

# **USB Speakers Demo**

Demo configuration, software and development tools Rev. 2





# **Table of Contents**

1 Overview	
2 Features	6
3 Hardware	
3.1 Requirements	
3.2 Settings	7
4 Software	9
4.1 Footprint	Error! Bookmark not defined.
4.2 CPU Load	Error! Bookmark not defined.
5 Loading the Demo	
5.1 Change System output	
5.1.1 Mac OS	
5.1.2 Ubuntu	
6 OSJTAG	
6.1 Updating OSJTAG	
6.2 Troubleshooting OSJTAG	
7 Development Software	
7.1 Download CW	
7.2 Update CW	



# List of Figures

-igure 1. TWR-K60D100M Jumpers	7
-igure 2. TWR-SER Jumpers	8
-igure 3. TWR-AUDIO-SGTL	9
-igure 4. USB Speakers Demo SW	10
-igure 5. CodeWarrior reset perspective	11
-igure 6. CodeWarrior import project	11
Figure 7. Flash file to target	12
-igure 8. File selected	12
-igure 9. USB Speakers	13
-igure 10. Mac System Preferences	14
-igure 11. Sound Preferences	14
-igure 12. Sound Output	15
-igure 13. System Preferences Sound	16
-igure 14. Linux Output	16
Figure 15. Firmware update	18
-igure 16. Device Manager	19
-igure 17. OSJTAG uninstall	19
-igure 18. OSJTAG install	20
-igure 19. OSJTAG install option	20
-igure 20. OSJTAG driver browse	21
-igure 21. CodeWarrior update site	22
-igure 22. CodeWarrior update packages	23
-igure 23. CodeWarrior install packages	24
-igure 24. CodeWarrior terms and licensing	25





# **Revision History**

Revision	Date	Changes
2	Sept 11, 2012	Initial Release
2.1	Sept 18, 2012	<ul> <li>Added steps to change system audio output for different OS supported</li> <li>Changed supported OS</li> </ul>



### 1 **Overview**

The USB speaker enables high quality audio streaming thru USB implementing the USB Audio class and Tower system with enough flexibility to add audio post-processing such as equalizers, digital volume controls, audio enhancement algorithms.

To achieve the high quality audio, the demo implements 2 audio channels @ 96KHz with 24-bit samples and SW synchronization based on Isochronous Asynchronous transfers with a feedback endpoint, eliminating any need of extra HW for synch purposes.

The USB Speakers demo is a modification of the USB Speaker example application available on the USB stack with PHDC support:

www.freescale.com/usb

## 2 Features

- Stereo speakers with 24-bit samples @ 96 Khz
- USB Audio class v1.0 compliant
- Use resident USB driver from Windows , Mac and Linux dropping the need of specialized driver
- Isochronous Asynchronous transfers with a feedback endpoint implementation to eliminate the need of additional HW for audio synchronization
- Easily to build using Tower system
- DMA implementation with SAI module to free CPU load
- Compatible with Mac OS (Lion and Snow Leopard), Linux (Ubuntu 10.04 and above)

# 3 Hardware

### **3.1 Requirements**

In order to set up the USB Speakers demo you would need:

- TWR-K60D100M
- TWR-SER
- TWR-AUDIO-SGTL (Rev B1)
- TWR-ELEV
- Active stereo speakers with 3.5mm plug and volume control
- One mini USB cable



### **3.2 Settings**

The demo requires certain jumper configurations on the TWR-K60D100M and TWR-SER modules.

For the TWR-K60D100M:

• J10 to position 2-3 to get the 50 MHz clock from the TWR-SER



Figure 1. TWR-K60D100M Jumpers

For the TWR-SER:

- Set J3 in 2-3 position to provide 50MHz to the MCU (if TWR-K60N512 is used)
- J10 must be set to 2-3 to power the Tower thru USB
- J16 to position 3-4 to get 5v from the USB cable





Figure 2. TWR-SER Jumpers



Connect the active speakers to the J2 line out connector on the TWR-AUDIO-SGTL.



