## Ultra-Low Power Consumption Low-Saturation Three-Pin Regulators with On/Off Pin

# Monolithic ICs MM1065 and 1165

## Outline

These ICs are stabilized power supply devices with ultra-low consumption currents, designed for a greatly reduced reactive current at low input voltages, and with a small input/output difference voltage of 0.2V at an output current of 40mA. The output current is limited to a maximum of 100mA, and in the MMP-4A package, an on/off pin enables the device to be switched on and off.

## Features

1. Input/output voltage difference — 0.2V typ. ($I_O$=40mA)
2. No-load input current — 13μA typ.
3. Maximum reactive current at low input voltages — 15μA typ. (no-load)
4. Maximum output current — 100mA max.
5. Temperature coefficient of output voltage — ±0.01%/°C typ.
6. Output voltage ranks — MM1065, 1165
   - F : 6.0V±4%
   - G : 5.0V±4%
   - H : 4.5V±4%
   - I : 4.0V±4%
   - J : 3.0V±4%
   - Z : 3.3V±4%
7. With overcurrent protection circuit
8. With thermal shutdown circuit
9. With function to turn output on and off (MMP-4A package only)

| On/Off Pin Level | Low | High |
|---|---|---|
| MM1065 output | ON | OFF |
| MM1165 output | OFF | ON |

## Package

TO-92A (MM1065□T, MM1165□T)
MMP-4A (MM1065□M, MM1165□M)
*The output voltage rank appears in the boxes.

## Applications

1. Handheld computers
2. Portable transceivers
3. Cordless phones
4. Other portable equipment which uses batteries

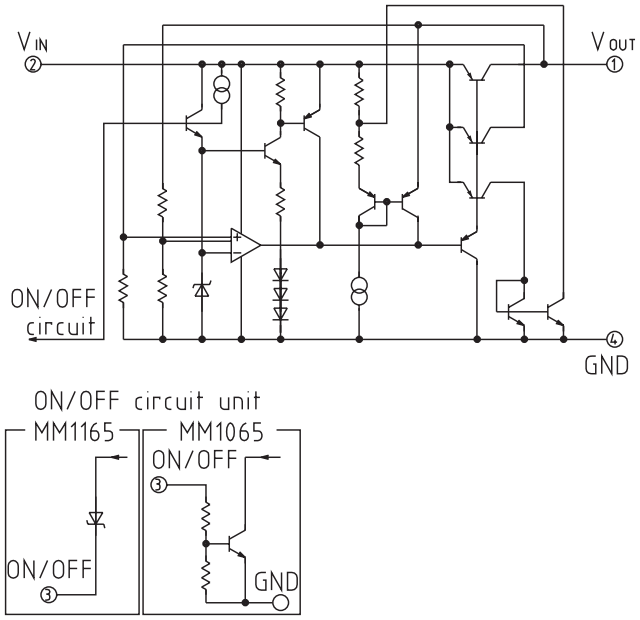
## Absolute Maximum Ratings

| Item | Symbol | Ratings | Units |
|---|---|---|---|
| Operating temperature | $T_{OPR}$ | –20~+75 | °C |
| Storage temperature | $T_{STG}$ | –40~+125 | °C |
| Power supply current | $V_{CC}$ max. | –0.3~10 | V |
| Output current | $I_{OUT}$ | 100 | mA |
| Maximum Ratings | Pd | 200 (MMP-4A)<br>300 (TO-92A) | mW |

## Electrical Characteristics

| Item | Symbol | Measurement conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Output voltage | Vo | $V_{IN}$=Vo+1V<br>Io=40mA | F | 5.76 | 6.00 | 6.24 | V |
| | | | G | 4.80 | 5.00 | 5.20 | |
| | | | H | 4.32 | 4.50 | 4.68 | |
| | | | I | 3.84 | 4.00 | 4.16 | |
| | | | J | 2.88 | 3.00 | 3.12 | |
| | | | Z | 3.17 | 3.30 | 3.43 | |
| No-load input current | Iccq1 | $V_{IN}$=Vo+1V, Io=0mA | | | 13 | 20 | μA |
| Minimum I/O voltage difference | Vd min. | $V_{IN}$=Vo min., Io=40mA | | | 0.2 | 0.3 | V |
| Input fluctuation rate | ⊿V2 | $V_{IN}$=(Vo+1V)~10V, Io=40mA | | | ±0.01 | ±0.1 | %/V |
| Load fluctuation rate | ⊿V1 | $V_{IN}$=Vo+1V, Io=0~100mA | | | ±0.01 | ±0.03 | %/mA |
| Output voltage temperature coefficient | ⊿Vo/T | Tj=–20~+75°C | | | ±100 | | ppm/°C |
| Ripple rejection rate | RR | $V_{RIPPLE}$=1V, $V_{IN}$=Vo+2V<br>f=120Hz, Io=40mA | | 50 | 60 | | dB |

