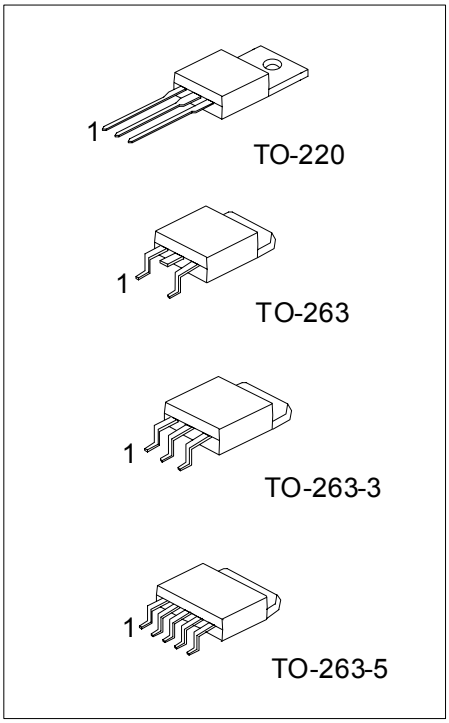
# 500mA LOW DROPOUT VOLTAGE REGULATOR




*Pb-free plating product number:LM2937L-XX

## ■ DESCRIPTION

The UTC **LM2937** is a positive voltage regulator capable of supplying up to 500mA of load current. The use of a PNP power transistor provides a low dropout voltage characteristic. With a load current of 500mA the minimum input to output voltage differential required for the output to remain in regulation is typically 0.5V(1V guaranteed maximum over the full operating temperature range). Special circuitry has been incorporated to minimize the quiescent current to typically only 10mA with a full 500mA load current when the input to output voltage differential is greater than 3V.

The UTC **LM2937** requires an output bypass capacitor for stability. As with most low dropout regulators, the ESR of this capacitor remains a critical design parameter, but the LM2937 includes special compensation circuitry that relaxes ESR requirements. The UTC **LM2937** is stable for all ESR below 3Ω.This allows the use of low ESR chip capacitors.

Ideally suited for automotive applications, the UTC **LM2937** will protect itself and any load circuitry from reverse battery connections, two-battery jumps and up to +60V/-50V load dump transients. Familiar regulator features such as short circuit and thermal shutdown protection are also built in.

## ■ FEATURES

* Fully specified for operation over -40°C~ +125°C
* Output current in excess of 500mA
* Output trimmed for 5% tolerance under all operating conditions
* Typical dropout voltage of 0.5V at full rated load current
* Wide output capacitor ESR range, up to 3Ω
* Reverse battery protection
* Internal short circuit and thermal overload protection
* 60V input transient protection
* Mirror image insertion protection
* Built-in ON/OFF control function

## ■ ORDERING INFORMATION

| Order Number | | Package | Packing |
|---|---|---|---|
| Normal | Lead Free Plating | | |
| LM2937-xx-TA3-T | LM2937L-xx-TA3-T | TO-220 | Tube |
| LM2937-xx-TQ2-R | LM2937L-xx-TQ2-R | TO-263 | Tape Reel |
| LM2937-xx-TQ2-T | LM2937L-xx-TQ2-T | TO-263 | Tube |
| LM2937-xx-TQ3-R | LM2937L-xx-TQ3-R | TO-263-3 | Tape Reel |
| LM2937-xx-TQ3-T | LM2937L-xx-TQ3-T | TO-263-3 | Tube |
| LM2937-xx-TQ5-R | LM2937L-xx-TQ5-R | TO-263-5 | Tape Reel |
| LM2937-xx-TQ5-T | LM2937L-xx-TQ5-T | TO-263-5 | Tube |