Figure 3. TWR-AUDIO-SGTL

# 4 Software

The SW is designed to minimize CPU load by implementing different HW modules:

- SAI driver (Master) for I2S mode
  - DMA and FIFO enabled
  - Audio buffer handler
    - Ringbuffer approach managed by DMA
- IIC driver

\_

- SGTL5000 Driver
  - o Lineout output enabled
  - 96KHz sampling rate
  - o I2S Slave



- DAP disable
- Headphone output enabled
- USB Audio device class v1.0
  - Enumerates as speaker
    - Stereo
    - 1 sampling rate (96Khz)
    - 24-bit samples
  - o Isochronous Asynchronous transfers
    - Feedback endpoint
    - Algorithm for feedback calculation
    - Ensures complete synched audio without adding or dropping samples or using external clock synthesizers

The SW follows the layered scheme shown in Figure 3:



HAL: Hardware abstraction layer

HIL: Hardware independent layer

# 5 Loading the Demo

- 1) Follow the directions in Section 6.1 to update OSJTAG firmware and 7 to install CodeWarrior 10.2 with updates
- 2) Open CW10.2. At the welcome screen, set the workspace default location.



- 3) If you already have CW10 open, you can change the workspace by going to File->Switch Workspace.
- 4) The first time you open CW10, you will be taken to the welcome screen. Click on Go To Workbench on the lower-left-hand side.
- 5) The workbench view will open. To ensure all the windows are properly set, go to Window-> Reset Perspective.



Figure 5. CodeWarrior reset perspective

- 6) Unzip the USB\_Speaker\_96Khz\_24\_bits\_K60D100.zip file on any location of your computer
- 7) On CW click on File->Import in the menu bar. In the dialog box that appears, select Existing Projects into Workspace under the General folder. Click Next.

Select an import source:
type filter text
🖃 🗁 General
🖳 📴 Archive File
Existing Projects into Workspace
File System
Preferences

Figure 6. CodeWarrior import project

- 8) On the next screen, select the Select root directory: Option, and click Browse.
- 9) Navigate to the directory where the USB\_Speaker\_96Khz\_24\_bits\_K60D100.zip was uncompressed and click OK.
- 10) Select the project. Then click Finish.
- 11) Clean the project by right-clicking on the project then selecting Clean...
- 12) Build the project by clicking the Hammer icon in the toolbar.
- 13) Open the Flash File to Target tool by clicking on the black arrow of the lightning icon





Figure 7. Flash file to target

- 14) On the File Options section select Browse then Workspace.
- 15) A new window appears with the list of projects, expand the
- USB\_Speaker\_96Khz\_24\_bits\_K60D100 project then the MK60DN512\_INTERNAL\_FLASH folder 16) Select the USB\_Speaker\_96Khz\_24\_bits\_K60D100.afx file then click Ok

🥙 Flash File To Target	
Erase and program flash devices.	
Simplified user interface for Hash Programmer	
Connection	
Connection: 🖦 USB_Speaker_K60D100_MK60DN512_INTERNAL_FLASH_PnE U-MultiLink 🛛 Edit	New
Flash Configuration	
K60DIV512M10	Browse
File Options	
File: \${workspace_loc:/USB_Speaker_48Khz_16_bits_K60D100/MK60DN512_INTERNAL_FLASH/USB_Speaker_48Khz_1	Browse
Offset: 0x 0 File size is 0x27824 bytes	
Erase Whole Device Erase and Program Cr	ancel

Figure 8. File selected

- 17) Connect the mini USB cable to USB connector on the TWR-K60D100M (J17)
- 18) Click on Erase and Program
- 19) Once CW finished programming the MCU unplug it from the PC
- 20) Assemble the Tower System
- 21) Connect the Tower System to the host PC by connecting the mini USB cable to the TWR-SER and the other end to the PC<sup>[1][2]</sup>
- 22) The Tower System will power up and the LED on D11 will start toggling
- 23) Wait for the driver to be installed if needed
- 24) Open a multimedia player and start playing a music file

[1]Isochronous Asynchronous transfers are not supported on Windows XP and below releases [2]This demo has been tested in:

- \* Mac OS (Snow Leopard, Lion)
- \* Linux (Ubuntu 10.04 and above)





Figure 9. USB Speakers



### 5.1 Change System output

In order to select the system output to the Freescale USB Speakers follow the steps detailed below for the different OS supported.

