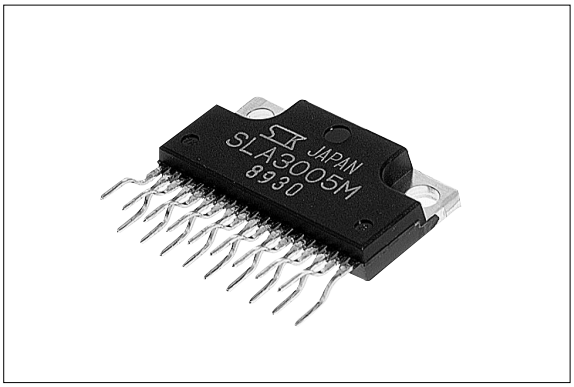
# SLA3005M/3006M/3007M

# 4-Output, Low Dropout Voltage Dropper Type for USB Hub




## ■Features

- 4 regulators combined in one package
- Insulated single inline package
- SLA3005M/3006M with 5V/0.5A × 4 outputs and SLA3007M with 5V/0.5A × 3, 3.3V/0.5A × 1 outputs
- Low dropout voltage: $V_{DIF}$≤0.5V (at $I_O$=0.5A)
- Output-independent ON/OFF control terminal compatible with LS-TTL (Active High)
- Output-independent overcurrent and thermal protection circuits built in
- Open collector flag-output terminals built in to output OCP operation to each output terminal (Active Low)
- SLA3005M/3007M (excluding Reg4) for $V_O$ shutdown aftπer OCP operation and SLA3006M for continuous OCP operation
- Built-in anti-malfunction delay circuit whose time can be set with an external capacitor

## ■Applications

- USB hub power supplies
- Electronic equipment

## ■Absolute Maximum Ratings

($T_a$=25°C)

| Parameter | Symbol | Ratings | | Unit |
|---|---|---|---|---|
| | | SLA3005M/3006M | SLA3007M | |
| DC Input Voltage | $V_{IN}$ | 20 | 18 | V |
| Voltage of Output Control Terminal | $V_C$ | $V_{IN}$ | | V |
| DC Output Current | $I_O$ | 0.5 | | A |
| Power Dissipation | $P_{D1}$ | 30(With infinite heatsink) | | W |
| | $P_{D2}$ | 3.36(Without heatsink, stand-alone operation) | | W |
| Junction Temperature | $T_j$ | –30 to +125 | | °C |
| Ambient Operating Temperature | $T_{OP}$ | –30 to +100 | | °C |
| Storage Temperature | $T_{stg}$ | –30 to +125 | | °C |
| Thermal Resistance (junction-to-case) | $R_{t(j-c)}$ | 9.0 | | °C/W |
| Thermal Resistance (junction-to-ambient air) | $R_{th(j-a)}$ | 29.8(Without heatsink, stand-alone operation)5V/0.5A × 4 | | °C/W |

## ■Recommended Operating Conditions

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| DC Input Voltage Range | $V_{IN}$ | 5.5 to 10 | V |
| Output Current Range | $I_O$ | 0 to 0.5 | A |
| Operating Junction Temperature Range | $T_{jop}$ | –20 to +100 | °C |
| Ambient Operating Temperature Range | $T_{aop}$ | –20 to +85 | °C |

## ■Electrical Characteristics

($T_a$=25°C unless otherwise specified)

