

# CD4543 CMOS BCD-to-Seven-Segment Latch/Decoder/Driver for Liquid-Crystal Displays

## 1. General Description

### 1.1 Description

The CD4543 is a BCD-to-seven segment latch/decoder/driver designed primarily for liquid-crystal display(LCD)applications.It is.also capable of driving light emitting diode(LED),incandescent, gas-discharge, and fluorescent displays. This device is functionally similar to and serves as direct replacement for the CD4056 when pin7 is connected to VSS. It differs from the CD4056 in that it has a display blanking capability instead of a level-shifting function and requires only one power supply. When the CD4056 is used in the level shifting mode, two power supplies are required,When the CD45438 is used for LCD applications,a square wave must be applied to the PHASE input and the backplane of the LCD device. For LED applications a logic 0 is required at the PHASE input for common-cathode devices; a logic1 is required for common-anode devices(see truth table).

### 1.2 Features

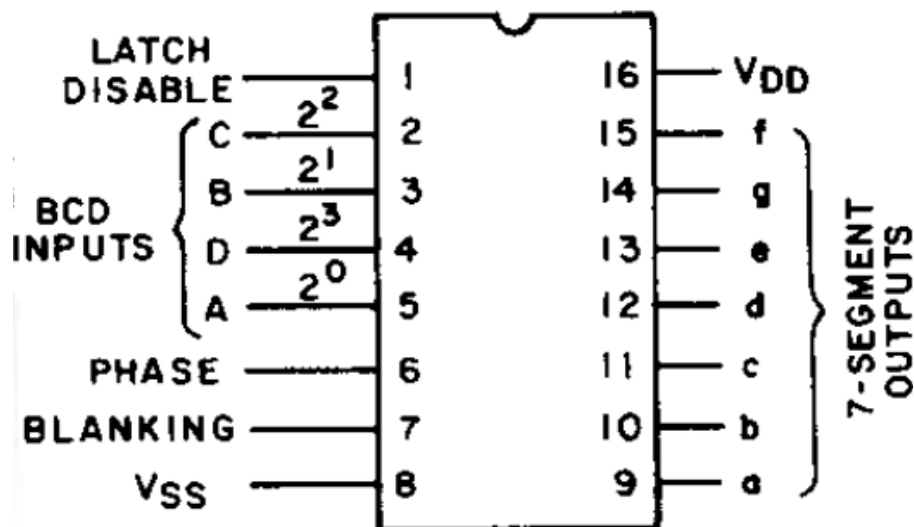
- Display blanking of all illegal input combinations
- Latch storage of code
- Direct LED driving capability
- 100% tested for quiescent current at 18V
- Maximum input current of 1μA at 18V and 25°C
- 5V,10V, and 15V parametric ratings

### 1.3 Device Information

| PART NUMBER | PACKAGE |
|-------------|---------|
| CD4543      | DIP     |
|             | SOP     |
|             | TSSOP   |

