AB176D

Audio Player Microcontroller

Versions: 0.0.2

2025.7.11

Declaration

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Revision History

Date	Version	Comments	Revised by
2025-05-23	0.0.1	First draft	Leo
2025-07-11	0.0.2	Update Product Features	Leo

Table of Contents

1 Product Features

CPU and Flexible IO

- High performance 32bit RISC-V processor Core with DSP instruction
- Typical 128MHz operating frequency
- Internal 28KB RAM for data and program
- Program memory: SiP 1Mbit flash
- Flexible GPIO pins with Programmable pull-up and pull-down resistors
- Support GPIO wakeup or interrupt

Audio Interface

- MIC amplifier x1
- High performance 16bits Sigma-Delta ADC x1:
  -SNR: 97dB
  -Sample rate: 8KHz /12KHz /16KHz /24KHz /32KHz /48KHz
- High performance 16bits Sigma-Delta DAC x2:
  -SNR @Single mode: 98dB
  -SNR @VCMBUF mode: 100dB
  -Sample rate: 4KHz /6KHz /8KHz /11.025KHz /12KHz /16KHz /22.05KHz /24KHz /32KHz /38KHz /44.1KHz /48KHz
- Audio DAC support single-ended and VCMBUF mode
- Support flexible audio EQ adjust
- Support analog line-in
- Supports insertion and removal detection for 4-segment headphones, 3-segment headphones

Peripheral and Interfaces

- Watch Dog
- Frequency detector
- Master/Slave SPI x2
- Normal UART x2; High speed UART with CTS/RTS x1
- Full speed USB1.1 Host/Device controller x1
- 32-bit normal timer x 2; multi-function 32-bit timer x 2
- 10-bit SAR ADC x8ch
- Crossbar Input/Output
- Built in PMU, capless LDOs and LDO
- 8 Individually programmable and multiplexed GPIO pin

Applications

- Type-C Wired Headphones

Package

- QFN20 3*3

Temperature

- Operating temperature: -40℃ to +85℃
- Storage temperature: -65℃ to +150℃
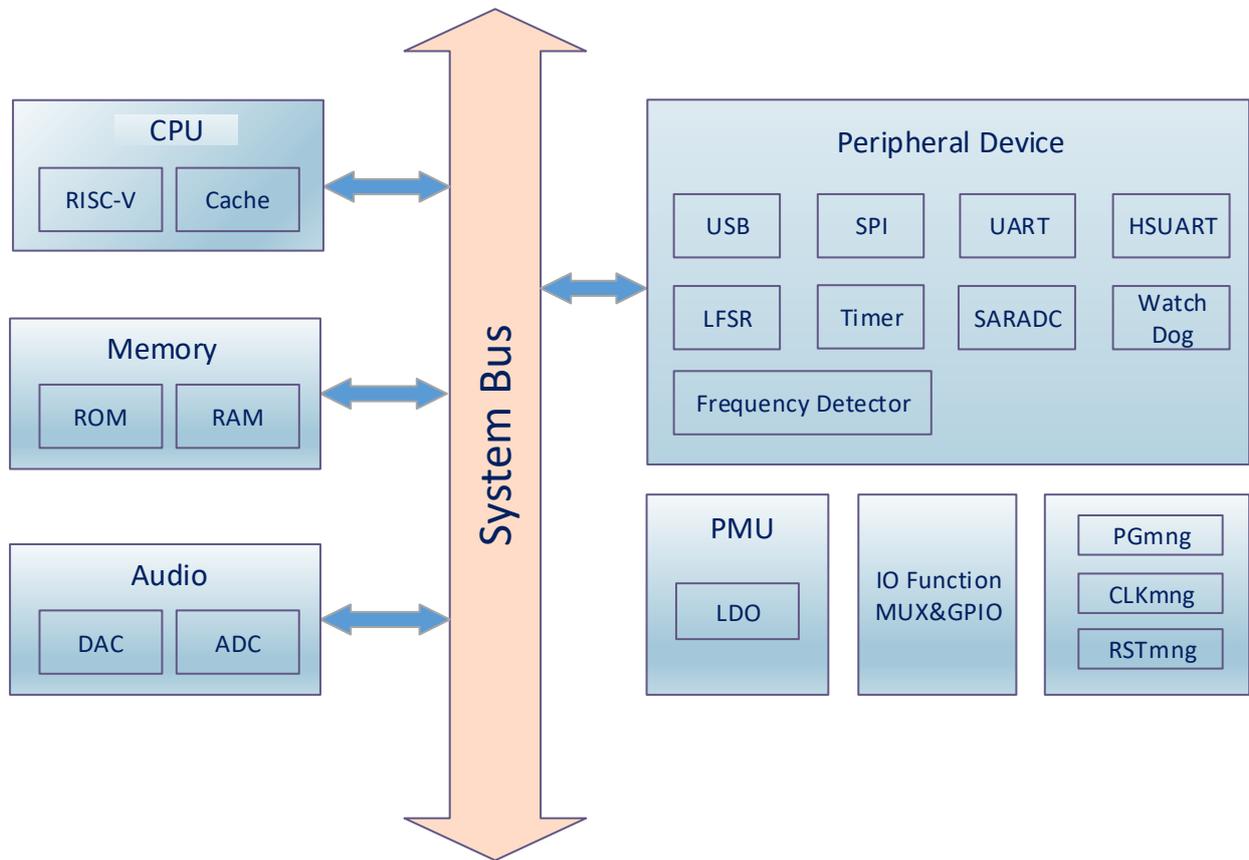
SoC Architecture

