

# DATA SHEET

**74F198**

**8-bit bidirectional universal shift register**

Product specification

1987 Oct 02

IC15 Data Handbook

## 8-bit bidirectional universal shift register

74F198

## FEATURES

- Buffered clock and control inputs
- Shift right, shift left, and parallel load capability
- Asynchronous Master Reset

## DESCRIPTION

The 74F198 Bidirectional Universal Shift Register is designed to incorporate virtually all of the features a system designer may want in a shift register. This circuit features parallel inputs and outputs, shift right and shift left serial inputs, operating mode select inputs, and direct overriding master reset input. The register has four distinct modes of operation:

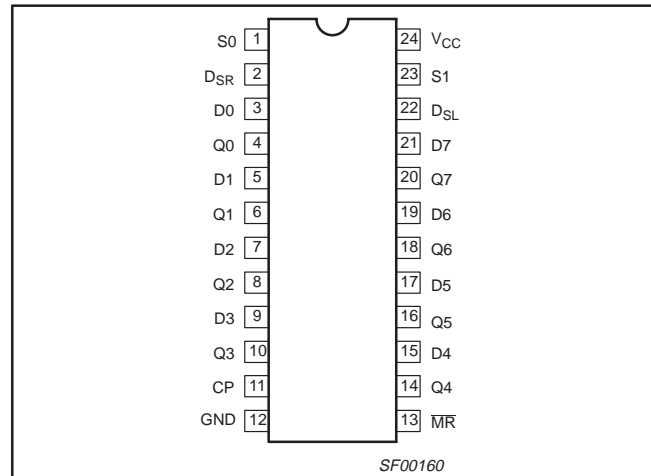
- Parallel (broadside) load
- Shift right (in the direction Q0 toward Q7)
- Shift left (in the direction Q7 toward Q0)
- Inhibit clock (do nothing).

Synchronous parallel loading is accomplished by applying the 8 bits of data and taking both mode control inputs, S0 and S1, High. The data is loaded into the associated flip-flop and appears at the outputs after the positive transition of the clock inputs. During loading, serial data flow is inhibited.

Shift right is accomplished synchronously, with the rising edge of the clock pulse when S0 is High and S1 is Low. Serial data for this mode is entered at the right data input (D<sub>SR</sub>). When S0 is Low and S1 is High, data shifts left synchronously and new data is entered at the shift-left serial input (D<sub>SL</sub>).

Clocking of the flip-flops is inhibited when both mode control inputs are Low.

## PIN CONFIGURATION



TYPE	TYPICAL $f_{MAX}$	TYPICAL SUPPLY CURRENT (TOTAL)
74F198	95MHz	73mA

## ORDERING INFORMATION

DESCRIPTION	COMMERCIAL RANGE $V_{CC} = 5V \pm 10\%$ , $T_{amb} = 0^{\circ}C$ to $+70^{\circ}C$	PKG DWG #
24-pin Plastic Slim DIP (300mil)	N74F198N	SOT222-1
24-pin Plastic SOL	N74F198D	SOT137-1

## INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

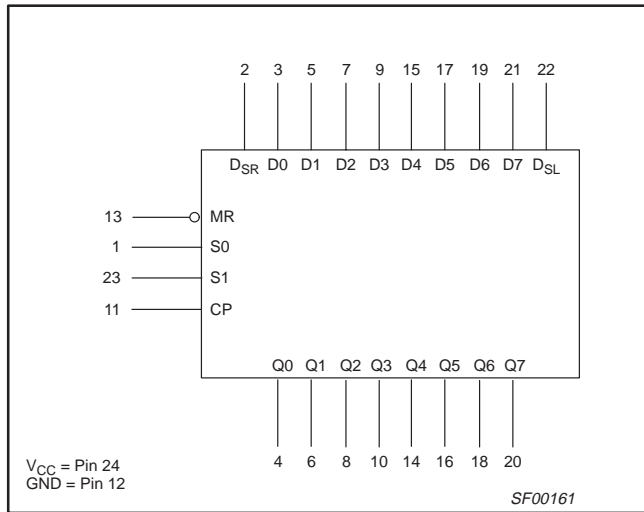
PINS	DESCRIPTION	74F (U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
D0–D7	Parallel data inputs	1.0/1.0	20 $\mu$ A/0.6mA
D <sub>SR</sub>	Serial data input (Shift Right)	1.0/1.0	20 $\mu$ A/0.6mA
D <sub>SL</sub>	Serial data input (Shift Left)	1.0/1.0	20 $\mu$ A/0.6mA
S0–S1	Mode Select inputs	1.0/1.0	20 $\mu$ A/0.6mA
CP	Clock Pulse input (Active rising edge)	1.0/1.0	20 $\mu$ A/0.6mA
MR	Master Reset input (Active Low)	1.0/1.0	20 $\mu$ A/0.6mA
Q0–Q7	Data outputs	50/33	1.0mA/20mA

**NOTE:** One (1.0) FAST unit load is defined as: 20 $\mu$ A in the High state and 0.6mA in the Low state.

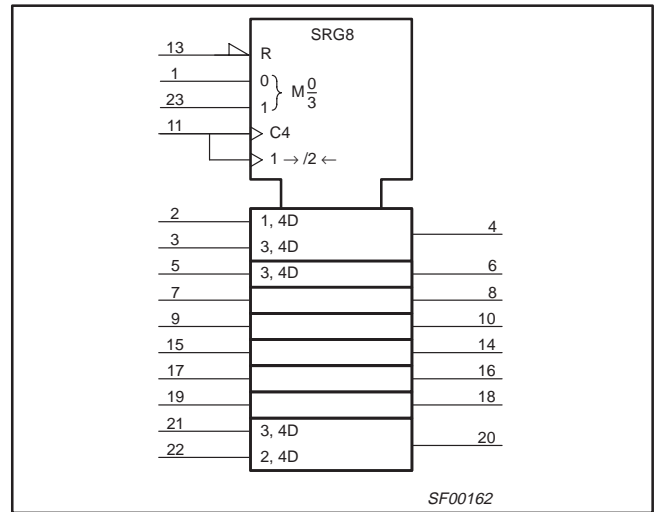
# 8-bit bidirectional universal shift register

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## LOGIC SYMBOL



## IEC/IEEE SYMBOL



## FUNCTION TABLE

INPUTS						OUTPUTS					
MR	MODE		CP	SERIAL		PARALLEL	Q0	Q1	...	Q6	Q7
	S0	S1		LEFT	RIGHT	0...7					
L	X	X	X	X	X	X	L	L		L	L
H	X	X	L	X	X	X	Q00	Q10		Q60	Q70
H	H	H	↑	X	X	0...7	0	1		6	7
H	H	L	↑	X	H	X	H	Q0n		Q5n	Q6n
H	H	L	↑	X	L	X	L	Q0n		Q5n	Q6n
H	L	H	↑	H	X	X	Q1n	Q2n		Q7n	H
H	L	H	↑	L	X	X	Q1n	Q2n		Q7n	L
H	L	L	X	X	X	X	Q00	Q10		Q60	Q70

H = High voltage level

L = Low voltage level

X = Don't care

↑ = Low-to-High transition of designated input

0...7 = The level of steady input at inputs 0 through 7, respectively.

