

# MC33465

## Micropower Undervoltage Sensing Circuits with Programmable Output Delay

The MC33465 series are micropower undervoltage sensing circuits that are specifically designed for use with battery powered microprocessor based systems, where extended battery life is required. A choice of several threshold voltages from 0.9 V to 4.5 V are available. This device features a very low quiescent bias current of 1.0  $\mu$ A typical.

The MC33465 series features a highly accurate voltage reference, a comparator with precise thresholds and built-in hysteresis to prevent erratic reset operation, a choice of output configurations between open drain or complementary, a time delayed output, which can be programmed by the system designer, and guaranteed operation below 1.0 V with extremely low standby current. This device is available in a SOT-23 5-pin surface mount package.

Applications include direct monitoring of the MPU/logic power supply used in appliance, automotive, industrial and portable equipment.

### MC33465 Features:

- Extremely Low Standby Current of 1.0  $\mu$ A at  $V_{in} = 3.5$  V
- Wide Input Voltage Range (0.7 V to 10 V)
- Monitors Power Supply Voltages from 1.1 V to 5.0 V
- High Accuracy Detector Threshold ( $\pm 2.5\%$ )
- Two Reset Output Types (Open Drain or Complementary Drive)
- Programmable Output Delay by External Capacitor (100 ms typ. with 0.15  $\mu$ F)
- Surface Mount Package (SOT-23 5-Pin)
- Convenient Tape and Reel (3000 per Reel)

### ORDERING INFORMATION

| Device         | Threshold Voltage | Type                          | Marking     | Package |
|----------------|-------------------|-------------------------------|-------------|---------|
| MC33465N-09ATR | 0.9               | Open<br>Drain<br><u>Reset</u> | $\bar{A}9$  | SOT-23  |
| MC33465N-20ATR | 2.0               |                               | $\bar{C}0$  |         |
| MC33465N-22ATR | 2.2               |                               | $\bar{C}2$  |         |
| MC33465N-27ATR | 2.7               |                               | $\bar{C}7$  |         |
| MC33465N-28ATR | 2.8               |                               | $\bar{D}8$  |         |
| MC33465N-30ATR | 3.0               |                               | $\bar{D}0$  |         |
| MC33465N-32ATR | 3.2               |                               | $\bar{D}2$  |         |
| MC33465N-34ATR | 3.4               |                               | $\bar{D}4$  |         |
| MC33465N-38ATR | 3.8               |                               | $\bar{D}8$  |         |
| MC33465N-45ATR | 4.5               |                               | $\bar{E}5$  |         |
| MC33465N-46ATR | 4.6               |                               | $\bar{E}6$  |         |
| MC33465N-47ATR | 4.7               |                               | $\bar{E}7$  |         |
| MC33465N-09CTR | 0.9               | Compl.<br>MOS<br><u>Reset</u> | 9 $\bar{A}$ |         |
| MC33465N-20CTR | 2.0               |                               | 0 $\bar{C}$ |         |
| MC33465N-27CTR | 2.7               |                               | 7 $\bar{C}$ |         |
| MC33465N-30CTR | 3.0               |                               | 0 $\bar{D}$ |         |
| MC33465N-43CTR | 4.3               |                               | 3 $\bar{E}$ |         |
| MC33465N-44CTR | 4.4               |                               | 4 $\bar{E}$ |         |
| MC33465N-45CTR | 4.5               |                               | 5 $\bar{E}$ |         |

Other voltages from 0.9 to 6.0 V, in 0.1 V increments, are available. Consult factory for information.

