Texas Instruments

TRF3750 (QFN/TSSOP)

Evaluation Module

User's Guide

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Wireless Infrastructure Products

SLWU009

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Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the 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 25°C. The EVM is designed to operate properly with certain components above 65°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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Preface

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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Contents

Figures

Tables

Chapter 1

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.

Topic **Page**

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.

Voltrage Limits

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

Chapter 2

Software Installation

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

Topic **Page**

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.

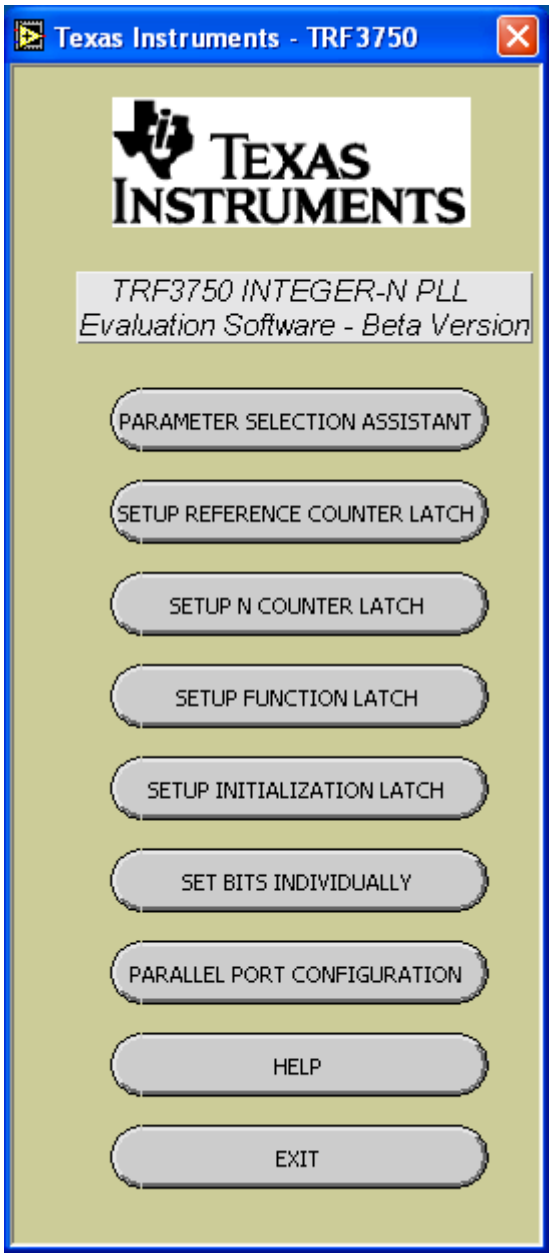
Once you restart, the program is ready to function. Ensure that you have connected your PC's parallel port cable to the TRF3750 EVM (connector J5).

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



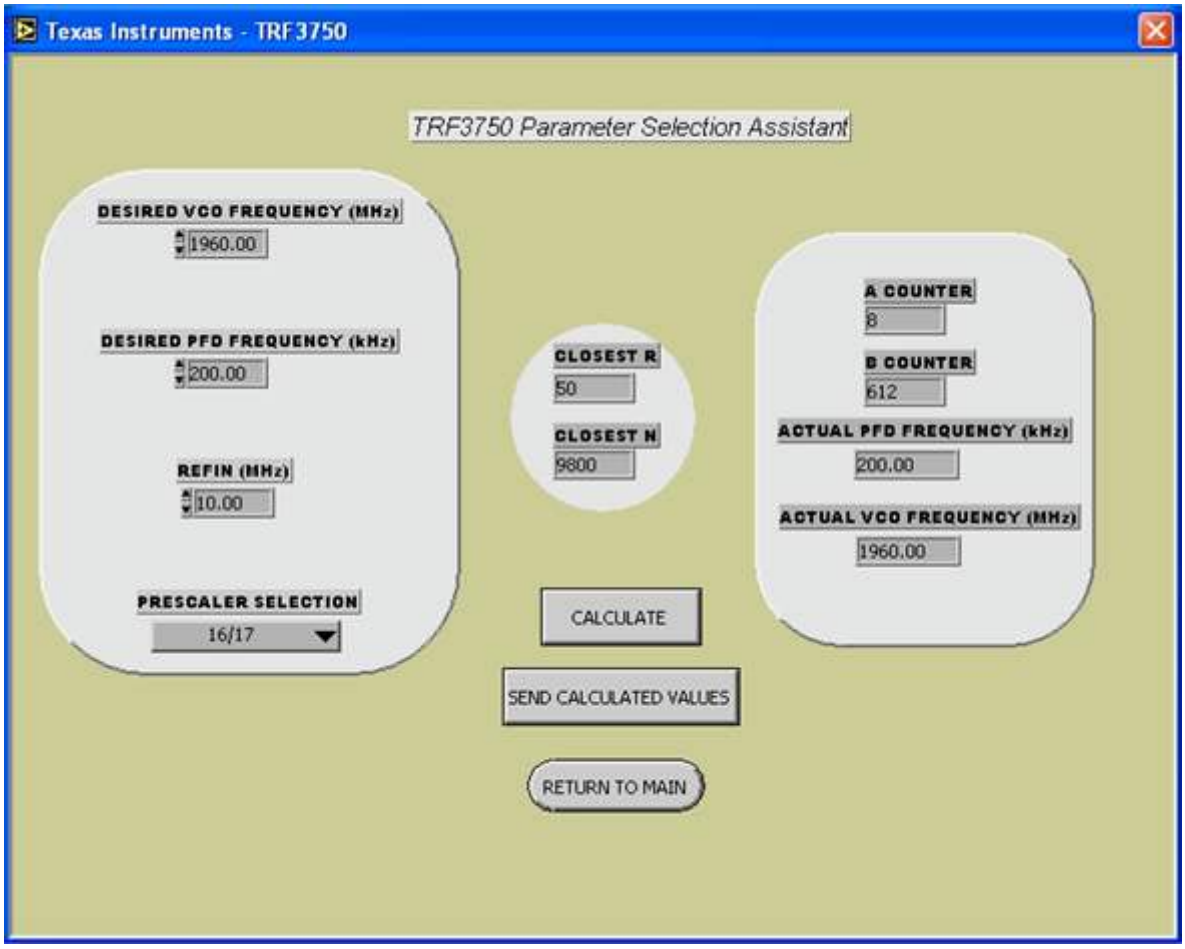
2.2 Selecting Menus and Settings

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.



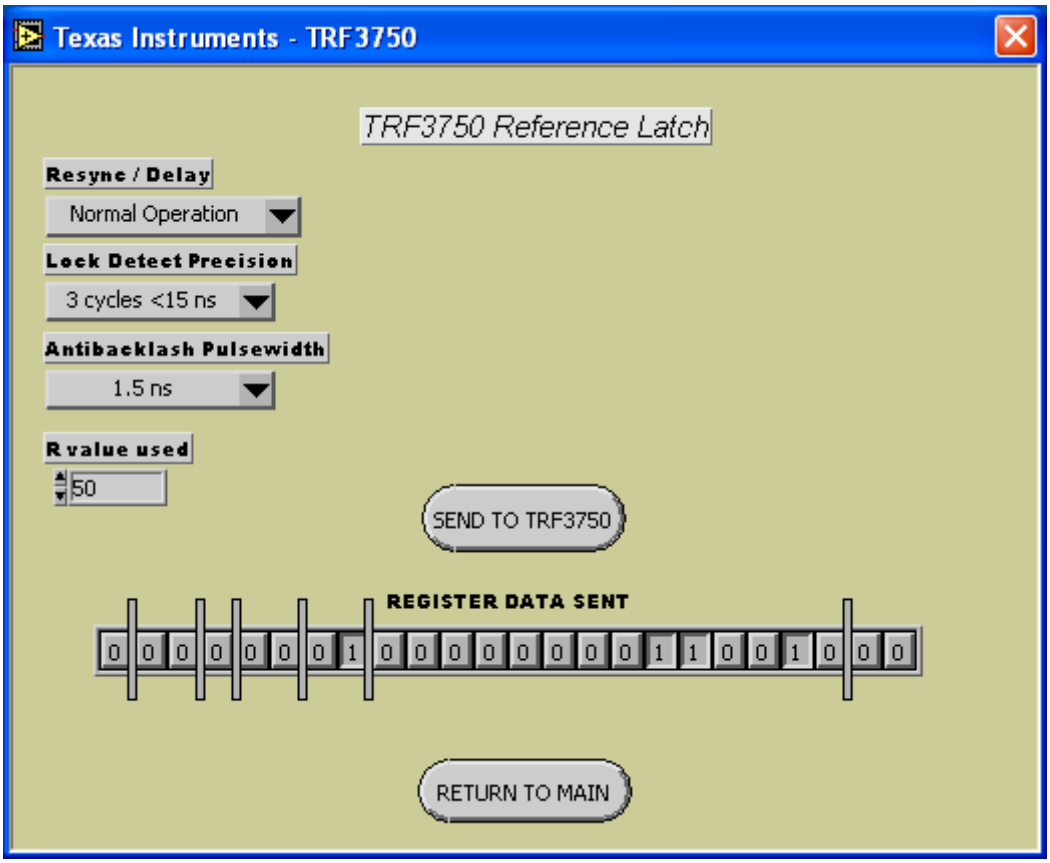
3) Left click the *SEND CALCULATED VALUES* to load the PLL registers.

