

Precision, Low Noise, Rail-to-Rail Output, CMOS Operational Amplifier

■ GENERAL DESCRIPTION

The NJU7076/NJU7077/NJU7078 is a high precision Rail-to-Rail output Single/Dual/Quad CMOS operational amplifier featuring a low noise of 10nV/√Hz typ., low input offset voltage of 150μV max., low temperature drift of 0.5μV/°C typ. and low bias current of 1pA typ..

The output swing can reach 20 mV from the rails, while driving a 10kΩ load (at 5V operation). The NJU7076/NJU7077/NJU7078 also has a high RF noise immunity which can reduce malfunctions caused by RF noises from mobile phones and others. The combination of these specifications makes the NJU7076/ NJU7077/NJU7078 well-suited for sensor applications such as a temperature sensor, weight sensor and others, high precision current sensing amplifiers and current voltage converters.

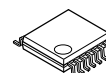
■ PACKAGE OUTLINE



NJU7076F
(SOT-23-5)



NJU7077R
(MSOP8(VSP8))



NJU7078V
(SSOP14)

■ FEATURES

- High Precision
 - Low Offset Voltage

NJU7076/NJU7077	150μV max.
NJU7078	200μV max.
 - Low Offset Voltage Drift

	0.5μV/°C typ.
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- Low Noise

	10nV/√Hz typ.
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- Low Input Bias Current

	1pA typ.
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- Rail-to-Rail Output

$R_L=10k\Omega$	0.02V to 4.98V typ. ($V^+=5V$)
$R_L=600\Omega$	0.08V to 4.92V typ. ($V^+=5V$)
- Ground sense
- RF Noise Immunity
- Operating Voltage

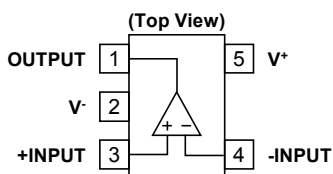
	2.2V to 5.5V
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- Unity-Gain Stable
- Package

NJU7076	SOT-23-5
NJU7077	MSOP8(VSP8)*
	*MEET JEDEC MO-187-DA
NJU7078	SSOP14

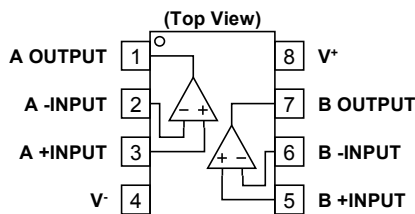
■ APPLICATIONS

- Thermocouple / Thermopile Amplifiers
- Strain Gauge / Pressure sensor Amplifiers
- Load Cell and Bridge Transducer Amplifiers
- High Resolution Data Acquisition
- Precision Current Sensing
- Battery monitoring
- Photo-Diode pre amplifier

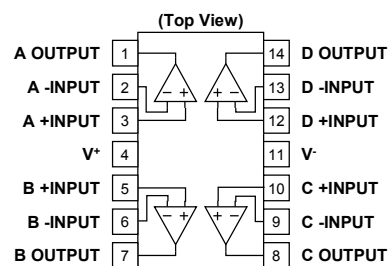
PIN CONFIGURATION



NJU7076F



NJU7077R



NJU7078V

ABSOLUTE MAXIMUM RATINGS(Ta=25°C, unless otherwise noted.)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	$V^+ - V^-$	7 ⁽¹⁾	V
Differential Input Voltage ⁽²⁾	V_{ID}	± 7 ⁽³⁾	V
Input Voltage	V_{IN}	$V^- - 0.3$ to $V^+ + 0.3$	V
Power Dissipation ⁽⁴⁾		(2-layer / 4-layer)	mW
SOT-23-5	P_D	480 / 650	mW
MSOP8(VSP8)		500 / 660	mW
SSOP14		555 / 690	mW
Operating Temperature Range	T_{opr}	-40 to +125	°C
Storage Temperature Range	T_{stg}	-55 to +150	°C

(1) Supply Voltage is the voltage difference between V^+ and V^- .

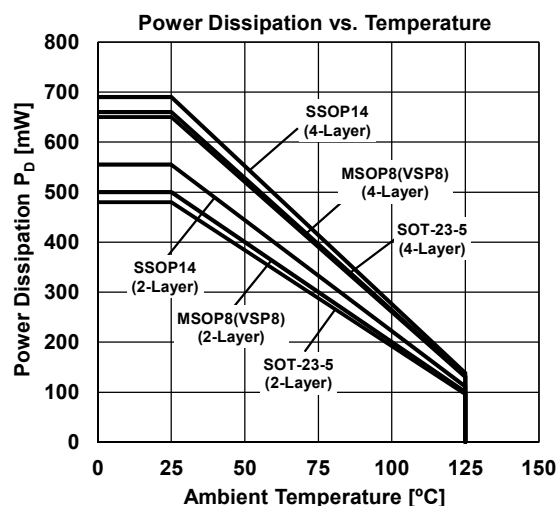
(2) Differential voltage is the voltage difference between +INPUT and -INPUT.

(3) For supply voltage less than 7V, the absolute maximum rating is equal to the supply voltage.

(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. When using the IC over Ta=25°C subtract the value [mW/°C]=PD/(Tstg(MAX)-25) per temperature.

2-layer: EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layers, FR-4) mounting

4-layer: EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 4layers, FR-4) mounting



RECOMMENDED OPERATING CONDITIONS(Ta=25°C)

