DATA SHEET

74LV377

Octal D-type flip-flop with data enable; positive edge-trigger

Product specification
Supersedes data of 1997 Mar 04
IC24 Data Handbook

1998 Jun 10

Philips
Semiconductors

PHILIPS

Octal D-type flip-flop with data enable; positive edge-trigger

74LV377

FEATURES

- Optimized for Low Voltage applications: 1.0 to 3.6V
- Accepts TTL input levels between V_{CC} = 2.7V and V_{CC} = 3.6V
- Typical V_{OLP} (output ground bounce) < 0.8V @ V_{CC} = 3.3V, T_{amb} = 25°C
- Typical V_{OHV} (output V_{OH} undershoot) > 2V @ V_{CC} = 3.3V, T_{amb} = 25°C
- Ideal for addressable register applications
- Data enable for address and data synchronization applications
- Eight positive-edge triggered D-type flip-flops
- Output capability: standard
- I_{CC} category: MSI

DESCRIPTION

The 74LV377 is a low–voltage CMOS device and is pin and function compatible with 74HC/HCT377.

The 74LV377 has eight edge-triggered, D-type flip-flops with individual D inputs and Q outputs. A common clock (CP) input loads all flip-flops simultaneously when the data enable ($\overline{E}$) is LOW. The state of each D input, one set-up time before the LOW-to-HIGH clock transition, is transferred to the corresponding output (Q_n) of the flip-flop. The $\overline{E}$ input must be stable only one set-up time prior to the LOW-to-HIGH transition for predictable operation.

QUICK REFERENCE DATA

GND = 0V; T_{amb} = 25°C; $t_r = t_f \leq 2.5$ ns

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay CP to Q_n	C_L = 15pF, V_{CC} = 3.3V	13	ns
f_{max}	Maximum clock frequency		77	MHz
C_I	Input capacitance		3.5	pF
C_{PD}	Power dissipation capacitance per flip-flop	Notes 1 and 2	20	pF

NOTES:

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 capacity 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 the outputs.
2. The condition is V_I = GND to V_{CC}

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic DIL	–40°C to +125°C	74LV377 N	74LV377 N	SOT146-1
20-Pin Plastic SO	–40°C to +125°C	74LV377 D	74LV377 D	SOT163-1
20-Pin Plastic SSOP Type II	–40°C to +125°C	74LV377 DB	74LV377 DB	SOT339-1
20-Pin Plastic TSSOP Type I	–40°C to +125°C	74LV377 PW	74LV377PW DH	SOT360-1

PIN DESCRIPTION

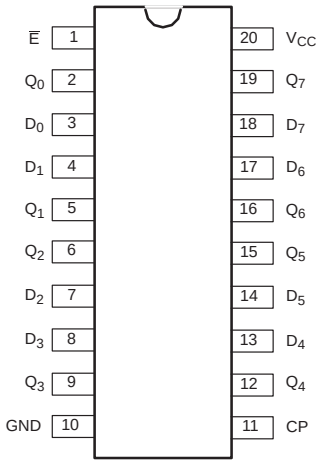
PIN NUMBER	SYMBOL	FUNCTION
1	$\overline{E}$	Data enable input (active-LOW)
2, 5, 6, 9, 12, 15, 16, 19	Q_0 to Q_7	flip-flop outputs
3, 4, 7, 8, 13, 14, 17, 18	D_0 to D_7	Data inputs
10	GND	Ground (0V)
11	CP	Clock input (LOW-to-HIGH, edge-triggered)
20	V_{CC}	Positive supply voltage

FUNCTION TABLE

OPERATING MODES	INPUTS			OUTPUTS
	CP	$\overline{E}$	D_n	Q_n
Load “1”	↑	l	h	H
Load “0”	↑	l	l	L
Hold (do nothing)	↑	h	X	No change
	X	H	X	No change

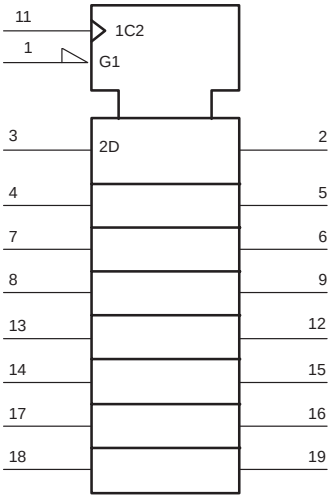
H = HIGH voltage level
h = HIGH voltage level one set-up time prior to the LOW-to-HIGH CP transition
L = LOW voltage level
l = LOW voltage level one set-up time prior to the LOW-to-HIGH CP transition
↑ = LOW–to–HIGH CP transition
X = Don’t care

