# ±70V 总线故障保护、3V 至 5.5V RS-485 收发器

**UM3783S8 *SOP8***
**UM3783M8 *MSOP8***

## 1 描述

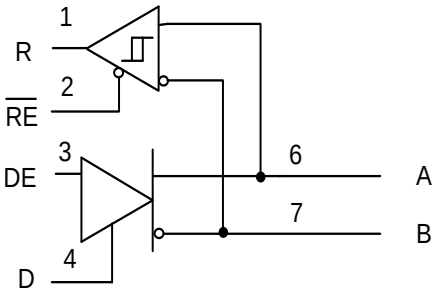
UM3783 是一款±70V 总线故障保护、半双工、RS-485 收发器，由 3V 至 5.5V 的单电源供电。在所有运行模式下均可保护总线接口引脚不受过压条件破坏，可确保在恶劣的工业环境中实现稳定可靠的通信。

在更长的电缆敷设长度和/或存在大接地环路电压的情况下，扩展 ±25V 输入共模范围可保证数据通信稳定可靠。增强型 250mV 接收器迟滞可确保实现高噪声抑制。此外，当输入同时开路或短路时，接收器失效防护功能可保证处于逻辑高电平。

UM3783 系列采用 SOP8 和 MSOP8 封装，适用于空间受限的应用。该器件的工作环境温度范围为-40°C 至 125°C。

## 2 应用

- 电机驱动
- 工厂自动化和控制
- HVAC 系统
- 楼宇自动化
- 电网基础设施
- 电表
- 过程分析
- 视频监控




UM3783 简化版原理图

## 3 特性

- 符合或超过 TIA/EIA-485A 标准的要求
- 3V 至 5.5V 电源电压
- 差分输出超过 2.1V，在 5V 电源下与 PROFIBUS 兼容
- 总线 I/O 保护
  - ±70V 直流总线故障保护
  - ±18kV 人体放电模型
  - ±9kV IEC 61000-4-2 接触放电
- 闩锁（Latch-up）性能超过 800mA，符合 JESD 78 规范
- 速率为 500 kbps 的半双工设备
- 工作环境温度范围：-40°C to 125°C
- 拓展级运行共模范围：±25 V
- 开路、短路和空闲总线失效防护
- 热关断
- 1/8 单位负载（多达 256 个总线节点）
- 小型 SOP8 和 MSOP8 封装

## 4 Ordering Information

| Part Number | Mark Code | Package Type | Shipping Qty |
|---|---|---|---|
| UM3783S8 | UM3783S8 | SOP8 | 3000pcs/13Inch Tape & Reel |
| UM3783M8 | 3783 | MSOP8 | 4000pcs/13Inch Tape & Reel |

## 5 Pin Configuration and Function

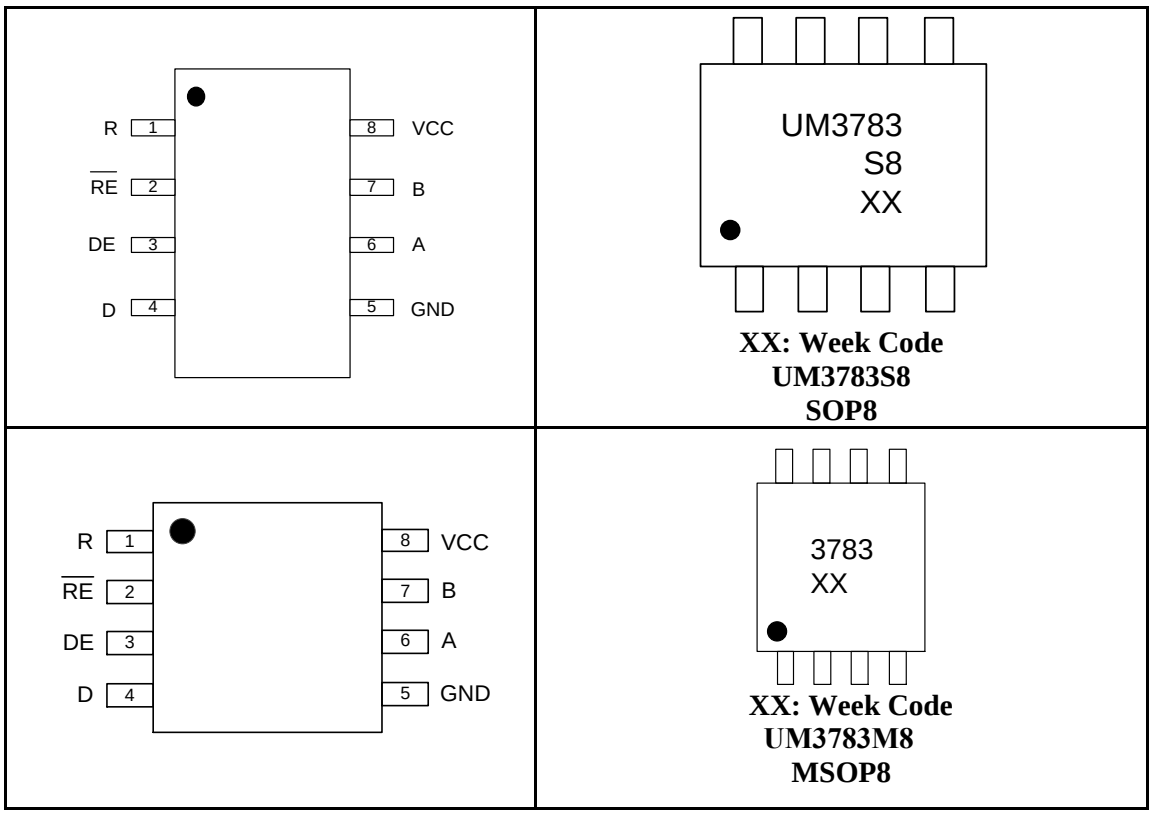



Table 5-1. Pin Functions

| Pin No. | Pin Name | Function |
|---|---|---|
| 1 | R | Receive data output |
| 2 | $\overline{RE}$ | Receiver enable, active low; integrated pull-up |
| 3 | DE | Driver enable, active high; integrated pull-down |
| 4 | D | Driver data input; integrated pull-up |
| 5 | GND | Local device ground |
| 6 | A | Driver output or receiver input (complementary to B) |
| 7 | B | Driver output or receiver input (complementary to A) |
| 8 | VCC | Supply voltage |

## 6 Specifications

### 6.1 Recommended Operating Conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 3 | | 5.5 | V |
| $V_I$ | Input voltage at any bus terminal (separately or common mode) | Note 1 | -25 | | 25 | V |
| $V_{ID}$ | Differential input voltage | | -25 | | 25 | V |
| $V_{ESD}$ | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 | Bus terminals and GND | | ±18 | | kV |
| | | All pins except bus terminals and GND | | ±8 | | kV |
| | Contact discharge, per IEC 61000-4-2 | Bus terminals and GND | | ±9 | | kV |
| $I_O$ | Output current, driver | | -60 | | 60 | mA |
| $I_{OR}$ | Output current, receiver | | -8 | | 8 | mA |
| $R_L$ | Differential load resistance | | 54 | 60 | | Ω |
| $1/ t_{UI}$ | Signaling rate | | | | 500 | kbps |
| $T_A$ | Operating free-air temperature (see application section for thermal information) | | -40 | | 125 | ℃ |
| $T_J$ | Junction temperature | | -40 | | 150 | ℃ |

Note 1: The algebraic convention, in which the least positive (most negative) limit is designated as minimum is used in this data sheet.

