DATA SHEET

74LV688
8-bit magnitude comparator

Product specification
Supersedes data of 1997 May 15
IC24 Data Handbook

1998 Jun 23

Philips
Semiconductors

PHILIPS

8-bit magnitude comparator 74LV688

FEATURES

- Wide operating voltage: 1.0 to 5.5V
- Optimized for low voltage applications: 1.0V 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 at V_{CC} = 3.3V, T_{amb} = 25°C
- Typical V_{OHV} (output V_{OH} undershoot) > 2V at V_{CC} = 3.3V, T_{amb} = 25°C
- Compare two 8-bit words
- Output capability: standard
- I_{CC} category: MSI

DESCRIPTION

The 74LV688 is a high-speed Si-gate CMOS device, pin compatible with the 74HC/HCT688

The 74LV688 is an 8-bit magnitude comparator. It performs comparisons of two 8-bit binary or BCD words. The output provides $\overline{P = Q}$ (equal-to).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay P_n, Q_n to $\overline{P=Q}$	C_L = 15pF V_{CC} = 3.3V	17	ns
C_I	Input capacitance		3.5	pF
C_{PD}	Power dissipation capacitance per gate	V_I = GND to V_{CC}[1]	22	pF

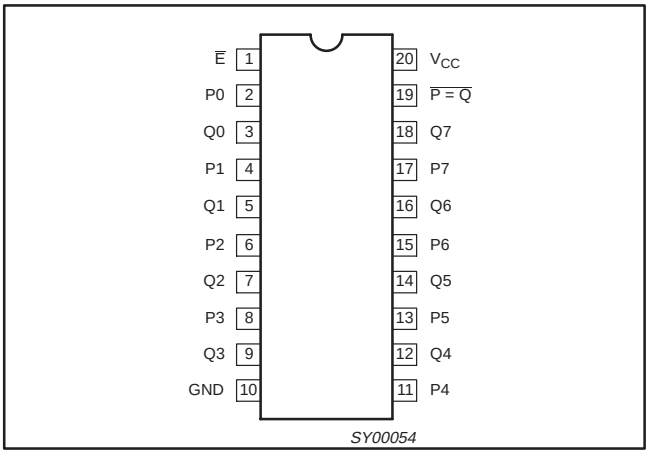
NOTE:

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

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic DIL	–40°C to +125°C	74LV688 N	74LV688 N	SOT146-1
20-Pin Plastic SO	–40°C to +125°C	74LV688 D	74LV688 D	SOT163-1
20-Pin Plastic SSOP Type II	–40°C to +125°C	74LV688 DB	74LV688 DB	SOT339-1
20-Pin Plastic TSSOP Type I	–40°C to +125°C	74LV688 PW	74LV688PW DH	SOT360-1

