



CD3313

Digital Controlled Stereo Audio Processor with Loudness

Product Specification

Specification Revision History:

Version	Date	Description
2010-01-A	2010-01	Replace the new template
2012-01-B1	2012-01	Increase the manual number and release history
2019-04-B2	2019-04	Replace the new template
2022-01-B3	2022-01	Modify Ordering Information
2024-01-C1	2024-01	Replace the new template



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1、General Description

The CD3313 is a volume, tone (bass and treble) balance (Left/Right) and fader (front/rear) processor for quality audio applications in car radio and Hi-Fi systems. Selectable input gain and external loudness function are provided. Control is accomplished by serial I²C bus microprocessor interface.

The AC signal setting is obtained by resistor networks and switches combined with operational amplifiers. Thanks to the used BIPOLAR/CMOS Technology, Low Distortion, Low Noise and Low DC stepping are obtained.

Features:

- Input Multiplexer:
 - 3 Stereo Inputs
 - Selectable Input Gain For Optimal
- Adaption To Different Sources
- Input and Output for External
- Equalizer or Noise Reduction System
- Loudness Function
- Volume Control in 1.25dB/ steps
- Treble and Bass Control
- Four Speaker Attenuators:
 - 4 Independent Speakers Control in 1.25 dB/ steps for Balance and Fader Facilities
 - Independent Mute Function
- All Functions Programmable Via Serial I²C BUS
- Package form: SOP28/SSOP28(0.635mm)/SSOP28(0.65mm)

**Ordering Information:****Tube packing specifications:**

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
CD3313EOSA28.TB	SOP28	CD3313EO	25 PCS/tube	80 tube/box	2000 PCS/box	Dimensions of plastic enclosure: 17.9mm×7.55mm Pin spacing: 1.27mm
CD3313EOVA28.TB	SSOP28-0.65	CD3313EO	46 PCS/tube	100 tube/box	4600 PCS/box	Dimensions of plastic enclosure: 10.2mm×5.3mm Pin spacing: 0.65mm
CD3313EOVB28.TB	SSOP28-0.635	CD3313EO	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 9.9mm×3.9mm Pin spacing: 0.635mm

Reel packing specifications:

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
CD3313EOSA28.TR	SOP28	CD3313EO	1250 PCS/reel	1250 PCS/box	Dimensions of plastic enclosure: 17.9mm×7.55mm Pin spacing: 1.27mm
CD3313EOVA28.TR	SSOP28-0.65	CD3313EO	2500 PCS/reel	5000 PCS/box	Dimensions of plastic enclosure: 10.2mm×5.3mm Pin spacing: 0.65mm
CD3313EOVB28.TR	SSOP28-0.635	CD3313EO	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 9.9mm×3.9mm Pin spacing: 0.635mm

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.



