+3.3V 低压供电、 ±8kV ESD保护、失效保护 RS-422 收发器

UM3488EESA *SOP8*
UM3488EEPA *DIP8*
UM3491EESE *SOP14*
UM3491EEPE *DIP14*

描述

UM3488/UM3491是具有±8kV ESD保护的高速RS-422收发器，该器件包含一个驱动器和一个接收器。UM3491包含一个额外的接收器和驱动器使能控制。这些器件具有失效保护电路，可在接收器输入开路或短路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。UM3488/UM3491允许的传输速率高达10Mbps，具有增强型ESD保护。所有发射器输出和接收器输入均能耐受±8kV的人体放电模型。

UM3488/UM3491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。UM3488/UM3491都可用于全双工通信。

应用

- RS-422 通信
- 电平转换器
- 适用于 EMI 敏感应用的收发器
- 工业控制局域网络

特性

- RS-422 I/O 引脚提供 ESD 保护
  - ±8kV，人体放电模型
- 真正的失效保护接收器，同时符合 EIA/TIA-422 标准
- 数据传输速率高达 10Mbps
- 无误码数据传输
- 1nA 低电流关断模式(UM3491)
- 支持总线连接多达 256 个节点

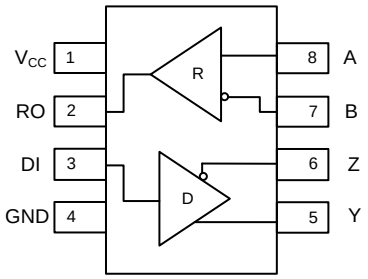
选型指南

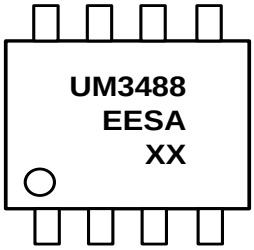
Part Number	Half/Full Duplex	Data Rate (Mbps)	Slew-Rate Limited	Low-Power Shutdown	Receiver/ Driver Enable	Transceivers On Bus	Pin Count
UM3488	full	10	Yes	No	No	256	8
UM3491	full	10	Yes	Yes	Yes	256	14

订购信息

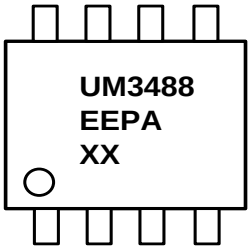
Part Number	Temperature Range	Packaging Type	Shipping Qty
UM3488EESA	-40℃ to +85℃	SOP8	3000pcs/13 Inch Tape & Reel
UM3488EEPA	-40℃ to +85℃	DIP8	50pcs/Tube
UM3491EESE	-40℃ to +85℃	SOP14	2500pcs/13 Inch Tape & Reel
UM3491EEPE	-40℃ to +85℃	DIP14	25pcs/Tube

Pin Configurations **Top View**

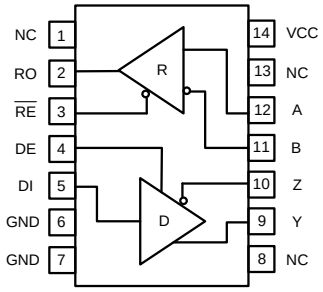


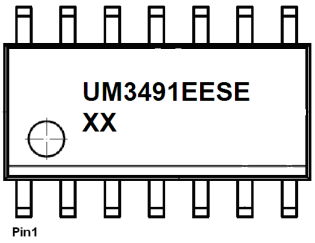


XX: Week Code
UM3488EESA
SOP8

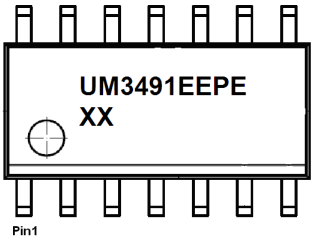


XX: Week Code
UM3488EEPA
DIP8





XX: Week Code
UM3491EESE
SOP14



XX: Week Code
UM3491EEPE
DIP14

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	+7	V
	Control Input Voltage ($\overline{RE}$, DE)	-0.3V to (VCC + 0.3V)	V
	Driver Input Voltage (DI)	-0.3V to (VCC + 0.3V)	V
	Driver Output Voltage (Y, Z)	-7.5 to +12.5	V
	Receiver Input Voltage (A, B)	-7.5 to +12.5	V
	Receiver Output Voltage (RO)	-0.3V to (VCC + 0.3V)	V
P_D	8-Pin SO (derate 9.09mW/℃ above +70℃)	520	mW
	8-Pin Plastic DIP (derate 9.09mW/℃ above +70℃)	727	
	14-Pin Plastic DIP (derate 10.0mW/℃ above +70℃)	800	
	14-Pin SO (derate 8.33mW/℃ above +70℃)	667	
T_A	Ambient Temperature	-40 to +85	℃
T_J	Junction Temperature	-40 to +150	℃
T_{STG}	Storage Temperature Range	-65 to +150	℃
T_L	Lead Temperature for Soldering 10 seconds	+300	℃

