

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC4028BP, TC4028BF, TC4028BFN

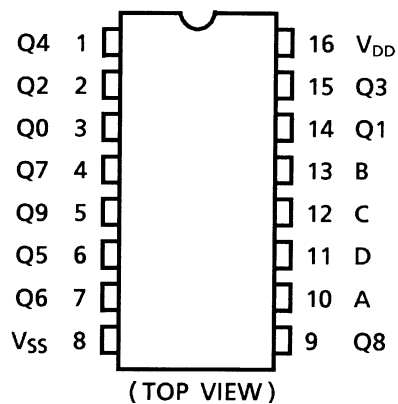
## TC4028B BCD-to-Decimal Decoder

TC4028B is a BCD-to-DECIMAL decoder which converts BCD signal into DECIMAL signal.

Of ten outputs from Q0 to Q9, one output corresponding to input BCD code goes to the "H" level and all the others remain at the "L" level.

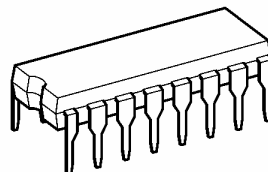
When D is used as inhibit input by use of three input lines from A to C, this decoder can be served as a BINARY-to-OCTAL decoder.

### Pin Assignment



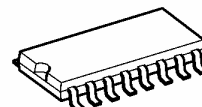
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4028BP

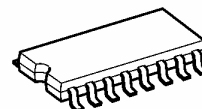


DIP16-P-300-2.54A

TC4028BF

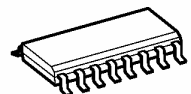


SOP16-P-300-1.27A



SOP16-P-300-1.27

TC4028BFN



SOL16-P-150-1.27

### Weight

DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)
SOP16-P-300-1.27	: 0.18 g (typ.)
SOL16-P-150-1.27	: 0.13 g (typ.)

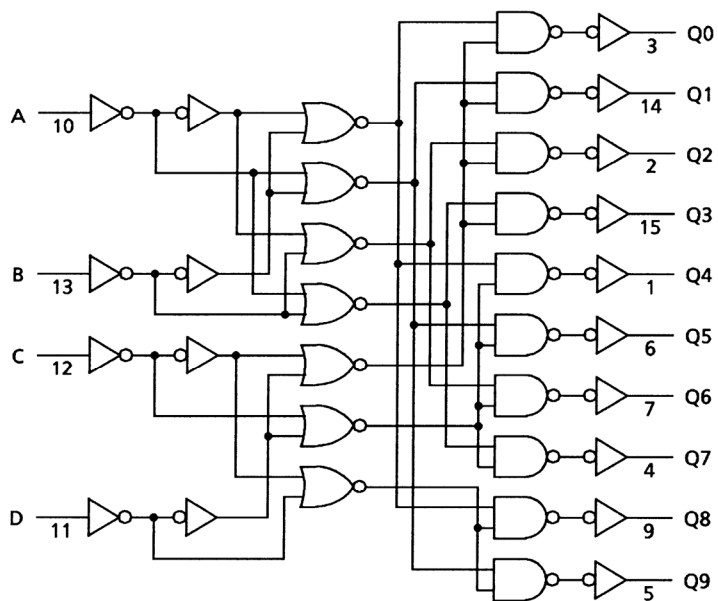
## Truth Table

Inputs				Outputs									
D	C	B	A	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
L	L	L	L	H	L	L	L	L	L	L	L	L	L
L	L	L	H	L	H	L	L	L	L	L	L	L	L
L	L	H	L	L	L	H	L	L	L	L	L	L	L
L	L	H	H	L	L	L	H	L	L	L	L	L	L
L	H	L	L	L	L	L	L	H	L	L	L	L	L
L	H	L	H	L	L	L	L	L	H	L	L	L	L
L	H	H	L	L	L	L	L	L	L	H	L	L	L
L	H	H	H	L	L	L	L	L	L	L	H	L	L
H	L	L	L	L	L	L	L	L	L	L	L	H	L
H	L	L	H	L	L	L	L	L	L	L	L	L	H
H	L	H	L	L	L	L	L	L	L	L	L	L	L
H	L	H	H	L	L	L	L	L	L	L	L	L	L
H	H	L	L	L	L	L	L	L	L	L	L	L	L
H	H	L	H	L	L	L	L	L	L	L	L	L	L
H	H	H	L	L	L	L	L	L	L	L	L	L	L
H	H	H	H	L	L	L	L	L	L	L	L	L	L

