

TRF3750 (QFN/TSSOP)

Evaluation Module

User's Guide

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Read This First

About This Manual

This user's guide provides an overview of the TRF3750 evaluation module (EVM) and the software environment to get you started using the TRF3750 EVM right away. It also provides a general description of the features and functions to be considered while using this module.

How to Use This Manual

This document contains the following chapters:

- ☐ Chapter 1—Introduction
- ☐ Chapter 2—Software Installation
- ☐ Chapter 3—Hardware Configuration
- ☐ Chapter 4—Physical Description
- ☐ Chapter 5—Schematic

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A warning statement describes a situation that could potentially cause harm to you.

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Introduction

The TRF3750 EVM provides a platform for evaluating the TRF3750 integer-N PLL frequency synthesizer under various signals, reference, and supply conditions. This document should be used in combination with the EVM schematic diagram supplied. Using the TRF3750 EVM, you can rapidly evaluate the TRF3750 PLL with a minimum of manual setup. The CD-ROM provides all the software you need to test the device.

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1.2 Power Requirements	1-2

1.1 EVM Basic Functions

The reference input can be provided using the on-board oscillator (Y1) or brought in externally using the SMA connector J4. The VCO output can be monitored through the SMA connector J3.

Power connections to the EVM are via a five terminal screw style connector J1. EMI filters provide isolated power for the analog, digital, and charge pump power inputs to the TRF3750 and the high-frequency VCO power input. A mating connector is provided to allow for easy connections to external power supplies.

The TRF3750 EVM allows the user to program the TRF3750 internal registers via the supplied computer parallel port cable and serial interface software. The interface allows read and write access to all registers that define the operation modes of the TRF3750.

1.2 Power Requirements

The EVM has four terminals for dc power supply and one for ground. Connect a 5-V dc supply to terminal 1 (VVCO) for the VCO power. Connect 3.3 Vdc or 5 Vdc to terminal 2 (AVDD) for the TRF3750 analog power. DVDD must be set equal to AVDD, connect either 3.3 Vdc or 5 Vdc to terminal 4 (DVDD) for the TRF3750 digital power. Connect 7 Vdc to terminal 5 (Vp) for the TRF3750 charge pump supply. Connect ground to terminal 3 (GND).

Note: The operating range for the charge pump supply (VCP) is 8 Vdc max.

Voltage Limits

Exceeding the maximum input voltages can damage EVM components. Undervoltage may cause improper operation of some or all of the EVM components.

Software Installation

This section explains how to install the software and gives an overview of the main parts tool menus.

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2.1 Software Installation

All necessary software to operate the serial interface is provided on the enclosed CD-ROM.

Version 1.0 of the TRF3750 software allows full control and programmability of all the different functions and modes of the TRF3750. The software is GUI-based and employs an intuitive graphical environment. You can load the software in the following ways:

- 1) Insert the CD-ROM into the computer to be used to operate the serial interface.
- 2) Double click the file called setup.exe.

The installer prompts you to select the directory in which you wish to install the program. The installer automatically installs the TRF3750 software, the National Instruments LabVIEW run-time engine, and the LabWindows run-time engine in one seamless installation. After the computer goes through the automatic installation, you will be prompted to restart your computer. The software was created using LabVIEW, but it does not require LabVIEW to be installed on the PC. This is why the run0time engines are installed.

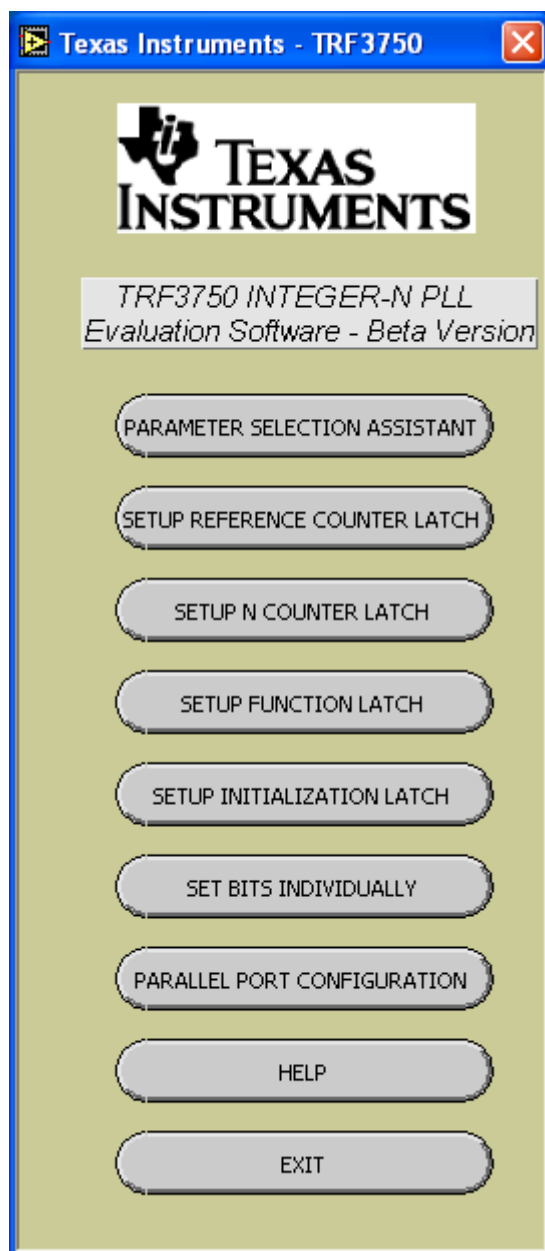
Once you restart, the program is ready to function. Ensure that you have connected your PC's parallel port cable to the TRF3750 EVM (connector J5).

- 3) Once the installation is complete, the software is launched by running C:\TRF3750.exe.

Once you launch the program, it automatically runs and gives you several options (icons).

Figure 2–1 shows the structure of the main menu.

Figure 2–1. Structure of the Main Menu



2.2 Selecting Menus and Settings

- 1) Left click the *PARAMETER SELECTION ASSISTANT* to display the menu for configuring the PLL.

The menu is shown edited for:

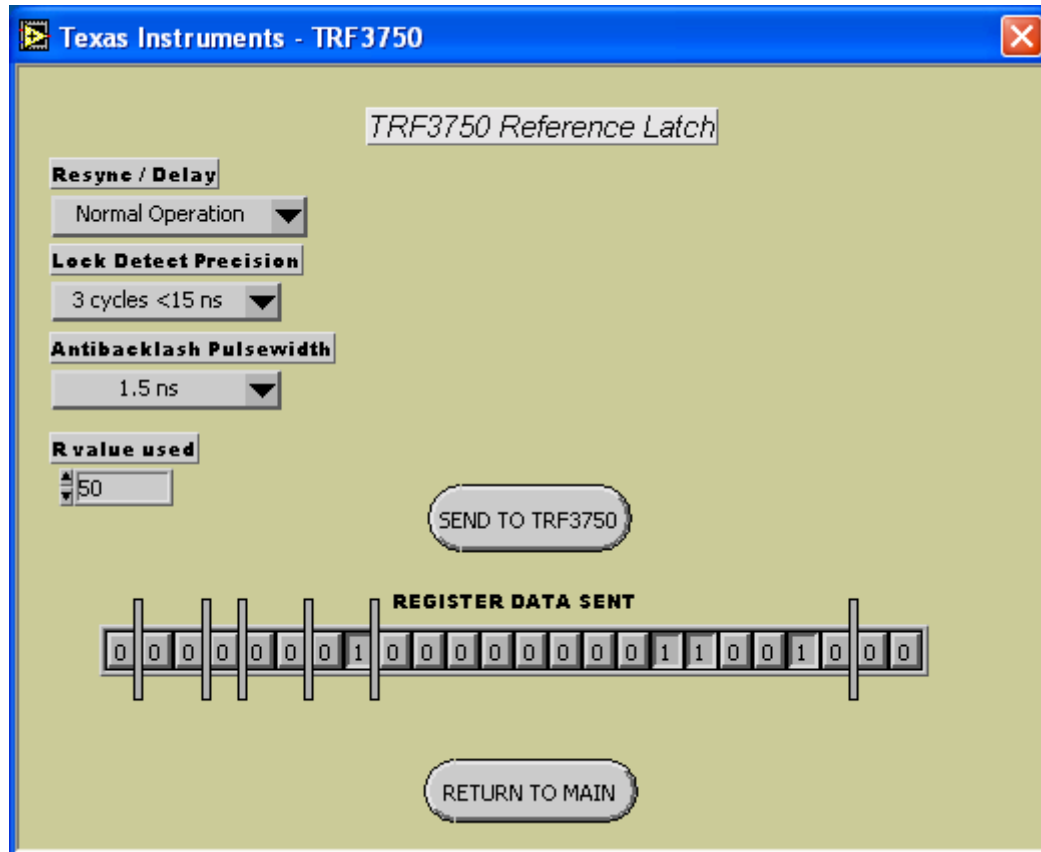
- ☐ VCO frequency = 1960 MHz
 - ☐ PFD frequency = 200 kHz
 - ☐ Reference frequency (REFIN) = 10 MHz and
 - ☐ Prescaler selection 16/17
- 2) Left click on the *CALCULATE* button and the program calculates the data-set for the A counter and B counter. You also have the option of setting a specific value directly in the A and B counters that equates to the set or desired PFD frequency.

