Value Soundbar Reference Design Kit Development Guide

This document assists users in quickly setting up and using the Texas Instruments Value Soundbar Reference Design Kit.

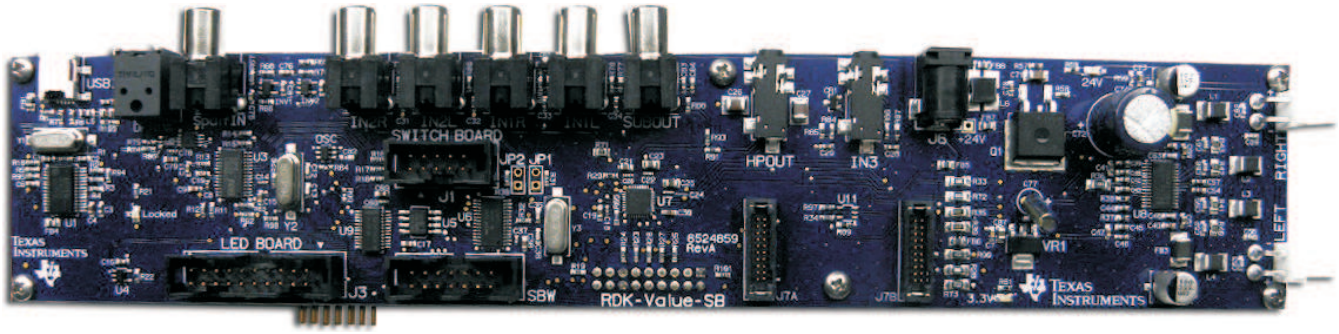
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1 Introduction



This document introduces the Value Soundbar Reference Design Kit from Texas Instruments. This reference design is the first of many that will span the complete market, from entry-level soundbars (ADC + I^2S input amplifier) through to high-performance, multichannel soundbar reference designs incorporating Dolby AC-3 decoders, etc.

The primary market of this value-level soundbar reference design is LCD television accessories; a secondary market is docking stations and gaming accessories.

Different stuffing options on the board allow the system to be configured for various I/O options, including S/PDIF, USB, wireless subwoofer, and even simple upgrades of the power stage.

The intent of this reference design is for customers to be able to go to production within 8 weeks of receiving documents. Everything is provided, even the hardware for factory production programming.

2 Specification

2.1 Inputs

- 3x analog stereo inputs (maximum input level set by stuffing resistors)
- 2x stereo RCA connectors
- 1x 3,5-mm jack (for simple MP3 connection)
- 1x coaxial S/PDIF input (stuffing option)
- 1x optical S/PDIF input (stuffing option)
- 1x USB streaming controller (stuffing option).
  - This streaming controller is only for personal computer (PC) connections. It cannot be used with memory sticks or portable media players (e.g., iPod™).
    - The PCM27xx device used is a USB slave, not a USB host.

2.2 Processing

2x miniDSP cores, running at 50 MIPS each, programmed using the Purepath™ Studio graphical interface.

2.3 Outputs

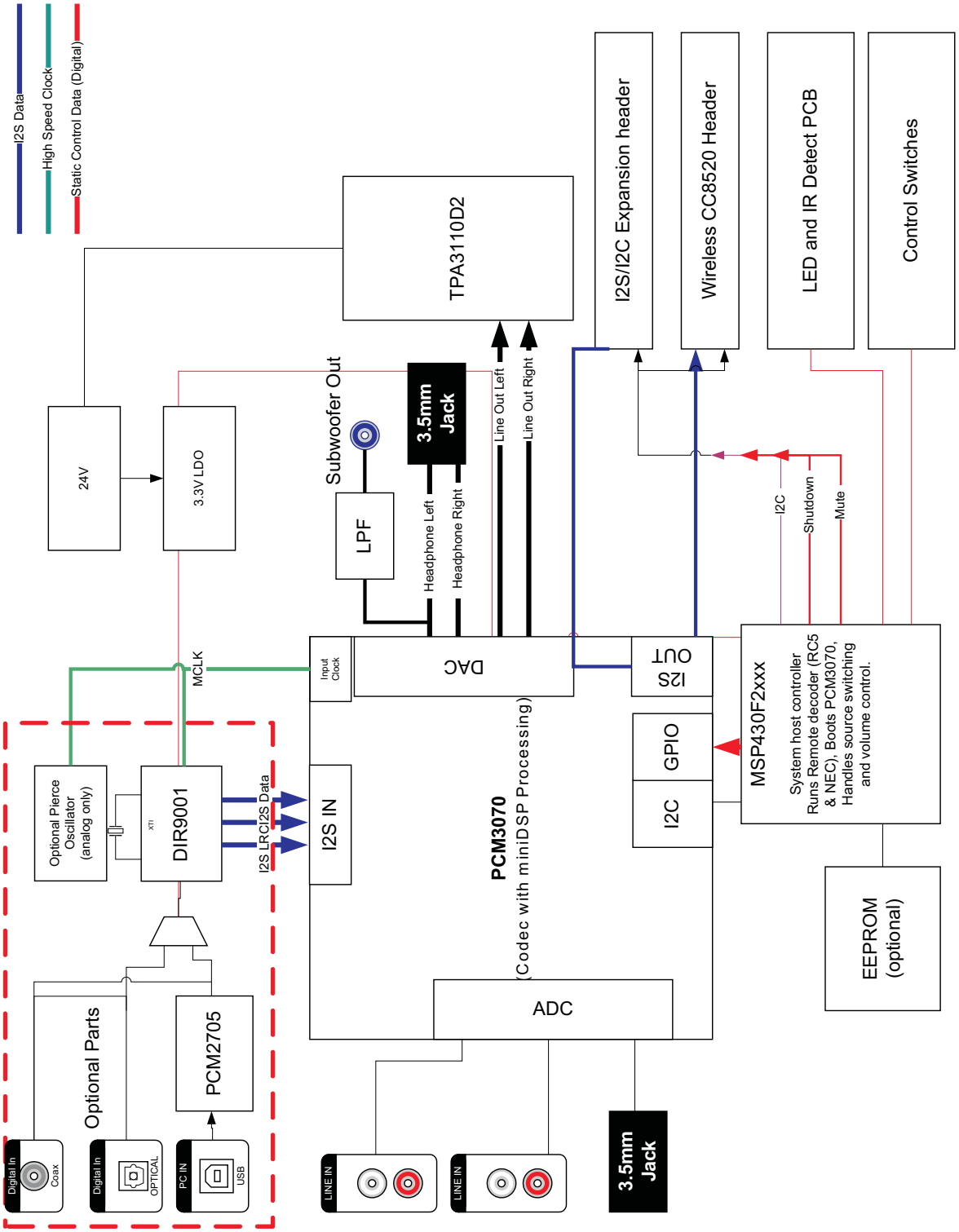
- 2x 15-W amplifier (TPA3110D2)
- Stereo headphone output on 3,5-mm stereo jack
- Mono subwoofer output on RCA
- I^2S and I^2C additional header for 2-channel expansion (e.g., wireless subwoofer, extra stereo pair, etc.)

