IMS1423M
CMOS
High Performance
4K x 4 Static RAM
MIL-STD-883C

FEATURES

- INMOS' Very High Speed CMOS
- Advanced Process - 1.6 Micron Design Rules
- Specifications guaranteed over full military temperature range (-55° C to + 125° C)
- 4K x 4 Bit Organization
- 35, 45, and 55 nsec Access Times
- Single +5V ± 10% Operation
- Power Down Function for Low Standby Power
- Fully TTL Compatible
- Common Data Input and Output
- Three-state Output
- Standard Military Drawing version available (refer to page B-7)
- 20-Pin DIP, LCC (JEDEC Std.) and FP
- Pin Compatible with IMS1420M

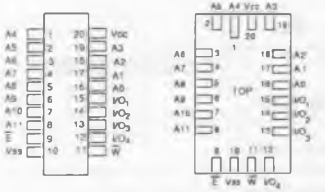
DESCRIPTION

The INMOS IMS1423M is a high speed 4K x 4 CMOS static RAM processed in full compliance to MIL-STD-883C. The IMS1423M provides maximum density and performance enhancements to existing 16K applications.

The IMS1423M features fully static operation requiring no external clocks or timing strobes, and equal address access and cycle times. Additionally, the IMS1423M provides a Chip Enable (/E) function that can be used to place the device into a low-power standby mode.

The IMS1423M is a VLSI static RAM intended for military applications that demand high performance and superior reliability.

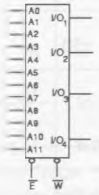
PIN CONFIGURATION



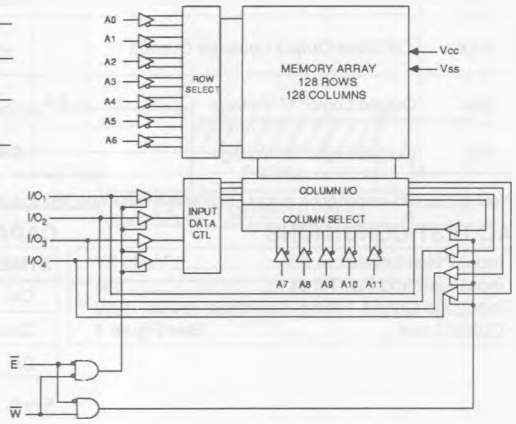
DIP and FLAT PACK

CHIP CARRIER

LOGIC SYMBOL



BLOCK DIAGRAM



PIN NAMES

A_0 - A_{11}	ADDRESS INPUTS	Vcc POWER (+5V)
$\overline{W}$	WRITE ENABLE	Vss GROUND
$\overline{E}$	CHIP ENABLE	
I/O	DATA IN/OUT	

ABSOLUTE MAXIMUM RATINGS*

Voltage on any pin relative to Vss.....-2.0 to 7.0V
Voltage on I/O.....-1.0 to (Vcc+0.5)V
Temperature Under Bias.....-55° C to 125°C
Storage Temperature .....-65° C to 150°C
Power Dissipation.....1W
DC Output Current.....25mA
(One output at a time, one second duration)

*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 reliability.

DC OPERATING CONDITIONS

	PARAMETER	MIN	TYP	MAX	UNITS	NOTES
V_{CC}	Supply Voltage	4.5	5.0	5.5	V	
V_{SS}	Supply Voltage	0	0	0	V	
V_{IH}	Input Logic "1" Voltage	2.0		Vcc+0.5	V	All inputs
V_{IL}	Input Logic "0" Voltage	-1.0*		0.8	V	All inputs
T_A	Ambient Operating Temperature	-55	25	125	°C	400 linear ft/min air flow

*V_{IL} min = -3 volts for pulse width <20ns, note b.

