DATA SHEET

Part No.	AN12945A
Package Code No.	ULGA020-L-0404

Contents

AN12945A

Monophonic audio power IC with built-in AGC

■ Overview

AN12945A is the monophonic BTL amplifier which contained the AGC circuit for clip prevention of a speaker output.
It is possible to set up the on-level of AGC arbitrarily by adjustment of external resistance.
3 V power supply operation is also possible for small signal system circuits other than the output stage.
Moreover, the small package of 4 mm × 4 mm size is adopted, and it is the the best for especially the apparatus for mobile uses.

■ Features

- 2 W Monophonic BTL amplifier
  (V_{CCSP} = 5 V, 4 Ω load, THD = 10%)
- The AGC circuit for output clip prevention
- Standby function
- Speaker power save function
- AGC On/Off function
- AGC On level variable function
- Small package

■ Applications

- For the notebook personal computer

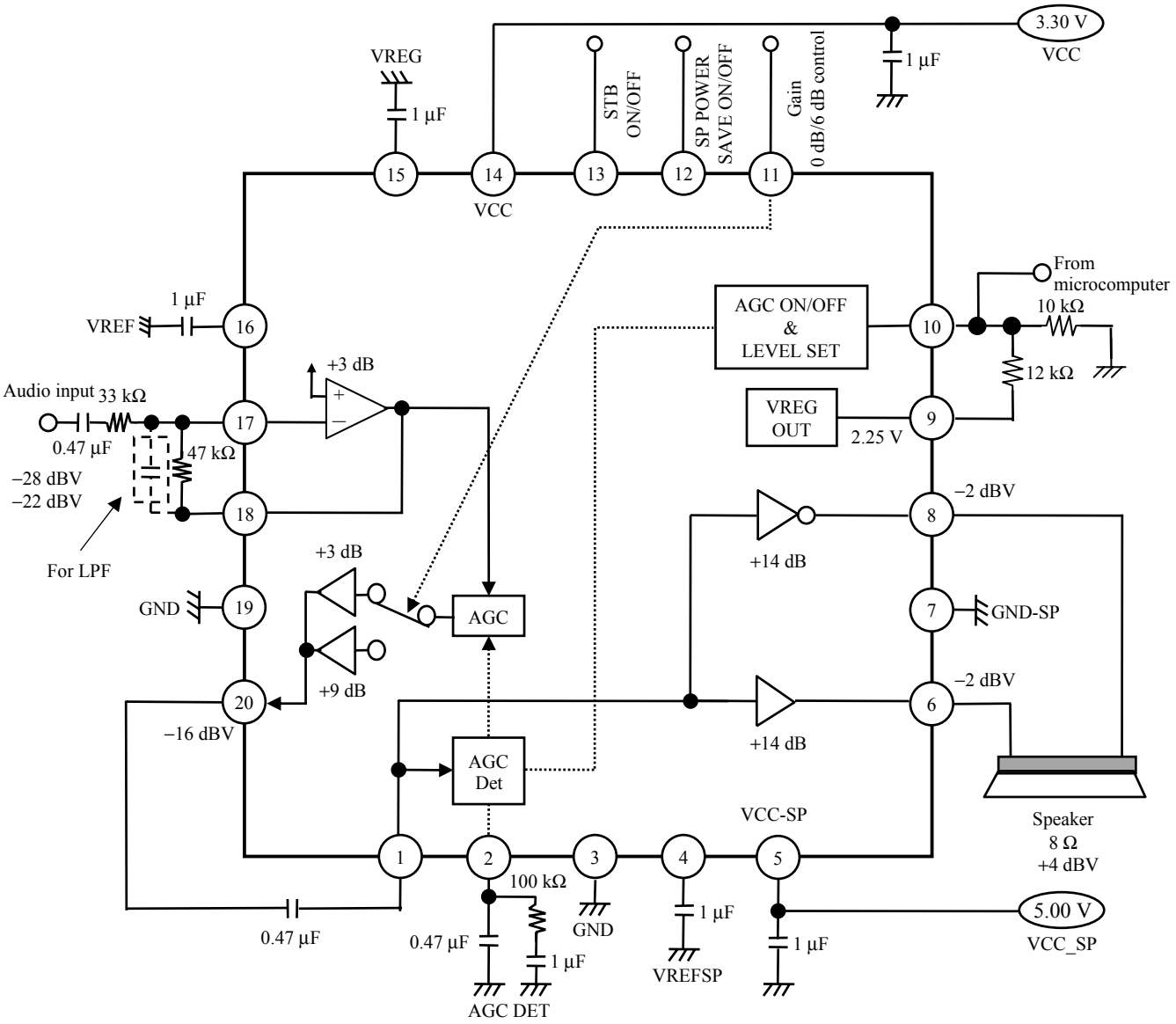
■ Package

- 20-pin plastic non lead package of four directions

■ Type

- Silicon monolithic bipolar IC

■ Application Circuit Example (Block Diagram)



Note) This circuit and these circuit constants show an example and do not guarantee the design as a mass-production set.

