AiP2112
Audio Driver with Adjustable Gain

Product　　Specification

Specification Revision History：

Version	Date	Description
2012-07-A1	2012-07	New
2019-04-A2	2019-04	Replace the new template
2021-12-A3	2021-12	Modify Ordering Information of reel; Modify the contents
2022-01-A4	2022-01	Modify Ordering Information
2023-02-B1	2023-02	Replace the template

Contents

1、General Description

AiP2112 is an audio driver with adjustable gain, especially designed for set-top box and HD-player. It possesses the best audio driver performance. A few external components not only lower the cost but also reduce the noise. The 2Vms stereo audio driver is designed to eliminate coupling capacitors and has a gain range of ±1V/V to ±10V/V in differential mode with a 3.3v supply voltage and 10KΩ load. And the gain ranges can all be achieved by adjusting external resistors. AiP2112 has a built-in muting circuit to solve the bursting sound during power on/off. And the circuit has an external low voltage detection function. AiP2112 is mainly applied in set-top boxes, HD DVD players, car audio, medical and other systems.

Features:

- Ultra-low distortion, THD+N<0.01% at 2Vms output amplitude
- SNR>80dB
- Noise <100μVrms
- Eliminating popping sound when switching on and off
- Avoiding output isolation current
- Optimal frequency response between 20Hz to 20KHz
- Differential inputs are allowed
- External low voltage detection function
- Package information: TSSOP14

Ordering Information:

Tube packing specifications:

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP2112TA14.TB	TSSOP14	AiP2112	96 PCS/tube	200 tube/box	19200 PCS/box	Dimensions of plastic enclosure: 4.96mm×4.4mm Pin spacing: 0.65mm

Reel packing specifications:

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP2112TA14.TR	TSSOP14	AiP2112	5000 PCS/reel	10000 PCS/reel	Dimensions of plastic enclosure: 4.96mm×4.4mm Pin spacing: 0.65mm

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

2、Block Diagram And Pin Description
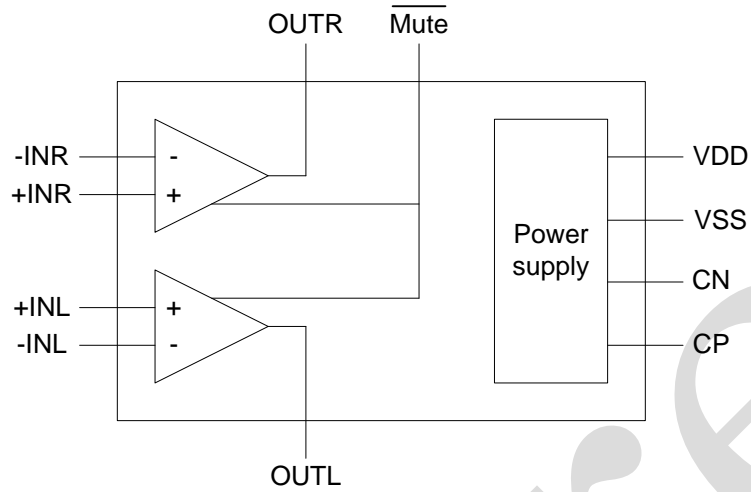
2.1、Block Diagram
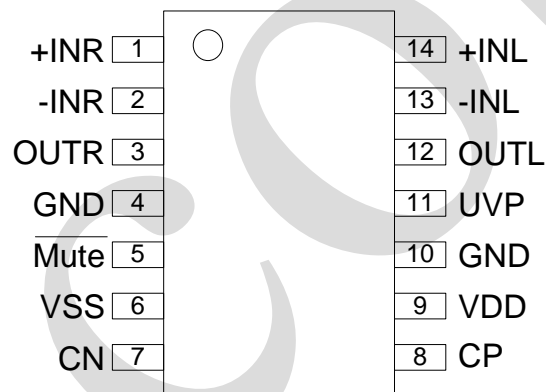