DC ELECTRICAL CHARACTERISTICS (-55°C ≤ T_A ≤ 125°C) (V_{CC} = 5.0V ± 10%)[a]

SYMBOL	PARAMETER	MIN	MAX	UNITS	NOTES
I_{CC1}	Average Vcc Power Supply Current		130 120 110	mA mA mA	tAVAV = 35ns tAVAV = 45ns tAVAV = 55ns
I_{CC2}	Vcc Power Supply Current (Standby,Stable TTL Input Levels)		20	mA	E ≥ V_{IH} . All other inputs at V_{IN} ≤ V_{IL} or ≥ V_{IH}
I_{CC3}	Vcc Power Supply Current (Standby, Stable CMOS Input Levels)		8	mA	E ≥ (Vcc - 0.2) . All other inputs at V_{IN} ≤ 0.2 or ≥ (Vcc - 0.2V)
I_{CC4}	Vcc Power Supply Current (Standby, Cycling CMOS Input Levels)		15 14 13	mA mA mA	tAVAV = 35ns tAVAV = 45ns tAVAV = 55ns E ≥ (Vcc - 0.2). all other iInputs cycling at V_{IN} ≤ 0.2 or ≥ (Vcc - 0.2V)
I_{ILK}	Input Leakage Current (Any Input)		±10	µA	Vcc = max V_{IN} = Vss to Vcc
I_{OLK}	Off State Output Leakage Current		±50	µA	Vcc = max V_{IN} = Vss to Vcc
V_{OH}	Output Logic "1" Voltage	2.4		V	I_{OUT} = -4mA
V_{OL}	Output Logic "0" Voltage		0 4	V	I_{OUT} = 8mA

Note a: Icc is dependent on output loading and cycle rate, the specified values are obtained with the output unloaded.

AC TEST CONDITIONS

Input Pulse Levels .....V_{SS} to 3V
Input Rise and Fall Times 5ns
Input and Output Timing Reference Levels..1.5V
Output Load .....See Figure 1

CAPACITANCE[b] (T_A=25°C, f=1.0MHZ)

SYMBOL	PARAMETER	MAX	UNITS	CONDITIONS
C_{IN}	Input Capacitance	4	pF	ΔV = 0 to 3V
C_{OUT}	Output Capacitance	7	pF	ΔV = 0 to 3V
C_E	/E Capacitance	6	pF	ΔV = 0 to 3V

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

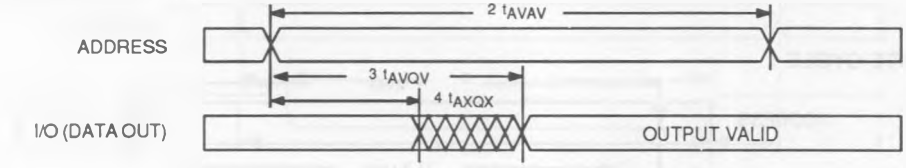
RECOMMENDED AC OPERATING CONDITIONS ($-55°C \le T_A \le 125°C$) ($V_{CC} = 5.0V \pm 10\%$)

READ CYCLE [g]

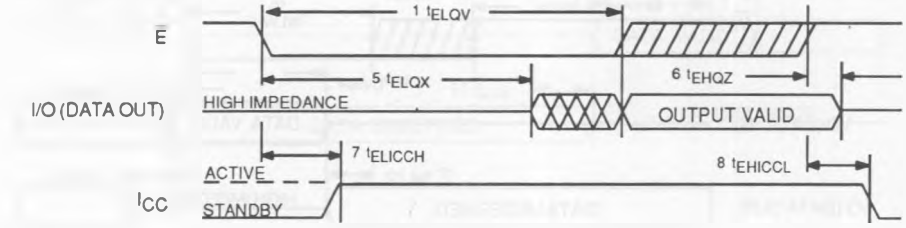
NO.	SYMBOL		PARAMETER	IMS1423M-35		IMS1423M-45		IMS1423M-55		UNITS	NOTES
	Standard	Alternate		MIN	MAX	MIN	MAX	MIN	MAX		
1	t_{ELQV}	t_{ACS}	Chip Enable Access Time		35		45		55	ns	
2	t_{AVAV}	t_{RC}	Read Cycle Time	35		45		55		ns	c
3	t_{AVQV}	t_{AA}	Address Access Time		35		45		55	ns	d
4	t_{AXQX}	t_{OH}	Output Hold After Address Change	3		3		3		ns	j
5	t_{ELQX}	t_{LZ}	Chip Enable to Output Active	5		5		5		ns	
6	t_{EHQZ}	t_{HZ}	Chip Disable to Output Inactive	0	20	0	20	0	20	ns	f, j
7	t_{ELICCH}	t_{PU}	Chip Enable to Power Up	0		0		0		ns	j
8	t_{EHICCL}	t_{PD}	Chip Enable to Power Down		35		45		55	ns	j
		t_T	Input Rise and Fall Times		50		50		50	ns	e, j

Note c: For READ CYCLE 1 & 2, $\overline{W}$ is high for entire cycle.
Note d: Device is continuously selected; $\overline{E}$ low.
Note e: Measured between V_{IL} max and V_{IH} min.
Note f: Measured ±200mV from steady state output voltage. Load capacitance is 5pF.
Note g: $\overline{E}$ and $\overline{W}$ must transition between V_{IH} to V_{IL} or V_{IL} to V_{IH} in a monotonic fashion.
Note j: Parameter guaranteed but not tested.