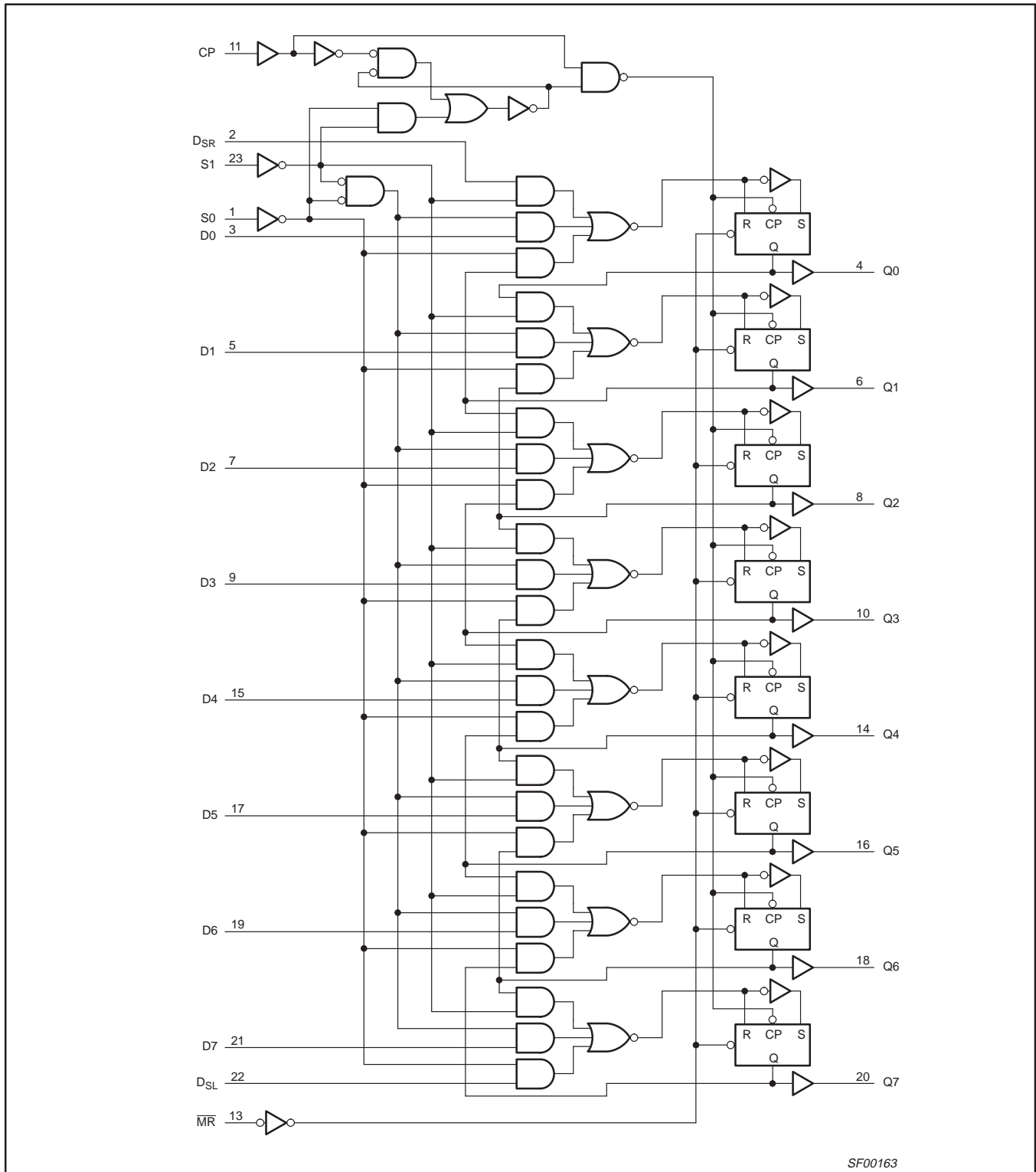
Q00, Q10, Q60, Q70 = The level of Q0, Q1, Q6, Q7, respectively, before the indicated steady state input conditions were established.

Q0n, Q1n, Q6n, Q7n = The level of Q0, Q1, Q6, Q7, respectively, before the most recent Low-to-High clock transition.

