

TRF3722 EVM User's Guide

TRF3722 is a high performance direct conversion quadrature modulator with exceptional linearity and low noise performance. The TRF3722 converts low frequency baseband signals to high frequency RF signals and integrates PLL and VCO to provide the local oscillator (LO) to the integrated modulator. This document provides the operating procedures of the TRF3722 evaluation module (EVM).

Contents

1	Introduction	2
2	GUI Installation	2
2.1	GUI Details	4
3	EVM Jumper Configuration	4
3.1	Board Power-up	5
3.2	Modulator Linearity Validation	6
4	EXT_VCO Modulator Linearity Validation	9
5	Phase Noise Validation - Integer Mode	11
5.1	Phase Noise Validation - Fractional Mode	14

List of Figures

1	TRF3722EVM Board Photo	2
2	GUI Installer Initialization	3
3	Directory Installation Windows	3
4	GUI Warning	4
5	Voltage Supply Inputs	5
6	GUI Settings (a)	6
7	GUI Settings (b)	7
8	TRF3722 EVM	7
9	TRF3722 OIP3	8
10	TRF3722 GUI, Ext VCO Configuration (a)	10
11	TRF3722 GUI, Ext VCO Configuration (b)	10
12	Integer Mode Loop Filter	11
13	Integer Mode Loop Filter (a)	12
14	Integer Mode Loop Filter (b)	12
15	Integer Mode Phase Noise at 1800 MHz	13
16	Fractional Mode Loop Filter	14
17	Fractional Mode Loop Filter (a)	15
18	Fractional Mode Loop Filter (b)	15
19	Fractional Phase Noise at 3532.9 MHz	16

List of Tables

1	Default Jumper Connections	4
---	----------------------------------	---

1 Introduction

TRF3722 is a quadrature modulator with integrated PLL and VCO. The typical 0.25-V baseband common mode voltage supports seamless interface with current sourcing DACs. The PLL and VCO provides excellent phase noise. The device also provides additional LO output for driving a second modulator or down converting mixer. The modulator features a high gain mode along with a low power mode when power optimization is desired. [Figure 1](#) shows the TRF3722 EVM.

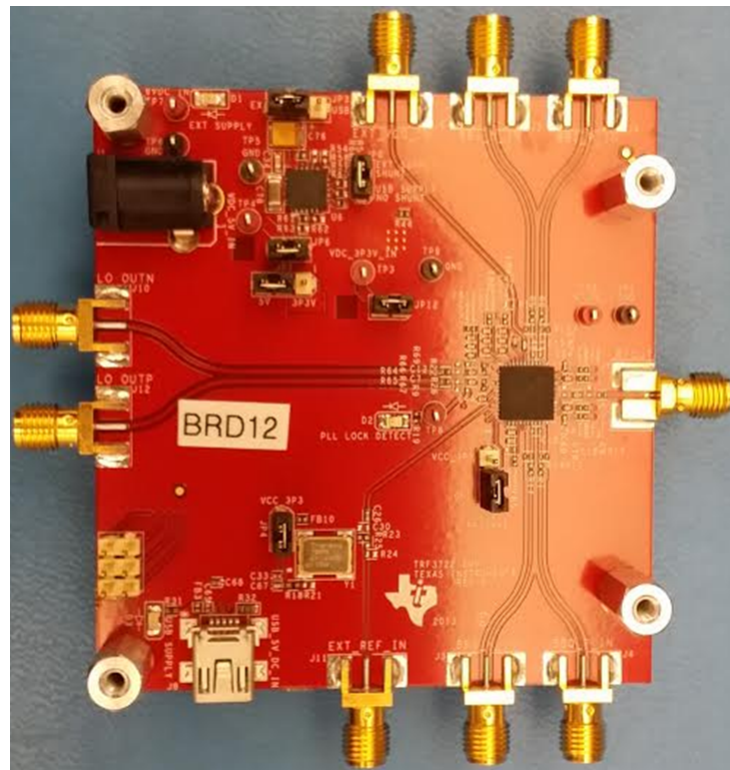


Figure 1. TRF3722EVM Board Photo

2 GUI Installation

Install the GUI using the following steps:

1. This is a one-time installation. Download the TRF3722 GUI ([SLOC306](#)) from the TI website.
2. Run *SETUP* from the *TRF3722GUI_Installer/Volume* folder.
3. The window in [Figure 2](#) appears.

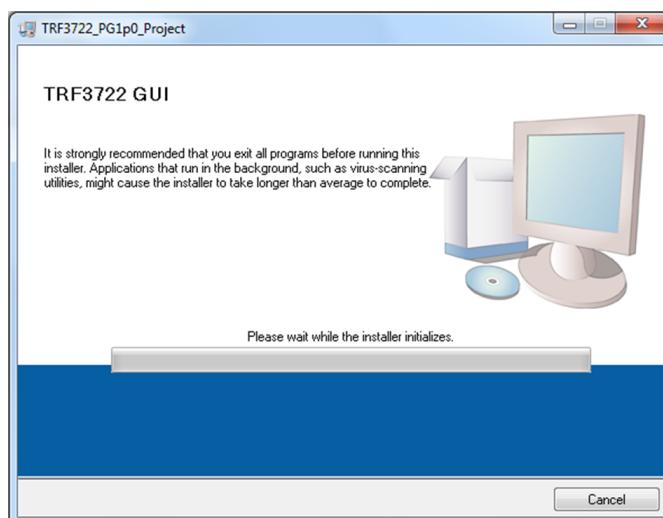


Figure 2. GUI Installer Initialization

4. When the destination directory installation windows appear (Figure 3), click the **Next >>** buttons.

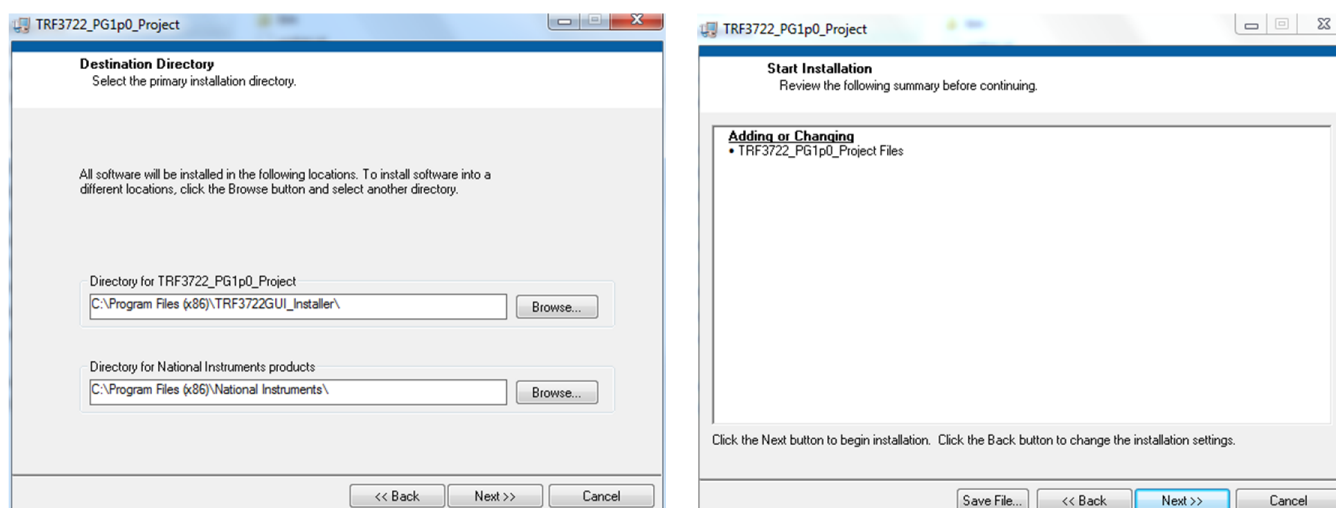


Figure 3. Directory Installation Windows

5. Once the installation is complete, select **Finish**
6. Go to *Start* → *All Programs* → *TRF3722_PG1p0_Project* to launch the **TRF3722 GUI**.

