



78DXX

LINEAR INTEGRATED CIRCUIT

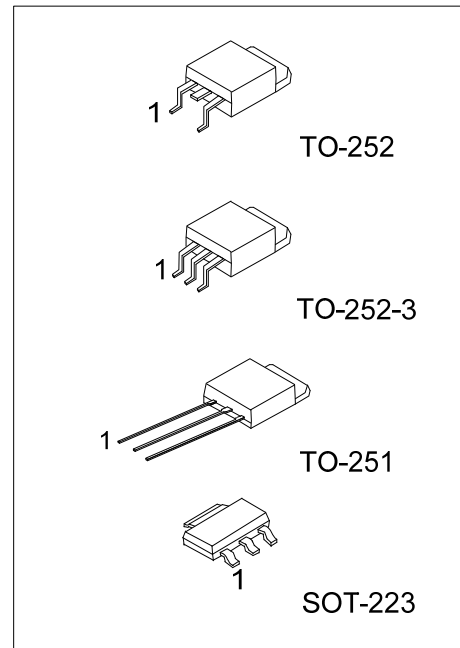
3-TERMINALS 0.5A POSITIVE VOLTAGE REGULATOR

DESCRIPTION

The UTC **78DXX** family is monolithic fixed voltage regulator integrated circuit. They are suitable for applications that required supply current up to 0.5 A.

FEATURE

- * Output current up to 0.5 A
- * Fixed output voltage of 4.7V, 5V, 6V, 8V, 9V, 12V, 15V, 18V and 24V available
- * Thermal overload shutdown protection
- * Short circuit current limiting
- * Output transistor SOA protection



Lead-free: 78DxxL
 Halogen-free: 78DxxG

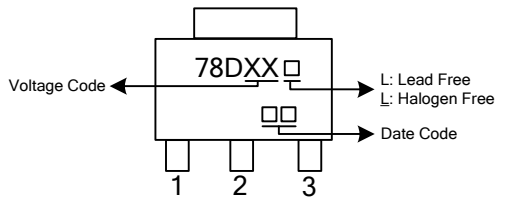
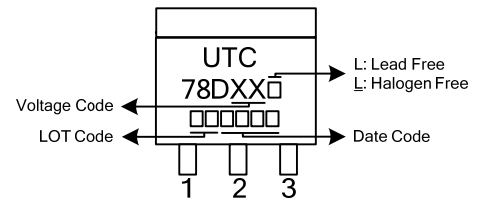
ORDERING INFORMATION

| Ordering Number | | | Package | Pin Assignment | | | Packing |
|-----------------|-------------------|--------------|----------|----------------|---|---|-----------|
| Normal | Lead Free Plating | Halogen Free | | 1 | 2 | 3 | |
| 78Dxx-AA3-R | 78DxxL-AA3-R | 78DxxG-AA3-R | SOT-223 | I | G | O | Tape Reel |
| 78Dxx-TM3-T | 78DxxL-TM3-T | 78DxxG-TM3-T | TO-251 | I | G | O | Tube |
| 78Dxx-TN3-R | 78DxxL-TN3-R | 78DxxG-TN3-R | TO-252 | I | G | O | Tape Reel |
| 78Dxx-TNA-R | 78DxxL-TNA-R | 78DxxG-TNA-R | TO-252-3 | I | G | O | Tape Reel |

