

# 200mA Regulator IC Monolithic IC MM3404 Series

## Outline

This IC is a high speed response 200mA regulator IC with low quiescent current and high ripple rejection. No load input current is 20 $\mu$ A typ. And ripple rejection is 75dB typ. Dropout voltage is low at 80mV typ., and the output current is 200mA. Therefore the IC applies to most mobile equipment.

## Features

|                            |                                       |
|----------------------------|---------------------------------------|
| 1. Output current          | 200mA                                 |
| 2. No load input current   | 20 $\mu$ A typ.                       |
| 3. Input current(OFF)      | 0.1 $\mu$ A max.                      |
| 4. Output voltage range    | 0.8~5.0V                              |
| 5. Output voltage accuracy | $\pm 1\%$ ( $\pm 20$ mV, $V_o < 2$ V) |
| 6. Dropout voltage         | 80mV typ. ( $I_o = 100$ mA)           |
| 7. Line regulation         | 0.2%/V max.                           |
| 8. Load regulation         | 40mV max. ( $I_o = 0.1 \sim 100$ mA)  |
| 9. Ripple rejection        | 75dB typ. ( $f = 1$ kHz)              |
| 10. Output capacitor       | 1 $\mu$ F                             |

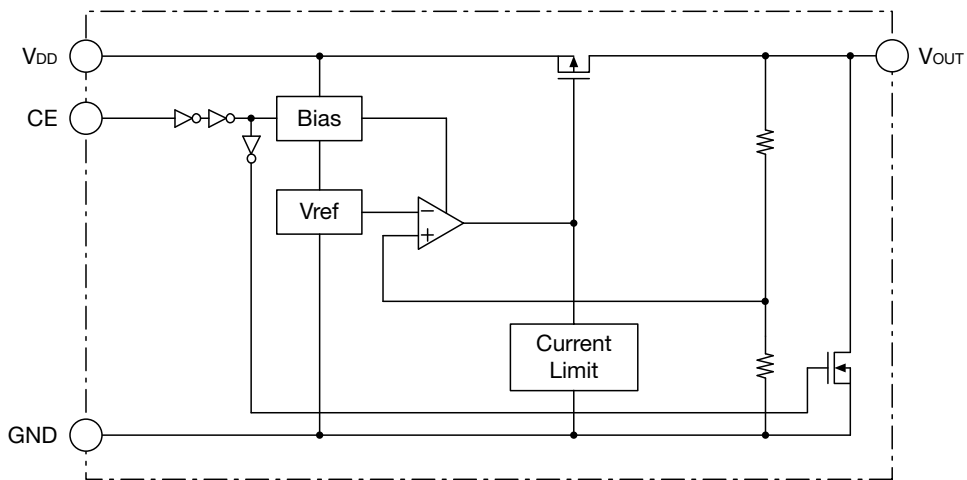
## Package

SOT-25A  
SC-82  
PLP-4B

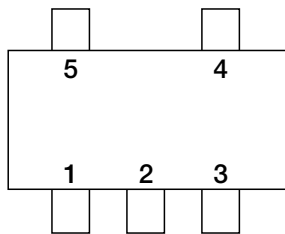
## Applications

1. Cellular phones
2. Digital still cameras
3. Mobile equipments

**Block Diagram**

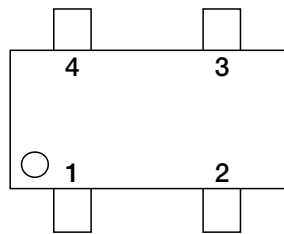


**Pin Assignment**



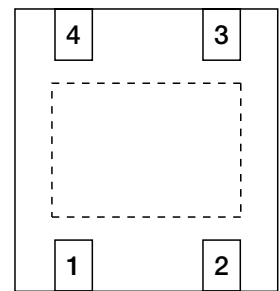
SOT-25A  
(TOP VIEW)

|   |                  |
|---|------------------|
| 1 | V <sub>DD</sub>  |
| 2 | GND              |
| 3 | CE               |
| 4 | NC               |
| 5 | V <sub>OUT</sub> |



SC-82  
(TOP VIEW)

|   |                  |
|---|------------------|
| 1 | CE               |
| 2 | GND              |
| 3 | V <sub>OUT</sub> |
| 4 | V <sub>DD</sub>  |



PLP-4B  
(TOP VIEW)

|   |                  |
|---|------------------|
| 1 | V <sub>OUT</sub> |
| 2 | GND              |
| 3 | CE               |
| 4 | V <sub>DD</sub>  |

**Pin Description**

**SOT-25A**

| Pin No.   | Pin name         | Functions          |
|---|------------------|--------------------|
| 1   | V <sub>DD</sub>  | Voltage-supply pin |
| 2   | GND              | Ground pin         |
| 3   | CE               | ON/OFF-Control pin |
|   |                  | CE      OUTPUT     |
|   |                  | Low      OFF       |
|   |                  | High      ON       |
| Connect CE pin with V <sub>DD</sub> pin, when it is not used. |                  |                    |
| 4   | NC               | No connection      |
| 5   | V <sub>OUT</sub> | Output pin         |

**SC-82**

| Pin No.   | Pin name         | Functions          |
|---|------------------|--------------------|
| 1   | CE               | ON/OFF-Control pin |
|   |                  | CE      OUTPUT     |
|   |                  | Low      OFF       |
|   |                  | High      ON       |
| Connect CE pin with V <sub>DD</sub> pin, when it is not used. |                  |                    |
| 2   | GND              | Ground pin         |
| 3   | V <sub>OUT</sub> | Output pin         |
| 4   | V <sub>DD</sub>  | Voltage-Supply pin |

**PLP-4B**

| Pin No.   | Pin name         | Functions          |
|---|------------------|--------------------|
| 1   | V <sub>OUT</sub> | Output pin         |
| 2   | GND              | Ground pin         |
| 3   | CE               | ON/OFF-Control pin |
|   |                  | CE      OUTPUT     |
|   |                  | Low      OFF       |
|   |                  | High      ON       |
| Connect CE pin with V <sub>DD</sub> pin, when it is not used. |                  |                    |
| 4   | V <sub>DD</sub>  | Voltage-supply pin |

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

| Item                | Symbol              | Ratings                   | Units |
|---------------------|---------------------|---------------------------|-------|
| Storage temperature | T <sub>STG</sub>    | -55~+150                  | °C    |
| Supply voltage      | V <sub>DD</sub>     | -0.3~7.0                  | V     |
| CE input voltage    | V <sub>CE</sub>     | -0.3~V <sub>DD</sub> +0.3 | V     |
| Output voltage      | V <sub>OUT</sub>    | -0.3~V <sub>DD</sub> +0.3 | V     |
| Output current      | I <sub>o max.</sub> | 400                       | mA    |
| Power dissipation   | Pd                  | 350(Note1) (SOT-25A)      | mW    |
|                     |                     | 330(Note2) (SC-82)        |       |
|                     |                     | 120(Note3) (PLP-4B)       |       |