PARAMETER	Value	UNIT
Supply Voltage	+2.2 to +5.5 (± 1.1 to ± 2.75)	V

■ ELECTRICAL CHARACTERISTICS($V^+=5V$, $V^-=0V$, $V_{COM}=V^+/2$, $T_a=25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC CHARACTERISTICS						
Input Offset Voltage NJU7076/NJU7077	V _{IO}	Ta=-40°C to 125°C	-	20	150	μV
			-	-	400	μV
NJU7078		Ta=-40°C to 125°C	-	20	200	μV
			-	-	400	μV
Input Offset Voltage Drift	ΔV _{IO} /ΔT	Ta=-40°C to 125°C ⁽⁵⁾	-	0.5	5	μV/°C
Input Bias Current	I _B		-	1	-	pA
Input Offset Current	I _{IO}		-	1	-	pA
Open-Loop Voltage Gain	A _V	Vo=0.5V to 4.5V, R _L =10kΩ to 2.5V	100	130	-	dB
		Vo=0.5V to 4.5V, R _L =10kΩ to 2.5V, Ta= -40°C to 125°C	100	-	-	dB
Common-Mode Rejection Ratio	CMR	V _{ICM} =0V to 4V	70	90	-	dB
		V _{ICM} =0V to 4V, Ta= -40°C to 125°C	70	-	-	dB
Supply Voltage Rejection Ratio	SVR	V ⁺ =2.2V to 5.5V	70	90	-	dB
		V ⁺ =2.2V to 5.5V, Ta= -40°C to 125°C	70	-	-	dB
High-level Output Voltage	V _{OH}	R _L =10kΩ to 2.5V	4.95	4.98	-	V
		R _L =10kΩ to 2.5V, Ta= -40°C to 125°C	4.95	-	-	V
		R _L =600Ω to 2.5V	4.85	4.92	-	V
		R _L =600Ω to 2.5V, Ta= -40°C to 125°C	4.85	-	-	V
		I _{SOURCE} =2mA	4.9	4.96	-	V
		I _{SOURCE} =2mA, Ta= -40°C to 125°C	4.85	-	-	V
Low-level Output Voltage	V _{OL}	R _L =10kΩ to 2.5V	-	0.02	0.05	V
		R _L =10kΩ to 2.5V, Ta= -40°C to 125°C	-	-	0.05	V
		R _L =600Ω to 2.5V	-	0.08	0.15	V
		R _L =600Ω to 2.5V, Ta= -40°C to 125°C	-	-	0.2	V
		I _{SINK} =2mA	-	0.04	0.1	V
		I _{SINK} =2mA, Ta= -40°C to 125°C	-	-	0.15	V
Common-Mode Input Voltage Range	V _{ICM}	CMR≥70dB	0	-	4	V
		CMR≥70dB, Ta= -40°C to 125°C	0	-	4	V
Supply Current(All Amplifiers) NJU7076	I _{SUPPLY}	No Signal, R _L =OPEN	-	0.6	0.9	mA
		No Signal, R _L =OPEN, Ta = -40°C to 125°C	-	-	0.9	mA
NJU7077		No Signal, R _L =OPEN	-	1.2	1.8	mA
		No Signal, R _L =OPEN, Ta = -40°C to 125°C	-	-	1.8	mA
NJU7078		No Signal, R _L =OPEN	-	2.3	3.5	mA
		No Signal, R _L =OPEN, Ta = -40°C to 125°C	-	-	3.5	mA
AC CHARACTERISTICS						
Gain Bandwidth Product	GBW	G _V =40dB, R _F =100kΩ, R _L =10kΩ to 2.5V, C _L =20pF, f=100kHz	-	1.3	-	MHz
Phase Margin	Φ _m	G _V =40dB, R _F =100kΩ, R _L =10kΩ to 2.5V, C _L =20pF	-	60	-	deg
Gain Margin	G _m	G _V =40dB, R _F =100kΩ, R _L =10kΩ to 2.5V, C _L =20pF	-	12	-	dB
Equivalent Input Noise Voltage	e _n	f=1kHz	-	10	-	nV/√Hz
Slew Rate	SR	G _V =0dB, R _L =10kΩ to 2.5V, C _L =20pF, V _{IN} =3V _{PP}	-	0.5	-	V/μs
Total Harmonic Distortion + Noise	THD+N	G _V =20dB, R _L =10kΩ to 2.5V, f=1kHz, V _O =3V _{PP}	-	0.01	-	%
Channel Separation	CS	f=1kHz, NJU7077/NJU7078	-	140	-	dB

