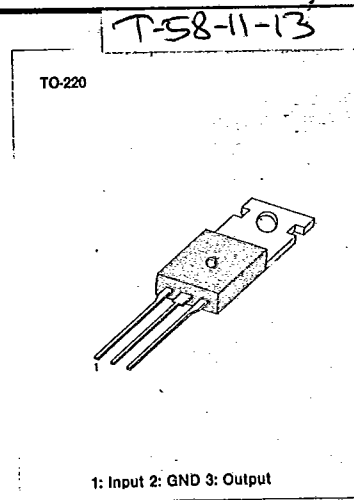


MC78XXC

LINEAR INTEGRATED CIRCUIT

3-TERMINAL 1A POSITIVE VOLTAGE REGULATORS

The MC78XX series of three-terminal positive regulators are available in the TO-220 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 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.



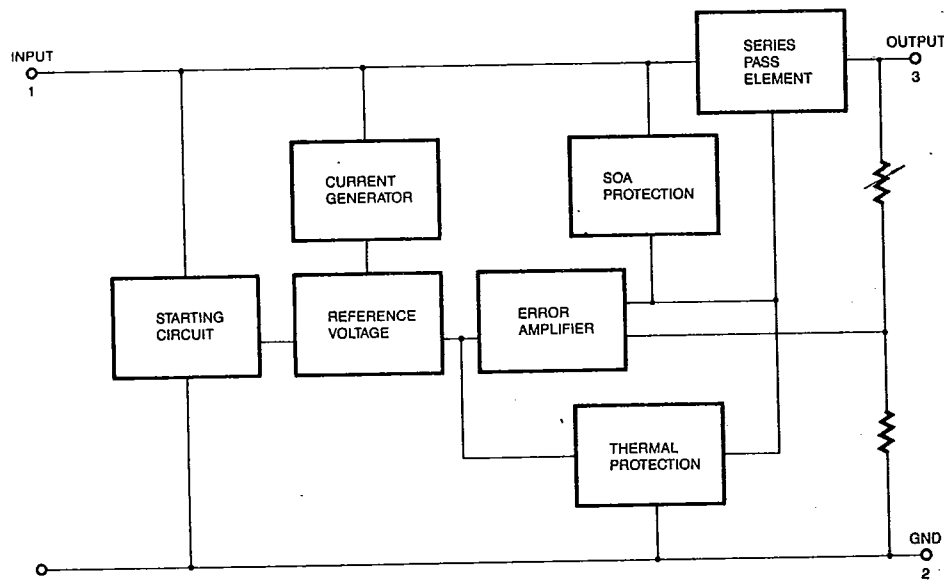
FEATURES

- Output Current up to 1A
- Output Voltages of 5; 8; 12; 15; 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor SOA Protection

ORDERING INFORMATION

| Device | Package | Operating Temperature |
|----------|---------|-----------------------|
| MC78XXCT | TO-220 | 0 ~ +125°C |

BLOCK DIAGRAM



MC78XXC

LINEAR INTEGRATED CIRCUIT

T-58-11-13

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C, unless otherwise specified)

| Characteristic | Symbol | Value | Unit |
|--|------------------|------------|------|
| Input Voltage (for V _o = 5V to 15V) (for V _o = 24V) | V _{IN} | 35 | V |
| | V _{IN} | 40 | V |
| Thermal Resistance Junction-Cases | θ _{JC} | 5 | °C/W |
| Thermal Resistance Junction-Air | θ _{JA} | 65 | °C/W |
| Operating Temperature Range | T _{opr} | 0 ~ +125 | °C |
| Storage Temperature Range | T _{stg} | -65 ~ +150 | °C |