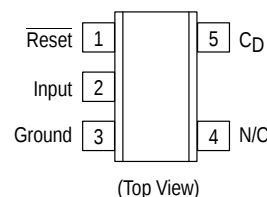
## MICROPOWER UNDervoltage SENSING CIRCUITS WITH PROGRAMMABLE OUTPUT DELAY

### SEMICONDUCTOR TECHNICAL DATA



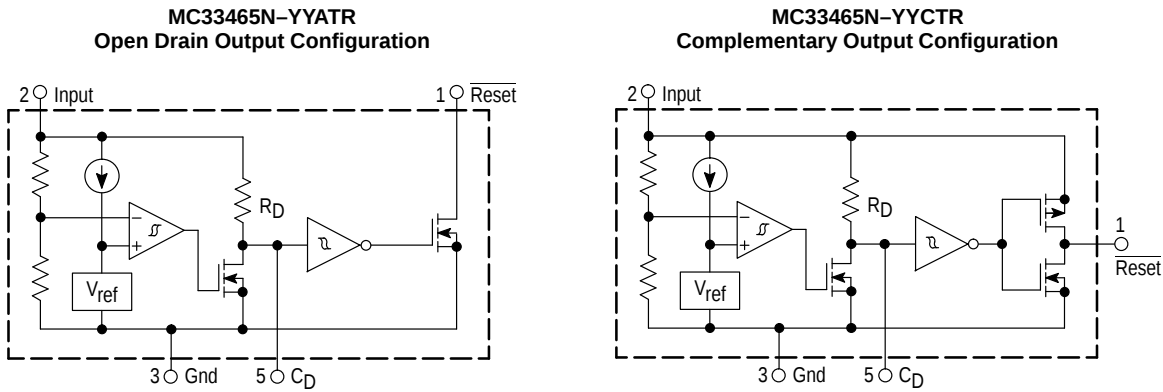
**N SUFFIX**  
PLASTIC PACKAGE  
CASE 1212  
(SOT-23-5)

### PIN CONNECTIONS



MC33465

Representative Block Diagrams



YY Denotes Threshold Voltage

This device contains 28 active transistors.

MAXIMUM RATINGS

| Rating                                                  | Symbol          | Value                         | Unit                 |
|---------------------------------------------------------|-----------------|-------------------------------|----------------------|
| Power Input Supply Voltage                              | $V_{in}$        | 0 to 12                       | V                    |
| Reset Output Voltage                                    | $V_O$           | -0.3 to 12                    | V                    |
| Reset Output Current (Source or Sink)                   | $I_O$           | 70                            | mA                   |
| Power Dissipation and Thermal Characteristics           |                 |                               |                      |
| Maximum Power Dissipation at $T_A = 25^{\circ}\text{C}$ | $P_D$           | 150                           | mW                   |
| Case 1212 (SOT-23) N Suffix                             |                 |                               |                      |
| Thermal Resistance, Junction-to-Ambient                 | $R_{\theta JA}$ | 667                           | $^{\circ}\text{C/W}$ |
| Operating Junction Temperature                          | $T_J$           | +125                          | $^{\circ}\text{C}$   |
| Operating Ambient Temperature                           | $T_A$           | -40 to +85                    | $^{\circ}\text{C}$   |
| Storage Temperature Range                               | $T_{stg}$       | -40 to +125                   | $^{\circ}\text{C}$   |
| Lead Temperature (Soldering)                            | $T_{solder}$    | 260 $^{\circ}\text{C}$ , 10 s |                      |

