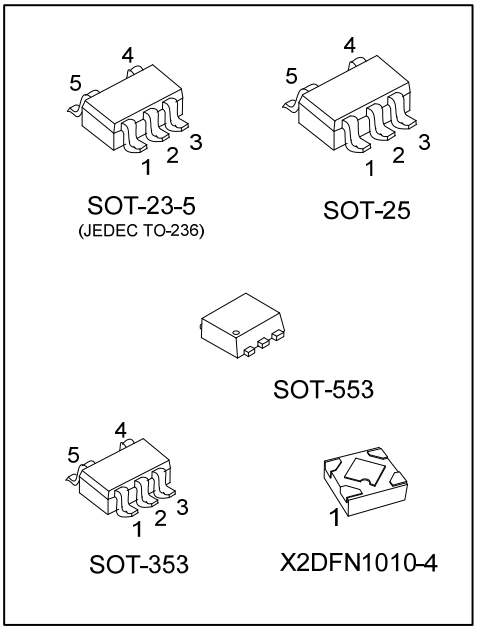
# LR9113

**CMOS IC**

## LOW NOISE 300mA LDO REGULATOR




## ■ DESCRIPTION

The UTC **LR9113** is a typical LDO (linear regulator) with the features of high output voltage accuracy, low supply current, low ON-resistance, and high ripple rejection.

During operation of the UTC **LR9113**, the dropout voltage is very low and the response of line transient and load transient are very well.

Internally, there're many functions of UTC **LR9113** which can be seen in the block figure. There are a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit, and a chip enable circuit in each UTC **LR9113**.

The UTC **LR9113** can be used as an ideal of the power supply for hand-held communication equipment, such as: power source for portable communication equipment, power source for electrical appliances, for example, cameras, VCRs and camcorders and power source for battery-powered equipment.

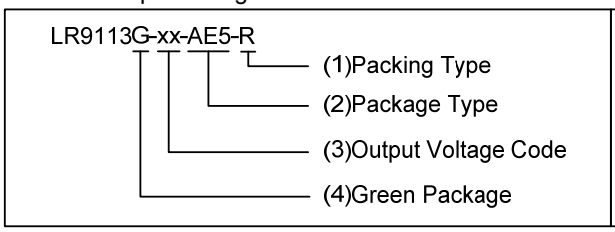
## ■ FEATURES

* Ultra Supply Current: 42μA (Typ.)
* Standby Mode: 0.1μA (Typ.)
* Very Low Dropout Voltage: 0.23V (Typ.) @ $I_{OUT}$ =300mA, $V_{OUT}$ =2.8V
* Power-Supply Ripple Rejection: 72dB (Typ.) @ f=100Hz,$V_{OUT}$=1.8V
* Temperature-Drift Coefficient of Output Voltage: ±50ppm/°C (Typ.)
* Well Line Regulation: 0.02%/ V (Typ.)
* *Output Voltage Accuracy: ±1.0%
* Internal Fold Back Protection Circuit: 50mA (Typ.) (Current at short mode)
* $C_{IN}$=$C_{OUT}$=1.0μF or more (Ceramic capacitors) are recommended to be used with this IC
* ESD Susceptibility (Human Body Mode): ±2kV

## ■ ORDERING INFORMATION

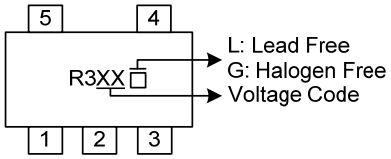
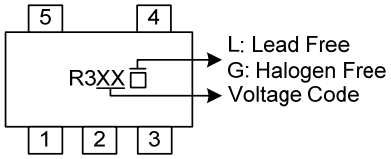
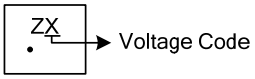
| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen Free | | |
| LR9113L-xx-AE5-R | LR9113G-xx-AE5-R | SOT-23-5 | Tape Reel |
| LR9113L-xx-AF5-R | LR9113G-xx-AF5-R | SOT-25 | Tape Reel |
| LR9113L-xx-AL5-R | LR9113G-xx-AL5-R | SOT-353 | Tape Reel |
| LR9113L-AN5-R | LR9113G-AN5-R | SOT-553 | Tape Reel |
| LR9113L-xx-K04-1010X2-R | LR9113G-xx-K04-1010X2-R | X2DFN1010-4 | Tape Reel |

Note: xx: Output Voltage.

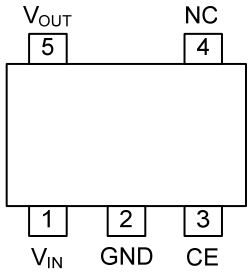



(1) R: Tape Reel
(2) AE5: SOT-23-5, AF5: SOT-25, AL5: SOT-353
AN5: SOT-553, K04-1010X2: X2DFN1010-4
(3) xx: 11: 1.1V, 12: 1.2V... 50: 5.0V
(4) G: Halogen Free and Lead Free, L: Lead Free

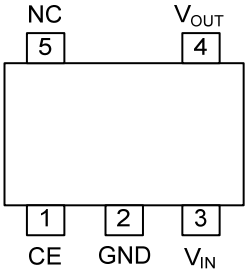
## ■ MARKING INFORMATION

| PACKAGE | VOLTAGE CODE | MARKING |
|---|---|---|
| SOT-23-5<br>SOT-25<br>SOT-353 | 11: 1.1V<br>12: 1.2V<br>15: 1.5V<br>18: 1.8V<br>20: 2.0V<br>25: 2.5V<br>28: 2.8V<br>30: 3.0V<br>33: 3.3V<br>50: 5.0V |  |
| SOT-553 | |  |
| X2DFN1010-4 | A: 1.1V<br>B: 1.2V<br>C: 1.5V<br>D: 1.8V<br>E: 2.5V<br>G: 2.8V<br>J: 3.0V<br>K: 3.3V<br>P: 3.5V |  |

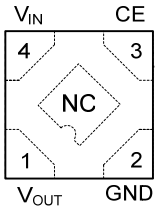
## ■ PIN CONFIGURATION




SOT-23-5 / SOT-25 / SOT-353




SOT-553

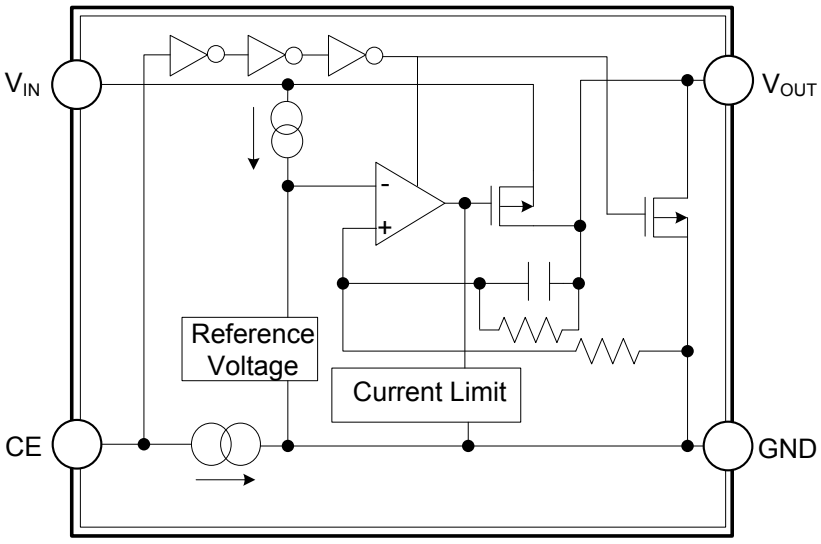



X2DFN1010-4
(TOP VIEW)

## ■ PIN DESCRIPTION

| PIN NO. | | | PIN NAME | DESCRIPTION |
|---|---|---|---|---|
| SOT-23-5<br>SOT-25<br>SOT-353 | SOT-553 | X2DFN1010-4 | | |
| 1 | 3 | 4 | $V_{IN}$ | Input Pin |
| 2 | 2 | 2 | GND | Ground Pin |
| 3 | 1 | 3 | CE | Chip Enable Pin. Active when this Pin is high. |
| 4 | 5 | - | NC | No Connection |
| 5 | 4 | 1 | $V_{OUT}$ | Output Pin |
| - | - | Exposed Pad | NC | Thermal pad |

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATING

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Input Voltage | | $V_{IN}$ | 6 | V |
| Input Voltage (CE Pin) | | $V_{CE}$ | 6 | V |
| Output Voltage | | $V_{OUT}$ | -0.3~ $V_{IN}$+0.3 | V |
| Output Current | | $I_{OUT}$ | 300 | mA |
| Power Dissipation | SOT-23-5<br>SOT-25 | $P_D$ | 380 | mW |
| | SOT-353 | | 250 | mW |
| | SOT-553 | | 200 | mW |
| | X2DFN1010-4 | | 550 (Note 2) | mW |
| Junction Temperature | | $T_J$ | +125 | °C |
| Operating Temperature | | $T_{OPR}$ | -40 ~ +125 | °C |
| Storage Temperature | | $T_{STG}$ | -55 ~ +125 | °C |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Heat Sink Area of PCB for DFN1x1-4 is recommended at least 2.5mmx4mm.

## ■ THERMAL DATA

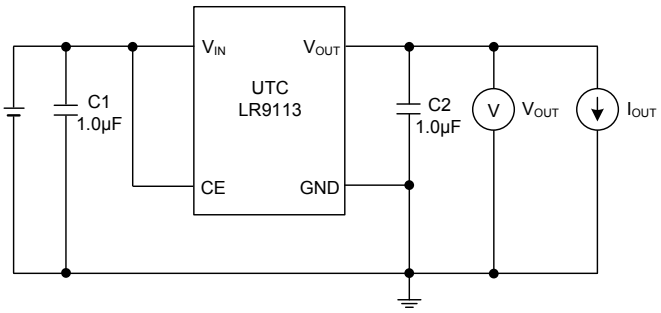
| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Junction to Ambient | SOT-23-5<br>SOT-25 | $\theta_{JA}$ | 263 | °C/W |
| | SOT-353 | | 400 | °C/W |
| | SOT-553 | | 500 | °C/W |
| | X2DFN1010-4 | | 181 | °C/W |
| Junction to Case | SOT-23-5<br>SOT-25 | $\theta_{JC}$ | 90 | °C/W |
| | SOT-353 | | 130 | °C/W |
| | SOT-553 | | 150 | °C/W |
| | X2DFN1010-4 | | 38 | °C/W |

## ■ ELECTRICAL CHARACTERISTICS

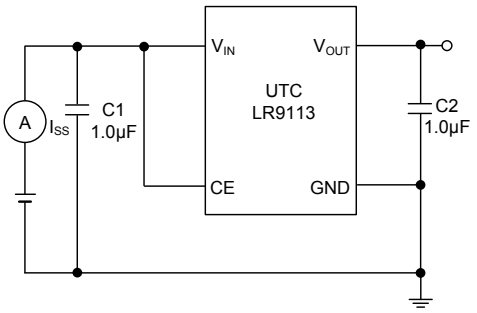
($T_A$=25°C,$V_{IN}$= $V_{OUT}$+1V for $V_{OUT}$ >1.5V ,$V_{IN}$ =2.5V for $V_{OUT}$ ≤1.5V,$I_{OUT}$=1mA, $C_I$ =$C_O$=1.0μF, unless otherwise specified)

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Output Voltage | | $V_{OUT}$ | $V_{IN}$ = Set $V_{OUT}$+1V | $V_{OUT}$ > 2.0V | ×0.99 | | ×1.01 | V |
| | | | | $V_{OUT}$ ≤ 2.0V | -20 | | +20 | mV |
| Input Voltage | | $V_{IN}$ | | | | | 6 | V |
| Load Regulation | | $\Delta V_{OUT}$ | 1mA≤$I_{OUT}$≤300mA | | | 20 | 50 | mV |
| Output Current | | $I_{OUT}$ | | | 300 | | | mA |
| Supply Current | | $I_{SS}$ | $I_{OUT}$=0A | | | 42 | 60 | μA |
| Supply Current (Standby) | | $I_{ST-BY}$ | $V_{CE}$=0V | | | 0.1 | 2 | μA |
| Short Current Limit | | $I_{LIMIT}$ | $V_{OUT}$=0V | | | 50 | | mA |
| CE Pull-down Current | | $I_{PD}$ | | | | 0.3 | | μA |
| CE Input Voltage | High | $V_{CEH}$ | | | 1 | | | V |
| | Low | $V_{CEL}$ | | | | | 0.3 | V |
| Output Noise | | eN | $B_W$=10Hz to 100kHz, $I_{OUT}$ =30mA | | | 30 | | μVrms |
| Power-Supply Ripple Rejection | | PSRR | Ripple 0.2$V_{P-P}$ $V_{IN}$=Set $V_{OUT}$+1V, $I_{OUT}$=10mA (In case that $V_{OUT}$=1.8V, $V_{IN}$=2.8V) | f=100Hz | | 72 | | dB |
| | | | | f=1kHz | | 63 | | dB |
| | | | | f=10kHz | | 44 | | dB |
| | | | | f=100kHz | | 32 | | dB |
| | | | | f=1MHz | | 52 | | dB |
| 'Dropout Voltage | | $V_D$ | $I_{OUT}$=300mA | 1.1V≤$V_{OUT}$＜1.2V | | 0.80 | | V |
| | | | | 1.2V≤$V_{OUT}$＜1.5V | | 0.70 | | |
| | | | | 1.5V≤$V_{OUT}$＜1.7V | | 0.43 | | |
| | | | | 1.7V≤$V_{OUT}$＜2.0V | | 0.37 | | |
| | | | | 2.0V≤$V_{OUT}$＜2.5V | | 0.30 | | |
| | | | | 2.5V≤$V_{OUT}$＜2.8V | | 0.25 | | |
| | | | | 2.8V≤$V_{OUT}$≤ 5.0V | | 0.23 | | |
| Line Regulation | | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | 1.1V≤$V_{OUT}$≤4.0V, $V_{SET}$+0.5V≤$V_{IN}$≤5V | | | 0.02 | 0.10 | %/V |
| | | | 4.0V<$V_{OUT}$≤5.0V, $V_{SET}$+0.5V≤$V_{IN}$≤6.5V | | | | | |
| Output Voltage Temperature Coefficient | | $\frac{\Delta V_{OUT}}{\Delta T}$ | -40°C≤$T_{OPR}$≤85°C | | | ±50 | | ppm/°C |
| Low Output Nch Tr. ON Resistance | | $R_{LOW}$ | $V_{IN}$=4.0,$V_{CE}$=0V | | | 70 | | Ω |

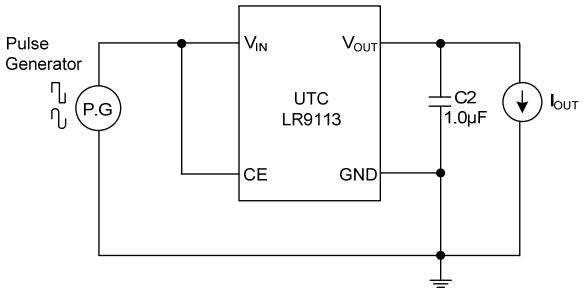
## ■ TEST CIRCUIT



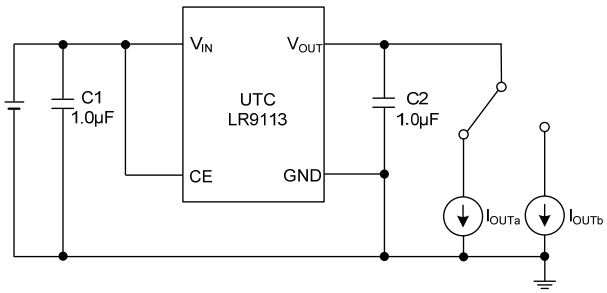

Basic Test Circuit




Test Circuit for Supply Current

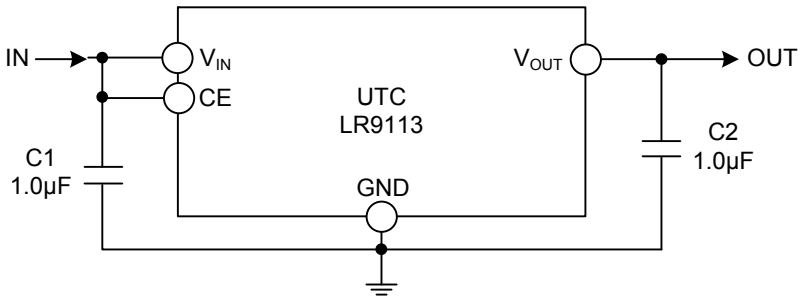



Test Circuit for Ripple Rejection




Test Circuit for Load Transient Response

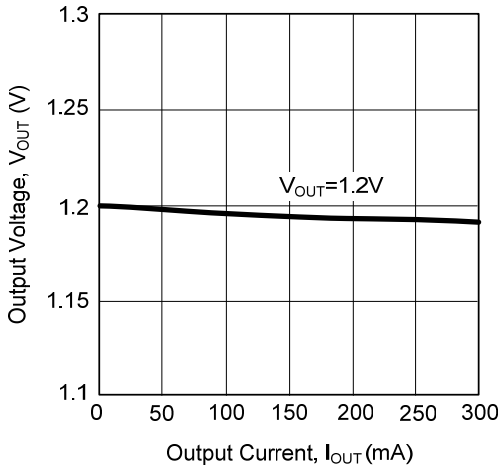
## ■ TYPICAL APPLICATION CIRCUIT



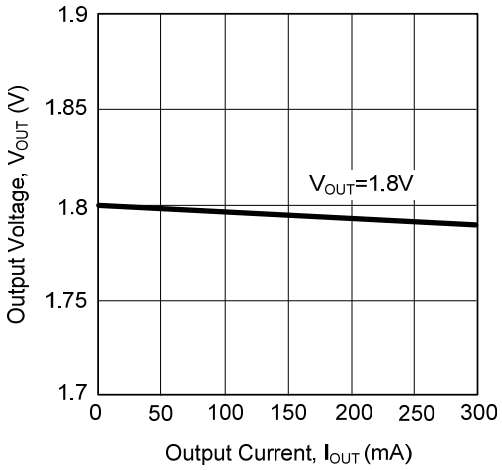
## ■ TYPICAL CHARACTERISTICS

($T_J$=25°C, $V_J$=Set $V_{OUT+}$1V, $I_O$=10mA, $C_J$=1μF, unless otherwise specified)

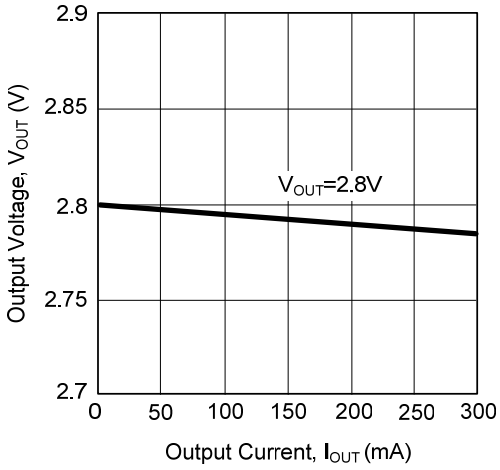
Load Regulation



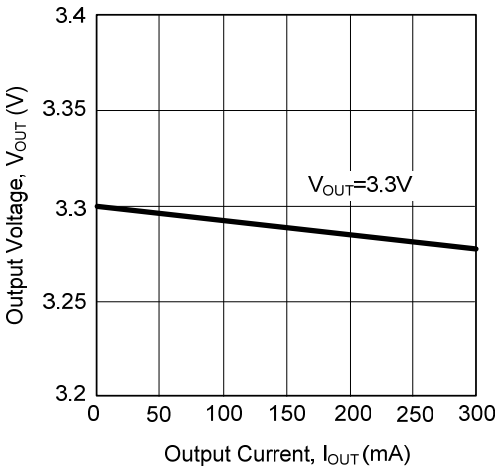

Load Regulation



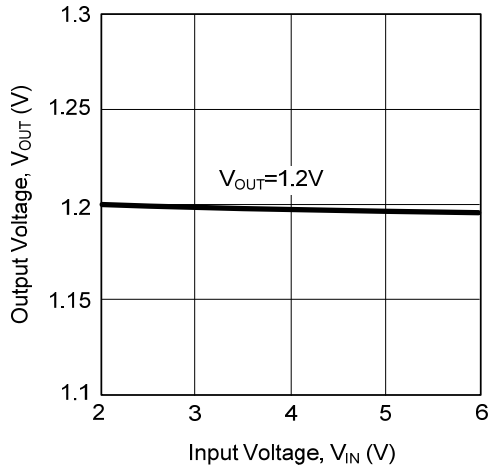

Load Regulation



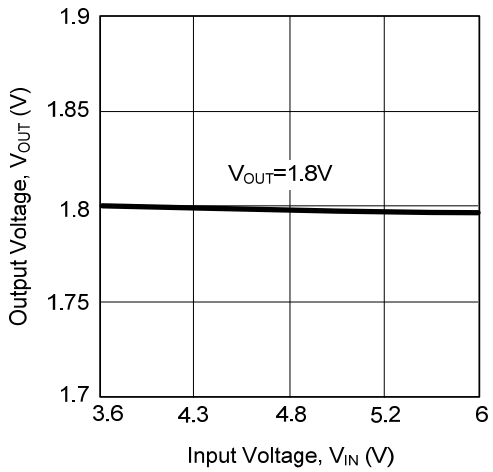

Load Regulation




Line Regulation

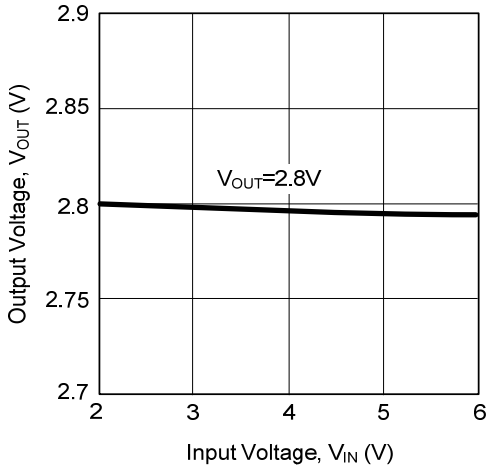



Line Regulation

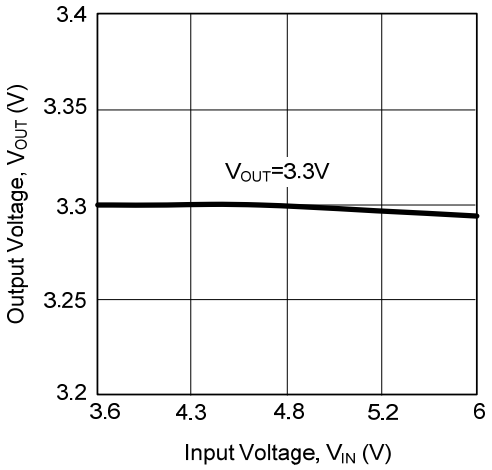


## ■ TYPICAL CHARACTERISTICS (Cont.)

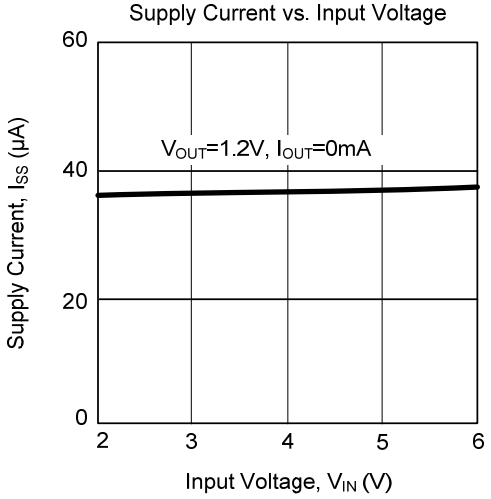
Line Regulation



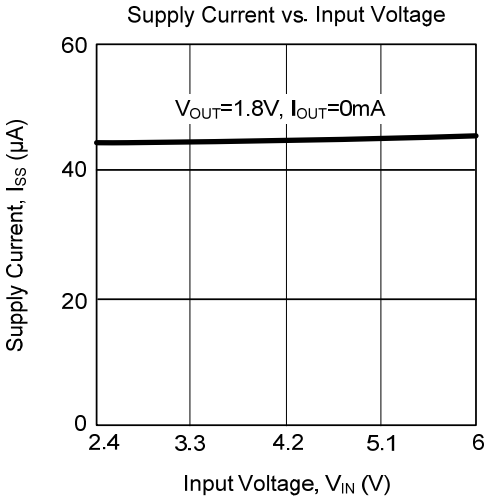

Line Regulation



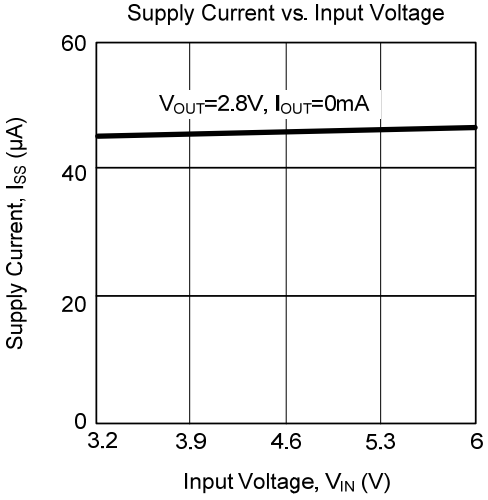

Supply Current vs. Input Voltage



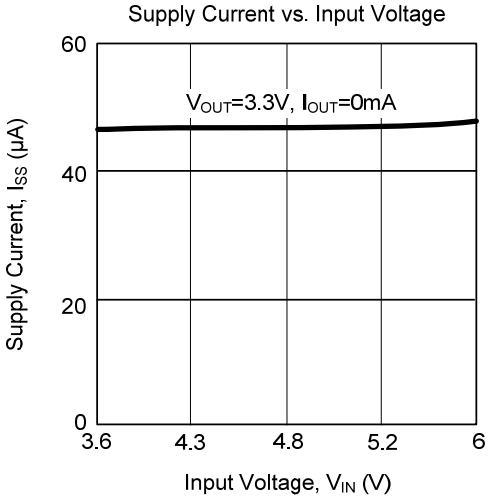

Supply Current vs. Input Voltage




Supply Current vs. Input Voltage

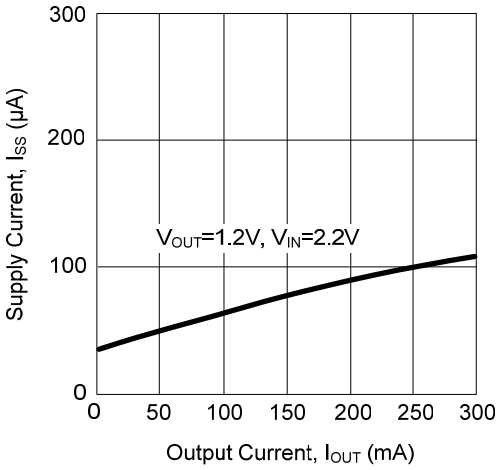



Supply Current vs. Input Voltage

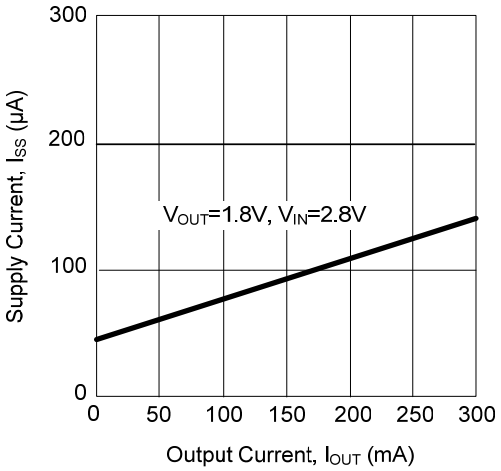


## ■ TYPICAL CHARACTERISTICS (Cont.)

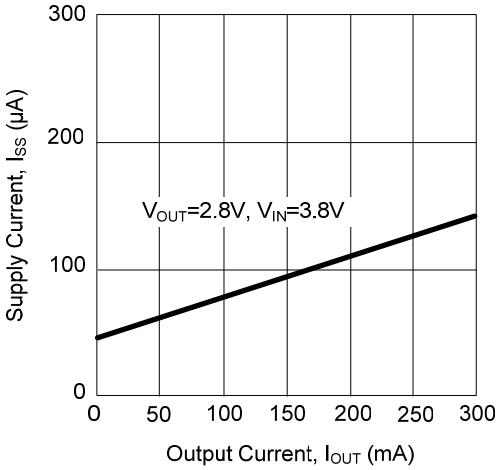
Supply Current vs. Output Current



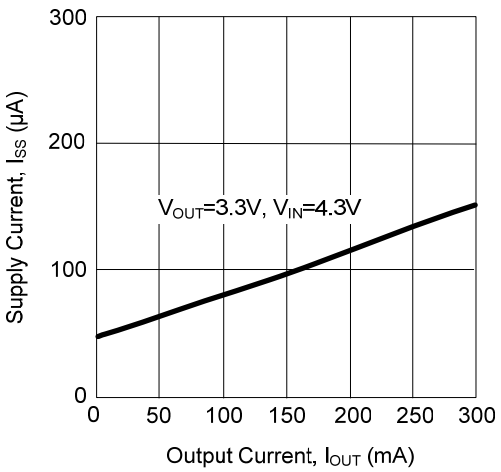

Supply Current vs. Output Current



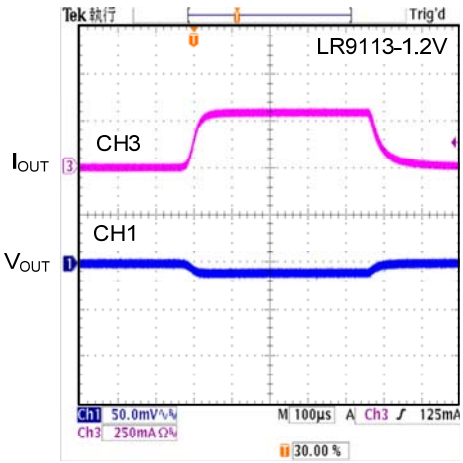

Supply Current vs. Output Current



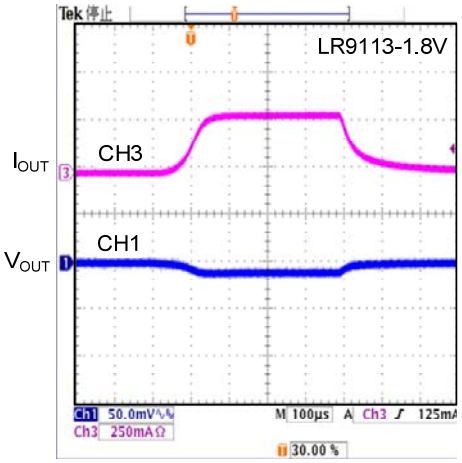

Supply Current vs. Output Current




Load Transient Response

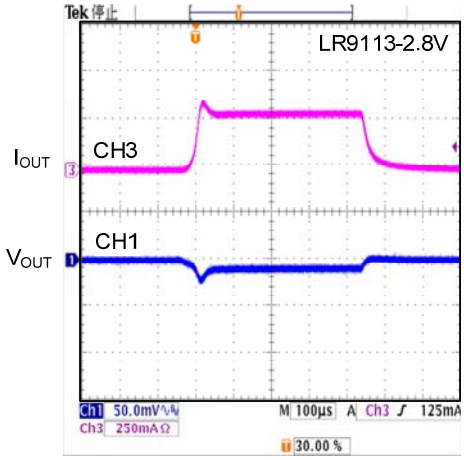



Load Transient Response

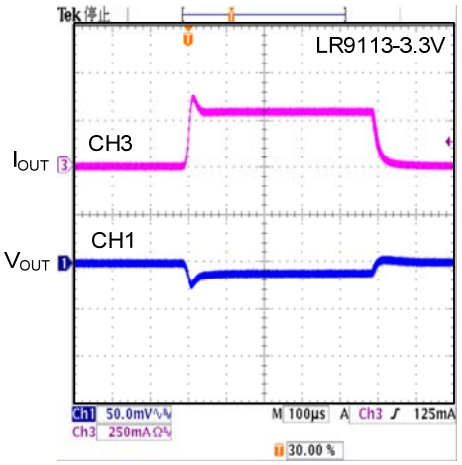


## ■ TYPICAL CHARACTERISTICS (Cont.)

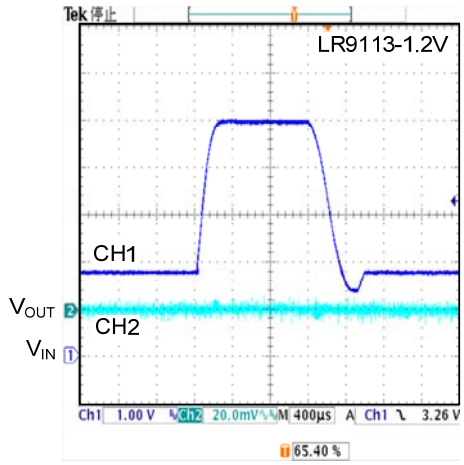
Load Transient Response



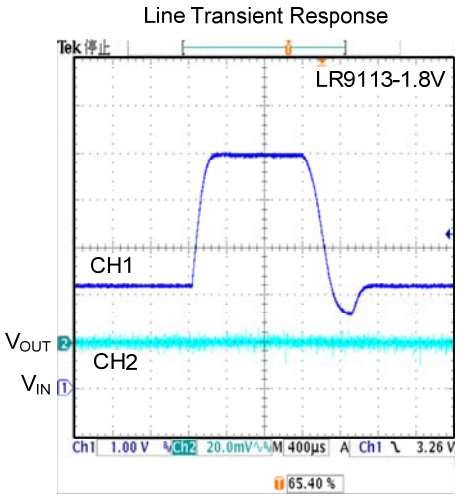

Load Transient Response



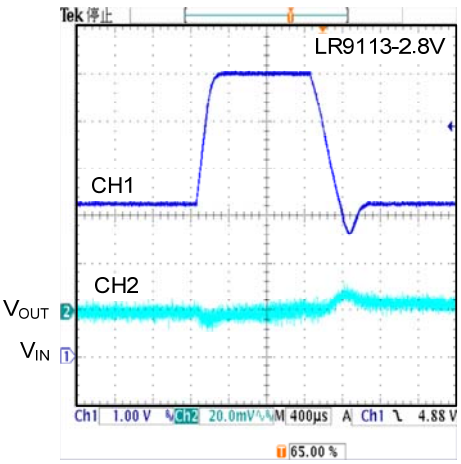

Line Transient Response



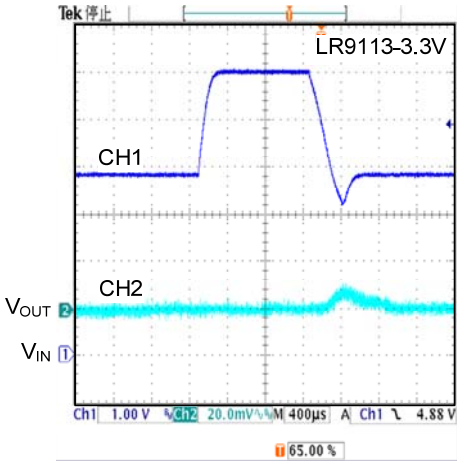

Line Transient Response




Line Transient Response




Line Transient Response



## ■ TYPICAL CHARACTERISTICS (Cont.)