Audio Capacitive Touch BoosterPack Hardware

Rafael Mena

ABSTRACT

The ACTBP is a twist on the Capacitive Touch BoosterPack that features several capacitive touch elements including a scroll wheel, button and proximity sensor, and nine LEDs that provide instant feedback as users interact with the capacitive touch elements.

## Contents

List of Figures

List of Tables

1   ACTBP Hardware

The Audio Capacitive Touch BoosterPack is a plug-in board for the $9.99 MSP430™ LaunchPad™ development kit (MSP-EXP430G2 - sold separately).

Figure 1. Audio Capacitive Touch BoosterPack

The C5532/33/34/35 Family|TMS320C5535 DSP and TLV320AIC3204 CODEC on the Audio Capacitive Touch BoosterPack provides MP3 player capabilities to the MSP430 LaunchPad. The onboard USB, microSD card, organic light emitting diode (OLED) display, and headset interface make the ACTBP the most attractive BoosterPack yet.

This BoosterPack also includes a pre-programmed MSP430G2553IN20 Value Line microcontroller that provides a capacitive touch interface, a hardware universal asynchronous receiver/transmitter (UART) interface to the C5535 DSP, and an easy, open-source MSP430 software.
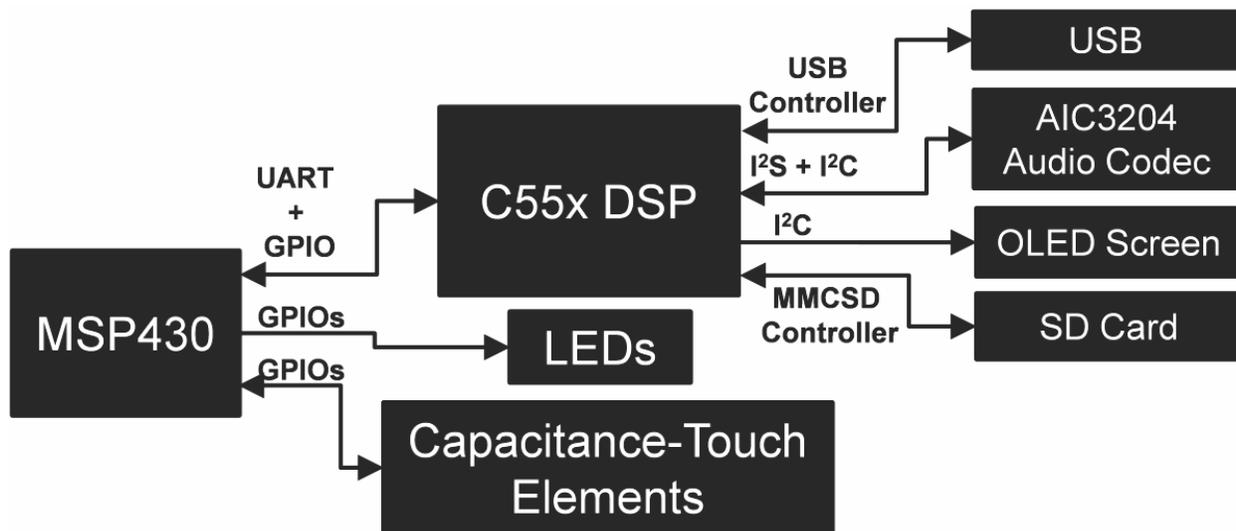
Figure 2. Audio Capacitive Touch BoosterPack Block Diagram

eZdsp, MSP430, LaunchPad are trademarks of Texas Instruments.
All other trademarks are the property of their respective owners.

2 Download

Download the ACTBP board files from Table 1.