2.1 GUI Details

The TRF3722 GUI has two tabs, a *Top Level* tab and an *Advanced Settings* tab. The *Top Level* tab has two ON/OFF buttons which turn the LO section and IQ modulator section ON or OFF individually. When only the IQ modulator is turned ON, make sure a LO signal is provided at the *EXT_VCO_IN* SMA connector.

The TRF3722 has seven registers (registers 0–6). Register 0 is a read-back register. The yellow circle in [Figure 4](#) illustrates the *Device Communication Failure* warning that appears when the GUI doesn't talk to the device. Whenever this happens, make sure the FTDI FT245RL device drivers are installed on your computer, reconnect the USB cable, and press the **USB Reset** button.

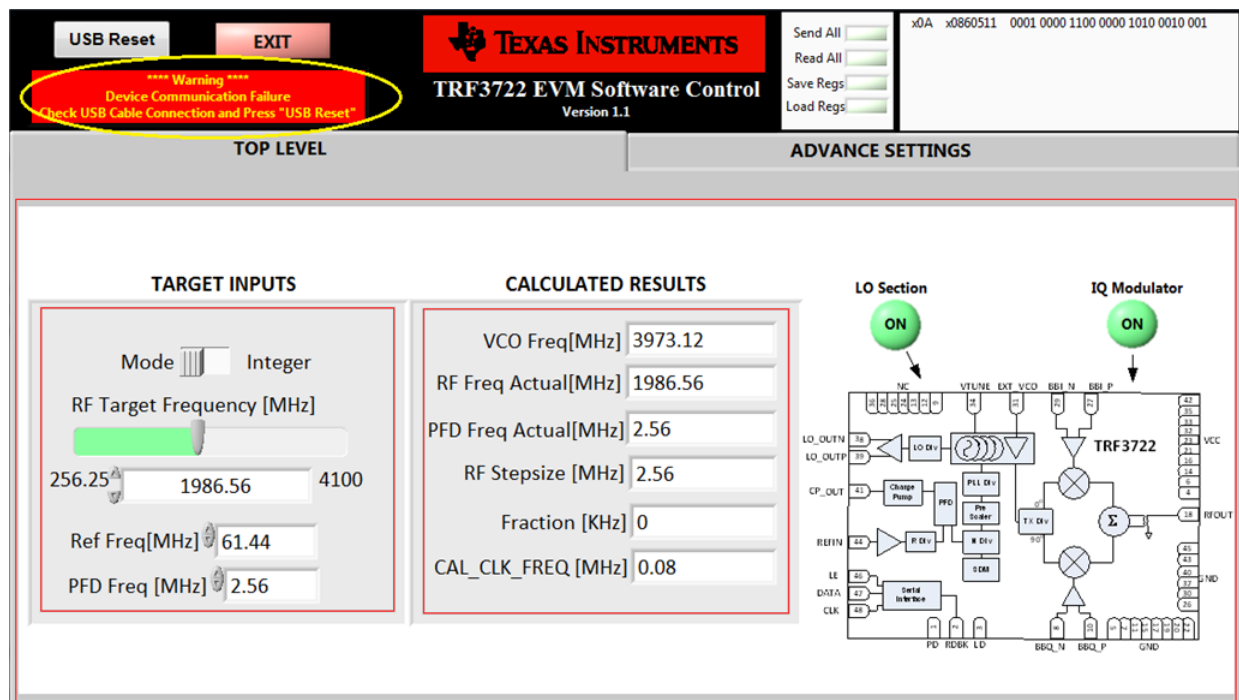


Figure 4. GUI Warning

3 EVM Jumper Configuration

The default EVM jumper installation is listed in [Figure 5](#).

Table 1. Default Jumper Connections

Jumper	Description	Default Connection	Notes
JP2	Power save	Pins 2-3	Typical Operating Mode (1-2, power save mode)
JP4	Crystal supply	Pins 1-2	On-board crystal (make sure R23 is populated and R25 is DNI)
JP3	Ext/USB supply	Pins 1-2	External supply
JP8	5-V LDO (U6) load	Pins 1-2	External supply
JP6	5 V from LDO (U6)	Pins 1-2	LDO supply
JP8	3.3 V from LDO (U5)	Pins 1-2	LDO supply

3.1 Board Power-up

Power up the board using the following steps:

1. Make sure the jumpers are properly placed as shown in [Table 1](#).
2. The board can be powered up either by using a single 6-V DC power supply (either using connector jack J1 or test point TP7) or using 3.3- and 5-V DC supplies. To obtain optimum phase noise performance, TI recommends operating the board using clean 3.3- and 5-V linearDC supplies without engaging the LDOs.
3. Power up the board using a single 6-V DC supply by connecting a 6-V DC supply either at the J1 power connector jack or at the test point (TP7) as shown in [Figure 5](#).
4. When the 6-V DC supply is applied, red LED D1 turns ON.
5. When the 6-V DC supply is connected, the voltage at TP3 should read 3.3 V and the voltage at TP4 should read 5 V.
6. Power the board using 3.3- and 5-V DC supplies by removing jumpers JP12 and JP6. Directly connect a 3.3-V DC supply at test point TP3 and a 5-V DC supply at test point TP4.
7. At initial power up (before the device is programmed), typical consumption from a 3.3-V DC supply is around 55 mA (± 15 mA) and typical consumption from a 5-V DC supply is around 20 mA (± 7 mA). [Figure 5](#) shows the voltage supply inputs.

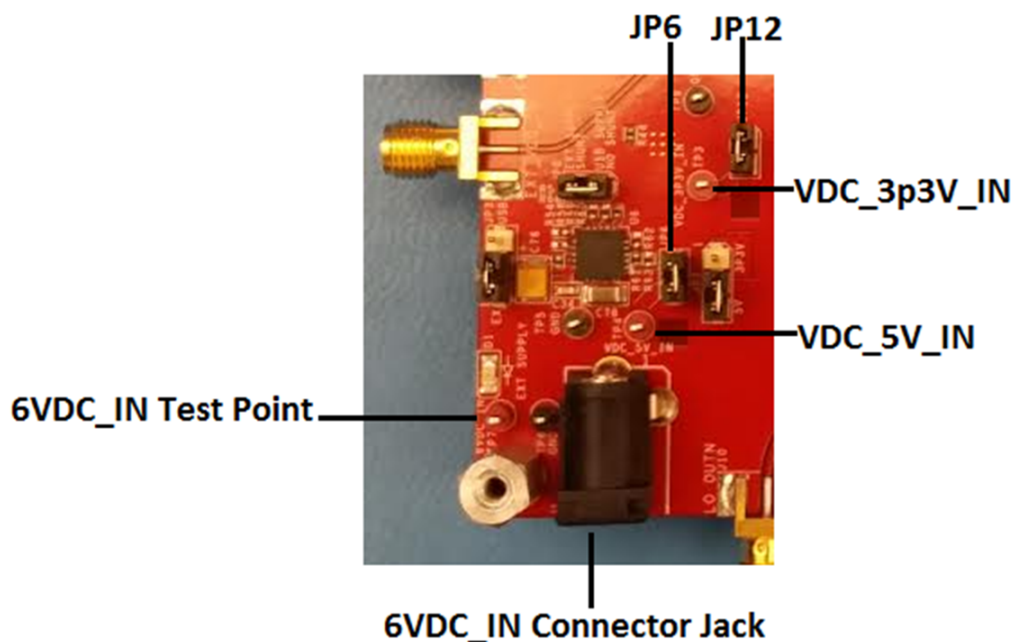


Figure 5. Voltage Supply Inputs

3.2 Modulator Linearity Validation

Validate modular linearity using the following steps:

