

# $\mu$ A7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

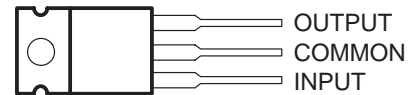
- 3-Terminal Regulators
- Output Current up to 1.5 A
- Internal Thermal-Overload Protection
- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Direct Replacements for Fairchild  $\mu$ A7800 Series

## description

This series of fixed-voltage monolithic integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators.

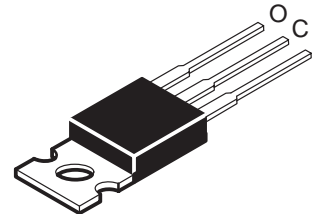
The  $\mu$ A7800C series is characterized for operation over the virtual junction temperature range of 0°C to 125°C.

KC PACKAGE  
(TOP VIEW)

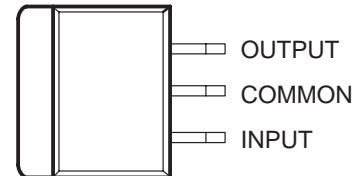


The COMMON terminal is in electrical contact with the mounting base.

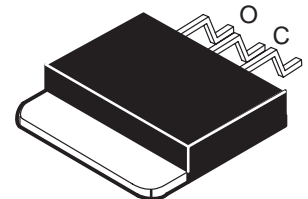
TO-220AB



KTE PACKAGE  
(TOP VIEW)



The COMMON terminal is in electrical contact with the mounting base.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

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# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

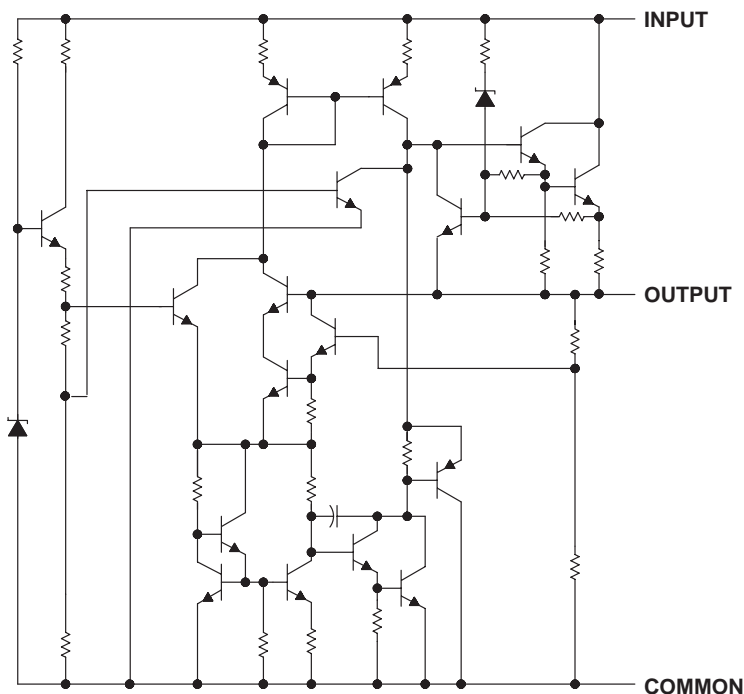
SLVS056E – MAY 1976 – REVISED JULY 1999

## AVAILABLE OPTIONS

| T <sub>J</sub> | V <sub>O(NOM)</sub><br>(V) | PACKAGED DEVICES                |                               | CHIP<br>FORM<br>(Y) |
|----------------|----------------------------|---------------------------------|-------------------------------|---------------------|
|                |                            | PLASTIC<br>FLANGE-MOUNT<br>(KC) | HEAT-SINK<br>MOUNTED<br>(KTE) |                     |
| 0°C to 125°C   | 5                          | μA7805CKC                       | μA7805CKTE                    | μA7805Y             |
|                | 6                          | μA7806CKC                       | μA7806CKTE                    | μA7806Y             |
|                | 8                          | μA7808CKC                       | μA7808CKTE                    | μA7808Y             |
|                | 8.5                        | μA7885CKC                       | μA7885CKTE                    | μA7885Y             |
|                | 10                         | μA7810CKC                       | μA7810CKTE                    | μA7810Y             |
|                | 12                         | μA7812CKC                       | μA7812CKTE                    | μA7812Y             |
|                | 15                         | μA7815CKC                       | μA7815CKTE                    | μA7815Y             |
|                | 18                         | μA7818CKC                       | μA7818CKTE                    | μA7818Y             |
|                | 24                         | μA7824CKC                       | μA7824CKTE                    | μA7824Y             |

The KTE package is only available taped and reeled. Add the suffix R to the device type (e.g., μA7805CKTER). Chip forms are tested at 25°C.

