

DATA SHEET

74LV175

Quad D-type flip-flop with reset;
positive-edge trigger

Product specification
Supersedes data of 1997 Feb 19
IC24 Data Handbook

1998 May 20

Quad D-type flip-flop with reset; positive-edge trigger

74LV175

FEATURES

- Optimized for low voltage applications: 1.0 to 3.6 V
- Accepts TTL input levels between $V_{CC} = 2.7$ V and $V_{CC} = 3.6$ V
- Typical V_{OLP} (output ground bounce) < 0.8 V at $V_{CC} = 3.3$ V, $T_{amb} = 25^{\circ}\text{C}$
- Typical V_{OHV} (output V_{OH} undershoot) > 2 V at $V_{CC} = 3.3$ V, $T_{amb} = 25^{\circ}\text{C}$
- Four edge-triggered D flip-flops
- Output capability: standard
- I_{CC} category: MSI

DESCRIPTION

The 74LV175 is a low-voltage Si-gate CMOS device and is pin and function compatible with 74HC/HCT175.

The 74LV175 has four edge-triggered, D-type flip-flops with individual D inputs and both Q and \bar{Q} outputs. The common clock (CP) and master reset (\bar{MR}) inputs load and reset (clear) all flip-flops simultaneously.

The register is fully edge-triggered. The state of each D input, one set-up time prior to the LOW-to-HIGH clock transition, is transferred to the corresponding output (Q_n) of the flip-flop.

All Q_n outputs will be forced LOW independently of clock or data inputs by a LOW voltage level on the \bar{MR} input.

The device is useful for applications where both the true and complement outputs are required and the clock and master reset are common to all storage elements.

QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay CP to Q_n, \bar{Q}_n \bar{MR} to Q_n, \bar{Q}_n	$C_L = 15$ pF; $V_{CC} = 3.3$ V	16 14	ns ns
f_{max}	Maximum clock frequency		77	MHz
C_I	Input capacitance		3.5	pF
C_{PD}	Power dissipation capacitance per flip-flop	$V_{CC} = 3.3$ V $V_I = \text{GND to } V_{CC}^1$	32	pF

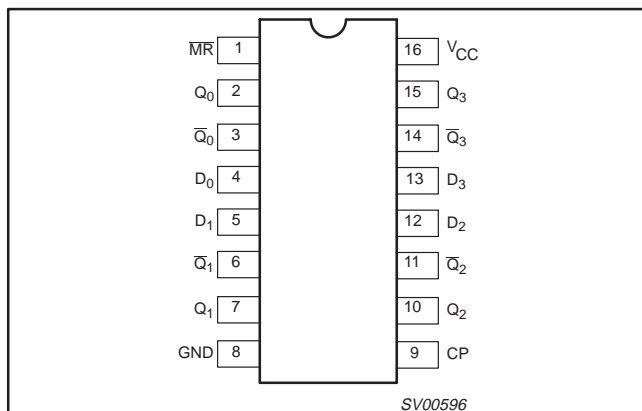
NOTE:

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW)
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ 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;
 $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
16-Pin Plastic DIL	-40°C to $+125^{\circ}\text{C}$	74LV175 N	74LV175 N	SOT38-4
16-Pin Plastic SO	-40°C to $+125^{\circ}\text{C}$	74LV175 D	74LV175 D	SOT109-1
16-Pin Plastic SSOP Type II	-40°C to $+125^{\circ}\text{C}$	74LV175 DB	74LV175 DB	SOT338-1
16-Pin Plastic TSSOP Type I	-40°C to $+125^{\circ}\text{C}$	74LV175 PW	74LV175PW DH	SOT403-1

