74AC/ACT11109

Dual J-$\overline{K}$ Flip-Flop with Set and Reset; Positive Edge-Triggered

Product Specification

FEATURES

- **Output capability: ±24 mA**
- **CMOS (AC) and TTL (ACT) voltage level inputs**
- **50Ω incident wave switching**
- **Center-pin V_{CC} and ground configuration to minimize high-speed switching noise**
- **I_{CC} category: SSI**

DESCRIPTION

The 74AC/ACT11109 high-performance CMOS devices combine very high speed and high output drive comparable to the most advanced TTL families.

The 74AC/ACT11109 provides two J-$\overline{K}$ flip-flops with independent Data, Clock, Set and Reset inputs, and complementary Q and $\overline{Q}$ outputs.

Set ($\overline{S}_n$) and Reset ($\overline{R}_n$) are asynchronous active-Low inputs and operate independently of the Clock input.

Information at the J and $\overline{K}$ inputs is transferred to the Q output on the Low-to-High transition of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive-going pulse. The J and $\overline{K}$ inputs must be stable one set-up time prior to the Low-to-High clock transition for predictable operation. The J and K inputs may be tied together to allow operation as a D flip-flop.

GENERAL INFORMATION

SYMBOL	PARAMETER	CONDITIONS T_A = 25°C; GND = 0V; V_{CC} = 5.0V	TYPICAL		UNIT
			AC	ACT	
t_{PLH}/t_{PHL}	Propagation delay CP_n to Q_n or $\overline{Q}_n$	C_L = 50pF	5.3	5.8	ns
C_{PD}	Power dissipation capacitance per flip-flop[1]	f = 1MHz; C_L = 50pF	32	31	pF
C_{IN}	Input capacitance	V_I = 0V or V_{CC}	3.5	3.5	pF
I_{LATCH}	Latch-up current	Per Jedec JC40.2 Standard 17	500	500	mA
f_{MAX}	Maximum clock frequency	C_L = 50pF	125	125	MHz

Note:

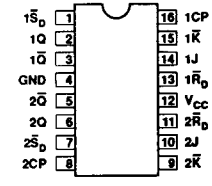
1. C_{PD} is used to determine the dynamic power dissipation (P_D in µW):
   $P_D = C_{PD} \times V_{CC}^2 \times f_I + \Sigma (C_L \times V_{CC}^2 \times f_O)$ where:
   f_I = input frequency in MHz, C_L = output load capacitance in pF,
   f_O = output frequency in MHz, V_{CC} = supply voltage in V,
   $\Sigma (C_L \times V_{CC}^2 \times f_O)$ = sum of outputs

ORDERING INFORMATION

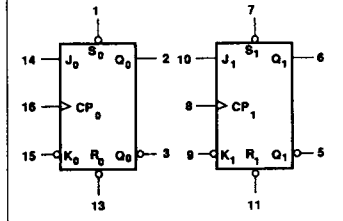
PACKAGES	TEMPERATURE RANGE	ORDER CODE
16-pin plastic DIP (300mil-wide)	-40°C to +85°C	74AC11109N 74ACT11109N
16-pin plastic SO (150mil-wide)	-40°C to +85°C	74AC11109D 74ACT11109D

PIN CONFIGURATION

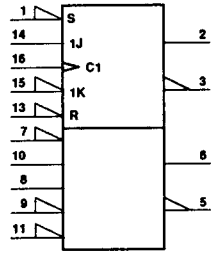
N and D Packages



LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



Dual J-$\overline{K}$ Flip-Flop with Set and Reset; Positive Edge-Triggered

74AC/ACT11109

PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
14, 10	J_0 - J_1	Data inputs
15, 9	$\overline{K}_0$ - $\overline{K}_1$	Data inputs
2, 6	Q_0 - Q_1	Data outputs
3, 5	$\overline{Q}_0$ - $\overline{Q}_1$	Data outputs (complements of Q_n outputs)
1, 7	$\overline{S}_0$ - $\overline{S}_1$	Set inputs (active Low)
13, 11	$\overline{R}_0$ - $\overline{R}_1$	Reset inputs (active Low)
16, 8	CP_0 - CP_1	Clock inputs
4	GND	Ground (0V)
12	V_{CC}	Positive supply voltage

FUNCTION TABLE

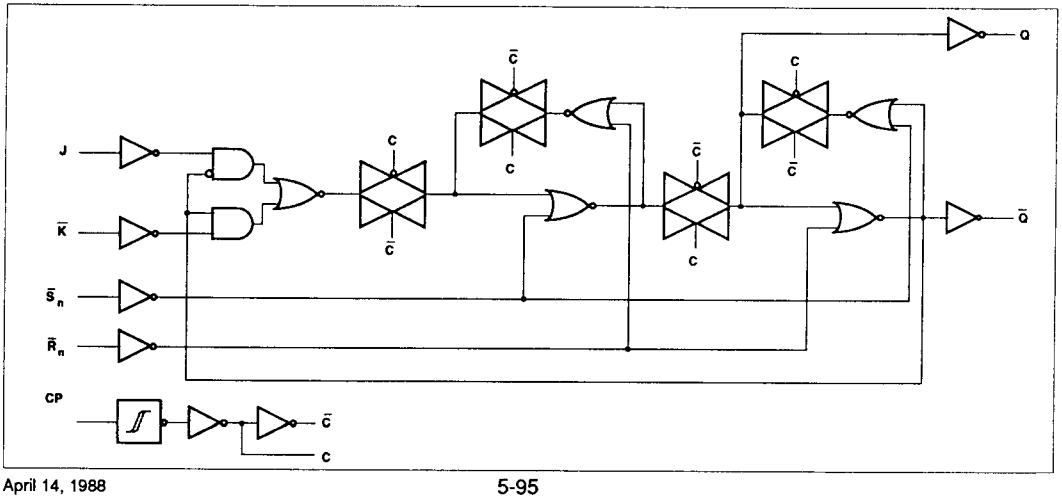
OPERATING MODE	INPUTS					OUTPUTS	
	$\overline{S}$	$\overline{R}$	CP	J	$\overline{K}$	Q	$\overline{Q}$
Asynchronous set	L	H	X	X	X	H	L
Asynchronous reset (clear)	H	L	X	X	X	L	H
Undetermined[1]	L	L	X	X	X	H	H
Load "0" (reset)	H	H	↑	l	l	L	H
Load "1" (set)	H	H	↑	h	h	H	L
Toggle	H	H	↑	h	l	$\overline{q}$	q
No change – hold	H	H	L	X	X	Q_0	$\overline{Q}_0$

