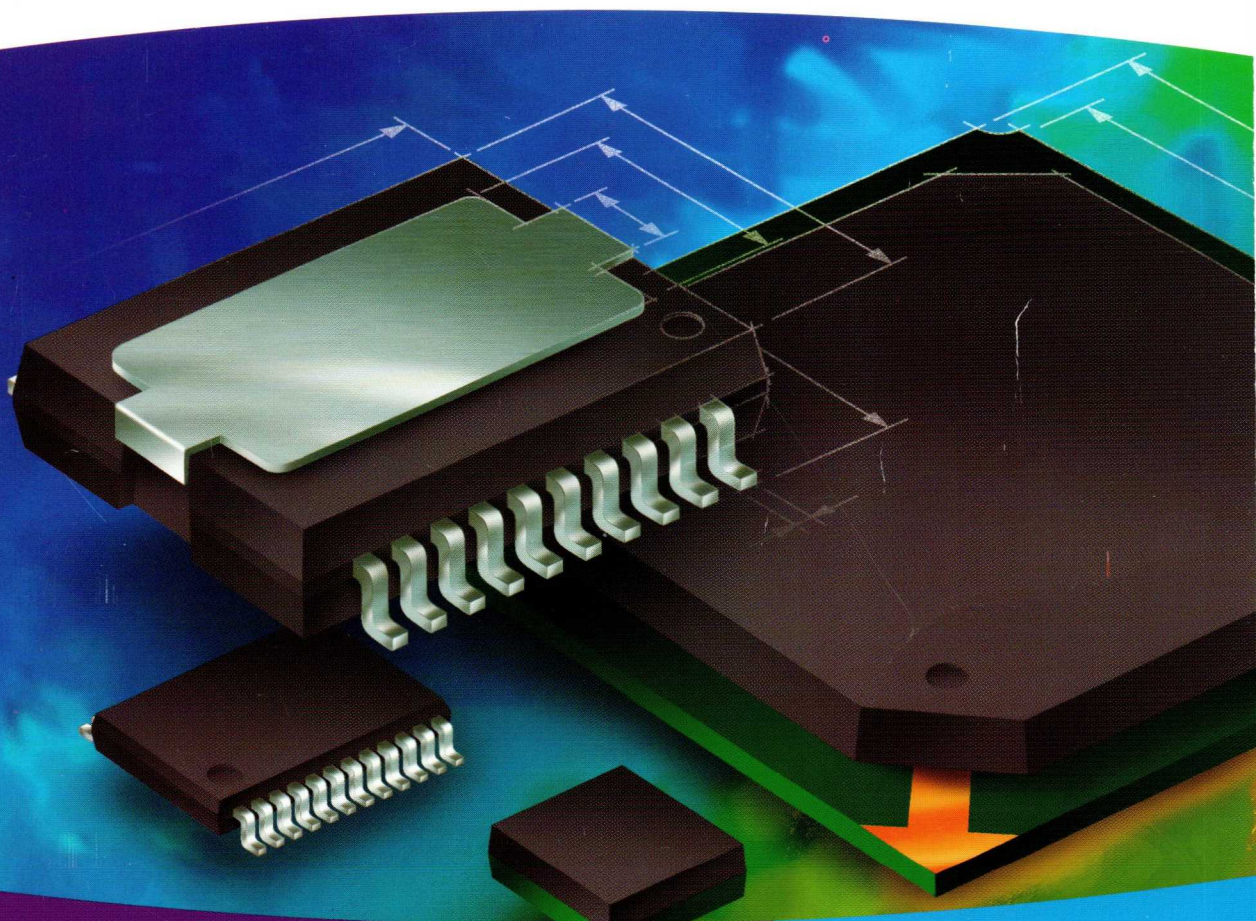


INTEGRATED CIRCUITS

Integrated Circuit Packages

Data Handbook IC26
2000



PHILIPS

Let's make things better.

<http://www.semiconductors.philips.com>

QUALITY ASSURED

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

PRODUCT SAFETY

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.

Preface

TABLE OF CONTENTS

Introduction	iv
 Chapter 1 - Overview of IC packages	1 - 1
Package overview	1 - 2
Through-hole mount packages (photograph)	1 - 4
Surface mount packages (photograph)	1 - 5
Package type overview with lead count	1 - 6
 Chapter 2 - IC package range and dimensions	2 - 1
Packages in ascending order of package name	2 - 2
Packages in ascending order of Philips outline code (SOT number)	2 - 10
Package outline drawings	2 - 17
 Chapter 3 - Handling precautions	3 - 1
Electrostatic charges	3 - 2
Workstation for handling electrostatic-sensitive devices	3 - 2
Receipt and storage of components	3 - 2
PCB assembly	3 - 2
Testing PCBs	3 - 2
 Chapter 4 - Through-hole mounting methods	4 - 1
Soldering by dipping or solder wave	4 - 2
Repairing soldered joints	4 - 2
 Chapter 5 - SMD mounting methods	5 - 1
Introduction	5 - 2
Double-wave soldering	5 - 2
Reflow soldering	5 - 4
Replacing a soldered IC	5 - 9
Assessment of soldered joint quality	5 - 9
SMD footprints	5 - 10

Preface

BGA, HBGA, LFBGA & TFBGA footprint (reflow soldering)	5 - 12
SO & SOJ footprint (reflow soldering)	5 - 14
SO & SOJ footprint (wave soldering)	5 - 16
HTSSOP footprint (reflow soldering)	5 - 18
SSOP, TSSOP & VSO footprint (reflow soldering)	5 - 20
HTSSOP, SSOP, TSSOP & VSO footprint (wave soldering)	5 - 22
HTQFP, HLQFP footprint (reflow soldering)	5 - 24
LQFP, MSQFP, QFP, SQFP & TQFP footprint (reflow soldering)	5 - 26
HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP footprint (wave soldering)	5 - 28
PLCC footprint (reflow soldering)	5 - 32
PLCC footprint (wave soldering)	5 - 34
 Chapter 6 - Thermal design considerations.	 6 - 1
Introduction	6 - 2
Thermal resistance	6 - 2
Junction temperature	6 - 2
Factors affecting $R_{th(j-a)}$	6 - 2
Thermal resistance test methods	6 - 3
Test procedure	6 - 3
Forced air factors for thermal resistance.	6 - 4
Thermal resistance data - assumptions and precautions	6 - 5
Thermal resistance ($R_{th(j-a)}$) data.	6 - 6
Thermal resistance ($R_{th(j-c)}$) data tables - power packages.	6 - 24
 Chapter 7 - Packing methods	 7 - 1
Introduction	7 - 2
Glossary of terms	7 - 2
Drypack for moisture sensitive SMDs	7 - 3
Survey of IC packing methods	7 - 5
Packing methods in exploded view.	7 - 6
Packing quantities, box dimensions and carrier shapes	7 - 13

Preface

Chapter 8 - Environmental data on ICs	8 - 1
Introduction	8 - 2
Explanation of the tables	8 - 2
Substances not used by Philips Semiconductors	8 - 5
Disposal	8 - 6
Recycling	8 - 6
General warnings	8 - 6
Plastic ball grid array packages	8 - 7
Low profile fine pitch ball grid array package	8 - 8
Dual in-line packages	8 - 9
Shrink dual in-line packages	8 - 10
Small outline packages	8 - 11
Shrink small outline packages	8 - 12
Thin shrink small outline packages	8 - 13
Plastic leaded carrier packages	8 - 14
Quad flat packages	8 - 15
Low profile quad flat packages	8 - 16
Through hole power packages	8 - 17
Through hole medium power packages	8 - 18
Heatslug small outline packages	8 - 19
Thin quad flat packages	8 - 20
 Chapter - 9 Data handbook system	 9 - 1

Preface

INTRODUCTION

Welcome to the latest edition of Philips Semiconductor's IC Package Data Handbook. The book's publication is in direct response to the many requests received by our customers and contains detailed information about all aspects of our IC packages, from dimensioned outline drawings and footprint designs, to thermal design considerations, packing data, and environmental data on ICs. It should be viewed as a logical extension to our IC Data Handbook series and, as such, is intended to serve as a practical data reference to all those involved in production and engineering design, as well as a guide to package selection and availability.

IC PACKAGE TRENDS

Since the first integrated circuits were manufactured, the number of devices that have been successfully integrated onto a single die or chip of silicon has approximately doubled every eighteen months (Moore's Law) - an increase of a factor of one hundred every decade.

Today, ICs containing over ten million transistors are readily available (for example, Trimedia ICs contain approximately five million transistors, and cache memory chips for PCs contain as many as fifteen million transistors). And this trend towards ever greater integration and functional complexity shows every sign of continuing.

With such high integration densities, the IC package design has become increasingly more important in determining, not only the size of the component, but also its overall performance and functionality. Higher lead count, smaller pitch, minimum footprint area and reduced component volume all contribute to a more compact circuit assembly. As a consequence, when designing and manufacturing printed circuit boards, their dimensions and tolerances are perhaps more crucial than ever before.

Furthermore, as the package directly affects factors such as heat dissipation and frequency dependency, a good design is essential in optimizing IC performance.

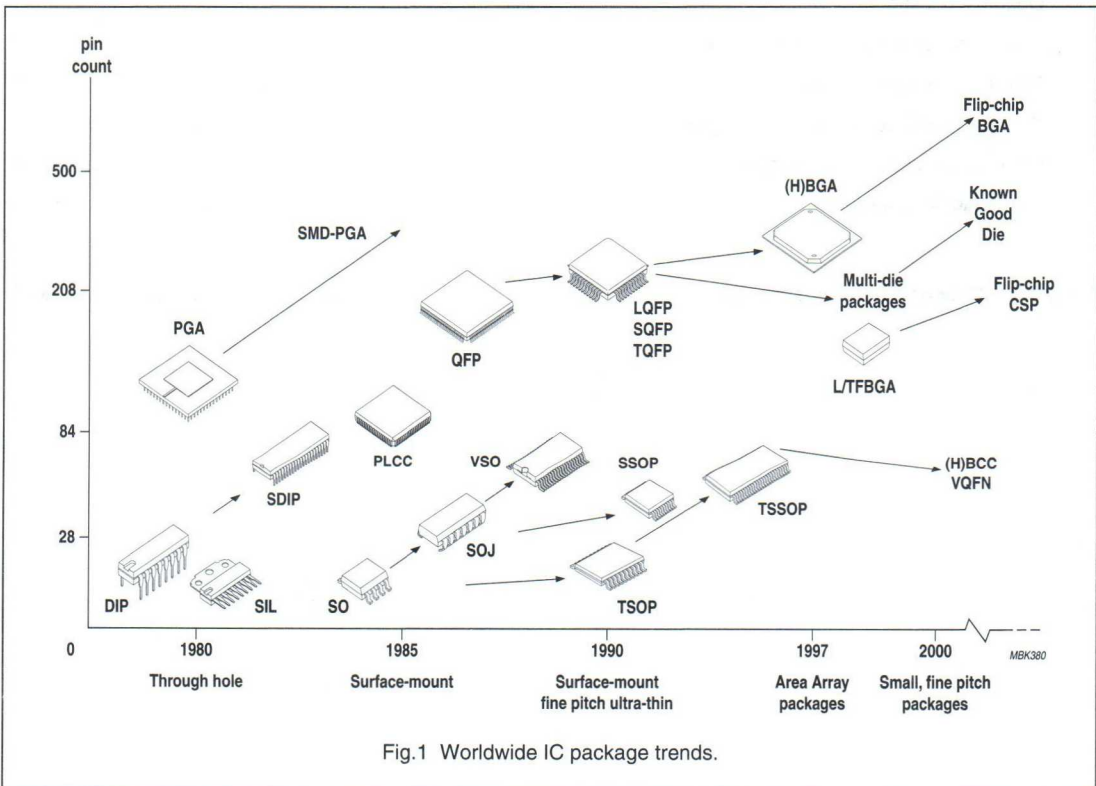


Fig.1 Worldwide IC package trends.

Preface

AN INOVATIVE PARTNER

Here at Philips Semiconductors, we have been involved in IC design and development since the early 1960's, during which time we have built up a wealth of expertise and know-how in advanced process technologies and IC packaging and assembly procedures. By fully exploiting this expertise, and establishing close working partnerships with our customers, we have developed many market-driven and innovative products. This is backed up by our worldwide network of application laboratories which are geared to meeting, and often anticipating, customer requirements.

One example of this was our work on, and commitment to, surface mount technology back in the mid-1980's which has since revolutionized equipment manufacture. Using Surface Mount Devices (SMDs), a circuit can be just one-sixth the size of a conventional assembly with through-hole components, or the component density can be increased to give more functions within the same space. This, coupled with fast, automated assembly for which SMDs are designed, offers the double advantage of improved products and reduced production costs.

In the nineties, Philips Semiconductors was involved in several areas of advanced packaging, include multi-die packages, area array packages (Standard, thermal/electrical enhanced, and CSP) and advanced power management (through-hole and SMD).

And in the new millennium, Philips Semiconductors will continue to lead the way in IC package designs. Our Flip Chip packages, for example, not only improve electrical performance but also minimize printed circuit board real estate. And the new bumped dies (gold bumps as well as solder bumps) are designed to meet our customers most advanced designs.

OUR IC PACKING POLICY

We can summarize our work into IC package development in the following four-point policy:

- Market and application driven package development
- Innovation in miniaturization and system solutions
- Focus on flexibility, low cost and high quality
- Designs according to IEC, JEDEC and EIAJ standards.

HOW THIS BOOK IS ORGANIZED

We organized this handbook into the following chapters:

Chapter 1 gives an overview of all our IC packages, classified by type in a family tree with a photograph of each type.

Chapter 2 contains outline dimensional drawings for most of our IC packages. It also lists all the packages in ascending order of package name and Philips outline code (SOT number).

Chapter 3 reviews handling precautions with emphasis on ESD precautions.

Chapters 4 and 5 look at through-hole and SMD mounting and soldering techniques, and include recommended footprint designs for most SMD packages.

Chapter 6 discusses thermal design considerations.

Chapter 7 explains the packing methods used for ICs with exploded views, packing quantities, weights and markings.

Chapter 8 provides comprehensive environmental data on our ICs with information on their safe disposal.

Chapter 9 lists the current set of data handbooks available from Philips Semiconductors.

WE WANT TO HEAR FROM YOU!

Philips Semiconductors is committed to continually improving its products and services (and that includes this handbook). On the following page you'll find a "Customer's Response Page", if you find any errors, oversights or omissions in this edition, or indeed if you have any ideas on how we could improve future updates of the book, fill it in and fax or send a copy of it to us.

Preface

CUSTOMER'S RESPONSE PAGE

As we intent to update this book at regular intervals, we encourage you to use this page to list any errors or omissions you may come across, or any ideas you may have on how we could improve future editions of this book. Please feel free to copy this page, and if necessary the page on which your comments refer, and fax or send to:

Philips Semiconductors
Marketing Communications Department
Building BE-027
PO Box 218
5600 MD Eindhoven
The Netherlands
Fax: +31 40 2724825

Your name:

Company:

Address:

Please list below any comments you may have:

CHAPTER 1

OVERVIEW OF IC PACKAGES

	page
Package overview	1 - 2
Through-hole mount packages	1 - 4
Surface mount packages	1 - 5
Package type overview with lead count	1 - 6

Overview of IC packages

Chapter 1

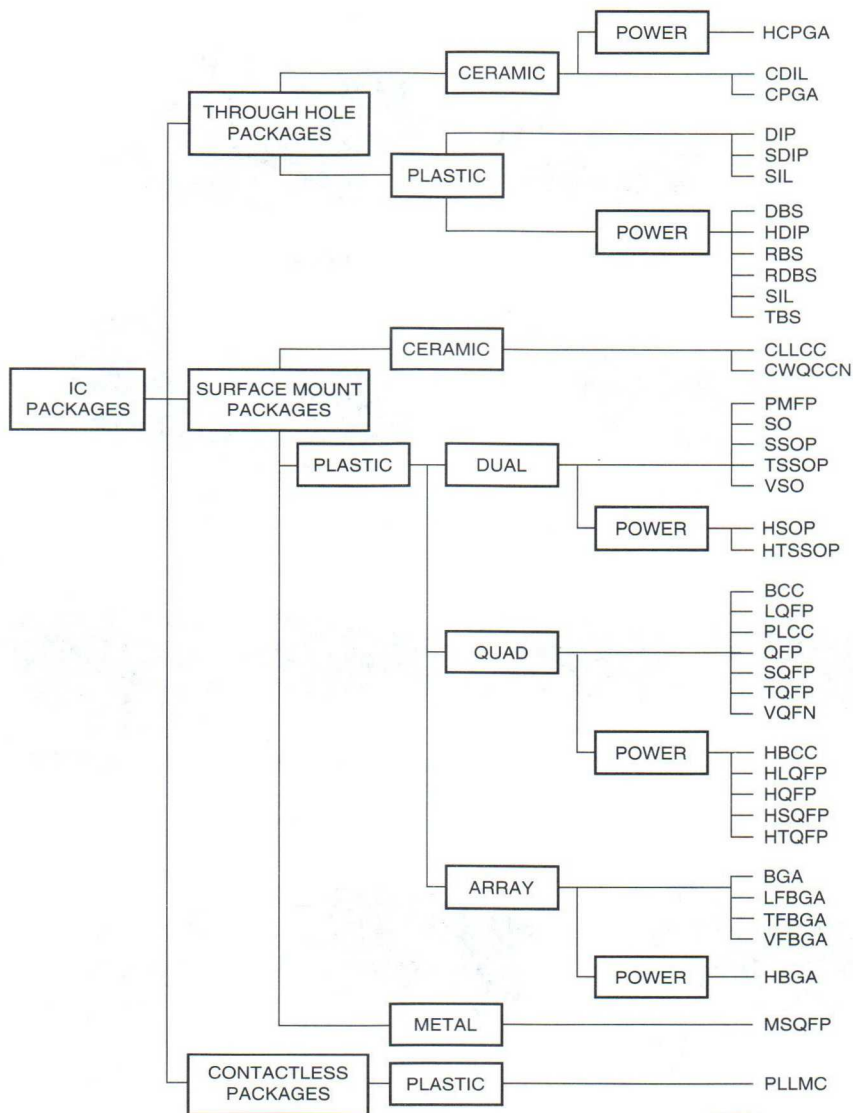
PACKAGE OVERVIEW

The development of the IC package is a dynamic technology. Applications that were unattainable only a few years ago are today common place thanks in part to advances in package design. From mobile telecommunications and satellite broadcasting to aerospace and automotive applications, each imposes its own individual demands on the electronic package.

To meet such a diverse range of application requirements, our IC package range encompasses over thirty different types, most of which are sub-divided into a number of outline versions. An overview of this range is shown in Fig.1, with packages classified into board mounting methods, construction form and power handling capability. The packages in these "power" categories offer a high thermal dissipation enabling IC usage in some of the most demanding application areas.

Notable extensions to our range since the last publication of this book include the Ball Gate Array (BGA) packages with their high pin count, and the miniature LFBGA packages.

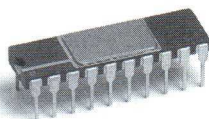
A photograph of each package type is given on pages 1 - 4 and 1 - 5, and a package overview with lead count is presented in the tables on pages 1 - 6 to 1 - 8.



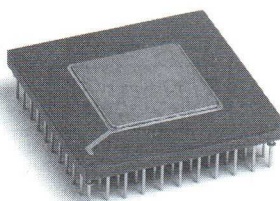
MLC751

Fig.1 Package classification.

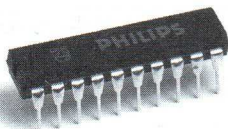
TROUGH-HOLE MOUNT PACKAGES



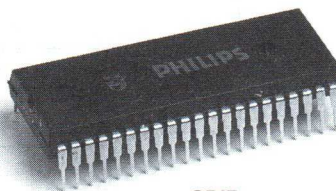
CDIL



CPGA



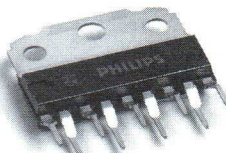
DIP
HDIP



SDIP



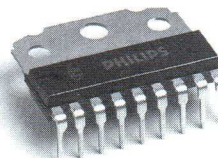
SIL.MPF



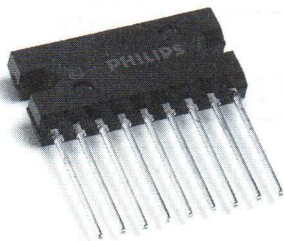
DBS.MPF



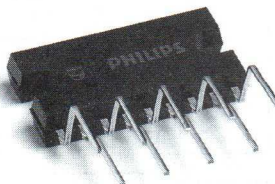
SIL.MP



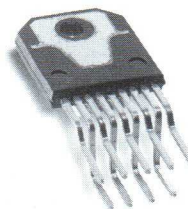
RBS.MPF



SIL.P

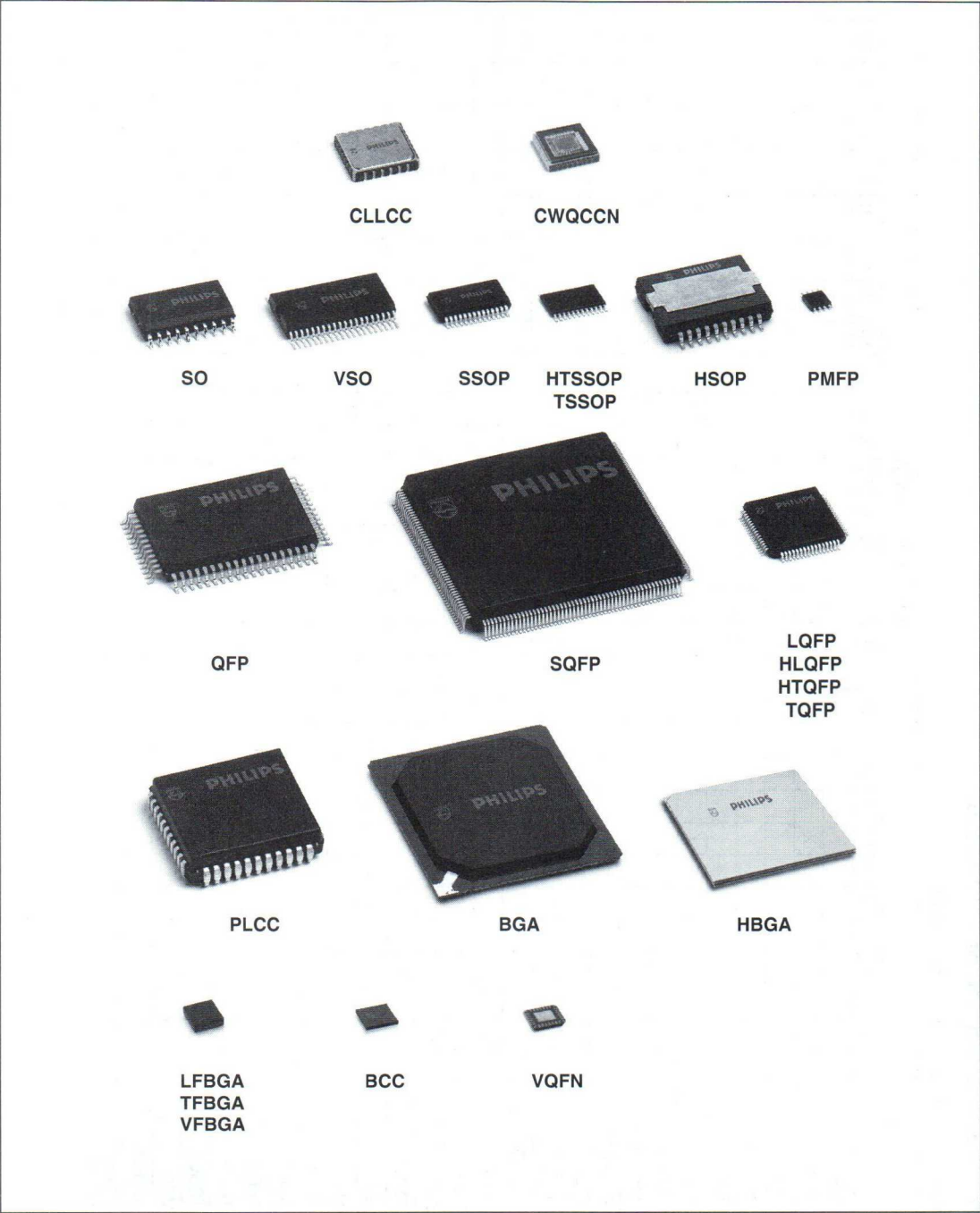


DBS.P



DBS.P
Exposed die pad

SURFACE MOUNT PACKAGES



Overview of IC packages

Chapter 1

PACKAGE TYPE OVERVIEW WITH LEAD COUNT

Surface mount packages (part 1 of 2)

PACKAGE NAME	NUMBER OF LEADS																																	
	4	8	9	10	13	14	16	20	24	28	30	32	38	40	44	48	52	56	64	68	80	81	84	96	100	114	120	128	132	144	156	160		
BGA																																X		
HBCC							X				X																							
HBGA																																		
HLQFP																									X						X			
HQFP																																	X	
HSOP								X	X																									
HSQFP																					X													
HTQFP											X	X				X				X				X										
HTSSOP								X				X																						
LFBGA																		X	X			X		X									X	
LQFP											X	X			X				X		X													
MSQFP																	X																	
PLCC								X		X													X											
PMFP									X																									
QFP															X		X		X		X			X									X	
SMS.P									X																									
SO	X	X			X	X	X	X	X	X																								
SOJ														X																				
SQFP																												X						
SSOP																X																		
TFBGA																		X	X	X	X									X				
TQFP															X			X	X	X									X					
TSSOP	X		X	X	X	X	X	X	X	X	X	X	X					X																
VSO																		X																
VFBGA																																		
VQFN												X						X																

Overview of IC packages

Chapter 1

Surface mount packages (part 2 of 2)

PACKAGE NAME	NUMBER OF LEADS																										
	176	180	208	240	256	272	280	292	304	316	324	329	352	388	420	456	492	504	516	553	596	600	656	776	1140	1160	1312
BGA			X		X	X		X	X	X		X	X	X		X	X		X	X	X		X				
HBCC																											
HBGA					X			X	X				X		X			X				X			X	X	X
HLQFP																											
HQFP																											
HSOP																											
HSQFP			X	X																							
HTQFP																											
HTSSOP																											
LFBGA											X																
LQFP	X		X																								
MSQFP				X																							
PLCC																											
PMFP																											
QFP																											
SMS.P																											
SO																											
SOJ																											
SQFP			X	X					X																	X	X
SSOP																											
TFBGA	X		X				X																				
TQFP																											
TSSOP																											
VSO																											
VFBGA																											
VQFN																											

Overview of IC packages

Chapter 1

Trough-hole mount packages

PACKAGE NAME	NUMBER OF LEADS																					
	3	7	8	9	13	14	16	17	18	20	22	23	24	27	28	32	40	42	48	52	56	64
DBS.MP				X																		
DBS.MPF				X																		
DBS.P		X		X	X			X				X		X								
DIP			X			X	X		X	X	X		X		X	X			X			X
HDIP									X													
RBS.MPF				X																		
RDBS.P					X			X														
SDIP													X			X		X		X		X
SIL.MP				X																		
SIL.MPF				X																		
SIL.P				X	X																	
TBS.P					X																	
TO-92	X																					

CHAPTER 2

IC PACKAGE RANGE AND DIMENSIONS

	page
Packages in ascending order of package name	2 - 2
Packages in ascending order of Philips outline code (SOT number)	2 - 10
Package outline drawings	2 - 17

IC package range and dimensions

Chapter 2

PACKAGES IN ASCENDING ORDER OF PACKAGE NAME

The following table lists our IC packages in alphanumeric order of package name, and includes the SOT number, a brief description of the package and the page number on which you'll find the outline drawing. A similar list in ascending order of SOT numbers (for cross-reference purposes) is given on page 2 - 10.