- 3) Left click the *SEND CALCULATED VALUES* to load the PLL registers.
- 4) Left click *RETURN TO MAIN* returns to the main menu.

2.3 TRF3750 Reference Latch Menu

- ☐ Select a menu item using the pulldown arrows.
- ☐ Press the *SEND TO TRF3750* button to send the data to the register.
- ☐ Press the *RETURN TO MAIN* button to close the menu.

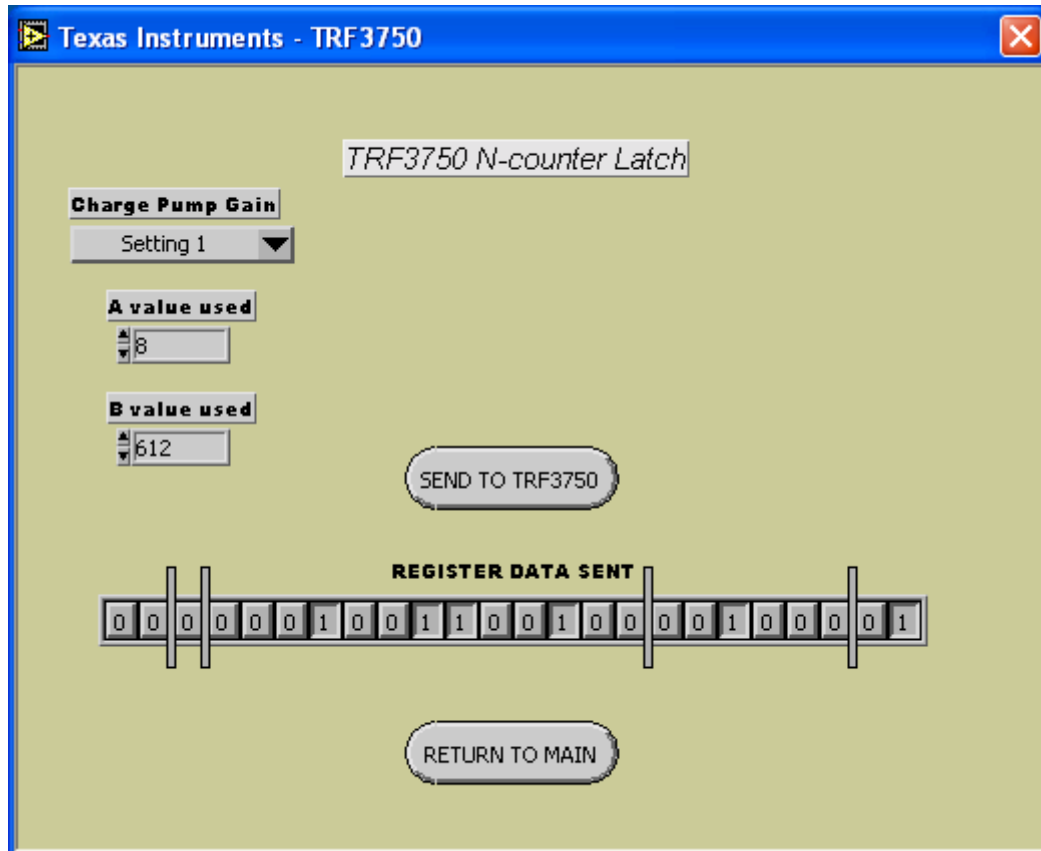
The palette settings displayed are typical and the R-value representing the relationship between the reference 10-MHz oscillator and the 200-kHz comparison frequency.



2.4 TRF3750 N-Counter Latch

Figure 2–2 shows an example of the N-counter settings.

Figure 2–2. Example of N-Counter Latch



2.5 TRF3750 Function Latch

Use the *Pull* button to set the charge pump current and other function latch-specific features supported.

Texas Instruments - TRF3750

TRF3750 Function Latch

PRESCALER SELECTION

16/17

POWERDOWN

NORMAL OPERATION

FASTLOCK MODE

DISABLED

CHARGE PUMP OUTPUT

NORMAL

PHASE DETECTOR POLARITY

POSITIVE

MUXOUT CONTROL

3-STATE OUTPUT

COUNTER OPERATION

NORMAL

CURRENT SETTING 2

2.7k 4.7k 10k Ohms

lcp(mA) 8.70 5.00 2.35

CURRENT SETTING 1

2.7k 4.7k 10k Ohms

lcp(mA) 8.70 5.00 2.35

TIMER COUNTER

7 PFD cycles

SEND TO TRF3750

REGISTER DATA SENT

0 1 0 1 1 1 1 1 1 0 0 0 1 0 0 0 1 0 0 0 0 0 0 1 0

RETURN TO MAIN

2.6 TRF3750 Initialization Latch

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TRF3750 Initialization Latch

