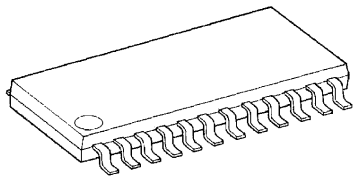
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA8155FG,TA8155FNG

REC / PB System Dual Pre−amplifier (1.5 / 3V USE)

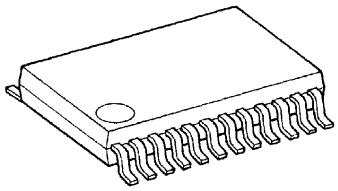
The TA8155FG and TA8155FNG are REC / PB system dual pre amplifier ICs, which are developed for low voltage operation (1.5 / 3V use). These are especially suitable for a stereo headphone cassette player.

TA8155FG



SSOP24-P-300-1.00

TA8155FNG



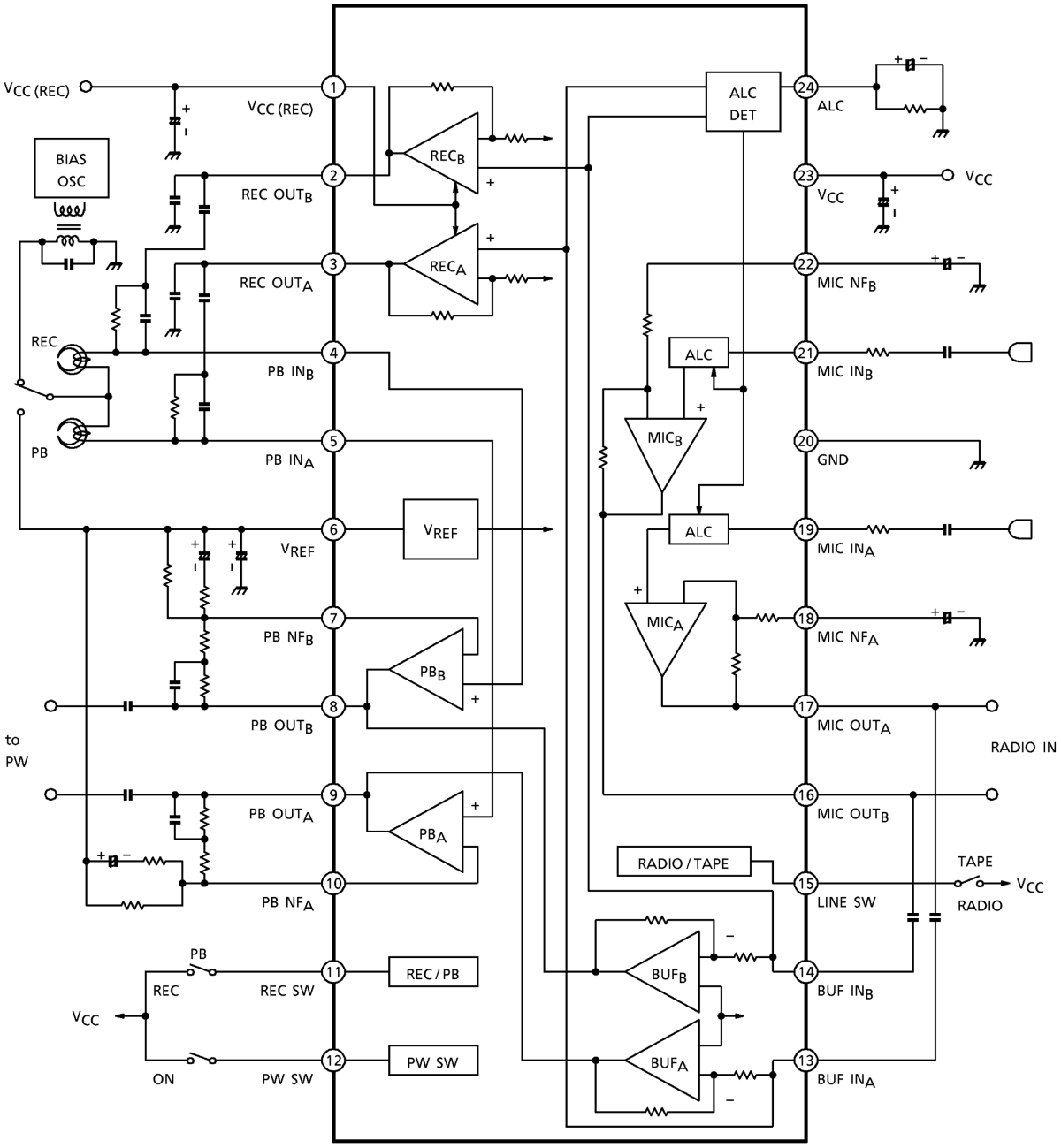
SSOP24-P-300-0.65A

Weigh
SSOP24-P-300-1.00: 0.32g (typ.)
SSOP24-P-300-0.65A: 0.14g (typ.)

Features

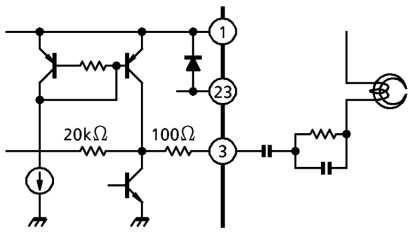
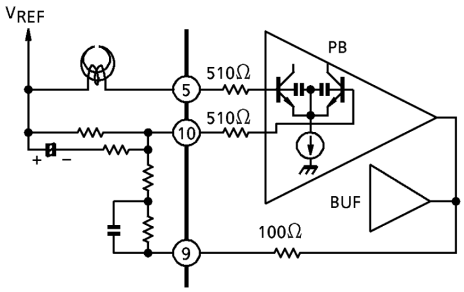
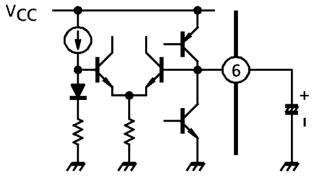
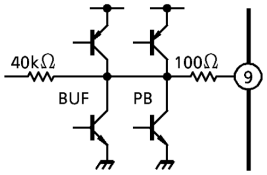
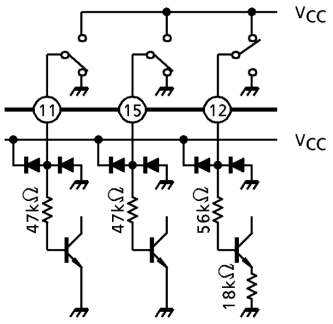
- Built−in dual playback amplifiers.
  Input coupling condenser−less.
  Built−in capacitor for buzz noise.
- Built−in dual buffer amplifiers.
  For radio signal inut.
  Monitor for REC mode.
- Built−in dual microphone amplifiers.
  Built−in an ALC circuit for MIC−REC mode.
  Attack time. : 0.1s (typ.)
  Recovery time. : 3.5s (typ.)
- Built−in dual recording amplifiers.
  Single−end output type.
- Built−in a power switch.
- Low quiescent current. (V_{CC} = 1.2V, Ta = 25°C)
  PB mode ..... I_{CCQ2} = 2.6mA (typ.)
  Radio mode ..... I_{CCQ3} = 2.4mA (typ.)
  Radio−REC mode ... I_{CCQ4} = 3.0mA (typ.)
  MIC−REC mode ..... I_{CCQ5} = 4.5mA (typ.)
- Low power dissipation.
  PB mode : 2.9mW (typ.)
  MIC−REC mode : 8.9mW (typ.)
- Operating supply voltage range. (Ta = 25°C)
  $V_{CC\ (opr)}$ = 0.9~4V
  $V_{CC\ (opr)\ (REC)}$ = 1.8~4V

