# 300mA Dual Voltage Regulator IC
# Monolithic IC MM3348

June, 2008

## Outline

This IC is a 300mA-output low-saturation type Dual regulator developed as a combined power supply for cell-phones.
The output voltages of the regulator can be fixed to desired voltages in a 1.2 V to 5.0 V range.
The device is further provided with a switching terminal for each output, making it an IC especially suitable for cell-phones.

## Features

| | | |
|---|---|---|
| 1. | Maximum output current | 300mA max. |
| 2. | Ripple rejection | 70dB (1kHz, $I_{OUT}$=30mA) |
| 3. | Output voltage accuracy | Vo1, Vo2 : ±2% |
| 4. | No load input current | Vo1 : 45μA typ.<br>Vo2 : 45μA typ. |
| 5. | Input voltage | 6V max. |
| 6. | Output ON/OFF control function | High : ON Low : OFF |

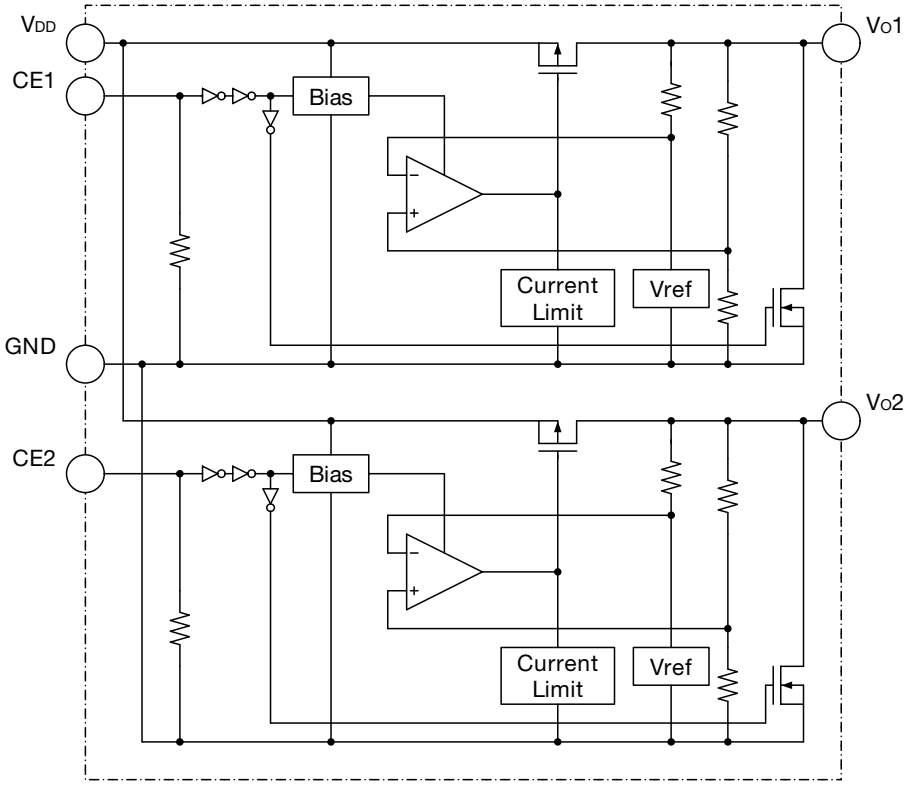
## Package

HSOP-8A

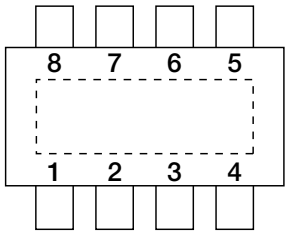
## Applications

1. Mobile phones
2. Portable players
3. Digital still cameras
4. Mobile game machines
5. PDAs

## Block Diagram




## Pin Assignment




HSOP-8A
(TOP VIEW)

| | |
|---|---|
| 1 | NC |
| 2 | CE1 |
| 3 | GND |
| 4 | VO1 |
| 5 | VO2 |
| 6 | GND |
| 7 | CE2 |
| 8 | VDD |

## Pin Description

| Pin No. | Pin name | Functions | Internal equivalent circuit |
|---|---|---|---|
| 1 | NC | No connection | |
| 2,7 | CE1, CE2 | ON/OFF-CONTROL 1, 2PIN<br>CE: Low → OUTPUT: OFF; CE: High → OUTPUT: ON<br>Connect CE pin with VDD pin, when it is not used. | Please refer to Block diagram. |
| 3,6 | GND | GND Pin | |
| 4,5 | $V_{O1}$,$V_{O2}$ | Output 1, 2 pin | |
| 8 | $V_{DD}$ | Voltage–supply pin | |

