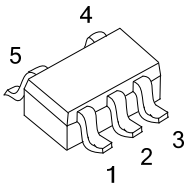
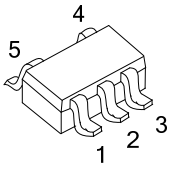
# U74AUP1T34

**CMOS IC**

## 1-BIT UNIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR




SOT-23-5
(JEDEC TO-236)




SOT-353

## ■ DESCRIPTION

The **U74AUP1T34** evice is a 1-bit noninverting translator that uses two separate configurable power supply rails. It is a uni-directional translator from A to B. The A port is designed to track $V_{CCA}$. $V_{CCA}$ accepts supply voltages from 0.9V to 3.6V. The B port is designed to track $V_{CCY}$. $V_{CCY}$ accepts supply voltages from 0.9V to 3.6V. This allows for low-voltage translation between 1V, 1.2V, 1.5V, 1.8V, 2.5V, and 3.3V voltage nodes. The **U74AUP1T34** is also fully specified for partial-power-down applications using Ioff. The Ioff circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

The $V_{CC}$ isolation feature ensures that if $V_{CCA}$ input is at GND, the B port is in the high-impedance state.

## ■ FEATURES

* Wide supply voltage range from 0.9V to 3.6V
* Inputs accept voltages up to 3.6V
* $I_{OFF}$ supports partial-power-down mode
* Low static power consumption; $I_{CC}$=5 μA (Max.)

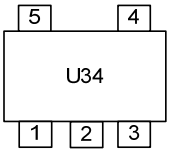
## ■ ORDERING INFORMATION

| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen Free | | |
| U74AUP1T34L-AE5-R | U74AUP1T34G-AE5-R | SOT-23-5 | Tape Reel |
| U74AUP1T34L-AL5-R | U74AUP1T34G-AL5-R | SOT-353 | Tape Reel |

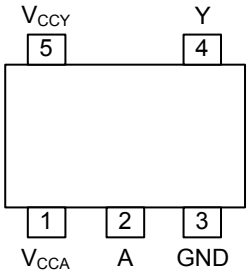
U74AUP1T34G-AE5-R
(1)Packing Type
(2)Package Type
(3)Green Package

(1) R: Tape Reel
(2) AE5: SOT-23-5, AL5: SOT-353
(3) G: Halogen Free and Lead Free, L: Lead Free

## ■ MARKING




## ■ PIN CONFIGURATION




## ■ PIN DESCRIPTION

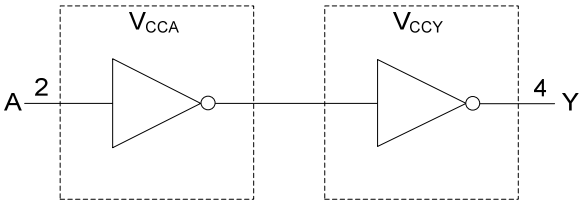
| PIN NO. | PIN NAME | I/O | DESCRIPTION |
|---|---|---|---|
| 1 | $V_{CCA}$ | | Input Port DC Power Supply |
| 2 | A | I | Input Port |
| 3 | GND | | Ground |
| 4 | Y | O | Output Port |
| 5 | $V_{CCY}$ | | Output Port DC Power Supply |

## ■ FUNCTION TABLE (each gate)

| INPUT | OUTPUT |
|---|---|
| A PORT | B PORT |
| L | L |
| H | H |

Note: H: HIGH voltage level; L: LOW voltage level.

