TRF372017EVM

The TRF372017 is a high-performance, direct up-conversion device, integrating a high-linear, low-noise IQ modulator and an integer-fractional PLL/VCO. The device is capable of converting complex modulated signals from baseband or IF directly up to RF frequencies ranging from 300 MHz to 4.8 GHz. The PLL/VCO, along with the internal 2/4/8 divider configuration as shown in the following table, is used to obtain the desired frequency.

Part Number	VCO Frequency		Div by 2		Div by 4		Div by 8	
	Fmin	Fmax	Fmin	Fmax	Fmin	Fmax	Fmin	Fmax
TRF372017	2400	4800	1200	2400	600	1200	300	600

This document outlines the basic procedures for connecting the evaluation module (EVM) to test equipment for basic testing.

1 Power Requirements

The TRF372017 requires a 3.3-Vdc Vcc power supply through test-point TP2 and 5-Vdc Vcc power supply through test-point TP5.

Removing jumper JP6 enables the onboard regulator. With the onboard regulator enabled, the 5-V supply is regulated to provide 3.3 V, and no direct 3.3-V connection through TP2 is required. High-performance analog measurements must not be performed using the onboard regulator.

2 TRF372017 Operating Procedures for Modulator and Internal VCO Mode

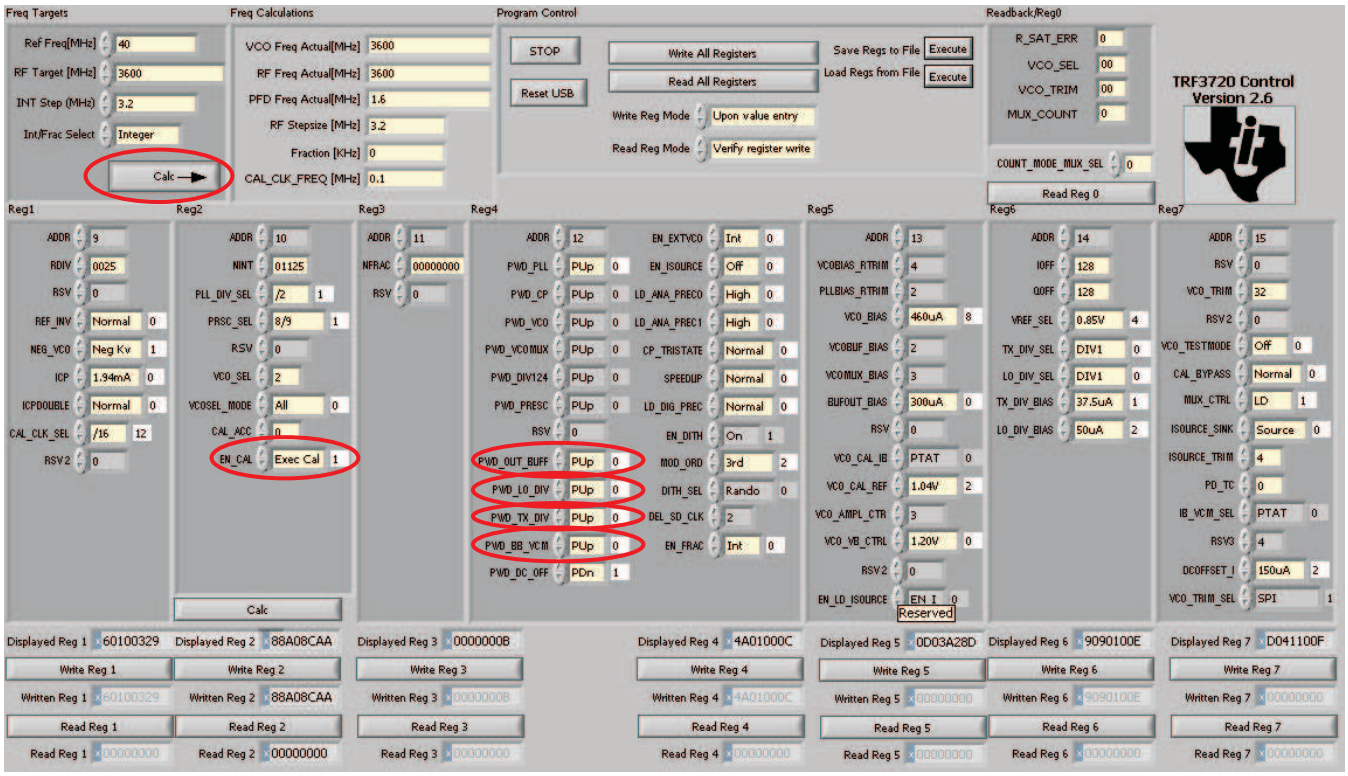
1. Connect the USB to the computer and the mini-USB to the EVM board.
2. Power-supply connections:
   (a) Set the 3.3-V supply current limit to 450 mA.
   (b) Set the 5-V supply current limit to 200 mA.
   (c) Connect the 3.3-V supply to TP2, 5-V supply to TP5, and common ground to TP4.
   (d) Switch on the Vcc 3.3-V supply.
   (e) Switch on the Vcc 5-V supply.
3. Input connections: Use a DAC or an arbitrary waveform generator to provide I/Q input signals at 1.7 Vdc to J3/J4 and J9/J10. By default, the EVM ac couples the I/Q signals to the device.
4. Output connections:
   (a) To measure the PLL output: Connect a spectrum analyzer to the SMA connector marked LON (J1) or LOP (J5) to monitor the VCO output single-ended. These output nodes can be used for two purposes:
      (i) Check the PLL functionality and measure the frequency range.
      (ii) Use the TRF372017 in the PLL/VCO mode alone.
   (b) To measure the modulator output: Connect a spectrum analyzer to the SMA connector marked RF_OUT (J6) to monitor the up-converted signal in the regular operational mode (default mode of operation).
5. Run the TRF372017 GUI software.
6. Click **Reset USB** to reset the USB connection.
7. Click on **Write All Regs** to load the GUI default settings to the device.
8. On start, the LOP and LON outputs and the RF_OUT output are disabled. Enable them as follows:

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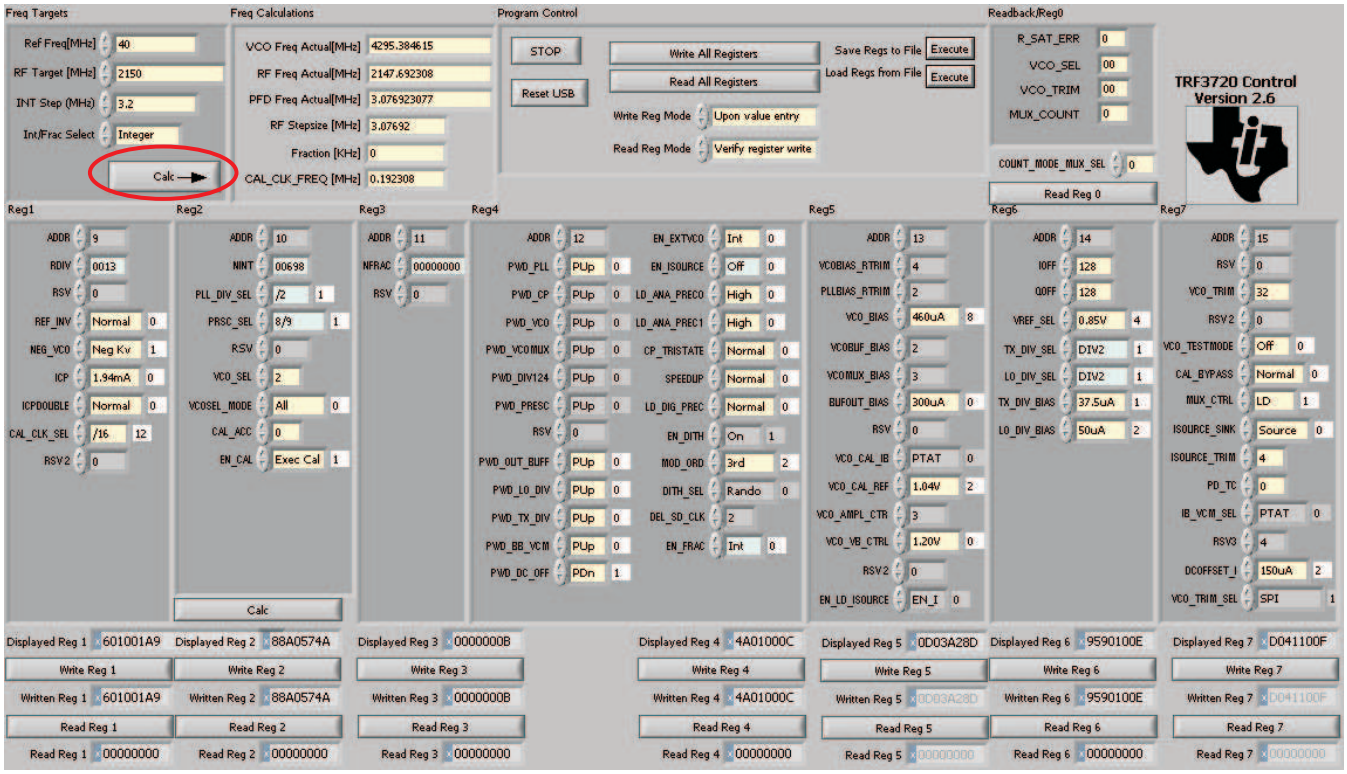
(a) To enable the PLL output: toggle PWD_OUT_BUFF and PWD_LO_DIV from PDn to PUp.
(b) To enable the RF_OUT output: toggle PWD_TX_DIV, PWD_BB_VCM, from PDn to PUp. If offset adjustment is performed, also toggle PWD_DC_OFFSET from PDn to PUp.