2.4 Power Supply

- 2,1-mm barrel jack for a 24-Vdc, 2-A external power supply

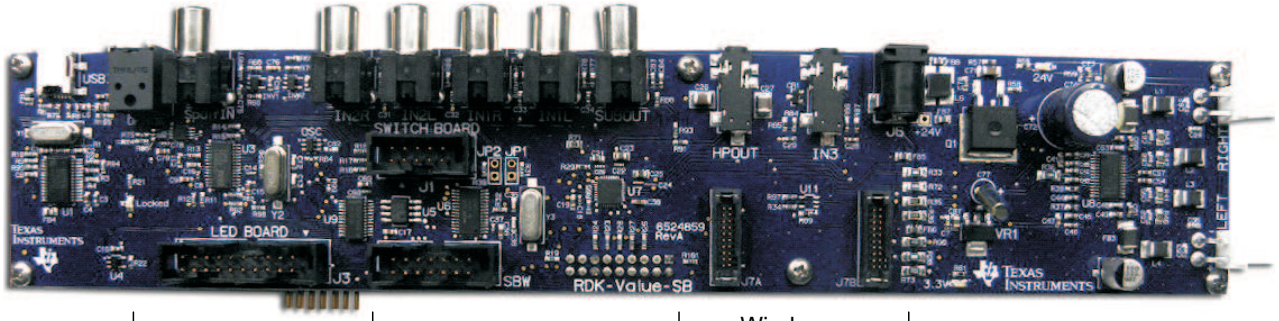
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3 High-Level Block Diagram



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4 Hardware Description



PCM2705 Streaming USB Input	DIR9001 S/PDIF Inputs	Host MSP 430 F2132 and PCM 3070 Audio Codec	Wireless CC 8520 Module Interface	Power Supply and TPA 3110 D2 Power Amplifier

The core converter and processor in this reference design is the PCM3070 codec. The reference design takes advantage of the two different outputs available on the PCM3070: namely, the main DAC output and the I^2S output to provide up to four different signal outputs. This allows systems with additional wireless subwoofers or extra DAC pairs to be added easily on dedicated headers on the printed-circuit board (PCB).

Two of the three S/PDIF options can be brought into the PCM3070 codec. Optical, coaxial, and USB PC audio are available using different stuffing options. See the hardware customization section for more details. For USB functionality, the S/PDIF input circuit must also be enabled.

IN1x through IN3x are brought through potential dividers to lower their level from 2 Vrms to acceptable ADC input levels. They are also dc-coupled.

Line out L and R (LOL and LOR) are taken to the TPA3110D2.

The headphone outputs from the PCM3070 can be used for either headphone outputs (through HPOUT) or a simple analog subwoofer output (SUBOUT).

J7A and J7B are designed to be connected to the Chipcon CC8520 daughtercard. Program the card using TI's CC8520 Configuration software in autonomous mode. In this mode, a simple *pair* signal can be sent from the MSP430 to have the device pair with a wireless subwoofer.

J2 is a generic IDC header that brings out I^2C and I^2S interfaces for use with extra outputs (such as TAS57xx amplifiers or PCM17xx DACs). It is also the interface that is used to program the board (with I^2C) with the Soundbar Programmer board.

On the amplifier side of the board, the TPA3110D2 is used on a 24-V rail to provide a low distortion 15-W x 2 output. U11 (AND gate) is used to allow the amplifier to be put into reset by the MSP430 or the internal fault signal from the TPA device. In addition, the R89 pulldown resistor holds the shutdown pin low until the MSP430 finishes its start-up process and unmutes the amplifier.

Two extra cards are printed on the board and are designed to be separated from the PCB. The first is the LED and IR receiver board. Typically, it is mounted on the front of the soundbar to give users feedback on the current volume status, the input being used, and any additional processing.

The other board used is a switch board, typically found at the top of the soundbar, giving access to eight pushbuttons.

5 Hardware Customization Options

5.1 Inputs

Three different configurations can be used for the S/PDIF inputs. Three input devices are made available for stuffing options – COAX S/PDIF, Optical S/PDIF, and USB (S/PDIF); however, only two of the three can be used in production.

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U2 is the S/PDIF selector for the input to the DIR9001 S/PDIF receiver.

The coaxial input is brought through INV1 and INV2 to the Y2 input of U2.

The optical input is brought directly to the Y1 input of U2.

If either the coaxial or optical input needs replacing with the USB circuitry, then R74 or R75 can be used in place.

For instance, if the optical input is not required, then using a 0-Ω resistor in R75 connects the S/PDIF output of the PCM2705 USB DAC directly to the Y1 input.

If the coaxial input is not required, then R74 can be populated, which brings the USB S/PDIF output to input Y2 of the USB selector switch (U2).

If no S/PDIF or USB inputs are required, then the DIR9001 can be removed from the bill of materials, as well as its supporting circuitry. The clock generator IC OSC must be populated (see the following text).

5.2 Clocking the System

Master clock generation is done either from the S/PDIF recovered signal, or from Y2 – the crystal connected to the DIR9001. In systems where the DIR9001 is populated, then device OSC (SN74LVC1GX04DBVT) can be omitted from the assembly.

In analog-only products (no S/PDIF or USB), Y2, C13, and C12 must still be populated, as well as R64, C82, and OSC. This creates a stand-alone master clock generator. If in S/PDIF mode, then C82 and OSC must be omitted

5.3 Outputs

The RCA connector SUBOUT can replace the 3,5-mm jack HPOUT. This allows users to create a low-cost 2.1 soundbar, using a mono-mix with a low-pass filter for the subwoofer.

For systems that require a headphone output (such as a computer monitor soundbar), 0-Ω resistor R91 can be used. This sends the outputs through the HPOUT connector. In systems that do not require the headphone output, but do require an extra subwoofer output, then R93 (0 Ω) must be populated. This patches HPR through a low-pass circuit and a dc blocking capacitor.