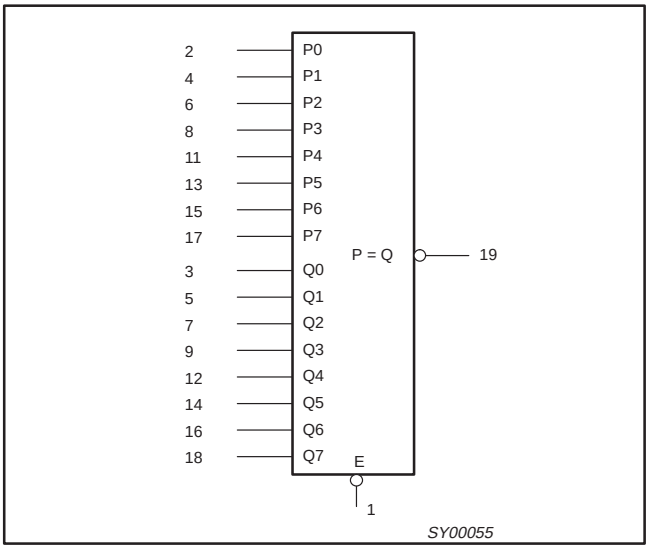
PIN CONFIGURATION



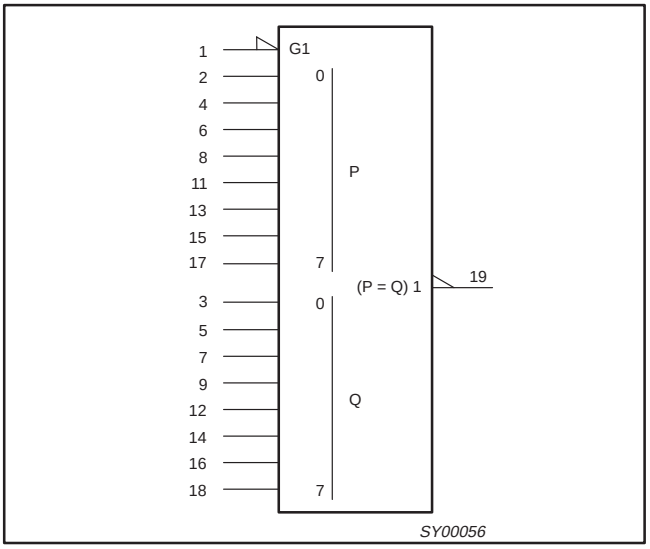
PIN DESCRIPTION

PIN NO.	SYMBOL	FUNCTION
1	$\overline{E}$	Enable input (active LOW)
2, 4, 6, 8, 11, 13, 15, 17	P0 to P7	Word inputs
3, 5, 7, 9, 12, 14, 16, 18	Q0 to Q7	Word inputs
10	GND	Ground (0V)
19	$\overline{P=Q}$	Equal to output
20	V_{CC}	Positive Supply Voltage

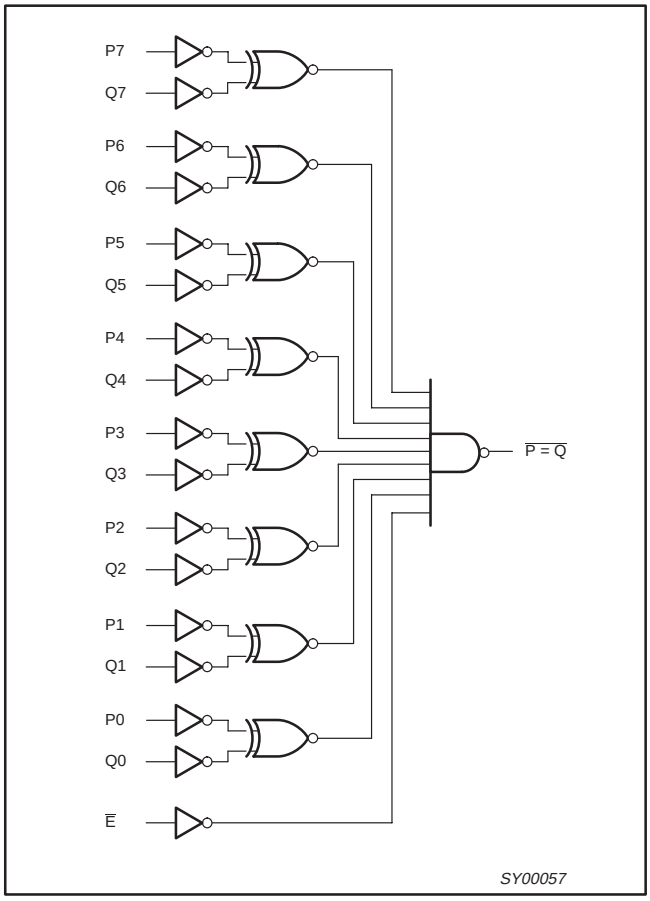
LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



LOGIC DIAGRAM



FUNCTION TABLE

INPUTS		OUTPUT
DATA Pn, Qn	**ENABLE $\overline{E}$**	**$\overline{P = Q}$**
P = Q	L	L
X	H	H
P > Q	L	H
P < Q	L	H