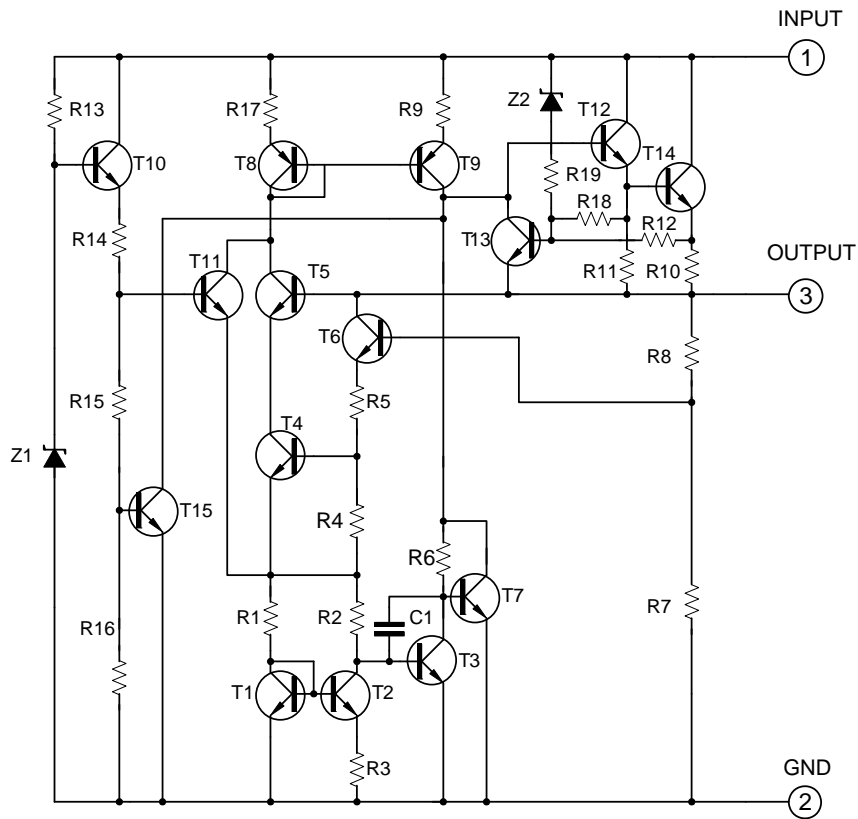
Note: 1. xx: output voltage, refer to Marking Information
 2. Pin Code: I: Input G: GND O: Output

| | |
|---------------------|---|
| <p>78DxxL-AA3-R</p> | <p>(1) Packing Type (2) Package Type (3) Lead Plating (4) Output Voltage Code</p> <p>(1) R: Tape Reel, T: Tube (2) AA3: SOT-223, TM3: TO-251, TN3: TO-252, TNA: TO-252-3 (3) G: Halogen Free, L: Lead Free, Blank: Pb/Sn (4) xx: refer to Marking Information</p> |
|---------------------|---|

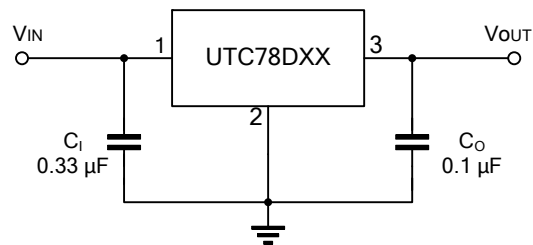
MARKING INFORMATION

| PACKAGE | VOLTAGE CODE | MARKING |
|------------------------------|---|---|
| SOT-223 | 47 : 4.7V 05 : 5V 06 : 6V 08 : 8V 09 : 9V |  <p>The diagram shows a top view of a SOT-223 package. The marking '78DXX' is located on the top surface. To the left of the marking is an arrow pointing to the 'Voltage Code'. To the right are two arrows: the top one points to 'L: Lead Free' and 'L: Halogen Free', and the bottom one points to 'Date Code'. The package has three pins labeled 1, 2, and 3 at the bottom.</p> |
| TO-251 TO-252 TO-252-3 | 12 : 12V 15 : 15V 18 : 18V 24 : 24V |  <p>The diagram shows a top view of a TO-251/252/252-3 package. The marking 'UTC' is on the top surface, with '78DXX' below it. To the left of '78DXX' is an arrow pointing to 'Voltage Code'. Below '78DXX' is an arrow pointing to 'LOT Code'. To the right are two arrows: the top one points to 'L: Lead Free' and 'L: Halogen Free', and the bottom one points to 'Date Code'. The package has three pins labeled 1, 2, and 3 at the bottom.</p> |

■ BLOCK DIAGRAM



■ TYPICAL APPLICATION CIRCUIT



Note: Bypass capacitors are recommended for optimum stability and transient response and should be located as close as possible to the regulators.

