SCI 781OY series
SCI 791OY series
POWER SUPPLY IC

3. Voltage Regulator

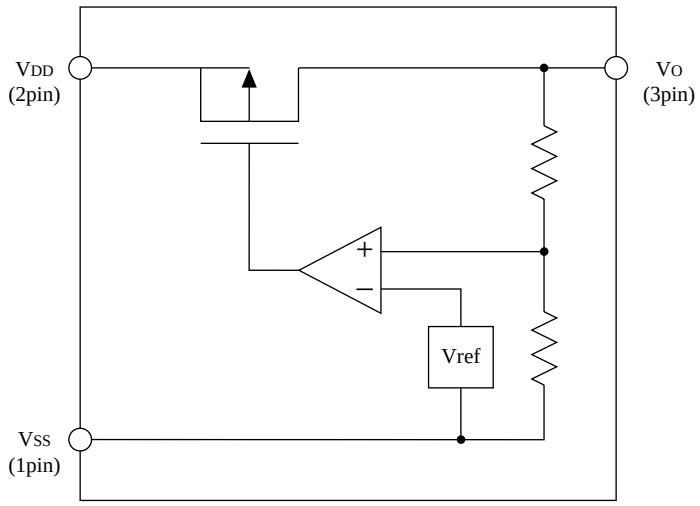
DESCRIPTION

The SCI7810Y series products are the fixed type positive voltage regulators being developed utilizing the CMOS silicon gate process. It is mainly consisted of the reference voltage circuit driven with low operating current, differential amplifier, transistor for output control and voltage setting resistor.
Output voltage is fixed on ICs. A wide variety of standard voltage products are prepared.
The package used is the SOT89-3 pins plastic package.

FEATURES

- A wide variety of lineups: 12 types are offered in the range of 2V to 6V.
- Low operating current: Typ. 1.5 µA (V_{DD} = 5.0V).
- Smaller difference between the input and output voltage: Typ. 0.02V (I_O = 10 mA, V_O = 5.0V).
- Built-in, highly stable reference voltage source: Typ. 1.0V.
- Smaller temperature factor on output voltage: Typ. –100 ppm/°C.
- Wider operating voltage range: Maximum 15V.

BLOCK DIAGRAM



MODEL CLASSIFICATION

Product name	Output voltage		
	Min.	Typ.	Max.
SCI7810YAA	5.75	6.00	6.25
SCI7810YBA	4.90	5.00	5.10
SCI7810YMA	4.40	4.50	4.60
SCI7810YPA	3.90	4.00	4.10
SCI7810YKA	3.80	3.90	4.00
SCI7810YNA	3.43	3.50	3.57
SCI7810YTA	3.23	3.30	3.37
SCI7810YCA	3.13	3.20	3.27
SCI7810YDA	2.93	3.00	3.07
SCI7810YRA	2.73	2.80	2.87
SCI7810YLA	2.53	2.60	2.67
SCI7810YFA	2.15	2.20	2.25
SCI7810YGA	1.75	1.80	1.85
SCI7810YHA	1.45	1.50	1.55

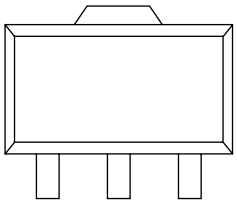
PIN DESCRIPTION

Pin Function

Pin No.	Pin name	Pin function
1	V_{SS}	Input voltage pin (negative side)
2	V_{DD}	Input voltage pin (positive side)
3	V_O	Output voltage pin

