User's Guide
TRF37x73 and TRF37x75 EVM

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ABSTRACT

This document outlines the basic steps and functions that are required to ensure the proper operation and quick setup of the TRF37x73 and TRF37x75 EVM. This document also includes a schematic diagram, a bill of materials (BOM), printed-circuit board (PCB) layouts, board loss plots, and test block diagrams. Throughout this document, the abbreviations *EVM*, *TRF37x73/75 EVM*, and the term *evaluation module* are synonymous with the TRF37x73 and TRF37x75 EVM, unless otherwise noted.

Table of Contents

1 Contents

The TRF37x73/75 EVM consists of the following components:

- TRF37x73/75 EVM board

2 EVM Overview

This section includes the schematic diagram, a bill of materials (BOM), and general usage information.

2.1 Schematic and BOM

The TRF37x73/75 EVM for RF gain blocks comes in a 2 × 2 WSON package. The device type is visually identified in component U1 by the 0402 selection resistors TRF37A73, TRF37B73, TRF37C73, TRF37A75, TRF37B75, and TRF37C75.

The TRF37x73 are a family of 3.3-V, RF gain blocks that have 3 gain variants (A73 = 12 dB, B73 = 15 dB, and C73 = 18 dB). The TRF37x75 are a family of 5-V, RF gain blocks that have 3 gain variants (A75 = 12 dB, B75 = 15 dB, and C75 = 18 dB).

The TRF37x73/75 EVM schematic is shown in Figure 2-1.

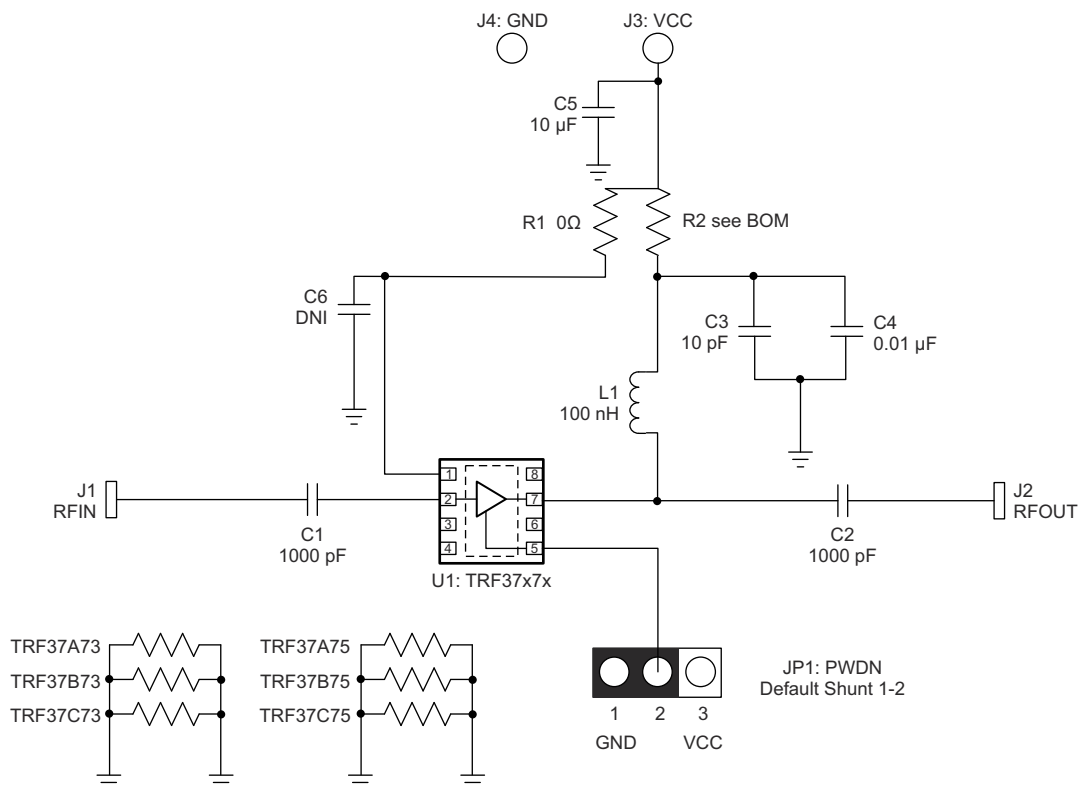**Figure 2-1. TRF37x73/75 EVM Schematic**