Thermal Information

Symbol	Thermal Metric		Value	UNIT
$R_{\theta JA}$	Junction to Ambient Thermal Resistance	SOP8	110	℃/W
		SOP14	85	
		DIP8	87	
		DIP14	63	
$R_{\theta JC}$	Junction to Case Thermal Resistance	SOP8	54	
		SOP14	42	
		DIP8	43	
		DIP14	37	

DC Electrical Characteristics

(V_{CC} = +3.3V ±5%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +3.3V and T_A = +25℃.) (Note 1)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
DRIVER							
Differential Driver Output (No Load)	V_{OD1}	Figure 3				V_{CC}	V
Differential Driver Output	V_{OD2}	Figure 3, R = 50Ω		1.8		V_{CC}	V
Differential Driver Output	V_{OD3}	Figure 3, R = 27Ω		1.3		V_{CC}	V
Change-in-Magnitude of Differential Output Voltage (Note 2)	ΔV_{OD}	Figure 3, R = 50Ω				0.2	V
Driver Common-Mode Output Voltage	V_{OC}	Figure 3, R = 50Ω				3.0	V
Input High Voltage	V_{IH}	DE, DI, $\overline{RE}$		2.0			V
Input Low Voltage	V_{IL}	DE, DI, $\overline{RE}$				0.8	V
DI Input Hysteresis	V_{HYS}				100		mV
Driver Short-Circuit Output Current (Note 3)	I_{OSD}	-7V≤V_{OUT}≤V_{CC}		-250			mA
		0V≤V_{OUT}≤12V				250	
RECEIVER							
Input Current (A and B)	I_{IN}	DE = GND, V_{CC} = GND or 3.465V	V_{IN} = 12V			125	μA
			V_{IN} = -7V			-75	
Receiver Differential Threshold Voltage	V_{TH}	-7V≤V_{CM}≤12V		-200	-125	-50	mV

Receiver Input Hysteresis	ΔV_{TH}			25		mV
Receiver Output High Voltage	V_{OH}	I_O = -4mA, V_{ID} = -50mV	V_{CC} -0.4			V
Receiver Output Low Voltage	V_{OL}	I_O = 4mA, V_{ID} = -200mV			0.4	V
Three-State Output Current at Receiver	I_{OZR}	0.4V ≤ V_O ≤ 2.4V			±1	μA
Receiver Input Resistance	R_{IN}	-7V≤V_{CM}≤12V	96			kΩ
Receiver Output Short Circuit Current	I_{OSR}	0V≤V_{RO} ≤V_{CC}	±7		±95	mA
SUPPLY CURRENT						
Supply Current	I_{CC}	No Load, DI= 0V or V_{CC}	DE=V_{CC}, $\overline{RE}$=0V or V_{CC}		500	800	μA
			DE=0V, $\overline{RE}$=0V		475	750	
Supply Current in Shutdown Mode	I_{SHDN}	DE=0V, $\overline{RE}$=V_{CC}, DI =0V or V_{CC}			0.001	10	μA
ESD Protection for Y, Z, A, B		Human Body Model			±8		kV

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 foldback-current limiting; minimum current level applies during current limiting.

Switching Characteristics

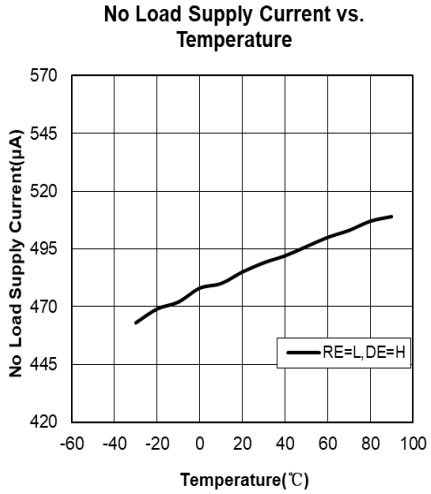
(V_{CC} = +3.3V ±5%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +3.3V and T_A = +25℃.)

