

# High Performance Stereo Audio ADC

## FEATURES

- High performance multi-bit delta-sigma audio ADC
- 101 dB signal to noise ratio
- -90 dB THD+N
- Low noise PGA
- 24-bit, 8 to 48 kHz sampling frequency
- I<sup>2</sup>S/PCM master or slave serial data port
- Support TDM up to 16 channels
- 256/384Fs, USB 12/24 MHz and other non standard audio system clocks
- Auto level control (ALC) and noise gate
- Support digital mic
- Low power

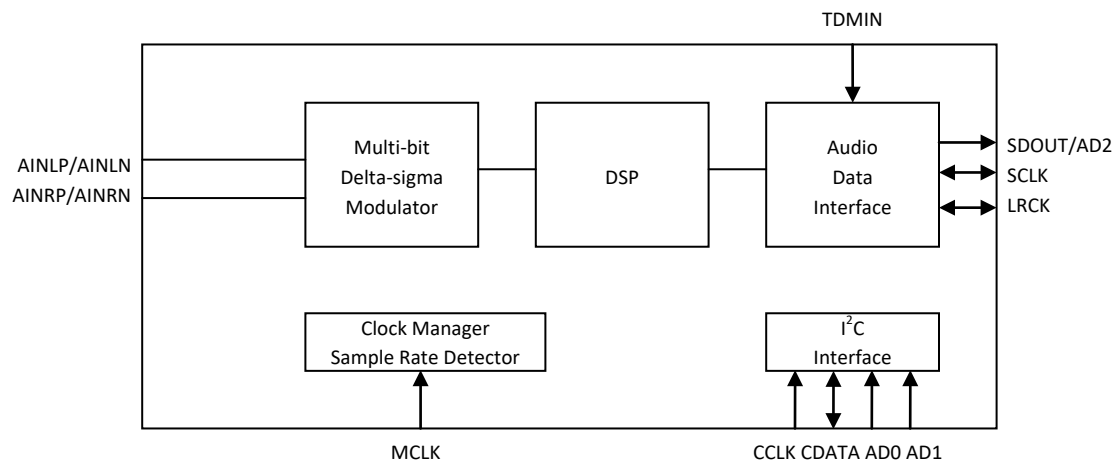
## APPLICATIONS

- Mic Array
- Soundbar
- Audio Interface
- Digital TV
- A/V Receiver
- DVR
- NVR

## ORDERING INFORMATION

ES7243E -40°C ~ +85°C  
QFN-20

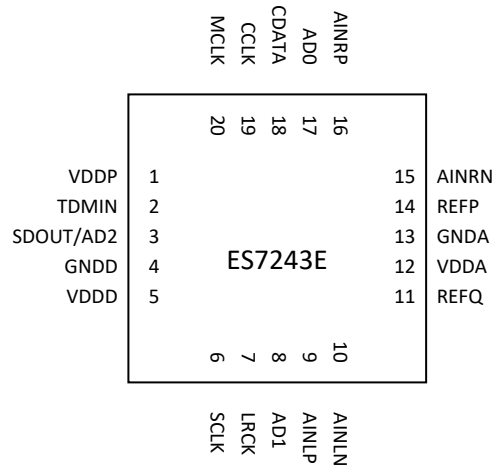
## BLOCK DIAGRAM



1.	<i>PIN OUT AND DESCRIPTION</i> .....	4
2.	<i>TYPICAL APPLICATION CIRCUIT</i> .....	5
3.	<i>CLOCK MODES AND SAMPLING FREQUENCIES</i> .....	6
4.	<i>MICRO-CONTROLLER CONFIGURATION INTERFACE</i> .....	6
5.	<i>DIGITAL AUDIO INTERFACE</i> .....	8
6.	<i>ELECTRICAL CHARACTERISTICS</i> .....	10
	ABSOLUTE MAXIMUM RATINGS.....	10
	RECOMMENDED OPERATING CONDITIONS .....	10
	Note: for VDDD=1.8V, sampling frequency must be less than 24 kHz.....	10
	ADC ANALOG AND FILTER CHARACTERISTICS AND SPECIFICATIONS .....	10
	DC CHARACTERISTICS .....	11
	I <sup>2</sup> C SWITCHING SPECIFICATIONS (SLOW SPEED MODE/HIGH SPEED MODE) .....	11
	SERIAL AUDIO PORT SWITCHING SPECIFICATIONS .....	12
7.	<i>CONFIGURATION REGISTER DEFINITION</i> .....	13
	REGISTER 0X00 –RESET, DEFAULT 0001 1110.....	13
	REGISTER 0X01 – CLOCK MANAGER, DEFAULT 0000 0000 .....	13
	REGISTER 0X02 – CLOCK MANAGER, DEFAULT 0000 0000 .....	13
	REGISTER 0X03 – CLOCK MANAGER, DEFAULT 0010 0000 .....	14
	REGISTER 0X04 – CLOCK MANAGER, DEFAULT 0000 0000 .....	14
	REGISTER 0X05 – CLOCK MANAGER, DEFAULT 0000 0000 .....	14
	REGISTER 0X06 – CLOCK MANAGER, DEFAULT 0000 0011 .....	14
	REGISTER 0X07 – CLOCK MANAGER, DEFAULT 0000 0001 .....	15
	REGISTER 0X08 – CLOCK MANAGER, DEFAULT 1111 1111 .....	15
	REGISTER 0X09 – CLOCK MANAGER, DEFAULT 1100 0001 .....	15
	REGISTER 0X0A – SDP, DEFAULT 1000 0001 .....	15
	REGISTER 0X0B – SDP, DEFAULT 1100 0000.....	16
	REGISTER 0X0C – SDP, DEFAULT 0000 0000.....	16
	REGISTER 0X0D – ADC CONTROL, DEFAULT 0000 0000 .....	17
	REGISTER 0X0E – ADC CONTROL, DEFAULT 0000 0000.....	17
	REGISTER 0X0F – ADC CONTROL, DEFAULT 0000 0000.....	17
	REGISTER 0X10 – ADC CONTROL, DEFAULT 0000 0000.....	18
	REGISTER 0X11 – ADC CONTROL, DEFAULT 0000 0000.....	18
	REGISTER 0X12 – ADC CONTROL, DEFAULT 0000 0000.....	19
	REGISTER 0X13 – ADC CONTROL, DEFAULT 0000 0000.....	19
	REGISTER 0X14 – ADC CONTROL, DEFAULT 0000 1100.....	20

