INTERSIL

# μA777
# Precision Operational Amplifier

## FEATURES

- Low offset voltage and offset current
- Low offset voltage and current drift
- Low input bias current
- Low input noise voltage
- Large common mode and differential voltage ranges

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage .......................... ±22V
Internal Power Dissipation (Note 1)
Metal Can .......................... 500mW
Differential Input Voltage .................. ±30V
Input Voltage (Note 2) ..................... ±15V
Storage Temperature Range ...... −65°C to +150°C
Operating Temperature Range (HC) ....... 0°C to 70°C
(HM) .. −55°C to +125°C
Lead Temperature (Soldering, 10s) ........... 300°C
...................................... 260°C
Output Short Circuit Duration (Note 3) ..... Indefinite

**Note 1:** Rating applies to ambient temperatures up to 70°C. Above 70°C ambient derate linearly at 6.3mW/°C for Metal Can, 8.3mW/°C for the DIP, and 5.6mW/°C for the Mini DIP.

**Note 2.** For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

**Note 3.** Short Circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C ambient temperature for $I_{SET} \leq 30\mu A$.

## ORDERING INFORMATION

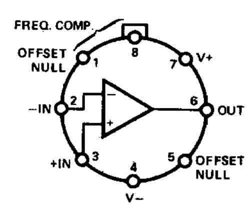
| | Dice | TO-99 Can |
|---|---|---|
| μA777C | μA777C/D | μA777HC |
| μA777M | μA777M/D | μA777MC |

## GENERAL DESCRIPTION

The μA777 is a monolithic Precision Operational Amplifier. It is an excellent choice when performance versus cost trade-offs are possible between super beta or FET input operational amplifiers and low cost general purpose operational amplifiers. Low offset and bias currents improve system accuracy when used in applications such as long term integrators, sample and hold circuits and high source impedance summing amplifiers. Even though the input bias current is extremely low, the μA777 maintains full ±30V differential voltage range. High common mode input voltage range, latch-up protection, short circuit protection and simple frequency compensation make the device versatile and easily used.

## PIN CONFIGURATION

**8-LEAD METAL CAN**
(TOP VIEW)




(outline dwg TY)

**ELECTRICAL CHARACTERISTICS FOR µA777** ($V_S$ = ±15V, $T_A$ = 25°C, $C_C$ = 30pF unless otherwise specified)

| PARAMETERS | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Input Offset Voltage | $R_S \leq 50k\Omega$ | | 0.7 | 5.0 | mV |
| Input Offset Current | | | 0.7 | 20.0 | nA |
| Input Bias Current | | | 25 | 100 | nA |
| Input Resistance | | 1.0 | 2.0 | | MΩ |
| Input Capacitance | | | 3.0 | | pF |
| Offset Voltage Adjustment Range | | | ±25 | | mV |
| Large Signal Voltage Gain | $R_L \geq 2k\Omega$, $V_{OUT}$ = ±10V | 25,000 | 250,000 | | V/V |
| Output Resistance | | | 100 | | Ω |
| Output Short Circuit Current | | | ±25 | | mA |
| Supply Current | | | 1.9 | 2.8 | mA |
| Power Consumption | | | 60 | 85 | mW |
| Transient Response (Voltage Follower, Gain of 1) — Rise Time | $V_{IN}$ = 20mV, $C_C$ = 30pF, $R_L$ = 2kΩ, $C_L \leq$ 100pF | | 0.3 | | µs |
| Transient Response (Voltage Follower, Gain of 1) — Overshoot | | | 5.0 | | % |
| Slew Rate (Voltage Follower, Gain of 1) | $R_L \geq 2k\Omega$ | | 0.5 | | V/µs |
| Transient Response (Voltage Follower, Gain of 10) — Rise Time | $V_{IN}$ = 20mV, $C_C$ = 3.5pF, $R_L$ = 2kΩ, $C_L \leq$ 100pF | | 0.3 | | µs |
| Transient Response (Voltage Follower, Gain of 10) — Overshoot | | | 5.0 | | % |
| Slew Rate (Voltage Follower, Gain of 10) | $R_L \leq 2k\Omega$, $C_C$ = 3.5pF | | 5.5 | | V/µs |
| The following specifications apply over operating temperature range. | | | | | |
| Input Offset Voltage | $R_S \leq 50k\Omega$ | | 0.8 | 5.0 | mV |
| Average Input Offset Voltage Drift | $R_S \leq 50k\Omega$ | | 4.0 | 30 | µV/°C |
| Input Offset Current | | | | 40 | nA |
| Average Input Offset Current Drift | 25°C ≤ $T_A$ ≤ +70°C | | 0.01 | 10.3 | nA/°C |
| | 0°C ≤ $T_A$ ≤ +25°C | | 0.02 | 0.6 | nA/°C |
| Input Bias Current | | | | 200 | nA |
| Input Voltage Range | | ±12 | ±13 | | V |
| Common Mode Rejection Ratio | $R_S \leq 50k\Omega$ | 70 | 95 | | dB |
| Supply Voltage Rejection Ratio | $R_S \leq 50k\Omega$ | | 15 | 150 | µV/V |
| Large Signal Voltage Gain | $R_L \geq 2k\Omega$, $V_{OUT}$ = ±10V | 15,000 | | | V/V |
| Output Voltage Swing | $R_L \geq 10k\Omega$ | ±12 | ±14 | | V |
| | $R_L \geq 2k\Omega$ | ±10 | ±13 | | V |
| Power Consumption | | | 60 | 100 | mW |