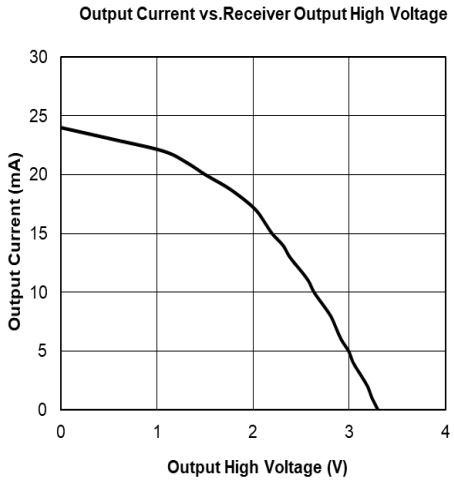
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Driver Input-to-Output	t_{DPLH}	Figures 5 and 7, R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF	10	30	60	ns
	t_{DPHL}		10	30	60	
Driver Output Skew | t_{DPLH} - t_{DPH}L |	t_{DSKEW}	Figures 5 and 7, R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF		10	25	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	Figures 5 and 7, R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF	5	15	30	ns
Maximum Data Rate	f_{MAX}				10	Mbps
Driver Enable to Output High	t_{DZH}	Figures 6 and 8, C_L = 100pF, S2 closed		40	70	ns
Driver Enable to Output Low	t_{DZL}	Figures 6 and 8, C_L = 100pF, S1 closed		40	70	ns
Driver Disable Time from Low	t_{DLZ}	Figures 6 and 8, C_L = 15pF, S1 closed		40	70	ns
Driver Disable Time from High	t_{DHZ}	Figures 6 and 8, C_L = 15pF, S2 closed		40	70	ns
Receiver Input to Output	t_{RPLH}, t_{RPHL}	Figures 9 and 11; | V_{ID} | ≥2.0V; rise and fall time of V_{ID}≤15ns	20	100	180	ns
| t_{RPLH} - t_{RPHL} | Differential Receiver Skew	t_{RSKD}	Figures 9 and 11; | V_{ID} | ≥2.0V; rise and fall time of V_{ID}≤15ns		13		ns
Receiver Enable to Output Low	t_{RZL}	Figures 4 and 10, C_L = 15pF, S1 closed		40	100	ns
Receiver Enable to Output High	t_{RZH}	Figures 4 and 10, C_L = 15pF, S2 closed		40	100	ns
Receiver Disable Time from Low	t_{RLZ}	Figures 4 and 10, C_L = 15pF, S1 closed		40	100	ns
Receiver Disable Time from High	t_{RHZ}	Figures 4 and 10, C_L = 15pF, S2 closed		40	100	ns
Time to Shutdown	t_{SHDN}	(Note 4)	50	200	600	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figures 6 and 8, C_L = 100pF, S2 closed		3	4	μs
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figures 6 and 8, C_L = 100pF, S1 closed		3	4	μs
Receiver Enable from Shutdown- to-Output High	$t_{RZH(SHDN)}$	Figures 4 and 10, C_L = 15pF, S2 closed		3	4	μs
Receiver Enable from Shutdown- to-Output Low	$t_{RZL(SHDN)}$	Figures 4 and 10, C_L = 15pF, S1 closed		3	4	μs

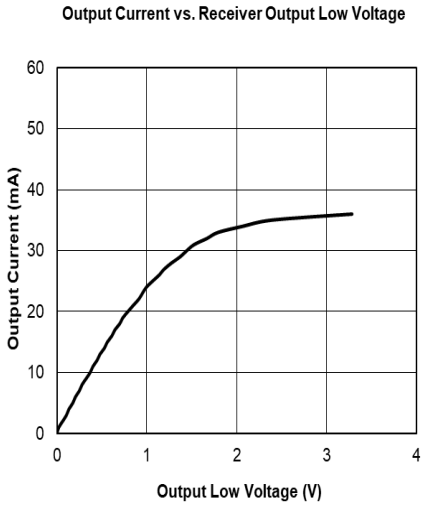
Note 4: The device is put into shutdown by bringing $\overline{RE}$ high and DE low. If the enable inputs are in this state for less than 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the device is guaranteed to have entered shutdown.

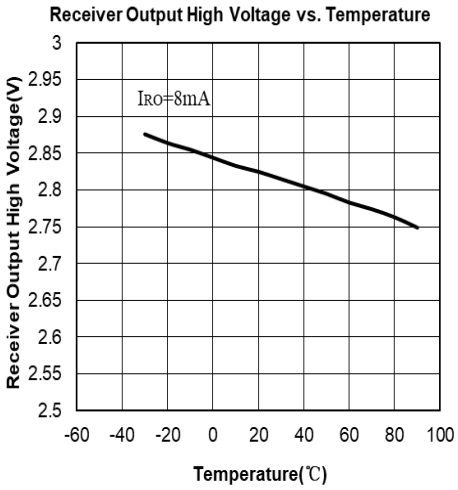
Typical Operating Characteristics

(V_{CC} = +3.3V, T_A = +25℃, unless otherwise noted.)





