

# Earth Leakage Detector

## KA2803

### Description

The KA2803 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 Zero Current Transformer (ZCT). The amplified output of differential amplifier is integrated at external capacitor to gain adequate time delay. The level comparator generates a high level when earth leakage current is greater than the fixed level.

### 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
- SOP Package, High Packing Density
- High Noise Immunity, Large Surge Margin
- Super Temperature Characteristic of Input Sensitivity
- Wide Operating Temperature Range:  
 $T_A = -25^\circ\text{C}$  to  $+80^\circ\text{C}$  for KA2803B and KA2803BDTF  
 $T_A = -25^\circ\text{C}$  to  $+100^\circ\text{C}$  for KA2803CDTF
- Operation from 12 V to 20 V Input

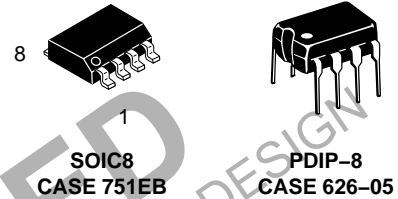
### Functions

- Differential Amplifier
- Level Comparator
- Latch Circuit

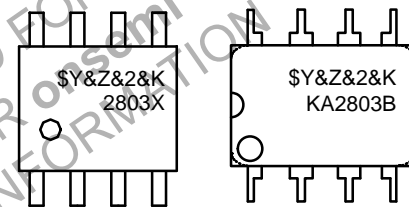


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### MARKING DIAGRAM



\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&2	= Data Code (Year & Week)
&K	= Lot
KA2803B or 2803X	= Specific Device Code
	X = B or C

### ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

# KA2803

## BLOCK DIAGRAM

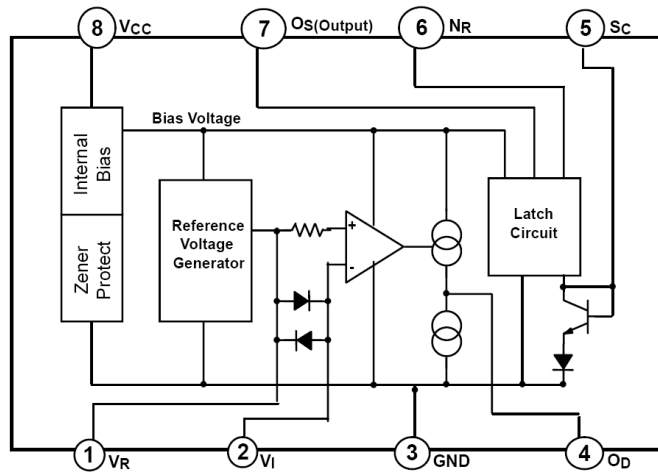


Figure 1. Block Diagram

## PIN CONFIGURATION

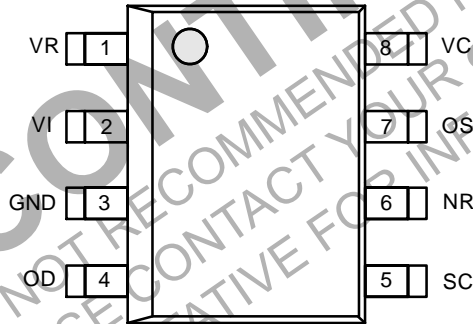


Figure 2. Pin Assignment

## PIN DESCRIPTION

Pin No.	Name	Description
1	VR	Non inverting input for current sensing amplifier
2	VI	Inverting Input for current sensing amplifier
3	GND	Ground
4	OD	Output of current sensing amplifier
5	SC	Input of latch circuit
6	NR	Noise absorption
7	OS	Gate drive for external SCR
8	VCC	Power supply input for KA2803 circuitry

APPLICATION CIRCUITS

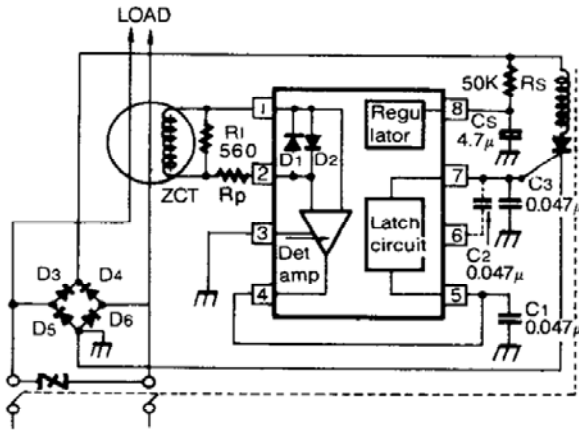


Figure 3. Full-wave Application Circuit

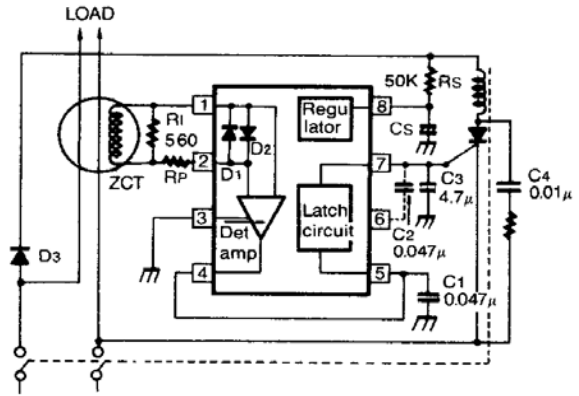


Figure 4. Half-wave Application Circuit

APPLICATION INFORMATION

(Refer to full-wave application circuit in Figure 3)

Figure 3 shows the KA2803 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  $\mu F$ .

