TRF1x22EVM Rev 1.0

This user's guide provides an overview of the TRF1x22 evaluation module (EVM). It provides a general description of the features and functions to be considered while using this module.

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1 Overview

1.1 Purpose

This is the user's guide for the TRF1x22EVM. The TRF1x22 is a transmit up-converter with integrated amplifiers and digital attenuator for use in a WiMAX system.

1.2 EVM Configuration Options

The EVM can be configured as a TRF1122 or TRF1222. The configuration of the board is marked by a component placed in either the R1122 or R1222 location. The TRF1121 operates in the 2.3GHz to 2.7GHz band and the TRF1222 operates in the 3.3GHz to 3.8GHz band.

1.3 System Block Diagram

The basic radio system block diagram in Figure 1 demonstrates where the TRF1x22 fits in the overall transceiver. The dashed-line box highlights the TRF1x22 device.

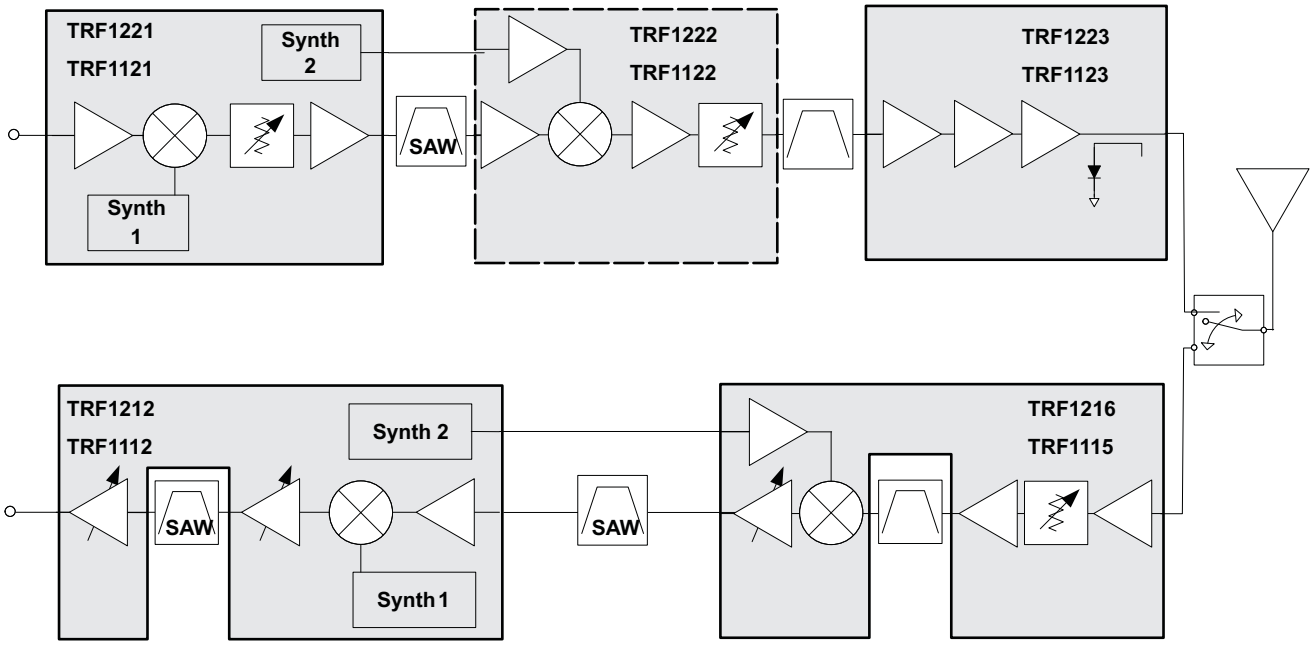


Figure 1. System Block Diagram

2 EVM Test Configuration

2.1 Test Block Diagram

The test setup for general testing of the TX FE EVM is shown in Figure 2.

