QUALITY SEMICONDUCTOR, INC.

High-Speed CMOS 8-Bit Bus Interface Register Transceivers

QS54/74FCT646T
QS54/74FCT2646T

FEATURES/BENEFITS

- Pin and function compatible to the 74F646 74FCT646 and 74FCT646T
- CMOS power levels: <7.5mW static
- Available in DIP, SOIC, QSOP, ZIP, HQSOP
- Undershoot clamp diodes on all inputs
- TTL-compatible input and output levels
- Ground bounce controlled outputs
- Reduced output swing of 0-3.5V
- Military product compliant to MIL-STD-883

FCT-T 646T

- JEDEC-FCT spec compatible
- Fastest CMOS logic family available
- Std., A, and C speed grades with 4.8ns t_{PD} for C
- I_{OL} = 64mA Ind., 48mA Mil.

FCT-T 2646T

- Built-in 25Ω series resistor outputs reduce reflection and other system noise
- Std., A, and C speed grades with 4.8ns t_{PD} for C
- I_{OL} = 12mA Ind.

DESCRIPTION

The QSFCT646T and QSFCT2646T are 8-bit high-speed CMOS TTL-compatible registered bus transceivers with three-state outputs that are ideal for driving high capacitance loads such as memory and address buses. The 2646 device is a 25Ω resistor output version useful for driving transmission lines and reducing system noise. The 2646 series parts can replace the 646 series to reduce noise in an existing design. All inputs have clamp diodes for undershoot noise suppression. All outputs have ground bounce suppression (see QSI Application Note AN-001), and outputs will not load an active bus when V_{CC} is removed from the device.

Figure 1. Functional Block Diagram

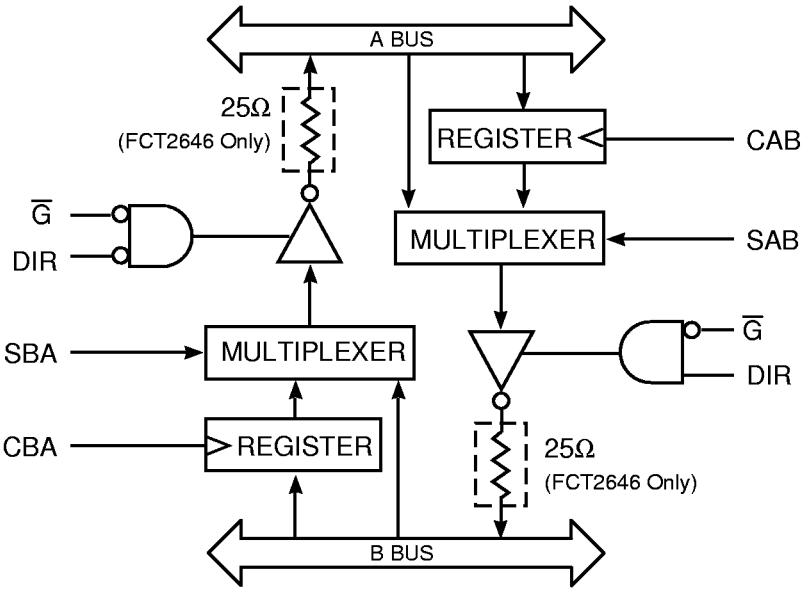
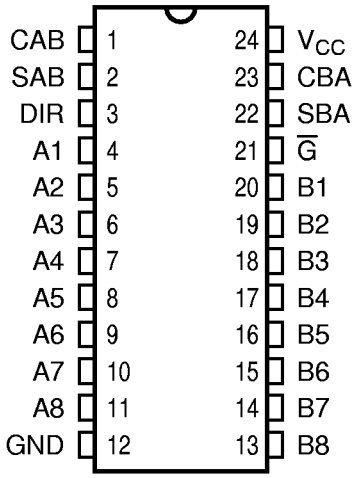


Figure 2. Pin Configurations (All Pins Top View)

