

# M51945A,B/M51946A,B

## VOLTAGE DETECTING, SYSTEM RESETTING IC SERIES

### DESCRIPTION

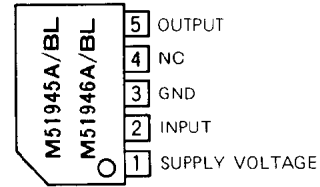
M51945A,B/M51946A,B are semiconductor integrated circuits designed for input voltage detection and for resetting of all types of logic circuits such as CPUs.

Possible applications are extensive, including circuits for battery checking, level detecting and waveform shaping.

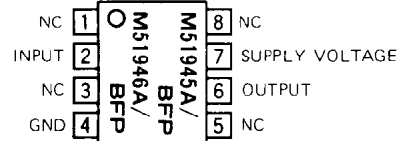
### FEATURES

- Few external parts
- Low threshold operating voltage (Supply voltage to keep low-state at low supply voltage) . . . . . 0.6V (TYP.) at  $R_L = 22k\Omega$
- Wide supply voltage range . . . . . 2 ~ 17V
- Sudden change in power supply has minimal effect on the ICs
- Wide operation range of detecting input pin . . . . Narrower ranges of  $-0.3V \sim V_{CC}$  or  $-0.3V \sim 7V$  (Input voltage detecting type)
- Suitable for high supply voltage circuit with simple circuit structure (M51945B, M51946B)
- Permits easy configuration of a circuit for protection against reverse connection or surges. (M51945B, M51946B)
- Wide application range
- SIL package of the same height as DIP (5-pin SIP)

### PIN CONFIGURATION (TOP VIEW)



Outline 5P5T



Outline 8P2S-A

NC: NO CONNECTION

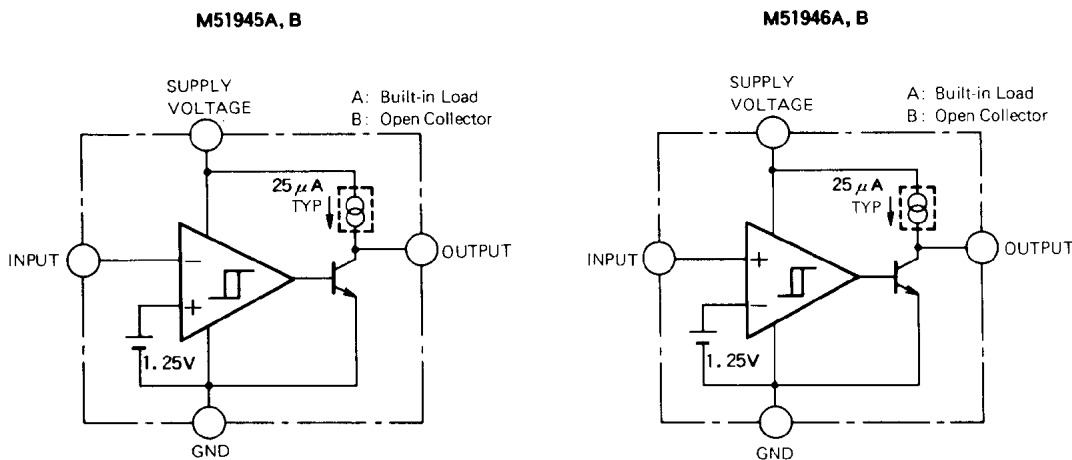
### APPLICATION

Reset circuit of Pch, Nch, CMOS, microcomputer, CPU and microcomputer, Reset of logic circuit, Battery check circuit, Switching circuit back-up voltage, Level detecting circuit, Waveform shaping circuit, Delay waveform generating circuit, DC-DC converter, Over voltage protection circuit.

