±15kV ESD保护、限摆率、失效保护 真RS-485收发器

UM3352E SOP8/DIP8

描述

UM3352E系列是具有±15kV ESD保护、支持RS-485半双工通信包含一个驱动器和一个接收器的高速收发器。这些器件具有失效保护电路，可在接收器输入开路、短路或闲置时确保接收器输出为逻辑高电平。这意味着如果端接总线上的所有发射器都被禁用（高阻抗），接收器输出将为逻辑高电平。UM3352E具有低摆率驱动器，可充分降低EMI并减少因电缆端接不当引起的反射，从而实现高达500kbps的无误差数据传输。同时它也具有增强型ESD保护。所有发射器输出和接收器输入都采用了先进的结构，使其能够承受超过±8kV人体放电模型和±15kV IEC61000-4-2 空气间隙放电、±8kV IEC61000-4-2接触放电的ESD电压。无论是否上电，在-7V至12V的RS-485的共模电压范围内，新的ESD结构都能保护。UM3352E内部包括一个热插拔电路，这允许插拔带电电缆。在A端口和B端口上内置专有保护电路，可将高达6A的浪涌电流耗散到地。

该器件在空载时或满载且禁用驱动器时的典型电源电流消耗为450µA。所有器件都具有1/8单位负载接收器输入阻抗，支持总线连接多达256个节点，且均适用于半双工通信。

应用

- RS-485 收发器
- 智能仪表和传感器
- 工业控制
- 照明系统
- 安防系统
- HVAC 应用

特性

- 电源电压范围：3V 至 5.5V
- RS-485 I/O 引脚提供 ESD 保护
  ±8kV，人体放电模型
  ±15kV，IEC61000-4-2 空气间隙放电
  ±8kV，IEC61000-4-2 接触放电
- 真正的失效保护接收器
- 增强型摆率限制有助于实现无误差数据传输
- 2µA 低电流关断模式
- -7V 至+12V 共模输入电压范围
- 支持总线连接多达 256 个节点
- 热关断
- 驱动过载限流保护
- 支持热插拔

订购信息

| Part Number	Operating Temperature	Mark Code	Package Type	Shipping Qty
UM3352EESA	-40℃ to +85℃	UM3352EESA	SOP8	3000pcs/13 Inch Tape & Reel
UM3352EEPA	-40℃ to +85℃	UM3352EEPA	DIP8	50pcs/Tube

设备电气特性概述

Part Number	Guaranteed Date Rate (Mbps)	Low-Power Shutdown	Slew-Rate Limited	Driver/ Receiver Enable	Shutdown Current (µA)	Transceivers On Bus	±15kV ESD Protection

UM3352E	0.5	Yes	Yes	Yes	2	256	Yes

Pin Configurations   Top View

UM3352
EESA
XX

XX: Week Code
UM3352EESA
SOP8

UM3352
EEPA
XX

XX: Week Code
UM3352EEPA
DIP8
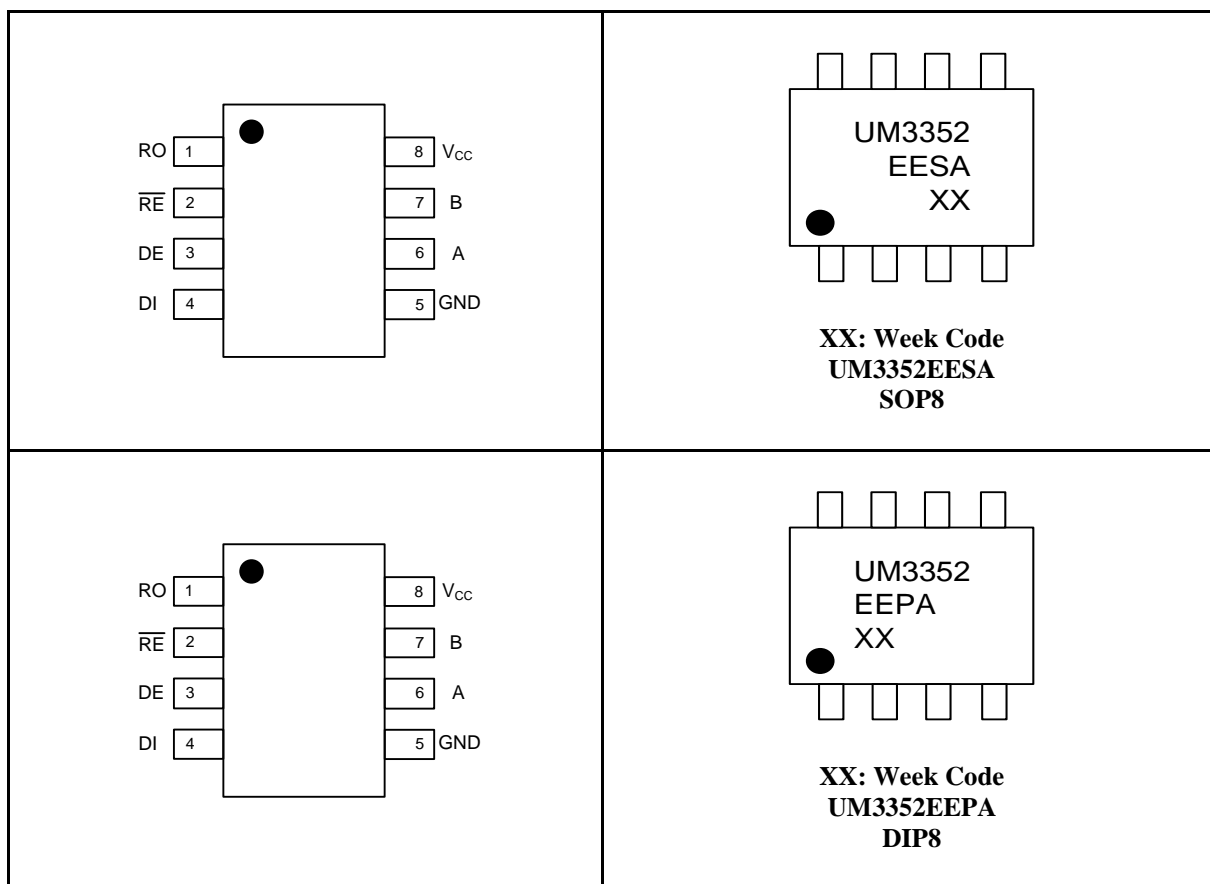
Pin Description

