

## Reset Circuit with Adjustable Delay

### Description

The EM6354 is an ultra-low current reset circuit available in a large variety of configurations and very small packages for maximum flexibility in all end-applications up to 125°C and using power supplies between 1.5V and 5.5V.

This circuit monitors the supply voltage of any electronic system, and generates the appropriate reset signal. The threshold defines the minimum allowed voltage which guarantees the good functionality of the system. When  $V_{DD}$  rises above  $V_{TH}$ , the output remains active for an additional delay time. This allows the system to stabilize before going fully active. This delay time, or reset timeout period, can be adjusted using an external capacitor.

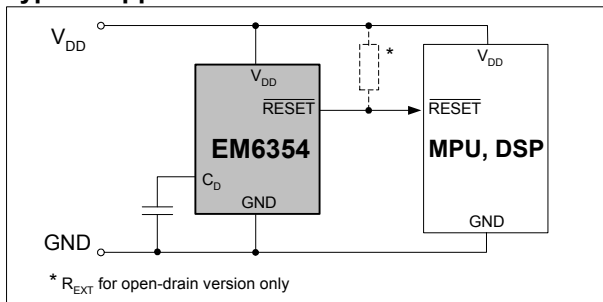
The output is guaranteed to be in the correct state for  $V_{DD}$  down to 0.8V. There are 11 reset threshold voltages starting as low as 1.31V and up to 4.63V. The EM6354 features three output types: active-low push-pull, active-low open-drain and active-high push-pull.

Small SC70 and SOT23 packages as well as ultra-low supply current of 2.9µA make the EM6354 an ideal choice for portable and battery-operated devices.

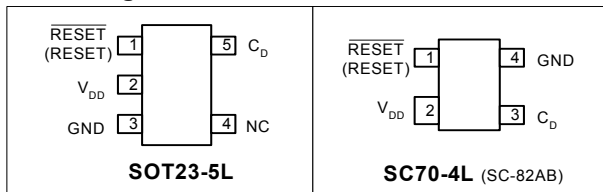
### Features

- Adjustable reset timeout period using an external capacitor
- Ultra-low supply current of 2.9µA ( $V_{DD}=3.3V$ )
- Operating temperature range: -40°C to +125°C
- ±1.5% reset threshold accuracy
- 11 reset threshold voltages  $V_{TH}$ : 4.63V, 4.4V, 3.08V, 2.93V, 2.63V, 2.2V, 1.8V, 1.66V, 1.57V, 1.38V, 1.31V
- 3 reset output options:
  - Active-low  $\overline{RESET}$  push-pull
  - Active-low  $\overline{RESET}$  open-drain
  - Active-high  $RESET$  push-pull
- Immune to short negative  $V_{DD}$  transients
- Guaranteed Reset valid down to 0.8V
- Threshold hysteresis: 2.1% of  $V_{TH}$
- Very small SOT23-5L and SC70-4L (SC-82AB) packages

### Typical Application



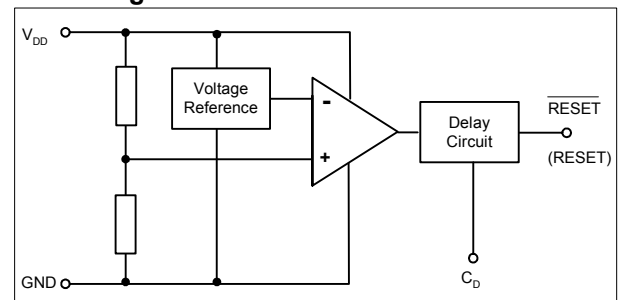
### Pin Configuration (top view)



### Applications

- Home appliances
- Modems
- Routers, hubs and gateways
- WAN, LAN
- Handheld GPS
- Metering and Instrumentation
- TV sets
- Automotive systems