For this basic 2.1 output mode, a standard left and right output can be transmitted through LOL (line out left) and LOR (line out right); then, an internal mono-mix can be created with the mixer for HPR (headphone right). Note that the mono-mix available on the headphone outputs is essentially LDAC_M and RDAC_P. This causes the outputs to subtract, not always useful for subwoofers. One way around this is to rewire the inputs to the TPA3110D2 so that LOR is sent to the inverting input, rather than the noninverting input, thereby inverting one of the DAC outputs in software.

If you are only manufacturing an analog input, another solution is to create a basic mono-mix of the inputs and send the unprocessed mix of both to HPR using MAL and MAR bypasses. This avoids the phase subtraction. See the PCM3070 data sheet and application reference guide for more details on the routing available from HPR.

Once you have a summed additive mono-mix, R88 and C84 then can be used to create a low-pass filter, ensuring that only the low frequencies (that have no directional information in them) are amplified by the externally powered subwoofer.

6 Programming and Development Hardware

6.1 Soundbar Programmer Board

Attached to the Value Soundbar Reference Design Kit is a Soundbar Programmer board. This is an interface to connect the soundbar to your PC for Purepath™ Studio development. It allows development and customization of the audio processing in-system, rather than on a separate evaluation board. Details for using the programming board as an interface to develop with the Value Soundbar Reference Design Kit can be found in the subsequent sections of this document, as well as in help guides on http://e2e.ti.com.

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The board also can be remade with pogo pins for production programming. Details on using the board for production will soon be available on the http://e2e.ti.com.

6.2 MSP430 Programmer

Included in the kit is an MSP430 in-circuit programmer (FET430UIF). This can be connected directly to the top board (RDK-Value-SB) when needed during development and connected to the Soundbar Programmer board when moving to volume production.

7 Software

Two sets of code are required to get the system up and running. One set is for the MSP430 host controller, and the other is for the PCM3070. For more details, including short tutorial videos, search http://e2e.ti.com for RDK-Value-SB.

Those files are available for download from the RDK-Value-SB product folder at:
http://focus.ti.com/docs/toolsw/folders/print/rdk-value-sb.html

In short, software must first be developed for the audio processing, then the host controller (MSP430) code.

7.1 MSP430 Code

TI provides a baseline for the MSP430 host controller that does the following:

- Selects the input (Analog 1,2,3, Coax S/PDIF, or Optical S/PDIF/USB)
- Decodes remote control signals for both RC-5 and NEC protocols.
- Handles front-panel responsibilities (LED display for input, mute, and volume)
- Extracts PCM3070 miniDSP code from the onboard EEPROM and downloads it to the PCM3070.

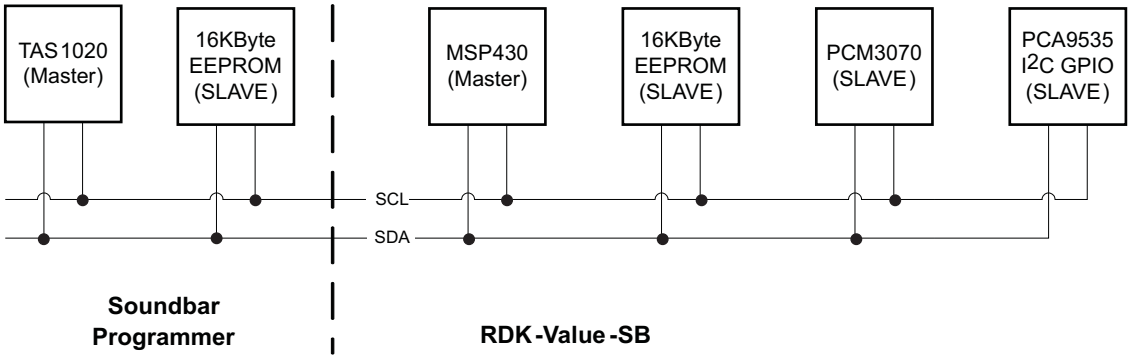
7.2 PCM3070 miniDSP Process Flow

The other set of code is typically held in the EEPROM for download to the PCM3070. This code can be developed in Purepath™ Studio.

8 System Communication and Control Flow

The whole system is controlled over the I^2C bus, with additional GPIO for individual control signals (such as amplifier shutdown, button presses, and LED on/off).

The I^2C bus has the following topology:



In a typical final product, the Soundbar Programmer board is not attached. It is only be used for development, and potentially, production line programming. The power supply on the RDK-Value-SB actually powers the TAS1020 streaming controller on the RDK-Value-SB. As such, the 3V3 regulator on the soundbar may dissipate a little more heat in development than in final use.

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During development, having two I^2C masters on the bus (MSP430 on the soundbar and the TAS1020 I^2C programmer) may cause some contention. However, providing that both masters are not trying to access the bus at the same time, device miscommunication will not occur. TI strongly recommends that the MSP430 must always wait a short time before executing its own code, to give the TAS1020 Soundbar Programmer time to boot.

In production, always program the EEPROM before programming the MSP430. This ensures that only the TAS1020 (for the EEPROM) controls the I2C bus from the MSP430 (runtime host).

8.1 Typical Software Flow for the MSP430 Host

Startup

1. Power On
2. Hold TPA3110D2 amplifier in Shutdown mode, while the system boots (no pop/click)
3. Wait while TAS1020 Programmer board reads its firmware from the EEPROM.
4. Start reading PCM3070 firmware from EEPROM and writing each byte to the PCM3070's registers.
5. Set up LEDs, etc., on the PCM9535 I^2C Expander.
6. Go to sleep, and wait for interrupt from button press or IR receiver.

Interrupt Routine

1. Detect which button was pressed (or IR command sent)
2. Write appropriate values for GPIO (multiplexers and Shutdown, etc.)
3. Write appropriate PCM3070 commands.

9 Getting Started

9.1 Contents of the Box

The RDK-Value-SB contains the following items:

- 1x RDK-Value-SB circuit board, with the Soundbar Programmer board preattached
- 1x LED board
- 1x Button board
- 1x 24-V, 2.5-A external power supply and cable
- 1x MSP430 programmer (FET430UIF)
- 1x Stereo RCA-RCA cable
- 1x Stereo RCA-3,5-mm jack
- 1x Mono RCA-RCA (for S/PDIF)

9.2 What else is needed to get sound out of the kit?

To get audio out of the design, you need a pair of passive speakers (with a rated capacity of at least 8 Ω, ~15 W) and some speaker cables with some 2-pin JST 3,96-mm connectors (the male pair is B2PS-VH(LF)(SN), the female connector is VHR-2N (plus the terminals).