■ Pin Descriptions

Pin No.	Pin name	Type	Description
1	SP_IN	Input	SP amp input
2	AGC_CAP	Input	Detection terminal for AGC
3	GND	GND	GND
4	V_{REFSP}	Input	V_{REF} for SP amp system
5	V_{CCSP}	Power supply	V_{CC} for SP amp system
6	SP_OUT_+	Output	SP amp output (+)
7	GND_SP	GND	GND for SP amp system
8	SP_OUT_−	Output	SP amp output (−)
9	V_{REG}_OUT	Output	Regulator voltage output
10	AGC_CTL	Input	AGC-ON level setup and AGC On/Off
11	Gv_CTL	TTL Input	Gain 0 dB/6 dB control
12	SP_SAVE	TTL Input	SP power save On/Off control
13	STANDBY	TTL Input	Standby On/Off control
14	V_{CC}	Power supply	V_{CC}
15	REG_CAP	Input	Ripple removal condenser terminal for the regulator
16	V_{REF}	Input	V_{REF}
17	INPUT	Input	Input terminal (negative return terminal)
18	INPUT2	Output	First rank amplifier output
19	GND	GND	GND
20	AGC出力	Output	AGC output

■ Absolute Maximum Ratings

A No.	Parameter	Symbol	Rating	Unit	Note
1	Supply voltage	V_{CC}	5.75	V	*1
		V_{CCSP}	5.75		
2	Supply current	I_{CC}	—	A	
3	Power dissipation	P_D	208	mW	*2
4	Operating ambient temperature	T_{opr}	–20 to +75	°C	*3
5	Storage temperature	T_{stg}	–55 to +150	°C	*3

Note) *1: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

*2: The power dissipation shown is the value at Ta = 75°C for the independent (unmounted) IC package.
When using this IC, refer to the • $P_D - T_a$ diagram in the ■ Technical Data and use under the condition not exceeding the allowable value.

*3: Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for Ta = 25°C.

■ Operating Supply Voltage Range

Parameter	Symbol	Range	Unit	Note
Supply voltage range	V_{CC}	3.0 to 5.5	V	
	V_{CCSP}	3.0 to 5.5		*

Note) *: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

■ Electrical Characteristics at V_{CC} = 3.3 V, V_{CCSP} = 5.0V

Note) T_a = 25°C±2°C unless otherwise specified.

B No.	Parameter	Symbol	Conditions	Limits			Unit	Note
				Min	Typ	Max		
Circuit current								
1	Circuit current 1A at non-signal (V_{CC})	I_{VCC1A}	V_{CC} = 3.3 V, Non-signal STB = Off, AGC = On, SP = On	2.2	4.5	6.8	mA	
2	Circuit current 2A at non-signal (V_{CCSP})	I_{VCC2A}	V_{CC} _SP = 5.0 V, Non-signal STB = Off, AGC = On, SP = On	1.0	3.0	5.0	mA	
3	Circuit current 1B at non-signal (V_{CC}) (SP power save = On)	I_{VCC1B}	V_{CC} = 3.3 V, Non-signal STB = Off, AGC = On, SP = Off	2.0	4.0	6.0	mA	
4	Circuit current 2B at non-signal (V_{CCSP}) (SP power save = On)	I_{VCC2B}	V_{CCSP} = 5.0 V, Non-signal STB = Off, AGC = On, SP = Off	150	300	450	µA	
5	Circuit current 1C at non-signal (V_{CC}) (Standby = On)	I_{VCC1C}	V_{CC} = 3.3 V, Non-signal STB = On, AGC = On, SP = Off	—	10	50	µA	
6	Circuit current 2C at non-signal (V_{CCSP}) (Standby = On)	I_{VCC2C}	V_{CC} _SP = 5.0 V, Non-signal STB = On, AGC = On, SP = Off	—	10	50	µA	
Speaker amplifier (Input: Pin 17 → Output: Pin 6 to Pin 8)								
11	Speaker amplifier Audio output level	VOSP	Vin = –28.0 dBV, 1 kHz , RL = 8 Ω	2.0	4.0	6.0	dBV	
12	Speaker amplifier Audio output distortion	THSP	Vin = –28.0 dBV, 1 kHz, to THD 5 th, RL = 8 Ω	—	0.05	0.50	%	
13	Speaker amplifier Audio output noise	VNSP	Non-signal A curve filter, RL = 8 Ω	—	–68.0	–62.0	dBV	
14	Speaker amplifier maximum output electric power 1	VM8SP	Vin = 1kHz, THD = 10% RL = 8 Ω , AGC = Off	0.7	1.0	—	W	
15	Speaker amplifier maximum output electric power 2	VM4SP	Vin = 1 kHz, THD = 10% RL = 4 Ω , AGC = Off	1.4	2.0	—	W	
16	Speaker amplifier AGC output level	VAGSP	Vin = –12.0 dBV, 1 kHz RL = 8 Ω , V10 = 1.0 V	5.5	7.0	8.5	dBV	
17	Maximum input level	VINMA	Vin = 1 kHz, V10 = 1.0 V THD = 1%, to THD 5 th	–10	—	—	dBV	

