Texas Instruments

User's Guide
SLWU056–June 2008

TRF3762 EVM User's Guide

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1 Hardware Setup

This manual can help users to operate the TRF3762 evaluation module (EVM) with the supplied software. The required hardware for testing the EVM is listed in Table 1.

Table 1. Required Test Hardware

Hardware	Specifications		Units
Power supply (1)	4.5 to 5.2		V
Spectrum analyzer (1)	0 to 6 Spurs –160 resolution (phase noise)		GHz dBm
Agilent's 5052 (1)			
Low phase noise reference source (1)	1 kHz	–120.22	dBc
	100 kHz	–145.6	
	590 kHz	–158	
	1 MHz	–158	
	3 MHz	–160	
	5 MHz	–161	
	Rms jitter	236.69	ps
Personal computer (PC) (1)	2-GHz processor, CD drive, Parallel port		
Power cable (1)	Supplied by Texas Instruments		
Parallel-to-parallel connector cable(1)	Not supplied by Texas Instruments		DB25 to DB25
Coaxial cable (2)	50		Ω

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LabVIEW is a trademark of National Instruments Corporation.

To achieve the test data, all hardware that is supplied with EVM is required. TRF3762 measured performance depends on the phase noise characteristics of the reference source used as well as the resolution of the hardware used for phase noise measurements.

The setup of the device is simple. See Figure 1.

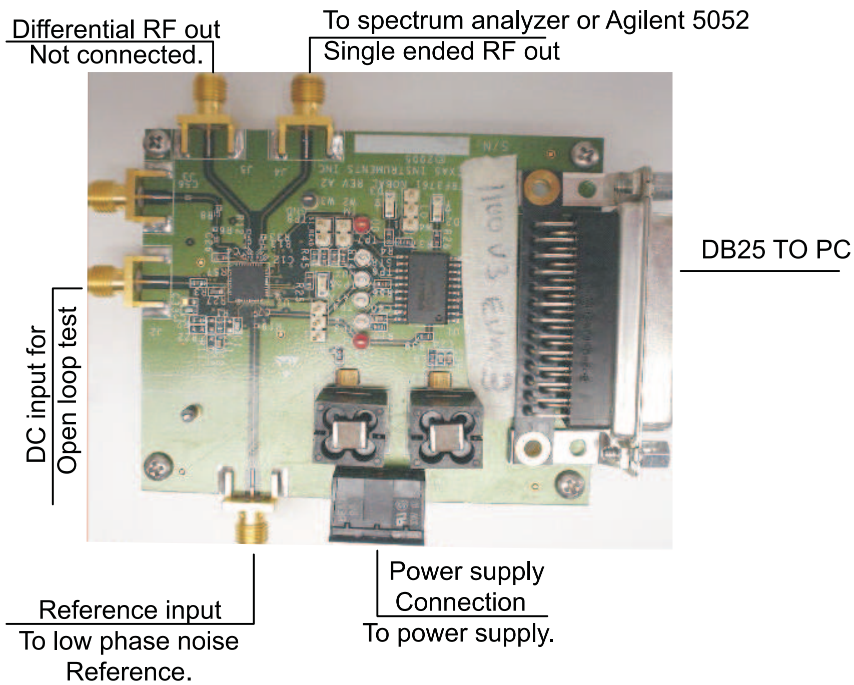


Figure 1. Single Output Without Balun

The board shown in Figure 1 has a 3-dB lower output power when configured as a single-ended output, approximately 0 dBm. When converting to a differential output by removing the 50-Ω resistor R32 in the differential path the output power should increase by 3-dB minus the balun losses. Components can be added to achieve a tuned reactive load which improves the output power. See Appendix B for output configuration options.

The following items are provided in the TRF3762EVM kit.

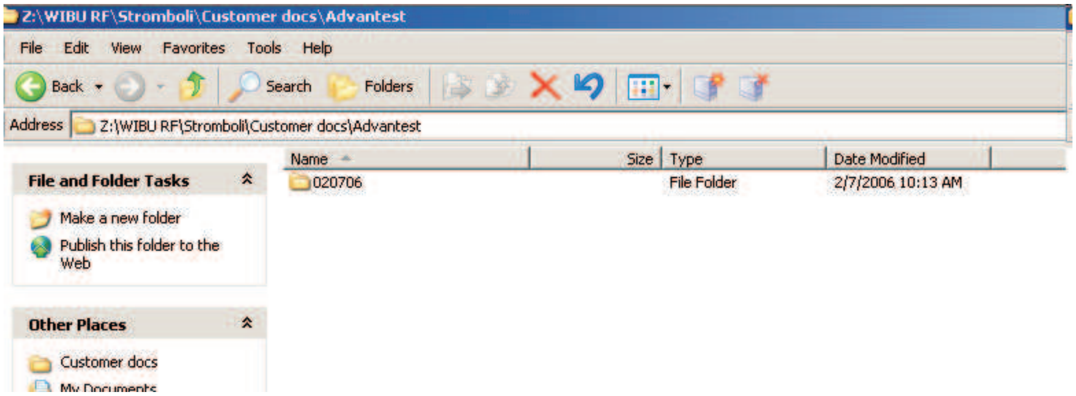
- CD-ROM
- EVM board
- Power cable
- Programming cable

