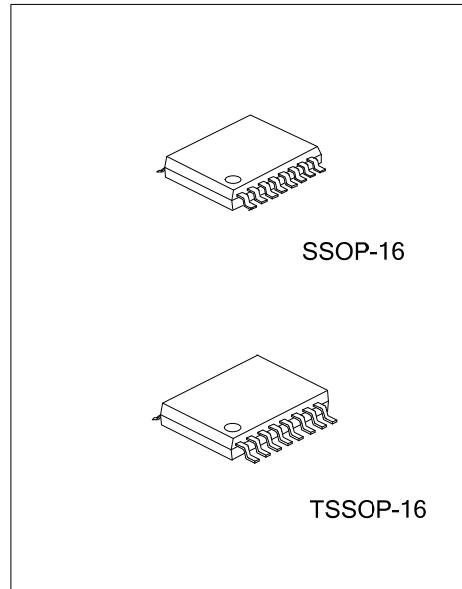




## UT3221/E

CMOS IC

### +3.0V TO +5.5V POWER SUPPLY, 250KBPS, MULTICHANNEL RS-232 LINE DRIVER/RECEIVER



#### DESCRIPTION

The UTC **UT3221/E** consists of 1 driver and 1 receiver. It meets EIA/TIA-232 and V.28/V.24 specifications, it intended for notebook computer applications. A high-efficiency, dual charge-pumps power supply and a low-dropout transmitter combine to deliver true RS-232 performance from a single +3.0V~+5.5V power supply. A guaranteed data rate of 250kbps provides compatibility with popular software for communicating with PCs.

The UTC **UT3221/E** achieves 1µA supply current in shutdown condition. When the **UT3221/E** doesn't detect a valid signal level on its receiver input, the on-board power supply and driver will shutdown, and when a valid level is applied to RS-232 receiver input, then the system turns on again. Therefore, the system saves power without changes to the existing BIOS or operating system.

The UTC **UT3221/E** requires only 0.1µF capacitors in 3.3V operation, and can operate from input voltages ranging from +3.0V ~+5.5V. It is ideal for 3.3V-only systems, 5.0V-only systems, or mixed 3.3V and 5.0V systems that require true RS-232 performance.

#### FEATURES

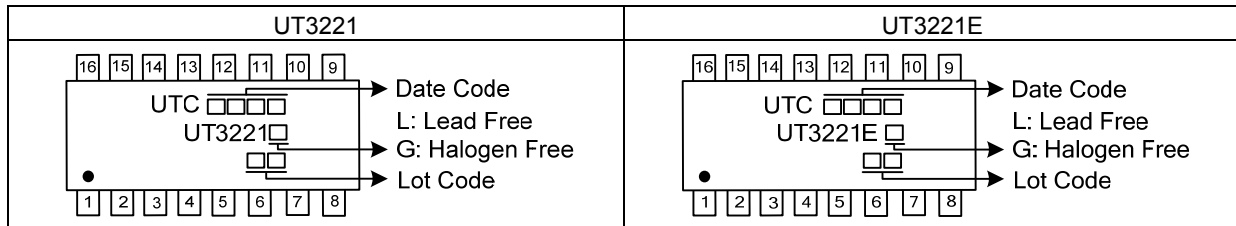
- \* Operates With 3.0V to 5.5V Power Supply
- \* One Driver and One Receiver
- \* Operates Up To 250 kbps
- \* Designed to Transmit at a Data Rate of 250 kbps
- \* Low Standby Current (1µA Typical)
- \* External Capacitors (4\*0.1µF)
- \* Accepts 5.0V Logic Input With 3.3V Supply
- \* Serial-Mouse Drivability
- \* Exceeds ±8KV ESD Protection(HBM) for RS-232 I/O Pins