Figure 1. Block Diagram

2.2、Pin Configurations

Figure 2. Pin Configurations

2.3、Pin Description

Pin No.	Pin Name	I/O	Description
1	+INR	I	input of right channel positive end
2	-INR	I	input of right channel negative end
3	OUTR	O	output of right channel
4	GND	P	ground
5	$\overline{\text{Mute}}$	I	mute input, active-Low
6	VSS	O	negative supply
7	CN	I/O	negative end of fast charging capacitor
8	CP	I/O	positive end of fast charging capacitor
9	VDD	P	power supply
10	GND	P	ground
11	UVP	I	input of low-voltage protection

12	OUTL	O	output of left channel
13	-INL	I	input of left channel negative end
14	+INL	I	input of left channel positive end

3、Electrical Parameter

3.1、Absolute Maximum Ratings

(T_{amb}=25℃, unless otherwise specified)

Characteristic	Symbol	Conditions	Value	Unit
Power Supply Voltage	VDD	-	-0.3～3.6	V
Input Voltage	-	-	-0.3～VDD	V
minimum load resistance	-	-	600	Ω
Operating Temperature	T_{amb}	-	-40～+85	℃
Storage Temperature	T_{stg}	-	-60～150	℃
Soldering Temperature	T_L	10s	260	℃

3.2、Electrical Characteristics

3.2.1、DC Characteristics

(T_{amb}=25℃, VDD=3.3V, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating voltage	VDD	-	3	-	3.3	V
Voltage input high	V_{IH}	-	—	0.6*V	—	V
Voltage input low	V_{IL}	-	—	0.4*V	—	V
Output offset voltage	V_{OS}	input ground, unit	—	1.0	—	mV
Power supply	PSRR	—	—	90	—	dB
High-level output	V_{OH}	R_L=10KΩ	3.1	—	—	V
Low-level output	V_{OL}	R_L=10KΩ	—	—	-3.05	V
High-level mute output current	I_{IH}	V_I=VDD	—	—	1	μA
Low-level mute output current	I_{IL}	V_I=0V	—	—	1	μA
Operating current	I_{DD}	V_I=VDD, no-load	—	16	—	mA
		silent mode	—	0.8	—	

3.2.2、AC Characteristics

(T_{amb}=25℃, VDD=3.3V, R_L=10KΩ, C_{PUMP}=C_{PVSS}=1μF, C_{IN}=10μF, R_{IN}=15KΩ, R_{FB}=30KΩ, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output amplitude	V_O	THD=1%，f=1KHz	2.05	2.3	—	Vrms
Degree of distortion	THD	V_O=2Vrms，f=1KHz	—	0.002	—	%
Channel interference	X_{TALK}	V_O=2Vrms，f=1KHz	—	-85	—	dB
Signal-noise ratio	SNR	V_O=2Vrms，BW=22KHz	80	85	—	dB
Maximum capacitive load	C_L	—	—	220	—	pF
Output noise	V_N	BW=20Hz～22KHz	—	100	—	μVrms
Unity-gain bandwidth	G_{BW}	—	—	6.5	—	MHz
Open loop voltage gain	A_{VO}	—	—	145	—	dB
External low voltage detection	V_{UVP}	—	—	1.24	—	V
External low-voltage detection hysteresis current	I_{HYS}	—	—	4	—	μA
Charge frequency	fcp	—	—	280	—	KHz

4、Function Introduction

4.1、The Setting Range of Gain Resistance and Input DC Isolation Capacitor

The gain setting resistance R_{IN} and R_{FB} should be as low noise as possible, and the size of capacitor should be selected within the acceptable range. Table 1 lists the recommended values of resistances for different gains. And if the value chosen is too low, then a large input coupling capacitor is required; if the value chosen is too high, then the noise of the amplifier will be increased. The gain setting resistances should be placed as close to the amplifier pins as possible to minimize the capacitive on these input pins to ensure maximum stability.

