
***Low Supply Current, 3V to 5.5V,
3Driver/5Receiver, Enhanced ESD Protection RS-232 Transceivers***

UM3243U SSOP28/TSSOP28/SOP28/QFN32 5.0×5.0

1 Description

The UM3243U is 3-driver/5-receiver 3V-5.5V powered RS-232 transceivers featuring Auto Shutdown and low supply current, when no valid RS-232 level signal is sensed on any receiver inputs, the charge pump circuit and drivers will be powered off. Disconnection of the RS-232 cable or shutdown of the transmitters of the attaching peripherals will lead to Auto Shutdown mode. When a valid level is applied to any RS-232 receiver inputs, the chip will turn on again. Auto Shutdown mode helps to save power without changing the existing system.

The devices have a regulated discontinuous mode dual charge pump power supply and low-dropout transmitters, which combine to deliver true RS-232 performance from a single +3V to +5.5V supply. The UM3243U is available in 1Mbps.

The charge pump needs only four 0.1μF capacitors in 3.3V operation, and can operate from input voltages ranging from +3V to +5.5V. They are ideal for 3.3V-only systems, mixed 3.3V and 5.0V systems, or 5.0V-only systems that require true RS-232 performance or EIA/TIA-562 levels of ±3.7V with supply voltages as low as +2.7V.

The device integrates one complementary always-active receiver. This receiver can monitor an external device (such as a modem) in Shutdown. The devices also include an always-active INVALID output which indicates valid RS-232 signal levels on any receiver inputs. It is usually used in UART wakeup.

2 Features

- Meets True EIA/TIA-232-F Standards from a +3.0V to +5.5V Power Supply
- Enhanced ESD Specifications for RS-232 Pins:
 - ±8kV Human body model (HBM)
 - ±8kV IEC 61000-4-2 contact discharge
- Latch-Up Performance Exceeds 200mA
- Glitch-free power-up/down for hot plug-in capability
- Auto Shutdown Feature to Disable Driver Outputs when No Valid RS-232 Signal is Sensed
- 1μA (Typ) Low Shutdown Current
- Accepts 5V Logic Input with 3.3V Supply
- Up to 1Mbps Transmission Rate
- Extended ambient temperature range: -40 °C to 125 °C
- Available in SSOP28, TSSOP28, SOP28 and QFN32 Packages

3 Applications

- Industrial Controllers and Instruments
- Notebooks, Palmtop PCs and Laptops
- Printers, PDAs and POS
- Networking Routers and Switches
- Peripherals

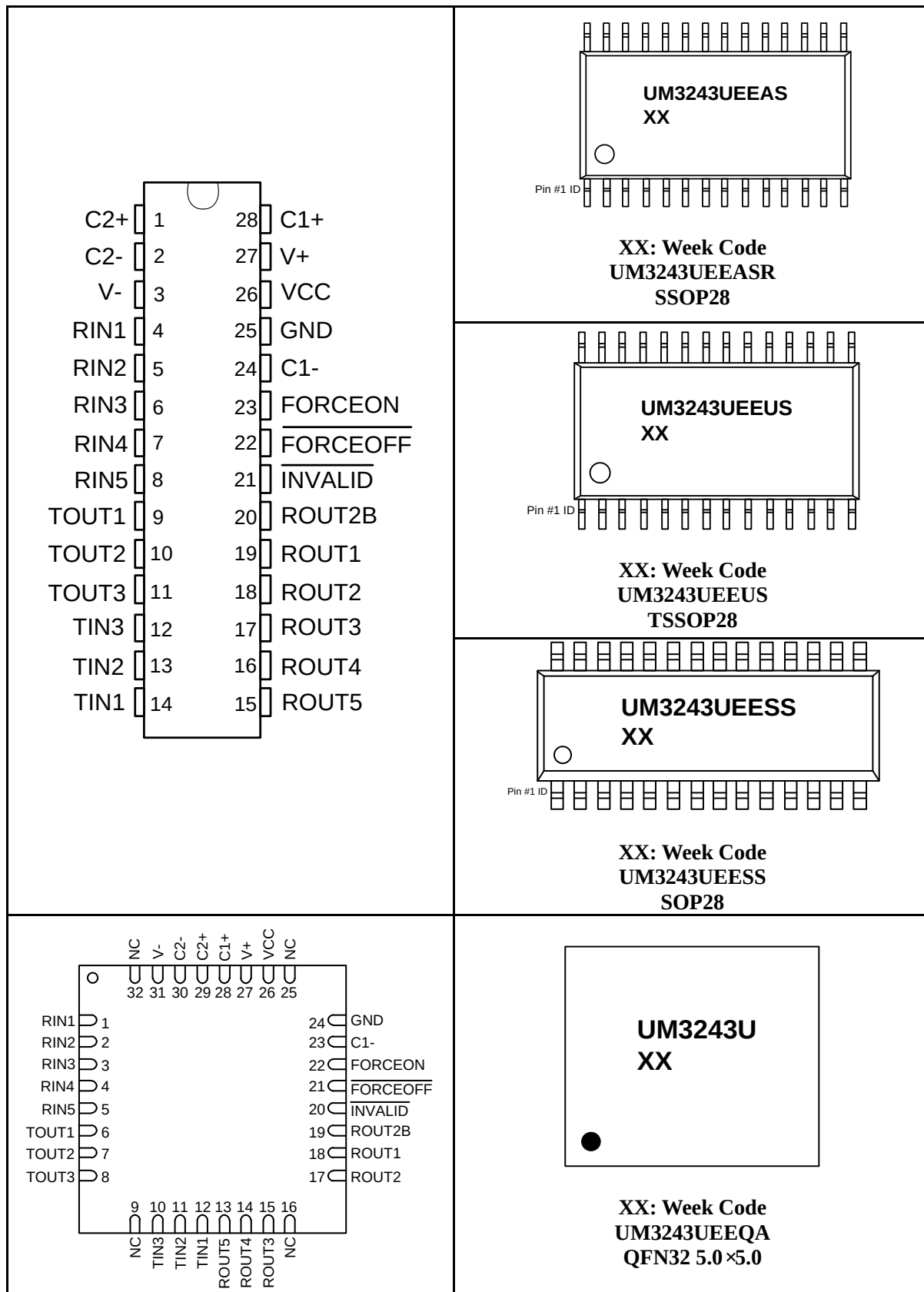
4 Selection Guide

Part Number	V _{CC} Range (V)	Data Rate (Mbps)
UM3243U	3.0 to 5.5	1

5 Ordering Information

Part Number	Mark Code	Package Type	Shipping Qty
UM3243UEEASR	UM3243UEEAS	SSOP28	2000pcs/13Inch Tape & Reel
UM3243UEEUS	UM3243UEEUS	TSSOP28	3000pcs/13Inch Tape & Reel
UM3243UEESS	UM3243UEESS	SOP28	25pcs/Tube
UM3243UEEQA	UM3243U	QFN32 5.0×5.0	3000pcs/13Inch Tape & Reel

6 Pin Configuration and Function



6 Pin Configuration and Function (continued)

Table 6-1. Pin Functions

Pin Name	Function
VCC	3 V to 5.5 V supply voltage.
C1+	Positive Terminal of the Voltage Doubler Charge-Pump Capacitor.
C1-	Negative Terminal of the Voltage Doubler Charge-Pump Capacitor.
C2+	Positive Terminal of Inverting Charge-Pump Capacitor.
C2-	Negative Terminal of Inverting Charge-Pump Capacitor.
V+	Positive Voltage Generated by the Charge Pump.
V-	Negative Voltage Generated by the Charge Pump.
GND	Ground.
NC	Not connected.
RIN	RS-232 Receiver Inputs.
TOUT	RS-232 Transmitter outputs.
TIN	TTL/CMOS Transmitter Inputs.
ROUT	TTL/CMOS Receiver outputs.
ROUT2B	Non-Inverting Receiver Output—active in Shutdown.
$\overline{\text{INVALID}}$	Output of the Valid Signal Detector. $\overline{\text{INVALID}}$ is enabled high if a valid RS-232 level is present on any receiver inputs.
$\overline{\text{FORCEOFF}}$	Drive low to shut down transmitters and on-board power supply. This overrides all Automatic circuitry and FORCEON (See Function Tables).
FORCEON	Drive high to override automatic circuitry keeping transmitters on ($\overline{\text{FORCEOFF}}$ must be high) (See Function Tables).

