TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74HC165AP, TC74HC165AF, TC74HC165AFN

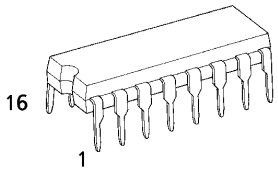
8 – BIT SHIFT REGISTER (P – IN, S – OUT)

(Note) The JEDEC SOP (FN) is not available in Japan.

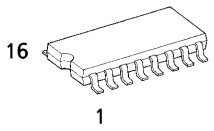
The TC74HC165A is a high speed CMOS 8-BIT PARALLEL/SERIAL-IN, SERIAL-OUT SHIFT REGISTER fabricated with silicon gate C^2MOS technology.
It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.
It consists of parallel-in or serial-in, serial-out 8 - bit shift register with a gated clock inputs. When the SHIFT/$\overline{\text{LOAD}}$ input is held high, the serial data input is enabled and the eight frip-frops perform serial shifting with each clock pulse.
When the SHIFT/$\overline{\text{LOAD}}$ input is held low, the parallel data is loaded asynchronously into the register at positive going transition of the clock pulse.
The CK-INH input should be shifted high only when the CK input is held high.
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES :

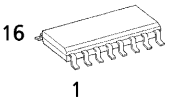
- High Speed ····· f_{MAX} = 56MHz(typ.)at V_{CC} = 5V
- Low Power Dissipation ····· I_{CC} = 4μA(Max.)at Ta = 25°C
- High Noise Immunity ····· $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Output Drive Capability ····· 10 LSTTL Loads
- Symmetrical Output Impedance ··· $|I_{OH}| = I_{OL}$ = 4mA(Min.)
- Balanced Propagation Delays ····· $t_{pLH} \simeq t_{pHL}$
- Wide Operating Voltage Range ···· V_{CC} (opr.) = 2V ~ 6V
- Pin and Function Compatible with 74LS165



P (DIP16-P-300-2.54A)
Weight : 1.00g (Typ.)

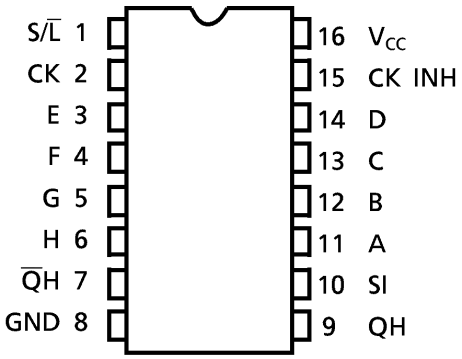


F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)



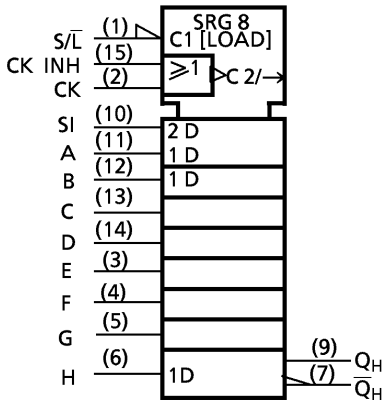
FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

PIN ASSIGNMENT



(TOP VIEW)

