

# KA78XXE/KA78XXAE

## 3-Terminal 1A Positive Voltage Regulator

### Features

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

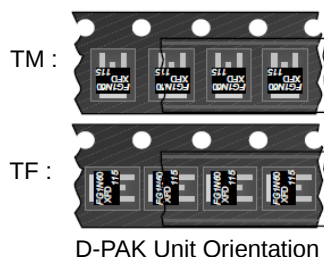
### General Description

The KA78XXE/KA78XXAE series of three-terminal positive regulator are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

### Ordering Information

| Product Number | Output Voltage Tolerance | Package             | Operating Temperature |
|----------------|--------------------------|---------------------|-----------------------|
| KA7805ETU      | ±4%                      | TO-220 (Dual Gauge) | 0°C to +125°C         |
| KA7806ETU      |                          |                     |                       |
| KA7808ETU      |                          |                     |                       |
| KA7809ETU      |                          |                     |                       |
| KA7810ETU      |                          |                     |                       |
| KA7812ETU      |                          |                     |                       |
| KA7815ETU      |                          |                     |                       |
| KA7818ETU      |                          |                     |                       |
| KA7824ETU      |                          |                     |                       |
| KA7805AETU     | ±2%                      |                     |                       |
| KA7809AETU     |                          |                     |                       |
| KA7810AETU     |                          |                     |                       |
| KA7812AETU     |                          |                     |                       |
| KA7815AETU     |                          |                     |                       |
| KA7824AETU     |                          |                     |                       |
| KA7805ERTF     | ±4%                      | D-PAK               |                       |
| KA7805ERTM     |                          |                     |                       |
| KA7808ERTM     |                          |                     |                       |
| KA7809ERTM     |                          |                     |                       |
| KA7812ERTM     |                          |                     |                       |

\* Refer to below figure for TM / TF Suffix for DPAK



## Block Diagram

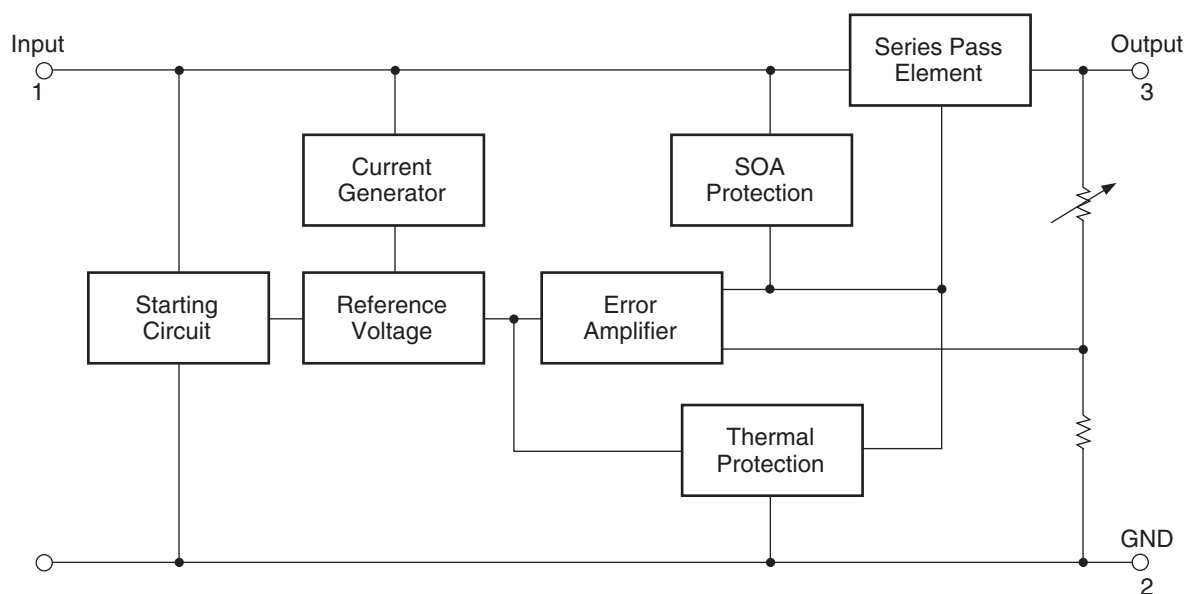


Figure 1.

## Pin Assignment

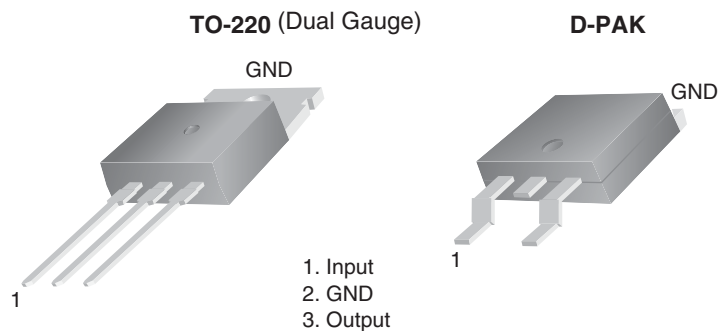


Figure 2.

## Absolute Maximum Ratings

| Symbol          | Parameter                                   |                            | Value       | Unit          |
|-----------------|---------------------------------------------|----------------------------|-------------|---------------|
| $V_I$           | Input Voltage                               | $V_O = 5V \text{ to } 18V$ | 35          | V             |
|                 |                                             | $V_O = 24V$                | 40          |               |
| $R_{\theta JC}$ | Thermal Resistance Junction-Cases (TO-220)  |                            | 5           | $^{\circ}C/W$ |
| $R_{\theta JA}$ | Thermal Resistance Junction-Air (TO-220)    |                            | 65          | $^{\circ}C/W$ |
| $T_{OPR}$       | Operating Temperature Range (KA78XXE/AE/ER) |                            | 0 to +125   | $^{\circ}C$   |
| $T_{STG}$       | Storage Temperature Range                   |                            | -65 to +150 | $^{\circ}C$   |

**Electrical Characteristics (KA7805E/KA7805ER)**

Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 10\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                  | Parameter                           | Conditions                                                                                           | KA7805E/ER |      |      | Unit                   |
|-------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------|------------|------|------|------------------------|
|                         |                                     |                                                                                                      | Min.       | Typ. | Max. |                        |
| $V_O$                   | Output Voltage                      | $T_J = +25^{\circ}\text{C}$                                                                          | 4.8        | 5.0  | 5.2  | V                      |
|                         |                                     | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 7\text{V to } 20\text{V}$ | 4.75       | 5.0  | 5.25 |                        |
| Regline                 | Line Regulation <sup>(1)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                          |            |      |      | mV                     |
|                         |                                     | $V_O = 7\text{V to } 25\text{V}$                                                                     | –          | 4.0  | 100  |                        |
|                         |                                     | $V_I = 8\text{V to } 12\text{V}$                                                                     | –          | 1.6  | 50   |                        |
| Regload                 | Load Regulation <sup>(1)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                          |            |      |      | mV                     |
|                         |                                     | $I_O = 5.0\text{mA to } 1.5\text{A}$                                                                 | –          | 9    | 100  |                        |
|                         |                                     | $I_O = 250\text{mA to } 750\text{mA}$                                                                | –          | 4    | 50   |                        |
| $I_Q$                   | Quiescent Current                   | $T_J = +25^{\circ}\text{C}$                                                                          | –          | 5.0  | 8.0  | mA                     |
| $\Delta I_Q$            | Quiescent Current Change            | $I_O = 5\text{mA to } 1.0\text{A}$                                                                   | –          | 0.03 | 0.5  | mA                     |
|                         |                                     | $V_I = 7\text{V to } 25\text{V}$                                                                     | –          | 0.3  | 1.3  |                        |
| $\Delta V_O / \Delta T$ | Output Voltage Drift <sup>(2)</sup> | $I_O = 5\text{mA}$                                                                                   | –          | -0.8 | –    | mV/ $^{\circ}\text{C}$ |
| $V_N$                   | Output Noise Voltage                | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                    | –          | 42   | –    | $\mu\text{V}/V_O$      |
| RR                      | Ripple Rejection <sup>(2)</sup>     | $f = 120\text{Hz}$ , $V_O = 8\text{V to } 18\text{V}$                                                | 62         | 73   | –    | dB                     |
| $V_{\text{Drop}}$       | Dropout Voltage                     | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                      | –          | 2    | –    | V                      |
| $r_O$                   | Output Resistance <sup>(2)</sup>    | $f = 1\text{kHz}$                                                                                    | –          | 15   | –    | m $\Omega$             |
| $I_{\text{SC}}$         | Short Circuit Current               | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                     | –          | 230  | –    | mA                     |
| $I_{\text{PK}}$         | Peak Current <sup>(2)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                          | –          | 2.2  | –    | A                      |