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
Ball grid array package			
BGA156	SOT472-1	plastic ball grid array package; 156 balls; body 15 × 15 × 1.15 mm	2 - 17
BGA208	SOT595-1	plastic ball grid array package; 208 balls; body 17 × 17 × 1.20 mm	2 - 18
BGA256	SOT471-1	plastic ball grid array package; 256 balls; body 27 × 27 × 1.55 mm	2 - 19
BGA256	SOT466-1	plastic ball grid array package; 256 balls; body 27 × 27 × 1.75 mm	2 - 20
BGA272	SOT579-1	plastic ball grid array package; 272 balls; body 27 × 27 × 1.55 mm	2 - 21
BGA292	SOT489-1	plastic ball grid array package; 292 balls; body 27 × 27 × 1.75 mm	2 - 22
BGA304	SOT550-1	plastic ball grid array package; 304 balls; body 31 × 31 × 1.75 mm	2 - 23
BGA316	SOT531-1	plastic ball grid array package; 316 balls; body 27 × 27 × 1.75 mm	2 - 24
BGA329	SOT611-1	plastic ball grid array package; 329 balls; body 31 × 31 × 1.75 mm	2 - 25
BGA329	SOT611-2	plastic ball grid array package; 329 balls; body 31 × 31 × 1.75 mm	2 - 26
BGA352	SOT581-1	plastic ball grid array package; 352 balls; body 35 × 35 × 1.75 mm	2 - 27
BGA388	SOT532-1	plastic ball grid array package; 388 balls; body 35 × 35 × 1.75 mm	2 - 28
BGA388	SOT582-1	plastic ball grid array package; 388 balls; body 35 × 35 × 2.15 mm	2 - 29
BGA456	SOT584-1	plastic ball grid array package; 456 balls; body 35 × 35 × 1.75 mm	2 - 30
BGA456	SOT583-1	plastic ball grid array package; 456 balls; body 35 × 35 × 2.15 mm	2 - 31
BGA492	SOT514-1	plastic ball grid array package; 492 balls; body 35 × 35 × 1.75 mm	2 - 32
BGA516	SOT585-1	plastic ball grid array package; 516 balls; body 35 × 35 × 2.15 mm	2 - 33
BGA553	SOT589-1	plastic ball grid array package; 553 balls; body 37.5 × 37.5 × 1.75 mm	2 - 34
BGA596	SOT587-1	plastic ball grid array package; 596 balls; body 40 × 40 × 1.75 mm	2 - 35
BGA596	SOT586-1	plastic ball grid array package; 596 balls; body 40 × 40 × 2.15 mm	2 - 36
BGA656	SOT588-1	plastic ball grid array package; 656 balls; body 40 × 40 × 1.75 mm	2 - 37
BGA656	SOT590-1	plastic ball grid array package; 656 balls; body 40 × 40 × 2.15 mm	2 - 38
BGA776	SOT591-1	plastic ball grid array package; 776 balls; body 40 × 40 × 2.15 mm	2 - 39
Ceramic window quad chip carrier; no leads			
CWQCCN32	SOT594-1	ceramic window quad chip carrier; no leads	2 - 40
DIL-bent-SIL medium power package with fin			
DBS9MPF	SOT111-1	plastic DIL-bent-SIL medium power package with fin; 9 leads	2 - 41
DIL-bent-SIL power package			
DBS7P	SOT524-1	plastic DIL-bent-SIL power package; 7 leads (lead length 12/11 mm); exposed die pad	2 - 42
DBS9P	SOT157-4	plastic DIL-bent-SIL power package; 9 leads (lead length 7.7 mm)	2 - 43
DBS9P	SOT157-2	plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm)	2 - 44
DBS9P	SOT523-1	plastic DIL-bent-SIL power package; 9 leads (lead length 12/11 mm); exposed die pad	2 - 45

IC package range and dimensions

Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
DBS13P	SOT141-8	plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm)	2 - 46
DBS13P	SOT141-6	plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	2 - 47
DBS17P	SOT243-3	plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)	2 - 48
DBS17P	SOT243-1	plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm)	2 - 49
DBS17P	SOT475-1	plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm)	2 - 50
DBS23P	SOT411-1	plastic DIL-bent-SIL power package; 23 leads (straight lead length 3.2 mm)	2 - 51
DBS23P	SOT411-2	plastic DIL-bent-SIL power package; 23 leads (lead length 12 mm)	2 - 52
DBS27P	SOT521-1	plastic DIL-bent-SIL power package; 27 leads (lead length 7.7 mm)	2 - 53
Dual in-line package			
DIP8	SOT97-1	plastic dual in-line package; 8 leads (300 mil)	2 - 54
DIP14	SOT27-1	plastic dual in-line package; 14 leads (300 mil)	2 - 55
DIP16	SOT38-4	plastic dual in-line package; 16 leads (300 mil)	2 - 56
DIP16	SOT38-1	plastic dual in-line package; 16 leads (300 mil); long body	2 - 57
DIP16	SOT38-9	plastic dual in-line package; 16 leads (300 mil)	2 - 58
DIP18	SOT102-1	plastic dual in-line package; 18 leads (300 mil)	2 - 59
DIP18	SOT102-2	plastic dual in-line package; 18 leads (300 mil); slim corner leads	2 - 60
DIP18	SOT102-4	plastic dual in-line package; 18 leads (300 mil); long body	2 - 61
DIP20	SOT146-1	plastic dual in-line package; 20 leads (300 mil)	2 - 62
DIP22	SOT116-1	plastic dual in-line package; 22 leads (400 mil)	2 - 63
DIP24	SOT222-1	plastic dual in-line package; 24 leads (300 mil)	2 - 64
DIP24	SOT248-1	plastic dual in-line package; 24 leads (400 mil)	2 - 65
DIP24	SOT101-1	plastic dual in-line package; 24 leads (600 mil)	2 - 66
DIP28	SOT117-1	plastic dual in-line package; 28 leads (600 mil)	2 - 67
DIP28	SOT117-2	plastic dual in-line package; 28 leads (600 mil); long body	2 - 68
DIP32	SOT201-1	plastic dual in-line package; 32 leads (600 mil)	2 - 69
DIP40	SOT129-1	plastic dual in-line package; 40 leads (600 mil)	2 - 70
DIP48	SOT240-1	plastic dual in-line package; 48 leads (600 mil)	2 - 71
Heatsink bottom chip carrier package			
HBCC24	SOT564-1	plastic, heatsink bottom chip carrier; 24 terminals; body 4 × 4 × 0.65 mm	2 - 72
HBCC32	SOT560-1	plastic, heatsink bottom chip carrier; 32 terminals; body 5 × 5 × 0.65 mm	2 - 73
Heatsink ball grid array package			
HBGA256	SOT602-1	plastic, heatsink ball grid array package; 256 balls; body 27 × 27 × 0.9 mm	2 - 74
HBGA292	SOT553-1	plastic, heatsink ball grid array package; 292 balls; body 27 × 27 × 1.75 mm	2 - 75
HBGA352	SOT546-2	plastic, heatsink ball grid array package; 352 balls; body 35 × 35 × 0.9 mm	2 - 76
HBGA420	SOT603-1	plastic, heatsink ball grid array package; 420 balls; body 35 × 35 × 0.9 mm	2 - 77
HBGA504	SOT604-1	plastic, heatsink ball grid array package; 504 balls; body 35 × 35 × 0.9 mm	2 - 78
HBGA600	SOT605-1	plastic, heatsink ball grid array package; 600 balls; body 40 × 40 × 0.9 mm	2 - 79

IC package range and dimensions

Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
Heat-dissipating dual in-line package			
HDIP18	SOT398-1	plastic heat-dissipating dual in-line package; 18 leads	2 - 80
Heat-dissipating low profile quad flat package			
HLQFP100	SOT470-1	plastic heat-dissipating low profile quad flat package; 100 leads; body 14 × 14 × 1.4 mm	2 - 81
Heatsink low profile quad flat package			
HLQFP144	SOT612-1	plastic, heatsink low profile quad flat package; 144 leads; body 20 × 20 × 1.4 mm	2 - 82
Heatsink quad flat package			
HQFP160	SOT576-1	plastic, heatsink quad flat package; 160 leads; (lead length 1.6 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 83
Heatsink small outline package			
HSOP20	SOT397-1	plastic, heatsink small outline package; 20 leads	2 - 84
HSOP20	SOT418-2	plastic, heatsink small outline package; 20 leads; low stand-off	2 - 85
HSOP24	SOT566-1	plastic, heatsink small outline package; 24 leads	2 - 86
HSOP24	SOT566-2	plastic, heatsink small outline package; 24 leads; low stand-off	2 - 87
HSOP24	SOT592-1	plastic, heatsink small outline package; 24 leads	2 - 88
Heatsink shrink quad flat package			
HSQFP208	SOT431-1	plastic, heatsink shrink quad flat package; 208 leads (lead length 1.3 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 89
Heatsink thin quad flat package			
HTQFP32	SOT547-1	plastic, heatsink thin quad flat package; 32 leads; body 5 × 5 × 1.0 mm	2 - 90
HTQFP32	SOT547-2	plastic, heatsink thin quad flat package; 32 leads; body 5 × 5 × 1.0 mm	2 - 91
HTQFP48	SOT545-2	plastic, heatsink thin quad flat package; 48 leads; body 7 × 7 × 1.0 mm	2 - 92
HTQFP80	SOT513-1	plastic, heatsink thin quad flat package; 80 leads; body 14 × 14 × 1.0 mm	2 - 93
Heatsink thin shrink small outline package			
HTSSOP20	SOT527-1	plastic, heatsink thin shrink small outline package; 20 leads; body width 4.4 mm	2 - 94
HTSSOP32	SOT549-1	plastic, heatsink thin shrink small outline package; 32 leads; body width 6.1 mm; lead pitch 0.65 mm	2 - 95
Low profile fine pitch ball grid array			
LFBGA56	SOT516-1	plastic low profile fine-pitch ball grid array; 56 balls; body 6 × 6 × 1.05 mm	2 - 96
LFBGA64	SOT534-1	plastic low profile fine-pitch ball grid array; 64 balls; body 8 × 8 × 1.05 mm	2 - 97
LFBGA84	SOT518-1	plastic low profile fine-pitch ball grid array; 84 balls; body 7 × 7 × 1.05 mm	2 - 98
LFBGA96	SOT536-1	plastic low profile fine-pitch ball grid array; 96 balls; body 13.5 × 5.5 × 1.05 mm	2 - 99
LFBGA114	SOT537-1	plastic low profile fine-pitch ball grid array; 114 balls; body 16 × 5.5 × 1.05 mm	2 - 100
LFBGA324	SOT571-1	plastic low profile fine-pitch ball grid array; 324 balls; body 16 × 16 × 1.2 mm	2 - 101

IC package range and dimensions

Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
Low profile quad flat package			
LQFP32	SOT401-1	plastic low profile quad flat package; 32 leads; body $5 \times 5 \times 1.4$ mm	2 - 102
LQFP32	SOT358-1	plastic low profile quad flat package; 32 leads; body $7 \times 7 \times 1.4$ mm	2 - 103
LQFP44	SOT389-1	plastic low profile quad flat package; 44 leads; body $10 \times 10 \times 1.4$ mm	2 - 104
LQFP48	SOT313-2	plastic low profile quad flat package; 48 leads; body $7 \times 7 \times 1.4$ mm	2 - 105
LQFP64	SOT414-1	plastic low profile quad flat package; 64 leads; body $7 \times 7 \times 1.4$ mm	2 - 106
LQFP64	SOT314-2	plastic low profile quad flat package; 64 leads; body $10 \times 10 \times 1.4$ mm	2 - 107
LQFP80	SOT315-1	plastic low profile quad flat package; 80 leads; body $12 \times 12 \times 1.4$ mm	2 - 108
LQFP100	SOT572-1	plastic low profile quad flat package; 100 leads; body $12 \times 12 \times 1.4$ mm	2 - 109
LQFP100	SOT407-1	plastic low profile quad flat package; 100 leads; body $14 \times 14 \times 1.4$ mm	2 - 110
LQFP128	SOT420-1	plastic low profile quad flat package; 128 leads; body $14 \times 14 \times 1.4$ mm	2 - 111
LQFP128	SOT425-1	plastic low profile quad flat package; 128 leads; body $14 \times 20 \times 1.4$ mm	2 - 112
LQFP144	SOT486-1	plastic low profile quad flat package; 144 leads; body $20 \times 20 \times 1.4$ mm	2 - 113
LQFP160	SOT435-1	plastic low profile quad flat package; 160 leads; body $24 \times 24 \times 1.4$ mm	2 - 114
LQFP176	SOT506-1	plastic low profile quad flat package; 176 leads; body $24 \times 24 \times 1.4$ mm	2 - 115
LQFP208	SOT459-1	plastic low profile quad flat package; 208 leads; body $28 \times 28 \times 1.4$ mm	2 - 116
Metal shrink quad flat package			
MSQFP240	SOT474-2	metal shrink quad flat package; 240 leads; body $32 \times 32 \times 3.4$ mm	2 - 117
Plastic leaded chip carrier			
PLCC20	SOT380-1	plastic leaded chip carrier; 20 leads	2 - 118
PLCC28	SOT261-2	plastic leaded chip carrier; 28 leads	2 - 119
PLCC28	SOT261-3	plastic leaded chip carrier; 28 leads; pedestal	2 - 120
PLCC44	SOT187-2	plastic leaded chip carrier; 44 leads	2 - 121
PLCC52	SOT238-2	plastic leaded chip carrier; 52 leads	2 - 122
PLCC52	SOT238-3	plastic leaded chip carrier; 52 leads; pedestal	2 - 123
PLCC68	SOT188-2	plastic leaded chip carrier; 68 leads	2 - 124
PLCC68	SOT188-3	plastic leaded chip carrier; 68 leads; pedestal	2 - 125
PLCC84	SOT189-2	plastic leaded chip carrier; 84 leads	2 - 126
PLCC84	SOT189-3	plastic leaded chip carrier; 84 leads; pedestal	2 - 127
Plastic micro flat package			
PMFP8	SOT144-1	plastic micro flat package; 8 leads (straight)	2 - 128
Quad flat package			
QFP44	SOT307-2	plastic quad flat package; 44 leads (lead length 1.3 mm); body $10 \times 10 \times 1.75$ mm	2 - 129
QFP44	SOT205-1	plastic quad flat package; 44 leads (lead length 2.35 mm); body $14 \times 14 \times 2.2$ mm	2 - 130
QFP52	SOT379-1	plastic quad flat package; 52 leads (lead length 1.6 mm); body $10 \times 10 \times 2.0$ mm	2 - 131

IC package range and dimensions

Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
QFP64	SOT393-1	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm	2 - 132
QFP64	SOT393-2	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm; high stand-off height	2 - 133
QFP64	SOT319-1	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 - 134
QFP64	SOT319-2	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 135
QFP64	SOT319-5	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 136
QFP80	SOT496-1	plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 × 14 × 2.67 mm	2 - 137
QFP80	SOT318-1	plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 - 138
QFP80	SOT318-2	plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 139
QFP80	SOT310-1	plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 × 20 × 3.0 mm	2 - 140
QFP100	SOT317-1	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 - 141
QFP100	SOT382-1	plastic quad flat package; 100 leads (lead length 1.6 mm); body 14 × 20 × 2.8 mm	2 - 142
QFP100	SOT317-2	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 143
QFP100	SOT317-3	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 144
QFP100	SOT382-2	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 145
QFP120	SOT349-2	plastic quad flat package; 120 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 146
QFP120	SOT349-1	plastic quad flat package; 120 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 147
QFP128	SOT320-2	plastic quad flat package; 128 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 148
QFP144	SOT573-1	plastic quad flat package; 144 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm	2 - 149
QFP160	SOT322-2	plastic quad flat package; 160 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 150
QFP160	SOT322-1	plastic quad flat package; 160 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 151
Rectangular-bent single in-line medium power package			
RBS9MPF	SOT352-1	plastic rectangular-bent single in-line medium power package with fin; 9 leads	2 - 152

IC package range and dimensions

Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
Rectangular-DIL-bent-SIL power package			
RDBS13P	SOT528-1	plastic rectangular-DIL-bent-SIL power package; 13 leads	2 - 153
RDBS13P	SOT462-1	plastic rectangular-DIL-bent-SIL (reverse bent) power package; 13 leads	2 - 154
RDBS17P	SOT577-1	plastic rectangular-DIL-bent-SIL power package; 17 leads (row spacing 2.54 mm)	2 - 155
Shrink dual in-line package			
SDIP24	SOT234-1	plastic shrink dual in-line package; 24 leads (400 mil)	2 - 156
SDIP32	SOT232-1	plastic shrink dual in-line package; 32 leads (400 mil)	2 - 157
SDIP42	SOT270-1	plastic shrink dual in-line package; 42 leads (600 mil)	2 - 158
SDIP52	SOT247-1	plastic shrink dual in-line package; 52 leads (600 mil)	2 - 159
SDIP56	SOT400-1	plastic shrink dual in-line package; 56 leads (600 mil)	2 - 160
SDIP64	SOT274-1	plastic shrink dual in-line package; 64 leads (750 mil)	2 - 161
Single in-line medium power package			
SIL9MP	SOT142-1	plastic single in-line medium power package; 9 leads	2 - 162
Single in-line medium power package with fin			
SIL9MPF	SOT110-1	plastic single in-line medium power package with fin; 9 leads	2 - 163
Single in-line power package			
SIL9P	SOT131-2	plastic single in-line power package; 9 leads	2 - 164
SIL13P	SOT193-2	plastic single in-line power package; 13 leads	2 - 165
Surface mounted single in-line power package			
SMS9P	SOT354-1	plastic surface mounted single in-line power package; 9 leads	2 - 166
SMS13P	SOT517-1	plastic surface mounted single in-line power package; 13 leads	2 - 167
Small outline package			
SO4	SOT223-1	plastic small outline package; 4 leads; body width 3.5 mm	2 - 168
SO8	SOT96-1	plastic small outline package; 8 leads; body width 3.9 mm	2 - 169
SO8	SOT96-2	plastic small outline package; 8 leads (straight); body width 3.9 mm	2 - 170
SO8	SOT176-1	plastic small outline package; 8 leads; body width 7.5 mm	2 - 171
SO14	SOT108-1	plastic small outline package; 14 leads; body width 3.9 mm	2 - 172
SO16	SOT109-1	plastic small outline package; 16 leads; body width 3.9 mm	2 - 173
SO16	SOT109-2	plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height	2 - 174
SO16	SOT109-3	plastic small outline package; 16 leads; body width 3.9 mm; body thickness 1.47 mm	2 - 175
SO16	SOT162-1	plastic small outline package; 16 leads; body width 7.5 mm	2 - 176
SO20	SOT163-1	plastic small outline package; 20 leads; body width 7.5 mm	2 - 177
SO24	SOT137-1	plastic small outline package; 24 leads; body width 7.5 mm	2 - 178
SO28	SOT136-1	plastic small outline package; 28 leads; body width 7.5 mm	2 - 179
SO32	SOT287-1	plastic small outline package; 32 leads; body width 7.5 mm	2 - 180

IC package range and dimensions

Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
Small outline (J-bent) package			
SOJ40	SOT449-1	plastic small outline package; 40 leads (J-bent); body width 10.16 mm	2 - 181
Shrink quad flat package			
SQFP128	SOT387-3	plastic shrink quad flat package; 128 leads (lead length 1.6 mm); body 14 × 20 × 2.72 mm	2 - 182
SQFP208	SOT316-1	plastic shrink quad flat package; 208 leads (lead length 1.3 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 183
SQFP304	SOT575-1	plastic shrink quad flat package; 304 leads (lead length 1.3 mm); body 40 × 40 × 3.8 mm	2 - 184
Shrink small outline package			
SSOP14	SOT337-1	plastic shrink small outline package; 14 leads; body width 5.3 mm	2 - 185
SSOP16	SOT519-1	plastic shrink small outline package; 16 leads; body width 3.9 mm; lead pitch 0.635 mm	2 - 186
SSOP16	SOT369-1	plastic shrink small outline package; 16 leads; body width 4.4 mm	2 - 187
SSOP16	SOT338-1	plastic shrink small outline package; 16 leads; body width 5.3 mm	2 - 188
SSOP20	SOT266-1	plastic shrink small outline package; 20 leads; body width 4.4 mm	2 - 189
SSOP20	SOT339-1	plastic shrink small outline package; 20 leads; body width 5.3 mm	2 - 190
SSOP24	SOT556-1	plastic shrink small outline package; 24 leads; body width 3.9 mm; lead pitch 0.635 mm	2 - 191
SSOP24	SOT340-1	plastic shrink small outline package; 24 leads; body width 5.3 mm	2 - 192
SSOP28	SOT341-1	plastic shrink small outline package; 28 leads; body width 5.3 mm	2 - 193
SSOP48	SOT370-1	plastic shrink small outline package; 48 leads; body width 7.5 mm	2 - 194
SSOP56	SOT371-1	plastic shrink small outline package; 56 leads; body width 7.5 mm	2 - 195
Triple-bent-SIL power package			
TBS13P	SOT578-1	plastic Triple-bent-SIL power package; 13 leads; (lead length 7.7 mm)	2 - 196
Thin fine-pitch ball grid array package			
TFBGA56	SOT542-1	plastic thin fine-pitch ball grid array package; 56 balls; body 6 × 6 × 0.8 mm	2 - 197
TFBGA64	SOT543-1	plastic thin fine-pitch ball grid array package; 64 balls; body 6 × 6 × 0.8 mm	2 - 198
TFBGA80	SOT557-1	plastic thin fine-pitch ball grid array package; 80 balls; body 7 × 7 × 0.8 mm	2 - 199
TFBGA96	SOT597-1	plastic thin fine-pitch ball grid array package; 96 balls; body 8 × 8 × 0.8 mm	2 - 200
TFBGA100	SOT598-1	plastic thin fine-pitch ball grid array package; 100 balls; body 9 × 9 × 0.8 mm	2 - 201
TFBGA132	SOT599-1	plastic thin fine-pitch ball grid array package; 132 balls; body 12 × 12 × 0.8 mm	2 - 202
TFBGA144	SOT569-1	plastic thin fine-pitch ball grid array package; 144 balls; body 12 × 12 × 0.8 mm	2 - 203
TFBGA180	SOT570-1	plastic thin fine-pitch ball grid array package; 180 balls; body 12 × 12 × 0.8 mm	2 - 204
TFBGA208	SOT600-1	plastic thin fine-pitch ball grid array package; 208 balls; body 15 × 15 × 0.8 mm	2 - 205
TFBGA280	SOT601-1	plastic thin fine-pitch ball grid array package; 280 balls; body 16 × 16 × 0.8 mm	2 - 206
Transistor outline package			
TO-92	SOT465-1	TO-92: 3 leads; body diameter 4.7 mm	2 - 207

IC package range and dimensions

Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
Thin quad flat package			
TQFP44	SOT376-1	plastic thin quad flat package; 44 leads; body 10 × 10 × 1.0 mm	2 - 208
TQFP64	SOT357-1	plastic thin quad flat package; 64 leads; body 10 × 10 × 1.0 mm	2 - 209
TQFP80	SOT375-1	plastic thin quad flat package; 80 leads; body 12 × 12 × 1.0 mm	2 - 210
TQFP100	SOT386-1	plastic thin quad flat package; 100 leads; body 14 × 14 × 1.0 mm	2 - 211
TQFP128	SOT574-1	plastic thin quad flat package; 128 leads; body 14 × 14 × 1.0 mm	2 - 212
Thin shrink small outline package			
TSSOP8	SOT505-1	plastic thin shrink small outline package; 8 leads; body width 3 mm	2 - 213
TSSOP10	SOT552-1	plastic thin shrink small outline package; 10 leads; body width 3 mm	2 - 214
TSSOP14	SOT402-1	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	2 - 215
TSSOP16	SOT403-1	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	2 - 216
TSSOP20	SOT360-1	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	2 - 217
TSSOP24	SOT355-1	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	2 - 218
TSSOP28	SOT361-1	plastic thin shrink small outline package; 28 leads; body width 4.4 mm	2 - 219
TSSOP30	SOT607-1	plastic thin shrink small outline package; 30 leads; body width 4.4 mm; lead pitch 0.5 mm	2 - 220
TSSOP32	SOT487-1	plastic thin shrink small outline package; 32 leads; body width 6.1 mm; lead pitch 0.65 mm	2 - 221
TSSOP38	SOT510-1	plastic thin shrink small outline package; 38 leads; body width 4.4 mm; lead pitch 0.5 mm	2 - 222
TSSOP48	SOT362-1	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	2 - 223
TSSOP56	SOT364-1	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	2 - 224
Very small outline package			
VSO40	SOT158-1	plastic very small outline package; 40 leads	2 - 225
VSO40	SOT158-2	plastic very small outline package; 40 leads; face down	2 - 226
VSO56	SOT190-1	plastic very small outline package; 56 leads	2 - 227
VSO56	SOT190-2	plastic very small outline package; 56 leads; face down	2 - 228

IC package range and dimensions

Chapter 2

PACKAGES IN ASCENDING ORDER OF PHILIPS OUTLINE CODE (SOT NUMBER)

PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT27-1	DIP14	plastic dual in-line package; 14 leads (300 mil)	2 - 55
SOT38-1	DIP16	plastic dual in-line package; 16 leads (300 mil); long body	2 - 57
SOT38-4	DIP16	plastic dual in-line package; 16 leads (300 mil)	2 - 56
SOT38-9	DIP16	plastic dual in-line package; 16 leads (300 mil)	2 - 58
SOT96-1	SO8	plastic small outline package; 8 leads; body width 3.9 mm	2 - 169
SOT96-2	SO8	plastic small outline package; 8 leads (straight); body width 3.9 mm	2 - 170
SOT97-1	DIP8	plastic dual in-line package; 8 leads (300 mil)	2 - 54
SOT101-1	DIP24	plastic dual in-line package; 24 leads (600 mil)	2 - 66
SOT102-1	DIP18	plastic dual in-line package; 18 leads (300 mil)	2 - 59
SOT102-2	DIP18	plastic dual in-line package; 18 leads (300 mil); slim corner leads	2 - 60
SOT102-4	DIP18	plastic dual in-line package; 18 leads (300 mil); long body	2 - 61
SOT108-1	SO14	plastic small outline package; 14 leads; body width 3.9 mm	2 - 172
SOT109-1	SO16	plastic small outline package; 16 leads; body width 3.9 mm	2 - 173
SOT109-2	SO16	plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height	2 - 174
SOT109-3	SO16	plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height; body thickness 1.47 mm	2 - 175
SOT110-1	SIL9MPF	plastic single in-line medium power package with fin; 9 leads	2 - 163
SOT111-1	DBS9MPF	plastic DIL-bent-SIL medium power package with fin; 9 leads	2 - 41
SOT116-1	DIP22	plastic dual in-line package; 22 leads (400 mil)	2 - 63
SOT117-1	DIP28	plastic dual in-line package; 28 leads (600 mil)	2 - 67
SOT117-2	DIP28	plastic dual in-line package; 28 leads (600 mil); long body	2 - 68
SOT129-1	DIP40	plastic dual in-line package; 40 leads (600 mil)	2 - 70
SOT131-2	SIL9P	plastic single in-line power package; 9 leads	2 - 164
SOT136-1	SO28	plastic small outline package; 28 leads; body width 7.5 mm	2 - 179
SOT137-1	SO24	plastic small outline package; 24 leads; body width 7.5 mm	2 - 178
SOT141-6	DBS13P	plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	2 - 47
SOT141-8	DBS13P	plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm)	2 - 46
SOT142-1	SIL9MP	plastic single in-line medium power package; 9 leads	2 - 162
SOT144-1	PMFP8	plastic micro flat package; 8 leads (straight)	2 - 128
SOT146-1	DIP20	plastic dual in-line package; 20 leads (300 mil)	2 - 62
SOT157-2	DBS9P	plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm)	2 - 44
SOT157-4	DBS9P	plastic DIL-bent-SIL power package; 9 leads (lead length 7.7 mm)	2 - 43
SOT158-1	VSO40	plastic very small outline package; 40 leads	2 - 225
SOT158-2	VSO40	plastic very small outline package; 40 leads; face down	2 - 226
SOT162-1	SO16	plastic small outline package; 16 leads; body width 7.5 mm	2 - 176
SOT163-1	SO20	plastic small outline package; 20 leads; body width 7.5 mm	2 - 177
SOT176-1	SO8	plastic small outline package; 8 leads; body width 7.5 mm	2 - 171
SOT187-2	PLCC44	plastic leaded chip carrier; 44 leads	2 - 121

IC package range and dimensions

Chapter 2

PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT188-2	PLCC68	plastic leaded chip carrier; 68 leads	2 - 124
SOT188-3	PLCC68	plastic leaded chip carrier; 68 leads; pedestal	2 - 125
SOT189-2	PLCC84	plastic leaded chip carrier; 84 leads	2 - 126
SOT189-3	PLCC84	plastic leaded chip carrier; 84 leads; pedestal	2 - 127
SOT190-1	VSO56	plastic very small outline package; 56 leads	2 - 227
SOT190-2	VSO56	plastic very small outline package; 56 leads; face down	2 - 228
SOT193-2	SIL13P	plastic single in-line power package; 13 leads	2 - 165
SOT201-1	DIP32	plastic dual in-line package; 32 leads (600 mil)	2 - 69
SOT205-1	QFP44	plastic quad flat package; 44 leads (lead length 2.35 mm); body 14 × 14 × 2.2 mm	2 - 130
SOT222-1	DIP24	plastic dual in-line package; 24 leads (300 mil)	2 - 64
SOT223-1	SO4	plastic small outline package; 4 leads; body width 3.5 mm	2 - 168
SOT232-1	SDIP32	plastic shrink dual in-line package; 32 leads (400 mil)	2 - 157
SOT234-1	SDIP24	plastic shrink dual in-line package; 24 leads (400 mil)	2 - 156
SOT238-2	PLCC52	plastic leaded chip carrier; 52 leads	2 - 122
SOT238-3	PLCC52	plastic leaded chip carrier; 52 leads; pedestal	2 - 123
SOT240-1	DIP48	plastic dual in-line package; 48 leads (600 mil)	2 - 71
SOT243-1	DBS17P	plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm)	2 - 49
SOT243-3	DBS17P	plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)	2 - 48
SOT247-1	SDIP52	plastic shrink dual in-line package; 52 leads (600 mil)	2 - 159
SOT248-1	DIP24	plastic dual in-line package; 24 leads (400 mil)	2 - 65
SOT261-2	PLCC28	plastic leaded chip carrier; 28 leads	2 - 119
SOT261-3	PLCC28	plastic leaded chip carrier; 28 leads; pedestal	2 - 120
SOT266-1	SSOP20	plastic shrink small outline package; 20 leads; body width 4.4 mm	2 - 189
SOT270-1	SDIP42	plastic shrink dual in-line package; 42 leads (600 mil)	2 - 158
SOT274-1	SDIP64	plastic shrink dual in-line package; 64 leads (750 mil)	2 - 161
SOT287-1	SO32	plastic small outline package; 32 leads; body width 7.5 mm	2 - 180
SOT307-2	QFP44	plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 × 10 × 1.75 mm	2 - 129
SOT310-1	QFP80	plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 × 20 × 3.0 mm	2 - 140
SOT313-2	LQFP48	plastic low profile quad flat package; 48 leads; body 7 × 7 × 1.4 mm	2 - 105
SOT314-2	LQFP64	plastic low profile quad flat package; 64 leads; body 10 × 10 × 1.4 mm	2 - 107
SOT315-1	LQFP80	plastic low profile quad flat package; 80 leads; body 12 × 12 × 1.4 mm	2 - 108
SOT316-1	SQFP208	plastic shrink quad flat package; 208 leads (lead length 1.3 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 183
SOT317-1	QFP100	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 - 141
SOT317-2	QFP100	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 143