### Block Diagram



### Pin Description

Pin		Name	Function
SOT23-5L	SC70-4L		
1	1	$\overline{RESET}$	Active-low $\overline{RESET}$ output. $\overline{RESET}$ remains low for the reset timeout period after all reset conditions are deasserted and then goes high.
		$RESET$	Active-high $RESET$ output. $RESET$ remains high for the reset timeout period after all reset conditions are deasserted and then goes low.
2	2	$V_{DD}$	Supply Voltage (5.5V max.)
3	4	GND	Ground
4	-	N.C.	Not connected. Not internally connected
5	3	$C_D$	Connect a capacitor between $C_D$ and GND to set the timeout period ( $C_D$ min=1nF; $C_D$ max=10000nF). Reset Timeout Period in [ms] is equal to $C_D$ in [nF]



## Ordering Information

EM6354		X	SP5B	-	2.9	+
<b>Reset Output Type:</b>				<b>RoHS Compliance:</b>		
X = Active-low /RES push-pull				+ = lead-free/green mold compliant		
Y = Active-low /RES open-drain				[blank] = leaded		
Z = Active-high RES push-pull				<b>Reset Threshold Voltage (V<sub>TH</sub>):</b>		
				1.3 = 1.31V	2.6 = 2.63V	
				1.4 = 1.38V	2.9 = 2.93V	
				1.6 = 1.57V	3.1 = 3.08V	
				1.7 = 1.66V	4.4 = 4.40V	
				1.8 = 1.80V	4.6 = 4.63V	
				2.2 = 2.20V		
<b>Package:</b>						
SP5B = SOT23-5, Tape&Reel 3000 pcs						
SC4B = SC70-4, Tape&Reel 3000 pcs						

**Note:** subject to availability (see standard versions list below). Please give complete Part Number when ordering.

## Standard Versions (Top Marking)

Part Number	Top Marking <sup>1)</sup>	Top Marking <sup>2)</sup> with 4 Characters
EM6354XSP5B-1.3	KC##	AMAA
EM6354XSP5B-1.8		AMAE
EM6354XSP5B-1.8+		BMAE
EM6354XSP5B-2.6		AMAG
EM6354XSP5B-2.9		AMAH
EM6354XSP5B-2.9+	KA##	BMAH
EM6354XSP5B-4.6		AMAL
EM6354XSC4B-1.3		AMAA
EM6354XSC4B-1.8	K4##	AMAE
EM6354XSC4B-2.6		AMAG
EM6354XSC4B-2.6+		BMAG
EM6354XSC4B-2.9		AMAH
EM6354XSC4B-4.6		AMAL
EM6354XSC4B-4.6+	KB##	BMAL
EM6354YSP5B-2.6		AMAT
EM6354YSP5B-4.4		AMAW

Part Number	Top Marking <sup>1)</sup>	Top Marking <sup>2)</sup> with 4 Characters
<b>EM6354YSP5B-4.6</b>	K1##	AMAX
EM6354YSP5B-4.6+		BMAX
EM6354XSP5B-1.3		AMAA
EM6354XSP5B-1.8		AMAE
EM6354XSP5B-2.6		AMAG
EM6354XSP5B-2.9		AMAH

<sup>1)</sup> Top marking is the standard from 2006. No bottom marking exists. Where ## refers to the lot number (EM internal reference only)

<sup>2)</sup> Top marking with 4 characters is standard from 2003. For lead-free/green mold (RoHS) parts, the first letter of top marking with 4 characters begins with letter "B" instead of letter "A". Bottom marking indicates the lot number.

## Standard Versions (samples)

Part Number
EM6354XSC4B-2.6+
EM6354XSC4B-4.6

Part Number
EM6354XSP5B-2.9+
EM6354YSP5B-4.6+

Sample stock is generally held on **standard versions** only. Non standard versions have a 30,000 pieces minimum order quantity. Please contact factory for other versions not shown here and for availability of non standard versions.

## Absolute Maximum Ratings

Parameter	Symbol	Conditions
Voltage at V <sub>DD</sub> to GND	V <sub>DD</sub>	-0.3V to +6V
Minimum voltage at any signal pin	V <sub>MIN</sub>	GND - 0.3V
Maximum voltage at any signal pin	V <sub>MAX</sub>	V <sub>DD</sub> + 0.3V
Electrostatic discharge max. to MIL-STD-883C method 3015.7 with ref. to V <sub>SS</sub>	V <sub>ESD</sub>	2000V
Max. soldering conditions	T <sub>MAX</sub>	250°C x 10s
Storage Temperature Range	T <sub>STG</sub>	-65°C to +150°C

Stresses above these listed maximum ratings may cause permanent damages to the device. Exposure beyond specified operating conditions may affect device reliability or cause malfunction.