**Notes:**

1. Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.
2. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7806E)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 11\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                  | Parameter                           | Conditions                                                                                             | KA7806E/ER |      |      | Unit                   |
|-------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------|------------|------|------|------------------------|
|                         |                                     |                                                                                                        | Min.       | Typ. | Max. |                        |
| $V_O$                   | Output Voltage                      | $T_J = +25^{\circ}\text{C}$                                                                            | 5.75       | 6.0  | 6.25 | V                      |
|                         |                                     | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 8.0\text{V to } 21\text{V}$ | 5.7        | 6.0  | 6.3  |                        |
| Regline                 | Line Regulation <sup>(3)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                            |            |      |      | mV                     |
|                         |                                     | $V_I = 8\text{V to } 25\text{V}$                                                                       | —          | 5    | 120  |                        |
|                         |                                     | $V_I = 9\text{V to } 13\text{V}$                                                                       | —          | 1.5  | 60   |                        |
| Regload                 | Load Regulation <sup>(3)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                            |            |      |      | mV                     |
|                         |                                     | $I_O = 5\text{mA to } 1.5\text{A}$                                                                     | —          | 9    | 120  |                        |
|                         |                                     | $I_O = 250\text{mA to } 750\text{mA}$                                                                  | —          | 3    | 60   |                        |
| $I_Q$                   | Quiescent Current                   | $T_J = +25^{\circ}\text{C}$                                                                            | —          | 5.0  | 8.0  | mA                     |
| $\Delta I_Q$            | Quiescent Current Change            | $I_O = 5\text{mA to } 1\text{A}$                                                                       | —          | —    | 0.5  | mA                     |
|                         |                                     | $V_I = 8\text{V to } 25\text{V}$                                                                       | —          | —    | 1.3  |                        |
| $\Delta V_O / \Delta T$ | Output Voltage Drift <sup>(4)</sup> | $I_O = 5\text{mA}$                                                                                     | —          | -0.8 | —    | mV/ $^{\circ}\text{C}$ |
| $V_N$                   | Output Noise Voltage                | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                      | —          | 45   | —    | $\mu\text{V}/V_O$      |
| RR                      | Ripple Rejection <sup>(4)</sup>     | $f = 120\text{Hz}$<br>$V_I = 9\text{V to } 19\text{V}$                                                 | 59         | 75   | —    | dB                     |
| $V_{\text{Drop}}$       | Dropout Voltage                     | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                        | —          | 2    | —    | V                      |
| $r_O$                   | Output Resistance <sup>(4)</sup>    | $f = 1\text{kHz}$                                                                                      | —          | 19   | —    | m $\Omega$             |
| $I_{\text{SC}}$         | Short Circuit Current               | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                       | —          | 250  | —    | mA                     |
| $I_{\text{PK}}$         | Peak Current <sup>(4)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                            | —          | 2.2  | —    | A                      |

**Notes:**

- Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.
- These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7808E/KA7808ER)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 14\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                | Parameter                           | Conditions                                                                                              | KA7808E/ER |      |      | Unit                   |
|-----------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------|------------|------|------|------------------------|
|                       |                                     |                                                                                                         | Min.       | Typ. | Max. |                        |
| $V_O$                 | Output Voltage                      | $T_J = +25^{\circ}\text{C}$                                                                             | 7.7        | 8.0  | 8.3  | V                      |
|                       |                                     | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 10.5\text{V to } 23\text{V}$ | 7.6        | 8.0  | 8.4  |                        |
| Regline               | Line Regulation <sup>(5)</sup>      | $T_J = +25^{\circ}\text{C}$<br>$V_I = 10.5\text{V to } 25\text{V}$                                      | —          | 5.0  | 160  | mV                     |
|                       |                                     |                                                                                                         | —          | 2.0  | 80   |                        |
| Regload               | Load Regulation <sup>(5)</sup>      | $T_J = +25^{\circ}\text{C}$<br>$I_O = 5.0\text{mA to } 1.5\text{A}$                                     | —          | 10   | 160  | mV                     |
|                       |                                     |                                                                                                         | —          | 5.0  | 80   |                        |
| $I_Q$                 | Quiescent Current                   | $T_J = +25^{\circ}\text{C}$                                                                             | —          | 5.0  | 8.0  | mA                     |
| $\Delta I_Q$          | Quiescent Current Change            | $I_O = 5\text{mA to } 1.0\text{A}$                                                                      | —          | 0.05 | 0.5  | mA                     |
|                       |                                     | $V_I = 10.5\text{A to } 25\text{V}$                                                                     | —          | 0.5  | 1.0  |                        |
| $\Delta V_O/\Delta T$ | Output Voltage Drift <sup>(6)</sup> | $I_O = 5\text{mA}$                                                                                      | —          | -0.8 | —    | mV/ $^{\circ}\text{C}$ |
| $V_N$                 | Output Noise Voltage                | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                       | —          | 52   | —    | $\mu\text{V}/V_O$      |
| RR                    | Ripple Rejection <sup>(6)</sup>     | $f = 120\text{Hz}$ , $V_I = 11.5\text{V to } 21.5\text{V}$                                              | 56         | 73   | —    | dB                     |
| $V_{\text{Drop}}$     | Dropout Voltage                     | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                         | —          | 2    | —    | V                      |
| $r_O$                 | Output Resistance <sup>(6)</sup>    | $f = 1\text{kHz}$                                                                                       | —          | 17   | —    | m $\Omega$             |
| $I_{\text{SC}}$       | Short Circuit Current               | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                        | —          | 230  | —    | mA                     |
| $I_{\text{PK}}$       | Peak Current <sup>(6)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                             | —          | 2.2  | —    | A                      |

**Notes:**

- Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.
- These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7809E/KA7809ER)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 15\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                  | Parameter                           | Conditions                                                                                              | KA7809E/ER |      |      | Unit                   |
|-------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------|------------|------|------|------------------------|
|                         |                                     |                                                                                                         | Min.       | Typ. | Max. |                        |
| $V_O$                   | Output Voltage                      | $T_J = +25^{\circ}\text{C}$                                                                             | 8.65       | 9    | 9.35 | V                      |
|                         |                                     | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 11.5\text{V to } 24\text{V}$ | 8.6        | 9    | 9.4  |                        |
| Regline                 | Line Regulation <sup>(7)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                             |            |      |      | mV                     |
|                         |                                     | $V_I = 11.5\text{V to } 25\text{V}$                                                                     | –          | 6    | 180  |                        |
|                         |                                     | $V_I = 12\text{V to } 17\text{V}$                                                                       | –          | 2    | 90   |                        |
| Regload                 | Load Regulation <sup>(7)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                             |            |      |      | mV                     |
|                         |                                     | $I_O = 5\text{mA to } 1.5\text{A}$                                                                      | –          | 12   | 180  |                        |
|                         |                                     | $I_O = 250\text{mA to } 750\text{mA}$                                                                   | –          | 4    | 90   |                        |
| $I_Q$                   | Quiescent Current                   | $T_J = +25^{\circ}\text{C}$                                                                             | –          | 5.0  | 8.0  | mA                     |
| $\Delta I_Q$            | Quiescent Current Change            | $I_O = 5\text{mA to } 1.0\text{A}$                                                                      | –          | –    | 0.5  | mA                     |
|                         |                                     | $V_I = 11.5\text{V to } 26\text{V}$                                                                     | –          | –    | 1.3  |                        |
| $\Delta V_O / \Delta T$ | Output Voltage Drift <sup>(8)</sup> | $I_O = 5\text{mA}$                                                                                      | –          | -1   | –    | mV/ $^{\circ}\text{C}$ |
| $V_N$                   | Output Noise Voltage                | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                       | –          | 58   | –    | $\mu\text{V}/V_O$      |
| RR                      | Ripple Rejection <sup>(8)</sup>     | $f = 120\text{Hz}$<br>$V_I = 13\text{V to } 23\text{V}$                                                 | 56         | 71   | –    | dB                     |
| $V_{\text{Drop}}$       | Dropout Voltage                     | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                         | –          | 2    | –    | V                      |
| $r_O$                   | Output Resistance <sup>(8)</sup>    | $f = 1\text{kHz}$                                                                                       | –          | 17   | –    | m $\Omega$             |
| $I_{\text{SC}}$         | Short Circuit Current               | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                        | –          | 250  | –    | mA                     |
| $I_{\text{PK}}$         | Peak Current <sup>(8)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                             | –          | 2.2  | –    | A                      |

**Notes:**

- Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.
- These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7810E)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 16\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                  | Parameter                            | Conditions                                                                                          | KA7810E |      |      | Unit                   |
|-------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------|---------|------|------|------------------------|
|                         |                                      |                                                                                                     | Min.    | Typ. | Max. |                        |
| $V_O$                   | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                         | 9.6     | 10.0 | 10.4 | V                      |
|                         |                                      | $5\text{mA} \leq I_O \leq 1\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 12.5\text{V to } 25\text{V}$ | 9.5     | 10.0 | 10.5 |                        |
| Regline                 | Line Regulation <sup>(9)</sup>       | $T_J = +25^{\circ}\text{C}$                                                                         |         |      |      | mV                     |
|                         |                                      | $V_I = 12.5\text{V to } 25\text{V}$                                                                 | –       | 10.0 | 200  |                        |
| Regload                 | Load Regulation <sup>(9)</sup>       | $T_J = +25^{\circ}\text{C}$                                                                         |         |      |      | mV                     |
|                         |                                      | $I_O = 5\text{mA to } 1.5\text{A}$                                                                  | –       | 12.0 | 200  |                        |
|                         |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                               | –       | 4.0  | 400  |                        |
| $I_Q$                   | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                         | –       | 5.1  | 8.0  | mA                     |
| $\Delta I_Q$            | Quiescent Current Change             | $I_O = 5\text{mA to } 1\text{A}$                                                                    | –       | –    | 0.5  | mA                     |
|                         |                                      | $V_I = 12.5\text{V to } 29\text{V}$                                                                 | –       | –    | 1.0  |                        |
| $\Delta V_O / \Delta T$ | Output Voltage Drift <sup>(10)</sup> | $I_O = 5\text{mA}$                                                                                  | –       | -1.0 | –    | mV/ $^{\circ}\text{C}$ |
| $V_N$                   | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                   | –       | 58.0 | –    | $\mu\text{V}/V_O$      |
| RR                      | Ripple Rejection <sup>(10)</sup>     | $f = 120\text{Hz}$<br>$V_O = 13\text{V to } 23\text{V}$                                             | 56.0    | 71.0 | –    | dB                     |
| $V_{\text{Drop}}$       | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                     | –       | 2.0  | –    | V                      |
| $r_O$                   | Output Resistance <sup>(10)</sup>    | $f = 1\text{kHz}$                                                                                   | –       | 17.0 | –    | m $\Omega$             |
| $I_{\text{SC}}$         | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                    | –       | 250  | –    | mA                     |
| $I_{\text{PK}}$         | Peak Current <sup>(10)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                         | –       | 2.2  | –    | A                      |