PRESALER SELECTION

16/17

POWERDOWN

NORMAL OPERATION

CURRENT SETTING 2

2.7k 4.7k 10k Ohms

icp(mA) 8.70 5.00 2.35

CURRENT SETTING 1

2.7k 4.7k 10k Ohms

icp(mA) 8.70 5.00 2.35

TIMER COUNTER

7 PFD cycles

FASTLOCK MODE

DISABLED

CHARGE PUMP OUTPUT

NORMAL

PHASE DETECTOR POLARITY

POSITIVE

MUXOUT CONTROL

3-STATE OUTPUT

COUNTER OPERATION

NORMAL

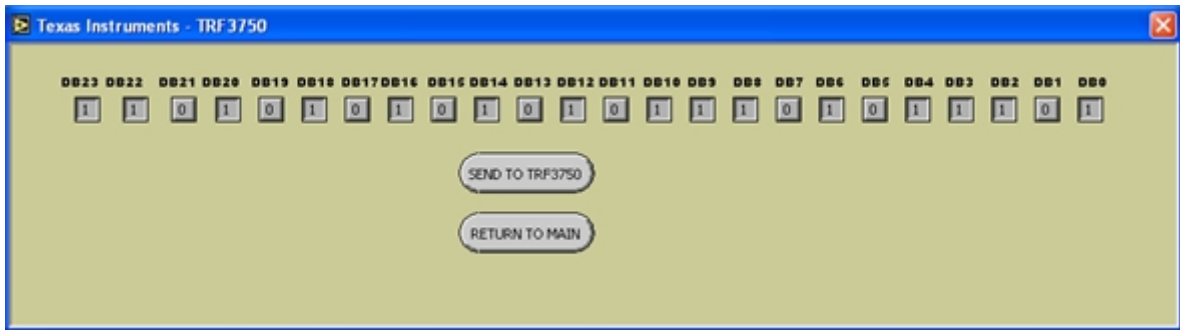
SEND TO TRF3750

REGISTER DATA SENT

010111110001000100000011

RETURN TO MAIN

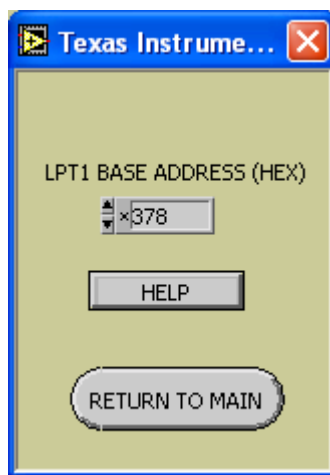
2.7 TRF3750 Set Blts Individually



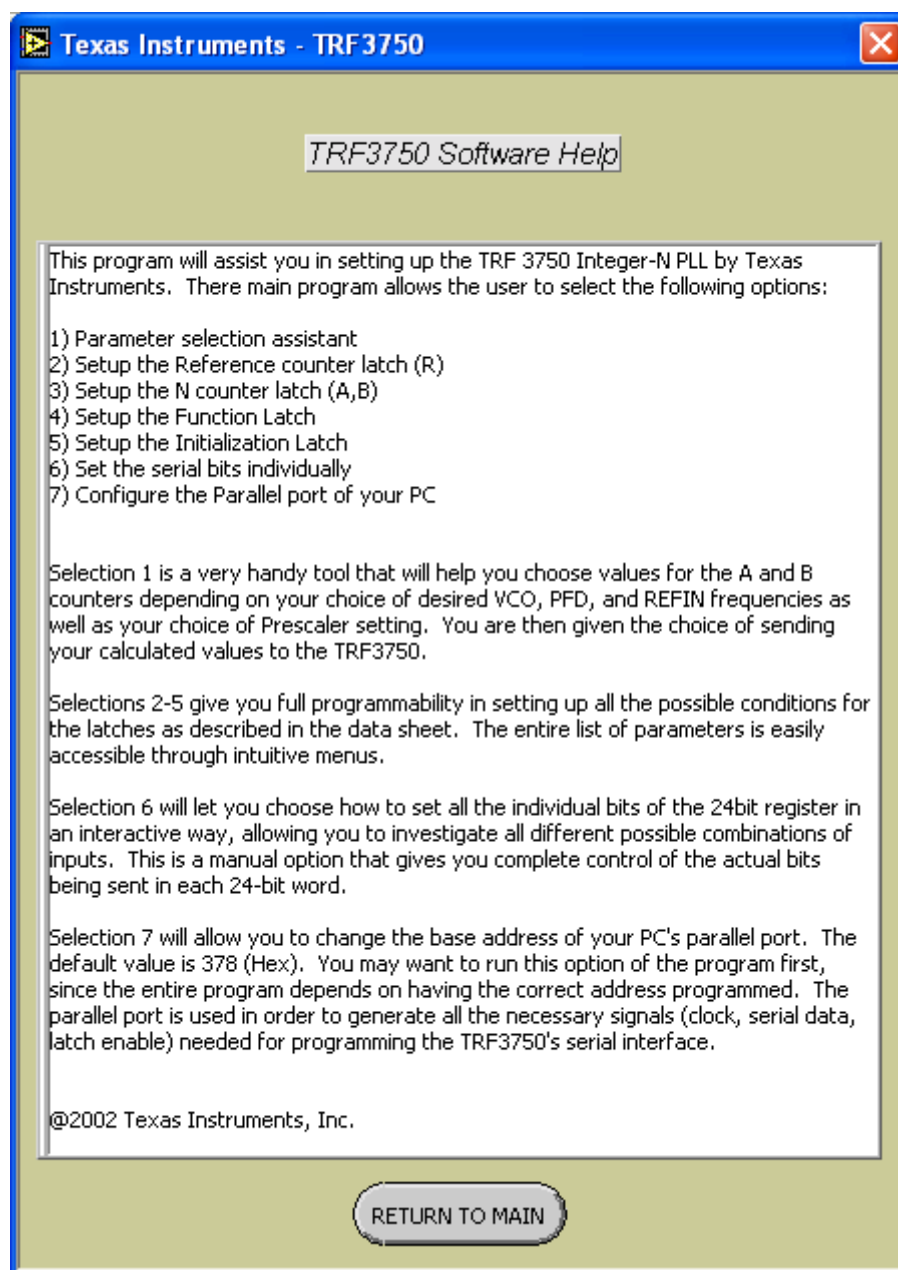
2.8 Parallel Port

The program assumes that the base address of your parallel port is Hexadecimal 378. If that is not the case, you can change the base address by left clicking on the parallel port configuration button. You can access the built-in help file by left clicking on the *HELP* button. The program includes the parameter assistant, which can help you choose divider ratios and parameters depending on your choice of VCO frequency, prescaler value, and PFD frequency. By simply Left clicking on each of the respective buttons brings up a window from which you can control the individual registers and all the settings. There is also an option to set all the bits of the serial interface manually, if so desired.

If you have any questions or encounter any difficulties, contact yiannis@ti.com.

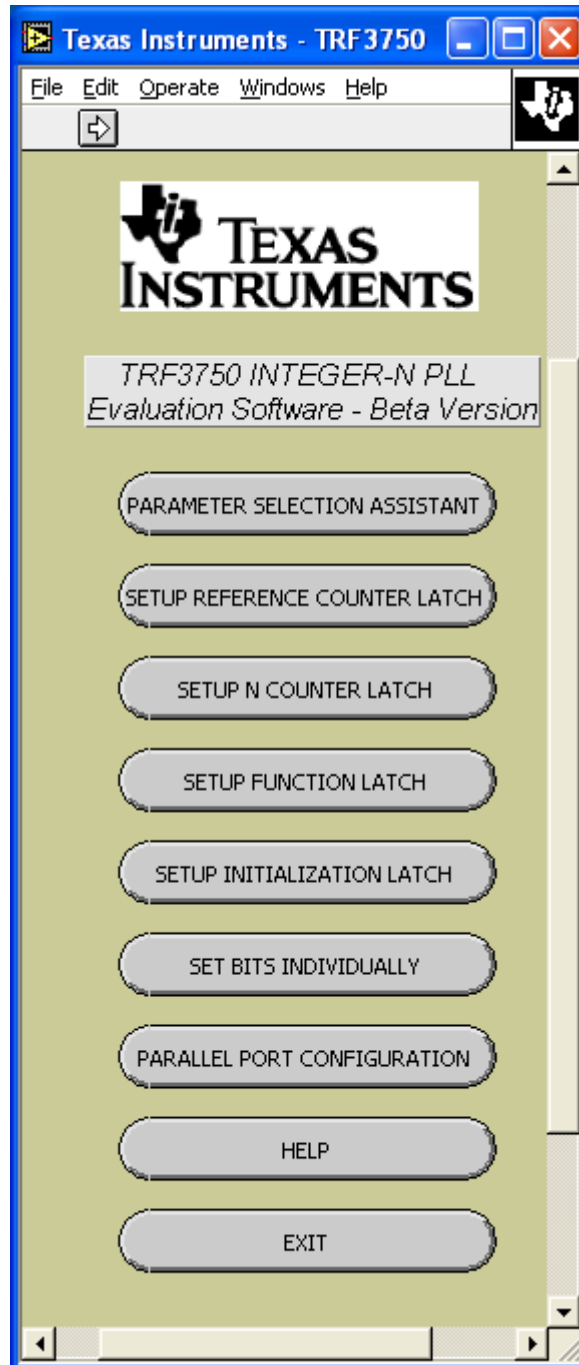


2.9 Help Menu



2.10 Exit

Pressing the *EXIT* button stops the execution of the program and returns you to the main menu. You can also rerun the last configuration automatically by left clicking on the arrow located on the tool bar, just below *Edit*.



Hardware Configuration

This chapter discusses the EVM configuration and also contains the EVM schematic.