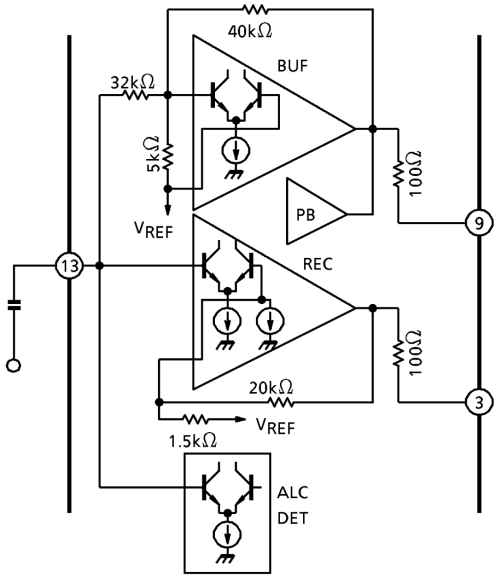
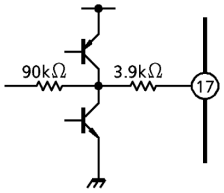
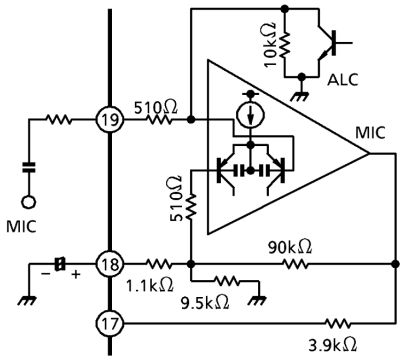
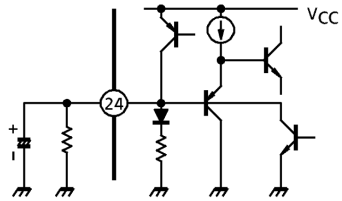
Block Diagram



Terminal Explanation

Terminal Voltage : Typical Terminal Voltage at no Signal with Test Circuit.
(V_{CC} = 1.2V, $V_{CC\ (REC)}$ = 2.4V, Ta = 25°C)

Terminal No.	Terminal Name	Function	Internal Circuit	Terminal Voltage (V)
1	$V_{CC(REC)}$	This terminal voltage supplies output stage of recording amplifier with power source.		2.4
2	REC OUT_B	Output of recording amplifier.		1.15
3	REC OUT_A			
4	PB IN_B	Input of playback amplifier.		0.85
5	PB IN_A			
7	PB NF_B	NF of playback amplifier.		0.85
10	PB NF_A			
6	V_{REF}	Reference voltage. All amplifier operate on this voltage.		0.85
8	PB OUT_B	Output of playback amplifier and buffer amplifier.		0.55
9	PB OUT_A			
11	REC SW	REC / PB switch. V_{CC}: REC mode. GND / OPEN: PB mode.		—
12	PW SW	Power switch. V_{CC}: Power on. GND / OPEN: Power off.		—
15	Line SW	Line switch. VCC: BUF (radio) mode. GND / OPEN: Tape mode.		—

Terminal No.	Terminal Name	Function	Internal Circuit	Terminal Voltage (V)
13	BUF IN_A	Input of buffer amplifier and recording amplifier. (Buffer amplifier is inverter type.) ALC level of microphone amplifier is determined by signal level of this terminal		0.85
14	BUF IN_B			
16	MIC OUT_B	Output of microphone amplifier.		0.55
17	MIC OUT_A			
18	MIC NF_A	NF of microphone amplifier.		0.05
22	MIC NF_B			
19	MIC IN_A	Input of microphone amplifier. Built−in capacitor for buzz noise.		0.01
21	MIC IN_B			
20	GND	—	—	0
23	V_{CC}	—	—	1.2
24	ALC	ALC terminal. ALC function is operated in only MIC−REC mode.		0.11

Application Note

(1) PW SW

It is necessary to connect an external pull–down resistor with the terminal PW SW (pin(12)), in case that this IC is turned on due to external noise etc.

(2) Mode SW

IC mode is determined by switch condition of RED SW (pin(11)) and LINE SW (pin(15))

(Table.1)
H level: Bias current should be applied to switch terminal more than 5μA.
L level: Bias voltage should be applied to switch terminal from 0V to 0.3V.

Table.1 IC mode

LINE SW \ REC SW	L	H
L	PB mode (PB)	MIC–REC (BUF,MIC,REC)
H	Radio mode (BUF)	Radio–REC mode (BUF,REC)

( ) : Operating amplifier.

The leak current flows through the terminal of REC SW (pin(11)) or LINE SW (pin(15)), in case that the terminals connected with V_{CC} line independently, even though this IC is off–mode (the terminal of PW SW (pin(12)) is off–mode).
And it is necessary to connect an external pull–down resistor with the terminal REC SW (pin(11)) and LINE SW (pin(15)), in case that this IC is turned on due to external noise etc.

(3) Playback amplifier
Output voltage of playback amplifier is determined by an external resistor R_1 and R_f.

$$V_{O\ (PRE)} = V_{REF} - \Delta V - R_f\left(\frac{\Delta V}{R_1} - I_{B(NF)}\right)$$

ΔV is an off–set voltage which is designed to 18mV.
In case that β of transistor is assumed 100, $I_{B(NF)}$ is flowed 0.2μA in Fig.1. And output voltage of playback amplifier (pin (8),(9)) in Fig.1 is

$$V_{O\ (PRE)} = 0.85V - 0.018V - (330k\Omega + 13k\Omega) \times \left(\frac{0.018V}{18k\Omega} - 0.2\mu A\right) = 0.56(V)$$

Output voltage of playback amplifier should be fixed V_{CC} / 2, because playback amplifier get a enough dynamic range.
And current source of 20μA is operated except playback mode, in order to reduce a pop sound in swichover between playback on / off mode (Fig.2).

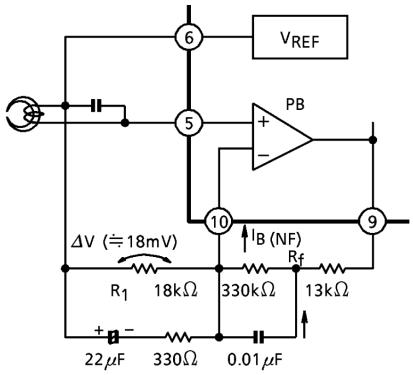


Fig.1 DC output voltage of playback amplifier.

(4) Microphone amplifier

Current source of 5.5μA is operated except MIC–REC mode, because bias is applied to the same output voltage as output voltage of microphone amplifier in operation (Fig.3).

(5) $V_{CC\ (REC)}$

The $V_{CC\ (REC)}$ terminal (pin(1)) is applied bias to $V_{CC\ (REC)} = V_{CC}-0.7V$, because the $V_{CC\ (REC)}$ terminal (pin(1)) is connected with the V_{CC} terminal (pin(23)) by diode, as internal circuit of termial explanation.
And supply current doesn't flow through $V_{CC\ (REC)}$ terminal (pin(1)), in case that the terminal is connectd with V_{CC} line, even though this IC is on–mode and except REC mode.