## 2. Pin Description and Functional Diagram

Figure 2.1 Top View



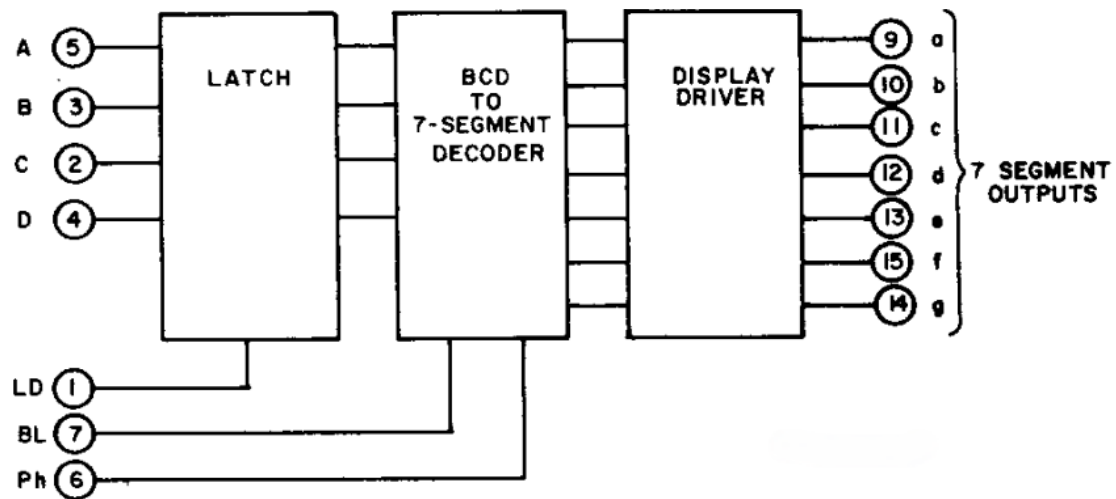


Figure 2.2 Functional Diagram

| PIN No. | NAME          | I/O | FUNCTION                       |
|---------|---------------|-----|--------------------------------|
| 1       | LATCH DISABLE | I   | Latch Enable Input(Active LOW) |
| 2       | C             | I   | Address Data Input             |
| 3       | B             | I   | Address Data Input             |
| 4       | D             | I   | Address Data Input             |
| 5       | A             | I   | Address Data Input             |
| 6       | PHASE         | I   | Phase Input(Active HIGH)       |
| 7       | BLANKING      | I   | Blanking Input(Active HIGH)    |
| 8       | VSS           |     | Ground                         |
| 9       | a             | O   | Segment Output                 |
| 10      | b             | O   | Segment Output                 |
| 11      | c             | O   | Segment Output                 |
| 12      | d             | O   | Segment Output                 |
| 13      | e             | O   | Segment Output                 |
| 14      | g             | O   | Segment Output                 |
| 15      | f             | O   | Segment Output                 |
| 16      | VDD           |     | Supply Voltage                 |