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3.1 EVM Configuration	3-2

3.1 EVM Configuration

The TRF3750 EVM can be set up in a variety of configurations to accommodate a specific mode of operation. Before starting evaluation, the user should decide on the configuration and make the appropriate connections or changes. The basic synthesizer circuit is shown in the schematic (Chapter 5). The demonstration board comes with the following factory-set configuration:

3.1.1 REFIN

This is the input reference signal to the PLL. It is advantageous to have the capability of the REFIN input either via a stable on-board reference TCXO or a stable external frequency source. The default setting for the EVM is with REFIN provided externally through SMA connector J4. Note that the user can change the on-board TCXO and if the oscillator has an adjustment voltage input, TP8 can be used to fine-tune the frequency by applying an external voltage.

Note:

When using the on-board oscillator, make sure DVDD is within the oscillator input power specification.

Only minor modifications have to be made to the circuit when using the internal source and these are shown in Table 3–1.

Table 3–1. Reference Oscillator Configuration

REFIN Signal Source	Circuit Configuration
Y1	Remove R3, install R20 and FB1 or FB2 [‡]
External signal source	Install R3, remove R20 and FB1/FB2

[‡] Use FB2 and E1 to provide the TCXO power if different then DVDD.

- ☐ An easy and reliable way to provide this signal is by using the 10-MHz output of a spectrum analyzer or phase-noise analyzer.
- ☐ The current setting resistor jumper, J6, can be used to select one of three resistors for setting the maximum charge pump current. The values installed are 2.7 k Ω , 4.7 k Ω , and 10 k Ω . Use a jumper to short pin 1 (the center pin) to the preferred resistor. The default setting for the EVM uses R15 (4.7 k Ω).
- ☐ RFINA (J3), RFINB (J7)—The reference oscillator (U2) output is connected to J3 and to the reference input A pin of the TRF3750. The TRF3750 can accept either single ended or differential inputs. The TRF3750 EVM uses a single-ended VCO and the reference B input (J7) unconnected. If a differential input was to be used, C16 must be removed. J3 is connected through a resistive splitter to the output of the VCO and is the output of the board. Connect this to a 50- Ω load (spectrum or phase-noise analyzer) for monitoring purposes.
- ☐ MUXOUT—MUXOUT is used to output internal TRF3750 signals. The signal type is selected through the interface software. TP2 allows direct

access to the MUXOUT pin. An LED is also connected for visual identification. Note that R13 and R14 are removed. R12 limits the current going into the LED. To connect the MUXOUT output to the parallel port connector J5, install R2 (0 Ω).

- ☐ W1—This jumper controls the chip enable. When this signal is a logic 1, the device is in operate mode. The default setting for the EVM is with W1 between pins CE and HI.

To prepare the TRF3750 EVM for evaluation, connect the following:

- 1) 5 V to J1-1 and the return to J1-3.
- 2) 7 V to J1-5 and the return to J1-3.
- 3) 3.3 V to J1-2 and J1-4 and the return to J1-3.
- 4) If a crystal oscillator (usually 10 MHz) is installed go to step 5.
- 5) Use a frequency generator with 50- Ω output to input a 10-MHz single-ended, 3 V_{pp}, 0-V offset square or sine wave signal to SMA connector J4 (REFIN). Another option is to use the 10-MHz output of a spectrum analyzer or phase-noise analyzer.
- 6) Connect the supplied serial interface cable to the parallel port of a PC and the EVM.
- 7) Start the TRF3750 interface software and load the desired settings.
- 8) The VCO RF output can now be monitored using SMA connector J3. The TRF3750 internal signals can be monitored using TP2 or the PC if R2 is installed.

Physical Description

This chapter describes the physical characteristics and PCB layout of the EVM and lists the components used on the module.

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4.2 Parts List	4-10

4.1 PCB Layout

The EVM is constructed on a 4-layer, 3.4 inch x 4 inch, 0.062 inch thick PCB using FR-4 material. Figure 4-1 through Figure 4-4 show the PCB layout for the TSSOP EVM and Figures 4-5 through 4-8 show the PCB layout for the QFN EVM.

Figure 4-1. Top Layer 1 (TSSOP EVM)

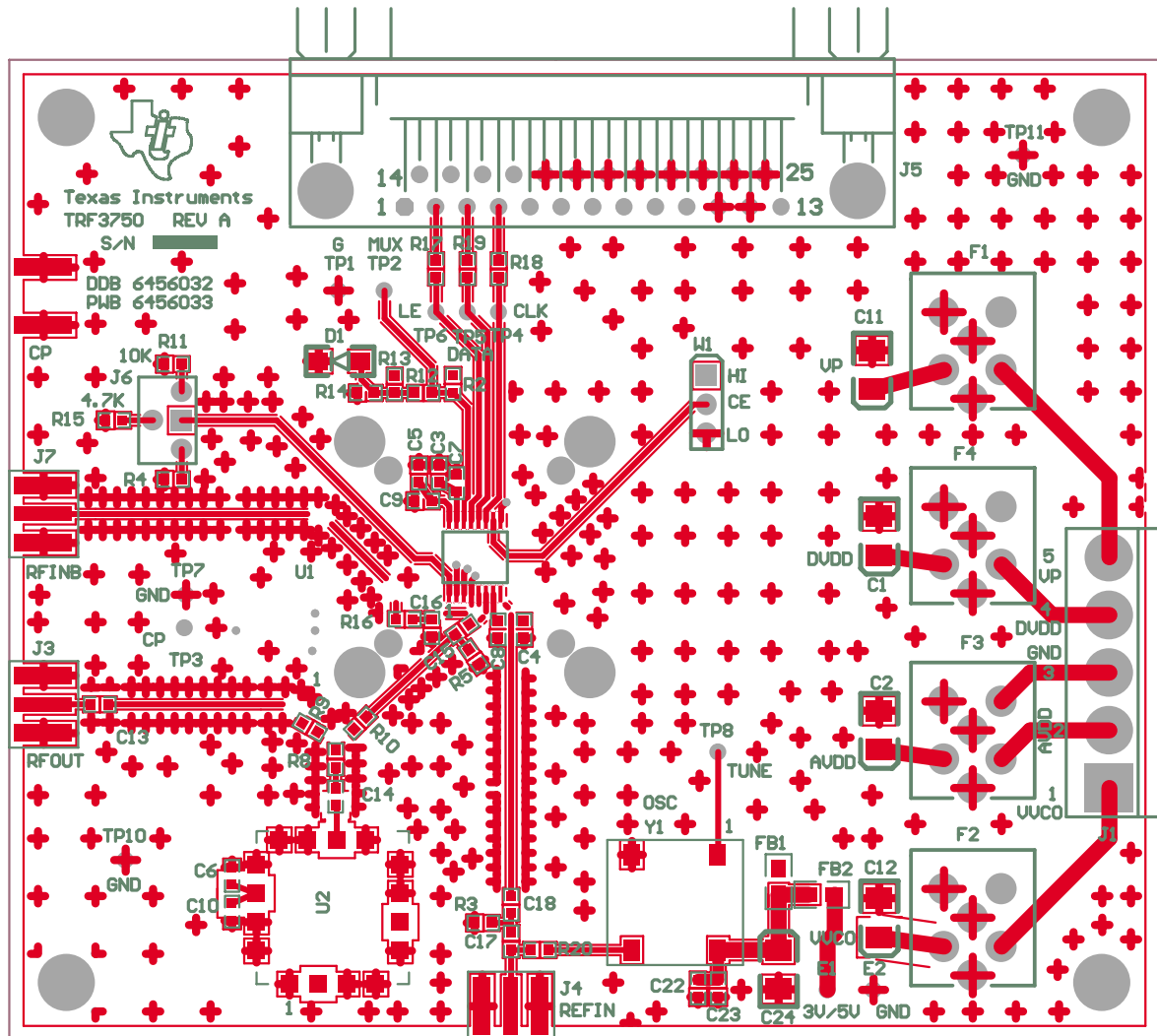




Figure 4–3. Power Plane Layer 3 (TSSOP EVM)