■ Electrical Characteristics at V_{CC} = 3.3 V, V_{CCSP} = 5.0V (continued)

Note) T_a = 25°C±2°C unless otherwise specified.

B No.	Parameter	Symbol	Conditions	Limits			Unit	Note
				Min	Typ	Max		
Voltage range holding mode of control pins								
21	Gain +6 dB/0 dB control Voltage range holding +6 dB	V11H	—	2.0	—	3.3	V	
22	Gain +6 dB/0 dB control Voltage range holding 0 dB	V11L	—	0.0	—	0.8	V	
23	Standby On/Off Voltage range holding Off	V13H	—	2.0	—	3.3	V	
24	Standby On/Off Voltage range holding On	V13L	—	0.0	—	0.8	V	
25	SP power save On/Off Voltage range holding Off	V12H	—	2.0	—	3.3	V	
26	SP power save On/Off Voltage range holding On	V12L	—	0.0	—	0.8	V	
27	Gain +6 dB/0 dB control Voltage range holding +6 dB	V10H	—	2.5	—	3.3	V	
28	Gain +6 dB/0 dB control Voltage range holding 0 dB	V10L	—	0.0	—	1.5	V	

■ Control Pin Mode Table

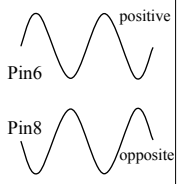
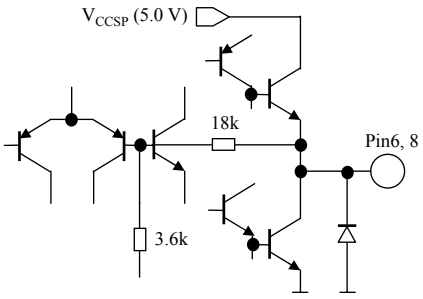
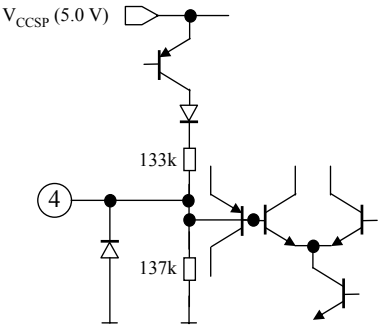
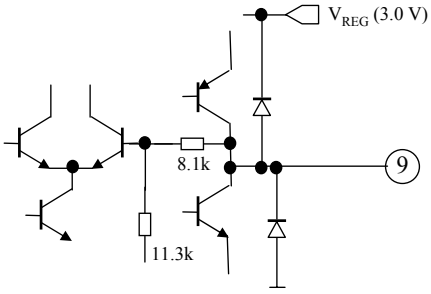
Note) See parameters B No. 21 to B No. 28 in the ■ Electrical Characteristics for control voltage retention ranges.

Pin No.	Description	Pin voltage		Remarks
		Low	High	
Mode Setup				
11	Gain +6 dB/0 dB control	0 dB	+6 dB	–
12	SP power save On/Off	Save On (SP output Off)	Save Off (SP output On)	–
13	Standby On/Off	STB On	STB Off	–
AGC On/Off and AGC On level Variable				
Pin No.	Description	Pin voltage		–
		0.5 V to 1.5 V	2.5 V to 3.3 V	
10	AGC On/Off and AGC On level setup	– 3 dB to +3 dB	AGC Off	