PIN CONFIGURATION



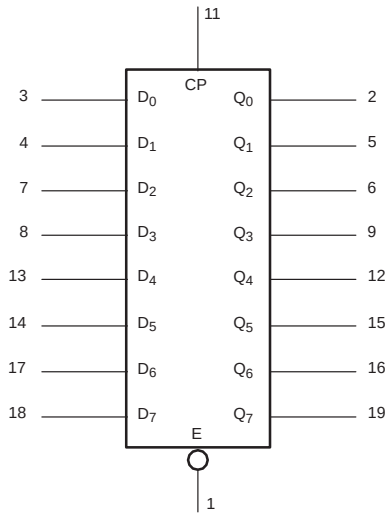
SV00667

LOGIC SYMBOL (IEEE/IEC)



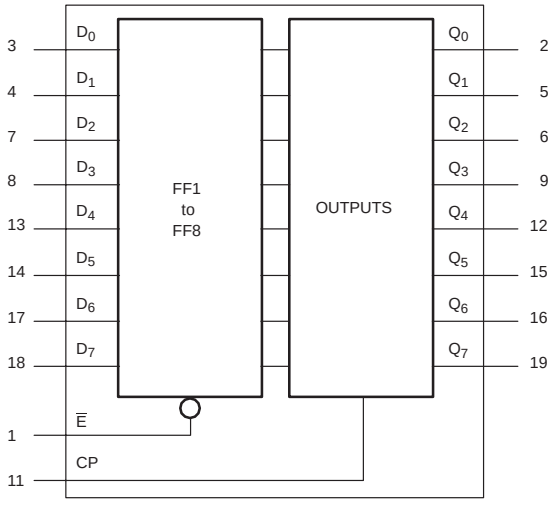
SV00669

LOGIC SYMBOL



SV00668

FUNCTIONAL DIAGRAM



SV00670

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
V_{CC}	DC supply voltage	See Note 1	1.0	3.3	3.6	V
V_I	Input voltage		0	–	V_{CC}	V
V_O	Output voltage		0	–	V_{CC}	V
T_{amb}	Operating ambient temperature range in free air	See DC and AC characteristics	–40 –40		+85 +125	°C
t_r, t_f	Input rise and fall times	V_{CC} = 1.0V to 2.0V V_{CC} = 2.0V to 2.7V V_{CC} = 2.7V to 3.6V	– – –	– – – –	500 200 100	ns/V

NOTE:
1. The LV is guaranteed to function down to V_{CC} = 1.0V (input levels GND or V_{CC}); DC characteristics are guaranteed from V_{CC} = 1.2V to V_{CC} = 3.6V.

ABSOLUTE MAXIMUM RATINGS[1, 2]

In accordance with the Absolute Maximum Rating System (IEC 134).
Voltages are referenced to GND (ground = 0V).

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V_{CC}	DC supply voltage		–0.5 to +4.6	V
$\pm I_{IK}$	DC input diode current	$V_I < –0.5$ or $V_I > V_{CC} + 0.5V$	20	mA
$\pm I_{OK}$	DC output diode current	$V_O < –0.5$ or $V_O > V_{CC} + 0.5V$	50	mA
$\pm I_O$	DC output source or sink current – standard outputs	$–0.5V < V_O < V_{CC} + 0.5V$	25	mA
$\pm I_{GND}$, $\pm I_{CC}$	DC V_{CC} or GND current for types with –standard outputs		50	mA
T_{stg}	Storage temperature range		–65 to +150	°C
P_{tot}	Power dissipation per package –plastic DIL –plastic mini-pack (SO) –plastic shrink mini-pack (SSOP and TSSOP)	for temperature range: –40 to +125°C above +70°C derate linearly with 12mW/K above +70°C derate linearly with 8 mW/K above +60°C derate linearly with 5.5 mW/K	 750 500 400	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 CHARACTERISTICS FOR THE LV FAMILY

Over recommended operating conditions. Voltages are referenced to GND (ground = 0V).