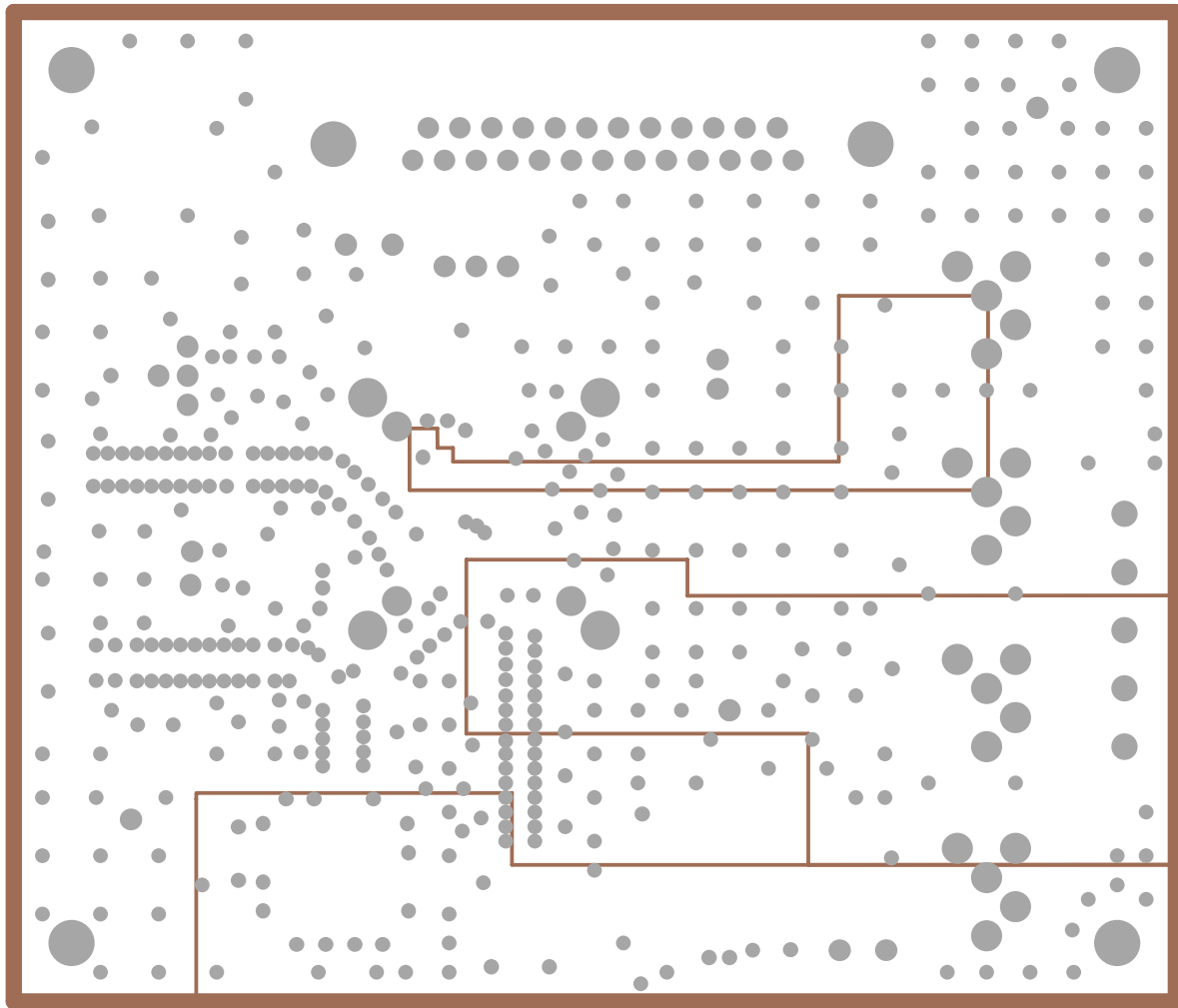


Figure 4-4. Bottom Layer 4 (TSSOP EVM)

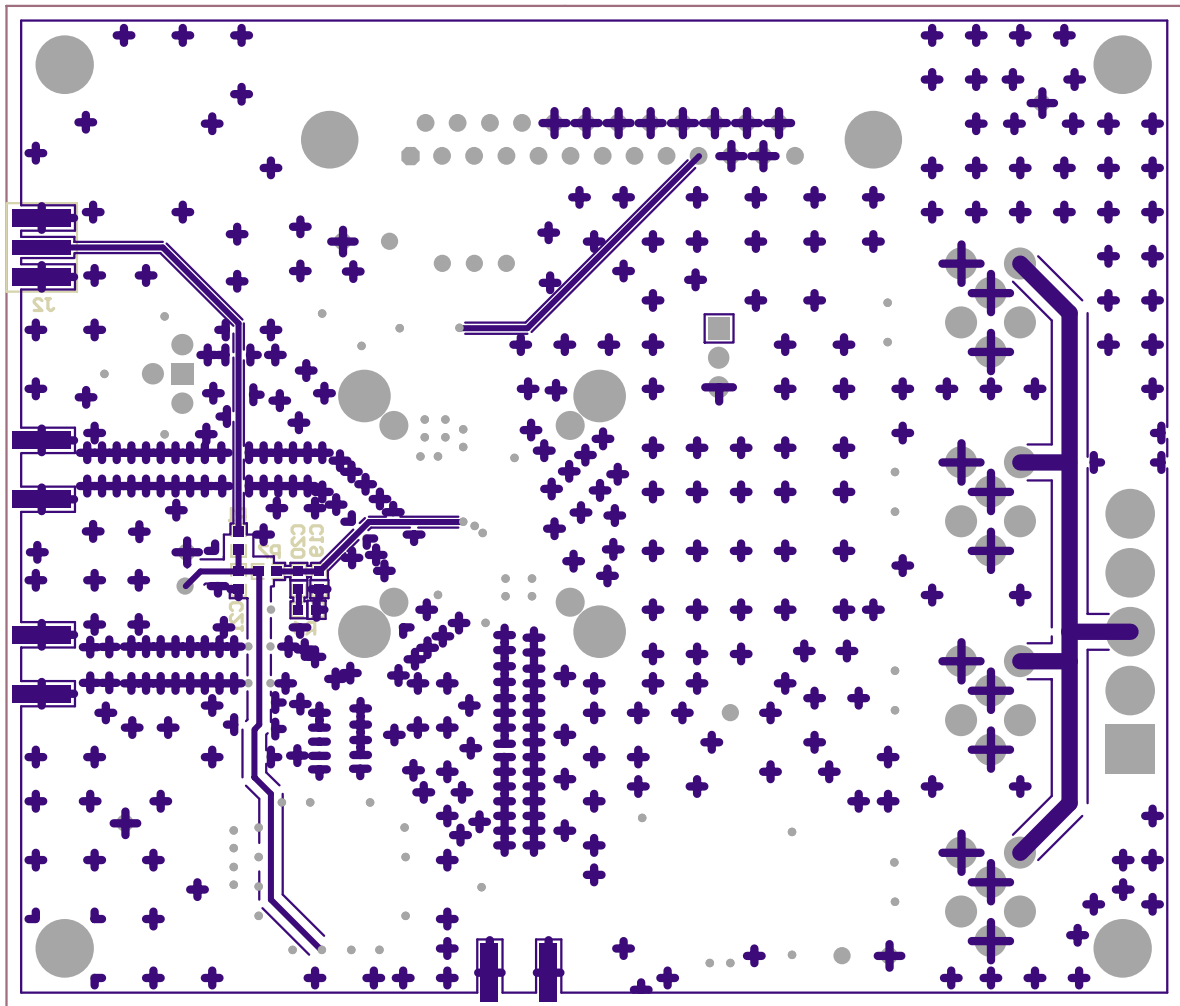


Figure 4–5. Top Layer 1 (QFN EVM)