IC package range and dimensions

Chapter 2

PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT317-3	QFP100	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 144
SOT318-1	QFP80	plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 - 138
SOT318-2	QFP80	plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 139
SOT319-1	QFP64	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.7 mm; high stand-off height	2 - 134
SOT319-2	QFP64	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 135
SOT319-5	QFP64	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 136
SOT320-2	QFP128	plastic quad flat package; 128 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 148
SOT322-1	QFP160	plastic quad flat package; 160 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 151
SOT322-2	QFP160	plastic quad flat package; 160 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 150
SOT337-1	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	2 - 185
SOT338-1	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	2 - 188
SOT339-1	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	2 - 190
SOT340-1	SSOP24	plastic shrink small outline package; 24 leads; body width 5.3 mm	2 - 192
SOT341-1	SSOP28	plastic shrink small outline package; 28 leads; body width 5.3 mm	2 - 193
SOT349-1	QFP120	plastic quad flat package; 120 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 147
SOT349-2	QFP120	plastic quad flat package; 120 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 146
SOT352-1	RBS9MPF	plastic rectangular-bent single in-line medium power package with fin; 9 leads	2 - 152
SOT354-1	SMS9P	plastic surface mounted single in-line power package; 9 leads	2 - 166
SOT355-1	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	2 - 218
SOT357-1	TQFP64	plastic thin quad flat package; 64 leads; body 10 × 10 × 1.0 mm	2 - 209
SOT358-1	LQFP32	plastic low profile quad flat package; 32 leads; body 7 × 7 × 1.4 mm	2 - 103
SOT360-1	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	2 - 217
SOT361-1	TSSOP28	plastic thin shrink small outline package; 28 leads; body width 4.4 mm	2 - 219
SOT362-1	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	2 - 223
SOT364-1	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	2 - 224
SOT369-1	SSOP16	plastic shrink small outline package; 16 leads; body width 4.4 mm	2 - 187
SOT370-1	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	2 - 194
SOT371-1	SSOP56	plastic shrink small outline package; 56 leads; body width 7.5 mm	2 - 195
SOT375-1	TQFP80	plastic thin quad flat package; 80 leads; body 12 × 12 × 1.0 mm	2 - 210
SOT376-1	TQFP44	plastic thin quad flat package; 44 leads; body 10 × 10 × 1.0 mm	2 - 208

IC package range and dimensions

Chapter 2

PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT379-1	QFP52	plastic quad flat package; 52 leads (lead length 1.6 mm); body 10 × 10 × 2.0 mm	2 - 131
SOT380-1	PLCC20	plastic leaded chip carrier; 20 leads	2 - 118
SOT382-1	QFP100	plastic quad flat package; 100 leads (lead length 1.6 mm); body 14 × 20 × 2.8 mm	2 - 142
SOT382-2	QFP100	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 145
SOT386-1	TQFP100	plastic thin quad flat package; 100 leads; body 14 × 14 × 1.0 mm	2 - 211
SOT387-3	SQFP128	plastic shrink quad flat package; 128 leads (lead length 1.6 mm); body 14 × 20 × 2.72 mm	2 - 182
SOT389-1	LQFP44	plastic low profile quad flat package; 44 leads; body 10 × 10 × 1.4 mm	2 - 104
SOT393-1	QFP64	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm	2 - 132
SOT393-2	QFP64	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm; high stand-off height	2 - 133
SOT397-1	HSOP20	plastic, heatsink small outline package; 20 leads	2 - 84
SOT398-1	HDIP18	plastic heat-dissipating dual in-line package; 18 leads	2 - 80
SOT400-1	SDIP56	plastic shrink dual in-line package; 56 leads (600 mil)	2 - 160
SOT401-1	LQFP32	plastic low profile quad flat package; 32 leads; body 5 × 5 × 1.4 mm	2 - 102
SOT402-1	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	2 - 215
SOT403-1	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	2 - 216
SOT407-1	LQFP100	plastic low profile quad flat package; 100 leads; body 14 × 14 × 1.4 mm	2 - 110
SOT411-1	DBS23P	plastic DIL-bent-SIL power package; 23 leads (straight lead length 3.2 mm)	2 - 51
SOT411-2	DBS23P	plastic DIL-bent-SIL power package; 23 leads (lead length 12 mm)	2 - 52
SOT414-1	LQFP64	plastic low profile quad flat package; 64 leads; body 7 × 7 × 1.4 mm	2 - 106
SOT418-2	HSOP20	plastic, heatsink small outline package; 20 leads; low stand-off	2 - 85
SOT420-1	LQFP128	plastic low profile quad flat package; 128 leads; body 14 × 14 × 1.4 mm	2 - 111
SOT425-1	LQFP128	plastic low profile quad flat package; 128 leads; body 14 × 20 × 1.4 mm	2 - 112
SOT431-1	HSQFP208	plastic, heatsink shrink quad flat package; 208 leads (lead length 1.3 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 89
SOT435-1	LQFP160	plastic low profile quad flat package; 160 leads; body 24 × 24 × 1.4 mm	2 - 114
SOT449-1	SOJ40	plastic small outline package; 40 leads (J-bent); body width 10.16 mm	2 - 181
SOT459-1	LQFP208	plastic low profile quad flat package; 208 leads; body 28 × 28 × 1.4 mm	2 - 116
SOT462-1	RDBS13P	plastic rectangular-DIL-bent-SIL (reverse bent) power package; 13 leads	2 - 154
SOT465-1	TO-92	TO-92: 3 leads; body diameter 4.7 mm	2 - 207
SOT466-1	BGA256	plastic ball grid array package; 256 balls; body 27 × 27 × 1.75 mm	2 - 20
SOT470-1	HLQFP100	plastic heat-dissipating low profile quad flat package; 100 leads; body 14 × 14 × 1.4 mm	2 - 81
SOT471-1	BGA256	plastic ball grid array package; 256 balls; body 27 × 27 × 1.55 mm	2 - 19
SOT472-1	BGA156	plastic ball grid array package; 156 balls; body 15 × 15 × 1.15 mm	2 - 17
SOT474-2	MSQFP240	metal shrink quad flat package; 240 leads; body 32 × 32 × 3.4 mm	2 - 117

IC package range and dimensions

Chapter 2

PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT475-1	DBS17P	plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm)	2 - 50
SOT486-1	LQFP144	plastic low profile quad flat package; 144 leads; body $20 \times 20 \times 1.4$ mm	2 - 113
SOT487-1	TSSOP32	plastic thin shrink small outline package; 32 leads; body width 6.1 mm; lead pitch 0.65 mm	2 - 221
SOT489-1	BGA292	plastic ball grid array package; 292 balls; body $27 \times 27 \times 1.75$ mm	2 - 22
SOT496-1	QFP80	plastic quad flat package; 80 leads (lead length 1.6 mm); body $14 \times 14 \times 2.67$ mm	2 - 137
SOT505-1	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm	2 - 213
SOT506-1	LQFP176	plastic low profile quad flat package; 176 leads; body $24 \times 24 \times 1.4$ mm	2 - 115
SOT510-1	TSSOP38	plastic thin shrink small outline package; 38 leads; body width 4.4 mm; lead pitch 0.5 mm	2 - 222
SOT513-1	HTQFP80	plastic, heatsink thin quad flat package; 80 leads; body $14 \times 14 \times 1.0$ mm	2 - 93
SOT514-1	BGA492	plastic ball grid array package; 492 balls; body $35 \times 35 \times 1.75$ mm	2 - 32
SOT516-1	LFBGA56	plastic low profile fine-pitch ball grid array; 56 balls; body $6 \times 6 \times 1.05$ mm	2 - 96
SOT517-1	SMS13P	plastic surface mounted single in-line power package; 13 leads	2 - 167
SOT518-1	LFBGA84	plastic low profile fine-pitch ball grid array; 84 balls; body $7 \times 7 \times 1.05$ mm	2 - 98
SOT519-1	SSOP16	plastic shrink small outline package; 16 leads; body width 3.9 mm; lead pitch 0.635 mm	2 - 186
SOT521-1	DBS27P	plastic DIL-bent-SIL power package; 27 leads (lead length 7.7 mm)	2 - 53
SOT523-1	DBS9P	plastic DIL-bent-SIL power package; 9 leads (lead length 12/11 mm); exposed die pad	2 - 45
SOT524-1	DBS7P	plastic DIL-bent-SIL power package; 7 leads (lead length 12/11 mm); exposed die pad	2 - 42
SOT527-1	HTSSOP20	plastic, heatsink thin shrink small outline package; 20 leads; body width 4.4 mm	2 - 94
SOT528-1	RDBS13P	plastic rectangular-DIL-bent-SIL power package; 13 leads	2 - 153
SOT531-1	BGA316	plastic ball grid array package; 316 balls; body $27 \times 27 \times 1.75$ mm	2 - 24
SOT532-1	BGA388	plastic ball grid array package; 388 balls; body $35 \times 35 \times 1.75$ mm	2 - 28
SOT534-1	LFBGA64	plastic low profile fine-pitch ball grid array; 64 balls; body $8 \times 8 \times 1.05$ mm	2 - 97
SOT536-1	LFBGA96	plastic low profile fine-pitch ball grid array; 96 balls; body $13.5 \times 5.5 \times 1.05$ mm	2 - 99
SOT537-1	LFBG114	plastic low profile fine-pitch ball grid array; 114 balls; body $16 \times 5.5 \times 1.05$ mm	2 - 100
SOT542-1	TFBGA56	plastic thin fine-pitch ball grid array package; 56 balls; body $6 \times 6 \times 0.8$ mm	2 - 197
SOT543-1	TFBGA64	plastic thin fine-pitch ball grid array package; 64 balls; body $6 \times 6 \times 0.8$ mm	2 - 198
SOT545-2	HTQFP48	plastic, heatsink thin quad flat package; 48 leads; body $7 \times 7 \times 1.0$ mm	2 - 92
SOT546-2	HBGA352	plastic, heatsink ball grid array package; 352 balls; body $35 \times 35 \times 0.9$ mm	2 - 76
SOT547-1	HTQFP32	plastic, heatsink thin quad flat package; 32 leads; body $5 \times 5 \times 1.0$ mm	2 - 90
SOT547-2	HTQFP32	plastic, heatsink thin quad flat package; 32 leads; body $5 \times 5 \times 1.0$ mm	2 - 91
SOT549-1	HTSSOP32	plastic, heatsink thin shrink small outline package; 32 leads; body width 6.1 mm; lead pitch 0.65 mm	2 - 95
SOT550-1	BGA304	plastic ball grid array package; 304 balls; body $31 \times 31 \times 1.75$ mm	2 - 23
SOT552-1	TSSOP10	plastic thin shrink small outline package; 10 leads; body width 3 mm	2 - 214

IC package range and dimensions

Chapter 2

PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT553-1	HBGA292	plastic, heatsink ball grid array package; 292 balls; body $27 \times 27 \times 1.75$ mm	2 - 75
SOT556-1	SSOP24	plastic shrink small outline package; 24 leads; body width 3.9 mm; lead pitch 0.635 mm	2 - 191
SOT557-1	TFBGA80	plastic thin fine-pitch ball grid array package; 80 balls; body $7 \times 7 \times 0.8$ mm	2 - 199
SOT560-1	HBCC32	plastic, heatsink bottom chip carrier; 32 terminals; body $5 \times 5 \times 0.65$ mm	2 - 73
SOT564-1	HBCC24	plastic, heatsink bottom chip carrier; 24 terminals; body $4 \times 4 \times 0.65$ mm	2 - 72
SOT566-1	HSOP24	plastic, heatsink small outline package; 24 leads	2 - 86
SOT566-2	HSOP24	plastic, heatsink small outline package; 24 leads; low stand-off	2 - 87
SOT569-1	TFBGA144	plastic thin fine-pitch ball grid array package; 144 balls; body $12 \times 12 \times 0.8$ mm	2 - 203
SOT570-1	TFBGA180	plastic thin fine-pitch ball grid array package; 180 balls; body $12 \times 12 \times 0.8$ mm	2 - 204
SOT571-1	LFBGA324	plastic low profile fine-pitch ball grid array; 324 balls; body $16 \times 16 \times 1.2$ mm	2 - 101
SOT572-1	LQFP100	plastic low profile quad flat package; 100 leads; body $12 \times 12 \times 1.4$ mm	2 - 109
SOT573-1	QFP144	plastic quad flat package; 144 leads (lead length 1.6 mm); body $28 \times 28 \times 3.4$ mm	2 - 149
SOT574-1	TQFP128	plastic thin quad flat package; 128 leads; body $14 \times 14 \times 1.0$ mm	2 - 212
SOT575-1	SQFP304	plastic shrink quad flat package; 304 leads (lead length 1.3 mm); body $40 \times 40 \times 3.8$ mm	2 - 184
SOT576-1	HQFP160	plastic, heatsink quad flat package; 160 leads; (lead length 1.6 mm); body $28 \times 28 \times 3.4$ mm; high stand-off height	2 - 83
SOT577-1	RDBS17P	plastic rectangular-DIL-bent-SIL power package; 17 leads (row spacing 2.54 mm)	2 - 155
SOT578-1	TBS13P	plastic Triple-bent-SIL power package; 13 leads; (lead length 7.7 mm)	2 - 196
SOT579-1	BGA272	plastic ball grid array package; 272 balls; body $27 \times 27 \times 1.55$ mm	2 - 21
SOT581-1	BGA352	plastic ball grid array package; 352 balls; body $35 \times 35 \times 1.75$ mm	2 - 27
SOT582-1	BGA388	plastic ball grid array package; 388 balls; body $35 \times 35 \times 2.15$ mm	2 - 29
SOT583-1	BGA456	plastic ball grid array package; 456 balls; body $35 \times 35 \times 2.15$ mm	2 - 31
SOT584-1	BGA456	plastic ball grid array package; 456 balls; body $35 \times 35 \times 1.75$ mm	2 - 30
SOT585-1	BGA516	plastic ball grid array package; 516 balls; body $35 \times 35 \times 2.15$ mm	2 - 33
SOT586-1	BGA596	plastic ball grid array package; 596 balls; body $40 \times 40 \times 2.15$ mm	2 - 36
SOT587-1	BGA596	plastic ball grid array package; 596 balls; body $40 \times 40 \times 1.75$ mm	2 - 35
SOT588-1	BGA656	plastic ball grid array package; 656 balls; body $40 \times 40 \times 1.75$ mm	2 - 37
SOT589-1	BGA553	plastic ball grid array package; 553 balls; body $37.5 \times 37.5 \times 1.75$ mm	2 - 34
SOT590-1	BGA656	plastic ball grid array package; 656 balls; body $40 \times 40 \times 2.15$ mm	2 - 38
SOT591-1	BGA776	plastic ball grid array package; 776 balls; body $40 \times 40 \times 2.15$ mm	2 - 39
SOT592-1	HSOP24	plastic, heatsink small outline package; 24 leads	2 - 88
SOT594-1	CWQCCN32	ceramic window quad chip carrier; no leads	2 - 40
SOT595-1	BGA208	plastic ball grid array package; 208 balls; body $17 \times 17 \times 1.20$ mm	2 - 18
SOT597-1	TFBGA96	plastic thin fine-pitch ball grid array package; 96 balls; body $8 \times 8 \times 0.8$ mm	2 - 200
SOT598-1	TFBGA100	plastic thin fine-pitch ball grid array package; 100 balls; body $9 \times 9 \times 0.8$ mm	2 - 201
SOT599-1	TFBGA132	plastic thin fine-pitch ball grid array package; 132 balls; body $12 \times 12 \times 0.8$ mm	2 - 202

IC package range and dimensions

Chapter 2

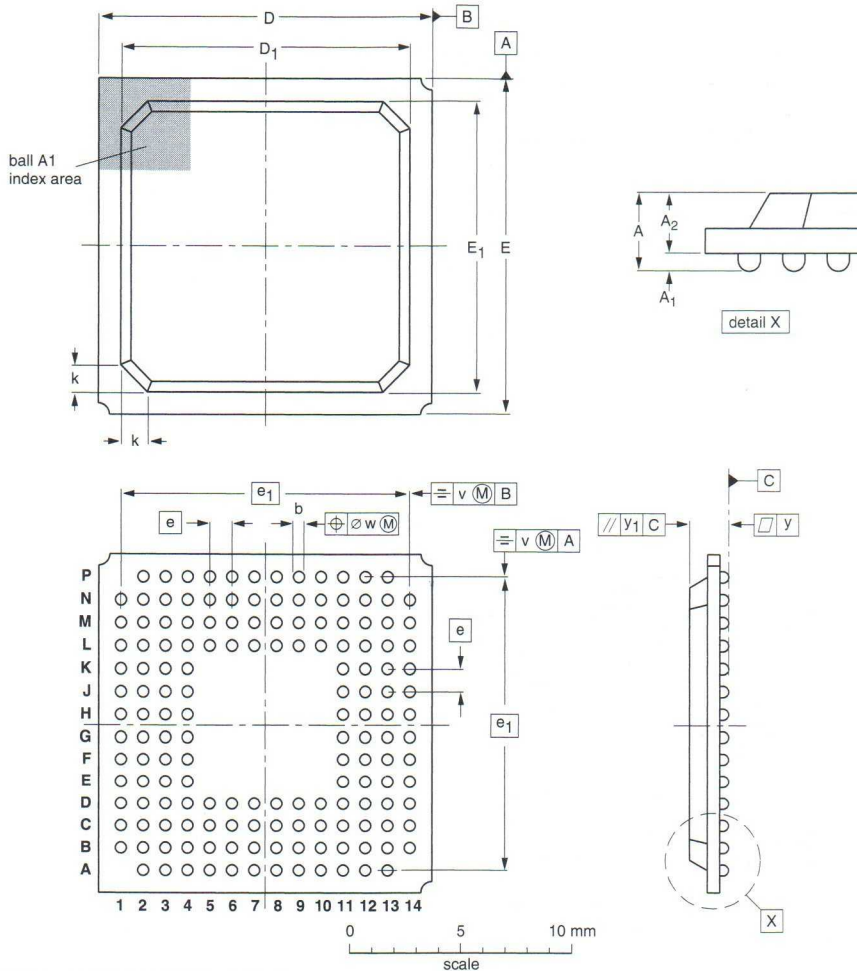
PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT600-1	TFBGA208	plastic thin fine-pitch ball grid array package; 208 balls; body 15 × 15 × 0.8 mm	2 - 205
SOT601-1	TFBGA280	plastic thin fine-pitch ball grid array package; 280 balls; body 16 × 16 × 0.8 mm	2 - 206
SOT602-1	HBGA256	plastic, heatsink ball grid array package; 256 balls; body 27 × 27 × 0.9 mm	2 - 74
SOT603-1	HBGA420	plastic, heatsink ball grid array package; 420 balls; body 35 × 35 × 0.9 mm	2 - 77
SOT604-1	HBGA504	plastic, heatsink ball grid array package; 504 balls; body 35 × 35 × 0.9 mm	2 - 78
SOT605-1	HBGA600	plastic, heatsink ball grid array package; 600 balls; body 40 × 40 × 0.9 mm	2 - 79
SOT607-1	TSSOP30	plastic thin shrink small outline package; 30 leads; body width 4.4 mm; lead pitch 0.5 mm	2 - 220
SOT611-1	BGA329	plastic ball grid array package; 329 balls; body 31 × 31 × 1.75 mm	2 - 25
SOT611-2	BGA329	plastic ball grid array package; 329 balls; body 31 × 31 × 1.75 mm	2 - 26
SOT612-1	HLQFP144	plastic, heatsink low profile quad flat package; 144 leads; body 20 × 20 × 1.4 mm	2 - 82

IC package range and dimensions

Chapter 2

BGA156: plastic ball grid array package; 156 balls; body 15 x 15 x 1.15 mm

SOT472-1



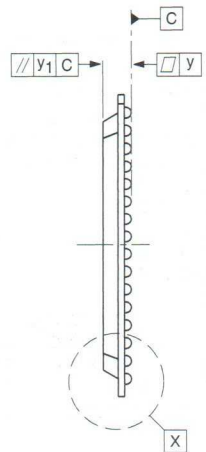
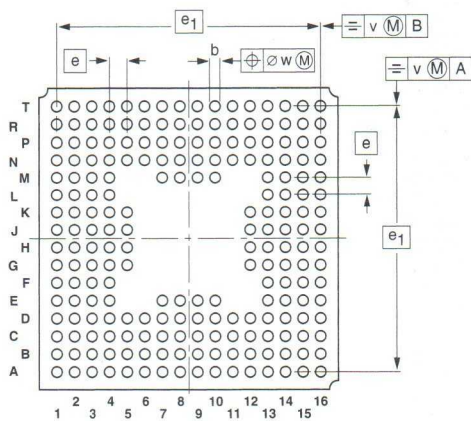
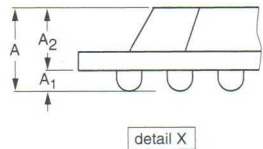
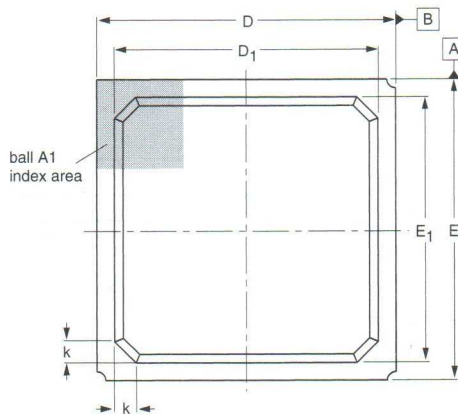
DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	1.75	0.5 0.3	1.25 1.05	0.6 0.4	15.2 14.8	13.7 13.0	15.2 14.8	13.7 13.0	1.0	13.0	1.65 1.10	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT472-1						99-12-02 00-03-04

BGA208: plastic ball grid array package; 208 balls; body 17 x 17 x 1.20 mm

SOT595-1



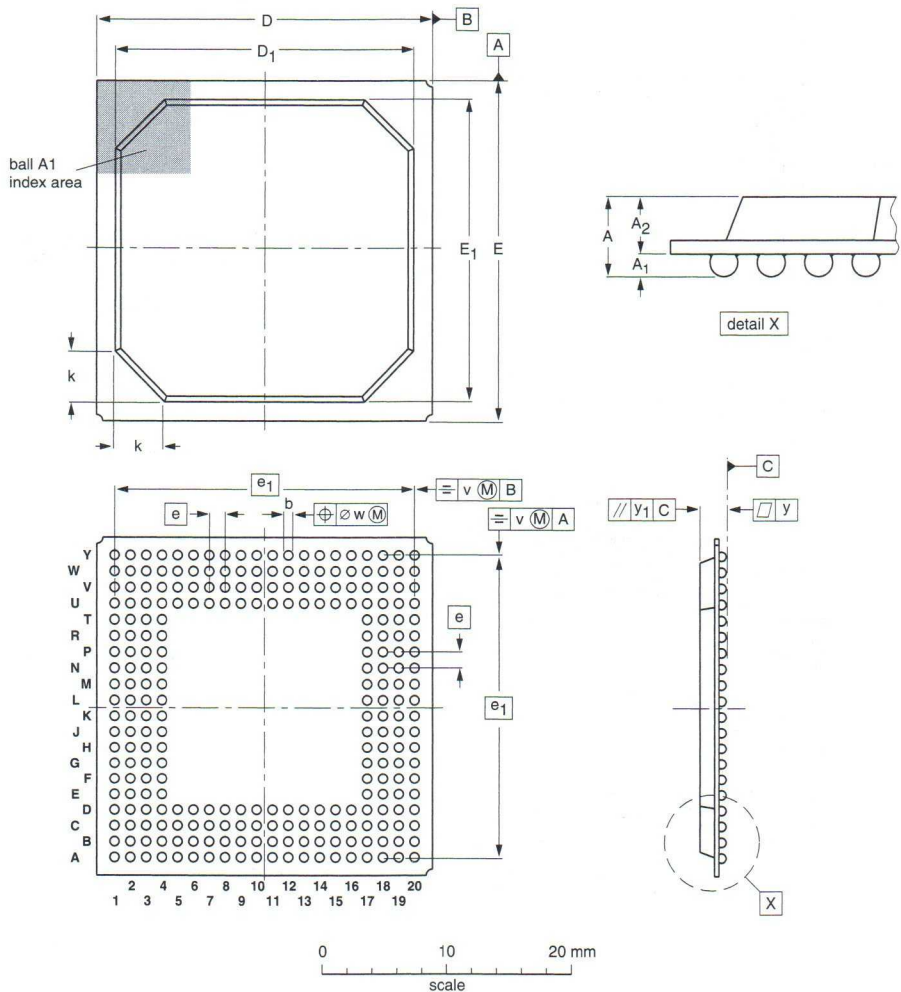
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	1.86	0.50 0.30	1.36 1.06	0.7 0.5	17.2 16.8	15.2 14.8	17.2 16.8	15.2 14.8	1.0	15.0	1.3 1.1	0.25	0.1	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT595-1						00-02-01 00-03-04

BGA256: plastic ball grid array package; 256 balls; body 27 x 27 x 1.55 mm

SOT471-1



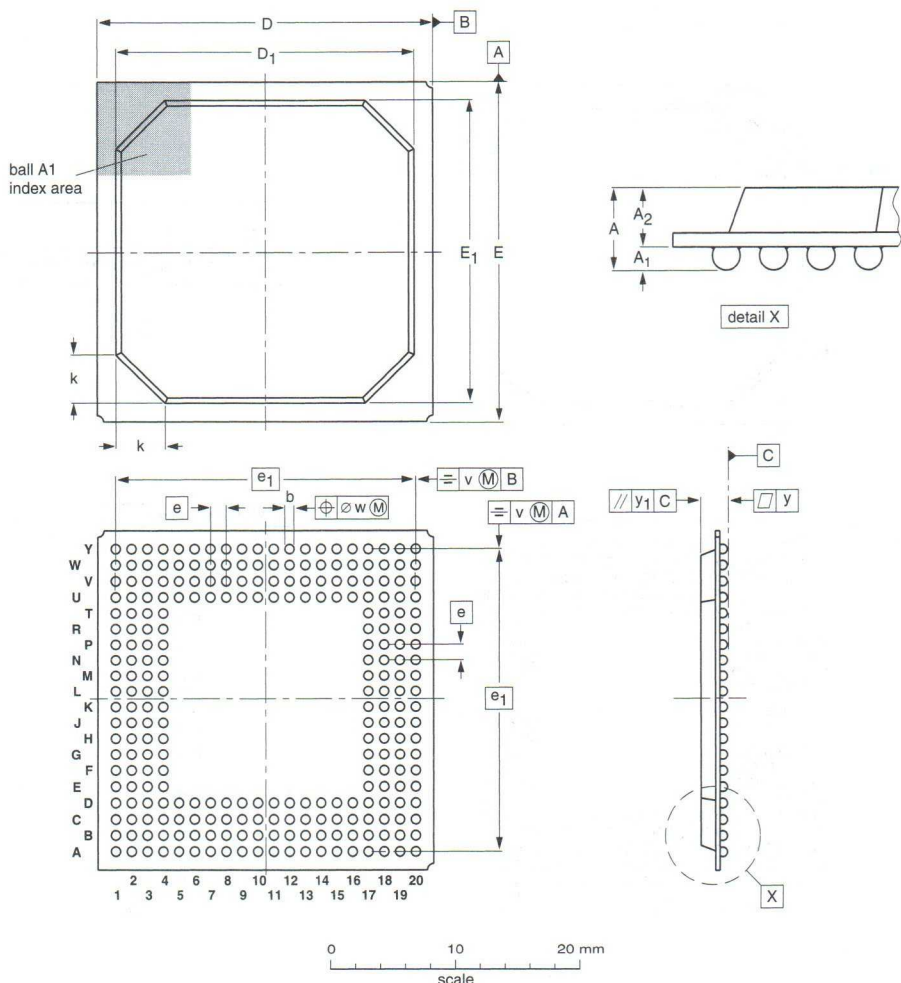
DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.32	0.70 0.50	1.64 1.42	0.90 0.60	27.20 26.80	24.70 23.95	27.20 26.80	24.70 23.95	1.27	24.13	4.05 3.85	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT471-1						00-02-01 00-03-04