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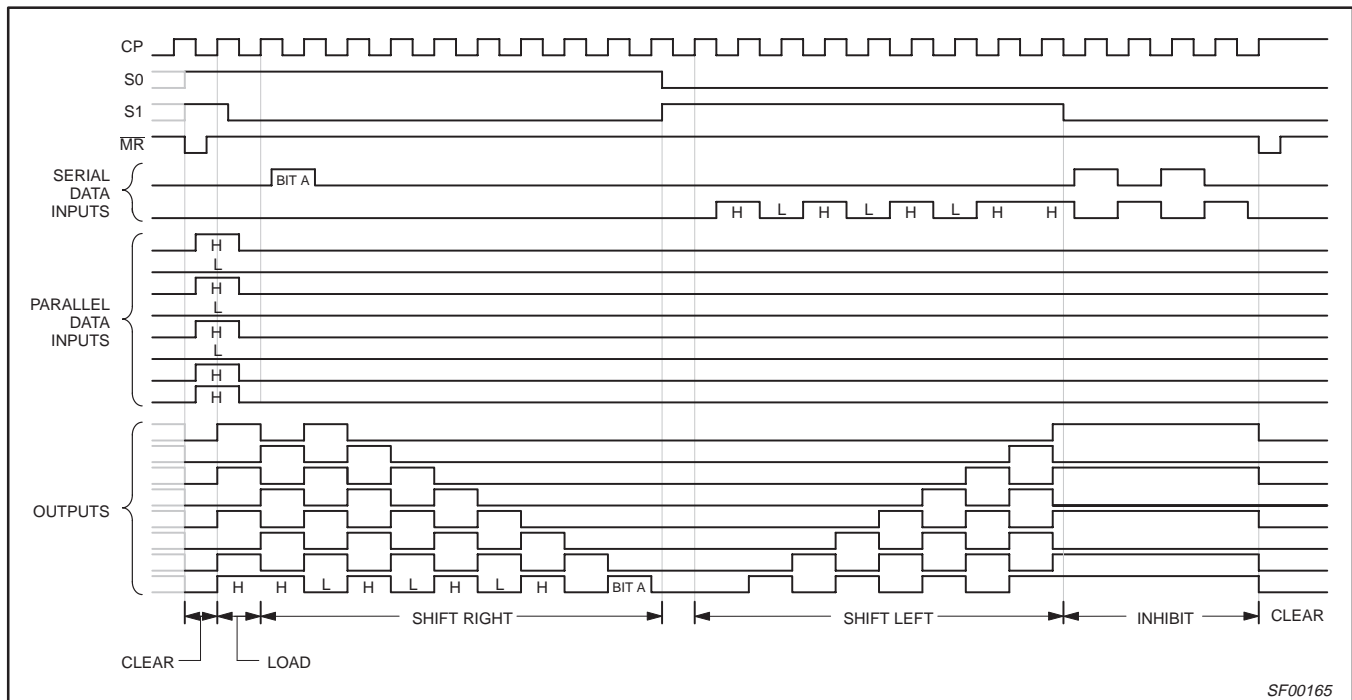
## LOGIC DIAGRAM



# 8-bit bidirectional universal shift register

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## TYPICAL TIMING DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limits set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free-air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT
V <sub>CC</sub>	Supply voltage	-0.5 to +7.0	V
V <sub>IN</sub>	Input voltage	-0.5 to +7.0	V
I <sub>IN</sub>	Input current	-30 to +5	mA
V <sub>OUT</sub>	Voltage applied to output in High output state	-0.5 to V <sub>CC</sub>	V
I <sub>OUT</sub>	Current applied to output in Low output state	40	mA
T <sub>amb</sub>	Operating free-air temperature range	0 to +70	°C
T <sub>stg</sub>	Storage temperature range	-65 to +150	°C

## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5.0	5.5	V
V <sub>IH</sub>	High-level input voltage	2.0			V
V <sub>IL</sub>	Low-level input voltage			0.8	V
I <sub>IK</sub>	Input clamp current			-18	mA
I <sub>OH</sub>	High-level output current			-1	mA
I <sub>OL</sub>	Low-level output current			20	mA
T <sub>amb</sub>	Operating free-air temperature range	0		+70	°C

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**DC ELECTRICAL CHARACTERISTICS**

(Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS <sup>1</sup>		LIMITS			UNIT
				MIN	TYP <sup>2</sup>	MAX	
V <sub>OH</sub>	High-level output voltage	V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX	±10%V <sub>CC</sub>	2.5			V
		V <sub>IH</sub> = MIN, I <sub>OH</sub> = MAX	±5%V <sub>CC</sub>	2.7	3.4		
V <sub>OL</sub>	Low-level output voltage	V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX	±10%V <sub>CC</sub>		0.35	0.50	V
		V <sub>IH</sub> = MIN, I <sub>OL</sub> = MAX	±5%V <sub>CC</sub>		0.35	0.50	
V <sub>IK</sub>	Input clamp voltage	V <sub>CC</sub> = MIN, I <sub>I</sub> = I <sub>IK</sub>			-0.73	-1.2	V
I <sub>I</sub>	Input current at maximum input voltage	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7.0V				100	μA
I <sub>IH</sub>	High-level input current	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7V				20	μA
I <sub>IL</sub>	Low-level input current	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5V				-0.6	mA
I <sub>OS</sub>	Short-circuit output current <sup>3</sup>	V <sub>CC</sub> = MAX		-60		-150	mA
I <sub>CC</sub>	Supply current (total)	I <sub>CCH</sub>	V <sub>CC</sub> = MAX		70	100	mA
		I <sub>CCL</sub>			75	110	mA

**NOTES:**

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
- All typical values are at V<sub>CC</sub> = 5V, T<sub>amb</sub> = 25°C.
- Not more than one output should be shorted at a time. For testing I<sub>OS</sub>, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a High output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I<sub>OS</sub> tests should be performed last.

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## AC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITION	LIMITS					UNIT
			V <sub>CC</sub> = +5.0V T <sub>amb</sub> = +25°C C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω			V <sub>CC</sub> = +5.0V ± 10% T <sub>amb</sub> = 0°C to +70°C C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
f <sub>MAX</sub>	Maximum clock frequency	Waveform 1	80	95		70		MHz
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay CP to Qn	Waveform 1	5.0 6.0	7.5 8.5	10.0 11.0	4.5 5.5	11.0 12.0	ns
t <sub>PHL</sub>	Propagation delay	Waveform 3	5.0	7.5	10.0	4.5	11.0	ns

## AC SETUP REQUIREMENTS

SYMBOL	PARAMETER	TEST CONDITION	LIMITS					UNIT
			V <sub>CC</sub> = +5.0V T <sub>amb</sub> = +25°C C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω			V <sub>CC</sub> = +5.0V ± 10% T <sub>amb</sub> = 0°C to +70°C C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
t <sub>S</sub> (H) t <sub>S</sub> (L)	Setup time, High or Low Dn to CP	Waveform 2	0.0 3.0			0.0 3.0		ns
t <sub>H</sub> (H) t <sub>H</sub> (L)	Hold time, High or Low Dn to CP	Waveform 2	0.0 3.5			1.0 4.0		ns
t <sub>S</sub> (H) t <sub>S</sub> (L)	Setup time, High or Low D <sub>SR</sub> , D <sub>SL</sub> to CP	Waveform 2	0.0 3.0			0.0 3.0		ns
t <sub>H</sub> (H) t <sub>H</sub> (L)	Hold time, High or Low D <sub>SR</sub> , D <sub>SL</sub> to CP	Waveform 2	0.0 2.5			0.0 3.0		ns
t <sub>S</sub> (H) t <sub>S</sub> (L)	Setup time, High or Low Sn to CP	Waveform 2	9.0 6.0			10.0 7.0		ns
t <sub>H</sub> (H) t <sub>H</sub> (L)	Hold time, High or Low Sn to CP	Waveform 2	0.0 0.0			0.0 0.0		ns
t <sub>w</sub> (H) t <sub>w</sub> (L)	CP Pulse width, High or Low	Waveform 1	5.0 5.0			6.0 6.0		ns
t <sub>w</sub> (L)	$\overline{MR}$ Pulse width, Low	Waveform 3	5.0			5.0		ns
t <sub>REC</sub>	Recovery time $\overline{MR}$ to CP	Waveform 3	5.0			6.0		ns