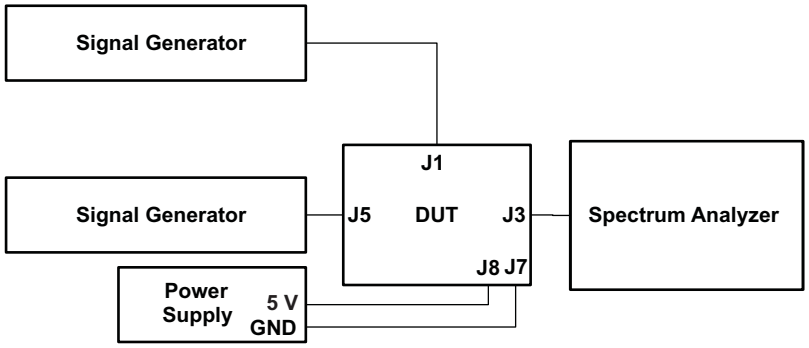


Figure 2. Test Setup Block Diagram

2.2 Test Equipment

The following equipment is required for completing RF Testing:

- Power supply with current readout — Agilent E3631 or equivalent
- Signal generator for input signal — Agilent E4438C or equivalent
- Signal generator for LO source — Agilent E4438C or equivalent
- Spectrum analyzer — Agilent E4440A or equivalent

2.3 Calibration

The output RF cable and input LO cable should be good-quality RF cables because of the high-frequency signals.

- Measure the insertion loss of the RF output cable and use this value to compensate for the output power read from the spectrum analyzer. The insertion loss value can be stored in the analyzer's Reference Level Offset parameter.
- Measure the insertion loss of the RF cable used to inject the LO signal. Compensate for the loss of this cable by incrementing the amplitude of the signal generator over the desired value by the amount of insertion loss. For example, if the insertion loss of the cable is 1.2 dB and the desired set point is 0 dBm, set the amplitude of the generator to 1.2 dB.
- Verify that the input signal at the end of the cable connected to the board is at the desired set-point value. If not, adjust for the insertion loss by incrementing the amplitude on the signal generator.

3 Basic Test Procedure

This section outlines the basic test procedure for testing the EVM.

3.1 Initial Inspection

- Determine which device is placed on the board by inspecting which jumper resistor is installed at the R1122 and R1222 location.
- Verify jumper connection at J9 is it the *0 dB* location.

3.2 DC Test

- Connect +5 V to J8; connect ground to J7.
- Engage power supplies.
- Verify that current is 175 ±25 mA

3.3 Basic RF Test

- Inject 325-MHz CW signal in at J5 at -20 dBm.
- Connect spectrum analyzer at J3.
- Set spectrum analyzer center frequency to: 3500 MHz (TRF1222) or 2400 MHz (TRF1122).
- Verify that the jumper at J9 is set to *0 dB.*
- Connect second signal generator at J1 and set to 0 dBm at frequency: 3175 MHz (TRF1222) or 2075 MHz (TRF1122); ensure that LO cable loss is compensated for.
- Measure signal at 3500 MHz (TRF1222) or 2400 MHz (TRF1122) and verify that signal is at –3.5 dBm (TRF1222) or 1 dBm (TRF1122) ±2 dB; ensure that the RF output cable loss is compensated for.
- Change *UCATTN* jumper at J9 to *–16 dB* and verify that the signal decreases 16 ±2 dB.
- Revert jumper back to original position at *0 dB.*

3.4 Modulated RF Performance

- Inject 325-MHz modulated signal in at J5 at -30 dBm.
- Inject CW LO source at J1 and set to 0 dBm at frequency: 3175 MHz (TRF1222) or 2075 MHz (TRF1122). Note, this should be a low-phase noise source. Verify that the LO cable loss is compensated for.
- Connect cable to spectrum analyzer at J5, and initiate WiMAX analysis program.
- Set spectrum analyzer center frequency to: 3500 MHz (TRF1222) or 2400MHz (TRF1122).
- Adjust reference level offset to appropriate range for output signal.
- Verify that the output signal power is at –15.5 dBm (TRF1222) or –11 dBm (TRF1122) ±2 dB; ensure that the RF output cable loss is compensated for.
- Verify that the EVM performance is less than –40 dB.