Note1 : With PC Board of glass epoxy 60 × 40 × 1.6<sup>t</sup>mm

Note2 : With PC Board of glass epoxy 110 × 40 × 0.8<sup>t</sup>mm

Note3 : Single device

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

| Item                          | Symbol           | Ratings | Units |
|-------------------------------|------------------|---------|-------|
| Operating ambient temperature | T <sub>JOP</sub> | -40~85  | °C    |
| Operating voltage             | V <sub>OP</sub>  | 1.6~6.5 | V     |
| Output current                | I <sub>o</sub>   | 0~200   | mA    |

**Electrical Characteristics 1** (Except where noted otherwise  $V_{DD}=V_{OUT}(typ.)+1V$ ,  $V_{CE}=V_{DD}$ ,  $T_a=25^{\circ}C$ )

| Item   | Symbol                    | Measurement conditions   | Min.          | Typ.     | Max.          | Units            |
|--|---------------------------|--|---------------|----------|---------------|------------------|
| Input current(OFF)                           | $I_{DDoff}$               | $V_{CE}=0V$  |               | 0.01     | 0.1           | $\mu A$          |
| No-load input current                        | $I_{DD}$                  | $I_{OUT}=0mA$  |               | 20       | 50            | $\mu A$          |
| Output voltage                               | $V_{OUT}$                 | $I_{OUT}=10mA$<br>( $V_{OUT} \geq 2.0V$ )                                  | $\times 0.99$ |          | $\times 1.01$ | V                |
|  |                           | $I_{OUT}=10mA$<br>( $V_{OUT} \leq 1.95V$ )                                 | -0.02         |          | 0.02          | v                |
| Line regulation                              | $V_{LINE}$                | $V_O(yp.)+0.5V \leq V_{DD} \leq 6.5V$<br>$V_{OUT} \geq 1.1V, I_{OUT}=10mA$ |               | 0.01     | 0.2           | %V               |
|  |                           | $1.6V \leq V_{DD} \leq 6.5V$<br>$V_{OUT} \leq 1.05V, I_{OUT}=10mA$         |               |          |               |                  |
| Load regulation                              | $V_{LOAD}$                | $0.1mA \leq I_{OUT} \leq 100mA$  |               | 10       | 40            | mV               |
| Dropout voltage                              | $V_{io}$                  | Please refer to another page   |               |          |               | V                |
| Ripple rejection<br>(Note4)                  | RR                        | $f=1kHz, V_{ripple}=0.5V, I_{OUT}=30mA$<br>$V_{OUT} \geq 0.85V$            |               | 75       |               | dB               |
|  |                           | $f=1kHz, V_{ripple}=0.5V, I_{OUT}=30mA$<br>$V_{OUT}=0.8V$                  |               |          |               |                  |
| $V_{OUT}$ Temperature coefficient<br>(Note4) | $\Delta V_{OUT}/\Delta T$ | $I_{OUT}=30mA$<br>$-40^{\circ}C \leq T_{OP} \leq 85^{\circ}C$              |               | $\pm 50$ |               | ppm/ $^{\circ}C$ |
| Output current limit                         | $I_{lim}$                 |  | 200           | 250      |               | mA               |
| Output short-circuit current                 | $I_{short}$               | $V_{OUT}=0V$   |               | 30       |               | mA               |
| CE H threshold voltage                       | $V_{CEH}$                 |  | 1.2           |          | 6.0           | V                |
| CE L threshold voltage                       | $V_{CEL}$                 |  |               |          | 0.3           | V                |
| CE H threshold voltage                       | $I_{CEH}$                 |  | -0.1          |          | 0.1           | $\mu A$          |
| CE L threshold voltage                       | $I_{CEL}$                 |  | -0.1          |          | 0.1           | $\mu A$          |
| CL Discharge resistance                      | $R_{disc}$                |  |               | 780      |               | $\Omega$         |

Note4 : The item is guaranteed by design.

**Electrical Characteristics 2** (Except where noted otherwise  $V_{DD}=V_{OUT}(typ.)+1V$ ,  $V_{CE}=V_{DD}$ ,  $T_a=25^{\circ}C$ )

