TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT

TA31101P, TA31101F
TA31101AP, TA31101AF

SILICON MONOLITHIC

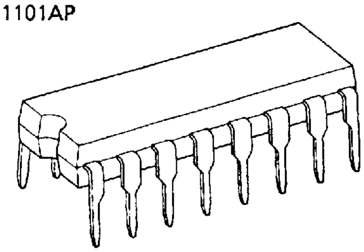
COMPANDER IC FOR CORDLESS TELEPHONE

FEATURES

- Low operating supply voltage and small consumption current make this IC suitable for its application to the sets using the battery such as the codeless telephone set. etc.
  $V_{CC\,(MIN)} = 1.8V$ (Ta = 25°C)
  $I_{CCQ} = 2.7mA$ (Typ.) ($V_{CC} = 3V$, Ta = 25°C)
- For noise reduction, compressor and expander are incorporated into a package.
- Wide operating supply voltage range : $V_{CC} = 1.8\sim9V$
- Recommendable operating supply voltage : $V_{CC} = 3V$
- Difference between TA31101P, TA31101F and TA31101AP, TA31101AF

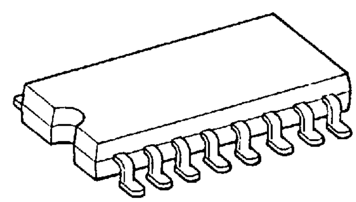
NAME OF PRODUCT	INPUT REFERENCE LEVEL (Typ.)
TA31101P, TA31101F	−18.5dBV
TA31101AP, TA31101AF	−20.0dBV

TA31101P
TA31101AP



DIP16-P-300A

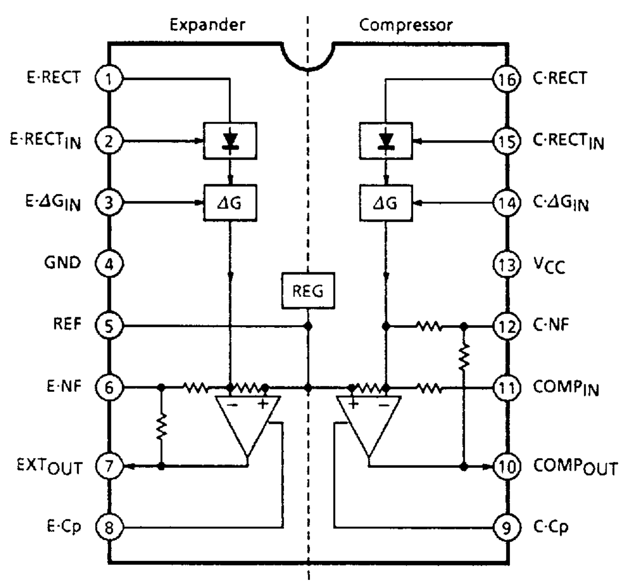
TA31101F
TA31101AF



SSOP16-P-225

Weight DIP16-P-300A : 1.1g (Typ.)
SSOP16-P-225 : 0.14g (Typ.)

BLOCK DIAGRAM



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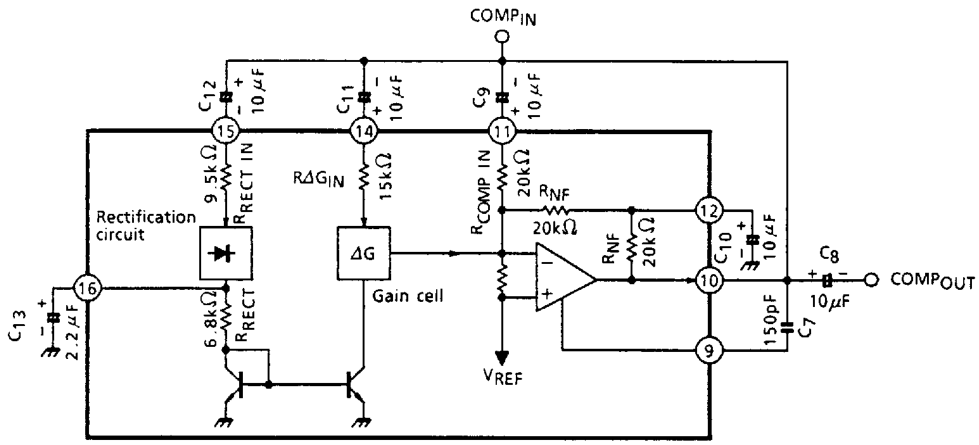
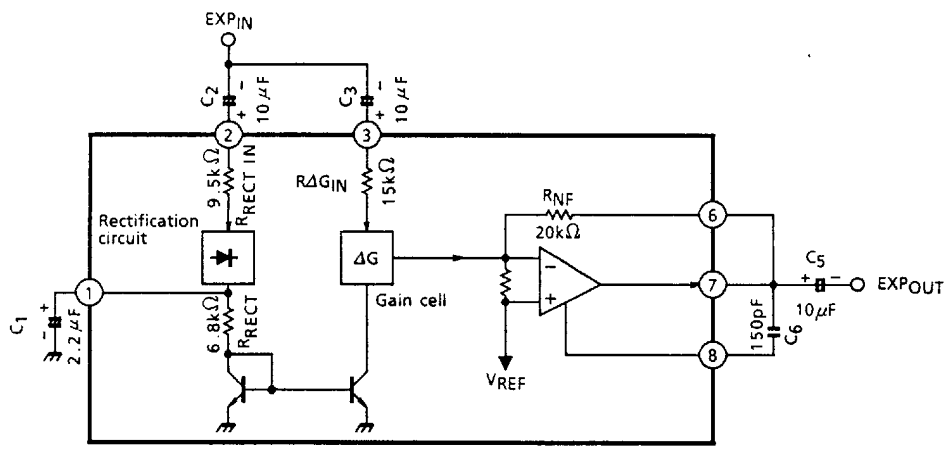
The compressor and the expander of this IC are individually composed of the rectification circuit, the gain cell and the operation amplification circuit as shown in the figure below.