#### ORDERING INFORMATION

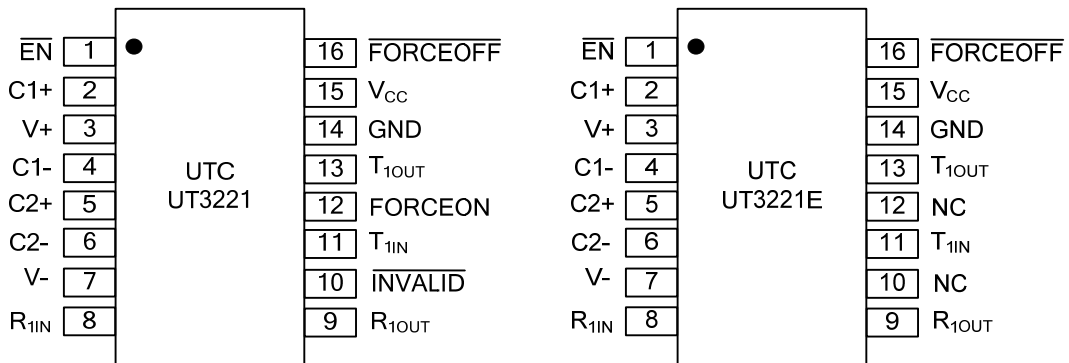
Ordering Number		Package	Packing
Lead Free	Halogen Free		
UT3221L-R16-R	UT3221G-R16-R	SSOP-16	Tape Reel
UT3221L-P16-R	UT3221G-P16-R	TSSOP-16	Tape Reel
UT3221EL-R16-T	UT3221EG-R16-T	SSOP-16	Tape Reel
UT3221EL-P16-T	UT3221EG-P16-T	TSSOP-16	Tape Reel

<p>UT3221G-R16-R</p> <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Green Package</p>	<p>(1) R: Tape Reel</p> <p>(2) R16: SSOP-16, P16: TSSOP-16</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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## MARKING



