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# KA2803B

## Earth Leakage Detector

### Features

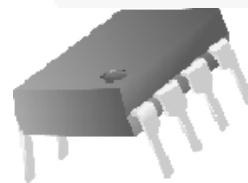
- Low Power Consumption: 5 mW, 100 V/200 V
- Built-In Voltage Regulator
- High-Gain Differential Amplifier
- 0.4 mA Output Current Pulse to Trigger SCRs
- Low External Part Count
- DIP & SOP Packages, High Packing Density
- High Noise Immunity, Large Surge Margin
- Super Temperature Characteristic of Input Sensitivity
- Wide Operating Temperature Range:  
T<sub>A</sub> = -25°C to +80°C
- Operation from 12 V to 20 V Input

### Functions

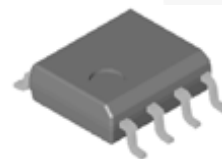
- Differential Amplifier
- Level Comparator
- Latch Circuit

### Description

The KA2803B is designed for use in earth leakage circuit interrupters, for operation directly off the AC line in breakers. The input of the differential amplifier is connected to the secondary coil of ZCT (Zero Current Transformer). The amplified output of differential amplifier is integrated at external capacitor to gain adequate time delay specified in KSC4613. The level comparator generates a high level when earth leakage current is greater than the fixed level.



8-DIP



8-SOP

### Ordering Information

Part Number	Operating Temperature Range	Package	Packing Method
KA2803B	-25 to +80°C	8-Lead, Dual Inline Package (DIP)	Tube

## Block Diagram

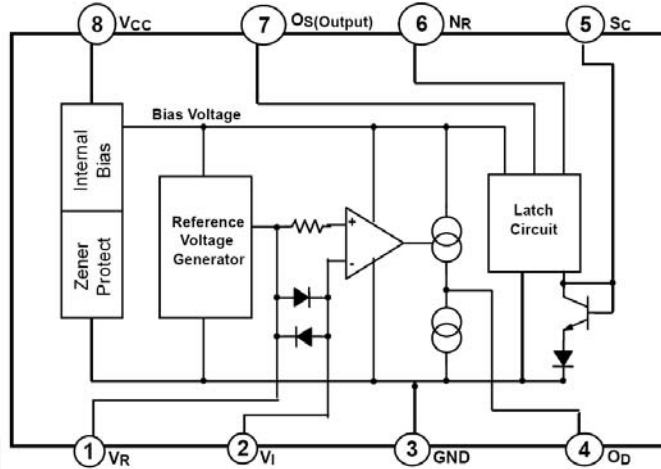


Figure 1. Block Diagram

## Application Circuit

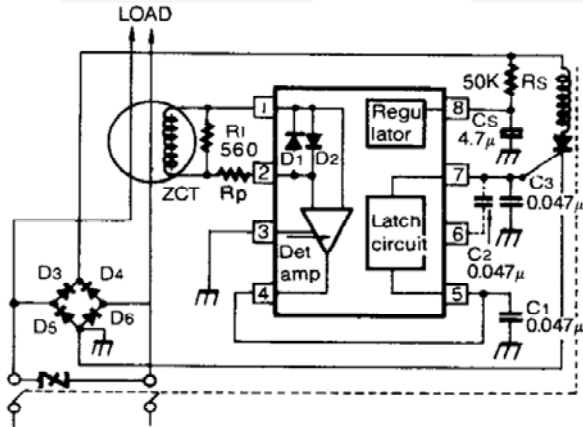


Figure 2. Full-Wave Application Circuit

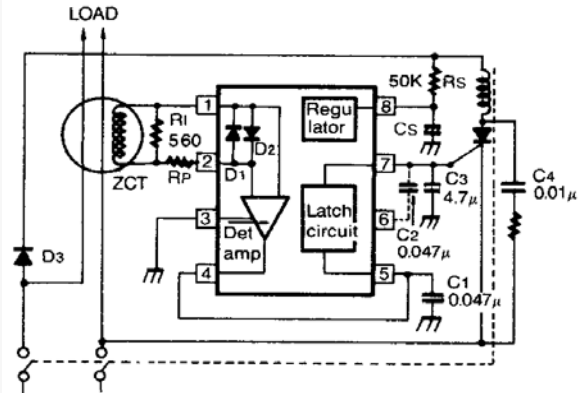


Figure 3. Half-Wave Application Circuit

## Application Information

(Refer to full-wave application circuit in Figure 2)

Figure 2 shows the KA2803B connected in a typical leakage current detector system. The power is applied to the  $V_{CC}$  terminal (Pin 8) directly from the power line. The resistor  $R_S$  and capacitor  $C_S$  are chosen so that Pin 8 voltage is at least 12 V. The value of  $C_S$  is recommended above 1  $\mu\text{F}$ .

