## General Description

The EMP6213 is a high accuracy, low noise, high speed, low dropout CMOS Linear regulator with high ripple rejection and fast discharge function. The device offers a new level of cost effective performance in cellular phones, surveillance system, Bluetooth, wireless and other portable electronic devices.
EMP6213 can provide product selections of output value in the range of 1.2V~3.6V by every 0.1V step.
The current limiter's fold-back circuit also operates as a short circuit protection and an output current limiter at the output pin.
The EMP6213 regulators are available in standard SOT23-5L and DFN1x1-4L packages. Standard products are Pb-free and Halogen-free.

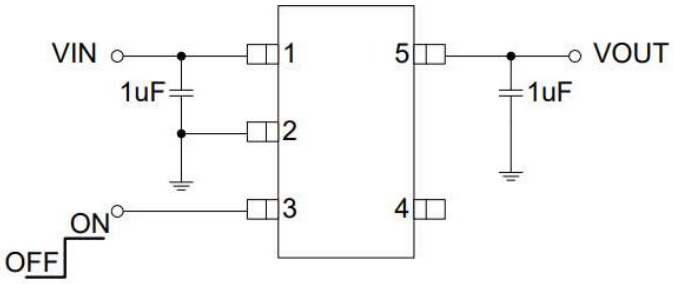
## Features

- ◆Input voltage: 2.5V~6.5V
- ◆Output range: 1.2V~3.6V (customized by every 0.1V step)
- ◆Maximum output current: 400mA @ $V_{IN}$- $V_{OUT}$=0.5V
- ◆PSRR: 75dB @1KHz
- ◆Dropout voltage: 220mV @ $I_{OUT}$=200mA
- ◆Quiescent current: 50μA Typ.
- ◆Shut-down current: < 1μA
- ◆Recommend capacitor: 4.7μF
- ◆Ultra-low output noise: 100μVRMS

## Applications

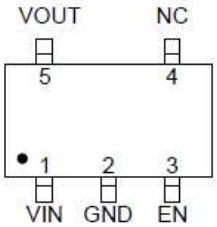
- ◆Digital cameras
- ◆Cellphones
- ◆Bluetooth and wireless handsets
- ◆Other portable electronic devices

## Typical Application Circuit



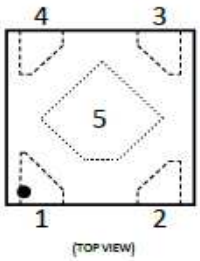

## Pin Assignment

SOT23-5L




(Top View)

DFN1x1-4L




1 VOUT
2 GND
3 EN
4 VIN
5 Thermal Pad: GND

## Order Information

EMP6213 □ □-□

Voltage version:
XX: 1.2V~3.6V by 0.1V step Example:
28: 2.8V

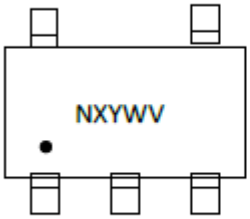
Package:
S5: SOT23-5L
D4: DFN1x1-4L

Vout discharge
A: Yes
B: No

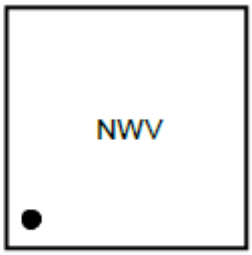
| PART NO | PACAKGE | VOUT DISCHARGE | TEMPERATURE | TAPE & REEL |
|---|---|---|---|---|
| EMP6213AS5-XX Note | SOT23-5L | Yes | -40 ~ +85℃ | 3000/REEL |
| EMP6213BS5-XX Note | SOT23-5L | No | -40 ~ +85℃ | 3000/REEL |
| EMP6213AD4-XXNote | DFN1x1-4L | Yes | -40 ~ +85℃ | 10000/REEL |
| EMP6213BD4-XXNote | DFN1x1-4L | No | -40 ~ +85℃ | 10000/REEL |

**Note:** XX indicates 1.2V~3.6V by 0.1V step. For example, 28 means product outputs 2.8V

## Marking Description




SOT23-5L




DFN1x1-4L

"N": Product code, here use "L" stand for "EMP6213""X": Internal Control Code
"Y": Internal Control Code
"W": The week of manufacturing. "A" stands for week 1, "Z" stands for week 26, "a" standsfor week 27, "z" stands for week 52.
"V": Output voltage code.

