

## Wide Supply RS-485 Transceiver with 1.65V-5.5V I/O Interface

UM13430DA DFN10 3.0×3.0

### General Description

The UM13430DA is a 3.0V to 5.5V RS-485 transceiver designed to meet the increasing system requirements found in today's communication, infrastructure and industrial equipment environments. This is a wide supply (3.0V to 5.5V) device that operates at maximum data rate of 10 Mbps and features a 1.65V to 5.5V I/O logic supply, simplifying multi-voltage system interfacing requirements.

The receiver includes full fail-safe circuitry, guaranteeing a logic-high receiver output when the receiver inputs are open, shorted or floating. The UM13430DA receiver input impedance is at least 96kΩ (1/8 unit load), allowing more than 256 devices on the bus.

The driver is protected by short circuit detection as well as thermal shutdown and maintains high impedance in shutdown or when powered off. The UM13430DA does not have slew limiting and is intended for high-speed applications requiring data rates up to 10Mbps.

The chip can enter a 1μA low current shutdown mode for extreme power savings.

The UM13430DA is a half-duplex device that operates at max data rates of 10Mbps. It is available in a 10-pin DFN package.

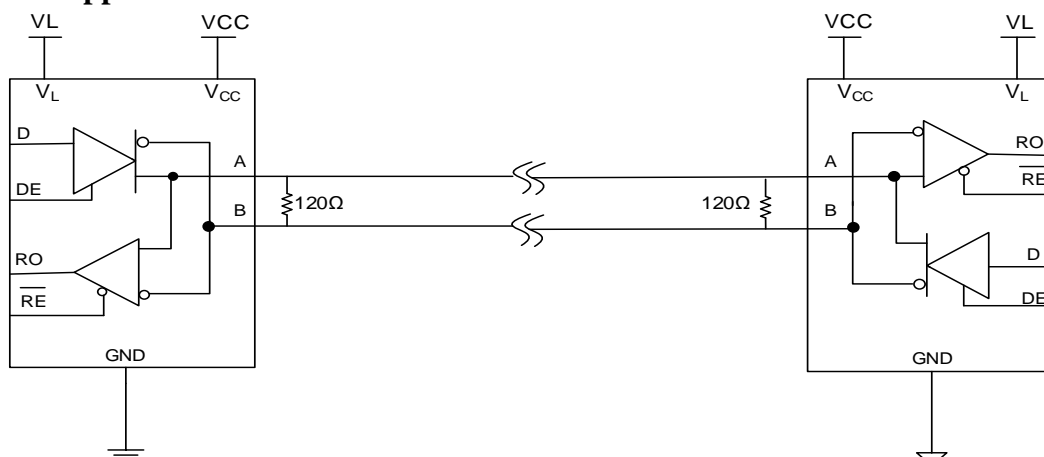
### Applications

- Telecom Infrastructure
- High Speed data links
- Low Voltage μC Communications
- Industrial control equipment
- Building security and automation

### Features

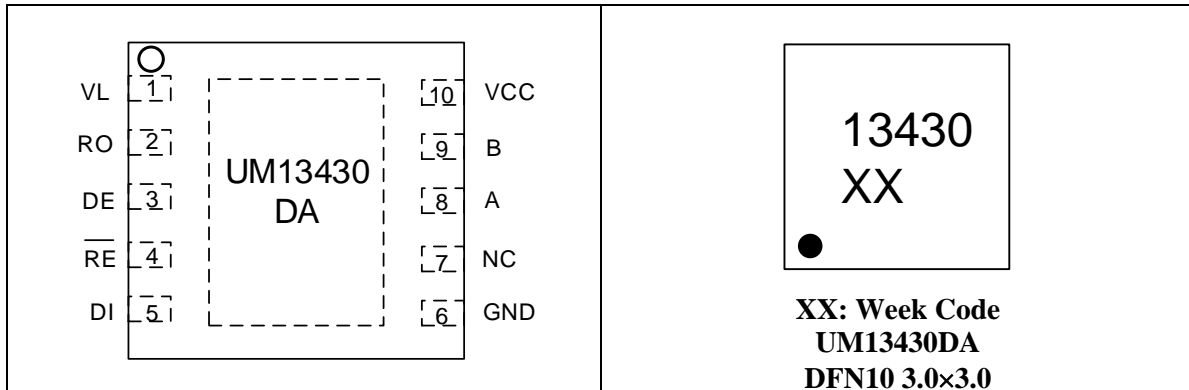
- Wide 3.0V to 5.5V supply operation
- 1.65V to 5.5V I/O logic interface V<sub>L</sub> pin
- Max data rate of 10Mbps
- 1/8 unit load, up to 256 receivers
- Robust ESD protection for RS-485 bus pins
- Driver short circuit limit and thermal shutdown for overload protection
- -40 °C to 85 °C operating temperature range
- Lead-free (RoHS 6) DFN