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.

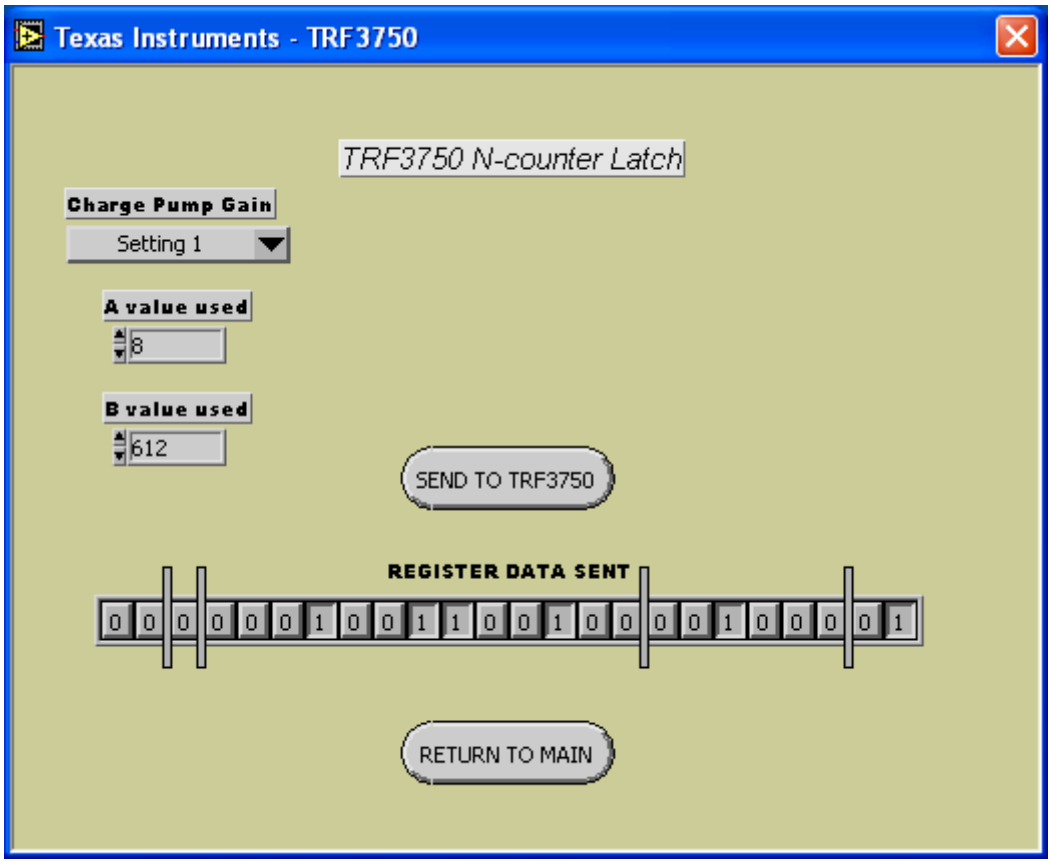
The palette settings displayed are typical and the R-value representing the relationship between the reference 10-MHz oscillator and the 200-kHz comparison frequency.



2.4 TRF3750 N-Counter Latch

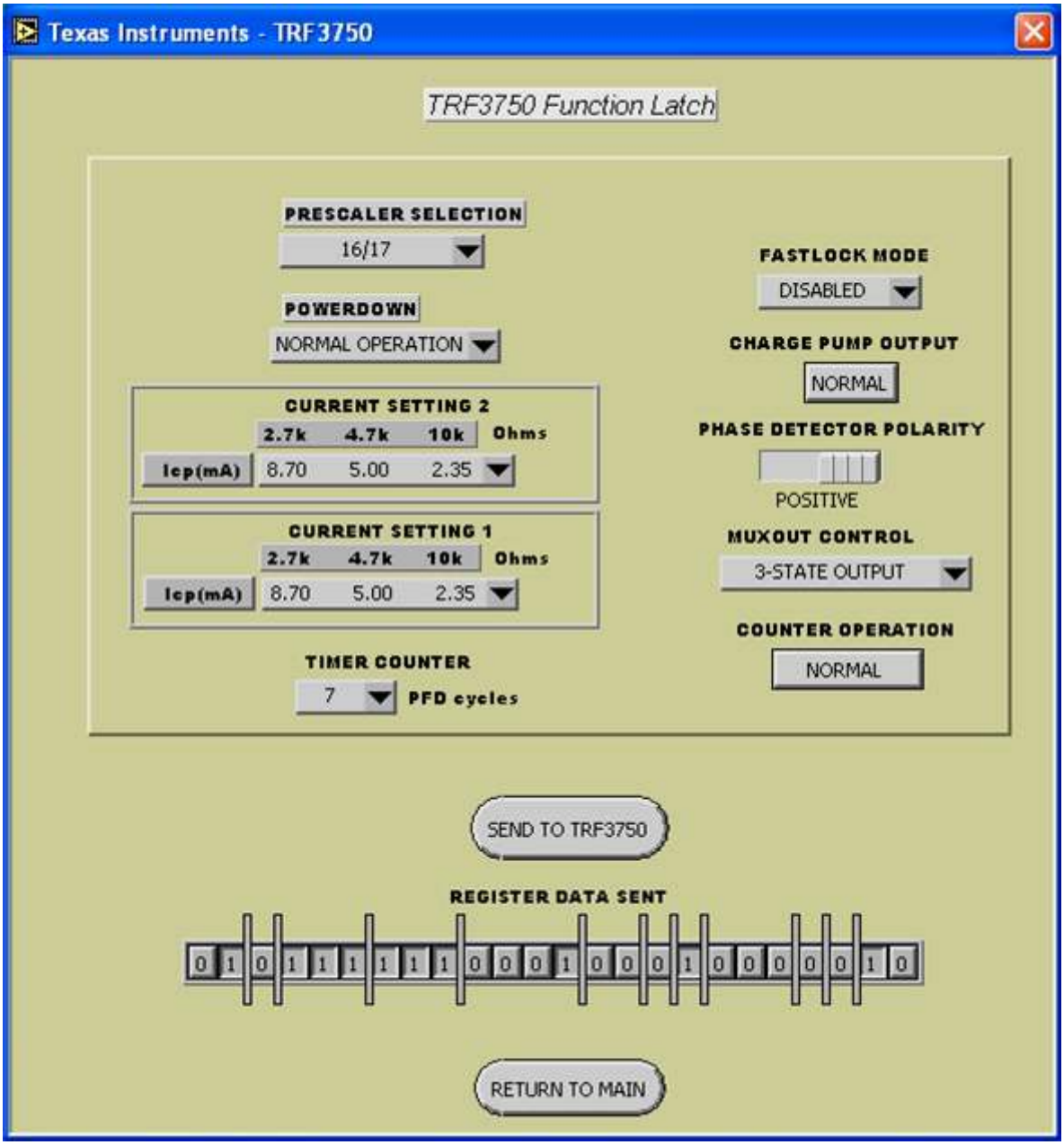
Figure 2−2 shows an example of the N-counter settings.

