

MC14017B

Decade Counter

The MC14017B is a five-stage Johnson decade counter with built-in code converter. High speed operation and spike-free outputs are obtained by use of a Johnson decade counter design. The ten decoded outputs are normally low, and go high only at their appropriate decimal time period. The output changes occur on the positive-going edge of the clock pulse. This part can be used in frequency division applications as well as decade counter or decimal decode display applications.

Features

- Fully Static Operation
- DC Clock Input Circuit Allows Slow Rise Times
- Carry Out Output for Cascading
- Divide-by-N Counting
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low-Power TTL Loads or One Low-Power Schottky TTL Load Over the Rated Temperature Range
- Pin-for-Pin Replacement for CD4017B
- Triple Diode Protection on All Inputs
- These Devices are Pb-Free and are RoHS Compliant

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V _{DD}	DC Supply Voltage Range	-0.5 to +18.0	V
V _{in} , V _{out}	Input or Output Voltage Range (DC or Transient)	-0.5 to V _{DD} + 0.5	V
I _{in} , I _{out}	Input or Output Current (DC or Transient) per Pin	±10	mA
P _D	Power Dissipation, per Package (Note 1)	500	mW
T _A	Ambient Temperature Range	-55 to +125	°C
T _{stg}	Storage Temperature Range	-65 to +150	°C
T _L	Lead Temperature (8-Second Soldering)	260	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. Temperature Derating:
Plastic "P and D/DW" Packages: - 7.0 mW/°C From 65°C To 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range V_{SS} ≤ (V_{in} or V_{out}) ≤ V_{DD}.

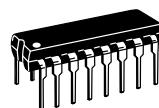
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.



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MARKING DIAGRAMS



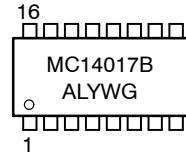
PDIP-16
P SUFFIX
CASE 648



SOIC-16
D SUFFIX
CASE 751B



SOEIAJ-16
F SUFFIX
CASE 966



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G = Pb-Free Indicator

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

MC14017B

PIN ASSIGNMENT

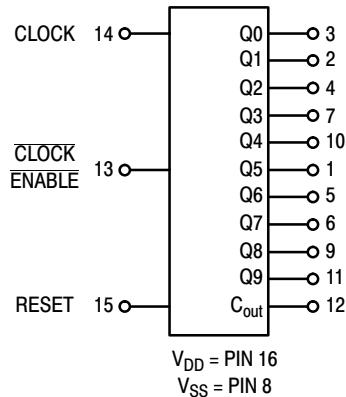
Q5	1	16	V _{DD}
Q1	2	15	RESET
Q0	3	14	CLOCK
Q2	4	13	CE
Q6	5	12	C _{out}
Q7	6	11	Q9
Q3	7	10	Q4
V _{SS}	8	9	Q8

FUNCTIONAL TRUTH TABLE (Positive Logic)

