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.

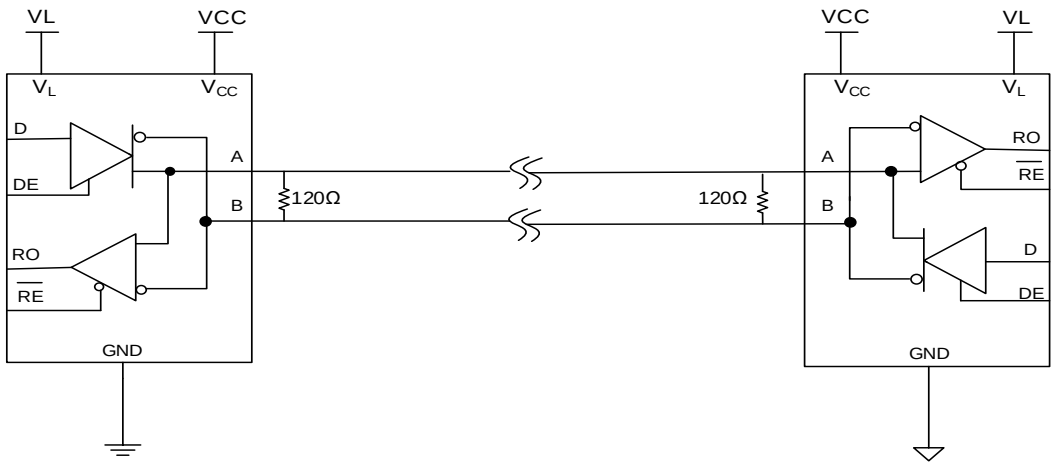
Applications

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

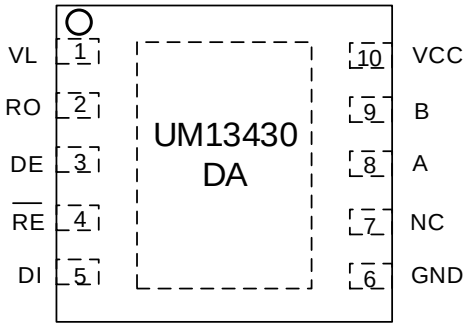
Features

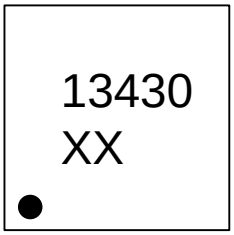
- Wide 3.0V to 5.5V supply operation
- 1.65V to 5.5V I/O logic interface V_L pin
- Max data rate of 10Mbps
- 1/8 unit load, up to 256 receivers
- Robust ESD protection for RS-485 bus pins
- Driver short circuit limit and thermal shutdown for overload protection
- -40℃ to 85℃ operating temperature range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

Typical Application Circuit



Pin Configurations **Top View**





XX: Week Code
UM13430DA
DFN10 3.0×3.0

Pin Description

Pin Number	Symbol	Description
1	V_L	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_{CC}	Power supply

Ordering Information

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

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Value	Unit
V_{CC}	V_{CC} Supply Voltage	-0.3 to +6.0	V
V_L	Logic Interface Voltage	-0.3 to +6.0	V
V_{DE}, V_{DI}, $V_{/RE}$	Logic Input Voltage	-0.3 to +6.0	V
V_{RO}	Receiver Output Voltage	-0.3 to V_L+0.3	V
V_A/V_B	Driver Output Voltage/Receiver Input Voltage	-7.5 to +12.5	V
T_{OP}	Operating Temperature Range	-40 to +85	℃
T_J	Operating Junction Temperature	-40 to +125	℃
T_{STG}	Storage Temperature Range	-65 to +150	℃
T_L	Lead Temperature (Soldering, 10s)	+260	℃

