

# $\mu$ A741/ $\mu$ A741C/SA741C General Purpose Operational Amplifier

## Product Specification

### Linear Products

#### DESCRIPTION

The  $\mu$ A741 is a high performance operational amplifier with high open-loop gain, internal compensation, high common mode range and exceptional temperature stability. The  $\mu$ A741 is short-circuit-protected and allows for nulling of offset voltage.

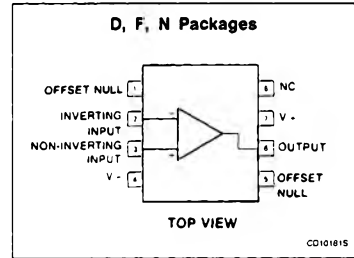
#### FEATURES

- Internal frequency compensation
- Short circuit protection
- Excellent temperature stability
- High input voltage range

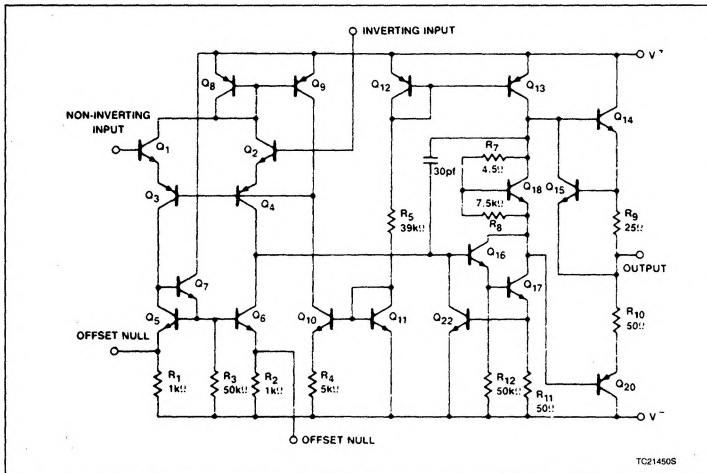
#### ORDERING INFORMATION

| DESCRIPTION       | TEMPERATURE RANGE | ORDER CODE   |
|-------------------|-------------------|--------------|
| 8-Pin Plastic DIP | -55°C to +125°C   | $\mu$ A741N  |
| 8-Pin Plastic DIP | 0 to +70°C        | $\mu$ A741CN |
| 8-Pin Plastic DIP | -40°C to +85°C    | SA741CN      |
| 8-Pin Cerdip      | -55°C to +125°C   | $\mu$ A741F  |
| 8-Pin Cerdip      | 0 to +70°C        | $\mu$ A741CF |
| 8-Pin SO          | 0 to +70°C        | $\mu$ A741CD |

#### PIN CONFIGURATION



#### EQUIVALENT SCHEMATIC



## General Purpose Operational Amplifier

 $\mu$ A741/ $\mu$ A741C/SA741C

## ABSOLUTE MAXIMUM RATINGS

| SYMBOL     | PARAMETER  | RATING      | UNIT |
|------------|--|-------------|------|
| $V_S$      | Supply voltage<br>$\mu$ A741C<br>$\mu$ A741                        | $\pm 18$    | V    |
|            |  | $\pm 22$    | V    |
| $P_D$      | Internal power dissipation   |             |      |
|            | D package  | 780         | mW   |
|            | N package  | 1170        | mW   |
|            | F package  | 800         | mW   |
| $V_{IN}$   | Differential input voltage   | $\pm 30$    | V    |
| $V_{IN}$   | Input voltage <sup>1</sup>   | $\pm 15$    | V    |
| $I_{sc}$   | Output short-circuit duration                                      | Continuous  |      |
| $T_A$      | Operating temperature range<br>$\mu$ A741C<br>SA741C<br>$\mu$ A741 | 0 to +70    | °C   |
|            |  | -40 to +85  | °C   |
|            |  | -55 to +125 | °C   |
| $T_{STG}$  | Storage temperature range  | -65 to +150 | °C   |
| $T_{SOLD}$ | Lead soldering temperature (10sec max)                             | 300         | °C   |