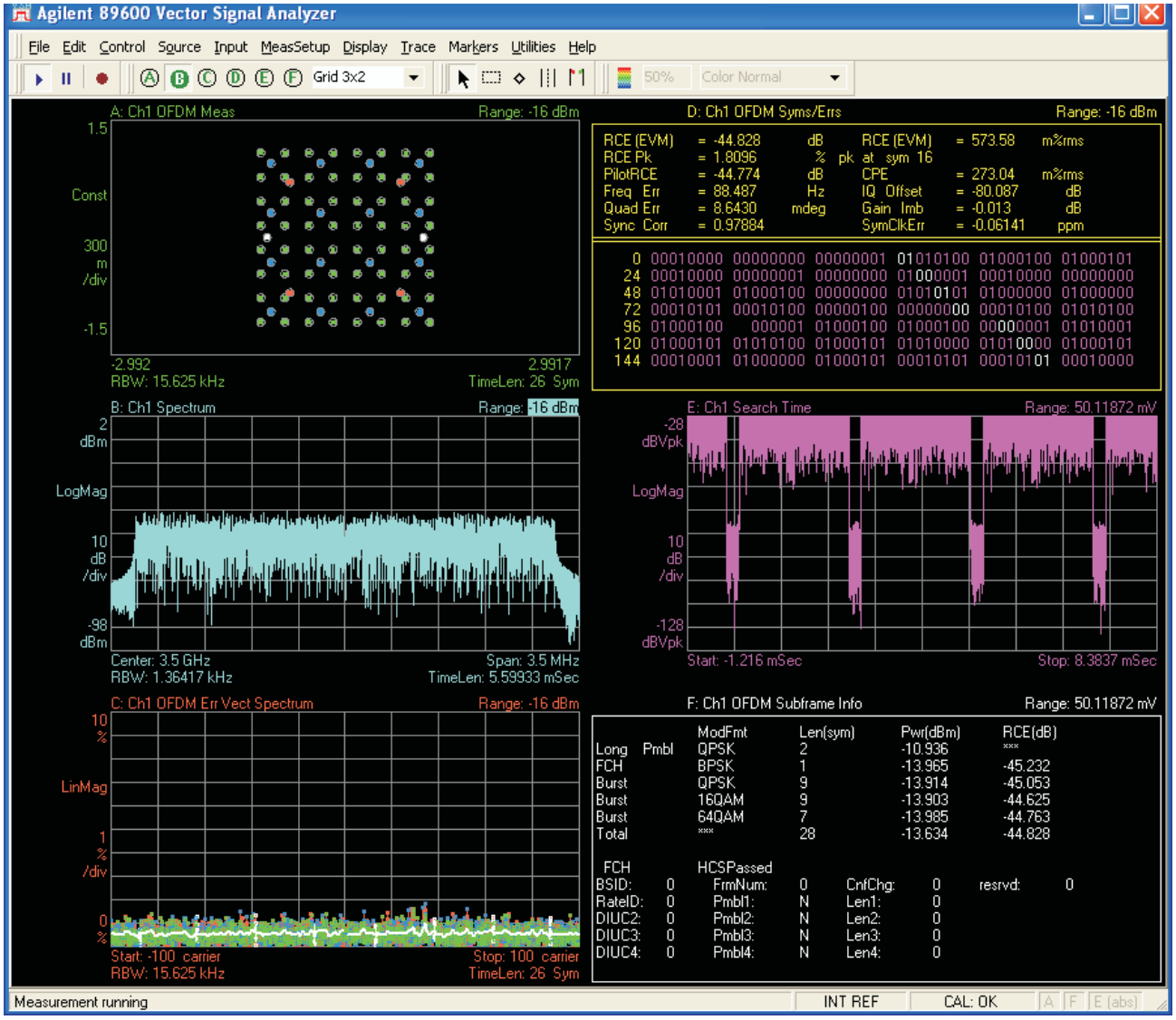


Figure 3. TRF1x22EVM Performance

4 Optional Configurations

4.1 External RF Filter

The EVM is configured with the mixer output directly connected to RF amplifier inputs. These ports are intended to provide an option for an RF filter at this location. An external filter can be used by installing the jumpers to route the signal to the SMA connectors. To employ this option, the following modifications are required.

- Move R9 to R10 location.
- Move R4 to R9 location.
- Monitor at connectors J10 (mixer output) and J6 (Amplifier Input).

4.2 Differential Inputs

The normal configuration uses transformers and baluns to convert the differential signals to single-ended to facilitate laboratory testing. If desired, any of the inputs can be converted to differential operation which may be desirable when cascading one or more of the chipset's EVMs together.

4.2.1 IF Input

- Remove T2 place.
- R1: 0-Ω resistor (1210)
- Place R12: 0-Ω resistor.
- Differential outputs at J5 and J4

4.2.2 LO Input

- Remove T1
- Jumper across pads of T2 (input to output on each side) using a 0-Ω 0201 resistor
- Place 3.7 pF (1222) or 4.7 pF (1122) at R3
- Differential inputs at J1 and J2

5 Physical Description

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

5.1 PCB Layout

The EVM is constructed on a 4-layer, 2.5-inch × 2.5-inch, 0.062-inch-thick PCB using FR4-170 material. Figure 4 through Figure 7 show the PCB layout for the EVM.

