Dual Operational Amplifier

FEATURES (V^+/V^-=±2.5V, typical value)

●Low Noise	6.5n/√Hz
●High Slew Rate	4V/μs
●Wide Bandwidth	12MHz
●Low Distortion	0.002%
●Supply Voltage	
Dual Supply	±1.1V to ±3.5V
Single Supply	2.2V to 7V
●Low Saturation (R_L=2.5kΩ)	±2.2V typ.
●Operating Temperature	-40°C to 125°C
●Bipolar Technology	
●Package Outline	DMP8, SSOP8, MSOP8 (TVSP8)*

*meet JEDEC MO-187-DA / thin type

DESCRIPTION

The NJM2740 is a dual low saturation output operational amplifier featuring low noise of 6.5nV/√Hz.

It can be used both single supply and dual supply, by using proper bias voltage.

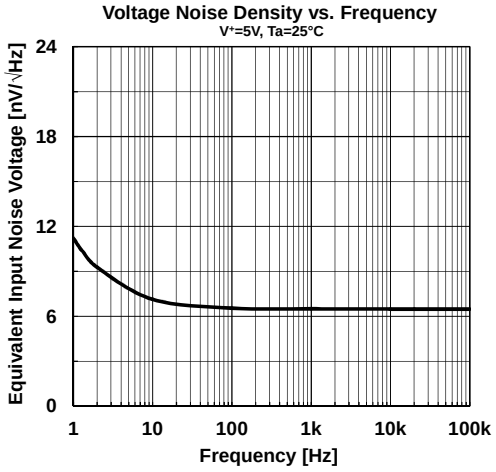
Low operating voltage single 2.2V to 7V or dual ±1.1V to ±3.5V and low saturation output performance makes NJM2740 suitable for Battery-powered instruments, portable audio devices that require a low voltage and low saturation output.

The NJM2740 is available in 8-pin DMP, SSOP and MSOP(TVSP): meet JEDEC MO-187-DA / thin type package.

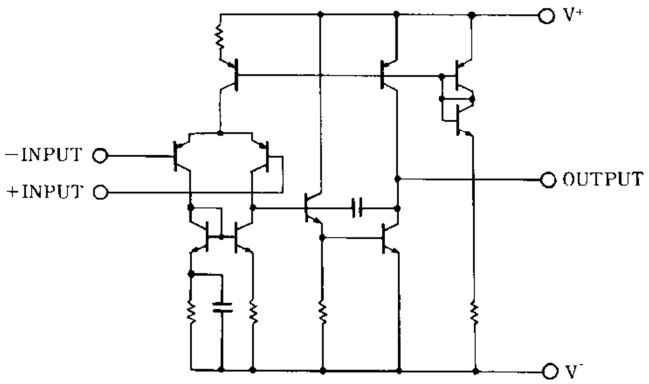
APPLICATIONS

●Portable Audio
●PC Audio
●AD/DA Converter Buffer
●Active Filter

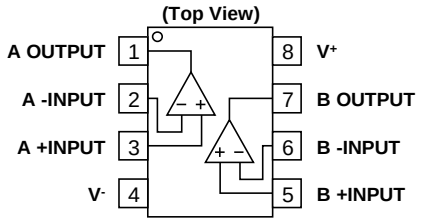
TYPICAL CHARACTERISTICS



EQUIVALENT CIRCUIT



■ PIN CONFIGURATION

Pin Function			
			
Package	DMP8	SSOP8	MSOP8(TVSP8)
Product Name	**NJM2740M**	**NJM2740V**	**NJM2740RB1**

■ PRODUCT NAME INFORMATION

NJM2740 RB1 (TE1)

Part Number Package Taping Form

■ ORDER INFORMATION

Part Number	Package Outline	RoHS	Halogen-Free	Terminal Finish	Marking	Weight (mg)	MOQ (pcs)
NJM2740M	DMP8	○	○	Sn2Bi	2740	95	2000
NJM2740V	SSOP8	○	○	Sn2Bi	2740	42	2000
NJM2740RB1	MSOP8(TVSP8)	○	○	Sn2Bi	2740	18	2000

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V^+/V^-	±4	V
Input Voltage(1)	V_{IN}	±4	V
Differential Input Voltage(1)(2)	V_{ID}	±8	V
Input Current(3)	I_{IN}	1	mA
Power Dissipation(4) DMP8 SSOP8 MSOP8(TVSP8)	P_D	(2-Layer / 4-Layer) 470 / 600 410 / 510 510 / 680	mW
Storage Temperature Range	T_{stg}	-40 to +150	°C

(1) For supply voltage less than ±4V (8V), the absolute maximum rating is equal to the supply voltage.
(2) Differential voltage is the voltage difference between +INPUT and -INPUT.
(3) Input voltages outside the supply voltage will be clamped by ESD protection diodes. If the input voltage exceeds the supply voltage, the input current must be limited 1mA or less by using a restriction resistance.
(4) Power dissipation is the power that can be consumed by the IC at Ta=25°C, and is the typical measured value based on JEDEC condition.
2-layer: Mounted on glass epoxy board. (76.2×114.3×1.6mm: based on EIA/JDEC standard, 2Layers FR4)
4-layer: Mounted on glass epoxy board. (76.2×114.3×1.6mm: based on EIA/JDEC standard, 4Layers FR4), internal Cu area: 74.2 x 74.2mm

■ THERMAL CHARACTERISTICS

Package	SYMBOL	VALUE	UNIT
Junction-to-ambient thermal resistance	Θja	(2-layer / 4-Layer)	°C/W
DMP8		262 / 206	
SSOP8		288 / 230	
TVSP8		244 / 185	
Junction-to-top of package characterization parameter	Ψjt	(2-layer / 4-Layer)	°C/W
DMP8		72 / 65	
SSOP8		46 /45	
TVSP8		51 /45	

■ RECOMMENDED OPERATING CONDITIONS (Ta=25°C)

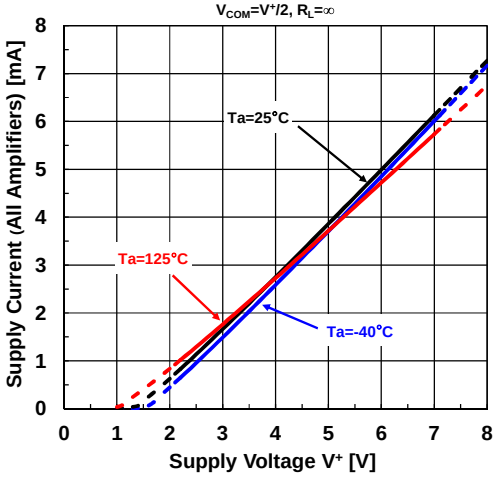
PARAMETER		SYMBOL	VALUE	UNIT
Supply Voltage	Dual Supply	V^+/V^-	±1.1 to ±3.5	V
	Single Supply	$V^+ - V^-$	2.2 to 7	V
Operating Temperature Range		T_{opr}	-40 to 125	°C

■ ELECTRICAL CHARACTERISTICS (V^+/V^-=±2.5V, Ta=25°C)