BGA256: plastic ball grid array package; 256 balls; body 27 x 27 x 1.75 mm

SOT466-1



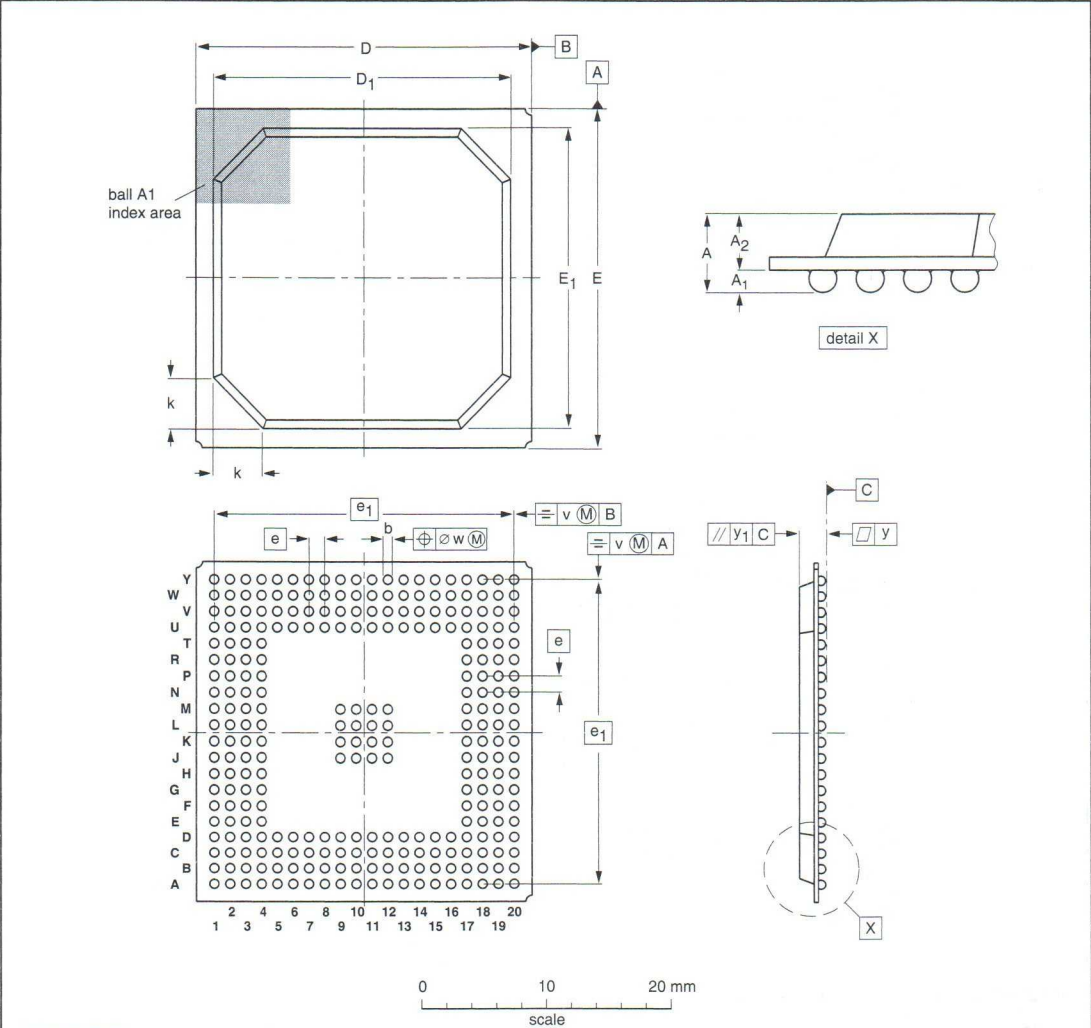
DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.54	0.70 0.50	1.78 1.68	0.90 0.60	27.2 26.8	24.7 24.0	27.2 26.8	24.7 24.0	1.27	24.13	4.0 3.9	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT466-1						00-01-17 00-03-04

BGA272: plastic ball grid array package; 272 balls; body 27 x 27 x 1.55 mm

SOT579-1



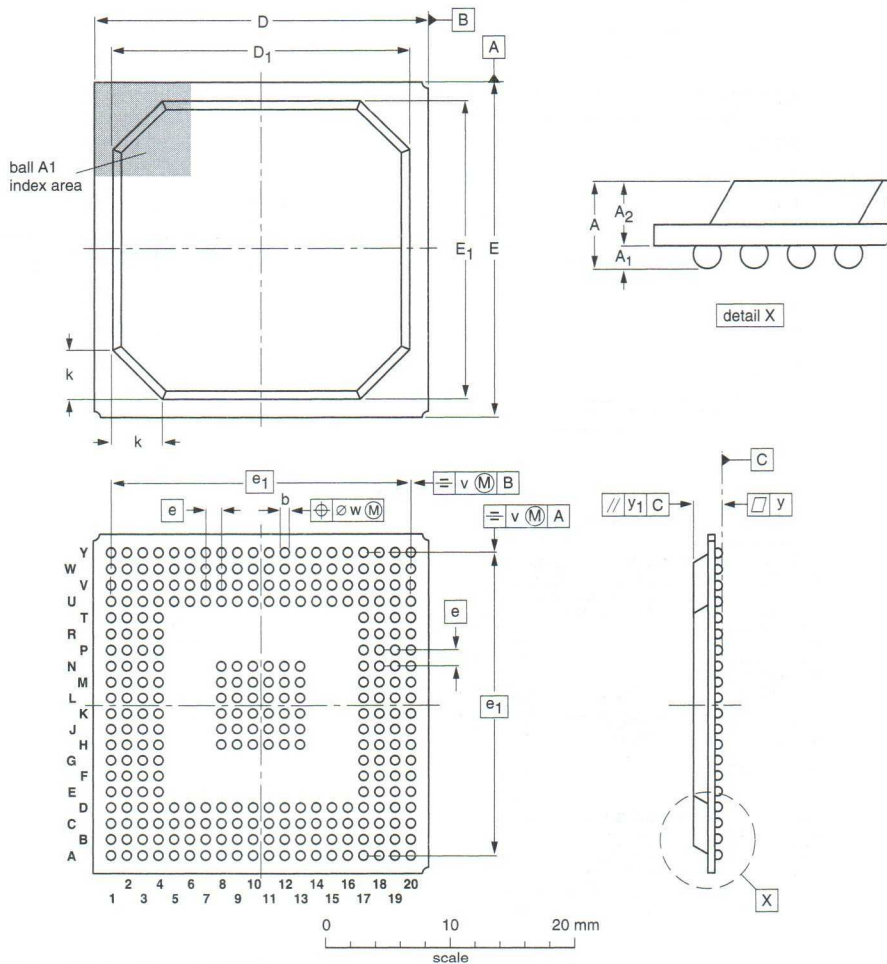
DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.32	0.70 0.50	1.64 1.42	0.90 0.60	27.2 26.8	24.70 23.95	27.2 26.8	24.70 23.95	1.27	24.13	4.05 3.85	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT579-1						00-02-01 00-03-04

BGA292: plastic ball grid array package; 292 balls; body 27 x 27 x 1.75 mm

SOT489-1



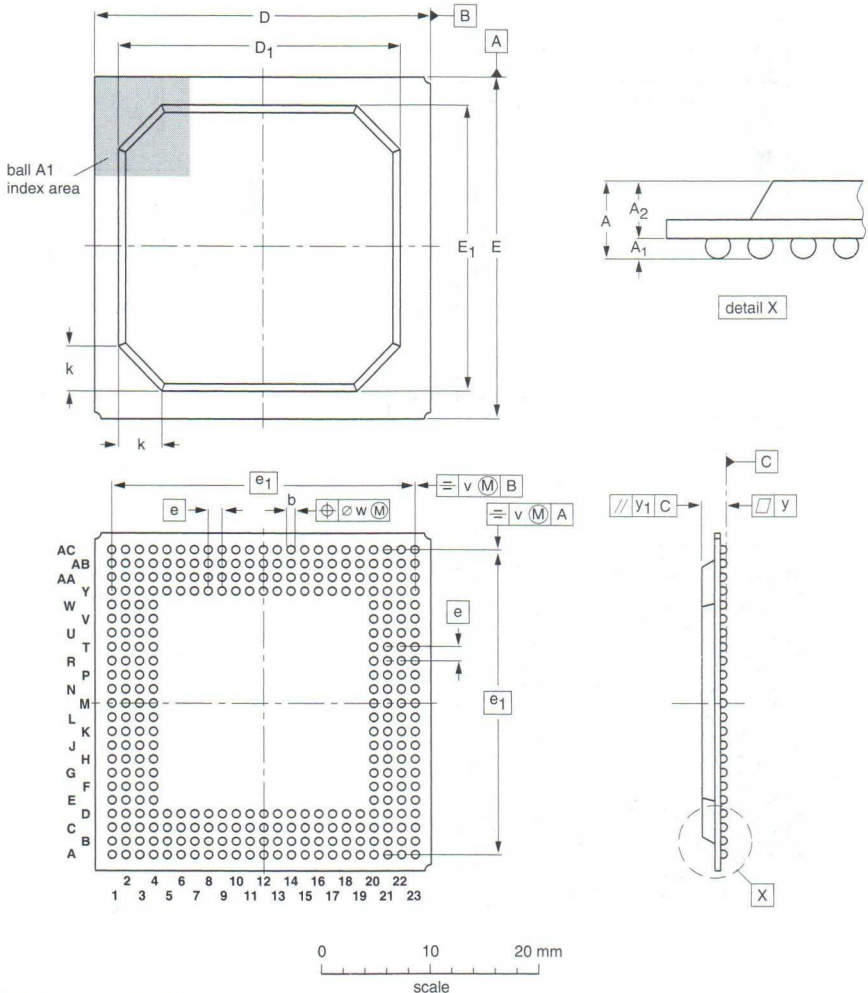
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.46	0.70 0.50	1.85 1.62	0.90 0.60	27.2 26.8	24.7 24.0	27.2 26.8	24.7 24.0	1.27	24.13	4.0 3.9	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT489-1		MO-151			99-12-27 00-03-04

BGA304: plastic ball grid array package; 304 balls; body 31 x 31 x 1.75 mm

SOT550-1



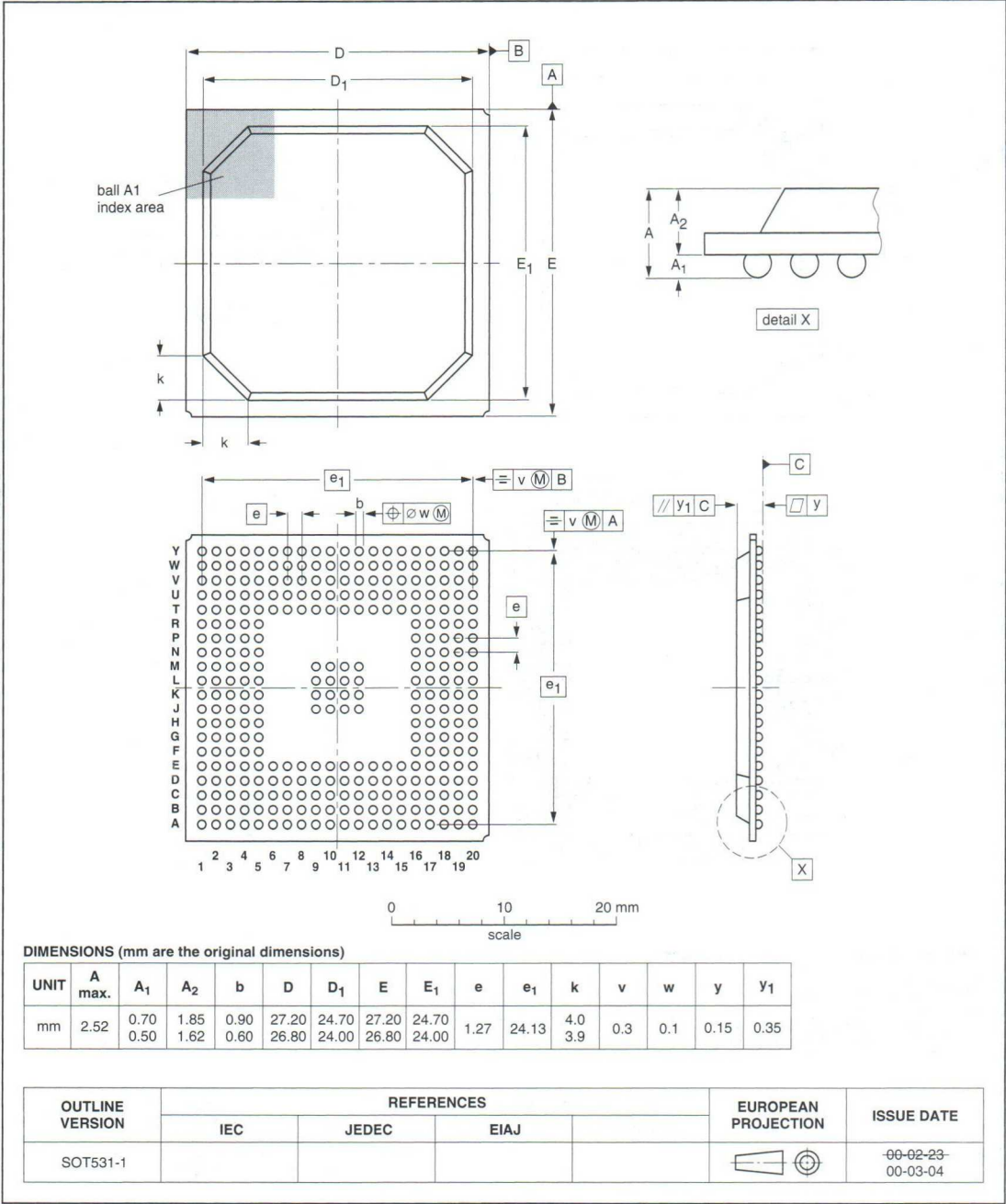
DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.54	0.70 0.50	1.84 1.62	0.90 0.60	31.20 30.80	26.70 25.95	31.20 30.80	26.70 25.95	1.27	27.94	4.1 3.9	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT550-1						00-02-01 00-03-04

BGA316: plastic ball grid array package; 316 balls; body 27 x 27 x 1.75 mm

SOT531-1

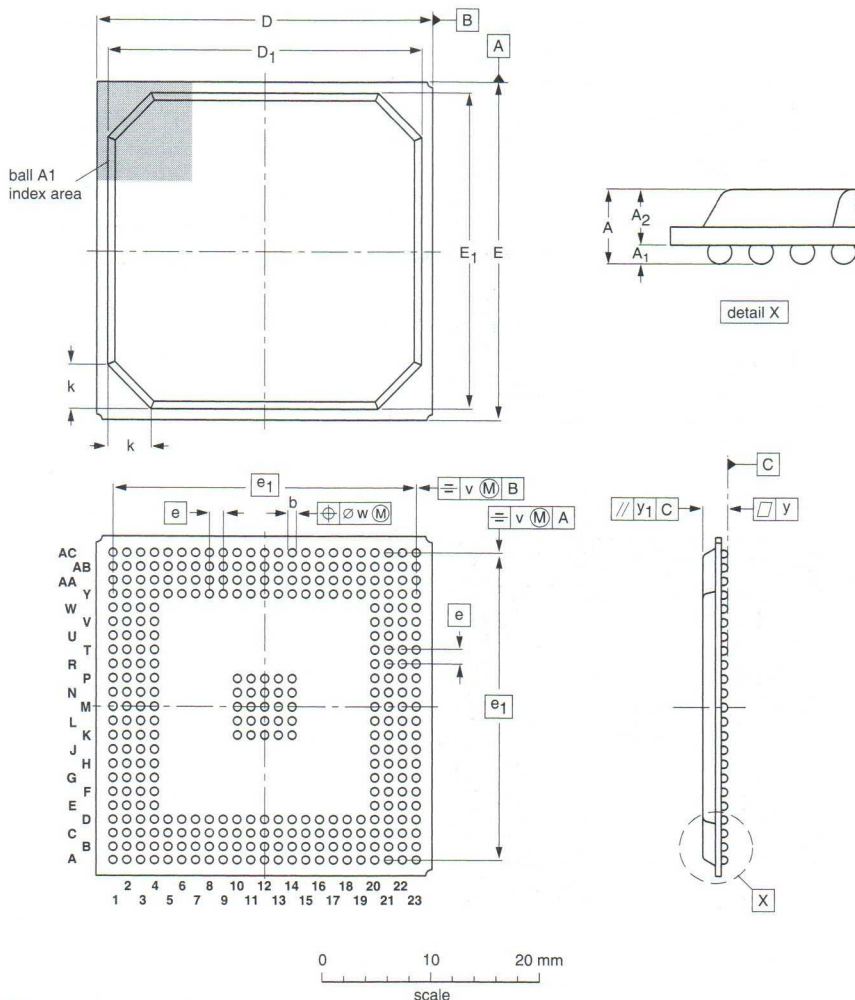


IC package range and dimensions

Chapter 2

BGA329: plastic ball grid array package; 329 balls; body 31 x 31 x 1.75 mm

SOT611-1



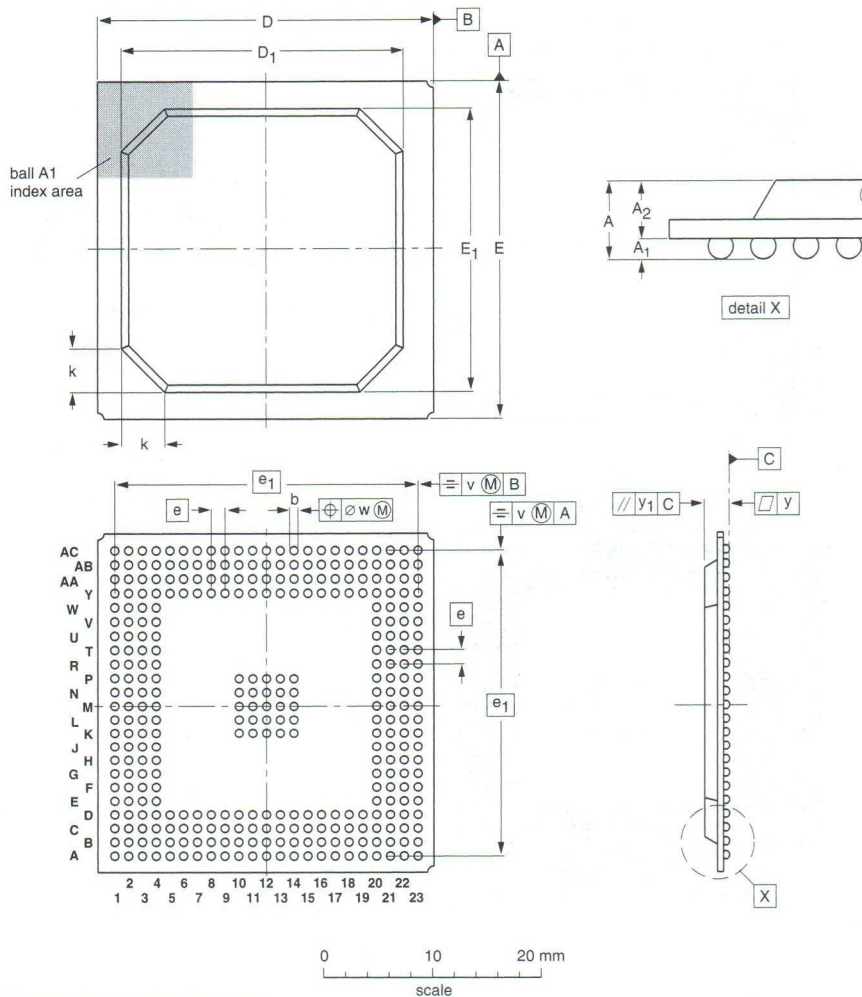
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.54	0.70 0.50	1.84 1.62	0.90 0.60	31.20 30.80	29.20 28.80	31.20 30.80	29.20 28.80	1.27	27.94	4.1 3.9	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT611-1						00-03-24

BGA329: plastic ball grid array package; 329 balls; body 31 x 31 x 1.75 mm

SOT611-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.54	0.70 0.50	1.84 1.62	0.90 0.60	31.20 30.80	26.70 25.95	31.20 30.80	26.70 25.95	1.27	27.94	4.1 3.9	0.3	0.1	0.15	0.35

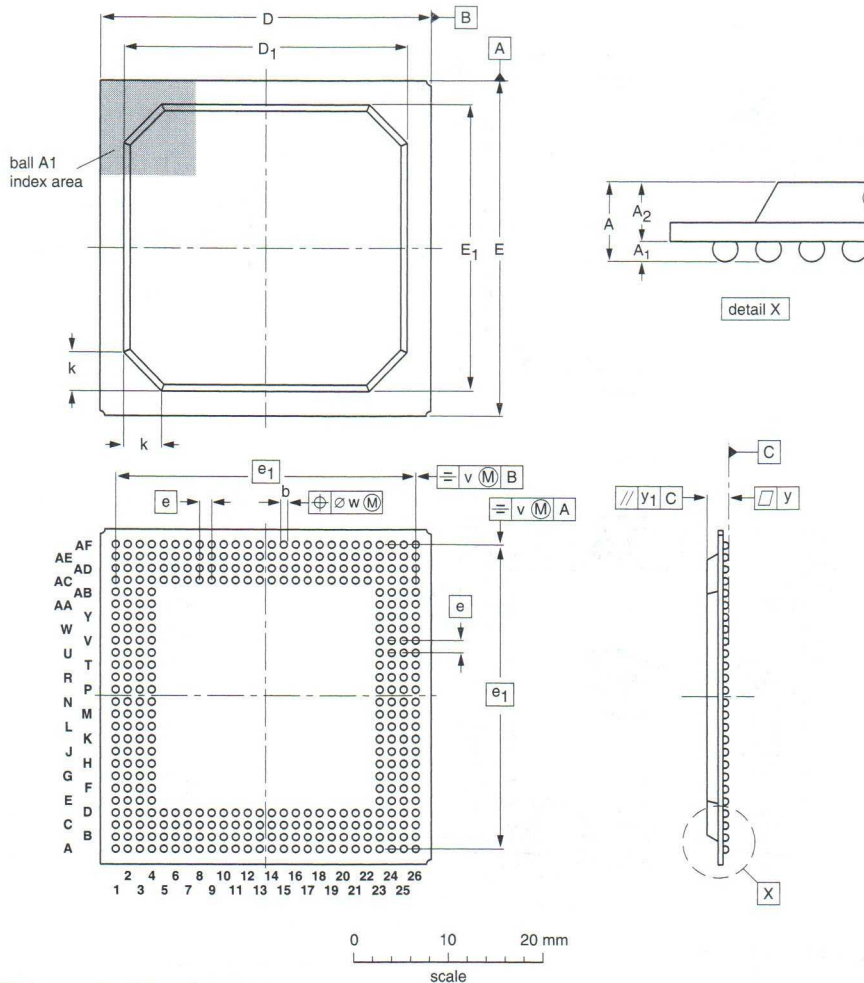
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT611-2						00-03-04 00-03-21

IC package range and dimensions

Chapter 2

BGA352: plastic ball grid array package; 352 balls; body 35 x 35 x 1.75 mm

SOT581-1



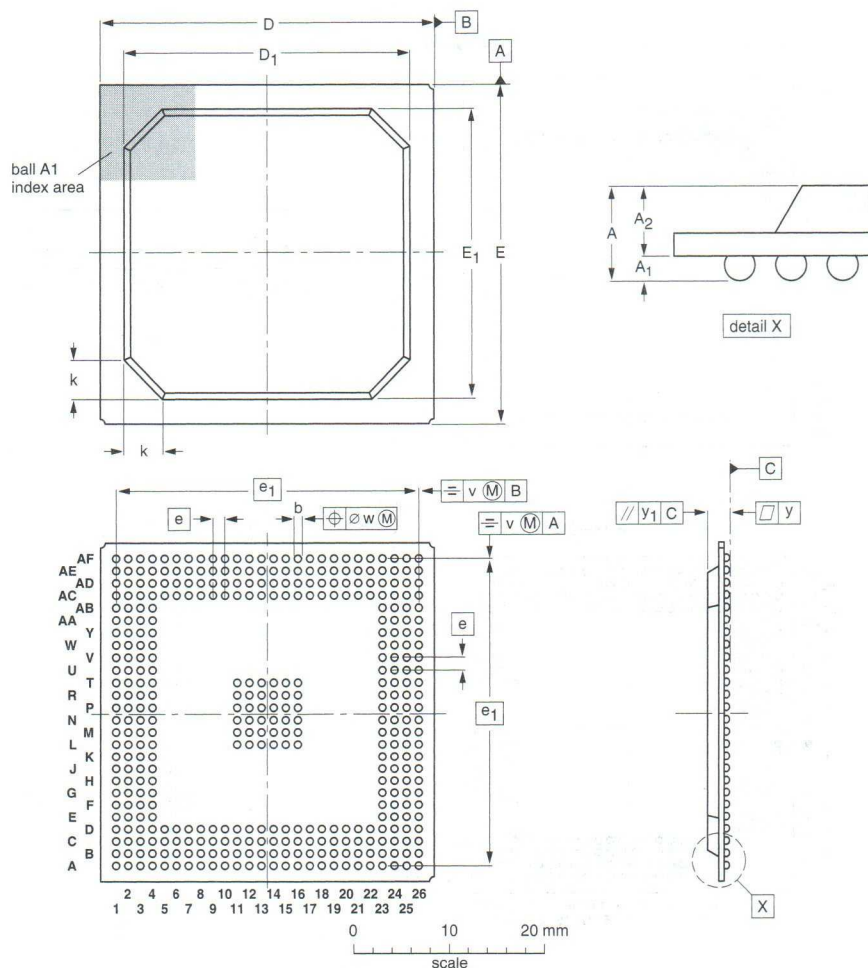
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.54	0.70 0.50	1.84 1.62	0.90 0.60	35.20 34.80	30.70 29.95	35.20 34.80	30.70 29.95	1.27	31.75	4.1 3.9	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT581-1						00-02-10 00-03-04

BGA388: plastic ball grid array package; 388 balls; body 35 x 35 x 1.75 mm

SOT532-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.54	0.7 0.5	1.84 1.62	0.9 0.6	35.2 34.8	30.70 29.95	35.2 34.8	30.70 29.95	1.27	31.75	4.1 3.9	0.3	0.1	0.15	0.35

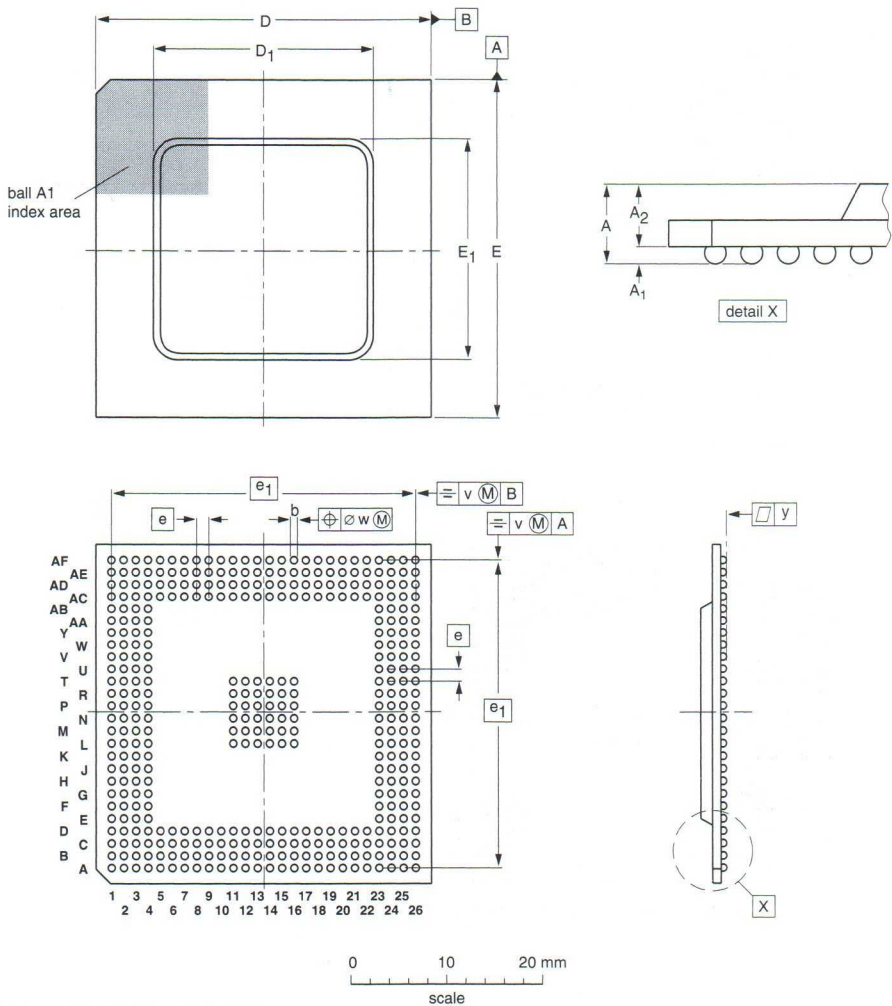
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT532-1						00-02-29 00-03-04