PDIP, SOIC, QSOP, HQSOP



ZIP

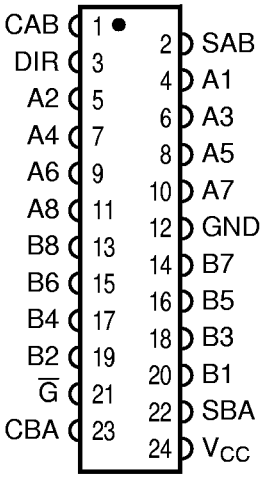


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Table 1. Pin Description

Name	I/O	Description
A8-A1	I/O	A Bus
B8-B1	I/O	B Bus
CAB	I	Clock A to Register
CBA	I	Clock B to Register
SAB	I	A Bus or Reg to B
SBA	I	B Bus or Reg to A
DIR	I	Direction, A → B or B → A
$\overline{G}$	I	Output Enable

Table 2. Function Table

Inputs						Outputs		
$\overline{G}$	DIR	CAB	CBA	SAB	SBA	A8-A1	B8-B1	Function
H	—	—	—	—	—	Hi-Z	Hi-Z	Disabled
L	L	—	—	—	—	A	Hi-Z	Output A
L	H	—	—	—	—	Hi-Z	B	Output B
—	—	↑	—	—	—	—	—	Load A Register
—	—	—	↑	—	—	—	—	Load B Register
—	—	—	—	L	—	—	—	A Bus → B Bus
—	—	—	—	H	—	—	—	A Reg → B Bus
—	—	—	—	—	L	—	—	B Bus → A Bus
—	—	—	—	—	H	—	—	B Reg → A Bus

Table 3. Absolute Maximum Ratings

Supply Voltage to Ground	–0.5V to 7.0V
DC Output Voltage V_{OUT}	–0.5V to 7.0V
DC Input Voltage V_{IN}	–0.5V to 7.0V
AC Input Voltage (for a pulse width ≤ 20ns)	–3.0V
DC Input Diode Current with $V_{IN} < 0$	–20mA
DC Output Diode Current with $V_{OUT} < 0$	–50mA
DC Output Current Max. Sink Current/Pin	120mA
Maximum Power Dissipation	0.5 watts
T_{STG} Storage Temperature	–65° to 150°C

Note: Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to QSI devices that result in functional or reliability type failures.

Table 4. Capacitance

T_A = 25°C, f = 1MHz, V_{IN} = 0V, V_{OUT} = 0V

Pins	SOIC	QSOP	PDIP	ZIP	Unit
—	4	4	5	7	pF
—	6	6	7	9	pF
1-11, 13-23	8	8	9	10	pF

Note: Capacitance is characterized but not tested.

Table 5. Power Supply Characteristics

Symbol	Parameter	Test Conditions[1]	Min	Max	Unit
I_{CC}	Quiescent Power Supply Current	V_{CC} = Max., freq = 0 0V ≤ V_{IN} ≤ 0.2V or V_{CC} –0.2V ≤ V_{IN} ≤ V_{CC}	—	1.5	mA
ΔI_{CC}	Supply Current per Input @ TTL HIGH	V_{CC} = Max., V_{IN} = 3.4V, freq = 0[2]	—	2.0	mA
Q_{CCD}	Supply Current per Input per MHz	V_{CC} = Max., Outputs Open and Enabled One Bit Toggling @ 50% Duty Cycle Other Inputs at GND or V_{CC}[3,4]	—	0.25	mA/ MHz

Notes:
1. For conditions shown as Min. or Max., use the appropriate values specified under DC specifications.
2. Per TTL driven input (V_{IN} = 3.4V).
3. For flip-flops, Q_{CCD} is measured by switching one of the data input pins so that the output changes every clock cycle. This is a measurement of device power consumption only and does not include power to drive load capacitance or tester capacitance. This parameter is guaranteed by design but not tested.
4. I_C can be computed using the above parameters as explained in the Technical Overview section.