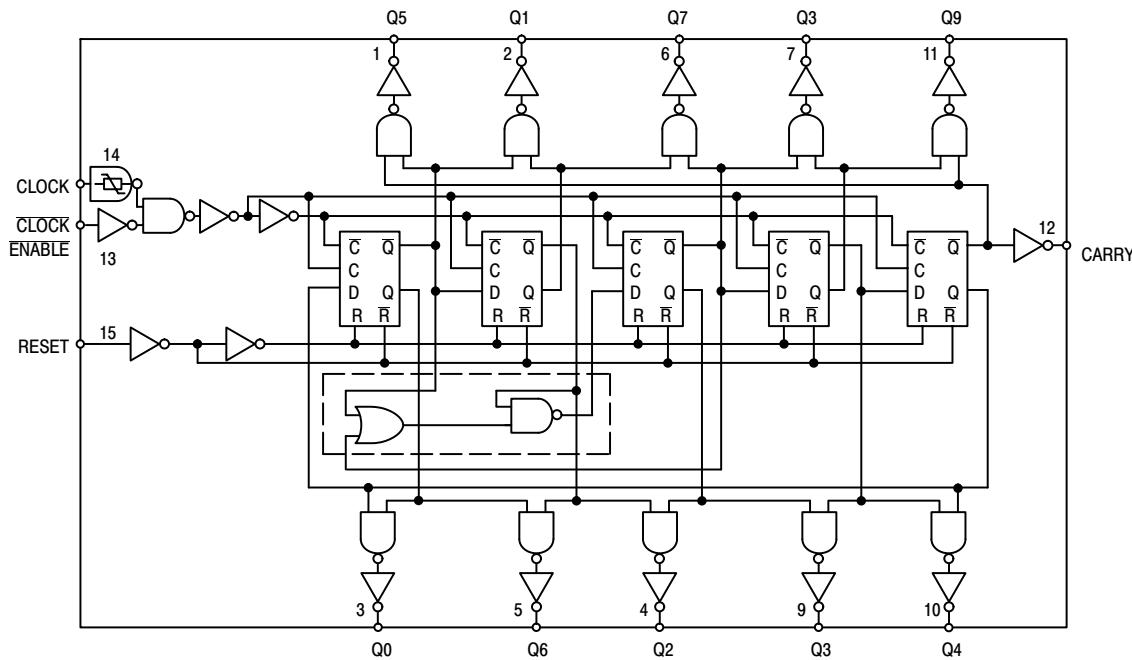
Clock	Clock Enable	Reset	Decode Output=n
0	X	0	n
X	1	0	n
X	X	1	Q0
/	0	0	n+1
\	X	0	n
X	/	0	n
1	\	0	n+1

X = Don't Care. If n < 5 Carry = "1", Otherwise = "0".

BLOCK DIAGRAM



LOGIC DIAGRAM



MC14017B

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V _{DD} Vdc	- 55°C		25°C			125°C		Unit
			Min	Max	Min	Typ (Note 2)	Max	Min	Max	
Output Voltage V _{in} = V _{DD} or 0	V _{OL}	5.0	—	0.05	—	0	0.05	—	0.05	Vdc
		10	—	0.05	—	0	0.05	—	0.05	Vdc
		15	—	0.05	—	0	0.05	—	0.05	Vdc
	V _{OH}	5.0	4.95	—	4.95	5.0	—	4.95	—	Vdc
		10	9.95	—	9.95	10	—	9.95	—	Vdc
		15	14.95	—	14.95	15	—	14.95	—	Vdc
Input Voltage (V _O = 4.5 or 0.5 Vdc) (V _O = 9.0 or 1.0 Vdc) (V _O = 13.5 or 1.5 Vdc)	V _{IL}	5.0	—	1.5	—	2.25	1.5	—	1.5	Vdc
		10	—	3.0	—	4.50	3.0	—	3.0	Vdc
		15	—	4.0	—	6.75	4.0	—	4.0	Vdc
	V _{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	Vdc
		10	7.0	—	7.0	5.50	—	7.0	—	Vdc
		15	11	—	11	8.25	—	11	—	Vdc
Output Drive Current (V _{OH} = 2.5 Vdc) (V _{OH} = 4.6 Vdc) (V _{OH} = 9.5 Vdc) (V _{OH} = 13.5 Vdc)	Source	I _{OH}	5.0	-3.0	—	-2.4	-4.2	—	-1.7	mA
			5.0	-0.64	—	-0.51	-0.88	—	-0.36	mA
			10	-1.6	—	-1.3	-2.25	—	-0.9	mA
			15	-4.2	—	-3.4	-8.8	—	-2.4	mA
	Sink	I _{OL}	5.0	0.64	—	0.51	0.88	—	0.36	mA
			10	1.6	—	1.3	2.25	—	0.9	mA
			15	4.2	—	3.4	8.8	—	2.4	mA
Input Current	I _{in}	15	—	± 0.1	—	± 0.00001	± 0.1	—	± 1.0	μA
Input Capacitance (V _{in} = 0)	C _{in}	—	—	—	—	5.0	7.5	—	—	pF
Quiescent Current (Per Package)	I _{DD}	5.0	—	5.0	—	0.005	5.0	—	150	μA
Total Supply Current (Notes 3 & 4) (Dynamic plus Quiescent, Per Package) (C _L = 50 pF on all outputs, all buffers switching)	I _T	10	—	10	—	0.010	10	—	300	μA
		15	—	20	—	0.015	20	—	600	μA
		5.0	—	5.0	—	0.005	5.0	—	150	μA

2. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

3. The formulas given are for the typical characteristics only at 25°C.

4. To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) V f k$$

where: I_T is in μA (per package), C_L in pF, V = (V_{DD} - V_{SS}) in volts, f in kHz is input frequency, and k = 0.0011.

ORDERING INFORMATION

Device	Package	Shipping [†]
MC14017BCPG	PDIP-16 (Pb-Free)	500 Units / Rail
MC14017BDG	SOIC-16	48 Units / Rail
MC14017BDR2G	SOIC-16 (Pb-Free)	2500 Units / Tape & Reel
MC14017BFELG	SOEIAJ-16	2000 Units / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MC14017B

SWITCHING CHARACTERISTICS (Note 5) ($C_L = 50 \text{ pF}$, $T_A = 25^\circ\text{C}$)

Characteristic	Symbol	V_{DD} V_{DC}	Min	Typ (Note 6)	Max	Unit
Output Rise and Fall Time $t_{TLH}, t_{THL} = (1.5 \text{ ns/pF}) C_L + 25 \text{ ns}$ $t_{TLH}, t_{THL} = (0.75 \text{ ns/pF}) C_L + 12.5 \text{ ns}$ $t_{TLH}, t_{THL} = (0.55 \text{ ns/pF}) C_L + 9.5 \text{ ns}$	$t_{TLH},$ t_{THL}	5.0 10 15	— — —	100 50 40	200 100 80	ns
Propagation Delay Time Reset to Decode Output $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 415 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 197 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 150 \text{ ns}$	$t_{PLH},$ t_{PHL}	5.0 10 15	— — —	500 230 175	1000 460 350	ns
Propagation Delay Time Clock to C_{out} $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 315 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 142 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 100 \text{ ns}$	$t_{PLH},$ t_{PHL}	5.0 10 15	— — —	400 175 125	800 350 250	ns
Propagation Delay Time Clock to Decode Output $t_{PLH}, t_{PHL} = (1.7 \text{ ns/pF}) C_L + 415 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.66 \text{ ns/pF}) C_L + 197 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.5 \text{ ns/pF}) C_L + 150 \text{ ns}$	$t_{PLH},$ t_{PHL}	5.0 10 15	— — —	500 230 175	1000 460 350	ns
Turn-Off Delay Time Reset to C_{out} $t_{PLH} = (1.7 \text{ ns/pF}) C_L + 315 \text{ ns}$ $t_{PLH} = (0.66 \text{ ns/pF}) C_L + 142 \text{ ns}$ $t_{PLH} = (0.5 \text{ ns/pF}) C_L + 100 \text{ ns}$	t_{PLH}	5.0 10 15	— — —	400 175 125	800 350 250	ns
Clock Pulse Width	$t_{w(H)}$	5.0 10 15	250 100 75	125 50 35	— — —	ns
Clock Frequency	f_{cl}	5.0 10 15	— — —	5.0 12 16	2.0 5.0 6.7	MHz
Reset Pulse Width	$t_{w(H)}$	5.0 10 15	500 250 190	250 125 95	— — —	ns
Reset Removal Time	t_{rem}	5.0 10 15	750 275 210	375 135 105	— — —	ns
Clock Input Rise and Fall Time	$t_{TLH},$ t_{THL}	5.0 10 15	No Limit			—
Clock Enable Setup Time	t_{su}	5.0 10 15	350 150 115	175 75 52	— — —	ns
Clock Enable Removal Time	t_{rem}	5.0 10 15	420 200 140	260 100 70	— — —	ns