## NOTE:

1. For supply voltages less than  $\pm 15V$ , the absolute maximum input voltage is equal to the supply voltage.DC ELECTRICAL CHARACTERISTICS ( $\mu$ A741,  $\mu$ A741C)  $T_A = 25^\circ\text{C}$ ,  $V_S = \pm 15V$ , unless otherwise specified.

| SYMBOL                   | PARAMETER                       | TEST CONDITIONS  | $\mu$ A741 |          |      | $\mu$ A741C |          |     | UNIT                   |
|--------------------------|---------------------------------|--|------------|----------|------|-------------|----------|-----|------------------------|
|                          |                                 |  | Min        | Typ      | Max  | Min         | Typ      | Max |                        |
| $V_{OS}$                 | Offset voltage                  | $R_S = 10k\Omega$<br>$R_S = 10k\Omega$ , over temp.                                      |            | 1.0      | 5.0  |             | 2.0      | 6.0 | mV                     |
| $\Delta V_{OS}/\Delta T$ |                                 |  |            | 1.0      | 6.0  |             | 10       | 7.5 | mV/°C                  |
| $I_{OS}$                 | Offset current                  | Over temp.<br>$T_A = +125^\circ\text{C}$<br>$T_A = -55^\circ\text{C}$                    |            | 20       | 200  |             | 20       | 200 | nA                     |
| $\Delta I_{OS}/\Delta T$ |                                 |  |            | 7.0      | 200  |             | 200      | 300 | nA                     |
| $I_{BIAS}$               | Input bias current              | Over temp.<br>$T_A = +125^\circ\text{C}$<br>$T_A = -55^\circ\text{C}$                    |            | 80       | 500  |             | 80       | 500 | nA                     |
| $\Delta I_B/\Delta T$    |                                 |  |            | 30       | 500  |             | 1        | 800 | nA                     |
|                          |                                 |  |            | 300      | 1500 |             |          | nA  | nA/°C                  |
| $V_{OUT}$                | Output voltage swing            | $R_L = 10k\Omega$<br>$R_L = 2k\Omega$ , over temp.                                       | $\pm 12$   | $\pm 14$ |      | $\pm 12$    | $\pm 14$ |     | V                      |
|                          |                                 |  | $\pm 10$   | $\pm 13$ |      | $\pm 10$    | $\pm 13$ |     | V                      |
| $A_{VOL}$                | Large-signal voltage gain       | $R_L = 2k\Omega$ , $V_O = \pm 10V$<br>$R_L = 2k\Omega$ , $V_O = \pm 10V$ ,<br>over temp. | 50         | 200      |      | 20          | 200      |     | V/mV                   |
|                          |                                 |  | 25         |          |      | 15          |          |     | V/mV                   |
|                          | Offset voltage adjustment range |  |            | $\pm 30$ |      |             | $\pm 30$ |     | mV                     |
| PSRR                     | Supply voltage rejection ratio  | $R_S \leq 10k\Omega$<br>$R_S \leq 10k\Omega$ , over temp.                                |            | 10       | 150  |             | 10       | 150 | $\mu$ V/V<br>$\mu$ V/V |
| CMRR                     | Common-mode rejection ratio     | Over temp.   | 70         | 90       |      | 70          | 90       |     | dB<br>dB               |
| $I_{CC}$                 | Supply current                  | $T_A = +125^\circ\text{C}$<br>$T_A = -55^\circ\text{C}$                                  |            | 1.4      | 2.8  |             | 1.4      | 2.8 | mA                     |
|                          |                                 |  |            | 1.5      | 2.5  |             |          |     | mA                     |
|                          |                                 |  |            | 2.0      | 3.3  |             |          |     | mA                     |

## General Purpose Operational Amplifier

 $\mu A741/\mu A741C/SA741C$ **DC ELECTRICAL CHARACTERISTICS** (Continued) ( $\mu A741, \mu A741C$ )  $T_A = 25^\circ C, V_S = \pm 15V$ , unless otherwise specified.