IC package range and dimensions

Chapter 2

BGA388: plastic ball grid array package; 388 balls; body 35 x 35 x 2.15 mm

SOT582-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁ max.	E	E ₁ max.	e	e ₁	v	w	y
mm	3.05	0.7 0.5	2.40 1.85	0.9 0.6	35.1 34.9	23.0	35.1 34.9	23.0	1.27	31.75	0.3	0.15	0.2

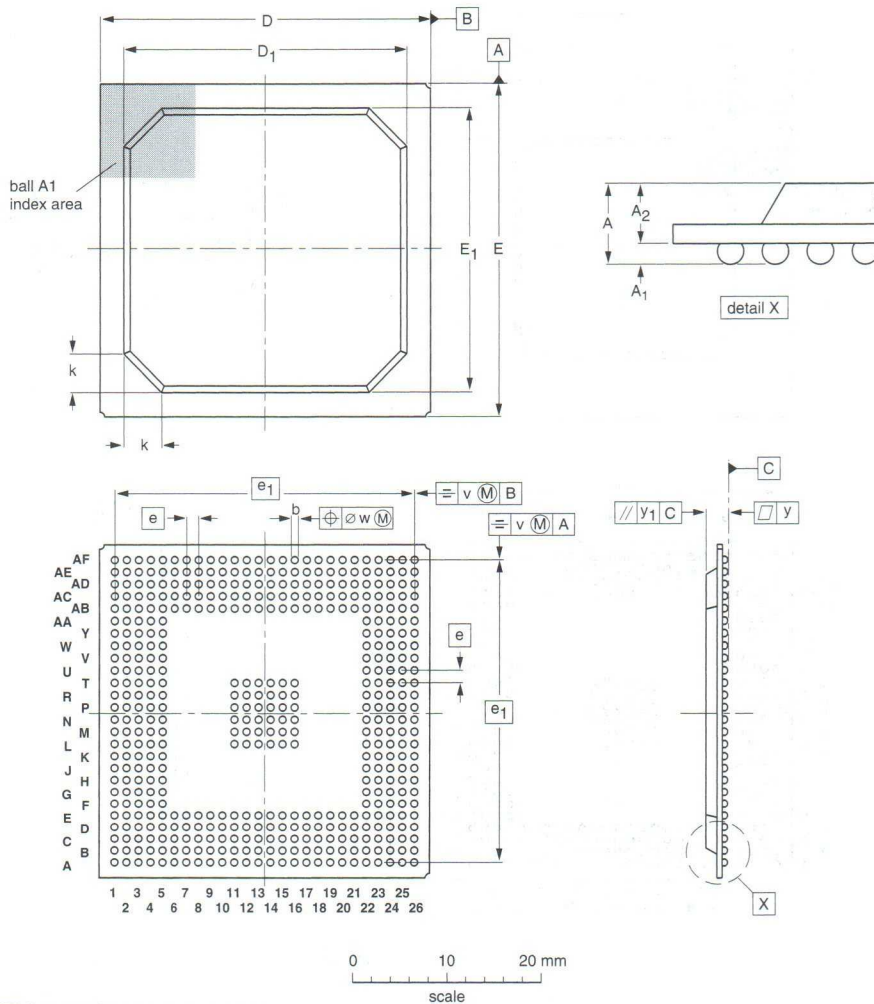
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT582-1						00-02-00 00-03-04

IC package range and dimensions

Chapter 2

BGA456: plastic ball grid array package; 456 balls; body 35 x 35 x 1.75 mm

SOT584-1



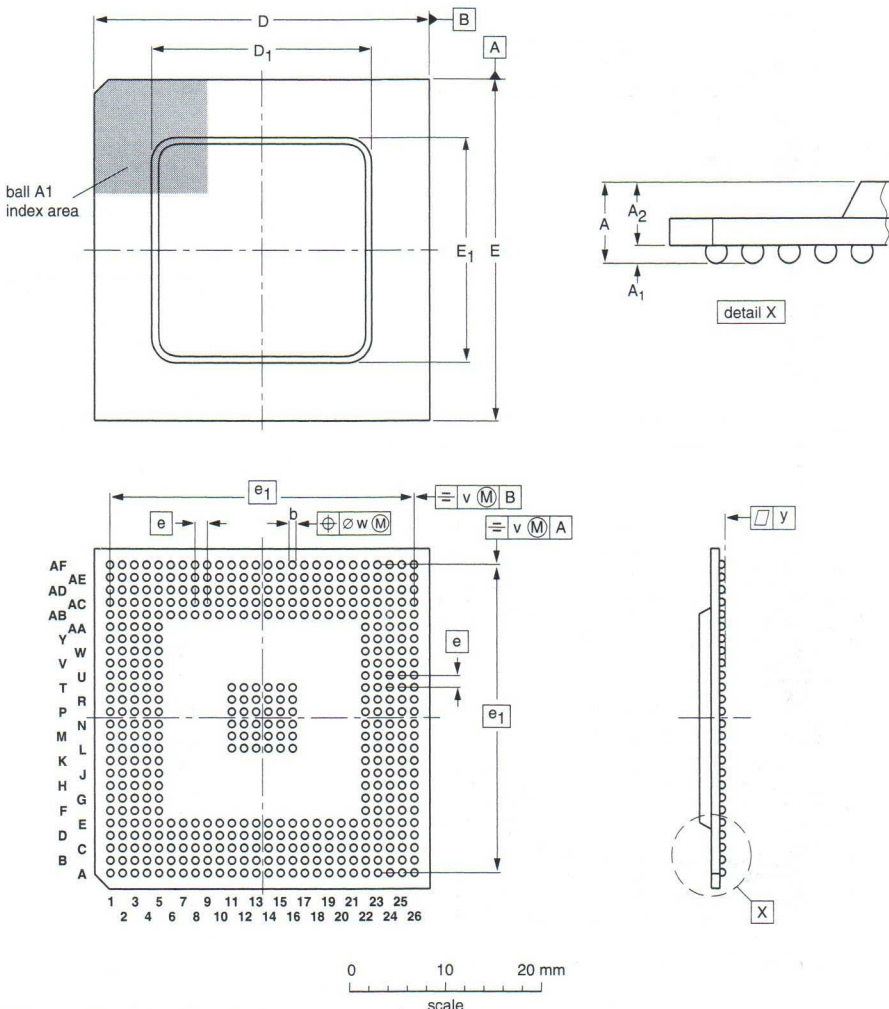
DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k	v	w	y	y ₁
mm	2.54	0.70 0.50	1.84 1.62	0.90 0.60	35.20 34.80	30.70 29.95	35.20 34.80	30.70 29.95	1.27	31.75	4.1 3.9	0.3	0.1	0.15	0.35

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT584-1						00-02-10 00-03-04

BGA456: plastic ball grid array package; 456 balls; body 35 x 35 x 2.15 mm

SOT583-1



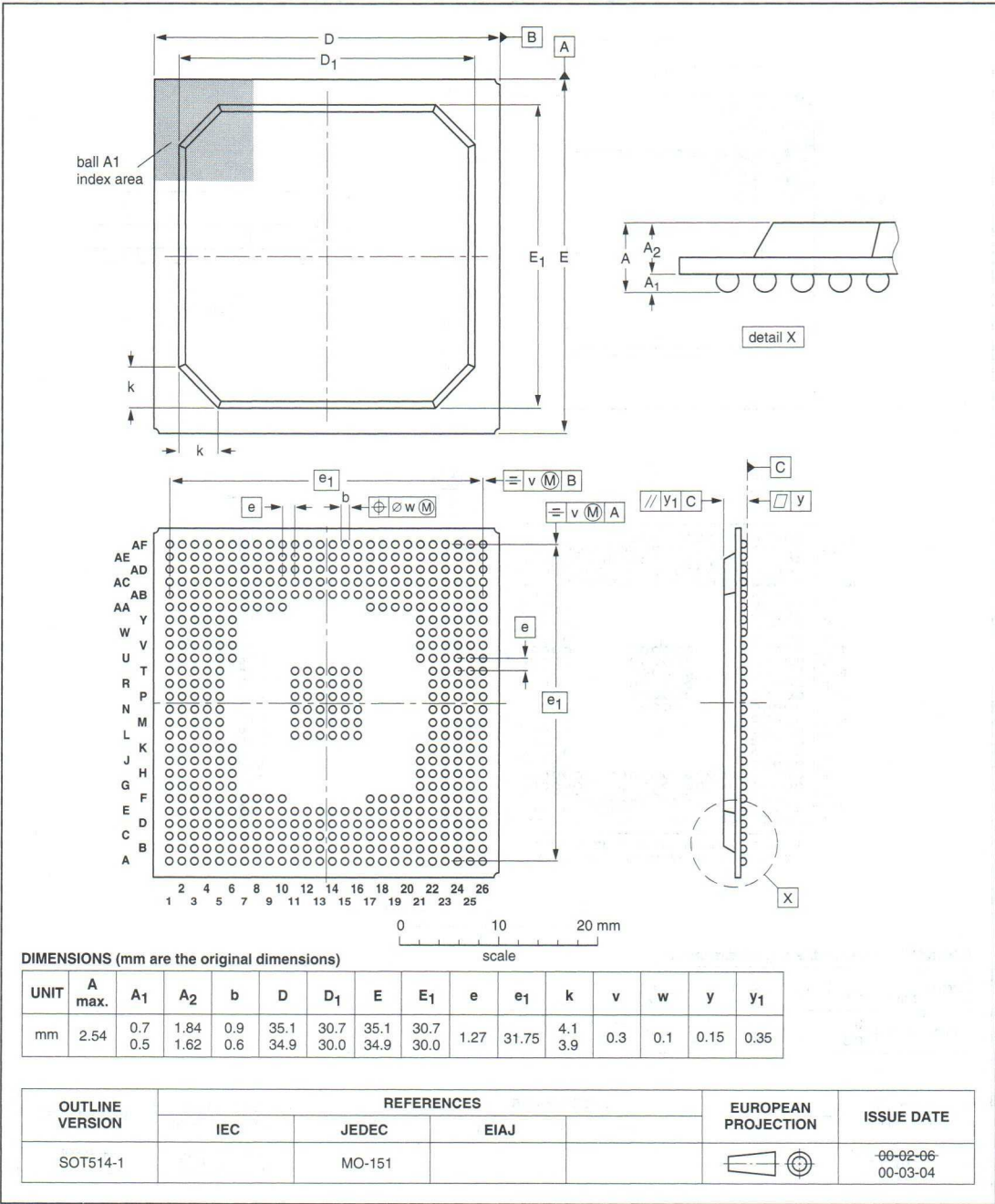
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁ max.	E	E ₁ max.	e	e ₁	v	w	y
mm	3.05	0.7 0.5	2.40 1.85	0.9 0.6	35.1 34.9	23.0	35.1 34.9	23.0	1.27	31.75	0.3	0.15	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT583-1						00-02-08 00-03-04

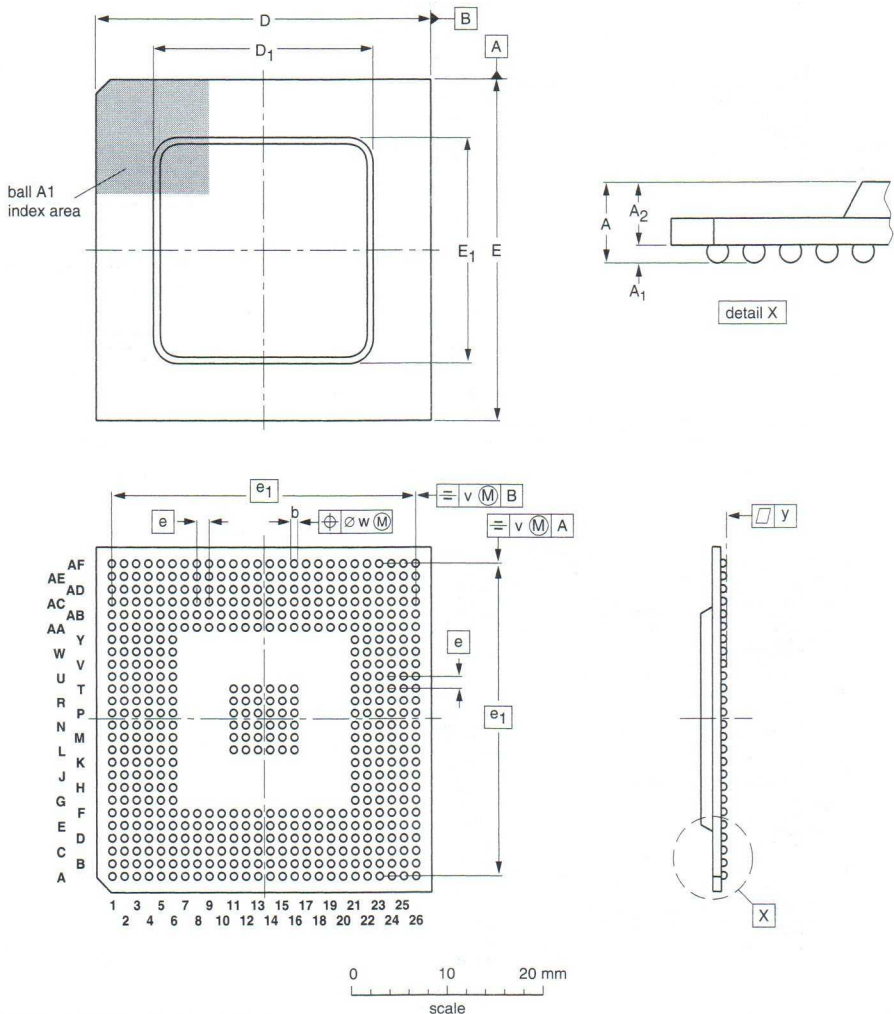
BGA492: plastic ball grid array package; 492 balls; body 35 x 35 x 1.75 mm

SOT514-1



BGA516: plastic ball grid array package; 516 balls; body 35 x 35 x 2.15 mm

SOT585-1



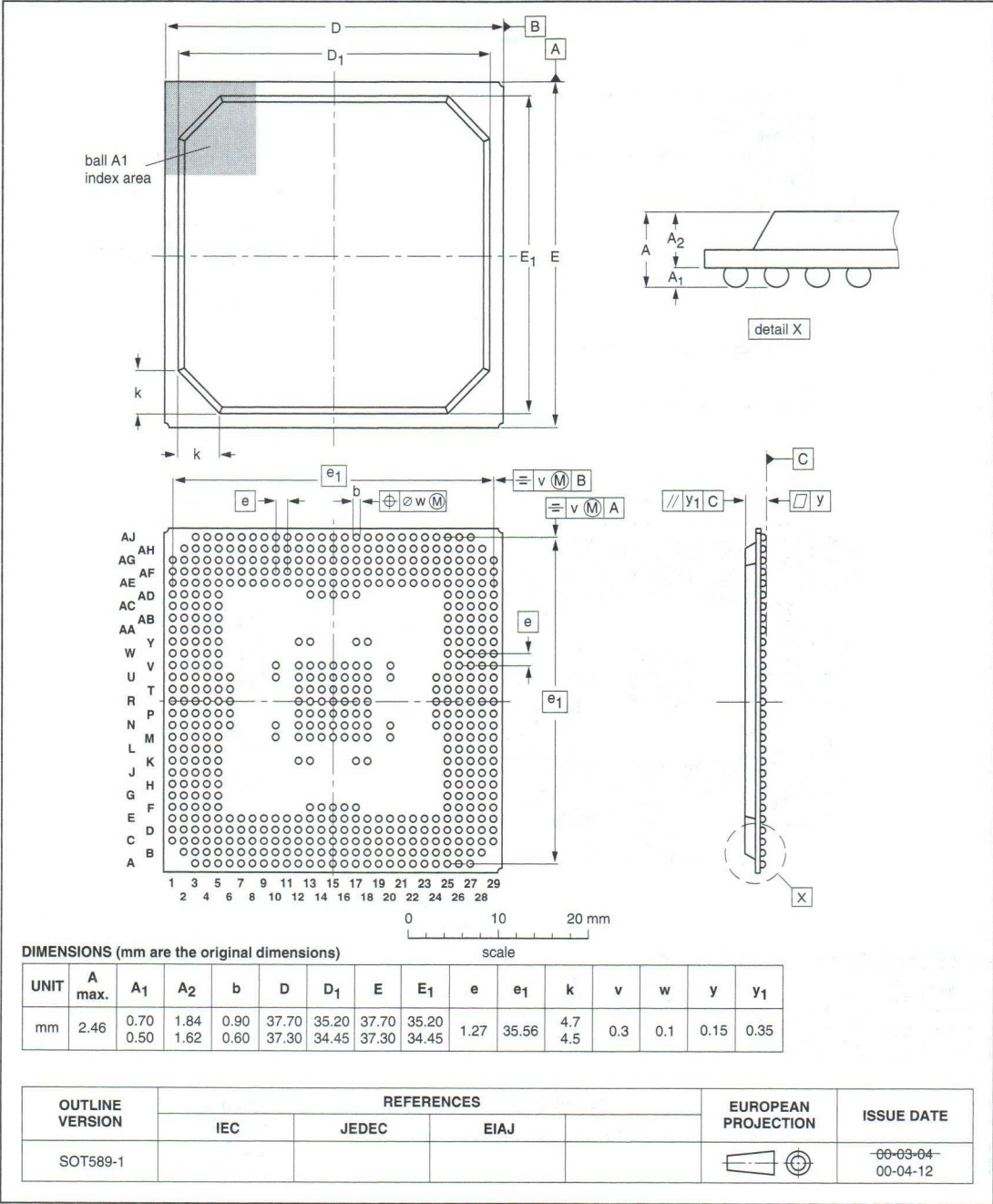
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁ max.	E	E ₁ max.	e	e ₁	v	w	y
mm	3.05	0.7 0.5	2.40 1.85	0.9 0.6	35.1 34.9	23.0	35.1 34.9	23.0	1.27	31.75	0.3	0.15	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT585-1						00-02-08 00-03-04

BGA553: plastic ball grid array package; 553 balls; body 37.5 x 37.5 x 1.75 mm

SOT589-1

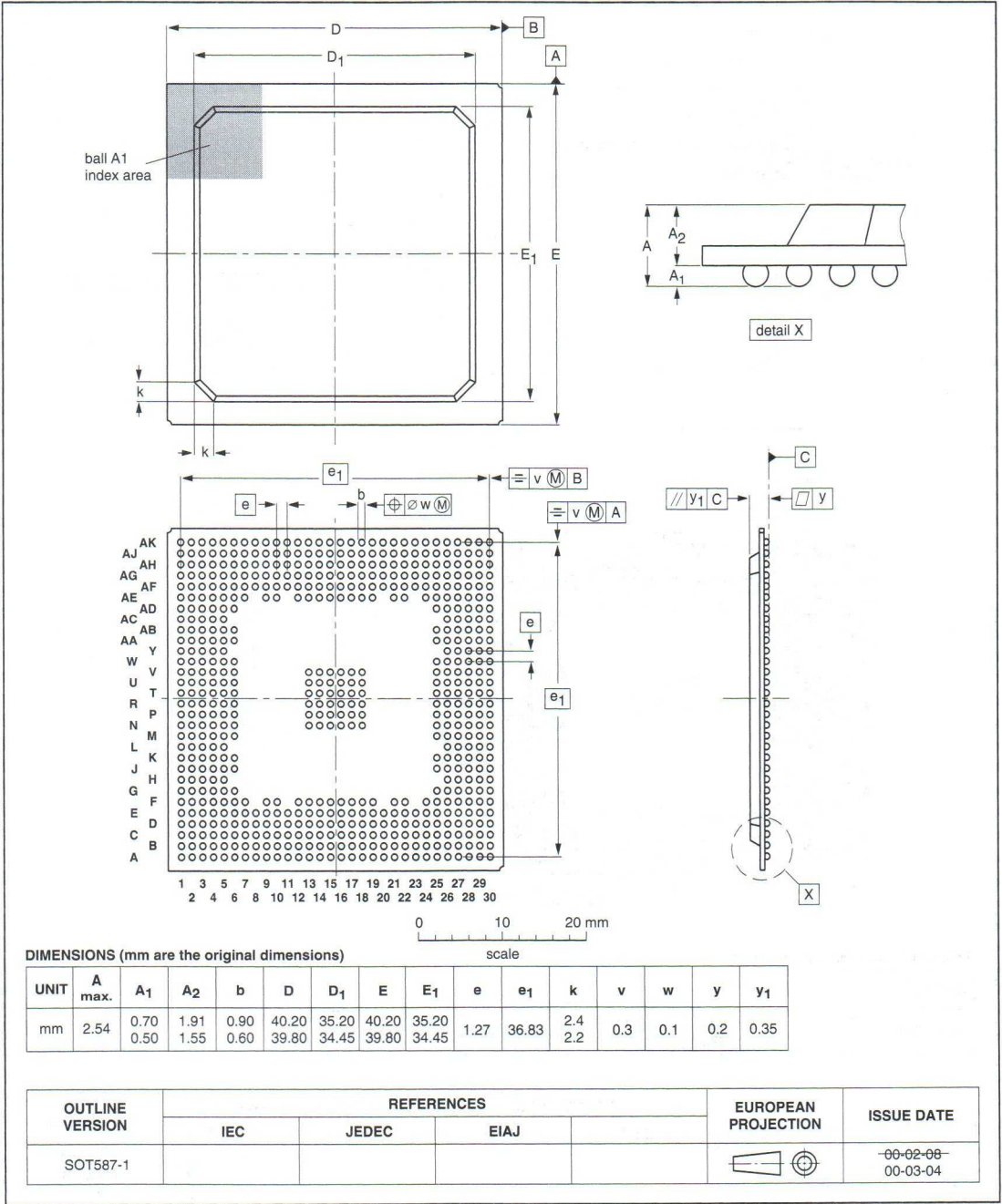


IC package range and dimensions

Chapter 2

BGA596: plastic ball grid array package; 596 balls; body 40 x 40 x 1.75 mm

SOT587-1

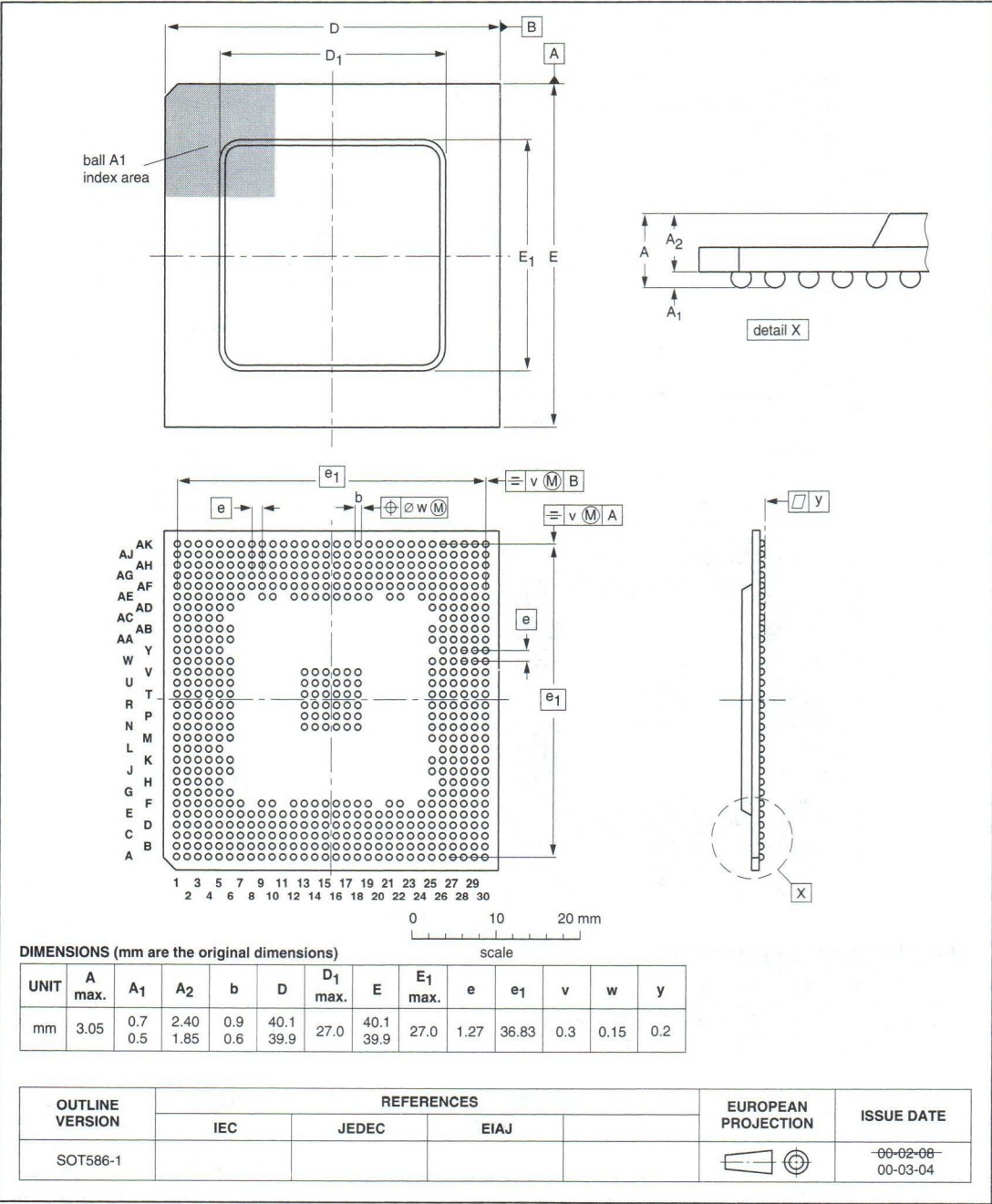


IC package range and dimensions

Chapter 2

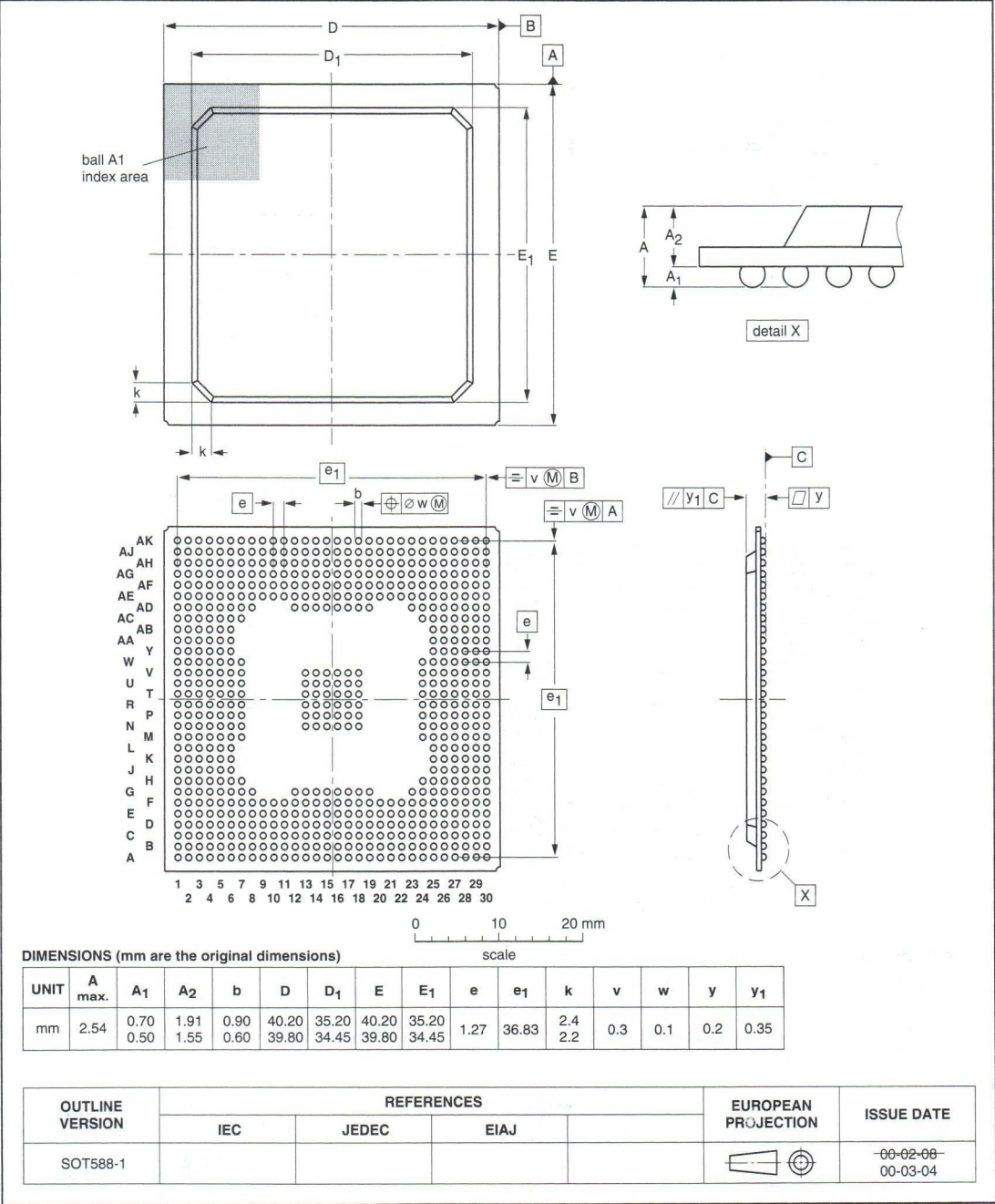
BGA596: plastic ball grid array package; 596 balls; body 40 x 40 x 2.15 mm