### Typical Application Circuit



## Pin Configurations

## Top View



## Pin Description

Pin Number	Symbol	Description
1	V <sub>L</sub>	I/O power supply, sets the logic levels for RO, DE, $\overline{RE}$ and DI
2	RO	Receiver Output
3	DE	Driver enable, driver active when DE = 1, disabled when DE = 0
4	$\overline{RE}$	Receiver enable, receiver is disabled when $\overline{RE}$ = 1, enabled when $\overline{RE}$ = 0
5	DI	Driver input
6	GND	Ground
7	NC	No connection, can be connected to ground
8	A	RS-485 half-duplex non-inverting receiver input and non-inverting driver output
9	B	RS-485 half-duplex inverting receiver input and inverting driver output
10	V <sub>CC</sub>	Power supply

## Ordering Information

Part Number	Packaging Type	Marking Code	Shipping Qty
UM13430DA	DFN10 3.0x3.0	13430	3000pcs/13Inch Tape & Reel

**Absolute Maximum Ratings (Note 1)**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	V <sub>CC</sub> Supply Voltage	-0.3 to +6.0	V
V <sub>L</sub>	Logic Interface Voltage	-0.3 to +6.0	V
V <sub>DE</sub> , V <sub>DI</sub> , V <sub>RE</sub>	Logic Input Voltage	-0.3 to +6.0	V
V <sub>RO</sub>	Receiver Output Voltage	-0.3 to V <sub>L</sub> +0.3	V
V <sub>A</sub> /V <sub>B</sub>	Driver Output Voltage/Receiver Input Voltage	-7.5 to +12.5	V
T <sub>OP</sub>	Operating Temperature Range	-40 to +85	°C
T <sub>J</sub>	Operating Junction Temperature	-40 to +125	°C
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (Soldering, 10s)	+260	°C

Note 1: Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

**Package Thermal Impedance**

Symbol	Parameter	Value	Unit
θ <sub>JA</sub>	Junction-to-ambient thermal resistance	41	°C/W
θ <sub>JC</sub>	Junction-to-case thermal resistance	9	°C/W

**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	

## Electrical Characteristics

( $V_{CC} = +3V$  to  $+5.5V$ ,  $V_L = +1.65V$  to  $V_{CC}$ ,  $T_A = -40\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ , unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Power Supply</b>						
$V_{CC}$	Supply-Voltage Range		3.0		5.5	V
$V_L$	Supply-Voltage Range		1.65		$V_{CC}$	
$I_{CC}$	Supply Current				2	mA
$I_{SHDN}$	Supply Current in Shutdown Mode			1	10	$\mu\text{A}$
<b>Driver DC Characteristics</b>						
$V_{OD}$	Differential Driver Output	Figure1 $R_L=54\ \Omega$ , $V_{CC}=3.3V$	1.5		$V_{CC}$	V
		$R_L=54\ \Omega$ , $V_{CC}=4.5V$	2		$V_{CC}$	V
$\Delta V_{OD}$ (Note1)	Change in Magnitude of Differential Output Voltage	Figure1, $R_L=54\ \Omega$	-0.2		0.2	V
$V_{OC}$	Driver Common Mode Output Voltage (Steady State)	Figure1, $R_L=54\ \Omega$		$V_{CC}/2$	3	V
$\Delta V_{OC}$ (Note1)	Change in Driver Common Mode Output Voltage	Figure1, $R_L=54\ \Omega$	-0.2		0.2	V
$I_{A, B}$	Input Current (A or B)	$V_{OUT}=12V$ , $DE=0V$ , $V_{CC}=0V$ or $5.5V$			125	$\mu\text{A}$
		$V_{OUT}=-7V$ , $DE=0V$ , $V_{CC}=0V$ or $5.5V$	-100			$\mu\text{A}$
$I_{OSD}$ (Note2)	Driver short circuit output current	$-7V \leq V_{OUT} \leq 12V$	-250		250	mA
<b>Receiver DC Characteristics</b>						
$V_{TH}$	Receiver Differential Threshold Voltage ( $V_A-V_B$ )	$-7V \leq V_{CM} \leq 12V$	-200		-50	mV
$\Delta V_{TH}$	Receiver Input Hysteresis	$V_{CM}=0V$		25		mV
$R_{IN}$	Receiver Input Resistance	$-7V \leq V_{CM} \leq 12V$	96			k $\Omega$
$I_{OSR}$	Receiver Output Short Circuit Current	$0V \leq V_{RO} \leq V_L$	-100		100	mA
$I_{OZR}$	High-Z receiver output current	$0V \leq V_{OUT} \leq V_L$	-1		1	$\mu\text{A}$
<b>Logic Input and Output</b>						
$V_{IH}$	Logic Input thresholds (DI, DE, RE) $1.65V \leq V_L \leq 5.5V$ & $V_L \leq V_{CC}$	Logic Input High	$2/3 * V_L$			V
$V_{IL}$		Logic Input Low			$1/3 * V_L$	
$V_{HYS}$	Input Hysteresis (DI, DE, RE)			300		mV
$I_{IN1}$	Logic Input Current	DE, DI, RE	-1		1	$\mu\text{A}$
$V_{OH}$	Receiver Output High Voltage (RO)	$I_{OUT}=-1mA$	$V_L-0.6$			V
$V_{OL}$	Receiver Output Low Voltage (RO)	$I_{OUT}=1mA$			0.4	V