Compressor



Expander



1. Rectification circuit

   In this circuit, the feedback-type full-wave rectification circuit is applied for improving the precision of detection, and the response characteristics (attack time, recovery time) are determined by the time constant of the smoothing capacitor of the rectifying output current connected to the E·RECT terminal and the C·RECT terminal (pin 1, pin 16) and by the time constant of the internal resistance of IC.

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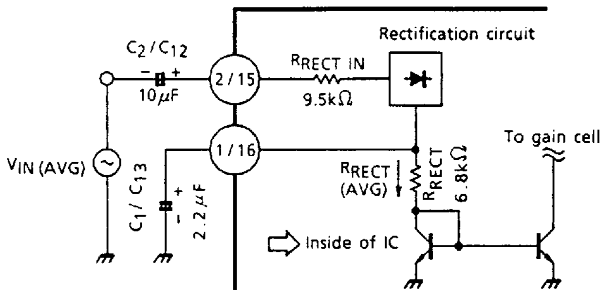
- The internal resistance of E·RECT terminal and C·RECT terminal (pin 1, pin 16) becomes the series resistance of the R·RECT 6.8Ω and the emitter resistance re in the current miller circuit. The emitter resistance re of transistor varies according to the signal level as shown below.



$$3 \cdot \frac{V_{IN\,(AVG)}}{R_{RECT\ IN}} = I_{RECT\,(AVG)}$$

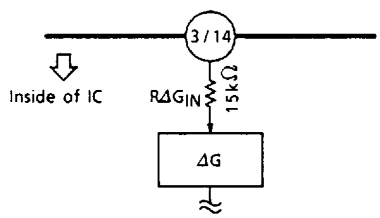
$$re = \frac{V_T}{I_{RECT\,(AVG)}}\ (\Omega)$$

$V_{IN\,(AVG)}$: Mean input signal voltage
$I_{RECT\,(AVG)}$: Mean rectification output
re : Emitter resistance
V_T : Approx. 26mV (At room temperature)

- The input resistance of the input E·RECT$_{IN}$ terminal and C·RECT$_{IN}$ terminal (pin 2, pin 15) of the rectification circuit is approximately 9.5kΩ.

2. Gain cell (ΔG)

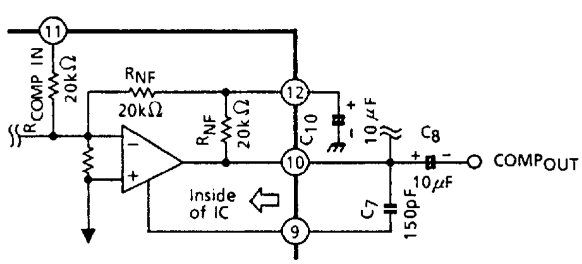
This circuit is a variable gain amplifier for controlling the gain with the rectification output current of the rectification circuit.
The input resistance of the input E·ΔG$_{IN}$ terminal and C·ΔG$_{IN}$ terminal of the gain cell (pin 3, pin 14) is approximately 15kΩ.



3. Operation amplification circuit

In the compressor, since the variable gain amplifier is involved in the feedback loop of the operation amplification circuit, the oscillation is liable to be generated, however, in this circuit, since the C·Cp terminal (pin 9) for phase compensation is provided, the countermeasure can be taken against the oscillation through the external capacitor.
In the compressor, for making the current gain maximum, the capacitor for decoupling the current signal is connected to the C·NF terminal (pin 12).
The cut-off frequency of the compressor is determined by the product of the capacitor C_{10} connected to the C·NF terminal multiplied by R_{NF} 20kΩ of the internal resistance.
The cut-off frequency is obtained by the expression below.

$$f_C = \frac{1}{2\pi \cdot C_{10} \cdot R_{NF}}$$



MAXIMUM RATINGS ($Ta = 25°C$)

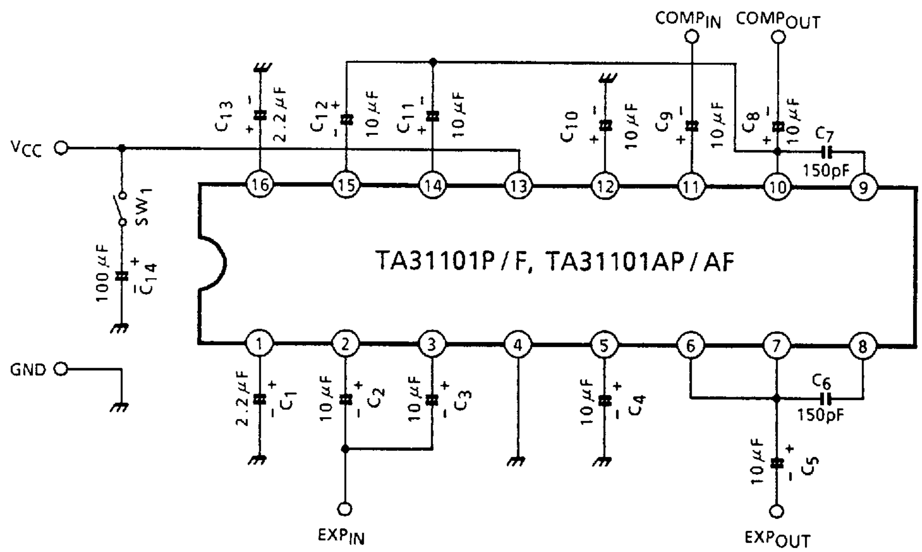
CHARACTERISTIC		SYMBOL	RATING	UNIT
Supply Voltage		V_{CC}	10	V
Power Dissipation	P type	P_D	1000	mW
	F type		370	
Operating Temperature		T_{opr}	−25~75	°C
Storage Temperature		T_{stg}	−55~150	°C

