

PRODUCT SPECIFICATION



GoldStar
GOLD STAR CO., LTD.

GM76C164 16,384 × 4 BIT STATIC RAM

Description

The GM76C164 is a 65,536-bit fully-static, asynchronous, random access memory organized as 16,384 words by 4-bits per word. The GM76C164 is based on an advanced, isoplanar, oxide-isolation CMOS process. The process utilizes fully-implanted CMOS technology with sub-2 micron design rules and tantalum silicide gate electrodes for high performance. The combination of this high-performance technology, and speed-optimized circuitry results in a very high-speed memory device.

Feature

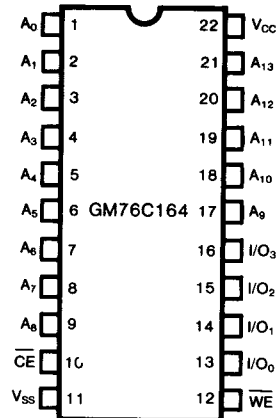
- **Fast Address Times: 25ns/30ns/35ns (Max)**
- **Enable Read Access Faster Than Address Access**
- **Minimum Write Cycle Time, Including Moderate System Timing Skews, Equal to Minimum Read Cycle Time**
- **No Internal Clocks**
- **All Inputs and Outputs Directly TTL Compatible**
- **Common I/O (Three-State Output)**
- **Available in 22-Pin DIP**
- **Single +5V Operation ($\pm 10\%$)**

Pin Names

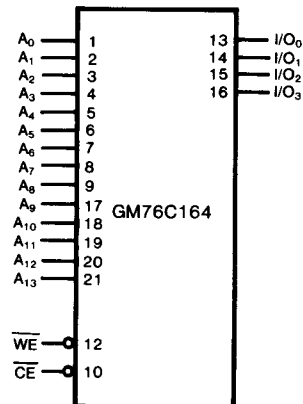
$A_0 \sim A_{13}$	Address Inputs
\overline{CE}	Chip Enable
\overline{WE}	Write Enable
$I/O_0 \sim I/O_7$	Data Inputs/Outputs
V_{CC}	Power (+5.0V)
V_{SS}	Ground (0V)

Pin Configuration

22-Pin Dip (Top View)



Logic Symbol



Absolute Maximum Ratings

Voltage on Any Input or Output Pin With Respect to V_{SS}	$V_{I/O}$	-2.0V to $V_{CC}+2V$
Storage Temperature	T_{STG}	-65°C to +150°C
Operating Temperature	T_{OPR}	0°C to +70°C
Power Dissipation	P_D	1.0W
Continuous Output Current		
Per Output	I_O	25 mA
Average Output Current		
Per Output	$I_{O(AVG)}$	25 mA

(Averaged over any 1 μ s time interval)