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_{JA}	Junction-to-ambient thermal resistance	41	℃/W
θ_{JC}	Junction-to-case thermal resistance	9	℃/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℃ to +85℃, unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Power Supply						
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	μA
Driver DC Characteristics						
V_{OD}	Differential Driver Output	Figure1 R_L=54 Ω, V_{CC}=3.3V	1.5		V_{CC}	V
		R_L=54 Ω, V_{CC}=4.5V	2		V_{CC}	V
ΔV_{OD} （Note1）	Change in Magnitude of Differential Output Voltage	Figure1，R_L=54 Ω	-0.2		0.2	V
V_{OC}	Driver Common Mode Output Voltage (Steady State)	Figure1，R_L=54 Ω		V_{CC}/2	3	V
ΔV_{OC} （Note1）	Change in Driver Common Mode Output Voltage	Figure1，R_L=54 Ω	-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	μA
		V_{OUT}=-7V，DE=0V, V_{CC}=0V or 5.5V	-100			μA
I_{OSD} （Note2）	Driver short circuit output current	-7V≤V_{OUT}≤ 12V	-250		250	mA
Receiver DC Characteristics						
V_{TH}	Receiver Differential Threshold Voltage (V_A-V_B)	-7V≤V_{CM}≤ 12V	-200		-50	mV
ΔV_{TH}	Receiver Input Hysteresis	V_{CM}=0V		25		mV
R_{IN}	Receiver Input Resistance	-7V≤V_{CM}≤ 12V	96			kΩ
I_{OSR}	Receiver Output Short Circuit Current	0V≤V_{RO}≤ V_L	-100		100	mA
I_{OZR}	High-Z receiver output current	0V ≤ V_{OUT} ≤ VL	-1		1	μA
Logic Input and Output						
V_{IH}	Logic Input thresholds (DI, DE, $\overline{RE}$) 1.65V≤V_L≤ 5.5V & V_L≤ V_{CC}	Logic Input High	2/3 *V_L			V
V_{IL}		Logic Input Low			1/3 *V_L	V
V_{HYS}	Input Hysteresis (DI, DE, $\overline{RE}$)			300		mV
I_{IN1}	Logic Input Current	DE, DI, $\overline{RE}$	-1		1	μA
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：ΔV_{OD} and ΔV_{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℃ to +85℃, unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Driver AC Characteristics						
t_{DPLH}	Driver prop delay (low to high)	See Figure3 R_L=54 Ω, C_L=50pF			60	ns
t_{DPHL}	Driver prop delay (high to low)	See Figure3 R_L=54 Ω, C_L=50pF			60	ns
t_{DSKEW}	Differential Driver Output Skew $\|t_{DPLH} - t_{DPHL}\|$	See Figure3 R_L=54 Ω, C_L=50pF			10	ns
t_{DR}, t_{DF}	Differential Driver Output Rise Time or Fall Time	See Figure3 R_L=54 Ω, C_L=50pF			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 Ω, C_L=50pF			100	ns
t_{DZL}	Driver Enable to Output Low	See Figure4 R_L=500 Ω, C_L=50pF			100	ns
t_{DHZ}	Driver Disable from Output High	See Figure4 R_L=500 Ω, C_L=50pF			100	ns
t_{DLZ}	Driver Disable from Output Low	See Figure4 R_L=500 Ω, C_L=50pF			100	ns
$t_{DZH(SHDN)}$	Driver Enable from Shutdown to output high	See Figure4 R_L=500 Ω, C_L=50pF			5000	ns
$t_{DZL(SHDN)}$	Driver Enable from Shutdown to output low	See Figure4 R_L=500 Ω, C_L=50pF			5000	ns
t_{SHDN}	Time to Shutdown				1000	ns
Receiver AC Characteristics						
Symbol	**Parameter**	**Test Conditions**	**Min**	**Typ**	**Max**	**Unit**
t_{RPLH}	Receiver prop delay (low to high)	See Figure5 C_L=15pF	30	60	90	ns
t_{RPHL}	Receiver prop delay (high to low)	See Figure5 C_L=15pF	30	60	90	ns
t_{RSKEW}	Differential Receiver Output Skew $\|t_{RPLH}-t_{RPHL}\|$	C_L=15pF			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=1kΩ, C_L=15pF			100	ns
t_{RZL}	Receiver enable to output low	See Figure6 R_L=1kΩ, C_L=15pF			100	ns
t_{RHZ}	Receiver Disable from output high	See Figure6 R_L=1kΩ, C_L=15pF			100	ns
t_{RLZ}	Receiver Disable from output low	See Figure6 R_L=1kΩ, C_L=15pF			100	ns
$t_{RZH(SHDN)}$	Receiver enable from shutdown to output high	See Figure6 R_L=1kΩ, C_L=15pF			5000	ns
$t_{RZL(SHDN)}$	Receiver enable from shutdown to output low	See Figure6 R_L=1kΩ, C_L=15pF			5000	ns
t_{SHDN}	Time to shutdown				1000	ns