2、Block Diagram And Pin Description

2.1、Block Diagram

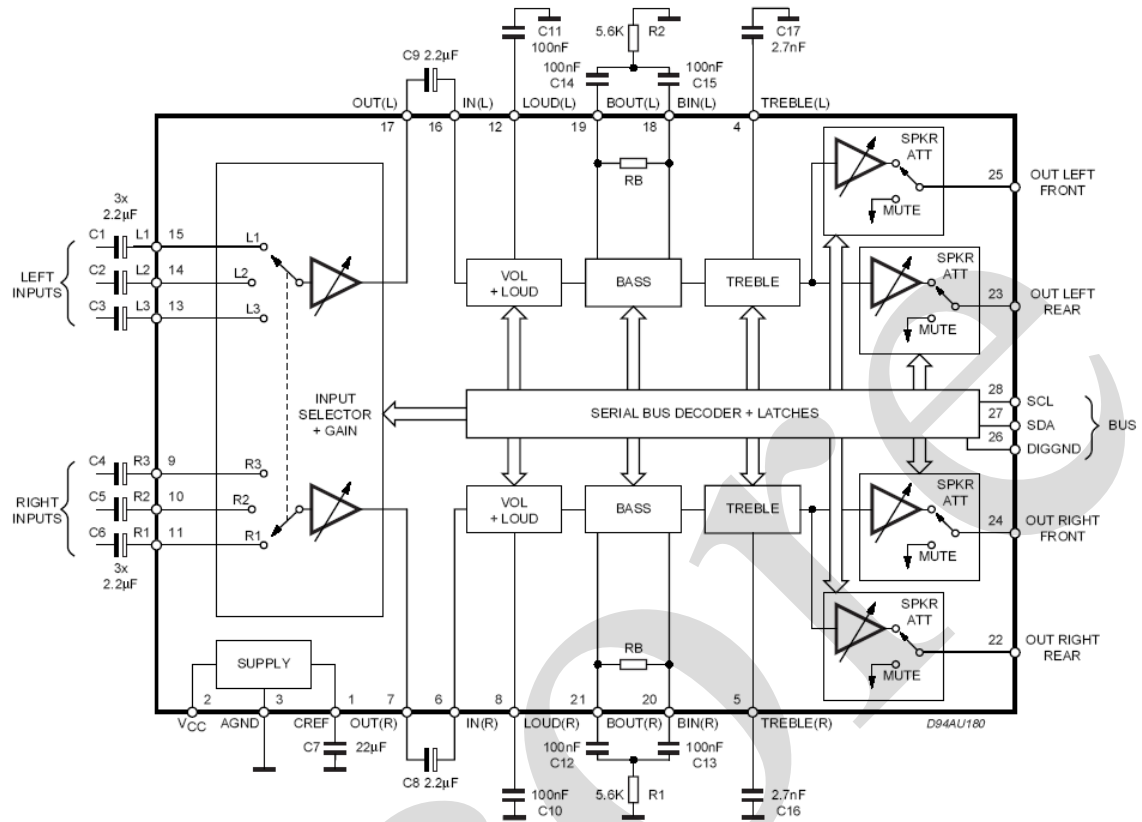


Fig1. Block Diagram

2.2、Pin Configurations

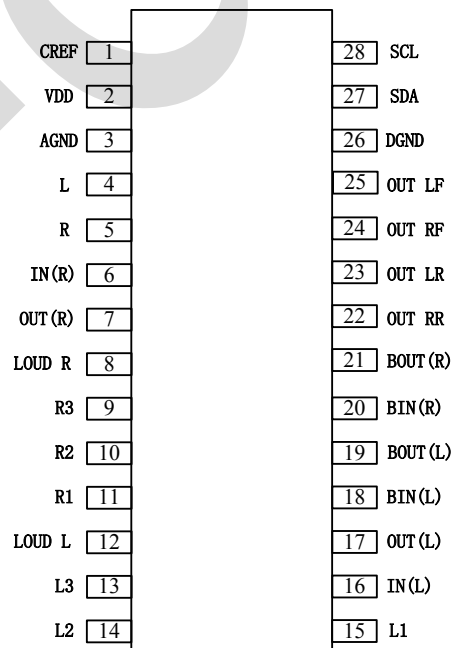


Fig2. Pin Configurations



2.3、Pin Description

Pin No.	Pin Name	Description
1	CREF	Analog reference voltage(1/2VDD)
2	VDD	Supply input voltage
3	AGND	Analog ground
4	L	Left channel input for treble controller
5	R	Right channel input for treble control
6	IN(R)	Audio processor right channel input
7	OUT(R)	Gain output and input selector for right channel
8	LOUD R	Right channel loudness input
9	R3	Right channel input 3
10	R2	Right channel input 2
11	R1	Right channel input 1
12	LOUD L	Left channel loudness input
13	L3	Left channel input 3
14	L2	Left channel input 2
15	L1	Left channel input 1
16	IN(L)	Audio processor left channel input
17	OUT(L)	Gain output and input selector for left channel
18	BIN(L)	Left channel input for bass controller
19	BOUT(L)	Left bass controller output channel
20	BIN(R)	Right channel input for bass controller
21	BOUT(R)	Right channel output for bass controller
22	OUTRR	Right rear speaker output
23	OUTLR	Left rear speaker output
24	OUTRF	Right fader speaker output
25	OUTLF	Left fader speaker output
26	DGND	Digital ground
27	SDA	Control data input
28	SCL	Clock input for serial data transmission