#### 5.1.1 Mac OS

1. Go to System Preferences



Figure 10. Mac System Preferences

2. Select Sound preferences

00			System P	references			
	Show All					Q	
Personal							
File New On	<b>2</b>		<b>7</b>	<b>100</b>	Ô	0	
General	Screen Saver	Dock	Control	& Text	& Privacy	Spotlight	Access
Hardware							
6		Ş					۵
CDs & DVDs	Displays	Energy Saver	Keyboard	Mouse	Trackpad	Print & Scan	Sound
Internet &	Wireless						
$\bigcirc$	@		۲	8	•		
iCloud	Mail, Contacts & Calendars	MobileMe	Network	Bluetooth	Sharing		
System							
Users & Groups	Parental Controls	Date & Time	Software Update	Speech	() Time Machine	Startup Disk	

Figure 11. Sound Preferences



3. Select Output and then choose the Freescale USB Speakers

	Sound Effects Output Input
Select a device for sound	d output:
Name	Туре
Internal Speakers	Built-in
FREESCALE USB SPEAKER	USB
Balan	ice:
Balan	ice:
Balan Use audio port f	rce: left right ( for: Sound Output ‡

Figure 12. Sound Output



#### 5.1.2 Ubuntu

1. Select System menu, then Preferences and Sound



Figure 13. System Preferences Sound

2. Select Output from the Sound preferences window and choose Freescale USB Speakers as the default output

Output volume	e: 🕼 —				Mute
Sound Effects	Hardware	Input	Output	Applications	;
Choose a d	evice for	sound	output	:	
Internal / Stereo	Audio Analo	g Stere	:0		
FREESCA     Stereo	LE USB SPE	AKER /	Analog St	ereo	
Settings fo	r the sele	cted d	evice:		
Balance:	Lef	t	I F	light	
					Close

Figure 14. Linux Output



# 6 **OSJTAG**

The TWR-K60D100M includes the OSJTAG circuit. By default, all of the demo projects are set up to use OSJTAG to download and debug code.

# 6.1 Updating OSJTAG

Open Source JTAG, also known as OSBDM on ColdFire Tower processor modules, allows a user to program, debug, and get serial data from Kinetis devices via a USB cable. The firmware runs on a Freescale MCFS08JM60 on the underside of the Kinetis Tower processor module. To ensure compatibility between the drivers, firmware, and terminal window, the latest versions of each must be installed.

- 1. Download and install both of the latest P&E Firmware Updates and Recovery and OSBDM Virtual Serial Toolkit programs which can be found at <u>http://www.pemicro.com/osbdm</u>.
- 2. Make sure your Tower module is plugged in, and run the P&E Firmware Updater Utility to use the OSJTAG boot loader to upgrade to the latest OSJTAG version.
- 3. Under Select Hardware Type, ensure OSBDM/OSJTAG is selected. It should automatically detect your module settings and fill out the rest of the fields automatically.



🕿 Multilink/Osbdr	m Firmware Update and Architecture Selection Utility - Version 1.07 👘 🔲 🔲 🔀			
New vinterfact older a Inc. http:///	ersions of P&E's software products automatically update the firmware of the different hardware ces as necessary. This application allows updating/configuration of the hardware for use with pplications which do not have this capability. (C)opyright 2011, P&E Microcomputer Systems, www.pemicro.com			
1. Select Hardware	Type : OSBDM/OSJTAG - Embedded debug circuitry in Freescale Tower boards			
	Freescale embeds an open source debug processor in many of it's Tower cards and Demonstration boards. P&E has taken a leading role, along with the open source community, in maintaining and updating the firmware of this hardware. This utility allows updating of the firmware of these boards. The Multilink Universal is a much higher speed, more fully featured, interface designed to work either with the tower cards or the user's own target hardware.			
	Information : <u>Click this link for more information on this hardware</u>			
2. Select Device :	Embedded Kinetis OSBDM/OSJTAG Device (Firmware Version 30.21)			
3. Select Architectu	ure to Support : Kinetis			
<ul> <li>4. Firmware File Selection :         <ul> <li>Automatic</li> <li>osbdmens_arm.3021</li> <li>Choose Firmware Update File or S-Record Select</li> <li>Unselected</li> </ul> </li> </ul>				
	Update Firmware Ready			