9. Click **Calc** → to initialize the PLL divider settings.
10. Toggle the EN_CAL control from Idle to Exec Cal to perform a calibration and lock the PLL/VCO at the default setting.



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11. The GUI settings now look as follows:



12. To change frequencies, enter the desired operating frequency in the RF Target (MHz) control. The GUI automatically calculates resulting frequencies to display in the Freq Calculations display. It also automatically calculates values for the necessary register settings and writes those values to the device. The calculated register entries are highlighted in blue.

3 TRF372017 GUI Setup and Board Options

Place the mouse over any control that corresponds directly to a register bit to see a brief description of the control functionality and the corresponding SPI bit. More detailed descriptions may be found in the TRF372017 data sheet (SLWS224).

1. RF Frequencies

   RF frequency control is split into sets of controls and outputs.

   (a) Frequency controls. The Ref Freq (MHz) control must be set to match the frequency injected onto the DUT REFIN terminal. By default, the EVM is configured to use a 40-MHz VCO included on the board. Jumpers are included to allow the user to connect an external signal to connector EXT_REF (J8). Remove JP3 and JP4 to use an external reference signal.

   (b) Frequency controls. VCO Target (MHz) must be set to the desired VCO frequency. This is the frequency at which the VCO oscillates, before any divider, and may not match the final RF output frequency. This control is a factor in determining the PLL N-divider factor.

   (c) Frequency controls. RF Step (MHz) is used by the GUI to set the PLL R-divider, prior to the PFD.

   (d) RF outputs. LO Freq Actual (MHz) is calculated by the GUI software based on the R Divider, N Divider, and LO Divider settings.

   (e) RF outputs. Mix Freq Actual (MHz) is calculated by the GUI software based on the R Divider, N Divider, and Tx Divider settings.

   (f) Frequency calculations. By default, changing any control in the Freq Targets area initiates a recalculation of register values.

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2. Program Control

   Program controls provide an interface to the GUI function without directly impacting the register settings.

   (a) STOP. The STOP button must be used to terminate program operation. Terminating the program through other means may require a USB reset to re-establish USB communications.
   (b) Reset USB. The USB-to-SPI converter device is powered through the USB connection, not the DUT supplies. This button can be used to reset the USB session.
   (c) Write All Registers. The Write All Registers button initiates a write to each register using the displayed values. The write sequence starts with the lowest numbered register and proceeds sequentially to the highest numbered register. If the Read Reg Mod control is set to verify the writes by reading the registers, then the read registers occur after all writes have been completed.
   (d) Read All Registers. The Read All Registers button initiates a read of each register, starting with register 1, proceeding sequentially to register 7, and finishing with register 0.
   (e) Write Reg Mode. When the Write Reg Mode control is set to Upon value entry, changing any displayed register setting or frequency target initiates a write of the impacted registers. When it is toggled to Write button only, register writes only occur when the Write All Registers or Write Reg n buttons are used.
   (f) Read Reg Mode. When the Read Reg Mode button is set to Verify register write, each write sequence is followed by a read sequence for the affected registers. When it is set to Read button only, register reads only occur when the Read All Registers or Read Reg n buttons are used.
   (g) Save Regs to File. The Save Regs to File button saves all of the displayed register values to a file.
   (h) Load Regs from File. The Load Regs from File button loads a previously saved set of register values into the displayed controls. The loaded values are not automatically written to the DUT.