### RECOMMENDED OPERATING CONDITION

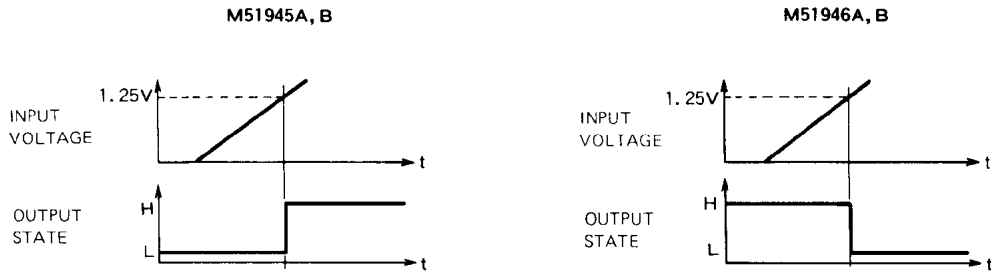
Supply voltage range . . . . . 2 ~ 17V

### BLOCK DIAGRAM



**VOLTAGE DETECTING, SYSTEM RESETTING IC SERIES**

**FUNCTION DIAGRAM**



**ABSOLUTE MAXIMUM RATINGS** (Ta = 25 °C, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit	
V <sub>CC</sub>	Supply voltage		18	V	
I <sub>sink</sub>	Output Sink Current		6	mA	
V <sub>O</sub>	Output voltage	A Type (Output with constant current load)	V <sub>CC</sub>	V	
		B Type (Open collector output)	18		
P <sub>D</sub>	Power dissipation	5P SIP	450	mW	
		8P SOP	300		
K <sub>θ</sub>	Thermal Derating	Ta ≥ 25 °C	5P SIP 8P SOP	4.5 3	mW/°C
T <sub>opr</sub>	Operating temperature		-30 ~ +85	°C	
T <sub>stg</sub>	Storage temperature		-40 ~ +125	°C	

**ELECTRICAL CHARACTERISTICS** (Ta = 25 °C, unless otherwise noted)

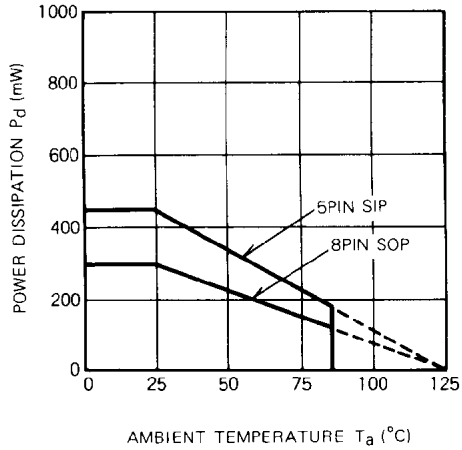
"L" reset type	"H" reset type
<b>M51945A</b>	<b>M51946A</b>
<b>M51945B</b>	<b>M51946B</b>

