3V to 5.5V, 1T/1R, 250kbps, RS-232 Transceivers with Automatic power-down Mode

UM3221B *TSSOP16/SSOP16*

1 Description

The UM3221B consists of 1 driver/1 receiver with dedicated enable pin, and a dual charge-pump circuit with ±8kV ESD protection. The charge pump needs four small external capacitors that allows operation from a single 3V to 5.5V supply. The device meets the requirements of TIA/EIA-232F and provides the electrical interface between an asynchronous communication controller and the serial-port connector. The device operates at up to 250 kbps and a maximum of 30V/μs driver output slew rate.

The UM3221B features flexible control options for power management when the serial port is inactive. The automatic power-down feature functions when FORCEON is low and nFORCEOFF is high. During this mode of operation, if the device does not sense a valid RS-232 signal on the receiver input, the driver output is disabled and achieve extremely low current consumption. The nINVALID output enters low state to notify the user if an RS-232 signal is present at the receiver input.

The UM3221B is available in TSSOP16 and SSOP16 packages. The operating ambient temperature is from -40 ℃ to 125 ℃.

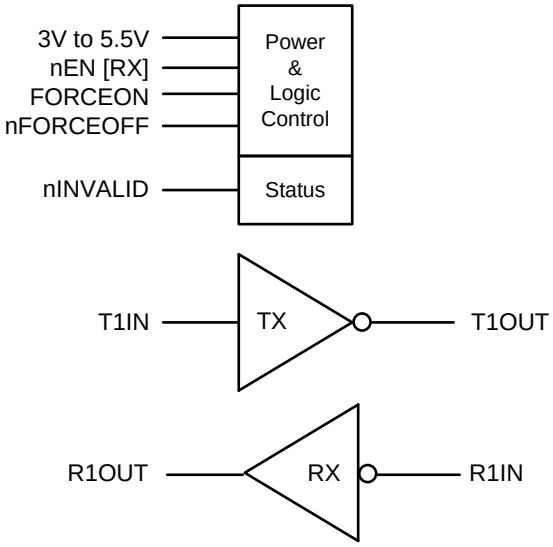
2 Features

- Meets the requirements of TIA/EIA-232F standards
- 3V to 5.5V supply voltage
- 1 transmitter, 1 receiver for RS-232 port
- Operates up to 250 kbps
- External capacitors: 4 × 0.1 μF
- ESD protection:
  - ±8kV Human Body Model
  - ±8kV IEC61000-4-2 Contact Discharge
- Automatic power-down feature automatically disables drivers for power savings
- Extended ambient temperature range: -40°C to 125°C
- Available in TSSOP16 and SSOP16 packages

3 Applications

- Industrial PCs
- Wired networking
- Notebooks
- PDAs
- Data center and enterprise computing

4 Simplified Schematic



5 Selection Guide

Part Number	V_{CC} Supply (V)	RS-232 Transceivers Number	Automatic Power-down	RS-232 Transceivers Data Rate (Mbps)
UM3221B	3 to 5.5	1T / 1R	Yes	0.25

6 Ordering Information

Part Number	Mark Code	Package Type	Shipping Qty
UM3221BEEAE	UM3221BEEAE	SSOP16	2000pcs/13Inch Tape & Reel
UM3221BEEUE	UM3221BEEUE	TSSOP16	3000pcs/13Inch Tape & Reel

