

# CMOS Operational Amplifier (Single) Monolithic IC MM3002

## Outline

This IC is a CMOS (Single) operating amp for which input/output voltage both can be used up to the power supply voltage. Further, low offset voltage, low drift and low consumption current have been achieved. The package is the ultra-small SOT-25.

## Features

- |  |                                 |
|--|---------------------------------|
| (1) Input voltage range ( $V_{DD}=3V$ )    | $-0.1V \sim V_{DD} + 0.1V$ typ. |
| (2) Output voltage range ( $V_{DD}=3V$ )   | $0.03V \sim 2.97V$ typ.         |
| (3) Input offset voltage                   | 1mV typ.                        |
| (4) Input offset voltage temperature drift | $5\mu V/^\circ C$ typ.          |
| (5) Input bias current                     | 5pA typ.                        |
| (6) Consumption current                    | $120\mu A$ typ.                 |
| (7) Output current                         | $\pm 5mA$ typ.                  |
| (8) Through rate                           | $0.6V/\mu S$                    |

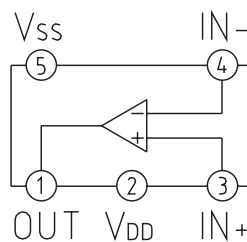
## Package

SOT-25

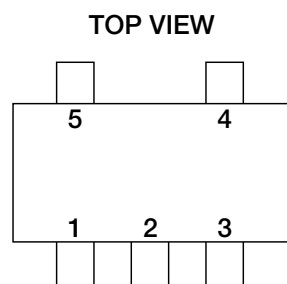
## Applications

- (1) Communication equipment (mobile telephones, cordless telephones, etc.)
- (2) Computers and computer peripherals (notebook PCs, mini PCs, PDA, digital cameras, printers, scanners, etc.)
- (3) AV equipment (movies, CD players, MD players, etc.)
- (4) Other (navigation equipment, measurement equipment, handy terminals, etc.)

## Block Diagram



## Pin Assignment



SOT-25

1	OUT
2	$V_{DD}$
3	IN+
4	IN-
5	$V_{SS}$

**Pin Description**

Pin No.	Pin name	Functions	Internal Equivaalent Circuit
1	OUT	Output pin	
2	V <sub>DD</sub>	Power supply input pin	
3	IN+	Non - inverting input pin	
4	IN-	Inverting input pin	
5	V <sub>SS</sub>	V <sub>SS</sub> PIN	

**Absolute Maximum Ratings** (Except where noted otherwise, Ta=25°C)

Item	Symbol	Ratings	Units
Storage temperature	T <sub>STG</sub>	-40~+125	°C
Operating temperature	T <sub>OPR</sub>	-30~+85	°C
Power supply voltage	V <sub>DD</sub> max.	10	V
Input voltage	V <sub>I</sub>	-0.3~V <sub>DD</sub> +0.3	V

## Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating temperature	T <sub>OPR</sub>	-30~+85	°C
Power supply voltage	V <sub>OPR</sub>	+2.7~+9	V
Input voltage	V <sub>I</sub>	0~V <sub>DD</sub>	V

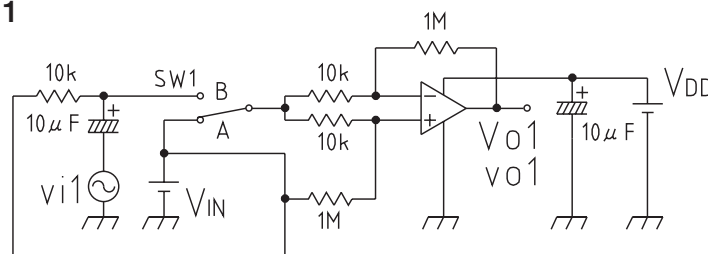
## Electrical Characteristics (Except where noted otherwise, Ta=25°C, V<sub>DD</sub>=3V, V<sub>IN</sub>=1.5V)

Item	Symbol	Measurement conditions	Measurement circuit	Min.	Typ.	Max.	Units
Input offset voltage	V <sub>OS</sub>	R <sub>S</sub> ≤ 10kΩ	1		1	3	mV
Input offset voltage temperature Drift	ΔV <sub>OS</sub> /ΔTa	Ta=30°C~+85°C	1		5		μV/°C
Input bias current	I <sub>B</sub>		2		5		pA
Common - mode signal rejection ratio	CMRR		1	60	70		dB
Power supply voltage rejection ratio	PSRR	V <sub>DD</sub> =3V~5V	1	70	90		dB
Current consumption	I <sub>DD</sub>		3	50	120	240	μA
Input voltage L	V <sub>IL</sub>		4		-0.1	0	V
Input voltage H	V <sub>IH</sub>		5	V <sub>DD</sub>	V <sub>DD</sub> +0.1		V
Voltage gain	A <sub>V</sub>	R <sub>L</sub> ≥ 100kΩ	6	80	95		dB
Gain band area	GBW	A <sub>V</sub> =0dB	6		800		kHz
Output voltage L	V <sub>OL</sub>		7		0.03	0.05	V
Output voltage H	V <sub>OH</sub>		8	2.95	2.97		V
Output flow current	I <sub>SO</sub>		9	2.5	5		mA
Output inflow current	I <sub>SI</sub>		10	2.5	5		mA
Through rate	SR		11		0.6		V/μS

