AB5716D

Audio Player Microcontroller

Versions: 0.0.4
2024.12.12

Declaration

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Revision History

Date	Version	Comments	Revised by
2024-02-28	0.0.1	First draft	Leo
2024-03-06	0.0.2	Modify the parameter of BT and Audio	Leo
2024-04-03	0.0.3	Modify I/O drive current parameters	Leo
2024-12-12	0.0.4	Update to BT6.0	Leo

Table of Contents

1 Product Features

CPU and Flexible IO

- High performance 32bit RISC-V processor Core with DSP instruction
- RISC-V typical speed: 140MHz
- Program memory: internal 8M bit flash
- Internal 280KB RAM for data and program
- Flexible GPIO pins with Programmable pull-up and pull-down resistors
- Support GPIO wakeup or interrupt

Bluetooth Radio

- Compliant with Bluetooth V6.0 + BR + EDR + BLE specification

  QDID：Q309899 (Controller)

  QDID：Q304434 (Host)
- Maximum TX output power +9dBm
- RX Sensitivity with -94.5dBm @2M EDR
- Support TWS communication with balance-efficiency Power consumption
- Support TWS Master-slave switch

Audio Interface

- High performance mono DAC with 103dB SNR, support differential mode and VCMBUF mode
- High performance mono ADC with 100dB SNR
- One channel MIC amplifier input
- Support flexible audio EQ adjust
- Support Sample rate 8, 11.025, 12, 16, 22.05, 32, 44.1, 48, 88.2,96, 176.4 and 192KHz

Applications

- TWS Bluetooth headset

Peripheral and Interfaces

- Support DNN Environmental Noise Cancellation (ENC)
- Support Neural Network Processing Unit (NPU)
- Support MPEG-1/2/3; AAC, SBC high quality decode
- Support Low power Touch Key
- 32-bit normal timer x 3; multi-function 32-bit timer x 3
- WatchDog;
- Full-duplex normal UART x 3; high speed UART x 1
- Master/Slave SPI x2
- Master/Slave IIC x1
- IR controller
- Full speed USB 2.0 HOST/DEVICE controller x1
- 10-bit SARADC x 6
- Integrate IRTC
- Build in PMU, such as charger/buck/LDO