7 Pin Configuration and Function

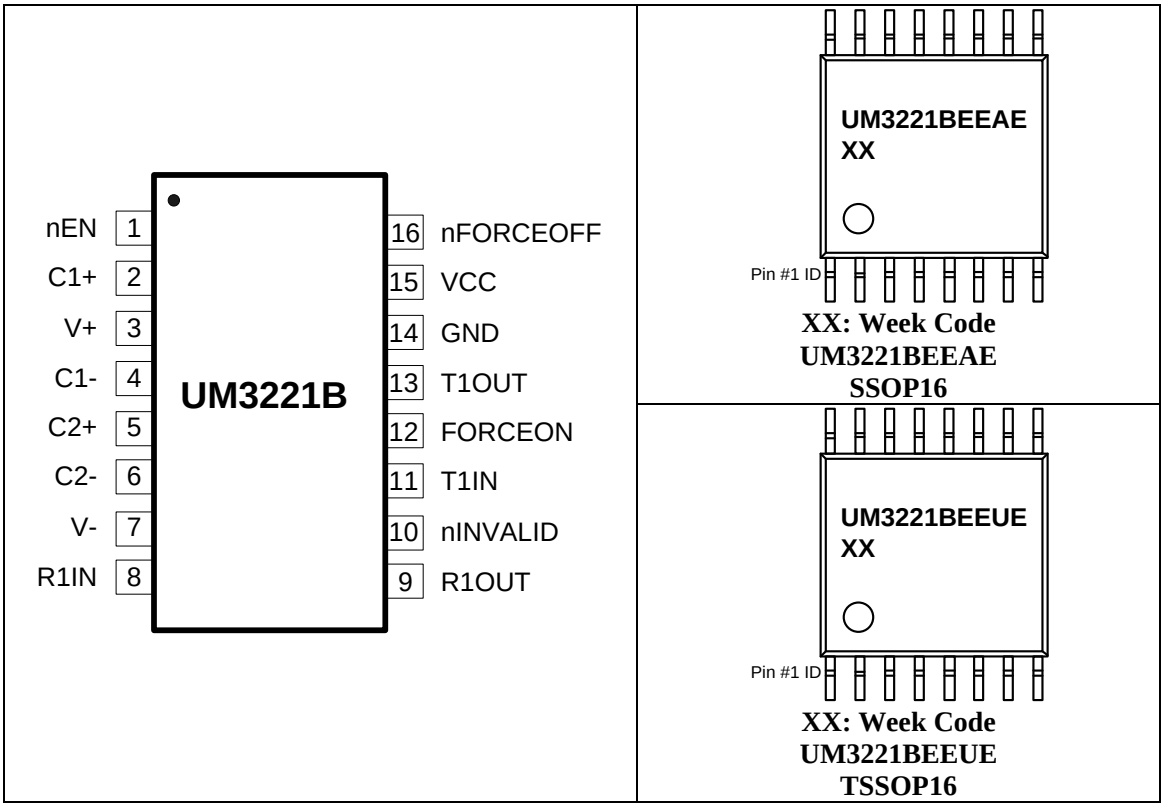


Table 7-1. Pin Functions

Pin No.	Pin Name	Function
1	nEN	Receiver enable, Active low. High input sets R1OUT to high impedance.
2	C1+	Positive terminals of voltage-doubler charge pump capacitor.
3	V+	Positive voltage generated by the charge pump.
4	C1-	Negative terminals of voltage-doubler charge pump capacitor.
5	C2+	Positive terminals of inverting charge pump capacitor.
6	C2-	Negative terminals of inverting charge pump capacitor.
7	V-	Negative voltage generated by the charge pump.
8	R1IN	RS-232 receiver input.
9	R1OUT	RS-232 receiver output.
10	nINVALID	Output of the valid signal detector. nINVALID is enabled high if a valid RS-232 level is present on any receiver inputs.
11	T1IN	RS-232 driver input
12	FORCEON	Automatic power-down control input.
13	T1OUT	RS-232 driver output
14	GND	Ground.
15	VCC	+3.0V to +5.5V supply voltage input.
16	nFORCEOFF	Automatic power-down control input.

8 Specifications

8.1 Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply Voltage on V_{CC}	V_{CC} to GND	-0.5	6.0	V
V+	Charge pump positive-output supply voltage	V+ to GND	-0.3	7.5	V
V-	Charge pump negative-output supply voltage	V- to GND	-7.5	0.3	V
I_{CC}	DC Vcc or GND current		-100	100	mA
V_I	Input voltage	T1IN, nEN, nFORCEOFF, FORCEON to GND	-0.3	6	V
		R1IN to GND	-25	25	V
V_O	Output voltage	T1OUT to GND	-13.2	13.2	V
		R1OUT, nINVALID to GND	-0.3	V_{CC}+0.3	V
V_{ESD}	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001	T1OUT, R1IN pins	-8	8	kV
	Contact discharge, per IEC 61000-4-2	T1OUT, R1IN pins	-8	8	kV
	Short-Circuit Duration	T1OUT pin	Continuous		
T_{STG}	Storage temperature		-65	150	℃

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

8.2 Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	Bus supply voltage		3		5.5	V
DR	Data rate				250	kbps
T_A	Operating ambient temperature		-40		125	℃

8.3 Thermal Information

Symbol	Parameter		Value	Unit
$R_{\theta JA}$	Junction to ambient thermal resistance	TSSOP16	100.4	°C/W
		SSOP16	87	°C/W
$R_{\theta JC(TOP)}$	Junction-to-case (top) thermal resistance	TSSOP16	19	°C/W
		SSOP16	26	°C/W

8.4 Electrical Characteristics(Static)

V_{CC} = 3V to 5.5V, T_A = -40 ℃ to 125 ℃, unless otherwise noted. All typical values are at T_A = 25°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply						
I_{CC}	Supply current, Automatic power-down enabled	R1IN open, nFORCEOFF = V_{CC}, FORCEON = GND, T1IN = V_{CC} or GND			20	μA
	Supply current, Powered off	R1IN open, nFORCEOFF=GND, T1IN= V_{CC} or GND		1	10	μA
	Supply current, Automatic power-down disabled	nFORCEOFF = FORCEON = V_{CC}, T1IN = V_{CC} or GND, No load		0.6	2.5	mA

8.4 Electrical Characteristics(Static) (continued)

V_{CC} = 3V to 5.5V, T_A = -40 ℃ to 125 ℃, unless otherwise noted. All typical values are at T_A = 25°C.