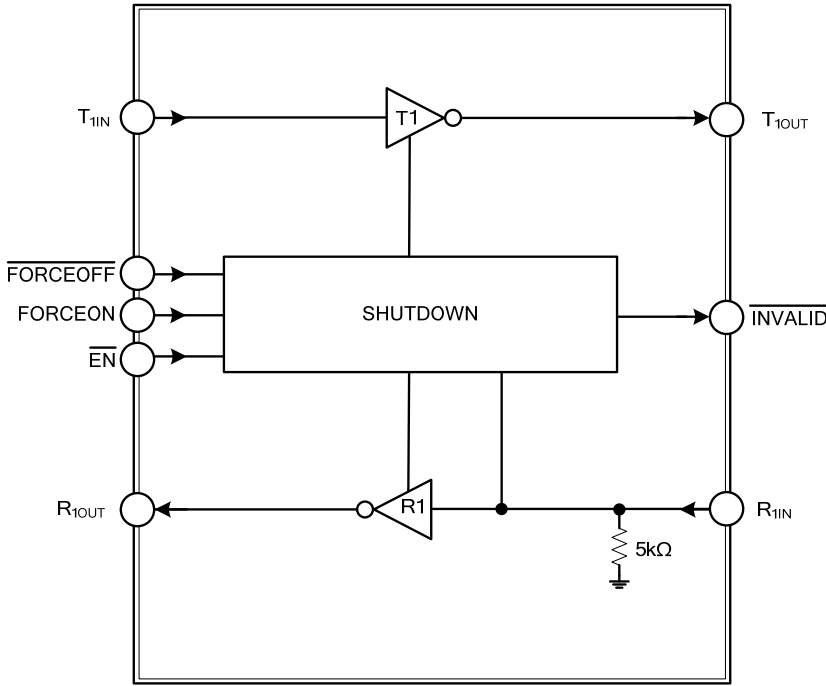
## PIN CONFIGURATION



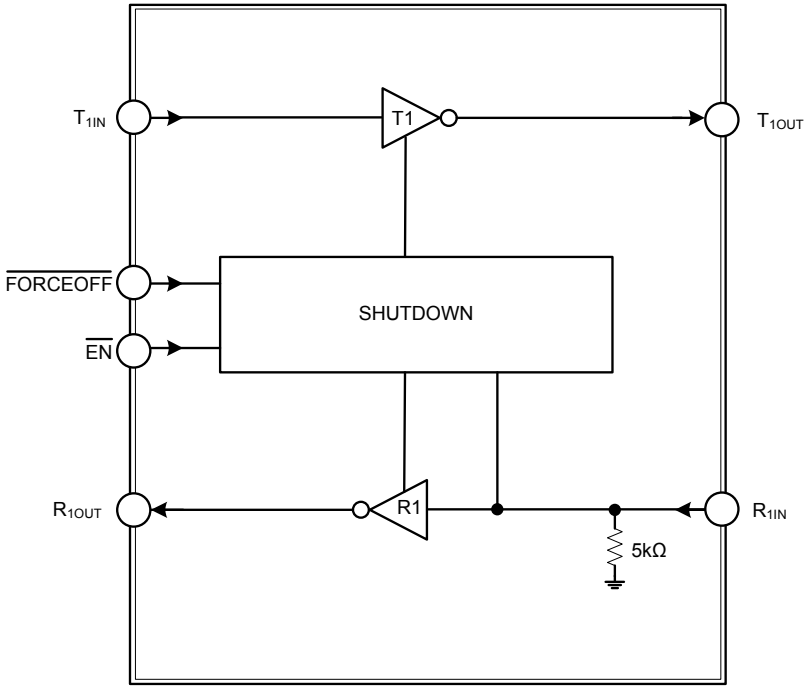
## PIN DESCRIPTION

PIN NO.		PIN NAME	DESCRIPTION
UT3221	UT3221E		
1	1	$\overline{\text{EN}}$	Receiver Enable Control. Drive low for normal operation. Drive high to force the receiver output (R_OUT) into a high-impedance state.
2	2	C1+	Positive terminal of the voltage doubler charge-pump capacitor.
3	3	V+	+5.5V generated by the charge pump.
4	4	C1-	Negative terminal of the voltage doubler charge-pump capacitor.
5	5	C2+	Positive terminal of inverting charge-pump capacitor.
6	6	C2-	Negative terminal of inverting charge-pump capacitor.
7	7	V-	-5.5V generated by the charge pump.
8	8	R <sub>1IN</sub>	RS-232 Receiver 1 Input.
9	9	R <sub>1OUT</sub>	TTL/CMOS Receiver 1 Output.
10	-	$\overline{\text{INVALID}}$	Output of the valid signal detector. Indicates if a valid RS-232 level is present on receiver input logic "1".
11	11	T <sub>1IN</sub>	TTL/CMOS Transmitter 1 Input.
12	-	FORCEON	Drive high to override automatic circuitry keeping transmitter on (FORCEOFF must be high) (Table 2).
13	13	T <sub>1OUT</sub>	RS-232 Transmitter 1 Output.
14	14	GND	Ground.
15	15	V <sub>CC</sub>	+3.0V ~ +5.5V Supply Voltage.
16	-	$\overline{\text{FORCEOFF}}$	Drive low to shut down transmitter and on-board power supply. This over-rides all automatic circuitry and FORCEON (Table 2).
-	10, 12	NC	No connect
-	16	$\overline{\text{FORCEOFF}}$	Shut off Pump Power and Transmitters. Active low.

■ BLOCK DIAGRAM



UT3221



UT3221E

## ■ ABSOLUTE MAXIMUM RATING

PARAMETER		SYMBOL	RATINGS	UNIT
V <sub>CC</sub>		V <sub>CC</sub>	6.0	V
V+ (Note 2)		V+	7.0	V
V- (Note 2)		V-	-7.0	V
V+ + V-  (Note 2)		V <sub>PUMP</sub>	+13.0	V
Input Voltages	T_IN, $\overline{\text{FORCEOFF}}$ , FORCEON, $\overline{\text{EN}}$	V <sub>IN</sub>	6.0	V
	R_IN		±25	V
Output Voltages	T_OUT	V <sub>OUT</sub>	±13.2	V
	R_OUT, INVALID		-0.3 ~ (V <sub>CC</sub> +0.3)	V
Short-Circuit Duration	T_OUT	SC	Continuous	
Power Dissipation(T <sub>A</sub> =25°C)		P <sub>D</sub>	680	mW
Operating Temperature		T <sub>OPR</sub>	-40 ~ +85	°C
Storage Temperature		T <sub>STG</sub>	-65 ~ +150	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. V+ and V- can have maximum magnitudes of 7.0V, but their absolute difference cannot exceed 13.0V.