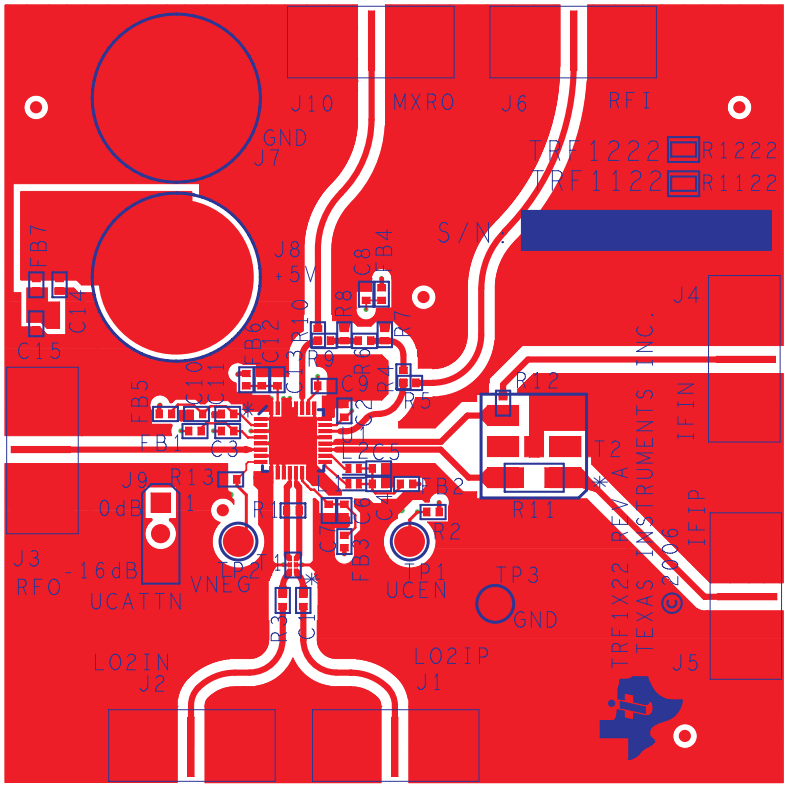


Figure 4. Top Layer 1

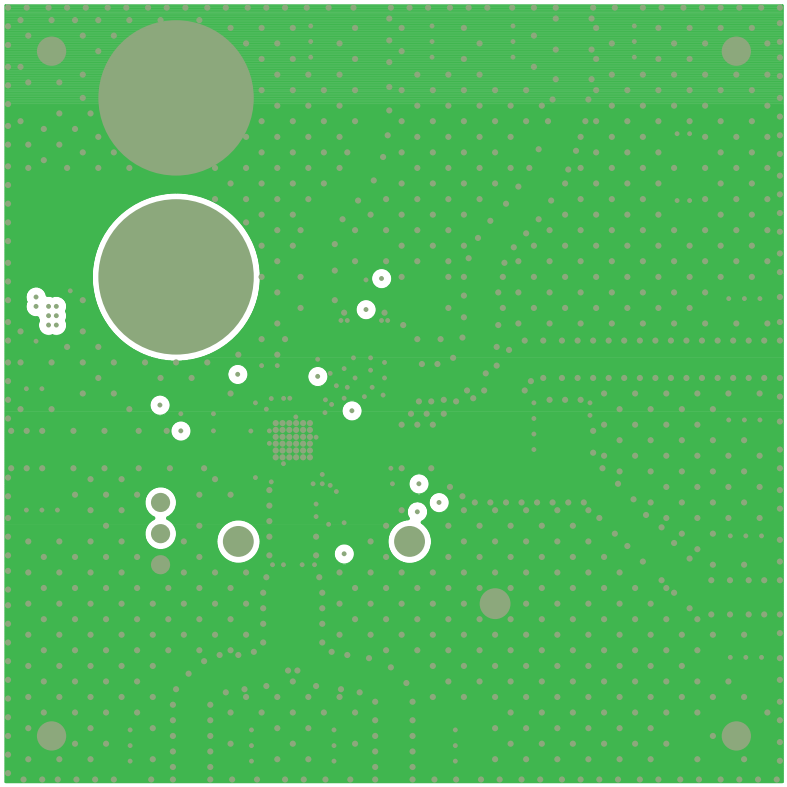


Figure 5. Ground Plane Layer 2

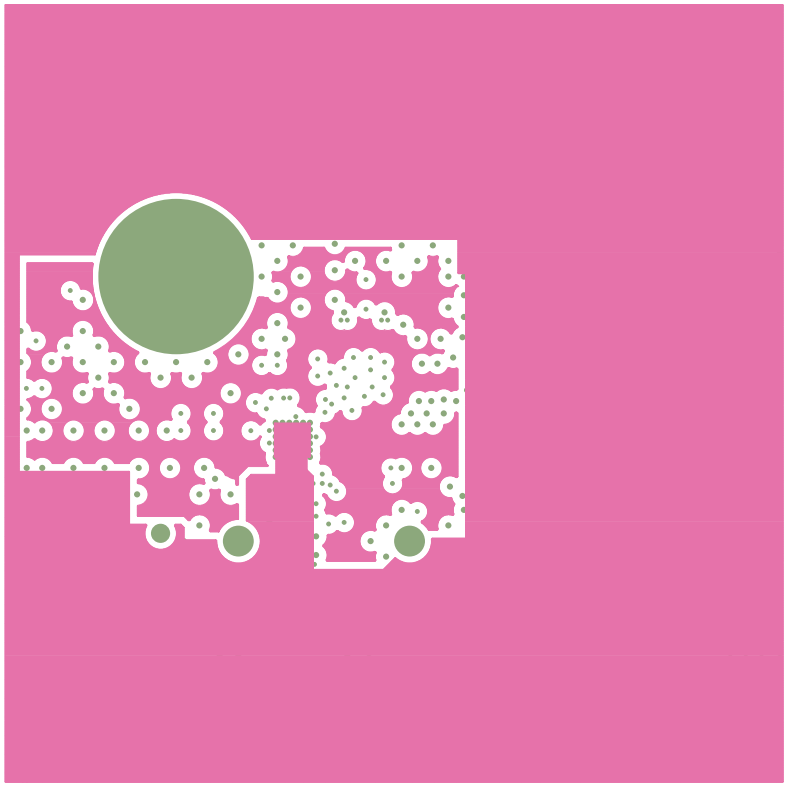