1. Connect the J7 RFOUT SMA connector to a Spectrum analyzer.
2. Connect the baseband in-phase positive signal to SMA connector J6 and in-phase negative signal to SMA connector J5. Connect positive quadrature signal to SMA connector J4 and negative quadrature signal to SMA connector J3.
3. Connect a mini-USB cable from the computer to J8. This should turn ON the blue LED (D3).
4. Terminate any unused SMA connectors to 50-Ω load.
5. Connect 6-V power adaptor. This should turn ON the red LED (D1).
6. Launch the TRF3722 GUI.
7. As an example, this guide now considers an RF target frequency of 1986.56 MHz.
8. Set the GUI as shown in Figure 6 and Figure 7.

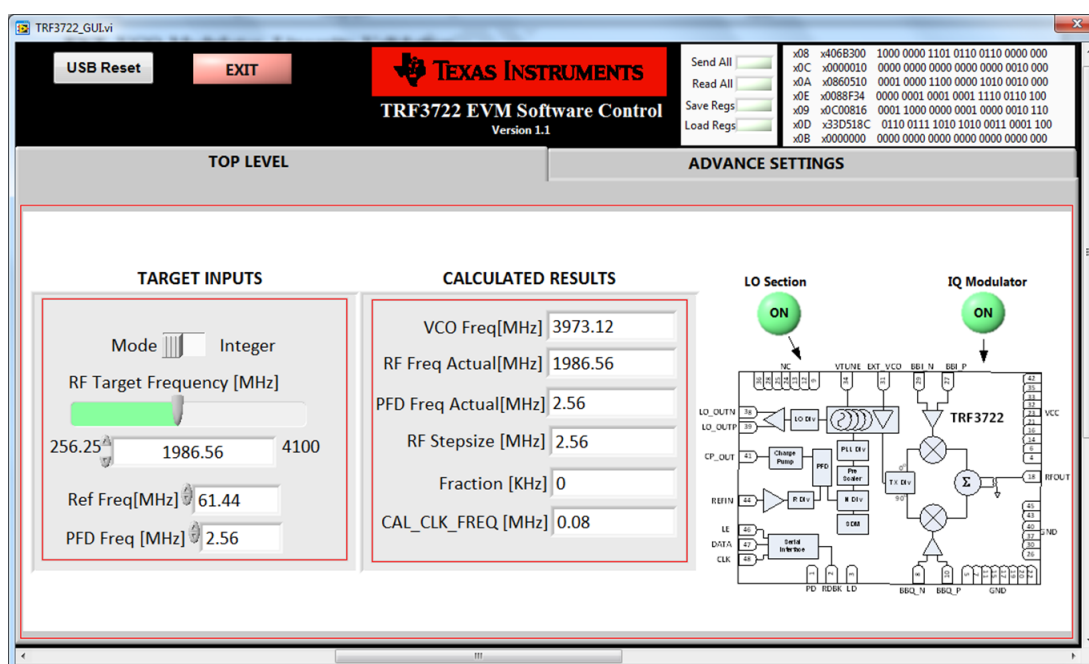


Figure 6. GUI Settings (a)

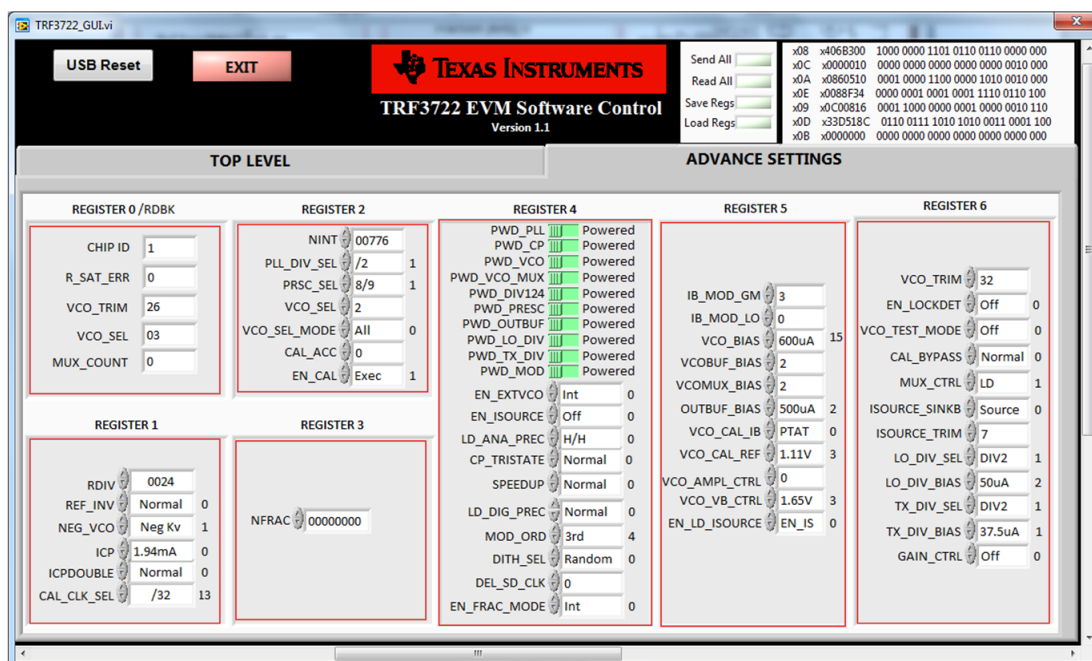


Figure 7. GUI Settings (b)

9. After setting proper register settings, click the **Send All** button. When the device is programmed, the green LED (D2) should turn ON which indicates PLL is locked as shown in Figure 8.



Figure 8. TRF3722 EVM

10. Current consumption from the 3.3-V DC supply should now change to 390 mA (± 20 mA), and the 5-V DC supply should change to 27 mA (± 7 mA).
11. This is the typical current consumption with the GUI settings shown in Figure 6 and Figure 7, adjusting various bias settings in register 5 and register 6 change this current.
12. Use a DAC or an arbitrary waveform generator to generate two-tone I/Q baseband input signals. For example, consider 4.5 MHz and 5.5 MHz.

13. A typical setup using Agilent's E4438C ESG vector signal generator to provide I/Q signals is as follows:
 - (a) Press Preset.
 - (b) Press Mode → More (1 of 2) → Multitone
 - (c) Press Initialize Table → Number of Tones → 12 → Enter.
 - (d) Press Freq Spacing → 1 → MHz.
 - (e) Press Done.
 - (f) Highlight each of the first 10 rows and press Toggle State to turn OFF the first 10 frequencies and only keep the last two rows with the BB frequency 4.5 MHz and 5.5 MHz ON.
 - (g) Press Multitone Off/On to ON to generate the multitone waveform.
 - (h) Adjust the differential I or Q voltage level by pressing Mode → I/Q → I/Q Output Control → I/Q Output Atten → Enter 9 → Press dB.
 - (i) Set the common mode voltage to 0.25 V by pressing Mode → I/Q → I/Q Output Control → Common Mode I/Q Offset → 250 → mV. Use a DC voltage meter to monitor the DC common voltage at the inputs of I and Q and fine-tune the common mode voltage setting until it measures 250 mV.
14. Measure the TRF3722 output OIP3. The OIP3 at LO 1986.56 MHz should be around 28.5 ± 2 dBm, as shown in [Figure 9](#).

