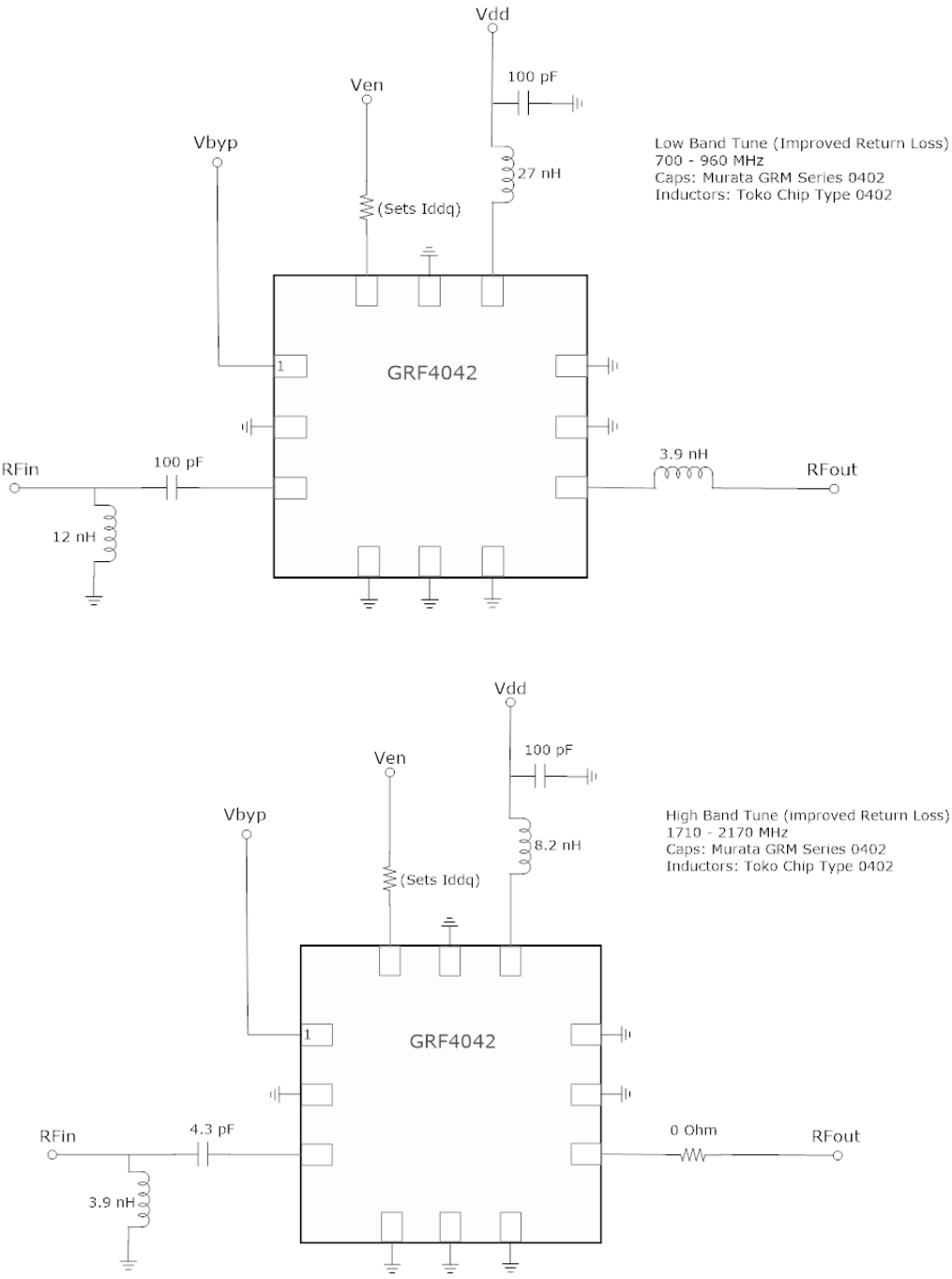



## GRF4042 EVB Stability Mu Factor: 4.3 volts and 40 mA (Gain Mode)



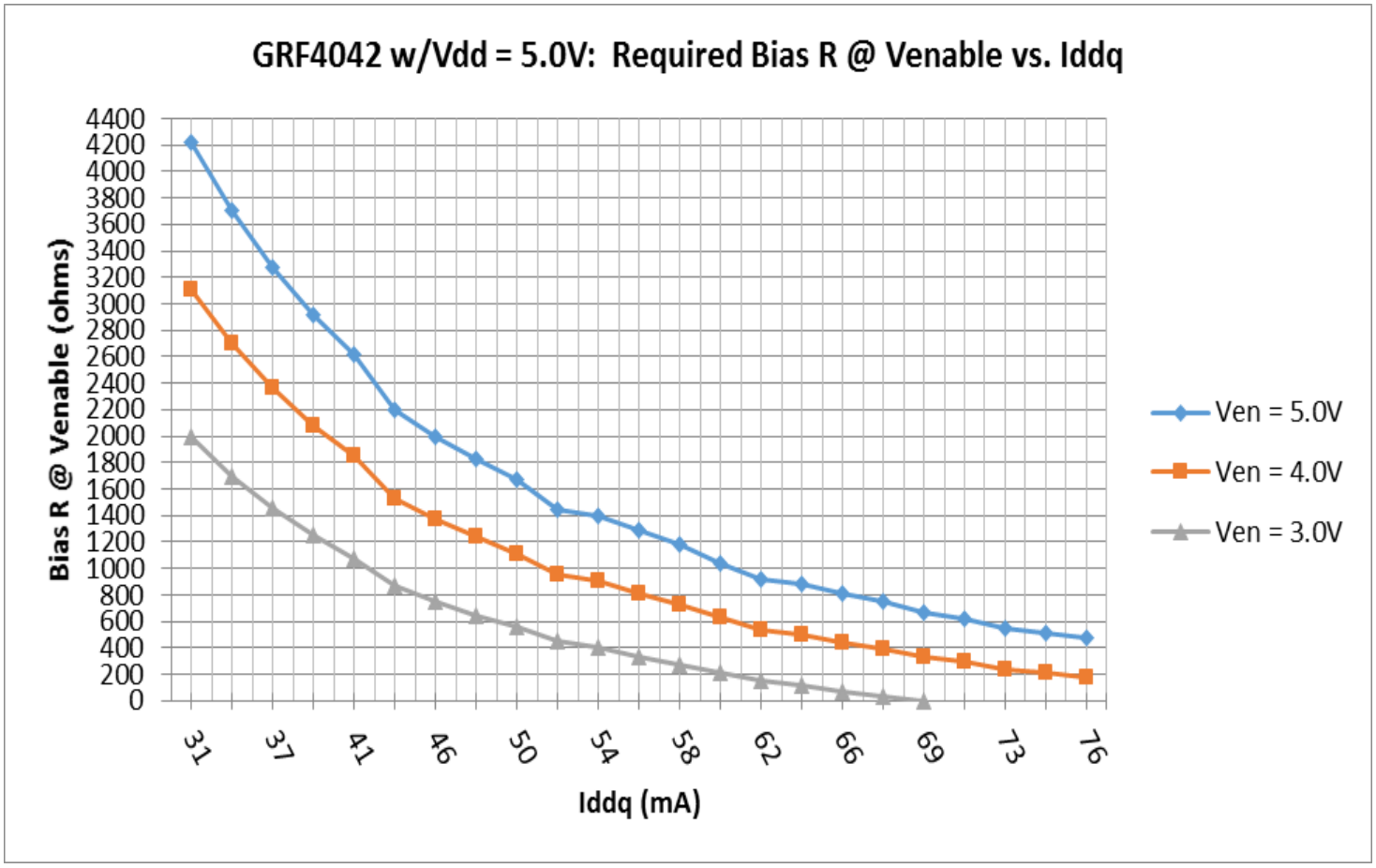



