

TRF3722 具有集成 PLL 和 VCO 的正交调制器

1 特性

- 具有集成 PLL 和 VCO 的 IQ 调制器
- 整数 N/分数 N PLL
- 调制器支持 400MHz 至 4200MHz 频率范围
- PLL 和 VCO 支持 280MHz 至 4100MHz 的频率范围
- 900MHz 时的 OIP3 为 31 dBm
- 1800MHz 时的 OIP3 为 30 dBm
- VCO 1800MHz 开环相位噪声: 1MHz 偏移时为 -141 dBc/Hz
- 独立式 LO 输出支持 1/2/4/8 分频
- 调制器低功耗和高增益模式
- 多种断电模式

2 应用

- 无线基础设施
 - CDMA: IS95, UMTS, CDMA2000, TD-SCDMA
 - LTE, TD-LTE, LTE Advanced
 - TDMA: GSM, EDGE, MC-GSM
- 点对点微波, 点对多点微波
- 软件定义的无线电
- 射频中继器, 分布式天线系统

3 说明

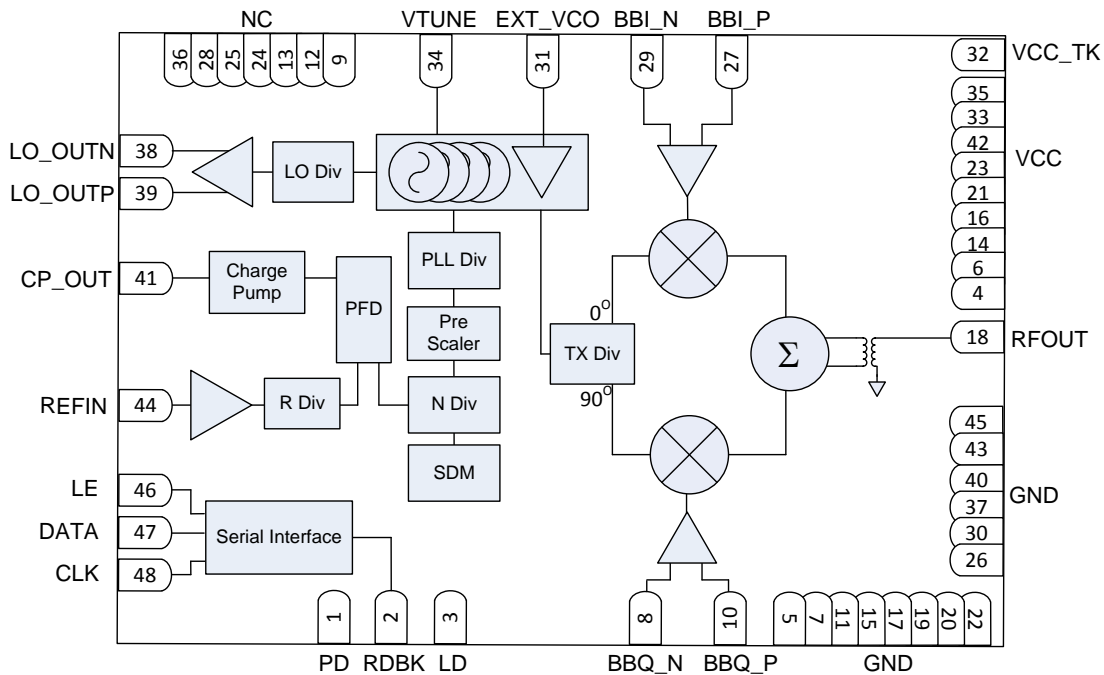
TRF3722 是一款高性能直接转换正交调制器, 具有优异的线性和低噪声性能。基带共模电压典型值为 0.25V, 支持与电流源 DAC 的无缝连接。此器件集成了 PLL 和 VCO, 能够为调制器提供本地振荡器 (LO)。PLL 和 VCO 可实现卓越的相位噪声性能, 能够满足最为严格的传输通信要求。此器件还提供了额外的 LO 输出, 用于驱动其它调制器或降频混频器。该调制器具有一个可实现典型 3dB 增益提升的高增益模式和一个适用于需要对功耗进行优化的应用的低功耗模式。

器件信息(1)

| 器件型号 | 封装 | 封装尺寸 (标称值) |
|---------|-----------|-----------------|
| TRF3722 | VQFN (48) | 7.00mm x 7.00mm |

(1) 如需了解所有可用封装, 请见数据表末尾的可订购产品附录。

方框图



目录

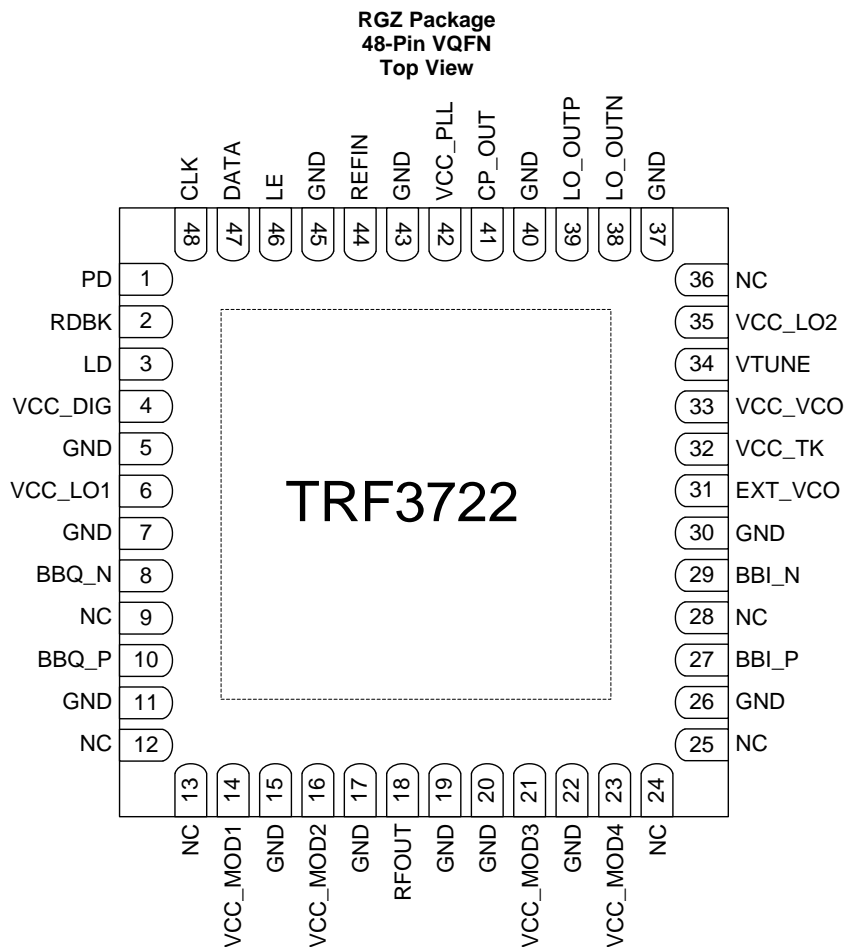
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4 修订历史记录

| Changes from Revision A (June 2014) to Revision B | Page |
|--|-------------|
| • 已更改 256MHz 更改为 280MHz (PLL 和 VCO 特性 要点部分) | 1 |
| • Changed <i>ESD Ratings</i> table title, updated to current standards | 4 |
| • Added <i>Typical</i> and footnote 2 to <i>Typical VCO frequency range</i> and <i>Typical output frequency range</i> parameters | 8 |
| • Changed Figure 1 | 9 |
| • Changed location of <i>TRF3722 Application Schematic</i> figure and all associated text to be under <i>Typical Application</i> section | 55 |

| Changes from Original (May 2014) to Revision A | Page |
|---|-------------|
| • 从单页产品预览更改为生产 | 1 |

5 Pin Configuration and Functions



Pin Functions

| PIN | | I/O | DESCRIPTION |
|---------|--|-----|--|
| NAME | NO. | | |
| BBI_N | 29 | I | BB in-phase input: negative |
| BBI_P | 27 | I | BB in-phase input: positive |
| BBQ_N | 8 | I | BB quadrature input: negative |
| BBQ_P | 10 | I | BB quadrature input: positive |
| CLK | 48 | I | Serial interface clock input; digital input |
| CP_OUT | 41 | O | Charge pump output |
| DATA | 47 | I | Serial interface data input; digital input |
| EXT_VCO | 31 | I | External local oscillator input |
| GND | 5, 7, 11, 15, 17, 19, 20, 22, 26, 30, 37, 40, 43, 45 | | Ground |
| LD | 3 | O | PLL lock detect output |
| LE | 46 | I | Serial interface latch enable; digital input |
| LO_OUTN | 38 | O | Local oscillator output: negative |
| LO_OUTP | 39 | O | Local oscillator output: positive |
| NC | 9, 12, 13, 24, 25, 36 | | No connect |
| NC | 28 | | No connect; N/C or ground to paddle |

Pin Functions (continued)

| PIN | | I/O | DESCRIPTION |
|----------|-----|-----|---|
| NAME | NO. | | |
| PD | 1 | I | LO Div, TX Div, modulator power down (High = PD) |
| RDBK | 2 | O | Serial interface internal registers readback output |
| REFIN | 44 | I | Reference clock input |
| RFOUT | 18 | O | RF output |
| VCC_DIG | 4 | | 3.3 V digital power supply |
| VCC_LO1 | 6 | | 3.3 V TX Div power supply |
| VCC_LO2 | 35 | | 3.3 V LO Div power supply |
| VCC_MOD1 | 14 | | 3.3 V modulator power supply |
| VCC_MOD2 | 16 | | 3.3 V modulator power supply |
| VCC_MOD3 | 21 | | 3.3 V modulator power supply |
| VCC_MOD4 | 23 | | 3.3 V modulator power supply |
| VCC_PLL | 42 | | 3.3 V PLL power supply |
| VCC_TK | 32 | | 3.3 V or 5 V VCO tank power supply |
| VCC_VCO | 33 | | 3.3 V VCO power supply |
| VTUNE | 34 | I | VCO control voltage input |

6 Specifications

6.1 Absolute Maximum Ratings

 over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|---------------------------------------|-----------------------|------|------|------|
| Supply voltage | All VCC except VCC_TK | -0.3 | +3.6 | V |
| | VCC_TK | -0.3 | +5.5 | |
| Digital I/O voltage | | -0.3 | 3.6 | V |
| Operating junction temperature | | -40 | 150 | °C |
| Storage temperature, T _{stg} | | -40 | 150 | °C |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--|--|-------|------|
| V _(ESD) Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | ±2000 | V |
| | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | ±750 | |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | | MIN | NOM | MAX | UNIT |
|-----------------|---|-----|-------|-----|------|
| V _{CC} | 3.3 V power-supply voltage | 3 | 3.3 | 3.6 | V |
| | 5 V or 3.3 V power-supply voltage, VCC_TK | 3 | 3.3/5 | 5.5 | V |
| T _J | Operating junction temperature range | -40 | | 125 | °C |
| T _A | Ambient temperature range | -40 | | 85 | °C |

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | TRF3722 | UNIT |
|-------------------------------|--|------------|------|
| | | RGZ (VQFN) | |
| | | 48 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 27.5 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 12.8 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 4.3 | °C/W |
| ψ _{JT} | Junction-to-top characterization parameter | 0.2 | °C/W |
| ψ _{JB} | Junction-to-board characterization parameter | 4.3 | °C/W |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | 0.8 | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics

Over recommended operating conditions: VCC = 3.3 V, VCC_TK = 5 V, T_A = 25°C. Optimized bias settings as per [Table 16](#).

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|----------------------------------|---|------|--------------------|------|--------|
| DC PARAMETERS | | | | | | |
| I _{CC} | 3.3 V Supply Current | Typical Operating Mode; LO out = Off | | 328 ⁽¹⁾ | | mA |
| | | Typical Operating Mode; LO out = On | | 374 | | mA |
| I _{CC_TK} | 5 V Supply Current | | | 21 | | mA |
| P _{DISS} | Total Power Dissipation | Typical Operating Mode; LO out = Off | | 1.18 | | W |
| | | Typical Operating Mode; LO out = On | | 1.34 | | W |
| | | Low Power Mode (Mod); LO out = Off | | 0.91 | | W |
| I _{PD} | Power Down Current | Hardware Power Down | | 76 | | mA |
| | | Serial interface Power Down | | 2 | | mA |
| RFOUT FREQUENCY | | | | | | |
| | Frequency | | 400 | | 4200 | MHz |
| IQ MODULATOR f_{LO} = 750 MHz | | | | | | |
| G | Gain | Typical Operating Mode | | 0.8 | | dB |
| | | High Gain Mode | | 3.6 | | dB |
| | Gain Flatness | In 300MHz bandwidth | -0.5 | | 0.5 | dB |
| OP1dB | Output Compression Point | | | 10.2 | | dBm |
| OIP3 | Output 3rd Order Intercept Point | F _{BB} = 4.5, 5.5 MHz | | 31 | | dBm |
| OIP2 | Output 2nd Order Intercept Point | F _{BB} = 4.5, 5.5 MHz | | 62 | | dBm |
| SBS | Unadj. SideBand Suppression | | | -42 | | dBc |
| CF | Unadj. Carrier Feedthrough | | | -50 | | dBm |
| NSD _O | Output Noise Spectral Density | BB inputs terminated on 50 Ω | | -159 | | dBm/Hz |
| HD2 _{LO} | LO Second Harmonic | Measured at 2 × f _{LO} | | -49 | | dBc |
| HD3 _{LO} | LO Third Harmonic | Measured at 3 × f _{LO} | | -47 | | dBc |
| HD2 _{BB} | Baseband Second Harmonic | Measured at f _{LO} ± 2 × f _{BB} | | -72 | | dBc |
| HD3 _{BB} | Baseband Third Harmonic | Measured at f _{LO} ± 3 × f _{BB} | | -70 | | dBc |

(1) Powered down output buffer and LO divider.

Electrical Characteristics (continued)

 Over recommended operating conditions: $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$. Optimized bias settings as per [Table 16](#).

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|----------------------------------|--|------|-------|-----|--------|
| IQ MODULATOR $f_{LO} = 900\text{ MHz}$ | | | | | | |
| G | Gain | Typical Operating Mode | | 0.8 | | dB |
| | | High Gain Mode | | 3.6 | | dB |
| | Gain Flatness | In 300MHz bandwidth | -0.5 | | 0.5 | dB |
| OP1dB | Output Compression Point | | | 10 | | dBm |
| OIP3 | Output 3rd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 31 | | dBm |
| OIP2 | Output 2nd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 62.5 | | dBm |
| SBS | Unadj. Side Band Suppression | | | -42.5 | | dBc |
| CF | Unadj. Carrier Feed through | | | -50 | | dBm |
| NSD _O | Output Noise Spectral Density | BB inputs terminated on 50 Ω | | -159 | | dBm/Hz |
| HD2 _{LO} | LO Second Harmonic | Measured at $2 \times f_{LO}$ | | -47 | | dBc |
| HD3 _{LO} | LO Third Harmonic | Measured at $3 \times f_{LO}$ | | -54.5 | | dBc |
| HD2 _{BB} | Baseband Second Harmonic | Measured at $f_{LO} \pm 2 \times f_{BB}$ | | -65.5 | | dBc |
| HD3 _{BB} | Baseband Third Harmonic | Measured at $f_{LO} \pm 3 \times f_{BB}$ | | -71.5 | | dBc |
| IQ MODULATOR $f_{LO} = 1800\text{ MHz}$ | | | | | | |
| G | Gain | Typical Operating Mode | | 0.3 | | dB |
| | | High Gain Mode | | 3 | | dB |
| | Gain Flatness | In 300 MHz bandwidth | -0.5 | | 0.5 | dB |
| OP1dB | Output Compression Point | | | 13 | | dBm |
| OIP3 | Output 3rd Order Intercept Point | $f_{BB} = 4.5, 5.5\text{ MHz}$ | | 29.5 | | dBm |
| OIP2 | Output 2nd Order Intercept Point | $f_{BB} = 4.5, 5.5\text{ MHz}$ | | 57 | | dBm |
| SBS | Unadj. Side Band Suppression | | | -54.5 | | dBc |
| CF | Unadj. Carrier Feed through | | | -57 | | dBm |
| NSD _O | Output Noise Spectral Density | BB inputs terminated on 50 Ω | | -158 | | dBm/Hz |
| HD2 _{LO} | LO Second Harmonic | Measured at $2 \times f_{LO}$ | | -36.5 | | dBc |
| HD3 _{LO} | LO Third Harmonic | Measured at $3 \times f_{LO}$ | | -33.5 | | dBc |
| HD2 _{BB} | Baseband Second Harmonic | Measured at $f_{LO} \pm 2 \times f_{BB}$ | | -65.5 | | dBc |
| HD3 _{BB} | Baseband Third Harmonic | Measured at $f_{LO} \pm 3 \times f_{BB}$ | | -73 | | dBc |
| RL _O | RF Output Return Loss | | | 6 | | dB |
| IQ MODULATOR $f_{LO} = 2150\text{ MHz}$ | | | | | | |
| G | Gain | Typical Operating Mode | | 0.2 | | dB |
| | | High Gain Mode | | 3 | | dB |
| | Gain Flatness | In 300 MHz bandwidth | -0.5 | | 0.5 | dB |
| OP1dB | Output Compression Point | | | 11.6 | | dBm |
| OIP3 | Output 3rd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 30 | | dBm |
| OIP2 | Output 2nd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 43 | | dBm |
| SBS | Unadj. Side Band Suppression | | | -43 | | dBc |
| CF | Unadj. Carrier Feedt hrough | | | -42 | | dBm |
| NSD _O | Output Noise Spectral Density | BB inputs terminated on 50 Ω | | -157 | | dBm/Hz |
| HD2 _{LO} | LO Second Harmonic | Measured at $2 \times f_{LO}$ | | -40 | | dBc |
| HD3 _{LO} | LO Third Harmonic | Measured at $3 \times f_{LO}$ | | -31 | | dBc |
| HD2 _{BB} | Baseband Second Harmonic | Measured at $f_{LO} \pm 2 \times f_{BB}$ | | -51 | | dBc |
| HD3 _{BB} | Baseband Third Harmonic | Measured at $f_{LO} \pm 3 \times f_{BB}$ | | -69 | | dBc |

Electrical Characteristics (continued)

Over recommended operating conditions: $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$. Optimized bias settings as per [Table 16](#).

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|----------------------------------|---|------|-------|-----|-----------------|
| IQ MODULATOR $f_{LO} = 2700\text{ MHz}$ | | | | | | |
| G | Gain | Typical Operating Mode | | 0 | | dB |
| | | High Gain Mode | | 2.4 | | dB |
| | Gain Flatness | In 300MHz bandwidth | -0.5 | | 0.5 | dB |
| OP1dB | Output Compression Point | | | 10.4 | | dBm |
| OIP3 | Output 3rd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 29.5 | | dBm |
| OIP2 | Output 2nd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 45.5 | | dBm |
| SBS | Unadj. Side Band Suppression | | | -33 | | dBc |
| CF | Unadj. Carrier Feed through | | | -39.6 | | dBm |
| NSD _O | Output Noise Spectral Density | BB inputs terminated on 50 Ω | | -156 | | dBm/Hz |
| HD2 _{LO} | LO Second Harmonic | Measured at $2 \times f_{LO}$ | | -29 | | dBc |
| HD3 _{LO} | LO Third Harmonic | Measured at $3 \times f_{LO}$ | | -37 | | dBc |
| HD2 _{BB} | Baseband Second Harmonic | Measured at $f_{LO} \pm 2 \times f_{BB}$ | | -53 | | dBc |
| HD3 _{BB} | Baseband Third Harmonic | Measured at $f_{LO} \pm 3 \times f_{BB}$ | | -68 | | dBc |
| IQ MODULATOR $f_{LO} = 3600\text{ MHz}$ | | | | | | |
| G | Gain | Typical Operating Mode | | -2 | | dB |
| | | High Gain Mode | | 0.4 | | dB |
| OP1dB | Output Compression Point | | | 8.7 | | dBm |
| OIP3 | Output 3rd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 24.5 | | dBm |
| OIP2 | Output 2nd Order Intercept Point | $F_{BB} = 4.5, 5.5\text{ MHz}$ | | 45.5 | | dBm |
| SBS | Unadj. Side Band Suppression | | | -31.5 | | dBc |
| CF | Unadj. Carrier Feed through | | | -39.5 | | dBm |
| HD2 _{LO} | LO Second Harmonic | Measured at $2 \times f_{LO}$ | | -28.4 | | dBc |
| HD3 _{LO} | LO Third Harmonic | Measured at $3 \times f_{LO}$ | | -31.5 | | dBc |
| HD2 _{BB} | Baseband Second Harmonic | Measured at $f_{LO} \pm 2 \times f_{BB}$ | | -55 | | dBc |
| HD3 _{BB} | Baseband Third Harmonic | Measured at $f_{LO} \pm 3 \times f_{BB}$ | | -65 | | dBc |
| BASEBAND INPUTS | | | | | | |
| V_{CM} | Common Mode Voltage | Baseband I/Q input | 0 | 0.25 | 0.5 | V |
| BW_{BB} | Baseband Bandwidth | 1 dB Bandwidth | | 900 | | MHz |
| Z_{inBB} | Baseband Input Impedance | Resistance | | 5 | | k Ω |
| | | Capacitance | | 4 | | pF |
| REFERENCE OSCILLATOR PARAMETERS | | | | | | |
| F_{ref} | Reference Frequency | Max | | 350 | | MHz |
| | Reference Input Sensitivity | | 0.2 | | 3.3 | V _{PP} |
| Z_{inref} | Reference Input Impedance | Parallel capacitance | | 2 | | pF |
| | | Parallel resistance | | 2.2 | | k Ω |
| PFD, CP | | | | | | |
| F_{PFD} | PFD Frequency | Max, refer to the Typical Application | | | 65 | MHz |
| I_{CP_OUT} | Charge Pump Current | Max | | 1.94 | | mA |
| | In-band Normalized PN Floor | Integer Mode | | -221 | | dBc/Hz |

Electrical Characteristics (continued)

 Over recommended operating conditions: $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$. Optimized bias settings as per [Table 16](#).

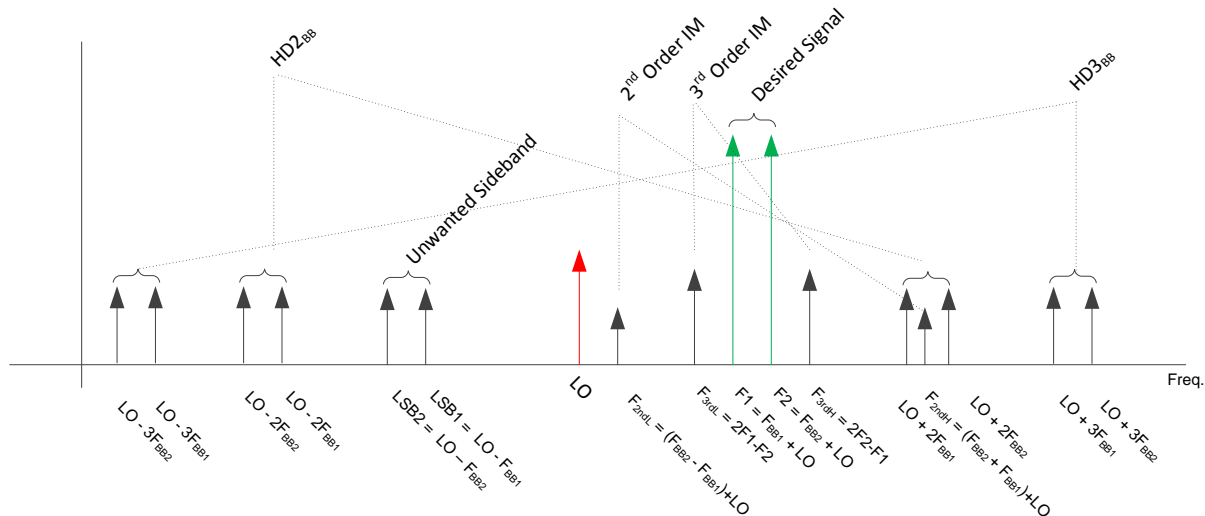
| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|---|--|-----------|-------|-----------|--------|
| VCO | | | | | | |
| f_{VCO} | Typical VCO frequency range ⁽²⁾ | | 2050 | | 4100 | MHz |
| K_V | VCO gain | VTUNE = 1.1 V | | 30 | | MHz/V |
| PN | VCO Open Loop Phase Noise; $f_{VCO} = 3600\text{ MHz}$; TX Div = Div-by-1; $f_{OUT} = 3600\text{ MHz}$ VTUNE = 1.1 V | 10 kHz | | -74 | | dBc/Hz |
| | | 100 kHz | | -109 | | |
| | | 1 MHz | | -135 | | |
| | | 10 MHz | | -152 | | |
| | | 40 MHz | | -156 | | |
| | VCO Open Loop Phase Noise; $f_{VCO} = 3600\text{ MHz}$; TX Div = Div-by-2; $f_{OUT} = 1800\text{ MHz}$; VTUNE = 1.1 V | 10 kHz | | -80 | | dBc/Hz |
| | | 100 kHz | | -115 | | |
| | | 1 MHz | | -141 | | |
| | | 10 MHz | | -156 | | |
| | | 40 MHz | | -158 | | |
| LO OUTPUT | | | | | | |
| f_{OUT} | Typical output frequency range ⁽²⁾ | Divide by 1 | 2050 | | 4100 | MHz |
| | | Divide by 2 | 1025 | | 2050 | |
| | | Divide by 4 | 512.5 | | 1025 | |
| | | Divide by 8 | 256.25 | | 512.5 | |
| P_{LO} | Output power | SE at 1800 MHz, OUTBUF_BIAS = 2 | | 1 | | dBm |
| | External VCO input Frequency Range | | 250 | | 4200 | MHz |
| | External VCO Input Level | | -10 | 0 | 10 | dBm |
| CLOSE LOOP PLL OR VCO | | | | | | |
| Integrated Phase Noise | | Frac-N; PFD = 15.36 MHz; $f_{OUT} = 3532.89\text{ MHz}$; Integration BW = 1 kHz to 10 MHz; SSB | | -45.2 | | dB |
| | | Int-N; PFD = 2.56 MHz; $f_{OUT} = 1799.68\text{ MHz}$; Integration BW = 500 Hz to 20 MHz; SSB | | -49.8 | | dB |
| VCO Close Loop Phase Noise; $f_{VCO} = 3600\text{ MHz}$; TX DIV = Div-by-2; $f_{OUT} = 1800\text{ MHz}$; Integer Mode, PFD = 2.56MHz | | 10 kHz | | -96 | | dBc/Hz |
| | | 100 kHz | | -114 | | |
| | | 1 MHz | | -140 | | |
| | | 10 MHz | | -156 | | |
| | | 40 MHz | | -158 | | |
| DIGITAL INTERFACE | | | | | | |
| V_{IH} | High Level Input Voltage | | 2 | 3.3 | | V |
| V_{IL} | Low Level Input Voltage | | 0 | | 0.8 | V |
| V_{OH} | High Level Output Voltage | Referenced to VCC_DIG | 0.8 x VCC | | | V |
| V_{OL} | Low Level Output Voltage | Referenced to VCC_DIG | | | 0.2 x VCC | V |

(2) Divided-down ranges minimum and maximum values are typical but are not specified.

6.6 Typical Characteristics

6.6.1 Modulator Output Spectrum

Graphical illustration of the modulator output spectrum with two tones is shown in Figure 1.



- F_{BBn} = Baseband Frequency
- F_n = RF Frequency
- $F_{3rdH/L}$ = 3rd Order Intermodulation Product Frequency (High Side / Low Side)
- $F_{2ndH/L}$ = 2nd Order Intermodulation Product Frequency (High Side / Low Side)
- LO = Local Oscillator Frequency
- LSBn = Lower Sideband Frequency
- HD2_{BB} = Baseband second harmonic (High Side / Low Side)
- HD3_{BB} = Baseband third harmonic (High Side / Low Side)

Figure 1. Graphical Illustration of Modulator Output Spectrum

6.7 Typical Characteristics - Output Power

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, 500 mV_{PP}, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16. Total P_{out} is two tones combined power.