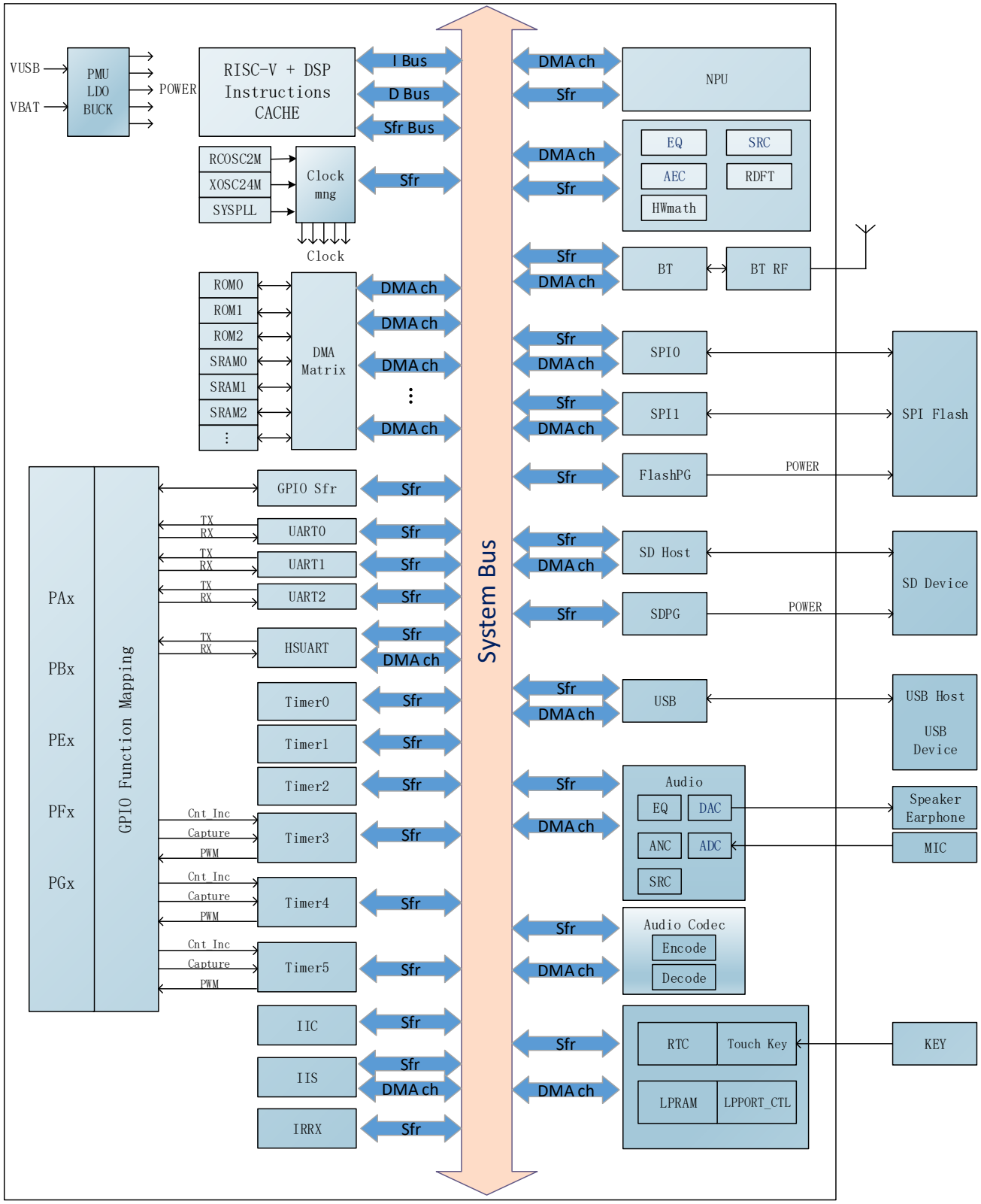
Package

- QFN20 3*3

Temperature

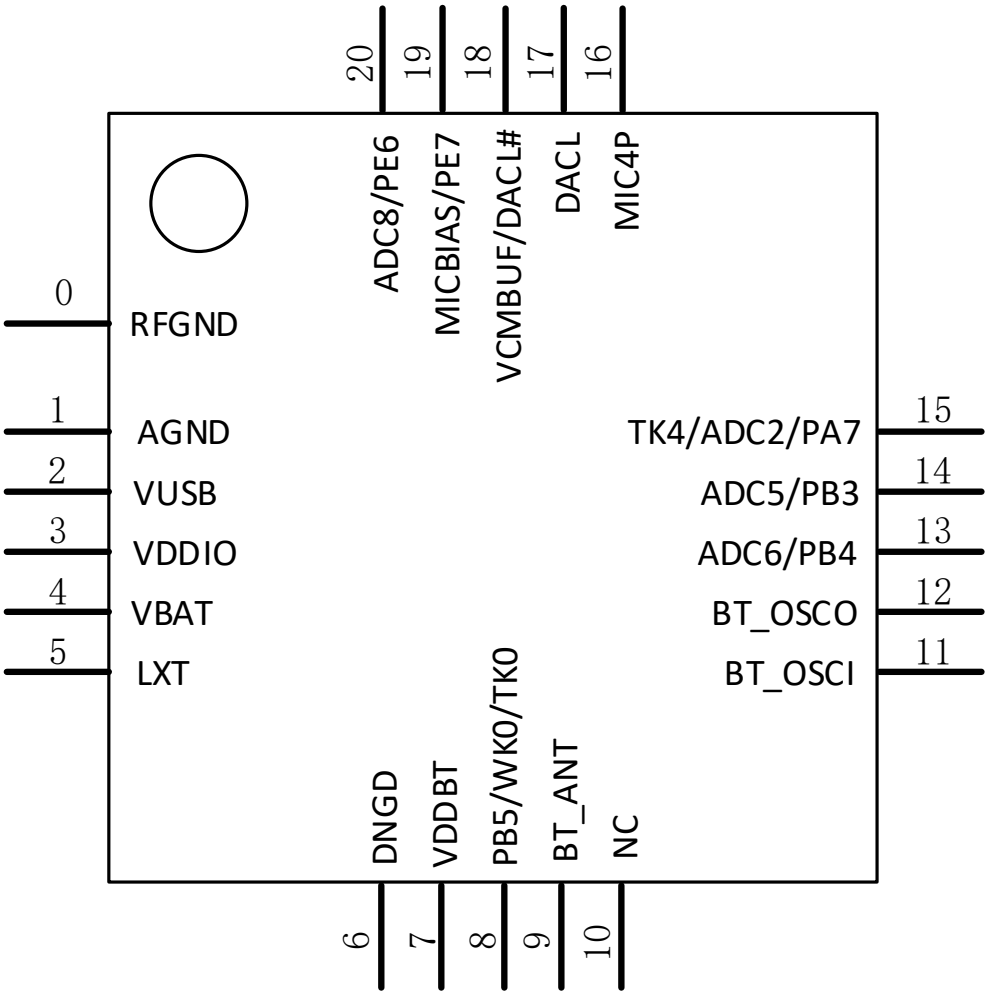
- Operating temperature: -40℃ to +85℃
- Storage temperature: -65℃ to +150℃