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, $V_{CC} = 3V$, $f = 1kHz$, $Ta = 25°C$, $0dB = -20dBV$)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage		V_{CC}	—	—	1.8	3.0	9.0	V
Quiescent Current		I_{CCQ}	1	$V_{CC} = 3.0V$	—	2.7	5.0	mA
Input Reference Level	TA31101P TA31101F	V_{REF}	2	$V_{IN} = V_{OUT}$	−20.0	−18.5	−17.0	dBV
	TA31101AP TA31101AF				−21.5	−20.0	−18.5	
Total Harmonic Distortion	COMP	THD_C	3	$V_{IN} = 0dB$	—	−55	−46	dB
	EXP	THD_E			—	−55	−46	
Output Noise Voltage	COMP	V_{NOC}	4	$V_{IN} = -\infty$, $f = 15Hz \sim 20kHz$	—	0.5	—	mV_{rms}
	EXP	V_{NOE}			—	15	—	μV_{rms}
Cross Talk	C→E	CT (C→E)	5	$V_{IN} = 0dBV$	—	−95	—	dBV
	E→C	CT (E→C)	6	$V_{IN} = -12dBV$	—	−55	—	
Ripple Rejection Ratio	COMP	RR_C	7	$V_R = 100mV_{rms}$, $f = 1kHz$	—	−30	—	dB
	EXP	RR_E			—	−60	—	
Maximum Output Voltage (EXP)		V_{OM}	8	$R_L = 10k\Omega$	—	800	—	mV_{rms}
Output Deviation (Note 1)	COMP	V_{OC1}	9	$V_{IN} = 20dB$	−0.4	0.1	0.6	dB
		V_{OC2}		$V_{IN} = -20dB$	−0.5	0	0.5	
		V_{OC3}		$V_{IN} = -40dB$	−0.6	−0.1	0.4	
	EXP	V_{OE1}	9	$V_{IN} = 6.5dB$	−1.1	−0.1	0.9	
		V_{OE2}		$V_{IN} = -10dB$	−0.9	0.1	1.1	
		V_{OE3}		$V_{IN} = -25dB$	−1.0	0	1.0	
Frequency Characteristic	COMP	FR_C	10	$V_{IN} = 0dB$, $f = 200 \sim 3500Hz$ and $f = 1kHz$ are references.	—	±0.1	—	dB
	EXP	FR_E			—	±0.1	—	

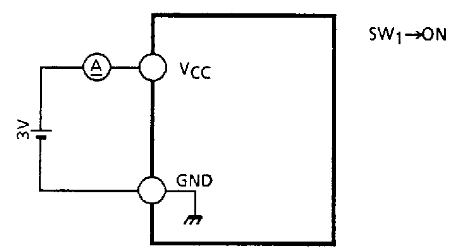
Note 1 : Output deviation $= (V_{OUT} - V_{REF}) - V_{IN} \times \alpha\beta$
$\alpha\beta$: (COMP = 0.5, EXP = 2)