### 6.2 Absolute Maximum Ratings (Note 1)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | -0.5 | | 6.5 | V |
| $V_I$ | Voltage on A, B pins | | -70 | | 70 | V |
| | Voltage on any logic pins (D, DE , $\overline{RE}$) | | -0.3 | | 5.7 | V |
| $I_O$ | RXD output current | | -24 | | 24 | mA |
| $T_{STG}$ | Storage temperature | | -65 | | 150 | ℃ |
| $T_L$ | Lead Temperature for Soldering 10 Seconds | | | | 260 | ℃ |

Note 1: Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If briefly operating outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not sustain damage, but it may not be fully functional. Operating the device in this manner may affect device reliability, functionality, performance, and shorten the device lifetime.

### 6.3 Electrical Characteristics (Static)

over operating free-air temperature range (unless otherwise noted). All typical values are at 25°C and supply voltage of $V_{CC}$= 5 V.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Supply** | | | | | | |
| $I_{CC}$ | Supply current | $\overline{RE}$ = 0 V, DE = $V_{CC}$, No load ( Driver and receiver enabled ) | | 3.0 | 5.6 | mA |
| | | $\overline{RE}$= $V_{CC}$, DE = $V_{CC}$, No load (Driver enabled, receiver disabled ) | | 3.0 | 5.6 | mA |
| | | $\overline{RE}$ = 0 V, DE = 0 V, No load (Driver disabled, receiver enabled ) | | 1.5 | 2.4 | mA |
| | | $\overline{RE}$ = $V_{CC}$, DE = 0 V, D = open, No load (Driver and receiver disabled ) | | 0.5 | 2 | μA |
| **Driver** | | | | | | |
| $\|V_{OD}\|$ | Driver differential output voltage magnitude | $R_L$ = 60 Ω, −25 V ≤ $V_{TEST}$ ≤ 25 V, See Figure 7-1 | 1.5 | 3 | | V |
| | | $R_L$ = 60 Ω, −25 V ≤ $V_{TEST}$ ≤ 25V, 4.5 V ≤ $V_{CC}$ ≤ 5.5 V, See Figure 7-1 | 2.1 | 3 | | V |
| | | $R_L$ = 100 Ω, See Figure 7-2 | 2 | 3.8 | | V |
| | | $R_L$ = 54 Ω, See Figure 7-2 | 1.5 | 3 | | V |
| $\Delta\|V_{OD}\|$ | Change in magnitude of driver differential output voltage | $R_L$= 54 Ω or 100 Ω See Figure 7-2 | -150 | | 150 | mV |
| $V_{OC}$ | Common-mode output voltage | $R_L$= 54 Ω or 100 Ω See Figure 7-2 | 1 | $V_{CC}$/2 | 3 | V |
| $\Delta V_{OC(SS)}$ | Steady-state common-mode output voltage | $R_L$= 54 Ω or 100 Ω See Figure 7-2 | -100 | | 100 | mV |
| $I_{OS}$ | Short-circuit output current | DE = $V_{CC}$, -70V ≤ ($V_A$ or $V_B$) ≤ 70V | -250 | | 250 | mA |

**6.3 Electrical Characteristics (Static)---continued (Note 1)**

over operating free-air temperature range (unless otherwise noted). All typical values are at 25°C and supply voltage of $V_{CC}$= 5 V.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Receiver** | | | | | | |
| $I_I$ | Bus input current | DE = 0V, $V_{CC}$ = 0V or 5.5V, $V_I$ =12V | | 50 | 125 | μA |
| | | DE = 0V, $V_{CC}$ = 0V or 5.5V, $V_I$ = 25V | | 125 | 250 | |
| | | DE = 0V, $V_{CC}$ = 0V or 5.5V, $V_I$ =-7V | -100 | -50 | | |
| | | DE = 0V, $V_{CC}$ = 0V or 5.5V, $V_I$ =-25V | -250 | -140 | | |
| $V_{TH+}$ | Positive-going input threshold voltage | Over common-mode range of ±25 V | 40 | 125 | 200 | mV |
| $V_{TH-}$ | Negative-going input threshold voltage | | -200 | -125 | -40 | |
| $V_{HYS}$ | Input hysteresis | | | 250 | | |
| $V_{TH\_FSH}$ | Input fail-safe threshold | | -40 | | 40 | |
| $C_{A,B}$ | Input differential capacitance | Measured between A and B, f = 1 MHz | | 50 | | pF |
| $V_{OH}$ | Output high voltage | $I_{OH}$ = –8 mA | $V_{CC}$-0.4 | $V_{CC}$-0.2 | | V |
| $V_{OL}$ | Output low voltage | $I_{OL}$ = 8 mA | | 0.2 | 0.4 | V |
| $I_{OZ}$ | Output high-impedance current | $V_O$ = 0 V or $V_{CC}$, $\overline{RE}$ = $V_{CC}$ | -1 | | 1 | μA |
| **Logic** | | | | | | |
| $V_{IH}$ | Input High Voltage | DE, DI , $\overline{RE}$ | 2 | | | V |
| $V_{IL}$ | Input low Voltage | DE, DI , $\overline{RE}$ | | | 0.8 | V |
| $I_I$ | Input current on DE pin | 3 V ≤ $V_{CC}$ ≤ 5.5 V, 0 V ≤ $V_{IN}$ ≤ $V_{CC}$ V | | | 5 | μA |
| | Input current on D, $\overline{RE}$ pin | 3 V ≤ $V_{CC}$ ≤ 5.5 V, 0 V ≤ $V_{IN}$ ≤ $V_{CC}$ V | -5 | | | μA |
| **Thermal Protection** | | | | | | |
| $T_{SD}$ | Thermal shutdown threshold | Temperature rising | 150 | 170 | | ℃ |
| $T_{HYS}$ | Thermal shutdown hysteresis | | | 10 | | ℃ |