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			-40°C to +85°C			-40°C to +125°C		
			MIN	TYP[1]	MAX	MIN	MAX	
V_{IH}	HIGH level Input voltage	V_{CC} = 1.2V	0.9			0.9		V
		V_{CC} = 2.0V	1.4			1.4		
		V_{CC} = 2.7 to 3.6V	2.0			2.0		
V_{IL}	LOW level Input voltage	V_{CC} = 1.2V			0.3		0.3	V
		V_{CC} = 2.0V			0.6		0.6	
		V_{CC} = 2.7 to 3.6V			0.8		0.8	
V_{OH}	HIGH level output voltage; all outputs	V_{CC} = 1.2V; $V_I = V_{IH}$ or V_{IL}; $-I_O$ = 100µA		1.2				V
		V_{CC} = 2.0V; $V_I = V_{IH}$ or V_{IL}; $-I_O$ = 100µA	1.8	2.0		1.8		
		V_{CC} = 2.7V; $V_I = V_{IH}$ or V_{IL}; $-I_O$ = 100µA	2.5	2.7		2.5		
		V_{CC} = 3.0V; $V_I = V_{IH}$ or V_{IL}; $-I_O$ = 100µA	2.8	3.0		2.8		
	HIGH level output voltage; STANDARD outputs	V_{CC} = 3.0V; $V_I = V_{IH}$ or V_{IL}; $-I_O$ = 6mA	2.40	2.82		2.20		
V_{OL}	LOW level output voltage; all outputs	V_{CC} = 1.2V; $V_I = V_{IH}$ or V_{IL}; I_O = 100µA		0				V
		V_{CC} = 2.0V; $V_I = V_{IH}$ or V_{IL}; I_O = 100µA		0	0.2		0.2	
		V_{CC} = 2.7V; $V_I = V_{IH}$ or V_{IL}; I_O = 100µA		0	0.2		0.2	
		V_{CC} = 3.0V; $V_I = V_{IH}$ or V_{IL}; I_O = 100µA		0	0.2		0.2	
	LOW level output voltage; STANDARD outputs	V_{CC} = 3.0V; $V_I = V_{IH}$ or V_{IL}; I_O = 6mA		0.25	0.40		0.50	
I_I	Input leakage current	V_{CC} = 3.6V; $V_I = V_{CC}$ or GND			1.0		1.0	µA
I_{CC}	Quiescent supply current; MSI	V_{CC} = 3.6V; $V_I = V_{CC}$ or GND; I_O = 0			20.0		160	µA
ΔI_{CC}	Additional quiescent supply current per input	V_{CC} = 2.7V to 3.6V; $V_I = V_{CC} - 0.6V$			500		850	µA

NOTE:

1. All typical values are measured at T_{amb} = 25°C.

AC CHARACTERISTICS

GND = 0V; $t_r = t_f \leq 2.5$ns; $C_L = 50$pF; $R_L = 1K\Omega$

SYMBOL	PARAMETER	WAVEFORM	CONDITION	LIMITS					UNIT
				–40 to +85 °C			–40 to +125 °C		
			V_{CC}(V)	MIN	TYP[1]	MAX	MIN	MAX	
t_{PHL}/t_{PLH}	Propagation delay CP to Q_n	Figure 1	1.2	–	80	–	–	–	ns
			2.0	–	27	51	–	61	
			2.7	–	20	38	–	45	
			3.0 to 3.6	–	15[2]	30	–	36	
t_W	Clock pulse width HIGH or LOW	Figure 2	2.0	34	9	–	41	–	ns
			2.7	25	6	–	30	–	
			3.0 to 3.6	20	5[2]	–	24	–	
t_{su}	Set-up time D_n to CP	Figure 2	1.2	–	25	–	–	–	ns
			2.0	22	9	–	26	–	
			2.7	16	6	–	19	–	
			3.0 to 3.6	13	5[2]	–	15	–	
t_{su}	Set-up time $\overline{E}$ to CP	Figure 2	1.2	–	10	–	–	–	ns
			2.0	22	4	–	26	–	
			2.7	16	3	–	19	–	
			3.0 to 3.6	13	2[2]	–	15	–	
t_h	Hold time D_n to CP	Figure 2	1.2	–	–15	–	–	–	ns
			2.0	5	–5	–	5	–	
			2.7	5	–4	–	5	–	
			3.0 to 3.6	5	–3[2]	–	5	–	
t_h	Hold time $\overline{E}$ to CP	Figure 2	1.2	–	–5	–	–	–	ns
			2.0	5	–2	–	5	–	
			2.7	5	–2	–	5	–	
			3.0 to 3.6	5	–1[2]	–	5	–	
f_{max}	Maximum clock pulse frequency	Figure 1	2.0	14	40	–	12	–	MHz
			2.7	19	58	–	16	–	
			3.0 to 3.6	24	70[2]	–	20	–	

NOTES:
1. Unless otherwise stated, all typical values are at $T_{amb} = 25°C$.
2. Typical value measured at $V_{CC} = 3.3V$.