2.2 TRF37x73/75 EVM Bill of Material

Table 2-1. TRF37x73/75 EVM BOM

Component	Description (Footprint)	Value	Manufacturer	Part Number
Common BOM				
C1, C2, C6	AC coupling capacitor (0402)	1000 pF	Murata	GRM1555C1H102JA01D
C3	Power Supply Decoupling (0402)	10 pF	Murata	GRM1555C1H100JZ01D
C4	Power Supply Decoupling (0603)	0.01 µF	Kemet	C0603C103K1RACTU
C5	Power Supply Decoupling (Tantalum)	10 µF	Kemet	T494A106M016AS
J1, J2	AC signal SMA connector		Emerson Connectivity (Johnson)	142-0701-851
J3	Terminals for VCC (Clip)	Red	Keystone	5005
J4	Terminal for GND (Clip)	Black	Keystone	5006
JP1	Terminals for PWDN		1:3 10 mil header	
L1	DC biasing inductor (0603)	100 nH	CoilCraft	0603HP-R10XJLW
R1	DC Biasing resistor (0603)	0 Ω		
TRF37A75-Specific BOM				
R2	DC biasing resistor (0603)	1.8 Ω	Panasonic	ERG-3GEYJ1R8V
U1	TRF37A75	5 V, 12 dB gain	TI	TRF37A75
TRF37A75	0402 BOM Identification resistor	0 Ω		
TRF37B75-Specific BOM				
R2	DC biasing resistor (0603)	3.9 Ω	Panasonic	ERG-3GEYJ3R9V
U1	TRF37B75	5 V, 15 dB gain	TI	TRF37B75
TRF37B75	0402 BOM Identification resistor	0 Ω		
TRF37C75-Specific BOM				
R2	DC biasing resistor (0603)	6.8 Ω	Panasonic	ERG-3GEYJ6R8V
U1	TRF37C75	5 V, 18 dB gain	TI	TRF37C75
TRF37C75	0402 BOM Identification resistor	0 Ω		
TRF37A73-Specific BOM				
R2	DC biasing resistor (0603)	0 Ω		
U1	TRF37A73	3.3 V, 12 dB gain	TI	TRF37A73
TRF37A73	0402 BOM Identification resistor	0 Ω		
TRF37B73-Specific BOM				
R2	DC biasing resistor (0603)	0 Ω		
U1	TRF37B73	3.3 V, 15 dB gain	TI	TRF37B73
TRF37B73	0402 BOM Identification resistor	0 Ω		
TRF37C73-Specific BOM				
R2	DC biasing resistor (0603)	0 Ω		
U1	TRF37C73	3.3 V, 18 dB gain	TI	TRF37C73
TRF37C73	0402 BOM Identification resistor	0 Ω		

2.3 General Usage Information

This section provides general usage information for the EVM.

1. Recommended power up sequence:
   a. Connect GND to J4 (black – GND)
   b. Connect Vcc to J3 (red – VCC)
   c. Connect RF input signal to J1 (RFIN)
   d. Connect measurement instrument to J2 (RFOUT)
   e. Ensure the device is not in power-down mode by shorting JP1 terminals 1 and 2 or simply remove JP1 to take advantage of the TRF37x73/75's internal pull-down resistor.
2. Power supply options:
   a. For TRF37x73 devices, set VCC to 3.3 V
   b. For TRF37x75 devices, set VCC to 5.0 V
3. PWDN option:
   a. Short terminals 2 and 3 on JP1 to put the TRF37x73/75 in its power down state.
4. Tuning options:
   a. Solder mask has been removed along the RF signal paths and VCC path allowing an easy method to slide surface mount components along these traces for optimal tuning.

3 EVM Layout

3.1 Description: Stack up and Material

The TRF37x73/75 EVM is a 62-mil, 4-layer board whose material type is Isola® 370HR. The top layer routes the power, ground, and signals to and from the device. The signal impedance is targeted at 49.9 Ω. The bottom 3 layers are ground layers.