Pin Layout

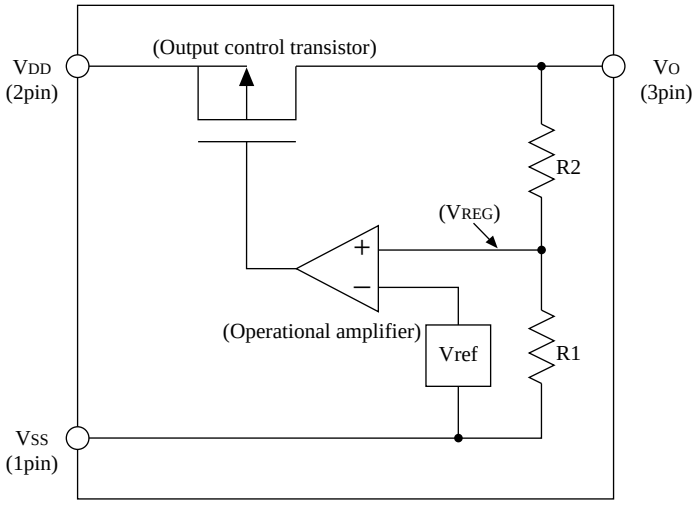
SOT89-3pin



DESCRIPTION OF FUNCTION

The SCI7810Y series products are the fixed type positive output voltage regulators. They employ the series regulation approach using CMOS transistors between the input and output for control of the output.
The voltage divided by the built-in resistors R1 and R2 (V_{REG}) is fed back to the operational amplifier and compared against the reference voltage (Vref). This process enables to control the gate voltage of the output control transistor so that stable output voltage (V_O) independent of input voltage is ensured. Output voltage is internally fixed and determined by the following formula.

$$V_O = \frac{R_1 + R_2}{R_1} \cdot Vref$$



Voltage Regulator

ABSOLUTE MAXIMUM RATING

Parameter	Symbol	Rating	Unit
Input voltage	V_{DD} – V_{SS}	18	V
Output voltage	V_O	V_{DD} + 0.3 to V_{SS} – 0.3	
Output current	I_O	100	mA
Allowable dissipation	P_D	200	mW
Operating temperature	Topr	–30 to +85	°C
Storage temperature	Tstg	–65 to +150	
Soldering time Soldering temperature	Tsol	260°C 10 seconds (at lead)	—

