

## LH1263 E & M Signaling Circuit

### Features

- Switches controlled by TTL compatible data inputs
- One switch with 250 mA current-break capability
- Two switches have low ON-resistance
  - $<8\ \Omega$  at 250 mA
  - $<35\ \Omega$  at 85 mA (current-limit switch)
- No EMI
- 180 mA driver circuit for external relays (TTL compatible)
- Clean, bounce-free switching
- Solid-state reliability
- High-voltage monolithic IC fabricated in a dielectric process

### Description

The LH1263AE E & M Signaling Circuit replaces electromechanical relays and discrete components that are utilized in line signaling interface circuits such as E & M trunk signaling and FX ground-start applications. This IC is comprised of logic-programmable, latched switch control; three high-voltage switches (one for overcurrent protection); a ground-reference comparator, and a driver for external relays. The latches store data, which establishes this IC as a Type I, II, III, IV, or V interface. The ground reference comparator and a few resistors provide the E lead and M lead detector. The overcurrent protection eliminates the need for a positive temperature coefficient (PTC) resistor or a ballast lamp on the M lead battery supply.

The LH1263AE device can be configured to perform Type I, II, III, IV, and V interfaces. Multiple ICs are required for some of the interfaces. The LH1263AE device is available in a 20-pin, plastic DIP.