NOTES:
H = HIGH voltage level
L = LOW voltage level
X = Don't care

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	MIN	MAX	UNIT
V_{CC}	DC supply voltage		–0.5	+7.0	V
I_{IK}	DC input diode current	$V_I < –0.5$ V or $V_1 > V_{CC} + 0.5$V	–	± 20	mA
I_{OK}	DC output diode current	$V_O < –0.5$ V or $V_0 > V_{CC} + 0.5$V	–	± 50	mA
I_O	DC output source or sink current – standard outputs	$–0.5V < V_O < V_{CC} + 0.5V$		± 25	mA
± I_{GND}, ± I_{CC}	DC V_{CC} or GND current for types with – standard outputs			± 50	mA
T_{stg}	Storage temperature range		–65	+150	°C
P_{tot}	power dissipation per package – plastic DIL – plastic mini-pack (SO) – plastic medium-shrink SO (SSOP and TSSOP)	for temperature range: –40 to +125°C above +70°C derate linearly with 12 mW/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 performance capability of a high–performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
3. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CC}	DC supply voltage	see note 1	1.0	3.3	5.5	V
V_I	DC Input voltage		0	–	V_{CC}	V
V_O	DC 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 ($\Delta t/\Delta v$)	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 V_{CC} = 3.6V to 5.5V		– – – –	500 200 100 50	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} = 5.5V.

DC ELECTRICAL CHARACTERISTICS

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_{CC} = 4.5 to 5.5V	0.7 * V_{CC}			0.7 * V_{CC}		
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_{CC} = 4.5 to 5.5			0.3 * V_{CC}		0.3 * V_{CC}	
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_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; $-I_O$ = 100µA	4.3	4.5		4.3		
	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_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; $-I_O$ = 12mA	3.60	4.20		3.50		
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_{CC} = 4.5V; 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	
		V_{CC} = 4.5V; V_I = V_{IH} or V_{IL}; I_O = 12mA		0.35	0.55		0.65	
I_I	Input leakage current	V_{CC} = 5.5V; V_I = V_{CC} or GND			1.0		1.0	µA
I_{CC}	Quiescent supply current; MSI	V_{CC} = 5.5V; V_I = V_{CC} or GND; I_O = 0			20.0		160	µA
ΔI_{CC}	Additional quiescent supply current	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

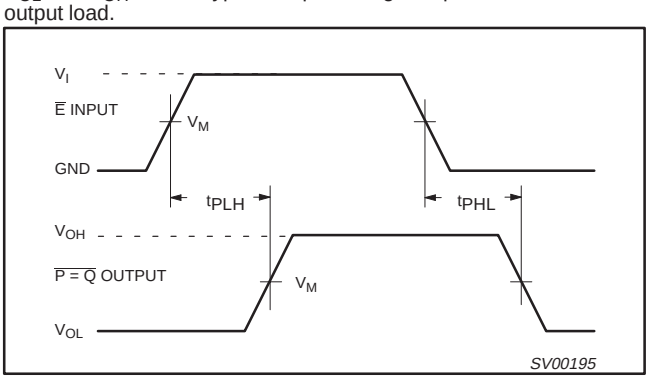
GND = 0V; $t_r = t_f$ = 2.5ns; C_L = 50pF; R_L = 1KΩ

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 P_n, Q_n to $\overline{P=Q}$	2	1.2		100	–		–	ns
			2.0		28	45		57	
			2.7		20	32		40	
			3.0 to 3.6		16[2]	26		33	
			4.5 to 5.5		11[2]	18		22	
t_{PHL}/t_{PLH}	Propagation delay $\overline{E}$ to $\overline{P=Q}$	1	1.2		50	–		–	ns
			2.0		17	29		38	
			2.7		13	21		27	
			3.0 to 3.6		10[2]	17		22	
			4.5 to 5.5		7[2]	12		15	

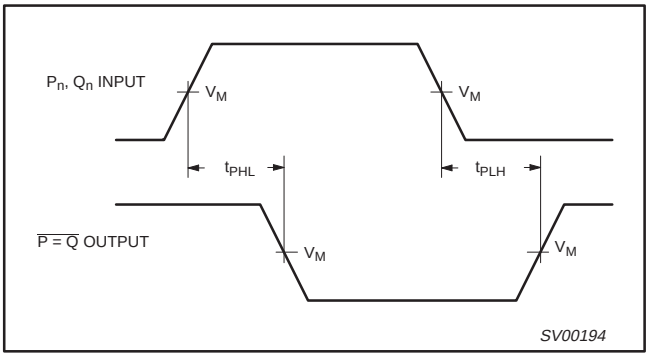
NOTES:
1. Unless otherwise stated, all typical values are at T_{amb} = 25°C.
2. Typical value measured at V_{CC} = 3.3V.
3. Typical value measured at V_{CC} = 5.0V.