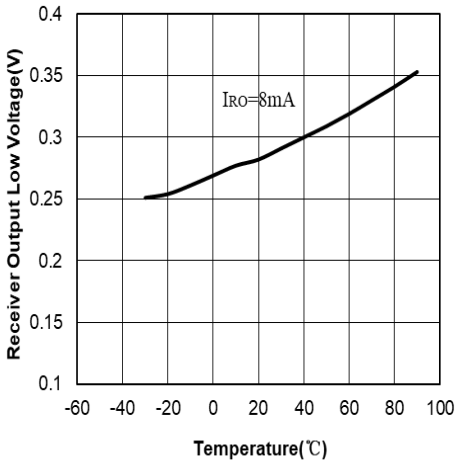




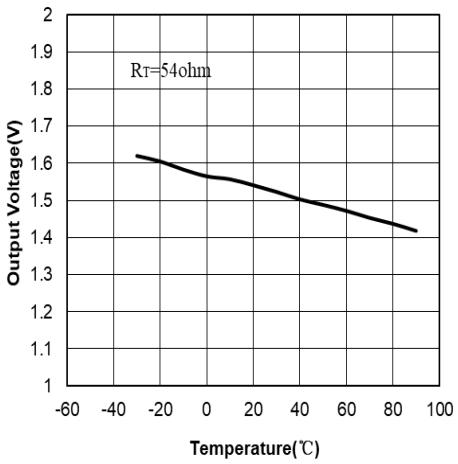
Typical Operating Characteristics (Continued)

(V_{CC} = +3.3V, T_A = +25℃, unless otherwise noted.)

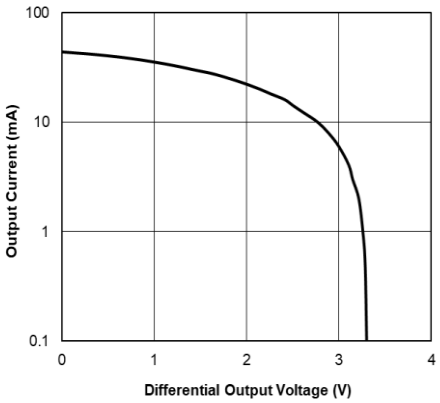
Receiver Output Low Voltage vs. Temperature



Driver Differential Output Voltage vs. Temperature



Driver Output Current vs.Differential Output Voltage



Pin Description

Pin Number		Symbol	Function
UM3488	UM3491		
-	1	NC	Not Connected
2	2	RO	Receiver Output. When $\overline{RE}$ is low and if A - B ≥-50mV, RO will be high; if A - B ≤ -200mV, RO will be low.
-	3	$\overline{RE}$	Receiver Output Enable. Drive $\overline{RE}$ low to enable RO; RO is high impedance when $\overline{RE}$ is high. Drive $\overline{RE}$ high and DE low to enter low-power shutdown mode.
-	4	DE	Driver Output Enable. Drive DE high to enable driver outputs. These outputs are high impedance when DE is low. Drive $\overline{RE}$ high and DE low to enter low-power shutdown mode.
3	5	DI	Driver Input. With DE high, a low on DI forces non-inverting output low and inverting output high. Similarly, a high on DI forces non-inverting output high and inverting output low.
4	6	GND	Ground
4	7	GND	Ground
-	8	NC	Not Connected
5	9	Y	Non-inverting Driver Output
6	10	Z	Inverting Driver Output
7	11	B	Inverting Receiver Input
8	12	A	Non-inverting Receiver Input
-	13	NC	Not Connected
1	14	VCC	Positive Supply 3.135V ≤ V_{CC}≤ 3.465V

Functions Tables

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

RECEIVING			
INPUTS			OUTPUT
$\overline{RE}$	DE	A-B	RO
0	X	≥-0.05V	1
0	X	≤-0.2V	0
0	X	Open/Short	1
1	1	X	High-Z
1	0	X	Shutdown