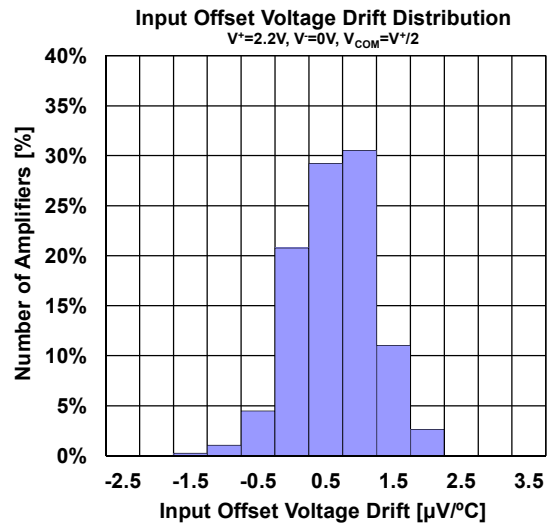
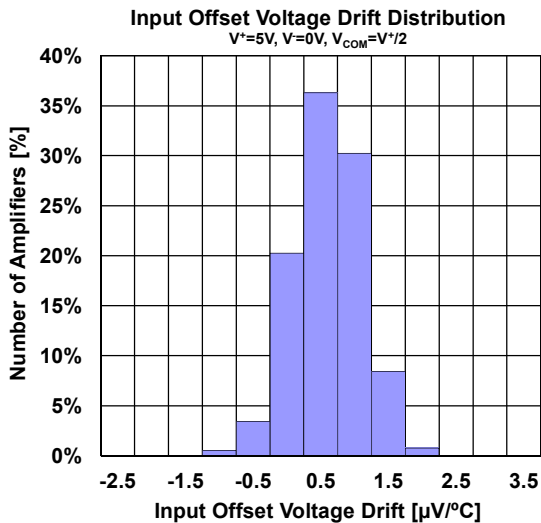
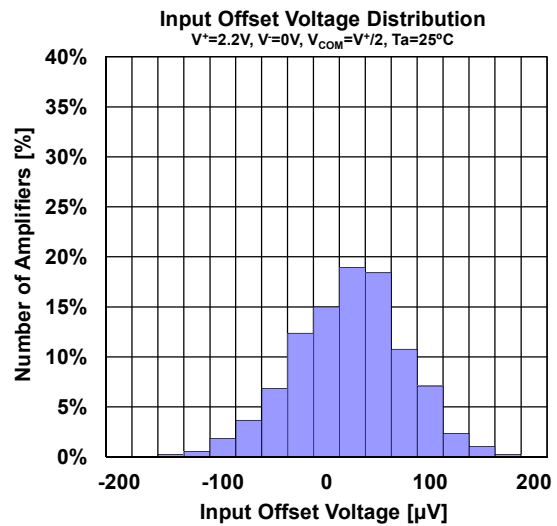
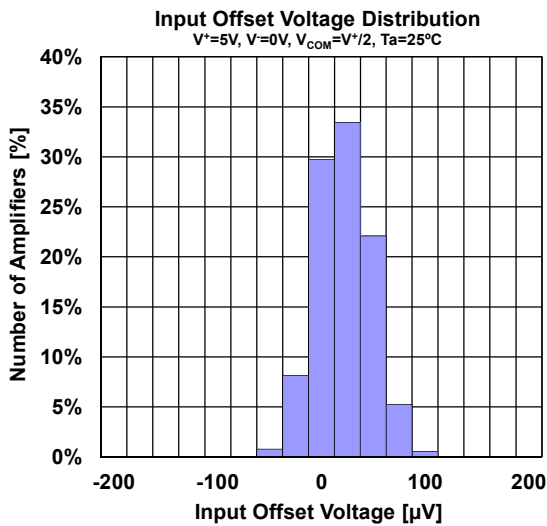
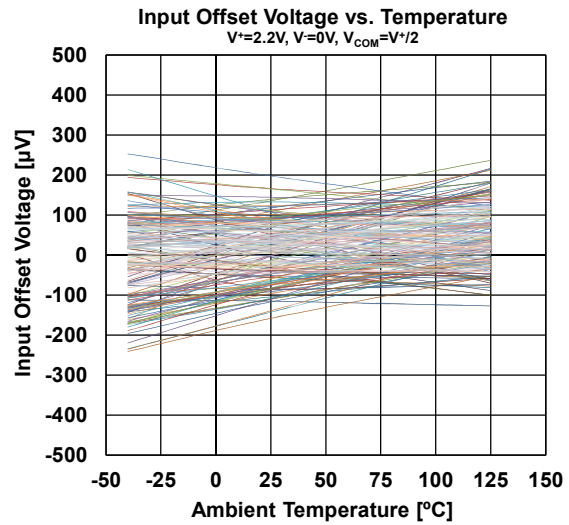
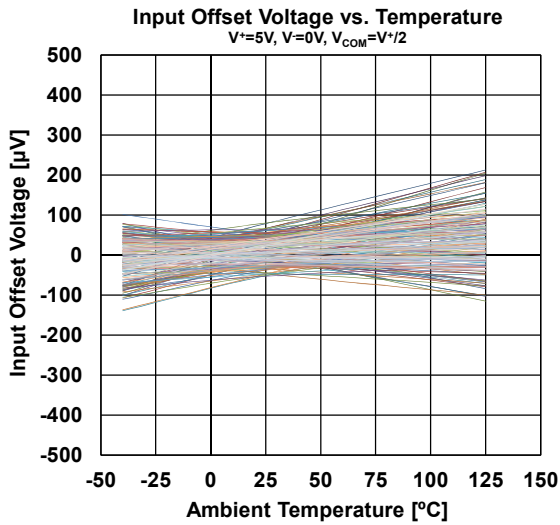
(5) Guaranteed by two points of Temperature $-40^\circ C$ and $+125^\circ C$

■ ELECTRICAL CHARACTERISTICS($V^+=2.2\text{V}$, $V^-=0\text{V}$, $V_{\text{COM}}=V^+/2$, $T_a=25^\circ\text{C}$, unless otherwise noted.)