Input Resistance（RIN）	Feedback Resistance（RFB）	Differential Gain	Inverting Gain	Non-Inverting Gain
22KΩ	22KΩ	1V/V	-1V/V	2V/V
15KΩ	30KΩ	2V/V	-2V/V	3V/V
10KΩ	100KΩ	10V/V	-10V/V	11V/V

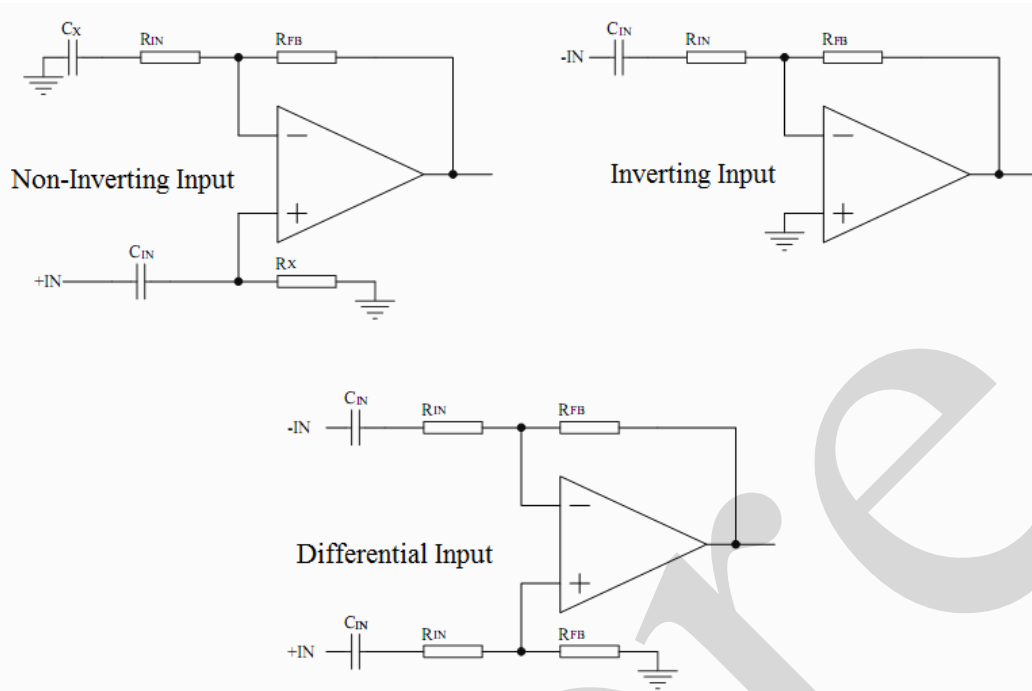Table 1. Recommended Values of Values

Figure 3. Gain Structure Diagram for Differential Input, Inverting Input and Non-inverting Input

The input pins must have input isolation capacitors. These capacitors prevent the DC component of the signal source from being added to the circuit to allow the inputs to be correctly biased to provide the highest performance.

4.2、Typical Applications of Second-Order Filters.

