

# PRODUCT SPECIFICATION



## GM76C88 8,192 x 8 BIT STATIC RAM

T-46-23-12

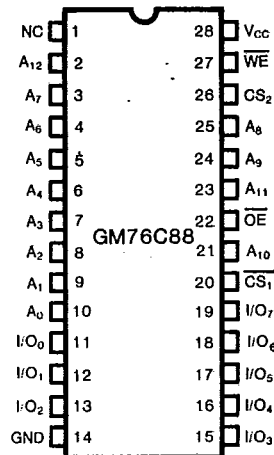
### Description

The GM76C88 is 65,536 bit static random access memory organized as 8,192 words by 8 bits using CMOS technology, and operated from a single 5V supply. Advanced circuit techniques provide both high speed and low power features with a maximum operating current of 80mA and minimum cycle time of 70/85/100ns. The combination of speed-optimized circuitry results in a very high-speed memory device. Thus the GM76C88 is suitable for use in various microprocessor application systems where high speed are required. The GM76C88 is offered in 28 pin DIP.

### Features

- 8,192 x 8 organization
- High Speed:  
Fast Access and Cycle Time 70/85/100ns (max.)
- Low Power Standby and Low Power Operation
- Completely Static RAM: No Clock or Timing Strobe Required
- Common I/O (Three-State Output)
- Directly TTL Compatible: All Inputs and Outputs
- Single +5V Operation ( $\pm 10\%$ )
- Standard 28 DIP (600 mil)/28 SOP (330 mil)

### Pin Configuration (Top View)



### Pin Name

- $A_0 \sim A_{12}$  : Address Input
- $\overline{WE}$  : Write Enable Input
- $\overline{OE}$  : Output Enable Input
- $\overline{CS1}, CS2$  : Chip Select Input
- $I/O_0 \sim I/O_7$  : Data Input/Output
- $V_{CC}$  : Power Supply, +5V
- GND : Ground

**Absolute Maximum Ratings**

Voltage on Any Pin with respect to GND

$V_{CC}$	-2.0 to 7.0V
Storage Temperature $T_{STG}$	-55°C to +150°C
Operating Temperature $T_{OPR}$	0°C to +70°C
Power dissipation $P_D$	1.0W

**Recommended Operating Conditions:**

$T_A=0^\circ\text{C}$  to  $+70^\circ\text{C}$

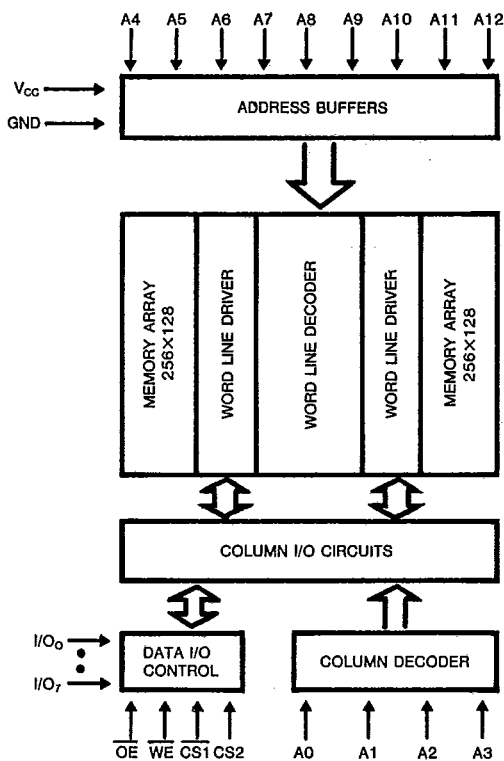
$V_{CC}$ Supply Voltage	4.5 to 5.5V
$V_{IH}$ Input High Voltage	2.2 to 6.0V
$V_{IL}$ Input Low Voltage	-0.5 to 0.8V

All voltages are referenced to GND pin=0V.

Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, It is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit.