Symbol	Parameter	Test condition	Limits			Unit
			Min	Typ	Max	
V <sub>S</sub>	Detecting voltage		1.20	1.25	1.30	V
ΔV <sub>S</sub>	Hysteresis voltage	V <sub>CC</sub> = 5V	9	15	23	mV
V <sub>S</sub> /ΔT	Detecting Voltage Temperature Coefficient		—	0.01	—	%/°C
V <sub>CC</sub>	Supply Voltage Range	Ta = -30 ~ +85 °C	2	—	17	V
V <sub>IN</sub>	Input voltage Range	Ta = -30 ~ +85 °C, V <sub>CC</sub> ≤ 7V	-0.3	—	V <sub>CC</sub>	V
		Ta = -30 ~ +85 °C, V <sub>CC</sub> > 7V	-0.3	—	7	
I <sub>IN</sub>	Input Current	V <sub>IN</sub> = 1.25V	—	100	500	nA
I <sub>CC</sub>	Circuit Current	Type A V <sub>CC</sub> = 5V	—	310	470	μA
		Type B V <sub>CC</sub> = 5V	—	280	420	
V <sub>sat</sub>	Output Saturation Voltage	L reset type V <sub>CC</sub> = 5V, V <sub>IN</sub> < 1.2V, I <sub>sink</sub> = 4mA	—	0.2	0.4	V
		H reset type V <sub>CC</sub> = 5V, V <sub>IN</sub> > 1.35V, I <sub>sink</sub> = 4mA	—	—	—	
V <sub>OPL</sub>	Threshold Operating Voltage	L reset type minimum supply voltage for IC operation				V
		R <sub>L</sub> = 2.2kΩ, V <sub>sat</sub> ≤ 0.4V	—	0.67	0.8	
		R <sub>L</sub> = 100kΩ, V <sub>sat</sub> ≤ 0.4V	—	0.55	0.7	
I <sub>OH</sub>	Output Leakage Current	Type B	—	—	30	nA
		Type B, Ta = -30 ~ +85 °C	—	—	1	μA
I <sub>OC</sub>	Output Load Current	Type A V <sub>CC</sub> = 5V, V <sub>O</sub> = 1/2 V <sub>CC</sub>	-40	-25	-17	μA
V <sub>OH</sub>	Output High Voltage	Type A	V <sub>CC</sub> - 0.2	V <sub>CC</sub> - 0.06	—	V
t <sub>PHL</sub>	Propagation Delay Time	Response time when V <sub>CC</sub> changes H → L	—	4	—	μs
t <sub>PLH</sub>		Response time when V <sub>CC</sub> changes L → H	—	2	—	μs

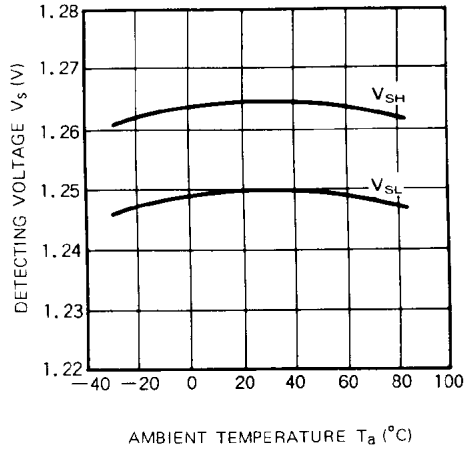
**VOLTAGE DETECTING, SYSTEM RESETTING IC SERIES**

**TYPICAL CHARACTERISTICS**

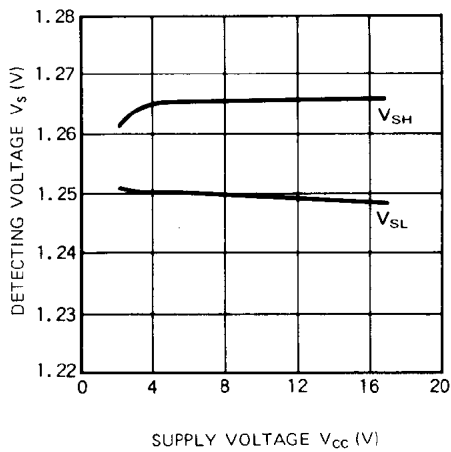
**TYPICAL CHARACTERISTICS  
 THERMAL DERATING  
 (MAXIMUM RATING)**



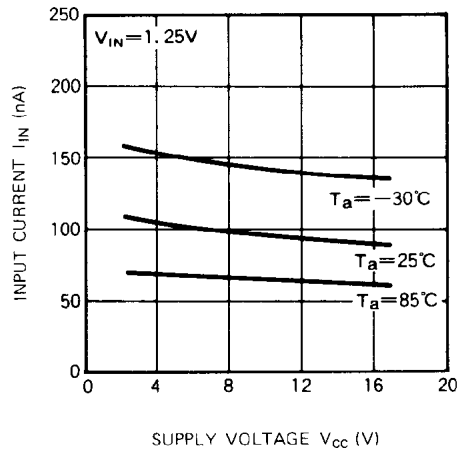
**DETECTING VOLTAGE VS.  
 AMBIENT TEMPERATURE  
 (Input voltage detecting series)**