H = High voltage level steady state
h = High voltage level one set-up time prior to the Low-to-High clock transition
L = Low voltage level steady state
l = Low voltage level one set-up time prior to the Low-to-High clock transition
X = Don't care
q = Lower case letters indicate the state of the referenced output prior to the Low-to-High clock transition
↑ = Low-to-High clock transition

NOTE:

1. This configuration is nonstable; that is, it will not persist when either Set or Reset returns to its inactive (High) level.

LOGIC DIAGRAM



RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	74AC11109			74ACT11109			UNIT
		Min	Nom	Max	Min	Nom	Max	
V_{CC}	DC supply voltage	3.0[1]	5.0	5.5	4.5	5.0	5.5	V
V_I	Input voltage	0		V_{CC}	0		V_{CC}	V
V_O	Output voltage	0		V_{CC}	0		V_{CC}	V
$\Delta t/\Delta v$	Input transition rise or fall rate	0		10	0		10	ns/V
T_A	Operating free-air temperature	-40		+85	-40		+85	°C

NOTE:

1. No electrical or switching characteristics are specified at $V_{CC} < 3V$. Operation between 2V and 3V is not recommended, but within that range, a device output will maintain a previously established logic state.

ABSOLUTE MAXIMUM RATINGS[1]

SYMBOL	PARAMETER	TEST CONDITIONS	RATING	UNIT
V_{CC}	DC supply voltage		-0.5 to+7.0	V
I_{IK} or V_I	DC input diode current[2]	$V_I < 0$	-20	mA
		$V_I > V_{CC}$	20	
	DC input voltage		-0.5 to V_{CC} +0.5	V
I_{OK} or V_O	DC output diode current[2]	$V_O < 0$	-50	mA
		$V_O > V_{CC}$	50	
	DC output voltage		-0.5 to V_{CC} +0.5	V
I_O	DC output source or sink current per output pin	V_O = 0 to V_{CC}	±50	mA
I_{CC} or I_{GND}	DC V_{CC} current		±100	mA
	DC ground current		±100	
T_{STG}	Storage temperature		-65 to 150	°C
P_{TOT}	Power dissipation per package Plastic DIP	Above 70°C:derate linearly by 8mW/K	500	mW
	Power dissipation per package	Above 70°C:derate linearly by 6mW/K	400	mW

NOTES:

1. Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS		V_{CC}	74AC11109				74ACT11109				UNIT
					T_A = +25°C		T_A = -40°C to +85°C		T_A = +25°C		T_A = -40°C to +85°C		
				V	Min	Max	Min	Max	Min	Max	Min	Max	
V_{IH}	High-level input voltage			3.0	2.10		2.10						V
				4.5	3.15		3.15		2.0		2.0		
				5.5	3.85		3.85		2.0		2.0		
V_{IL}	Low-level input voltage			3.0		0.90		0.90					V
				4.5		1.35		1.35		0.8		0.8	
				5.5		1.65		1.65		0.8		0.8	
V_{OH}	High-level output voltage	V_I = V_{IL} or V_{IH}	I_{OH} = -50μA	3.0	2.9		2.9						V
				4.5	4.4		4.4		4.4		4.4		
				5.5	5.4		5.4		5.4		5.4		
			I_{OH} = -4mA	3.0	2.58		2.48						
			I_{OH} = -24mA	4.5	3.94		3.8		3.94		3.8		
				5.5	4.94		4.8		4.94		4.8		
			I_{OH} = -75mA[1]	5.5			3.85				3.85		
V_{OL}	Low-level output voltage	V_I = V_{IL} or V_{IH}	I_{OL} = 50μA	3.0		0.1		0.1					V
				4.5		0.1		0.1		0.1		0.1	
				5.5		0.1		0.1		0.1		0.1	
			I_{OL} = 12mA	3.0		0.36		0.44					
			I_{OL} = 24mA	4.5		0.36		0.44		0.36		0.44	
				5.5		0.36		0.44		0.36		0.44	
			I_{OL} = 75mA[1]	5.5				1.65				1.65	
I_I	Input leakage current	V_I = V_{CC} or GND		5.5		±0.1		±1.0		±0.1		±1.0	μA
I_{CC}	Quiescent supply current	V_I = V_{CC} or GND, I_O = 0		5.5		4.0		40		4.0		40	μA
ΔI_{CC}	Supply current, TTL inputs High[2]	One input at 3.4V, other inputs at V_{CC} or GND		5.5						0.9		1.0	mA

NOTES:
1. Not more than one output should be tested at a time, and the duration of the test should not exceed 10ms.
2. This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than 0V or V_{CC}.