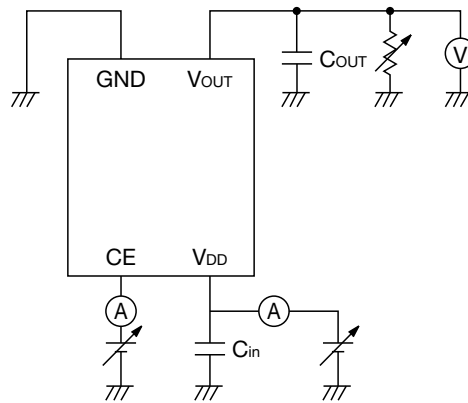
| Model No. | Item                   |       |       |       |   |  |      |      |
|-----------|------------------------|-------|-------|-------|---|--|------|------|
|           | Output voltage         |       |       |       | Dropout voltage                           |  |      |      |
|           | $V_{OUT}$ (V)          |       |       |       | $V_{io}$ (mV)                             |  |      |      |
|           | Measurement conditions | Min.  | Typ.  | Max.  | Measurement conditions                    | Min.   | Typ. | Max. |
| MM3404A08 | $I_{OUT}=10mA$         | 0.780 | 0.800 | 0.820 | $I_{OUT}=100mA$<br>$V_{OUT}<1.5V$ (Note5) |  | 500  | 850  |
| MM3404Z08 |                        | 0.830 | 0.850 | 0.870 |   |  |      |      |
| MM3404A09 |                        | 0.880 | 0.900 | 0.920 |   |  | 410  | 750  |
| MM3404Z09 |                        | 0.930 | 0.950 | 0.970 |   |  |      |      |
| MM3404A10 |                        | 0.980 | 1.000 | 1.020 |   |  |      |      |
| MM3404Z10 |                        | 1.030 | 1.050 | 1.070 |   |  | 330  | 650  |
| MM3404A11 |                        | 1.080 | 1.100 | 1.120 |   |  |      |      |
| MM3404Z11 |                        | 1.130 | 1.150 | 1.170 |   |  |      |      |
| MM3404A12 |                        | 1.180 | 1.200 | 1.220 |   |  |      |      |
| MM3404Z12 |                        | 1.230 | 1.250 | 1.270 |   |  | 230  | 380  |
| MM3404A13 |                        | 1.280 | 1.300 | 1.320 |   |  |      |      |
| MM3404Z13 |                        | 1.330 | 1.350 | 1.370 |   |  |      |      |
| MM3404A14 |                        | 1.380 | 1.400 | 1.420 |   |  |      |      |
| MM3404Z14 |                        | 1.430 | 1.450 | 1.470 |   |  | 200  | 360  |
| MM3404A15 |                        | 1.480 | 1.500 | 1.520 |   | $I_{OUT}=100mA$<br>$V_{OUT}\geq 1.5V$<br>$V_{DD}=V_{OUT}(typ.)-0.2V$ |      | 180  |
| MM3404Z15 |                        | 1.530 | 1.550 | 1.570 |   |  |      |      |
| MM3404A16 |                        | 1.580 | 1.600 | 1.620 |   |  |      |      |
| MM3404Z16 |                        | 1.630 | 1.650 | 1.670 |   |  | 160  | 250  |
| MM3404A17 |                        | 1.680 | 1.700 | 1.720 |   |  |      |      |
| MM3404Z17 |                        | 1.730 | 1.750 | 1.770 |   |  |      |      |
| MM3404A18 |                        | 1.780 | 1.800 | 1.820 |   |  |      |      |
| MM3404Z18 |                        | 1.830 | 1.850 | 1.870 |   |  | 125  | 210  |
| MM3404A19 |                        | 1.880 | 1.900 | 1.920 |   |  |      |      |
| MM3404Z19 |                        | 1.930 | 1.950 | 1.970 |   |  |      |      |
| MM3404A20 |                        | 1.980 | 2.000 | 2.020 |   |  |      |      |
| MM3404Z20 |                        | 2.030 | 2.050 | 2.071 |   |  |      |      |
| MM3404A21 |                        | 2.079 | 2.100 | 2.121 |   |  |      |      |
| MM3404Z21 |                        | 2.129 | 2.150 | 2.172 |   |  |      |      |
| MM3404A22 |                        | 2.178 | 2.200 | 2.222 |   |  | 115  | 195  |
| MM3404Z22 |                        | 2.228 | 2.250 | 2.273 |   |  |      |      |
| MM3404A23 |                        | 2.277 | 2.300 | 2.323 |   |  |      |      |
| MM3404Z23 |                        | 2.327 | 2.350 | 2.374 |   |  |      |      |
| MM3404A24 | 2.376                  | 2.400 | 2.424 |       |   |  |      |      |
| MM3404Z24 | 2.426                  | 2.450 | 2.475 |       |   |  |      |      |
| MM3404A25 | 2.475                  | 2.500 | 2.525 |       |   |  |      |      |
| MM3404Z25 | 2.525                  | 2.550 | 2.576 |       |   |  |      |      |
| MM3404A26 | 2.574                  | 2.600 | 2.626 |       |   |  |      |      |
| MM3404Z26 | 2.624                  | 2.650 | 2.677 |       |   |  |      |      |
| MM3404A27 | 2.673                  | 2.700 | 2.727 |       |   |  |      |      |
| MM3404Z27 | 2.723                  | 2.750 | 2.778 |       | 95  | 170  |      |      |
| MM3404A28 | 2.772                  | 2.800 | 2.828 |       |   |  |      |      |
| MM3404Z28 | 2.822                  | 2.850 | 2.879 |       |   |  |      |      |
| MM3404A29 | 2.871                  | 2.900 | 2.929 |       |   |  |      |      |
| MM3404Z29 | 2.921                  | 2.950 | 2.980 |       |   |  |      |      |

Note5 : Dropout voltage max. value in the input and it is confirmed that there is no output abnormal voltage impression the load 100mA in the model less than  $V_{OUT}=1.45V$ .

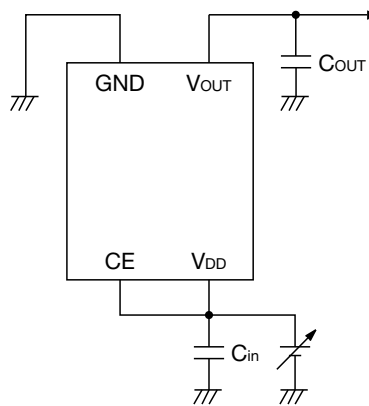
| Model No. | Item                   |       |       |       |  |      |      |      |
|-----------|------------------------|-------|-------|-------|--|------|------|------|
|           | Output voltage         |       |       |       | Dropout voltage  |      |      |      |
|           | V <sub>OUT</sub> (V)   |       |       |       | V <sub>IO</sub> (mV)   |      |      |      |
|           | Measurement conditions | Min.  | Typ.  | Max.  | Measurement conditions   | Min. | Typ. | Max. |
| MM3404A30 | I <sub>OUT</sub> =10mA | 2.970 | 3.000 | 3.030 | I <sub>OUT</sub> =100mA<br>V <sub>OUT</sub> ≥1.5V<br>V <sub>DD</sub> =V <sub>OUT</sub> (typ.)-0.2V |      | 80   | 140  |
| MM3404Z30 |                        | 3.020 | 3.050 | 3.081 |  |      |      |      |
| MM3404A31 |                        | 3.069 | 3.100 | 3.131 |  |      |      |      |
| MM3404Z31 |                        | 3.119 | 3.150 | 3.182 |  |      |      |      |
| MM3404A32 |                        | 3.168 | 3.200 | 3.232 |  |      |      |      |
| MM3404Z32 |                        | 3.218 | 3.250 | 3.283 |  |      |      |      |
| MM3404A33 |                        | 3.267 | 3.300 | 3.333 |  |      |      |      |
| MM3404Z33 |                        | 3.317 | 3.350 | 3.384 |  |      |      |      |
| MM3404A34 |                        | 3.366 | 3.400 | 3.434 |  |      |      |      |
| MM3404Z34 |                        | 3.416 | 3.450 | 3.485 |  |      |      |      |
| MM3404A35 |                        | 3.465 | 3.500 | 3.535 |  |      |      |      |
| MM3404Z35 |                        | 3.515 | 3.550 | 3.586 |  |      |      |      |
| MM3404A36 |                        | 3.564 | 3.600 | 3.636 |  |      |      |      |
| MM3404Z36 |                        | 3.614 | 3.650 | 3.687 |  |      |      |      |
| MM3404A37 |                        | 3.663 | 3.700 | 3.737 |  |      |      |      |
| MM3404Z37 |                        | 3.713 | 3.750 | 3.788 |  |      |      |      |
| MM3404A38 |                        | 3.762 | 3.800 | 3.838 |  |      |      |      |
| MM3404Z38 |                        | 3.812 | 3.850 | 3.889 |  |      |      |      |
| MM3404A39 |                        | 3.861 | 3.900 | 3.939 |  |      |      |      |
| MM3404Z39 |                        | 3.911 | 3.950 | 3.990 |  |      |      |      |
| MM3404A40 |                        | 3.960 | 4.000 | 4.040 |  |      |      |      |
| MM3404Z40 |                        | 4.010 | 4.050 | 4.091 |  |      |      |      |
| MM3404A41 |                        | 4.059 | 4.100 | 4.141 |  |      |      |      |
| MM3404Z41 |                        | 4.109 | 4.150 | 4.192 |  |      |      |      |
| MM3404A42 |                        | 4.158 | 4.200 | 4.242 |  |      |      |      |
| MM3404Z42 |                        | 4.208 | 4.250 | 4.293 |  |      |      |      |
| MM3404A43 |                        | 4.257 | 4.300 | 4.343 |  |      |      |      |
| MM3404Z43 |                        | 4.307 | 4.350 | 4.394 |  |      |      |      |
| MM3404A44 |                        | 4.356 | 4.400 | 4.444 |  |      |      |      |
| MM3404Z44 |                        | 4.405 | 4.450 | 4.495 |  |      |      |      |
| MM3404A45 |                        | 4.455 | 4.500 | 4.545 |  |      |      |      |
| MM3404Z45 |                        | 4.504 | 4.550 | 4.595 |  |      |      |      |
| MM3404A46 | 4.554                  | 4.600 | 4.646 |       |  |      |      |      |
| MM3404Z46 | 4.603                  | 4.650 | 4.696 |       |  |      |      |      |
| MM3404A47 | 4.653                  | 4.700 | 4.747 |       |  |      |      |      |
| MM3404Z47 | 4.702                  | 4.750 | 4.797 |       |  |      |      |      |
| MM3404A48 | 4.752                  | 4.800 | 4.848 |       |  |      |      |      |
| MM3404Z48 | 4.801                  | 4.850 | 4.898 |       |  |      |      |      |
| MM3404A49 | 4.851                  | 4.900 | 4.949 |       |  |      |      |      |
| MM3404Z49 | 4.900                  | 4.950 | 4.999 |       |  |      |      |      |
| MM3404A50 | 4.950                  | 5.000 | 5.050 |       |  |      |      |      |

