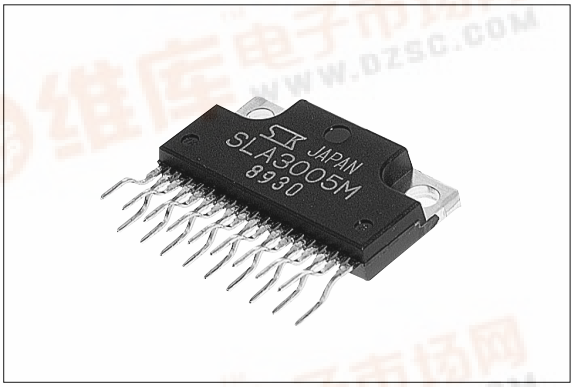
SLA3005M/3006M/3007M

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 after 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		ΔV_{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		ΔV_{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_C1 to 4=0V			V_{IN}=7V, V_C1 to 4=0V			V_{IN}=7V, V_C1 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	V
	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.

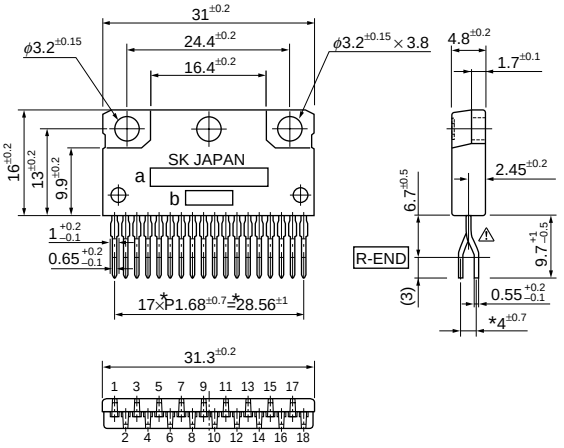
*2 Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL. Therefore, it may be directly driven by an LS-TTL circuit.

*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)

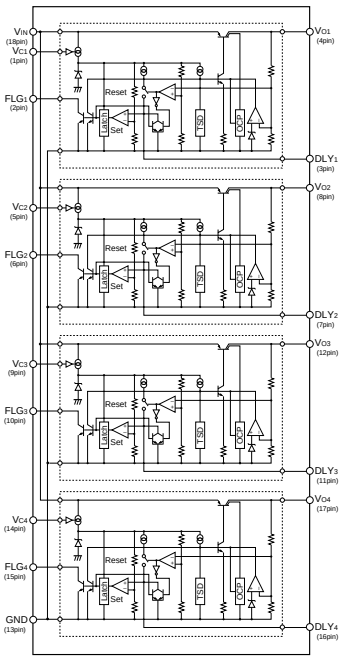


① V_{C1}	⑩ FLG3	a. Part Number
② FLG1	⑪ DLY	b. Lot Number
③ DLY1	⑫ V_{O3}	
④ V_{O1}	⑬ GND	
⑤ V_{C2}	⑭ V_{C4}	
⑥ FLG2	⑮ FLG4(N. C on SLA3007M)	
⑦ DLY2	⑯ DLY4(N. C on SLA3007M)	
⑧ V_{O2}	⑰ V_{O4}	
⑨ V_{C3}	⑱ V_{IN}	