Nowadays different audio signals require an external low-pass filter to eliminate noise outside the passband, which is straightforward to implement for AiP2112 as it can be used like a standard operational amplifier, and the function of the low-pass filter can be realized with different filter topologies. In Figure 4, the differential and single-ended inputs are the structure of the multiple feedback. As shown, an AC coupling capacitor removes the DC component from the signal source, giving a DC gain of 1 and helping to minimize the output current offset.
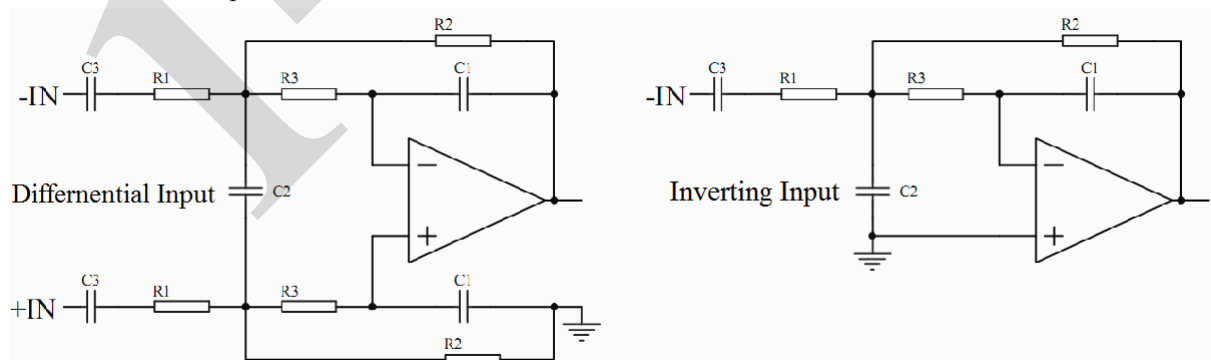

Figure 4. Second-Order Low Pass Filter

4.3、Charge Pump Fast Charging Capacitor and VSS Capacitor

The capacitance of the charge pump generates a negative voltage during charge transfer, and the external V_{SS} capacitance value must be at least equal to the charge pump's electrical capacity in order to achieve maximum charge conversion. A low ESR capacitor is an ideal choice, with a typical value of 1µF. Capacitor values less than 1µF also can be used, but the maximum output voltage may be reduced, causing the circuit to fail to operate properly.

4.4、Filter Capacitor

AiP2112 requires sufficient power supply filter capacitance to ensure that noise and total harmonic distortion are minimized. Ceramic capacitors with low equal series resistance are good choices, typically 1µF, and should be used as close to the pins of V_{DD} as possible. For filtering low frequency noise signals, a 10µF or larger capacitor placed close to the pin of V_{DD} also helps a lot. Because of the high PSRR of this circuit, a 10µF capacitor will not be applied most of the time.

4.5、The Disposal of Electric Bursting Sound

The elimination of the bursting sound is based on the principle of ensuring that the voltage at the power supply pin rises and falls slowly when the voltage at the mute pin is low. Until the input AC coupling capacitor is fully charge, then the mute is set high, which achieves the purpose of eliminating the bursting sound. Figure 5 shows the relationship between them.
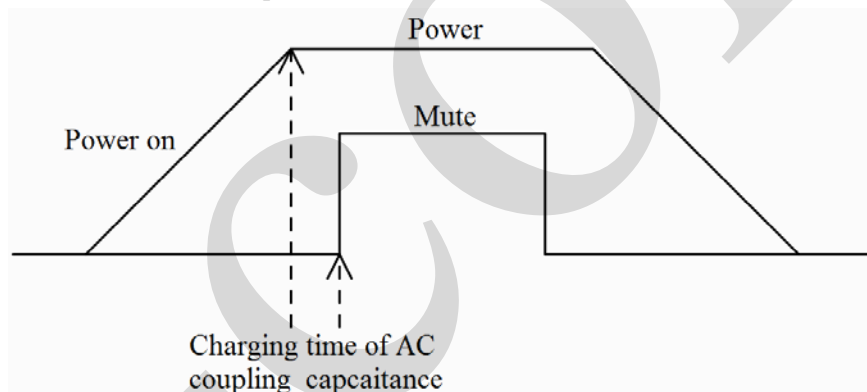