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 KA2803 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

(KA2803). The range of  $R_P$  is from several hundred  $\Omega$  to several  $k\Omega$ .

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

When high noise is present, a 0.047  $\mu F$  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 KA2803. 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  $\mu F$  to satisfy the required trip time. The full-wave bridge supplies power to the KA2803 during both the positive and negative half cycles of the line voltage. This allows the hot and neutral lines to be interchanged.

# KA2803

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min.	Max.	Unit
V <sub>CC</sub>	Supply Voltage		20	V
I <sub>CC</sub>	Supply Current		8	mA
P <sub>D</sub>	Power Dissipation		300	mW
T <sub>L</sub>	Lead Temperature, Soldering 10 Seconds		260	°C
T <sub>A</sub>	Operation Temperature Range for KA2803B and KA2803BDTF	-25	80	°C
	Operation Temperature Range for KA2803CDTF	-25	+100	°C
T <sub>STG</sub>	Storage Temperature Range	-65	+150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**RECOMMENDED OPERATING CONDITIONS** (For KA2803B and KA2803BDTF, T<sub>A</sub> = -25°C to 80°C unless otherwise noted. For KA2803CDTF, T<sub>A</sub> = -25°C to +100°C unless otherwise noted.)

Symbol	Parameter	Conditions	Test Circuit	Min.	Typ.	Max.	Units	
I <sub>CC</sub>	Supply Current 1	V <sub>CC</sub> = 12V, V <sub>R</sub> = OPEN, V <sub>I</sub> = 2 V	Figure 5	T <sub>A</sub> = -25°C		580	μA	
				T <sub>A</sub> = +25°C	300	400		530
				T <sub>A</sub> = +100°C				480
V <sub>T</sub>	Trip Voltage	V <sub>CC</sub> = 16 V, V <sub>R</sub> = 2 V~2.02 V, V <sub>I</sub> = 2 V	Figure 6	14	16	18	mV (rms)	
I <sub>O(D)</sub>	Differential Amplifier Current Current 1	V <sub>CC</sub> = 16 V, V <sub>R</sub> -V <sub>I</sub> = 30 mV, V <sub>OD</sub> = 1.2 V	Figure 8	-12	-20	-30	μA	
	Differential Amplifier Current Current 2	V <sub>CC</sub> = 16 V, V <sub>OD</sub> = 0.8 V, V <sub>R</sub> , V <sub>I</sub> Short = V <sub>P</sub>	Figure 9	17	27	37		
I <sub>O</sub>	Output Current	V <sub>SC</sub> = 1.4 V, V <sub>OS</sub> = 0.8 V, V <sub>CC</sub> = 16.0 V	Figure 10	T <sub>A</sub> = -25°C	200	400	800	μA
				T <sub>A</sub> = +25°C	200	400	800	
				T <sub>A</sub> = +100°C	100	300	600	
V <sub>SCON</sub>	Latch-On Voltage	V <sub>CC</sub> = 16 V	Figure 11	0.7	1.0	1.4	V	
I <sub>SCON</sub>	Latch Input Current	V <sub>CC</sub> = 16 V	Figure 12	-13	-7	-1	μA	
I <sub>OSL</sub>	Output Low Current	V <sub>CC</sub> = 12 V, V <sub>OSL</sub> = 0.2 V	Figure 13	200	800	1400	μA	
V <sub>IDC</sub>	Differential Input Clamp Voltage	V <sub>CC</sub> = 16 V, I <sub>IDC</sub> = 100 mA	Figure 14	0.4	1.2	2.0	V	
V <sub>SM</sub>	Maximum Current Voltage	I <sub>SM</sub> = 7 mA	Figure 15	20	24	28	V	
I <sub>S2</sub>	Supply Current 2	V <sub>CC</sub> = 12.0 V, V <sub>OSL</sub> = 0.6 V	Figure 16	200	400	900	μA	
V <sub>SOFF</sub>	Latch-Off Supply Voltage	V <sub>OS</sub> = 12.0 V	Figure 17	7	8	9	V	
		V <sub>SC</sub> = 1.8 V						
		I <sub>IDC</sub> = 100.0 mA						
t <sub>ON</sub>	Response Time	V <sub>CC</sub> = 16 V, V <sub>R</sub> -V <sub>I</sub> = 0.3 V, 1 V < V <sub>X</sub> < 5 V	Figure 18	2	3	4	ms	