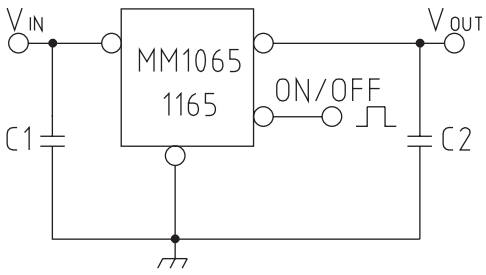
## Equivalent Circuit Diagram




## Electrical Characteristics (MMP-4P)

| Item | Symbol | Measurement conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Input current while off | Iccq2 | MM1065 | $V_{IN}$=6V V(ON/OFF)=High | | 2.5 | 7 | µA |
| | | MM1165 | $V_{IN}$=6V V(ON/OFF)=Low | | 3 | 6 | µA |
| On/off pin current while off | $I_{OFF}$ | MM1065 | V(ON/OFF)=2.4V | | 4 | 7 | µA |
| | | MM1165 | V(ON/OFF)=0.4V | | 0.2 | 0.1 | µA |
| On/off pin level | | | | | | | |
| On/off pin high level | High | | | 2.4 | | $V_{IN}$ +0.3 | V |
| On/off pin low level | Low | | | –0.3 | | 0.4 | V |

## Basic Circuit Connection Diagram

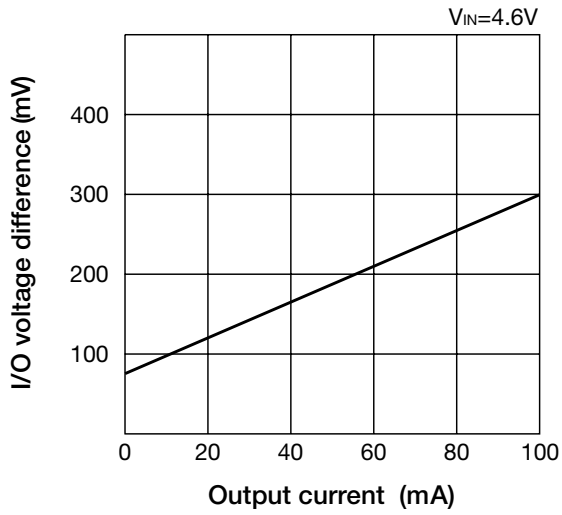



C1 ≧ 1µF (ceramic)
C2 ≧ 1µF (ceramic)

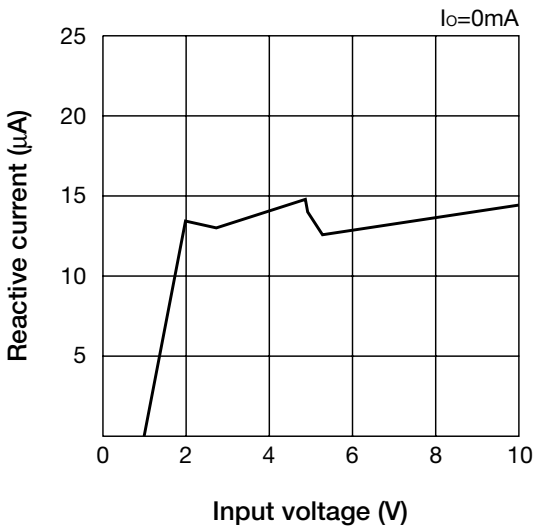
| On/Off Pin Level | Low | High |
|---|---|---|
| MM1065 output | ON | OFF |
| MM1165 output | OFF | ON |