Figure 2-1 Architecture Block Diagram

3 Package Definition

3.1   Pin Assignment
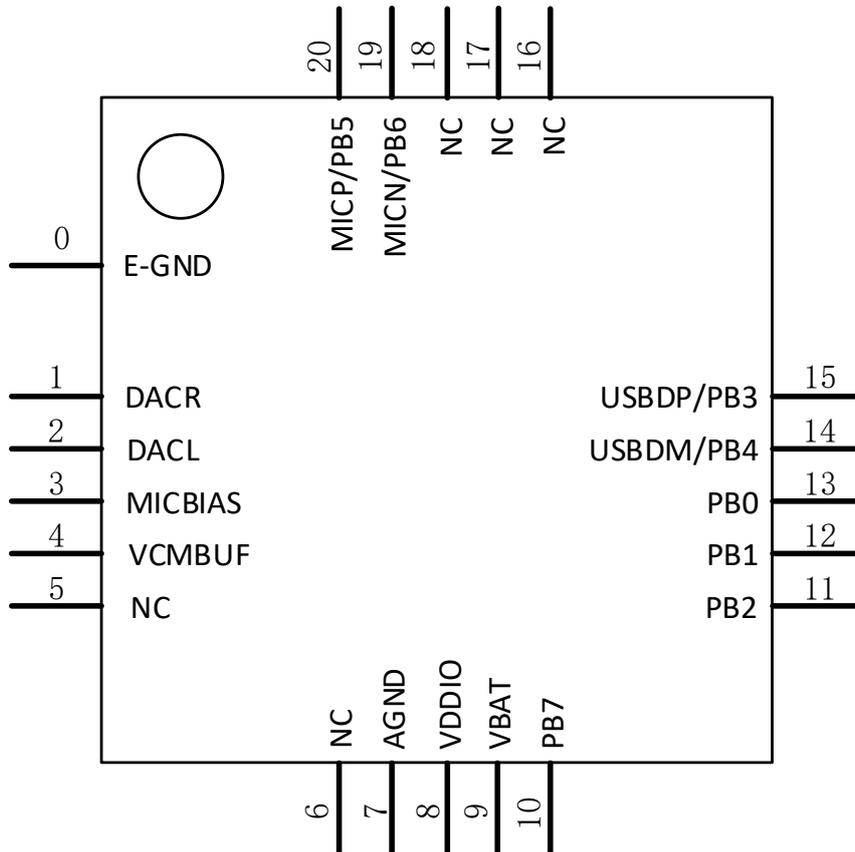
Figure 3-1 Pin Assignment for QFN20

3.2   Pin Descriptions

Table 3-1 QFN20 Pin Description

Pin No.	Name	Type	Drive (mA)	Function
0	E-GND	GND	/	E-pad Ground
1	DACR	A	/	DAC right channel output
2	DACL	A	/	DAC left channel output
3	MICBIAS	A	/	Microphone Bias
4	VCMBUF	A	/	VCM buffer output
5	NC	-	-	-