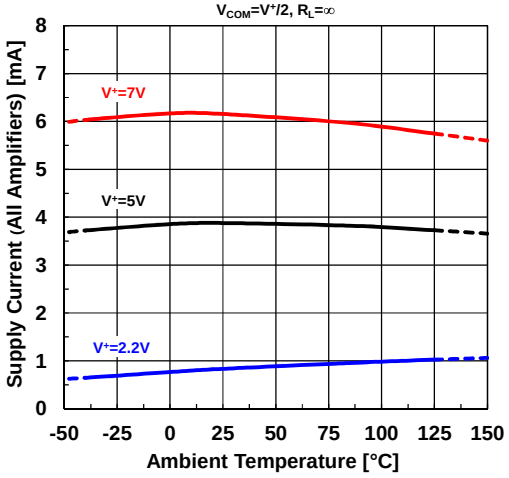
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC CHARACTERISTICS						
Input Offset Voltage	V_{IO}	R_S≤10kΩ	-	1	6	mV
Input Bias Current	I_B		-	100	300	nA
Input Offset Current	I_{IO}		-	5	100	nA
Open-Loop Voltage Gain	A_V	R_L≥10kΩ	60	80	-	dB
Common-Mode Rejection Ratio	CMR		60	74	-	dB
Common-Mode Input Voltage Range	V_{ICM}		-1.4 /+1.5	-	-	V
Maximum Output Voltage	V_{OM}	R_L≥2.5kΩ	±2	±2.2	-	V
Supply Current (All Amplifiers)	I_{SUPPLY}	No Signal, R_L=∞	-	3.5	5	mA
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±1.1V to ±3.5V	60	80	-	dB
AC CHARACTERISTICS						
Slew Rate	SR	A_V=1, V_{IN}=±1V	-	4	-	V/μs
Gain Bandwidth Product	GBW	f=10kHz	-	12	-	MHz
Total Harmonic Distortion + Noise	THD+N	f=1kHz, V_O=1Vrms	-	0.002	-	%
Equivalent Input Noise Voltage	e_n	f=1kHz	-	6.5	-	nV/√Hz

■ TYPICAL CHARACTERISTICS

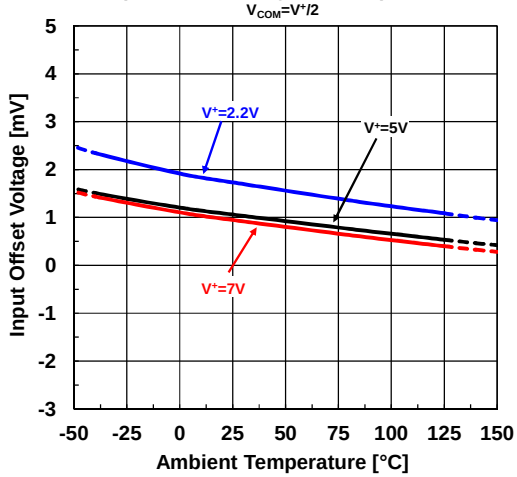
Supply Current (All Amplifiers) vs. Supply Voltage
$V_{COM}=V^+/2$, $R_L=\infty$



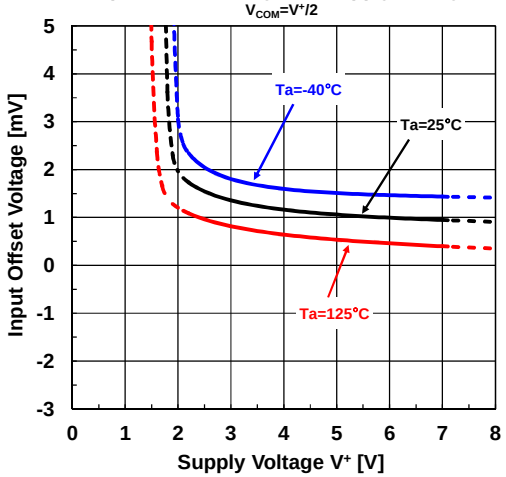
Supply Current (All Amplifiers) vs. Temperature
$V_{COM}=V^+/2$, $R_L=\infty$



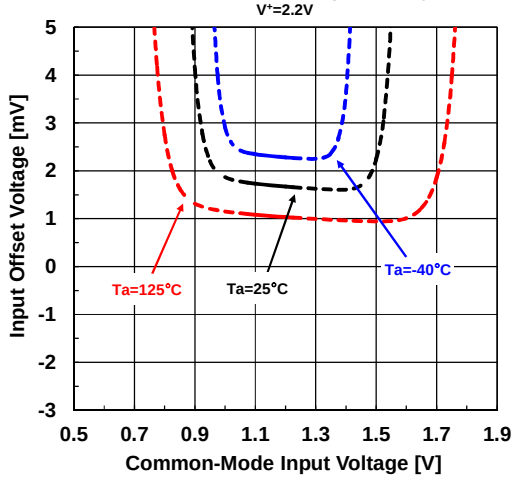
Input Offset Voltage vs. Temperature
$V_{COM}=V^+/2$



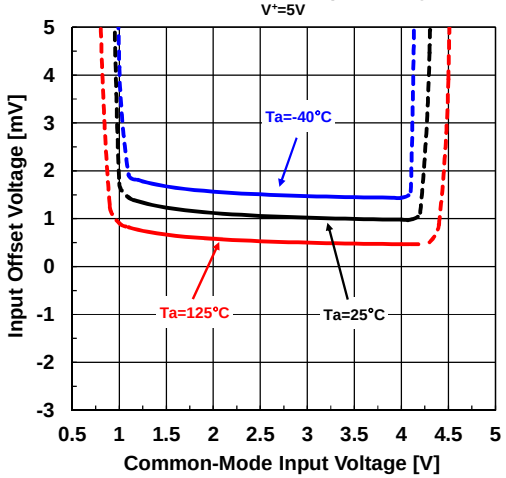
Input Offset Voltage vs. Supply Voltage
$V_{COM}=V^+/2$



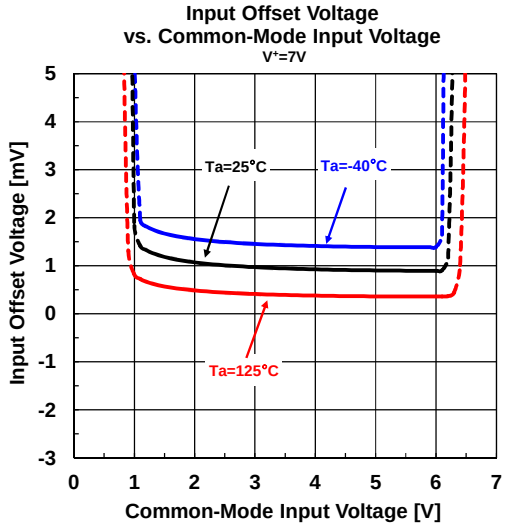
Input Offset Voltage vs. Common-Mode Input Voltage
$V^+=2.2V$

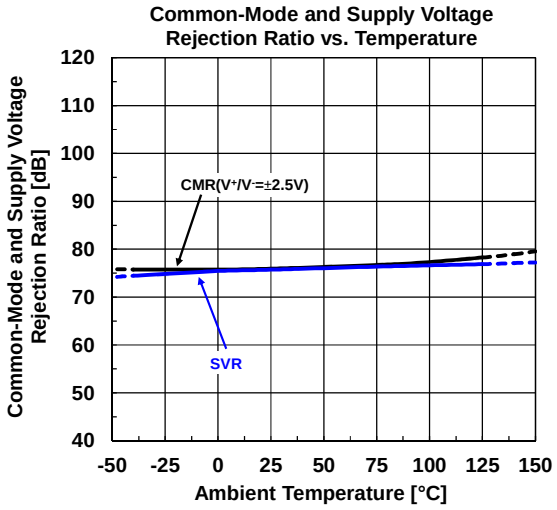


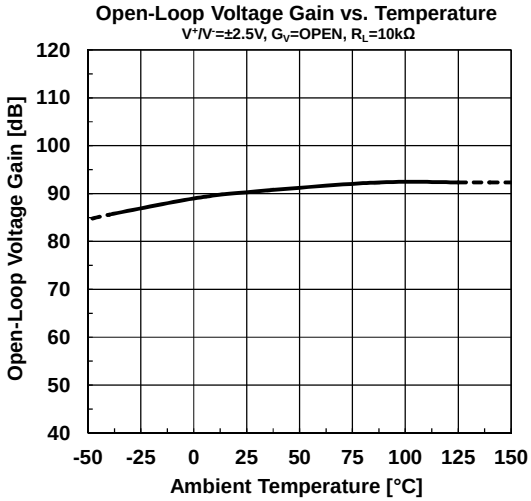
Input Offset Voltage vs. Common-Mode Input Voltage
$V^+=5V$