3. Register 0

   (a) Register 0 is used to initiate register Readback for each register. Writes to register 0 for the purpose of reading back registers are performed with every read operation.
   (b) Readback bits from register 0 can either indicate VCO calibration results or frequency counter results depending on the value of the VCO_TESTMODE control. The register 0 readback display changes appropriately with the VCO_TESTMODE control. When VCO_TESTMODE is set to On, the register 0 display shows both the count bits and a calculated value indicating the corresponding approximate frequency.

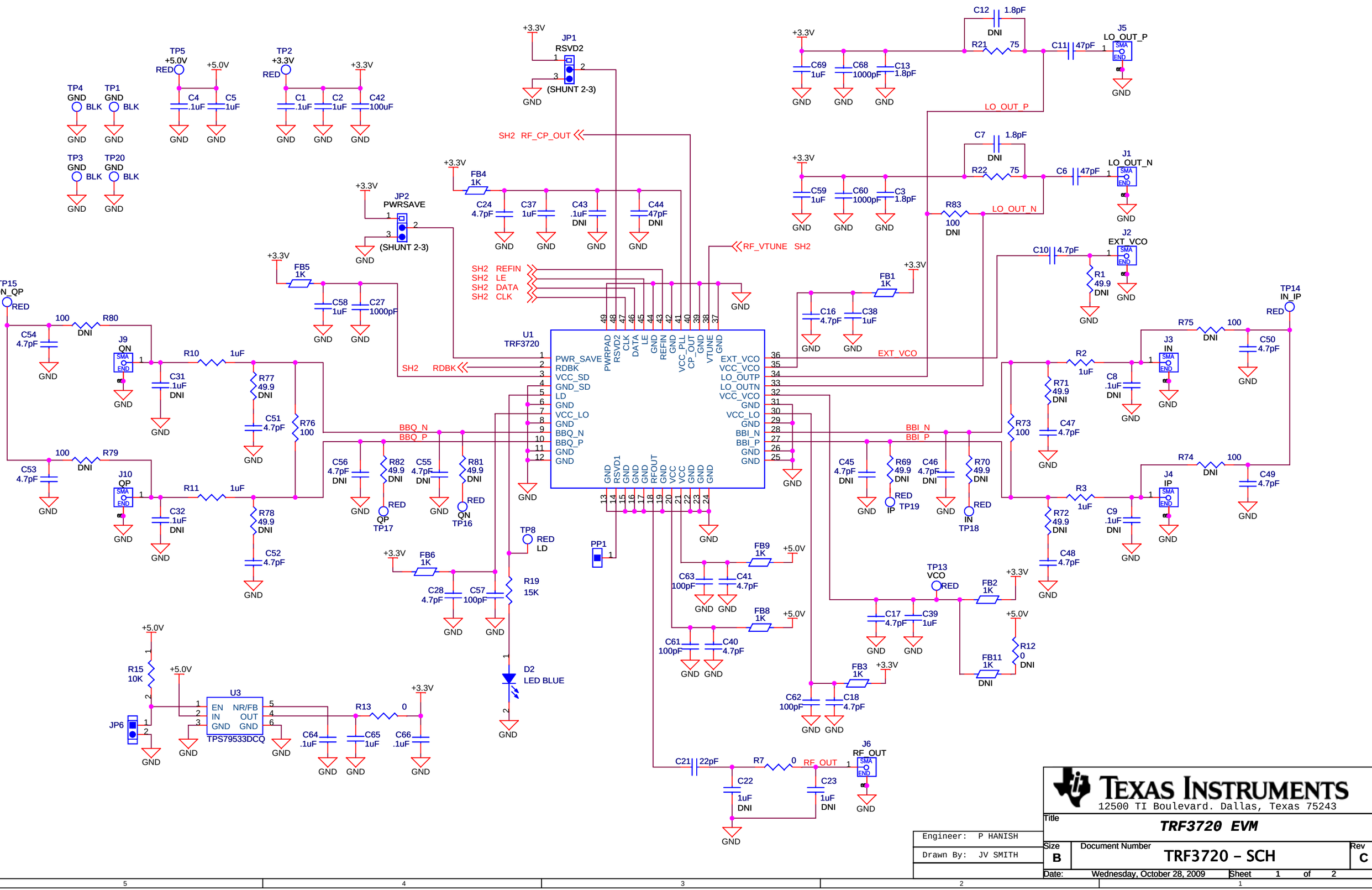
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Revision History