7 Specifications

7.1 Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	Supply voltage		3	3.3	3.6	V
			4.5	5	5.5	V
	Signaling rate				1	Mbps
T _A	Operating free-air temperature		-40		125	°C

7.2 Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	Supply voltage		-0.3		6	V
V ₊	Voltage on V+		-0.3		7.5	V
V ₋	Voltage on V-		-7.5		0.3	V
V _I	Voltage on TIN, FORCEOFF, FORCEON		-0.3		6	V
	Voltage on RIN		-25		25	V
V _O	Voltage on ROUT, INVALID, ROUT2B		-0.3		6	V
	Voltage on TOUT		-13.2		13.2	V
R _{θJA}	Junction-to-ambient thermal resistance	SSOP28		82.5		°C/W
		TSSOP28		73.0		
		SOP28		60.0		
		QFN32		34.1		
V _{ESD}	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001	RIN and TOUT		±8		kV
		Other pins		±2		kV
	Contact discharge, per IEC 61000-4-2	RIN and TOUT		±8		kV
I _{LU}	Latch up, per JEDEC JESD78			200		mA
T _{STG}	Storage temperature range		-65		150	°C
T _L	Lead Temperature for Soldering 10 Seconds				260	°C

Note 1: Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

7.3 Electrical Characteristics (Static)

$V_{CC}=3.0V$ to $5.5V$, $C1-C4=0.1\mu F$, $T_A=-40\text{ }^{\circ}C$ to $125\text{ }^{\circ}C$ (unless otherwise noted). Typical values are at $T_A=25\text{ }^{\circ}C$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
V_{CC}	Supply voltage range		3		5.5	V
I_{CC}	Supply current, Auto Shutdown	No load, All RIN Open, $\overline{FORCEON}=GND$, $\overline{FORCEOFF} = V_{CC}$, $TIN = V_{CC}$ or GND		1	10	μA
	Supply current, Shutdown	No load, $\overline{FORCEOFF}= GND$, $TIN = V_{CC}$ or GND		1	10	μA
	Supply current, Normal	No load, $\overline{FORCEON}=\overline{FORCEOFF}=$ V_{CC} , $TIN = V_{CC}$ or GND		0.6	2.5	mA
Logic inputs						
V_{IH}	Input high voltage on TIN , $\overline{FORCEON}$, $\overline{FORCEOFF}$	$V_{CC}=3.3V$	2.0			V
		$V_{CC}=5.0V$	2.4			V
V_{IL}	Input low voltage on TIN , $\overline{FORCEON}$, $\overline{FORCEOFF}$	$V_{CC}=3.3V$			0.8	V
		$V_{CC}=5.0V$			0.8	V
I_I	Input leakage current	$\overline{FORCEON}$, $\overline{FORCEOFF}$, TIN , $0V \leq V_{IN} \leq V_{CC}$		± 0.1	± 1	μA
Logic outputs						
V_{OH}	Output high voltage	$ROUT$, $\overline{INVALID}$, $I_{OH} = -1mA$	$V_{CC}-0.6$			V
V_{OL}	Output low voltage	$ROUT$, $\overline{INVALID}$, $I_{OL} = 1.6mA$			0.4	V
I_{OL}	Output leakage current	$ROUT$ (Receivers disabled), $0V \leq V_{OUT} \leq V_{CC}$		± 0.1	± 10	μA

7.3 Electrical Characteristics (Static) (continued)

$V_{CC}=3.0V$ to $5.5V$, $C1- C4=0.1\mu F$, $T_A=-40\text{ }^{\circ}C$ to $125\text{ }^{\circ}C$ (unless otherwise noted). Typical values are at $T_A=25\text{ }^{\circ}C$.

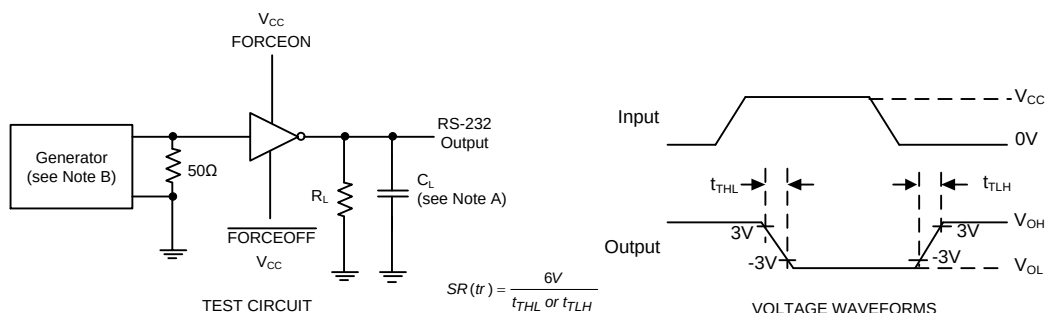
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Driver outputs						
V_{SWING}	Output voltage swing	All drivers outputs loaded with $3k\Omega$ to GND	± 5			V
I_{OS}	Output short-circuit Current	$V_{OUT} = 0V$			± 60	mA
I_{OL}	Output leakage current	$V_{CC} = 0V$ or $3.0V$ to $5.5V$, $V_{OUT} = \pm 12V$, Transmitters disabled			± 25	μA
Receiver inputs						
V_R	Input voltage range		-25		25	V
V_{IH}	Input high voltage	$V_{CC} = 3.3V$		1.5	2	V
		$V_{CC} = 5V$		2	2.4	V
V_{IL}	Input low voltage	$V_{CC} = 3.3V$	0.8	1.15		V
		$V_{CC} = 5V$	0.8	1.6		V
$V_{HYS(RIN)}$	Receiver input hysteresis			0.4		V
R_I	Receiver input resistance		3	5	7	$k\Omega$
Auto Shutdown characteristics						
$V_{IT+(VALID)}$	Receiver input positive threshold to <u>INVALID</u> output high	$FORCEON=GND$, $FORCEOFF=V_{CC}$			2.7	V
$V_{IT-(VALID)}$	Receiver input negative threshold to <u>INVALID</u> output high	$FORCEON=GND$, $FORCEOFF=V_{CC}$	-2.7			V
$V_{T(INVALID)}$	Receiver input threshold to <u>INVALID</u> output low	$FORCEON=GND$, $FORCEOFF=V_{CC}$	-0.3		0.3	V