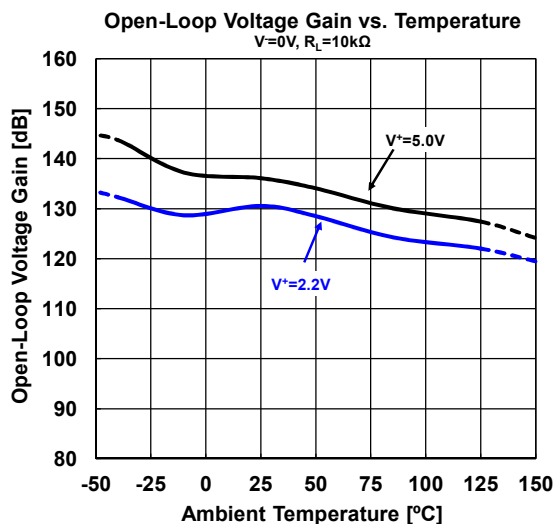
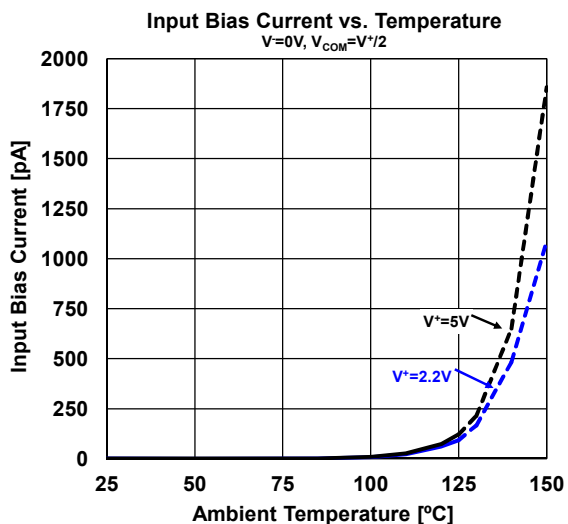
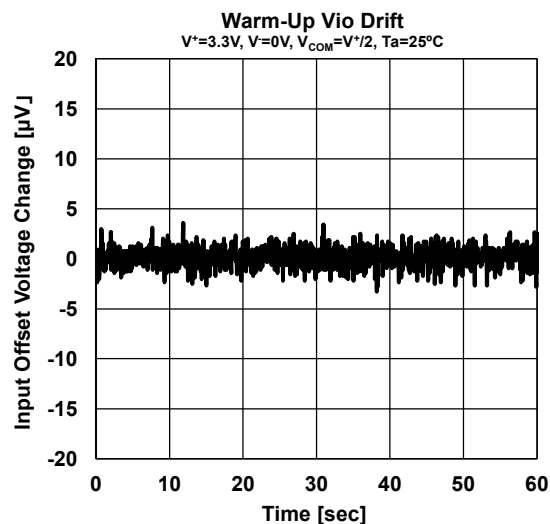
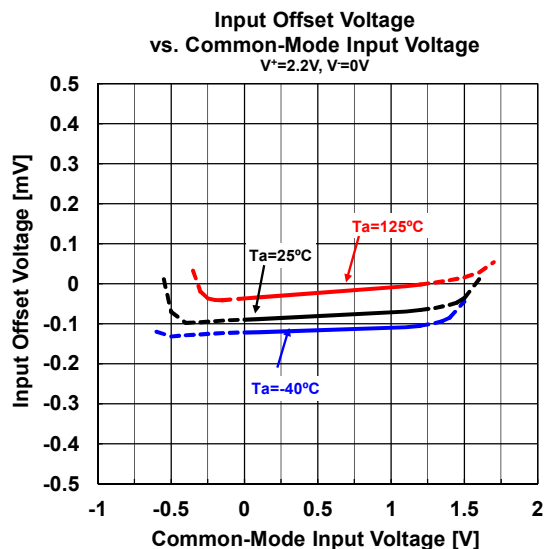
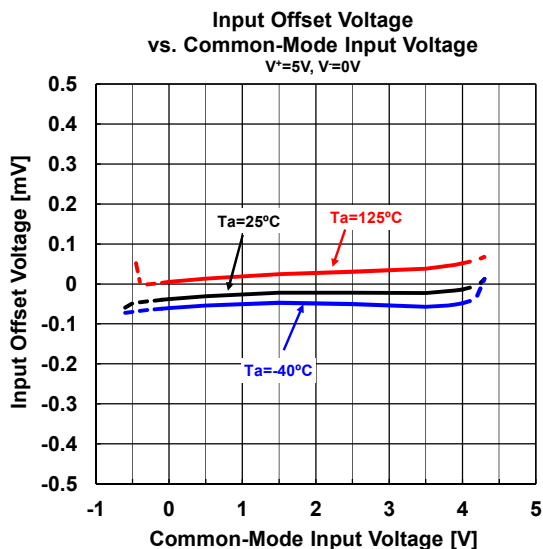
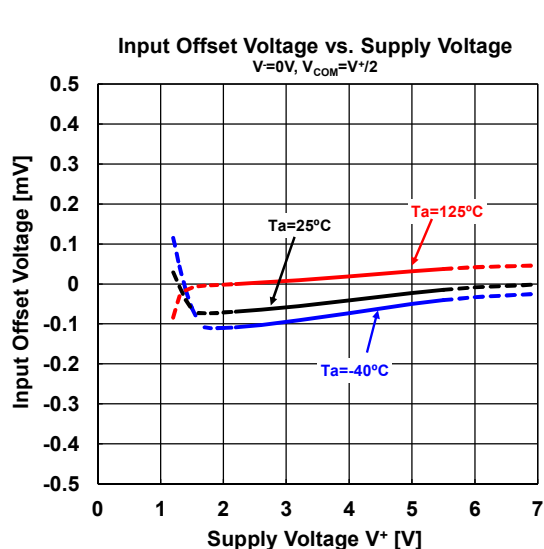
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC CHARACTERISTICS						
Input Offset Voltage NJU7076/NJU7077	V _{IO}	Ta= -40°C to 125°C	-	60	250	μV
			-	-	400	μV
NJU7078			-	60	300	μV
		Ta= -40°C to 125°C	-	-	400	μV
Input Offset Voltage Drift	ΔV _{IO} /ΔT	Ta= -40°C to 125°C ⁽⁵⁾	-	0.6	5	μV/°C
Input Bias Current	I _B		-	1	-	pA
Input Offset Current	I _{IO}		-	1	-	pA
Open-Loop Voltage Gain	A _V	Vo=0.6V to 1.6V, R _L =10kΩ to 1.1V	100	130	-	dB
		Vo=0.6V to 1.6V, R _L =10kΩ to 1.1V, Ta= -40°C to 125°C	100	-	-	dB
Common-Mode Rejection Ratio	CMR	V _{ICM} =0V to 1.2V	70	90	-	dB
		V _{ICM} =0V to 1.2V, Ta= -40°C to 125°C	70	-	-	dB
High-level Output Voltage	V _{OH}	R _L =10kΩ to 1.1V	2.15	2.18	-	V
		R _L =10kΩ to 1.1V, Ta= -40°C to 125°C	2.15	-	-	V
		R _L =600Ω to 1.1V	2.1	2.14	-	V
		R _L =600Ω to 1.1V, Ta= -40°C to 125°C	2.05	-	-	V
		I _{SOURCE} =2mA	2.05	2.13	-	V
		I _{SOURCE} =2mA, Ta= -40°C to 125°C	2	-	-	V
Low-level Output Voltage	V _{OL}	R _L =10kΩ to 1.1V	-	0.02	0.05	V
		R _L =10kΩ to 1.1V, Ta= -40°C to 125°C	-	-	0.05	V
		R _L =600Ω to 1.1V	-	0.06	0.1	V
		R _L =600Ω to 1.1V, Ta= -40°C to 125°C	-	-	0.15	V
		I _{SINK} =2mA	-	0.07	0.15	V
		I _{SINK} =2mA, Ta= -40°C to 125°C	-	-	0.2	V
Common-Mode Input Voltage Range	V _{ICM}	CMR≥70dB	0	-	1.2	V
		CMR≥70dB, Ta= -40°C to 125°C	0	-	1.2	V
Supply Current(All Amplifiers) NJU7076	I _{SUPPLY}	No Signal, R _L =OPEN	-	0.55	0.82	mA
		No Signal, R _L =OPEN, Ta = -40°C to 125°C	-	-	0.82	mA
NJU7077		No Signal, R _L =OPEN	-	1.0	1.5	mA
		No Signal, R _L =OPEN, Ta = -40°C to 125°C	-	-	1.5	mA
NJU7078		No Signal, R _L =OPEN	-	2.0	3.0	mA
		No Signal, R _L =OPEN, Ta = -40°C to 125°C	-	-	3.0	mA
AC CHARACTERISTICS						
Gain Bandwidth Product	GBW	G _V =40dB, R _F =100kΩ, R _L =10kΩ to 1.1V, C _L =20pF, f=100kHz	-	1.2	-	MHz
Phase Margin	Φ _m	G _V =40dB, R _F =100kΩ, R _L =10kΩ to 1.1V, C _L =20pF	-	60	-	deg
Gain Margin	G _m	G _V =40dB, R _F =100kΩ, R _L =10kΩ to 1.1V, C _L =20pF	-	12	-	dB
Equivalent Input Noise Voltage	e _n	f=1kHz	-	10	-	nV/√Hz
Slew Rate	SR	G _V =0dB, R _L =10kΩ to 1.1V, C _L =20pF, V _{IN} =1V _{PP}	-	0.5	-	V/μs
Total Harmonic Distortion + Noise	THD+N	G _V =20dB, R _L =10kΩ to 1.1V, f=1kHz, V _O =1V _{PP}	-	0.01	-	%
Channel Separation	CS	f=1kHz, NJU7077/NJU7078	-	140	-	dB