## 3. System Diagram

### 3.1 Logic Diagram

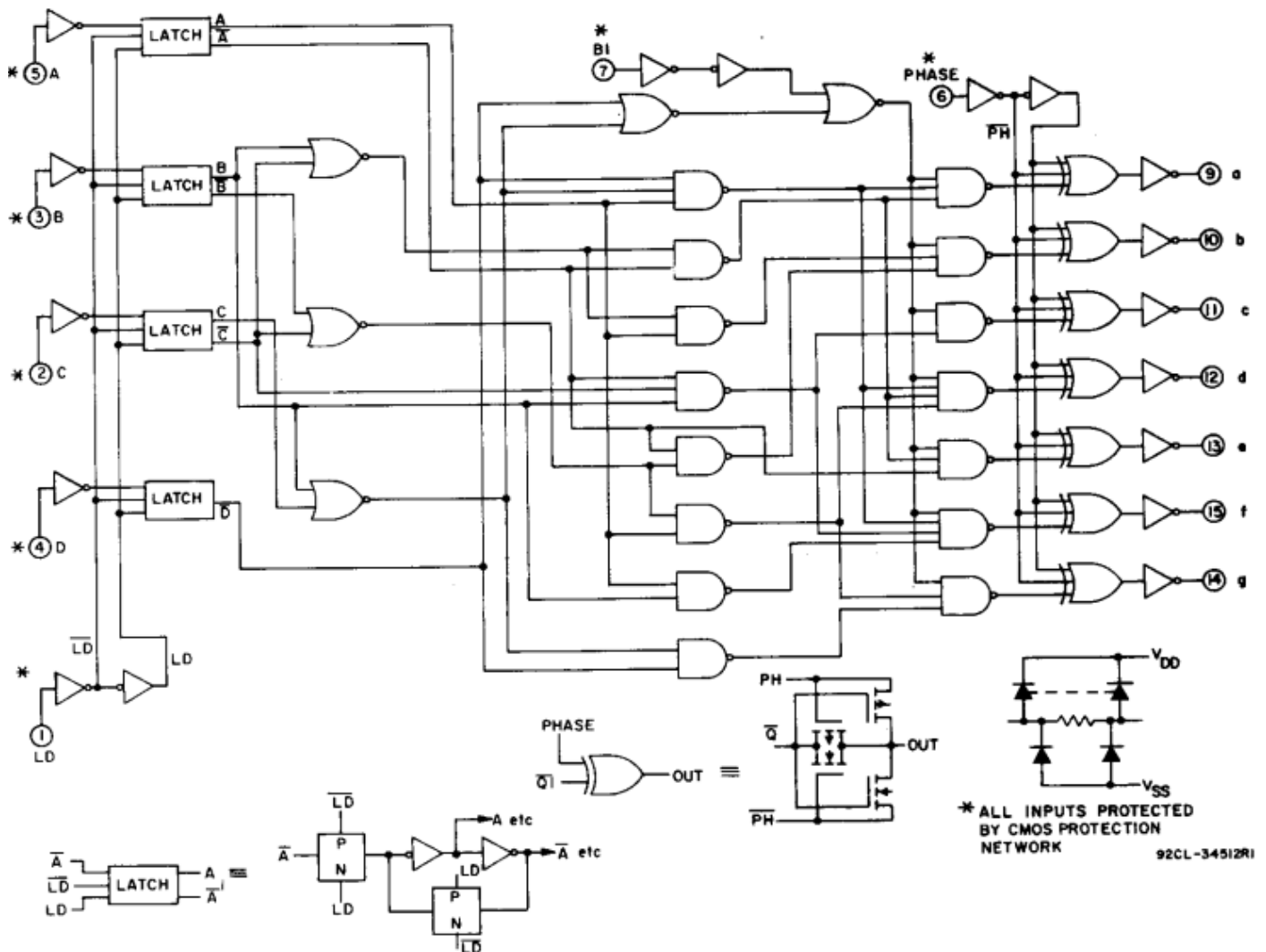


Figure 3.1: CD4543 Logic Diagram

### 3.2 Truth Table

| Input |     |    |   |   |   |   | Output                               |   |   |   |   |   |   | Display Character |
|-------|-----|----|---|---|---|---|--------------------------------------|---|---|---|---|---|---|-------------------|
| LD    | 0BI | Ph | D | C | B | A | a                                    | b | c | d | e | f | g |                   |
| X     | 1   | 0  | 0 | X | X | X | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 |                   |
| 1     | 0   | 0  | 0 | 0 | 0 | 0 | 1                                    | 1 | 1 | 1 | 1 | 1 | 0 | 0                 |
| 1     | 0   | 0  | 0 | 0 | 0 | 1 | 0                                    | 1 | 1 | 0 | 0 | 0 | 0 | 1                 |
| 1     | 0   | 0  | 0 | 0 | 1 | 0 | 1                                    | 1 | 0 | 1 | 1 | 0 | 1 | 2                 |
| 1     | 0   | 0  | 0 | 0 | 1 | 1 | 1                                    | 1 | 1 | 1 | 0 | 0 | 1 | 3                 |
| 1     | 0   | 0  | 0 | 1 | 0 | 0 | 0                                    | 1 | 1 | 0 | 0 | 1 | 1 | 4                 |
| 1     | 0   | 0  | 0 | 1 | 0 | 1 | 1                                    | 0 | 1 | 1 | 0 | 1 | 1 | 5                 |
| 1     | 0   | 0  | 0 | 1 | 1 | 0 | 1                                    | 0 | 1 | 1 | 1 | 1 | 1 | 6                 |
| 1     | 0   | 0  | 0 | 1 | 1 | 1 | 1                                    | 1 | 1 | 0 | 0 | 0 | 0 | 7                 |
| 1     | 0   | 0  | 1 | 0 | 0 | 0 | 1                                    | 1 | 1 | 1 | 1 | 1 | 1 | 8                 |
| 1     | 0   | 0  | 1 | 0 | 0 | 1 | 1                                    | 1 | 1 | 1 | 0 | 1 | 1 | 9                 |
| 1     | 0   | 0  | 1 | 0 | 1 | 0 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1     | 0   | 0  | 1 | 0 | 1 | 1 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1     | 0   | 0  | 1 | 1 | 0 | 0 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1     | 0   | 0  | 1 | 1 | 0 | 1 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1     | 0   | 0  | 1 | 1 | 1 | 0 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 1     | 0   | 0  | 1 | 1 | 1 | 1 | 0                                    | 0 | 0 | 0 | 0 | 0 | 0 | Blank             |
| 0     | 0   | 0  | X | X | X | X | **                                   |   |   |   |   |   |   | **                |
| †     | †   | 1  | † |   |   |   | Inverse of Output Combinations Above |   |   |   |   |   |   | Display As Above  |

X = Don't Care, 1 ≡ High State, 0 ≡ Low State

†=Above combinations

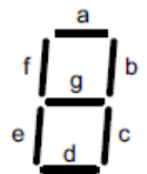
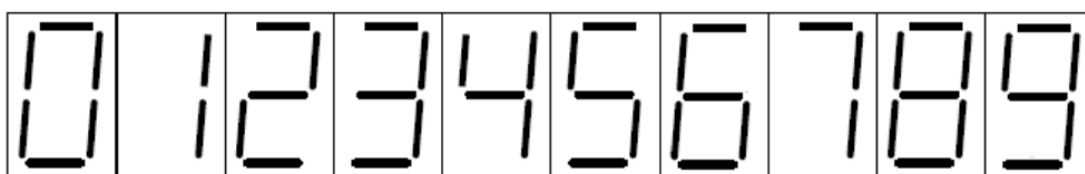
\*=For liquid crystal readouts, apply a square wave to Ph.