Typical Operating Circuit

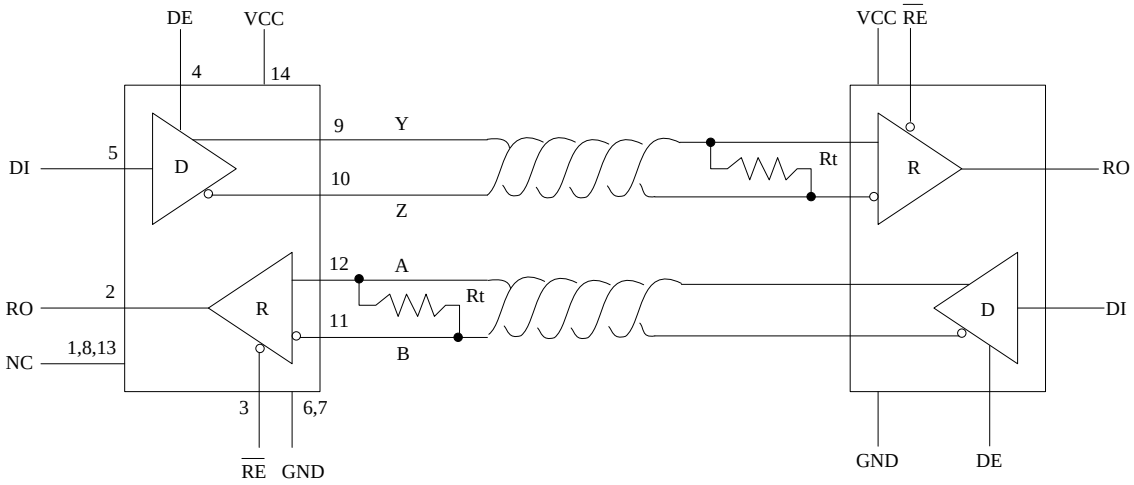


Figure 1: UM3491 pin configuration and typical full-duplex operating circuit

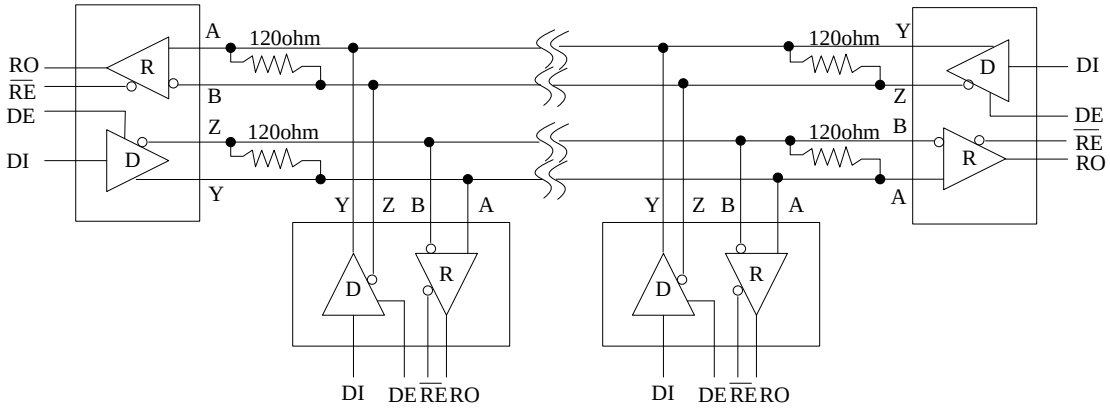


Figure 2: Typical Full-Duplex RS-422 Network

Detailed Description

The UM3488/UM3491 high-speed transceivers for RS-422 communication contain one driver and one receiver. The device features fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open or shorted, or when they are connected to a terminated transmission line with all drivers disabled.
The UM3488/UM3491 offer higher driver output slew-rate limits, allowing transmit speeds up to 10Mbps.
The UM3488/UM3491 is full-duplex transceiver. It operates from a single +3.3V 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.

Receiver Input Filtering

The receivers of the UM3488/UM3491 incorporate input filtering in addition to input hysteresis. This filtering enhances noise immunity with differential signals that have very slow rise and fall times. Receiver propagation delay increases by 20% due to this filtering.

Fail-Safe

The UM3488/UM3491 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 UM3488/UM3491, 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-422 standard.

±8kV ESD Protection

As with all Union devices, ESD-protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The driver outputs and receiver inputs of the UM3488/UM3491 have extra protection against static electricity. Union's engineers have developed state-of-the-art structures to protect these pins against ESD of ±8kV without damage.
The ESD-protected pins are tested with reference to the ground pin in a powered-down condition. They are tested to ±8kV using the Human Body Model.

