SI-3000KM Series Surface Mount, Low Current Consumption, Low Dropout Voltage Linear Regulator ICs

■Features

- Compact surface mount package (TO252-5)
- Output current: 1.0 A
- Low dropout voltage: $V_{DIF} \leq 0.6$ V (at I_O = 1.0 A)
- Low current consumption: Iq ≤ 350 μA (600 μA for SI-3010KM/SI-3050KM/SI-3090KM/SI-3120KM)
- Low circuit current at output OFF: Iq (OFF) ≤ 1 μA
- Built-in overcurrent and thermal protection circuits
- Output ON/OFF control function
- Compatible with low ESR capacitors (SI-3012KM/SI-3025KM/SI-3033KM)

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings		Unit
		SI-3012KM/ 3025KM/3033KM	SI-3010KM/3050KM/ 3090KM/3120KM	
DC Input Voltage	V_{IN}	17	35*1	V
Output Control Terminal Voltage	V_C	V_{IN}		V
DC Output Current	I_O	1.0		A
Power Dissipation	P_D*2	1		W
Junction Temperature	T_j	–30 to +125		°C
Storage Temperature	T_{stg}	–30 to +125		°C
Thermal Resistance (Junction to Ambient Air)	$\theta_{j\text{-}a}$*2	95		°C/W
Thermal Resistance (Junction to case)	$\theta_{j\text{-}c}$	6		°C/W

*1: A built-in input-overvoltage-protection circuit shuts down the output voltage at the Input Overvoltage Shutdown Voltage of the electrical characteristics.

*2: When mounted on glass-epoxy board of 900mm^2 (copper laminate area 4.3%).

■Applications

- Secondary stabilized power supply (local power supply)

■Recommended Operating Conditions

Parameter	Symbol	Ratings							Unit
		SI-3012KM	SI-3025KM	SI-3033KM	SI-3010KM	SI-3050KM	SI-3090KM	SI-3120KM	
Input Voltage Range	V_{IN}	2.4*2 to 6.0*1	2.4*2 to 5*1	*2 to 6*1	2.4*2 to 27*1	2.4*2 to 17*1	*2 to 20*1	*2 to 25*1	V
Output Current Range	I_O	0 to 1.0							A
Operating Ambient Temperature	T_{op}	–30 to +85							°C
Operating Junction Temperature	T_j	–20 to +100							°C

*1: V_{IN} (max) and I_O (max) are restricted according to operating conditions due to the relation $P_D = (V_{IN}\text{-}V_O) \times I_O$. Please calculate these values referring to the Copper Laminate Area vs. Power Dissipation data as shown hereinafter.

*2: Refer to the Dropout Voltage parameter.

■Electrical Characteristics 1 (Low V_O type compatible with low ESR output capacitor)

Parameter		Symbol	Ratings									Unit
			SI-3012KM (Variable type)			SI-3025KM			SI-3033KM			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	2.4*1			*1			*1			V
Output Voltage (Reference voltage VADJ for SI-3012KM)		V_O (V_{ADJ})	1.24	1.28	1.32	2.45	2.50	2.55	3.234	3.300	3.366	V
		Conditions	V_{IN}=3.3V, I_O=10mA			V_{IN}=3.3V, I_O=10mA			V_{IN}=5V, I_O=10mA			
Line Regulation		ΔV_{OLINE}			15			15			15	mV
		Conditions	V_{IN}=3.3 to 8V, I_O=10mA (V_O=2.5V)			V_{IN}=3.3 to 8V, I_O=10mA			V_{IN}=5 to 10V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			40			40			50	mV
		Conditions	V_{IN}=3.3V, I_O=0 to 1A (V_O=2.5V)			V_{IN}=3.3V, I_O=0 to 1A			V_{IN}=5V, I_O=0 to 1A			
Dropout Voltage		V_{DIF}			0.4			0.4			0.4	V
		Conditions	I_O=0.5A (V_O=2.5V)			I_O=0.5A			I_O=0.5A			
					0.6			0.6			0.6	
		Conditions	I_O=1A (V_O=2.5V)			I_O=1A			I_O=1A			
Quiescent Circuit Current		Iq			350			350			350	μA
		Conditions	V_{IN}=3.3V, I_O=0A, V_C=2V, R2=24kΩ			V_{IN}=3.3V, I_O=0A, V_C=2V			V_{IN}=5V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		Iq (OFF)			1			1			1	μA
		Conditions	V_{IN}=3.3V, V_C=0V			V_{IN}=3.3V, V_C=0V			V_{IN}=5V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.3			±0.3			±0.3		mV/°C
		Conditions	T_j=0 to 100°C (V_C=2.5V)			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		55			55			55		dB
		Conditions	V_{IN}=3.3V, f=100 to 120Hz (V_O=2.5V)			V_{IN}=3.3V, f=100 to 120Hz			V_{IN}=5V, f=100 to 120Hz			
Overcurrent Protection Starting Current*2		I_{S1}	1.1				1.1			1.1		A
		Conditions	V_{IN}=3.3V			V_{IN}=3.3V			V_{IN}=5V			
V_C Terminal	Control Voltage (Output ON)	V_C, IH	2.0			2.0			2.0			V
	Control Voltage (Output OFF)	V_C, IL			0.8			0.8			0.8	V
	Control Current (Output ON)	I_C, IH			40			40			40	μA
		Conditions	V_C=2V			V_C=2V			V_C=2V			
	Control Current (Output OFF)	I_C, IL	–5	0		–5	0		–5	0		μA
		Conditions		V_C=0V			V_C=0V			V_C=0V		

*1: Refer to the Dropout Voltage parameter.

*2: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN}=overcurrent protection starting current, I_O = 10 mA).

*3: Output is OFF when output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

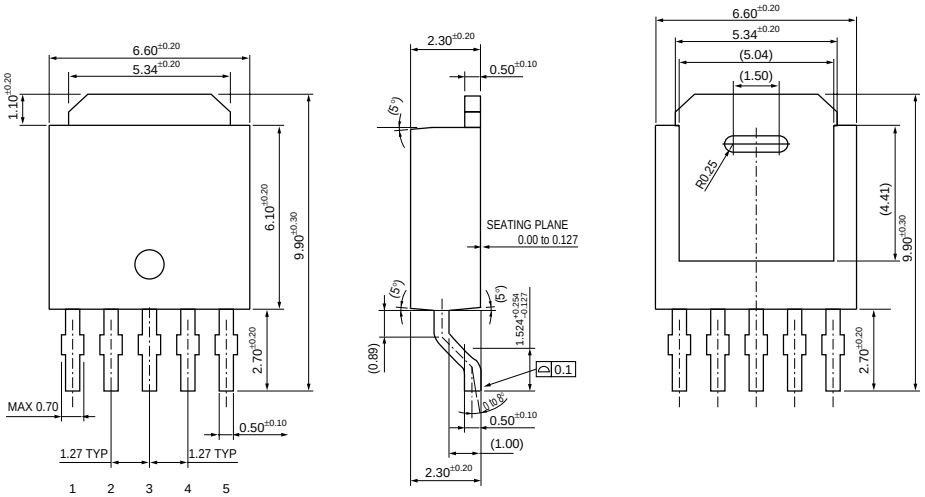
■Electrical Characteristics 2 (High V_O type)