Parameter Measurement Information

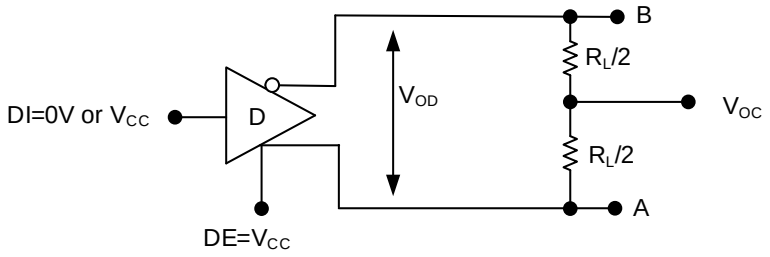


Figure 1. Differential Driver Output Voltage

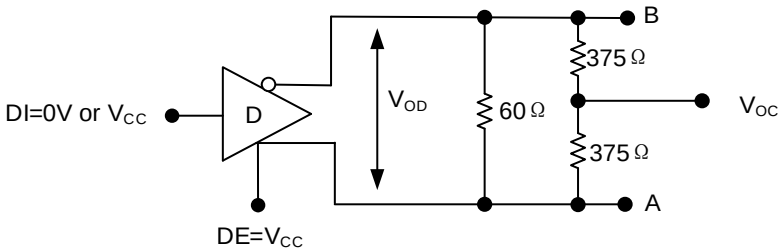


Figure 2. Differential Driver Output Voltage Over Common Mode

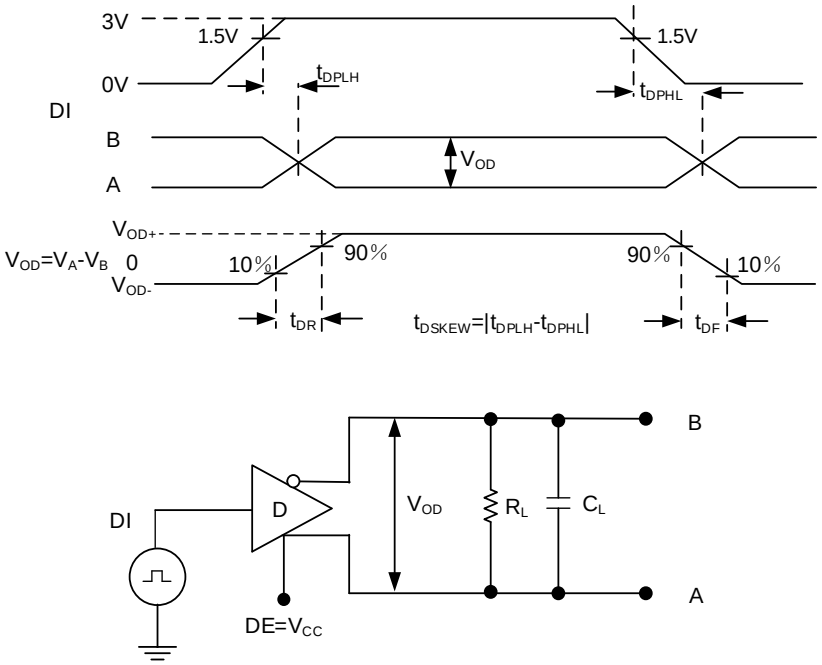


Figure 3. Driver Propagation Delay Test Circuit and Timing Diagram

Parameter Measurement Information (continued)

