

1.8V Low Power Dual RS-232 Transceiver
Support 1.65V to 5V IO**UM3122EEQA****General Description**

The UM3122EEQA is a two-driver and two-receiver RS-232 interface device, with split supply pins for mixed-voltage operation. All RS-232 inputs and outputs are protected to $\pm 15\text{kV}$ using the IEC 61000-4-2 Air-Gap Discharge method, $\pm 8\text{kV}$ using the IEC 61000-4-2 Contact Discharge method, and $\pm 8\text{kV}$ using the Human-Body Model. The charge pump requires five small $0.1\mu\text{F}$ capacitors for operation from as low as a 1.8V supply. The UM3122EEQA is capable of running at data rates up to 1000 kbps, while maintaining RS-232 compatible output levels. The UM3122EEQA has a unique V_L pin that allows operation in mixed-logic voltage systems. Both driver in (D_{IN}) and receiver out (R_{OUT}) logic levels are pin programmable through the V_L pin. This eliminates the need for additional voltage level shifter while interfacing with low-voltage microcontrollers or UARTs. Auto Powerdown Plus automatically places the device in a low power mode when the device has not received or transmitted data for more than 30 seconds. This feature makes this device a very attractive option for battery powered or other power sensitive applications.

Applications

- Remote Radio Unit (RRU)
- Base Band Unit (BBU)
- Electronic Point of Sale (EPOS)
- Diagnostics & Data Transmission
- Battery-Powered Equipment

Features

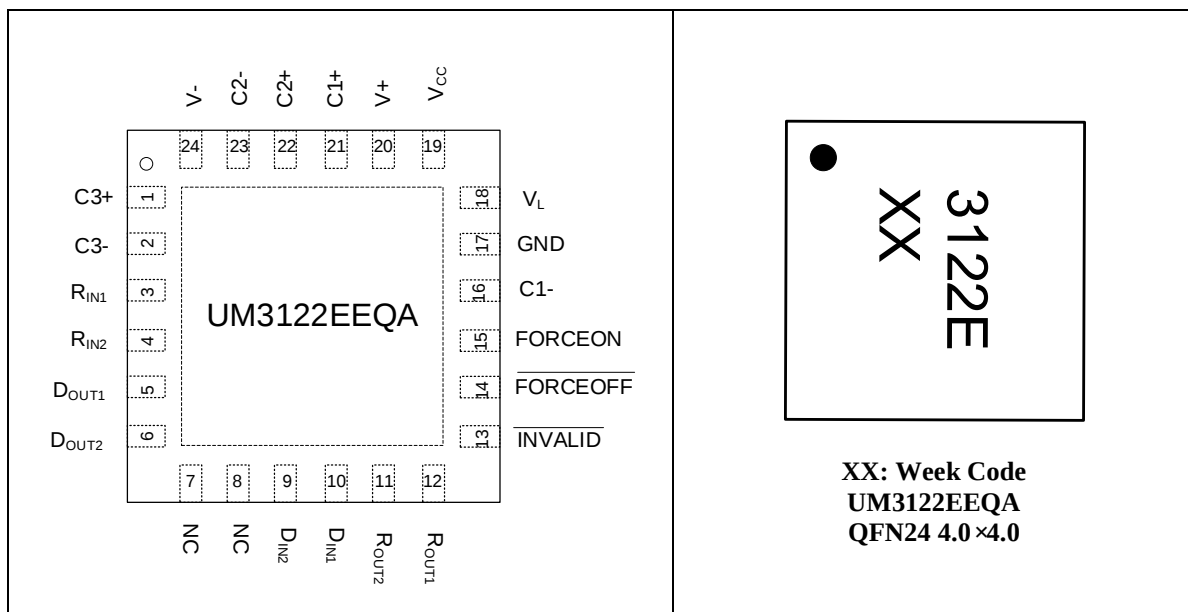
- Extended V_{CC} operating nodes: 1.8V, 3.3V, or 5.0V
 - Unique Tripler Charge Pump Architecture Enables Low V_{CC} of 1.8V While Maintaining Compatibility with 3.3V and 5V Supplies
- Integrated Level-Shifting Functionality Eliminates the Need for External Power or Additional Level Shifter While Interfacing with Low-Voltage MCUs
- Enhanced ESD Protection on R_{IN} Inputs and D_{OUT} Outputs
 - $\pm 15\text{kV}$ IEC 61000-4-2 Air-Gap Discharge
 - $\pm 8\text{kV}$ IEC 61000-4-2 Contact Discharge
 - $\pm 8\text{kV}$ Human-Body Model
- Specified 1000 kbps Data Rate
- Auto Powerdown Plus Feature
- Low $0.5\mu\text{A}$ Shutdown Supply Current
- Meets or Exceeds Compatibility Requirements of RS-232 Interface

Ordering Information

Part Number	Temp. Range	Marking Code	Package Type	Shipping Qty
UM3122EEQA	-40 °C to +105 °C	3122E	QFN24 4.0×4.0	3000pcs/13Inch Tape & Reel

Pin Configurations

Top View



Pin Description

Pin No.	Pin Name	Function
1	C3+	Positive terminal of voltage-tripler charge-pump capacitor (Not needed for V _{CC} 3V to 5.5V)
2	C3-	Negative terminal of voltage-tripler charge-pump capacitor (Not needed for V _{CC} 3V to 5.5V)
3	R _{IN1}	RS-232 Receiver Input
4	R _{IN2}	RS-232 Receiver Input
5	D _{OUT1}	RS-232 Driver Output
6	D _{OUT2}	RS-232 Driver Output
7	NC	Factory pin, can be unconnected or connected to GND
8	NC	Factory pin, can be unconnected or connected to GND
9	D _{IN2}	RS-232 Driver Input
10	D _{IN1}	RS-232 Driver Input
11	R _{OUT2}	RS-232 Receiver Output
12	R _{OUT1}	RS-232 Receiver Output
13	INVALID	Invalid Output Pin
14	FORCEOFF	Auto Powerdown Control input (Refer to Truth Table)
15	FORCEON	Auto Powerdown Control input (Refer to Truth Table)
16	C1-	Negative terminal of voltage-doubler charge-pump capacitors (required)
17	GND	Ground
18	V _L	Logic-level supply. All CMOS inputs (D _{IN}) and outputs (R _{OUT}) are referenced to this supply
19	V _{CC}	1.8V or 3V to 5V Supply Voltage Input
20	V ₊	Positive charge pump storage capacitor (required)
21	C1+	Positive terminal of voltage-doubler charge-pump capacitor (required)
22	C2+	Positive terminal of voltage-doubler charge-pump capacitor (required)
23	C2-	Negative terminal of voltage-doubler charge-pump capacitors (required)
24	V-	Negative charge pump storage capacitor (required)

