T54LS247/248
T74LS247/248

LOW POWER SCHOTTKY INTEGRATED CIRCUITS

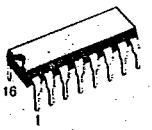
67C 16345 D T-51-17

PRELIMINARY DATA

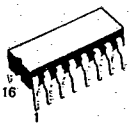
BCD-TO-SEVEN-SEGMENT DECODER/DRIVES

DESCRIPTION

The T54LS/T74LS247/248 are BCD-to-seven segment Decoder/Drivers. They compose the and with the tails. The LS247 has active low outputs for direct drive of indicators, while the LS248 has active - high outputs for driving lamp buffers. Both types feature a lamp test input and full ripple-blanking input/output controls. An automatic leading and/or trailing edge zero-blanking control (RBI and RBO) is incorporated. An over-riding blanking input (BI) may be used to control the lamp intensity. Display pattern for BCD input counts above 9 are unique symbols to authenticate input conditions.



B1
Plastic Package



D1/D2
Ceramic Package

M1
Micro Package

C1
Plastic Chip Carrier

ORDERING NUMBERS:

T54LSXXX D2	T74LSXXX C1
T74LSXXX D1	T74LSXXX M1
T74LSXXX B1	

LS247

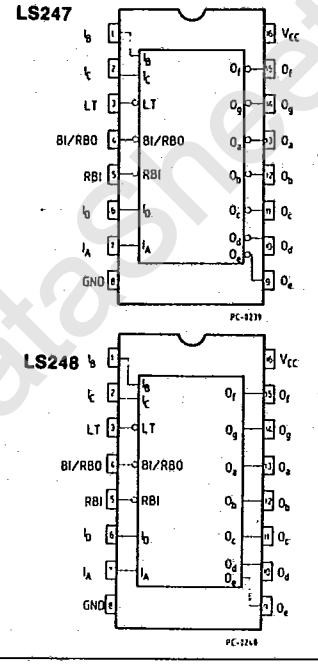
- OPEN-COLLECTR OUTPUTS DRIVE INIDICATORS DIRECTLY
- LAMP-TEST PROVISION
- LEADING/TRAILING ZERO SUPPRESSION

LS248

- INTERNAL PULL-UPS ELIMINATE NEED FOR EXTERNAL RESISTORS
- LAMP-TEST PROVISION
- LEADING/TRAILING ZERO SUPPRESSION

PIN CONNECTION
(top view)

DUAL IN LINE



PIN NAMES

A,B,C,D	Inputs
a,b,c,d,e,f,g	Outputs
LT	Lamp Test
RBO	Rubout Outputs
RBI	Rubout Inputs
BI	Blanking Inputs

T54LS247/248
T74LS247/248

CHIP CARRIER

NC = No Internal Connection

ALL CIRCUIT TYPES FEATURE LAMP INTENSITY MODULATION CAPABILITY

TYPE	DRIVER OUTPUTS				TYPICAL POWER DISSIPATION
	ACTIVE LEVEL	OUTPUT CONFIGURATION	SINK CURRENT	MAX VOLTAGE	
T54LS247 T54LS248	low high	open-collector 2-kΩ pull-up	12 mA 2.0 mA	15 V 5.5 V	35 mW 125 mW
T74LS247 T74LS248	low high	open-collector 2-kΩ pull-up	24 mA 6.0 mA	15 V 5.5 V	35 mW 125 mW

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	−0.5 to 7	V
V_I	Input Voltage, Applied to Input	−0.5 to 15	V
V_O	Output Voltage, Applied to Output	0 to 10	V
I_I	Input Current, Into Inputs	−30 to 5	mA
I_O	Output Current, Into Outputs	50	mA

Stresses in excess of those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions in excess of those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

GUARANTEED OPERATING RANGES

Part Numbers	Supply Voltage			Temperature
	Min	Typ	Max	
T54LS247/248D2	4.5 V	5.0 V	5.5 V	−55°C to +125°C
T74LS247/248XX	4.75 V	5.0 V	5.25 V	0°C to +70°C

XX = package type.