■ ABSOLUTE MAXIMUM RATINGS (Operating temperature range applies unless otherwise specified.)

| PARAMETER | SYMBOL | RATINGS | UNIT | |
|--------------------------------|-----------|-----------------------|------|---|
| Input Voltage | V_{IN} | $V_{OUT}=4.7\sim 18V$ | 35 | V |
| | | $V_{OUT}=20\sim 24V$ | 40 | V |
| Output Current | I_{OUT} | 0.5 | A | |
| Power Dissipation | P_D | Internally Limited | W | |
| Operating Junction Temperature | T_J | -20~ +150 | °C | |
| Storage Temperature | T_{STG} | -65 ~ +150 | °C | |

Note:1. Absolute maximum ratings are stress ratings only and functional device operation is not implied. The device could be damaged beyond Absolute maximum ratings.

2. The maximum steady state usable output current are dependent on input voltage, heat sinking, lead length of the package and copper pattern of PCB. The data are showed as electrical characteristics table represents pulse test conditions with junction temperatures specified at the initiation of test.

■ ELECTRICAL CHARACTERISTICS

($T_J=25^\circ\text{C}$, $C_1=0.33\mu\text{F}$, $C_0=0.1\mu\text{F}$, $P_D\leq 7W$, unless otherwise specified)

For 78D47 ($V_{IN}=9.7V$, $I_{OUT}=0.5A$.)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|--|-------|------|-------|----------------------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5\text{mA}\sim 0.5A$ | 4.512 | 4.7 | 4.888 | V |
| | | $V_{IN}=7.2\sim 19.7V$, $I_{OUT}=5\text{mA}\sim 0.5A$ | 4.465 | | 4.935 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5\text{mA}\sim 0.5A$ | | | 47 | mV |
| | | $I_{OUT}=5\text{mA}\sim 200\text{mA}$ | | | 24 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=7.2\sim 19.7V$ | | | 47 | mV |
| | | $V_{IN}=7.2\sim 19.7V$, $I_{OUT}=0.5A$ | | | 47 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=7.2\sim 19.7V$ | | | 1 | mA |
| | | $I_{OUT}=5\text{mA}\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10\text{Hz}\leq f\leq 100\text{kHz}$ | | 40 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5\text{mA}$ | | -0.6 | | $\text{mV}/^\circ\text{C}$ |
| Ripple Rejection | RR | $V_{IN}=7.7\sim 17.7V$, $f=120\text{Hz}$ | 62 | 80 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.8 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

For 78D05 ($V_{IN}=10V$, $I_{OUT}=0.5A$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|--|------|------|------|----------------------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5\text{mA}\sim 0.5A$ | 4.8 | 5 | 5.2 | V |
| | | $V_{IN}=7.5\sim 20V$, $I_{OUT}=5\text{mA}\sim 0.5A$ | 4.75 | | 5.25 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5\text{mA}\sim 0.5A$ | | | 100 | mV |
| | | $I_{OUT}=5\text{mA}\sim 200\text{mA}$ | | | 50 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=7V\sim 25V$ | | | 100 | mV |
| | | $V_{IN}=7.5\sim 20V$, $I_{OUT}=0.5A$ | | | 50 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{OUT}=7.5\sim 20V$ | | | 1 | mA |
| | | $I_{OUT}=5\text{mA}\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10\text{Hz}\leq f\leq 100\text{kHz}$ | | 40 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5\text{mA}$ | | -0.6 | | $\text{mV}/^\circ\text{C}$ |
| Ripple Rejection | RR | $V_{IN}=8\sim 18V$, $f=120\text{Hz}$ | 62 | 80 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

■ ELECTRICAL CHARACTERISTICS(Cont.)