H = High level

L = Low level

## Logic Diagram



**Absolute Maximum Ratings (Note)**

Characteristics	Symbol	Rating	Unit
DC supply voltage	$V_{DD}$	$V_{SS} - 0.5$ to $V_{SS} + 20$	V
Input voltage	$V_{IN}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
Output voltage	$V_{OUT}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
DC input current	$I_{IN}$	$\pm 10$	mA
Power dissipation	$P_D$	300 (DIP)/180 (SOIC)	mW
Operating temperature range	$T_{opr}$	-40 to 85	°C
Storage temperature range	$T_{stg}$	-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 ( $V_{SS} = 0$  V) (Note)**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	$V_{DD}$	—	3	—	18	V
Input voltage	$V_{IN}$	—	0	—	$V_{DD}$	V

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.

**Static Electrical Characteristics ( $V_{SS} = 0$  V)**

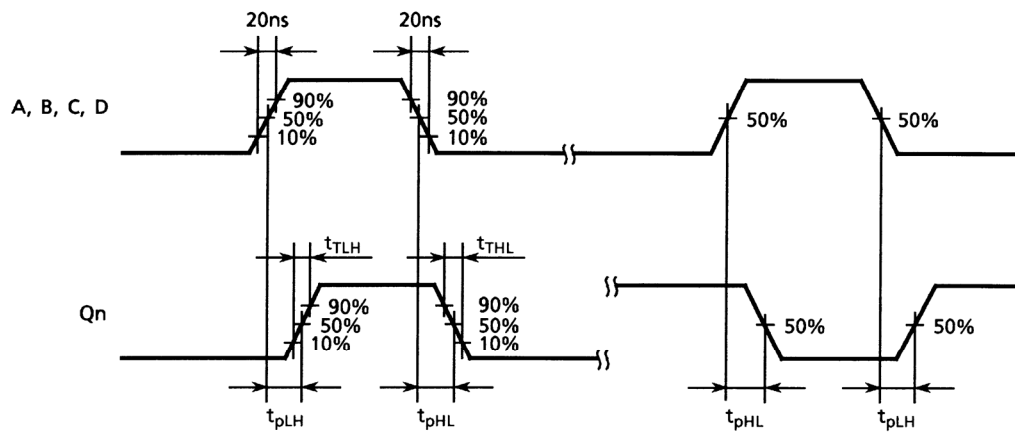
Characteristics		Sym- bol	Test Condition	$V_{DD}$ (V)	-40°C		25°C			85°C		Unit
					Min	Max	Min	Typ.	Max	Min	Max	
High-level output voltage		$V_{OH}$	$ I_{OUT}  < 1 \mu A$ $V_{IN} = V_{SS}, V_{DD}$	5	4.95	—	4.95	5.00	—	4.95	—	V
				10	9.95	—	9.95	10.00	—	9.95	—	
				15	14.95	—	14.95	15.00	—	14.95	—	
Low-level output voltage		$V_{OL}$	$ I_{OUT}  < 1 \mu A$ $V_{IN} = V_{SS}, V_{DD}$	5	—	0.05	—	0.00	0.05	—	0.05	V
				10	—	0.05	—	0.00	0.05	—	0.05	
				15	—	0.05	—	0.00	0.05	—	0.05	
Output high current		$I_{OH}$	$V_{OH} = 4.6$ V	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA
			$V_{OH} = 2.5$ V	5	-2.50	—	-2.10	-4.0	—	-1.70	—	
			$V_{OH} = 9.5$ V	10	-1.50	—	-1.30	-2.2	—	-1.10	—	
			$V_{OH} = 13.5$ V	15	-4.00	—	-3.40	-9.0	—	-2.80	—	
			$V_{IN} = V_{SS}, V_{DD}$									
Output low current		$I_{OL}$	$V_{OL} = 0.4$ V	5	0.61	—	0.51	1.2	—	0.42	—	mA
			$V_{OL} = 0.5$ V	10	1.50	—	1.30	3.2	—	1.10	—	
			$V_{OL} = 1.5$ V	15	4.00	—	3.40	12.0	—	2.80	—	
			$V_{IN} = V_{SS}, V_{DD}$									
Input high voltage		$V_{IH}$	$V_{OUT} = 0.5$ V, 4.5 V	5	3.5	—	3.5	2.75	—	3.5	—	V
			$V_{OUT} = 1.0$ V, 9.0 V	10	7.0	—	7.0	5.50	—	7.0	—	
			$V_{OUT} = 1.5$ V, 13.5 V	15	11.0	—	11.0	8.25	—	11.0	—	
			$ I_{OUT}  < 1 \mu A$									
Input low voltage		$V_{IL}$	$V_{OUT} = 0.5$ V, 4.5 V	5	—	1.5	—	2.25	1.5	—	1.5	V
			$V_{OUT} = 1.0$ V, 9.0 V	10	—	3.0	—	4.50	3.0	—	3.0	
			$V_{OUT} = 1.5$ V, 13.5 V	15	—	4.0	—	6.75	4.0	—	4.0	
			$ I_{OUT}  < 1 \mu A$									
Input current	"H" level	$I_{IH}$	$V_{IH} = 18$ V	18	—	0.1	—	$10^{-5}$	0.1	—	1.0	$\mu A$
	"L" level	$I_{IL}$	$V_{IL} = 0$ V	18	—	-0.1	—	$-10^{-5}$	-0.1	—	-1.0	
Quiescent supply current		$I_{DD}$	$V_{IN} = V_{SS}, V_{DD}$ (Note)	5	—	5	—	0.005	5	—	150	$\mu A$
				10	—	10	—	0.010	10	—	300	
				15	—	20	—	0.015	20	—	600	

