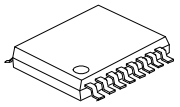
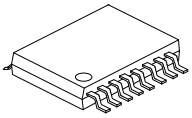
UT3221/E

CMOS IC

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



SSOP-16



TSSOP-16

■ 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

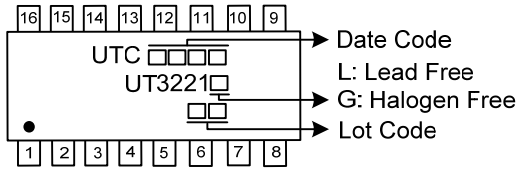
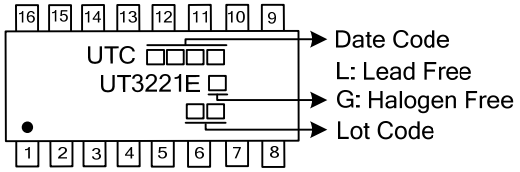
■ ORDERING INFORMATION

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
UR3221EL-R16-R	UR3221EG-R16-R	SSOP-16	Tape Reel
UR3221EL-P16-R	UR3221EG-P16-R	TSSOP-16	Tape Reel

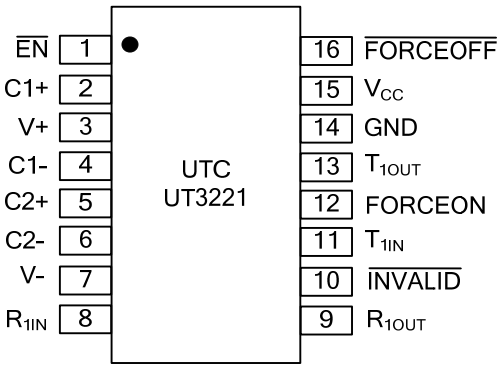
UT3221G-R16-R
(1)Packing Type
(2)Package Type
(3)Green Package

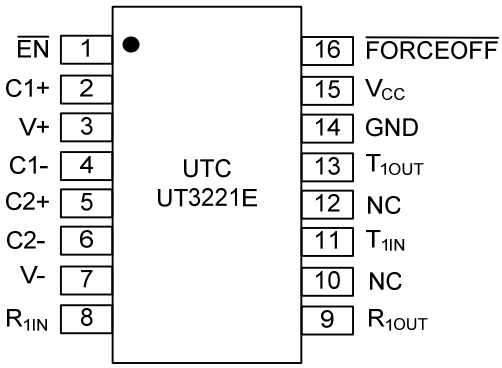
(1) R: Tape Reel
(2) R16: SSOP-16, P16: TSSOP-16
(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING

UT3221	UT3221E
	

■ PIN CONFIGURATION

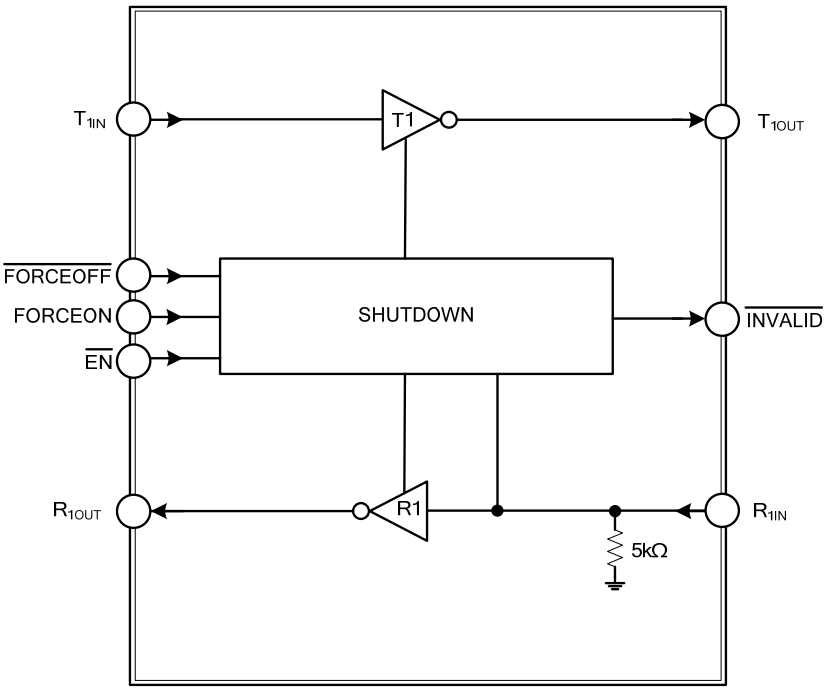




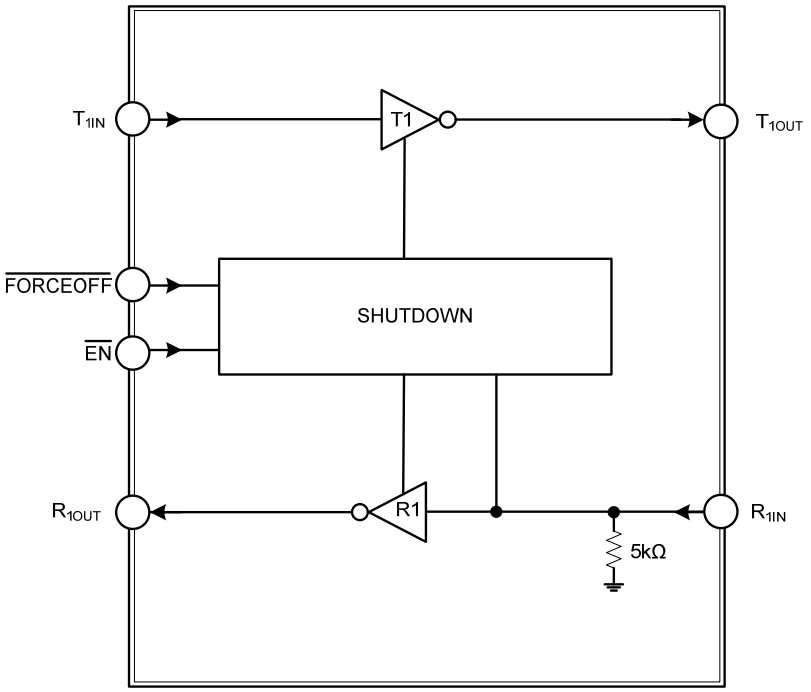
■ PIN DESCRIPTION

PIN NO.		PIN NAME	DESCRIPTION
UT3221	UT3221E		
1	1	$\overline{EN}$	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_{1IN}	RS-232 Receiver 1 Input.
9	9	R_{1OUT}	TTL/CMOS Receiver 1 Output.
10	-	$\overline{INVALID}$	Output of the valid signal detector. Indicates if a valid RS-232 level is present on receiver input logic “1”.
11	11	T_{1IN}	TTL/CMOS Transmitter 1 Input.
12	-	FORCEON	Drive high to override automatic circuitry keeping transmitter on ($\overline{FORCEOFF}$ must be high) (Table 2).
13	13	T_{1OUT}	RS-232 Transmitter 1 Output.
14	14	GND	Ground.
15	15	V_{CC}	+3.0V ~ +5.5V Supply Voltage.
16	-	$\overline{FORCEOFF}$	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	$\overline{FORCEOFF}$	Shut off Pump Power and Transmitters. Active low.

■ BLOCK DIAGRAM



UT3221



UT3221E

■ ABSOLUTE MAXIMUM RATING

PARAMETER		SYMBOL	RATINGS	UNIT
V_{CC}		V_{CC}	6.0	V
V+ (Note 2)		V+	7.0	V
V- (Note 2)		V-	-7.0	V
V+ +|V-| (Note 2)		V_{PUMP}	+13.0	V
Input Voltages	T_IN, $\overline{\text{FORCEOFF}}$, FORCEON, $\overline{\text{EN}}$	V_{IN}	6.0	V
	R_IN		±25	V
Output Voltages	T_OUT	V_{OUT}	±13.2	V
	R_OUT, $\overline{\text{INVALID}}$		-0.3 ~ (V_{CC}+0.3)	V
Short-Circuit Duration	T_OUT	SC	Continuous	
Power Dissipation(T_A=25°C)		P_D	680	mW
Operating Temperature		T_{OPR}	-40 ~ +85	°C
Storage Temperature		T_{STG}	-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_{CC}=+3.0V~+5.5V, C1~C4=0.1μF (Note 2), T_A = T_{MIN} to T_{MAX}, unless otherwise specified)

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

■ ELECTRICAL CHARACTERISTICS (Cont.)