AC ELECTRICAL CHARACTERISTICS AT 3.3V ±0.3V

SYMBOL	PARAMETER	WAVEFORM	74AC11109					UNIT
			T_A = +25°C			T_A = -40°C to +85°C		
			Min	Typ	Max	Min	Max	
f_{MAX}	Maximum clock frequency	1	70	100		70		MHz
t_{PLH} t_{PHL}	Propagation delay CP_n to Q_n, $\overline{Q}_n$	1	1.5 1.5	8.0 7.5	11.4 10.5	1.5 1.5	12.7 11.8	ns
t_{PLH} t_{PHL}	Propagation delay $\overline{S}_n$, $\overline{R}_n$ to Q_n, $\overline{Q}_n$	2	1.5 1.5	6.5 8.0	9.0 12.6	1.5 1.5	9.9 13.7	ns
t_S	Setup time, High or Low J_n or $\overline{K}_n$ to CP_n	1	5.5			5.5		ns
t_H	Hold time, High or Low CP_n to J_n or $\overline{K}_n$	1	0			0		ns
t_W	Clock pulse width High or Low	1	7.2			7.2		ns
t_W	$\overline{S}_n$ or $\overline{R}_n$ pulse width, Low	2	5.0			5.0		ns
t_{REC}	Recovery time $\overline{S}_n$ or $\overline{R}_n$ to CP_n	3	2.5			2.5		ns

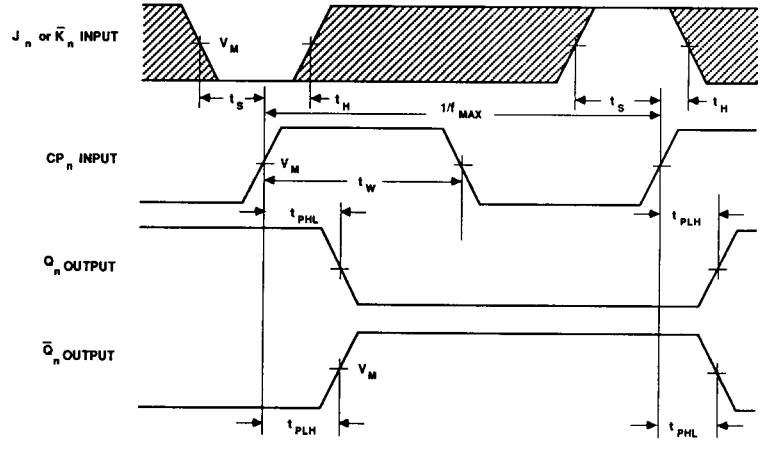
AC ELECTRICAL CHARACTERISTICS AT 5.0V ±0.5V

SYMBOL	PARAMETER	WAVEFORM	74AC11109					UNIT
			T_A = +25°C			T_A = -40°C to +85°C		
			Min	Typ	Max	Min	Max	
f_{MAX}	Maximum clock frequency	1	100	125		100		MHz
t_{PLH} t_{PHL}	Propagation delay CP_n to Q_n, $\overline{Q}_n$	1	1.5 1.5	5.5 5.0	7.9 7.3	1.5 1.5	8.8 8.1	ns
t_{PLH} t_{PHL}	Propagation delay $\overline{S}_n$, $\overline{R}_n$ to Q_n, $\overline{Q}_n$	2	1.5 1.5	4.5 5.0	6.5 8.6	1.5 1.5	7.1 9.6	ns
t_S	Setup time, High or Low J_n or $\overline{K}_n$ to CP_n	1	4.5			4.5		ns
t_H	Hold time, High or Low CP_n to J_n or $\overline{K}_n$	1	0			0		ns
t_W	Clock pulse width High or Low	1	5.0			5.0		ns
t_W	$\overline{S}_n$ or $\overline{R}_n$ pulse width, Low	2	4.0			4.0		ns
t_{REC}	Recovery time $\overline{S}_n$ or $\overline{R}_n$ to CP_n	3	2.0			2.0		ns

AC ELECTRICAL CHARACTERISTICS AT 5.0V ±0.5V

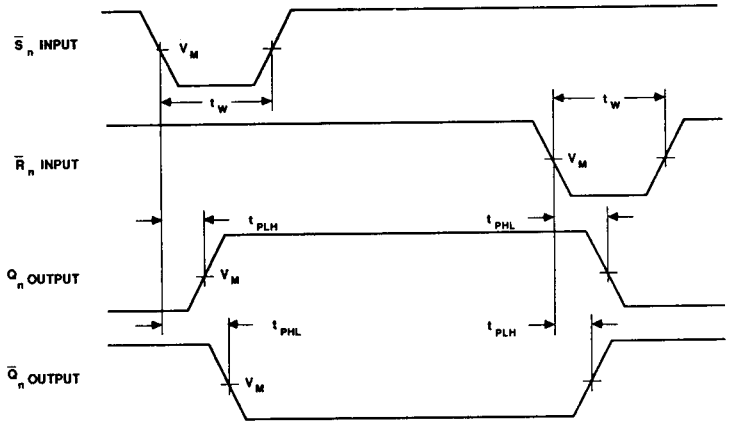
SYMBOL	PARAMETER	WAVEFORM	74ACT11109					UNIT
			T_A = +25°C			T_A = -40°C to +85°C		
			Min	Typ	Max	Min	Max	
f_{MAX}	Maximum clock frequency	1	100	125		100		MHz
t_{PLH} t_{PHL}	Propagation delay CP_n to Q_n, $\overline{Q}_n$	1	1.5 1.5	6.0 5.5	8.3 7.6	1.5 1.5	9.1 8.3	ns
t_{PLH} t_{PHL}	Propagation delay $\overline{S}_n$, $\overline{R}_n$ to Q_n, $\overline{Q}_n$	2	1.5 1.5	5.5 6.0	8.6 10.8	1.5 1.5	9.2 11.8	ns
t_S	Setup time, High or Low J_n or $\overline{K}_n$ to CP_n	1	5.5			5.5		ns
t_H	Hold time, High or Low CP_n to J_n or $\overline{K}_n$	1	0			0		ns
t_W	Clock pulse width High or Low	1	5.0			5.0		ns
t_W	$\overline{S}_n$ or $\overline{R}_n$ pulse width, Low	2	5.5			5.5		ns
t_{REC}	Recovery time $\overline{S}_n$ or $\overline{R}_n$ to CP_n	3	2.0			2.0		ns