## Description (continued)

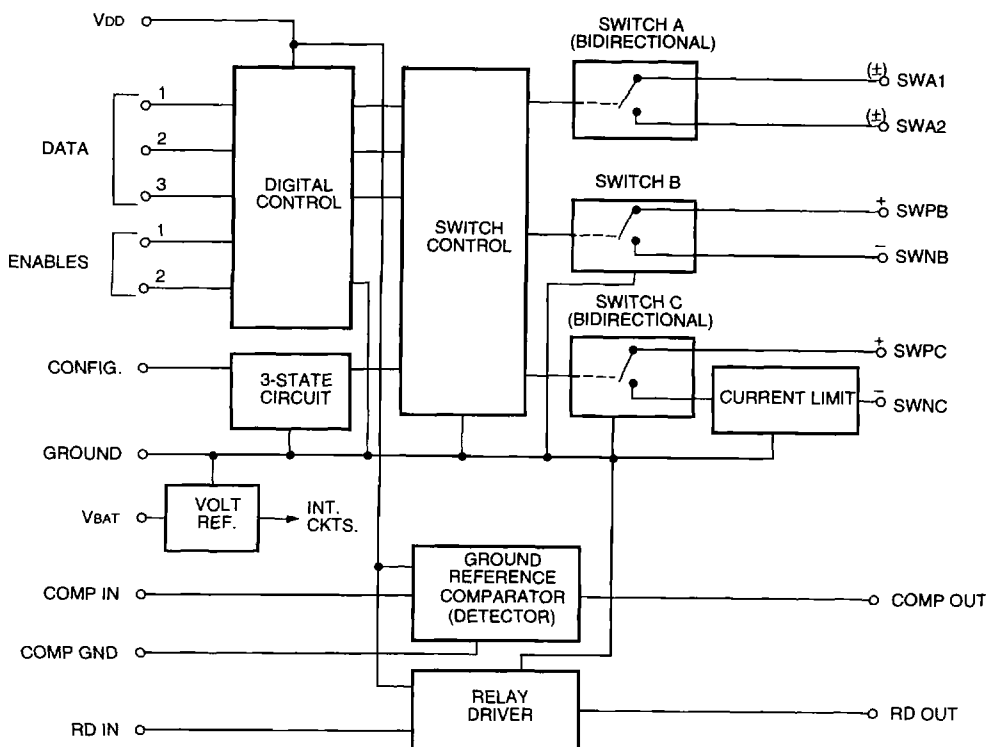


Figure 1. Functional Block Diagram

## Pin Information

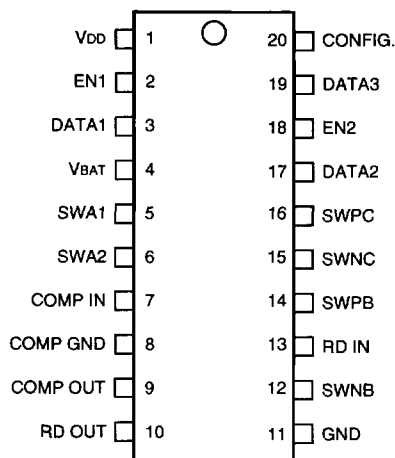


Figure 2. Pin Diagram

Table 1. Pin Descriptions

| Pin           | Symbol                  | Name/Function   |
|---------------|-------------------------|---|
| 1             | VDD                     | <b>Positive Supply Voltage.</b> Operating voltage is +5.0 V ( $\pm 0.25$ V).  |
| 2<br>18       | EN1<br>EN2              | <b>ENABLE.</b> These TTL compatible inputs enable (logic-high) or disable (logic-low) inputs DATA1 and DATA3 respectively.  |
| 3<br>17<br>19 | DATA1<br>DATA2<br>DATA3 | <b>DATA.</b> These TTL-compatible inputs provide the logic for controlling switches 1, 2, and 3.  |
| 4             | VBAT                    | <b>VBAT.</b> Connections for the negative external power (operating voltage is $-42.5$ V to $-60$ V). This pin is typically connected to a central office supply in telephone applications. |
| 5<br>6        | SWA1<br>SWA2            | <b>Outputs for Bidirectional Switch A.</b> Loads can be connected to these outputs irrespective of polarity.  |
| 7<br>9        | COMP IN<br>COMP OUT     | <b>Comparator.</b> Ground reference comparator input and output respectively.   |
| 8             | COMP GND                | <b>Comparator Ground.</b> An independent ground or common for the comparator.   |
| 10<br>13      | RD OUT<br>RD IN         | <b>Relay I/O.</b> Relay output and input respectively.  |
| 11            | GND                     | <b>Ground.</b> Common ground point for device circuitry (except the comparator).  |
| 12<br>14      | SWNB<br>SWPB            | <b>Outputs for Switch B.</b> SWNB and SWPB connect to the negative and positive potentials respectively of a load for Switch B.   |
| 15<br>16      | SWNC<br>SWPC            | <b>Outputs for Switch C.</b> SWNC and SWPC connect to the negative and positive potentials respectively of a load for Switch C.   |
| 20            | CONFIG                  | <b>Configuration.</b> Pin for determining one of three possible logic combinations for switch control (see Table 7).  |

## Absolute Maximum Ratings (T<sub>A</sub> = 25 °C)

Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to Absolute Maximum Ratings for extended periods of time can adversely affect device reliability.

**Table 2. Absolute Maximum Ratings**

| Parameter                                   | Symbol           | Min  | Max  | Unit |
|---|------------------|------|------|------|
| Ambient Operating Temperature Range         | T <sub>A</sub>   | -40  | +85  | °C   |
| Storage Temperature Range                   | T <sub>stg</sub> | -40  | +125 | °C   |
| Pin Soldering Temperature (t = 15 s max)    | T <sub>s</sub>   | —    | 300  | °C   |
| Supply Voltage (V <sub>DD</sub> to Common)  | V <sub>s</sub>   | —    | 5.50 | V    |
| Supply Voltage (V <sub>NEG</sub> to Common) | V <sub>s</sub>   | -60  | —    | V    |
| Switch A and B Terminal Voltage             | —                | -200 | +200 | V    |
| Switch C Terminal Voltage                   | —                | —    | —    | —    |
| Pin 15 (Pin 16 at GND)                      | —                | -80  | +200 | V    |
| Pin 16 (Pin 15 at -48 V)                    | —                | -200 | +152 | V    |
| dc Switch Current Capacity                  | —                | —    | —    | —    |
| Switch A and B                              | —                | —    | 360  | mA   |
| Switch C                                    | —                | —    | *    | mA   |

\* Switch C is current limited between 140 mA and 360 mA.

**Table 3. Excessive Fault Conditions**

| Description   | Condition | Specifications                   | Switch |
|---------------|-----------|----------------------------------|--------|
| Fault Current | On        | 4 A to 0.8 A in 10 ms            | A      |
|               | On        | 1.5 A for 1 s                    | A      |
|               | Shutdown  | Between 140 mAdc & 360 mAdc      | C      |
| Lightning     | On/Off    | 1000 V, 10 x 1000 μs, 2.5 A peak | A      |
|               |           | 1000 V, 10 x 1000 μs, 50 mA peak | B, C   |
| Power Cross   | On/Off    | 600 Vrms — 1 s, 1 kΩ             | A      |

## Recommended Operating Conditions

**Table 4. Supply Voltages**

| Name           | Symbol           | Value          | Unit |
|----------------|------------------|----------------|------|
| Supply Voltage | V <sub>DD</sub>  | +5.0 ± 0.25    | V    |
| Supply Voltage | V <sub>BAT</sub> | -42.5 to -52.5 | V    |

**Table 5. Comparator Operation (BAT/GND Detector)**

COMP GND pin is connected to an external ground reference.

| Input Voltage at COMP IN* | Resulting Output Voltage at COMP OUT | Operational Conditions at COMP OUT |
|---------------------------|--------------------------------------|------------------------------------|
| +50 mV to V <sub>DD</sub> | 2.4 V to V <sub>DD</sub> (TTL high)  | Sources current up to 50 μA        |
| ≤ -50 mV                  | 0 V to 0.4 V (TTL low)               | Sinks current up to 500 μA         |

\* COMP IN is internally diode clamped to V<sub>DD</sub> and COMP GND with a maximum current of 20 mA.