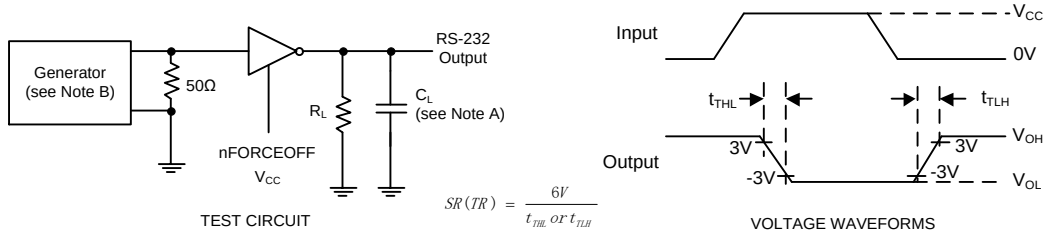
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Logic inputs and receiver output						
V_{IT+}	Input high voltage on T1IN, nEN, FORCEON, nFORCEOFF pins	V_{CC} = 3.3V	2.0			V
		V_{CC} = 5V	2.4			
V_{IT-}	Input low voltage on T1IN, nEN, FORCEON, nFORCEOFF pins	V_{CC} = 3.3V			0.8	V
		V_{CC} = 5V			0.8	
I_{IL}	Input leakage current	V_{IN}= 0V to V_{CC}, T1IN, nEN, nFORCEOFF, FORCEON pins			±20	μA
I_{OL}	Output leakage current	Receiver disabled, V_{OUT} = 0V to V_{CC}		±0.05	±10	μA
V_{OH}	High-level output voltage	I_{OUT} = -1 mA	V_{CC}-0.6	V_{CC}-0.1		V
V_{OL}	Low-level output voltage	I_{OUT} = 1.6 mA			0.4	V
Driver output						
V_{OUT}	Output voltage swing	Driver output loaded with 3kΩ to GND, T_A = +25 ℃	±5.0			V
I_{OS}	Output short-circuit current	V_{OUT} = 0V			±60	mA
I_{OL}	Output leakage current	V_{CC} = 0V or 3.0V to 5.5V, V_{OUT} = ±12V, Driver disabled			±25	μA
Receiver input						
V_{IN}	Input voltage range		-25		25	V
V_{IT+}	Positive-going input threshold voltage	V_{CC} = 3.3V		1.5	2	V
		V_{CC} = 5V		2	2.4	V
V_{IT-}	Negative-going input threshold voltage	V_{CC} = 3.3V	0.8	1.15		V
		V_{CC} = 5V	0.8	1.6		V
V_{HYS}	Input hysteresis ($V_{IT+} - V_{IT-}$)			0.4		V
R_I	Input resistance		3	5	7	kΩ
Automatic power-down characteristics						
V_{OH}	High-level output voltage	nINVALID pin, I_{OUT} = -1 mA	V_{CC}-0.6			V
V_{OL}	Low-level output voltage	nINVALID pin, I_{OUT} = 1.6 mA			0.4	V

8.5 Switching Characteristics

V_{CC} = 3V to 5.5V, T_A = -40 ℃ to 125 ℃, unless otherwise noted. All typical values are at T_A = 25°C.

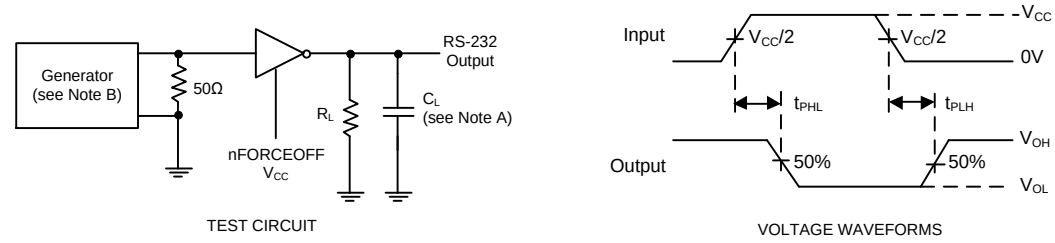
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Timing characteristics						
DR	Data Rate	R_L=3kΩ to 7kΩ,C_L=150pF to 1000pF	250			kbps
Transmitter switching characteristics						
t_{PHL}, t_{PLH}	Transmitter propagation delay	R_L=3kΩ, C_L=1000pF, see Figure 9-2		0.9		μs
$t_{SK(P)}$	Driver pulse skew	$\lvert t_{PHL} - t_{PLH} \rvert$, C_L = 1000 pF, R_L = 3 kΩ, see Figure 9-2		0.23		μs
$SR_{(TR)}$	Slew rate, transition region	V_{CC} = 3.3V, R_L = 3kΩ, C_L = 150pF to 2500pF, T_A = 25 ℃, measurements taken from -3.0V to +3.0V or +3.0V to -3.0V, see Figure 9-1	4		30	V/μs
Receiver switching characteristics						
t_{PHL}, t_{PLH}	Receiver propagation delay time	C_L = 150pF, see Figure 9-3		0.23		μs
t_{EN}	Receiver output enable time	C_L = 150 pF, R_L = 3 kΩ, see Figure 9-4		20		ns
t_{DIS}	Receiver output disable time	C_L = 150 pF, R_L = 3 kΩ, see Figure 9-4		50		ns
$t_{SK(P)}$	Receiver pulse skew	$\lvert t_{PHL} - t_{PLH} \rvert$, C_L = 150 pF, see Figure 9-3		90		ns
Automatic power-down status characteristics						
t_{EN}	Receiver Threshold to Driver Enabled	see Figure 9-5		12		μs
t_{VALID}	Receiver positive or negative threshold to nINVALID high	see Figure 9-5		0.5		μs
$t_{INVALID}$	Receiver positive or negative threshold to nINVALID low	see Figure 9-5		30		μs