7.4 Electrical Characteristics (Dynamic)

$V_{CC}=3.0V$ to $5.5V$, C_1 - $C_4=0.1\mu F$, $T_A=-40\text{ }^{\circ}C$ to $125\text{ }^{\circ}C$ (unless otherwise noted). Typical values are at $T_A=25\text{ }^{\circ}C$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Timing characteristics						
DR _{MAX}	Maximum data rate	R _L =3kΩ to 7kΩ,C _L =150pF to 1000pF,One Transmitter Switching	1			Mbps
Receiver switching characteristics						
t _{PHL} , t _{PLH}	Receiver propagation delay	Receiver input to Receiver output, C _L =150pF, see Figure 8-3		0.2		μs
t _{SK(P)}	Receiver skew, t _{PHL} -t _{PLH}			0.03		μs
t _{EN}	Receiver output enable time	C _L =150pF, R _L =3kΩ, see Figure 8-4		0.28		μs
t _{DIS}	Receiver output disable time			0.32		μs
Transmitter switching characteristics						
t _{PHL} , t _{PLH}	Transmitter propagation delay	R _L =3kΩ, C _L =1000pF, see Figure 8-2		250		ns
t _{SK(P)}	Transmitter skew, t _{PHL} -t _{PLH}	R _L =3kΩ to 7kΩ, C _L =150pF to 1000pF			100	ns
SR _{TR}	Transition-region slew rate	T _A =+25 ℃, V _{CC} =3.3V, R _L =3kΩ to 7kΩ, C _L =150pF to 1000pF, Measured from -3V to +3V or +3V to -3V, see Figure 8-1	18		150	V/μs
Auto Shutdown characteristics						
t _{VALID}	Receiver positive or negative threshold to INVALID high	FORCEON=GND, $\overline{\text{FORCEOFF}}=V_{CC}$ V _{CC} =5V, see Figure 8-5		1		μs
t _{INVALID}	Receiver positive or negative threshold to INVALID low	FORCEON=GND, $\overline{\text{FORCEOFF}}=V_{CC}$ V _{CC} =5V, see Figure 8-5		30		μs
t _{EN}	Receiver edge to charge pump setup	FORCEON=GND, $\overline{\text{FORCEOFF}}=V_{CC}$ V _{CC} =5V, see Figure 8-5		20		μs

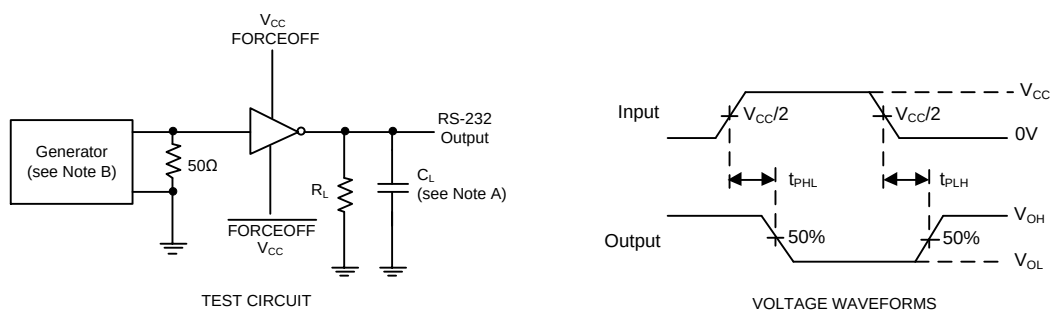
8 Parameter Measurement Information



NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: $Z_0=50\Omega$, 50% duty cycle, $t_r \leq 10ns$, $t_f \leq 10ns$.

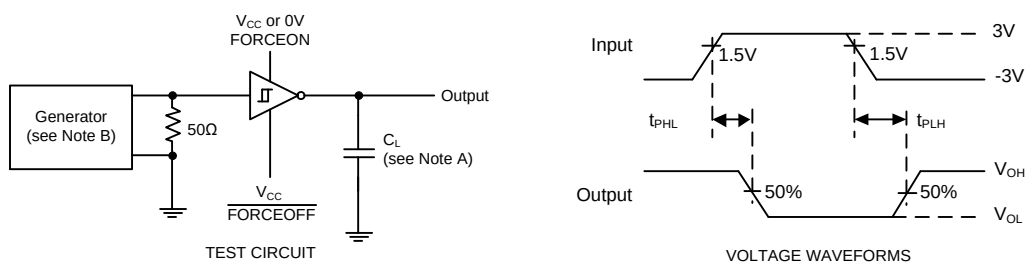
Figure 8-1. Transmitter Slew Rate



NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR=1Mbit/s, $Z_0=50\Omega$, 50% duty cycle, $t_r \leq 10ns$, $t_f \leq 10ns$.

Figure 8-2. Transmitter Pulse Skew



NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: $Z_0=50\Omega$, 50% duty cycle, $t_r \leq 10ns$, $t_f \leq 10ns$.

Figure 8-3. Receiver Propagation Delay Times

8 Parameter Measurement Information (continued)

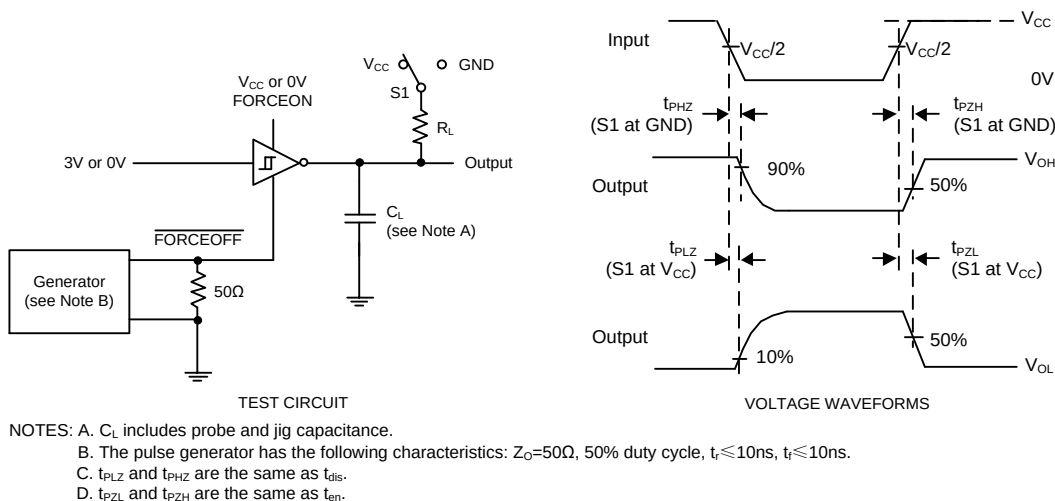
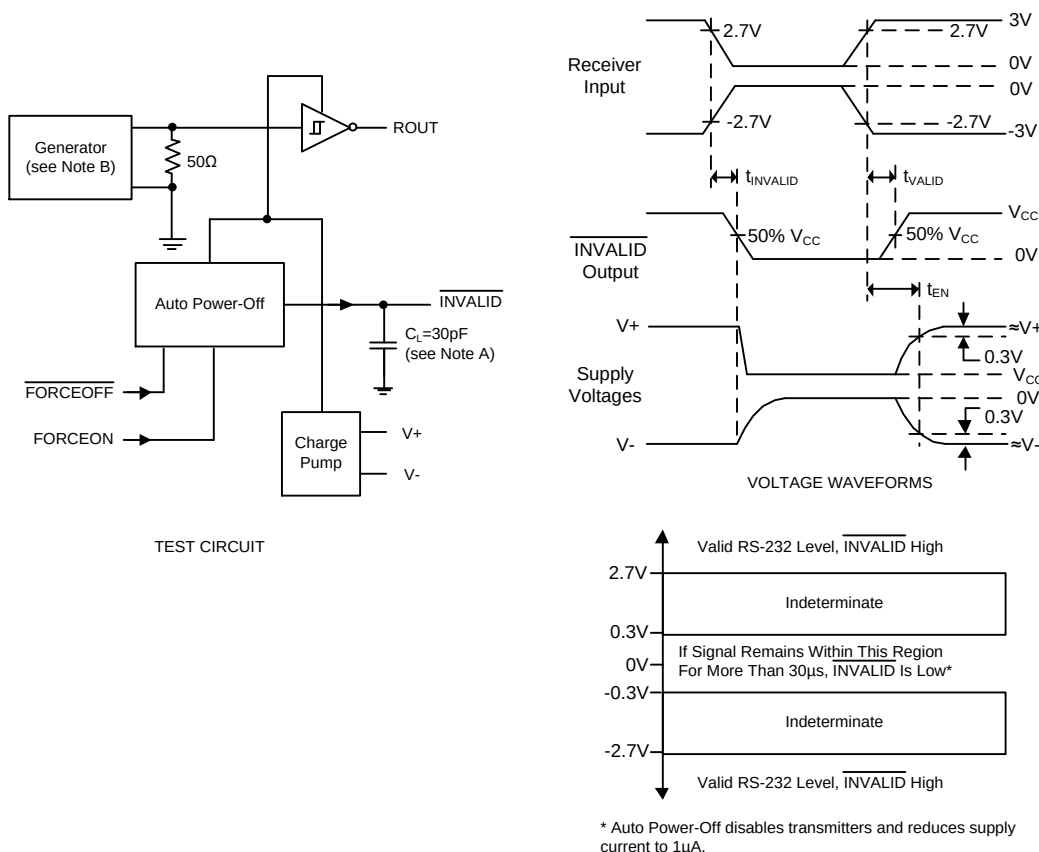