6	NC	-	-	-
7	AGND	GND	/	DAC Ground
8	VDDIO	PWR	/	VDDIO power output
9	VBAT	PWR	/	VBAT power input
10	PB7	I/O	8/32	ADC7 SPI1_CLK/DO/DI-G8 TX0/RX0-G8 TX1/RX1-G8 HSTRX/CTS/RTS-G8 FMOSC-G8 PWM0/1/2-G8 T2CPT/T3CPT-G8 INT7 PB7
11	PB2	I/O	8/32	ADC2 SPI1_CLK/DO/DI-G3 TX0/RX0-G3 TX1/RX1-G3 HSTRX/CTS/RTS-G3 FMOSC-G3 PWM0/1/2-G3 T2CPT/T3CPT-G3 INT2 PB2
12	PB1	I/O	8/32	ADC1 SPI1_CLK/DO/DI-G2 TX0/RX0-G2 TX1/RX1-G2 HSTRX/CTS/RTS-G2 FMOSC-G2 PWM0/1/2-G2 T2CPT/T3CPT-G2 INT1 PB1
13	PB0	I/O	8/32	ADC0 SPI1_CLK/DO/DI-G1 TX0/RX0-G1 TX1/RX1-G1 HSTRX/CTS/RTS-G1 FMOSC-G1 PWM0/1/2-G1 T2CPT/T3CPT-G1 INT0 PB0
14	PB4/USBDM	I/O	8/32	USBDM ADC4 SPI1_CLK/DO/DI-G5 TX0/RX0-G5 TX1/RX1-G5 HSTRX/CTS/RTS-G5 FMOSC-G5 PWM0/1/2-G5 T2CPT/T3CPT-G5 INT4 PB4
15	PB3/USBDP	I/O	8/32	USBDP ADC3 SPI1_CLK/DO/DI-G4

				TX0/RX0-G4 TX1/RX1-G4 HSTRX/CTS/RTS-G4 FMOSC-G4 PWM0/1/2-G4 T2CPT/T3CPT-G4 INT3 PB3
16	NC	-	-	-
17	NC	-	-	-
18	NC	-	-	-
19	PB6/MICN	I/O	8/32	MICN ADC6 SPI1_CLK/DO/DI-G7 TX0/RX0-G7 TX1/RX1-G7 HSTRX/CTS/RTS-G7 FMOSC-G7 PWM0/1/2-G7 T2CPT/T3CPT-G7 INT6 PB6
20	PB5/MICP	I/O	8/32	MICP ADC5 SPI1_CLK/DO/DI-G6 TX0/RX0-G6 TX1/RX1-G6 HSTRX/CTS/RTS-G6 FMOSC-G6 PWM0/1/2-G6 T2CPT/T3CPT-G6 INT5 PB5

Note: I/O: Digital input/output;   I : Digital input;   A : Analog Pin; PWR: Power Pin; GND: Ground.

4 Characteristics

4.1 PMU Parameters

Table 4-1 PMU voltage input Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VBAT	Voltage input	2.3	3.7	5.5	V	

Table 4-2 VDDIO LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDIO	3.3V LDO voltage output	1.5	3.3	3.6	V	Light Loading condition
△V VDDIO	Output Mismatch 1-sigma	-	11	-	mV	VDDIO=3.3v
ILOAD	Maximum output current	-	-	70	mA	@VBAT=3.6v
ISC	Short Circuit Current Limit	-	150	230	mA	@VBAT=3.8v

Table 4-3 AVDD LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
AVDD	3.3V LDO voltage output	1.5	3.3	3.6	V	Light Loading condition
△V AVDD	Output Mismatch 1-sigma	-	10	-	mV	AVDD=3.3v
ILOAD	Maximum output current	-	-	150	mA	@VBAT=3.6v
ISC	Short Circuit Current Limit	-	100	150	mA	@VBAT=3.8v