AC WAVEFORMS

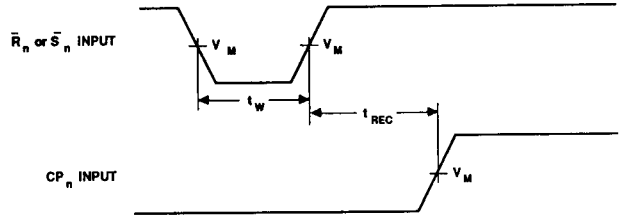


Waveform 1. Waveforms Showing Clock to Output Delays, Data Setup, and Clock Pulse Width

AC WAVEFORMS (Continued)



Waveform 2. Waveforms Showing Set and Reset to Output Delays, Set and Reset Pulse Widths

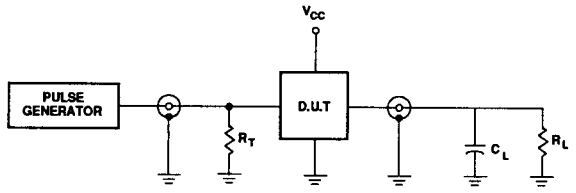


Waveform 3. Waveforms Showing Recovery Time

WAVEFORM CONDITIONS

	INPUTS	OUTPUTS
AC	V_{IN} = GND to V_{CC}, V_M = 50% V_{CC}	V_{OUT} = V_{OL} to V_{OH}
ACT	V_{IN} = GND to 3.0V, V_M = 1.5V	V_M = 50% V_{CC}

TEST CIRCUIT



Test Circuit

DEFINITIONS

C_L = Load capacitance, 50pF; includes jig and probe capacitance

R_L = Load resistor, 500Ω

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators

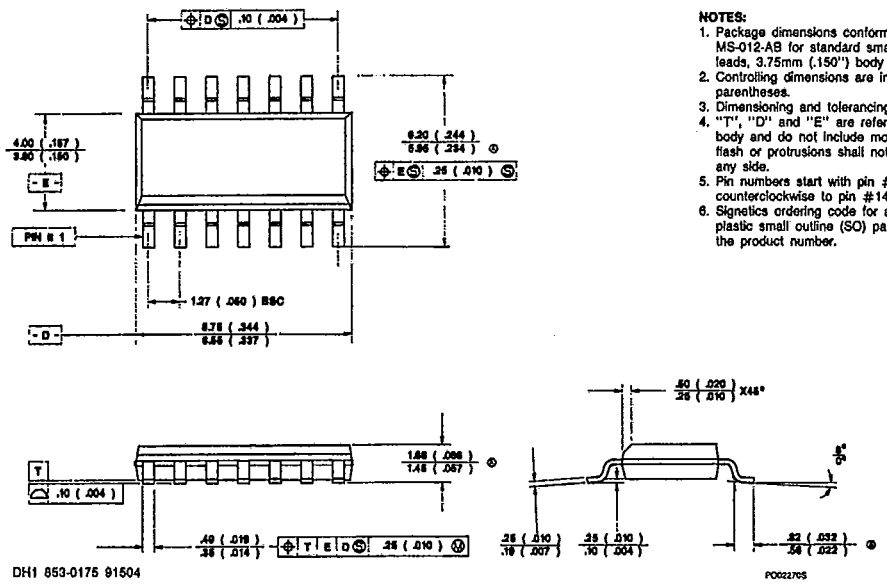
Input pulses: PRR ≤ 10MHz

$t_r = t_f = 3ns$

Packaging Information

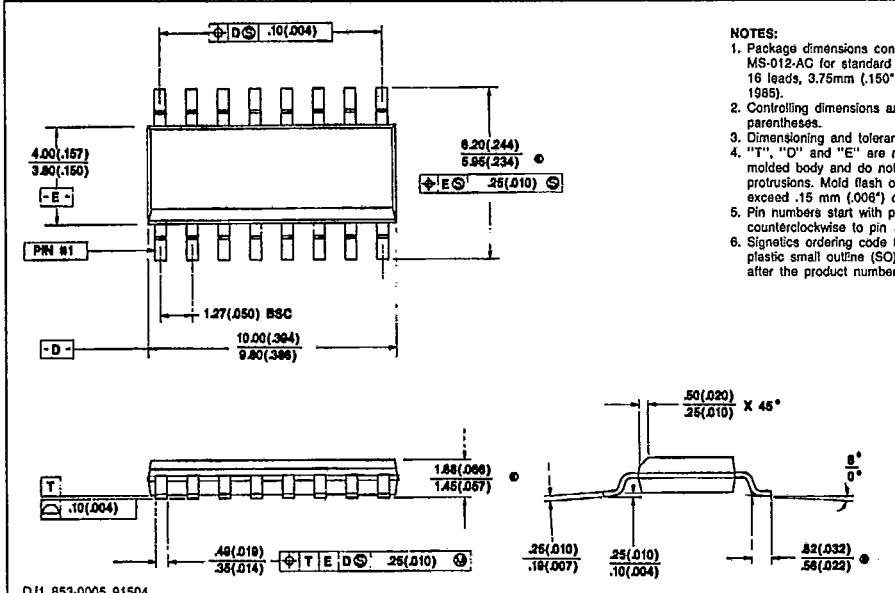
T-90-20

14-PIN PLASTIC SMALL OUTLINE (SO)



NOTES:
1. Package dimensions conform to JEDEC specification MS-012-AB for standard small outline (SO) package, 14 leads, 3.75mm (.150") body width (issue A, June 1985).
2. Controlling dimensions are in mm. Inch dimensions in parentheses.
3. Dimensioning and tolerancing per ANSI Y14.5M- 1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .15mm (.006") on any side.
5. Pin numbers start with pin #1 and continue counterclockwise to pin #14 when viewed from top.
6. Signetics ordering code for a product packaged in a plastic small outline (SO) package is the suffix D after the product number.