Pin Number	Symbol	Function
1	RO	Receiver Output. If A＞B by -50mV, RO will be high; if A＜B by 200mV, RO will be low.
2	$\overline{RE}$	Receiver Output Enable. Drive $\overline{RE}$ low to enable Receiver, RO is high impedance when $\overline{RE}$ is high. Drive $\overline{RE}$ high and DE low to enter low-power shutdown mode.
3	DE	Driver Enable. Drive DE high to enable drivers. The outputs are high impedance when DE is low. Drive $\overline{RE}$ high and DE low to enter low-power shutdown mode.
4	DI	Driver Input. A low on DI forces output A low and output B high. Similarly, a high on DI forces output A high and output B low.
5	GND	Ground.
6	A	Non-Inverting Receiver Input and Non-Inverting Driver Output.
7	B	Inverting Receiver Input and Inverting Driver Output.
8	V_{CC}	Power Supply for RS-485 Transceiver.

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	+7	V
	Control Input Voltage ($\overline{RE}$, DE)	-0.3V to (V_{CC} + 0.3)	V
	Driver Input Voltage (DI)	-0.3V to (V_{CC} + 0.3)	V
	Driver Output Voltage (A, B)	-7.5 to +12.5	V
	Receiver Input Voltage (A, B)	-7.5 to +12.5	V
	Receiver Output Voltage (RO)	-0.3V to (V_{CC} + 0.3)	V
T_A	Ambient Temperature	-40 to +85	℃
T_{STG}	Storage Temperature Range	-65 to +160	℃
T_L	Lead Temperature for Soldering 10 seconds	+300	℃

DC Electrical Characteristics

(V_{CC}=+5V ± 5%, T_A=-40 ℃ to +85 ℃, unless otherwise noted. Typical values are at V_{CC}=+5V and T_A =+25 ℃.) (Note 1)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
SUPPLY CURRENT							
Supply Current	I_{CC}	No Load, DI=GND or V_{CC}	DE=V_{CC}, $\overline{RE}$=0V or V_{CC}		0.45		mA
			DE=0V, $\overline{RE}$=0V		0.45		
Supply Current in Shutdown Mode	I_{SHDN}	DE = GND, $\overline{RE}$= V_{CC}			2		μA
LOGIC							
Input High Voltage	V_{IH}	DE, DI, $\overline{RE}$		2.0			V
Input Low Voltage	V_{IL}	DE, DI, $\overline{RE}$				0.8	V
Input Hysteresis	V_{HYS}	DE, DI, $\overline{RE}$			100		mV
Input Leakage Current	I_{LEAK}	DE, DI, $\overline{RE}$				±2	μA
DRIVER							
Differential Driver Output	V_{OD1}	No Load, Figure 2				5	V
Differential Driver Output	V_{OD2}	Figure 2, R_{LOAD}=50Ω		1.5			V
Change-in-Magnitude of Differential Output Voltage	ΔV_{OD}	Figure 2, R_{LOAD}=50Ω (Note 2)				0.2	V
Driver Common-Mode Output Voltage	V_{OC}	Figure 2, R_{LOAD}=50Ω				3.0	V
Change-in-Magnitude of Common-Mode Voltage	ΔV_{OC}	Figure 2, R_{LOAD}=50Ω (Note 2)				0.2	V
Driver Short-Circuit Output Current (Note 3)	I_{OSD}	V_{OUT}=-7V			-250		mA
		V_{OUT}=12V			250		

DC Electrical Characteristics (Continued)

(V_{CC}=+5V ± 5%, T_A=-40℃ to +85℃, unless otherwise noted. Typical values are at V_{CC}=+5V and T_A=+25℃.) (Note 1)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
RECEIVER							
Receiver Differential Threshold Voltage	V_{TH}	-7V≤V_{CM}≤12V		-200		-50	mV
Receiver Input Hysteresis	ΔV_{TH}	V_{CM}=0V			25		mV
Receiver Input Resistance	R_{IN}	-7V≤V_{CM}≤12V		96			kΩ
Input Current (A and B)	I_{IN2}	DE=GND, V_{CC}=GND or 5V	V_{IN}=12V			1.0	mA
			V_{IN}=-7V			-0.8	
Receiver Output High Voltage	V_{OH}	I_O=-1.5mA, V_{ID}=+200mV		V_{CC} -1.5			V
Receiver Output Low Voltage	V_{OL}	I_O=2.5mA, V_{ID}=-200mV				0.4	V
Three-State Output Current at Receiver	I_{OZR}	V_{CC}=5V, 0V≤V_O≤V_{CC}				±1	μA
Receiver Output Short Circuit Current	I_{OSR}	0V≤V_{RO}≤V_{CC}		±8		±60	mA
ESD Protection							
ESD Protection for A, B		Human Body Mode			±8		kV
		IEC61000-4-2 Air Discharge Mode			±15		
		IEC61000-4-2 Contact Discharge Mode			±8		

Note 1: All currents into the device are positive; all currents out of the device are negative. All voltages are referred to device ground unless otherwise noted.