NOTE1 Put capacitors of number μF between V<sub>DD</sub>-V<sub>SS</sub> when using.

## Measuring Circuit (Except where noted otherwise, Ta=25°C, V<sub>DD</sub>=3V, V<sub>IN</sub>=V<sub>DD</sub>/2, SW1;A)

### Measuring circuit 1

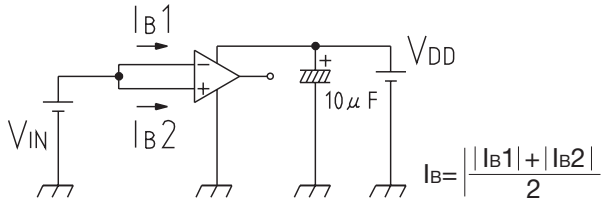


$$V_{OS} = \left| \frac{V_{O1} - V_{IN}}{100} \right|$$

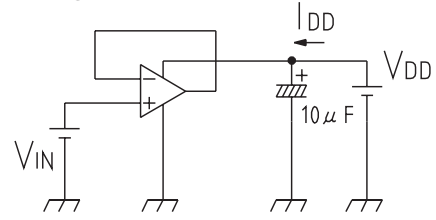
$$CMRR = 20 \log \left| \frac{100 \times v_{i1}}{v_{o1}} \right| \quad \text{SW1 ; B } v_{i1} = 1V_{(P-P)}$$

$$PSRR = 20 \log \left| \frac{(5-3) \times 100}{(v_{o1} - V_{IN1}) - (v_{o2} - V_{IN2})} \right| \quad V_{IN2}, V_{O2}; V_{DD} = 5V$$