| SYMBOL               | PARAMETER                               | TEST CONDITIONS                             | $\mu A741$      |                 |                 | $\mu A741C$     |                 |     | UNIT            |
|----------------------|---|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----|-----------------|
|                      |   |   | Min             | Typ             | Max             | Min             | Typ             | Max |                 |
| $V_{IN}$<br>$R_{IN}$ | Input voltage range<br>Input resistance | ( $\mu A741$ , over temp.)                  | $\pm 12$<br>0.3 | $\pm 13$<br>2.0 |                 | $\pm 12$<br>0.3 | $\pm 13$<br>2.0 |     | V<br>M $\Omega$ |
| $P_D$                | Power consumption                       | $T_A = +125^\circ C$<br>$T_A = -55^\circ C$ |                 | 50<br>45<br>45  | 85<br>75<br>100 |                 | 50<br>75<br>85  |     | mW<br>mW<br>mW  |
| $R_{OUT}$            | Output resistance                       |   |                 | 75              |                 |                 | 75              |     | $\Omega$        |
| $I_{SC}$             | Output short-circuit current            |   | 10              | 25              | 60              | 10              | 25              | 60  | mA              |

**DC ELECTRICAL CHARACTERISTICS** (SA741C)  $T_A = 25^\circ C, V_S = \pm 15V$ , unless otherwise specified.

| SYMBOL                               | PARAMETER                       | TEST CONDITIONS   | SA741C               |                      |             | UNIT                         |
|--------------------------------------|---------------------------------|---|----------------------|----------------------|-------------|------------------------------|
|                                      |                                 |   | Min                  | Typ                  | Max         |                              |
| $V_{OS}$<br>$\Delta V_{OS}/\Delta T$ | Offset voltage                  | $R_S = 10k\Omega$<br>$R_S = 10k\Omega$ , over temp.                             |                      | 2.0<br>10            | 6.0<br>7.5  | mV<br>mV<br>$\mu V/^\circ C$ |
| $I_{OS}$<br>$\Delta I_{OS}/\Delta T$ | Offset current                  | Over temp.  |                      | 20<br>200            | 200<br>500  | nA<br>nA<br>pA/°C            |
| $I_{BIAS}$<br>$\Delta I_B/\Delta T$  | Input bias current              | Over temp.  |                      | 80<br>1              | 500<br>1500 | nA<br>nA<br>nA/°C            |
| $V_{OUT}$                            | Output voltage swing            | $R_L = 10k\Omega$<br>$R_L = 2k\Omega$ , over temp.                              | $\pm 12$<br>$\pm 10$ | $\pm 14$<br>$\pm 13$ |             | V<br>V                       |
| $A_{VOL}$                            | Large-signal voltage gain       | $R_L = 2k\Omega, V_O = \pm 10V$<br>$R_L = 2k\Omega, V_O = \pm 10V$ , over temp. | 20<br>15             | 200                  |             | V/mV<br>V/mV                 |
|                                      | Offset voltage adjustment range |   |                      | $\pm 30$             |             | mV                           |
| PSRR                                 | Supply voltage rejection ratio  | $R_S \leq 10k\Omega$  |                      | 10                   | 150         | $\mu V/V$                    |
| CMRR                                 | Common mode rejection ratio     |   | 70                   | 90                   |             | dB                           |
| $V_{IN}$                             | Input voltage range             | Over temp.  | $\pm 12$             | $\pm 13$             |             | V                            |
| $R_{IN}$                             | Input resistance                |   | 0.3                  | 2.0                  |             | M $\Omega$                   |
| $P_d$                                | Power consumption               |   |                      | 50                   | 85          | mW                           |
| $R_{OUT}$                            | Output resistance               |   |                      | 75                   |             | $\Omega$                     |
| $I_{SC}$                             | Output short-circuit current    |   |                      | 25                   |             | mA                           |