(V_{CC}=+3.0V~+5.5V, C1~C4=0.1μF (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		μs
	Low	t_{INVL}				30		μs
RECEIVER INPUT								
Input Voltage Range		V_{RR}			-25		25	V
Input Threshold Low		V_{RINL}	T_A=25°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°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°C		3	5	7	kΩ
TRANSMITTER OUTPUT								
Output Voltage Swing		V_{TOUTSW}	The transmitter output loaded with 3kΩ to ground		±5.0	±5.4		V
Output Resistance		$V_{TOUTRES}$	V_{CC}= V+=V-=0V, Transmitter output=±2V		300	10M		Ω
Output Short-Circuit Current		I_{TSC}				±35	±60	mA
Output Leakage Current		$I_{TOUT(LK)}$	V_{CC}=3.0V~5.0V, V_{OUT}=±12V, Transmitter disabled				±25	μA
TIMING CHARACTERISTICS								
Maximum Data Rate		DR	R_L=3kΩ, C_L=1000pF, one transmitter switching		250			kbps
Receiver Propagation Delay		t_{PHL}	Receiver input to receiver output, C_L=150pF			0.15		μs
		t_{PLH}				0.15		
Receiver Output Time	Enable	$t_{R(EN)}$	Normal operation			200		ns
	Disable	$t_{R(DIS)}$				200		ns
Transmitter Skew		t_{TS}	$\lvert t_{PHL} - t_{PLH} \rvert$			100		ns
Receiver Skew		t_{RS}	$\lvert t_{PHL} - t_{PLH} \rvert$			50		ns
Transition-Region Slew Rate		SR	V_{CC}=3.3V, T_A=25°C, R_L=3kΩ~7kΩ, measured from +3V ~ -3V or -3V~+3V	C_L=150pF~1000pF	4		35	V/μs

Notes: 1. Typical values are at T_A=25°C.

2. C1~C4=0.1μF, measured at 3.3V±10%. C1=0.047μF, C2~C4=0.33μF, measured at 5.0V ±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 autoshutdown, 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 ($\overline{\text{FORCEOFF}}$ = 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.

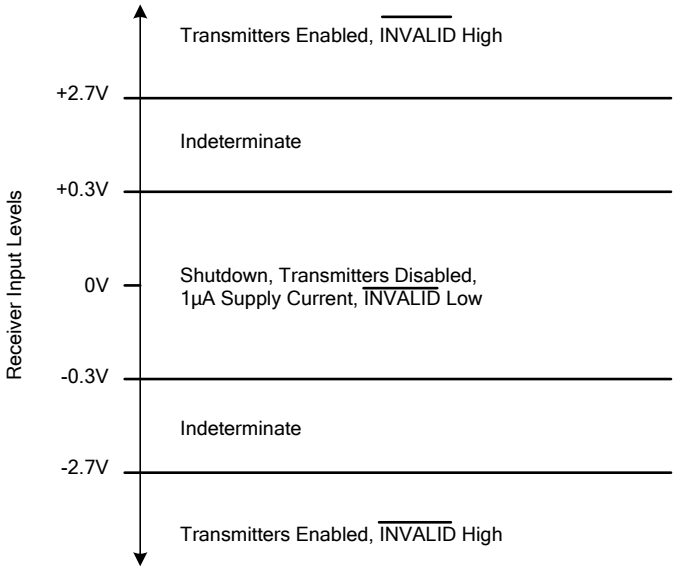


Fig.1 Shutdown Input Levels

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.