SOT586-1



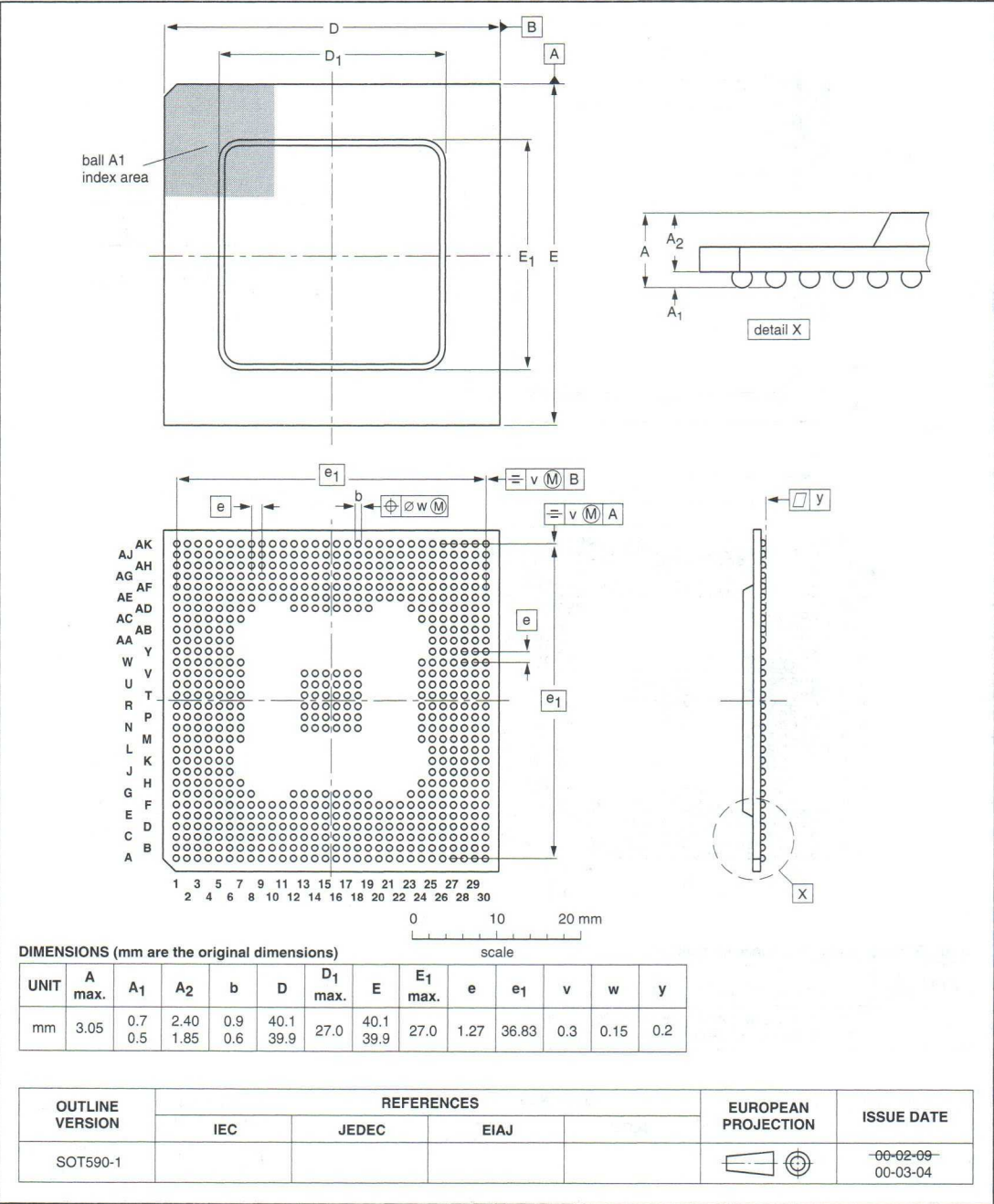
BGA656: plastic ball grid array package; 656 balls; body 40 x 40 x 1.75 mm

SOT588-1



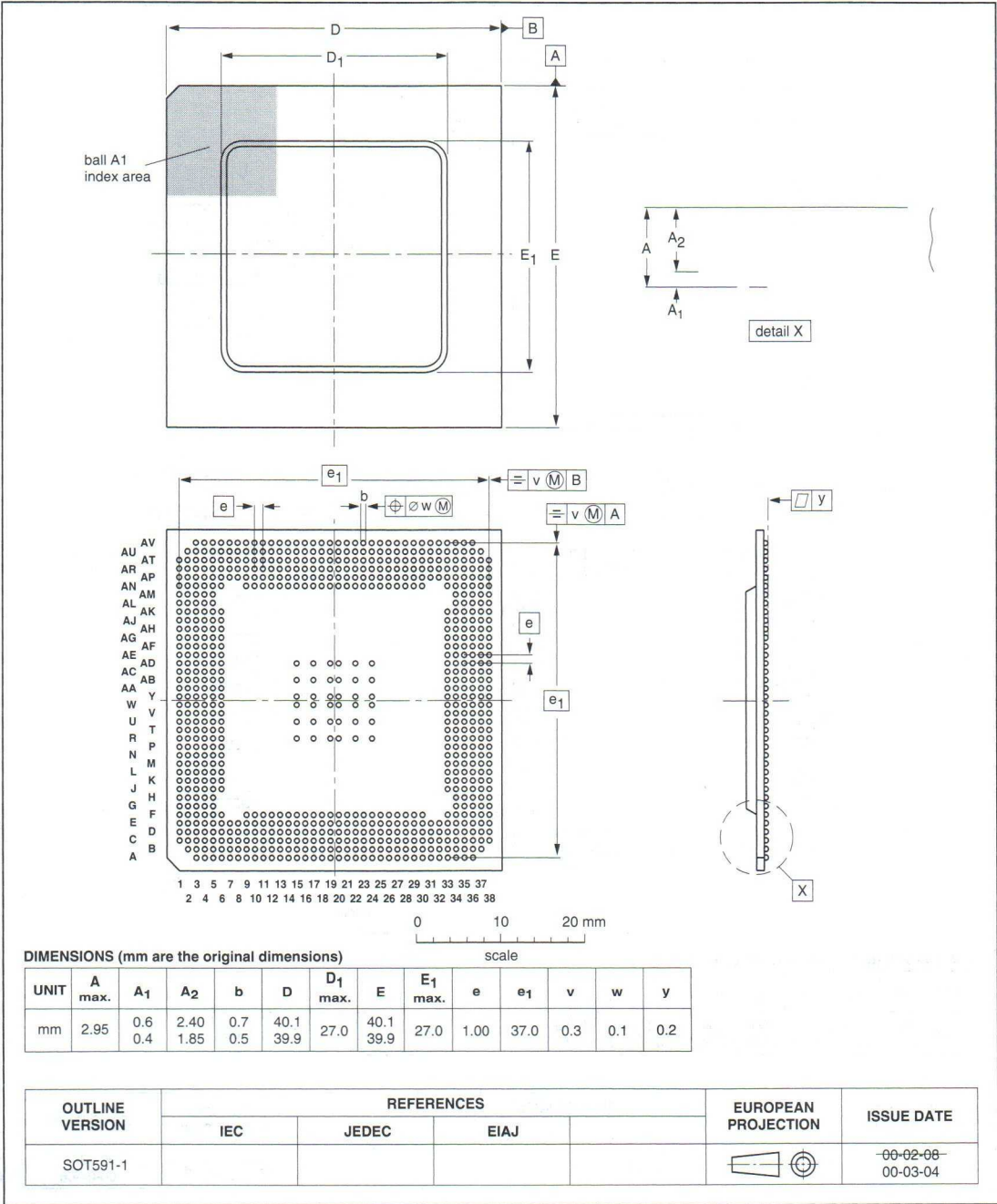
BGA656: plastic ball grid array package; 656 balls; body 40 x 40 x 2.15 mm

SOT590-1



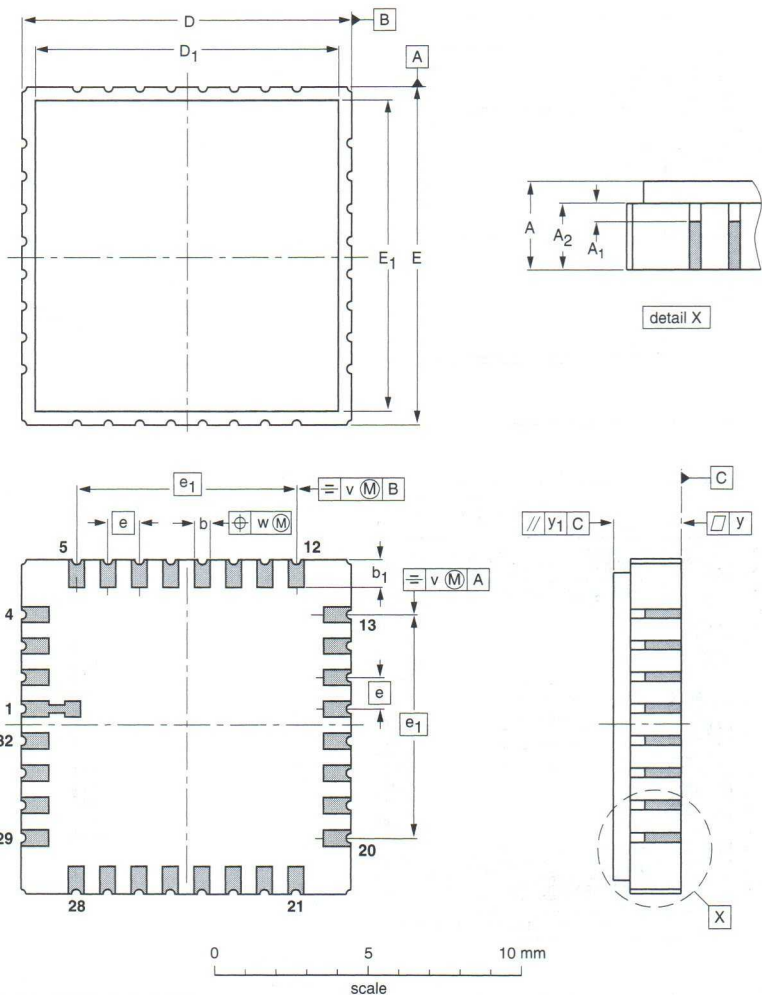
BGA776: plastic ball grid array package; 776 balls; body 40 x 40 x 2.15 mm

SOT591-1



CWQCCN32: ceramic window quad chip carrier; no leads

SOT594-1



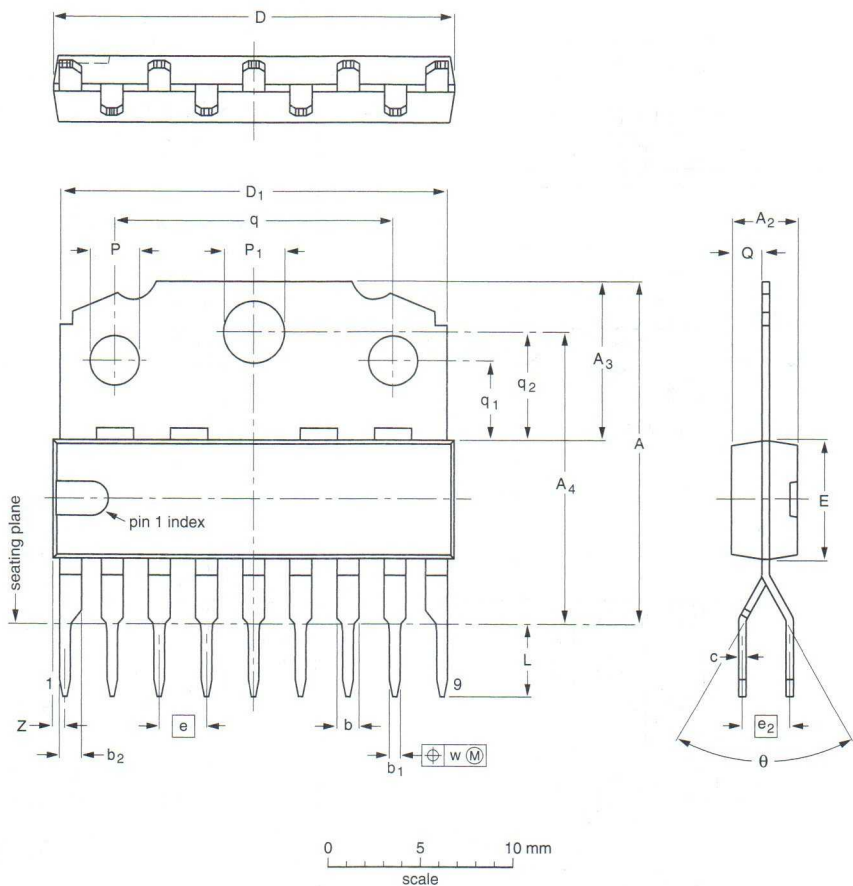
DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	A ₂	b	b ₁	D	D ₁	E	E ₁	e	e ₁	v	w	y	y ₁
mm	2.50 2.00	0.52 0.42	1.85 1.45	0.58 0.43	1.04 0.74	10.92 10.54	9.9 9.7	10.92 10.54	9.9 9.7	1.016	7.112	0.13	0.1	0.08	0.08

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT594-1		MS-009				00-03-24 00-04-06

DBS9MPF: plastic DIL-bent-SIL medium power package with fin; 9 leads

SOT111-1



DIMENSIONS (mm are the original dimensions)

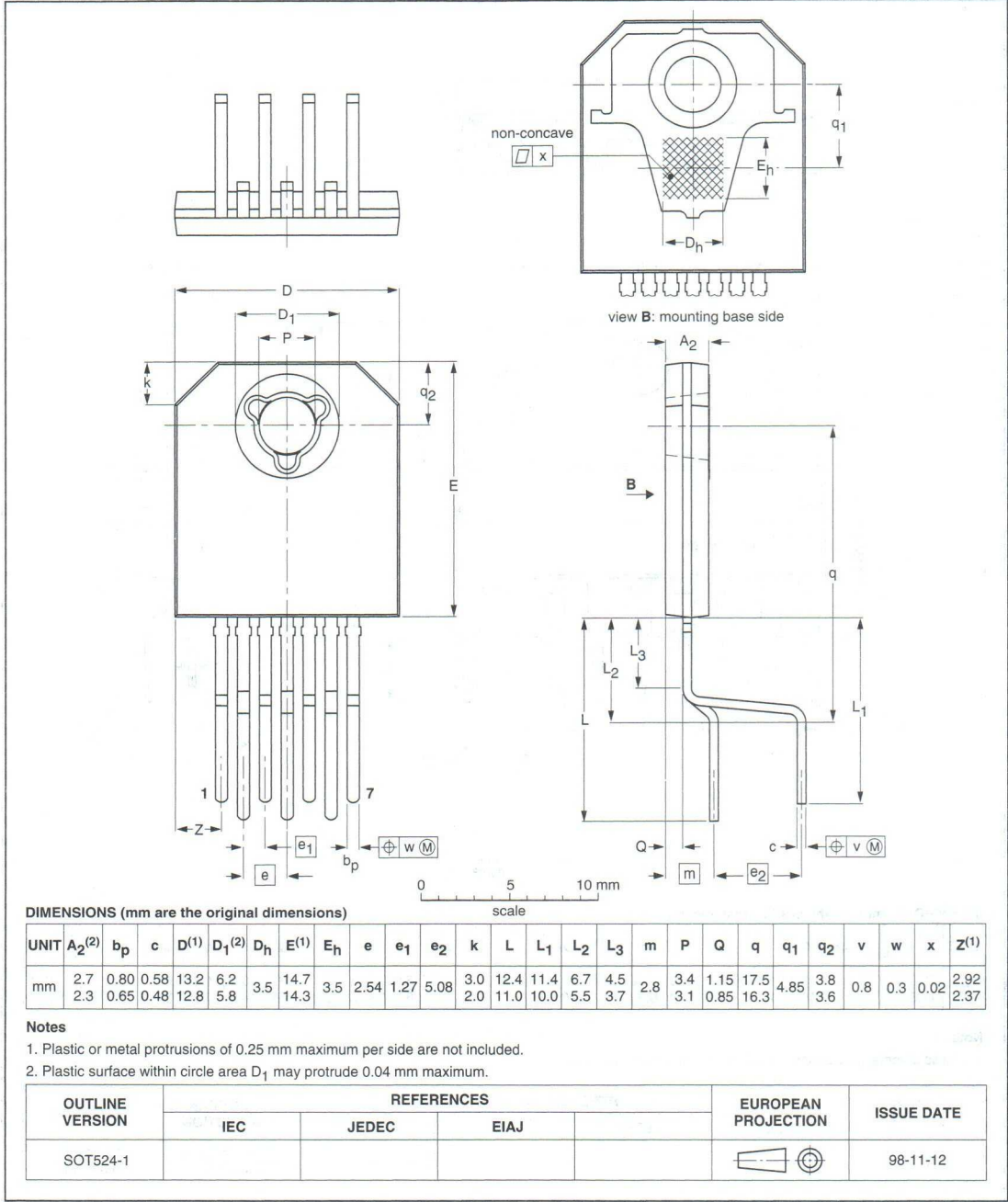
UNIT	A	A ₂ max.	A ₃	A ₄	b	b ₁	b ₂	c	D ⁽¹⁾	D ₁	E ⁽¹⁾	e	e ₂	L	P	P ₁	Q	q	q ₁	q ₂	w	Z ⁽¹⁾ max.	θ
mm	18.5 17.8	3.7	8.7 8.0	15.5 15.1	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54 2.54	3.9 3.4	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.25	1.0	65° 55°	

Note

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

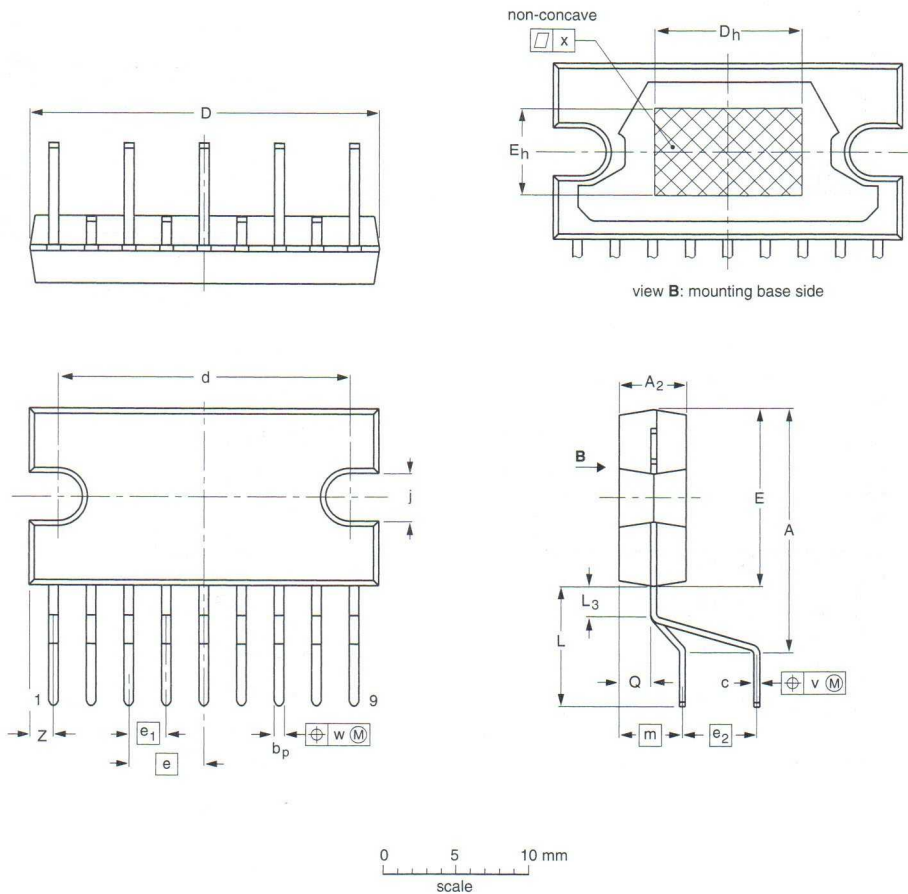
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT111-1						92-11-17 95-03-11

DBS7P: plastic DIL-bent-SIL power package; 7 leads (lead length 12/11 mm); exposed die pad SOT524-1



DBS9P: plastic DIL-bent-SIL power package; 9 leads (lead length 7.7 mm)

SOT157-4



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₃	m	Q	v	w	x	Z ⁽¹⁾
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	5.08	2.54	5.08	6	3.4 3.1	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	2.00 1.45

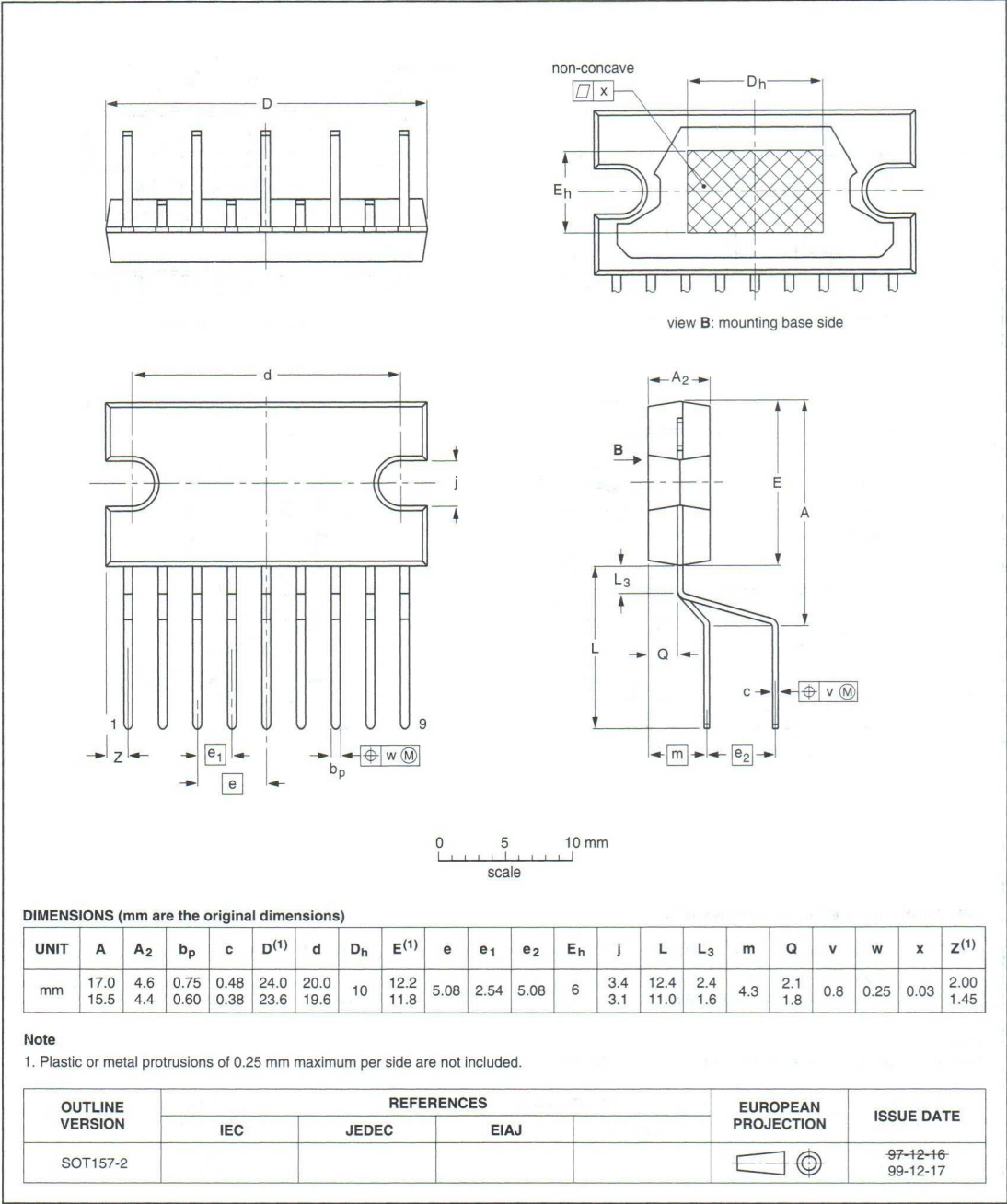
Note

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			
SOT157-4						97-12-16 99-12-17

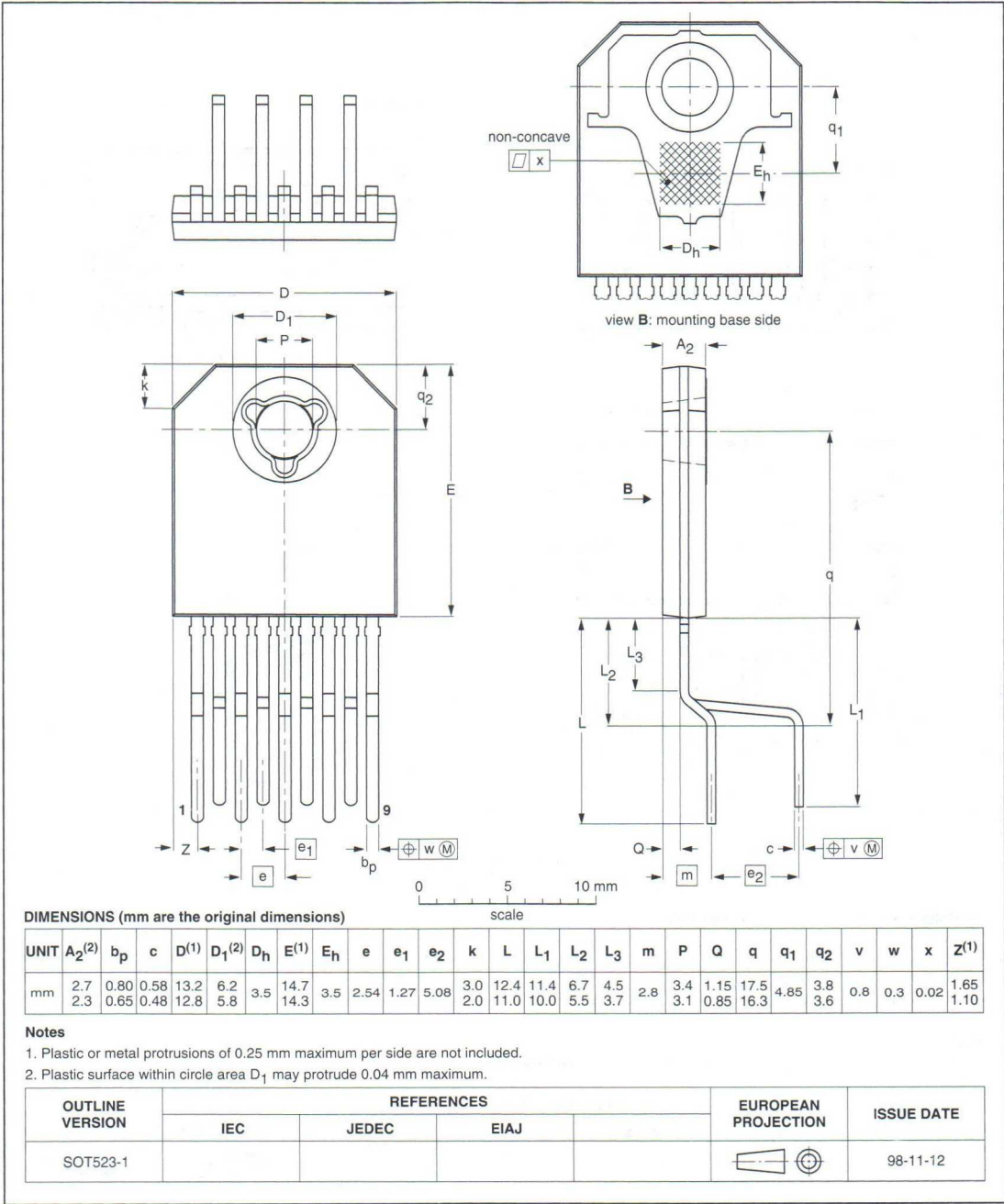
DBS9P: plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm)