AC WAVEFORMS

V_M = 1.5V at $V_{CC} \geq$ 2.7V
V_M = 0.5V * V_{CC} at $V_{CC} <$ 2.7V
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

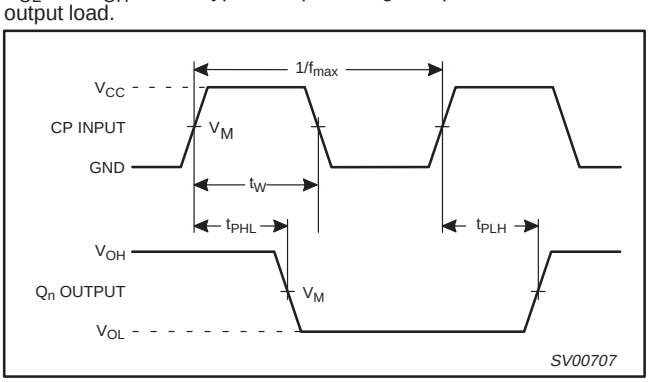


Figure 1. Clock (CP) to output (Q_n) propagation delays, the clock pulse width and the maximum clock pulse frequency.

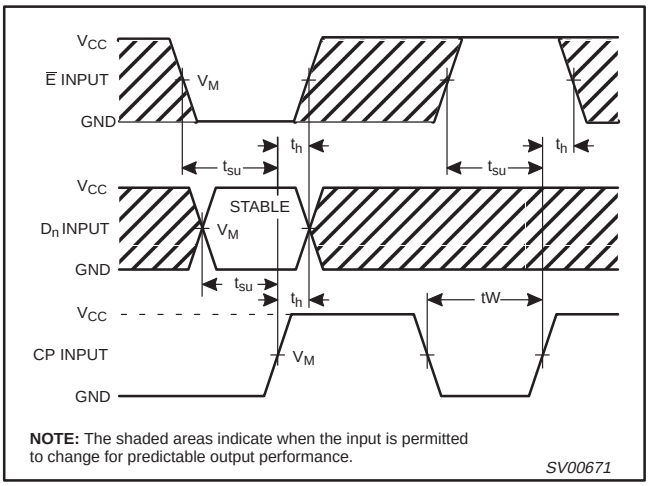
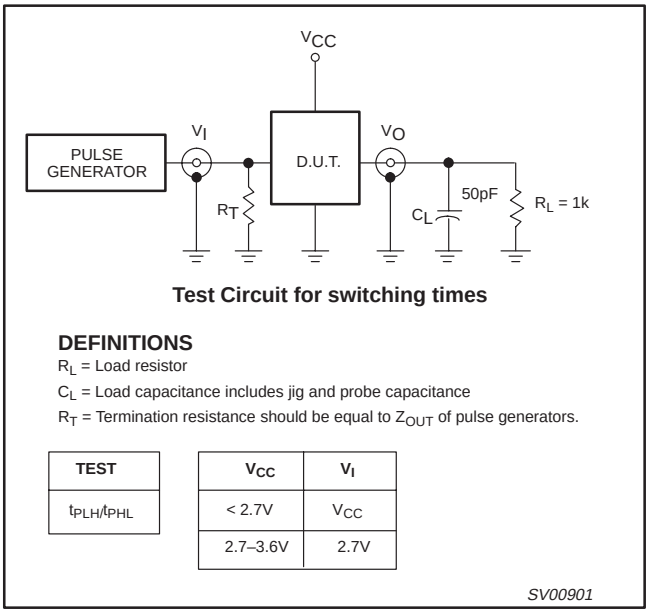


Figure 2. Data set-up and hold times from the data input (Dn) and from the enable input (Ē) to the clock (CP).