5. The formulas given are for the typical characteristics only at 25°C .

6. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

MC14017B

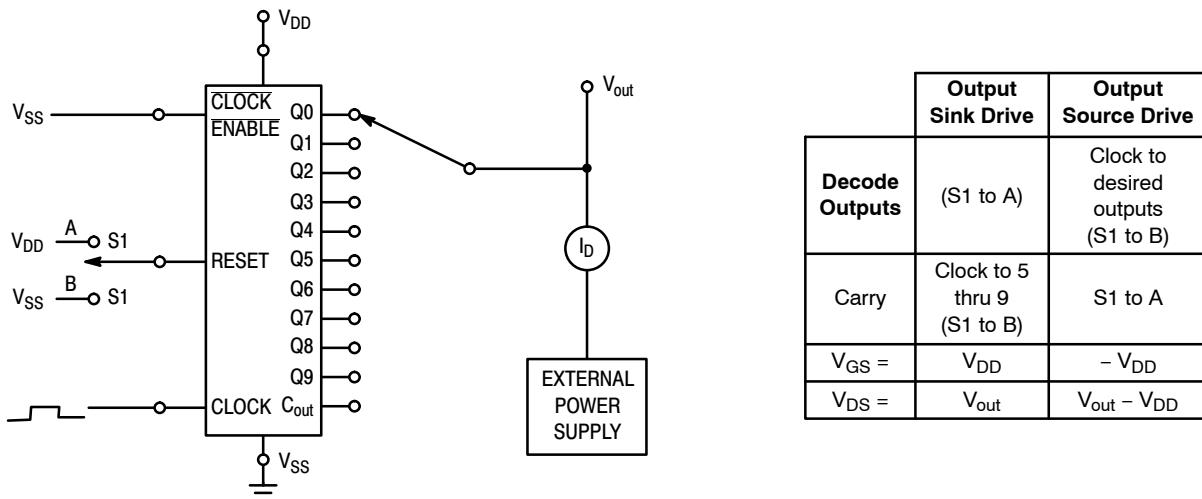


Figure 1. Typical Output Source and Output Sink Characteristics Test Circuit

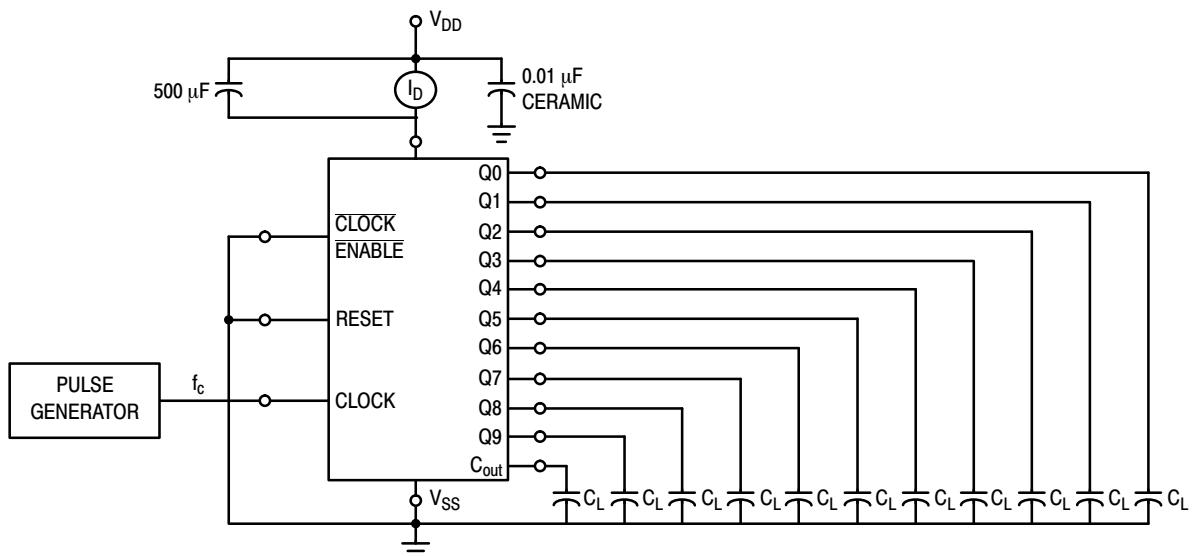


Figure 2. Typical Power Dissipation Test Circuit

MC14017B

APPLICATIONS INFORMATION

Figure 3 shows a technique for extending the number of decoded output states for the MC14017B. Decoded outputs are sequential within each stage and from stage to stage, with no dead time (except propagation delay).