REGISTER 0X15 – ADC CONTROL, DEFAULT 0000 1100.....	20
REGISTER 0X16 – ANALOG, DEFAULT 1111 1111 .....	20
REGISTER 0X17 – ANALOG, DEFAULT 0000 0000 .....	20
REGISTER 0X18 – ANALOG, DEFAULT 0010 0100 .....	20
REGISTER 0X19 – ANALOG, DEFAULT 1000 1000 .....	21
REGISTER 0X1A – ANALOG, DEFAULT 0100 0100.....	21
REGISTER 0X1B – ANALOG, DEFAULT 0100 0100 .....	22
REGISTER 0X1C – ANALOG, DEFAULT 0100 0100 .....	23
REGISTER 0X1D – ANALOG, DEFAULT 0000 0000.....	23
REGISTER 0X1E – ANALOG, DEFAULT 0000 0101 .....	24
REGISTER 0X1F – ANALOG, DEFAULT 0000 1100 .....	24
REGISTER 0X20 – ANALOG, DEFAULT 0000 0000 .....	24
REGISTER 0X21 – ANALOG, DEFAULT 0000 0000 .....	25
REGISTER 0XF7 – TEST MODE, DEFAULT 1111 0000 .....	25
REGISTER 0XF8 – TEST MODE, DEFAULT 0000 0000 .....	26
REGISTER 0XF9 – TEST MODE, DEFAULT 0000 0000 .....	26
REGISTER 0XFA – I2C CONFIGURE, DEFAULT 0000 0000.....	26
REGISTER 0XFC – FLAG, DEFAULT 0000 0000.....	26
REGISTER 0XFD – CHIP ID1, DEFAULT 0111 1010.....	26
REGISTER 0XFE – CHIP ID2, DEFAULT 0100 0011 .....	26
REGISTER 0XFF – CHIP VERSION, DEFAULT 0000 0000 .....	27
8. PACKAGE.....	28
9. CORPORATE INFORMATION .....	29

## 1. PIN OUT AND DESCRIPTION



Pin Name	Pin number	Input or Output	Pin Description
CCLK, CDATA	19, 18	I/O	I <sup>2</sup> C clock and data
ADO, AD1	17, 8	I	I <sup>2</sup> C addresses
MCLK	20	I	Master clock
SCLK	6	I/O	Serial data bit clock
LRCK	7	I/O	Serial data left and right channel frame clock
TDMIN	2	I	TDM data in
SDOUT/AD2	3	O	Serial data output/ I <sup>2</sup> C address AD2
AINLP, AINLN AINRP, AINRN	9, 10 16, 15	I	Analog left and right inputs
VDDP	1	I	Power supply for the digital input and output
VDDD/GNDD	5, 4	I	Digital power supply
VDDA/GNDA	12, 13	I	Analog power supply
REFP	14	O	Filtering capacitor connection
REFQ	11	O	Filtering capacitor connection



### 3. CLOCK MODES AND SAMPLING FREQUENCIES

The device supports standard audio clocks (64Fs, 128Fs, 256Fs, 384Fs, 512Fs, etc), USB clocks (12/24 MHz), and some common non standard audio clocks (25 MHz, 26 MHz, etc).

The device can work either in master clock mode or slave clock mode. In slave mode, LRCK and SCLK are supplied externally, and LRCK and SCLK must be synchronously derived from the system clock with specific rates. In master mode, LRCK and SCLK are derived internally from device master clock.

### 4. MICRO-CONTROLLER CONFIGURATION INTERFACE

The device supports standard I<sup>2</sup>C micro-controller configuration interface. External micro-controller can completely configure the device through writing to internal configuration registers.

I<sup>2</sup>C interface is a bi-directional serial bus that uses a serial data line (CDATA) and a serial clock line (CCLK) for data transfer. The timing diagram for data transfer of this interface is given in Figure 1a and Figure 1b. Data are transmitted synchronously to CCLK clock on the CDATA line on a byte-by-byte basis. Each bit in a byte is sampled during CCLK high with MSB bit being transmitted firstly. Each transferred byte is followed by an acknowledge bit from receiver to pull the CDATA low. The transfer rate of this interface can be up to 400 kbps.

A master controller initiates the transmission by sending a “start” signal, which is defined as a high-to-low transition at CDATA while CCLK is high. The first byte transferred is the slave address. It is a seven-bit chip address followed by a RW bit. The chip address must be 0010 x, where x equals AD2 AD1 AD0. The RW bit indicates the slave data transfer direction. Once an acknowledge bit is received, the data transfer starts to proceed on a byte-by-byte basis in the direction specified by the RW bit. The master can terminate the communication by generating a “stop” signal, which is defined as a low-to-high transition at CDATA while CCLK is high.

In I<sup>2</sup>C interface mode, the registers can be written and read. The formats of “write” and “read” instructions are shown in Table 1 and Table 2. Please note that, to read data from a register, you must set R/W bit to 0 to access the register address and then set R/W to 1 to read data from the register.

Table 1 Write Data to Register in I<sup>2</sup>C Interface Mode

	Chip Address	R/W		Register Address		Data to be written		
start	0010 AD2 AD1 AD0	0	ACK	RAM	ACK	DATA	ACK	Stop

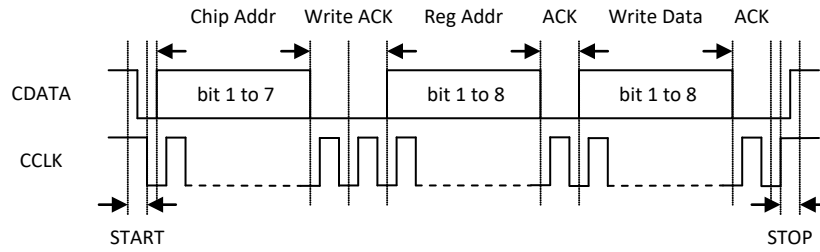


Figure 1a I<sup>2</sup>C Write Timing

Table 2 Read Data from Register in I<sup>2</sup>C Interface Mode

	Chip Address	R/W		Register Address		
Start	0010 AD2 AD1 AD0	0	ACK	RAM	ACK	
	Chip Address	R/W		Data to be read		
Start	0010 AD2 AD1 AD0	1	ACK	Data	NACK	Stop

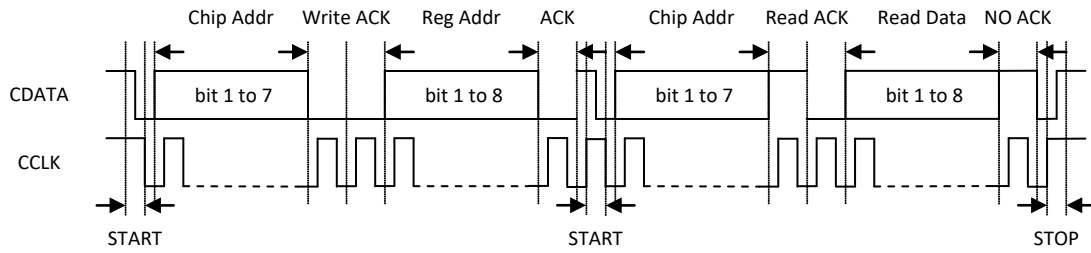


Figure 1b I<sup>2</sup>C Read Timing

### 5. DIGITAL AUDIO INTERFACE

The device provides many formats of serial audio data interface to the output from the ADC through LRCK, SCLK and SDOUT pins. These formats are I<sup>2</sup>S, left justified, DSP/PCM mode and TDM. ADC data is out at SDOUT on the falling edge of SCLK. The relationships of SDOUT, SCLK and LRCK with these formats are shown through Figure 2a to Figure 2h. ES7243E can be cascaded up to 8-ch through single I<sup>2</sup>S or TDM, please refer to the user guide for detail description.