For common cathode LED readouts, select Ph = 0.

For common anode LED readouts, select Ph = 1.

\*\*=Depends upon the BCD code previously applied when LD = 1

### 3.3 Display Format



## 4. Specifications

### 4.1 Absolute Maximum Ratings

| Symbol   | Parameter                                                        | MIN  | MAX          | Unit |
|----------|------------------------------------------------------------------|------|--------------|------|
| $V_{DD}$ | DC Supply Voltage Range<br>(Voltage Referenced to VSS Terminals) | -0.5 | 20           | V    |
| $V_I$    | Input Voltage Range, All Inputs                                  | 0.5  | $V_{DD}+0.5$ | V    |
| $P_D$    | Power Dissipation                                                |      | 500          | mW   |
| $T_J$    | Junction Temperature                                             |      | 125          | °C   |
| $T_{OP}$ | Operating Temperature                                            | 0    | 70           | °C   |

Absolute maximum ratings are those values beyond which the device could be permanently damaged, These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions.

### 4.2 Electrical Characteristics

#### 4.2.1 DC Specifications

( $T_a=25^{\circ}\text{C}$ , voltages are referenced to VSS (ground=0V), unless otherwise specified)

| Symbol   | Parameter                 | Test Condition |      |     | MIN   | TYP | MAX  | Unit |
|----------|---------------------------|----------------|------|-----|-------|-----|------|------|
|          |                           | VO             | VIN  | VDD |       |     |      |      |
| $I_{DD}$ | Supply Current            | --             | 0,5  | 5   | --    | 0   | 1    | uA   |
|          |                           | --             | 0,10 | 10  | --    | 0   | 1    | uA   |
|          |                           | --             | 0,18 | 18  | --    | 0   | 1    | uA   |
| $I_{OL}$ | Low Level Output Current  | 0.4            | 0,5  | 5   | 0.5   | 1.5 | --   | mA   |
|          |                           | 0.5            | 0,10 | 10  | 2     | 4   | --   | mA   |
|          |                           | 1.5            | 0,15 | 15  | 7     | 14  | --   | mA   |
| $I_{OH}$ | High Level Output Current | 4.6            | 0,5  | 5   | -0.5  | -1  | --   | mA   |
|          |                           | 2.5            | 0,5  | 5   | -1.5  | -3  | --   | mA   |
|          |                           | 9.5            | 0,10 | 10  | -1    | -2  | --   | mA   |
|          |                           | 13.5           | 0,15 | 15  | -3    | -7  | --   | mA   |
| $V_{OL}$ | Low Level Output Voltage  | --             | 0,5  | 5   | --    | 0   | 0.05 | V    |
|          |                           | --             | 0,10 | 10  | --    | 0   | 0.05 | V    |
|          |                           | --             | 0,15 | 15  | --    | 0   | 0.05 | V    |
| $V_{OH}$ | High Level Output Voltage | --             | 0,5  | 5   | 4.95  | 5   | --   | V    |
|          |                           | --             | 0,10 | 10  | 9.95  | 10  | --   | V    |
|          |                           | --             | 0,15 | 15  | 14.95 | 15  | --   | V    |
| $V_{IL}$ | Low Level Input Voltage   | 0.5,4.5        | --   | 5   | --    | --  | 1.5  | V    |
|          |                           | 1,9            | --   | 10  | --    | --  | 3    | V    |
|          |                           | 1.5,13.5       | --   | 15  | --    | --  | 4    | V    |
| $V_{IH}$ | High Level Input Voltage  | 0.5,4.5        | --   | 5   | 3.5   | --  | --   | V    |
|          |                           | 1,9            | --   | 10  | 7     | --  | --   | V    |
|          |                           | 1.5,13.5       | --   | 15  | 11    | --  | --   | V    |
| $I_{IN}$ | Input Leakage Current     | --             | 0,18 | 18  | --    | 0   | ±1   | uA   |