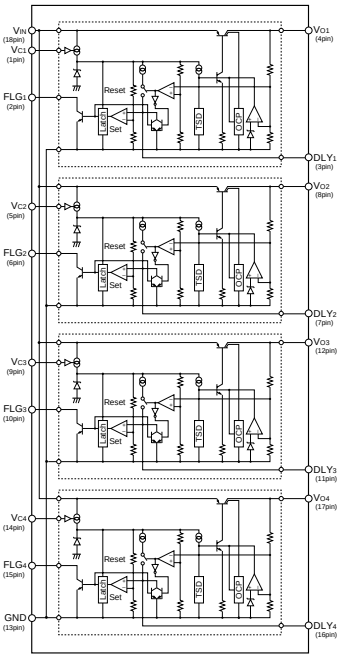
Weight:Approx. 6g

■Block Diagram

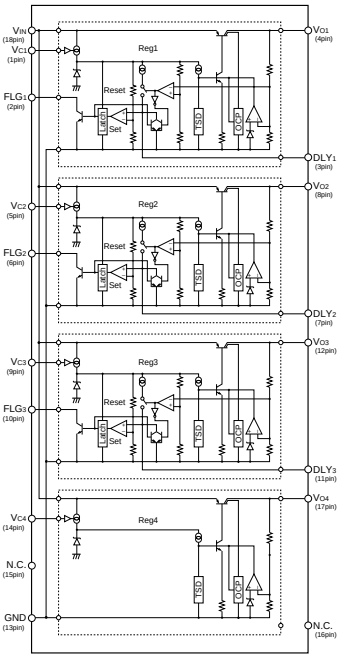
SLA3005M



SLA3006M

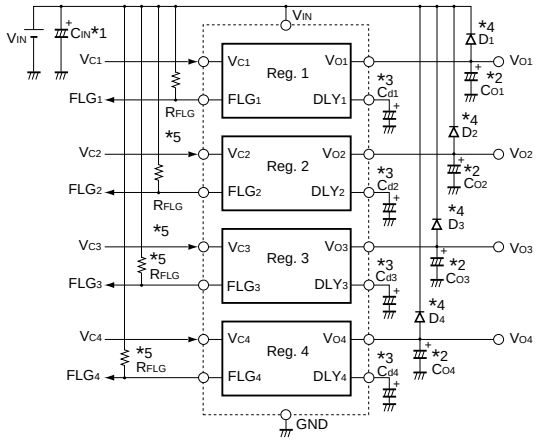


SLA3007M

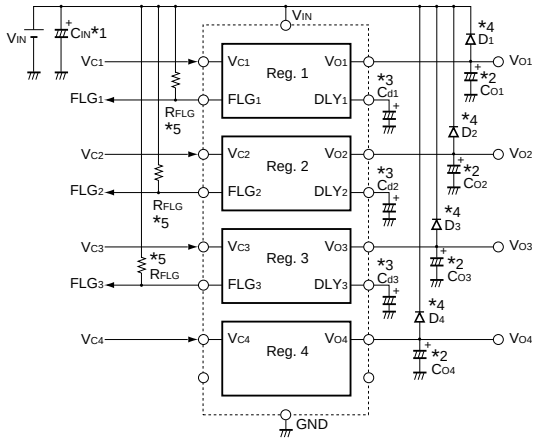


■Standard External Circuit

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.

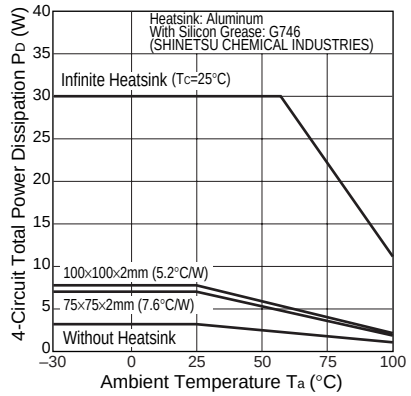
*2 C_O : Output capacitor (47 to 220µF)

*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.

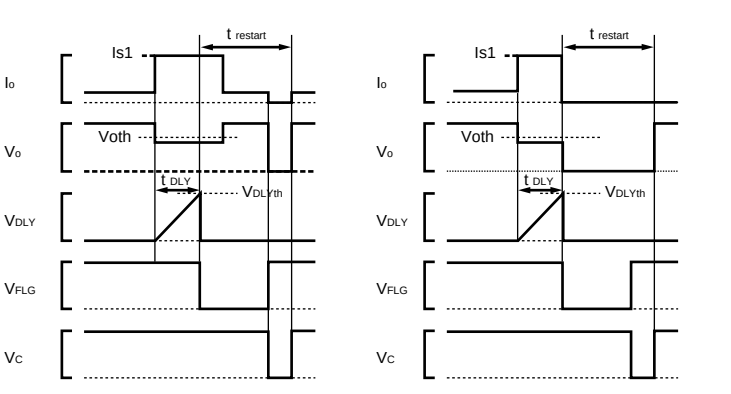
*4 D_1 to D_4 : Reverse biasing protection diode
This diode is required for protection against reverse biasing of the input and output.