Note5 : Dropout voltage Max. value in the input and it is confirmed that there is no output abnormal voltage impression the load 100mA in the model less than V<sub>OUT</sub>=1.45V.

Measuring Circuit



Application Circuit



(reference example of external parts)

- Output capacitor                      Ceramic capacitor 1.0 $\mu$ F
- Input capacitor                        Ceramic capacitor 1.0 $\mu$ F

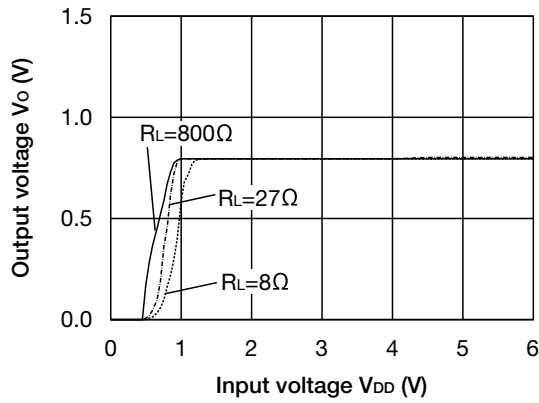
★ Temperature Characteristics : B

· Note

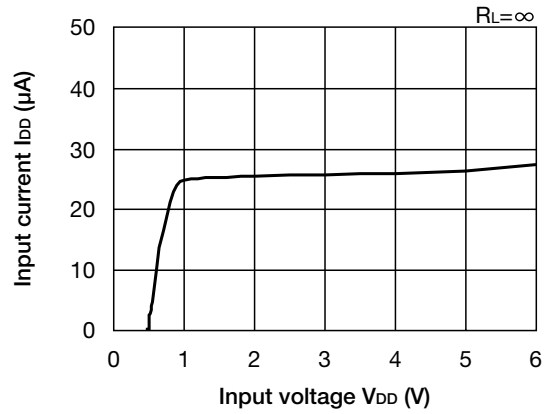
1. The output capacitor is required between output and GND to prevent oscillation.
2. The ESR of capacitor must be defined in ESR stability area.  
It is possible to use a ceramic capacitor without ESR resistance for output.  
The ceramic capacitor must be used more than 1.0 $\mu$ F and B temperature 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.

**Characteristics (Vo=0.8V)** (Except where noted otherwise  $V_{DD}=V_{OUT}(\text{typ.}) + 1V$ ,  $V_{CE}=V_{DD}$ ,  $T_a=25^\circ\text{C}$ )