Table 6. DC Electrical Characteristics Over Operating Range

Industrial T_A = –40°C to 85°C, V_{CC} = 5.0V ±5% Military T_A = –55°C to 125°C, V_{CC} = 5.0V ±10%

Symbol	Parameter	Test Conditions	Min	Typ(1)	Max	Unit
V_{IH}	Input HIGH Voltage	Logic HIGH for All Inputs	2.0	—	—	V
V_{IL}	Input LOW Voltage	Logic LOW for All Inputs	—	—	0.8	V
ΔV_T	Input Hysteresis	$V_{TLH} - V_{THL}$ for All Inputs	—	0.2	—	V
$\lvert I_{IH} \rvert$ $\lvert I_{IL} \rvert$	Input Current Input HIGH or LOW	V_{CC} = Max., $0 \le V_{IN} < V_{CC}$	—	—	5	µA
$\lvert I_{OZ} \rvert$	Off-State Output Current (Hi-Z)	V_{CC} = Max., $0 \le V_{IN} \le V_{CC}$	—	—	5	µA
I_{OS}	Short Circuit Current (FCT646)	V_{CC} = Max., V_{OUT} = GND(2,3)	–60	—	—	mA
I_{OR}	Current Drive (FCT2646)	V_{CC} = Max., V_{OUT} = 2.0V(3)	50	—	—	mA
V_{IC}	Input Clamp Voltage	V_{CC} = Min., I_{IN} = –18mA, T_A = 25°C(3)	—	–0.7	–1.2	V
V_{OH}	Output HIGH Voltage	V_{CC} = Min. I_{OH} = –12mA (MIL) I_{OH} = –15mA (IND)	2.4 2.4	— —	— —	V
V_{OL}	Output LOW Voltage (FCT646)	V_{CC} = Min. I_{OL} = 48mA (MIL) I_{OL} = 64mA (IND)	— —	— —	0.55 0.55	V
V_{OL}	Output LOW Voltage (FCT2646- 25Ω)	V_{CC} = Min. I_{OL} = 12mA (MIL) I_{OL} = 12mA (IND)	— —	— —	0.50 0.50	V
R_{OUT}	Output Resistance (FCT2646- 25Ω)	V_{CC} = Min. I_{OL} = 12mA (MIL) I_{OL} = 12mA (IND)	— 20	25 28	— 40	Ω

Notes:
1. Typical values indicate V_{CC} = 5.0V and T_A = 25°C.
2. Not more than one output should be shorted and the duration is ≤1 second.
3. These parameters are guaranteed by design but not tested.

Table 7. Switching Characteristics Over Operating Range

Industrial T_A = –40°C to 85°C, V_{CC} = 5.0V ±5% Military T_A = –55°C to 125°C, V_{CC} = 5.0V ±10%
C_{LOAD} = 50pF, R_{LOAD} = 500Ω unless otherwise noted.

Symbol	Description[1]		646 2646 Min	646 2646 Max	646A 2646A Min	646A 2646A Max	646C 2646C Min	646C 2646C Max	646D Min	646D Max	Unit
t_{PHLB}	Bus to Bus	Ind	2.0	9.0	2.0	6.3	1.5	5.4	1.5	4.8	ns
t_{PLHB}	Delay, 646	Mil	2.0	11	2.0	7.7	1.5	6.0	—	—	
t_{PHLB}	Bus to Bus	Ind	2.0	9.0	2.0	6.3	1.5	5.4	1.5	4.8	ns
t_{PLHB}	Delay, 2646	Mil	2.0	11	2.0	7.7	1.5	6.0	—	—	
t_{PZH}	Ouput Enable	Ind	2.0	14	2.0	9.8	1.5	7.8	1.5	7.3	ns
t_{PZL}	Time, 646	Mil	2.0	15	2.0	10.5	1.5	8.9	—	—	
t_{PZH}	Output Enable	Ind	2.0	14	2.0	9.8	1.5	7.8	1.5	7.3	ns
t_{PZL}	Time, 2646	Mil	2.0	15	2.0	10.5	1.5	8.9	—	—	
t_{PHZ}	Output Disable	Ind[2]	2.0	9.0	2.0	6.3	1.5	6.3	1.5	6.3	ns
t_{PLZ}	Time	Mil[2]	2.0	11	2.0	7.7	1.5	7.7	—	—	
t_{PHLC}	Clock to Bus	Ind	2.0	9.0	2.0	6.3	1.5	5.7	1.5	5.2	ns
t_{PLHC}	Delay, 646	Mil	2.0	10	2.0	7.0	1.5	6.3	—	—	
t_{PHLC}	Clock to Bus	Ind	2.0	9.0	2.0	6.3	1.5	5.7	1.5	5.2	ns
t_{PLHC}	Delay, 2646	Mil	2.0	10	2.0	7.0	1.5	6.3	—	—	
t_{PHLS}	SBA/SAB to Bus	Ind	2.0	11	2.0	7.7	1.5	6.2	1.5	5.8	ns
t_{PLHS}	Delay, 646	Mil	2.0	12	2.0	8.4	1.5	7.0	—	—	
t_{PHLS}	SBA/SAB to Bus	Ind	2.0	11	2.0	7.7	1.5	6.2	1.5	5.8	ns
t_{PLHS}	Delay, 2646	Mil	2.0	12	2.0	8.4	1.5	7.0	—	—	
t_S	Data Setup Time	Ind	4.0	—	2.0	—	2.0	—	2.0	—	ns
		Mil	4.5	—	2.0	—	2.0	—	—	—	
t_H	Data Hold Time	Ind	2.0	—	1.5	—	1.5	—	1.5	—	ns
		Mil	2.0	—	1.5	—	1.5	—	—	—	
t_{PWH}	Clock Pulse Width	Ind[2]	6.0	—	5.0	—	5.0	—	5.0	—	ns
t_{PWL}	HIGH or LOW	Mil[2]	6.0	—	5.0	—	5.0	—	—	—	