*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:

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

■Estimating Tj by heat measurement

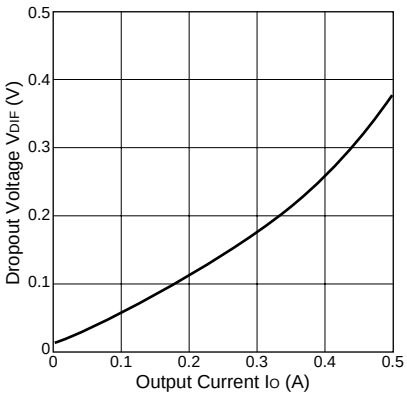
1. Measuring position: At the root of pin 13
2. Add the thermal resistance "θj-L" between the junction and pin 13 and the Pd product of each channel to the measured temperature.
   θj-L is as follows : θj-L1:8°C/W, θj-L2:7°C/W, θj-L3:5°C/W, θj-L4:8°C/W
   The calculation formula is as follows :Tj=θj-L1•Pd1+θj-L2•Pd2+θj-L3•Pd3+θj-L4•Pd4+T13pin

■Typical Characteristics

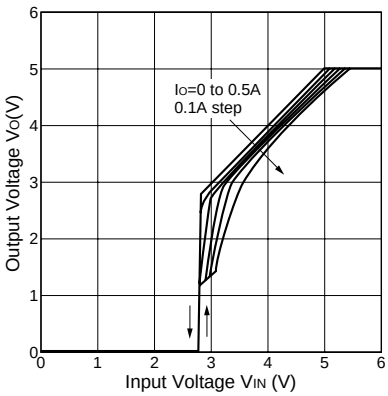
(T_a=25°C)