Table 4-4 VDDCORE LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDCORE	0.8V LDO voltage output	0.825	1.2	1.6	V	Light Loading condition
△VVDDCORE	Output Mismatch 1-sigma	-	6	-	mV	VDDCORE=1.1v
ILOAD	Maximum output current	-	-	30	mA	@VBAT=3.6v
ISC	Short Circuit Current Limit	-	-	680	mA	@VBAT=3.8v

4.2 IO Parameters

Table 4-3 I/O Parameters

GPIO—Electrical Characteristics							
Symbol	Description	Related GPIO	Min	Typical	Max	Units	Conditions
VIL	Low-level input voltage		-0.3		0.93	V	VDDIO=3.3V
VIH	High-level input voltage		2.31		3.6	V	VDDIO=3.3V
Driver Ability 1	Output Driver Ability 1			32		mA	VDDIO=3.3V

GPIO—Electrical Characteristics							
Driver Ability 0	Output Driver Ability 0			8		mA	VDDIO=3.3V
RPUP0	Internal pull-up resister 0		0.24	0.3	0.36	KΩ	
RPUP1	Internal pull-up resister 1		8	10	12	KΩ	
RPUP2	Internal pull-up resister 2		160	200	240	KΩ	
RPDN0	Internal pull-down resister 0		0.24	0.3	0.36	KΩ	
RPDN1	Internal pull-down resister 1		8	10	12	KΩ	
RPDN2	Internal pull-down resister 2		160	200	240	KΩ	

Table 4-4 Internal Resistor Characteristics

Port	General Output	High Drive	Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment
PB0-PB7 PG1,PG2,PG4,PG5	8mA	32mA	0.3K/10K/200K	0.3K/10K/200K	Internal pull-up/pull-down resistance accuracy ± 20%

4.3 Audio DAC Parameters

Table 4-5 Audio DAC Single Mode @VCM=1.25V

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
SNR		-	98.1	-	dB	with A-wt filter Output -2.75dBV with 32R 47uF loading Fin=1KHz
THD+N		-	-75.2	-	dB	with A-wt filter Output -2.75dBV with 32R 47uF loading Fin=1KHz
Output Range	Maximum output voltage	-	-2.75	-	dBV	with 32R 47uF loading

Table 4-6 Audio DAC VCMBUF Mode @VCM=1.25V

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
SNR		-	99.9	-	dB	With A-wt filter Output -2.33dBV with 32R loading Fin=1KHz
THD+N		-	-79.5	-	dB	With A-wt filter Output -2.33dBV with 32R loading Fin=1KHz
Output Range	Maximum output voltage	-	-2.33	-	dBV	With 32R loading

4.4 Audio ADC Parameters

Table 4-7 Audio ADC Parameters

Mode	Sym	Characteristics	Min	Typ	Max	Unit	Conditions
Differential input ADC Mode	SNR		-	97	-	dB	With A-wt filter Input -2dBV @ Fin=1KHz Gain = 6dB
	THD+N		-	-80	-	dB	
	Input Range	Maximum input voltage	-	-2	-	dBV	
Single input External-RC ADC mode	Gain		0	-	6	dB	0dB / 6dB
	SNR		-	89	-	dB	With A-wt filter Input -12dBV @ Fin=1KHz Gain=12dB
	THD+N		-	-58	-	dB	
	Input Range	Maximum input voltage	-	-12	-	dBV	
Internal-RC ADC mode	SNR		-	88	-	dB	With A-wt filter Input -13dBV @ Fin=1KHz Gain=6dB
	THD+N		-	-49	-	dB	
	Input Range	Maximum input voltage	-	-13	-	dBV	

4.5 Power Consumption Parameters

Table 4-8 Current Parameters

State	Min	Typ	Max	Unit	Conditions
Idle		8		mA	With 32Ω loading
Play music		9.5		mA	
Call/Record		17.1		mA	
USB Suspend		2.24		mA	