## Characteristics

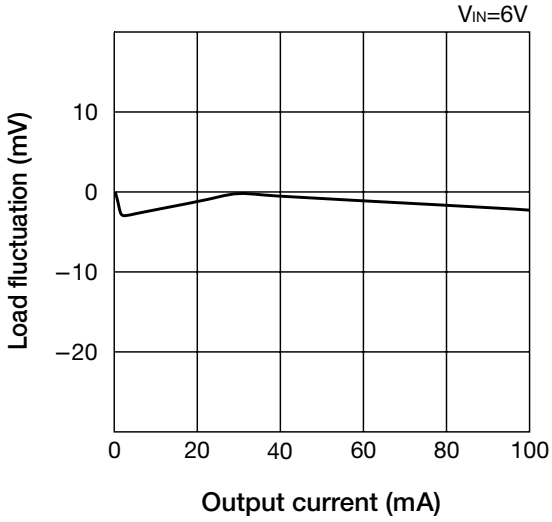
### I/O voltage difference



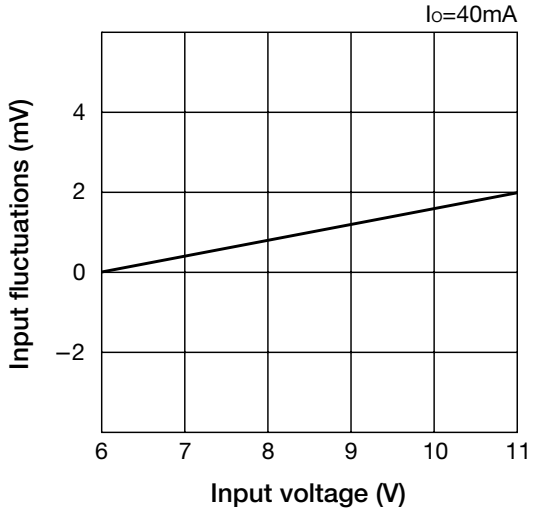

### No-load input current



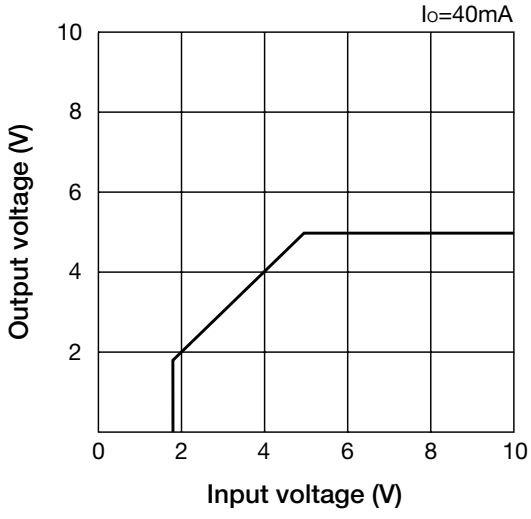

### Load fluctuation rate



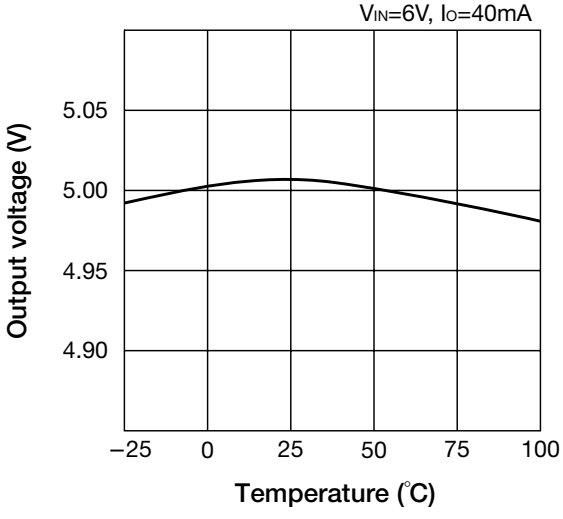

### Input fluctuation rate



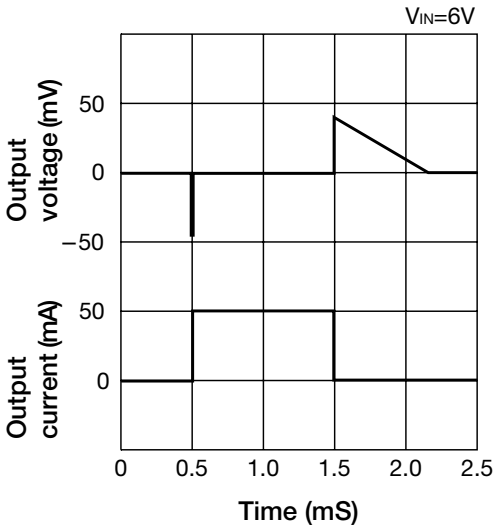

### Output voltage characteristic



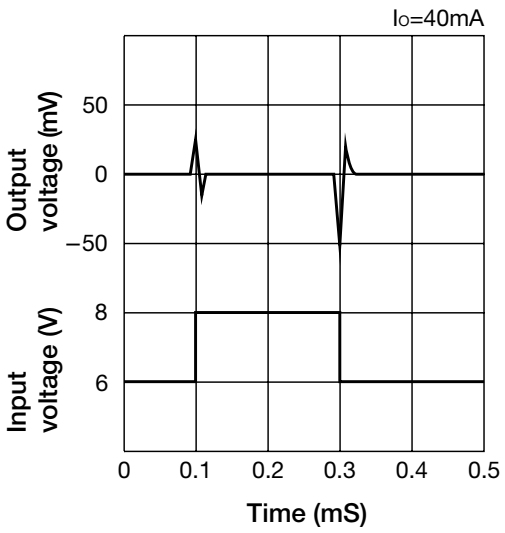