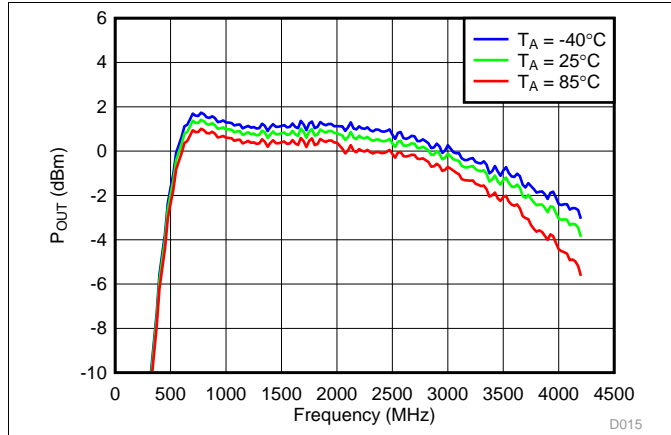


Figure 2. Total P_{OUT} vs Temperature, Typical Operating Mode

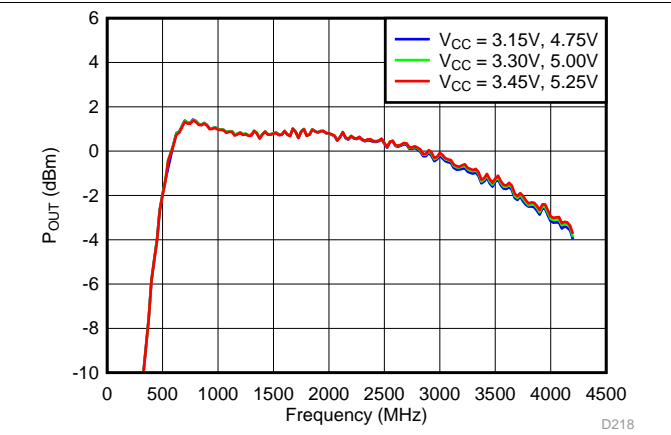


Figure 3. Total P_{OUT} vs Supply, Typical Operating Mode

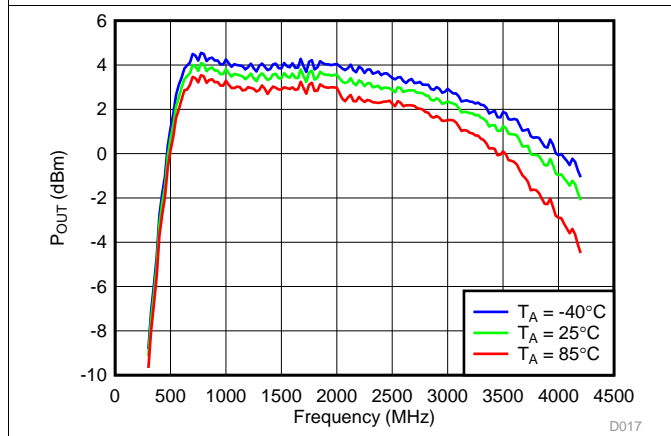


Figure 4. Total P_{OUT} vs Temperature, High Gain Mode

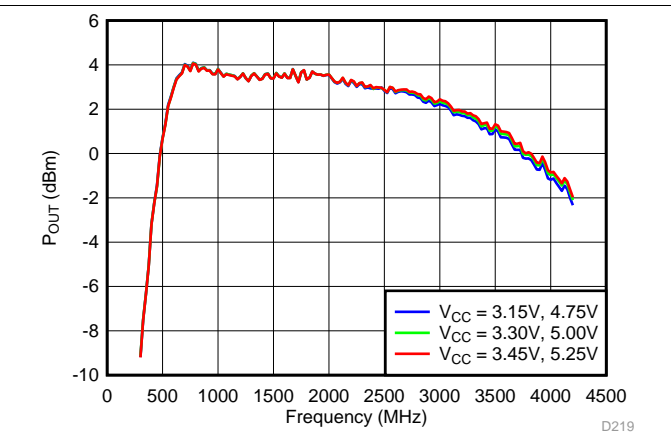


Figure 5. Total P_{OUT} vs Supply, High Gain Mode

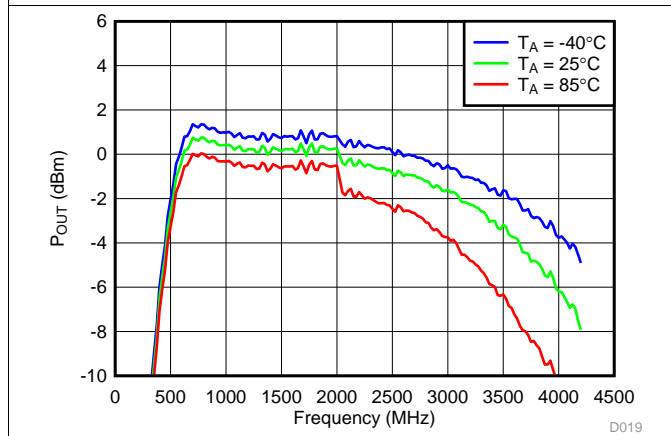


Figure 6. Total P_{OUT} vs Temperature, Low Power Mode

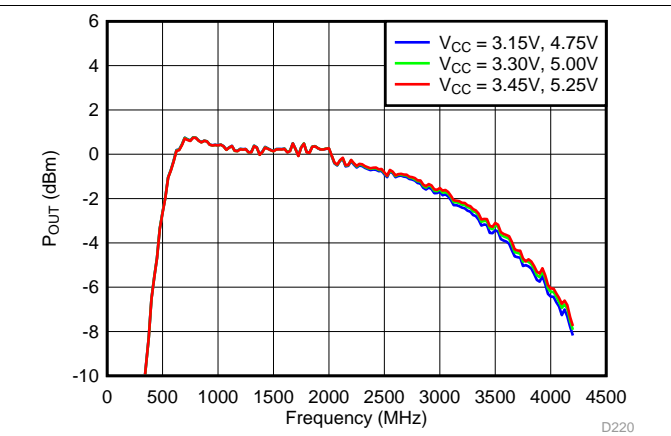


Figure 7. Total P_{OUT} vs Supply, Low Power Mode

6.8 Typical Characteristics - Gain

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16.

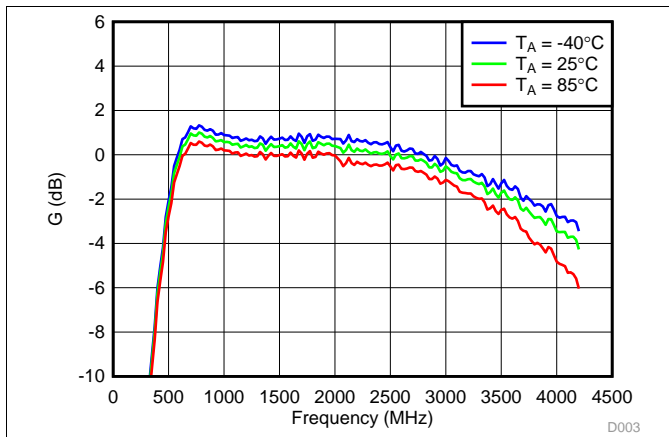


Figure 8. Voltage Gain vs Temperature, Typical Operating Mode

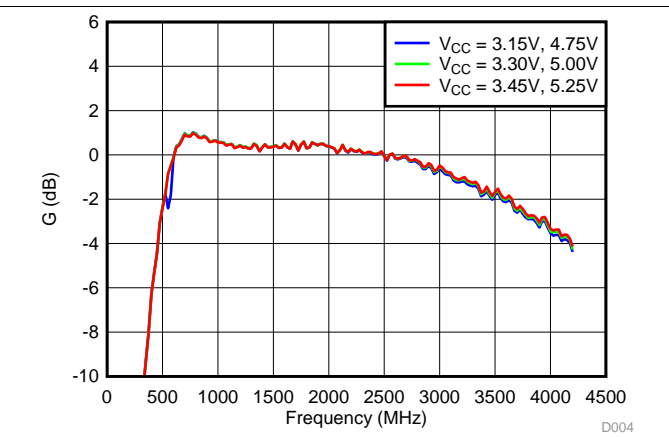


Figure 9. Voltage Gain vs Supply, Typical Operating Mode

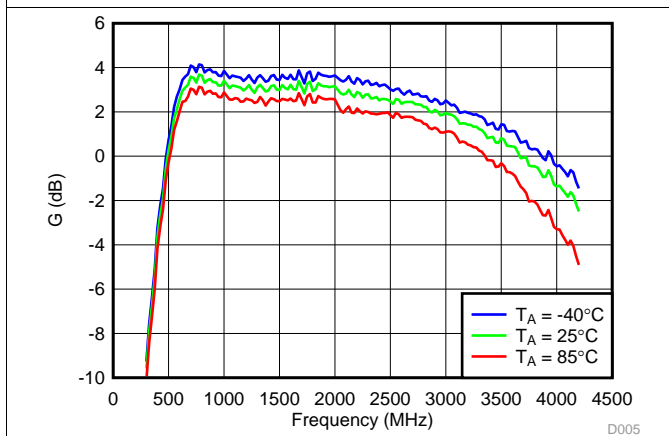


Figure 10. Voltage Gain vs Temperature, High Gain Mode

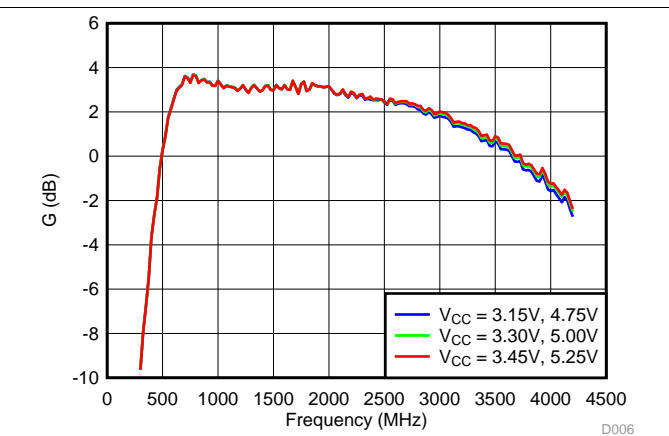


Figure 11. Voltage Gain vs Supply, High Gain Mode

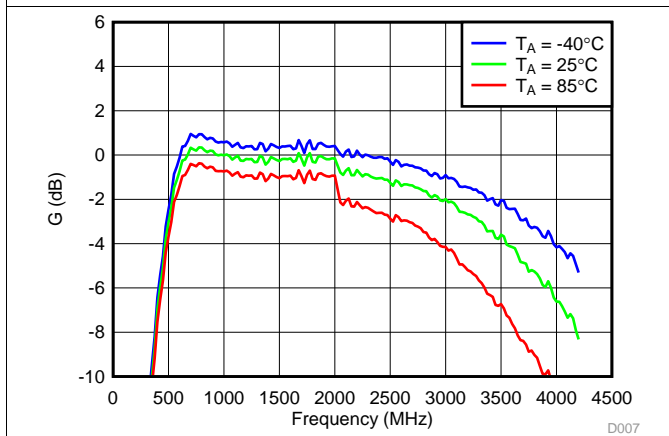


Figure 12. Voltage Gain vs Temperature, Low Power Mode

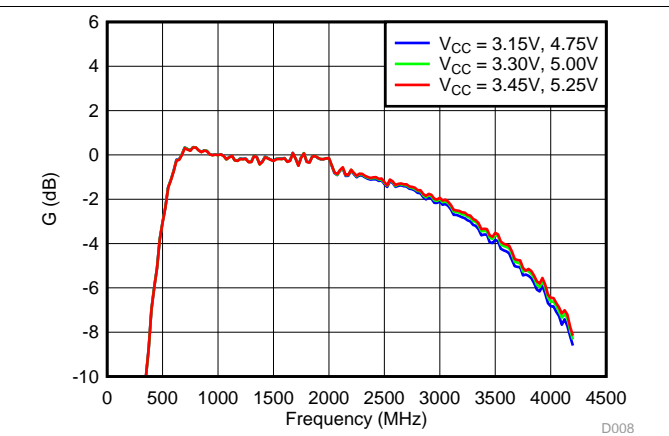


Figure 13. Voltage Gain vs Supply, Low Power Mode

6.9 Typical Characteristics - OIP3

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16. Reported OIP3 is minimum of low side and high side.

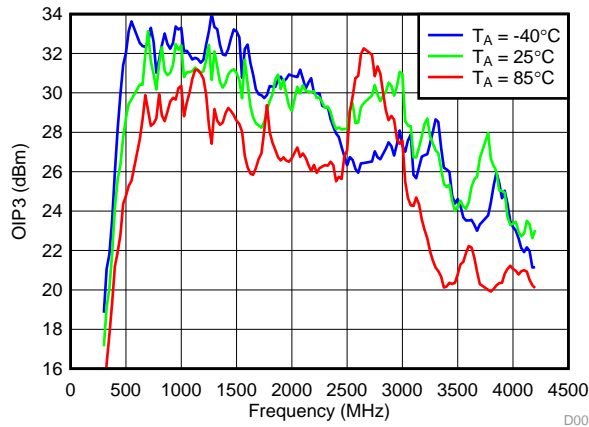


Figure 14. OIP3 vs Temperature, Typical Operating Mode

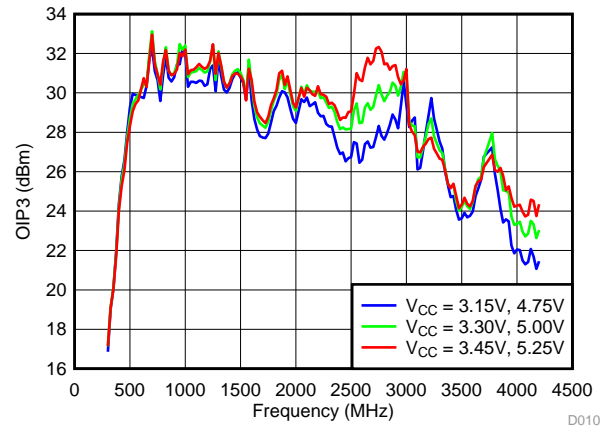


Figure 15. OIP3 vs Supply, Typical Operating Mode

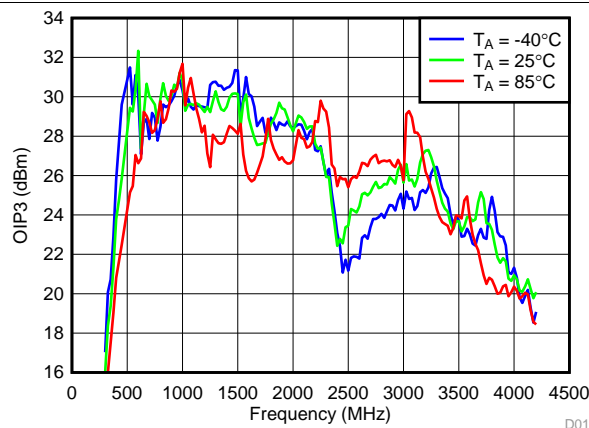


Figure 16. OIP3 vs Temperature, High Gain Mode

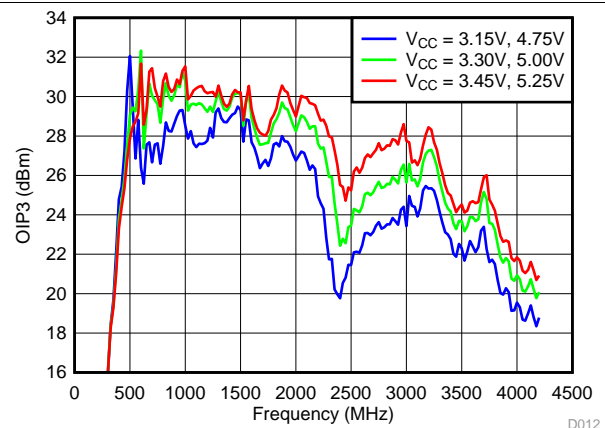


Figure 17. OIP3 vs Supply, High Gain Mode

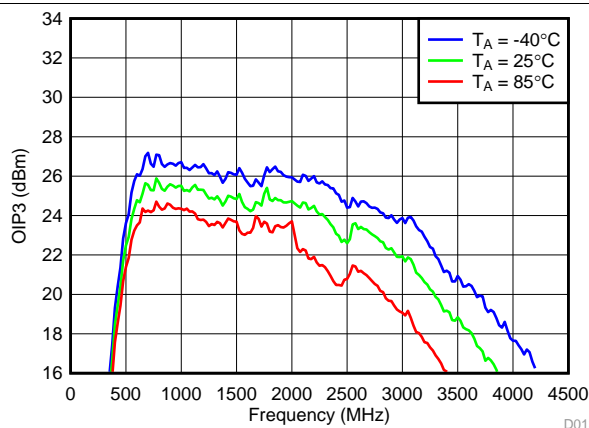


Figure 18. OIP3 vs Temperature, Low Power Mode

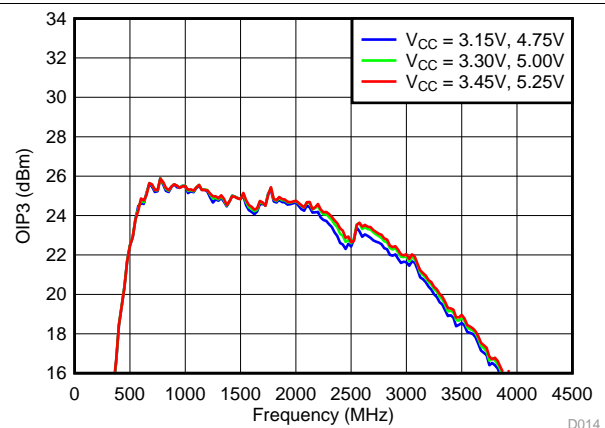


Figure 19. OIP3 vs Supply, Low Power Mode

6.10 Typical Characteristics - OIP2

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16. Reported OIP2 is minimum of low side and high side.

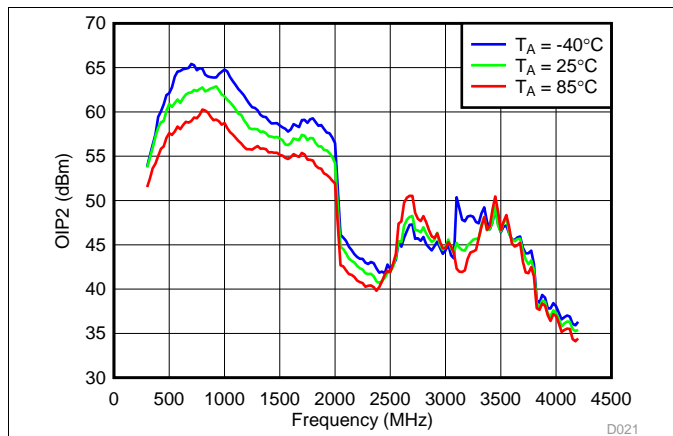


Figure 20. OIP2 vs Temperature, Typical Operating Mode

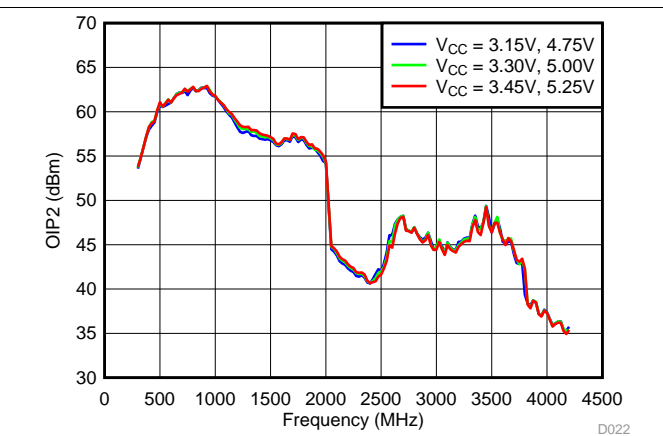


Figure 21. OIP2 vs Supply, Typical Operating Mode

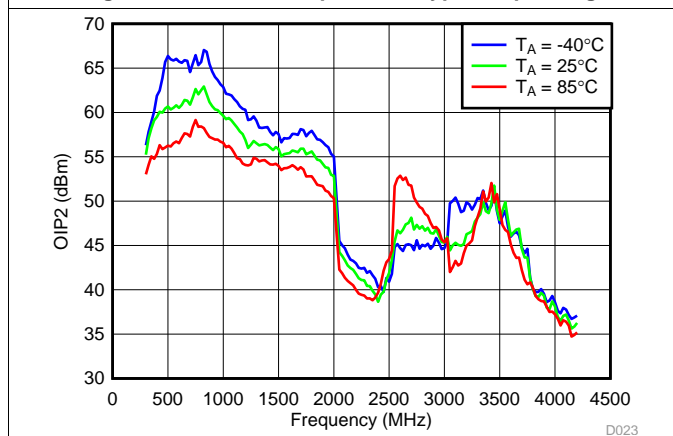


Figure 22. OIP2 vs Temperature, High Gain Mode

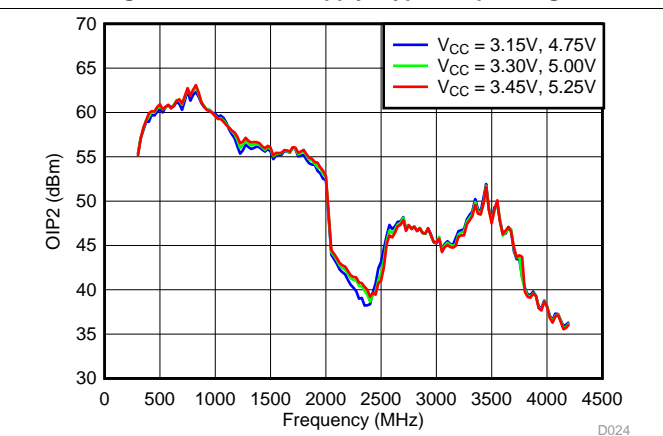


Figure 23. OIP2 vs Supply, High Gain Mode

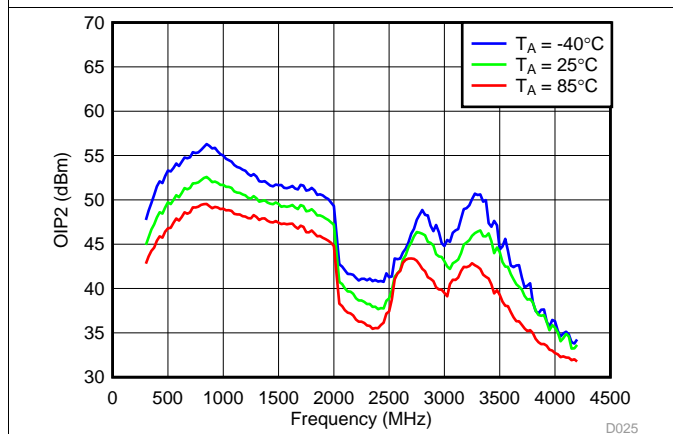


Figure 24. OIP2 vs Temperature, Low Power Mode

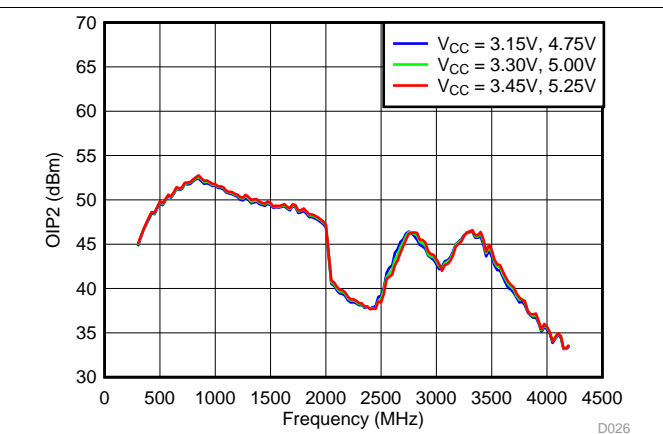


Figure 25. OIP2 vs Supply, Low Power Mode

6.11 Typical Characteristics - OP1dB

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16.

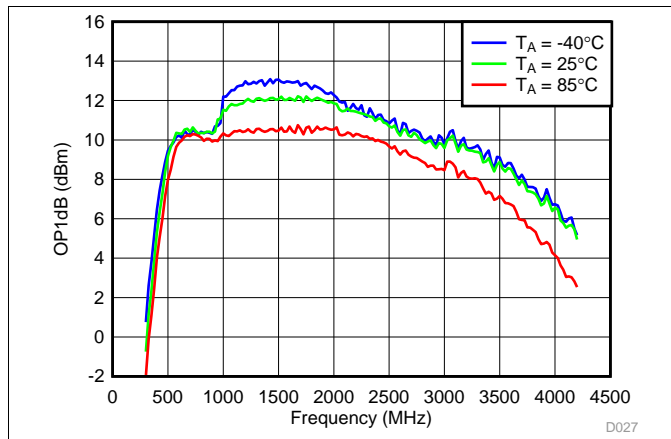


Figure 26. OP1dB vs Temperature, Typical Operating Mode

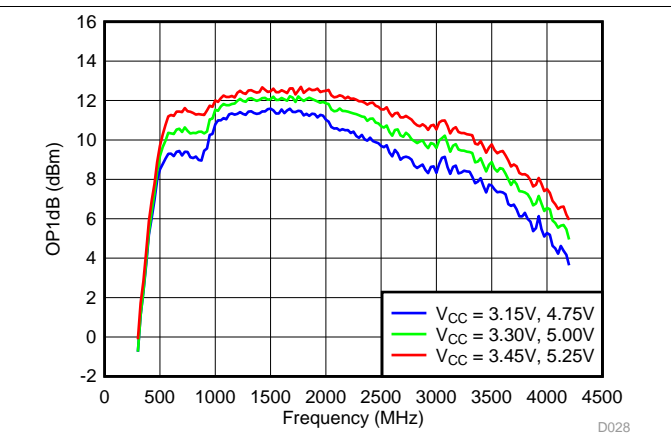


Figure 27. OP1dB vs Supply, Typical Operating Mode

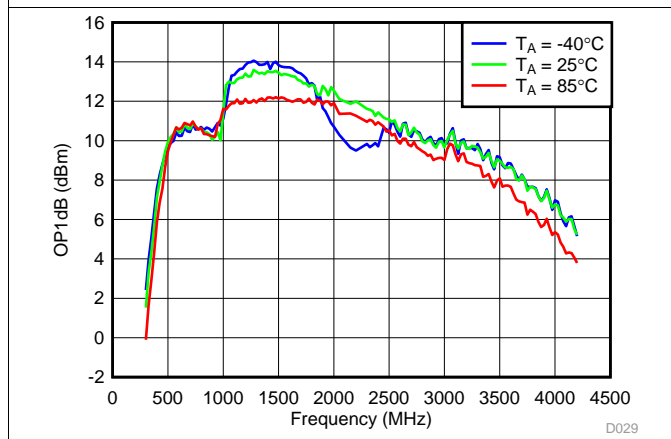


Figure 28. OP1dB vs Temperature, High Gain Mode

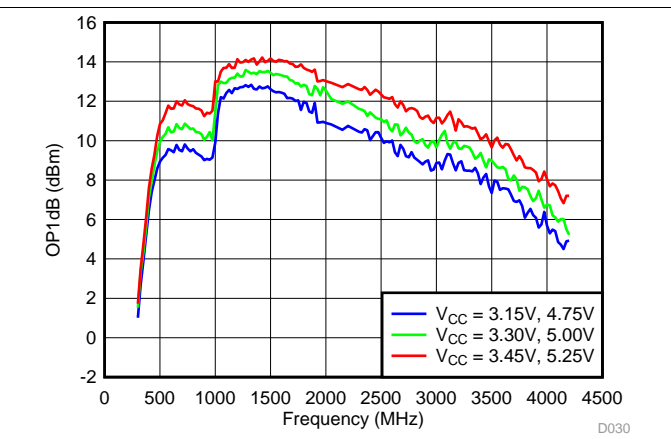


Figure 29. OP1dB vs Supply, High Gain Mode

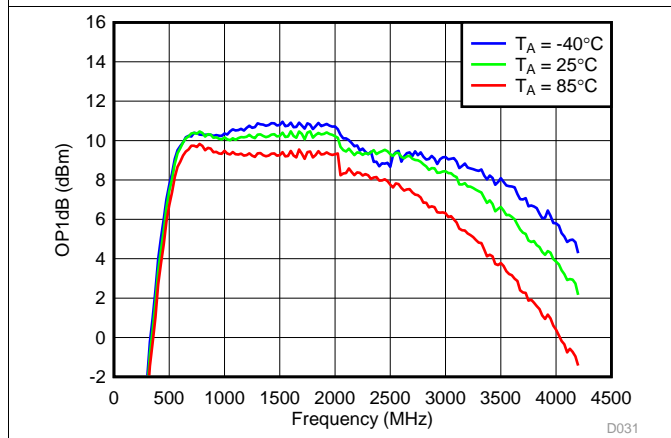


Figure 30. OP1dB vs Temperature, Low Power Mode

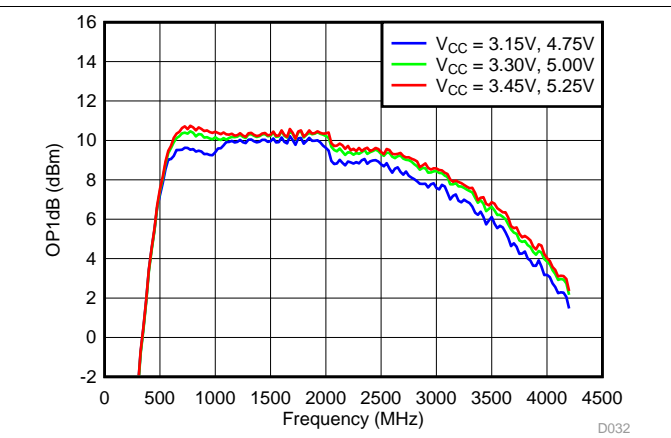


Figure 31. OP1dB vs Supply, Low Power Mode

6.12 Typical Characteristics - Noise

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, T_A = 25°C, BB inputs terminated to 50 Ω and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16.