## schematic



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SLVS056E – MAY 1976 – REVISED JULY 1999

## absolute maximum ratings over operating temperature ranges (unless otherwise noted)†

|  |             | μA78xx     | UNIT |
|--|-------------|------------|------|
| Input voltage, $V_I$   | μA7824C     | 40         | V    |
|  | All others  | 35         |      |
| Virtual junction temperature range, $T_J$                    |             | 0 to 150   | °C   |
| Package thermal impedance, $\theta_{JA}$ (see Notes 1 and 2) | KC package  | 22         | °C   |
|  | KTE package | 23         |      |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds |             | 260        | °C   |
| Storage temperature range, $T_{stg}$                         |             | -65 to 150 | °C   |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can impact reliability. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

2. The package thermal impedance is calculated in accordance with JE5D 51, except for through-hole packages, which use a trace length of zero.

## recommended operating conditions

|   |         | MIN            | MAX | UNIT |    |
|---|---------|----------------|-----|------|----|
| Input voltage, $V_I$                          | μA7805C | 7              | 25  | V    |    |
|   | μA7806C | 8              | 25  |      |    |
|   | μA7808C | 10.5           | 25  |      |    |
|   | μA7885C | 10.5           | 25  |      |    |
|   | μA7810C | 12.5           | 28  |      |    |
|   | μA7812C | 14.5           | 30  |      |    |
|   | μA7815C | 17.5           | 30  |      |    |
|   | μA7818C | 21             | 33  |      |    |
|   | μA7824C | 27             | 38  |      |    |
| Output current, $I_O$                         |         |                | 1.5 | A    |    |
| Operating virtual junction temperature, $T_J$ |         | μA7800C series | 0   | 125  | °C |



# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

electrical characteristics at specified virtual junction temperature,  $V_I = 10\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

| PARAMETER                                 | TEST CONDITIONS   | $T_J$ †      | μA7805C |     |      | UNIT  |
|---|---|--------------|---------|-----|------|-------|
|   |   |              | MIN     | TYP | MAX  |       |
| Output voltage                            | $I_O = 5\text{ mA to }1\text{ A}$ ,<br>$P_D \leq 15\text{ W}$ | 25°C         | 4.8     | 5   | 5.2  | V     |
|   |   | 0°C to 125°C | 4.75    |     | 5.25 |       |
| Input voltage regulation                  | $V_I = 7\text{ V to }25\text{ V}$                             | 25°C         |         | 3   | 100  | mV    |
|   | $V_I = 8\text{ V to }12\text{ V}$                             |              |         | 1   | 50   |       |
| Ripple rejection                          | $V_I = 8\text{ V to }18\text{ V}$ ,<br>$f = 120\text{ Hz}$    | 0°C to 125°C | 62      | 78  |      | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                           | 25°C         |         | 15  | 100  | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                        |              |         | 5   | 50   |       |
| Output resistance                         | $f = 1\text{ kHz}$  | 0°C to 125°C | 0.017   |     |      | Ω     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$   | 0°C to 125°C | -1.1    |     |      | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                          | 25°C         | 40      |     |      | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$  | 25°C         | 2       |     |      | V     |
| Bias current                              |   | 25°C         | 4.2     | 8   |      | mA    |
| Bias current change                       | $V_I = 7\text{ V to }25\text{ V}$                             | 0°C to 125°C |         |     | 1.3  | mA    |
|   | $I_O = 5\text{ mA to }1\text{ A}$                             |              |         |     | 0.5  |       |
| Short-circuit output current              |   | 25°C         | 750     |     |      | mA    |
| Peak output current                       |   | 25°C         | 2.2     |     |      | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

electrical characteristics at specified virtual junction temperature,  $V_I = 11\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

| PARAMETER                                 | TEST CONDITIONS   | $T_J$ †      | μA7806C |     |      | UNIT  |
|---|---|--------------|---------|-----|------|-------|
|   |   |              | MIN     | TYP | MAX  |       |
| Output voltage                            | $I_O = 5\text{ mA to }1\text{ A}$ ,<br>$P_D \leq 15\text{ W}$ | 25°C         | 5.75    | 6   | 6.25 | V     |
|   |   | 0°C to 125°C | 5.7     |     | 6.3  |       |
| Input voltage regulation                  | $V_I = 8\text{ V to }25\text{ V}$                             | 25°C         |         | 5   | 120  | mV    |
|   | $V_I = 9\text{ V to }13\text{ V}$                             |              |         | 1.5 | 60   |       |
| Ripple rejection                          | $V_I = 9\text{ V to }19\text{ V}$ ,<br>$f = 120\text{ Hz}$    | 0°C to 125°C | 59      | 75  |      | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                           | 25°C         |         | 14  | 120  | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                        |              |         | 4   | 60   |       |
| Output resistance                         | $f = 1\text{ kHz}$  | 0°C to 125°C | 0.019   |     |      | Ω     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$   | 0°C to 125°C | -0.8    |     |      | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                          | 25°C         | 45      |     |      | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$  | 25°C         | 2       |     |      | V     |
| Bias current                              |   | 25°C         | 4.3     | 8   |      | mA    |
| Bias current change                       | $V_I = 8\text{ V to }25\text{ V}$                             | 0°C to 125°C |         |     | 1.3  | mA    |
|   | $I_O = 5\text{ mA to }1\text{ A}$                             |              |         |     | 0.5  |       |
| Short-circuit output current              |   | 25°C         | 550     |     |      | mA    |
| Peak output current                       |   | 25°C         | 2.2     |     |      | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