Figure 15. Firmware update

4. Click on Update Firmware to update the firmware. It will prompt you to disconnect the USB cord from your computer, and then short the JM60 boot loader jumper header. It is J19. Then reconnect the module to your computer.

The firmware will then be updated on your module. When it is finished, it will prompt you again to disconnect the USB cable, remove the jumper, and then reconnect the module. OSJTAG is now updated.



### 6.2 Troubleshooting OSJTAG

When the Tower module is plugged in, it should enumerate as a composite device, with one driver for debugging, and the other as a serial port. If you go to the Device Manager you should see the following:



Figure 16. Device Manager

If you only see it enumerate as the Open Source BDM Debug Port, then your computer may be automatically picking up an outdated driver. To fix this, right-click on the OSBDM driver and select Uninstall. Then unplug and re-plug in the Tower processor module, and it should enumerate correctly.

LibUSB-Win32 Devices      LibUSB-Win32 Devices      Open Source BDM - Debug Por      Mice and other pointing devices      Modems      Modems      Monitors      Monitors      Monitors	Update Driver Disable Uninstall
	Scan for bardware changes

Figure 17. OSJTAG uninstall

If there are still problems with enumerating correctly, you can also manually select the drivers.





Figure 18. OSJTAG install

Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable <u>m</u> edia (floppy, CD-ROM)
Include this location in the search:
C:\Program Files\Freescale\Freescale JM60 GUI\JM 👽 🛛 🛛 🛛 🖉
Don't search. I will choose the driver to install. Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< <u>B</u> ack <u>N</u> ext > Cancel





Install F	rom Disk	
J	Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below.	OK Cancel
	Copy manufacturer's files from:	Browse

Figure 20. OSJTAG driver browse

- For the Open Source BDM Debug Port, use the driver at: C:\pemicro\kinetis\_tower\_toolkit\Drivers\osbdm\OSJTAG\_Debug\_Interface\_libusb.inf
- For the PEMicro USB Serial Port (i1), use the driver at: C:\pemicro\kinetis\_tower\_toolkit\Drivers\osbdm\OSJTAG\_Serial\_Interface\_windriver\_version.inf

# 7 **Development Software**

### 7.1 Download CW

Download CodeWarrior for MCU 10.2 from the following link and install it: <u>http://www.freescale.com/codewarrior</u>

### 7.2 Update CW

The USB Speakers demo must be used with the latest Service Packs (SP) and the update version 1.0.0 for CodeWarrior for MCU's v10.2. To download the available SP:

- 1. Go to Help->Install new Software...
- 2. On the "Work with" drop down menu, select the FSL MCU Eclipse Update Site



🥙 Install	
Available Software Select a site or enter the location of a site.	
Work with:       type or select a site         type or select a site      All Available Sites         C: Program Files\Freescale \Freescale MQX 3.8\tools\codewarrior_extensions\CW MCU v10.2\mux_p2_repository - file         type filter te       FSL MCU Eclipse Update Site - http://freescale.com/lgfiles/updates/Eclipse/MCU10_2/com.freescale.mcu.updatesite         Name       FSL MCU Updater Archive - jar: file:/C:/Program Files/Freescale/Freescale/Freescale TSS 2.6/tools/pe_component/com.freescale         Name       http://marketplace.eclipse.org/search/apachesolr_search/subversion         Subclipse 1.6.x Update Site - http://subclipse.tigris.org/update_1.6.x       update site: http://ehep.sourceforge.net/update         Image: the site: http://ehep.sourceforge.net/update - http://ehep.sourceforge.net/update       Image: the site: http://ehep.sourceforge.net/update	dd
Select All Deselect All	E.
<ul> <li>Show only the latest versions of available software</li> <li>Hide items that are already installed</li> <li>Group items by category</li> <li>What is <u>already installed</u>?</li> <li>Contact all update sites during install to find required software</li> </ul>	
(?)       < Back	ancel