Recommended Operating Conditions: $T_A=0^\circ\sim 70^\circ\text{C}$

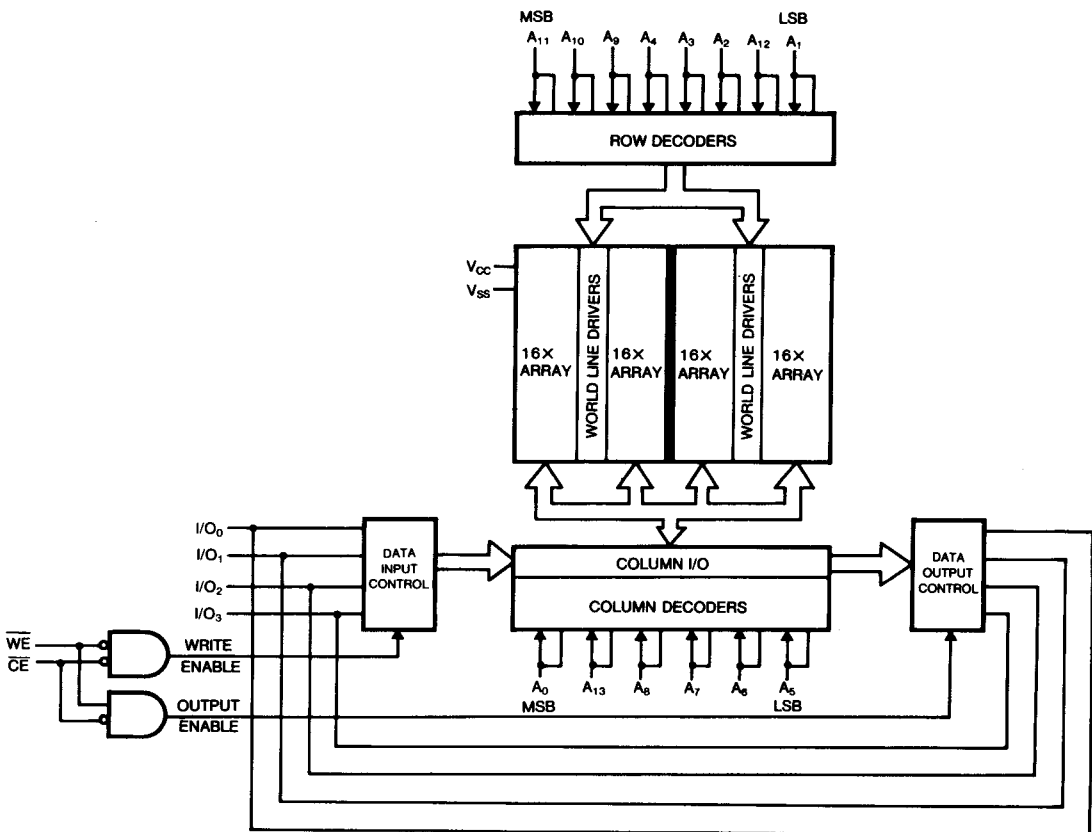
Supply Voltage	V_{CC}	4.5 to 5.5V
Input HIGH Voltage	V_{IH}	2.2 to $V_{CC}+0.5V$
Input LOW Voltage	V_{IL}	-1 to 0.8V

All Voltages are referenced to V_{SS} 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



DC Electrical Characteristics: $T_A=0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$, $V_{CC}=5.0\text{V}\pm 10\%$, $V_{SS}=0\text{V}$

SYMBOL	CHARACTERISTIC	CONDITION	GM76C164-25		GM76C164-30		GM76C164-35		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
I_{LI}	Input Leakage Current (Any input except O)	$V_{SS}\leq V_{IN}\leq V_{CC}$		5		5		5	μA
I_{LO}	Output Leakage Current (on O)	$\overline{CE}=V_{IH}$ or $\overline{WE}=V_{IL}$ $V_{SS}\leq V_{OUT}\leq V_{CC}$		5		5		5	μA
I_{CC}	Dynamic Operating Supply Current	Min. Read Cycle Duty Cycle=100% Outputs Open		80		70		60	mA
I_{SB1}	Standby Supply Current	$\overline{CE}=V_{IH}$ See note 1		20		20		20	mA
I_{SB2}	Full Standby Supply Current	$\overline{CE}\geq V_{CC}-0.2\text{V}$ See note 2		10		10		10	mA
V_{OL}	Output LOW Voltage	$I_{OL}=8.0\text{mA}$		0.4		0.4		0.4	V
V_{OH}	Output HIGH Voltage	$I_{OH}=-4.0\text{mA}$	2.4		2.4		2.4		V
		$I_{OH}=-0.05\text{mA}$	$V_{CC}-0.4$		$V_{CC}-0.4$		$V_{CC}-0.4$		V

AC Test Conditions

Input Pulse Levels 0V to 3.0V
 Input Rise and Fall Times 3ns
 Input and Output Timing Reference Levels 1.5V
 Output Load See Figures 1 and 2

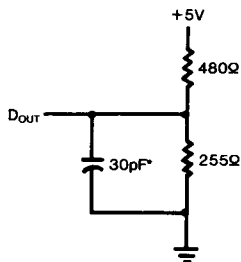
Capacitance (See note 2)