**Functional Block Diagram**



**Truth Table**

WE	CS <sub>1</sub>	CS <sub>2</sub>	OE	Mode	I/O PIN	V <sub>CC</sub> CURRENT	NOTE
X	H	X	X	Not Selected (Power Down)	High Z	I <sub>SB</sub> , I <sub>SB1</sub>	
X	X	L	X		High Z	I <sub>SB</sub> , I <sub>SB2</sub>	
H	L	H	H	Output Disabled	High Z	I <sub>CC</sub> , I <sub>CC1</sub>	
H	L	H	L	Read	Dout	I <sub>CC</sub> , I <sub>CC1</sub>	
L	L	H	H	Write	Din	I <sub>CC</sub> , I <sub>CC1</sub>	Write Cycle (1)
L	L	H	L		Din	I <sub>CC</sub> , I <sub>CC1</sub>	Write Cycle (2)

X: Don't Care

**DC Electrical Characteristics:** (V<sub>CC</sub>=5V±10%, T<sub>A</sub>=0°~70°C)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP*	MAX	UNIT
I <sub>I</sub>	Input Leakage Current	V <sub>IN</sub> =GND to V <sub>CC</sub>	-5	-	+5	μA
I <sub>O</sub>	Output Leakage Current	CS <sub>1</sub> =V <sub>IH</sub> or CS <sub>2</sub> =V <sub>IL</sub> or OE=V <sub>IH</sub> or WE=V <sub>IL</sub> , V <sub>I/O</sub> =GND to V <sub>CC</sub>	-10	-	+10	μA
I <sub>CC</sub>	Operating Power Supply Current	CS <sub>1</sub> =V <sub>IL</sub> , CS <sub>2</sub> =V <sub>IH</sub> , I <sub>I/O</sub> =0mA	-	40	80	mA
I <sub>CC1</sub>	Average Operating Current	Min. cycle, duty=100%, I <sub>I/O</sub> =0mA	-	60	110	mA
I <sub>SB</sub>	Standby Power Supply Current	CS <sub>1</sub> =V <sub>IH</sub> or CS <sub>2</sub> =V <sub>IL</sub>	-	1	3	mA
I <sub>SB1</sub> **		CS <sub>1</sub> ≥V <sub>CC</sub> -0.2V, CS <sub>2</sub> ≥V <sub>CC</sub> -0.2V or CS <sub>2</sub> ≤0.2V	-	0.02	2	mA
I <sub>SB2</sub> **		CS <sub>2</sub> ≤0.2V	-	0.02	2	mA
V <sub>OL</sub>	Output Voltage	I <sub>OL</sub> =2.1mA	-	-	0.4	V
V <sub>OH</sub>		I <sub>OH</sub> =-1.0mA	2.4	-	-	V

\* Typical limits are at V<sub>CC</sub>=5.0V, T<sub>A</sub>=25°C and specified loading.  
 \*\* V<sub>k</sub> min=-0.3V

**Capacitance:** (T<sub>A</sub>=25°C, f=1MHz)

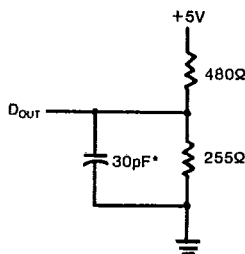
SYMBOL	PARAMETER	TEST CONDITION	MIN	MAX	UNIT
C <sub>IN</sub>	Input Capacitance	V <sub>I</sub> =0V		6	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>O</sub> =0V		8	

Note: This parameter is sampled and not 100% tested.

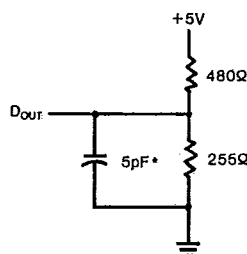
**AC Test Conditions**

Input Pulse Levels ..... GND to 3.0V  
 Input Rise and Fall Times ..... 10ns  
 Input and Output Timing References ..... 1.5V  
 Output Load ..... 1 TTL Gate and C<sub>L</sub>=100 pF  
 (including scope and jig.)