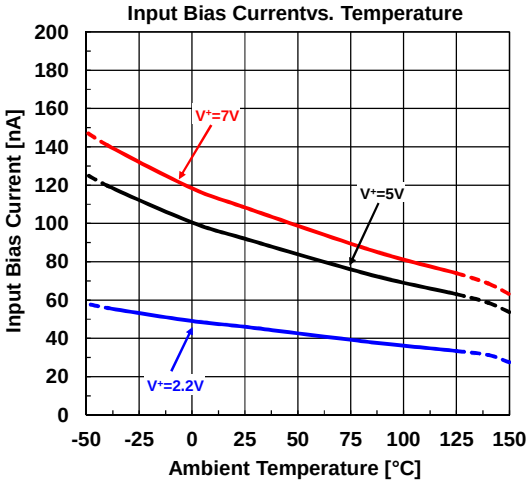


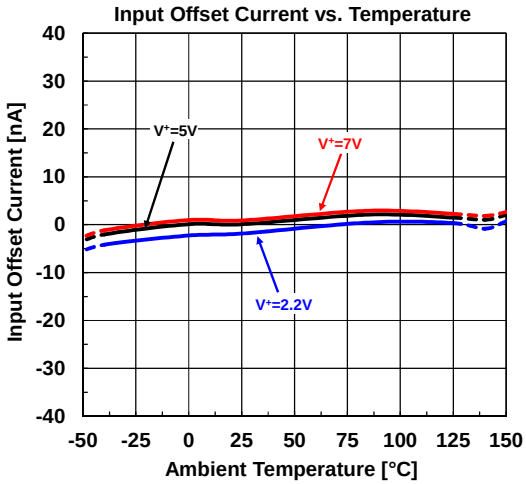
■ TYPICAL CHARACTERISTICS

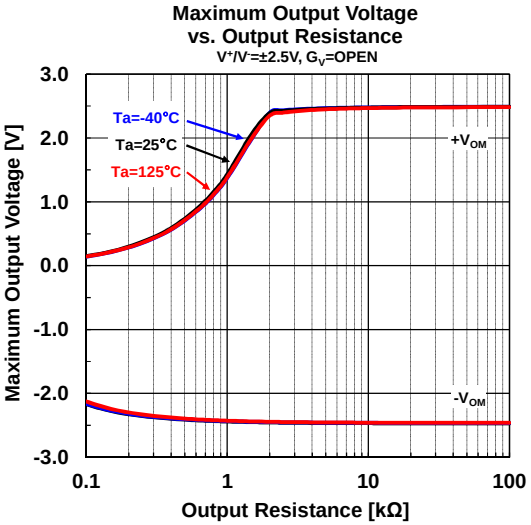






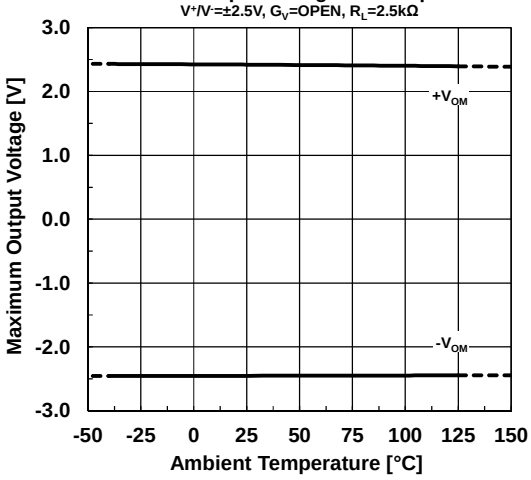




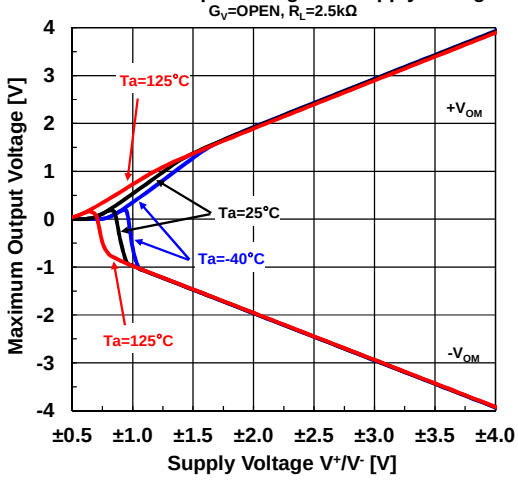


■ TYPICAL CHARACTERISTICS

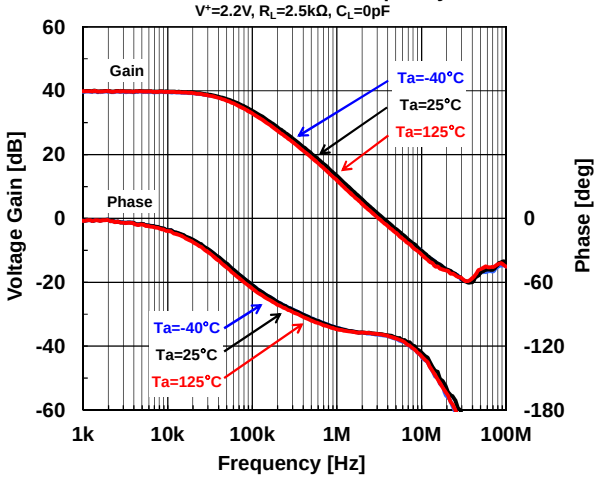
Maximum Output Voltage vs. Temperature
V⁺/V⁻=±2.5V, G_V=OPEN, R_L=2.5kΩ



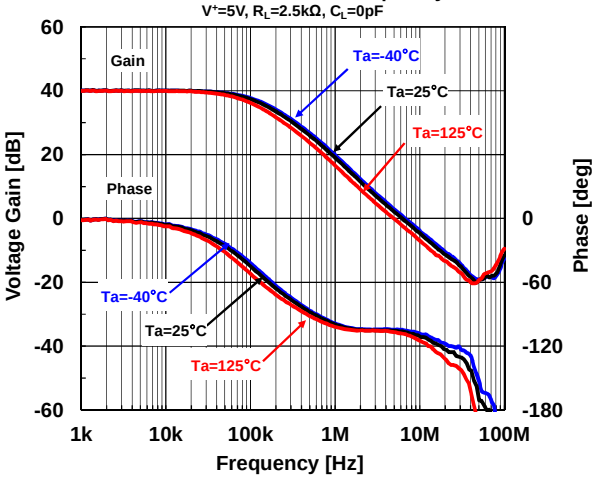
Maximum Output Voltage vs. Supply Voltage
G_V=OPEN, R_L=2.5kΩ



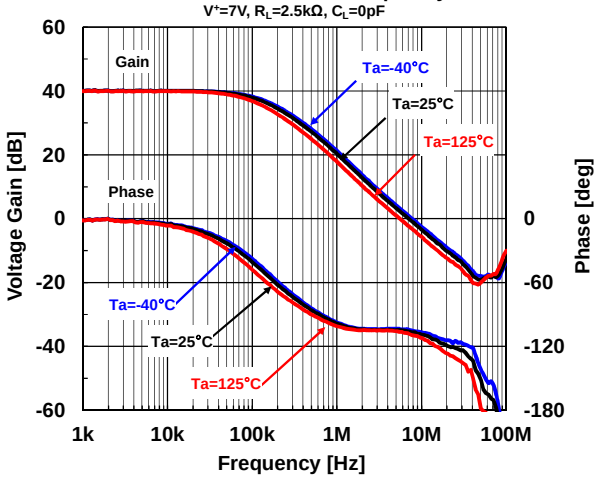
40dB Gain/Phase vs. Frequency
V⁺=2.2V, R_L=2.5kΩ, C_L=0pF