**electrical characteristics at specified virtual junction temperature,  $V_I = 14$  V,  $I_O = 500$  mA (unless otherwise noted)**

| PARAMETER                                 | TEST CONDITIONS  | $T_J$ †      | μA7808C |     |     | UNIT  |    |
|---|--|--------------|---------|-----|-----|-------|----|
|   |  |              | MIN     | TYP | MAX |       |    |
| Output voltage                            | $I_O = 5$ mA to 1 A, $V_I = 10.5$ V to 23 V, $P_D \leq 15$ W | 25°C         | 7.7     | 8   | 8.3 | V     |    |
|   |  | 0°C to 125°C |         |     | 8.4 |       |    |
| Input voltage regulation                  | $V_I = 10.5$ V to 25 V                                       | 25°C         |         | 6   | 160 | mV    |    |
|   | $V_I = 11$ V to 17 V   |              |         | 2   | 80  |       |    |
| Ripple rejection                          | $V_I = 11.5$ V to 21.5 V, $f = 120$ Hz                       | 0°C to 125°C | 55      | 72  |     | dB    |    |
| Output voltage regulation                 | $I_O = 5$ mA to 1.5 A  | 25°C         |         | 12  | 160 | mV    |    |
|   | $I_O = 250$ mA to 750 mA                                     |              |         | 4   | 80  |       |    |
| Output resistance                         | $f = 1$ kHz  | 0°C to 125°C | 0.016   |     |     | Ω     |    |
| Temperature coefficient of output voltage | $I_O = 5$ mA   | 0°C to 125°C | -0.8    |     |     | mV/°C |    |
| Output noise voltage                      | $f = 10$ Hz to 100 kHz                                       | 25°C         | 52      |     |     | μV    |    |
| Dropout voltage                           | $I_O = 1$ A  | 25°C         | 2       |     |     | V     |    |
| Bias current                              |  | 25°C         | 4.3     |     |     | 8 mA  |    |
| Bias current change                       | $V_I = 10.5$ V to 25 V                                       | 0°C to 125°C |         |     |     | 1     | mA |
|   | $I_O = 5$ mA to 1 A  |              |         |     |     | 0.5   |    |
| Short-circuit output current              |  | 25°C         | 450     |     |     | mA    |    |
| Peak output current                       |  | 25°C         | 2.2     |     |     | A     |    |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

**electrical characteristics at specified virtual junction temperature,  $V_I = 15$  V,  $I_O = 500$  mA (unless otherwise noted)**

| PARAMETER                                 | TEST CONDITIONS  | $T_J$ †      | μA7885C |     |      | UNIT  |    |
|---|--|--------------|---------|-----|------|-------|----|
|   |  |              | MIN     | TYP | MAX  |       |    |
| Output voltage                            | $I_O = 5$ mA to 1 A, $V_I = 11$ V to 23.5 V, $P_D \leq 15$ W | 25°C         | 8.15    | 8.5 | 8.85 | V     |    |
|   |  | 0°C to 125°C |         |     | 8.9  |       |    |
| Input voltage regulation                  | $V_I = 10.5$ V to 25 V                                       | 25°C         |         | 6   | 170  | mV    |    |
|   | $V_I = 11$ V to 17 V   |              |         | 2   | 85   |       |    |
| Ripple rejection                          | $V_I = 11.5$ V to 21.5 V, $f = 120$ Hz                       | 0°C to 125°C | 54      | 70  |      | dB    |    |
| Output voltage regulation                 | $I_O = 5$ mA to 1.5 A  | 25°C         |         | 12  | 170  | mV    |    |
|   | $I_O = 250$ mA to 750 mA                                     |              |         | 4   | 85   |       |    |
| Output resistance                         | $f = 1$ kHz  | 0°C to 125°C | 0.016   |     |      | Ω     |    |
| Temperature coefficient of output voltage | $I_O = 5$ mA   | 0°C to 125°C | -0.8    |     |      | mV/°C |    |
| Output noise voltage                      | $f = 10$ Hz to 100 kHz                                       | 25°C         | 55      |     |      | μV    |    |
| Dropout voltage                           | $I_O = 1$ A  | 25°C         | 2       |     |      | V     |    |
| Bias current                              |  | 25°C         | 4.3     |     |      | 8 mA  |    |
| Bias current change                       | $V_I = 10.5$ V to 25 V                                       | 0°C to 125°C |         |     |      | 1     | mA |
|   | $I_O = 5$ mA to 1 A  |              |         |     |      | 0.5   |    |
| Short-circuit output current              |  | 25°C         | 450     |     |      | mA    |    |
| Peak output current                       |  | 25°C         | 2.2     |     |      | A     |    |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