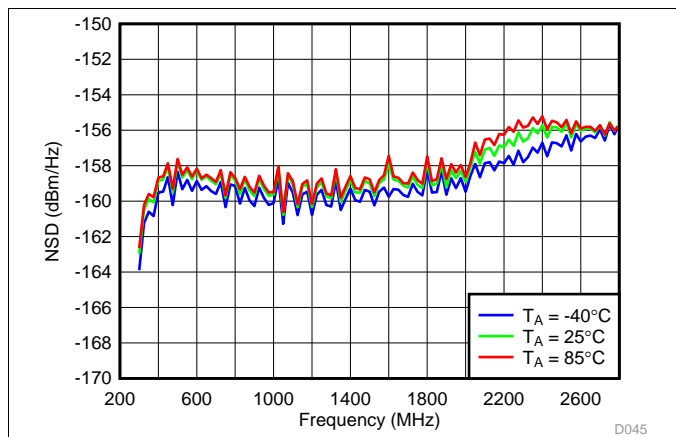


Figure 32. Noise vs Temperature, Typical Operating Mode

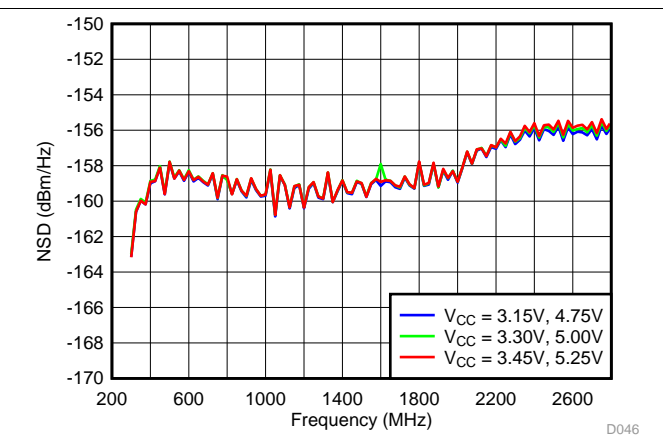


Figure 33. Noise vs Supply, Typical Operating Mode

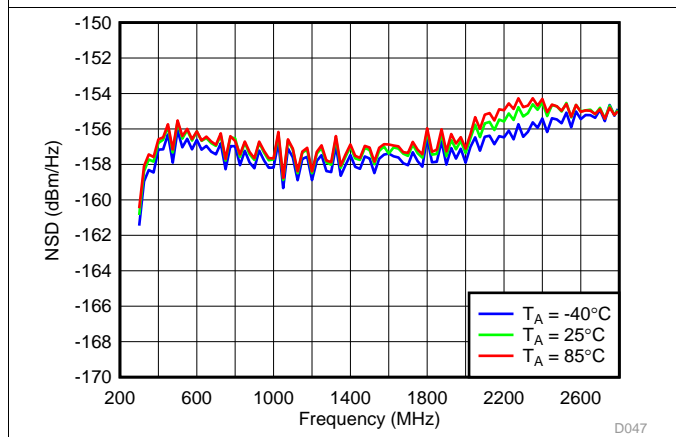


Figure 34. Noise vs Temperature, High Gain Mode

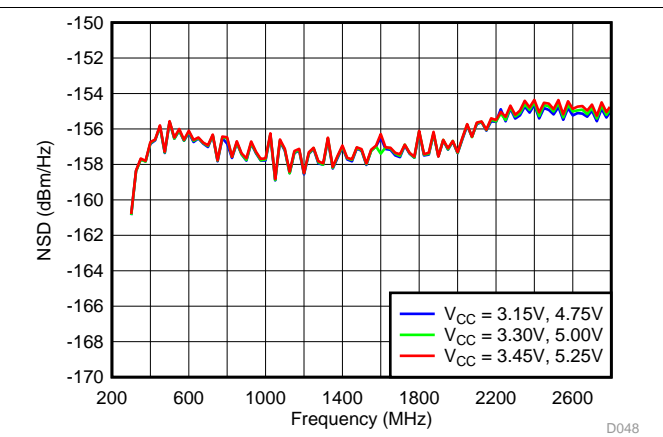


Figure 35. Noise vs Supply, High Gain Mode

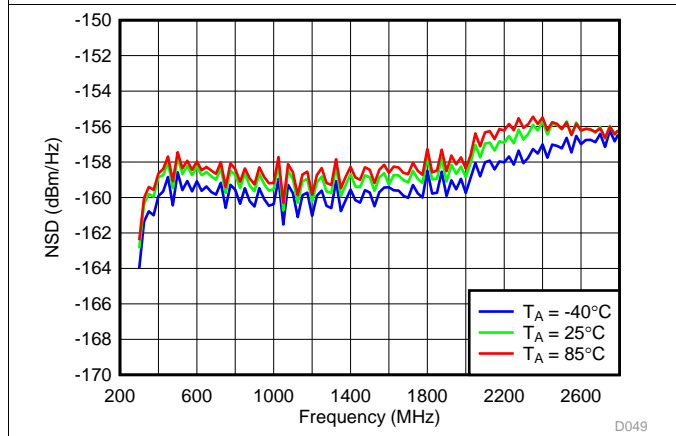


Figure 36. Noise vs Temperature, Low Power Mode

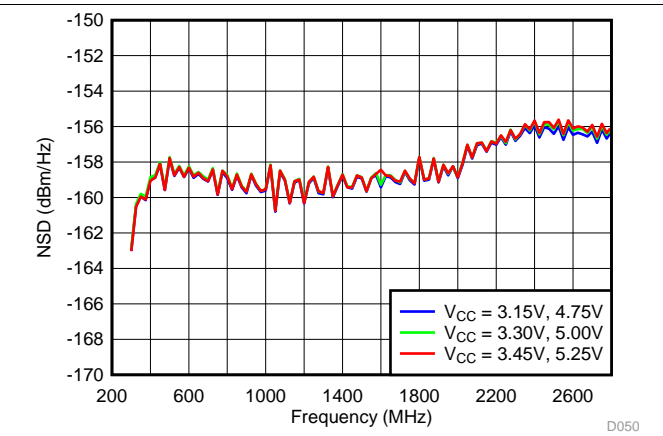


Figure 37. Noise vs Supply, Low Power Mode

6.13 Typical Characteristics - Unadjusted CF

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16.

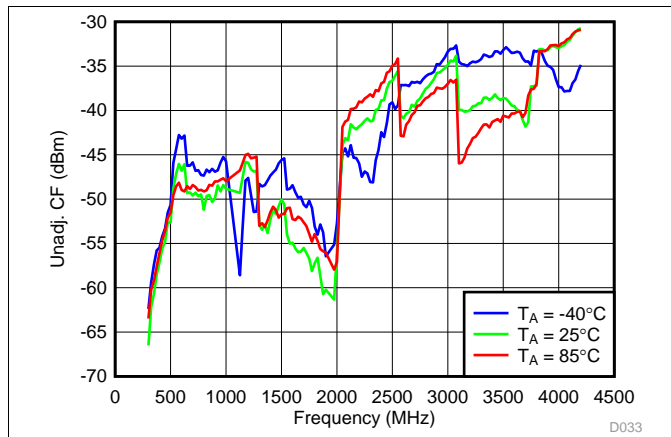


Figure 38. Unadjustable CF vs Temperature, Typical Operating Mode

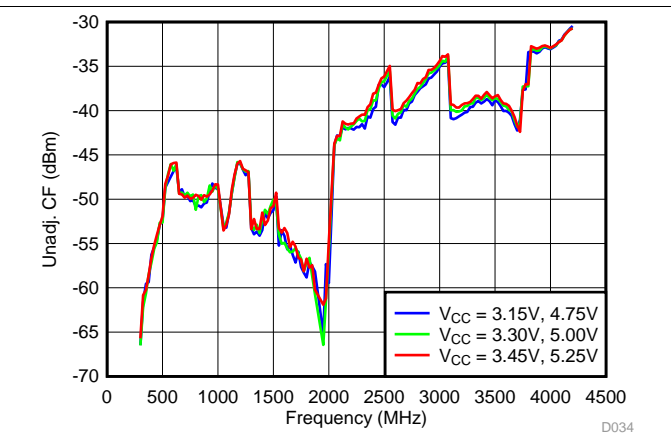


Figure 39. Unadjustable CF vs Supply, Typical Operating Mode

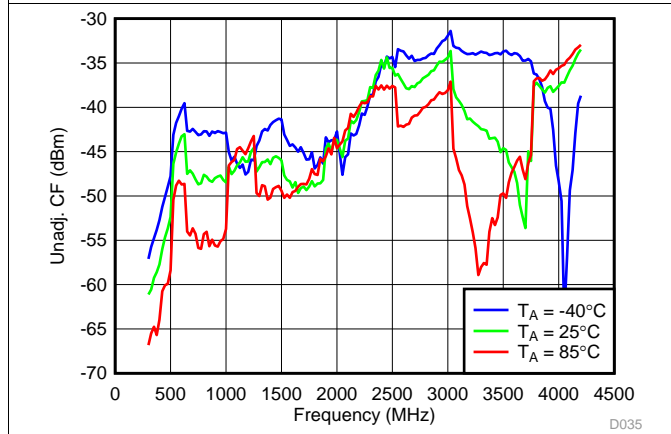


Figure 40. Unadjustable CF vs Temperature, High Gain Mode

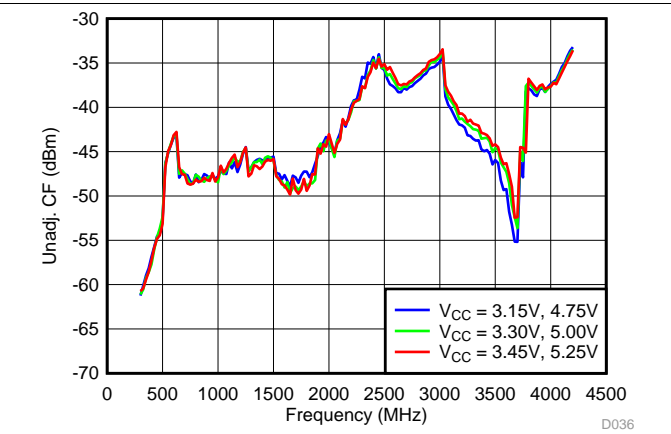


Figure 41. Unadjustable CF vs Supply, High Gain Mode

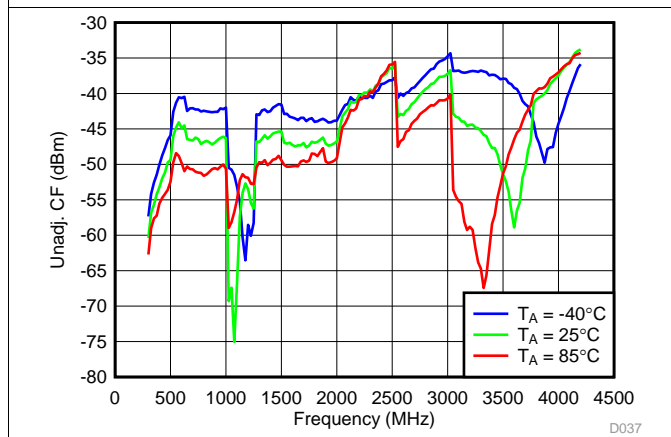


Figure 42. Unadjustable CF vs Temperature, Low Power Mode

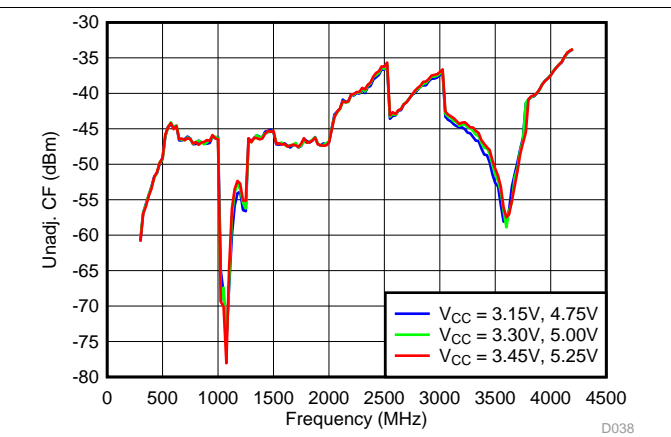


Figure 43. Unadjustable CF vs Supply, Low Power Mode

6.14 Typical Characteristics - Unadjusted SBS

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, and $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16.

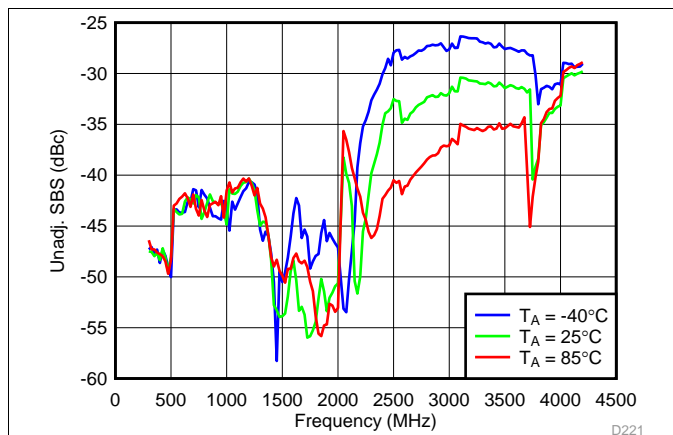


Figure 44. Unadjustable SBS vs Temperature, Typical Operating Mode

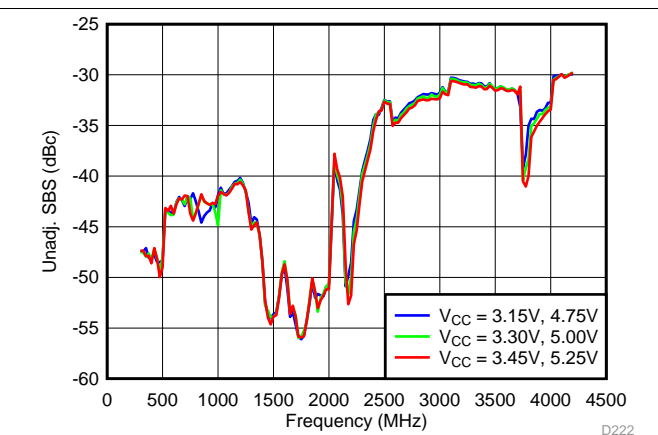


Figure 45. Unadjustable SBS vs Supply, Typical Operating Mode

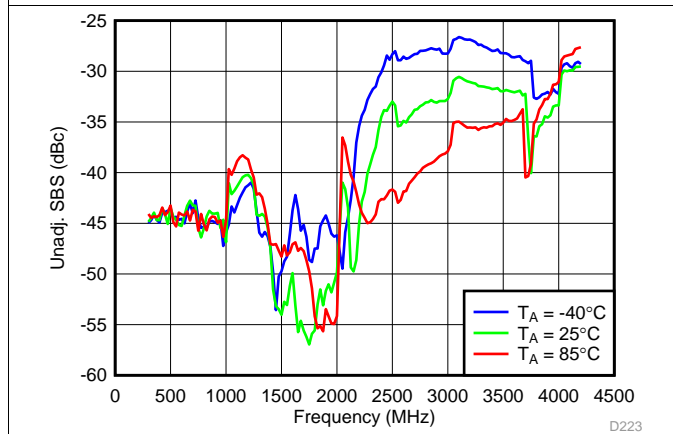


Figure 46. Unadjustable SBS vs Temperature, High Gain Mode

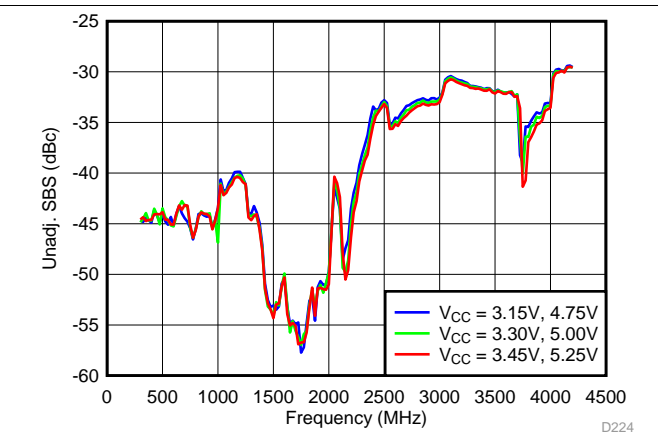


Figure 47. Unadjustable SBS vs Supply, High Gain Mode

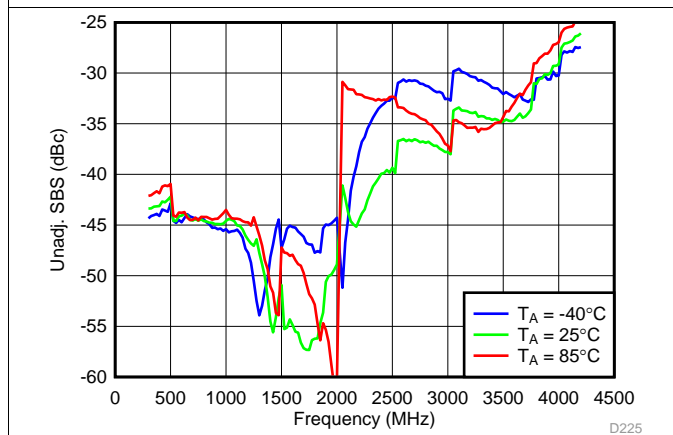


Figure 48. Unadjustable SBS vs Temperature, Low Power Mode

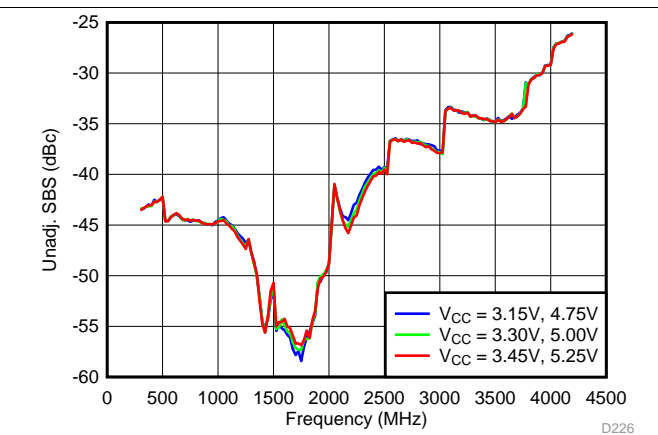


Figure 49. Unadjustable SBS vs Supply, Low Power Mode

6.15 Typical Characteristics - LO Harmonic

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, and $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16.

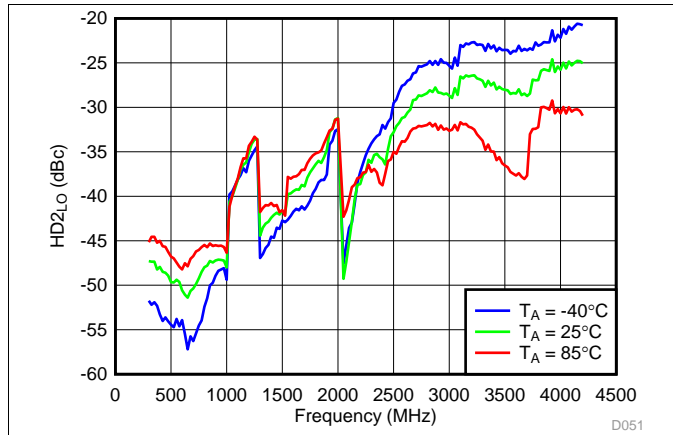


Figure 50. LO Second Harmonic vs Temperature, Typical Operating Mode

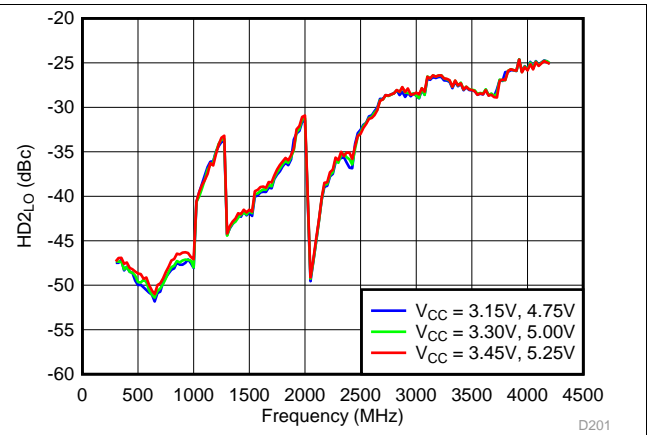


Figure 51. LO Second Harmonic vs Supply, Typical Operating Mode

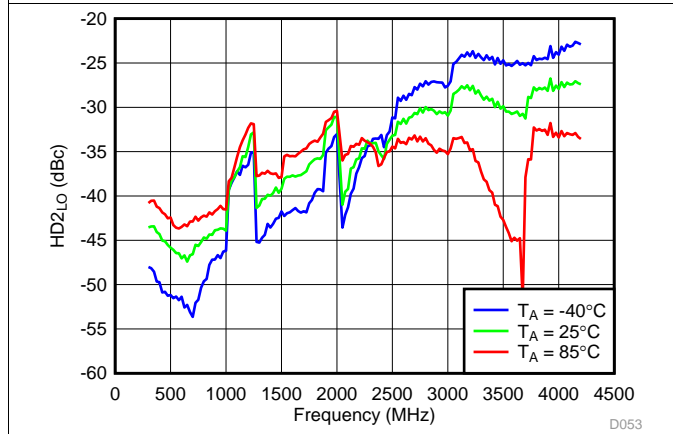


Figure 52. LO Second Harmonic vs Temperature, High Gain Mode

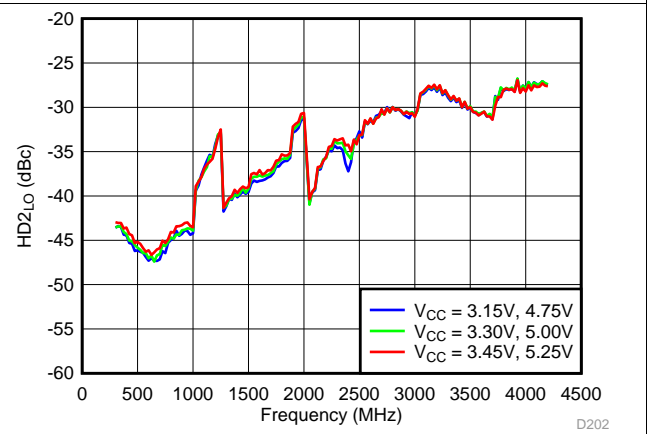


Figure 53. LO Second Harmonic vs Supply, High Gain Mode

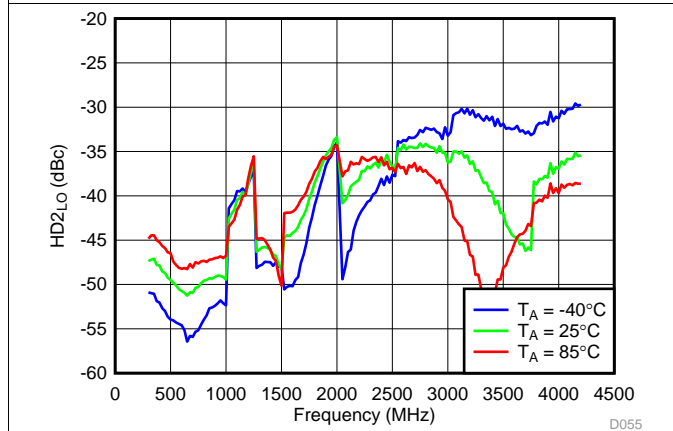


Figure 54. LO Second Harmonic vs Temperature, Low Power Mode

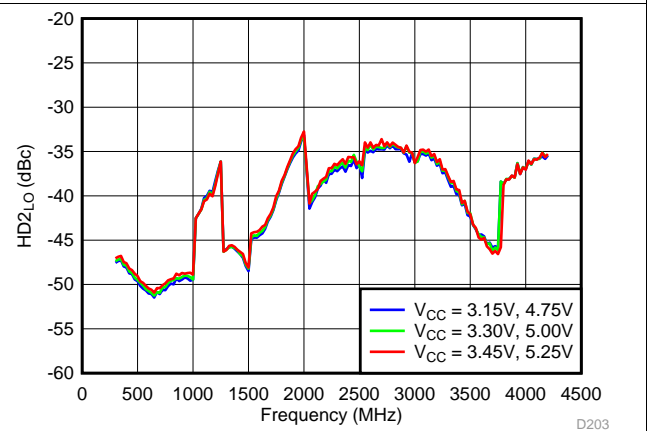


Figure 55. LO Second Harmonic vs Supply, Low Power Mode

Typical Characteristics - LO Harmonic (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, V_{CM} = 0.25 V, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16.

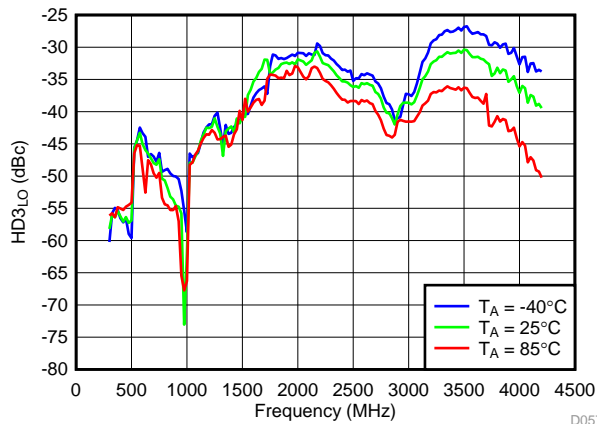


Figure 56. LO Third Harmonic vs Temperature, Typical Operating Mode

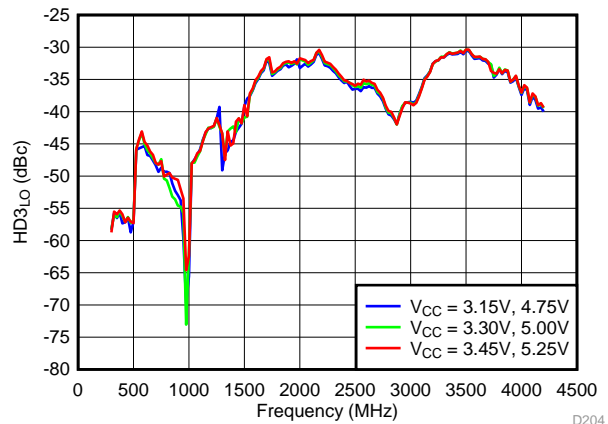


Figure 57. LO Third Harmonic vs Supply, Typical Operating Mode

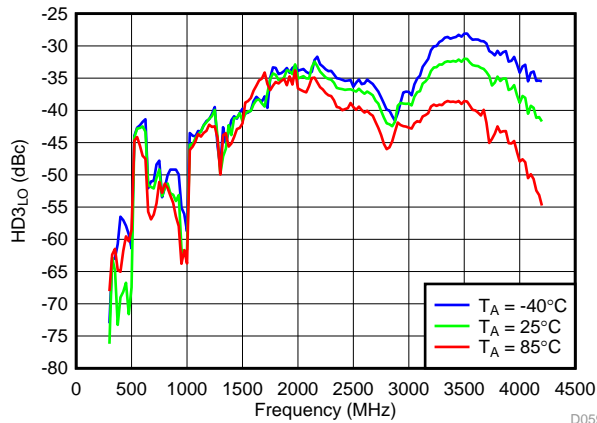


Figure 58. LO Third Harmonic vs Temperature, High Gain Mode

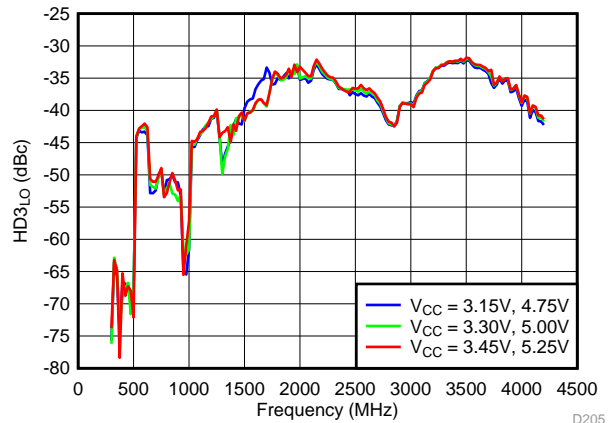


Figure 59. LO Third Harmonic vs Supply, High Gain Mode

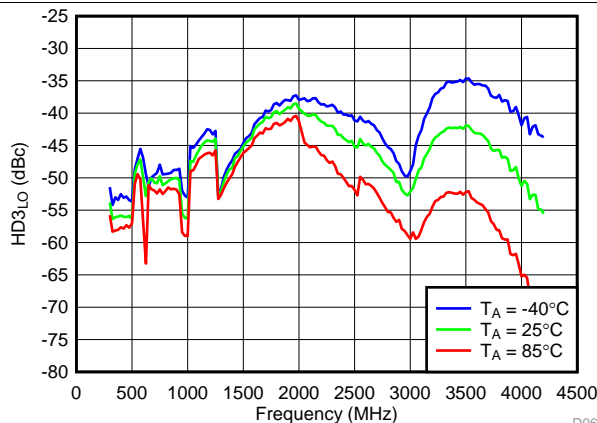


Figure 60. LO Third Harmonic vs Temperature, Low Power Mode

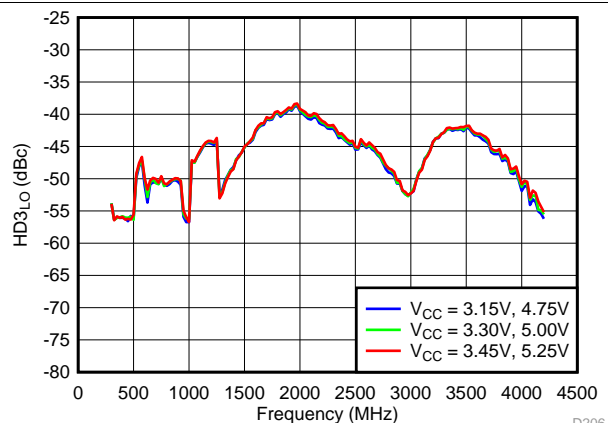


Figure 61. LO Third Harmonic vs Supply, Low Power Mode

6.16 Typical Characteristics - BB Harmonic

Unless specified all plots were created using TRF3722EVM, $V_{CC} = 3.3\text{ V}$, $V_{CC_TK} = 5\text{ V}$, and $T_A = 25^\circ\text{C}$, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, $V_{CM} = 0.25\text{ V}$, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16. Reported BB harmonic is from (f_{BB}) 4.5MHz.