## Pin Description

| PIN NO SOT23-5L | PIN NO DFN1x1-4L | SYMBOL | I/O | DESCRIPTTION |
|---|---|---|---|---|
| 1 | 4 | VIN | Power | Input |
| 2 | 2 | GND | Ground | Ground |
| 3 | 3 | EN | I | Enable (active high, do not float) |
| 4 | / | NC | / | Not connected |
| 5 | 1 | VOUT | O | Output |

## Typical Output Voltage Code Table

| $V_{OUT}$ | CODE | $V_{OUT}$ | CODE |
|---|---|---|---|
| 1.2V | B | 1.5V | C |
| 1.8V | D | 2.5V | E |
| 2.6V | F | 2.7V | L |
| 2.8V | M | 2.9V | N |
| 3.0V | G | 3.3V | H |
| 3.6V | I | 2.2V | V |

## Absolute Maximum Ratings(Note)

| SYMBOL | ITEMS | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | | -0.3~8 | V |
| $I_{OUT}$ | Output Current | | 550 | mA |
| $P_{DMAX}$ | Power Dissipation | SOT23-5L | 0.40 | W |
| | | DFN1x1-4L | 0.55 | |
| $R_{\theta JA}$ | Thermal Resistance | SOT23-5L | 270 | ℃/W |
| | | DFN1x1_4L | 220 | |
| $T_J$ | Junction Temperature | | -40~125 | ℃ |
| $T_A$ | Ambient Temperature | | -40~85 | ℃ |
| $T_{STG}$ | Storage Temperature | | -55 to 150 | ℃ |
| $T_{SOLDER}$ | Package Lead Soldering Temperature | | 260℃ / 10s | ℃ |
| ESD | ESD Susceptibility<br>HBM(Human Body Mode)<br>MM (Machine Mode) | | <br>5<br>200 | <br>kV<br>V |

Note: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

## Recommanded Operating Range

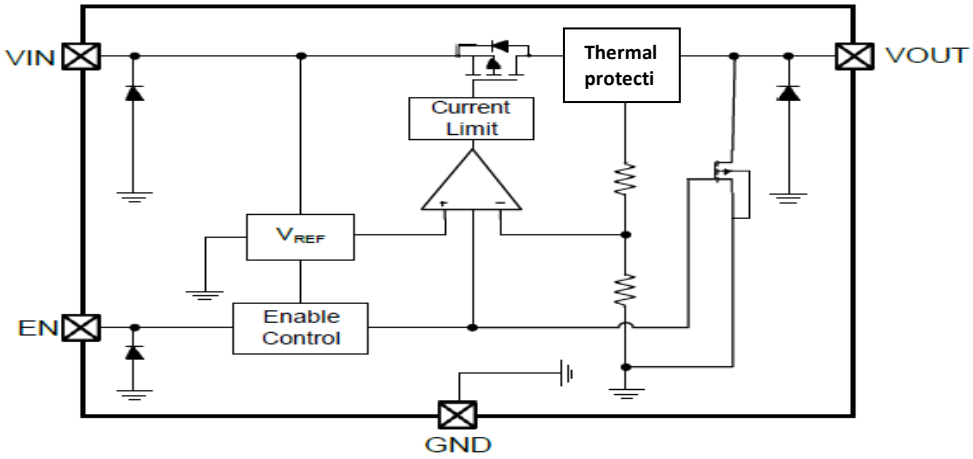
| SYMBOL | ITEMS | VALUE | UNIT |
|---|---|---|---|
| $V_{IN}$ | Supply Voltage | 2.5 to 6.5 | V |
| $I_{OUT}$ | Output Current | <300 | mA |
| $T_{OPT}$ | Operating Temperature | -40 to +85 | ℃ |
| $C_{IN}$ | Input Capacitor | 1μF ~10μF, 4.7μF or 10uF is recommended | μF |
| $C_{OUT}$ | Output Capacitor | | μF |

## Electrical Characteristics

The following specifications apply for $V_{IN}=V_{OUT}+1V$ $T_A=25\ ^{o}C$, unless specified otherwise.