9 Parameter Measurement Information



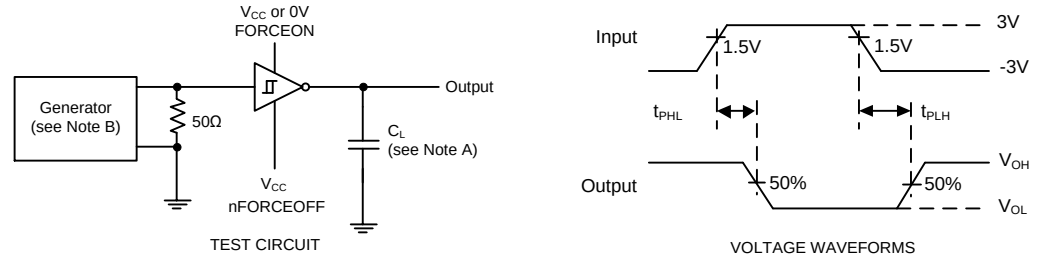
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: Z_O=50Ω, 50% duty cycle, t_r≤10ns, t_f≤10ns.

Figure 9-1. Transmitter Slew Rate



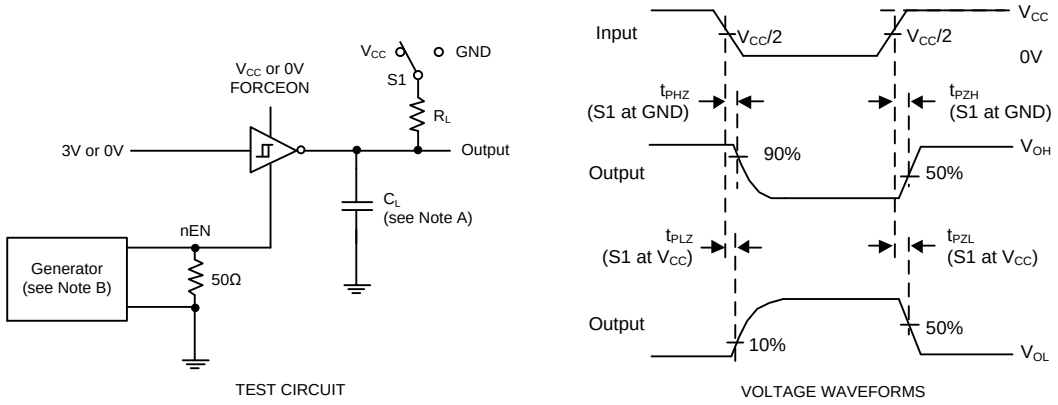
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR=250kbit/s, Z_O=50Ω, 50% duty cycle, t_r≤10ns, t_f≤10ns.

Figure 9-2. Transmitter Pulse Skew



NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: Z_O=50Ω, 50% duty cycle, t_r≤10ns, t_f≤10ns.

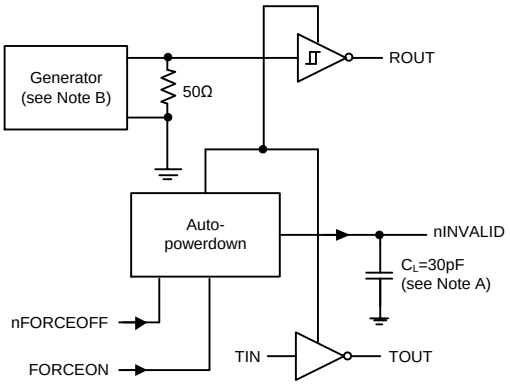
Figure 9-3. Receiver Propagation Delay Times