Absolute Maximum Ratings (Note1)

Symbol	Parameter	Value	Unit
V_{CC}	Charge pump power supply	-0.3 to +6	V
V_L	Logic Power Supply	-0.3 to +6	V
V_+	Positive storage capacitor voltage ₊	-0.3 to +7	V
V_-	Negative storage capacitor voltage	-7 to +0.3	V
D_{IN}	Voltage on D_{IN}	-0.3 to ($V_L + 0.3$)	V
R_{IN}	(0Ω series resistance)	±20	V
	(≥250Ω series resistance)	±25	
D_{OUT}	Output voltage	$V_- - 0.3$ to $V_+ + 0.3$	V
R_{OUT}	Output voltage	-0.3 to ($V_L + 0.3$)	V
$V_+ + V_- $ (Note2)		13	
$\overline{FORCEOFF}$	Input voltage	-0.3 to +6	V
$FORCEON$	Input voltage	-0.3 to +6	V
T_J	Junction temperature	150	°C
T_{stg}	Storage temperature range	-65 to 150	°C

Note1: 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.

Note2: V_+ and V_- can have maximum magnitudes of 7V, but their absolute difference cannot exceed 13V.

Thermal Characteristics

Symbol	Thermal Metric	Value	Unit
θ_{JA}	Junction-to-ambient thermal resistance	34.2	°C/W
θ_{JC}	Junction-to-case thermal resistance	27.2	

Recommended Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Charge pump power supply	V_{CC}	Tripler Mode	1.65	1.8	2	V
		Doubler Mode	3	3.3	3.6	
			4.5	5	5.5	
Logic power supply	V_L		1.65		V_{CC}	V
RS-232 Receiver interface	R_{IN}		-15		15	V
RS-232 Transmitter interface	D_{OUT}		-7		7	V
GPIO Input logic threshold low (D_{IN} , $\overline{FORCEOFF}$, $FORCEON$)	V_{IL}	$V_L = 5.0\text{ V}$	0		1.7	V
		$V_L = 3.3\text{ V}$	0		1.1	
		$V_L = 1.8\text{ V}$	0		0.6	
GPIO Input logic threshold high (D_{IN} , $\overline{FORCEOFF}$, $FORCEON$)	V_{IH}	$V_L = 5.0\text{ V}$	3.3		V_L	V
		$V_L = 3.3\text{ V}$	2.2		V_L	
		$V_L = 1.8\text{ V}$	1.2		V_L	
R_{OUT} disabled	V_{OZ}	$\overline{FORCEOFF} = 0\text{ V}$	0		V_L	V
Operating temperature			-40		105	°C

Electrical Characteristics

$V_{CC} = V_L = (1.65 \text{ V to } 2.0 \text{ V}) \text{ \& } (3.0 \text{ V to } 5.5 \text{ V})$, $T_A = -40 \text{ }^{\circ}\text{C to } 105 \text{ }^{\circ}\text{C}$ (unless otherwise noted).

Typical data is $T_A = 25 \text{ }^{\circ}\text{C}$, $V_{CC} = V_L = 3.3 \text{ V}$ (unless otherwise noted).

Power and Status Electrical Characteristics								
Parameter	Symbol	Condition			Min	Typ	Max	Unit
Static	I _{CC (static)}	D _{IN1} = GND or V _L ; D _{IN2} = GND or V _L , FORCEOFF = V _L FORCEON = V _L	No load	V _{CC} = 1.65V to 2.0V		1.0	1.9	mA
		V _{CC} = 3.0V to 3.6V			0.7	1.4		
		V _{CC} = 4.5V to 5.5V			0.8	1.9		
off	I _{CC (off)}	FORCEOFF=GND				0.4	10	μA
R _{IN} positive voltage threshold for INVALID output change	V _{IT+}	R _{IN1} = R _{IN2}			0.3		2.4	V
R _{IN} negative voltage threshold for INVALID output change	V _{IT-}				-2.4		-0.3	
INVALID high-level output voltage	V _{OH}	I _{OH} = -1 mA, FORCEON = GND, FORCEOFF = V _L			V _L -0.4	V _L -0.08	V _L	V
INVALID low-level output voltage	V _{OL}	I _{OL} = 1.6 mA, FORCEON = GND, FORCEOFF = V _L			0	0.06	0.4	V
Driver Electrical Characteristics								
Output voltage swing	V _{OUT}	All driver outputs loaded with 3 kΩ to ground C3 = 100 nF, V _{CC} = 1.8 V			±4.25	±4.7		V
		All driver outputs loaded with 3 kΩ to ground C3 = 0 F, V _{CC} = 3.3 V or 5 V			±5	±5.4		
Output short-circuit	I _{os}	V _{DOUT} = 0					±60	mA
Input leakage current		D _{IN} = GND to V _L ; FORCEOFF = GND to V _L ; FORCEON = GND to V _L				0	±10	μA

Electrical Characteristics (continued)

$V_{CC} = V_L = (1.65 \text{ V to } 2.0 \text{ V}) \text{ \& } (3.0 \text{ V to } 5.5 \text{ V})$, $T_A = -40 \text{ }^{\circ}\text{C to } 105 \text{ }^{\circ}\text{C}$ (unless otherwise noted).

Typical data is $T_A = 25 \text{ }^{\circ}\text{C}$, $V_{CC} = V_L = 3.3 \text{ V}$ (unless otherwise noted).