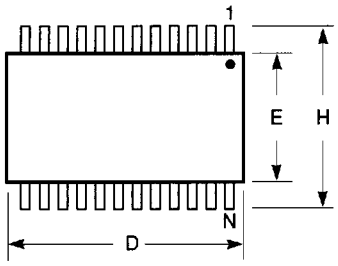
Notes:

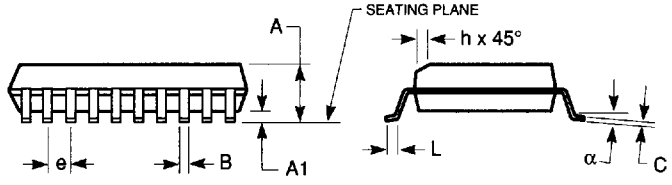
1. Minimums guaranteed but not tested for all parameters except t_S and t_H.
2. This parameter is guaranteed by design but not tested.
3. See Test Circuit and Waveforms.

300-MIL SOIC - Package Code SO

Plastic Small Outline Gull-Wing

Notes:
1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.006in. per side.
5. Lead coplanarity is 0.004in. maximum.

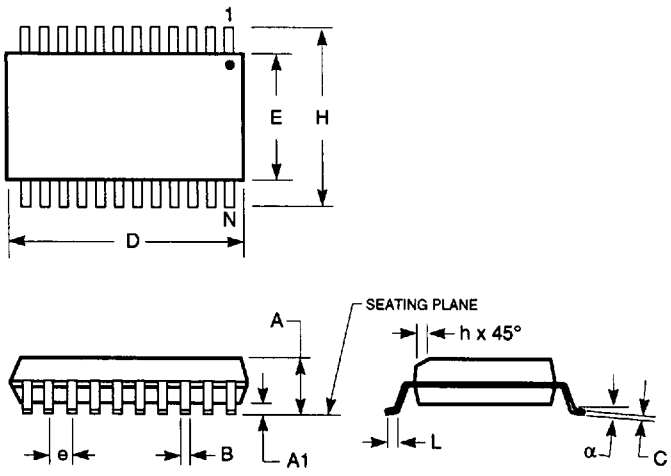




JEDEC#	MS-013AA		MS-013AC		MS-013AD		MS-013AE	
DWG#	PS16A		PS20A		PS24A		PS28A	
Symbol	Min	Max	Min	Max	Min	Max	Min	Max
A	0.096	0.104	0.096	0.104	0.096	0.104	0.096	0.104
A1	0.005	0.011	0.005	0.011	0.005	0.011	0.005	0.011
B	0.014	0.019	0.014	0.019	0.014	0.019	0.014	0.019
C	0.009	0.012	0.009	0.012	0.009	0.012	0.009	0.012
D	0.402	0.412	0.500	0.510	0.602	0.612	0.701	0.711
E	0.292	0.299	0.292	0.299	0.292	0.299	0.292	0.299
e	0.044	0.056	0.044	0.056	0.044	0.056	0.044	0.056
H	0.396	0.416	0.396	0.416	0.396	0.416	0.396	0.416
h	0.010	0.016	0.010	0.016	0.010	0.016	0.010	0.016
L	0.020	0.040	0.020	0.040	0.020	0.040	0.020	0.040
N	16		20		24		28	
α	0°	8°	0°	8°	0°	8°	0°	8°