16-PIN PLASTIC SMALL OUTLINE (SO)

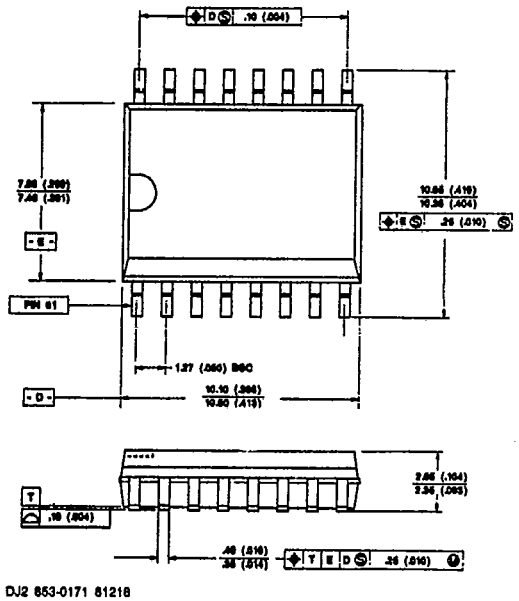


NOTES:
1. Package dimensions conform to JEDEC specification MS-012-AC for standard small outline (SO) package, 16 leads, 3.75mm (.150") body width (issue A, June 1985).
2. Controlling dimensions are mm. Inch dimensions in parentheses.
3. Dimensioning and tolerancing per ANSI Y14.5M-1982.
4. "T", "D" and "E" are reference Datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .15 mm (.006") on any side.
5. Pin numbers start with pin #1 and continue counterclockwise to pin #16 when viewed from top.
6. Signetics ordering code for a product packaged in a plastic small outline (SO) package is the suffix "D" after the product number.

T-90-20

Packaging Information

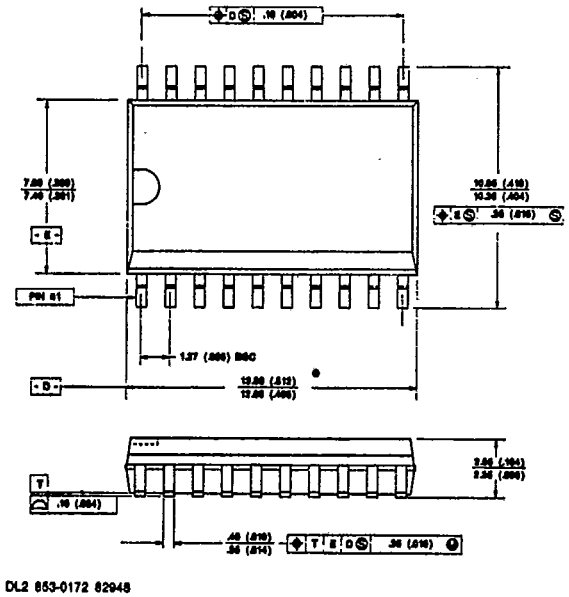
16-PIN PLASTIC SMALL OUTLINE (SOL)



NOTES:
1. Package dimensions conform to JEDEC specification MS-013-AA for standard small outline (SO) package, 16 leads, 7.50mm (.300") body width (Issue A, June 1985).
2. Controlling dimensions are in mm. Inch dimensions in parentheses.
3. Dimensioning and tolerancing per ANSI Y14.5M-1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .15mm (.006") on any side.
5. Pin numbers start with pin #1 and continue counterclockwise to pin #16 when viewed from top.
6. Signetics ordering code for a product packaged in a plastic small outline (SO) package is the suffix D after the product number.

DJ2 853-0171 81218

20-PIN PLASTIC SMALL OUTLINE (SOL)