## Handling Procedures

This device has built-in protection against high static voltages or electric fields; however, anti-static precautions must be taken as for any other CMOS component. Unless otherwise specified, proper operation can only occur when all terminal voltages are kept within the voltage range. Unused inputs must always be tied to a defined logic voltage level.

## Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply voltage (note 1)	V <sub>DD</sub>	0.8	5.5	V
Operating Temperature	T <sub>A</sub>	-40	+125	°C

## Electrical Characteristics

Unless otherwise specified: V<sub>DD</sub>= 0.8V to 5.5V, T<sub>A</sub>=+25°C (note 1).

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply current (note 2)	I <sub>DD</sub>	V <sub>DD</sub> =1.5V	+25°C	-	4.6	μA
			-40°C to +125°C	-	7	
		V <sub>DD</sub> =3.3V	+25°C	-	5.5	
			-40°C to +125°C	-	8.3	
		V <sub>DD</sub> =5.0V	+25°C	-	6.3	
			-40°C to +125°C	-	9.6	
Threshold voltage (note 3)	V <sub>TH</sub>	EM6354 – 1.3	1.290	1.31	1.330	V
		EM6354 – 1.4	1.359	1.38	1.401	
		EM6354 – 1.6	1.546	1.57	1.594	
		EM6354 – 1.7	1.635	1.66	1.685	
		EM6354 – 1.8	1.773	1.80	1.827	
		EM6354 – 2.2	2.167	2.20	2.233	
		EM6354 – 2.6	2.591	2.63	2.669	
		EM6354 – 2.9	2.886	2.93	2.974	
		EM6354 – 3.1	3.034	3.08	3.126	
		EM6354 – 4.4	4.334	4.40	4.466	
		EM6354 – 4.6	4.561	4.63	4.699	
Threshold voltage temperature coefficient (note 4)	$\frac{\Delta V_{TH}}{\Delta T_A}$	T <sub>A</sub> = -40°C to +125°C	-	±50	-	ppm/°C
Threshold hysteresis	V <sub>HYS</sub>		-	2.1%·V <sub>TH</sub>	-	V

**Note 1:** Production tested at +25°C only. Over temperature limits are guaranteed by design, not production tested.  
V<sub>DD</sub> min=0.9V for active-high versions (EM6354Z).

**Note 2:** RESET (RESET) open.

**Note 3:** Threshold voltage is specified for V<sub>DD</sub> falling.

**Note 4:** Typical variation ΔV<sub>TH</sub> of V<sub>TH</sub> at a given temperature T<sub>A</sub> is calculated as follows:

$$\Delta V_{TH}(T = T_A) = \frac{\Delta V_{TH}}{\Delta T_A} \times V_{TH} \times |T_A - 25^\circ\text{C}|$$

**Example:**

for version V<sub>TH</sub>=2.93V, variation at T<sub>A</sub>=70°C is equal to ΔV<sub>TH</sub>(70°C)=±50·10<sup>-6</sup> x 2.93 x (70-25)=±6.59mV

## Electrical Characteristics (continued)

Unless otherwise specified:  $V_{DD} = 0.8V$  to  $5.5V$ ,  $T_A = +25^\circ C$  (note 1).