3、Electrical Parameter

3.1、Absolute Maximum Ratings

(Tamb=25°C, All voltage referenced to GND, unless otherwise specified)

Characteristic	Symbol	Conditions	Value	Unit
Operating Supply Voltage	VDD	-	10	V
Operating Ambient Temperature	Topr	-	-40to85	°C
Storage Temperature Range	Tstg	-	-55to150	°C
Power Dissipation	P _D	-	500	mW
Soldering Temperature	T _L	10s	260	°C



3.2、Electrical Characteristics

(Tamb=25°C, VDD=9V, fosc=1KHz, RL=10KΩ, unless otherwise specified)

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
SUPPLY						
Supply Voltage	V _{DD}	-	6	9	10	V
Supply Current	I _{DD}	-	-	20.0	35.0	mA
Ripple Rejection	SVR	-	60	80	-	dB
INPUT SELECTORS						
Input Resistance	R _{II}	Input 1,2,3	35	50	70	KΩ
Clipping Level	V _{CL}	-	2	2.5	-	Vrms
Input Separation	S _{IN}	-	80	100	-	dB
Output Load resistance	R _L	pin7,17	4	-	-	KΩ
Min. Input Gain	G _{IN(MIN)}	-	-1	0	1	dB
Max. Input Gain	G _{IN(MAX)}	-	-	11.25	-	dB
Step Resolution	G _{STEP}	-	-	3.75	-	dB
Input Noise	e _{IN}	G=11.25 dB	-	2	-	uV
DC Steps	V _{DC}	adjacent gain steps	-	4	20	mV
		G=18.75 to Mute	-	4	-	mV
BASS CONTROL						
Control Range	G _B	Max. Boost/cut	±12	±14	±16	dB
Step Resolution	B _{STEP}	-	1	2	3	dB
Internal Feedback Resistance	R _B	-	34	44	58	KΩ
TREBLE CONTROL						
Control Range	G _t	Max. Boost/cut	±13	±14	±15	dB
Step Resolution	T _{STEP}	-	1	2	3	dB
AUDIO OUTPUTS						
Clipping Level	V _{OCL}	THD=0.3%	2	2.5	-	Vrms
Output Load Resistance	R _L	-	4	-	-	KΩ
Output Load Capacitance	C _L	-	-	-	10	nF
Output resistance	R _{OUT}	-	30	75	120	Ω
DC Voltage Level	V _{OUT}	-	4.2	4.5	4.8	V
Output Noise	e _{NO}	BW = 20-20KHz, Flat, output muted, all gains = 0dB	-	2.5	-	uV
			-	5	15	uV
		A curve all gains = 0dB	-	3	-	uV
Signal to Noise Ratio	S/N	all gains = 0dB; V _O = 1V _{rm}	-	106	-	dB
Distortion	THD	Av=0, V _{IN} =10mV	-	0.01	0.1	%
		Av=-20dB, V _{IN} =1Vrms	-	0.09	0.3	%
		Av=-20dB, V _{IN} =0.3Vrms	-	0.04	-	%