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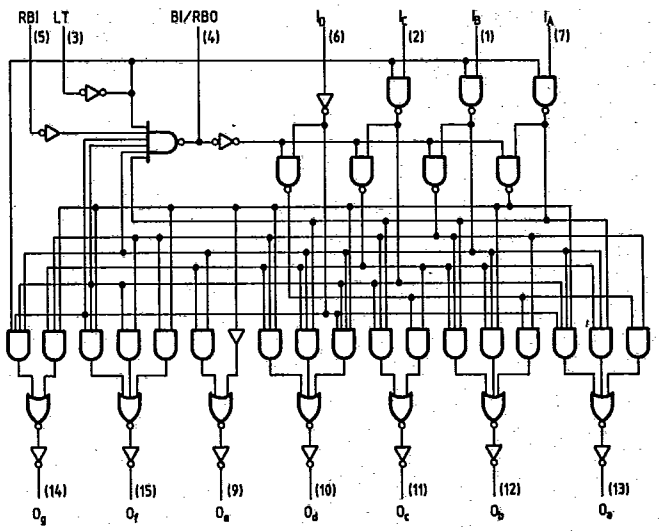
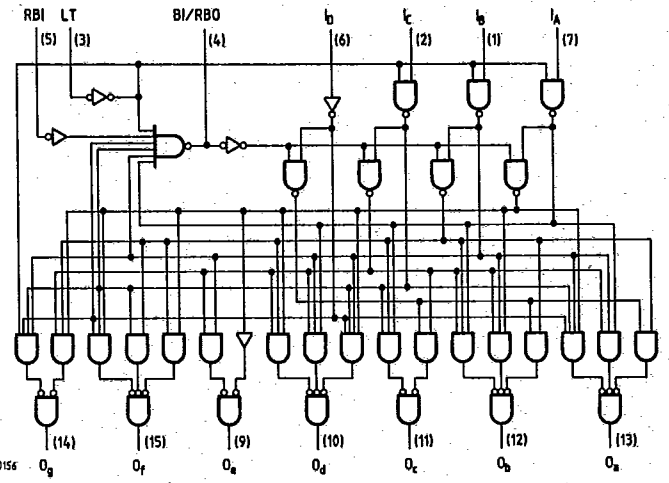
LOGIC DIAGRAMS

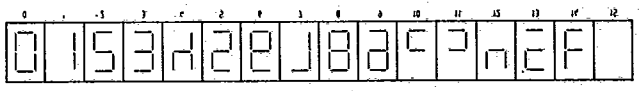
LS247



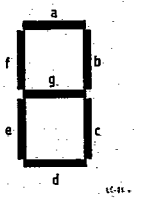
LS248



V_{CC} = Pin 16
GND = Pin 8
() = Pin numbers



NUMERICAL DESIGNATIONS AND RESULTANT DISPLAY



SEGMENT IDENTIFICATION

T54LS247/248
T74LS247/248

LS247 TRUTH TABLE

DECIMAL OR FUNCTION	INPUTS						BI/RBO*	OUTPUTS							NOTE
	LT	RBI	D	C	B	A		a	b	c	d	e	f	g	
0	H	H	L	L	L	L	H	ON	ON	ON	ON	ON	ON	OFF	
1	H	X	L	L	L	H	H	OFF	ON	ON	OFF	OFF	OFF	OFF	
2	H	X	L	L	H	L	H	ON	ON	OFF	ON	ON	OFF	ON	
3	H	X	L	L	H	H	H	ON	ON	ON	ON	OFF	OFF	ON	
4	H	X	L	H	L	L	H	OFF	ON	ON	OFF	OFF	ON	ON	
5	H	X	L	H	L	H	H	ON	OFF	ON	ON	OFF	ON	ON	
6	H	X	L	H	H	L	H	ON	OFF	ON	ON	ON	ON	ON	
7	H	X	L	H	H	H	H	ON	ON	ON	OFF	OFF	OFF	OFF	1
8	H	X	H	L	L	L	H	ON	ON	ON	ON	ON	ON	ON	
9	H	X	H	L	L	H	H	ON	ON	ON	ON	OFF	ON	ON	
10	H	X	H	L	H	L	H	OFF	OFF	OFF	ON	ON	OFF	ON	
11	H	X	H	L	H	H	H	OFF	OFF	ON	ON	OFF	OFF	ON	
12	H	X	H	H	L	L	H	OFF	ON	OFF	OFF	OFF	ON	ON	
13	H	X	H	H	L	H	H	ON	OFF	OFF	ON	OFF	ON	ON	
14	H	X	H	H	H	L	H	OFF	OFF	OFF	ON	ON	ON	ON	
15	H	X	H	H	H	H	H	OFF	OFF	OFF	OFF	OFF	OFF	OFF	
BI	X	X	X	X	X	X	L	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2
RBI	H	L	L	L	L	L	L	OFF	OFF	OFF	OFF	OFF	OFF	OFF	3
LT	L	X	X	X	X	X	H	ON	ON	ON	ON	ON	ON	ON	4