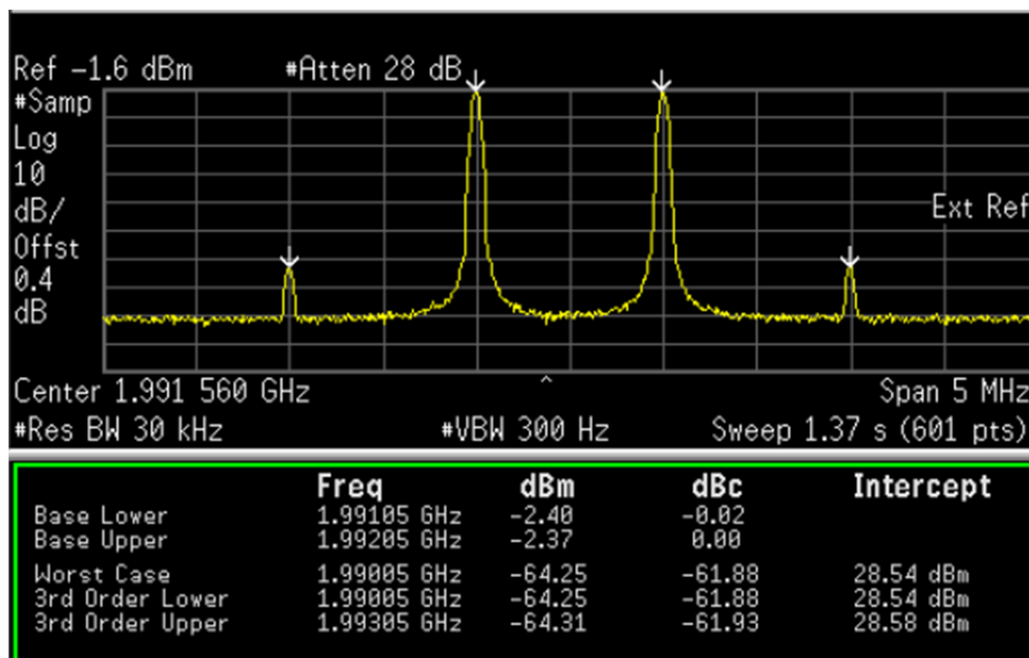


Figure 9. TRF3722 OIP3

4 EXT_VCO Modulator Linearity Validation

To test the external VCO / LO, turn off the LO section and apply LO signal at the EXT_VCO SMA connector. As an example, consider a frequency of 1986.56 MHz:

1. Use the GUI settings as shown in [Figure 10](#) and [Figure 11](#).
2. Since LO_DIV_SEL is Div2, apply a 3973.12-MHz signal at the EXT_VCO_IN SMA connector.
3. Use a DAC or an arbitrary waveform generator to generate two tone I/Q baseband input signals. As an example, consider 4.5 MHz and 5.5 MHz.
4. A typical setup using Agilent's E4438C ESG vector signal generator to provide I/Q signals is as follows:
 - (a) Press Preset.
 - (b) Press Mode → More (1of 2) → Multitone
 - (c) Press Initialize Table → Number of Tones → 12 → Enter.
 - (d) Press Freq Spacing → 1 → MHz.
 - (e) Press Done.
 - (f) Highlight each of the first 10 rows and press 'Toggle State' to turn OFF the first 10 frequencies and only keep the last two rows with the BB frequency 4.5 MHz and 5.5 MHz ON.
 - (g) Press Multitone Off/On to ON to generate the multitone waveform.
 - (h) Adjust the differential I or Q voltage level by pressing Mode → I/Q → I/Q Output Control → I/Q Output Atten → Enter 9 → Press dB.
 - (i) Set the common mode voltage to 0.25 V by pressing Mode → I/Q → I/Q Output Control → Common Mode I/Q Offset → 250 → mV. Use a DC voltage meter to monitor the DC common voltage at the inputs of I and Q and fine-tune the common mode voltage setting until it measures 250 mV.

5. Measure the TRF3722 output OIP3. The OIP3 at LO 1986.56 MHz should be around 28.5 dBm as shown in Figure 10 and Figure 11.

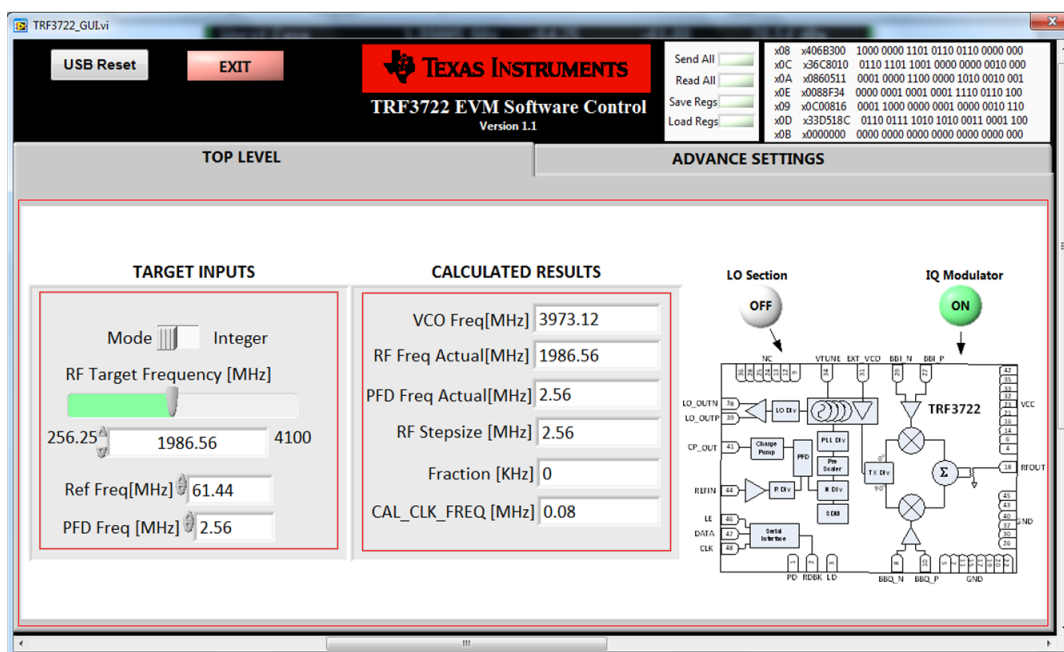


Figure 10. TRF3722 GUI, Ext VCO Configuration (a)