Channel Separation left/right	Sc	-	80	103	-	dB
Total Tracking error	-	Av=0 to -20dB	-	0	1	dB
		Av=-20 to -60dB	-	0	2	dB
BUS INPUTS						
Input Low Voltage	V _{IL}	-	-	-	1	V
Input High Voltage	V _{IH}	-	3	-	-	V
Input Current	I _{IN}	-	-5	-	+5	uA
Output Voltage SDA Acknowledge	V _O	Io=1.6mA	-	-	0.4	V
VOLUME CONTROL						
Input Resistance	R _{IV}	-	20	33	50	KΩ
Control Range	Crange	-	70	75	80	dB
Min. Attenuation	Av(MIN)	-	-1	0	1	dB
Max. Attenuation	Av(MAX)	-	70	75	80	dB
Step Resolution	A _{STEP}	-	0.5	1.25	1.75	dB
Attenuation Set Error	E _A	Av=0 to -20dB	-1.25	0	1.25	dB
		Av=-20 to -60dB	-3	-	2	dB
Tracking Error	E _T	-	-	-	2	dB
DC Steps	V _{DC}	adjacent attenuation steps	-	0	3	mV
		From 0dB to Av max	-	0.5	7.5	mV
SPEAKER ATTENUATORS						
Control Range	Crange	-	3.5	37.5	40	dB
Step Resolution	S _{STEP}	-	0.5	1.25	1.75	dB
Attenuation set error	E _A	-	-	-	1.5	dB
Output Mute Attenuation	A _{MUTE}	-	80	100	-	dB
DC Steps	V _{DC}	adjacent attenuation steps	-	0	3	mV
		from 0 to mute	-	1	10	mV
TREBLE CONTROL						
Control Range	Gt	Max. Boost/cut	±13	±14	±15	dB
Step Resolution	T _{STEP}	-	1	2	3	dB
AUDIO OUTPUTS						
Clipping Level	V _{OCL}	THD=0.3%	2	2.5	-	Vrms
Output Load Resistance	R _L	-	4	-	-	KΩ
Output Load Capacitance	C _L	-	-	-	10	nF
Output resistance	R _{OUT}	-	30	75	120	Ω
DC Voltage Level	V _{OUT}	-	4.2	4.5	4.8	V
GENERAL						
Output Noise	e _{NO}	BW = 20-20KHz, flat output muted all gains = 0dB	-	2.5	-	uV
			-	5	15	uV



		A curve all gains = 0dB	-	3	-	uV
Signal to Noise Ratio	S/N	all gains = 0dB; V _O = 1V _{rm}	-	106	-	dB
Distortion	THD	Av=0, V _{IN} =10mV	-	0.01	0.1	%
		Av=-20dB, V _{IN} = 1V _{rms}	-	0.09	0.3	%
		Av=-20dB, V _{IN} =0.3V _{rms}	-	0.04	-	%
Channel Separation left/right	Sc	-	80	103	-	dB
Total Tracking error	-	AV = 0 to -20dB	-	0	1	dB
		-20 to -60 dB	-	0	2	dB
BUS INPUTS						
Input Low Voltage	V _{IL}	-	-	-	1	V
Input High Voltage	V _{IH}	-	3	-	-	V
Input Current	I _{IN}	-	-5	-	+5	uA
Output Voltage SDA Acknowledge	V _O	I _o =1.6mA	-	-	0.4	V
VOLUME CONTROL						
Input Resistance	R _{IV}	-	20	33	50	KΩ
Control Range	Crange	-	70	75	80	dB
Min. Attenuation	Av(MIN)	-	-1	0	1	dB
Max. Attenuation	Av(MAX)	-	70	75	80	dB
Step Resolution	A _{STEP}	-	0.5	1.25	1.75	dB
Attenuation Set Error	E _A	Av = 0 to -20dB	-1.25	0	1.25	dB
		Av = -20 to -60dB	-3	-	2	dB
Tracking Error	E _T	-	-	-	2	dB
DC Steps	V _{DC}	adjacent attenuation steps	-	0	3	mV
		From 0dB to Av max	-	0.5	7.5	mV
SPEAKER ATTENUATORS						
Control Range	Crange	-	3.5	37.5	40	dB
Step Resolution	S _{STEP}	-	0.5	1.25	1.75	dB
Attenuation set error	E _A	-	-	-	1.5	dB
Output Mute Attenuation	A _{MUTE}	-	80	100	-	dB
DC Steps	V _{DC}	adjacent att. steps	-	0	3	mV
		from 0 to mute	-	1	10	mV



4、Function Description

4.1、I²C BUS INTERFACE

Data transmission from microprocessor to the CD3313 and vice versa takes place thru the 2 wires I²C BUS interface, consisting of the two lines SDA and SCL (pull-up resistors to positive supply voltage must be connected).

4.1.1、Data Validity

As shown below, the data on the SDA line must be stable during the high period of the clock. The HIGH and LOW state of the data line can only change when the clock signal on the SCL line is LOW.