LS248 TRUTH TABLE

DECIMAL OR FUNCTION	INPUTS						BI/RBO*	OUTPUTS							NOTE
	LT	RBI	D	C	B	A		a	b	c	d	e	f	g	
0	H	H	L	L	L	L	H	H	H	H	H	H	H	L	1
1	H	X	L	L	L	H	H	L	H	H	L	L	L	L	1
2	H	X	L	L	H	L	H	H	H	L	H	H	L	H	
3	H	X	L	L	H	H	H	H	H	H	H	L	L	H	
4	H	X	L	H	L	L	H	L	H	H	L	L	H	H	
5	H	X	L	H	L	H	H	H	L	H	H	L	H	H	
6	H	X	L	H	H	L	H	H	L	H	H	H	H	H	
7	H	X	L	H	H	H	H	H	H	H	L	L	L	L	1
8	H	X	H	L	L	L	H	H	H	H	H	H	H	H	
9	H	X	H	L	L	H	H	H	H	H	H	L	H	H	
10	H	X	H	L	H	L	H	L	L	L	H	H	L	H	
11	H	X	H	L	H	H	H	L	L	H	H	L	L	H	
12	H	X	H	H	L	L	H	L	H	L	L	L	H	H	
13	H	X	H	H	L	H	H	H	L	L	H	L	H	H	
14	H	X	H	H	H	L	H	L	L	L	H	H	H	H	
15	H	X	H	H	H	H	H	L	L	L	L	L	L	L	
BI	X	X	X	X	X	X	L	L	L	L	L	L	L	L	2
RBI	H	L	L	L	L	L	L	L	L	L	L	L	L	L	3
LT	L	X	X	X	X	X	H	H	H	H	H	H	H	H	4

H = HIGH Level, L = LOW Voltage Level, X = Don't Care

NOTES: 1. The Blanking input (BI) must be open or held at a high logic level when output functions 0 through 15 are desired. The ripple-blanking input (RBI) must be open or high if blanking of a decimal zero is not desired.
2. When a low logic level is applied directly to the blanking input (BI), all segment outputs are off regardless of the level of any other input.
3. When ripple-blanking input (RBI) and inputs A, B, C, and D are at a low level with the lamp test input high, all segment outputs go off and the ripple-blanking output (RBO) goes to a low level (response condition).
4. When the blanking input/ripple blanking output (BI/RBO) is open or held high and a low is applied to the lamp-test input, all segment outputs are on.

* BI/RBO is wire-AND logic serving as blanking input (BI) and/or ripple-blanking output (RBO).

T54LS247/248
T74LS247/248

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (T54LS/T74LS247)

Symbol	Parameter		Limits Min.	Limits Typ.	Limits Max.	Test Conditions (Note 1)	Units
V_{IH}	Input HIGH Voltage		2.0			Guaranteed input HIGH Voltage for all Inputs	V
V_{IL}	Input LOW Voltage	54			0.7	Guaranteed input LOW Voltage for all Inputs	V
		74			0.8		
V_{CD}	Input Clamp Diode Voltage			−0.65	−1.5	V_{CC} = MIN, I_{IN} = −18mA	V
V_{OH}	Output HIGH Voltage BI/RBO	54	2.4	4.2		V_{CC} = MIN, I_{OH} = −50μA, V_{IN} = V_{IH} or V_{IL} per Truth Table	V
		74	2.4	4.2			
V_{OL}	Output LOW Voltage BI/RBO	54,74		0.25	0.4	I_{OL} = 4.0mA; V_{CC} = MIN, V_{IN} = V_{IL} or V_{IH} per Truth Table	V
		74		0.35	0.5	I_{OL} = 3.2mA	
$I_{O(off)}$	Off-State Output Current a-g	54,74			250	V_{CC} = MAX, V_{IH} = 2.0V, $V_{O(off)}$ = 15V, V_{IL} = MAX	μA
$V_{O(on)}$	On-State Output Voltage a-g	54,74		0.25	0.4	$I_{O(on)}$ = 12mA; V_{CC} = MIN, V_{IH} = 2.0V, V_{IL} per Truth Table	V
		74		0.35	0.5	I_{OL} = 24mA	
I_{IH}	Input HIGH Current				20 0.1	V_{CC} = MAX, V_{IN} = 2.7V V_{CC} = MAX, V_{IN} = 7.0V	μA mA
I_{IL}	Input LOW Current Any Input, except BI/RBO BI/RBO				−0.4 −1.2	V_{CC} = MAX, V_{IN} = 0.4V	mA
I_{OS}	Output Short Circuit Current BI/RBO (Note 2)		−0.3		−2.0	V_{CC} = MAX	mA
I_{CC}	Power Supply Current			7.0	13	V_{CC} = MAX	mA

