3.0V to 5.5V，10Mbps, Fail-Safe, Hot-Swap, RS-485 Transceivers

UM13088S8 *SOP8*
UM13088M8 *MSOP8*
UM13088DA *DFN8 3.0×3.0*

General Description

The UM13088 are high-speed transceivers for RS-485 communication that contain one driver and one receiver. These devices feature fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open, shorted or idle. This means that the receiver output will be logic high if all transmitters on a terminated bus are disabled (high impedance). The UM13088 driver slew rates are not limited, making transmit speeds up to 10Mbps possible.
The transceivers typically draw 650μA of supply current when unloaded, or when fully loaded with the drivers disabled. All devices have a 1/8-unit-load receiver input impedance that allows up to 256 transceivers on the bus and are intended for half-duplex communications.

Applications

- RS-485 Transceivers
- Level Translators
- Industrial-Control Local Area Networks
- Telecommunications
- Security Systems
- Instrumentation

Features

- Data Rates up to 10 Mbps
- True Fail-Safe Receiver while Maintaining EIA/TIA-485 Compatibility
- -7V to +12V Common-Mode Input Voltage Range
- Allows up to 256 Transceivers on the Bus
- Thermal Shutdown
- Current-Limiting for Driver Overload Protection

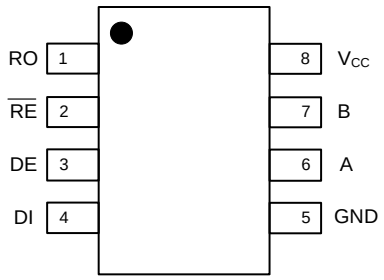
Ordering Information

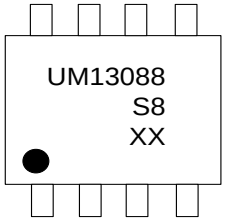
Part Number	Temp. Range	Marking Code	Package Type	Shipping Qty
UM13088S8	-40℃ to +85℃	UM13088S8	SOP8	3000pcs/13 Inch Tape & Reel
UM13088M8	-40℃ to +85℃	13088	MSOP8	4000pcs/13 Inch Tape & Reel
UM13088DA	-40℃ to +85℃	13088	DFN8 3.0×3.0	3000pcs/13 Inch Tape & Reel

Selection Guide

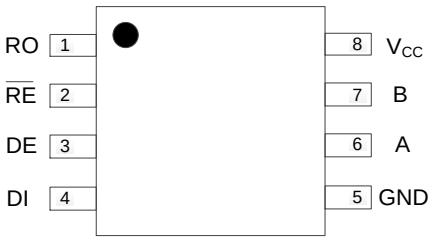
Part Number	Guaranteed Date Rate (Mbps)	Low-Power Shutdown	Slew-Rate Limited	Driver/ Receiver Enable	Transceivers On Bus
UM13088S8	10	Yes	No	Yes	256
UM13088M8	10	Yes	No	Yes	256
UM13088DA	10	Yes	No	Yes	256

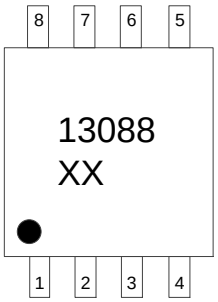
Pin Configurations **Top View**





XX: Week Code
UM13088S8
SOP8





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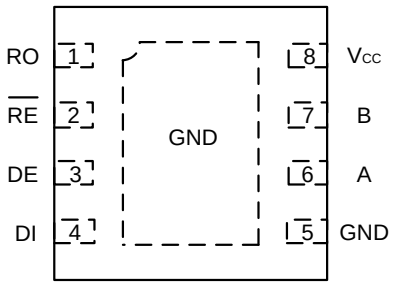
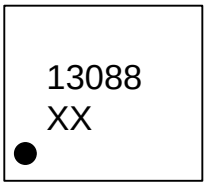