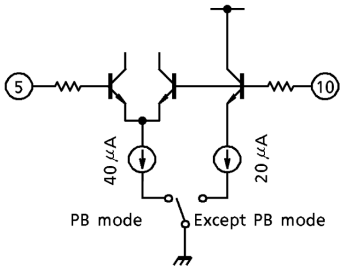


Fig.2 Reducing a pop sound of mode switchover (1).

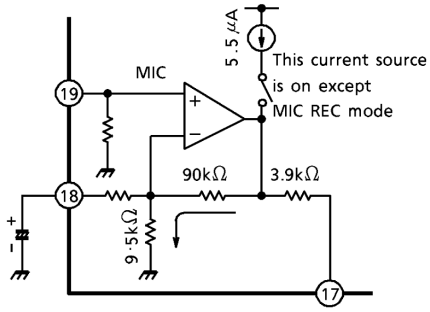


Fig.3 Reducing a pop sound of mode switchover (2).

Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
Supply voltage		V_{CC}	4.5	V
		$V_{CC\ (REC)}$	4.5	
Power dissipation	TA8155FG	P_D (Note)	400	mW
	TA8155FNG		500	
Operating Temperature		T_{opr}	−25~75	°C
Storage temperature		T_{stg}	−55~150	°C

(Note) Derated above Ta = 25°C in the proportion of 3.2mW / °C for TA8155FG, and of 4mW / °C for TA8155FNG.

Electrical Characteristics

Unless Otherwise Specified: V_{CC} = 1.2V, $V_{CC(REC)}$ = 2.4V, f = 1kHz, Ta = 25°C, SW_1: a, SW_8: OPEN, SW_9: ON, SW_{10}: ON, SW_{11}: ON, SW_2~SW_7 condition by next page

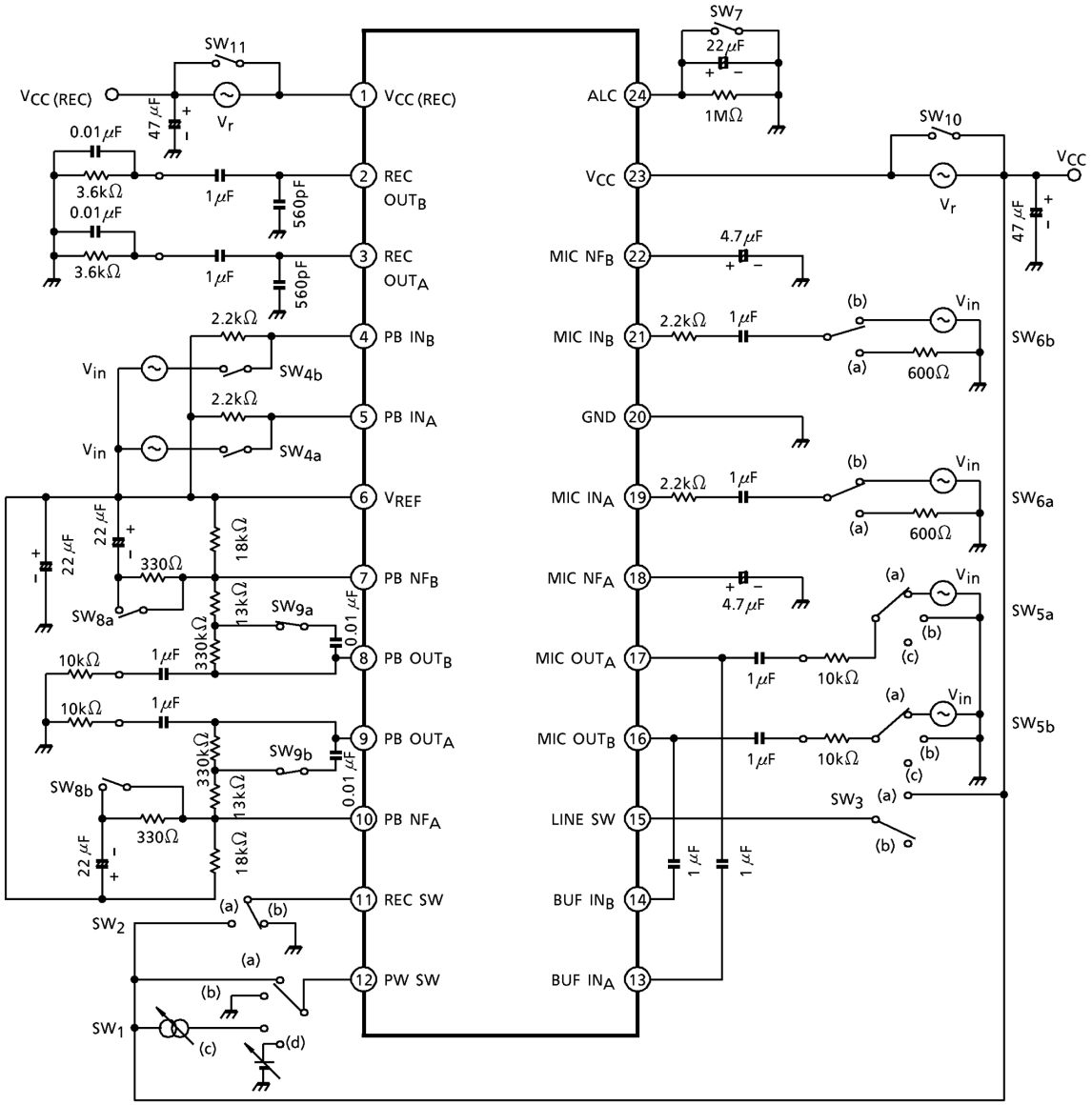
Characteristic			Symbol	Test Cir−cuit	Test Condition	Min.	Typ.	Max.	Unit
Quiescent current		PW off	I_{CCQ1}	—	SW_1: b, SW_2: b, SW_3: b	—	0.1	5	μA
		PB	I_{CCQ2}		SW_2: b, SW_3: b	—	2.6	3.9	mA
		Radio	I_{CCQ3}		SW_2: b, SW_3: a	—	2.4	3.6	
		Radio−REC	I_{CCQ4}		SW_2: a, SW_3: a	—	3.0	4.5	
		MIC−REC	I_{CCQ5}		SW_2: a, SW_3: b	—	4.5	6.5	
		$V_{CC\ (REC)}$	I_{CCQ6}		SW_2: a, SW_3: b	1.3	1.5	2.4	
Reference voltage			V_{REF}	—		0.8	0.85	0.9	V
Playback amplifier	Open loop voltage gain		G_{VO}	—	SW_8: ON, SW_9: OPEN V_o = −17dBV	58	70	—	dB
	Closed loop voltage gain		G_{VC}	—	V_o = −17dBV	—	36	—	
	Maximum output voltage		V_{om1}	—	THD = 1%	200	310	—	mV_{rms}
	Total harmonic distortion		THD1	—	V_o = −17dBV	—	0.1	0.3	%
	Equivalent input noise voltage		V_{ni}	—	SW_4: OPEN BPF = 30Hz~20kHz NAB (G_V = 36dB,f = 1kHz)	—	1.2	3.0	$μV_{rms}$
	Cross talk (CH−A / CH−B)		CT1	—	V_o = −17dBV	—	62	—	dB
	Ripple rejection ratio		RR1	—	SW_4: OPEN, SW_{10}: OPEN f_r = 100Hz, V_r = −32dBV	—	40	—	
Buffer amplifier	Voltage gain		G_{V2}	—	V_o = −17dBV	−4	−2	0	dB
	Maximum output voltage		V_{om2}	—	THD = 1%	200	270	—	mV_{rms}
	Total harmonic distortion		THD2	—	V_o = −17dBV	—	0.1	—	%
	Output noise voltage		V_{no2}	—	SW_5: b, BPF = 30Hz~20kHz	—	35	—	$μV_{rms}$
	Cross talk (CH−A / CH−B)		CT2	—	V_o = −17dBV	—	51	—	dB
	Ripple rejection ratio		RR2	—	SW_5: b, SW_{10}: OPEN f_r = 100Hz,V_r = −32dBV	—	55	—	
Recording amplifier	Voltage gain		G_{V3}	—	V_o = −12dBV	16.5	18.5	20.5	dB
	Maximum output voltage		V_{om3}	—	THD = 1%	500	720	—	mV_{rms}
	Total harmonic distortion		THD3	—	V_o = −12dBV	—	0.1	0.5	%
	Output noise voltage		V_{no3}	—	SW_5: b, BPF = 30Hz~20kHz	—	0.09	0.25	mV_{rms}
	Cross talk (CH−A / CH−B)		CT3	—	V_o = −12dBV	—	49	—	dB
	Ripple rejection ratio		RR3	—	SW_5: b, SW_{10}: OPEN f_r = 100Hz, V_r = −32dBV	—	40	—	