Once the speakers are connected, connect the LED board and the switch board using the included ribbon cable, with pin 1 being located nearest the small white triangle on the PCB silkscreen.

With the two accessory boards connected and the speakers connected, connect an analog audio source to IN1L and IN1R. Ideally, a 2-Vrms source is used for maximum volume output.

Once that is connected, connect the 24-V power supply.

You now have audio running through your system.

The user interface (button board) is self-explanatory for input selection.

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NOTE: The USB cable for the Soundbar Programmer board must only be connected after the RKD-Value-SB is powered up.

10 Software Development Flow

10.1 Preparation

TOOLS required:

- Purepath™ Studio Graphical Development Environment (Home Audio)
- PCM3070 Control Software (http://www.ti.com/lit/zip/sloc229)
- IAR Kickstart Tools for MSP430

Recommended reading: PCM3070EVM-K application reference guide (SLAU331)

NOTE: The Programmer Board is designed to emulate the I2C interface of the PCM3070EVM-K (i.e., when you plug in the programmer, it looks like the PCM3070EVM-K).

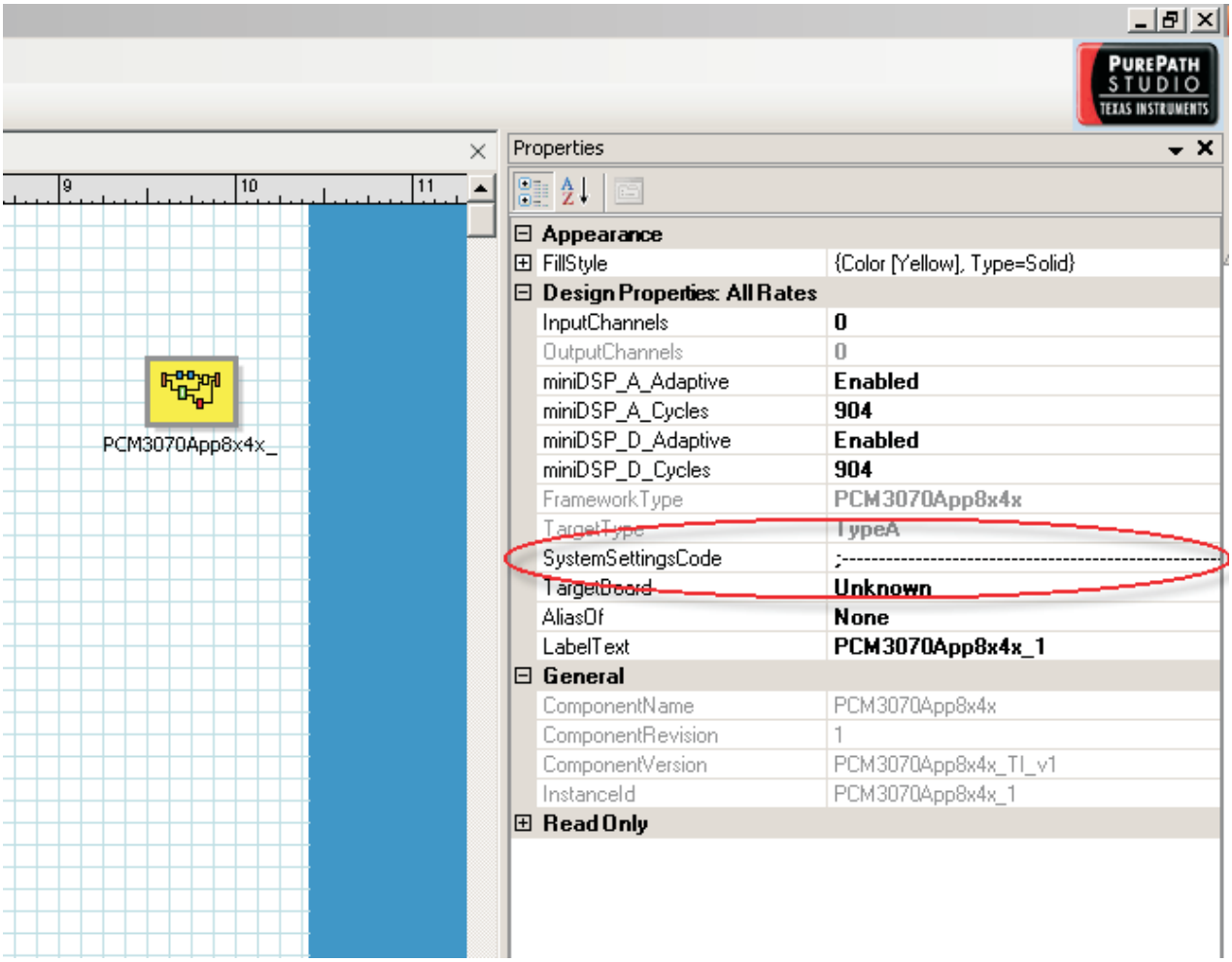
10.2 Software Development Step by Step

Download the example code from the RDK-Value-SB Product Folder. It should contain an MSP430 project and code files for use with IAR Kickstart for MSP430, and a PCM3070 PFW (Process Flow) for use with Purepath Studio Home.

Download and unzip the files to your hard drive before starting any modification.

1. Connect and power up system.
   (a) Connect speakers.
   (b) Connect analog audio source on IN1L and IN1R.
   (c) Expected result: working hardware is confirmed.
2. Develop your own audio process flow.
   (a) Only connect USB to Programmer board after power up. (This gives the TAS1020B time to boot.)
   (b) Open PCM3070 Control Software; confirm connection and firmware, etc.
   (c) Open Purepath™ Studio.
   (d) Open the default process flow (available from the RDK-Value-SB folder).
   - The RDK-Value-SB process flow actually contains extra PCM3070 commands that set up the board differently than the EVM (e.g., input gain settings, sampling rate, etc.). See the following image to see the custom system settings.

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(e) Modify the process flow as needed, then click TOOLS → Download Code.

(f) Confirm that your speaker system now sounds different with an analog input.

(g) Click TOOLS → Disconnect

(h) Expected result: Your system now is playing back with your audio processing.