PIN CONFIGURATION



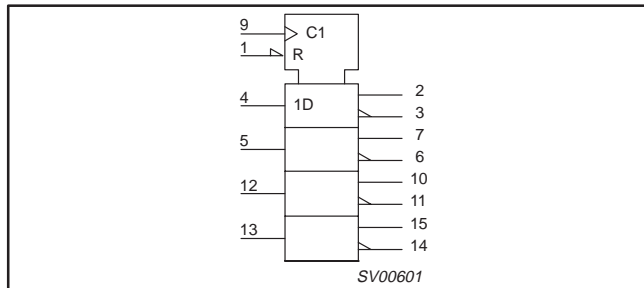
PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1	\bar{MR}	Master reset input (active LOW)
2, 7, 10, 15	Q_0 to Q_3	Flip-flop outputs
3, 6, 11, 14	\bar{Q}_0 to \bar{Q}_3	Complementary flip-flop outputs
4, 5, 12, 13	D_0 to D_3	Data inputs
8	GND	Ground (0 V)
9	CP	Clock input (LOW-to-HIGH, edge-triggered)
16	V_{CC}	Positive supply voltage

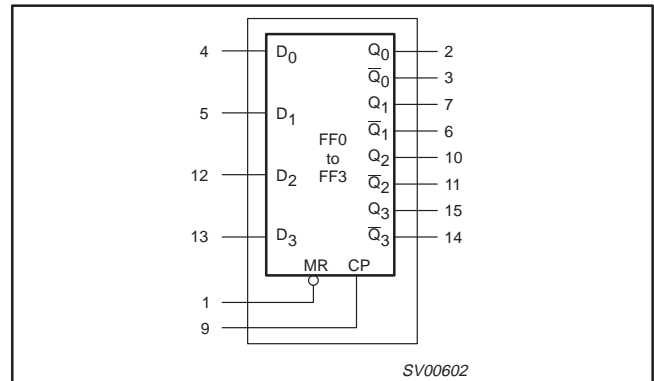
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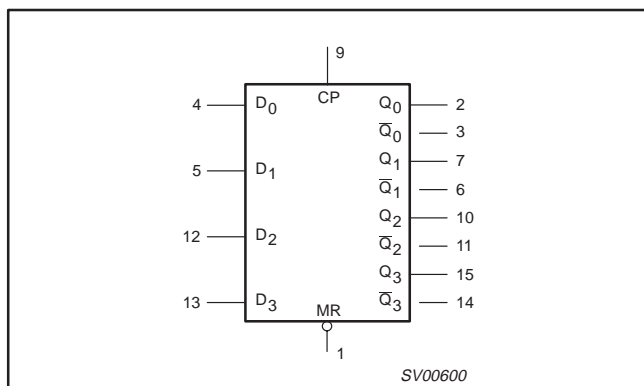
LOGIC SYMBOL (IEEE/IEC)