### 6.4 Electrical Characteristics (Dynamic) (Note 1)

over recommended operating conditions. All typical values are at 25°C and supply voltage of $V_{CC}$=5V.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Driver** | | | | | | |
| $t_R$, $t_F$ | Driver differential output rise/fall time | $R_L$ = 54 Ω, $C_L$ = 50 pF, see Figure 7-3 | 240 | 420 | 600 | ns |
| $t_{PHL}$, $t_{PLH}$ | Driver propagation delay time | | | 275 | 350 | ns |
| $t_{SK(P)}$ | Driver differential output pulse skew, $\|t_{PHL} - t_{PLH}\|$ | | | | 10 | ns |
| $t_{PHZ}$, $t_{PLZ}$ | Disable time | See Figure 7-4 and Figure 7-5 | | 80 | 200 | ns |
| $t_{PZH}$, $t_{PZL}$ | Enable time | $\overline{RE}$ = 0 V, See Figure 7-4 and Figure 7-5 | | 200 | 270 | ns |
| | | $\overline{RE}$ = $V_{CC}$, See Figure 7-4 and Figure 7-5 | | 2 | 4 | μs |
| $t_{SD}$ | Time to shutdown | $\overline{RE}$ = $V_{CC}$, See Figure 7-4 and Figure 7-5 | 50 | | 500 | ns |
| **Receiver** | | | | | | |
| $t_R$, $t_F$ | Receiver output rise/fall time | $C_L$ = 15 pF, see Figure 7-6 | | 13 | 20 | ns |
| $t_{PHL}$, $t_{PLH}$ | Receiver propagation delay time | | | 50 | 80 | ns |
| $t_{SK(P)}$ | Receiver output pulse skew,$\|t_{PHL} - t_{PLH}\|$ | | | | 7 | ns |
| $t_{PHZ}$, $t_{PLZ}$ | Receiver disable time | | | 30 | 40 | ns |
| $t_{PZL(1)}$, $t_{PZH(1)}$ | Receiver enable time | DE = $V_{CC}$, see Figure 7-7 | | 40 | 120 | ns |
| $t_{PZL(2)}$, $t_{PZH(2)}$ | | DE = 0 V, see Figure 7-8 | | 2 | 4 | μs |
| $t_{D(OFS)}$ | Delay to enter fail-safe operation | $C_L$ = 15 pF, see Figure 7-9 | | 13 | 18 | μs |
| $t_{D(FSO)}$ | Delay to exit fail-safe operation | | | 35 | 60 | ns |
| $t_{SD}$ | Time to shutdown | DE = 0 V, see Figure 7-8 | 50 | | 500 | ns |

## 7 Parameter Measurement Information

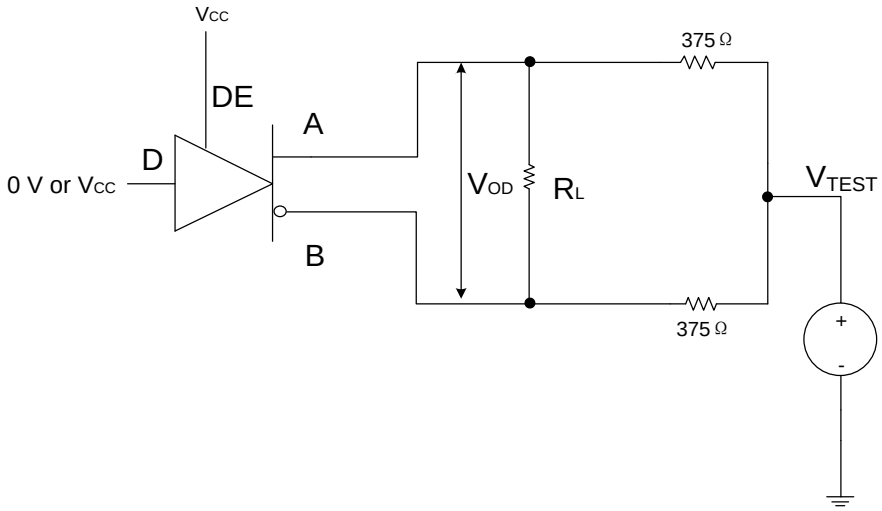



Figure 7-1. Measurement of Driver Differential Output Voltage With Common-Mode Load

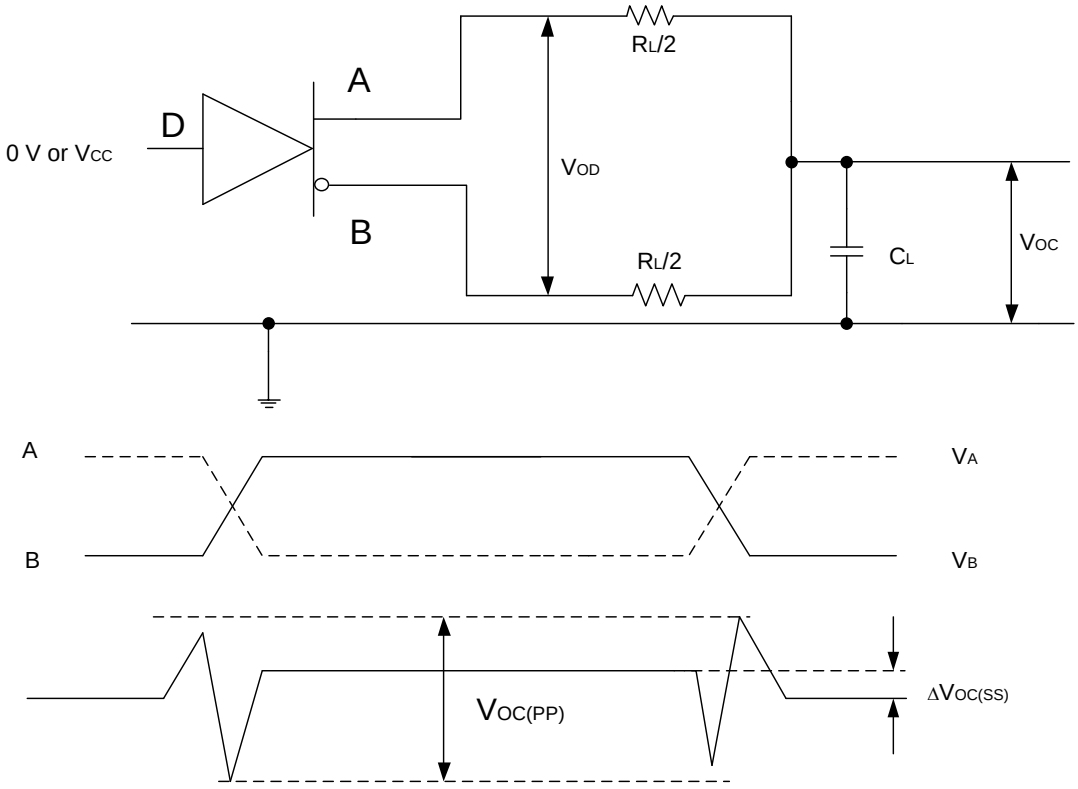



Figure 7-2. Measurement of Driver Differential and Common-Mode Output With RS-485 Load