■ Technical Data

- I/O block circuit diagrams and pin function descriptions

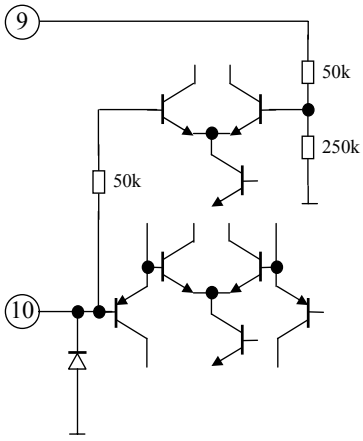
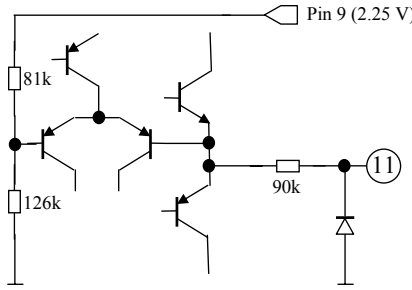
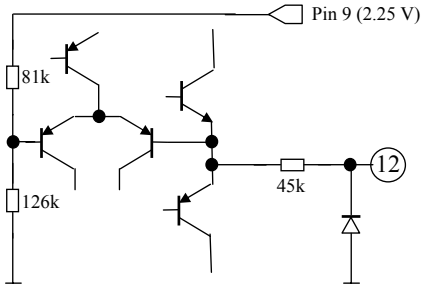
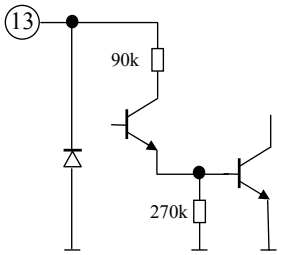
Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

Pin No.	Waveform and voltage	Internal circuit	Impedance	Description
6 8	Speaker output  DC 2.2 V AC 4 dBV	 	The output Impedance equal to or less than 10 Ω	It is t he output terminal of the speaker amplifier. It becomes BTL output. The positive aspect output pin: 6 The opposite aspect output pin: 8 Also , when the speaker amplifier saves power, too , DC voltage is maintained.
7	GND ———— DC 0.0 V	—	—	It is GND pin for the speaker amplifier. It isn't connected with the substrate potential in the IC.
4	V_{REFSP} ———— DC 2.2 V	 	Entry impedance Is about 66 kΩ	It is the standard voltage terminal to fix the DC bias of the speaker output. It connects a condenser to remove a ripple.
5	V_{CCSP} ———— DC 5.0 V	—	—	It is the specifically designed power Pin of the speaker amplifier.
9	DC output for the AGC-On level adjustment ———— DC 2.25 V	 	The output Impedance equal to or less than 10 Ω	It is an DC voltage output terminal for the AGC-On level adjustment.

■ Technical Data (continued)

- I/O block circuit diagrams and pin function descriptions (continued)

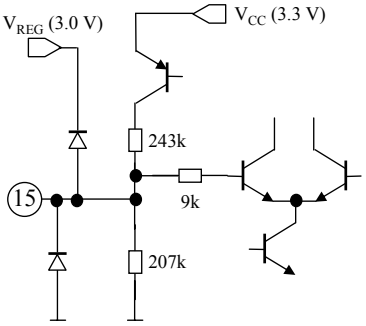
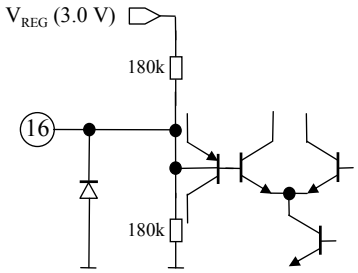
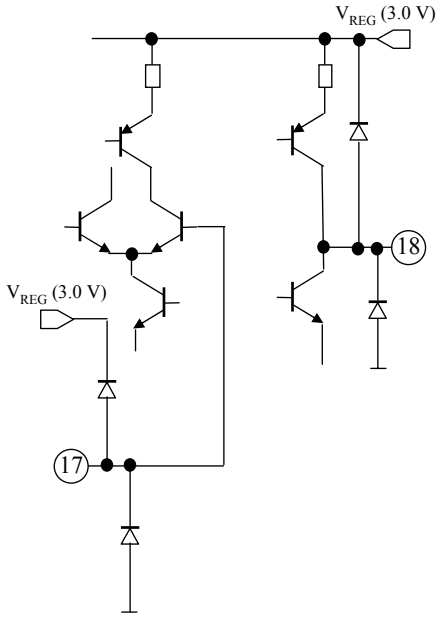
Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