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

1. Guaranteed by design, not tested in production.

TEST CIRCUITS

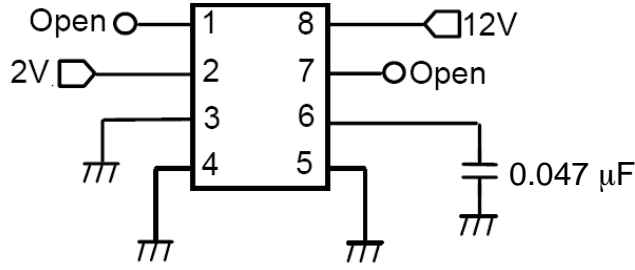


Figure 5. Supply Current 1

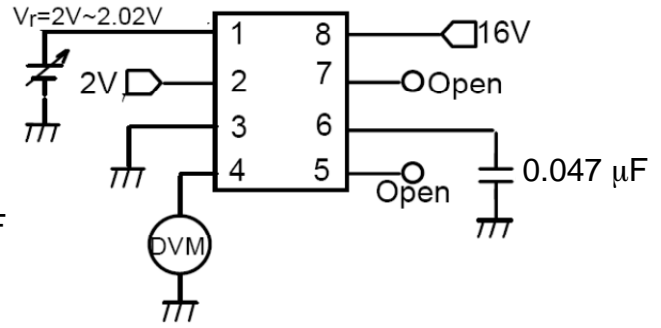
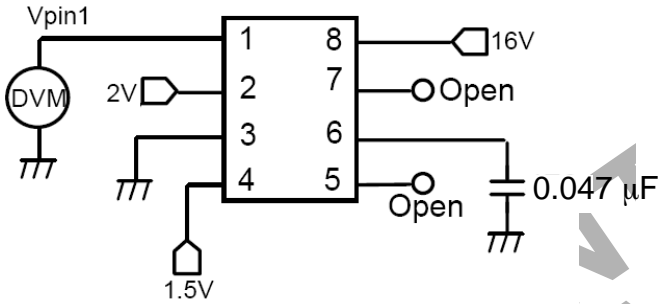


Figure 6. Trip Voltage



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

Figure 7.  $V_{PN1}$  for  $V_p$  Measurement

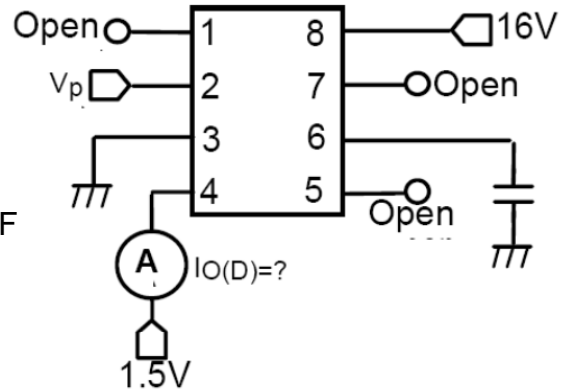


Figure 8. Differential Amplifier Output Current 1

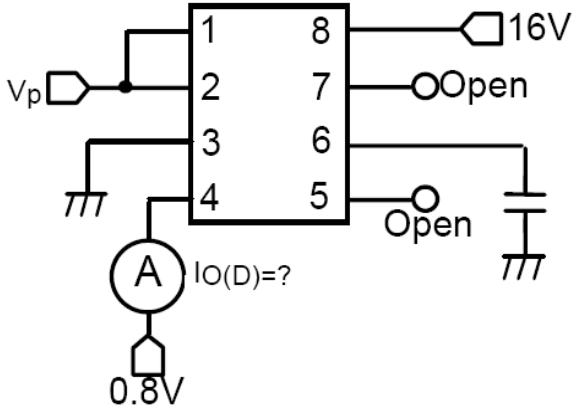


Figure 9. Differential Amplifier Output Current 2

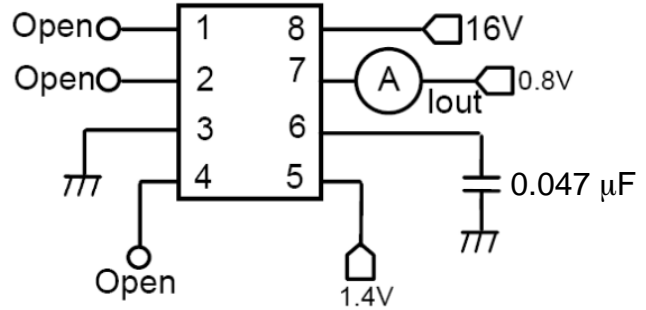


Figure 10. Output Current

TEST CIRCUITS (Continued)

