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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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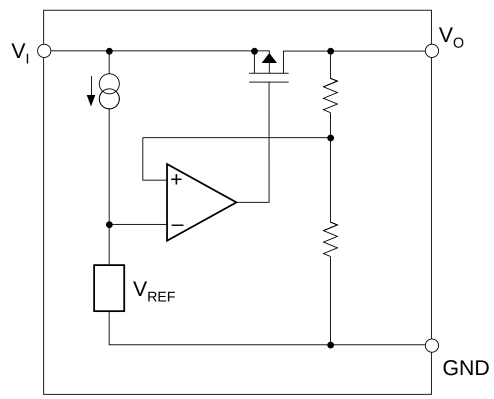
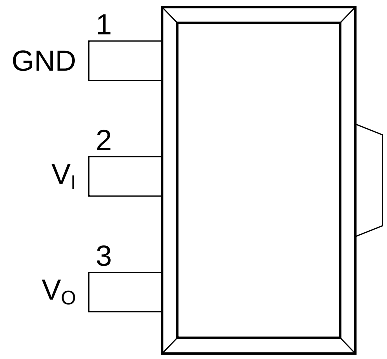
S-MOS SYSTEMS
A Seiko Epson Affiliate

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 Min	Rating Typ	Rating Max	Unit
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	$\|V_I - V_O\|$	V_I = 1.5V, I_O = 1mA	—	55.0	120	mV
Input voltage stabilization ratio	$\frac{\|\Delta V_O\|}{\|\Delta V_I \cdot V_O\|}$	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 Min	Rating Typ	Rating Max	Unit
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	$\|V_I - V_O\|$	V_I = 1.8V, I_O = 1mA	—	50.0	100	mV
Input voltage stabilization ratio	$\frac{\|\Delta V_O\|}{\|\Delta V_I \cdot V_O\|}$	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	$\|V_I - V_O\|$	V_I = 2.2V, I_O = 1mA	—	40.0	80.0	V
Input voltage stabilization ratio	$\frac{\|\Delta V_O\|}{\|\Delta V_I \cdot V_O\|}$	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	$\|V_I - V_O\|$	V_I = 2.45V, I_O = 10mA	—	0.4	0.8	V
Input voltage stabilization ratio	$\frac{\|\Delta V_O\|}{\|\Delta V_I \cdot V_O\|}$	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	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \cdot V_O \rvert}$	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	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \cdot V_O \rvert}$	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

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■ 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	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \cdot V_O \rvert}$	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	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \cdot V_O \rvert}$	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

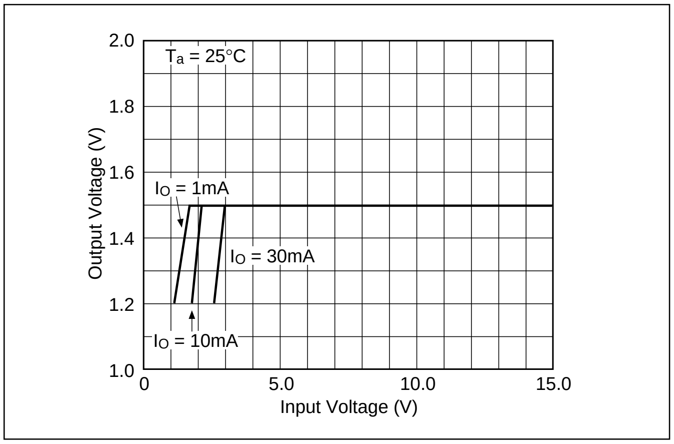
V_{SS} = 0V, T_a = –20 to 70°C, unless otherwise noted

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	$\frac{\lvert \Delta V_O \rvert}{\lvert \Delta V_I \cdot V_O \rvert}$	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

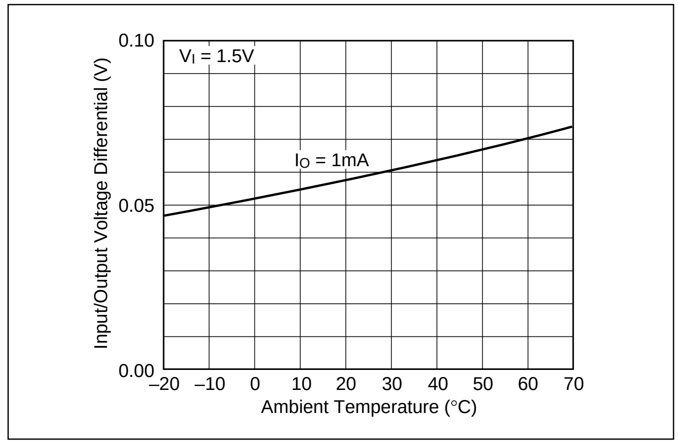
■ TYPICAL PERFORMANCE CHARACTERISTICS

● SCI7710YHA

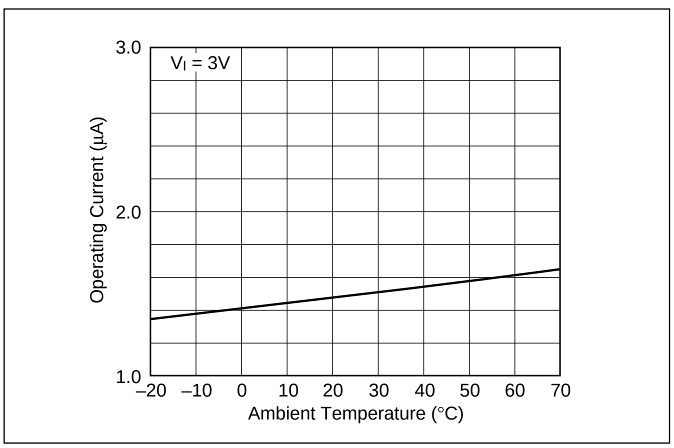
Output voltage vs. input voltage



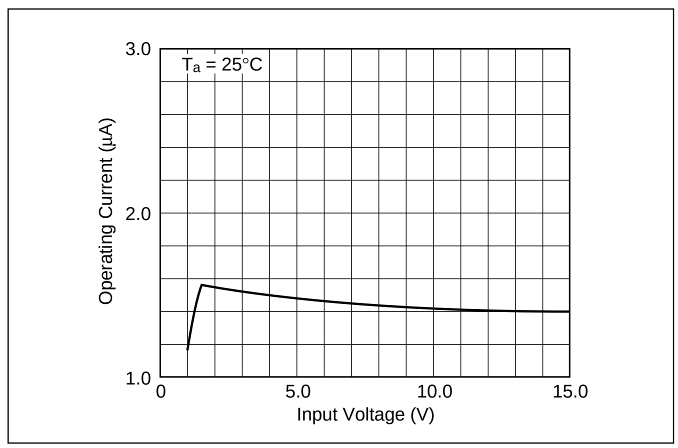
Input/output voltage differential vs. ambient temperature



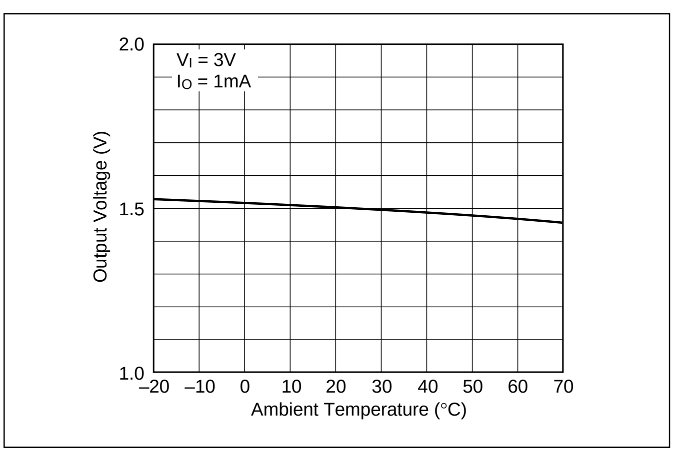
Operating current vs. ambient temperature



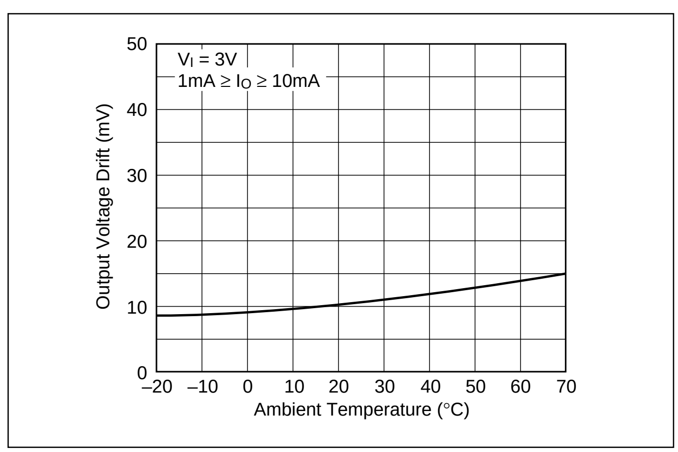
Operating current vs Input voltage



Output voltage vs. ambient temperature



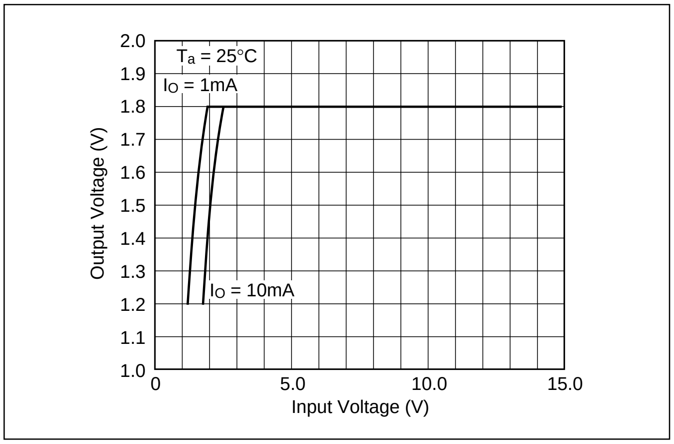
Output voltage drift vs. ambient temperature



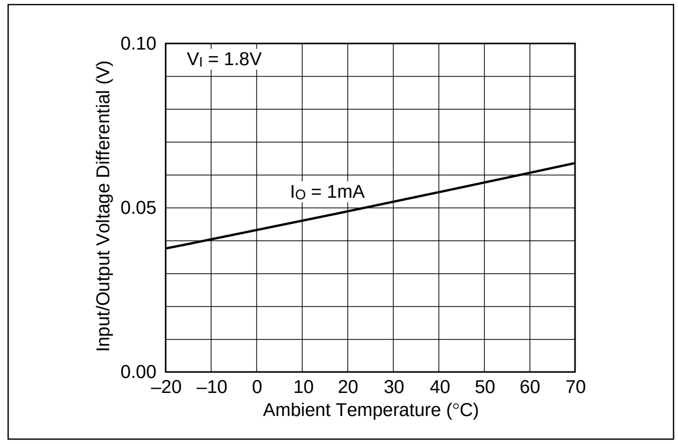
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YGA

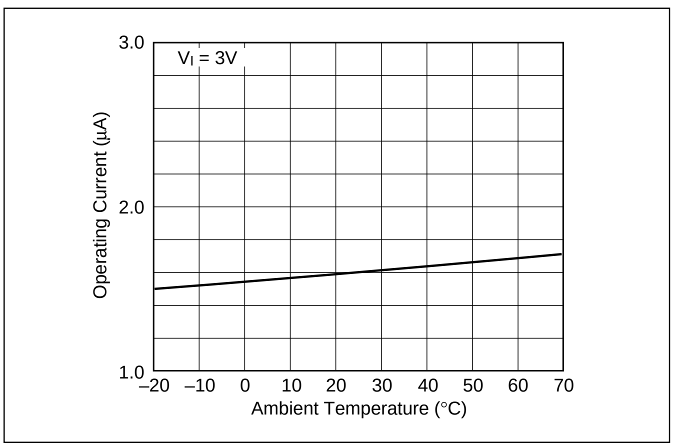
Output voltage vs. input voltage



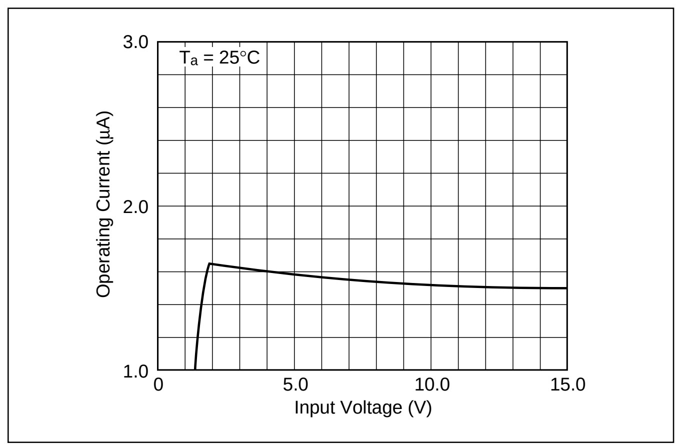
Input/output voltage differential vs. ambient temperature



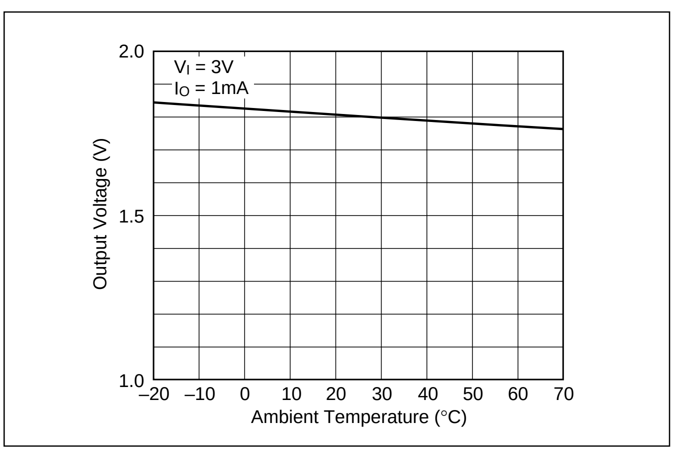
Operating current vs. ambient temperature



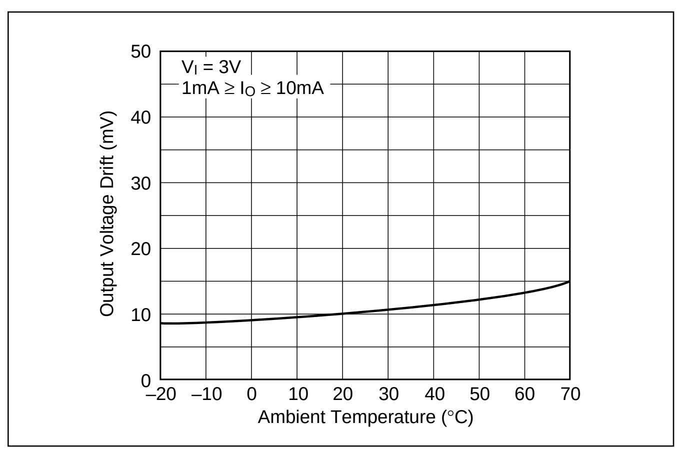
Operating current vs Input voltage



Output voltage vs. ambient temperature



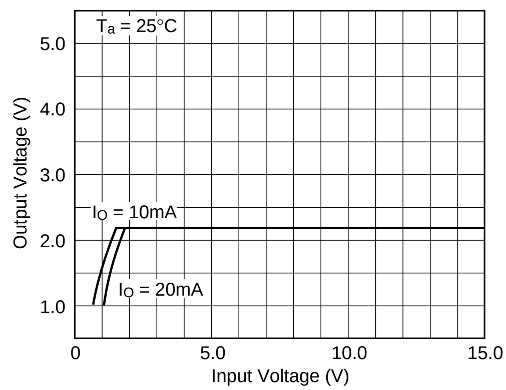
Output voltage drift vs. ambient temperature



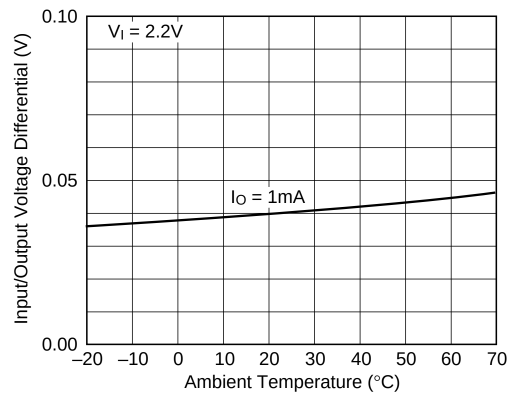
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YFA

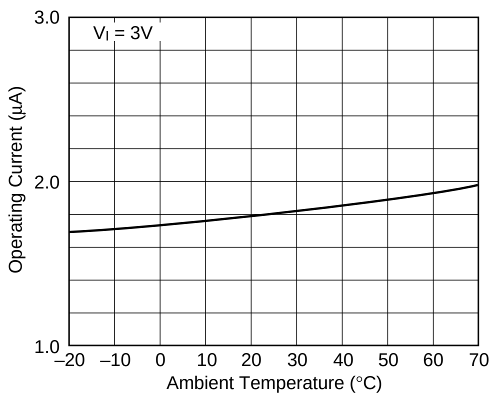
Output voltage vs. input voltage



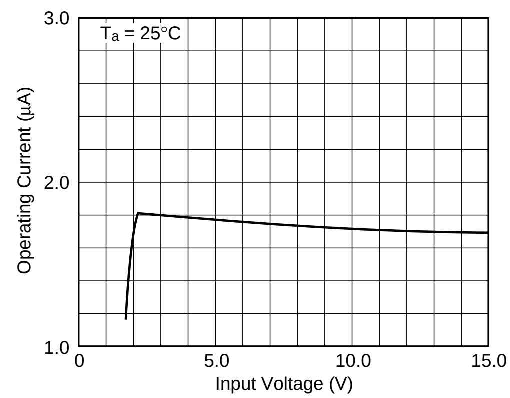
Input/output voltage differential vs. ambient temperature



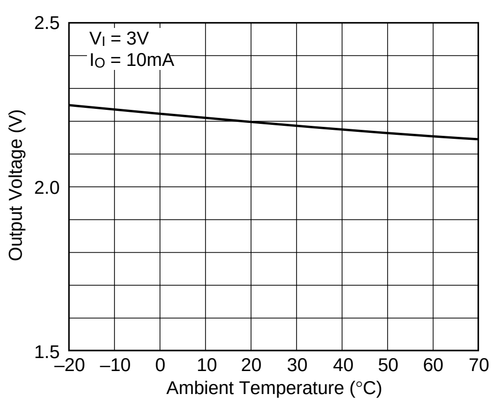
Operating current vs. ambient temperature



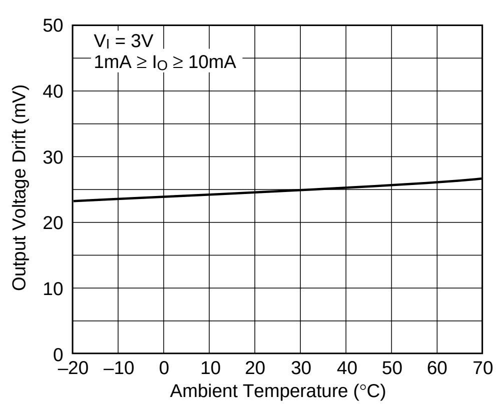
Operating current vs Input voltage



Output voltage vs. ambient temperature



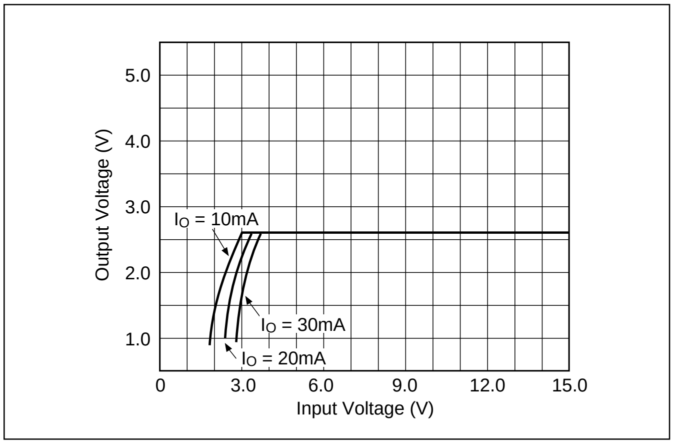
Output voltage drift vs. ambient temperature



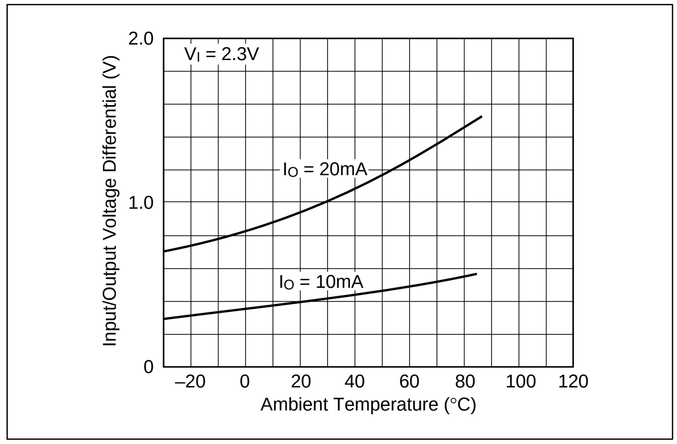
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YLA

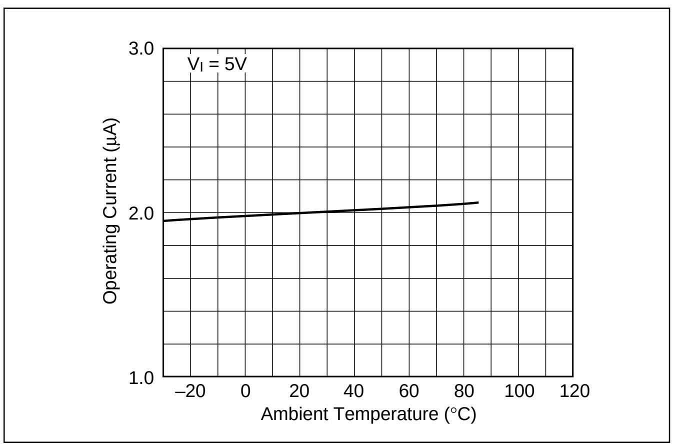
Output voltage vs. input voltage



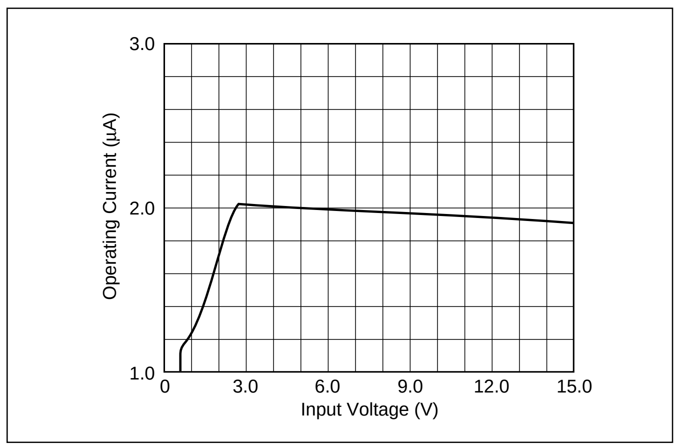
Input/output voltage differential vs. ambient temperature



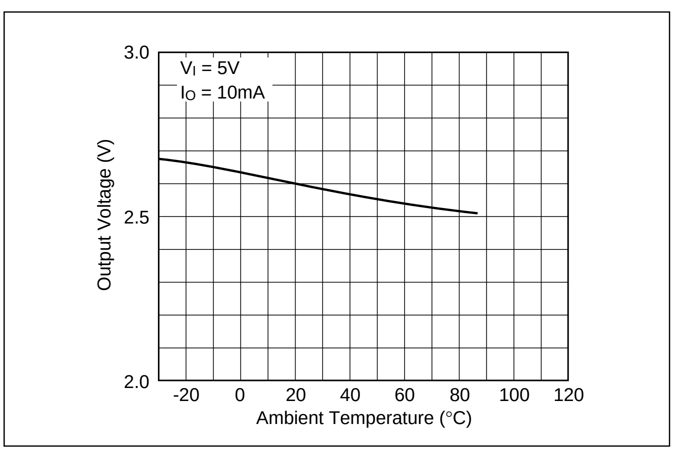
Operating current vs. ambient temperature



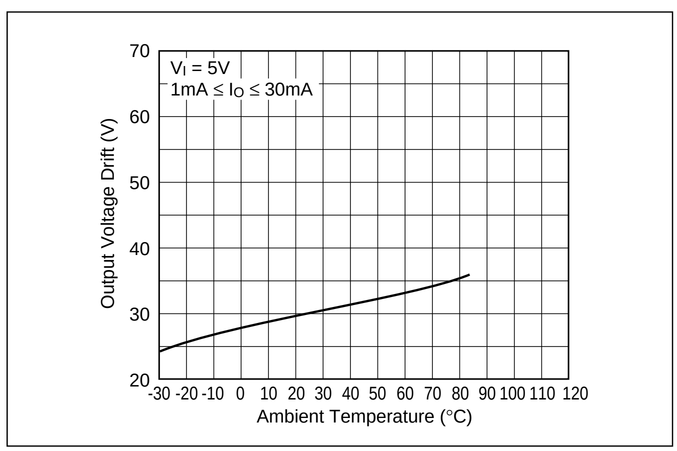
Operating current vs Input voltage



Output voltage vs. ambient temperature



Output voltage drift vs. ambient temperature



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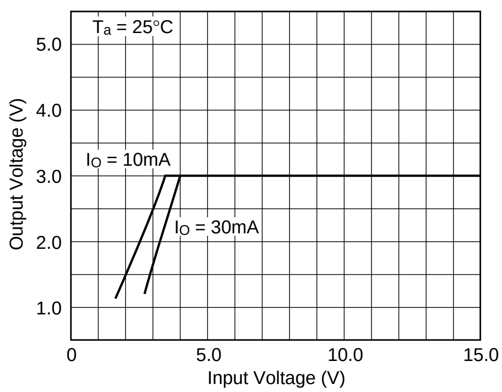
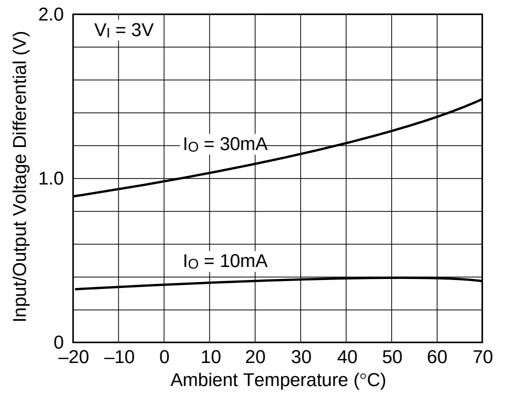
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YDA

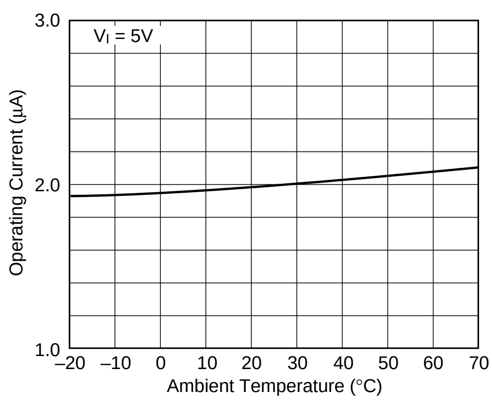
Output voltage vs. input voltage



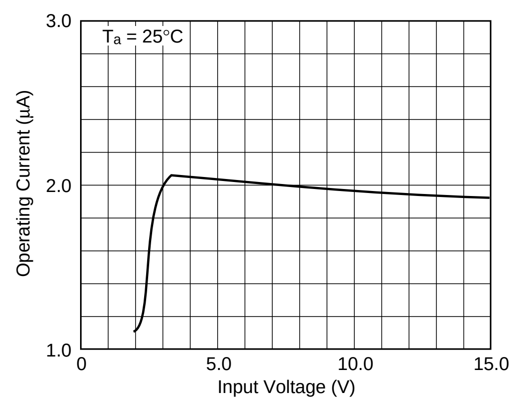
Input/output voltage differential vs. ambient temperature



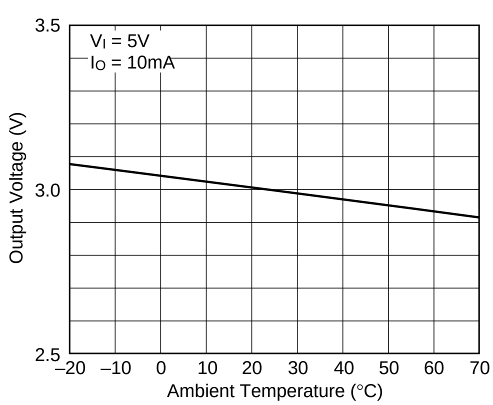
Operating current vs. ambient temperature



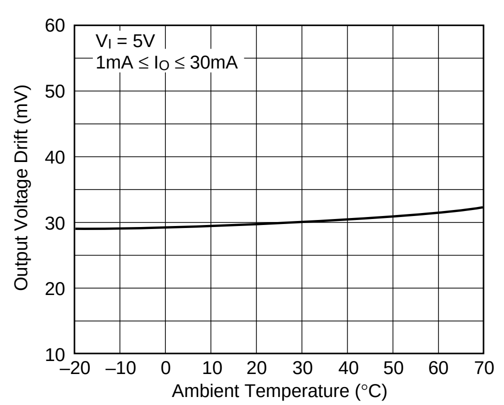
Operating current vs Input voltage



Output voltage vs. ambient temperature



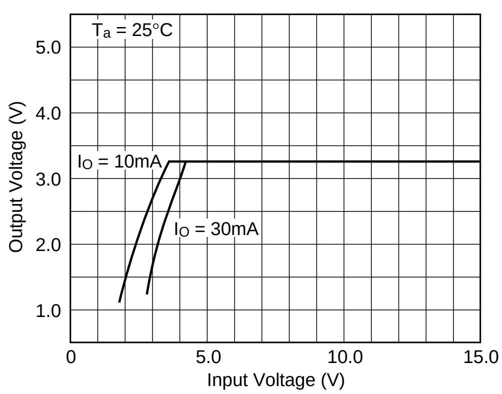
Output voltage drift vs. ambient temperature



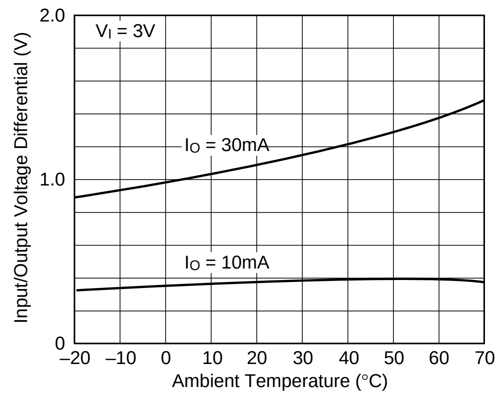
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YCA

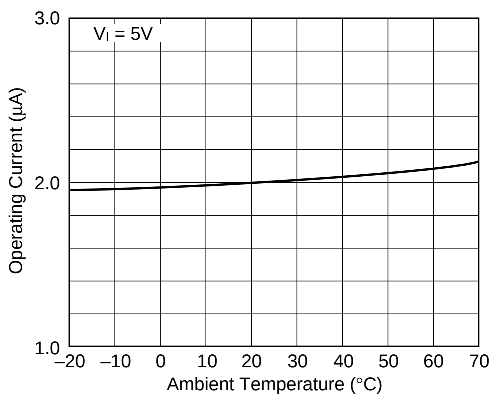
Output voltage vs. input voltage



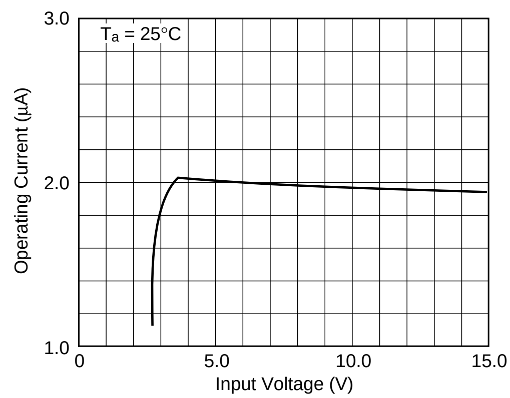
Input/output voltage differential vs. ambient temperature



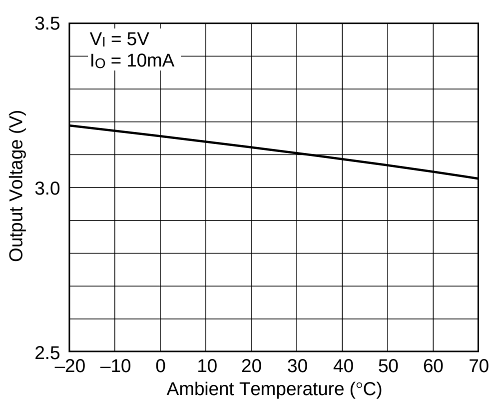
Operating current vs. ambient temperature



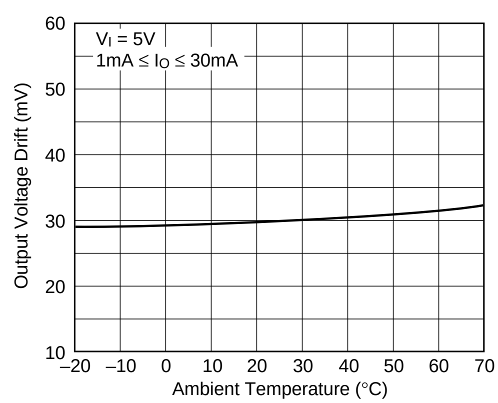
Operating current vs Input voltage



Output voltage vs. ambient temperature



Output voltage drift vs. ambient temperature



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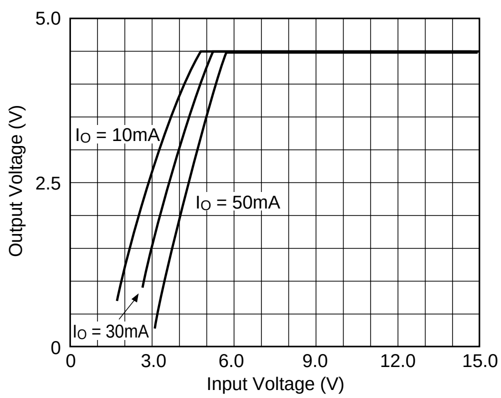
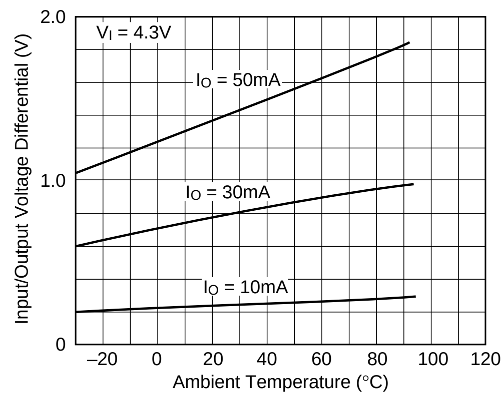
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YMA

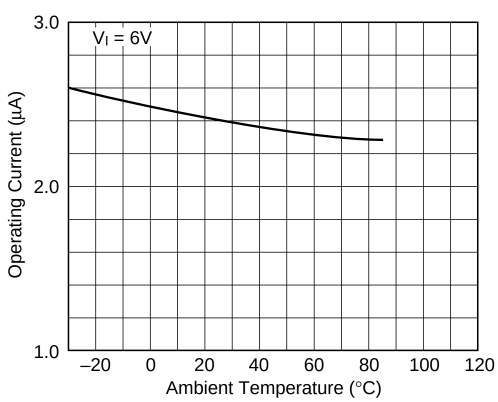
Output voltage vs. input voltage



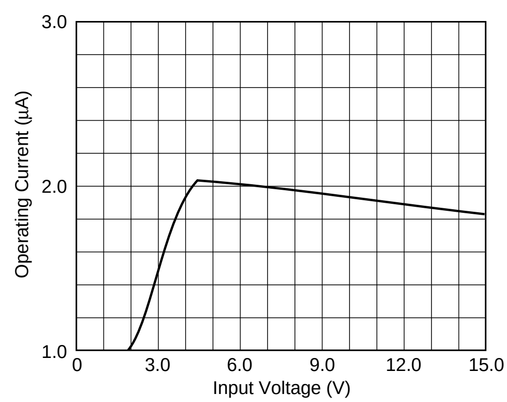
Input/output voltage differential vs. ambient temperature



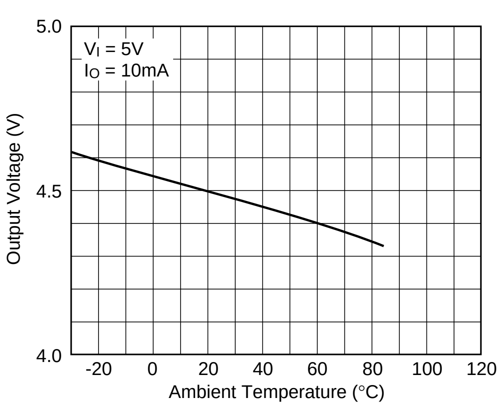
Operating current vs. ambient temperature



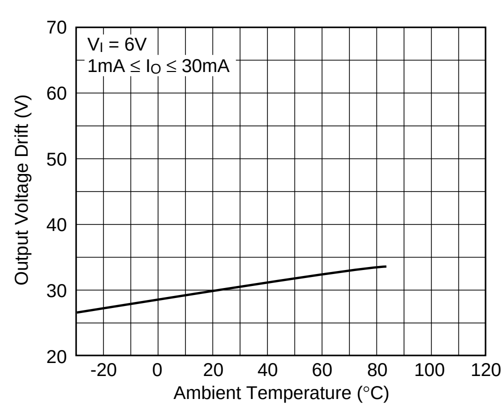
Operating current vs Input voltage



Output voltage vs. ambient temperature



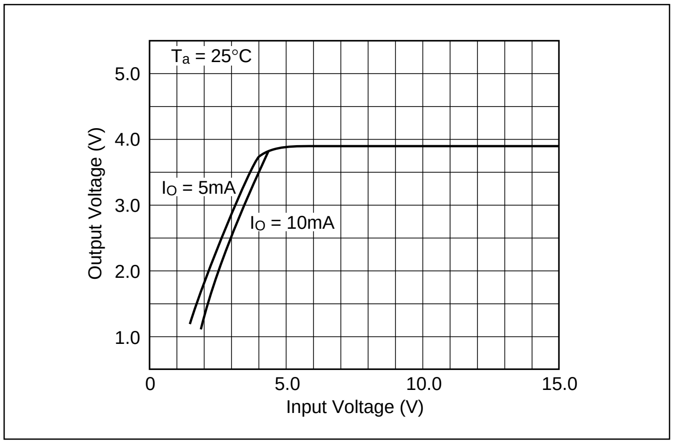
Output voltage drift vs. ambient temperature



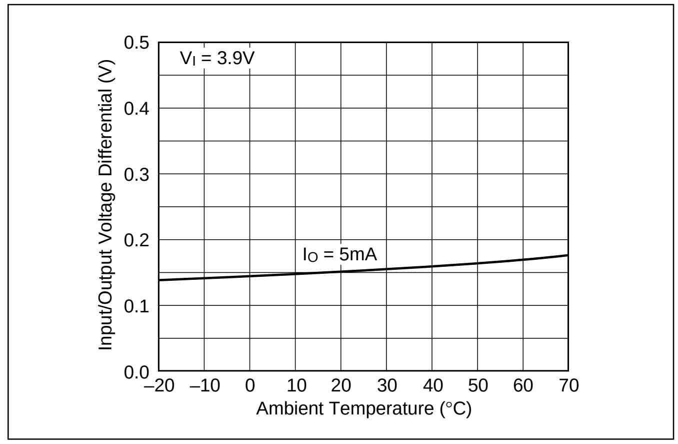
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YKA

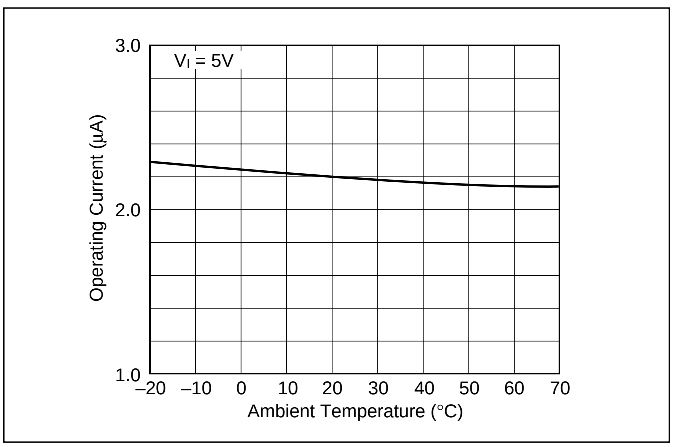
Output voltage vs. input voltage



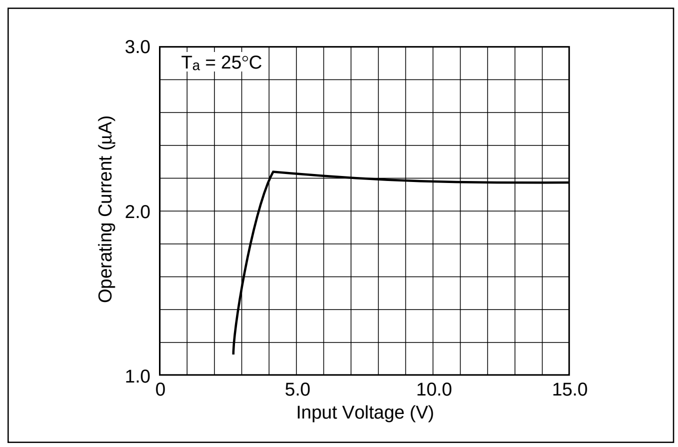
Input/output voltage differential vs. ambient temperature



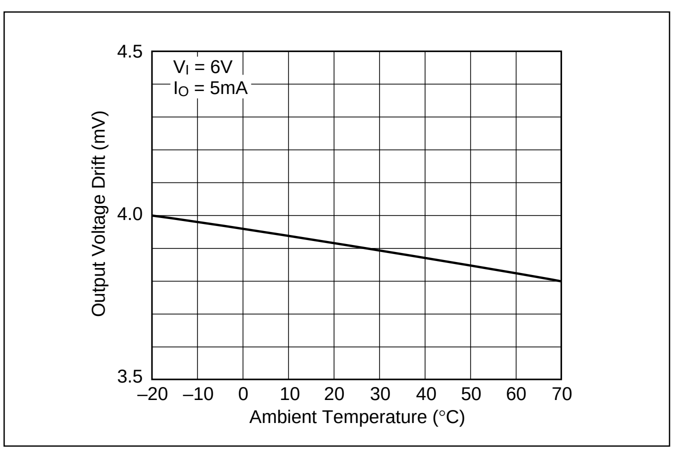
Operating current vs. ambient temperature



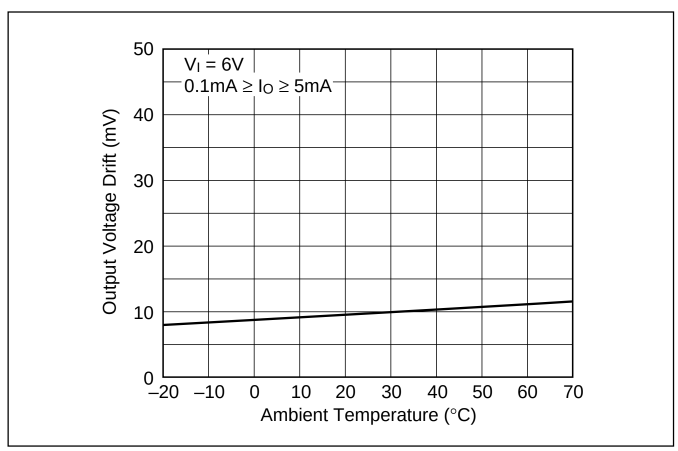
Operating current vs Input voltage



Output voltage vs. ambient temperature



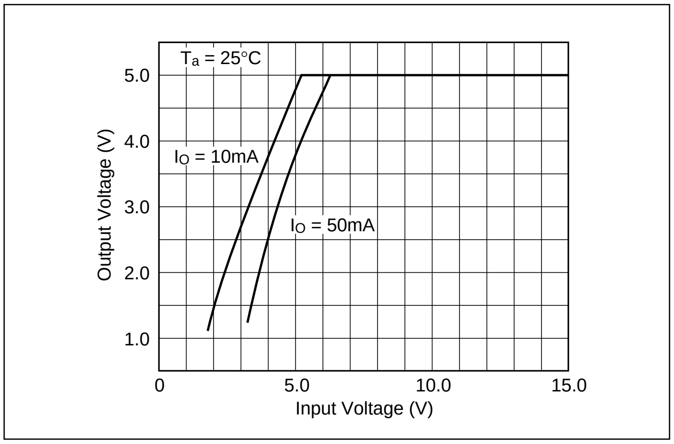
Output voltage drift vs. ambient temperature



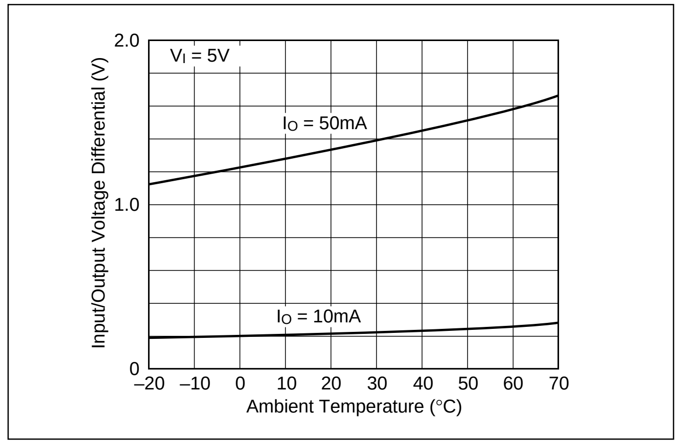
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

● SCI7710YBA

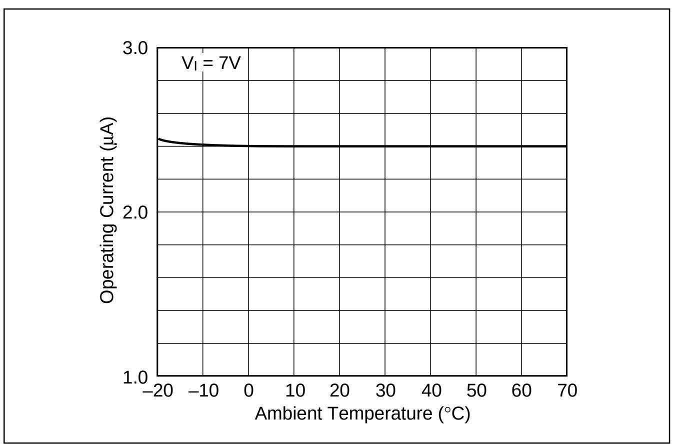
Output voltage vs. input voltage



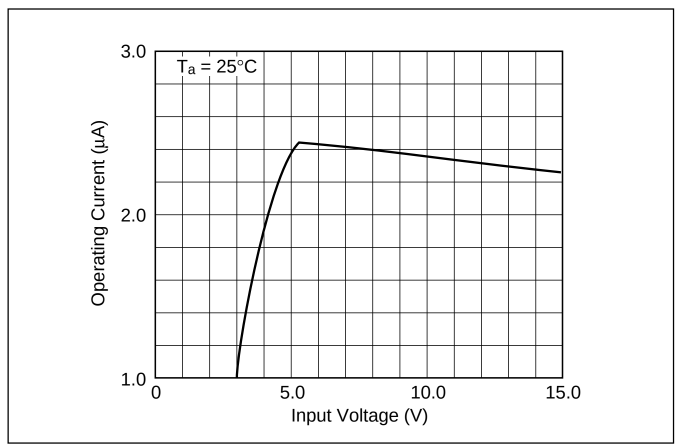
Input/output voltage differential vs. ambient temperature



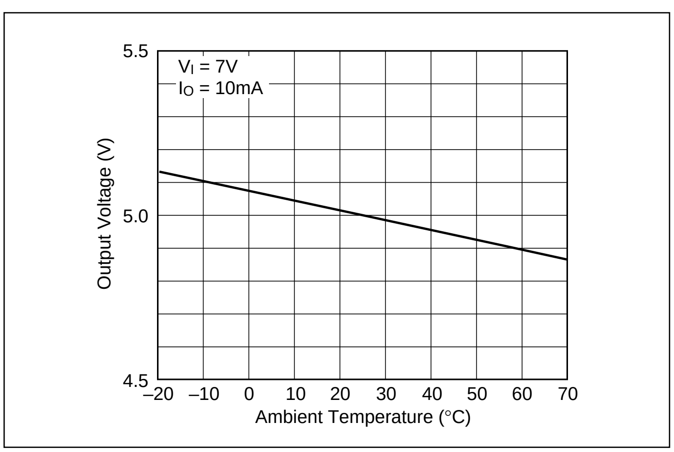
Operating current vs. ambient temperature



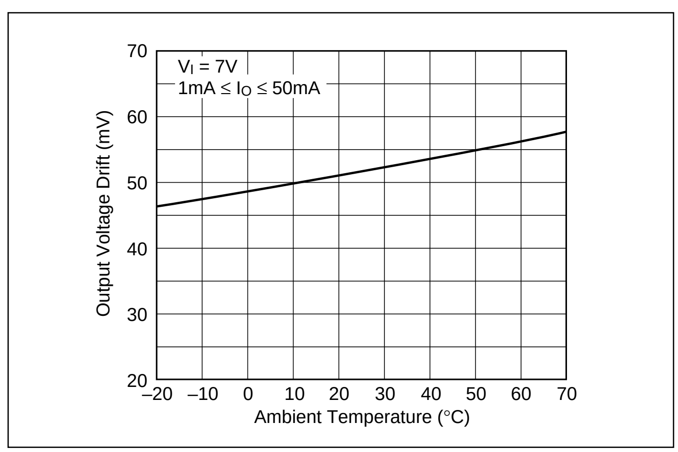
Operating current vs Input voltage



Output voltage vs. ambient temperature



Output voltage drift vs. ambient temperature

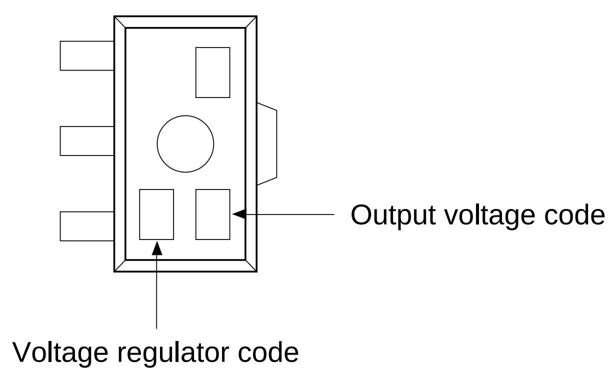


PACKAGE MARKING

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

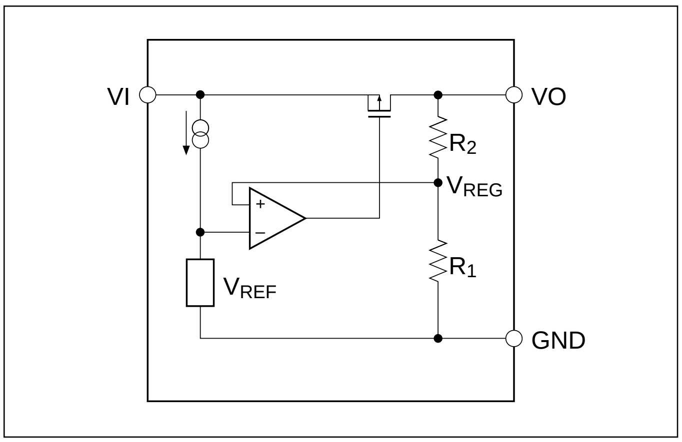


September 1993

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.