ELECTRICAL CHARACTERISTICS MC7805C

V_{IN} = 10V, I_{OUT} = 500mA, 0°C ≤ T_J ≤ 125°C, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, unless otherwise specified. (Note)

| Characteristic | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---------------------|---|---------------------------------|------|------|-------|
| Output Voltage | V _o | T _J = 25°C | 4.8 | 5.0 | 5.2 | V |
| | | 5.0mA ≤ I _o ≤ 1.0A, P _o ≤ 15W V _i = 7V to 20V | 4.75 | 5.0 | 5.25 | |
| Line Regulation | ΔV _o | T _J = 25°C | V _i = 7V to 25V | 4.0 | 100 | mV |
| | | | V _i = 8V to 12V | 1.6 | 50 | |
| Load Regulation | ΔV _o | T _J = 25°C | I _o = 5.0mA to 1.5A | 9 | 100 | mV |
| | | | I _o = 250mA to 750mA | 4 | 50 | |
| Quiescent Current | I _d | T _J = 25°C | | 5.0 | 8 | mA |
| Quiescent Current Change | ΔI _d | I _o = 5mA to 1.0A | | 0.03 | 0.5 | mA |
| | | V _i = 7V to 25V | | 0.3 | 1.3 | |
| Temperature Coefficient of V _o | ΔV _o /ΔT | I _o = 5mA | | -0.8 | | mV/°C |
| Output Noise Voltage | V _N | f = 10Hz to 100KHz, T _a = 25°C | | 42 | | μV |
| Ripple Rejection | RR | f = 120Hz V _i = 8 to 18V | | 62 | 73 | dB |
| Dropout Voltage | V _D | I _o = 1A, T _J = 25°C | | 2 | | V |
| Output Resistance | R _o | f = 1KHz | | 15 | | mΩ |
| Short Circuit Current | I _{sc} | V _i = 35V, T _J = 25°C | | 230 | | mA |
| Peak Current | I _{peak} | T _J = 25°C | | 2.2 | | A |

* 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.

MC78XXC

LINEAR INTEGRATED CIRCUIT

T-58-11-13

ELECTRICAL CHARACTERISTICS MC7808C

$V_{IN} = 14V$, $I_{OUT} = 500mA$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$, $C_{IN} = 0.33\mu F$, $C_{OUT} = 0.1\mu F$, unless otherwise specified. (Note)

| Characteristic | Symbol | Test Conditions | Min | Typ | Max | Unit | |
|----------------------------------|-------------------------|---|--------------------------|------|-----|-----------------|----|
| Output Voltage | V_o | $T_j = 25^{\circ}C$ | 7.7 | 8.0 | 8.3 | V | |
| | | $5.0mA \leq I_o \leq 1.0A$, $P_o \leq 15W$ $V_i = 10.5V$ to $23V$ | 7.6 | 8.0 | 8.4 | | |
| Line Regulation | ΔV_o | $T_j = 25^{\circ}C$ | $V_i = 10.5V$ to $25V$ | | 5 | 160 | mV |
| | | | $V_i = 11.5V$ to $17V$ | | 2.0 | 80 | |
| Load Regulation | ΔV_o | $T_j = 25^{\circ}C$ | $I_o = 5.0mA$ to $1.5A$ | | 10 | 160 | mV |
| | | | $I_o = 250mA$ to $750mA$ | | 5.0 | 80 | |
| Quiescent Current | I_q | $T_j = 25^{\circ}C$ | | 5.0 | 8 | mA | |
| Quiescent Current Change | ΔI_q | $I_o = 5mA$ to $1.0A$ | | 0.05 | 0.5 | mA | |
| | | $V_i = 10.5V$ to $25V$ | | 0.5 | 1.0 | | |
| Temperature Coefficient of V_o | $\Delta V_o / \Delta T$ | $I_o = 5mA$ | | -0.8 | | mV/ $^{\circ}C$ | |
| Output Noise Voltage | V_N | $f = 10Hz$ to $100KHz$, $T_a = 25^{\circ}C$ | | 52 | | μV | |
| Ripple Rejection | RR | $f = 120Hz$, $V_i = 11.5$ to $21.5V$ | 56 | 73 | | dB | |
| Dropout Voltage | V_D | $I_o = 1A$, $T_j = 25^{\circ}C$ | | 2 | | V | |
| Output Resistance | R_o | $f = 1KHz$ | | 17 | | m Ω | |
| Short Circuit Current | I_{sc} | $V_i = 35V$, $T_j = 25^{\circ}C$ | | 230 | | mA | |
| Peak Current | I_{peak} | $T_j = 25^{\circ}C$ | | 2.2 | | A | |

* 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.