Figure 5. Power On

4.6、External Low-Voltage Detection Function

The external low voltage detection function can mute or turn off the AiP2112. It can be used to detect if the preamp circuitry is working properly. The threshold voltage for shutdown is 1.25V at the UVP pin, and the user can use a resistor divider at the UVP pin to obtain the desired associated voltage and hysteresis for the application. The threshold and hysteresis voltages are determined by the following equation:

$$V_{UVP}=（1.25V-5µA*R13）*(R11+R12)/R12$$
$$Vhysteresis=4µA*R13*(R11+R12)/R12$$

Resistance value R13>>R11//R12
Example: If R11=2KΩ, R12=1.5KΩ, then R13=15KΩ. When V_{UVP}=2.67V，Vhysteresis=0.14V.
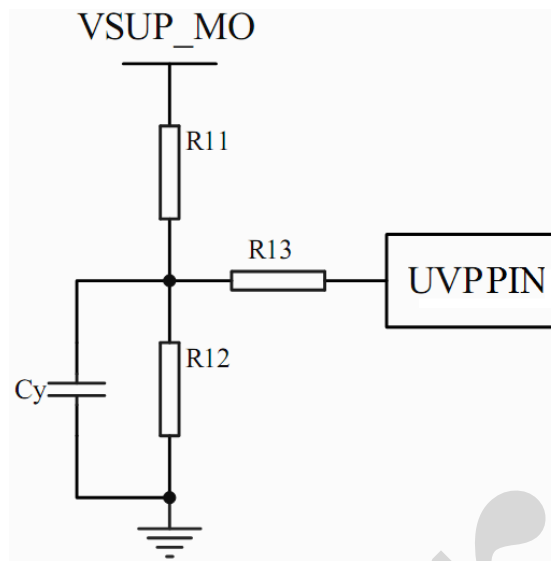
Figure 6. The Setting of External Low Voltage Detection
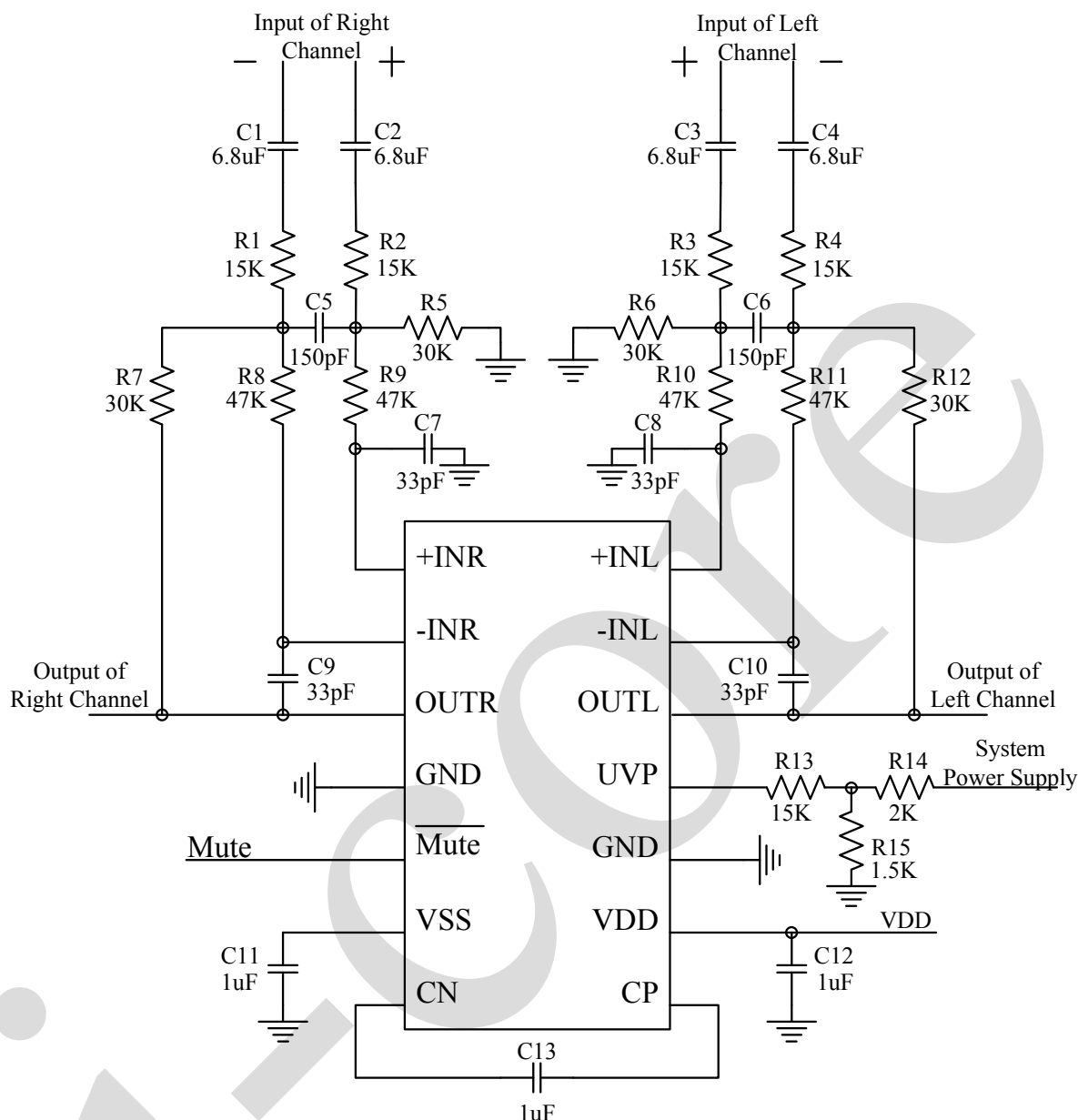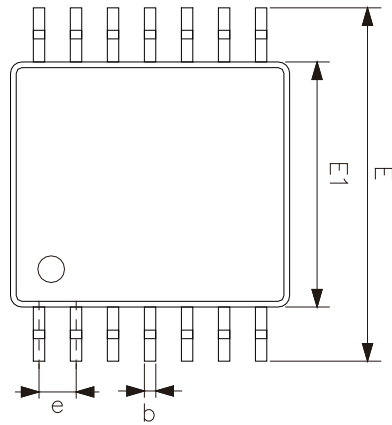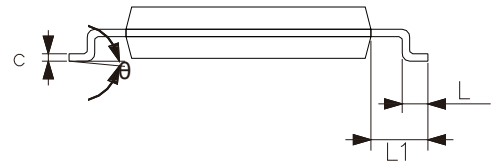
4.7、Capacitive Load