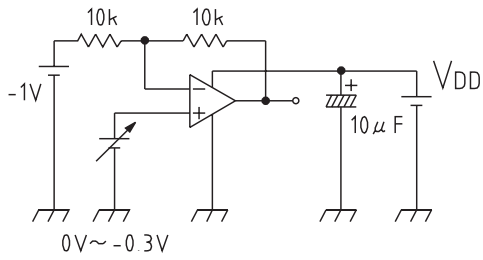
■ Measuring circuit 2



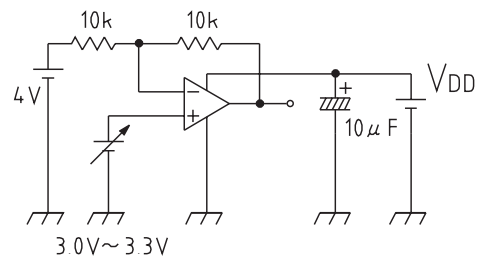
■ Measuring circuit 3



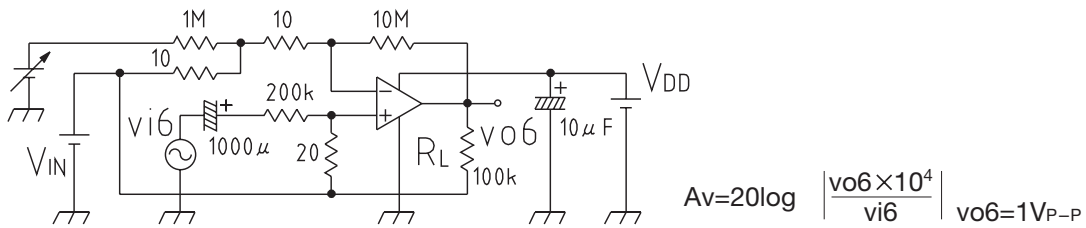
■ Measuring circuit 4



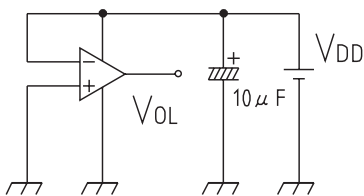
■ Measuring circuit 5



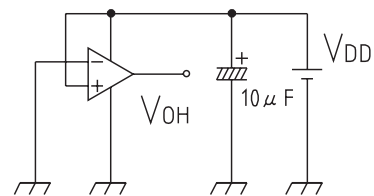
■ Measuring circuit 6



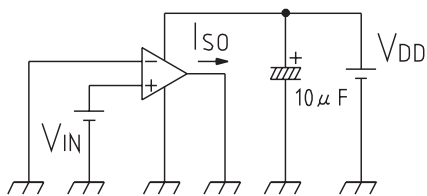
■ Measuring circuit 7



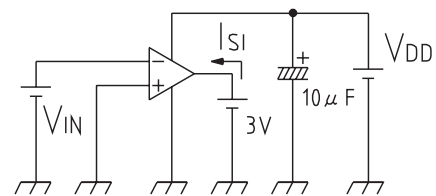
■ Measuring circuit 8



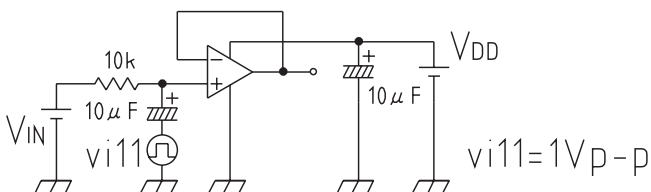
■ Measuring circuit 9



■ Measuring circuit 10

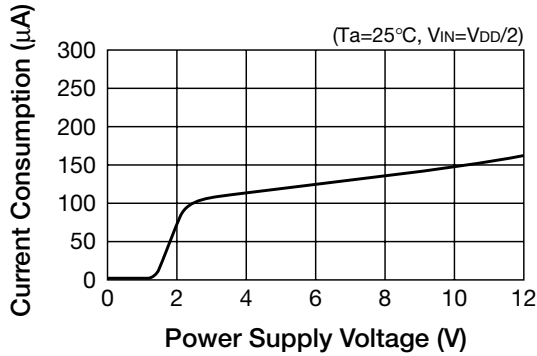


■ Measuring circuit 11

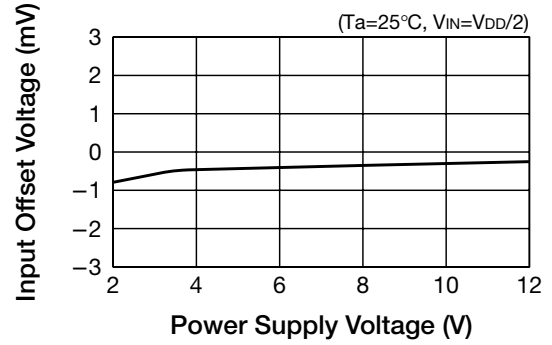


Characteristics

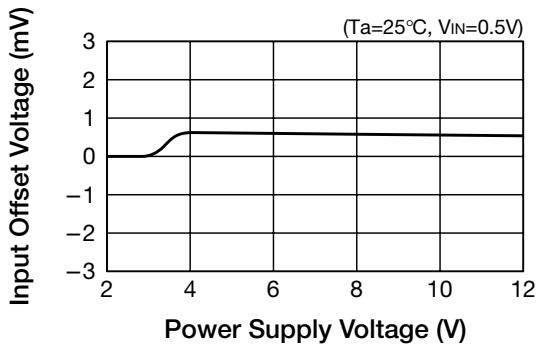
■ Current consumption vs power supply voltage



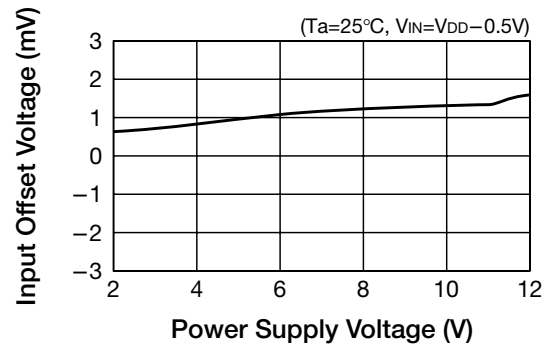
■ Input offset voltage vs power supply voltage



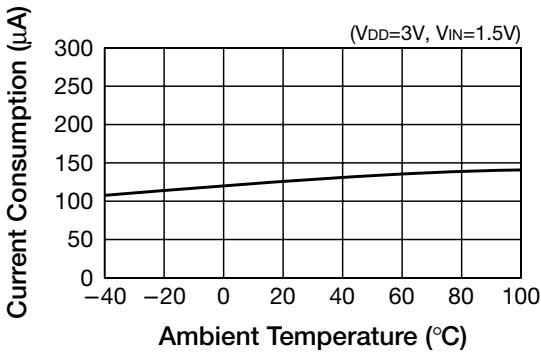
■ Input offset voltage vs power supply voltage