## ■ ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub>=+3.0V~+5.5V, C1~C4=0.1μF (Note 2), T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>DC CHARACTERISTICS</b>							
Supply Current, Shutdown	I <sub>SHDN</sub>	V <sub>CC</sub> =3.3V or 5.0V, T <sub>A</sub> = 25°C	All R_IN open, $\overline{\text{FORCEOFF}} = \text{V}_{\text{CC}}$ , FORCEON=GND		1.0	10	μA
			$\overline{\text{FORCEOFF}} = \text{GND}$ , All R_IN=GND ( $\overline{\text{FORCEOFF}} = \text{GND}$ , UT3221E)		1.0	10	μA
Supply Current, Shutdown Disabled	I <sub>CC</sub>		FORCEON= $\overline{\text{FORCEOFF}} = \text{V}_{\text{CC}}$ , no load ( $\overline{\text{FORCEOFF}} = \text{V}_{\text{CC}}$ , UT3221E)		0.3	1.0	mA
<b>LOGIC INPUTS</b>							
Input Logic Threshold	Low	V <sub>LGL</sub>	$\overline{\text{EN}}$ , T_IN, FORCEON, $\overline{\text{FORCEOFF}}$		0.8		V
	High	V <sub>LGH</sub>	$\overline{\text{EN}}$ , T_IN, EN, FORCEON, $\overline{\text{FORCEOFF}}$	V <sub>CC</sub> = 3.3V V <sub>CC</sub> = 5.0V	2.0 2.4		V
Input Leakage Current	I <sub>IN(LK)</sub>	T_IN, $\overline{\text{EN}}$ , FORCEON, $\overline{\text{FORCEOFF}}$		±0.01	±1.0		μA
<b>RECEIVER OUTPUT</b>							
Output Leakage Current	I <sub>ROUT(LK)</sub>	Receiver disabled		±0.05	±10		μA
Output Voltage	Low	V <sub>ROUTL</sub>	I <sub>OUT</sub> = 1.6mA			0.4	V
	High	V <sub>ROUTH</sub>	I <sub>OUT</sub> = -1.0mA	V <sub>CC</sub> - 0.6	V <sub>CC</sub> - 0.1		V
<b>AUTOSHUTDOWN (FORCEON=GND, <math>\overline{\text{FORCEOFF}} = \text{V}_{\text{CC}}</math>, UT3221)</b>							
Receiver Input Thresholds to Transmitter	Enabled	V <sub>R(EN)</sub>	Fig.1	Positive threshold		2.7	V
				Negative threshold	-2.7		
	Disabled	V <sub>R(DIS)</sub>	1μA supply current, Fig.1		-0.3	0.3	V
INVALID Output Voltage	Low	V <sub>INVL</sub>	I <sub>OUT</sub> =1.6mA			0.4	V
	High	V <sub>INVH</sub>	I <sub>OUT</sub> =-1.0mA	V <sub>CC</sub> - 0.6			V
Receiver Threshold to Transmitter Enabled	t <sub>WU</sub>	Fig.2			100		μs