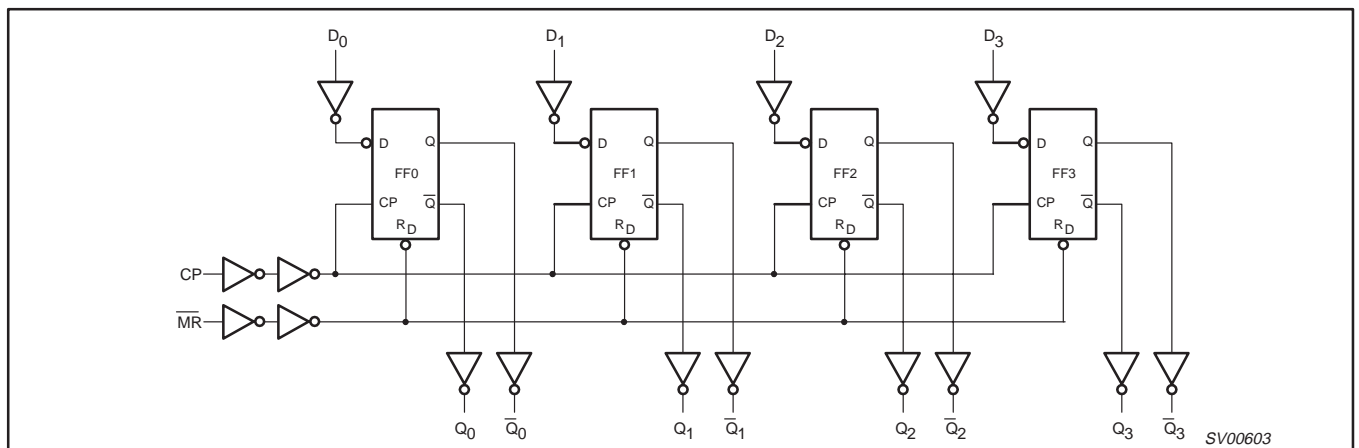
FUNCTIONAL DIAGRAM



LOGIC SYMBOL



LOGIC DIAGRAM



FUNCTION TABLE

OPERATING MODES	INPUTS			OUTPUTS	
	\overline{MR}	CP	D_n	Q_n	\overline{Q}_n
Reset (clear)	L	X	X	L	H
Load '1'	H	↑	h	H	L
Load '0'	H	↑	l	L	H

NOTES:

- H = HIGH voltage level
- h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition
- L = LOW voltage level
- l = LOW voltage level level one set-up time prior to the LOW-to-HIGH clock transition
- ↑ = LOW-to-HIGH clock transition
- X = don't care

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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_p, 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:

- 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.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

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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		
V _{OH}	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
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	
V _{OL}	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	V
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.

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AC CHARACTERISTICSGND = 0V; $t_r = t_f \leq 2.5\text{ns}$; $C_L = 50\text{pF}$; $R_L = 1\text{K}\Omega$

SYMBOL	PARAMETER	WAVEFORM	CONDITION	LIMITS					UNIT
				-40 to +85 °C			-40 to +125 °C		
				V _{CC} (V)	MIN	TYP ¹	MAX	MIN	
t _{PHL} /t _{PLH}	Propagation delay CP to Q _n , \bar{Q}_n	Figures 1	1.2		100				ns
			2.0		34	65		77	
			2.7		25	48		56	
			3.0 to 3.6		19 ²	38		45	
t _{PHL} /t _{PLH}	Propagation delay \bar{MR} to Q _n , \bar{Q}_n	Figures 2	1.2		90				ns
			2.0		31	58		70	
			2.7		23	43		51	
			3.0 to 3.6		17 ²	34		41	
t _w	Clock pulse width HIGH or LOW	Figures 1	2.0	34	14		41		ns
			2.7	25	10		30		
			3.0 to 3.6	20	8 ²		24		
t _w	Master reset pulse width LOW	Figures 2	2.0	34	14		41		ns
			2.7	25	9		30		
			3.0 to 3.6	20	7 ²		24		
t _{rem}	Removal time \bar{MR} to CP	Figures 2	1.2		-60				ns
			2.0	5	-20		5		
			2.7	5	-15		5		
			3.0 to 3.6	5	-12 ²		5		
t _{su}	Set-up time D _n to CP	Figures 3	1.2		5				ns
			2.0	22	2		26		
			2.7	16	2		19		
			3.0 to 3.6	13	1 ²		15		
t _h	Hold time D _n to CP	Figures 3	1.2		-5				ns
			2.0	5	-1		5		
			2.7	5	0		5		
			3.0 to 3.6	5	0 ²		5		
f _{max}	Maximum clock pulse frequency	Figures 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 measured at T_{amb} = 25°C.
2. Typical values are measured at V_{CC} = 3.3 V.

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AC WAVEFORMS

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

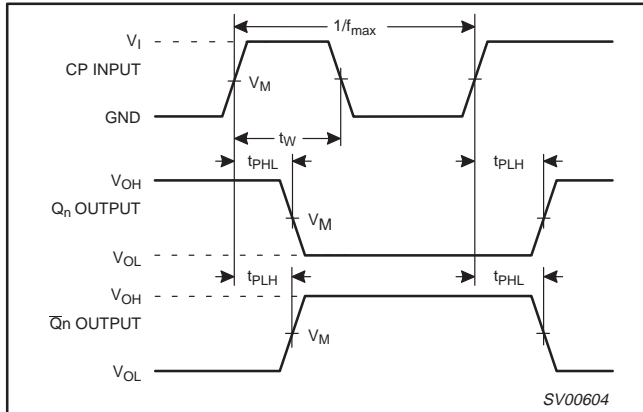


Figure 1. Clock (CP) to outputs (Q_n , \bar{Q}_n) propagation delays, the clock pulse width and the maximum clock pulse frequency.