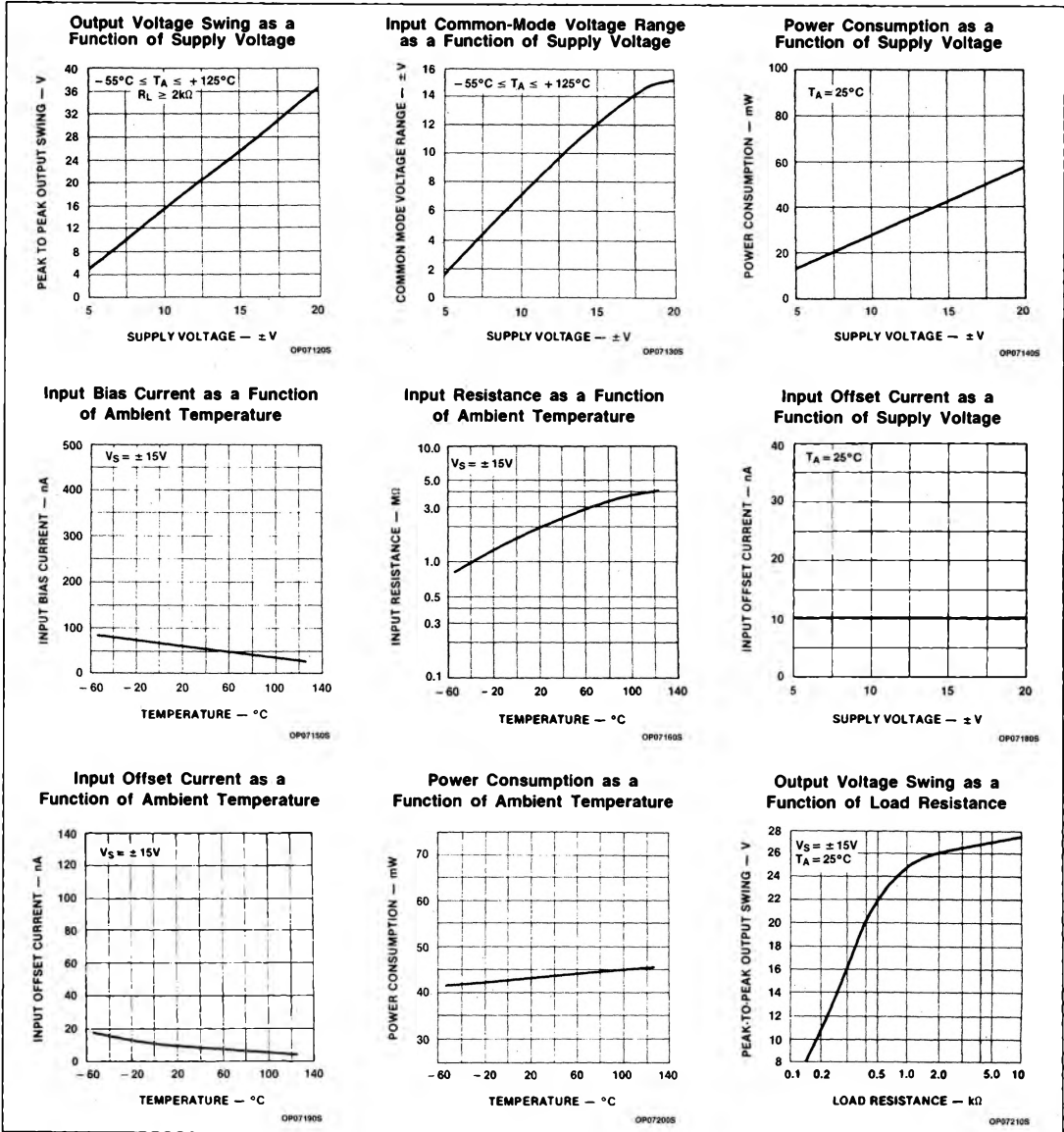
**AC ELECTRICAL CHARACTERISTICS**  $T_A = 25^\circ C, V_S = \pm 15V$ , unless otherwise specified.