## Recommended Operating Conditions (continued)

Table 6. Relay Driver Operation

| Input Voltage at RD IN          | Resulting Output Voltage at RD OUT | Operational Conditions at RD OUT    |
|---------------------------------|------------------------------------|-------------------------------------|
| Low — 0 V to 0.8 V              | ≤0.9 V                             | Sinks current ≤ 180 mA              |
| High — 2.2 V to V <sub>DD</sub> | Open circuit                       | ≤50 μA leakage at ≤ V <sub>DD</sub> |

## Electrical Characteristics T<sub>A</sub> = 25 °C

| Parameter                             | Test Condition   | Min | Typ   | Max | Unit |
|---------------------------------------|--|-----|-------|-----|------|
| Power Supply Current V <sub>DD</sub>  | Measure I <sub>VDD</sub> (See Figure 7.)                                   | —   | 0.5   | 5.0 | mA   |
| Power Supply Current V <sub>BAT</sub> | Measure I <sub>BAT</sub> (See Figure 7.)                                   | —   | 1.6   | 2.5 | mA   |
| Switch A On Voltage                   | Measure pin 6 = +85 mA (See Figure 8.)                                     | —   | 1.0   | 2.0 | V    |
|                                       | Measure pin 6 = -85 mA (See Figure 8.)                                     | —   | 1.0   | 2.0 | V    |
| Switch B On Voltage                   | Measure pin 14 = 250 mA (See Figure 9.)                                    | —   | 1.6   | 2.0 | V    |
| Switch C On Voltage                   | Measure pin 16 = 85 mA (See Figure 10.)                                    | —   | 2.2   | 3.0 | V    |
| Switch A Break Current*               | Pin 6 = +130 mA (See Figure 11.)   | —   |       |     |      |
|                                       | Pin 6 = -130 mA (See Figure 11.)   |     |       |     |      |
| Switch B Break Current*               | Pin 14 = 250 mA (See Figure 12.)   | —   |       |     |      |
| Switch A Leakage Current              | V <sub>S</sub> = +200 V, Measure +I (See Figure 13.)                       | —   | <1.0  | 10  | μA   |
|                                       | V <sub>S</sub> = -200 V, Measure -I (See Figure 13.)                       | —   | <-1.0 | -10 | μA   |
|                                       | V <sub>S</sub> = +152 V, Measure +I (See Figure 14.)                       | —   | <1.0  | 10  | μA   |
|                                       | V <sub>S</sub> = -248 V, Measure -I (See Figure 14.)                       | —   | <-1.0 | -10 | μA   |
| Switch B Leakage Current              | V <sub>S</sub> = +200 V, Measure +I (See Figure 15.)                       | —   | <1.0  | 10  | μA   |
|                                       | V <sub>S</sub> = -200 V, Measure -I (See Figure 15.)                       | —   | <-1.0 | -10 | μA   |
|                                       | V <sub>S</sub> = +152 V, Measure +I (See Figure 16.)                       | —   | <1.0  | 10  | μA   |
|                                       | V <sub>S</sub> = -248 V, Measure -I (See Figure 16.)                       | —   | <-1.0 | -10 | μA   |
| Switch C Leakage Current              | V <sub>S</sub> = +200 V, Measure +I (See Figure 17.)                       | —   | <1.0  | 10  | μA   |
|                                       | V <sub>S</sub> = -80 V, Measure -I (See Figure 17.)                        | —   | <-1.0 | -10 | μA   |
|                                       | V <sub>S</sub> = +152 V, Measure +I (See Figure 18.)                       | —   | <1.0  | 10  | μA   |
|                                       | V <sub>S</sub> = -200 V, Measure -I (See Figure 18.)                       | —   | <-1.0 | -10 | μA   |
| Relay Driver On Voltage               | Measure Pin 10 (See Figure 19.)  | —   | —     | 0.9 | V    |
| Relay Driver Output Leakage Current   | (See Figure 20.)   | —   | —     | 50  | μA   |
| Comparator Output:<br>On Voltage      | Measure Pin 9 (See Figure 21.)<br>V <sub>S</sub> = -50 mV, Pin 9 = +500 μA | —   | —     | 0.4 | V    |
|                                       | Off Voltage<br>V <sub>S</sub> = +50 mV, Pin 9 = -50 μA                     | 2.4 | —     | —   | V    |
| Switch C Shutdown†                    | (See Figure 22.)   | —   |       |     |      |
| Digital Input Low-level Voltage       | —  | —   | —     | 0.8 | V    |
| Digital Input High-level Voltage      | —  | 2.2 | —     | —   | V    |
| Feedthrough Capacitance:              | Switch off, f = 1 MHz  | —   | 9.0   | —   | pF   |
|                                       | Switch off, f = 1 MHz  | —   | 2.0   | —   | pF   |
|                                       | Switch off, f = 1 MHz  | —   | 65    | —   | pF   |

\* The test figures show the initial setup conditions (relay in the normally closed position). The relay is activated to complete the break-current capability test.

† This switch has overcurrent protection. Figure 22 describes the fault condition. S1 is to be closed after all other connections have been made. Typical average current on pin 15 during a fault is less than 30 mA. The shutdown current window is between 140 mA and 360 mA.

