TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VHCU04F,TC74VHCU04FN,TC74VHCU04FT

Hex Inverter

The TC74VHCU04 is an advanced high speed CMOS INVERTER fabricated with silicon gate C^2MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

Since the internal circuit is composed of a single stage inverter, it can be used in analog applications such as crystal oscillators.

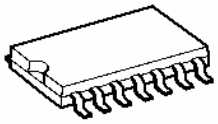
An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

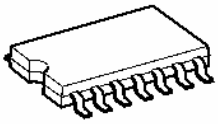
- High speed: t_{pd} = 3.5 ns (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 2 μA (max) at Ta = 25°C
- High noise immunity: $V_{NIH} = V_{NIL}$ = 10% V_{CC} (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: V_{CC} (opr) = 2 V to 5.5 V
- Low noise: V_{OLP} = 0.8 V (max)
- Pin and function compatible with 74ALS04

Note: xxxFN (JEDEC SOP) is not available in Japan.

TC74VHCU04F

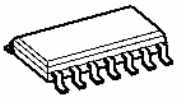


SOP14-P-300-1.27A



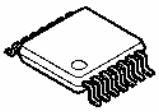
SOP14-P-300-1.27

TC74VHCU04FN



SOL14-P-150-1.27

TC74VHCU04FT

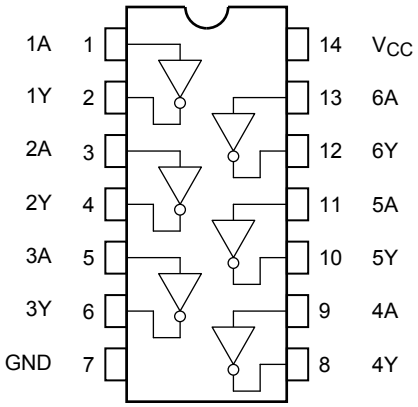


TSSOP14-P-0044-0.65A

Weight

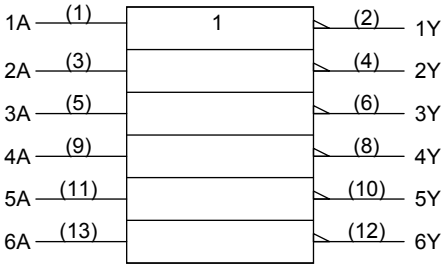
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOP14-P-300-1.27	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)

Pin Assignment



(top view)

IEC Logic Symbol



Truth Table

A	Y
L	H
H	L

Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	−0.5 to 7.0	V
DC input voltage	V_{IN}	−0.5 to 7.0	V
DC output voltage	V_{OUT}	−0.5 to V_{CC} + 0.5	V
Input diode current	I_{IK}	−20	mA
Output diode current	I_{OK}	±20	mA
DC output current	I_{OUT}	±25	mA
DC V_{CC}/ground current	I_{CC}	±50	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	−65 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Recommended Operating Conditions (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2.0 to 5.5	V
Input voltage	V_{IN}	0 to 5.5	V
Output voltage	V_{OUT}	0 to V_{CC}	V
Operating temperature	T_{opr}	−40 to 85	°C

Note: The recommended operating conditions are required to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition		V_{CC} (V)	Ta = 25°C Min	Typ.	Max	Ta = −40 to 85°C Min	Max	Unit
High-level input voltage	V_{IH}	V_{OUT} = V_{OL}		2.0	1.70	—	—	1.70	—	V
				3.0 to 5.5	V_{CC} × 0.8	—	—	V_{CC} × 0.8	—	
Low-level input voltage	V_{IL}	V_{OUT} = V_{OH}		2.0	—	—	0.30	—	0.30	V
				3.0 to 5.5	—	—	V_{CC} × 0.2	—	V_{CC} × 0.2	
High-level output voltage	V_{OH}	V_{IN} = V_{IL}	I_{OH} = −50 μA	2.0	1.8	2.0	—	1.8	—	V
				3.0	2.7	3.0	—	2.7	—	
				4.5	4.0	4.5	—	4.0	—	
		V_{IN} = GND	I_{OH} = −4 mA	3.0	2.58	—	—	2.48	—	
			I_{OH} = −8 mA	4.5	3.94	—	—	3.80	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 50 μA	2.0	—	0.0	0.2	—	0.2	V
				3.0	—	0.0	0.3	—	0.3	
				4.5	—	0.0	0.5	—	0.5	
		V_{IN} = V_{CC}	I_{OL} = 4 mA	3.0	—	—	0.36	—	0.44	
			I_{OL} = 8 mA	4.5	—	—	0.36	—	0.44	
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	2.0	—	20.0	μA