Receiver Electrical Characteristics							
Parameter	Symbol	Condition		Min	Typ	Max	Unit
Output leakage current	I _{off}	R _{OUT} , receives disabled			±0.01	±10	µA
Output voltage low	V _{OL}	I _{out} =2.0mA			0.04	0.3	V
Output voltage high	V _{OH}	I _{out} = -2.0mA		V _L -0.3	V _L -0.04		V
Input threshold low	V _{IT-}	T _A =25°C	V _L =5	0.8	1.5		V
			V _L =3.3V	0.7	1.1		
			V _L =1.8V	0.6	0.7		
Input threshold high	V _{IT+}	T _A =25°C	V _L =5V		2.0	2.4	V
			V _L =3.3V		1.5	2.4	
			V _L =1.8V		0.9	1.4	
Input hysteresis	V _{hys}	T _A =25°C	V _L =5V		0.45		V
			V _L =3.3V		0.35		
			V _L =1.8V		0.26		
Input resistance		T _A = -40 to 105 °C		3	5	7	kΩ
Driver Switching Characteristics							
Maximum data rate		R _L = 3 kΩ, C _L = 500 pF (one driver)		1000			kbps
		R _L = 3 kΩ, C _L = 1000 pF (one driver)		500			
Time-to-exit powerdown		V _{DOUT} > 3.7 V			30	150	µs
Driver skew (Note1)	t _{PHL} – t _{PLH}	R _L = 3 kΩ		0	50	100	ns
Transition-Region slew rate		R _L = 3 kΩ to 7 kΩ, T _A = 25 °C Measured from 3 V to –3V or –3 V to 3 V	V _{CC} = 1.8V, C _L = 200 pF		33		V/µs
			V _{CC} = 1.8V, C _L = 1000pF		25		
			V _{CC} = 3.3 V, C _L = 200 pF		38		
			V _{CC} = 3.3 V, C _L = 1000pF		28		
			V _{CC} = 5 V, C _L = 200 pF		41		
			V _{CC} = 5 V, C _L = 1000 pF		30		

Electrical Characteristics (continued)

$V_{CC} = V_L = (1.65 \text{ V to } 2.0 \text{ V}) \& (3.0 \text{ V to } 5.5 \text{ V})$, $T_A = -40 \text{ }^{\circ}\text{C to } 105 \text{ }^{\circ}\text{C}$ (unless otherwise noted).

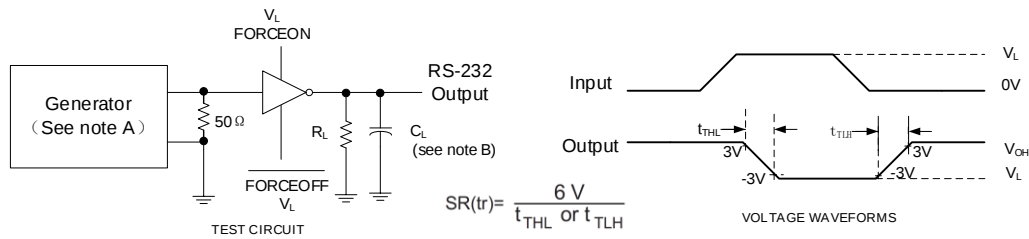
Typical data is $T_A = 25 \text{ }^{\circ}\text{C}$, $V_{CC} = V_L = 3.3 \text{ V}$ (unless otherwise noted).

Receiver Switching Characteristics						
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Receiver propagation delay, high to low	t _{PHL}	Receiver input to receiver output C _L = 150 pF		0.15	0.4	μs
Receiver propagation delay, low to high	t _{PLH}			0.15	0.4	μs
Receiver skew	t _{PHL} –t _{PLH}			50	300	ns
Receiver output enable time	t _{en}	From $\overline{\text{FORCEOFF}}$ to R _{OUT} = V _L /2 C _L = 150 pF, R _L = 3 kΩ		200	400	ns
Receiver output disable time	t _{dis}			200	400	ns
Power and Status Switching Characteristics						
Propagation delay time, low to high level output	t _{valid}			1		μs
Propagation delay time, high to low level output	t _{invalid}			30		μs
Receiver or driver edge to auto powerdown plus	t _{dis}		15	30	60	s
ESD						
Electrostatic discharge	V _(ESD)	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins (Note2)	All pins except RS-232 bus	±2000		V
			RS-232 bus pins	±8000		
		IEC 61000-4-2 Air-Gap Discharge	RS-232 bus pins	±15000		
		IEC 61000-4-2 Contact Discharge		±8000		

Note1: Driver skew is measured at the driver zero crosspoint.

Note2: JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.

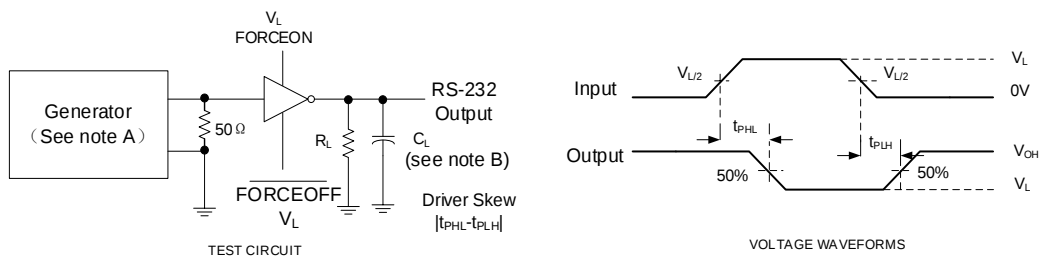
Parameter Measurement Information



Notes: A. The pulse generator has the following characteristics: PRR = 1000 kbit/s, $Z_O = 50\Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

B. C_L includes probe and jig capacitance.

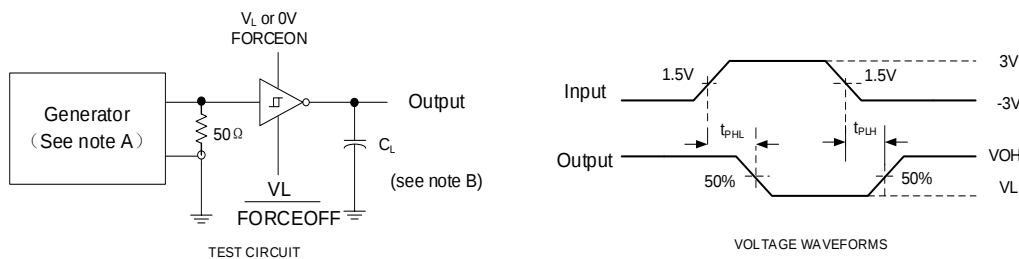
Figure 1. Driver Slew Rate



Notes: A. The pulse generator has the following characteristics: PRR = 1000 kbit/s, $Z_O = 50\Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