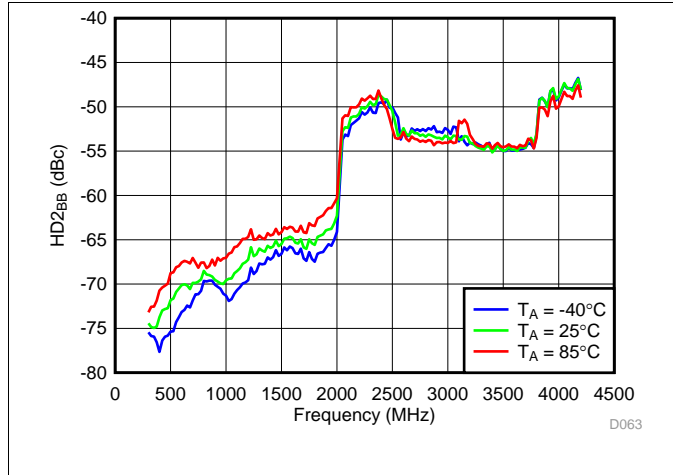


Figure 62. BB-HD2 vs Temperature, Typical Operating Mode

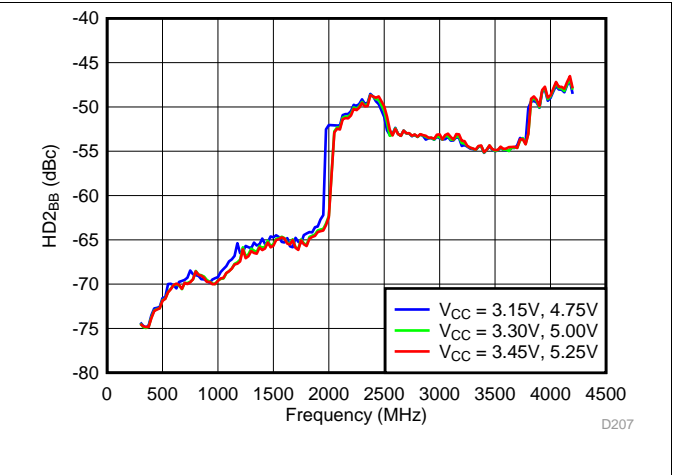


Figure 63. BB-HD2 vs Supply, Typical Operating Mode

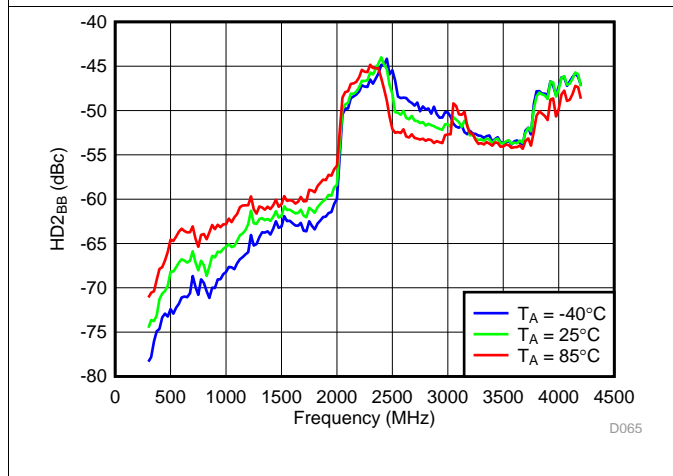


Figure 64. BB-HD2 vs Temperature, High Gain Mode

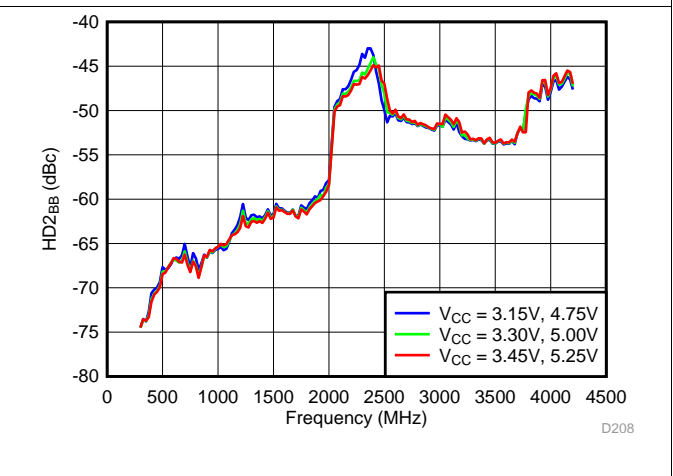


Figure 65. BB-HD2 vs Supply, High Gain Mode

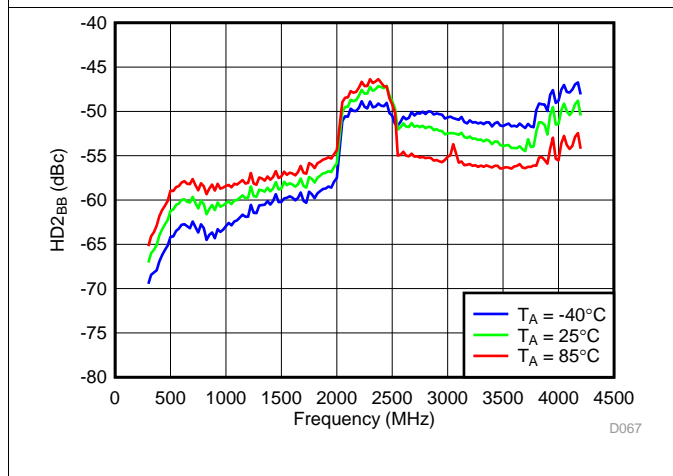


Figure 66. BB-HD2 vs Temperature, Low Power Mode

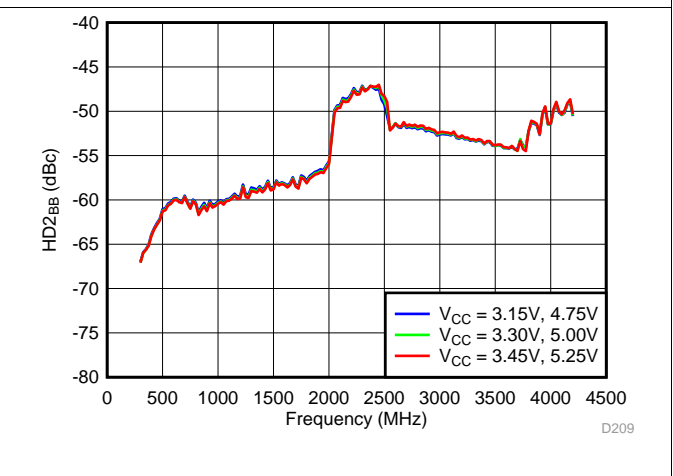


Figure 67. BB-HD2 vs Supply, Low Power Mode

Typical Characteristics - BB Harmonic (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK= 5 V, and TA = 25°C, I/Q frequency (f_{BB}) 4.5 MHz and 5.5 MHz, V_{CM} = 0.25 V, and 4.7 pF series capacitor at RFOUT. Optimized bias settings as per Table 16. Reported BB harmonic is from (f_{BB}) 4.5MHz.

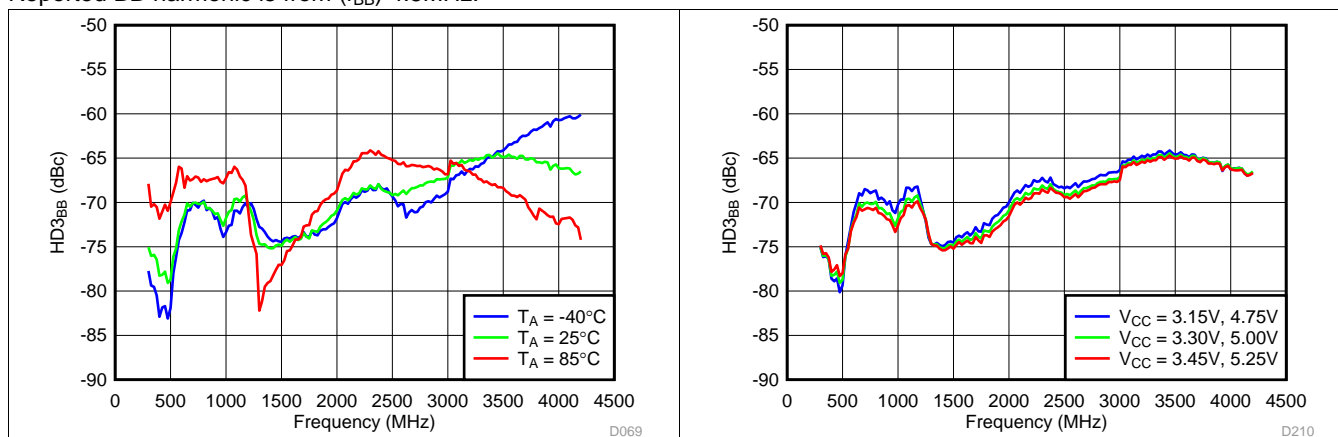


Figure 68. BB-HD3 vs Temperature, Typical Operating Mode

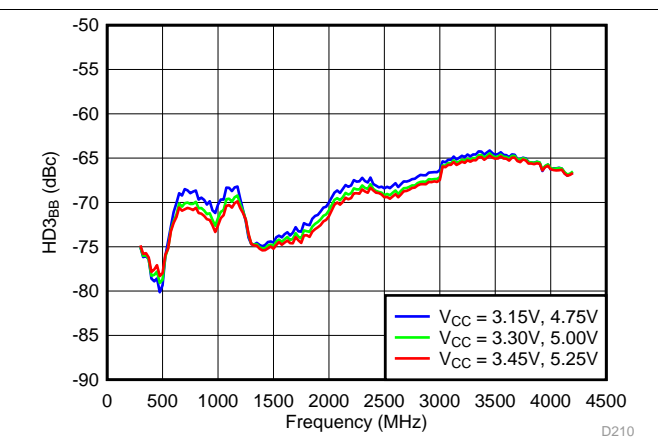


Figure 69. BB-HD3 vs Supply, Typical Operating Mode

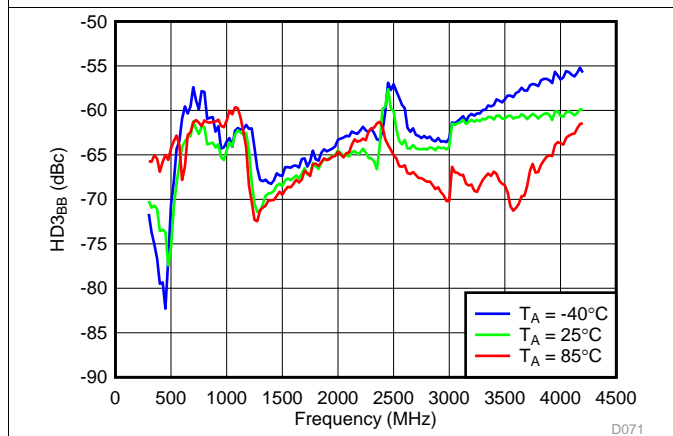


Figure 70. BB-HD3 vs Temperature, High Gain Mode

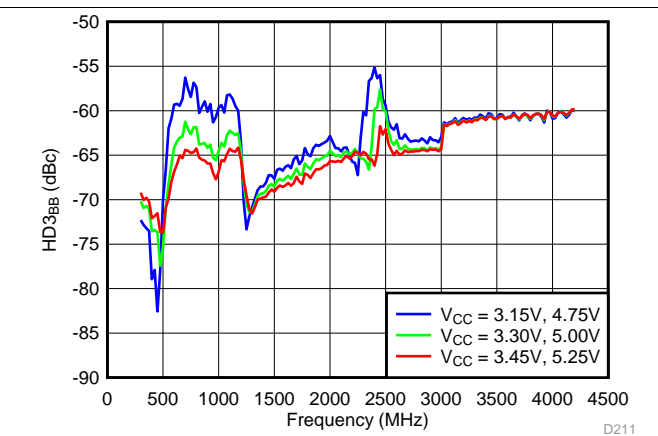


Figure 71. BB-HD3 vs Supply, High Gain Mode

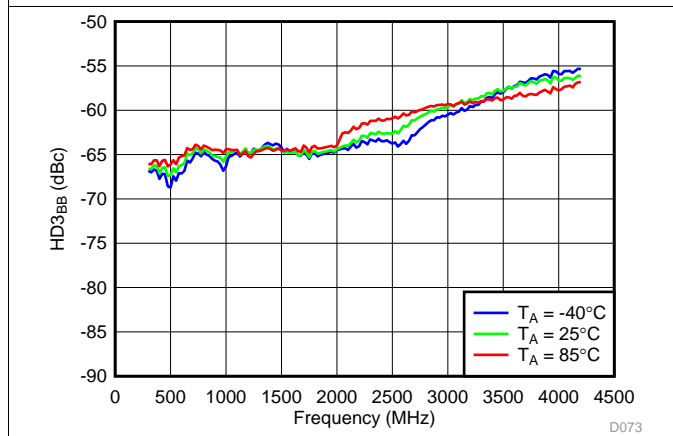


Figure 72. BB-HD3 vs Temperature, Low Power Mode

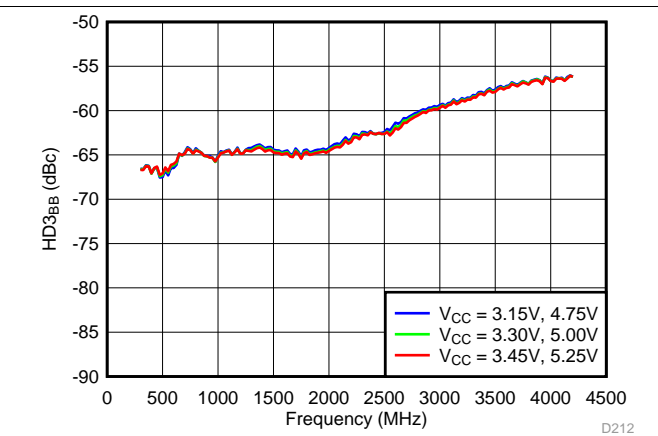


Figure 73. BB-HD3 vs Supply, Low Power Mode

6.17 Typical Characteristics - RF Output Return Loss

Unless specified all plots were created at RFOUT pin using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C

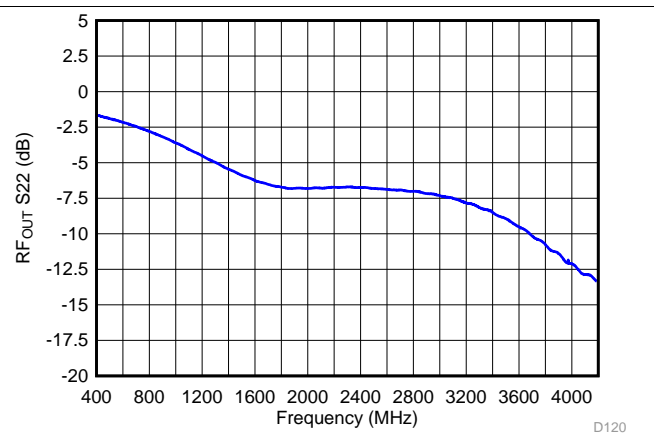
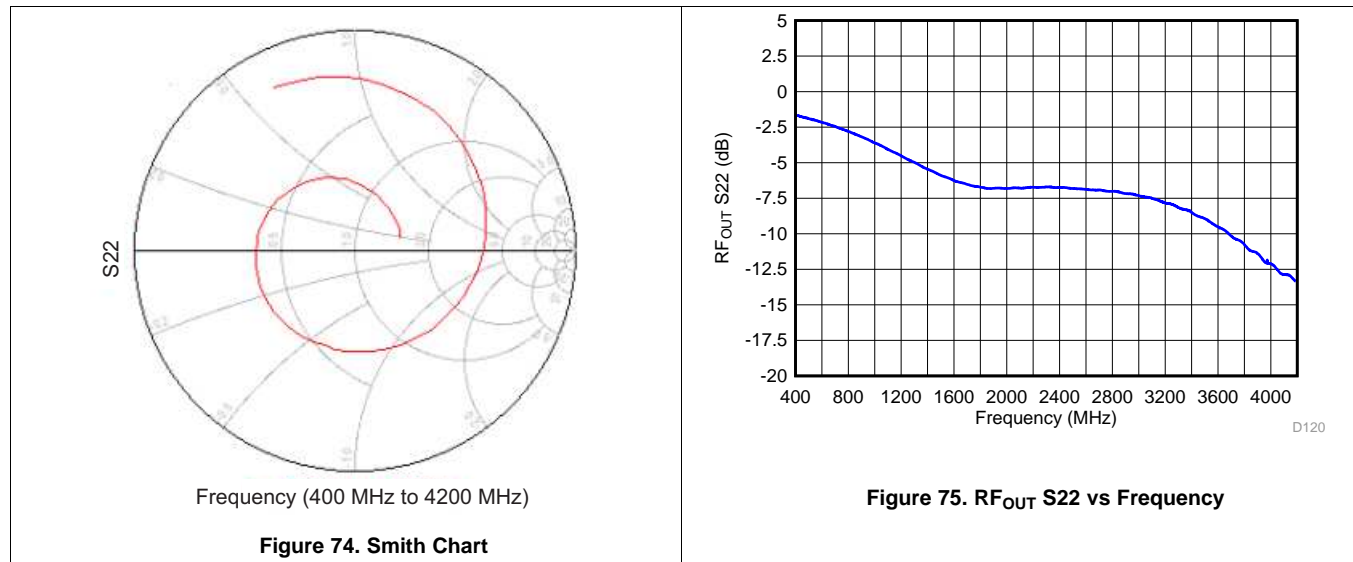
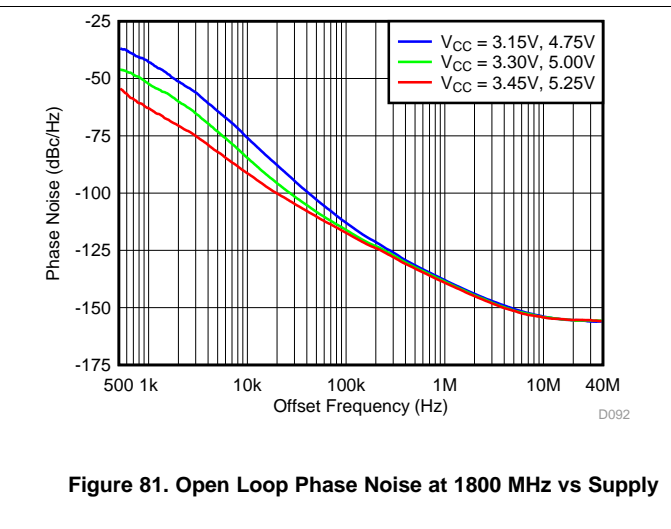
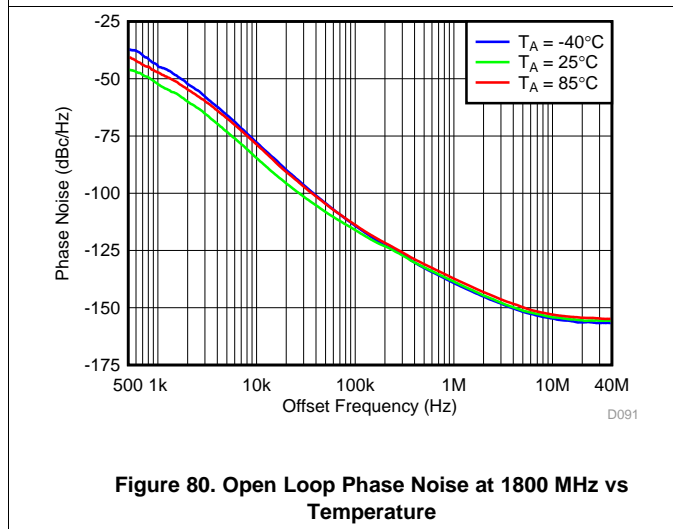
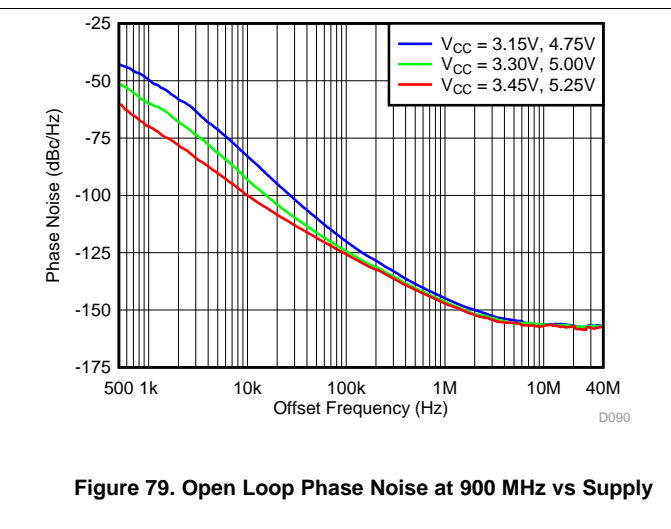
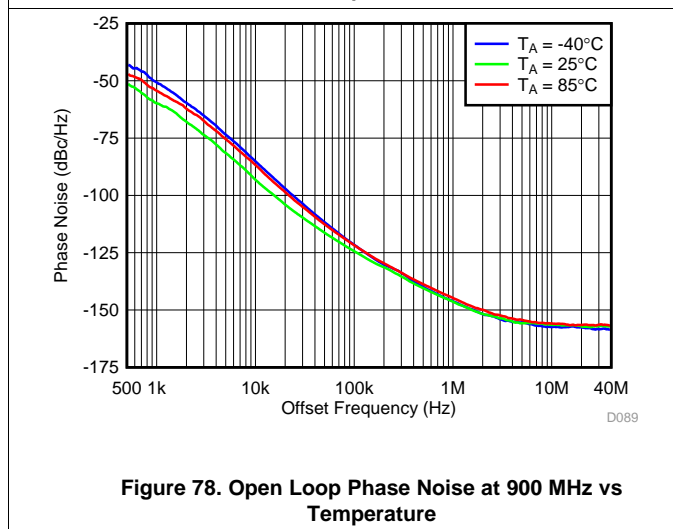
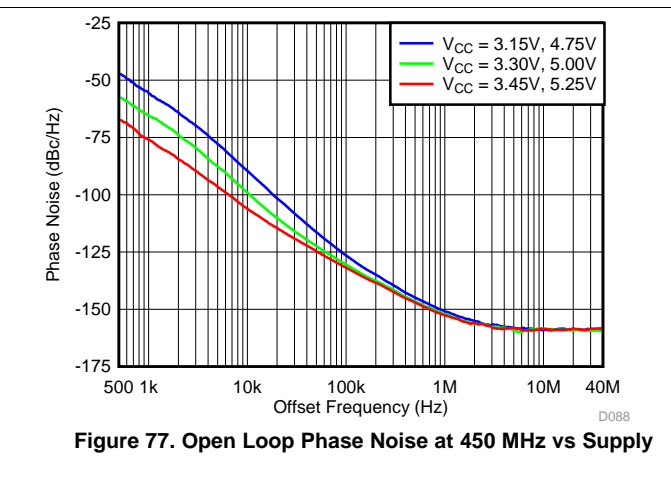
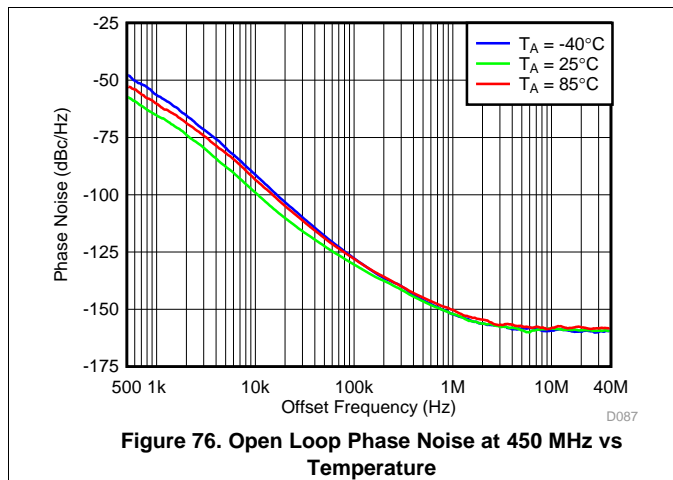


Figure 75. RF_{OUT} S₂₂ vs Frequency

6.18 Typical Characteristics - PLL/VCO

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C. Measured at LO_OUTP with 50 Ω bias resistor and 47 pF series capacitor. Modulator section powered down. Reference frequency is set to 61.44 MHz. Optimized bias settings as per Table 16.



Typical Characteristics - PLL/VCO (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C. Measured at LO_OUTP with 50 Ω bias resistor and 47 pF series capacitor. Modulator section powered down. Reference frequency is set to 61.44 MHz. Optimized bias settings as per Table 16.

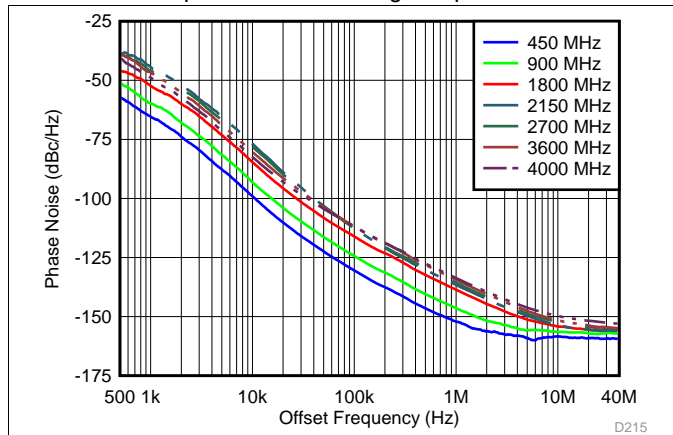


Figure 82. Open Loop Phase Noise vs Frequency

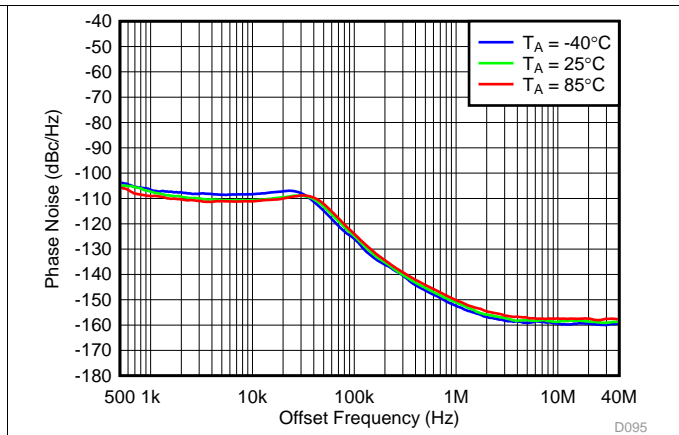


Figure 83. 450 MHz Frac-N (Closed Loop Phase Noise) vs Temperature

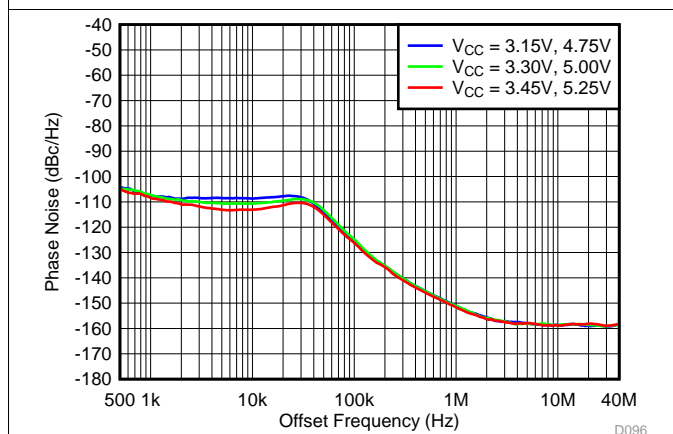


Figure 84. 450 MHz Frac-N (Closed Loop Phase Noise) vs Supply

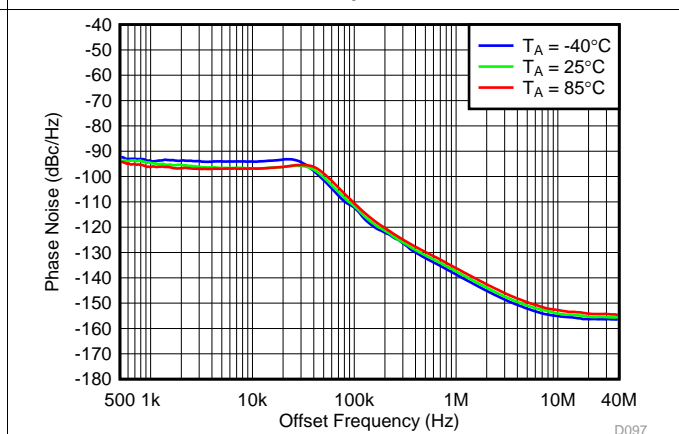


Figure 85. 1800 MHz Frac-N (Closed Loop Phase Noise) vs Temperature

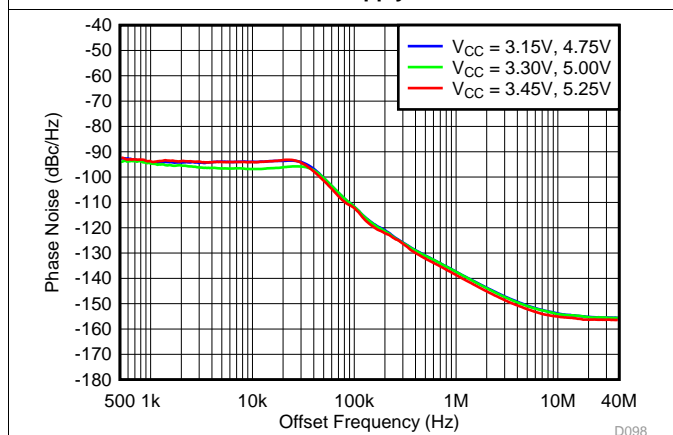


Figure 86. 1800 MHz Frac-N (Closed Loop Phase Noise) vs Supply

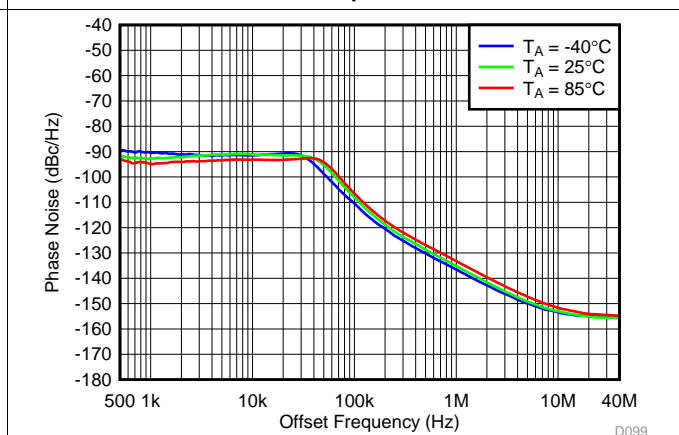


Figure 87. 2150 MHz Frac-N (Closed Loop Phase Noise) vs Temperature

Typical Characteristics - PLL/VCO (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and TA = 25°C. Measured at LO_OUTP with 50 Ω bias resistor and 47 pF series capacitor. Modulator section powered down. Reference frequency is set to 61.44 MHz. Optimized bias settings as per Table 16.