XX: Week Code
UM13088DA
DFN8 3.0×3.0

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	+6	V
	Control Input Voltage ($\overline{RE}$, DE)	-0.3V to (V_{CC} + 0.3V)	V
	Driver Input Voltage (DI)	-0.3V to (V_{CC} + 0.3V)	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} + 0.3V)	V
T_A	Ambient Temperature	-40 to +85	℃
T_J	Operating Junction Temperature	-40 to +125	℃
T_{STG}	Storage Temperature Range	-65 to +150	℃
T_L	Lead Temperature for Soldering 10 seconds	+260	℃

Package Thermal Impedance

Symbol	Parameter		Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	SOP8	121	℃/W
		MSOP8	165.69	
		DFN8 3.0×3.0	47.6	
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	SOP8	41	
		MSOP8	49.61	
		DFN8 3.0×3.0	49.4	

ESD Rating

Symbol	Parameter	Value	Unit
ESD Protection	HBM - Human Body Model (RS-485 bus pins A, B)	±8	kV
	HBM - Human Body Model (all other pins)	±4	

DC Electrical Characteristics

(V_{CC} = 3.0V to 5.5V, T_A = -40℃ to +85℃, unless otherwise noted.) (Note 1)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Power Supply							
Supply-Voltage Range	V_{CC}			3.0		5.5	V
Supply Current	I_{CC}	No Load, DI=GND or V_{CC}	DE=V_{CC}, $\overline{RE}$=0V or V_{CC}		0.65	1.3	mA
			DE=0V, $\overline{RE}$=0V		0.6	1.2	
Supply Current in Shutdown Mode	I_{SHDN}	DE=GND, $\overline{RE}$=V_{CC}			1	10	μA
Logic							
Input High Voltage	V_{IH}	DE, DI, $\overline{RE}$		2/3*V_{CC}			V
Input Low Voltage	V_{IL}	DE, DI, $\overline{RE}$				0.8	V
Input Hysteresis	V_{HYS}				300		mV
Logic Input Current	I_{IN1}	DE, DI, $\overline{RE}$		-1		1	μA
Receiver Output High Voltage (RO)	V_{OH}	I_{OUT}=-1mA		V_{CC} -0.6			V
Receiver Output Low Voltage (RO)	V_{OL}	I_{OUT}=1mA				0.4	V
Driver							
Differential Driver Output	V_{OD1}	No Load, Figure 2				V_{CC}	V
Differential Driver Output	V_{OD2}	R_L=54 Ω, V_{CC}=3.3V		1.5			V
Change-in-Magnitude of Differential Output Voltage	ΔV_{OD}	Figure 2, R_L=54Ω (Note 2)				0.2	V
Driver Common-Mode Output Voltage	V_{OC}	Figure 2, R_L=54Ω			V_{CC} /2	3.0	V
Change-in-Magnitude of Common-Mode Voltage	ΔV_{OC}	Figure 2, R_L=54Ω (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} = 3.0V to 5.5V, T_A = -40℃ to +85℃, unless otherwise noted.) (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 3.3V	V_{IN}=12V			1	mA
			V_{IN}= -7V	-0.8			
Three-State Output Current at Receiver	I_{OZR}	0V≤V_O≤V_{CC}				±1	μA
Receiver Output Short Circuit Current	I_{OSR}	0V≤V_{RO}≤V_{CC}		±8		±60	mA

