



# MC3476

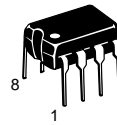
## Low Cost Programmable Operational Amplifier

The MC3476 is a low cost selection of the popular industry standard MC1776 programmable operational amplifier. This extremely versatile operational amplifier features low power consumption and high input impedance. In addition, the quiescent currents within the device may be programmed by the choice of an external resistor value or current source applied to the  $I_{set}$  input. This allows the amplifier's characteristics to be optimized for input current and power consumption despite wide variations in operating power supply voltages.

- $\pm 6.0$  V to  $\pm 18$  V Operation
- Wide Programming Range
- Offset Null Capability
- No Frequency Compensation Required
- Low Input Bias Currents
- Short Circuit Protection

### LOW COST PROGRAMMABLE OPERATIONAL AMPLIFIER

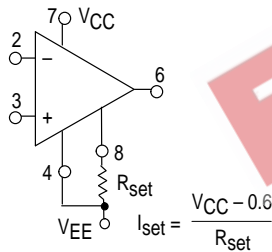
#### SEMICONDUCTOR TECHNICAL DATA



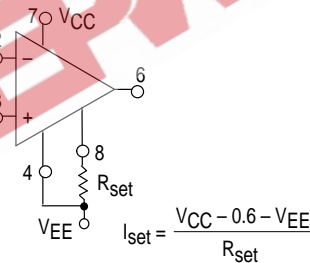
**P1 SUFFIX**  
PLASTIC PACKAGE  
CASE 626

#### Resistive Programming (See Figure 1)

##### $R_{set}$ to Ground



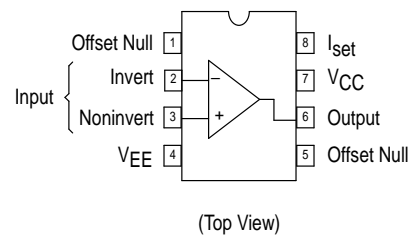
##### $R_{set}$ to Negative Supply (Recommended for supply voltage less than $\pm 6.0$ V)



Typical $R_{set}$ Values		
$V_{CC}, V_{EE}$	$I_{set} = 1.5 \mu A$	$I_{set} = 15 \mu A$
$\pm 6.0$ V	3.6 M $\Omega$	360 k $\Omega$
$\pm 10$ V	6.2 M $\Omega$	620 k $\Omega$
$\pm 12$ V	7.5 M $\Omega$	750 k $\Omega$
$\pm 15$ V	10 M $\Omega$	1.0 M $\Omega$

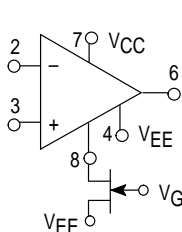
Typical $R_{set}$ Values		
$V_{CC}, V_{EE}$	$I_{set} = 1.5 \mu A$	$I_{set} = 15 \mu A$
+1.5 V	1.6 M $\Omega$	160 k $\Omega$
+3.0 V	3.6 M $\Omega$	360 k $\Omega$
+6.0 V	7.5 M $\Omega$	750 k $\Omega$
+15 V	20 M $\Omega$	2.0 M $\Omega$

#### PIN CONNECTIONS

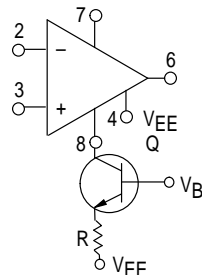


#### Active Programming

##### FET Current Source



##### Bipolar Current Source



Pins not shown are not connected.

#### ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC3476P1	$T_A = 0^\circ$ to $+70^\circ C$	Plastic DIP

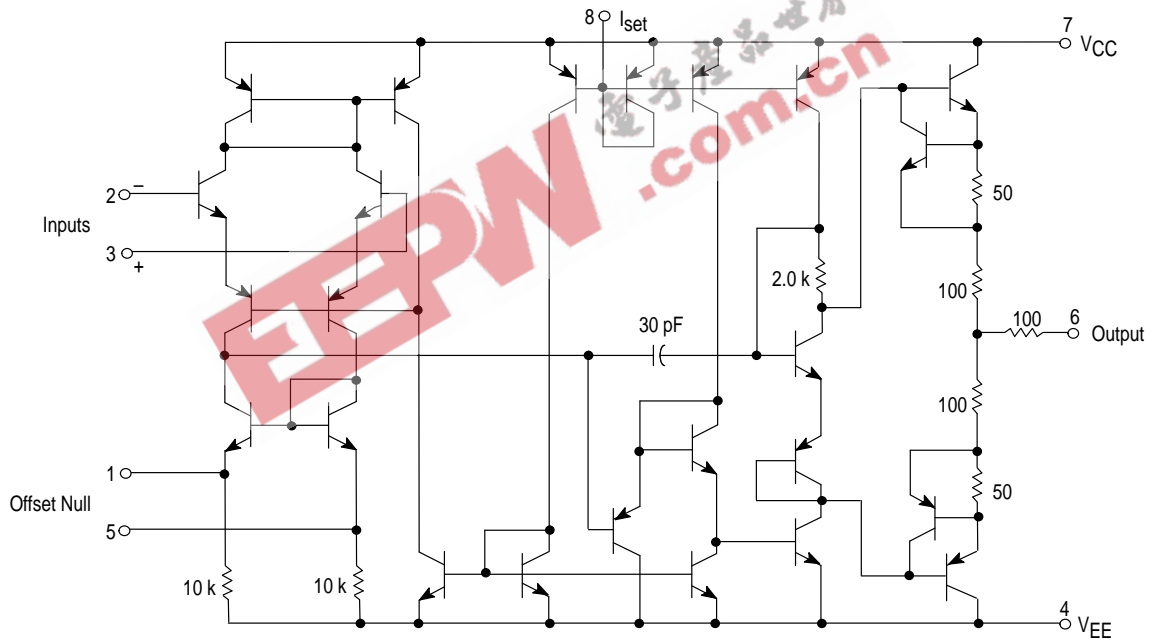
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**MAXIMUM RATINGS** ( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

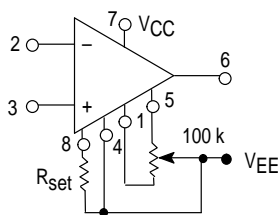
Rating	Symbol	Value	Unit
Power Supply Voltages	$V_{CC}, V_{EE}$	$\pm 18$	Vdc
Input Differential Voltage Range	$V_{IDR}$	$\pm 30$	Vdc
Input Common Mode Voltage Range	$V_{ICR}$	$V_{CC}, V_{EE}$	Vdc
Offset Null to $V_{EE}$ Voltage	$V_{off} - V_{EE}$	$\pm 0.5$	Vdc
Programming Current	$I_{set}$	200	$\mu\text{A}$
Programming Voltage (Voltage from $I_{set}$ Terminal to Ground)	$V_{set}$	$(V_{CC} - 0.6 \text{ V})$ to $V_{CC}$	Vdc
Output Short Circuit Duration (Note 1)	$t_{SC}$	Indefinite	sec
Operating Ambient Temperature Range	$T_A$	0 to $+70$	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	$-55$ to $+125$	$^\circ\text{C}$
Junction Temperature	$T_J$	150	$^\circ\text{C}$

**NOTES:** 1. Short circuit to ground with  $I_{set} \leq 15 \mu\text{A}$ . Rating applies up to ambient temperature of  $+70^\circ\text{C}$ .