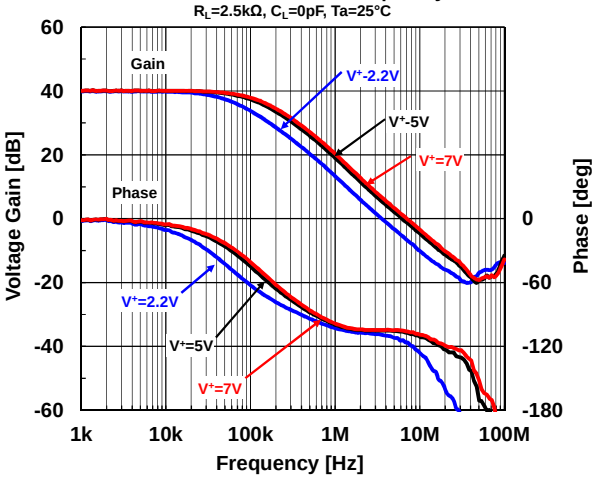
40dB Gain/Phase vs. Frequency
V⁺=5V, R_L=2.5kΩ, C_L=0pF



40dB Gain/Phase vs. Frequency
V⁺=7V, R_L=2.5kΩ, C_L=0pF

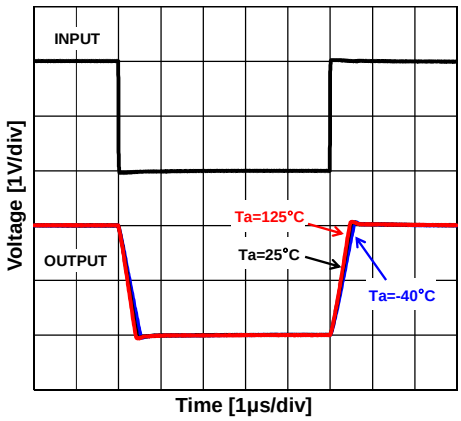


40dB Gain/Phase vs. Frequency
R_L=2.5kΩ, C_L=0pF, Ta=25°C

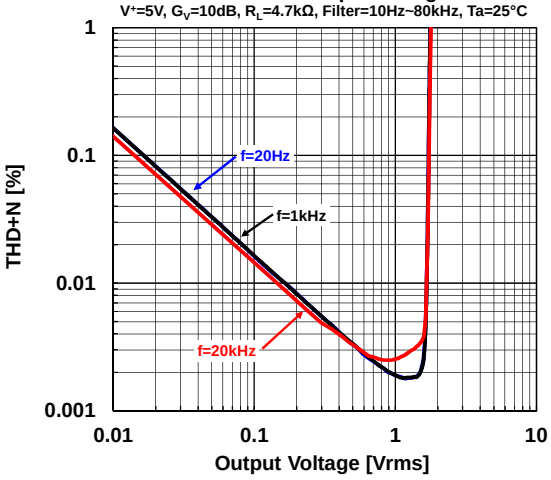


■ TYPICAL CHARACTERISTICS

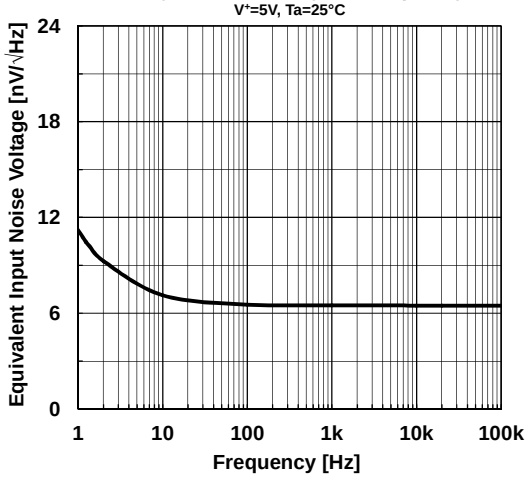
Pulse Response
V+/V-=±2.5V, Gain=0dB, f=100kHz, R_L=10kΩ, C_L=0pF



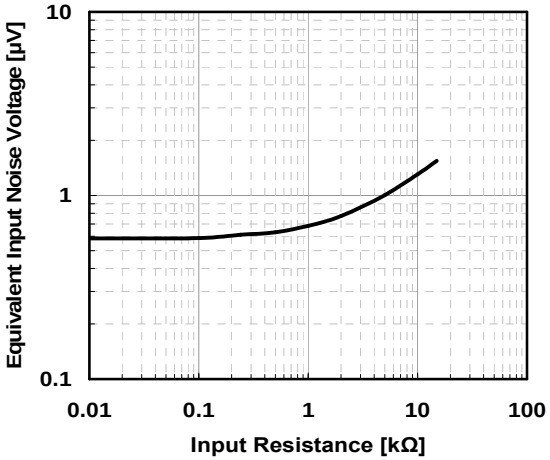
THD+N vs. Output Voltage
V+=5V, G_V=10dB, R_L=4.7kΩ, Filter=10Hz~80kHz, Ta=25°C



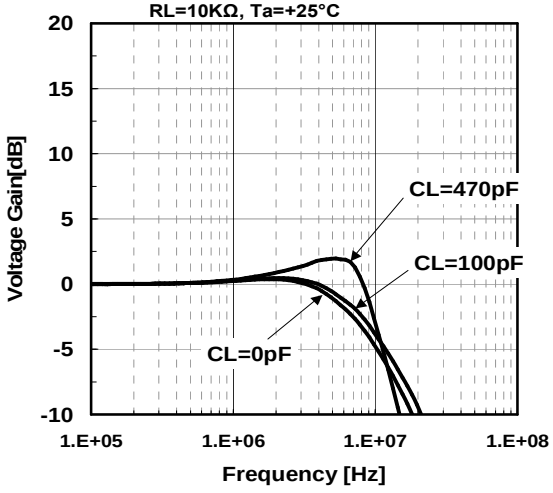
Voltage Noise Density vs. Frequency
V+=5V, Ta=25°C



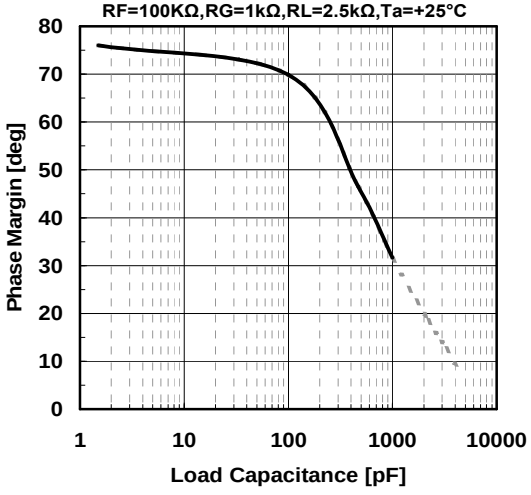
Equivalent Input Noise Voltage vs. Input Resistance
V+/V-=±3.0V ,RF=100kΩ,RG=100Ω,JIS A,Ta=25°C



Peak Gain of Voltege Follower
V+/V-=2.5V, GV=0dB,RS=50Ω,
RL=10KΩ, Ta=+25°C

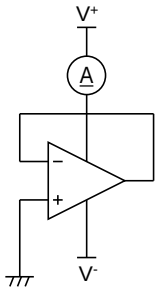


Phase Margin vs. Load Capacitance
V+/V-=±2.5V ,GV=40dB,
RF=100KΩ,RG=1kΩ,RL=2.5kΩ,Ta=+25°C