Test Circuit

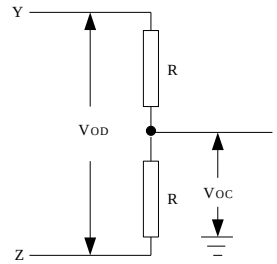


Figure 3. Driver DC Test Load

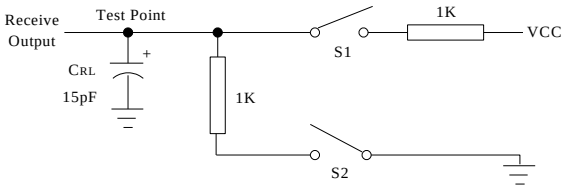


Figure 4. Receiver Enable/Disable Timing Test Load

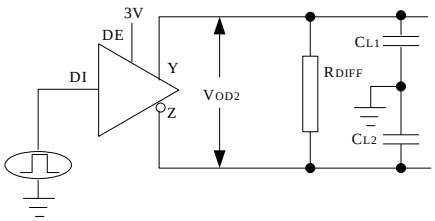


Figure 5. Driver Timing Test Circuit

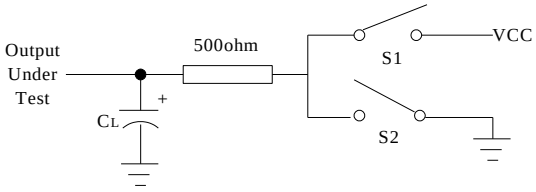


Figure 6. Driver Enable and Disable Timing Test Load

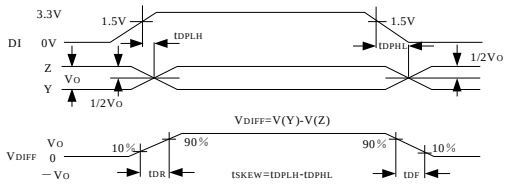


Figure 7. Driver Propagation Delays

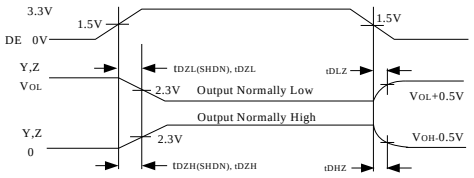


Figure 8. Driver Enable and Disable Times

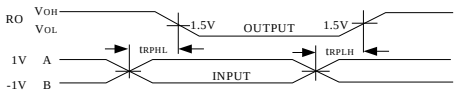


Figure 9. Receiver Propagation Delays

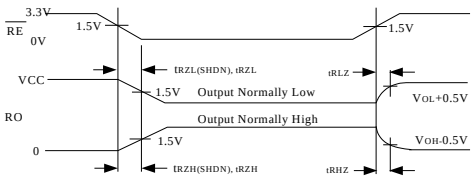


Figure 10. Receiver Enable and Disable Times

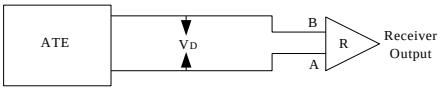


Figure 11. Receiver Propagation Delay Test Circuit

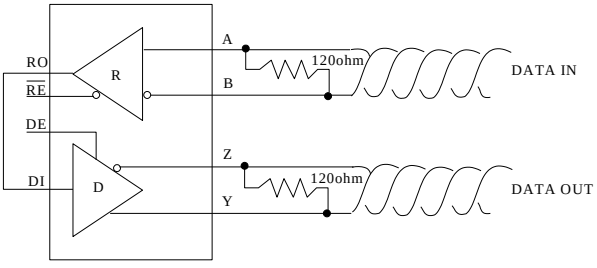


Figure 12: Line Repeater

Applications Information

256 Transceivers on the Bus

The standard RS-422 receiver input impedance is 12kΩ (one-unit load), and the standard driver can drive up to 32 unit loads. The UM3491 has 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 and/or other RS-422 transceivers with a total of 32 unit loads or less can be connected to the line.

Reduced EMI and Reflections

The UM3488/UM3491 is slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables. Its high-frequency harmonic components are much lower in amplitude, and the potential for EMI is significantly reduced.

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:

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

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

Low-Power Shutdown Mode (UM3491)

Low-power shutdown mode is initiated by bringing both $\overline{RE}$ high and DE low. In shutdown, the devices typically draw only 1nA 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 ($t_{ZH(SHDN)}$, $t_{ZH(SHDN)}$) 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.

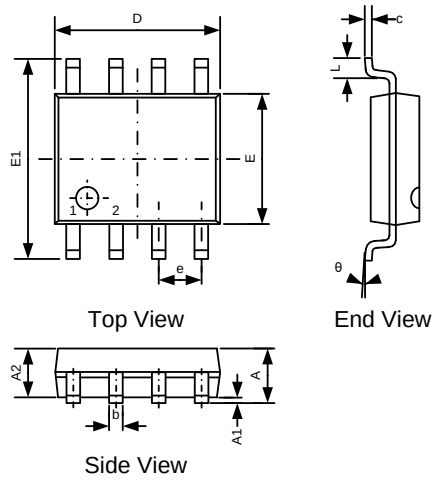
Line Length vs. Data Rate

The RS-422 standard covers line lengths up to 4000 feet. For line lengths greater than 4000 feet, use the repeater application shown in Figure 12.

Package Information

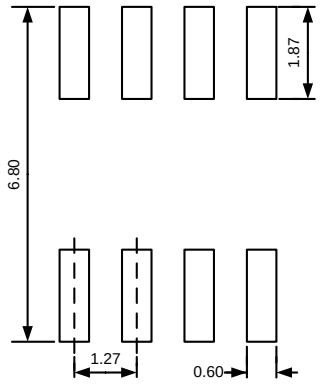
UM3488EESA SOP8

Outline Drawing



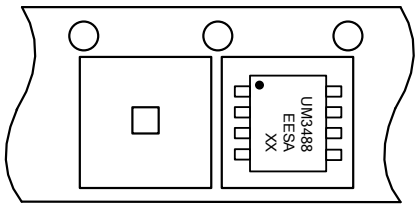
DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	1.35	1.55	1.75	0.053	0.061	0.069
A1	0.10	-	0.25	0.004	-	0.010
A2	1.25	-	1.65	0.049	-	0.065
b	0.30	-	0.51	0.012	-	0.020
c	0.15	-	0.25	0.006	-	0.010
D	4.70	4.90	5.10	0.185	0.193	0.200
E	3.80	3.90	4.00	0.150	0.154	0.157
E1	5.80	6.00	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