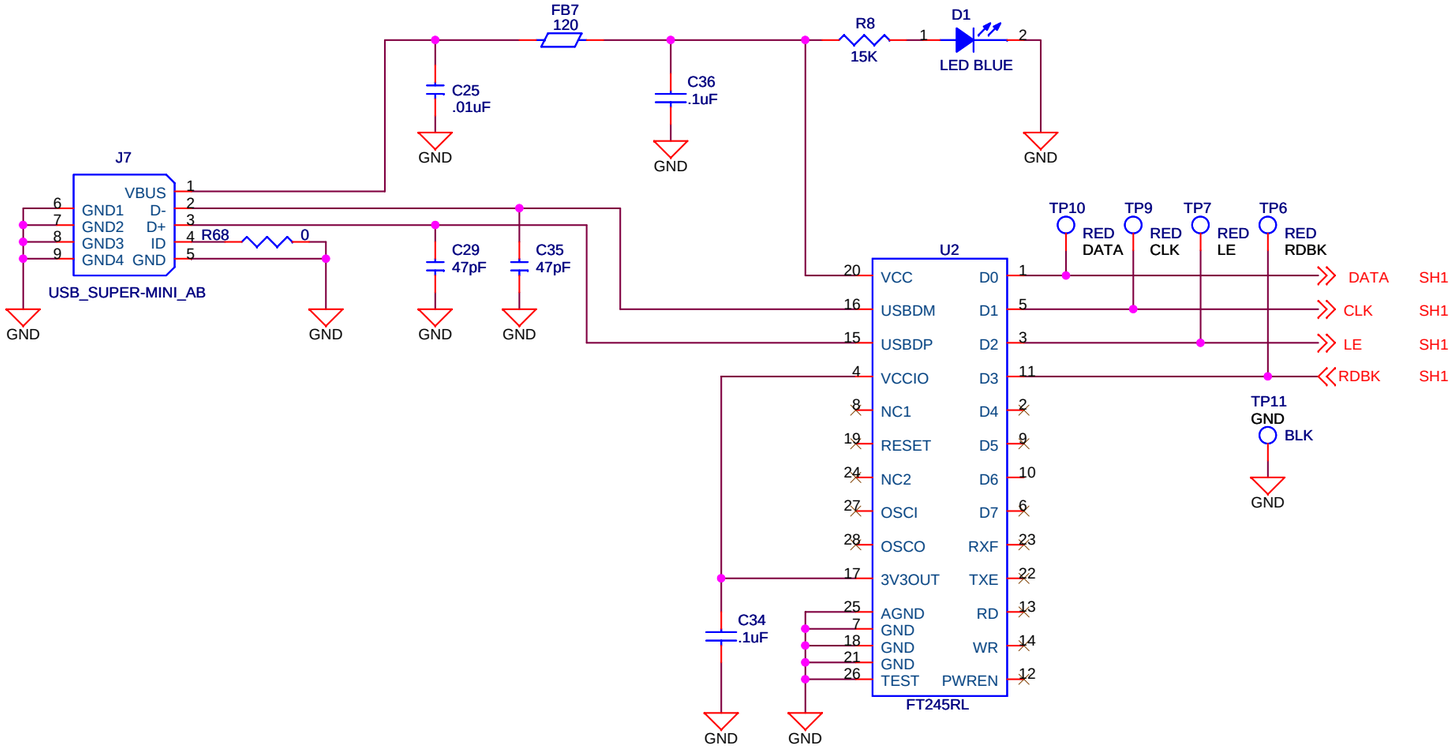
Changes from Original (October, 2010) to A Revision	Page
• Changed document title	1