5 Package Information

QFN3X3-20L(P0.4T0.75)
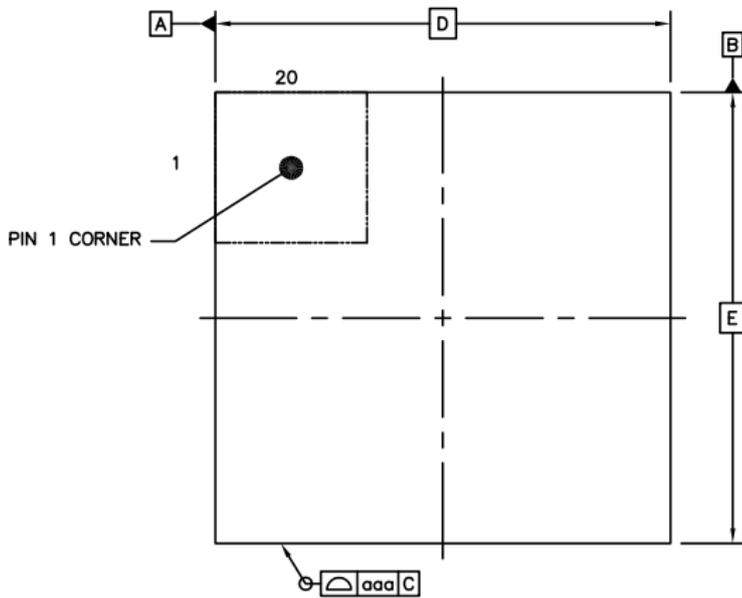
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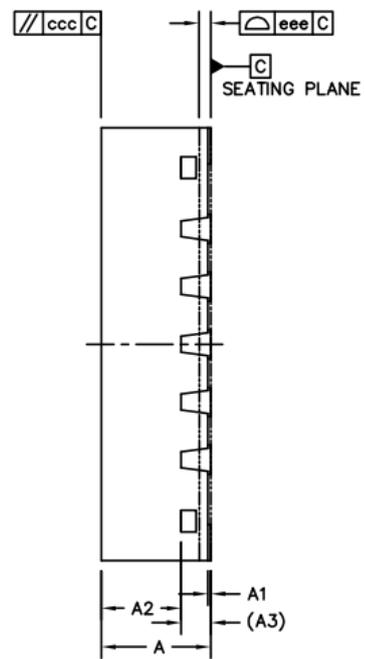
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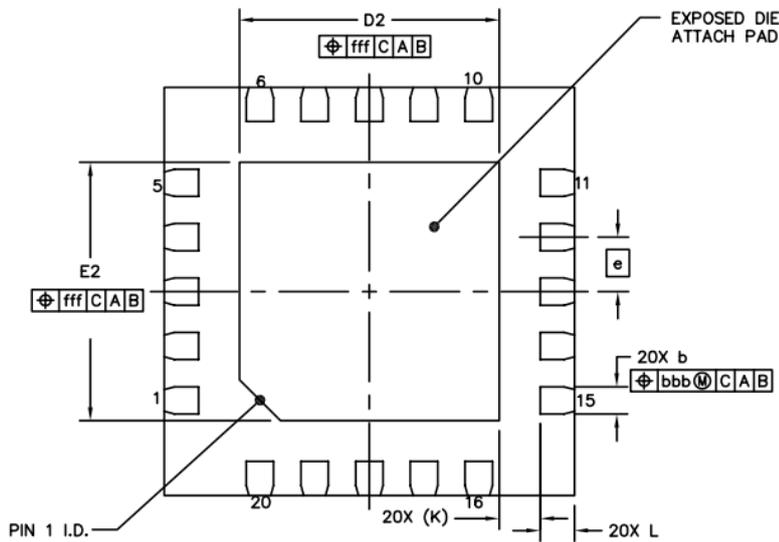
BOTTOM VIEW

		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.7	0.75	0.8
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.55	---
L/F THICKNESS		A3	0.203 REF		
LEAD WIDTH		b	0.15	0.2	0.25
BODY SIZE	X	D	3 BSC		
	Y	E	3 BSC		
LEAD PITCH		e	0.4 BSC		
EP SIZE	X	D2	1.8	1.9	2
	Y	E2	1.8	1.9	2
LEAD LENGTH		L	0.15	0.25	0.35
LEAD TIP TO EXPOSED PAD EDGE		K	0.3 REF		
PACKAGE EDGE TOLERANCE		aaa	0.1		
MOLD FLATNESS		ccc	0.1		
COPLANARITY		eee	0.08		
LEAD OFFSET		bbb	0.07		
EXPOSED PAD OFFSET		fff	0.1		

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