SOT157-2



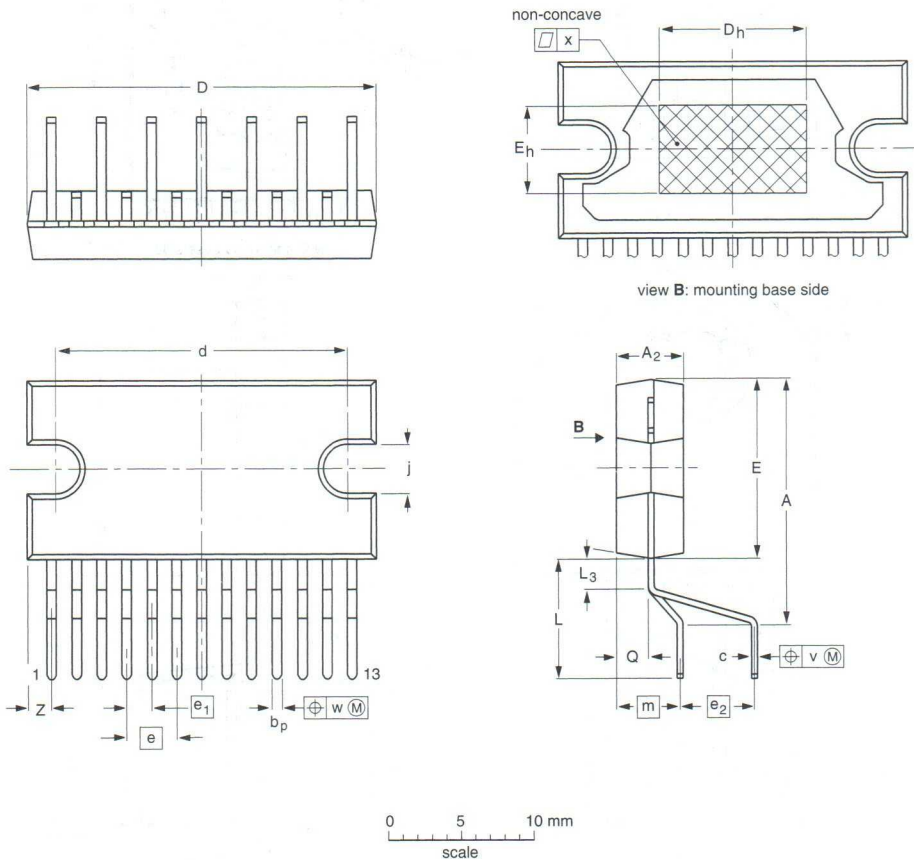
DBS9P: plastic DIL-bent-SIL power package; 9 leads (lead length 12/11 mm); exposed die pad

SOT523-1



DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm)

SOT141-8



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₃	m	Q	v	w	x	Z ⁽¹⁾
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	2.00 1.45

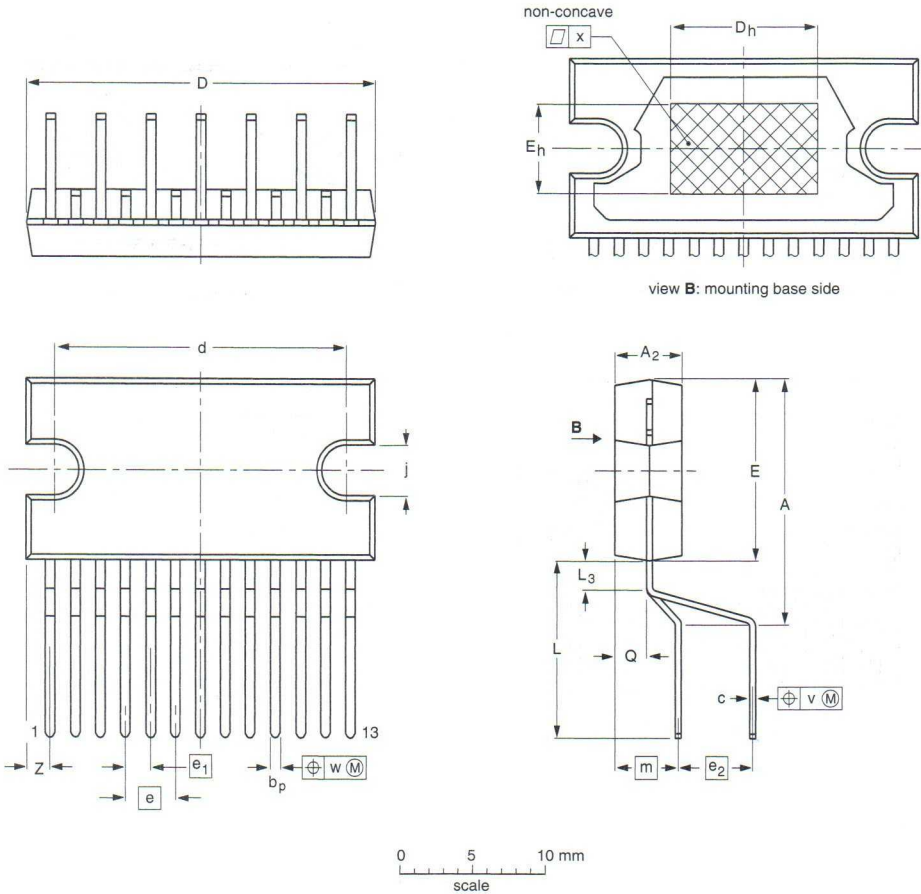
Note

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			
SOT141-8						97-12-16 99-12-17

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)

SOT141-6



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₃	m	Q	v	w	x	Z ⁽¹⁾
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	2.00 1.45

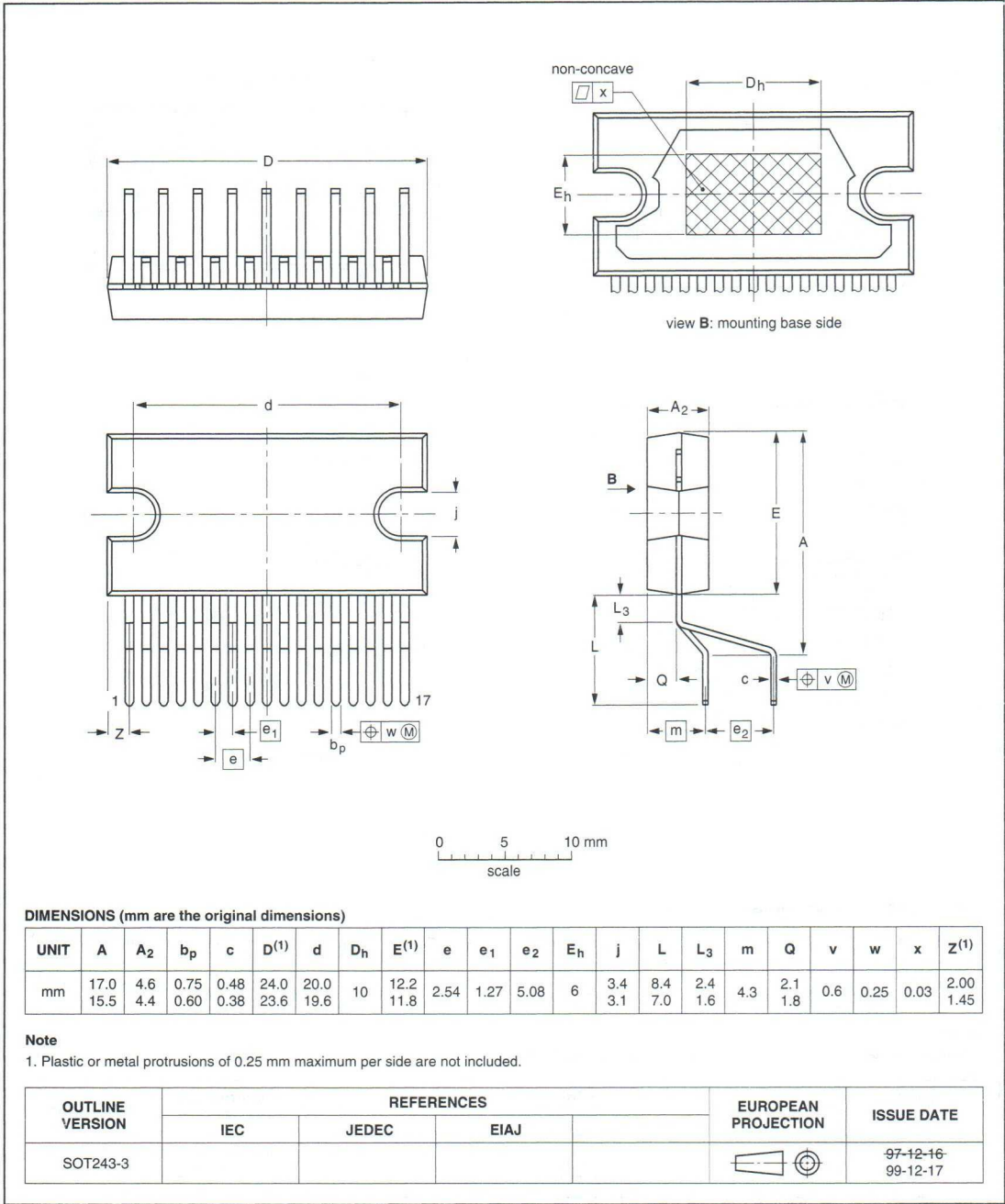
Note

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			
SOT141-6						97-12-16 99-12-17

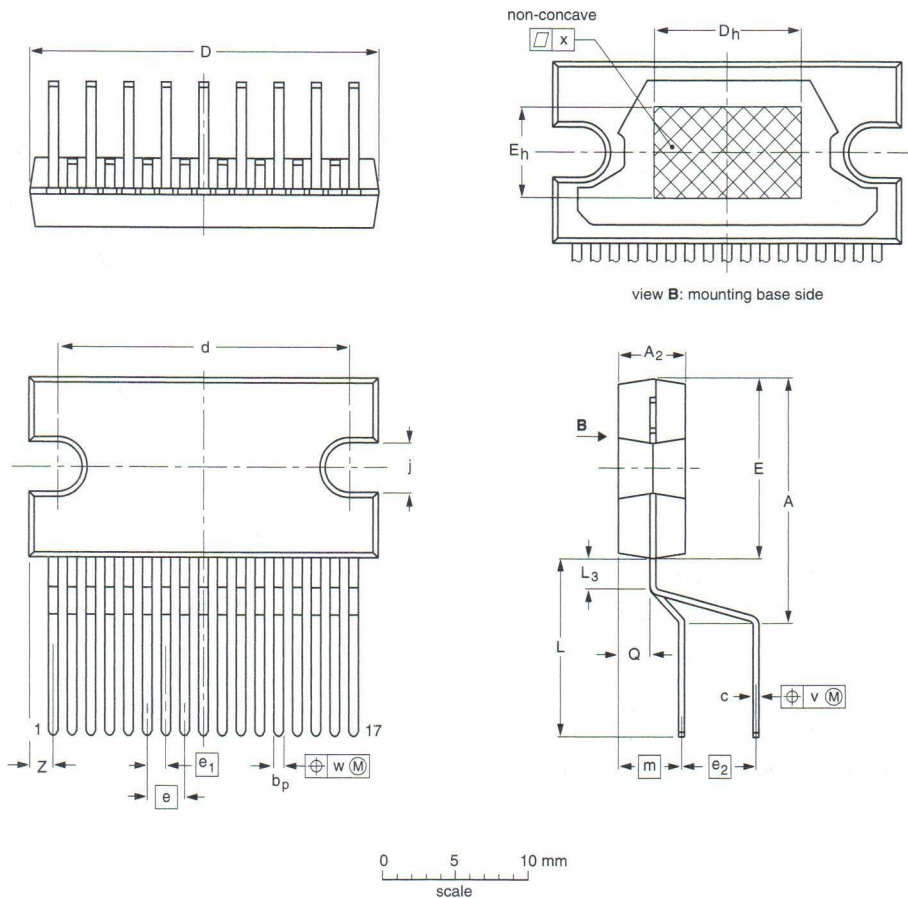
DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)

SOT243-3



DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm)

SOT243-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₃	m	Q	v	w	x	Z ⁽¹⁾
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	1.27	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.4	0.03	2.00 1.45

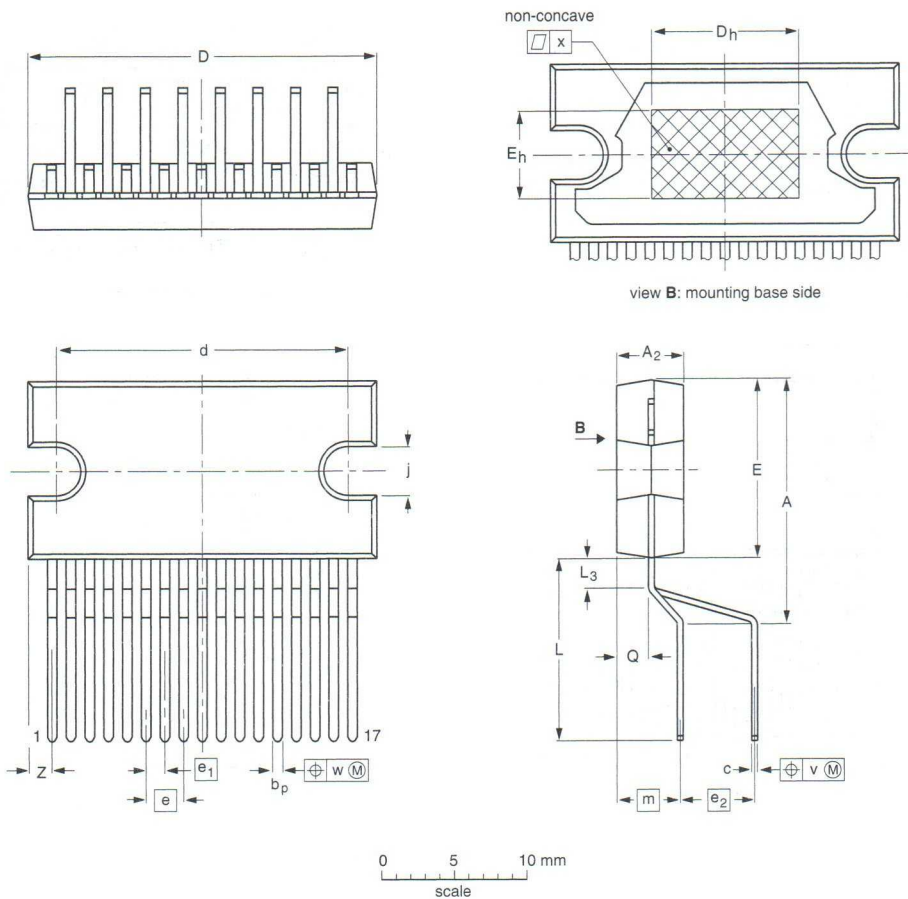
Note

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			
SOT243-1						97-12-16 99-12-17

DBS17P: plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm)

SOT475-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₃	m	Q	v	w	x	Z ⁽¹⁾
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	1.27	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.4	0.03	2.00 1.45

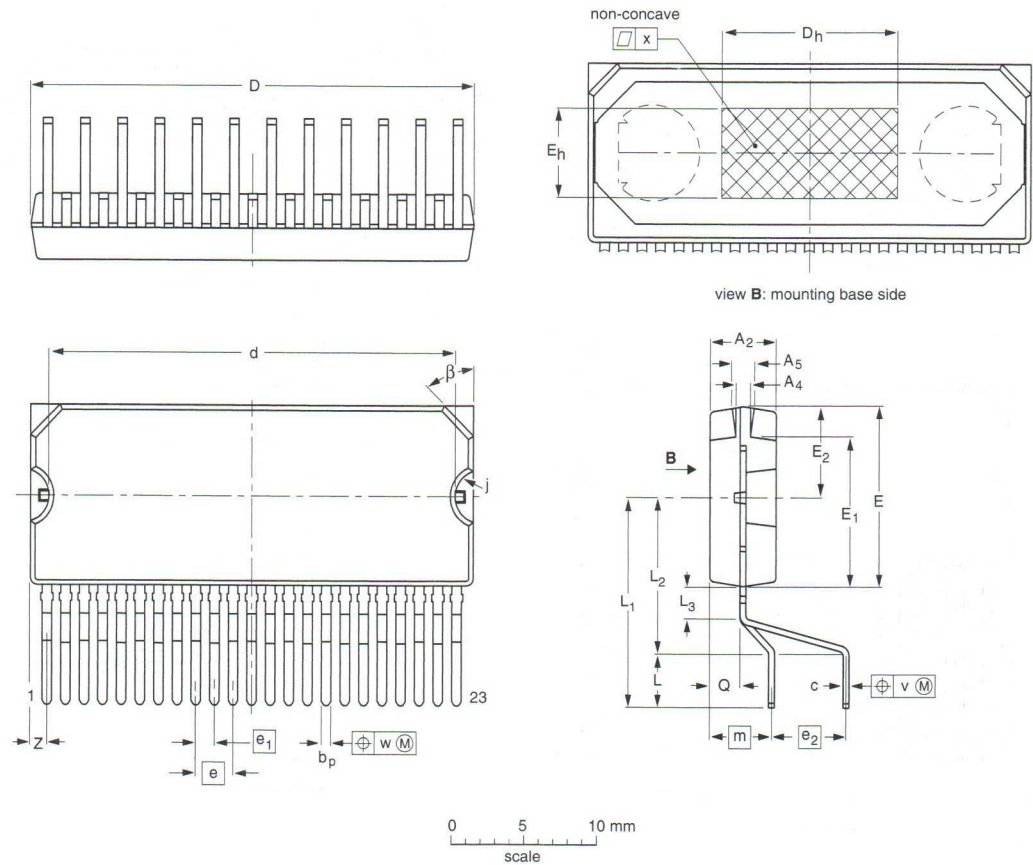
Note

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			
SOT475-1						-97-05-20- 99-12-17

DBS23P: plastic DIL-bent-SIL power package; 23 leads (straight lead length 3.2 mm)

SOT411-1



DIMENSIONS (mm are the original dimensions)

UNIT	A ₂	A ₄	A ₅	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	E ₁	E ₂	j	L	L ₁	L ₂	L ₃	m	Q	v	w	x	β	Z ⁽¹⁾
mm	4.6 4.3	1.15 0.85	1.65 1.35	0.75 0.60	0.55 0.35	30.4 29.9	28.0 27.5	12	12.2 11.8	2.54	1.27	5.08	6	10.15 9.85	6.2 5.8	1.85 1.65	3.6 2.8	14.0 13.0	10.7 9.9	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	45°	1.43 0.78

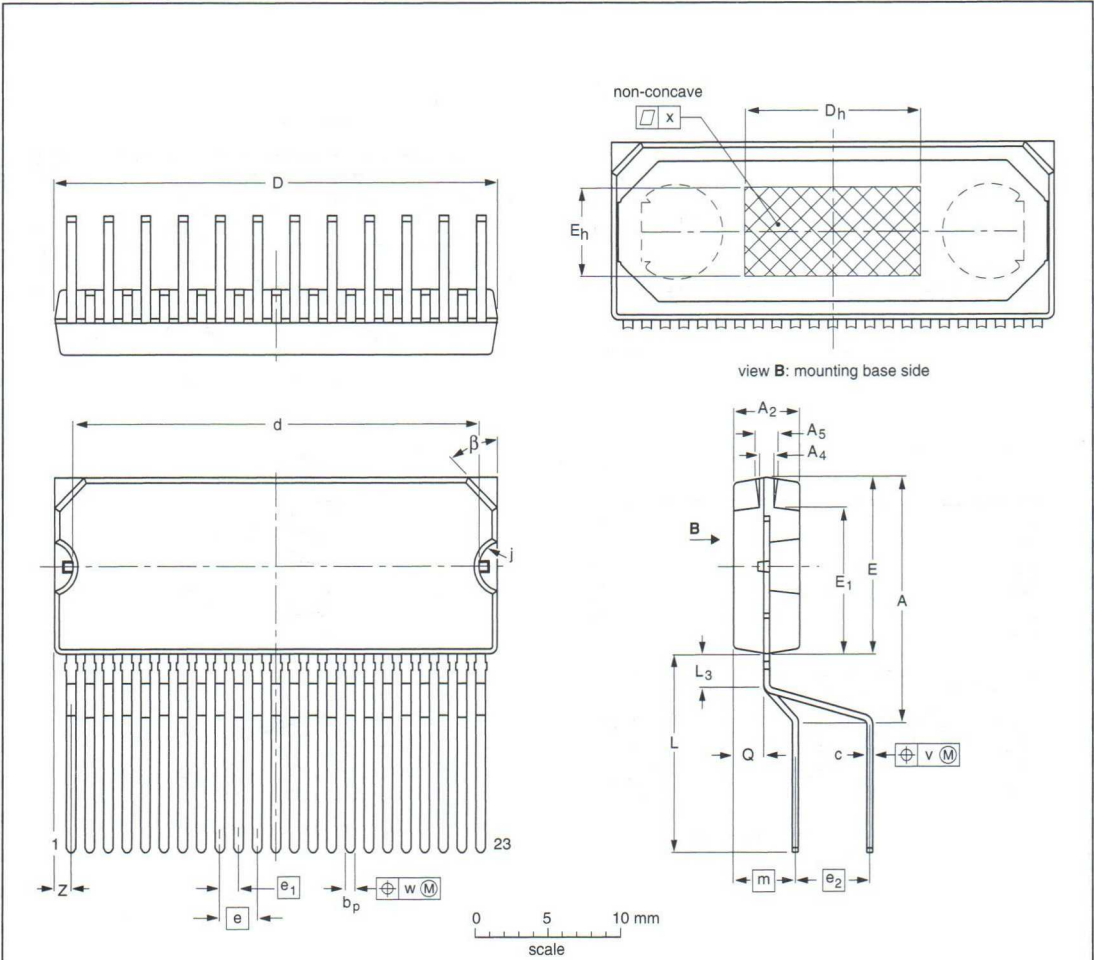
Note

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			
SOT411-1						96-10-11 98-02-20

DBS23P: plastic DIL-bent-SIL power package; 23 leads (lead length 12 mm)

SOT411-2



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	A ₄	A ₅	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	E ₁	j	L	L ₃	m	Q	v	w	x	β	z ⁽¹⁾
mm	17.0 15.5	4.6 4.3	1.15 0.85	1.65 1.35	0.75 0.60	0.55 0.35	30.4 29.9	28.0 27.5	12	12.2 11.8	2.54	1.27	5.08	6	10.15 9.85	1.85 1.65	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	45°	1.43 0.78

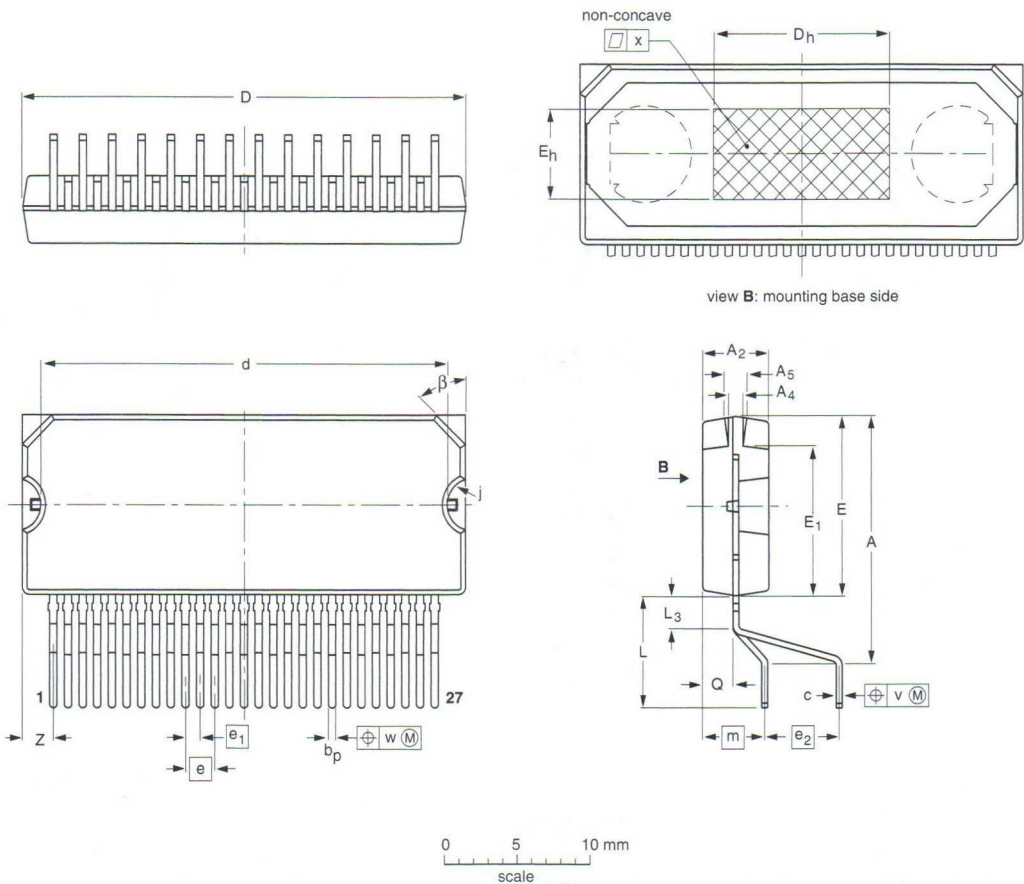
Note

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			
SOT411-2						96-10-25 98-02-18

DBS27P: plastic DIL-bent-SIL power package; 27 leads (lead length 7.7 mm)

SOT521-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	A ₄	A ₅	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	E ₁	j	L	L ₃	m	Q	v	w	x	β	Z ⁽¹⁾
mm	17.0 15.5	4.6 4.3	1.15 0.85	1.65 1.35	0.60 0.45	0.5 0.3	30.4 29.9	28.0 27.5	12	12.2 11.8	2.0	1.0	4.0	6	10.15 9.85	1.85 1.65	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	45°	2.4 1.8

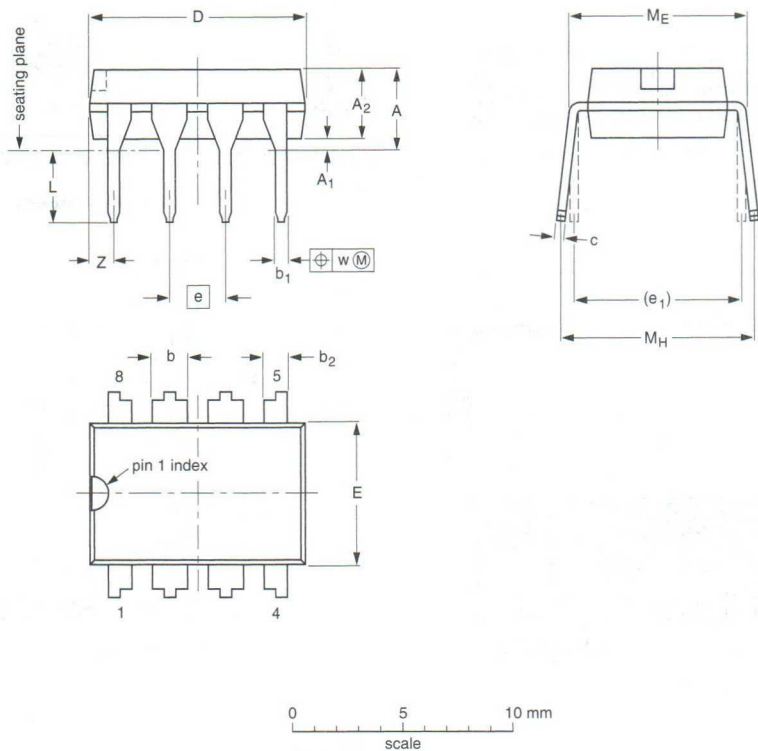
Note

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			
SOT521-1						99-01-05

DIP8: plastic dual in-line package; 8 leads (300 mil)

SOT97-1



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 1.14	0.53 0.38	1.07 0.89	0.36 0.23	9.8 9.2	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	1.15
inches	0.17	0.020	0.13	0.068 0.045	0.021 0.015	0.042 0.035	0.014 0.009	0.39 0.36	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.045

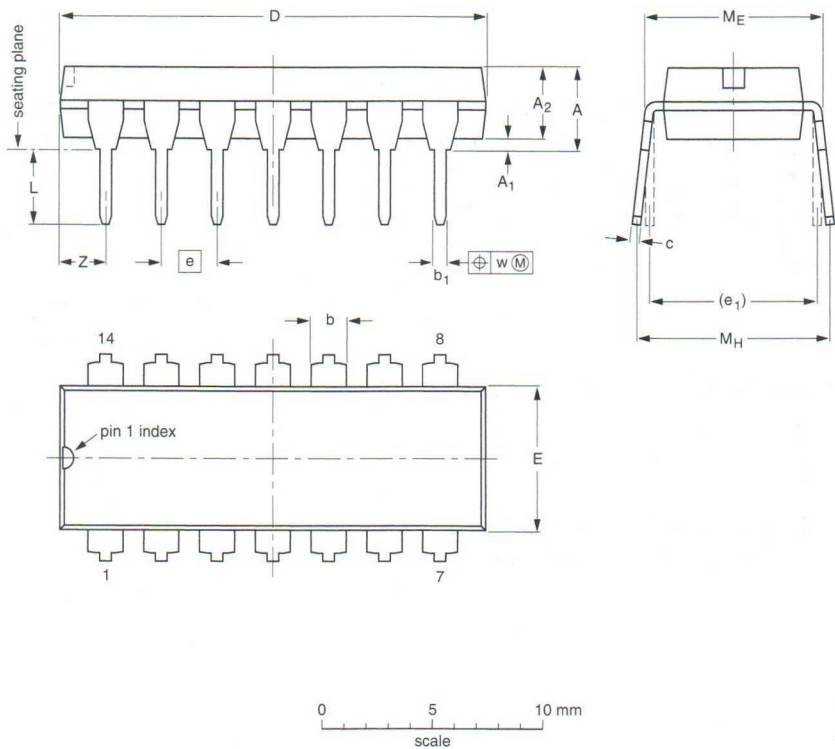
Note

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			
SOT97-1	050G01	MO-001	SC-504-B			95-02-04 99-12-27

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1



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 1.13	0.53 0.38	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	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	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	0.087

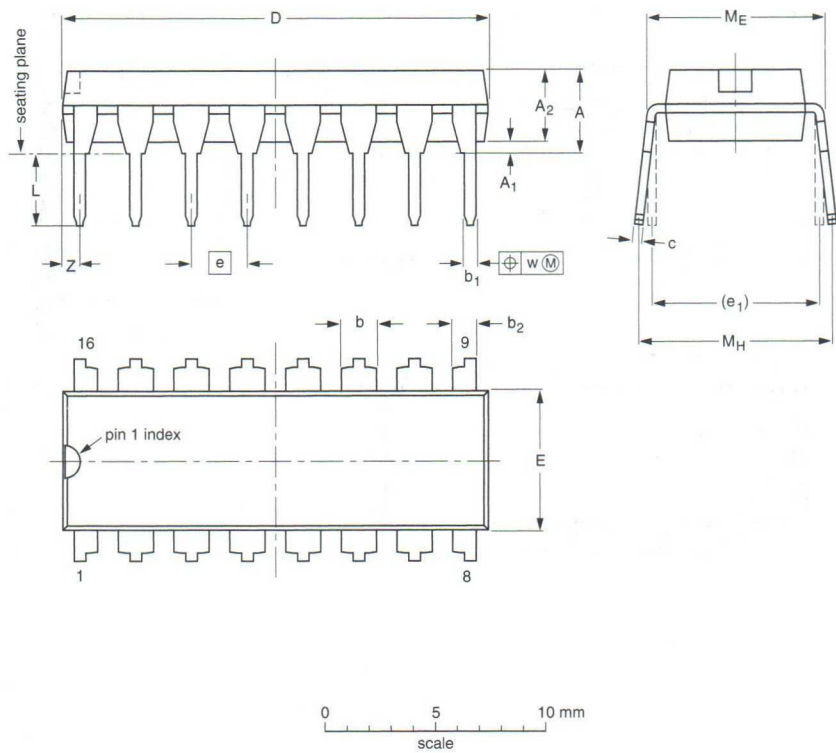
Note

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			
SOT27-1	050G04	MO-001	SC-501-14			95-03-11 99-12-27

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.