READ CYCLE 1[c, d]



READ CYCLE 2[c]



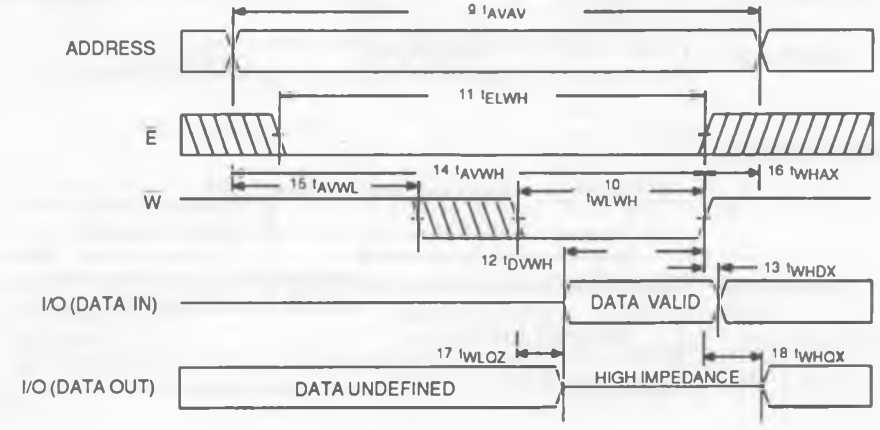
RECOMMENDED AC OPERATING CONDITIONS ($-55°C \le T_A \le 125°C$) ($V_{CC} = 5.0V \pm 10\%$)

WRITE CYCLE 1: $\overline{W}$ CONTROLLED[g, h]

NO.	SYMBOL		PARAMETER	IMS1403M-35		IMS1403M-45		IMS1403M-55		UNITS	NOTES
	Standard	Alternate		MIN	MAX	MIN	MAX	MIN	MAX		
9	t_{AVAV}	t_{WC}	Write Cycle Time	35		45		55		ns	
10	t_{WLWH}	t_{WP}	Write Pulse Width	30		40		50		ns	
11	t_{ELWH}	t_{CW}	Chip Enable to End of Write	30		40		50		ns	
12	t_{DVWH}	t_{DW}	Data Set-up to End of Write	15		20		25		ns	
13	t_{WHDX}	t_{DH}	Data Hold After End of Write	3		3		3		ns	
14	t_{AVWH}	t_{AW}	Address Set-up to End of Write	30		40		50		ns	
15	t_{AVWL}	t_{AS}	Address Set-up to Beginning of Write	0		0		0		ns	
16	t_{WHAX}	t_{WR}	Address Hold After End of Write	5		5		5		ns	
17	t_{WLQZ}	t_{WZ}	Write Enable to Output Disable	0	15	0	20	0	25	ns	f, j
18	t_{WHQX}	t_{OW}	Output Active After End of Write	5		5		5			i, j

Note f: Measured ±200mV from steady state output voltage. Load capacitance is 5pF.
Note g: $\overline{E}$ and $\overline{W}$ must transition between V_{IH} to V_{IL} or V_{IL} to V_{IH} in a monotonic fashion.
Note h: $\overline{E}$ or $\overline{W}$ must be $\ge V_{IH}$ during address transitions.
Note i: If $\overline{W}$ is low when $\overline{E}$ goes low, the outputs remain in the high impedance state.
Note j: Parameter guaranteed but not tested.