Note 2: ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC}, respectively, when the DI input changes state.

Note 3: Maximum current level applies to peak current just prior to fold back current limiting; minimum current level applies during current limiting.

Switching Characteristics

(V_{CC}=+5V ± 5%, T_A=-40℃ to +85℃, unless otherwise noted. Typical values are at V_{CC}=+5V and T_A=+25℃.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Maximum Data Rate	f_{MAX}			500		kbps
Driver Input-to-Output	t_{DPLH}	Figures 3 and 7, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF		50	1000	ns
	t_{DPHL}			50	1000	
Driver Output Skew | t_{DPLH} - t_{DPHL} |	t_{DSKEW}	Figures 3 and 7, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF		15	100	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	Figures 3 and 7, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF		100	750	ns
Driver Enable to Output High	t_{DZH}	Figures 4 and 8, C_L=100pF, S2 Closed		30	2500	ns
Driver Enable to Output Low	t_{DZL}	Figures 4 and 8, C_L=100pF, S1 Closed		30	2500	ns
Driver Disable Time from Low	t_{DLZ}	Figures 4 and 8, C_L=15pF, S1 Closed		60	200	ns
Driver Disable Time from High	t_{DHZ}	Figures 4 and 8, C_L=15pF, S2 Closed		100	200	ns
Receiver Input to Output	t_{RPLH}, t_{RPHL}	|V_{ID}|≥2.0V, Rise and Fall Time of V_{ID}≤15ns		75	200	ns
Differential Receiver Skew | t_{RPLH} - t_{RPHL} |	t_{RSKD}	Figures 6 and 9, |V_{ID}|≥2.0V, Rise and Fall Time of V_{ID}≤15ns		0	30	ns
Receiver Enable to Output Low	t_{RZL}	Figures 5 and 10, C_L=100pF, S1 Closed		20	50	ns
Receiver Enable to Output High	t_{RZH}	Figures 5 and 10, C_L=100pF, S2 Closed		20	50	ns
Receiver Disable Time from Low	t_{RLZ}	Figures 5 and 10, C_L=100pF, S1 Closed		20	50	ns
Receiver Disable Time from High	t_{RHZ}	Figures 5 and 10, C_L=100pF, S2 Closed		20	50	ns
Time to Shutdown	t_{SHDN}	(Note 4)		200	600	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figures 4 and 8, C_L=15pF, S2 Closed		700	4500	ns
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figures 4 and 8, C_L=15pF, S1 Closed		700	4500	ns
Receiver Enable from Shutdown to Output High	$t_{RZH(SHDN)}$	Figures 5 and 10, C_L=100pF, S2 Closed		700	3500	ns
Receiver Enable from Shutdown to Output Low	$t_{RZL(SHDN)}$	Figures 5 and 10, C_L=100pF, S1 Closed		700	3500	ns

Note 4: The device is put into shutdown by bringing $\overline{RE}$ high and DE low. If the enable inputs are in this state for less than 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the device is guaranteed to have entered shutdown.
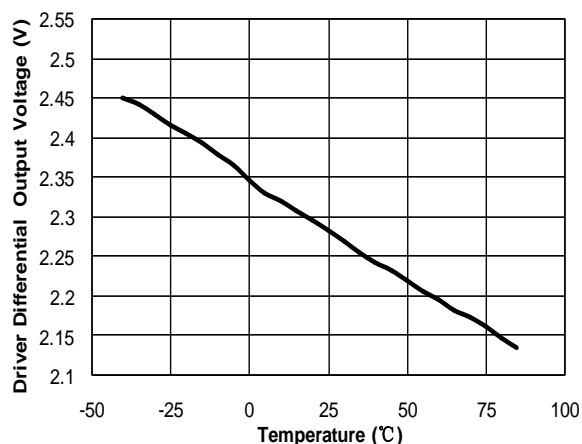
Typical Operating Characteristics

(V_{CC}=+5.0V, T_A=+25° C, unless otherwise noted.)