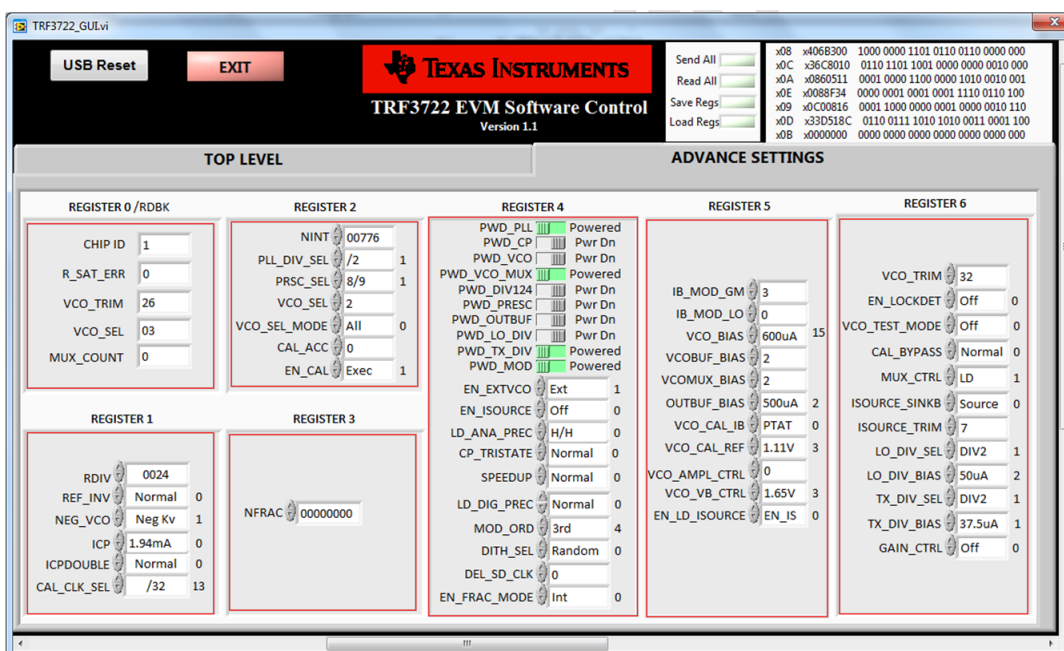


Figure 11. TRF3722 GUI, Ext VCO Configuration (b)

5 Phase Noise Validation - Integer Mode

Validate integer mode phase noise using the following steps:

1. The default loop filter populated on the TRF3722 EVM is an integer mode loop filter.
2. A 40-kHz bandwidth and 2.56-MHz Fpfd loop filter has been designed using the [loop filter calculator tool](#), available from [www.ti.com](#).
3. Figure 12 shows the screen shot of a loop filter.

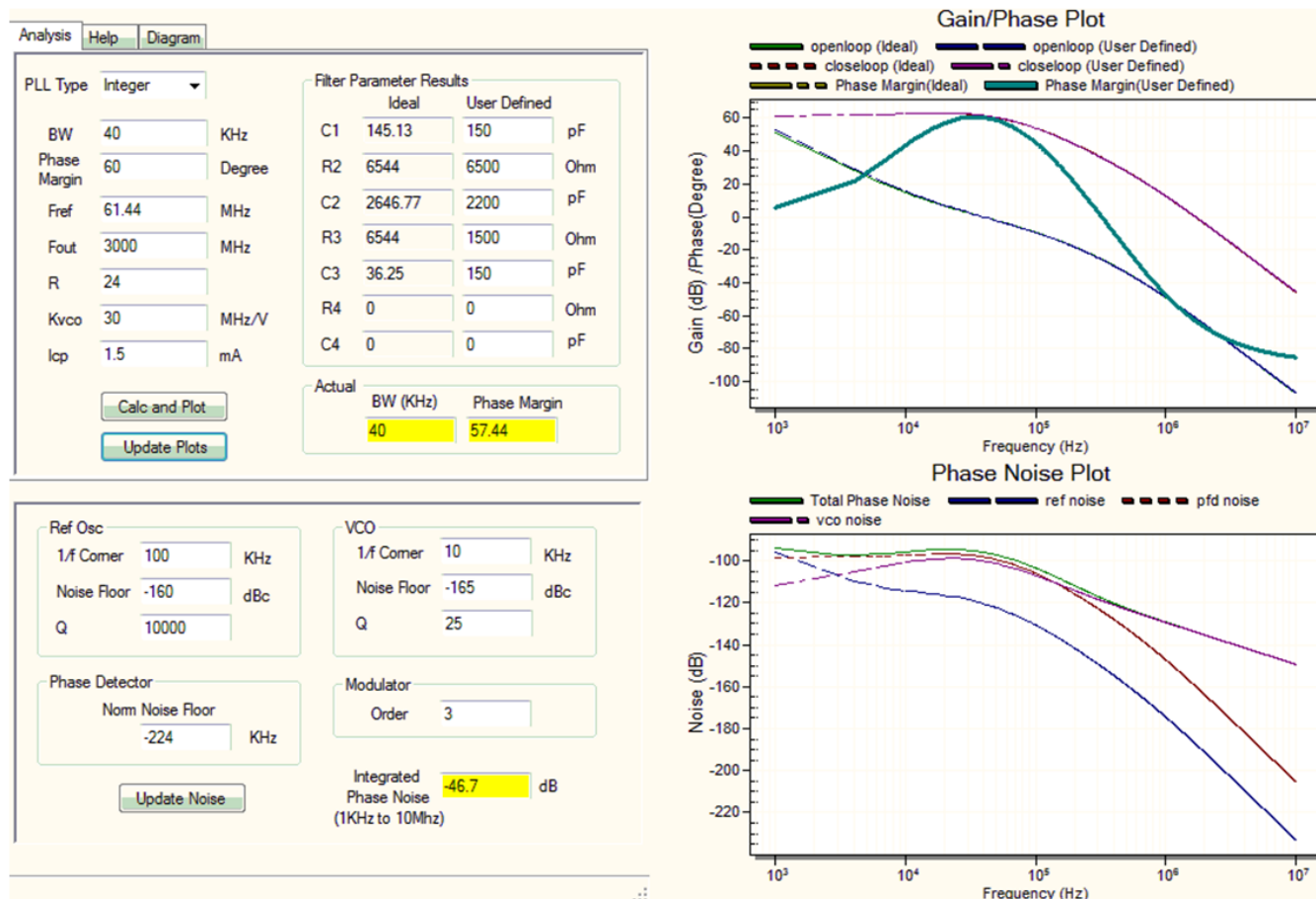


Figure 12. Integer Mode Loop Filter

4. As an example, consider an 1800-MHz target frequency.

- Set the GUI as shown in Figure 13 and Figure 14.

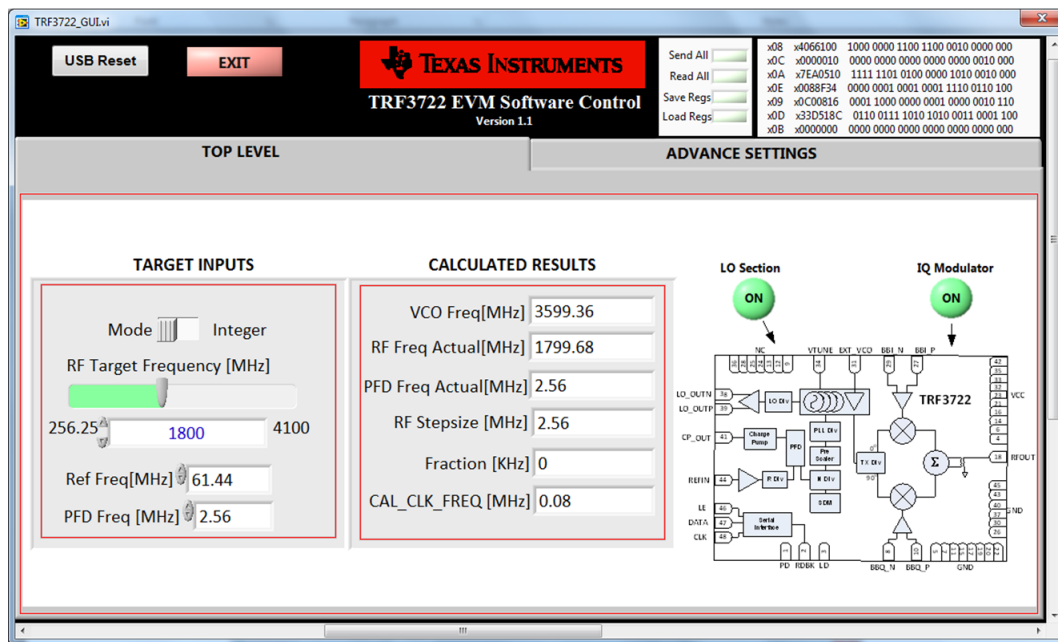


Figure 13. Integer Mode Loop Filter (a)