150-MIL SOIC - Package Code S1

Plastic Small Outline Gull-Wing



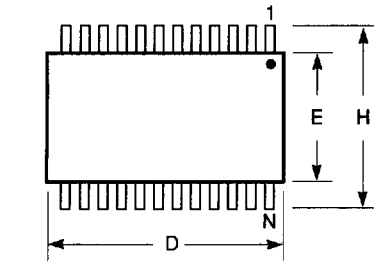
JEDEC#	MS-012AB			MS-012AC		
DWG#	PS-14B			PS-16B		
Symbol	Min	Nom	Max	Min	Nom	Max
A	0.060	0.064	0.068	0.060	0.064	0.068
A1	0.004	0.006	0.008	0.004	0.006	0.008
B	0.014	0.016	0.019	0.014	0.016	0.019
C	0.0075	0.008	0.0098	0.0075	0.008	0.0098
D	0.337	0.341	0.346	0.386	0.390	0.394
E	0.150	0.154	0.157	0.150	0.154	0.157
e	0.050 BSC			0.050 BSC		
H	0.230	0.236	0.244	0.230	0.236	0.244
h	0.010	0.013	0.016	0.010	0.013	0.016
L	0.016	0.025	0.035	0.016	0.025	0.035
N	14			16		
α	0°	5°	8°	0°	5°	8°

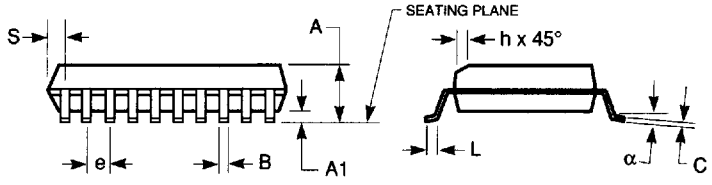
Notes:
1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.006 in. per side.
5. Lead coplanarity is 0.004 in. maximum.

150-MIL QSOP - Package Code Q

Quarter-Size Outline Package
Plastic Small Outline Gull-Wing

Notes:
1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.006in. per side.
5. Lead coplanarity is 0.004in. maximum.