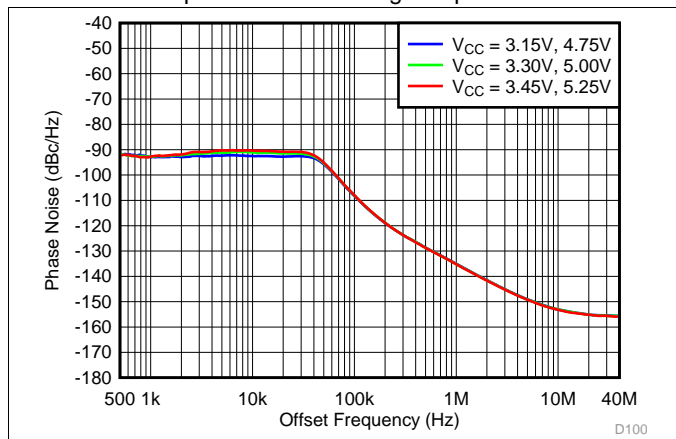


Figure 88. 2150 MHz Frac-N (Closed Loop Phase Noise) vs Supply

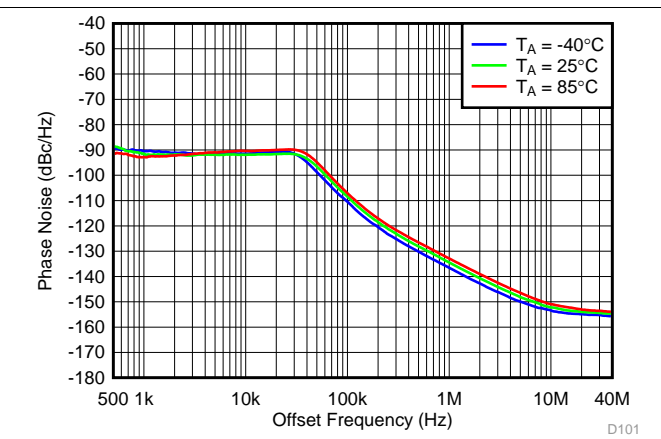


Figure 89. 2700 MHz Frac-N (Closed Loop Phase Noise) vs Temperature

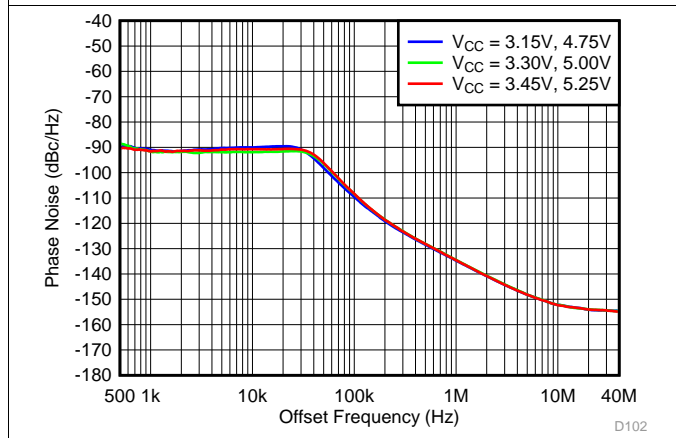


Figure 90. 2700 MHz Frac-N (Closed Loop Phase Noise) vs Supply

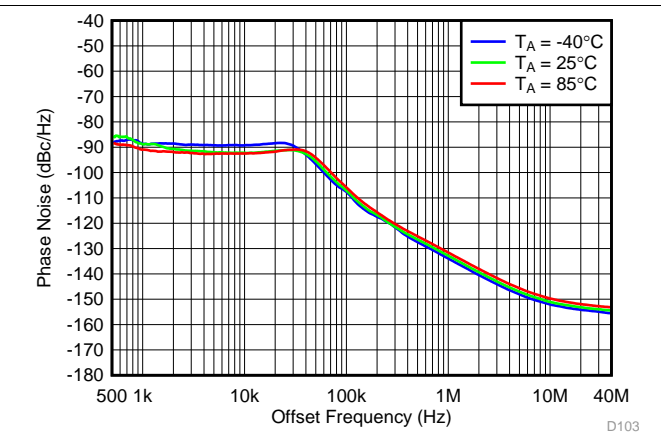


Figure 91. 3600 MHz Frac-N (Closed Loop Phase Noise) vs Temperature

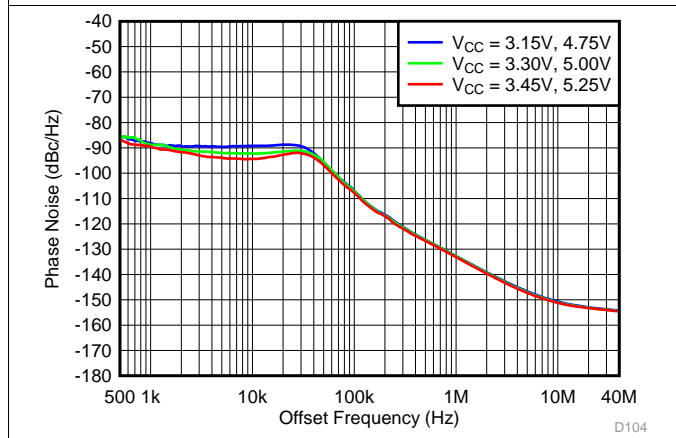


Figure 92. 3600 MHz Frac-N (Closed Loop Phase Noise) vs Supply

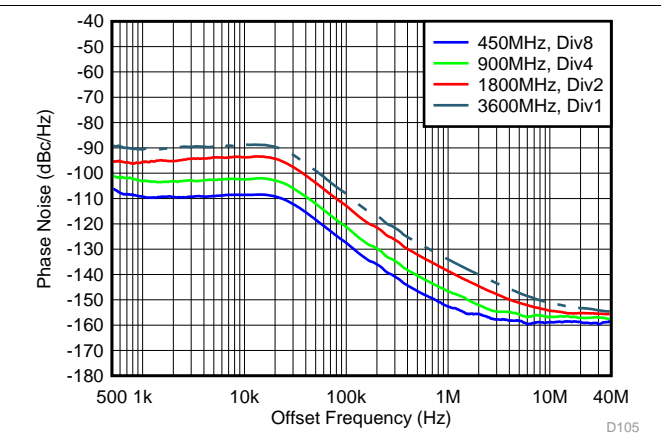
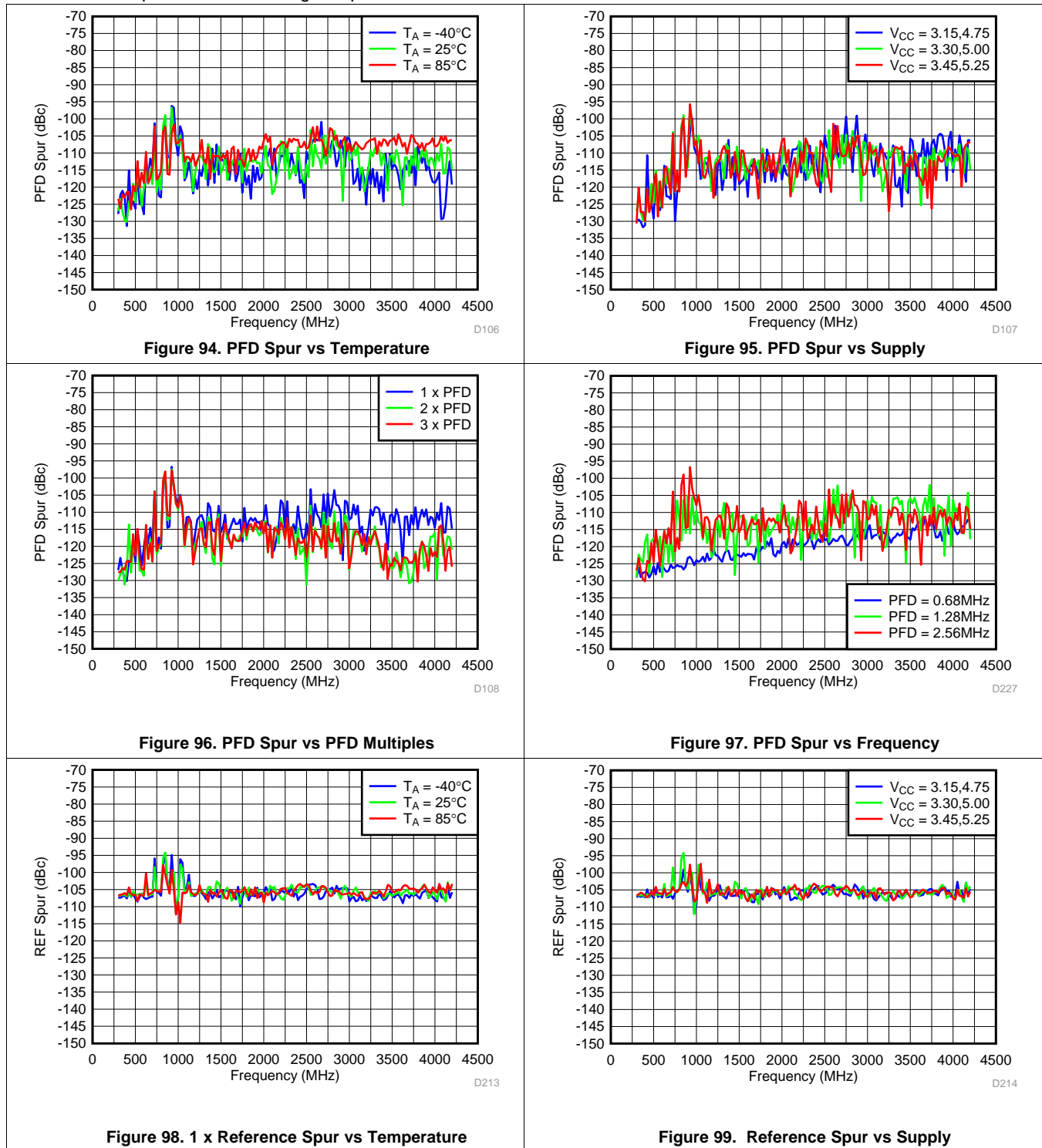


Figure 93. 450, 900, 1800, 3600 MHz Closed Loop Phase Noise vs Offset Frequency

Typical Characteristics - PLL/VCO (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C. Measured at LO_OUTP with 50 Ω bias resistor and 47 pF series capacitor. Modulator section powered down. Reference frequency is set to 61.44 MHz. Optimized bias settings as per Table 16.



Typical Characteristics - PLL/VCO (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and TA = 25°C. Measured at LO_OUTP with 50 Ω bias resistor and 47 pF series capacitor. Modulator section powered down. Reference frequency is set to 61.44 MHz. Optimized bias settings as per Table 16.

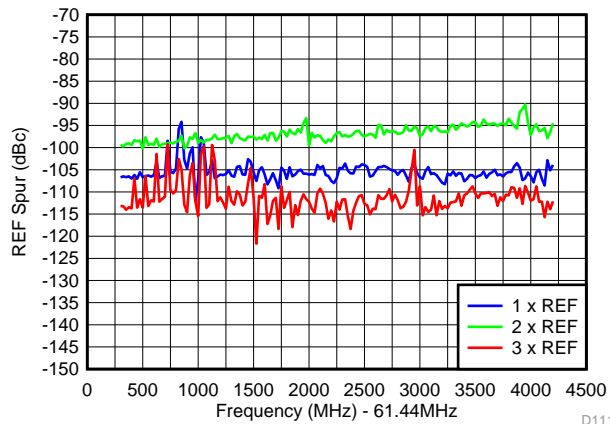


Figure 100. Reference Spur vs Reference Multiples

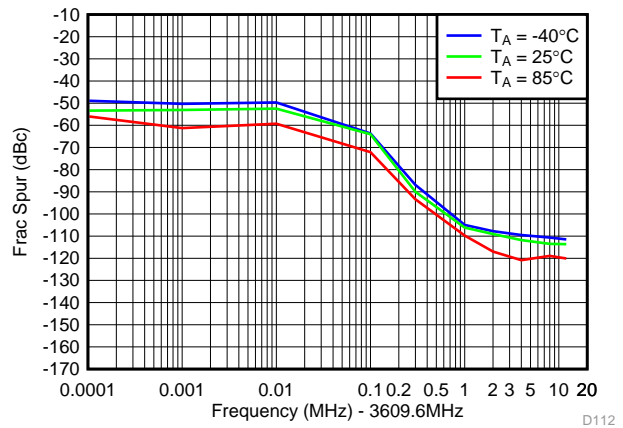


Figure 101. 3609.6 MHz Integer Boundary Spur vs Temperature

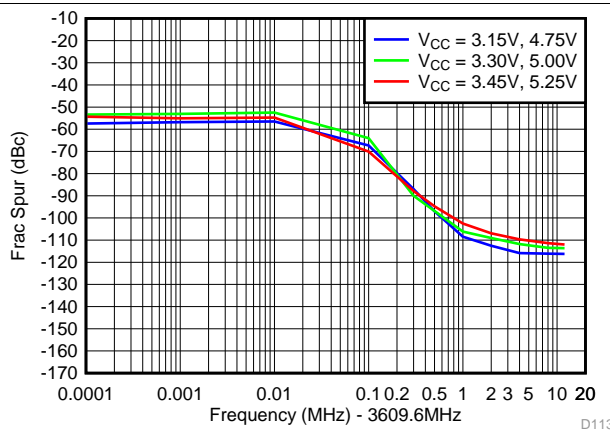


Figure 102. 3609.6 MHz Integer Boundary Spur vs Supply

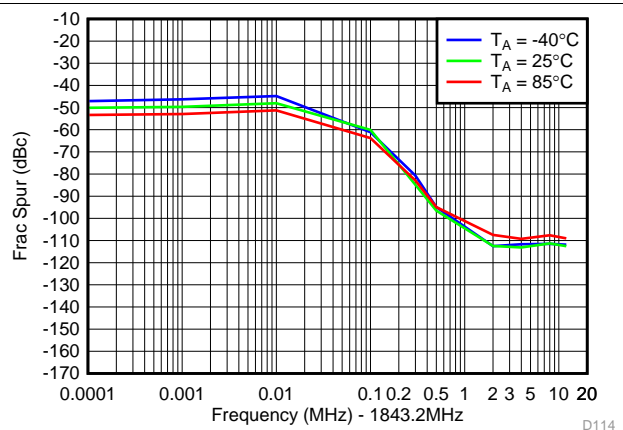


Figure 103. 1843.2 MHz Integer Boundary Spur vs Temperature

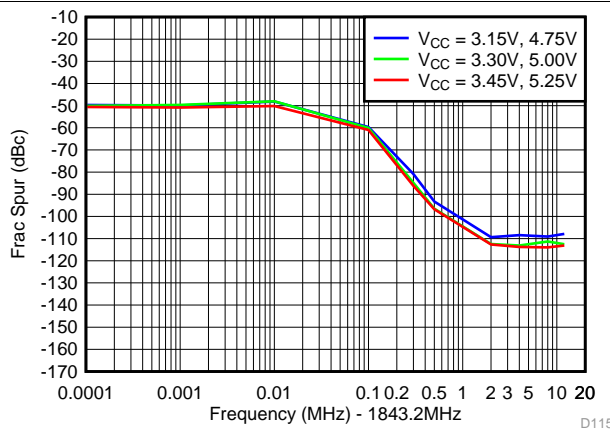
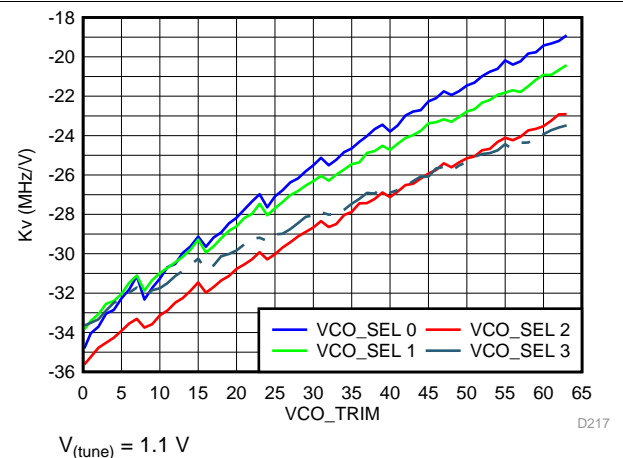


Figure 104. 1842.2 MHz Integer Boundary Spur vs Supply



V_(tune) = 1.1 V

Figure 105. KVCO vs VCO Trim

Typical Characteristics - PLL/VCO (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C. Measured at LO_OUTP with 50 Ω bias resistor and 47 pF series capacitor. Modulator section powered down. Reference frequency is set to 61.44 MHz. Optimized bias settings as per Table 16.

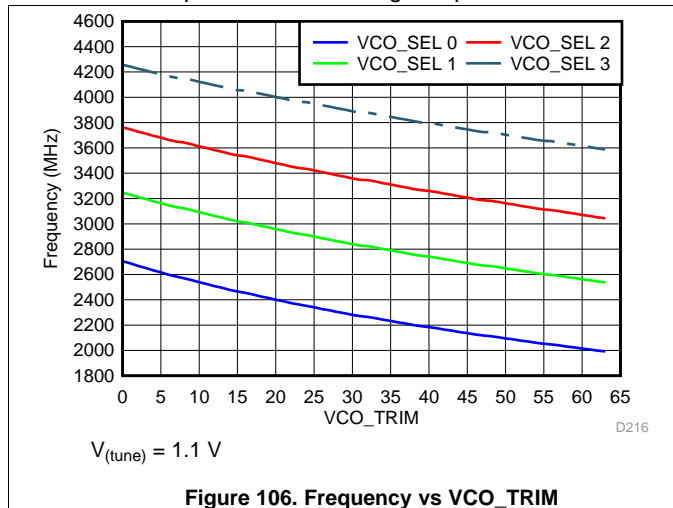


Figure 106. Frequency vs VCO_TRIM

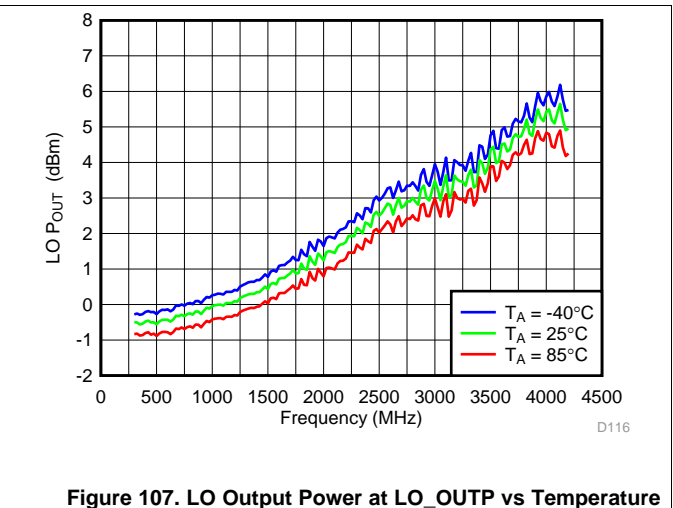


Figure 107. LO Output Power at LO_OUTP vs Temperature

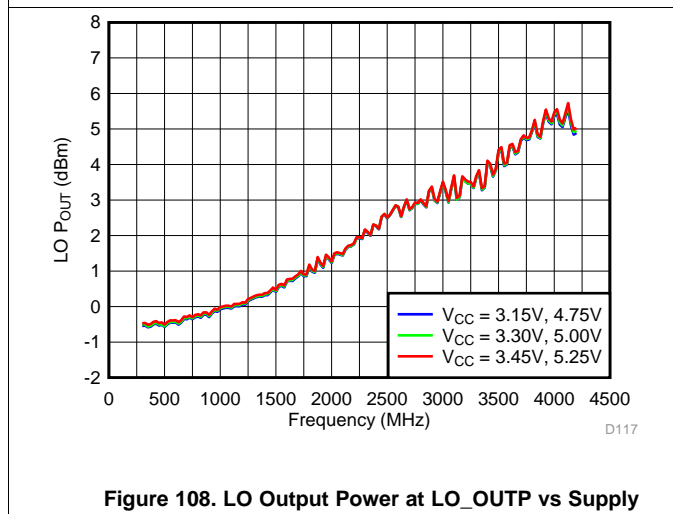


Figure 108. LO Output Power at LO_OUTP vs Supply

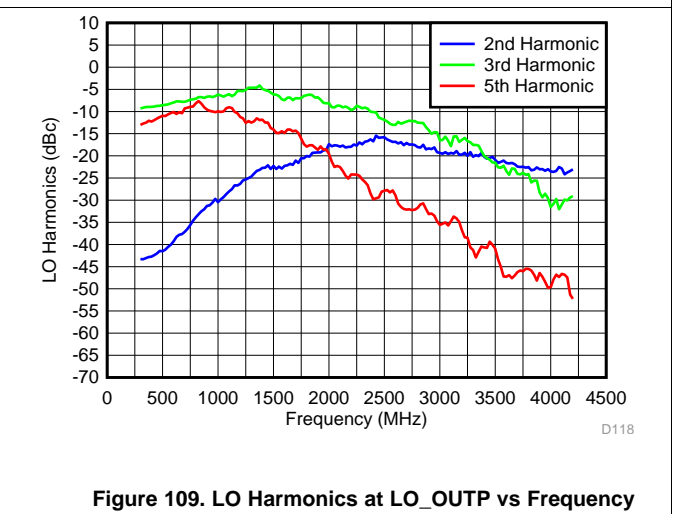


Figure 109. LO Harmonics at LO_OUTP vs Frequency

6.19 Typical Characteristics - Current Consumption

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C. Optimized bias settings as per Table 16

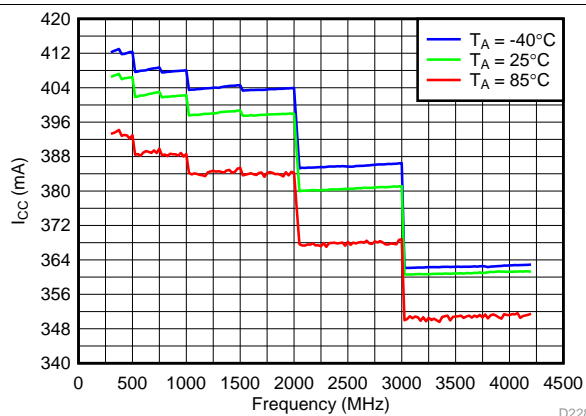


Figure 110. 3.3V Supply Current vs Temperature, Typical Operating Mode

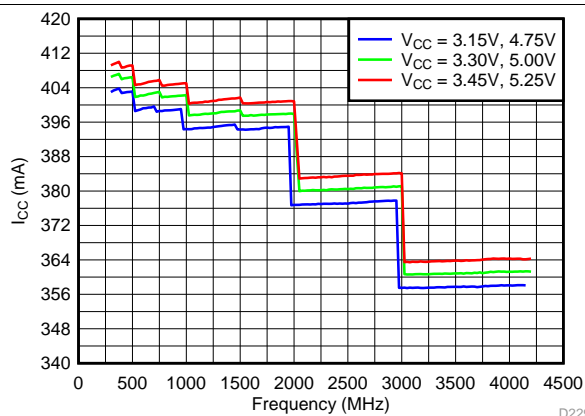


Figure 111. 3.3V Supply Current vs Supply, Typical Operating Mode

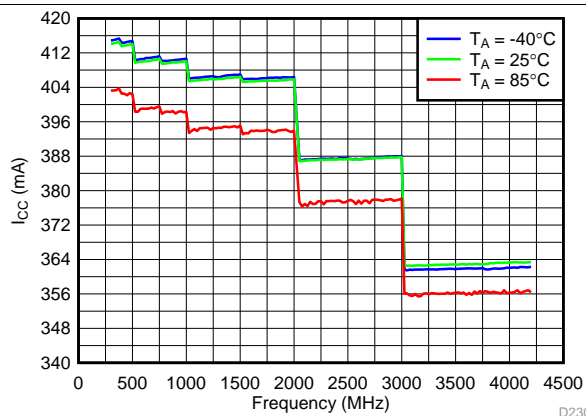


Figure 112. 3.3V Supply Current vs Temperature, High Gain Mode

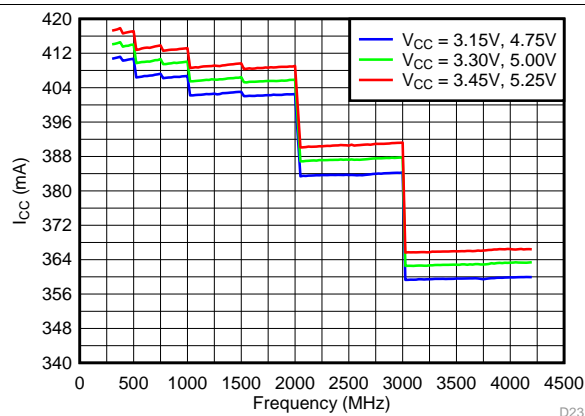


Figure 113. 3.3V Supply Current vs Supply, High Gain Mode

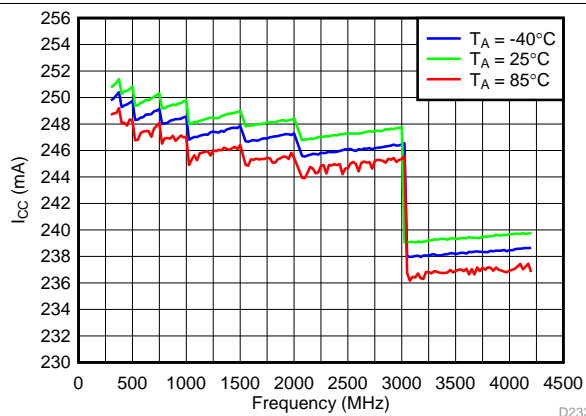


Figure 114. 3.3V Supply Current vs Temperature, Low Power Mode

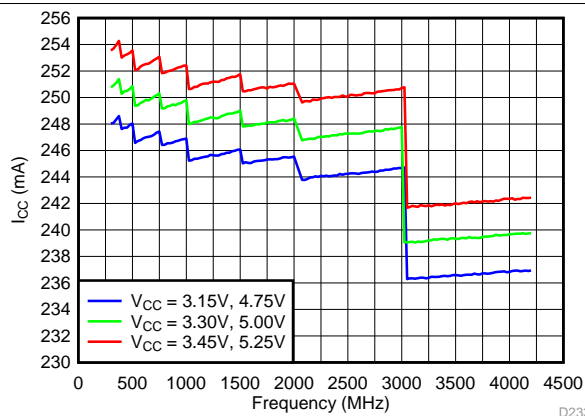
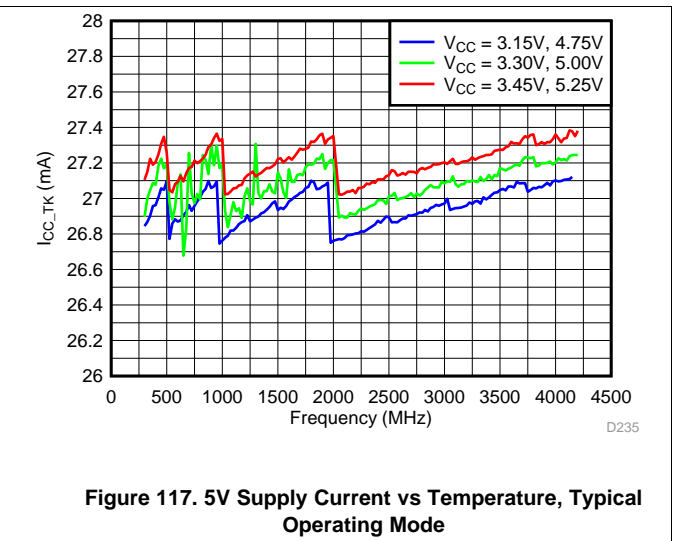
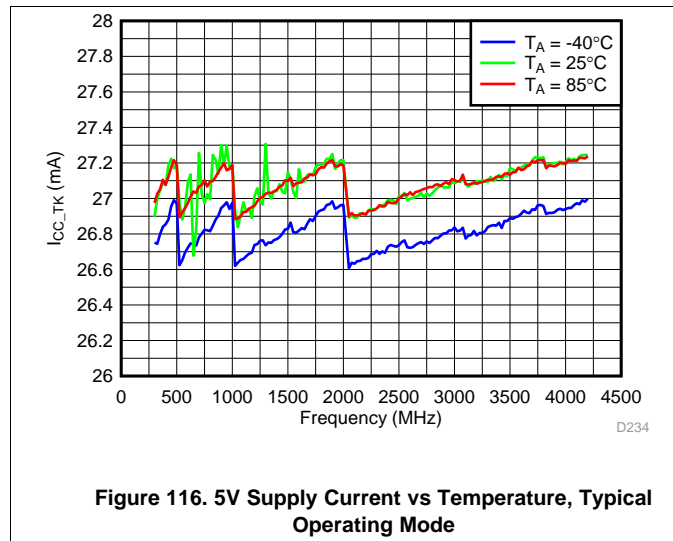


Figure 115. 5V Supply Current vs Supply, Low Power Mode

Typical Characteristics - Current Consumption (continued)



6.20 Typical Characteristics - Power Dissipation

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C. Optimized bias settings as per Table 16.