MC78XXC

LINEAR INTEGRATED CIRCUIT

T-58-11-13

ELECTRICAL CHARACTERISTICS MC7812C

$V_{IN} = 19V$, $I_{OUT} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{IN} = 0.33\mu F$, $C_{OUT} = 0.1\mu F$, unless otherwise specified. (Note)

| Characteristic | Symbol | Test Conditions | Min | Typ | Max | Unit | |
|----------------------------------|-----------------------|--|--------------------------|-----|-------------------|-----------------|----|
| Output Voltage | V_o | $T_J = 25^{\circ}C$ | 11.5 | 12 | 12.5 | | |
| | | $5.0mA \leq I_o \leq 1.0A$, $P_o \leq 15W$ $V_{in} = 14.5V$ to $27V$ | 11.4 | 12 | 12.6 ^V | | |
| Line Regulation | ΔV_o | $T_J = 25^{\circ}C$ | $V_i = 14.5$ to $30V$ | | 10 | 240 | mV |
| | | | $V_i = 16$ to $22V$ | | 3.0 | 120 | |
| Load Regulation | ΔV_o | $T_J = 25^{\circ}C$ | $I_o = 5mA$ to $1.5A$ | | 11 | 240 | mV |
| | | | $I_o = 250mA$ to $750mA$ | | 5 | 120 | |
| Quiescent Current | I_d | $T_J = 25^{\circ}C$ | | 5.1 | 8 | mA | |
| Quiescent Current Change | ΔI_d | $I_o = 5mA$ to $1.0A$ | | 0.1 | 0.5 | mA | |
| | | $V_i = 14.5V$ to $30V$ | | 0.5 | 1.0 | | |
| Temperature Coefficient of V_o | $\Delta V_o/\Delta T$ | $I_o = 5mA$ | | -1 | | mV/ $^{\circ}C$ | |
| Output Noise Voltage | V_N | $f = 10Hz$ to $100KHz$, $T_a = 25^{\circ}C$ | | 76 | | μV | |
| Ripple Rejection | RR | $f = 120Hz$ $V_i = 15V$ to $25V$ | 55 | 71 | | dB | |
| Dropout Voltage | V_D | $I_o = 1A$, $T_J = 25^{\circ}C$ | | 2 | | V | |
| Output Resistance | R_o | $f = 1KHz$ | | 18 | | m Ω | |
| Short Circuit Current | I_{sc} | $V_i = 35V$, $T_J = 25^{\circ}C$ | | 230 | | mA | |
| Peak Current | I_{peak} | $T_J = 25^{\circ}C$ | | 2.2 | | A | |

* 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.

MC78XXC

LINEAR INTEGRATED CIRCUIT

T-58-11-13

ELECTRICAL CHARACTERISTICS MC7815C

 $V_{IN} = 23V$, $I_{OUT} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{IN} = 0.33\mu F$, $C_{OUT} = 0.1\mu F$, unless otherwise specified. (Note)