| SYMBOL | ITEMS | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | | 2.5 | | 6.5 | V |
| $V_{OUT}$ | Output Range | $V_{OUT}$ <1.8V $V_{IN}$=2.7V, $I_{OUT}$=1mA | -3 | $V_{OUT}$ | 3 | % |
| | | $V_{OUT}$≥1.8V, $I_{OUT}$=1mA | -2 | $V_{OUT}$ | 2 | |
| $I_Q$ | Quiescent Current | $V_{IN}$=5.0V, $I_{OUT}$=0 | | 50 | | μA |
| $I_{LIMIT}$ | Current Limit | $V_{IN}=V_{OUT}$+1V | | 500 | | mA |
| $V_{DROP}$ | Dropout Voltage | $V_{OUT}$>=2.5V, $I_{OUT}$=200mA | | 220 | 250 | mV |
| | | $V_{OUT}$>=2.5V, $I_{OUT}$=300mA | | 320 | 350 | |
| $\triangle V_{LINE}$ | Line Regulation | $V_{IN}$=2.7~5.5V, $I_{OUT}$=1mA | | 0.01 | 0.15 | %/V |
| $\triangle V_{LOAD}$ | Load Regulation | $V_{OUT}$>1.8V, IOUT=1~300mA<br>$V_{OUT}$<=1.8V, IOUT=1~200mA | | 40 | 70 | mV |
| $I_{SHORT}$ | Output Short Current | $V_{EN}=V_{IN}$, $V_{OUT}$ Short to GND with 1Ω | | 100 | | mA |
| $I_{SHDN}$ | Shut-down Current | $V_{EN}$=0V | | | 1 | μA |
| PSRR | Power Supply Rejection Rate | $V_{IN}=5V_{DC}+0.5V_{P-P}$<br>F=1KHz, $I_{OUT}$=10mA | | 75 | | dB |
| | | $V_{IN}=5V_{DC}+0.5V_{P-P}$<br>F=1MHz, $I_{OUT}$=10mA | | 45 | | |
| $V_{ENH}$ | EN logic high voltage | $V_{IN}$=5.5V, $I_{OUT}$=1mA | 1.2 | | $V_{IN}$ | V |
| $V_{ENL}$ | EN logic low voltage | $V_{IN}$=5.5V, $V_{OUT}$=0V | | | 0.4 | V |
| $I_{EN}$ | EN Input Current | $V_{EN}$= 0 to 5.5V | | | 1.0 | μA |
| $e_{NO}$ | Output Noise Voltage | 10Hz to 100KHz, $C_{OUT}$=1μF | | 100 | | $\mu V_{RMS}$ |
| $R_{DIS}$ | Output Discharge Resistance | $V_{IN}$=5.0V, $V_{EN}$= 0V, (A version only) | | 160 | | Ω |
| TSD | Thermal Shutdown Temp | | | 150 | | ℃ |
| ΔTSD | Thermal Shutdown Temp Hysteresis | | | 22 | | ℃ |

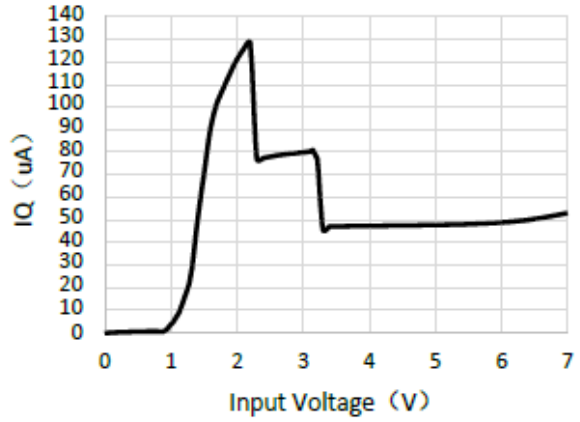
## Simplified Block Diagram



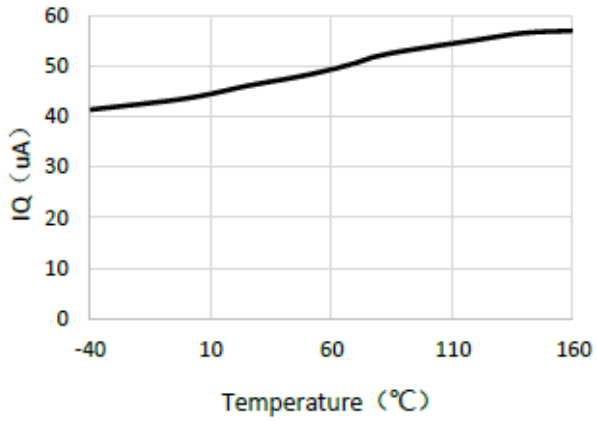
## Typical Performance Characteristics

$C_{IN}$=4.7uF, $C_{OUT}$=4.7uF, $V_{IN}$=4.3V, $V_{OUT}$=3.3V $T_A$=25 °C, Package is SOT23-5L, unless specified otherwise.