## ■ LOGIC DIAGRAM (positive logic)



## ■ ABSOLUTE MAXIMUM RATING (Unless otherwise specified)

| PARAMETER | SYMBOL | CONDITIONS | RATINGS | UNIT |
|---|---|---|---|---|
| Supply Voltage | $V_{CCA}$, $V_{CCY}$ | | -0.3 ~ 4 | V |
| Input Voltage | $V_{IN}$ | | -0.5 ~ 4.6 | V |
| Voltage Applied To Any Output In The High-Impedance or Power-Off State | $V_{OUT}$ | | -0.5 ~ 4.6 | V |
| Voltage Applied To Any Output In The High or Low State | $V_{OUT}$ | | -0.5 ~ 4.6 | V |
| Continuous Current Through $V_{CCA}$ or GND | $I_{CCA}$ | | ±50 | mA |
| Continuous Output Current | $I_{OUT}$ | $V_{OUT}$=0V to $V_{CCB}$ | ±20 | mA |
| Input Clamp Current | $I_{IK}$ | $V_{IN}$<0 | -50 | mA |
| Output Clamp Current | $I_{OK}$ | $V_{OUT}$<0 | -50 | mA |
| Operating Junction Temperature, | $T_J$ | | +150 | °C |
| Storage Temperature | $T_{STG}$ | | -65 ~ +150 | °C |

Note: 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.

## ■ RECOMMENDED OPERATING CONDITIONS (Unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CCA}$, $V_{CCY}$ | | 0.9 | | 3.6 | V |
| Input Transition Rise or Fall Rate | $\Delta t/\Delta v$ | $V_{CCA}$=3V~3.6V<br>$V_{CCY}$=0.9V~3.6V | | | 200 | ns/V |
| Operating Temperature | $T_A$ | | -40 | | +125 | °C |

## ■ ELECTRICAL CHARACTERISTICS (Unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | $T_A$=25°C | | | $T_A$=-40°C~+125°C | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| High-level Input Voltage | $V_{IH}$ | $V_{CCA}$=0.9V~1.95V<br>$V_{CCY}$=0.9V~3.6V | 0.65×$V_{CCA}$ | | | 0.7×$V_{CCA}$ | | | V |
| | | $V_{CCA}$=2.3V~2.7V<br>$V_{CCY}$=0.9V~3.6V | 1.6 | | | 1.6 | | | V |
| | | $V_{CCA}$=3V~3.6V<br>$V_{CCY}$=0.9V~3.6V | 2 | | | 2 | | | V |
| Low-level Input Voltage | $V_{IL}$ | $V_{CCA}$=0.9V, $V_{CCY}$=0.9V~3.6V | | | 0.3×$V_{CCA}$ | | | 0.3×$V_{CCA}$ | V |
| | | $V_{CCA}$=1V~1.95V<br>$V_{CCY}$=0.9V~3.6V | | | 0.35×$V_{CCA}$ | | | 0.3×$V_{CCA}$ | V |
| | | $V_{CCA}$=2.3V~2.7V<br>$V_{CCY}$=0.9V~3.6V | | | 0.7 | | | 0.7 | V |
| | | $V_{CCA}$=3V~3.6V<br>$V_{CCY}$=0.9V~3.6V | | | 0.9 | | | 0.9 | V |

