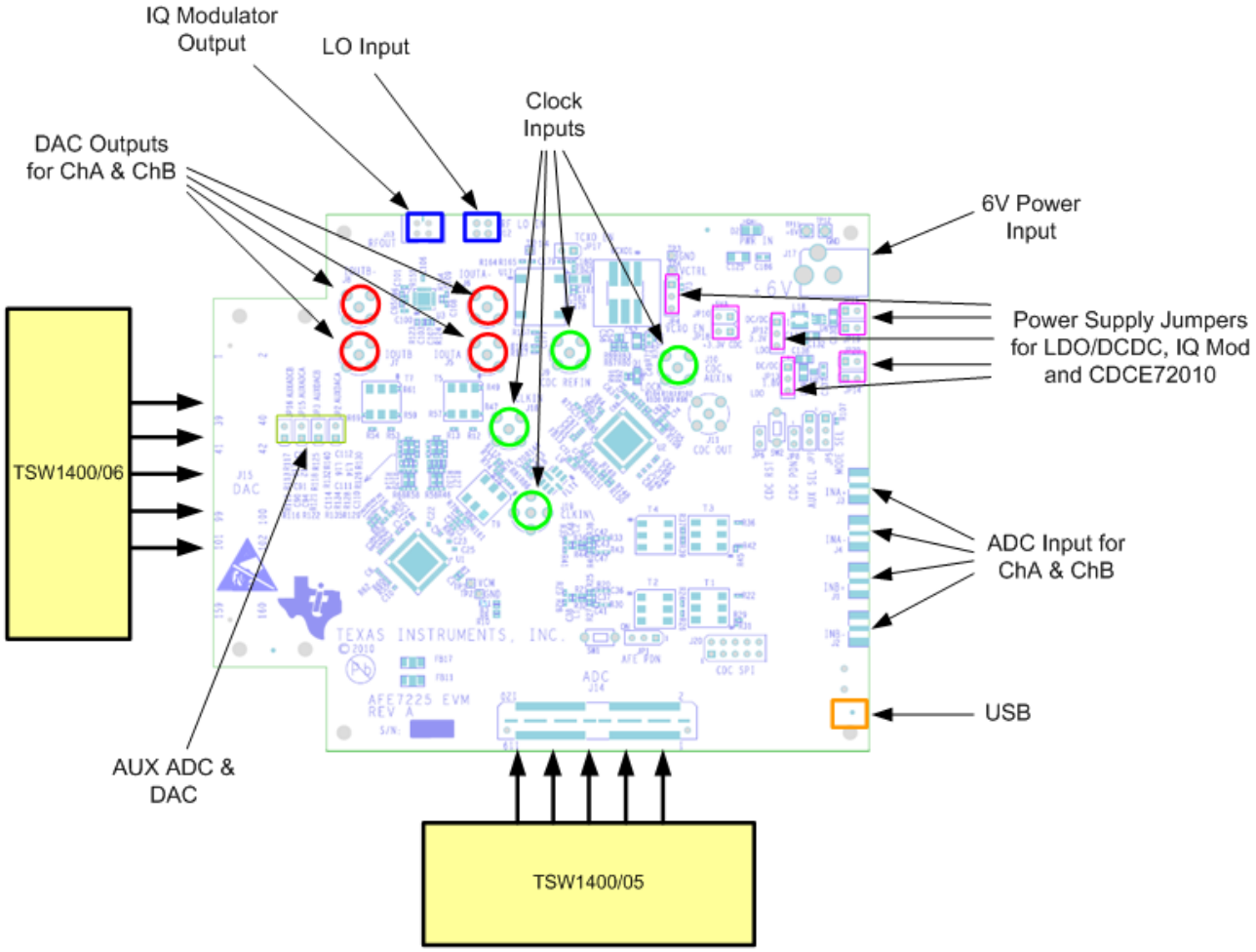
AFE722x Evaluation Module (AFE722xEVM) User's Guide

The AFE722x EVM includes a great level of flexibility enabling testing in a more system-like environment. The individual power rails can be generated through LDOs or DC/DC converters from a 6-V power source and the EVM clock architecture allows for external clock input as well as clock generation using a low-jitter PLL in combination with a VCXO. On the transmit side, the EVM provides the option of connecting directly to the DAC outputs or perform up-conversion via an on-board IQ modulator.

On the digital side, the EVM provides a seamless interface to the TSW1400 and TSW1405 capture card in order to evaluate received data directly on a PC. The TSW1400 and TSW1406 pattern generation card can be used to provide data to the dual DAC of the AFE722x and the on board, CDCE72010 generates the appropriate clock for the TSW1400 and TSW1406 for synchronous operation. Both the AFE722x and CDCE72010 can be programmed via SPI, conveniently, through the USB connection.



Copyright © 2013, Texas Instruments Incorporated

Contents

1 Software Installation 2
2 AFE722x.ini file for TSW140x 3
3 AFE722x EVM Software - SPI Control 3
4 Initial EVM Setup and Basic Test Procedure 4
4.1 CDCE72010 Configuration 5
4.2 RX Path Using TSW1400 5
4.3 TX Path Using TSW1400 7
5 Power Supply Options 11
6 Clocking Configuration 11
6.1 Non-VCXO Option (Default) 12
6.2 System Level 13
6.3 RX Only 13
6.4 RX and TX Independent Clocking 13
6.5 Interpolation on the DAC 13
6.6 Decimation on the ADC 14
7 RX Setup 14
8 TX Setup 15

List of Figures

1 Software Installation Screens 3
2 AFE722x EVM Software Control 4
3 AFE722x EVM Setup 5
4 CDCE72010 Configuration 5
5 HSDCP Settings 7
6 8
7 9
8 Spectrum Analyzer: Sample Rate = 245.76 Msps, Input Tone = 15 MHz 10
9 Power Supply Jumper Settings 11
10 Configuration of Clock Output in CDCE72010 12
11 Receive Control Tab in RX Setup 15
12 AFE722x Schematic 16
13 Transmit Control Tab in TX Setup 17

List of Tables

1 Control Registers 7
2 Clock Delays for Listed DAC Sampling Rates 8

1 Software Installation

1. Open the folder named AFE722x_Installer_vxpx (xpx represents the latest version)
2. Run Setup.exe
3. Follow the on-screen instructions
4. Once installed, launch by clicking on the AFE722x_GUI_vxpx program in Start→Texas Instruments ADCs.
5. When plugging in the USB cable for the first time, a prompt to install the USB drivers for *USB Serial Converter* and *USB Serial Port* comes up (see Figure 1).
   (a) Follow the on-screen instructions to install the USB drivers.
   (b) If needed, access the drivers directly in the install directory

Copyright © 2013, Texas Instruments Incorporated

Figure 1. Software Installation Screens

2 AFE722x.ini file for TSW140x

The AFE722xEVM software package comes with new ini files for the TSW140x. These AFE722x.ini files (AFE722x_ADC.ini for TSW1400/TSW1405 and AFE722x_DAC.ini for TSW1400/TSW1406) are placed automatically into the following directory once you install TSW140x GUI (High Speed Data Converter Pro): In the Windows™ 7 operating system, ini files for the TSW1400 are located in the paths as shown below:

- C:\Program Files (x86)\Texas Instruments\High Speed Data Converter Pro\1400 Details\ADC files
- C:\Program Files (x86)\Texas Instruments\High Speed Data Converter Pro\1400 Details\DAC files

3 AFE722x EVM Software - SPI Control

The AFE722x EVM software controls the AFE722x and CDCE72010 on the EVM via SPI register writes through a USB connection with the PC. Below is a snapshot of the GUI front panel highlighting the various tabs to control the setup of the AFE722x as well as the CDCE72010.