AC WAVEFORMS

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

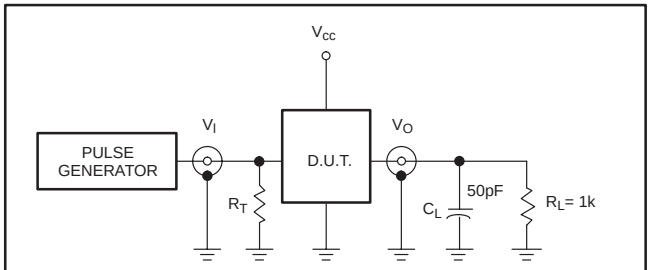


Waveform 1. Propagation delays from the enable input ($\overline{E}$) to the equal-to output ($\overline{P = Q}$).



Waveform 2. Propagation delays from the inputs (P_n, Q_n) to the equal-to output ($\overline{P = Q}$).

TEST CIRCUIT



Test Circuit for Outputs

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.

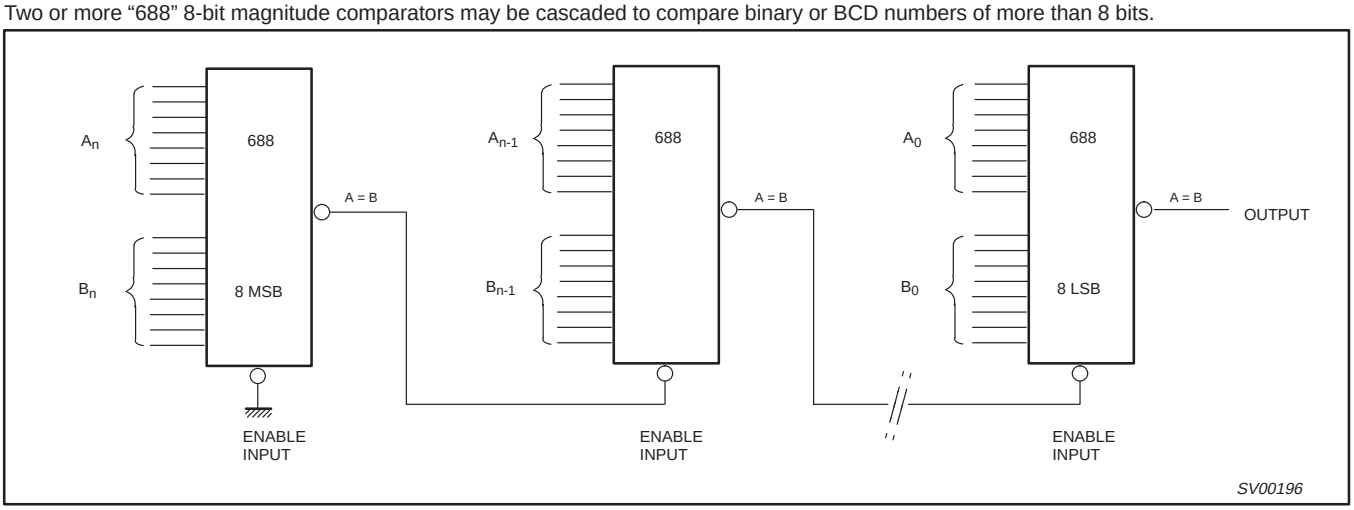
TEST	V_{CC}	V_I
t_{PLH}/t_{PHL}	< 2.7V	V_{CC}
	2.7–3.6V	2.7V
	≥ 4.5 V	V_{CC}