Characteristic		Symbol	Test Cir–cuit	Test Condition	Min.	Typ.	Max.	Unit
Microphone amplifier	Voltage gain	G_{V4}	—	V_o = –17dBV	30	32.5	35	dB
	Maximum output voltage	V_{om4}	—	THD = 1%	120	200	—	mV_{rms}
	Total harmonic distortion	THD4	—	V_o = –17dBV	—	0.25	0.8	%
	Output noise voltage	V_{no4}	—	SW_6: a, BPF = 30Hz~20kHz	—	0.12	—	mV_{rms}
	Cross talk (CH–A / CH–B)	CT4	—	V_o = –17dBV	—	52	—	dB
	Ripple rejection ratio	RR4	—	SW_6: a, SW_{10}: OPEN f_r = 100Hz,V_r = –32dBV	—	36	—	
Microphone amplifier + recording amplifier	Voltage gain	G_{V5}	—	SW_7: ON, V_o = –17dBV	—	58	—	dB
	Maximum output voltage	V_{om5}	—	THD = 3%	600	800	—	mV_{rms}
	ALC total harmonic distortion	THD5	—	V_{in} = –32dBV	—	0.8	—	%
	Output noise voltage	V_{no5}	—	SW_6: a, BPF = 30Hz~20kHz	—	2.1	3.5	mV_{rms}
	ALC voltage	V_{oALC1}	—	V_{in} = –62dBV	–11.7	–8.5	–6.7	dBV
		V_{oALC2}	—	V_{in} = –32dBV	–11.7	–8.5	–6.7	
	ALC channel balance	CB_{ALC}	—		—	0	1.5	dB
	ALC width	W_{ALC}	—	V_{oALC} ≤ 3dB (input voltage) with respect to standard V_{in} = –42dBV	—	48	—	
	Cross talk (CH–A / CH–B)	CT5	—	V_{in} = –32dBV	—	37	—	dB
	Ripple rejection ratio	RR5	—	SW_6: a, f_r = 100Hz, V_r = –17dBV	—	39	—	
Power switch	Power on current	I_{12}	—	SW_1: c, SW_2: b, SW_3: b V_6 ≥ 0.6V	5	—	—	μA
	Power off voltage	V_{12}	—	SW_1: d, SW_2: b, SW_3: b V_6 ≤ 0.2V	0	—	0.3	V

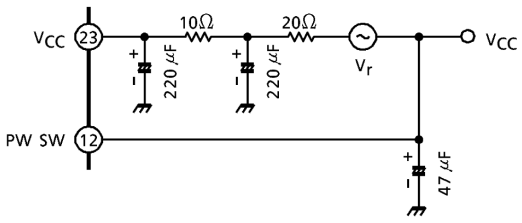
Switch Condition For Test Mode (unless otherwise specified.)

Mode	PB AMP. (PB mode)	BUF AMP. (radio mode)	REC AMP. (radio–REC mode)	MIC AMP. (MIC mode)	MIC AMP. + REC AMP. (MIC–REC mode)
Operating Amplifier / Switch	PB	BUF	BUF REC	MIC–ALC BUF, REC	
SW_2	b	b	a	a	
SW_3	b	a	a	b	
SW_4	ON	OPEN	OPEN	OPEN	
SW_5	b	a	a	b	c
SW_6	a	a	a	b	
SW_7	OPEN	OPEN	OPEN	ON	OPEN

Test Circuit



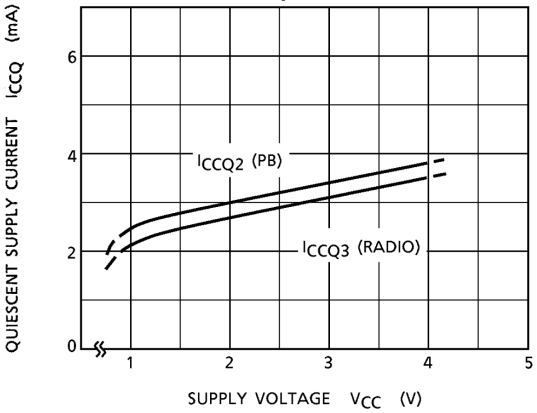
(*) RR5 is measured by circuit below (for V_{CC} line)



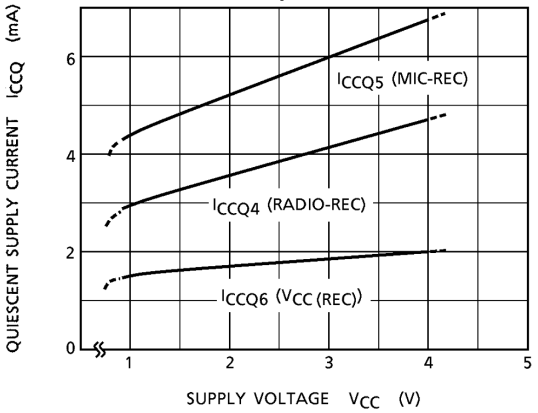
Characteristic Curves

Unless Otherwise Specified V_{CC} = 1.2V, $V_{CC(REC)}$ = 2.4V, f = 1kHz, Ta = 25°C
R_L = 10kΩ : PB amp., BUF amp., MIC amp.
(load of recoading amplifier is shown in test circuit)