SLA3005M

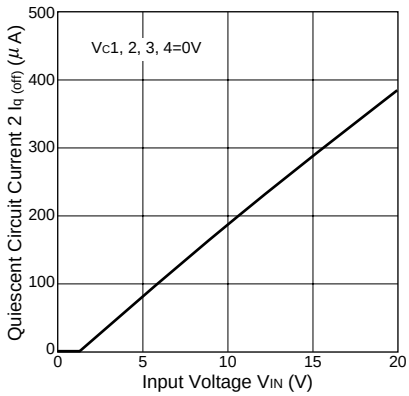
I_O vs. V_{DIF} Characteristics



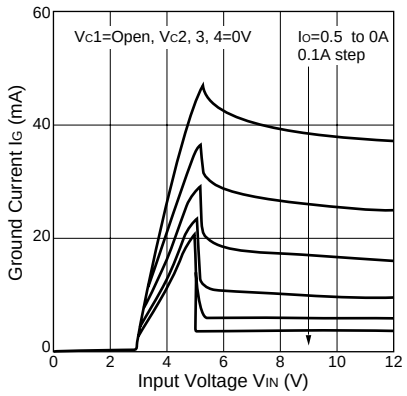
Rise Characteristics



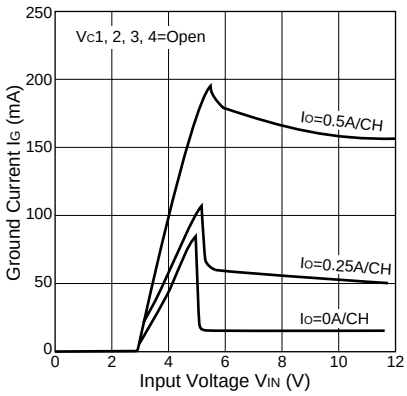
Quiescent Circuit Current



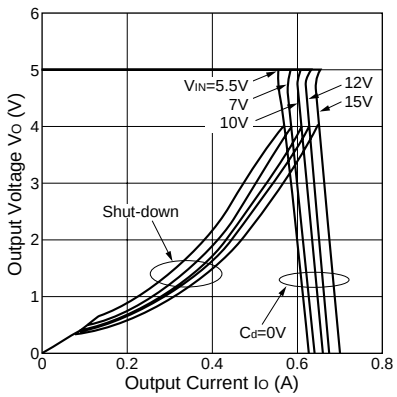
Circuit Current 1-Circuit



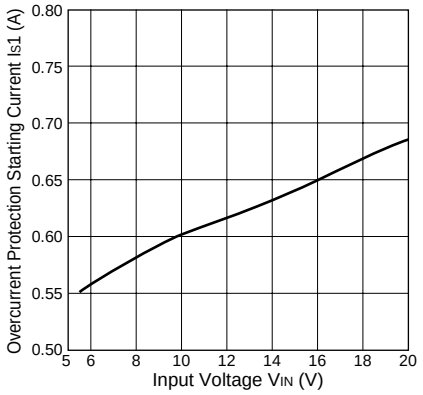
Circuit Current 4-Circuits



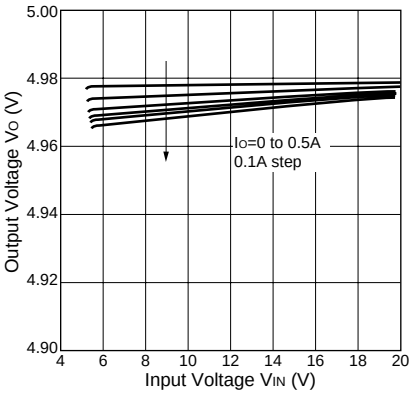
Overcurrent Protection Characteristics



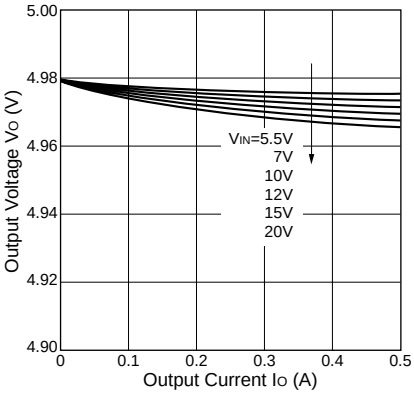
VIN vs. IS1 Characteristics



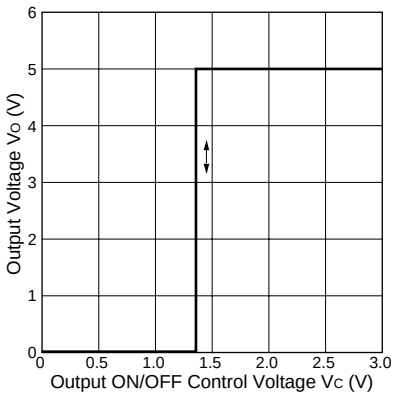
Line Regulation



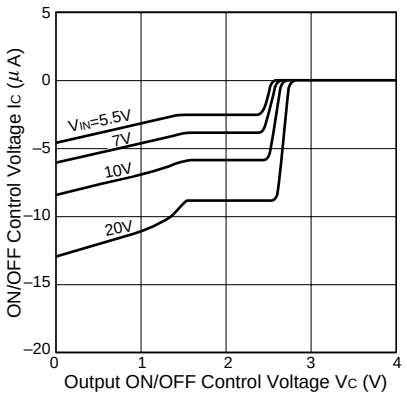
Load Regulation



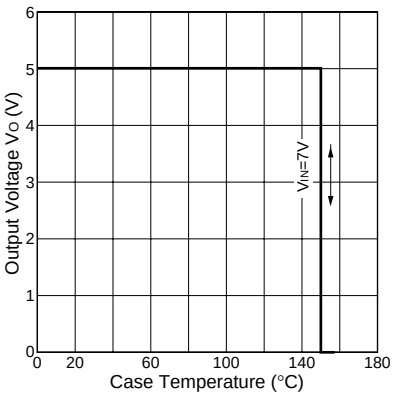
ON/OFF Control Characteristics



VC Terminal Characteristics



Thermal Protection Characteristics

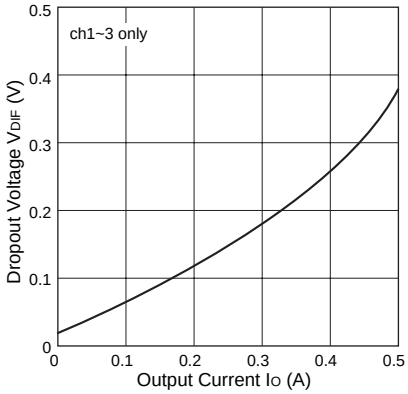


■Typical Characteristics

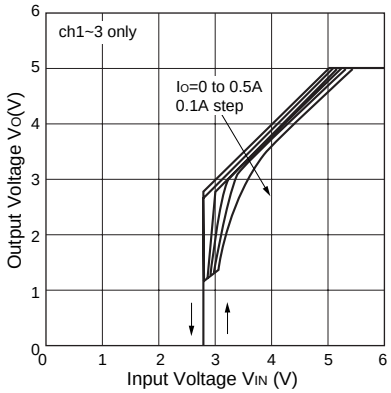
(T_a=25°C)