SV00902

Waveform 3. Load circuitry for switching times

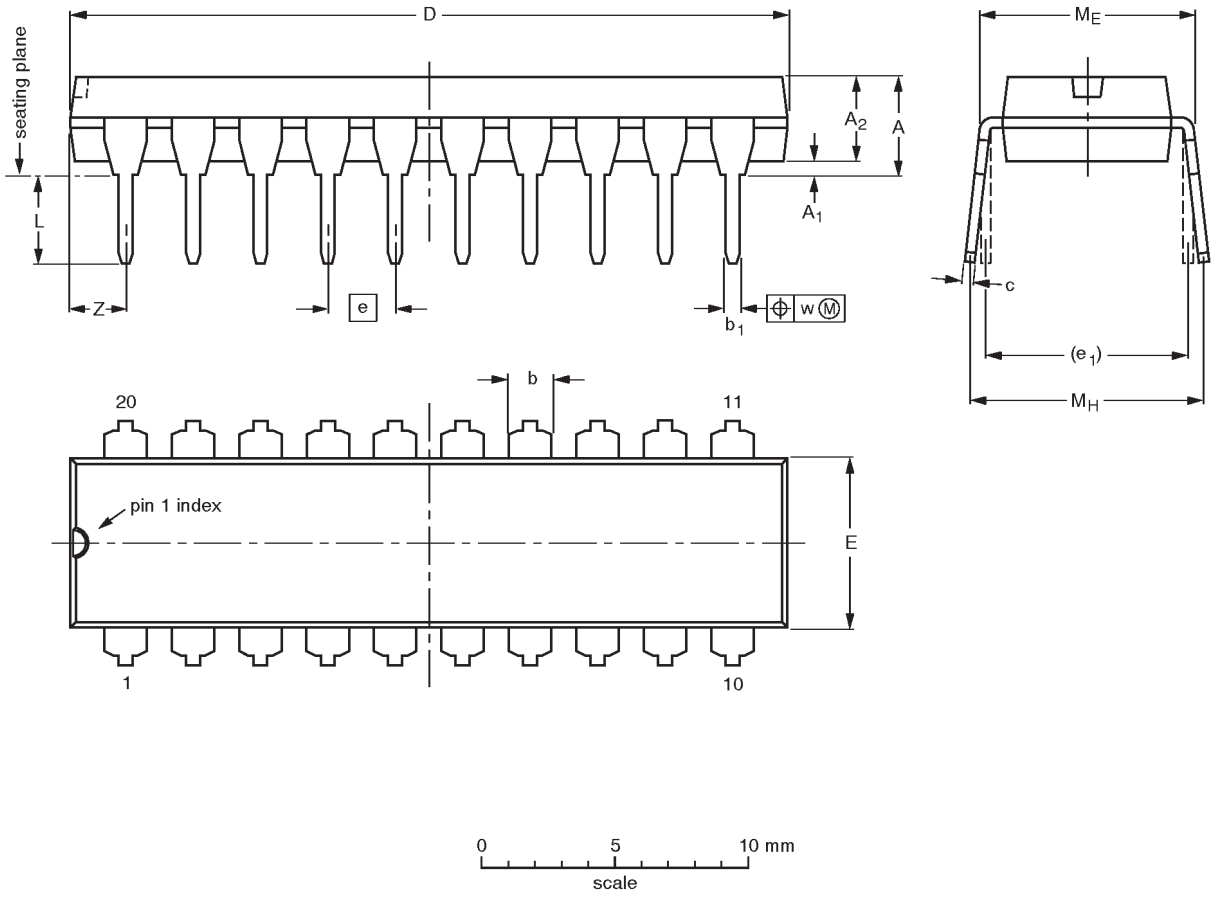
APPLICATION INFORMATION

Two or more “688” 8-bit magnitude comparators may be cascaded to compare binary or BCD numbers of more than 8 bits.