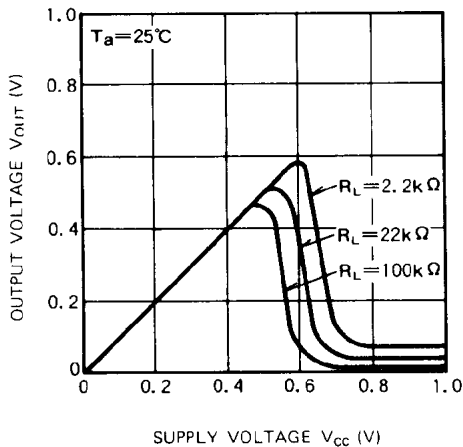
**DETECTION VOLTAGE VS.  
 SUPPLY VOLTAGE  
 (Input voltage detection series)**



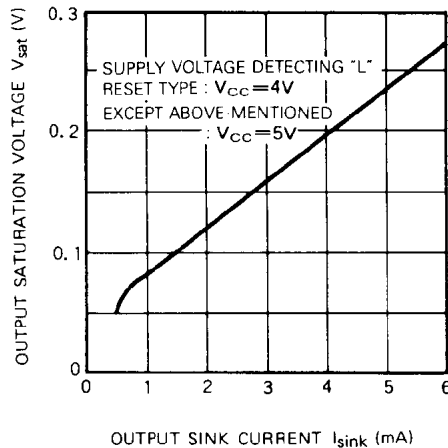
**INPUT CURRENT VS.  
 SUPPLY VOLTAGE  
 (Input voltage detecting series)**