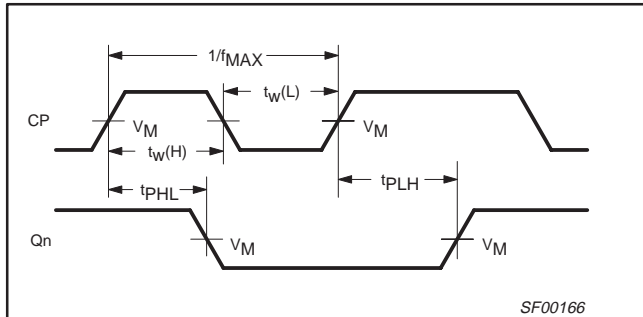
# 8-bit bidirectional universal shift register

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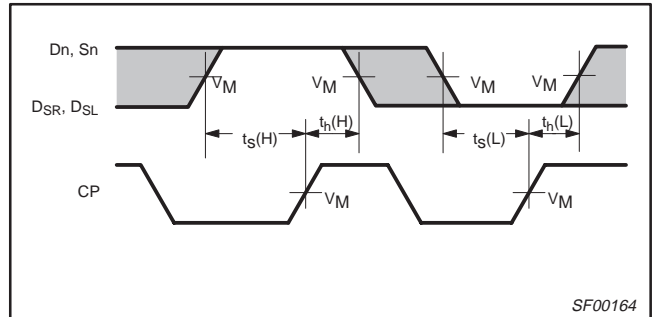
## AC WAVEFORMS

For all waveforms,  $V_M = 1.5V$ .

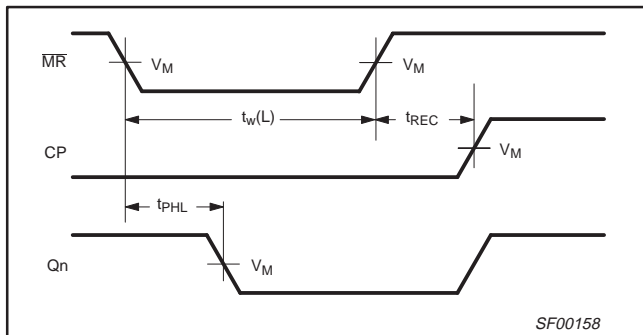
The shaded areas indicate when the input is permitted to change for predictable output performance.