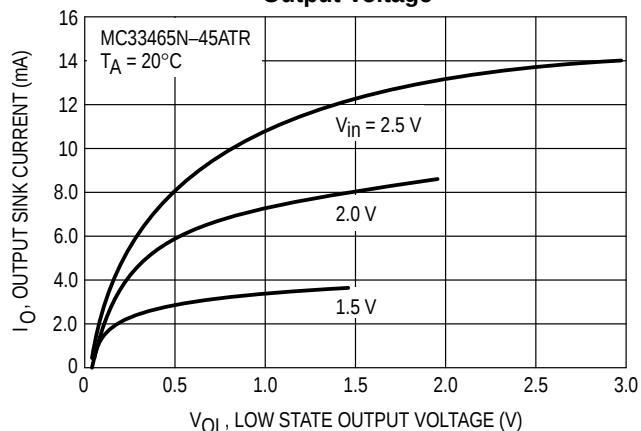
# MC33465

## ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$ (Note 1), unless otherwise noted.)

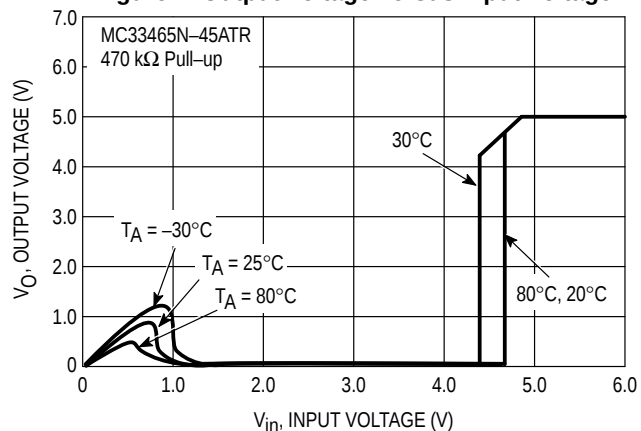
| Characteristic                                                                                                                                                                  | Symbol               | Min                 | Typ                    | Max             | Unit                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------|------------------------|-----------------|-----------------------|
| <b>SENSE COMPARATOR</b>                                                                                                                                                         |                      |                     |                        |                 |                       |
| Threshold Voltage<br>High to Low State Output ( $V_{in}$ Decreasing)                                                                                                            | $V_{IL}$             |                     |                        |                 | V                     |
| 09 Suffix                                                                                                                                                                       |                      | 0.878               | 0.9                    | 0.922           |                       |
| 20 Suffix                                                                                                                                                                       |                      | 1.950               | 2.0                    | 2.050           |                       |
| 22 Suffix                                                                                                                                                                       |                      | 2.145               | 2.2                    | 2.255           |                       |
| 27 Suffix                                                                                                                                                                       |                      | 2.633               | 2.7                    | 2.767           |                       |
| 28 Suffix                                                                                                                                                                       |                      | 2.730               | 2.8                    | 2.870           |                       |
| 30 Suffix                                                                                                                                                                       |                      | 2.925               | 3.0                    | 3.075           |                       |
| 32 Suffix                                                                                                                                                                       |                      | 3.120               | 3.2                    | 3.280           |                       |
| 34 Suffix                                                                                                                                                                       |                      | 3.315               | 3.4                    | 3.485           |                       |
| 38 Suffix                                                                                                                                                                       |                      | 3.705               | 3.8                    | 3.895           |                       |
| 43 Suffix                                                                                                                                                                       |                      | 4.193               | 4.3                    | 4.407           |                       |
| 44 Suffix                                                                                                                                                                       |                      | 4.290               | 4.4                    | 4.510           |                       |
| 45 Suffix                                                                                                                                                                       |                      | 4.387               | 4.5                    | 4.612           |                       |
| 46 Suffix                                                                                                                                                                       |                      | 4.485               | 4.6                    | 4.715           |                       |
| 47 Suffix                                                                                                                                                                       |                      | 4.583               | 4.7                    | 4.817           |                       |
| Threshold Hysteresis ( $V_{in}$ Increasing)                                                                                                                                     | $V_H$                |                     |                        |                 | V                     |
| 09 Suffix                                                                                                                                                                       |                      | 0.027               | 0.045                  | 0.063           |                       |
| 20 Suffix                                                                                                                                                                       |                      | 0.060               | 0.100                  | 0.140           |                       |
| 22 Suffix                                                                                                                                                                       |                      | 0.066               | 0.110                  | 0.154           |                       |