| Parameter | | SYmbol | Ratings | | | | | | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SLA3005M | | | SLA3006M | | | SLA3007M Regulator1, 2, 3 | | | SLA3007M Regulator4 | | | |
| | | | min. | typ. | max. | min. | typ. | max. | min. | typ. | max. | min. | typ. | max. | |
| Output Voltage | | $V_O$ | 4.85 | 5.00 | 5.15 | 4.85 | 5.00 | 5.15 | 4.85 | 5.00 | 5.15 | 3.234 | 3.300 | 3.366 | V |
| | | Conditions | $V_{IN}$=7V, $I_O$=0.1A | | | $V_{IN}$=7V, $I_O$=0.1A | | | $V_{IN}$=7V, $I_O$=0.1A | | | $V_{IN}$=7V, $I_O$=0.1A | | | |
| Dropout Voltage | | $V_{DIF}$ | | | 0.5 | | | 0.5 | | | 0.5 | | | 2.0 | V |
| | | Conditions | $I_O$≤0.5A | | | $I_O$≤0.5A | | | $I_O$≤0.5A | | | $I_O$≤0.5A | | | |
| Line Regulation | | $\Delta V_{OLINE}$ | | | 30 | | | 30 | | | 30 | | | 30 | mV |
| | | Conditions | $V_{IN}$=6 to 15V, $I_O$=0.1A | | | $V_{IN}$=6 to 15V, $I_O$=0.1A | | | $V_{IN}$=6 to 15V, $I_O$=0.1A | | | $V_{IN}$=6 to 15V, $I_O$=0.1A | | | |
| Load Regulation | | $\Delta V_{OLOAD}$ | | | 50 | | | 50 | | | 50 | | | 30 | mV |
| | | Conditions | $V_{IN}$=7V, $I_O$=0 to 0.5A | | | $V_{IN}$=7V, $I_O$=0 to 0.5A | | | $V_{IN}$=7V, $I_O$=0 to 0.5A | | | $V_{IN}$=7V, $I_O$=0 to 0.2A | | | |
| Temperature Coefficient of Output Voltage | | $\Delta V_O/\Delta T_a$ | | ±0.5 | | | ±0.5 | | | ±0.5 | | | ±0.3 | | mV/°C |
| | | Conditions | $V_{IN}$=7V, $I_O$=5mA, $T_j$=–10 to 100°C | | | $V_{IN}$=7V, $I_O$=5mA, $T_j$=–10 to 100°C | | | $V_{IN}$=7V, $I_O$=5mA, $T_j$=–10 to 100°C | | | $V_{IN}$=7V, $I_O$=5mA, $T_j$=–10 to 100°C | | | |
| Quiescent Circuit Current*3 | | $I_q$ | | | 20 | | | 20 | | | 20 | | ——— | | mA |
| | | Conditions | $V_{IN}$=7V, $I_O$=0A | | | $V_{IN}$=7V, $I_O$=0A | | | $V_{IN}$=7V, $I_O$=0A | | | | | | |
| Quiescent Circuit Current (Output OFF)*3 | | $I_{q(off)}$ | | | 0.5 | | | 0.5 | | | 0.5 | | ——— | | mA |
| | | Conditions | $V_{IN}$=7V, $V_C$1 to 4=0V | | | $V_{IN}$=7V, $V_C$1 to 4=0V | | | $V_{IN}$=7V, $V_C$1 to 4=0V | | | | | | |
| Overcurrent Protection Starting Current*1 | | $I_{S1}$ | 0.55 | | 0.65 | 0.75 | | 0.96 | 0.55 | | 0.65 | 0.55 | | 0.65 | A |
| | | Conditions | $V_{IN}$=7V | | | $V_{IN}$=7V | | | $V_{IN}$=7V | | | $V_{IN}$=7V | | | |
| $V_C$ Terminal*2 | Control Voltage (Output ON) | $V_{C.IH}$ | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | | V |
| | Control Voltage (Output OFF) | $V_{C.IL}$ | | | 0.7 | | | 0.7 | | | 0.7 | | | 0.7 | |
| | Control Current (Output ON) | $I_{C.IH}$ | | | 50 | | | 50 | | | 50 | | | 50 | µA |
| | Conditions | | $V_C$=2.7V | | | $V_C$=2.7V | | | $V_C$=2.7V | | | $V_C$=2.7V | | | |
| | Control Current (Output OFF) | $I_{C.IL}$ | | | –100 | | | –100 | | | –100 | | | –100 | µA |
| | Conditions | | $V_C$=0V | | | $V_C$=0V | | | $V_C$=0V | | | $V_C$=0V | | | |
| OCP Detection Voltage Level | | $V_{oth}$ | 3.7 | 4.0 | 4.3 | 3.7 | 4.0 | 4.3 | 3.7 | 4.0 | 4.3 | ——— | | | V |
| Delay Threshold Voltage | | $V_{DLYth}$ | 2.1 | 2.3 | 2.5 | 2.1 | 2.3 | 2.5 | 2.1 | 2.3 | 2.5 | ——— | | | V |
| Delay Terminal Runoff Current | | $I_{DLY}$ | 35 | 50 | 65 | 35 | 50 | 65 | 35 | 50 | 65 | ——— | | | µA |
| Flag Output Terminal | Before OCP Detection | $V_{FLGh}$ | $V_{IN}$–0.4 | | | $V_{IN}$–0.4 | | | $V_{IN}$–0.4 | | | ——— | | | V |
| | Conditions | | $R_{FLG}$ connected between FLG and $V_{IN}$ | | | $R_{FLG}$ connected between FLG and $V_{IN}$ | | | $R_{FLG}$ connected between FLG and $V_{IN}$ | | | | | | |
| | After OCP Detection | $V_{FLGl}$ | | | 0.5 | | | 0.5 | | | 0.5 | ——— | | | V |
| | Conditions | | $I_{FLG}$=1mA | | | $I_{FLG}$=1mA | | | $I_{FLG}$=1mA | | | | | | |

*1 $I_{S1}$ is specified at –5(%) drop point of output voltage $V_O$ on the condition that $V_{IN}$ = 7V, $I_O$ = 0.1A.

