TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC4020BP,TC4020BF,TC4020BFN

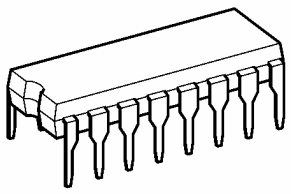
TC4020B 14 Stage Ripple-Carry Binary Counter/Dividers

TC4020B is 14 stage ripple carry binary counter having asynchronous clear function. The counter advances its counting stage by falling edge of $\overline{\text{CLOCK}}$ input. When RESET input is placed "H", all the circuits are reset regardless of $\overline{\text{CLOCK}}$ input making all the outputs (Q1, Q4~Q14) to be "L".

This is most suitable for frequency dividers, control circuits and timing circuits.

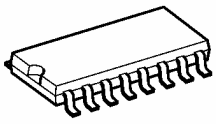
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4020BP



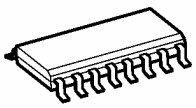
DIP16-P-300-2.54A

TC4020BF



SOP16-P-300-1.27A

TC4020BFN

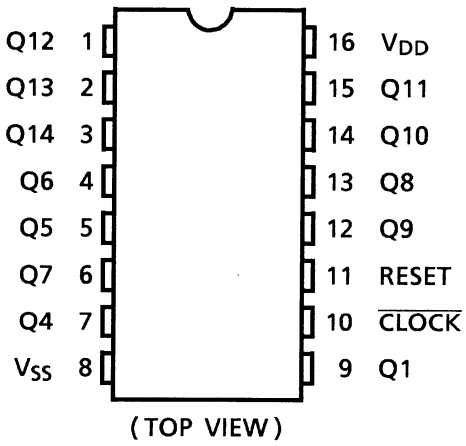


SOL16-P-150-1.27

Weight

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

Pin Assignment



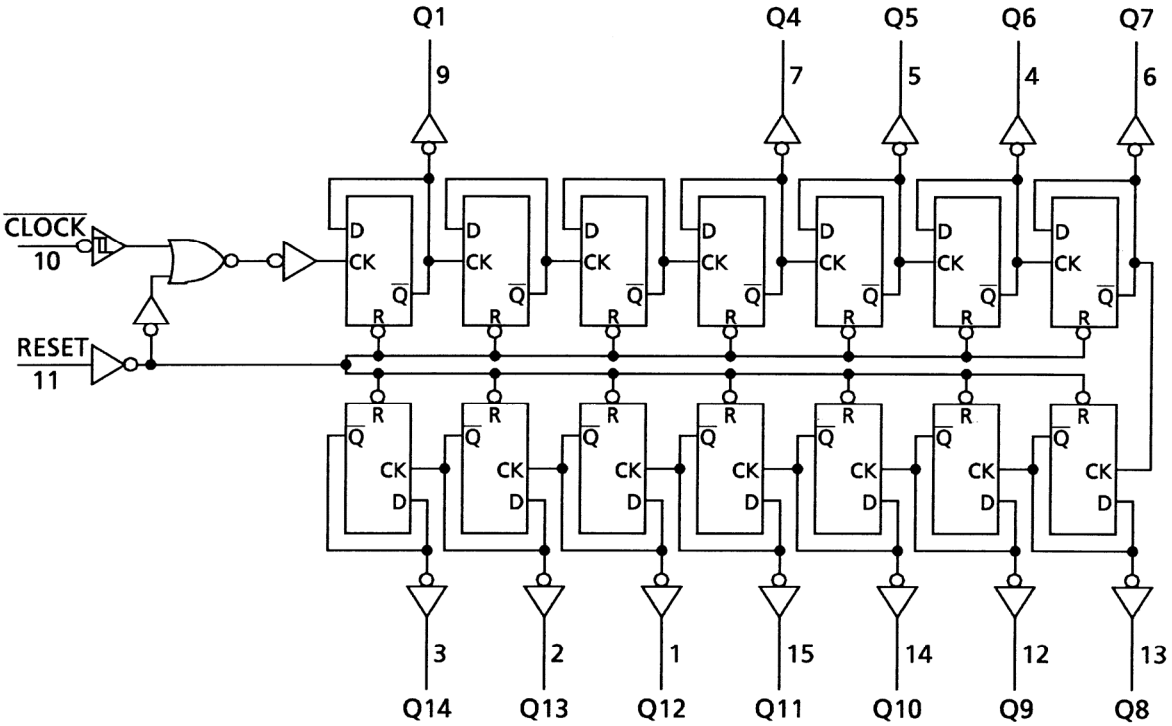
Truth Table

$\overline{\text{CLOCK}}$ ∆	RESET	Output State
*	H	All Outputs = "L"
↑	L	No Change
↓	L	Advance to Next State

∆: Level change

*: Don't care

Logic Diagram



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	V_{DD}	V_{SS} − 0.5~V_{SS} + 20	V
Input voltage	V_{IN}	V_{SS} − 0.5~V_{DD} + 0.5	V