Parameter		Symbol	Ratings												Unit
			SI-3010KM (Variable type)			SI-3050KM			SI-3090KM			SI-3120KM			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	2.4*1			*1			*1			*1			V
Output Voltage (Reference voltage VADJ for SI-3010KM)		V_O (V_{ADJ})	0.98	1.00	1.02	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	V
		Conditions	V_{IN}=7V, I_O=10mA			V_{IN}=7V, I_O=10mA			V_{IN}=11V, I_O=10mA			V_{IN}=14V, I_O=10mA			
Line Regulation		ΔV_{OLINE}			30			30			54			72	mV
		Conditions	V_{IN}=6 to 11V, I_O=10mA (V_O=5V)			V_{IN}=6 to 11V, I_O=10mA			V_{IN}=10 to 15V, I_O=10mA			V_{IN}=13 to 18V, I_O=10mA			
Load Regulation		ΔV_{OLOAD}			75			75			135			180	mV
		Conditions	V_{IN}=7V, I_O=0 to 1A (V_O=5V)			V_{IN}=7V, I_O=0 to 1A			V_{IN}=11V, I_O=0 to 1A			V_{IN}=14V, I_O=0 to 1A			
Dropout Voltage		V_{DIF}			0.3			0.3			0.3			0.3	V
		Conditions	I_O=0.5A (V_O=5V)			I_O=0.5A			I_O=0.5A			I_O=0.5A			
					0.6			0.6			0.6			0.6	
		Conditions	I_O=1A (V_O=5V)			I_O=1A			I_O=1A			I_O=1A			
Quiescent Circuit Current		Iq			600			600			600			600	μA
		Conditions	V_{IN}=7V, I_O=0A, V_C=2V R2=10kΩ			V_{IN}=7V, I_O=0A, V_C=2V			V_{IN}=11V, I_O=0A, V_C=2V			V_{IN}=14V, I_O=0A, V_C=2V			
Circuit Current at Output OFF		Iq (OFF)			1			1			1			1	μA
		Conditions	V_{IN}=7V, V_C=0V			V_{IN}=7V, V_C=0V			V_{IN}=11V, V_C=0V			V_{IN}=14V, V_C=0V			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0			±1.5		mV/°C
		Conditions	T_j=0 to 100°C (V_O=5V)			T_j=0 to 100°C			T_j=0 to 100°C			T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		75			75			68			66		dB
		Conditions	V_{IN}=7V, f=100 to 120Hz (V_O=5V)			V_{IN}=7V, f=100 to 120Hz			V_{IN}=11V, f=100 to 120Hz			V_{IN}=14V, f=100 to 120Hz			
Overcurrent Protection Starting Current*2		I_{S1}	1.1			1.1			1.1			1.1			A
		Conditions	V_{IN}=7V			V_{IN}=7V			V_{IN}=11V			V_{IN}=14V			
V_C Terminal	Control Voltage (Output ON)	V_C, IH	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	V_C, IL			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	I_C, IH			40			40			40			40	μA
		Conditions	V_C=2V			V_C=2V			V_C=2V			V_C=2V			
	Control Current (Output OFF)	I_C, IL	–5	0		–5	0		–5	0		–5	0		μA
		Conditions	V_C=0V			V_C=0V			V_C=0V			V_C=0V			
Input Overvoltage Shutdown Voltage		V_{OVP}	33			26			30			33			V
		Conditions	I_O=10mA			I_O=10mA			I_O=10mA			I_O=10mA			

*1: Refer to the Dropout Voltage parameter.
*2: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN}=overcurrent protection starting current, I_O = 10 mA).
*3: Output is OFF when output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*4: SI-3010KM, SI-3050KM and SI-3090KM, SI-3120KM cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage
*5: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$. Please calculate these values referring to the Copper Laminate Area vs. Power Dissipation data as shown hereinafter.

■External Dimensions (TO252-5)

(Unit : mm)

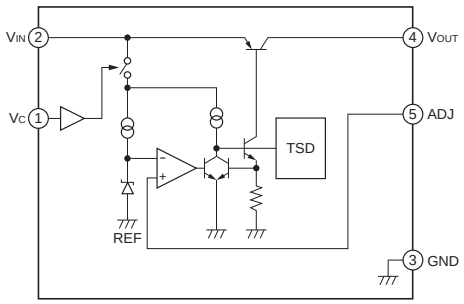


Pin Assignment
① V_C
② V_{IN}
③ GND
④ V_O
⑤ SENSE
(ADJ for SI-3010KM/SI-3120KM)

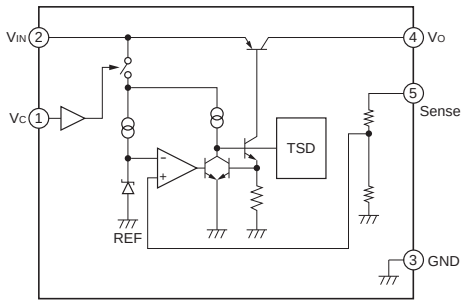
Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 0.33g

■Block Diagram

●SI-3010KM/SI-3012KM

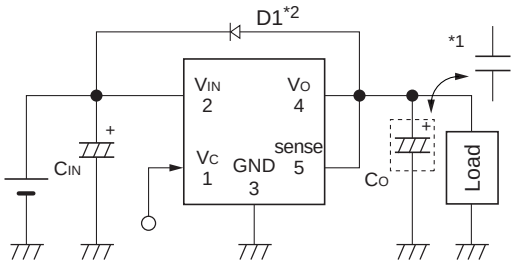


●SI-3025KM/SI-3033KM/SI-3050KM/SI-3090KM/SI-3120KM

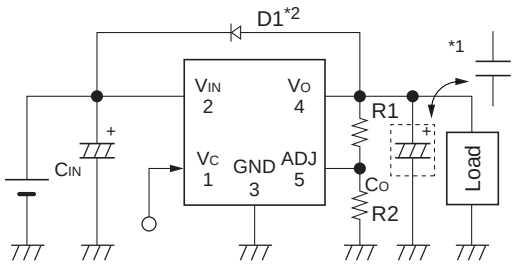


■Typical Connection Diagram

●SI-3025KM/SI-3033KM/SI-3050KM/
SI-3090KM/SI-3120KM



●SI-3010KM/SI-3012KM



CIN: Input capacitor (22 μF or larger)
CO: Output capacitor

*1: SI-3012KM/3025KM/3033KM (22 μF or larger)
It comes with a circuit configuration that uses a low ESR capacitor for the output capacitor.
If an electrolytic capacitor is used, oscillation may occur at a low temperature.

SI-3010KM/3050KM/3090KM/3120KM (47 μF or larger)
If a low ESR capacitor is used, oscillation may occur.

*2: D1: Reverse bias protection diode
This diode is required for protection against reverse biasing between the input and output.
(Sanken SJPL-H2 is recommended.)
This diode is not required at VO ≤ 3.3 V.

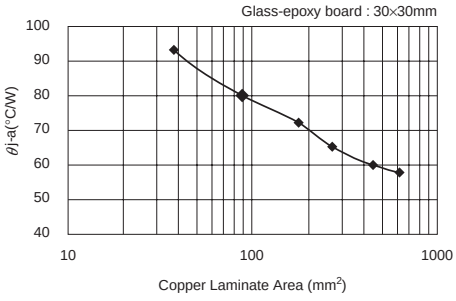
R1, R2: Output voltage setting resistors
Output voltage can be set by connecting R1 and R2 as shown above.
R2: 10 kΩ is recommended (24 kΩ for SI-3012KM).

$R1=(V_O-V_{ADJ})\div(V_{ADJ}/R2)$

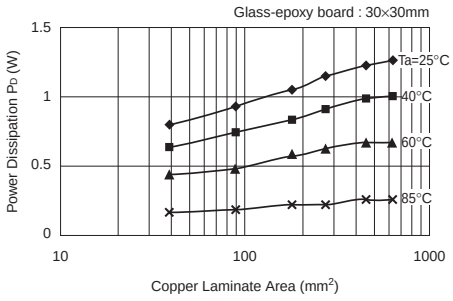
*3: For SI-3010KM, insert R3 in case of setting VO to VO ≤ 1.5V.
Recommended value for R3 is 10kΩ.

