

Section 4.2

REGULATOR SPECIFICATIONS

● Description

The Seiko Instruments voltage regulators are 3-pin positive and negative, low drop-out voltage regulators made using the CMOS process technology. The output voltages are fixed internally. The S-802 Series provide a negative output in -3V and -5V. The S-812/813 Series are positive outputs with a precision accuracy of $\pm 2.4\%$ and $\pm 2.0\%$. They are highly efficient, with a typical I/O voltage difference of 120mV at 40 mA. Battery-powered portable equipment can maintain a higher capacity and a longer service life by using these regulators. All of the regulators include a reference voltage supply, an error amplifier, a control transistor, and a resistor network which controls the output voltage. All of the performance features of the low drop-out regulators are available in the tiny SOT-23-5 packages, perfect for all low power applications.

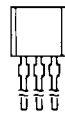
● Features

- Low power consumption (1.2 μ A typ S-812)
- Low drop-out voltage ($V_{IN} - V_{OUT}$), for 5V output, 160 mV at 10 mA
- High accuracy of output voltage
 $\pm 2\%$: $V_{OUT} \geq 2.7V$, $\pm 2.4\%$: $V_{OUT} \leq 2.6V$
- Low temperature coefficient of output voltage ($\pm .625$ mV/ $^{\circ}$ C typ)
- Wide operating voltage range up to 16V
- Output current up to 100 mA
- Good line regulation:
 S-812 = 40 mV for $I_{OUT} = 1\mu A$ to 40 mA
- Superior input stability 0.1%/V typ.
- 3 Packages: TO-92, SOT-89-3, SOT-23-5

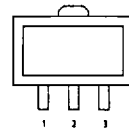
● Applications

- Standard stable voltage supply
- Constant voltage power supply for battery-powered devices
- Communications equipment
- Video equipment
- Cellular phones
- Cordless phones
- Automotive electronics
- Others

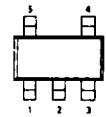
● Packages



TO-92

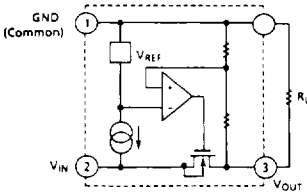


SOT-89-3

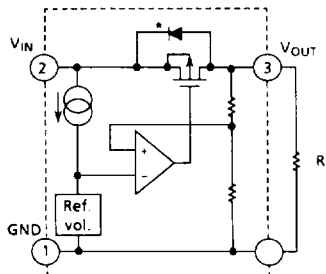


SOT-23-5

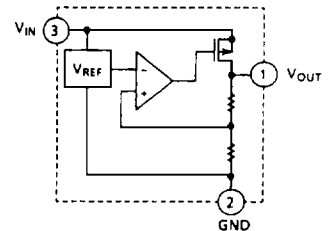
● Block Diagrams



S-802



S-812 * Parasitic diode



S-813

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● Ratings

Parameter	Symbol	Conditions	Ratings
Input voltage	V_{IN}	$V_{OUT} \leq 2.6V$ for S-812	10V nom, 12V max
		$V_{OUT} \leq 2.7V$ for S-812	16V nom, 18V max
		for S-802	-10V max
		for S-813	15V max
Output voltage	V_{OUT}		$V_{IN} + 0.3V$ to $V_{SS} - 0.3V$
Output current	I_{OUT}		100 mA max
Current consumption (No load)	I_{SS}	TO-92, SOT-89-3 (PG)	1.2 μA nom, 3.2 μA max
		SOT-23-5 (SG)	2.5 μA max
		for S-802	3 μA nom, 7 μA max
		for S-813	16 μA nom, 30 μA max
Power dissipation	P_D	TO-92 (AG/HG)	200 mW
		TO-92 (PG)	400mW
		SOT-89-3 (all S-813)	500 mW
		SOT-23-5 (SG)	150 mW
Temperature characteristic of ΔV_{OUT} per volt	$\frac{\Delta V_{OUT}}{\Delta T_a}$ per Volt	$V_{IN} = 1.5V, I_{OUT} = 10mA, S-812PG$	$\pm 0.125 mV/^\circ C$ per volt
		$V_{IN} = 5-7V, I_{OUT} = 30-40mA, S-813$	$\pm 0.11 mV/^\circ C$ per volt
Operating temperature	T_{opr}	for S-802	-20°C to +70°C
		for S-813	-30°C to +80°C
		for S-812	-40°C to +85°C
Storage temperature	T_{stg}		-40°C to +125°C
Ripple rejection	$ RR $	$f = 100 Hz, C_L = 100 \mu F, I_{OUT} = 30 - 40 mA, V_{IN} = 5-7V$ (S-813 only)	45 - 48 dB

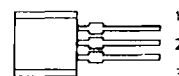
● Pin Assignments

Pin No.	S-802 (SOT-89-3) S-812, S-813 (SOT-23-5)	S-802 (TO-92), S-812 and S-813 (TO-92 and SOT-89-3)
1	Ground	V_{OUT}
2	V_{IN}	Gnd
3	V_{OUT}	V_{IN}
4	NC	NC
5	NC	NC

SOT-23-5



TO-92



SOT-89-3



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● Product Selection

Output voltage	TO-92	SOT-89-3	SOT-23-5	Standard
-3.0 V ± 5%	S-80230AG	S-80230AG-GA-X	--	S
-5.0 V ± 5%	S-80250AG	S-80250AG-GS-X	--	S
1.1 V ± 2.4%	S-81211PG	S-81211PG-PA-X	S-81211SG-QA-X	
1.5 V ± 2.4%	S-81215PG	S-81215PG-PK-X	S-81215SG-QK-X	S
2.0 V ± 2.4%	S-81220PG	S-81220PG-PS-X	S-81220SG-QS-X	
2.1 V ± 2.4%	--	S-81221PG-PU-X	--	
2.2 V ± 2.4%	--	S-81222PG-PV-X	--	
2.3 V ± 2.4%	S-81223PG	--	--	
2.4 V ± 2.4%	S-81224PG	S-81224PG-PX-X	S-81224SG-QX-X	
2.5 V ± 2.4%	S-81225PG	S-81225PG-PH-X	S-81225SG-QH-X	
2.7 V ± 2.4%	--	S-81227PG-PZ-X	--	
3.0 V ± 2.4%	S-81230PG or S-81330HG	S-81230PG-PB-X or S-81330HG-KB-X	S-81230SG-QB-X	S
3.2 V ± 2.4%	S-81332HG	S-81332HG-KC-X	--	
3.3 V ± 2.4%	S-81233PG	S-81233PG-PF-X	S-81233SG-QF-X	S
3.5 V ± 2.4%	S-81235PG	S-81235PG-PI-X	S-81235SG-QI-X	
3.7 V ± 2.4%	S-81237PG	S-81237PG-PE-X or S-81337HG-KE-X	S-81237SG-QE-X	
4.0 V ± 2.4%	S-81240PG	S-81240PG-PJ-X or S-81340HG-KJ-X	S-81240SG-QJ-X	S
4.5 V ± 2.4%	S-81245PG	S-81245PG-P5-X	S-81245SG-Q5-X	
4.6 V ± 2.4%	S-81246PG	S-81246PG-PM-X	S-81246SG-QM-X	
4.7 V ± 2.4%	--	S-81347HG-KQ-X	S-81247SG-IE-X	
5.0 V ± 2.4%	S-81250PG or S-81350HG	S-81250PG-PD-X or S-81350HG-KD-X	S-81250SG-QD-X	S
5.2 V ± 2.4%	S-81252PG	S-81252PG-PL-X	S-81252SG-QL-X	
5.3 V ± 2.4%	--	S-81253PG-TJ-X	--	
5.4 V ± 2.4%	--	S-81254PG-TK-X	--	
5.5 V ± 2.4%	--	S-81255PG-TL-X	--	
5.6 V ± 2.4%	--	S-81256PG-TM-X	--	