## Typical Characteristic Curves

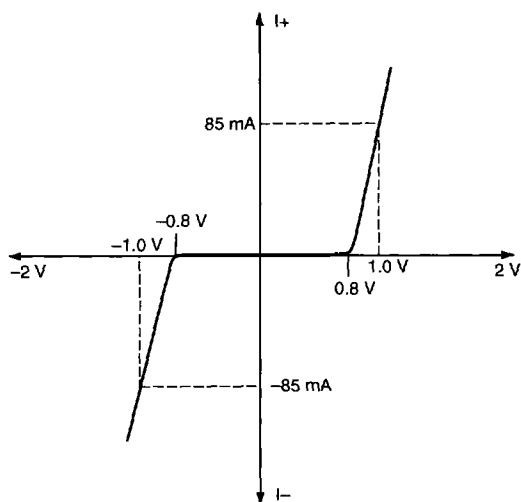


Figure 3. Typical ON Characteristics Switch A

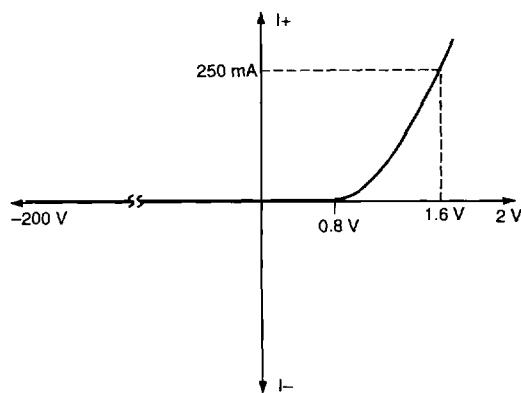


Figure 4. Typical ON Characteristics Switch C

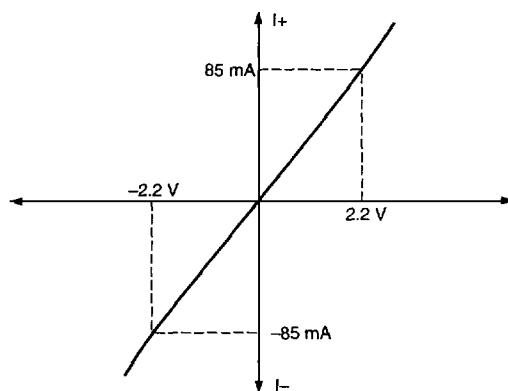


Figure 5. Typical ON Characteristics Switch B

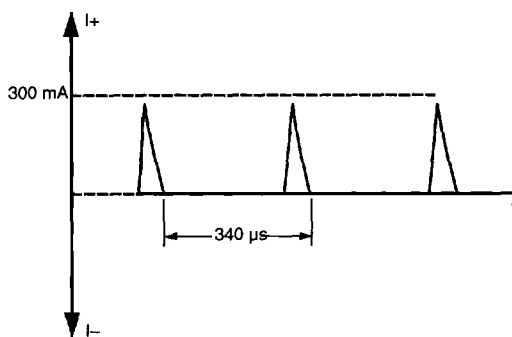


Figure 6. Switch C, Current-Limit Mode

## Logic Table

**Table 7. Logic Table**

Pins EN1 and EN2 are enabled (logic high).

| Inputs |       |       |                  | Device State |          |          |
|--------|-------|-------|------------------|--------------|----------|----------|
| DATA1  | DATA2 | DATA3 | CONFIG           | Switch A     | Switch B | Switch C |
| Low    | Low   | Low   | Ground           | Closed       | Open     | Open     |
| Low    | Low   | High  | Ground           | Closed       | Open     | Open     |
| Low    | High  | Low   | Ground           | Open         | Open     | Open     |
| Low    | High  | High  | Ground           | Open         | Open     | Open     |
| High   | Low   | Low   | Ground           | Closed       | Open     | Open     |
| High   | Low   | High  | Ground           | Closed       | Closed   | Closed   |
| High   | High  | Low   | Ground           | Open         | Open     | Open     |
| High   | High  | High  | Ground           | Open         | Closed   | Closed   |
| Low    | Low   | Low   | N/C              | Closed       | Open     | Open     |
| Low    | Low   | High  | N/C              | Closed       | Open     | Closed   |
| Low    | High  | Low   | N/C              | Open         | Open     | Open     |
| Low    | High  | High  | N/C              | Open         | Open     | Closed   |
| High   | Low   | Low   | N/C              | Closed       | Open     | Open     |
| High   | Low   | High  | N/C              | Closed       | Open     | Closed   |
| High   | High  | Low   | N/C              | Open         | Closed   | Open     |
| High   | High  | High  | N/C              | Open         | Closed   | Closed   |
| Low    | Low   | Low   | V <sub>BAT</sub> | Closed       | Open     | Open     |
| Low    | Low   | High  | V <sub>BAT</sub> | Closed       | Open     | Closed   |
| Low    | High  | Low   | V <sub>BAT</sub> | Open         | Open     | Open     |
| Low    | High  | High  | V <sub>BAT</sub> | Open         | Open     | Closed   |
| High   | Low   | Low   | V <sub>BAT</sub> | Open         | Closed   | Open     |
| High   | Low   | High  | V <sub>BAT</sub> | Open         | Closed   | Closed   |
| High   | High  | Low   | V <sub>BAT</sub> | Open         | Open     | Open     |
| High   | High  | High  | V <sub>BAT</sub> | Open         | Open     | Closed   |