■Reference Data

Copper Laminate Area-Thermal Resistance

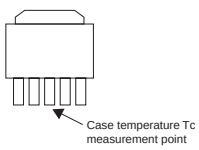


Copper Laminate Area-Power Dissipation



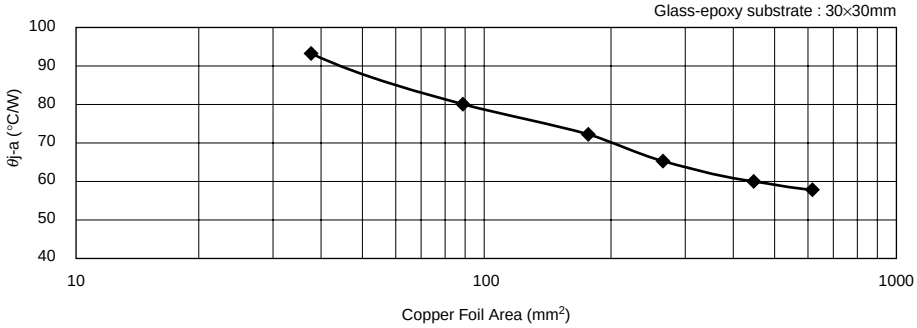
• Obtaining the junction temperature
Measure the temperature TC at the lead part of the GND pin with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

$T_j=P_D\times\theta_{j-c}+T_C \quad (\theta_{j-c}=6°C/W)$

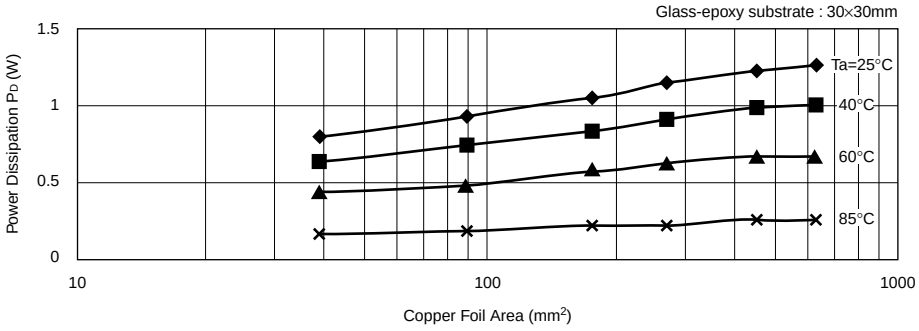


■Reference Data

Copper Foil Area-Thermal Resistance

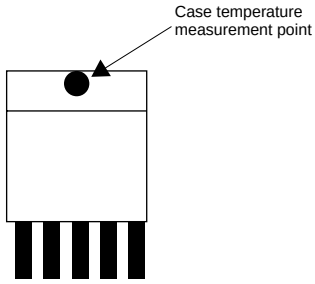


Copper Foil Area-Power Dissipation



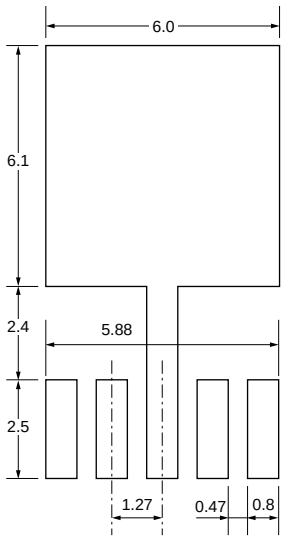
- Obtaining Junction Temperature
  Temperature of lead part of GND terminal: Measure T_C with thermocouple. Substitute value to the following formula to obtain the junction temperature

$$T_j = P_D \times \theta_{j-C} + T_C \qquad (\theta_{j-C} = 6°C/W)$$



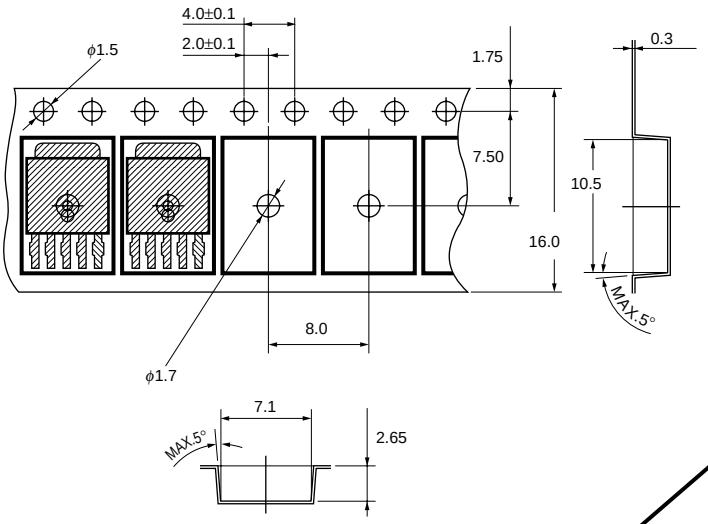
■Example of Soldering Pattern Design

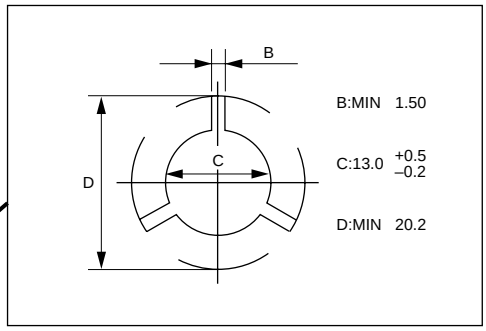
(Unit : mm)



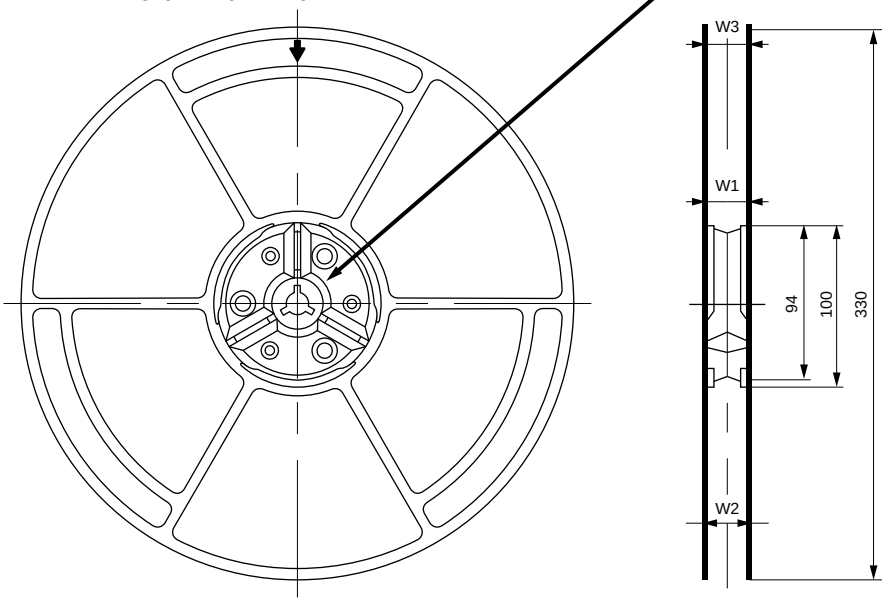
■Packing Specifications

(Unit : mm)





Reel : Packing quantity 3000 pcs

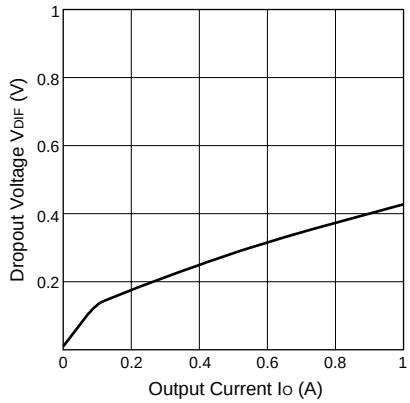


W1 +2 –0	W2 MAX	W1 +3 –0.5
16.4 mm	22.4 mm	16.4 mm

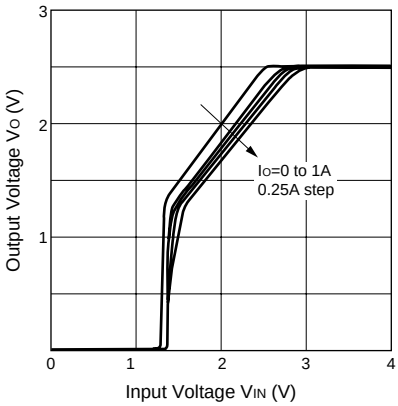
■SI-3012KM Typical Characteristics

(T_a=25°C) *At V_{out}=2.5V measurement (R2=24kΩ)