B. C_L includes probe and jig capacitance.

Figure 2. Driver Pulse Skew

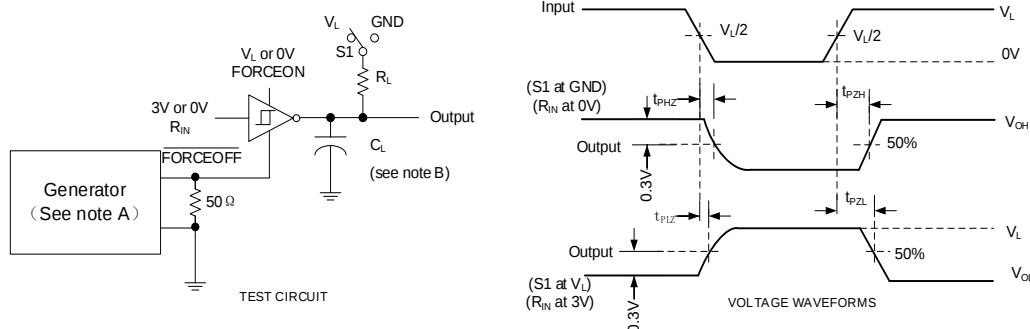


Notes: A. The pulse generator has the following characteristics: $Z_O = 50\Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

B. C_L includes probe and jig capacitance.

Figure 3. Receiver Propagation Delay Times

Parameter Measurement Information (continued)



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

B. C_L includes probe and jig capacitance.

C. t_{PLZ} and t_{PHZ} are the same as t_{dis} .

D. t_{PLZ} and t_{PHZ} are the same as t_{en} .

Figure 4. Receiver Enable and Disable Times

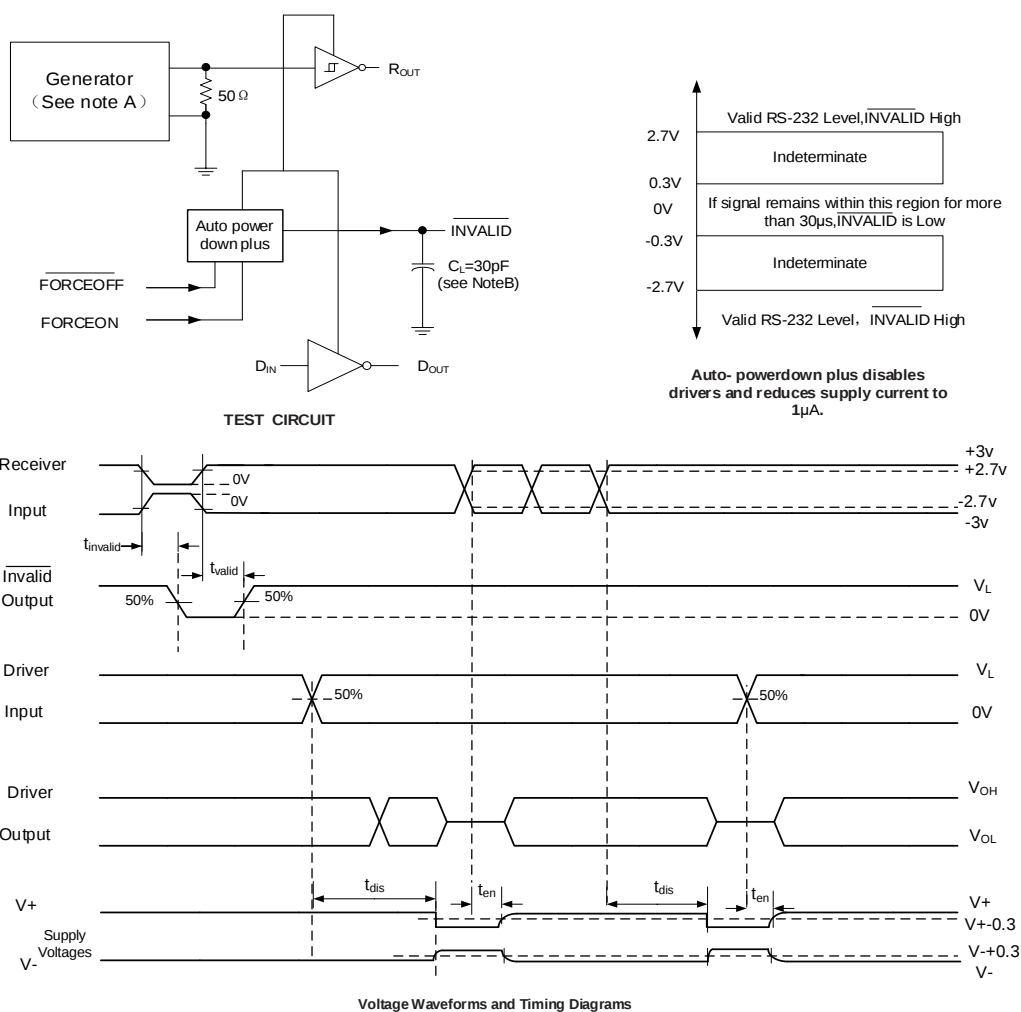


Figure 5. INVALID Propagation-Delay Times and Supply-Enabling Time

Typical Characteristics

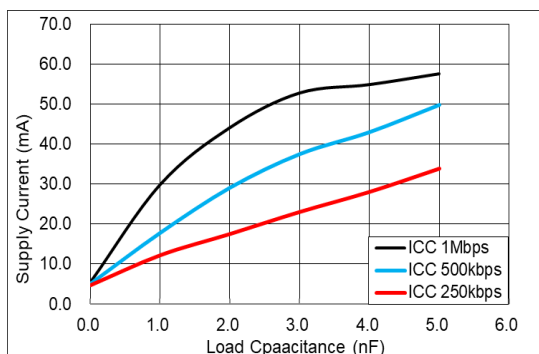


Figure 6. Supply Current vs Load Capacitance
 $V_{CC}=3.3V$, $V_L=1.8V$, $R_{LOAD}=3k\Omega$, $CH2=32kbps$

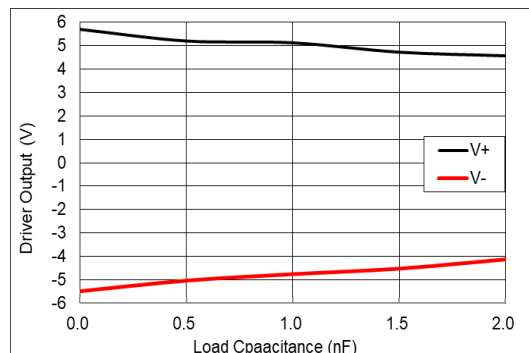


Figure 7. Driver Output vs Load Capacitance
 $V_{CC}=3.3V$, $V_L=1.8V$, $R_{LOAD}=3k\Omega$, $CH1=1Mbps$, $CH2=32kbps$