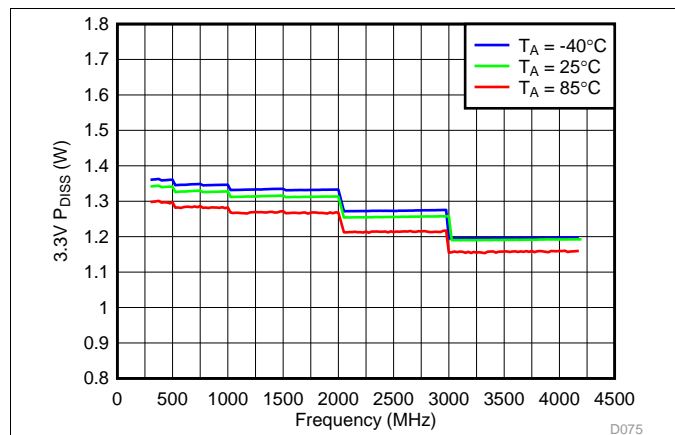


Figure 118. 3.3 V P_{DISS} vs Temperature, Typical Operating Mode

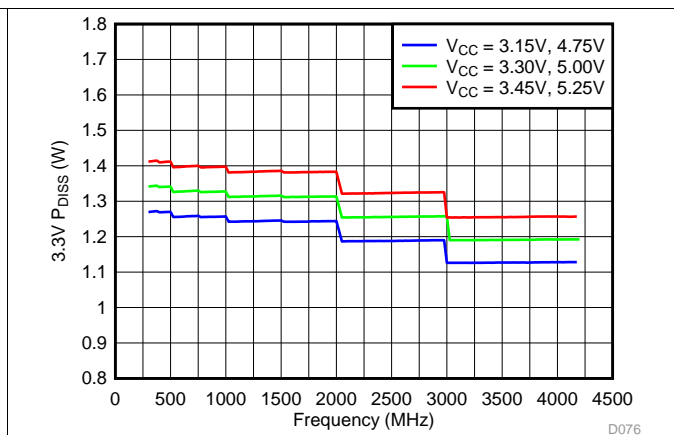


Figure 119. 3.3 V P_{DISS} vs Supply, Typical Operating Mode

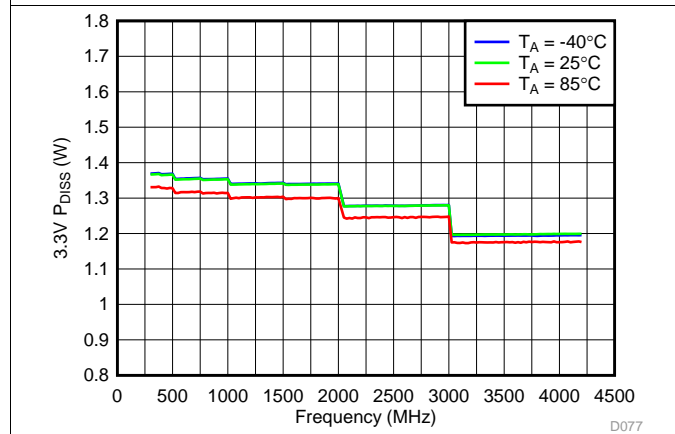


Figure 120. 3.3 V P_{DISS} vs Temperature, High Gain Mode

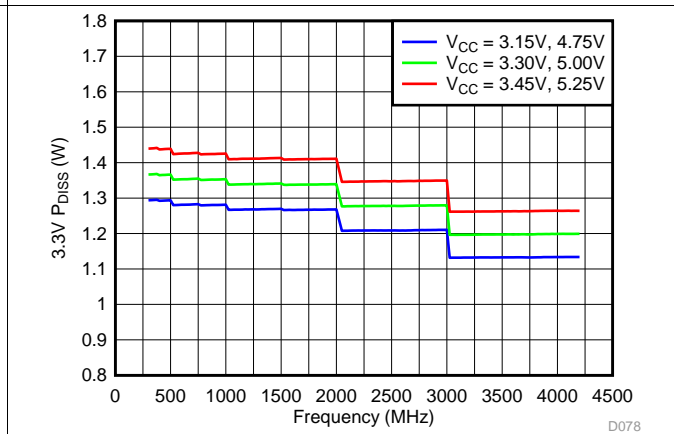


Figure 121. 3.3 V P_{DISS} vs Supply, High Gain Mode

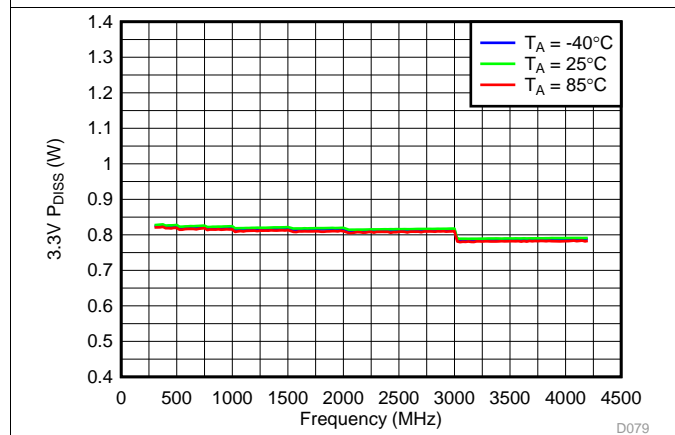


Figure 122. 3.3 V P_{DISS} vs Temperature, Low Power Mode

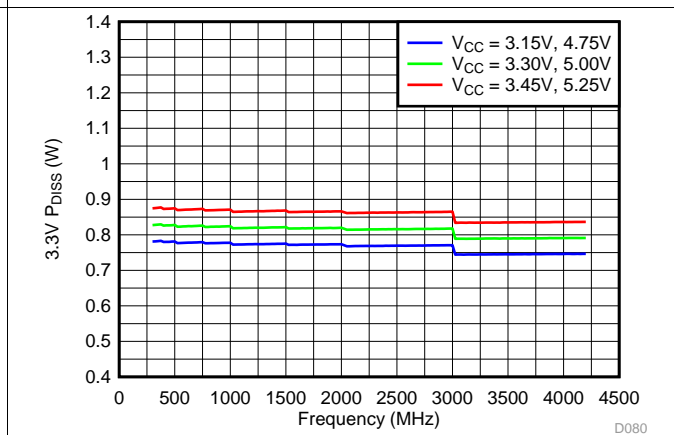


Figure 123. 3.3 V P_{DISS} vs Supply, Low Power Mode

Typical Characteristics - Power Dissipation (continued)

Unless specified all plots were created using TRF3722EVM, VCC = 3.3 V, VCC_TK = 5 V, and T_A = 25°C. Optimized bias settings as per Table 16.

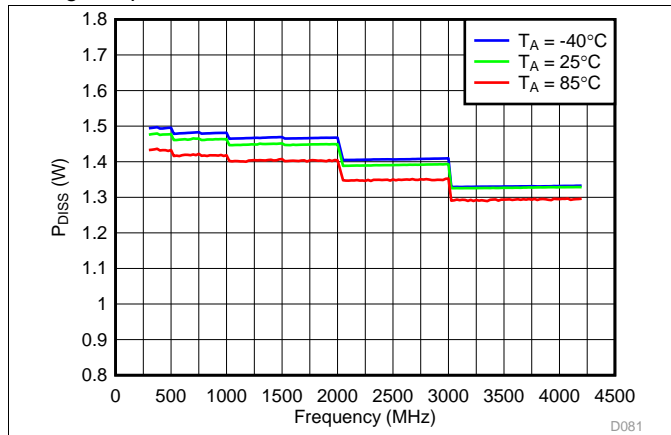


Figure 124. Total P_{DISS} vs Temperature, Typical Operating Mode

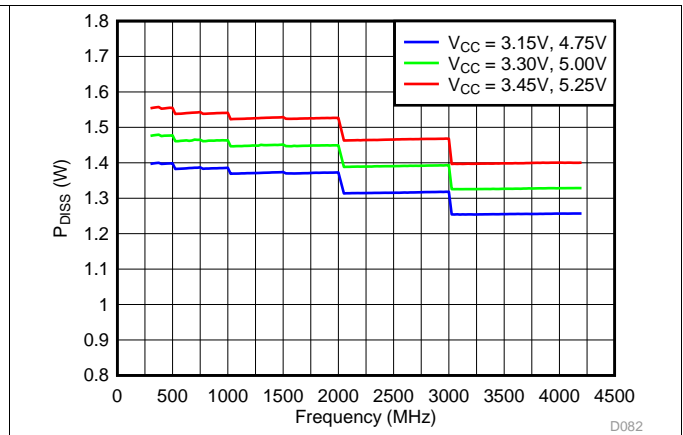


Figure 125. Total P_{DISS} vs Supply, Typical Operating Mode

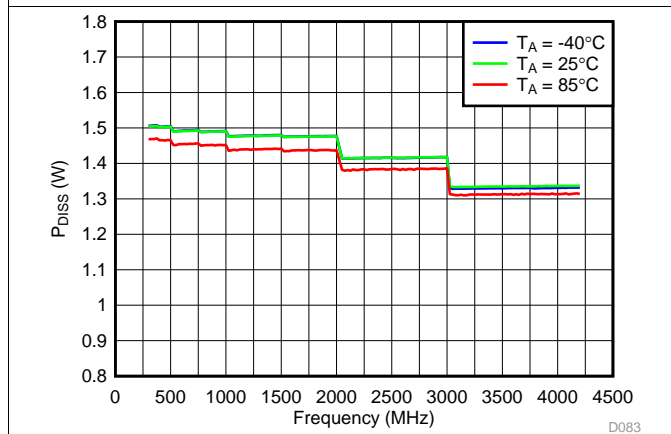


Figure 126. Total P_{DISS} vs Temperature, High Gain Mode

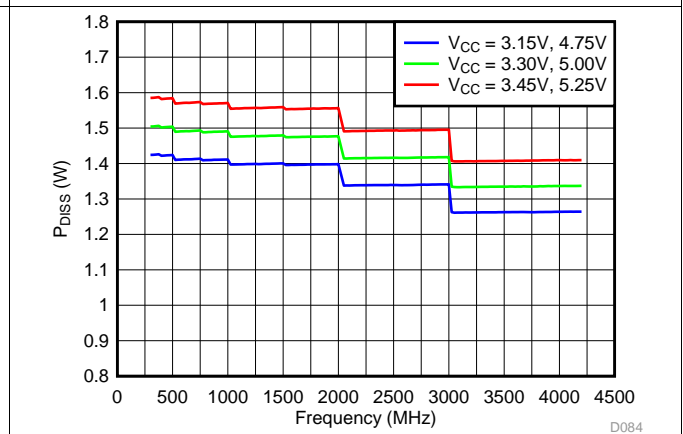


Figure 127. Total P_{DISS} vs Supply, High Gain Mode

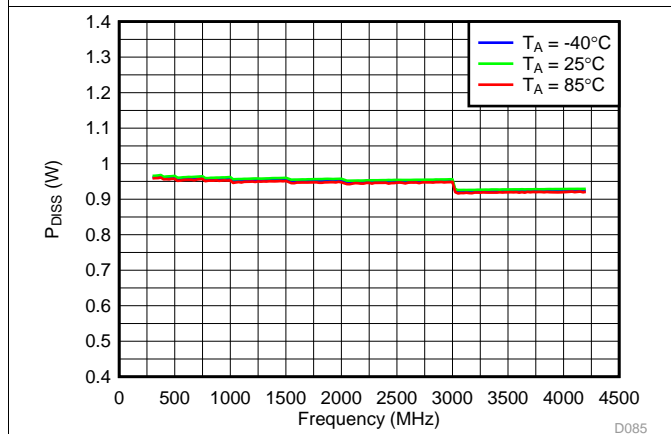


Figure 128. Total P_{DISS} vs Temperature, Low Power Mode

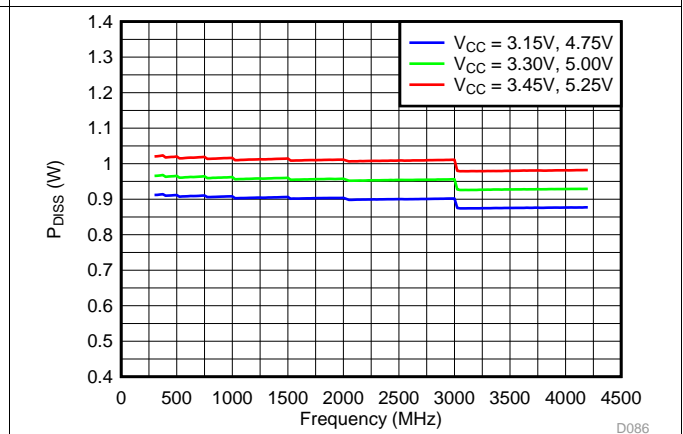


Figure 129. Total P_{DISS} vs Supply, Low Power Mode

7 Parameter Measurement Information

7.1 Serial Interface Timing Diagram

The TRF3722 features a four-wire serial programming interface (4WI) that controls an internal 32-bit shift register with seven parallel registers. There are total of three signals that must be applied: the clock (CLK), the serial data (DATA), and the latch enable (LE). The fourth signal is the read back (RDBK) signal. The serial data (DB0-DB31) are loaded least significant bit (LSB) first, and read on the rising edge of the CLK. LE is asynchronous to the CLK signal; at its rising edge, the data in the shift register are loaded into the selected internal register. Figure 130 shows the timing diagram the 4WI. Table 1 lists the 4WI timing for the write operation.

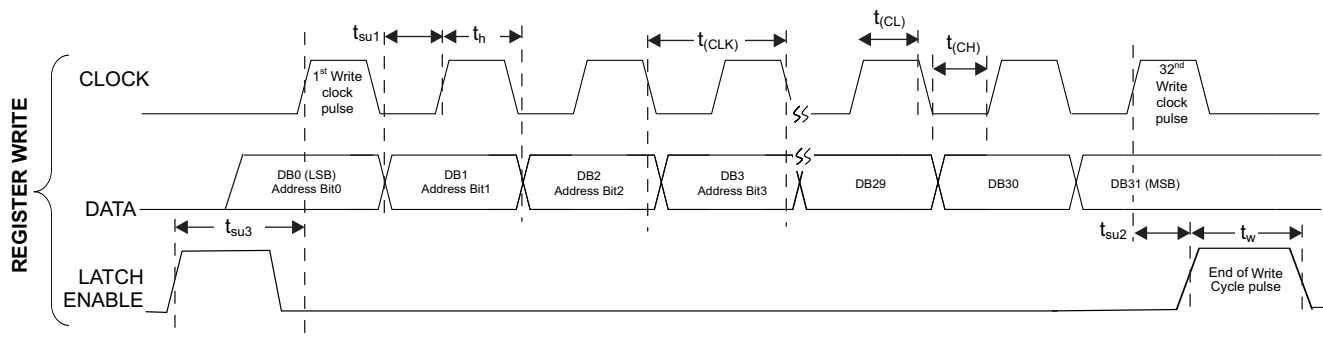


Figure 130. 4WI Writing Timing Diagram

Table 1. 4WI Timing for Write Operation

| | | MIN | TYP | MAX | UNIT |
|-----------|-----------------------------|-----|-----|-----|------|
| t_h | Hold time, data to clock | 20 | | | ns |
| t_{su1} | Setup time, data to clock | 20 | | | ns |
| t_{CH} | Clock low duration | 20 | | | ns |
| t_{CL} | Clock High duration | 20 | | | ns |
| t_{su2} | Setup time, clock to enable | 20 | | | ns |
| t_{CLK} | Clock period | 50 | | | ns |
| t_w | Enable Time | 50 | | | ns |
| t_{su3} | Setup time, Latch to Data | 70 | | | ns |

TRF3722 integrates 7 registers: Register 0 (000) to Register 6 (110). Registers 1 through 6 are used to set-up and control the TRF3722 functionalities, while register 0 is used for the read-back function. Each read-back is composed by two phases: writing followed by the actual reading of the internal data. This is shown in the timing diagram in [Figure 131](#).

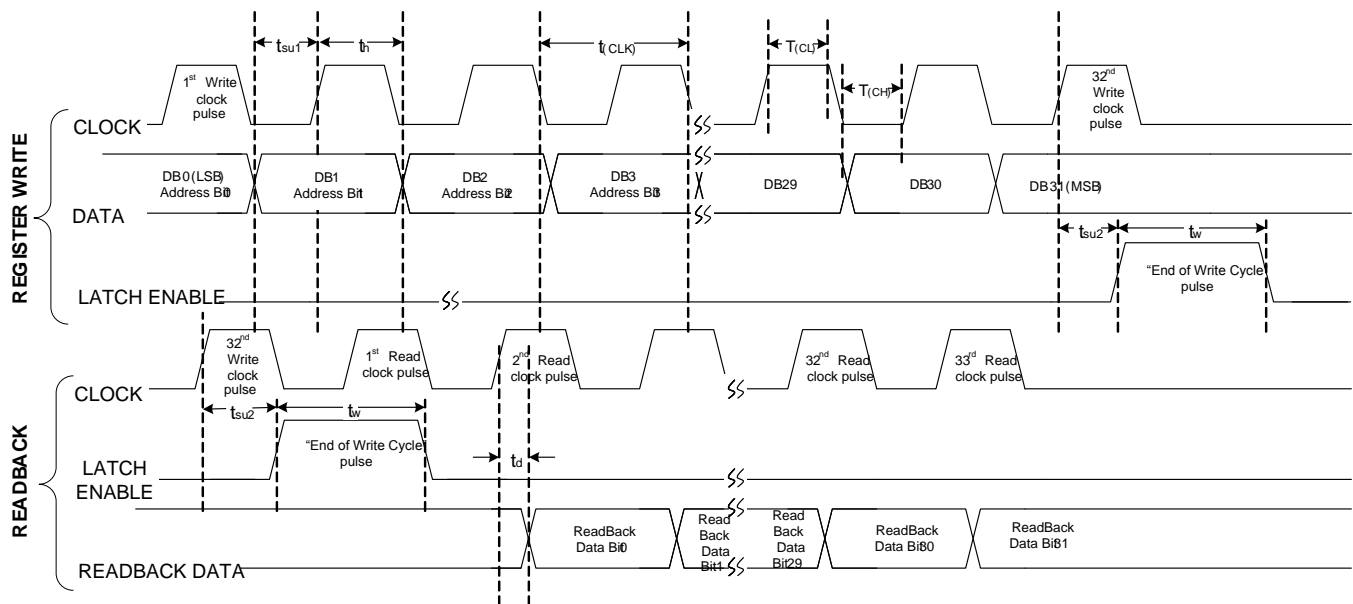


Figure 131. 4WI Read-Back Timing Diagram

During the writing phase a command is sent to TRF3722 register 0 to set it in read-back mode and to specify which register is to be read. In the proper reading phase, at each rising clock edge, the internal data is transferred into the RDBK pin and can be read at the following falling edge (LSB first). The first clock after the LE goes high (end of writing cycle) is idle and the following 32 clocks pulses will transfer the internal register content to the RDBK pin. [Table 2](#) shows the Readback timing.

Table 2. 4WI Timing for Readback Timing

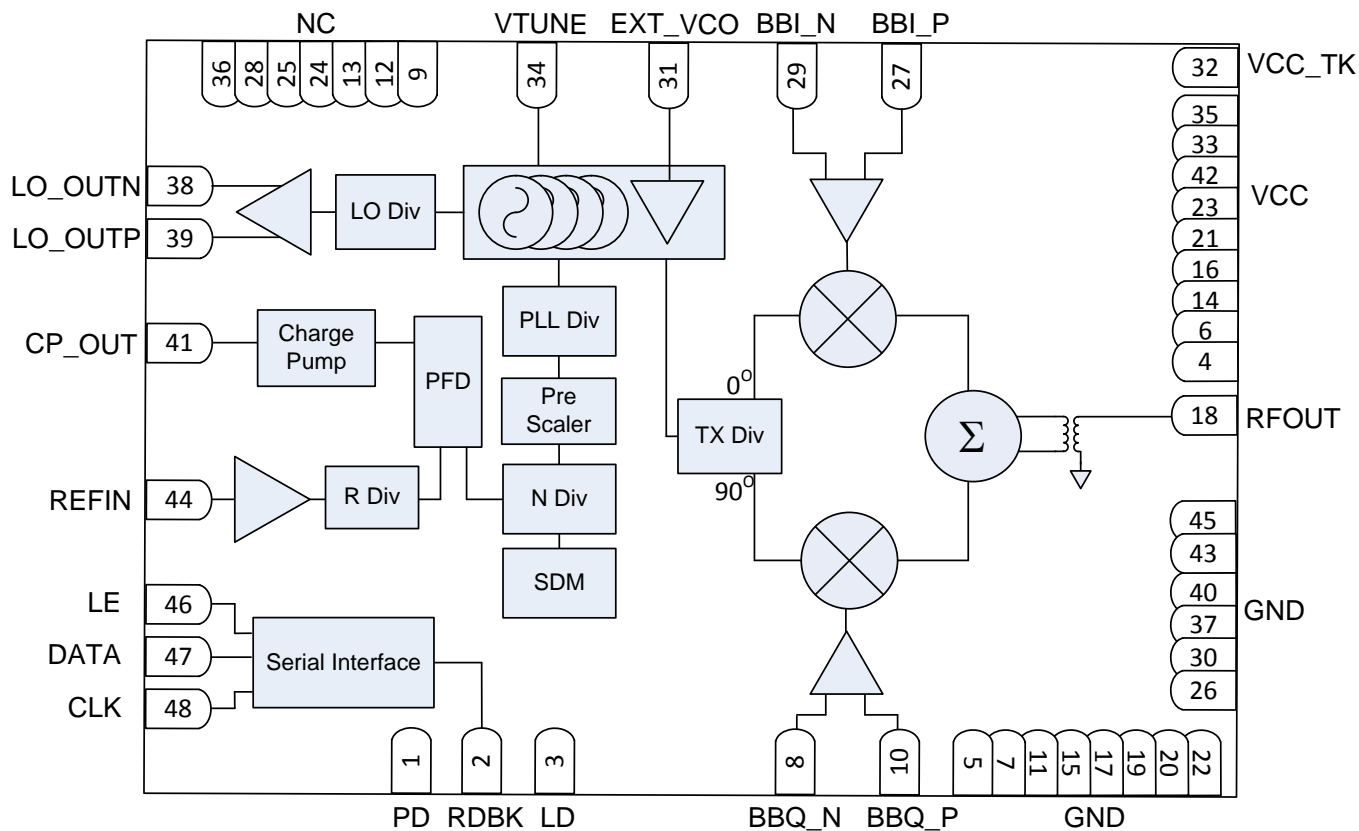
| | | MIN | TYP | MAX | UNIT | COMMENT |
|-------------|---|-----|-----|-----|------|---------------------|
| t_h | Hold time, data to clock | 20 | | | ns | |
| t_{SU1} | Setup time, data to clock | 20 | | | ns | |
| t_{CH} | Clock low duration | 20 | | | ns | |
| t_{CL} | Clock High duration | 20 | | | ns | |
| t_{SU2} | Setup time, clock to enable | 20 | | | ns | |
| t_{SU3} | Setup time, enable to Readback clock | 20 | | | ns | |
| t_d | Delay time, clock to Readback data output | 10 | | | | |
| t_W | Enable Time | 50 | | | ns | Equals Clock period |
| $t_{(CLK)}$ | Clock period | 50 | | | ns | |

8 Detailed Description

8.1 Overview

TRF3722 integrates a high performance direct conversion quadrature modulator with exceptional linearity and low noise performance. The modulator which upconverts low frequency baseband signal to high frequency RF typically operates at 0.25 V common mode. It supports seamless interface with current source DACs. It also features high gain and low power operating modes. Additionally, TRF3722 integrates PLL and VCO to provide the local oscillator (LO) to the integrated modulator. The PLL and VCO provides excellent phase noise and extremely low spurious performance. The device also provides an LO output for driving another modulator or mixer. TRF3722 supports the use of an external VCO or LO signal.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 RF Output

The RF output is single ended and can drive a 50-Ω load. It can be tuned with the use of an output matching network to optimize the linearity and return loss performance within a selected band.

8.3.2 Baseband Inputs

The baseband inputs consist of the in-phase signal (I) and the quadrature-phase signals (Q). These I and Q signals are differential. The baseband lines are nominally biased at 0.25-V common-mode voltage (V_{CM}); however, the device can operate with a V_{CM} in the range of 0 V to 0.5 V. The baseband input lines are normally terminated externally 50 Ω on TRF3722 evaluation board, though it is possible to modify this value if necessary to match to an external filter load impedance requirement.

8.3.3 LO Output

The LO outputs are open collector differential outputs and are biased externally. These differential outputs can be tuned to optimized output power along with OUTBUF_BIAS register settings. It also is possible to use LO outputs in single ended mode.

8.3.4 PLL Architecture

Figure 132 illustrates a block diagram of the PLL architecture.

The VCO output frequency (f_{VCO}) is given by Equation 1:

$$f_{VCO} = \frac{f_{REF}}{RDIV} \times PLL\ DIV \times \left(NINT + \frac{NFRAC}{2^{25}} \right) \quad (1)$$

$$f_{PFD} = \frac{f_{REF}}{RDIV} \quad (2)$$

$$PLL\ DIV = 2^{PLL_DIV_SEL} \quad (3)$$

$$f_{VCO} = f_{PFD} \times PLL\ DIV \times \left(NINT + \frac{NFRAC}{2^{25}} \right) \quad (4)$$

Where f_{REF} is the reference input frequency, $RDIV$ is the reference divider division ratio and the phase - frequency detector frequency is f_{PFD} . PLL_DIV_SEL controls the division ratio of the programmable divider (PLL DIV) before the dual-modulus prescaler (DMP). $NINT$ and $NFRAC/2^{25}$ is the integer and fractional part of the fractional divider (N.f), respectively. In Integer mode, the fractional setting is ignored and Equation 5 is applied.

$$f_{VCO} = f_{PFD} \times PLL\ DIV \times NINT \quad (5)$$

The complete feedback divider block consists of a PLL DIV, DMP, and N.f. The prescaler can be programmed as either a 4/5 or an 8/9. N.f includes an A and M digital counters.

Feature Description (continued)

Frac-N performance data is obtained using the fractional loop filter shown in Figure 134. 40 kHz loop bandwidth and 15.36 MHz PFD was considered.

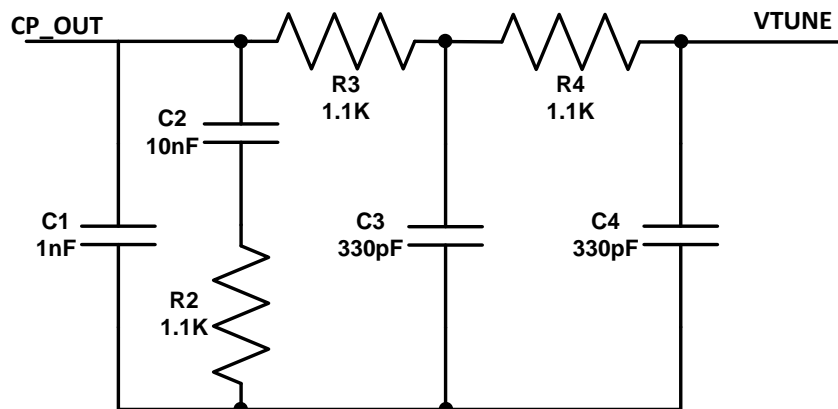


Figure 134. Fractional Loop Filter

8.3.7 Lock Detect

The lock detect signal is generated in the phase frequency detector by comparing the two input signals. When the two compared phase signals remain aligned for several clock cycles, an internal signal goes high. The precision of this comparison is controlled through the LD_ANA_PREC bits. This internal signal is then averaged and compared against a reference voltage to generate the lock detect (LD) signal. The number of averages used is controlled through LD_DIG_PREC. Therefore, when the VCO is frequency locked, LD is high. When the VCO frequency is not locked, LD may pulse high or exhibit periodic behavior.

By default, the internal lock detect signal is made available on the LD terminal. Register bits MUX_CTRL can be used to control a multiplexer to output other diagnostic signals on the LD output.