**GRF4042 Standard Application Schematic**

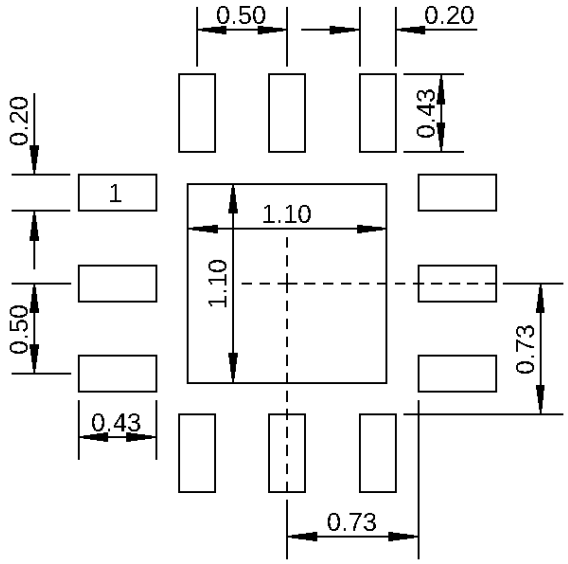



**GRF4042 Low Band/High Band Application Schematics**

## GRF4042 Bias Resistor Selection Curves

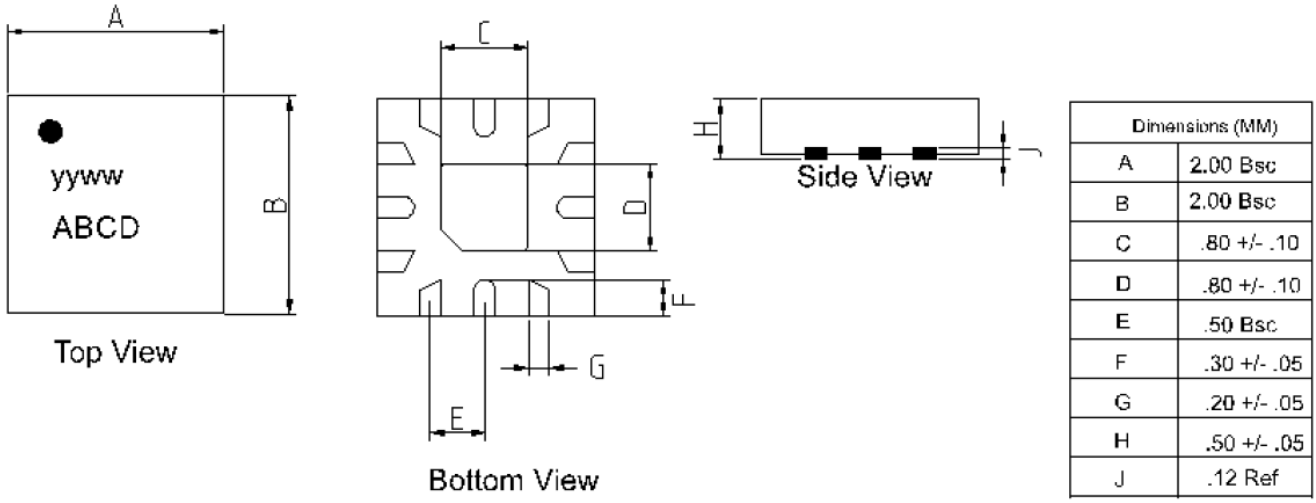



Note: Standard evaluation board bias: Vdd: 5.0V; Venable: 5.0V; M1:




Dimensions in millimeters

**2.0 mm QFN-12 Suggested PCB Footprint (Top View)**



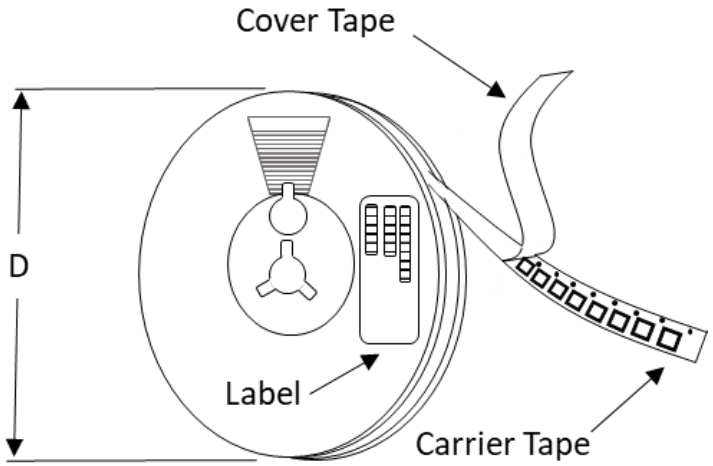

| Dimensions (MM) | |
|---|---|
| A | 2.00 Bsc |
| B | 2.00 Bsc |
| C | .80 +/- .10 |
| D | .80 +/- .10 |
| E | .50 Bsc |
| F | .30 +/- .05 |
| G | .20 +/- .05 |
| H | .50 +/- .05 |
| J | .12 Ref |

**2.0 mm QFN-12 Package Dimensions**

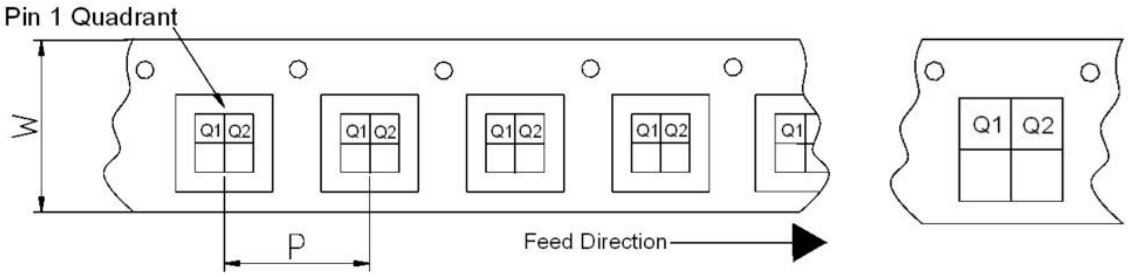
## Tape and Reel Information:

Guerrilla RF's Tape and Reel specification complies with the Electronics Industries Association (EIA) standards for 'Embossed Carrier Tape of Surface Mount Components for Automatic Handling". Reference EIA-481. See the table on the following page for Tape and Reel specifications along with units per reel.

Devices are loaded with pins down into the carrier pocket with protective cover tape, wound into a plastic reel. Each reel will be packaged in a cardboard box. There will be product labels on the reel, the protective ESD bag and the outside surface of the box.




**Tape and Reel Packaging with Reel Diameter Noted (D)**




**Carrier Tape Width (W), Pitch (P), Feed Direction and Pin 1 Quadrant Information**

## Tape and Reel Specification and Device Package Information Table

| Package | | | | Carrier Tape | | | Reel | |
|---|---|---|---|---|---|---|---|---|
| Type | Dimensions (mm) | Leads | Weight (mg) | Width (W) (mm) | Pocket Pitch (P) (mm) | Pin 1 Quad-rant | Diameter (D) (inches) | Units per Reel |
| QFN | 2.0 x 2.0 x 0.50 | 12 | 7 | 8 | 4 | Q1 | 7 | 2500 |
| QFN | 3.0 x 3.0 x 0.85 | 16 | 24 | 12 | 8 | Q1 | 7 | 1500 |
| DFN | 1.5 x 1.5 x 0.45 | 6 | 4 | 8 | 4 | Q1 | 7 | 2500 |
| DFN | 2.0 x 2.0 x 0.75 | 8 | 12 | 8 | 4 | Q1 | 7 | 2500 |
| LFM | 3.5 x 3.5 x 0.75 | See | TBD | 12 | 8 | Q2 | 7 | 1500 |
| LFM | 4.0 x 4.0 x 0.75 | See note | TBD | 12 | 8 | Q2 | 7 | 1500 |

Note: Lead count may vary. Reference applicable product data sheet

| Data Sheet Release Status: | Notes |
|---|---|
| Advance | S-parameter and NF data based on EM simulations for the fully packaged device using foundry supplied transistor s-parameters. Linearity estimates based on device size, bias condition and experience with related devices. |
| Preliminary | All data based on evaluation board measurements in the Guerrilla RF Applications Lab. |
| Released | All data based on device qualification data. Typically, this data is nearly identical to the data found in the preliminary version. Max and min values for key RF parameters are included. |

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