Table 1. ACTBP Board Files

DOWNLOAD	DESCRIPTION
ACTBP Schematics	Schematics of the Audio Capacitive Touch BoosterPack
ACTBP Layout	Layout of the Audio Capacitive Touch BoosterPack (Protel/Altium Format)
Complete Board Design Files	Audio Capacitive Touch BoosterPack Schematics, Layout, BOM in Protel/Altium Format

3 Hardware Features

3.1 *Capacitive Touch*

- Capacitive touch elements including scroll wheel, button and proximity sensor
- Nine onboard LEDs for instant feedback

3.2 *C5535 DSP*

- Texas Instruments TMS320C5535 Digital Signal Processor
- Texas Instruments TLV320AIC3204 Stereo Codec
- Texas Instruments TS3A225E Headset Detection and Switch
- microSD card connector
- USB 2.0 interface to C5535 processor
- Inter-integrated circuit (I2C) OLED display
- INA219 I2C current and power monitor
- TRRS Stereo Headset Jack
- MSP430 LaunchPad interface

3.3 MSP430

- Texas Instruments MSP430G2553IN20 (provided in box)
  - Pre-programmed with MP3 player host interface
  - Low supply-voltage range: 1.8 to 3.6 V
  - Ultra-low power consumption
  - Universal Serial Communication Interface (USCI)
    - Enhanced UART supporting auto baudrate detection (LIN)
 - Up to 24 touch-sense-enabled I/O pins

3.4 Power

Power can be supplied by any of the following USB connectors:

- ACTBP USB connector
  - Provides power to BoosterPack and LaunchPad (BoosterPack JP3 jumper must be populated)
  - Required for USB Mass Storage Class operation
- MSP430 LaunchPad connector
  - Provides power to LaunchPad and BoosterPack (BoosterPack JP3 jumper must be populated)
  - LaunchPad J3 jumpers VCC, TEST, RST must be populated
- 3.6 V supplied to BoosterPack JP3
  - Lowest-power option
  - Provide constant 3.6 V to VCC_3V6

3.5 Audio

The ACTBP has a TRRS headset jack for stereo headset output and headset microphone input. To support the various types of headsets, the TS3A225E Autonomous Audio Switch with Headset Type Detection is connected in between the TRRS headset jack and the TLV320AIC3204 Stereo Audio Codec.
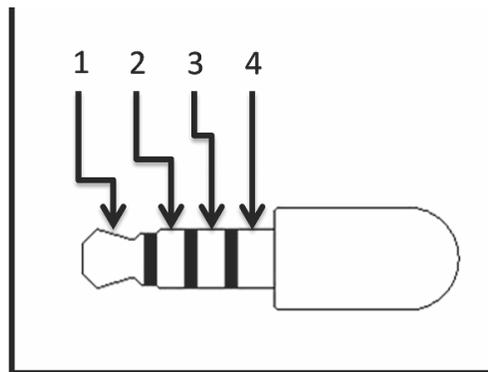
Figure 3. TRRS Headset Jack

TRRS Headset Pins

PIN NUMBER	PIN NAME	SIGNAL NAME
1	Tip	HP_Left
2	Ring 1	HP_Right
3	Ring 2	MICP or GND[1]
4	Sleeve	GND or MICP[1]

[1] The TS3A225E automatically detects and switches GND and MICP to Ring 2 and Sleeve depending on the headset connected.

3.6   Communication

3.6.1   LaunchPad Interface Header

The ACTBP mounts to the J1 and J2 headers on the MSP430 LaunchPad through P4 and P3 headers, respectively. When correctly connected, both USB connectors will point in the same direction. Most of the interface pins connect the MSP430 to the capacitive touch pads and feedback LEDs. In addition, UART signals from the MSP430 are connected to the C5535 DSP for host and client communication. MSP430 GPIOs P2.6_INT0 and P2.7_PWR_EN act as an interrupt to the DSP and as a power enable signal for the BoosterPack board.

Table 2. Pin Number and Signal Names

PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
P4:1	VCC_430 (3.6 V)	P3:1	GND
P4:2	P1.0	P3:2	430_P2.6_INT0 (Interrupt to C5535:INT0)
P4:3	P1.1_RX (MSP430 UART RX)	P3:3	P2.7_PWR_EN (BoosterPack Power Enable)
P4:4	P1.2_TX (MSP430 UART TX)	P3:4	TEST
P4:5	P1.3	P3:5	RST
P4:6	P1.4	P3:6	P1.7
P4:7	P1.5	P3:7	P1.6
P4:8	P2.0	P3:8	P2.5
P4:9	P2.1	P3:9	P2.4
P4:10	P2.2	P3:10	P2.3

3.6.2   I2C Devices

The ACTBP includes four I2C devices that are controlled by the C5535 DSP. The MSP430 sends UART commands to the DSP to configure the I2C devices - writing characters to the OLED display for example. The I2C devices and addresses are shown in Table 3.

Table 3. I2C Devices and Addresses

PART	I2C ADDRESS	FUNCTION
TLV320AIC3204	0x18	Audio CODEC
OSD9616GLBBG01	0x3C	OLED Display
INA219IDCN	0x48	VDD Core Power Monitor
TS3A225E	0x3B	Headset Detection and Switch

3.6.3   USB

The mini-USB jack on the ACTBP board (USB1) supports high-speed USB2.0. The USB signals are connected directly to the C5535 USB2.0 peripheral. Table 4 lists the pin descriptions.

Table 4. USB Pin Descriptions

PIN NUMBER	SIGNAL NAME
1	USBVDD (5 V)
2	D-
3	D+
4	ID / NC
5	USBVSS/GND
6, 7, 8, 9	GND (Shield)

3.6.4 MicroSD

The microSD connector (J1) on the bottom of the ACTBP board supports microSD and microSDHC cards. The MultiMedia Card/Secure Data (MMC/SD) signals are connected directly to the C5535 MMC/SD0 peripheral. Table 5 lists the pin descriptions.

Table 5. MicroSD Pin Descriptions

PIN NUMBER	SIGNAL NAME
1	DAT2, SD_DATA2
2	DAT3, SD_DATA3
3	CMD, SD_CMD
4	VDD, VCC_3V3
5	CLK, SD_CLK
6	GND
7	DAT0, SD_DATA0
8	DAT1, SD_DATA1
9	INSERT, VCC_3V3
10	INSERT_COM, GND
11,12,13,14,15	NC

3.6.5 OLED

The OLED connector (J2) on the bottom of the ACTBP board connects to the OSD9616 OLED display. The OLED is configured through I2C signals that are connected directly to the C5535 I2C peripheral. Table 6 lists the pin descriptions.

Table 6. OLED Pin Descriptions

PIN NUMBER	SIGNAL NAME
1	C2P
2	C2N
3	C1P
4	C1N
5	VBAT
6	VBREF
7	VSS, GND
8	VDD, VCC_3V3
9	RESn, TARGET_PWR_GOOD
10	SCL, I2C_SCL
11	SDA, I2C_SDA
12	IREF
13	VCOMH
14	VCC, V13

3.6.6   UART, Interrupt, and Power Enable

The UART RX and TX, P2.6_INT0 interrupt, and P2.7_PWR_EN signals allow MSP430 communication and control over the DSP and BoosterPack board.

- UART is used without flow control
- P2.6_INT0 interrupts the DSP to wake it from sleep mode
- P2.7_PWR_EN controls the 3.3-V voltage regulator (TPS79533)
    - 3.3 V supplies all components on the BoosterPack board
- All four signals are connected through a level-shifter (SN74AVC4T245) with 3.6 V on the MSP430 side and 3.3 V on the C5535 DSP side

4   Jumper Settings

- Lowest power jumper settings: all LaunchPad jumpers removed
- Power provided through BoosterPack USB
- Power provided through LaunchPad USB
- Power provided to both: remove JP3

5   Differences Between C5535 eZdsp™ and BoosterPack

- C5535 eZdsp tandem development platform for BoosterPack
- TS3A225E, no emulator or IEEE Standard 1149.1-1990, IEEE Standard Test Access Port and Boundary-Scan Architecture (JTAG)

6   FAQ

Can I connect a JTAG debugger to P1:JTAG Interface?

A: No. To protect licensed MP3 encode and decode source code, the JTAG of the C5535 DSP on each ACTBP is disabled.

IMPORTANT NOTICE

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		