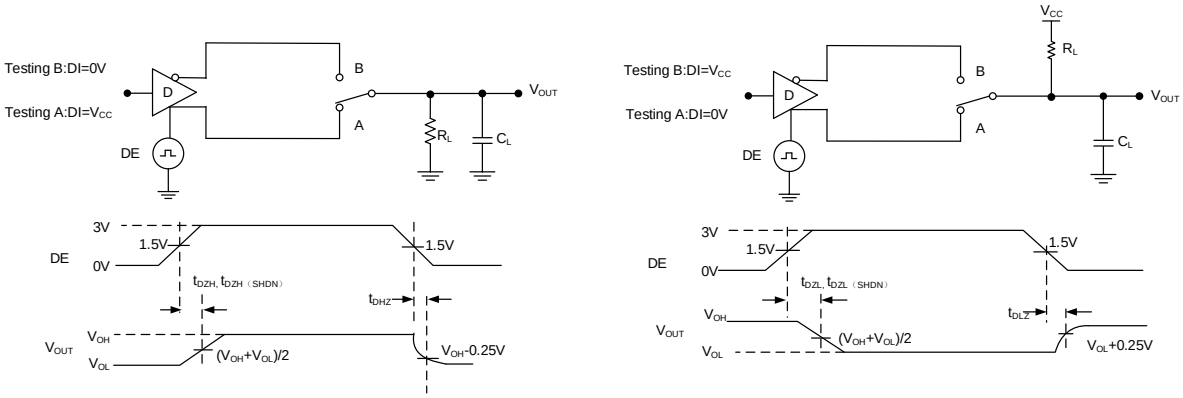


Figure 4. Driver Enable and Disable Timing Test Circuits and Timing Diagrams

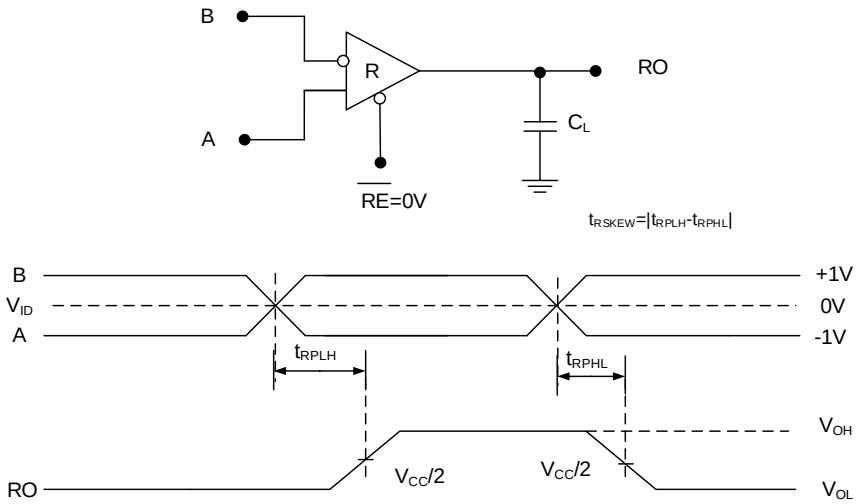


Figure 5. Receiver Propagation Delay Test Circuit and Timing Diagram

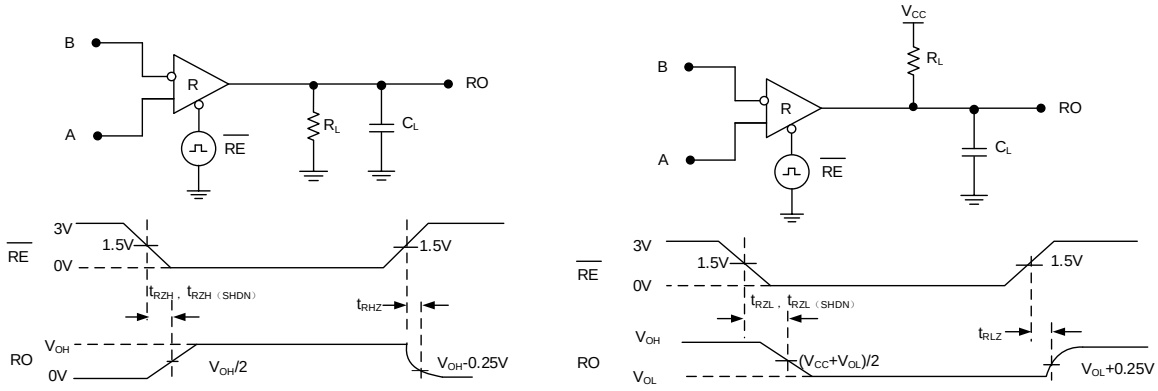


Figure 6. Receiver Enable and Disable Test Circuits and Timing Diagrams

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	≥-50mV	1
0	X	-200mV <V_A-V_B <-50mV	Undefined
0	X	≤-200mV	0
0	X	Open/Shorted/Idle	1
1	1	X	High -Z
1	0	X	Shutdown