Output voltage	V_{OUT}	V_{SS} − 0.5~V_{DD} + 0.5	V
DC input current	I_{IN}	±10	mA
Power dissipation	P_D	300 (DIP)/180 (SOIC)	mW
Operating temperature range	T_{opr}	−40~85	°C
Storage temperature range	T_{stg}	−65~150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Operating Ranges (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 operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either V_{DD} or V_{SS}.

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

Characteristics	Sym-bol	Test Condition		−40°C		25°C			85°C		Unit
			V_{DD} (V)	Min	Max	Min	Typ.	Max	Min	Max	
High-level output voltage	V_{OH}	$\|I_{OUT}\| < 1$ μA $V_{IN} = V_{SS}, V_{DD}$	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}	$\|I_{OUT}\| < 1$ μA $V_{IN} = V_{SS}, V_{DD}$	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	—	
		$\|I_{OUT}\| < 1$ μA									
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	
		$\|I_{OUT}\| < 1$ μA									
Input current "H" level	I_{IH}	V_{IH} = 18 V	18	—	0.1	—	10^{-5}	0.1	—	1.0	μA
Input current "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	μA
			10	—	10	—	0.010	10	—	300	
			15	—	20	—	0.015	20	—	600	

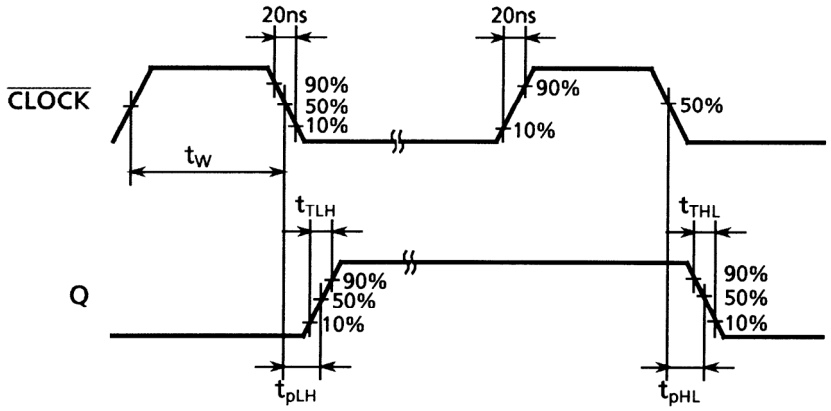
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, V_{SS} = 0 V, C_L = 50 pF)