3.2 PCB Layers

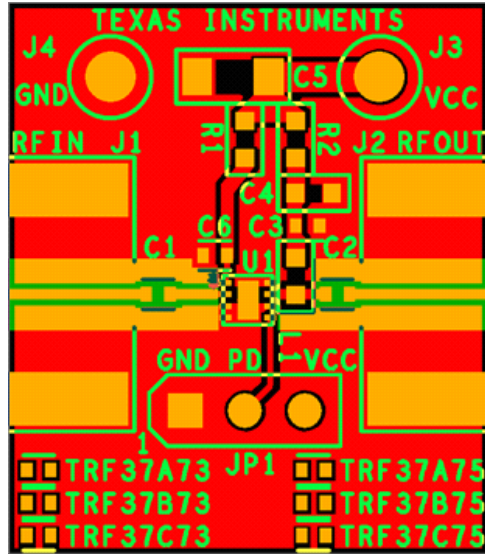Figure 3-1 through Figure 3-3 illustrate the PCB layers for this EVM.
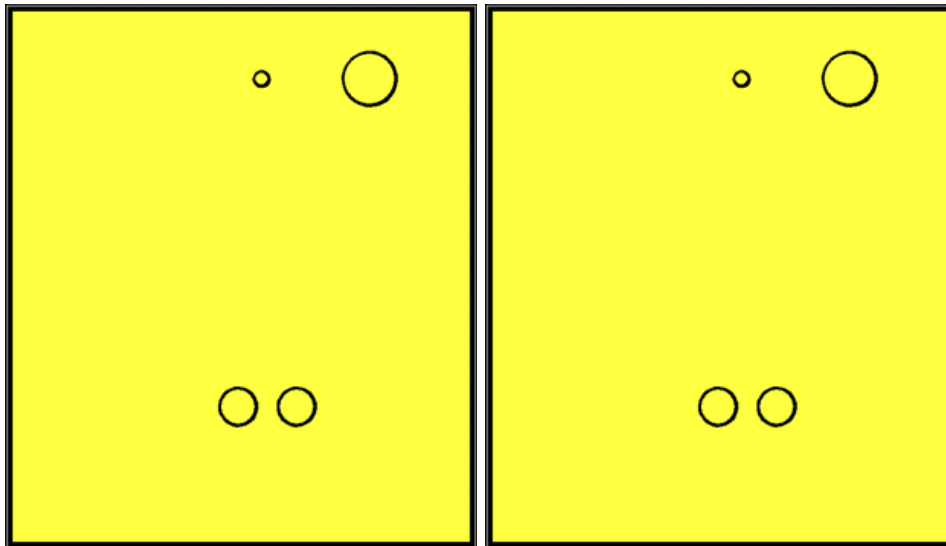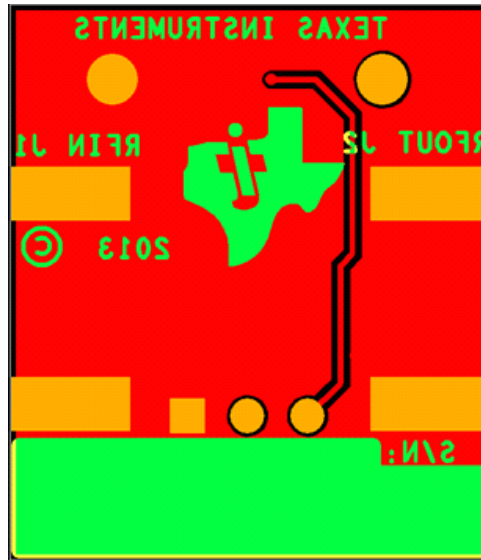

Figure 3-1. Top Layer

Figure 3-2. Layers 2 and 3

Figure 3-3. Bottom Layer (Through Top Side)

4 EVM Board Loss

Performance plots of the TRF37x73/75 EVM board are illustrated in Figure 4-1 and Figure 4-2, with the following modifications to the BOM:

• U1 gain block uninstalled
• C1 and C2 removed, terminals shorted with strip of copper whose width equaled the trace width.