## 5. Applications information

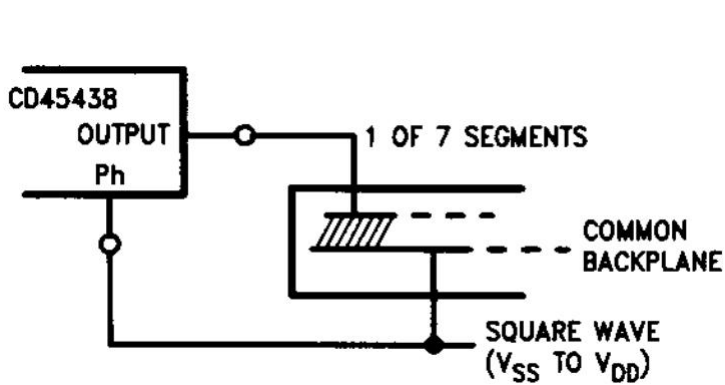


Figure 5.1: Liquid crystal (LC) readout

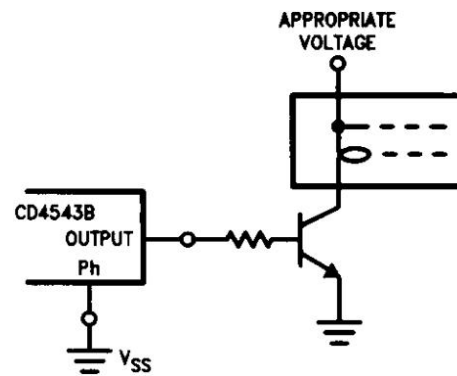


Figure 5.2: Incandescent readout

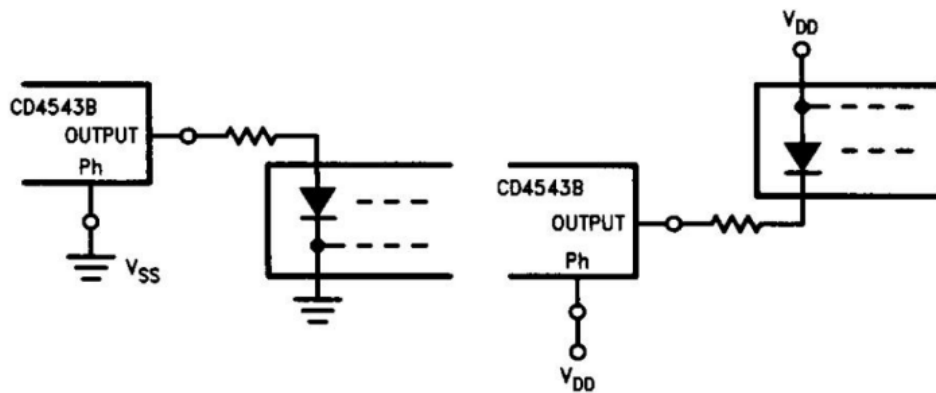


Figure 5.3: Light emitting diode (LED) readout

Note: Bipolar transistors may be added for gain (for  $V_{DD} \leq 10V$  or  $I_{OUT} \geq 10mA$ )