electrical characteristics at specified virtual junction temperature,  $V_I = 17\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

| PARAMETER                                 | TEST CONDITIONS   | $T_J$ †      | μA7810C |     |      | UNIT  |
|---|---|--------------|---------|-----|------|-------|
|   |   |              | MIN     | TYP | MAX  |       |
| Output voltage                            | $I_O = 5\text{ mA to }1\text{ A}$ ,<br>$P_D \leq 15\text{ W}$ | 25°C         | 9.6     | 10  | 10.4 | V     |
|   |   | 0°C to 125°C | 9.5     | 10  | 10.5 |       |
| Input voltage regulation                  | $V_I = 12.5\text{ V to }28\text{ V}$                          | 25°C         | 7       |     | 200  | mV    |
|   | $V_I = 14\text{ V to }20\text{ V}$                            |              | 2       |     | 100  |       |
| Ripple rejection                          | $V_I = 13\text{ V to }23\text{ V}$ ,<br>$f = 120\text{ Hz}$   | 0°C to 125°C | 55      | 71  |      | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                           | 25°C         | 12      |     | 200  | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                        |              | 4       |     | 100  |       |
| Output resistance                         | $f = 1\text{ kHz}$  | 0°C to 125°C | 0.018   |     |      | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$   | 0°C to 125°C | -1      |     |      | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                          | 25°C         | 70      |     |      | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$  | 25°C         | 2       |     |      | V     |
| Bias current                              |   | 25°C         | 4.3     |     | 8    | mA    |
| Bias current change                       | $V_I = 12.5\text{ V to }28\text{ V}$                          | 0°C to 125°C |         |     | 1    | mA    |
|   | $I_O = 5\text{ mA to }1\text{ A}$                             |              |         |     | 0.5  |       |
| Short-circuit output current              |   | 25°C         | 400     |     |      | mA    |
| Peak output current                       |   | 25°C         | 2.2     |     |      | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

electrical characteristics at specified virtual junction temperature,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

| PARAMETER                                 | TEST CONDITIONS   | $T_J$ †      | μA7812C |     |      | UNIT  |
|---|---|--------------|---------|-----|------|-------|
|   |   |              | MIN     | TYP | MAX  |       |
| Output voltage                            | $I_O = 5\text{ mA to }1\text{ A}$ ,<br>$P_D \leq 15\text{ W}$ | 25°C         | 11.5    | 12  | 12.5 | V     |
|   |   | 0°C to 125°C | 11.4    |     | 12.6 |       |
| Input voltage regulation                  | $V_I = 14.5\text{ V to }30\text{ V}$                          | 25°C         | 10      |     | 240  | mV    |
|   | $V_I = 16\text{ V to }22\text{ V}$                            |              | 3       |     | 120  |       |
| Ripple rejection                          | $V_I = 15\text{ V to }25\text{ V}$ ,<br>$f = 120\text{ Hz}$   | 0°C to 125°C | 55      | 71  |      | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                           | 25°C         | 12      |     | 240  | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                        |              | 4       |     | 120  |       |
| Output resistance                         | $f = 1\text{ kHz}$  | 0°C to 125°C | 0.018   |     |      | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$   | 0°C to 125°C | -1      |     |      | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                          | 25°C         | 75      |     |      | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$  | 25°C         | 2       |     |      | V     |
| Bias current                              |   | 25°C         | 4.3     |     | 8    | mA    |
| Bias current change                       | $V_I = 14.5\text{ V to }30\text{ V}$                          | 0°C to 125°C |         |     | 1    | mA    |
|   | $I_O = 5\text{ mA to }1\text{ A}$                             |              |         |     | 0.5  |       |
| Short-circuit output current              |   | 25°C         | 350     |     |      | mA    |
| Peak output current                       |   | 25°C         | 2.2     |     |      | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



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**electrical characteristics at specified virtual junction temperature,  $V_I = 23\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)**