AC CHARACTERISTICS: T_A = 25°C (T54LS/74LS247)

Symbol	Parameter	Limits Min.	Limits Typ.	Limits Max.	Test Conditions	Units
t_{PLH} t_{PHL}	Turn-Off Time from A Input Turn-On Time from A Input			100 100	C_L = 15pF, R_L = 665Ω	ns
t_{PLH} t_{PHL}	Turn-Off Time from RBI Input Turn-On Time from RBI Input			100 100		ns

Notes:
1) For conditions shown as MIN or MAX, use the appropriate value specified under guaranteed operating ranges.
2) Not more than one output should be shorted at a time.
3) Typical values are at V_{CC} = 5.0V, T_A = 25°C

T54LS247/248
T74LS247/248

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (T54LS/T74LS248)

Symbol	Parameter		Limits Min.	Typ.	Max.	Test Conditions (Note 1)		Units
V_{IH}	Input HIGH Voltage		2.0			Guaranteed input HIGH Voltage for all Inputs		V
V_{IL}	Input LOW Voltage	54			0.7	Guaranteed input LOW Voltage for all Inputs		V
		74			0.8			
V_{CD}	Input Clamp Diode Voltage			−0.65	−1.5	V_{CC} = MIN, I_{IN} = −18mA		V
V_{OH}	Output HIGH Voltage BI/RBO	54	2.4	4.2		V_{CC} = MIN, I_{OH} = MAX*, V_{IN} = V_{IH} or V_{IL} per Truth Table		V
		74	2.4	4.2				
I_O	Output Current a-g	54,74	−1.3	−20		V_{CC} = MIN, V_O = 0.85V Input Conditions as for V_{OH}		
V_{OL}	Output LOW Voltage a-g	54,74		0.25	0.4	I_{OL} = 2.0mA	V_{CC} = MIN, V_{IH} = 2.0V	V
		74		0.35	0.5	I_{OL} = 3.2mA		
	BI/RBO	54,74		0.25	0.4	I_{OL} = 1.6mA	V_{IL} = per Truth Table	V
		74		0.35	0.5	I_{OL} = 3.2mA		
I_{IH}	Input HIGH Current				20 0.1	V_{CC} = MAX, V_{IN} = 2.7V V_{CC} = MAX, V_{IN} = 7.0V		μA
I_{IL}	Input LOW Current Any Input, except BI/RBO BI/RBO				−0.4 −1.2	V_{CC} = MAX, V_{IN} = 0.4V		mA
I_{OS}	Output Short Circuit Current BI/RBO (Note 2)		−0.3		−2.0	V_{CC} = MAX		mA
I_{CC}	Power Supply Current			25	38	V_{CC} = MAX		mA

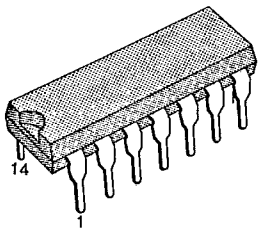
* I_{OH} = −50μA for BI/RBO, I_{OH} = −100μA for a-g

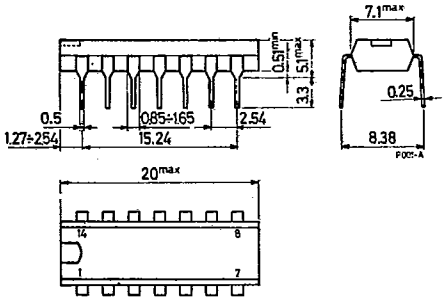
AC CHARACTERISTICS: T_A = 25°C, V_{CC} = 5.0V (T54LS/T74LS248)

Symbol	Parameter	Limit Max	Test Condition	Units
t_{PHL}	Propagation Delay Time, High-to-Low-Level Output from A Input	100	C_L = 15pF	
t_{PLH}	Propagation Delay Time, Low-to-High-Level Output from A Input	100	R_L = 4.0kΩ	
t_{PHL}	Propagation Delay Time, High-to-Low-Level Output from RBI Input	100	C_L = 15pF	
t_{PLH}	Propagation Delay Time, Low-to-High-Level Output from RBI Input	100	R_L = 6.0kΩ	