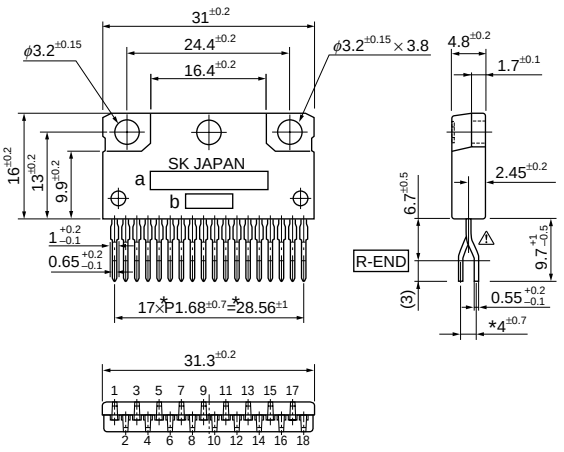
*2 Output is ON even when output control terminal $V_C$ is open. Each input level is equivalent to LS-TTL. Therefore, it may be directly driven by an LS-TTL circuit.

*3 Total of four circuits

*4 The FLG output latched by delay DLY after OCP detection. (SLA3005M/3007M(Reg1 to 3) shuts down the output voltage simultaneously at latching.) Set the $V_{IN}$ or $V_C$ to low to reset latching. Leave a time lag of $C_d \times 600$s or more before restart.

## ■Outline Drawing

(unit:mm)



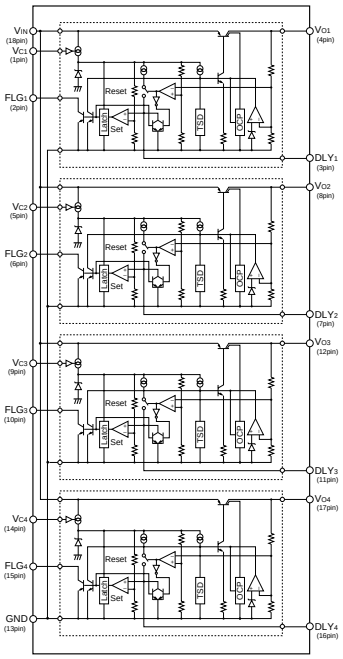

① $V_{C1}$
② FLG1
③ DLY1
④ $V_{O1}$
⑤ $V_{C2}$
⑥ FLG2
⑦ DLY2
⑧ $V_{O2}$
⑨ $V_{C3}$
⑩ FLG3
⑪ DLY
⑫ $V_{O3}$
⑬ GND
⑭ $V_{C4}$
⑮ FLG4(N. C on SLA3007M)
⑯ DLY4(N. C on SLA3007M)
⑰ $V_{O4}$
⑱ $V_{IN}$

