

# DATA SHEET

**74F538**

1-of -8 decoder (3-state)

Product specification

1989 Apr 06

IC15 Data Handbook

# 1-of-8 decoder (3-State)

# 74F538

## DESCRIPTION

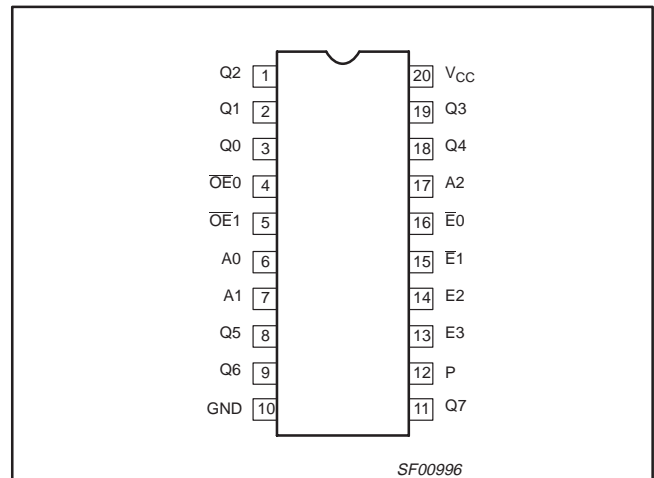
The 74F538 decoder/demultiplexer accepts three address (A0 - A2) input signals and decodes them to select one of eight mutually exclusive outputs. A Polarity control (P) input determines whether the outputs are active Low or active High. The 74F538 has 3-State outputs, and a High signal on the Output Enables (OEn) inputs will force all outputs to the high impedance state. Two active High (E2, E3) and two active Low ( $\bar{E}0$ ,  $\bar{E}1$ ) inputs are available for easy expansion to 1-of-32 decoding with four packages, or for data demultiplexing to 1-of-8 or 1-of-16 destinations.

TYPE	TYPICAL PROPAGATION DELAY	TYPICAL SUPPLY CURRENT (TOTAL)
74F538	8.5ns	35mA

## ORDERING INFORMATION

DESCRIPTION	COMMERCIAL RANGE $V_{CC} = 5V \pm 10\%$ , $T_{amb} = 0^{\circ}C$ to $+70^{\circ}C$	PKG DWG #
20-Pin Plastic DIP	N74F538N	SOT146-1
20-Pin Plastic SOL	N74F538D	SOT163-1

## PIN CONFIGURATION

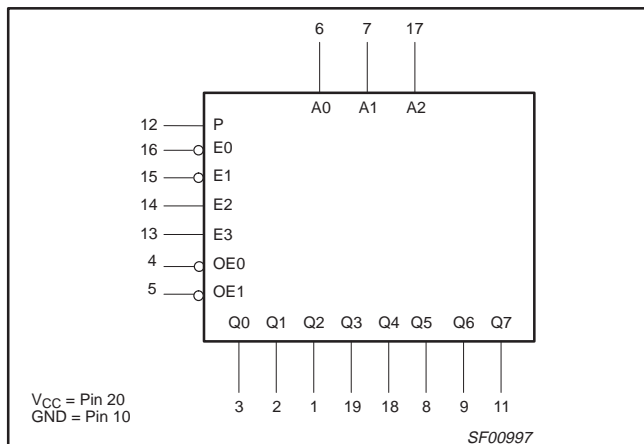


## INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

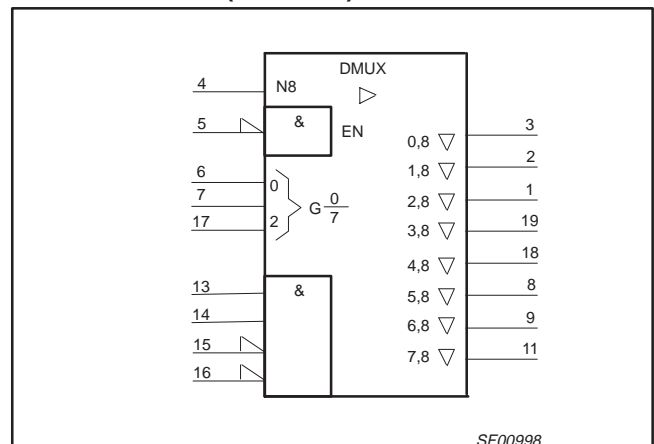
PINS	DESCRIPTION	74F(U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
A0 - A2	Address inputs	1.0/1.0	20 $\mu$ A/0.6mA
$\bar{E}0$ , $\bar{E}1$	Enable inputs (active Low)	1.0/1.0	20 $\mu$ A/0.6mA
E2, E3	Enable inputs (active High)	1.0/1.0	20 $\mu$ A/0.6mA
P	Polarity control input	1.0/1.0	20 $\mu$ A/0.6mA
$\bar{O}E0$ , $\bar{O}E1$	Output Enable inputs	1.0/1.0	20 $\mu$ A/0.6mA
Q0 - Q7	Data outputs	150/40	3.0mA/24mA