Figure 8-4. Receiver Enable and Disable Times



NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: PRR=5kbit/s, $Z_0=50\Omega$, 50% duty cycle, $t_r \leq 10\text{ns}$, $t_f \leq 10\text{ns}$.

Figure 8-5. $\overline{\text{INVALID}}$ Propagation Delay Times and Supply Enabling Time

9 Detailed Description

9.1 Functional Block Diagram

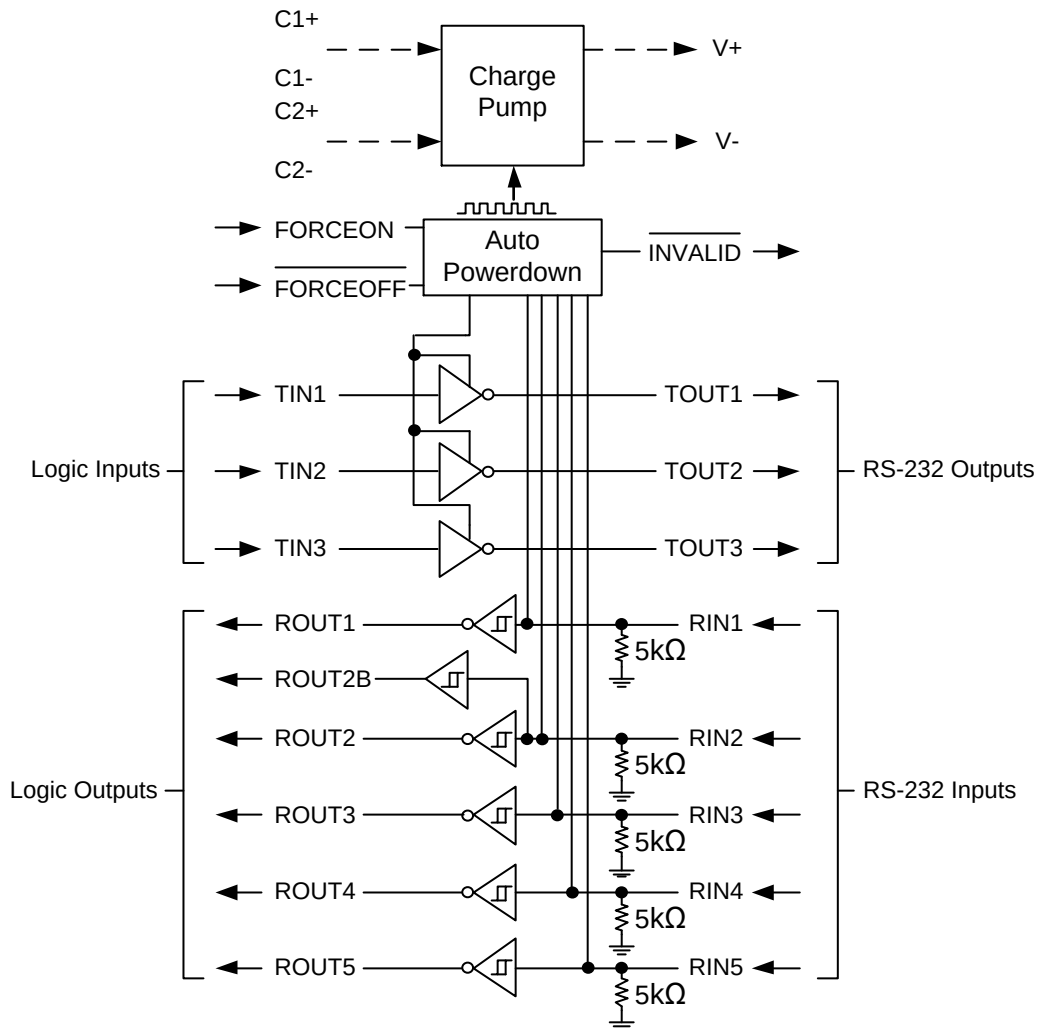


Figure 9-1. The Schematic of UM3243U

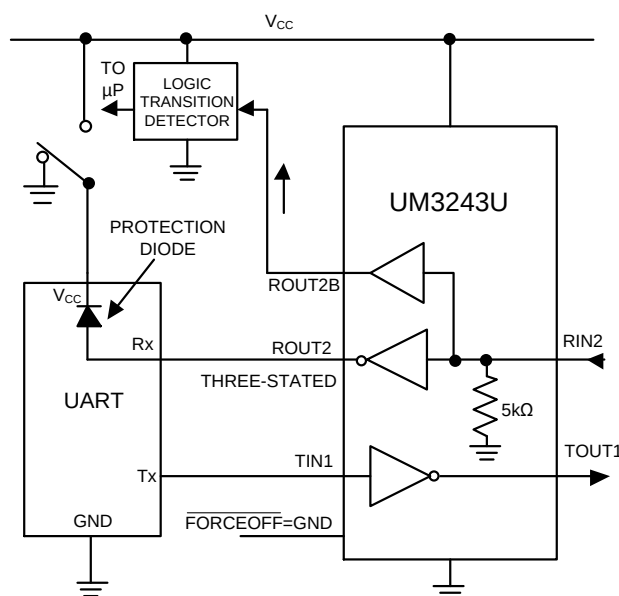
10 Feature Description

10.1 RS-232 Receivers

The devices' receivers convert RS-232 signals to CMOS-logic output levels. All receivers have inverting three-state outputs and can be active or inactive. The receivers are high-impedance when the part is in Forced Shutdown mode ($\overline{\text{FORCEOFF}}=\text{low}$).