S - Standard Product. All others listed are non-standard, available with longer lead time
Customization for other voltage levels available. Please contact Seiko Instrument, USA, Inc.
Electronic Components Division, Sales Department.

S-813 products provide higher output current with greater precision.

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● Electrical Characteristics

S-80230AG, S-80230AG-GA-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{\text{IN}} = -5\text{V}, I_{\text{OUT}} = 1\text{ mA}$	-3.15V	-3.00V	-2.85V
I/O voltage difference	V_{dif}	$I_{\text{OUT}} = 1\text{ mA}$	--	60mV	--
Line regulation	$\frac{\Delta V_{\text{OUT}}}{\Delta V_{\text{IN}}}$ V_{OUT}	$-10\text{V} \leq V_{\text{IN}} \leq -4\text{V}$ $I_{\text{OUT}} = 1\text{ mA}$	--	0.1%/V	--
Load regulation	ΔV_{OUT}	$1\text{ mA} \leq I_{\text{OUT}} \leq 20\text{ mA}$ $V_{\text{IN}} = -5\text{V}$	--	60mV	100mV

S-80250AG, S-80250AG-GB-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{\text{IN}} = -7\text{V}, I_{\text{OUT}} = 10\text{ mA}$	-5.25V	-5.00V	-4.75V
I/O voltage difference	V_{dif}	$I_{\text{OUT}} = 1\text{ mA}$	--	30mV	--
Line regulation	$\frac{\Delta V_{\text{OUT}}}{\Delta V_{\text{IN}}}$ V_{OUT}	$-10\text{V} \leq V_{\text{IN}} \leq -6\text{V}$ $I_{\text{OUT}} = 1\text{ mA}$	--	0.1%/V	--
Load regulation	ΔV_{OUT}	$1\text{ mA} \leq I_{\text{OUT}} \leq 40\text{ mA}$ $V_{\text{IN}} = -7\text{V}$	--	40mV	80mV

S-81211, S-81211PG-PA-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{\text{IN}} = 1.5\text{V}, I_{\text{OUT}} = 0.5\text{ mA}$	1.073V	1.100V	1.127V
I/O voltage difference	V_{dif}	$I_{\text{OUT}} = 0.5\text{ mA}$	--	0.05V	0.2V
Line regulation	$\Delta V_{\text{OUT}1}$	$V_{\text{IN}} = 1.5\text{ V to } 10\text{ V}$ $I_{\text{OUT}} = 0.5\mu\text{A}$	--	10mV	50mV
Line regulation	$\Delta V_{\text{OUT}2}$	$V_{\text{IN}} = 1.5\text{ V to } 10\text{ V}$ $I_{\text{OUT}} = 10\mu\text{A}$	--	10mV	77mV
Load regulation	$\Delta V_{\text{OUT}3}$	$V_{\text{IN}} = 1.5\text{ V}$ $I_{\text{OUT}} = 10\text{ mA to } 0.5\mu\text{A}$	--	10mV	100mV

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REGULATOR SPECIFICATIONS

● **Electrical Characteristics, cont.**

S-81215PG, S-81215PG-PK-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 3.5\text{V}, I_{OUT} = 0.5\text{mA}$	1.464V	1.500V	1.536V
I/O voltage difference	V_{dif}	$I_{OUT} = 0.5\text{mA}$	--	0.03V	0.18V
Line regulation	ΔV_{OUT1}	$V_{IN} = 2.5\text{V to } 10\text{V}$ $I_{OUT} = 0.5\mu\text{A}$	--	7mV	39mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 2.5\text{V to } 10\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	7mV	105mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 3.5\text{V}$ $I_{OUT} = 1\mu\text{A to } 10\text{mA}$	--	80mV	120mV

S-81220PG-S-81220PG-PS-X, S-8122SG-QS-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 4.0\text{V}, I_{OUT} = 10\text{mA}$	1.952V	2.000V	2.048V
I/O voltage difference	V_{dif}	$I_{OUT} = 10\text{mA}$	--	0.63V	1.39V
Line regulation	ΔV_{OUT1}	$V_{IN} = 3.0\text{V to } 10\text{V}$ $I_{OUT} = 1\text{mA}$	--	8mV	48mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 3.0\text{V to } 10\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	8mV	140mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 4.0\text{V}$ $I_{OUT} = 1\mu\text{A to } 10\text{mA}$	--	80mV	120mV

S-81222PG-PV-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 4.2\text{V}, I_{OUT} = 10\text{mA}$	2.147V	2.200V	2.253V
I/O voltage difference	V_{dif}	$I_{OUT} = 10\text{mA}$	--	0.56V	1.26V
Line regulation	ΔV_{OUT1}	$V_{IN} = 3.2\text{V to } 10\text{V}$ $I_{OUT} = 1\text{mA}$	--	9mV	52mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 3.2\text{V to } 10\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	9mV	154mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 4.2\text{V}$ $I_{OUT} = 1\mu\text{A to } 10\text{mA}$	--	80mV	120mV

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REGULATOR SPECIFICATIONS

● Electrical Characteristics, *cont.*

S-81224PG, S-81224PG-PX-X, S-81224SG-QX-X (Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 4.4\text{V}$, $I_{OUT} = 10\text{mA}$	2.342V	2.400V	2.458V
I/O voltage difference	V_{dif}	$I_{OUT} = 10\text{mA}$	--	0.49V	1.15V
Line regulation	ΔV_{OUT1}	$V_{IN} = 3.4\text{V to } 10\text{V}$ $I_{OUT} = 1\text{mA}$	--	10mV	55mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 3.4\text{V to } 10\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	10mV	168mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 4.4\text{V}$ $I_{OUT} = 1\mu\text{A to } 10\text{mA}$	--	80mV	120mV