If the leakage current is at the load, it is detected by the zero current transformer (ZCT). The output voltage signal of ZCT is amplified by the differential amplifier of the KA2803B internal circuit and appears as a half-cycle sine wave signal referred to input signal at the output of the amplifier. The amplifier closed-loop gain is fixed about 1000 times with internal feedback resistor to compensate for zero current transformer (ZCT) variations. The resistor  $R_L$  should be selected so that the breaker satisfies the required sensing current. The protection resistor  $R_P$  is not usually used when high current is injected at the breaker; this resistor should be

used to protect the earth leakage detector IC (KA2803B). The range of  $R_P$  is from several hundred  $\Omega$  to several  $\text{k}\Omega$ .

Capacitor  $C_1$  is for the noise canceller and a standard value of  $C_1$  is 0.047  $\mu\text{F}$ . Capacitor  $C_2$  is also a noise canceller capacitance, but it is not usually used.

When high noise is present, a 0.047  $\mu\text{F}$  capacitor may be connected between Pins 6 and 7. The amplified signal finally appears at the Pin 7 with pulse signal through the internal latch circuit of the KA2803B. This signal drives the gate of the external SCR, which energizes the trip coil, which opens the circuit breaker. The trip time of the breaker is determined by capacitor  $C_3$  and the mechanism breaker. This capacitor should be selected under 1  $\mu\text{F}$  to satisfy the required trip time. The full-wave bridge supplies power to the KA2803B during both the positive and negative half cycles of the line voltage. This allows the hot and neutral lines to be interchanged.

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Min.	Max.	Unit
$V_{CC}$	Supply Voltage		20	V
$I_{CC}$	Supply Current		8	mA
$P_D$	Power Dissipation		300	mW
$T_L$	Lead Temperature, Soldering 10 Seconds		260	°C
$T_A$	Operation Temperature Range	-25	+80	°C
$T_{STG}$	Storage Temperature Range	-65	+150	°C

## Electrical Characteristics

$T_A = -25^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Test Circuit	Min.	Typ.	Max.	Units	
$I_{CC}$	Supply Current 1	$V_{CC}=12\text{V}$ $V_R=\text{OPEN}$ $V_I=2\text{V}$	Figure 4			580	$\mu\text{A}$	
				$T_A = -25^{\circ}\text{C}$	300	400		530
				$T_A = +25^{\circ}\text{C}$				480
$V_T$	Trip Voltage	$V_{CC}=16\text{V}$ , $V_R=2\text{V}\sim 2.02\text{V}$ , $V_I=2$	Figure 5	14	16	18	mV (ms)	
				Note 1	12.5	14.2		17.0
$I_{O(D)}$	Differential Amplifier Current Current 1	$V_{CC}=16\text{V}$ , $V_R\sim V_I=30\text{mV}$ , $V_{OD}=1.2\text{V}$	Figure 7	-12	20	-30	$\mu\text{A}$	
	Differential Amplifier Current Current 2	$V_{CC}=16\text{V}$ , $V_{OD}=0.8\text{V}$ , $V_R$ , $V_I$ Short= $V_P$	Figure 8	17	27	37		
$I_O$	Output Current	$V_{SC}=1.4\text{V}$ , $V_{OS}=0.8\text{V}$ , $V_{CC}=16.0\text{V}$	Figure 9	$T_A = -25^{\circ}\text{C}$	200	400	800	$\mu\text{A}$
				$T_A = +25^{\circ}\text{C}$	200	400	800	
				$T_A = +80^{\circ}\text{C}$	100	300	600	
$V_{SCON}$	Latch-On Voltage	$V_{CC}=16\text{V}$	Figure 10	0.7	1.0	1.4	V	
$I_{SCON}$	Latch Input Current	$V_{CC}=16\text{V}$	Figure 11	-13	-7	-1	$\mu\text{A}$	
$I_{OSL}$	Output Low Current	$V_{CC}=12\text{V}$ , $V_{OSL}=0.2\text{V}$	Figure 12	200	800	1400	$\mu\text{A}$	
$V_{IDC}$	Differential Input Clamp Voltage	$V_{CC}=16\text{V}$ , $I_{IDC}=100\text{mA}$	Figure 13	0.4	1.2	2.0	V	
$V_{SM}$	Maximum Current Voltage	$I_{SM}=7\text{mA}$	Figure 14	20	24	28	V	
$I_{S2}$	Supply Current 2	$V_{CC}=12.0\text{V}$ , $V_{OSL}=0.6\text{V}$	Figure 15	200	400	900	$\mu\text{A}$	
$V_{SOFF}$	Latch-Off Supply Voltage	$V_{OS}=12.0\text{V}$ $V_{SC}=1.8\text{V}$ $I_{IDC}=100.0\text{mA}$	Figure 16	7	8	9	V	
$t_{ON}$	Response Time	$V_{CC}=16\text{V}$ , $V_R\sim V_I=0.3\text{V}$ , $1\text{V} < V_X < 5\text{V}$	Figure 17	2	3	4	ms	

### Note:

- Guaranteed by design, not tested in production.