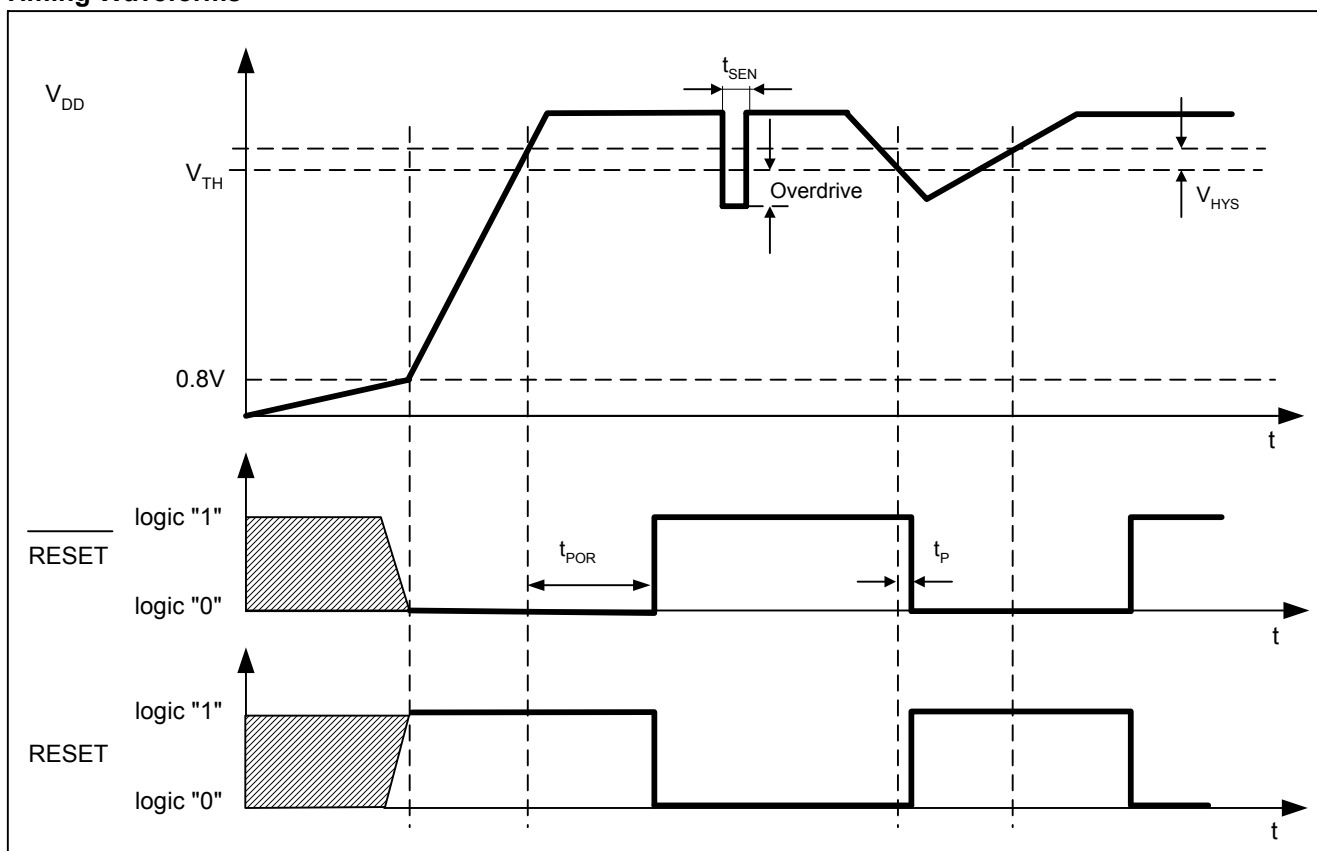
Parameter	Symbol	Conditions			Min	Typ	Max	Unit
Reset timeout period	t <sub>POR</sub>	C <sub>D</sub> =100nF (measured value, note 5) V <sub>DD</sub> from 0V to V <sub>TH (typ)</sub> +15% (note 2) EM6354-4.6 version			72	100	122	ms
Propagation delay time V <sub>DD</sub> to $\overline{\text{RESET}}$ (RESET) delay	t <sub>P</sub>	V <sub>DD</sub> drops from V <sub>TH (typ)</sub> +0.2V to V <sub>TH (typ)</sub> -0.2V (note 2)			2	130	255	μs
Open-drain $\overline{\text{RESET}}$ output Voltage	V <sub>OL</sub>	-40°C to +125°C	V <sub>DD</sub> >1V	I <sub>OL</sub> =100μA	-	-	0.3	V
			V <sub>DD</sub> >2.5V	I <sub>OL</sub> =1.5mA	-	-	0.3	
			V <sub>DD</sub> >5V	I <sub>OL</sub> =3mA	-	-	0.3	
Push-pull RESET / $\overline{\text{RESET}}$ Output voltage	V <sub>OL</sub>	-40°C to +125°C	V <sub>DD</sub> >1V	I <sub>OL</sub> =100μA	-	-	0.3	V
			V <sub>DD</sub> >2.5V	I <sub>OL</sub> =1.5mA	-	-	0.3	
			V <sub>DD</sub> >5V	I <sub>OL</sub> =3mA	-	-	0.3	
	V <sub>OH</sub>	-40°C to +125°C	V <sub>DD</sub> >1V	I <sub>OH</sub> =-30μA	0.8	-	-	
			V <sub>DD</sub> >2.5V	I <sub>OH</sub> =-1.5mA	2	-	-	
			V <sub>DD</sub> >5V	I <sub>OH</sub> =-3mA	4	-	-	
Output leakage current	I <sub>LEAK</sub>	-40°C to +125°C, only for EM6354Y (open-drain)			-	-	0.5	μA