3. Download miniDSP code into the EEPROM on the Soundbar PCB.

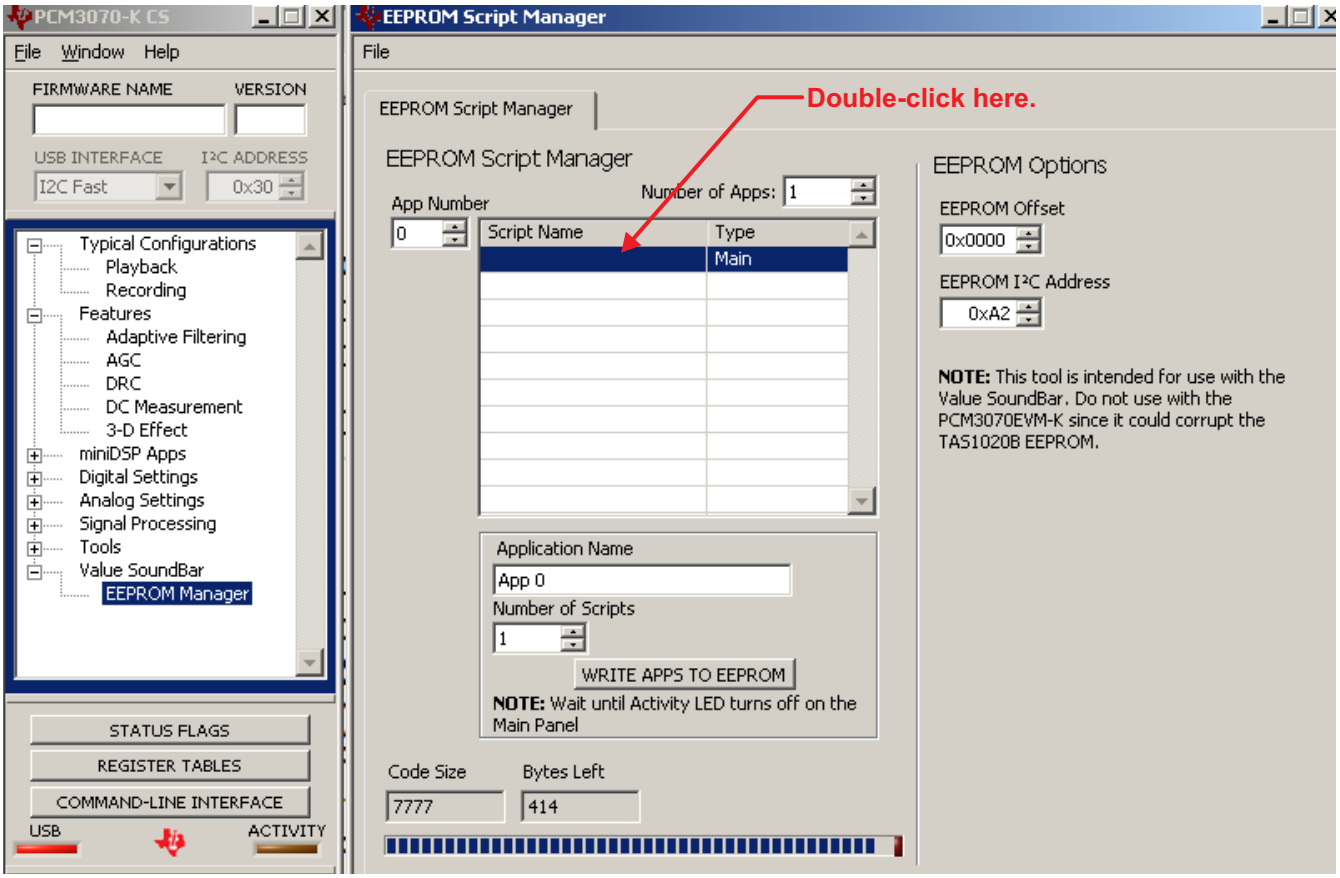
(a) Launch PCM3070 Control Software.

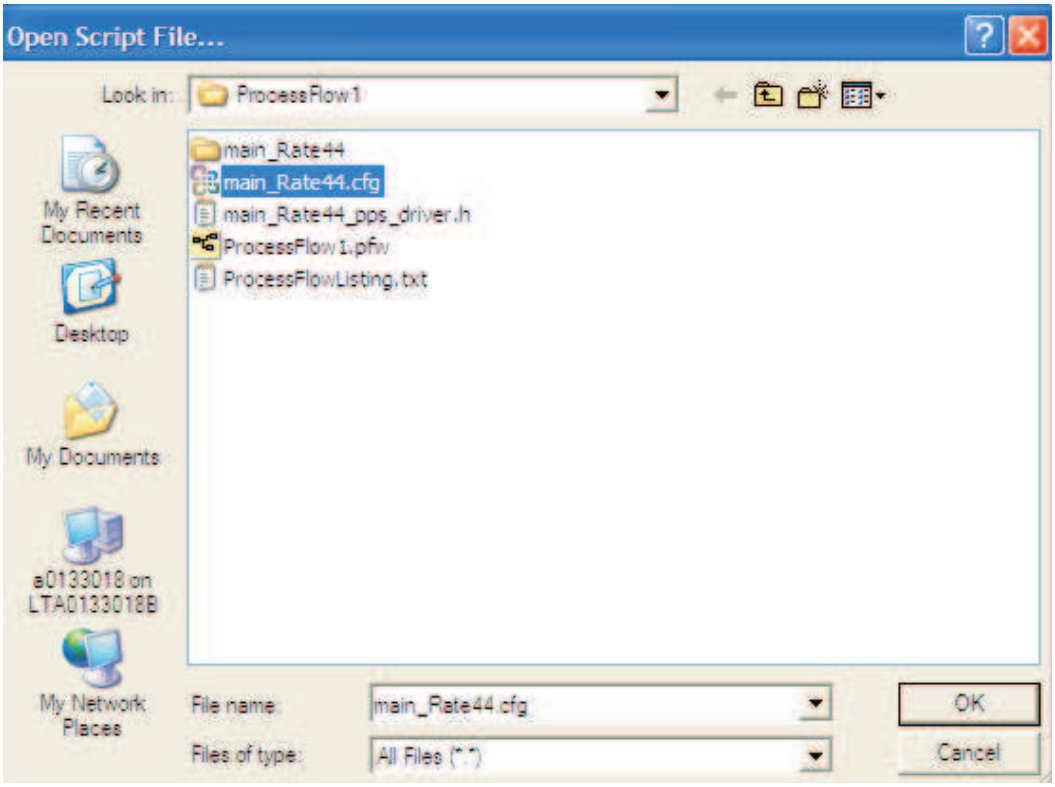
(b) Go to Tools → EEPROM Manager

(c) Double-click the highlighted area and you see the following interface.