Figure 4-1 and Figure 4-2 show the S11 and S22 log magnitude responses to a –10-dBm input signal. These measurements were taken with an Agilent E5071B vector network analyzer calibrated from 1 MHz to 6 GHz to the end of the coaxial cables. The coaxial cables were connected directly to J1 and J2 on the EVM board. Port 1 refers to J1 in the schematic and Port 2 refers to J2 in the schematic.
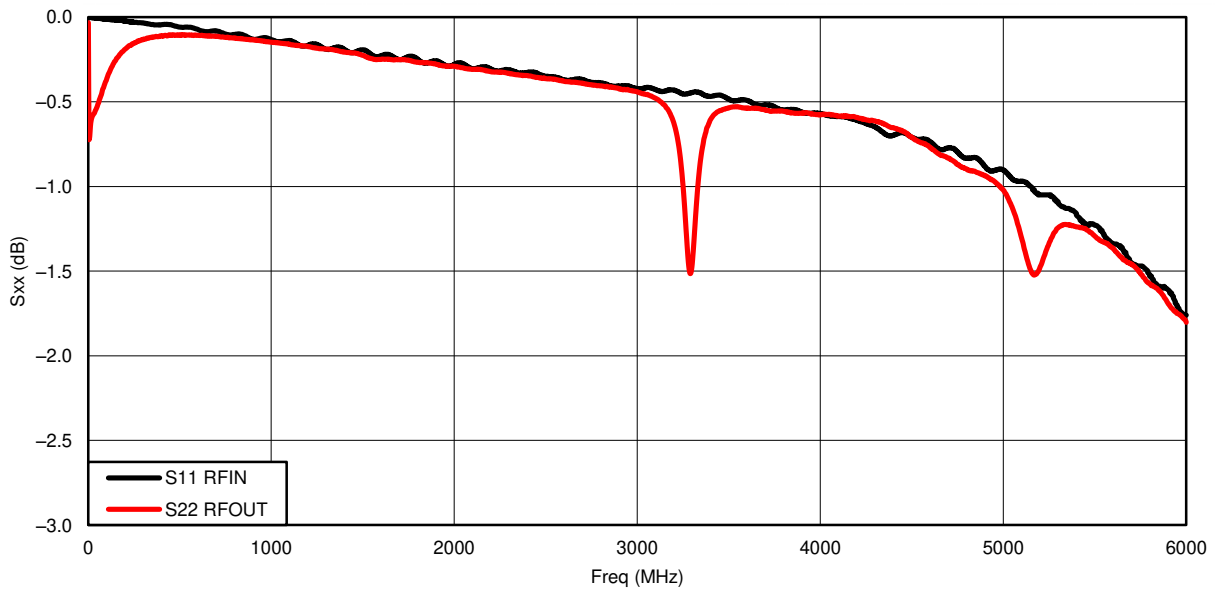
Figure 4-1. S11, S22 (Open), U1 Uninstalled
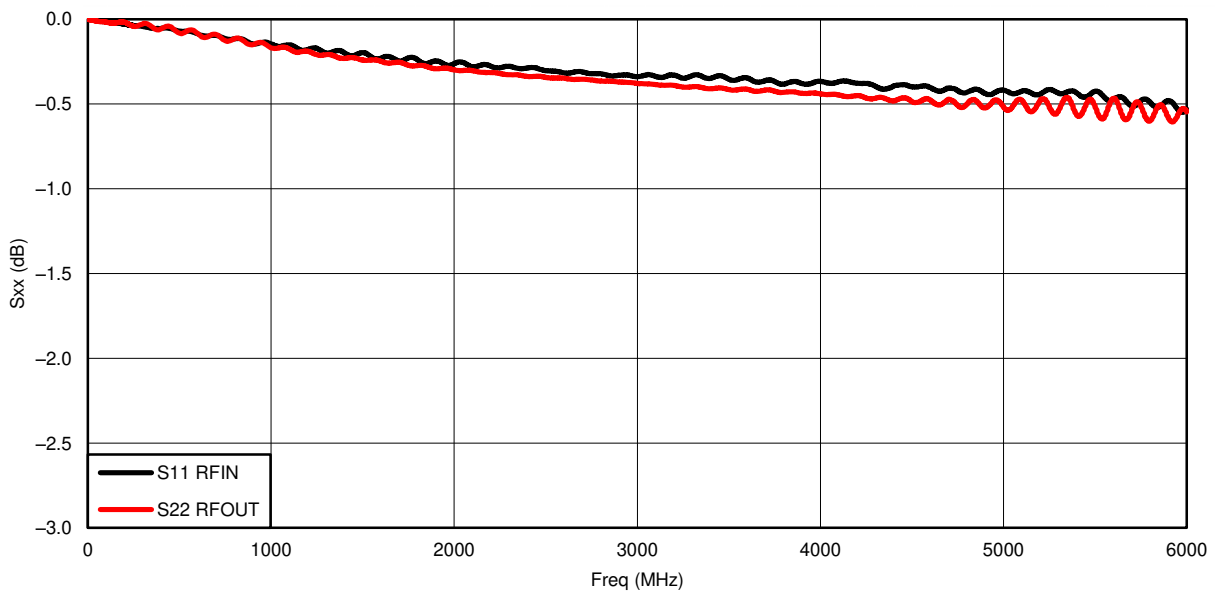
**Figure 4-2. S11, S22 (Open), U1 and L1 Uninstalled, Copper Tape Replaced C1 and C2**

5 Test Block Diagrams

This section includes recommendations, comments, and test block diagrams for noise figure, gain and P1dB, and OIP3.