**Figure 1 Output Load**



**Figure 2 Output Load**  
(for t<sub>LZ1</sub>, t<sub>LZ2</sub>, t<sub>WHZ</sub>, t<sub>OW</sub>)



\*Including scope and jig

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AC Operating Characteristics:  $V_{DD}=5V\pm 10\%$ ,  $T_A=0^\circ\sim 70^\circ C$ 

## • Read Cycle

SYMBOL	PARAMETER	GM76C88-70		GM76C88-85		GM76C88-10		UNIT	
		MIN	MAX	MIN	MIX	MIN	MAX		
$t_{RC}$	Read Cycle Time	70		85		100		ns	
$t_{ACC}$	Address Access Time		70		85		100	ns	
$t_{C01}$	Chip Selection to Output	$\overline{CS1}$	70		85		100	ns	
$t_{C02}$		CS2	70		85		100	ns	
$t_{OE}$	Output Enable to Output Valid		35		40		50	ns	
$t_{LZ1}$	Chip Selection to Output in Low Z	$\overline{CS1}$	10		10		10	ns	
$t_{LZ2}$		CS2	10		10		10	ns	
$t_{OLZ}$	Output Enable to Output in Low Z		5		5		5	ns	
$t_{HZ1}$	Chip Deselection to Output in High Z	$\overline{CS1}$	0	30	0	35	0	35	ns
$t_{HZ2}$		CS2	0	30	0	35	0	35	ns
$t_{OHZ}$	Output Disable to Output in High Z		0	30		0	35	ns	
$t_{OH}$	Output Hold from Address Change		10		10		10	ns	

## • Write Cycle

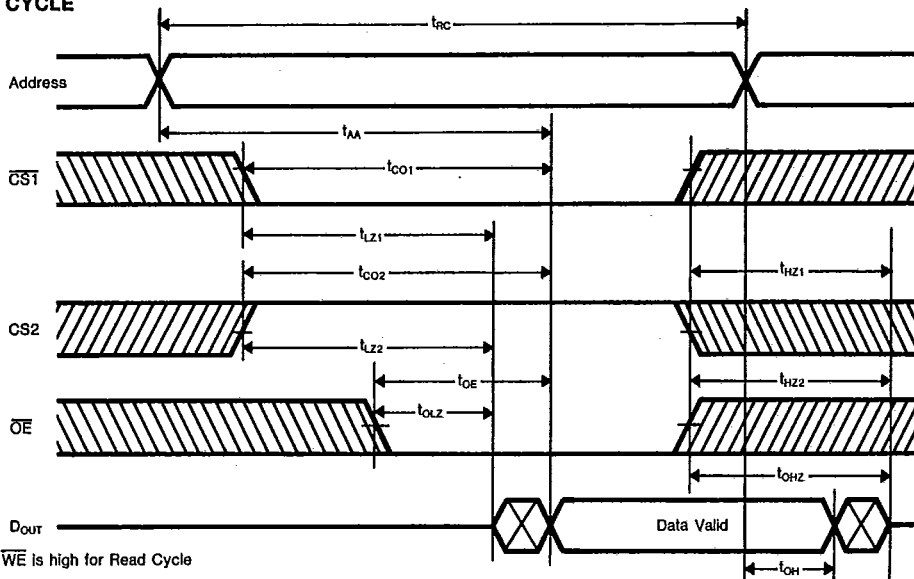
SYMBOL	PARAMETER	GM76C88-70		GM76C88-85		GM76C88-10		UNIT
		MIN	MAX	MIN	MIX	MIN	MAX	
$t_{WC}$	Write Cycle Time	70		85		100		ns
$t_{CW}$	Chip Selection to End of Write	60		70		80		ns
$t_{AS}$	Address Set up Time	0		0		0		ns
$t_{AW}$	Address Valid to End of Write	60		70		80		ns
$t_{WP}$	Write Pulse Width	40		50		60		ns
$t_{WR1}$	Write Recovery Time	CS1, WE	5		5		5	ns
$t_{WR2}$		CS2	15		15		15	ns
$t_{WHZ}$	Write to Output in High Z		0	30		0	35	ns
$t_{DW}$	Data to Write Overlap		35		40		40	ns
$t_{DH}$	Data Hold from Write Time		0		0		0	ns
$t_{OHZ}$	$\overline{OE}$ to Output in High Z		0	30		0	35	ns
$t_{OW}$	Output Active from end of Write		5		5		5	ns