**Note 1:** Production tested at  $+25^\circ C$  only. Over temperature limits are guaranteed by design, not production tested.  
 $V_{DD \min} = 0.9V$  for active-high version (EM6354Z).

**Note 2:**  $\overline{RESET}$  ( $\overline{RESET}$ ) open.

**Note 5:**  $t_{POR}$  is programmable by varying the value of the external capacitor connected to pin  $C_D$ . The relation is  $t_{POR} (ms) = C_D (nF)$ . The tolerance of the capacitor should be taken into account.

## Timing Waveforms



**Note 6:**  $t_{SEN}$  = Maximum Transient Duration. Please refer to figure on the next page.

**Note 7:** Overdrive =  $V_{TH} - V_{DD}$ . Please refer to figure on the next page.

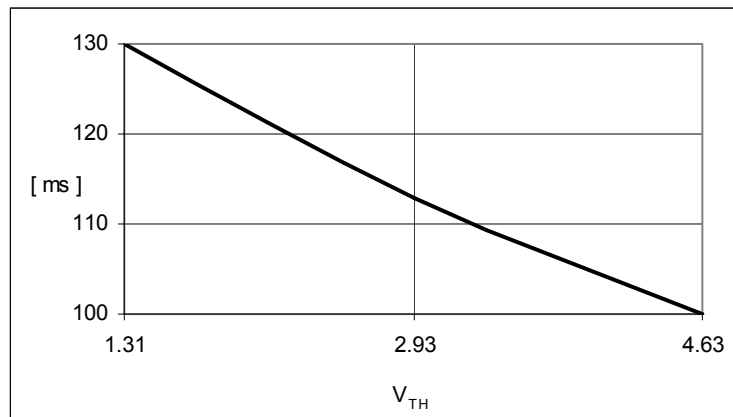
## Typical Reset Timeout Period

The Reset Timeout Period ( $t_{POR}$ ) is programmable using an external capacitor connected to pin  $C_D$  of EM6354. A ceramic chip capacitor rated at or above 10V is sufficient. The Reset Timeout Period ( $t_{POR}$ ) can be calculated using the following formula for  $V_{TH}=4.63V$  (EM6354-4.6):