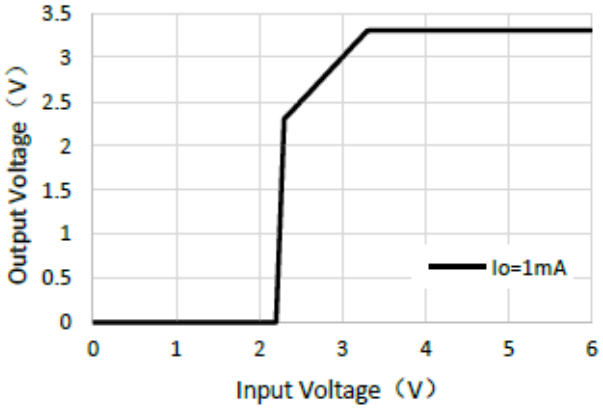
IQ vs. Input Voltage



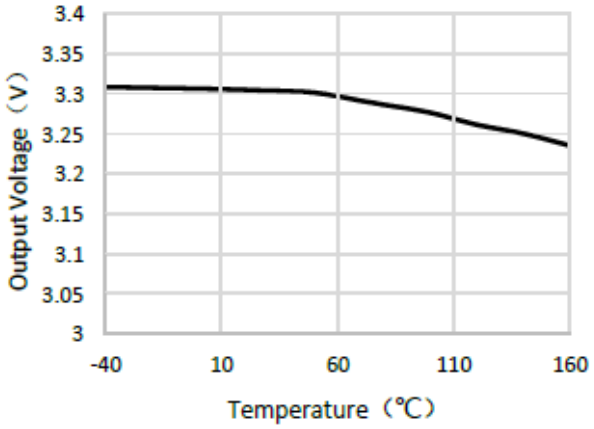

IQ vs. Temperature



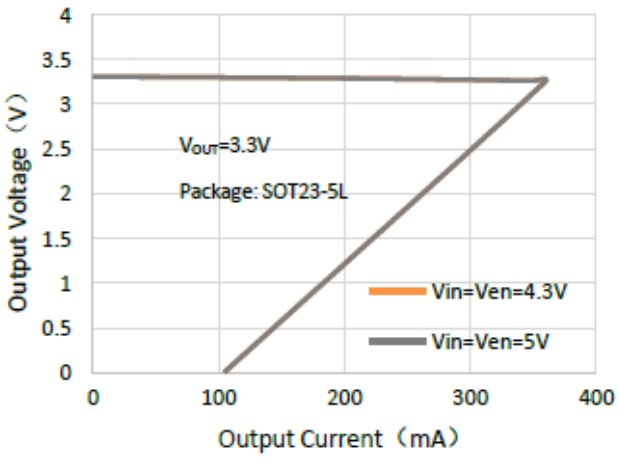

Output Voltage vs. Input Voltage



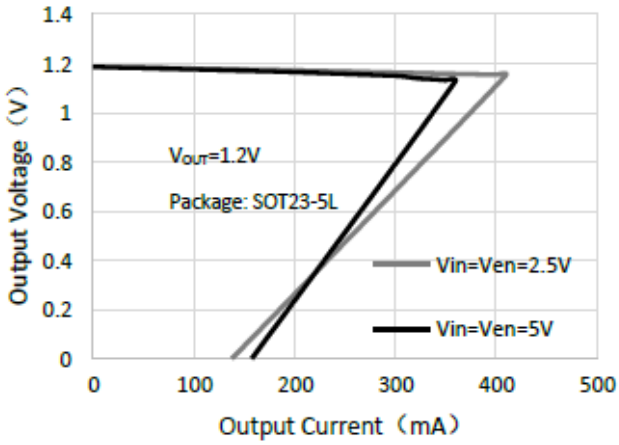

Output Voltage vs. Temperature



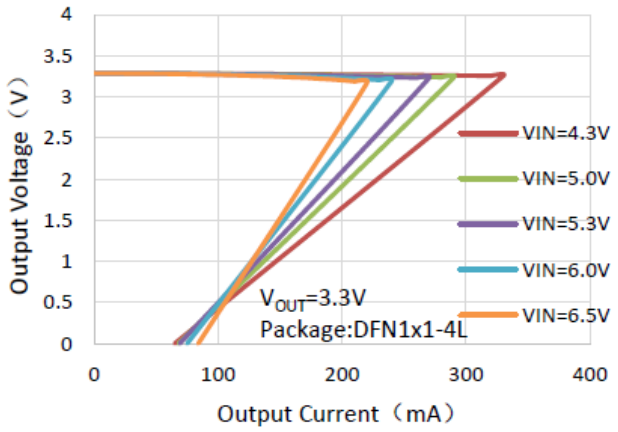

Output Voltage vs. Output Current



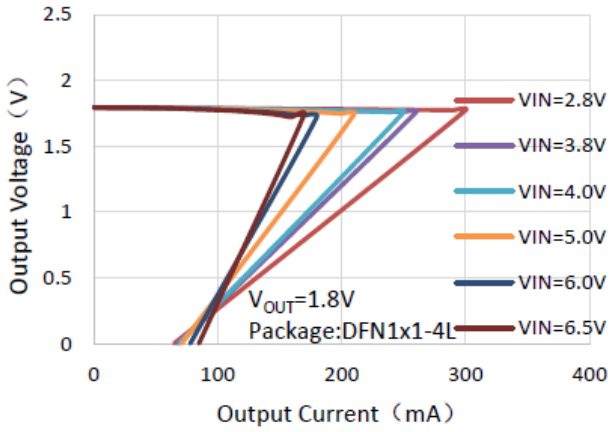

Output Voltage vs. Output Current