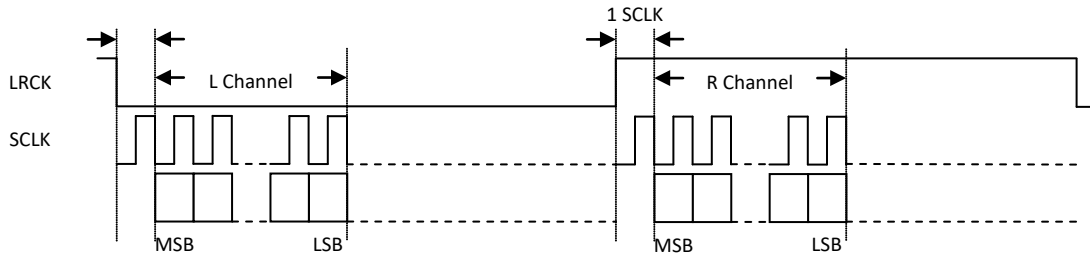


Figure 2a I<sup>2</sup>S Serial Audio Data Format

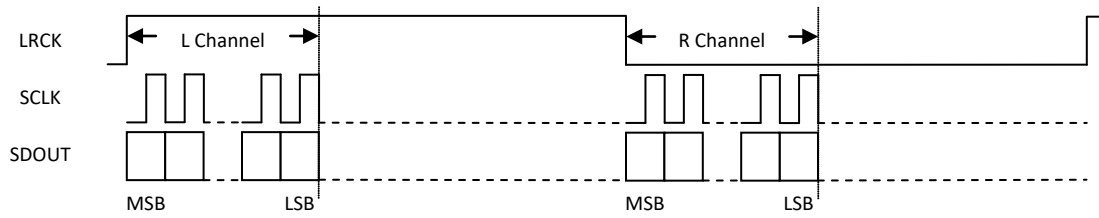


Figure 2b Left Justified Serial Audio Data Format

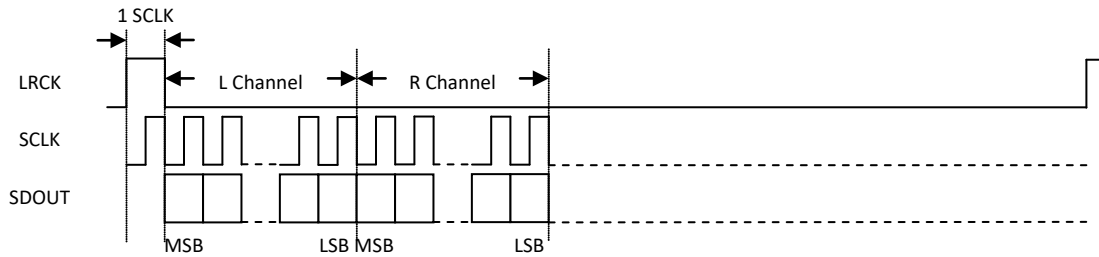


Figure 2c DSP/PCM Mode A Serial Audio Data Format

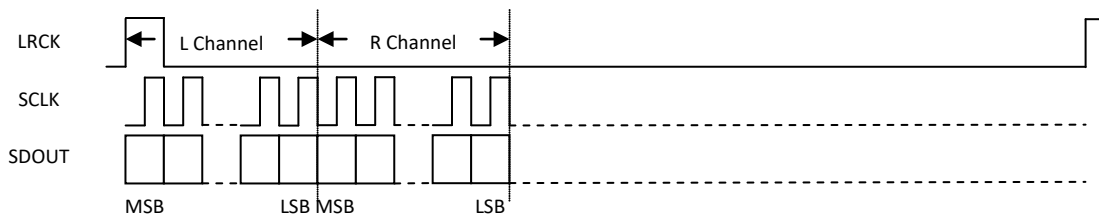


Figure 2d DSP/PCM Mode B Serial Audio Data Format



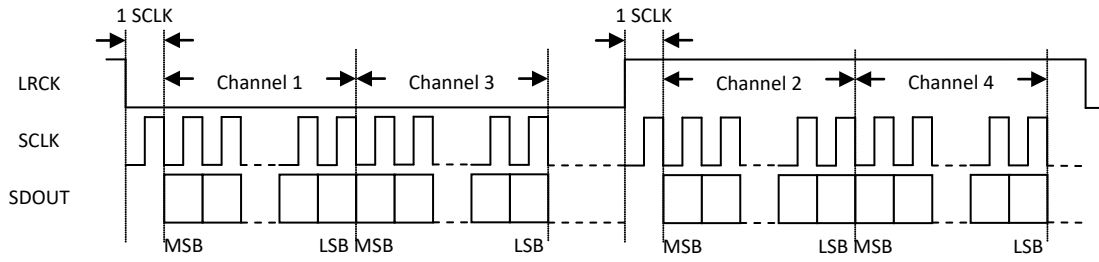


Figure 2e TDM I<sup>2</sup>S Serial Audio Data Format

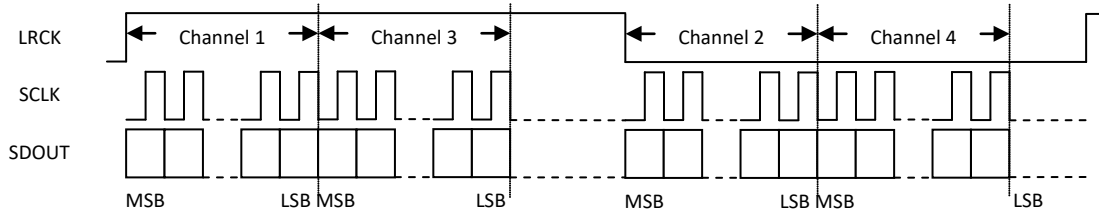


Figure 2f TDM Left Justified Serial Audio Data Format

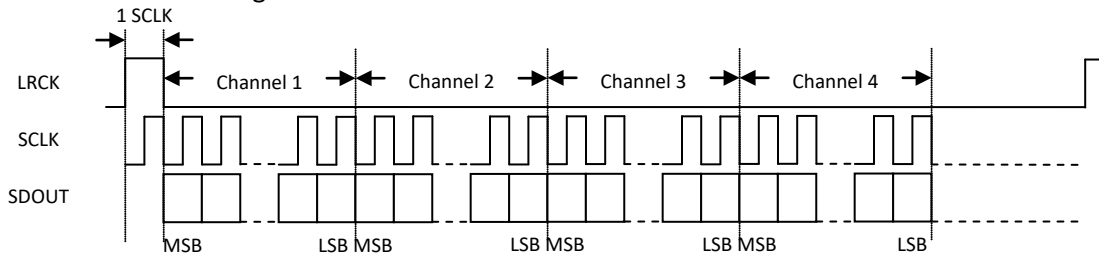


Figure 2g TDM DSP/PCM Mode A Serial Audio Data Format

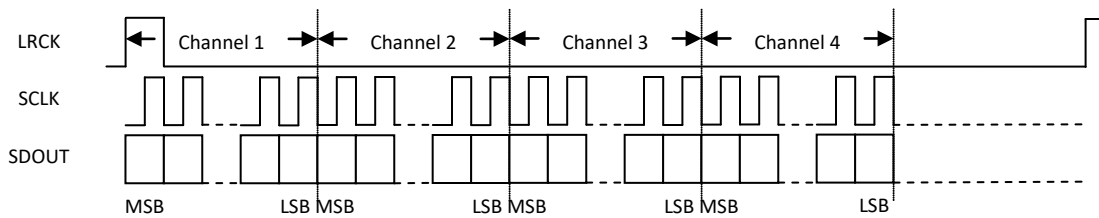


Figure 2h TDM DSP/PCM Mode B Serial Audio Data Format

## 6. ELECTRICAL CHARACTERISTICS

### ABSOLUTE MAXIMUM RATINGS

Continuous operation at or beyond these conditions may permanently damage the device.

PARAMETER	MIN	MAX
Analog Supply Voltage Level	-0.3V	+3.6V
Digital Supply Voltage Level	-0.3V	+3.6V
Analog Input Voltage Range	GNDA-0.3V	VDDA+0.3V
Digital Input Voltage Range	GNDD-0.3V	VDDP+0.3V
Operating Temperature Range	-40°C	+85°C
Storage Temperature	-65°C	+150°C

### RECOMMENDED OPERATING CONDITIONS

PARAMETER	MIN	TYP	MAX	UNIT
VDDA	1.7	3.3	3.6	V
VDDD	1.7	3.3	3.6	V
VDDP	1.7	3.3	3.6	V

Note: for VDDD=1.8V, sampling frequency must be less than 24 kHz.

### ADC ANALOG AND FILTER CHARACTERISTICS AND SPECIFICATIONS

Test conditions are as the following unless otherwise specify: VDDA=3.3V, VDDD=3.3V, GNDA=0V, GNDD=0V, ambient temperature=25°C, Fs=48 KHz, MCLK/LRCK=256.