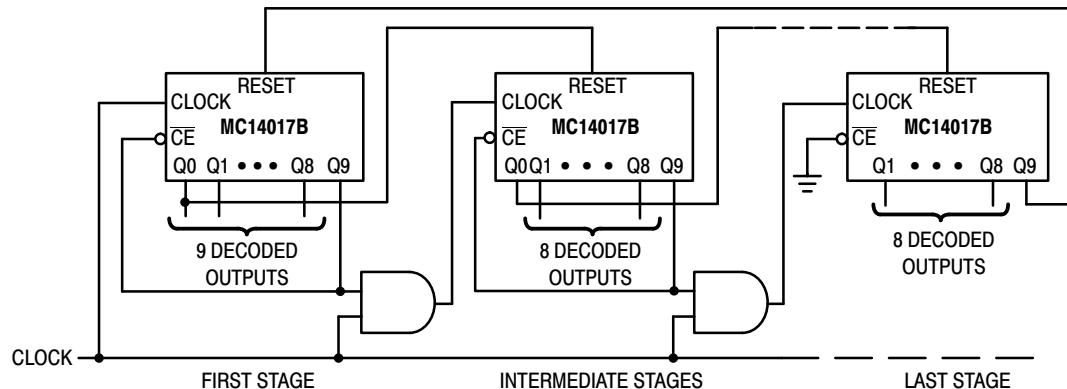


Figure 3. Counter Expansion

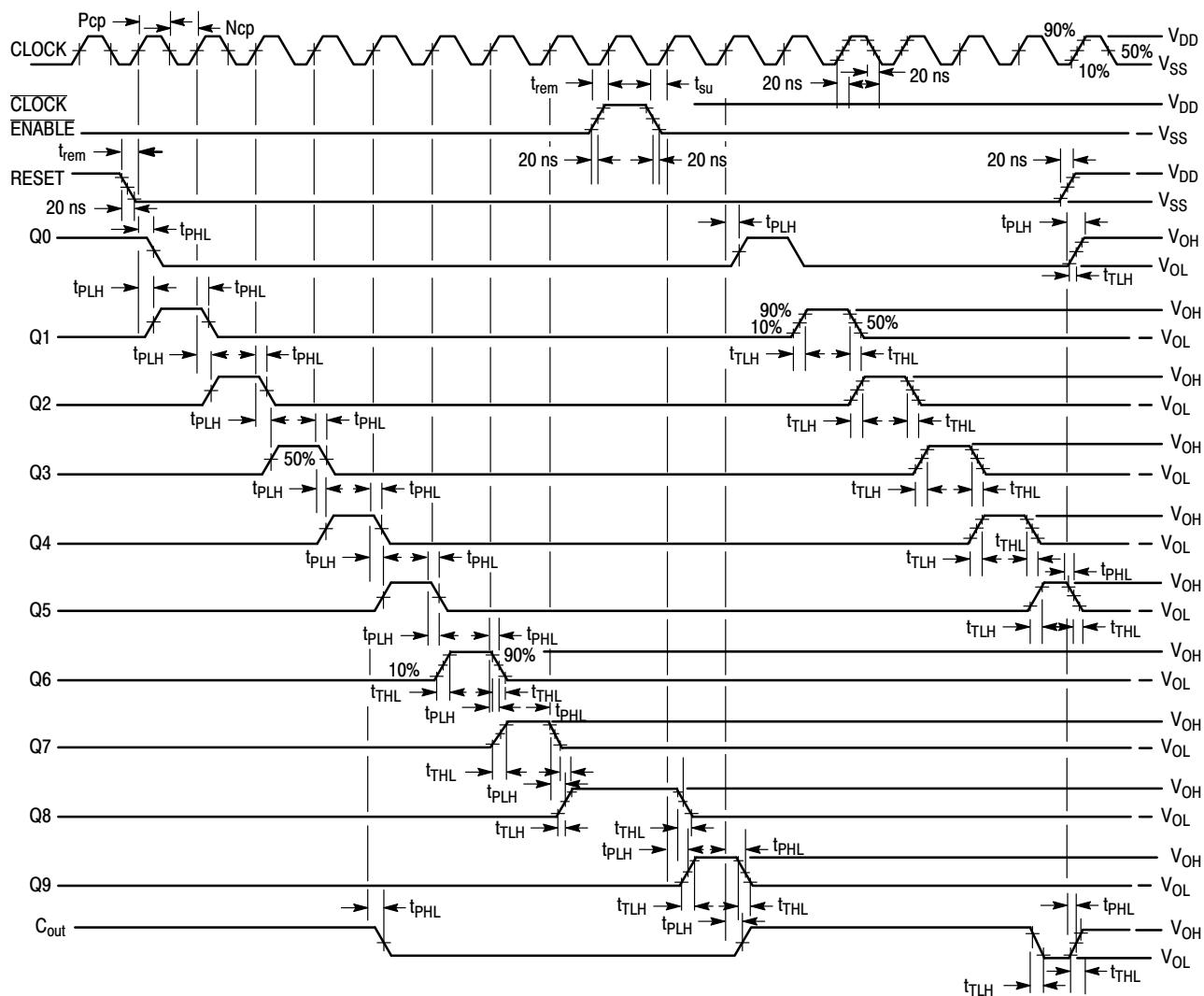


Figure 4. AC Measurement Definition and Functional Waveforms

MC14017B

PACKAGE DIMENSIONS

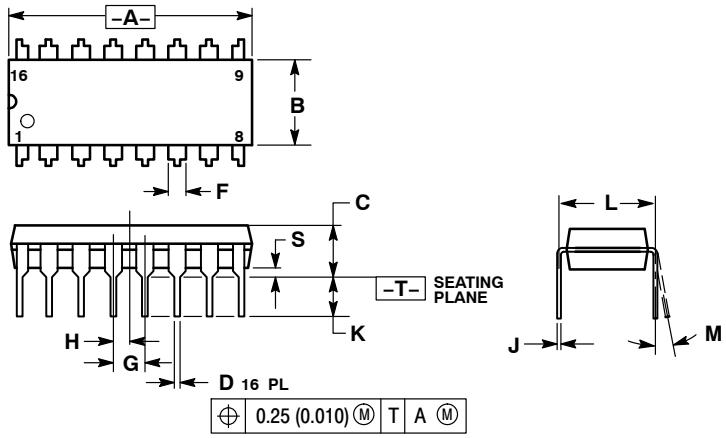
PDIP-16

P SUFFIX

PLASTIC DIP PACKAGE

CASE 648-08

ISSUE T

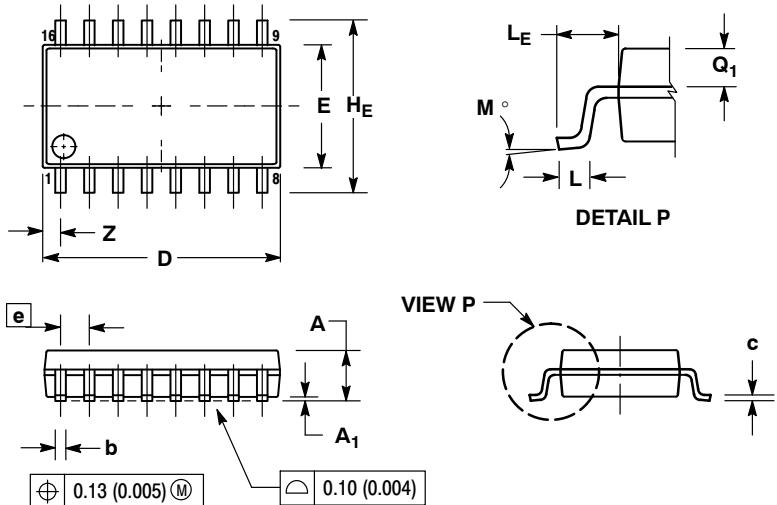


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