## 7 Parameter Measurement Information (continued)

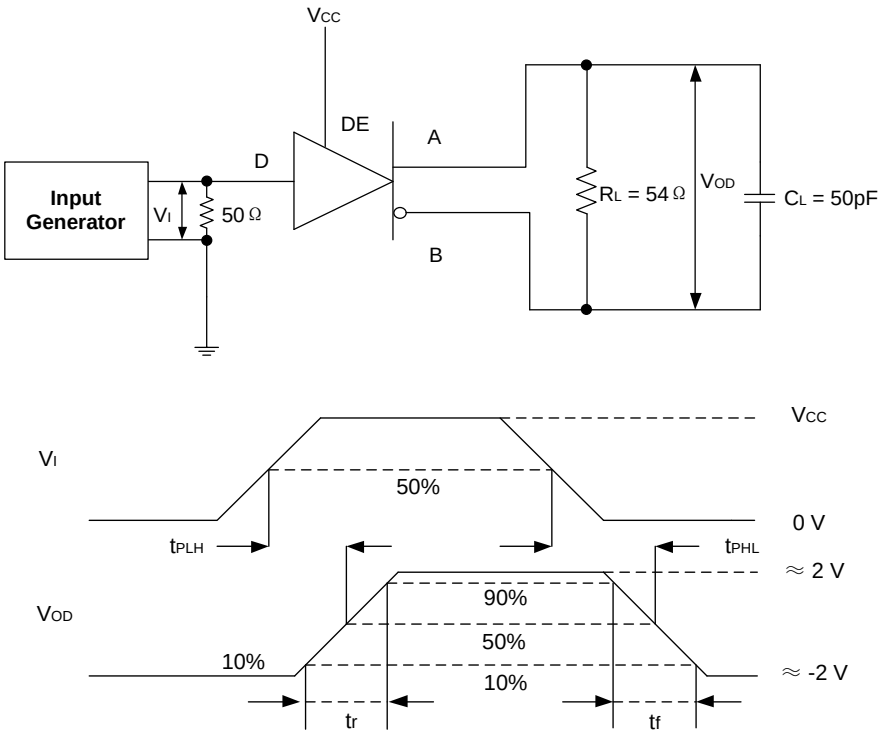



Figure 7-3. Measurement of Driver Differential Output Rise and Fall Times and Propagation Delays

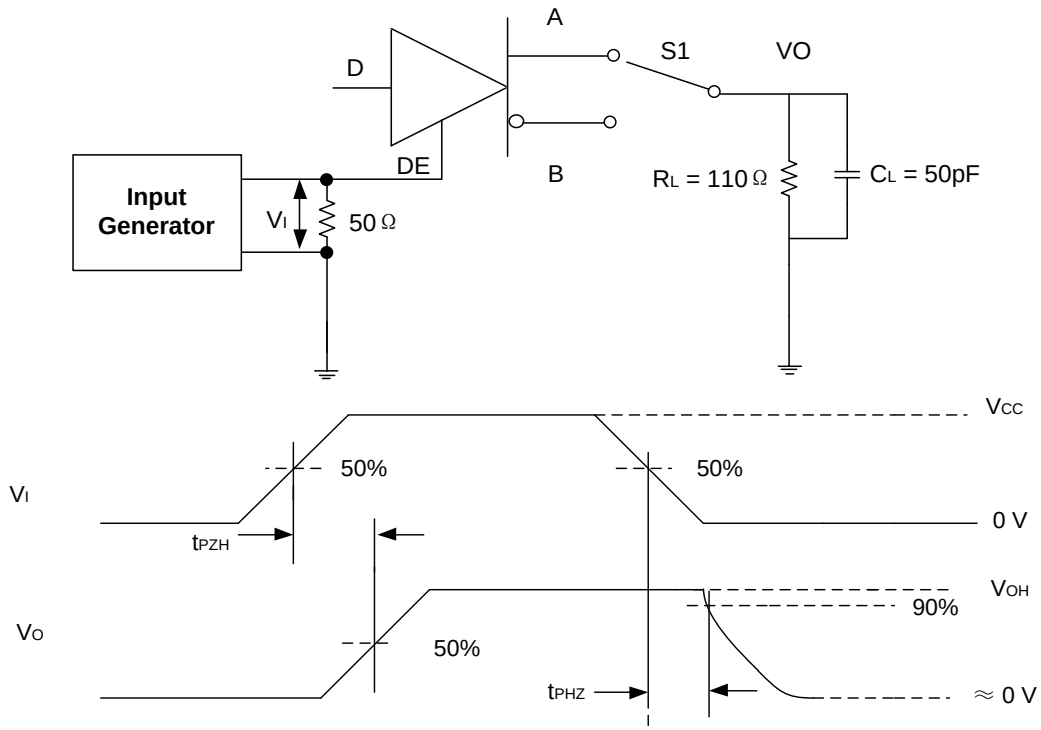



Figure 7-4. Measurement of Driver Enable and Disable Times With Active High Output and Pull-Down Load

