# VOLTAGE REGULATOR WITH ON/OFF SWITCH

## FEATURES

- Low Dropout Voltage
- CMOS/TTL Compatible ON/OFF Switch
- Very Low Standby Current 180 µA (ON, No Load)
- Internal Thermal Shutdown
- Short Circuit Protection
- Very Low (0.1 µA) Current in OFF Mode
- Low Noise with External Bypass Capacitor
- 130 mA Current Capability

## APPLICATIONS

- Battery Powered Systems
- Cellular Telephones
- Pagers
- Personal Communications Equipment
- Portable Instrumentation
- Portable Consumer Equipment
- Radio Control Systems
- Toys
- Low Voltage Systems

## DESCRIPTION

The TK112XX is a low power, linear regulator with a built-in electronic switch. The internal electronic switch can be controlled by TTL or CMOS logic levels. The device is in the ON state when the control pin is pulled to a high logic level. A pin for a bypass capacitor is provided, which connects to the internal circuitry, to lower the overall output noise level.

An internal PNP pass-transistor is used in order to achieve low dropout voltage (typically 100 mV at 30 mA load current). The device has very low quiescent current (180 µA) in the ON mode with no load and 1 mA with 30 mA load. The quiescent current is typically 2.5 mA at 60 mA load. When the device is in standby mode ($V_{CONT}$ = 0) , the quiescent current is typically 100 nA. An internal thermal shutdown circuit limits the junction temperature to below 150 °C. The load current is internally monitored and the device will shut down in the presence of a short circuit at the output.

Custom versions of the IC are available and the regulated output voltage may be specified in 0.5 V increments between 2.0 to 5.5 V. Additionally, 3.25 V, 6.0 V and 8.0 V versions can be obtained.

### ORDERING INFORMATION

TK112 □□ □ □ □□

- Voltage Code
- Tape/Reel Code
- Temp. Range
- Package Code

**VOLTAGE CODE**

| | | |
|---|---|---|
| 20 = 2.0 V | 27 = 2.75 V | 40 = 4.0 V |
| 21 = 2.1 V | 30 = 3.0 V | 45 = 4.5 V |
| 22 = 2.25 V | 32 = 3.25 V | 47 = 4.75 V |
| 25 = 2.5 V | 35 = 3.5 V | 50 = 5.0 V |
| | | 55 = 5.5 V |

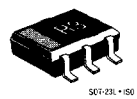
**PACKAGE CODE**
T : Surface Mount

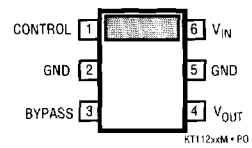
**TEMP. RANGE**
I : -40 to +85 °C

**TAPE/REEL CODE**
BX : Bulk/Bag
TX : Paper Tape
TR : Tape Right
TL : Tape Left
MG: Magazine

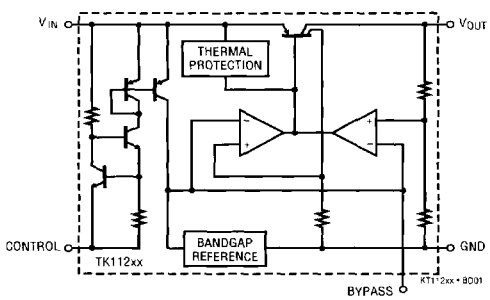
3

### TK112XXM






### BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ..... 16 V
Output Voltage ..... $V_{OUT}$ x1.15 V
Output Current ..... 220 mA
Power Dissipation (Note 1) ..... 200 mW
Storage Temperature Range ..... -55 to +150 °C
Operating Temperature Range (Note 2) ..... -40 to +85 °C
Lead Soldering Temp. (10 sec.) ..... 240 °C
Junction Temperature ..... 15 °C

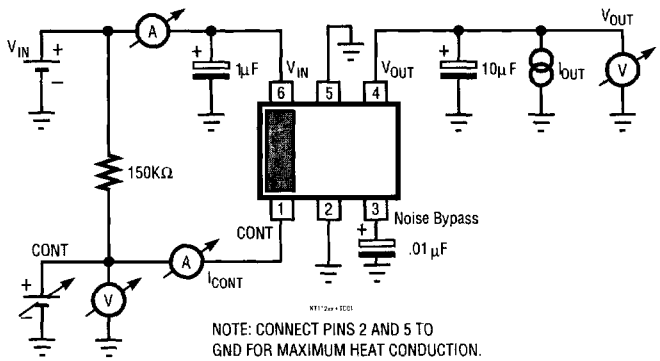
## ELECTRICAL CHARACTERISTICS

Test conditions: $T_A$ = 25 °C, unless otherwise specified.

| SYMBOL | PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| $I_{CC1}$ | Supply Current 1 | $I_O$ = 0 mA, Except $I_{CONT}$ | | 180.0 | | µA |
| $I_{CC2}$ | Supply Current 2 | $V_{IN}$ = 8 V, Output off | | | 100 | nA |
| $V_O$ | Output Voltage | $V_{IN}$ = $V_O$ + 1 V, $I_O$ = 30 mA | -3 | $V_O$ | +3 | % |
| $V_O$ | Output Voltage | $V_{IN}$ = $V_O$ = 030 mA | -100 | $V_O$ | +100 | % |
| $V_{DROP}$ | In/Out Voltage Drop | $I_O$ = 30 mA | | 0.1 | | V |
| $I_O$ | Output Current | Note 3 | 150 | 180 | | mA |
| $I_{OR}$ | Recommended Output Current | | | | 130.0 | mA |
| LinReg | Line Regulation | $V_{IN}$ =$V_O$ + (1~ 6) | | | 0.12 | %/V |
| LoaReg | Loading Regulation 1 | $I_O$ = 0 mA ~ 60 mA, Note 4 | | | 0.03 | %/mA |
| RR | Ripple Rejection<br>Temperature Coefficient | 100 mV(rms), f = 400 Hz,<br>$I_O$ = 10 mA, $V_O$ + 1.5 V | | 60.0 | | dB |
| $\Delta V_O/\Delta T_A$ | Temperature Dependency of $V_O$ | $I_O$ = 10 mA, $V_O$ + 1.5 V<br>$T_A$ = -25 ~ + 75 °C | | 0.2 | | mV/ °C |
| $V_{NO}$ | Output Noise Voltage | 10 Hz < f < 80 kHz,<br>$I_O$ = 10 mA | | 30.0 | | µV(rms) |
| **Control Terminal Specification** | | | | | | |
| $I_{CONT}$ | Control Terminal Current | Output on, $V_{CONT}$ = 2.4 V | | 15.0 | 40.0 | µA |
| $V_{CONT1}$ | Control Terminal Voltage 1 | Output on | 2.4 | | | V |
| $V_{CONT2}$ | Control Terminal Voltage 2 | Output off | | | 0.6 | V |
| $T_R$ | Output Rise Time | $I_O$ = 60 mA, $V_{CONT}$ = O V<br>~ 2.4 V | | 0.2 | 1.0 | ms |
| | Bypass Terminal Voltage | | | 1.25 | | V |

Note 1: Power dissipation must be derated at rate of 1.6 mW/°C for operation at 25 °C and over. Power dissipation = 400 mW (When mounted as recommended.)
Note 2: Output side capacitor should have low ESR at low temperatures if used below 0 °C.
Note 3: $I_O$ (Load Current) is the measured current when $V_O$ drops 0.3 V with respect to ($V_O$ at $I_O$ = 30 mA).
Note 4: This measurement (pulse measurement) is with a constant $T_J$. The output change due to temperature change is not included.

## TEST CIRCUIT

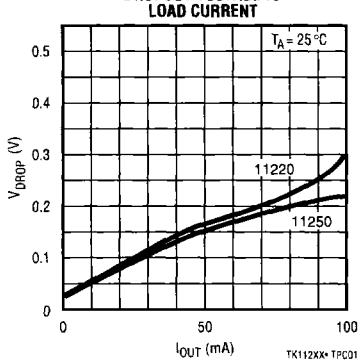



NOTE: CONNECT PINS 2 AND 5 TO GND FOR MAXIMUM HEAT CONDUCTION.

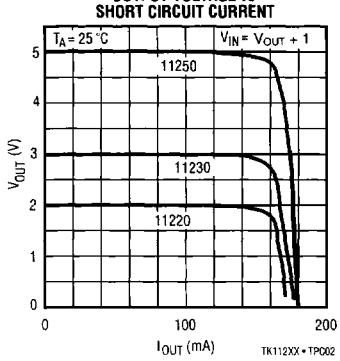
3

## TYPICAL PERFORMANCE CHARACTERISTICS

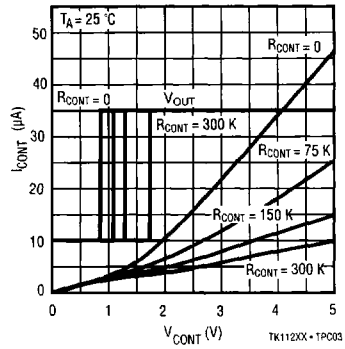
**DROPOUT VOLTAGE vs LOAD CURRENT**



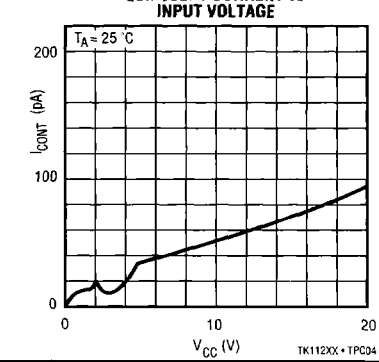

**OUTPUT VOLTAGE vs SHORT CIRCUIT CURRENT**



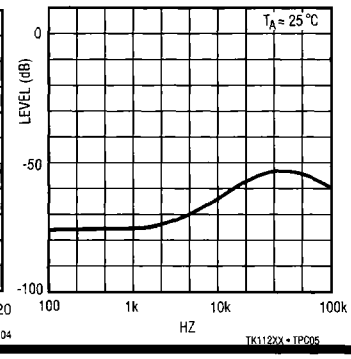

**CONTROL TERMINAL CIRCUIT CURRENT vs CONTROL TERMINAL VOLTAGE**



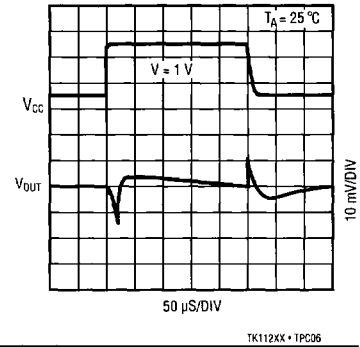

**QUIESCENT CURRENT vs INPUT VOLTAGE**




**RIPPLE REJECTION**

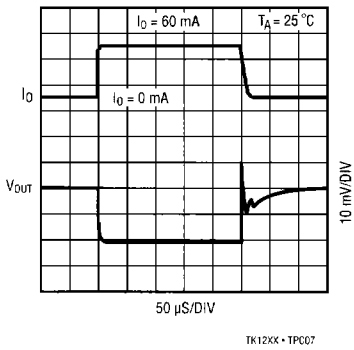



**LINE TRANSIENT RESPONSE**

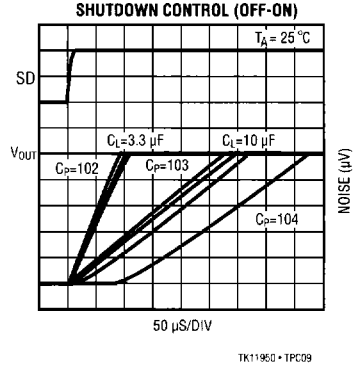


## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

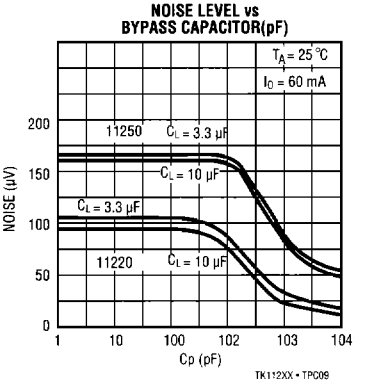
**LOAD TRANSIENT RESPONSE**



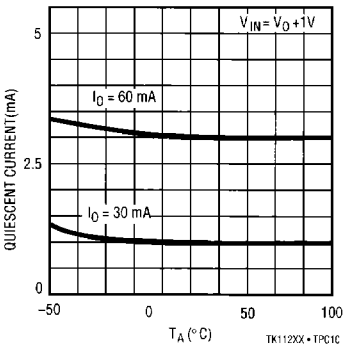

**SHUTDOWN CONTROL (OFF-ON)**



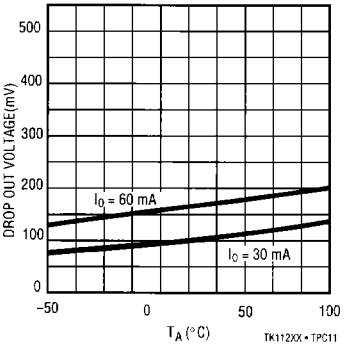

**NOISE LEVEL vs BYPASS CAPACITOR(pF)**



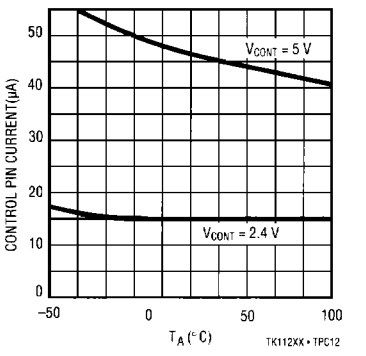

**QUIESCENT CURRENT vs TEMPERATURE**



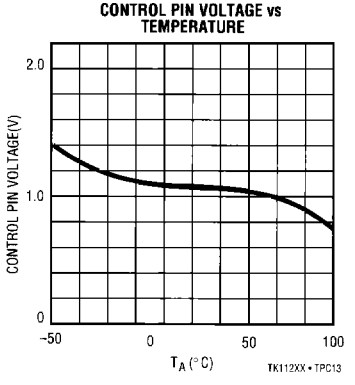

**DROPOUT VOLTAGE vs TEMPERATURE**



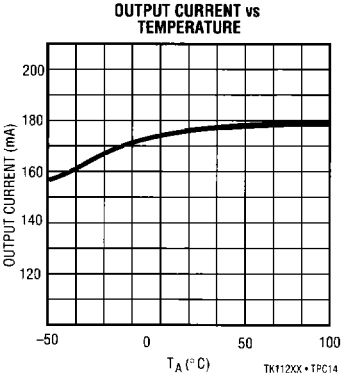

**CONTROL PIN CURRENT vs TEMPERATURE**




**CONTROL PIN VOLTAGE vs TEMPERATURE**



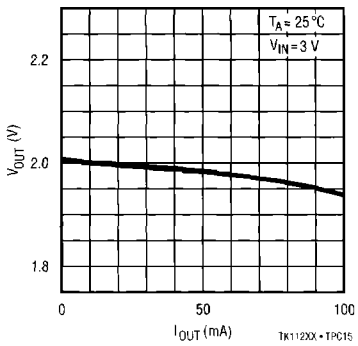

**OUTPUT CURRENT vs TEMPERATURE**



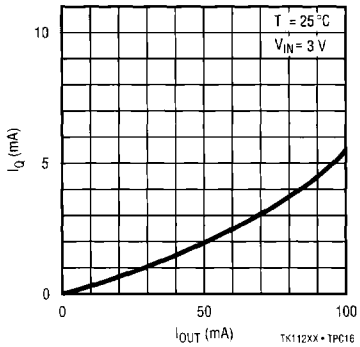
## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

### TK11220

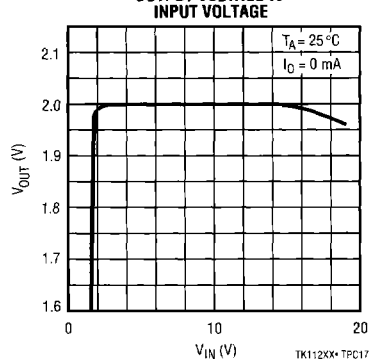
**OUTPUT VOLTAGE vs OUTPUT CURRENT**



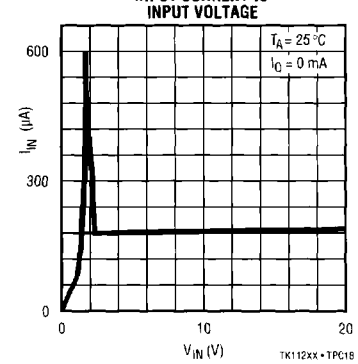

**QUIESCENT CURRENT vs LOAD CURRENT**



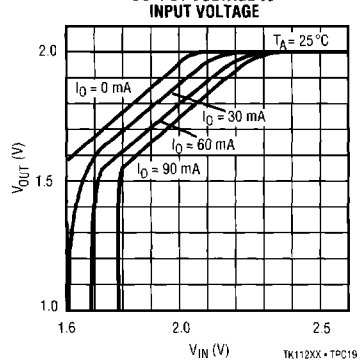

**OUTPUT VOLTAGE vs INPUT VOLTAGE**



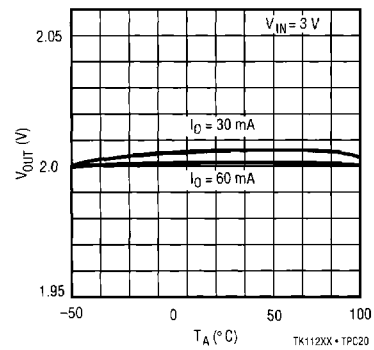

**INPUT CURRENT vs INPUT VOLTAGE**




**OUTPUT VOLTAGE vs INPUT VOLTAGE**

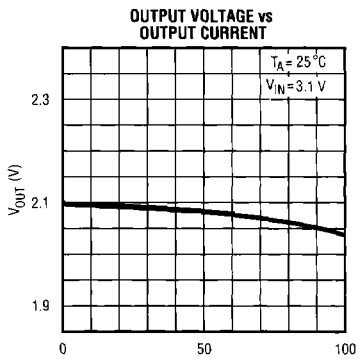



**OUTPUT VOLTAGE vs TEMPERATURE**

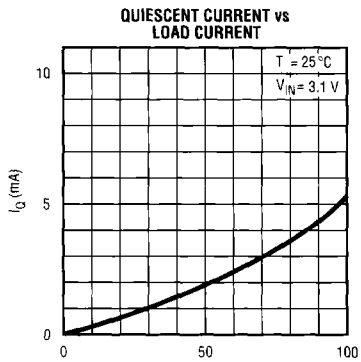



### TK11221

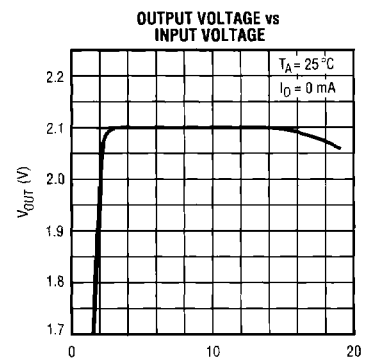
**OUTPUT VOLTAGE vs OUTPUT CURRENT**




**QUIESCENT CURRENT vs LOAD CURRENT**




**OUTPUT VOLTAGE vs INPUT VOLTAGE**

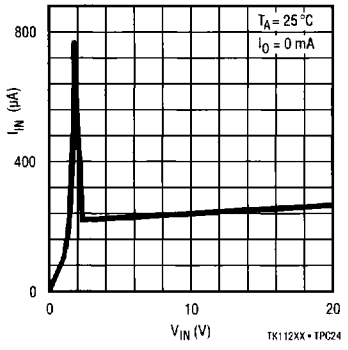



3

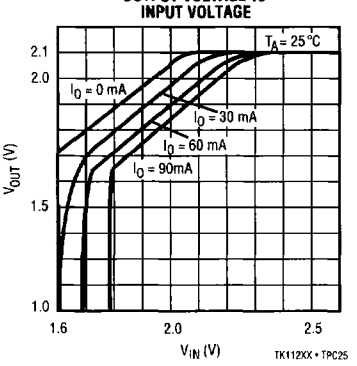
## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

### TK11221 (CONT.)

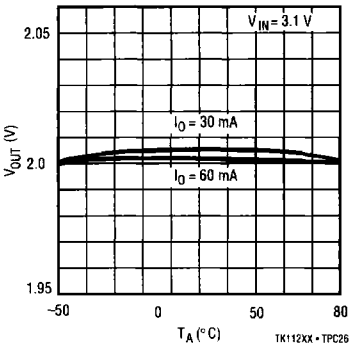
**INPUT CURRENT vs INPUT VOLTAGE**




**OUTPUT VOLTAGE vs INPUT VOLTAGE**

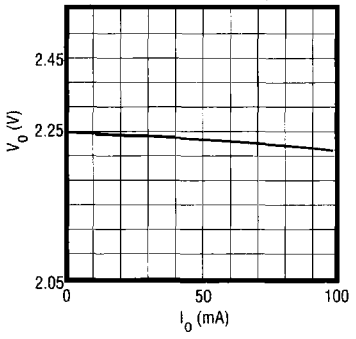



**OUTPUT VOLTAGE vs TEMPERATURE**



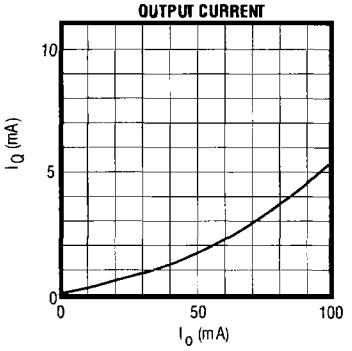

### TK11222

**LOAD REGULATION**



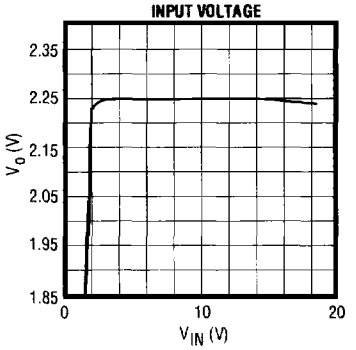

222-1

**QUIESCENT CURRENT vs OUTPUT CURRENT**



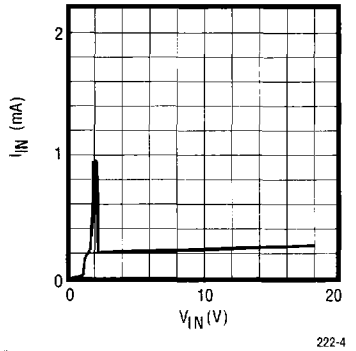

222-2

**OUTPUT VOLTAGE vs INPUT VOLTAGE**



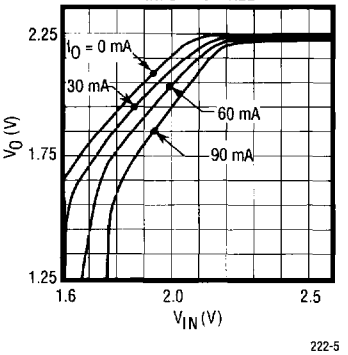

222-3

**INPUT CURRENT (NO LOAD) vs INPUT VOLTAGE**



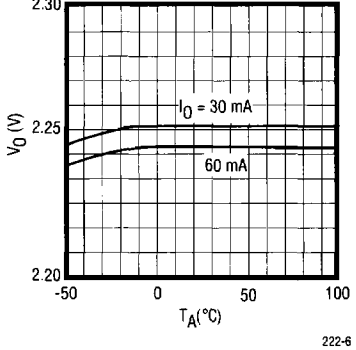

222-4

**OUTPUT VOLTAGE vs INPUT VOLTAGE**




222-5

**OUTPUT VOLTAGEvs TEMPERATURE**

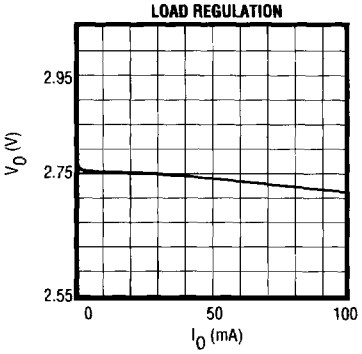



222-6

## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

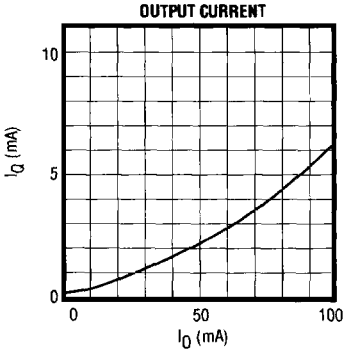
**TK11227**

**LOAD REGULATION**



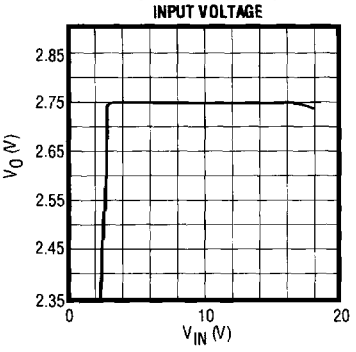

227-1

**QUIESCENT CURRENT vs OUTPUT CURRENT**



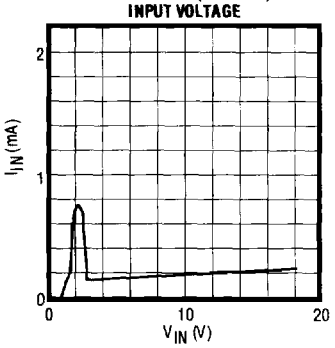

227-2

**OUTPUT VOLTAGE vs INPUT VOLTAGE**



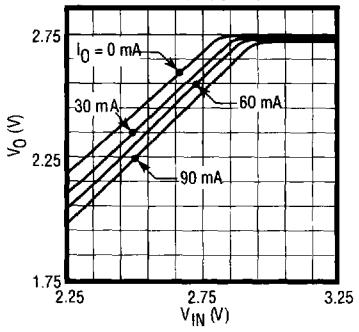

227-3

**INPUT CURRENT (NO LOAD) vs INPUT VOLTAGE**



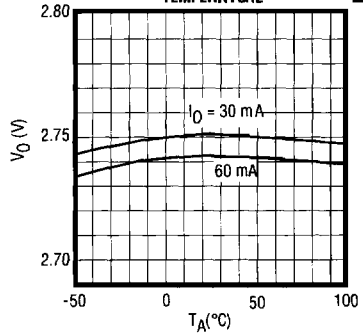

227-4

**OUTPUT VOLTAGE vs INPUT VOLTAGE**




227-5

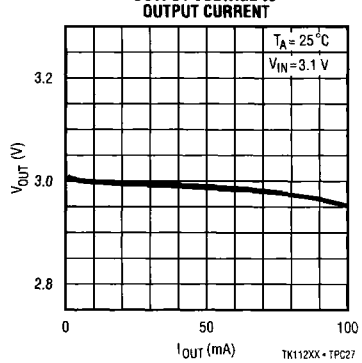
**OUTPUT VOLTAGE vs TEMPERATURE**




227-6

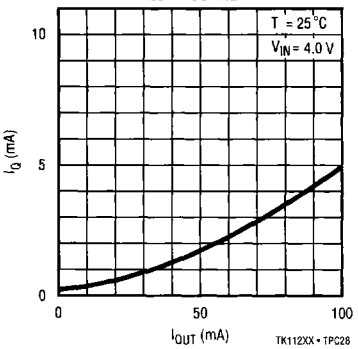
**TK11230**

**OUTPUT VOLTAGE vs OUTPUT CURRENT**



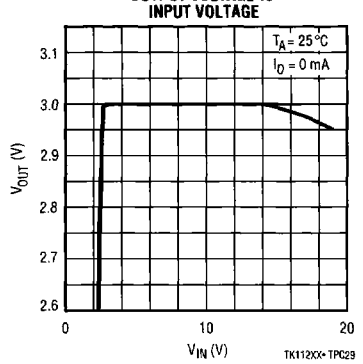

TK112XX • TPC27

**QUIESCENT CURRENT vs LOAD CURRENT**




TK112XX • TPC28

**OUTPUT VOLTAGE vs INPUT VOLTAGE**

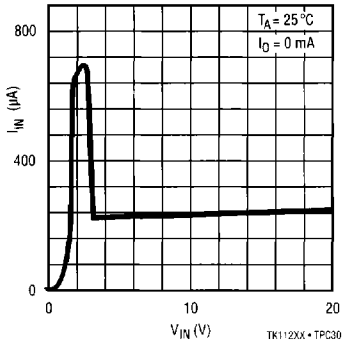



TK112XX• TPC29

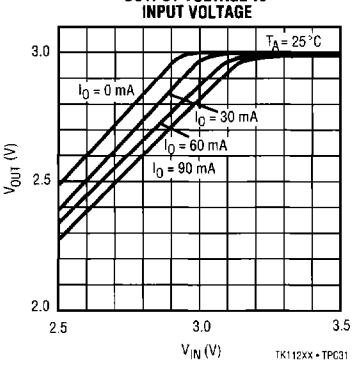
## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

### TK11230 (CONT.)

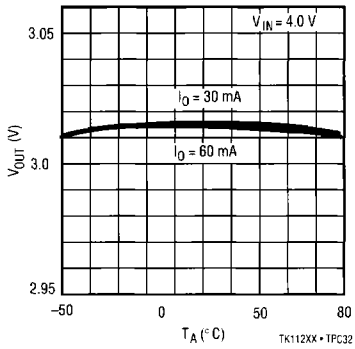
**INPUT CURRENT vs INPUT VOLTAGE**




**OUTPUT VOLTAGE vs INPUT VOLTAGE**

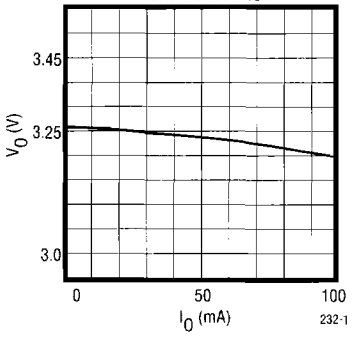



**OUTPUT VOLTAGE vs TEMPERATURE**

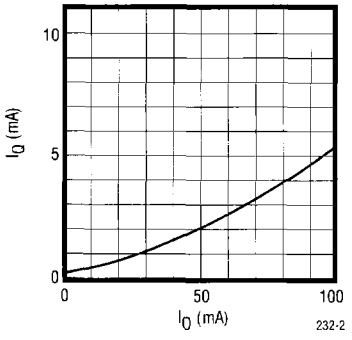



### TK11232

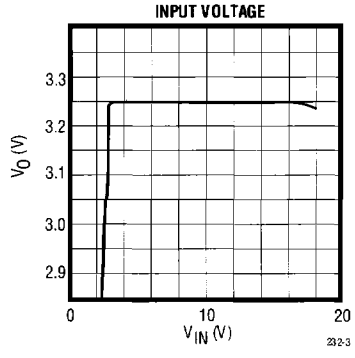
**LOAD REGULATION**



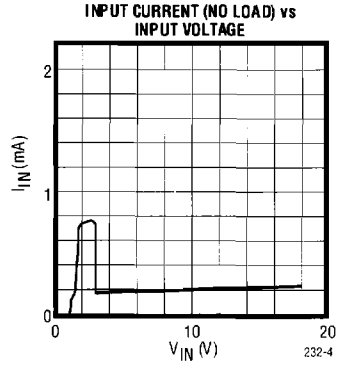

**QUIESCENT CURRENT vs OUTPUT CURRENT**



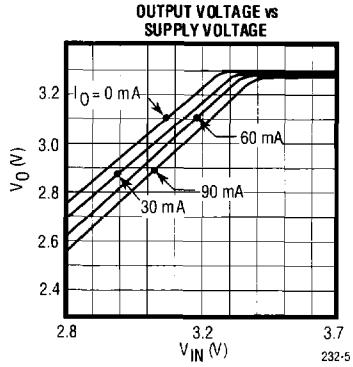

**OUTPUT VOLTAGE vs INPUT VOLTAGE**



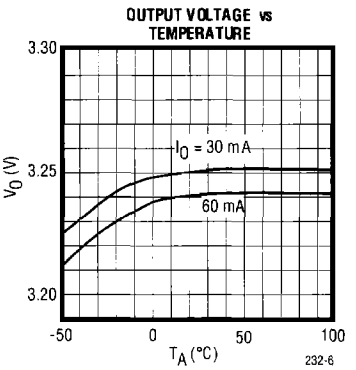

**INPUT CURRENT (NO LOAD) vs INPUT VOLTAGE**




**OUTPUT VOLTAGE vs SUPPLY VOLTAGE**



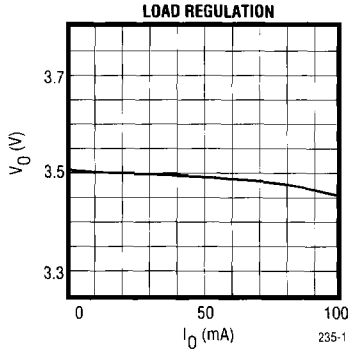

**OUTPUT VOLTAGE vs TEMPERATURE**



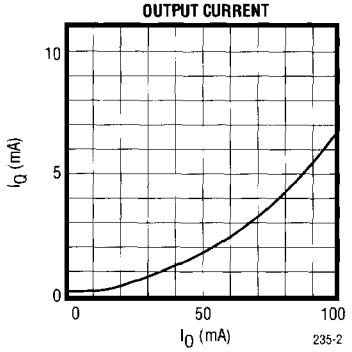
## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

**TK11235**

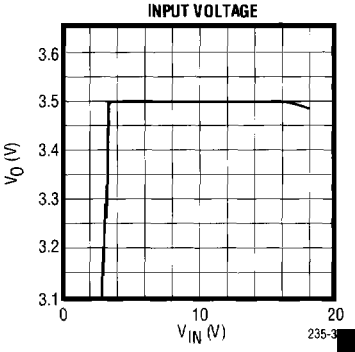
LOAD REGULATION



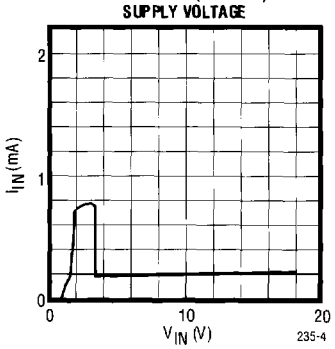

QUIESCENT CURRENT vs OUTPUT CURRENT



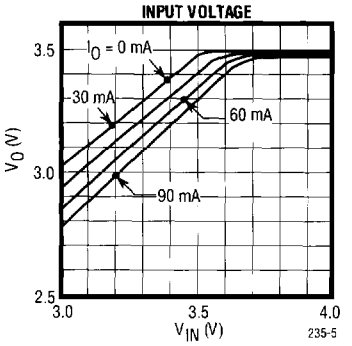

OUTPUT VOLTAGE vs INPUT VOLTAGE



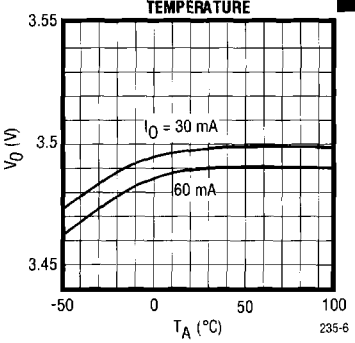

INPUT CURRENT (NO LOAD) vs SUPPLY VOLTAGE




OUTPUT VOLTAGE vs INPUT VOLTAGE

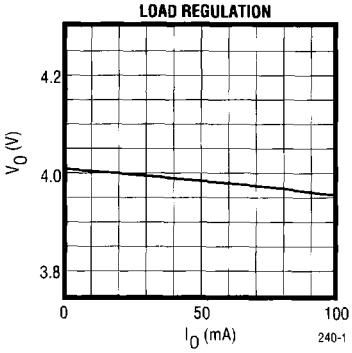



OUTPUT VOLTAGE vs TEMPERATURE

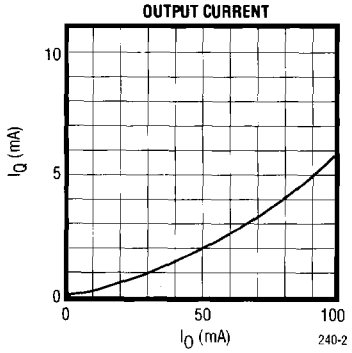



**TK11240**

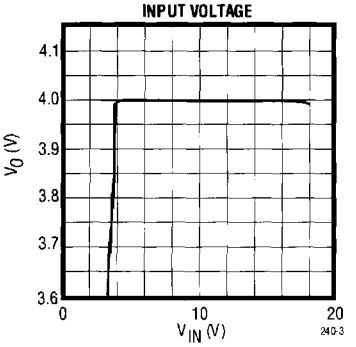
LOAD REGULATION




QUIESCENT CURRENTvs OUTPUT CURRENT



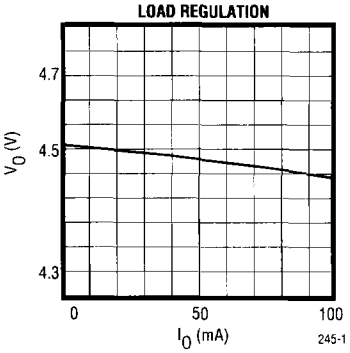

OUTPUT VOLTAGE vs INPUT VOLTAGE



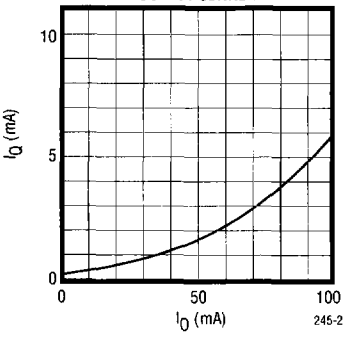
## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

**TK11245**

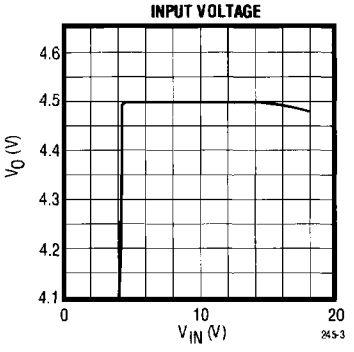
LOAD REGULATION



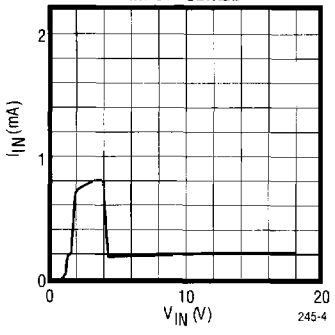

QUIESCENT CURRENT vs OUTPUT CURRENT



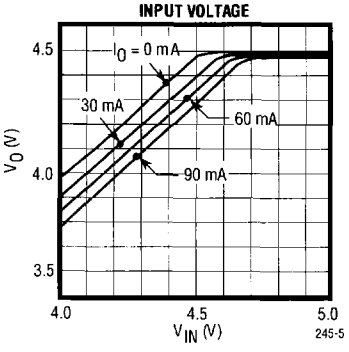

OUTPUT VOLTAGE vs INPUT VOLTAGE



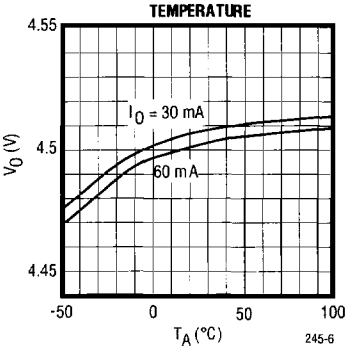

INPUT CURRENT (NO LOAD) vs INPUT VOLTAGE




OUTPUT VOLTAGE vs INPUT VOLTAGE

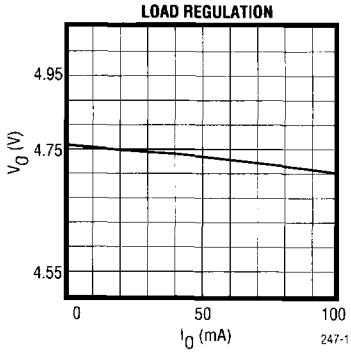



OUTPUT VOLTAGE vs TEMPERATURE

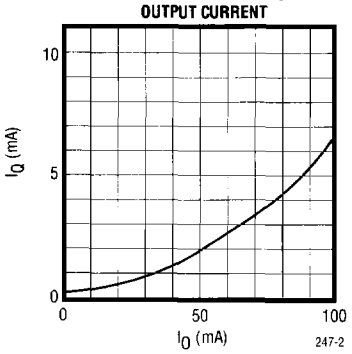



**TK11247**

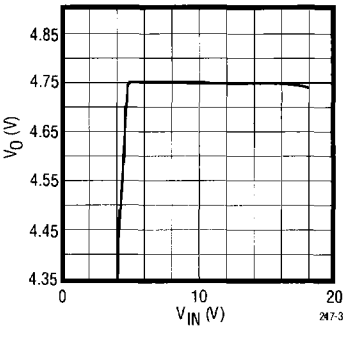
LOAD REGULATION




QUIESCENT CURRENT vs OUTPUT CURRENT



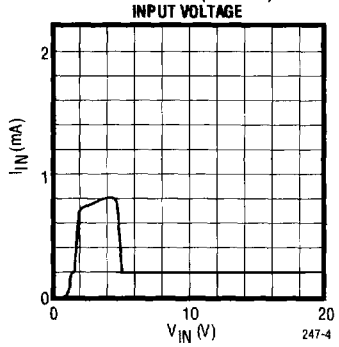

OUTPUT VOLTAGE vs SUPPLY VOLTAGE



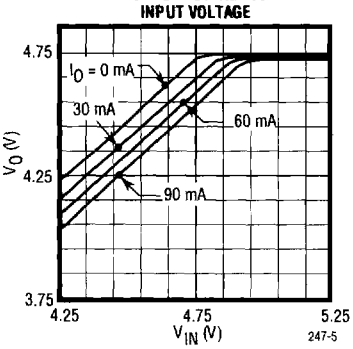
## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

**TK11247 (CONT.)**

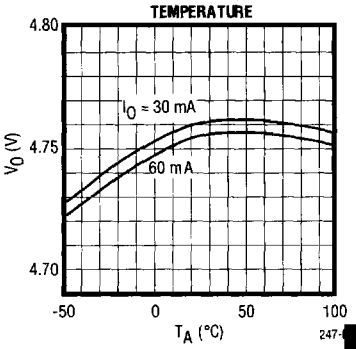
INPUT CURRENT (NO LOAD) vs INPUT VOLTAGE




OUTPUT VOLTAGE vs INPUT VOLTAGE

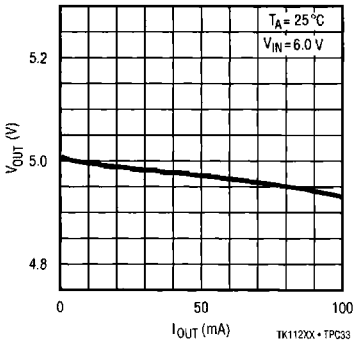



OUTPUT VOLTAGE vs TEMPERATURE

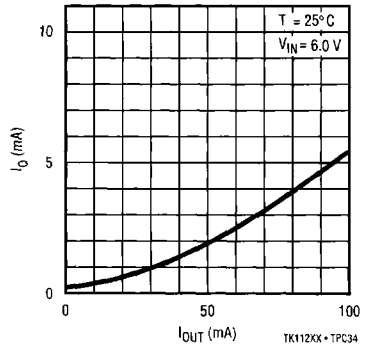



**TK11250**

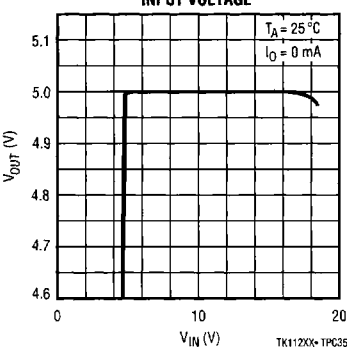
OUTPUT VOLTAGE vs OUTPUT CURRENT



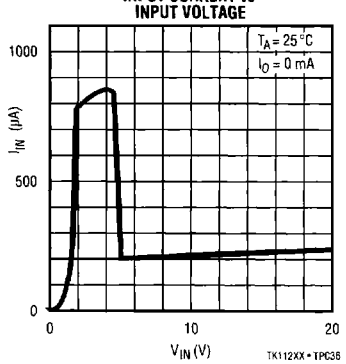

QUIESCENT CURRENT vs LOAD CURRENT



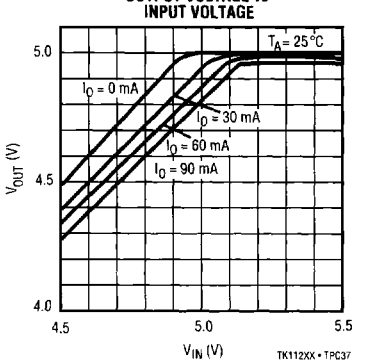

OUTPUT VOLTAGE vs INPUT VOLTAGE



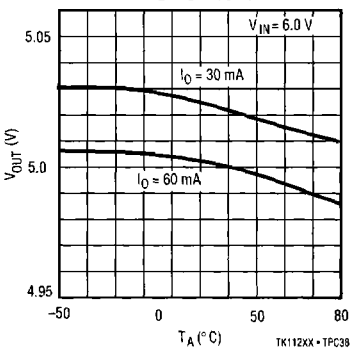

INPUT CURRENT vs INPUT VOLTAGE




OUTPUT VOLTAGE vs INPUT VOLTAGE




OUTPUT VOLTAGE vs TEMPERATURE

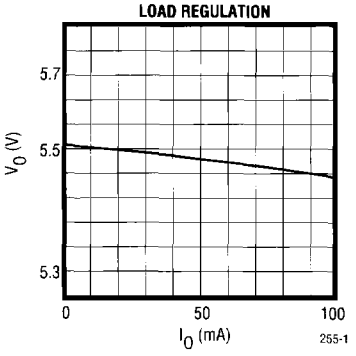



3

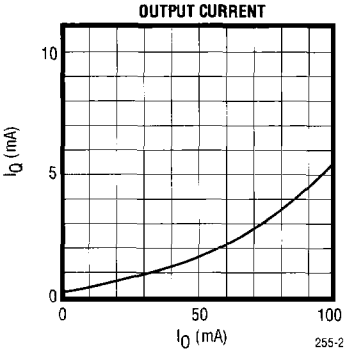
## TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

**TK11255**

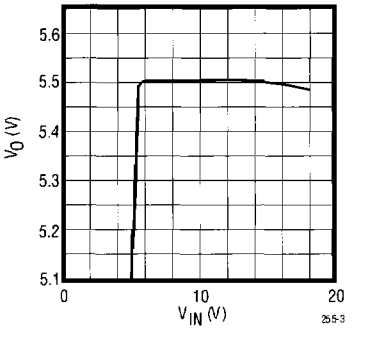
LOAD REGULATION



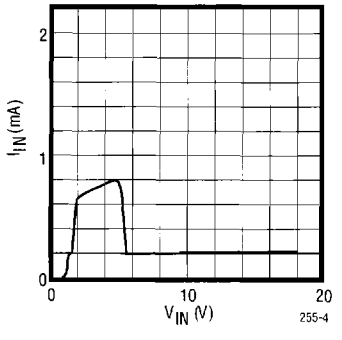

QUIESCENT CURRENT vs OUTPUT CURRENT



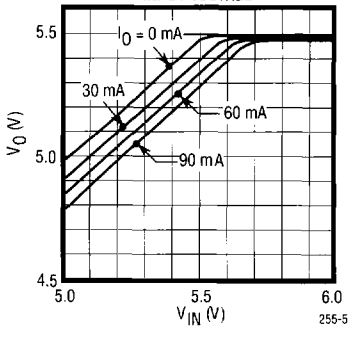

OUTPUT VOLTAGE vs INPUT VOLTAGE



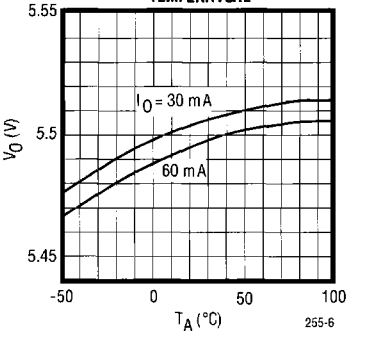

INPUT CURRENT (NO LOAD)vs INPUT VOLTAGE




OUTPUT VOLTAGE vs INPUT VOLTAGE




OUTPUT VOLTAGE vs TEMPERATURE



## APPLICATIONS INFORMATION

### 1.) DISABLING THE CONTROL PIN

Connect control terminal to $V_{CC}$ through R. Higher resistance values are good for reducing quiescent current but can cause the regulator to drop out at a higher voltage. (0 Ω <R< 300 kΩ.) See Figure A.

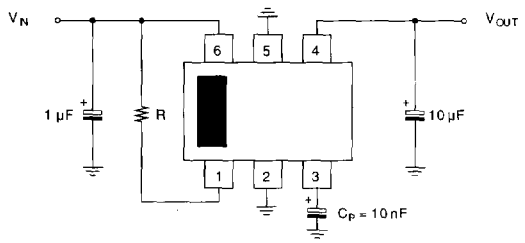



**Figure A.**

### 2.) USING THE CONTROL FUNCTION

Turn on the regulator by setting the control pin voltage to the same level as $V_{IN}$. Turn off the regulator by grounding the control pin. See Figure B.

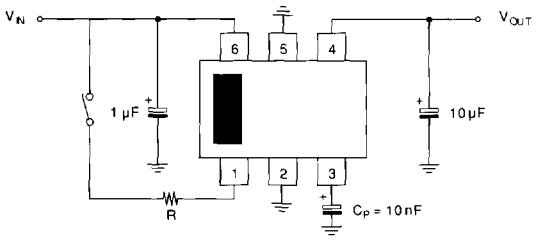



**Figure B.**

### 3.) HEAT DISSIPATION

Make the copper pattern as large as possible to provide good heat dissipation (pin 5 is the heatsink).
$P_D$ = 400 mW (When mounted as recommended)
See Figure C.

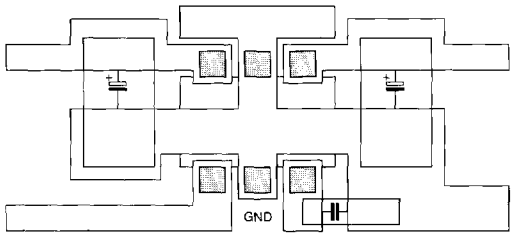



**Figure C.**

### 4.) BYPASS CAPACITOR

Connect the bypass capacitor as close as possible to the GND terminal of IC (Pin 5,2), otherwise oscillation may occur. Use a 3.3 µF tantalum capacitor, or 5.6 µF electrolytic to ensure stability. ($T_A$ = 25 C) For low temperatures, select a capacitor with low ESR at the desired temperature range. Use as large a capacitor as needed to meet transient, output impedance, and noise requirements. The noise bypass pin has high impedance, and it is sensitive to external noise if $C_P$ is not used.

### 5. Handling Molded Resin Packages

All Plastic molded packages absorb some moisture from the air. If moisture absorption occurs prior to soldering the devise into the printed circuit board, increased separation of the lead from the plastic molding may occur, degrading the moisture barrier characteristics of the device.
This property of plastic molding compounds should not be overlooked, particularly in the case of very small packages, where the plastic is very thin.
In order to preserve the original moisture barrier properties of the package, devices are stored and shipped in moisture proof bags, filled with dry air. The bags should not be opened or damaged prior to the actual use of the devices. If this is unavoidable, the devices should be stored in a low relative humidity environment (40 to 65%) or in an enclosed environment with desiccant.

3