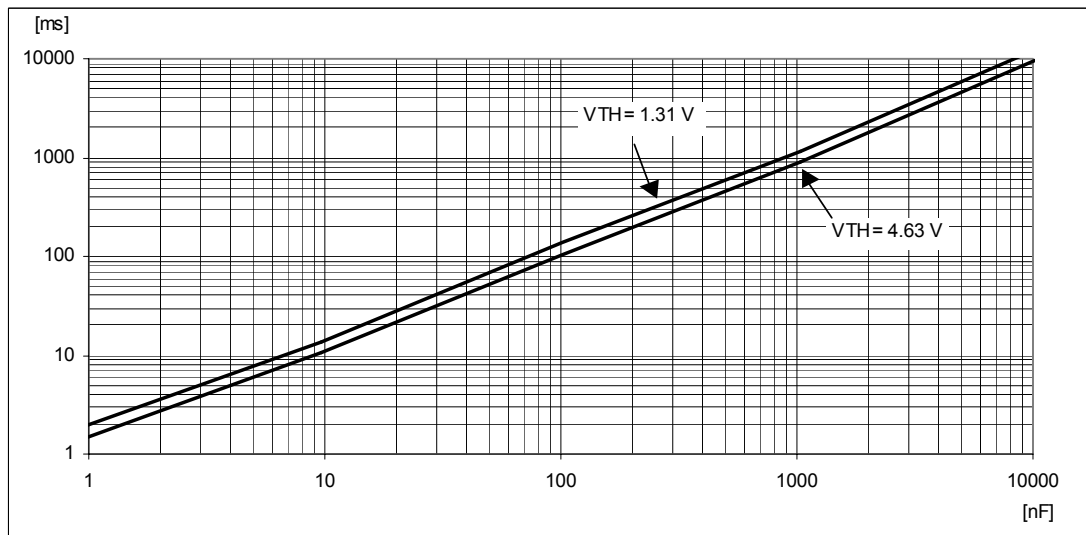
$$t_{POR} \text{ (ms)} = C_D \text{ (nF)}.$$

For example a  $C_D$  of 100nF will achieve a  $t_{POR}$  of 100 ms. The tolerance of the capacitor should be taken into account. If no delay due to  $t_{POR}$  is needed in a certain application, the circuit EM6352 should be used instead.

For threshold voltage between  $V_{TH}=4.63V$  and  $V_{TH}=1.31V$ , the following graphic applies :



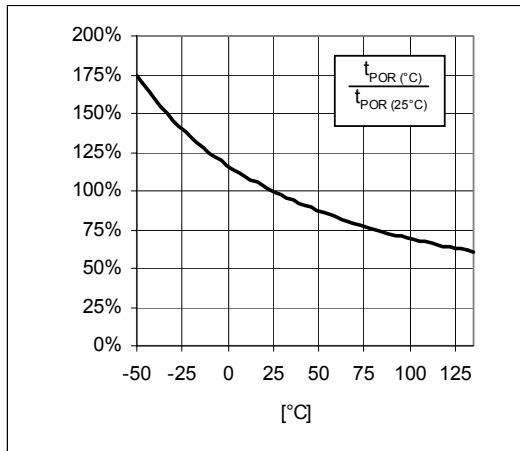
Typical Reset Timeout Period  $t_{POR}$  vs.  $V_{TH}$  for  $C_D=100\text{nF}$  at  $T_A=+25^\circ\text{C}$



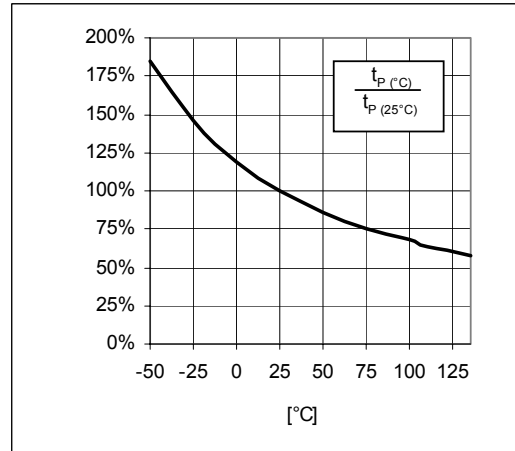
Reset Timeout Period  $t_{POR}$  vs. Capacitor  $C_D$  at  $T_A=+25^\circ\text{C}$

## Typical Operating Characteristics

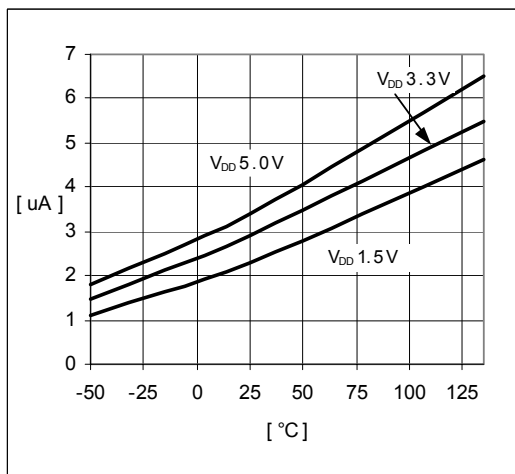
(Typical values are at  $T_A = +25^\circ\text{C}$  unless otherwise noted,  $\overline{\text{RESET}}$  or RESET open.)