■ TEST CIRCUIT

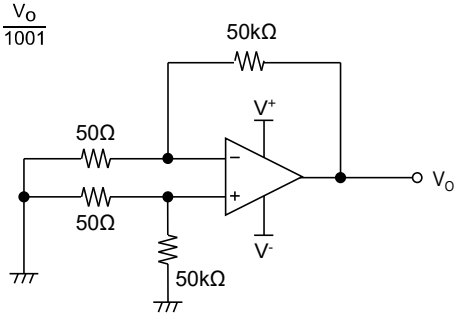
● Supply current



● Input offset voltage

$$V_{IO}=\frac{50}{(50+50k)}\times V_O$$

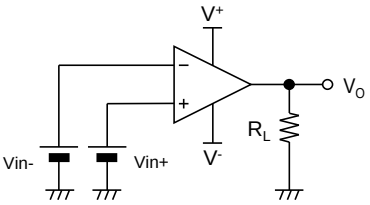
$$V_{IO}=\frac{V_O}{1001}$$



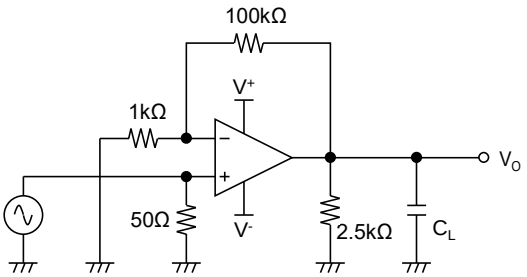
● Maximum output voltage

+Vom; Vin+ = 1V, Vin- = -1V

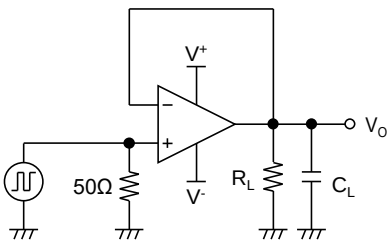
-Vom; Vin+ = -1V, Vin- = 1V

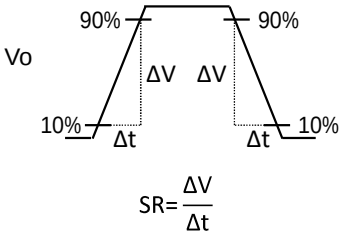


● GBW



● Slew rate





$$SR=\frac{\Delta V}{\Delta t}$$

■ APPLICATION NOTE

Single and Dual Supply Voltage Operation

The NJM2740 works with both single supply and dual supply when the voltage supplied is between V^+ and V^-. These amplifiers operate from single 2.2 to 7V supply and dual ±1.1V to ±3.5V supply.

Common-Mode Input Voltage Range

When the supply voltage does not meet the condition of electrical characteristics, the range of common-mode input voltage is as follows:

V_{ICM} (typ.) = V^-+1.1V to V^+-1V (Ta = 25°C)

Difference of V_{ICM} when Temperature change, refer to typical characteristic graph.

During designing, consider variations in characteristics for use with allowance.

Maximum Output Voltage Range

When the supply voltage does not meet the condition of electrical characteristics, the range of the typ. value of the maximum output voltage is as follows:

V_{OM} (typ.) = V^-+0.3V to V^+-0.3V (R_L=2.5kΩ to V^+/2, Ta=25°C)

During designing, consider variations in characteristics and temperature characteristics for use with allowance. In addition, also note that the output voltage range becomes narrow as shown in typical characteristics graph when an output current increases.

Input Voltage Exceeding the Supply Voltage

Inputs of the NJM2740 are protected by ESD diodes (shown in Figure1) that will conduct if the input voltages exceed the power supplies by more than approximately 300mV. Momentary voltages greater than 300mV beyond the power supply, inputs can be tolerated if the current is limited to 1mA.

Figure2 is easily accomplished with an input resistor. If the input voltage exceeds the supply voltage, the input current must be limited 1mA or less by using a restriction resistance (R_{LIMIT}) as shown in figure2.

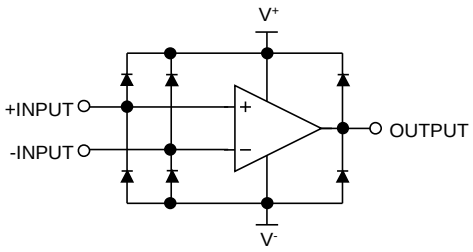


Figure1. Simplified Schematic

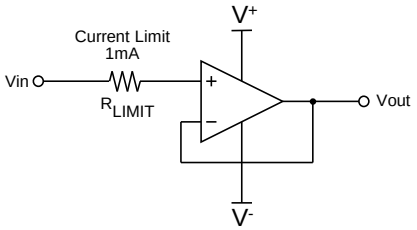


Figure2. Input Current Protection for Voltages exceeding the Supply Voltage.

Capacitive load

The NJM2740 can use at unity gain follower, but the unity gain follower is the most sensitive configuration to capacitive loading. The combination of capacitive load placed directly on the output of an amplifier along with the output impedance of the amplifier creates a phase lag which in turn reduces the phase margin of the amplifier. If phase margin is significantly reduced, the response will cause overshoot and ringing in the step response. It is 30 degree phase margin at 1000pF capacitive load.

To drive heavy capacitive loads, an isolation resistor, R_{ISO} as shown Figure3, should be used. R_{ISO} improves the feedback loop's phase margin by making the output load resistive at higher frequencies. The larger the value of R_{ISO}, the more stable the output voltage will be. However, larger values of R_{ISO} result in reduced output swing, reduced output current drive and reduced frequency bandwidth.

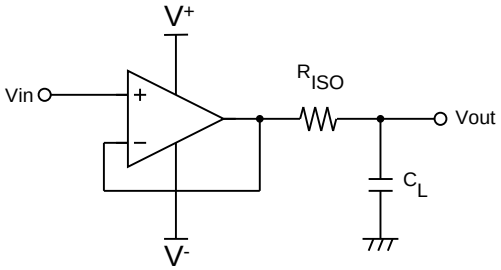
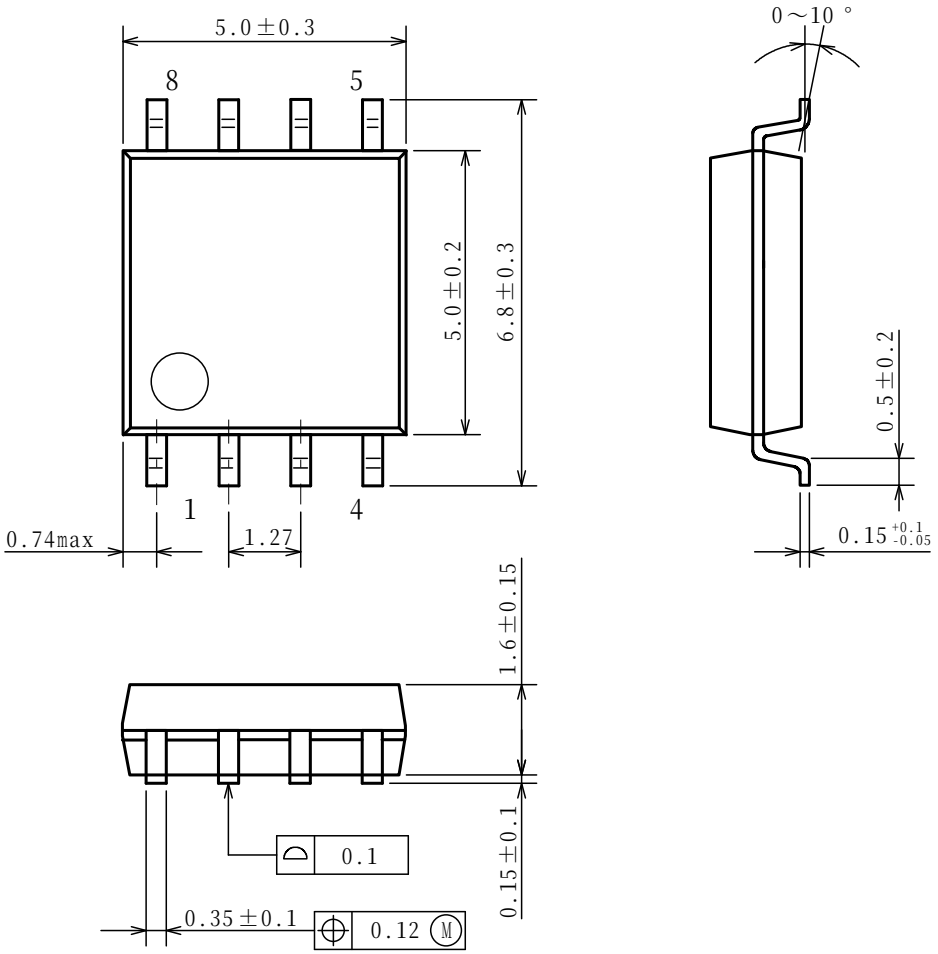