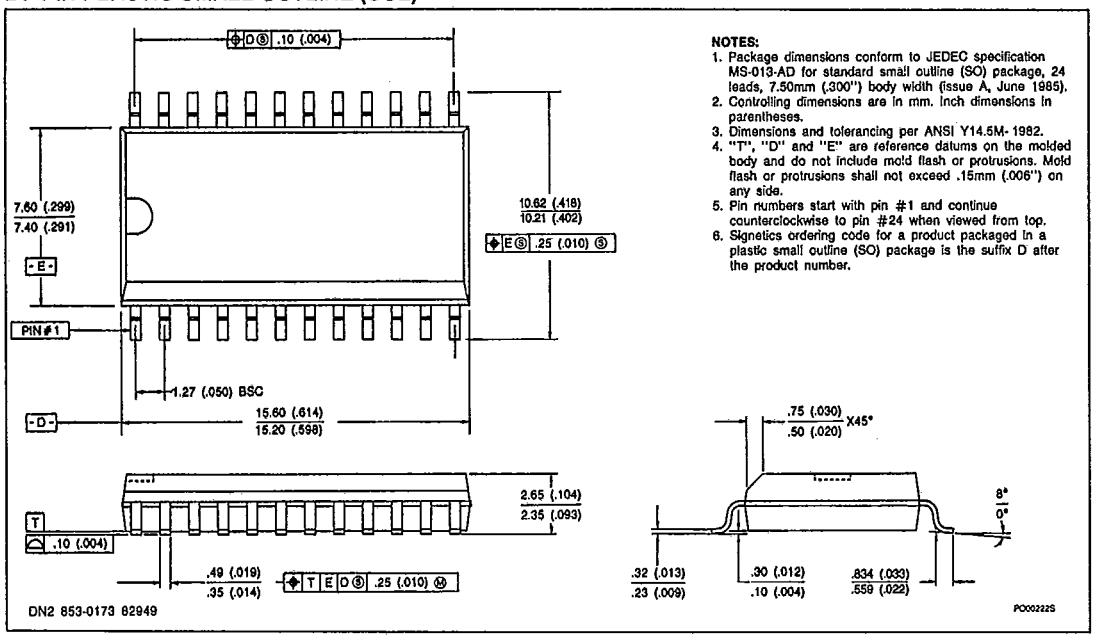


NOTES:
1. Package dimensions conform to JEDEC specification MS-013-AC for standard small outline (SO) package, 20 leads, 7.50mm (.300") body width (Issue A, June 1985).
2. Controlling dimensions are in mm. Inch dimensions in parentheses.
3. Dimensioning and tolerancing per ANSI Y14.5M-1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .15mm (.006") on any side.
5. Pin numbers start with pin #1 and continue counterclockwise to pin #20 when viewed from top.
6. Signetics ordering code for a product packaged in a plastic small outline (SO) package is the suffix D after the product number.

DL2 853-0172 82948

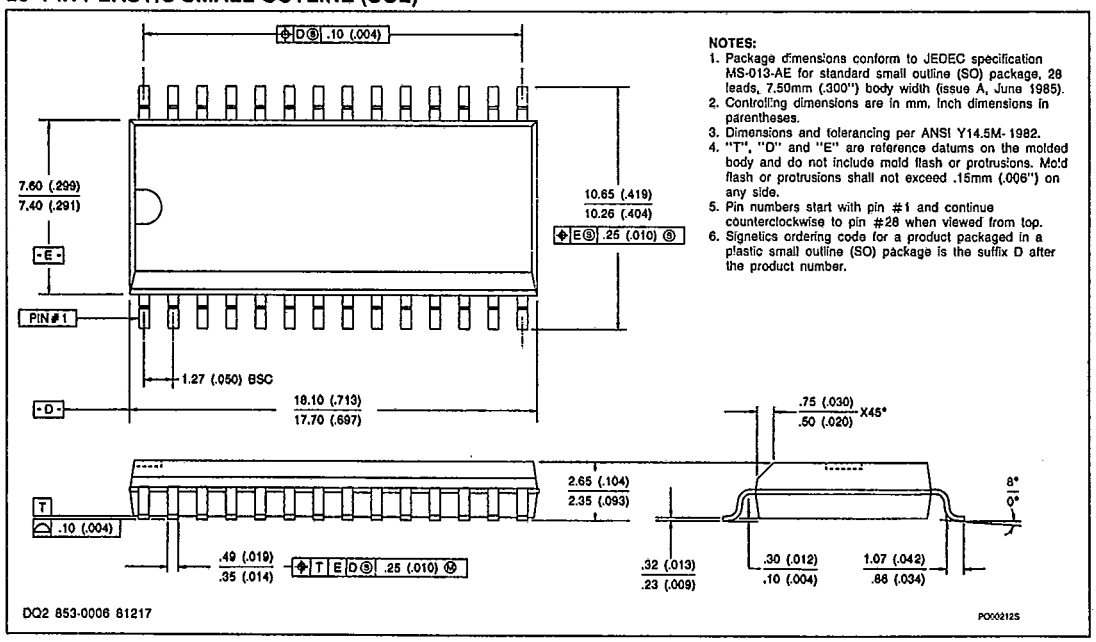
Packaging Information

24–PIN PLASTIC SMALL OUTLINE (SOL)



NOTES:
1. Package dimensions conform to JEDEC specification MS-013-AD for standard small outline (SO) package, 24 leads, 7.50mm (.300") body width (issue A, June 1985).
2. Controlling dimensions are in mm. Inch dimensions in parentheses.
3. Dimensions and tolerancing per ANSI Y14.5M- 1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .15mm (.006") on any side.
5. Pin numbers start with pin #1 and continue counterclockwise to pin #24 when viewed from top.
6. Signetics ordering code for a product packaged in a plastic small outline (SO) package is the suffix D after the product number.

28–PIN PLASTIC SMALL OUTLINE (SOL)

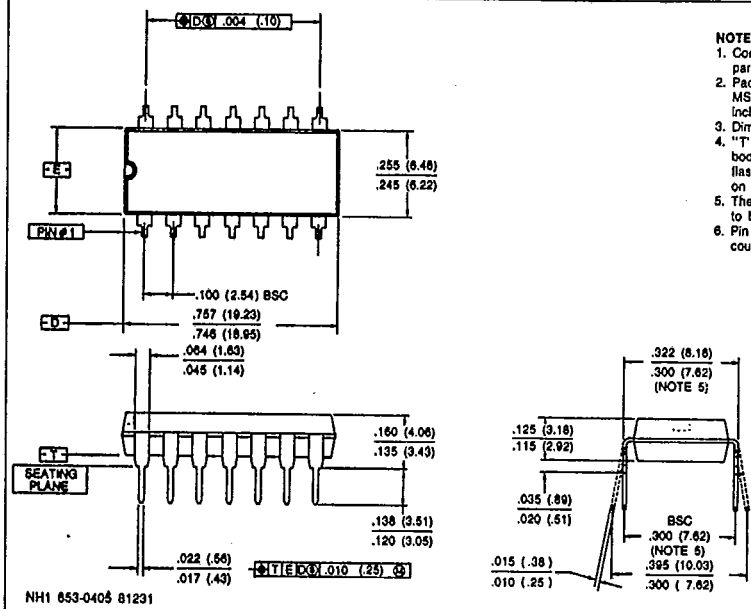


NOTES:
1. Package dimensions conform to JEDEC specification MS-013-AE for standard small outline (SO) package, 28 leads, 7.50mm (.300") body width (issue A, June 1985).
2. Controlling dimensions are in mm. Inch dimensions in parentheses.
3. Dimensions and tolerancing per ANSI Y14.5M- 1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .15mm (.006") on any side.
5. Pin numbers start with pin #1 and continue counterclockwise to pin #28 when viewed from top.
6. Signetics ordering code for a product packaged in a plastic small outline (SO) package is the suffix D after the product number.