2 Software Setup

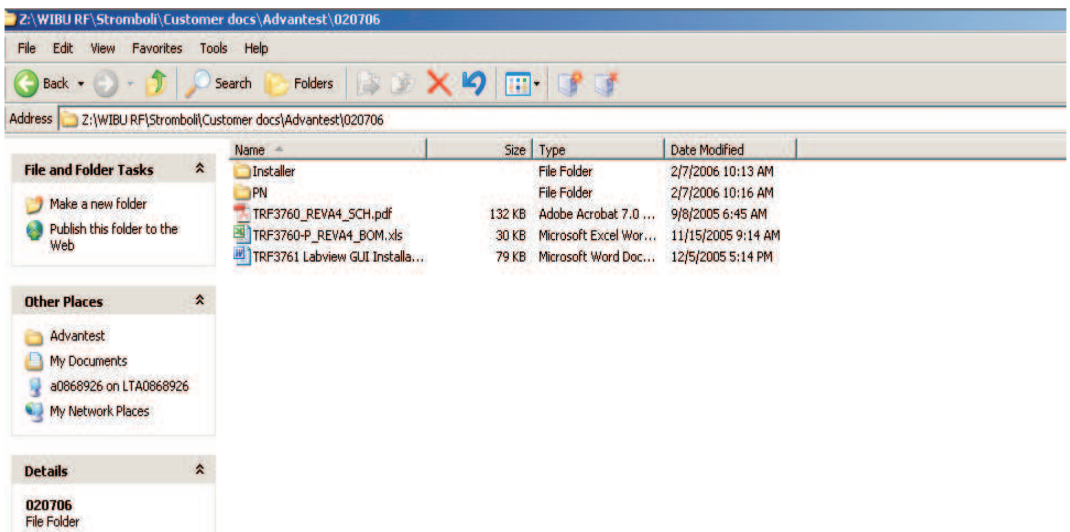
The LabVIEW™ software provided by Texas Instruments on the accompanying CD is the software that configures the TRF3762. It is used to set the registers inside the device for normal operation. The LabVIEW software interfaces to the EVM via a DB25 connector. The chip uses a SPI interface protocol with data formatted as little endian, which means the LSB is clocked in first.