TEST CIRCUIT



Test Circuit for switching times

DEFINITIONS

R_L = Load resistor

C_L = Load capacitance includes jig and probe capacitance

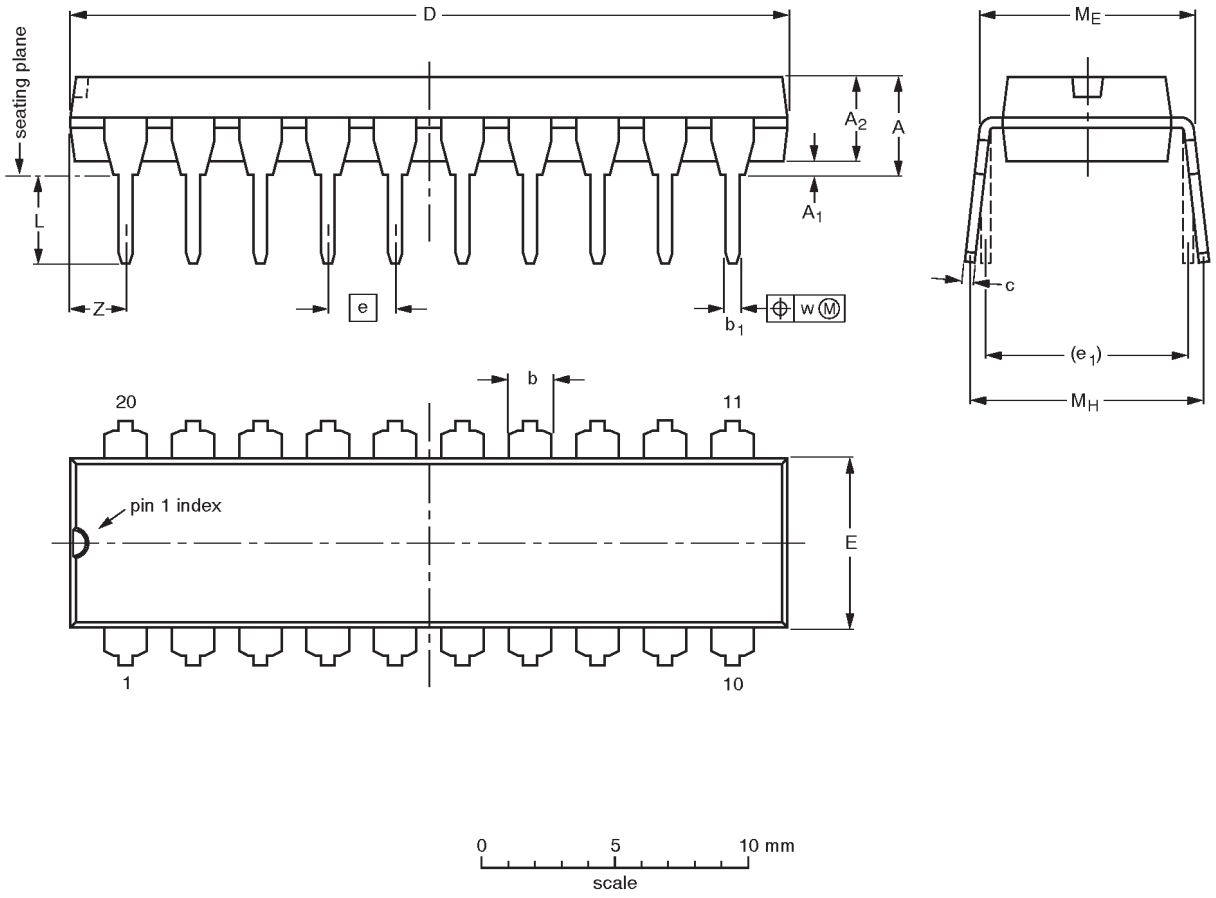
R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

TEST
t_{PLH}/t_{PHL}

V_{CC}	V_I
< 2.7V	V_{CC}
2.7–3.6V	2.7V

Figure 3. Load circuitry for switching times

DIP20: plastic dual in-line package; 20 leads (300 mil) **SOT146-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