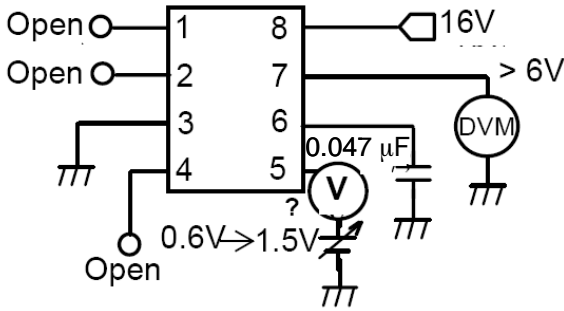


Figure 11. Latch-On Voltage

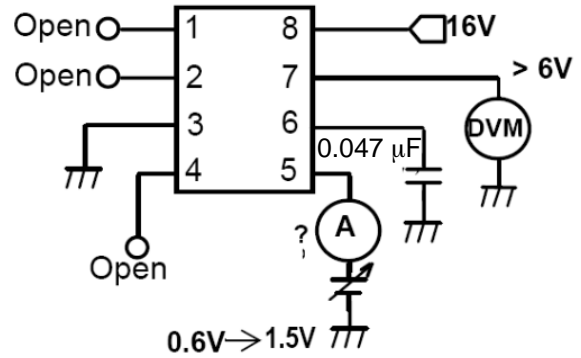


Figure 12. Latch Input Current

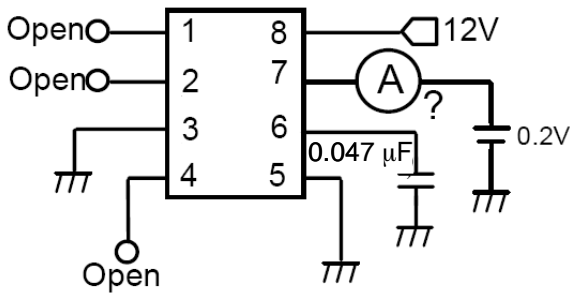


Figure 13. Output Low Current

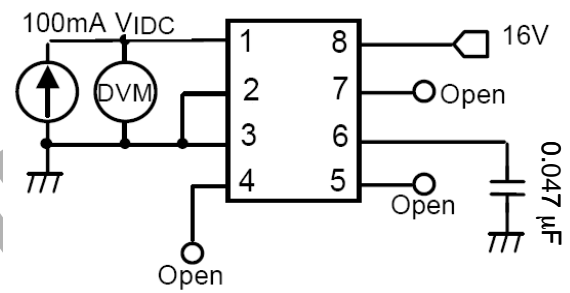


Figure 14. Differential Input Clamp Voltage

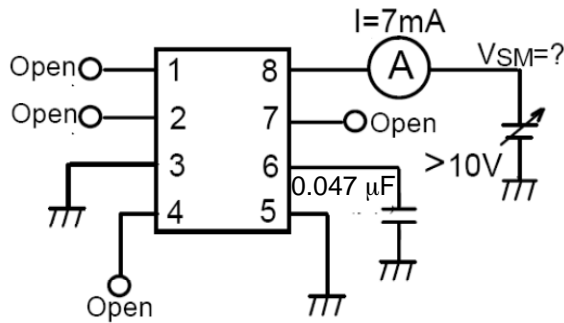


Figure 15. Maximum Current Voltage

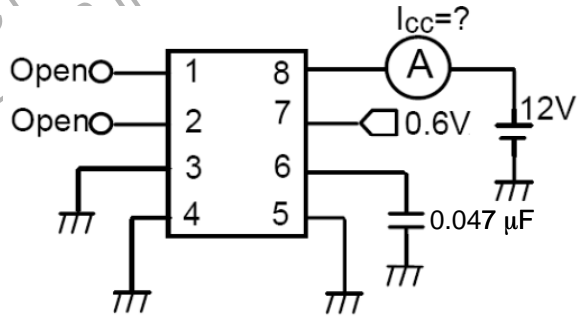


Figure 16. Supply Current 2

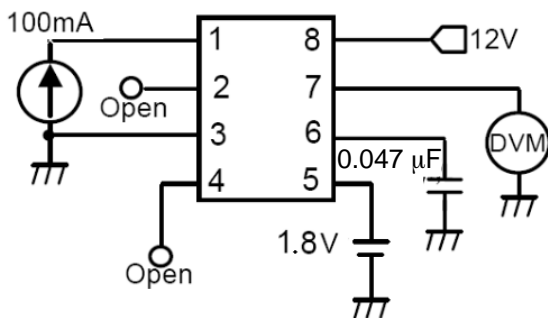


Figure 17. Latch-Off Supply Voltage

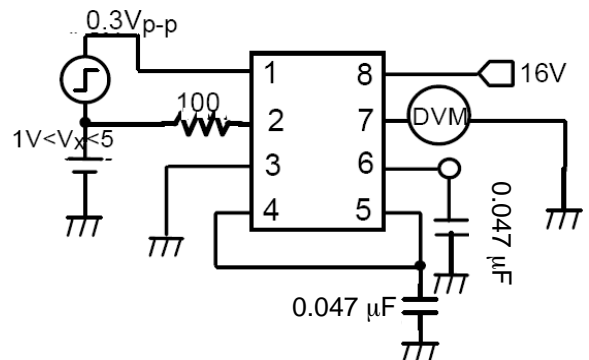


Figure 18. Response Time

TYPICAL PERFORMANCE CHARACTERISTICS

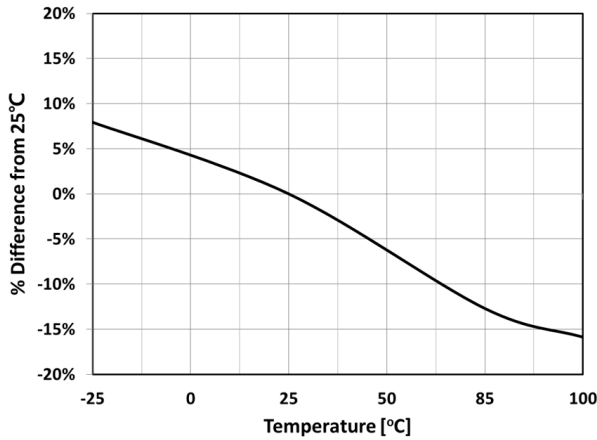


Figure 19. Supply Current

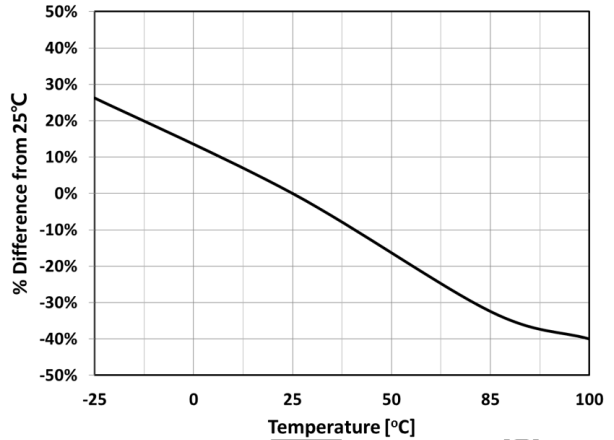


Figure 20. Differential Amplifier Output Current  
( $V_R - V_I = 30\text{ mV}$ ,  $V_{OD} = 1.2\text{ V}$ )