2.1 Software Installation

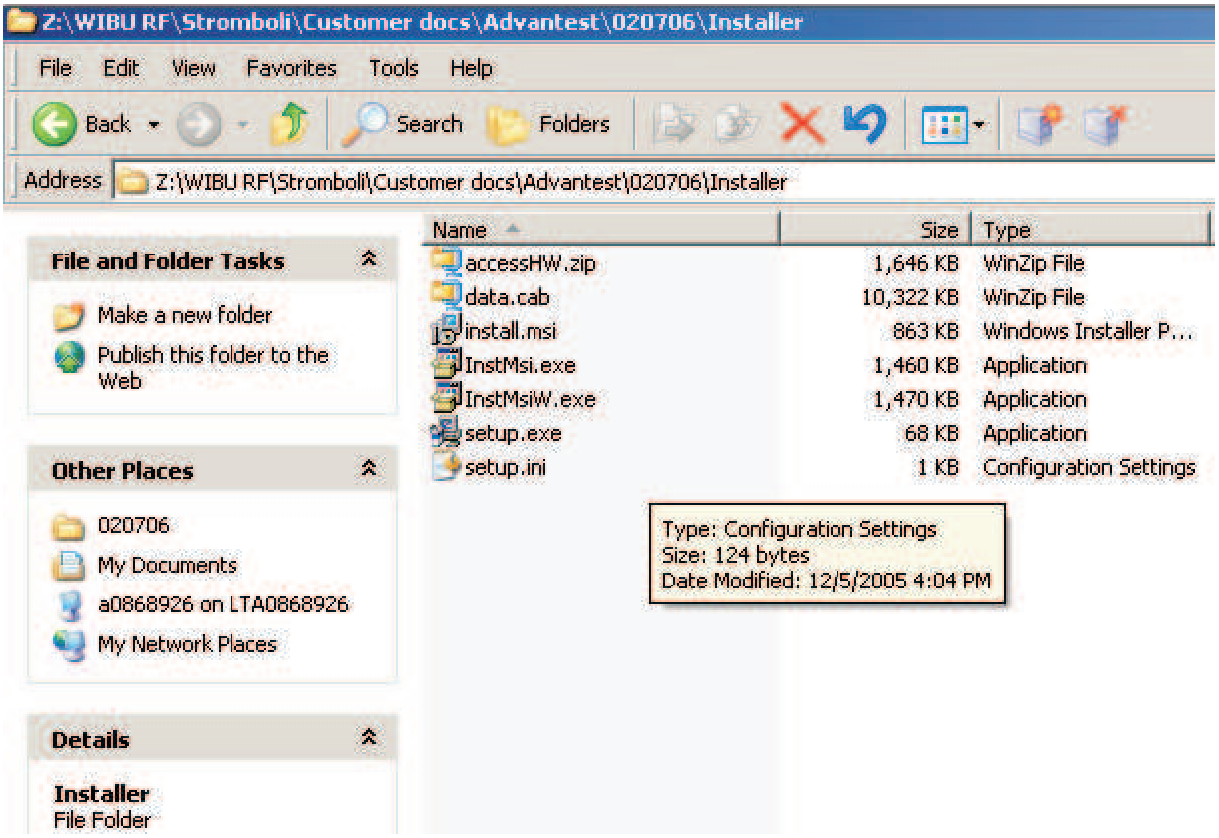
When loaded, the CD that accompanies the EVM displays on the PC monitor either a folder with a date for a file name or the full folder of files.



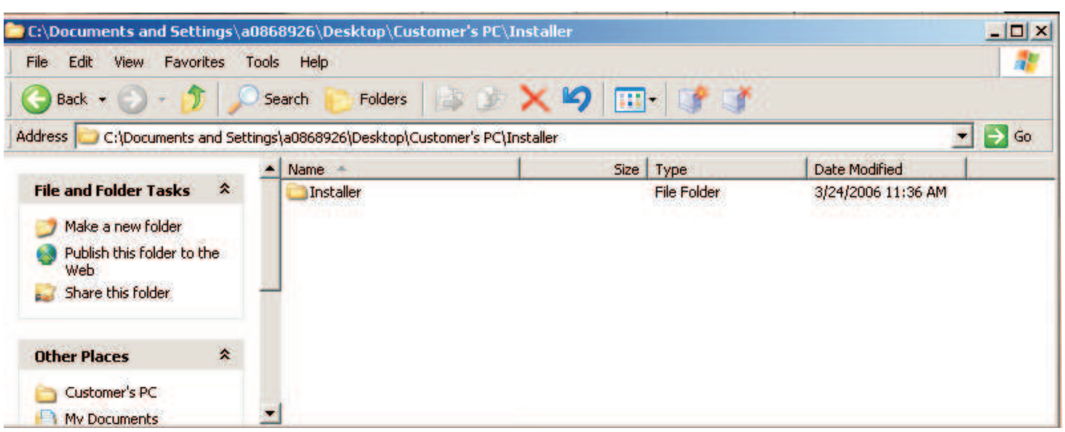
Or



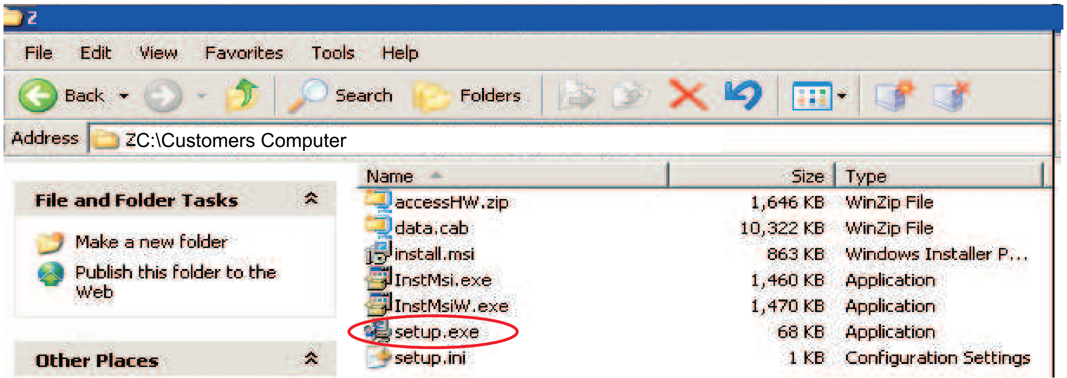
In either case, find the installer folder. This is the folder containing the program and its support files. Once found, open the installer folder, and the following screen displays.