Figure 6. Power Plane Layer 3

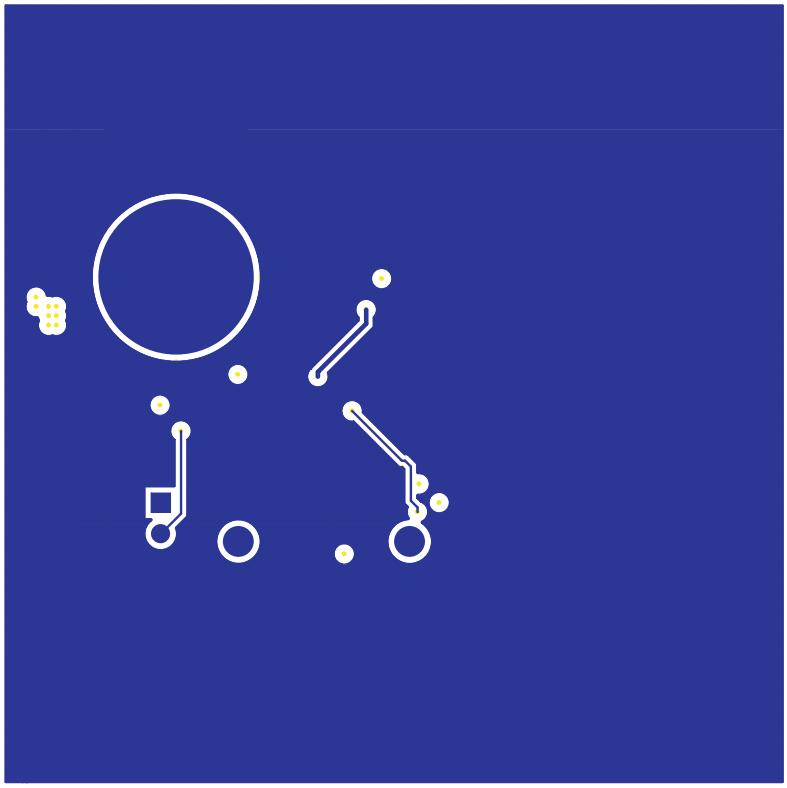


Figure 7. Bottom Layer 4

5.2 Parts List

Table 1 lists the parts used in constructing the EVM.