Figure 2−2. Example of N-Counter Latch

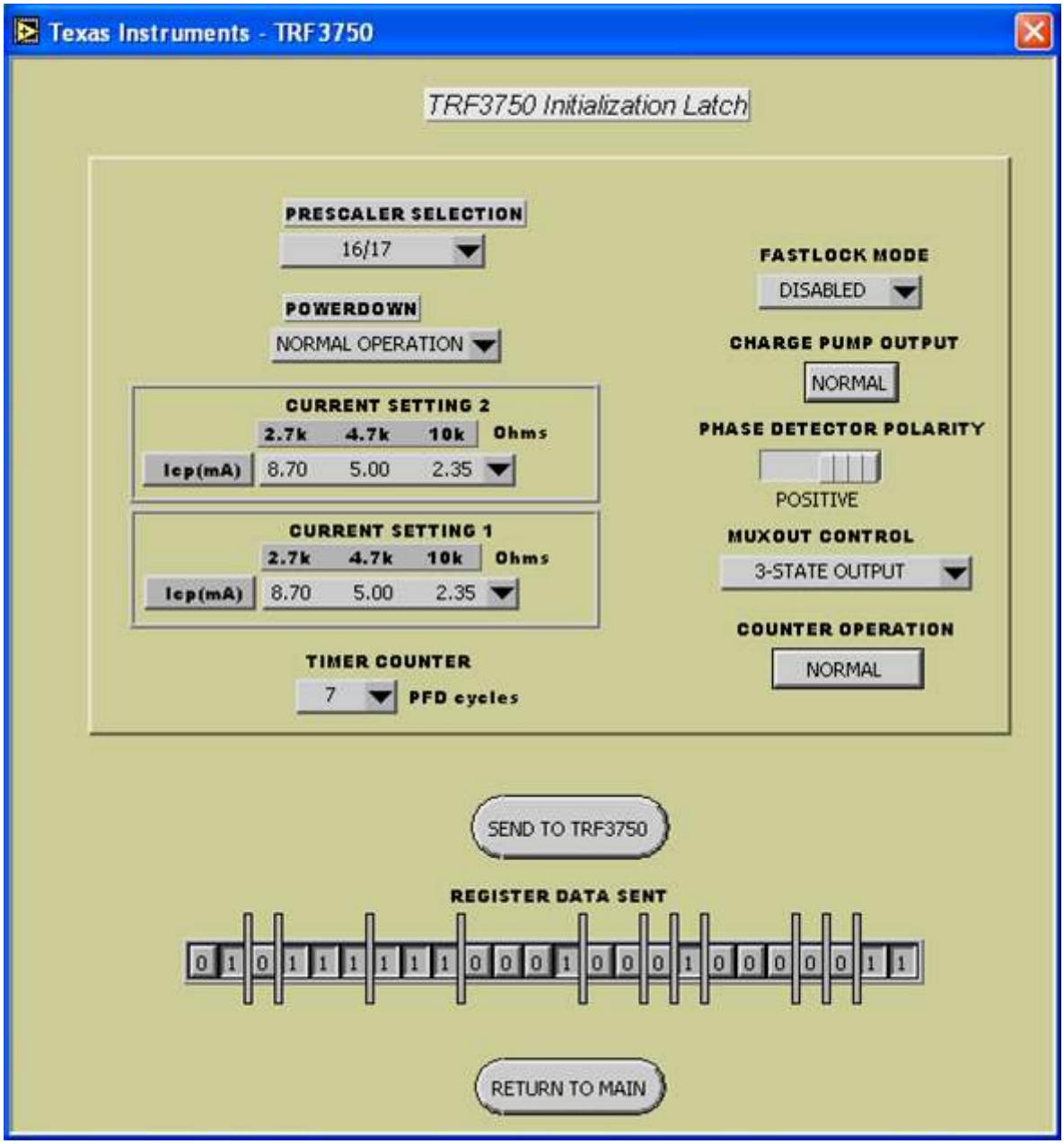


2.5 TRF3750 Function Latch

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



2.6 TRF3750 Initialization Latch

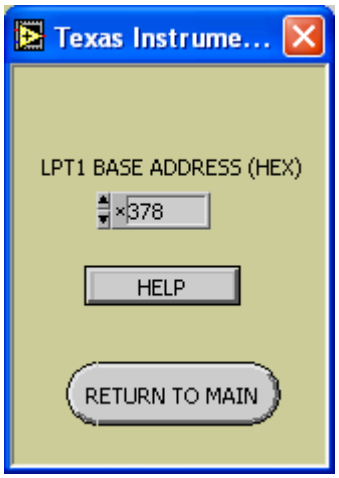


2.7 TRF3750 Set BIts Individually

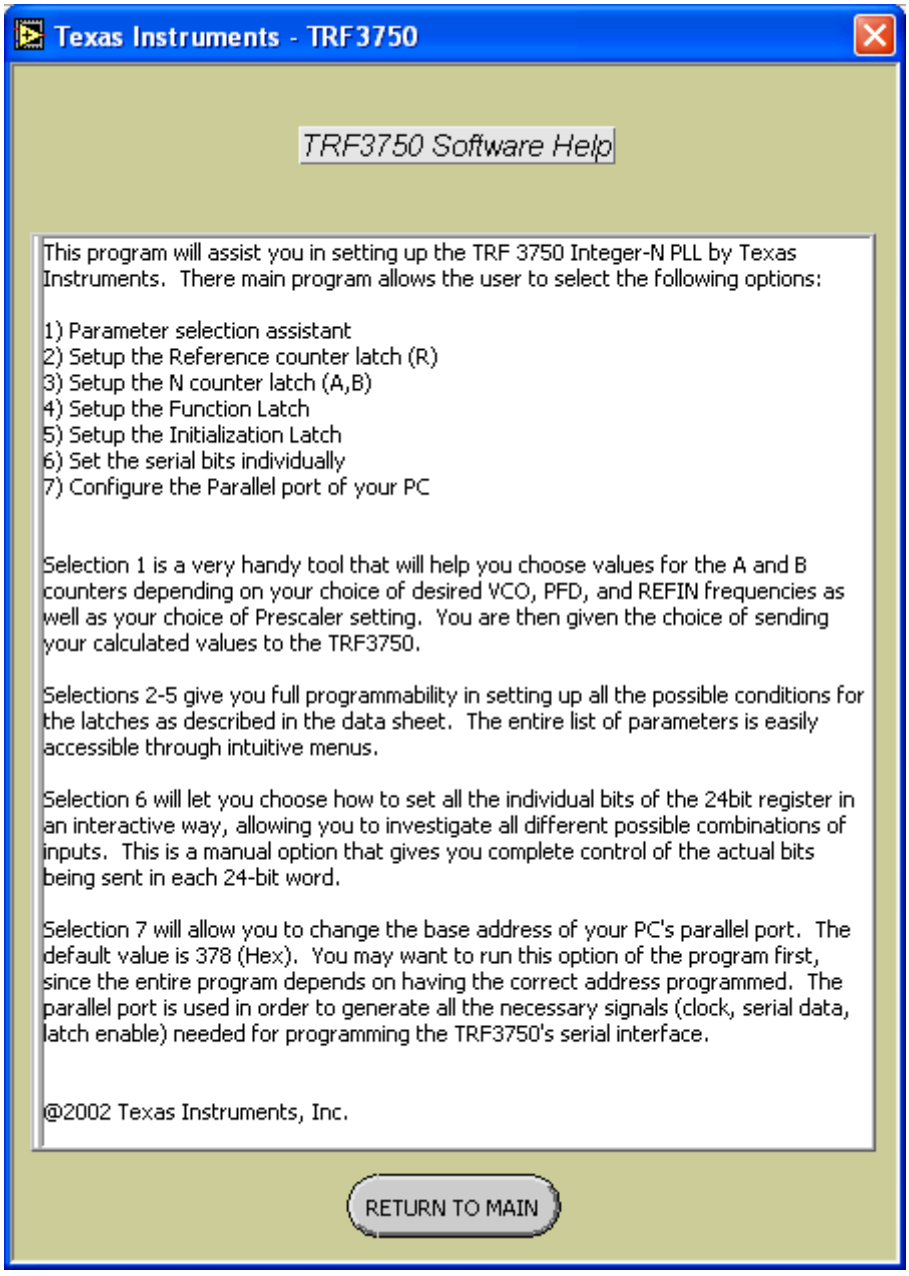
2.8 Parallel Port

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.