For 78D06 ($V_{IN}=11V$, $I_{OUT}=0.5A$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|--|------|------|------|---------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | 5.76 | 6 | 6.24 | V |
| | | $V_{IN}=8.5\sim 21V, I_{OUT}=5mA\sim 0.5A$ | 5.7 | | 6.3 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | | | 60 | mV |
| | | $I_{OUT}=5mA\sim 200mA$ | | | 30 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=8\sim 25V$ | | | 60 | mV |
| | | $V_{IN}=8.5\sim 21V, I_{OUT}=0.5A$ | | | 60 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=8.5\sim 21V$ | | | 1 | mA |
| | | $I_{OUT}=5mA\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10Hz \leq f \leq 100kHz$ | | 45 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5mA$ | | -0.7 | | $mV/^\circ C$ |
| Ripple Rejection | RR | $V_{IN}=9\sim 19V, f=120Hz$ | 59 | 75 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

For 78D08 ($V_{IN}=14V$, $I_{OUT}=0.5A$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|---|------|------|------|---------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | 7.68 | 8 | 8.32 | V |
| | | $V_{IN}=10.5\sim 23V, I_{OUT}=5mA\sim 0.5A$ | 7.6 | | 8.4 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | | | 80 | mV |
| | | $I_{OUT}=5mA\sim 200mA$ | | | 40 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=10.5\sim 25V$ | | | 80 | mV |
| | | $V_{IN}=10.5\sim 23V, I_{OUT}=0.5A$ | | | 80 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=10.5\sim 23V$ | | | 1 | mA |
| | | $I_{OUT}=5mA\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10Hz \leq f \leq 100kHz$ | | 58 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5mA$ | | -0.9 | | $mV/^\circ C$ |
| Ripple Rejection | RR | $V_{IN}=11.5\sim 21.5V, f=120Hz$ | 56 | 72 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

For 78D09 ($V_{IN}=15V$, $I_{OUT}=0.5A$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|---|------|------|------|---------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | 8.64 | 9 | 9.36 | V |
| | | $V_{IN}=11.5\sim 24V, I_{OUT}=5mA\sim 0.5A$ | 8.55 | | 9.45 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | | | 90 | mV |
| | | $I_{OUT}=5mA\sim 200mA$ | | | 45 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=11.5\sim 25V$ | | | 90 | mV |
| | | $V_{IN}=11.5\sim 24V, I_{OUT}=0.5A$ | | | 90 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=11.5\sim 24V$ | | | 1 | mA |
| | | $I_{OUT}=5mA\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10Hz \leq f \leq 100kHz$ | | 58 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5mA$ | | -1.1 | | $mV/^\circ C$ |
| Ripple Rejection | RR | $V_{IN}=12.5\sim 22.5V, f=120Hz$ | 56 | 72 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

■ ELECTRICAL CHARACTERISTICS(Cont.)

For 78D12 ($V_{IN}=19V$, $I_{OUT}=0.5A$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|---|-------|------|-------|---------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | 11.52 | 12 | 12.48 | V |
| | | $V_{IN}=14.5\sim 27V, I_{OUT}=5mA\sim 0.5A$ | 11.4 | | 12.6 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | | | 120 | mV |
| | | $I_{OUT}=5mA\sim 200mA$ | | | 60 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=14.5\sim 30V$ | | | 120 | mV |
| | | $V_{IN}=14.6\sim 27V, I_{OUT}=0.5A$ | | | 120 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=14.5\sim 30V$ | | | 1 | mA |
| | | $I_{OUT}=5mA\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10Hz \leq f \leq 100kHz$ | | 75 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5mA$ | | -1.5 | | $mV/^\circ C$ |
| Ripple Rejection | RR | $V_{IN}=15\sim 25V, f=120Hz$ | 55 | 72 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