8.4 Device Functional Modes

8.4.1 Selecting PLL Divider Values

With reference to the PLL architecture illustrated in [Figure 132](#), operation of the PLL requires TX_DIV_SEL / LO_DIV_SEL, PLL_DIV_SEL, RDIV, NINT, NFRAC and PRSC_SEL bits to be calculated.

a. TX_DIV_SEL / LO_DIV_SEL

The LO to the integrated modulator (f_{TX}) and additional LO output (f_{LO}) frequency is related to f_{VCO} according to the following:

$$f_{TX} = f_{VCO} / \text{TX DIV}$$

$$f_{LO} = f_{VCO} / \text{LO DIV}$$

Where TX DIV and LO DIV are related to TX_DIV_SEL and LO_DIV_SEL as:

| TX_DIV_SEL / LO_DIV_SEL | TX_DIV / LO_DIV | FREQUENCY RANGE |
|-------------------------|-----------------|---|
| TX_DIV_SEL = 0 | TX DIV = 1 | 2050 MHz \leq f_{TX} \leq 4100 MHz |
| TX_DIV_SEL = 1 | TX DIV = 2 | 1025 MHz \leq f_{TX} \leq 2050 MHz |
| TX_DIV_SEL = 2 | TX DIV = 4 | 512.5 MHz \leq f_{TX} \leq 1025 MHz |
| TX_DIV_SEL = 3 | TX DIV = 8 | 256.25 MHz \leq f_{TX} \leq 512.5 MHz |
| LO_DIV_SEL = 0 | LO DIV = 1 | 2050 MHz \leq f_{LO} \leq 4100 MHz |
| LO_DIV_SEL = 1 | LO DIV = 2 | 1025 MHz \leq f_{LO} \leq 2050 MHz |
| LO_DIV_SEL = 2 | LO DIV = 4 | 512.5 MHz \leq f_{LO} \leq 1025 MHz |
| LO_DIV_SEL = 3 | LO DIV = 8 | 256.25 MHz \leq f_{LO} \leq 512.5 MHz |

b. PLL_DIV_SEL

Given f_{VCO} , select PLL_DIV_SEL so that the division ratio PLL DIV limits the input frequency to the prescaler, f_{DMP} , is limited to a maximum of 3000 MHz.

$$\text{PLL DIV} = \min(1, 2, 4) \text{ such that } f_{DMP} \leq 3000 \text{ MHz}$$

PLL DIV is related to PLL_DIV_SEL according to the following equation:

$$\text{PLL_DIV} = 2^{\text{PLL_DIV_SEL}}$$

This calculation can be restated as [Equation 6](#).

$$\text{PLL DIV} = \text{Ceiling} \left(\frac{\text{LO DIV} \times f_{LO}}{3000 \text{ MHz}} \right) = \text{Ceiling} \left(\frac{\text{TX DIV} \times f_{TX}}{3000 \text{ MHz}} \right) \quad (6)$$

For both integer and fractional mode it is preferable to operate the f_{PFD} at the highest possible frequency determined by the required frequency step of the RFOUT or LO_OUT. In Integer mode, select the maximum f_{PFD} according to [Equation 7](#).

$$f_{PFD} = \frac{f_{VCO, \text{Stepsize}}}{\text{PLL DIV}} = \frac{f_{TX, \text{Stepsize}} \times \text{TX DIV}}{\text{PLL DIV}} \quad (7)$$

In Fractional mode, small RF stepsize can be obtained through the fractional divider. In this case, the highest f_{PFD} frequency should be selected according to the reference clock and system requirements.

c. RDIV, NINT, NFRAC, PRSC_SEL

The remaining PLL parameters are calculated according to the following equations:

$$\text{RDIV} = \frac{f_{\text{REF}}}{f_{\text{PFD}}}$$

$$\text{NINT} = \text{floor} \left(\frac{f_{\text{VCO}} \times \text{RDIV}}{f_{\text{REF}} \times \text{PLL DIV}} \right)$$

$$\text{NFRAC} = \text{floor} \left(\left(\left(\frac{f_{\text{VCO}} \times \text{RDIV}}{f_{\text{REF}} \times \text{PLL DIV}} \right) - \text{NINT} \right) \times 2^{25} \right)$$

The DMP division ratio (P/P+1) can be set to 4/5 or 8/9 through the PRSC_SEL bit. To allow proper fractional operation, set PRSC_SEL according to:

PRSC_SEL = 0, (P/P+1) = 4/5 for 20 ≤ NINT < 72 in integer mode or 23 ≤ NINT < 75 in fractional mode.

PRSC_SEL = 1, (P/P+1) = 8/9 for NINT ≥ 72 in integer mode or NINT ≥ 75 in fractional mode.

The PRSC_SEL limit at NINT < 75 applies to Fractional mode with third-order modulation. In Integer mode, the PRSC_SEL = 8/9 should be used with NINT as low as 72. The divider block accounts for either value of PRSC_SEL without requiring NINT or NFRAC to be adjusted. Then, calculate the maximum input frequency (f_N) to the digital divider. Use the lower of the possible prescaler divide settings, P = (4,8), as shown by [Equation 8](#).

$$f_{\text{N}} = \frac{f_{\text{VCO}}}{\text{PLL DIV} \times \text{P}} \quad (8)$$

Verify that the frequency into the digital divider, f_N, is less than or equal to 375 MHz. If f_N exceeds 375 MHz, choose a larger value for PLL_DIV_SEL and recalculate f_{PFD}, RDIV, NINT, NFRAC, and PRSC_SEL.

8.4.2 Setup Example for Integer Mode

Suppose the following operating characteristics fractional example are desired for Integer mode operation:

- f_{REF} = 61.44 MHz (reference input frequency)
- Step at RF = 2.56 MHz (RF channel spacing)
- f_{RF} = 1799.68 MHz (RF frequency)

The VCO range is 2050 MHz to 4100 MHz. Therefore:

- LO DIV = 2 (LO_DIV_SEL = 1)
- f_{VCO} = LO DIV × 1799.68 MHz = 3599.36 MHz

In order to keep the frequency of the prescaler below 3000 MHz:

- PLL_DIV = 2 (PLL_DIV_SEL = 1)

The desired stepsize at RF is 2.56 MHz, so:

- f_{PFD} = 2.56 MHz
- f_{VCO}, stepsize = PLL_DIV × f_{PFD} = 5.12 MHz

Using the reference frequency along with the required f_{PFD} gives:

- RDIV = 24
- NINT = 703

NINT ≥ 75; therefore, select the 8/9 prescaler.

$$f_{\text{N}} = 3599.36 \text{ MHz} / (2 \times 8) = 224.96 \text{ MHz} < 375 \text{ MHz}$$

This example shows that Integer mode operation gives sufficient resolution for the required stepsize.

8.4.3 Integer and Fractional Mode Selection

The PLL is designed to operate in either Integer mode or Fractional mode. If the desired local oscillator (LO) frequency is an integer multiple of f_{PFD}, then select integer mode otherwise select fractional mode. In Integer mode, the feedback divider ratio is an integer, and the fraction is zero. Thus, bits corresponding to the fractional control in integer mode are *don't care* and fractional divider functionality is disabled.

In Fractional mode, the accuracy of the final frequency is set by 25-bit resolution. The RF stepsize is $f_{\text{PFD}}/2^{25}$ which is less than 1 Hz for f_{PFD} up to 33 MHz. The appropriate fractional control bits in the serial register must be programmed. Optimal performance may require tuning the MOD_ORD, ISOURCE_SINK, and ISOURCE_TRIM values according to the chosen frequency band.

8.4.4 Selecting the VCO and VCO Frequency Control

To achieve a broad frequency tuning range, the TRF3722 integrates multiple VCOs. Each VCO tank uses a bank of coarse tuning capacitor to bring VCO frequency within a few MHz of the desired value. For a given LO frequency an appropriate VCO and capacitor array must be selected. The device integrates logic that automatically selects an appropriate VCO and capacitor array, such that in closed loop $V_{(\text{TUNE})}$ is approximately equal to the open loop calibration reference voltage set by VCO_CAL_REF. An on-chip temperature sensor automatically adjusts this reference voltage so that proper lock can be maintained over the temperature range.

The calibration logic is driven by a CAL_CLK signal which is scaled version of the reference frequency according to CAL_CLK_SEL. For optimum accuracy It is recommended to limit the CAL_CLK frequency to 600 kHz.

When VCO_SEL_MODE is '0', the device automatically selects the VCO and the capacitor array. When VCO_SEL_MODE is '1', the VCO selected by VCO_SEL is used and the logic automatically selects the capacitor array. The VCO and capacitor array settings resulting from the calibration can be read from Register 0 - read back register.

Automatic calibration can be disabled by setting CAL_BYPASS to '1'. In this manual calibration mode, the VCO is selected through register bits VCO_SEL, while the capacitor array is selected through register bits VCO_TRIM. Calibration modes are summarized in [Table 3](#).

Table 3. VCO Calibration Modes

| CAL_BYPASS | VCO_SEL_MODE | MAX CYCLES CAL_CLK | VCO | CAPACITOR ARRAY |
|------------|-------------------|-----------------------|-----------|--------------------|
| 0 | 0 | 46 | Automatic | |
| 0 | 1 | 34 | VCO_SEL | Automatic |
| 1 | <i>don't care</i> | N/A | VCO_SEL | VCO_TRIM |

8.5 Register Maps

Table 4. Serial interface Register Summary

| Bit | Register 1 | Register 2 | Register 3 | Register 4 | Register 5 | Register 6 |
|-------|------------------|------------------|------------------|------------------|------------------|------------------|
| Bit0 | Register Address | Register Address | Register Address | Register Address | Register Address | Register Address |
| Bit1 | | | | | | |
| Bit2 | | | | | | |
| Bit3 | | | | | | |
| Bit4 | | | | | | |
| Bit5 | RDIV | NINT | NFRAC | PWD_PLL | RSV | RSV |
| Bit6 | | | | PWD_CP | IB_MOD_GM | |
| Bit7 | | | | PWD_VCO | IB_MOD_LO | VCO_TRIM |
| Bit8 | | | | PWD_VCO_MUX | | |
| Bit9 | | | | PWD_DIV124 | VCO_BIAS | |
| Bit10 | | | | PWD_PRESC | | |
| Bit11 | | | | RSV | | |
| Bit12 | | | | PWD_OUTBUF | EN_LOCKDET | |
| Bit13 | | | | PWD_LO_DIV | | |
| Bit14 | | | | PWD_TX_DIV | VCOBUF_BIAS | |
| Bit15 | PWD_MOD | VCOMUX_BIAS | CAL_BYPASS | | | |
| Bit16 | EN_EXTVCO | | MUX_CTRL | | | |
| Bit17 | RSV | | | | | |
| Bit18 | RSV | OUTBUF_BIAS | ISOURCE_SINKB | | | |
| Bit19 | REF_INV | | | | | |
| Bit20 | NEG_VCO | RSV | ISOURCE_TRIM | | | |
| Bit21 | ICP | | | PLL_DIV_SEL | | |
| Bit22 | | PRSC_SEL | | | | |
| Bit23 | | RSV | | | | |
| Bit24 | | VCO_SEL | VCO_CAL_REF | LO_DIV_SEL | | |
| Bit25 | | | | VCO_AMPL_CTRL | LO_DIV_BIAS | |
| Bit26 | ICPDOUBLE | VCO_SEL_MODE | TX_DIV_SEL | | | |
| Bit27 | CAL_CLK_SEL | | CAL_ACC | TX_DIV_BIAS | | |
| Bit28 | | RSV | | | | |
| Bit29 | | | EN_CAL | GAIN_CTRL | | |
| Bit30 | RSV | EN_FRAC_MODE | EN_LD_ISOURCE | | | |
| Bit31 | RSV | EN_FRAC_MODE | EN_LD_ISOURCE | | | |

8.5.1 Serial interface Register Definition

Table 5. Register 1

| Register 1 | Bit Name | Reset Value | Description |
|------------|----------------|-------------|--|
| Bit0 | ADDR<0> | 1 | Register Address Bits |
| Bit1 | ADDR<1> | 0 | |
| Bit2 | ADDR<2> | 0 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | RDIV<0> | 1 | 13-bit Reference Divider Value (Rmin = 1, Rmax = 8191) |
| Bit6 | RDIV<1> | 0 | |
| Bit7 | RDIV<2> | 0 | |
| Bit8 | RDIV<3> | 0 | |
| Bit9 | RDIV<4> | 0 | |
| Bit10 | RDIV<5> | 0 | |
| Bit11 | RDIV<6> | 0 | |
| Bit12 | RDIV<7> | 0 | |
| Bit13 | RDIV<8> | 0 | |
| Bit14 | RDIV<9> | 0 | |
| Bit15 | RDIV<10> | 0 | |
| Bit16 | RDIV<11> | 0 | |
| Bit17 | RDIV<12> | 0 | |
| Bit18 | RSV | 0 | Reserved |
| Bit19 | REF_INV | 0 | Invert Reference Clock Polarity; 1 = use falling edge |
| Bit20 | NEG_VCO | 1 | VCO polarity control; 1 = negative slope (negative Kv) |
| Bit21 | ICP<0> | 0 | Program charge pump DC current: [00000] = 1.94 mA [11111] = 0.47 mA [01010] = 0.97 mA |
| Bit22 | ICP<1> | 1 | |
| Bit23 | ICP<2> | 0 | |
| Bit24 | ICP<3> | 1 | |
| Bit25 | ICP<4> | 0 | |
| Bit26 | ICPDOUBLE | 0 | 1 = Set ICP to double the current |
| Bit27 | CAL_CLK_SEL<0> | 0 | Multiplication or division factor to create VCO calibration clock from the PFD frequency: [0000] = Fastest (Rdiv / 128) [1111] = Slowest (Rdiv x 128), [1000] = Default (1x Rdiv) |
| Bit28 | CAL_CLK_SEL<1> | 0 | |
| Bit29 | CAL_CLK_SEL<2> | 0 | |
| Bit30 | CAL_CLK_SEL<3> | 1 | |
| Bit31 | RSV | 0 | Reserved |

CAL_CLK_SEL[3..0]: Set the frequency divider value used to derive the VCO calibration clock from the reference frequency.

Table 6. CAL_CLK_SEL Scaling Factor Setting

| CAL_CLK_SEL | Scaling Factor | CAL_CLK_SEL | Scaling Factor |
|-------------|----------------|-------------|----------------|
| 1111 | 1/128 | 0111 | NA |
| 1110 | 1/64 | 0110 | 2 |
| 1101 | 1/32 | 0101 | 4 |
| 1100 | 1/16 | 0100 | 8 |
| 1011 | 1/8 | 0011 | 16 |
| 1010 | 1/4 | 0010 | 32 |
| 1001 | 1/2 | 0001 | 64 |
| 1000 | 1 | 0000 | 128 |

ICP[4..0]: Set the charge pump current.

Table 7. Charge Pump Current Set-Point

| ICP[4..0] | Current (mA) | ICP[4..0] | Current (mA) |
|-----------|--------------|-----------|--------------|
| 00 000 | 1.94 | 10 000 | 0.75 |
| 00 001 | 1.76 | 10 001 | 0.72 |
| 00 010 | 1.62 | 10 010 | 0.69 |
| 00 011 | 1.49 | 10 011 | 0.67 |
| 00 100 | 1.38 | 10 100 | 0.65 |
| 00 101 | 1.29 | 10 101 | 0.63 |
| 00 110 | 1.21 | 10 110 | 0.61 |
| 00 111 | 1.14 | 10 111 | 0.59 |
| 01 000 | 1.08 | 11 000 | 0.57 |
| 01 001 | 1.02 | 11 001 | 0.55 |
| 01 010 | 0.97 | 11 010 | 0.54 |
| 01 011 | 0.92 | 11 011 | 0.52 |
| 01 100 | 0.88 | 11 100 | 0.51 |
| 01 101 | 0.84 | 11 101 | 0.50 |
| 01 110 | 0.81 | 11 110 | 0.48 |
| 01 111 | 0.78 | 11 111 | 0.47 |

Table 8. Register 2

| Register 2 | Bit Name | Reset Value | Description |
|------------|----------------|-------------|--|
| Bit0 | ADDR<0> | 0 | Register Address Bits |
| Bit1 | ADDR<1> | 1 | |
| Bit2 | ADDR<2> | 0 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | NINT<0> | 0 | PLL N-Divider Value |
| Bit6 | NINT<1> | 0 | |
| Bit7 | NINT<2> | 0 | |
| Bit8 | NINT<3> | 0 | |
| Bit9 | NINT<4> | 0 | |
| Bit10 | NINT<5> | 0 | |
| Bit11 | NINT<6> | 0 | |
| Bit12 | NINT<7> | 1 | |
| Bit13 | NINT<8> | 0 | |
| Bit14 | NINT<9> | 0 | |
| Bit15 | NINT<10> | 0 | |
| Bit16 | NINT<11> | 0 | |
| Bit17 | NINT<12> | 0 | |
| Bit18 | NINT<13> | 0 | |
| Bit19 | NINT<14> | 0 | |
| Bit20 | NINT<15> | 0 | |
| Bit21 | PLL_DIV_SEL<0> | 1 | Select division ratio of divider in front of prescaler [00] = 1X, [01] = div2, [10] = div4 |
| Bit22 | PLL_DIV_SEL<1> | 0 | |
| Bit23 | PRSC_SEL | 1 | Select precaler modulus: [0] = 4/5, [1] = 8/9 |
| Bit24 | RSV | 0 | Reserved |
| Bit25 | RSV | 0 | |
| Bit26 | VCO_SEL<0> | 0 | Selects between the four integrated VCOs [00] = lowest frequency, [11] = highest frequency |
| Bit27 | VCO_SEL<1> | 1 | |
| Bit28 | VCO_SEL_MODE | 0 | Single VCO auto-calibration mode: [1] = active |
| Bit29 | CAL_ACC<0> | 0 | Error count during the cap array calibration [00] = 0, [01] = 1/32, [10] = 1/64, [11] = 1/128 |
| Bit30 | CAL_ACC<1> | 0 | |
| Bit31 | EN_CAL | 0 | Initiate VCO auto-calibration, resets automatically |

Table 9. Register 3

| Register 3 | Bit Name | Reset Value | Description |
|------------|-----------|-------------|---|
| Bit0 | ADDR<0> | 1 | Register Address Bits |
| Bit1 | ADDR<1> | 1 | |
| Bit2 | ADDR<2> | 0 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | NFRAC<0> | 0 | Fractional PLL N-Divider 0 to 0.99999 in fractional mode |
| Bit6 | NFRAC<1> | 0 | |
| Bit7 | NFRAC<2> | 0 | |
| Bit8 | NFRAC<3> | 0 | |
| Bit9 | NFRAC<4> | 0 | |
| Bit10 | NFRAC<5> | 0 | |
| Bit11 | NFRAC<6> | 0 | |
| Bit12 | NFRAC<7> | 0 | |
| Bit13 | NFRAC<8> | 0 | |
| Bit14 | NFRAC<9> | 0 | |
| Bit15 | NFRAC<10> | 0 | |
| Bit16 | NFRAC<11> | 0 | |
| Bit17 | NFRAC<12> | 0 | |
| Bit18 | NFRAC<13> | 0 | |
| Bit19 | NFRAC<14> | 0 | |
| Bit20 | NFRAC<15> | 0 | |
| Bit21 | NFRAC<16> | 0 | |
| Bit22 | NFRAC<17> | 0 | |
| Bit23 | NFRAC<18> | 0 | |
| Bit24 | NFRAC<19> | 0 | |
| Bit25 | NFRAC<20> | 0 | |
| Bit26 | NFRAC<21> | 0 | |
| Bit27 | NFRAC<22> | 0 | |
| Bit28 | NFRAC<23> | 0 | |
| Bit29 | NFRAC<24> | 0 | |
| Bit30 | RSV | 0 | Reserved |
| Bit31 | RSV | 0 | |

Table 10. Register 4

| Register 4 | Bit Name | Reset Value | Description |
|------------|----------------|-------------|--|
| Bit0 | ADDR<0> | 0 | Register Address Bits |
| Bit1 | ADDR<1> | 0 | |
| Bit2 | ADDR<2> | 1 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | PWD_PLL | 0 | Power -down all PLL blocks: (1 = off) |
| Bit6 | PWD_CP | 0 | Power-down Charge Pump: (1=off) |
| Bit7 | PWD_VCO | 0 | Power-down VCO: (1=off) |
| Bit8 | PWD_VCO_MUX | 0 | Power-down VCO Mux blocks: (1=off) |
| Bit9 | PWD_DIV124 | 0 | Power-down the div 1,2,4 in the PLL f/b path: (1=off) |
| Bit10 | PWD_PRESC | 0 | Power-down Prescaler: (1=off) |
| Bit11 | RSV | 1 | Reserved |
| Bit12 | PWD_OUTBUF | 1 | Power-down Ouput Buffer: (1=off) |
| Bit13 | PWD_LO_DIV | 1 | Power-down LO divider block: (1=off) |
| Bit14 | PWD_TX_DIV | 1 | Power-down TX divider block: (1=off) |
| Bit15 | PWD_MOD | 1 | Power-down modulator block: (1=off) |
| Bit16 | EN_EXTVCO | 0 | Enable external VCO input buffer: (1 = enabled) |
| Bit17 | RSV | 0 | Reserved |
| Bit18 | EN_ISOURCE | 0 | Enable offset current at CP output (frac-n mode only). |
| Bit19 | LD_ANA_PREC<0> | 0 | Control precision of Analog Lock Detector: [00] = H/H (High), [01] = L/L (Low), [10] = H/L , [11] = L/L |
| Bit20 | LD_ANA_PREC<1> | 0 | |
| Bit21 | CP_TRISTATE<0> | 0 | Set the charge pump output in Tristate mode: [00] = Off, [01] = Down, [10] = Up, [11] = Tristate |
| Bit22 | CP_TRISTATE<1> | 0 | |
| Bit23 | SPEEDUP | 0 | Enable fast turn on/off time of bias blocks. |
| Bit24 | LD_DIG_PREC | 0 | Lock detector precision (increases sampling time if set to 1) |
| Bit25 | MOD_ORD<0> | 1 | Modulator order (1-4). Not used in integer mode (default 3rd order + dither) |
| Bit26 | MOD_ORD<1> | 0 | |
| Bit27 | MOD_ORD<2> | 1 | |
| Bit28 | DITH_SEL | 0 | Dither Mode: [0] = pseudo-random, [1] = constant |
| Bit29 | DEL_SD_CLK<0> | 0 | DS modulator clock delay. Frac-n mode only. [00] = Min delay, [11] = max delay |
| Bit30 | DEL_SD_CLK<1> | 1 | |
| Bit31 | EN_FRAC_MODE | 0 | Enable Frac-n mode when set to 1 |

Table 11. Register 5

| Register 5 | Bit Name | Reset Value | Description |
|------------|-------------------|-------------|--|
| Bit0 | ADDR<0> | 1 | Register Address Bits |
| Bit1 | ADDR<1> | 0 | |
| Bit2 | ADDR<2> | 1 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | RSV | 0 | Reserved |
| Bit6 | IB_MOD_GM<0> | 0 | Adjust modulator bias current gm |
| Bit7 | IB_MOD_GM<1> | 1 | |
| Bit8 | IB_MOD_LO<0> | 0 | Adjust modulator BB and LO bias current |
| Bit9 | IB_MOD_LO<1> | 1 | |
| Bit10 | VCO_BIAS<0> | 0 | Adjust VCO bias reference current |
| Bit11 | VCO_BIAS<1> | 0 | |
| Bit12 | VCO_BIAS<2> | 0 | |
| Bit13 | VCO_BIAS<3> | 1 | |
| Bit14 | VCOBUF_BIAS<0> | 0 | Adjust VCO buffer reference current |
| Bit15 | VCOBUF_BIAS<1> | 1 | |
| Bit16 | VCOMUX_BIAS<0> | 0 | Adjust VCO Mux reference current |
| Bit17 | VCOMUX_BIAS<1> | 1 | |
| Bit18 | OUTBUF_BIAS<0> | 0 | Adjust output buffer current |
| Bit19 | OUTBUF_BIAS<1> | 1 | |
| Bit20 | RSV | 0 | Reserved |
| Bit21 | RSV | 1 | |
| Bit22 | VCO_CAL_IB | 0 | Bias current for CAL reference voltage: [0] = PTAT, [1] = Constant |
| Bit23 | VCO_CAL_REF<0> | 0 | VCO calibration reference voltage adjustment [000] = 0.9 V, [111] = 1.4 V [011] = recommended = 1.11 V |
| Bit24 | VCO_CAL_REF<1> | 0 | |
| Bit25 | VCO_CAL_REF<2> | 1 | |
| Bit26 | VCO_AMPL_CTRL<0> | 0 | Adjusts the signal level at the VCO_MUX input: [00] =max, [11] = min |
| Bit27 | VCO_AMPL_CTRL<1> | 1 | |
| Bit28 | VCO_VB_CTRL<0> | 0 | Adjusts the VCO core bias voltage: [00] = 1.2 V, [01] = 1.35 V, [10] = 1.5 V, [11] = 1.65 V |
| Bit29 | VCO_VB_CTRL<1> | 1 | |
| Bit30 | RSV | 0 | Reserved |
| Bit31 | EN_LD_MON_ISOURCE | 1 | Enable monitoring of LD to turn on Isource; recommend [0] = Isource ctrl |

Table 12. Register 6

| Register 6 | Bit Name | Reset Value | Description |
|------------|-----------------|-------------|---|
| Bit0 | ADDR<0> | 0 | Register Address Bits |
| Bit1 | ADDR<1> | 1 | |
| Bit2 | ADDR<2> | 1 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | RSV | 0 | Reserved |
| Bit6 | RSV | 0 | |
| Bit7 | VCO_TRIM<0> | 0 | VCO capacitor array control bits; used in manual cal mode |
| Bit8 | VCO_TRIM<1> | 0 | |
| Bit9 | VCO_TRIM<2> | 0 | |
| Bit10 | VCO_TRIM<3> | 0 | |
| Bit11 | VCO_TRIM<4> | 0 | |
| Bit12 | VCO_TRIM<5> | 1 | |
| Bit13 | EN_LOCKDET | 0 | Enable monitor of lock detector output for autocal mode |
| Bit14 | VCO_TEST_MODE | 0 | Counter mode, measure max and min freq for each VCO |
| Bit15 | CAL_BYPASS | 0 | Bypass auto-cal; sets VCO_SEL and VCO_TRIM from Serial interface |
| Bit16 | MUX_CTRL<0> | 1 | Select signal for test output: [001] = LD, [010] = NDIV, [100] = RDIV, [110] = A_counter |
| Bit17 | MUX_CTRL<1> | 0 | |
| Bit18 | MUX_CTRL<2> | 0 | |
| Bit19 | ISOURCE_SINKB | 0 | Offset current polarity |
| Bit20 | ISOURCE_TRIM<0> | 0 | Adjust Isource bias current in frac-n mode. |
| Bit21 | ISOURCE_TRIM<1> | 0 | |
| Bit22 | ISOURCE_TRIM<2> | 1 | |
| Bit23 | LO_DIV_SEL<0> | 0 | Adjust LO path divider: [00] = Div/1, [01] = Div/2, [10] = Div/4. [11] = Div/8 |
| Bit24 | LO_DIV_SEL<1> | 0 | |
| Bit25 | LO_DIV_BIAS<0> | 0 | Adjust LO divider bias current: [00] = 25 uA, [01] = 37.5 uA, [10] = 50 uA, [11] = 62.5 uA |
| Bit26 | LO_DIV_BIAS<1> | 1 | |
| Bit27 | TX_DIV_SEL<0> | 0 | Adjust TX path divider. |
| Bit28 | TX_DIV_SEL<1> | 1 | [00] = Div/1, [01] = Div/2, [10] = Div/4. [11] = Div/8 |
| Bit29 | TX_DIV_BIAS<0> | 0 | Adjust TX divider bias current: [00] = 25 uA, [01] = 37.5 uA, [10] = 50 uA, [11] = 62.5 uA |
| Bit30 | TX_DIV_BIAS<1> | 1 | |
| Bit31 | GAIN_CTRL | 0 | Modulator gain control: [0] = Default, [1] = High Gain |

Table 13. READBACK Mode Summary Serial interface Map

| Bit | Register 0 | | RDBK | | | |
|-------|------------------|--|------------------|-----|-----------|--|
| Bit0 | Register Address | | Register Address | | | |
| Bit1 | | | | | | |
| Bit2 | | | | | | |
| Bit3 | | | | | | |
| Bit4 | | | | | | |
| Bit5 | CHIP_ID | | N/C | | | |
| Bit6 | NU | | | | | |
| Bit7 | | | | | | |
| Bit8 | | | | | | |
| Bit9 | | | | | | |
| Bit10 | | | | | | |
| Bit11 | R_SAT_ERR | | | | | |
| Bit12 | COUNT | | | N/C | | |
| Bit13 | | | | | VCO_TRIM | |
| Bit14 | | | | | | |
| Bit15 | | | | | | |
| Bit16 | | | | | | |
| Bit17 | | | | | | |
| Bit18 | | | | | | |
| Bit19 | | | | | | |
| Bit20 | | | VCO_SEL | | | |
| Bit21 | | | | | | |
| Bit22 | | | | | | |
| Bit23 | | | MUX_COUNT | | MUX_COUNT | |
| Bit24 | | | | | | |
| Bit25 | | | | | | |
| Bit26 | | | | | | |
| Bit27 | | | | | | |
| Bit28 | RB_REG | | | | | |
| Bit29 | RB_REG | | | | | |
| Bit30 | RB_REG | | | | | |
| Bit31 | MUX_COUNT | | RB_ENABLE | | | |

Table 14. Register 0 (Readback Only)

| Register 0 | Bit Name | Reset Value | Description |
|------------|----------------------|-------------|---|
| Bit0 | ADDR<0> | 0 | Register Address Bits |
| Bit1 | ADDR<1> | 0 | |
| Bit2 | ADDR<2> | 0 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | CHIP_ID<0> | 1 | Chip ID |
| Bit6 | CHIP_ID<1> | 0 | |
| Bit7 | NU | x | Not Used |
| Bit8 | NU | x | |
| Bit9 | NU | x | |
| Bit10 | NU | x | |
| Bit11 | NU | x | |
| Bit12 | R_SAT_ERR | x | R-div saturation error for cal |
| Bit13 | COUNT<0>/NU | x | VCO frequency counter high when MUX_COUNT = 0 and VCO_TEST_MODE = 1 VCO frequency counter low when MUX_COUNT = 1 and VCO_TEST_MODE = 1 Autocal results for VCO_TRIM and VCO_SEL when VCO_TEST_MODE = 0 |
| Bit14 | COUNT<1>/NU | x | |
| Bit15 | COUNT<2>/VCO_TRIM<0> | x | |
| Bit16 | COUNT<3>/VCO_TRIM<1> | x | |
| Bit17 | COUNT<4>/VCO_TRIM<2> | x | |
| Bit18 | COUNT<5>/VCO_TRIM<3> | x | |
| Bit19 | COUNT<6>/VCO_TRIM<4> | x | |
| Bit20 | COUNT<7>/VCO_TRIM<5> | x | |
| Bit21 | COUNT<8>/VCO_SEL<0> | x | |
| Bit22 | COUNT<9>/VCO_SEL<1> | x | |
| Bit23 | COUNT<10>/VCO_SEL<2> | x | |
| Bit24 | COUNT<11> | x | |
| Bit25 | COUNT<12> | x | |
| Bit26 | COUNT<13> | x | |
| Bit27 | COUNT<14> | x | |
| Bit28 | COUNT<15> | x | |
| Bit29 | COUNT<16> | x | |
| Bit30 | COUNT<17> | x | |
| Bit31 | MUX_COUNT | x | [0] = max freq count, [1] = min freq count |

Table 15. Register RDBK (Write Register for Readback)

| RDBK | Bit Name | Reset Value | Description |
|-------|-----------|-------------|--|
| Bit0 | ADDR<0> | 0 | Register Address Bits |
| Bit1 | ADDR<1> | 0 | |
| Bit2 | ADDR<2> | 0 | |
| Bit3 | ADDR<3> | 1 | |
| Bit4 | ADDR<4> | 0 | |
| Bit5 | N/C | 0 | |
| Bit6 | N/C | 0 | |
| Bit7 | N/C | 0 | |
| Bit8 | N/C | 0 | |
| Bit9 | N/C | 0 | |
| Bit10 | N/C | 0 | |
| Bit11 | N/C | 0 | |
| Bit12 | N/C | 0 | |
| Bit13 | N/C | 0 | |
| Bit14 | N/C | 0 | |
| Bit15 | N/C | 0 | |
| Bit16 | N/C | 0 | |
| Bit17 | N/C | 0 | |
| Bit18 | N/C | 0 | |
| Bit19 | N/C | 0 | |
| Bit20 | N/C | 0 | |
| Bit21 | N/C | 0 | |
| Bit22 | N/C | 0 | |
| Bit23 | N/C | 0 | |
| Bit24 | N/C | 0 | |
| Bit25 | N/C | 0 | |
| Bit26 | N/C | 0 | |
| Bit27 | MUX_COUNT | 0 | [0] = max freq count, [1] = min freq count |
| Bit28 | RB_REG<0> | x | Three LSBs of the address for the register that is being read: [001] = Register 1 [110] = Register 6 |
| Bit29 | RB_REG<1> | x | |
| Bit30 | RB_REG<2> | x | |
| Bit31 | RB_ENABLE | 1 | Puts device in Readback mode |

8.5.1.1 BIAS SETTINGS

Optimum TRF7322 bias settings used in the performance measurements are shown in [Table 16](#).