TEST CIRCUIT

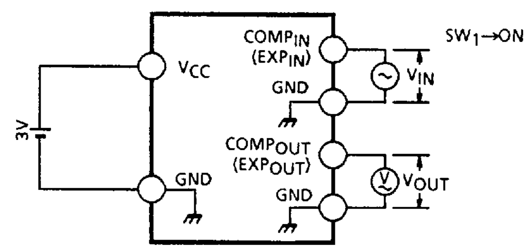


TEST CIRCUIT

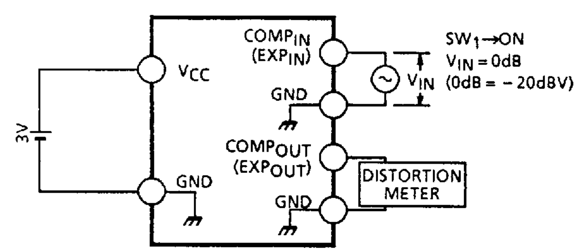
(1) I_{CCQ}



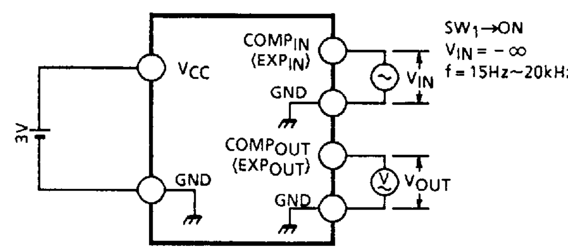
(2) V_{REF}



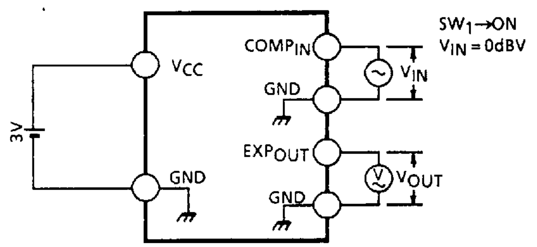
(3) THD_C, THD_E



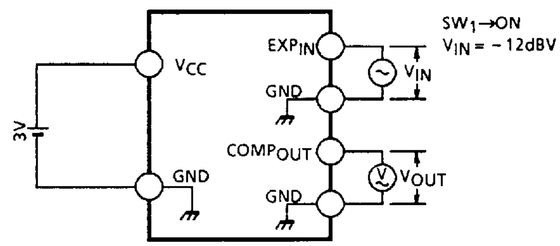
(4) V_{NOC}, V_{NOE}



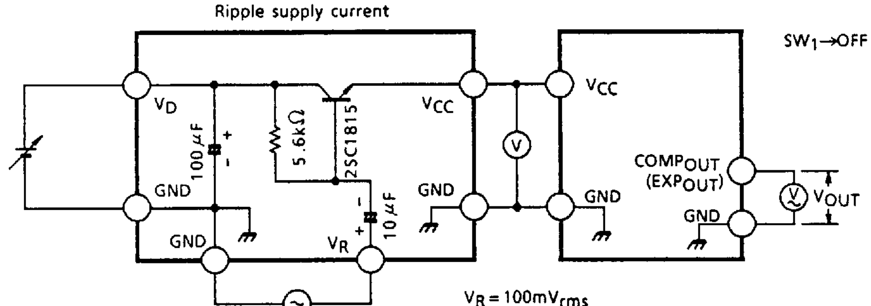
(5) CT (C→E)



(6) CT (E→C)

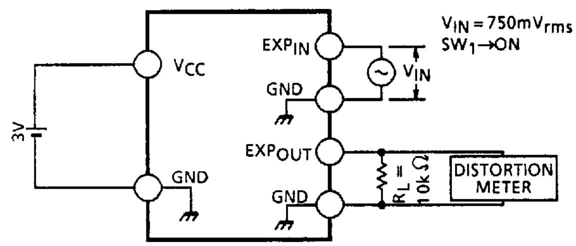


(7) RRC, RRE

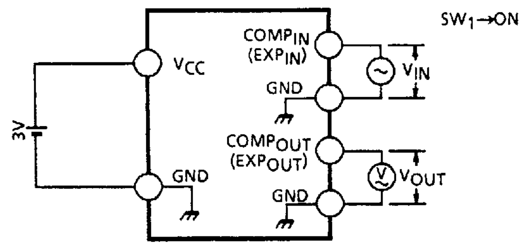


Setting is made so as to make V_{CC} become 3V.

(8) VOM



(9) VOC1, 2, 3, VOE1, 2, 3



Note : OUTPUT DEVIATION

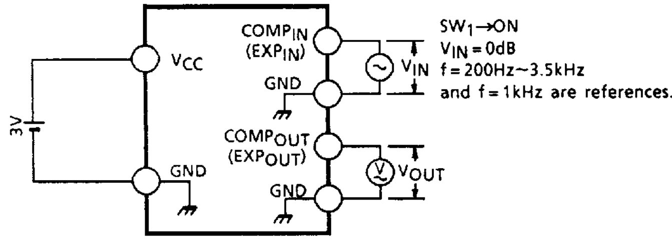
$= (V_{OUT} - V_{REF}) - V_{IN} \times \alpha\beta$

$\alpha\beta$: (COMP = 0.5, EXP = 2)

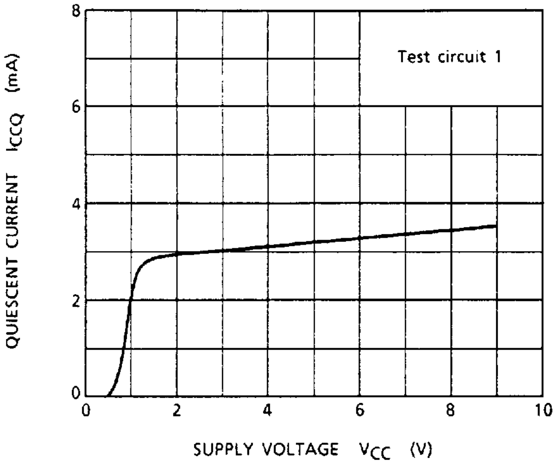
(0dB = −20dBV)

V_{OC1} → V_{IN} = +20dB	V_{OE1} → V_{IN} = +6.5dB
V_{OC2} → V_{IN} = −20dB	V_{OE2} → V_{IN} = −10dB
V_{OC3} → V_{IN} = −40dB	V_{OE3} → V_{IN} = −25dB