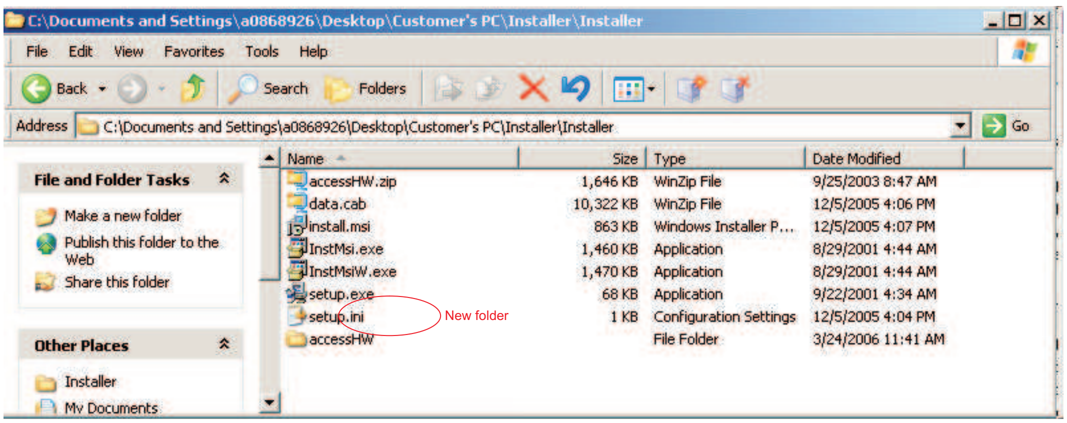
TI recommends that all files in the installer folder be copied to one folder on the PC or laptop that will be running the program before installing it. Do this by clicking on the installer folder and dragging it to the PC.



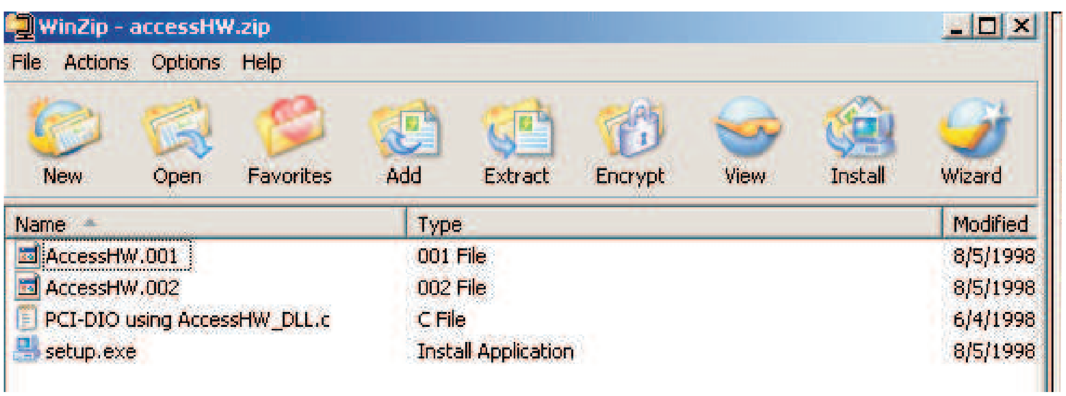
Once the folder *installer* has been copied on the computer, open it and find the LabVIEW runtime engine *setup.exe* file. Double-click it ,and execute the program by following the on-screen prompts.