The devices feature an always-active complementary output (ROUT2B). ROUT2B monitors receiver activity while the other receivers are high-impedance. This allows Ring Indicator to be monitored without forward biasing other devices connected to the receiver outputs. This is ideal for systems where V_{CC} drops to 0 in Shutdown to accommodate peripherals such as UARTs (Figure 10-1).

The devices feature an $\overline{\text{INVALID}}$ output that is enabled low when no valid RS-232 signal levels have been detected on all receiver inputs. $\overline{\text{INVALID}}$ is functional in any mode (Figure 8-5).



Note 1: In Power-Off, ROUT2B is used to monitor external devices and ROUT2 is three-stated, eliminating a current path through the UART's protection diode.

Figure 10-1. UM3243U detects RS-232 activity when the UART and interface are powered off

10.2 Auto Shutdown and Wakeup

The devices achieve a $1\mu\text{A}$ supply current in Auto Shutdown mode, which operates when FORCEON is low and $\overline{\text{FORCEOFF}}$ is high. When the device senses no valid signal levels on all receiver inputs for t_{INVALID} time (typically $30\mu\text{s}$), the onboard charge pump and drivers are powered off, reducing supply current to $1\mu\text{A}$. This occurs if the RS-232 cable is disconnected or the connected peripheral transmitters are turned off. The device turns on again when a valid level is applied to any RS-232 receiver input for t_{VALID} time (typically $1\mu\text{s}$). The charge pump will set up after t_{EN} time (typically $20\mu\text{s}$). As a result, the system saves power without changes to the existing system.

10.2 Auto Shutdown and Wakeup (continued)

Table 10-4 and Figure 10-2 summarize the operating modes. FORCEON and $\overline{\text{FORCEOFF}}$ override Auto Shutdown. When neither control is asserted, the IC will select between these states automatically, based on receiver input levels. Figure 8-5 depicts valid and invalid RS-232 receiver levels and timing diagram for Auto Shutdown operation.

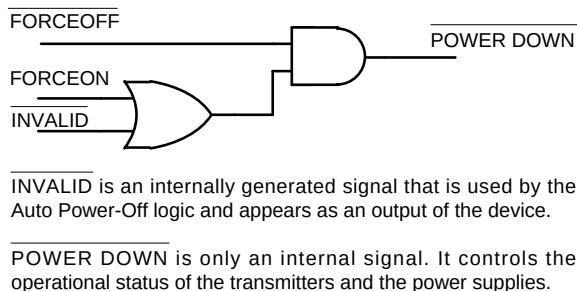


Figure 10-2. Auto Shutdown Logic

10.3 RS-232 Transmitters

The transmitters are inverting level translators that convert CMOS-logic levels to EIA/TIA-232 levels. The drivers have a minimum data rate of 1000kbps fully loaded, providing compatibility with PC-to-PC communication software. Transmitters can be paralleled to drive multiple receivers. In Shutdown mode (See Table 10-2), the transmitters are disabled and the outputs are forced into a high-impedance state.

10.4 Dual Charge Pump Voltage Converter and Capacitor Selection

The devices' internal power supply consists of a regulated dual charge pump that provides output voltages of charge pump and inverting charge pump, over the +3.0V to +5.5V V_{CC} range. The charge pump requires a flying capacitor (C1, C2) and a reservoir capacitor (C3, C4) to generate the V+ and V- supplies.

The capacitor type used for C1–C4 is not critical for proper operation; either polarized or non-polarized capacitors may be used. The charge pump requires 0.1 μ F capacitors for 3.3V operation. For other supply voltages, refer to Table 10-1 for required capacitor values. When using the minimum required capacitor values, make sure the capacitor value does not degrade excessively with temperature. If in doubt, use capacitors with a larger nominal value. The capacitor's equivalent series resistance (ESR) usually rises at low temperatures and influences the amount of ripple on V+ and V-.

Table 10-1. Required Capacitor Values

V_{CC} (V)	C1 (μ F)	C2, C3, C4 (μ F)
3.0 to 3.6	0.1	0.1
4.5 to 5.5	0.047	0.33
3.0 to 5.5	0.1	all = 0.47 or all = 0.1

10.5 Device Functional Modes

Table 10-2. Each Transmitter (Note 1)

Inputs				Output	Transmitter Status
TIN	FORCEON	$\overline{\text{FORCEOFF}}$	Valid RIN RS-232 level	TOUT	
X	X	L	X	Z	Forced Shutdown
L	H	H	X	H	Normal Operation with Forced Power-On
H	H	H	X	L	
L	L	H	Yes	H	Normal Operation with Auto Power-On
H	L	H	Yes	L	
X	L	H	No	Z	Auto Shutdown

Note 1: H=high level, L=low level, X=irrelevant, Z=high impedance

Table 10-3. Each Receiver (Note 2)

Inputs			Output	Receiver Status
RIN	FORCEON	$\overline{\text{FORCEOFF}}$	ROUT	
X	X	L	Z	Forced Shutdown
L	X	H	H	Normal Operation
H	X	H	L	
Open	X	H	H	

Table 10-4. ROUT2B and $\overline{\text{INVALID}}$ Outputs (Note 2)

Inputs				Output		Output Status
Valid RIN RS-232 level	RIN2	FORCEON	$\overline{\text{FORCEOFF}}$	$\overline{\text{INVALID}}$	ROUT2B	
Yes	L	X	X	H	L	Always Active
Yes	H	X	X	H	H	
Yes	Open	X	X	H	L	
No	Open	X	X	L	L	

Note 2: H=high level, L=low level, X=irrelevant, Z=high impedance (off), Open=input disconnected or connected driver off