Figure3. Isolating capacitive load

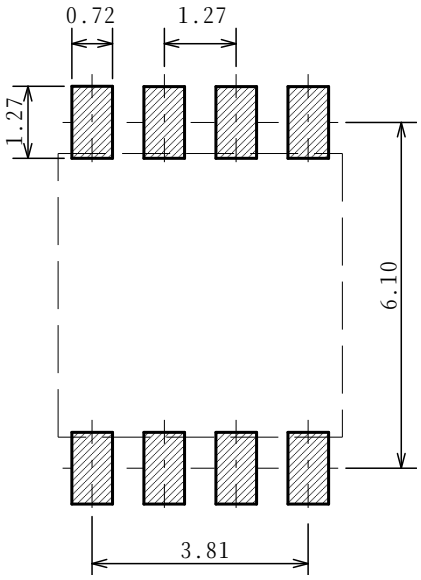
DMP8

Unit: mm

■PACKAGE DIMENSIONS



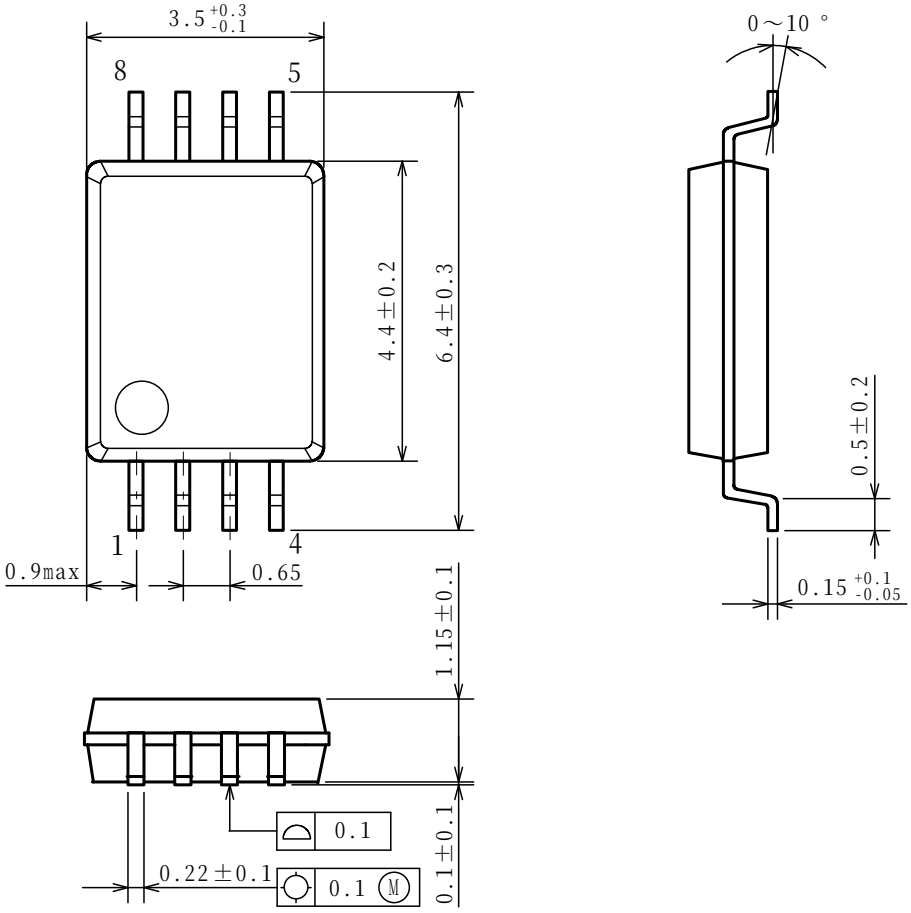
■EXAMPLE OF SOLDER PADS DIMENSIONS



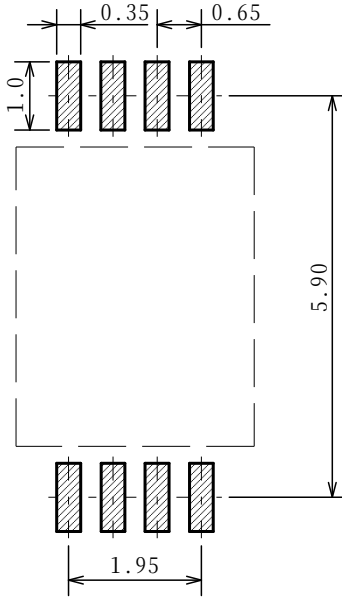
SSOP8

Unit: mm

■PACKAGE DIMENSIONS



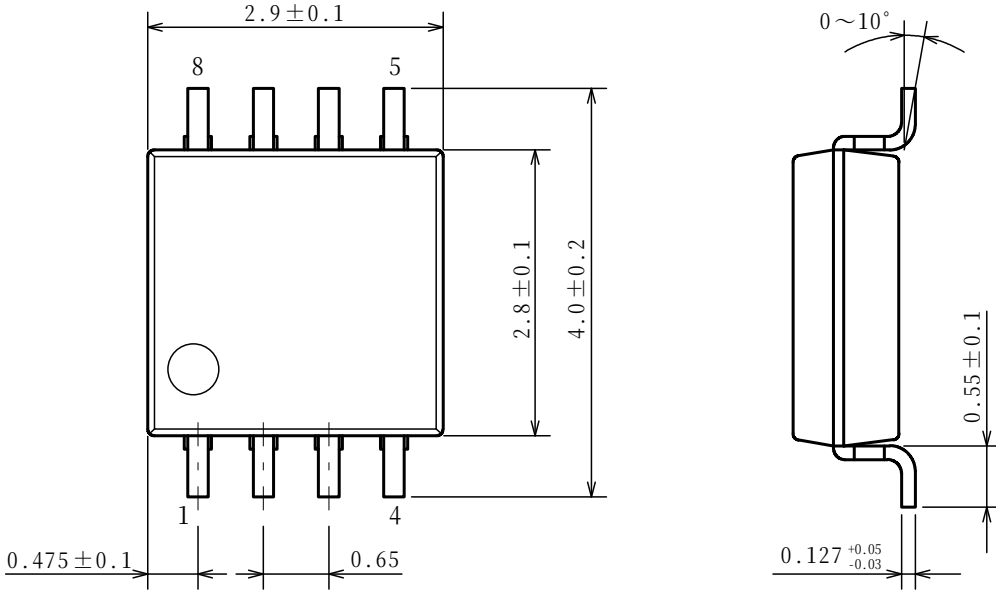
■EXAMPLE OF SOLDER PADS DIMENSIONS

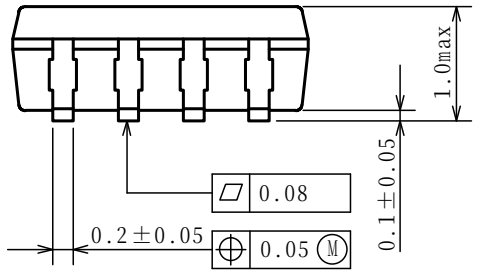


MSOP8 JEDEC MO-187-DA/THIN TYPE

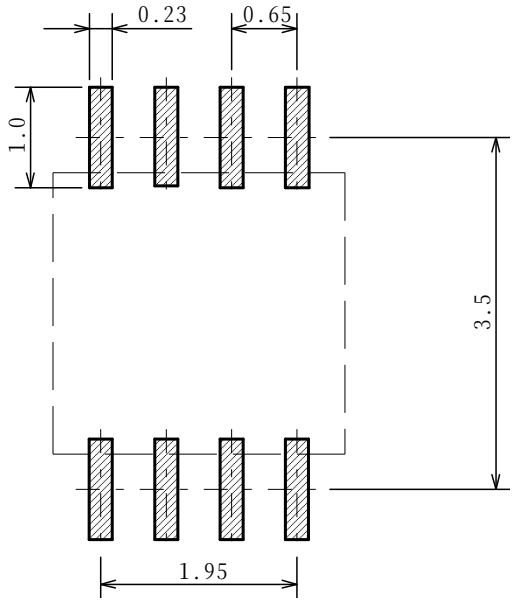
Unit: mm

■PACKAGE DIMENSIONS





■EXAMPLE OF SOLDER PADS DIMENSIONS

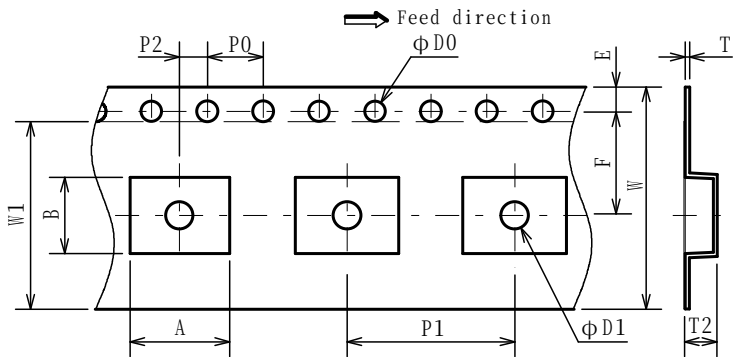


DMP8

■PACKING SPEC

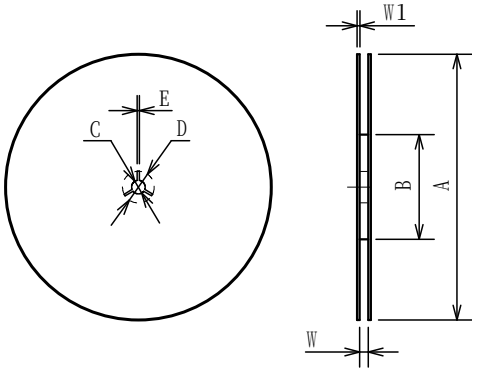
Unit: mm

TAPING DIMENSIONS



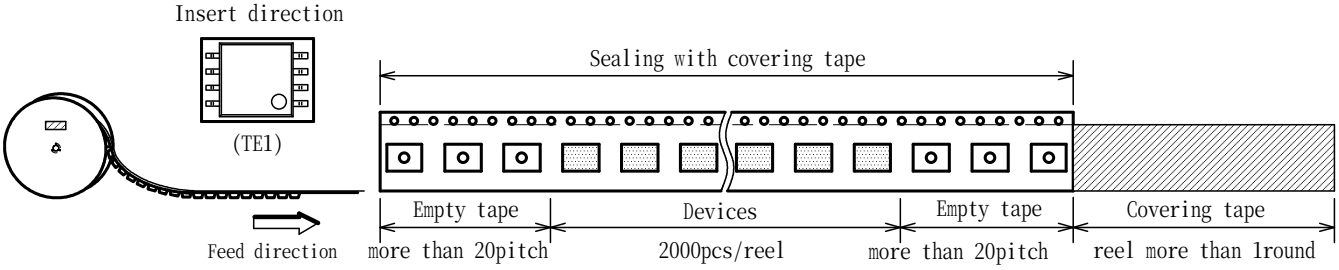
SYMBOL	DIMENSION	REMARKS
A	7.1	BOTTOM DIMENSION