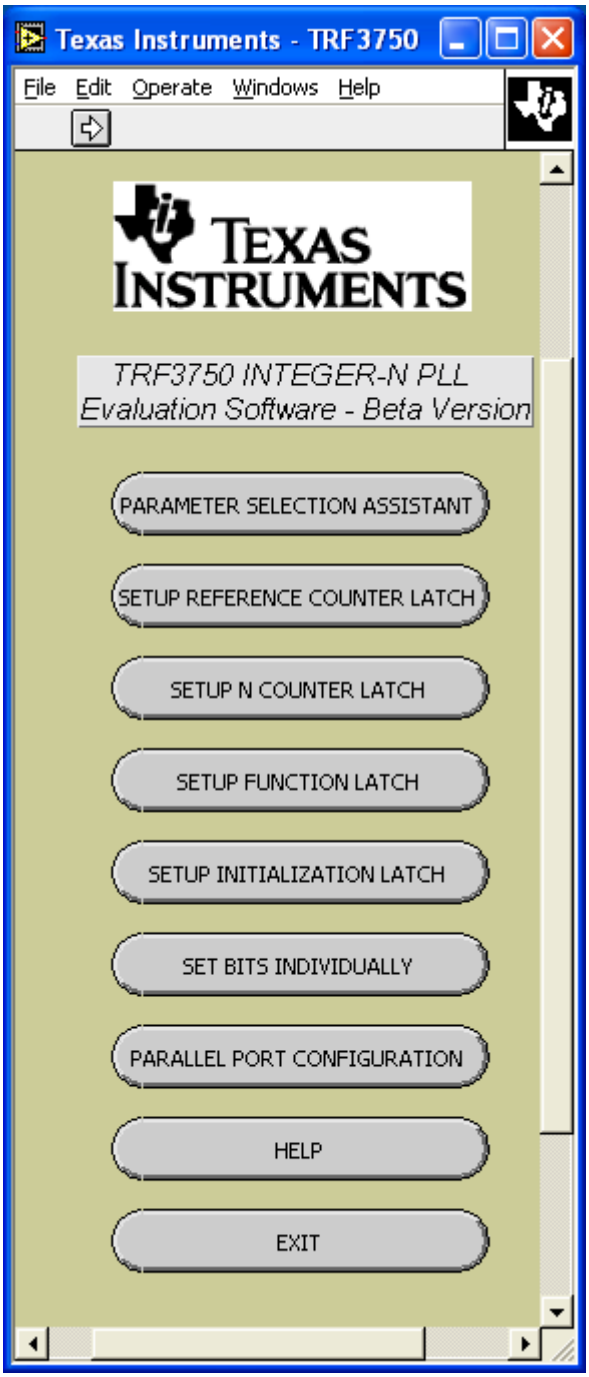


2.9 Help Menu


Texas Instruments - TRF3750
TRF3750 Software Help
This program will assist you in setting up the TRF 3750 Integer-N PLL by Texas Instruments. There main program allows the user to select the following options:
1) Parameter selection assistant
2) Setup the Reference counter latch (R)
3) Setup the N counter latch (A,B)
4) Setup the Function Latch
5) Setup the Initialization Latch
6) Set the serial bits individually
7) Configure the Parallel port of your PC
Selection 1 is a very handy tool that will help you choose values for the A and B counters depending on your choice of desired VCO, PFD, and REFIN frequencies as well as your choice of Prescaler setting. You are then given the choice of sending your calculated values to the TRF3750.
Selections 2-5 give you full programmability in setting up all the possible conditions for the latches as described in the data sheet. The entire list of parameters is easily accessible through intuitive menus.
Selection 6 will let you choose how to set all the individual bits of the 24bit register in an interactive way, allowing you to investigate all different possible combinations of inputs. This is a manual option that gives you complete control of the actual bits being sent in each 24-bit word.
Selection 7 will allow you to change the base address of your PC's parallel port. The default value is 378 (Hex). You may want to run this option of the program first, since the entire program depends on having the correct address programmed. The parallel port is used in order to generate all the necessary signals (clock, serial data, latch enable) needed for programming the TRF3750's serial interface.
@2002 Texas Instruments, Inc.
RETURN TO MAIN

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*.



Chapter 3

Hardware Configuration

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

Topic **Page**

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 kΩ, 4.7 kΩ, and 10 kΩ. Use a jumper to short pin 1 (the center pin) to the preferred resistor. The default setting for the EVM uses R15 (4.7 kΩ).
- 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 devices 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 Vpp, 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.

Chapter 4

Physical Description

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

Topic **Page**

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)

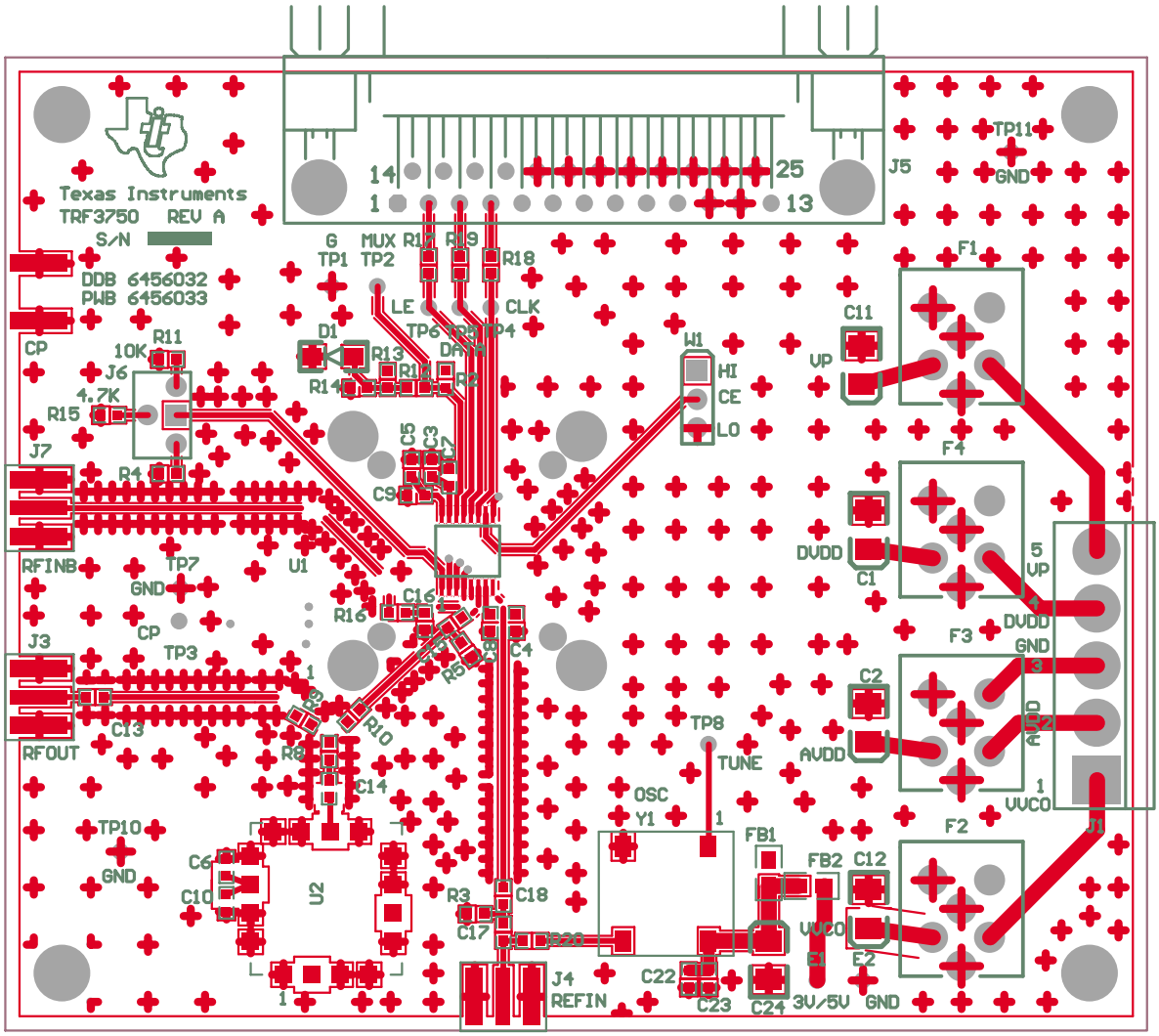


Figure 4−2. Ground Plane Layer 2 (TSSOP EVM)