## ■ ELECTRICAL CHARACTERISTICS (Cont.)

| PARAMETER | SYMBOL | TEST CONDITIONS | $T_A$=25°C | | | $T_A$=-40°C~+125°C | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| High-Level Output voltage | $V_{OH}$ | $V_{CCA}$=$V_{CCY}$=0.9V~3.6V, $I_{OH}$=-100μA | $V_{CCY}$ -0.2 | | | $V_{CCY}$ -0.2 | | | V |
| | | $V_{CCA}$=$V_{CCY}$=0.9V~1V, $I_{OH}$=-0.25mA | 0.75× $V_{CCY}$ | | | 0.6× $V_{CCY}$ | | | V |
| | | $V_{CCA}$=$V_{CCY}$=1.2V, $I_{OH}$=-1.5mA | 1 | | | 0.9 | | | V |
| | | $V_{CCA}$=$V_{CCY}$=1.65V, $I_{OH}$=-2mA | 1.32 | | | 1.17 | | | V |
| | | $V_{CCA}$=$V_{CCY}$=2.3V, $I_{OH}$=-3mA | 1.9 | | | 1.67 | | | V |
| | | $V_{CCA}$=$V_{CCY}$=3V, $I_{OH}$=-6mA | 2.72 | | | 2.30 | | | V |
| Low-Level Output voltage | $V_{OL}$ | $V_{CCA}$=$V_{CCY}$=0.9V~3.6V, $I_{OL}$=100μA | | | 0.1 | | | 0.1 | V |
| | | $V_{CCA}$=$V_{CCY}$=0.9V~1V, $I_{OL}$=0.25mA | | | 0.1 | | | 0.1 | V |
| | | $V_{CCA}$=$V_{CCY}$=1.2V, $I_{OL}$=1.5mA | | | 0.3× $V_{CCY}$ | | | 0.33× $V_{CCY}$ | V |
| | | $V_{CCA}$=$V_{CCY}$=1.65V, $I_{OL}$=2mA | | | 0.31 | | | 0.39 | V |
| | | $V_{CCA}$=$V_{CCY}$=2.3V, $I_{OL}$=3mA | | | 0.31 | | | 0.50 | V |
| | | $V_{CCA}$=$V_{CCY}$=3V, $I_{OL}$=6mA | | | 0.31 | | | 0.50 | V |
| Input Leakage Current | $I_{I(LEAK)}$ | $V_{CCA}$=$V_{CCY}$=0.9V~3.6V, $V_I$=$V_{CCA}$ or GND | | | ±1 | | | ±1 | μA |
| Power OFF Leakage Current | $I_{OFF}$ | A or B Port, $V_{IN}$ or $V_{OUT}$=0~3.6V, $V_{CCA}$=0V, $V_{CCY}$=0~3.6V | | | ±5 | | | ±5 | μA |
| | | A or B Port, $V_{IN}$ or $V_{OUT}$=0~3.6V, $V_{CCA}$=0~3.6V, $V_{CCY}$=0V | | | ±5 | | | ±5 | μA |
| $V_{CCA}$ Supply Current | $I_{CCA}$ | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=$V_{CCY}$=0.9V~3.6V | | | 5 | | | 20 | μA |
| | | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=0.9V~3.6V $V_{CCY}$= $V_{CCA}$ | | | 2 | | | 10 | μA |
| | | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=0V, $V_{CCY}$=0~3.6V | | | 1 | | | 5 | μA |
| | | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=0~3.6V, $V_{CCY}$=0V | | | 1 | | | 5 | μA |
| $V_{CCB}$ Supply Current | $I_{CCB}$ | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=$V_{CCY}$=0.9V~3.6V | | | 5 | | | 20 | μA |
| | | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=0.9V~3.6V $V_{CCY}$= $V_{CCA}$ | | | 2 | | | 10 | μA |
| | | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=0V, $V_{CCY}$=0~3.6V | | | 1 | | | 5 | μA |
| | | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA; $V_{CCA}$=0~3.6V, $V_{CCY}$=0V | | | 1 | | | 5 | μA |
| Combined Supply Current | $I_{CCA}$ + $I_{CCB}$ | $V_{IN}$=$V_{CCI}$ or GND, $I_O$=0mA $V_{CCA}$=$V_{CCY}$=0.9V~3.6V | | | 5.2 | | | 12 | μA |

## ■ ELECTRICAL CHARACTERISTICS (Cont.)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input Capacitance | $C_I$ | $V_{IN}$=3.3V or GND, $V_{CCA}$=$V_{CCY}$=3.3V | | | 4 | pF |
| Input-to-Output Internal Capacitance | $C_{I/O}$ | A or B Port: $V_{OUT}$=3.3V or GND, $V_{CCA}$=0V, $V_{CCY}$=3.3V | | | 7 | pF |