Note1 :  $\Delta V_{OD}$  and  $\Delta V_{OC}$  are the changes in  $V_{OD}$  and  $V_{OC}$ , respectively, when the DI input changes state.

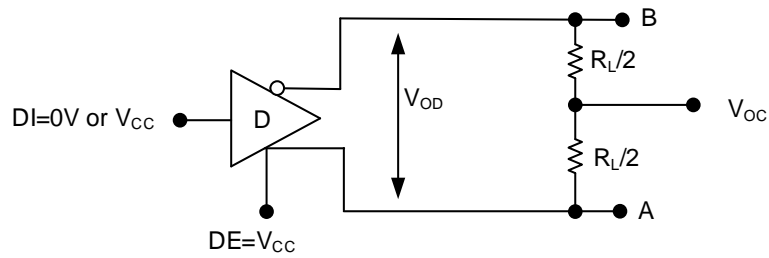
Note2 : The short-circuit output current is the peak current just prior to current limiting; the short-circuit foldback output current applies during current limiting to allow a recovery from bus contention.

## Switching Characteristics

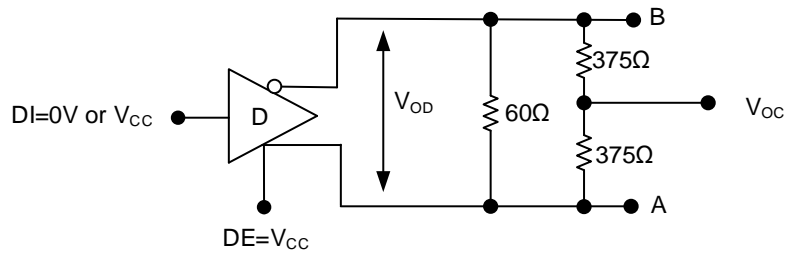
( $V_{CC} = +3V$  to  $+5.5V$ ,  $V_L = +1.65V$  to  $+V_{CC}$ ,  $T_A = -40\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ , unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Driver AC Characteristics</b>						
$t_{DPLH}$	Driver prop delay (low to high)	See Figure3 $R_L=54\ \Omega$ , $C_L=50\text{pF}$			60	ns
$t_{DPHL}$	Driver prop delay (high to low)	See Figure3 $R_L=54\ \Omega$ , $C_L=50\text{pF}$			60	ns
$t_{DSKEW}$	Differential Driver Output Skew $ t_{DPLH} - t_{DPHL} $	See Figure3 $R_L=54\ \Omega$ , $C_L=50\text{pF}$			10	ns
$t_{DR}$ , $t_{DF}$	Differential Driver Output Rise Time or Fall Time	See Figure3 $R_L=54\ \Omega$ , $C_L=50\text{pF}$			15	ns
$f_{MAX}$	Maximum Data Rate	Duty Cycle 40% to 60%		10		Mbps
$t_{DZH}$	Driver Enable to Output High	See Figure4 $R_L=500\ \Omega$ , $C_L=50\text{pF}$			100	ns
$t_{DZL}$	Driver Enable to Output Low	See Figure4 $R_L=500\ \Omega$ , $C_L=50\text{pF}$			100	ns
$t_{DZH}$	Driver Disable from Output High	See Figure4 $R_L=500\ \Omega$ , $C_L=50\text{pF}$			100	ns
$t_{DLZ}$	Driver Disable from Output Low	See Figure4 $R_L=500\ \Omega$ , $C_L=50\text{pF}$			100	ns
$t_{DZH(SHDN)}$	Driver Enable from Shutdown to output high	See Figure4 $R_L=500\ \Omega$ , $C_L=50\text{pF}$			5000	ns
$t_{DZL(SHDN)}$	Driver Enable from Shutdown to output low	See Figure4 $R_L=500\ \Omega$ , $C_L=50\text{pF}$			5000	ns
$t_{SHDN}$	Time to Shutdown				1000	ns
<b>Receiver AC Characteristics</b>						
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{RPLH}$	Receiver prop delay (low to high)	See Figure5 $C_L=15\text{pF}$	30	60	90	ns
$t_{RPHL}$	Receiver prop delay (high to low)	See Figure5 $C_L=15\text{pF}$	30	60	90	ns
$t_{RSKEW}$	Differential Receiver Output Skew $ t_{RPLH}-t_{RPHL} $	$C_L=15\text{pF}$			10	ns
$f_{MAX}$	Maximum Data Rate	Duty Cycle 40% to 60%		10		Mbps
$t_{RZH}$	Receiver enable to output high	See Figure6 $R_L=1\text{k}\Omega$ , $C_L=15\text{pF}$			100	ns
$t_{RZL}$	Receiver enable to output low	See Figure6 $R_L=1\text{k}\Omega$ , $C_L=15\text{pF}$			100	ns
$t_{RHZ}$	Receiver Disable from output high	See Figure6 $R_L=1\text{k}\Omega$ , $C_L=15\text{pF}$			100	ns
$t_{RLZ}$	Receiver Disable from output low	See Figure6 $R_L=1\text{k}\Omega$ , $C_L=15\text{pF}$			100	ns
$t_{RZH(SHDN)}$	Receiver enable from shutdown to output high	See Figure6 $R_L=1\text{k}\Omega$ , $C_L=15\text{pF}$			5000	ns
$t_{RZL(SHDN)}$	Receiver enable from shutdown to output low	See Figure6 $R_L=1\text{k}\Omega$ , $C_L=15\text{pF}$			5000	ns
$t_{SHDN}$	Time to shutdown				1000	ns