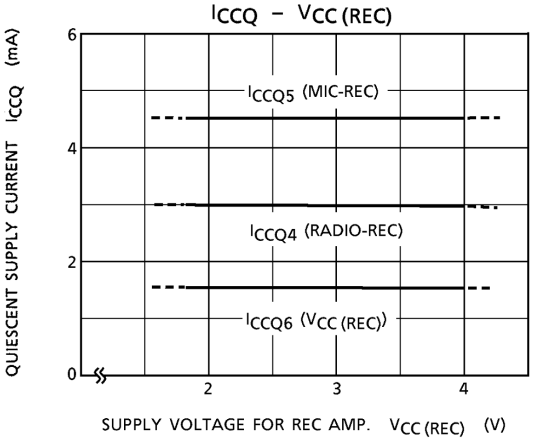
I_{CCQ} – V_{CC}



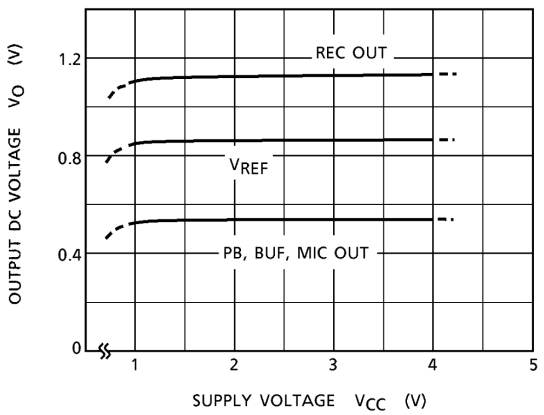
I_{CCQ} – V_{CC}



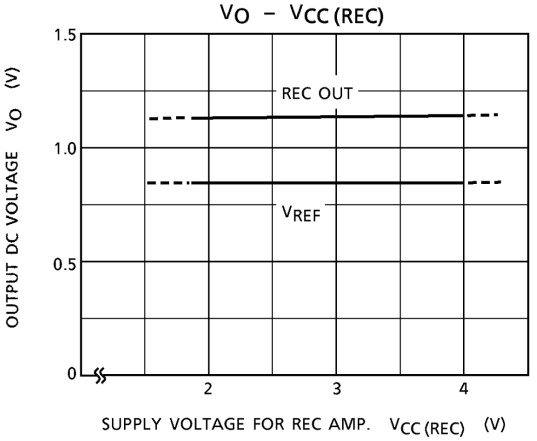
I_{CCQ} – $V_{CC\,(REC)}$



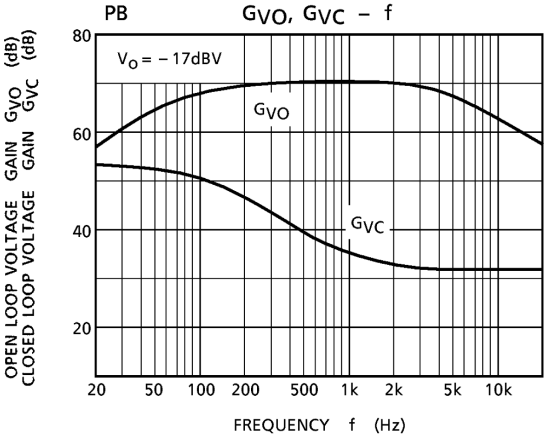
V_O – V_{CC}



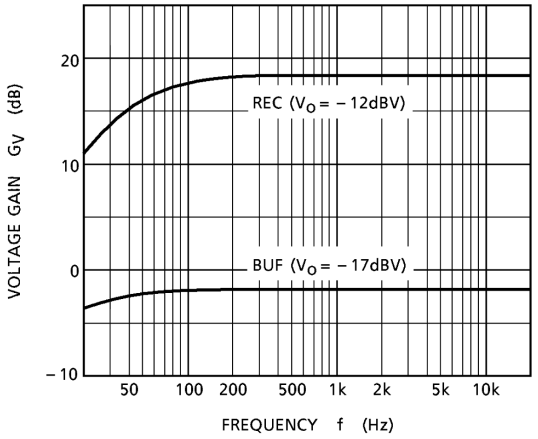
V_O – $V_{CC\,(REC)}$



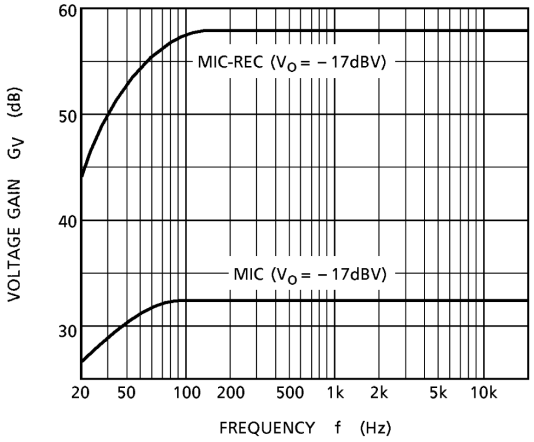
PB G_{VO}, G_{VC} – f



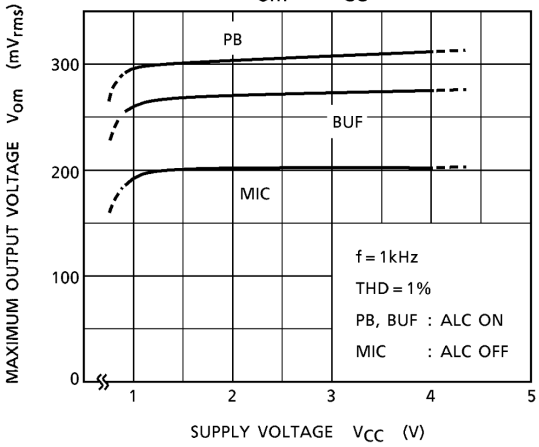
G_V – f



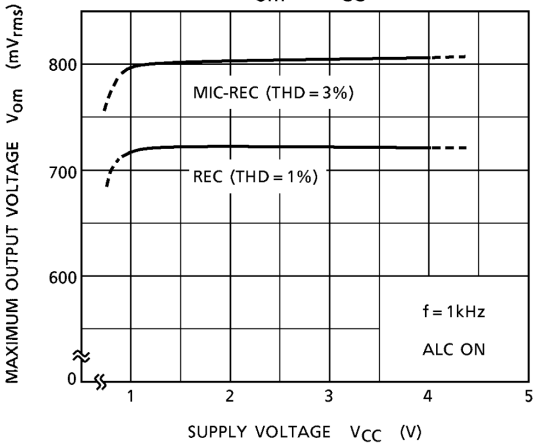
G_V – f



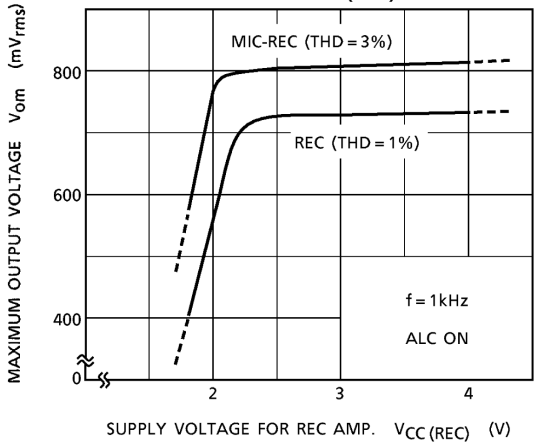
V_{om} – V_{CC}



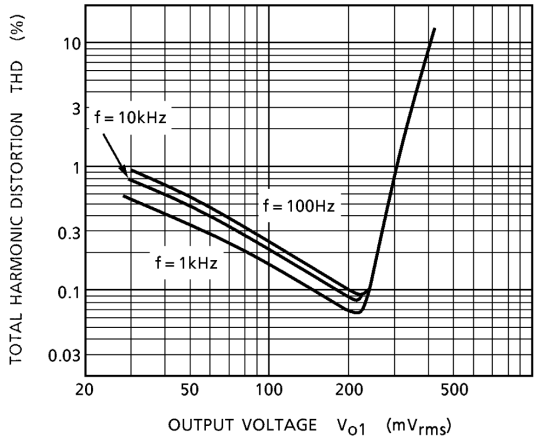