11 Application Information

11.1 Typical Operating Circuits

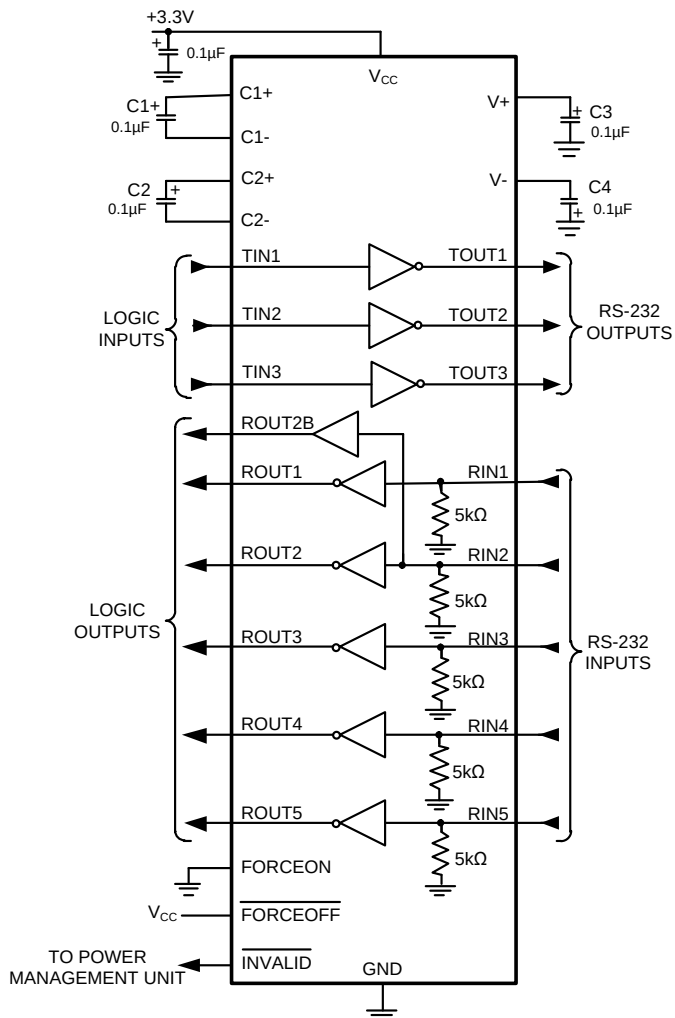
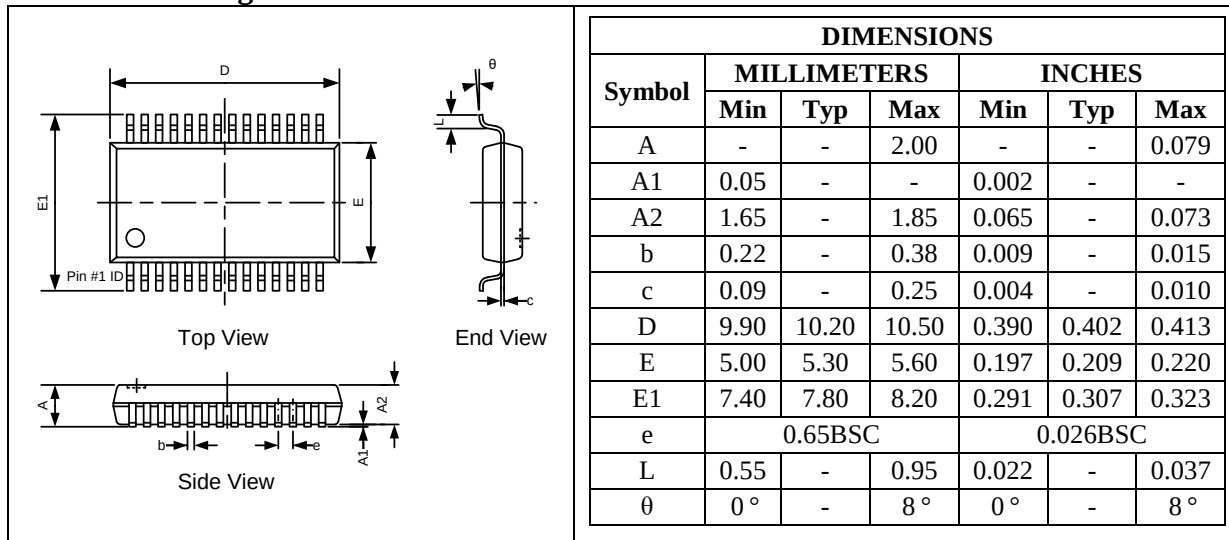