Note: All valid input combinations.

**Dynamic Electrical Characteristics (Ta = 25°C, V<sub>SS</sub> = 0 V, C<sub>L</sub> = 50 pF)**

Characteristics	Symbol	Test Condition		Min	Typ.	Max	Unit
			V <sub>DD</sub> (V)				
Output transition time (low to high)	t <sub>TLH</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t <sub>THL</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time	t <sub>pLH</sub> t <sub>pHL</sub>	—	5	—	110	350	ns
			10	—	55	160	
			15	—	40	120	
Input capacitance	C <sub>IN</sub>	—	—	—	5	7.5	pF

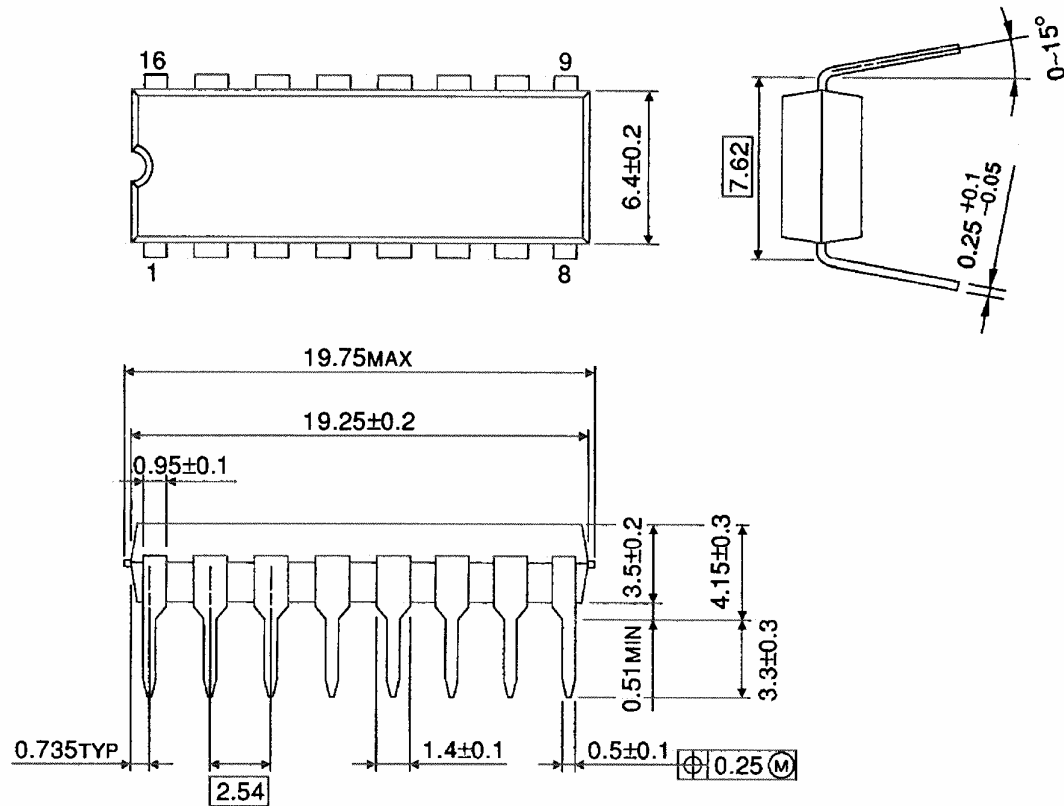
**Waveform for Measurement of Dynamic Characteristics**