V_{om} – V_{CC}



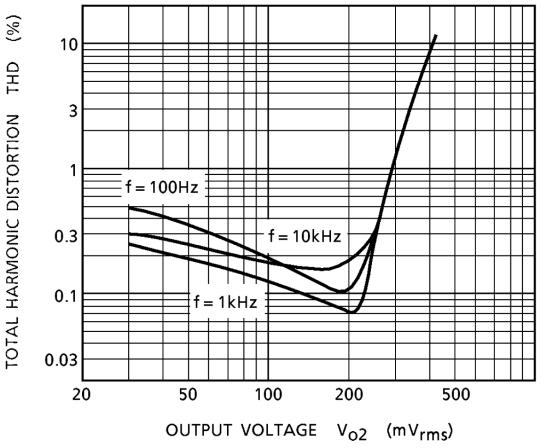
V_{om} – $V_{CC\,(REC)}$



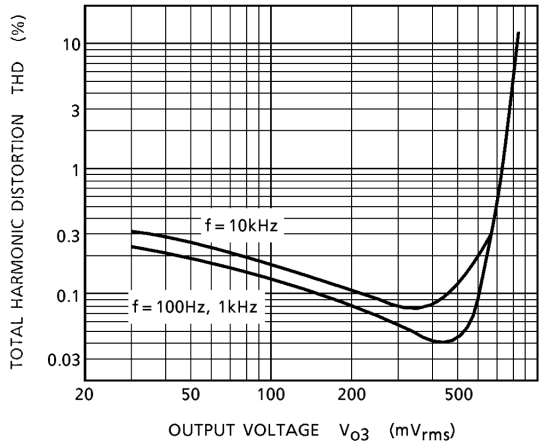
PB THD – V_{o1}



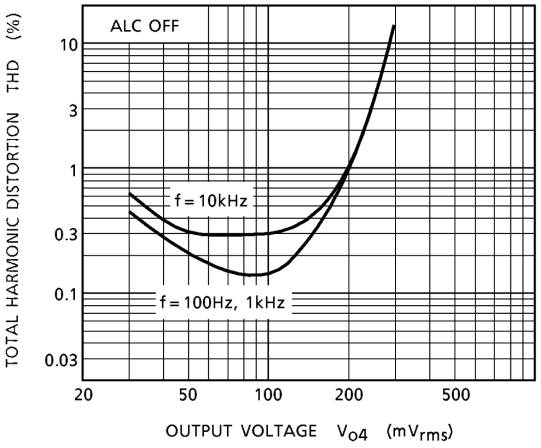
BUF THD – V_{O2}



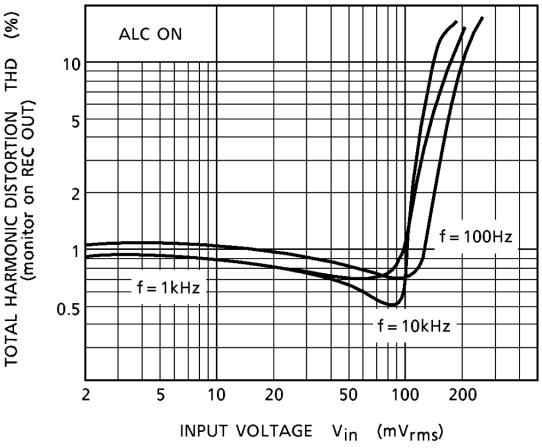
REC THD – V_{O3}



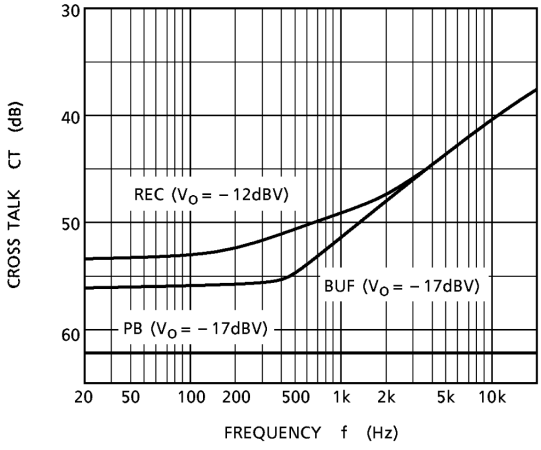
MIC THD – V_{O4}



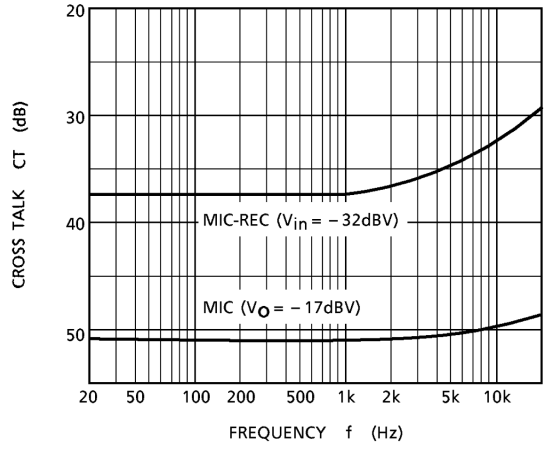
MIC-REC THD – V_{in}



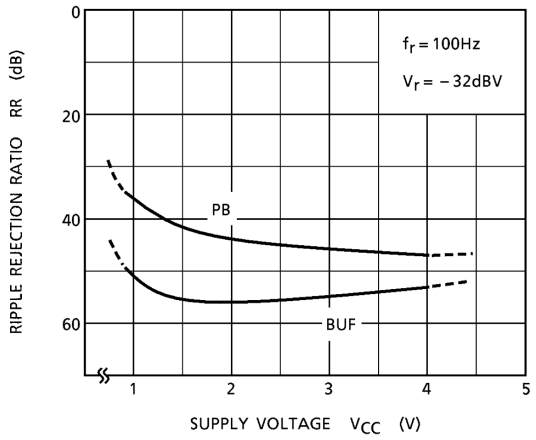
CT – f



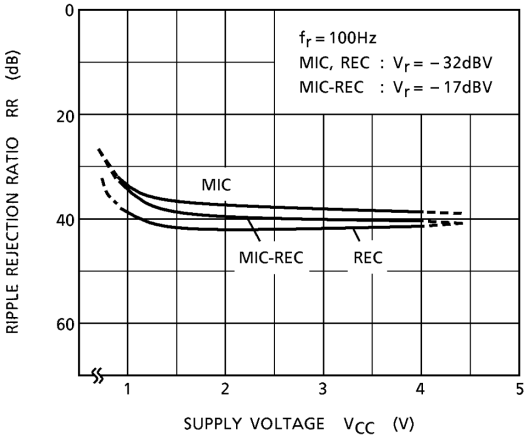
CT – f



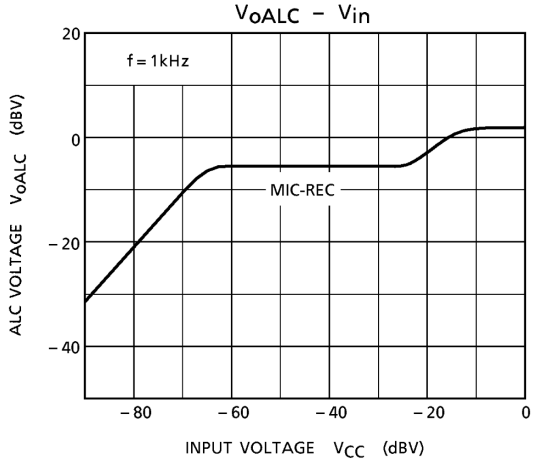
RR – V_{CC}