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

## LOGIC SYMBOL



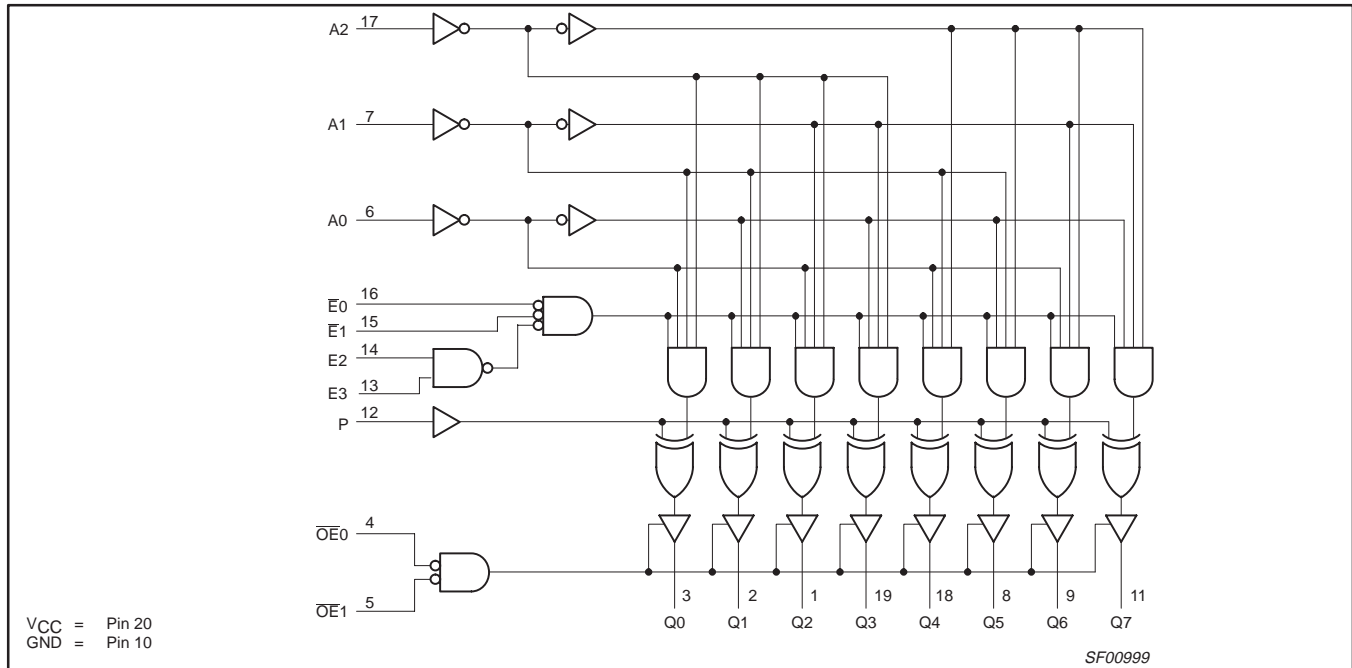
## LOGIC SYMBOL (IEEE/IEC)