Waveform 4. Binary or BCD comparator

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



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

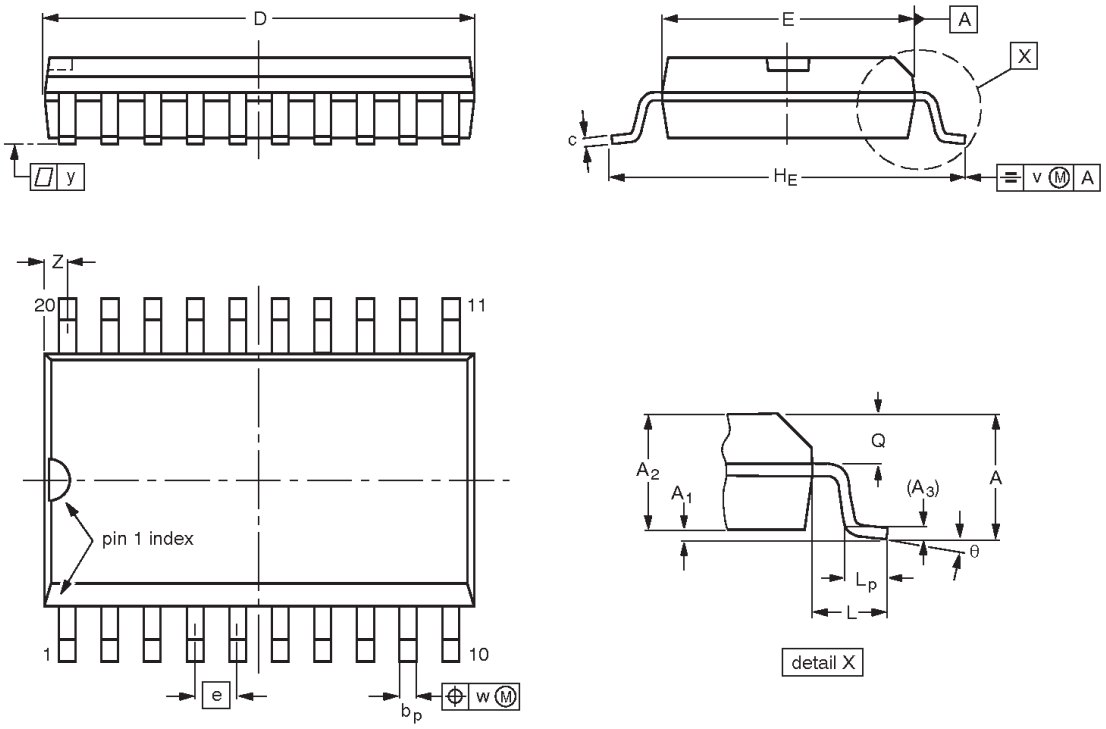
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32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

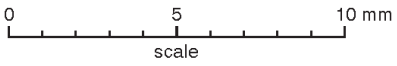
Note

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)

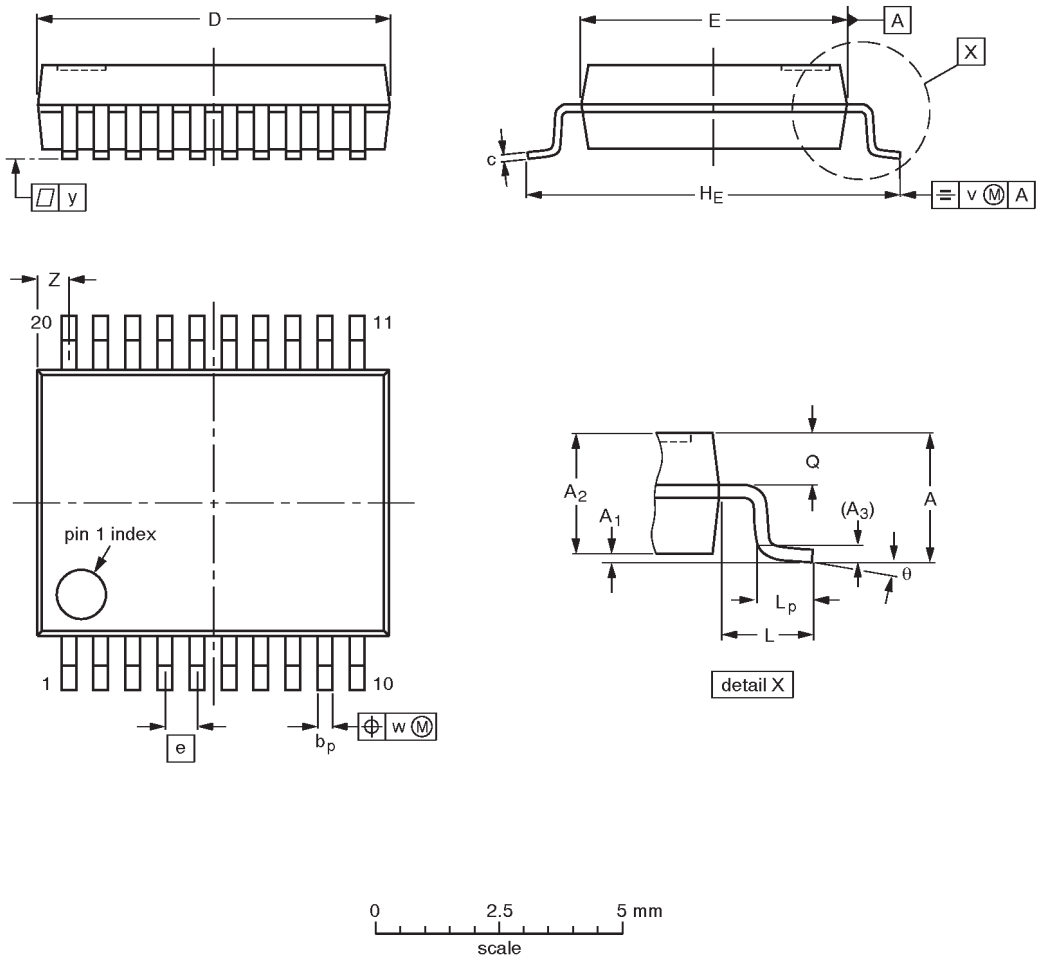
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42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