Notes:
1) For conditions shown as MIN or MAX, use the appropriate value specified under guaranteed operating ranges.
2) Not more than one output should be shorted at a time.
3) Typical values are at V_{CC} = 5.0V, T_A = 25°C

14-LEAD PLASTIC DIP





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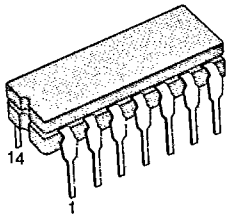

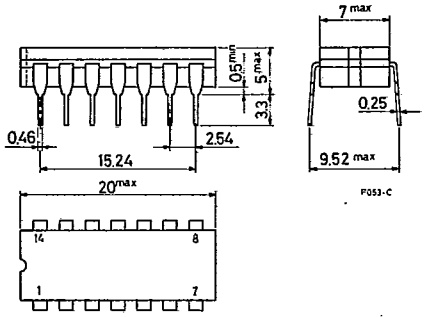

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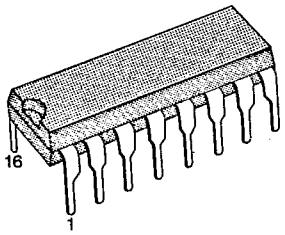
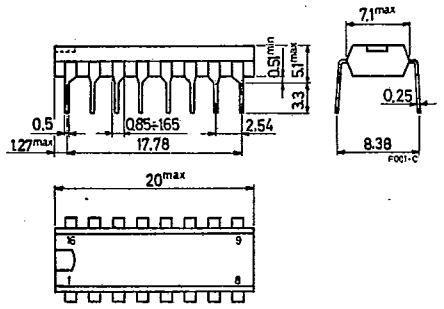
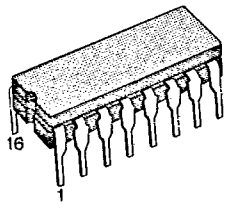
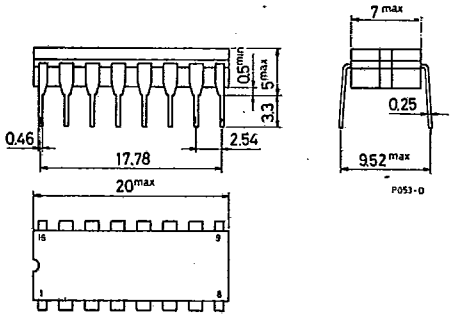




Packages

16-LEAD CERAMIC DIP





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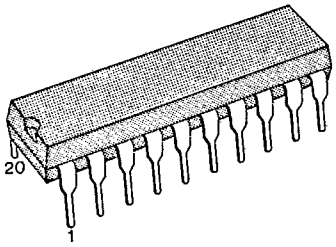

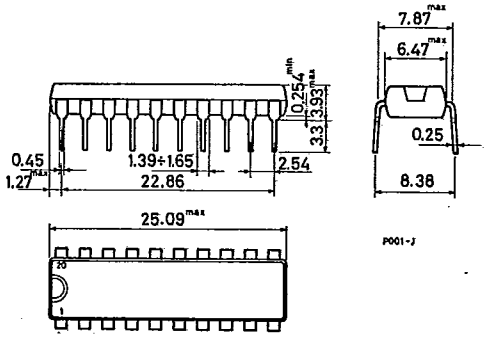

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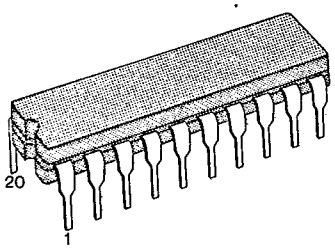
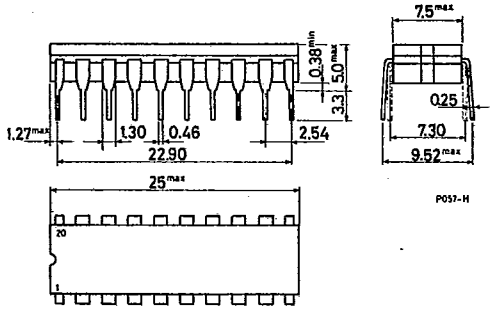
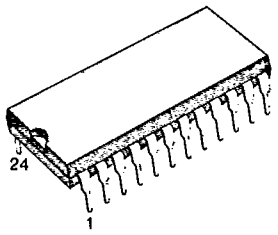
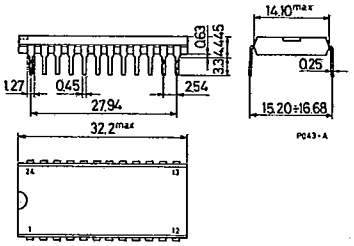