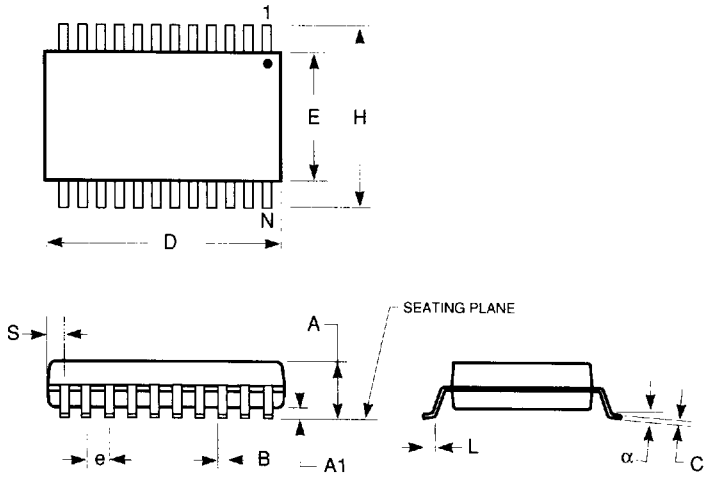




JEDEC#	MO-137AB			MO-137AD			MO-137AE			MO-137AF		
DWG#	PSS-16A			PSS-20A			PSS-24A			PSS-28A		
Symbol	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
A	0.060	0.064	0.068	0.060	0.064	0.068	0.060	0.064	0.068	0.060	0.064	0.068
A1	0.004	0.006	0.008	0.004	0.006	0.008	0.004	0.006	0.008	0.004	0.006	0.008
B	0.009	0.010	0.012	0.009	0.010	0.012	0.009	0.010	0.012	0.009	0.010	0.012
C	0.007	0.008	0.010	0.007	0.008	0.010	0.007	0.008	0.010	0.007	0.008	0.010
D	0.189	0.193	0.197	0.337	0.341	0.344	0.337	0.341	0.344	0.386	0.390	0.394
E	0.150	0.154	0.157	0.150	0.154	0.157	0.150	0.154	0.157	0.150	0.154	0.157
e	0.025 BSC			0.025 BSC			0.025 BSC			0.025 BSC		
H	0.230	0.236	0.244	0.230	0.236	0.244	0.230	0.236	0.244	0.230	0.236	0.244
h	0.010	0.013	0.016	0.010	0.013	0.016	0.010	0.013	0.016	0.010	0.013	0.016
L	0.016	0.025	0.035	0.016	0.025	0.035	0.016	0.025	0.035	0.016	0.025	0.035
N	16			20			24			28		
α	0°	5°	8°	0°	5°	8°	0°	5°	8°	0°	5°	8°
S	0.006	0.009	0.010	0.056	0.058	0.060	0.031	0.033	0.035	0.031	0.033	0.035

150-MIL HQSOP - Package Code H

Hermetic Quarter-Size Outline Package
Ceramic Small Outline Gull-Wing



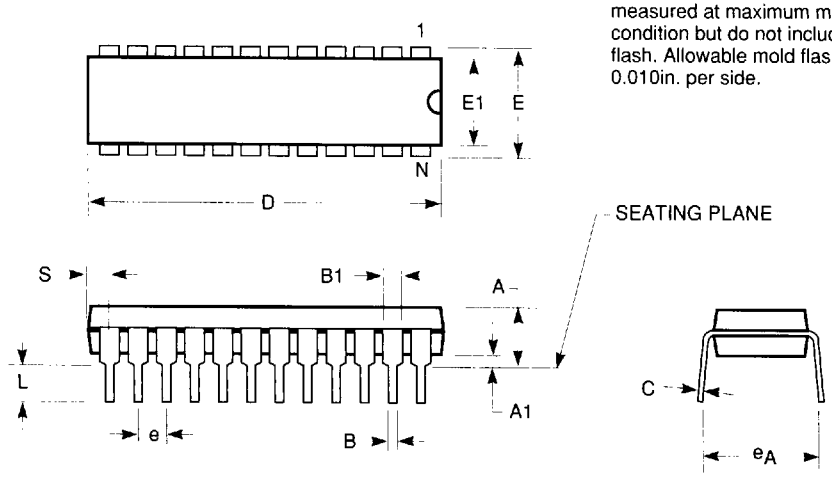
JEDEC#	TBD			TBD		
DWG#	HSS-20A			HSS-24A		
Symbol	Min	Nom	Max	Min	Nom	Max
A	0.070	0.074	0.078	0.070	0.074	0.078
A1	0.008	0.012	0.016	0.008	0.012	0.016
B	0.009	0.010	0.012	0.009	0.010	0.012
C	0.007	0.008	0.010	0.007	0.008	0.010
D	0.337	0.342	0.350	0.337	0.342	0.350
E	0.150	0.155	0.158	0.150	0.155	0.158
e	0.025 BSC			0.025 BSC		
H	0.230	0.236	0.244	0.230	0.236	0.244
L	0.016	0.025	0.035	0.016	0.025	0.035
N	20			24		
α	0°	5°	8°	0°	5°	8°
S	0.056	0.058	0.062	0.031	0.033	0.037

Notes:
1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition.
5. Lead coplanarity is 0.004in. maximum.