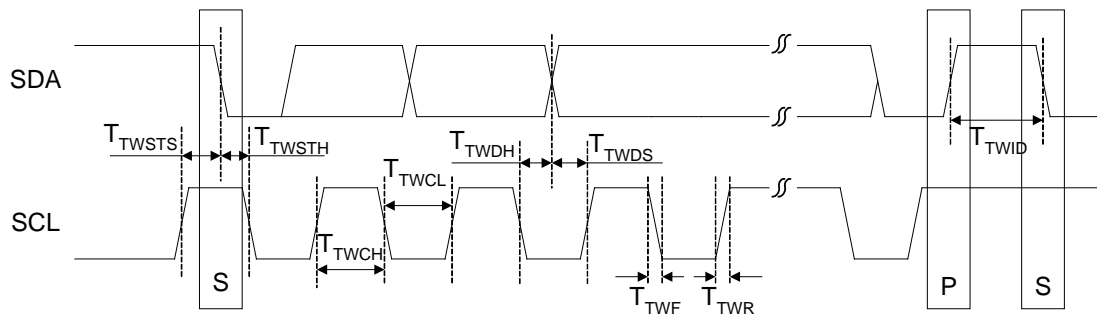
PARAMETER	MIN	TYP	MAX	UNIT
ADC Performance				
Signal to Noise ratio (A-weight)	96	101	104	dB
THD+N	-95	-90	-85	dB
Channel Separation (1KHz)	95	100	105	dB
Interchannel Gain Mismatch		0.1		dB
Gain Error			±5	%
Filter Frequency Response				
Passband	0		0.4535	Fs
Stopband	0.5465			Fs
Passband Ripple			±0.05	dB
Stopband Attenuation	70			dB
Analog Input				
Full Scale Input Level		VDDA/3.3		Vrms
Input Impedance		8 (0 dB PGA) 6 (33 dB PGA)		KΩ

**DC CHARACTERISTICS**

PARAMETER	MIN	TYP	MAX	UNIT
Normal Operation Mode				
VDDD=3.3V, VDDP=3.3V, VDDA=3.3V (16 kHz)		26		mW
VDDD=1.8V, VDDP=1.8V, VDDA=1.8V (16 kHz)		7.5		
Power Down Mode				
		0		uA
Digital Voltage Level				
Input High-level Voltage	0.7*VDDP			V
Input Low-level Voltage			0.5	V
Output High-level Voltage		VDDP		V
Output Low-level Voltage		0		V

**I<sup>2</sup>C SWITCHING SPECIFICATIONS (SLOW SPEED MODE/HIGH SPEED MODE)**

PARAMETER	Symbol	MIN	MAX	UNIT
CCLK Clock Frequency	F <sub>CCLK</sub>		100/400	KHz
Bus Free Time Between Transmissions	T <sub>TWID</sub>	4.7/1.3		us
Start Condition Hold Time	T <sub>TWSTH</sub>	4.0/0.6		us
Clock Low time	T <sub>TWCL</sub>	4.7/1.3		us
Clock High Time	T <sub>TWCH</sub>	4.0/0.6		us
Setup Time for Repeated Start Condition	T <sub>TWSTS</sub>	4.7/0.6		us
CDATA Hold Time from CCLK Falling	T <sub>TWDH</sub>		3.45/0.9	us
CDATA Setup time to CCLK Rising	T <sub>TWDS</sub>	0.25/0.1		us
Rise Time of CCLK	T <sub>TWR</sub>		1.0/0.3	us
Fall Time CCLK	T <sub>TWF</sub>		1.0/0.3	us