(5) Guaranteed by two points of Temperature -40°C and $+125^\circ\text{C}$

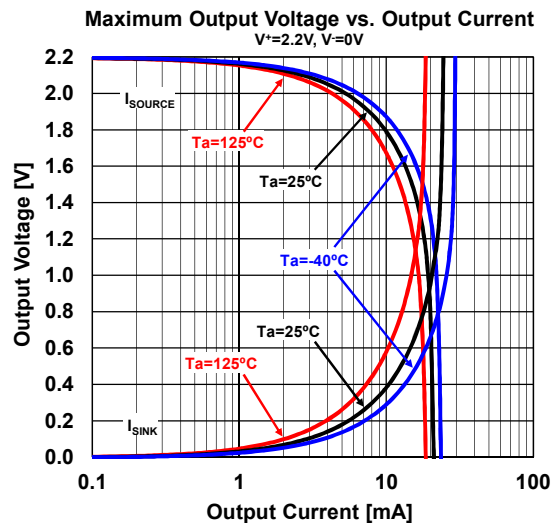
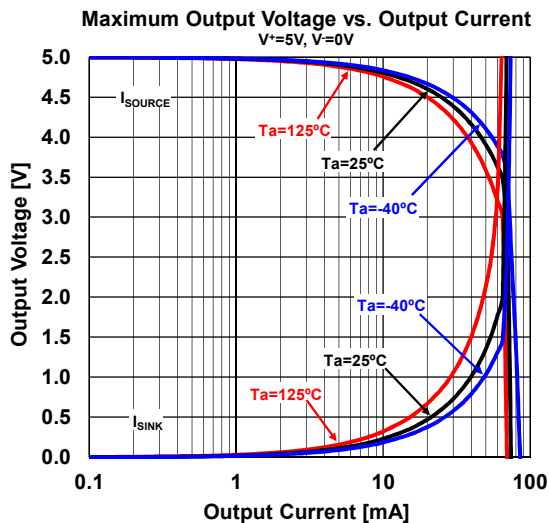
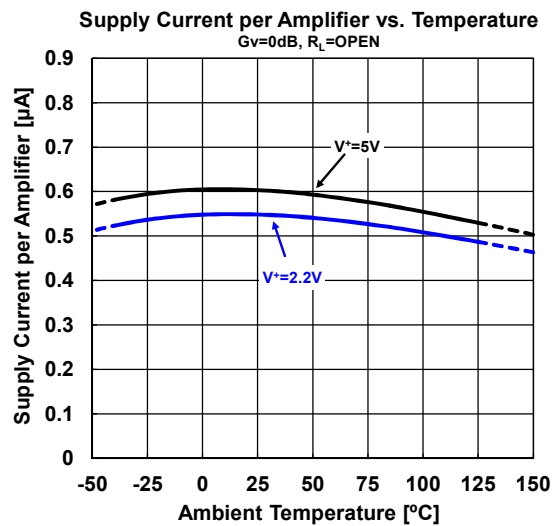
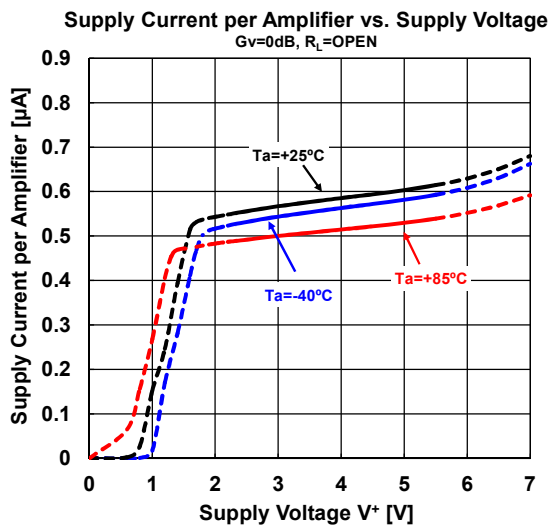
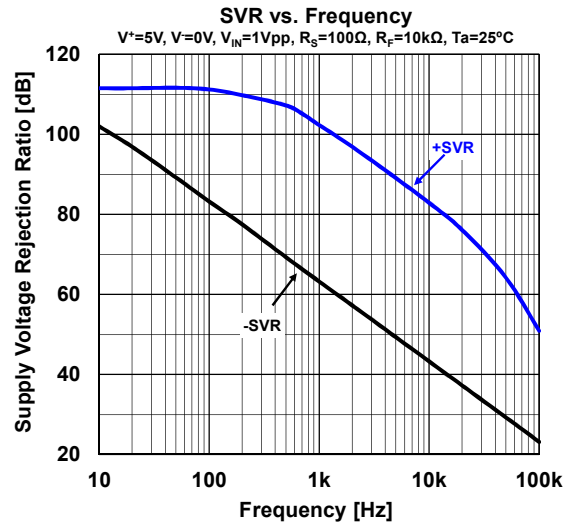
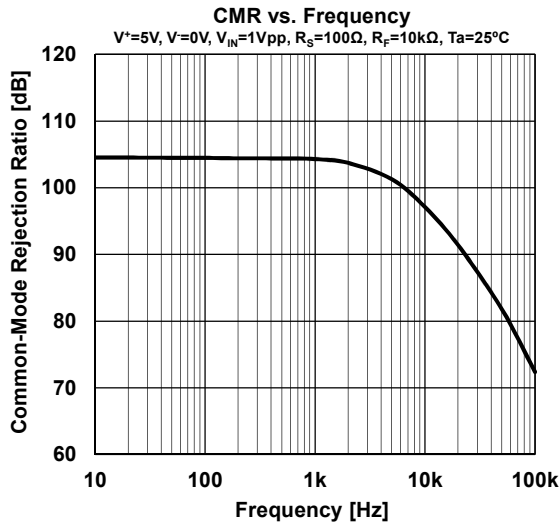
■ TYPICAL CHARACTERISTICS