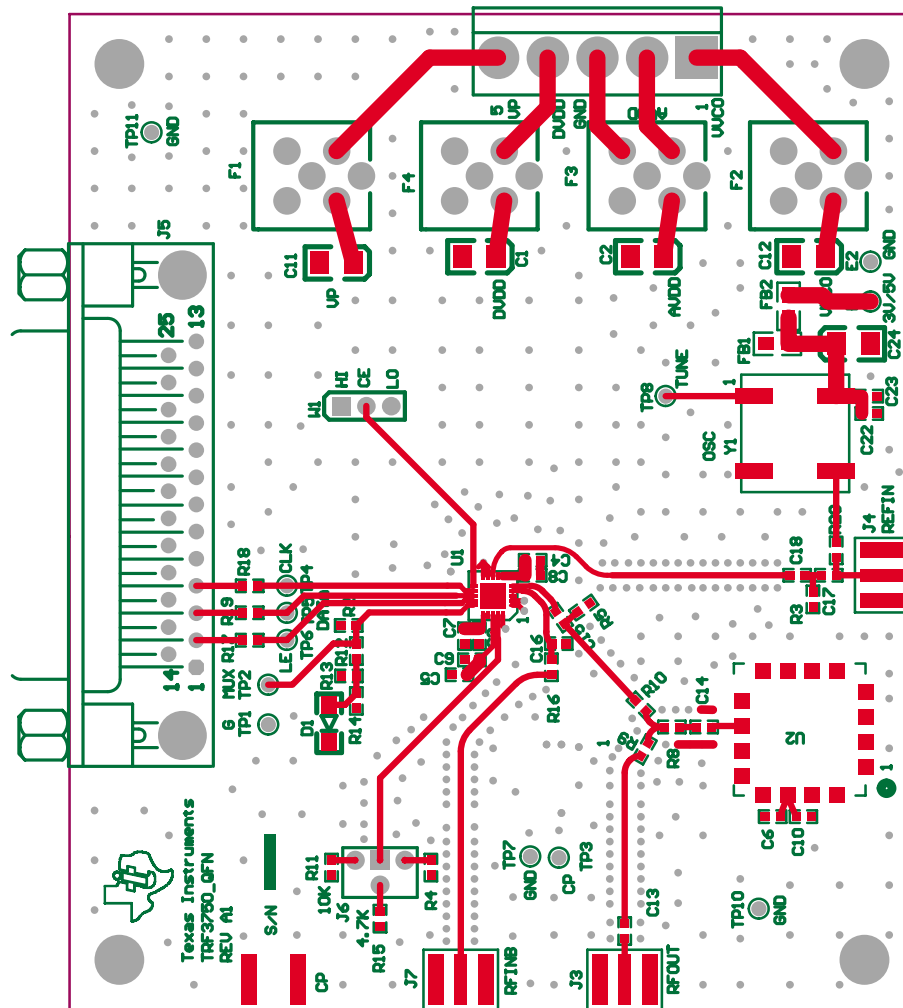


Figure 4–6. Ground Plane Layer 2 (QFN EVM)

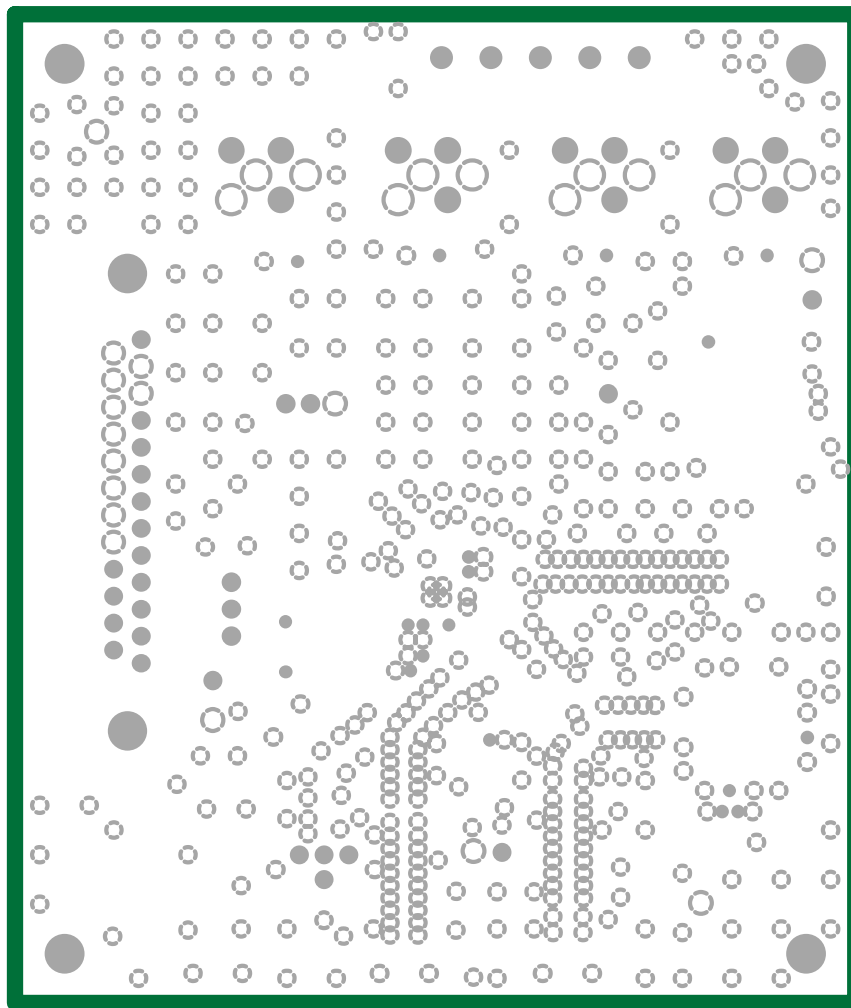


Figure 4–7. Power Plane Layer 3 (QFN EVM)