a. Part Number
b. Lot Number

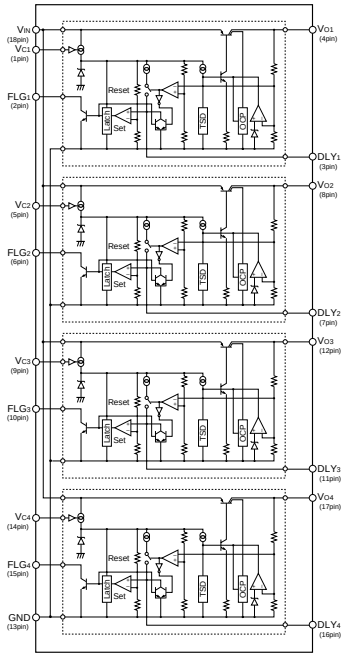
Weight:Approx. 6g

## ■Block Diagram

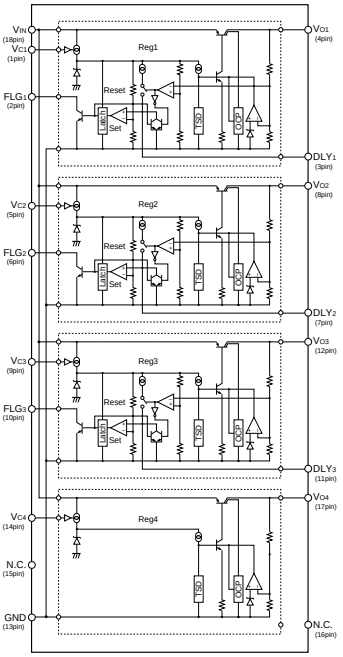
**SLA3005M**




**SLA3006M**

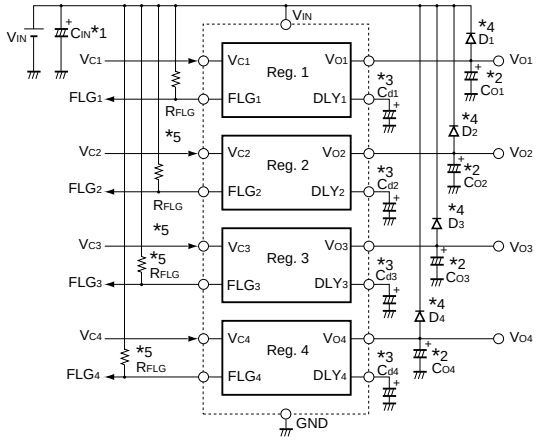



**SLA3007M**

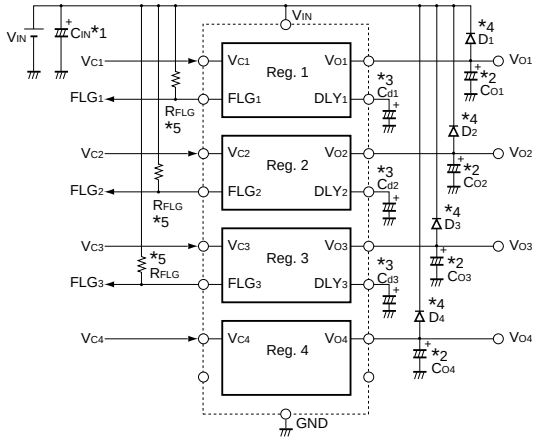


## ■Standard External Circuit

**SLA3005M/3006M**




**SLA3007M**




*1 $C_{IN}$ : Input capacitor (Approx. 47µF)
This capacitor is required if the input line is inductive and in the case of long wiring.

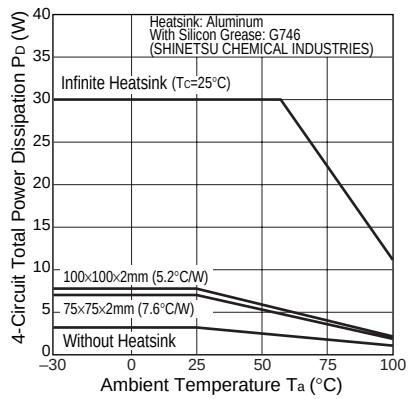
*2 $C_O$ : Output capacitor (47 to 220µF)

*3 $C_d$ : Delay setting capacitor (0.1µF or more)
Use $C_d$ to set the delay time ($t_{DLY}$) from when a low $V_O$ level due to OCP operation is detected until a flag signal is output. This prevents a rush current from causing malfunction.
Approximate calculation: $t_{DLY} \fallingdotseq (C_d \times V_{DLYth})/I_{DLY}$[sec]
When using soft start on $V_{IN}$ or if $C_{IN}$ has a large capacitance, set $t_{DLY}$ long enough for the output voltage to rise sufficiently
Be sure to connect Cd and do not use it for other applications, such as short circuiting Cd.

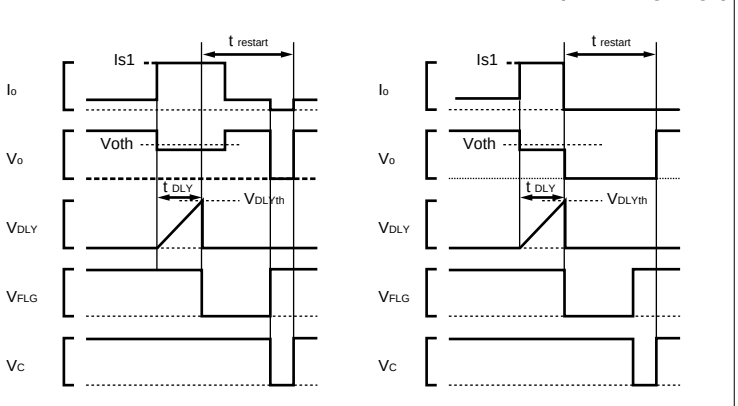
*4 $D_1$ to $D_4$ : Reverse biasing protection diode
This diode is required for protection against reverse biasing of the input and output.