Figure 3 I<sup>2</sup>C Timing

**SERIAL AUDIO PORT SWITCHING SPECIFICATIONS**

PARAMETER	Symbol	MIN	MAX	UNIT
MCLK frequency			49.2	MHz
MCLK duty cycle		40	60	%
LRCK frequency			200	KHz
LRCK duty cycle (Note 2)		40	60	%
SCLK frequency			26	MHz
SCLK pulse width low	$T_{SCLKL}$	16		ns
SCLK Pulse width high	$T_{SCLKH}$	16		ns
SCLK falling to LRCK edge (master mode only)	$T_{SLR}$		10	ns
LRCK edge to SCLK rising (slave mode only)	$T_{LSR}$	10		ns
SCLK falling to SDOUT valid	$T_{SDO}$		16 39	ns
LRCK edge to SDOUT valid (Note 3)	$T_{LDO}$		11 25	ns

Note 2: one SCLK period of high time in DSP/PCM modes.

Note 3: only apply to MSB of Left Justified or DSP/PCM mode B.

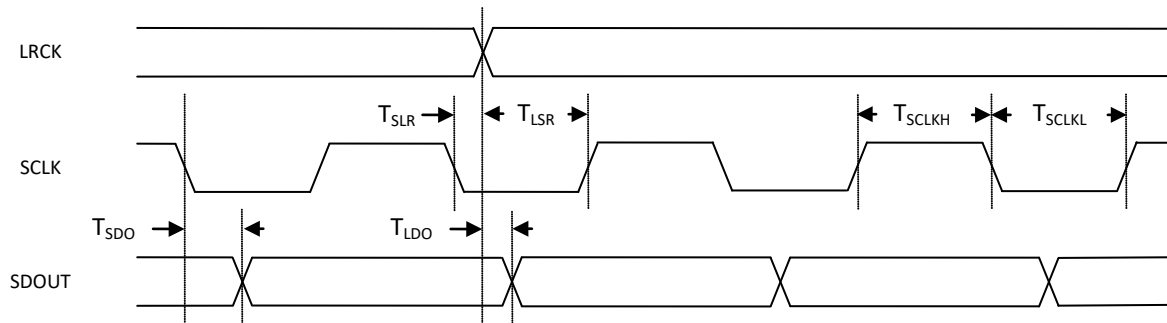


Figure 4 Serial Audio Port Timing

## 7. CONFIGURATION REGISTER DEFINITION

### REGISTER 0X00 – RESET, DEFAULT 0001 1110

Bit Name	Bit	Description
CSM_ON	7	Chip FSM ON/OFF control 0 - csm power down(default) 1 - csm power up
MSC	6	Master/Slave select for SDP 0 - slave mode(default) 1 - master mode
SEQ_DIS	5	Power up sequence enable control 0 - power up sequence enable(default) 1 - power up sequence disable
RST_DIG	4	Digital circuits reset 0 - Not reset(default) 1 - Reset
RST_CMG	3	Clock manager circuit reset 0 - Not reset (default) 1 - Reset
RST_MST	2	Master circuit reset 0 - Not reset (default) 1 - Reset
RST_ADC_DIG	1	Adc digital circuit reset 0 - Not reset (default) 1 - Reset

### REGISTER 0X01 – CLOCK MANAGER, DEFAULT 0000 0000

Bit Name	Bit	Description
MCLK_ON	5	MCLK ON/OFF control 0 - MCLK off (default) 1 - MCLK on
BCLK_ON	4	BCLK ON/OFF control 0 - BCLK off (default) 1 - BCLK on
CLKADC_ON	3	Clock clk_adc ON/OFF control 0: clk_adc off(default) 1: clk_adc on
ANACLKADC_ON	1	Clock anaclk_adc ON/OFF control 0 - anaclk_adc off(default) 1 - anaclk_adc on

### REGISTER 0X02 – CLOCK MANAGER, DEFAULT 0000 0000

Bit Name	Bit	Description
MCLK_SEL	7	Internal mclk select 0 - from MCLK PAD(default) 1 - from BCLK PAD
MSTBCLK_SEL	6	Master BCLK derive clocks 0 - from bclk_out[divided by DIV_BCLK](default) 1 - from anaclk_adc
MSTCLK_SEL	5:4	At master mode, source clock select

		0 - internal mclk(default) 1 - dig_mclk 2 - DSP_clk 3 - CF_clk
BCLK_FITBIT	2	BCLK out control when master mode 0 - continual bclk(default) 1 - master bclk stop after data transfer out
MCLK_INV	1	Internal mclk invert 0 - normal(default) 1 - invert
BCLK_INV	0	BCLK invert 0 - normal(default) 1 - BCLK invert

**REGISTER 0X03 – CLOCK MANAGER, DEFAULT 0010 0000**

Bit Name	Bit	Description
ADC_OSR	5:0	ADC Over Sample Rate control 0~14 - not used 15 - 60*fs 16 - 64*fs(default) ... 31 - 124*fs 32 - 128*fs ... 63 - 252*fs

**REGISTER 0X04 – CLOCK MANAGER, DEFAULT 0000 0000**

Bit Name	Bit	Description
DIV_PRE	7:4	Pre-divided mclk 1~15 - divide by 2~16 0 - divide by 1(default)
MULT_PRE	1:0	Pre-multiplication 0 - 1x(default) 1 - 2x 2 - 4x 3 - 8x

**REGISTER 0X05 – CLOCK MANAGER, DEFAULT 0000 0000**

Bit Name	Bit	Description
DIV_CLKCF	7:4	CF clock divider 1~15 - divide by 2~16 0 - divide by 1(default)
DIV_CLKDSP	3:0	DSP clock divider 1~15 - divide by 2~16 0 - divide by 1(default)

**REGISTER 0X06 – CLOCK MANAGER, DEFAULT 0000 0011**

Bit Name	Bit	Description
DIV_BCLK	6:0	BCLK divider at master mode 0~2 - divide by 1~3

		3 - divide by 4(default) 4~127 - divide by 5~128
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**REGISTER 0X07 – CLOCK MANAGER, DEFAULT 0000 0001**

Bit Name	Bit	Description
TRI_BCLK	6	BCLK Tri-state control 0 - normal(default) 1 - Tri-state
TRI_LRCK	5	LRCK Tri-state 0 - normal(default) 1 - Tri-state
TRI_SDOUT	4	SDOUT Tri-state 0 - normal(default) 1 - Tri-state
DIV_LRCK[11:8]	3:0	Master LRCK divider bit 11 to bit 8 0~4095 - divide by 1~4096 512 - divide by 512(default)