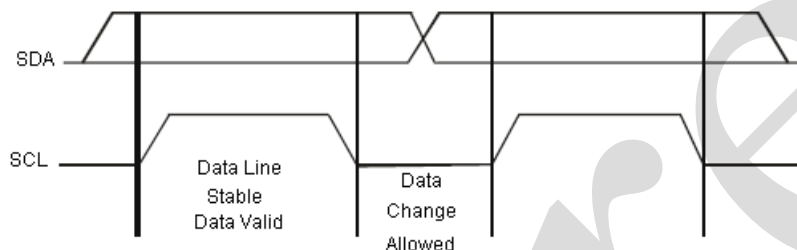


Fig3. Data validity

4.1.2、Start and Stop Conditions

As shown below, a start condition is a HIGH to LOW transition of the SDA line while SCL is HIGH. The stop condition is a LOW to HIGH transition of the SDA line while SCL is HIGH.

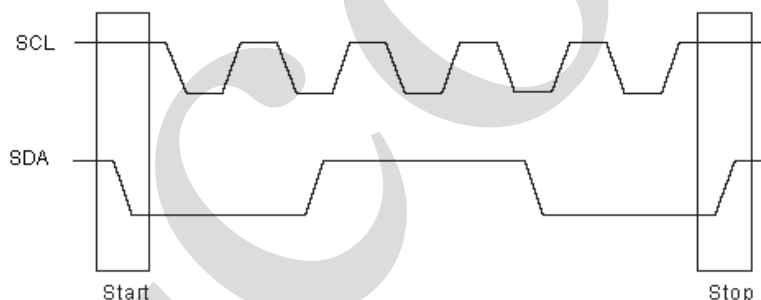


Fig4. Start and Stop Conditions

4.1.3、Byte Format

Every byte transferred on the SDA line must contain 8 bits. Each byte must be followed by an acknowledge bit. The MSB is transferred first.



4.1.4、 Acknowledge

The master (μP) puts a resistive HIGH level on the SDA line during the acknowledge clock pulse (see the Figure below). The peripheral (audio processor) that acknowledges has to pull-down (LOW) the SDA line during the acknowledge clock pulse, so that the SDA line is stable LOW during this clock pulse.

The audio processor which has been addressed has to generate an acknowledge after the reception of each byte, otherwise the SDA line remains at the HIGH level during the ninth clock pulse time. In this case the master transmitter can generate the STOP information in order to abort the transfer.

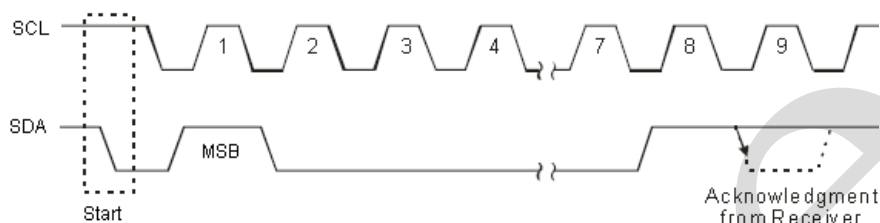


Fig5. Acknowledge

4.1.5、 Transmission without Acknowledge

Avoiding detecting the acknowledge of the audio processor, the μP can use a simpler transmission: simply it waits one clock without checking the slave acknowledging, and sends the new data.

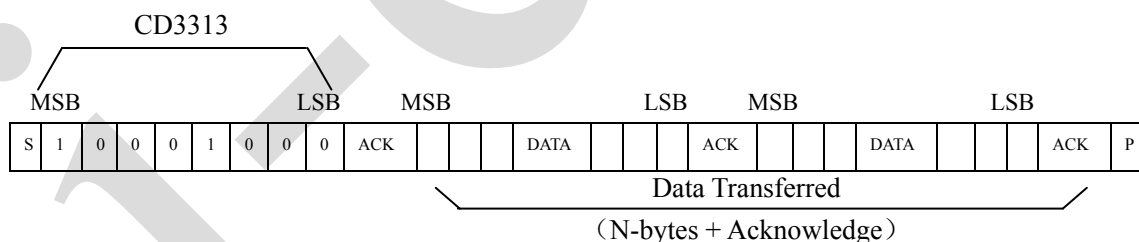
This approach of course is less protected from misworking and decreases the noise immunity.