Supply Current vs. Temperature
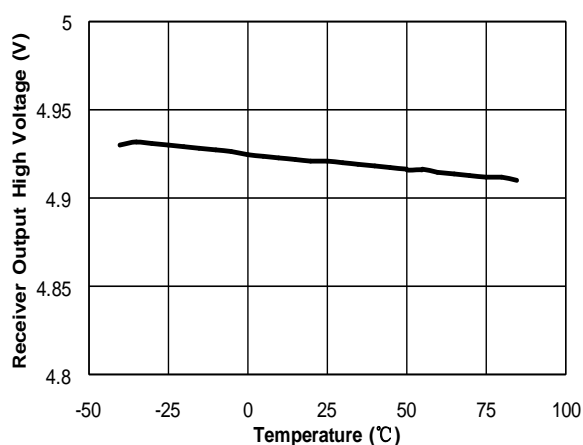
DE=0, $\overline{RE}$=0

DE=1, $\overline{RE}$=1
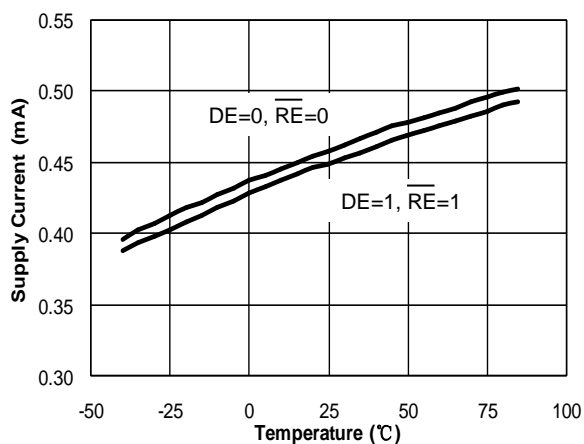
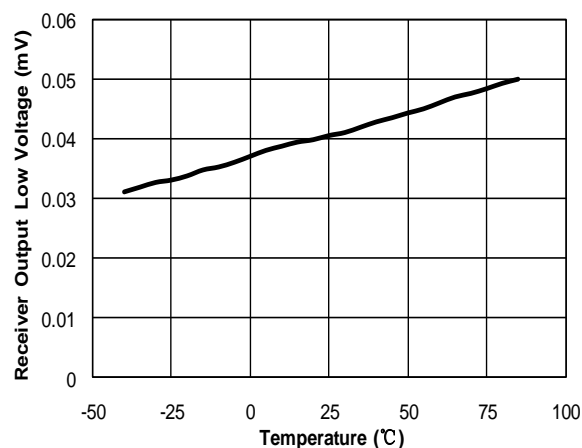**Driver Differential Output Voltage vs. Temperature**
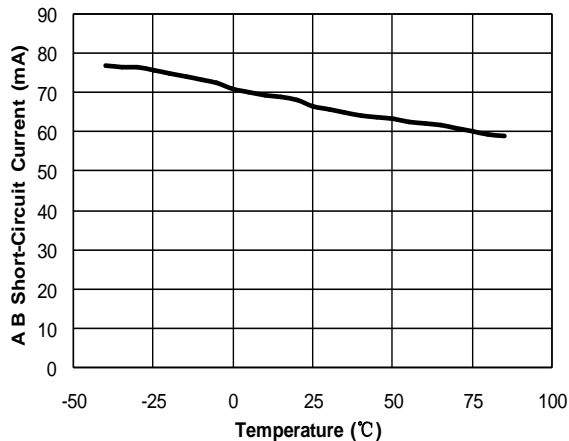R_{LOAD}=54Ω

Receiver Output High Voltage vs. Temperature

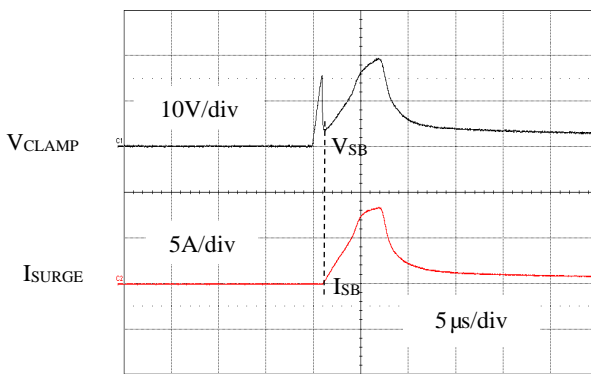**Receiver Output Low Voltage vs. Temperature**
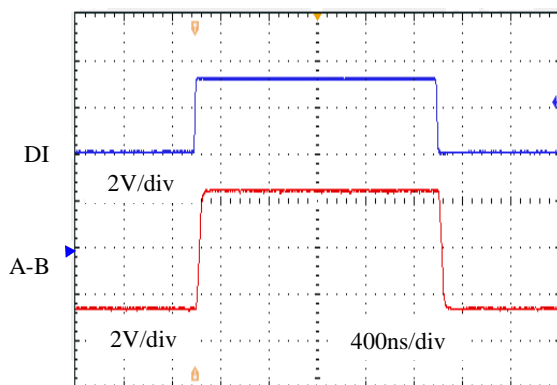
A B Short-Circuit Current vs. Temperature
DI=1

A B Pin I-V Snap Back Characteristic

V_{CLAMP}

10V/div

V_{SB}

I_{SURGE}

5A/div

I_{SB}

5 μs/div

Typical Operating Characteristics (Continued)

(V_{CC}=+5.0V, T_A=+25°C, unless otherwise noted.)