Table 16. Register Settings With Optimized Bias Set Used in the Performance Measurement.

| REGISTER | BITS | TYPICAL OPERATING MODE [256MHz-2GHz], INT MODE | TYPICAL OPERATING MODE [2GHz - 3GHz], INT MODE | TYPICAL OPERATING MODE [3GHz - 4.1GHz], INT MODE | LOW POWER MODE, INT MODE | FRACTIONAL MODE |
|------------|---------------|--|--|--|--------------------------|-----------------|
| REGISTER 1 | RDIV | x | x | x | x | x |
| REGISTER 1 | REF_INV | 0 | 0 | 0 | 0 | 0 |
| REGISTER 1 | NEG_VCO | 1 | 1 | 1 | 1 | 1 |
| REGISTER 1 | ICP | 0 | 0 | 0 | 0 | 0 |
| REGISTER 1 | ICPDOUBLE | 0 | 0 | 0 | 0 | 0 |
| REGISTER 1 | CAL_CLK_SEL | 13 | 13 | 13 | 13 | 15 |
| REGISTER 2 | NINT | x | x | x | x | x |
| REGISTER 2 | PLL_DIV_SEL | x | x | x | x | x |
| REGISTER 2 | PRSC_SEL | x | x | x | x | x |
| REGISTER 2 | VCO_SEL | x | x | x | x | x |
| REGISTER 2 | VCO_SEL_MODE | x | x | x | x | x |
| REGISTER 2 | CAL_ACC | 0 | 0 | 0 | 0 | 0 |
| REGISTER 2 | EN_CAL | 1 | 1 | 1 | 1 | 1 |
| REGISTER 3 | NFRAC | 0 | 0 | 0 | 0 | x |
| REGISTER 4 | PWD_PLL | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | PWD_CP | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | PWD_VCO | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | PWD_VCO_MUX | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | PWD_DIV124 | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | PWD_PRESC | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | PWD_OUTBUF | 0 | 0 | 0 | 1 | 0 |
| REGISTER 4 | PWD_LO_DIV | 0 | 0 | 0 | 1 | 0 |
| REGISTER 4 | PWD_TX_DIV | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | PWD_MOD | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | EN_EXTVCO | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | EN_ISOURCE | 0 | 0 | 0 | 0 | 1 |
| REGISTER 4 | LD_ANA_PREC | 0 | 0 | 0 | 0 | 3 |
| REGISTER 4 | CP_TRISTATE | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | SPEEDUP | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | LD_DIG_PREC | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | MOD_ORD | 5 | 5 | 5 | 5 | 4 |
| REGISTER 4 | DITH_SEL | 0 | 0 | 0 | 0 | 0 |
| REGISTER 4 | DEL_SD_CLK | 2 | 2 | 2 | 2 | 0 |
| REGISTER 4 | EN_FRAC_MODE | 0 | 0 | 0 | 0 | 1 |
| REGISTER 5 | IB_MOD_GM | 3 | 3 | 2 | 0 | 3 |
| REGISTER 5 | IB_MOD_LO | 0 | 1 | 0 | 0 | 0 |
| REGISTER 5 | VCO_BIAS | 15 | 15 | 15 | 15 | 15 |
| REGISTER 5 | VCOBUF_BIAS | 2 | 2 | 2 | 2 | 2 |
| REGISTER 5 | OUTBUF_BIAS | 2 | 2 | 2 | 0 | 2 |
| REGISTER 5 | VCOMUX_BIAS | 2 | 2 | 2 | 2 | 2 |
| REGISTER 5 | VCO_CAL_IB | 0 | 0 | 0 | 0 | 0 |
| REGISTER 5 | VCO_CAL_REF | 3 | 3 | 3 | 3 | 3 |
| REGISTER 5 | VCO_AMPL_CTRL | 0 | 0 | 0 | 0 | 0 |
| REGISTER 5 | VCO_VB_CTRL | 3 | 3 | 3 | 3 | 3 |
| REGISTER 5 | EN_LD_ISOURCE | 0 | 0 | 0 | 0 | 0 |

Table 16. Register Settings With Optimized Bias Set Used in the Performance Measurement. (continued)

| REGISTER | BITS | TYPICAL OPERATING MODE [256MHz-2GHz], INT MODE | TYPICAL OPERATING MODE [2GHz - 3GHz], INT MODE | TYPICAL OPERATING MODE [3GHz - 4.1GHz], INT MODE | LOW POWER MODE, INT MODE | FRACTIONAL MODE |
|------------|---------------|--|--|--|--------------------------|-----------------|
| REGISTER 6 | VCO_TRIM | x | x | x | x | x |
| REGISTER 6 | EN_LOCKDET | 0 | 0 | 0 | 0 | 0 |
| REGISTER 6 | VCO_TEST_MODE | 0 | 0 | 0 | 0 | 0 |
| REGISTER 6 | CAL_BYPASS | 0 | 0 | 0 | 0 | 0 |
| REGISTER 6 | MUX_CTRL | 1 | 1 | 1 | 1 | 5 |
| REGISTER 6 | ISOURCE_SINKB | 0 | 0 | 0 | 0 | 0 |
| REGISTER 6 | ISOURCE_TRIM | 4 | 4 | 4 | 4 | 7 |
| REGISTER 6 | LO_DIV_SEL | x | x | x | x | x |
| REGISTER 6 | LO_DIV_BIAS | 2 | 2 | 2 | 0 | 2 |
| REGISTER 6 | TX_DIV_SEL | x | x | x | x | x |
| REGISTER 6 | TX_DIV_BIAS | 1 | 1 | 1 | 0 | 1 |
| REGISTER 6 | GAIN_CTRL | 0 | 0 | 0 | 0 | 0 |

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

9.2 Typical Application

Figure 135 shows a typical application schematic for the TRF3722.

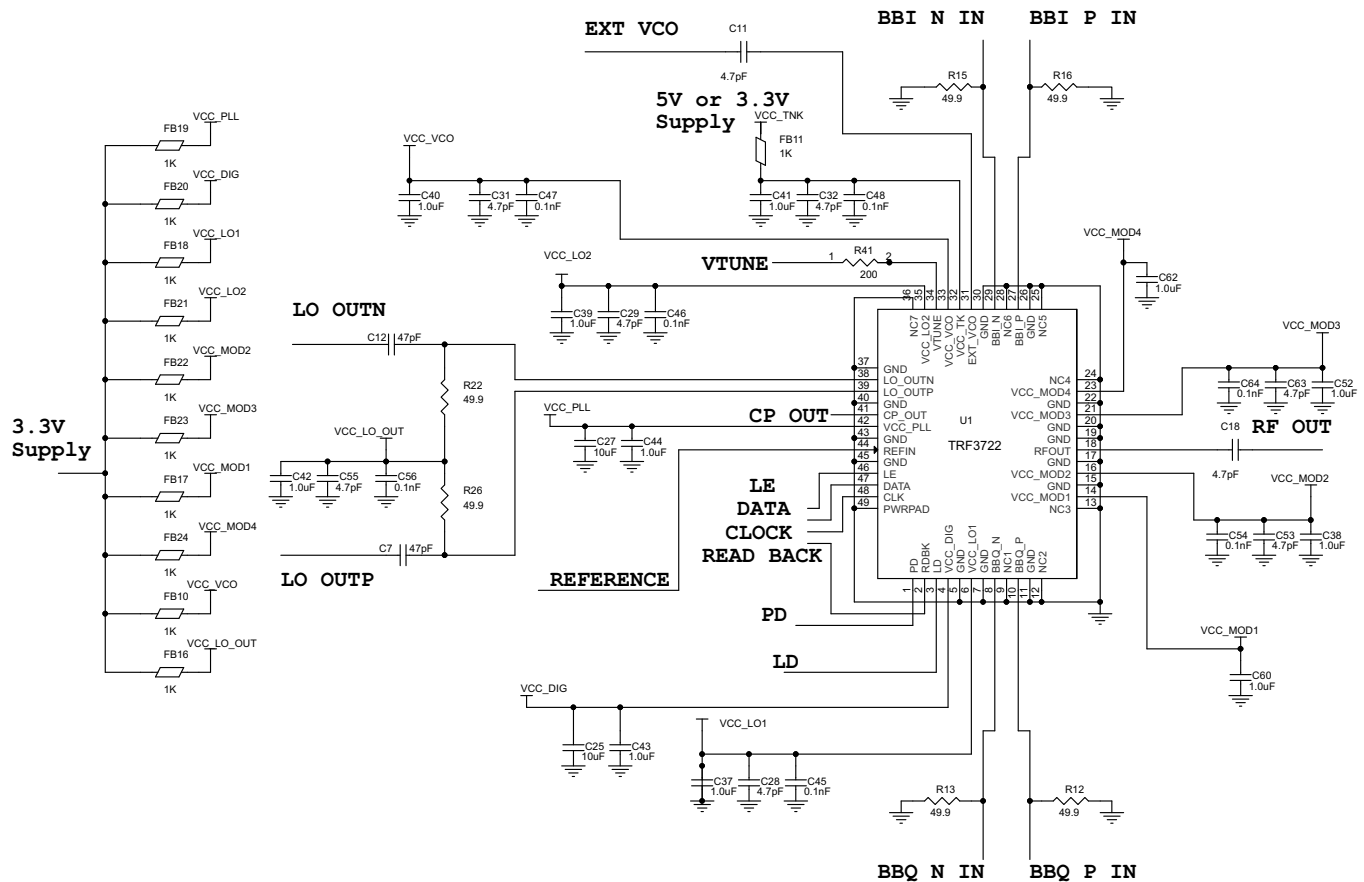


Figure 135. TRF3722 Application Schematic

Typical Application (continued)

9.2.1 Design Requirements

Table 17 lists the pin termination requirements and interfacing for the circuit.

Table 17. Termination Requirements and Interfacing

| PIN | NAME | DESCRIPTION |
|------------|----------------------------|---|
| 47 | DATA | 4WI data input: digital input, high impedance |
| 2 | RDBK | Readback output; digital output pins can source or sink up to 8 mA of current |
| 3 | LD | Lock detector digital output, as configured by MUX_CTRL |
| 8,10,27,29 | BBI_P, BBI_N, BBQ_P, BBQ_N | In-phase and quadrature baseband differential baseband signals. Typical 0.25V common mode is needed |
| 18 | RFOUT | Modulator RF output: must be ac-coupled and can drive 50 Ω load |
| 31 | EXT_VCO | External local oscillator input: high impedance, normally ac-coupled. If unused terminate to 50 ohms load |
| 38,39 | LO_OUTP, LO_OUTN | Local oscillator output: open-collector output. A pull-up resistor is LO_OUT required, normally ac-coupled. |
| 44 | REFIN | Reference clock input: high impedance, normally ac-coupled |
| 46 | LE | Serial interface latch enable: digital input, high impedance |
| 48 | CLK | Serial interface clock input: digital input, high impedance |
| 47 | DATA | Serial interface data input: digital input, high impedance |

9.2.2 Detailed Design Procedures: DAC to Modulator Interface Network

Digital-to-analog converter (DAC) can interface directly with the TRF3722 modulator. The common-mode voltage of the DAC and the modulator baseband inputs should be properly maintained. With the proper interface network, the common-mode voltage of the DAC can be translated to the proper common-mode voltage of the modulator. The TRF3722 common-mode voltage is typically 0.25 V, and is ideally suited to interface with the DAC3482/3484 (DAC348x) and DAC38J8x family. The interface network is shown in Figure 136.

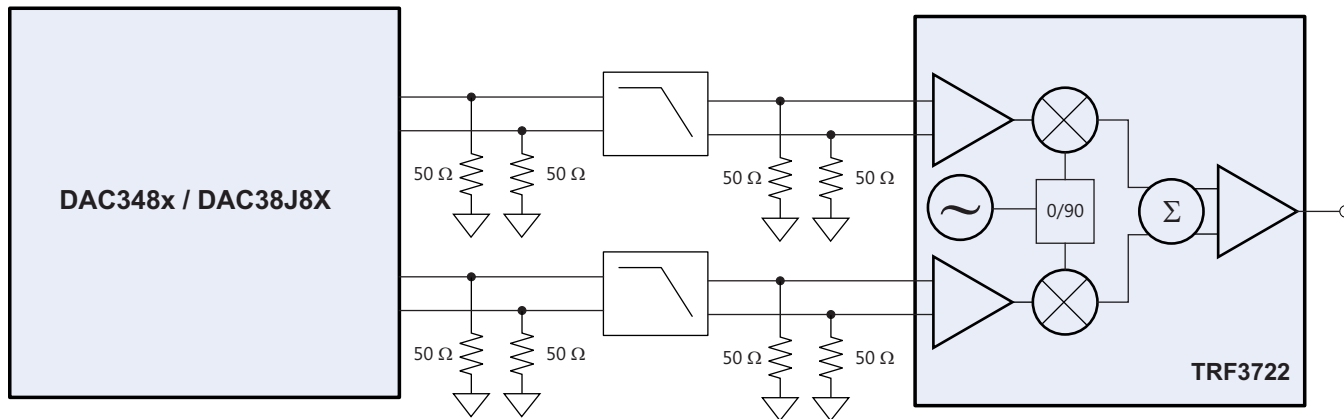


Figure 136. DAC348x Interface with the TRF3722 Modulator

The DAC348x requires a load resistance of 25 Ω per branch to maintain its optimum voltage swing of 1- V_{PP} differential with a 20-mA max current setting. The load of the DAC is separated into two parallel 50- Ω resistors placed on the input and output side of the low-pass filter. This configuration provides the proper resistive load to the DAC while also providing a convenient 50- Ω source and load termination for the filter.

9.2.3 Application Curves: DAC34H84 with TRF3722 Modulator Performance

The cascaded combination of the DAC34H84 and TRF3722 modulator yields excellent system parameters suitable for high-performance applications. Figure 137 and Figure 138 show 152.9 MHz IF adjacent channel power ratio (ACPR) performance.

- Mode integer
- PFD: 3.2 MHz
- Reference: 153.6 MHz
- LO = 1689.6 MHz
- IF = 152.9 MHz
- RF = 1842.5 MHz

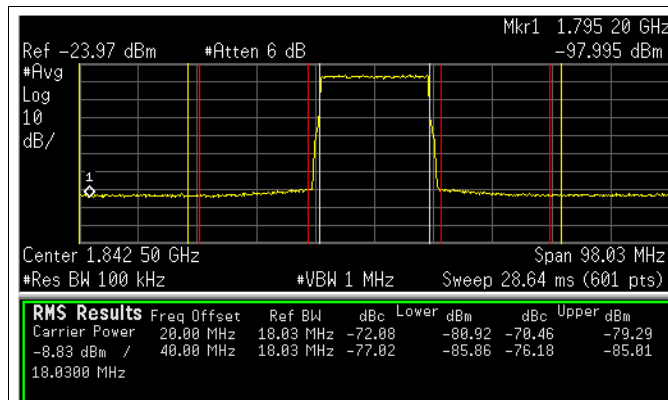


Figure 137. 152.9 MHz IF, DAC34H84 + TRF3722 20 MHz LTE ACPR

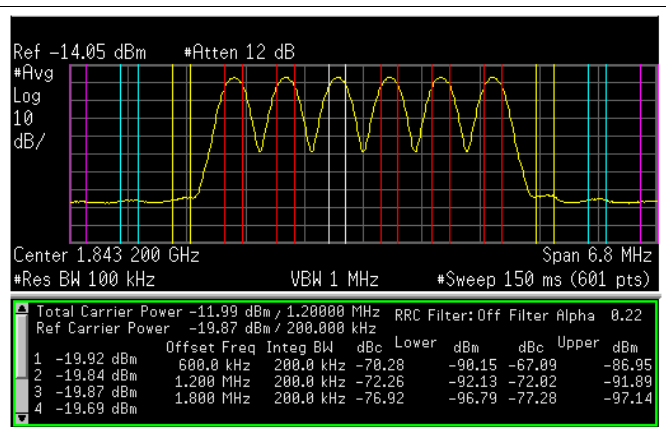


Figure 138. 152.9 MHz IF, 6 Carrier MC-GSM DAC34H84 + TRF3722 ACPR Performance

10 Power Supply Recommendations

The TRF3722 is powered by supplying a nominal 3.3 V and 5 V. It can also be powered using only 3.3V supply. Proper RF bypassing should be placed close to each power supply pin. Ground pin connections should have at least one ground via close to each ground pin to minimize ground inductance. The PowerPAD™ must be tied to ground, preferably with the recommended ground via pattern to provide a good thermal conduction path to the alternate side of the board and to provide a good RF ground for the device. (Refer to [Layout Guidelines](#) section for additional information.)

11 Layout

11.1 Layout Guidelines

Layout of the application board significantly impacts the analog performance of the TRF3722 device. Noise and high-speed signals should be prevented from leaking onto power-supply terminals or analog signals. The TRF3722 device is fitted with a ground slug on the back of the package that must be soldered to the printed circuit board (PCB) ground with adequate ground vias to ensure a good thermal and electrical connection. The ground pins of the device can be directly tied to the ground slug pad for a low-inductance path to ground. Additional ground vias may be added if space allows. Follow these recommendations:

- Place supply decoupling capacitors physically close to the device, on the same side of the board. Isolate supply terminals with a ferrite bead.
- Maintain a continuous ground plane in the vicinity of the device and as return paths for all high-speed signal lines. Place reference plane vias or decoupling capacitors near any signal line reference transition.
- Power planes should not overlap each other or high-speed signal lines.
- Isolate REFIN routing from loop filter lines, control lines, and other high-speed lines.

11.2 Layout Example

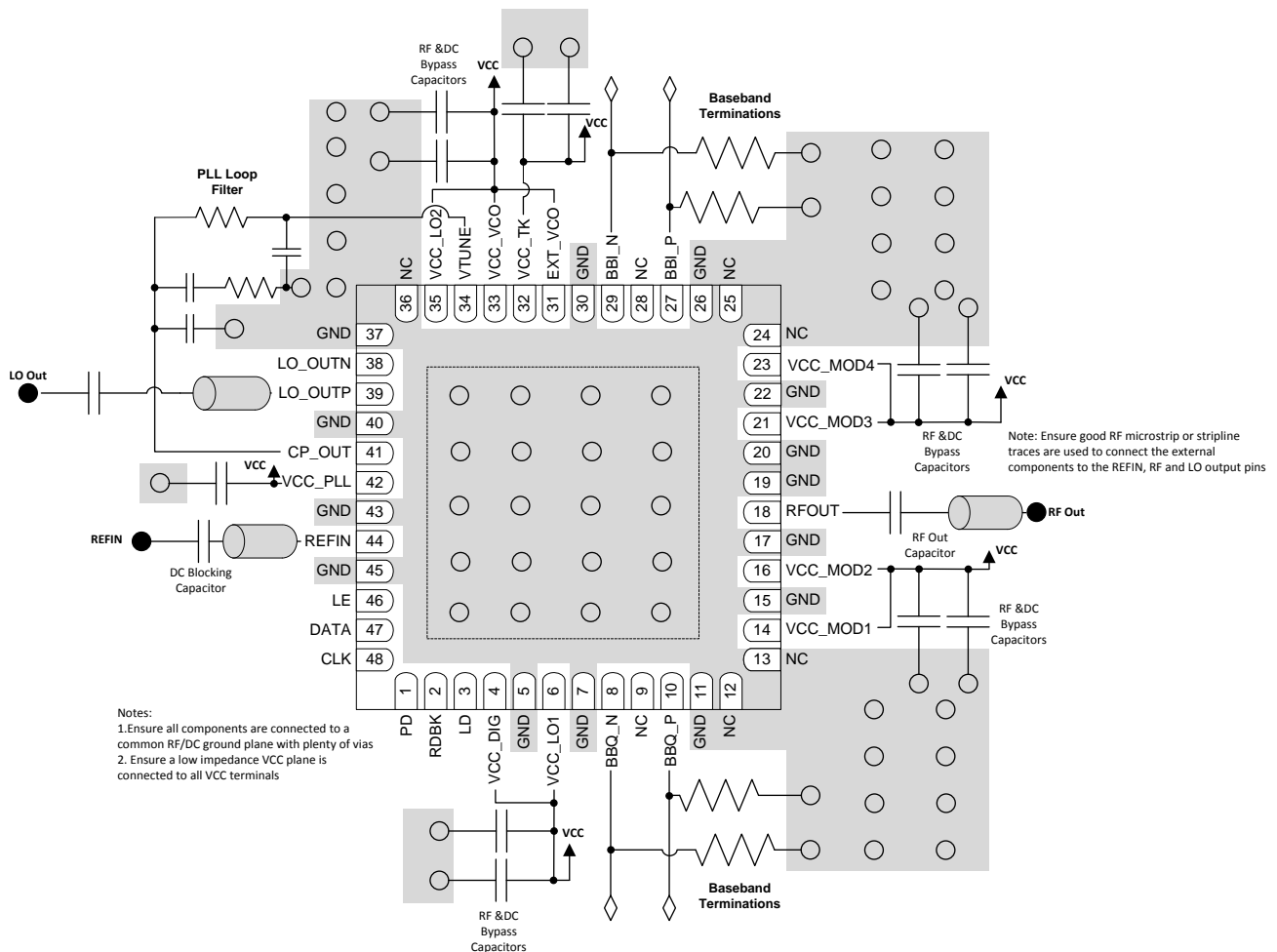


Figure 139. Layout

12 器件和文档支持

12.1 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。请单击右上角的通知我进行注册，即可收到任意产品信息更改每周摘要。有关更改的详细信息，请查看任意已修订文档中包含的修订历史记录。

12.2 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《使用条款》。

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设计支持 *TI 参考设计支持* 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

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ESD 可能会损坏该集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理措施和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

12.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 机械、封装和可订购信息

以下页面包括机械、封装和可订购信息。这些信息是指定器件的最新可用数据。这些数据发生变化时，我们可能不会另行通知或修订此文档。如欲获取此产品说明书的浏览器版本，请参见左侧的导航栏。

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TRF3722IRGZR | Active | Production | VQFN (RGZ) 48 | 2500 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TRF3722 IRGZ |
| TRF3722IRGZR.B | Active | Production | VQFN (RGZ) 48 | 2500 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TRF3722 IRGZ |
| TRF3722IRGZT | Active | Production | VQFN (RGZ) 48 | 250 SMALL T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TRF3722 IRGZ |
| TRF3722IRGZT.B | Active | Production | VQFN (RGZ) 48 | 250 SMALL T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TRF3722 IRGZ |
| TRF3722IRGZTG4 | Active | Production | VQFN (RGZ) 48 | 250 SMALL T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TRF3722 IRGZ |
| TRF3722IRGZTG4.B | Active | Production | VQFN (RGZ) 48 | 250 SMALL T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TRF3722 IRGZ |

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TRF3722IRGZR | VQFN | RGZ | 48 | 2500 | 330.0 | 16.4 | 7.3 | 7.3 | 1.5 | 12.0 | 16.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TRF3722IRGZR | VQFN | RGZ | 48 | 2500 | 350.0 | 350.0 | 43.0 |

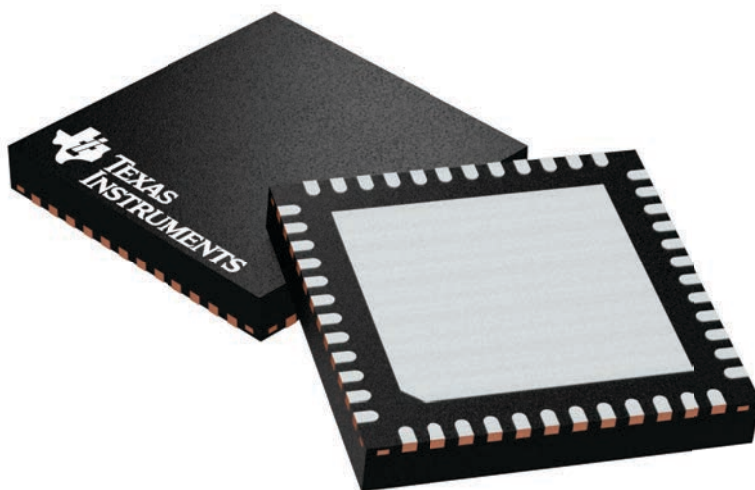
GENERIC PACKAGE VIEW

RGZ 48

VQFN - 1 mm max height

7 x 7, 0.5 mm pitch

PLASTIC QUADFLAT PACK- NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4224671/A



NOTES:

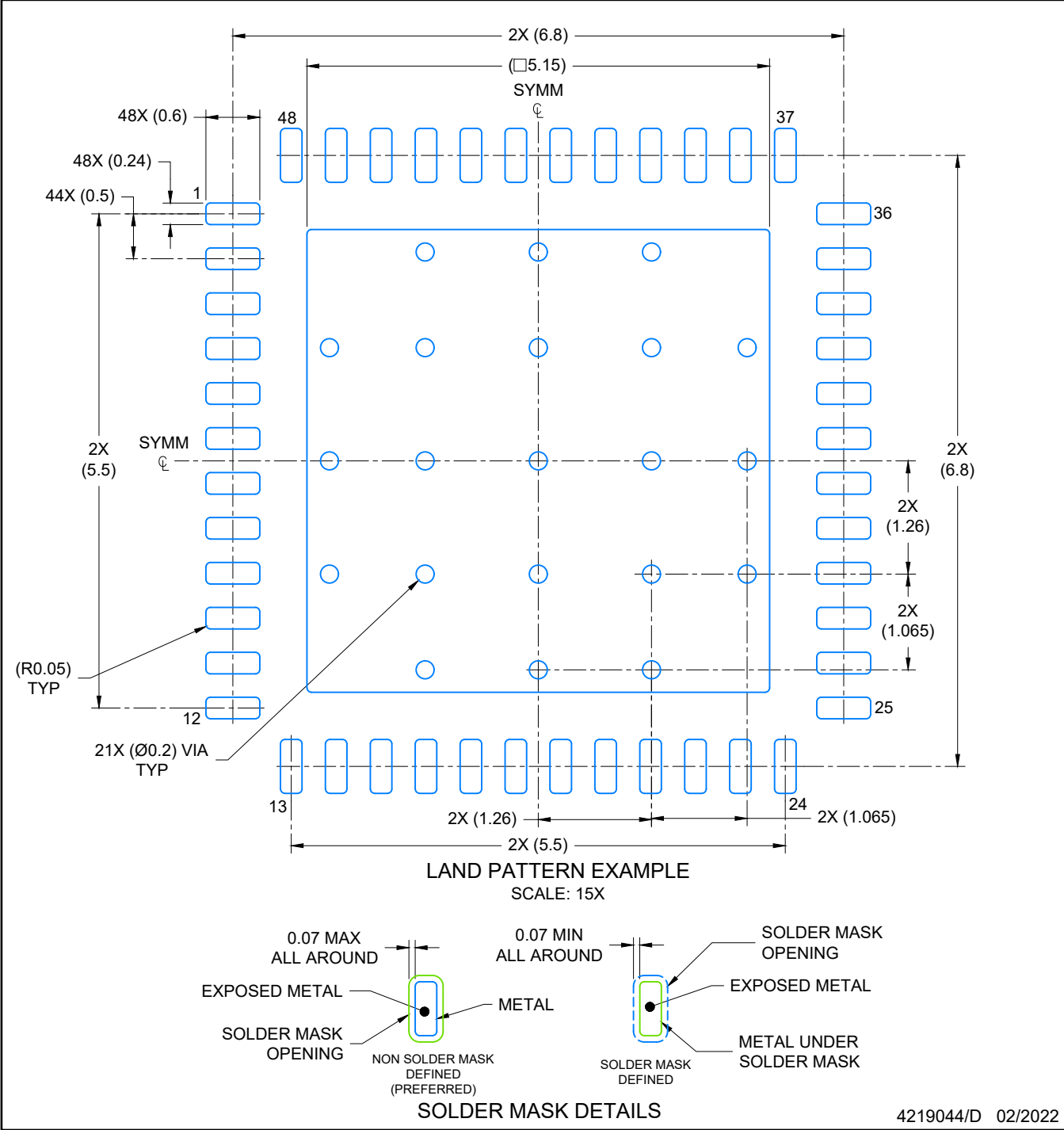
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

RGZ0048A

VQFN - 1 mm max height

PLASTIC QUADFLAT PACK- NO LEAD



NOTES: (continued)

- 4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
- 5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

RGZ0048A

VQFN - 1 mm max height

PLASTIC QUADFLAT PACK- NO LEAD



NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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