Test Circuits

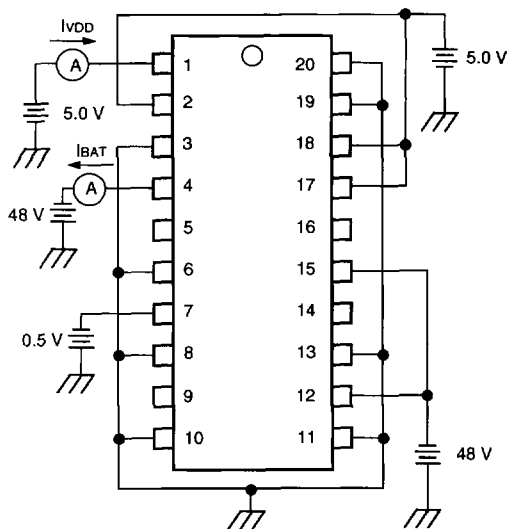


Figure 7. Supply Currents

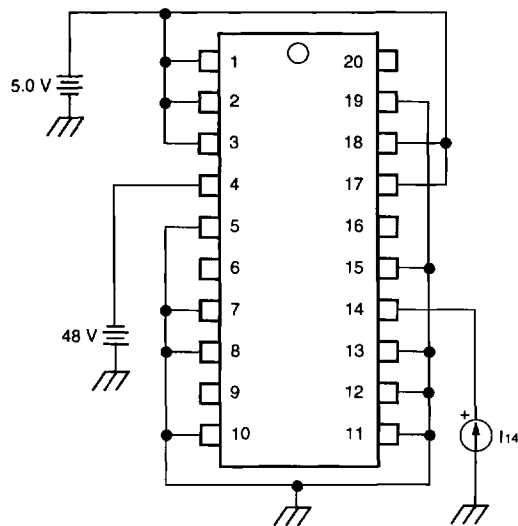


Figure 9. Positive ON Voltage — Switch B

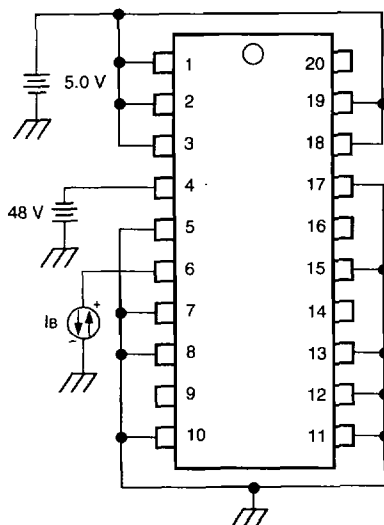


Figure 8. Positive/Negative ON Voltage — Switch A

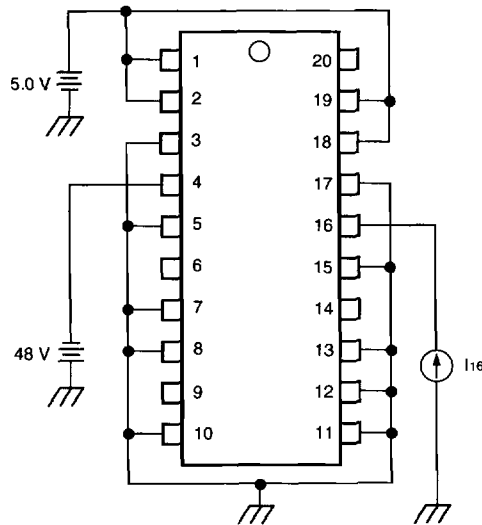


Figure 10. Positive ON Voltage — Switch C



Test Circuits (continued)