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

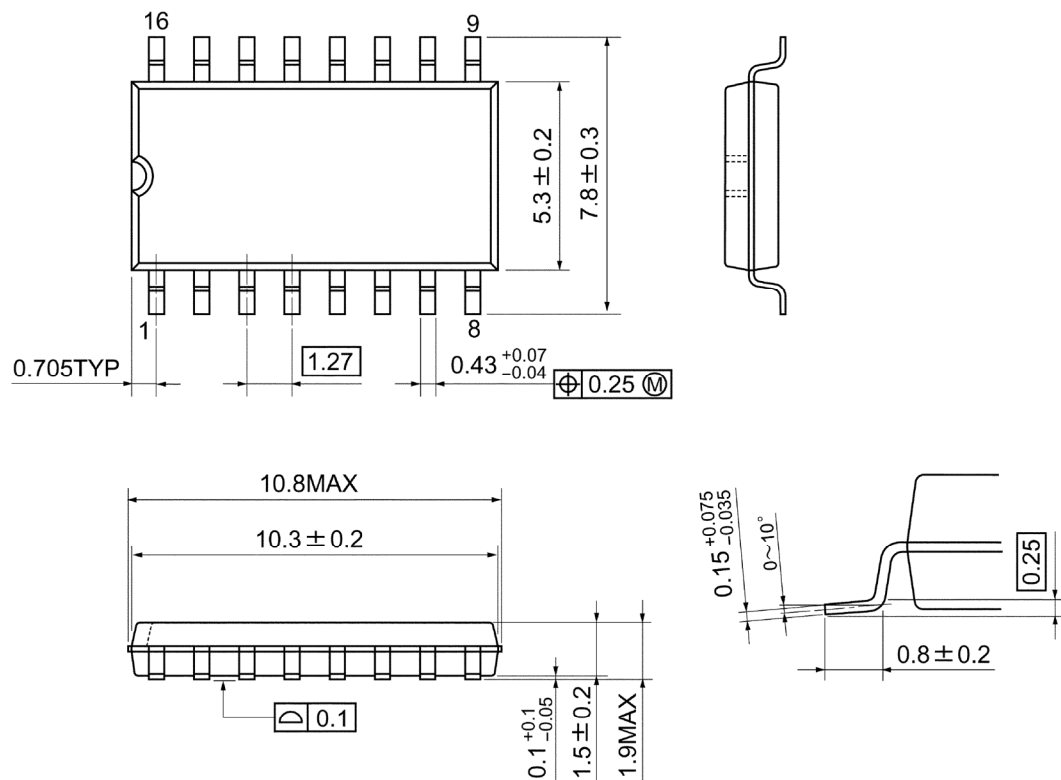


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm

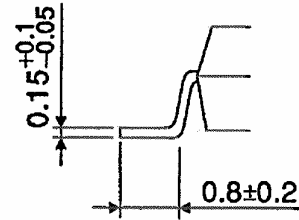
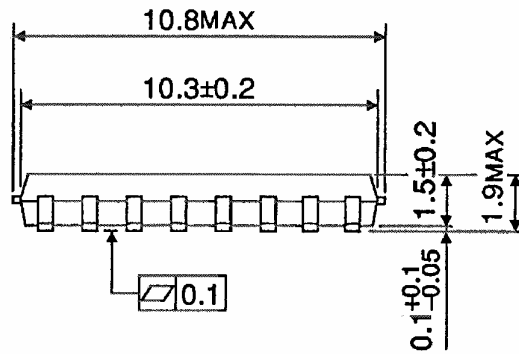
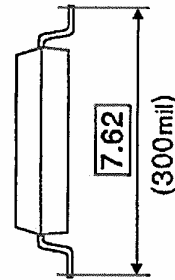
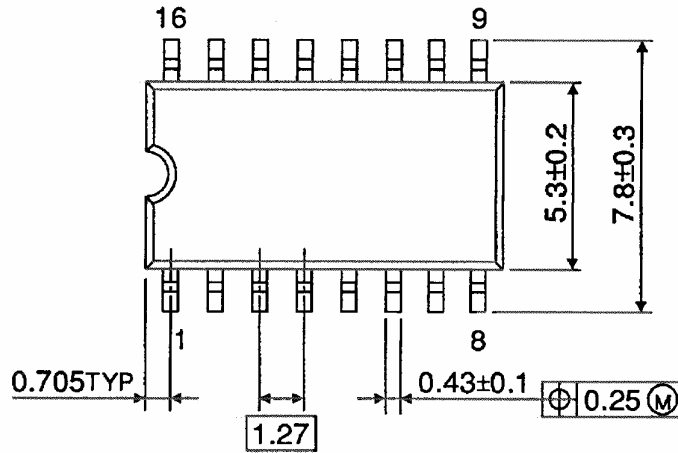


Weight: 0.18 g (typ.)