It is required to perform a USB reset after applying power to the EVM to establish proper connection with the PC. A warning sign on the bottom right flashes otherwise indicating USB communication failure.

Copyright © 2013, Texas Instruments Incorporated

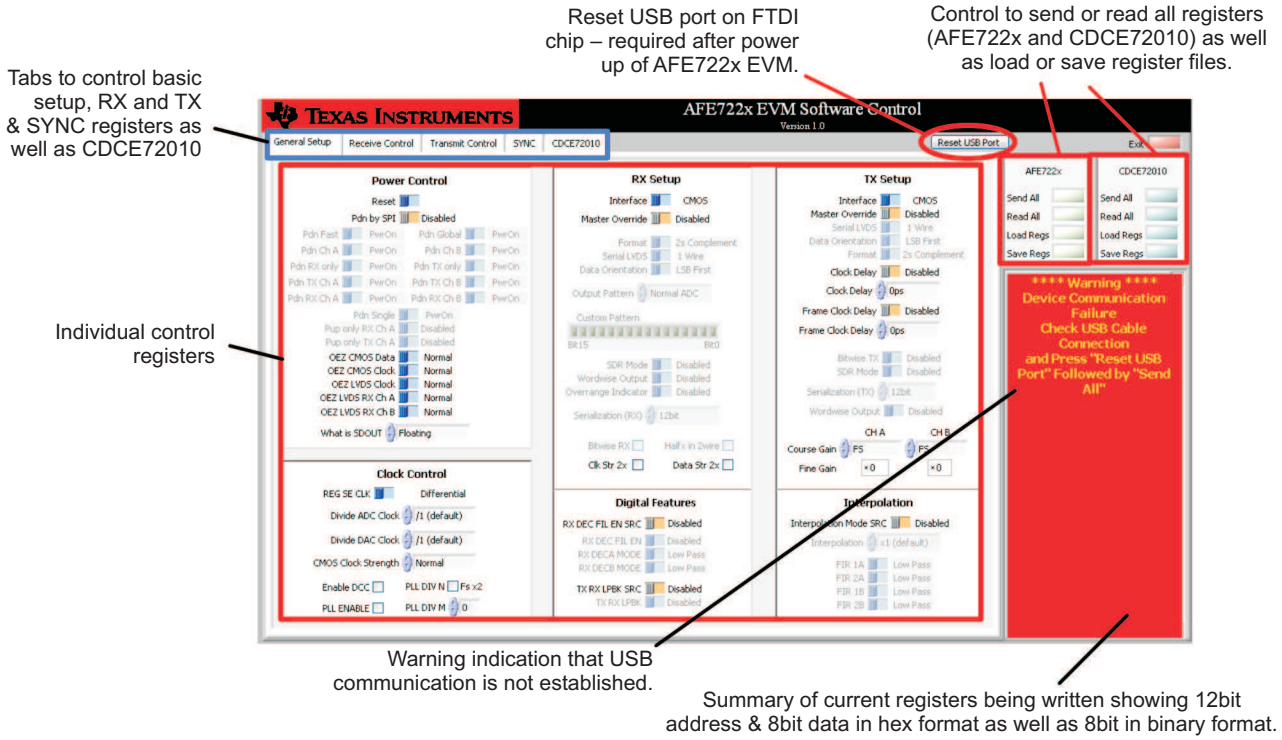


Figure 2. AFE722x EVM Software Control

The EVM software also provides the option to save all registers to a file or to load registers from a file.

4 Initial EVM Setup and Basic Test Procedure

The fastest way to get the AFE722x EVM up and running is to follow this operating procedure:

- Two signal generators should be connected to the clock and data input of the EVM - preferably with bandpass filter and 10-MHz reference locked for coherency.
- Clock input should be connected to *CDC AUX IN* input for AUX clock setup and the clock generator amplitude should be set to ~10–13 dBm.
- TSW1400 or TSW1405 (RX) capture card should be plugged in to the AFE722x EVM and connected to the PC via USB.
- TSW1400 or TSW1406 (TX) pattern generation card should be plugged into the AFE722x EVM and connected to PC via Ethernet cable.
- All appropriate power supplies should be connected – blue LED (D2) on AFE722x EVM indicating power good status.
- After performing USB reset in AFE722x EVM software, the flashing USB warning sign should disappear indicating successful USB communication.