## 7 Parameter Measurement Information (continued)

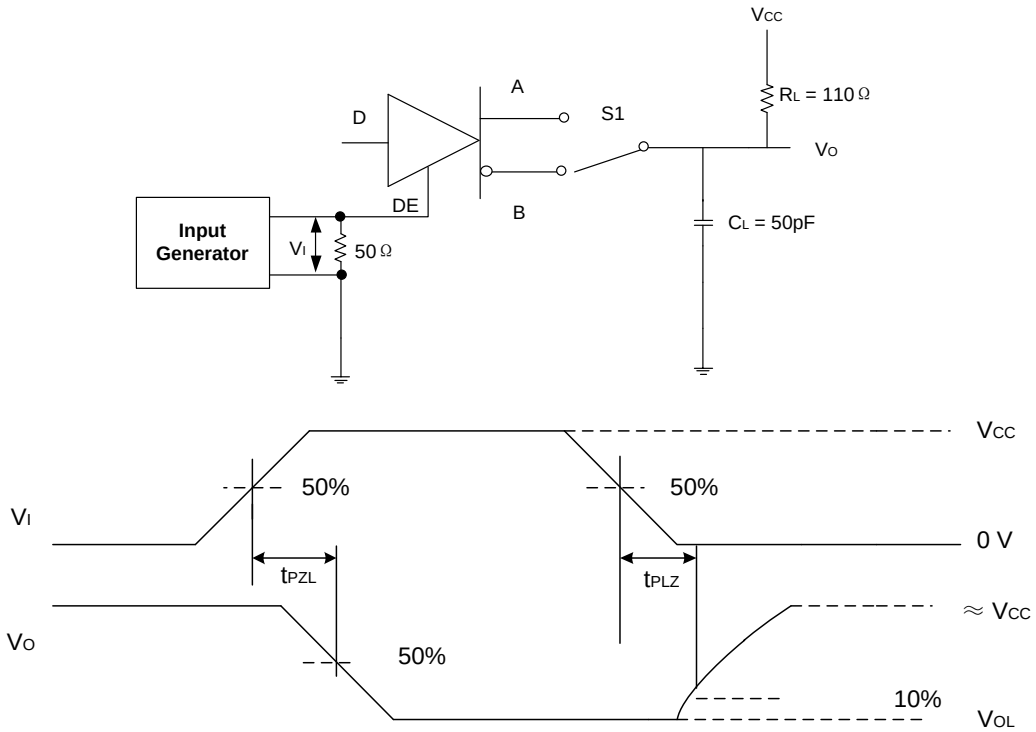



Figure 7-5. Measurement of Driver Enable and Disable Times With Active Low Output and Pull-up Load

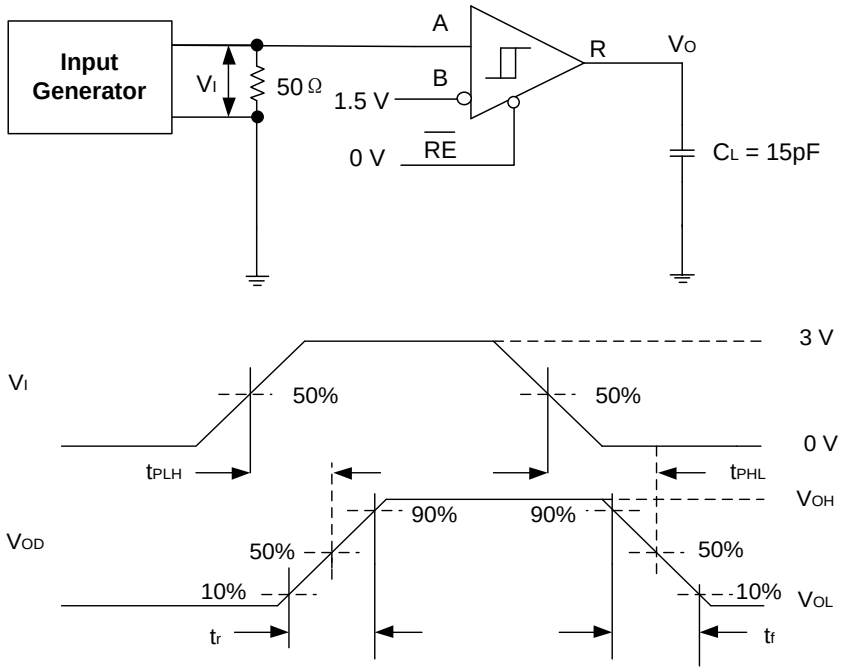



Figure 7-6. Measurement of Receiver Output Rise and Fall Times and Propagation Delays