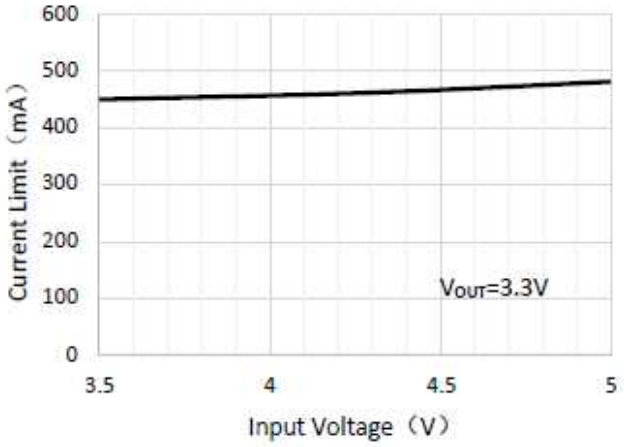
Output Voltage vs. Output Current



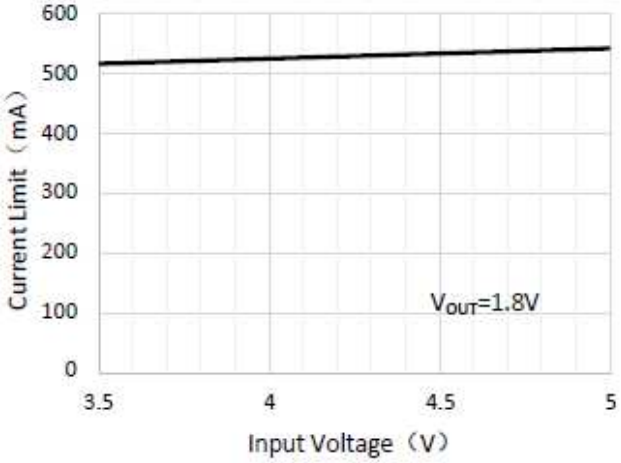

Output Voltage vs. Output Current



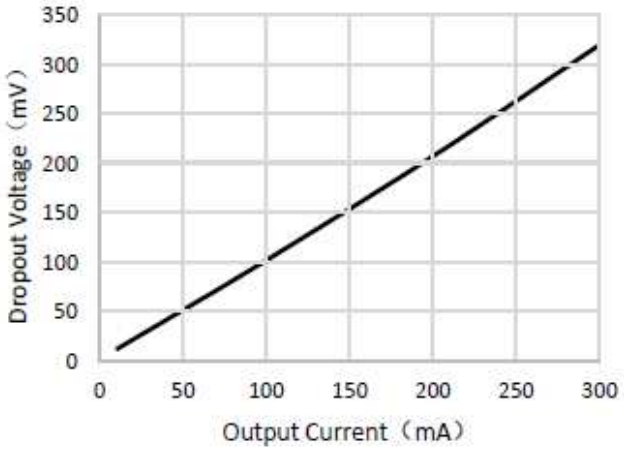

Current Limit vs. Input Voltage



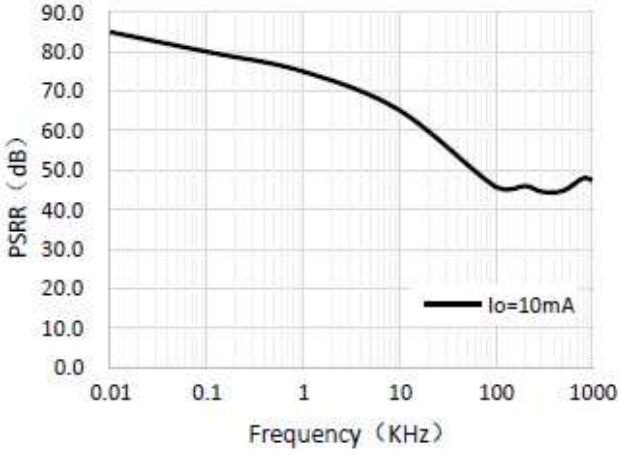

Current Limit vs. Input Voltage




Dropout Voltage vs. Output Current

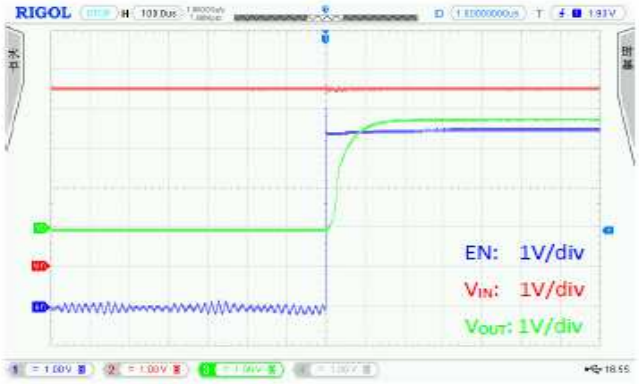



PSRR vs. Frequency



## EN ON / OFF

$V_{EN}$=0V to 4.5V $I_{OUT}$=10mA