## Absolute Maximum Ratings (Except where noted otherwise Ta=25°C)

| Item | Symbol | Ratings | Units |
|---|---|---|---|
| Storage Temperature | $T_{STG}$ | −55~+150 | °C |
| Supply Voltage | $V_{DD}$ | 6.5 | V |
| CE1, 2 input Voltage | $V_{CE}$1, 2 | −0.3~$V_{DD}$+0.3 | V |
| Output Voltage 1, 2 | $V_{O}$1, 2 | −0.3~$V_{DD}$+0.3 | V |
| Output Current 1, 2 | $I_{O}$1, 2max. | 350 | mA |
| Power Dissipation | Pd | 1800(Note1) | mW |

Note1 : With the double sided PC Board of glass epoxy. (37×37×1.6$^{t}$mm copper plane 80%)

## Recommended Operating Conditions (Except where noted otherwise Ta=25°C)

| Item | Symbol | Ratings | Units |
|---|---|---|---|
| Operating Ambient temperature | $T_{JOP}$ | −40~85 | °C |
| Operating Voltage | $V_{OP}$ | 2~6 | V |
| Output Current 1, 2 | $I_{O}$1, 2 | 0~300 | mA |

## Electrical Characteristics 1 (Except where noted otherwise $V_{DD}$=$V_{O}$ (typ.)+1V, $V_{CE}$=$V_{DD}$, Ta=25°C)

| Item | Symbol | Measurement conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Input Current (OFF) | $I_{DD}$off1 | $V_{CE}$1=$V_{CE}$2=0V | | 0.1 | 2.0 | µA |
| Voltage Regulator 1 | | | | | | |
| No-load Input Current 1 | $I_{DD}$1 | $V_{CE}$1=$V_{DD}$, $V_{CE}$2=0V<br>$I_{O}$1=0mA | | 45 | 70 | µA |
| Output Voltage 1 | Vo1 | 1mA≦$I_{O}$1≦30mA | ×0.98 | | ×1.02 | V |
| Line Regulation 1 | $V_{LINE}$1 | $V_{DD}$=$V_{O}$1(typ.)+0.5-6V, $I_{O}$1=30mA<br>($V_{O}$1≦1.6V, $V_{DD}$=2.2-6V) | | 0.02 | 0.10 | %/V |
| Load Regulation 1 | $V_{LOAD}$1 | 1mA≦$I_{OUT}$≦300mA | | 50 | 120 | mV |
| Dropout Voltage 1 | Vio1 | Please refer to another page | | | | V |