## ■ ELECTRICAL CHARACTERISTICS (Cont.)

( $V_{CC}=+3.0V\sim+5.5V$ ,  $C1\sim C4=0.1\mu F$  (Note 2),  $T_A = T_{MIN}$  to  $T_{MAX}$ , Unless Otherwise Specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Receiver Positive or Negative Threshold to INVALID	High	$t_{INVH}$	Fig.2		1.0		$\mu s$	
	Low	$t_{INVL}$			30		$\mu s$	
<b>RECEIVER INPUT</b>								
Input Voltage Range		$V_{RR}$		-25		25	V	
Input Threshold Low		$V_{RINL}$	$T_A=25^\circ C$	$V_{CC}=3.3V$	0.6	1.2	V	
				$V_{CC}=5.0V$	0.8	1.5		
Input Threshold High		$V_{RINH}$	$T_A=25^\circ C$	$V_{CC}=3.3V$		1.5	2.4	V
				$V_{CC}=5.0V$		1.8	2.4	
Input Hysteresis		$V_{RINHYS}$			0.5		V	
Input Resistance		$V_{RINRES}$	$T_A=25^\circ C$	3	5	7	k $\Omega$	
<b>TRANSMITTER OUTPUT</b>								
Output Voltage Swing		$V_{TOUTSW}$	The transmitter output loaded with 3k $\Omega$ to ground	$\pm 5.0$	$\pm 5.4$		V	
Output Resistance		$V_{TOUTRES}$	$V_{CC}=V+=V-=0V$ , Transmitter output= $\pm 2V$	300	10M		$\Omega$	
Output Short-Circuit Current		$I_{TSC}$			$\pm 35$	$\pm 60$	mA	
Output Leakage Current		$I_{TOUT(LK)}$	$V_{CC}=3.0V\sim 5.0V$ , $V_{OUT}=\pm 12V$ , Transmitter disabled			$\pm 25$	$\mu A$	
<b>TIMING CHARACTERISTICS</b>								
Maximum Data Rate		DR	$R_L=3k\Omega$ , $C_L=1000pF$ , one transmitter switching	250			kbps	
Receiver Propagation Delay		$t_{PHL}$	Receiver input to receiver output, $C_L=150pF$		0.15		$\mu s$	
		$t_{PLH}$			0.15			
Receiver Output Time		Enable	Normal operation		200		ns	
		Disable			200			
Transmitter Skew		$t_{TS}$	$ t_{PHL} - t_{PLH} $		100		ns	
Receiver Skew		$t_{RS}$	$ t_{PHL} - t_{PLH} $		50		ns	
Transition-Region Slew Rate		SR	$V_{CC}=3.3V$ , $T_A=25^\circ C$ , $R_L=3k\Omega\sim 7k\Omega$ , measured from +3V $\sim -3V$ or -3V $\sim +3V$	$C_L=150pF\sim 1000pF$	4	35	V/ $\mu s$	

Notes: 1. Typical values are at  $T_A=25^\circ C$ .

2.  $C1\sim C4=0.1\mu F$ , measured at  $3.3V\pm 10\%$ .  $C1=0.047\mu F$ ,  $C2\sim C4=0.33\mu F$ , measured at  $5.0V\pm 10\%$ .

■ DETAILED DESCRIPTION

**Charge-Pump Voltage Converter**

The UTC **UT3221/E** consists of a regulated dual charge pumps that provide output voltages of +5.5V and -5.5V, regardless of the input voltage ( $V_{CC}$ ) changing from +3.0V to +5.5V.

The charge pumps operate in a discontinuous mode: if the output voltages are less than 5.5V, the charge pumps are enabled; if the output voltages exceed 5.5V, the charge pumps are disabled.

Each charge pump requires a flying capacitor (C1, C2) and a reservoir capacitor (C3, C4) to generate the V+ and V- supplies, refer to application circuit.

**RS-232 Transmitter**

UTC **UT3221/E**'s transmitter is inverting level translators that convert CMOS-logic levels to 5.0V EIA/TIA-232 levels. They guarantee a 250kbps data rate with worst-case loads of 3kΩ in parallel with 1000pF, providing compatibility with PC-to-PC communication software.

Transmitter can be paralleled to drive multiple receiver or mouse. When  $\overline{\text{FORCEOFF}}$  is driven to ground, or shutdown circuitry senses invalid voltage levels at the receiver input, the transmitter is disabled and the output is forced into a high-impedance state.

**RS-232 Receiver**

The UTC **UT3221/E**'s receiver convert RS-232 signals to CMOS-logic output levels. The receiver has one inverting three-state output. In shutdown or in autosutdown, the **UT3221/E**'s receiver is active. Drive  $\overline{\text{EN}}$  high to place the receiver in a high-impedance state.

Table 1.  $\overline{\text{EN}}$  Control Truth Table

$\overline{\text{EN}}$	R_OUT
0	Active
1	High-Z

**Shutdown Function(UT3221E)**

Supply current falls to less than 1μA in shutdown mode ( $\overline{\text{FORCEOFF}} = \text{GND}$ ). When shutdown, the device's charge pumps are shut off, V+ is pulled down to VCC, V- is pulled to ground, and the transmitter outputs are disabled (high impedance). Connect  $\overline{\text{FORCEOFF}}$  to VCC if shutdown mode is not used.  $\overline{\text{FORCEOFF}}$  has no effect on R\_OUT.