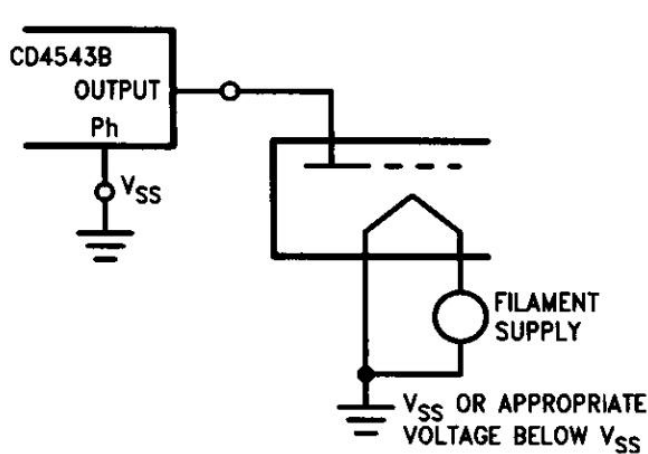


Figure 5.4: Fluorescent readout

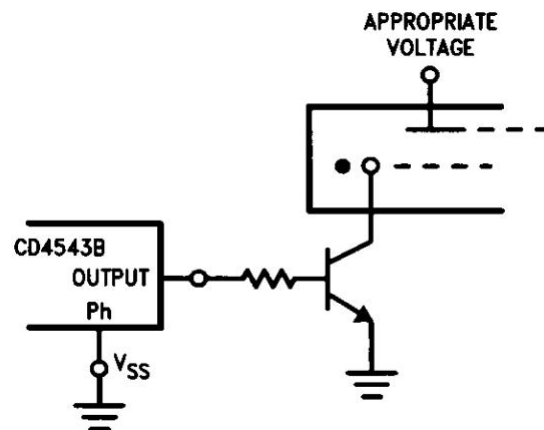
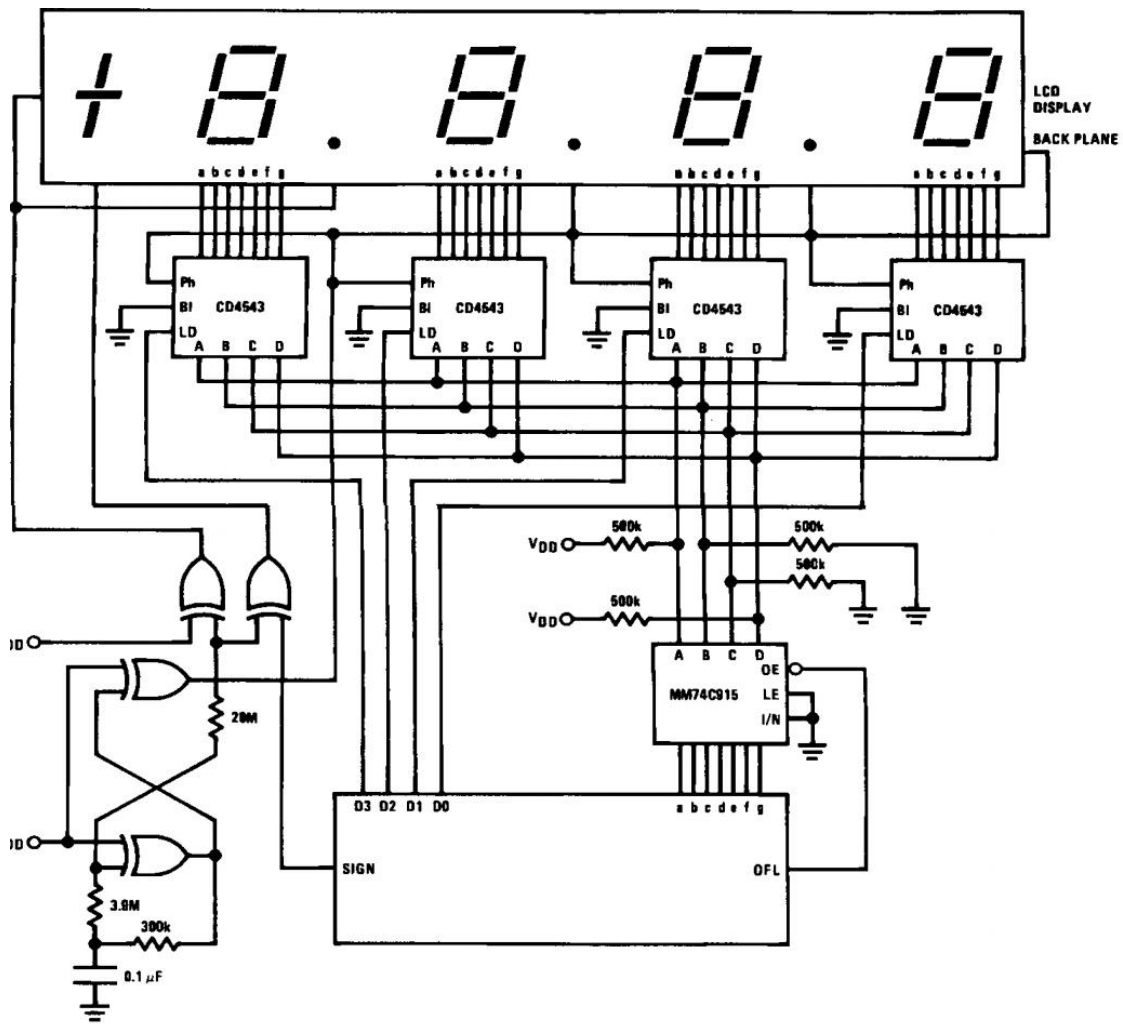


Figure 5.5: Gas discharge readout

Figure 5.6: 3½-digit DVM with LCD display



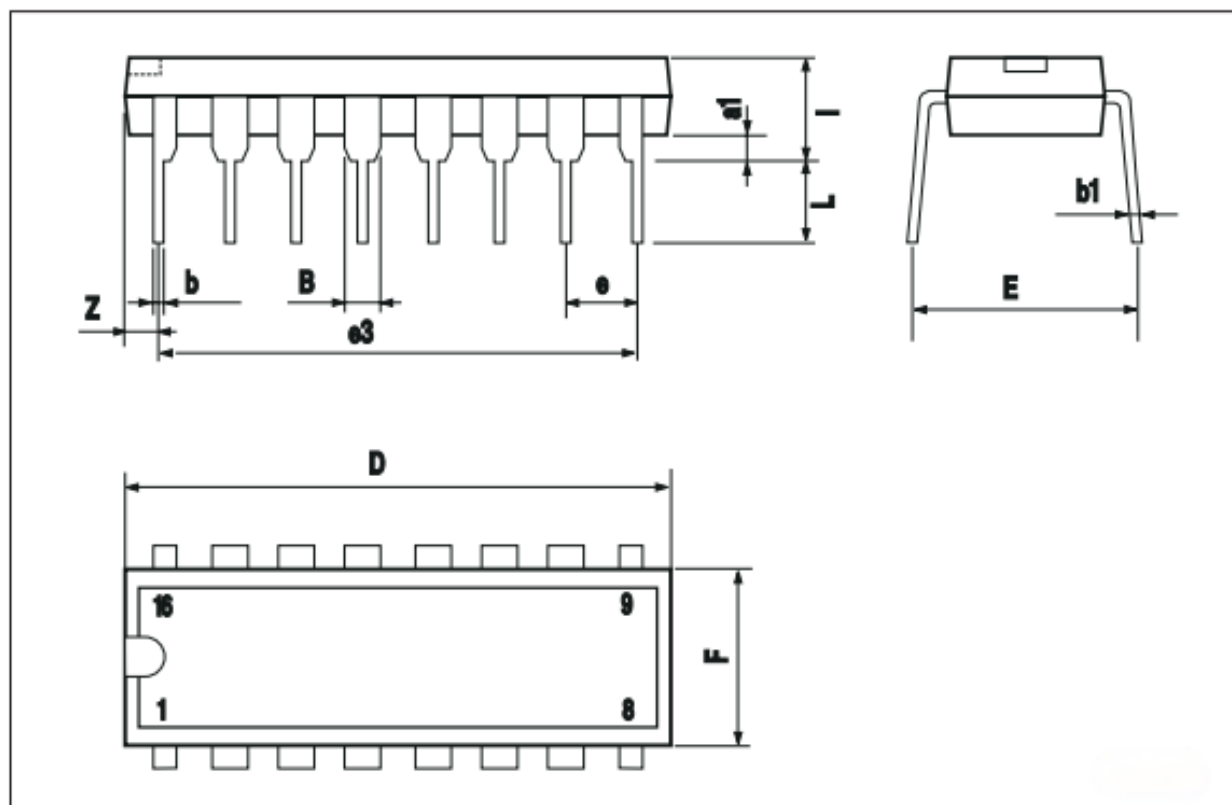
## 6. Ordering Information

| Orderable Device | Package Type | Pins | Packing     | Package Qty |
|------------------|--------------|------|-------------|-------------|
| CD4543ND16ATBE   | DIP          | 16   | Tube        | 25          |
| CD4543NS16ARDQ   | SOP          | 16   | Tape & Reel | 4000        |
| CD4543TS16ARDQ   | TSSOP        | 16   | Tape & Reel | 4000        |