SLA3007M

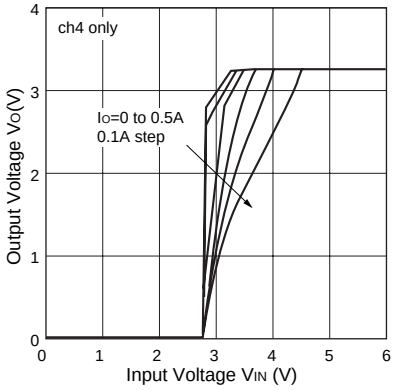
I_O vs. V_{DIF} Characteristics



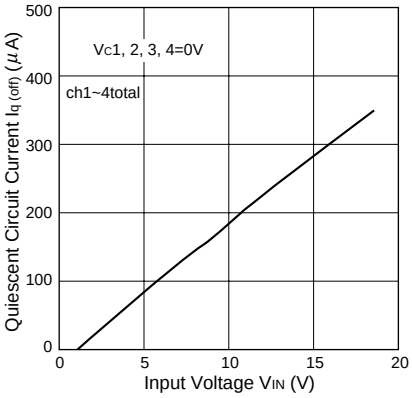
Rise Characteristics



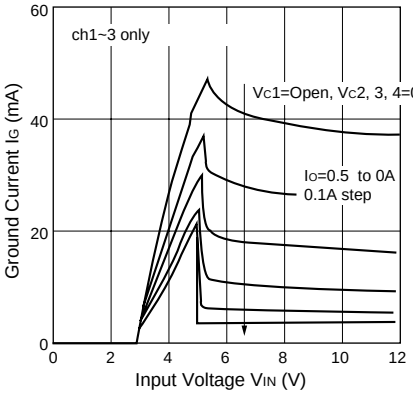
Rise Characteristics



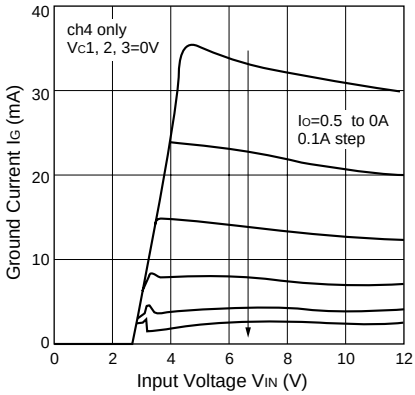
Quiescent Circuit Current



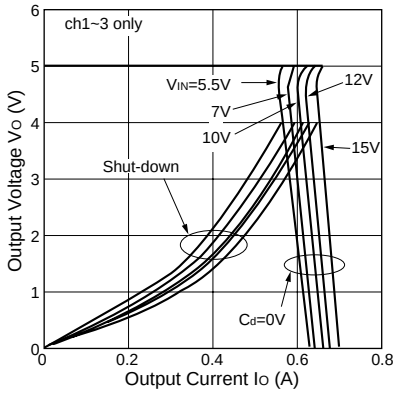
Circuit Current (ch1 operating)



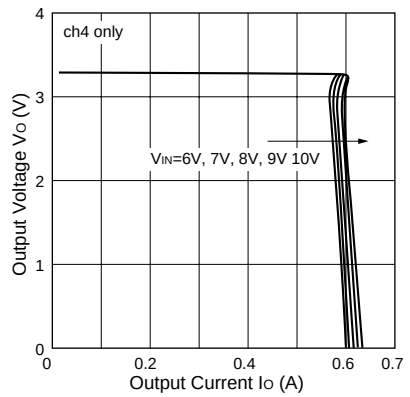
Circuit Current (ch4 operating)



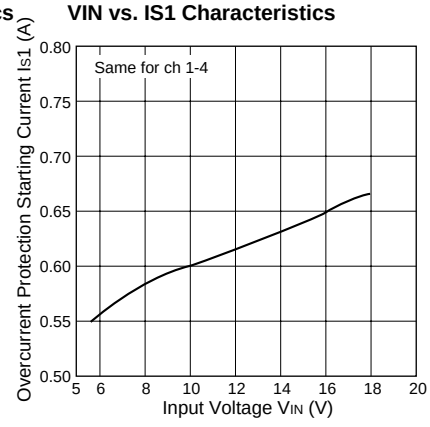
Overcurrent Protection Characteristics



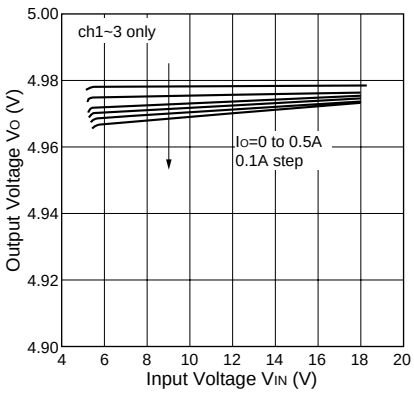
Overcurrent Protection Characteristics



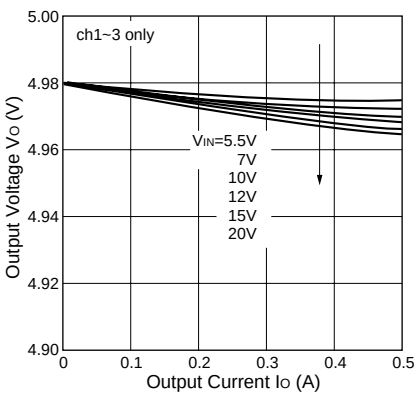
VIN vs. IS1 Characteristics



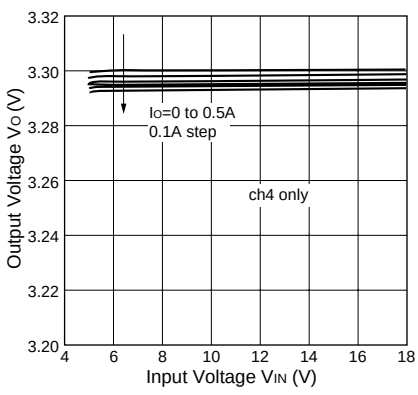
Line Regulation



Load Regulation



Line Regulation

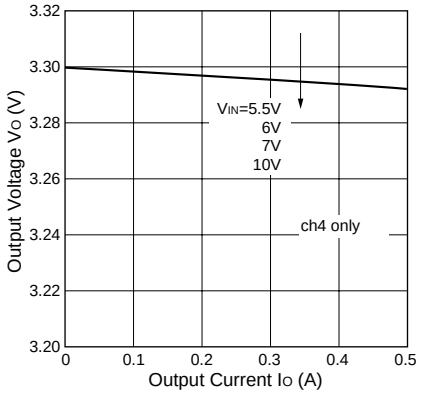


■Typical Characteristics

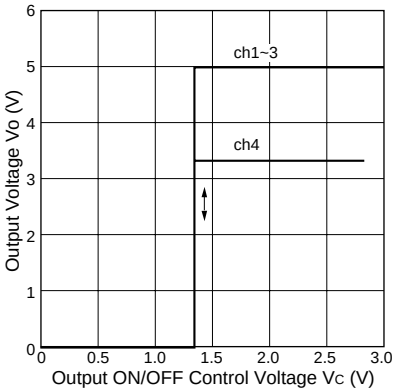
(T_a=25°C)

SLA3007M

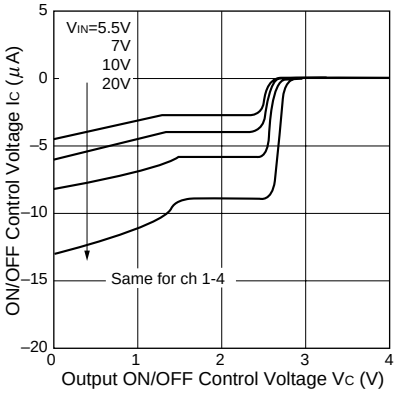
Load Regulation



ON/OFF Control Characteristics



VC Terminal Characteristics



Thermal Protection Characteristics