## Test Circuits

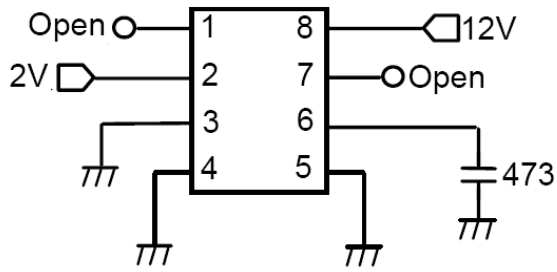


Figure 4. Supply Current 1

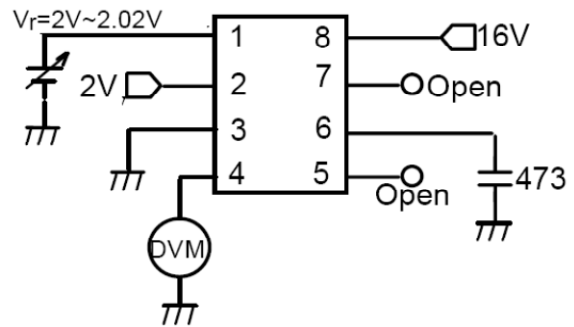
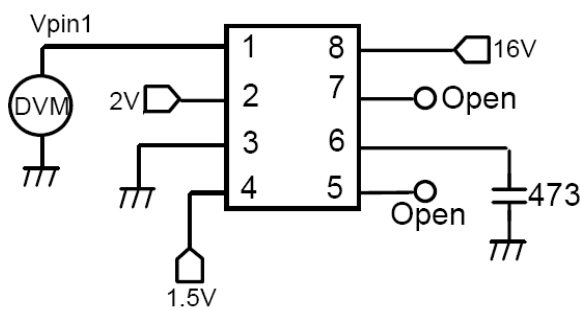


Figure 5. Trip Voltage



$$* V_p = V_{pin1} - 0.03V$$

Figure 6.  $V_{PN1}$  for  $V_P$  Measurement

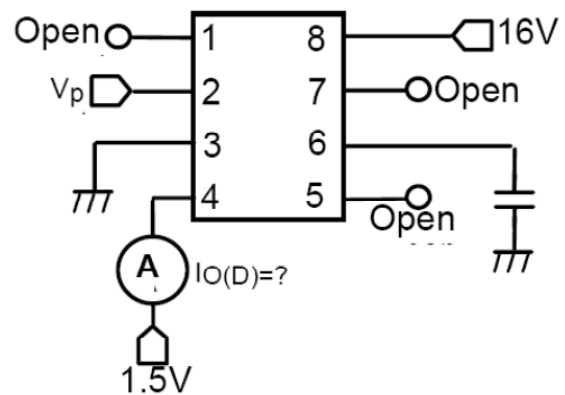


Figure 7. Differential Amplifier Output Current 1

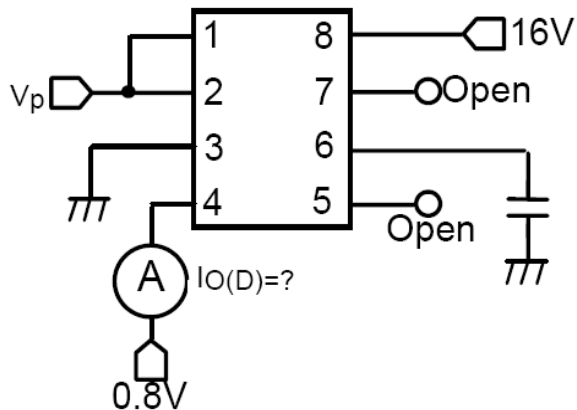


Figure 8. Differential Amplifier Output Current 2

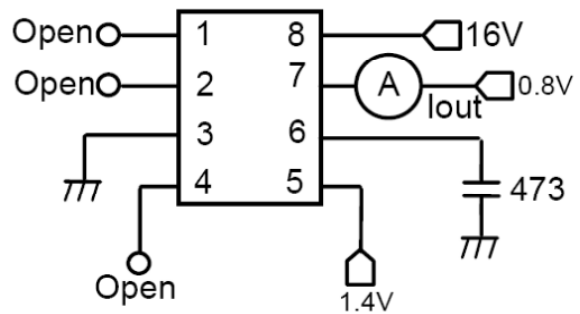
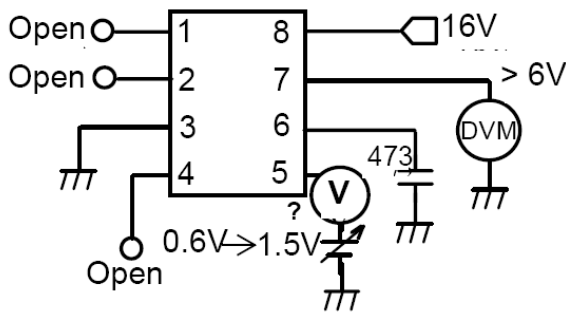
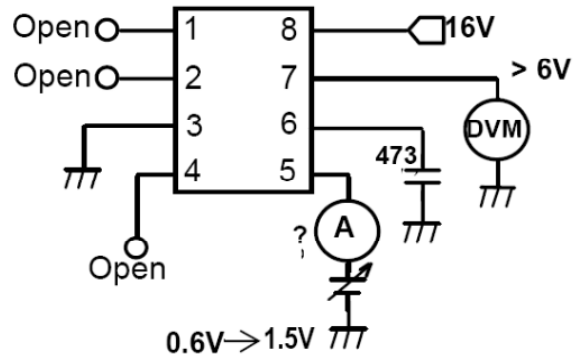