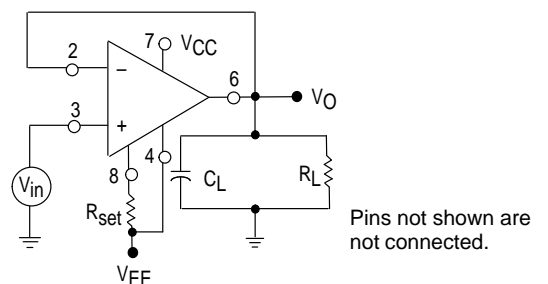
## Representative Schematic Diagram



### Voltage Offset Null Circuit



### Transient Response Test Circuit



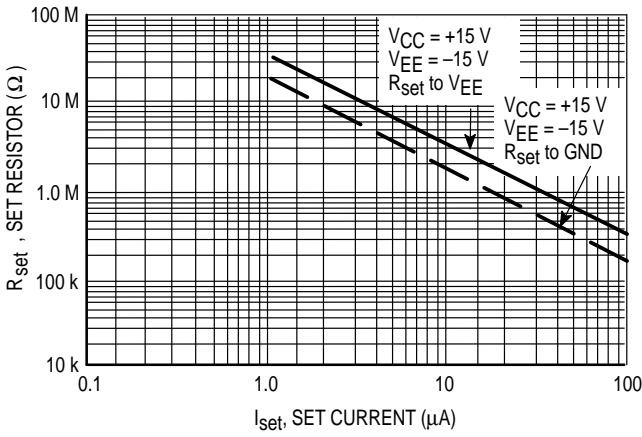
## MC3476

**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = +15\text{ V}$ ,  $V_{EE} = -15\text{ V}$ ,  $I_{set} = 15\text{ }\mu\text{A}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise noted).

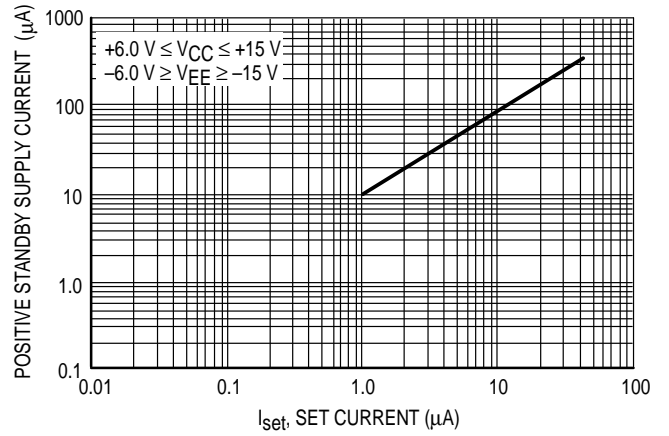
Characteristic	Symbol	Min	Typ	Max	Unit
Input Offset voltage ( $R_S \leq 10\text{ k}\Omega$ ) $T_A = +25^\circ\text{C}$ $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	$V_{IO}$	– –	2.0 –	6.0 7.5	mV
Offset Voltage Adjustment Range	$V_{IOR}$	–	18	–	mV
Input Offset Current $T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$ $T_A = 0^\circ\text{C}$	$I_{IO}$	– – –	20 – –	25 25 40	nA
Input Bias Current $T_A = +25^\circ\text{C}$ $T_A = +70^\circ\text{C}$ $T_A = 0^\circ\text{C}$	$I_{IB}$	– – –	15 – –	50 50 100	nA
Input Resistance	$r_i$	–	5.0	–	$\text{M}\Omega$
Input Capacitance	$C_i$	–	2.0	–	pF
Input Common Mode Voltage Gain $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	$V_{ICR}$	$\pm 10$	–	–	V
Large Signal Voltage Gain $R_L \geq 10\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$ , $T_A = +25^\circ\text{C}$ $R_L \geq 10\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$ , $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	$A_{VOL}$	50 k 25 k	400 k –	– –	V/V
Output Voltage Range $R_L \geq 10\text{ k}\Omega$ , $T_A = +25^\circ\text{C}$ $R_L \geq 10\text{ k}\Omega$ , $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	$V_{OR}$	$\pm 12$ $\pm 12$	$\pm 13$ –	– –	V
Output Resistance	$r_o$	–	1.0	–	$\text{k}\Omega$
Output Short Circuit Current	$I_{SC}$	–	12	–	mA
Common Mode Rejection $R_S \leq 10\text{ k}\Omega$ , $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	CMR	70	90	–	dB
Supply Voltage Rejection Ratio $R_S \leq 10\text{ k}\Omega$ , $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	PSRR	–	25	200	$\mu\text{V/V}$
Supply Current $T_A = +25^\circ\text{C}$ $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	$I_{CC}$ , $I_{EE}$	– –	160 –	200 225	$\mu\text{A}$
Power Dissipation $T_A = +25^\circ\text{C}$ $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$	$P_D$	– –	4.8 –	6.0 6.75	mW
Transient Response (Unity Gain) $V_{in} = 20\text{ mV}$ , $R_L \geq 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$ Rise Time Overshoot	$t_{TLH}$ $os$	– –	0.35 10	– –	$\mu\text{s}$ %
Slew Rate ( $R_L \geq 10\text{ k}\Omega$ )	SR	–	0.8	–	$\text{V}/\mu\text{s}$