| 27 Suffix                                                                                                                                                                       |                      | 0.081               | 0.135                  | 0.189           |                       |
| 28 Suffix                                                                                                                                                                       |                      | 0.084               | 0.140                  | 0.196           |                       |
| 30 Suffix                                                                                                                                                                       |                      | 0.090               | 0.150                  | 0.210           |                       |
| 32 Suffix                                                                                                                                                                       |                      | 0.096               | 0.160                  | 0.224           |                       |
| 34 Suffix                                                                                                                                                                       |                      | 0.102               | 0.170                  | 0.238           |                       |
| 38 Suffix                                                                                                                                                                       |                      | 0.114               | 0.190                  | 0.266           |                       |
| 43 Suffix                                                                                                                                                                       |                      | 0.129               | 0.215                  | 0.301           |                       |
| 44 Suffix                                                                                                                                                                       |                      | 0.132               | 0.220                  | 0.308           |                       |
| 45 Suffix                                                                                                                                                                       |                      | 0.135               | 0.225                  | 0.315           |                       |
| 46 Suffix                                                                                                                                                                       |                      | 0.138               | 0.230                  | 0.322           |                       |
| 47 Suffix                                                                                                                                                                       |                      | 0.141               | 0.235                  | 0.329           |                       |
| Threshold Voltage Temperature Coefficient                                                                                                                                       | $T_C$                | –                   | $\pm 100$              | –               | PPM/ $^\circ\text{C}$ |
| <b>RESET OUTPUT</b>                                                                                                                                                             |                      |                     |                        |                 |                       |
| Output Voltage<br>High State (Complementary Output: $I_{\text{source}} = 1.0\text{ mA}$ )<br>Low State (Complementary or Open Drain Output: $I_{\text{sink}} = 1.0\text{ mA}$ ) | $V_{OH}$<br>$V_{OL}$ | $V_{in} - 2.1$<br>– | $V_{in} - 1.0$<br>0.25 | $V_{in}$<br>0.5 | V                     |
| Output Sink Current ( $V_{in} = 1.5\text{ V}$ , $V_{OL} = 0.5\text{ V}$ )                                                                                                       | $I_{OL}$             | 1.0                 | 2.0                    | –               | mA                    |
| Output Source Current ( $V_{in} = 4.5\text{ V}$ , $V_{OH} = 2.4\text{ V}$ )                                                                                                     | $I_{OH}$             | 1.0                 | 2.0                    | –               | mA                    |
| <b>DELAY OUTPUT</b>                                                                                                                                                             |                      |                     |                        |                 |                       |
| Output Sink Current ( $V_{in} = 1.5\text{ V}$ , $V_{OL} = 0.5\text{ V}$ )                                                                                                       | $I_{OL}$             | 0.2                 | 0.8                    | –               | mA                    |
| Delay Resistance                                                                                                                                                                | $R_D$                | 0.5                 | 1.0                    | 2.0             | M $\Omega$            |
| <b>TOTAL DEVICE</b>                                                                                                                                                             |                      |                     |                        |                 |                       |
| Operating Input Voltage Range                                                                                                                                                   | $V_{in}$             | 0.8 to 10           | –                      | –               | V                     |
| Quiescent Input Current<br>$V_{in} = 4.34\text{ V}$<br>$V_{in} = 6.50\text{ V}$                                                                                                 | $I_{in}$             | –<br>–              | 5.5<br>1.3             | 11<br>3.9       | $\mu\text{A}$         |