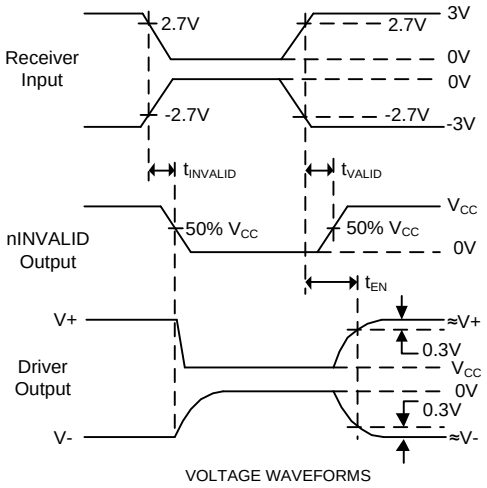
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: Z_O=50Ω, 50% duty cycle, t_r≤10ns, t_f≤10ns.
C. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
D. t_{PZL} and t_{PZH} are the same as t_{en}.

Figure 9-4. Receiver Enable and Disable Times

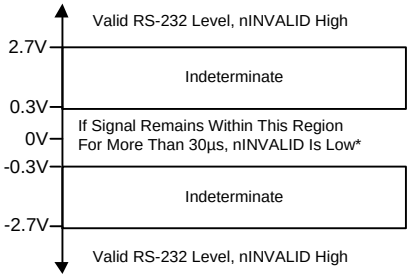
9 Parameter Measurement Information (continued)



TEST CIRCUIT



VOLTAGE WAVEFORMS



* Auto powerdown disables transmitters and reduces supply current to 1µA.

NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR=5kbit/s, Z_O=50Ω, 50% duty cycle, t_r≤10ns, t_f≤10ns.

Figure 9-5. nINVALID Propagation Delay Times and Supply Enabling Time

10 Detailed Description

10.1 Overview

The UM3221B is a 1-driver and 1-receiver RS-232 interface device ideal for portable or handheld applications. All RS-232 inputs and outputs are protected to ±8 kV using the Human Body Model. The charge pump requires only four small 0.1μF capacitors for operation from a 3V to 5.5V supply. The UM3221B is capable of running at data rates up to 250 kbps, while maintaining RS-232-compliant output levels.

Automatic power-down can be disabled when FORCEON and nFORCEOFF are high. With automatic power-down enabled, the device activates automatically when a valid signal is applied to any receiver input which is an ideal choice for power sensitive designs. The device can automatically power down the driver to save power when the R1IN input is unpowered.

nINVALID is high (valid data) if receiver input voltage is greater than 2.7 V or less than -2.7 V, or has been between -0.3 V and 0.3 V for less than 30 μs. nINVALID is low (invalid data) if receiver input voltages are between -0.3 V and 0.3 V for more than 30 μs. Refer to Figure 9-5 for receiver input levels.

10.2 Functional Block Diagram

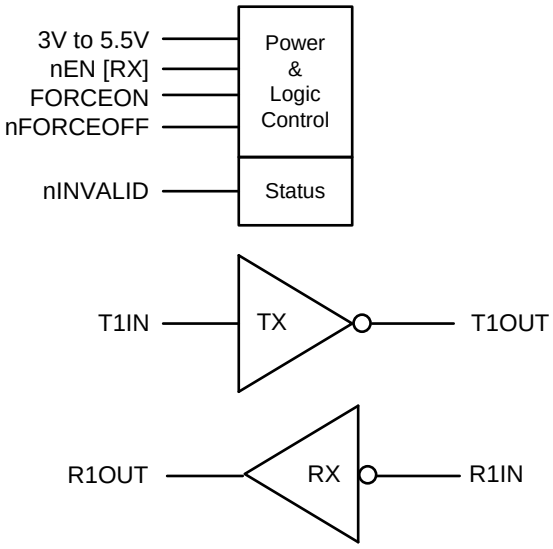


Figure 10-1. UM3221B Block Diagram

10.3 Feature Description

10.3.1 Power

The power block increases, inverts, and regulates voltage at V+ and V- pins using a charge pump that requires four external capacitors. Auto-power-down feature for driver is controlled by FORCEON and nFORCEOFF inputs. Receiver is controlled by nEN input. See Table 10-1 and Table 10-2. When the UM3221B is unpowered, it can be safely connected to an active remote RS-232 device for its robust port protection.

10.3.2 RS-232 Status

The nINVALID output goes low when R1IN input is unpowered for more than 30 μs. The nINVALID output goes high when receiver has a valid input. The nINVALID output is active when V_{CC} is powered irregardless of FORCEON and nFORCEOFF inputs (see Table 10-3).

10.3.3 Device Functional Modes

Table 10-1, Table 10-2 and Table 10-3 show the behavior of the driver, receiver, and nINVALID features under all possible relevant combinations of inputs.