Figure 21. CodeWarrior update site

3. Select all of the available updates, clear the box "Contact all update sites during install to find required software". Click Next.



Available Software		
Check the items that you wish to install.		
Work with: FSL MCU Eclipse Update Site - http://freescale.co	:om/lgfiles/updates/Eclipse/MCU10_2/com.freescale.mcu	.updatesite 👻 🛛 🗛 🗛 🗸 🗸
	Find more software by working with the "Ava	ailable Software Sites" preference
ype filter text		
Name	Version	
00 MCU v10.2 Service Packs		
🔲 💷 MCU v10.2 Update 1.0.0		
Select All Deselect All		
Select All Deselect All Deselect All		
Select All Deselect All Details		
Select All Deselect All Details MCU v10.2 Service Packs		
Select All Deselect All Details MCU v10.2 Service Packs		More
Select All Deselect All Details MCU v10.2 Service Packs Show only the latest versions of available software	Hide items that are already installed	<u>More</u>
Select All       Deselect All         Details       MCU v10.2 Service Packs         Show only the latest versions of available software         Group items by category	Hide items that are already installed What is already installed?	More
Select All       Deselect All         Details       MCU v10.2 Service Packs         Show only the latest versions of available software       Group items by category	Hide items that are already installed What is <u>already installed</u> ?	More
Select All       Deselect All         Details       MCU v10.2 Service Packs         Show only the latest versions of available software       Group items by category         Group items by category       Contact all update sites during install to find required software	Hide items that are already installed What is <u>already installed</u> ?	More
Select All       Deselect All         Details       MCU v10.2 Service Packs         Show only the latest versions of available software       Group items by category         Group items by category       Contact all update sites during install to find required software	Hide items that are already installed What is <u>already installed</u> ?	More
Select All       Deselect All         Details       MCU v10.2 Service Packs         Show only the latest versions of available software       Group items by category         Group items by category       Contact all update sites during install to find required software	Hide items that are already installed What is <u>already installed</u> ?	More
Select All       Deselect All         Details       MCU v10.2 Service Packs         Show only the latest versions of available software       Group items by category         Group items by category       Contact all update sites during install to find required software	Hide items that are already installed What is <u>already installed</u> ?	More
Select All Deselect All Details MCU v10.2 Service Packs Show only the latest versions of available software Group items by category Contact all update sites during install to find required software	Hide items that are already installed What is <u>already installed</u> ?	More

Figure 22. CodeWarrior update packages

4. A list of all the packages that will be installed is shown, select all of the packages and click Next.



#### 🥦 Install

#### Install Details

ഹ	Your original request has been modified.	See the details.
(L)	roar onginarroqueschas been meamean	pool cho docalipr