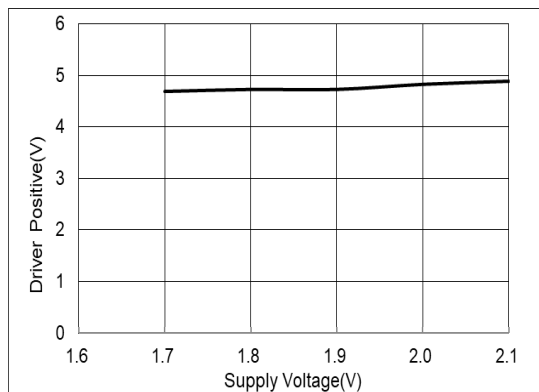


Figure 8. Driver Positive vs Supply Voltage (Tripler Mode)
 $1Mbps$, $R_{LOAD}=3k\Omega$, $C_{LOAD}=560pF$

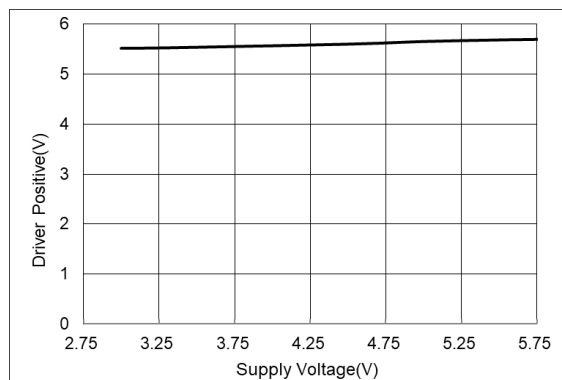


Figure 9. Driver Positive vs Supply Voltage (Doubler Mode)
 $1Mbps$, $R_{LOAD}=3k\Omega$, $C_{LOAD}=560pF$

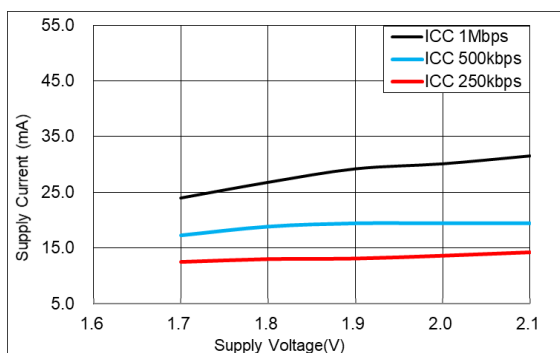


Figure 10. Supply Current vs Supply Voltage (Tripler Mode)
 $V_L=1.8V$, $R_{LOAD}=3k\Omega$, $C_{LOAD}=1nF$, $CH2=32kbps$

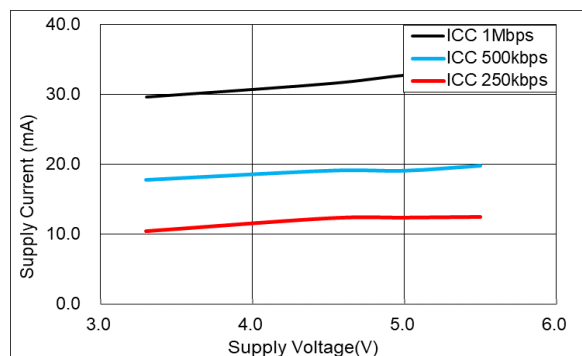


Figure 11. Supply Current vs Supply Voltage (Tripler Mode)
 $V_L=1.8V$, $R_{LOAD}=3k\Omega$, $C_{LOAD}=1nF$, $CH2=32kbps$

Detailed Description

Overview

The UM3122EEQA is an upgrade to standard RS-232 transceivers, offering compatibility with modern system needs like 1.8V GPIO capability, enhanced ESD & ultralow stand-by current. The majority of RS-232 transceivers with 1.8V GPIO compatibility require a logic supply pin for the I/O translation, in addition to a minimum 3.3V V_{CC} for all of the other active circuitry on the chip. Unlike these transceivers, UM3122EEQA can operate with both V_L and V_{CC} equal to 1.8V. When $V_{CC}=3.0V$ to 5.5V, the charge pump will sense V_{CC} and switch to doubler mode. C1 & C2 are the necessary flying capacitors, C3 is not needed, and the charge pump outputs V_+ & V_- will regulate to $\sim\pm 5.4V$. When $V_{CC}=1.65V$ to 2.0V, the charge pump will sense V_{CC} and switch to tripler mode. C1, C2 & C3 are all necessary, and the charge pump outputs V_+ & V_- will regulate to $\sim\pm 2.65 \cdot V_{CC}$ from $V_{CC}=1.65V$ to 2.0V.

With many modern applications expanding into products that use UM3122EEQA as a backup communication protocol, it is important for the transceiver to have efficient standby operation. In order to accommodate this, Auto Powerdown Plus has been integrated to shut-off all active circuitry, allowing UM3122EEQA to achieve an I_{off} of 1uA.

In order to comply with common interface system needs and environments, the RS-232 receive and transmit I/O pins comply with IEC 61000-4-2 ratings.