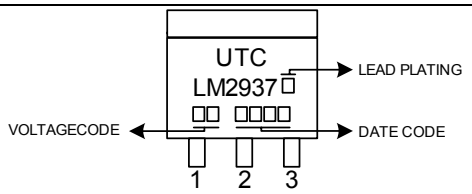
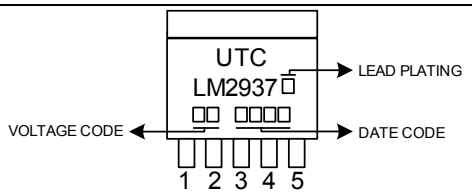
## ■ ORDERING INFORMATION (Cont.)

| | |
|---|---|
| LM2937L-xx-TA3-R<br>(1)Packing Type<br>(2)Package Type<br>(3)Output Voltage Code<br>(4)Lead Plating | (1) R: Tape Reel, T: Tube<br>(2) TA3: TO-220, TQ2: TO-263, TQ3: TO-263-3, TQ 5: TO-263-5<br>(3) xx: refer to Marking Information<br>(4) L: Lead Free Plating, Blank: Pb/Sn |

## ■ PIN CONFIGURATION

| PIN NO. | | PIN NAME |
|---|---|---|
| TO-263/TO-263-3/TO-220 | TO-263-5 | |
| 1 | 4 | Input |
| 2 | 3 | GND |
| 3 | 5 | Output |
| - | 1 | N/C |
| - | 2 | ON/OFF |

## ■ MARKING INFORMATION

| PACKAGE | VOLTAGE CODE | MARKING |
|---|---|---|
| TO-220<br>TO-263<br>TO-263-3 | 33 :3.3V<br>50 :5.0V<br>80 :8.0V<br>10 :10V<br>12 :12V<br>15 :15V |  |
| TO-263-5 | |  |

## ■ ABSOLUTE MAXIMUM RATINGS (Note 1)

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 26 | V |
| Power Dissipation(Note 2) | $P_D$ | Internally limited | |
| Maximum Junction Temperature | $T_J$ | +150 | °C |
| Storage Temperature | $T_{STG}$ | -40 ~ +150 | °C |

Note 1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical Specifications do not apply when operating the device outside of its rated Operating Conditions.

2. The maximum allowable power dissipation at any ambient temperature is $P_{MAX} = (125\text{-}T_A)/\theta_{JA}$, where 125 is the maximum junction temperature for operation, $T_A$ is the ambient temperature, and $\theta_{JA}$ is the junction to ambient thermal resistance. If this dissipation is exceeded, the die temperature will rise above 125°C and the electrical specifications do not apply. If the die temperature rises above 150°C, the LM2937 will go into thermal shutdown.

## ■ THERMAL DATA

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Thermal Resistance Junction- Ambient | TO-220 | $\theta_{JA}$ | 65 | °C/W |
| | TO-263 | | 73 | |
| | TO-263-5 | | 73 | |
| Thermal Resistance Junction- Case | TO-220 | $\theta_{JC}$ | 3 | |
| | TO-263 | | 4 | |
| | TO-263-5 | | 4 | |

## ■ ELECTRICAL CHARACTERISTICS

($V_{IN}=V_{NOM}+5V$, $I_{OUT}$=500mA, $C_{OUT}$=10μF, $T_J$=Ta=25°C, unless otherwise specified.)