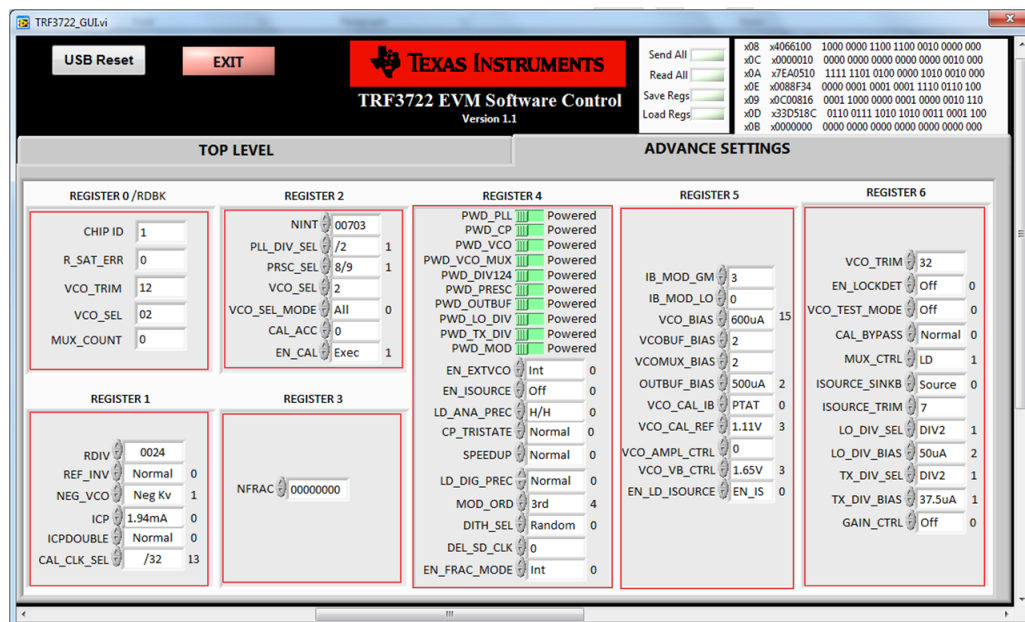


Figure 14. Integer Mode Loop Filter (b)

6. The TRF3722 phase noise at 1800-MHz frequency at the LO_OUTP SMA connector is shown in Figure 15.

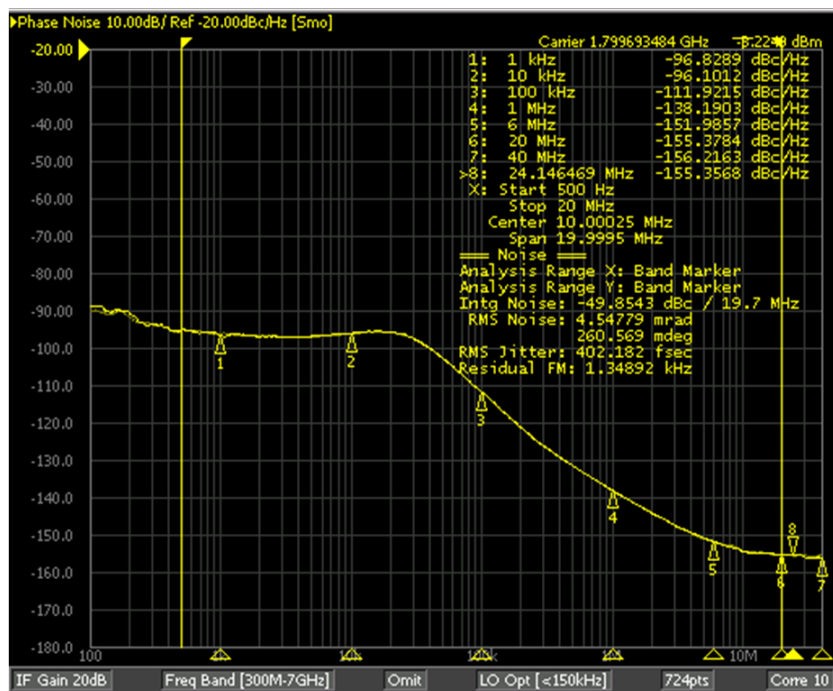


Figure 15. Integer Mode Phase Noise at 1800 MHz

7. Obtain optimum phase noise performance by using linear clean power supplies at TP3 3.3-V DC supply and TP4 5-V DC supply.
8. Obtain best close-in noise (below 500-Hz offset) by using a low phase noise reference signal at the J11 EXT_REF_IN SMA connector. When operating the board using an external reference, make sure to DNI R23, remove JP4, and populate R25.

5.1 Phase Noise Validation - Fractional Mode

Validate fractional mode phase noise using the following steps:

1. The default loop filter connected on the TRF3722 EVM is an integer mode loop filter. Change integer loop filter to fractional loop filter DNI R11 and DNI R40, and populate R8 and R10.
2. A 40-kHz bandwidth and 15.36-MHz Fpfd loop filter has been designed using the [loop filter calculator tool](#), available on [www.ti.com](#).
3. Figure 16 shows the screen shot of a loop filter tool.