**NOTE:** 1. Low duty pulse techniques are used during test to maintain junction temperature as close to ambient as possible.

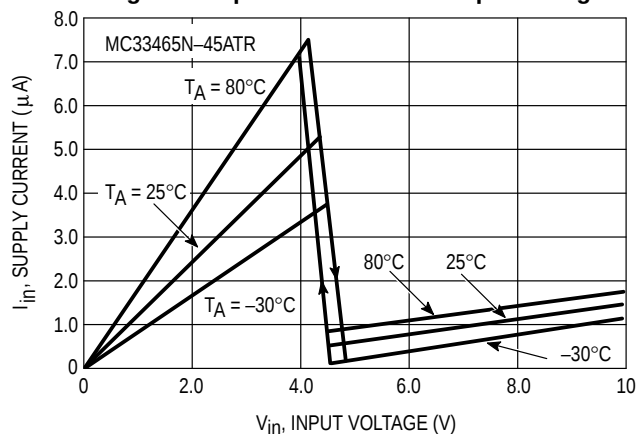
**Figure 1. Reset Low State Sink Current versus Output Voltage**



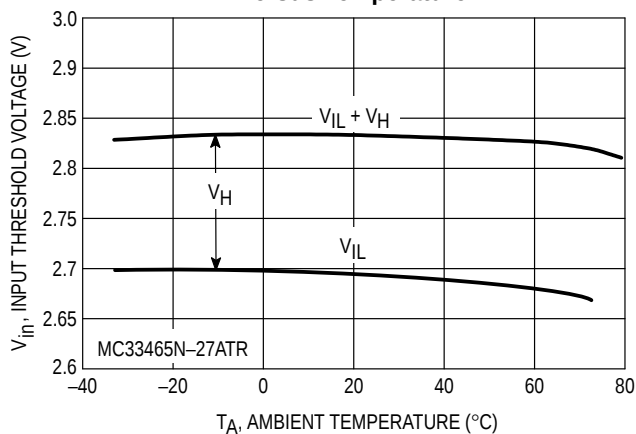
**Figure 2. Output Voltage versus Input Voltage**



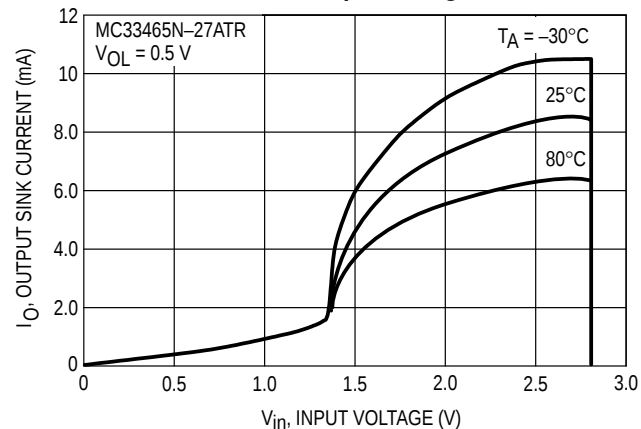
**Figure 3. Input Current versus Input Voltage**