## 7 Parameter Measurement Information (continued)

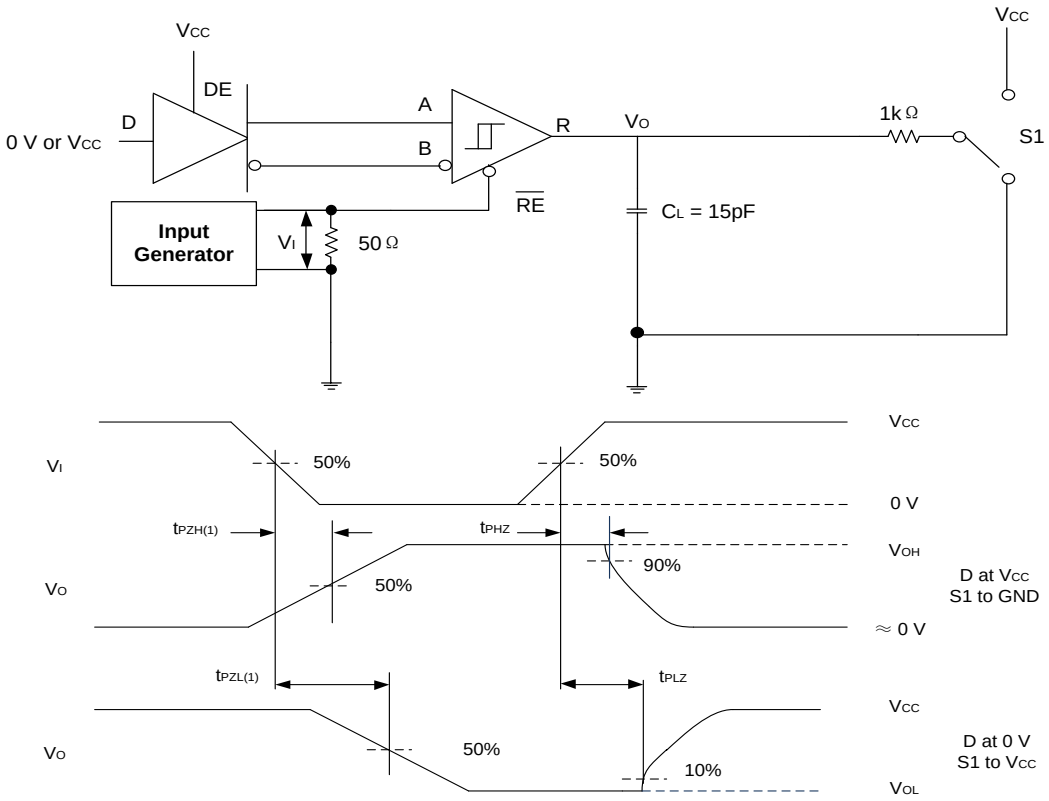



Figure 7-7. Measurement of Receiver Enable/Disable Times With Driver Enabled

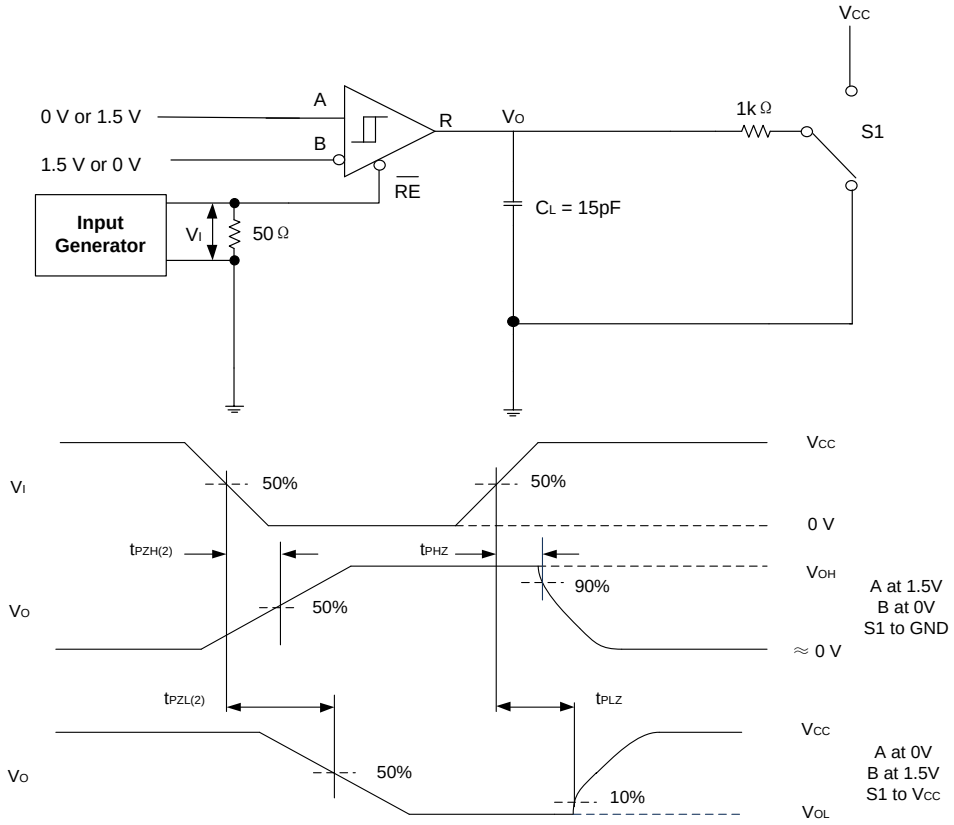



Figure 7-8. Measurement of Receiver Enable Times With Driver Disabled

## 7 Parameter Measurement Information(continued)

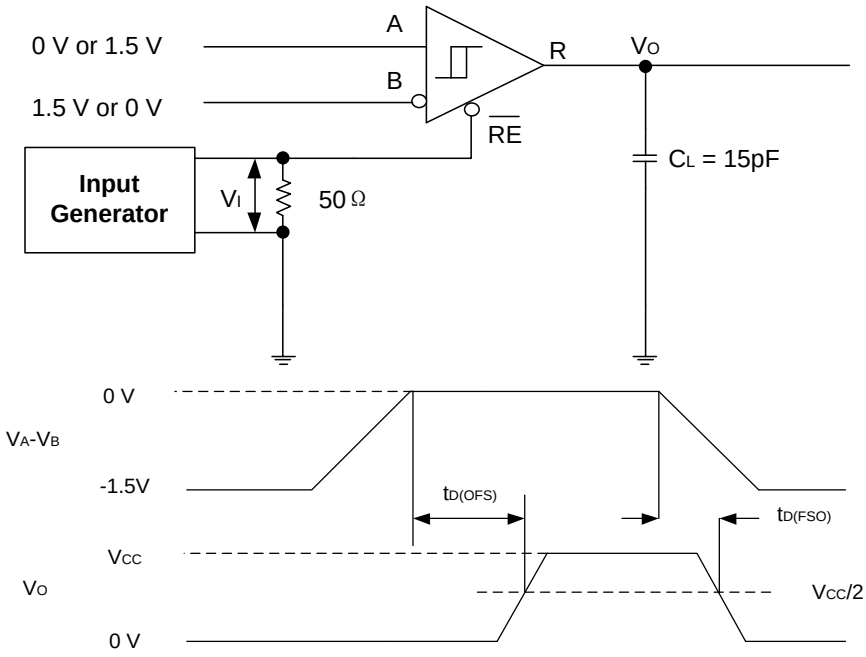



Figure 7-9. Measurement of Fail-Safe Delay

## 8 Detailed Description

### 8.1 Overview

The UM3783 is fault-protected, half duplex RS-485 transceivers available in speed grade suitable for data transmission up to 500 kbps. The device has active-high driver enables and active-low receiver enables. A shutdown current of less than 1 μA can be achieved by disabling both driver and receiver.

### 8.2 Functional Block Diagram

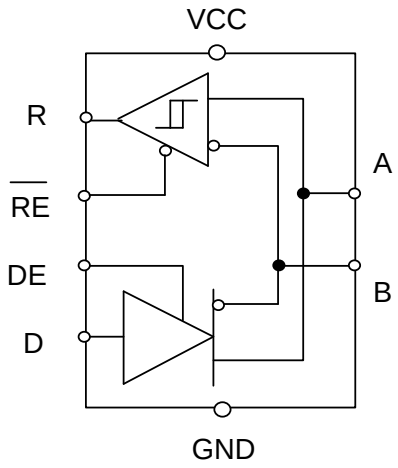



Figure 8-1. UM3783 Block Diagram

## 9 Feature Description

### 9.1 ±70V Fault Protection

The UM3783 has extended bus fault protection compared to standard RS-485 devices. Transceivers that operate in rugged industrial environments are often exposed to voltage transients greater than the -7 V to +12 V defined by the TIA/EIA-485A standard. To protect against such conditions, the generic RS-485 devices with lower absolute maximum ratings requires expensive external protection components. To simplify system design and reduce overall system cost, the UM3783 is protected up to ±70 V without the need for any external components.

### 9.2 Driver Overvoltage and Overcurrent Protection

The UM3783's drivers are protected against any DC supply shorts in the range of -70 V to +70 V. The device internally limits the short circuit current to ±250 mA in order to comply with the TIA/EIA-485A standard. In addition, a fold-back current limiting circuit further reduces the driver short circuit current to less than ±25 mA if the output fault voltage exceeds |±25 V|.