| Characteristic | Symbol | Test Conditions | Min | Typ | Max | Unit |
|----------------------------------|-------------------------|---|------------------------|-----|-------|-----------------|
| Output Voltage | V_O | $T_J = 25^{\circ}C$ | 14.4 | 15 | 15.6 | V |
| | | $5.0mA \leq I_O \leq 1.0A$, $P_D \leq 15W$ $V_I = 17.5V$ to 30V | 14.25 | 15 | 15.75 | |
| Line Regulation | ΔV_O | $T_J = 25^{\circ}C$ | $V_I = 17.5$ to 30V | 12 | 300 | mV |
| | | | $V_I = 20$ to 26V | 4 | 150 | |
| Load Regulation | ΔV_O | $T_J = 25^{\circ}C$ | $I_O = 5.0mA$ to 1.5A | 13 | 300 | mV |
| | | | $I_O = 250mA$ to 750mA | 5 | 150 | |
| Quiescent Current | I_d | $T_J = 25^{\circ}C$ | | 5.2 | 8 | mA |
| Quiescent Current Change | ΔI_d | $T_J = 25^{\circ}C$ | $I_O = 5mA$ to 1.0A | 0.1 | 0.5 | mA |
| | | | $V_I = 17.5V$ to 30V | 0.5 | 1.0 | |
| Temperature Coefficient of V_O | $\Delta V_O / \Delta T$ | $T_J = 25^{\circ}C$ $I_O = 5mA$ | | -1 | | mV/ $^{\circ}C$ |
| Output Noise Voltage | V_N | $f = 10Hz$ to 100KHz, $T_a = 25^{\circ}C$ | | 88 | | μV |
| Ripple Rejection | RR | $f = 120Hz$ $V_I = 18.5V$ to 28.5V | 54 | 70 | | dB |
| Dropout Voltage | V_D | $I_O = 1A$, $T_J = 25^{\circ}C$ | | 2 | | V |
| Output Resistance | R_O | $f = 1KHz$ | | 19 | | m Ω |
| Short Circuit Current | I_{SC} | $V_I = 35V$, $T_J = 25^{\circ}C$ | | 230 | | mA |
| Peak Current | I_{peak} | $T_J = 25^{\circ}C$ | | 2.2 | | A |

* 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.

MC78XXC

LINEAR INTEGRATED CIRCUIT

ELECTRICAL CHARACTERISTICS MC7824C

T-58-11-13

$V_{IN} = 33V$, $I_{OUT} = 500mA$, $0^{\circ}C \leq T_J \leq 125^{\circ}C$, $C_{IN} = 0.33\mu F$, $C_{OUT} = 0.1\mu F$, unless otherwise specified (Note)

| Characteristic | Symbol | Test Conditions | Min | Typ | Max | Unit |
|----------------------------------|-------------------------|---|--------------------------|------|------|-----------------|
| Output Voltage | V_o | $T_J = 25^{\circ}C$ | 23 | 24 | 25 | V |
| | | $5.0mA \leq I_o \leq 1.0A$, $P_o \leq 15W$ $V_i = 27V$ to $38V$ | 22.8 | 24 | 25.2 | |
| Line Regulation | ΔV_o | $T_J = 25^{\circ}C$ | $V_i = 27V$ to $38V$ | 17 | 480 | mV |
| | | | $V_i = 30V$ to $36V$ | 6 | 240 | |
| Load Regulation | ΔV_o | $T_J = 25^{\circ}C$ | $I_o = 5mA$ to $1.5A$ | 15 | 480 | mV |
| | | | $I_o = 250mA$ to $750mA$ | 5.0 | 240 | |
| Quiescent Current | I_d | $T_J = 25^{\circ}C$ | | 5.2 | 8 | mA |
| Quiescent Current Change | ΔI_d | | $I_o = 5mA$ to $1A$ | 0.1 | 0.5 | mA |
| | | | $V_i = 27V$ to $38V$ | 0.5 | 1 | |
| Temperature Coefficient of V_o | $\Delta V_o / \Delta T$ | | | -1.5 | | mV/ $^{\circ}C$ |
| Output Noise Voltage | V_N | $f = 10Hz$ to $100KHz$, $T_a = 25^{\circ}C$ | | 160 | | μV |
| Ripple Rejection | RR | $f = 120Hz$ $V_i = 28V$ to $38V$ | 50 | 67 | | dB |
| Dropout Voltage | V_D | $I_o = 1A$, $T_J = 25^{\circ}C$ | | 2 | | V |
| Output Resistance | R_o | $f = 1KHz$ | | 28 | | m Ω |
| Short Circuit Current | I_{sc} | $V_i = 35V$, $T_J = 25^{\circ}C$ | | 230 | | mA |
| Peak Current | I_{peak} | $T_J = 25^{\circ}C$ | | 2.2 | | A |

* 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.

MC78XXC

LINEAR INTEGRATED CIRCUIT

T-58-11-13

TEST CIRCUITS

Fig. 1 DC Parameters

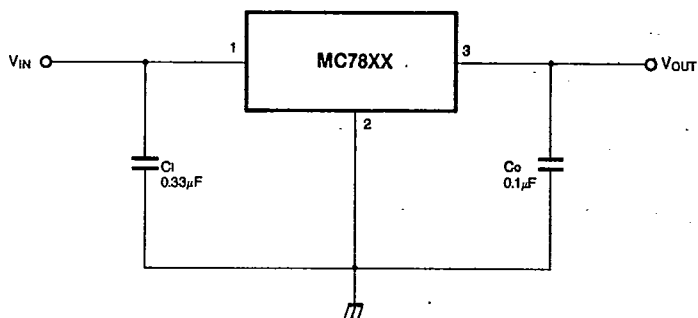


Fig. 2 Load Regulation

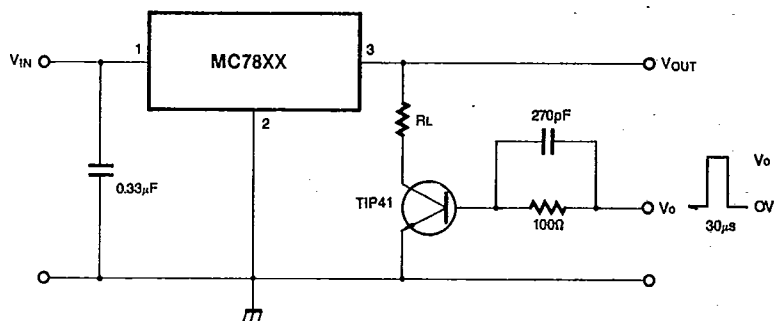
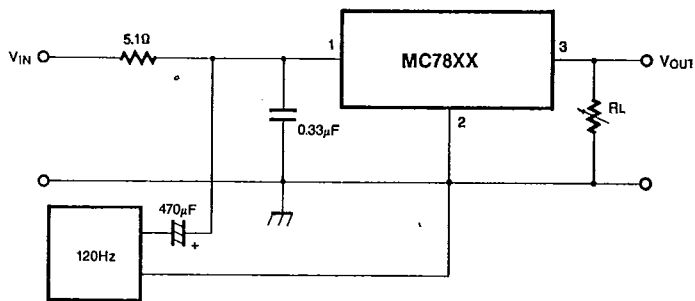


Fig. 3 Ripple Rejection



MC78XX

LINEAR INTEGRATED CIRCUIT

7-58-11-13

APPLICATION CIRCUITS

Fig. 4 Fixed Output Regulator

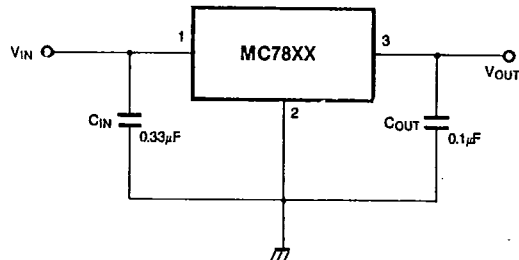
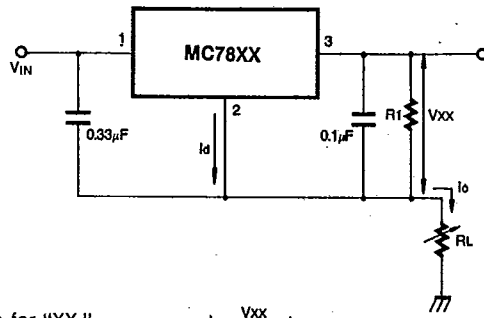


Fig. 5 Constant Current Regulator

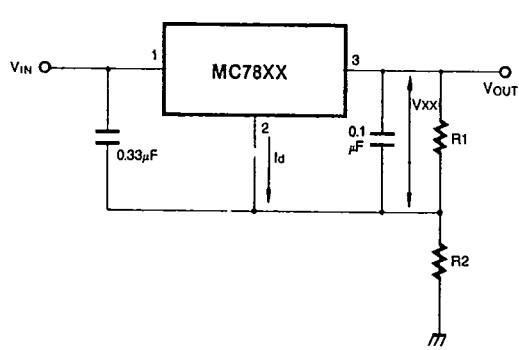


$$I_o = \frac{V_{xx}}{R_1} + I_d$$

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) CIN is required if regulator is located an appreciable distance from power supply filter.
- (3) COUT improves stability and transient response.

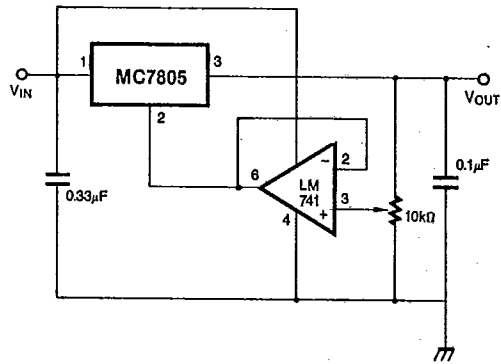
Fig. 6 Circuit for Increasing Output Voltage



$$I_{R1} \geq 5I_d$$

$$V_o = V_{xx} (1 + R_2/R_1) + I_d R_2$$

Fig. 7 Adjustable Output Regulator (7 to 30V)



MC78XX

LINEAR INTEGRATED CIRCUIT

T-58-11-13

APPLICATION CIRCUIT (continued)

Fig. 8 0.5 to 10V Regulator

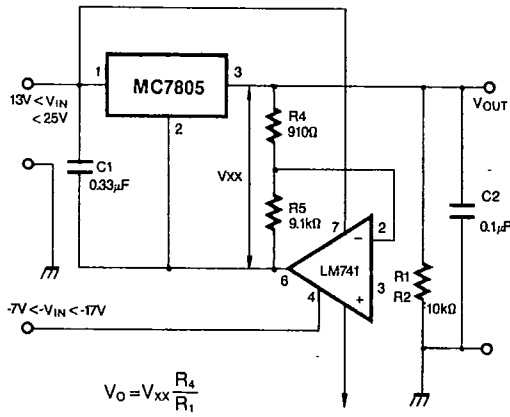


Fig. 9 High Current Voltage Regulator

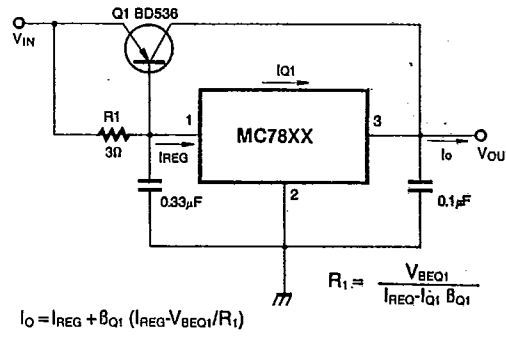


Fig. 10 High Output Current with Short Circuit Protection

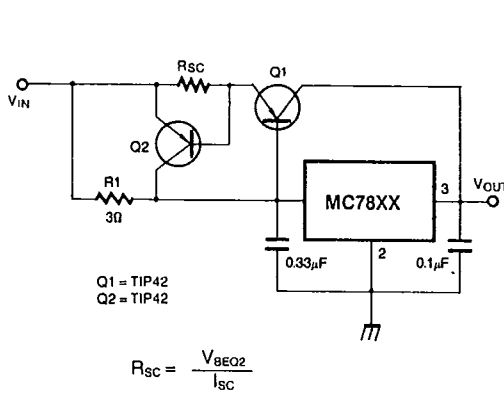
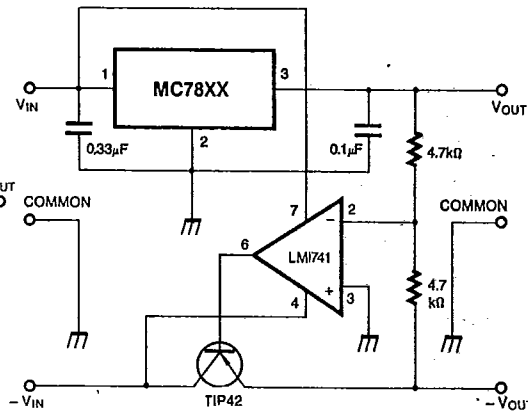