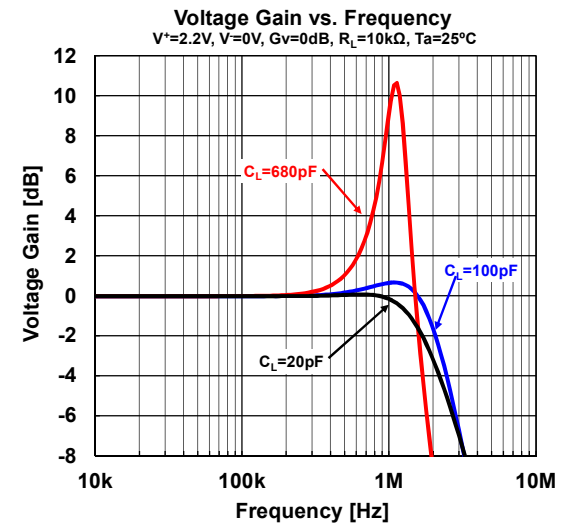
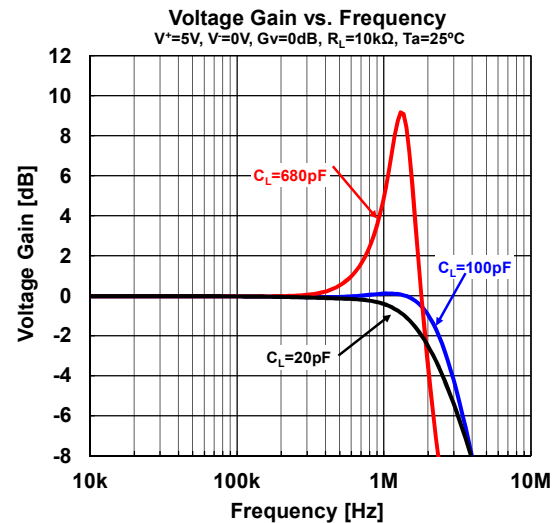
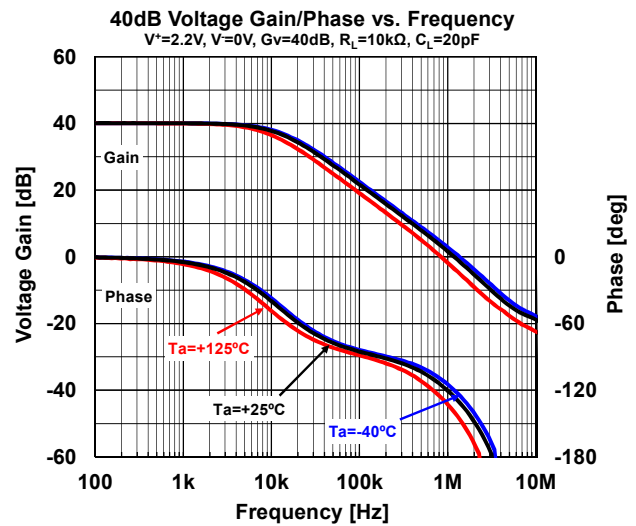
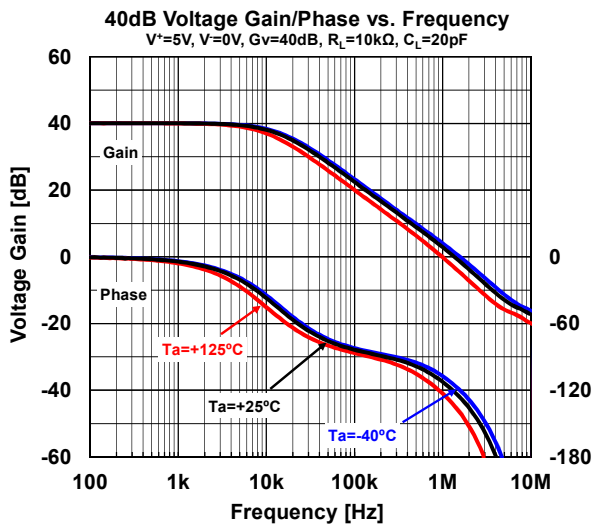
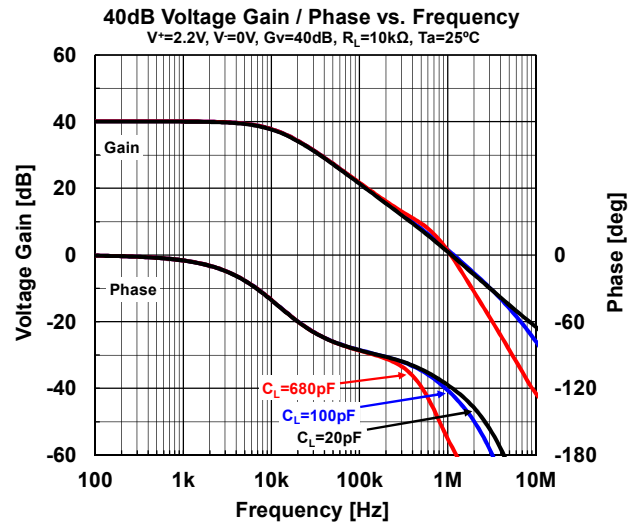
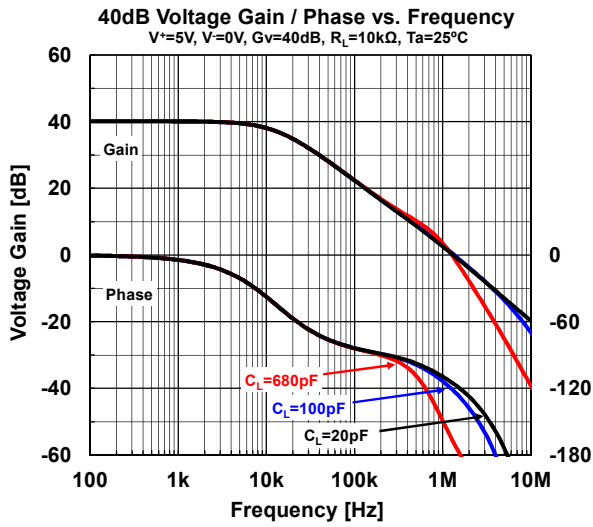
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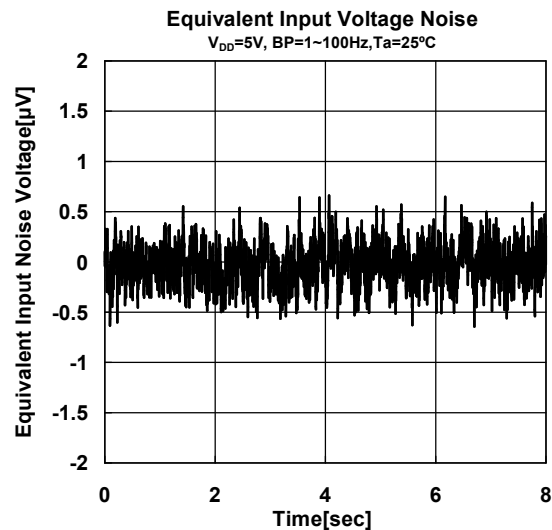
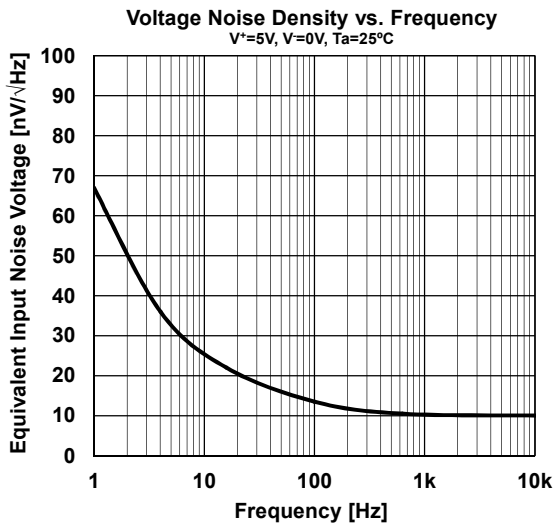
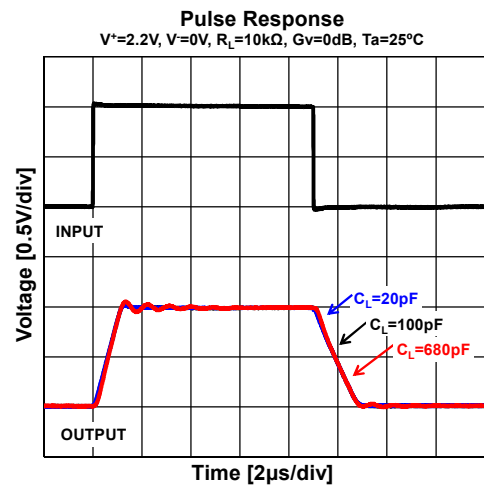
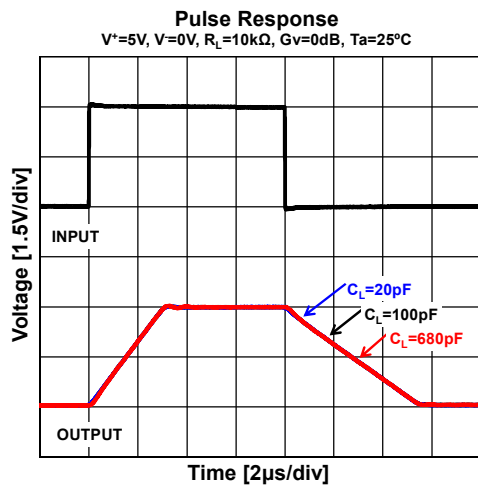
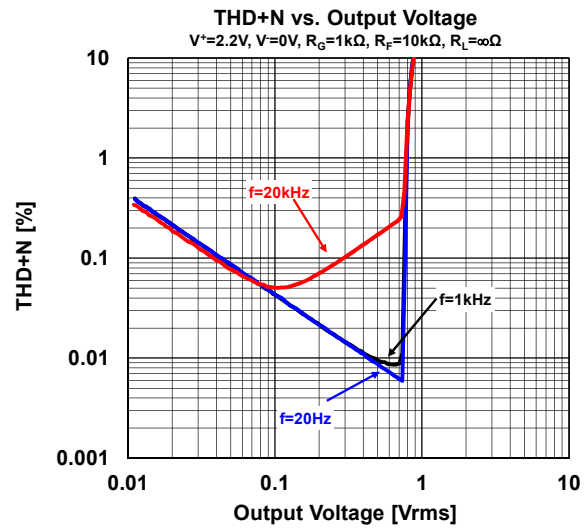
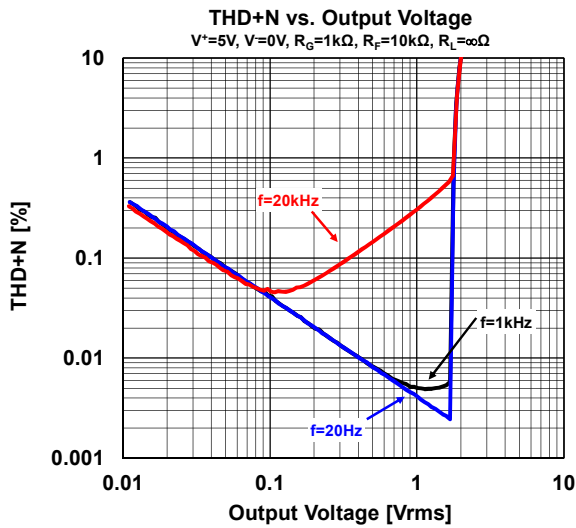
■ TYPICAL CHARACTERISTICS