S-81225PG, S-81225PG-PH-X, S-81225SG-QH-X (Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 4.5\text{V}$, $I_{OUT} = 10\text{mA}$	2.440V	2.500V	2.560V
I/O voltage difference	V_{dif}	$I_{OUT} = 10\text{mA}$	--	0.59V	1.32V
Line regulation	ΔV_{OUT1}	$V_{IN} = 3.5\text{V to } 10\text{V}$ $I_{OUT} = 1\text{mA}$	--	10mV	57mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 3.5\text{V to } 10\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	10mV	175mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 4.5\text{V}$ $I_{OUT} = 10\mu\text{A to } 10\text{mA}$	--	80mV	120mV

S-81230PG, S-81230PG-PB-X, S-81230SG-QB-X (Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 5.0\text{V}$, $I_{OUT} = 10\text{mA}$	2.928V	3.000V	3.072V
I/O voltage difference	V_{dif}	$I_{OUT} = 10\text{mA}$	--	0.44V	1.04V
Line regulation	ΔV_{OUT1}	$V_{IN} = 4.0\text{V to } 16\text{V}$ $I_{OUT} = 1\text{mA}$	--	39mV	78mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 4.0\text{V to } 16\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	39mV	210mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 5\text{V}$ $I_{OUT} = 1\mu\text{A to } 20\text{mA}$	--	60mV	100mV

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REGULATOR SPECIFICATIONS

● Electrical Characteristics, *cont.*

S-81233PG, S-81233PG-PF-X, S-81233SG-QF-X (Unless otherwise specified: Ta = 25°C)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V _{OUT}	V _{IN} = 5.3V, I _{OUT} = 10mA	3.220V	3.300V	3.380V
		for SOT 23-5	3.234V	3.300V	3.366V
I/O voltage difference	V _{diff}	I _{OUT} = 10 mA	--	0.37V	0.91V
Line regulation	Δ V _{OUT1}	V _{IN} = 4.3 V to 16 V I _{OUT} = 1 mA	--	42mV	84mV
Line regulation	Δ V _{OUT2}	V _{IN} = 4.3 V to 16 V I _{OUT} = 1μA	--	42mV	231mV
Load regulation	Δ V _{OUT3}	V _{IN} = 5.3 V I _{OUT} = 1 μA to 20 mA	--	60mV	100mV

S-81235PG, S-81235PG-PI-X, S-81235SG-QI-X (Unless otherwise specified: Ta = 25°C)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V _{OUT}	V _{IN} = 5.5V, I _{OUT} = 10mA	3.416V	3.500V	3.584V
		for SOT 23-5	3.430V	3.500V	3.570V
I/O voltage difference	V _{diff}	I _{OUT} = 10 mA	--	0.34V	0.84V
Line regulation	Δ V _{OUT1}	V _{IN} = 4.5 V to 16 V I _{OUT} = 1 mA	--	44mV	88mV
Line regulation	Δ V _{OUT2}	V _{IN} = 4.5 V to 16 V I _{OUT} = 1μA	--	44mV	245mV
Load regulation	Δ V _{OUT3}	V _{IN} = 5.5 V I _{OUT} = 1 μA to 20 mA	--	60mV	100mV

S-81237PG, S-81237PG-PE-X, S-81237SG-QE-X (Unless otherwise specified: Ta = 25°C)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V _{OUT}	V _{IN} = 5.7V, I _{OUT} = 10mA	3.611V	3.700V	3.789V
		for SOT-23-5	3.625V	3.700V	3.774V
I/O voltage difference	V _{diff}	I _{OUT} = 10 mA	--	0.31V	0.78V
Line regulation	Δ V _{OUT1}	V _{IN} = 4.7 V to 16 V I _{OUT} = 1mA	--	46mV	92mV
Line regulation	Δ V _{OUT2}	V _{IN} = 4.7 V to 16 V I _{OUT} = 1μA	--	46mV	259mV
Load regulation	Δ V _{OUT3}	V _{IN} = 5.7 V I _{OUT} = 1 μA to 30 mA	--	60mV	100mV

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● **Electrical Characteristics, cont.**

S-81240PG, S-81240PG-PJ-X, S-81240SG-QJ-X (Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 6.0\text{V}$, $I_{OUT} = 10\text{mA}$	3.904V	4.000V	4.096V
		for SOT-23-5	3.92V	4.000V	4.08V
I/O voltage difference	V_{diff}	$I_{OUT} = 10\text{mA}$	--	0.27V	0.7V
Line regulation	ΔV_{OUT1}	$V_{IN} = 5.0\text{V to }16\text{V}$ $I_{OUT} = 1\text{mA}$	--	48mV	96mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 5.0\text{V to }16\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	48mV	280mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 6.0\text{V}$ $I_{OUT} = 1\mu\text{A to }30\text{mA}$	--	50mV	90mV

S-81245PG, S-81245PG-P5-X, S-81245SG-Q5-X (Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 6.5\text{V}$, $I_{OUT} = 10\text{mA}$	4.392V	4.500V	4.608V
		for SOT-23-5	4.410V	4.500V	4.590V
I/O voltage difference	V_{diff}	$I_{OUT} = 10\text{mA}$	--	0.21V	0.58V
Line regulation	ΔV_{OUT1}	$V_{IN} = 5.5\text{V to }16\text{V}$ $I_{OUT} = 1\text{mA}$	--	52mV	104mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 5.5\text{V to }16\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	52mV	315mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 6.5\text{V}$ $I_{OUT} = 1\mu\text{A to }30\text{mA}$	--	50mV	90mV

S-81246PG, S-81246PG-PM-X, S-81246SG-QM-X (Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 6.6\text{V}$, $I_{OUT} = 10\text{mA}$	4.489V	4.600V	4.711V
		For SOT-23-5	4.580V	4.600V	4.692V
I/O voltage difference	V_{diff}	$I_{OUT} = 10\text{mA}$	--	0.2V	0.57V
Line regulation	ΔV_{OUT1}	$V_{IN} = 5.6\text{V to }16\text{V}$ $I_{OUT} = 1\text{mA}$	--	53mV	105mV
Line regulation	ΔV_{OUT2}	$V_{IN} = 5.6\text{V to }16\text{V}$ $I_{OUT} = 1\mu\text{A}$	--	53mV	322mV
Load regulation	ΔV_{OUT3}	$V_{IN} = 6.6\text{V}$ $I_{OUT} = 1\mu\text{A to }30\text{mA}$	--	50mV	90mV