The device features thermal shutdown protection that disables the driver and the receiver if the junction temperature exceeds the $T_{SHDN}$ threshold due to excessive power dissipation.

### 9.3 Receiver Fail-Safe Operation

The receivers are fail-safe to invalid bus states caused by the following:

- Open bus conditions, such as a disconnected connector
- Shorted bus conditions, such as cable damage shorting the twisted-pair together
- Idle bus conditions that occur when no driver on the bus is actively driving

In any of these cases, the receiver outputs a fail-safe logic high state if the input amplitude stays for longer than $t_{D(OFS)}$ at less than $|V_{TH\_FSH}|$.

### 9.4 Low-Power Shutdown Mode

Driving DE low and $\overline{RE}$ high for longer than 500 ns puts the devices into the shutdown mode. If either DE goes high or $\overline{RE}$ goes low, the counters reset. The device does not enter the shutdown mode if the enable pins are in disable state for less than 50 ns. This feature prevents the devices from accidentally going into shutdown mode due to skew between DE and $\overline{RE}$.

### 9.5 Device Functional Modes

When the driver enable pin, DE, is logic high, the differential outputs A and B follow the logic states at data input D. A logic high at D causes A to turn high and B to turn low. In this case, the differential output voltage defined as $V_{OD} = V_A - V_B$ is positive. When D is low, the output states reverse: B turns high, A becomes low, and $V_{OD}$ is negative.

When DE is low, both outputs turn high-impedance. In this condition, the logic state at D is irrelevant. The DE pin has an internal pull-down resistor to ground, thus when left open the driver is disabled (high-impedance) by default. The D pin has an internal pull-up resistor to $V_{CC}$, thus, when left open while the driver is enabled, output A turns high and B turns low.

## 9.5 Device Functional Modes (continued)

Table 9-1. Driver Function Table

| INPUT | ENABLE | OUTPUTS | | FUNCTION |
|---|---|---|---|---|
| D | DE | A | B | |
| H | H | H | L | Actively drive bus high |
| L | H | L | H | Actively drive bus low |
| X | L | Z | Z | Driver disabled |
| X | OPEN | Z | Z | Driver disabled by default |
| OPEN | H | H | L | Actively drive bus high by default |

When the receiver enable pin, $\overline{RE}$, is logic low, the receiver is enabled. When the differential input voltage defined as $V_{ID} = V_A - V_B$ is higher than the positive input threshold, $V_{TH+}$, the receiver output, R, turns high. When $V_{ID}$ is lower than the negative input threshold, $V_{TH-}$, the receiver output, R, turns low. If $V_{ID}$ is between $V_{TH+}$ and $V_{TH-}$, the output is indeterminate.

When $\overline{RE}$ is logic high or left open, the receiver output is high-impedance and the magnitude and polarity of $V_{ID}$ are irrelevant. Internal biasing of the receiver inputs causes the output to go failsafe-high when the transceiver is disconnected from the bus (open-circuit), or he bus lines are shorted to one another (short-circuit), or the bus is not actively driven (idle bus).

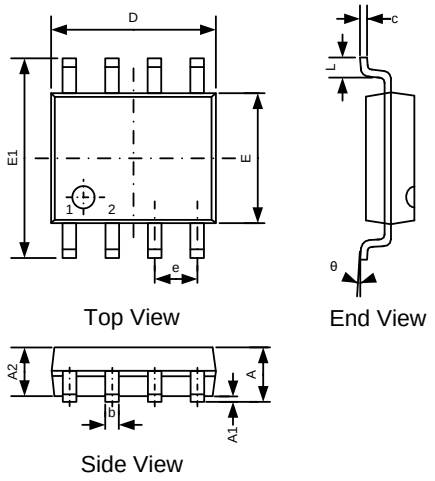
Table 9-2. Driver Function Table

| DIFFERENTIAL INPUT | ENABLE | OUTPUTS | FUNCTION |
|---|---|---|---|
| $V_{ID} = V_A - V_B$ | $\overline{RE}$ | R | |
| $V_{TH+} < V_{ID}$ | L | H | Receive valid bus high |
| $V_{TH-} < V_{ID} < V_{TH+}$ | L | N/A | Indeterminate bus state |
| $V_{ID} < V_{TH-}$ | L | L | Receive valid bus low |
| X | H | Z | Receiver disabled |
| X | OPEN | Z | Receiver disabled by default |
| Open-circuit bus | L | H | Fail-safe high output |
| Short-circuit bus | L | H | Fail-safe high output |
| Idle (terminated) bus | L | H | Fail-safe high output |

## Package Information

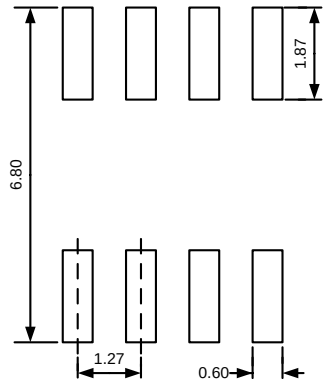
### SOP8

**Outline Drawing**




| DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | MILLIMETERS | | | INCHES | | |
| | Min | Typ | Max | Min | Typ | Max |
| A | 1.35 | 1.55 | 1.75 | 0.053 | 0.061 | 0.069 |
| A1 | 0.10 | - | 0.25 | 0.004 | - | 0.010 |
| A2 | 1.25 | - | 1.65 | 0.049 | - | 0.065 |
| b | 0.30 | - | 0.51 | 0.012 | - | 0.020 |
| c | 0.15 | - | 0.25 | 0.006 | - | 0.010 |
| D | 4.70 | 4.90 | 5.10 | 0.185 | 0.193 | 0.200 |
| E | 3.80 | 3.90 | 4.00 | 0.150 | 0.154 | 0.157 |
| E1 | 5.80 | 6.00 | 6.20 | 0.228 | 0.236 | 0.244 |
| e | 1.27BSC | | | 0.050 BSC | | |
| L | 0.40 | - | 1.27 | 0.016 | - | 0.050 |
| θ | 0 ° | - | 8 ° | 0 ° | - | 8 ° |

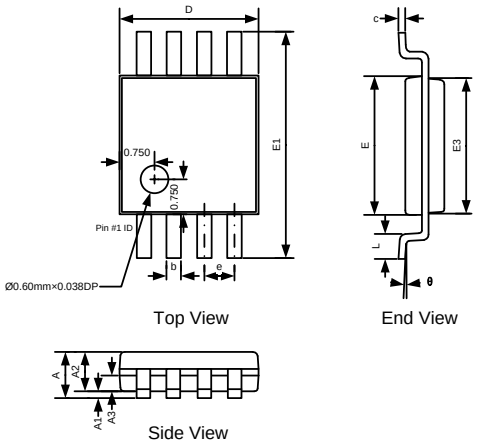
**Land Pattern**




NOTES:
1. Compound dimension: 4.90×3.90;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