AC Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	C_L (pF)	Ta = 25°C Min	Typ.	Max	Ta = −40 to 85°C Min	Max	Unit
Propagation delay time	t_{pLH} t_{pHL}	—	3.3 ± 0.3	15	—	5.0	8.9	1.0	10.5	ns
				50	—	7.5	11.4	1.0	13.0	
		—	5.0 ± 0.5	15	—	3.5	5.5	1.0	6.5	
				50	—	5.0	7.0	1.0	8.0	
Input capacitance	C_{IN}	—			—	4	10	—	10	pF
Power dissipation capacitance	C_{PD}	(Note)			—	9	—	—	—	pF

Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

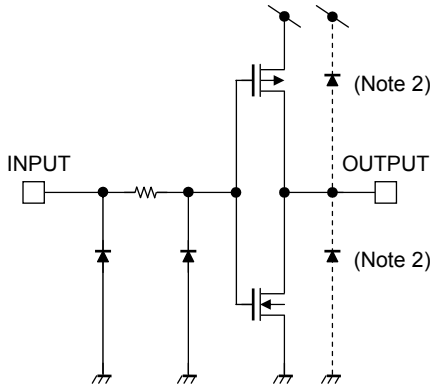
Average operating current can be obtained by the equation:

$$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per gate)}$$

Noise Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C		Unit
			V_{CC} (V)	Typ.	Max	
Quiet output maximum dynamic V_{OL}	V_{OLP}	C_L = 50 pF	5.0	0.5	0.8	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	−0.5	−0.8	V
Minimum high level dynamic input voltage	V_{IHD}	C_L = 50 pF	5.0	—	4.0	V
Maximum low level dynamic input voltage	V_{ILD}	C_L = 50 pF	5.0	—	1.0	V