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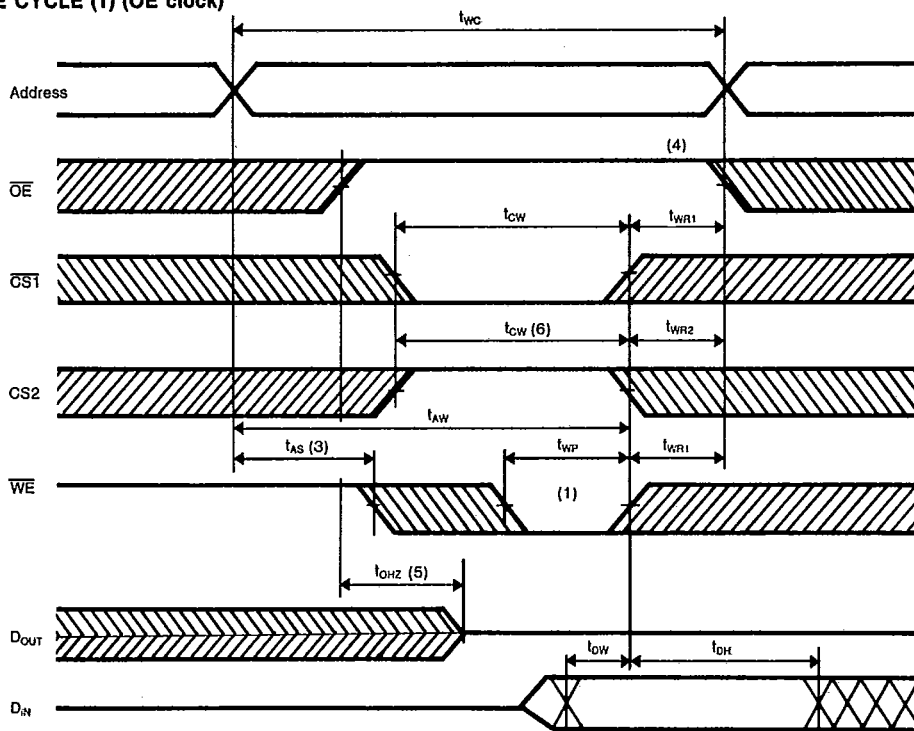
**Timing Waveforms**

• **READ CYCLE**



NOTE: 1)  $\overline{WE}$  is high for Read Cycle

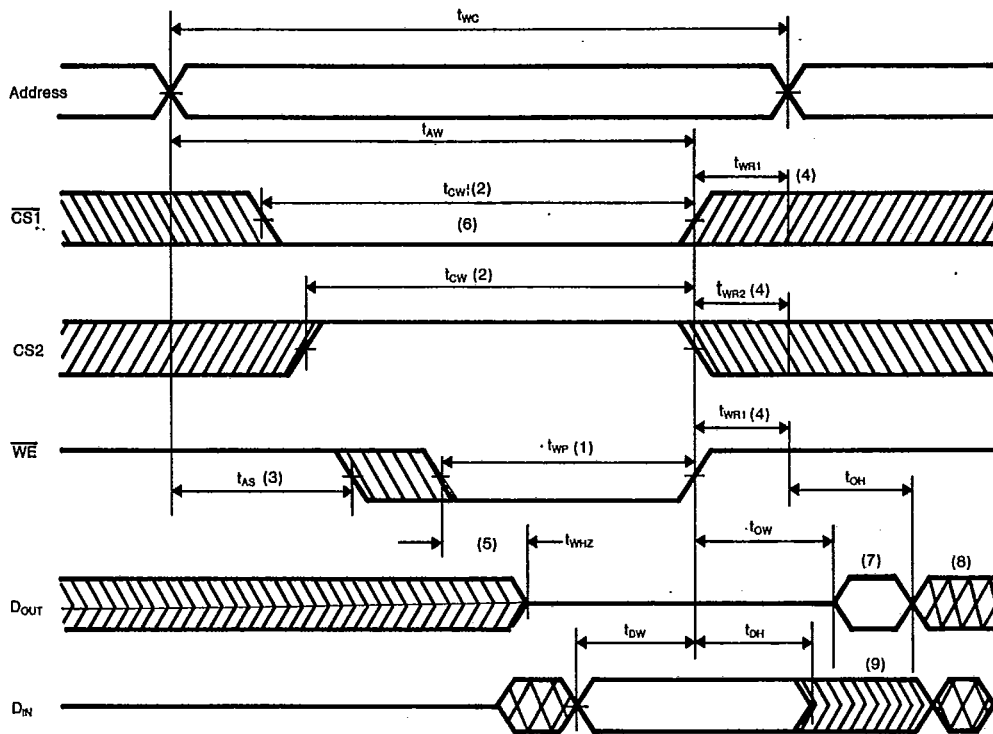
• **WRITE CYCLE (1) ( $\overline{OE}$  clock)**