Figure 9. Output Current

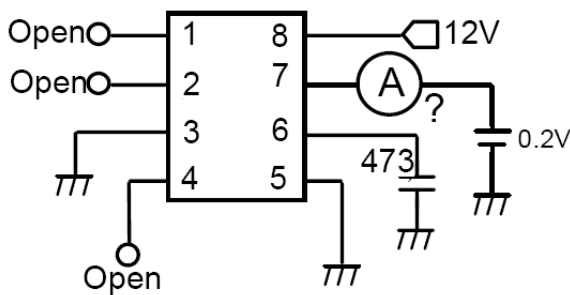
**Test Circuits** (Continued)



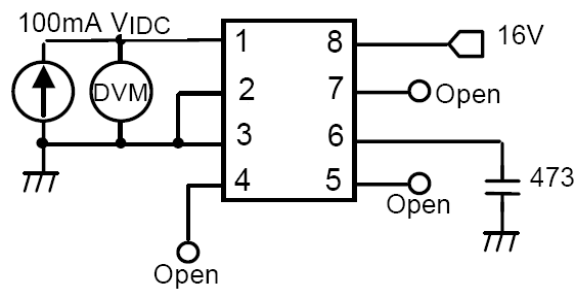
**Figure 10. Latch-On Voltage**



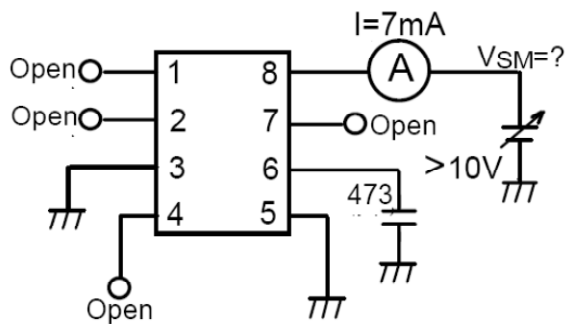
**Figure 11. Latch Input Current**



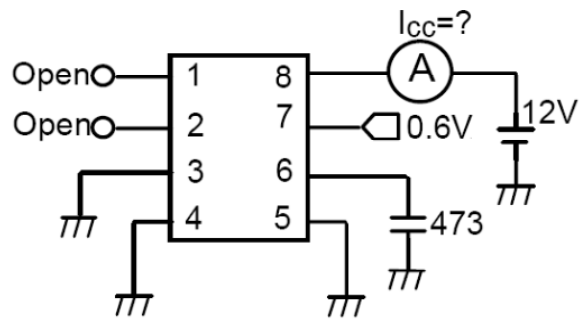
**Figure 12. Output Low Current**



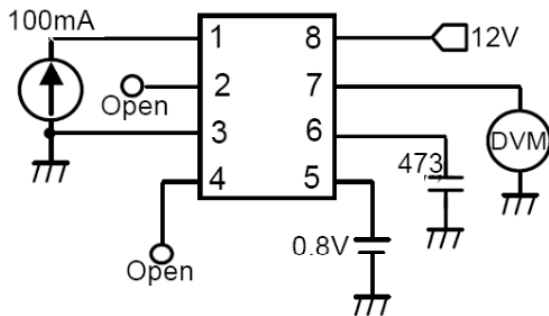
**Figure 13. Differential Input Clamp Voltage**