Packages

24-LEAD PLASTIC DIP





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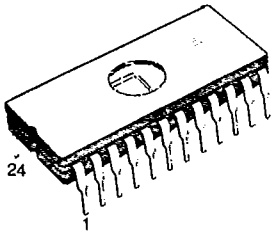
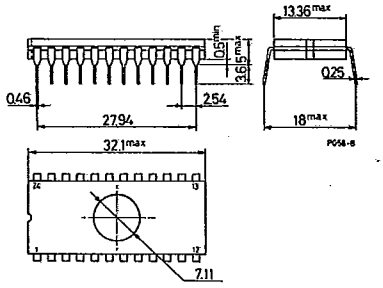
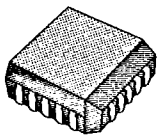
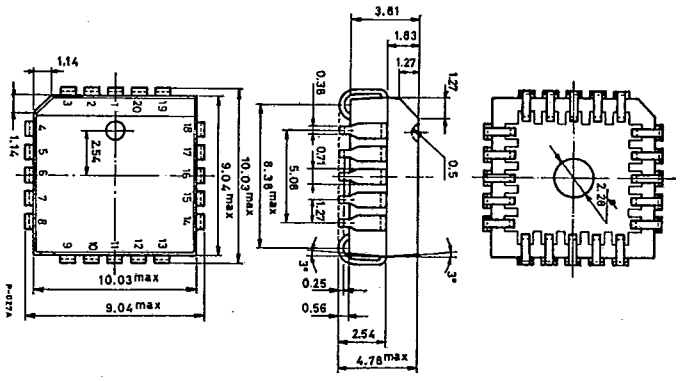




CHIP CARRIER 20 LEAD PLASTIC

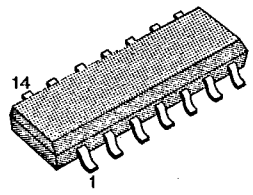


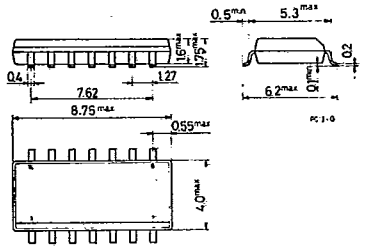


Packages

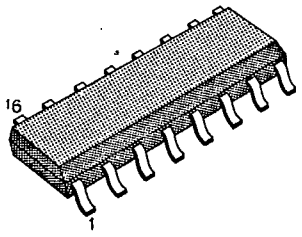
T-90-20

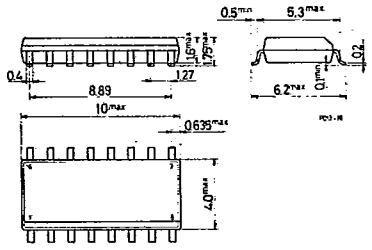
14-LEAD PLASTIC DIP MICROPACKAGE





16-LEAD PLASTIC DIP MICROPACKAGE





NOTE: FOR 20-LEAD PLASTIC DIP MICROPACKAGE CONTACT SGS

Surface Mounted

One possible solution to the important problem of PWB minimization, is that of using surface mounted components. Integrated circuits in SO (Small Outline) packages are made up of standard chips mounted in very small plastic packages.
The advantages given by using these devices are:

PWB Reduction

This is by far the most important advantage since the reduction of PWB size varies from 40 to 60% in comparison with standard board types. (See page 584 for package dimensions.)

Assembly Cost Reduction

SO Devices require no preliminary operation prior to mounting and can therefore be easily utilized in fully automatic equipment.

Increasing Reliability

The following characteristics lead to a higher level of reliability with respect to their standard packaged counter parts:

- The mounting system is fully automatic
- PWB number and the interconnections between them are reduced when the same number of devices are used.
- The high density of components on the board makes it thermally much more stable.

Noise Reduction and Improved Frequency Response

The reduction of the length of the connecting wires between the leads and the silicon guarantees a more homogeneous propogation delay between the external pins, with respect to the standard type.

Assembly Without Board Holes

The devices are placed on the board and soldered. This technology permits a higher level of tolerance in the positioning (automatic) of the device. For the standard DIP types this must be done with great accuracy due to the insertion of the leads into their holes.