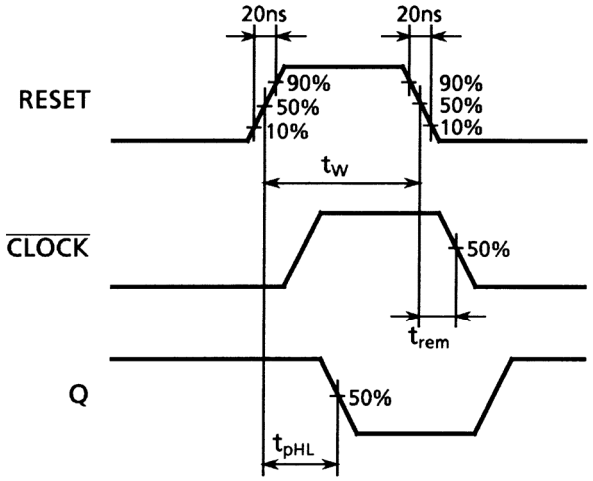
Characteristics	Symbol	Test Condition	V_{DD} (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t_{TLH}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t_{THL}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time ($\overline{CLOCK}$ -Q1)	t_{pLH}	—	5	—	160	360	ns
			10	—	80	160	
			15	—	65	130	
Propagation delay time ($\overline{CLOCK}$ -Q1)	t_{pHL}	—	5	—	160	360	ns
			10	—	80	160	
			15	—	65	130	
Propagation delay time ($\overline{CLOCK}$ -Q14)	t_{pLH}	—	5	—	1000	2000	ns
			10	—	500	1000	
			15	—	400	800	
Propagation delay time ($\overline{CLOCK}$ -Q14)	t_{pHL}	—	5	—	1000	2000	ns
			10	—	500	1000	
			15	—	400	800	
Propagation delay time (RESET-Q)	t_{pHL}	—	5	—	150	280	ns
			10	—	70	120	
			15	—	50	100	
Max clock frequency	f_{CL}	—	5	3.5	10	—	MHz
			10	8.0	20	—	
			15	12.0	25	—	
Min clock pulse width (RESET)	t_W	—	5	—	50	140	ns
			10	—	20	60	
			15	—	15	40	
Min pulse width	t_W	—	5	—	100	200	ns
			10	—	40	80	
			15	—	30	60	
Min removal time (RESET- $\overline{CLOCK}$)	t_{rem}	—	5	—	—	350	ns
			10	—	—	150	
			15	—	—	100	
Max clock input rise time Max clock input fall time	t_{rCL} t_{fCL}	—	5 10 15	No limit			μs
Input capacitance	C_{IN}	—		—	5	7.5	pF