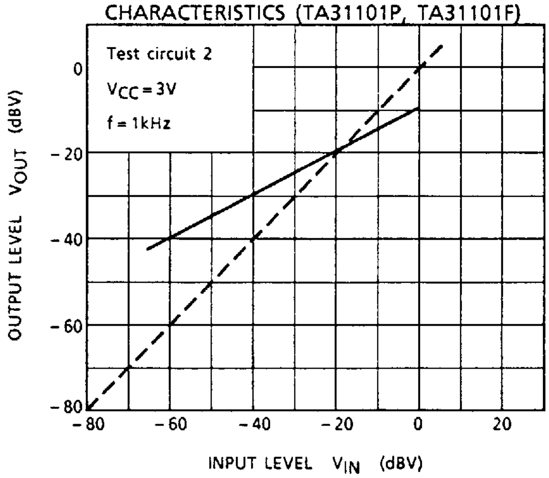
(10) FRC, FRE



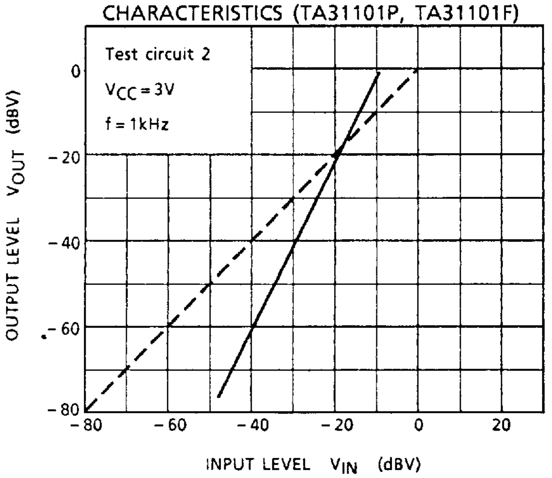
QUIESCENT CURRENT – SUPPLY VOLTAGE



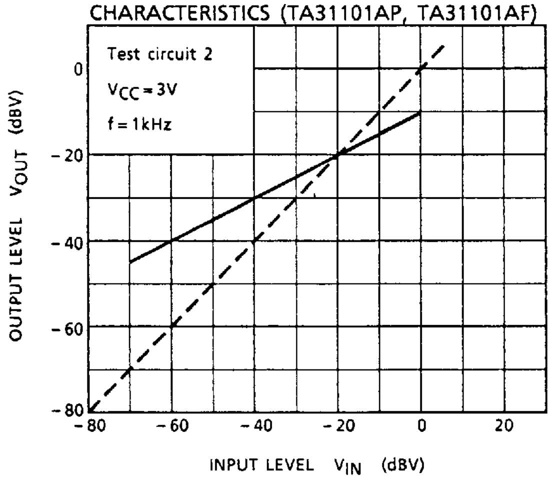
COMPRESSOR INPUT / OUTPUT CHARACTERISTICS (TA31101P, TA31101F)



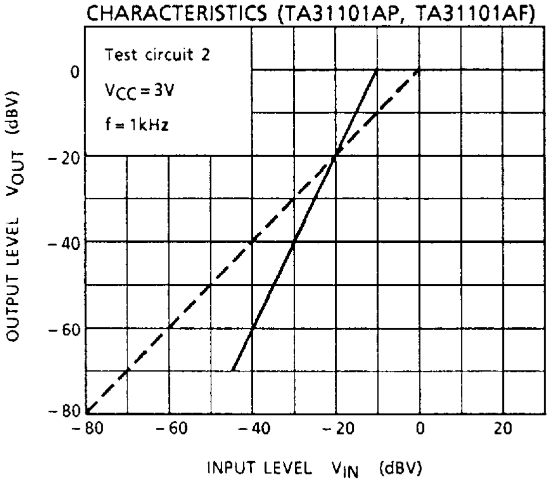
EXPANDER INPUT / OUTPUT CHARACTERISTICS (TA31101P, TA31101F)



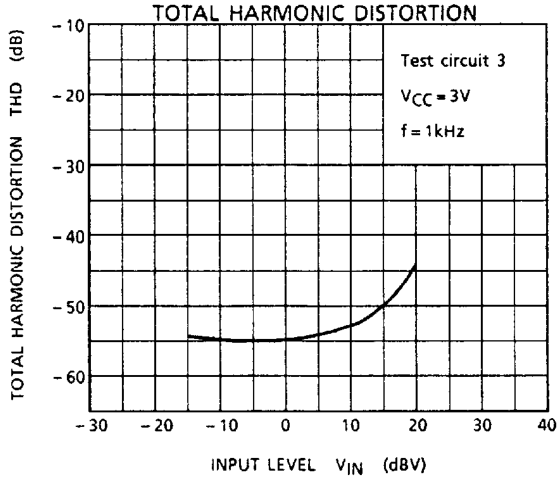
COMPRESSOR INPUT / OUTPUT CHARACTERISTICS (TA31101AP, TA31101AF)



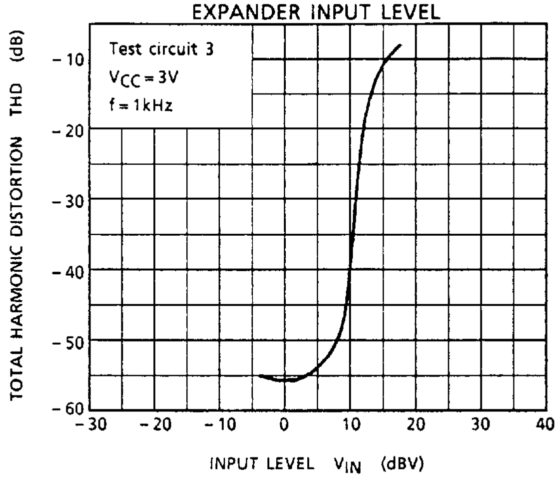
EXPANDER INPUT / OUTPUT CHARACTERISTICS (TA31101AP, TA31101AF)