Transmitter Propagation Delay
R_L=54Ω, C_L=100pF

Receiver Propagation Delay
R_L=54Ω, C_L=100pF

DI

2V/div

A-B

2V/div   400ns/div

A-B

2V/div

RO

2V/div   400ns/div
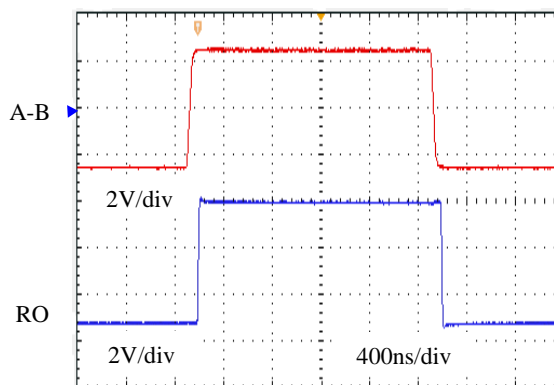
RS-485 Communication Function Table

Table1. Transmitting

INPUTS			OUTPUTS	
$\overline{RE}$	DE	DI	B	A
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	Shutdown	

X=Don't care; High-Z=High impedance

Table2. Receiving

INPUTS			OUTPUTS
$\overline{RE}$	DE	A-B	RO
0	X	≥-50mV	1
0	X	≤-200mV	0
0	X	Open/Shorted	1
1	1	X	High-Z
1	0	X	Shutdown

X=Don't care; High-Z=High impedance
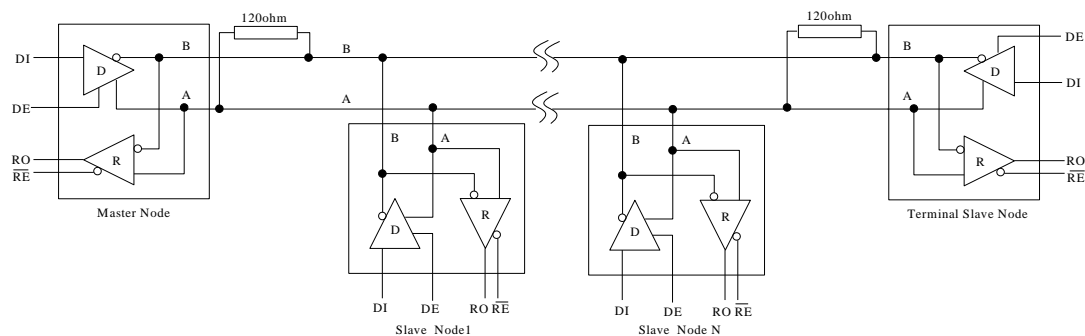
Typical Operating Circuit

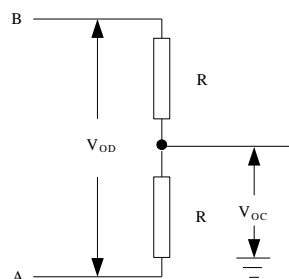Figure 1. Typical Half-Duplex RS-485 Network

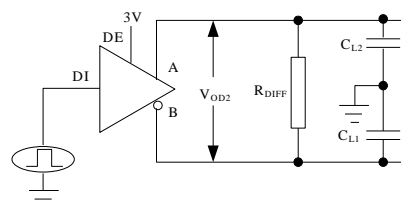## Test Circuit

Figure 2. Driver DC Test Load

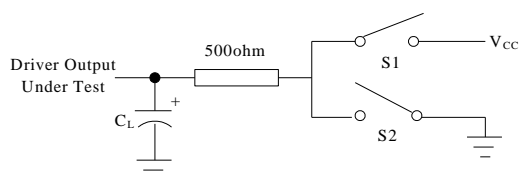Figure 3. Driver Timing Test Circuit

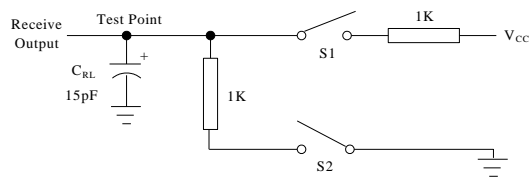

Figure 4. Driver Enable/Disable Timing Test Load

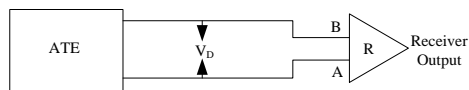Figure 5. Receiver Enable/Disable Timing Test Load

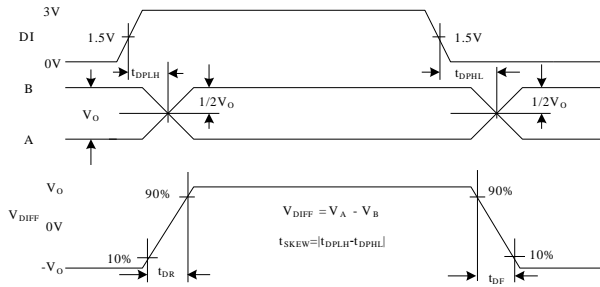Figure 6. Receiver Propagation Delay Test Circuit
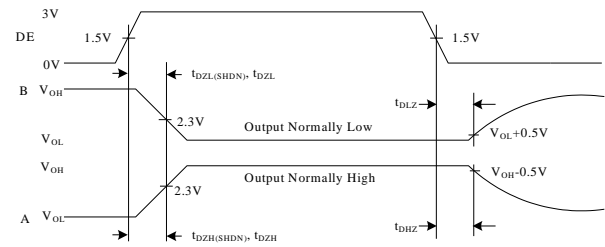
Figure 7. Driver Propagation Delays