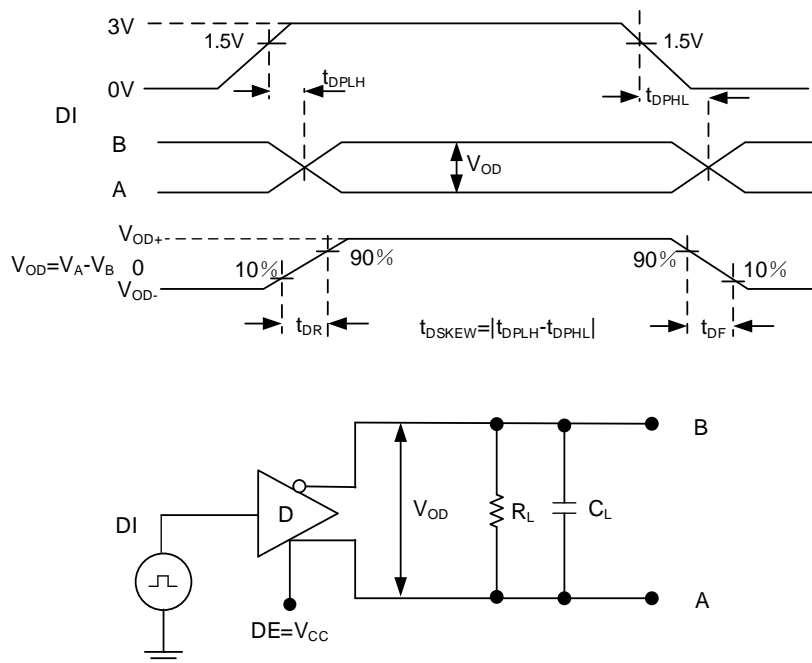
## Parameter Measurement Information



**Figure 1. Differential Driver Output Voltage**

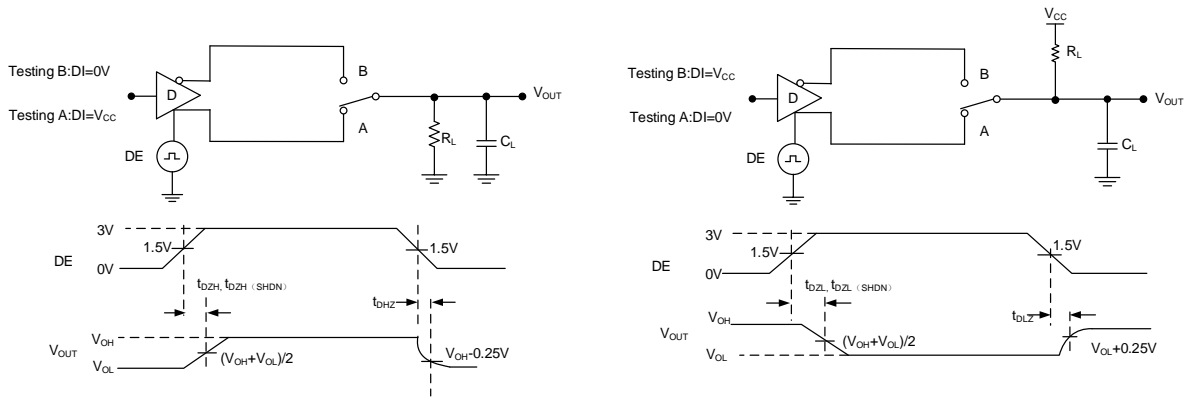


**Figure 2. Differential Driver Output Voltage Over Common Mode**

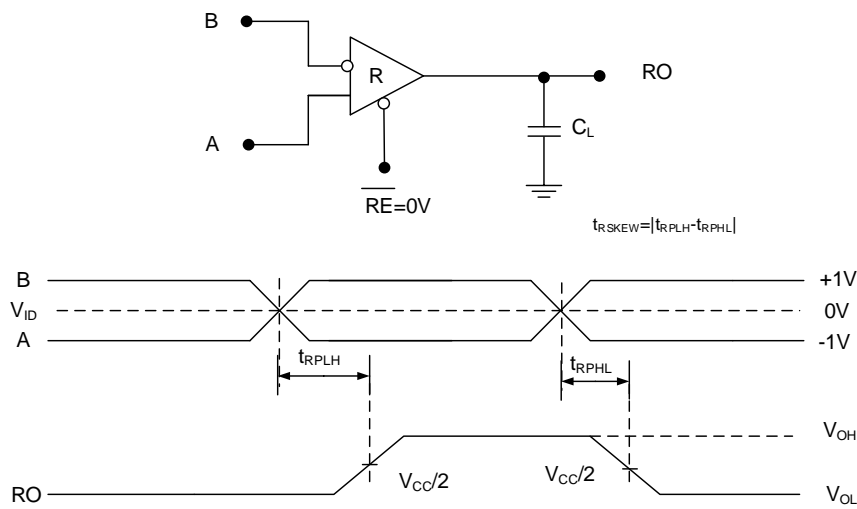


**Figure 3. Driver Propagation Delay Test Circuit and Timing Diagram**

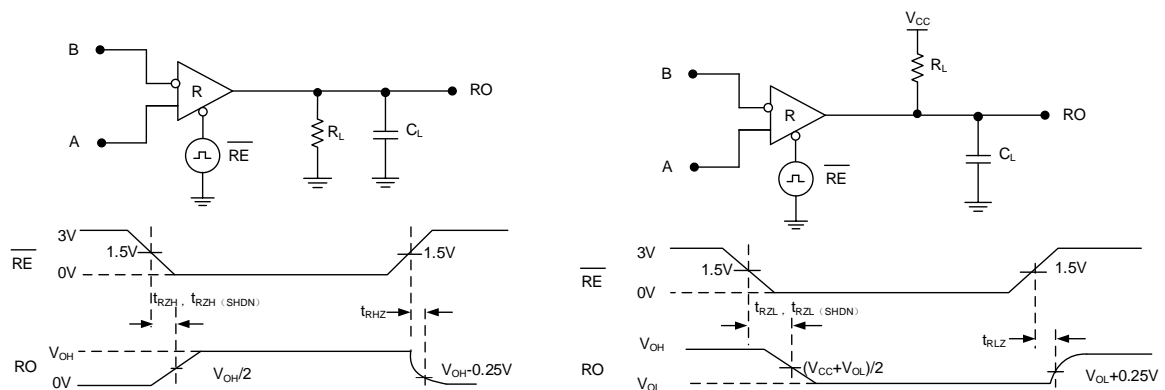
## Parameter Measurement Information (continued)