| Item | Symbol | Measurement conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Ripple Rejection 1-1 (Note2) | RR1-1 | f=1kHz, Vripple=0.5V, $I_{O1}$=30mA ($V_{O1}$≦1.7V, $V_{DD}$=Vo1+1.2V) | | 70 | | dB |
| Ripple Rejection 1-2 (Note2) | RR1-2 | f=10kHz, Vripple=0.5V, $I_{O1}$=30mA ($V_{O1}$≦1.7V, $V_{DD}$=Vo1+1.2V) | | 60 | | dB |
| Vo1 Temperature Coefficient (Note2) | ⊿Vo1 /⊿T | Io1=30mA −40≦Top≦85°C | | ±100 | | ppm/°C |
| Output Noise Voltage 1 (Note2) | Vn1 | $f_{BW}$=10~100kHz | | 30 | | μVrms |
| Output Short-Circuit Current 1 (Note2) | Ilim1 | $V_{O1}$=0V | | 40 | | mA |
| CE1 Pull-down Resistance | $R_{pd}$1 | | 0.7 | 2 | 8 | MΩ |
| CE1 High Threshold Voltage | $V_{CE1H}$ | | 1.5 | | $V_{DD}$ | V |
| CE1 Low Threshold Voltage | $V_{CE1L}$ | | 0 | | 0.3 | V |
| Output NMOS ON Resistance 1 | $R_{DON}$1 | $V_{CE}$1=0V $V_{DD}$=4V($V_{O1}$<3V) | | 60 | | Ω |
| Voltage Regulator 2 | | | | | | |
| No-load Input Current 2 | $I_{DD}$2 | $V_{CE}$2=$V_{DD}$, $V_{CE}$1=0V Io1=0mA | | 45 | 70 | μA |
| Output Voltage 2 | $V_{O2}$ | 1mA≦Io2≦30mA | ×0.98 | | ×1.02 | V |
| Line Regulation 2 | $V_{LINE}$2 | $V_{DD}$=$V_{O2}$(typ.)+0.5~6V, Io2=30mA ($V_{O2}$≦1.6V, $V_{DD}$=2.2~6V) | | 0.02 | 0.10 | %/V |
| Load Regulation 2 | $V_{LOAD}$2 | 1mA≦$I_{OUT}$≦300mA | | 50 | 120 | mV |
| Dropout Voltage 2 | Vio2 | Please refer to another page | | | | V |
| Ripple Rejection 2-1 (Note2) | RR2-1 | f=1kHz, Vripple=0.5V, Io2=30mA ($V_{O2}$≦1.7V, $V_{DD}$=Vo2+1.2V) | | 70 | | dB |
| Ripple Rejection 2-2 (Note2) | RR2-2 | f=10kHz, Vripple=0.5V, Io2=30mA ($V_{O2}$≦1.7V, $V_{DD}$=Vo2+1.2V) | | 60 | | dB |
| Vo2 Temperature Coefficient (Note2) | ⊿Vo2 /⊿T | Io2=30mA −40≦Top≦85°C | | ±100 | | ppm/°C |
| Output Noise Voltage 2 (Note2) | Vn2 | $f_{BW}$=10~100kHz | | 30 | | μVrms |
| Output Short-Circuit Current 2 (Note2) | Ilim2 | $V_{O2}$=0V | | 40 | | mA |
| CE2 Pull-down Resistance | $R_{pd}$2 | | 0.7 | 2 | 8 | MΩ |
| CE2 High Threshold Voltage | $V_{CE2H}$ | | 1.5 | | $V_{DD}$ | V |
| CE2 Low Threshold Voltage | $V_{CE2L}$ | | 0 | | 0.3 | V |
| Output NMOS ON Resistance 2 | $R_{DON}$2 | $V_{CE}$1=0V $V_{DD}$=4V($V_{O2}$<3V) | | 60 | | Ω |

Note2 : The item is guaranteed by design.

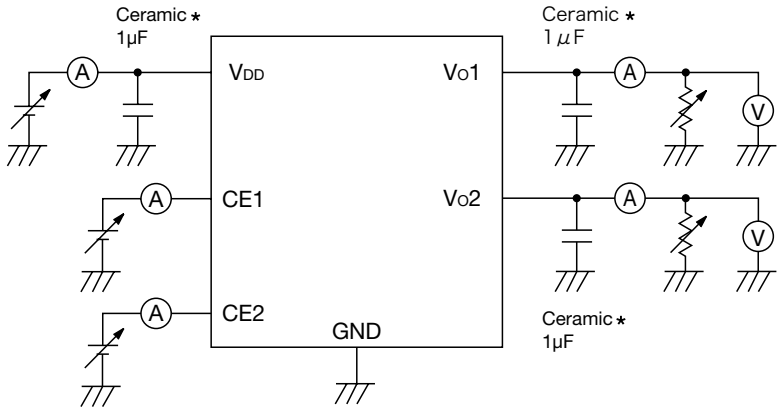
## Electrical Characteristics 2

(Except where noted otherwise $V_{DD}=V_O$ (typ.)+1V, $V_{CE}=V_{DD}$, Ta=25°C)