5.1 Noise Figure
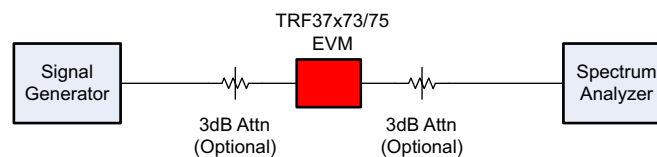
Recommendations and comments:

1. Use the traditional Y-factor method
2. Take into account losses of coax to the EVM board
3. Take into account losses of traces on the board up to the input pin of the device under test (DUT)
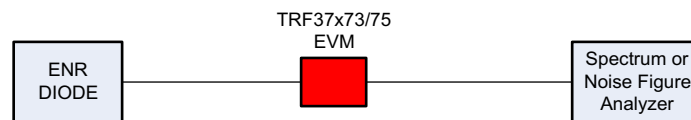
## 5.2 Gain and P1dB

Recommendations and comments:

1. Take into account losses of coax and attenuators to and from the EVM board
2. Take into account losses of traces on the board up to the I/O pins of the DUT
3. Power meters are typically a few tenths of dB more accurate than a signal generator's level controls and spectrum analyzer measurement capability. For precise measurements, use a power meter to measure the output of the signal generator and output of the TRF37x73/75 EVM.

5.3 OIP3

Recommendations and comments:

1. This setup can also be used for gain and P1dB, if desired
2. For wideband measurements, the 30-dB gain stage and 10-dB attenuators are used to improve the input IP3 level that is created from the interaction of the 2 signal generators via the isolation of the combiner. For narrow band measurements, it maybe possible to create a setup with enough isolation using an isolator and/or combiner. In this case the 10-dB pads could be reduced or removed.
3. Power meter A is used to ensure the amplitude of the two tones at the input of the TRF37x73/75 EVM are within a certain tolerance. The gain stages will have unique gain characteristics and their gain can drift over time
4. Power meter B can be used for measuring the amplitude of individual tones for more accurate measurements.
5. Keep spectrum analyzer RBW and VBW settings identical for main tone and IM3 products
6. Take into account losses of coax and attenuators to and from the EVM board
7. Take into account losses of traces on the board up to the I/O pins of the DUT
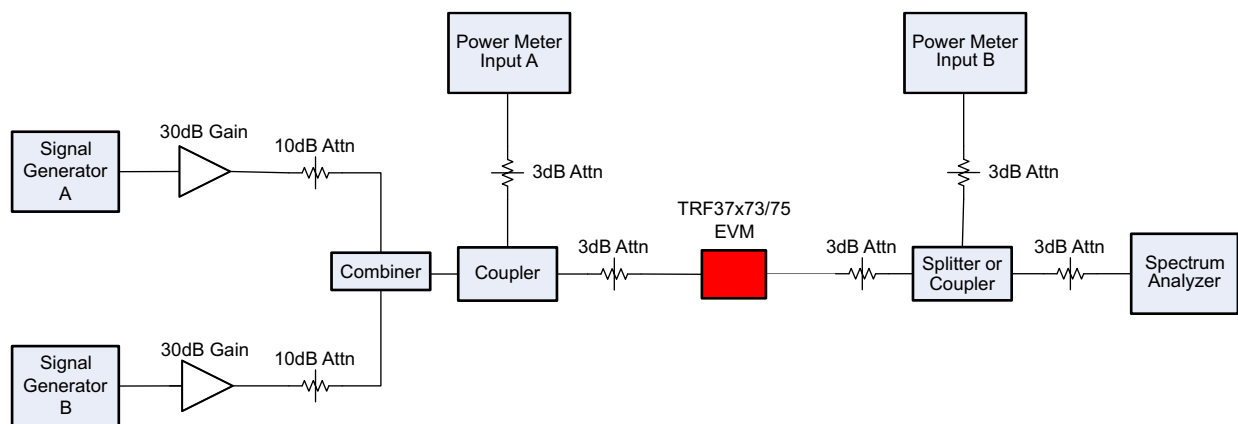
6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (March 2014) to Revision A (October 2021) **Page**

- Updated the numbering format for tables, figures, and cross-references throughout the document...................2
- Updated the L1 components part number from *-6-3HP-F10XJLU* to *0603HP-R10XJLW* in the *TRF37x73/75 EVM BOM* table..3

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