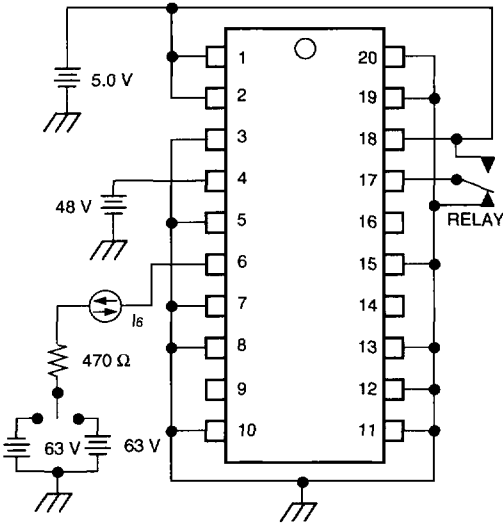


Figure 11. Break-Current Capability — Switch A

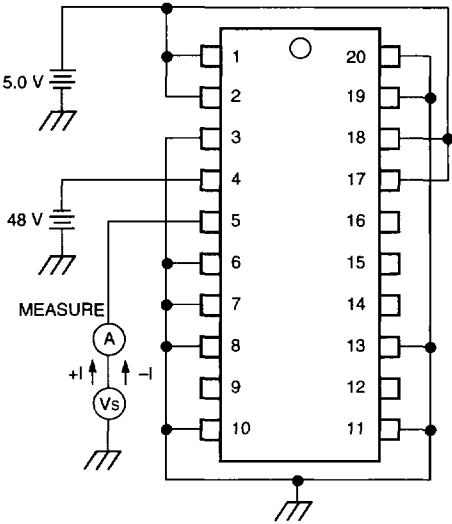


Figure 13. High-Voltage Leakage Current — Switch A

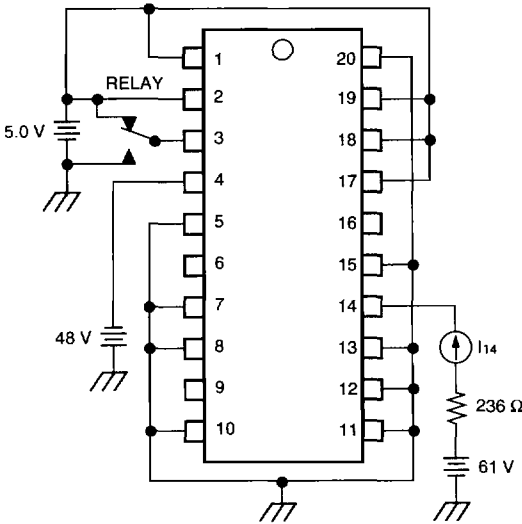


Figure 12. Break-Current Capability — Switch B

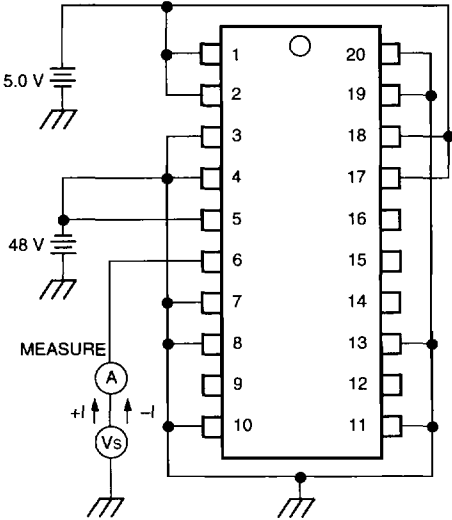


Figure 14. High-Voltage Leakage Current — Switch A

## Test Circuits (continued)

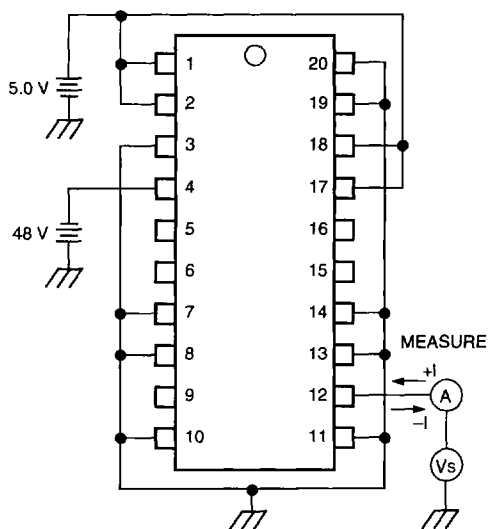


Figure 15. High-Voltage Leakage  
Current — Switch B

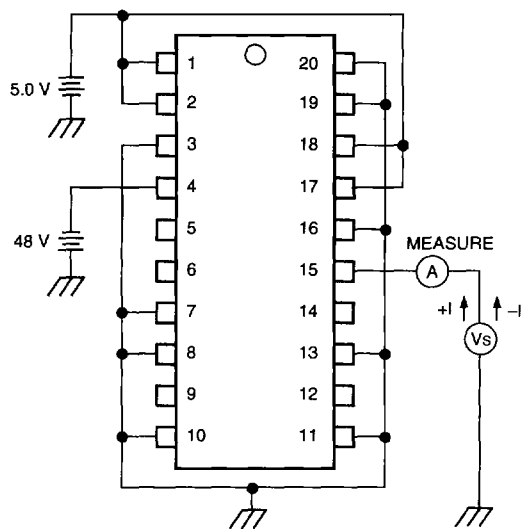


Figure 17. High-Voltage Leakage  
Current — Switch C

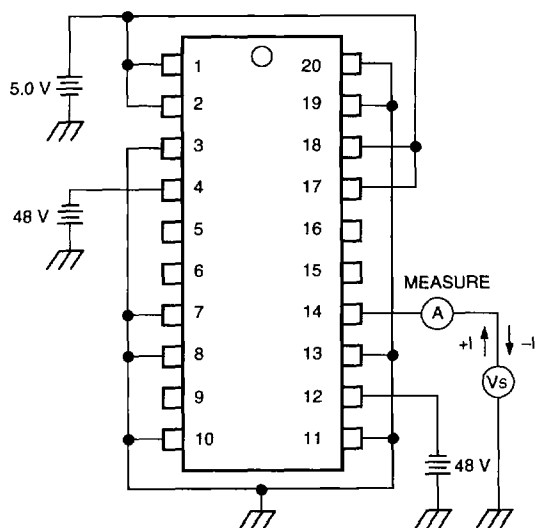


Figure 16. High-Voltage Leakage  