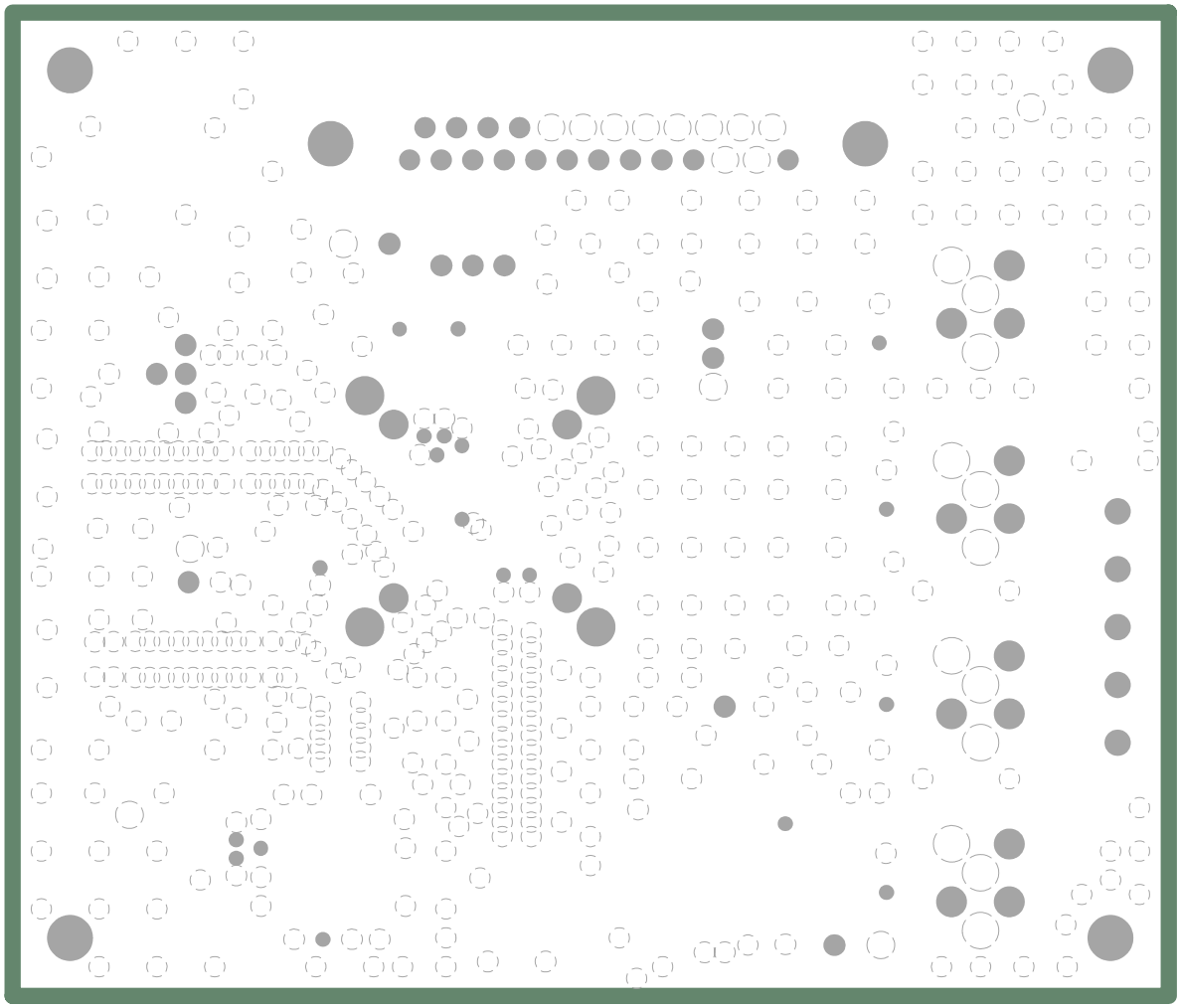


Figure 4−3. Power Plane Layer 3 (TSSOP EVM)

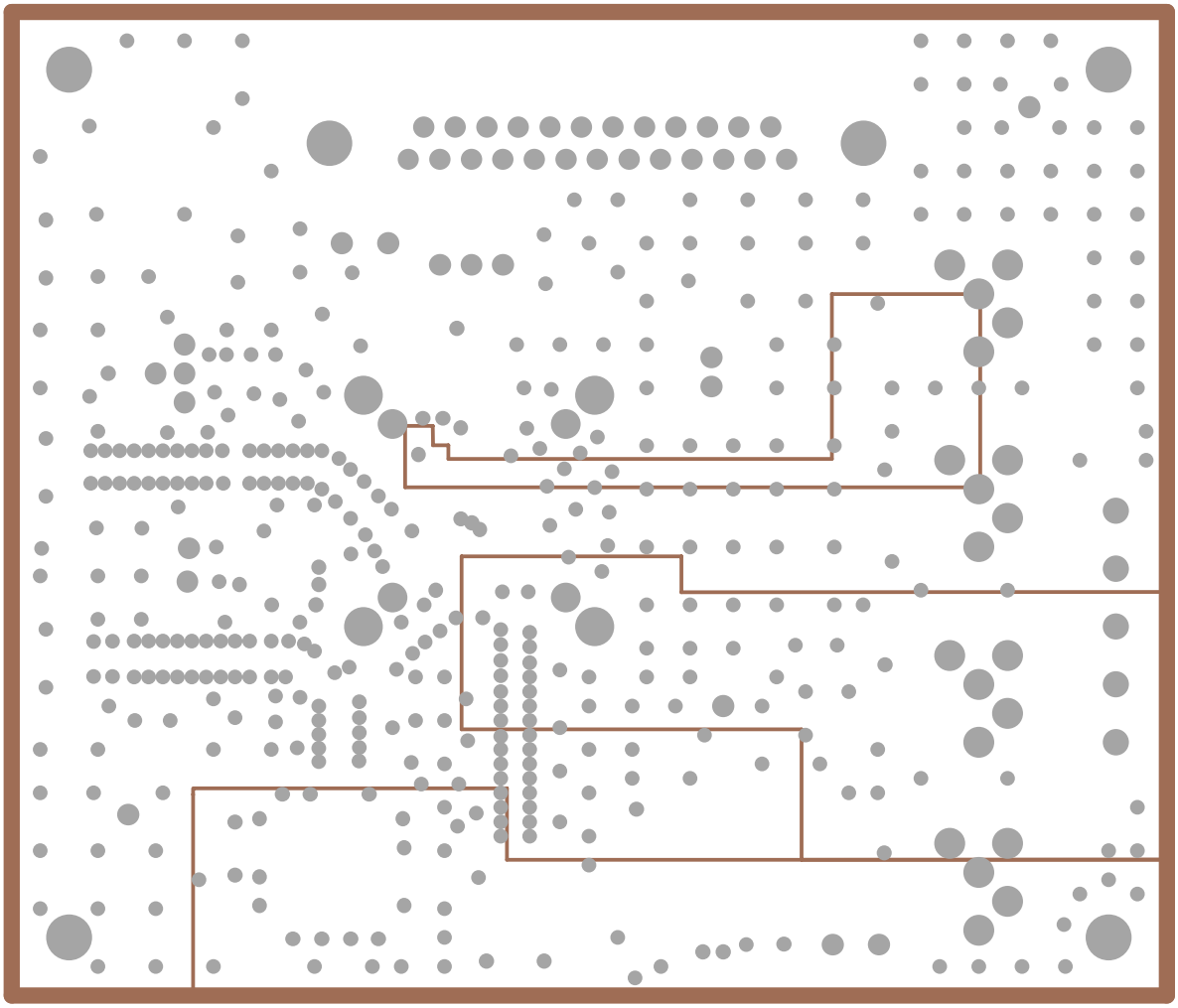


Figure 4−4. Bottom Layer 4 (TSSOP EVM)