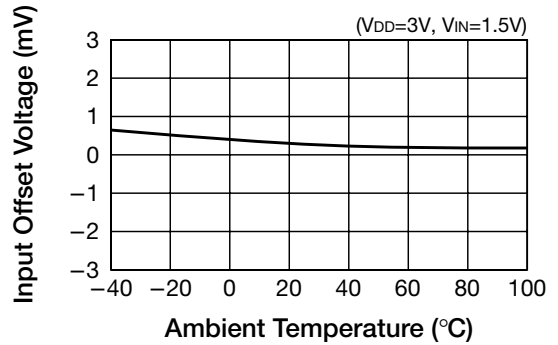
■ Input offset voltage vs power supply voltage



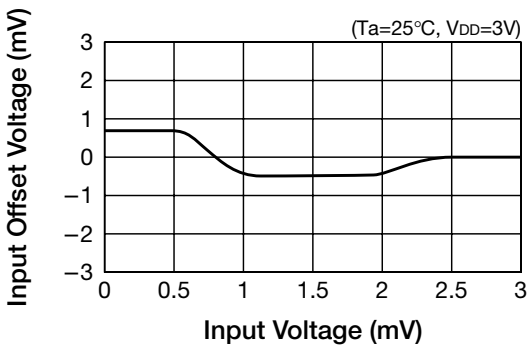
■ Current consumption vs ambient temperature



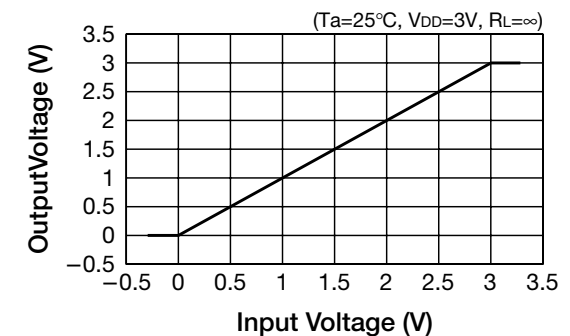
■ Input offset voltage vs ambient temperature



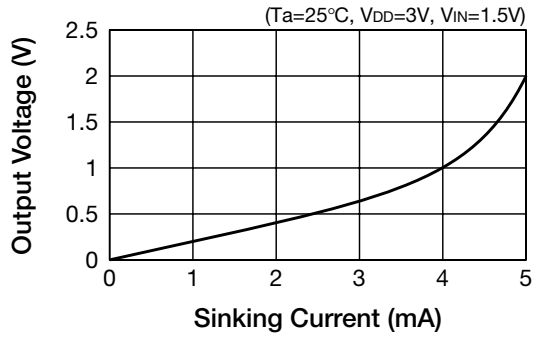
■ Input offset voltage vs input voltage



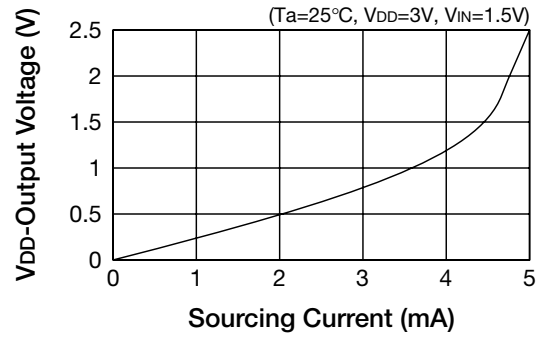
■ Output voltage vs input voltage



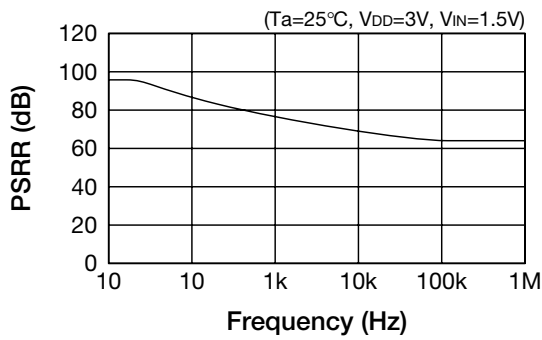
■ Output voltage vs sinking current



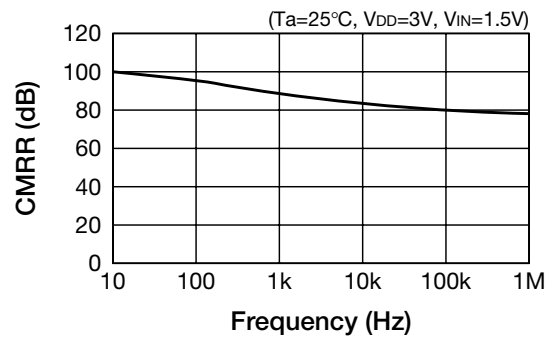
■ Output voltage vs sourcing current



■ PSRR vs frequency



■ CMRR vs frequency



■ Voltage gain vs frequency