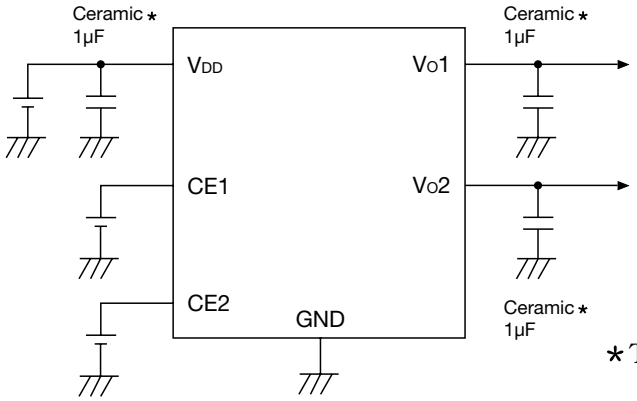
| Output Voltage Vo1, Vo2 | Item | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Output Voltage 1, 2 | | | | Dropout Voltage 1, 2 | | | |
| | Vo1, Vo2 (V) | | | | Vio1, Vio2 (V) | | | |
| | Measurement Conditions | Min. | Typ. | Max. | Measurement Conditions | Min. | Typ. | Max. |
| 1.2V | 1mA≦Io≦30mA | 1.170 | 1.200 | 1.230 | (Note3) | | | |
| 1.3V | | 1.270 | 1.300 | 1.330 | | | | |
| 1.4V | | 1.370 | 1.400 | 1.430 | | | | |
| 1.5V | | 1.470 | 1.500 | 1.530 | Io=150mA | | 0.38 | 0.70 |
| 1.6V | | 1.568 | 1.600 | 1.632 | | | 0.36 | 0.65 |
| 1.7V | | 1.666 | 1.700 | 1.734 | | | 0.34 | 0.60 |
| 1.8V | | 1.764 | 1.800 | 1.836 | 1.8V≦Vo≦2.0V Io=150mA | | 0.32 | 0.55 |
| 1.9V | | 1.862 | 1.900 | 1.938 | | | | |
| 2.0V | | 1.960 | 2.000 | 2.040 | | | | |
| 2.1V | | 2.058 | 2.100 | 2.142 | 2.1V≦Vo≦2.7V Io=150mA | | 0.28 | 0.50 |
| 2.2V | | 2.156 | 2.200 | 2.244 | | | | |
| 2.3V | | 2.254 | 2.300 | 2.346 | | | | |
| 2.4V | | 2.352 | 2.400 | 2.448 | | | | |
| 2.5V | | 2.450 | 2.500 | 2.550 | | | | |
| 2.6V | | 2.548 | 2.600 | 2.652 | | | | |
| 2.7V | | 2.646 | 2.700 | 2.754 | | | | |
| 2.8V | | 2.744 | 2.800 | 2.856 | 2.5V≦Vo≦5.0V Io=150mA | | 0.22 | 0.35 |
| 2.9V | | 2.842 | 2.900 | 2.958 | | | | |
| 3.0V | | 2.940 | 3.000 | 3.060 | | | | |
| 3.1V | | 3.038 | 3.100 | 3.162 | | | | |
| 3.2V | | 3.136 | 3.200 | 3.264 | | | | |
| 3.3V | | 3.234 | 3.300 | 3.366 | | | | |
| 3.4V | | 3.332 | 3.400 | 3.468 | | | | |
| 3.5V | | 3.430 | 3.500 | 3.570 | | | | |
| 3.6V | | 3.528 | 3.600 | 3.672 | | | | |
| 3.7V | | 3.626 | 3.700 | 3.774 | | | | |
| 3.8V | | 3.724 | 3.800 | 3.876 | | | | |
| 3.9V | | 3.822 | 3.900 | 3.978 | | | | |
| 4.0V | | 3.920 | 4.000 | 4.080 | | | | |
| 4.1V | | 4.018 | 4.100 | 4.182 | | | | |
| 4.2V | | 4.116 | 4.200 | 4.284 | | | | |
| 4.3V | | 4.214 | 4.300 | 4.386 | | | | |
| 4.4V | | 4.312 | 4.400 | 4.488 | | | | |
| 4.5V | | 4.410 | 4.500 | 4.590 | | | | |
| 4.6V | | 4.508 | 4.600 | 4.692 | | | | |
| 4.7V | | 4.606 | 4.700 | 4.794 | | | | |
| 4.8V | | 4.704 | 4.800 | 4.896 | | | | |
| 4.9V | | 4.802 | 4.900 | 4.998 | | | | |
| 5.0V | | 4.900 | 5.000 | 5.100 | | | | |

Note3 : The parameter is not guaranteed in the model less than $V_O$=1.4V.