| SYMBOL   | PARAMETER                                  | TEST CONDITIONS                                     | $\mu A741, \mu A741C$ |     |     | UNIT       |
|----------|--|---|-----------------------|-----|-----|------------|
|          |  |   | Min                   | Typ | Max |            |
| $R_{IN}$ | Parallel input resistance                  | Open-loop, $f = 20Hz$                               | 0.3                   |     |     | M $\Omega$ |
| $C_{IN}$ | Parallel input capacitance                 | Open-loop, $f = 20Hz$                               |                       | 1.4 |     | pF         |
|          | Unity gain crossover frequency             | Open-loop   |                       | 1.0 |     | MHz        |
| $t_R$    | Transient response unity gain<br>Rise time | $V_{IN} = 20mV, R_L = 2k\Omega, C_L \leq 100pF$     |                       | 0.3 |     | $\mu s$    |
|          | Overshoot                                  |   |                       | 5.0 |     | %          |
| SR       | Slew rate                                  | $C \leq 100pF, R_L \geq 2k\Omega, V_{IN} = \pm 10V$ |                       | 0.5 |     | V/ $\mu s$ |

# General Purpose Operational Amplifier

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## TYPICAL PERFORMANCE CHARACTERISTICS

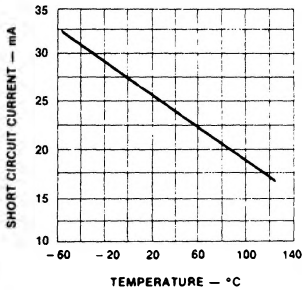


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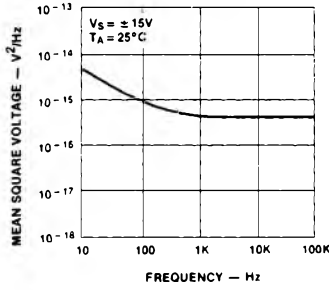
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### Output Short-Circuit Current as a Function of Ambient Temperature



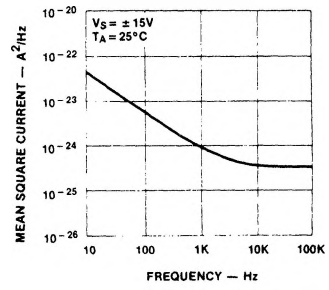
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### Input Noise Voltage as a Function of Frequency



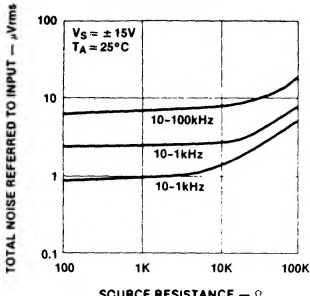
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### Input Noise Current as a Function of Frequency



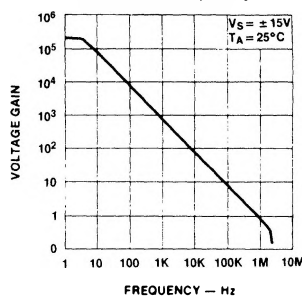
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### Broadband Noise for Various Bandwidths



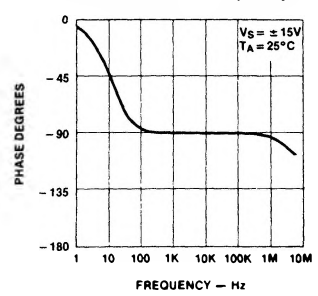
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### Open-Loop Voltage Gain as a Function of Frequency



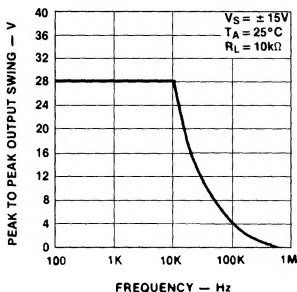
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### Open-Loop Phase Response as a Function of Frequency



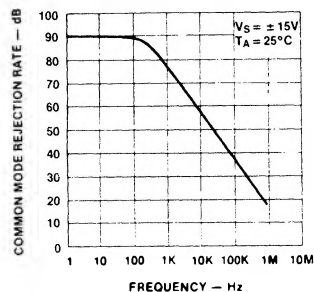
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### Output Voltage Swing as a Function of Frequency



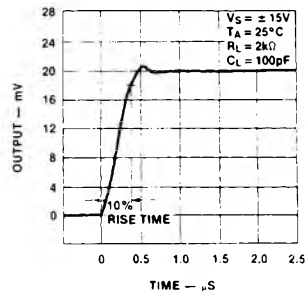
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### Common-Mode Rejection Ratio as a Function of Frequency



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### Transient Response



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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