Operating Supply Current Test Circuit

Waveform 1

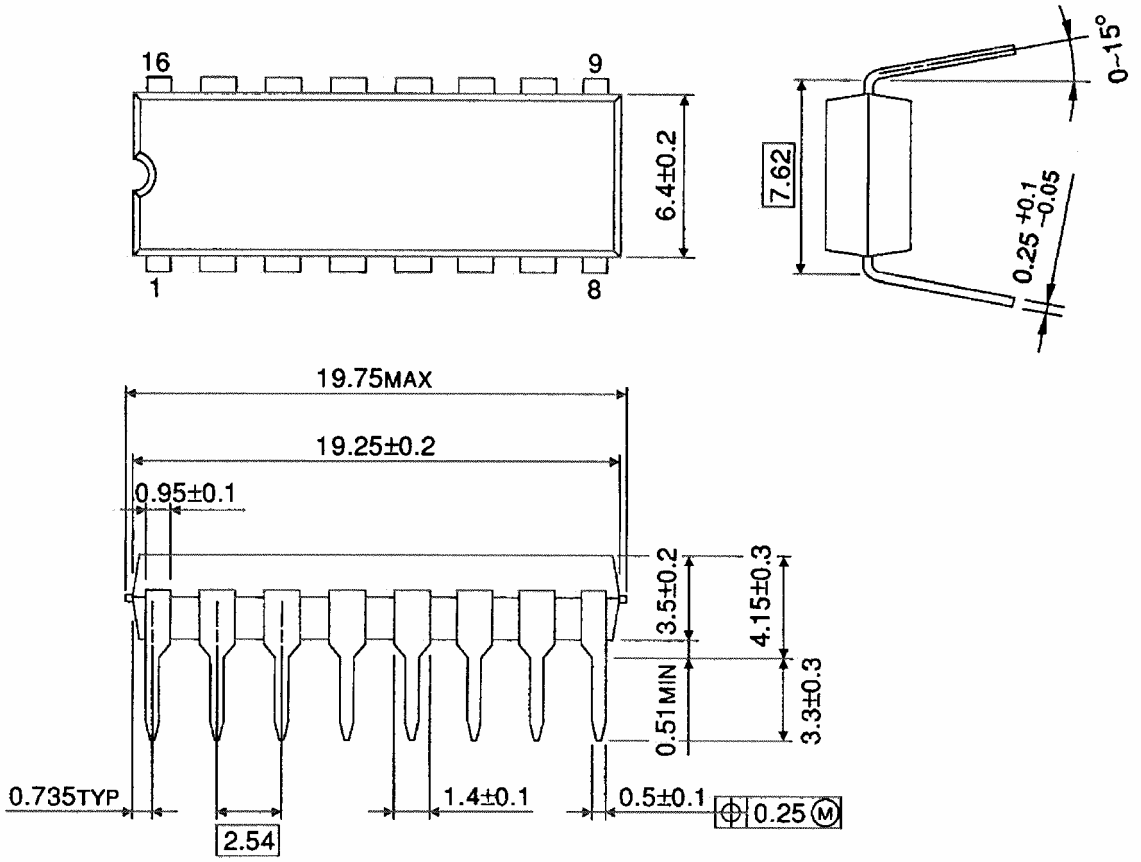


Waveform 2



Package Dimensions

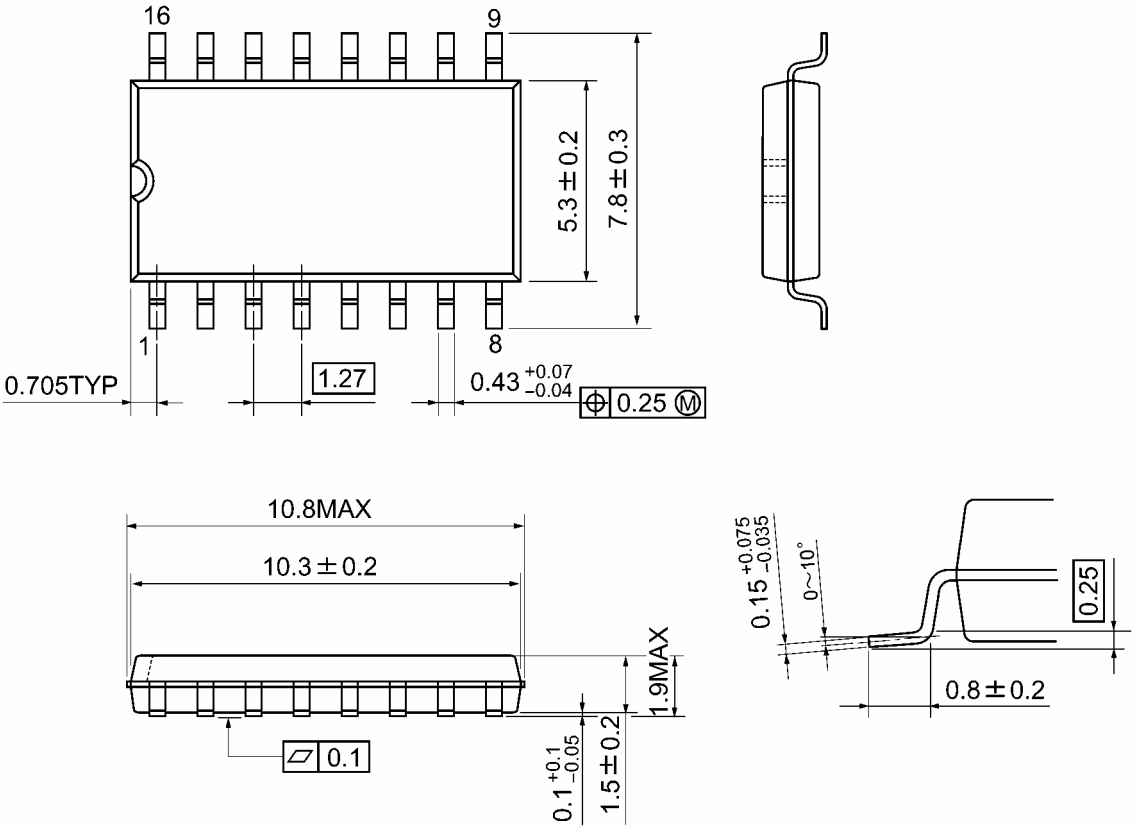
DIP16-P-300-2.54A Unit : mm



Weight: 1.00 g (typ.)