(d) Load the miniDSP codes from the .cfg file that you generated.

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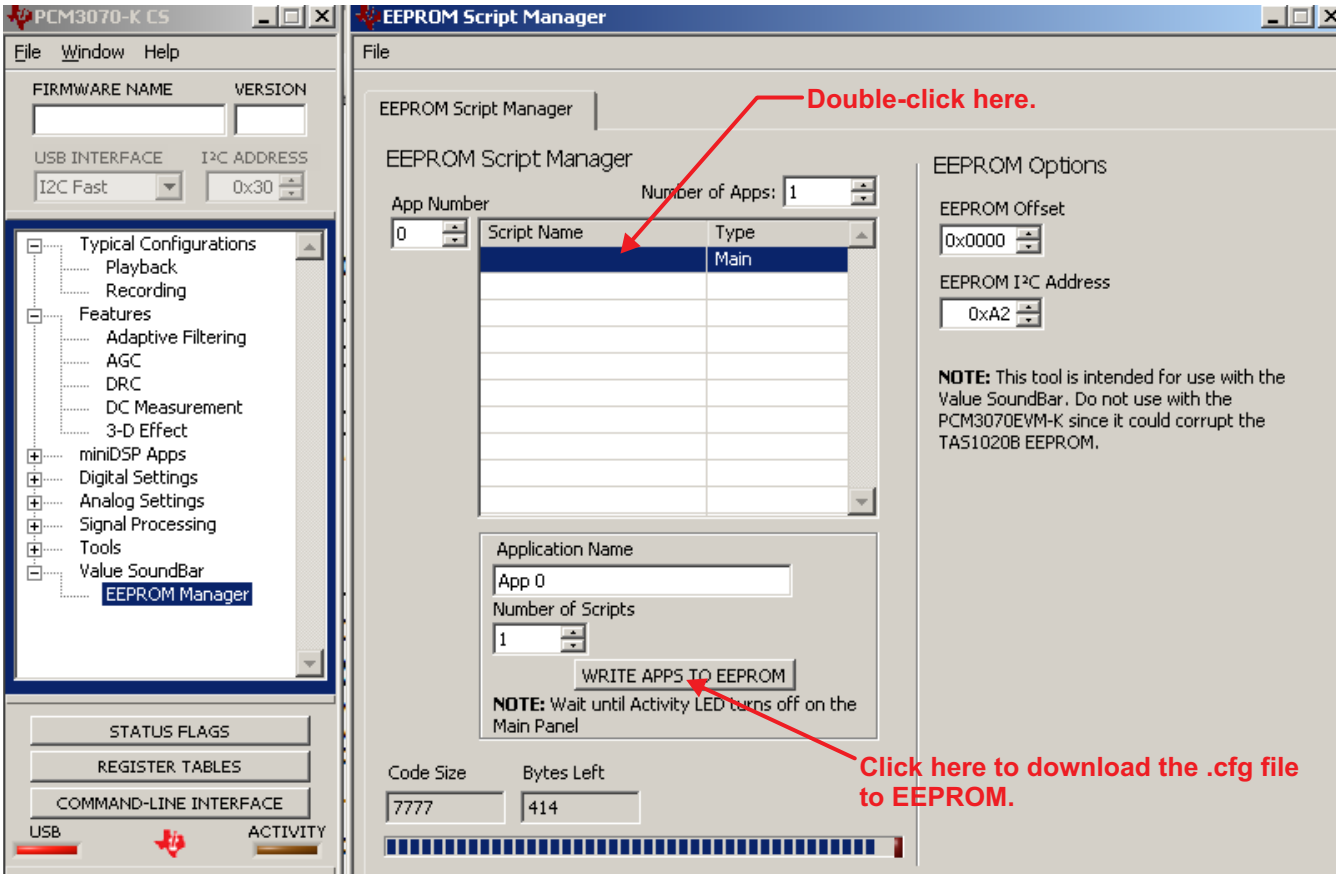


(e) Select the .cfg file in the Purepath™ Studio PS from /MiniDSPcode/ProcessFlow1/ folder.

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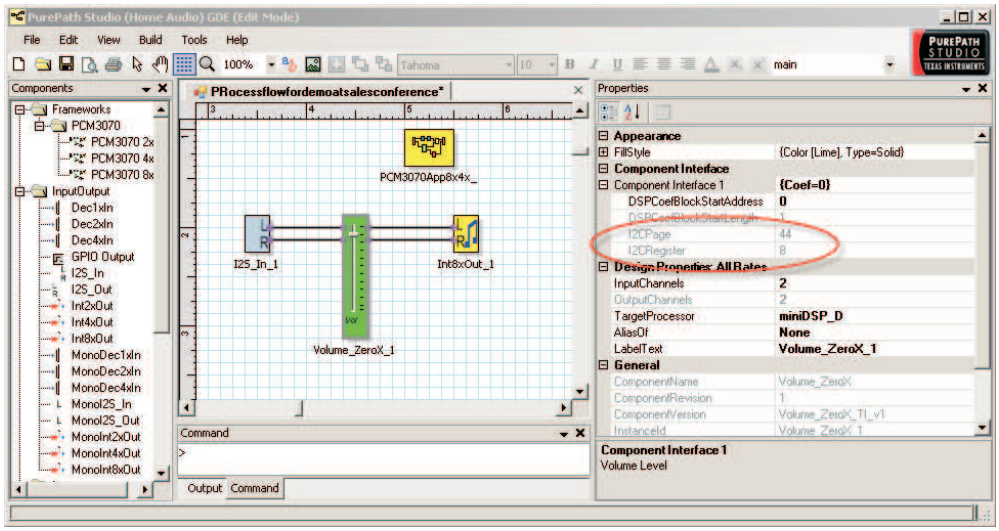
(f) Click OK and *Write Apps TO EEPROM* as it is shown in the following illustration.

(g) Cycle power.