WRITE CYCLE 1



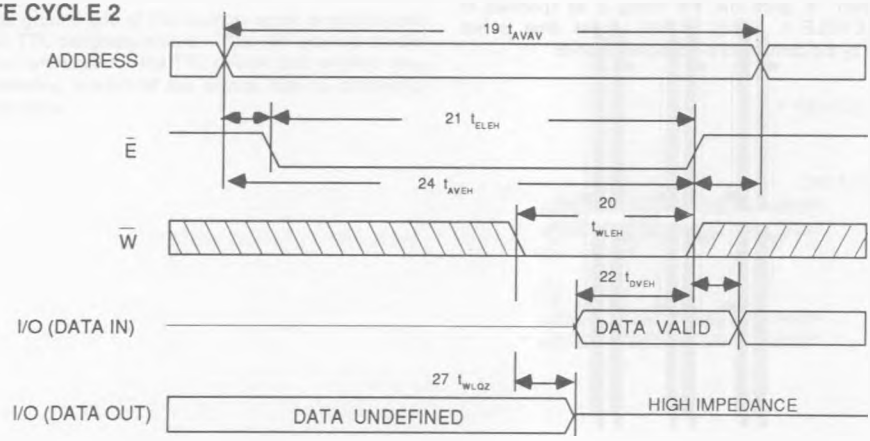
RECOMMENDED AC OPERATING CONDITIONS ($-55°C \le T_A \le 125°C$) ($V_{CC} = 5.0V \pm 10\%$)

WRITE CYCLE 2: $\overline{E}$ CONTROLLED[g, h]

No	SYMBOL		PARAMETER	IMS 1423M-35		IMS 1423M-45		IMS 1423M-55		UNITS	NOTES
	Standard	Alternate		MIN	MAX	MIN	MAX	MIN	MAX		
19	tAVAV	tWC	Write Cycle Time	35		45		55		ns	
20	tWLEH	tWP	Write Pulse Width	30		40		50		ns	
21	tELEH	tCW	Chip Enable to End of Write	30		40		50		ns	
22	tDVEH	tDW	Data Setup to End of Write	15		20		25		ns	
23	tEHDX	tDH	Data Hold after End of Write	3		3		3		ns	
24	tAVEH	tAW	Address Setup to End of Write	30		40		50		ns	
25	tEHAX	tWR	Address Hold After End of Write	5		5		5		ns	
26	tAVEL	tAS	Address Setup to Beginning of Write	3		3		3		ns	
27	tWLQZ	tWZ	Write Enable to Output Disable	0	15	0	20	0	25	ns	f,j

Note f: Measured ±200mV from steady state output voltage. Load capacitance is 5pF.
Note g: $\overline{E}$ and $\overline{W}$ must transition between V_{IH} to V_{IL} or V_{IL} to V_{IH} in a monotonic fashion.
Note h: $\overline{E}$ or $\overline{W}$ must be > V_{IH} during address transitions.
Note i: If $\overline{W}$ is low when $\overline{E}$ goes low, the output remains in the high impedance state.
Note j: Parameter guaranteed but not tested.

WRITE CYCLE 2



DEVICE OPERATION

The IMS1423M has two control inputs, Chip Enable (/E) and Write Enable (/W), 12 address inputs (A0 -A11), and four Data I/O lines. The /E input controls device selection as well as active and standby modes. With /E low, the device is selected and the 12 address inputs are decoded to select one four-bit word out of 4K words. Read and Write operations on the memory cell are controlled by the /W input. With /E high, the device is deselected, the outputs are disabled and the power consumption is reduced to less than one-fourth of the active mode power with TTL levels and even lower with CMOS levels.

READ CYCLE

A read cycle is defined as /W $\geq V_{IH}$ min with /E $\leq V_{IL}$ max. Read access time is measured from either /E going low or from valid address.

The READ CYCLE 1 waveform shows a read access that is initiated by a change in the address inputs while /E is low. The outputs remain active throughout READ CYCLE 1 and is valid at the specified address access time. The address inputs may change at access time and long as /E remains low, the cycle time is equal to the address access time.

The READ CYCLE 2 waveform shows a read access that is initiated by /E going low. As long as address is stable when /E goes low, valid data is at the outputs at the specified Chip Enable Access time. If address is not valid when /E goes low, the timing is as specified in READ CYCLE 1. Chip Enable access time is not affected by the duration of the deselect interval.

WRITE CYCLE

The write cycle of the IMS1423M is initiated by the latter of /E or /W to transition from a high to a low. In the case of /W falling last, the output buffers will be turned on t_{ELQX} after the falling edge of /E (just as in a read cycle). The output buffers are then turned off within t_{WLQZ} of the falling edge of /W. During this interval, it is possible to have bus contention between devices with common I/O configurations. To avoid bus contention, input data should not be active until t_{WLQZ}.