## Measuring Circuit




## Application Circuit




* Temperature Characteristics : B

(reference example of external parts)

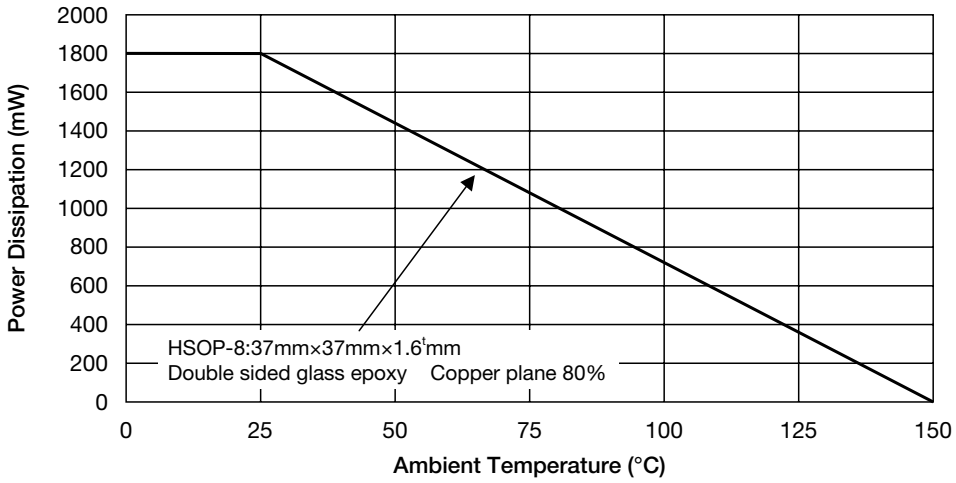
| | |
|---|---|
| · Output capacitor | Ceramic capacitor 1μF |
| · Input Capacitor | Ceramic capacitor 1μF |

· Note

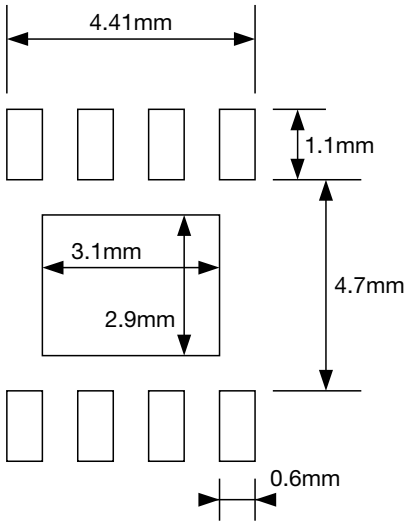
1. The output capacitor is required between output and GND to prevent oscillation.
2. The ESR of capacitor must be defined in ESR stability area.
   It is possible to use a ceramic capacitor without ESR resistance for output.
   The ceramic capacitor must be used more than 1.0μF and B temperature characteristics.
3. The wire of Vcc and GND is required to print full ground plane for noise and stability.
4. The input capacitor must be connected a distance of less than 1cm from input pin.
5. In case the output voltage is above the input voltage, the overcurrent flow by internal parastic diode from output to input.

## About Power Dissipation

This IC's GND pin and Heat Spreader Bottom effectively radiate heat. By increasing these copper foil pattern area of PCB, Power dissipation improves. Please kindly design PCB pattern taking care of above features about power dissipation.