## 7. Package Information

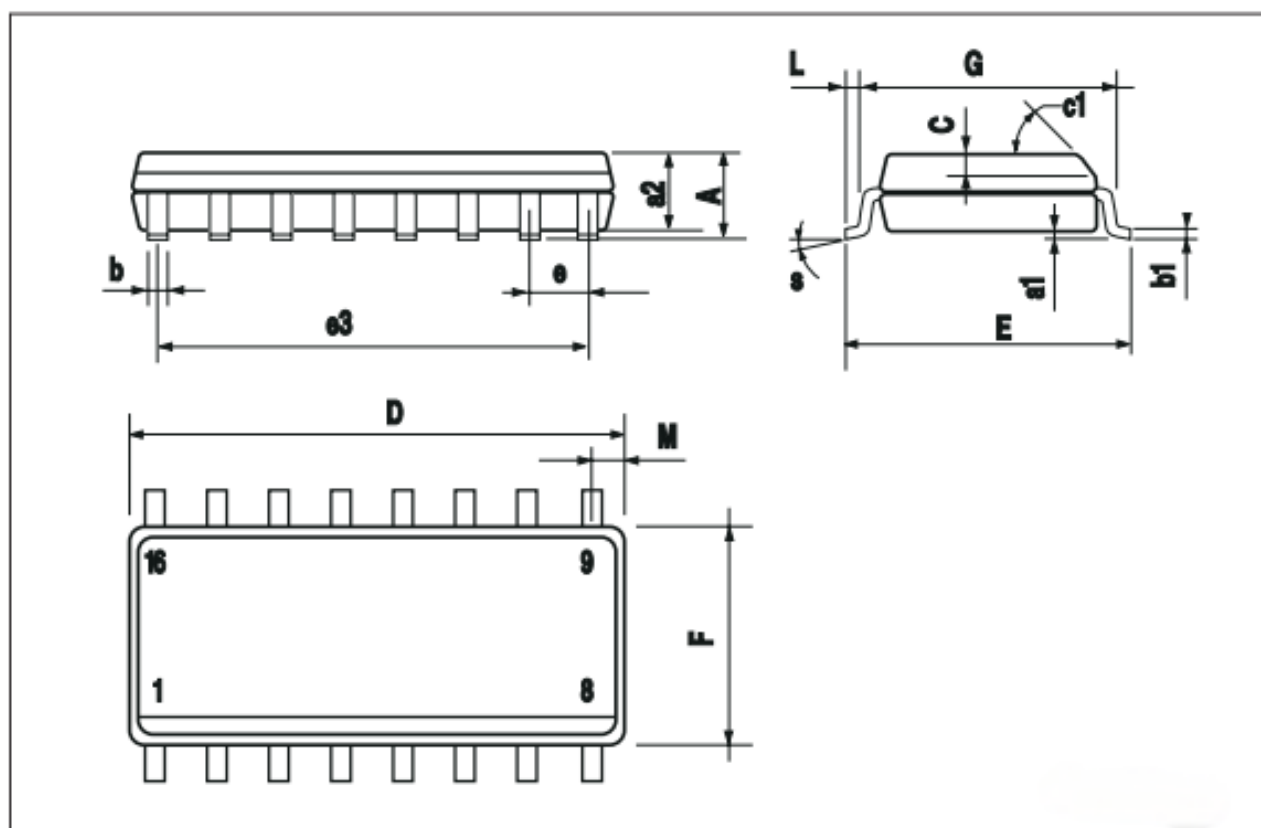
### 7.1 DIP16

| Dim. | mm.  |       |      | inch. |       |       |
|------|------|-------|------|-------|-------|-------|
|      | Min. | Typ.  | Max. | Min.  | Typ.  | Max.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |



## 7.2 SOP16

| Dim. | mm.        |      |      | inch. |       |       |
|------|------------|------|------|-------|-------|-------|
|      | Min.       | Typ. | Max. | Min.  | Typ.  | Max.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.25 | 0.004 |       | 0.010 |
| a2   |            |      | 1.64 |       |       | 0.063 |
| b    | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C    |            | 0.5  |      |       | 0.019 |       |
| c1   | 45° (typ.) |      |      |       |       |       |
| D    | 9.8        |      | 10   | 0.385 |       | 0.393 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 8.89 |      |       | 0.350 |       |
| F    | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M    |            |      | 0.62 |       |       | 0.024 |
| S    | 8° (max.)  |      |      |       |       |       |



## 7.3 TSSOP16

| Dim. | mm.  |          |      | inch. |            |        |
|------|------|----------|------|-------|------------|--------|
|      | Min. | Typ.     | Max. | Min.  | Typ.       | Max.   |
| A    |      |          | 1.2  |       |            | 0.047  |
| A1   | 0.05 |          | 0.15 | 0.002 | 0.004      | 0.006  |
| A2   | 0.8  | 1        | 1.05 | 0.031 | 0.039      | 0.041  |
| b    | 0.19 |          | 0.30 | 0.007 |            | 0.012  |
| c    | 0.09 |          | 0.20 | 0.004 |            | 0.0079 |
| D    | 4.9  | 5        | 5.1  | 0.193 | 0.197      | 0.201  |
| E    | 6.2  | 6.4      | 6.6  | 0.244 | 0.252      | 0.260  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169 | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |       | 0.0256 BSC |        |
| K    | 0°   |          | 8°   | 0°    |            | 8°     |
| L    | 0.45 | 0.60     | 0.75 | 0.018 | 0.024      | 0.030  |