Detailed Functional Block Diagram

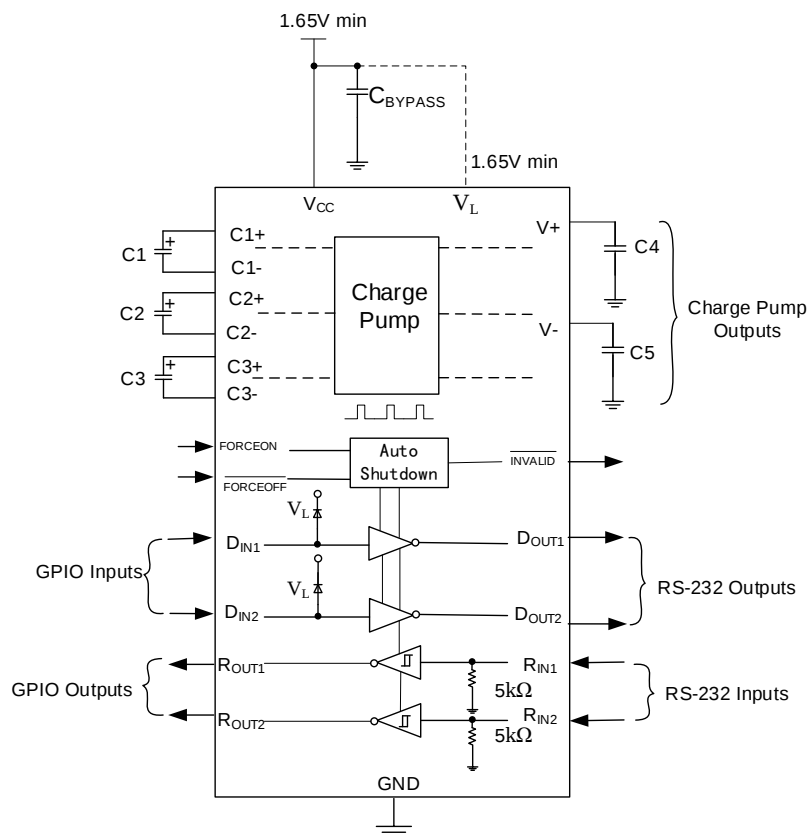


Figure 12. Schematic

Feature Description

Charge Pump

The internal power supply consists of a regulated auto-sensing charge pump that provides RS-232 compatible output voltages, over the 1.65V to 2.0V and 3.0V to 5.5V V_{CC} ranges. The charge pump operates in two modes to efficiently accommodate low voltage (1.8V) and higher voltage (3.3V & 5.0V) supplies.

Doubler Mode: The charge pump requires two flying capacitors (C1, C2) and reservoir capacitors (C4, C5) to generate the V_+ and V_- supplies of approximately $\pm 5.4V$ when V_{CC} is greater than 3 V. When V_{CC} is $> 2.9V$, UM3122EEQA will sense the supply voltage level and switch the charge pump to a doubler. Hence, no need for a third flying capacitor. C3+&C3- pins can be left open for proper operation. If a capacitor is placed between C3+&C3-, the charge pump will ignore this capacitor and still behave as a doubler. For capacitor choice recommendations, please refer to Capacitor Selection Table.

Tripler Mode: The charge pump requires three flying capacitors (C1, C2&C3) and reservoir capacitors (C4, C5) to generate the V_+ and V_- supplies of approximately $\pm 2.65 \cdot V_{CC}$ when V_{CC} is greater than 1.65V. When V_{CC} is $< 2.1V$, UM3122EEQA will sense the supply voltage level and switch the charge pump to a tripler.

Drivers

The drivers are inverting level transmitters that convert TTL or CMOS logic levels to RS-232 levels. For $V_{CC} = 3.0V$ to $5.0V$, the RS-232 output voltage swing is typically $\pm 5.4V$ fully loaded and $\pm 5V$ minimum fully loaded. For $V_{CC} = 1.8V$, the RS-232 output voltage swing is typically $\pm 4.7V$ fully loaded and $\pm 4.25V$ minimum fully loaded. The driver outputs are protected against indefinite short-circuits to ground without degradation in reliability. These drivers are compatible with RS-232 logic levels and all previous RS-232 versions. Unused driver inputs should be connected to GND or V_{CC} .

Receivers

The receivers convert EIA/TIA-232 levels to TTL or CMOS logic output levels. Receivers have an inverting output that can be disabled by using the $\overline{\text{FORCEOFF}}$ pin. Receivers remain active when the Auto Powerdown Plus circuitry autonomously enters a low power state. See Auto Powerdown Plus for more information on the Auto Powerdown mode. If the $\overline{\text{FORCEOFF}}$ pin is manually set low, the receivers will be disabled and put into 3-state mode. In either of these Powerdown modes, the device will typically consume about 0.5 μA . The truth table logic of the UM3122EEQA driver and receiver outputs can be found in Device Functional Modes. Since receiver input is usually from a transmission line where long cable lengths and system interference can degrade the signal, the inputs have a typical hysteresis margin of 300 mV. This ensures that the receiver is virtually immune to noisy transmission lines. Should an input be left unconnected, an internal 5k Ω pull-down resistor to ground will commit the output of the receiver to a HIGH state.

Auto Powerdown Plus

Powerdown is engaged in two separate cases: automatically, when no activity has occurred for a period of time, and manually, using the $\overline{\text{FORCEOFF}}$ device pin.

Automatic Powerdown: Auto Powerdown Plus is enabled when FORCEON is set LOW and

$\overline{\text{FORCEOFF}}$ is set HIGH. Using UM3122EEQA's integrated edge detection circuitry and timer, the device can sense when there is no activity on the driver or receiver inputs for 30 seconds. When this condition is sensed by the device, it automatically shuts the charge pump off, reducing supply current to 0.5 μ A. When a valid transition is sensed on one of the driver or receiver inputs, the charge pump turns back on and UM3122EEQA exits powerdown. The typical time to exit powerdown is typically in 30 μ s, but can be as long as 150 μ s. As a result, the system saves power without requiring any software control. Device Functional Modes summarizes the operating modes in truth table form. While in the low power mode with Automatic Powerdown enabled ($\overline{\text{FORCEOFF}}$ = HIGH and FORCEON = LOW), the receiver inputs are still enabled.

Manual Powerdown:

The device can be manually powered down by externally setting $\overline{\text{FORCEOFF}}$ pin to low logic level. Both the drivers and receivers will be powered off. Device Functional Modes summarizes the operating modes in truth table form.

Forced On: If the $\overline{\text{FORCEOFF}}$ and FORCEON pins are both set HIGH, the device will power on with Auto Powerdown Plus disabled. Both the drivers and receiver will be active regardless of inactivity. Because Powerdown is autonomous, FORCEON can be used ensure drivers are ready for new data transmission if the time since last transmission (or receive data) was more than 15 seconds. Device Functional Modes summarizes the operating modes in truth table form.

Device Functional Modes

Each Driver (Note1)

Inputs				Outputs	Driver status
D _{IN}	FORCEON	$\overline{\text{FORCEOFF}}$	Time elapsed since last R _{IN} or D _{IN} transition	D _{OUT}	
X	X	L	X	Z	Powered off
L	H	H	X	H	Normal operation with auto-powerdown plus disabled
H	H	H	X	L	
L	L	H	<30s	H	Normal operation with auto-powerdown plus enabled
H	L	H	<30s	L	
L	L	H	>30s	Z	Normal operation with auto-powerdown plus feature
H	L	H	>30s	Z	

Note1: H = high level, L = low level, X = irrelevant, Z = high impedance (off), 30s is typical inactivity time.