Table 1. TRF1x22EVM Parts List

QTY	Ref	Value	MFR	Part number	Note
8	C1–C3 C5 C7 C9 C11 C13	4.7pF	Murata	GRM1555C1H4R7CZ01D	TRF1122 EVM
8	C1–C3 C5 C7 C9 C11 C13	3.6pF	Murata	GRM1555C1H3R6CZ01D	TRF1222 EVM
5	C4 C6 C8 C10 C12	470pF	Murata	GRM1555C1H471JA01D	
2	C14 C15	1µF	Panasonic	ECJ-0EB1A105M	
7	FB1–FB7	120	Murata	BLM15AG121SNIB	
7	J1–J6 J10	SMA	Johnson Components	142-0701-851	
1	J7	BLK	Allied Electronics	ST-351B	
1	J8	RED	Allied Electronics	ST-351A	
1	J9	JUMPER	Samtec	TSW-103-07-L-S	
2	L1 L2	33nH	Coilcraft	0402CS-33NXJLU	
4	MT1–MT4	STANDOFF	Keystone	1902CK	
1	R1	100	Panasonic	ERJ-2RKF1000X	
1	R2	1K	Panasonic	ERJ-2RKF1001X	
7	R3 R5 R7 R8 R10 R12 R11 R22	0	Panasonic	ERJ-2GE0R00X	DNI
5	R4 R6 R9 R13 R12 R22	0	Panasonic	ERJ-2GE0R00X	DNI
1	R11	0	Panasonic	ERJ-8GEY0R00V	
1	T1	2326MHz	Anaren	BD2326L50100A00	TRF1122 EVM

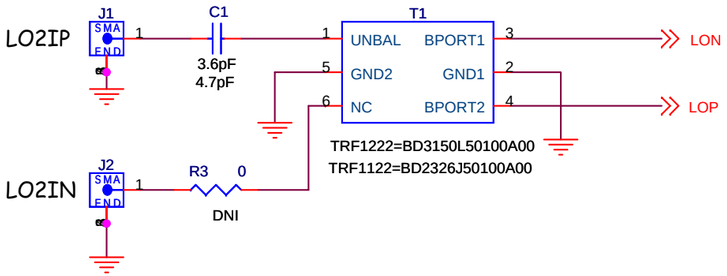
Table 1. TRF1x22EVM Parts List (continued)

QTY	Ref	Value	MFR	Part number	Note
1	T1	3150MHz	Anaren	BD3150L50100A00	TRF1222 EVM
1	T2	ADT2-1T	Minicircuits	ADT2-1T	
2	TP1 TP2	Red	Keystone	5000	
1	TP3	Blk	Keystone	5001	
1	U1	TRF1122	TI	TRF1122	TRF1122 EVM
	U1	TRF1222	TI	TRF1222	TRF1222 EVN
Notes: 1 DNI = Do Not Install 2. Jumper pins 1 and 2 on J9					

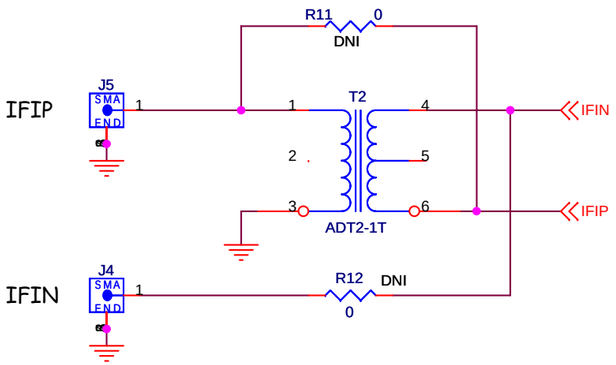
5.3 Schematic

The TRF1x22EVM schematic follows this page.