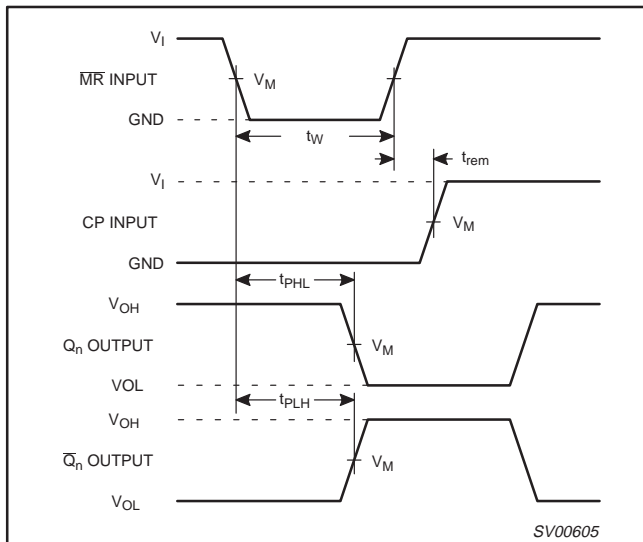


Figure 2. Master reset (\overline{MR}) pulse width, the master reset to outputs (Q_n , \bar{Q}_n) propagation delay and master reset to clock (CP) removal time.

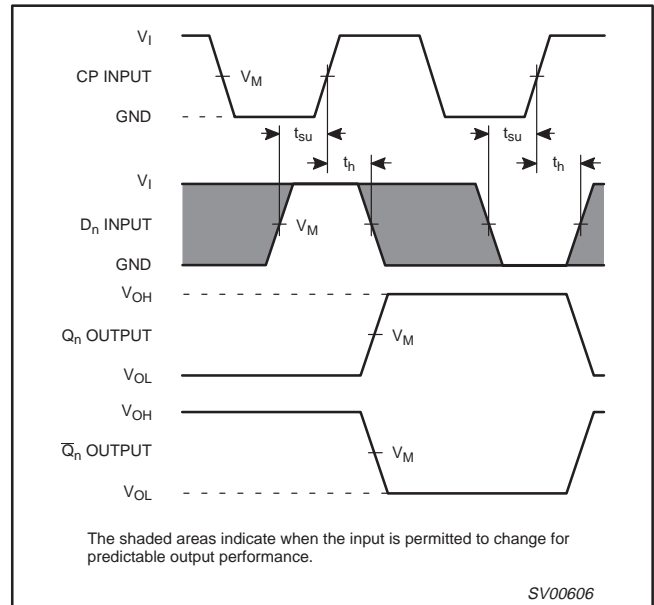


Figure 3. Data set-up and hold times for data input (D_n).