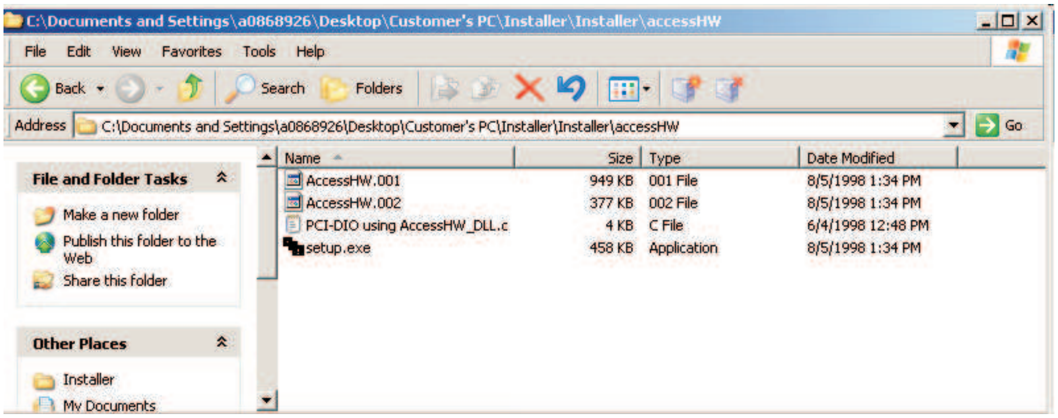
Once the LabVIEW runtime engine is installed, go back to the installer folder and create a folder called *accessHW*.



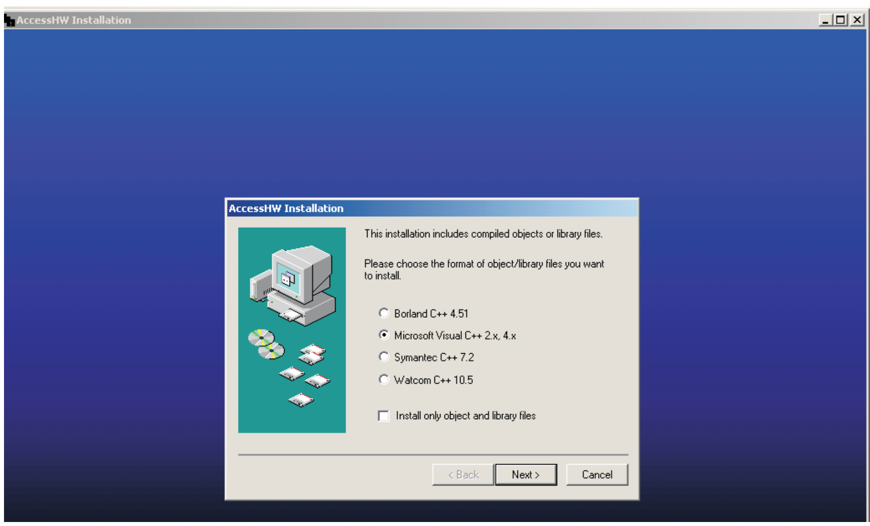
Open the *accessHW.zip* file. This file contains the software to set up the port on the PC.



Extract all files in the zip folder to the folder you created (*accessHW*). The files should look like the following.