**Figure 4. Driver Enable and Disable Timing Test Circuits and Timing Diagrams**



**Figure 5. Receiver Propagation Delay Test Circuit and Timing Diagram**



**Figure 6. Receiver Enable and Disable Test Circuits and Timing Diagrams**

## Device Function Table

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

Receiving			
Inputs			Output
$\overline{RE}$	DE	$V_A - V_B$	RO
0	X	$\geq -50\text{mV}$	1
0	X	$-200\text{mV} < V_A - V_B < -50\text{mV}$	Undefined
0	X	$\leq -200\text{mV}$	0
0	X	Open/Shorted/Idle	1
1	1	X	High -Z
1	0	X	Shutdown

## Typical Operating Characteristics

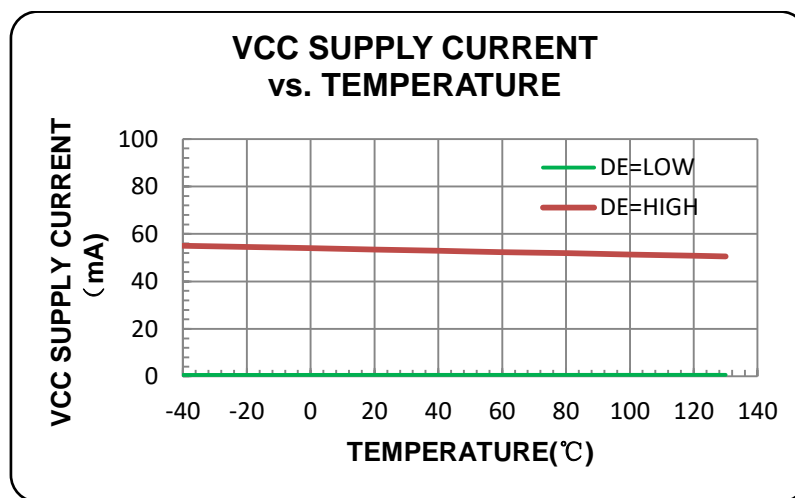


Figure 7. V<sub>CC</sub> Supply Current vs. Temperature



Typical Operating Characteristics (continued)