SYMBOL	PARAMETER	MAX	UNITS
C_{IN}	Input Capacitance	5	pF
C_{OUT}	Output Capacitance	7	pF

Effective capacitance calculated from the equation

$$C = \frac{\Delta Q}{\Delta V} \text{ where } \Delta V = 3\text{V}$$

Figure 1 Output Load

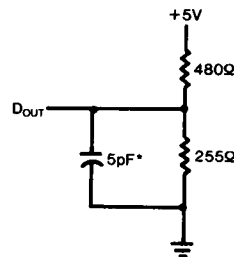


Truth Table

MODE	\overline{CE}	\overline{WE}	I/O _x	Power Level
Standby	H	X	HIGH Z	Standby
Read	L	H	D _{OUT}	Active
Write	L	L	D _{IN}	Active

HIGH Z=High impedance
 D_{IN}=Valid data bit IN
 X=Don't care
 D_{OUT}=Valid data bit Out

Figure 2 Output Load (for t_{CHZ} , t_{CLZ} , t_{WZ} , t_{OW})

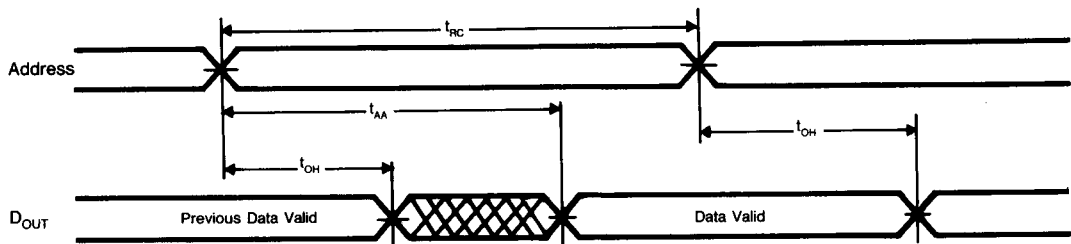


*Including scope and jig capacitance

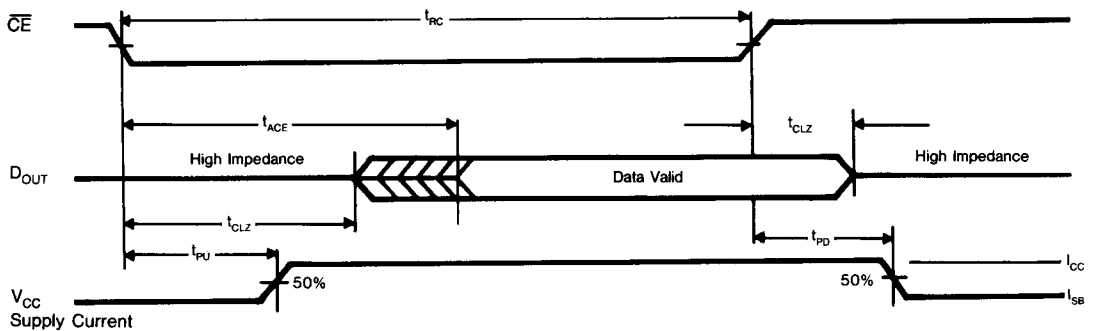
Read Cycle (3,11) ($V_{CC}=5.0V\pm 10\%$, $GND=0V$, $T_A=0^\circ C$ to $+70^\circ C$)

SYMBOL	PARAMETER	GM76C164-25		GM76C164-30		GM76C164-35		UNITS	NOTES
		Min.	Max.	Min.	Max.	Min.	Max.		
t_{RC}	Read Cycle Time	25	—	30	—	35	—	ns	
t_{AA}	Address Access Time	—	25	—	30	—	35	ns	
t_{ACE}	Chip Enable Access Time	—	25	—	30	—	35	ns	
t_{OH}	Output Hold from Address Change	5	—	5	—	5	—	ns	4
t_{CLZ}	Chip Enable Low to Output in Low Z	5	—	5	—	5	—	ns	4
t_{CHZ}	Chip Enable High to Output in High Z	—	10	—	10	—	10	ns	
t_{PU}	Chip Enable to Power Up Time	0	—	0	—	0	—	ns	4.5
t_{PD}	Chip Enable High to Power Down Time	—	25	—	30	—	35	ns	4.5