**REGISTER 0X08 – CLOCK MANAGER, DEFAULT 1111 1111**

Bit Name	Bit	Description
DIV_LRCK[7:0]	7:0	Master LRCK divider bit 7 to bit 0 0~4095 - divide by 1~4096 512 - divide by 512(default)

**REGISTER 0X09 – CLOCK MANAGER, DEFAULT 1100 0001**

Bit Name	Bit	Description
S1_SEL	7:6	SEL S1 00 – NA 01 – default 10 – state2 11 – state3
S1_TIME	5:0	Timer for S1 For LRCK=48KHz: 0 - 21us 1 - 104us(default) 2 - 5ms ... 63 - 167ms(max)

**REGISTER 0X0A – SDP, DEFAULT 1000 0001**

Bit Name	Bit	Description
S3_SEL	7:6	SEL S3 00 – NA 01 – default 10 – state2 11 – state3
S3_TIME	5:0	Timer for S3 For LRCK=48KHz: 0 - 21us 1 - 104us(default)

		2 - 5ms ... 63 - 167ms(max)
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**REGISTER 0X0B – SDP, DEFAULT 1100 0000**

Bit Name	Bit	Description
SDP_OUT_MUTE	7:6	SDP out mute control 0 - unmute 1 - mute R channel 2 - mute L channel 3 - mute L/R channels(default)
SDP_LRP	5	I2S/Left Justify case: 0 - L/R normal polarity(default) Left/Right=High/Low (LJ) Left/Right=Low/High (I2S) 1 - L/R invert polarity Left/Right=Low/High (LJ) Left/Right=High/Low (I2S) DSP mode case: 0 - Mode A, MSB is available on 2nd SCLK rising edge after LRCK rising edge(default) 1 - Mode B, MSB is available on 1st SCLK rising edge after LRCK rising edge
SDP_WL	4:2	SDP word length 0 – 24-bit(default) 1 – 20-bit 2 – 18-bit 3 – 16-bit 4 – 32-bit others - 24-bit
SDP_FMT	1:0	SDP format 0 - I2S(default) 1 - LJ 2 - reserved 3 - DSP

**REGISTER 0X0C – SDP, DEFAULT 0000 0000**

Bit Name	Bit	Description
TDM_FLAG	5:4	NFS flag at slot0/LSB 0 - no flag(default) 1 - first chip, generate flag '1' at slot0/LSB 2 - sync chip, get tdm flag '1' and sync, and send flag '1' at current slot 3 - all LSB is flag '0'
TDM_MODE	3:0	TDM mode selection 0 - ADC no TDM(default) 1 - 2FS 2 - 3FS 3 - 4FS 4 - 5FS 5 - 6FS 6 - 7Fs 7 - 8FS 8 - ADC + TDM shift (1FS)



		9 - TDM loop other - not used
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**REGISTER 0X0D – ADC CONTROL, DEFAULT 0000 0000**

Bit Name	Bit	Description
ADC_DATASEL	7:6	ADC data mux 0 - output L - R (default) 1 - output L - L 2 - output R - R 3 - output R - L
ADC_INV	5:4	ADC polarity inverted 0 - normal(default) 1 - ADCR invert 2 - ADCL invert 3 - ADCL/R invert
ADC_RAMCLR	3	ADC ram clear when lrck/adc_mclk active
ADC_SCALE	2:0	ADC gain scale up 0 - 0dB(default) (recommended when ADC_OSR=0x1C~0x20) 1 - 6dB (recommended when ADC_OSR=0x18~0x1B) 2 - 12dB (recommended when ADC_OSR=0x14~0x17) 3 - 18dB (recommended when ADC_OSR=0x11~0x13) 4 - 24dB (recommended when ADC_OSR=0x10) 5 - 30dB 6 - 36dB 7 - 42dB

**REGISTER 0X0E – ADC CONTROL, DEFAULT 0000 0000**

Bit Name	Bit	Description
ADC_VOLUME	7:0	ADC volume control 0x00 - '-95.5dB' (default) 0x01 - '-90.5dB' ... 0.5dB/step 0xBE - '-0.5dB' 0xBF - '0dB' 0xC0 - '+0.5dB' ... 0xFF - '+32dB'  ADC_VOLUME is the maxgain when ALC on

**REGISTER 0X0F – ADC CONTROL, DEFAULT 0000 0000**

Bit Name	Bit	Description
ADC_HPF	7	ADC offset freeze 0 - freeze offset(default) 1 - dynamic HPF
ALC_EN	6	ADC auto level control 0 - ALC disable(default) 1 - ALC enable
ADC_AUTOMUTE_EN	5:4	ADC auto mute control 0/1 - ADC automute dis (default) 2 - ADC automute enable

		3 – internal use
ADC_RAMPRATE	3:0	ADC VC ramp rate 0 - disable (default) For LRCK=48KHz: 1 - 0.25dB/80us 2 - 0.25dB /160us 3 - 0.25dB /320us 4 - 0.25dB /640us 5 - 0.25dB /1.28ms 6 - 0.25dB /2.56ms 7 - 0.25dB /5.12ms 8 - 0.25dB /10.24ms 9 - 0.25dB /20.48ms 10 - 0.25dB /40.96ms 11 - 0.25dB /81.92ms 12 - 0.25dB /163.84ms 13 - 0.25dB /327.68ms 14 - 0.25dB /655.36ms 15 - 0.25dB /1.3s

**REGISTER 0X10 – ADC CONTROL, DEFAULT 0000 0000**

Bit Name	Bit	Description
ADC_AUTOMUTE_NG	6:4	ADC automute noise gate 0 - '-96dB'(default) 1 - '-90dB' 2 - '-84dB' 3 - '-78dB' 4 - '-72dB' 5 - '-66dB' 6 - '-60dB' 7 - '-54dB'
ADC_AUTOMUTE_WS	3:0	ADC automute detection For LRCK=48KHz: 0 - 40us(default) 1 – 60us 2 – 120us ... 10 – 30ms 11 – 60ms others: not used

**REGISTER 0X11 – ADC CONTROL, DEFAULT 0000 0000**

Bit Name	Bit	Description
AUTOMUTE_SDP	5	ADC automute SDP control 0 - not mute(default) 1 - mute sdp, SDP_OUT_MUTE=3
ADC_AUTOMUTE_VOL	4:0	ADC auto mute out gain select 0 - mute to -95.5dB(default) ... -4dB/step 23 - mute to 0dB 31 - mute to +32dB