**Waveform 1. Propagation Delay, Clock Input to Output, Clock Widths, and Maximum Clock Frequency**

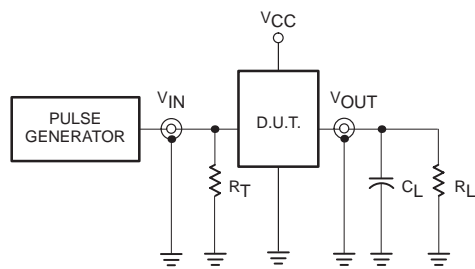


**Waveform 2. Setup Time and Hold Time**

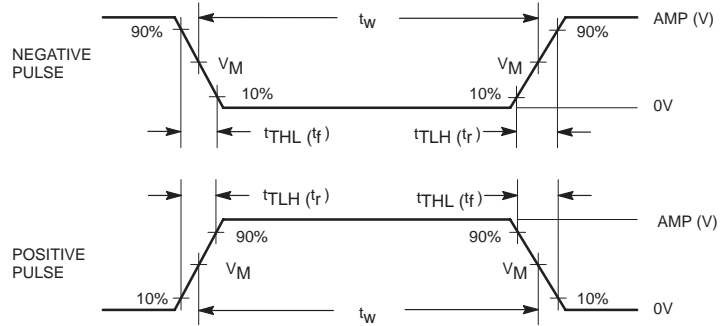


**Waveform 3. Master Reset Pulse Width, Master Reset to Output Delay and Master Reset to Clock Recovery Time**

## TEST CIRCUIT AND WAVEFORMS



**Test Circuit for Totem-Pole Outputs**



**Input Pulse Definition**

family	INPUT PULSE REQUIREMENTS					
	amplitude	$V_M$	rep. rate	$t_w$	$t_{TLH}$	$t_{THL}$
74F	3.0V	1.5V	1MHz	500ns	2.5ns	2.5ns

SF00006

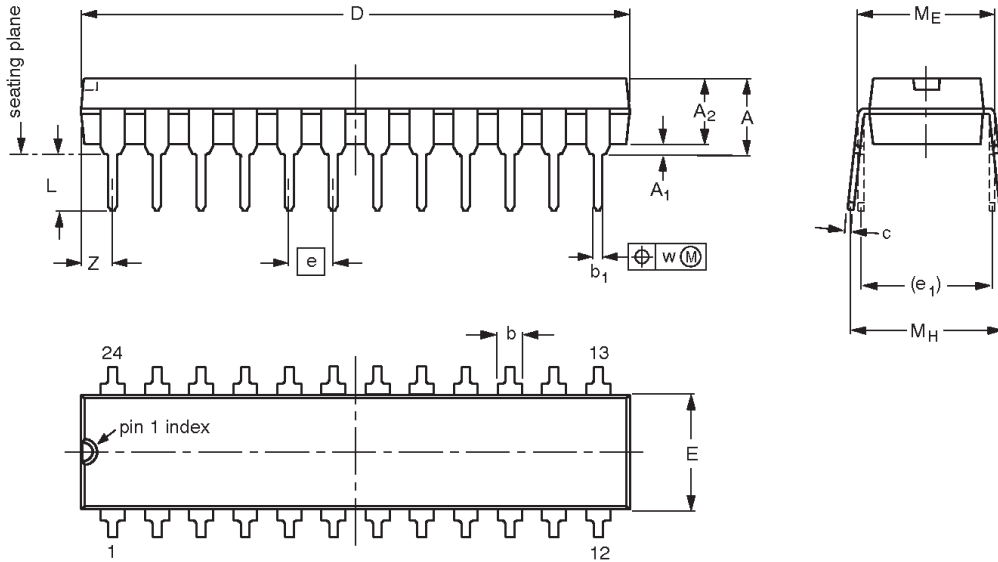


# 8-bit bidirectional universal shift register

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DIP24: plastic dual in-line package; 24 leads (300 mil)

SOT222-1



**DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)**

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	Z <sup>(1)</sup> max.
mm	4.70	0.38	3.94	1.63 1.14	0.56 0.43	0.36 0.25	31.9 31.5	6.73 6.48	2.54	7.62	3.51 3.05	8.13 7.62	10.03 7.62	0.25	2.05
inches	0.185	0.015	0.155	0.064 0.045	0.022 0.017	0.014 0.010	1.256 1.240	0.265 0.255	0.100	0.300	0.138 0.120	0.32 0.30	0.395 0.300	0.01	0.081