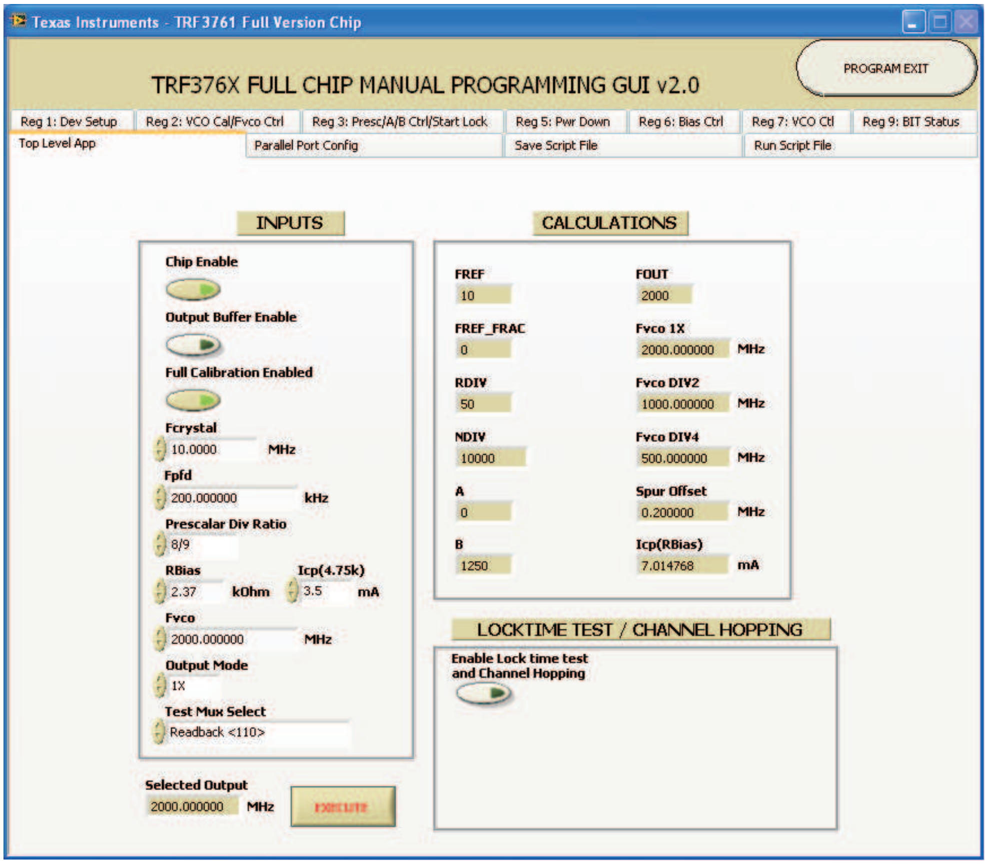


Double-click on the *setup.exe* file, and run the setup of the port. You are prompted for which object or library to use.



Select Microsoft Visual C++ 2x, 4x, and then click Next. Follow the prompts.

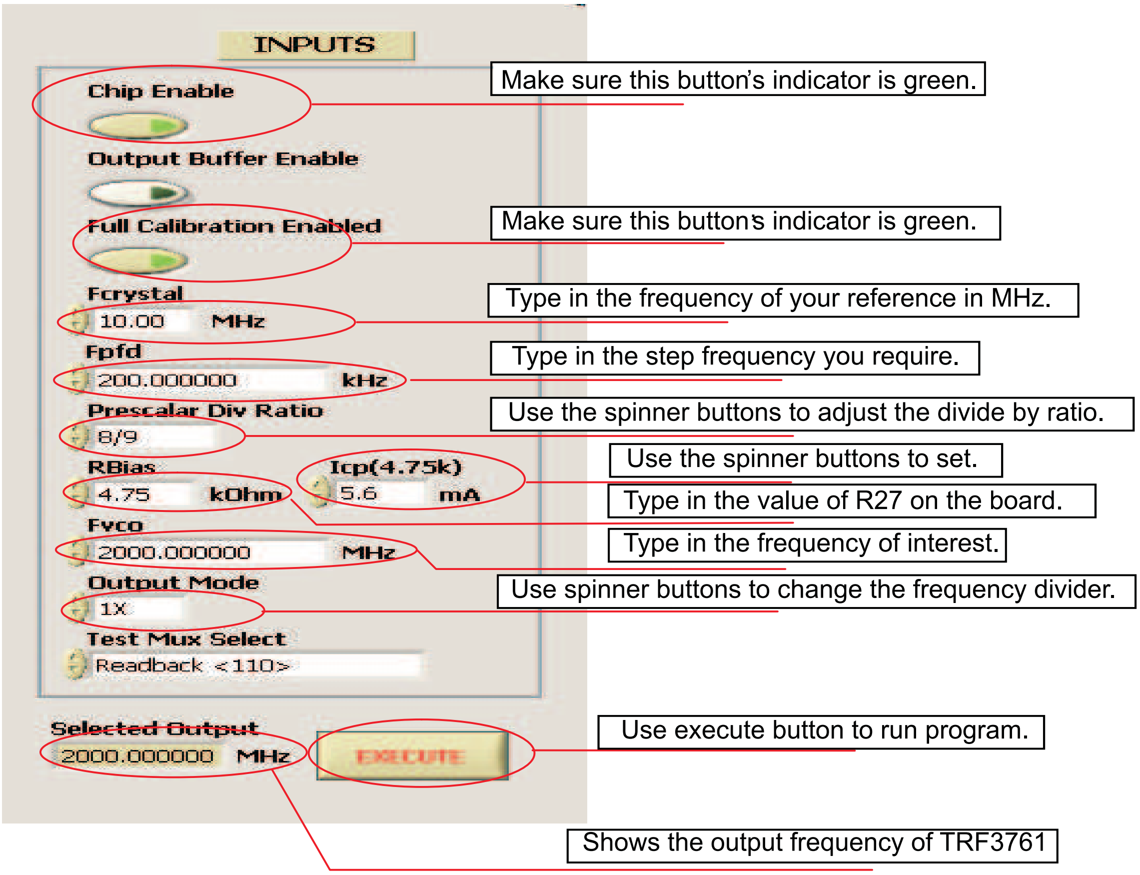
Once the program is installed, open it and you should see the following display.



This is the main control screen to use for programming the TRF3762; the frequency of interest is under the tab labeled Top Level App.