Typical Operating Characteristics

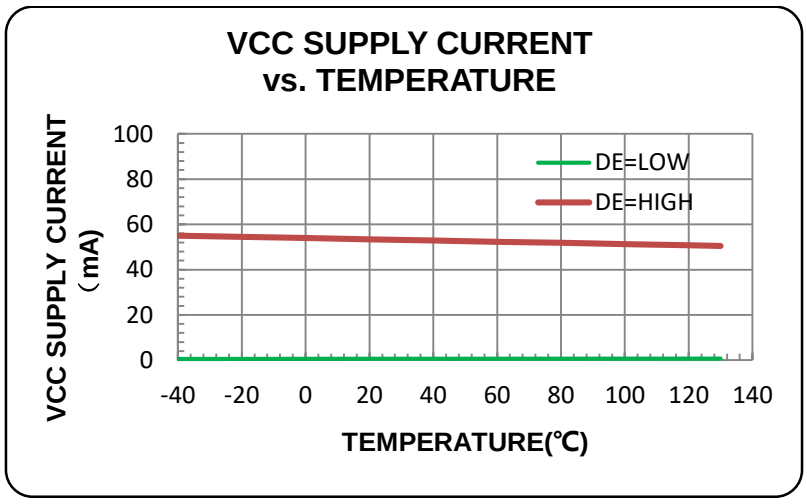


Figure 7. V_{CC} Supply Current vs. Temperature

Typical Operating Characteristics (continued)