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} = 3.0V to 5.5V, T_A = -40℃ to +85℃, unless otherwise noted.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Maximum Data Rate	f_{MAX}			10		Mbps
Driver Input-to-Output	t_{DPLH}	Figure 3 and 6, R_{DIFF}=54Ω, C_{L1}=C_{L2}=50pF	10	25	50	ns
	t_{DPHL}		10	25	50	
Driver Output Skew $\|t_{DPLH} - t_{DPHL}\|$	t_{DSKEW}	Figure 3 and 6, R_{DIFF}=54Ω, C_{L1}=C_{L2}=50pF		5	10	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	Figure 3 and 6, R_{DIFF}=54Ω, C_{L1}=C_{L2}=50pF			15	ns
Driver Enable to Output High	t_{DZH}	Figure 4 and 7, C_L=50pF, S2 Closed		40	70	ns
Driver Enable to Output Low	t_{DZL}	Figure 4 and 7, C_L=50pF, S1 Closed		40	70	ns
Driver Disable Time from Low	t_{DLZ}	Figure 4 and 7, C_L=50pF, S1 Closed		40	70	ns
Driver Disable Time from High	t_{DHZ}	Figure 4 and 7, C_L=50pF, S2 Closed		40	70	ns
Receiver Input to Output	t_{RPLH}, t_{RPHL}	C_L=15pF, Figure 8, $\|V_{ID}\|$≥2.0V, Rise and Fall Time of V_{ID}≤15ns	20	50	80	ns
Differential Receiver Skew $\|t_{RPLH} - t_{RPHL}\|$	t_{RSKD}	C_L=15pF, Figure 8, $\|V_{ID}\|$≥2.0V, Rise and Fall Time of V_{ID}≤15ns		8	15	ns
Receiver Enable to Output Low	t_{RZL}	Figure 5 and 9, C_L=15pF, S1 Closed		25	50	ns
Receiver Enable to Output High	t_{RZH}	Figure 5 and 9, C_L=15pF, S2 Closed		25	50	ns
Receiver Disable Time from Low	t_{RLZ}	Figure 5 and 9, C_L=15pF, S1 Closed		25	50	ns
Receiver Disable Time from High	t_{RHZ}	Figure 5 and 9, C_L=15pF, S2 Closed		25	50	ns
Time to Shutdown	t_{SHDN}	(Note 4)			1000	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figure 4 and 7, C_L=15pF, S2 Closed		3.0		μs
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figure 4 and 7, C_L=15pF, S1 Closed		3.0		μs
Receiver Enable from Shutdown to Output High	$t_{RZH(SHDN)}$	Figure 5 and 9, C_L=15pF, S2 Closed		3.0		μs
Receiver Enable from Shutdown to Output Low	$t_{RZL(SHDN)}$	Figure 5 and 9, C_L=15pF, S1 Closed		3.0		μs

Note 4: The device is put into shutdown by bringing $\overline{RE}$ high and DE low.

Communication Function

Table1. Transmitting

Inputs			Outputs		Mode
$\overline{RE}$	DE	DI	B	A	
X	1	1	0	1	Normal
X	1	0	1	0	Normal
0	0	X	High-Z	High-Z	Normal
1	0	X	High-Z	High-Z	Shutdown

Note：X=Don’t care; High-Z=High Impedance

Table2. Receiving

Inputs			Outputs	Mode
$\overline{RE}$	DE	A, B	RO	
0	X	≥ -50mV	1	Normal
0	X	≤ -200mV	0	Normal
0	X	Open/Shorted	1	Normal
1	0	X	High-Z	Shutdown