| PARAMETER                                 | TEST CONDITIONS   | $T_J$ †      | μA7815C |     |       | UNIT  |
|---|---|--------------|---------|-----|-------|-------|
|   |   |              | MIN     | TYP | MAX   |       |
| Output voltage                            | $I_O = 5\text{ mA to }1\text{ A}$ ,<br>$P_D \leq 15\text{ W}$   | 25°C         | 14.4    | 15  | 15.6  | V     |
|   |   | 0°C to 125°C | 14.25   |     | 15.75 |       |
| Input voltage regulation                  | $V_I = 17.5\text{ V to }30\text{ V}$                            | 25°C         | 11      |     | 300   | mV    |
|   | $V_I = 20\text{ V to }26\text{ V}$                              |              | 3       |     | 150   |       |
| Ripple rejection                          | $V_I = 18.5\text{ V to }28.5\text{ V}$ ,<br>$f = 120\text{ Hz}$ | 0°C to 125°C | 54      | 70  |       | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                             | 25°C         | 12      |     | 300   | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                          |              | 4       |     | 150   |       |
| Output resistance                         | $f = 1\text{ kHz}$  | 0°C to 125°C | 0.019   |     |       | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$   | 0°C to 125°C | -1      |     |       | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                            | 25°C         | 90      |     |       | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$  | 25°C         | 2       |     |       | V     |
| Bias current                              |   | 25°C         | 4.4     |     | 8     | mA    |
| Bias current change                       | $V_I = 17.5\text{ V to }30\text{ V}$                            | 0°C to 125°C |         |     | 1     | mA    |
|   | $I_O = 5\text{ mA to }1\text{ A}$                               |              |         |     | 0.5   |       |
| Short-circuit output current              |   | 25°C         | 230     |     |       | mA    |
| Peak output current                       |   | 25°C         | 2.1     |     |       | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

**electrical characteristics at specified virtual junction temperature,  $V_I = 27\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)**

| PARAMETER                                 | TEST CONDITIONS   | $T_J$ †      | μA7818C |     |      | UNIT  |
|---|---|--------------|---------|-----|------|-------|
|   |   |              | MIN     | TYP | MAX  |       |
| Output voltage                            | $I_O = 5\text{ mA to }1\text{ A}$ ,<br>$P_D \leq 15\text{ W}$ | 25°C         | 17.3    | 18  | 18.7 | V     |
|   |   | 0°C to 125°C | 17.1    |     | 18.9 |       |
| Input voltage regulation                  | $V_I = 21\text{ V to }33\text{ V}$                            | 25°C         | 15      |     | 360  | mV    |
|   | $V_I = 24\text{ V to }30\text{ V}$                            |              | 5       |     | 180  |       |
| Ripple rejection                          | $V_I = 22\text{ V to }32\text{ V}$ ,<br>$f = 120\text{ Hz}$   | 0°C to 125°C | 53      | 69  |      | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                           | 25°C         | 12      |     | 360  | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                        |              | 4       |     | 180  |       |
| Output resistance                         | $f = 1\text{ kHz}$  | 0°C to 125°C | 0.022   |     |      | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$   | 0°C to 125°C | -1      |     |      | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                          | 25°C         | 110     |     |      | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$  | 25°C         | 2       |     |      | V     |
| Bias current                              |   | 25°C         | 4.5     |     | 8    | mA    |
| Bias current change                       | $V_I = 21\text{ V to }33\text{ V}$                            | 0°C to 125°C |         |     | 1    | mA    |
|   | $I_O = 5\text{ mA to }1\text{ A}$                             |              |         |     | 0.5  |       |
| Short-circuit output current              |   | 25°C         | 200     |     |      | mA    |
| Peak output current                       |   | 25°C         | 2.1     |     |      | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

electrical characteristics at specified virtual junction temperature,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)

| PARAMETER                                 | TEST CONDITIONS   | $T_J$ †      | μA7824C |     |      | UNIT  |
|---|---|--------------|---------|-----|------|-------|
|   |   |              | MIN     | TYP | MAX  |       |
| Output voltage                            | $I_O = 5\text{ mA to }1\text{ A}$ ,<br>$P_D \leq 15\text{ W}$ | 25°C         | 23      | 24  | 25   | V     |
|   |   | 0°C to 125°C | 22.8    |     | 25.2 |       |
| Input voltage regulation                  | $V_I = 27\text{ V to }38\text{ V}$                            | 25°C         |         | 18  | 480  | mV    |
|   | $V_I = 30\text{ V to }36\text{ V}$                            |              |         | 6   | 240  |       |
| Ripple rejection                          | $V_I = 28\text{ V to }38\text{ V}$ ,<br>$f = 120\text{ Hz}$   | 0°C to 125°C | 50      | 66  |      | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                           | 25°C         |         | 12  | 480  | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                        |              |         | 4   | 240  |       |
| Output resistance                         | $f = 1\text{ kHz}$  | 0°C to 125°C | 0.028   |     |      | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$   | 0°C to 125°C | -1.5    |     |      | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                          | 25°C         | 170     |     |      | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$  | 25°C         | 2       |     |      | V     |
| Bias current                              |   | 25°C         | 4.6     | 8   |      | mA    |
| Bias current change                       | $V_I = 27\text{ V to }38\text{ V}$                            | 0°C to 125°C |         |     | 1    | mA    |
|   | $I_O = 5\text{ mA to }1\text{ A}$                             |              |         |     | 0.5  |       |
| Short-circuit output current              |   | 25°C         | 150     |     |      | mA    |
| Peak output current                       |   | 25°C         | 2.1     |     |      | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