4. Cycle power, and confirm new sounding board.
   (a) Your hardware interface may not control the process flow very well, as the registers that it was previously controlling may have moved (e.g,. Software Muxs and Volume Controls).
   (b) Expected result: new audio processing through the speakers.
5. Develop your MSP430 button and LED software.
   (a) Connect the MSP430 FET430UIF Programmer.
   (b) Open IAR Kickstart for MSP430.
   (c) Download and open MSP430 Software from the RDK-Value-SB folder.
   (d) Modify button interrupt routine I^2C writes with new I^2C writes needed.
      (i) Registers for various functions in the audio processing flow can be found in your PPS window by clicking on the function (e.g., your input mux) and clicking in the properties field *Component Interface*. See the following image.

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(e) Download the code in debug mode to the flash of the MSP430.

(f) Disconnect the USB and the MSP430 Debugger.

(g) Cycle power, and test button presses.

6. Cycle power, and test button presses.
7. Expected result: Button Presses and LEDs that align and match with the audio processing flow. If not, return to Step 5d.

By following the preceding procedure, you now have valid code for the PCM3070/EEPROM and the MSP430F2132.

11 Production Flow

11.1 Tools

To move into production, the following hardware and software tools are required:

- FET430UIF – MSP430 Programmer (Included with the kit)
- Soundbar Programmer board

11.2 Software and Files

The following software is necessary:

- Elpotronic MSP430 Programming software (free download)
- Codec Control for RDK-Value-SB
- PCM3070 Codec control software
- EEPROM WRITER (in PCM3070 CS)

The following files are necessary.

- .cfg (Purepath™ Process Flow Output)
- .d43 (MSP430 flash code)

11.3 Process

To initiate production flow, the following steps are required.

1. Press fresh board (with no EEPROM code or MSP430 code) on to programmer, and power up.
2. Connect USB to the Programming port.
3. Connect FET320UIF MSP430 Programmer to the SpyBiWire Port of the programmer, or the SpyBiWire

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soundbar board itself.

4. PCM3070 control software shows that the board is connected with the right software.
5. Open Codec control software, and download *.cfg to the EEPROM. (shown in the preceding section entitled “Download PCM3070 code to miniDSP).
6. Open Elpotronic Programmer software, and download *.d43 file. (See the Elpotronic documentation on how to download the .d43 file.)
7. Disconnect programmers, and cycle power.

12 Support

Direct all support questions to the audio forum at http://e2e.ti.com with RDK-Value-SB as part of the title.

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Appendix A Reprogramming the Programming Board and FAQs

A.1 How to Reprogram the Programming Board

The Programming board uses a TAS1020B as an interface between your development PC and the I2C bus. Customers wanting to move to volume production will likely need to create their own programming boards for production line programming.

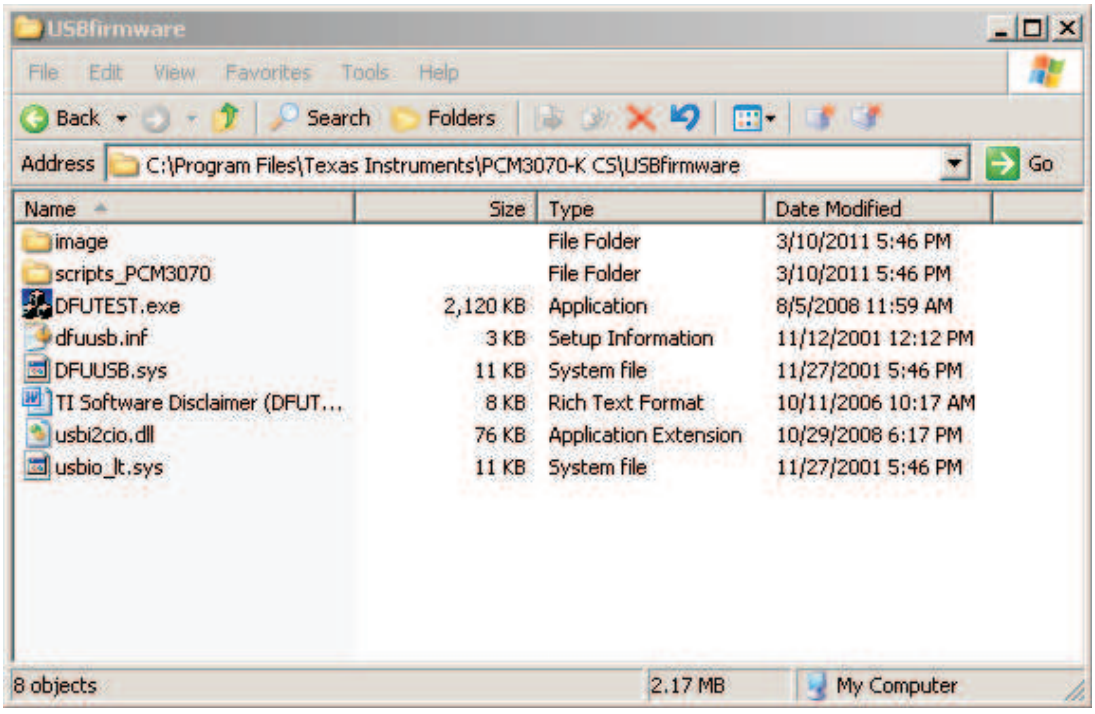
Gerbers and Bill of materials for the soundbar programmer can be found in the RDK-Value-SB product folder along with the Gerbers and Schematics for the RDK-Value-SB itself.

The TAS1020B needs to be programmed to act as a PC ↔ I^2C interface.

1. **Power Up**. Power up the soundbar PCB (top board) through the 24-V power supply. Once it is powered, the 24-V LED light and 3V3 LED lights turn on.
2. 2. **TAS1020 Drivers Installation**. Connect Soundbar programmer board (USB port at the bottom board) to PC USB port, and wait until it enumerates as TI DFU device.



NOTE: The TAS1020 driver needs to be installed in the PC for the first time only. Go to the directory shown in the following illustration to install the TAS1020 USB driver.