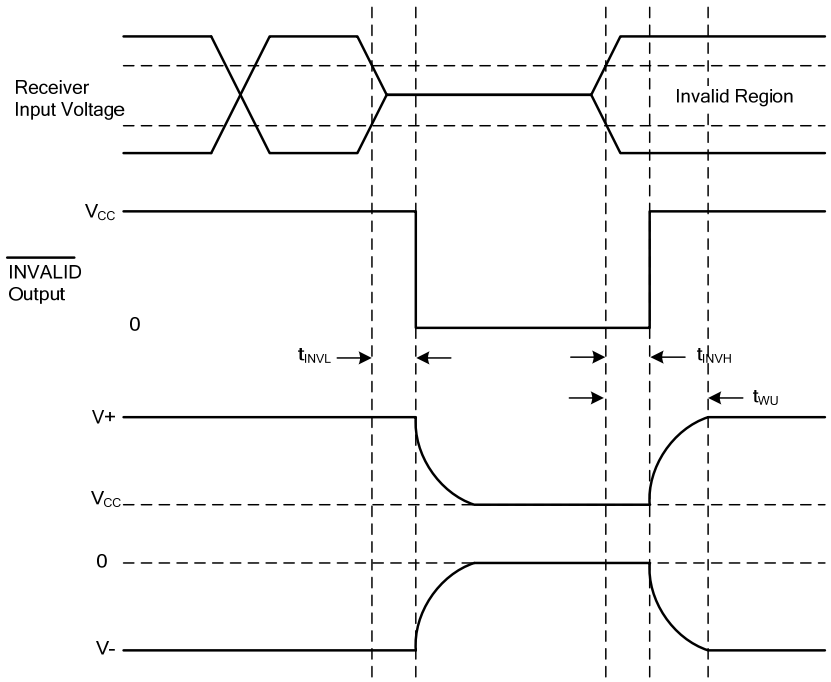
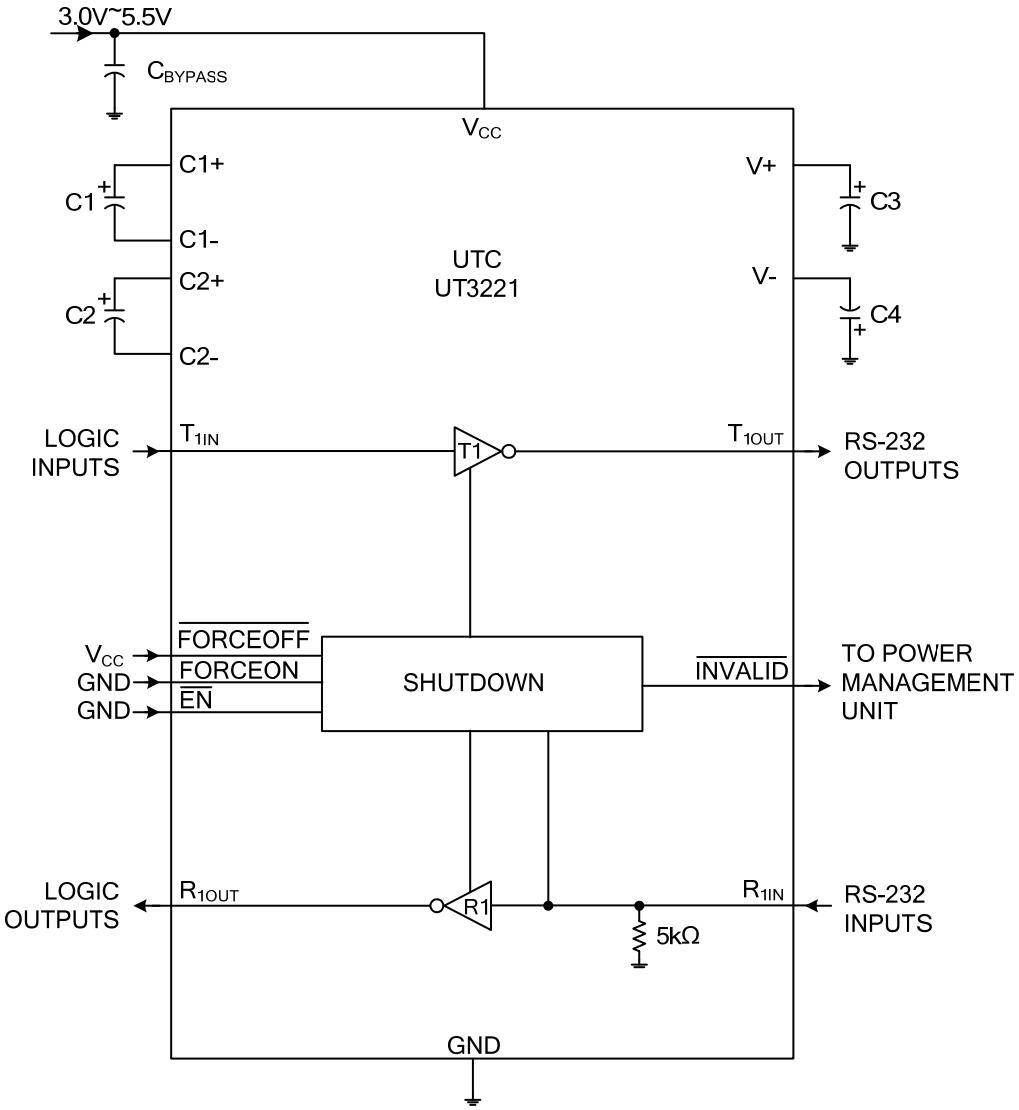


Fig.2 Shutdown Input Timing

■ TYPICAL APPLICATION CIRCUIT



■ TYPICAL APPLICATION CIRCUIT (Cont.)