**THRESHOLD OPERATING VOLTAGE  
 ([L] reset type)**

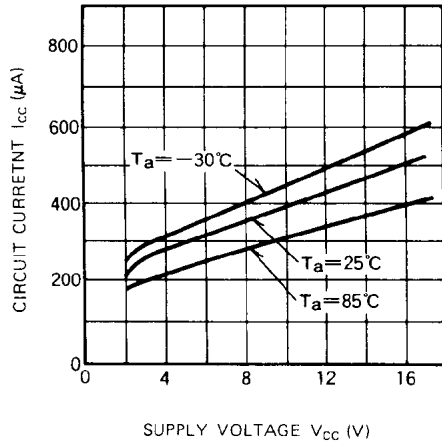


**OUTPUT SATURATION VOLTAGE VS.  
 OUTPUT SINK CURRENT**

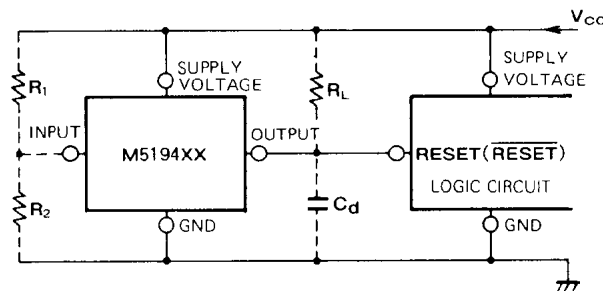


**VOLTAGE DETECTING, SYSTEM RESETTING IC SERIES**

**CIRCUIT CURRENT VS.  
 SUPPLY VOLTAGE  
 (M51945B, M51946B)**



**EXAMPLE OF APPLICATION CIRCUIT  
 Reset Circuit of M5194XX Series**



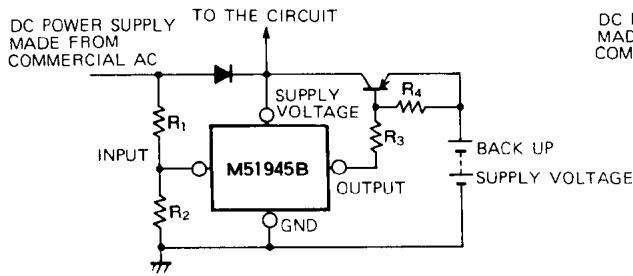
- Note 1. When the detecting supply voltage is 4.25V, M51943 and M51944 are used and R<sub>1</sub> and R<sub>2</sub> are not necessary.  
 When the voltage is anything except 4.25V, M51945 and M51946 are used. In this case, the detecting supply voltage is  $1.25 \times \frac{(R_1 + R_2)}{R_2}$  (V) approximately. The detecting supply voltage can be set between 2V and 15V.
- Note 2. If the M5194XX and the logic circuit share a common power source, type A (built-in load type) can be used whether a pull-up resistor is included in the logic circuit or not.
- Note 3. The logic circuit preferably should not have a pull-down resistor, but if one is present, add load resistor R<sub>L</sub> to overcome the pull-down resistor.

- Note 4. It is better to use the M5195XX series to cause a delay, but if the delay is caused by the M5194XX series, the delay capacitor C<sub>d</sub> is applied between the output and GND.
- Note 5. When the reset terminal in the logic circuit is of the low reset type, M51943 and M51945 are used and when the terminal is of the high reset type, M51944 and M51946 are used.
- Note 6. When a delay is necessary at both rise time and fall time, M51945 and M51946 are used and the series resistors (R<sub>11</sub>, R<sub>12</sub>) are applied between the output and GND or instead of R<sub>1</sub>, and these connect the capacitor between the connection point and GND. The connection point of the capacitor is fixed according to the ratio of delay at fall/rise time.
- Note 7. When a negative supply voltage is used, the supply voltage side of M5194XX and the GND side are connected to GND and the negative supply voltage respectively.

**VOLTAGE DETECTING, SYSTEM RESETTNG IC SERIES**

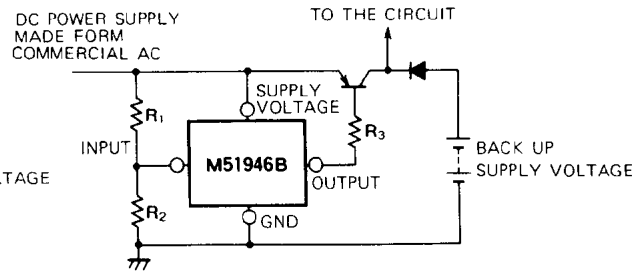
**Switching Circuit to Back-up Power Supply**

(a)



$$\text{SWITCHING VOLTAGE} \approx 1.25 \times \frac{R_1 + R_2}{R_2} (\text{V})$$

(b)

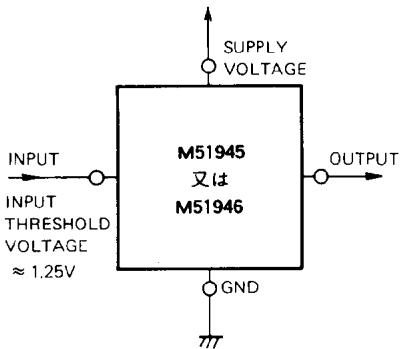


$$\text{SWITCHING VOLTAGE} \approx 1.25 \times \frac{R_1 + R_2}{R_2} (\text{V})$$

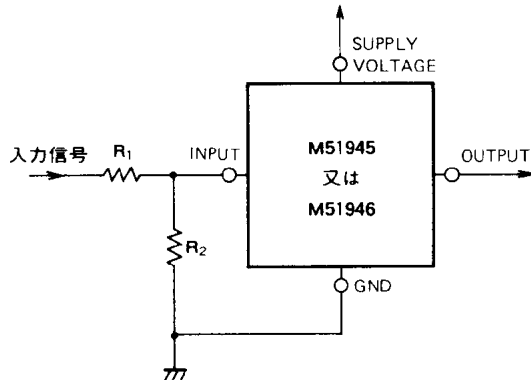
**Level Detecting Circuit, Waveform Shaping Circuit**

Because the input threshold of M51945 and M51946 is little dependent on supply voltage and temperature and has hysteresis of 15mV approximately, these ICs can be used in level detecting circuits and waveform shaping circuits.