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REGULATOR SPECIFICATIONS

● Electrical Characteristics, *cont.*

S-81247SG-IE-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 7\text{ V}$, $I_{OUT} = 30\text{ mA}$	4.606V	4.700V	4.794V
I/O voltage difference	V_{dif}	$I_{OUT} = 40\text{ mA}$	--	0.19V	0.55V
Line Regulation	ΔV_{OUT}^1	$V_{IN} = 5.7\text{ V to } 16\text{ V}$ $I_{OUT} = 1\text{ mA}$	--	54mV	107mV
Line regulation	ΔV_{OUT}^2	$V_{IN} = 5.7\text{ V to } 16\text{ V}$ $I_{OUT} = 1\text{ }\mu\text{A}$	--	54mV	329mV
Load regulation	ΔV_{OUT}^3	$V_{IN} = 6.7\text{ V}$ $I_{OUT} = 1\text{ }\mu\text{A to } 30\text{ mA}$	--	50mV	90mV

S-81250PG, S-81250PG-PD-X, S-81250SG-QD-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 7.0\text{ V}$, $I_{OUT} = 10\text{ mA}$	4.880V	5.000V	5.120V
		for SOT-23-5	4.900V	5.000V	5.100V
I/O voltage difference	V_{dif}	$I_{OUT} = 10\text{ mA}$	--	0.16V	0.5V
Line regulation	ΔV_{OUT}^1	$V_{IN} = 6.0\text{ V to } 16\text{ V}$ $I_{OUT} = 1\text{ mA}$	--	55mV	110mV
Line regulation	ΔV_{OUT}^2	$V_{IN} = 6.0\text{ V to } 16\text{ V}$ $I_{OUT} = 1\text{ }\mu\text{A}$	--	55mV	350mV
Load regulation	ΔV_{OUT}^3	$V_{IN} = 7.0\text{ V}$ $I_{OUT} = 1\text{ }\mu\text{A to } 40\text{ mA}$	--	40mV	80mV

S-81252PG, S-81252PG-PL-X, S-81252SG-QL-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 7.2\text{ V}$, $I_{OUT} = 10\text{ mA}$	5.075V	5.200V	5.325V
		for SOT-23-5	5.096V	5.200V	5.304V
I/O voltage difference	V_{dif}	$I_{OUT} = 10\text{ mA}$	--	0.15V	0.47V
Line regulation	ΔV_{OUT}^1	$V_{IN} = 6.2\text{ V to } 16\text{ V}$ $I_{OUT} = 1\text{ mA}$	--	57mV	113mV
Line regulation	ΔV_{OUT}^2	$V_{IN} = 6.2\text{ V to } 16\text{ V}$ $I_{OUT} = 1\text{ }\mu\text{A}$	--	57mV	364mV
Load regulation	ΔV_{OUT}^3	$V_{IN} = 7.2\text{ V}$ $I_{OUT} = 1\text{ }\mu\text{A to } 40\text{ mA}$	--	40mV	80mV

Section 4.2

REGULATOR SPECIFICATIONS

● Electrical Characteristics, *cont.*

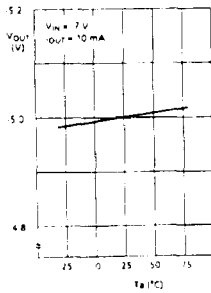
S-81330HG, S-81330HG-KB-X, S-81332HG, S-81332HG-KC-X, S-81337HG-KE-X,
S-81340HG-KJ-X, S-81347HG-KQ-X, S-81350HG, S-81350HG-KD-X

(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

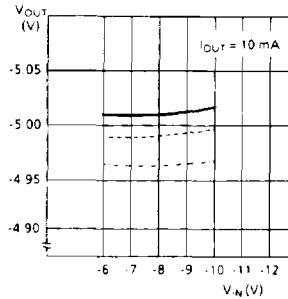
Parameter	Symbol	Conditions	Min.	Typ.	Max.
Output voltage	V_{OUT}	$V_{IN} = 5\text{V}, I_{OUT} = 30\text{ mA}$	2.92V	3.000V	3.072V
		$V_{IN} = 5.2\text{V}, I_{OUT} = 30\text{ mA}$	3.112V	3.200V	3.277V
		$V_{IN} = 5.7\text{V}, I_{OUT} = 30\text{ mA}$	3.611V	3.900V	3.989V
		$V_{IN} = 6\text{V}, I_{OUT} = 40\text{ mA}$	3.904V	4.000V	4.096V
		$V_{IN} = 6.7\text{V}, I_{OUT} = 40\text{ mA}$	4.589V	4.700V	4.813V
I/O Voltage Difference	V_{diff}	$I_{OUT} = 30\text{ mA}$	--	0.14V	0.28V
		$I_{OUT} = 40\text{ mA}$	--	0.12V	0.24V
Load Regulation	ΔV_{OUT}	$I_{OUT} = 10\text{ }\mu\text{A to } 30\text{ mA}$ $V_{IN} = 5\text{ to } 5.7\text{ V}$	--	60mV	150mV
		$I_{OUT} = 50\text{ }\mu\text{A to } 60\text{ mA}$ $V_{IN} = 6\text{ to } 7\text{ V}$	--	70mV	110mV
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	$V_{IN} = 4\text{ to } 15\text{ V}$ $I_{OUT} = 30\text{ - } 40\text{ mA}$		0.04%/V	0.2%/V

● Typical Operating Characteristics

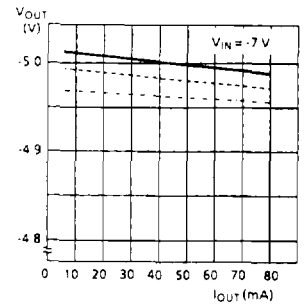
-5V S-802
 V_{OUT} vs T_a



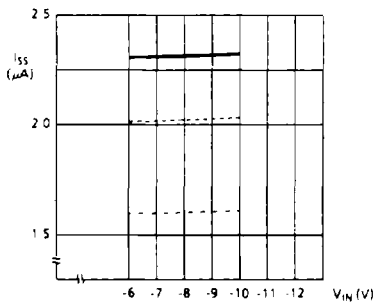
-5V S-802 V_{OUT} vs V_{IN}
($V_{IN} < -5\text{V}$)



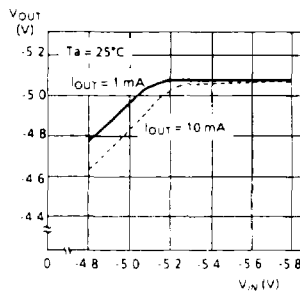
-5V S-802
 V_{OUT} vs I_{OUT}



-5V S-802
 I_{SS} vs V_{IN}



-5V S-802 V_{OUT} vs V_{IN}
($V_{IN} > -5.8\text{V}$)

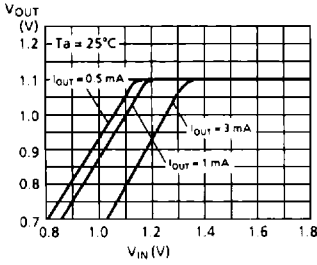


Section 4.2

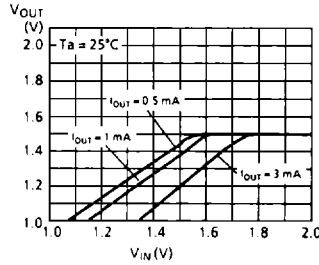
REGULATOR SPECIFICATIONS

● Typical Operating Characteristics, *cont.*

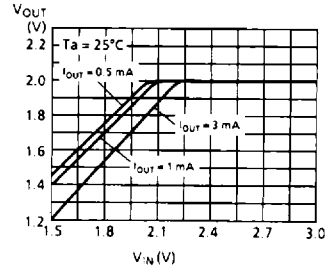
S-812, 1.1V
 V_{OUT} vs V_{IN}



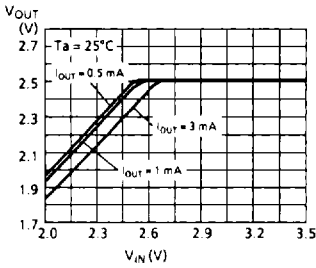
S-812, 1.5V
 V_{OUT} vs V_{IN}



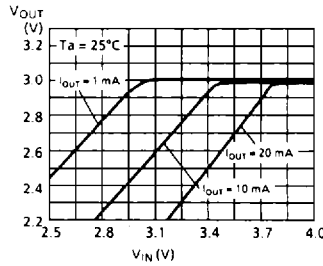
S-812, 2.0V
 V_{OUT} vs V_{IN}



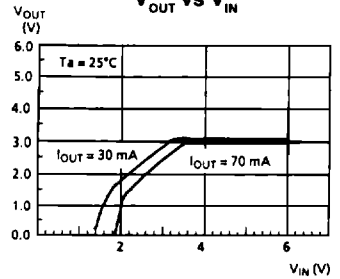
S-812, 2.5V
 V_{OUT} vs V_{IN}



S-812, 3.0V
 V_{OUT} vs V_{IN}

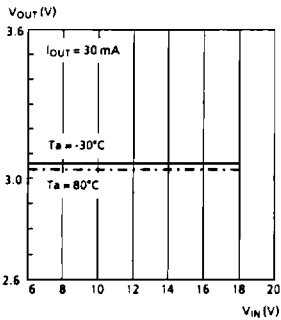


S-813, 3.0V, $T_a = 25^\circ\text{C}$,
 V_{OUT} vs V_{IN}

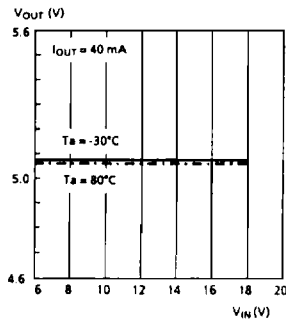


4

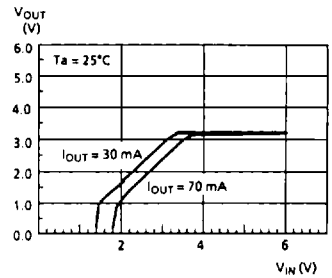
S-813 3.0V $I_{OUT} = 30\text{ mA}$
 V_{OUT} vs V_{IN}



S-813, 3.0V $I_{OUT} = 40\text{ mA}$,
 V_{OUT} vs V_{IN}



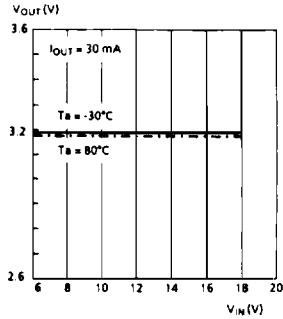
S-813, 3.2V $T_a = 25^\circ\text{C}$
 V_{OUT} vs V_{IN}



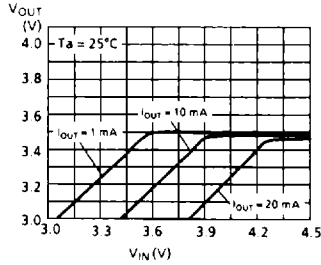
Section 4.2 REGULATOR SPECIFICATIONS

● Typical Operating Characteristics, *cont.*

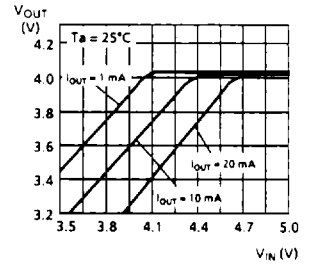
S-813, 3.2V, $I_{OUT} = 30\text{ mA}$
 V_{OUT} vs V_{IN}



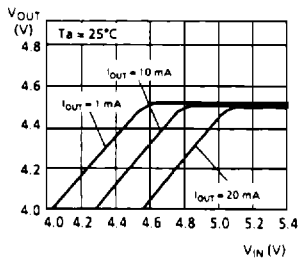
S-812, 3.5V
 V_{OUT} vs V_{IN}



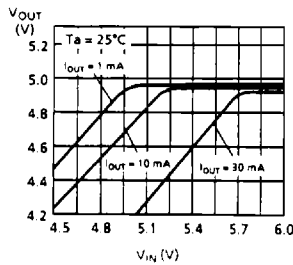
S-812, 4.0V
 V_{OUT} vs V_{IN}



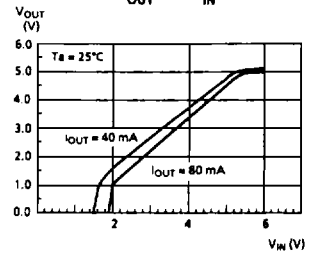
S-812, 4.5V
 V_{OUT} vs V_{IN}



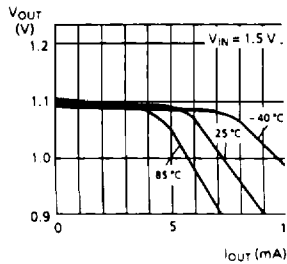
S-812, 5.0V
 V_{OUT} vs V_{IN}



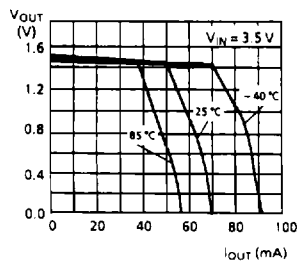
S-813, 5.0V
 V_{OUT} vs V_{IN}



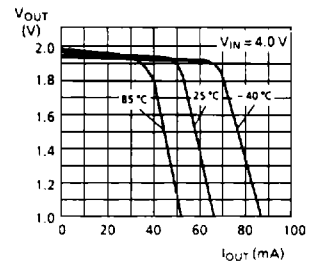
S-812, 1.1V
 V_{OUT} vs I_{OUT}



S-812, 1.5V
 V_{OUT} vs I_{OUT}



S-812, 2.0V
 V_{OUT} vs I_{OUT}

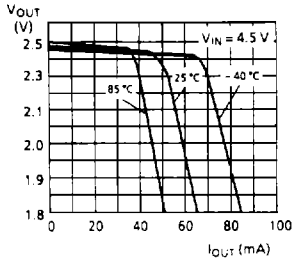


Section 4.2

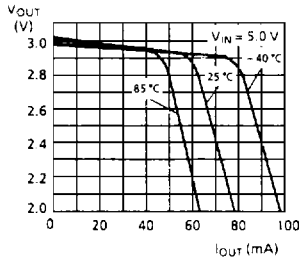
REGULATOR SPECIFICATIONS

● Typical Operating Characteristics, *cont.*

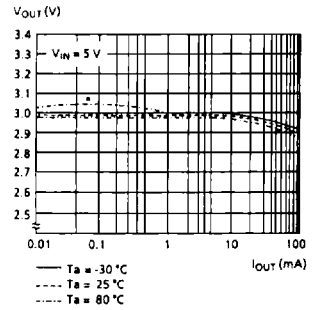
S-812, 2.5V
 V_{OUT} vs I_{OUT}



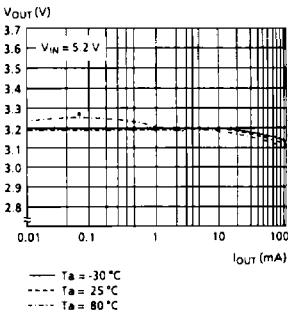
S-812, 3.0V
 V_{OUT} vs I_{OUT}



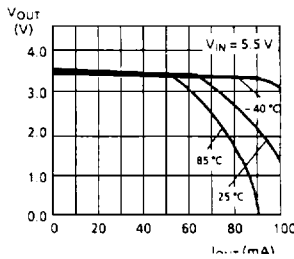
S-813, 3.0V
 V_{OUT} vs I_{OUT}



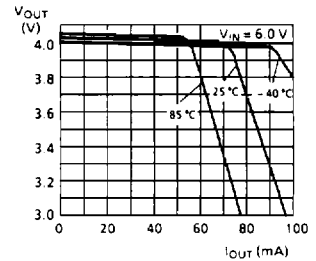
S-813, 3.2V
 V_{OUT} vs I_{OUT}



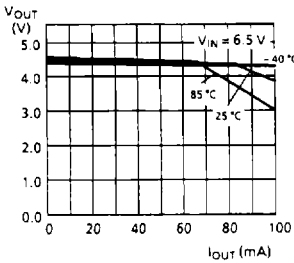
S-812, 3.5V
 V_{OUT} vs I_{OUT}



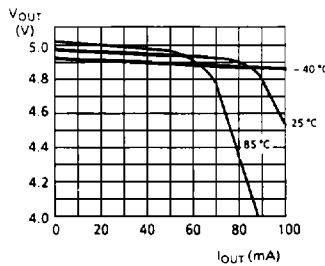
S-812, 4.0V
 V_{OUT} vs I_{OUT}



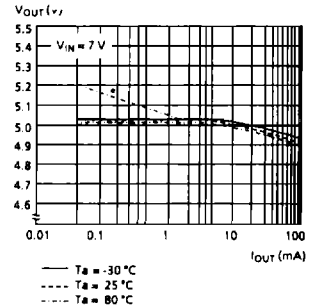
S-812, 4.5V
 V_{OUT} vs I_{OUT}



S-812, 5.0V
 V_{OUT} vs I_{OUT}

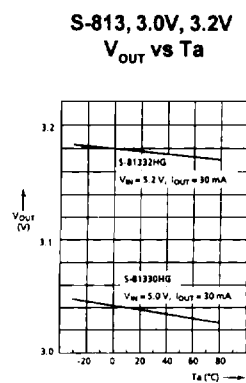
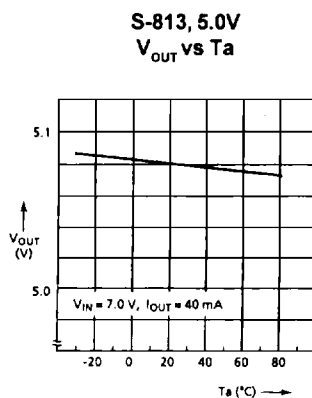
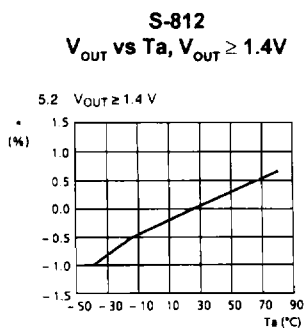
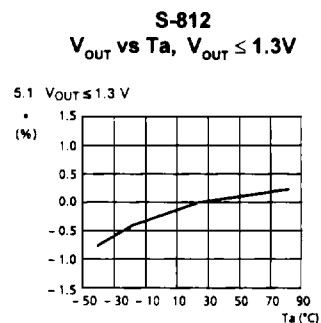
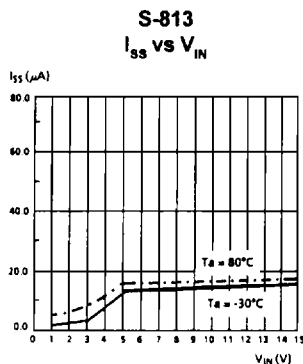
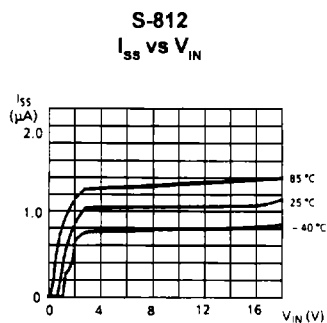
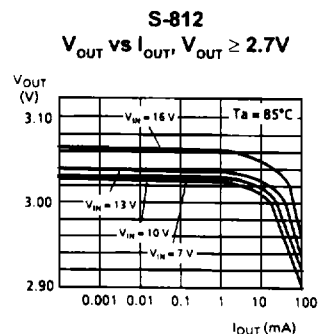
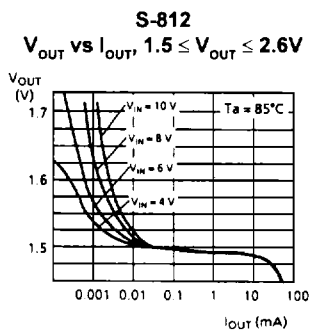
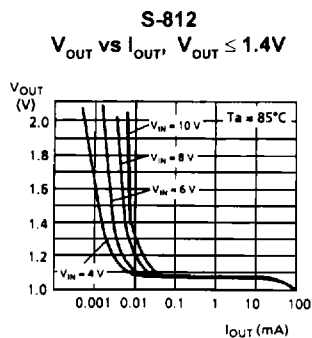


S-813, 5.0V
 V_{OUT} vs I_{OUT}



Section 4.2 REGULATOR SPECIFICATIONS

● Typical Operating Characteristics, *cont.*



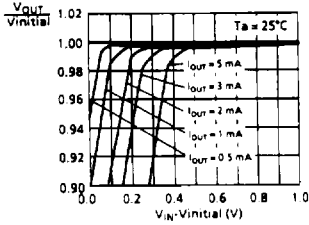
Section 4.2

REGULATOR SPECIFICATIONS

● Typical Operating Characteristics, *cont.*

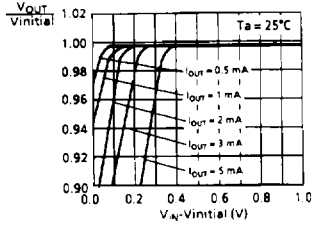
S-812, 1.1V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 1.5 V and I_{OUT} = 0.5 mA)



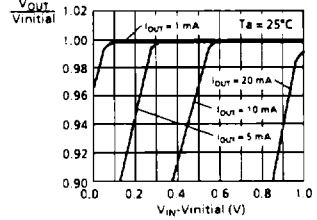
S-812 1.5V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 3.5 V and I_{OUT} = 0.5 mA)



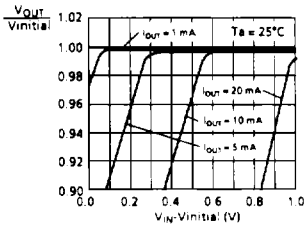
S-812 2.0V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 4.0 V and I_{OUT} = 10 mA)



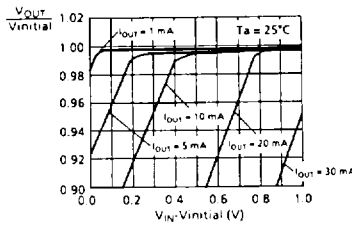
S-812 2.5V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 4.5 V and I_{OUT} = 10 mA)



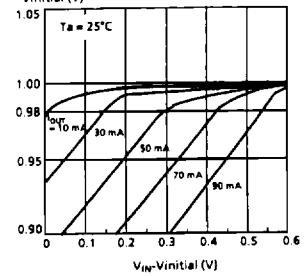
S-812 3.0V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 5.0 V and I_{OUT} = 10 mA)



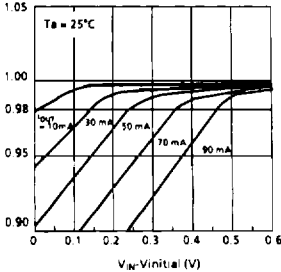
S-813 3.0V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 5.0 V and I_{OUT} = 10 mA)



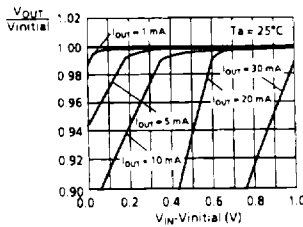
S-813 3.2V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 5.0 V and I_{OUT} = 10 mA)



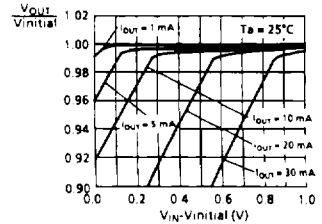
S-812 3.5V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 5.5 V and I_{OUT} = 10 mA)



S-812 4.0V
I/OV_{diff}

(V_{initial}: Output voltage value at V_{IN} = 6.0 V and I_{OUT} = 10 mA)

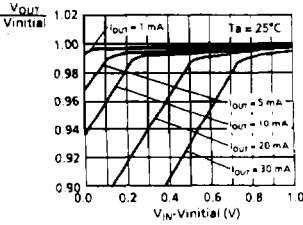


Section 4.2 REGULATOR SPECIFICATIONS

● Typical Operating Characteristics, *cont.*

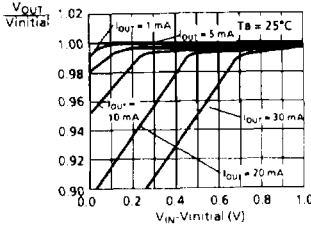
S-812 4.5V
I/O V_{diff}

(V_{initial}: Output voltage value at
V_{IN} = 6.5 V and I_{OUT} = 10 mA)

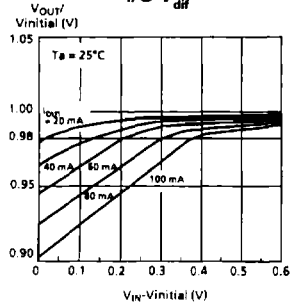


S-812 5.0V
I/O V_{diff}

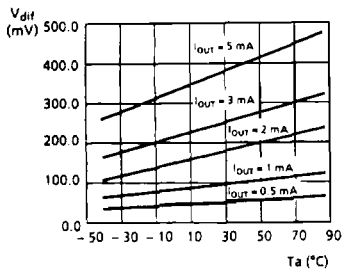
(V_{initial}: Output voltage value at
V_{IN} = 7.0 V and I_{OUT} = 10 mA)



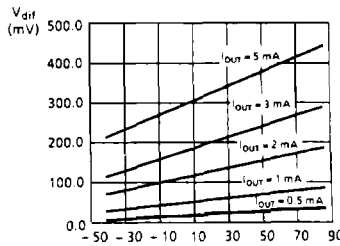
S-813 5.0V
I/O V_{diff}



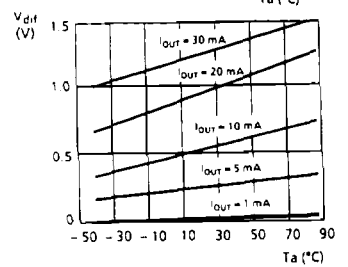
S-812 1.1V
I/O V_{diff} vs Ta



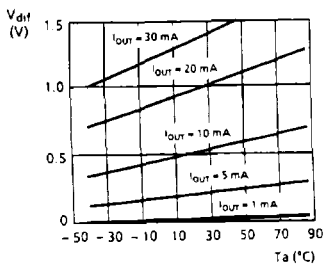
S-812 1.5V
I/O V_{diff} vs Ta



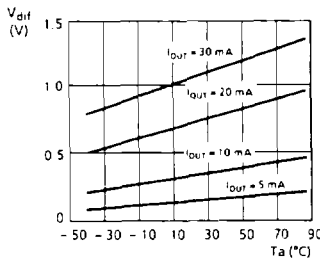
S-812 2.0V
I/O V_{diff} vs Ta



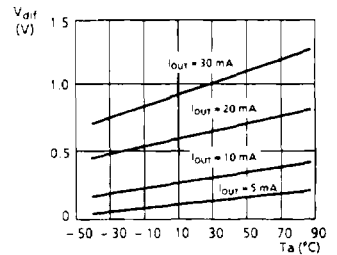
S-812 2.5V
I/O V_{diff} vs Ta



S-812 3.0V
I/O V_{diff} vs Ta



S-812 3.5V
I/O V_{diff} vs Ta

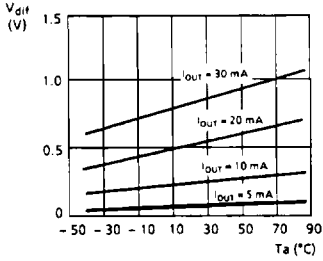


Section 4.2

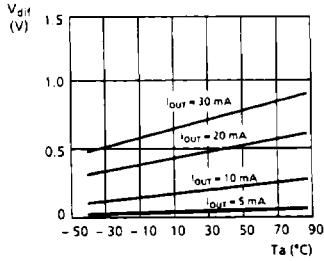
REGULATOR SPECIFICATIONS

● Typical Operating Characteristics, *cont.*

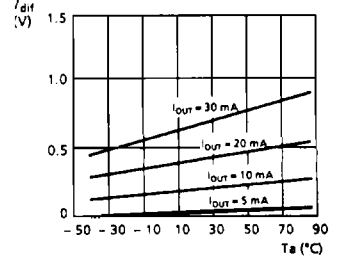
S-812 4.0V
I/O V_{diff} vs T_a



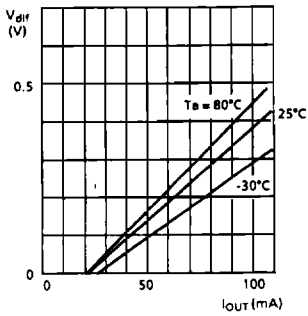
S-812 4.5V
I/O V_{diff} vs T_a



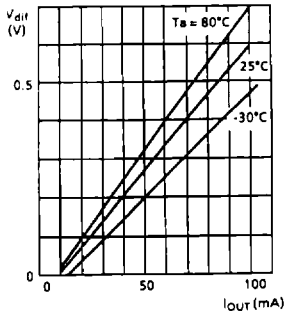
S-812 5.0V
I/O V_{diff} vs T_a



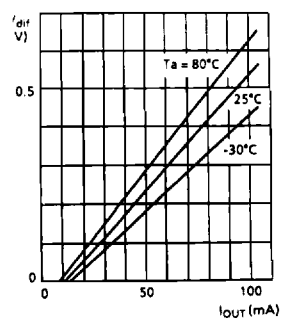
S-813 3.0V
 I_{OUT} vs V_{diff}



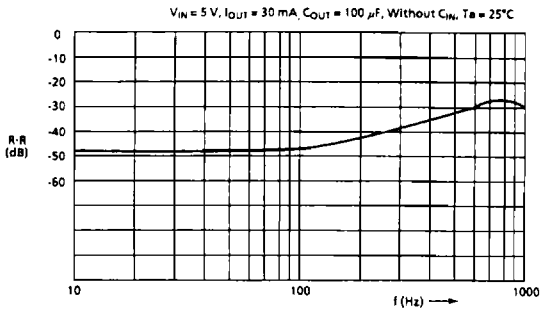
S-813 3.2V
 I_{OUT} vs V_{diff}



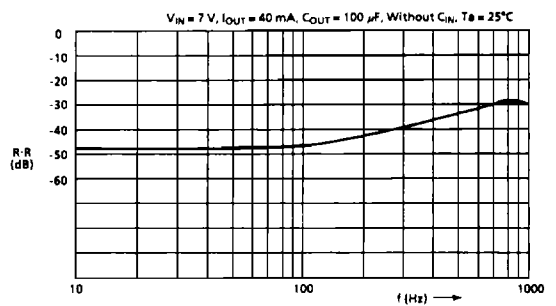
S-813 5.0V
 I_{OUT} vs V_{diff}



S-813
3.0V Ripple rejection

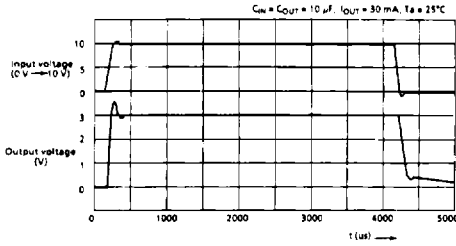


S-813
5.0V Ripple rejection

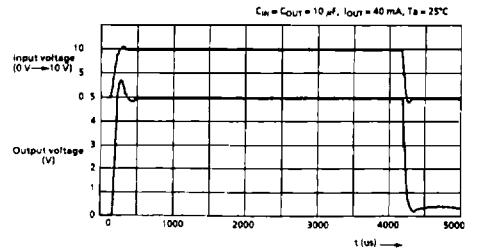


Section 4.2 REGULATOR SPECIFICATIONS

**S-813 3.0V
Line Transient Response**

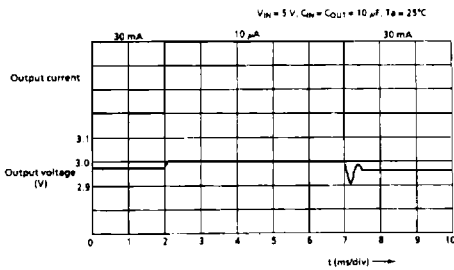


**S-813 5.0V
Line Transient Response**

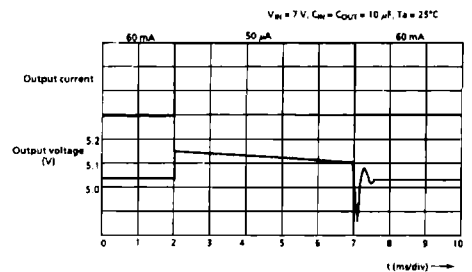


Note: Use an output capacitor (C_{OUT}) whose pressure proof is over the overshooting value.

**S-813 3.0V
Load Transient Response**



**S-813 5.0V
Load Transient Response**



Note: Use a voltage detector whose detection voltage is suitable for the undershooting value, when a voltage detector is connected to the output terminal.