# 1-of-8 decoder (3-State)

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## LOGIC DIAGRAM



## FUNCTION TABLE

INPUTS						OUTPUTS								OPERATING MODE			
OE <sub>0</sub>	OE <sub>1</sub>	E <sub>0</sub>	E <sub>1</sub>	E <sub>2</sub>	E <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	Q <sub>0</sub>	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>		Q <sub>5</sub>	Q <sub>6</sub>	Q <sub>7</sub>
H	X	X	X	X	X	X	X	X	Z	Z	Z	Z	Z	Z	Z	Z	High Impedance
X	H	X	X	X	X	X	X	X	Z	Z	Z	Z	Z	Z	Z	Z	
L	L	H	X	X	X	X	X	X	Outputs equal P input								Disable
L	L	X	H	X	X	X	X	X									
L	L	X	X	L	X	X	X	X									
L	L	X	X	X	L	X	X	X									
L	L	L	L	H	H	L	L	L	H	L	L	L	L	L	L	L	Active High output (P = L)
L	L	L	L	H	H	L	L	H	L	H	L	L	L	L	L	L	
L	L	L	L	H	H	L	H	L	L	L	H	L	L	L	H	L	
L	L	L	L	H	H	L	H	H	L	L	L	L	L	L	L	H	
L	L	L	L	H	H	L	L	L	L	H	H	H	H	H	H	H	Active Low output (P = H)
L	L	L	L	H	H	L	L	H	H	L	H	H	H	H	H	H	
L	L	L	L	H	H	L	H	L	H	H	L	H	H	H	H	H	
L	L	L	L	H	H	L	H	H	H	H	H	L	H	H	H	L	

H = High voltage level  
 L = Low voltage level  
 X = Don't care  
 Z = High impedance "off" state

## 1-of-8 decoder (3-State)

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**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
$V_{CC}$	Supply voltage	-0.5 to +7.0	V
$V_{IN}$	Input voltage	-0.5 to +7.0	V
$I_{IN}$	Input current	-30 to +5.0	mA
$V_{OUT}$	Voltage applied to output in High output state	-0.5 to + $V_{CC}$	V
$I_{OUT}$	Current applied to output in Low output state	48	mA
$T_{amb}$	Operating free-air temperature range	0 to +70	°C
$T_{stg}$	Storage temperature	-65 to +150	°C

**RECOMMENDED OPERATING CONDITIONS**

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5.0	5.5	V
$V_{IH}$	High-level input voltage	2.0			V
$V_{IL}$	Low-level input voltage			0.8	V
$I_{IK}$	Input clamp current			-18	mA
$I_{OH}$	High-level output current			-3.0	mA
$I_{OL}$	Low-level output current			24	mA
$T_{amb}$	Operating free-air temperature range	0		70	°C

**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		
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, V_{IH} = \text{MIN}, I_{OH} = \text{MAX}$	$\pm 10\%V_{CC}$	2.4		V	
			$\pm 5\%V_{CC}$	2.7	3.3	V	
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, V_{IH} = \text{MIN}, I_{OL} = \text{MAX}$	$\pm 10\%V_{CC}$		0.35	0.50	V
			$\pm 5\%V_{CC}$		0.35	0.50	V
$V_{IK}$	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = I_{IK}$		-0.73	-1.2	V	
$I_I$	Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 7.0V$			100	$\mu\text{A}$	
$I_{IH}$	High-level input current	$V_{CC} = \text{MAX}, V_I = 2.7V$			20	$\mu\text{A}$	
$I_{IL}$	Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.5V$			-0.6	mA	
$I_{OZH}$	Off-state output current High-level voltage applied	$V_{CC} = \text{MAX}, V_O = 2.7V$			50	$\mu\text{A}$	
$I_{OZL}$	Off-state output current Low-level voltage applied	$V_{CC} = \text{MAX}, V_O = 0.5V$			-50	$\mu\text{A}$	
$I_{OS}$	Short-circuit output current <sup>3</sup>	$V_{CC} = \text{MAX}$	-60		-150	mA	
$I_{CC}$	Supply current	$V_{CC} = \text{MAX}$	$I_{CCH}$		30	40	mA
			$I_{CCL}$		35	50	mA
			$I_{CCZ}$		35	50	mA

**NOTES:**

- For conditions shown as MIN or MAX, use the appropriate value under the recommended operating conditions for the applicable type.
- All typical values are at  $V_{CC} = 5V, T_{amb} = 25^\circ\text{C}$ .
- Not more than one output should be shorted at a time. For testing  $I_{OS}$ , 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,  $I_{OS}$  should be performed last.