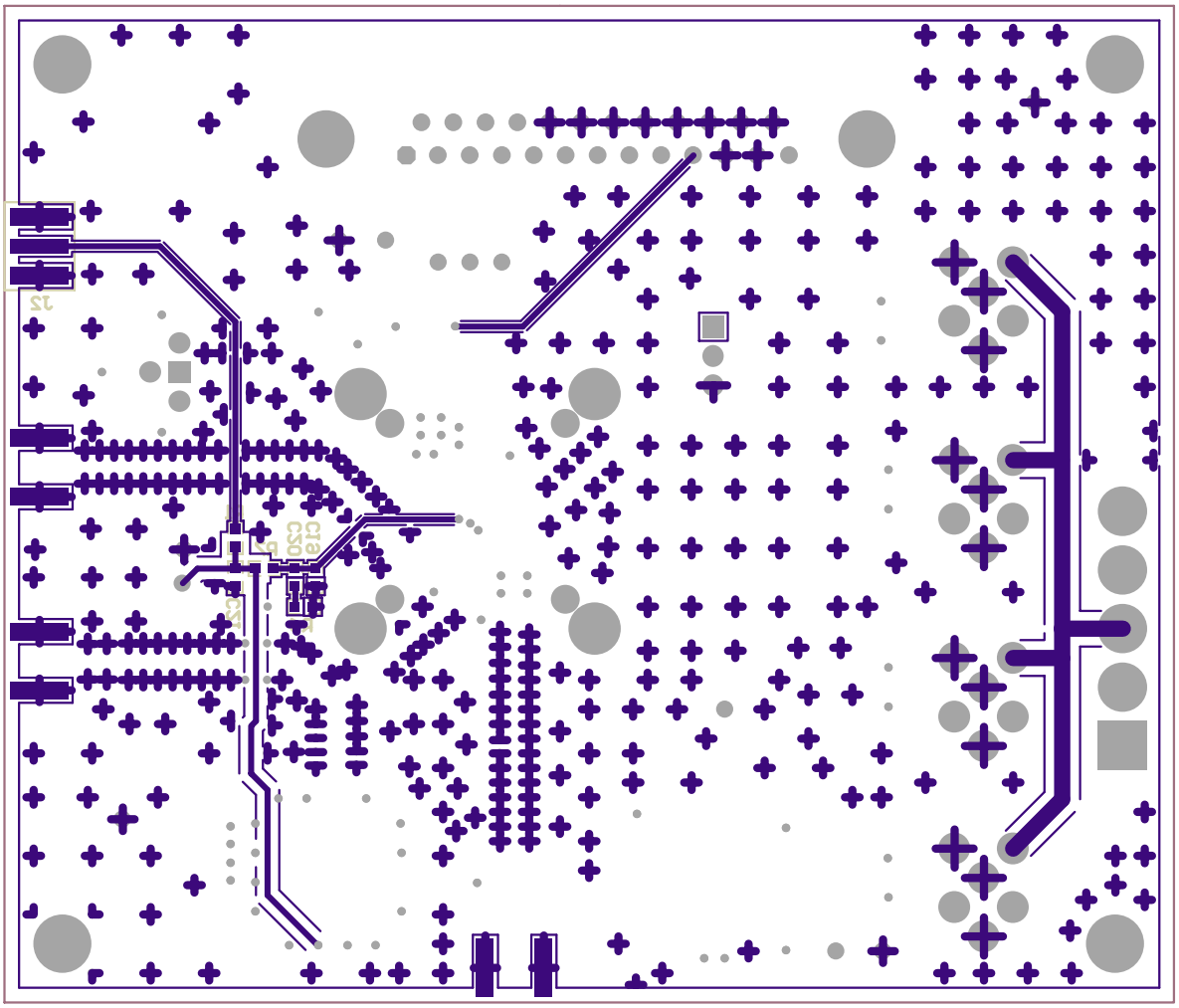


Figure 4−5. Top Layer 1 (QFN EVM)

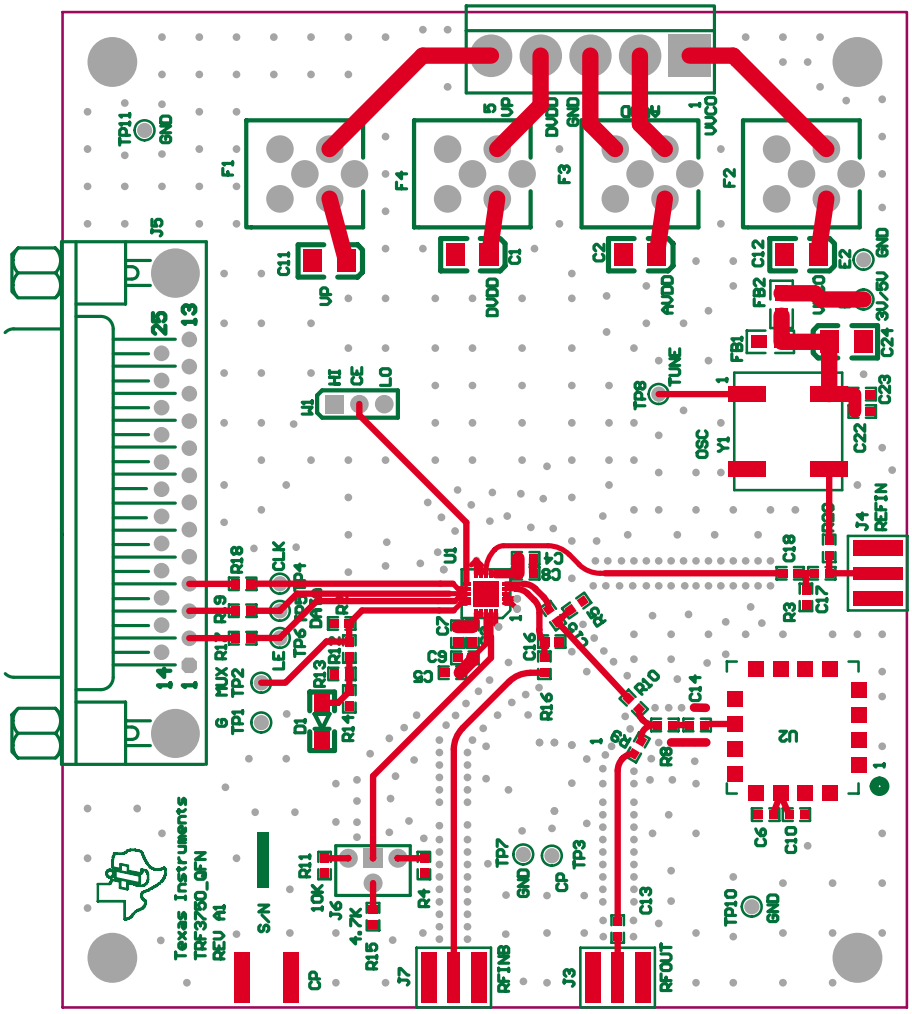


Figure 4−6. Ground Plane Layer 2 (QFN EVM)

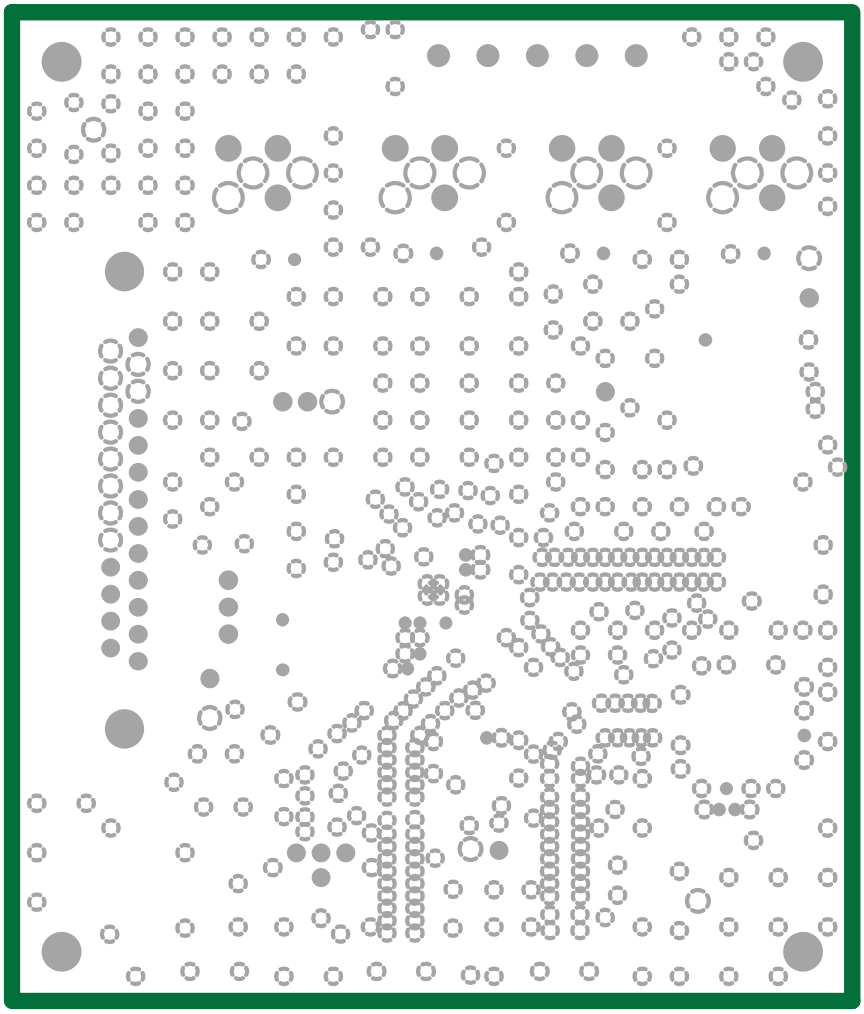


Figure 4−7. Power Plane Layer 3 (QFN EVM)