Timing Waveform of Read Cycle No. 1 (6,7) (Address Controlled)



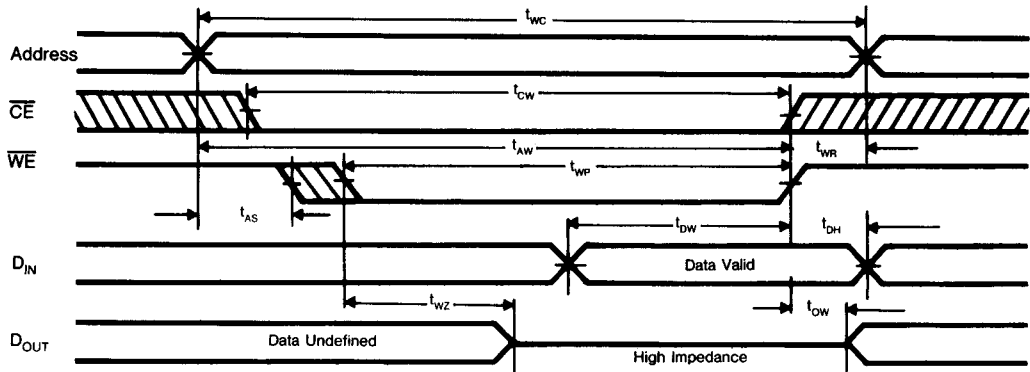
Timing Waveform of Read Cycle No. 2 (6,8) (\overline{CE} Controlled)



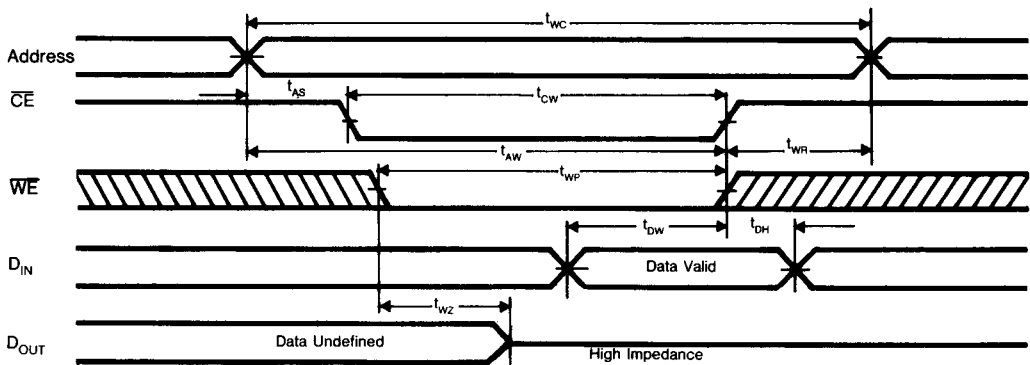
Write Cycle (3,10) ($V_{CC}=5V \pm 10\%$, $GND=0V$, $T_A=0^\circ C$ to $+70^\circ C$)

SYMBOL	PARAMETER	GM76C164-25		GM76C164-30		GM76C164-35		UNIT	NOTES
		Min.	Max.	Min.	Max.	Min.	Max.		
t_{WC}	Write Cycle Time	20	—	25	—	30	—	ns	
t_{CW}	Chip Enable to Write End	20	—	25	—	30	—	ns	
t_{AW}	Address Set-up to Write End	20	—	25	—	25	—	ns	
t_{AS}	Address Set-up Time	0	—	0	—	0	—	ns	
t_{WP}	Write Pulse Width	20	—	25	—	25	—	ns	
t_{WR}	Write Recovery Time	0	—	0	—	0	—	ns	
t_{DW}	Data Valid to Write End	13	—	15	—	15	—	ns	
t_{DH}	Data Hold Time	0	—	0	—	0	—	ns	
t_{WZ}	Write Enable to Output in High Z	—	6	—	8	—	10	ns	4
t_{OW}	Output Active from Write End	5	—	5	—	5	—	ns	4