2 Block diagram



3 Package Definition

3.1 Pin Assignment



3.2 Pin Descriptions

Table 3-1 QFN20 pin description

Pin No.	Name	Type	Drive(mA)	Function
0	RFGND	GND	/	RF Ground
1	AGND	GND	/	DAC Ground
2	VUSB	PWR	/	VUSB power input TX0-G6 TX1-G3 TX2-G3

				HSTRX-G11
3	VDDIO	PWR	/	VDDIO power output
4	VBAT	PWR	/	VBAT power input
5	LXT	PWR	/	Buck inductor interface for BT
6	DGND	GND	/	Digital Ground
7	VDDBT	PWR	/	BT power
8	PB5 / WK0 / TK0	I/O	8/32	10S Reset Touch0 ADC12 SPI1DI-G1 SPI2W_DIO1-G1 INT5-G0 PWM3-G2 PB5
9	BT_ANT	A	/	BT ANT
10	NC	/	/	/
11	BT_OSCI	A	/	24M OSC input
12	BT_OSCO	A	/	24M OSC output
13	PB4 / ADC6	I/O	8/32	USBDM ADC6 SPI1DO/SPI1DATA-G1 IIC_DAT-G7 RX0-G3 HSTRX-G8 INT4-G0 FMOSC-G7 PWM2-G2 PB4
14	PB3 / ADC5	I/O	8/32	USBDP ADC5 SPI1CLK-G1 IIC_CLK-G7 TX0-G3 HSTRX-G3 INT3-G0 PWM1-G2 PB3
15	PA7 / ADC2 / TK4	I/O	8/32	Touch4 ADC2 AUXR1 SPI1DO/SPI1DATA-G2 IIC_DAT-G1 TX0-G1 TX1-G1 HSTRX-G1 INT0-G0 PWM3-G1 PA7
16	MIC4P	A	/	Microphone4 positive input

17	DACL	A	/	DAC Left Channel
18	VCMBUF / DACL#	A	/	VCM buffer output DACL#
19	PE7 / MICBIAS	I/O	8/32	MICBIAS2-300R ADC9 AUXR0 SPI1DO/SPI1DATA-G4 IIC_DAT-G5 TX0-G4 TX2-G1 HSTRX-G4 INT3-G1 PWM2-G3 TMR4CAP_G1/IR_G8 PE7
20	PE6 / ADC8	I/O	8/32	ADC8 AUXL0 SPI1CLK-G4 IIC_CLK-G5/G6 RX0-G4 RX2-G1 HSTRX-G9 INT2-G2 FMOSC-G6 PWM1-G3 TMR3CAP_G7/IR_G7 PE6

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
VUSB	Charger Voltage input	4.6	5.0	5.5	V	
VBAT	Voltage input	3.0	3.7	4.5	V	

Table 4-2 3.3V LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDIO	3.3V LDO voltage output	2.4	3.3	3.6	V	Light Loading condition Step 0.1v
△VVDDIO	Output Mismatch 1-sigma	-	17	-	mV	VDDIO=3.3v
ILOAD	Maximum output current	-	-	150	mA	@VBAT=3.6v
ISC	Short Circuit Current Limit	-	-	750	mA	@VBAT=3.8v

Table 4-3 1.25V LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDBT/BT_AVDD	1.25V LDO voltage output	0.85	1.25	1.6	V	Light Loading condition Step 0.05v
△VVDDBT	Output Mismatch 1-sigma	-	9	-	mV	VDDBT=1.25v
ILOAD	Maximum output current	-	-	100	mA	@VBAT=3.0v
ISC	Short Circuit Current Limit	-	-	300	mA	@VBAT=3.8v