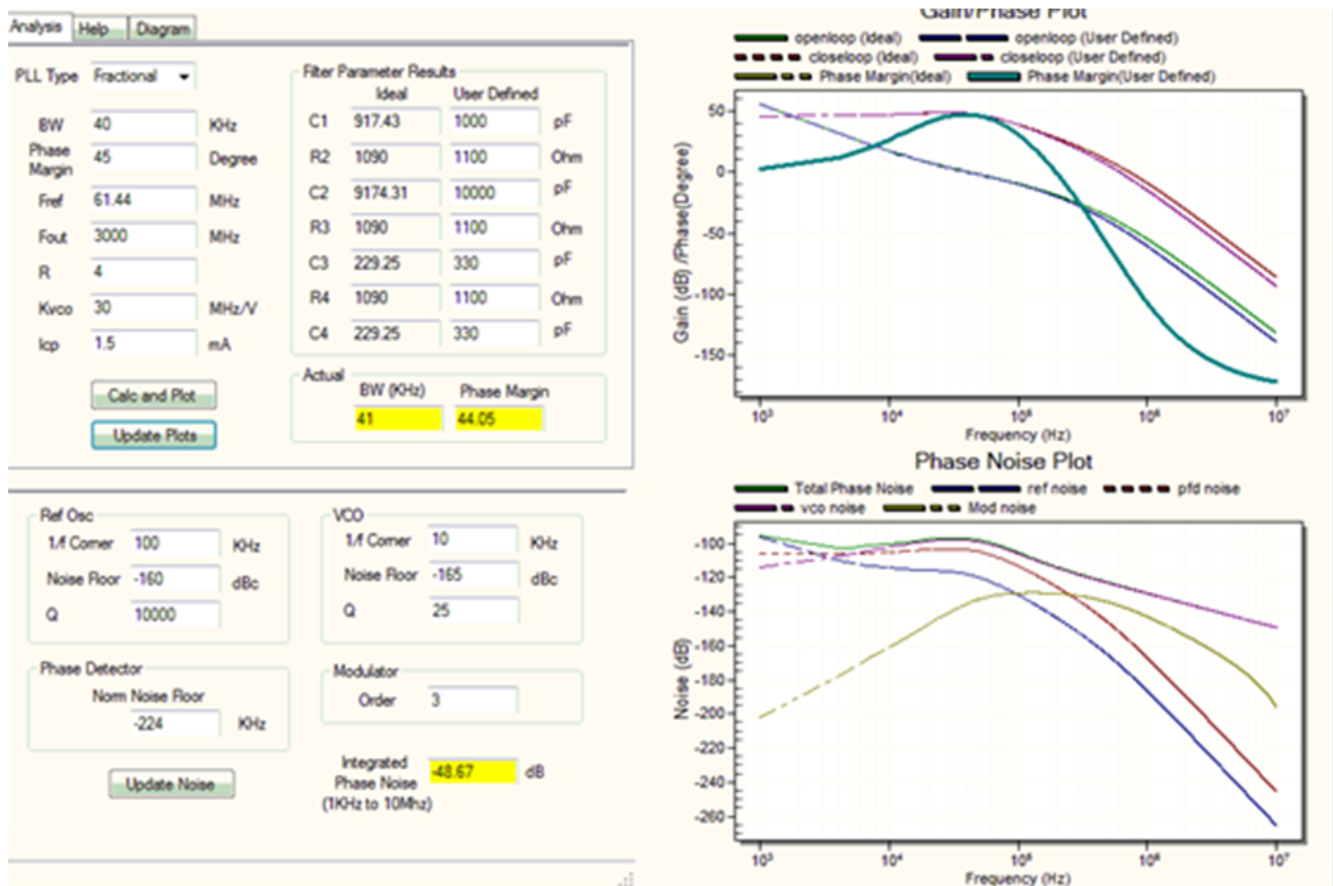


Figure 16. Fractional Mode Loop Filter

4. As an example, use a 3532.9 MHz target frequency.
5. An external reference of 153.6 MHz is used. To use an external reference, make sure to DNI R23, remove JP4, and populate R25.

- Set the GUI as shown in Figure 17 and Figure 18.

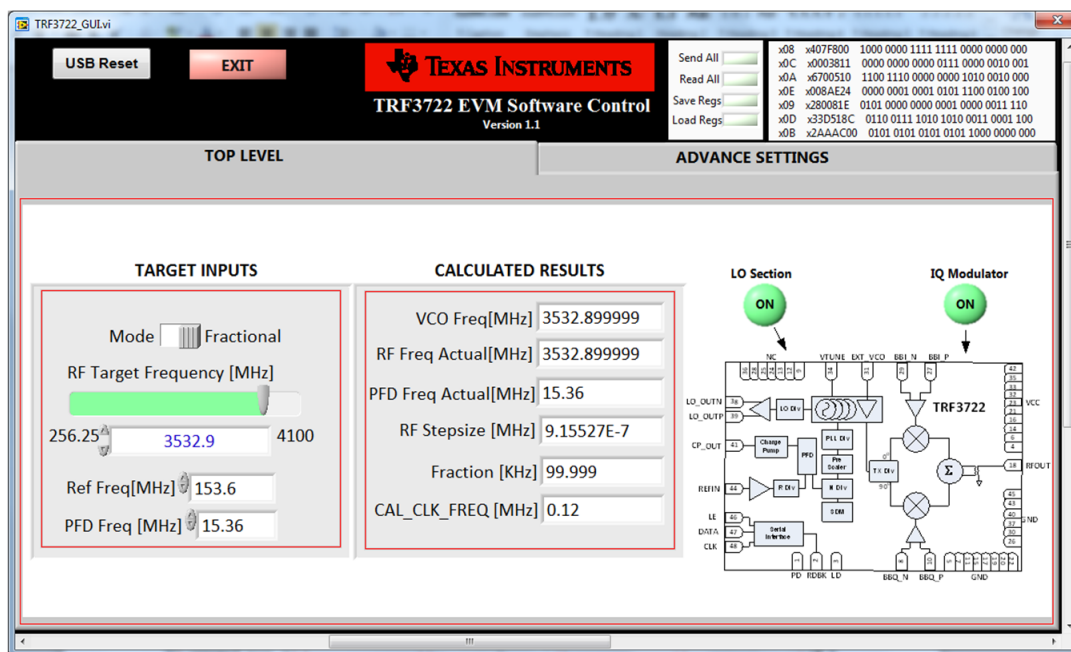


Figure 17. Fractional Mode Loop Filter (a)

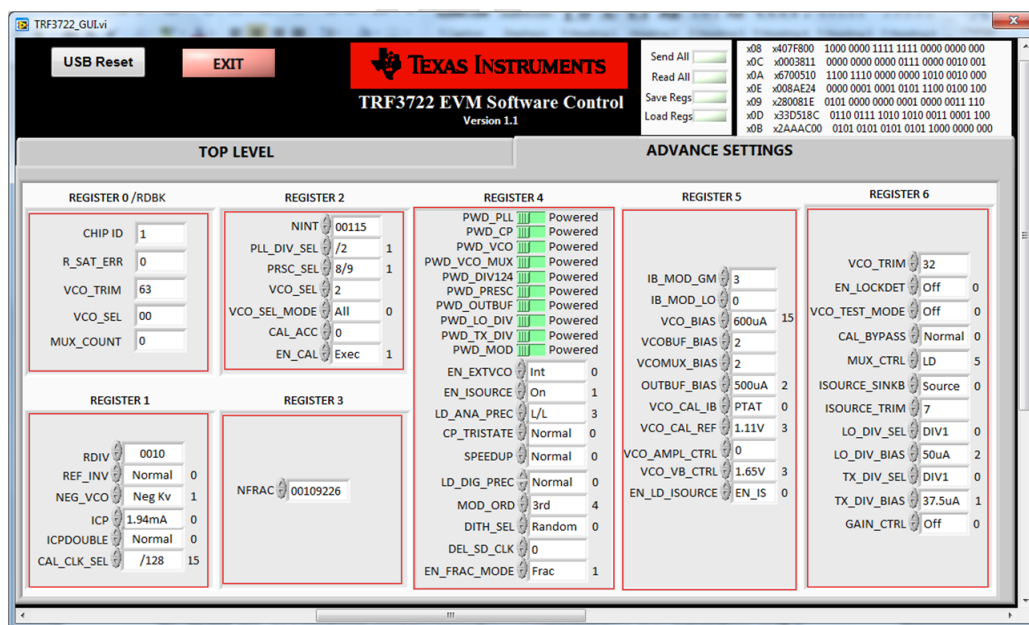


Figure 18. Fractional Mode Loop Filter (b)