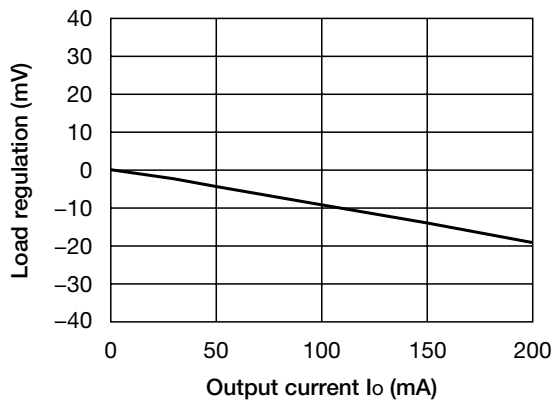
**Output - Input voltage**



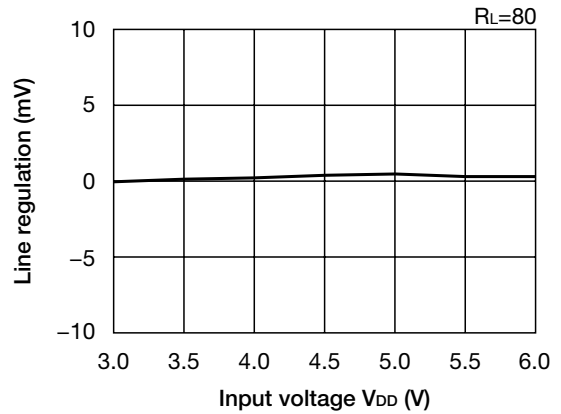
**Input current - Input voltage**



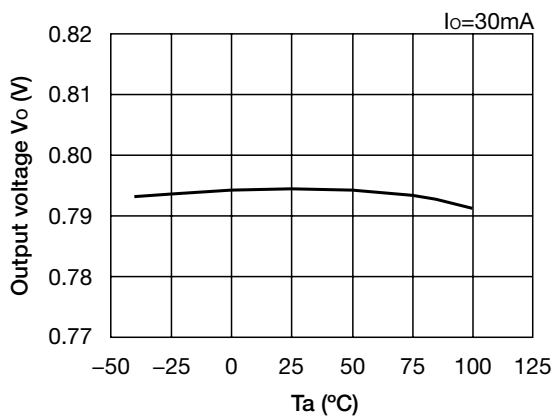
**Load regulation**



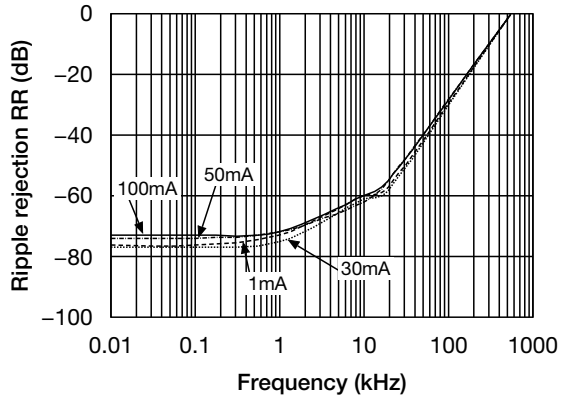
**Line regulation**



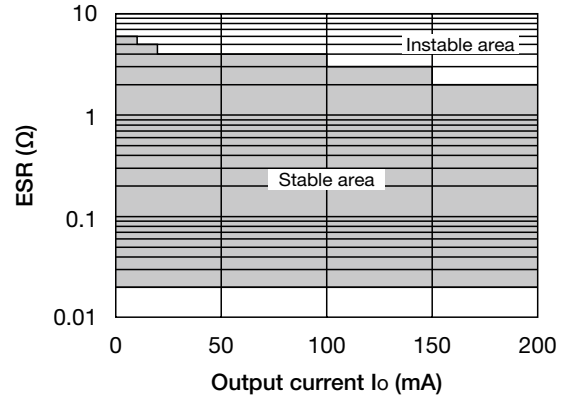
**$V_{OUT}$  temperature coefficient**



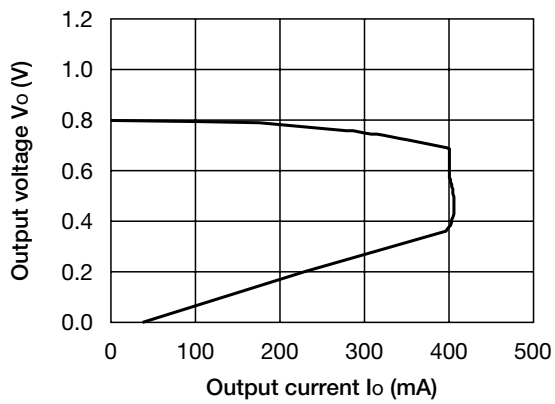
**Ripple Rejection**



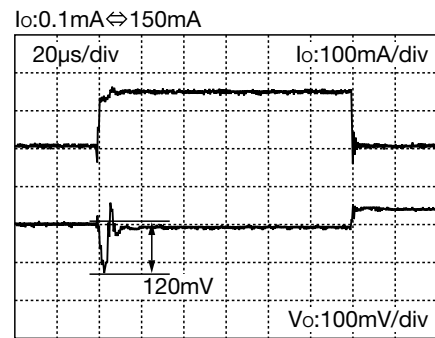
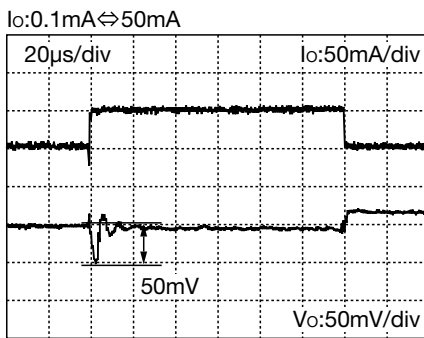
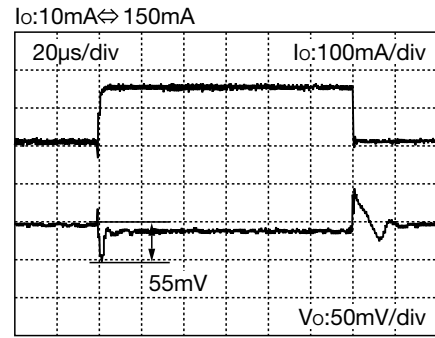
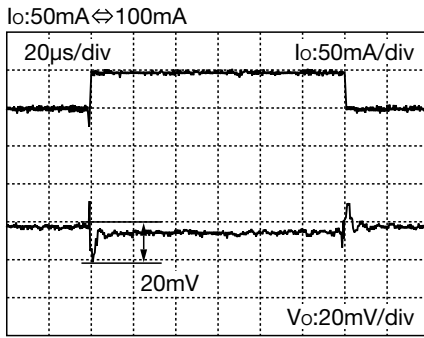
**ESR stability area**



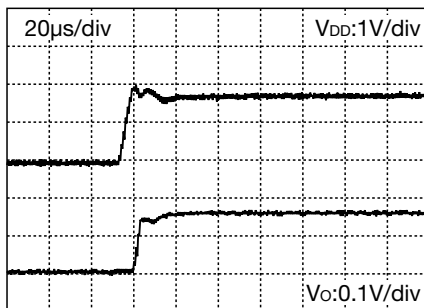
**Current Limit**



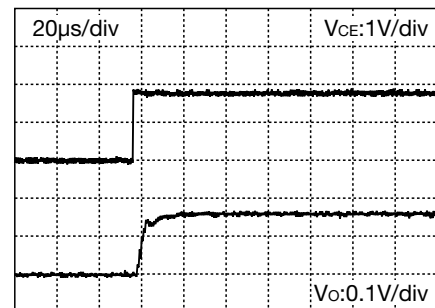
■ Load transient response ( $V_{DD}=V_o+1V$ ,  $V_{CE}=V_{DD}$ ,  $C_{in}=C_o=1\mu F$ )



■ Input rise characteristics  
( $V_{DD}=0V \rightarrow 1.8V$ ,  $V_{CE}=V_{DD}$ ,  $I_o=30mA$ )

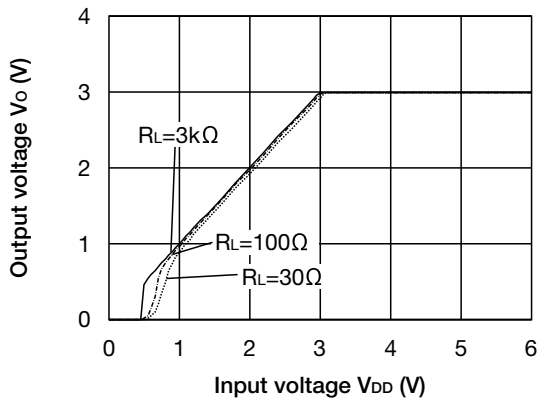


■ CE rise characteristics  
( $V_{DD}=1.8V$ ,  $V_{CE}=0V \rightarrow V_{DD}$ ,  $I_o=30mA$ )