Each Receiver (Note1)

Inputs			Outputs	Receiver status
R _{IN}	FORCEOFF	Time elapsed since last R _{IN} or D _{IN} transition	R _{OUT}	
X	L	X	Z	Powered off
L	H	X	H	Normal operation with auto-powerdown plus disabled
H	H	X	L	
Open	H	X	H	Normal operation with auto-powerdown plus enabled

Note1: H = high level, L = low level, X = irrelevant, Z = high impedance (off), Open = input disconnected or connected driver off.

Invalid Status Truth (Note1)

Inputs				Outputs
R _{IN1} , R _{IN2}	FORCEON	FORCEOFF	Time elapsed since last R _{IN} or D _{IN} transition	Invalid
Any L or H	X	X	X	H
All Open	X	X	X	L

Note1: H = high level, L = low level, X = irrelevant, Z = high impedance (off), 30s is typical inactivity time.

Applications Information

UM3122EEQA is used to communicate between two electrical units on separate PCBs across cables <40 ft. Common UM3122EEQA cables are RJ45, DB9 & DB25. Typical 1.8V Application is shown in the figure below.

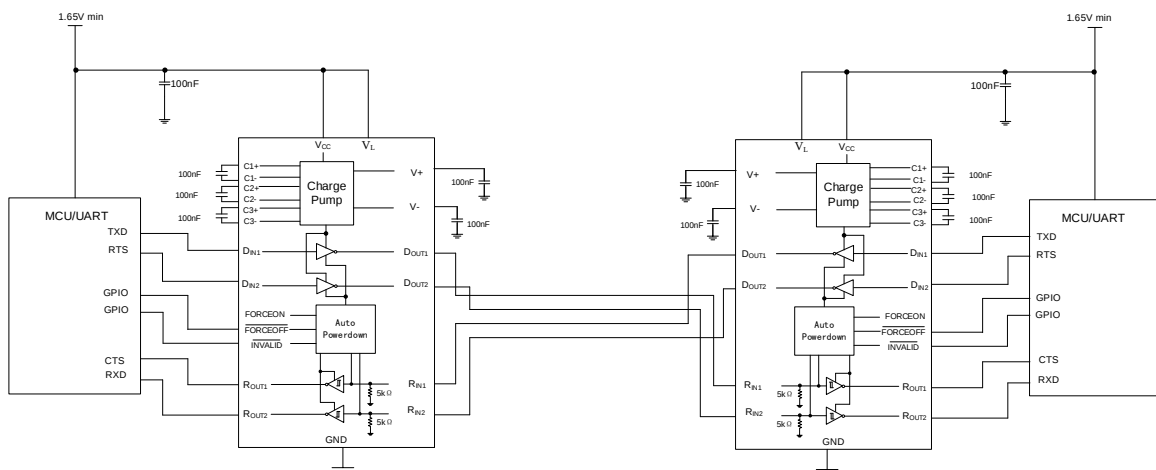


Figure 13. Typical 1.8V Application

Data-Rate and Cable Length

RS-232 intended is for short range data transmission. The rise time for RS-232 driver edges is slow enough that the data cable appears as a capacitor instead of a transmission line impedance. The elapsed time for one bit of data far exceeds the transit time of any practical RS-232 cable length. The capacitance of the cable is the limiting factor. Therefore, the capacitance per foot (or meter) of the cable is important if long data cables are used. Capacitance slows the rise and fall time of the signal. For low data rates, the delay is insignificant. However, high data rates will have reduced percentage of time that the output is at V_{OL} or V_{OH} and more time in the transitions.

The timing of the UART (universal asynchronous receiver/transmitter) must sample the signal at the right time to coincide with V_{OL} and V_{OH} plateaus. At some point data reliability will be impacted. There are no hard limits for cable capacitance and data rate.

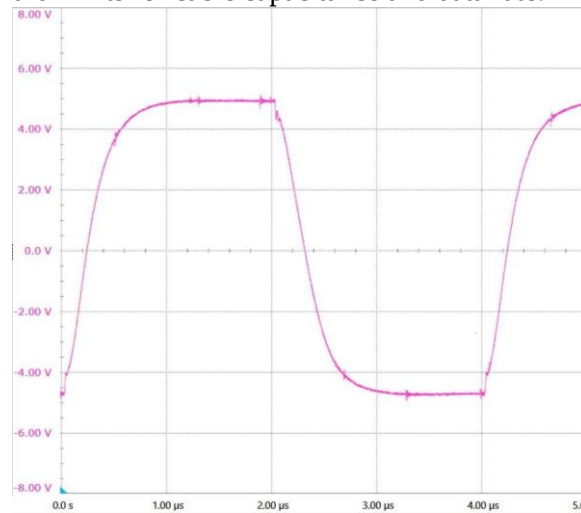


Figure 14. Typical Waveform with Capacitive Load

$V_{CC} = 3.3\text{ V}$, $R_{LOAD} = 3\text{ k}\Omega$, Data Rate = 500kbps, $C = 2\text{ nF}$

The maximum cable length depends on the cable used (pf/ft), data rate, timing of receiving UART, system tolerance to data errors.

Capacitor Selection

The capacitor type used for C1–C5 is not critical for proper operation; polarized or non-polarized capacitors can be used, though lower ESR capacitors are preferred. The charge pump requires 0.1 μF capacitors for $V_{CC} = 1.8\text{ V}$ or $V_{CC} = 3.3\text{ V}$ operation. For other supply voltages, see the Capacitor Selection Table for required capacitor values. Do not use values smaller than those listed in Capacitor Selection Table. Increasing the capacitor values, except for C1, reduces ripple on the transmitter outputs and slightly reduces power consumption. C2, C3, C4 and C5 can be increased without changing C1's value. However, do not increase C1 without also increasing the values of C2, C3, C4, C5, $C_{BYPASS1}$, and $C_{BYPASS2}$ to maintain the proper ratios (C1 to the other capacitors). 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 increases at low temperatures.

For best charge pump efficiency locate the charge pump and bypass capacitors as close as possible to the IC. Surface mount capacitors are best for this purpose. Using capacitors with lower equivalent series resistance (ESR) and self-inductance, along with minimizing parasitic PCB trace inductance will optimize charge pump operation. Designers are also advised to consider that capacitor values may shift over time and operating temperature.

Capacitor Selection Table

$V_{CC} = V_L$	C1 Capacitor Value	C2 Capacitor Value	C3 Capacitor Value	C4 Capacitor Value	C5 Capacitor Value
1.65 V to 2 V (Note1)	100 nF				
3.0 V to 3.6 V (Note1)	100 nF		100 nF or open	100nF	
4.5 V to 5.5 V (Note1)	47 nF	330 nF	100 nF or open	330nF	
3 V to 5.5 V (Note2)	47 nF	470 nF	100 nF or open	470nF	

Note1: For optimized performance, we recommend using these configurations.

Note2: For applications where the V_{CC} variation is larger, this configuration is acceptable.

Application Curves

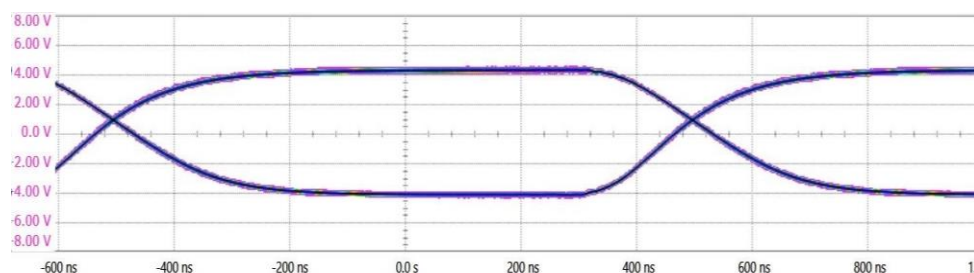


Figure 14.1 Mbps Eye Diagram, 2 V/div, 200 ns/ div

$V_{CC} = 1.8 \text{ V}$, $C_{LOAD} = 500 \text{ pF}$, $R_{LOAD} = 3 \text{ k}\Omega$

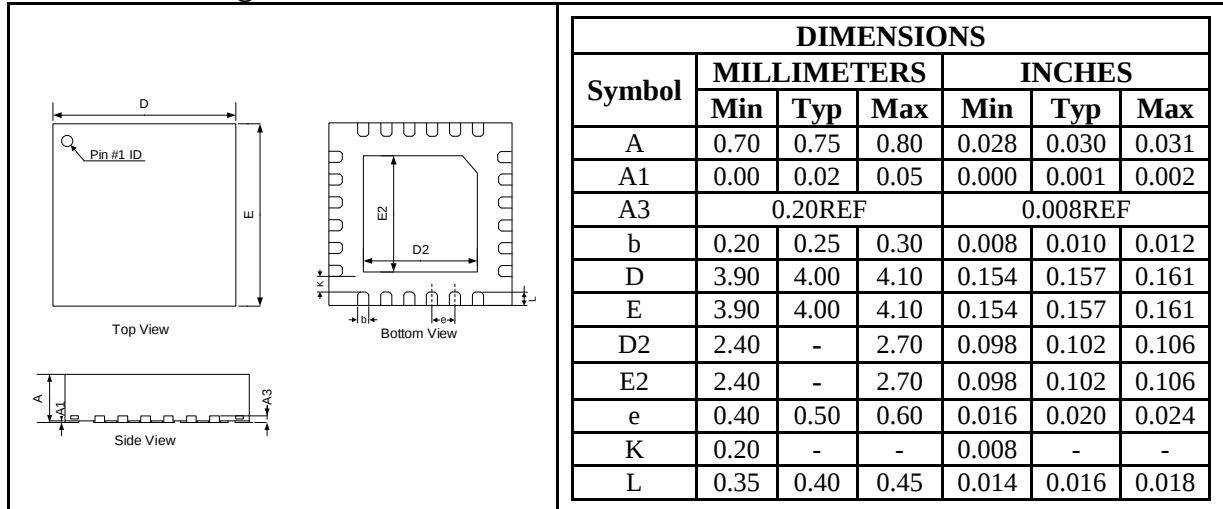
Power Supply Recommendations

In most circumstances, a $0.1\mu\text{F}$ V_{CC} bypass capacitor and a $1\mu\text{F}$ V_L bypass capacitor are adequate. In applications that are sensitive to power-supply noise, use larger value V_{CC} bypass capacitor. There is no maximum limit for bypass capacitor. Place bypass capacitors as close to the IC as possible. It is not recommended to use this device when V_{CC} is powered and $V_L = 0 \text{ V}$ or floating for an extended period of time because operation is undefined. V_{CC} and V_L must be powered to guarantee charge pump operation. Also, to achieve full functionality as described in Specifications, it is recommended to not use a higher voltage on V_L than V_{CC} . Full functionality can be achieved when V_{CC} is greater than or equal to V_L .

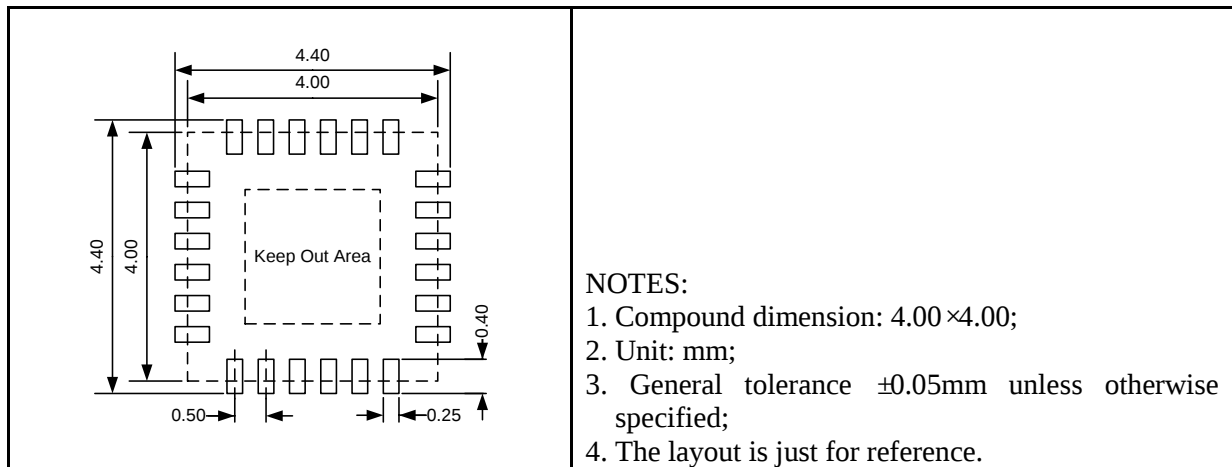
Package Information

UM3122EEQA: QFN24 4.0 × 4.0

Outline Drawing



Land Pattern



Tape and Reel Orientation



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