■ SWITCHING CHARACTERISTICS (Cont.)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Propagation Delay From Low-to-High Output / High-to-Low Output | $t_{PLH}$ / $t_{PHL}$ | $C_L$=5pF, $V_{CCA}$=0.9V | $V_{CCY}$=0.9V | | 25 | | ns |
| | | | $V_{CCY}$=1.2V | | 18 | | ns |
| | | | $V_{CCY}$=1.65V | | 16.2 | | ns |
| | | | $V_{CCY}$=2.3V | | 16.3 | | ns |
| | | | $V_{CCY}$=3V | | 16.8 | | ns |
| | | $C_L$=5pF, $V_{CCA}$=1.2V | $V_{CCY}$=0.9V | | | 42.5 | ns |
| | | | $V_{CCY}$=1.2V | | | 24.9 | ns |
| | | | $V_{CCY}$=1.65V | | | 23.2 | ns |
| | | | $V_{CCY}$=2.3V | | | 22.6 | ns |
| | | | $V_{CCY}$=3V | | | 22.5 | ns |
| | | $C_L$=5pF, $V_{CCA}$=1.65V | $V_{CCY}$=0.9V | | | 40 | ns |
| | | | $V_{CCY}$=1.2V | | | 10.7 | ns |
| | | | $V_{CCY}$=1.65V | | | 8.84 | ns |
| | | | $V_{CCY}$=2.3V | | | 8.08 | ns |
| | | | $V_{CCY}$=3V | | | 7.88 | ns |
| | | $C_L$=5pF, $V_{CCA}$=2.3V | $V_{CCY}$=0.9V | | | 41.3 | ns |
| | | | $V_{CCY}$=1.2V | | | 8.02 | ns |
| | | | $V_{CCY}$=1.65V | | | 5.73 | ns |
| | | | $V_{CCY}$=2.3V | | | 4.92 | ns |
| | | | $V_{CCY}$=3V | | | 4.2 | ns |
| | | $C_L$=5pF, $V_{CCA}$=3V | $V_{CCY}$=0.9V | | | 42.5 | ns |
| | | | $V_{CCY}$=1.2V | | | 7.61 | ns |
| | | | $V_{CCY}$=1.65V | | | 4.5 | ns |
| | | | $V_{CCY}$=2.3V | | | 3.65 | ns |
| | | | $V_{CCY}$=3V | | | 3.39 | ns |
| Propagation Delay From Low-to-High Output / High-to-Low Output | $t_{PLH}$ / $t_{PHL}$ | $C_L$=10pF, $V_{CCA}$=0.9V | $V_{CCY}$=0.9V | | 28.9 | | ns |
| | | | $V_{CCY}$=1.2V | | 19.8 | | ns |
| | | | $V_{CCY}$=1.65V | | 17.9 | | ns |
| | | | $V_{CCY}$=2.3V | | 18 | | ns |
| | | | $V_{CCY}$=3V | | 18.5 | | ns |
| | | $C_L$=10pF, $V_{CCA}$=1.2V | $V_{CCY}$=0.9V | | | 43.22 | ns |
| | | | $V_{CCY}$=1.2V | | | 12.33 | ns |
| | | | $V_{CCY}$=1.65V | | | 9.57 | ns |
| | | | $V_{CCY}$=2.3V | | | 8.81 | ns |
| | | | $V_{CCY}$=3V | | | 8.61 | ns |
| | | $C_L$=10pF, $V_{CCA}$=1.65V | $V_{CCY}$=0.9V | | | 40.44 | ns |
| | | | $V_{CCY}$=1.2V | | | 9.21 | ns |
| | | | $V_{CCY}$=1.65V | | | 6.57 | ns |
| | | | $V_{CCY}$=2.3V | | | 5.5 | ns |
| | | | $V_{CCY}$=3V | | | 4.73 | ns |
| | | $C_L$=10pF, $V_{CCA}$=2.3V | $V_{CCY}$=0.9V | | | 41.56 | ns |
| | | | $V_{CCY}$=1.2V | | | 8.3 | ns |
| | | | $V_{CCY}$=1.65V | | | 5.54 | ns |
| | | | $V_{CCY}$=2.3V | | | 4.42 | ns |
| | | | $V_{CCY}$=3V | | | 4.01 | ns |
| | | $C_L$=10pF, $V_{CCA}$=3V | $V_{CCY}$=0.9V | | | 42.81 | ns |
| | | | $V_{CCY}$=1.2V | | | 7.87 | ns |
| | | | $V_{CCY}$=1.65V | | | 4.55 | ns |
| | | | $V_{CCY}$=2.3V | | | 3.8 | ns |
| | | | $V_{CCY}$=3V | | | 3.36 | ns |