Copyright © 2013, Texas Instruments Incorporated

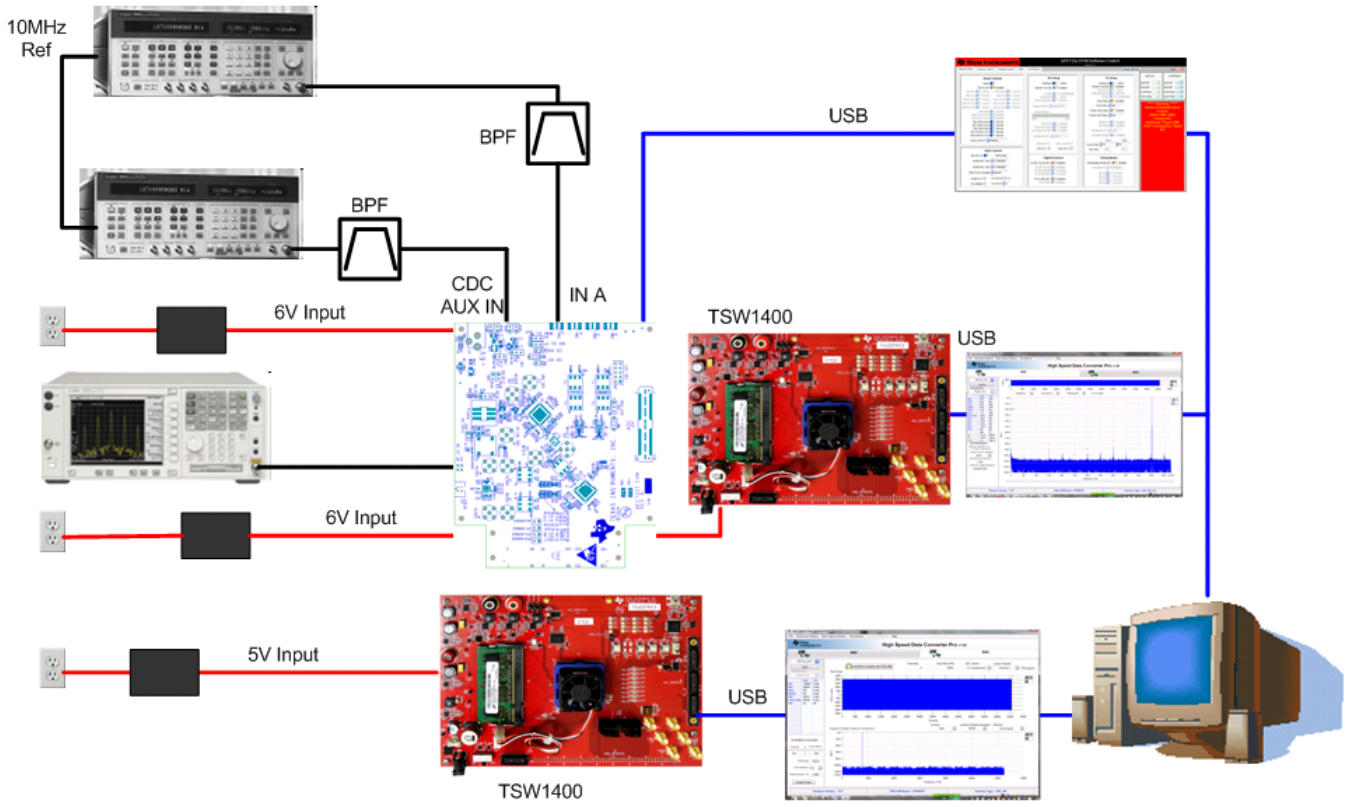


Figure 3. AFE722x EVM Setup

4.1 CDCE72010 Configuration

The initial EVM setup is configured so that the AFE722x can be operated at any desired sampling rate. Since the TSW1400 requires an external clock at ¾ of the AFE clock rate (see clocking section) the external clock applied to the *CDC AUX IN* connector needs to be 3× the AFE sampling rate (that is, 368.64 MHz for 122.88-MHz operation). Loading a preconfigured register file (*AUX IN - div3 AFE div4 TSW.txt*) to the CDCE72010, it then sets the dividers so that a /3 copy of the input clock is routed to the AFE722x clock input and a /4 copy to the TSW1400.

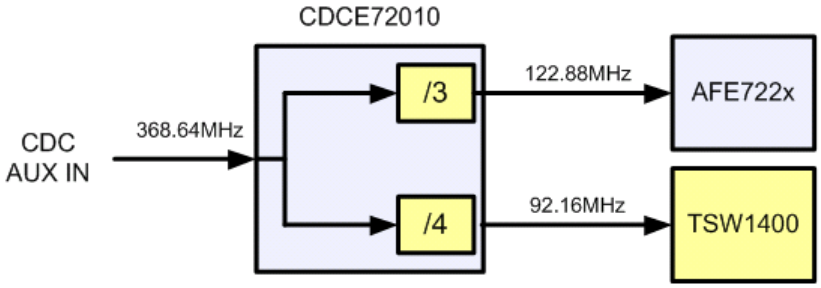


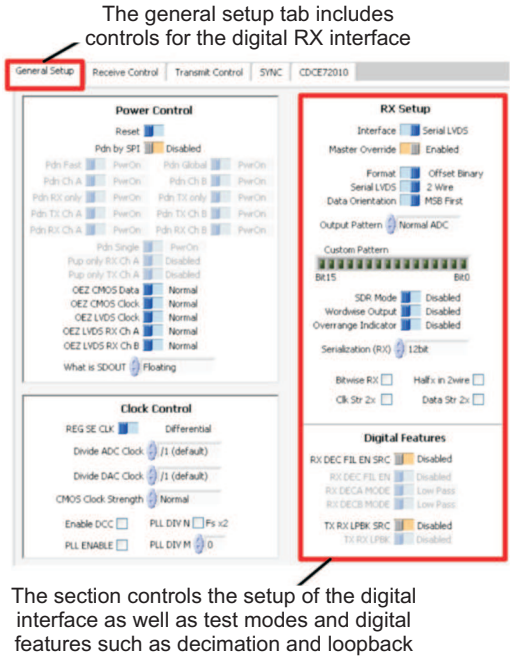
Figure 4. CDCE72010 Configuration

4.2 RX Path Using TSW1400

First the AFE722x digital interface needs to be configured to match the serial LVDS interface that the TSW1400 is expecting. The following control registers need to be set in the *General Setup* tab of the AFE722x programming software. Also, the USB communication warning sign should be monitored after the USB reset, to ensure proper communication with the AFE722x EVM.

Copyright © 2013, Texas Instruments Incorporated

Register Bit	Setting
Interface	Serial LVDS
Master Override	Enabled
Format	Offset Binary
Serial LVDS	2 Wire
Data Orientation	MSB First
SDR Mode	Disabled
Wordwise Output	Disabled
Bitwise RX	Disabled
Halfrx in 2wire	Disabled



In the TSW1400 software, select the AFE722x as the ADC. Next, enter the sampling rate and ADC input frequency and the TSW1400 software will calculate the coherent frequency.

Performing a capture should yield:

Fs = 122.88 Msps

Fin = 9.98625 MHz

Copyright © 2013, Texas Instruments Incorporated

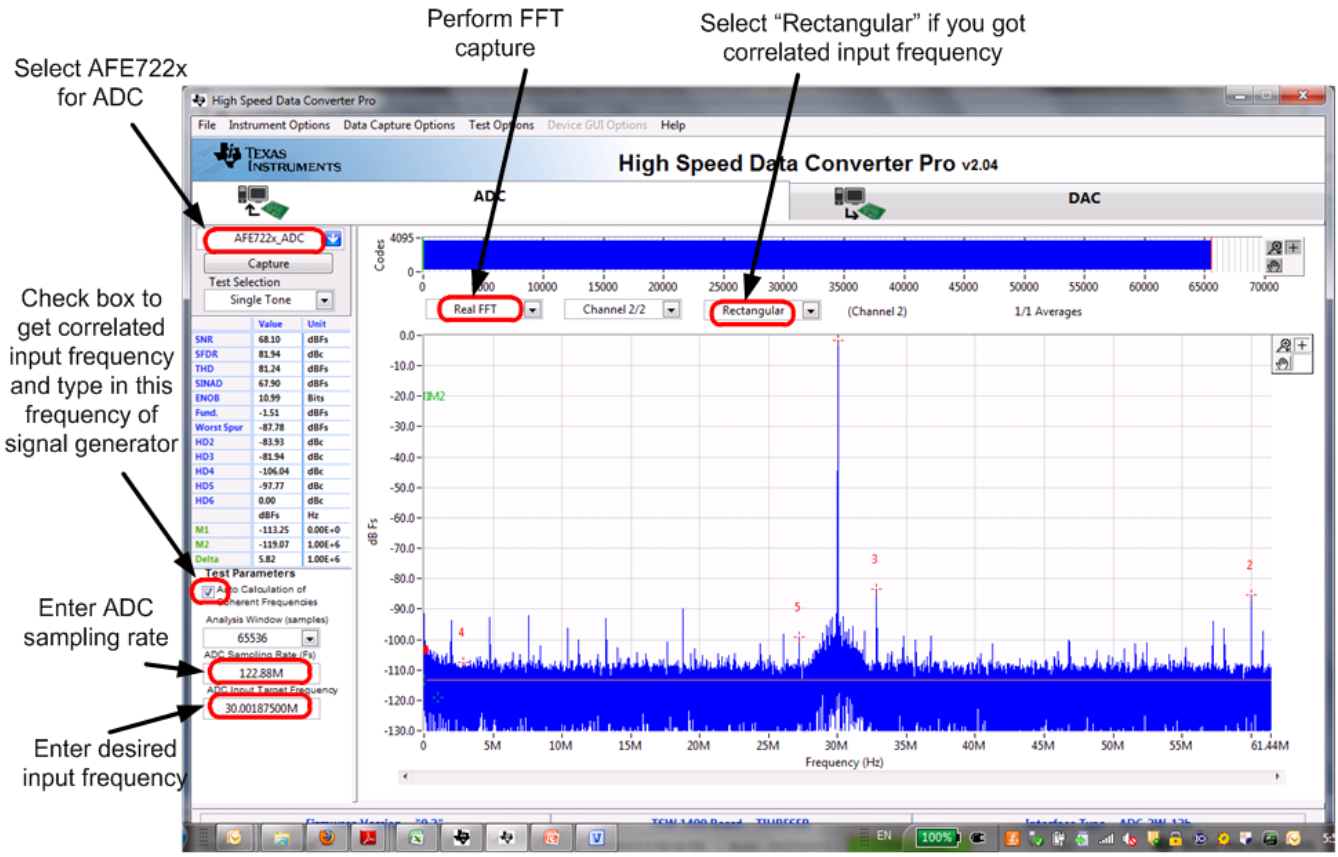


Figure 5. HSDCP Settings

4.3 TX Path Using TSW1400

Configure the AFE722x digital interface to match the serial LVDS interface from the TSW1400.