4.2、 SOFTWARE SPECIFICATION

4.2.1、 Interface Protocol

The interface protocol comprises:

- A start condition (s)
A chip address byte, containing the CD3313 address (the 8th bit of the byte must be 0). The CD3313 must always acknowledge at the end of each transmitted byte.
- A sequence of data (N-bytes + acknowledge)
- A stop condition (P)



ACK = Acknowledge

S = Start

P = Stop

Max Clock Speed 100kbts/s

4.2.2、 Chip address

1 (MSB)	0	0	0	1	0	0	0 (LSB)
------------	---	---	---	---	---	---	------------



4.2.3、Data Bytes

MSB							LSB	FUNCTION
0	0	B2	B1	B0	A2	A1	A0	Volume control
1	1	0	B1	B0	A2	A1	A0	Speaker ATT LR
1	1	1	B1	B0	A2	A1	A0	Speaker ATT RR
1	0	0	B1	B0	A2	A1	A0	Speaker ATT LF
1	0	1	B1	B0	A2	A1	A0	Speaker ATT RF
0	1	0	G1	G0	S2	S1	S0	Audio switch
0	1	1	0	C3	C2	C1	C0	Bass control
0	1	1	1	C3	C2	C1	C0	Treble control

Ax = 1.25dB steps; Bx = 10dB steps; Cx = 2dB steps; Gx = 3.75dB steps

4.2.4、Volume

MSB							LSB	FUNCTION
0	0	B2	B1	B0	A2	A1	A0	Volume 1.25dB steps
					0	0	0	0
					0	0	1	-1.25
					0	1	0	-2.5
					0	1	1	-3.75
					1	0	0	-5
					1	0	1	-6.25
					1	1	0	-7.5
					1	1	1	-8.75
0	0	B2	B1	B0	A2	A1	A0	Volume 10dB steps
		0	0	0				0
		0	0	1				-10
		0	1	0				-20
		0	1	1				-30
		1	0	0				-40
		1	0	1				-50
		1	1	0				-60
		1	1	1				-70

For example a volume of 45dB is given by:00100100



4.2.5、Speaker Attenuators

MSB							LSB	FUNCTION
1	0	0	B1	B0	A2	A1	A0	Speaker LF
1	0	1	B1	B0	A2	A1	A0	Speaker RF
1	1	0	B1	B0	A2	A1	A0	Speaker LR
1	1	1	B1	B0	A2	A1	A0	Speaker RR
					0	0	0	0
					0	0	1	-1.25
					0	1	0	-2.5
					0	1	1	-3.75
					1	0	0	-5
					1	0	1	-6.25
					1	1	0	-7.5
					1	1	1	-8.75
			0	0				0
			0	1				-10
			1	0				-20
			1	1				-30
			1	1	1	1	1	Mute

For example attenuation of -25dB on speaker RF is given by: 10110100

4.2.6、Audio Switch

MSB							LSB	FUNCTION
0	1	0	G1	G0	S2	S1	S0	Audio Switch
						0	0	Stereo 1
						0	1	Stereo 2
						1	0	Stereo 3
						1	1	Stereo 4 (*)
					0			LOUDNESS ON
					1			LOUDNESS OFF
			0	0				+11.25dB
			0	1				+7.5dB
			1	0				+3.75dB
			1	1				0dB

For example to select the stereo 2 input with a gain of +7.5dB LOUDNESS ON the 8bit string is:

01001001

(*) Stereo 4 is connected internally, but not available on pins.



4.2.7、Bass and Treble

MSB							LSB	FUNCTION
0	1	1	0	C3	C2	C1	C0	Bass
0	1	1	1	C3	C2	C1	C0	Treble
				0	0	0	0	-14
				0	0	0	1	-12
				0	0	1	0	-10
				0	0	1	1	-8
				0	1	0	0	-6
				0	1	0	1	-4
				0	1	1	0	-2
				0	1	1	1	0
				1	1	1	1	0
				1	1	1	0	2
				1	1	0	1	4
				1	1	0	0	6
				1	0	1	1	8
				1	0	1	0	10
				1	0	0	1	12
				1	0	0	0	14