2.2 The Controls

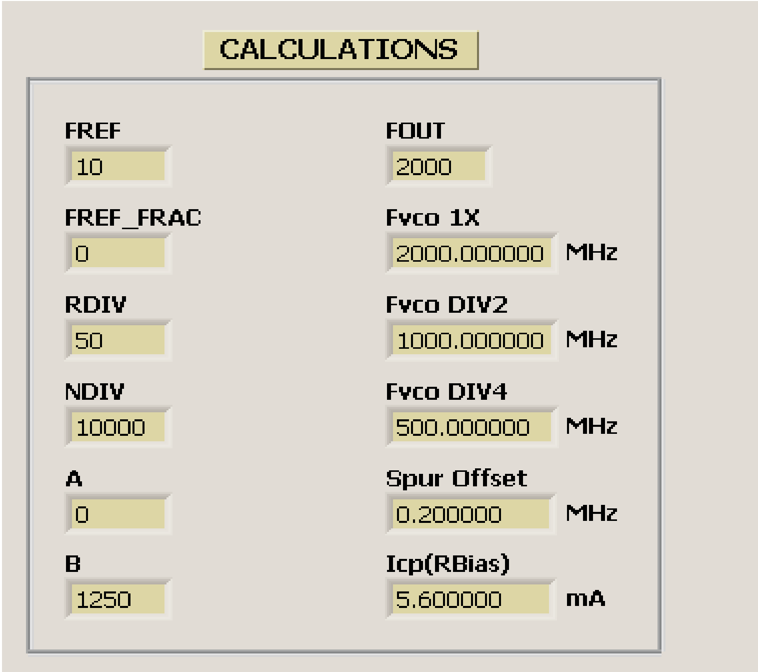
The left side of the main control screen is where inputs can be adjusted.



- Fcrystal is the reference used on the EVM. It can between 10 MHz to 104 MHz.
- Fpfd is the phase frequency detector frequency and sets the frequency step size. For example, if the main frequency is 2000 MHz and the Fpfd is 200 kHz, then the next frequency step can be 2000.2 MHz.
- Prescalar Div Ratio is the ratio used in the Fout equation, Fout = Fpfd (A+PB), where the numerator of the Prescalar Div Ratio is equal to P, and A and B are calculated. For more information, see Appendix A.
- Rbias is used for a calculation which is on the right side of the Main Control Screen in the window *Icp(Rbias)*.The value of Rbias is set to the same value as R27 on the EVM board is 2.73 kΩ. The resistor value can be changed on the board if a different charge pump current is desired.
- Icp sets the amount of current on the charge pump as well. Eight setting are used to increase and decrease the current; they are 0.7, 1.4, 2.1, 2.8, 3.5, 4.2, 4.9, and 5.6. These numbers represent the current seen if a 4.75-kΩ resistor is used. The calculation to determine the desired Icp_{actual} is [Icp(4.75k)]/Rbias = Icp_{actual}, which should give the same answer as the Icp(Rbias) on the right side calculations.
- Fvco is the output frequency of VCO.
- Output Mode sets the frequency divider. For example, if 500 MHz is required, then set the Fvco to 2000 MHz and the Output Mode to “/4”.
- The Selected Output window at the bottom by the Execute button shows the output frequency that the user sets up.
- To enter the data into the TRF3762, press the Execute button. Once pressed, the output changes to the frequency shown in the *Selected Output* window.

2.3 The Calculations

The right side of the main control screen shows the system setup calculations.



- FREF is the reference oscillator frequency in MHz.
- Fref_Frac is not used.
- RDIV is the number the reference frequency is divided by to get Fpfd.
- NDIV is the number the output frequency is divided by to get Fpfd.
- A and B are the variables in the equation Fout = Fpfd (A+PB) as discussed in the prescalar section of the controls. See Appendix A.
- Fout is the actual frequency out.
- Fvco 1x is the undivided frequency out of the VCO.
- Fvco DIV2 is the frequency out of the VCO divided by 2.
- Fvco DIV4 is the frequency out of the VCO divided by 4.
- Spur offset is the offset of the phase frequency detector spur.
- Icp (Rbias) is the actual current of the charge pump. Calculated from [Icp(4.75k)]/Rbias = Icp_{actual}.