■ SWITCHING CHARACTERISTICS (Cont.)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Propagation Delay From Low-to-High Output / High-to-Low Output | $t_{PLH}$ / $t_{PHL}$ | $C_L$=15pF, $V_{CCA}$=0.9V | $V_{CCY}$=0.9V | | 30.6 | | ns |
| | | | $V_{CCY}$=1.2V | | 21.6 | | ns |
| | | | $V_{CCY}$=1.65V | | 19.6 | | ns |
| | | | $V_{CCY}$=2.3V | | 19.7 | | ns |
| | | | $V_{CCY}$=3V | | 20.3 | | ns |
| | | $C_L$=15pF, $V_{CCA}$=1.2V | $V_{CCY}$=0.9V | | | 43.87 | ns |
| | | | $V_{CCY}$=1.2V | | | 12.98 | ns |
| | | | $V_{CCY}$=1.65V | | | 10.3 | ns |
| | | | $V_{CCY}$=2.3V | | | 9.54 | ns |
| | | | $V_{CCY}$=3V | | | 9.34 | ns |
| | | $C_L$=15pF, $V_{CCA}$=1.65V | $V_{CCY}$=0.9V | | | 40.78 | ns |
| | | | $V_{CCY}$=1.2V | | | 9.59 | ns |
| | | | $V_{CCY}$=1.65V | | | 6.95 | ns |
| | | | $V_{CCY}$=2.3V | | | 5.87 | ns |
| | | | $V_{CCY}$=3V | | | 5.07 | ns |
| | | $C_L$=15pF, $V_{CCA}$=2.3V | $V_{CCY}$=0.9V | | | 41.79 | ns |
| | | | $V_{CCY}$=1.2V | | | 8.55 | ns |
| | | | $V_{CCY}$=1.65V | | | 5.8 | ns |
| | | | $V_{CCY}$=2.3V | | | 4.68 | ns |
| | | | $V_{CCY}$=3V | | | 4.27 | ns |
| | | $C_L$=15pF, $V_{CCA}$=3V | $V_{CCY}$=0.9V | | | 43.09 | ns |
| | | | $V_{CCY}$=1.2V | | | 8.16 | ns |
| | | | $V_{CCY}$=1.65V | | | 4.84 | ns |
| | | | $V_{CCY}$=2.3V | | | 4.09 | ns |
| | | | $V_{CCY}$=3V | | | 3.65 | ns |
| Propagation Delay From Low-to-High Output / High-to-Low Output | $t_{PLH}$ / $t_{PHL}$ | $C_L$=30pF, $V_{CCA}$=0.9V | $V_{CCY}$=0.9V | | 32.1 | | ns |
| | | | $V_{CCY}$=1.2V | | 21.3 | | ns |
| | | | $V_{CCY}$=1.65V | | 18.7 | | ns |
| | | | $V_{CCY}$=2.3V | | 18 | | ns |
| | | | $V_{CCY}$=3V | | 18.3 | | ns |
| | | $C_L$=30pF, $V_{CCA}$=1.2V | $V_{CCY}$=0.9V | | | 45.65 | ns |
| | | | $V_{CCY}$=1.2V | | | 14.76 | ns |
| | | | $V_{CCY}$=1.65V | | | 12.37 | ns |
| | | | $V_{CCY}$=2.3V | | | 11.61 | ns |
| | | | $V_{CCY}$=3V | | | 11.41 | ns |
| | | $C_L$=30pF, $V_{CCA}$=1.65V | $V_{CCY}$=0.9V | | | 41.72 | ns |
| | | | $V_{CCY}$=1.2V | | | 10.65 | ns |
| | | | $V_{CCY}$=1.65V | | | 8.01 | ns |
| | | | $V_{CCY}$=2.3V | | | 6.94 | ns |
| | | | $V_{CCY}$=3V | | | 5.99 | ns |
| | | $C_L$=30pF, $V_{CCA}$=2.3V | $V_{CCY}$=0.9V | | | 42.44 | ns |
| | | | $V_{CCY}$=1.2V | | | 9.26 | ns |
| | | | $V_{CCY}$=1.65V | | | 6.51 | ns |
| | | | $V_{CCY}$=2.3V | | | 5.39 | ns |
| | | | $V_{CCY}$=3V | | | 4.97 | ns |
| | | $C_L$=30pF, $V_{CCA}$=3V | $V_{CCY}$=0.9V | | | 43.69 | ns |
| | | | $V_{CCY}$=1.2V | | | 8.8 | ns |
| | | | $V_{CCY}$=1.65V | | | 5.48 | ns |
| | | | $V_{CCY}$=2.3V | | | 4.72 | ns |
| | | | $V_{CCY}$=3V | | | 4.28 | ns |