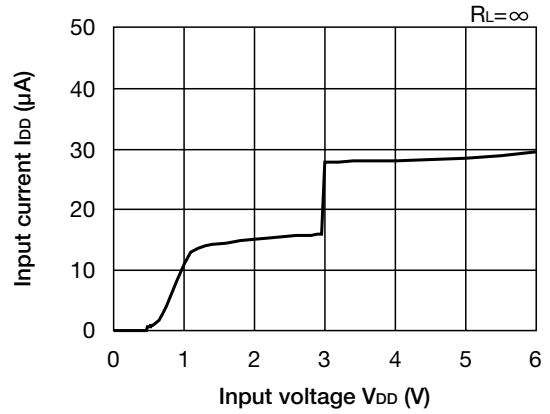


**Characteristics (Vo=3.0V)** (Except where noted otherwise VDD=VOUT (typ.) +1V, VCE=VDD, Ta=25°C)

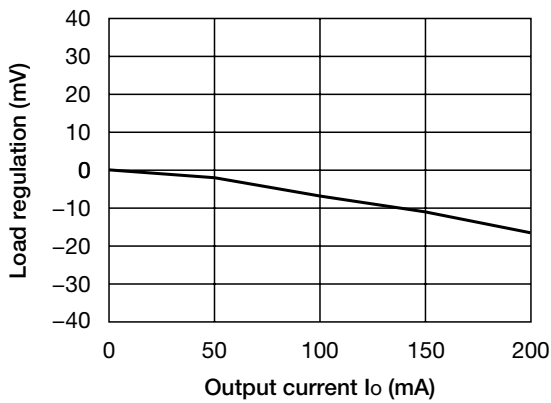
**Output - Input voltage**



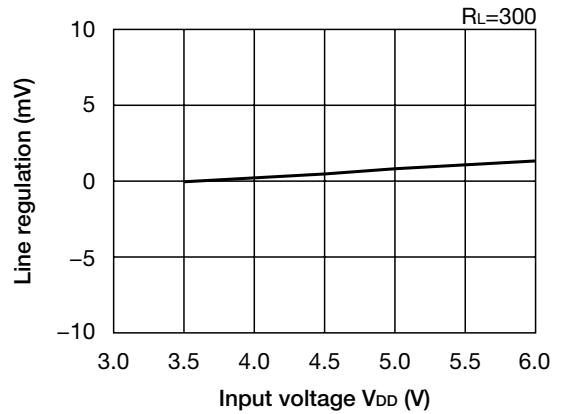
**Input current - Input voltage**



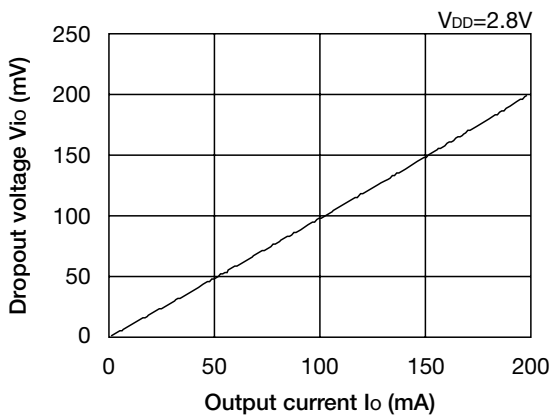
**Load regulation**



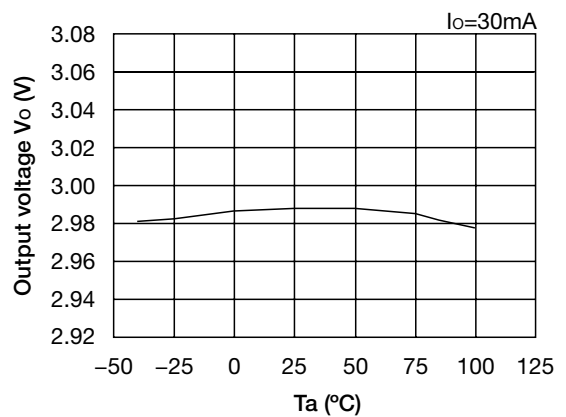
**Line regulation**



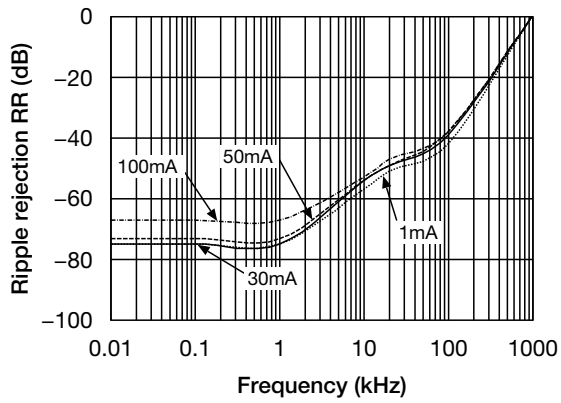
**Dropout voltage**



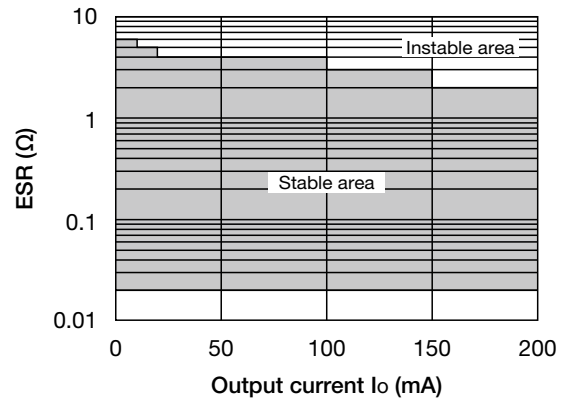
**VOUT temperature coefficient**



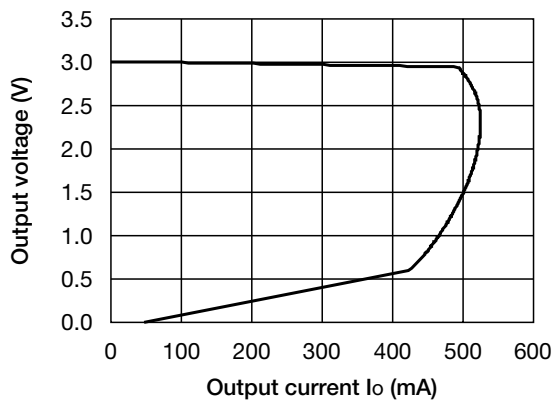
**Ripple Rejection**



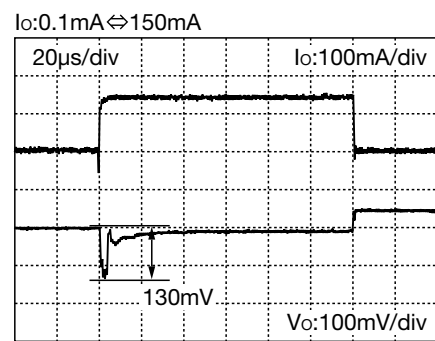
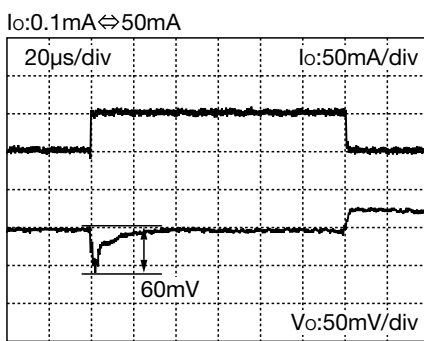