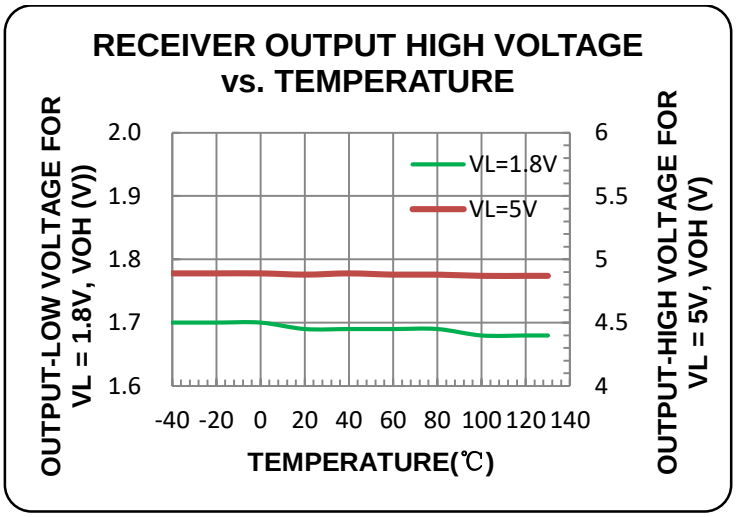


Figure 8. Receiver Output High Voltage vs. Temperature

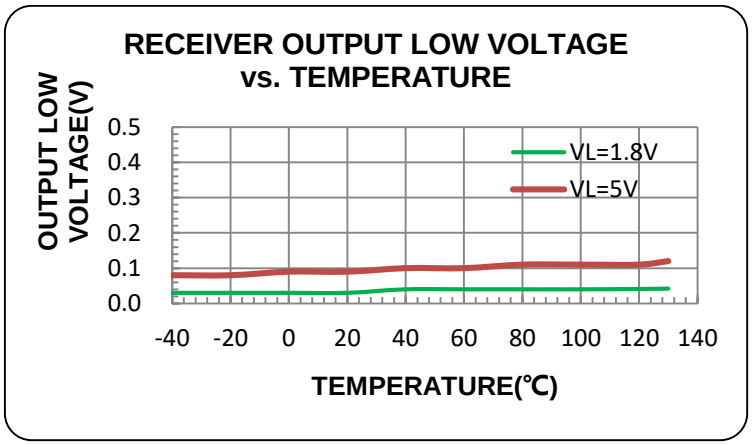


Figure 9. Receiver Output Low Voltage vs. Temperature

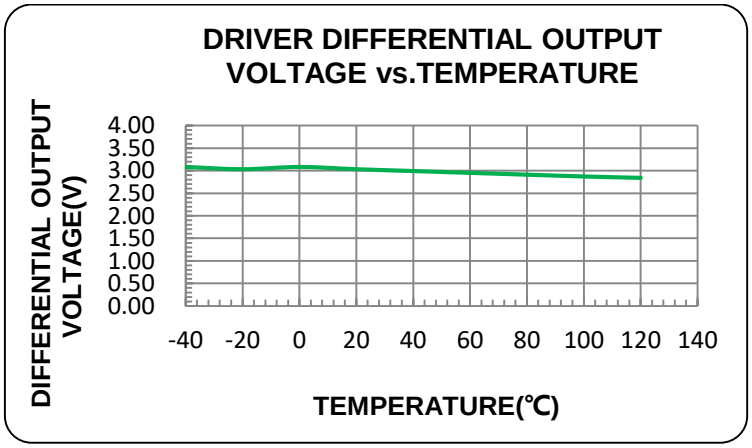


Figure 10. Driver Differential Output Voltage vs. Temperature

Block Diagram

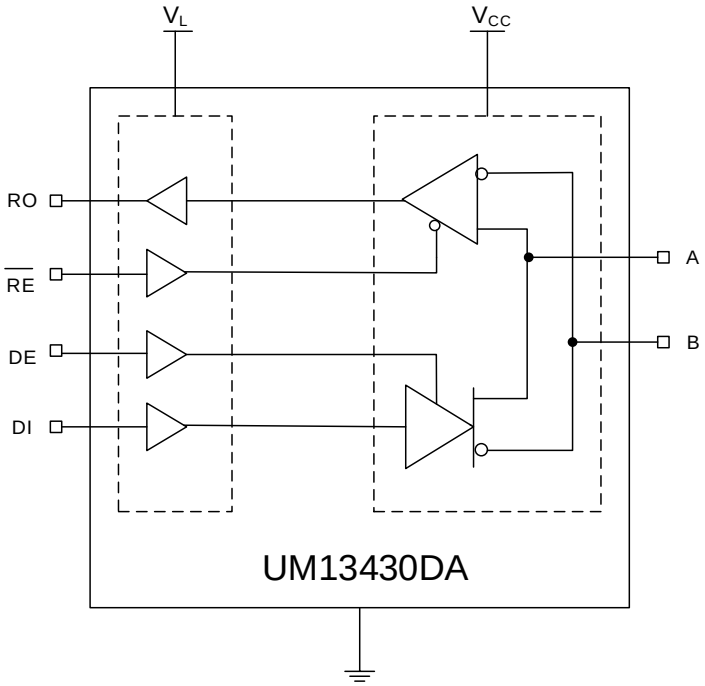


Figure 11. Block Diagram:

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 ±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.

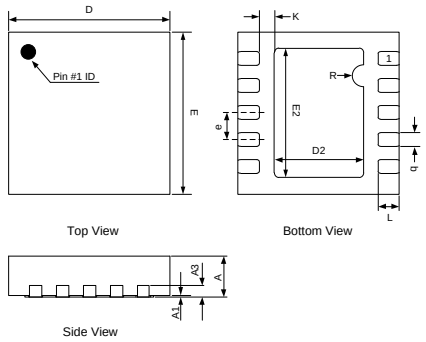
Typical Applications

The 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

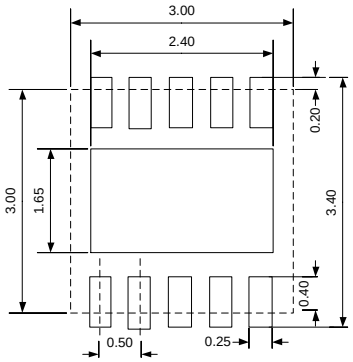
UM13430DA DFN10 3.0 ×3.0

Outline Drawing



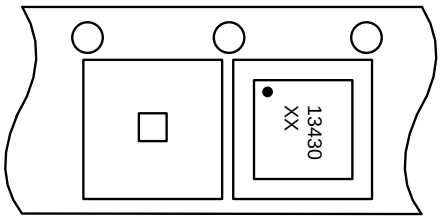
Symbol	DIMENSIONS					
	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	0.70	0.75	0.80	0.028	0.030	0.032
A1	0.00	0.02	0.05	0.000	0.001	0.002
A3	0.20REF			0.008REF		
b	0.20	0.25	0.30	0.008	0.010	0.012
D	2.90	3.00	3.10	0.116	0.120	0.124
E	2.90	3.00	3.10	0.116	0.120	0.124
D2	1.55	1.65	1.75	0.062	0.066	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