**Notes:**

9. Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

10. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7812E/KA7812ER)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 19\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                | Parameter                            | Conditions                                                                                              | KA7812E/ER |      |      | Unit                   |
|-----------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------|------------|------|------|------------------------|
|                       |                                      |                                                                                                         | Min.       | Typ. | Max. |                        |
| $V_O$                 | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                             | 11.5       | 12   | 12.5 | V                      |
|                       |                                      | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 14.5\text{V to } 27\text{V}$ | 11.4       | 12   | 12.6 |                        |
| Regline               | Line Regulation <sup>(11)</sup>      | $T_J = +25^{\circ}\text{C}$ $V_I = 14.5\text{V to } 30\text{V}$                                         | –          | 10   | 240  | mV                     |
|                       |                                      | $V_I = 16\text{V to } 22\text{V}$                                                                       | –          | 3.0  | 120  |                        |
| Regload               | Load Regulation <sup>(11)</sup>      | $T_J = +25^{\circ}\text{C}$ $I_O = 5\text{mA to } 1.5\text{A}$                                          | –          | 11   | 240  | mV                     |
|                       |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                                   | –          | 5.0  | 120  |                        |
| $I_Q$                 | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                             | –          | 5.1  | 8.0  | mA                     |
| $\Delta I_Q$          | Quiescent Current Change             | $I_O = 5\text{mA to } 1.0\text{A}$                                                                      | –          | 0.1  | 0.5  | mA                     |
|                       |                                      | $V_I = 14.5\text{V to } 30\text{V}$                                                                     | –          | 0.5  | 1.0  |                        |
| $\Delta V_O/\Delta T$ | Output Voltage Drift <sup>(12)</sup> | $I_O = 5\text{mA}$                                                                                      | –          | -1   | –    | mV/ $^{\circ}\text{C}$ |
| $V_N$                 | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                       | –          | 76   | –    | $\mu\text{V}/V_O$      |
| RR                    | Ripple Rejection <sup>(12)</sup>     | $f = 120\text{Hz}$<br>$V_I = 15\text{V to } 25\text{V}$                                                 | 55         | 71   | –    | dB                     |
| $V_{\text{Drop}}$     | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                         | –          | 2    | –    | V                      |
| $r_O$                 | Output Resistance <sup>(12)</sup>    | $f = 1\text{kHz}$                                                                                       | –          | 18   | –    | m $\Omega$             |
| $I_{\text{SC}}$       | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                        | –          | 230  | –    | mA                     |
| $I_{\text{PK}}$       | Peak Current <sup>(12)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                             | –          | 2.2  | –    | A                      |

**Notes:**

11. Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.
12. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7815E)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 23\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                | Parameter                            | Conditions                                                                                              | KA7815E |      |       | Unit                   |
|-----------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------|---------|------|-------|------------------------|
|                       |                                      |                                                                                                         | Min.    | Typ. | Max.  |                        |
| $V_O$                 | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                             | 14.4    | 15   | 15.6  | V                      |
|                       |                                      | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 17.5\text{V to } 30\text{V}$ | 14.25   | 15   | 15.75 |                        |
| Regline               | Line Regulation <sup>(13)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                             |         |      |       | mV                     |
|                       |                                      | $V_I = 17.5\text{V to } 30\text{V}$                                                                     | –       | 11   | 300   |                        |
| Regload               | Load Regulation <sup>(13)</sup>      | $T_J = +25^{\circ}\text{C}$                                                                             |         |      |       | mV                     |
|                       |                                      | $I_O = 5\text{mA to } 1.5\text{A}$                                                                      | –       | 12   | 300   |                        |
|                       |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                                   | –       | 4    | 150   |                        |
| $I_Q$                 | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                             | –       | 5.2  | 8.0   | mA                     |
| $\Delta I_Q$          | Quiescent Current Change             | $I_O = 5\text{mA to } 1.0\text{A}$                                                                      | –       | –    | 0.5   | mA                     |
|                       |                                      | $V_I = 17.5\text{V to } 30\text{V}$                                                                     | –       | –    | 1.0   |                        |
| $\Delta V_O/\Delta T$ | Output Voltage Drift <sup>(14)</sup> | $I_O = 5\text{mA}$                                                                                      | –       | -1   | –     | mV/ $^{\circ}\text{C}$ |
| $V_N$                 | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                       | –       | 90   | –     | $\mu\text{V}/V_O$      |
| RR                    | Ripple Rejection <sup>(14)</sup>     | $f = 120\text{Hz}$<br>$V_I = 18.5\text{V to } 28.5\text{V}$                                             | 54      | 70   | –     | dB                     |
| $V_{\text{Drop}}$     | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                         | –       | 2    | –     | V                      |
| $r_O$                 | Output Resistance <sup>(14)</sup>    | $f = 1\text{kHz}$                                                                                       | –       | 19   | –     | $\text{m}\Omega$       |
| $I_{\text{SC}}$       | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                        | –       | 250  | –     | mA                     |
| $I_{\text{PK}}$       | Peak Current <sup>(14)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                             | –       | 2.2  | –     | A                      |

**Notes:**

13. Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

14. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7818E)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 27\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                  | Parameter                            | Conditions                                                                                            | KA7818E |      |      | Unit                   |
|-------------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------|---------|------|------|------------------------|
|                         |                                      |                                                                                                       | Min.    | Typ. | Max. |                        |
| $V_O$                   | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                           | 17.3    | 18   | 18.7 | V                      |
|                         |                                      | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 21\text{V to } 33\text{V}$ | 17.1    | 18   | 18.9 |                        |
| Regline                 | Line Regulation <sup>(15)</sup>      | $T_J = +25^{\circ}\text{C}$ $V_I = 21\text{V to } 33\text{V}$                                         | —       | 15   | 360  | mV                     |
|                         |                                      | $V_I = 24\text{V to } 30\text{V}$                                                                     | —       | 5    | 180  |                        |
| Regload                 | Load Regulation <sup>(15)</sup>      | $T_J = +25^{\circ}\text{C}$ $I_O = 5\text{mA to } 1.5\text{A}$                                        | —       | 15   | 360  | mV                     |
|                         |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                                 | —       | 5.0  | 180  |                        |
| $I_Q$                   | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                           | —       | 5.2  | 8.0  | mA                     |
| $\Delta I_Q$            | Quiescent Current Change             | $I_O = 5\text{mA to } 1.0\text{A}$                                                                    | —       | —    | 0.5  | mA                     |
|                         |                                      | $V_I = 21\text{V to } 33\text{V}$                                                                     | —       | —    | 1    |                        |
| $\Delta V_O / \Delta T$ | Output Voltage Drift <sup>(16)</sup> | $I_O = 5\text{mA}$                                                                                    | —       | -1   | —    | mV/ $^{\circ}\text{C}$ |
| $V_N$                   | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                     | —       | 110  | —    | $\mu\text{V}/V_O$      |
| RR                      | Ripple Rejection <sup>(16)</sup>     | $f = 120\text{Hz}$<br>$V_I = 22\text{V to } 32\text{V}$                                               | 53      | 69   | —    | dB                     |
| $V_{\text{Drop}}$       | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                       | —       | 2    | —    | V                      |
| $r_O$                   | Output Resistance <sup>(16)</sup>    | $f = 1\text{kHz}$                                                                                     | —       | 22   | —    | $\text{m}\Omega$       |
| $I_{\text{SC}}$         | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                      | —       | 250  | —    | mA                     |
| $I_{\text{PK}}$         | Peak Current <sup>(16)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                           | —       | 2.2  | —    | A                      |

**Notes:**

15. Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

16. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7824E)** (Continued)Refer to test circuit,  $0^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$ ,  $I_O = 500\text{mA}$ ,  $V_I = 33\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                | Parameter                            | Conditions                                                                                            | KA7824E |      |       | Unit                   |
|-----------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------|---------|------|-------|------------------------|
|                       |                                      |                                                                                                       | Min.    | Typ. | Max.  |                        |
| $V_O$                 | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                           | 23      | 24   | 25    | V                      |
|                       |                                      | $5.0\text{mA} \leq I_O \leq 1.0\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 27\text{V to } 38\text{V}$ | 22.8    | 24   | 25.25 |                        |
| Regline               | Line Regulation <sup>(17)</sup>      | $T_J = +25^{\circ}\text{C}$<br>$V_I = 27\text{V to } 38\text{V}$                                      | –       | 17   | 480   | mV                     |
|                       |                                      |                                                                                                       | –       | 6    | 240   |                        |
| Regload               | Load Regulation <sup>(17)</sup>      | $T_J = +25^{\circ}\text{C}$<br>$I_O = 5\text{mA to } 1.5\text{A}$                                     | –       | 15   | 480   | mV                     |
|                       |                                      |                                                                                                       | –       | 5.0  | 240   |                        |
| $I_Q$                 | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                           | –       | 5.2  | 8.0   | mA                     |
| $\Delta I_Q$          | Quiescent Current Change             | $I_O = 5\text{mA to } 1.0\text{A}$                                                                    | –       | 0.1  | 0.5   | mA                     |
|                       |                                      | $V_I = 27\text{V to } 38\text{V}$                                                                     | –       | 0.5  | 1     |                        |
| $\Delta V_O/\Delta T$ | Output Voltage Drift <sup>(18)</sup> | $I_O = 5\text{mA}$                                                                                    | –       | -1.5 | –     | mV/ $^{\circ}\text{C}$ |
| $V_N$                 | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                                     | –       | 60   | –     | $\mu\text{V}/V_O$      |
| RR                    | Ripple Rejection <sup>(18)</sup>     | $f = 120\text{Hz}$<br>$V_I = 28\text{V to } 38\text{V}$                                               | 50      | 67   | –     | dB                     |
| $V_{\text{Drop}}$     | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                       | –       | 2    | –     | V                      |
| $r_O$                 | Output Resistance <sup>(18)</sup>    | $f = 1\text{kHz}$                                                                                     | –       | 28   | –     | m $\Omega$             |
| $I_{\text{SC}}$       | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                      | –       | 230  | –     | mA                     |
| $I_{\text{PK}}$       | Peak Current <sup>(18)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                           | –       | 2.2  | –     | A                      |