Current — Switch B

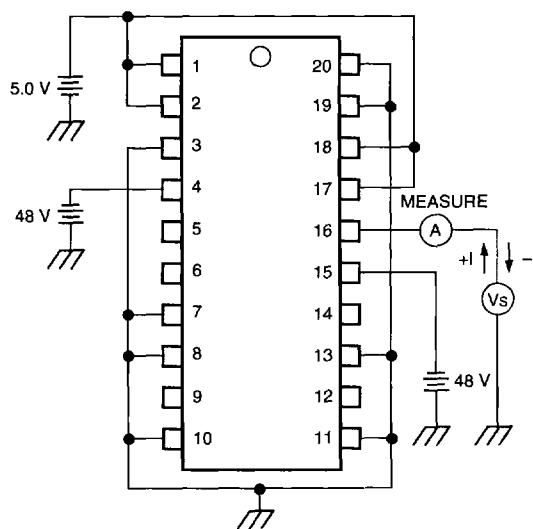


Figure 18. High-Voltage Leakage  
Current — Switch C

## Test Circuits (continued)

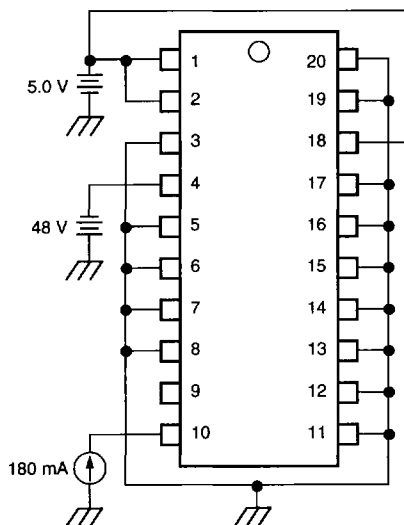


Figure 19. Relay Driver ON Voltage

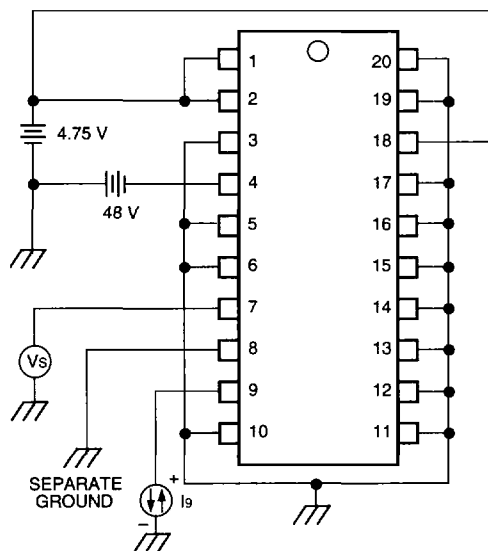


Figure 21. Comparator ON/OFF Voltage

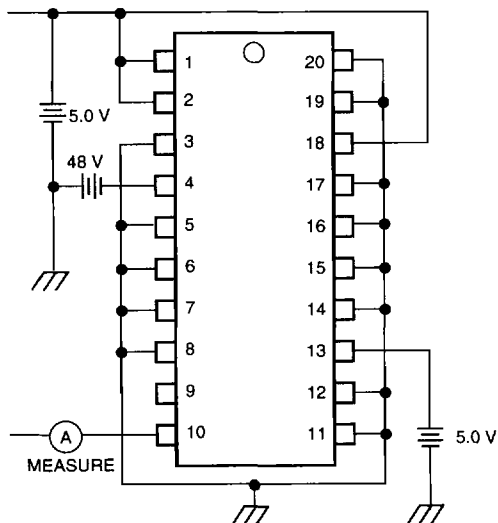


Figure 20. Relay Driver Output, Leakage Current

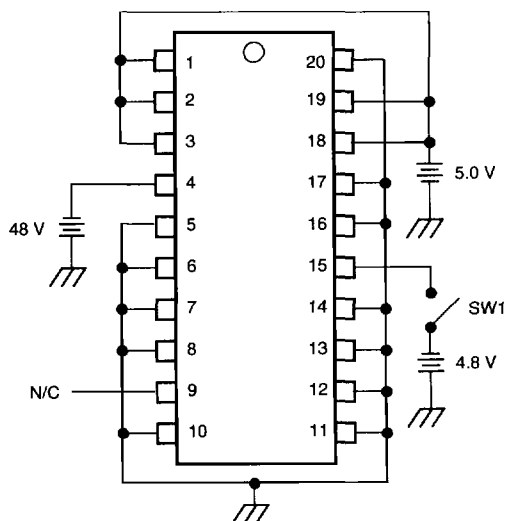


Figure 22. Switch C Shutdown Test

## Simplified Output Circuits

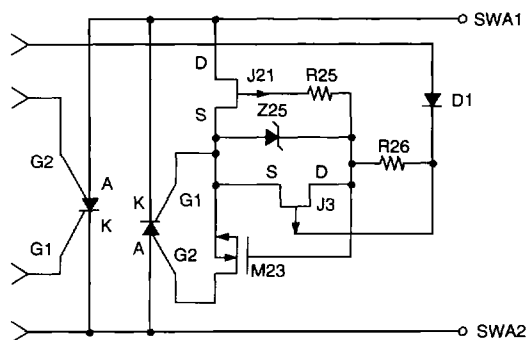


Figure 23. Switch A Output

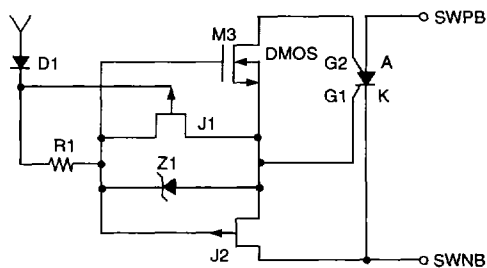


Figure 24. Switch B Output

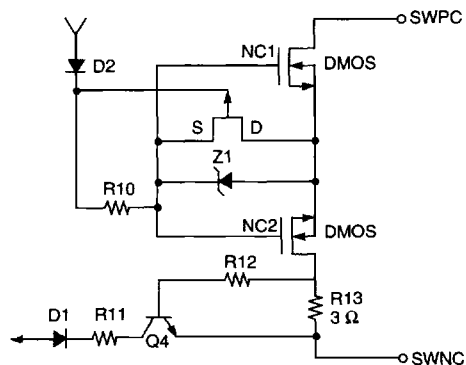