Table 10-1. Transmitter (Note 1)

Inputs				Output	Transmitter Status
T1IN	FORCEON	nFORCEOFF	Valid RIN RS-232 level	T1OUT	
X	X	L	X	Z	Powered off
L	H	H	X	H	Normal operation with automatic power down disabled
H	H	H	X	L	
L	L	H	Yes	H	Normal operation with automatic power down enabled
H	L	H	Yes	L	
L	L	H	No	Z	Powered off by automatic power down feature
H	L	H	No	Z	

Note 1: H=high level, L=low level, X=irrelevant, Z=high impedance, Yes = |RIN| > 2.7 V, No = |RIN| <0.3 V

10.3.3 Device Functional Modes (continued)

Table 10-2. Receiver (Note 1)

Inputs			Output	Receiver Status
R1IN	nEN	Valid RIN RS-232 level	R1OUT	
X	H	X	Z	Output off
L	L	X	H	Normal operation
H	L	X	L	
Open	L	No	H	

Note 1: H = high level, L = low level, X = irrelevant, Z = high impedance (off), Open = input disconnected or connected driver off.

Table 10-3. nINVALID (Note 1)

Inputs				Output
R1IN	FORCEON	nFORCEOFF	nEN	nINVALID
L	X	X	X	H
H	X	X	X	H
Open	X	X	X	L

Note 1: H = high level, L = low level, X = irrelevant, Z = high impedance (off), Open = input disconnected or connected driver off.

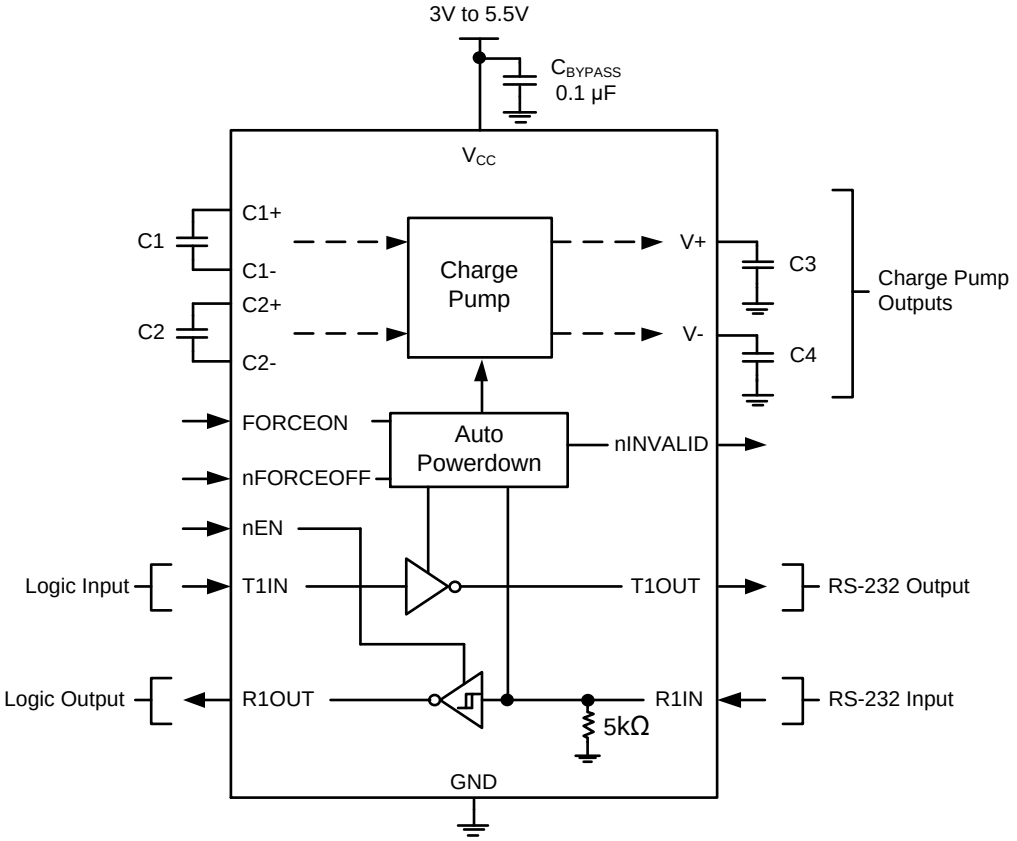
11 Application and Implementation

11.1 Application Information

The UM3221B line driver and receiver is a specialized device for 3V to 5.5V RS-232 communication applications. In many portable or handheld applications, an RS-232 cable can be disconnected or a connected peripheral can be turned off. Under these conditions, the internal charge pump and the drivers will be shutdown. Otherwise, the system automatically comes online. This feature allows design engineers to address power saving concerns without major design changes.

11.2 Typical Application

R1OUT and T1IN can connect to UART or general purpose logic lines. FORCEON and nFORCEOFF may be connected general purpose logic lines or tied to ground or V_{CC}. nINVALID may be connected to a general purpose logic line or left unconnected. R1IN and T1OUT lines connect to a RS-232 connector or cable. T1IN, nEN, FORCEON and nFORCEOFF inputs must not be left unconnected.