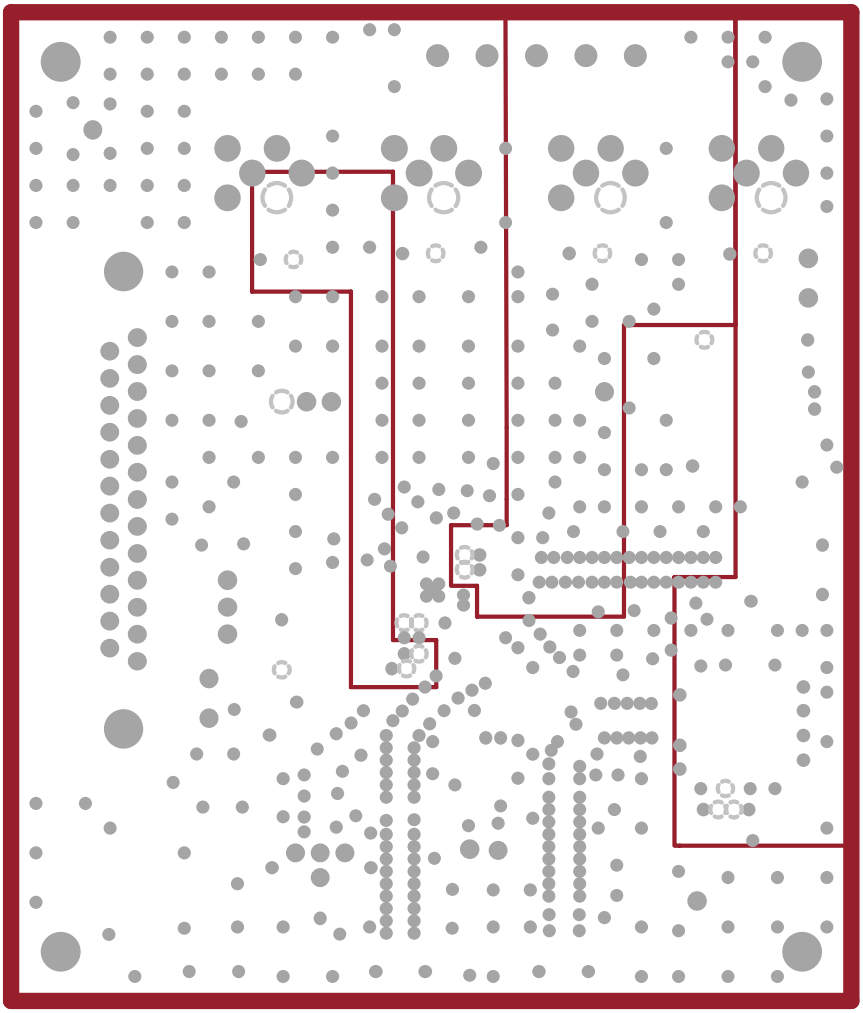
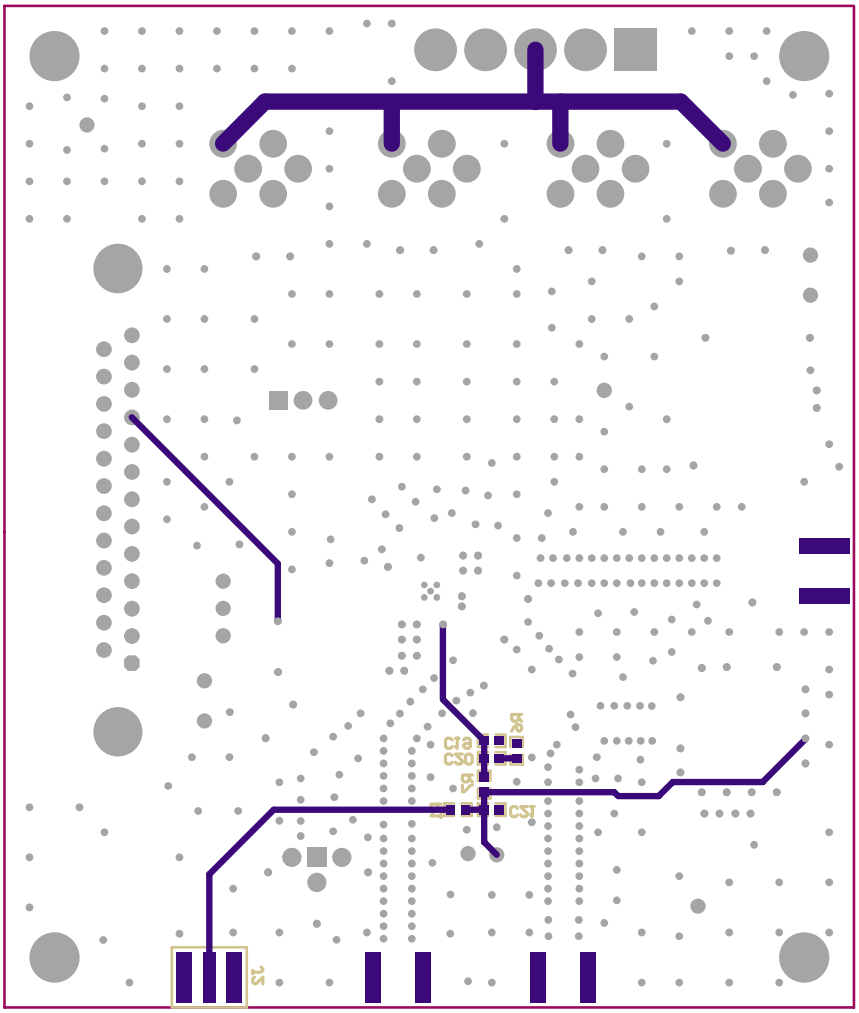


Figure 4−8. Bottom Layer 4 (QFN EVM)