7. TRF3722 phase noise at 3532.9-MHz frequency at LO_OUTP is shown in Figure 19.

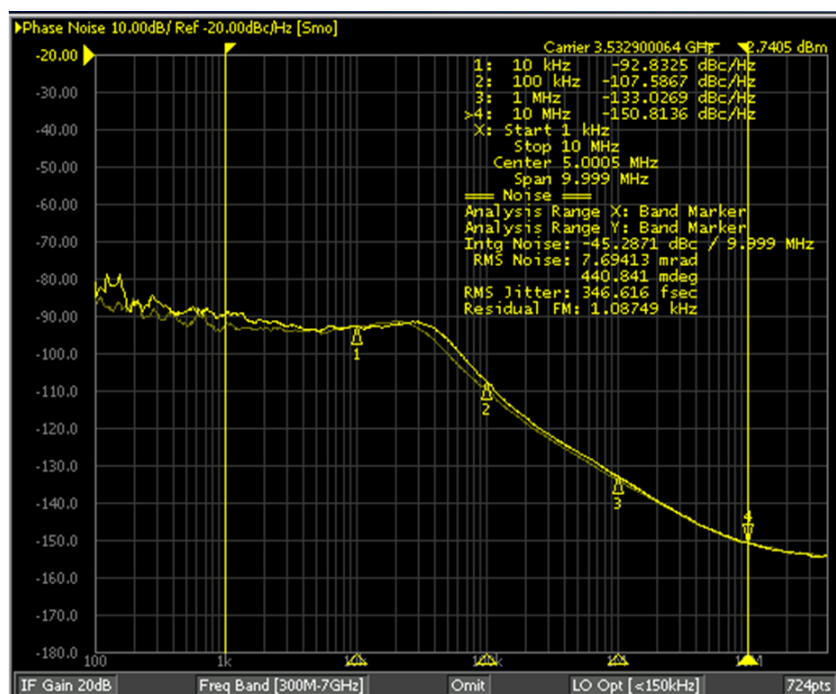


Figure 19. Fractional Phase Noise at 3532.9 MHz

8. To obtain optimum phase noise performance use linear clean power supplies at TP3 3.3-V DC supply and TP4 5-V DC supply.
9. To obtain best close-in noise (below 500-Hz offset), use a low phase noise reference signal at J11 EXT_REF_IN SMA connector.

ADDITIONAL TERMS AND CONDITIONS, WARNINGS, RESTRICTIONS, AND DISCLAIMERS FOR EVALUATION MODULES

Texas Instruments Incorporated (TI) markets, sells, and loans all evaluation boards, kits, and/or modules (EVMs) pursuant to, and user expressly acknowledges, represents, and agrees, and takes sole responsibility and risk with respect to, the following:

1. User agrees and acknowledges that EVMs are intended to be handled and used for feasibility evaluation only in laboratory and/or development environments. Notwithstanding the foregoing, in certain instances, TI makes certain EVMs available to users that do not handle and use EVMs solely for feasibility evaluation only in laboratory and/or development environments, but may use EVMs in a hobbyist environment. All EVMs made available to hobbyist users are FCC certified, as applicable. Hobbyist users acknowledge, agree, and shall comply with all applicable terms, conditions, warnings, and restrictions in this document and are subject to the disclaimer and indemnity provisions included in this document.
2. Unless otherwise indicated, EVMs are not finished products and not intended for consumer use. EVMs are intended solely for use by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.
3. User agrees that EVMs shall not be used as, or incorporated into, all or any part of a finished product.
4. User agrees and acknowledges that certain EVMs may not be designed or manufactured by TI.
5. User must read the user's guide and all other documentation accompanying EVMs, including without limitation any warning or restriction notices, prior to handling and/or using EVMs. Such notices contain important safety information related to, for example, temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.
6. User assumes all responsibility, obligation, and any corresponding liability for proper and safe handling and use of EVMs.
7. Should any EVM not meet the specifications indicated in the user's guide or other documentation accompanying such EVM, the EVM may be returned to TI within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY TI TO USER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. TI SHALL NOT BE LIABLE TO USER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RELATED TO THE HANDLING OR USE OF ANY EVM.
8. No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which EVMs might be or are used. TI currently deals with a variety of customers, and therefore TI's arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services with respect to the handling or use of EVMs.
9. User assumes sole responsibility to determine whether EVMs may be subject to any applicable federal, state, or local laws and regulatory requirements (including but not limited to U.S. Food and Drug Administration regulations, if applicable) related to its handling and use of EVMs and, if applicable, compliance in all respects with such laws and regulations.
10. User has sole responsibility to ensure the safety of any activities to be conducted by it and its employees, affiliates, contractors or designees, with respect to handling and using EVMs. Further, user is responsible to ensure that any interfaces (electronic and/or mechanical) between EVMs and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
11. User shall employ reasonable safeguards to ensure that user's use of EVMs will not result in any property damage, injury or death, even if EVMs should fail to perform as described or expected.
12. User shall be solely responsible for proper disposal and recycling of EVMs consistent with all applicable federal, state, and local requirements.

Certain Instructions. User shall operate EVMs within TI's recommended specifications and environmental considerations per the user's guide, accompanying documentation, and any other applicable requirements. Exceeding the specified ratings (including but not limited to input and output voltage, current, power, and environmental ranges) for EVMs may cause property damage, personal injury or death. If there are questions concerning these ratings, user should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the applicable EVM user's guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using EVMs' schematics located in the applicable EVM user's guide. When placing measurement probes near EVMs during normal operation, please be aware that EVMs may become very warm. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use EVMs.

Agreement to Defend, Indemnify and Hold Harmless. User agrees to defend, indemnify, and hold TI, its directors, officers, employees, agents, representatives, affiliates, licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of, or in connection with, any handling and/or use of EVMs. User's indemnity shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if EVMs fail to perform as described or expected.

Safety-Critical or Life-Critical Applications. If user intends to use EVMs in evaluations of safety critical applications (such as life support), and a failure of a TI product considered for purchase by user for use in user's product would reasonably be expected to cause severe personal injury or death such as devices which are classified as FDA Class III or similar classification, then user must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

RADIO FREQUENCY REGULATORY COMPLIANCE INFORMATION FOR EVALUATION MODULES

Texas Instruments Incorporated (TI) evaluation boards, kits, and/or modules (EVMs) and/or accompanying hardware that is marketed, sold, or loaned to users may or may not be subject to radio frequency regulations in specific countries.

General Statement for EVMs Not Including a Radio

For EVMs not including a radio and not subject to the U.S. Federal Communications Commission (FCC) or Industry Canada (IC) regulations, TI intends EVMs to be used only for engineering development, demonstration, or evaluation purposes. EVMs are not finished products typically fit for general consumer use. EVMs may nonetheless generate, use, or radiate radio frequency energy, but have not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or the ICES-003 rules. Operation of such EVMs may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: For EVMs including a radio, the radio included in such EVMs is intended for development and/or professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability in such EVMs and their development application(s) must comply with local laws governing radio spectrum allocation and power limits for such EVMs. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by TI unless user has obtained appropriate experimental and/or development licenses from local regulatory authorities, which is the sole responsibility of the user, including its acceptable authorization.

U.S. Federal Communications Commission Compliance

For EVMs Annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at its own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada Compliance (English)

For EVMs Annotated as IC – INDUSTRY CANADA Compliant:

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs Including Radio Transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs Including Detachable Antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Canada Industry Canada Compliance (French)

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2014, Texas Instruments Incorporated

Important Notice for Users of EVMs Considered “Radio Frequency Products” in Japan

EVMs entering Japan are NOT certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If user uses EVMs in Japan, user is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after user obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after user obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless user gives the same notice above to the transferee. Please note that if user does not follow the instructions above, user will be subject to penalties of Radio Law of Japan.

<http://www.tij.co.jp>

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 本開発キットは技術基準適合証明を受けておりません。 本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

<http://www.tij.co.jp>

Texas Instruments Japan Limited

(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com