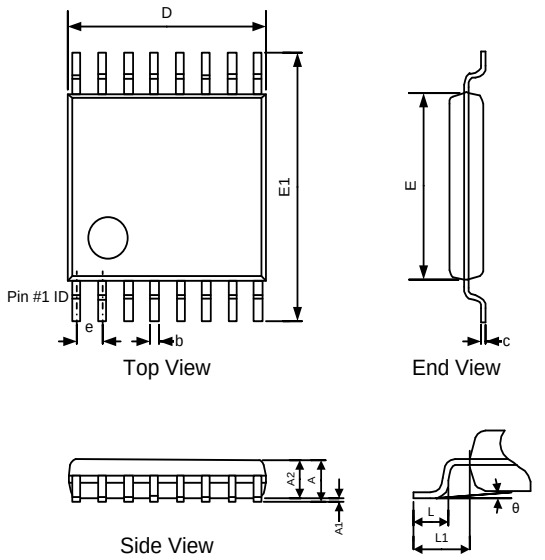
V_{CC}	C1 (µF)	C2, C3 and C4 (µF)
3.3 V ± 0.3 V	0.1	0.1
5 V ± 0.5 V	0.047	0.33
3 V to 5.5 V	0.1	all = 0.47 or all = 0.1

Figure 11-1. Typical Operating Circuit and Capacitor Values

12 Package Information

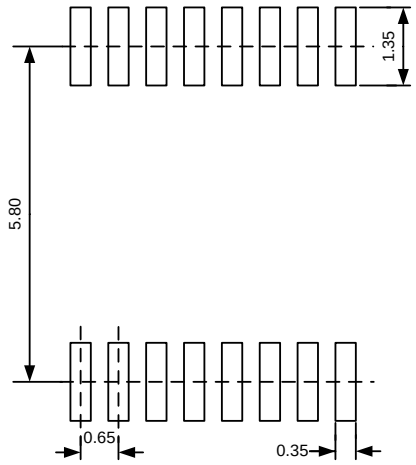
TSSOP16

Outline Drawing



DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	-	-	1.20	-	-	0.048
A1	0.05	-	0.15	0.002	-	0.006
A2	0.80	-	1.05	0.032	-	0.042
b	0.19	-	0.30	0.008	-	0.012
c	0.09	-	0.20	0.004	-	0.008
D	4.80	-	5.10	0.192	-	0.204
E	4.30	4.40	4.50	0.172	0.176	0.180
E1	6.20	6.40	6.60	0.248	0.256	0.264
e	0.65BSC			0.026BSC		
L	0.45	0.60	0.75	0.018	0.024	0.030
L1	1.00REF			0.039REF		
θ	0 °	-	8 °	0 °	-	8 °

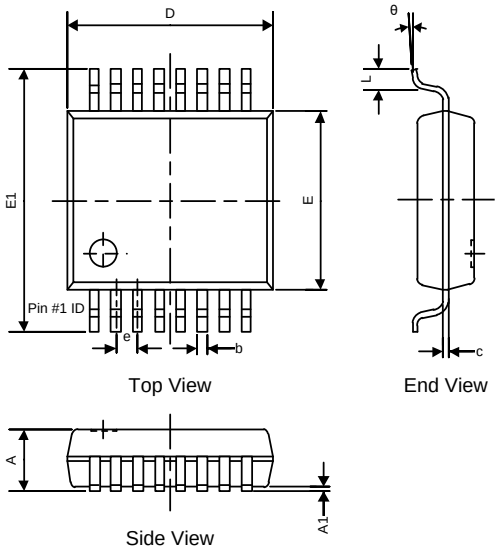
Land Pattern



NOTES:
1. Unit: mm.
2. General tolerance ±0.05mm unless otherwise specified.
3. The layout is just for reference.