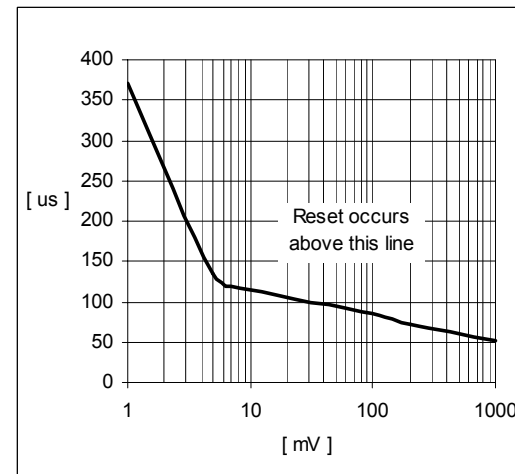
**Reset Timeout Period  $t_{POR}$  vs. Temperature**  
(normalized with respect to  $t_{POR}(25^\circ\text{C})$ )



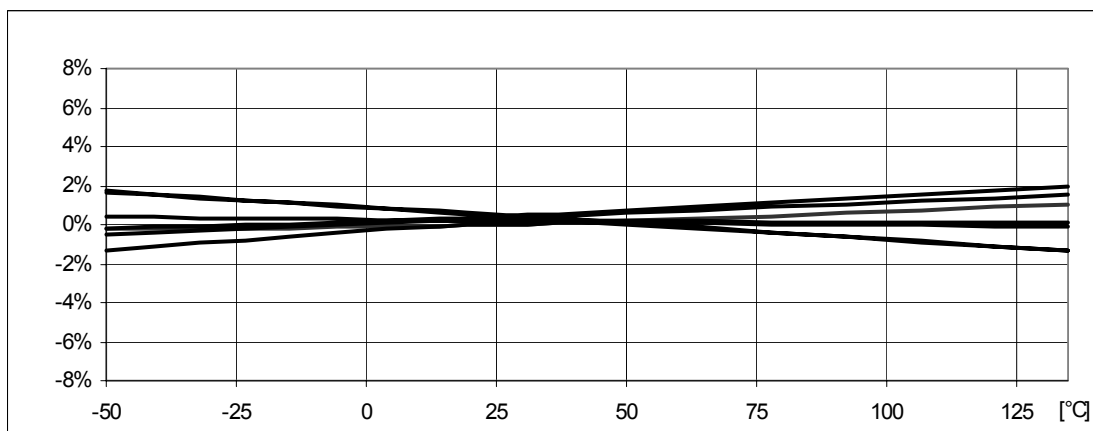
**Propagation Time  $t_P$  vs. Temperature**  
(normalized with respect to  $t_P(25^\circ\text{C})$ )