IEC LOGIC SYMBOL



TRUTH TABLE

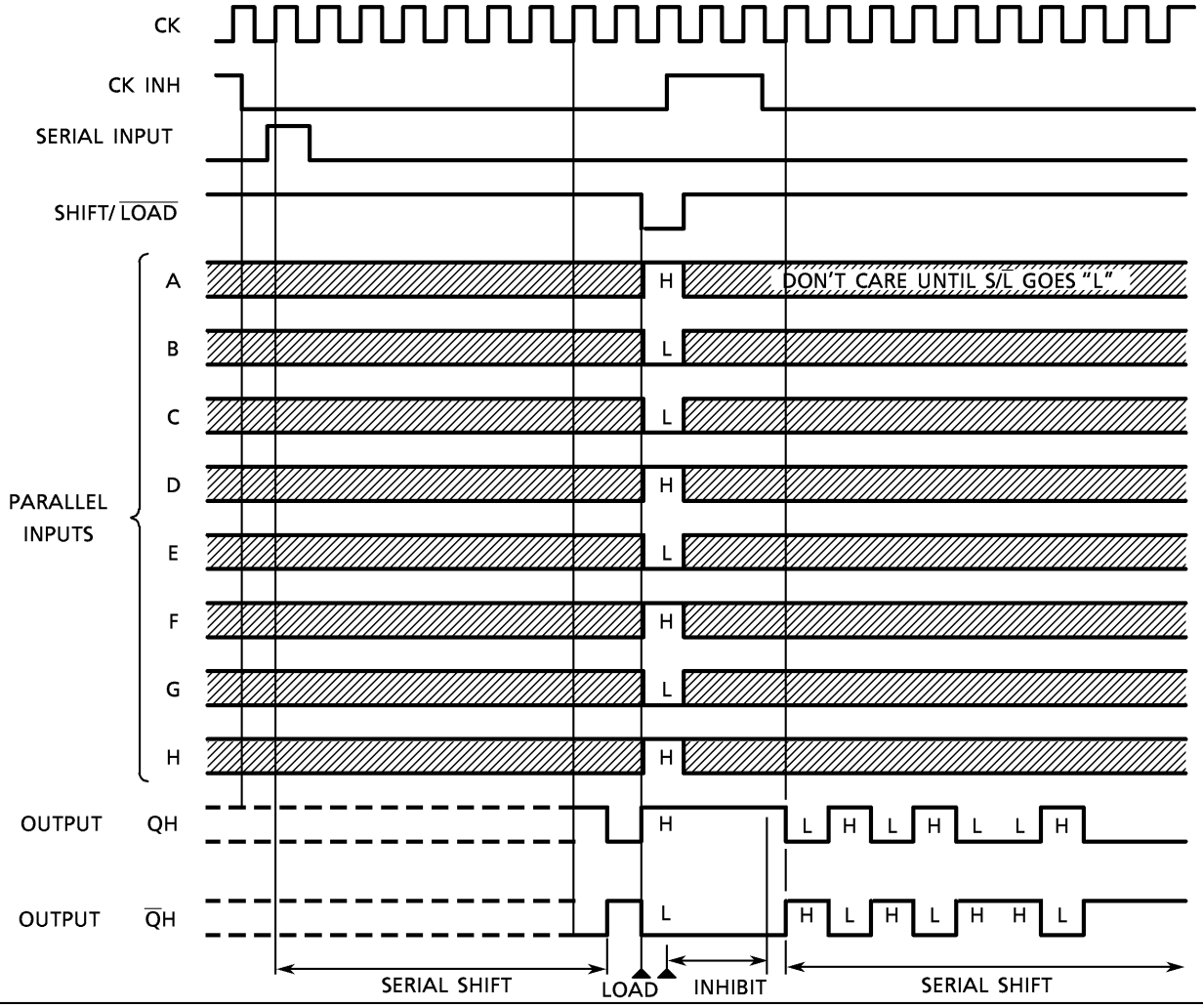
INPUTS					INTERNAL OUTPUTS		OUTPUT	
SHIFT/ LOAD	CLOCK INH	CLOCK	SERIAL IN	PARALLEL A …… H	QA	QB	QH	$\overline{QH}$
L	X	X	X	a …… h	a	b	h	$\overline{h}$
H	L	↑	H	X	H	QAn	QGn	$\overline{QGn}$
H	L	↑	L	X	L	QAn	QGn	$\overline{QGn}$
H	↑	L	H	X	H	QAn	QGn	$\overline{QGn}$
H	↑	L	L	X	L	QAn	QGn	$\overline{QGn}$
H	X	H	X	X	NO CHANGE			
H	H	X	X	X	NO CHANGE			