**REGISTER 0X12 – ADC CONTROL, DEFAULT 0000 0000**

Bit Name	Bit	Description
AUTOMUTE_PGA	3	ADC automute PDN_PGA control 0 - not mute(default) 1 - mute pga
AUTOMUTE_MOD	2	ADC automute MOD control 0 - not mute(default) 1 - mute mod
AUTOMUTE_MRST	1	ADC automute MOD reset control 0 - not mute(default) 1 - mute mod reset
AUTOMUTE_DIG	0	ADC automute digital circuit control 0 - not mute(default) 1 - mute ADC digital

**REGISTER 0X13 – ADC CONTROL, DEFAULT 0000 0000**

Bit Name	Bit	Description
ALC_WINSIZE	7:4	ALC rate selection For LRCK=48KHz: 1 - 0.25dB/40us 2 - 0.25dB /80us 3 - 0.25dB /160us 4 - 0.25dB /320us 5 - 0.25dB /640us 6 - 0.25dB / 1.28ms 7 - 0.25dB / 2.56ms 8 - 0.25dB /5.12ms 9 - 0.25dB /10.24ms 10 - 0.25dB /20.48ms 11 - 0.25dB /40.96ms 12 - 0.25dB /81.92ms 13 - 0.25dB /163.84ms 14 - 0.25dB /327.68ms 15 - 0.25dB /655.36ms
ALC_LEVEL	3:0	ALC target level 0 - '-30.0dB' (default) 1 - '-27.0dB' 2 - '-24.0dB' 3 - '-22.0dB' 4 - '-19.0dB' 5 - '-17.0dB' 6 - '-15.0dB' 7 - '-13.5dB' 8 - '-12.0dB' 9 - '-10.5dB' 10 - '-9.0 dB' 11 - '-7.5 dB' 12 - '-6.0 dB' 13 - '-4.5 dB' 14 - '-3.0 dB' 15 - '-1.5 dB'

**REGISTER 0X14 – ADC CONTROL, DEFAULT 0000 1100**

Bit Name	Bit	Description
ADC_HPFS1	4:0	ADCHPF stage1 coeff 0x0C (default)

**REGISTER 0X15 – ADC CONTROL, DEFAULT 0000 1100**

Bit Name	Bit	Description
ADC_HPFS2	4:0	ADCHPF stage2 coeff 0x0C (default)

**REGISTER 0X16 – ANALOG, DEFAULT 1111 1111**

Bit Name	Bit	Description
PDN_ANA	7	0 – enable analog circuits 1 – power down analog circuits(default)
PDN_ADCVREFGEN	6	0 – enable analog ADC bias circuits 1 – power down analog ADC bias circuits(default)
MODTOP1_RST	5	0 – disable(default) 1 – reset modulator1
MODTOP2_RST	4	0 – disable(default) 1 – reset modulator2
PDN_MOD1	3	0 – enable analog ADC modulator1 1 – power down analog ADC modulator1(default)
PDN_MOD2	2	0 – enable analog ADC modulator2 1 – power down analog ADC modulator2(default)
PDN_PGA1	1	0 – enable analog PGA1 1 – power down analog PGA 1(default)
PDN_PGA2	0	0 – enable analog PGA2 1 – power down analog PGA2(default)

**REGISTER 0X17 – ANALOG, DEFAULT 0000 0000**

Bit Name	Bit	Description
VMIDSEL	1:0	0 – power down(default) 1 – speed charge1 2 – normal vmid operation 3 – speed charge3

**REGISTER 0X18 – ANALOG, DEFAULT 0010 0100**

Bit Name	Bit	Description
ADCBIAS_SW	5:4	0 –bias setting level0, (default) 1 –bias setting level1 2 –bias setting level2 3 –bias setting level3(highest bias)
ADCFL_SW	3:0	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7

		1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)
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**REGISTER 0X19 – ANALOG, DEFAULT 1000 1000**

Bit Name	Bit	Description
PGA1BIAS_SW	7:4	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)
PGA2BIAS_SW	3:0	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)

**REGISTER 0X1A – ANALOG, DEFAULT 0100 0100**

Bit Name	Bit	Description
ADC11BIAS_SW	7:4	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4

		0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)
ADC123BIAS_SW	3:0	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)

**REGISTER 0X1B – ANALOG, DEFAULT 0100 0100**

Bit Name	Bit	Description
ADCSMBIAS_SW	7:4	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)
ADCCMBIAS_SW	3:0	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5

		0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)
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**REGISTER 0X1C – ANALOG, DEFAULT 0100 0100**

Bit Name	Bit	Description
ADCVRPBIAS_SW	7:4	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)
ADCCPPBIAS_SW	3:0	0000 – not allowed 0001 - bias setting level1(lowest) 0010 - bias setting level2 0011 - bias setting level3 0100 - bias setting level4 0101 - bias setting level5 0110 - bias setting level6 0111 - bias setting level7 1000 - bias setting level8 1001 - bias setting level9 1010 - bias setting level10 1011 - bias setting level11 1100 - bias setting level12 1101 - bias setting level13 1110 - bias setting level14 1111 - bias setting level15(highest)

**REGISTER 0X1D – ANALOG, DEFAULT 0000 0000**

Bit Name	Bit	Description
LP_VRP	7	0 – default 1 – low power
LP_VRPOUT	6	0 – default

		1 – low power
LP_ADCMOD1	5	0 – default 1 – low power
LP_ADCMOD2	4	0 – default 1 – low power
LP_ADCMODF1	3	0 – default 1 – low power
LP_ADCMODF2	2	0 – default 1 – low power
LP_ADCMODI1	1	0 – default 1 – low power
LP_ADCMODI2	0	0 – default 1 – low power

**REGISTER 0X1E – ANALOG, DEFAULT 0000 0101**

Bit Name	Bit	Description
LP_PGA1	5	0 – default 1 – low power
LP_PGA2	4	0 – default 1 – low power
LP_PGA11	3	0 – default 1 – low power
LP_PGA12	2	0 – default 1 – low power
LP_PGA21	1	0 – default 1 – low power
LP_PGA22	0	0 – default 1 – low power

**REGISTER 0X1F – ANALOG, DEFAULT 0000 1100**

Bit Name	Bit	Description
ADC_DMIC_ON	5	0 – default 1 – enable Dmic
REFSEL	4	0 – default 1 – internal use
VX2OFF	3	0 – enable internal reference voltage 1 – off(default)
VX1SEL	2	0 – level1 1 – level2(default)
VMIDLVL	1:0	0 – 'vdda/2' (default) 1 – vmid level1 2 – vmid level2 3 – vmid level3