electrical characteristics at specified virtual junction temperature,  $V_I = 10\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†

| PARAMETER                                 | TEST CONDITIONS  | μA7805Y |       |     | UNIT  |
|---|--|---------|-------|-----|-------|
|   |  | MIN     | TYP   | MAX |       |
| Output voltage                            |  |         | 5     |     | V     |
| Input voltage regulation                  | $V_I = 7\text{ V to }25\text{ V}$                          |         | 3     |     | mV    |
|   | $V_I = 8\text{ V to }12\text{ V}$                          |         | 1     |     |       |
| Ripple rejection                          | $V_I = 8\text{ V to }18\text{ V}$ ,<br>$f = 120\text{ Hz}$ |         | 78    |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                        |         | 15    |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                     |         | 5     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$   |         | 0.017 |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$  |         | -1.1  |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                       |         | 40    |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$   |         | 2     |     | V     |
| Bias current                              |  |         | 4.2   |     | mA    |
| Short-circuit output current              |  |         | 750   |     | mA    |
| Peak output current                       |  |         | 2.2   |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.





# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

**electrical characteristics at specified virtual junction temperature,  $V_I = 11\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS   | μA7806Y |       |     | UNIT  |
|---|---|---------|-------|-----|-------|
|   |   | MIN     | TYP   | MAX |       |
| Output voltage                            |   |         | 6     |     | V     |
| Input voltage regulation                  | $V_I = 8\text{ V to }25\text{ V}$                       |         | 5     |     | mV    |
|   | $V_I = 9\text{ V to }13\text{ V}$                       |         | 1.5   |     |       |
| Ripple rejection                          | $V_I = 9\text{ V to }19\text{ V}$ , $f = 120\text{ Hz}$ |         | 75    |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                     |         | 14    |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                  |         | 4     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$                                      |         | 0.019 |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$                                     |         | -0.8  |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                    |         | 45    |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$                                      |         | 2     |     | V     |
| Bias current                              |   |         | 4.3   |     | mA    |
| Short-circuit output current              |   |         | 550   |     | mA    |
| Peak output current                       |   |         | 2.2   |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

**electrical characteristics at specified virtual junction temperature,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS  | μA7808Y |       |     | UNIT  |
|---|--|---------|-------|-----|-------|
|   |  | MIN     | TYP   | MAX |       |
| Output voltage                            |  |         | 8     |     | V     |
| Input voltage regulation                  | $V_I = 10.5\text{ V to }25\text{ V}$                         |         | 6     |     | mV    |
|   | $V_I = 11\text{ V to }17\text{ V}$                           |         | 2     |     |       |
| Ripple rejection                          | $V_I = 11.5\text{ V to }21.5\text{ V}$ , $f = 120\text{ Hz}$ |         | 72    |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                          |         | 12    |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                       |         | 4     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$   |         | 0.016 |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$  |         | -0.8  |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                         |         | 52    |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$   |         | 2     |     | V     |
| Bias current                              |  |         | 4.3   |     | mA    |
| Short-circuit output current              |  |         | 450   |     | mA    |
| Peak output current                       |  |         | 2.2   |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

**electrical characteristics at specified virtual junction temperature,  $V_I = 15\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS  | μA7885Y |     |     | UNIT  |
|---|--|---------|-----|-----|-------|
|   |  | MIN     | TYP | MAX |       |
| Output voltage                            |  | 8.5     |     |     | V     |
| Input voltage regulation                  | $V_I = 10.5\text{ V to }25\text{ V}$                         | 6       |     |     | mV    |
|   | $V_I = 11\text{ V to }17\text{ V}$                           | 2       |     |     |       |
| Ripple rejection                          | $V_I = 11.5\text{ V to }21.5\text{ V}$ , $f = 120\text{ Hz}$ | 70      |     |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                          | 12      |     |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                       | 4       |     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$   | 0.016   |     |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$  | -0.8    |     |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                         | 55      |     |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$   | 2       |     |     | V     |
| Bias current                              |  | 4.3     |     |     | mA    |
| Short-circuit output current              |  | 450     |     |     | mA    |
| Peak output current                       |  | 2.2     |     |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

**electrical characteristics at specified virtual junction temperature,  $V_I = 17\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS  | μA7810Y |     |     | UNIT  |
|---|--|---------|-----|-----|-------|
|   |  | MIN     | TYP | MAX |       |
| Output voltage                            |  | 10      |     |     | V     |
| Input voltage regulation                  | $V_I = 12.5\text{ V to }28\text{ V}$                     | 7       |     |     | mV    |
|   | $V_I = 14\text{ V to }20\text{ V}$                       | 2       |     |     |       |
| Ripple rejection                          | $V_I = 13\text{ V to }23\text{ V}$ , $f = 120\text{ Hz}$ | 71      |     |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                      | 12      |     |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                   | 4       |     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$                                       | 0.018   |     |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$                                      | -1      |     |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                     | 70      |     |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$                                       | 2       |     |     | V     |
| Bias current                              |  | 4.3     |     |     | mA    |
| Short-circuit output current              |  | 400     |     |     | mA    |
| Peak output current                       |  | 2.2     |     |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