*5 $R_{FLG}$ : Set this to limit the inflow current into the FLG terminal to 1mA or less.

## ■$T_a$-$P_D$ Characteristics




## ■Timing Charts




## ■Calculating the internal dissipation

$P_D$ is calculated as follows:

$P_D=[I_{O1}\bullet(V_{IN}-V_{O1})]+[I_{O2}\bullet(V_{IN}-V_{O2})]+[I_{O3}\bullet(V_{IN}-V_{O3})]+[I_{O4}\bullet(V_{IN}-V_{O4})]+V_{IN}\bullet IG$

## ■Estimating Tj by heat measurement

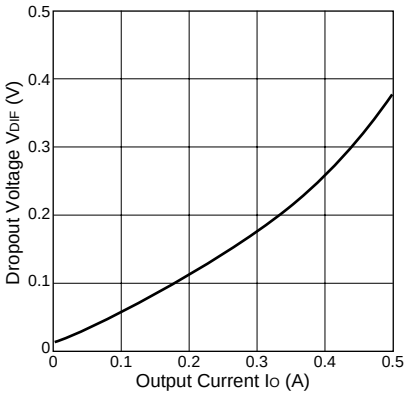
1. Measuring position: At the root of pin 13
2. Add the thermal resistance "θj-L" between the junction and pin 13 and the Pd product of each channel to the measured temperature.
   θj-L is as follows : θj-L1:8°C/W, θj-L2:7°C/W, θj-L3:5°C/W, θj-L4:8°C/W
   The calculation formula is as follows :Tj=θj-L1•Pd1+θj-L2•Pd2+θj-L3•Pd3+θj-L4•Pd4+T13pin

## ■Typical Characteristics

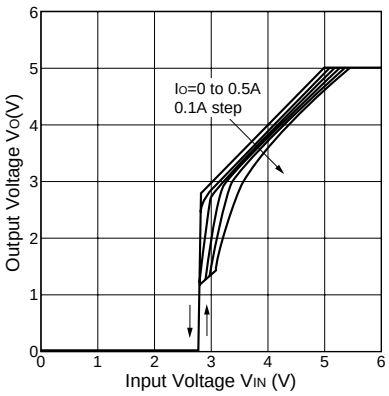
($T_a$=25°C)