Timing Waveform of Write Cycle No. 1 (9) (\overline{WE} Controlled)



Timing Waveform of Write Cycle No. 2 (9) (\overline{CE} Controlled)

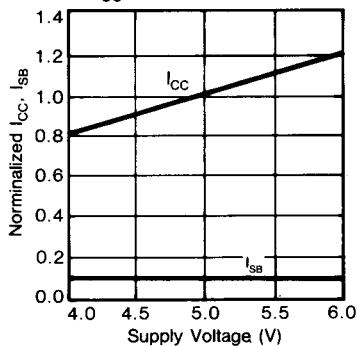


Notes

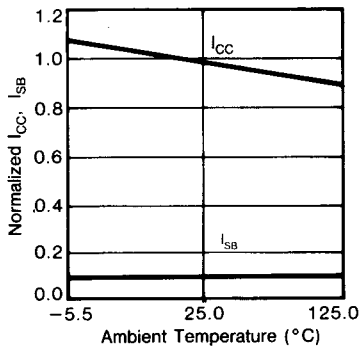
1. During V_{CC} power-up, a pull-up resistor to V_{CC} on the \overline{CE} is required to meet I_{sa} specification.
2. This parameter is sampled and not 100% tested.
3. For test conditions, see AC Characteristics Figure A and C.
4. t_{CLZ} and t_{CHZ} are specified with CL=5pF as in Figure 2 . Transition is measured ± 500 mV from steady state voltage.
5. This parameter is guaranteed but not tested.
6. \overline{WE} is high for read cycle.
7. \overline{CE} is low for read cycle.
8. Address valid prior to or coincident with \overline{CE} transition low.
9. \overline{CE} or \overline{WE} must be high during Address transitions.
10. All write cycle timings are referenced from the last valid address to the first transitioning address.
11. All read cycle timings are referenced from the last valid address to the first transitioning address.

Typical DC and AC Characteristics

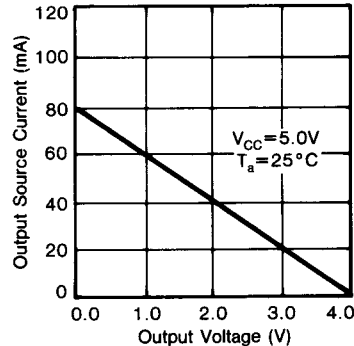
Normalized Supply Current vs. Supply Voltage
 I_{CC} (normalized) vs. V_{CC}



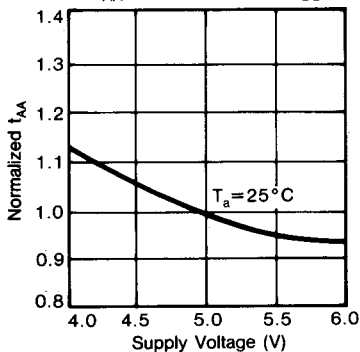
Normalized Supply Current vs. Ambient Temperature
 I_{CC} (normalized) vs. T_A



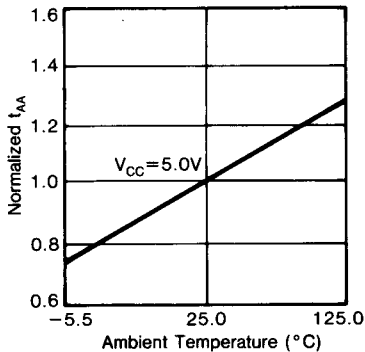
Output Source Current vs. Output Voltage
 I_{OH} vs. V_{OH}