**For LM2937-3.3V**

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | 3.21 | 3.30 | 3.39 | V |
| Line Regulation | △$V_{OUT}$ | $V_{OUT}$+2V≤$V_{IN}$≤26V, $I_{OUT}$=5mA | | 9 | 30 | mV |
| Load Regulation | △$V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | | 3 | 30 | mV |
| Quiescent Current | $I_Q$ | ($V_O$+2V)≤$V_{IN}$ ≤26V, $I_{OUT}$=5mA | | 2 | 10 | mA |
| | | $V_{IN}$= $V_{OUT}$+5V, $I_{OUT}$=500mA | | 10 | 20 | mA |
| Output Noise Voltage | eN | 10Hz-100kHz, $I_{OUT}$=5mA | | 100 | | μVrms |
| Long Term Stability | | 1000Hrs | | 12 | | mV |
| Dropout Voltage | $V_D$ | $I_{OUT}$=500mA | | 0.5 | 1.0 | V |
| | | $I_{OUT}$=50mA | | 110 | 250 | mV |
| Short Circuit Current | $I_{SC}$ | | 0.6 | 1.0 | | A |
| Peak Line Transient Voltage | $T_{IN}$ | $t_F$≤100ms, $R_L$=100Ω | 60 | 75 | | V |
| Reverse DC Input Voltage | $V_{RIN}$ | $V_{OUT}$ ≥-0.6V, $R_L$=100Ω | -15 | -30 | | V |
| Reverse Transient Input Voltage | $V_{TRRI}$ | $t_F$<1ms, $R_L$=100Ω | -50 | -75 | | V |

**For LM2937-5.0V**

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | 4.85 | 5.00 | 5.15 | V |
| Line Regulation | △$V_{OUT}$ | $V_{OUT}$+2V≤$V_{IN}$≤26V, $I_{OUT}$=5mA | | 15 | 50 | mV |
| Load Regulation | △$V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | | 5 | 50 | mV |
| Quiescent Current | $I_Q$ | ($V_{OUT}$+2V)≤$V_{IN}$ ≤26V, $I_{OUT}$=5mA | | 2 | 10 | mA |
| | | $V_{IN}$= $V_{OUT}$+5V, $I_{OUT}$=500mA | | 10 | 20 | mA |
| Output Noise Voltage | eN | 10Hz-100kHz, $I_{OUT}$=5mA | | 150 | | μVrms |
| Long Term Stability | | 1000Hrs | | 20 | | mV |
| Dropout Voltage | $V_D$ | $I_{OUT}$=500mA | | 0.5 | 1.0 | V |
| | | $I_{OUT}$=50mA | | 110 | 250 | mV |

■ ELECTRICAL CHARACTERISTICS (Cont.)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Short Circuit Current | $I_{SC}$ | | 0.6 | 1.0 | | A |
| Peak Line Transient Voltage | $T_{IN}$ | $t_F$≤100ms, $R_L$=100Ω | 60 | 75 | | V |
| Reverse DC Input Voltage | $V_{RIN}$ | $V_{OUT}$ ≥-0.6V, $R_L$=100Ω | -15 | -30 | | V |
| Reverse Transient Input Voltage | $V_{TRRI}$ | $t_F$<1ms, $R_L$=100Ω | -50 | -75 | | V |

**For LM2937-8.0V**

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | 7.76 | 8.00 | 8.24 | V |
| Line Regulation | △$V_{OUT}$ | $V_{OUT}$+2V≤$V_{IN}$≤26V, $I_{OUT}$=5mA | | 24 | 80 | mV |
| Load Regulation | △$V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | | 8 | 80 | mV |
| Quiescent Current | $I_Q$ | ($V_{OUT}$+2V)≤$V_{IN}$ ≤26V,$I_{OUT}$=5mA | | 2 | 10 | mA |
| | | $V_{IN}$= Vo+5V, $I_{OUT}$=500mA | | 10 | 20 | mA |
| Output Noise Voltage | eN | 10Hz-100kHz, $I_{OUT}$=5mA | | 240 | | μVrms |
| Long Term Stability | | 1000Hrs | | 32 | | mV |
| Dropout Voltage | $V_D$ | $I_{OUT}$=500mA | | 0.5 | 1.0 | V |
| | | $I_{OUT}$=50mA | | 110 | 250 | mV |
| Short Circuit Current | $I_{SC}$ | | 0.6 | 1.0 | | A |
| Peak Line Transient Voltage | $T_{IN}$ | $t_F$≤100ms, $R_L$=100Ω | 60 | 75 | | V |
| Reverse DC Input Voltage | $V_{RIN}$ | $V_{OUT}$ ≥-0.6V, $R_L$=100Ω | -15 | -30 | | V |
| Reverse Transient Input Voltage | $V_{TRRI}$ | $t_F$<1ms, $R_L$=100Ω | -50 | -75 | | V |

**For LM2937-10.0V**

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | 9.70 | 10.00 | 10.30 | V |
| Line Regulation | △$V_{OUT}$ | $V_{OUT}$+2V≤$V_{IN}$≤26V, $I_{OUT}$=5mA | | 30 | 100 | mV |
| Load Regulation | △$V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | | 10 | 100 | mV |
| Quiescent Current | $I_Q$ | ($V_{OUT}$+2V)≤$V_{IN}$ ≤26V,$I_{OUT}$=5mA | | 2 | 10 | mA |
| | | $V_{IN}$= $V_{OUT}$+5V, $I_{OUT}$=500mA | | 10 | 20 | mA |
| Output Noise Voltage | eN | 10Hz-100kHz, $I_{OUT}$=5mA | | 300 | | μVrms |
| Long Term Stability | | 1000Hrs | | 40 | | mV |
| Dropout Voltage | $V_D$ | $I_{OUT}$=500mA | | 0.5 | 1.0 | V |
| | | $I_{OUT}$=50mA | | 110 | 250 | mV |
| Short Circuit Current | $I_{SC}$ | | 0.6 | 1.0 | | A |
| Peak Line Transient Voltage | $T_{IN}$ | $t_F$≤100ms ,$R_L$=100Ω | 60 | 75 | | V |
| Reverse DC Input Voltage | $V_{RIN}$ | $V_{OUT}$≥-0.6V ,$R_L$=100Ω | -15 | -30 | | V |
| Reverse Transient Input Voltage | $V_{TRRI}$ | $t_F$<1ms ,$R_L$=100Ω | -50 | -75 | | V |

**For LM2937-12.0V**

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | 11.64 | 12.00 | 12.36 | V |
| Line Regulation | △$V_{OUT}$ | $V_{OUT}$+2V≤$V_{IN}$≤26V, $I_{OUT}$=5mA | | 36 | 120 | mV |
| Load Regulation | △$V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | | 12 | 120 | mV |
| Quiescent Current | $I_Q$ | ($V_{OUT}$+2V)≤$V_{IN}$ ≤26V,$I_{OUT}$=5mA | | 2 | 10 | mA |
| | | $V_{IN}$= $V_{OUT}$+5V, $I_{OUT}$=500mA | | 10 | 20 | mA |
| Output Noise Voltage | eN | 10Hz-100kHz, $I_{OUT}$=5mA | | 360 | | μVrms |
| Long Term Stability | | 1000Hrs | | 44 | | mV |
| Dropout Voltage | $V_D$ | $I_{OUT}$=500mA | | 0.5 | 1.0 | V |
| | | $I_{OUT}$=50mA | | 110 | 250 | mV |
| Short Circuit Current | $I_{SC}$ | | 0.6 | 1.0 | | A |
| Peak Line Transient Voltage | $T_{IN}$ | $t_F$≤100ms, $R_L$=100Ω | 60 | 75 | | V |
| Reverse DC Input Voltage | $V_{RIN}$ | $V_{OUT}$≥-0.6V, $R_L$=100Ω | -15 | -30 | | V |
| Reverse Transient Input Voltage | $V_{TRRI}$ | $t_F$<1ms, $R_L$=100Ω | -50 | -75 | | V |

## ■ ELECTRICAL CHARACTERISTICS (Cont.)

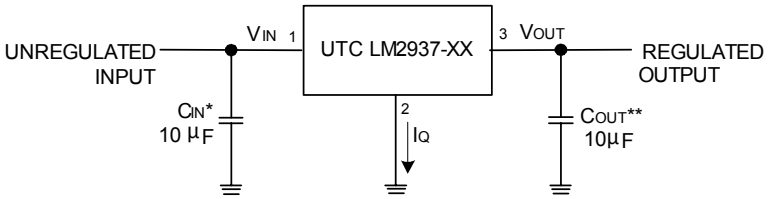
**For LM2937-15.0V**

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | 14.55 | 15.00 | 15.45 | V |
| Line Regulation | △$V_{OUT}$ | $V_{OUT}$+2V≤$V_{IN}$≤26V, $I_{OUT}$=5mA | | 45 | 150 | mV |
| Load Regulation | △$V_{OUT}$ | 5mA≤$I_{OUT}$≤500mA | | 15 | 150 | mV |
| Quiescent Current | $I_Q$ | ($V_{OUT}$+2V)≤$V_{IN}$ ≤26V,$I_{OUT}$=5mA | | 2 | 10 | mA |
| | | $V_{IN}$= $V_{OUT}$+5V, $I_{OUT}$=500mA | | 10 | 20 | mA |
| Output Noise Voltage | eN | 10Hz-100kHz, $I_{OUT}$=5mA | | 450 | | μVrms |
| Long Term Stability | | 1000Hrs | | 56 | | mV |
| Dropout Voltage | $V_D$ | $I_{OUT}$=500mA | | 0.5 | 1.0 | V |
| | | $I_{OUT}$=50mA | | 110 | 250 | mV |
| Short Circuit Current | $I_{SC}$ | | 0.6 | 1.0 | | A |
| Peak Line Transient Voltage | $T_{IN}$ | $t_F$≤100ms, $R_L$=100Ω | 60 | 75 | | V |
| Reverse DC Input Voltage | $V_{RIN}$ | $V_{OUT}$≥-0.6V, $R_L$=100Ω | -15 | -30 | | V |
| Reverse Transient Input Voltage | $V_{TRRI}$ | $t_F$<1ms, $R_L$=100Ω | -50 | -75 | | V |

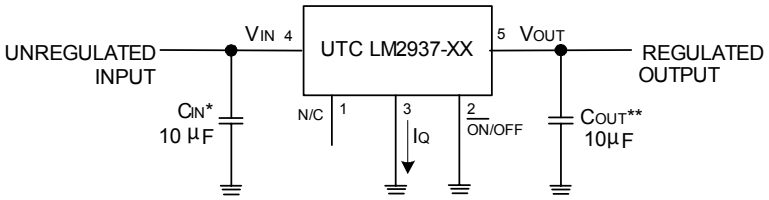
## ■ ON/OFF CONTROL (For 5 pins only)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| ON/OFF Threshold Voltage ON | $V_{ON}$ | $I_{OUT}$≦0.5A | | | 0.8 | V |
| ON/OFF Threshold Voltage OFF | $V_{OFF}$ | $I_{OUT}$≦0.5A | 2.0 | | | V |
| ON/OFF Threshold Current | $I_{ON/OFF}$ | $V_{ON/OFF}$=2.0V, $I_{OUT}$=0.5A | | 50 | 100 | μA |

## ■ TYPICAL APPLICATION

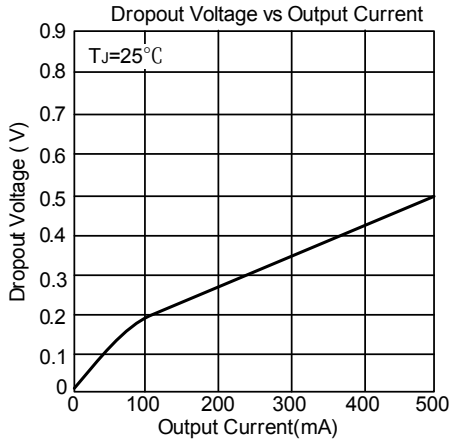


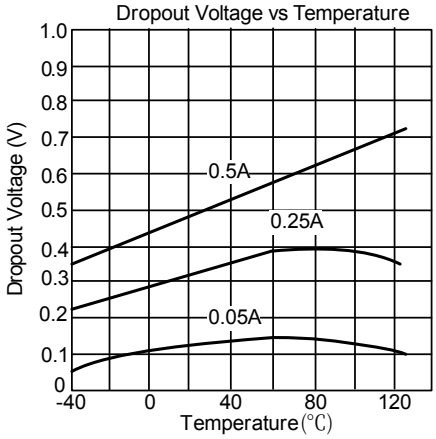

## ■ ON/OFF CONTROL APPLICATION

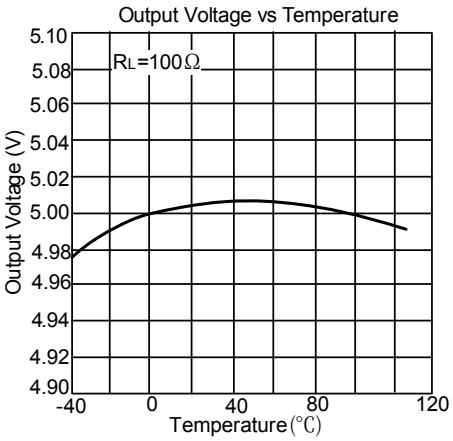


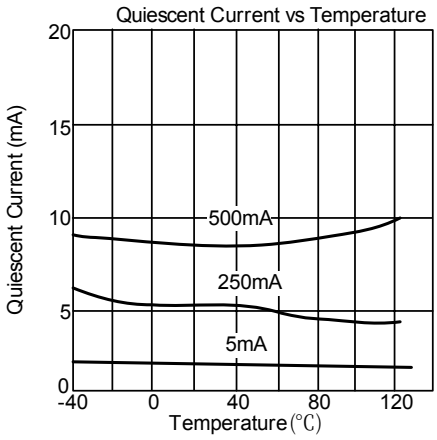

* Required if the regulator is located more than 3 inches from the power supply filter capacitors.
**Required for stability. $C_{OUT}$ must be at least 10µF (over the full expected operating temperature range) and located as close as possible to the regulator. The equivalent series resistance, ESR, of this capacitor may be as high as 3Ω.

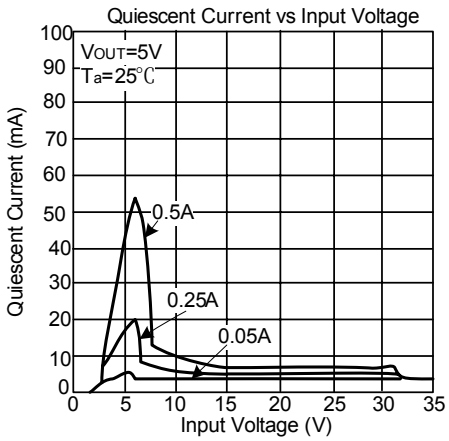
## ■ TYPICAL CHARACTERISTICS

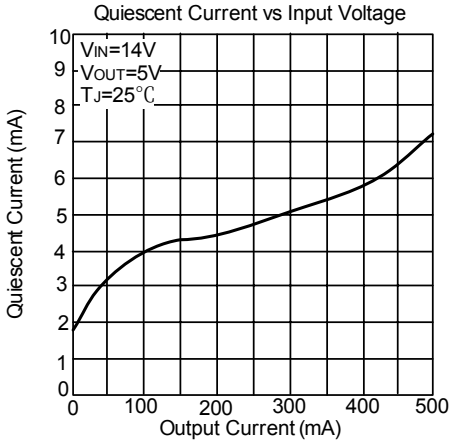


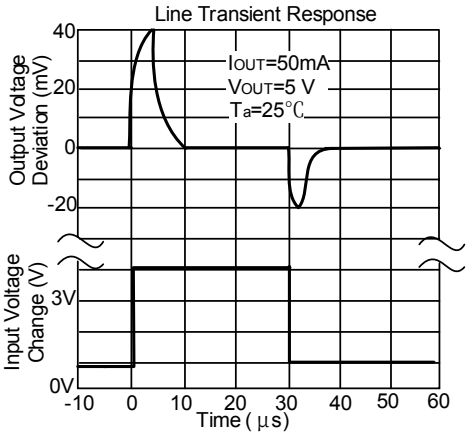



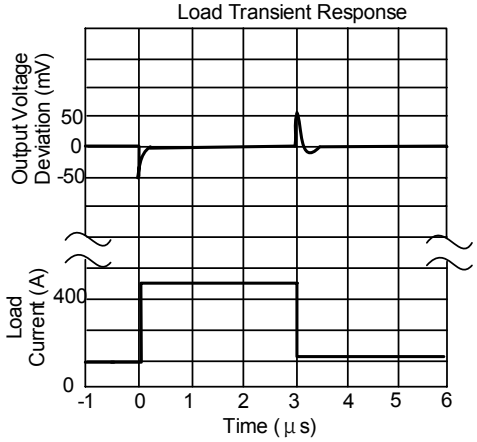



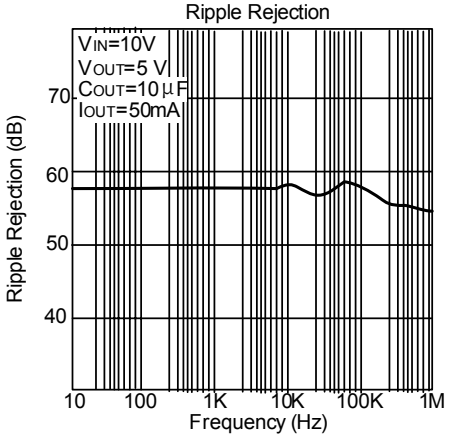



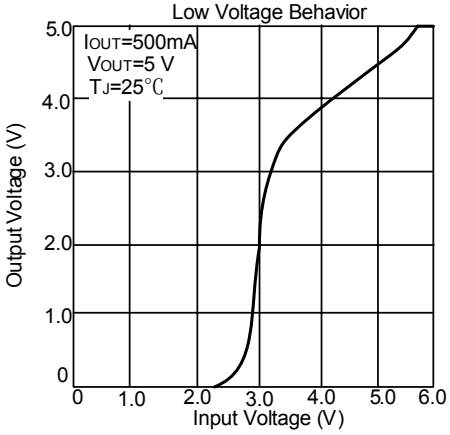



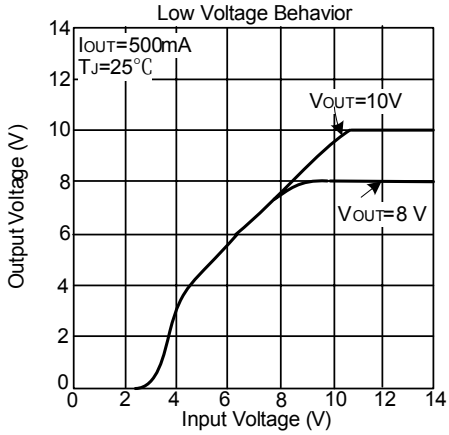
■ TYPICAL CHARACTERISTICS(Cont.)

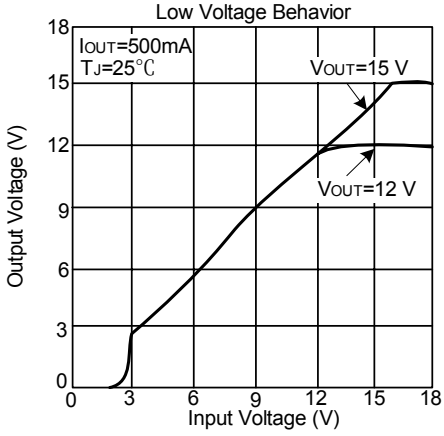


■ TYPICAL CHARACTERISTICS(Cont.)