### SLA3005M

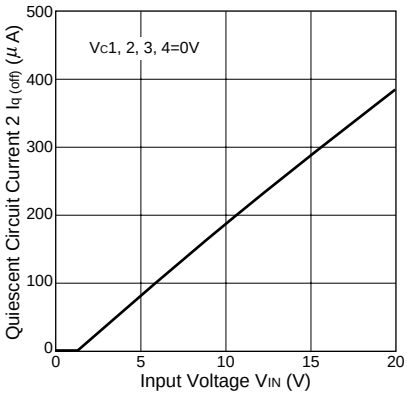
**$I_O$ vs. $V_{DIF}$ Characteristics**



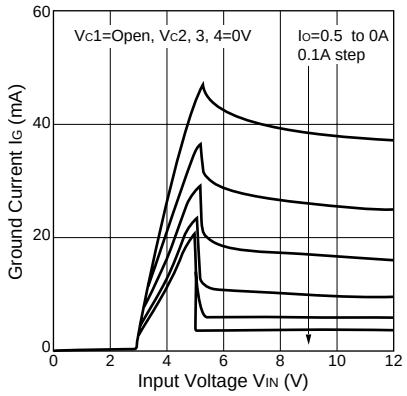

**Rise Characteristics**



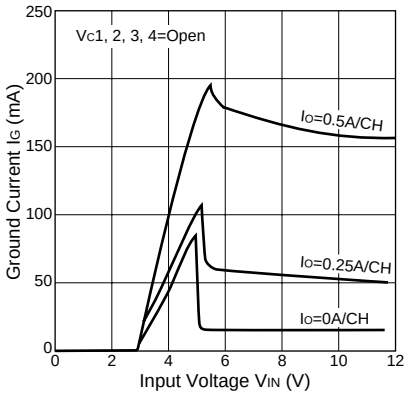

**Quiescent Circuit Current**



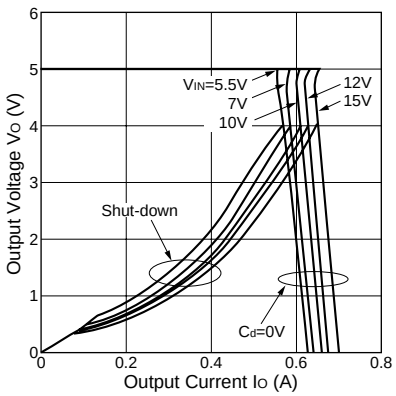

**Circuit Current 1-Circuit**



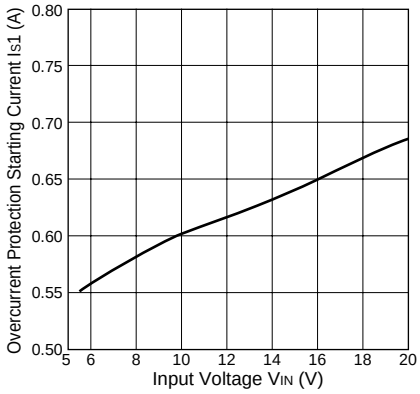

**Circuit Current 4-Circuits**



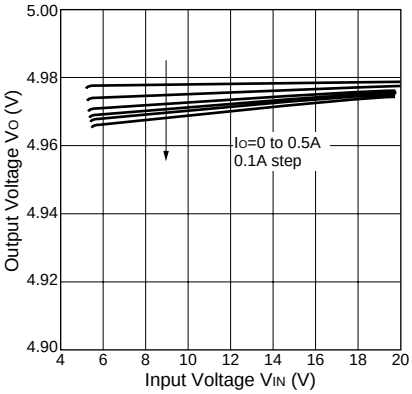

**Overcurrent Protection Characteristics**



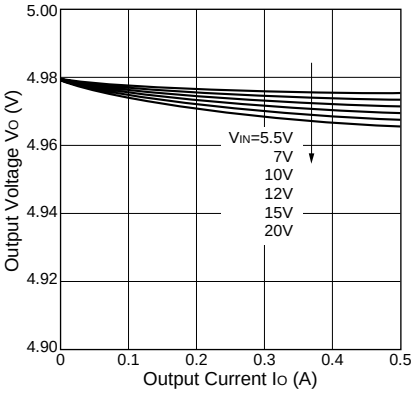

**VIN vs. IS1 Characteristics**



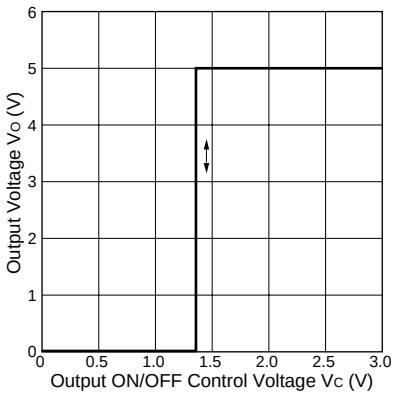

**Line Regulation**



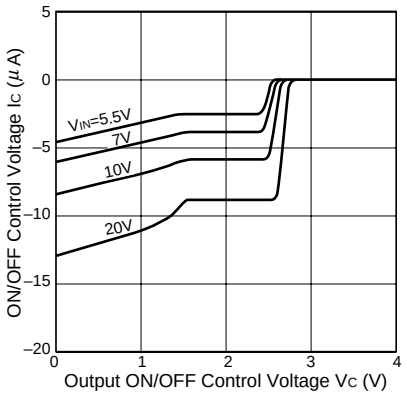

**Load Regulation**



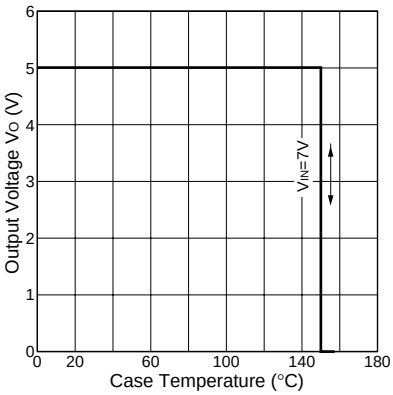

**ON/OFF Control Characteristics**




**VC Terminal Characteristics**




**Thermal Protection Characteristics**

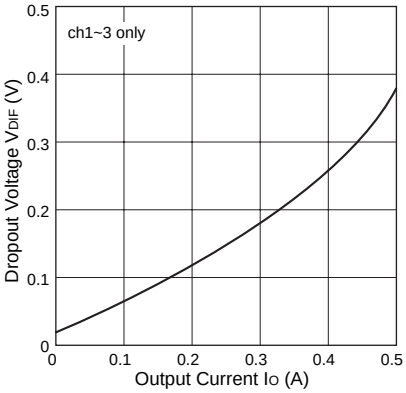


## ■Typical Characteristics

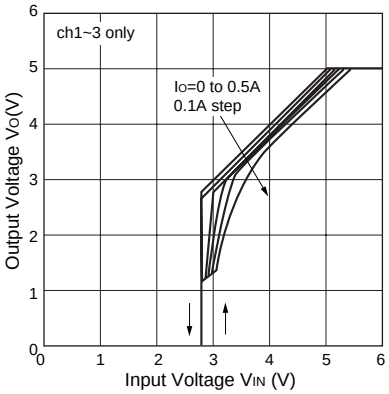
($T_a$=25°C)