**Figure 4. Comparator Input Threshold Voltage versus Temperature**



**Figure 5. Reset Output Sink Current versus Input Voltage**



**Figure 6. Reset Output Source Current versus Input Voltage**

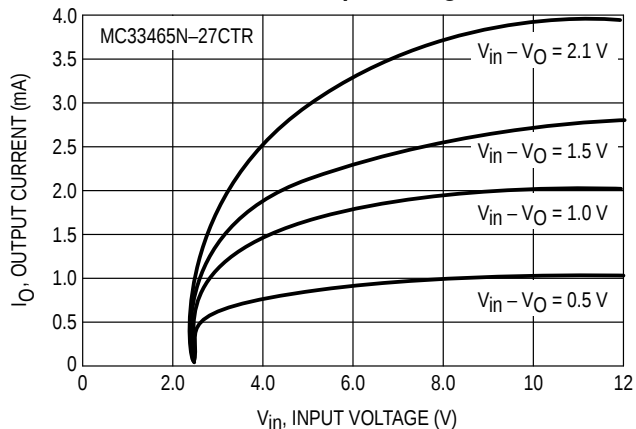


Figure 7.  $C_D$  Sink Current versus Input Voltage

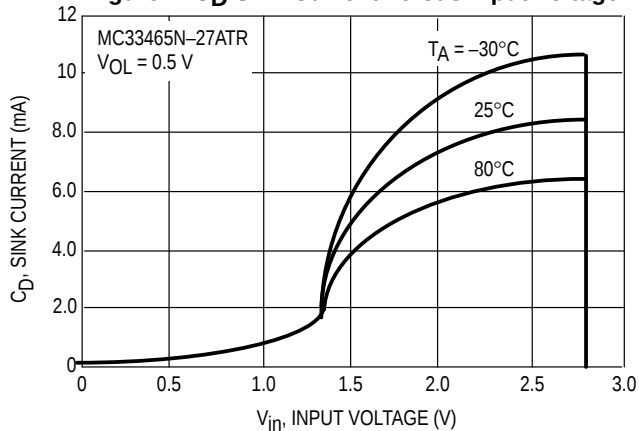


Figure 8.  $C_D$  Sink Current versus  $C_D$  Voltage

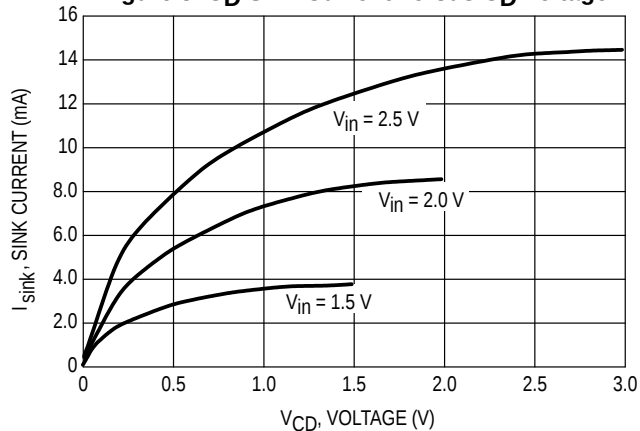