**Notes:**

17. Load and line regulation are specified at constant junction temperature. Changes in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

18. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7805AE)** (Continued)Refer to the test circuits.  $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$ ,  $I_O = 1\text{A}$ ,  $V_I = 10\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol              | Parameter                            | Conditions                                                                                     | KA7805AE |      |      | Unit                   |
|---------------------|--------------------------------------|------------------------------------------------------------------------------------------------|----------|------|------|------------------------|
|                     |                                      |                                                                                                | Min.     | Typ. | Max. |                        |
| $V_O$               | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                    | 4.9      | 5    | 5.1  | V                      |
|                     |                                      | $I_O = 5\text{mA to } 1\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 7.5\text{V to } 20\text{V}$ | 4.8      | 5    | 5.2  |                        |
| Regline             | Line Regulation <sup>(19)</sup>      | $V_I = 7.5\text{V to } 25\text{V}$<br>$I_O = 500\text{mA}$                                     | —        | 5    | 50   | mV                     |
|                     |                                      | $V_I = 8\text{V to } 12\text{V}$                                                               | —        | 3    | 50   |                        |
|                     |                                      | $T_J = +25^{\circ}\text{C}$ $V_I = 7.3\text{V to } 20\text{V}$                                 | —        | 5    | 50   |                        |
|                     |                                      | $V_I = 8\text{V to } 12\text{V}$                                                               | —        | 1.5  | 25   |                        |
| Regload             | Load Regulation <sup>(19)</sup>      | $T_J = +25^{\circ}\text{C}$<br>$I_O = 5\text{mA to } 1.5\text{A}$                              | —        | 9    | 100  | mV                     |
|                     |                                      | $I_O = 5\text{mA to } 1\text{A}$                                                               | —        | 9    | 100  |                        |
|                     |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                          | —        | 4    | 50   |                        |
| $I_Q$               | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                    | —        | 5.0  | 6.0  | mA                     |
| $\Delta I_Q$        | Quiescent Current Change             | $I_O = 5\text{mA to } 1\text{A}$                                                               | —        | —    | 0.5  | mA                     |
|                     |                                      | $V_I = 8\text{V to } 25\text{V}$ , $I_O = 500\text{mA}$                                        | —        | —    | 0.8  |                        |
|                     |                                      | $V_I = 7.5\text{V to } 20\text{V}$ , $T_J = +25^{\circ}\text{C}$                               | —        | —    | 0.8  |                        |
| $\Delta V/\Delta T$ | Output Voltage Drift <sup>(20)</sup> | $I_O = 5\text{mA}$                                                                             | —        | -0.8 | —    | mV/ $^{\circ}\text{C}$ |
| $V_N$               | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$<br>$T_A = +25^{\circ}\text{C}$                             | —        | 10   | —    | $\mu\text{V}/V_O$      |
| RR                  | Ripple Rejection <sup>(20)</sup>     | $f = 120\text{Hz}$ , $I_O = 500\text{mA}$<br>$V_I = 8\text{V to } 18\text{V}$                  | —        | 68   | —    | dB                     |
| $V_{\text{Drop}}$   | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                | —        | 2    | —    | V                      |
| $r_O$               | Output Resistance <sup>(20)</sup>    | $f = 1\text{kHz}$                                                                              | —        | 17   | —    | m $\Omega$             |
| $I_{\text{SC}}$     | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                               | —        | 250  | —    | mA                     |
| $I_{\text{PK}}$     | Peak Current <sup>(20)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                    | —        | 2.2  | —    | A                      |

**Notes:**

19. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

20. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7809AE)** (Continued)Refer to the test circuits.  $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$ ,  $I_O = 1\text{A}$ ,  $V_I = 15\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol            | Parameter                            | Conditions                                                                        | KA7809AE                      |      |      | Unit              |    |
|-------------------|--------------------------------------|-----------------------------------------------------------------------------------|-------------------------------|------|------|-------------------|----|
|                   |                                      |                                                                                   | Min.                          | Typ. | Max. |                   |    |
| V <sub>O</sub>    | Output Voltage                       | T <sub>J</sub> = +25°C                                                            | 8.82                          | 9.0  | 9.18 | V                 |    |
|                   |                                      | I <sub>O</sub> = 5mA to 1A, P <sub>O</sub> ≤ 15W<br>V <sub>I</sub> = 11.2V to 24V | 8.65                          | 9.0  | 9.35 |                   |    |
| Regline           | Line Regulation <sup>(21)</sup>      | V <sub>I</sub> = 11.7V to 25V, I <sub>O</sub> = 500mA                             | —                             | 6    | 90   | mV                |    |
|                   |                                      | V <sub>I</sub> = 12.5V to 19V                                                     | —                             | 4    | 45   |                   |    |
|                   |                                      | T <sub>J</sub> = +25°C                                                            | V <sub>I</sub> = 11.5V to 24V | —    | 6    |                   | 90 |
|                   |                                      |                                                                                   | V <sub>I</sub> = 12.5V to 19V | —    | 2    |                   | 45 |
| Regload           | Load Regulation <sup>(21)</sup>      | T <sub>J</sub> = +25°C, I <sub>O</sub> = 5mA to 1.0A                              | —                             | 12   | 100  | mV                |    |
|                   |                                      | I <sub>O</sub> = 5mA to 1.0A                                                      | —                             | 12   | 100  |                   |    |
|                   |                                      | I <sub>O</sub> = 250mA to 750mA                                                   | —                             | 5    | 50   |                   |    |
| I <sub>Q</sub>    | Quiescent Current                    | T <sub>J</sub> = +25°C                                                            | —                             | 5.0  | 6.0  | mA                |    |
| ΔI <sub>Q</sub>   | Quiescent Current Change             | V <sub>I</sub> = 11.7V to 25V, T <sub>J</sub> = +25°C                             | —                             | —    | 0.8  | mA                |    |
|                   |                                      | V <sub>I</sub> = 12V to 25V, I <sub>O</sub> = 500mA                               | —                             | —    | 0.8  |                   |    |
|                   |                                      | I <sub>O</sub> = 5mA to 1.0A                                                      | —                             | —    | 0.5  |                   |    |
| ΔV/ΔT             | Output Voltage Drift <sup>(22)</sup> | I <sub>O</sub> = 5mA                                                              | —                             | -1.0 | —    | mV/°C             |    |
| V <sub>N</sub>    | Output Noise Voltage                 | f = 10Hz to 100kHz, T <sub>A</sub> = +25°C                                        | —                             | 10   | —    | μV/V <sub>O</sub> |    |
| RR                | Ripple Rejection <sup>(22)</sup>     | f = 120Hz, I <sub>O</sub> = 500mA<br>V <sub>I</sub> = 12V to 22V                  | —                             | 62   | —    | dB                |    |
| V <sub>Drop</sub> | Dropout Voltage                      | I <sub>O</sub> = 1A, T <sub>J</sub> = +25°C                                       | —                             | 2.0  | —    | V                 |    |
| r <sub>O</sub>    | Output Resistance <sup>(22)</sup>    | f = 1kHz                                                                          | —                             | 17   | —    | mΩ                |    |
| I <sub>SC</sub>   | Short Circuit Current                | V <sub>I</sub> = 35V, T <sub>A</sub> = +25°C                                      | —                             | 250  | —    | mA                |    |
| I <sub>PK</sub>   | Peak Current <sup>(22)</sup>         | T <sub>J</sub> = +25°C                                                            | —                             | 2.2  | —    | A                 |    |

**Notes:**

21. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.
22. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7810AE)** (Continued)Refer to the test circuits.  $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$ ,  $I_O = 1\text{A}$ ,  $V_I = 16\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol                | Parameter                            | Conditions                                                                                      | KA7810AE |      |      | Unit                   |
|-----------------------|--------------------------------------|-------------------------------------------------------------------------------------------------|----------|------|------|------------------------|
|                       |                                      |                                                                                                 | Min.     | Typ. | Max. |                        |
| $V_O$                 | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                     | 9.8      | 10.0 | 10.2 | V                      |
|                       |                                      | $I_O = 5\text{mA to } 1\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 12.8\text{V to } 25\text{V}$ | 9.6      | 10.0 | 10.4 |                        |
| Regline               | Line Regulation <sup>(23)</sup>      | $V_I = 12.8\text{V to } 26\text{V}$ , $I_O = 500\text{mA}$                                      | –        | 8.0  | 100  | mV                     |
|                       |                                      | $V_I = 13\text{V to } 20\text{V}$                                                               | –        | 4.0  | 50.0 |                        |
|                       |                                      | $T_J = +25^{\circ}\text{C}$ $V_I = 12.5\text{V to } 25\text{V}$                                 | –        | 8.0  | 100  |                        |
|                       |                                      | $V_I = 13\text{V to } 20\text{V}$                                                               | –        | 3.0  | 50.0 |                        |
| Regload               | Load Regulation <sup>(23)</sup>      | $T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{mA to } 1.5\text{A}$                                | –        | 12.0 | 100  | mV                     |
|                       |                                      | $I_O = 5\text{mA to } 1\text{mA}$                                                               | –        | 12.0 | 100  |                        |
|                       |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                           | –        | 5.0  | 50.0 |                        |
| $I_Q$                 | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 5.0  | 6.0  | mA                     |
| $\Delta I_Q$          | Quiescent Current Change             | $I_O = 5\text{mA to } 1\text{A}$                                                                | –        | –    | 0.5  | mA                     |
|                       |                                      | $V_I = 12.8\text{V to } 25\text{V}$ , $I_O = 500\text{mA}$                                      | –        | –    | 0.8  |                        |
|                       |                                      | $V_I = 13\text{V to } 26\text{V}$ , $T_J = +25^{\circ}\text{C}$                                 | –        | –    | 0.5  |                        |
| $\Delta V_O/\Delta T$ | Output Voltage Drift <sup>(24)</sup> | $I_O = 5\text{mA}$                                                                              | –        | -1.0 | –    | mV/ $^{\circ}\text{C}$ |
| $V_N$                 | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                               | –        | 10.0 | –    | $\mu\text{V}/V_O$      |
| RR                    | Ripple Rejection <sup>(24)</sup>     | $f = 120\text{Hz}$ , $I_O = 500\text{mA}$<br>$V_I = 14\text{V to } 24\text{V}$                  | –        | 62.0 | –    | dB                     |
| $V_{\text{Drop}}$     | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                 | –        | 2.0  | –    | V                      |
| $r_O$                 | Output Resistance <sup>(24)</sup>    | $f = 1\text{kHz}$                                                                               | –        | 17.0 | –    | $\text{m}\Omega$       |
| $I_{\text{SC}}$       | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                | –        | 250  | –    | mA                     |
| $I_{\text{PK}}$       | Peak Current <sup>(24)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 2.2  | –    | A                      |