Packaging Information

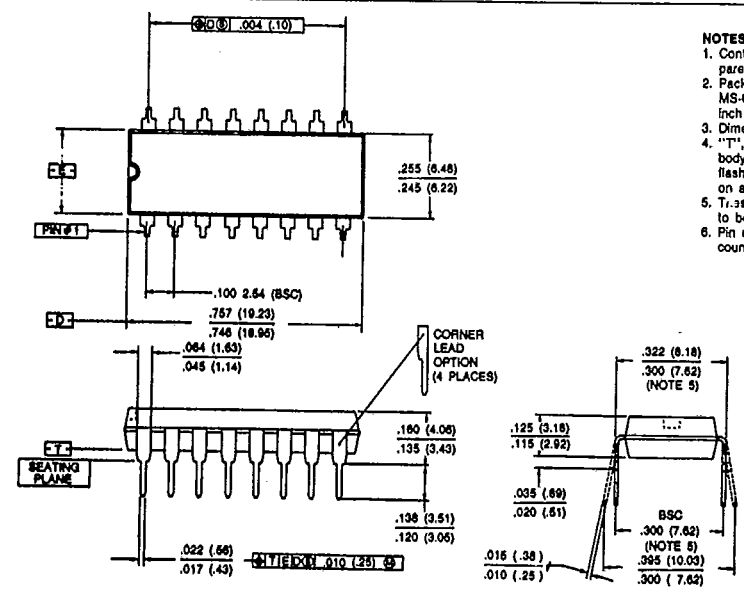
T-90-20

14-PIN PLASTIC DUAL IN-LINE (PDIP)



NOTES:
1. Controlling dimension: inches. Metric are shown in parentheses.
2. Package dimensions conform to JEDEC specification MS-001-AC for standard dual in-line (DIP) package .300 inch row spacing (PLASTIC) 14 leads (issue B. 7/85)
3. Dimensions and tolerancing per ANSI Y14. 5M-1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010 inch (.25mm) on any side.
5. These dimensions measured with the leads constrained to be perpendicular to plane T.
6. Pin numbers start with pin #1 and continue counterclockwise to pin #14 when viewed from the top.

16-PIN PLASTIC DUAL IN-LINE (PDIP)



NOTES:
1. Controlling dimension: inches. Metric are shown in parentheses.
2. Package dimensions conform to JEDEC specification MS-001-AA for standard dual in-line (DIP) package .300 inch row spacing (PLASTIC) 16 leads (issue B. 7/85)
3. Dimensions and tolerancing per ANSI Y14. 5M-1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010 inch (.25mm) on any side.
5. These dimensions measured with the leads constrained to be perpendicular to plane T.
6. Pin numbers start with pin #1 and continue counterclockwise to pin #16 when viewed from the top.