In the *General Setup* tab of the AFE722x programming software, set the control registers as shown in Table 1. Also, the USB communication warning sign should be monitored after the USB reset to ensure proper communication with the AFE722x EVM.

Table 1. Control Registers

Register Bit	Setting
Interface	Serial LVDS
Master Override	Enabled
Serial LVDS	2 Wire
Data Orientation	MSB first
Format	2s Complement
Clock Delay	Enabled
Clock Delay	300 ps
Frame Clock Delay	Disabled
Frame Clock Delay	0 ps

Copyright © 2013, Texas Instruments Incorporated

The data coming from the TSW1400 is edge aligned while the AFE722x expects the serial LVDS data to arrive edge centered. Here the programmable clock delay inside the AFE722x can be used to delay the edge-aligned clock closer towards the center of the data.

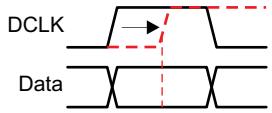


Table 2 shows clock delays for DAC sampling rates that showed proper operation.

Table 2. Clock Delays for Listed DAC Sampling Rates

DAC Sampling Rate	Suitable Clock Delay
130 Msps	0 ps to 900 ps
122.88 Msps	0 ps to 900 ps
100 Msps	0 ps to 1.2 ns
80 Msps	0 ps to 1.8 ns
65 Msps	0 ps to 2.1 ns
40 Msps	0 ps to 2.1 ns

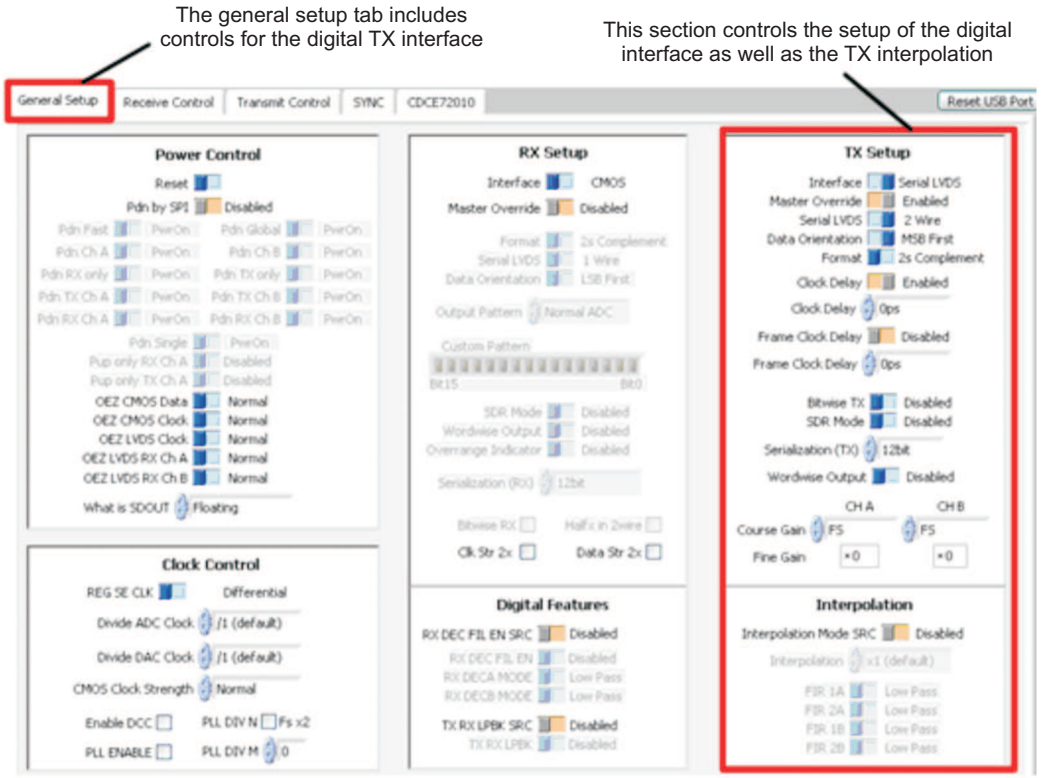


Figure 6.

For TX, the output data of the TSW1400 needs to be properly configured for 6× serialization using *High Speed Data Converter Pro*.

1. Install the latest High Speed Data Converter Pro GUI Installer from www.ti.com/tool/tsw1400evm
2. Open High Speed Data Converter Pro GUI
3. Enter *Data Rate* to DAC
4. Enter *Tone BW*, # and *Tone Center* frequency
5. Ensure match on data format between TSW1400 and AFE722x