TEST CIRCUIT

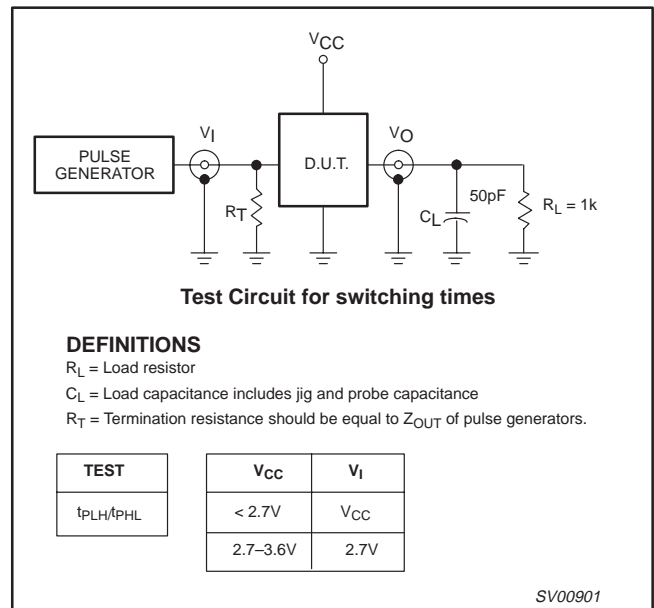


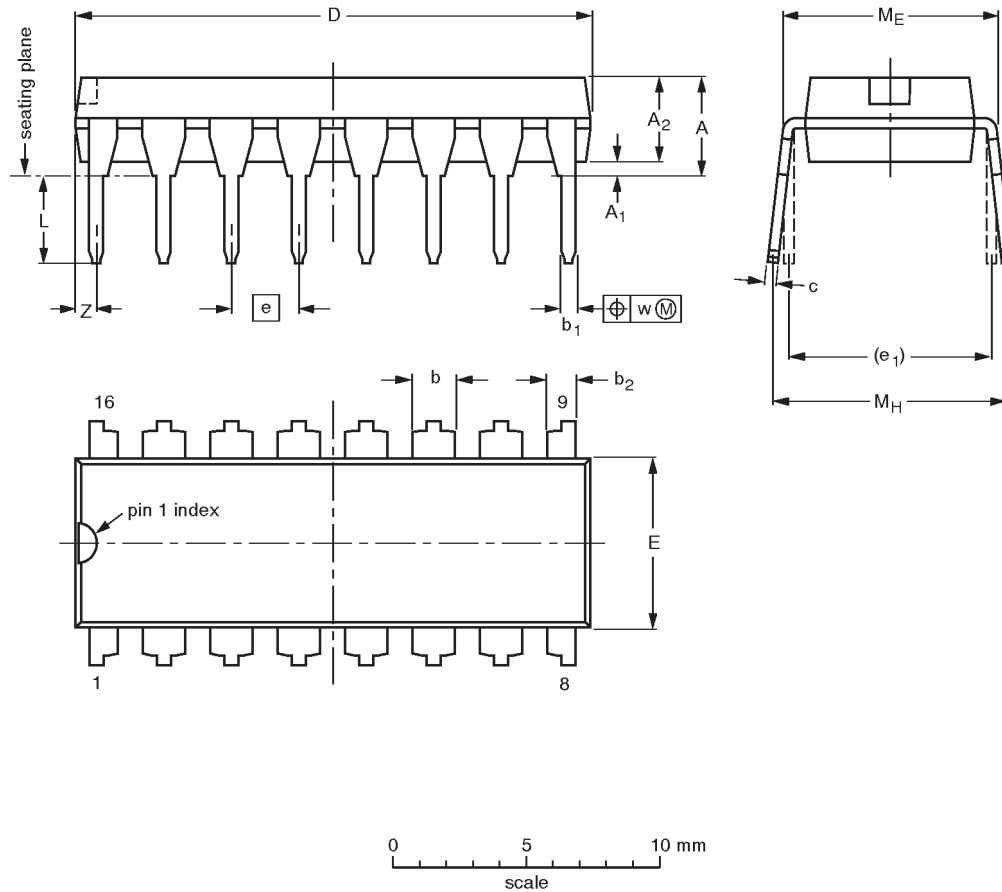
Figure 4. Load circuitry for switching times.