Packaging Information

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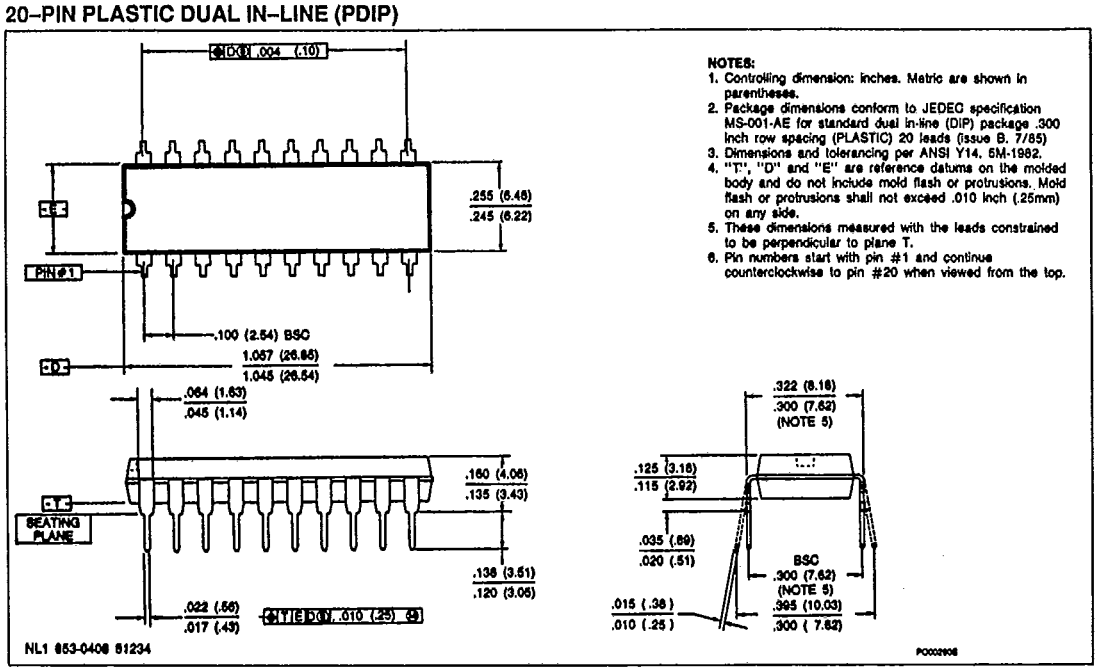
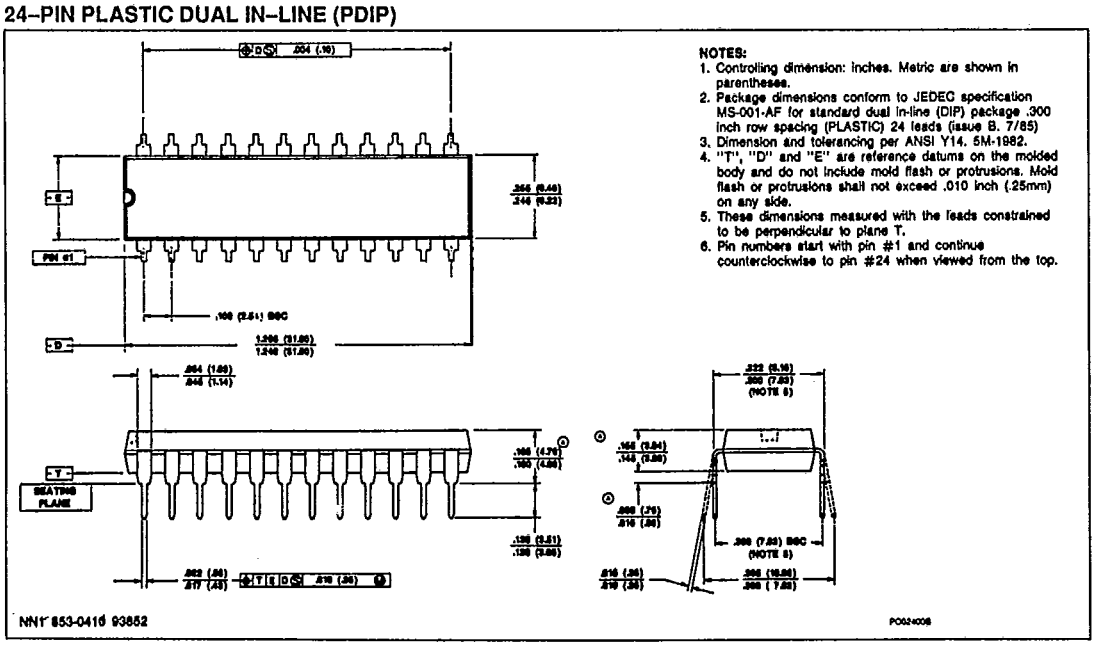
20-PIN PLASTIC DUAL IN-LINE (PDIP)



NOTES:
1. Controlling dimension: inches. Metric are shown in parentheses.
2. Package dimensions conform to JEDEC specification MS-001-AE for standard dual in-line (DIP) package .300 inch row spacing (PLASTIC) 20 leads (issue B, 7/85)
3. Dimensions and toleraricing per ANSI Y14. 5M-1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010 inch (.25mm) on any side.
5. These dimensions measured with the leads constrained to be perpendicular to plane T.
6. Pin numbers start with pin #1 and continue counterclockwise to pin #20 when viewed from the top.

24-PIN PLASTIC DUAL IN-LINE (PDIP)

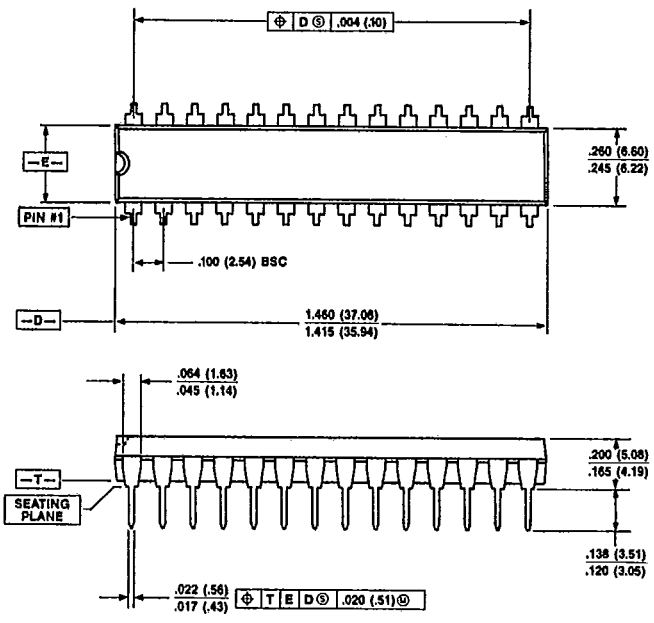


NOTES:
1. Controlling dimension: inches. Metric are shown in parentheses.
2. Package dimensions conform to JEDEC specification MS-001-AF for standard dual in-line (DIP) package .300 inch row spacing (PLASTIC) 24 leads (issue B, 7/85)
3. Dimension and toleraricing per ANSI Y14. 5M-1982.
4. "T", "D" and "E" are reference datums on the molded body and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010 inch (.25mm) on any side.
5. These dimensions measured with the leads constrained to be perpendicular to plane T.
6. Pin numbers start with pin #1 and continue counterclockwise to pin #24 when viewed from the top.

T-90-20

Packaging Information

28-PIN PLASTIC DUAL IN-LINE (PDIP) (300-mil-wide)



NOTES:
1. Controlling dimensions: inches. Metric are shown in parentheses.
2. Dimensions are tolerancing per ANSI Y14.5M-1982.
3. "T", "D", and "E" are reference datums on the molded body and do not include mold-flash or protrusions which shall not exceed .010 inch (.25 mm) on any side.
4. These dimensions measured with the leads constrained to be perpendicular to plane "T".
5. Pin numbers start with #1 and continue counterclockwise to pin #28 when viewed from the top.

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