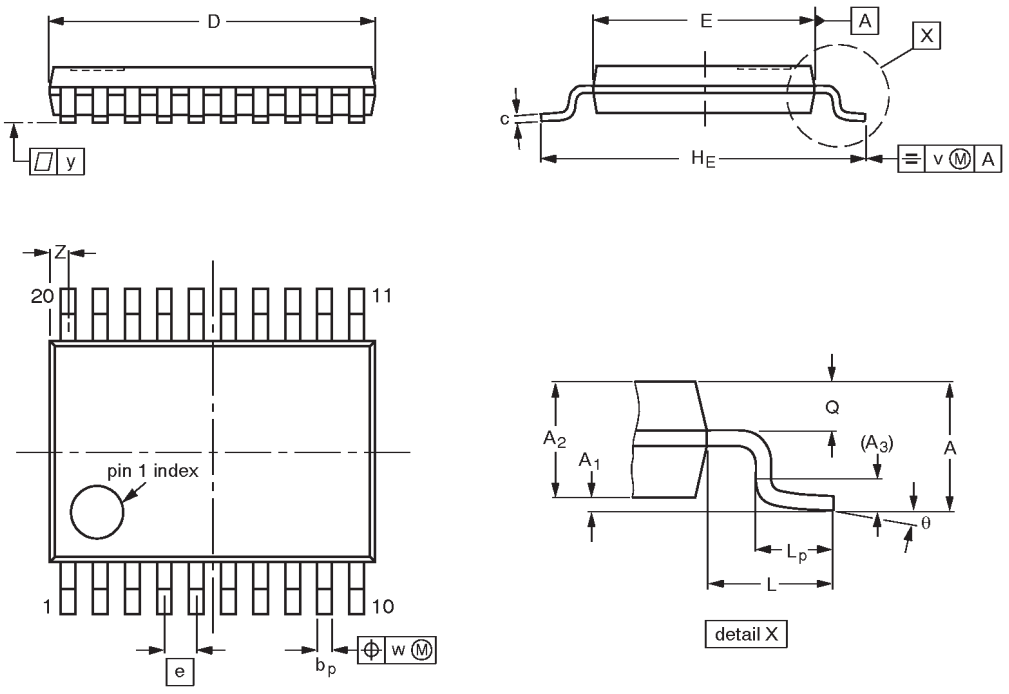
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

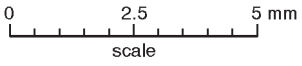
Note

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.
Preliminary Specification	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.
Product Specification	Full Production	This data sheet contains Final Specifications. Philips Semiconductors reserves the right to make changes at any time without notice, in order to improve design and supply the best possible product.

Philips Semiconductors
811 East Arques Avenue
P.O. Box 3409
Sunnyvale, California 94088–3409
Telephone 800-234-7381

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