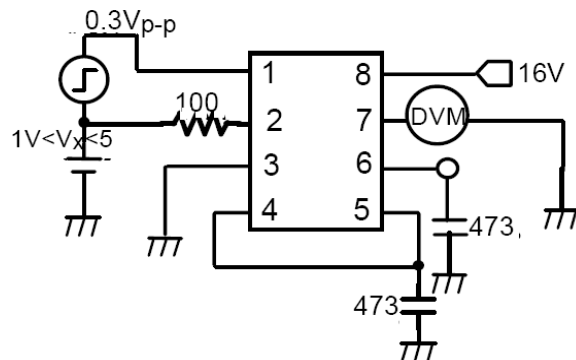
**Figure 14. Maximum Current Voltage**



**Figure 15. Supply Current 2**



**Figure 16. Latch-Off Supply Voltage**



**Figure 17. Response Time**

## Typical Performance Characteristics

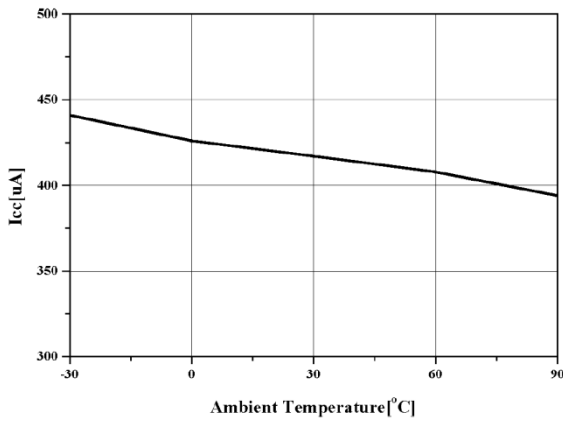


Figure 18. Supply Current

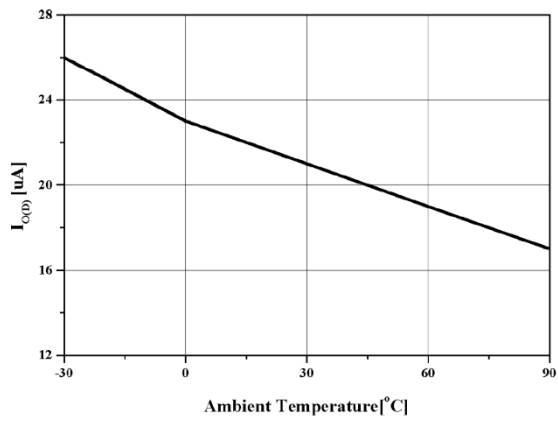


Figure 19. Differential Amplifier Output Current  
( $V_R - V_I = 30 \text{ mV}$ ,  $V_{OD} = 1.2 \text{ V}$ )

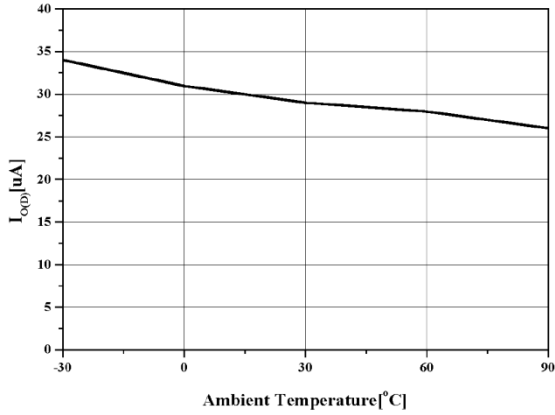


Figure 20. Differential Amplifier Output Current  
( $V_R$ ,  $V_I = V_P$ ,  $V_{OD} = 0.8 \text{ V}$ )

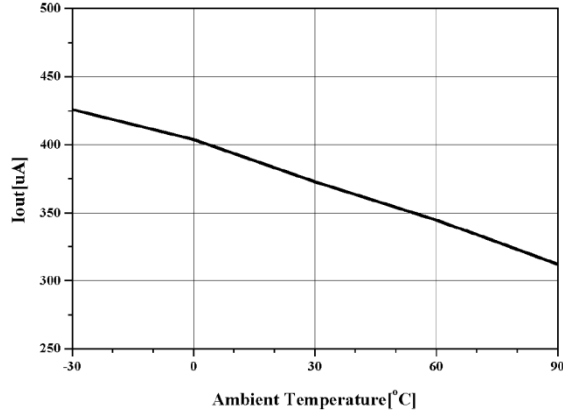


Figure 21. Output Current

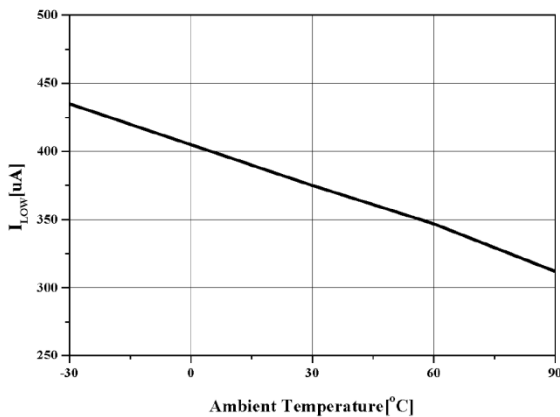


Figure 22. Output Low Current

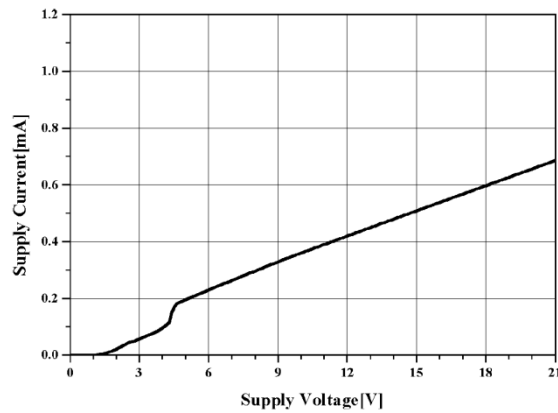


Figure 23. V<sub>CC</sub> Voltage vs. Supply Current 1

Typical Performance Characteristics (Continued)