Pin No.	Waveform and voltage	Internal circuit	Impedance	Description
10	It controls AGC-On level & On/Off DC —		Entry impedance =the high impedance	It is the terminal which controls the operation of the AGC circuit of the SP output for the clip prevention in On/Off , and adjustment of AGC-On level. At the time of Off , the AGC circuit doesn't work. 0.5 V to 1.5 V: AGC-On (+3 dB to –3 dB) 2.5 V to 3.3 V: AGC-Off
11	Gain 0dB/+6dB Control terminal. DC —		Entry impedance =the high impedance	It is the terminal which controls gain 0 dB/+6 dB of SP output. High: +6 dB Low: 0 dB
12	SP amplifier power saving On/Off control terminal. DC —		Entry impedance =the high impedance	It is the terminal which controls power saving by SP amplifier.
13	Standby On/Off control terminal. DC 0.0 V		Entry impedance = About 90 kΩ	It changes whether or not it makes this IC an operation condition or whether or not it makes it a standby. Low: standby condition High: The operation condition In that the power changes a connected condition to the standby. The circuit electric current can be almost made 0.

■ Technical Data (continued)

- I/O block circuit diagrams and pin function descriptions (continued)

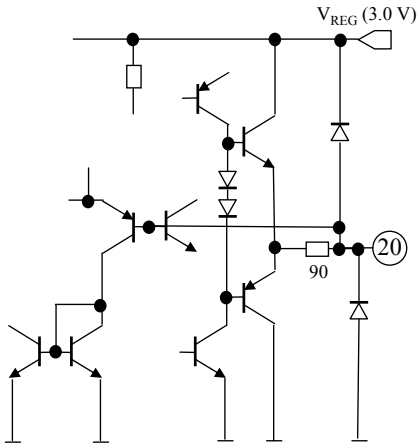
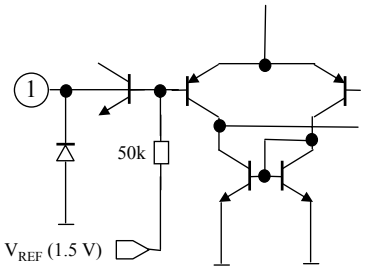
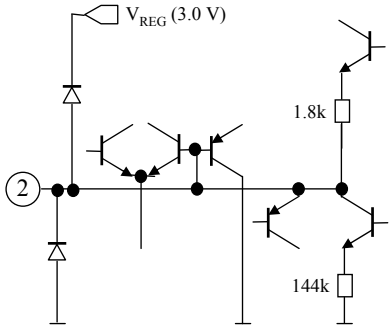
Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

Pin No.	Waveform and voltage	Internal circuit	Impedance	Description
14	V_{CC} DC 3.3 V	—	—	It is the power V_{CC} terminal to supply the regulator circuit to create the inner power V_{REG} with the voltage. It is separating from V_{CCSP} of Pin 5 fully inside.
15	Ripple removal condenser terminal for the regulator DC 1.5 V		—	To remove a power ripple with the regulator circuit to create the inner power V_{REG} , it puts a condenser.
16	V_{REF} DC 1.5 V		Entry impedance = About 90 kΩ	With the pin to fix the bias voltage (the operation point) of the system which the inner power (V_{REG}) works , it becomes 1/2 V_{REG} (V). To remove noise , it connects a condenser with the interval of GND.
18	Input amplifier output terminal DC 1.5 V AC –22 dBV (Gv = 0 dB) AC –28 dBV (Gv = +6 dB)		The output Impedance equal to or less than 10 Ω	It is the output terminal of the input amplifier.
17	Input amplifier negative return terminal DC 1.5 V		Entry impedance =the high impedance	It is the negative feedback of the input amplifier. The gain of input amplifier can be set up by connecting external resistance to Pin 18 and Pin 17.

■ Technical Data (continued)

- I/O block circuit diagrams and pin function descriptions (continued)

Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

Pin No.	Waveform and voltage	Internal circuit	Impedance	Description
3 19	GND DC 0.0 V	—	—	It is the GND terminal of the signal system. It is connected with the substrate potential of the IC.
20	AGC amplifier output terminal DC 1.5 V AC –16 dBV		The output impedance equal to or less than 10 Ω	It is the output terminal of the AGC circuit to hold an output clip in excessive output of the SP output.
1	Speaker amplifier input DC 1.5 V AC –16 dBV		Entry impedance = About 50 kΩ	It is the voice input terminal of the speaker amplifier. To make offset voltage in power saving On/Off changing by the SP amplifier little , it combines capacity. (It makes POP noise small.)
2	AGC detection terminal DC 0 V to 1 V		Entry impedance = Unsettled	It is the detection circuit to detect the signal level of the AGC circuit of the SP output for the clip prevention. It connects a condenser for the detection.