**Notes:**

23. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

24. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7812AE)** (Continued)Refer to the test circuits.  $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$ ,  $I_O = 1\text{A}$ ,  $V_I = 19\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol              | Parameter                            | Conditions                                                                                      | KA7812AE |      |       | Unit                   |
|---------------------|--------------------------------------|-------------------------------------------------------------------------------------------------|----------|------|-------|------------------------|
|                     |                                      |                                                                                                 | Min.     | Typ. | Max.  |                        |
| $V_O$               | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                     | 11.75    | 12   | 12.25 | V                      |
|                     |                                      | $I_O = 5\text{mA to } 1\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 14.8\text{V to } 27\text{V}$ | 11.5     | 12   | 12.5  |                        |
| Regline             | Line Regulation <sup>(25)</sup>      | $V_I = 14.8\text{V to } 30\text{V}$ , $I_O = 500\text{mA}$                                      | –        | 10   | 120   | mV                     |
|                     |                                      | $V_I = 16\text{V to } 22\text{V}$                                                               | –        | 4    | 120   |                        |
|                     |                                      | $T_J = +25^{\circ}\text{C}$ $V_I = 14.5\text{V to } 27\text{V}$                                 | –        | 10   | 120   |                        |
|                     |                                      | $V_I = 16\text{V to } 22\text{V}$                                                               | –        | 3    | 60    |                        |
| Regload             | Load Regulation <sup>(25)</sup>      | $T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{mA to } 1.5\text{A}$                                | –        | 12   | 100   | mV                     |
|                     |                                      | $I_O = 5\text{mA to } 1.0\text{A}$                                                              | –        | 12   | 100   |                        |
|                     |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                           | –        | 5    | 50    |                        |
| $I_Q$               | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 5.1  | 6.0   | mA                     |
| $\Delta I_Q$        | Quiescent Current Change             | $V_I = 15\text{V to } 30\text{V}$ , $T_J = +25^{\circ}\text{C}$                                 | –        | –    | 0.8   | mA                     |
|                     |                                      | $V_I = 14\text{V to } 27\text{V}$ , $I_O = 500\text{mA}$                                        | –        | –    | 0.8   |                        |
|                     |                                      | $I_O = 5\text{mA to } 1.0\text{A}$                                                              | –        | –    | 0.5   |                        |
| $\Delta V/\Delta T$ | Output Voltage Drift <sup>(26)</sup> | $I_O = 5\text{mA}$                                                                              | –        | -1.0 | –     | mV/ $^{\circ}\text{C}$ |
| $V_N$               | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                               | –        | 10   | –     | $\mu\text{V}/V_O$      |
| RR                  | Ripple Rejection <sup>(26)</sup>     | $f = 120\text{Hz}$ , $I_O = 500\text{mA}$<br>$V_I = 14\text{V to } 24\text{V}$                  | –        | 60   | –     | dB                     |
| $V_{\text{Drop}}$   | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                 | –        | 2.0  | –     | V                      |
| $r_O$               | Output Resistance <sup>(26)</sup>    | $f = 1\text{kHz}$                                                                               | –        | 18   | –     | m $\Omega$             |
| $I_{\text{SC}}$     | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                | –        | 250  | –     | mA                     |
| $I_{\text{PK}}$     | Peak Current <sup>(26)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 2.2  | –     | A                      |

**Notes:**

25. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

26. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7815AE)** (Continued)Refer to the test circuits.  $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$ ,  $I_O = 1\text{A}$ ,  $V_I = 23\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol              | Parameter                            | Conditions                                                                                      | KA7815AE |      |      | Unit                   |
|---------------------|--------------------------------------|-------------------------------------------------------------------------------------------------|----------|------|------|------------------------|
|                     |                                      |                                                                                                 | Min.     | Typ. | Max. |                        |
| $V_O$               | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                     | 14.7     | 15   | 15.3 | V                      |
|                     |                                      | $I_O = 5\text{mA to } 1\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 17.7\text{V to } 30\text{V}$ | 14.4     | 15   | 15.6 |                        |
| Regline             | Line Regulation <sup>(27)</sup>      | $V_I = 17.9\text{V to } 30\text{V}$ , $I_O = 500\text{mA}$                                      | –        | 10   | 150  | mV                     |
|                     |                                      | $V_I = 20\text{V to } 26\text{V}$                                                               | –        | 5    | 150  |                        |
|                     |                                      | $T_J = +25^{\circ}\text{C}$ $V_I = 17.5\text{V to } 30\text{V}$                                 | –        | 11   | 150  |                        |
|                     |                                      | $V_I = 20\text{V to } 26\text{V}$                                                               | –        | 3    | 75   |                        |
| Regload             | Load Regulation <sup>(27)</sup>      | $T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{mA to } 1.5\text{A}$                                | –        | 12   | 100  | mV                     |
|                     |                                      | $I_O = 5\text{mA to } 1.0\text{A}$                                                              | –        | 12   | 100  |                        |
|                     |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                           | –        | 5    | 50   |                        |
| $I_Q$               | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 5.2  | 6.0  | mA                     |
| $\Delta I_Q$        | Quiescent Current Change             | $V_I = 17.5\text{V to } 30\text{V}$ , $T_J = +25^{\circ}\text{C}$                               | –        | –    | 0.8  | mA                     |
|                     |                                      | $V_I = 17.5\text{V to } 30\text{V}$ , $I_O = 500\text{mA}$                                      | –        | –    | 0.8  |                        |
|                     |                                      | $I_O = 5\text{mA to } 1.0\text{A}$                                                              | –        | –    | 0.5  |                        |
| $\Delta V/\Delta T$ | Output Voltage Drift <sup>(28)</sup> | $I_O = 5\text{mA}$                                                                              | –        | -1.0 | –    | mV/ $^{\circ}\text{C}$ |
| $V_N$               | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = +25^{\circ}\text{C}$                               | –        | 10   | –    | $\mu\text{V}/V_O$      |
| RR                  | Ripple Rejection <sup>(28)</sup>     | $f = 120\text{Hz}$ , $I_O = 500\text{mA}$<br>$V_I = 18.5\text{V to } 28.5\text{V}$              | –        | 58   | –    | dB                     |
| $V_{\text{Drop}}$   | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                 | –        | 2.0  | –    | V                      |
| $r_O$               | Output Resistance <sup>(28)</sup>    | $f = 1\text{kHz}$                                                                               | –        | 19   | –    | m $\Omega$             |
| $I_{\text{SC}}$     | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                | –        | 250  | –    | mA                     |
| $I_{\text{PK}}$     | Peak Current <sup>(28)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 2.2  | –    | A                      |

**Notes:**

27. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

28. These parameters, although guaranteed, are not 100% tested in production.

**Electrical Characteristics (KA7824AE)** (Continued)Refer to the test circuits.  $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$ ,  $I_O = 1\text{A}$ ,  $V_I = 33\text{V}$ ,  $C_I = 0.33\mu\text{F}$ ,  $C_O = 0.1\mu\text{F}$ , unless otherwise specified.

| Symbol              | Parameter                            | Conditions                                                                                      | KA7824AE |      |      | Unit                   |
|---------------------|--------------------------------------|-------------------------------------------------------------------------------------------------|----------|------|------|------------------------|
|                     |                                      |                                                                                                 | Min.     | Typ. | Max. |                        |
| $V_O$               | Output Voltage                       | $T_J = +25^{\circ}\text{C}$                                                                     | 23.5     | 24   | 24.5 | V                      |
|                     |                                      | $I_O = 5\text{mA to } 1\text{A}$ , $P_O \leq 15\text{W}$<br>$V_I = 27.3\text{V to } 38\text{V}$ | 23       | 24   | 25   |                        |
| Regline             | Line Regulation <sup>(29)</sup>      | $V_I = 27\text{V to } 38\text{V}$ , $I_O = 500\text{mA}$                                        | –        | 18   | 240  | mV                     |
|                     |                                      | $V_I = 21\text{V to } 33\text{V}$                                                               | –        | 6    | 240  |                        |
|                     |                                      | $T_J = +25^{\circ}\text{C}$ $V_I = 26.7\text{V to } 38\text{V}$                                 | –        | 18   | 240  |                        |
|                     |                                      | $V_I = 30\text{V to } 36\text{V}$                                                               | –        | 6    | 120  |                        |
| Regload             | Load Regulation <sup>(29)</sup>      | $T_J = +25^{\circ}\text{C}$ , $I_O = 5\text{mA to } 1.5\text{A}$                                | –        | 15   | 100  | mV                     |
|                     |                                      | $I_O = 5\text{mA to } 1.0\text{A}$                                                              | –        | 15   | 100  |                        |
|                     |                                      | $I_O = 250\text{mA to } 750\text{mA}$                                                           | –        | 7    | 50   |                        |
| $I_Q$               | Quiescent Current                    | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 5.2  | 6.0  | mA                     |
| $\Delta I_Q$        | Quiescent Current Change             | $V_I = 27.3\text{V to } 38\text{V}$ , $T_J = +25^{\circ}\text{C}$                               | –        | –    | 0.8  | mA                     |
|                     |                                      | $V_I = 27.3\text{V to } 38\text{V}$ , $I_O = 500\text{mA}$                                      | –        | –    | 0.8  |                        |
|                     |                                      | $I_O = 5\text{mA to } 1.0\text{A}$                                                              | –        | –    | 0.5  |                        |
| $\Delta V/\Delta T$ | Output Voltage Drift <sup>(30)</sup> | $I_O = 5\text{mA}$                                                                              | –        | -1.5 | –    | mV/ $^{\circ}\text{C}$ |
| $V_N$               | Output Noise Voltage                 | $f = 10\text{Hz to } 100\text{kHz}$ , $T_A = 25^{\circ}\text{C}$                                | –        | 10   | –    | $\mu\text{V}/V_O$      |
| RR                  | Ripple Rejection <sup>(30)</sup>     | $f = 120\text{Hz}$ , $I_O = 500\text{mA}$<br>$V_I = 28\text{V to } 38\text{V}$                  | –        | 54   | –    | dB                     |
| $V_{\text{Drop}}$   | Dropout Voltage                      | $I_O = 1\text{A}$ , $T_J = +25^{\circ}\text{C}$                                                 | –        | 2.0  | –    | V                      |
| $r_O$               | Output Resistance <sup>(30)</sup>    | $f = 1\text{kHz}$                                                                               | –        | 20   | –    | $\text{m}\Omega$       |
| $I_{\text{SC}}$     | Short Circuit Current                | $V_I = 35\text{V}$ , $T_A = +25^{\circ}\text{C}$                                                | –        | 250  | –    | mA                     |
| $I_{\text{PK}}$     | Peak Current <sup>(30)</sup>         | $T_J = +25^{\circ}\text{C}$                                                                     | –        | 2.2  | –    | A                      |