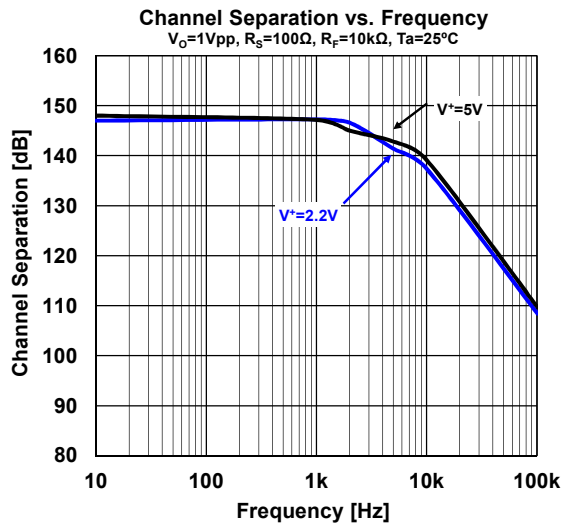
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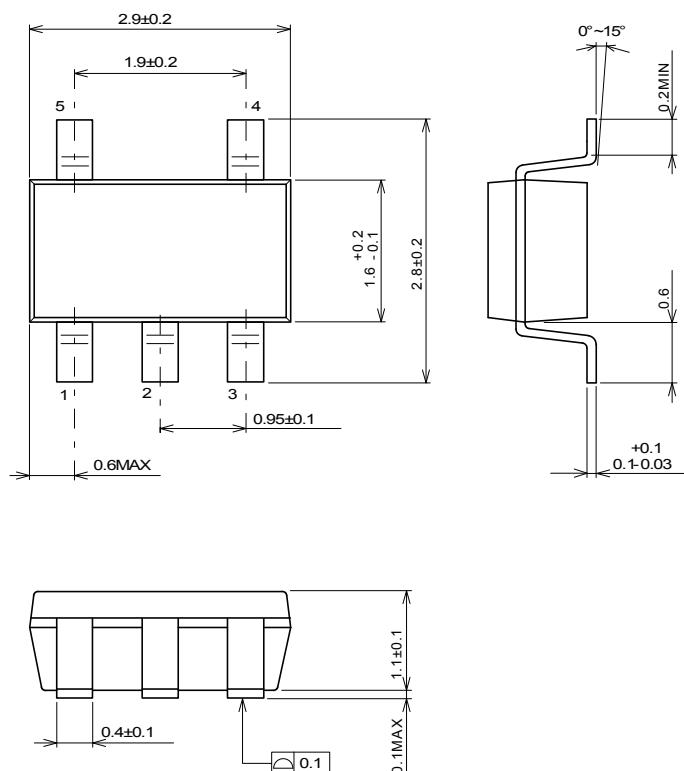
■ TYPICAL CHARACTERISTICS