Appendix A Synthesizing Desired Frequencies

Prescalar Div is a multiselection dual modulus to limit the frequency of the Prescalar to below 250 MHz. The setting are 8/9, 6/17, 32/33, and 64/65. The TRF3762 has an integer-N PLL synthesizer, and because of its flexibility (14-bit R, 6-bit A, 13-bit B counter, and dual modulus prescalar), is ideal for synthesizing virtually any desired frequency. Assume that one needs to synthesize a 900-MHz local oscillator, with spacing capability (minimum frequency increment) of 200 kHz, as in a typical GSM application. The choice of the external reference oscillator to be used is beyond the scope of this user's guide, but assuming that a 10-MHz reference is selected, one can calculate the settings that yield the desired output frequency and channel spacing. Although more than one solution can often apply to a specific set of conditions, the following is one means of achieving the desired result.

First, select the appropriate R counter value. Because a channel spacing of 200 kHz is desired, the PFD can also be set to 200 kHz. Calculate the R value through R = REFIN/PFD = 10 MHz/ 200 kHz = 50. Assume that a prescalar value of 8/9 is selected. This is a valid choice because the prescalar output will be well within the 200-MHz limit (900 MHz / 8 = 112.5 MHz). Select the appropriate A and B counter values. It is known that RFOUT = Fpfd $\times$ N = (F_{REFIN} / R) $\times$ (A + P $\times$ B). Therefore, solve the following equation:

$$900\ \text{MHz} = 200\ \text{kHz} \times (A + 8 \times B)$$

Clearly, many solutions exist for this single equation with two unknowns; however, because $3 \leq B \leq 8191$, and also $B \geq A$, there are some basic constraints on the solution. So, if A = 4, solving the equation yields B = 562. Thus, one complete solution would be to choose: R = 50, A = 4, B = 562, and P = 8/9, resulting in the desired N = 4500.

Appendix B Output Configuration Options

Single/Differential	Output Configurations	Load	Pout
Single-ended	Differential 50-Ω shunt	Resistive	0
Single-ended	Differential 50-Ω shunt	Tuned (LC)	3
Differential	External balun	Resistive	3
Differential	External balun	Tuned (LC)	6

Appendix C TRF3762 QFN Installation Using a Hakko Hot Air Rework Station

The TRF3762 devices are optionally sampled separately from the board (TRF3671EVM-X). This guideline is designed to help the person evaluating these parts to install the sample device on the board provided.

The EVM board has an immersion gold plating. Due to gold leaching into the solder joint, it is a best practice to tin the pads and wick off the extra solder. Using a solder with silver content helps but is unnecessary.

Apply solder paste to each pad including the center ground; do not skimp when applying paste to the center ground. It is recommended to use a type 6 Sn62Pb36Ag2 alloy with an 82% loading in an EFD dispensing system; solder paste can be applied manually with a dental pick.

Under a microscope, place the device inside the square silkscreen labeled U2. Pin 1 of the device is designated by a round dot on the package; pin 1 on the board is designated by an asterisk and a slightly mitered corner.

Use a tool like a dental pick or the point of a hobby knife (like an X-ACTO™ knife) to position the part so that the device leads are centered on the traces. The solder paste may smear; this is not an issue at this point.

Place the board in the Hakko Omnivise, and position it over the Hakko preheater. With the preheater set at 200°C, let the part heat up for 30 seconds. Place the Hakko hot air nozzle (A1130, this is a 0,44-mm diameter nozzle) over the device. With the temperature set at 343°C and the air flow set at 15 liters/minute, turn on the hot air rework station. This setting can be adjusted lower if adjacent components are being disturbed. Letting the board thermally soak over the preheater along with letting the hot air come up to temperature while blowing on the part provides a thermal ramp profile. This helps to ensure a good solder joint.

Watch the device as it heats up; when the solder paste reflows, let the part continue to heat for 15 seconds. Remove it from the heat. Inspect the part immediately, and verify that there are no solder shorts and that there is connection at all pins. A soldering iron with a tip radius of 0.008 at 370°C works well for this; add extra flux when doing rework.

To clean the flux residue from the board: spray the board with a flux cleaner, lay a thin absorbent tissue over the board, and brush the board through the tissue. The absorbent tissue wicks up the flux-contaminated solvent. Blow the board dry with compressed air. If spurs are present, additional cleaning in an ultrasonic cleaner and subsequent baking may be necessary.

C.1 USEFUL LINKS

Hakko Products:

http://www.hakkousa.com/2006/default_1.asp?Assistant=Dinky

Solder Paste, Flux, Dispenser:

http://www.efd-inc.com/mikros/index.html
http://www.efdsolder.com/

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 4.5 V to 5.25 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 40°C. The EVM is designed to operate properly with certain components above 40°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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Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
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