4.2 Parts List

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

Table 4−1. TRF3750 EVM Parts List

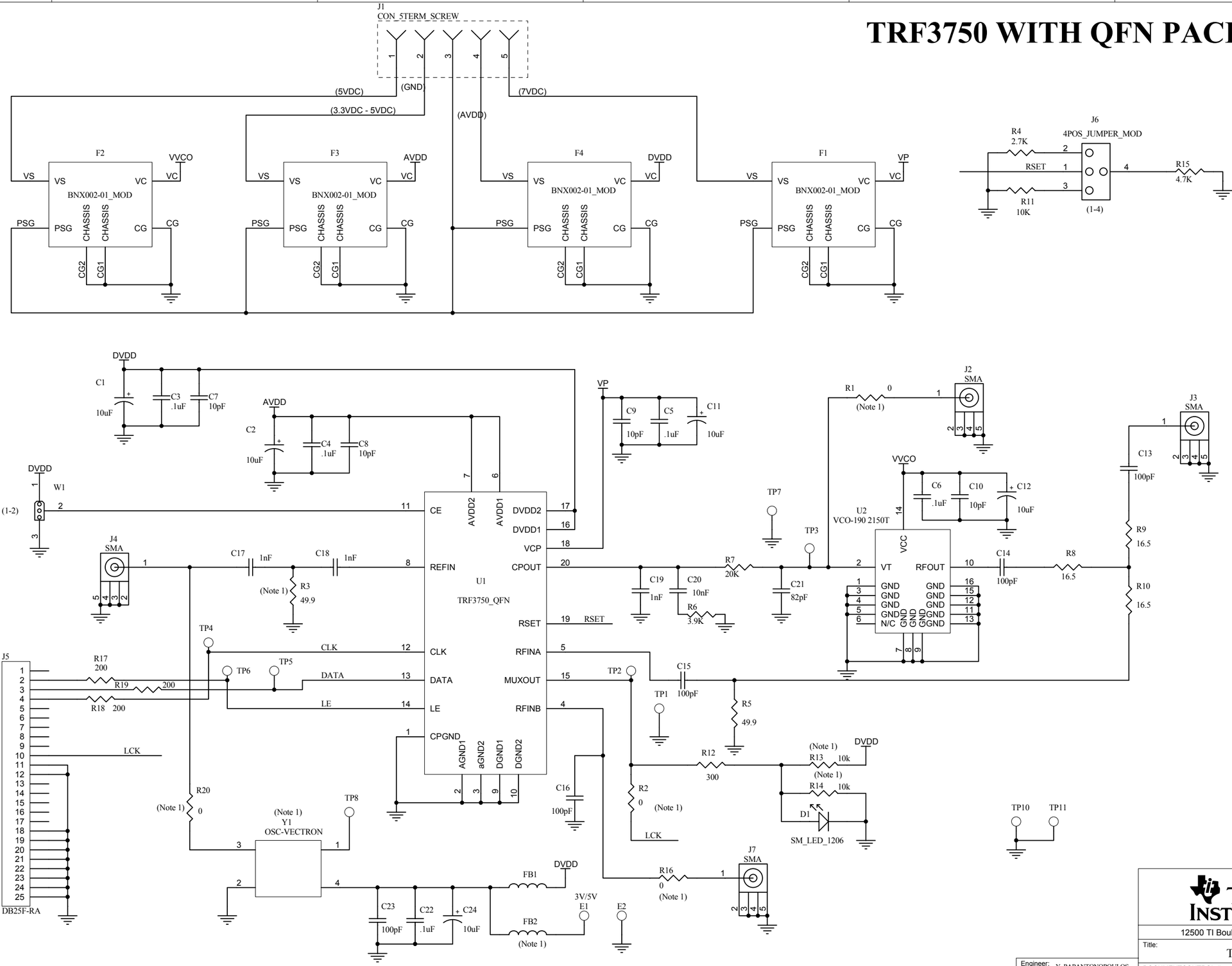
Value	QTY	Part Number	Vendor	REF DES	Not Installed
Capacitors					
10 μF, 16 V, 10% capacitor	5	293D106X9016B2T	Kemet	C1, C2, C11, C12, C24	
0.1 μF,16 V, 10% capacitor	5	ECJ−1VB1C104K	Panasonic	C3−C6, C22	
100 pF, 50 V,5% capacitor	5	ECJ−1VC1H101J	Panasonic	C13−C16, C23	
0.01 μF,16 V, 10%, capacitor	1	ECJ−1VB1C103K	Panasonic	C20	
10 pF, 50 V, 5% capacitor	4	GMC10CG100J50NT	CALCHIP	C7−C10	
0.001 μF, 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-kΩ 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-kΩ 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-kΩ resistor, 1/16 W, 1%	1	ERJ−3EKF2002V	Panasonic	R7	
3.9-kΩ resistor, 1/10 W, 1%	1	9C06031A3901FKHFT	Yageo−America	R6	
4.7-kΩ 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		

Chapter 5

Schematics

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

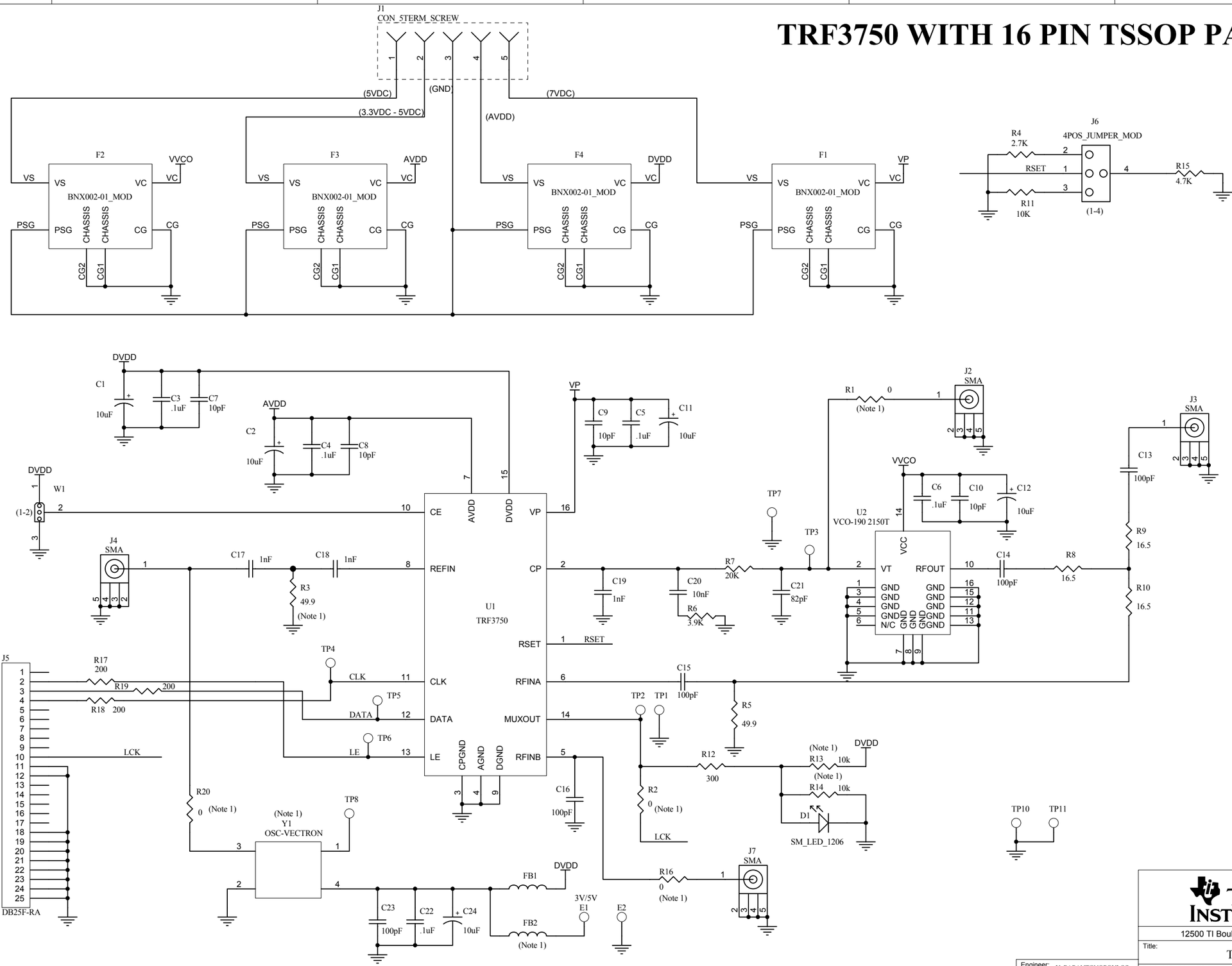
TRF3750 WITH QFN PACKAGE



NOTE 1. PART NOT INSTALLED

TEXAS INSTRUMENTS	12500 TI Boulevard. Dallas, Texas 75243
Title:	TRF3750_QFN
Engineer: Y. PAPANTONOPOULOS	DOCUMENTCONTROL #
Drawn By: Y. DEWONCK	REV: A1
FILE:	DATE: 26-Aug-2004 SIZE: SHEET: 1 OF:

TRF3750 WITH 16 PIN TSSOP PACKAGE



NOTE 1. PART NOT INSTALLED

TEXAS INSTRUMENTS	
12500 TI Boulevard. Dallas, Texas 75243	
Title: TRF3750	
Engineer: Y. PAPANTONOPOULOS	DOCUMENTCONTROL # REV: A
Drawn By: Y. DEWONCK	
FILE:	DATE: 26-Aug-2004 SIZE: SHEET: 1 OF: