Elektronische Bauelemente

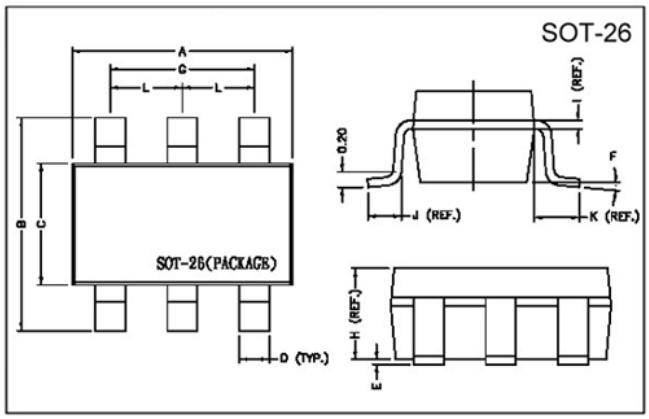
# ST2123

**CMOS Positive Voltage Regulator**

RoHS Compliant Product

## Description

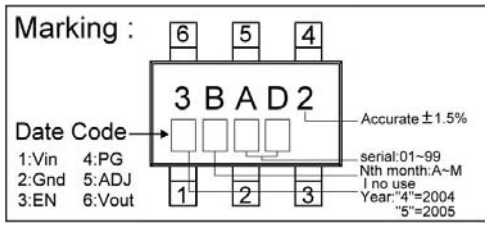
The ST2123 series of positive,linear regulators feature low quiescent current (35μA typ.) with low dropout voltage, making them ideal for battery applications. These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" of operating conditions. The SOT-26 version also features a "Power Good" detector, which pulls low when the output is out of regulation.
The ST2123 is stable with an output capacitance of 2.2μF or greater.




| REF. | Millimeter | | REF. | Dimensions |
|---|---|---|---|---|
| | Min. | Max. | | Millimeter |
| A | 2.70 | 3.10 | G | 1.90 REF. |
| B | 2.60 | 3.00 | H | 1.20 REF. |
| C | 1.40 | 1.80 | I | 0.12 REF. |
| D | 0.30 | 0.55 | J | 0.37 REF. |
| E | 0 | 0.10 | K | 0.60 REF. |
| F | 0° | 10° | L | 0.95 REF. |

## Features

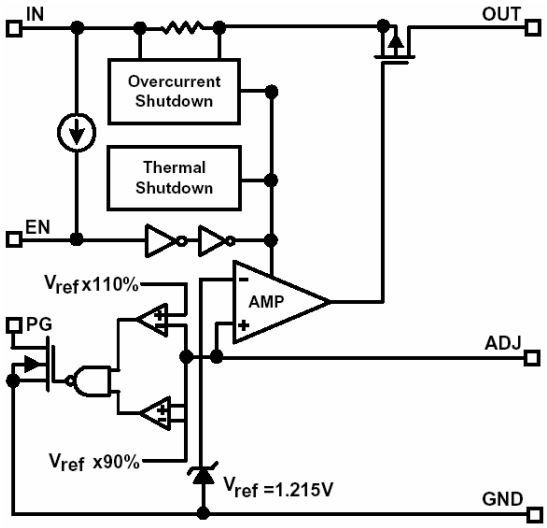
* High Accurate ±1.5%
* Over-Temperature Shutdown
* Adjustable Output Voltage
* Very Low Dropout Voltage
* Low Temperature Coefficient
* Short Circuit Current Fold-back
* Guaranteed 300mA output
* Current Limiting
* Power Good Detector
* Power-Saving Shutdown Mode



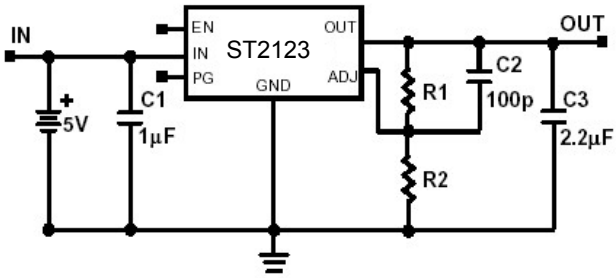

## Applications

* PC Peripherals
* Wireless Devices
* Portable Electronics
* Battery Powered Widgets
* Electronic Scales
* Instrumentation
* Cordless Phones

## Functional Block Diagram




## Typical Application Circuit



Elektronische Bauelemente

# ST2123

**CMOS Positive Voltage Regulator**

## Absolute Maximum Ratings

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 8 | V |
| Output Current | $I_{OUT}$ | $P_D/(V_{IN}-V_O)$ | mA |
| Input, Output Voltage | | GND-0.3 to $V_{IN}$+0.3 | V |
| Operating Ambient Temperature | Topr | -40~+85 | °C |
| Junction Temperature | Tj | -40~+125 | °C |
| Max. Junction Temperature | Tj Max. | 150 | °C |
| Thermal Resistance | θja | 260 | °C/W |
| Power Dissipation (△ T=100°C) | $P_D$ | 380 | mW |
| EDS Classification | | B | |

## Electrical Characteristics Ta=25°C unless otherwise noted

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition | |
|---|---|---|---|---|---|---|---|
| Output Voltage | $V_O$ | -1.5% | – | 1.5% | V | $V_{IN}$=5V,Io=1mA | |
| Ground Pin Current | $I_{GND}$ | – | 35 | – | uA | $V_{IN}$=5V,Io=1mA~300mA | |
| Output Current | Io | 300 | – | – | mA | $V_{IN}$=5V,Io>1.2 | |
| Current Limit | $I_{LIM}$ | 300 | 450 | – | mA | $V_{IN}$=5V,Io>1.2 | |
| Load Regulation | $REG_{LOAD}$ | – | 0.2 | 1 | % | $V_{IN}$=5V,Io=1mA~300mA | |
| Dropout Voltage | $V_{DROPOUT}$ | – | – | 1300 | mV | 1.5V< $V_{ON(NOM)}$ ≤2.0V | Io=300mA |
| | | – | – | 400 | | 2.0V < $V_{ON(NOM)}$ ≤2.8V | Vo=$V_{ON(NOM)}$-2% |
| | | – | – | 300 | | 2.8V<$V_{ON(NOM)}$<3.8V | |
| Line Regulation | $REG_{LINE}$ | – | – | 0.15 | % | Vo<2.0V | Io=5mA $V_{IN}$=$V_{OUT}$(T)+1 to $V_{OUT}$(T)+2 |
| | | – | 0.02 | 0.1 | | Vo≥2.0V | |
| Input Voltage | $V_{IN}$ | Note[1] | – | 7 | V | | |
| Over Temperature Shutdown | $O_{TS}$ | – | 150 | – | °C | | |
| Over Temperature Hystersis | $O_{TH}$ | – | 30 | – | °C | | |
| Output Voltage Temperature Coefficient | $T_C$ | – | 30 | – | ppm/°C | | |
| Short Circuit Current[2] | $I_{SC}$ | – | 150 | 300 | mA | $V_{IN}$=5V,$V_{OUT}$<0.8V | |
| Power Supply Rejection | PSRR | – | 60 | – | dB | f=100Hz | $V_{IN}$=5V Io=100mA Co=2.2Mf |
| | | – | 50 | – | | f=1kHz | |
| | | – | 20 | – | | f=10kHz | |
| Output Voltage Noise | eN | – | 30 | – | uVrms | Co=2.2uF | f=10Hz~100kHz Io=10mA $C_{BYP}$=0uF |
| EN Input Threshold | $V_{EH}$ | 2 | – | $V_{IN}$ | V | $V_{IN}$=2.7V to 7V | |
| | $V_{EL}$ | 0 | – | 0.4 | | | |
| EN Input Bias Current | $I_{EH}$ | – | – | 0.1 | uA | $V_{EN}$=$V_{IN}$,$V_{IN}$=2.7V to 7V | |
| | $I_{EL}$ | – | – | 0.5 | | $V_{EN}$=0V,$V_{IN}$=2.7V to 7V | |
| Shutdown Supply Current | $I_{SD}$ | – | 0.5 | 1 | uA | $V_{IN}$=5V,Vo=0V,$V_{EN}$<$V_{EL}$ | |
| Shutdown Output Voltage | $Vo_{,SD}$ | 0 | – | 0.1 | V | Io=35uA,$V_{EN}$<$V_{EL}$ | |
| Output Under Voltage | $V_{UV}$ | – | – | 85 | % $V_{ON(NOM)}$ | | |
| Output Over Voltage | $V_{OV}$ | 115 | – | – | % $V_{ON(NOM)}$ | | |
| ADJ Input Bias Current | $I_{ADJ}$ | – | 1.0 | – | uA | | |
| ADJ Reference Voltage | $V_{REF}$ | 1.2 | 1.215 | 1.23 | V | | |
| PG Leakage Current | $I_{LC}$ | – | – | 1 | uA | $V_{PG}$=7V | |
| PG Voltage Rating | $V_{PG}$ | – | – | 7 | V | Vo in regulation | |
| PG Voltage Low | $V_{OL}$ | – | – | 0.4 | V | $I_{SINK}$=0.4mA | |

Note: 1.$V_{IN(MON)}=V_{OUT}+V_{DROPOUT}$
2.To prevent the Short Current protection feature from being prematurely activated, the input voltage must be applied before a current source loas is applied.

## Ordering Information(contd.)

| Part Number | Marking | Output Voltage | Part Number | Marking | Output Voltage |
|---|---|---|---|---|---|
| ST2123-AD | 3BAD2<br>XXXX | Adjustable | | | |

## Detailed Description

The ST2123 of COMS regulators contain a PMOS pass transistor,voltage reference, error amplifier,over-current protection and thermal shutdown and Power Good detection circuitry.The P-channel pass transistor receives data from the error amplifier, over-current shutdown,and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference.Over-current and Thermal shutdown circuits become active when the junction temperature exceeds150$^{o}$C, or the current exceeds 300mA.During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120$^{o}$C· The ST2123 switches from voltage mode to current mode when the load exceeds the rated output current.This prevents over-stress.The ST2123 also incorporates current fold-back to reduce power dissipation when the output is short circuited.This feature becomes active when the output drops below 0.8 volts, and reduces the current flow by 65%. Full current is restored when the voltage exceeds 0.8 volts.

## External Capacitors

The ST2123 is stable with an output capacitance to ground of 2.2uF or greater. Ceramic capacitors have the lowest ESR, and will offer the best AC performance. Conversely, Aluminum Elertrolytic capacitors exhibit the highest ESR, resulting in the poorest AC response. Unfortunately, large value ceramic capacitors are comparatively expensive. One option is to parallel a 0.1 uF ceramic capacitor with a 10 uF Aluminum Electrolytic. The benefit is low ESR, high capacitance, and low overall cost. A second capacitor is recommended between the input and ground to stabilize Vin. The input capacitor should be at least 0.1uF to have a beneficial effect. All capacitors should be placed in close proximity to the pins. A "Quiet" ground termination is desirable . The can be achieved with a "Star" connection.

## Enable

The Enable pin normally floats high. When actively, pulled low, the PMOS pass transistor shuts off, and all internal circuits are powered down. In this state, the quiescent current is less than 1uA. This pin behaves much like an electronic switch.

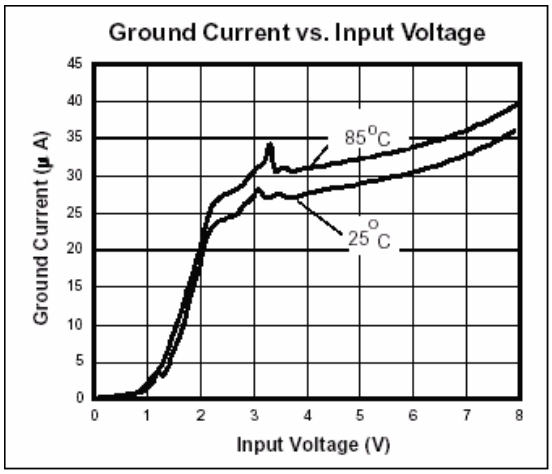
## Power Good

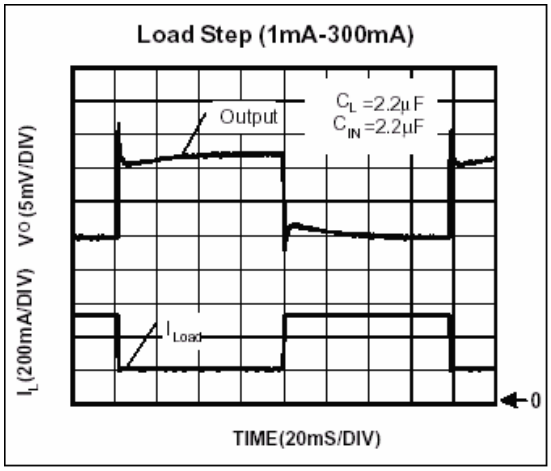
The ST2123 includes the Power Good feature. When the output is not within ± 10% of the specified voltage, it pulls low.
This can occur under the following confitions:

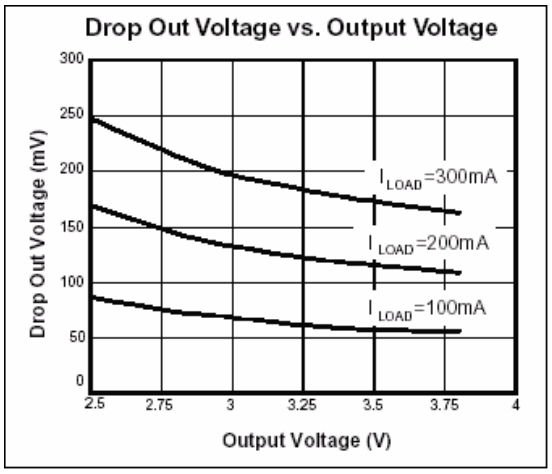
1. Input voltage too low
2. During over-temperature
3. During over-current
4. If output is pulled up

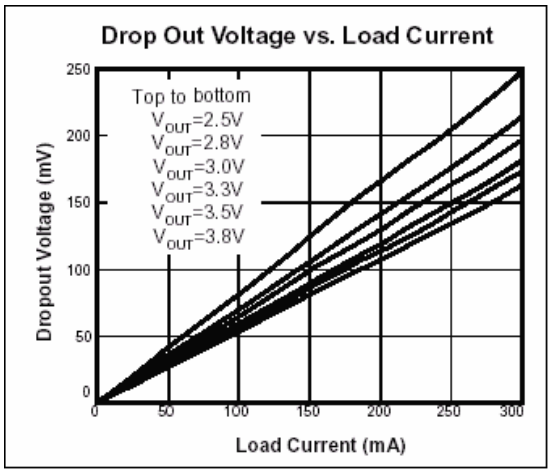
(note: PG pin is an open-drain output)

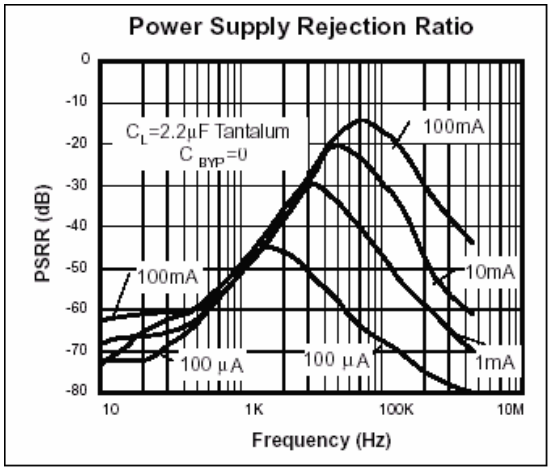
## Characteristics Curve

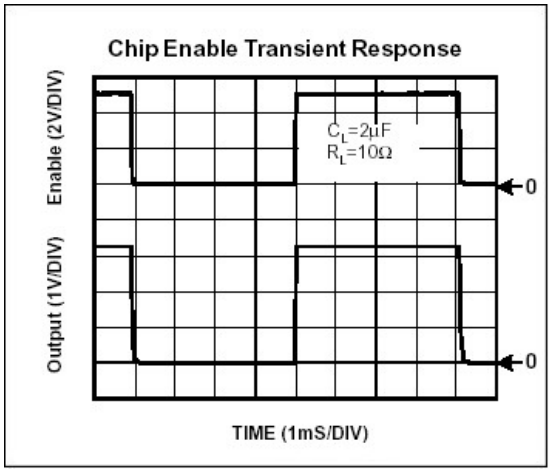


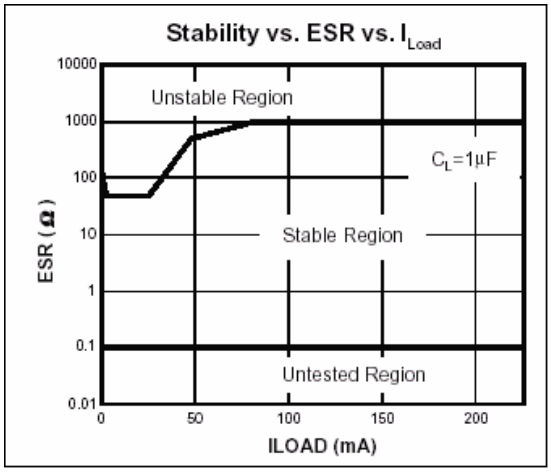



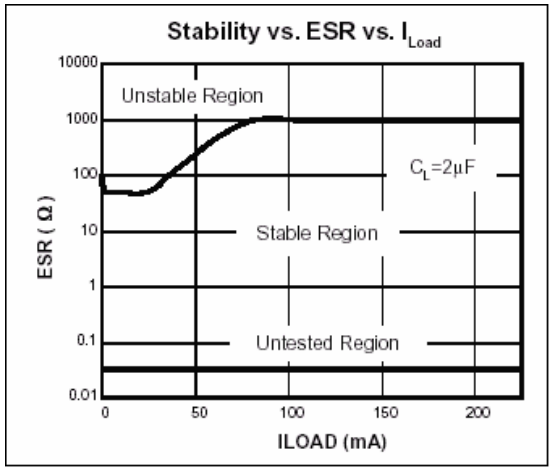



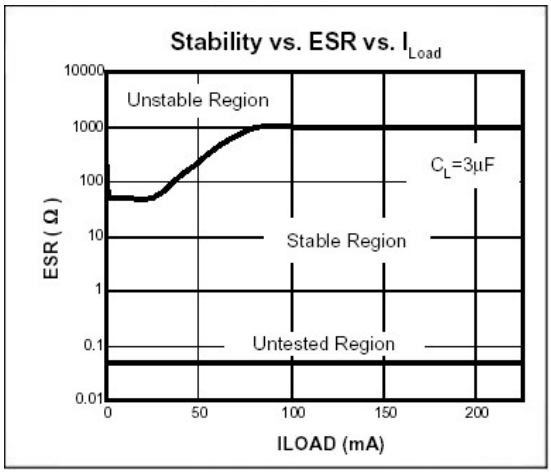



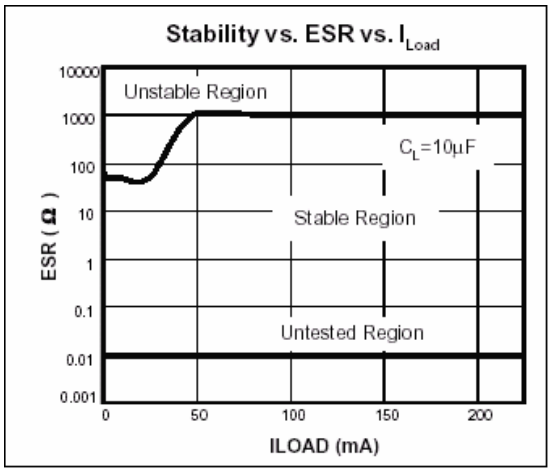



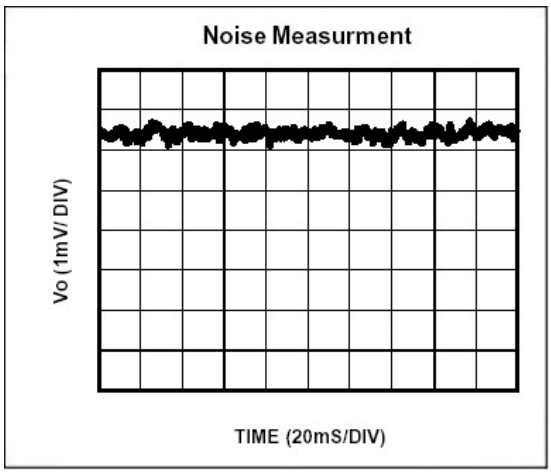



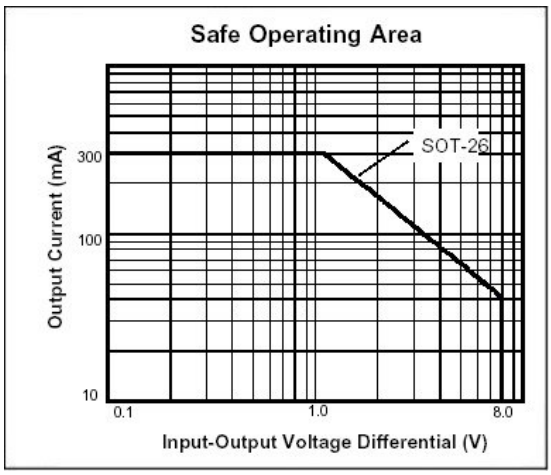

Stability vs. ESR vs. $I_{Load}$
Unstable Region
$C_L$=1µF
Stable Region
Untested Region
ESR ( Ω )
ILOAD (mA)

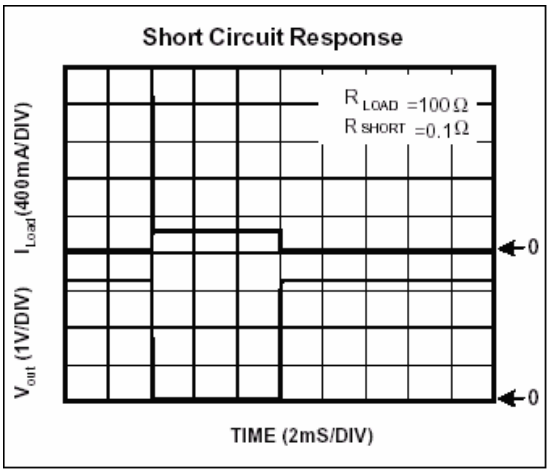

Stability vs. ESR vs. $I_{Load}$
Unstable Region
$C_L$=2µF
Stable Region
Untested Region
ESR ( Ω )
ILOAD (mA)

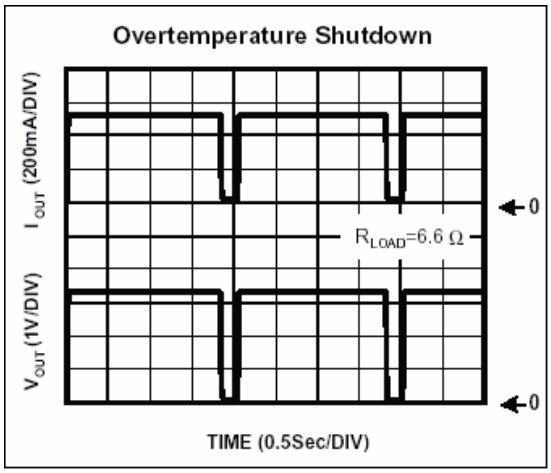

Stability vs. ESR vs. $I_{Load}$
Unstable Region
$C_L$=3µF
Stable Region
Untested Region
ESR ( Ω )
ILOAD (mA)

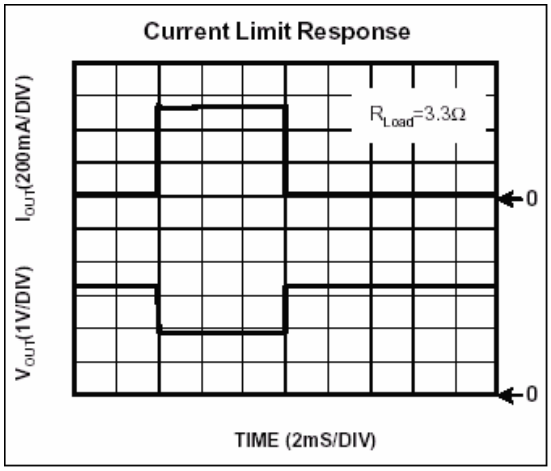

Stability vs. ESR vs. $I_{Load}$
Unstable Region
$C_L$=10µF
Stable Region
Untested Region
ESR ( Ω )
ILOAD (mA)

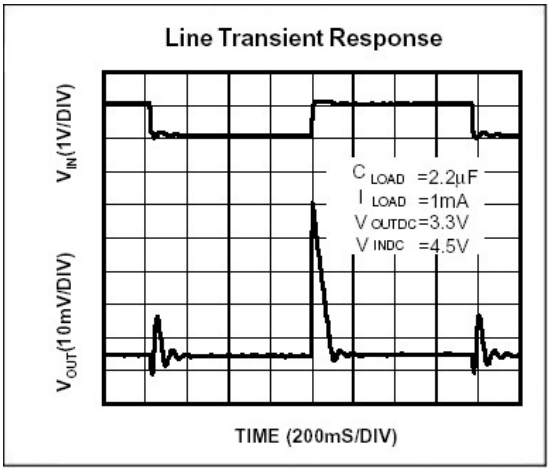

Noise Measurment
Vo (1mV/ DIV)
TIME (20mS/DIV)


Safe Operating Area
SOT-26
Output Current (mA)
Input-Output Voltage Differential (V)


Short Circuit Response
R LOAD =100Ω
R SHORT =0.1Ω
V out (1V/DIV) I Load(400mA/DIV)
0
0
TIME (2mS/DIV)


Overtemperature Shutdown
I OUT (200mA/DIV)
R LOAD=6.6 Ω
V OUT (1V/DIV)
0
0
TIME (0.5Sec/DIV)


Current Limit Response
R Load=3.3Ω
I OUT(200mA/DIV)
V OUT(1V/DIV)
0
0
TIME (2mS/DIV)


Line Transient Response
V IN(1V/DIV)
C LOAD =2.2μF
I LOAD =1mA
V OUTDC=3.3V
V INDC =4.5V
V OUT(10mV/DIV)
TIME (200mS/DIV)

## External Resistor Divider Table

| R1(K Ohm) | 1 | 2 | 5 | 10 | 20 | 50 | 100 | 200 | 500 | 1000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Vout | R2(K Ohm)=(1.215*R1(K Ohm))/(VOUT-1.215) | | | | | | | | | |
| 1.30 | 14.29 | 28.59 | 71.47 | 142.94 | 285.88 | 714.71 | | | | |
| 1.35 | 9.00 | 18.00 | 45.00 | 90.00 | 180.00 | 450.00 | | | | |
| 1.40 | 6.57 | 13.14 | 32.84 | 65.68 | 131.35 | 328.38 | | | | |
| 1.45 | 5.17 | 10.34 | 25.85 | 51.70 | 103.40 | 258.51 | 517.02 | | | |
| 1.50 | 4.26 | 8.53 | 21.32 | 42.63 | 85.26 | 213.16 | 426.32 | 852.63 | | |
| 1.55 | 3.63 | 7.25 | 18.13 | 36.27 | 72.54 | 181.34 | 362.69 | 725.37 | | |
| 1.60 | 3.16 | 6.31 | 15.78 | 31.56 | 63.12 | 157.79 | 315.58 | 631.17 | | |
| 1.65 | 2.79 | 5.59 | 13.97 | 27.93 | 55.86 | 139.66 | 279.31 | 558.62 | | |
| 1.70 | 2.51 | 5.01 | 12.53 | 25.05 | 50.10 | 125.26 | 250.52 | 501.03 | | |
| 1.75 | 2.27 | 4.54 | 11.36 | 22.71 | 45.42 | 113.55 | 227.10 | 454.21 | | |
| 1.80 | 2.08 | 4.15 | 10.38 | 20.77 | 41.54 | 103.85 | 207.69 | 415.38 | | |
| 1.85 | 1.91 | 3.83 | 9.57 | 19.13 | 38.27 | 95.67 | 191.34 | 382.68 | | |
| 1.90 | 1.77 | 3.55 | 8.87 | 17.74 | 35.47 | 88.69 | 177.37 | 354.74 | | |
| 1.95 | 1.65 | 3.31 | 8.27 | 16.53 | 33.06 | 82.65 | 165.33 | 330.61 | 826.53 | |
| 2.00 | 1.55 | 3.10 | 7.74 | 15.48 | 30.96 | 77.39 | 154.78 | 309.55 | 773.89 | |
| 2.05 | 1.46 | 2.91 | 7.28 | 14.55 | 29.10 | 72.75 | 145.51 | 291.02 | 727.54 | |
| 2.10 | 1.37 | 2.75 | 6.86 | 13.73 | 27.46 | 68.64 | 137.29 | 274.58 | 686.44 | |
| 2.15 | 1.30 | 2.60 | 6.50 | 12.99 | 25.99 | 64.97 | 129.95 | 259.89 | 649.73 | |
| 2.20 | 1.23 | 2.47 | 6.17 | 12.34 | 24.67 | 61.68 | 123.35 | 246.70 | 616.75 | |
| 2.25 | 1.71 | 2.35 | 5.87 | 11.74 | 23.48 | 58.70 | 117.39 | 234.78 | 586.96 | |
| 2.30 | 1.12 | 2.24 | 5.60 | 11.20 | 22.40 | 55.99 | 111.98 | 223.96 | 559.91 | |
| 2.35 | 1.07 | 2.14 | 5.35 | 10.70 | 21.41 | 53.52 | 107.05 | 214.10 | 535.24 | |
| 2.40 | 1.03 | 2.05 | 5.13 | 10.25 | 20.51 | 51.27 | 102.53 | 205.06 | 512.66 | |
| 2.45 | 0.98 | 1.97 | 4.92 | 9.84 | 19.68 | 49.19 | 98.38 | 196.76 | 491.90 | |
| 2.50 | 0.95 | 1.89 | 4.73 | 9.46 | 18.91 | 47.28 | 94.55 | 189.11 | 472.76 | |
| 2.55 | 0.91 | 1.82 | 4.55 | 9.10 | 18.20 | 45.51 | 91.01 | 182.02 | 455.06 | |
| 2.60 | 0.88 | 1.75 | 4.39 | 8.77 | 17.55 | 43.86 | 87.73 | 175.45 | 438.63 | 877.26 |
| 2.65 | 0.85 | 1.69 | 4.23 | 8.47 | 16.93 | 42.33 | 84.67 | 169.34 | 423.34 | 846.69 |
| 2.70 | 0.82 | 1.64 | 4.09 | 8.18 | 16.36 | 40.91 | 81.82 | 163.64 | 409.09 | 818.18 |
| 2.75 | 0.79 | 1.58 | 3.96 | 7.92 | 15.83 | 39.58 | 79.15 | 158.31 | 395.77 | 791.53 |
| 2.80 | 0.77 | 1.53 | 3.83 | 7.67 | 15.33 | 38.33 | 76.66 | 153.31 | 383.28 | 766.56 |
| 2.85 | 0.74 | 1.49 | 3.72 | 7.43 | 14.86 | 37.16 | 74.13 | 148.62 | 371.56 | 743.12 |
| 2.90 | 0.72 | 1.44 | 3.61 | 7.21 | 14.42 | 36.05 | 72.11 | 144.21 | 360.53 | 721.07 |
| 2.95 | 0.70 | 1.40 | 3.50 | 7.00 | 14.01 | 35.01 | 70.03 | 140.06 | 350.14 | 700.29 |
| 3.00 | 0.68 | 1.36 | 3.40 | 6.81 | 13.61 | 34.03 | 68.07 | 136.13 | 340.34 | 680.67 |
| 3.05 | 0.66 | 1.32 | 3.31 | 6.62 | 13.24 | 33.11 | 66.21 | 132.43 | 331.06 | 662.13 |
| 3.10 | 0.64 | 1.29 | 3.22 | 6.45 | 12.89 | 32.23 | 64.46 | 128.91 | 322.28 | 644.56 |
| 3.15 | 0.63 | 1.26 | 3.14 | 6.28 | 12.56 | 31.40 | 62.79 | 125.58 | 313.95 | 627.91 |
| 3.20 | 0.61 | 1.22 | 3.06 | 6.12 | 12.24 | 30.60 | 61.21 | 122.42 | 306.05 | 612.09 |
| 3.25 | 0.60 | 1.19 | 2.99 | 5.97 | 11.94 | 29.85 | 59.71 | 119.41 | 298.53 | 597.05 |
| 3.30 | 0.58 | 1.17 | 2.91 | 5.83 | 11.65 | 11.65 | 58.27 | 116.55 | 291.37 | 582.73 |

## External Resistor Divider Table

| R1(K Ohm) | 1 | 2 | 5 | 10 | 20 | 50 | 100 | 200 | 500 | 1000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Vout | R2(K Ohm)=(1.215*R1(K Ohm))/(VOUT-1.215) | | | | | | | | | |
| 3.35 | 0.57 | 1.14 | 2.85 | 5.69 | 11.38 | 28.45 | 56.91 | 113.82 | 284.54 | 569.09 |
| 3.40 | 0.56 | 1.11 | 2.78 | 5.56 | 11.12 | 27.80 | 55.61 | 111.21 | 278.03 | 556.06 |
| 3.45 | 0.54 | 1.09 | 2.72 | 5.44 | 10.87 | 27.18 | 54.36 | 108.72 | 271.81 | 543.62 |
| 3.50 | 0.53 | 1.06 | 2.66 | 5.32 | 10.63 | 26.59 | 53.17 | 106.35 | 265.86 | 531.73 |
| 3.55 | 0.52 | 1.04 | 2.60 | 5.20 | 10.41 | 26.02 | 52.03 | 104.07 | 260.17 | 520.34 |
| 3.60 | 0.51 | 1.02 | 2.55 | 5.09 | 10.19 | 25.47 | 50.94 | 101.89 | 254.72 | 509.43 |
| 3.65 | 0.50 | 1.00 | 2.49 | 4.99 | 9.98 | 24.95 | 49.90 | 99.79 | 249.49 | 498.97 |
| 3.70 | 0.49 | 0.98 | 2.44 | 4.89 | 9.78 | 24.45 | 48.89 | 97.79 | 244.47 | 488.93 |
| 3.75 | 0.48 | 0.96 | 2.40 | 4.79 | 9.59 | 23.96 | 47.93 | 95.86 | 239.64 | 479.29 |
| 3.80 | 0.47 | 0.94 | 2.35 | 4.70 | 9.40 | 23.50 | 47.00 | 94.00 | 235.01 | 470.02 |
| 3.85 | 0.46 | 0.92 | 2.31 | 4.61 | 9.22 | 23.06 | 46.11 | 92.22 | 230.55 | 461.10 |
| 3.90 | 0.45 | 0.91 | 2.26 | 4.53 | 90.5 | 22.63 | 45.25 | 90.50 | 226.26 | 452.51 |
| 3.95 | 0.44 | 0.89 | 2.22 | 4.44 | 8.88 | 22.21 | 44.42 | 88.85 | 222.12 | 444.24 |
| 4.00 | 0.44 | 0.87 | 2.18 | 4.36 | 8.73 | 21.81 | 43.63 | 87.25 | 218.13 | 436.27 |
| 4.05 | 0.43 | 0.86 | 2.14 | 4.29 | 8.57 | 21.43 | 42.86 | 85.71 | 214.29 | 428.57 |
| 4.10 | 0.42 | 0.84 | 2.11 | 4.21 | 8.42 | 21.06 | 42.11 | 84.23 | 210.57 | 421.14 |
| 4.15 | 0.41 | 0.83 | 2.07 | 4.14 | 8.28 | 20.70 | 41.40 | 82.79 | 206.98 | 413.97 |
| 4.20 | 0.41 | 0.81 | 2.04 | 4.07 | 8.14 | 20.35 | 40.70 | 81.41 | 203.52 | 407.04 |
| 4.25 | 0.40 | 0.80 | 2.00 | 4.00 | 8.01 | 20.02 | 40.03 | 80.07 | 200.16 | 400.33 |
| 4.30 | 0.39 | 0.79 | 1.97 | 3.94 | 7.88 | 19.69 | 39.38 | 78.77 | 196.92 | 393.84 |
| 4.35 | 0.39 | 0.78 | 1.97 | 3.88 | 7.75 | 19.38 | 38.76 | 77.51 | 193.78 | 387.56 |
| 4.40 | 0.38 | 0.76 | 1.91 | 3.81 | 7.63 | 19.07 | 38.15 | 76.30 | 190.74 | 381.48 |
| 4.45 | 0.38 | 0.75 | 1.88 | 3.76 | 7.51 | 18.78 | 37.56 | 75.12 | 187.79 | 375.58 |
| 4.50 | 0.37 | 0.74 | 1.85 | 3.70 | 7.40 | 18.49 | 36.99 | 73.97 | 184.93 | 369.86 |
| 4.55 | 0.36 | 0.73 | 1.82 | 3.64 | 7.29 | 18.22 | 36.43 | 72.86 | 182.16 | 364.32 |
| 4.60 | 0.36 | 0.72 | 1.79 | 3.59 | 7.18 | 17.95 | 35.89 | 71.79 | 179.47 | 358.94 |
| 4.65 | 0.35 | 0.71 | 1.77 | 3.54 | 7.07 | 17.69 | 35.37 | 70.74 | 176.86 | 353.71 |
| 4.70 | 0.35 | 0.70 | 1.74 | 3.49 | 6.97 | 17.43 | 34.86 | 69.73 | 174.32 | 348.64 |
| 4.75 | 0.34 | 0.69 | 1.72 | 3.44 | 6.87 | 17.19 | 34.37 | 68.74 | 171.85 | 343.71 |
| 4.80 | 0.34 | 0.68 | 1.69 | 3.39 | 6.78 | 16.95 | 33.89 | 67.78 | 169.46 | 338.91 |
| 4.85 | 0.33 | 0.67 | 1.67 | 3.34 | 6.69 | 16.71 | 33.43 | 66.85 | 167.13 | 334.25 |
| 4.90 | 0.33 | 0.66 | 1.65 | 3.30 | 6.59 | 16.49 | 32.97 | 65.94 | 164.86 | 329.72 |
| 4.95 | 0.33 | 0.65 | 1.63 | 3.25 | 6.51 | 16.27 | 32.53 | 65.06 | 162.65 | 325.30 |
| 5.00 | 0.32 | 0.64 | 1.61 | 3.21 | 6.42 | 16.05 | 32.10 | 64.02 | 160.50 | 321.00 |

Note: Small load (greater than 2mA) is necessary as R1 or R2 is large than 50Kohm. Otherwise, output voltage probably cannot be pulled down to 0V on disable mode