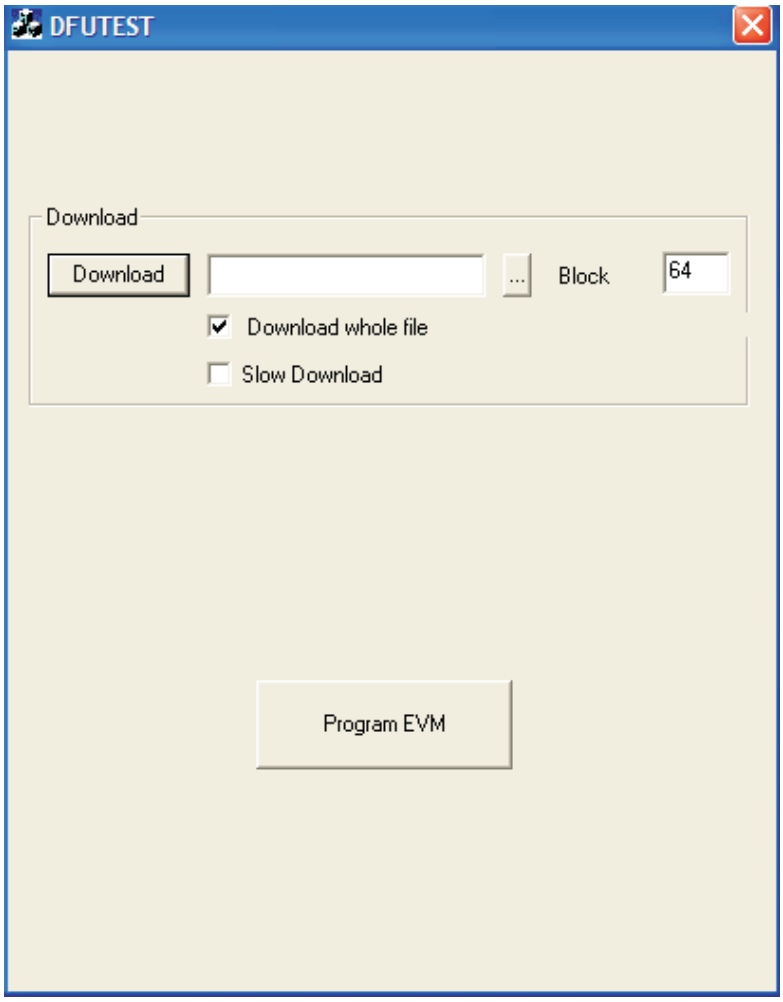


3. 3. Launch DFU Test

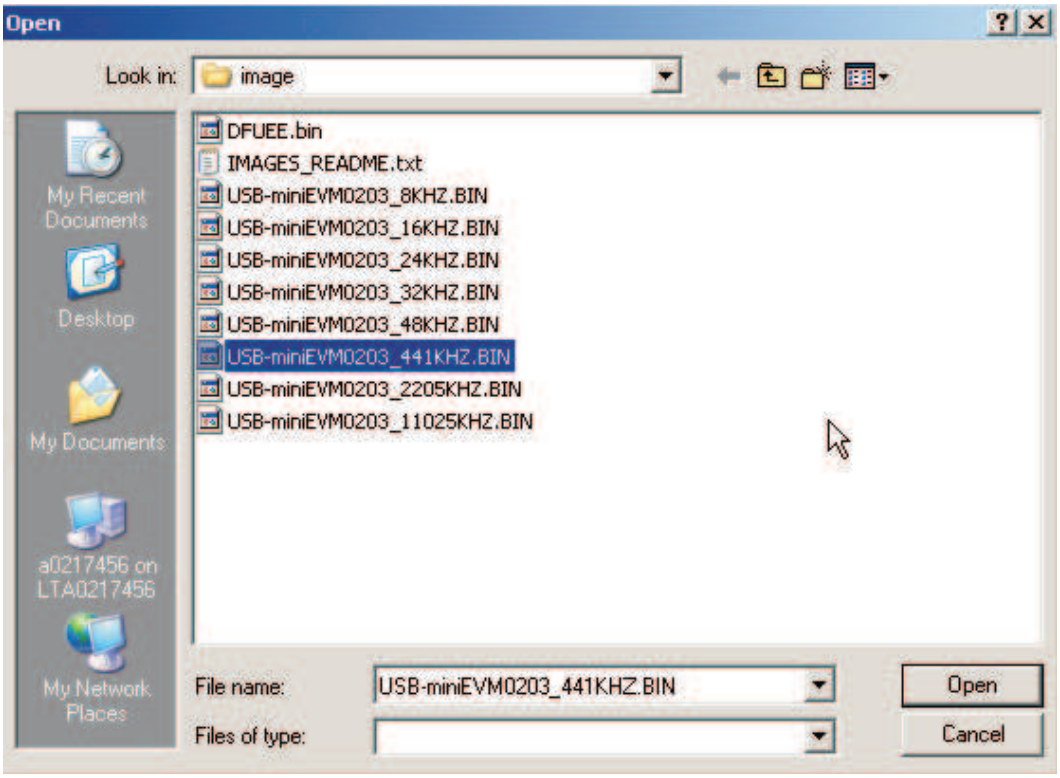
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(a) Go to PCM3070 Control Software product folder. The location of product folder depends on where you install the PCM3070 control software. For example- C:\Program Files\Texas Instruments\PCM3070 CS\USBfirmware

(b) b. Double-click *DFUTEST.exe*, and then you see the following interface



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(c) Click on "…" and select *USB-miniEVM0203_441KHZ.BIN*, and click *Download*.

(d) You are informed once the download completes; close the DFUTEST window.

(e) Disconnect and re-connect Soundbar programmer to PC USB port.

(f) Power cycle the soundbar.

(g) Wait until it enumerates as USB Composite device

A.2 Frequently Asked Questions

Why do I lose my latest process flow that I just downloaded when I power cycle the board?

When downloading the process flow from Purepath™ Studio, the code is only downloaded to the Volatile Instruction RAM in the PCM3070, not to the EEPROM.

To download your process flow to the EEPROM and make it nonvolatile, the .cfg file must be taken from Purepath™ Studio, and programmed to the EEPROM using the process described in the software development in this document.

What happens if I bring in a 48-kHz digital audio into the product?

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A mismatch between the default process flow sampling frequency and the digital data coming in may occur. By default, the only effect may be a slight change in filters, etc. The FSOUT pins from the DIR9001 are actually brought to the MSP430 if you need to differentiate your processing based on sampling frequency.

The FSOUT pins from the DIR9001 are actually brought to the MSP430 if you need to differentiate your processing based on sampling frequency.

Why are the boards getting very warm?

The input 24 V is brought down to 3V3 using a linear regulator. As such, the more power drawn on the 3V3 rail, the more heat generated by the regulator. When in development, the TAS1020B is actually driven from the 3V3 rail, therefore adding to the current requirement.

This should not be a problem in operation of the final system, as the current consumption on the 3V3 rail from the MSP430 Host Processor, PCM3070, and the DIR9001 should not contribute highly to the temperature of the PCB.

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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 is 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.

REGULATORY COMPLIANCE INFORMATION (continued)

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.

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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.

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