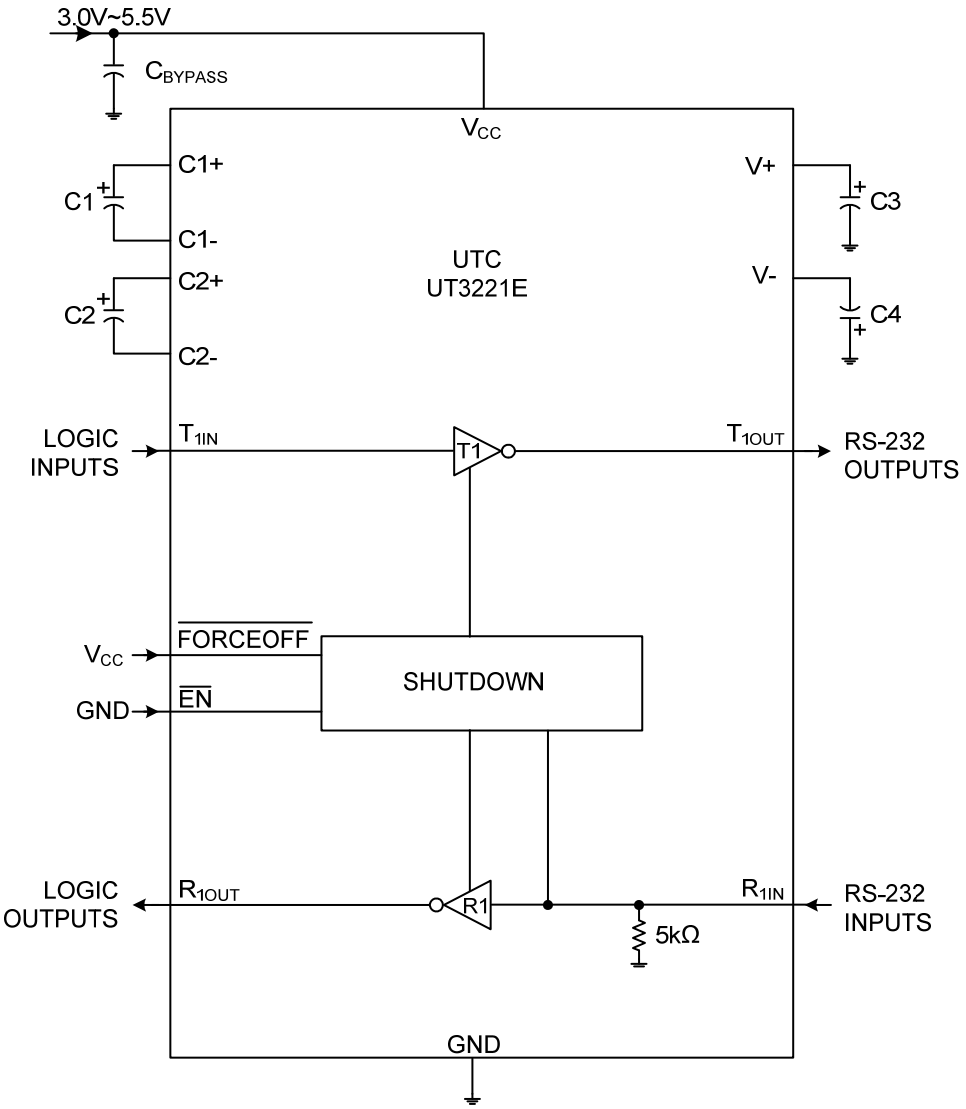


Fig.3 Application Circuit

Table 3. Required Capacitor Value

V_{CC} (V)	C1 (μF)	C2, C3, C4 (μF)	C_{BYPASS} (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