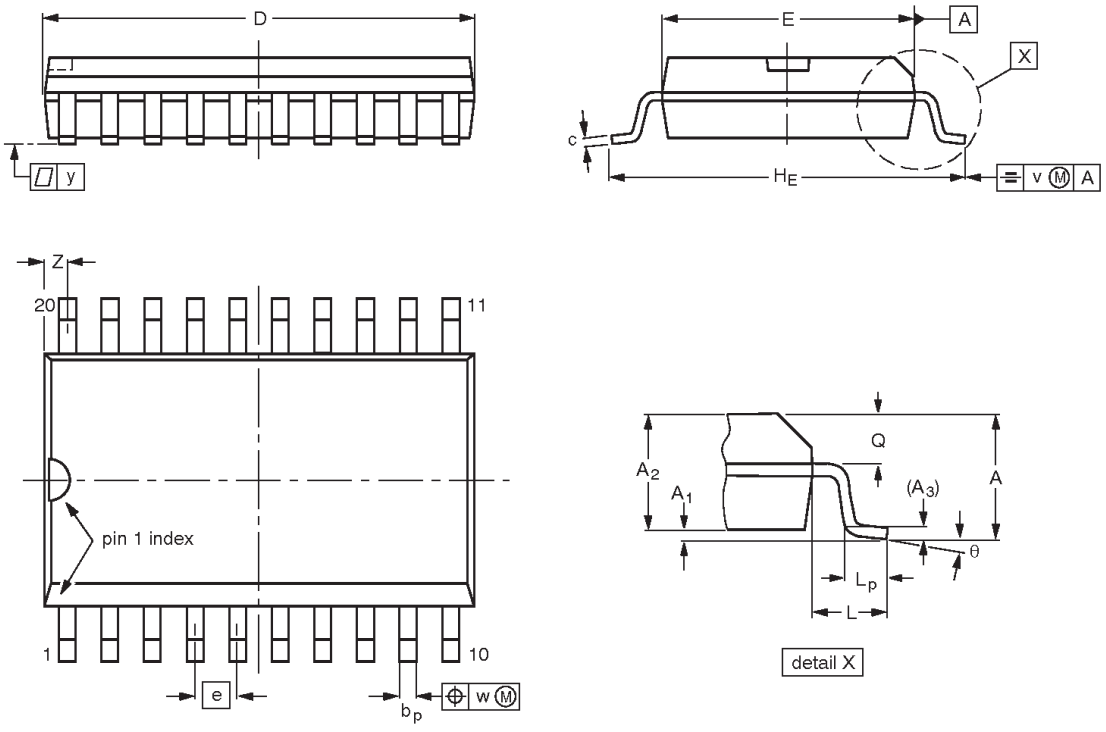
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

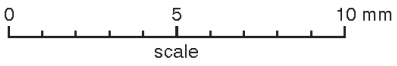
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT146-1			SC603			~~92-11-17~~ 95-05-24

SO20: plastic small outline package; 20 leads; body width 7.5 mm **SOT163-1**





DIMENSIONS (inch dimensions are derived from the original mm dimensions)

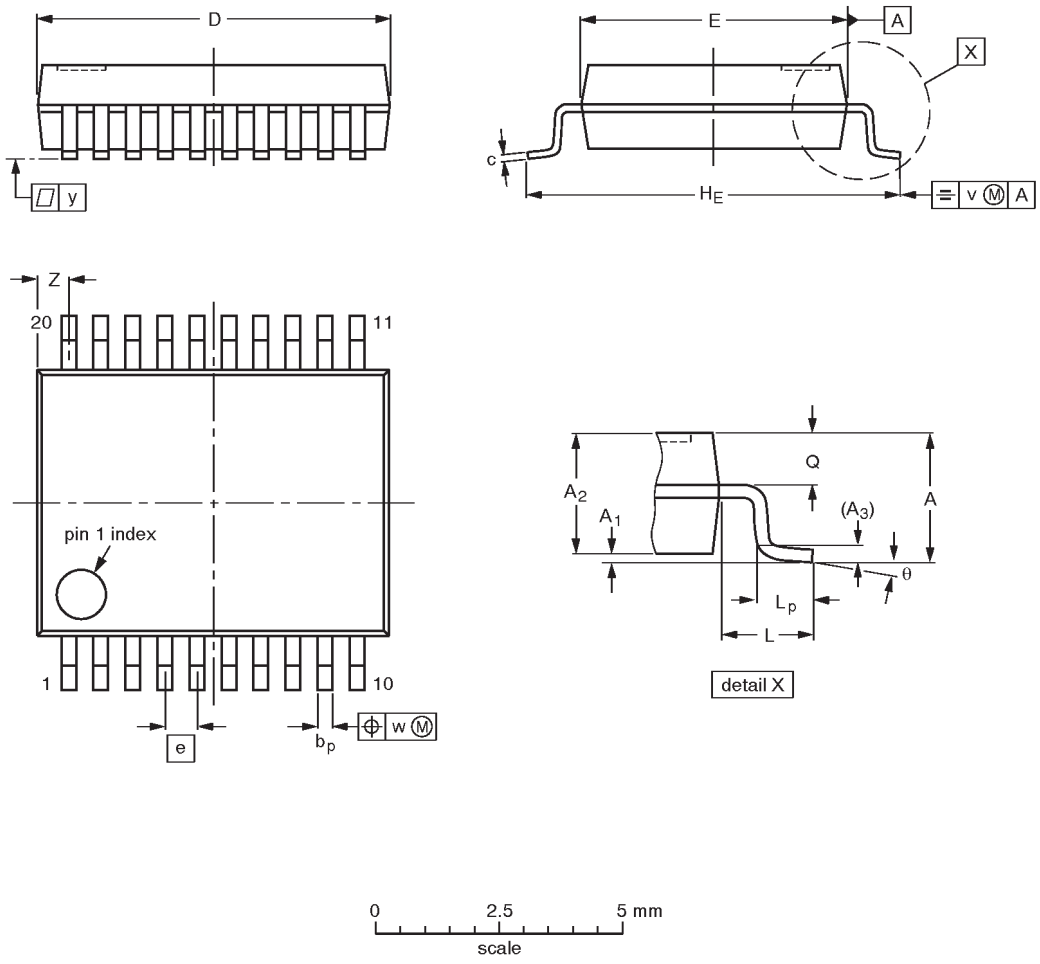
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013AC				~~92-11-17~~ 95-01-24