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DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4



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

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	b ₂	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	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.030

Note

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

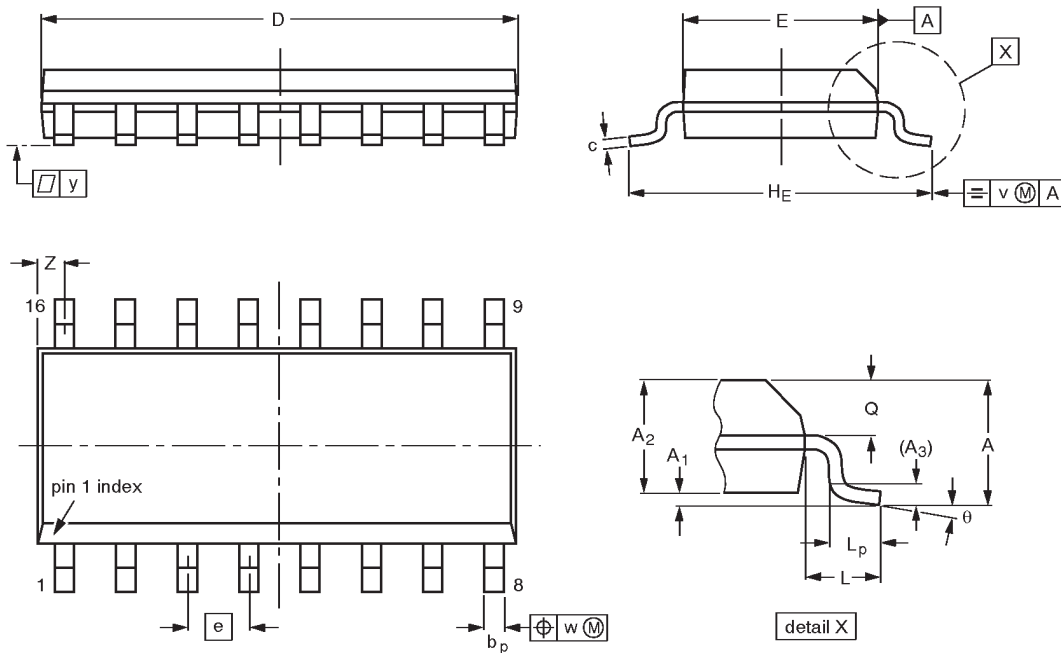
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-4						92-11-17 95-01-14

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SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



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	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

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

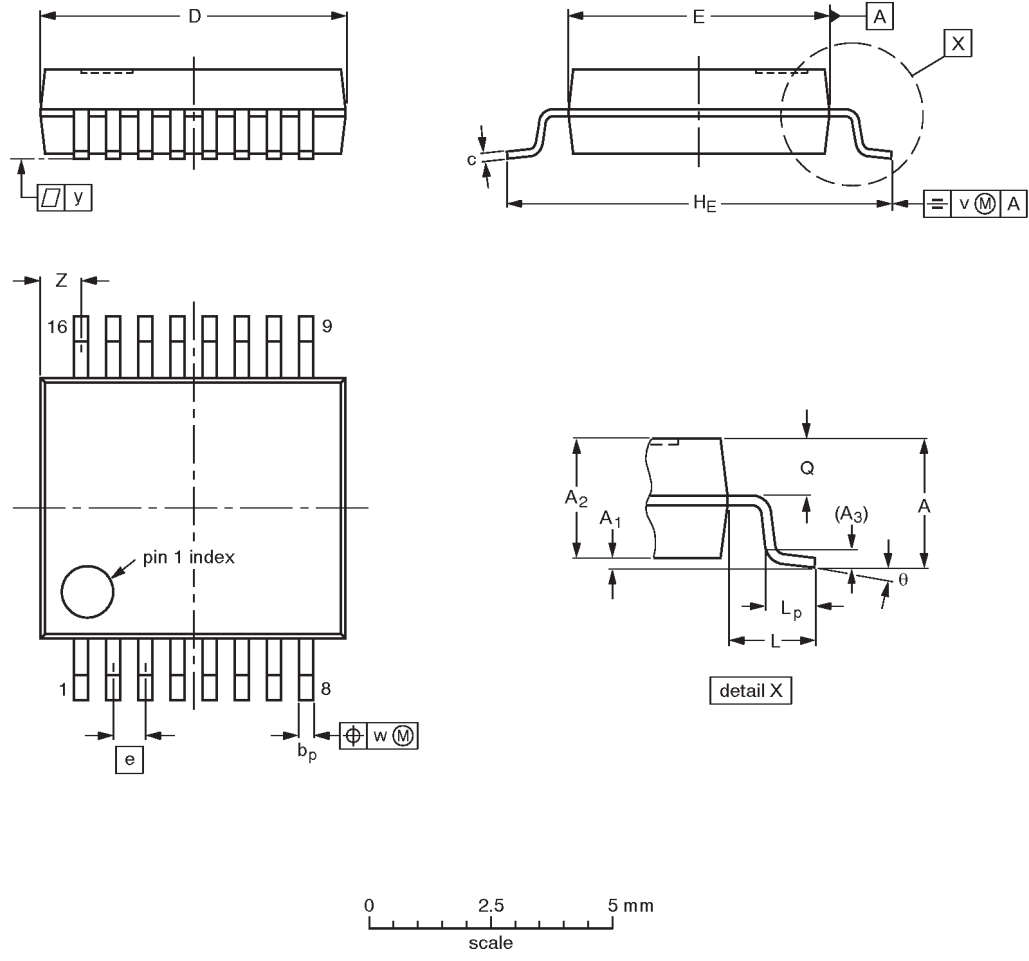
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SOT109-1	076E07S	MS-012AC				91-08-13 95-01-23

