KA2803B

Earth Leakage Detector

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.

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_A = -25°C to +80°C
- Operation from 12 V to 20 V Input

Functions
- Differential Amplifier
- Level Comparator
- Latch Circuit

MARKING DIAGRAMS

ORDERING INFORMATION
See detailed ordering and shipping information on page 3 of this data sheet.
**Figure 1. Block Diagram**

**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 VCC terminal (Pin 8) directly from the power line. The resistor R₅ and capacitor Cₛ are chosen so that Pin 8 voltage is at least 12 V. The value of Cₛ is recommended above 1 μF.

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 R₅ should be selected so that the breaker satisfies the required sensing current. The protection resistor Rₚ 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 Rₚ is from several hundred Ω to several kΩ.

Capacitor C₁ is for the noise canceller and a standard value of C₁ is 0.047 μF. Capacitor C₂ is also a noise canceller capacitance, but it is not usually used.

When high noise is present, a 0.047 μF 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 C₃ and the mechanism breaker. This capacitor should be selected under 1 μF 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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>Supply Voltage</td>
<td>20</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>ICC</td>
<td>Supply Current</td>
<td>8</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>P_D</td>
<td>Power Dissipation</td>
<td>300</td>
<td></td>
<td>mW</td>
</tr>
<tr>
<td>T_L</td>
<td>Lead Temperature, Soldering 10 Seconds</td>
<td>260</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>T_A</td>
<td>Operation Temperature Range</td>
<td>−25</td>
<td>+80</td>
<td>°C</td>
</tr>
<tr>
<td>TSTG</td>
<td>Storage Temperature Range</td>
<td>−65</td>
<td>+150</td>
<td>°C</td>
</tr>
</tbody>
</table>

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.

PACKAGE MARKING AND ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Operating Temperature Range</th>
<th>Package</th>
<th>Packing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA2803B</td>
<td>−25 to +80°C</td>
<td>8–Lead, Dual Inline Package (DIP)</td>
<td>Tube</td>
</tr>
<tr>
<td>KA2803BD</td>
<td>−25 to +80°C</td>
<td>8–Lead, Small Outline Package (SOP)</td>
<td>Tape and Reel</td>
</tr>
</tbody>
</table>

ELECTRICAL CHARACTERISTICS (T_A = −25°C to + 80°C unless otherwise noted)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Test Circuit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC</td>
<td>Supply Current 1</td>
<td>VCC = 12V, VR = OPEN, VI = 2 V</td>
<td>Figure 4</td>
<td>580</td>
<td>300</td>
<td>530</td>
<td>μA</td>
</tr>
<tr>
<td>V_T</td>
<td>Trip Voltage</td>
<td>VCC = 16 V, VR = 2 V, VD = 2.02 V, VI = 2</td>
<td>Figure 5</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>mV (ms)</td>
</tr>
<tr>
<td>IOD</td>
<td>Differential Amplifier Current 1</td>
<td>VCC = 16 V, VR = 30 mV, VD = 1.2 V</td>
<td>Figure 7</td>
<td>−12</td>
<td>20</td>
<td>−30</td>
<td>μA</td>
</tr>
<tr>
<td>IOD</td>
<td>Differential Amplifier Current 2</td>
<td>VCC = 16 V, VOD = 0.8 V, VR = 1.2 V</td>
<td>Figure 8</td>
<td>17</td>
<td>27</td>
<td>37</td>
<td>μA</td>
</tr>
<tr>
<td>I_O</td>
<td>Output Current</td>
<td>VSC = 1.4 V, VOS = 0.8 V, VCC = 16.0 V</td>
<td>Figure 9</td>
<td>200</td>
<td>400</td>
<td>800</td>
<td>μA</td>
</tr>
<tr>
<td>VSCON</td>
<td>Latch–On Voltage</td>
<td>VCC = 16 V</td>
<td>Figure 10</td>
<td>0.7</td>
<td>1.0</td>
<td>1.4</td>
<td>V</td>
</tr>
<tr>
<td>ISCON</td>
<td>Latch Input Current</td>
<td>VCC = 16 V</td>
<td>Figure 11</td>
<td>−13</td>
<td>−7</td>
<td>−1</td>
<td>μA</td>
</tr>
<tr>
<td>IOSL</td>
<td>Output Low Current</td>
<td>VCC = 12 V, VOSL = 0.2 V</td>
<td>Figure 12</td>
<td>200</td>
<td>800</td>
<td>1400</td>
<td>μA</td>
</tr>
<tr>
<td>VDIC</td>
<td>Differential Input Clamp Voltage</td>
<td>VCC = 16 V, IDC = 100 mA</td>
<td>Figure 13</td>
<td>4.0</td>
<td>1.2</td>
<td>2.0</td>
<td>V</td>
</tr>
<tr>
<td>VSM</td>
<td>Maximum Current Voltage</td>
<td>ISM = 7 mA</td>
<td>Figure 14</td>
<td>20</td>
<td>24</td>
<td>28</td>
<td>V</td>
</tr>
<tr>
<td>IS2</td>
<td>Supply Current 2</td>
<td>VCC = 12.0 V, VOSL = 0.6 V</td>
<td>Figure 15</td>
<td>200</td>
<td>400</td>
<td>900</td>
<td>μA</td>
</tr>
<tr>
<td>VSOFF</td>
<td>Latch–Off Supply Voltage</td>
<td>VOS = 12.0 V</td>
<td>Figure 16</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>V</td>
</tr>
<tr>
<td>VSC</td>
<td>Latch–Off Supply Voltage</td>
<td>VSC = 1.8 V</td>
<td>Figure 17</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>ms</td>
</tr>
</tbody>
</table>