(a)



(b)

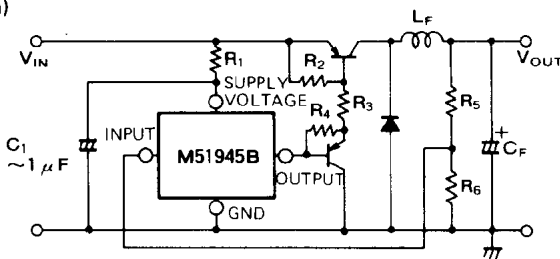


$$\text{THRESHOLD VOLTAGE} \approx 1.25 \times \frac{R_1 + R_2}{R_2} (\text{V})$$

**DC-DC Converter**

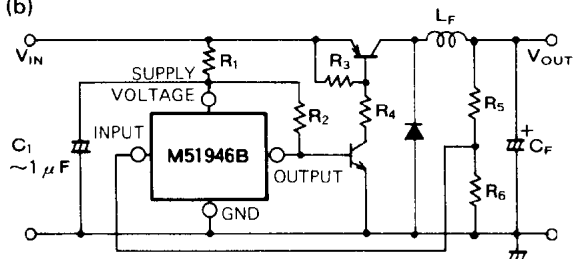
**Step Down Regulator**

(a)



$$V_{OUT} \approx 1.25 \times \frac{R_5 \times R_6}{R_6} (\text{V})$$

(b)

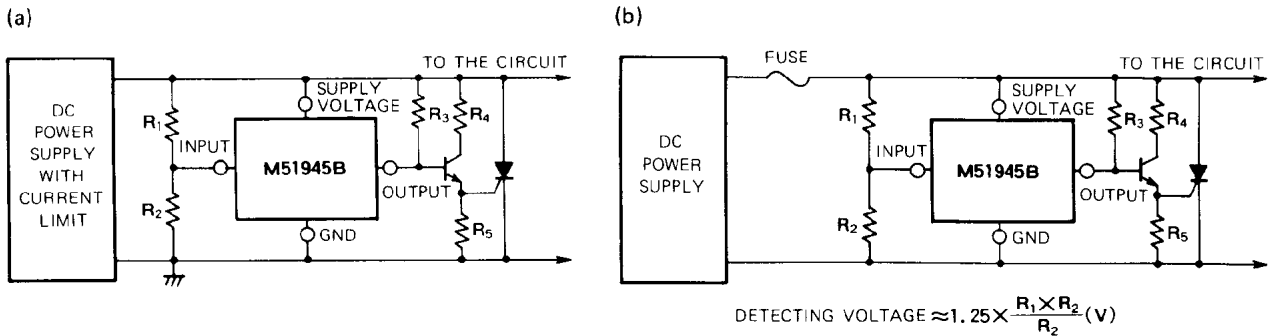


$$V_{OUT} \approx 1.25 \times \frac{R_5 \times R_6}{R_6} (\text{V})$$

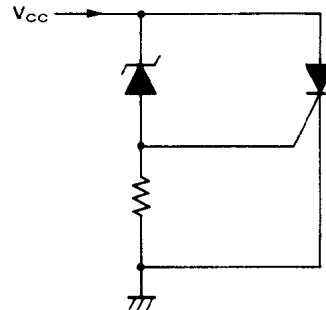
In (b) above, the power supply for M51946B is provided by both R<sub>1</sub> and R<sub>2</sub> (and the M51946B internal resistor) and so a high input voltage can be used.