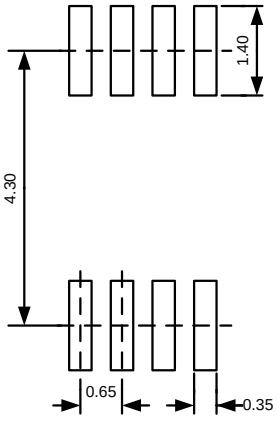
# MSOP8

## Outline Drawing



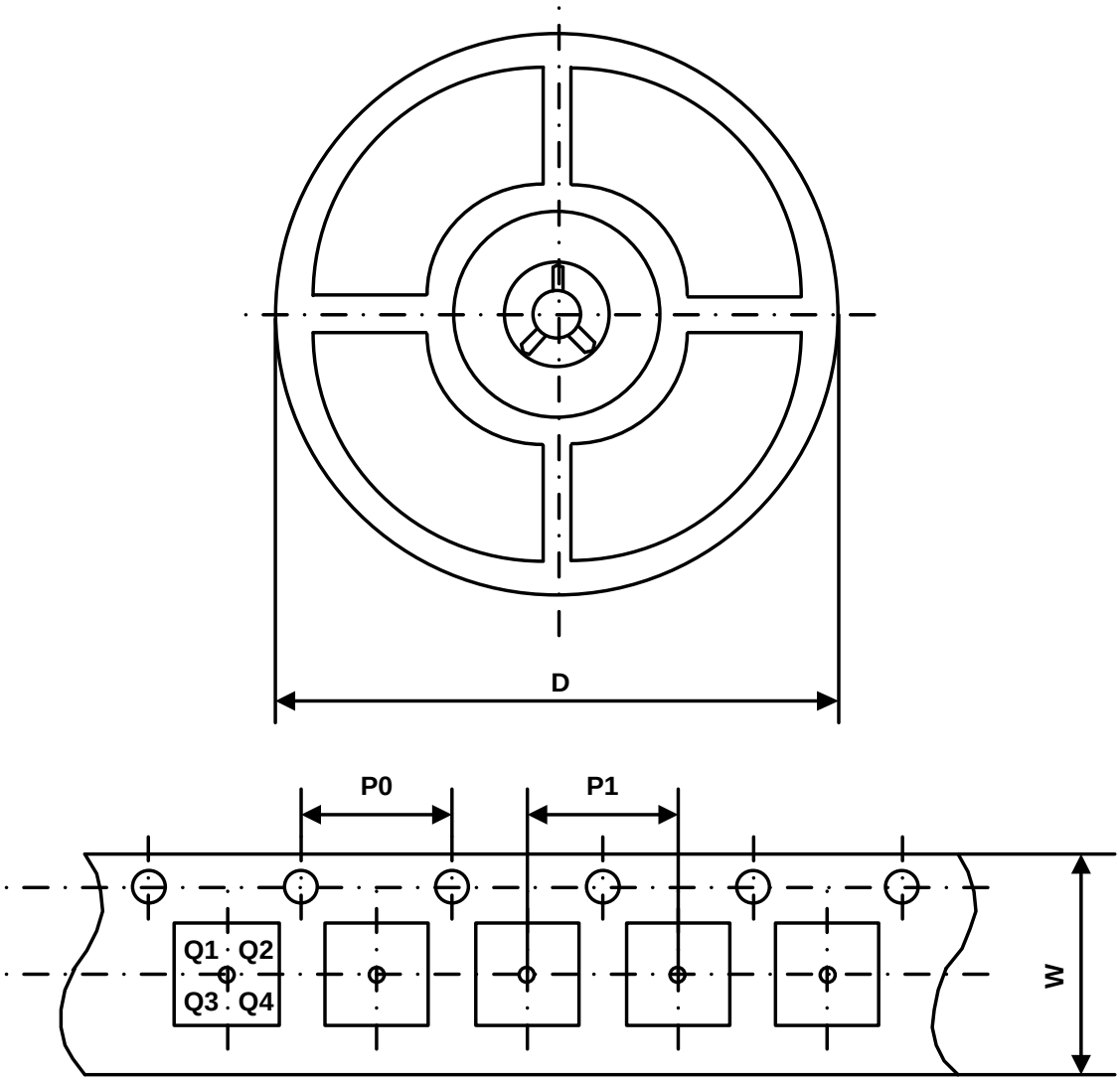

| DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | MILLIMETERS | | | INCHES | | |
| | Min | Typ | Max | Min | Typ | Max |
| A | - | - | 1.10 | - | - | 0.043 |
| A1 | 0.02 | - | 0.15 | 0.0008 | - | 0.006 |
| A2 | 0.75 | 0.86 | 0.95 | 0.030 | 0.034 | 0.037 |
| A3 | 0.29 | 0.39 | 0.49 | 0.011 | 0.015 | 0.019 |
| b | 0.22 | - | 0.38 | 0.009 | - | 0.015 |
| c | 0.08 | 0.15 | 0.23 | 0.003 | 0.006 | 0.009 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E1 | 4.70 | 4.90 | 5.10 | 0.185 | 0.193 | 0.201 |
| E3 | 2.85 | 2.95 | 3.05 | 0.112 | 0.116 | 0.120 |
| e | 0.65BSC | | | 0.026BSC | | |
| L | 0.40 | 0.60 | 0.80 | 0.016 | 0.024 | 0.031 |
| θ | 0° | - | 8° | 0° | - | 8° |

## Land Pattern




NOTES:
1. Compound dimension: 3.00×3.00;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

## Packing Information




| Part Number | Package Type | Carrier Width (W) | Pitch (P0) | Pitch (P1) | Reel Size (D) | PIN 1 Quadrant |
|---|---|---|---|---|---|---|
| UM3783S8 | SOP8 | 12 mm | 4 mm | 8 mm | 330 mm | Q1 |
| UM3783M8 | MSOP8 | 12 mm | 4 mm | 8 mm | 330 mm | Q1 |

## GREEN COMPLIANCE

Union Semiconductor is committed to environmental excellence in all aspects of its operations including meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.
All Union components are compliant with the RoHS directive, which helps to support customers in their compliance with environmental directives. For more green compliance information, please visit:
http://www.union-ic.com/index.aspx?cat_code=RoHSDeclaration

## IMPORTANT NOTICE

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