WRITE CYCLE 1 waveform shows a write cycle terminated by /W going high. Data set-up and hold times are referenced to the rising edge of /W. When /W goes high at the end of the cycle with /E active, the outputs of the memory become active. The data from the memory will be the same as the input data unless the input data or address changes.

WRITE CYCLE 2 waveform shows a write cycle terminated by /E going high. Data set-up and hold times are referenced to the rising edge of /E. With /E high the outputs remain in the high impedance state.

POWER DISTRIBUTION

The recommended power distribution scheme combines proper power trace layout and placement of decoupling capacitors to maintain the operating margins of the IMS1423M. The impedance in the decoupling path from the power pin through the decoupling capacitor to the ground pin should be kept to a minimum. The impedance of this path is determined by the series impedance of the power line inductance and the inductance and reactance of the decoupling capacitor.

Since the current transients associated with the operation of the high speed IMS1423M have very high frequency components, the line inductance is the dominating factor. To reduce the line inductance, the power trace and ground trace should be gridded or provided by separate power planes. The decoupling capacitor supplies energy for high frequency current transients and should be located as close to the devices with as short lead length as possible. The high frequency decoupling capacitor should have a value of 0.1 microfarad, and be placed between each row of devices in the array (see drawing). A larger tantalum capacitor, with a sufficient value to eliminate low frequency ripple, should be placed near the memory board edge connection where the power traces meet the backplane power distribution system. These larger capacitors provide bulk energy storage to prevent voltage drop due to the main supply being located off the memory board and at the end of a long inductive path.

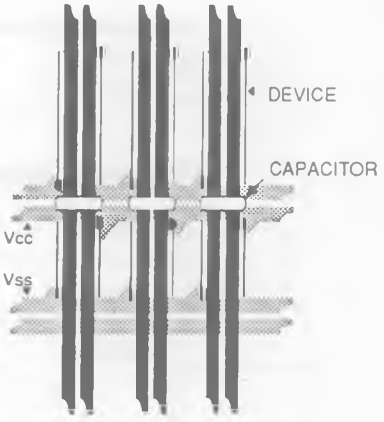
The ground grid of the memory array should extend to the TTL periphery circuit. This will provide a solid ground reference for the TTL drivers and prevent loss of operating margin of the drivers due to differential ground noise.

TERMINATION

Trace lines on a memory board in the array look to TTL driver signals like low impedance, unterminated transmission lines. In order to reduce or eliminate the reflections of the TTL signals propagating down the lines, especially low going TTL signals, line termination is recommended. The termination may be either series or parallel.

The recommended technique is to use series termination. The series termination technique has the advantage of drawing no DC current and using a minimum number of components. This is accomplished by placing a series resistor in the signal line at the output of the TTL driver to dampen the reflection on the line. The resistor should be placed as close to the driver package as is practical. The line should be kept short by placing the driver-termination combination close to the memory array.

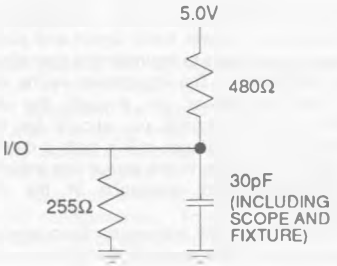
Some experimentation will have to be done to find the proper value to use for the series termination to minimize reflections, but generally a series resistor in the 10 to 33 ohm range will be required. Because each design will result in a different signal impedance, a resistor of predetermined value may not properly match the signal path impedance. The proper value of resistance should therefore be selected empirically.



V_{CC}, V_{SS} GRID SHOWING DECOUPLING CAPACITORS

Type	Package	Lead finish
A	Formed flat-pack	gold
B	Formed flat-pack	solder
C	LCC	gold
D	Cerdip	solder
E	Small outline, J-bend	solder
G	PGA	gold
H	Small outline, Gull wing	solder
J	PLCC, J-bend	solder
K	Sidebraze ceramic DIP	solder
N	Ceramic LCC	solder
P	Plastic DIP	solder
S	Sidebraze ceramic DIP	gold
T	(Skinny) Flat-pack	solder
W	Ceramic LCC	gold
Y	(Skinny) Flat-pack	gold

FIGURE 1. OUTPUT LOAD



TRUTH TABLE

$\overline{E}$	$\overline{W}$	Q	MODE
H	X	HI-Z	Standby (Isb)
L	H	Dout	Read
L	L	Din	Write