B	5.4	BOTTOM DIMENSION
D0	1.55±0.05	
D1	2.05±0.1	
E	1.75±0.1	
F	7.5±0.1	
P0	4.0±0.1	
P1	12.0±0.1	
P2	2.0±0.1	
T	0.3±0.05	
T2	2.3	
W	16.0±0.3	
W1	13.5	THICKNESS 0.1max

REEL DIMENSIONS

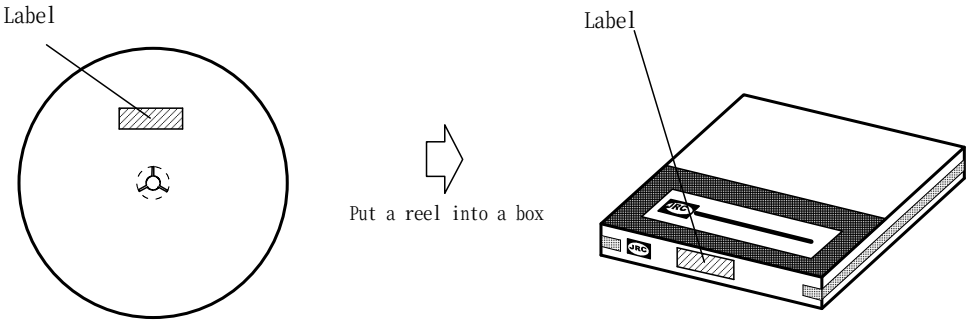


SYMBOL	DIMENSION
A	φ330±2
B	φ 80±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	17.5±0.5
W1	2±0.2

TAPING STATE



PACKING STATE

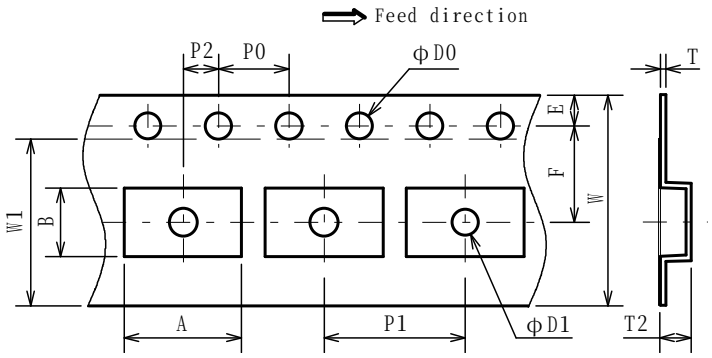


SSOP8

■PACKING SPEC

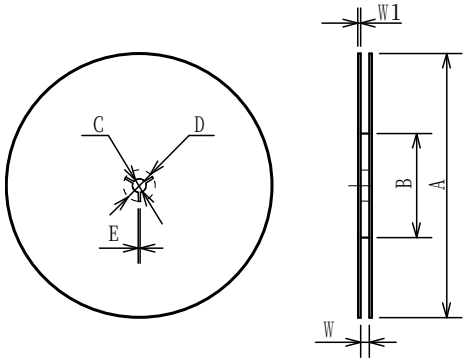
Unit: mm

TAPING DIMENSIONS



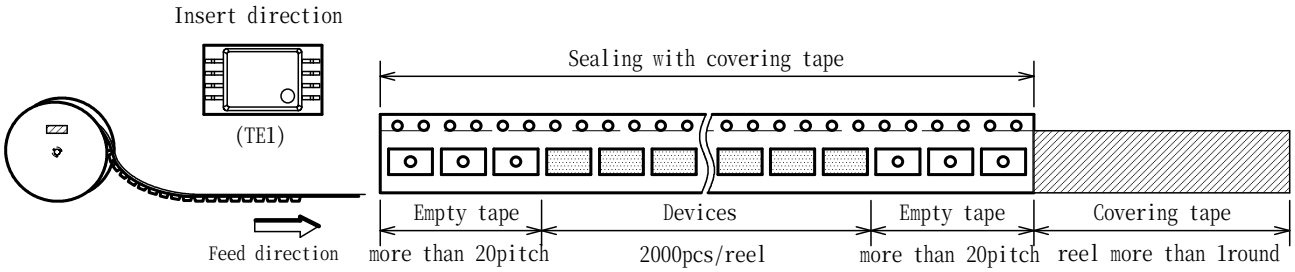
SYMBOL	DIMENSION	REMARKS
A	6.7	BOTTOM DIMENSION
B	3.9	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.55±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.3±0.05	
T2	2.2	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