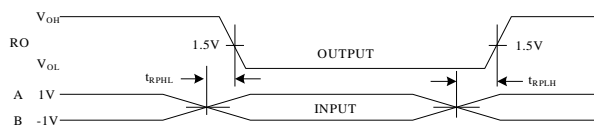Figure 8. Driver Enable and Disable Times
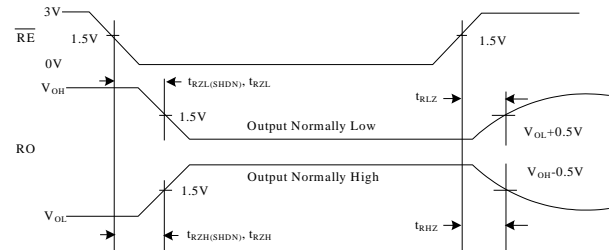

Figure 9. Receiver Propagation Delays

Figure 10. Receiver Enable and Disable Times

Detail Description

The UM3352E high-speed transceivers for RS-485 communication contain one driver and one receiver. The device features fail-safe circuitry, which guarantees a logic-high receiver output when the receiver input is open or shorted, or when it is connected to a terminated transmission line with all drivers disabled. The UM3352E features reduced slew-rate driver that minimizes EMI and reduces reflections caused by improperly terminated cables, allowing error-free data transmission up to 500kbps. It operates from a single +5V supply. Drivers are output short-circuit current limited. Thermal shutdown circuitry protects drivers against excessive power dissipation. When activated, the thermal shutdown circuitry places the driver outputs into a high impedance state.

Fail-Safe

The UM3352E guarantees a logic-high receiver output when the receiver inputs are shorted or open, or when they are connected to a terminated transmission line with all drivers disabled. This is done by setting the receiver threshold between -50mV and -200mV. If the differential receiver input voltage (A-B) is greater than or equal to -50mV, RO is logic high. If A-B is less than or equal to -200mV, RO is logic low. In the case of a terminated bus with all transmitters disabled, the receiver's differential input voltage is pulled to 0V by the termination. With the receiver thresholds of the UM3352E, this results in a logic high with a 50mV minimum noise margin. Unlike previous fail-safe devices, the -50mV to -200mV threshold complies with the ±200mV EIA/TIA-485 standard.

Applications Information

256 Transceivers on the Bus

The standard RS-485 receiver input impedance is 12kΩ (one unit load), and the standard driver can drive up to 32 unit loads. The Union family of transceivers have a 1/8 unit load receiver input impedance (96kΩ), allowing up to 256 transceivers to be connected in parallel on one communication line. Any combination of these devices, as well as other RS-485 transceivers with a total of 32 unit loads or fewer, can be connected to the line.

Reduced EMI and Reflections

The UM3352E is slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables. In general, a transmitter's rise time relates directly to the length of an unterminated stub, which can be driven with only minor waveform reflections. The following equation expresses this relationship conservatively:

Length=$t_{RISE}/(10 \times 1.5ns/ft)$

Where t_{RISE} is the transmitter's rise time.

A system can work well with longer unterminated stubs, even with severe reflections, if the waveform settles out before the receiver's UART samples them.

Low-Power Shutdown Mode

Low-power shutdown mode is initiated by bringing both $\overline{RE}$ high and DE low. In shutdown, the device typically draws only 2 μA of supply current. $\overline{RE}$ and DE may be driven simultaneously; the parts are guaranteed not to enter shutdown if $\overline{RE}$ is high and DE is low for less than 50ns. If the inputs are in this state for at least 600ns, the parts are guaranteed to enter shutdown. Enable times t_{ZH} and t_{ZL} in the Switching Characteristics tables assume the part was not in a low-power shutdown state. Enable times $t_{ZH(SHDN)}$ and $t_{ZL(SHDN)}$ assume the parts were shut down. It takes drivers and receivers longer to become enabled from low-power shutdown mode ($t_{ZH(SHDN)}$, $t_{ZL(SHDN)}$) than from driver/receiver-disable mode (t_{ZH}, t_{ZL}).

Driver Output Protection

Two mechanisms prevent excessive output current and power dissipation caused by faults or by bus contention. The first, a foldback current limit on the output stage, provides immediate protection against short circuits over the whole common-mode voltage range. The second, a thermal shutdown circuit, forces the driver outputs into a high-impedance state if the die temperature becomes excessive.

Line Length vs. Data Rate

The RS-485/RS-422 standard covers line lengths up to 4000 feet. For line lengths greater than 4000 feet, repeater is required.

ESD Protection

All pins on these devices include class 2 (>2kV) Human Body Model (HBM) ESD protection structures, but the RS-485 pins (driver outputs and receiver inputs) incorporate advanced structures allowing them to survive ESD events in excess of ±8kV HBM, ±15kV IEC61000-4-2 Air Discharge Mode and ±8kV IEC61000-4-2 Contact Discharge Mode. The RS-485 pins are particularly vulnerable to ESD strikes because they typically connect to an exposed port on the exterior of the finished product. Simply touching the port pins, or connecting a cable, can cause an ESD event that might destroy unprotected ICs.

These new ESD structures protect the device whether or not it is powered up, and without degrading the RS-485 common mode range of -7V to +12V. This built-in ESD protection cuts the need for board level protection structures (e.g., transient suppression diodes), and the associated, undesirable capacitive load they present.

IEC61000-4-2 Testing

The IEC61000 test method applies to finished equipments, rather than to an individual IC. Therefore, the pins most likely to suffer an ESD event are those that are exposed to the outside world (the RS-485 pins in this case), and the IC is tested in its typical application configuration (power applied) rather than testing each pin-to-pin combination. The IEC61000 standard's lower current limiting resistor coupled with the larger charge storage capacitor yields a test that is much more severe than the HBM test.