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SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1



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	6.4 6.0	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	1.00 0.55	8° 0°

Note

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

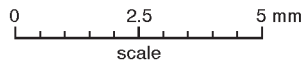
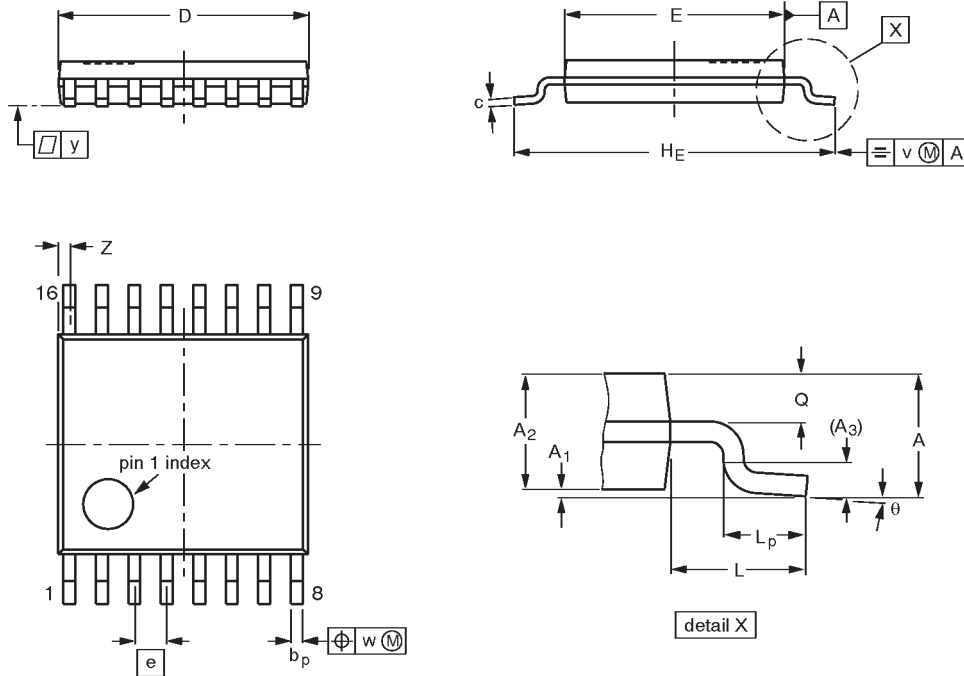
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	IEC	JEDEC	EIAJ			
SOT338-1		MO-150AC				94-01-14- 95-02-04

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TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1



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	5.1 4.9	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	0.40 0.06	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			
SOT403-1		MO-153				94-07-12 95-04-04

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NOTES

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DEFINITIONS

Data Sheet Identification	Product Status	Definition
<i>Objective Specification</i>	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.
<i>Preliminary Specification</i>	Preproduction Product	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
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