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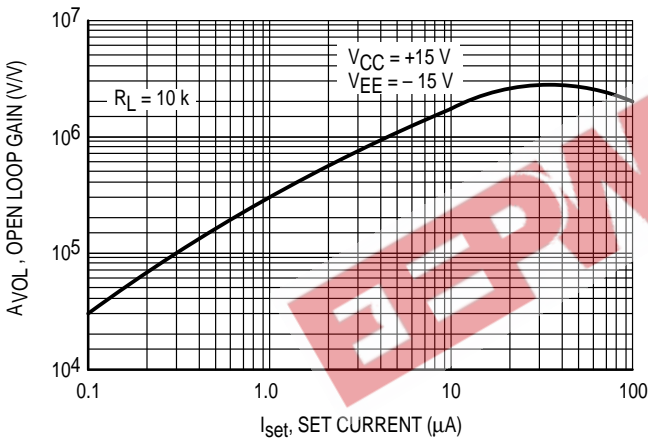
**Figure 1. Set Current versus Set Resistor**



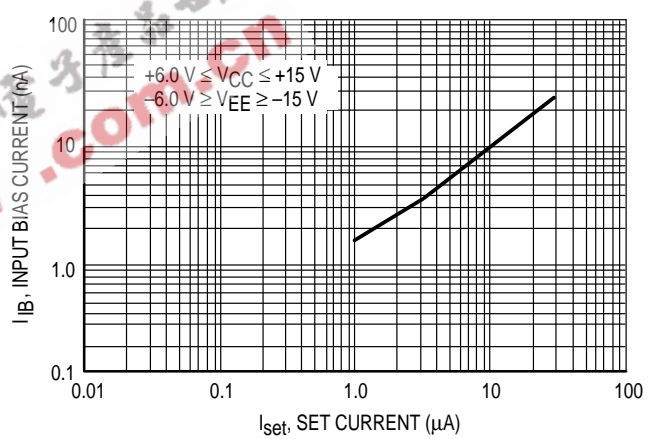
**Figure 2. Positive Standby Supply Current versus Set Current**



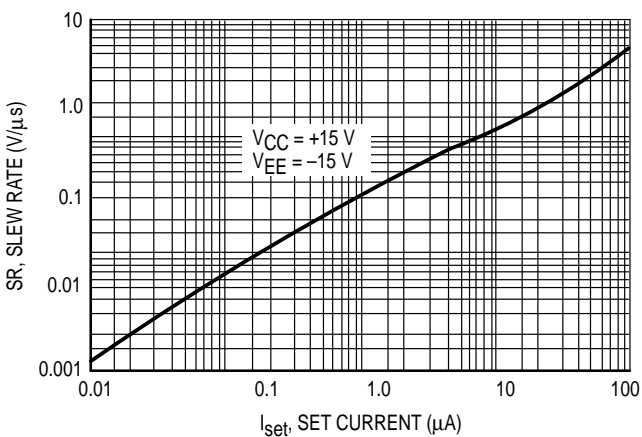
**Figure 3. Open Loop versus Set Current**



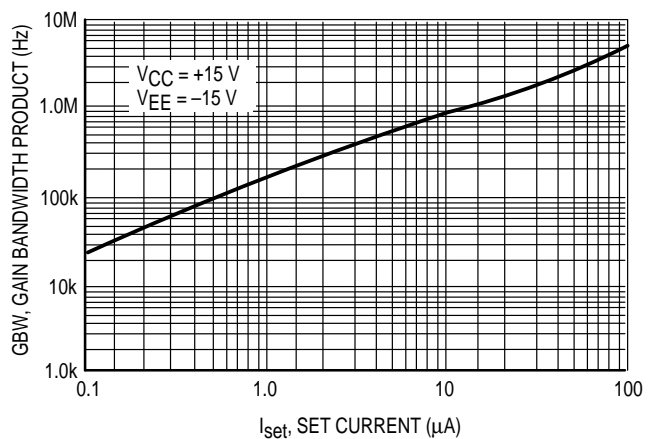
**Figure 4. Input Bias Current versus Set Current**