**electrical characteristics at specified virtual junction temperature,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS  | μA7812Y |       |     | UNIT  |
|---|--|---------|-------|-----|-------|
|   |  | MIN     | TYP   | MAX |       |
| Output voltage                            |  |         | 12    |     | V     |
| Input voltage regulation                  | $V_I = 14.5\text{ V to }30\text{ V}$                     |         | 10    |     | mV    |
|   | $V_I = 16\text{ V to }22\text{ V}$                       |         | 3     |     |       |
| Ripple rejection                          | $V_I = 15\text{ V to }25\text{ V}$ , $f = 120\text{ Hz}$ |         | 71    |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                      |         | 12    |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                   |         | 4     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$                                       |         | 0.018 |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$                                      |         | -1    |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                     |         | 75    |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$                                       |         | 2     |     | V     |
| Bias current                              |  |         | 4.3   |     | mA    |
| Short-circuit output current              |  |         | 350   |     | mA    |
| Peak output current                       |  |         | 2.2   |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

**electrical characteristics at specified virtual junction temperature,  $V_I = 23\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS  | μA7815Y |       |     | UNIT  |
|---|--|---------|-------|-----|-------|
|   |  | MIN     | TYP   | MAX |       |
| Output voltage                            |  |         | 15    |     | V     |
| Input voltage regulation                  | $V_I = 17.5\text{ V to }30\text{ V}$                         |         | 11    |     | mV    |
|   | $V_I = 20\text{ V to }26\text{ V}$                           |         | 3     |     |       |
| Ripple rejection                          | $V_I = 18.5\text{ V to }28.5\text{ V}$ , $f = 120\text{ Hz}$ |         | 70    |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                          |         | 12    |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                       |         | 4     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$   |         | 0.019 |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$  |         | -1    |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                         |         | 90    |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$   |         | 2     |     | V     |
| Bias current                              |  |         | 4.4   |     | mA    |
| Short-circuit output current              |  |         | 230   |     | mA    |
| Peak output current                       |  |         | 2.1   |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056E – MAY 1976 – REVISED JULY 1999

**electrical characteristics at specified virtual junction temperature,  $V_I = 27\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS  | μA7818Y |       |     | UNIT  |
|---|--|---------|-------|-----|-------|
|   |  | MIN     | TYP   | MAX |       |
| Output voltage                            |  |         | 18    |     | V     |
| Input voltage regulation                  | $V_I = 21\text{ V to }33\text{ V}$                       |         | 15    |     | mV    |
|   | $V_I = 24\text{ V to }30\text{ V}$                       |         | 5     |     |       |
| Ripple rejection                          | $V_I = 22\text{ V to }32\text{ V}$ , $f = 120\text{ Hz}$ |         | 69    |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                      |         | 12    |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                   |         | 4     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$                                       |         | 0.022 |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$                                      |         | -1    |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                     |         | 110   |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$                                       |         | 2     |     | V     |
| Bias current                              |  |         | 4.5   |     | mA    |
| Short-circuit output current              |  |         | 200   |     | mA    |
| Peak output current                       |  |         | 2.1   |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

**electrical characteristics at specified virtual junction temperature,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)†**

| PARAMETER                                 | TEST CONDITIONS  | μA7824Y |       |     | UNIT  |
|---|--|---------|-------|-----|-------|
|   |  | MIN     | TYP   | MAX |       |
| Output voltage                            |  |         | 24    |     | V     |
| Input voltage regulation                  | $V_I = 27\text{ V to }38\text{ V}$                       |         | 18    |     | mV    |
|   | $V_I = 30\text{ V to }36\text{ V}$                       |         | 6     |     |       |
| Ripple rejection                          | $V_I = 28\text{ V to }38\text{ V}$ , $f = 120\text{ Hz}$ |         | 66    |     | dB    |
| Output voltage regulation                 | $I_O = 5\text{ mA to }1.5\text{ A}$                      |         | 12    |     | mV    |
|   | $I_O = 250\text{ mA to }750\text{ mA}$                   |         | 4     |     |       |
| Output resistance                         | $f = 1\text{ kHz}$                                       |         | 0.028 |     | W     |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$                                      |         | -1.5  |     | mV/°C |
| Output noise voltage                      | $f = 10\text{ Hz to }100\text{ kHz}$                     |         | 170   |     | μV    |
| Dropout voltage                           | $I_O = 1\text{ A}$                                       |         | 2     |     | V     |
| Bias current                              |  |         | 4.6   |     | mA    |
| Short-circuit output current              |  |         | 150   |     | mA    |
| Peak output current                       |  |         | 2.1   |     | A     |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