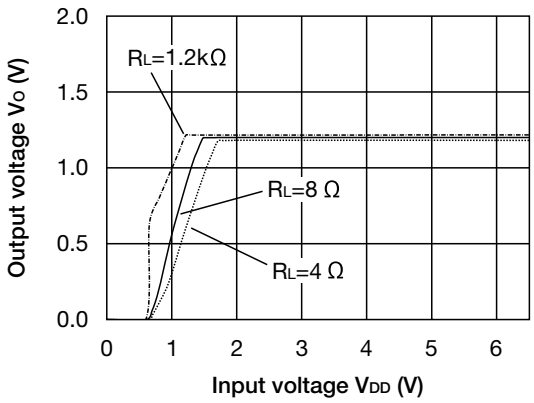



## Land Pattern Recommendation

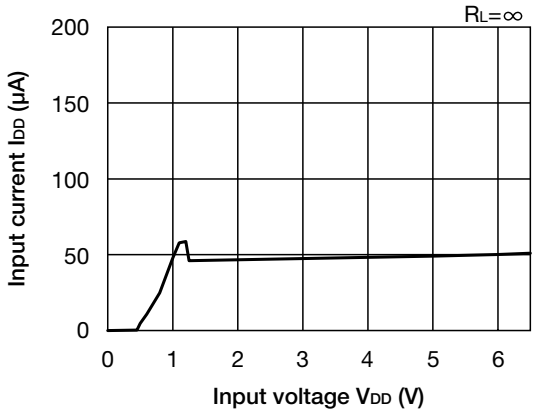


## Characteristics (Vo=1.2V) (Except where noted otherwise $V_{DD}$=$V_{OUT}$ (typ.) +1V, $V_{CE}$=$V_{DD}$, Ta=25°C)

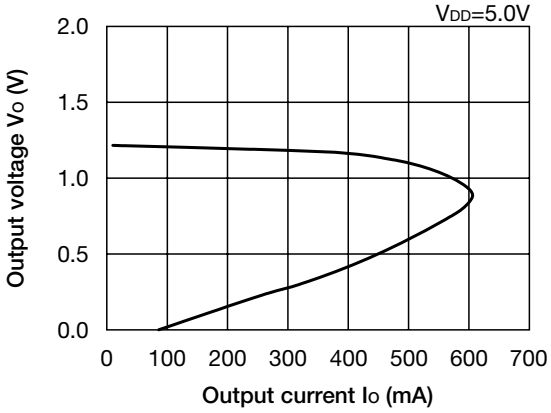
### Output voltage - Input voltage



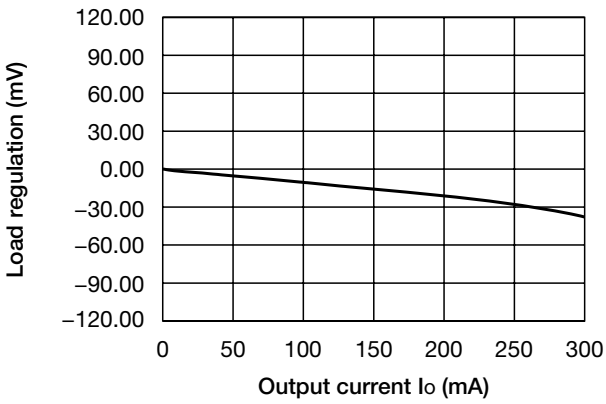

### Input current - Input voltage



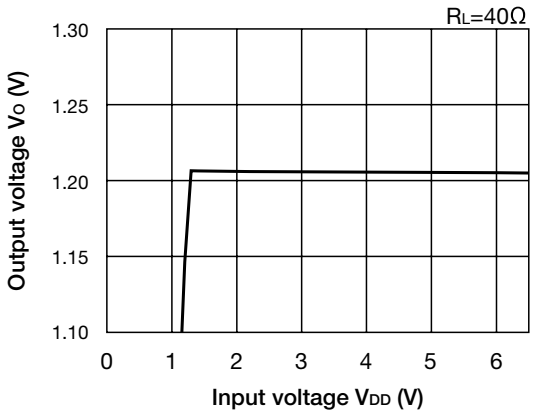

### Output voltage - Output current



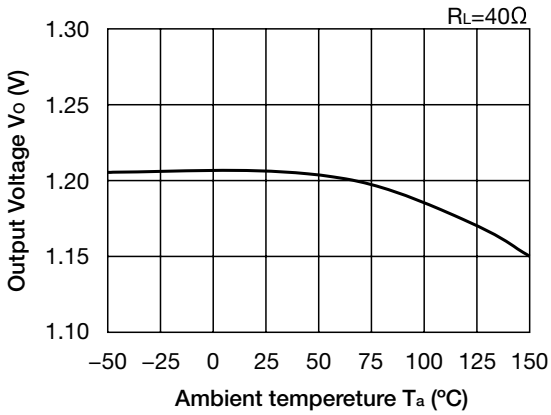