**SLA3007M**

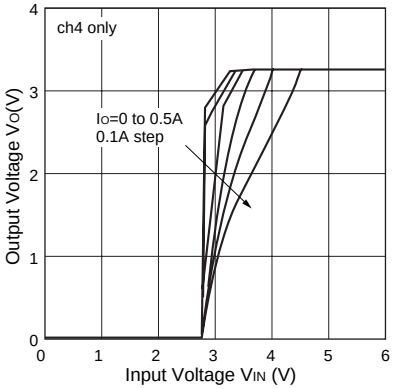
**Io vs. VDIF Characteristics**



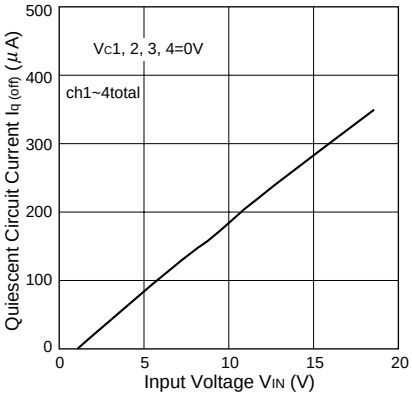

**Rise Characteristics**



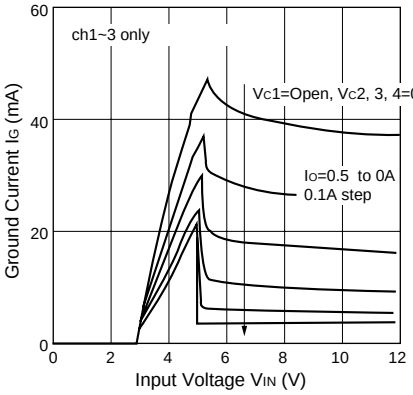

**Rise Characteristics**



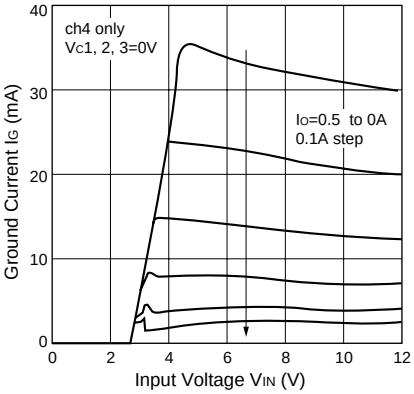

**Quiescent Circuit Current**



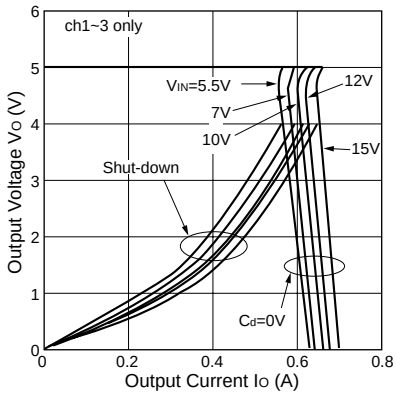

**Circuit Current (ch1 operating)**



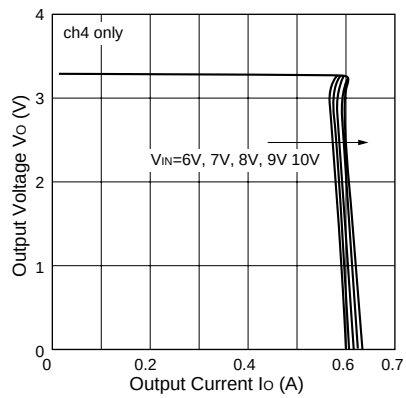

**Circuit Current (ch4 operating)**



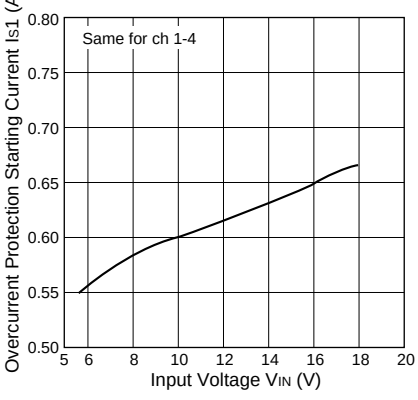

**Overcurrent Protection Characteristics**



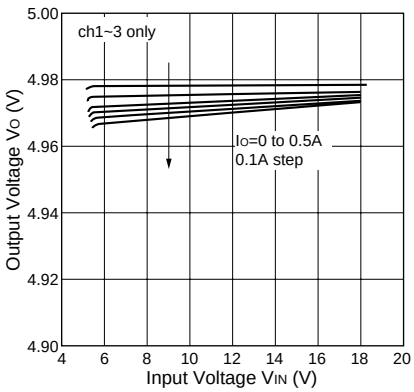