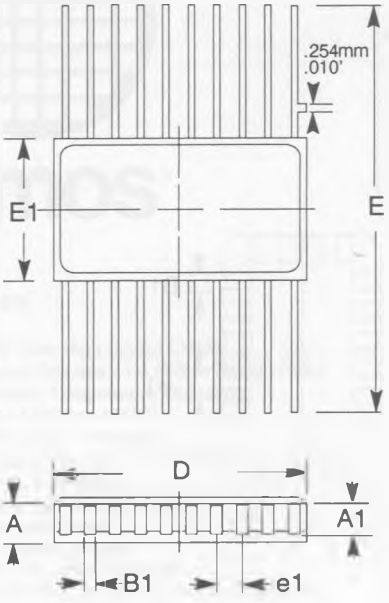
Standard Military Drawing version available, see SMD Reference Guide

ORDERING INFORMATION

DEVICE	SPEED	PACKAGE	PART NUMBER
IMS 1423M	35ns	CERAMIC DIP	IMS1423S-35M
	35ns	CERAMIC LCC	IMS1423N-35M
	35ns	FLAT PACK	IMS1423Y-35M
	45ns	CERAMIC DIP	IMS1423S-45M
	45ns	CERAMIC LCC	IMS1423N-45M
	45ns	FLAT PACK	IMS1423Y-45M
	55ns	CERAMIC DIP	IMS1423S-55M
	55ns	CERAMIC LCC	IMS1423N-55M
	55ns	FLAT PACK	IMS1423Y-55M

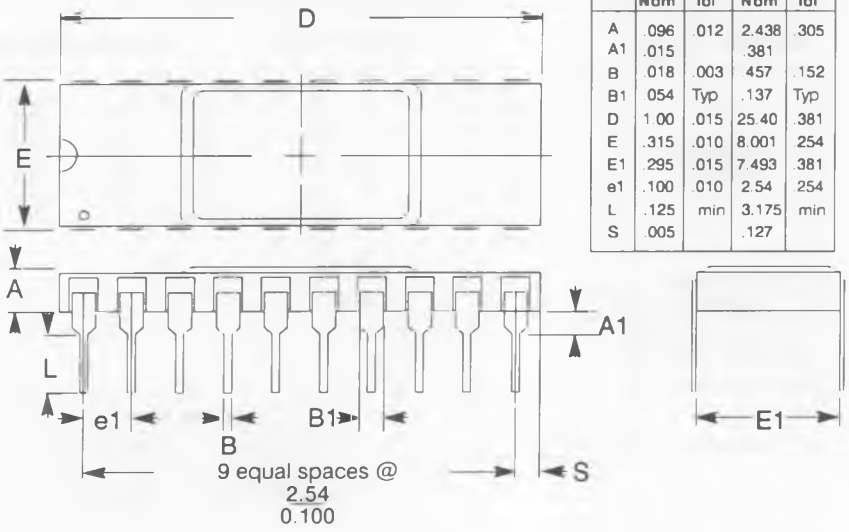
PACKAGING INFORMATION

20 Pin Flat Pack



Dim	Inches		mm		Notes
	Nom	Tol	Nom	Tol	
A	.070	.007	1.178	.178	
A1	.050	.007	1.270	.178	
B1	.017	.002	.432	.051	
D	.480	.010	12.192	.254	
C	.005	.002	.127	.051	
E	.895	Ref	22.73	Ref	
e1	.050	.003	1.270	.076	
eA	.215	.006	5.461	.152	

20 Pin Ceramic Dual-In-Line



Dim	Inches		mm	
	Nom	Tol	Nom	Tol
A	.096	.012	2.438	.305
A1	.015		.381	
B	.018	.003	.457	.152
B1	.054	Typ	.137	Typ
D	1.00	.015	25.40	.381
E	.315	.010	8.001	.254
E1	.295	.015	7.493	.381
e1	.100	.010	2.54	.254
L	.125	min	3.175	min
S	.005		.127	

20 Pin Leadless Chip Carrier

Dim	Inches		mm		Notes
	Nom	Tol	Nom	Tol	
A	.071	.007	1.803	.178	
B1	.025	.003	.635	.076	
D	.425	.010	10.795	254	
E	.290	.010	7.360	254	
e1	.050	.005	1.270