Package Dimensions

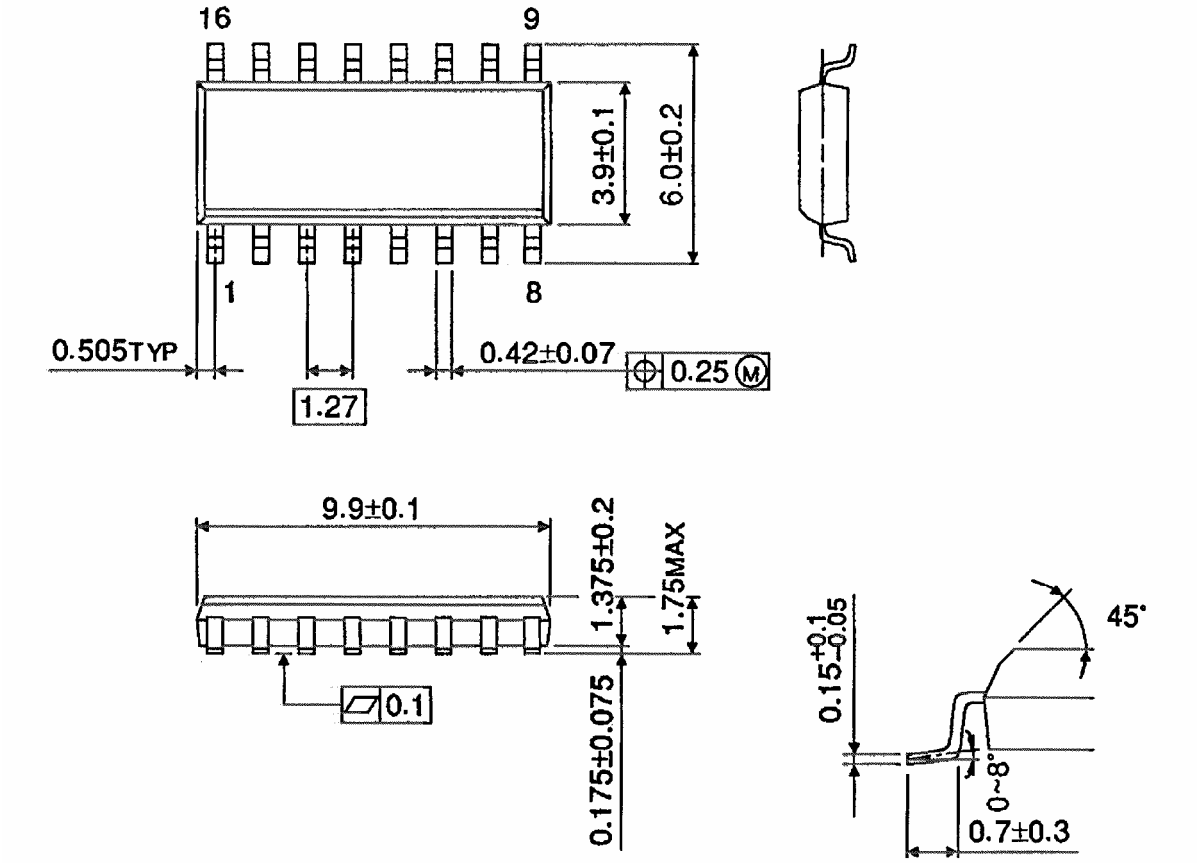
SOP16-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL16-P-150-1.27 Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN GENERAL

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in his document shall be made at the customer’s own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.