## ■ FEATURE DESCRIPTION

**Fully Configurable Dual-Rail Design**

Both $V_{CCA}$ and $V_{CCY}$ can be supplied at any voltage from 0.9V to 3.6V, making the device suitable for translating between any of the voltage nodes (1V, 1.2V, 1.8V, 2.5V, and 3.3V).

**Partial-Power-Down Mode Operation**

$I_{OFF}$ circuitry disables the outputs, preventing damaging current backflow through the **U74AUP1T34** when it is powered down. This can occur in applications where subsections of a system are powered down (partial-powerdown) to reduce power consumption.

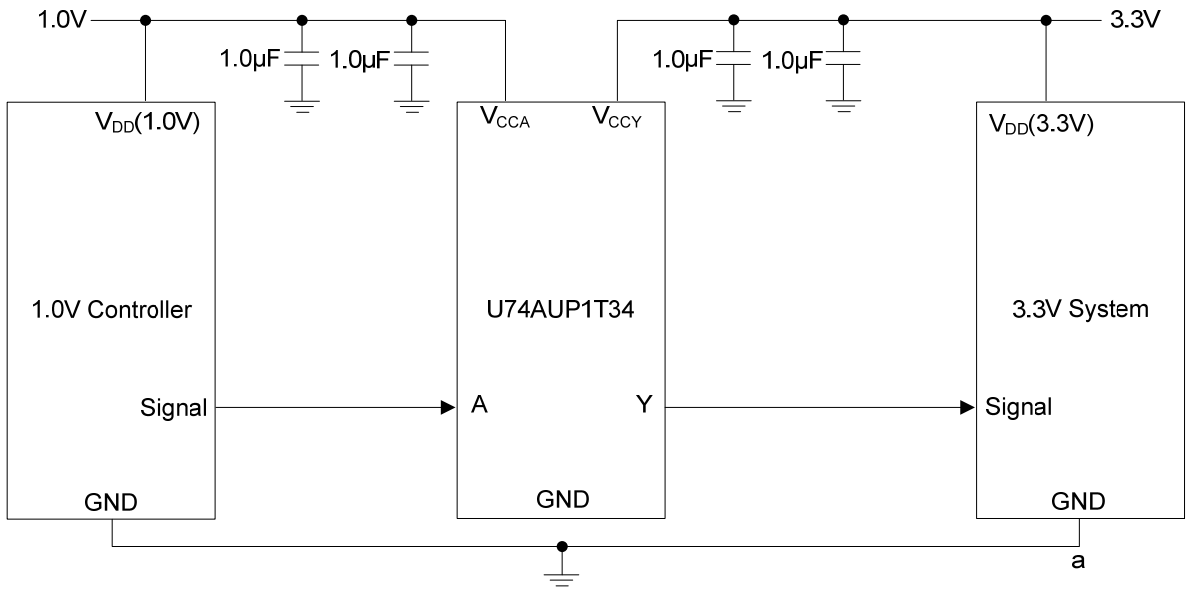
**$V_{CC}$ Isolation**

The $V_{CC}$ isolation feature ensures that if either $V_{CCA}$ or $V_{CCY}$ are at GND (or < 0.4V), both ports A and B are set to a high-impedance state, preventing false logic levels from being presented to either bus.