$V_{EN}$=4.5V to 0V $I_{OUT}$=10mA


## Power ON / OFF

$V_{IN}$=0V to 4.5V $I_{OUT}$=10mA


$V_{IN}$=4.5V to 0V $I_{OUT}$=10mA


## Line Transient

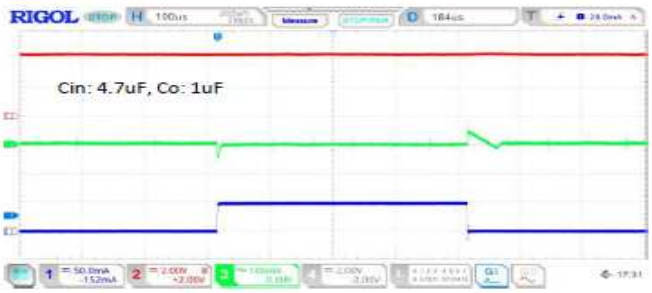
$V_{IN}$=4V to 5V $I_{OUT}$=10mA


$V_{IN}$=5V to 4V $I_{OUT}$=10mA

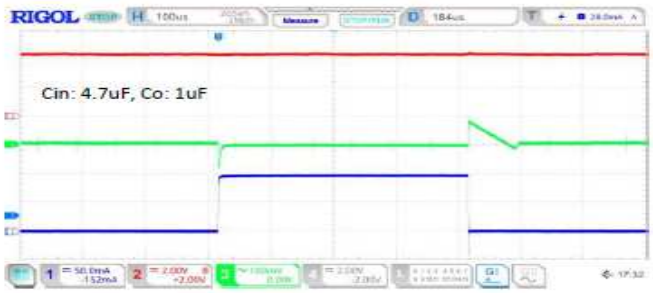

## Load Transient

CH1: Io CH2: Vin CH3: Vo

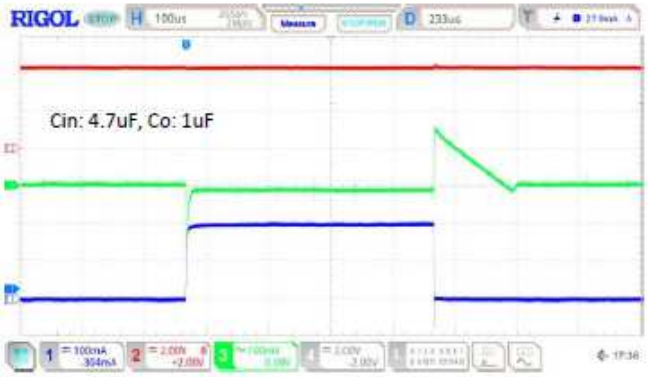
$V_{IN}$=4.3V, Vo=3.3V $I_{OUT}$=1mA to 50mA