**VOLTAGE DETECTING, SYSTEM RESETING IC SERIES**

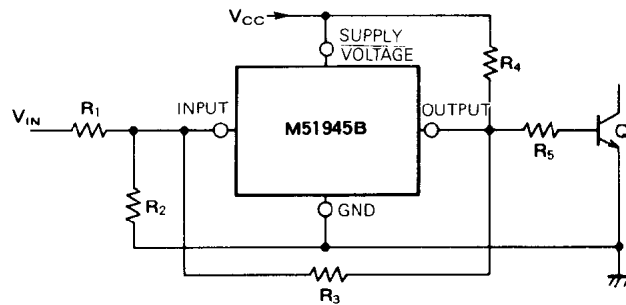
**Over Voltage "Crowbar" Circuit**



The over voltage "crowbar" circuit, using a zener diode as shown below, offers lower drive capacity and decreases the capacity for di/dt of SCR. (Enough gate current is needed to turn on SCR.)



**Expansion of Hysteresis Using M51945B**



$Q_1$ : OFF → ON

Threshold voltage

$$= \frac{(R_1 + R_2)}{R_2 \cdot R_3} [1.265(V) \cdot (R_1 // R_2 + R_3) - V_{sat} \cdot (R_1 // R_2)]$$

$Q_1$ : ON → OFF

Threshold voltage

$$= \frac{(R_1 + R_2)}{R_2 \cdot (R_3 + R_4 // R_5)} \cdot [1.25(V) \cdot (R_3 + R_1 // R_2 + R_4 // R_5) - \frac{R_1 // R_2}{R_4 + R_5} \cdot (R_4 \cdot V_{BE1} + R_5 \cdot V_{cc})]$$

Where  $V_{sat}$ : M51945B output saturation voltage

$V_{BE1}$ : Base-emitter voltage  $\approx 0.7V$  (Transistor  $Q_1$ )

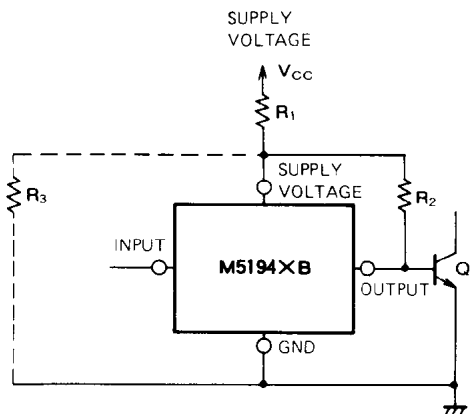
$$R_1 // R_2 \equiv \frac{R_1 \cdot R_2}{R_1 + R_2}, \quad R_4 // R_5 \equiv \frac{R_4 \cdot R_5}{R_4 + R_5}$$

**VOLTAGE DETECTING, SYSTEM RESETTNG IC SERIES**

**Application to High Supply Voltage Circuit**

The absolute maximum rating of supply voltage for M51945B, M51946B is 18V. By diving supply voltage using

resistors, these ICs can be used in high supply voltage circuit.



In the above figure, the voltage applied to M5194XB is as follows. The voltage range is set between 2V and 17V.

$$\text{at } Q_1 \text{ ON: } \frac{R_2 \cdot \left[ \frac{R_3}{(R_1 + R_3)} \cdot V_{CC} - (R_1 // R_3) \cdot I_{CC} \right] + (R_1 // R_3) \cdot V_{BE1}}{R_2 + (R_1 // R_3)}$$

$$\text{at } Q_1 \text{ OFF: } \frac{R_2 \cdot \left[ \frac{R_3}{(R_1 + R_3)} \cdot V_{CC} - (R_1 // R_3) \cdot I_{CC} \right]}{R_2 + (R_1 // R_3)}$$

$$R_1 // R_3 \equiv \frac{R_1 \cdot R_3}{R_1 + R_3}$$

$V_{CC}$ : Circuit current of M5194XB

$V_{BE1}$ : Base-emitter voltage  $\approx 0.7V$  (Transistor  $Q_1$ )

This circuit provides reverse protection (in case of reverse connection of power supply) and surge protection. Using this application circuit, the directly rectified or

smoothing commercial voltage can be applied as shown below.