Note：X=Don’t care; High-Z=High Impedance

Typical Operating Circuit

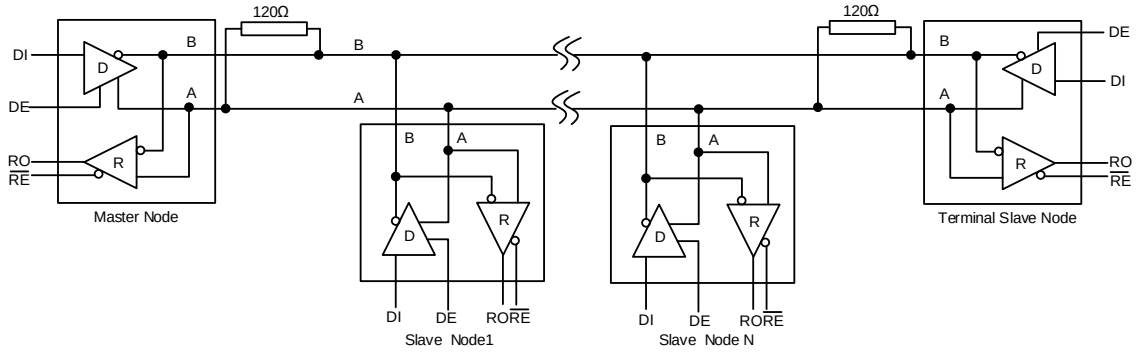


Figure 1. Typical Half-Duplex RS-485 Network

Test Circuit

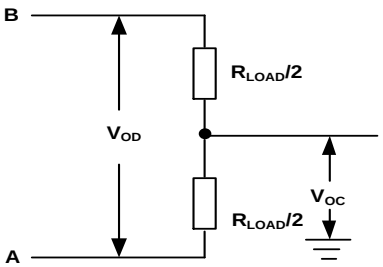


Figure 2. Driver DC Test Load

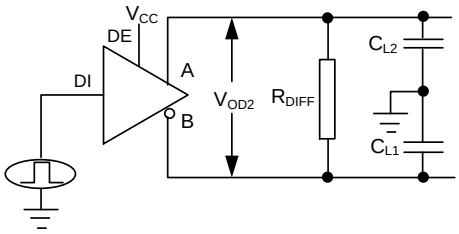


Figure 3. Driver Timing Test Circuit

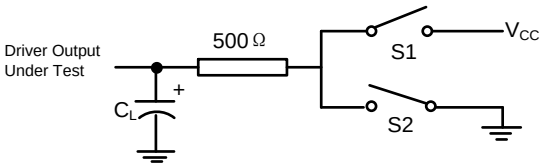


Figure 4. Driver Enable/Disable Timing Test Load

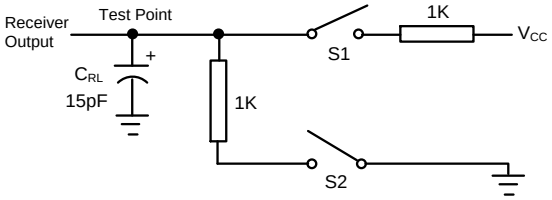


Figure 5. Receiver Enable/Disable Timing Test Load

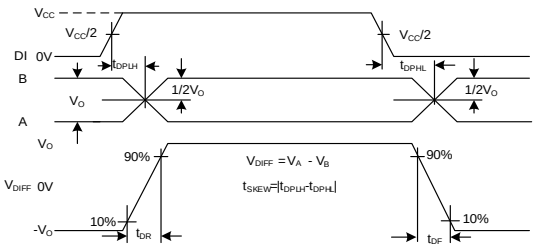


Figure 6. Driver Propagation Delays

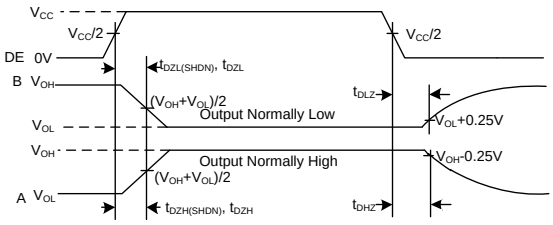


Figure 7. Driver Enable and Disable Times

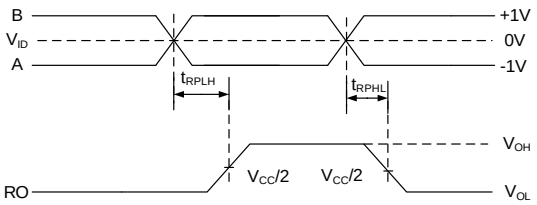


Figure 8. Receiver Propagation Delays

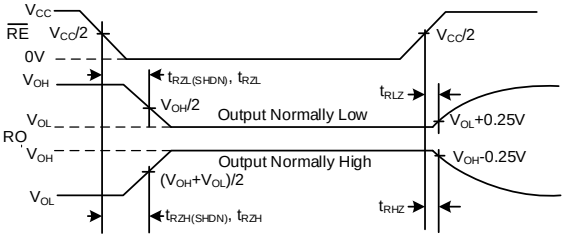


Figure 9. Receiver Enable and Disable Times

Detail Description

The UM13088 high-speed transceivers for RS-485 communication contain one driver and one receiver. These devices feature 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 UM13088 driver slew rates are not limited, making transmit speeds up to 10Mbps possible.

The UM13088 RS-485 transceivers operate with a V_{CC} voltage supply from 3V to 5.5V 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 UM13088 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 UM13088, 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 and/or other RS-485 transceivers with a total of 32 unit loads or less can be connected to the line.

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.