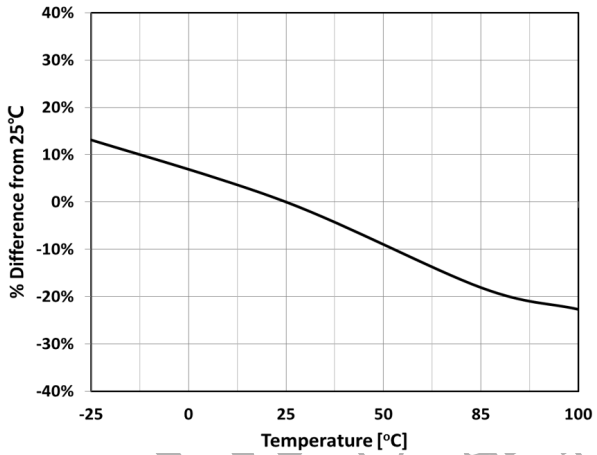


Figure 21. Differential Amplifier Output Current  
( $V_R, V_I = V_P, V_{OD} = 0.8\text{ V}$ )

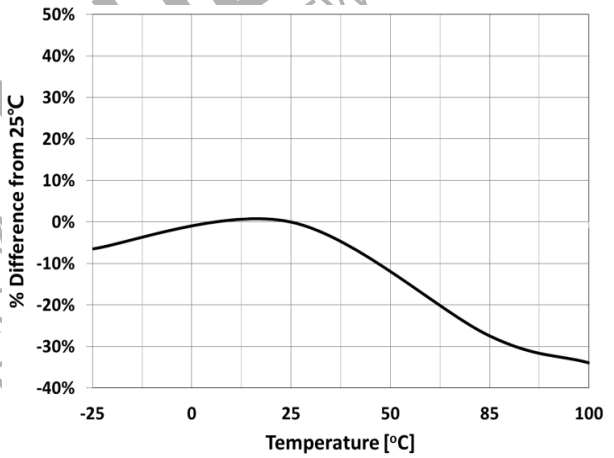


Figure 22. Output Current

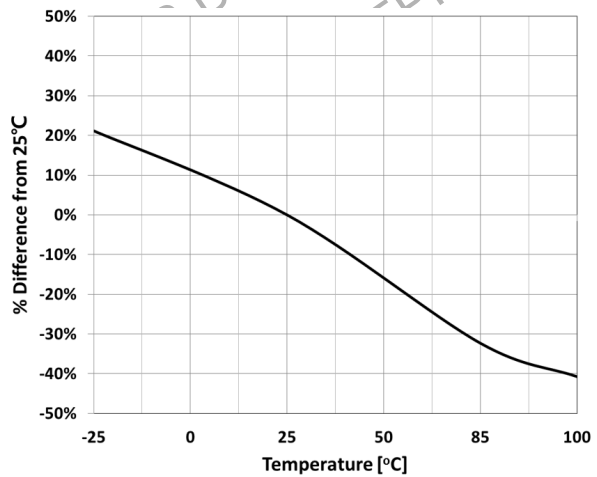


Figure 23. Output Low Current

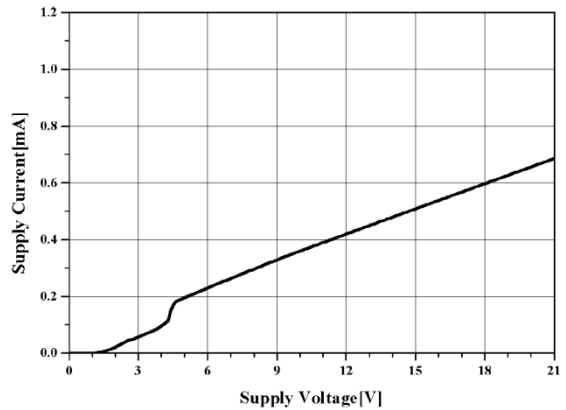


Figure 24.  $V_{CC}$  Voltage vs. Supply Current 1

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

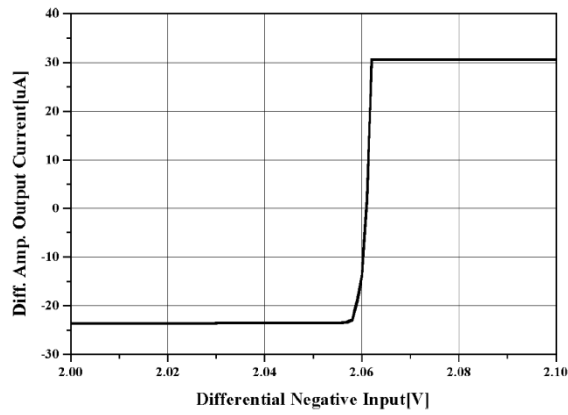


Figure 25. Differential Amplifier Output Current 1

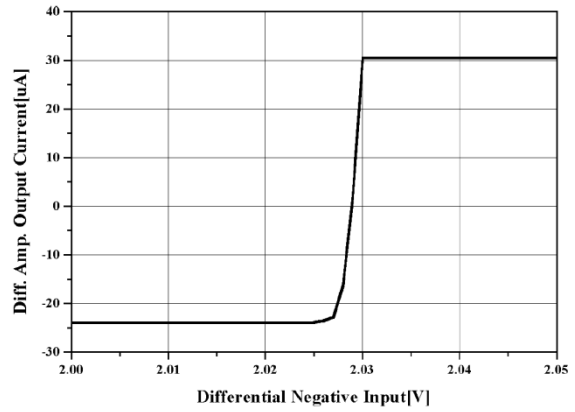


Figure 26. Differential Amplifier Output

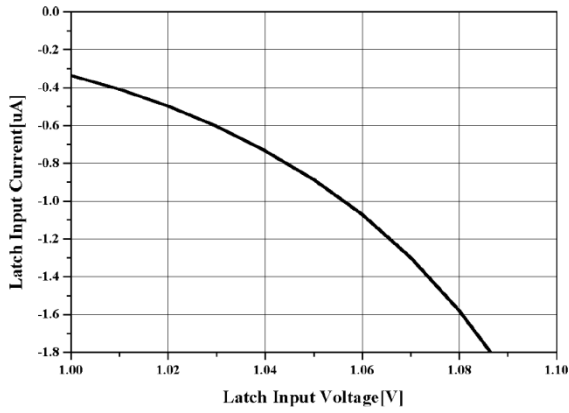


Figure 27. Latch Input Current

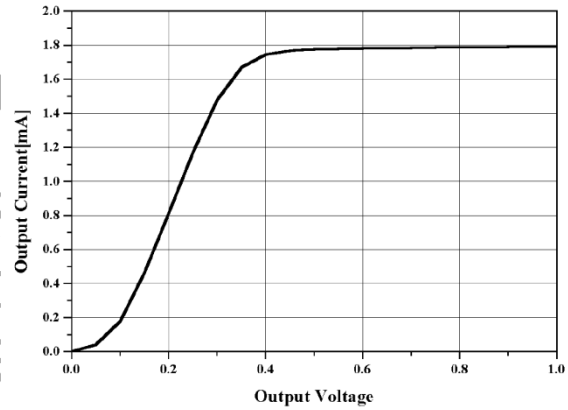


Figure 28. Output Low Current

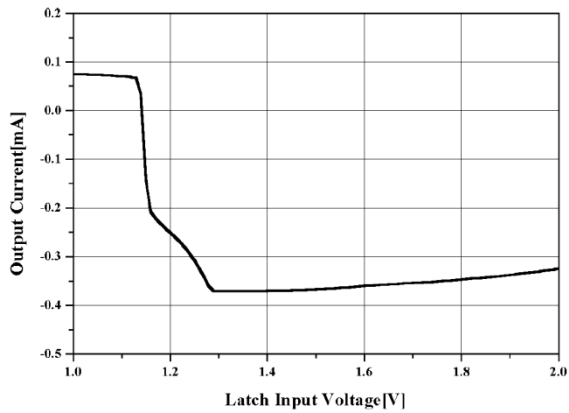


Figure 29. Output Current

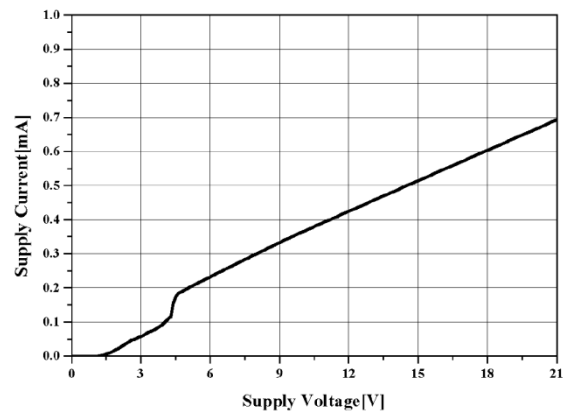


Figure 30. V<sub>CC</sub> Voltage vs. Supply Current 2



TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