# 1-of-8 decoder (3-State)

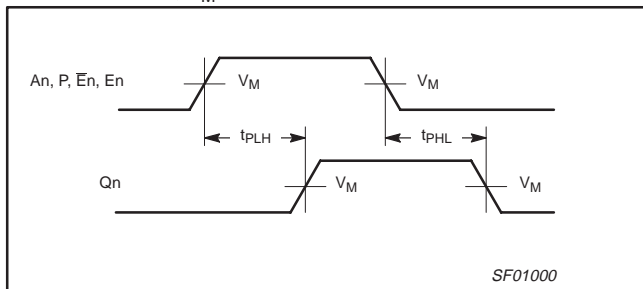
# 74F538

## AC ELECTRICAL CHARACTERISTICS

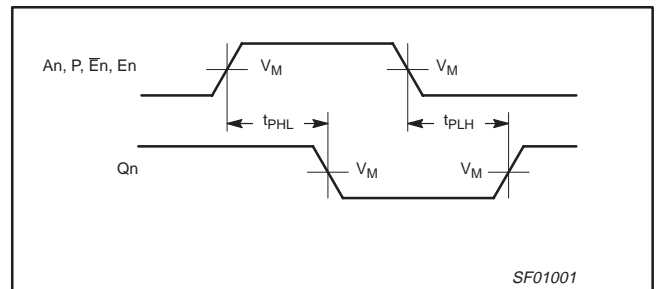
SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			T <sub>amb</sub> = +25°C V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω			T <sub>amb</sub> = 0°C to +70°C V <sub>CC</sub> = +5.0V ± 10% C <sub>L</sub> = 50pF, R <sub>L</sub> = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay An to Qn	Waveform 1, 2	5.5 3.0	8.5 7.5	13.0 12.5	5.0 3.0	14.0 13.5	ns ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay E0 or E1 to Qn	Waveform 1, 2	5.5 3.0	8.5 7.5	12.0 12.0	5.0 3.0	13.0 12.5	ns ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay E2 or E3 to Qn	Waveform 1, 2	6.5 4.0	9.0 7.0	12.5 12.5	5.5 3.5	13.5 13.0	ns ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay P to Qn	Waveform 1, 2	4.5 3.5	9.5 6.5	15.0 10.0	4.0 3.5	16.5 10.5	ns ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable time OE0 or OE1 to Qn	Waveform 3 Waveform 4	2.5 6.5	5.5 9.5	9.5 13.5	2.0 6.0	11.0 15.0	ns ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable time OE0 or OE1 to Qn	Waveform 3 Waveform 4	1.0 1.0	3.0 3.5	6.0 8.5	1.0 1.0	7.0 9.5	ns ns

## AC WAVEFORMS

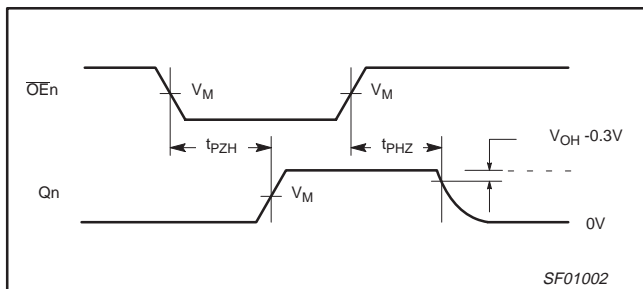
For all waveforms, V<sub>M</sub> = 1.5V.



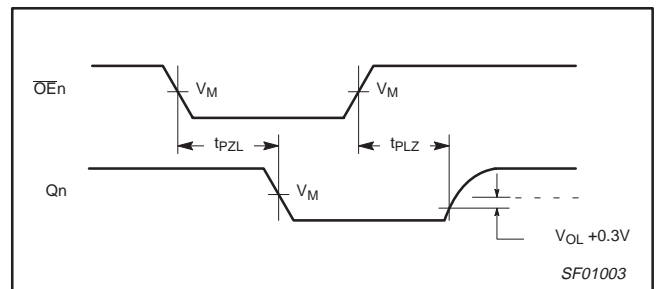
**Waveform 1. Propagation Delay for Non-Inverting Outputs**



**Waveform 2. Propagation Delay for Inverting Outputs**



**Waveform 3. 3-State Output Enable Time to High Level and Output Disable Time from High Level**

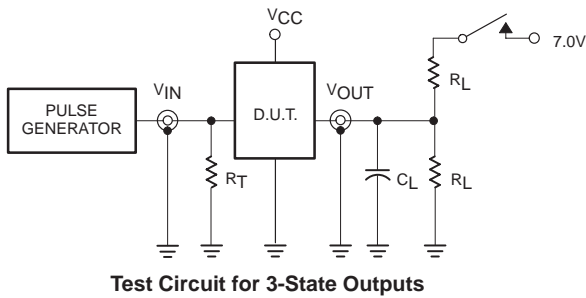


**Waveform 4. 3-State Output Enable Time to Low Level and Output Disable Time from Low Level**

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## TEST CIRCUIT AND WAVEFORM