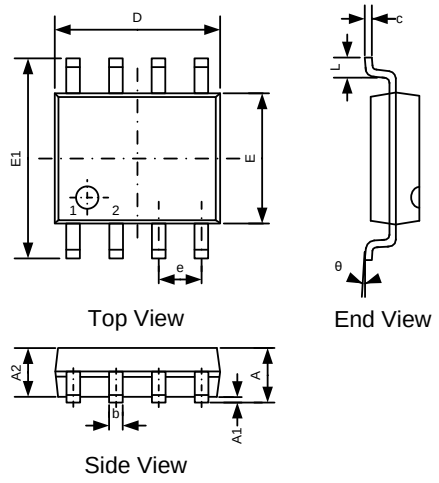
Typical Applications

The UM13088 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 off the main line should be kept as short as possible.

Package Information

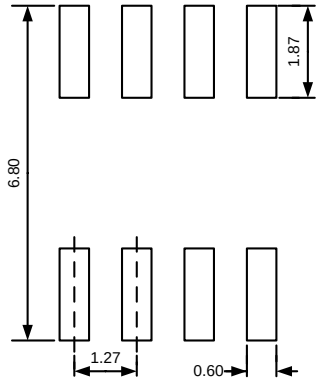
SOP8

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 °

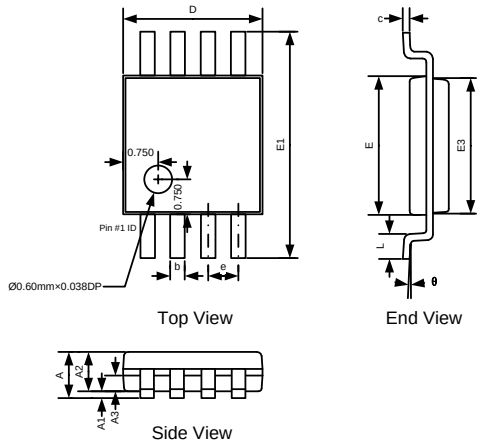
Land Pattern



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.

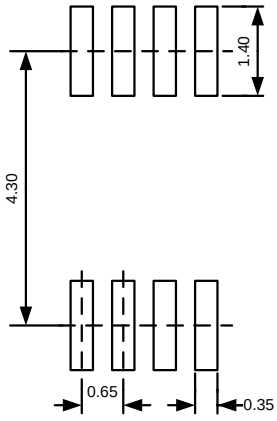
MSOP8

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°

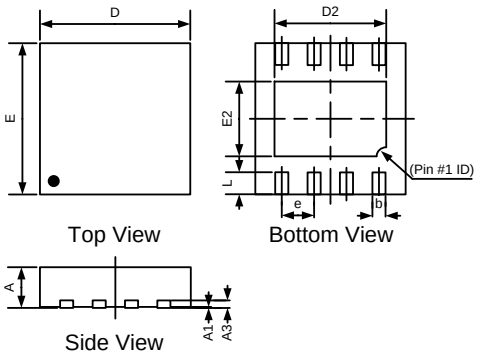
Land Pattern



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.

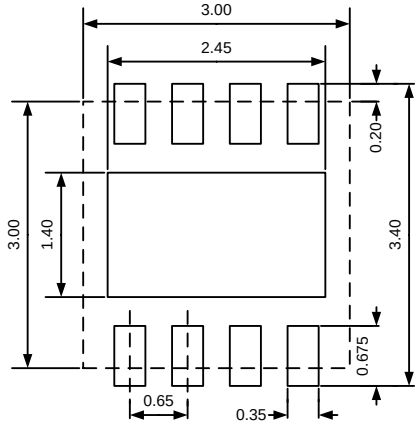
DFN8 3.0×3.0

Outline Drawing



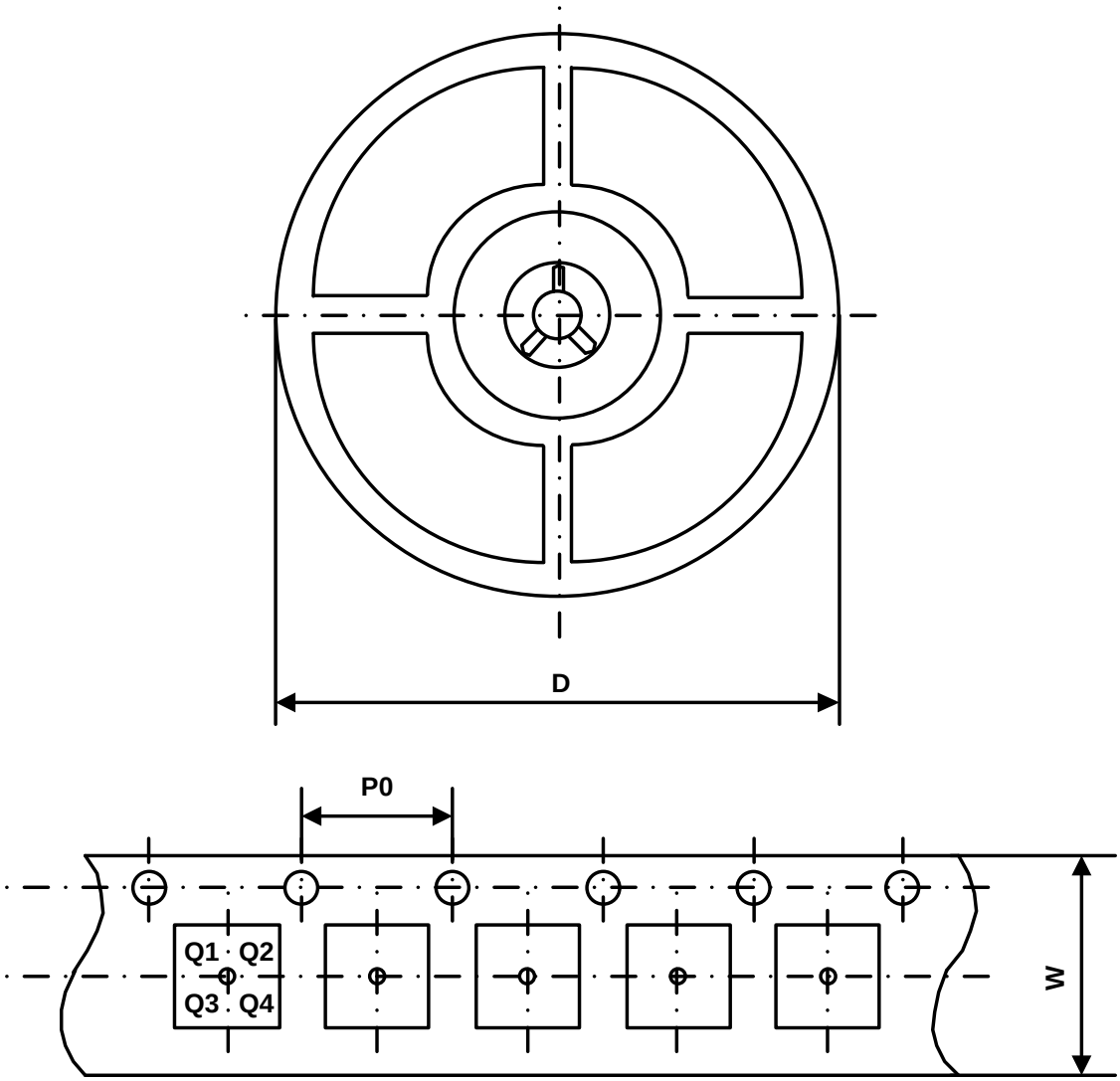
DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	0.57	-	0.80	0.022	-	0.031
A1	0.00	-	0.05	0.000	-	0.002
A3	0.20REF			0.008REF		
b	0.20	-	0.35	0.008	-	0.014
D	2.90	3.00	3.10	0.114	0.118	0.122
D2	2.15	-	2.55	0.085	-	0.100
E	2.90	3.00	3.10	0.114	0.118	0.122
E2	1.40	-	1.75	0.055	-	0.069
e	0.65BSC			0.026BSC		
L	0.30	-	0.60	0.012	-	0.024

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)	Reel Size (D)	PIN 1 Quadrant
UM13088S8	SOP8	12 mm	4 mm	330 mm	Q1
UM13088M8	MSOP8	12 mm	4 mm	330 mm	Q1
UM13088DA	DFN8 3.0×3.0	12 mm	4 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

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