ELECTRIC CHARACTERISTICS

SCI7810YAA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 8.0V, I_O = –10mA Ta = 25°C	5.75	6.00	6.25	V
Operating current	I_{OP}	V_{DD} = 6.0V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 6.0V, I_O = –10mA	—	0.16	0.32	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 7.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 8.0V I_O = –1mA to –50mA	—	50	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 8.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YBA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 7.0V, I_O = –10mA Ta = 25°C	4.90	5.00	5.10	V
Operating current	I_{OP}	V_{DD} = 5.0V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 5.0V, I_O = –10mA	—	0.17	0.34	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 6.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 7.0V I_O = –1mA to –50mA	—	50	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 7.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YMA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 6.0V, I_O = –10mA Ta = 25°C	4.40	4.50	4.60	V
Operating current	I_{OP}	V_{DD} = 4.5V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 4.5V, I_O = –10mA	—	0.18	0.36	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 6.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 6.0V I_O = –1mA to –40mA	—	40	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 6.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YPA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 6.0V, I_O = –10mA Ta = 25°C	3.90	4.00	4.10	V
Operating current	I_{OP}	V_{DD} = 4.0V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 4.0V, I_O = –10mA	—	0.19	0.38	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 6.0V I_O = –1mA to –40mA	—	40	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 6.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YKA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 6.0V, I_O = –10mA Ta = 25°C	3.80	3.90	4.00	V
Operating current	I_{OP}	V_{DD} = 3.9V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I – V_O$	V_O = 3.9V, I_O = –10mA	—	0.19	0.38	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 6.0V I_O = –1mA to –40mA	—	40	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 6.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YNA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 5.0V, I_O = –10mA Ta = 25°C	3.43	3.50	3.57	V
Operating current	I_{OP}	V_{DD} = 3.5V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I – V_O$	V_O = 3.5V, I_O = –10mA	—	0.21	0.42	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V I_O = –1mA to –30mA	—	30	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 5.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YTA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 5.0V, I_O = –10mA Ta = 25°C	3.23	3.30	3.37	V
Operating current	I_{OP}	V_{DD} = 3.3V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 3.3V, I_O = –10mA	—	0.22	0.44	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 4.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V I_O = –1mA to –40mA	—	30	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 5.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YCA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 5.0V, I_O = –10mA Ta = 25°C	3.13	3.20	3.27	V
Operating current	I_{OP}	V_{DD} = 3.2V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 3.2V, I_O = –10mA	—	0.22	0.44	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 4.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V I_O = –1mA to –30mA	—	30	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 5.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YDA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (VSS = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 5.0V, I_O = –10mA Ta = 25°C	2.93	3.00	3.07	V
Operating current	I_{OP}	V_{DD} = 3.0V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 3.0V, I_O = –10mA	—	0.23	0.46	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 4.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V I_O = –1mA to –30mA	—	30	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 5.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YRA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (VSS = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 5.0V, I_O = –10mA Ta = 25°C	2.73	2.80	2.87	V
Operating current	I_{OP}	V_{DD} = 2.8V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 2.8V, I_O = –10mA	—	0.24	0.48	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 4.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V I_O = –1mA to –30mA	—	30	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 5.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YLA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 5.0V, I_O = –10mA Ta = 25°C	2.53	2.60	2.67	V
Operating current	I_{OP}	V_{DD} = 2.6V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 2.6V, I_O = –10mA	—	0.25	0.50	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 4.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 5.0V I_O = –1mA to –30mA	—	30	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 5.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YFA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 3.0V, I_O = –10mA Ta = 25°C	2.15	2.20	2.25	V
Operating current	I_{OP}	V_{DD} = 2.2V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 2.2V, I_O = –10mA	—	0.28	0.56	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 3.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 3.0V I_O = –1mA to –30mA	—	20	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 3.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YGA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 3.0V, I_O = –10mA Ta = 25°C	1.75	1.80	1.85	V
Operating current	I_{OP}	V_{DD} = 2.2V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 1.8V, I_O = –1mA	—	35	90	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 3.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 3.0V I_O = –1mA to –30mA	—	20	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 3.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

SCI7810YHA

(Ta = –30°C to +85°C shall be assumed except where otherwise specified.)

Parameter	Symbol	Conditions (V_{SS} = 0.0v)	Min.	Typ.	Max.	Unit
Input voltage	V_I	———	—	—	15	V
Output voltage	V_O	V_{DD} = 3.0V, I_O = –10mA Ta = 25°C	1.45	1.50	1.55	V
Operating current	I_{OP}	V_{DD} = 2.2V to 15.0V No load	—	1.5	5.0	µA
Voltage difference between input and output	$V_I - V_O$	V_O = 1.5V, I_O = –1mA	—	40	110	V
Output voltage temperature characteristics	$\frac{\Delta V_O}{V_O}$	———	–300	–100	+100	ppm /°C
Input voltage stability	$\frac{dV_O}{dV_I \cdot V_O}$	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 3.0V to 15.0V I_O = –10mA	—	0.1	—	%/V
Load stability	ΔV_O	Ta = –30°C to +85°C (At the same temperature level) V_{DD} = 3.0V I_O = –1mA to –10mA	—	20	—	mV
Supply voltage regulation rejection ratio	PS_{RR}	V_{DD} = 3.0V, fin = 50kHz C_L = 10µF, I_O = –10mA	—	–40	—	dB

EXAMPLES OF APPLIED CIRCUITS

Current Boost Circuit

Configuring the current boost circuit as shown in Figure 3-4 enables to create a voltage regulator that is capable of providing higher output current at lower operating current.