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• **WRITE CYCLE (2) ( $\overline{OE}$  Low Fix)**



- NOTES:
1. A write occurs during the overlap of a low  $\overline{CS1}$ , a high  $CS2$  and a low  $\overline{WE}$ . A write begins at the latest transition among  $\overline{CS1}$  going low,  $CS2$  going high and  $\overline{WE}$  going low. A write ends at the earliest transition among  $\overline{CS1}$  going high,  $CS2$  going low and  $\overline{WE}$  going high.  $t_{WP}$  is measured from the beginning of write to the end of write.
  2.  $t_{CW}$  is measured from the later of  $\overline{CS1}$  going low or  $CS2$  going high to the end of write.
  3.  $t_{AS}$  is measured from the address valid to the beginning of write.
  4.  $t_{WR1}$  is measured from the end of write to the address change.  
 $t_{WR1}$  applies in case a write ends at  $\overline{CS1}$  or  $\overline{WE}$  going high.  
 $t_{WR2}$  applies in case a write ends at  $CS2$  going low.
  5. During this period, I/O pins are in the output state, therefore the input signals of opposite phase to the outputs must not be applied.
  6. If  $\overline{CS1}$  goes low simultaneously with  $\overline{WE}$  going low or after  $\overline{WE}$  going low, the outputs remain in high impedance state.
  7. Dout is the same phase of the latest written data in this write cycle.
  8. Dout is the read data of next address.
  9. If  $\overline{CS1}$  is low and  $CS2$  is high during this period, I/O pins are in the output state. Therefore, the input signals of opposite phase to the outputs must not be applied to them.

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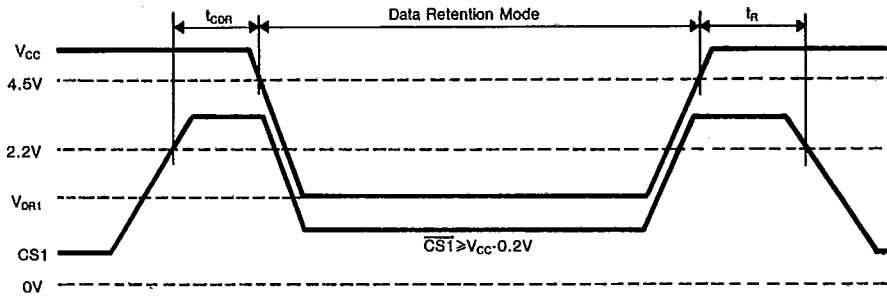
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Data Retention Characteristics: ( $T_A=0^{\circ}\sim 70^{\circ}\text{C}$ )