X : Don't Care

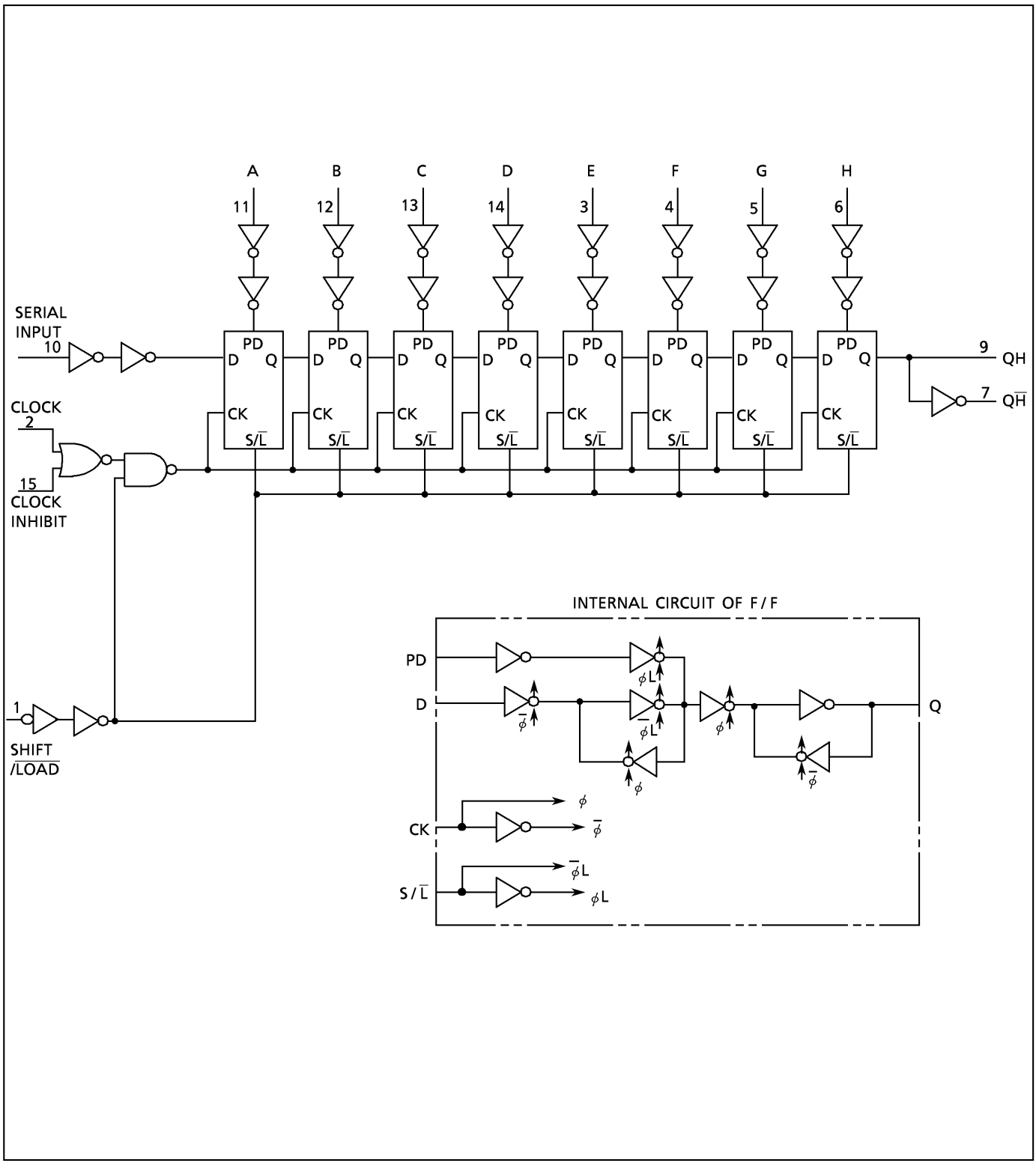
a …… h : The level of steady state input voltage at inputs A through H respectively

QAn~QGn : The level of QA~QG, respectively, before the most recent positive transition of the CK.

TIMING CHART



SYSTEM DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	−0.5~7	V
DC Input Voltage	V_{IN}	−0.5~V_{CC}+0.5	V
DC Output Voltage	V_{OUT}	−0.5~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	500 (DIP)* / 180 (SOP)	mW
Storage Temperature	T_{stg}	−65~150	°C

*500mW in the range of Ta = −40°C~65°C. From Ta = 65°C to 85 °C a derating factor of −10mW/ °C shall be applied until 300mW.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{CC}	2~6	V
Input Voltage	V_{IN}	0~V_{CC}	V
Output Voltage	V_{OUT}	0~V_{CC}	V
Operating Temperature	T_{opr}	−40~85	°C
Input Rise and Fall Time	t_r, t_f	0~ 1000 (V_{CC} = 2.0V) 0~ 500 (V_{CC} = 4.5V) 0~ 400 (V_{CC} = 6.0V)	ns

