# SPT116

## THREE TERMINAL VOLTAGE REGULATOR

### FEATURES

- Low Dropout Voltage
- Very Low Standby Current (No Load)
- Good Load Regulation
- Internal Thermal Shutdown
- Short Circuit Protection
- 3% Output Voltage Accuracy
- Available On Paper Tape
- Customized Versions Are Available

### APPLICATIONS

- Battery Powered Systems
- Portable Consumer Equipment
- Cordless Telephones
- Personal Communications Equipment
- Portable Instrumentation
- Radio Control Systems
- Low Voltage Systems

### GENERAL DESCRIPTION

The SPT116 series devices are low power, linear 3-terminal regulators.

An internal PNP pass-transistor is used in order to achieve low dropout voltage (typically 200 mV at 80 mA load current).

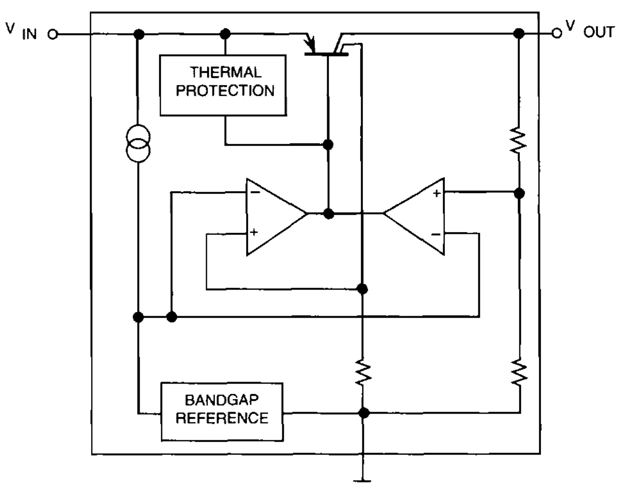
The regulated output voltage may be specified in 0.5 V increments between 2.0 to 5.5 V. The device has very low (400 µA) quiescent current with no load and 2 mA with 60 mA load.

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.

The SPT116 series is available in plastic TO-92N and plastic tape and reel TO-92NT packages.

7

### BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS (Beyond which damage may occur)[1] 25 °C

Supply Voltage ........................................ 18 V
Output Voltage ........................................ $V_{OUT}$ x1.15 V
Load Current (TO-92) ........................................ 180 mA
Load Current (U-Pack 3) ........................................ 250 mA
Power Dissipation (TO-92) Note 2 ........................ 500 mW
Power Dissipation (U-Pack 3) ........................ 600 mW
Storage Temperature Range ........................ -55 to +150 °C
Operating Temperature Range ........................ -40 to +85 °C
Lead Soldering Temp (10 sec) ........................ +240 °C
Junction Temperature ........................................ +150 °C