**Notes:**

29. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

30. These parameters, although guaranteed, are not 100% tested in production.

## Typical Performance Characteristics

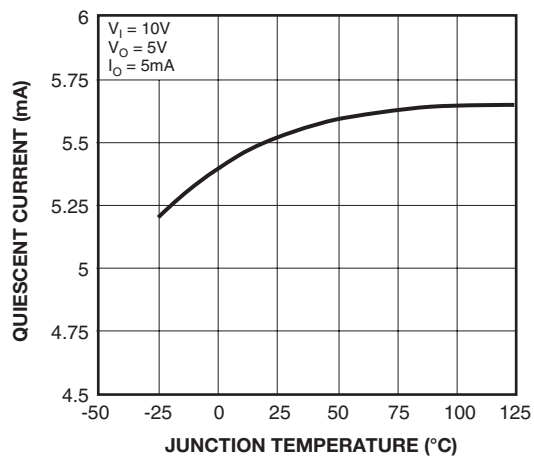


Figure 3. Quiescent Current

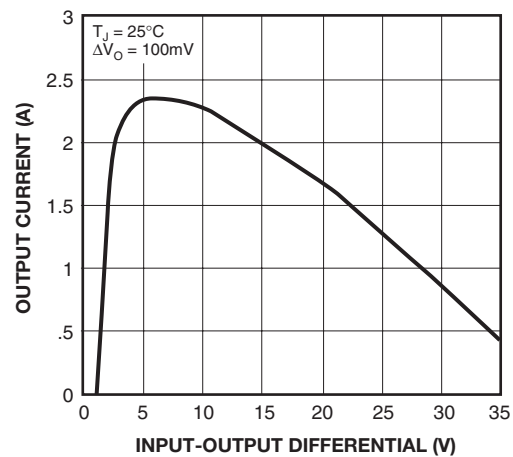


Figure 4. Peak Output Current

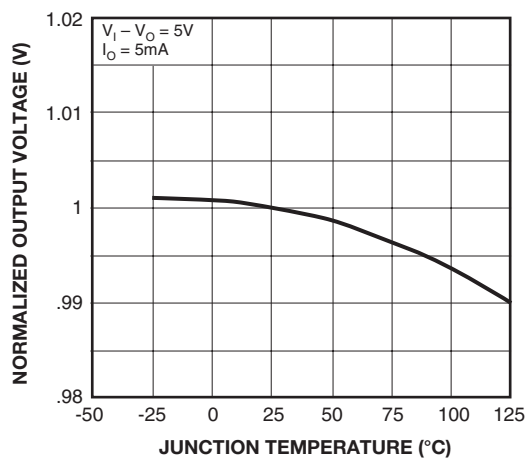


Figure 5. Output Voltage

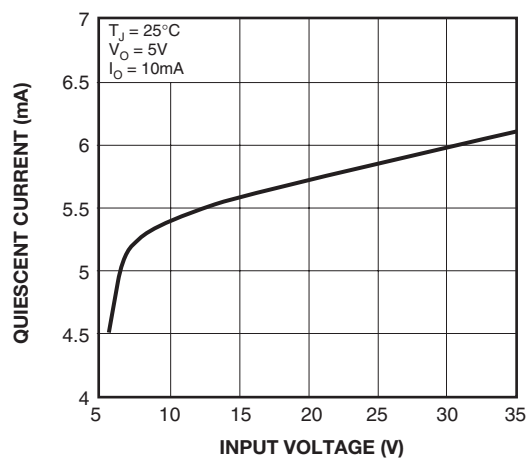


Figure 6. Quiescent Current

## Typical Applications

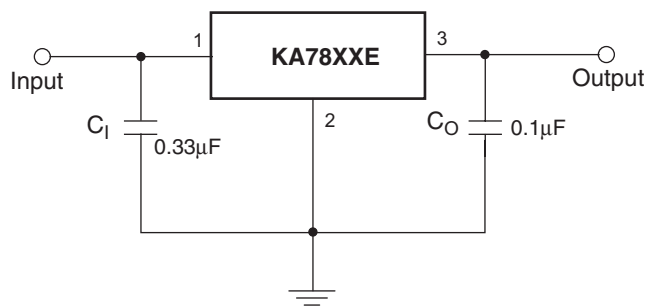


Figure 7. DC Parameters

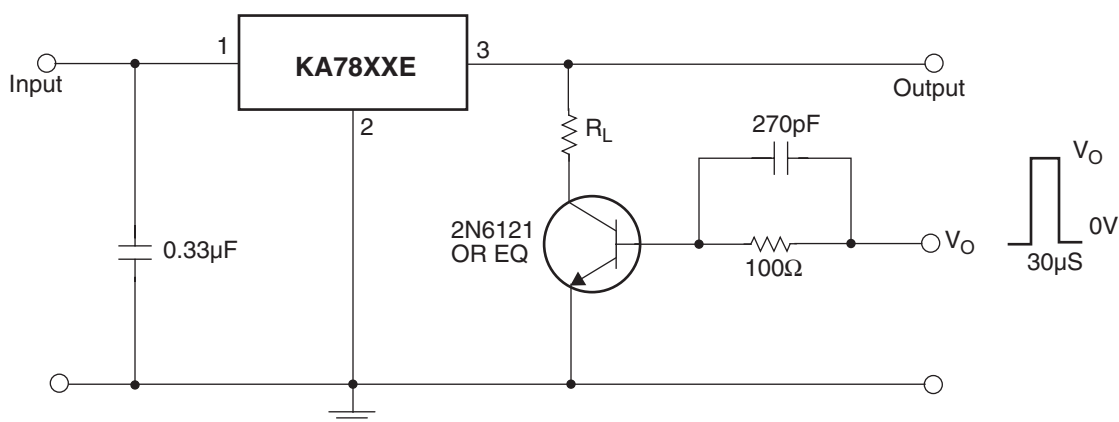


Figure 8. Load Regulation

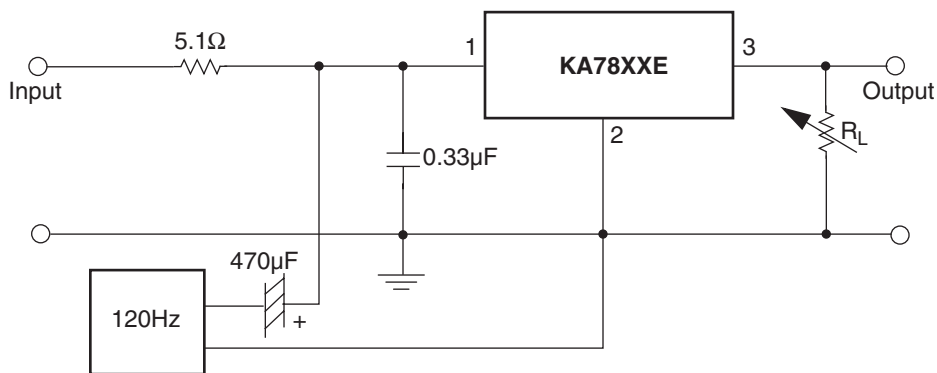


Figure 9. Ripple Rejection

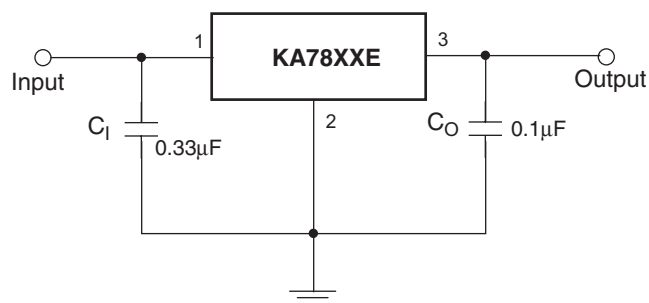


Figure 10. Fixed Output Regulator

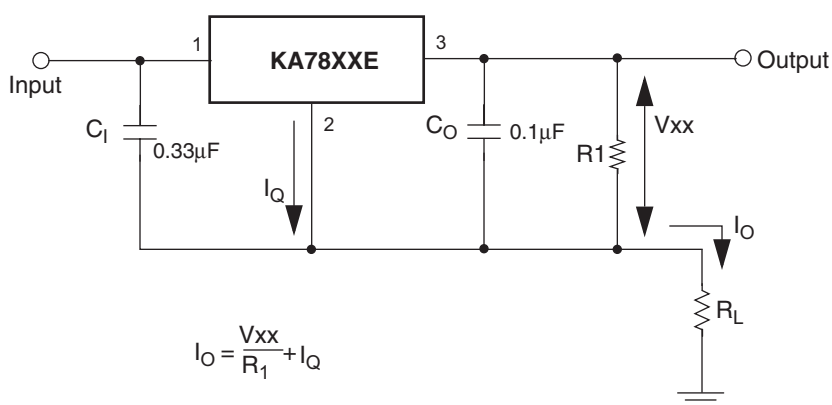


Figure 11. Constant Current Regulator

**Notes:**

1. To specify an output voltage, substitute voltage value for "XX." A common ground is required between the input and the Output voltage. The input voltage must remain typically 2.0V above the output voltage even during the low point on the input ripple voltage.
2.  $C_1$  is required if regulator is located an appreciable distance from power Supply filter.
3.  $C_0$  improves stability and transient response.