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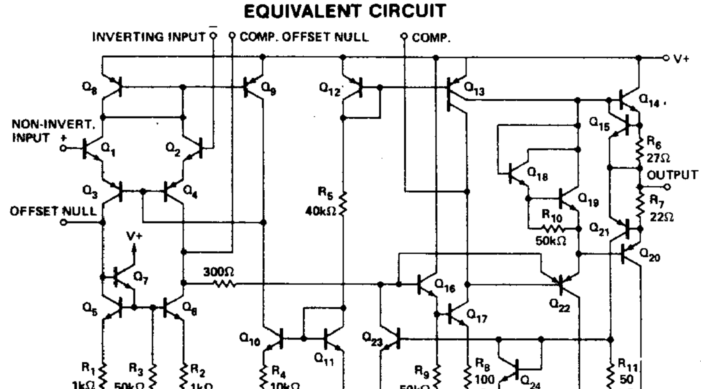
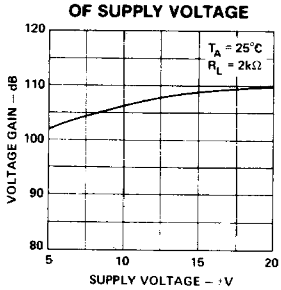
**EQUIVALENT CIRCUIT**

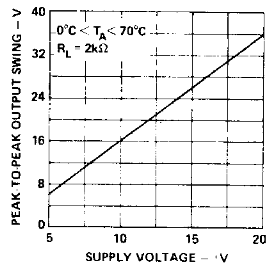


## TYPICAL PERFORMANCE CURVES

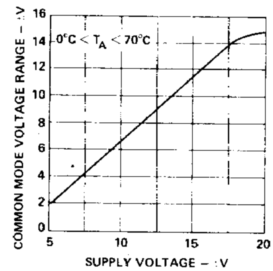
**OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGE**