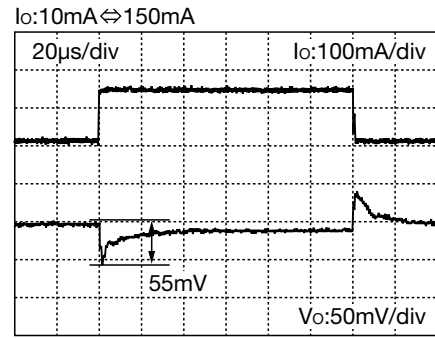
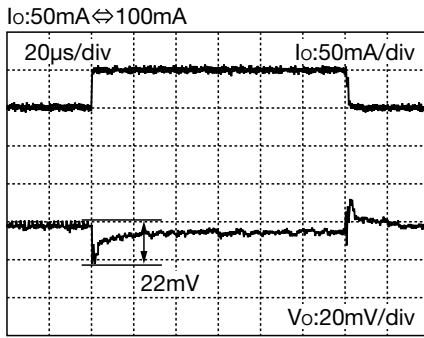
**ESR stability area**



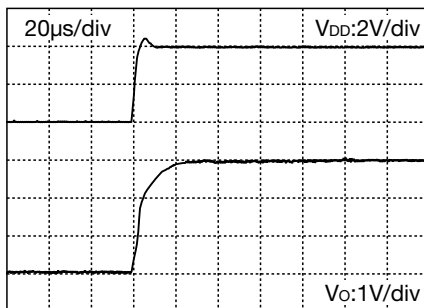
**Current Limit**



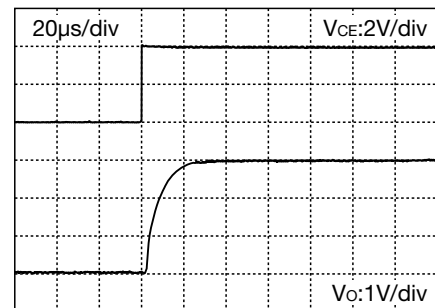
■ Load transient response ( $V_{DD}=V_o+1V$ ,  $V_{CE}=V_{DD}$ ,  $C_{in}=C_o=1\mu F$ )



■ Input rise characteristics  
( $V_{DD}=0V \rightarrow 4.0V$ ,  $V_{CE}=V_{DD}$ ,  $I_o=30mA$ )

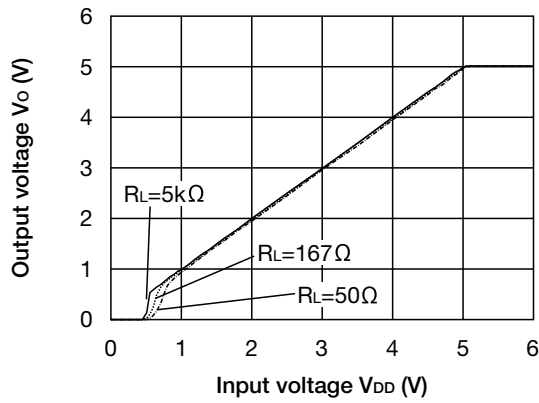


■ CE rise characteristics  
( $V_{DD}=4V$ ,  $V_{CE}=0V \rightarrow V_{DD}$ ,  $I_o=30mA$ )

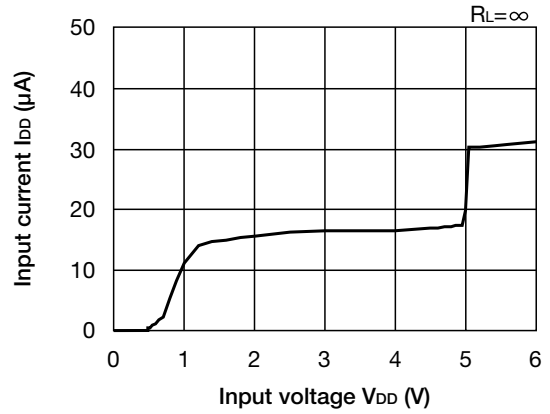


**Characteristics (Vo=5.0V)** (Except where noted otherwise  $V_{DD}=V_{OUT}(\text{typ.}) + 1V$ ,  $V_{CE}=V_{DD}$ ,  $T_a=25^\circ\text{C}$ )