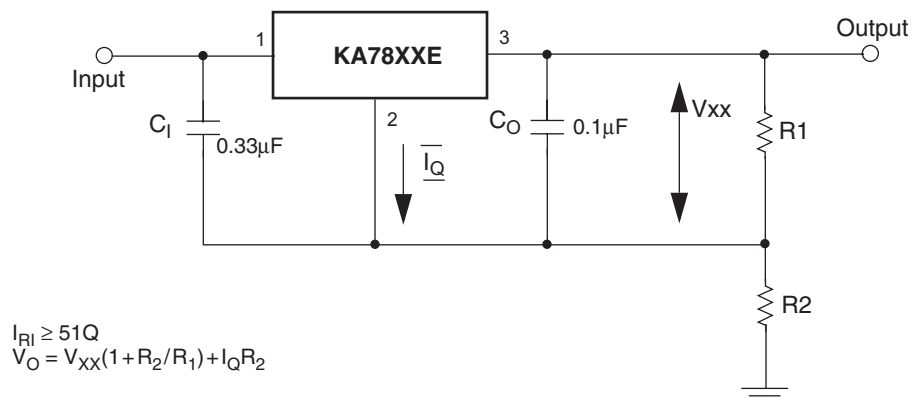


Figure 12. Circuit for Increasing Output Voltage

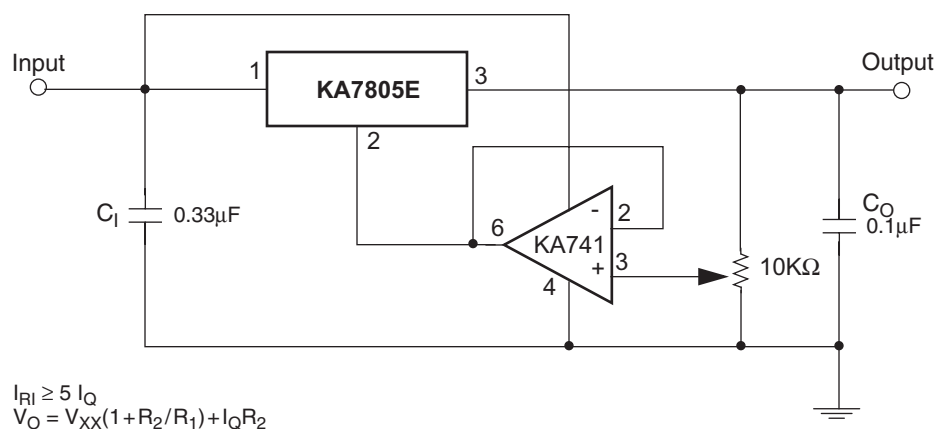


Figure 13. Adjustable Output Regulator (7 to 30V)

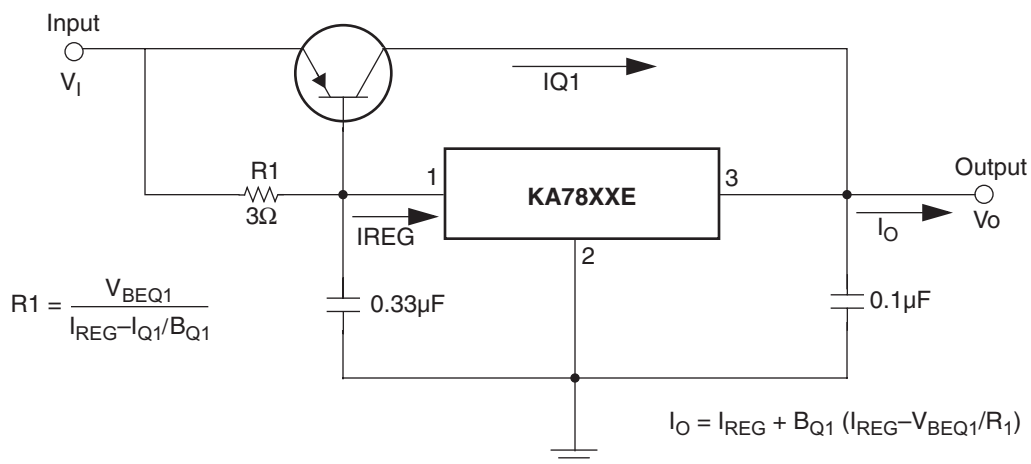


Figure 14. High Current Voltage Regulator

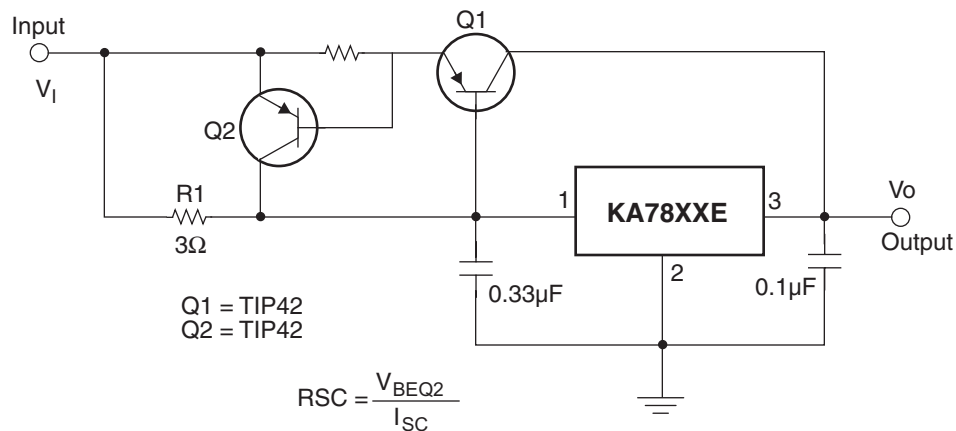


Figure 15. High Output Current with Short Circuit Protection

The circuit diagram shows two operational amplifiers, KA7815E and KA7915E, configured as differential amplifiers. The KA7815E is a non-inverting amplifier with a gain of 10, and the KA7915E is an inverting amplifier with a gain of 10. The inputs are connected to a +20V signal and a -20V signal. The outputs are connected to a common load consisting of two 1N4001 diodes in series to ground. The circuit is powered by a +15V supply and a -15V supply.