Air-Gap Discharge Test Method

For this test method, a charged probe tip moves toward the IC pin until the voltage arcs to it. The current waveform delivered to the IC pin depends on approach speed, humidity, temperature, etc., so it is difficult to obtain repeatable results. The UM3352E RS-485 pins withstand ±15kV air-gap discharges.

Contact Discharge Test Method

During the contact discharge test, the probe contacts the tested pin before the probe tip is energized, thereby eliminating the variables associated with the air-gap discharge. The result is a more repeatable and predictable test, but equipment limits prevent testing devices at voltages higher than ±8kV. The RS-485 pins of all the UM3352E versions survive ±8kV contact discharges.
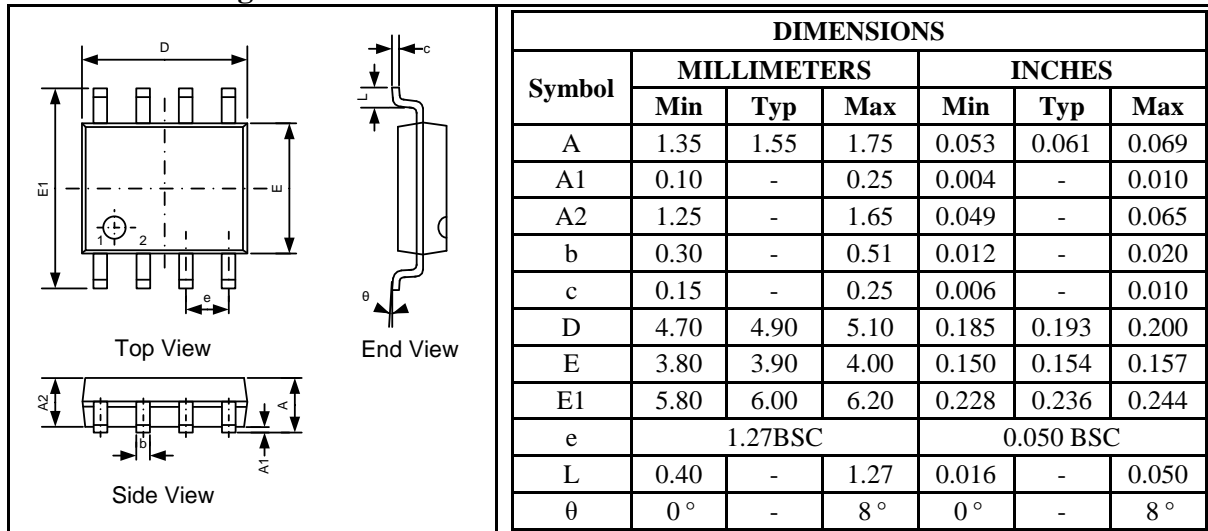
Typical Applications

The UM3352E transceivers are designed for bidirectional data communications on multipoint bus transmission lines. To minimize reflections, the line should be terminated at both ends in its characteristic impedance, and stub lengths of the main line should be kept as short as possible.

Package Information

UM3352EESA SOP8

Outline Drawing

Top View

End View

Side View

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.