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

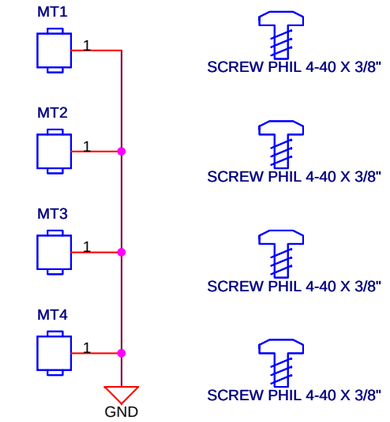
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TP5 +5.0V RED
TP2 +3.3V RED
TP4 GND BLK
TP1 GND BLK
TP3 GND BLK
TP20 GND BLK
C4 .1uF
C5 1uF
C1 .1uF
C2 1uF
C42 100uF
JP1 RSVD2 (SHUNT 2-3)
JP2 PWRSAVE (SHUNT 2-3)
SH2 RF_CP_OUT
FB4 1K
C24 4.7pF
C37 1uF
C43 .1uF DNI
C44 47pF DNI
FB5 1K
C58 1uF
C27 1000pF
SH2 REFIN
SH2 LE
SH2 DATA
SH2 CLK
RF_VTUNE SH2
SH2 RDBK
U1 TRF3720
PWR_SAVE
RDBK
VCC_SD
GND_SD
LD
VCC_LO
BBQ_N
BBQ_P
EXT_VCO
VCC_VCO
LO_OUTP
LO_OUTN
BBI_N
BBI_P
RFOUT
C12 1.8pF DNI
R21 75
C11 47pF
J5 LO_OUT_P
C69 1uF
C68 1000pF
C13 1.8pF
LO_OUT_P
C7 1.8pF DNI
R22 75
C6 47pF
J1 LO_OUT_N
C59 1uF
C60 1000pF
C3 1.8pF
R83 100 DNI
LO_OUT_N
C10 4.7pF
J2 EXT_VCO
R1 49.9 DNI
FB1 1K
C16 4.7pF
C38 1uF
EXT_VCO
TP15 QN_QP RED
C54 4.7pF
R80 100 DNI
J9 QN
C31 .1uF DNI
R10 1uF
R77 49.9 DNI
C51 4.7pF
R76 100
C53 4.7pF
R79 100 DNI
J10 QP
C32 .1uF DNI
R11 1uF
R78 49.9 DNI
C52 4.7pF
C56 4.7pF DNI
R82 49.9 DNI
QP TP17
C55 4.7pF DNI
R81 49.9 DNI
QN TP16
TP8 RED LD
R19 15K
D2 LED BLUE
PP1
FB6 1K
C28 4.7pF
C57 100pF
FB9 1K
C63 100pF
C41 4.7pF
FB8 1K
C61 100pF
C40 4.7pF
R15 10K
JP6
U3 TPS79533DCQ
EN
NR/FB
IN
OUT
GND
C64 .1uF
R13 0
C65 1uF
C66 .1uF
C45 4.7pF DNI
R69 49.9 DNI
IP TP19
C46 4.7pF DNI
R70 49.9 DNI
IN TP18
TP13 VCO RED
FB2 1K
C17 4.7pF
C39 1uF
FB11 1K DNI
R12 0 DNI
FB3 1K
C62 100pF
C18 4.7pF
C21 22pF
R7 0
RF_OUT
J6 RF_OUT
C22 1uF DNI
C23 1uF DNI
TP14 IN_IP RED
R75 100 DNI
C50 4.7pF
J3 IN
R2 1uF
C8 .1uF DNI
R71 49.9 DNI
R73 100
C47 4.7pF
R74 100 DNI
C49 4.7pF
J4 IP
R3 1uF
C9 .1uF DNI
R72 49.9 DNI
C48 4.7pF
TEXAS INSTRUMENTS
12500 TI Boulevard. Dallas, Texas 75243
Title
TRF3720 EVM
Engineer: P HANISH
Drawn By: JV SMITH
Size B
Document Number TRF3720 – SCH
Rev C
Date: Wednesday, October 28, 2009
Sheet 1 of 2