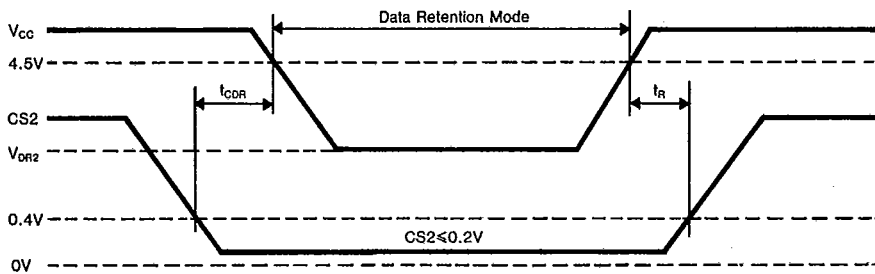
SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{DR}$	$V_{CC}$ for Data Retention	$V_{DR1}$	$\overline{CS1} \geq V_{CC} - 0.2V, CS2 \geq V_{CC} - 0.2V$ or $CS2 \leq 0.2V$	2.0	—	—	V
		$V_{DR2}$	$CS2 \leq 0.2V$	2.0	—	—	V
$I_{CCDR}$	Data Retention Current	$I_{CCDR1}$	$V_{CC} = 3.0V, \overline{CS1} \geq V_{CC} - 0.2V, CS2 \geq V_{CC} - 0.2V$ or $CS2 \leq 0.2V$	—	1	50*	$\mu A$
		$I_{CCDR2}$	$V_{CC} = 3.0V, CS2 \leq 0.2V$	—	1	50*	$\mu A$
$t_{CDR}$	Chip Deselect to Data Retention Time	$t_{CDR}$	See Retention Waveform	0	—	—	ns
$t_R$	Operation Recovery Time	$t_R$		$t_{RC}^{**}$	—	—	ns

\*  $V_{IL}$  min = -0.3V, 20 $\mu A$  max at  $T_A=0\sim 40^{\circ}\text{C}$   
 \*\*  $t_{RC}$  = Read Cycle Time

• Low  $V_{CC}$  Data Retention Mode: (1)  $\overline{CS1}$  Controlled



• Low  $V_{CC}$  Data Retention Mode: (2) CS2 Controlled

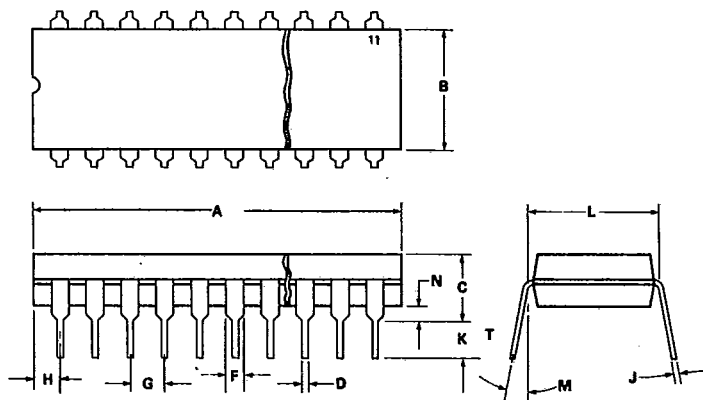


NOTE: In Data Retention Mode, CS2 controls the Address,  $\overline{WE}$ ,  $\overline{CS1}$ ,  $\overline{OE}$  and Din buffer. If CS2 controls data retention mode, Vin for these inputs can be in the high impedance state. If  $\overline{CS1}$  controls the data retention mode, CS2 must satisfy either  $CS2 \geq V_{CC} - 0.2V$  or  $CS2 \leq 0.2V$ . The other input levels (address,  $\overline{WE}$ ,  $\overline{OE}$ , I/O) can be in the high impedance state.