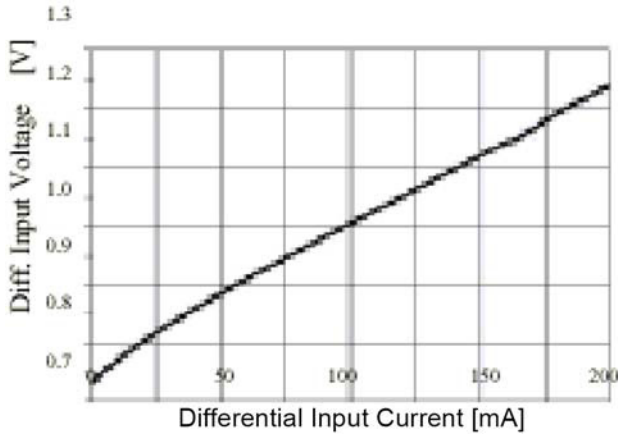


Figure 31. Differential Input Clamp Voltage

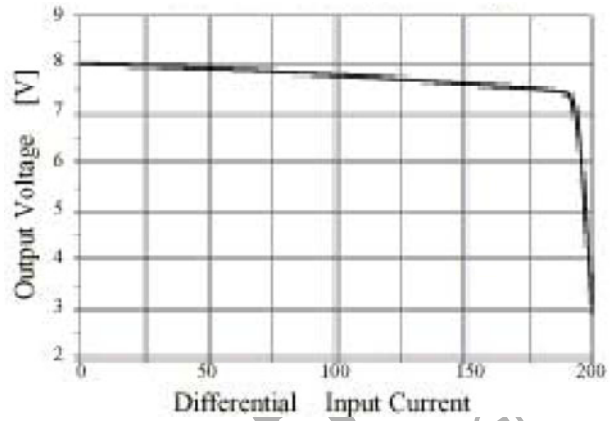


Figure 32. Latch-Off Supply Voltage

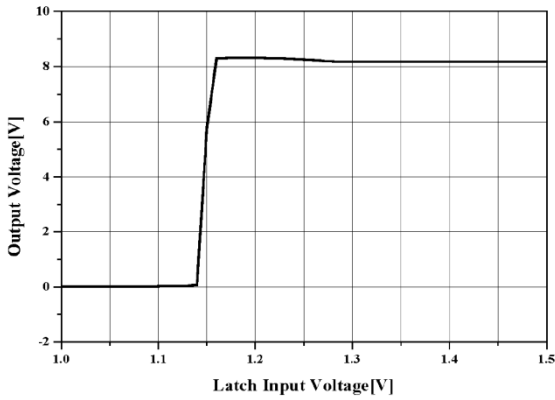


Figure 33. Latch-On Input Voltage

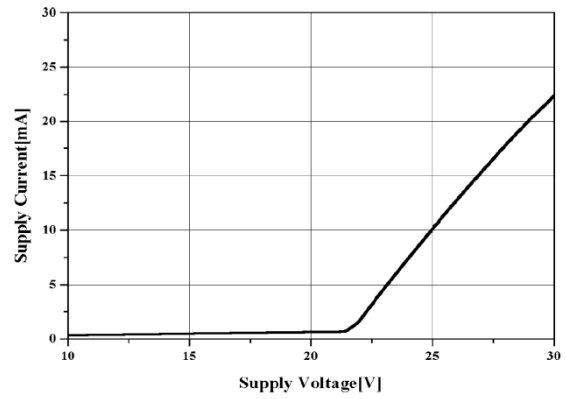


Figure 34. Maximum Supply

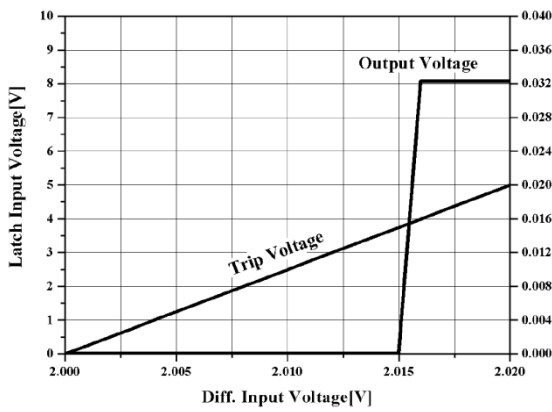


Figure 35. Trip and Output

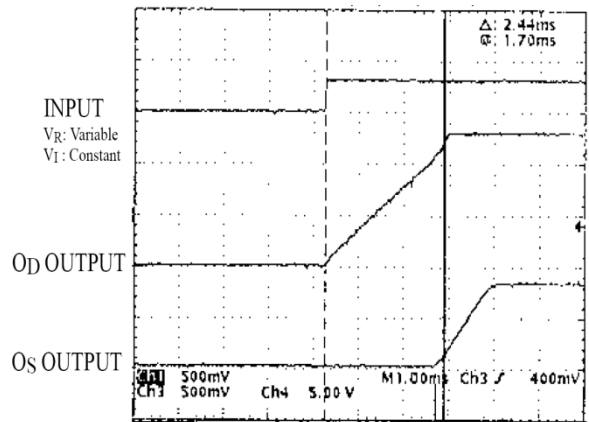


Figure 36. Output Response Time

# KA2803

## ORDERING INFORMATION

Part Number	Operating Temperature Range	Package	Shipping†
KA2803CDTF	-25 to +100°C	8-lead, Small Outline Package (SOP)	3,000 / Tape& Reel
KA2803B	-25 to 80°C	8-lead, Plastic Dual Inline Package (PDIP)	3,000 / Tube
KA2703BDTF	-25 to 80°C	8-lead, Small Outline Package (SOP)	3,000 / Tape& Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

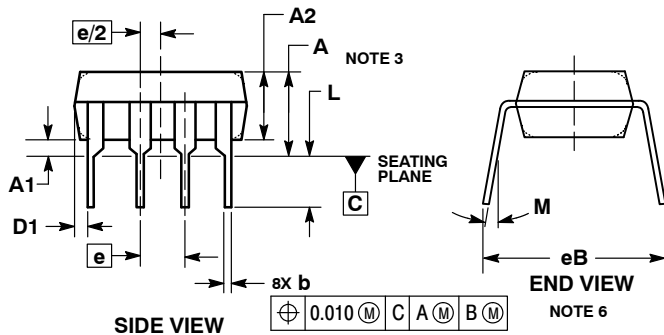
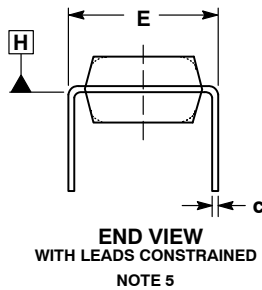
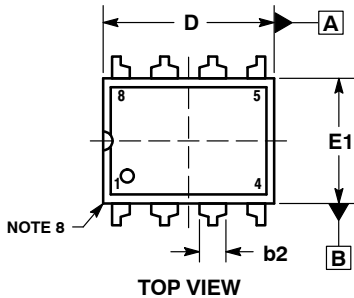
**DISCONTINUED**  
THIS DEVICE IS NOT RECOMMENDED FOR NEW DESIGN  