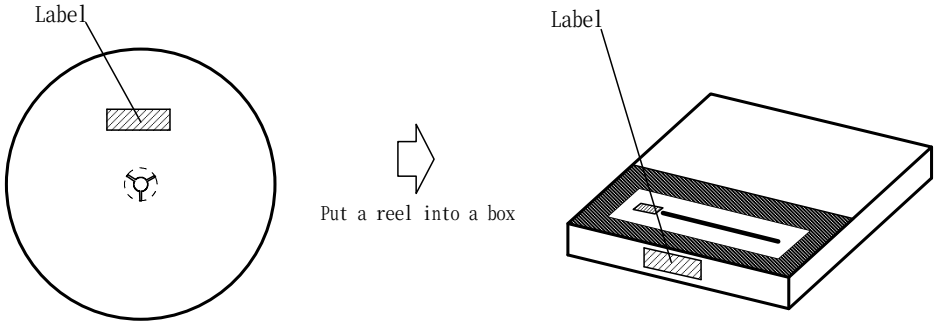


SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2±0.2

TAPING STATE



PACKING STATE

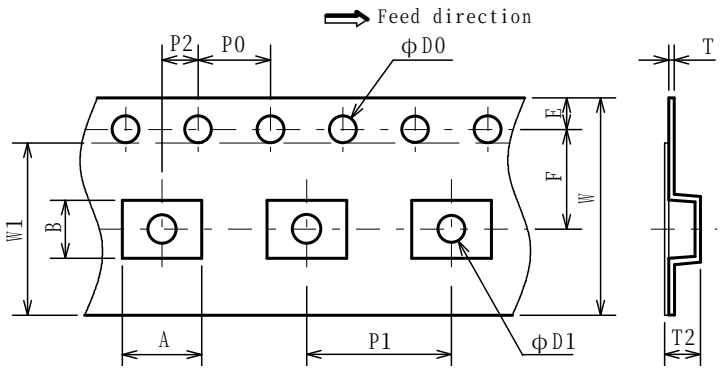


MSOP8 MEET JEDEC MO-187-DA/THIN TYPE

■PACKING SPEC

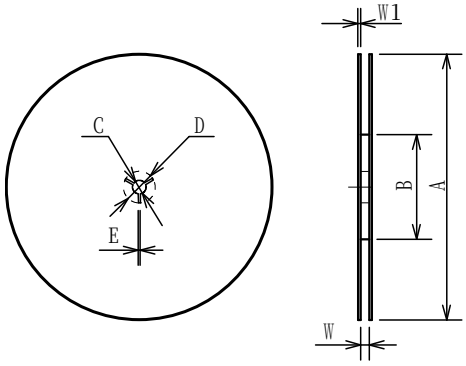
Unit: mm

TAPING DIMENSIONS



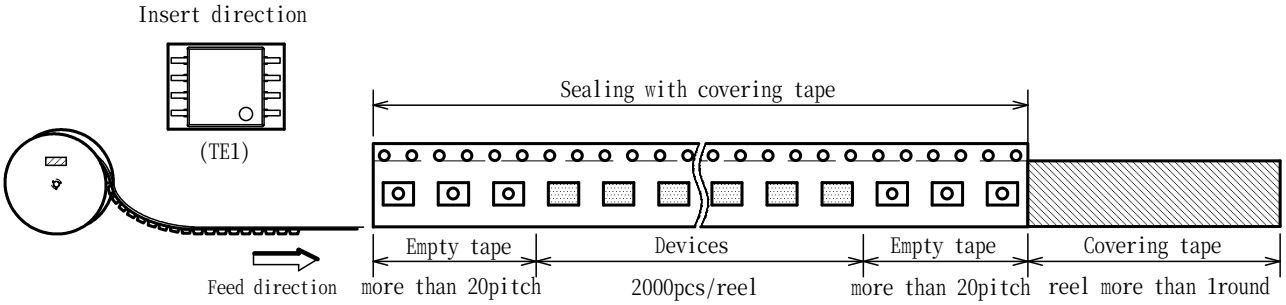
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	1.75 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

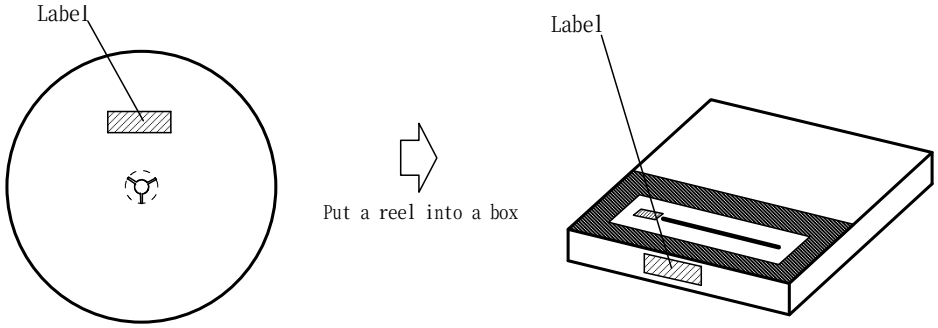


SYMBOL	DIMENSION
A	φ254±2
B	φ100±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE

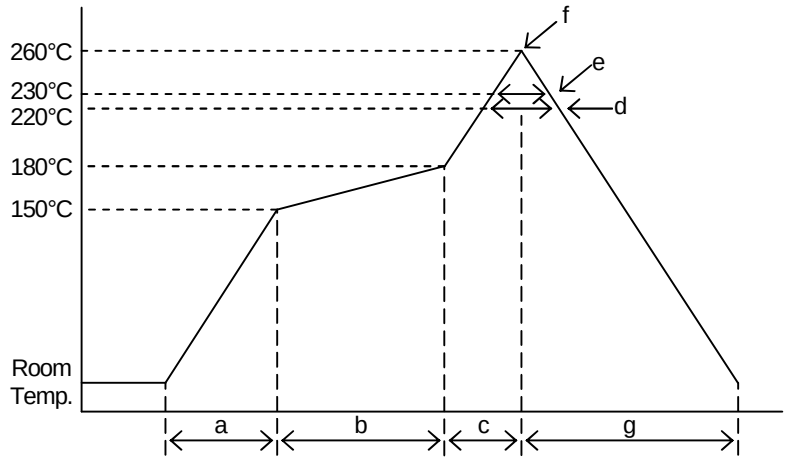


PACKING STATE



■ RECOMMENDED MOUNTING METHOD

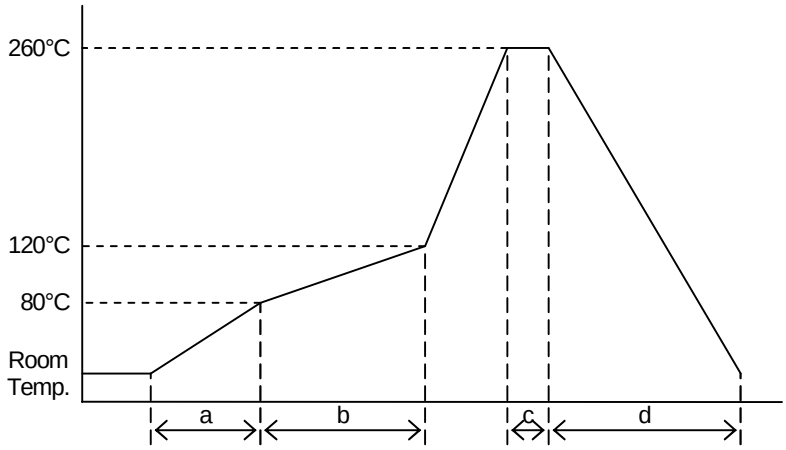
INFRARED REFLOW SOLDERING PROFILE



a	Temperature ramping rate	1 to 4°C/s
b	Pre-heating temperature Pre-heating time	150 to 180°C 60 to 120s
c	Temperature ramp rate	1 to 4°C/s
d	220°C or higher time	shorter than 60s
e	230°C or higher time	shorter than 40s
f	Peak temperature	lower than 260°C
g	Temperature ramping rate	1 to 6°C/s

The temperature indicates at the surface of mold package.

FLOW SOLDERING PROFILE



a	Temperature ramping rate	1 to 7°C/s
b	Pre-heating temperature Pre-heating time	80 to 120°C 60 to 120s
c	Peak temperature Peak time	lower than 260°C shorter than 10s
d	Temperature ramping rate	1 to 7°C/s

The temperature indicates at the surface of mold package.

IRON SOLDERING PROFILE

Temperature of Iron: not exceeding 350°C
Soldering time: within 3s (At 1 lead)

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