300-MIL PDIP - Package Code P

Plastic Dual In-line Package

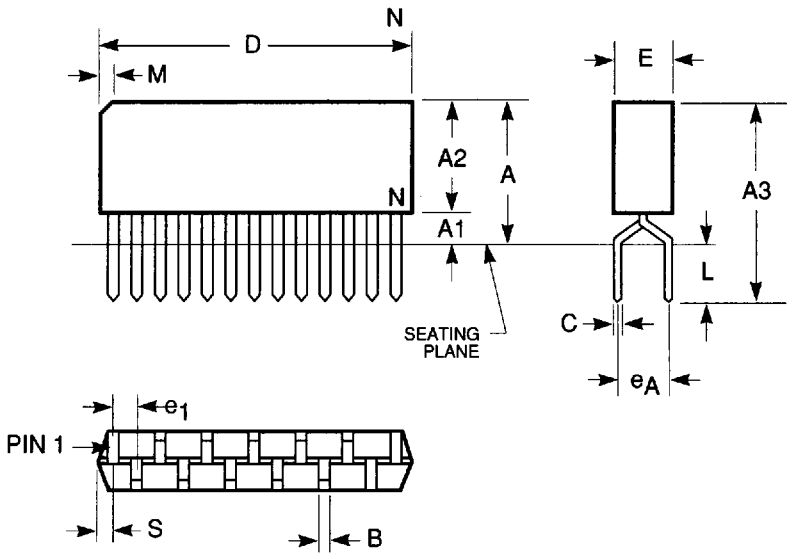
Notes:
1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E1 are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.010in. per side.



JEDEC#	MS-001AC		MS001AA		MS-001AE		N/A		MS-001AF		MO-095AH	
DWG#	PD14A		PD16A		PD20A		PT22B		PT24A		PT28A	
Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
A	0.130	0.170	0.130	0.170	0.130	0.170	0.130	0.170	0.130	0.170	0.130	0.180
A1	0.015	0.040	0.015	0.040	0.015	0.040	0.015	0.040	0.015	0.040	0.015	0.040
B	0.016	0.020	0.016	0.020	0.016	0.020	0.016	0.020	0.016	0.020	0.016	0.020
B1	0.045	0.070	0.045	0.070	0.045	0.070	0.045	0.070	0.045	0.070	0.045	0.060
C	0.009	0.012	0.009	0.012	0.009	0.012	0.009	0.012	0.009	0.012	0.009	0.012
D	0.745	0.765	0.745	0.765	1.020	1.040	1.020	1.040	1.150	1.260	1.345	1.385
E	0.300	0.325	0.300	0.325	0.300	0.325	0.300	0.325	0.300	0.325	0.300	0.325
E1	0.240	0.270	0.240	0.270	0.240	0.270	0.240	0.270	0.250	0.280	0.275	0.295
e	0.090	0.110	0.090	0.110	0.090	0.110	0.090	0.110	0.090	0.110	0.090	0.110
e_A	0.310	0.380	0.310	0.380	0.310	0.380	0.310	0.380	0.310	0.380	0.310	0.380
L	0.120	0.140	0.120	0.140	0.120	0.140	0.120	0.140	0.120	0.140	0.120	0.140
S	0.070	0.080	0.020	0.035	0.060	0.070	0.010	0.020	0.025	0.080	0.020	0.040
N	14		16		20		22		24		28	

300-MIL ZIP - Package Code Z

Zig-zag In-line Packages



JEDEC#	MO-072AB		MO-072AC		MO-072AD	
DWG#	PZ20A		PZ24A		PZ28A	
Symbol	Min	Max	Min	Max	Min	Max
A	0.350	0.400	0.350	0.400	0.350	0.400
A1	0.030	0.070	0.030	0.070	0.032	0.055
A2	0.280	0.340	0.320	0.350	0.335	0.345
A3	0.450	0.550	0.450	0.550	0.460	0.550
B	0.015	0.024	0.015	0.024	0.015	0.024
C	0.008	0.012	0.008	0.012	0.008	0.012
D	1.008	1.030	1.200	1.250	1.409	1.424
E	0.100	0.120	0.100	0.120	0.110	0.120
e1	0.050 BSC		0.050 BSC		0.050 BSC	
eA	0.100 BSC		0.100 BSC		0.100 BSC	
L	0.100	0.150	0.100	0.150	0.110	0.150
M	0.035	0.085	0.035	0.085	0.035	0.085
N	20		24		28	
S	0.018	0.032	0.018	0.032	0.025	0.038

Notes:
1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.010in. per side.