PLEASE CONTACT YOUR onsemi  
REPRESENTATIVE FOR INFORMATION



SCALE 1:1

PDIP-8  
CASE 626-05  
ISSUE P

DATE 22 APR 2015

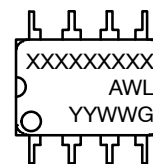


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACKAGE SEATED IN JEDEC SEATING PLANE GAUGE GS-3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 INCH.
5. DIMENSION E IS MEASURED AT A POINT 0.015 BELOW DATUM PLANE H WITH THE LEADS CONSTRAINED PERPENDICULAR TO DATUM C.
6. DIMENSION eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
7. DATUM PLANE H IS COINCIDENT WITH THE BOTTOM OF THE LEADS, WHERE THE LEADS EXIT THE BODY.
8. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	----	0.210	----	5.33
A1	0.015	----	0.38	----
A2	0.115	0.195	2.92	4.95
b	0.014	0.022	0.35	0.56
b2	0.060 TYP		1.52 TYP	
C	0.008	0.014	0.20	0.36
D	0.355	0.400	9.02	10.16
D1	0.005	----	0.13	----
E	0.300	0.325	7.62	8.26
E1	0.240	0.280	6.10	7.11
e	0.100 BSC		2.54 BSC	
eB	----	0.430	----	10.92
L	0.115	0.150	2.92	3.81
M	----	10°	----	10°