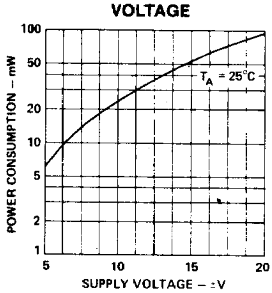

**OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE**



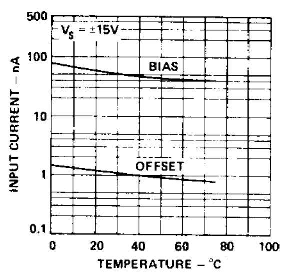

**INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE**



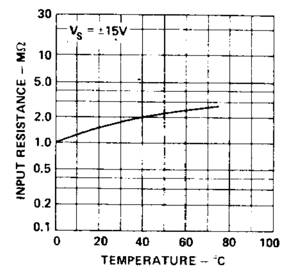

**POWER CONSUMPTION AS A FUNCTION OF SUPPLY VOLTAGE**



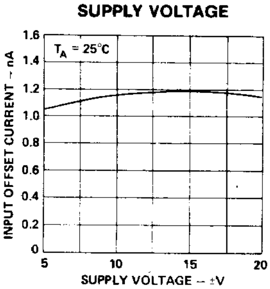

**INPUT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE**



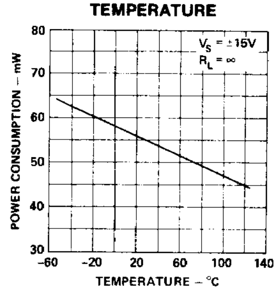

**INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE**



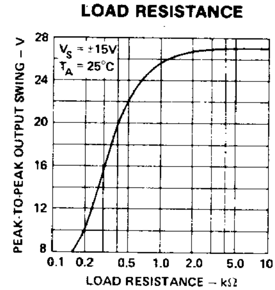

**INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGE**



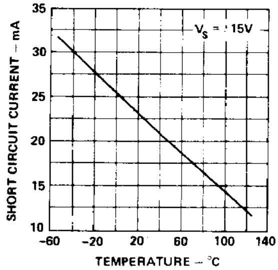

**POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE**



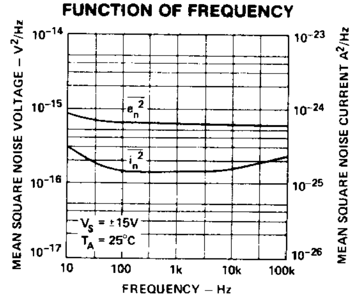

**OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE**




**OUTPUT SHORT-CIRCUIT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE**




**INPUT NOISE VOLTAGE AND CURRENT AS A FUNCTION OF FREQUENCY**



## TYPICAL PERFORMANCE CURVES

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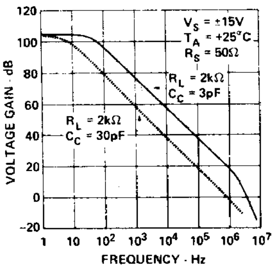
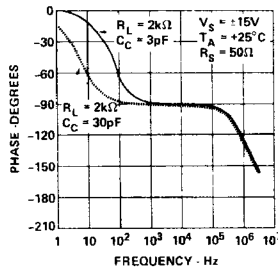
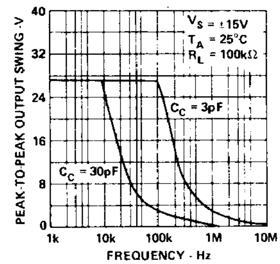
### OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY



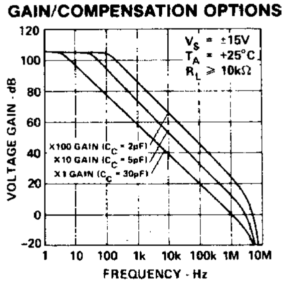

### OPEN LOOP PHASE RESPONSE AS A FUNCTION OF FREQUENCY



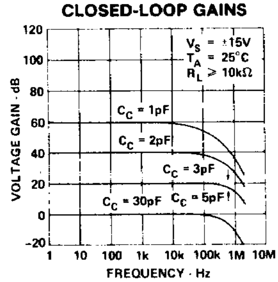

### OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY



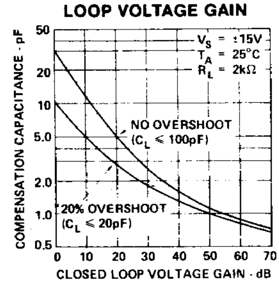

### OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY FOR VARIOUS GAIN/COMPENSATION OPTIONS



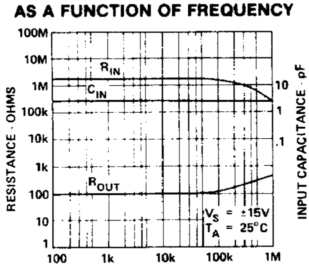

### FREQUENCY RESPONSE FOR VARIOUS CLOSED-LOOP GAINS



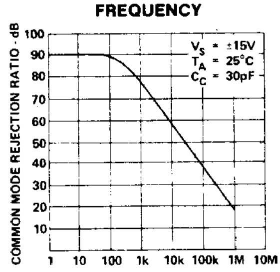

### COMPENSATION CAPACITANCE AS A FUNCTION OF CLOSED LOOP VOLTAGE GAIN



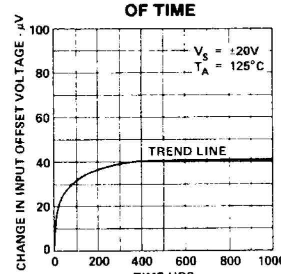

### INPUT RESISTANCE, OUTPUT RESISTANCE, AND INPUT CAPACITANCE AS A FUNCTION OF FREQUENCY



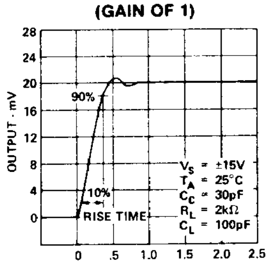

### COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



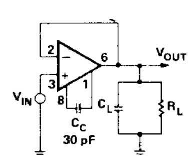

### INPUT OFFSET VOLTAGE DRIFT AS A FUNCTION OF TIME



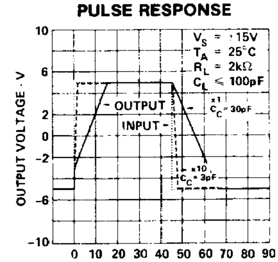

### VOLTAGE FOLLOWER TRANSIENT RESPONSE (GAIN OF 1)




### TRANSIENT RESPONSE TEST CIRCUIT

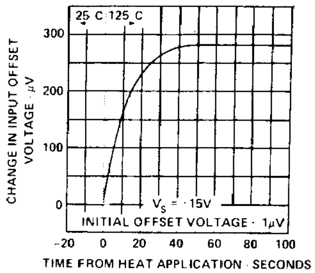



### VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE

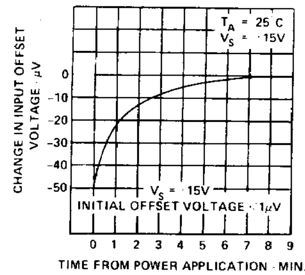


## TYPICAL PERFORMANCE CURVES

**THERMAL RESPONSE OF INPUT OFFSET VOLTAGE TO STEP CHANGE OF CASE TEMPERATURE**

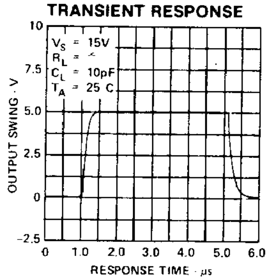


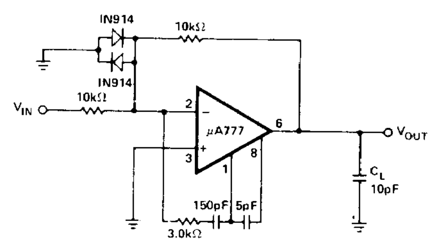

**STABILIZATION TIME OF INPUT OFF—SET VOLTAGE FROM POWER TURN-ON**



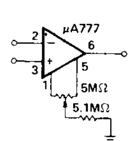