Fig. 11 Tracking Voltage Regulator



MC78XXC

LINEAR INTEGRATED CIRCUIT

T-58-11-13

Fig. 12 Split Power Supply ($\pm 15V - 1A$)

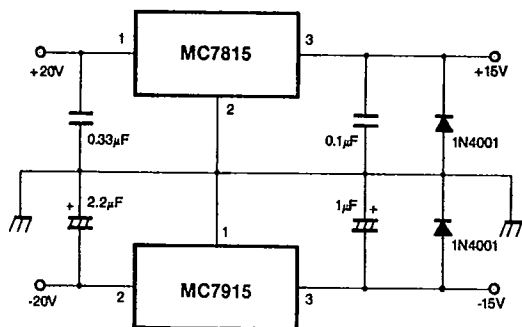


Fig. 13 Negative Output Voltage Circuit

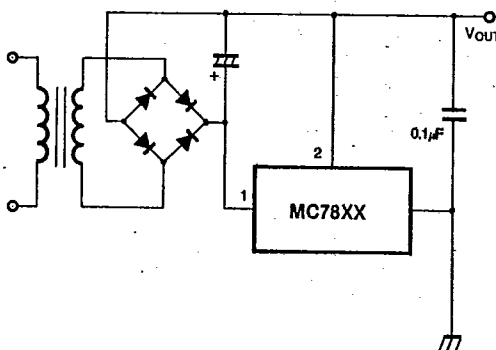
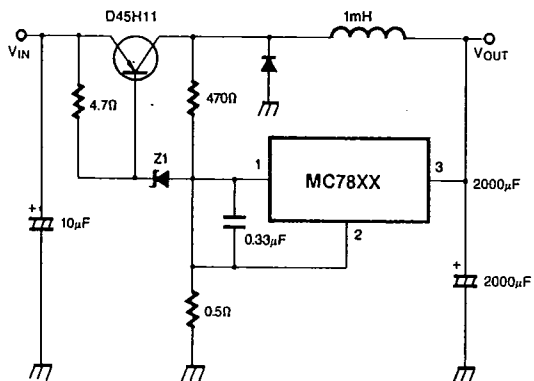


Fig. 14 Switching Regulator



MC78XXC

LINEAR INTEGRATED CIRCUIT

T-58-11-13

TYPICAL PERFORMANCE CHARACTERISTICS

FIG. 15 QUIESCENT CURRENT

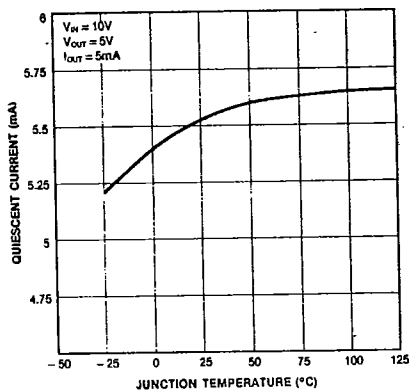


FIG. 16 PEAK OUTPUT CURRENT

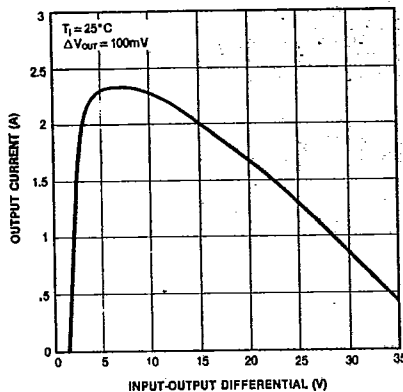


FIG. 17 OUTPUT VOLTAGE

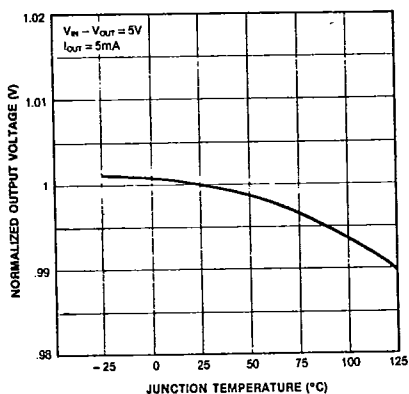


FIG. 18 QUIESCENT CURRENT