GENERIC  
MARKING DIAGRAM\*



- XXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

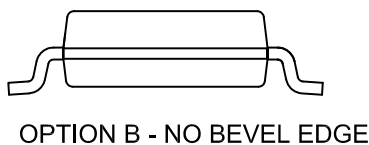
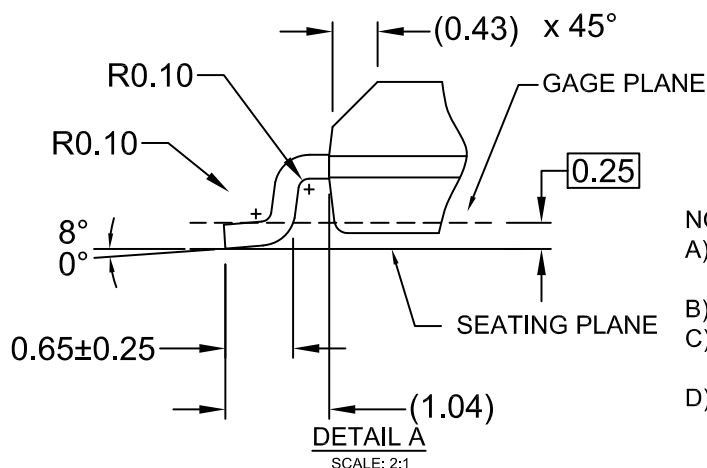
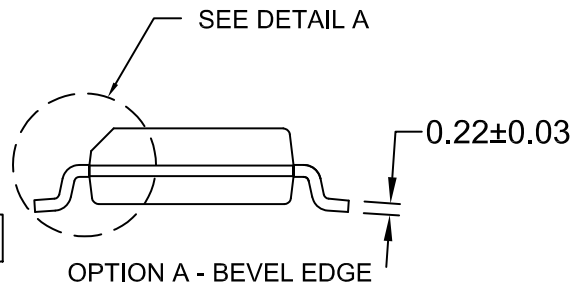
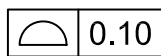
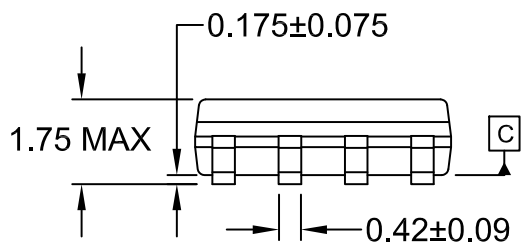
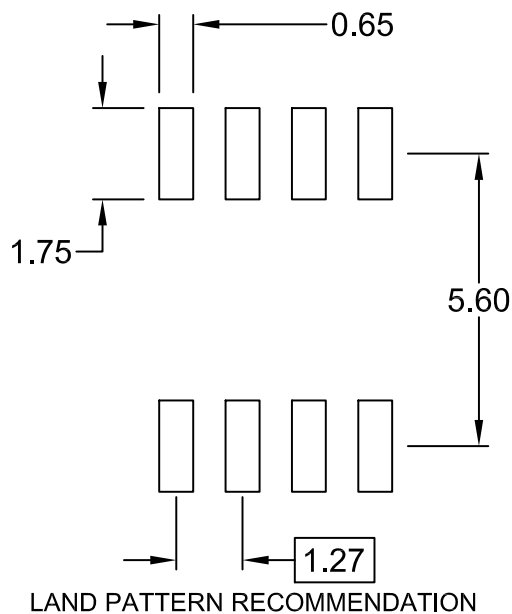
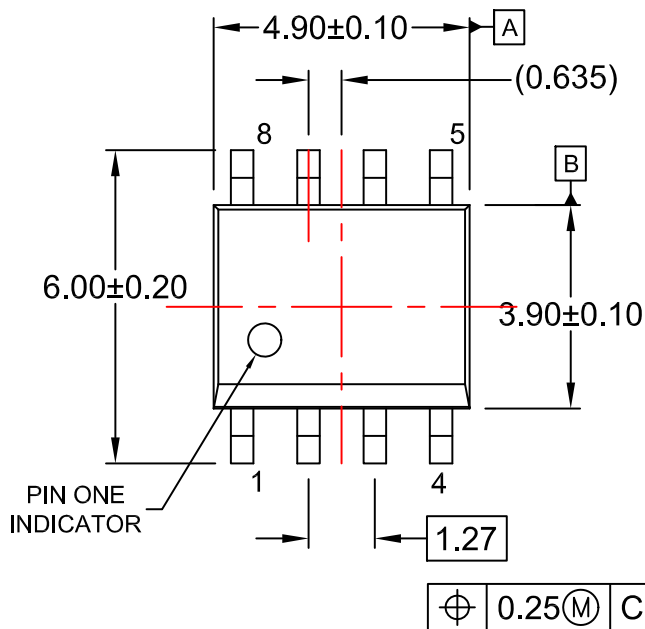
- STYLE 1:  
PIN 1. AC IN  
2. DC + IN  
3. DC - IN  
4. AC IN  
5. GROUND  
6. OUTPUT  
7. AUXILIARY  
8. V<sub>CC</sub>

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