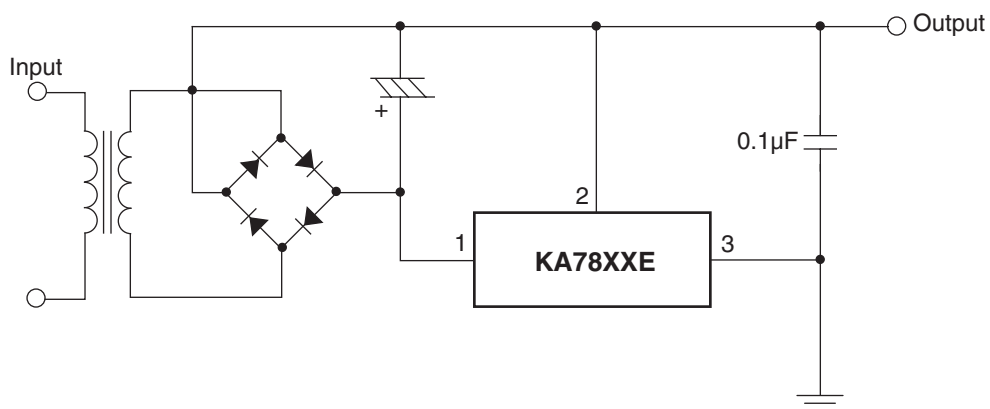


Figure 18. Negative Output Voltage Circuit

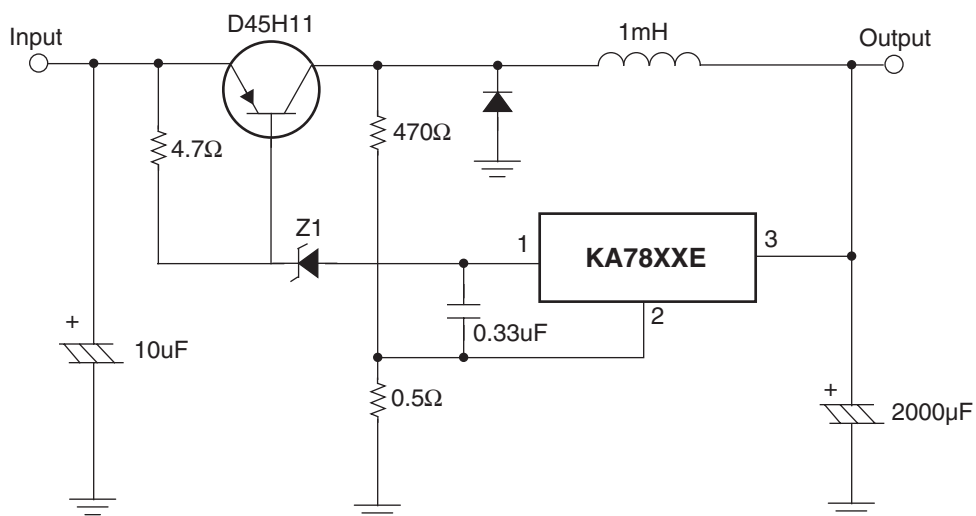
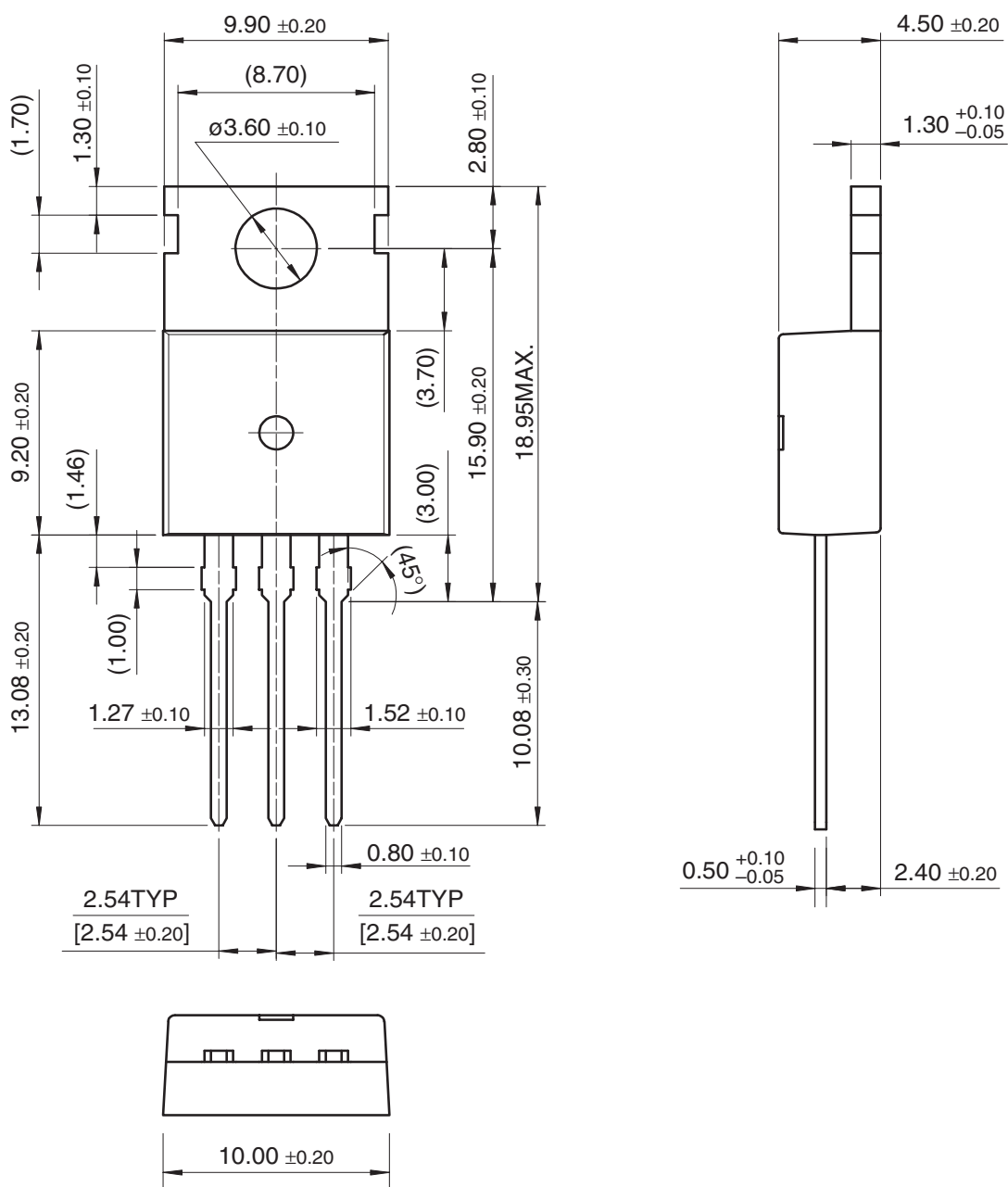


Figure 19. Switching Regulator

## Mechanical Dimensions

Dimensions in millimeters

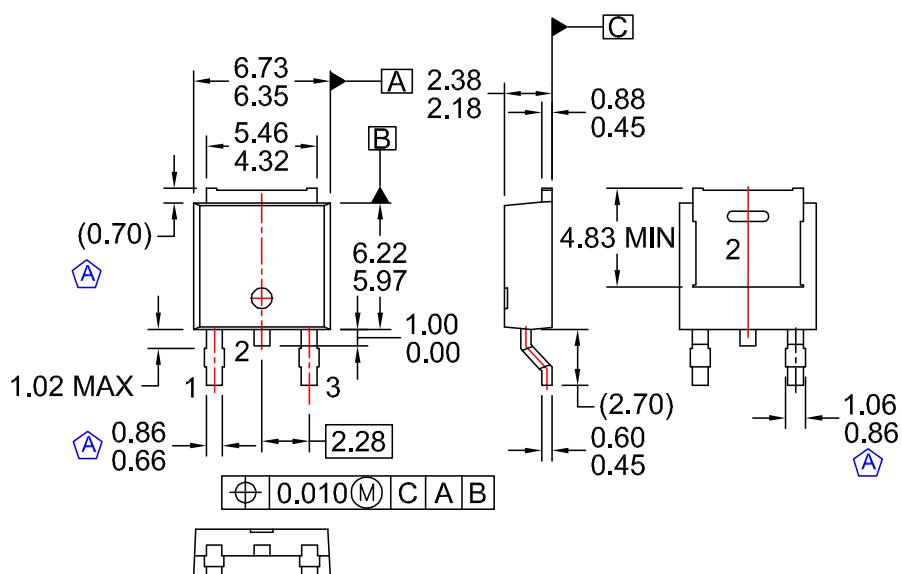
### TO-220 [ DUAL GAUGE ]



### Mechanical Dimensions (Continued)

Dimensions in millimeters

## D-PAK



NOTES: UNLESS OTHERWISE SPECIFIED

**A) CONFORMS TO JEDEC TO-252 VARIATION AB  
EXCEPT WHERE NOTED**

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DRAWING CONFORMS TO ASME Y14.5M-1994

D) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

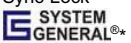
E) FORMERLY NAMED BD1733

F) DRAWING FILE NAME: MKT-TO252D03REV1



## TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

|                                                                                              |                                                |                                                                                                    |                                                                                             |
|----------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 2Cool™                                                                                       | F-PFS™                                         | PowerTrench®                                                                                       | The Power Franchise®                                                                        |
| AccuPower™                                                                                   | FRFET®                                         | PowerXS™                                                                                           | the power franchise                                                                         |
| AX-CAP™*                                                                                     | Global Power Resource™                         | Programmable Active Droop™                                                                         | TinyBoost™                                                                                  |
| BitSiC™                                                                                      | GreenBridge™                                   | QFET®                                                                                              | TinyBuck™                                                                                   |
| Build it Now™                                                                                | Green FPS™                                     | QS™                                                                                                | TinyCalc™                                                                                   |
| CorePLUS™                                                                                    | Green FPS™ e-Series™                           | Quiet Series™                                                                                      | TinyLogic®                                                                                  |
| CorePOWER™                                                                                   | Gmax™                                          | RapidConfigure™                                                                                    | TINYOPTO™                                                                                   |
| CROSSVOLT™                                                                                   | GTO™                                           |  ™                | TinyPower™                                                                                  |
| CTL™                                                                                         | IntelliMAX™                                    | Saving our world, 1mW/W/kW at a time™                                                              | TinyPWM™                                                                                    |
| Current Transfer Logic™                                                                      | ISOPLANAR™                                     | SignalWise™                                                                                        | TinyWire™                                                                                   |
| DEUXPEED®                                                                                    | Making Small Speakers Sound Louder and Better™ | SmartMax™                                                                                          | TranSiC™                                                                                    |
| Dual Cool™                                                                                   | MegaBuck™                                      | SMART START™                                                                                       | TriFault Detect™                                                                            |
| EcoSPARK®                                                                                    | MICROCOUPLER™                                  | Solutions for Your Success™                                                                        | TRUECURRENT®*                                                                               |
| EfficientMax™                                                                                | MicroFET™                                      | SPM®                                                                                               | µSerDes™                                                                                    |
| ESBC™                                                                                        | MicroPak™                                      | STEALTH™                                                                                           |  SerDes™ |
|  Fairchild® | MicroPak2™                                     | SuperFET®                                                                                          | UHC®                                                                                        |
| Fairchild Semiconductor®                                                                     | MillerDrive™                                   | SuperSOT™-3                                                                                        | Ultra FRFET™                                                                                |
| FACT Quiet Series™                                                                           | MotionMax™                                     | SuperSOT™-6                                                                                        | UniFET™                                                                                     |
| FACT®                                                                                        | Motion-SPM™                                    | SuperSOT™-8                                                                                        | VCX™                                                                                        |
| FAST®                                                                                        | mWSaver™                                       | SupreMOS®                                                                                          | VisualMax™                                                                                  |
| FastvCore™                                                                                   | OptoHiT™                                       | SyncFET™                                                                                           | VoltagePlus™                                                                                |
| FETBench™                                                                                    | OPTOLOGIC®                                     | Sync-Lock™                                                                                         | XS™                                                                                         |
| FlashWriter®*                                                                                | OPTOPLANAR®                                    |  SYSTEM GENERAL®* |                                                                                             |
| FPS™                                                                                         |                                                |                                                                                                    |                                                                                             |

\* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

## DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

## LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status        | Definition                                                                                                                                                                                          |
|--------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.                                               |
| Obsolete                 | Not In Production     | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.                                                    |

Rev. I61