$V_{IN}$=4.3V, Vo=3.3V $I_{OUT}$=1mA to 100mA

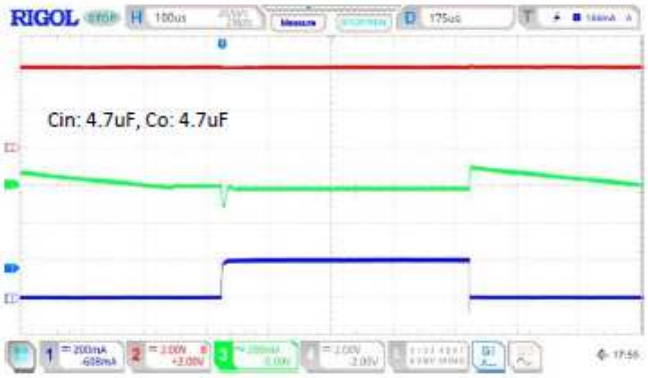


$V_{IN}$=4.3V, Vo=3.3V $I_{OUT}$=1mA to 200mA



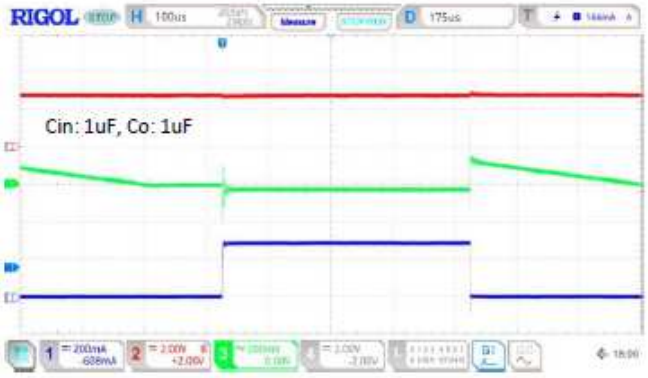

$V_{IN}$=4.3V, Vo=3.3V $I_{OUT}$=1mA to 300mA


$V_{IN}$=4.3V, Vo=3.3V $I_{OUT}$=1mA to 200mA

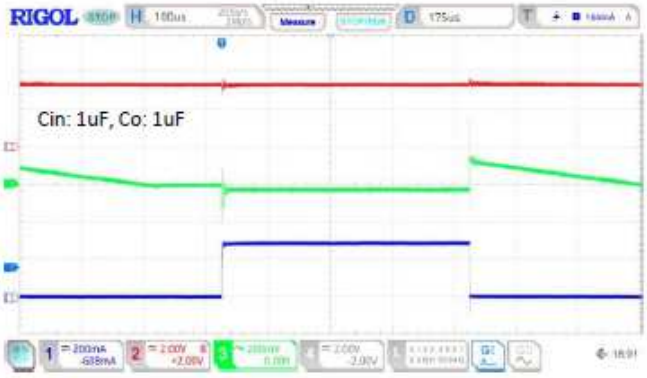



$V_{IN}$=4.3V, Vo=3.3V $I_{OUT}$=1mA to 300mA

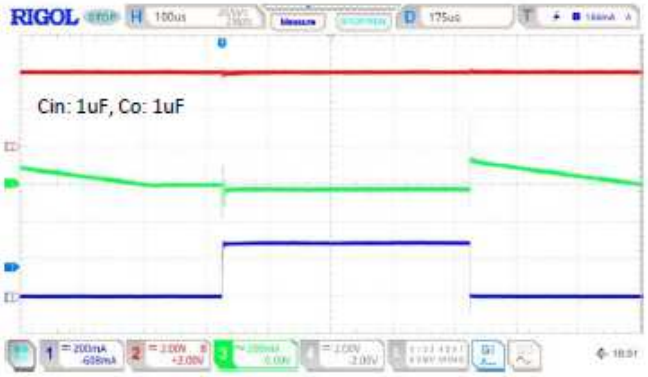

$V_{IN}$=2.8V, Vo=1.2V $I_{OUT}$=1mA to 300mA




$V_{IN}$=3.3V, Vo=1.2V $I_{OUT}$=1mA to 300mA




$V_{IN}$=4V, Vo=1.2V $I_{OUT}$=1mA to 300mA

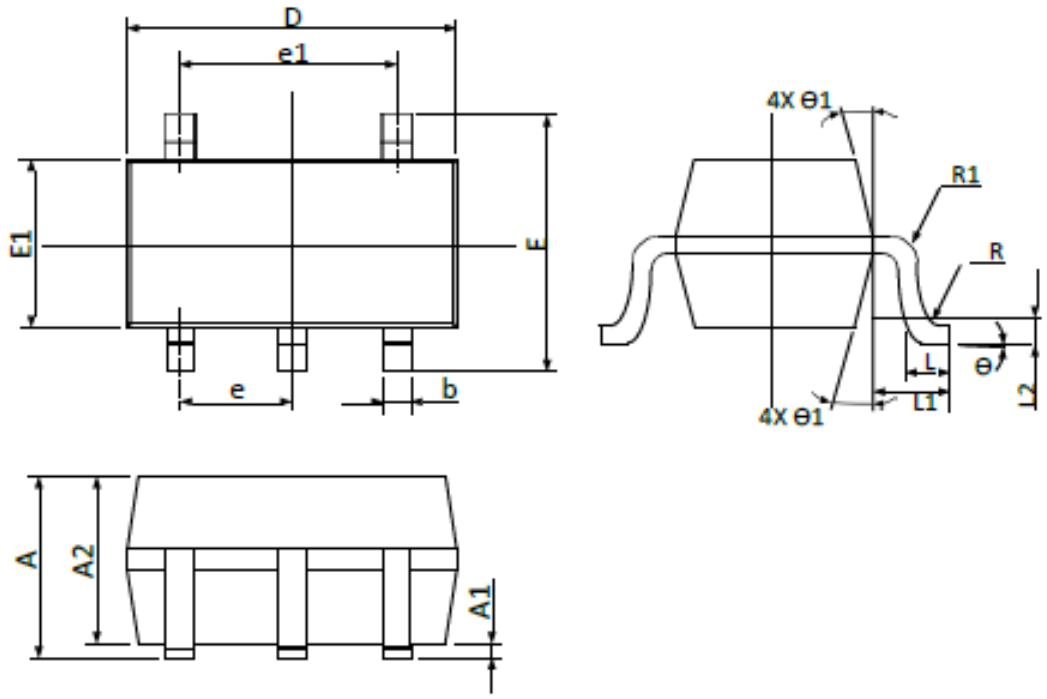



$V_{IN}$=5V, Vo=1.2V $I_{OUT}$=1mA to 300mA

## Package Outline

| Package | SOT23-5L | Devices per reel | 3000Pcs | Unit | mm |
|---|---|---|---|---|---|