C3 = Sign

For example Bass at -10dB is obtained by the following 8 bit string:01100010

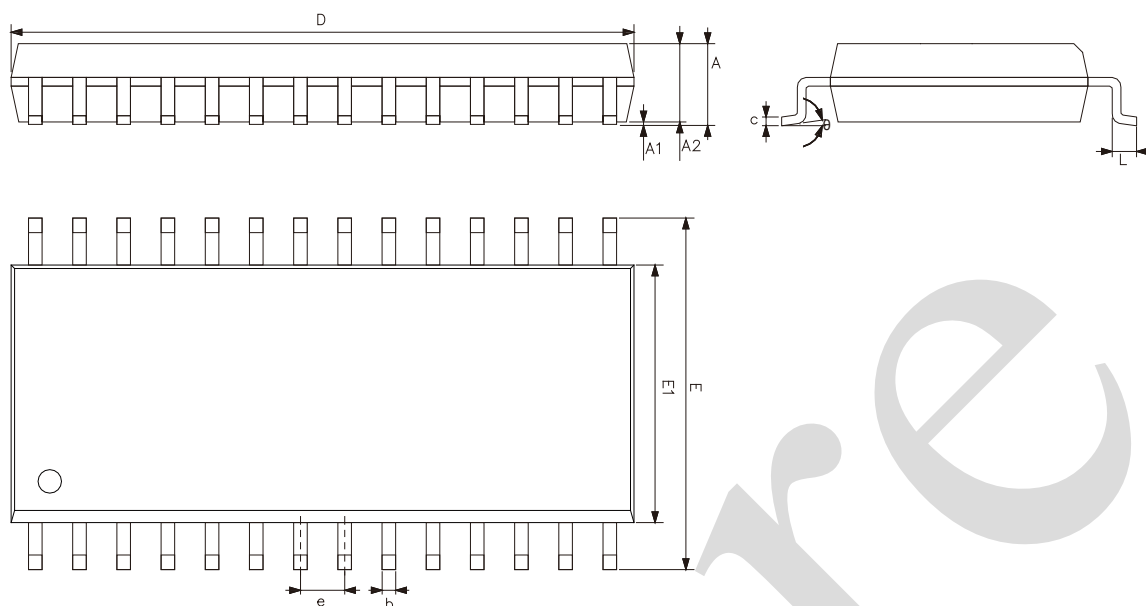


Number: CD3313-AX-YX-A014EN



6、Package Information

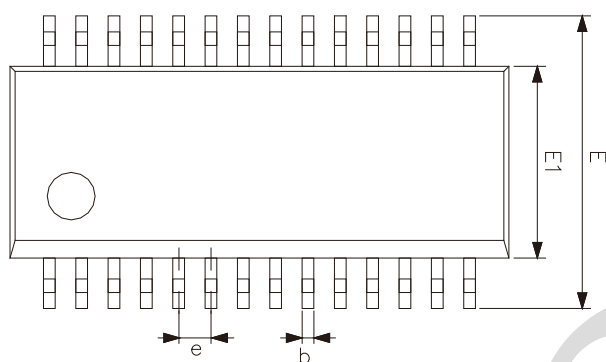
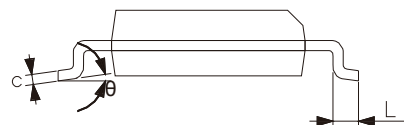
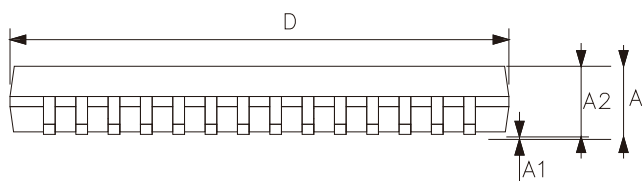
6.1、SOP28



Symbol	Dimensions (mm)	
	Min.	Max.
A	2.15	2.75
A1	0.03	0.30
A2	2.05	2.44
b	0.35	0.51
c	0.20	0.36
D	17.70	18.30
E	10.00	10.65
E1	7.30	7.70
e	1.27	
L	0.40	1.27
θ	0°	8°