**Figure 5. Slew Rate versus Set Current**



**Figure 6. Gain Bandwidth Product versus Set Current**



# MC3476

Figure 7. Output Voltage Swing versus Load Resistance

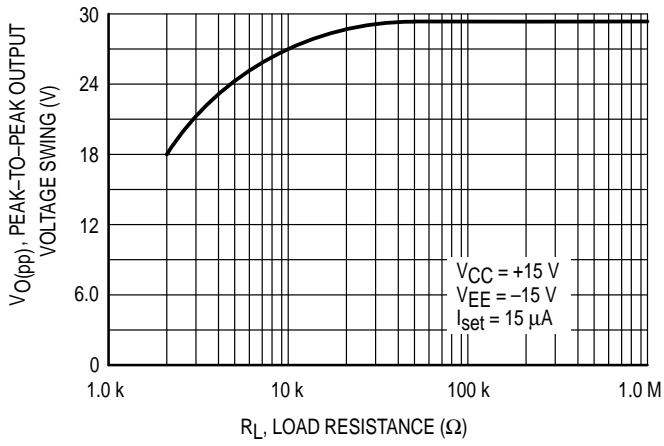
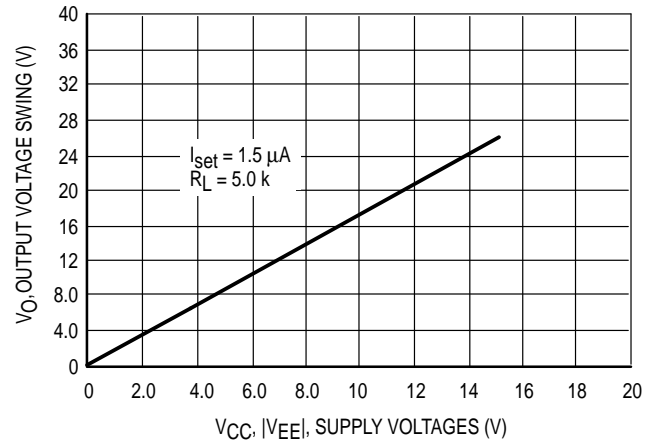


Figure 8. Output Voltage Swing versus Supply Voltage

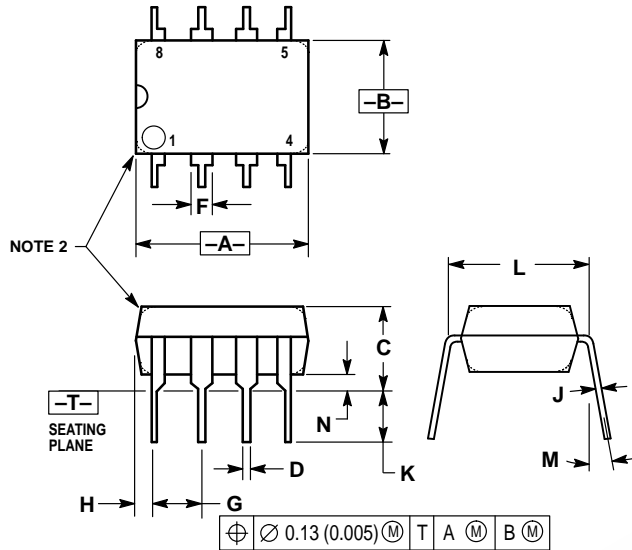


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## OUTLINE DIMENSIONS

P1 SUFFIX  
PLASTIC PACKAGE  
CASE 626-05  
ISSUE K



NOTES:


1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	—		10°	
N	0.76	1.01	0.030	0.040

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