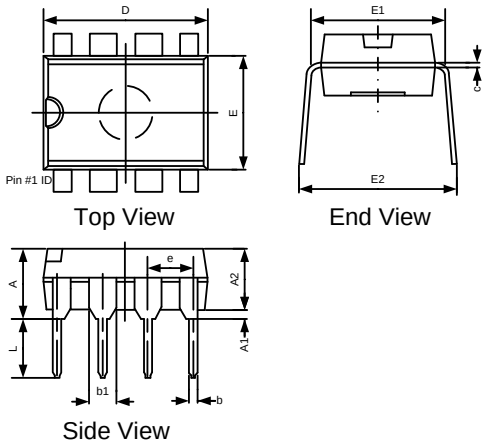
NOTES:
1. Compound dimension: 4.90×3.90;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

Tape and Reel Orientation



UM3488EEPA DIP8

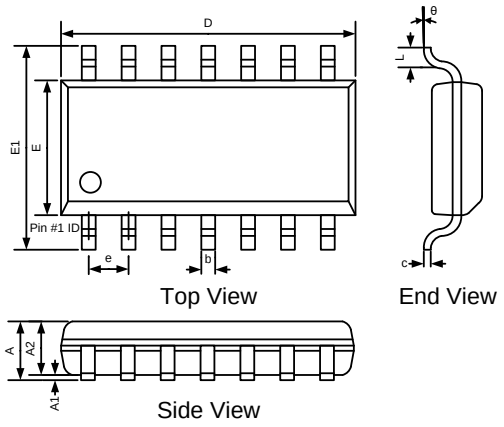
Outline Drawing



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

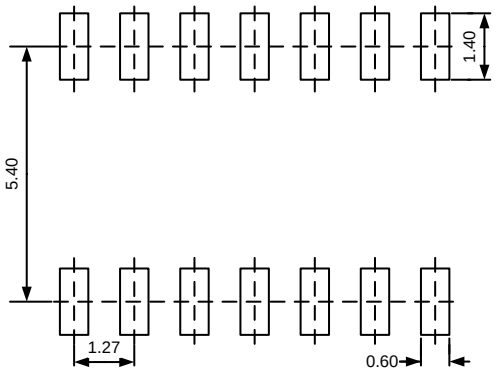
UM3491EESE SOP14

Outline Drawing



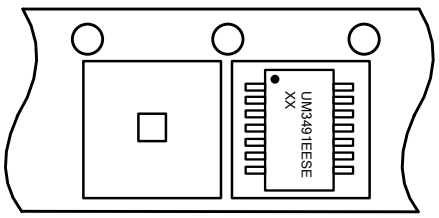
DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	1.35	1.60	1.75	0.053	0.063	0.069
A1	0.10	0.15	0.25	0.004	0.006	0.010
A2	1.25	1.45	1.65	0.049	0.057	0.065
b	0.36	-	0.51	0.014	-	0.020
c	0.17	-	0.25	0.007	-	0.010
D	8.53	8.63	8.73	0.336	0.340	0.344
E	3.80	3.90	4.00	0.150	0.154	0.157
E1	5.80	6.00	6.20	0.228	0.236	0.244
e	1.27BSC			0.050BSC		
L	0.45	0.60	0.80	0.018	0.024	0.031
θ	0 °	-	8 °	0 °	-	8 °

Land Pattern



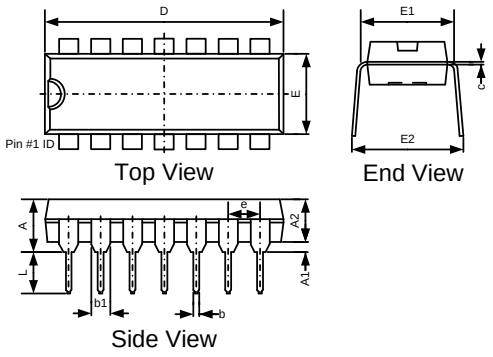
NOTES:
1. Compound dimension: 8.63×3.90 ;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