### Load regulation




### Line regulation

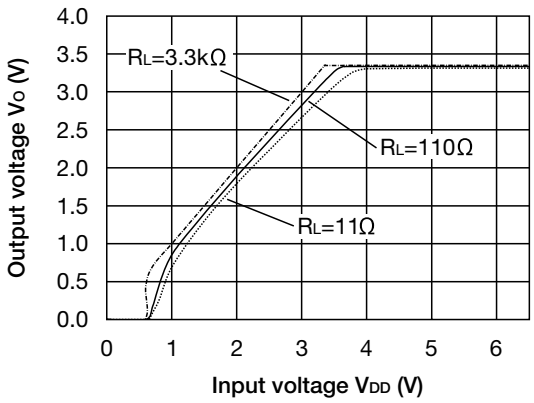



### Output voltage - Ambient temperature

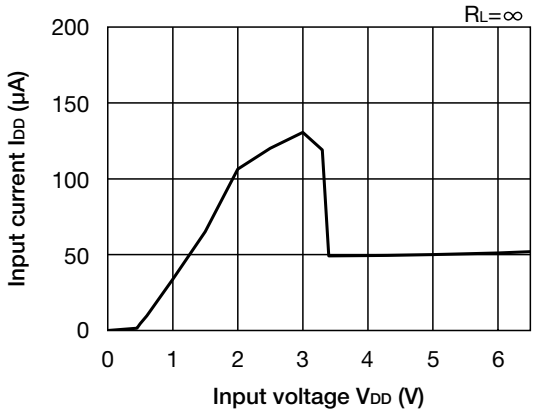


## Characteristics (Vo=3.3V) (Except where noted otherwise $V_{DD}$=$V_{OUT}$ (typ.) +1V, $V_{CE}$=$V_{DD}$, Ta=25°C)

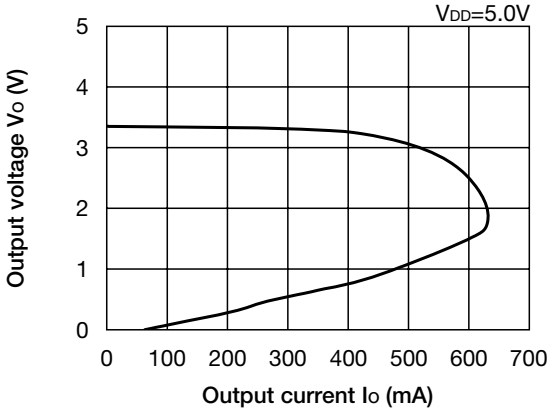
### Output voltage - Input voltage



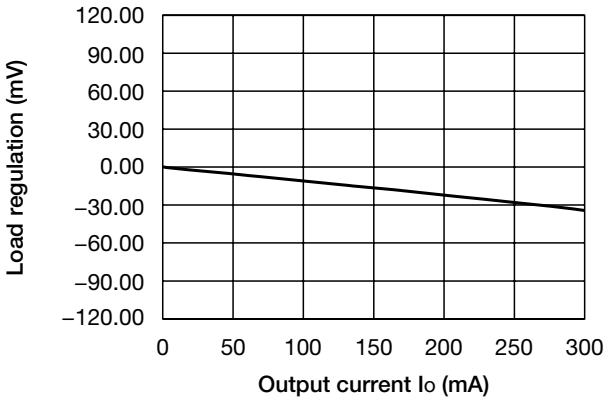

### Input current - Input voltage



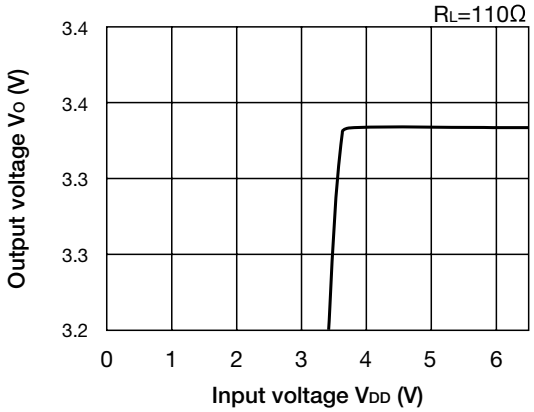

### Output voltage - Output current



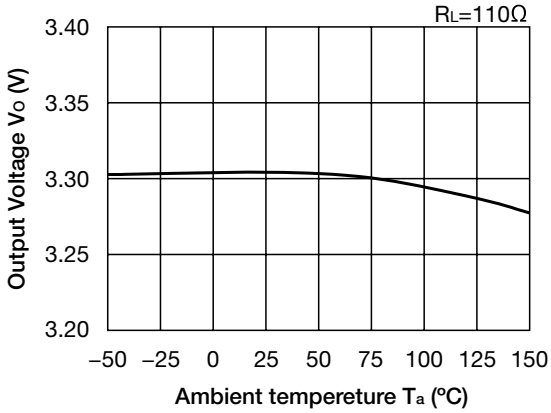