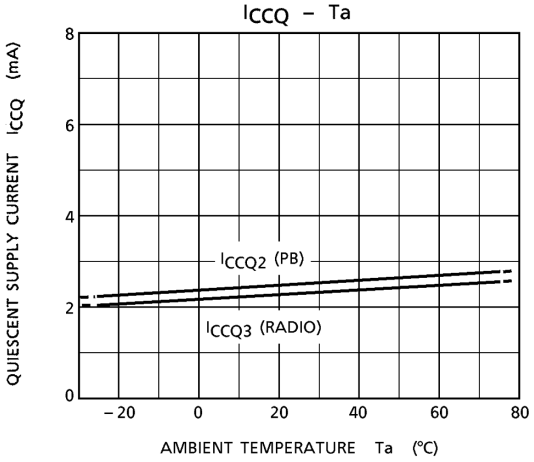
RR – V_{CC}



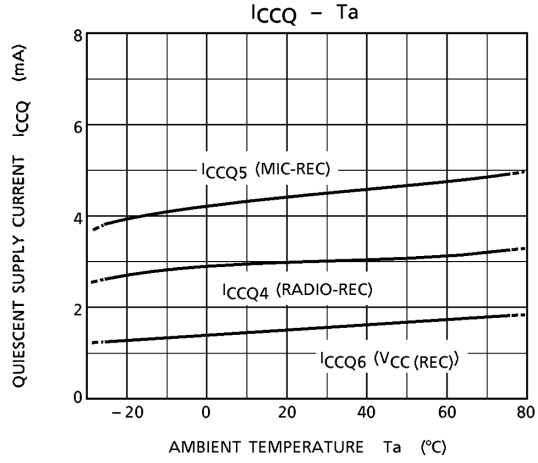
V_{oALC} – V_{in}



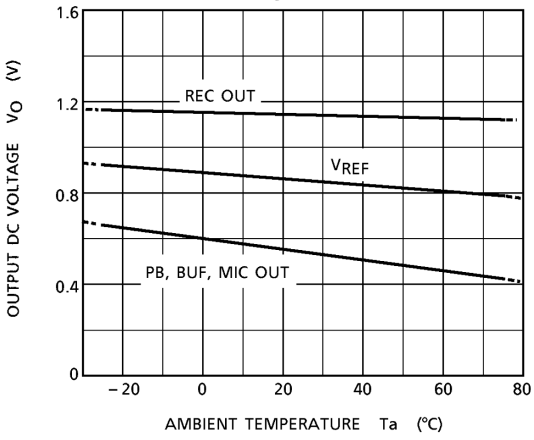
I_{CCQ} – Ta



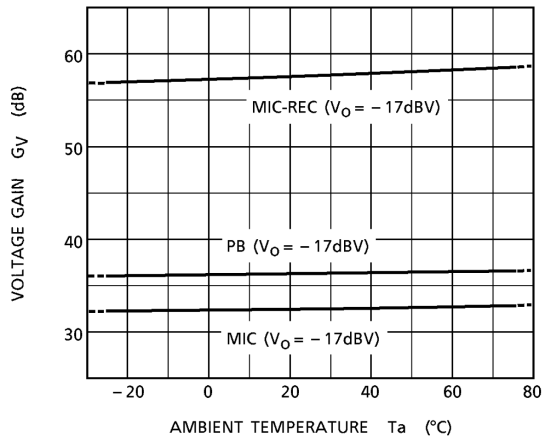
I_{CCQ} – Ta



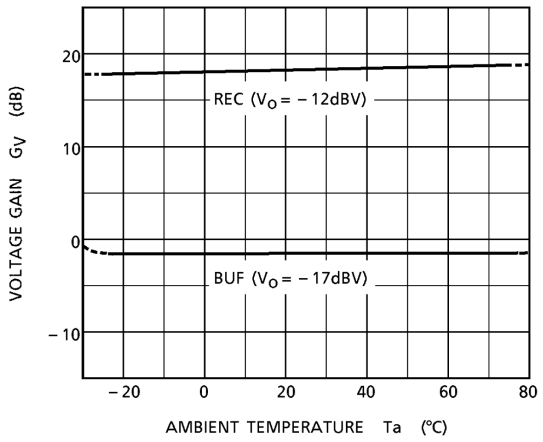
V_O – Ta



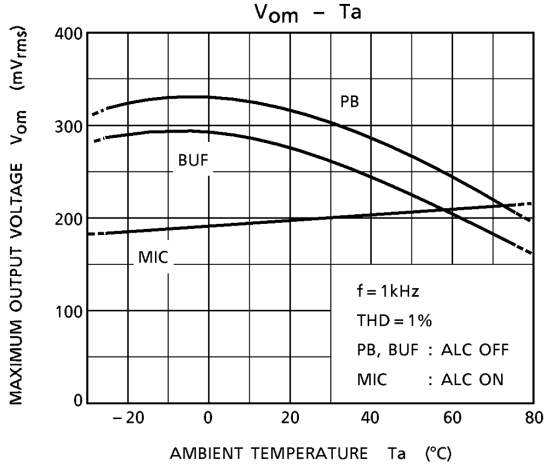
G_V – Ta



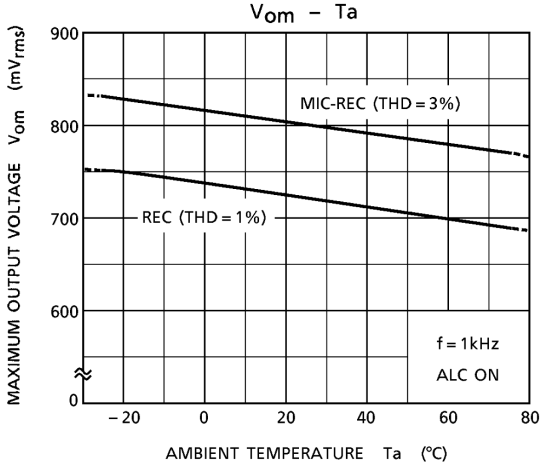
G_V – Ta



V_{om} – Ta

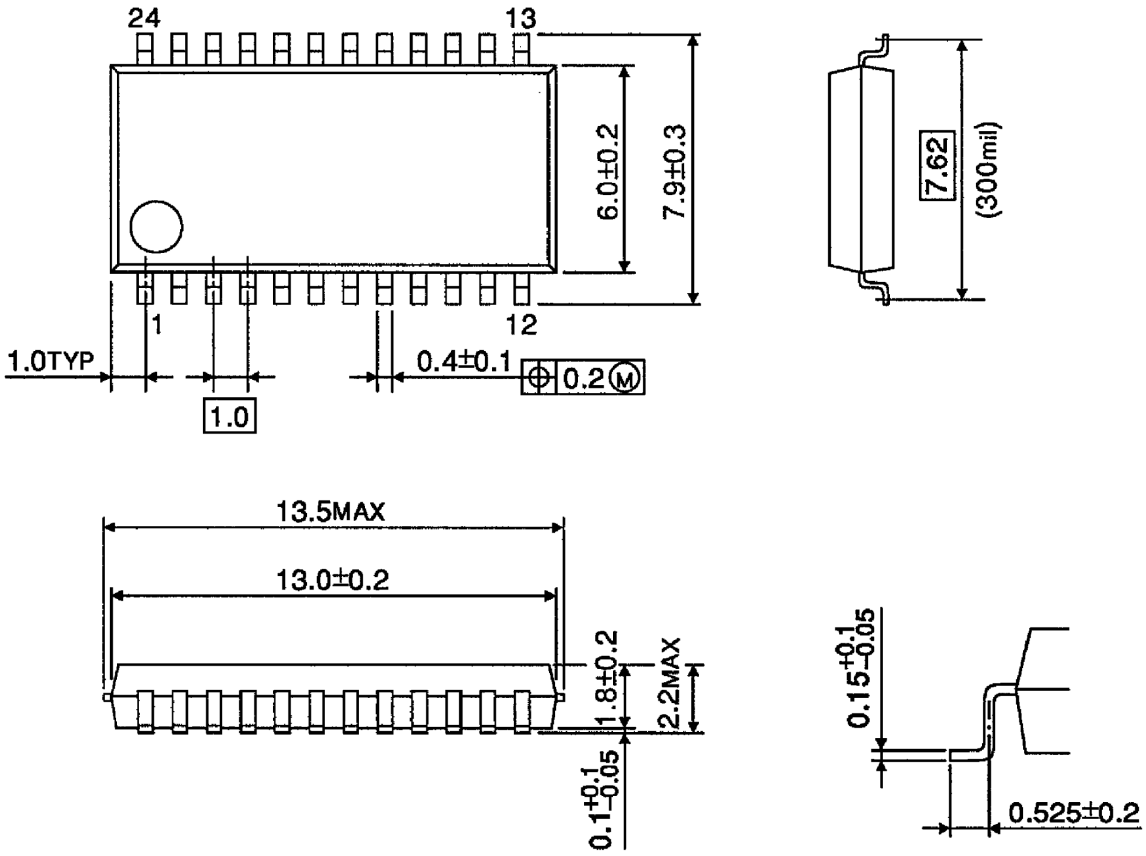


V_{om} – Ta



Package Dimensions

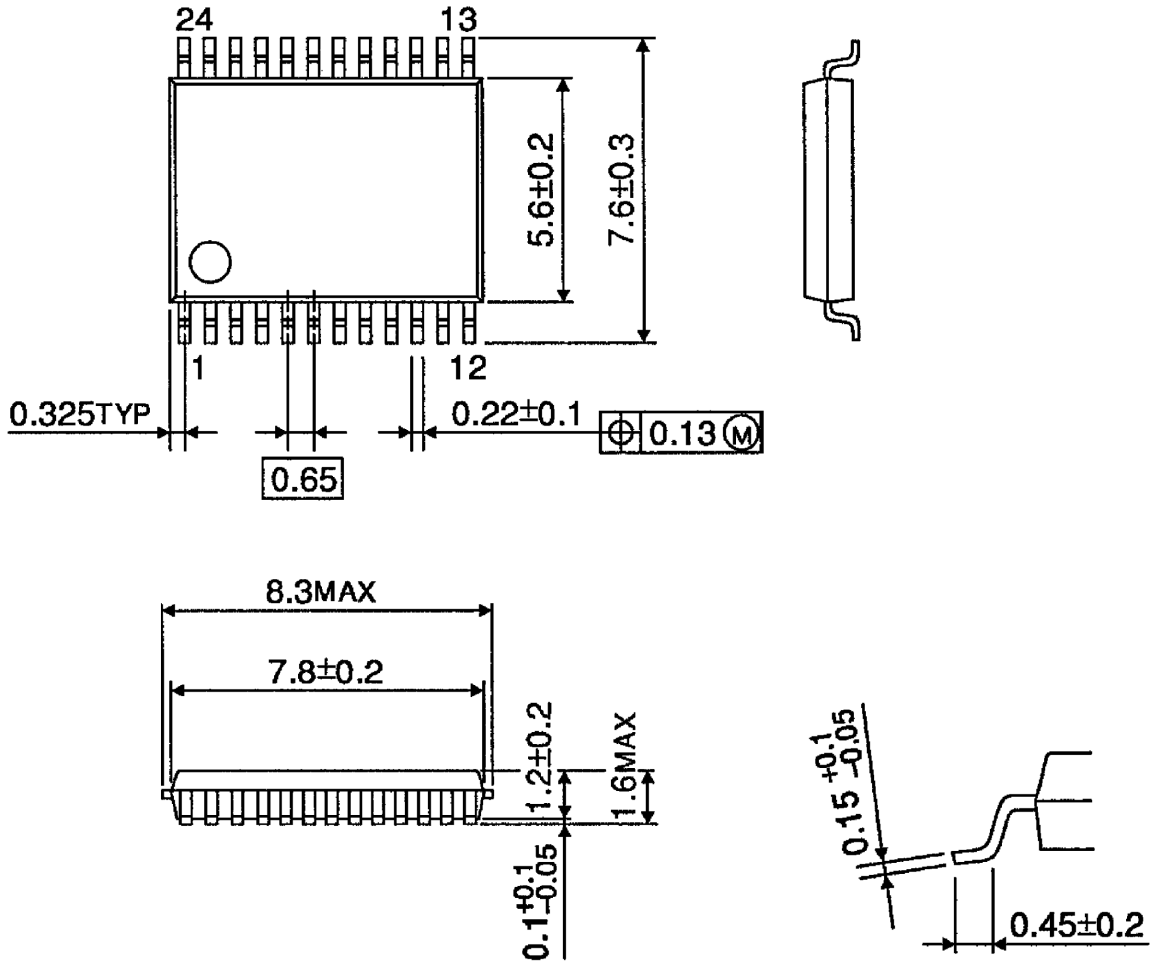
SSOP24-P-300-1.00 Unit : mm



Weight: 0.32g (typ.)

Package Dimensions

SSOP24-P-300-0.65A Unit : mm



Weight: 0.14g (typ.)

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060116EBA

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About solderability, following conditions were confirmed

- Solderability

  (1) Use of Sn-37Pb solder Bath
  - solder bath temperature = 230°C
  - dipping time = 5 seconds
  - the number of times = once
  - use of R-type flux

  (2) Use of Sn-3.0Ag-0.5Cu solder Bath
  - solder bath temperature = 245°C
  - dipping time = 5 seconds
  - the number of times = once
  - use of R-type flux