SOEIAJ-16
F SUFFIX
PLASTIC EIAJ SOIC PACKAGE
CASE 966-01
ISSUE A



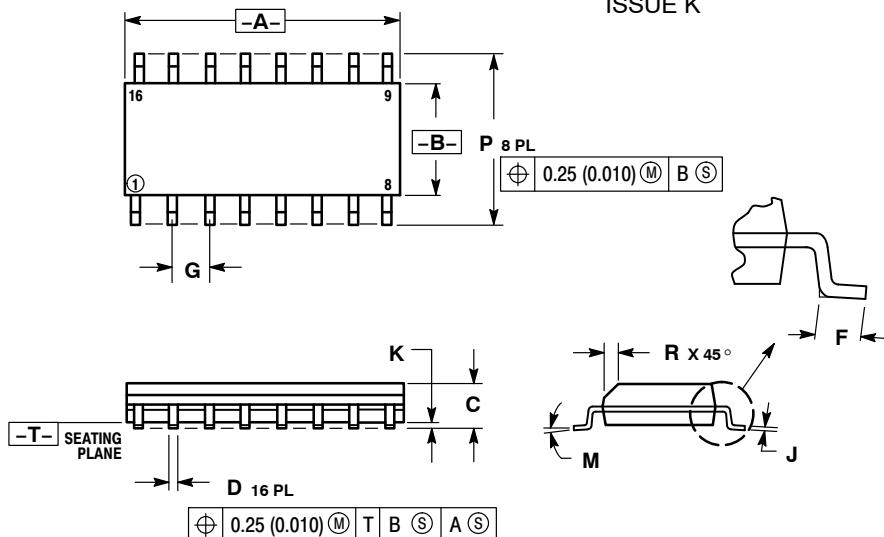
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.10	0.20	0.007	0.011
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q_1	0.70	0.90	0.028	0.035
Z	---	0.78	---	0.031

PACKAGE DIMENSIONS

**SOIC-16
D SUFFIX
PLASTIC SOIC PACKAGE
CASE 751B-05
ISSUE K**

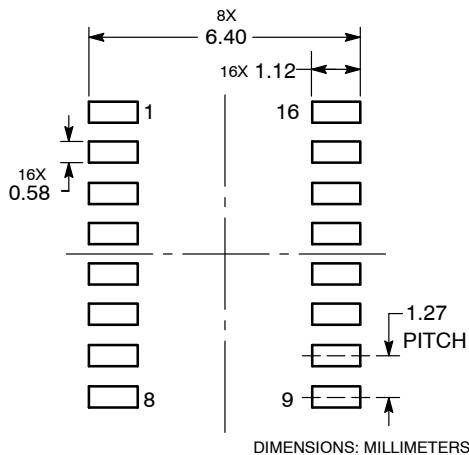


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27	BSC	0.050	BSC
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0 °	7 °	0 °	7 °
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

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Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru
moschip.ru_4

moschip.ru_6
moschip.ru_9