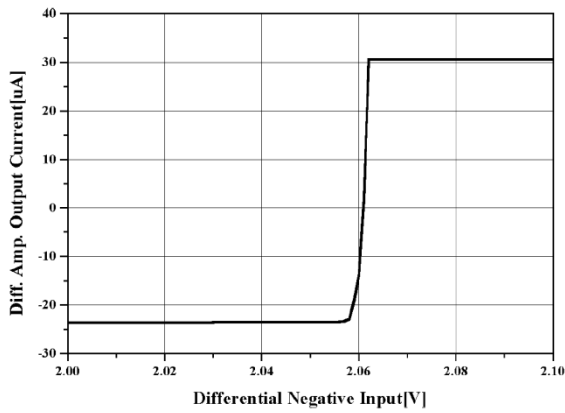


Figure 24. Differential Amplifier Output Current 1

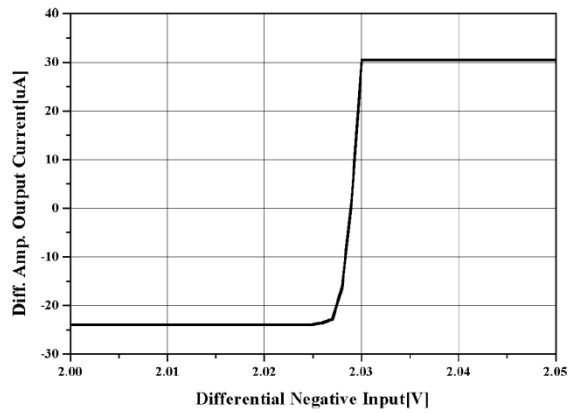


Figure 25. Differential Amplifier Output

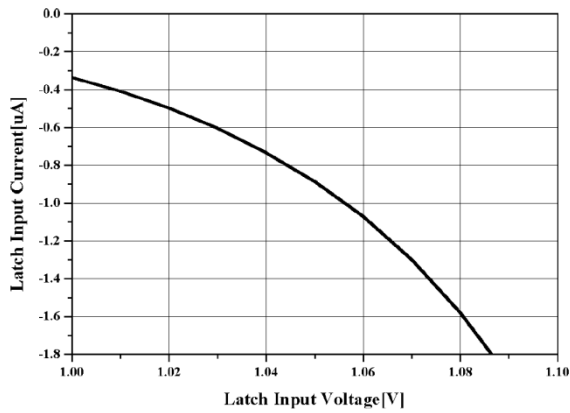


Figure 26. Latch Input Current

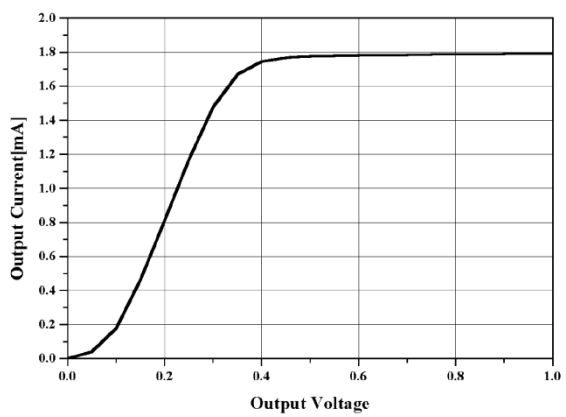


Figure 27. Output Low Current

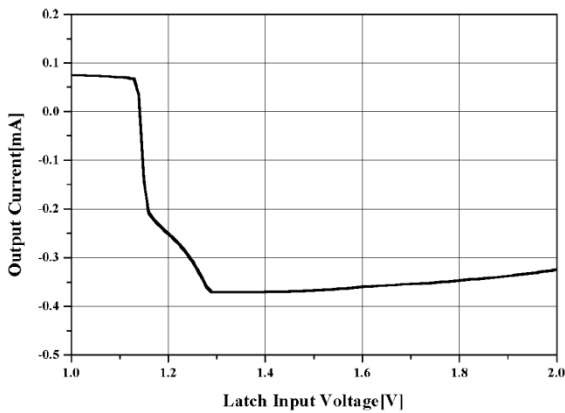


Figure 28. Output Current

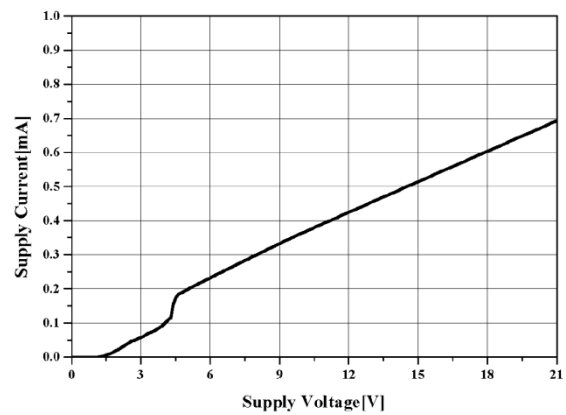


Figure 29. V<sub>CC</sub> Voltage vs. Supply Current 2



Typical Performance Characteristics (Continued)