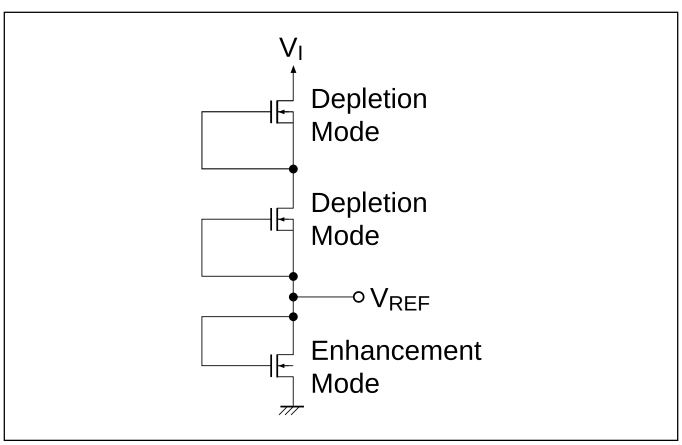


The following equation shows the relationship between V_O and V_{REF}.

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

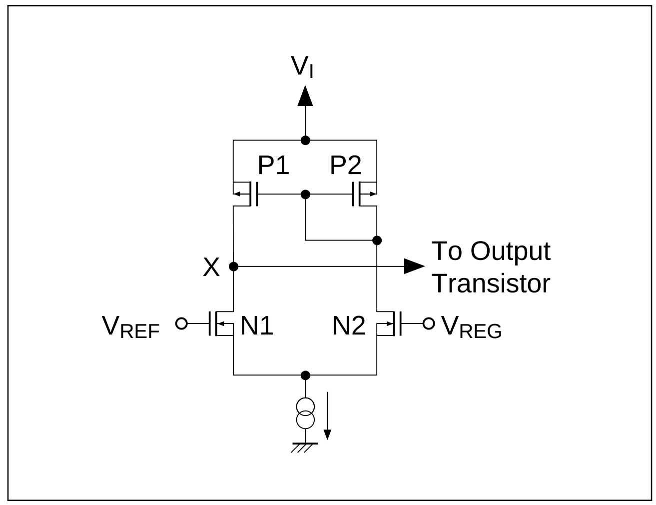
Internal Circuits-Reference voltage generator

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.



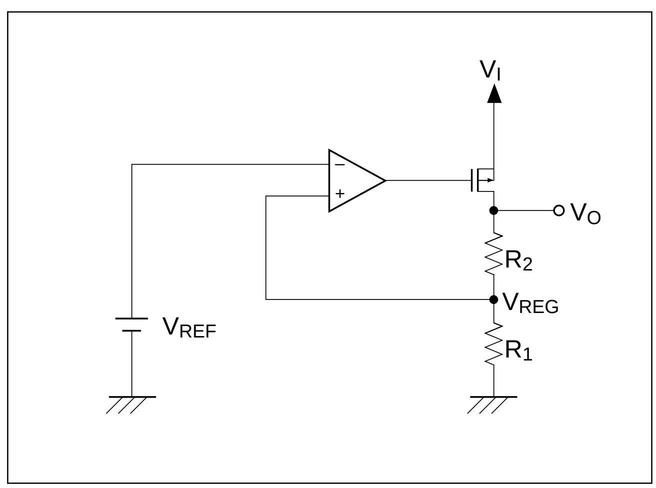
Differential Amplifier

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

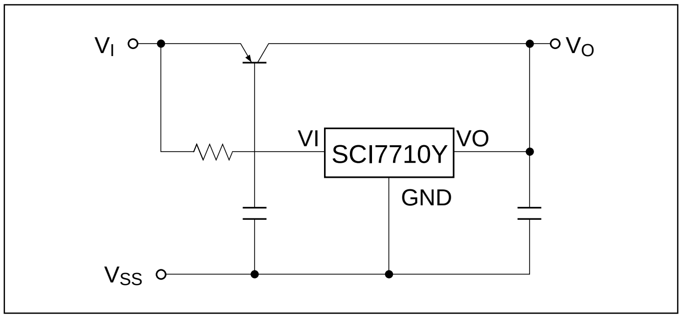
The output side of the p-channel MOS transistors in the output transistor circuit is connected to the voltage divider resistors in the feedback loop.



■ TYPICAL APPLICATIONS

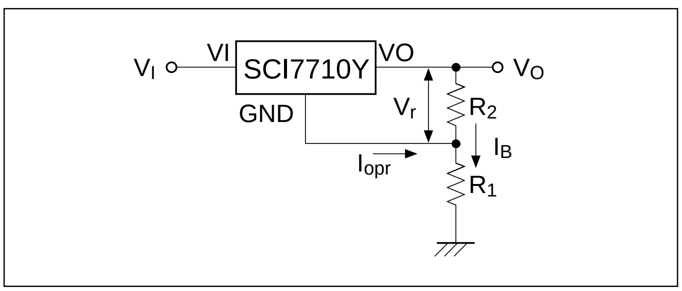
● Current Booster

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



● External Voltage Converter

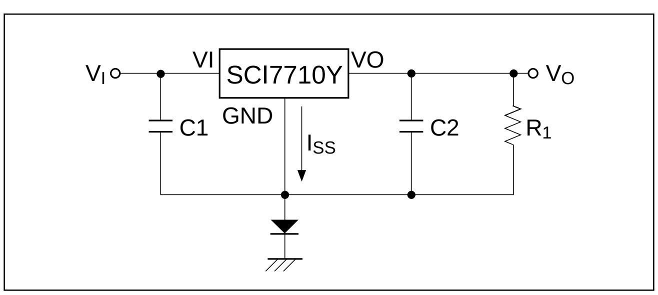
The following circuit raises the output voltage of a SCI7710Y series IC.



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.



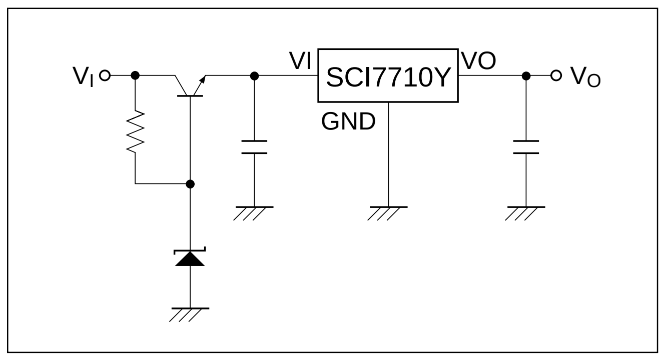
This configuration, however, introduces two design problems.

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.

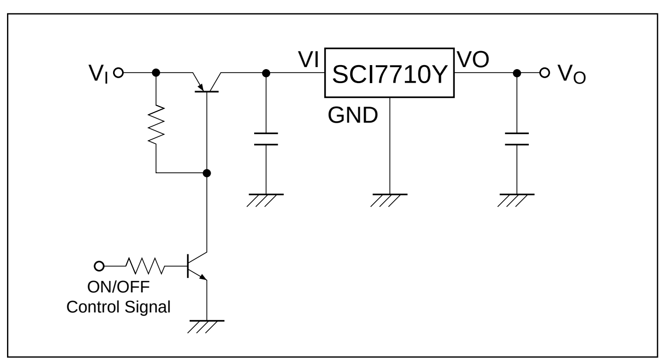
● Higher Input Voltages

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.



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San Jose, CA 95134	Wakefield, MA 01880	Raleigh, NC 27609	
Tel. (408) 922-0200	Tel. (617) 246-3600	Tel. (919) 781-7667	
Fax (408) 922-0238	Fax (617) 246-5443	Fax (919) 781-6778	