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm **SOT339-1**



DIMENSIONS (mm are the original dimensions)

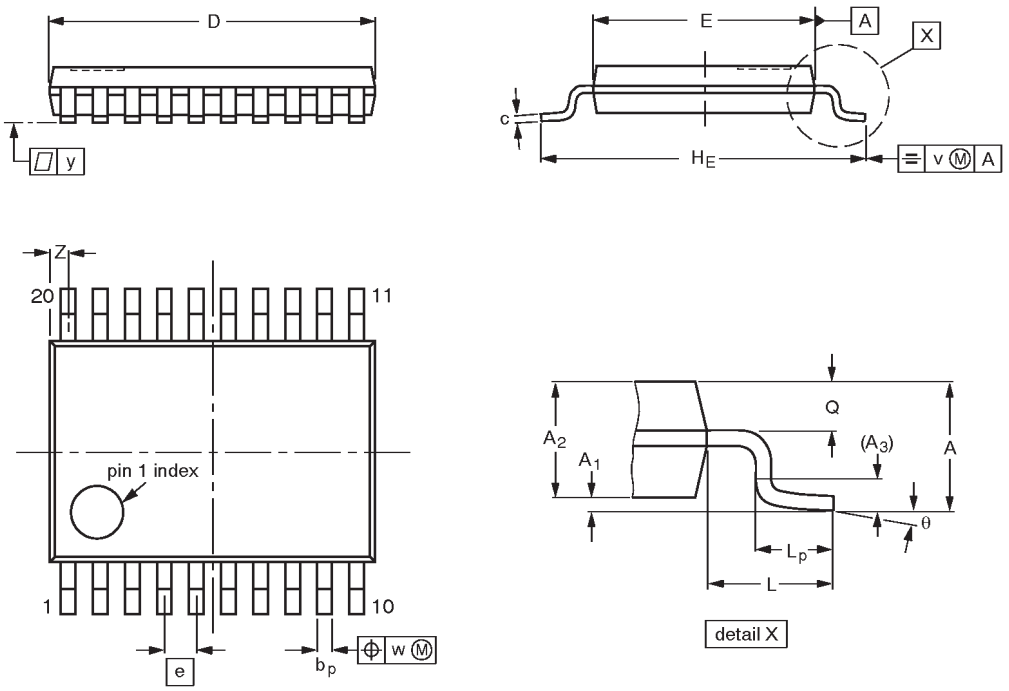
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

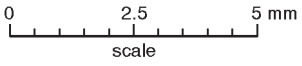
Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT339-1		MO-150AE				~~93-09-08~~ 95-02-04

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm SOT360-1





DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT360-1		MO-153AC				~~93-06-16~~ 95-02-04

DEFINITIONS

Data Sheet Identification	Product Status	Definition
Objective Specification	Formative or in Design	This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.
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