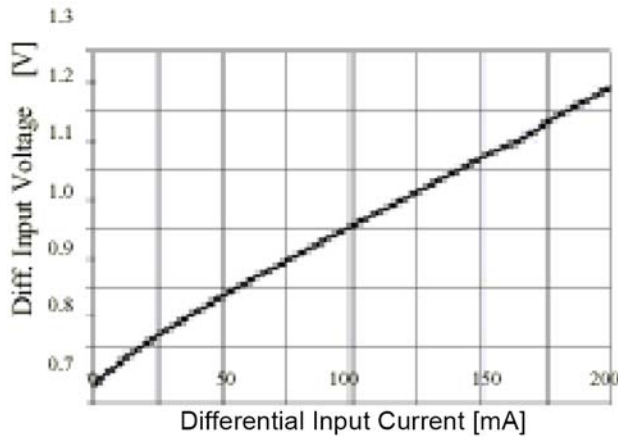


Figure 30. Differential Input Clamp Voltage

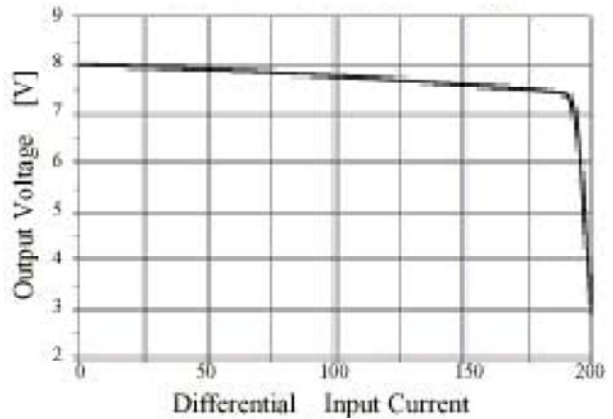


Figure 31. Latch-Off Supply Voltage

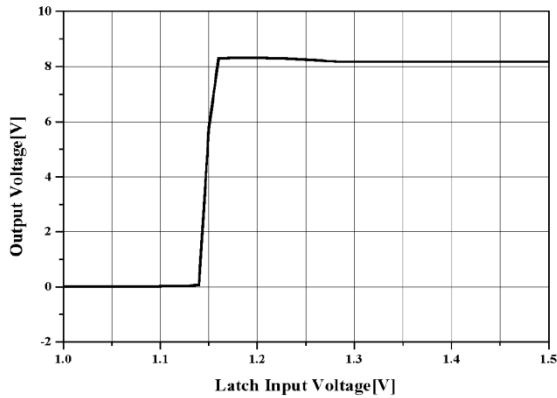


Figure 32. Latch-On Input Voltage

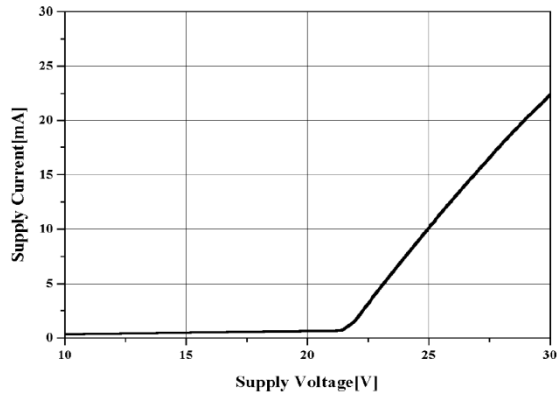


Figure 33. Maximum Supply

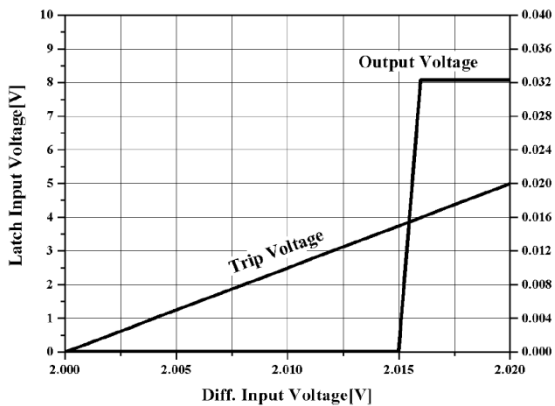


Figure 34. Trip and Output