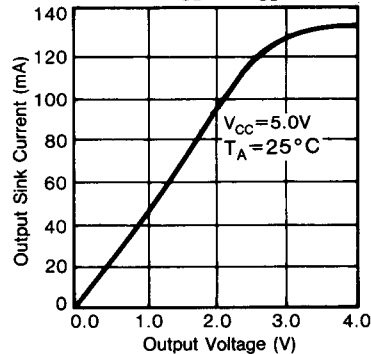
Normalized Access Time vs. Supply Voltage
 t_{AA} (normalized) vs. V_{DD}



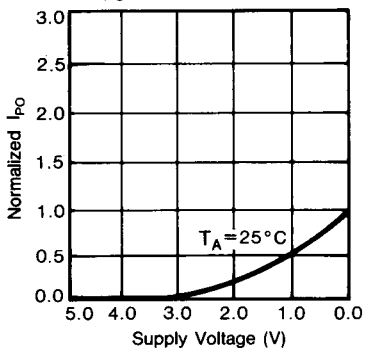
Normalized Access Time vs. Ambient Temperature
 t_{AA} (normalized) vs. T_A



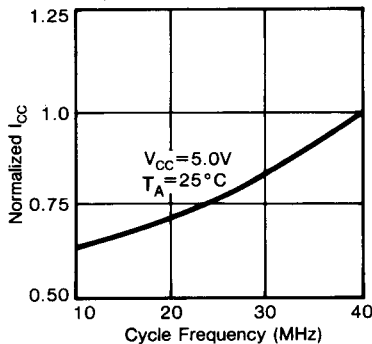
Output Sink Current vs. Output Voltage
 I_{OL} vs. V_{OL}



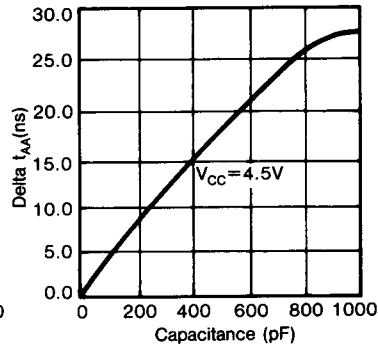
Typical Power On Current vs. Supply Voltage
 I_{PO} (normalized) vs. V_{CC}



Normalized I_{CC} vs. Cycle Time
 I_{CC} (normalized) t_{RC} or t_{WC}



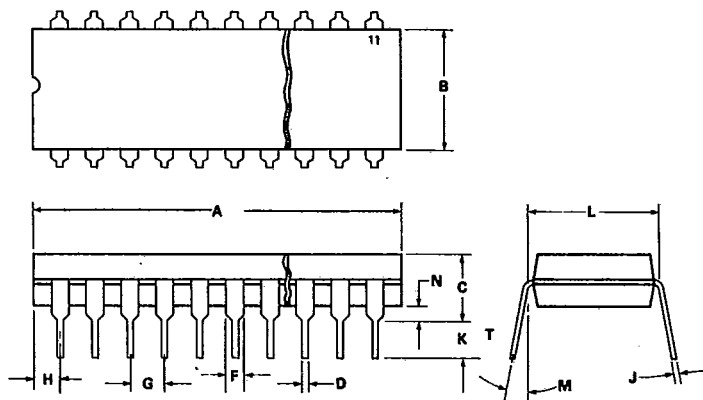
Typical Access Time Change vs. Output Loading
 t_{AA} vs. C_L



PACKAGE DIMENSION

PLASTIC DIP

T-90-20



(UNIT: INCHES)