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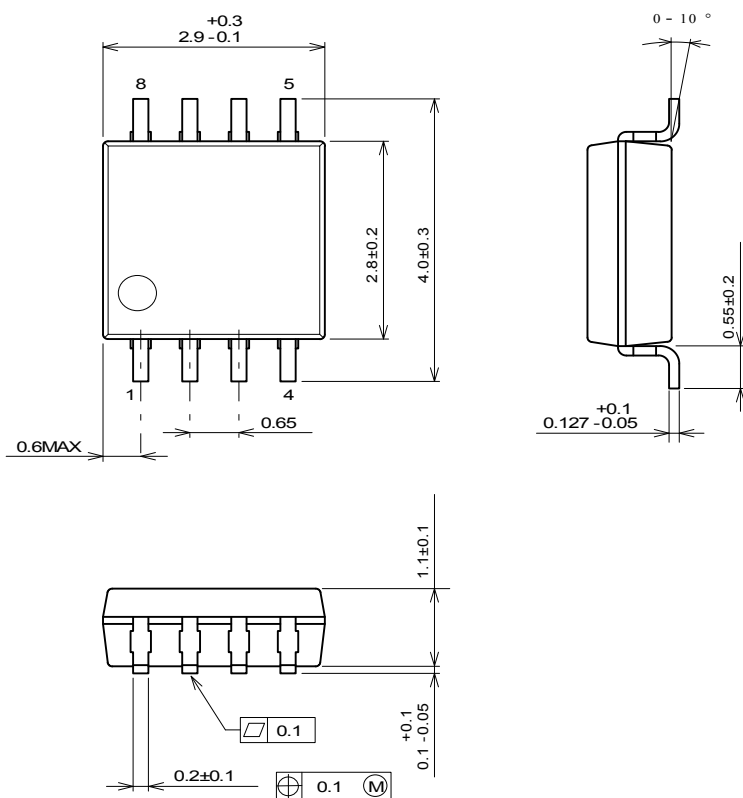


■ PACKAGE DIMENSIONS



Unit: mm

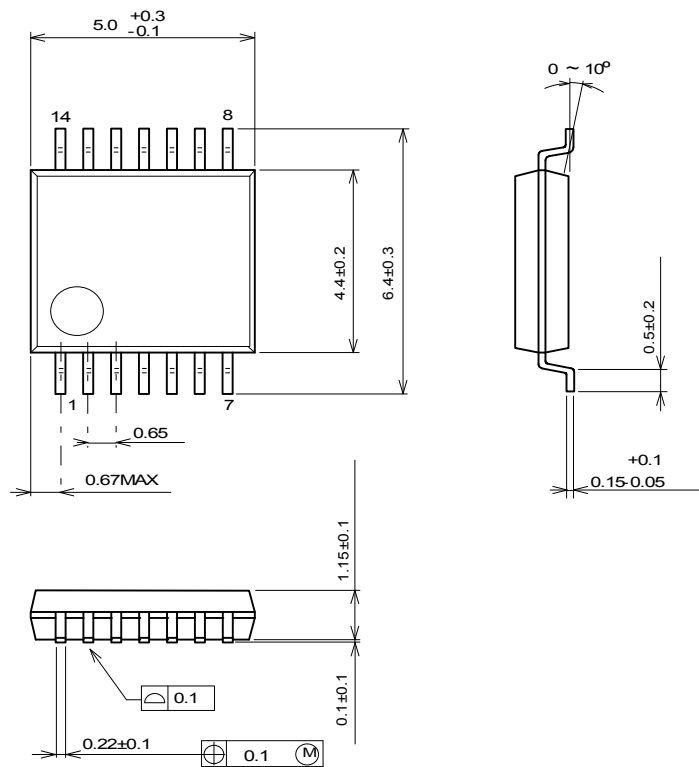
SOT-23-5 Package



Unit: mm

MSOP8(VSP8)* Package
***MEET JEDEC MO-187-DA**

■ PACKAGE DIMENSIONS



Unit: mm

SSOP14 Package

[CAUTION]
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