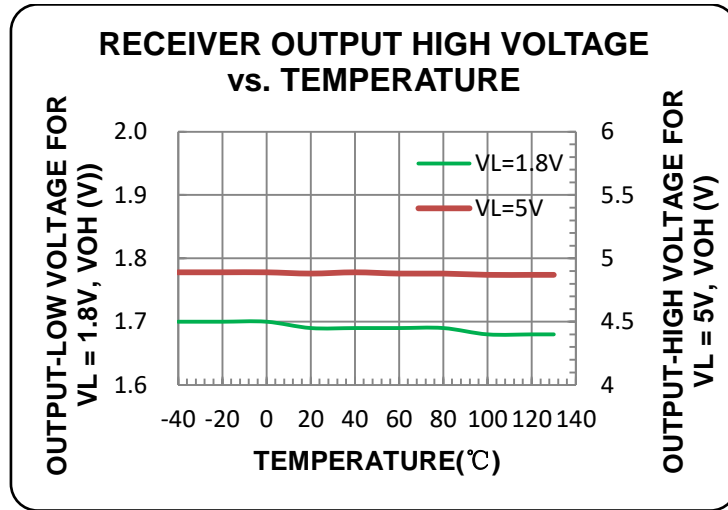


Figure 8. Receiver Output High Voltage vs. Temperature

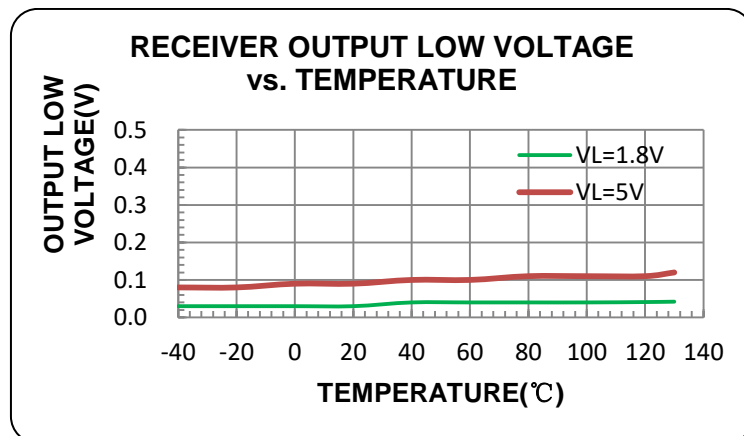


Figure 9. Receiver Output Low Voltage vs. Temperature

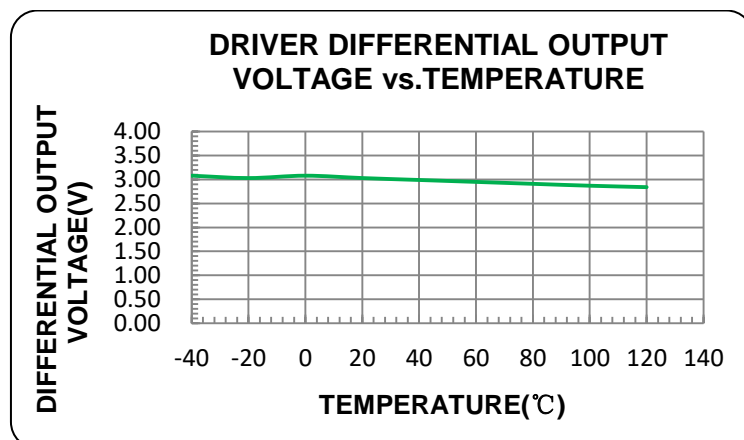
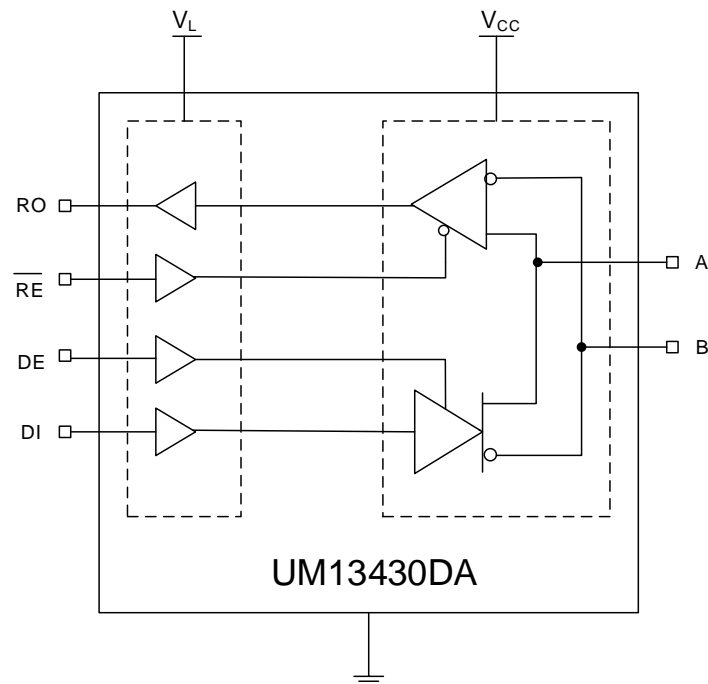


Figure 10. Driver Differential Output Voltage vs. Temperature

## Block Diagram



**Figure 11. Block Diagram:**

## Detail Description

The UM13430DA 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 UM13430DA driver slew rates are not limited, making transmit speeds up to 10Mbps possible.

The UM13430DA 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 UM13430DA 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 UM13430DA, 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  $\pm 200$ mV EIA/TIA-485 standard.

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## Applications Information