Tape and Reel Orientation

UM3352
EESA
XX

UM3352EEPA DIP8

Outline Drawing

Top View

Pin #1 ID

End View

Side View

DIMENSIONS						
Symbol	**MILLIMETERS**			**INCHES**		
	Min	**Typ**	**Max**	**Min**	**Typ**	**Max**
A	3.71	-	4.80	0.146	-	0.189
A1	0.38	-	-	0.015	-	-
A2	3.20	3.40	3.60	0.126	0.134	0.142
b	0.38	-	0.57	0.015	-	0.022
b1	1.52BSC			0.060BSC		
c	0.20	0.28	0.36	0.008	0.011	0.014
D	9.00	9.20	9.50	0.354	0.362	0.374
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	7.32	-	7.92	0.288	-	0.312
E2	8.40	-	9.05	0.331	-	0.356
e	2.54TYP			0.100TYP		
L	3.00	3.30	3.60	0.118	0.130	0.142
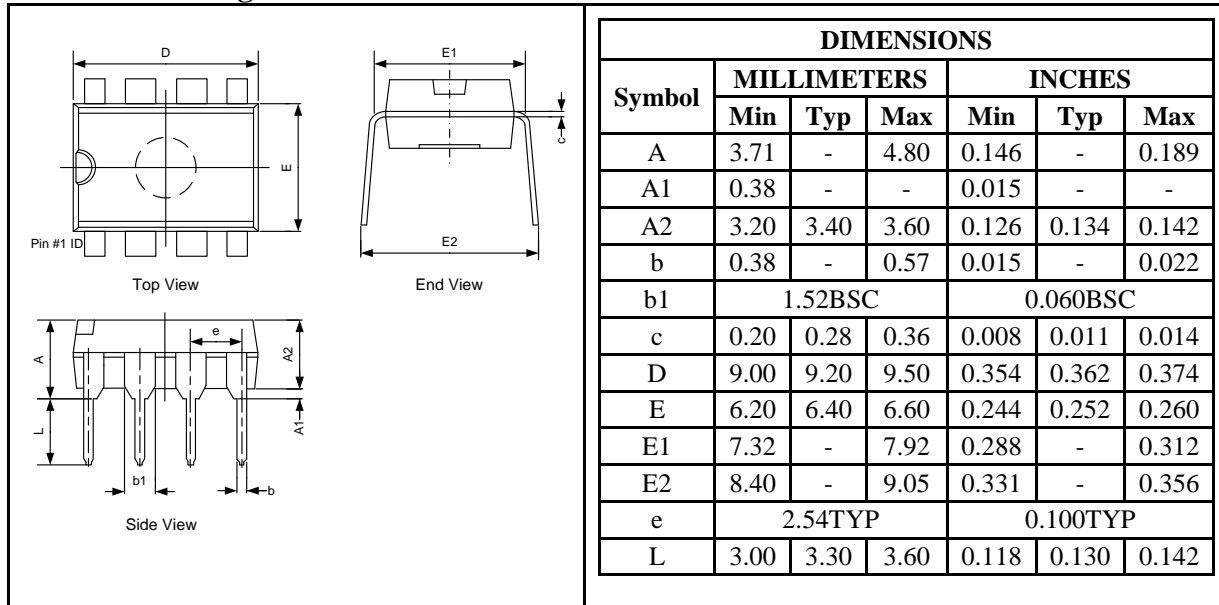
Packing Information
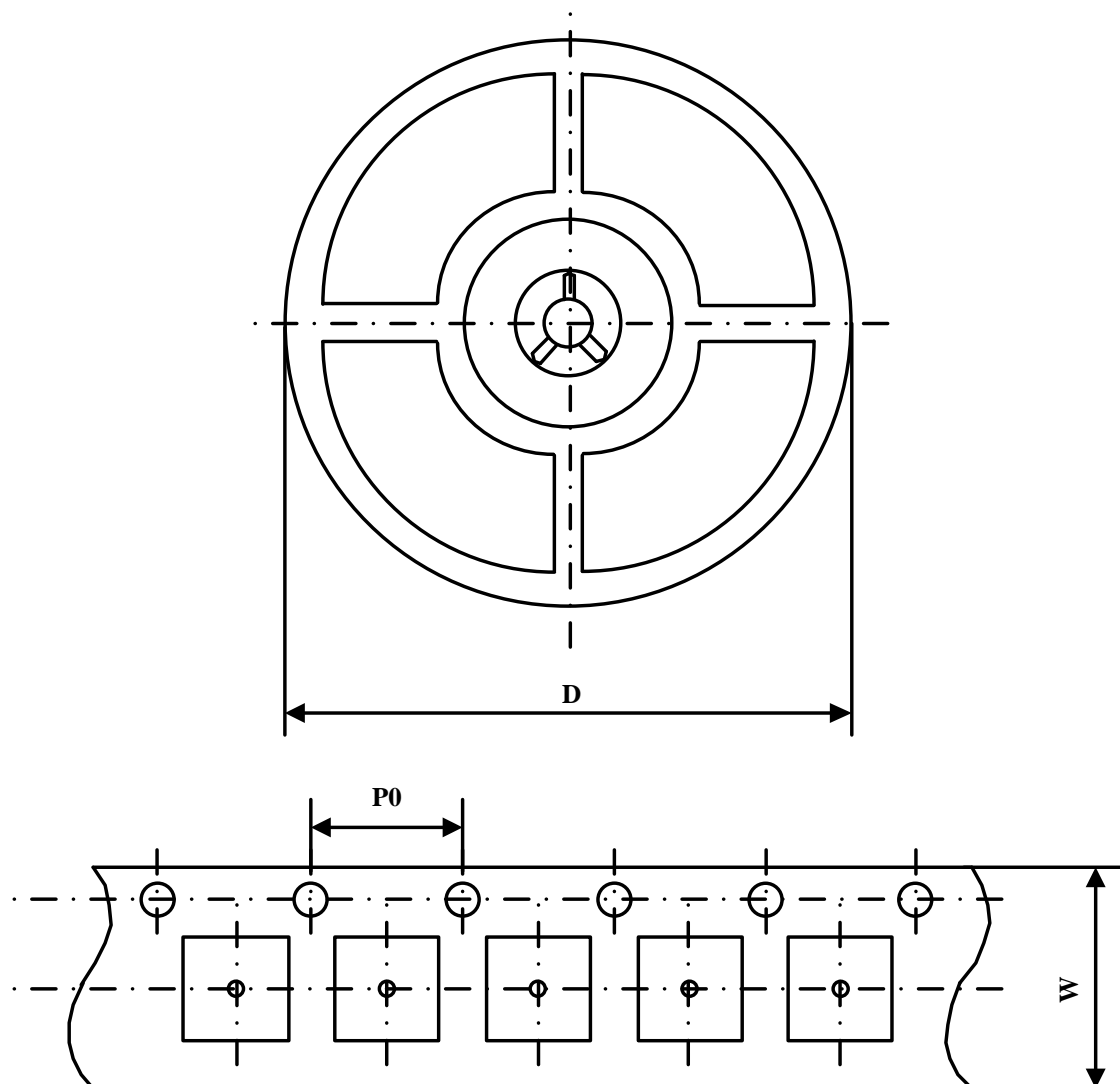
Part Number	Package Type	Carrier Width(W)	Pitch(P0)	Reel Size(D)
UM3352EESA	SOP8	12 mm	4 mm	330 mm

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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