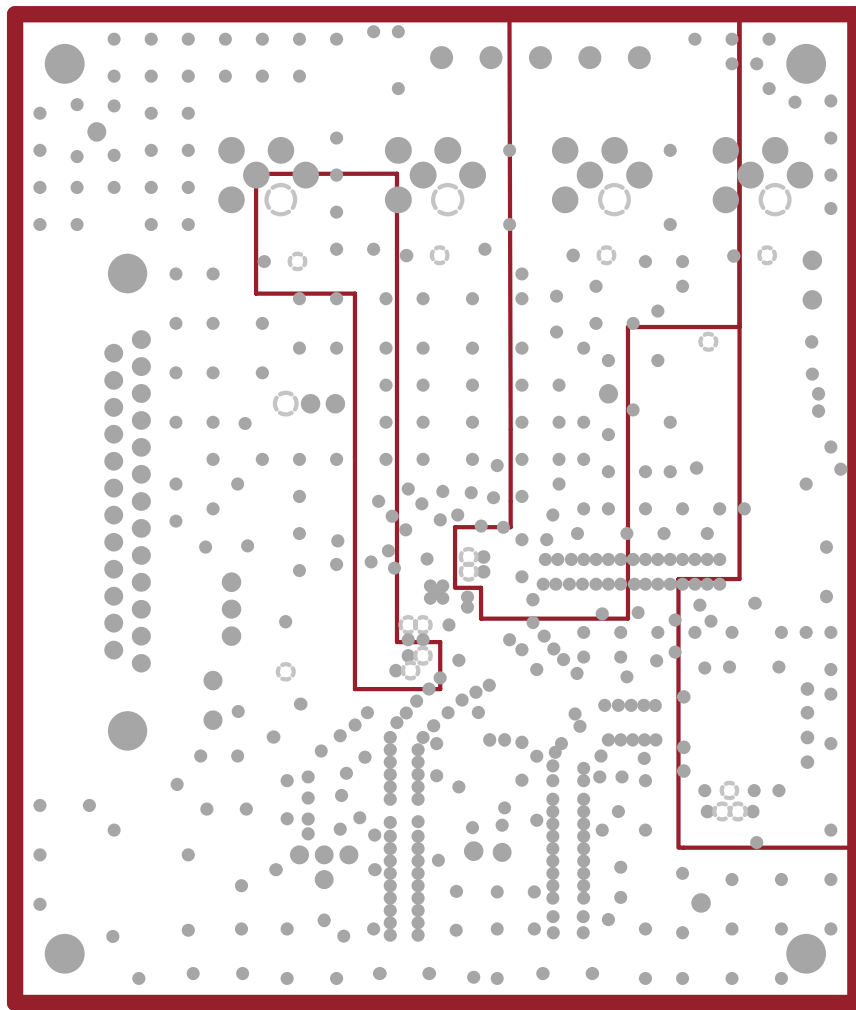
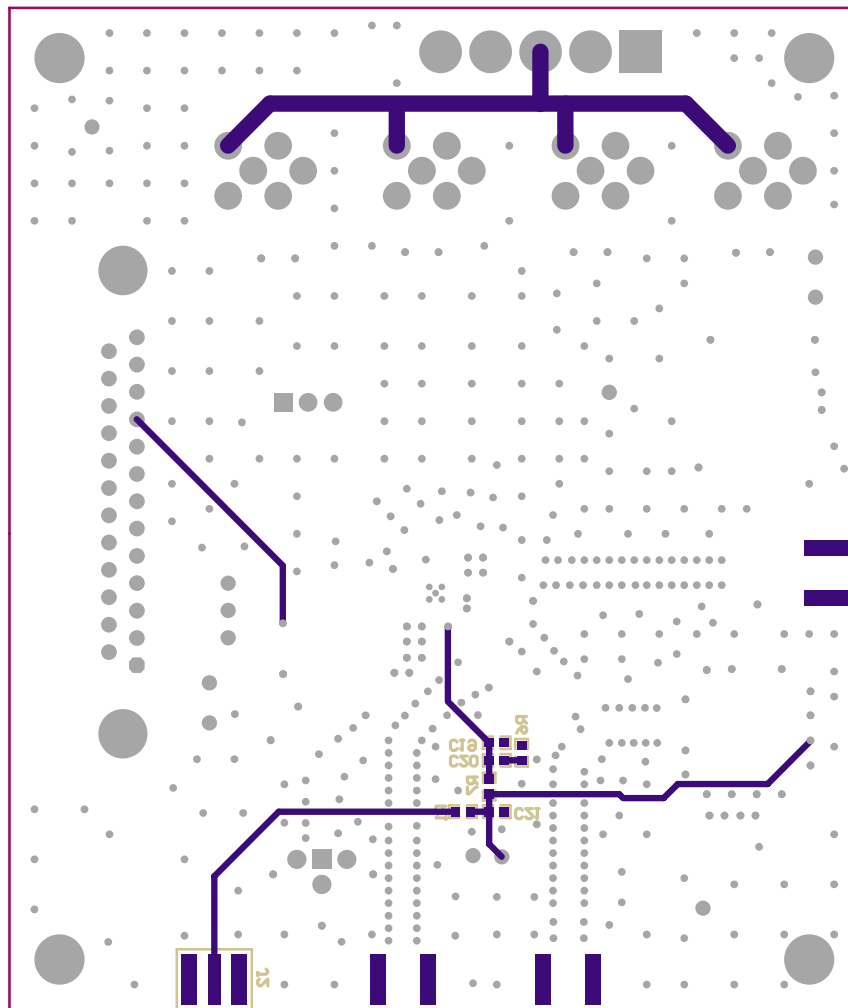


Figure 4-8. Bottom Layer 4 (QFN EVM)



4.2 Parts List

Table 4–1 lists the parts used in constructing the EVM.