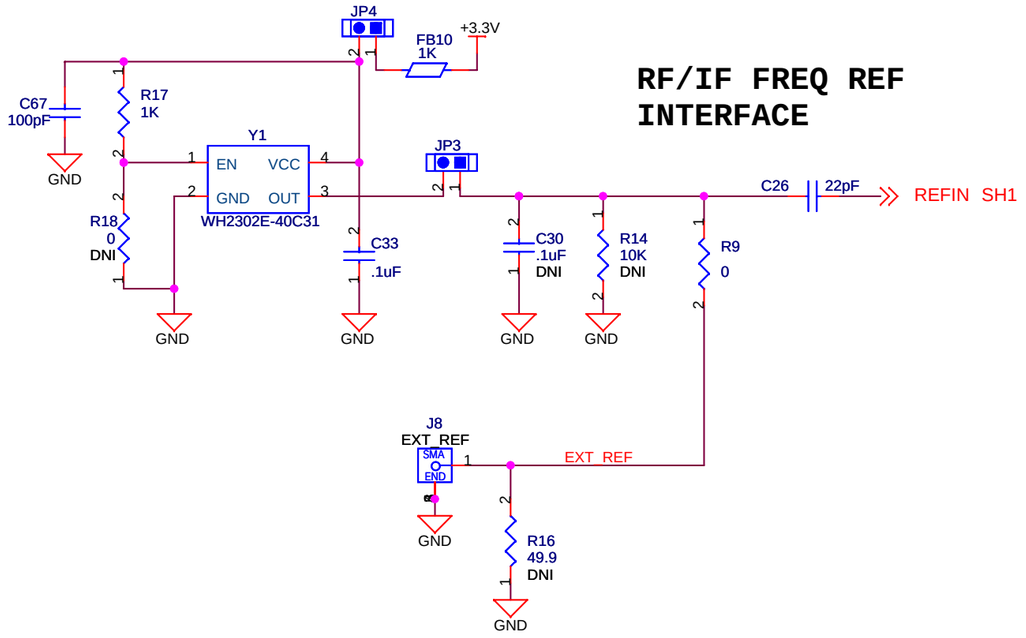
SERIAL INTERFACE



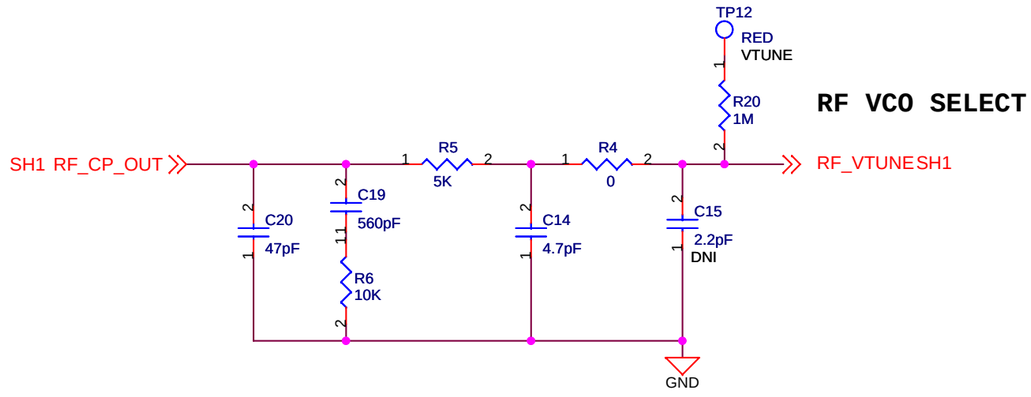
BOARD STANDOFFS



RF/IF FREQ REF INTERFACE



RF VCO SELECT



TEXAS INSTRUMENTS

Title	*TRF3720 EVM*	
Size: B	Document Number: TRF3720 – SCH	Rev: C
Date: Wednesday, October 28, 2009	Sheet 2 of 2	

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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.

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During normal operation, some circuit components may have case temperatures greater than +55° C. The EVM is designed to operate properly with certain components above +55° 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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