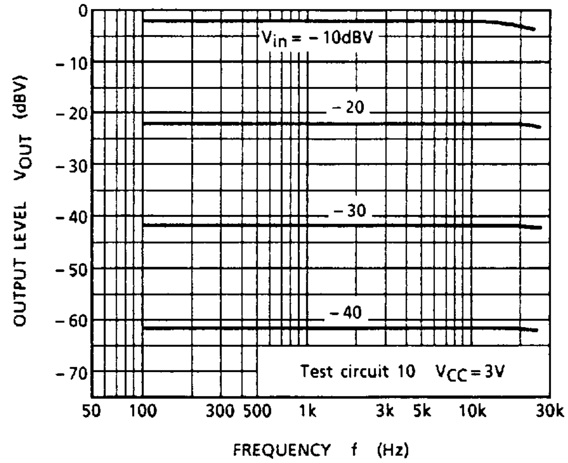
COMPRESSOR INPUT LEVEL – TOTAL HARMONIC DISTORTION



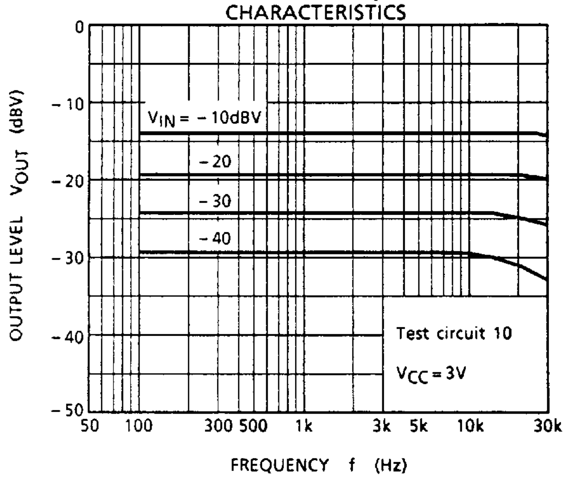
TOTAL HARMONIC DISTORTION – EXPANDER INPUT LEVEL



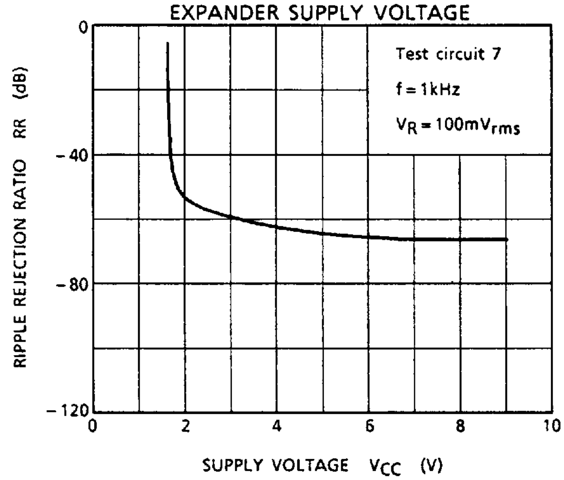
EXPANDER FREQUENCY CHARACTERISTICS



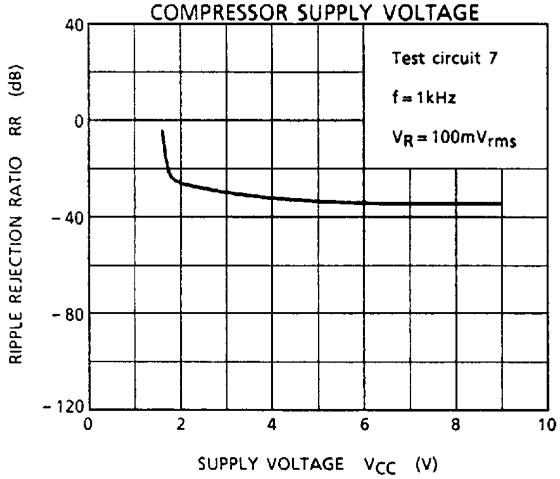
COMPRESSOR FREQUENCY CHARACTERISTICS



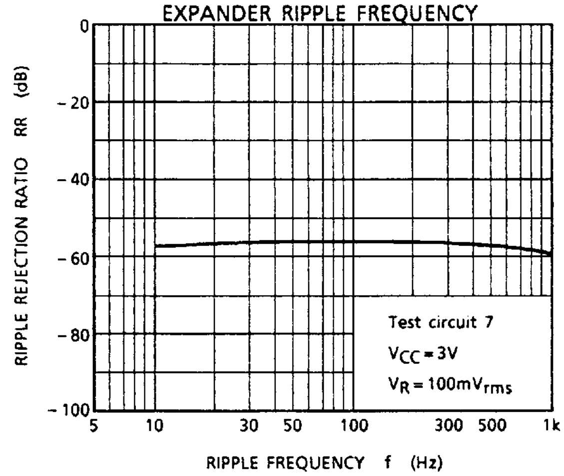
RIPPLE REJECTION RATIO – EXPANDER SUPPLY VOLTAGE

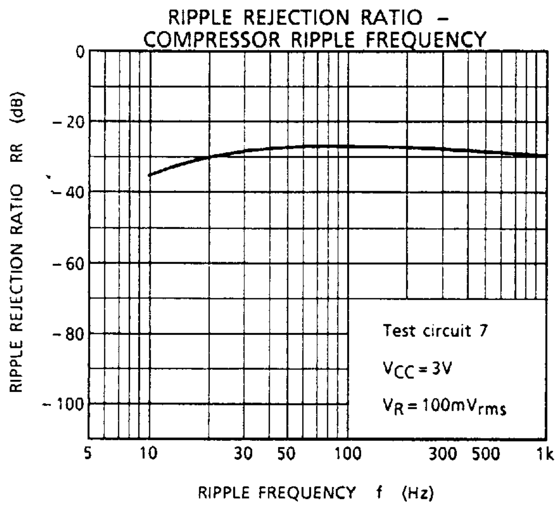


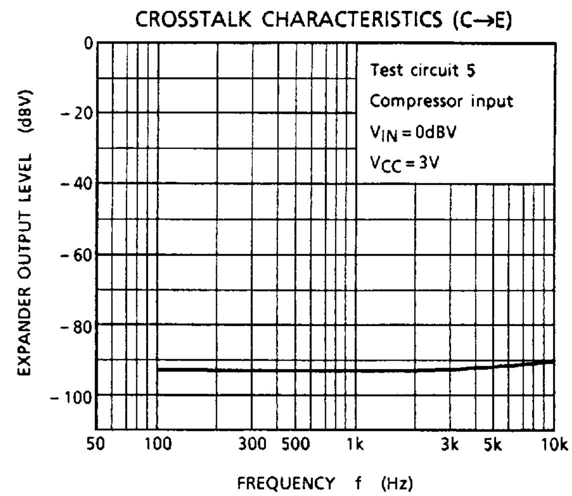
RIPPLE REJECTION RATIO – COMPRESSOR SUPPLY VOLTAGE

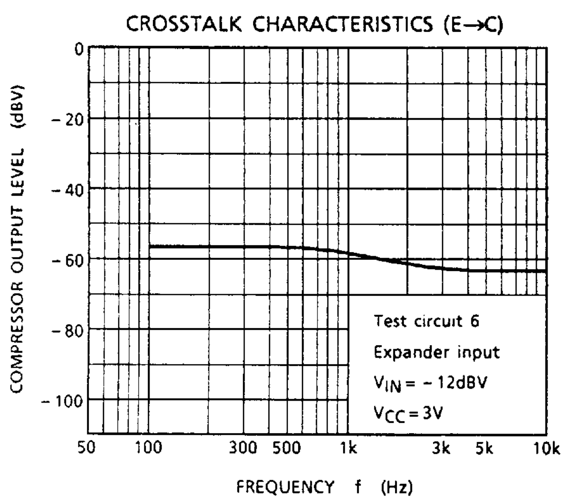


RIPPLE REJECTION RATIO – EXPANDER RIPPLE FREQUENCY