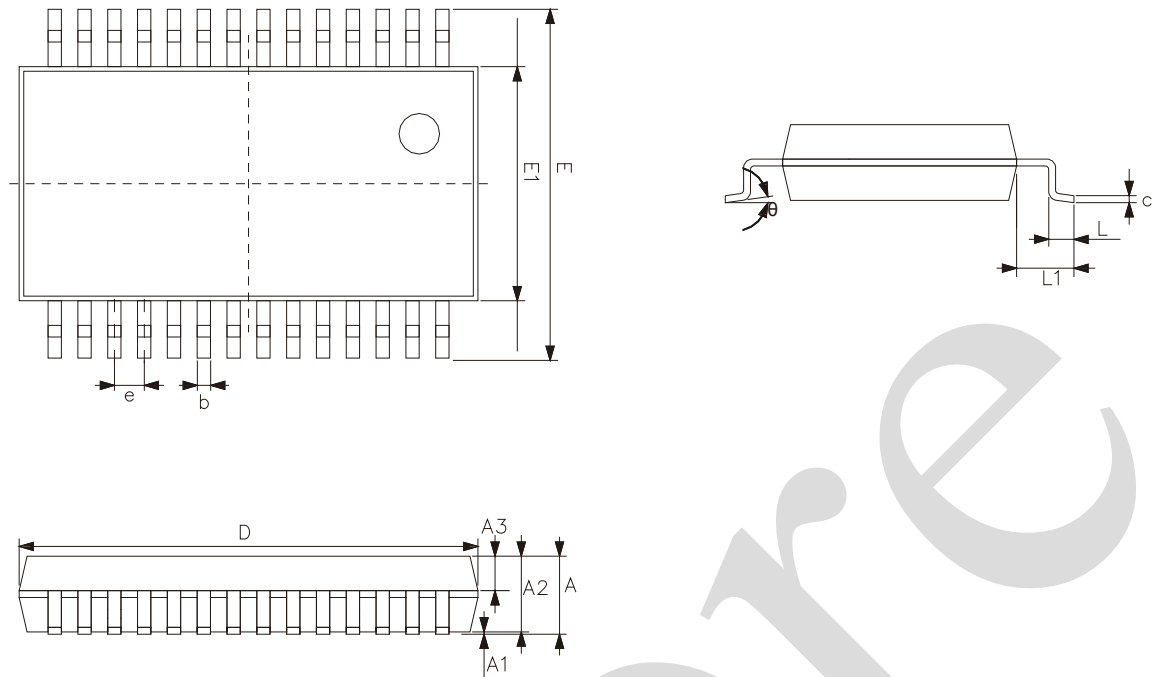
6.2、SSOP28(0.635mm)



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	1.75
A1	0.02	0.25
A2	1.30	1.60
b	0.23	0.31
c	0.19	0.25
D	9.75	10.00
E	5.80	6.45
E1	3.75	4.00
e	0.635	
L	0.35	0.80
θ	0°	8°



6.3、SSOP28(0.65mm)



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	2.00
A1	0.05	0.25
A2	1.65	1.85
A3	0.75	0.85
b	0.29	0.37
c	0.15	0.20
D	10.00	10.40
E	7.60	8.00
E1	5.10	5.50
e	0.65	
L	0.55	0.95
L1	1.25	
θ	0°	8°



7、Statements And Notes

7.1、The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements									
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers	Dibutyl phthalate	Butylbenzyl phthalate	Di-2-ethylhexyl phthalate	Diisobutyl phthalate
Lead frame	○	○	○	○	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
The lead	○	○	○	○	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○	○	○	○	○
explanation	○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.									

7.2、Notes

We recommend you to read this chapter carefully before using this product.

The information in this chapter is provided for reference only and i-Core disclaims any express or implied warranties, including but not limited to applicability, special application or non-infringement of third party rights.

This product is not suitable for critical equipment such as life-saving, life-sustaining or safety equipment. It is also not suitable for applications that may result in personal injury, death, or serious property or environmental damage due to product malfunction or failure. I-Core will not be liable for any damages incurred by the customers at their own risk for such applications.

The customer is responsible for conducting all necessary tests i-Core's application to avoid failure in the application or the application of the customer's third party users. I-Core does not accept any liability.

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