**Overcurrent Protection Characteristics**



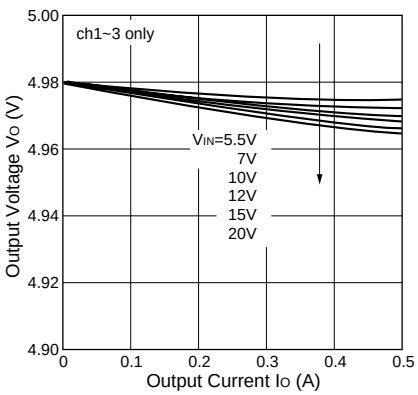

**VIN vs. IS1 Characteristics**



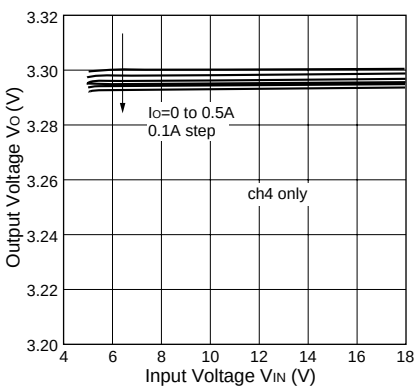

**Line Regulation**




**Load Regulation**




**Line Regulation**

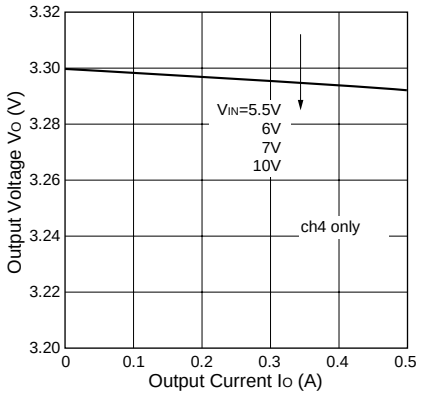


## ■Typical Characteristics

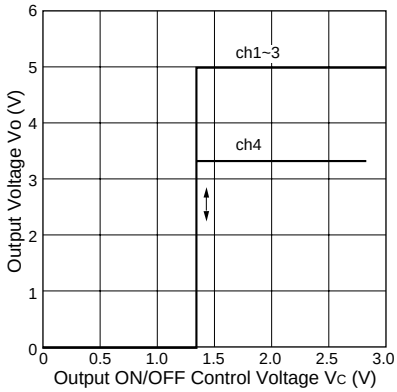
($T_a$=25°C)

**SLA3007M**

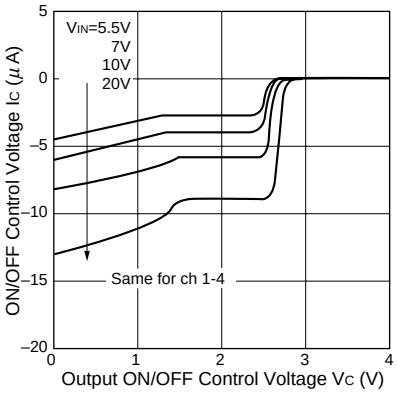
**Load Regulation**




**ON/OFF Control Characteristics**




**VC Terminal Characteristics**




**Thermal Protection Characteristics**