Figure 11-1. UM3243U Typical Operating Circuit

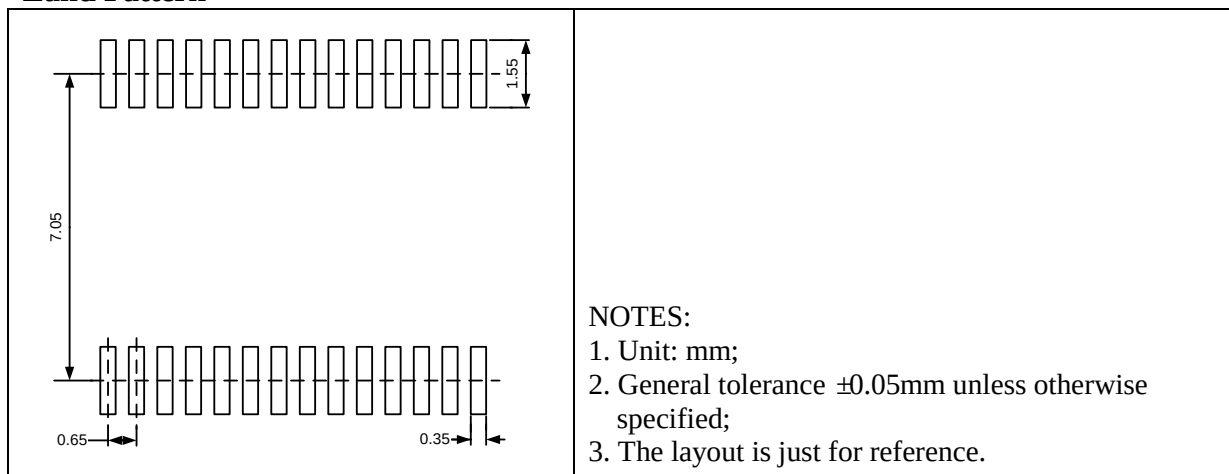
Package Information

SSOP28

Outline Drawing

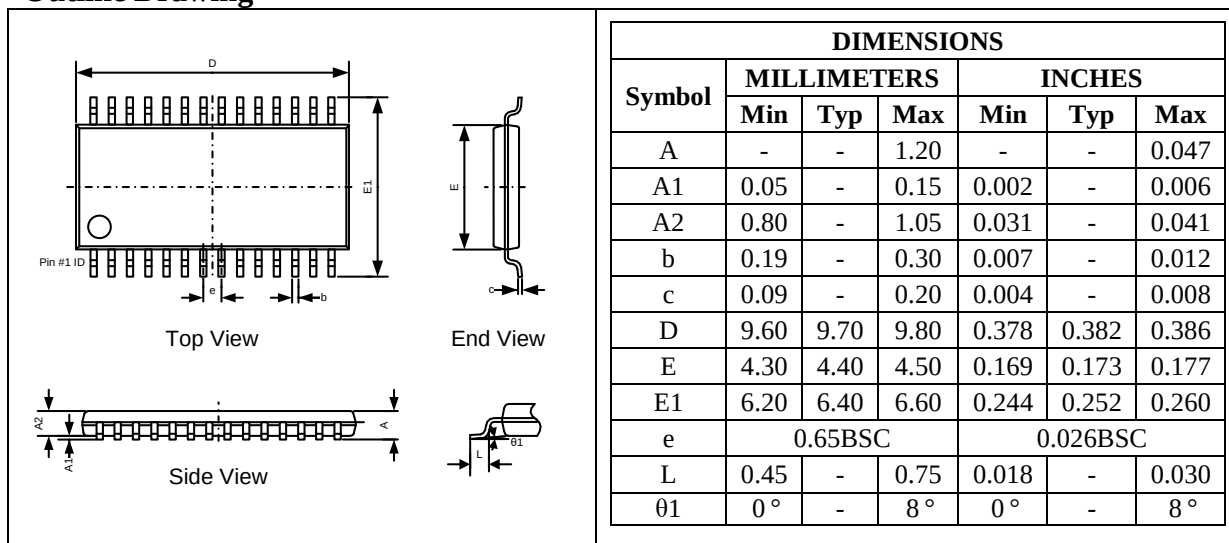


Land Pattern

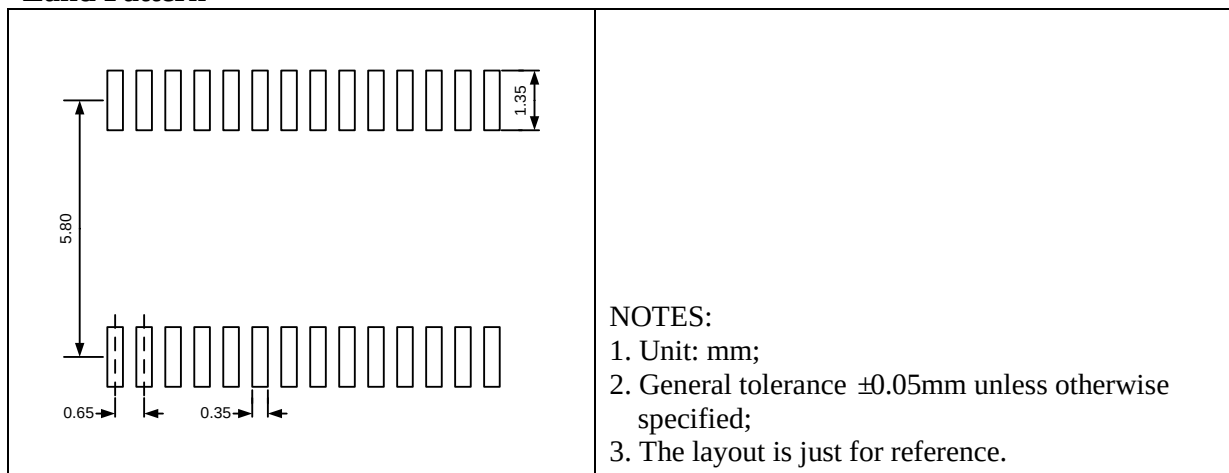


TSSOP28

Outline Drawing

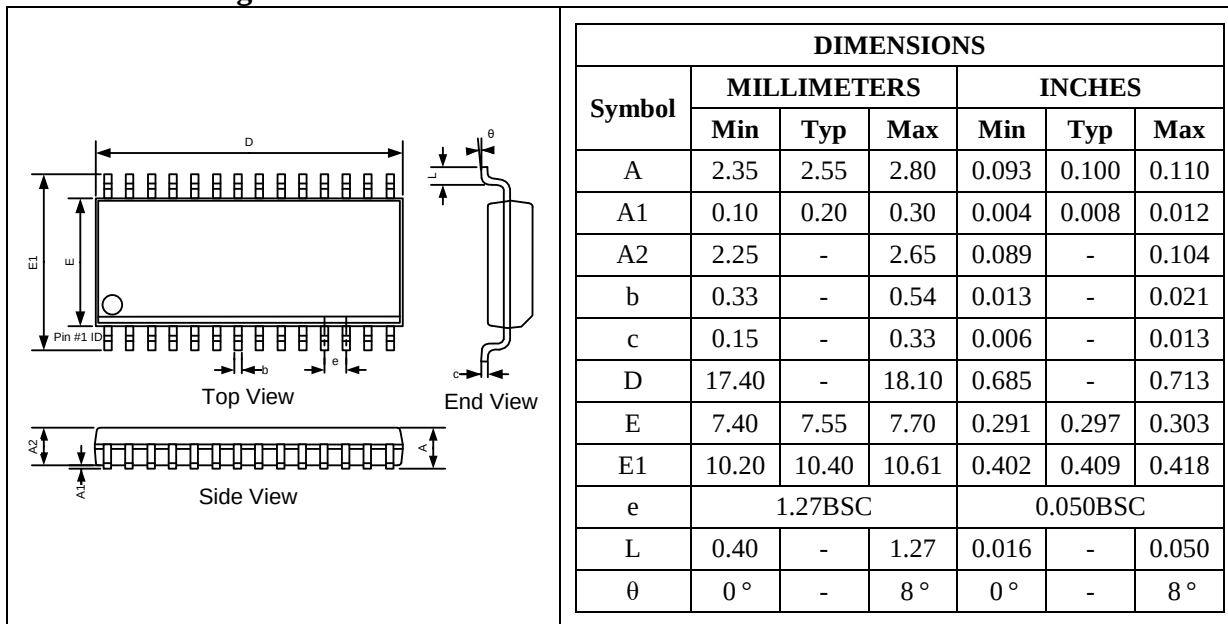


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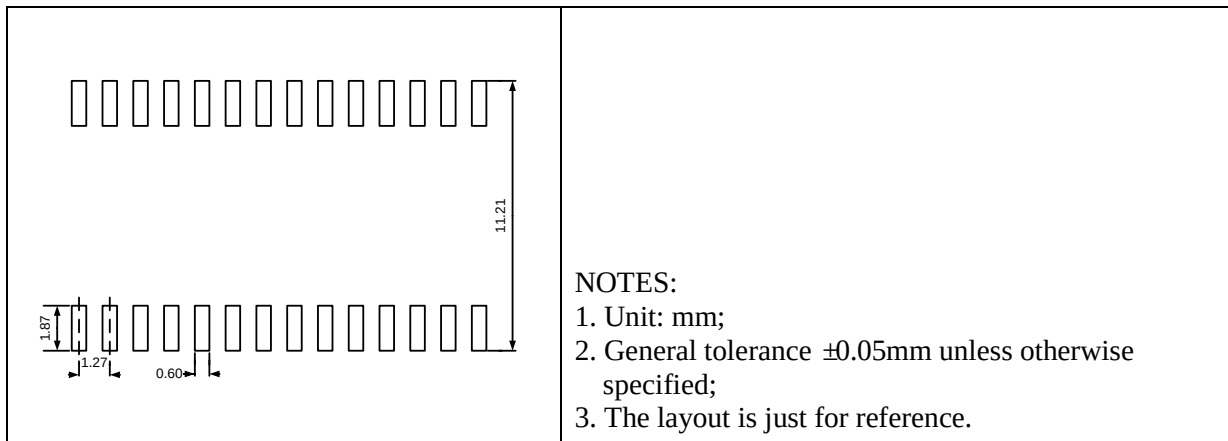