APPLICATION INFORMATION

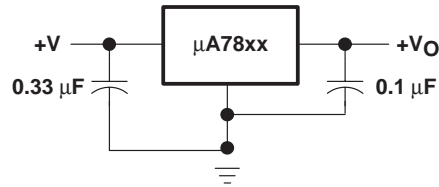


Figure 1. Fixed-Output Regulator

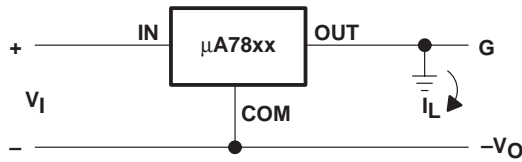
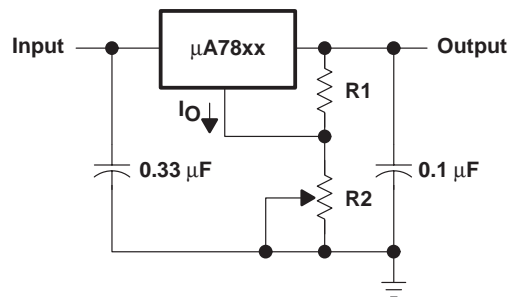


Figure 2. Positive Regulator in Negative Configuration ( $V_I$  Must Float)



NOTE A: The following formula is used when  $V_{xx}$  is the nominal output voltage (output to common) of the fixed regulator:

$$V_O = V_{xx} + \left( \frac{V_{xx}}{R_1} + I_O \right) R_2$$

Figure 3. Adjustable-Output Regulator

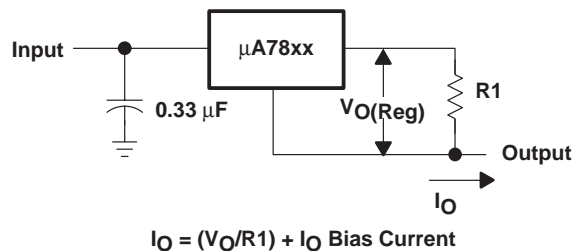
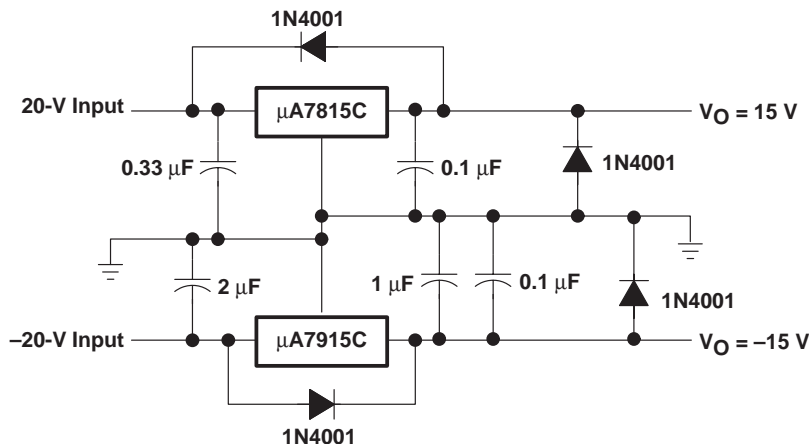


Figure 4. Current Regulator

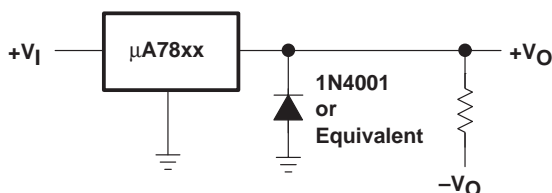
**APPLICATION INFORMATION**



**Figure 5. Regulated Dual Supply**

**operation with a load common to a voltage of opposite polarity**

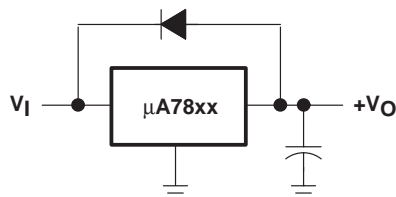
In many cases, a regulator powers a load that is not connected to ground but, instead, is connected to a voltage source of opposite polarity (e.g., operational amplifiers, level-shifting circuits, etc.). In these cases, a clamp diode should be connected to the regulator output as shown in Figure 6. This protects the regulator from output polarity reversals during startup and short-circuit operation.



**Figure 6. Output Polarity-Reversal-Protection Circuit**

**reverse-bias protection**

Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This can occur, for example, when the input supply is crowbarred during an output overvoltage condition. If the output voltage is greater than approximately 7 V, the emitter-base junction of the series-pass element (internal or external) could break down and be damaged. To prevent this, a diode shunt can be used as shown in Figure 7.



**Figure 7. Reverse-Bias-Protection Circuit**