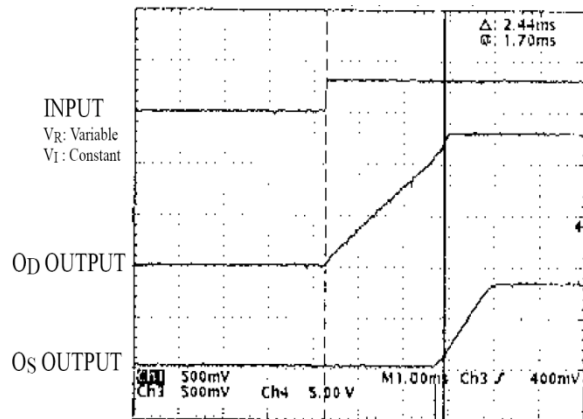


Figure 35. Output Response Time



Physical Dimensions

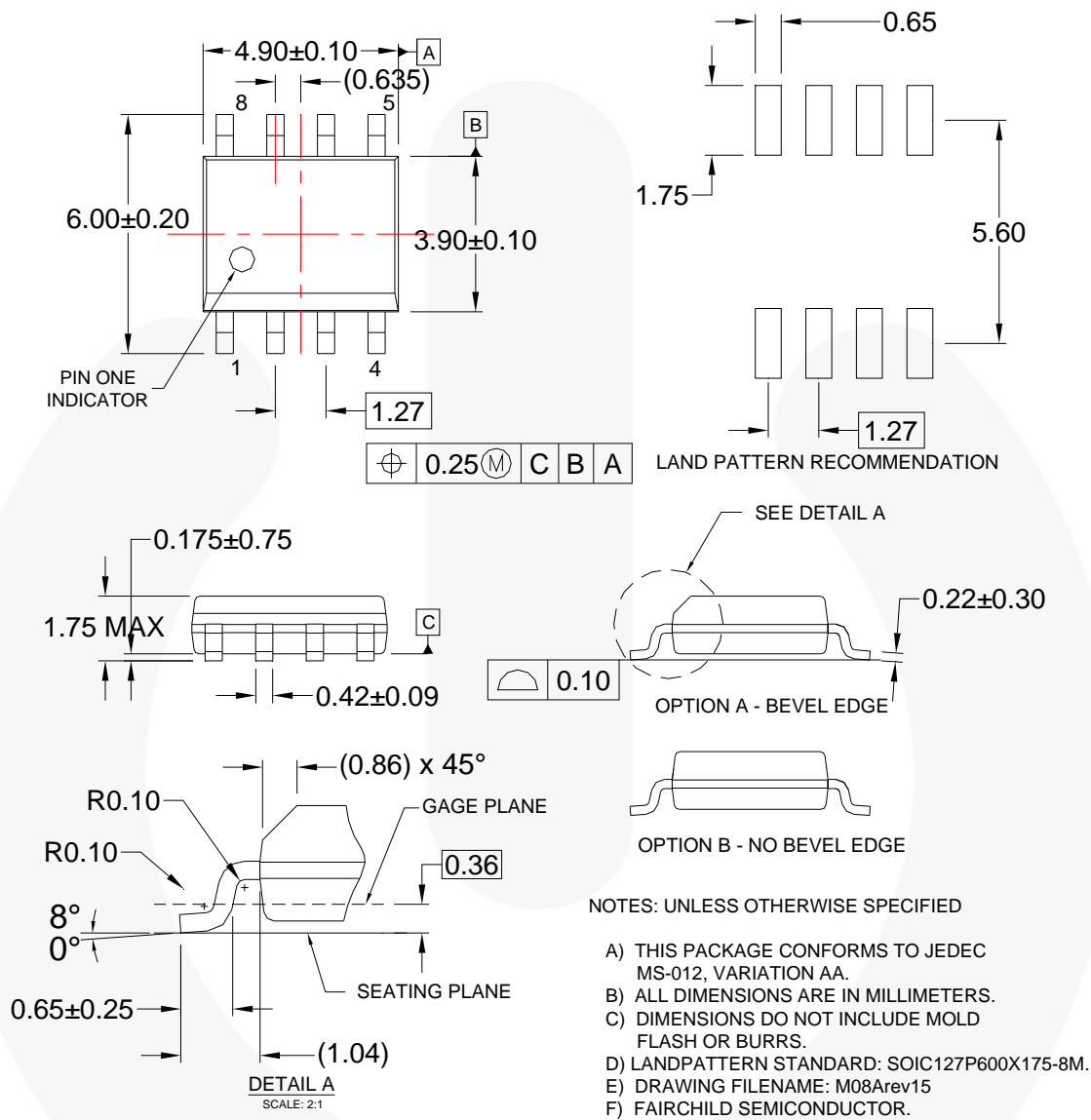


Figure 37.8-Lead, Small Outline Package (SOP)

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| CorePLUS™  | Green FPS™                                     | QST™                                  | TinyCalc™   |
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