## FEED FORWARD COMPENSATION

**LARGE SIGNAL FEEDFORWARD TRANSIENT RESPONSE**

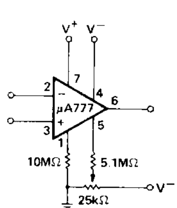



**VOLTAGE OFFSET NULL CIRCUIT**

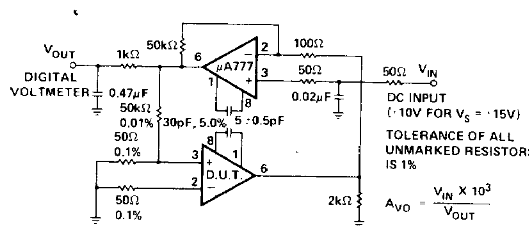



SUGGESTED



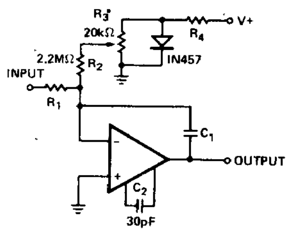

ALTERNATE

**GAIN TEST CIRCUIT**



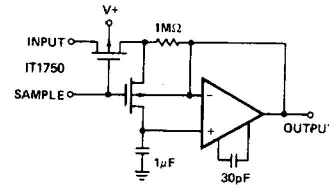
## TYPICAL APPLICATIONS

### BIAS COMPENSATED LONG TIME INTEGRATOR

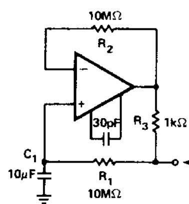



*ADJUST $R_3$ FOR MINIMUM INTEGRATOR DRIFT

### SAMPLE AND HOLD




### CAPACITANCE MULTIPLIER

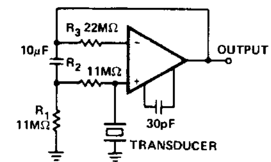



$$C = \frac{R_1}{R_3} C_1$$

$$I_L = \frac{V_{OS} + I_{OS} R_1}{R_3}$$

$$R_S = R_3$$

### AMPLIFIER FOR CAPACITANCE TRANSDUCERS




LOW FREQUENCY CUTOFF $R_1 \times C_1$

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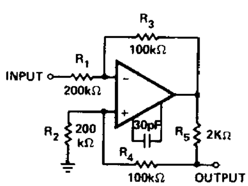
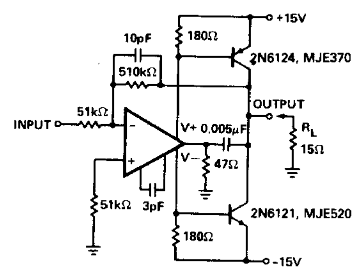
### BILATERAL CURRENT SOURCE

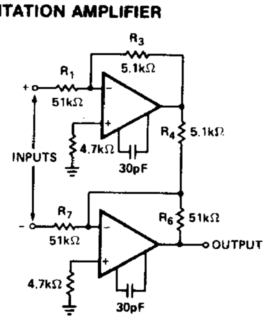



$$I_{OUT} = \frac{R_3 V_{IN}}{R_1 R_5}\ ;\ R_1 = R_2;\ R_3 = R_4 + R_5$$

### HIGH SLEW RATE POWER AMPLIFIER




### ±100V COMMON MODE RANGE INSTRUMENTATION AMPLIFIER



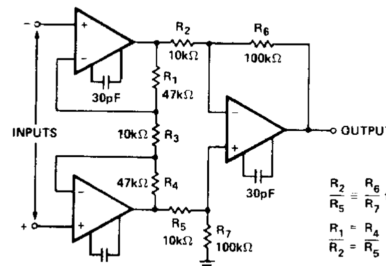

$$\frac{R_1}{R_7} \equiv \frac{R_3}{R_4} \text{ for best CMRR}$$

$$R_3 = R_4$$

$$R_1 = R_6 = 10R_3$$

$$\text{Gain} = \frac{R_7}{R_6}$$

### INSTRUMENTATION AMPLIFIER WITH HIGH COMMON MODE REJECTION




$$\frac{R_2}{R_5} \equiv \frac{R_6}{R_7} \text{ for best CMRR}$$

$$R_1 = R_4$$

$$R_2 = R_5$$

$$\text{Gain} = \frac{R_6}{R_2}\left(1 + \frac{2R_1}{R_3}\right)$$