Copyright © 2013, Texas Instruments Incorporated

6. Select *Create Tones*
7. Press the **Send** button

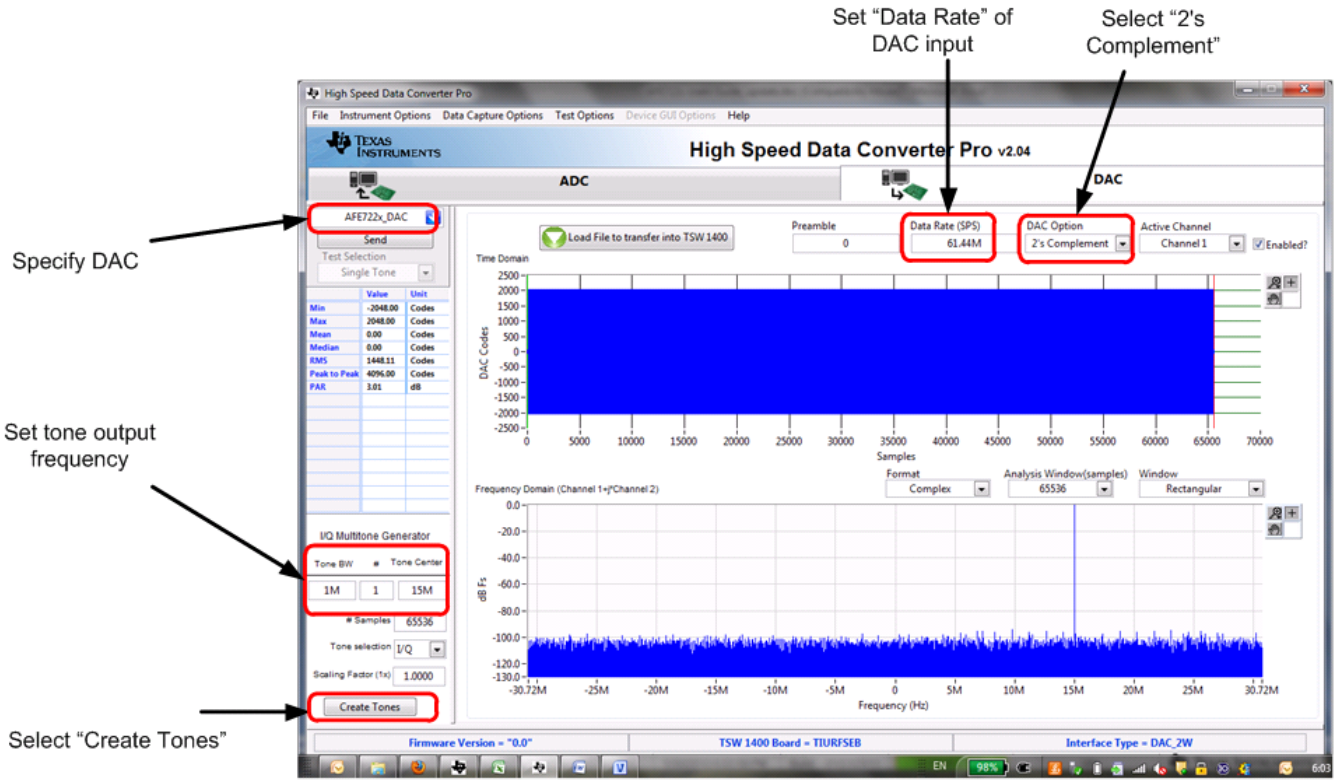


Figure 7.

The DAC output should show something like Figure 8 on the spectrum analyzer.

Copyright © 2013, Texas Instruments Incorporated

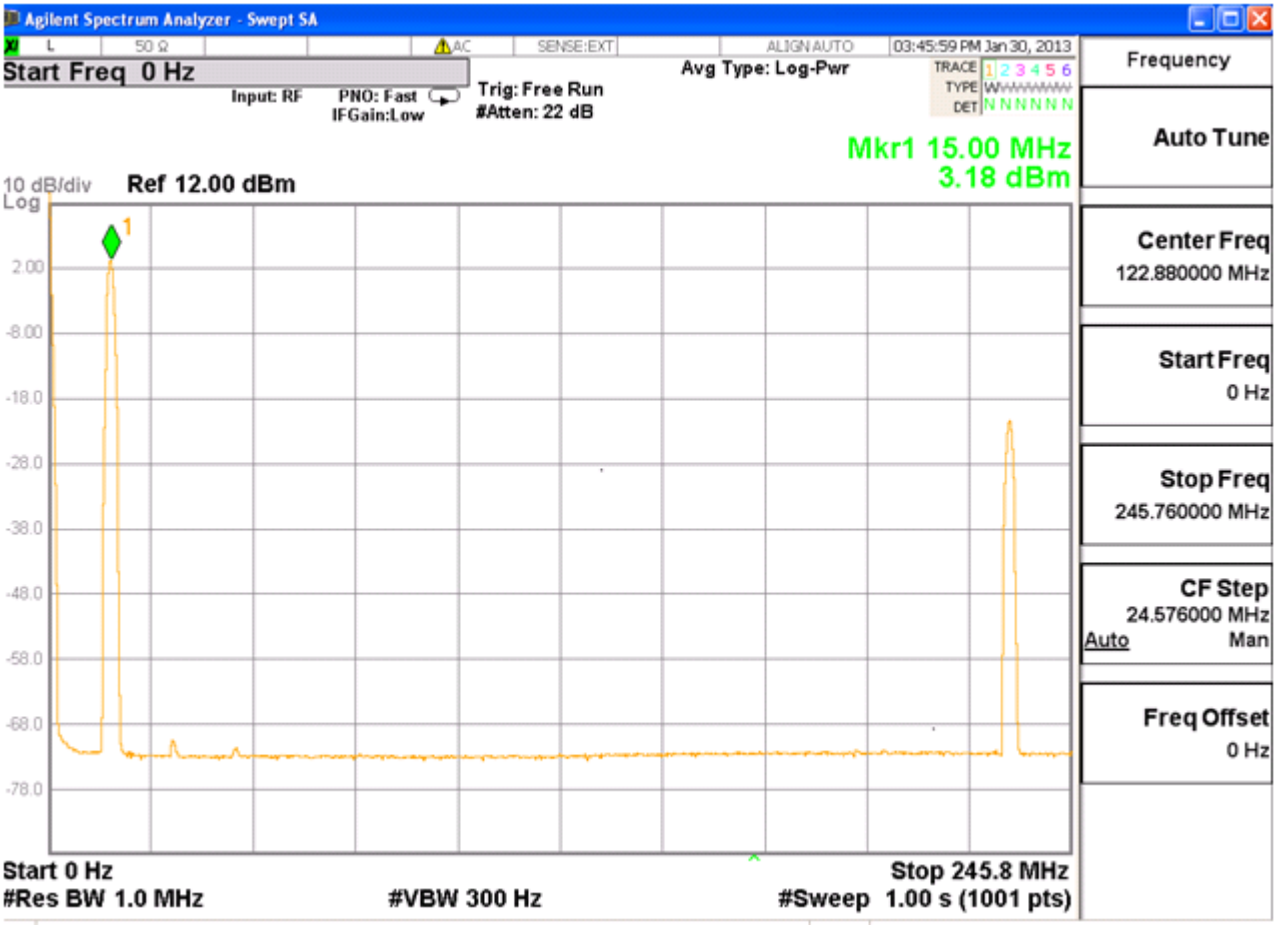


Figure 8. Spectrum Analyzer: Sample Rate = 245.76 Msps, Input Tone = 15 MHz

Copyright © 2013, Texas Instruments Incorporated

5 Power Supply Options

The AFE722x EVM is designed to operate from an external 6-V wall wart supply. An LDO generates a 5-V rail for the TRF3703 IQ modulator as well as for the low-noise LDOs, which are generating a 3.3-V and 1.8-V rail for the AFE722x and the CDCE72010. Alternatively, the 3.3-V and 1.8-V rails can be generated using DC/DC converters which operate directly from the 6-V input for maximum power efficiency.

The EVM provides options to disable unused circuits by means of pin headers. These headers can also be used for accurate power measurements where external power supplies can be directly connected to them.

Three pin headers allow a convenient change between powering the AFE722x and CDCE72010 either from a DC/DC converter or low-noise LDO.