# PACKAGE DIMENSION

PLASTIC DIP

T-90-20



(UNIT: INCHES)

SYMBOL	16 PIN		18 PIN		20 PIN		22 PIN	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	0.738	0.752	0.875	0.900	1.013	1.040	1.095	1.150
B	0.245	0.255	0.245	0.255	0.263	0.273	0.260	0.287
C	0.143	0.152	0.145	0.162	0.143	0.152	0.145	0.160
D	TYP. 0.018		TYP. 0.018		TYP. 0.018		TYP. 0.018	
F	TYP. 0.063		TYP. 0.060		TYP. 0.065		TYP. 0.060	
G	0.09	0.11	0.09	0.11	0.09	0.11	0.09	0.11
H	0.015	0.030	0.04	0.05	0.058	0.066	—	0.075
J	0.009	0.014	0.009	0.015	0.009	0.010	0.009	0.010
K	0.125	0.145	0.125	0.130	0.125	0.132	0.125	0.142
L	0.300 BSC		0.300 BSC		0.300 BSC		0.300 BSC	
M	0'	10'	0'	10'	0'	10'	0'	10'
N	0.015	—	0.015	—	0.015	—	0.015	—

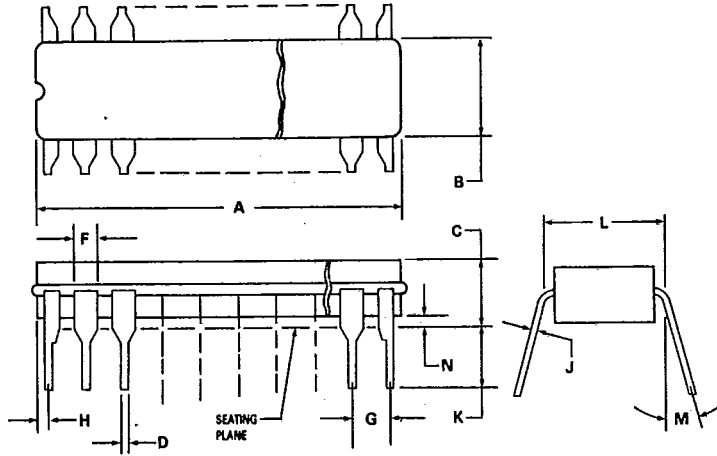
SYMBOL	24 PIN		28 PIN					
	MIN	MAX	MIN	MAX				
A	1.243	1.260	1.415	1.460				
B	0.535	0.545	0.535	0.545				
C	0.158	0.170	0.158	0.170				
D	TYP. 0.018		TYP. 0.018					
F	TYP. 0.060		TYP. 0.060					
G	0.09	0.11	0.09	0.11				
H	0.06	0.075	0.06	0.076				
J	0.009	0.015	0.009	0.015				
K	0.125	0.132	0.125	0.132				
L	0.600	0.625	0.600	0.620				
M	0'	10'	0'	10'				
N	0.008	—	0.008	—				



# PACKAGE DIMENSION

T-90-20

CER DIP



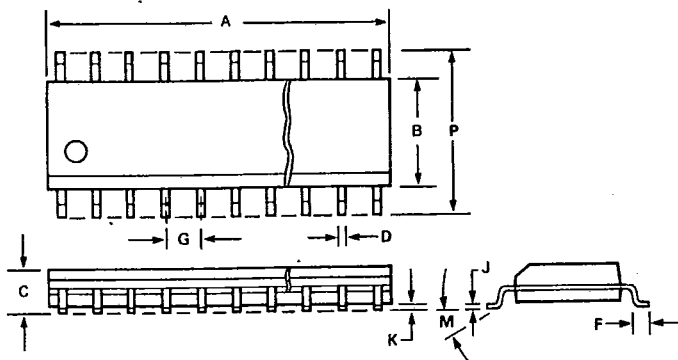
(UNIT : INCHES)

SYMBOL	16 PIN		20 PIN		24 PIN		28 PIN	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	0.753	0.785	0.940	0.985	1.240	1.290	1.440	1.485
B	0.272	0.294	0.265	0.306	0.514	0.526	0.514	0.598
C	0.165	0.200	0.165	0.200	0.165	0.200		0.225
D	0.015	0.021	0.015	0.021	0.015	0.021	0.015	0.023
F	0.055	0.065	0.055	0.065	0.055	0.065	0.055	0.065
G	0.09	0.11	0.09	0.11	0.09	0.11	0.09	0.11
H	0.012	0.060	0.012	0.060	0.040	0.098	0.040	0.098
J	0.008	0.012	0.008	0.012	0.008	0.012	0.008	0.012
K	0.125	0.20	0.125	0.20	0.125	0.20	0.125	0.20
L	0.29	0.32	0.29	0.32	0.590	0.620	0.590	0.620
M	0'	10'	0'	10'	0'	10'	0'	10'
N	0.02	0.06	0.02	0.07	0.02	0.07	0.02	0.07