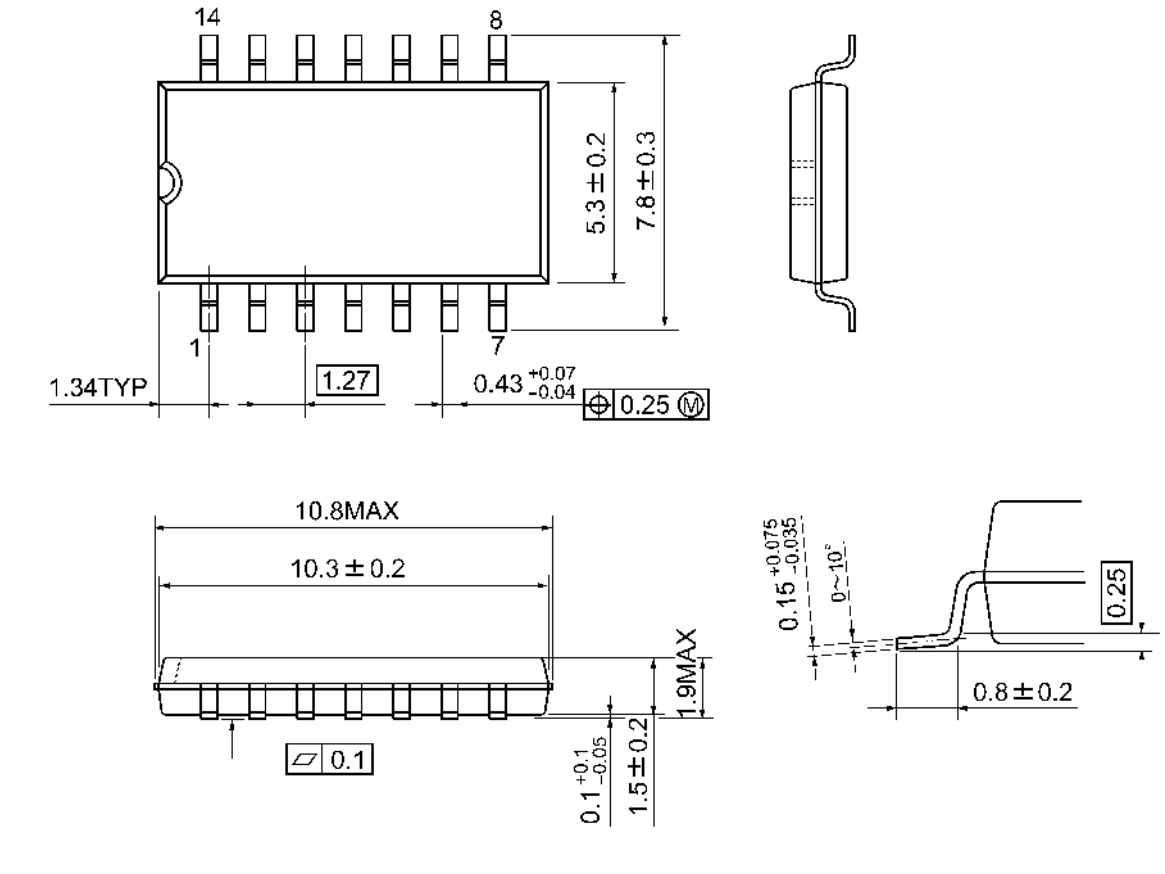
Input Equivalent Circuit



Note 2: Parastic diode

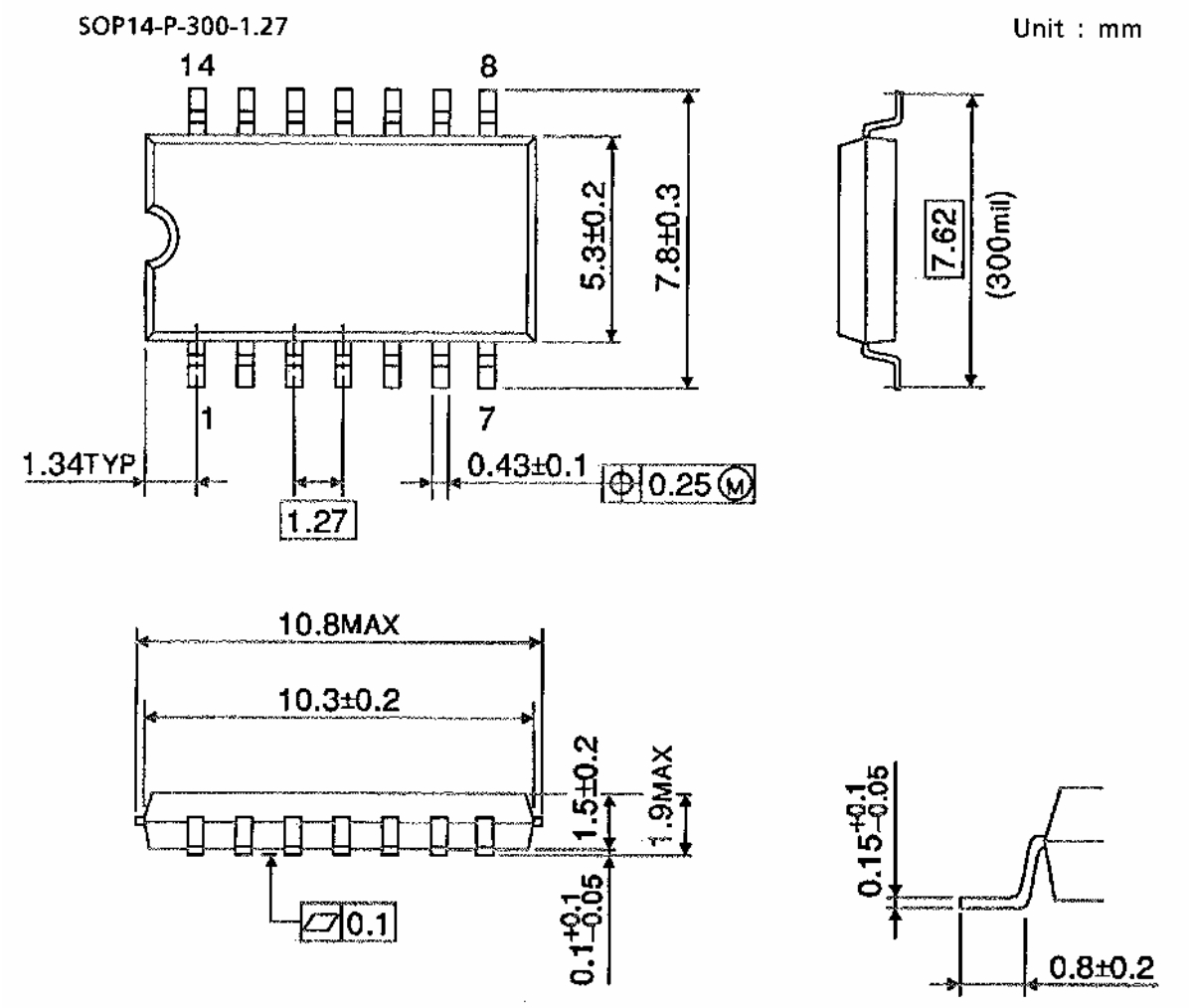
Package Dimensions

SOP14-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

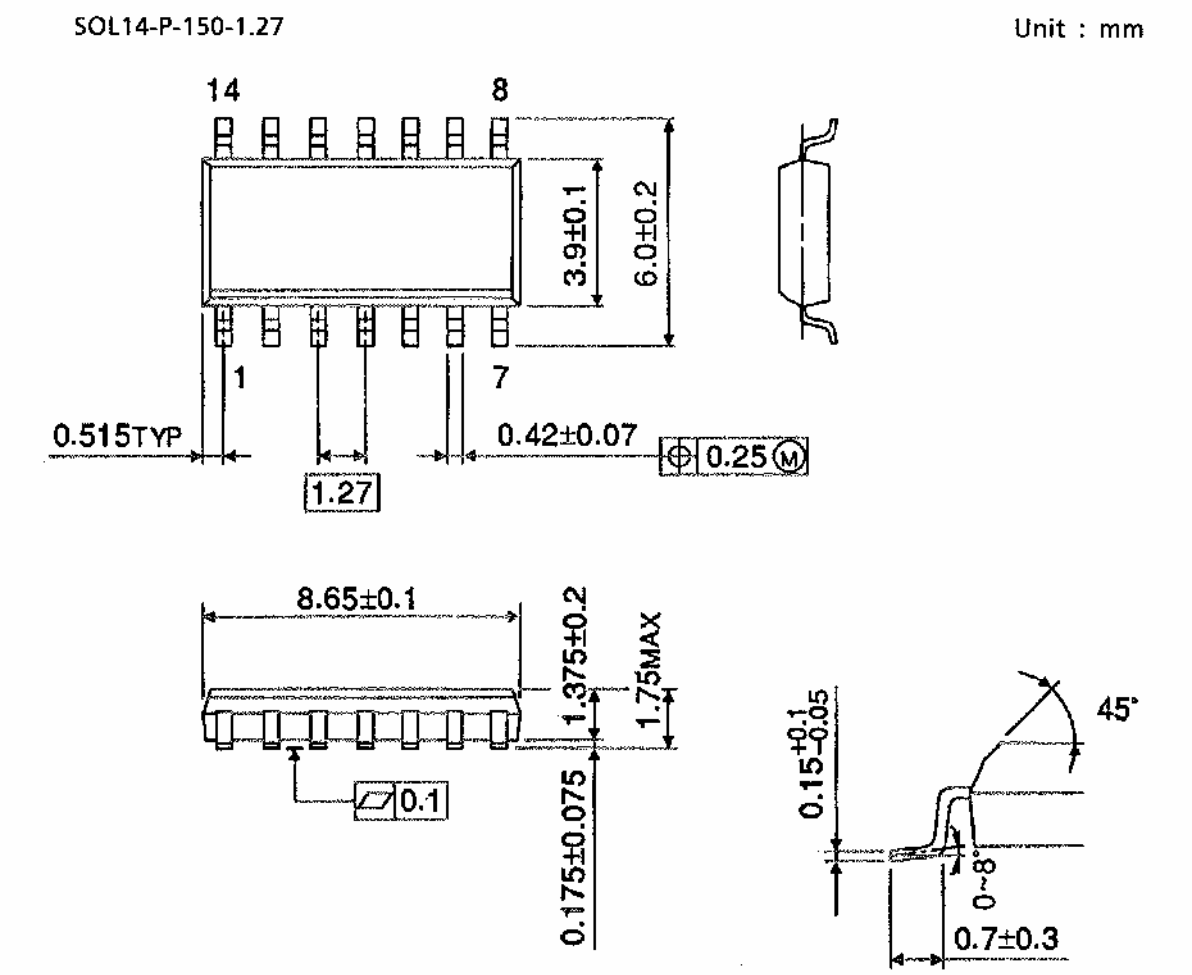
Package Dimensions



Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL14-P-150-1.27 Unit : mm

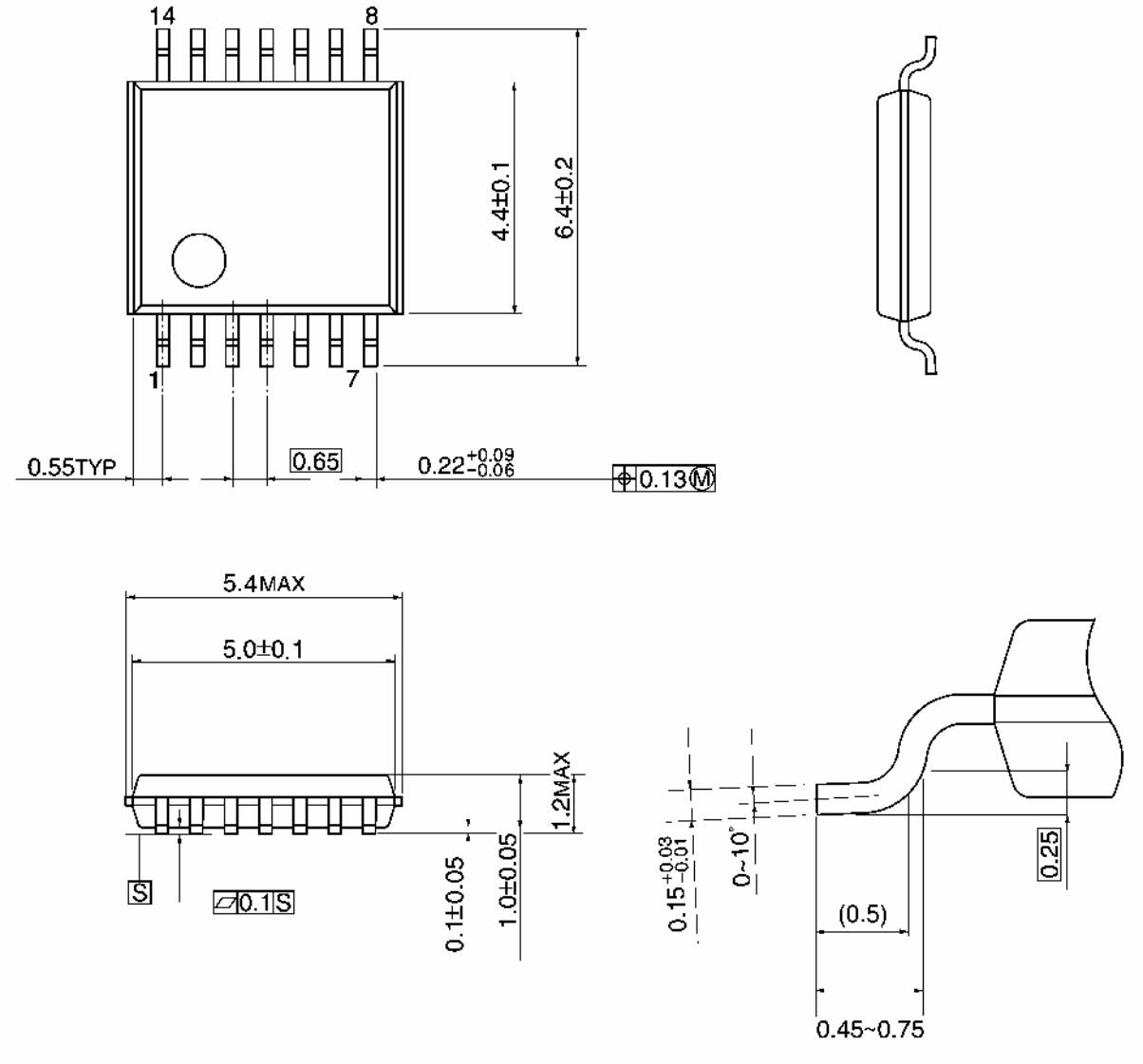


Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A Unit: mm



Weight: 0.06 g (typ.)

Note: Lead (Pb)-Free Packages

SOP14-P-300-1.27A SOL14-P-150-1.27 TSSOP14-P-0044-0.65A

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