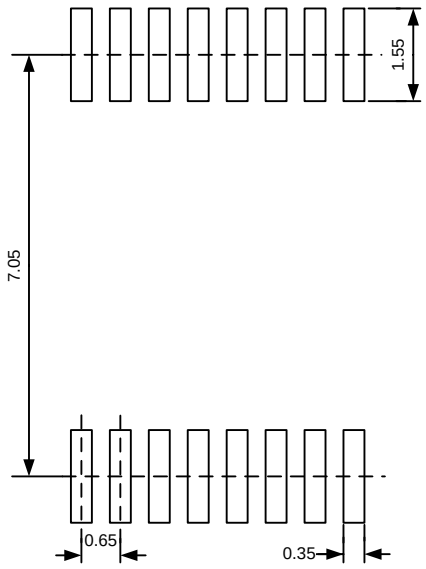
SSOP16

Outline Drawing



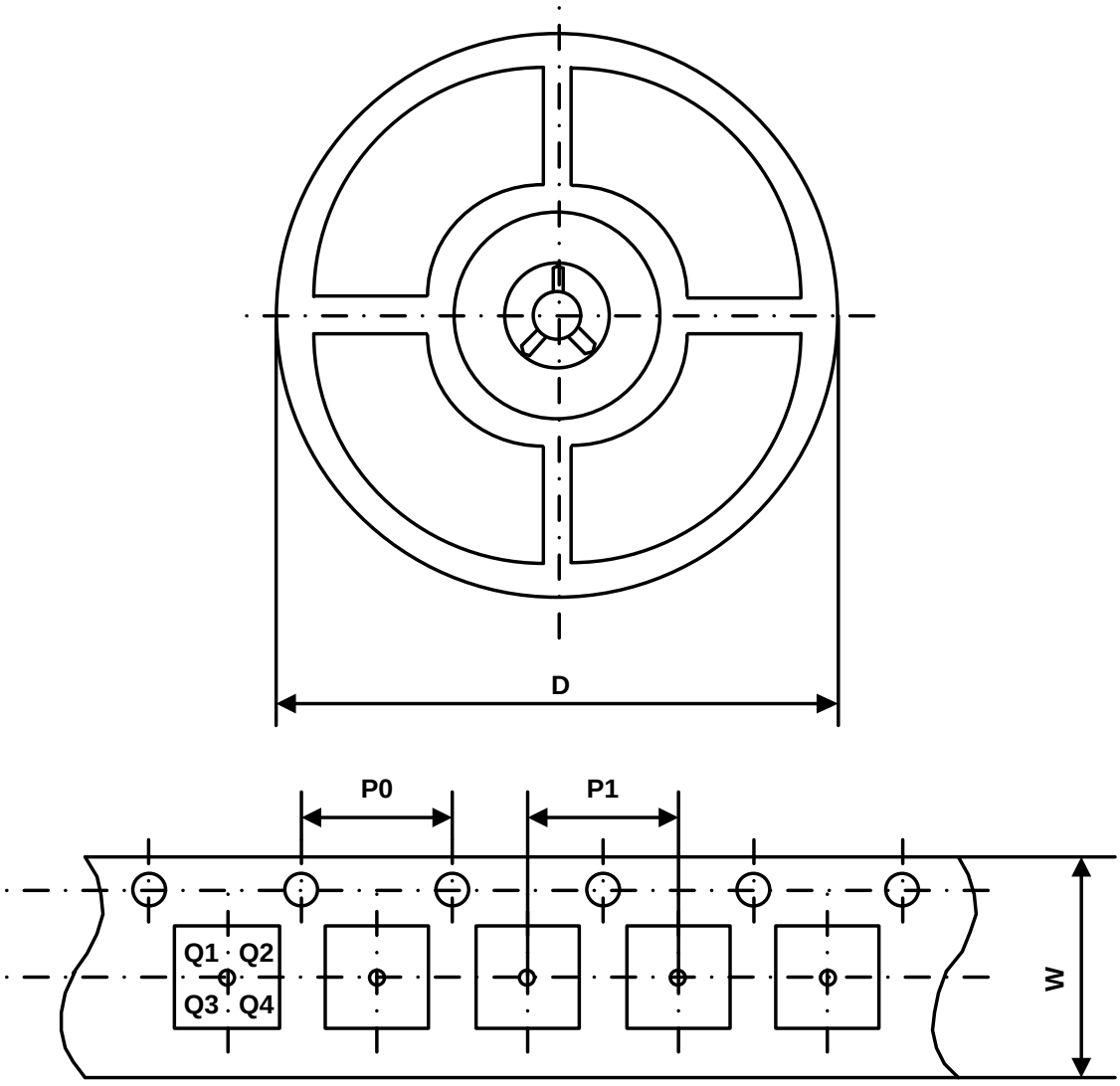
DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	-	-	2.00	-	-	0.079
A1	0.05	-	-	0.002	-	-
b	0.22	0.30	0.38	0.009	0.012	0.015
c	0.09	0.17	0.25	0.004	0.007	0.010
D	5.90	6.20	6.50	0.232	0.244	0.256
E	5.00	5.30	5.60	0.197	0.209	0.220
E1	7.40	7.80	8.20	0.291	0.307	0.323
e	0.65BSC			0.026BSC		
L	0.55	-	1.05	0.022	-	0.042
θ	0 °	-	8 °	0 °	-	8 °

Land Pattern



NOTES:
1. Unit: mm.
2. General tolerance ±0.05mm unless otherwise specified.
3. The layout is just for reference.

13 Packing Information



Part Number	Package Type	Carrier Width (W)	Pitch (P0)	Pitch (P1)	Reel Size (D)	PIN 1 Quadrant
UM3221BEEAE	SSOP16	16 mm	4 mm	12 mm	330 mm	Q1
UM3221BEEUE	TSSOP16	16 mm	4 mm	8 mm	330 mm	Q1

GREEN COMPLIANCE

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