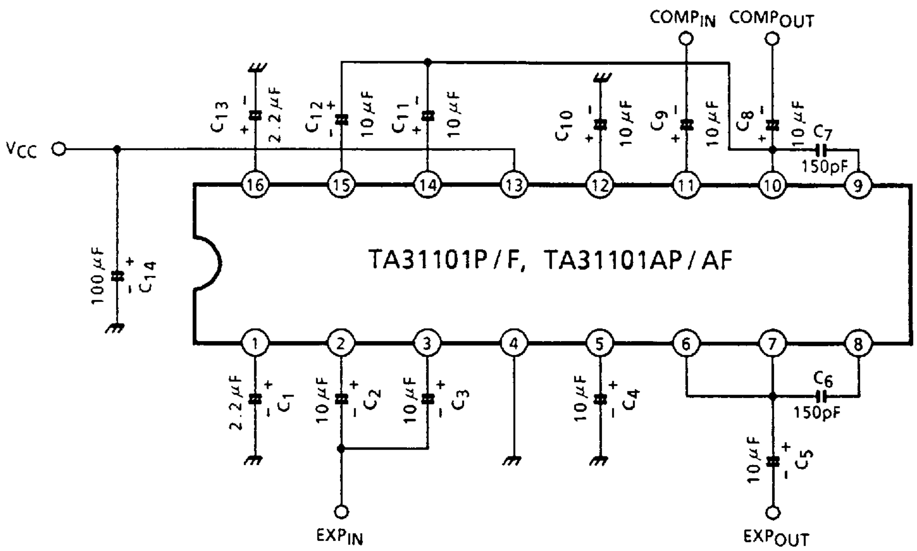



RIPPLE REJECTION RATIO – COMPRESSOR RIPPLE FREQUENCY
RIPPLE REJECTION RATIO RR (dB)
0
–20
–40
–60
–80
–100
Test circuit 7
V_{CC} = 3V
V_R = 100mV_{rms}
5
10
30
50
100
300
500
1k
RIPPLE FREQUENCY f (Hz)


CROSSTALK CHARACTERISTICS (C→E)
EXPANDER OUTPUT LEVEL (dBV)
0
–20
–40
–60
–80
–100
Test circuit 5
Compressor input
V_{IN} = 0dBV
V_{CC} = 3V
50
100
300
500
1k
3k
5k
10k
FREQUENCY f (Hz)


CROSSTALK CHARACTERISTICS (E→C)
COMPRESSOR OUTPUT LEVEL (dBV)
0
–20
–40
–60
–80
–100
Test circuit 6
Expander input
V_{IN} = –12dBV
V_{CC} = 3V
50
100
300
500
1k
3k
5k
10k
FREQUENCY f (Hz)

APPLICATION CIRCUIT



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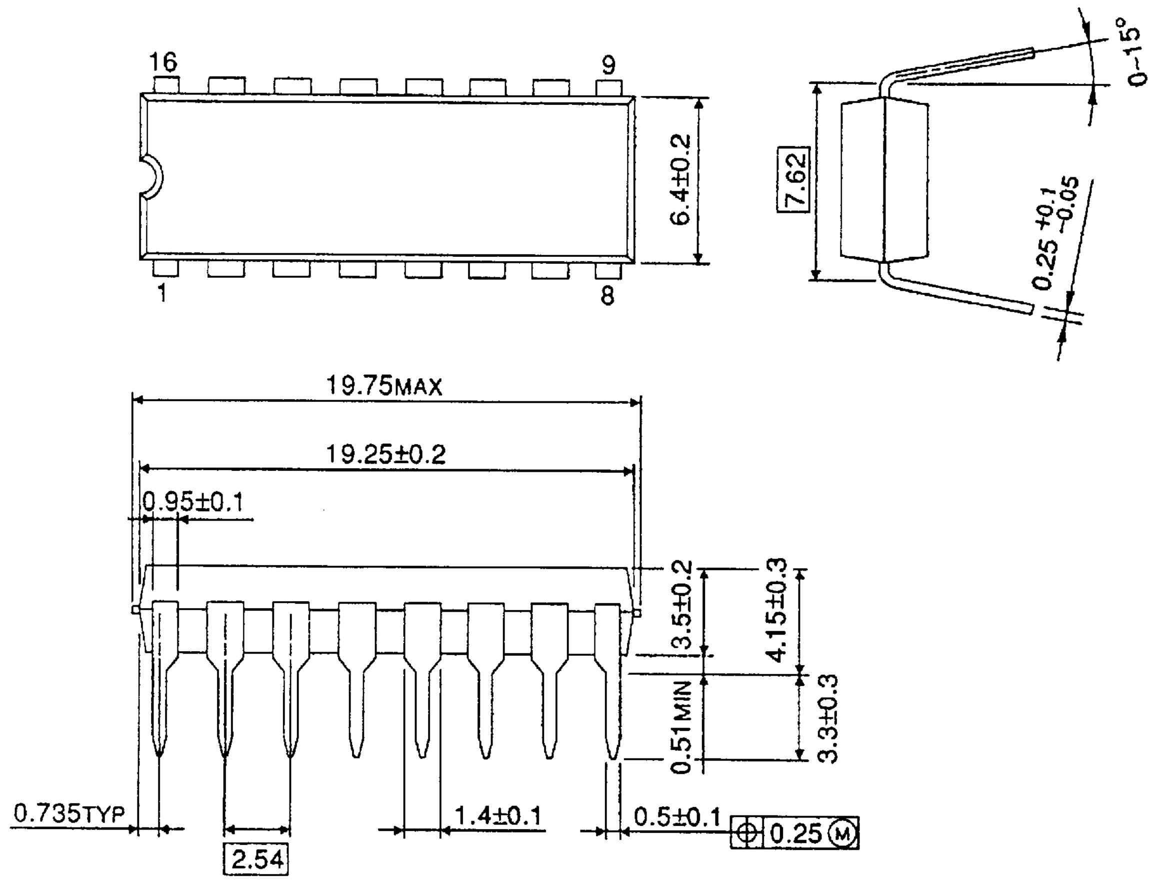
OUTLINE DRAWING
DIP16-P-300A

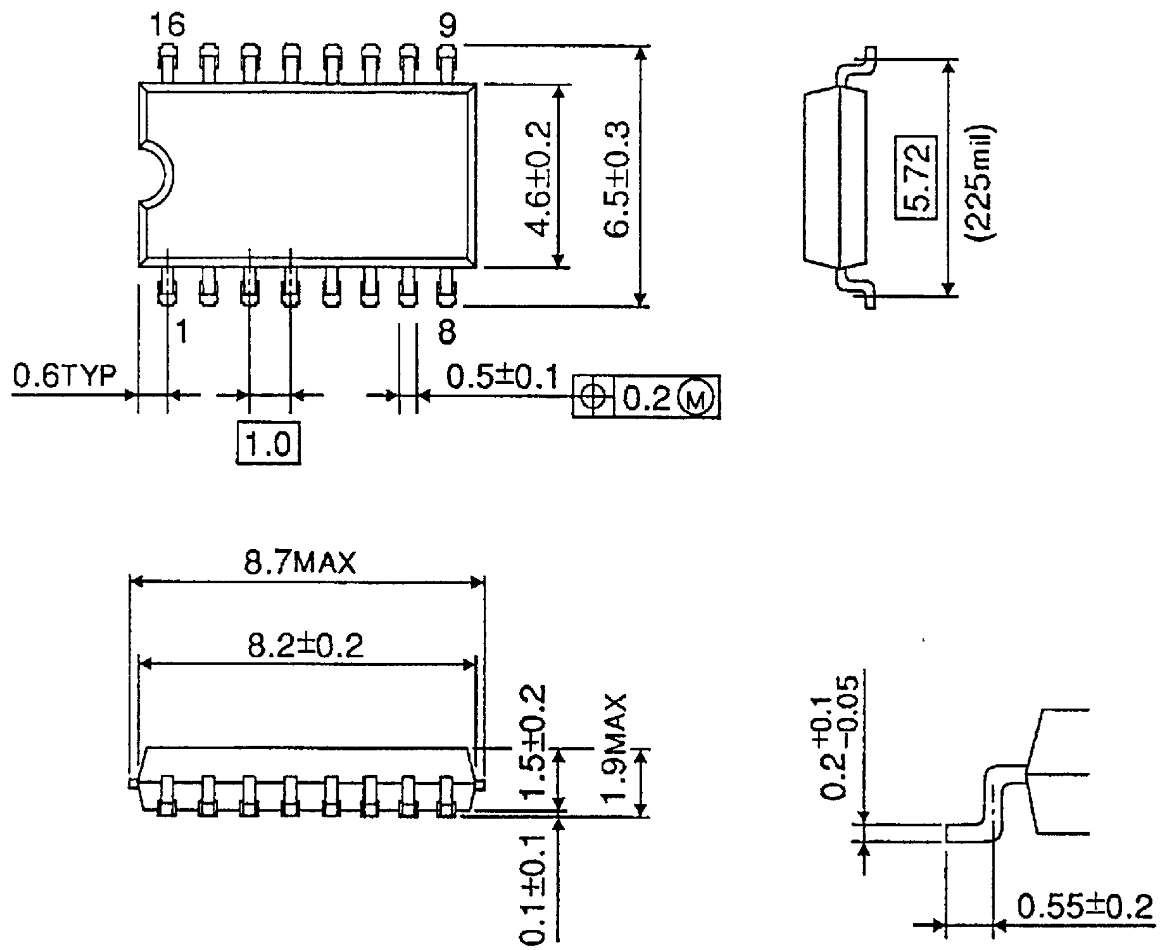
Unit : mm



Weight : 1.1g (Typ.)

OUTLINE DRAWING
SSOP16-P-225

Unit : mm



Weight : 0.14g (Typ.)

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