### 256 Transceivers on the Bus

The standard RS-485 receiver input impedance is  $12\text{k}\Omega$  (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 ( $96\text{k}\Omega$ ), 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 UM13430DA 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.

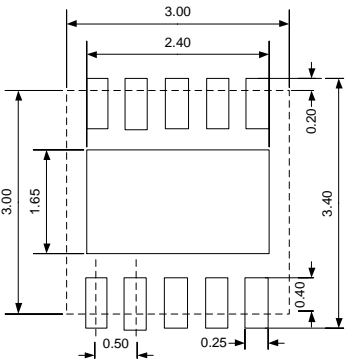
## Package Information

### UM13430DA DFN10 3.0 × 3.0

#### Outline Drawing

DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	0.70	0.75	0.80	0.028	0.030	0.032
A1	0.00	0.02	0.05	0.000	0.001	0.002
A3	0.20REF			0.008REF		
b	0.20	0.25	0.30	0.008	0.010	0.012
D	2.90	3.00	3.10	0.116	0.120	0.124
E	2.90	3.00	3.10	0.116	0.120	0.124
D2	1.55	1.65	1.75	0.062	0.066	0.070
E2	2.30	2.40	2.50	0.092	0.096	0.100
e	0.40	0.50	0.60	0.016	0.020	0.024
K	0.175	0.275	0.375	0.007	0.011	0.015
L	0.35	0.40	0.45	0.014	0.016	0.018
R	0.20REF			0.008REF		