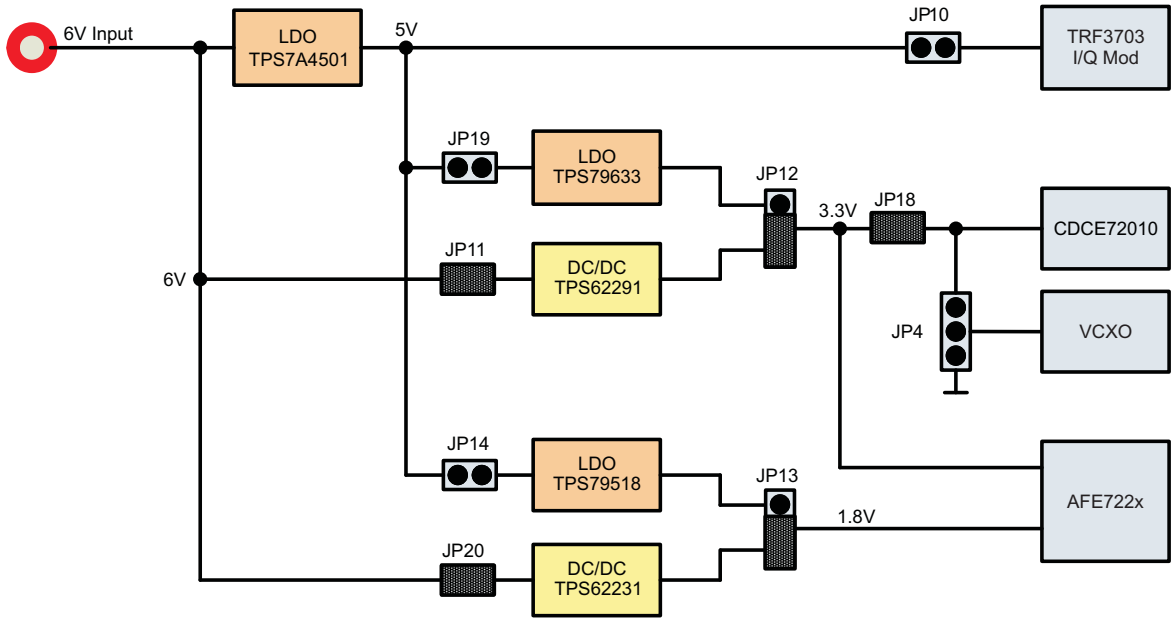
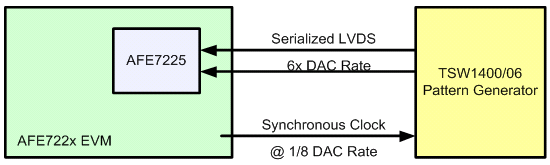


Figure 9. Power Supply Jumper Settings

6 Clocking Configuration

The AFE722x EVM offers 3 different options for providing the clock to the AFE722x as well as the supporting circuitry. The biggest challenge arises when using the DAC with the TSW1400 because the TSW1400 expects an input clock at 1/8 of the DAC input data rate. However, since the AFE722x is designed for the serial LVDS interface, the DAC data rate is 6x the actual AFE722x clock frequency. Hence, the clock to the TSW1400 needs to 6/8 = 3/4x the AFE722x clock frequency.



Copyright © 2013, Texas Instruments Incorporated

The CDCE72010 clock buffer on the AFE722x is used to provide the clock to the TSW1400. Additional dividers can be added to the clock output in order to divide the clock appropriately for optional interpolation by 2x or 4x.

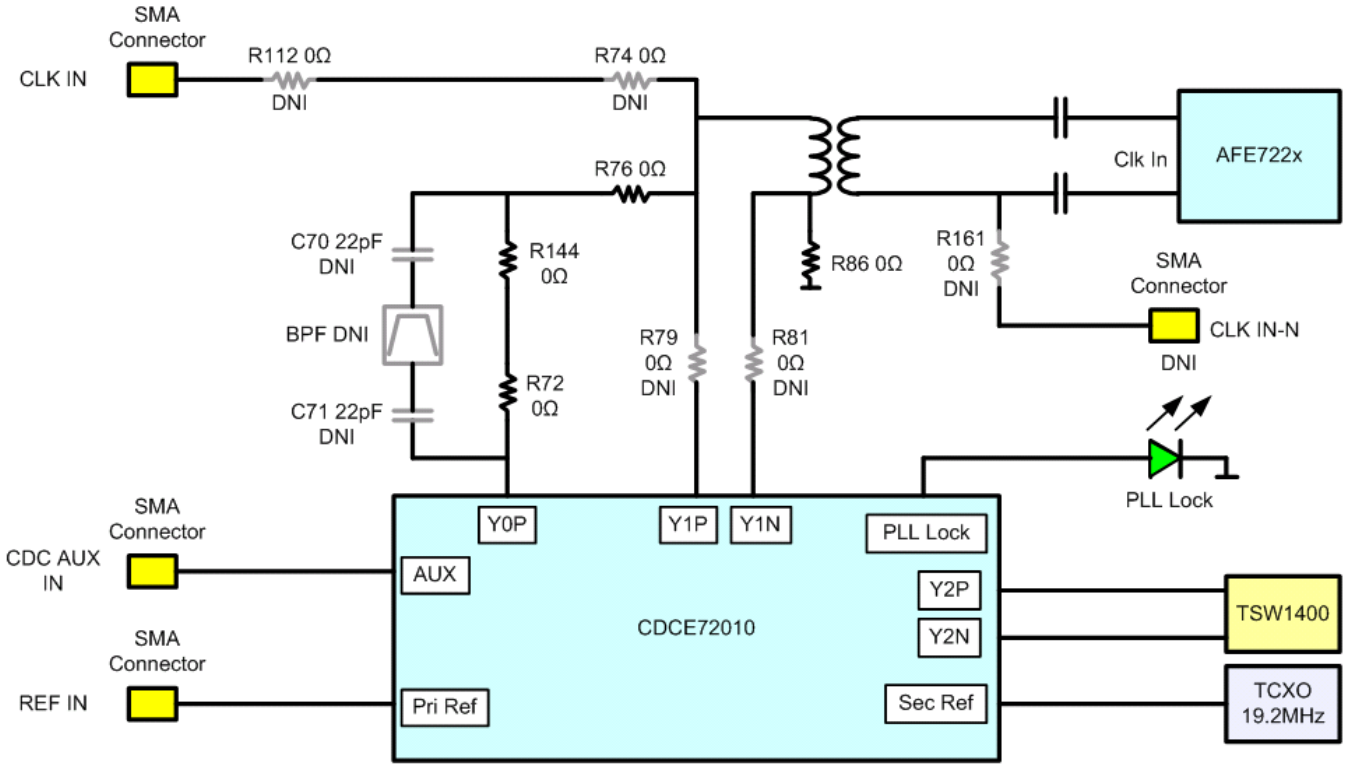


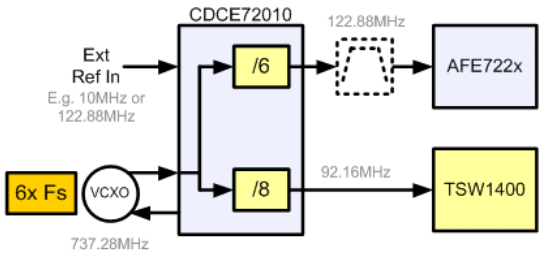
Figure 10. Configuration of Clock Output in CDCE72010

Preconfigured setup files:

AUX IN – INT2x – div3 AFE div8 TSW.txt	ext 3x clock to CDC AUX IN (see Section 6.5)
AUX IN – div3 AFE div4 TSW.txt	ext 3x clock to CDC AUX IN (see Section 6.1)
REF IN (10MHz) – div6 AFE div8 TSW.txt	ext 10MHz clock on REF IN (see Section 6.2)
REF IN (10MHz) – INT2x – div6 AFE div16 TSW.txt	ext 10MHz clock on REF IN (see Section 6.2/Section 6.5)
REF IN (122.88MHz) – div6 AFE div8 TSW.txt	ext 122.88MHz clock on REF IN (see Section 6.2)

6.1 Non-VCXO Option (Default)

This setup is the default configuration and provides the option to operate AFE722x and TSW1400 synchronous at any arbitrary sampling rate without the use of a VCXO. This setup is useful for testing the AFE722x at clock frequencies where a VCXO is not immediately available.