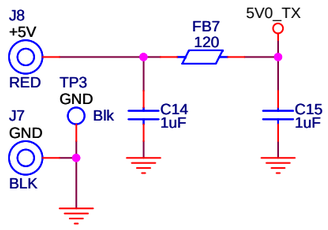
LO INPUT

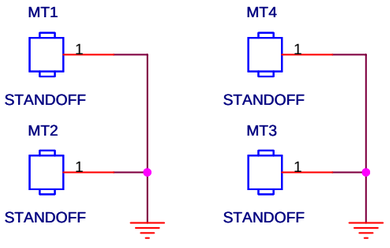


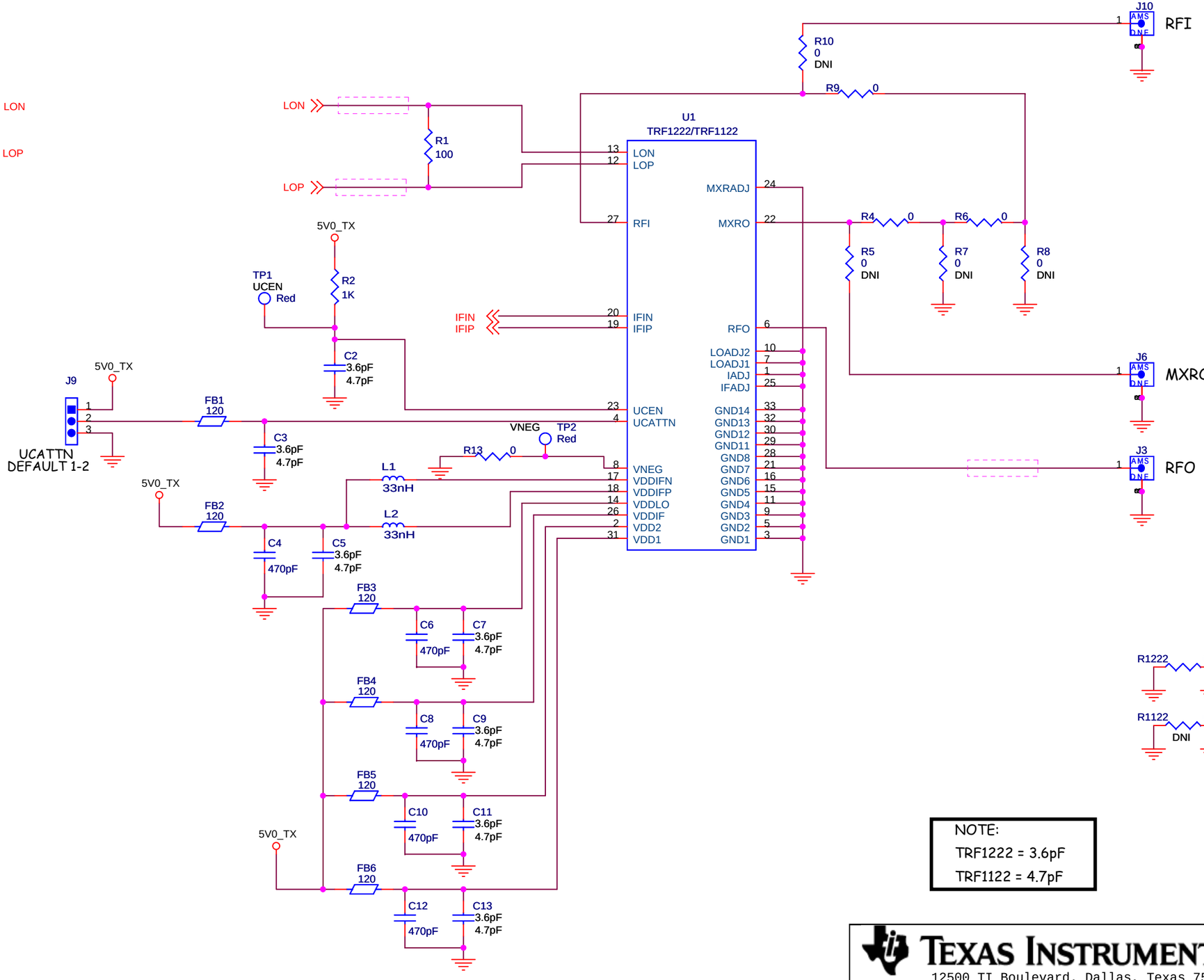
IF INPUT



DC POWER PORT







NOTE:
TRF1222 = 3.6pF
TRF1122 = 4.7pF

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Title	TRF1X22 EVM - SCH		
Size B	Document Number		Rev A
Date: Wednesday, July 26, 2006	Sheet 1 of 1		

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It is important to operate this EVM within the input voltage range of 0 V to 5 V and the output voltage range of 0 V to 5 V.

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 85°C . The EVM is designed to operate properly with certain components above 85°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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