## Package Dimensions

SOP16-P-300-1.27

Unit : mm



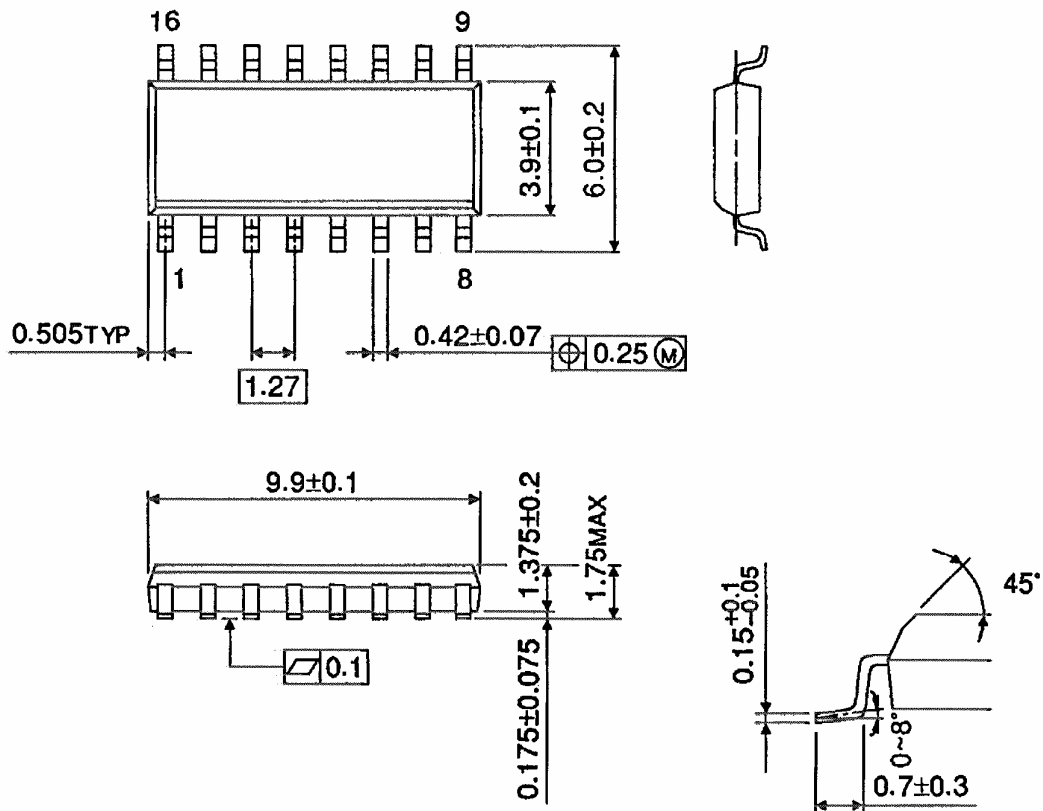
Weight: 0.18 g (typ.)



## Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

**Note: Lead (Pb)-Free Packages**

**DIP16-P-300-2.54A SOP16-P-300-1.27A SOL16-P-150-1.27**

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