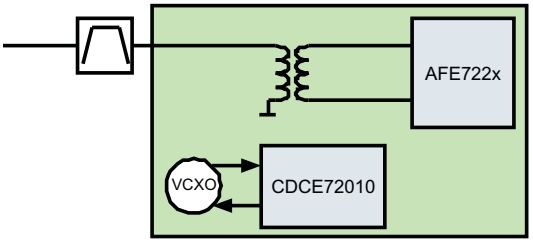


Copyright © 2013, Texas Instruments Incorporated

6.2 System Level

In this system configuration on the EVM a VCXO at 6x the desired clock frequency is required – alternatively a different VCXO frequency can be used and the internal CDCE72010 dividers adjusted accordingly. An external reference can be locked to the VCXO for coherency using the CDCE72010. In this configuration the CDCE72010 provides a /6 copy of the VCXO to the AFE722x clock input as well as a /8 copy to the TSW1400.

Also, the AFE722x EVM offers a placeholder for a surface mount bandpass filter between the CDCE72010 and AFE722x to limit the clock phase noise.



6.3 RX Only

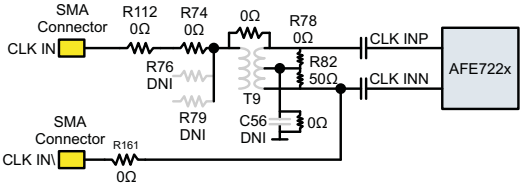
When testing only the ADCs for maximum performance, the EVM provides an option to connect an external clock directly to the AFE, bypassing the CDCE72010. R74, R76 and R112 need to be modified from their default configuration.

The DACs of the AFE can still be operated, however, the TSW1400 can't be used for data generation as no feedback clock is provided to it.

This option provides the lowest possible jitter option when combined with an external bandpass filter.

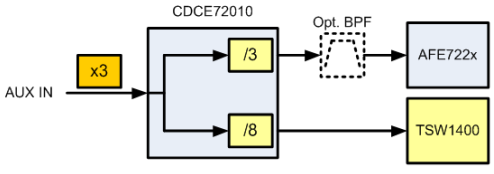
6.4 RX and TX Independent Clocking

The AFE722x supports an option to run the dual ADCs at a different sampling rate than the dual DACs. With a few resistor changes, the clocking circuitry on the AFE722x EVM can be configured to support that feature. However, in this scenario the CDCE72010 is bypassed and no clock is routed back to the TSW1400. Hence an additional clock needs to be provided and the CDCE72010 configured with the appropriate output divider to match the AFE722x DAC clock rate with the data rate from the TSW1400 (see Section 6.1 and Section 6.2).



6.5 Interpolation on the DAC

The AFE722x offers 2x and 4x interpolation of the DAC output data. In order to employ interpolation on the DAC, the clock going to the TSW1400 needs to be divided accordingly. For example, interpolation by 2x in the DAC requires that the data coming from the TSW1400 arrives at ½ of the AFE722x clock frequency.



Copyright © 2013, Texas Instruments Incorporated

6.6 Decimation on the ADC

On the receive channels of the AFE722x, the output can be decimated by 2x using the on-chip FIR halfband filter. This has no impact on the clock requirements to the AFE722x – it merely reduces the output data rate by a factor of 2x and settings (sampling and input frequency) on the TSW1400 capture card or other data capture tool need to be adjusted accordingly.

7 RX Setup

The RX section of the AFE722x is controlled on two separate tabs of the EVM software.

In the 'General Setup' tab are the control registers for the digital interface such as CMOS or serial LVDS output, for example. In order to use the TSW1400 to capture the received data, the following register settings are required:

Register Bit	Setting
Interface	Serial LVDS
Master Override	Enabled
Format	Offset Binary
Serial LVDS	2 Wire
Data Orientation	MSB First
DSR Mode	Disabled
Wordwise Output	Disabled
Bitwise RX	Disabled
Halfrx in 2wire	Disabled

This tab also controls the register to set the digital interface to test pattern mode and custom patterns can be loaded as well. Furthermore RX decimation settings as well as TX RX loopback mode are controlled here as well.

The general setup tab includes controls for the digital RX interface

The section controls the setup of the digital interface as well as test modes and digital features such as decimation and loopback

Copyright © 2013, Texas Instruments Incorporated

The other portion of the RX setup is located on the *Receive Control* tab which includes register access for the mixing stage, power meter, and power options for the digital RX section. Also, the auxiliary ADC registers are configured on this tab.

Figure 11. Receive Control Tab in RX Setup

8 TX Setup

For the transmit output, the AFE722x EVM provides an option to directly route the DACs to SMA connectors as well as an option to connect the dual DAC to an IQ modulator (TRF3703) for direct up-conversion. shows the two options and the relevant 0Ω resistors to switch between them.

When using the IQ modulator, there is a separate SMA connector on the EVM for the LO input. Also there is a low pass filter between DAC and IQ modulator for image suppression with a default cut off frequency of 125 MHz.

Copyright © 2013, Texas Instruments Incorporated

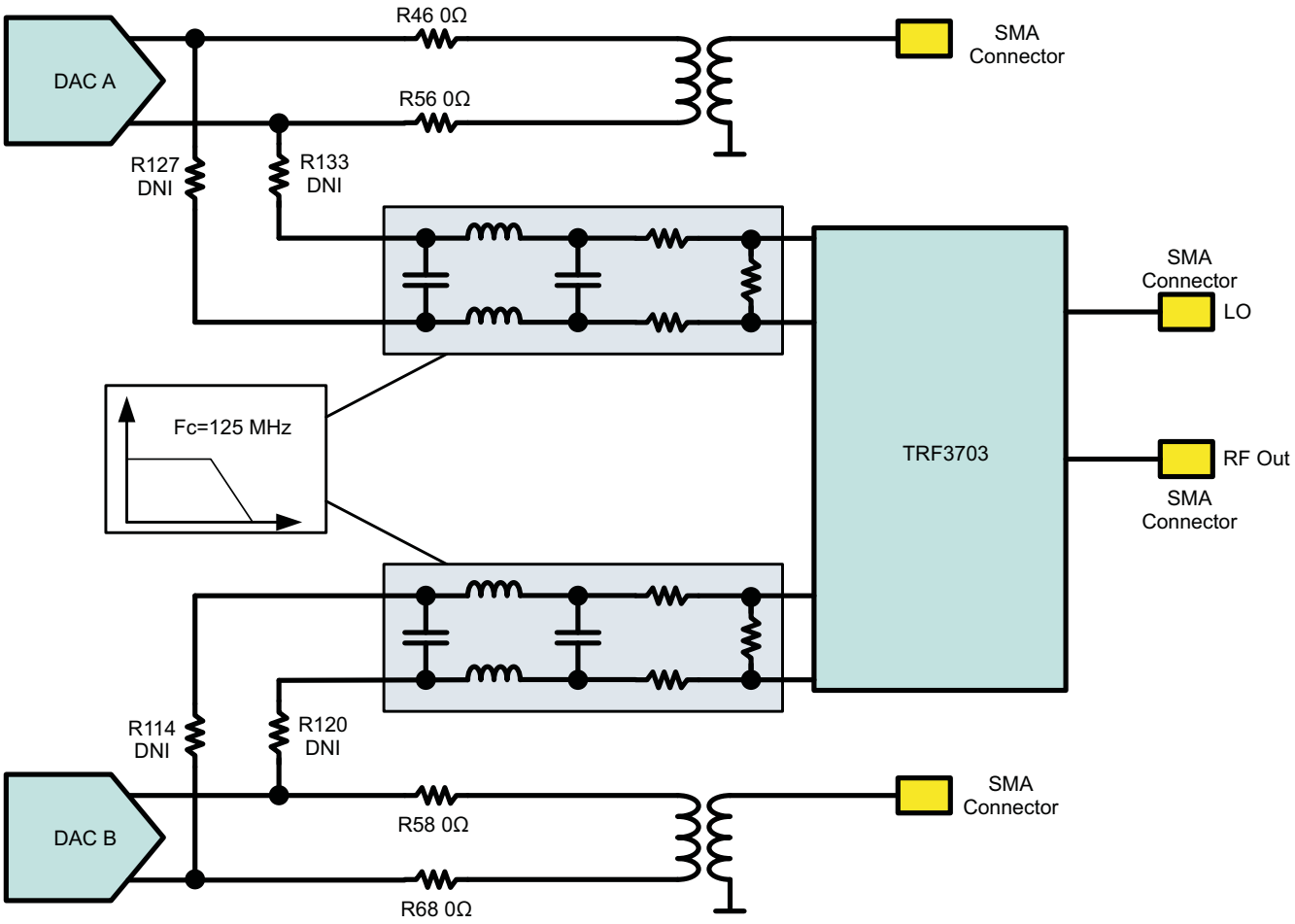
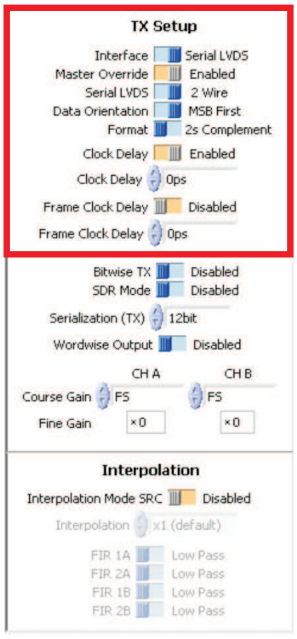