**Note**

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

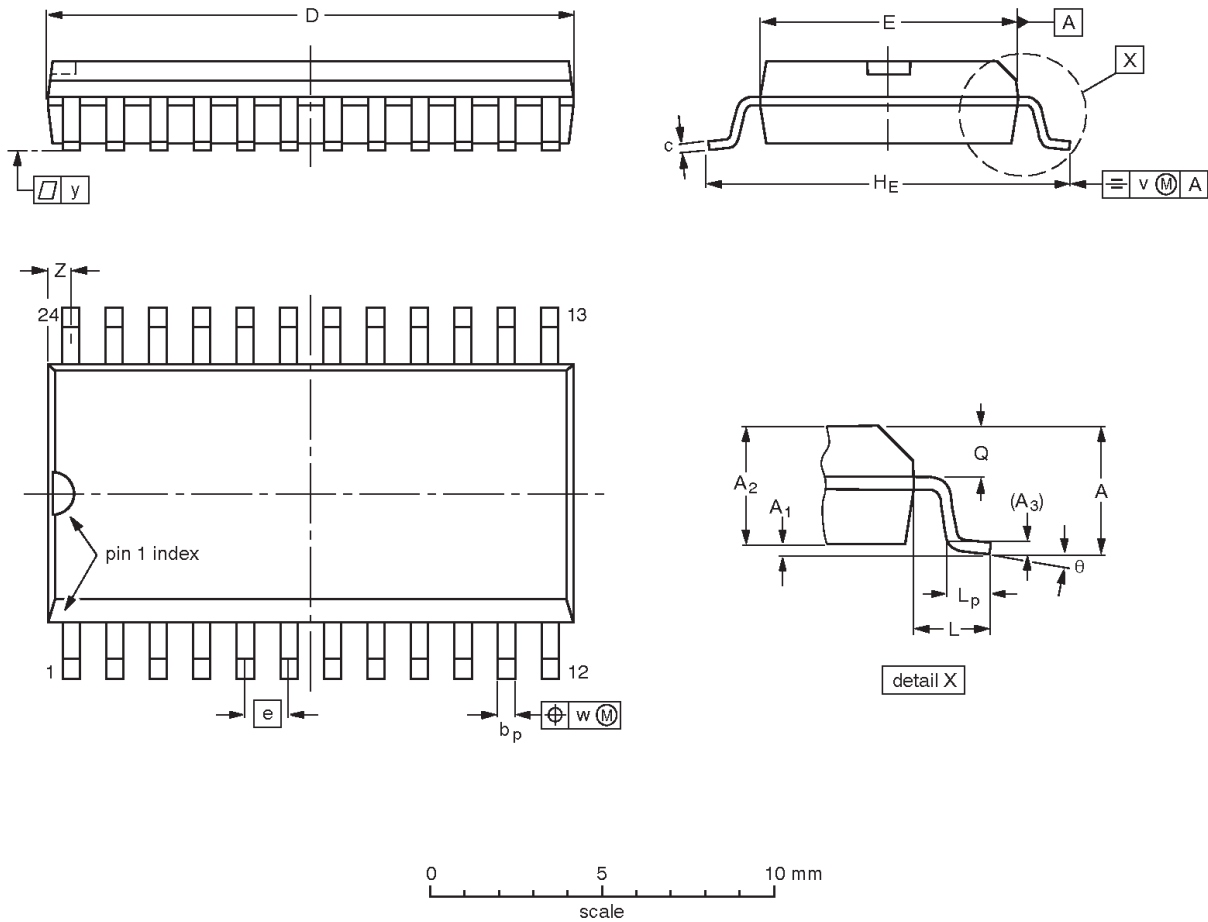
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT222-1		MS-001AF				95-03-11

# 8-bit bidirectional universal shift register

## 74F198

**SO24:** plastic small outline package; 24 leads; body width 7.5 mm

**SOT137-1**



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

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	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° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.050	0.419 0.394	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			
SOT137-1	075E05	MS-013AD				95-01-24 97-05-22

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**NOTES**

## 8-bit bidirectional universal shift register

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## Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
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