Name	Version	Id	<u>^</u>
🗉 🚯 C/C++ Development Tools	7.0.1.FSL_b18	org.eclipse.cdt.feature.group	
C/C++ Memory View Enhancements	2.1.0.FSL_b18	org.eclipse.cdt.debug.ui.memory.fea	
🚯 CodeWarrior ARM Debugger	10.2.0.FSL_b1800	com.freescale.arm.debugger.nls.feat	
🖚 CodeWarrior ARM Debugger	10.2.0.FSL_b1800	com.freescale.arm.debugger.feature	
🖚 CodeWarrior ColdFire Debugger	10.2.0.FSL_b7740	com.freescale.coldfire.debugger.nls	
🖚 CodeWarrior ColdFire Debugger	10.2.0.FSL_b7740	com.freescale.coldfire.debugger.feat	
🖚 CodeWarrior Core Debugger	7.18.1.FSL_b11	com.freescale.coretech.debugger.fe	
🖚 CodeWarrior Core Debugger NLS	7.18.0.FSL_b11	com.freescale.coretech.debugger.nls	
🖗 CodeWarrior Core IDE	1.0.0.FSL_b18	com.freescale.core.ide.feature.group	
🚯 CodeWarrior Core IDE NLS	1.0.0.FSL_b18	com.freescale.core.ide.nl1.feature.g	
🖚 CodeWarrior DSC Debugger	10.2.0.FSL_b1820	com.freescale.dsc.debugger.feature	
CodeWarrior HC(S)08 Debugger	10.2.0.FSL_b7720	com.freescale.hc08.debugger.nls.fe	
🚯 CodeWarrior HCS08 Debugger	10.2.0.FSL_b7720	com.freescale.hc08.debugger.featur	
🖚 CodeWarrior Power Architecture Debugger	10.2.0.FSL_b3920	com.freescale.eppc.debugger.periph	
🖚 CodeWarrior Power Architecture Debugger	10.0.0.FSL_b3920	com.freescale.eppc.debugger.featur	
🖚 CodeWarrior Remote Launch Feature	1.0.100.124988	com.freescale.remotelaunch.feature	
🖗 CodeWarrior RS08 Debugger	10.2.0.FSL_b7720	com.freescale.rs08.debugger.nls.fea	×
Size: 525,229 KB			
C Details			
Your original request has been modified.			
"Processor Expert Core" is already installed, so an update w	vill be performed inste	ad.	8
"CodeWarrior ARM Debugger" is already installed, so an upo	date will be performed	l instead.	✓
(?)		< Back Next >	Einish Cancel
U U			

Figure 23. CodeWarrior install packages

5. Now the licensing window appears, accept all terms and licensing and click Finish.



🥬 Install	
Review Licenses Licenses must be reviewed and accepted before the software can be installed.	
Licenses:	License <u>t</u> ext:
<ul> <li>Eclipse Foundation Software User Agreement</li> <li>FREESCALE SOFTWARE LICENSE AGREEMENT</li> <li>IMPORTANT. Read the following Freescale Software License Agreement ("Agre</li> <li>P&amp;E MICROCOMPUTER SYSTEMS SOFTWARE LICENSE AGREEMENT</li> </ul>	<ul> <li>A general state of the license agreements</li> <li>I go not accept the terms of the license agreements</li> </ul>
?	<back next=""> Einish Cancel</back>

Figure 24. CodeWarrior terms and licensing

6. After all of the packages are installed, restart CodeWarrior.



#### How to Reach Us:

Home Page: freescale.com

Web Support: freescale.com/support

Information in this document is provided solely to enable system and software implementers to use Freescale products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale reserves the right to make changes without further notice to any products herein. Freescale makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale does not convey any license under its patent rights nor the rights of others. Freescale sells products pursuant to standard terms and conditions of sale, which can be found at the following address:

http://www.reg.net/v2/webservices/Freescale/Docs/TermsandConditions.htm

Freescale, the Freescale logo, Altivec, C-5, CodeTest, CodeWarrior, ColdFire, C\_Ware, Energy Efficient Solutions logo, Kinetis, mobileGT, PowerQUICC, Processor Expert, QorlQ, Qorriva, StarCore, Symphony, and VortiQa are trademarks of Freescale Semiconductor, Inc., Reg. U.S. Pat. & m. Off, Airfast, BeeKit, BeeStack, ColdFire+, CoreNet, Flexis, MadniV, MXC, Platform in a Package, QorlQ Qonverge, QUICC Engine, Ready Play, SafeAssure, SMARTMOS, TurboLink, Vybrid, and Xtrinsic are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners. Apple, iPod, iPhone, and iPad are trademarks of Apple Inc., registered in the U.S. and other countries.



© Freescale Semiconductor, Inc. 2012. All rights reserved.

Rev. 2 09/2012