**Shutdown Function(UT3221)**

A 1μA supply current is achieved with shutdown feature, which operates when FORCEON is low and  $\overline{\text{FORCEOFF}}$  is high. When the UTC **UT3221** senses no valid signal levels on the receiver input for 30μs, the on-board power supply and driver is shut off, reducing supply current to 1μA. This occurs if the RS-232 cable is disconnected or the connected peripheral transmitter is turned off. The system turns on again when a valid level is applied to RS-232 receiver input. As a result, the system saves power without changes to the existing BIOS or operating system.  $\overline{\text{INVALID}}$  indicates the receiver input' condition, when using shutdown function, the  $\overline{\text{INVALID}}$  output is high when the device is on and low when the device is shut down.

Table 2. Shutdown Logic Control Truth Table

OPERATION STATUS	$\overline{\text{FORCEOFF}}$ INPUT	FORCEON INPUT	$\overline{\text{INVALID}}$ OUTPUT	T_OUT
Normal Operation (Forced On)	H	H	X	Active
Normal Operation (AutoShutdown)	H	L	H	Active
Normal Operation (AutoShutdown)	H	L	L	High-Z
Shutdown (Forced Off)	L	X	X	High-Z

■ DETAILED DESCRIPTION (Cont.)

Table 2 summarizes the UTC **UT3221** operating modes. FORCEON and  $\overline{\text{FORCEOFF}}$  override the automatic circuitry and force the transmitter into its normal operating state or into its low-power standby state. When neither control is asserted, the IC selects between these states automatically based on receiver input levels.

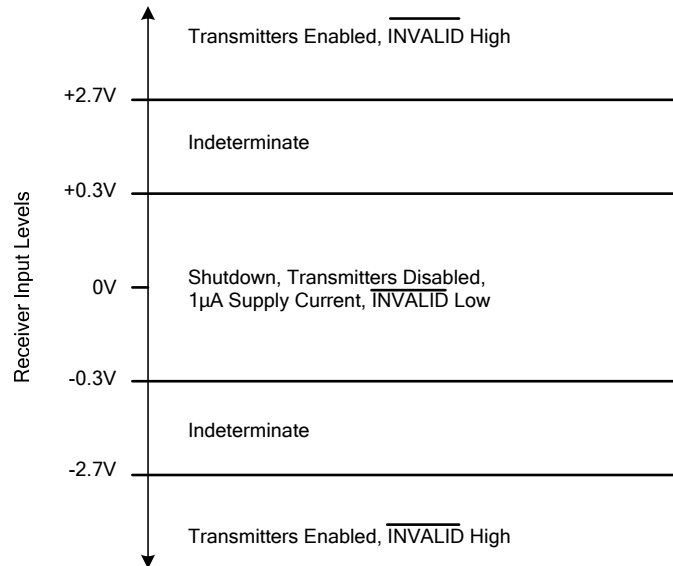


Fig.1 Shutdown Input Levels

When shutdown, the UTC **UT3221**'s charge pumps are turned off, V+ decays to  $V_{CC}$ , V- decays to ground, the transmitter output is disabled (high impedance). The time required to exit shutdown is typically 100µs.