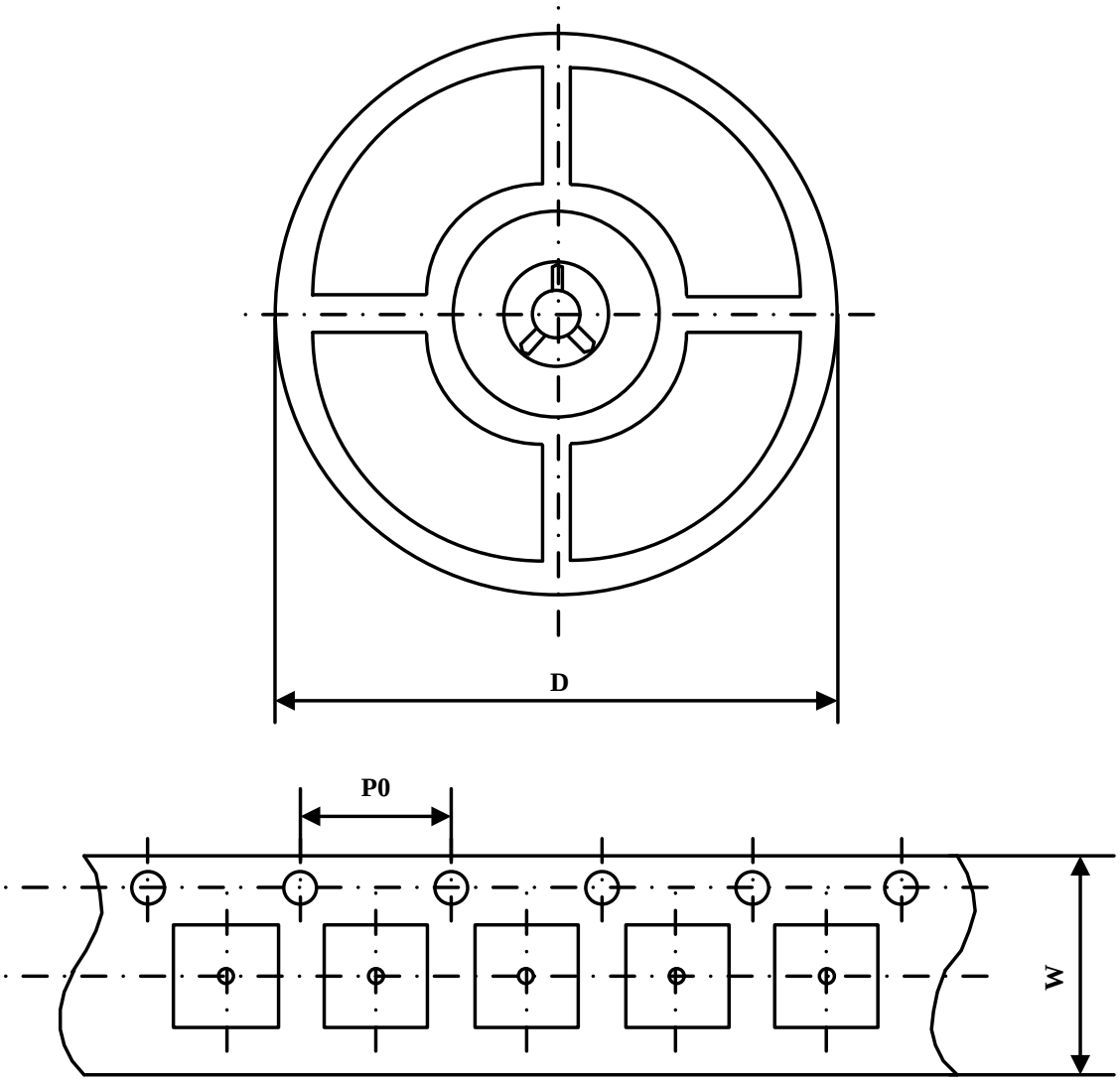


NOTES:
1. Compound dimension: 3.00×3.00;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

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

GREEN COMPLIANCE

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