Figure 9. Delay Resistance versus Temperature

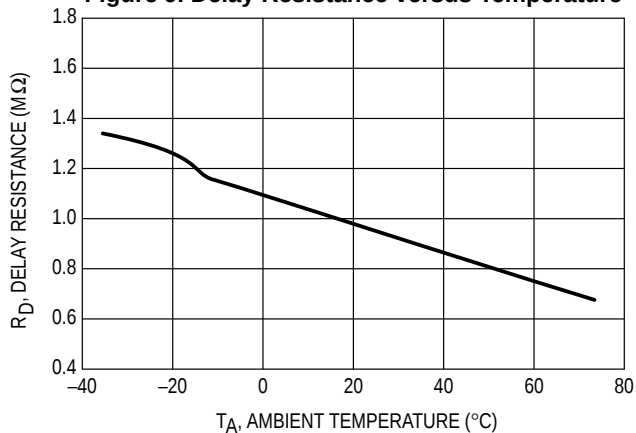


Figure 10. Detector Threshold versus Temperature

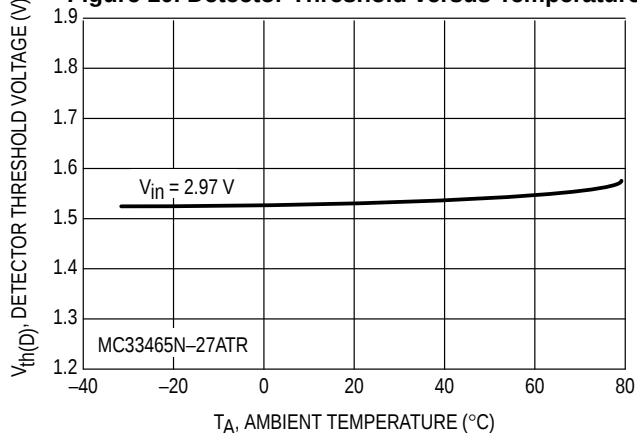


Figure 11. Output Delay Time versus Delay Capacitance

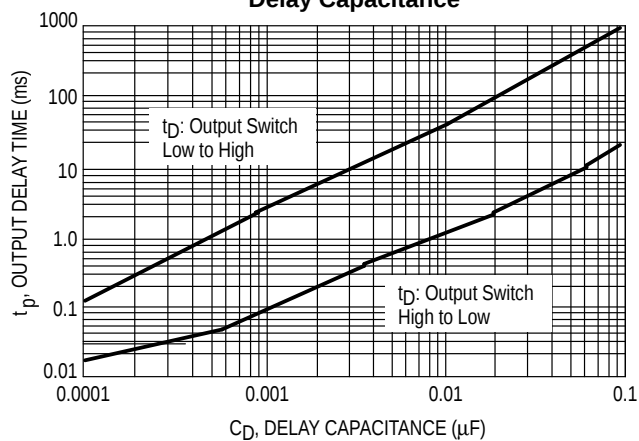


Figure 12. Typical Open Drain Application

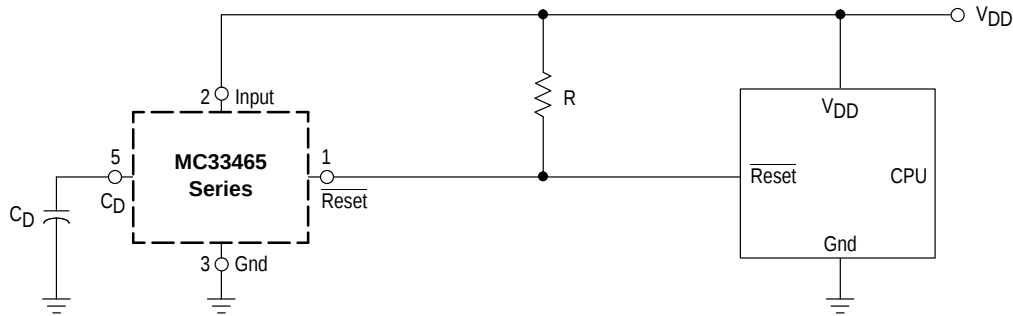
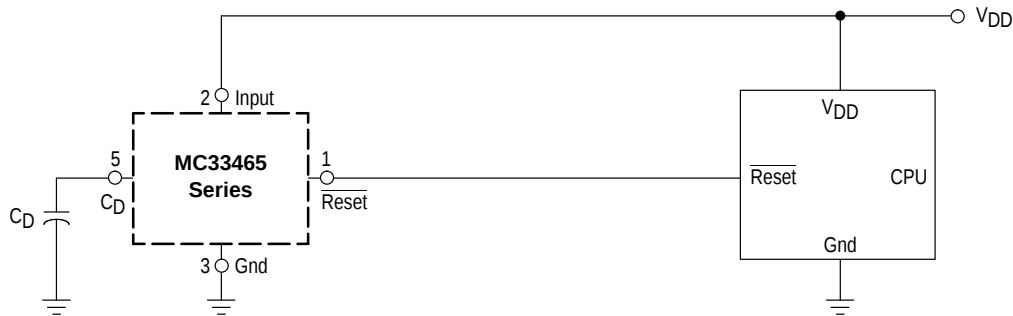