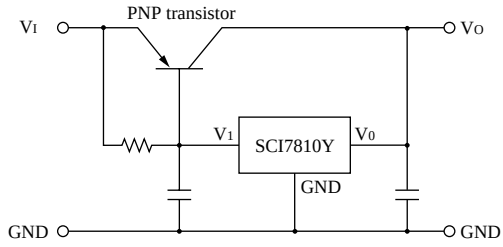


Figure 3-4 Current boost circuit

Variable Voltage Circuit 1

The SCI7810Y series consists of 3-pin regulators with fixed output voltage. Their output voltage, however, can be changed providing resistors externally as shown in Figure 3-5. In this case, the output voltage VO is determined by the following formula.

$$VO = \frac{R1 + R2}{R2} Vr$$

But, this arrangement requires to provide bias current (IB) enough to offset increased resistance on R1 that results from operating current (Iopr) of the SCI7810Y series.

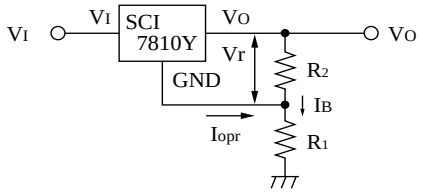


Figure 3-5 Providing resistors

Variable Voltage Circuit 2

It is also possible to increase output voltage using the SCI7810 series and diode, and configuring the circuit shown in Figure 3-6.

The circuit shown in Figure 3-6 takes into consideration of dispersion of the forward voltage VF resulting from the circuit element, temperature and IC's operating current ISS. This circuit is an example of using forward characteristic of the diode, but reverse voltage (Zener diode) can also be utilized depending on a given input voltage.

When you want to reduce ISS-dependent dispersion of VF or when ISS is not sufficient as the diode bias current, think of externally adding the resistor R1.

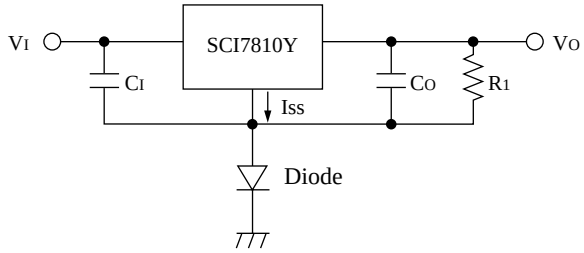


Figure 3-6

When Higher Input Voltage is Needed

When you want to apply an input voltage higher than the rating, add the regulator circuit in to the preceding stage so that the input voltage to the IC becomes less than the rating. See Figure 3-7.

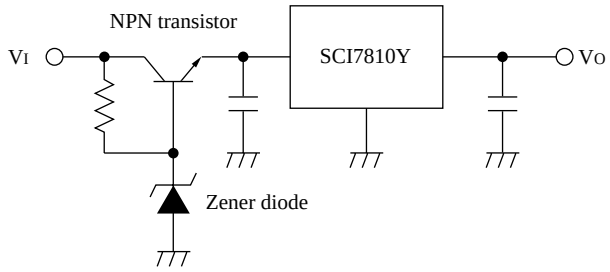


Figure 3-7

When Turning On or Off Output

The SCI7810Y series products are constantly in the operation mode, so applying an input voltage generates the specified output voltage. If, however, a SCI7810Y series product is connected to the external circuit configured with transistors and resistors (see Figure 3-8), its output voltage can be turned on or off.

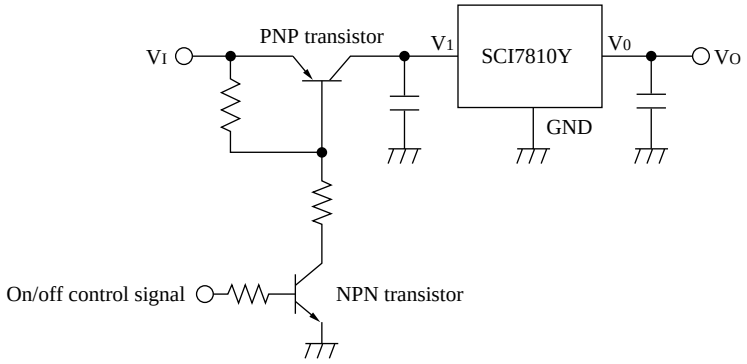


Figure 3-8