Figure 12. AFE722x Schematic

When using the TSW1400 as a pattern generator for the AFE722x, first the digital interface needs to be configured to match the serial LVDS interface from the TSW1400.

The following control registers need to be set in the *General Setup* tab of the AFE722x programming software.

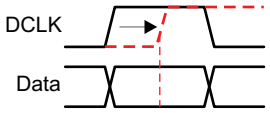
The USB communication warning sign should also be monitored after the USB reset to ensure proper communication with the AFE722x EVM.



Register Bit	Setting
Interface	Serial LVDS
Master Override	Enabled
Serial LVDS	2 Wire
Data Orientation	MSB First
Format	2s Complement
Clock Delay	Enabled
Clock Delay	300 ps
Frame Clock Delay	Disabled
Frame Clock Delay	0 ps

Copyright © 2013, Texas Instruments Incorporated

The data coming from the TSW1400 is edge aligned while the AFE722x expects the serial LVDS data to arrive edge centered. Here the programmable clock delay can be used to delay the edge-aligned clock closer towards the center of the data.



The table below shows clock delays for the listed DAC sampling rates that showed proper operation:.

DAC Sampling Rate	Suitable Clock Delay
130 Msps	0 ps to 900 ps
122.88 Msps	0 ps to 900 ps
100 Msps	0 ps to 1.2 ns
80 Msps	0 ps to 1.8 ns
65 Msps	0 ps to 2.1 ns
40 Msps	0 ps to 2.1 ns

The other portion of the TX setup is located on the *Transmit Control* tab which includes register access for the mixing stage, FIFO, Loopback and power options for the digital TX section. The auxiliary DAC registers are also configured on this tab.

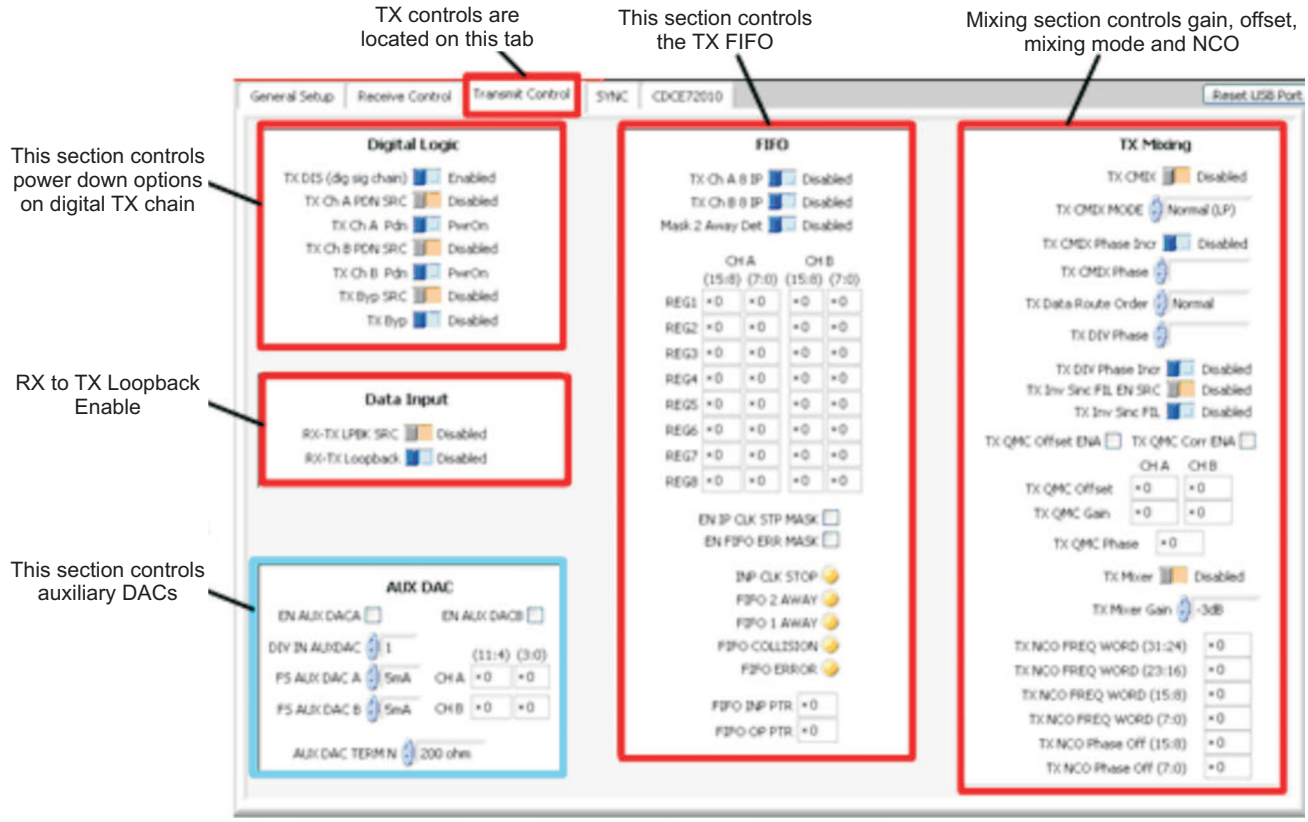


Figure 13. Transmit Control Tab in TX Setup

Copyright © 2013, Texas Instruments Incorporated

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated