

TAC5x1x Linux Driver User's guide

Revision history

Ver	Date	Author	Description
1.0	2024/04/10	Kevin Lu	1. Support Slave mode 2. Description for MIXERs 3. Support module installation

Information

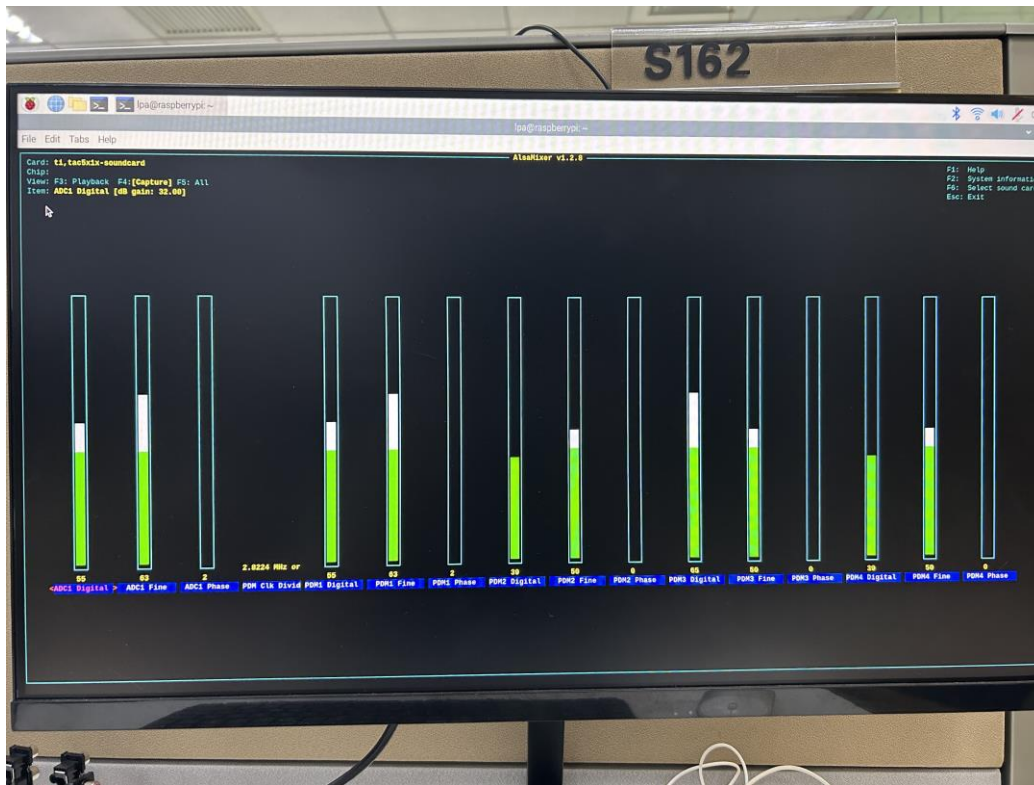
Driver	tac5x1x Linux Driver
7-bit I ² C Address	0x50 ~ 0x53
Platform	BeagleBone Black/Raspberry Pi
Architecture	ALSA/Tiny-ALSA
Bus type	I2C
Kernel Version	V6.5

Release Package

Driver Package	Source code	src./
	Document	doc/
	Other material	Makefile ti.tac5x1x.yaml tac5x1x-soundcard-overlay.dts

Amixer

- Use alsamixer/tinymix to adjust **Digital volume**, **Gain calibration**, **phase calibration**, **output level** and other control units visibly.
- Command1: **#alsamixer**
- Command2: **#amixer contents**



Kcontrol | ADC1 & DAC1

MIXER	Component	MIXER	Component
'ADC1 Audio BW'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 'Audio BW 24-kHz' ; Item #1 'Wide BW 96-kHz' : values=1	'DAC1 Audio BW'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 'Audio BW 24-kHz' ; Item #1 'Wide BW 96-kHz' : values=0
'ADC1 Digital Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=224 dBscale-min=-80.00dB,step=0.50dB,mute=0	'DAC1 Digital Playback Volume'	; type=INTEGER,access=rw---R-- ,values=2,min=0,max=255,step=0 : values=223,223 dBscale-min=-100.00dB,step=0.50dB,mute=0
'ADC1 Fine Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=162 dBminmax-min=-0.80dB,max=0.70dB	'DAC1 Gain Calibration Playback Volume'	; type=INTEGER,access=rw---R-- ,values=2,min=0,max=15,step=0 : values=8,8 dBminmax-min=-0.80dB,max=0.70dB
'ADC1 Phase Capture Volume'	; type=INTEGER,access=rw----- ,values=1,min=0,max=63,step=0 : values=1	'OUT1 Analog Level Playback Volume'	; type=INTEGER,access=rw---R-- ,values=2,min=0,max=6,step=0 : values=4,4 dBscale-min=-12.00dB,step=6.00dB,mute=0
'Playback Decimation Filter'	; type=ENUMERATED,access=rw-----,values=1,items=3 ; Item #0 'Linear Phase' ; Item #1 'Low Latency' ; Item #2 'Ultra-low Latency' : values=1	'PDM Clk Divider Capture Switch'	; type=ENUMERATED,access=rw-----,values=1,items=4 ; Item #0 '2.8224 MHz or 3.072 MHz' ; Item #1 '1.4112 MHz or 1.536 MHz' ; Item #2 '705.6 kHz or 768 kHz' ; Item #3 '5.6448 MHz or 6.144 MHz' : values=0

Kcontrol | ADC2 & DAC2

MIXER	Component	MIXER	Component
'ADC2 Audio BW'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 'Audio BW 24-kHz' ; Item #1 'Wide BW 96-kHz' : values=1	'DAC2 Audio BW'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 'Audio BW 24-kHz' ; Item #1 'Wide BW 96-kHz' : values=0
'ADC2 Digital Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=224 dBscale-min=-80.00dB,step=0.50dB,mute=0	'DAC2 Digital Playback Volume'	; type=INTEGER,access=rw---R-- ,values=2,min=0,max=255,step=0 : values=223,223 dBscale-min=-100.00dB,step=0.50dB,mute=0
'ADC2 Fine Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=162 dBminmax-min=-0.80dB,max=0.70dB	'DAC2 Gain Calibration Playback Volume'	; type=INTEGER,access=rw---R-- ,values=2,min=0,max=15,step=0 : values=8,8 dBminmax-min=-0.80dB,max=0.70dB
'ADC2 Phase Capture Volume'	; type=INTEGER,access=rw----- ,values=1,min=0,max=63,step=0 : values=1	'OUT2 Analog Level Playback Volume'	; type=INTEGER,access=rw---R-- ,values=2,min=0,max=6,step=0 : values=4,4 dBscale-min=-12.00dB,step=6.00dB,mute=0
'Record Decimation Filter'	; type=ENUMERATED,access=rw-----,values=1,items=3 ; Item #0 'Linear Phase' ; Item #1 'Low Latency' ; Item #2 'Ultra-low Latency' : values=0		

Kcontrol | PDM

MIXER	Component	MIXER	Component
'PDM1 Digital Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=224 dBscale-min=-80.00dB,step=0.50dB,mute=0	'PDM2 Digital Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=224 dBscale-min=-80.00dB,step=0.50dB,mute=0
'PDM1 Fine Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=162 dBminmax-min=-0.80dB,max=0.70dB	'PDM2 Fine Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=162 dBminmax-min=-0.80dB,max=0.70dB
'PDM1 Phase Capture Volume'	; type=INTEGER,access=rw----- ,values=1,min=0,max=63,step=0 : values=1	'PDM2 Phase Capture Volume'	; type=INTEGER,access=rw----- ,values=1,min=0,max=63,step=0 : values=1
'PDM3 Digital Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=224 dBscale-min=-80.00dB,step=0.50dB,mute=0	'PDM4 Digital Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=224 dBscale-min=-80.00dB,step=0.50dB,mute=0
'PDM3 Fine Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=162 dBminmax-min=-0.80dB,max=0.70dB	'PDM4 Fine Capture Volume'	; type=INTEGER,access=rw---R-- ,values=1,min=0,max=255,step=0 : values=162 dBminmax-min=-0.80dB,max=0.70dB
'PDM3 Phase Capture Volume'	; type=INTEGER,access=rw----- ,values=1,min=0,max=63,step=0 : values=1	'PDM4 Phase Capture Volume'	; type=INTEGER,access=rw----- ,values=1,min=0,max=63,step=0 : values=1

Widget | ADC1 & DAC1

MIXER	Component	MIXER	Component
'ADC1 Full-Scale'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 '1/2/5-VRMS' ; Item #1 '2/4/10-VRMS' : values=1	'IN1 Source Mux'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 'Analog' ; Item #1 'PDM' : values=1
'ADC1 Config'	; type=ENUMERATED,access=rw-----,values=1,items=4 ; Item #0 'Differential' ; Item #1 'Single-ended' ; Item #2 'Single-ended mux INxP' ; Item #3 'Single-ended mux INxM' : values=1	'OUT1x Source'	; type=ENUMERATED,access=rw-----,values=1,items=6 ; Item #0 'Disabled' ; Item #1 'DAC Input' ; Item #2 'Analog Bypass' ; Item #3 'DAC + Analog Bypass Mix' ; Item #4 'DAC -> OUTxP, INxP -> OUTxM' ; Item #5 'INxM -> OUTxP, DAC -> OUTxM' : values=1
'OUT1x Config'	; type=ENUMERATED,access=rw-----,values=1,items=7 ; Item #0 'Differential' ; Item #1 'Stereo Single-ended' ; Item #2 'Mono Single-ended at OUTxP only' ; Item #3 'Mono Single-ended at OUTxM only' ; Item #4 'Pseudo differential with OUTxM as VCOM' ; Item #5 'Pseudo differential with OUTxM as external sensing' ; Item #6 'Pseudo differential with OUTxP as VCOM' : values=1	'ASI_RX_CH1_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on
		'ASI_TX_CH1_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on
		'OUT1x Driver'	; type=ENUMERATED,access=rw-----,values=1,items=4 ; Item #0 'Line-out' ; Item #1 'Headphone' ; Item #2 '4 ohm' ; Item #3 'FD Receiver/Debug' : values=2

Widget | ADC2 & DAC2

MIXER	Component	MIXER	Component
'ADC2 Full-Scale'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 '1/2/5-VRMS' ; Item #1 '2/4/10-VRMS' : values=1	'IN2 Source Mux'	; type=ENUMERATED,access=rw-----,values=1,items=2 ; Item #0 'Analog' ; Item #1 'PDM' : values=1
'ADC2 Config'	; type=ENUMERATED,access=rw-----,values=1,items=4 ; Item #0 'Differential' ; Item #1 'Single-ended' ; Item #2 'Single-ended mux INxP' ; Item #3 'Single-ended mux INxM' : values=1	'OUT2x Source'	; type=ENUMERATED,access=rw-----,values=1,items=6 ; Item #0 'Disabled' ; Item #1 'DAC Input' ; Item #2 'Analog Bypass' ; Item #3 'DAC + Analog Bypass Mix' ; Item #4 'DAC -> OUTxP, INxP -> OUTxM' ; Item #5 'INxM -> OUTxP, DAC -> OUTxM' : values=1
'OUT2x Config'	; type=ENUMERATED,access=rw-----,values=1,items=7 ; Item #0 'Differential' ; Item #1 'Stereo Single-ended' ; Item #2 'Mono Single-ended at OUTxP only' ; Item #3 'Mono Single-ended at OUTxM only' ; Item #4 'Pseudo differential with OUTxM as VCOM' ; Item #5 'Pseudo differential with OUTxM as external sensing' ; Item #6 'Pseudo differential with OUTxP as VCOM' : values=1	'ASI_RX_CH2_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on
		'ASI_TX_CH2_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on
		'OUT2x Driver'	; type=ENUMERATED,access=rw-----,values=1,items=4 ; Item #0 'Line-out' ; Item #1 'Headphone' ; Item #2 '4 ohm' ; Item #3 'FD Receiver/Debug' : values=2

Widget | PDM

MIXER	Component	MIXER	Component
'PDM_ASI_TX_C H1_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on	'PDM ch1 & ch2 Datain Select'	; type=ENUMERATED,access=rw-----,values=1,items=4 ; Item #0 'Disable' ; Item #1 'GPIO1' ; Item #2 'GPIO2' ; Item #3 'GPI1' : values=1
'PDM_ASI_TX_C H2_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on	'PDM ch3 & ch4 Datain Select'	; type=ENUMERATED,access=rw-----,values=1,items=4 ; Item #0 'Disable' ; Item #1 'GPIO1' ; Item #2 'GPIO2' ; Item #3 'GPI1' : values=1
'PDM_ASI_TX_C H3_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on		
'PDM_ASI_TX_C H4_EN Switch'	; type=BOOLEAN,access=rw-----,values=1 : values=on		

Routing path | Analog

Before Playback and Recording, we need to create a path through amixer, below is the routing path

- **Left Analog Output (DAC1)**

- ASI IN1 => ASI_RX_CH1_EN => OUT1x Source => OUT1x Config => OUT1x Driver => Left DAC Enable => Left DAC Power => OUT1

- **Right Analog Output (DAC2)**

- ASI IN2 => ASI_RX_CH2_EN => OUT2x Source => OUT2x Config => OUT2x Driver => Right DAC Enable => Right DAC Power => OUT2

- **Left Analog Input (ADC1)**

- AIN1 => IN1 Source Mux (Analog) => IN2 Source Mux (Analog) => CH1_ADC_EN => ASI_TX_CH1_EN => ADC1 Config => ADC1 Full-Scale => Mic Bias => ADC Power => AIF OUT

- **Right Analog Input (ADC2)**

- AIN2 => CH2_ADC_EN => ASI_TX_CH2_EN => ADC2 Config => ADC2 Full-Scale => Mic Bias => ADC Power => AIF OUT

Routing path | PDM

- **Digital Input | PDM1**

- DIN1 => IN1 Source Mux (PDM) => PDM_ASI_TX_CH1_EN => CH1_PDM_EN => PDM ch1 & ch2 Datain Select
=> ADC Power => AIF OUT

- **Digital Input | PDM2**

- DIN2 => IN2 Source Mux (PDM) => PDM_ASI_TX_CH2_EN => CH2_PDM_EN => PDM ch1 & ch2 Datain Select
=> ADC Power => AIF OUT

- **Digital Input | PDM3**

- DIN3 => PDM_ASI_TX_CH3_EN => CH3_PDM_EN => PDM ch3 & ch4 Datain Select => ADC Power => AIF OUT

- **Digital Input | PDM4**

- DIN4 => PDM_ASI_TX_CH4_EN => CH4_PDM_EN => PDM ch3 & ch4 Datain Select => ADC Power => AIF OUT

Test Commands | Mono Playback

- 16-bit mono TDM
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='ASI_RX_CH1_EN Switch' on
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT1x Source' 'DAC Input'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT1x Config' 'Differential'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT1x Driver' 'Line-out'
 - #aplay **-c 1 -f S16_LE** -r 48000 -d 15 --device="hw:0,0" TDM-1slot-16b-play.wav

Test Commands | Stereo Playback

- 16-bit 2-slots TDM
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='ASI_RX_CH1_EN Switch' on
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT1x Source' 'DAC Input'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT1x Config' 'Differential'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT1x Driver' 'Line-out'

 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='ASI_RX_CH2_EN Switch' on
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT2x Source' 'DAC Input'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT2x Config' 'Differential'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='OUT2x Driver' 'Line-out'

 - #aplay -c 2 -f **S16_LE** -r 48000 -d 15 --device="hw:0,0" TDM-2slot-16b-play.wav

Test Commands | Mono Recording --Analog

- 16-bit mono TDM
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='IN1 Source Mux' 'Analog'`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='IN2 Source Mux' 'Analog'`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ASI_TX_CH1_EN Switch' on`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ADC1 Config' 'Differential'`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ADC1 Full-Scale' '1/2/5-VRMS'`
 - `#aplay -c 1 -f S16_LE -r 48000 -d 15 --device="hw:0,0" TDM-1slot-16b-record.wav`

Test Commands | Stereo Recording --Analog

- 16-bit Stereo TDM
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='IN1 Source Mux' 'Analog'`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='IN2 Source Mux' 'Analog'`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ASI_TX_CH1_EN Switch' on`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ADC1 Config' 'Differential'`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ADC1 Full-Scale' '1/2/5-VRMS'`

 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ASI_TX_CH2_EN Switch' on`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ADC2 Config' 'Differential'`
 - `#amixer -c [card id] cset numid=[id],iface=MIXER,name='ADC2 Full-Scale' '1/2/5-VRMS'`

 - `#arecord -c 2 -f S16_LE -r 48000 -d 15 --device="hw:0,0" TDM-2slot-16b-record.wav`

Test Commands | Stereo Recording –PDM1&2

- 16-bit Stereo TDM
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='IN1 Source Mux' 'PDM'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='IN2 Source Mux' 'PDM'
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='PDM_ASI_TX_CH1_EN Switch' on
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name='PDM_ASI_TX_CH2_EN Switch' on
 - #amixer -c [card id] cset numid=[id],iface=MIXER,name= 'PDM ch1 & ch2 Datain Select' 'GPIO1'
 - #arecord **-c 2 -f S16_LE** -r 48000 -d 15 --device="hw:0,0" TDM-2slot-16b-record.wav
- First of all, to enable PDM, need to multiplex a GPIO/GPO to be PDMCLK in DTS

Thank You