### Load regulation



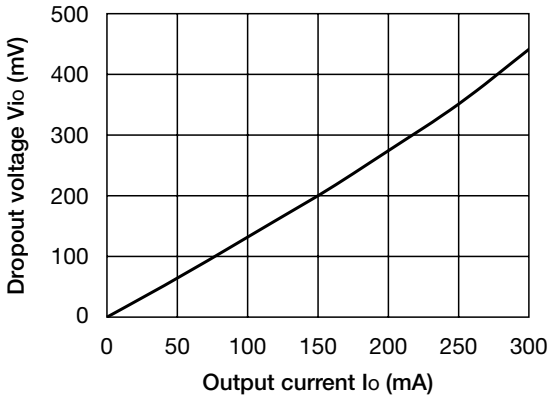

### Line regulation



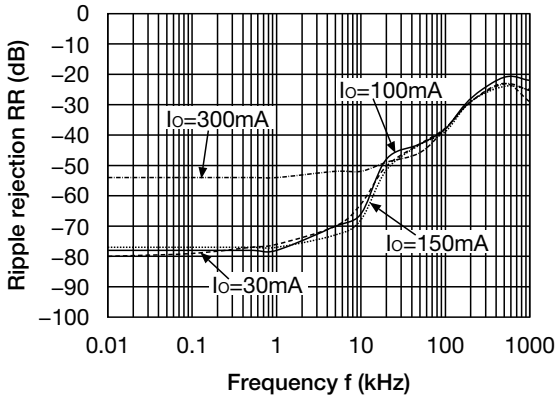

### Output voltage - Ambient temperature



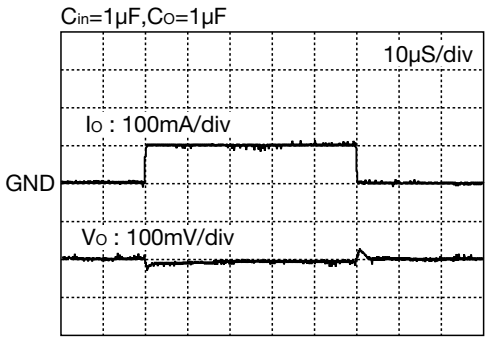
## Dropout voltage



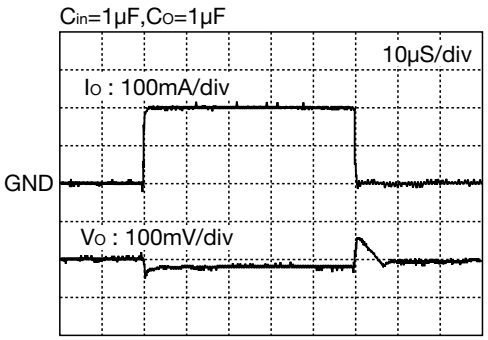

## Ripple Rejection



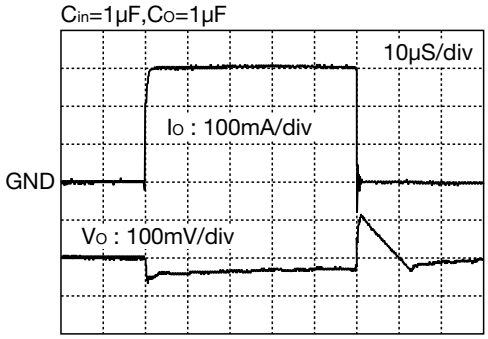

## Load transient response (Io=10→100mA)




## Load transient response (Io=10→200mA)




## Load transient response (Io=10→300mA)




## ESR stable area