■ Technical Data (continued)

- Control sequence at power On/Off

Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

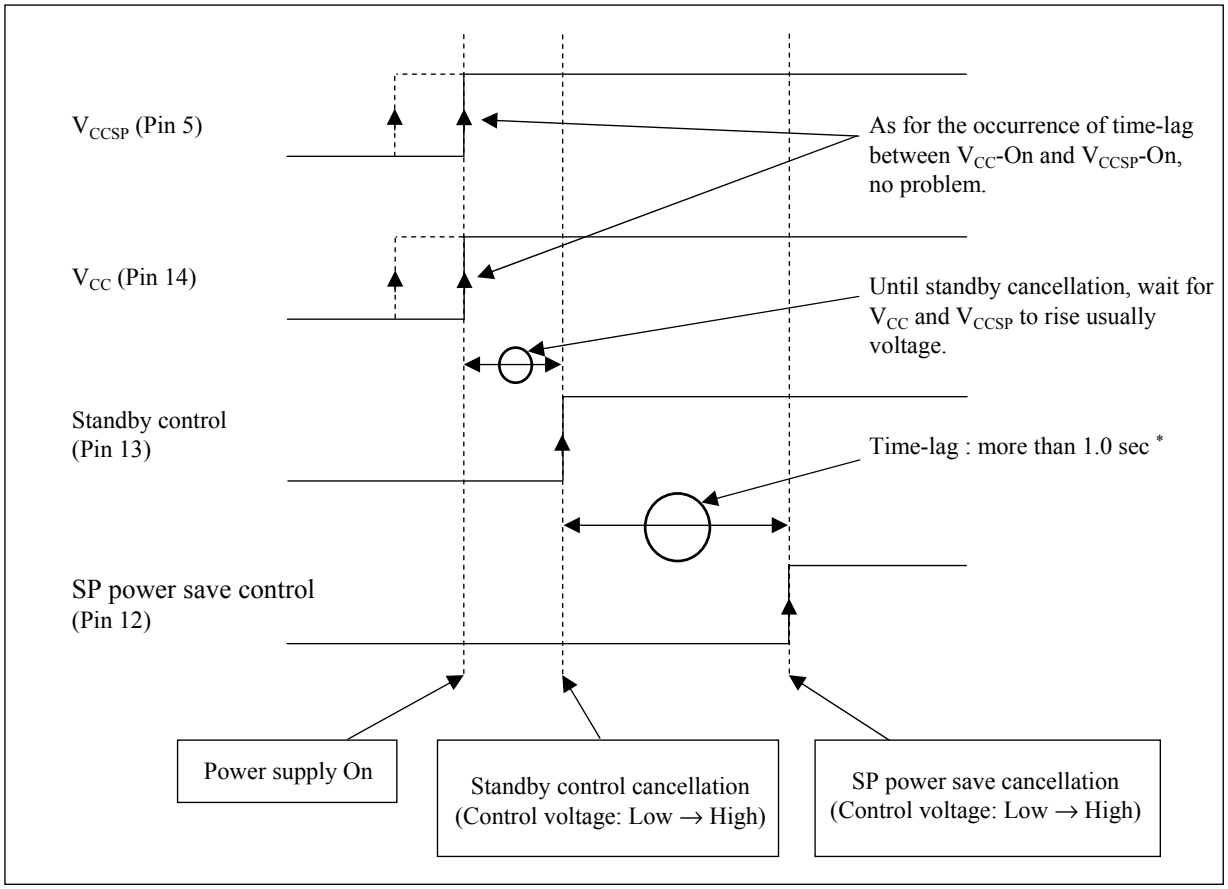
1. At power on

At power ON,as for the timing of each control pin, it much more recommends a procedure below the purpose of the pop noise measure in changing.

Control sequence

1. Power supply (V_{CCSP}, V_{CC}): OFF → ON
2. Standby control: ON → OFF
3. SP power save control: ON → OFF

Control timing



Note) *: The time to rise usually voltage, after standby control cancellation. It depend on the capacitance value of V_{REF} and V_{REFSP} .
It is a recommendable value as for C=1.0uF.

■ Technical Data (continued)

- Control sequence at power On/Off (continued)

Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

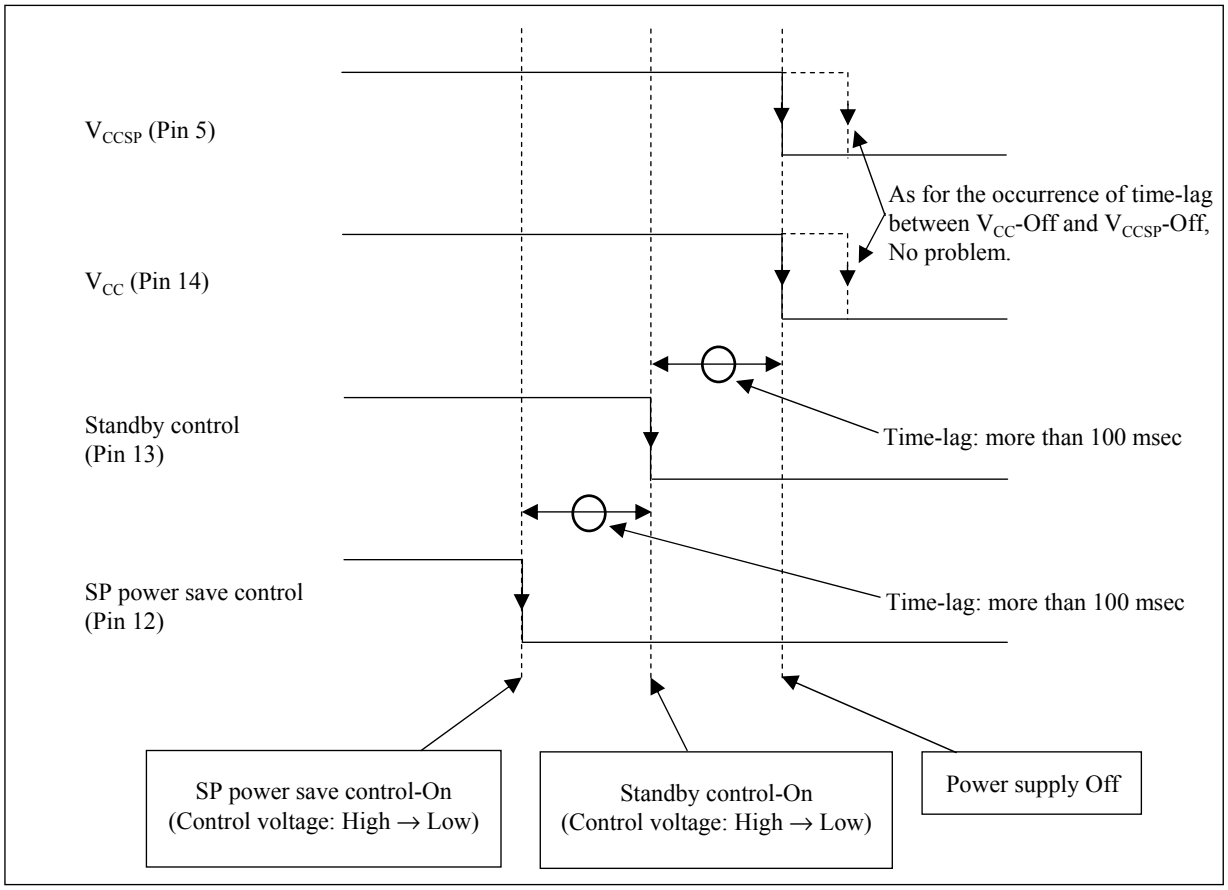
2. At power off

At power OFF,as for the timing of each control pin, it much more recommends a procedure below the purpose of the pop noise measure in changing.