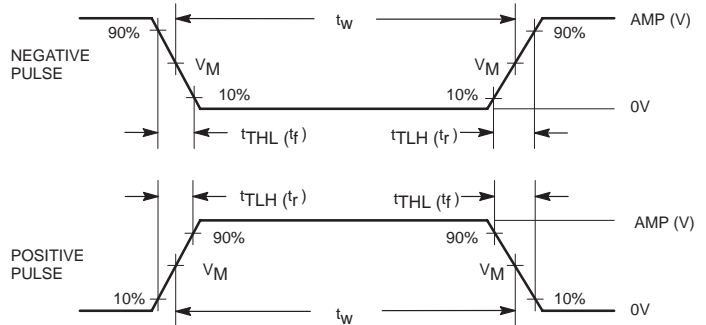
Test Circuit for 3-State Outputs

### SWITCH POSITION

TEST	SWITCH
$t_{PLZ}$	closed
$t_{PZL}$	closed
All other	open

### DEFINITIONS:

- $R_L$  = Load resistor; see AC electrical characteristics for value.
- $C_L$  = Load capacitance includes jig and probe capacitance; see AC electrical characteristics for value.
- $R_T$  = Termination resistance should be equal to  $Z_{OUT}$  of pulse generators.



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

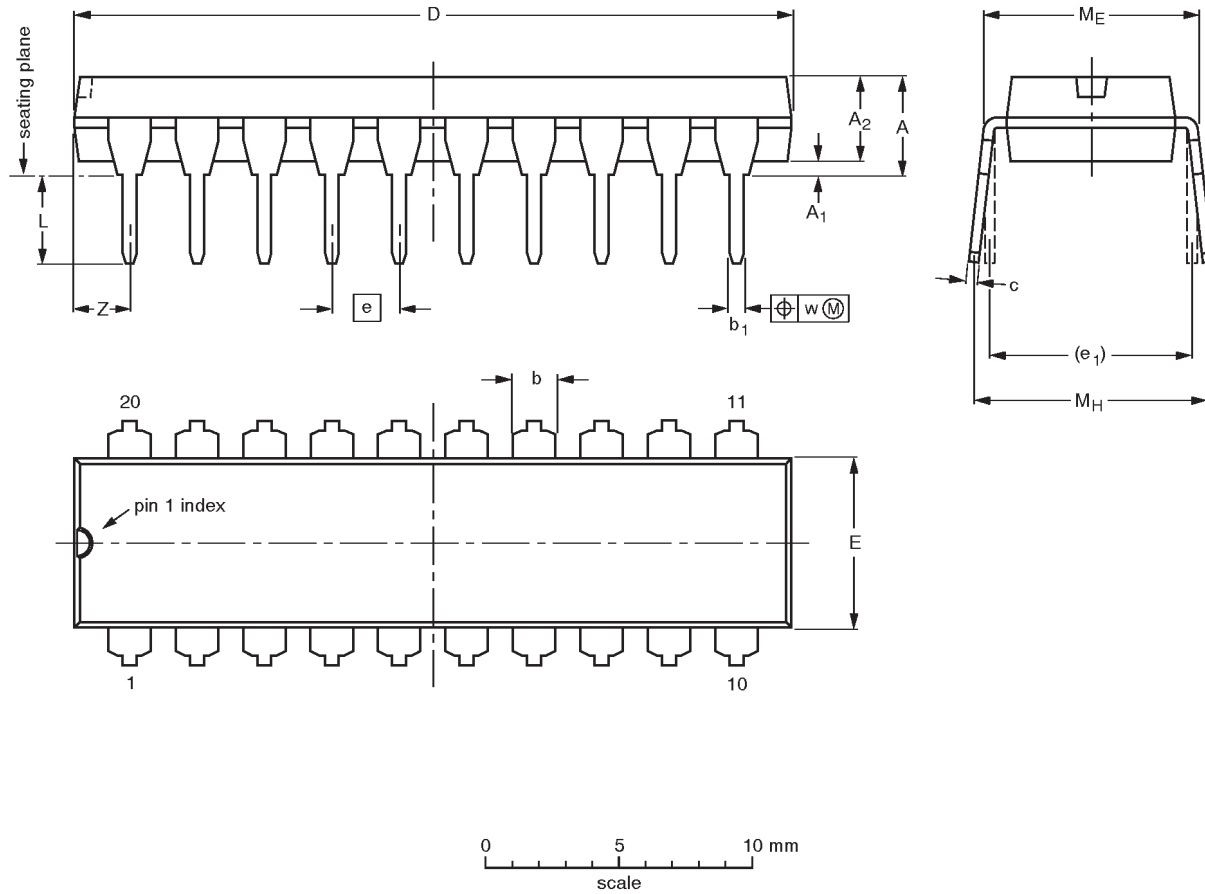
SF00777

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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 <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	4.2	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.

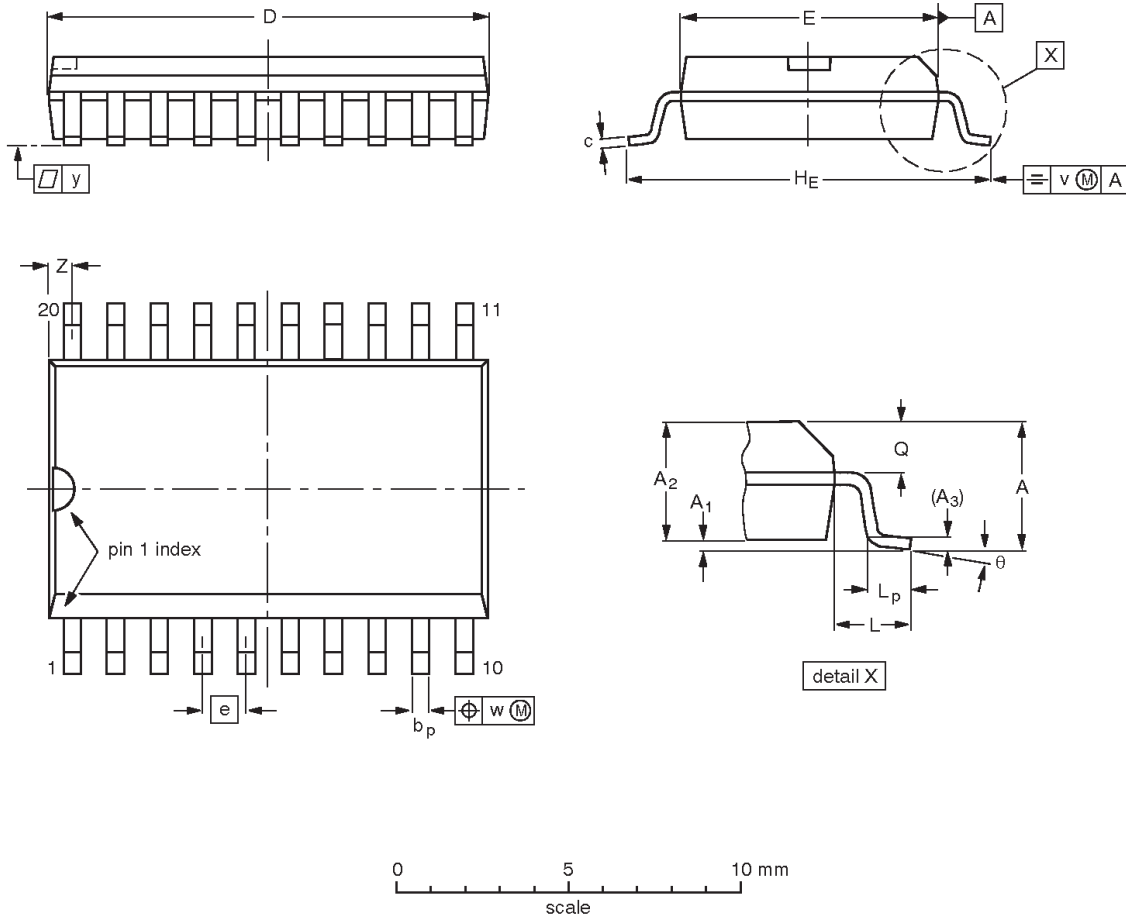
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT146-1			SC603			92-11-17 95-05-24

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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 <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	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° 0°
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	0.419 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			
SOT163-1	075E04	MS-013AC				95-01-24 97-05-22



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**NOTES**

## 1-of -8 decoder (3-state)

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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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[1] Please consult the most recently issued datasheet before initiating or completing a design.

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