### Output voltage temperature characteristic



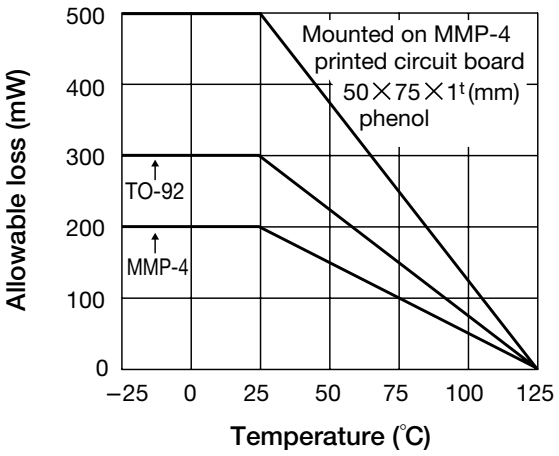
## Load transient response



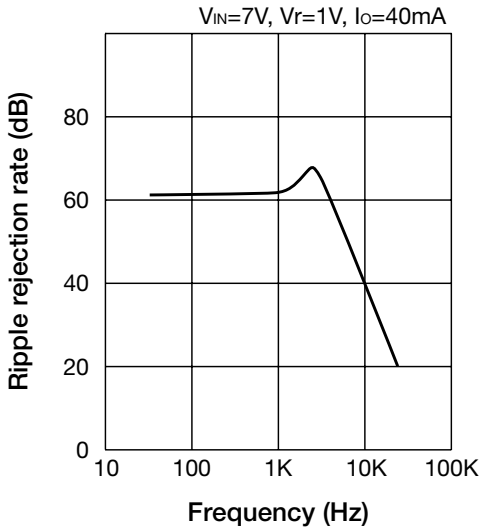

## Transient response to input fluctuation



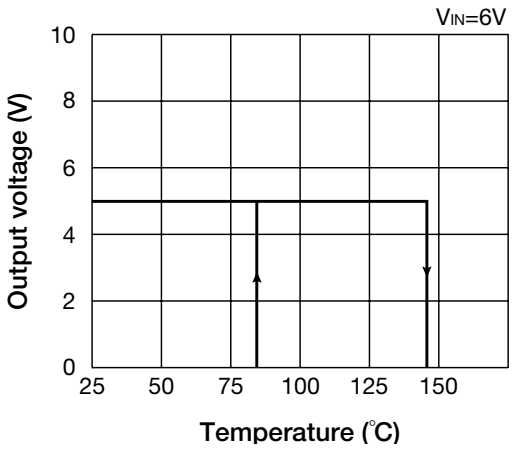

## Allowable loss




## Ripple rejection rate




## Thermal shutdown




## Output current characteristic