Control sequence

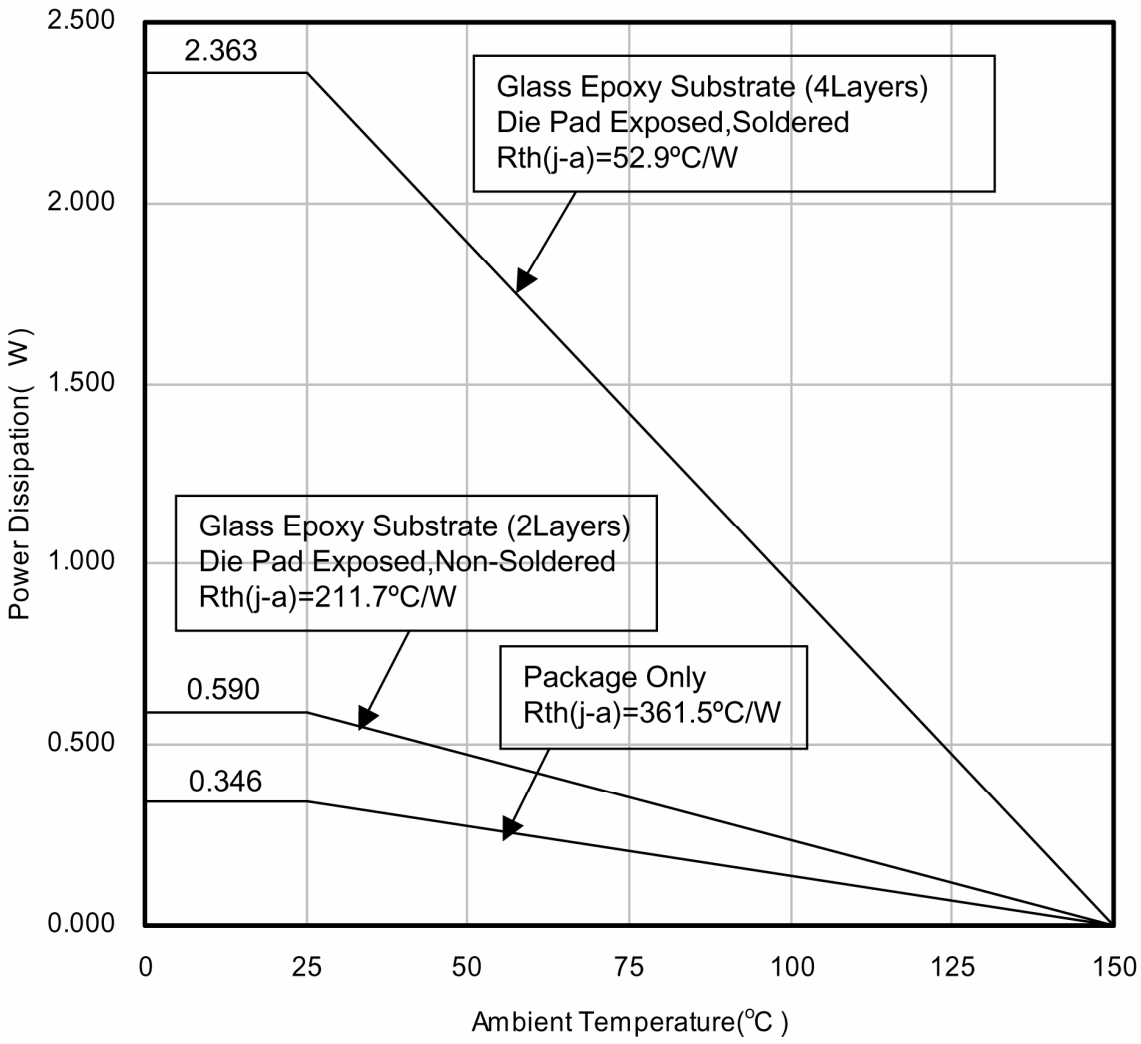
1. SP power save control: OFF → ON
2. Standby control: OFF → ON
3. Power supply (V_{CCSP} , V_{CC}): ON → OFF

Control timing



■ Technical Data (continued)

• P_D — T_a diagram



■ Usage Notes

1. Please carry out the thermal design with sufficient margin such that the power dissipation will not be exceeded, based on the conditions of power supply, load and surrounding temperature.
   Although indicated also in the column of the maximum rating, the maximum rating becomes an instant and the marginal value which must not exceed. It sufficiently evaluates, and I use-wish-do so that it may not exceed certainly. Moreover, don't impress neither voltage nor current to PIN which is not indicated. It may destroy in both cases.

2. Please pay attention in the pattern layout in order to prevent damage due to short circuit between pins.
   In addition , for the pin configuration, please refer to the ■ Pin Descriptions.

3. Please absolutely do not mount the LSI in the reverse direction on to the printed-circuit-board.
   It damaged when the electricity is turned on.

4. Please do a visual inspection on the printed-circuit-board before turning on the power supply, otherwise damage might happen due to problems such as a solder-bridge between the pins of the semiconductor device.
   Also perform a full technical verification on the assembly quality, because the same damage possibly can happen due to conductive substances, such as solder ball, that adhere to the LSI during transportation.

5. Please take notice in the use of this product that it might break or occasionally smoke when an abnormal state occurs such as output pin-power supply pin short, output pin-GND short, or output-to-output-pin short (load short).
   And, safety measures such as an installation of fuses are recommended because the extent of the above-mentioned damage and smoke emission will depend on the current capability of the power supply.

6. When using the LSI for model deployment or new products, perform fully the safety verification including the long-turn reliability for each product.

Request for your special attention and precautions in using the technical information and semiconductors described in this book

(1) If any of the products or technical information described in this book is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially, those with regard to security export control, must be observed.

(2) The technical information described in this book is intended only to show the main characteristics and application circuit examples of the products, and no license is granted under any intellectual property right or other right owned by our company or any other company. Therefore, no responsibility is assumed by our company as to the infringement upon any such right owned by any other company which may arise as a result of the use of technical information described in this book.

(3) The products described in this book are intended to be used for standard applications or general electronic equipment (such as office equipment, communications equipment, measuring instruments and household appliances).
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(5) When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.
Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

(6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.