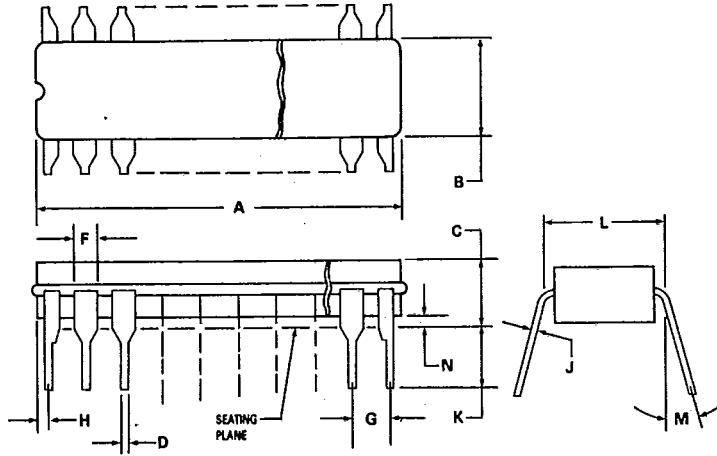
SYMBOL	16 PIN		18 PIN		20 PIN		22 PIN	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	0.738	0.752	0.875	0.900	1.013	1.040	1.095	1.150
B	0.245	0.255	0.245	0.255	0.263	0.273	0.260	0.287
C	0.143	0.152	0.145	0.162	0.143	0.152	0.145	0.160
D	TYP. 0.018		TYP. 0.018		TYP. 0.018		TYP. 0.018	
F	TYP. 0.063		TYP. 0.060		TYP. 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



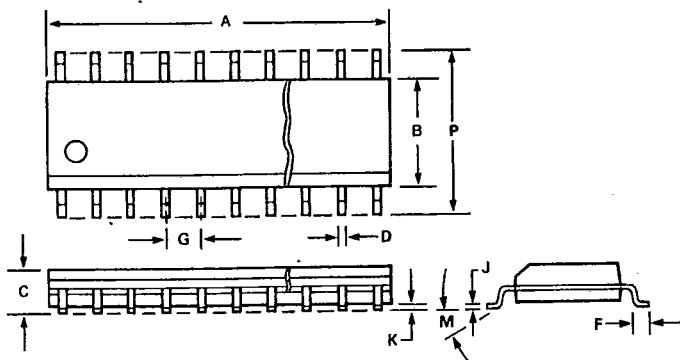
(UNIT : INCHES)

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)

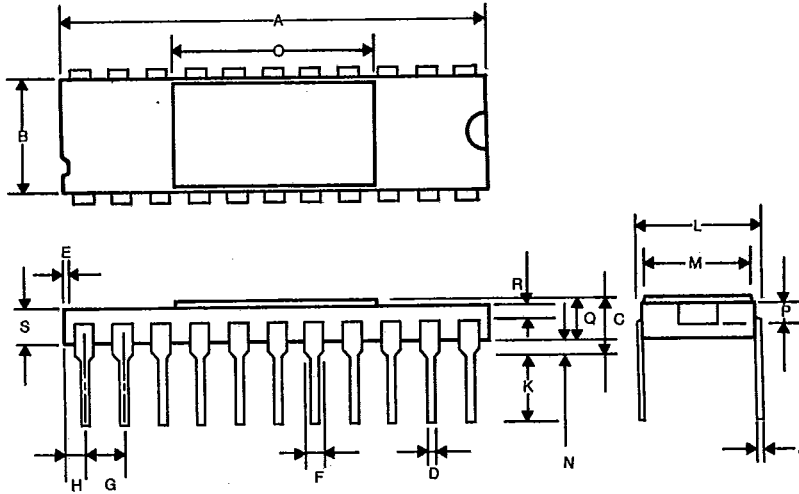
CODE NO. PIN SYMBOL	20 F		24 F		24 FW			
	20 PIN		24 PIN		24 PIN			
	MIN	MAX	MIN	MAX	MIN	MAX		
A	0.496	0.510	0.602	0.614	0.622	0.638		
B	0.292	0.299	0.292	0.299	TYP. 0.331			
C	0.097	0.104	0.097	0.104	—	0.098		
D	0.014	0.019	0.014	0.019	0.012	0.018		
F	0.018	0.035	0.018	0.035	TYP 0.039			
G	0.050 BSC		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	—