## ELECTRICAL SPECIFICATIONS (Unless otherwise specified, $T_A$=$T_{MIN}$ to $T_{MAX}$) Note 3

| PARAMETERS | TEST CONDITIONS | SYMBOL | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Supply Voltage Range | | $V_{IN}$ | 2.5 | | 16 | V |
| Supply Current 1 | $V_{IN}$=$V_{OUT}$ + 1 V, $I_{OUT}$ = 0 mA | $I_{IN1}$ | | 400 | 800 | µA |
| Supply Current 2 | $V_{IN}$=$V_{OUT}$ + 1 V, $I_{OUT}$ = 10 mA | $I_{IN2}$ | | 0.8 | 2.0 | mA |
| Regulated Output Voltage | $V_{IN}$=$V_{OUT}$ + 1 V, $I_{OUT}$=10 mA | $V_O$ | | | | |
| | $T_A$ = 25 °C | | | | ±3.0 | % |
| | | | | | ±100 | mV |
| | TO-92: $T_A$ = -20 to +70 °C | | | | ±4.0 | % |
| | | | | | ±130 | mV |
| | $T_A$ = -40 to +85 °C | | | | ±5.0 | % |
| | | | | | ±150 | mV |
| | U-Pack 3: $T_A$ =-20 to +70 °C | | | | ±4.5 | % |
| | | | | | ±130 | mV |
| | $T_A$ =-40 to +85 °C | | | | ±5.0 | % |
| | | | | | ±140 | mV |
| Dropout Voltage 1 | $I_{OUT}$=0 mA, TO-92 | $V_{DROP1}$ | | 25 | 80 | mV |
| | $I_{OUT}$=30 mA, U-Pack 3 | | | 80 | 150 | mV |
| Dropout Voltage 2 | $I_{OUT}$=60 mA, TO-92 | $V_{DROP2}$ | | 150 | 300 | mV |
| | $I_{OUT}$=60 mA, U-Pack 3 | | | 130 | 280 | mV |
| Dropout Voltage 3 | $I_{OUT}$=100 mA, U-Pack 3 | $V_{DROP3}$ | | 170 | 330 | mV |
| Output Current | $V_{IN}$=$V_{OUT}$ + 1 V, TO-92 | $I_{OUT}$ | | 130 | | mA |
| | $V_{IN}$=$V_{OUT}$ + 1 V, U-Pack 3 | | | 190 | | mA |
| Recommended Output Current | $V_{IN}$=$V_{OUT}$ + 1 V, TO-92 | $I_{OR}$ | | | 100 | mA |
| | $V_{IN}$=$V_{OUT}$ + 1 V, U-Pack 3 | | | | 150 | mA |
| Line Regulation | ($V_{OUT}$ + 1.0 V) ≤$V_{IN}$≤($V_{OUT}$+6.0 V) | $LI_{REG}$ | | 2.0 | 30 | mV |
| Load Regulation 1 | $I_{OUT}$=1 to 30 mA, TO-92 | $LD_{REG1}$ | | 15 | 70 | mV |
| | $I_{OUT}$=1 to 30 mA, U-Pack 3 | | | 15 | 60 | mV |
| Load Regulation 2 | $I_{OUT}$=1 to 60 mA, TO-92 | $LD_{REG2}$ | | 30 | 120 | mV |
| | $I_{OUT}$=1 to 100 mA, U-Pack 3 | | | 40 | 140 | mV |
| Ripple Rejection | $V_{IN}$=$V_{OUT}$ + 1.5 V, 100 mV/RMS $f$=400 Hz | RR | | 55 | | dB |
| Temperature Coefficient | $V_{IN}$=$V_{OUT}$ + 1.5 V, $I_{OUT}$=10 mA | | | | | |
| | TO-92 | | | ±0.3 | | mV/°C |
| | U-Pack 3 | | | ±0.35 | | mV/°C |
| Output Noise Voltage | $V_{IN}$=$V_{OUT}$ + 1.5 V, $I_{OUT}$=10 mA, TO-92 | $V_N$ | | 150 | | $\mu V_{RMS}$ |
| Quiescent Current | $V_{IN}$=6.0 V, $I_{OUT}$=60 mA, U-Pack 3 | $V_N$ | | 2 | 4.5 | mA |

**Note 1:** Operation at any Absolute Maximum Rating is not implied. See Operating Conditions for proper nominal applied conditions in typical applications.

**Note 2:** Derate above $T_A$=25 °C at 1.6 mW/°C.

**Note 3:** Due to the common format used here, some specifications may not apply to all versions of output voltage. Detailed specifications are available for each version.



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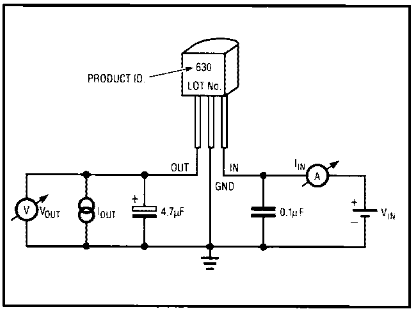
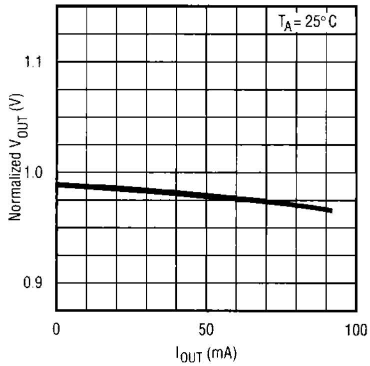
## TYPICAL PERFORMANCE CHARACTERISTICS (TO-92 PACKAGE ONLY)

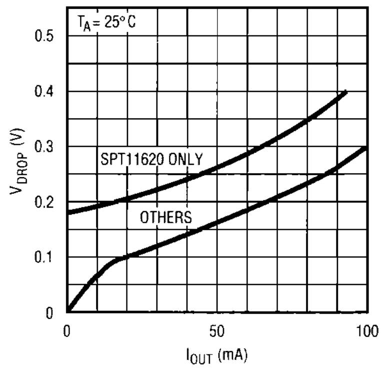
### TEST CIRCUIT 1



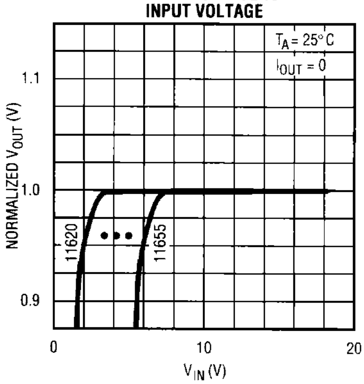

### OUTPUT VOLTAGE vs OUTPUT CURRENT



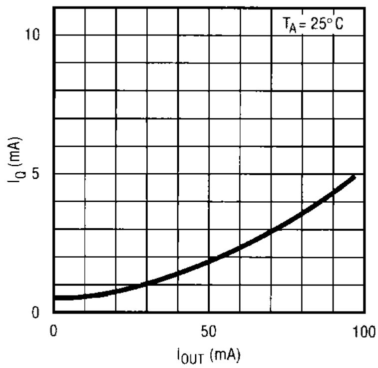

### DROPOUT VOLTAGE vs LOAD CURRENT



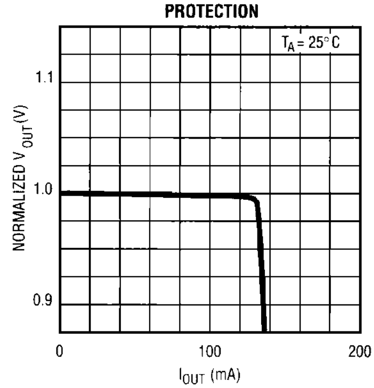

### OUTPUT VOLTAGE vs INPUT VOLTAGE



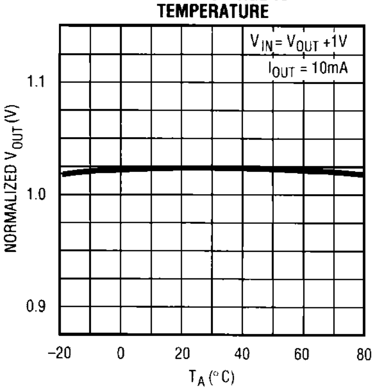

### QUIESCENT CURRENT vs LOAD CURRENT



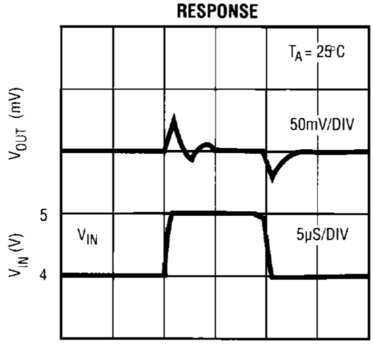

### SHORT CIRCUIT PROTECTION



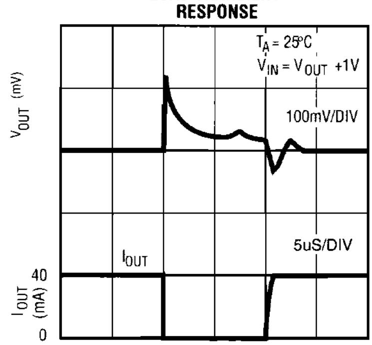

### OUTPUT VOLTAGE vs TEMPERATURE




### LINE TRANSIENT RESPONSE

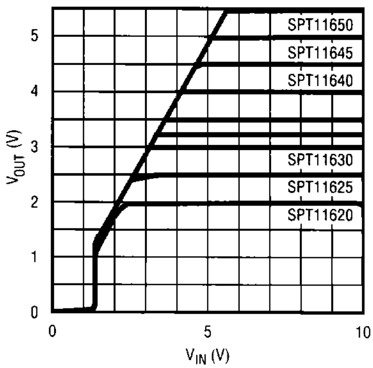



### LOAD TRANSIENT RESPONSE

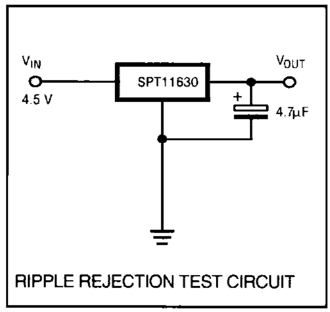


# TYPICAL PERFORMANCE CHARACTERISTICS (TO-92 PACKAGE ONLY)

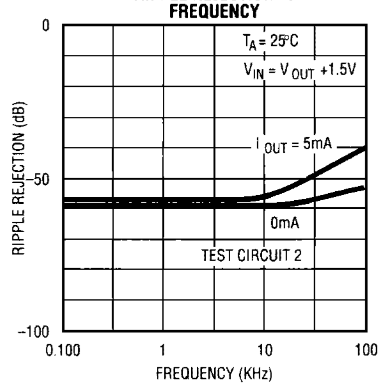
**INPUT OUTPUT CHARACTERISTICS**




**TEST CIRCUIT 2**

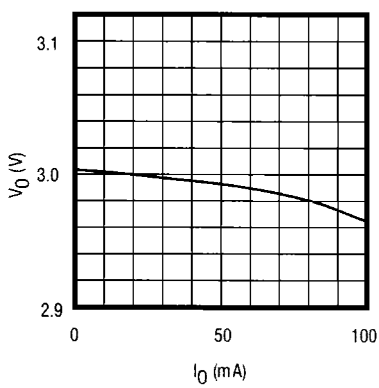



**RIPPLE REJECTION vs FREQUENCY**

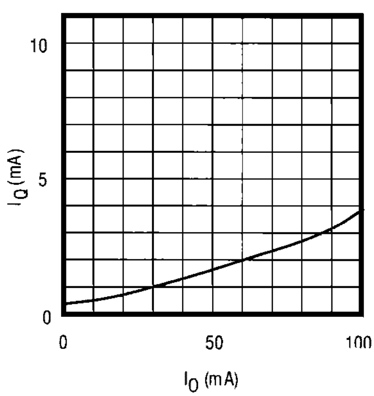



# TYPICAL PERFORMANCE CHARACTERISTICS (U-PACK 3 PACKAGE ONLY)

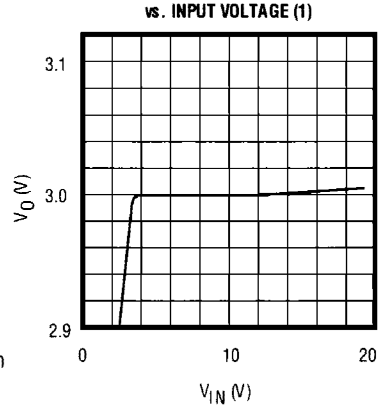
**OUTPUT VOLTAGE vs. OUTPUT CURRENT**




**QUIESCENT CURRENT vs. LOAD CURRENT**




**OUTPUT VOLTAGE vs. INPUT VOLTAGE (1)**



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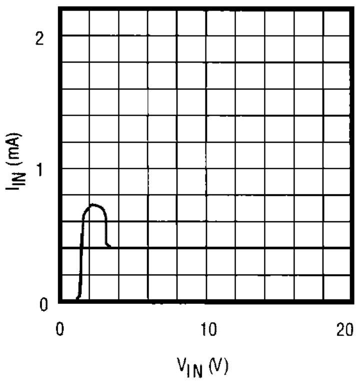
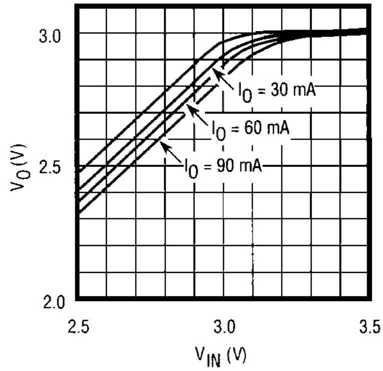
## TYPICAL PERFORMANCE CHARACTERISTICS (U-PACK 3 PACKAGE ONLY)



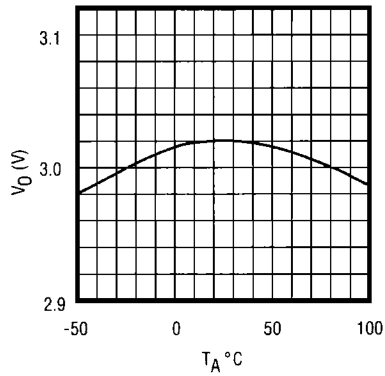
**INPUT CURRENT vs. INPUT VOLTAGE**




**OUTPUT VOLTAGE vs. INPUT VOLTAGE (2)**

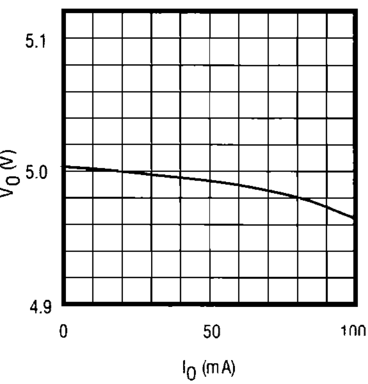



**OUTPUT VOLTAGE vs. TEMPERATURE**

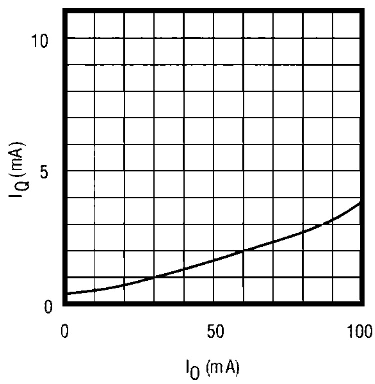




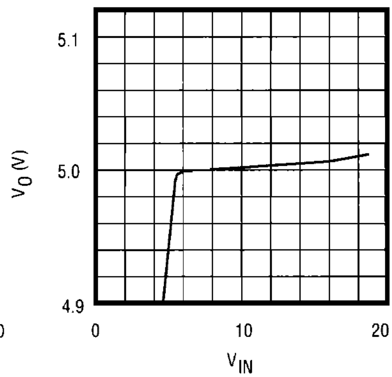

**OUTPUT VOLTAGE vs. OUTPUT CURRENT**



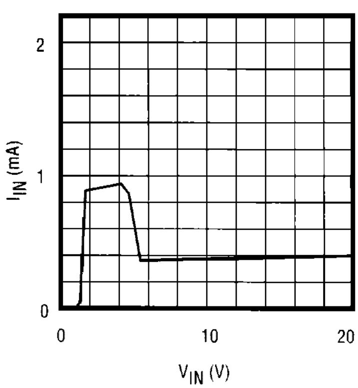

**QUIESCENT CURRENT vs. LOAD CURRENT**



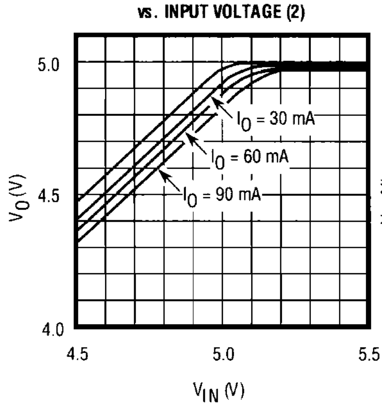

**OUTPUT VOLTAGE vs. INPUT VOLTAGE (1)**



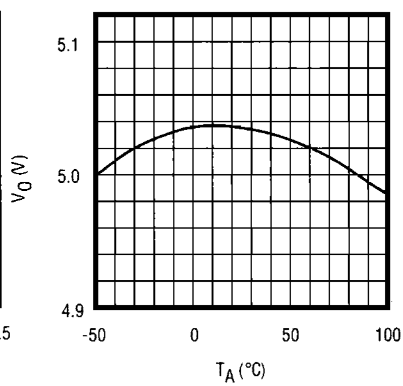

**INPUT CURRENT vs. INPUT VOLTAGE**



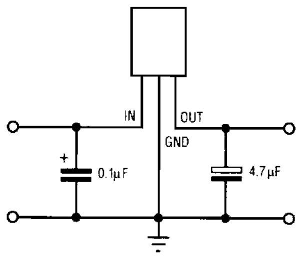

**OUTPUT VOLTAGE vs. INPUT VOLTAGE (2)**



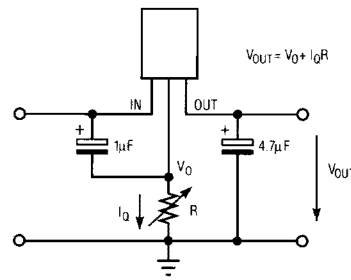

**OUTPUT VOLTAGE vs. TEMPERATURE**



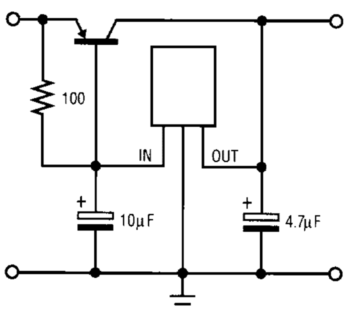
### VOLTAGE REGULATOR CIRCUIT



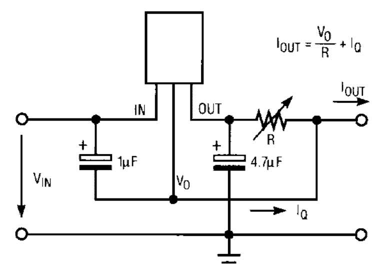

### VOLTAGE BOOST CIRCUIT




### CURRENT BOOST CIRCUIT




### CURRENT REGULATOR CIRCUIT




## APPLICATION HINTS

Maximize copper foil area connecting to all IC pins for optimum heat conduction. Place input and output bypass capacitors close to the GND pin.

For best transient behavior and lowest output impedance, use as large of a capacitor value as possible. The temperature coefficient of the capacitance and Equivalent Series Resistance (ESR) should be taken into account. These parameters can influence power supply noise and ripple rejection. In extreme cases, oscillation may occur. In order to maintain stability, the output bypass capacitor value should be minimum 1 μF in case of Tantalum electrolytic or 4.7 μF in case of Aluminium electrolytic at $T_A$=25 °C.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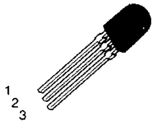
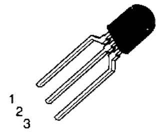
## PIN ASSIGNMENTS

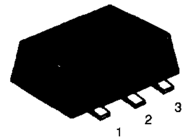
**SPT116xxN**




**SPT116xxNT**




**SPT116xxU**




PIN 1. OUTPUT
2. GROUND
3. INPUT

SIGNAL PROCESSING TECHNOLOGIES

# LEADERSHIP IN DATA CONVERSION AND SIGNAL PROCESSING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