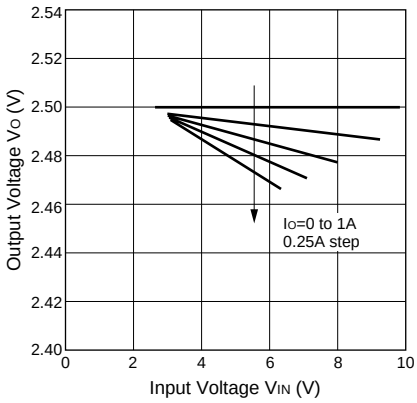
Dropout Voltage



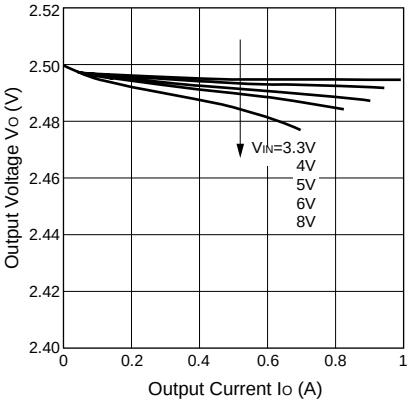
Output Rise Characteristics



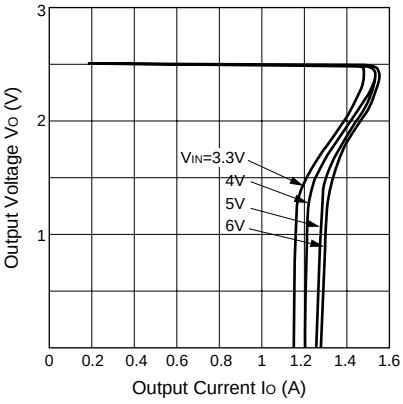
Line Regulation



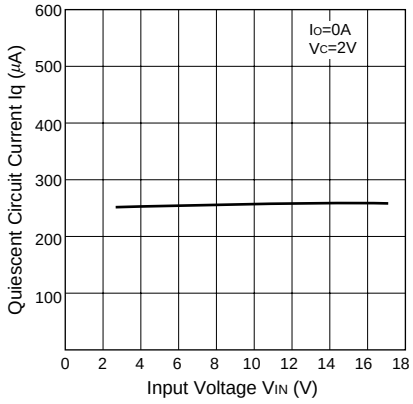
Load Regulation



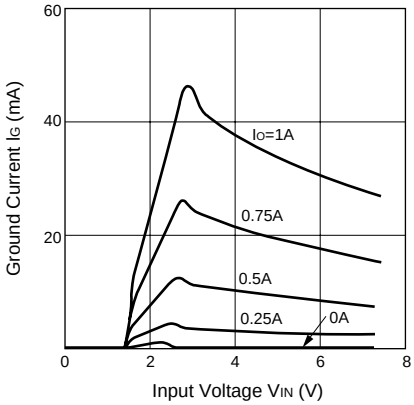
Overcurrent Protection Characteristics



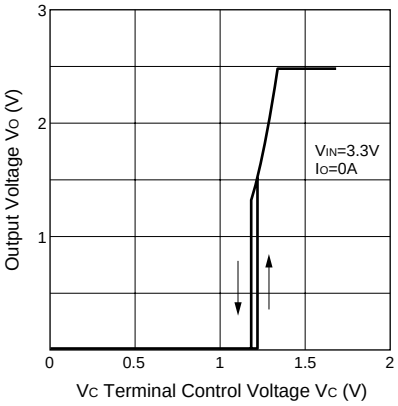
Quiescent Circuit Current



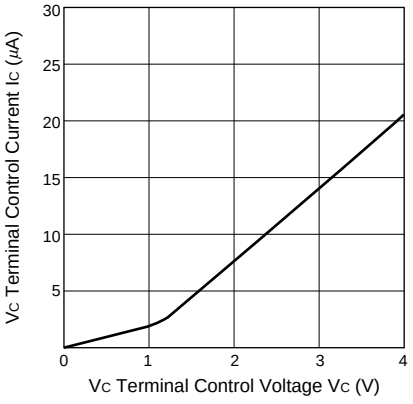
Circuit Current



Output ON/OFF Control



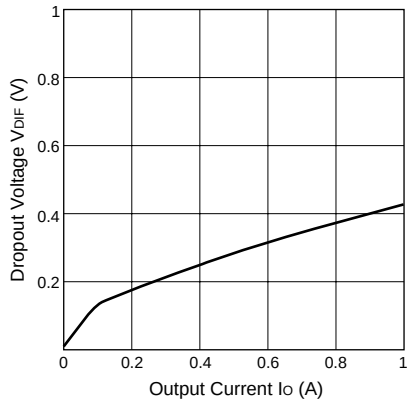
Output ON/OFF Control Current



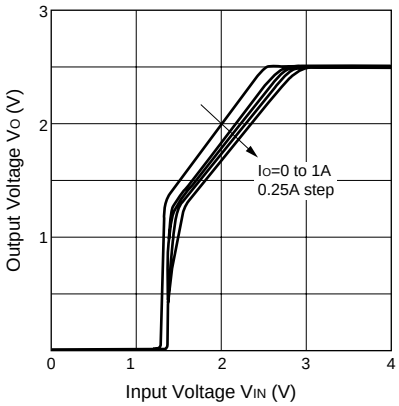
■SI-3025KM Typical Characteristics

(T_a=25°C)

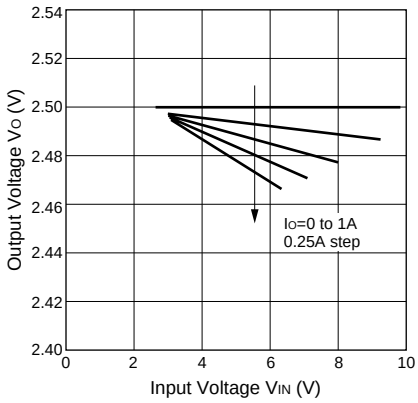
Dropout Voltage



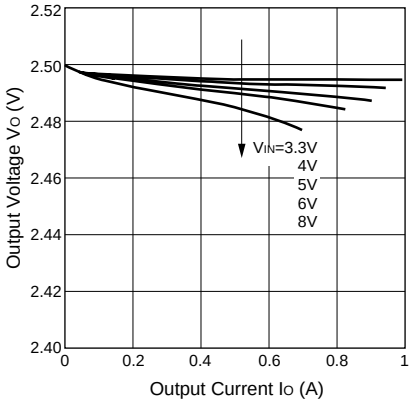
Output Rise Characteristics



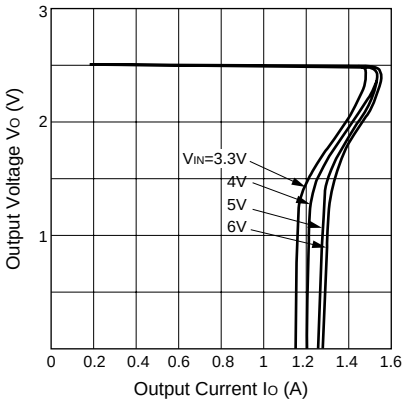
Line Regulation



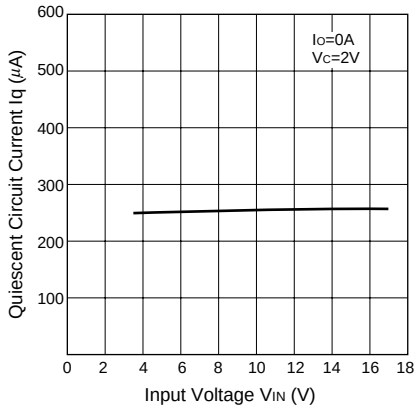
Load Regulation



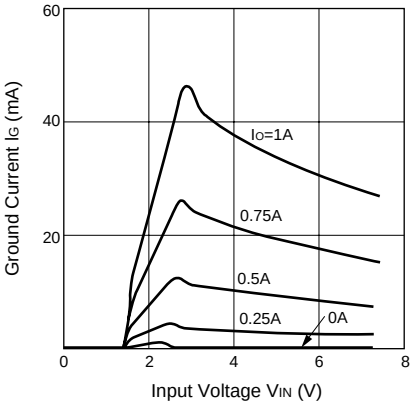
Overcurrent Protection Characteristics



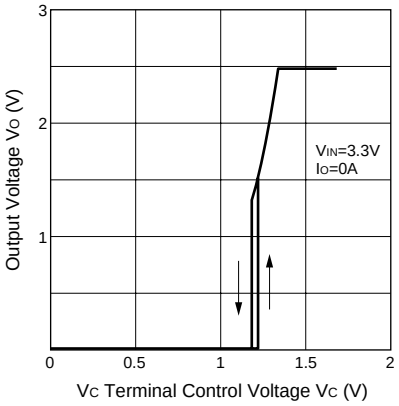
Quiescent Circuit Current



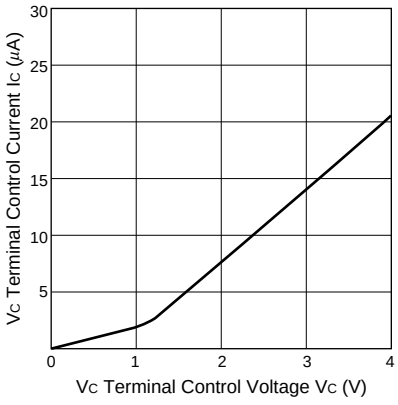
Circuit Current



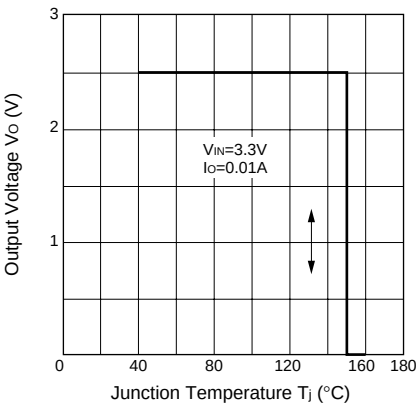
Output ON/OFF Control



Output ON/OFF Control Current



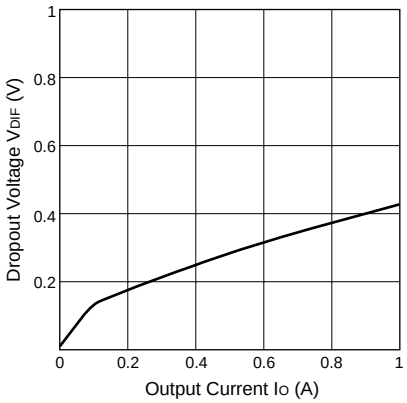
Thermanl Protection Characteristics



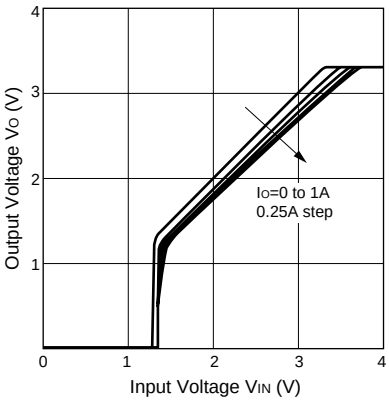
■SI-3033KM Typical Characteristics

(T_a=25°C)

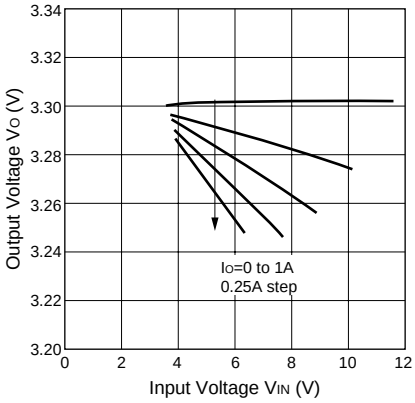
Dropout Voltage



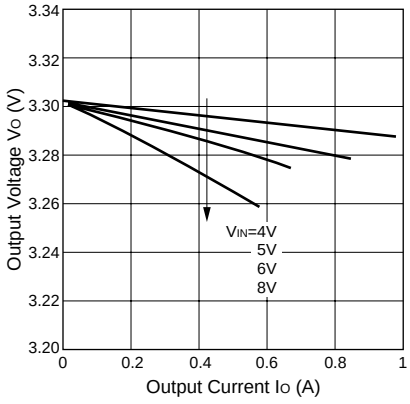
Output Rise Characteristics



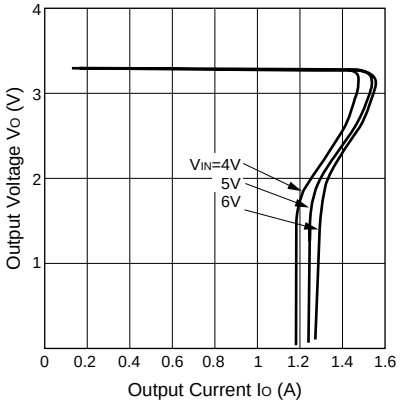
Line Regulation



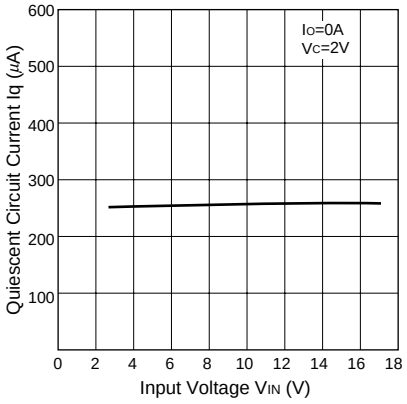
Load Regulation



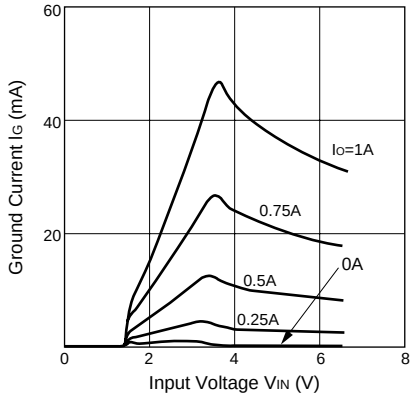
Overcurrent Protection Characteristics



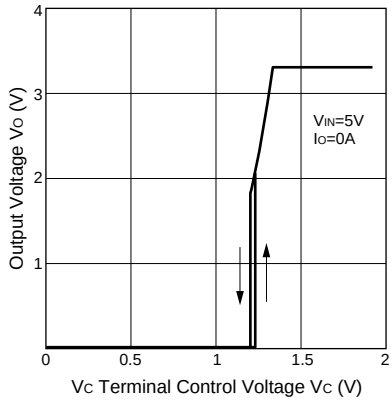
Quiescent Circuit Current



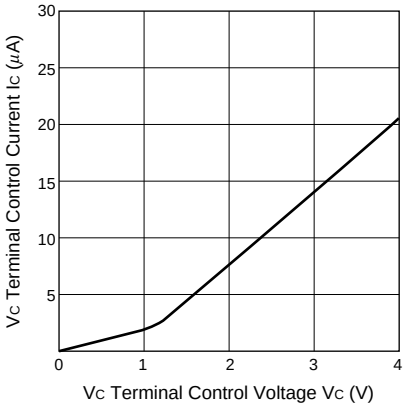
Circuit Current



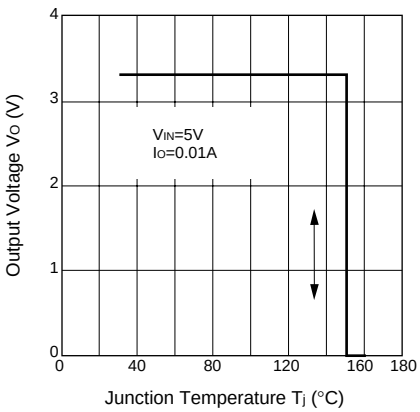
Output ON/OFF Control



Output ON/OFF Control Current



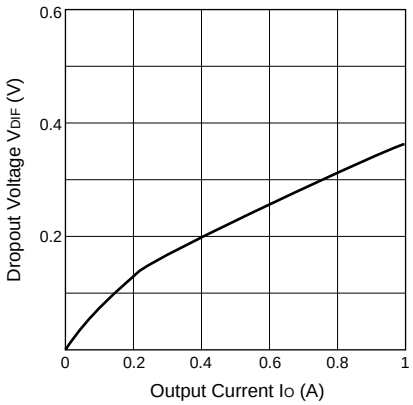
Thermanl Protection Characteristics



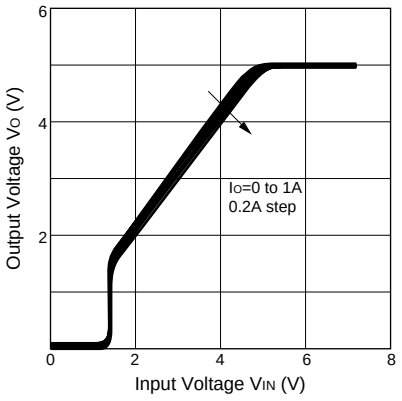
■SI-3010KM Typical Characteristics

(T_a=25°C) *At V_{out}=2.5 V measurement (R2=10 kΩ)

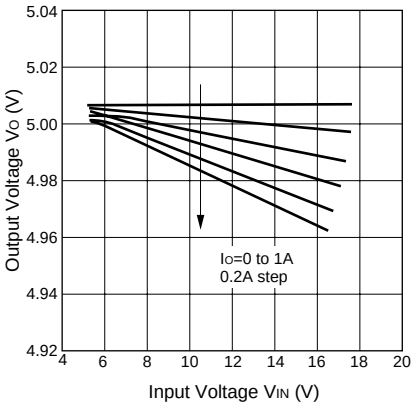
Dropout Voltage



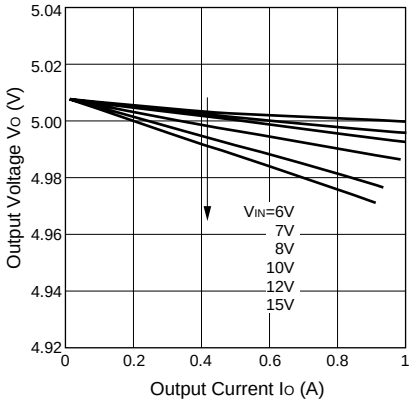
Output Rise Characteristics



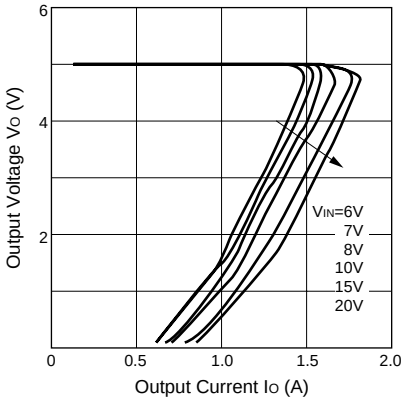
Line Regulation



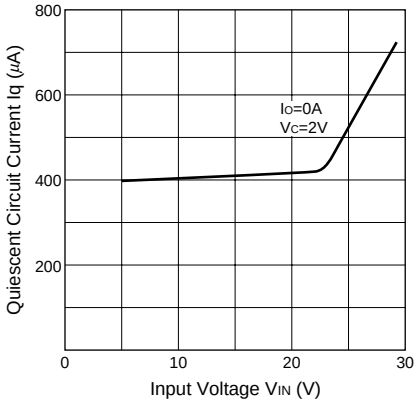
Load Regulation



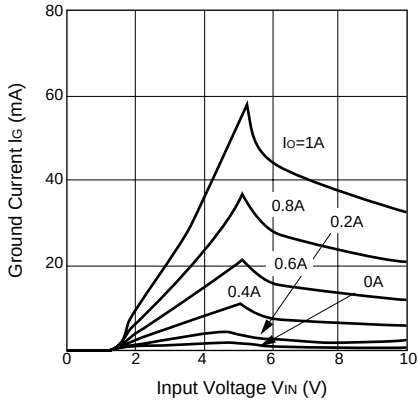
Overcurrent Protection Characteristics



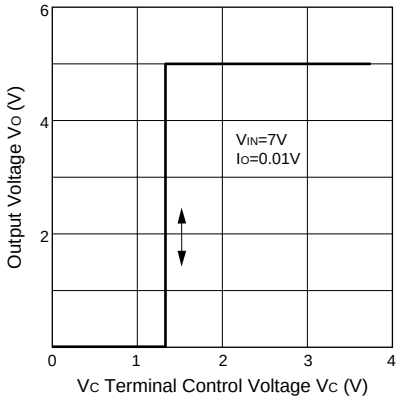
Quiescent Circuit Current



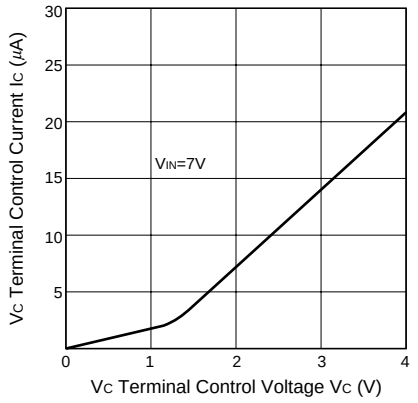
Circuit Current



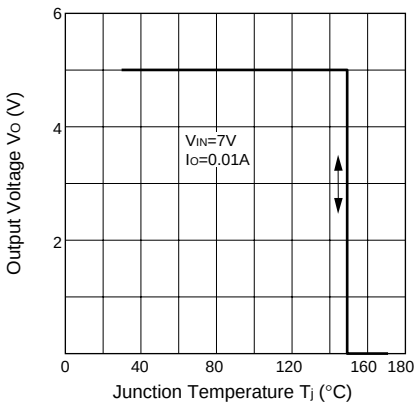
Output ON/OFF Control



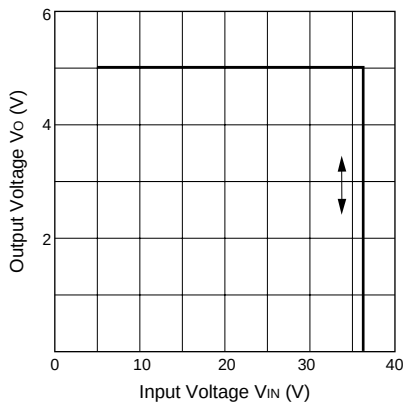
Output ON/OFF Control Current



Thermal Protection Characteristics



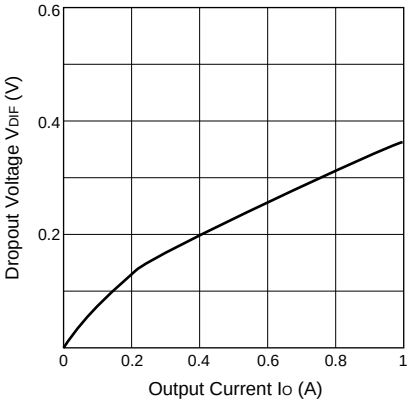
Overinput Voltage Protection Characteristics



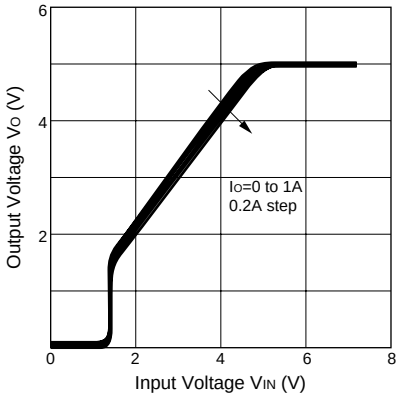
■SI-3050KM Typical Characteristics

(T_a=25°C)

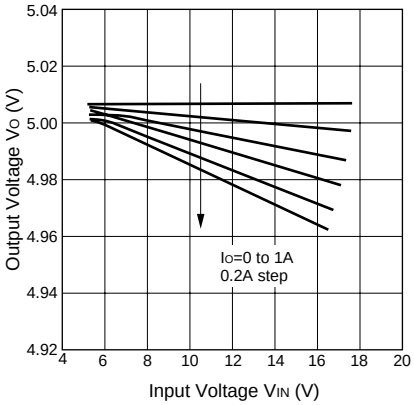
Dropout Voltage



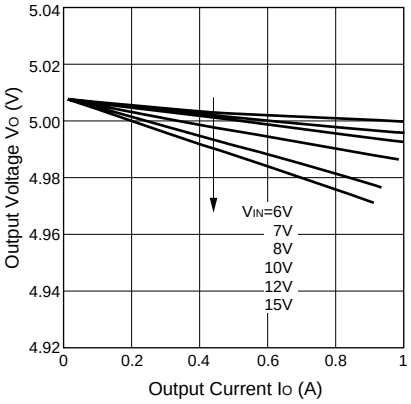
Output Rise Characteristics



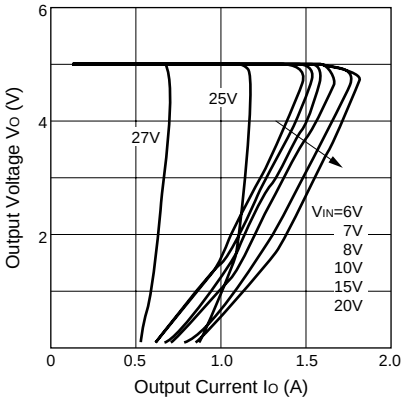
Line Regulation



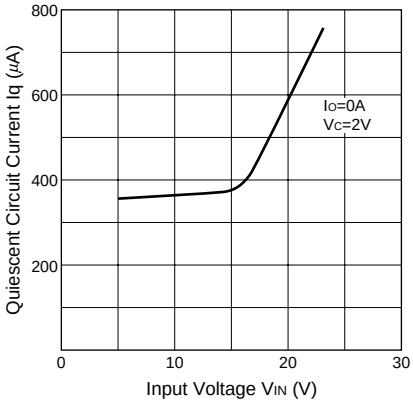
Load Regulation



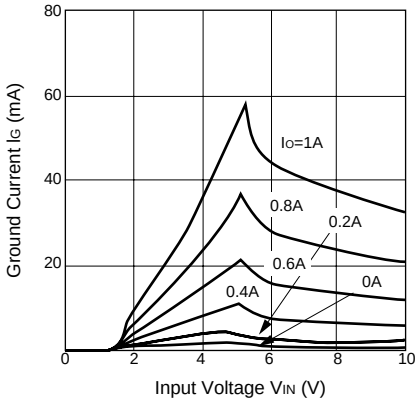
Overcurrent Protection Characteristics



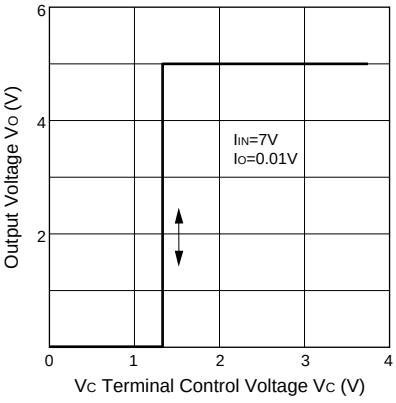
Quiescent Circuit Current



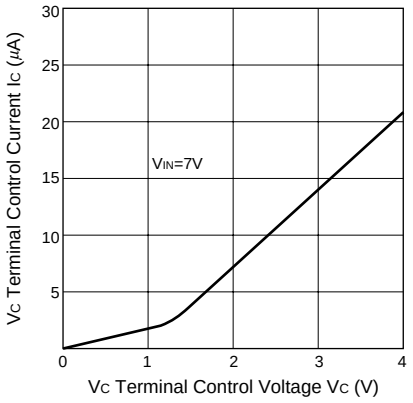
Circuit Current



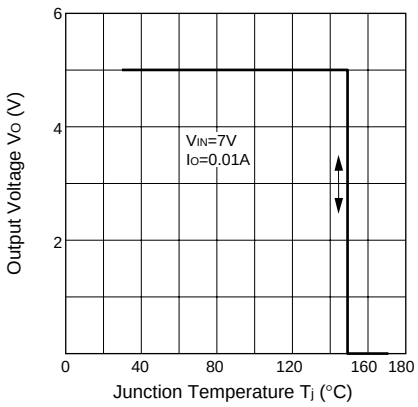
Output ON/OFF Control



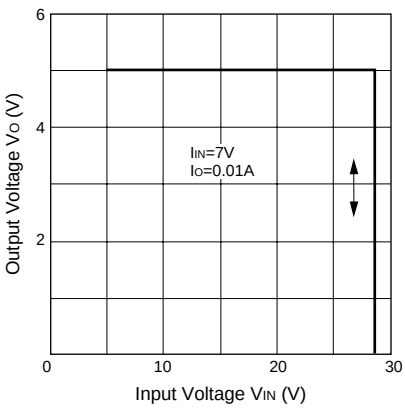
Output ON/OFF Control Current



Thermal Protection Characteristics



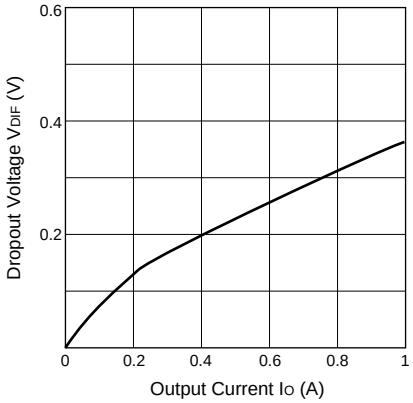
Overinput Voltage Protection Characteristics



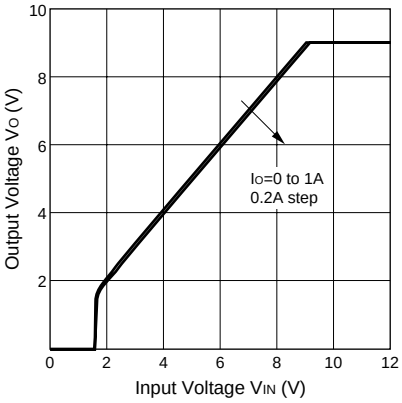
■SI-3090KM Typical Characteristics

(T_a=25°C)

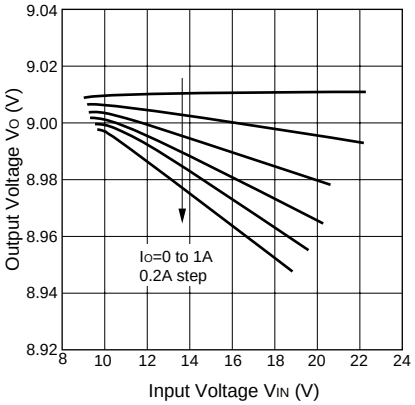
Dropout Voltage



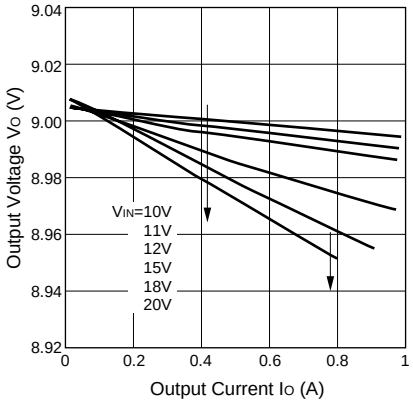
Output Rise Characteristics



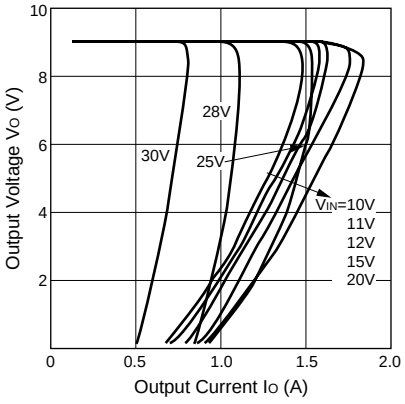
Line Regulation



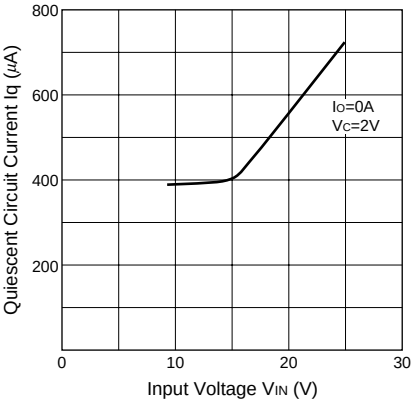
Load Regulation



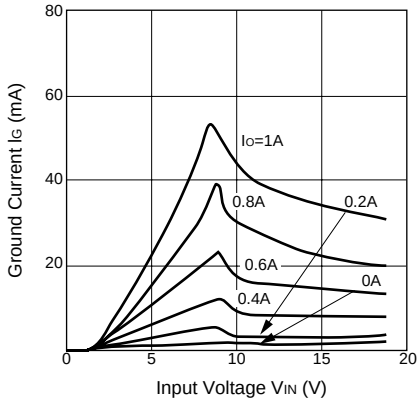
Overcurrent Protection Characteristics



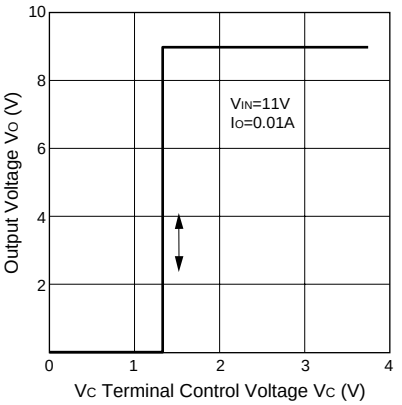
Quiescent Circuit Current



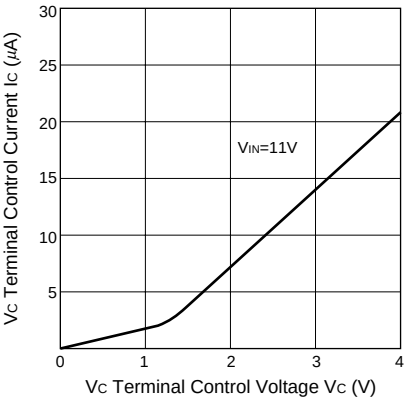
Circuit Current



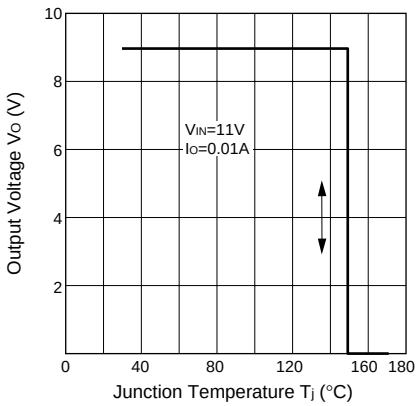
Output ON/OFF Control



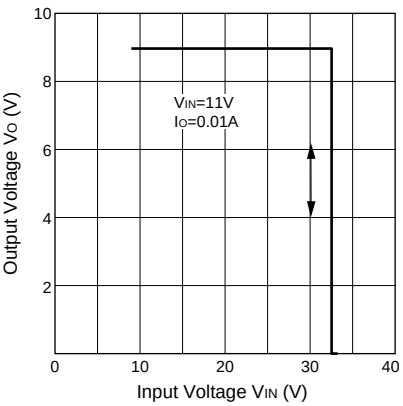
Output ON/OFF Control Current



Thermal Protection Characteristics



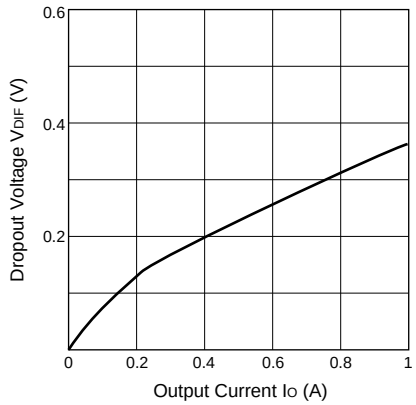
Overinput Voltage Protection Characteristics



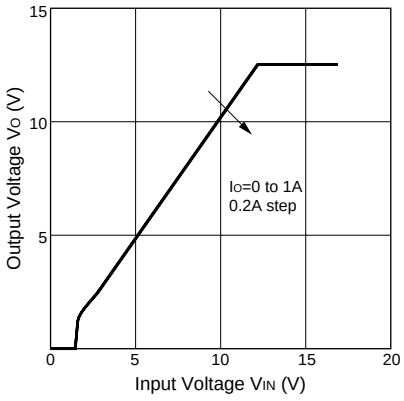
■SI-3120KM Typical Characteristics

(T_a=25°C)

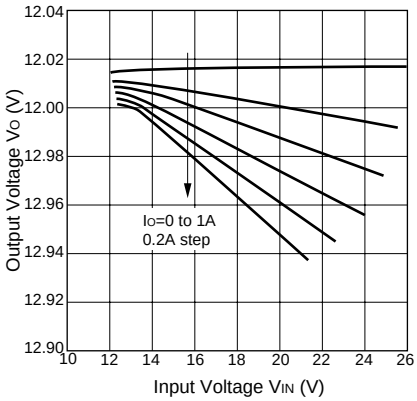
Dropout Voltage



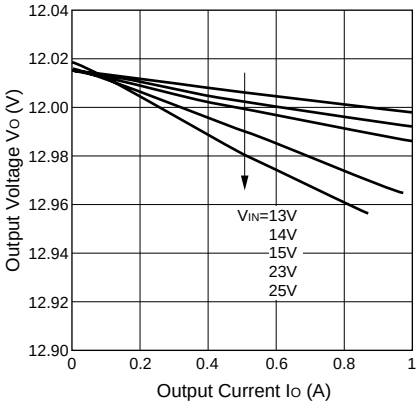
Output Rise Characteristics



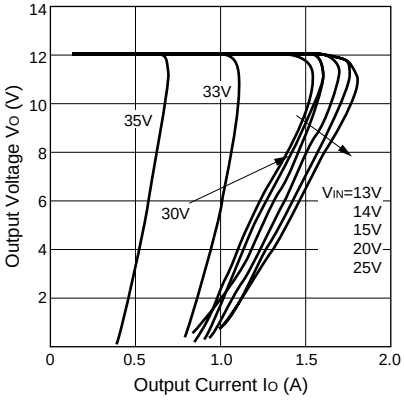
Line Regulation



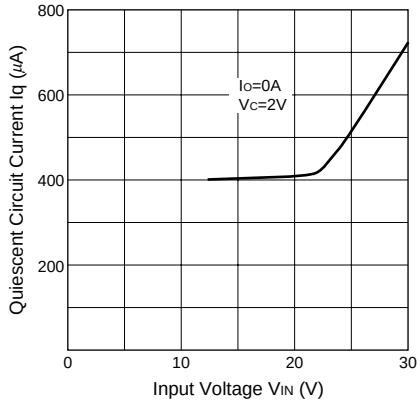
Load Regulation



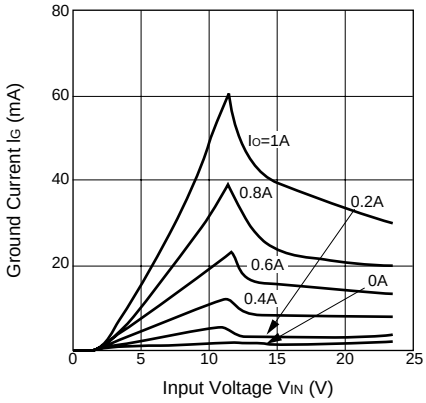
Overcurrent Protection Characteristics



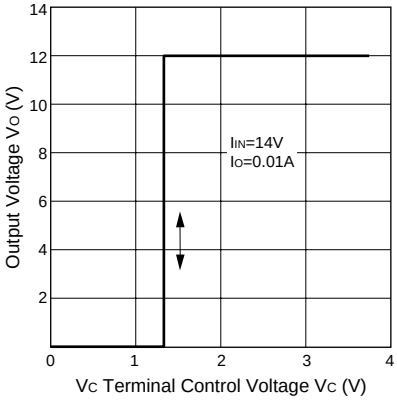
Quiescent Circuit Current



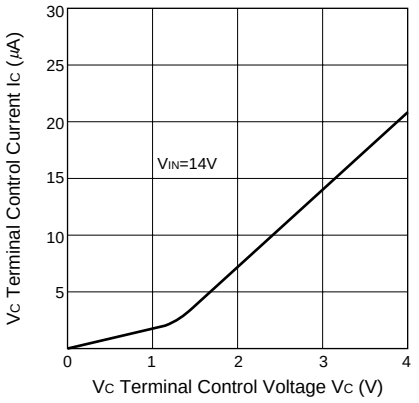
Circuit Current



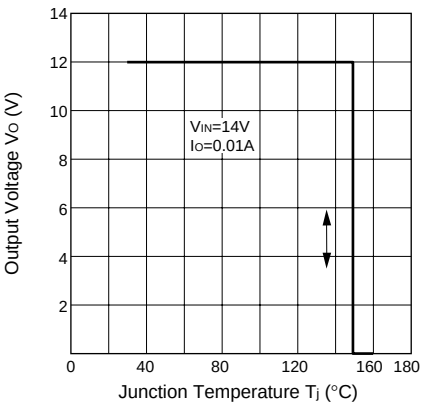
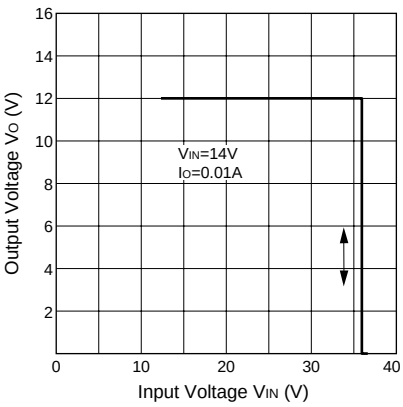
Output ON/OFF Control



Output ON/OFF Control Current



Thermal Protection Characteristics



Overinput Voltage Protection Characteristics