S-MOS SYSTEMS
A Seiko Epson Affiliate

DATA SHEET **GRAPHICS**

SCI7710/11Y Series

September 1993

DC/DC REGULATORS

The SCI7710Y family of CMOS voltage regulators comprises two series – the SCI7710Y series for positive input voltages and the SCI7711Y series for negative input voltages.

■ DESCRIPTION

SCI7710Y series voltage regulators provide step-down and stabilization of an input voltage to a specified fixed voltage. The nine devices in the series incorporate a precision, power-saving reference voltage generator, a transistorized differential amplifier and resistors for determining the output voltage. The SCI7710Y series is available in 3-pin plastic SOT89s.

■ APPLICATIONS

- Fixed-voltage power supplies for battery-operated equipment such as portable video cassette recorders, video cameras and radios
- Fixed-voltage power supplies for communications equipment
- High-stability reference voltage generators

■ FEATURES

- 1.5 μA (typ) current consumption (SCI7710YHA)
- –1.8 mV/deg. C (typ) temperature gradient (SCI7710YDA)
- Wide range of operating voltages
- 0.5 %/V (typ) input stability (SCI7710YDA)
- On-chip reference voltage generator
- On-chip differential amplifier
- 3-pin plastic SOT89

■ SCI7710Y Series/SCI7711Y Series

Device	Voltage (V)		Output current (mA)	Current consumption (μA)	Operating temperature (deg. C)
	Input	Output			
SCI7710YHA	15 (max)	1.5	10 at VI = 3V	1.5	–30 to 85
SCI7710YGA		1.8	10 at VI = 3V	1.6	
SCI7710YFA		2.2	10 at VI = 3V	1.8	
SCI7710YLA		2.6	30 at VI = 4V	2.0	
SCI7710YDA		3.0	30 at VI = 5V	2.0	
SCI7710YCA		3.2	30 at VI = 5V	2.0	
SCI7710YKA		3.9	40 at VI = 6V	2.2	
SCI7710YMA		4.5	50 at VI = 6V	2.4	
SCI7710YBA		5.0	50 at VI = 7V	2.4	

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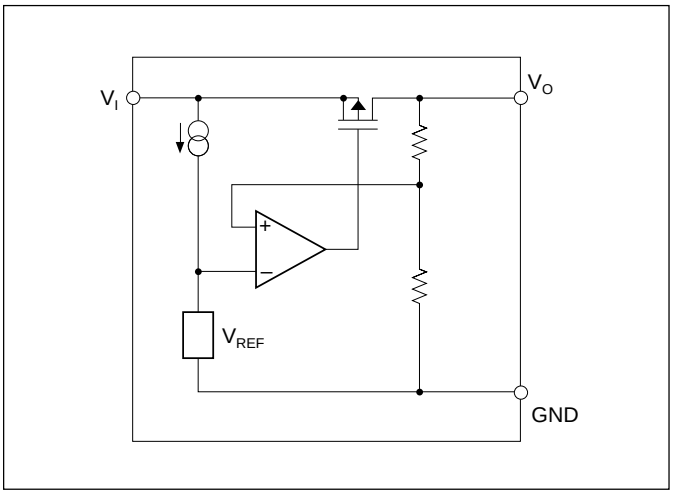
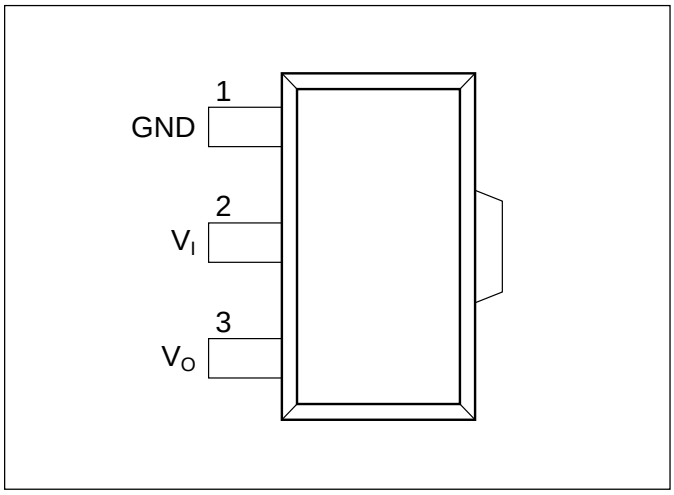
■ BLOCK DIAGRAM



■ PIN CONFIGURATION



■ PIN DESCRIPTION

Number	Name	Description
1	GND	Ground
2	V_I	Input voltage
3	V_O	Output voltage

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Input voltage	V_I	21	V
Output current	I_O	100	mA
Output voltage range	V_O	V_I + 0.3 to GND – 0.3	V
Power dissipation ($T_a \leq 25°C$)	P_D	400	mW
Operating temperature	T_{OPR}	–20 to 70	°C
Storage temperature	T_{STG}	–65 to 150	°C
Soldering temperature & time	T_{SOL}	260°C, 10s (at lead)	—

Note: Temperatures during reflow soldering must remain within the limits set out in LSI Device Precautions. Never use solder dip to mount SCI7000 series power supply devices.

■ ELECTRICAL CHARACTERISTICS

● SCI7710YHA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 3.0V, I_O = 1mA, T_a = 25°C	1.40	1.50	1.60	V
		V_I = 3.0V to 10.0V, I_O = 1mA	1.35	—	1.65	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 1.5V, I_O = 1mA	—	55.0	120	mV
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \cdot V_O \rvert}$	V_I = 3.0V to 10.0V, I_O = 1 to 10mA, Isothermal	—	0.10	—	% / V
Operating current	I_{DDO}	V_I = 1.8V to 15.0V, T_a = 25°C	—	1.50	4.0	µA
Temperature gradient	K_t		—	–1.0	—	mV/°C
Output voltage drift	ΔV_O	V_I = 3.0V, I_O = 1 to 10mA, T_a = 25°C	—	10.0	—	mV

● SCI7710YGA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 3.0V, I_O = 1mA, T_a = 25°C	1.70	1.80	1.90	V
		V_I = 3.0V to 10.0V, I_O = 1mA	1.60	—	2.0	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 1.8V, I_O = 1mA	—	50.0	100	mV
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \cdot V_O \rvert}$	V_I = 3.0V to 10.0V, I_O = 1 to 10mA, Isothermal	—	0.10	—	% / V
Operating current	I_{DDO}	V_I = 1.8V to 15.0V, T_a = 25°C	—	1.60	4.10	µA
Temperature gradient	K_t		—	–1.10	—	mV/°C
Output voltage drift	ΔV_O	V_I = 3.0V, I_O = 1 to 10mA, T_a = 25°C	—	10.0	—	mV

■ ELECTRICAL CHARACTERISTICS (Cont.)

● SCI7710YFA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 3.0V, I_O = 10mA, T_a = 25°C	2.10	2.20	2.30	V
		V_I = 3.0V to 10.0V, I_O = 10mA	2.0	—	2.40	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 2.2V, I_O = 1mA	—	40.0	80.0	V
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \bullet V_O \rvert}$	V_I = 3.0V to 10.0V, I_O = 1 to 10mA, Isothermal	—	0.10	—	% / V
Operating current	I_{DDO}	V_I = 2.2V to 15.0V, T_a = 25°C	—	1.80	4.30	µA
Temperature gradient	K_t		—	–1.30	—	mV/°C
Output voltage drift	ΔV_O	V_I = 3.0V, I_O = 1 to 10mA, T_a = 25°C	—	25.0	—	mV

● SCI7710YLA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 5.0V, I_O = 10mA, T_a = 25°C	2.45	2.60	2.75	V
		V_I = 5.0V to 15.0V, I_O = 10mA	2.30	—	2.90	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 2.45V, I_O = 10mA	—	0.4	0.8	V
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \bullet V_O \rvert}$	V_I = 5.0V to 15.0V, I_O = 1 to 10mA, Isothermal	—	0.20	—	% / V
Operating current	I_{DDO}	V_I = 3.0V to 15.0V, T_a = 25°C	—	2.0	4.5	µA
Temperature gradient	K_t	I_O = 1 to 30mA	—	–1.6	—	mV/°C
Output voltage drift	ΔV_O	V_I = 5.0V, I_O = 1 to 30mA, T_a = 25°C	—	30.0	—	mV

■ ELECTRICAL CHARACTERISTICS (Cont.)

● SCI7710YDA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 5.0V, I_O = 10mA, T_a = 25°C	2.85	3.0	3.15	V
		V_I = 4.0V to 15.0V, I_O = 10mA	2.70	—	3.30	
		V_I = 5.0V to 15.0V, I_O = 30mA	2.70	—	3.30	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 3.0V, I_O = 10mA	—	0.35	0.50	V
		V_I = 3.0V, I_O = 30mA	—	1.20	1.70	
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \bullet V_O \rvert}$	V_I = 4.0V to 15.0V, I_O = 1 to 10mA, Isothermal	—	0.15	—	% / V
Operating current	I_{DDO}	V_I = 3.0V to 15.0V, T_a = 25°C	—	2.0	4.5	µA
Temperature gradient	K_t		—	–1.8	—	mV/°C
Output voltage drift	ΔV_O	V_I = 5.0V, I_O = 1 to 30mA	—	30.0	—	mV

● SCI7710YCA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 5.0V, I_O = 10mA, T_a = 25°C	3.05	3.20	3.35	V
		V_I = 4.0V to 15.0V, I_O = 10mA	2.90	—	3.50	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 3.2V, I_O = 10mA	—	0.32	0.47	V
		V_I = 3.2V, I_O = 30mA	—	1.10	1.60	
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \bullet V_O \rvert}$	V_I = 4.0V to 10.0V, I_O = 1 to 10mA, Isothermal	—	0.10	—	% / V
Operating current	I_{DDO}	V_I = 3.2V to 15.0V, T_a = 25°C	—	2.0	4.50	µA
Temperature gradient	K_t		—	–1.90	—	mV/°C
Output voltage drift	ΔV_O	V_I = 5.0V, I_O = 1 to 30mA, T_a = 25°C	—	30.0	—	mV

■ ELECTRICAL CHARACTERISTICS (Cont.)

● SCI7710YKA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 6.0V, I_O = 5mA, T_a = 25°C	3.79	3.90	4.01	V
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 3.9V, I_O = 5mA	—	0.15	0.30	V
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \bullet V_O \rvert}$	V_I = 5.0V to 10.0V, I_O = 1 to 10mA, Isothermal	—	0.20	—	% / V
Operating current	I_{DDO}	V_I = 5.0V to 15.0V, T_a = 25°C	—	2.20	4.6	µA
Temperature gradient	K_t		—	–2.30	—	mV/°C
Output voltage drift	ΔV_O	V_I = 6.0V, I_O = 0.1 to 5mA, T_a = 25°C	—	10.0	—	mV

● SCI7710YMA

V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 6.0V, I_O = 10mA, T_a = 25°C	4.4	4.50	4.60	V
		V_I = 6.0V to 15.0V, I_O = 10mA	4.30	—	4.70	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 4.3V, I_O = 10mA	—	0.25	0.40	V
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \bullet V_O \rvert}$	V_I = 6.0V to 15.0V, I_O = 1 to 10mA, Isothermal	—	0.2	—	% / V
Operating current	I_{DDO}	V_I = 5.0V to 15.0V, T_a = 25°C	—	2.4	4.8	µA
Temperature gradient	K_t		—	–2.7	—	mV/°C
Output voltage drift	ΔV_O	V_I = 6.0V, I_O = 0.1 to 30mA, T_a = 25°C	—	30.0	—	mV

■ ELECTRICAL CHARACTERISTICS (Cont.)

● SCI7710YBA

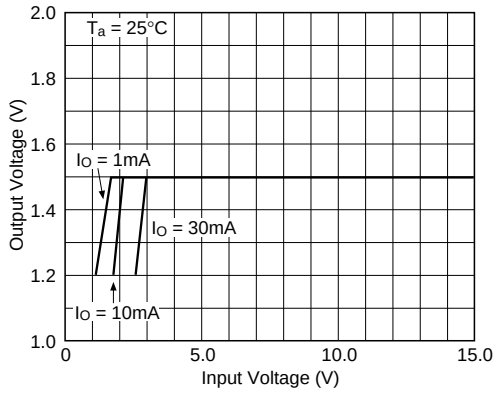
V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Input voltage	V_I		—	—	15.0	V
Output voltage	V_O	V_I = 7.0V, I_O = 10mA, T_a = 25°C	4.75	5.00	5.25	V
		V_I = 6.0V to 15.0V, I_O = 10mA	4.50	—	5.50	
		V_I = 7.2V to 15.0V, I_O = 50mA	4.50	—	5.50	
Input/output voltage differential	$\lvert V_I - V_O \rvert$	V_I = 5.0V, I_O = 10mA	—	0.25	0.35	V
		V_I = 5.0V, I_O = 30mA	—	1.35	1.70	
Input voltage stabilization ratio	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \bullet V_O \rvert}$	V_I = 6.0V to 15.0V, I_O = 1 to 10mA, Isothermal	—	0.18	—	% / V
Operating current	I_{DDO}	V_I = 5.0V to 15.0V, T_a = 25°C	—	2.40	4.80	µA
Temperature gradient	K_t		—	–3.0	—	mV/°C
Output voltage drift	ΔV_O	V_I = 7.0V, I_O = 1 to 50mA, T_a = 25°C	—	50.0	—	mV

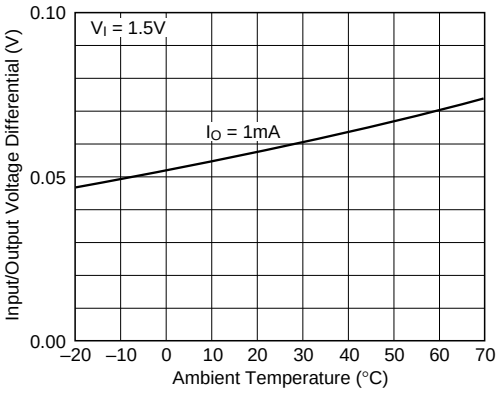
■ TYPICAL PERFORMANCE CHARACTERISTICS

● SCI7710YHA

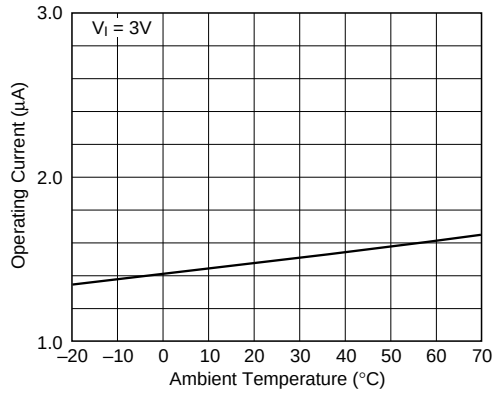
Output voltage vs. input voltage



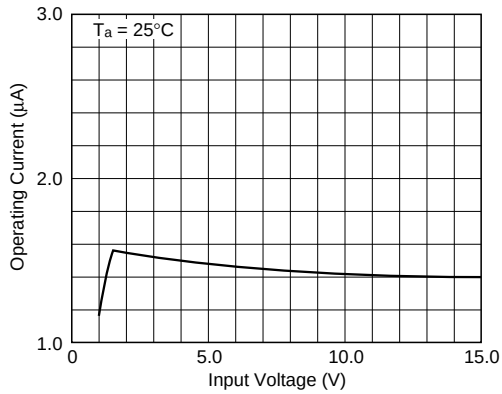
Input/output voltage differential vs. ambient temperature



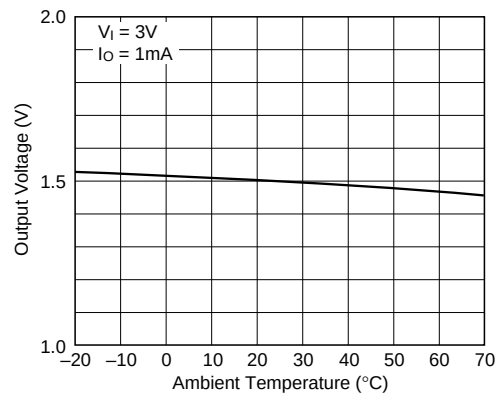
Operating current vs. ambient temperature



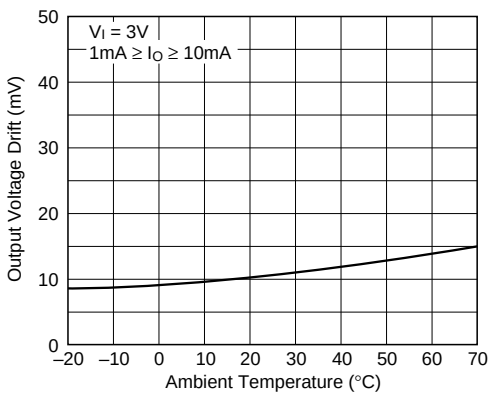
Operating current vs Input voltage



Output voltage vs. ambient temperature



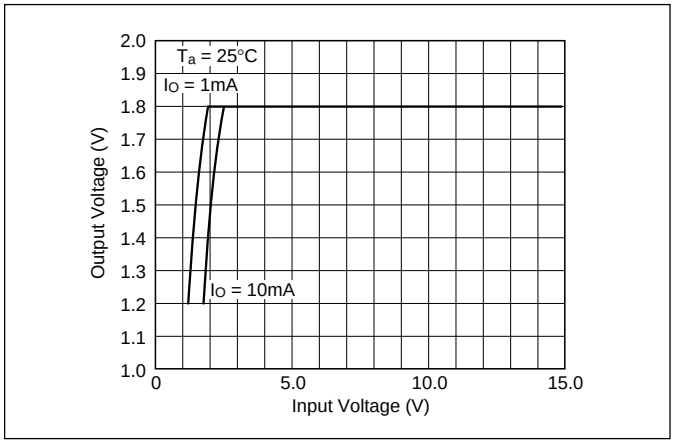
Output voltage drift vs. ambient temperature



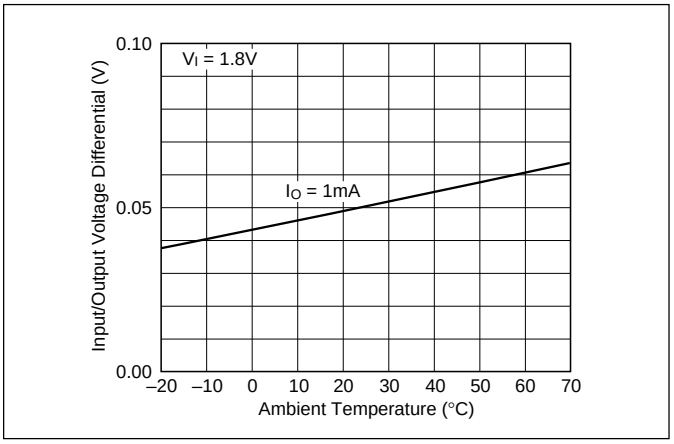
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YGA

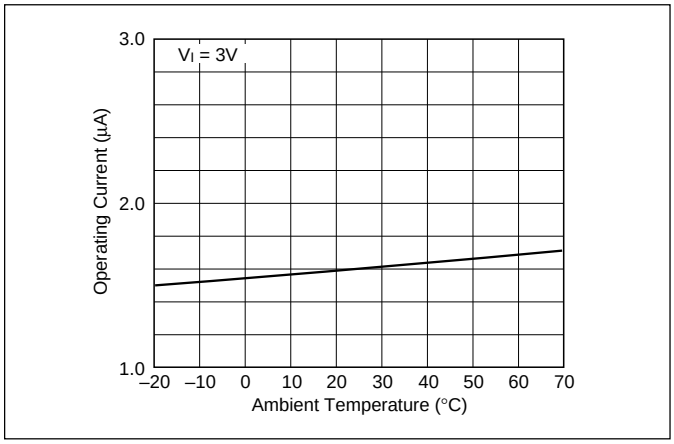
Output voltage vs. input voltage



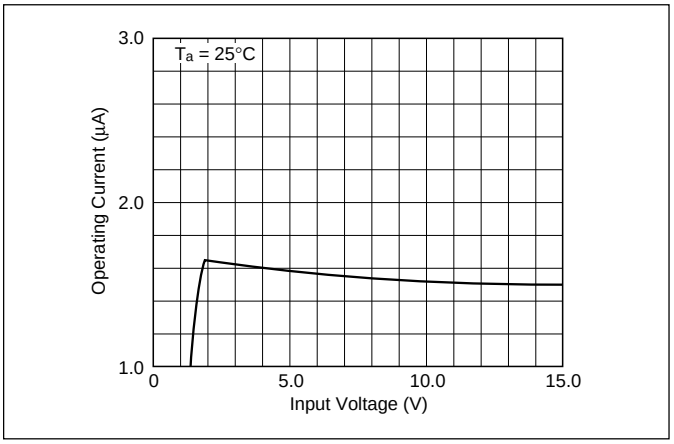
Input/output voltage differential vs. ambient temperature



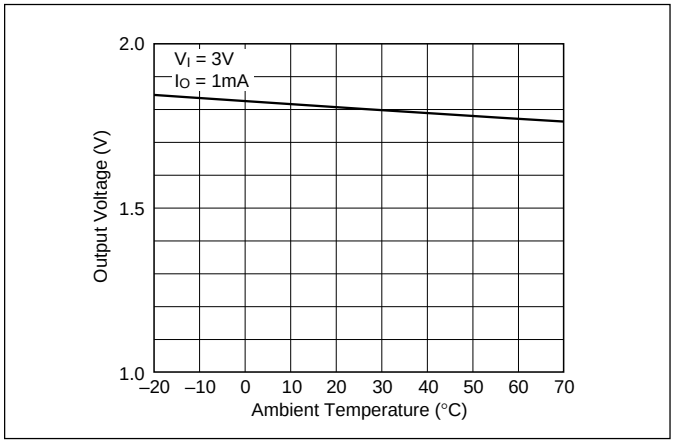
Operating current vs. ambient temperature



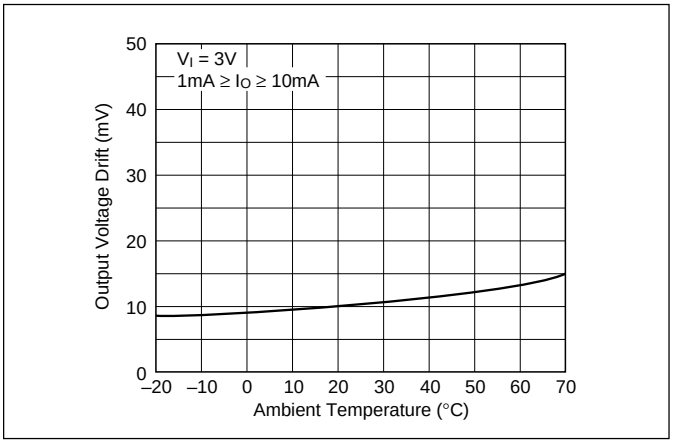
Operating current vs Input voltage



Output voltage vs. ambient temperature



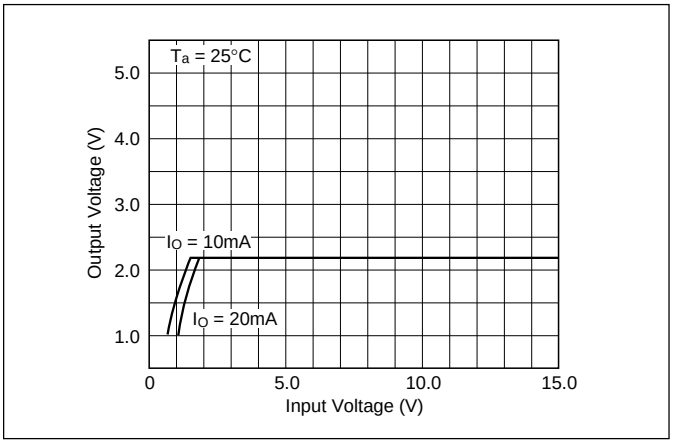
Output voltage drift vs. ambient temperature



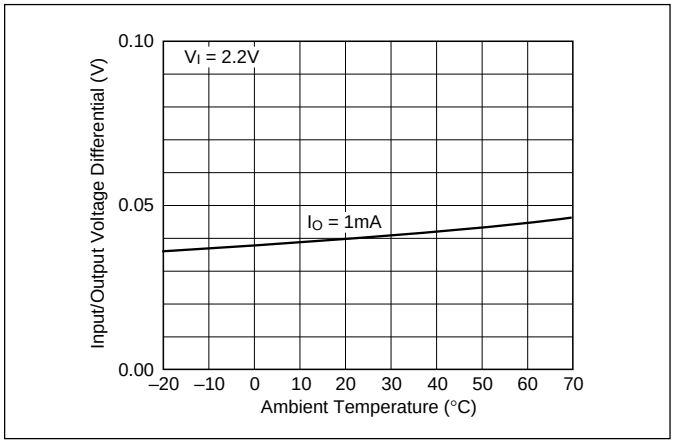
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YFA

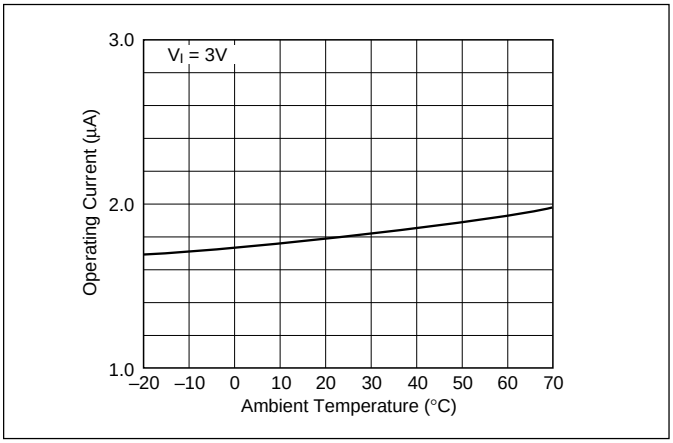
Output voltage vs. input voltage



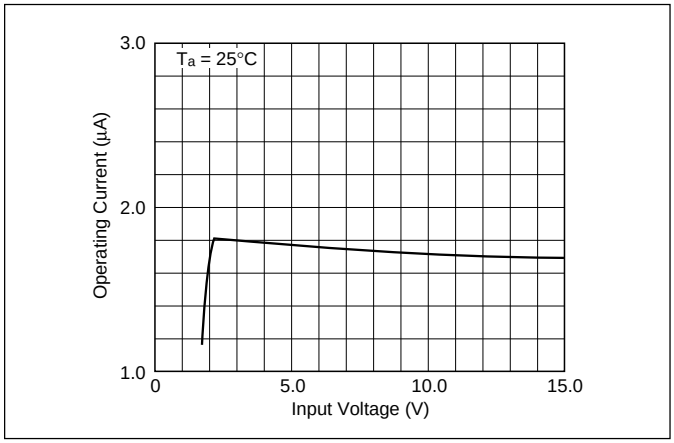
Input/output voltage differential vs. ambient temperature



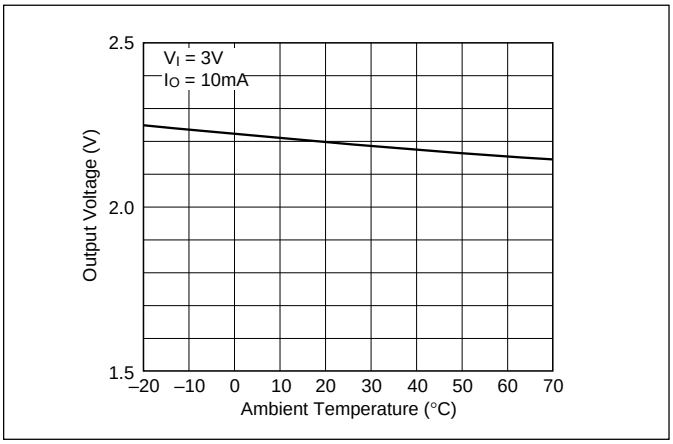
Operating current vs. ambient temperature



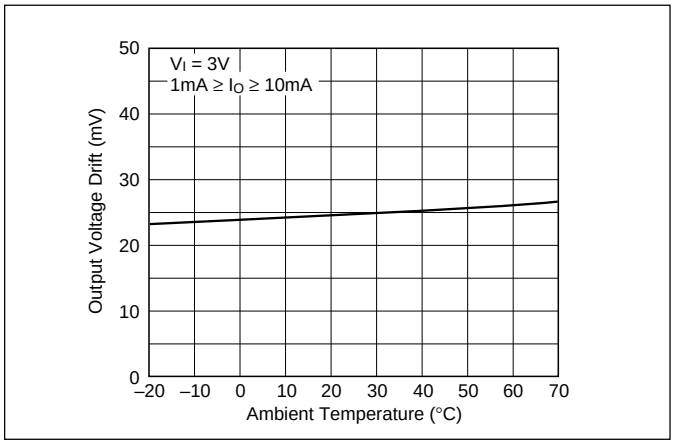
Operating current vs Input voltage



Output voltage vs. ambient temperature



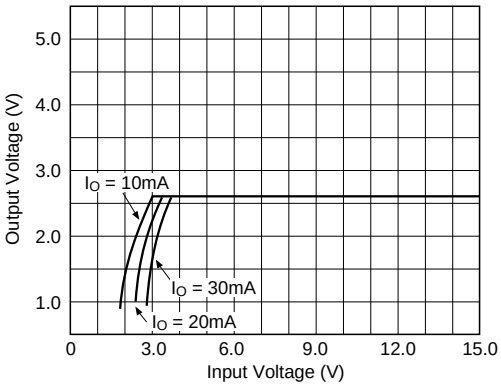
Output voltage drift vs. ambient temperature



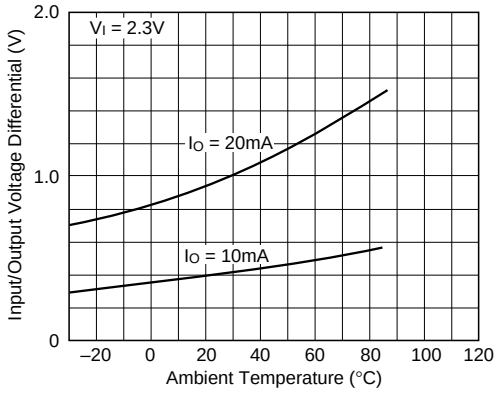
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YLA

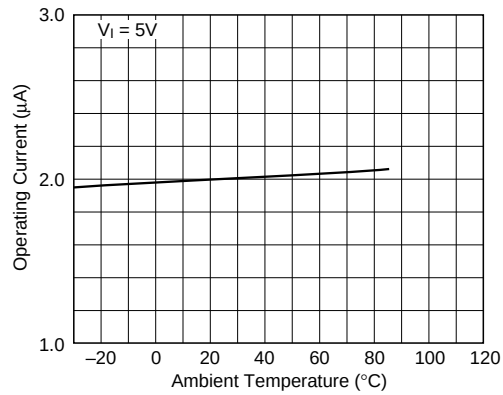
Output voltage vs. input voltage



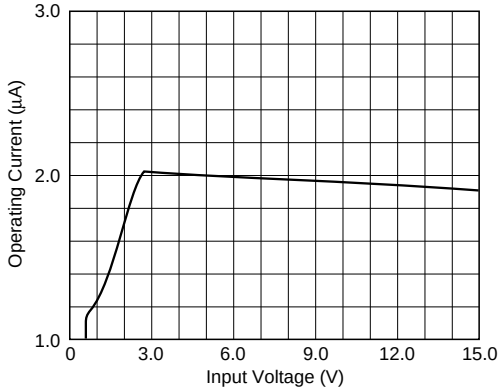
Input/output voltage differential vs. ambient temperature



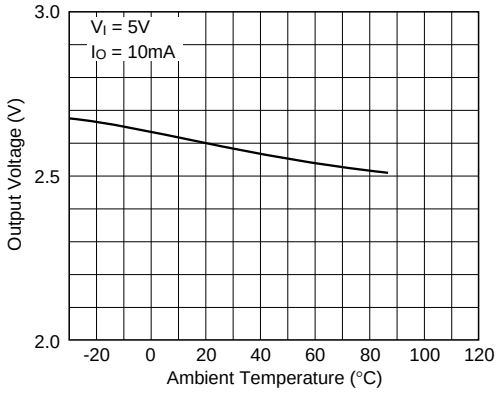
Operating current vs. ambient temperature



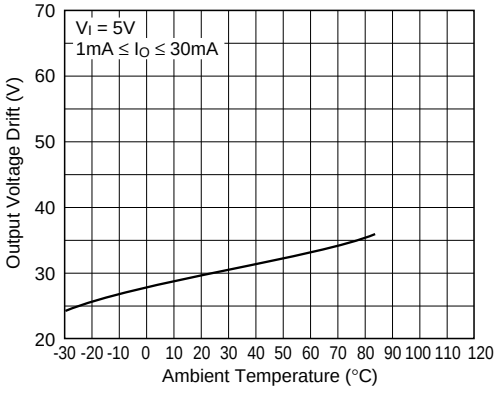
Operating current vs Input voltage



Output voltage vs. ambient temperature



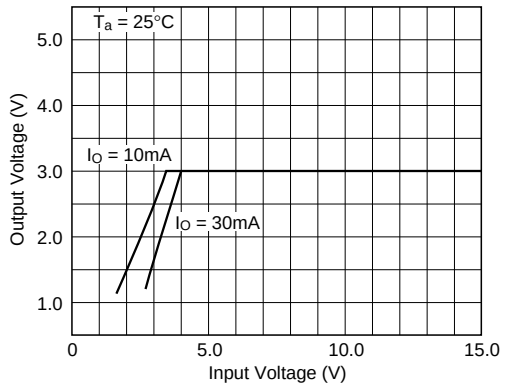
Output voltage drift vs. ambient temperature



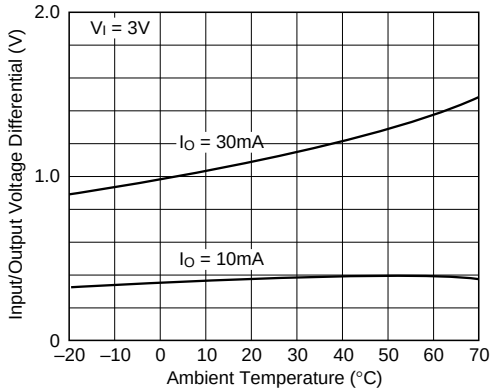
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YDA

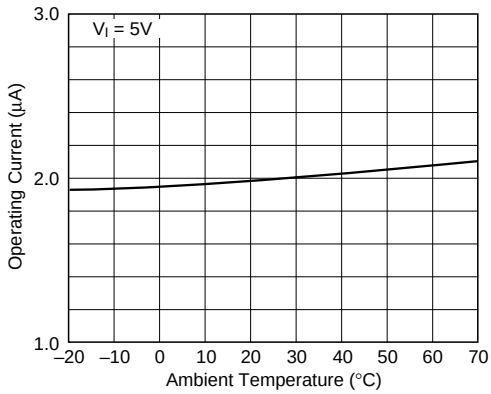
Output voltage vs. input voltage



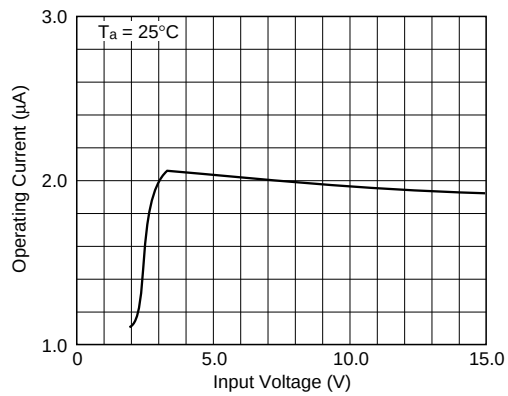
Input/output voltage differential vs. ambient temperature



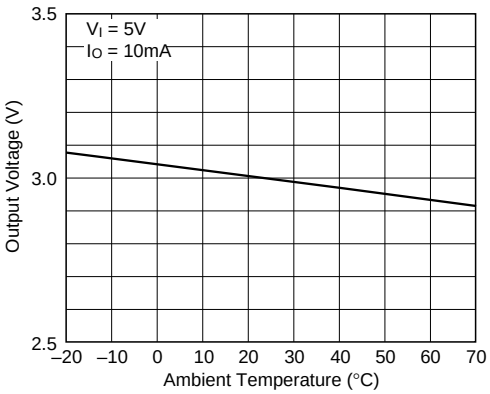
Operating current vs. ambient temperature



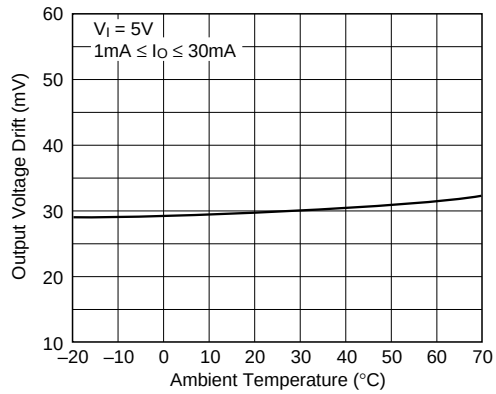
Operating current vs Input voltage



Output voltage vs. ambient temperature



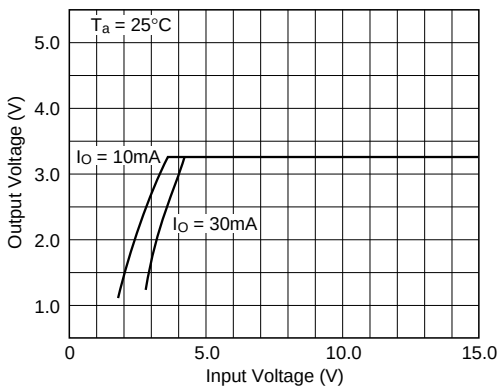
Output voltage drift vs. ambient temperature



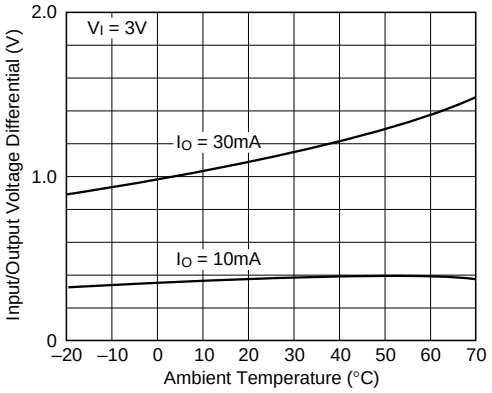
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YCA

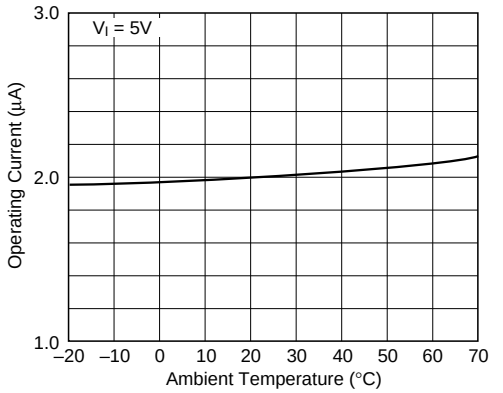
Output voltage vs. input voltage



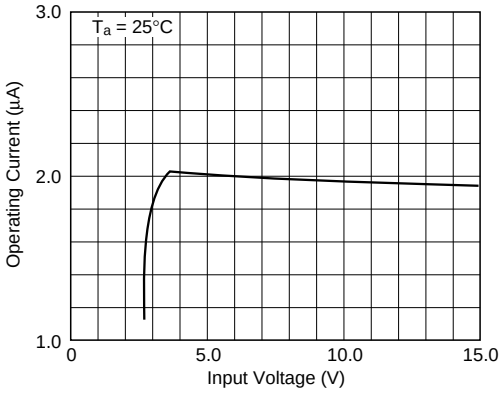
Input/output voltage differential vs. ambient temperature



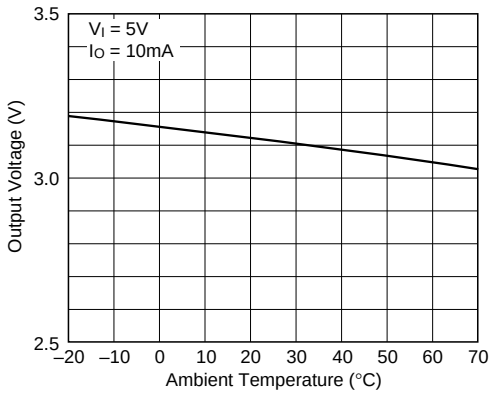
Operating current vs. ambient temperature



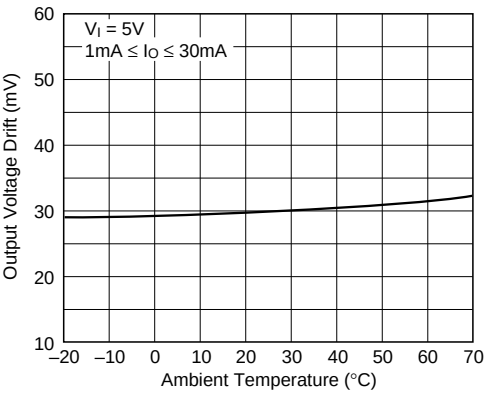
Operating current vs Input voltage



Output voltage vs. ambient temperature



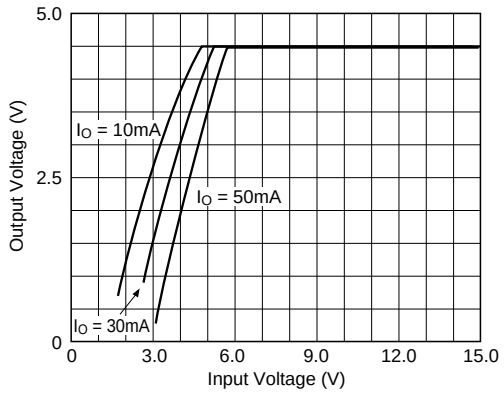
Output voltage drift vs. ambient temperature



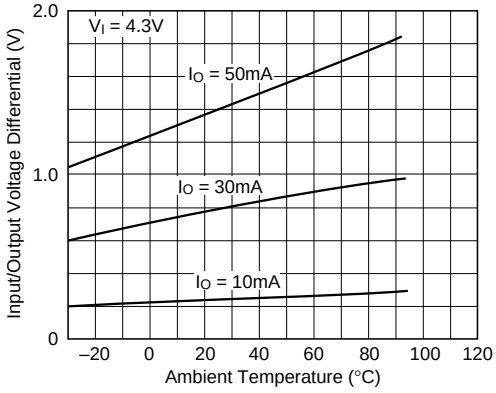
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YMA

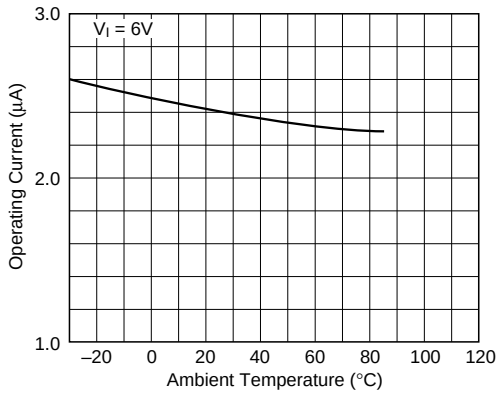
Output voltage vs. input voltage



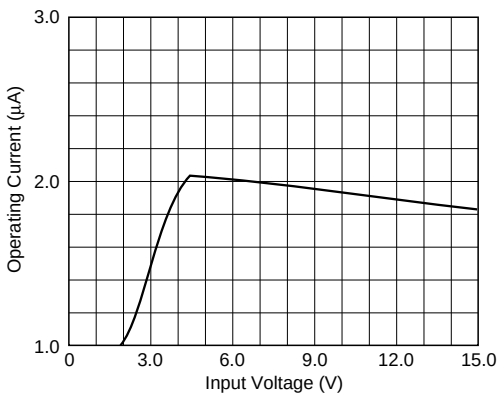
Input/output voltage differential vs. ambient temperature



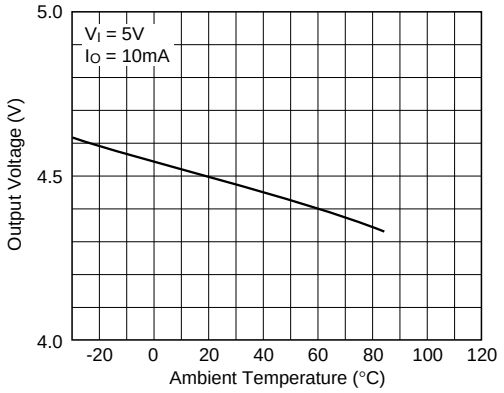
Operating current vs. ambient temperature



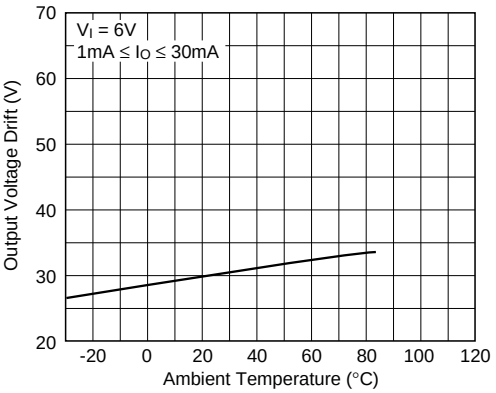
Operating current vs Input voltage



Output voltage vs. ambient temperature



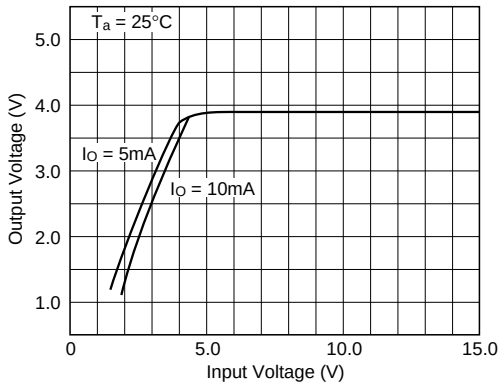
Output voltage drift vs. ambient temperature



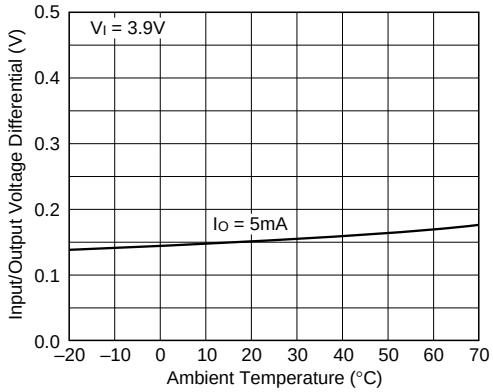
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YKA

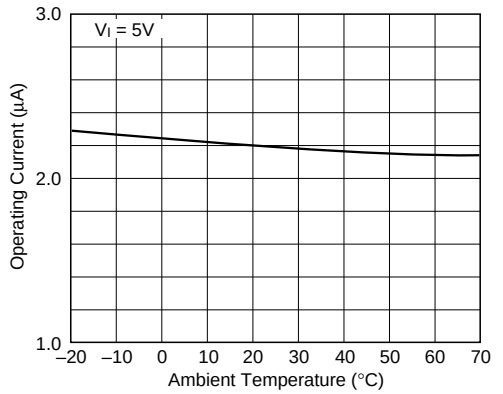
Output voltage vs. input voltage



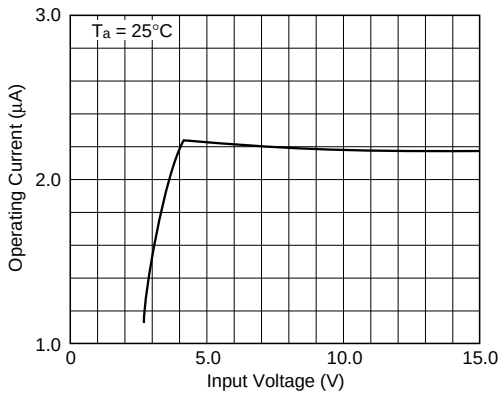
Input/output voltage differential vs. ambient temperature



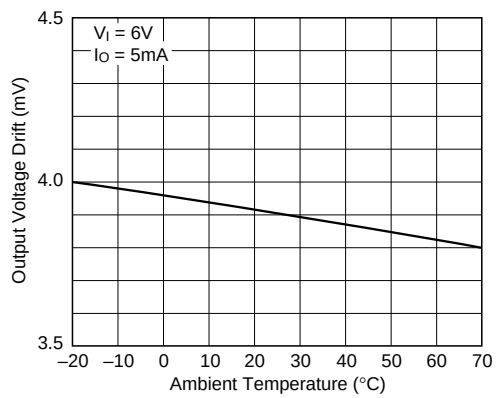
Operating current vs. ambient temperature



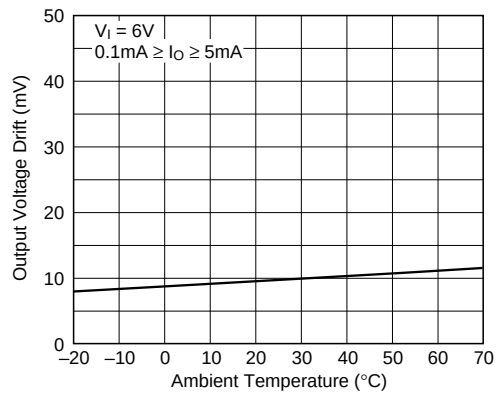
Operating current vs Input voltage



Output voltage vs. ambient temperature



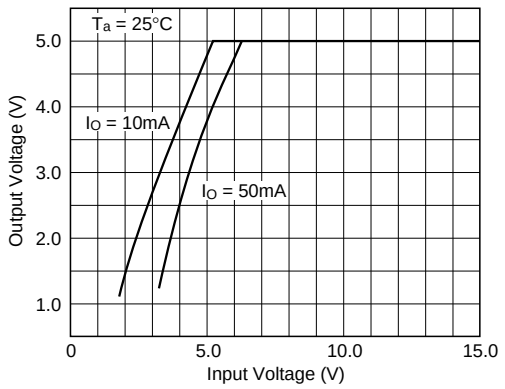
Output voltage drift vs. ambient temperature



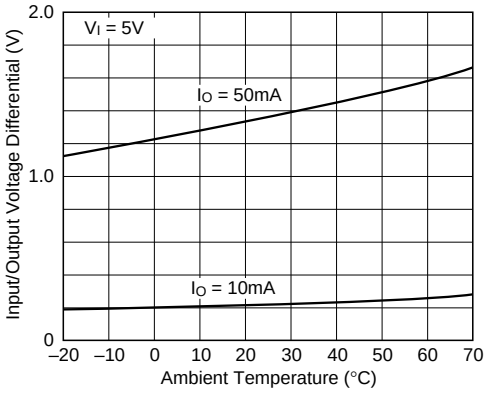
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YBA

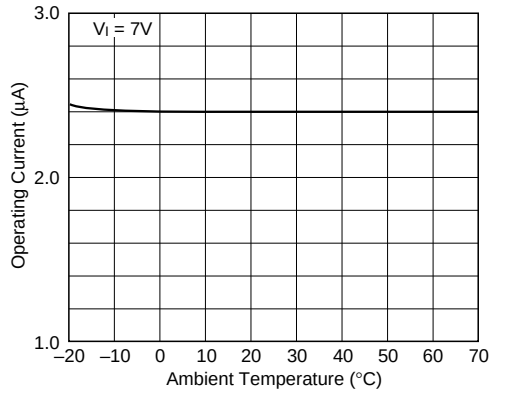
Output voltage vs. input voltage



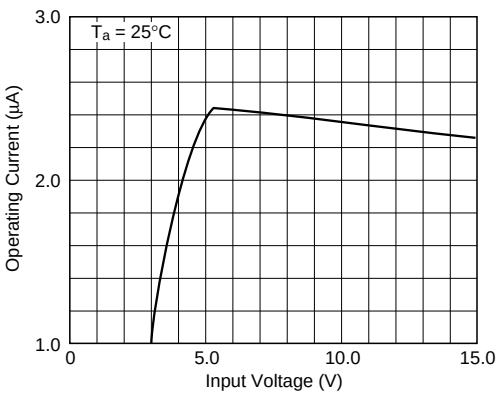
Input/output voltage differential vs. ambient temperature



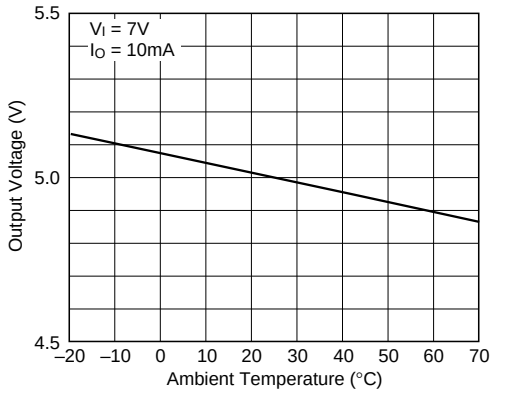
Operating current vs. ambient temperature



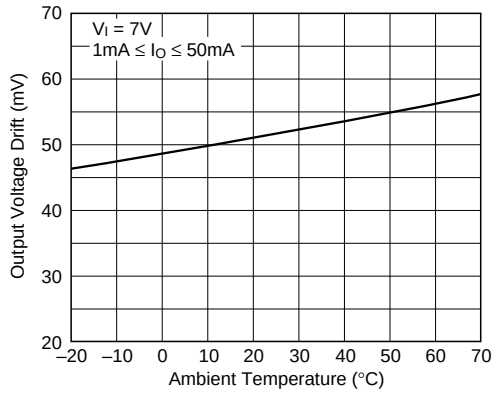
Operating current vs Input voltage



Output voltage vs. ambient temperature



Output voltage drift vs. ambient temperature

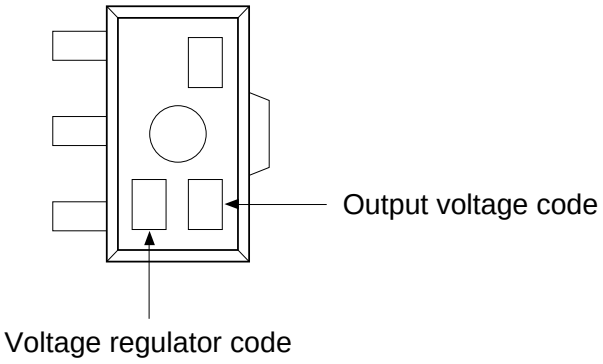


■ PACKAGE MARKING

The markings on SCI7710Y/11Y series device packages use the following abbreviations.

Parameter	Code	Description
Output voltage code	H	1.5V
	G	1.8V
	F	2.2V
	L	2.6V
	D	3.0V
	C	3.2V
	K	3.9V
	M	4.5V
	B	5.0V
Voltage regulator code	P	Positive
	N	Negative

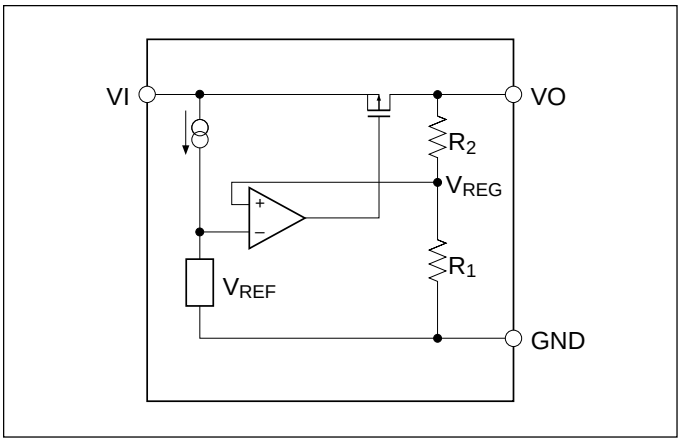
■ MARKING LOCATIONS



■ FUNCTIONAL DESCRIPTION

● Basic Operation

The SCI7710Y series uses a 3-pin series regulator feedback loop. An operational amplifier compares V_{REG} from the voltage divider formed by R_1 and R_2, with V_{REF}. The amplifier output adjusts the output transistor gate bias to equalize the voltages and compensate for fluctuations in V_1.

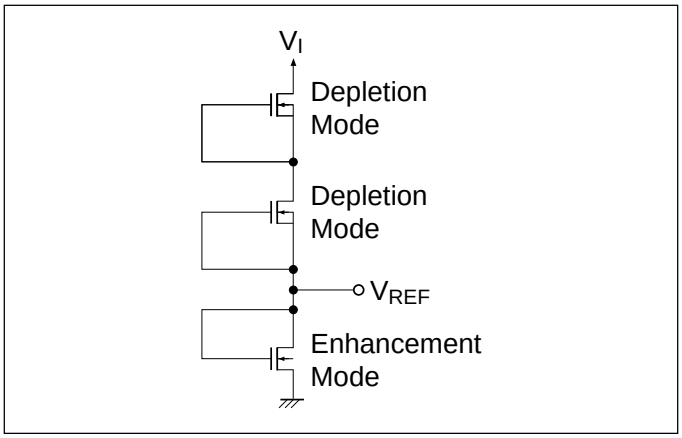


The following equation shows the relationship between V_O and V_{REF}.

$$V_O = \frac{R1 + R2}{R1} V_{REF}$$

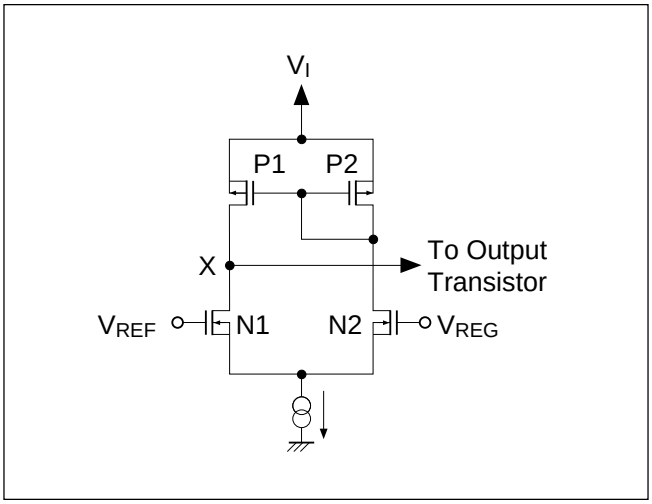
● Internal Circuits-Reference voltage generator

The offset structure, used in all three transistors, results in a high breakdown voltage that ensures a stable reference voltage output over a wide range of input voltages.



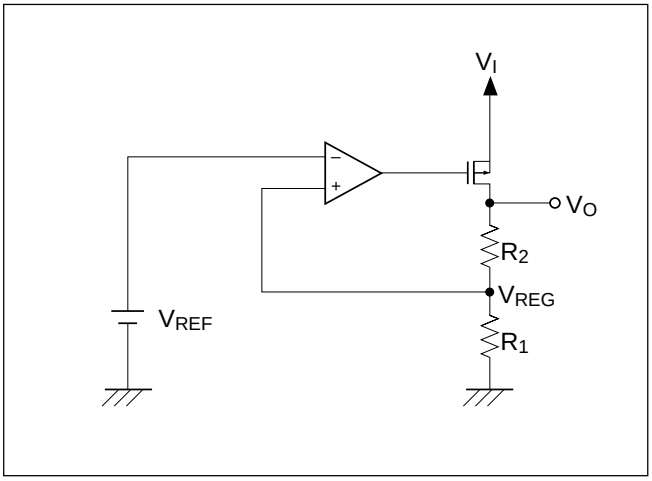
● Differential Amplifier

The built-in differential amplifier generates a potential at point X that adjusts the gate bias of the output transistor if there is any difference between V_{REF} and V_{REG}.



● Output transistor

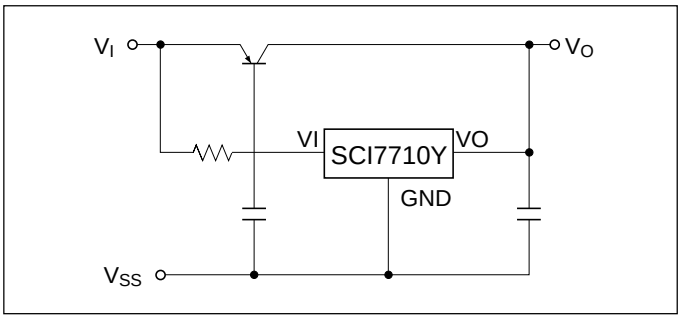
The output side of the p-channel MOS transistors in the output transistor circuit is connected to the voltage divider resistors in the feedback loop.



■ TYPICAL APPLICATIONS

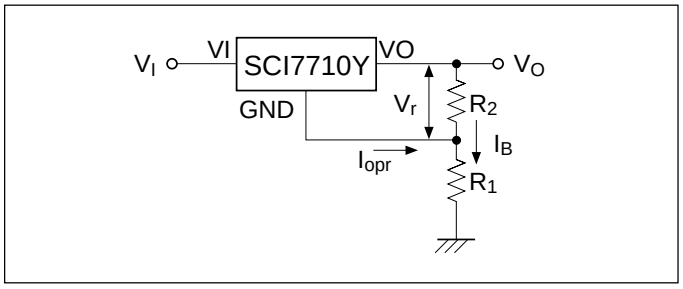
● Current Booster

At the cost of a small increase in current consumption, the voltage is regulated while maintaining high current output.



● External Voltage Converter

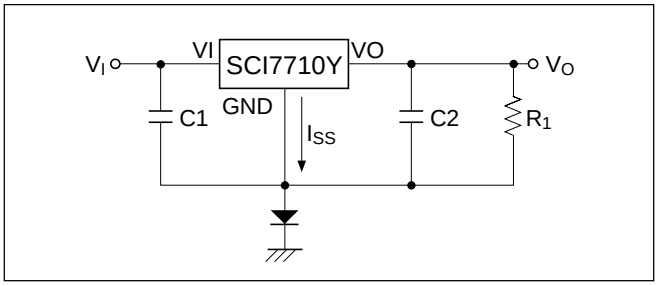
The following circuit raises the output voltage of a SCI7710Y series IC.



The following equation shows the relationship between the old and new voltages.

$$V_O = \frac{R1 + R2}{R2} V_R$$

Note that the application must supply a bias current, I_B, high enough to offset the increase in voltage across R_1 due to I_{opr}. An alternative circuit for raising the output voltage is shown in the following figure.



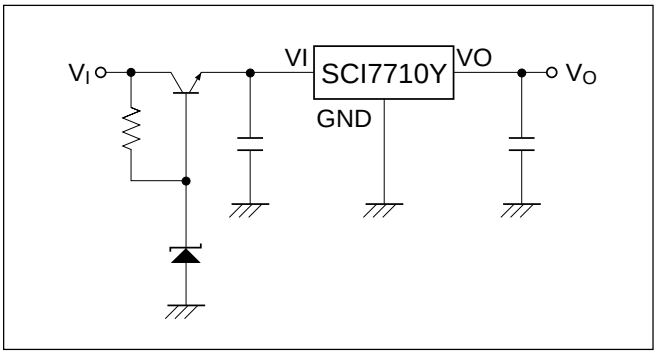
This configuration, however, introduces two design problems.

1. It reduces the output voltage by V_F, the forward voltage drop across the diode.
2. It is sensitive to fluctuations in V_F due to differences in diodes, operating temperatures and I_{SS}.

R_1 helps reduce the effect of I_{SS} on V_F. It is also required when I_{SS} is lower than the diode bias current. For certain input voltages, a Zener diode with a reverse polarity can be used.

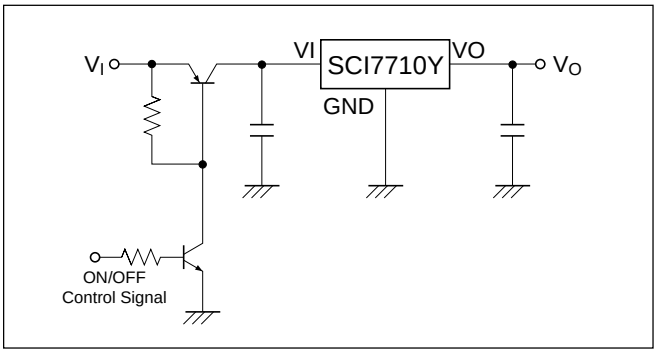
● Higher Input Voltages

A preliminary regulator circuit is required to bring the input voltage within the SCI7710Y series rated range.



● Switching output

SCI7710Y series devices are designed for continuous operation. An external switching circuit allows the regulated output to be switched ON and OFF.



September 1993

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