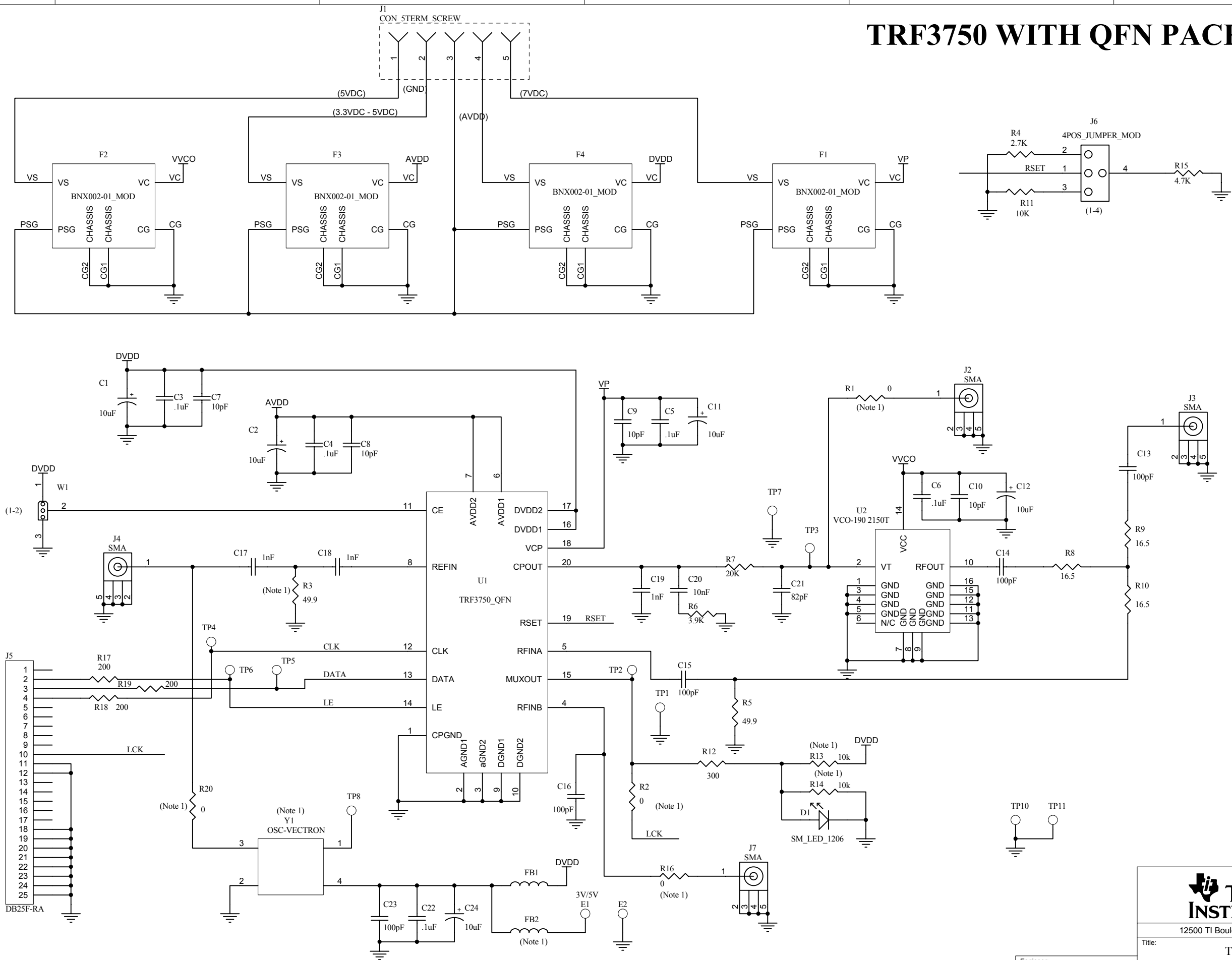
Table 4–1. TRF3750 EVM Parts List

Value	QTY	Part Number	Vendor	REF DES	Not Installed
Capacitors					
10 μ F, 16 V, 10% capacitor	5	293D106X9016B2T	Kemet	C1, C2, C11, C12, C24	
0.1 μ F, 16 V, 10% capacitor	5	ECJ-1VB1C104K	Panasonic	C3–C6, C22	
100 pF, 50 V, 5% capacitor	5	ECJ-1VC1H101J	Panasonic	C13–C16, C23	
0.01 μ F, 16 V, 10%, capacitor	1	ECJ-1VB1C103K	Panasonic	C20	
10 pF, 50 V, 5% capacitor	4	GMC10CG100J50NT	CALCHIP	C7–C10	
0.001 μ F, 50 V, 10% capacitor	3	ECJ-1VB1H102K	Panasonic	C17, C18, C19	
82 pF, 50 V 5% capacitor	1	ECU-V1H820J	Panasonic	C21	
Resistors					
0- Ω resistor, 1/16 W, 1%	0	ERJ-3EKF0R00V	Panasonic		R1, R2, R16, R20
300- Ω resistor, 1/16 W, 1%	1	ERJ-3EKF3000V	Panasonic	R12	
10-k Ω resistor, 1/10 W, 1%	1	ERJ-3EKF1002V	Panasonic	R11	R13, R14
16.5- Ω resistor, 1/10 W, 1%	3	ERJ-3EKF16R5V	Panasonic	R8, R9, R10	
2.7-k Ω resistor, 1/16 W, 1%	1	9C06031A2701FKHFT	Yageo–America	R4	
200- Ω resistor, 1/16 W, 1%	3	ERJ-3EKF2000V	Panasonic	R17, R18, R19	
20-k Ω resistor, 1/16 W, 1%	1	ERJ-3EKF2002V	Panasonic	R7	
3.9-k Ω resistor, 1/10 W, 1%	1	9C06031A3901FKHFT	Yageo–America	R6	
4.7-k Ω resistor, 1/16 W, 1%	1	9C06031A4701FKHFT	Yageo–America	R15	
49.9- Ω resistor, 1/16 W, 1%	1	ERJ-3EKF49R9V	Panasonic	R5	R3
Connectors, Jumpers, Headers, IC'S, etc.					
BNX002_01	4	BNX002_0100	MuRata	F1–F4	
3POS_HEADER	1	TSW-150-07-L-S	Samtec	W1	
4POS_JUMPER	1	87089-0616	Molex	J6	
CON_5TERM_SCREW (male)	1	39860-0705	Molex	J1	
CON_5TERM_SCREW (female)	1	39860-0105	Molex	J1 mate	
DB25F-RA	1	745536-2	AMP	J5	
SMA connectors	4	16F3627	Newark	J2, J3, J4, J7	
Ferrite bead	1	EXC-ML20A390U	Panasonic	FB1	FB2
Green SM_LED_1206	1	CMD15-21VGC/TR8	Panasonic	D1	
Red test point	6	5001K-ND	Keystone	TP2–TP6, TP8	
Black test point	4	5000K-ND	Keystone	TP1, TP7, TP10, TP11	
Crystal oscillator	0	T1115 / OSC3B0 at 10 MHz or TCO-986 at 10 MHz	Vectron or Toyocom		Y1
TRF3750	1	TRF3750	TI	U1	
VCO-19V	1	VCO-190-902T	Varil	U2	
Screws	4				
Stand off hex (1/4 x 0.5")	4	1902CK-ND	Allied		

Schematics

This chapter contains the schematics for both the TRF3750 TSSOP and QFN EVMs.

TRF3750 WITH QFN PACKAGE



NOTE 1. PART NOT INSTALLED



12500 TI Boulevard, Dallas, Texas 75243

Title: TRF3750_QFN

DOCUMENT CONTROL # REV: A1

Engineer: Y. PAPANTONOPoulos

Drawn By: Y. DEWONCK

FILE:

DATE: 26-Aug-2004 SIZE: SHEET: 1 OF:

The schematic diagram illustrates the TRF3750 with 16 PIN TSSOP package, showing four functional blocks (F1, F2, F3, F4) and a 4POS_JUMPER_MOD component.

Functional Blocks:

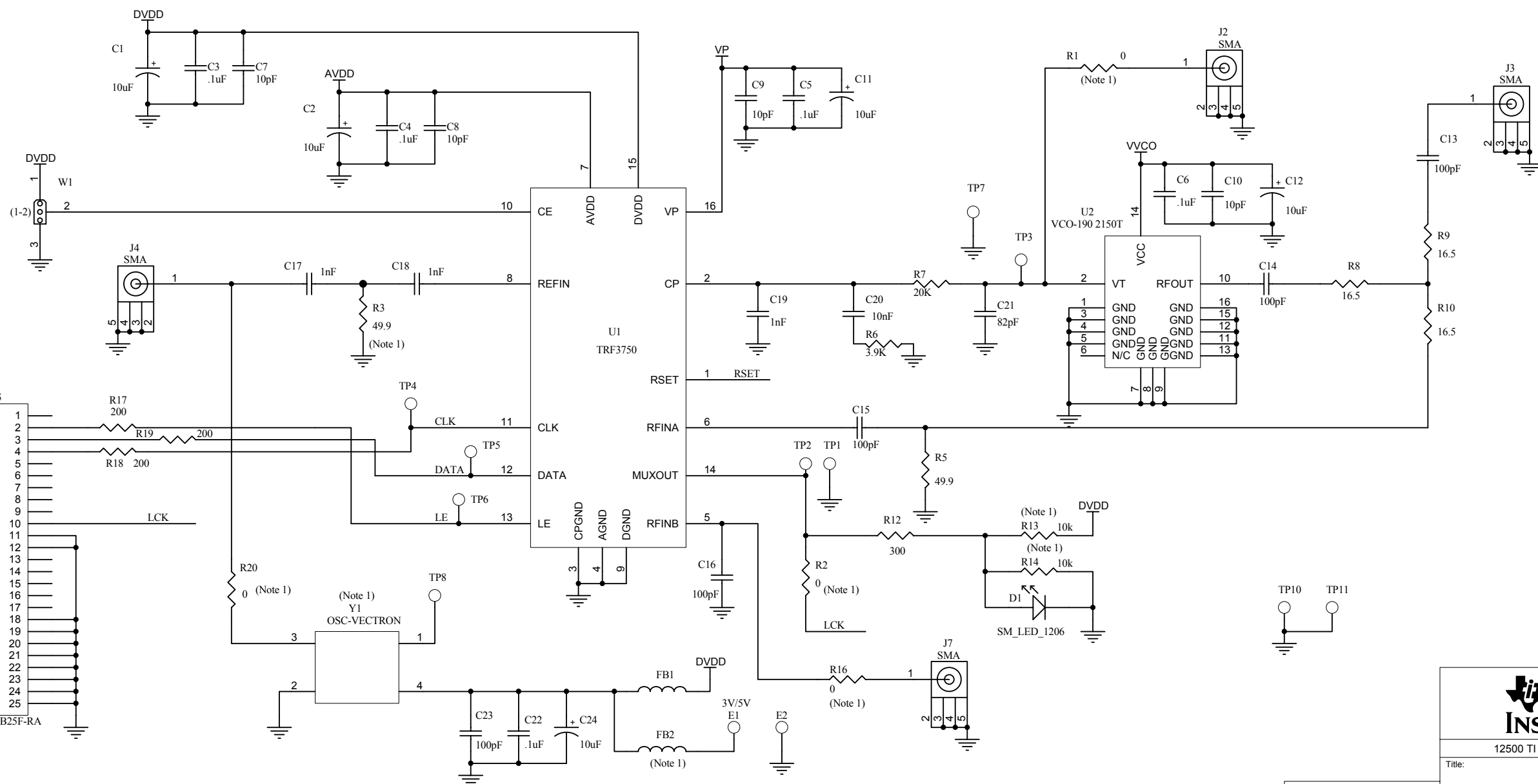
- F1, F2, F3, F4:** Each block is a BNX002-01_MOD component. The pins are labeled: VS (top left), PSG (bottom left), CHASSIS (bottom center), CG1 (bottom right), CG2 (bottom right), VC (top right), and VCO (top right).

Power and Ground Connections:

- VS:** Connected to the top rail.
- PSG:** Connected to the bottom rail.
- VC:** Connected to the top rail.
- VCO:** Connected to the top rail.
- CG1, CG2:** Connected to the bottom rail.

4POS_JUMPER_MOD Component:

- Pin 1:** RSET (2.7K).
- Pin 2:** R11 (10K).
- Pin 3:** R15 (4.7K).
- Pin 4:** (1-4).



NOTE 1. PART NOT INSTALLED