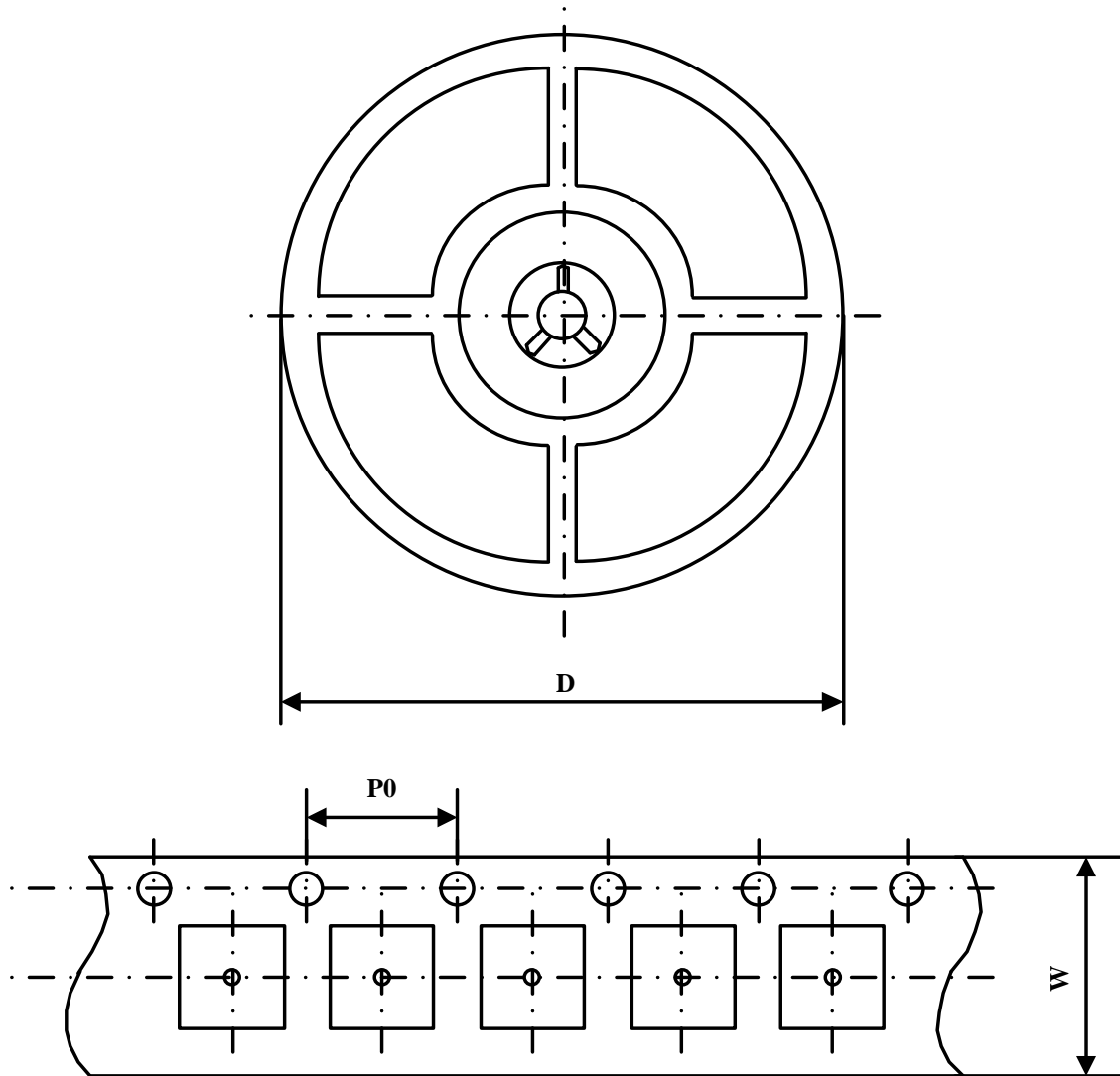
#### Land Pattern

	<p>NOTES:</p> <ol style="list-style-type: none"> <li>Compound dimension: 3.00×3.00;</li> <li>Unit: mm;</li> <li>General tolerance <math>\pm 0.05\text{mm}</math> unless otherwise specified;</li> <li>The layout is just for reference.</li> </ol>
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#### Tape and Reel Orientation



## Packing Information



Part Number	Package Type	Carrier Width(W)	Pitch(P0)	Reel Size(D)
UM13430DA	DFN10 3.0×3.0	12 mm	4 mm	330 mm

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