Table 4-4 1.1V LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDCORE	1.1V LDO voltage output	0.7	1.1	1.475	V	Light Loading condition Step 0.025v
△VVDDCORE	Output Mismatch 1-sigma	-	6	-	mV	VDDCORE=1.1v
ILOAD	Maximum output current	-	-	75	mA	@VBAT=3.6v
ISC	Short Circuit Current Limit	-	-	300	mA	@VBAT=3.8v

Table 4-5 1.25V BUCK Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDBT	1.25V BUCK voltage output	0.85	1.25	1.6	V	Light Loading condition Step=0.05v
△VVDDBT	Output Mismatch 1-sigma	-	6	-	mV	VDDBT=1.25v
ILOAD	Maximum output current	-	-	360	mA	@VBAT=3.8v
ISC	Short Circuit Current Limit	-	-	360	mA	@VBAT=3.8v

Table 4-6 1.1V BUCK Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDCORE	1.1V BUCK voltage output	0.7	1.1	1.475	V	Light Loading condition Step=0.025v
△VVDDCORE	Output Mismatch 1-sigma	-	6	-	mV	VDDCORE=1.1v
ILOAD	Maximum output current	-	-	360	mA	@VBAT=3.8v
ISC	Short Circuit Current Limit	-	-	360	mA	@VBAT=3.8v

4.2 IO Parameters

Table 4-6 I/O Parameters

GPIO—Electrical Characteristics							
Symbol	Description	Related GPIO	Min	Typical	Max	Units	Conditions
VIL	Low-level input voltage		-0.3		1.27	V	VDDIO=3.3V
VIH	High-level input voltage		2.03		3.6	V	VDDIO=3.3V
Driver Ability 1	Output Driver Ability 1			32		mA	VDDIO=3.3V
Driver Ability 0	Output Driver Ability 0			8		mA	VDDIO=3.3V
RPUP0	Internal pull-up resister 0		8	10	12	KΩ	
RPUP1	Internal pull-up resister 1		0.24	0.3	0.36	KΩ	
RPUP2	Internal pull-up resister 2		160	200	240	KΩ	
RPDN0	Internal pull-down resister 0		8	10	12	KΩ	
RPDN1	Internal pull-down resister 1		0.24	0.3	0.36	KΩ	
RPDN2	Internal pull-down resister 2		160	200	240	KΩ	

Table 4-7 Internal Resistor Characteristics

Port	General Output	High Drive	Internal Pull-Up Resistor（Ω）	Internal Pull-Down Resistor (Ω)	Comment
PA4-PA7 PB0-PB5 PE0, PE5-PE7 PF0-PF1 PG0-PG5	8mA	32mA	300/10K/200K	300/10K/200K	Internal pull-up/pull-down resistance accuracy +/-20%
PE4	8mA	32mA	10K	10K	

4.3 Audio DAC Parameters

Table 4-8 Audio DAC Normal Mode Parameters

Mode	Sym	Characteristics	Min	Typ	Max	Unit	Conditions
Differential Mode	SNR		-	103	-	dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz
	THD+N		-	-93	-	dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz
	Max Output Range		-	-2.4		dBV	32ohm Loading
VCMBUF Mode	SNR			96.2		dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz
	THD+N			-77.6		dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz
	Max Output Range			-8.6		dBV	32ohm Loading

Table 4-9 Audio DAC Expanded Mode Parameters

Mode	Sym	Characteristics	Min	Typ	Max	Unit	Conditions
Differential Mode	SNR		-	103	-	dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz
	THD+N		-	-95	-	dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz
	Output Range	Maximum output voltage	-	0		dBV	32ohm Loading@VCM=1.2V
VCMBUF Mode	SNR			102.7		dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz

Mode	Sym	Characteristics	Min	Typ	Max	Unit	Conditions
	THD+N			-72.5		dB	VCM cap=1uF VDDDAC cap=NC simulation with 32Ω loading Fin=1KHz
	Output Range			-1.9		dBV	32ohm Loading@VCM=1.2V