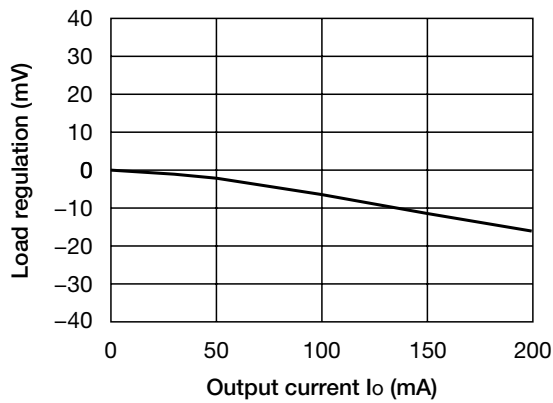
**Output - Input voltage**



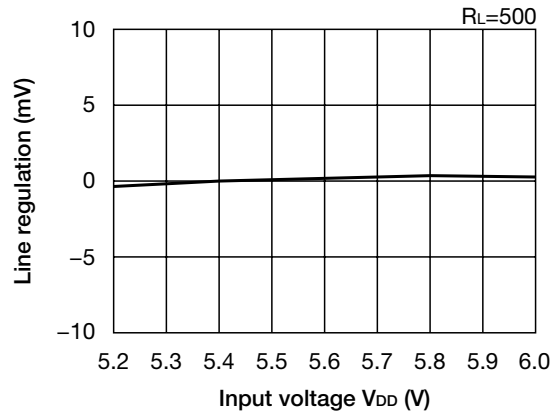
**Input current - Input voltage**



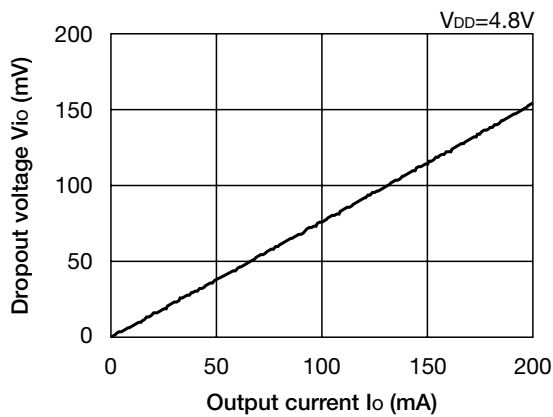
**Load regulation**



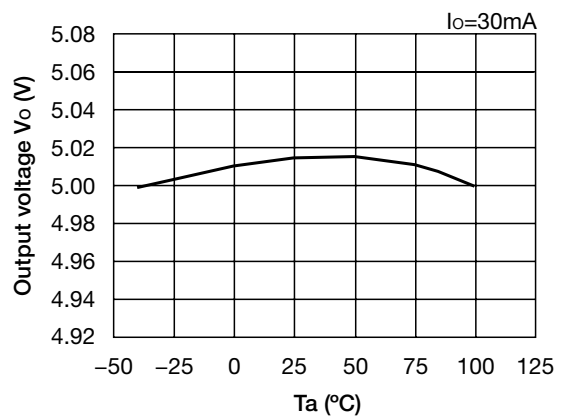
**Line regulation**



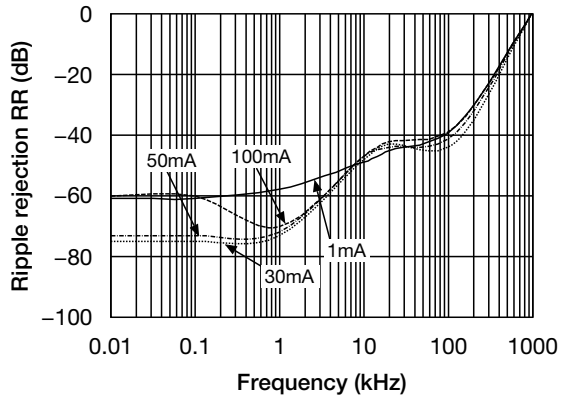
**Dropout voltage**



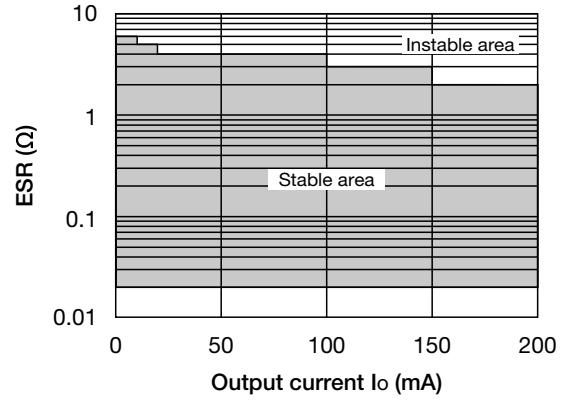
**V<sub>OUT</sub> temperature coefficient**



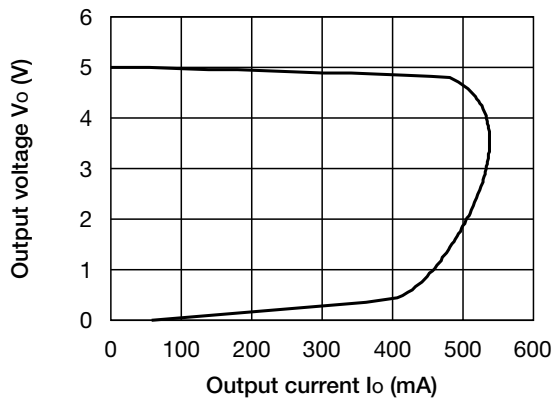
**Ripple Rejection**



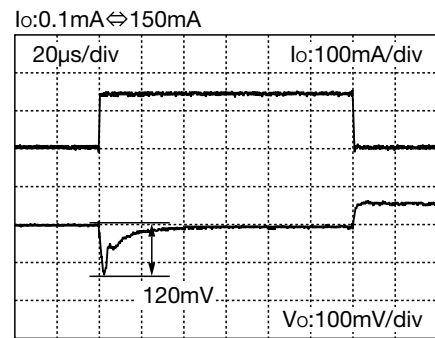
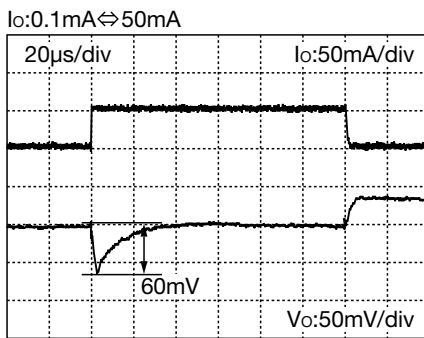
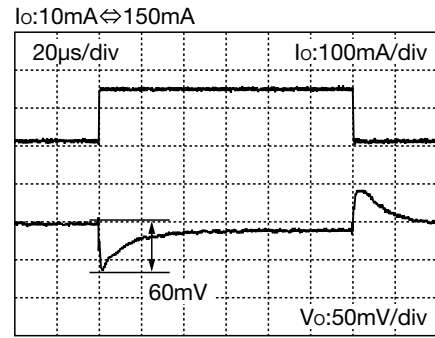
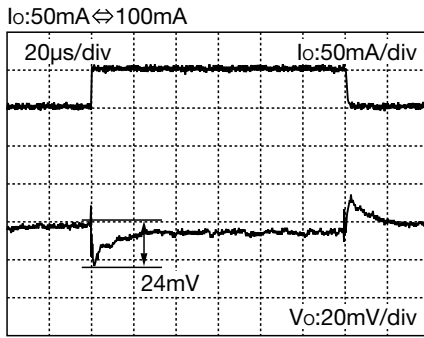
**ESR stability area**



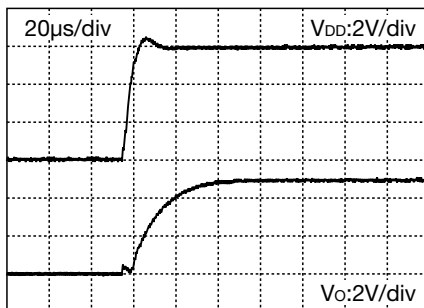
**Current Limit**



■ Load transient response ( $V_{DD}=V_o+1V$ ,  $V_{CE}=V_{DD}$ ,  $C_{in}=C_o=1\mu F$ )



■ Input rise characteristics  
( $V_{DD}=0V \rightarrow 6.0V$ ,  $V_{CE}=V_{DD}$ ,  $I_o=30mA$ )



■ CE rise characteristics  
( $V_{DD}=6.0V$ ,  $V_{CE}=0V \rightarrow V_{DD}$ ,  $I_o=30mA$ )