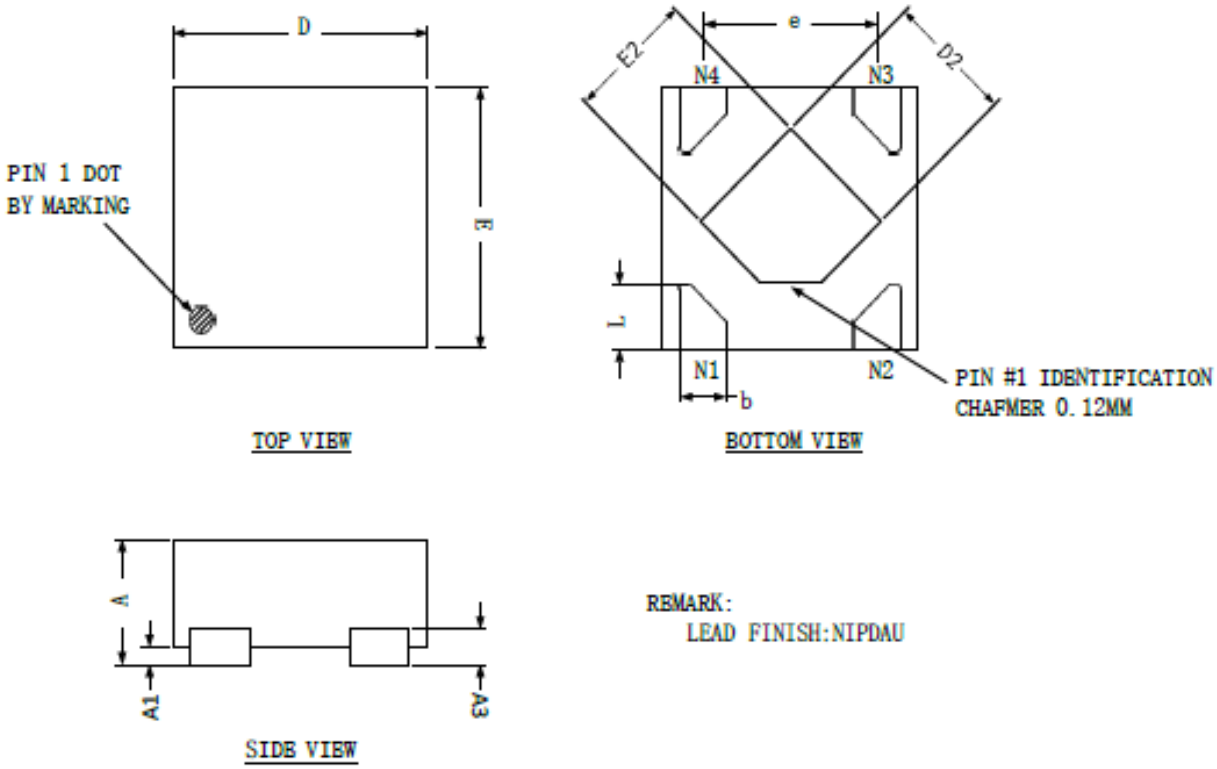
Package Dimension:




| DIMENSIONS IN MILLIMETERS | | | |
|---|---|---|---|
| SYMBOL | MINIMUM | NOMINAL | MAXIMUM |
| A | - | - | 1.35 |
| A1 | 0.00 | - | 0.15 |
| A2 | 1.00 | 1.10 | 1.20 |
| b | 0.30 | - | 0.50 |
| D | 2.82 | 2.92 | 3.02 |
| E | 2.60 | 2.80 | 3.00 |
| E1 | 1.50 | 1.60 | 1.70 |
| e | 0.90 | 0.95 | 1.00 |
| e1 | 1.80 | 1.90 | 2.00 |
| L | 0.30 | 0.45 | 0.60 |
| L1 | 0.60 REF | | |
| L2 | 0.25 REF | | |
| R | 0.10 | - | - |
| R1 | 0.10 | - | 0.25 |
| θ | 0° | 4° | 8° |
| θ1 | 5° | 10° | 15° |

| Package | DFN1x1-4L | Devices per reel | 10000Pcs | Unit | mm |
|---|---|---|---|---|---|

Package Dimension:




| DIMENSIONS IN MILLIMETERS | | | |
|---|---|---|---|
| Symbol | Min. | Nom. | Max. |
| A | 0.40 | - | 0.50 |
| A1 | 0.00 | - | 0.05 |
| A3 | 0.125REF. | | |
| D | 0.95 | 1.00 | 1.05 |
| E | 0.95 | 1.00 | 1.05 |
| b | 0.15 | 0.20 | 0.25 |
| L | 0.15 | 0.25 | 0.35 |
| D2 | 0.38 | 0.48 | 0.58 |
| E2 | 0.38 | 0.48 | 0.58 |
| e | 0.65 BSC | | |