Tape and Reel Orientation



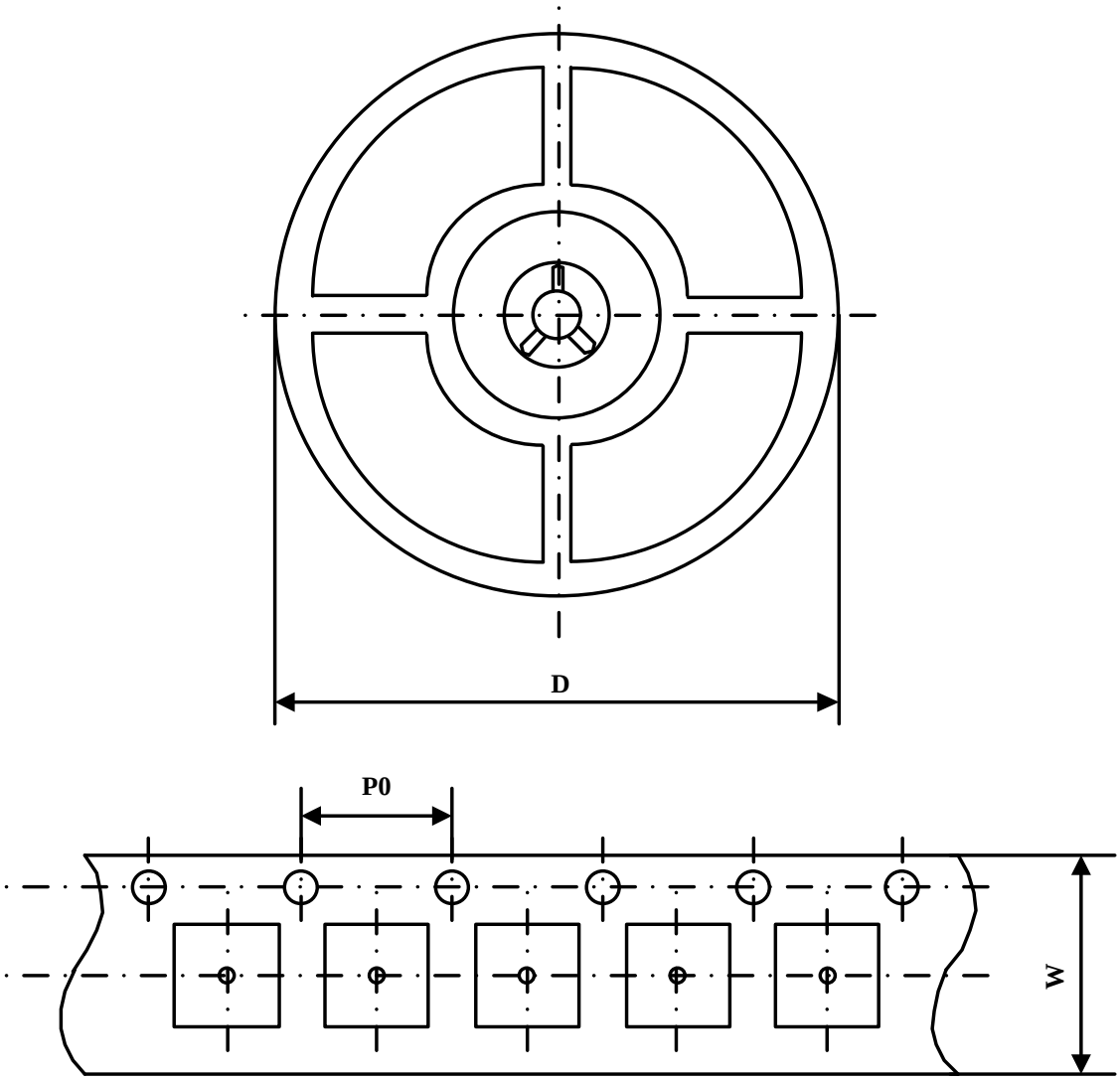
UM3491EEPE DIP14

Outline Drawing



DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	3.71	-	4.80	0.146	-	0.189
A1	0.50	-	-	0.020	-	-
A2	3.05	-	3.60	0.120	-	0.142
b	0.38	-	0.57	0.015	-	0.022
b1	1.52BSC			0.060BSC		
c	0.20	-	0.36	0.008	-	0.014
D	18.80	-	19.40	0.740	-	0.764
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	7.32	-	8.25	0.288	-	0.325
E2	7.62	-	10.90	0.300	-	0.429
e	2.54BSC			0.100BSC		
L	2.92	3.30	3.81	0.115	0.130	0.150

Packing Information



Part Number	Package Type	Carrier Width(W)	Pitch(P0)	Reel Size(D)
UM3488EESA	SOP8	12 mm	4 mm	330 mm
UM3491EESE	SOP14	16 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

The information in this document has been carefully reviewed and is believed to be accurate. Nonetheless, this document is subject to change without notice. Union assumes no responsibility for any inaccuracies that may be contained in this document, and makes no commitment to update or to keep current the contained information, or to notify a person or organization of any update. Union reserves the right to make changes, at any time, in order to improve reliability, function or design and to attempt to supply the best product possible.