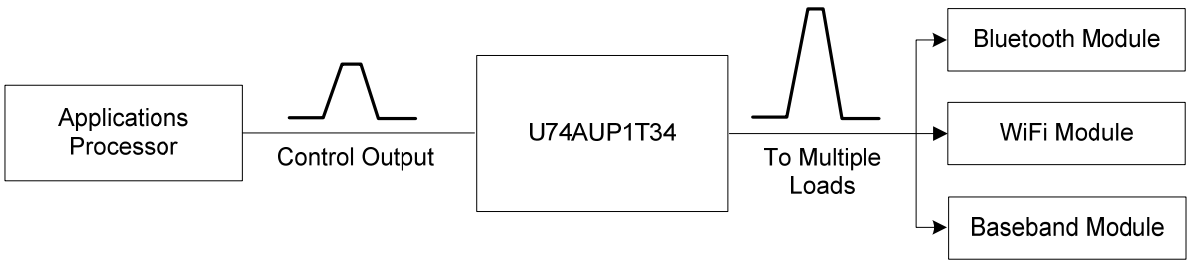
**Input Hysteresis**

Input hysteresis allows the input to support slew rates as slow as 200ns/V, improving switching noise immunity.

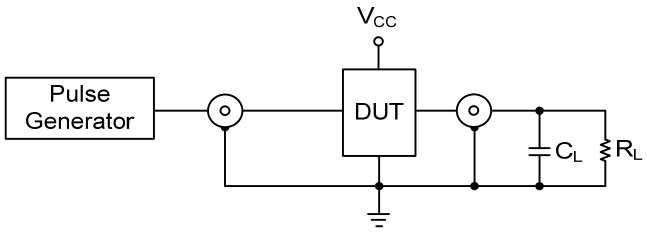
## ■ TYPICAL APPLICATION




## ■ EXAMPLE APPLICATION

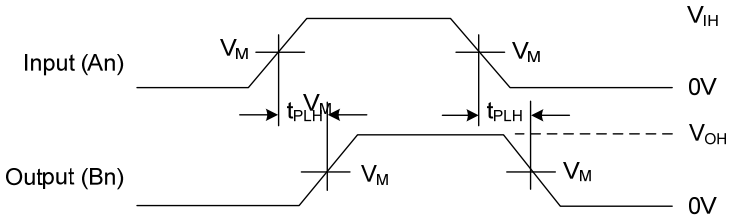


## ■ TEST CIRCUIT AND WAVEFORMS




Definitions for test circuit:
$t_{PLH}$ / $t_{PHL}$
$C_L$ = 5pF, 10pF, 15pF, 30pF or equivalent (includes probe and jig capacitance).
$R_L$ = 1MΩ or Equivalent.
$Z_{OUT}$ of pulse generator=50Ω

| $V_{CCA}$ / $V_{CCY}$ | $V_{IN}$ | $t_R = t_F$ | $V_M$ |
|---|---|---|---|
| 1.1V ~ 3.6V | $V_{CCA}$ | ≤ 3.0ns | 0.5×$V_{CCA}$ |




Notes: 1. $V_{MI}$=$V_{IH}$/2, $V_{MO}$=$V_{CCB}$/2
2. $t_R$=$t_F$=2.0ns,10% to 90%, f=1MHz, $t_W$=500ns

**PROPAGATION DELAYS**