Figure 13. Typical Complementary Output Application

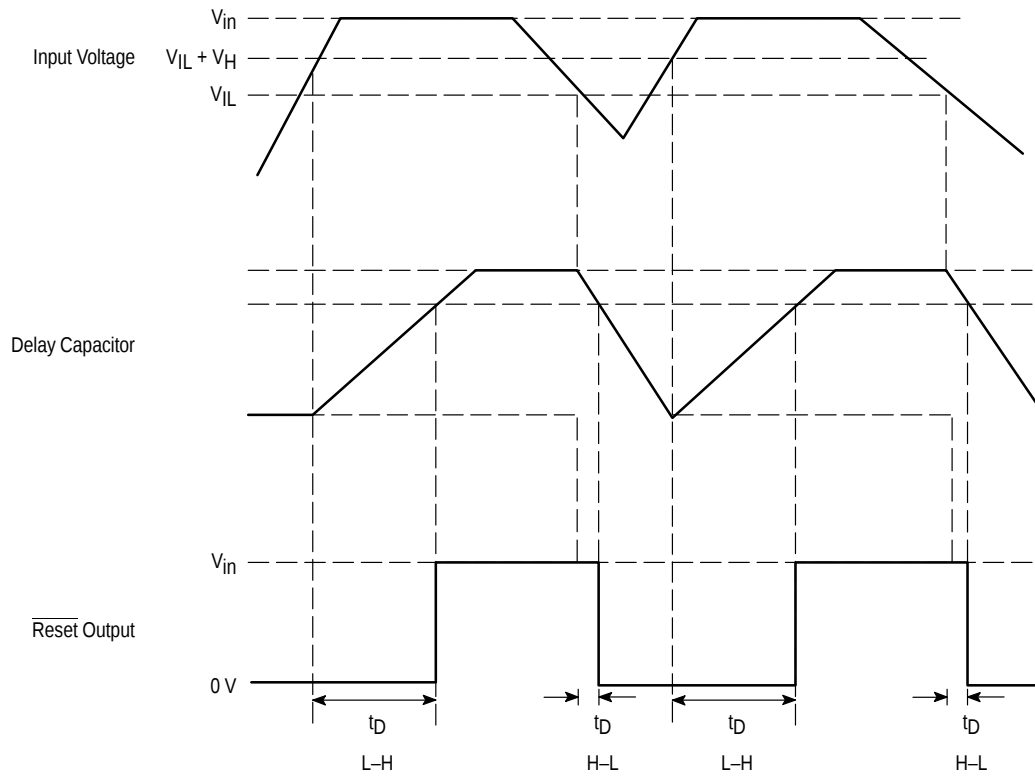


### APPLICATION CIRCUIT INFORMATION

The MC33465 series are micropower undervoltage sensing circuits which offer a programmable time delayed output with the choice of either complementary output drive or open drain output configurations. Figure 14 shows the timing relationships between the input voltage and the resulting circuit waveforms. When the input voltage ( $V_{IN}$ ) exceeds the sense comparator threshold, the timing capacitor is allowed to charge through the internal delay resistor. When the output inverting driver threshold is exceeded, the  $\overline{\text{Reset}}$  output switches from a logic "0" to a

logic "1". The top curve of Figure 11 provides the nominal delay time for a given value of delay capacitance. When  $V_{IN}$  drops below the comparator threshold minus hysteresis voltage, the delay capacitor discharges. When the capacitance voltage drops below the inverting driver threshold, the output switches from a logic "1" to a logic "0". The bottom curve in Figure 11 provides typical delay time for given delay capacitance values. The inverting driver threshold voltage is typically about  $V_{IN}/2$ , as shown in Figure 10.

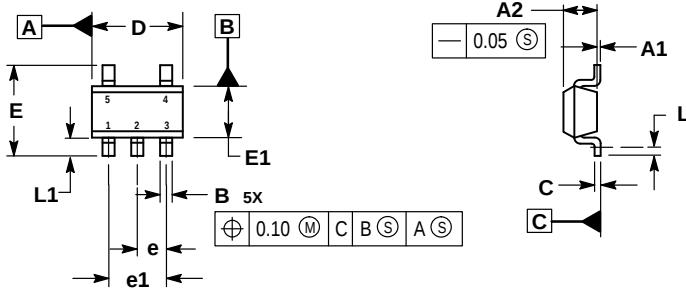
Figure 14. Timing Waveforms



# MC33465

## OUTLINE DIMENSIONS

**N SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 1212-01**  
**(SOT-23)**  
**ISSUE O**

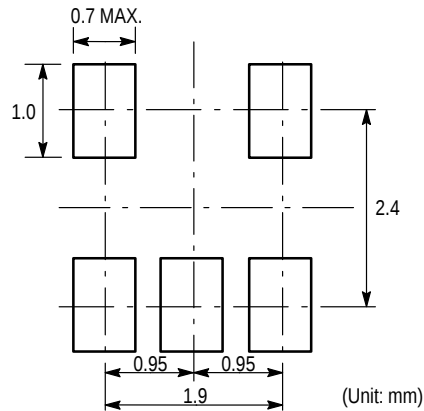


### NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM C IS A SEATING PLANE.

| DIM | MIN      | MAX  |
|-----|----------|------|
| A1  | 0.00     | 0.10 |
| A2  | 1.00     | 1.30 |
| B   | 0.30     | 0.50 |
| C   | 0.10     | 0.25 |
| D   | 2.80     | 3.00 |
| E   | 2.50     | 3.10 |
| E1  | 1.50     | 1.80 |
| e   | 0.95 BSC |      |
| e1  | 1.90 BSC |      |
| L   | 0.20     | —    |
| L1  | 0.45     | 0.75 |

## Recommended Footprint for Surface Mount Applications



### SOT-23-5

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