Figure 25. Switch C Output

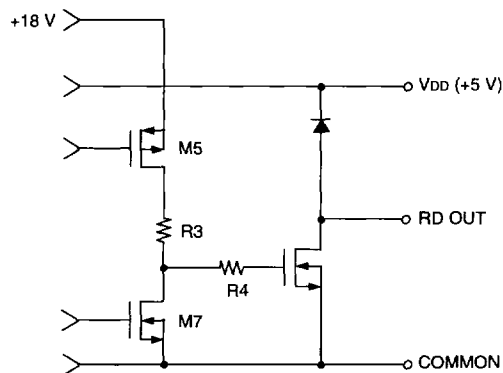


Figure 26. Relay Driver Output

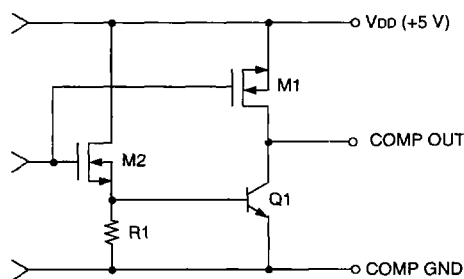


Figure 27. Comparator (Detector) Output

## Applications

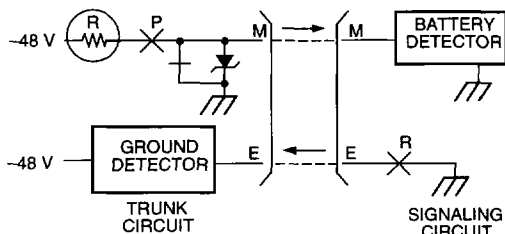


Figure 28. Type I Interface

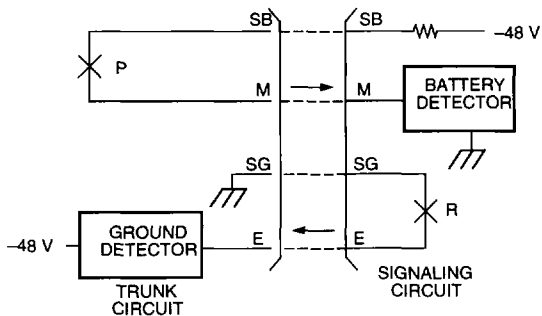


Figure 29. Type II Interface

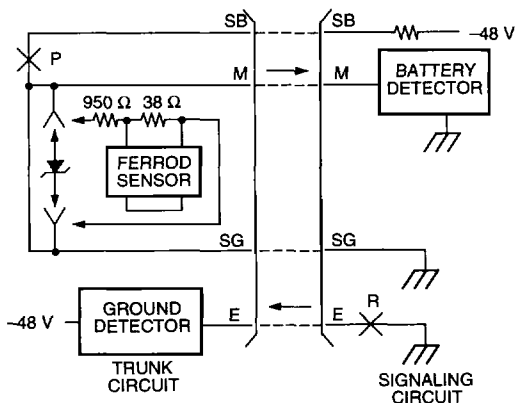


Figure 30. Type III Interface

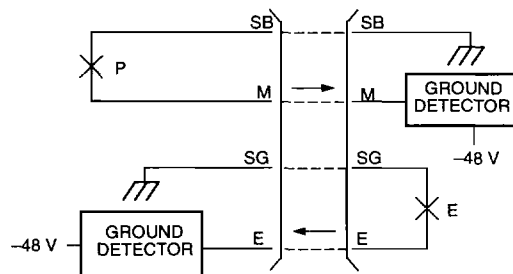


Figure 31. Type IV Interface

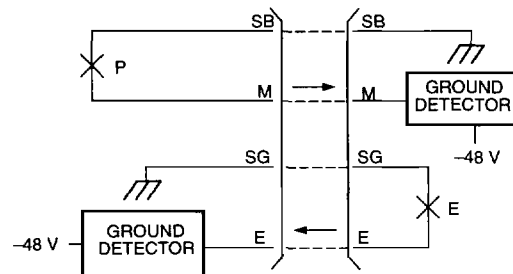


Figure 32. Type V Interface

Outline Diagrams

20-Pin Plastic DIP (LH1263AE)

Dimensions are in inches and (millimeters).