AiP2112 can directly drive a 220pF capacitive load. Higher capacitive loads are acceptable but require a 47Ω or larger resistor in series.

5、 Typical Application Circuit And Application Note

Input of Right Channel

Input of Left Channel

C1 6.8uF
C2 6.8uF
C3 6.8uF
C4 6.8uF

R1 15K
R2 15K
R3 15K
R4 15K

C5 150pF
R5 30K
R6 30K
C6 150pF

R7 30K
R8 47K
R9 47K
R10 47K
R11 47K
R12 30K

C7 33pF
C8 33pF

+INR
+INL

-INR
-INL

Output of Right Channel
C9 33pF
C10 33pF
Output of Left Channel

OUTR
OUTL

GND
UVP
System Power Supply

R13 15K
R14 2K

R15 1.5K

Mute
$\overline{\text{Mute}}$
GND

VSS
VDD
VDD

C11 1uF
C12 1uF

CN
CP

C13 1uF

6、Package Information

6.1、TSSOP14
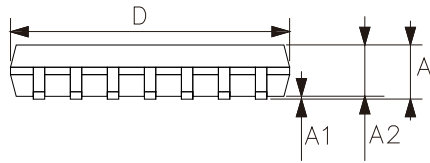
Symbol	Dimensions (mm)	
	Min.	**Max.**
A	-	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E1	4.30	4.50
E	6.20	6.60
e	0.65	
L	0.45	0.75
L1	1.00	
θ	0°	8°

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

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