**$I_{DD}$  vs. Temperature**

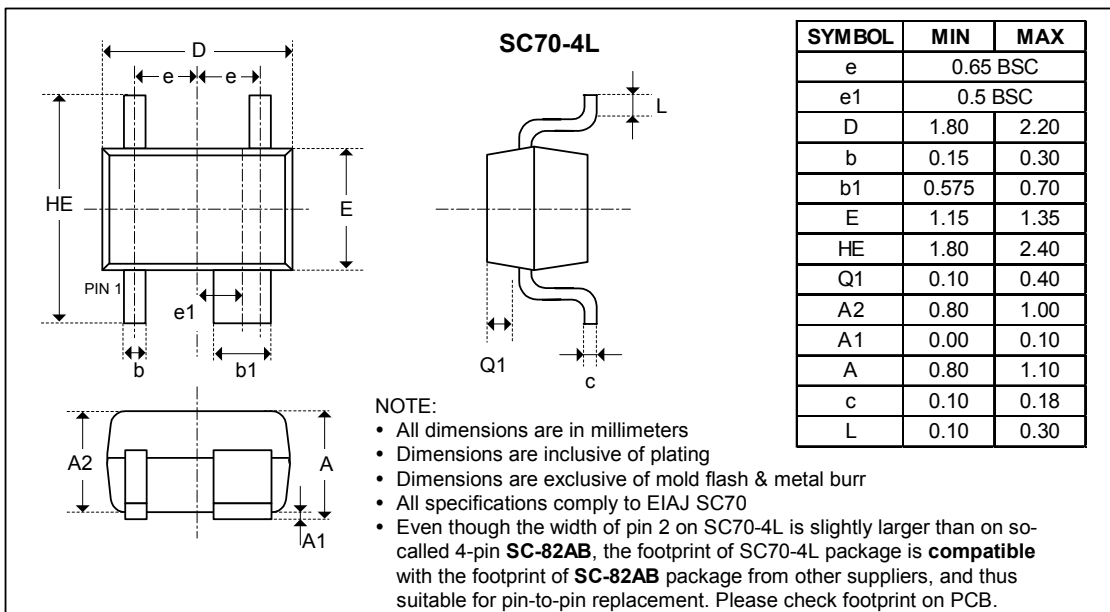
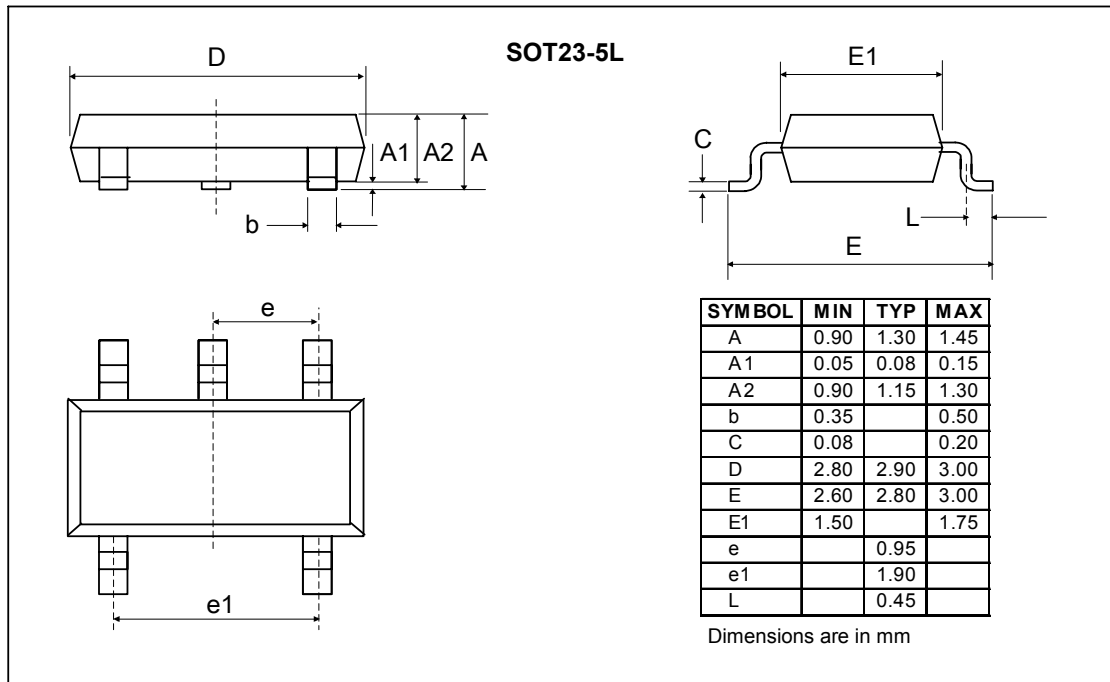


**Maximum Transient Duration  $t_{SEN}$**   
**vs. Overdrive  $V_{TH} - V_{DD}$**



**Threshold Voltage Variation vs. Temperature (normalized)**

## Package Information



### Traceability for small packages

Due to the limited space on the package surface, the bottom marking contains a limited number of characters that provide only partial information for lot traceability. Full information for complete traceability is however provided on the packing labels of the product at delivery from EM. It is highly recommended that the customer insures full lot traceability of EM product in his final product.

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