For 78D15 ($V_{IN}=23V$, $I_{OUT}=0.5A$, $C_1=0.33\mu F$, $C_O=0.1\mu F$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|---|-------|------|-------|---------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | 14.4 | 15 | 15.6 | V |
| | | $V_{IN}=17.5\sim 30V, I_{OUT}=5mA\sim 0.5A$ | 14.25 | | 15.75 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | | | 150 | mV |
| | | $I_{OUT}=5mA\sim 200mA$ | | | 75 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=18.5\sim 30V$ | | | 150 | mV |
| | | $V_{IN}=17.5\sim 30V, I_{OUT}=0.5A$ | | | 150 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=17.5\sim 30V$ | | | 1 | mA |
| | | $I_{OUT}=5mA\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10Hz \leq f \leq 100kHz$ | | 90 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5mA$ | | -1.8 | | $mV/^\circ C$ |
| Ripple Rejection | RR | $V_{IN}=18.5\sim 28.5V, f=120Hz$ | 54 | 70 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

For 78D18 ($V_{IN}=27V$, $I_{OUT}=0.5A$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|---|-------|------|-------|---------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | 17.28 | 18 | 18.72 | V |
| | | $V_{IN}=21\sim 33V, I_{OUT}=5mA\sim 0.5A$ | 17.1 | | 18.9 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | | | 180 | mV |
| | | $I_{OUT}=5mA\sim 200mA$ | | | 90 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=21\sim 33V$ | | | 180 | mV |
| | | $V_{IN}=21\sim 33V, I_{OUT}=0.5A$ | | | 180 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=21.5\sim 33V$ | | | 1 | mA |
| | | $I_{OUT}=5mA\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10Hz \leq f \leq 100kHz$ | | 110 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5mA$ | | -2.2 | | $mV/^\circ C$ |
| Ripple Rejection | RR | $V_{IN}=22\sim 32V, f=120Hz$ | 53 | 69 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

■ ELECTRICAL CHARACTERISTICS(Cont.)

For 78D24 ($V_{IN}=33V$, $I_{OUT}=0.5A$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------------------|--|-------|------|-------|-----------------|
| Output Voltage | V_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | 23.04 | 24 | 24.96 | V |
| | | $V_{IN}=27\sim 38V$, $I_{OUT}=5mA\sim 0.5A$ | 22.8 | | 25.2 | V |
| Load Regulation | ΔV_{OUT} | $I_{OUT}=5mA\sim 0.5A$ | | | 240 | mV |
| | | $I_{OUT}=5mA\sim 200mA$ | | | 120 | mV |
| Line Regulation | ΔV_{OUT} | $V_{IN}=27\sim 38V$ | | | 240 | mV |
| | | $V_{IN}=27\sim 38V$, $I_{OUT}=0.5A$ | | | 240 | mV |
| Quiescent Current | I_Q | $I_{OUT}=0.5A$ | | | 8 | mA |
| Quiescent Current Change | ΔI_Q | $V_{IN}=28\sim 38V$ | | | 1 | mA |
| | | $I_{OUT}=5mA\sim 0.5A$ | | | 0.5 | mA |
| Output Noise Voltage | eN | $10Hz \cong f \cong 100kHz$ | | 170 | | μV |
| Temperature coefficient of V_{OUT} | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=5mA$ | | -2.8 | | mV/ $^{\circ}C$ |
| Ripple Rejection | RR | $V_{IN}=28\sim 38V$, $f=120Hz$ | 50 | 66 | | dB |
| Peak Output Current | I_{PEAK} | | | 1.2 | | A |
| Short-Circuit Current | I_{SC} | $V_{IN}=35V$ | | 250 | | mA |
| Dropout Voltage | V_D | | | 2 | | V |

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