4.4 Audio ADC Parameters

Table 4-10 Audio ADC Parameters

Mode	Sym	Characteristics	Min	Typ	Max	Unit	Conditions
ADC Mode	SNR		-	100	-	dB	VCM cap=NC VDDMIC cap=1uF tran noise simulation Input -2dBV @ Fin=1KHz
	THD+N		-	-97	-	dB	
	Input Range	Maximum input voltage	-	-2	-	dBVrms	
PGA + ADC DIFF Mode	PGA Gain		-6		42	dB	-6 / 0~42dB@step=3dB
	SNR			94		dB	VCM cap=NC VDDMIC cap=1uF diff input Input 0dBV @ Fin=1KHz PGA Gain=0dB
	THD+N			-86		dB	
	Input Range	Maximum input voltage	-	3	-	dBVrms	
PGA + ADC SINGLE Mode	PGA Gain		-6		42	dB	-6 / 0~42dB@step=3dB
	SNR			92		dB	VCM cap=NC VDDMIC cap=1uF single input Input 0dBV @ Fin=1KHz PGA Gain=0dB
	THD+N			-63		dB	
	Input Range	Maximum input voltage	-	1	-	dBVrms	

4.5 BT Parameters

Table 4-11 BT Parameters

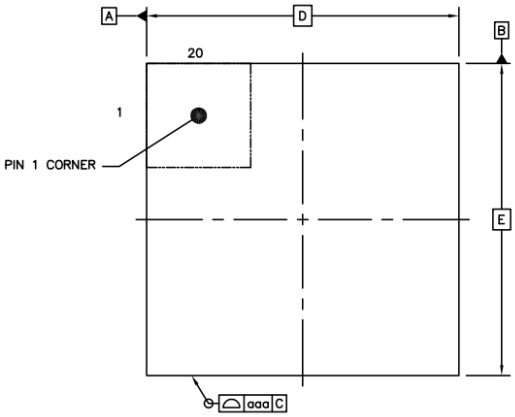
Characteristics	Min	Typical	Max	Unit	Conditions
Transmit Power	-	-	9	dBm	
RMS DEVM	-	5.5	-	%	Maximum TX power 2-DH5 packet
Peak DEVM	-	15	20	%	
EDR Relative Transmit Power	-	-0.2	-	dB	
Sensitivity @ Basic Rate	-	-94.5	-	dBm	BER=0.1%, using DH5 packet
Sensitivity @ EDR	-	-94.5	-	dBm	BER=0.01%, using 2-DH5 packet

4.6 Current Parameters

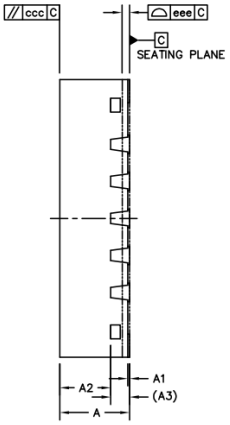
Table 4-12 Current Parameters

Mode	Characteristics	Min	Typ	Max	Unit	Conditions
With DC DC Buck Mode	TX RF Current @Pout = 0dBm		TBC		mA	VBAT=3.3V
	RX RF Current @Sensitivity level		TBC		mA	
	Supply Current @Sleep with RAM retention		TBC		uA	
	Supply Current @Deep sleep		TBC		uA	
	Supply Current @Power Down		TBC		uA	
	Supply Current @Sniff		TBC		uA	500ms interval
	Supply Current @Discoverable		TBC		uA	500ms interval
W/O DC DC LDO Mode	TX RF Current @Pout = 0dBm		TBC		mA	VBAT=3.3V
	RX RF Current @Sensitivity level		TBC		mA	
	Supply Current @ Sleep with RAM retention		TBC		uA	
	Supply Current @Deep sleep		TBC		uA	
	Supply Current @Power Down		TBC		uA	
	Supply Current @Sniff		TBC		uA	500ms interval
	Supply Current @Discoverable		TBC		uA	500ms interval

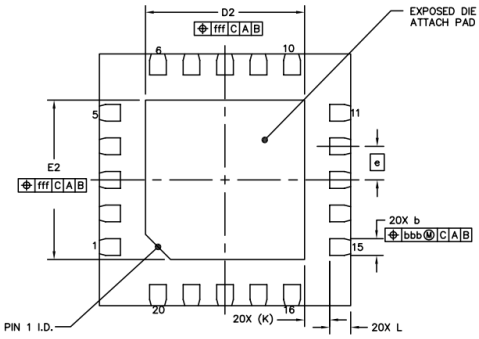
5 Package Information



TOP VIEW



SIDE VIEW



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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