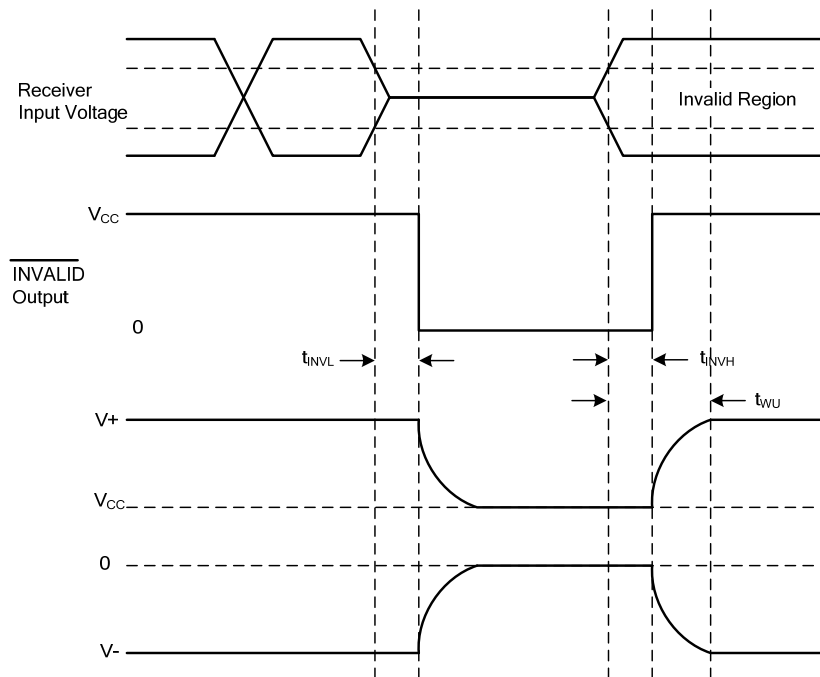
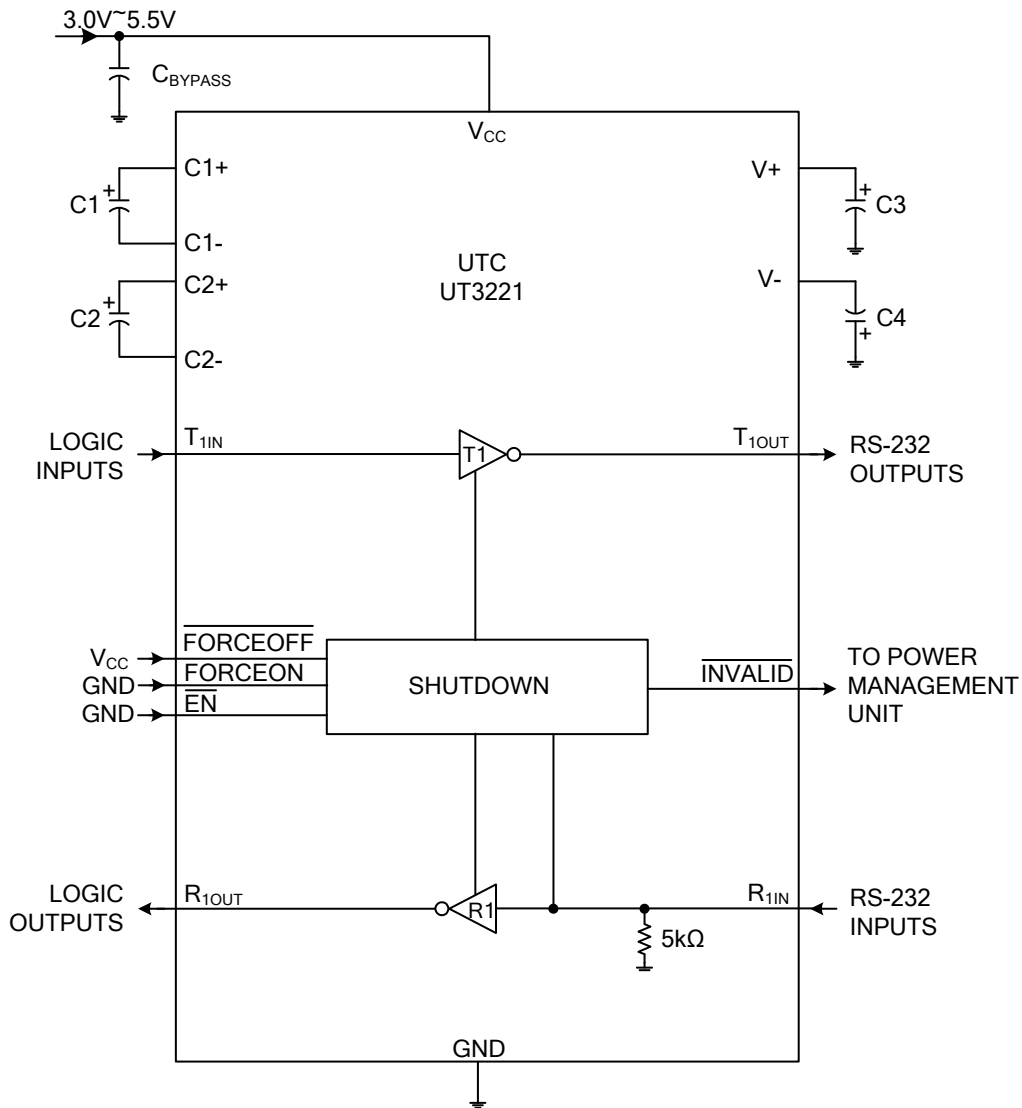


Fig.2 Shutdown Input Timing

■ TYPICAL APPLICATION CIRCUIT





## ■ TYPICAL APPLICATION CIRCUIT (Cont.)

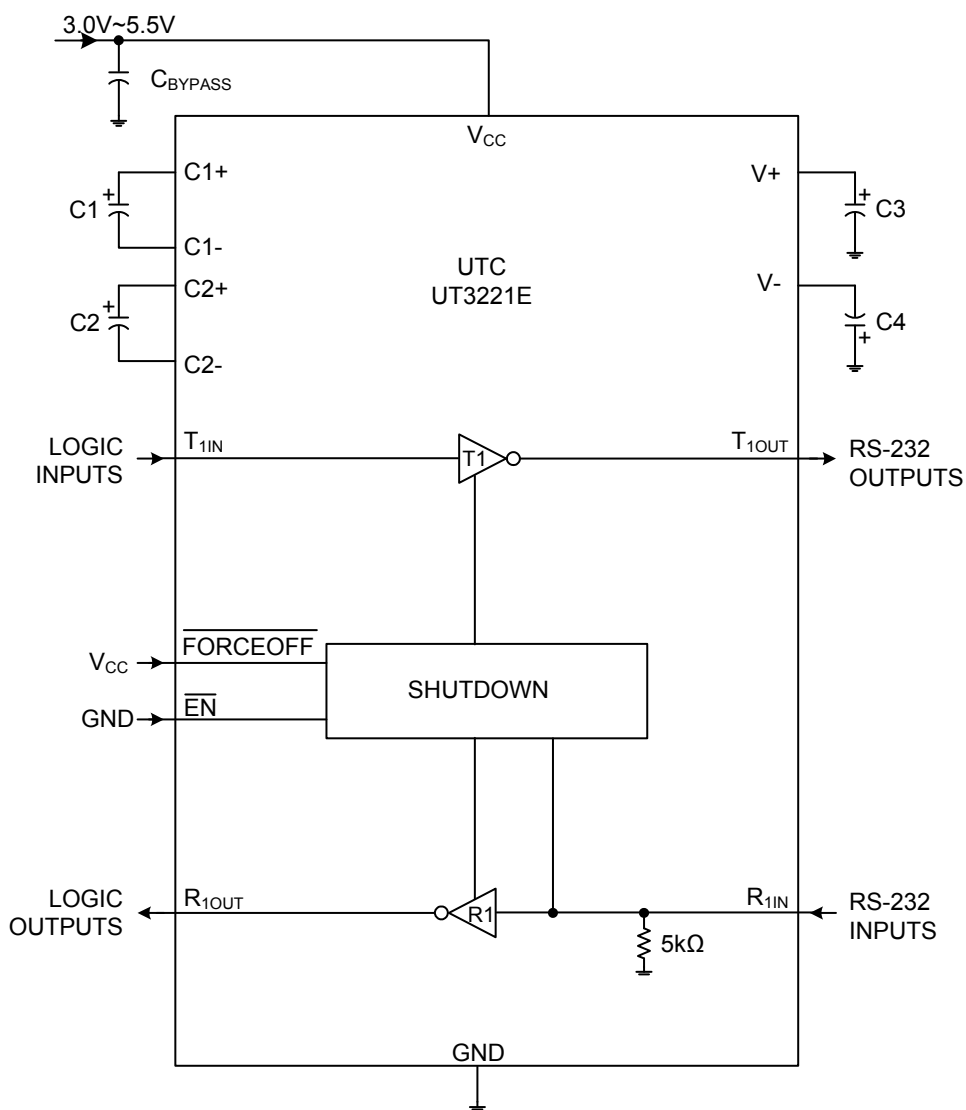


Fig.3 Application Circuit

Table 3. Required Capacitor Value

V <sub>CC</sub> (V)	C1 (μF)	C2, C3, C4 (μF)	C <sub>BYPASS</sub> (μF)
3.0 ~ 3.6	0.22	0.22	0.22
3.15 ~ 3.6	0.1	0.1	0.1
4.5 ~ 5.5	0.047	0.33	0.047
3.0 ~ 5.5	0.22	1.0	0.22

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