SOP28

Outline Drawing

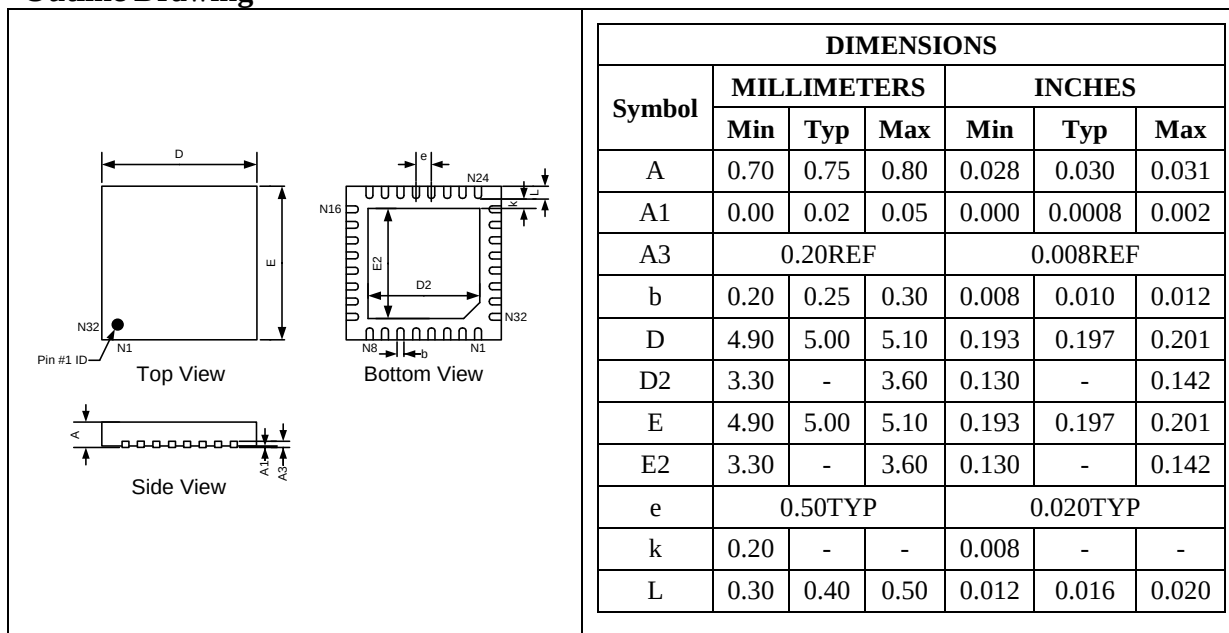


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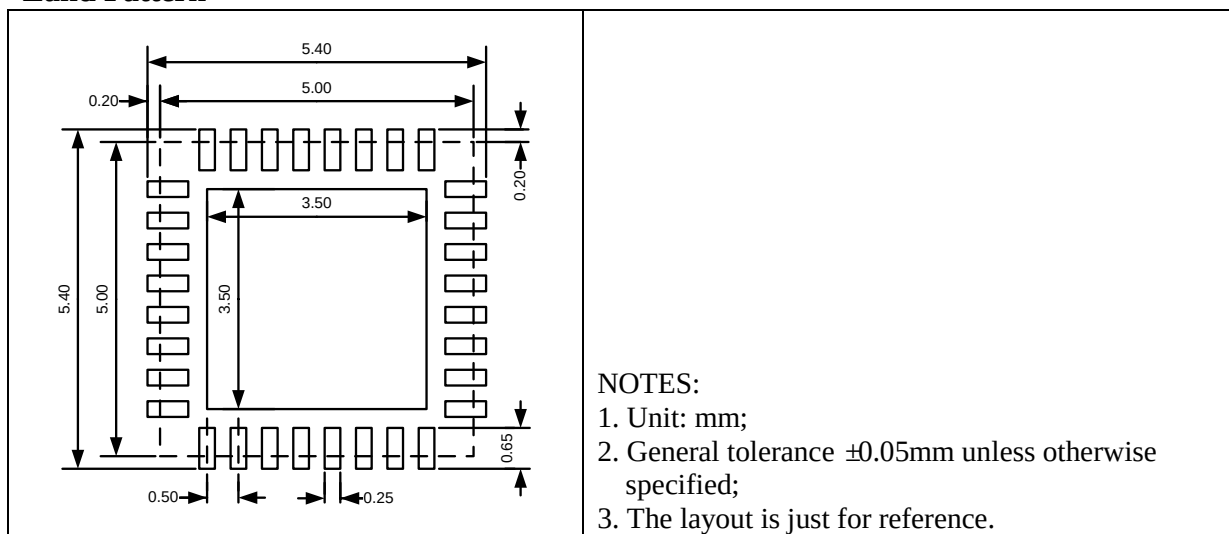


QFN32 5.0 × 5.0

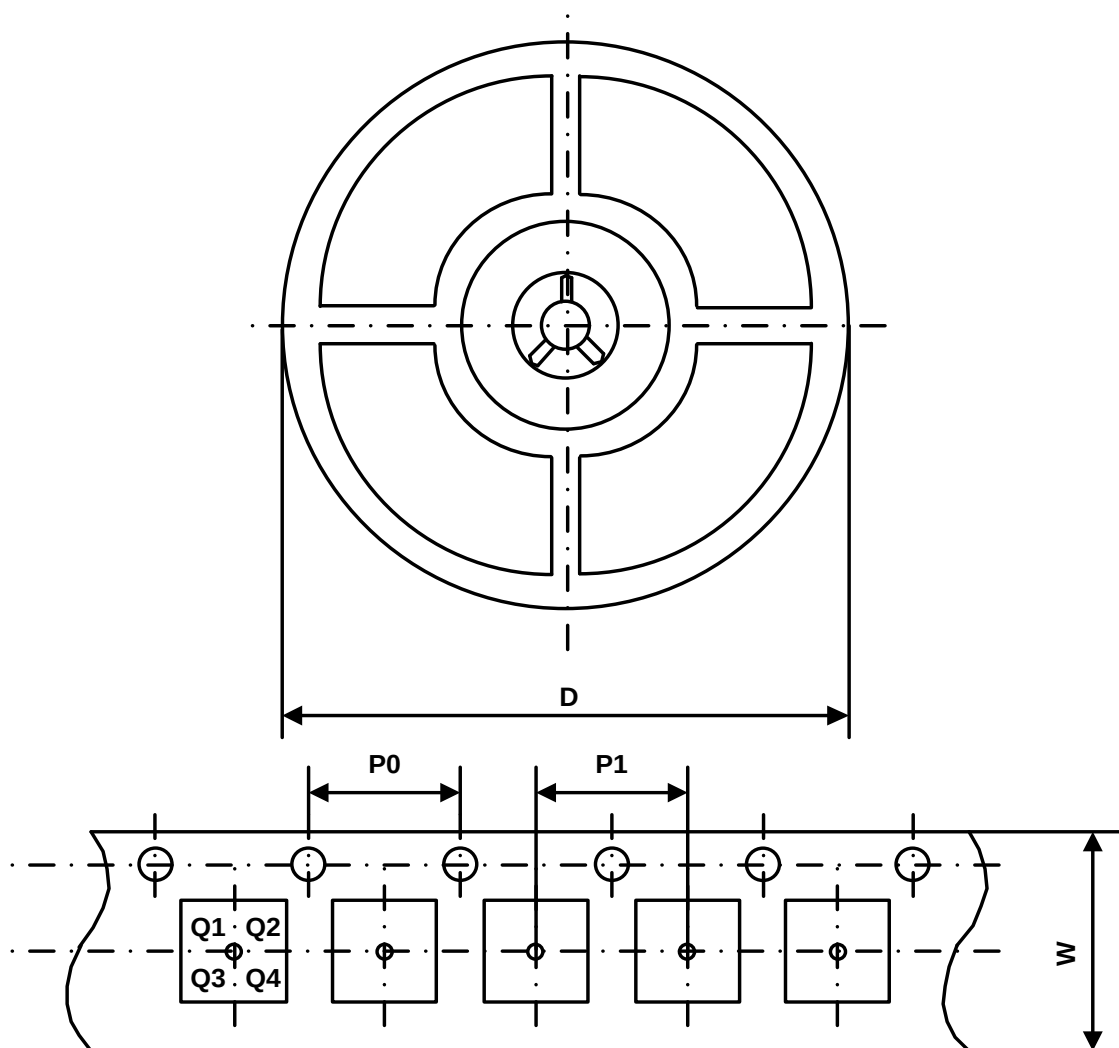
Outline Drawing



Land Pattern



Packing Information



Part Number	Package Type	Carrier Width (W)	Pitch (P0)	Pitch (P1)	Reel Size (D)	PIN 1 Quadrant
UM3243UEEASR	SSOP28	16 mm	4 mm	12 mm	330 mm	Q1
UM3243UEEUS	TSSOP28	16 mm	4 mm	8 mm	330 mm	Q1
UM3243UEEQA	QFN32 5.0×5.0	12 mm	4 mm	8 mm	330 mm	Q1

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