1. Guaranteed by design, not tested in production.
Figure 4. Supply Current 1
Figure 5. Trip Voltage

Figure 6. V_{PN1} for V_P Measurement

* V_P = V_{pin1} - 0.03V

Figure 7. Differential Amplifier Output Current 1

Figure 8. Differential Amplifier Output Current 2

Figure 9. Output Current
**KA2803B**

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
\( (V_R, V_I = V_R, V_{OD} = 0.8 \text{ V}) \)

Figure 21. Output Current

Figure 22. Output Low Current

Figure 23. \( V_{CC} \) 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. $V_{CC}$ 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**
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

NOTE 8

TOP VIEW

END VIEW WITH LEADS CONSTRAINED
NOTE 5

SIDE VIEW

END VIEW
NOTE 6

STYLE 1:
PIN 1. AC IN
2. DC + IN
3. DC – IN
4. AC IN
5. GROUND
6. OUTPUT
7. AUXILIARY
8. VCC

NOTES:
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACK-
   AGE 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);

<table>
<thead>
<tr>
<th>INCHES</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.210 – 0.219</td>
</tr>
<tr>
<td>A1</td>
<td>0.38 – 0.388</td>
</tr>
<tr>
<td>A2</td>
<td>0.195 – 0.202</td>
</tr>
<tr>
<td>b</td>
<td>0.35 – 0.355</td>
</tr>
<tr>
<td>b2</td>
<td>1.62 – 1.625</td>
</tr>
<tr>
<td>c</td>
<td>0.20 – 0.205</td>
</tr>
<tr>
<td>D</td>
<td>0.020 – 0.025</td>
</tr>
<tr>
<td>D1</td>
<td>0.100 – 0.106</td>
</tr>
<tr>
<td>E</td>
<td>0.375 – 0.390</td>
</tr>
<tr>
<td>E1</td>
<td>0.260 – 0.278</td>
</tr>
<tr>
<td>e</td>
<td>0.080 – 0.085</td>
</tr>
<tr>
<td>eB</td>
<td>2.54 – 2.545</td>
</tr>
<tr>
<td>L</td>
<td>0.150 – 0.156</td>
</tr>
<tr>
<td>M</td>
<td>10° – 10°</td>
</tr>
</tbody>
</table>

GENERIC
MARKING DIAGRAM*

XXXX XXXX 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.

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