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION		V_{CC} (V)	Ta = 25°C MIN.	Ta = 25°C TYP.	Ta = 25°C MAX.	Ta = −40~85°C MIN.	Ta = −40~85°C MAX.	UNIT
High - Level Input Voltage	V_{IH}			2.0 4.5 6.0	1.50 3.15 4.20	− − −	− − −	1.50 3.15 4.20	− − −	V
Low - Level Input Voltage	V_{IL}			2.0 4.5 6.0	− − −	− − −	0.50 1.35 1.80	− − −	0.50 1.35 1.80	V
High - Level Output Voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −20μA	2.0 4.5 6.0	1.9 4.4 5.9	2.0 4.5 6.0	− − −	1.9 4.4 5.9	− − −	V
			I_{OH} = −4 mA I_{OH} = −5.2mA	4.5 6.0	4.18 5.68	4.31 5.80	− −	4.13 5.63	− −	
Low - Level Output Voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20μA	2.0 4.5 6.0	− − −	0.0 0.0 0.0	0.1 0.1 0.1	− − −	0.1 0.1 0.1	V
			I_{OL} = 4 mA I_{OL} = 5.2mA	4.5 6.0	− −	0.17 0.18	0.26 0.26	− −	0.33 0.33	
Input Leakage Current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	−	−	±0.1	−	±1.0	μA
Quiescent Supply Current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	−	−	4.0	−	40.0	μA

TIMING REQUIREMENTS OPERATING CONDITIONS (Input $t_r = t_f = 6ns$)

PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C		Ta = −40~85°C	UNIT
			V_{CC} (V)	TYP.	LIMIT	LIMIT	
Minimum Pulse Width (CK, CK INH)	$t_{W(H)}$ $t_{W(L)}$		2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Pulse Width (S/$\overline{L}$)	$t_{W(L)}$		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set−up Time (PI−S/$\overline{L}$)	t_s		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set−up Time (SI−CK, CK INH)	t_s		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set−up Time (S/$\overline{L}$−CK, CK INH)	t_s		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Hold Time (PI−S/$\overline{L}$)	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Hold Time (SI−CK, CK INH)	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Hold Time (S/$\overline{L}$−CK, CK INH)	t_h		2.0	—	0	0	
			4.5	—	0	0	
			6.0	—	0	0	
Minimum Removal Time (CK INH−CK) (CK−CK INH)	t_{rem}		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Clock Frequency	f		2.0	—	7	6	MHz
			4.5	—	30	24	
			6.0	—	41	28	

AC ELECTRICAL CHARACTERISTICS ($C_L = 15pF$, $V_{CC} = 5V$, Ta = 25°C, Input $t_r = t_f = 6ns$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t_{TLH} t_{THL}		—	4	8	ns
Propagation Delay Time (CK, CK INH−QH, $\overline{Q}$H)	t_{pLH} t_{pHL}		—	15	25	
Propagation Delay Time (S/$\overline{L}$−QH, $\overline{Q}$H)	t_{pLH} t_{pHL}		—	15	25	
Propagation Delay Time (H−QH, $\overline{Q}$H)	t_{pLH} t_{pHL}		—	14	26	
Maximum Clock Frequency	f_{MAX}		35	56	—	MHz

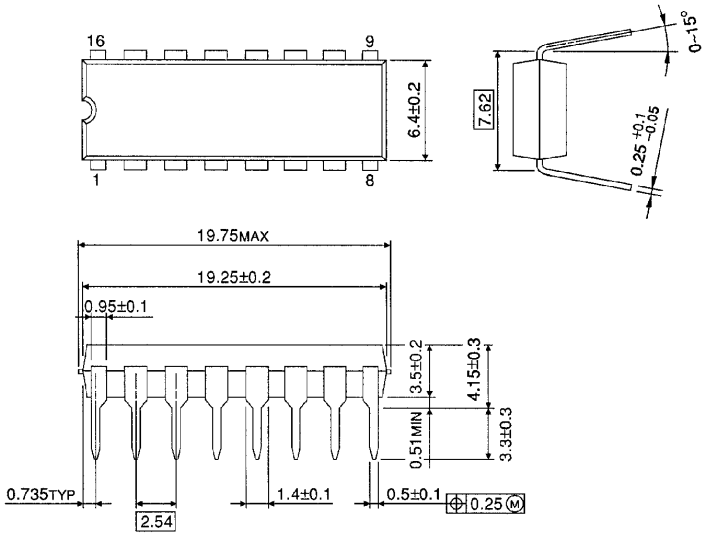
AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input $t_r = t_f$ = 6ns)

PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C			Ta = −40~85°C		UNIT
			V_{CC} (V)	MIN.	TYP.	MAX.	MIN.	MAX.	
Output Transition Time	t_{TLH} t_{THL}		2.0 4.5 6.0	− − −	25 8 7	75 15 13	− − −	95 19 16	ns
Propagation Delay Time (CK, CK INH − QH, $\overline{QH}$)	t_{pLH} t_{pHL}		2.0 4.5 6.0	− − −	55 18 15	150 30 26	− − −	190 38 33	
Propagation Delay Time ($\overline{S}/L$ − QH, $\overline{QH}$)	t_{pLH} t_{pHL}		2.0 4.5 6.0	− − −	60 19 16	165 33 28	− − −	205 41 35	
Propagation Delay Time (H − QH, $\overline{QH}$)	t_{pHL}		2.0 4.5 6.0	− − −	52 17 14	135 27 23	− − −	170 34 29	
Maximum Clock Frequency Frequency	f_{MAX}		2.0 4.5 6.0	7 30 41	14 46 65	− − −	6 24 28	− − −	MHz
Input Capacitance	C_{IN}			−	5	10	−	10	pF
Power Dissipation Capacitance	C_{PD} (1)			−	55	−	−	−	

Note (1) 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:

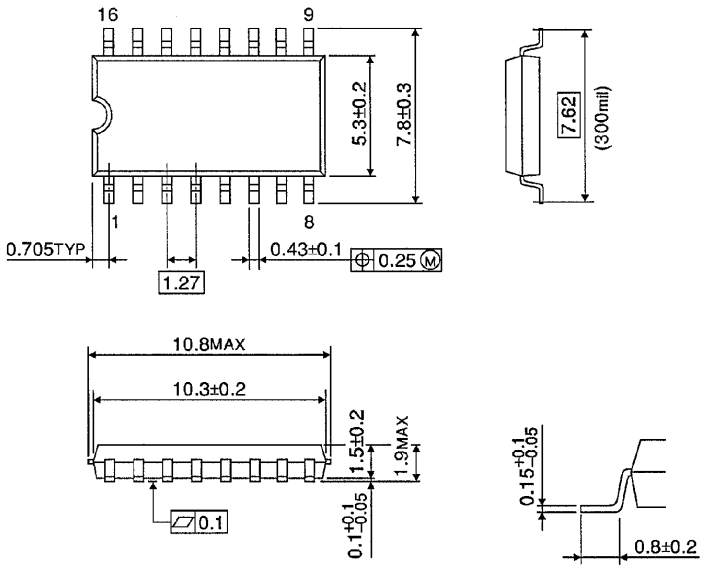
$$I_{CC}(opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

DIP 16PIN PACKAGE DIMENSIONS (DIP16-P-300-2.54A) Unit in mm



Weight : 1.00g (Typ.)

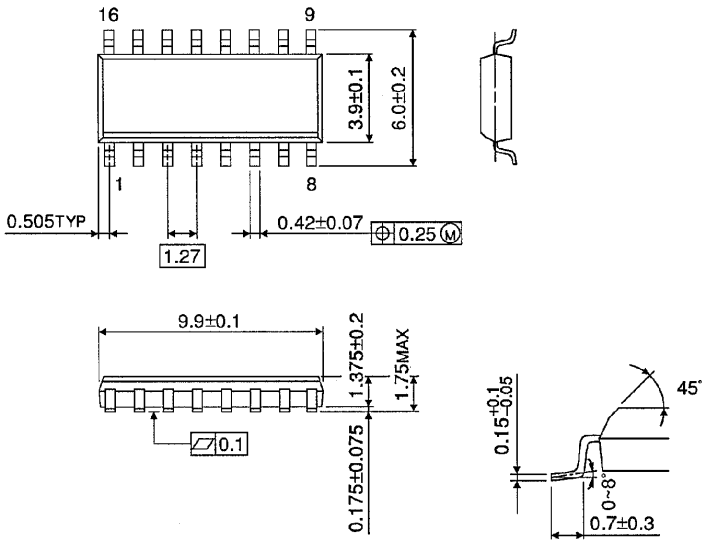
SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27) Unit in mm



Weight : 0.18g (Typ.)

SOP 16PIN (150mil BODY) PACKAGE DIMENSIONS (SOL16-P-150 -1.27) Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)

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