# PACKAGE DIMENSION

SOP

T-90-20



(UNIT : INCHES)

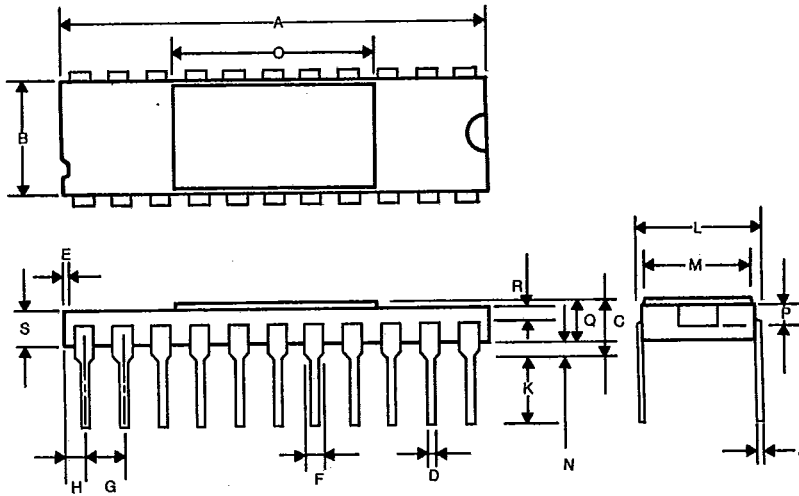
CODE NO. PIN SYMBOL	20 F		24 F		24 FW			
	20 PIN		24 PIN		24 PIN			
	MIN	MAX	MIN	MAX	MIN	MAX		
A	0.496	0.510	0.602	0.614	0.622	0.638		
B	0.292	0.299	0.292	0.299	TYP. 0.331			
C	0.097	0.104	0.097	0.104	—	0.098		
D	0.014	0.019	0.014	0.019	0.012	0.018		
F	0.018	0.035	0.018	0.035	TYP 0.039			
G	0.050 BSC		0.050 BSC		0.050 BSC			
J	0.010 BSC		0.010 BSC		0.010 BSC			
K	0.004	0.008	0.0055	0.0115	0.004			
P	0.400	0.410	0.400	0.410	0.453	0.477		
M	0'	8'	0'	8'	—	—		

CODE NO. PIN SYMBOL	28 F		28 FW					
	28 PIN		28 PIN					
	MIN	MAX	MIN	MAX				
A	0.703	0.712	0.720	0.750				
B	0.292	0.289	TYP. 0.331					
C	0.097	0.104		0.098				
D	0.014	0.019	0.012	0.018				
F	0.018	0.035	TYP. 0.039					
G	0.050 BSC		0.050 BSC					
J	0.010 BSC		0.010 BSC					
K	0.0055	0.0115	0.004	—				
P	0.400	0.410	0.453	0.477				
M	0'	8'	—	—				

# PACKAGE DIMENSION

SIDE BRAZED

T-90-20



(UNIT: INCHES)

SYMBOL	22 PIN	
	MIN	MAX
A	1.088	1.112
B	0.281	0.298
C	—	0.160
D	0.016	0.020
E	0.004	—
F	TYP. 0.050	
G	0.09	0.105
H	0.035	0.065
J	0.009	0.011

SYMBOL	22 PIN	
	MIN	MAX
K	0.14	0.170
L	0.290	0.310
M	0.265	0.275
N	0.020	0.050
O	0.555	0.565
P	TYP. 0.050	
Q	0.092	0.122
R	0.005	—
S	0.08	—