**REGISTER 0X20 – ANALOG, DEFAULT 0000 0000**

Bit Name	Bit	Description
SELMIC1	4	0 – default 1 – select MIC1 as PGA1 input
PGA1GAIN_SETTING	3:0	PGA1 gain 0 – 0dB(default)



		1 – 3dB 2 – 6dB 3 – 9dB 4 – 12dB 5 – 15dB 6 – 18dB 7 – 21dB 8 – 24dB 9 – 27dB 10 – 30dB 11 – 33dB 12 – 34.5dB 13 – 36dB 14 – 37.5dB
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**REGISTER 0X21 – ANALOG, DEFAULT 0000 0000**

Bit Name	Bit	Description
SELMIC2	4	0 – default 1 – select MIC2 as PGA2 input
PGA2GAIN_SETTING	3:0	PGA2 gain 0 – 0dB(default) 1 – 3dB 2 – 6dB 3 – 9dB 4 – 12dB 5 – 15dB 6 – 18dB 7 – 21dB 8 – 24dB 9 – 27dB 10 – 30dB 11 – 33dB 12 – 34.5dB 13 – 36dB 14 – 37.5dB

**REGISTER 0XF7 – TEST MODE, DEFAULT 1111 0000**

Bit Name	Bit	Description
PULLUPSE_BCLK	7	BCLK pullup control 0 - BCLK no pullup 1 - BCLK pullup(default)
PULLUPSE_LRCK	6	LRCK pullup control 0 - LRCK no pullup 1 - LRCK pullup(default)
PULLDNSE_TDMIN	5	TDMIN pulldown control 0 - TDMIN no pulldown 1 - TDMIN pulldown(default)
PULLDNSE_SDOUT	4	SDOUT pulldown control 0 - SDOUT no pulldown 1 - SDOUT pulldown(default)
SDOUT_DRIVE	2	SDOUT driver select

		0 - SDOOUT normal driver(default) 1 - SDOOUT weak driver
BCLK_DRIVE	1	BCLK driver select 0 - BCLK normal driver(default) 1 - BCLK weak driver
LRCK_DRIVE	0	LRCK driver select 0 - LRCK normal driver(default) 1 - LRCK weak driver

**REGISTER 0XF8 – TEST MODE, DEFAULT 0000 0000**

Bit Name	Bit	Description
SDOUT_FAST	7	Internal use
PATHSEL	6	Internal use
DELYSEL	5:4	Internal use
ADC_DLY_SEL	3	Internal use

**REGISTER 0XF9 – TEST MODE, DEFAULT 0000 0000**

Bit Name	Bit	Description
DLL_PWD	0	Internal use

**REGISTER 0XFA – I2C CONFIGURE, DEFAULT 0000 0000**

Bit Name	Bit	Description
I2C_RETIME	1	I2C signals retime 0 - normal(default) 1 - retime mode
INI_REG	0	Initial registers 0 - normal(default) 1 - reset registers to default

**REGISTER 0XFC – FLAG, DEFAULT 0000 0000**

Bit Name	Bit	Description
FLAG_CSM_CHIP	5:4	CSM flag, read only 0 - S0 1 - S1 2 - S2 3 - S3
FLAG_ADCAM	0	ADC automute flag, read only 0 - no mute 1 - mute flag

**REGISTER 0XFD – CHIP ID1, DEFAULT 0111 1010**

Bit Name	Bit	Description
CHIP_ID1	7:0	0X7A, read only

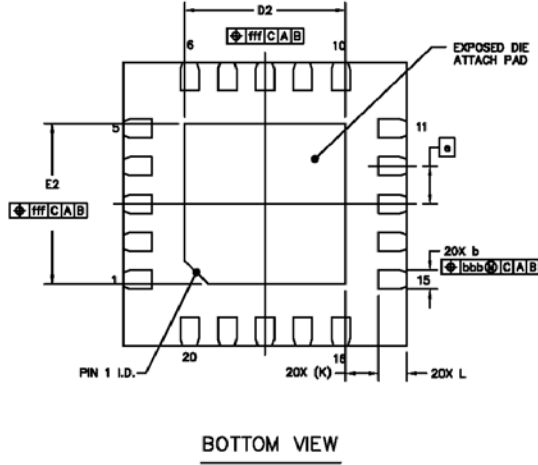
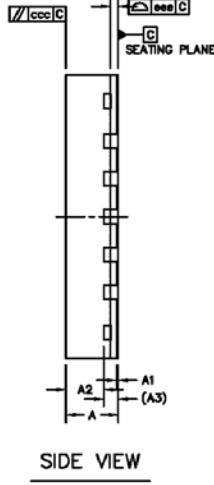
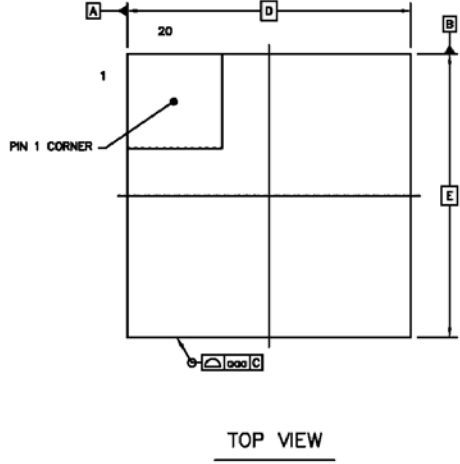
**REGISTER 0XFE – CHIP ID2, DEFAULT 0100 0011**

Bit Name	Bit	Description
CHIP_ID2	7:0	0X43, read only

**REGISTER 0XFF – CHIP VERSION, DEFAULT 0000 0000**

Bit Name	Bit	Description
CHIP_VER	7:0	0X00, read only

8. PACKAGE



	SYMBOL	MIN	NOM	MAX	
TOTAL THICKNESS	A	0.5	0.55	0.6	
STAND OFF	A1	0	0.02	0.05	
MOLD THICKNESS	A2	---	0.4	---	
L/F THICKNESS	A3	0.152 REF			
LEAD WIDTH	b	0.15	0.2	0.25	
BODY SIZE	X	3 BSC			
	Y	3 BSC			
LEAD PITCH	e	0.4 BSC			
EP SIZE	X	D2	1.6	1.7	1.8
	Y	E2	1.6	1.7	1.8
LEAD LENGTH	L	0.2	0.3	0.4	
LEAD TIP TO EXPOSED PAD EDGE	K	0.35 REF			
PACKAGE EDGE TOLERANCE	aaa	0.1			
MOLD FLATNESS	ccc	0.1			
COPLANARITY	eee	0.08			
LEAD OFFSET	bbb	0.1			
EXPOSED PAD OFFSET	fff	0.1			

## 9. CORPORATE INFORMATION

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