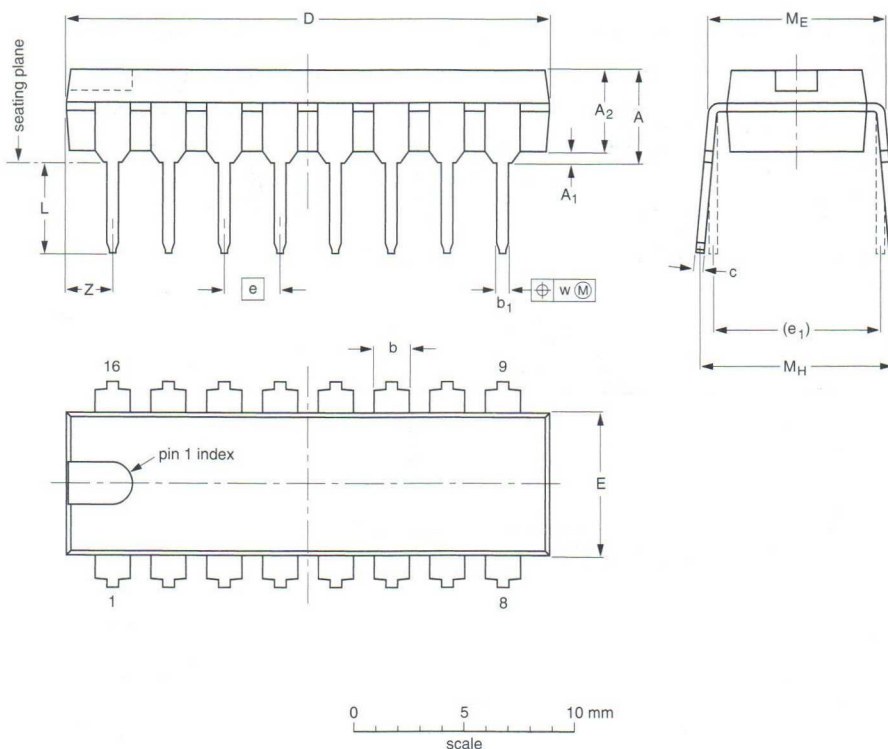
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-4						92-11-17 95-01-14

IC package range and dimensions

Chapter 2

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

SOT38-1



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	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.087

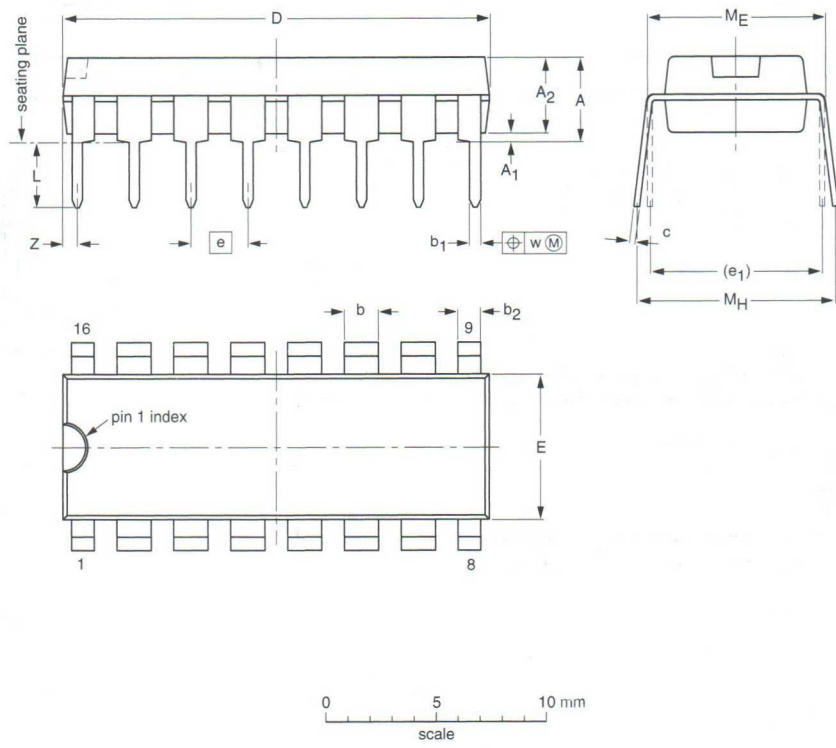
Note

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			
SOT38-1	050G09	MO-001	SC-503-16			95-01-19 99-12-27

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

SOT38-9



DIMENSIONS (mm dimensions are derived from the original inch 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	4.32	0.38	3.56	1.65 1.40	0.51 0.41	1.14 0.76	0.36 0.20	19.30 18.80	6.45 6.24	2.54	7.62	3.81 2.92	8.23 7.62	9.40 8.38	0.254	0.76
inches	0.17	0.015	0.14	0.065 0.055	0.020 0.016	0.045 0.030	0.014 0.008	0.76 0.74	0.254 0.246	0.10	0.30	0.150 0.115	0.324 0.300	0.37 0.33	0.01	0.030

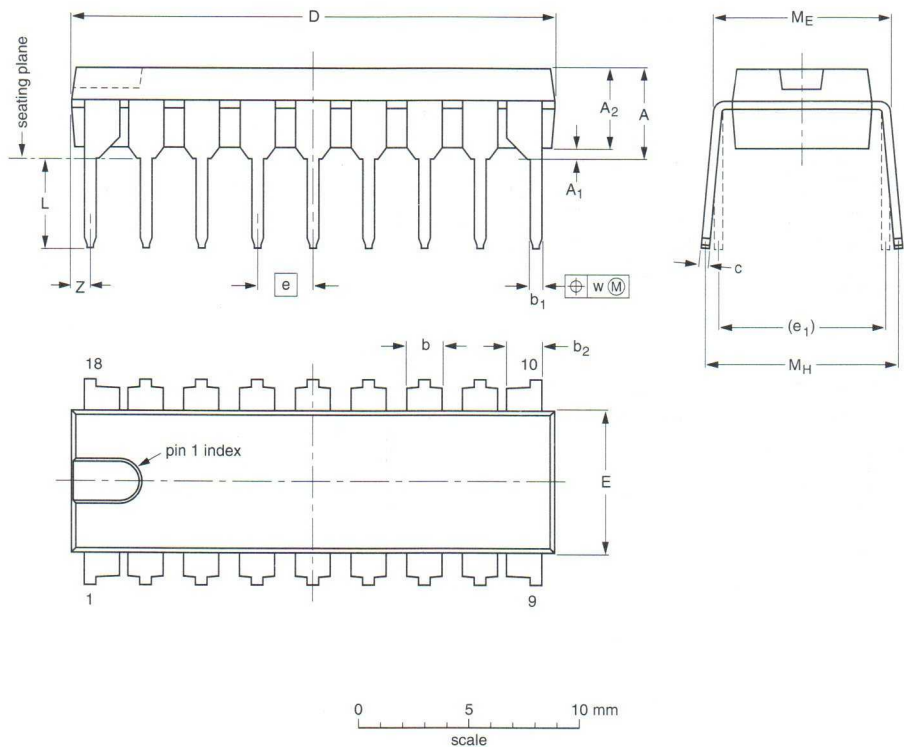
Note

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			
SOT38-9						97-07-24

DIP18: plastic dual in-line package; 18 leads (300 mil)

SOT102-1



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	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.40 1.14	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.044	0.021 0.015	0.055 0.044	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

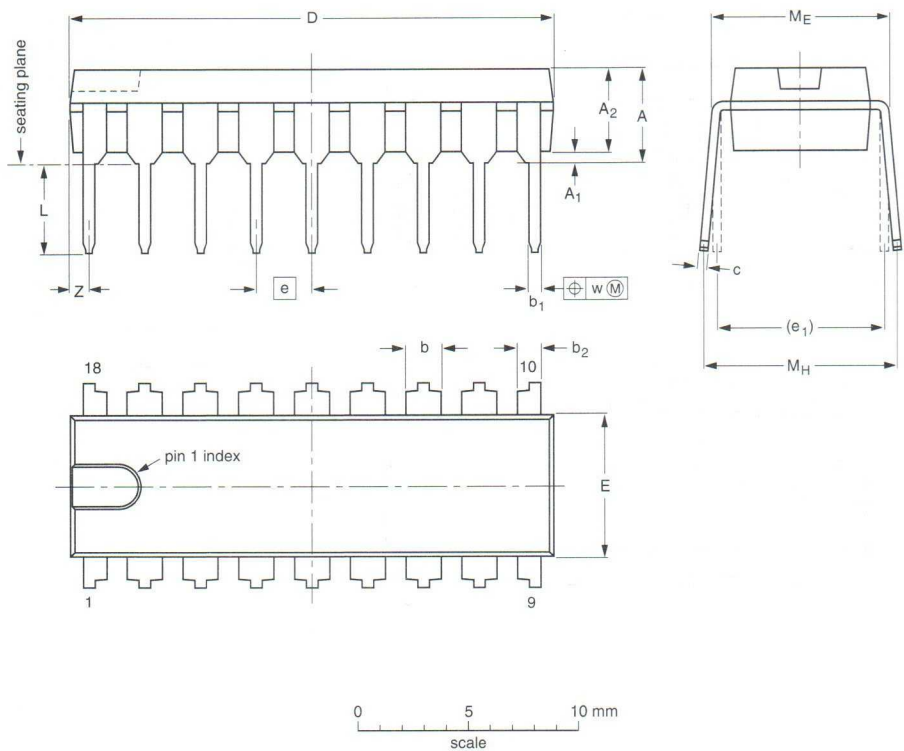
Note

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			
SOT102-1		MS-001				95-01-23 99-12-27

DIP18: plastic dual in-line package; 18 leads (300 mil); slim corner leads

SOT102-2



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	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.05 0.75	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.041 0.030	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

Note

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

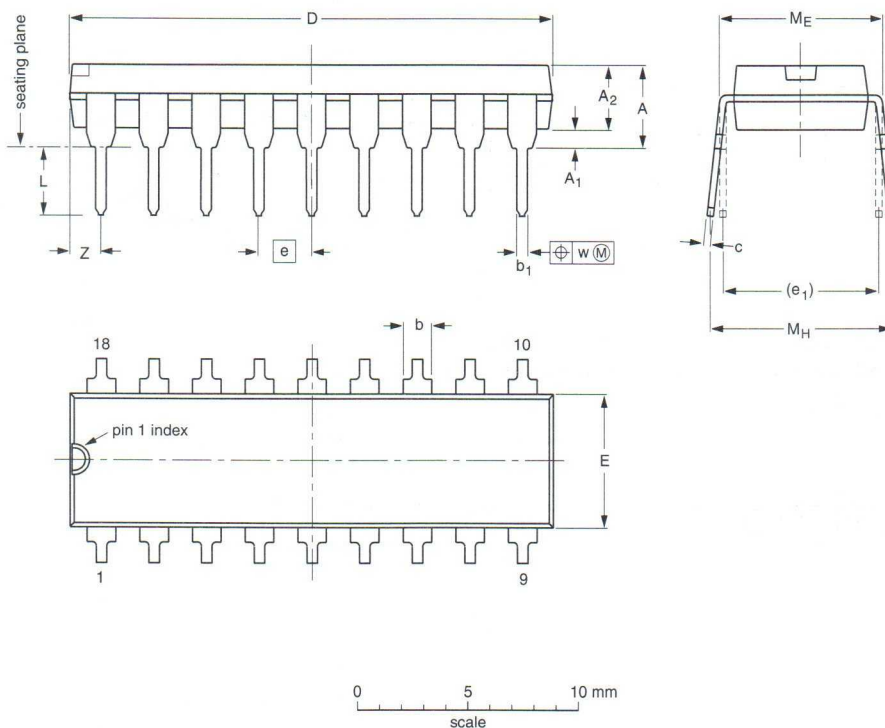
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT102-2		MS-001				95-01-23 99-12-27

IC package range and dimensions

Chapter 2

DIP18: plastic dual in-line package; 18 leads (300 mil); long body

SOT102-4



DIMENSIONS (millimetre dimensions are derived from the original inch 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	4.06	0.51	3.38	1.63 1.14	0.56 0.43	0.36 0.25	23.37 22.61	6.48 6.22	2.54	7.62	3.51 3.05	8.13 7.62	10.03 7.62	0.25	1.65
inches	0.160	0.020	0.140	0.064 0.045	0.022 0.017	0.014 0.010	0.920 0.890	0.255 0.245	0.100	0.300	0.138 0.120	0.32 0.30	0.395 0.300	0.01	0.065

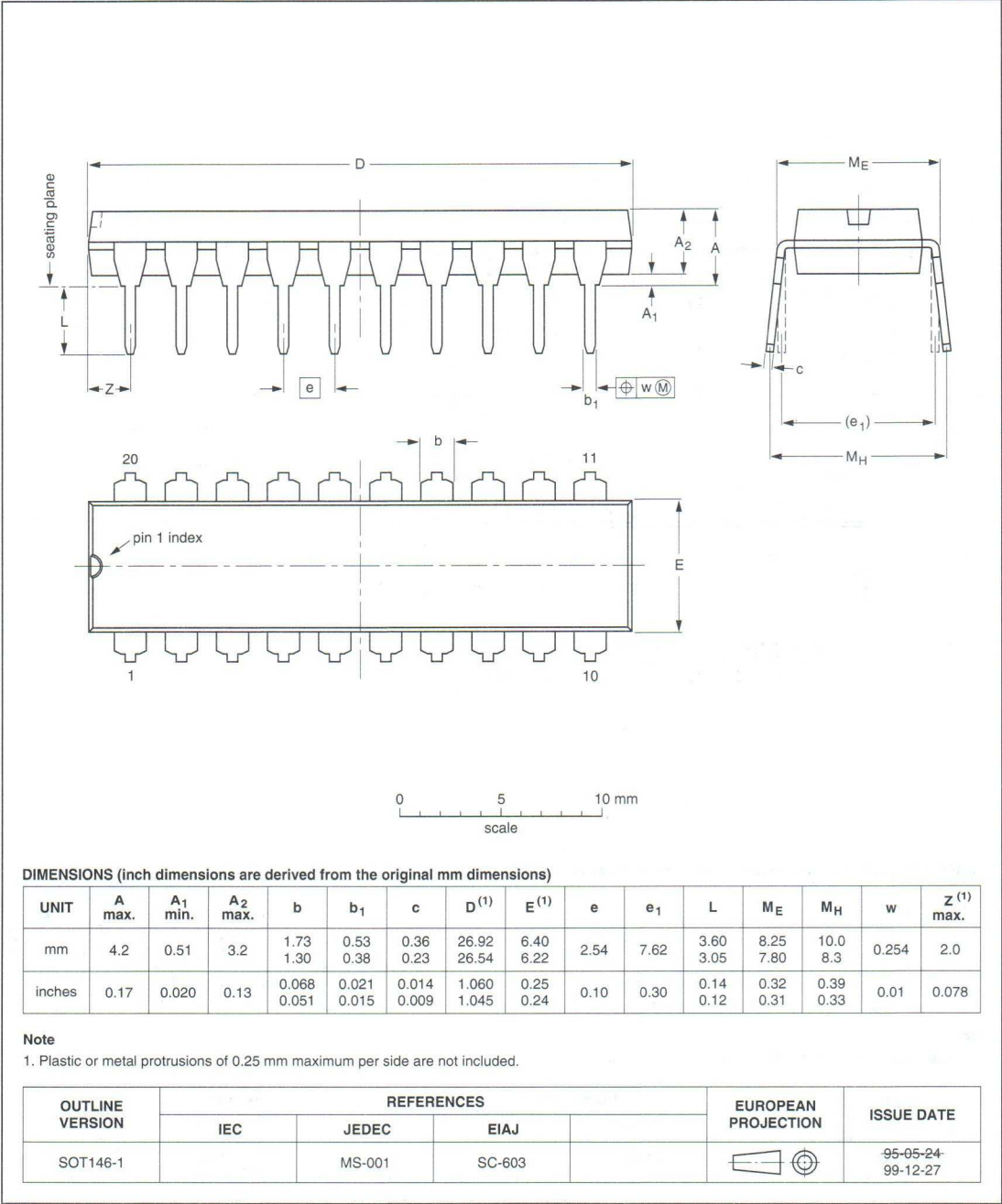
Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT102-4		MS-001				-99-07-08 99-12-27

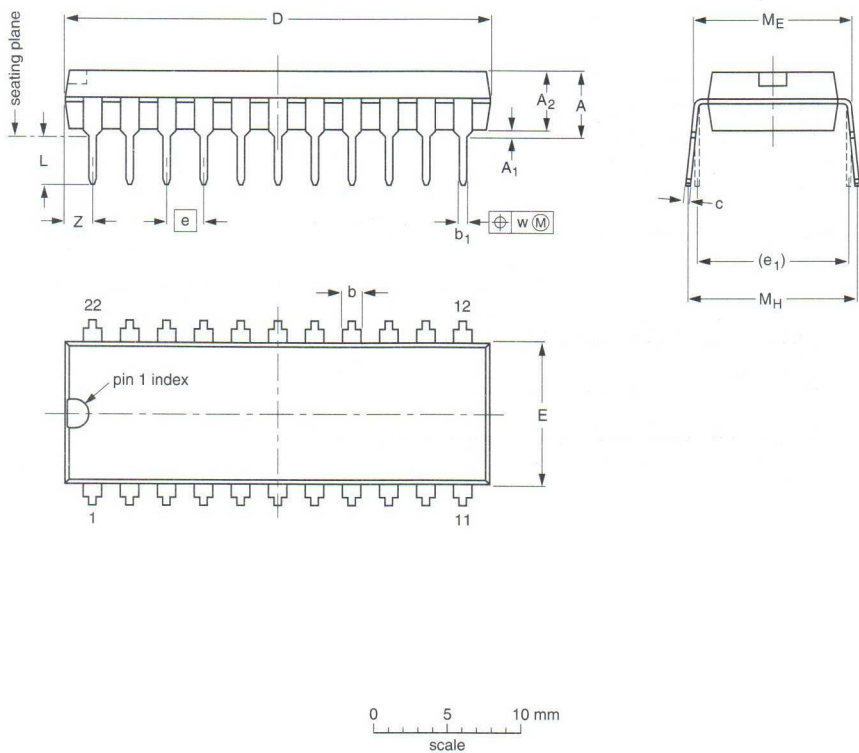
DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1



DIP22: plastic dual in-line package; 22 leads (400 mil)

SOT116-1



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	4.83	0.38	3.81	1.65 1.12	0.53 0.38	0.36 0.23	28.19 27.69	9.02 8.38	2.54	10.16	3.60 3.05	10.80 10.16	12.45 10.16	0.254	1.4
inches	0.19	0.015	0.15	0.064 0.044	0.021 0.015	0.014 0.009	1.11 1.09	0.36 0.33	0.10	0.40	0.14 0.12	0.43 0.40	0.49 0.40	0.01	0.055

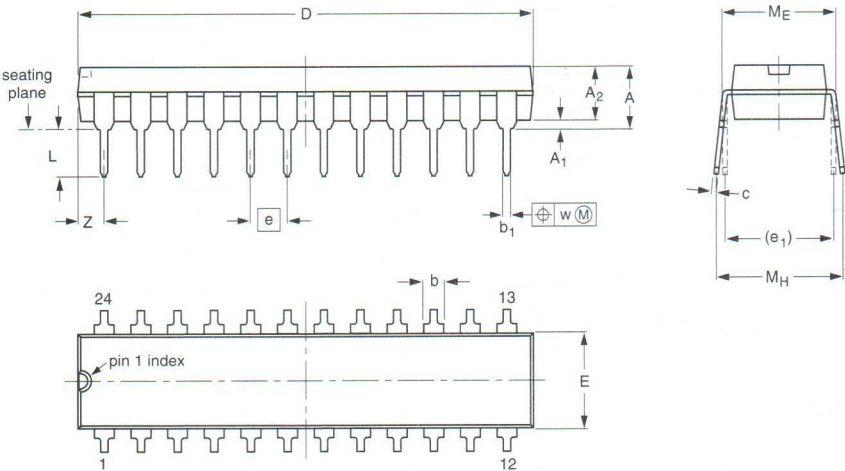
Note

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			
SOT116-1	060G07	MS-010	SC-502-22			95-01-23 99-12-27

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 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	4.70	0.38	3.94	1.63 1.14	0.56 0.43	0.36 0.25	31.9 31.5	6.73 6.25	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 0.246	0.100	0.300	0.138 0.120	0.32 0.30	0.395 0.300	0.01	0.081

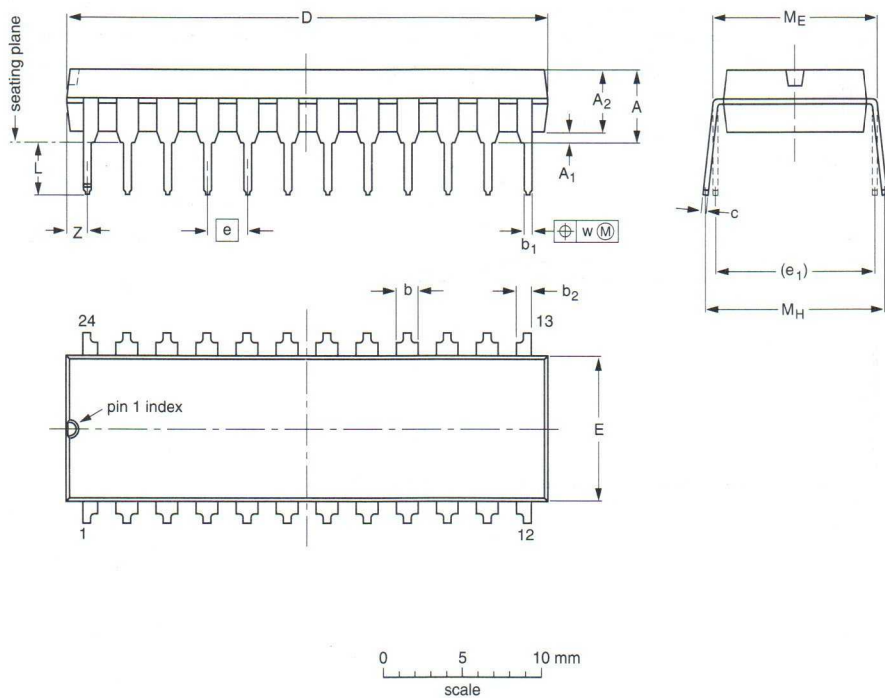
Note

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-001				99-04-28 99-12-27

DIP24: plastic dual in-line package; 24 leads (400 mil)

SOT248-1



DIMENSIONS (millimetre dimensions are derived from the original inch 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	4.83	0.51	3.94	1.63 1.14	0.56 0.43	1.07 0.86	0.36 0.25	30.61 30.23	9.40 8.76	2.54	10.16	3.51 3.05	10.72 10.16	12.57 10.16	0.25	1.40
inches	0.190	0.020	0.155	0.064 0.045	0.022 0.017	0.042 0.034	0.014 0.010	1.205 1.190	0.370 0.345	0.100	0.400	0.138 0.120	0.422 0.400	0.495 0.400	0.01	0.055

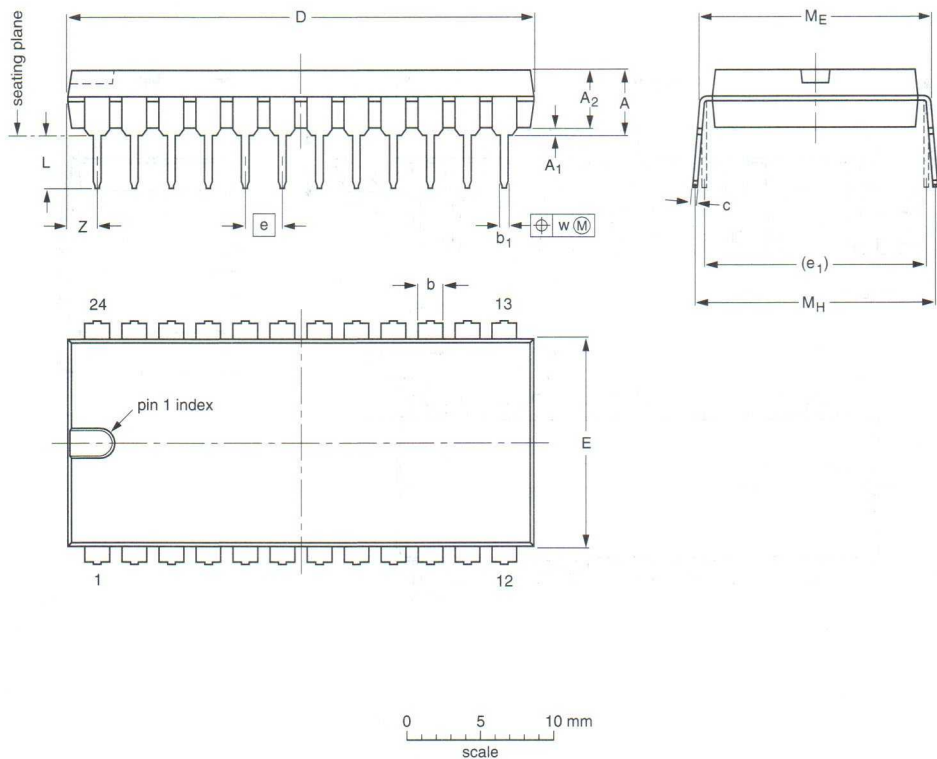
Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT248-1		MS-010				95-03-11 99-12-27

DIP24: plastic dual in-line package; 24 leads (600 mil)

SOT101-1



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	5.1	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	32.0 31.4	14.1 13.7	2.54	15.24	3.9 3.4	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.20	0.020	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.26 1.24	0.56 0.54	0.10	0.60	0.15 0.13	0.62 0.60	0.68 0.63	0.01	0.087

Note

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

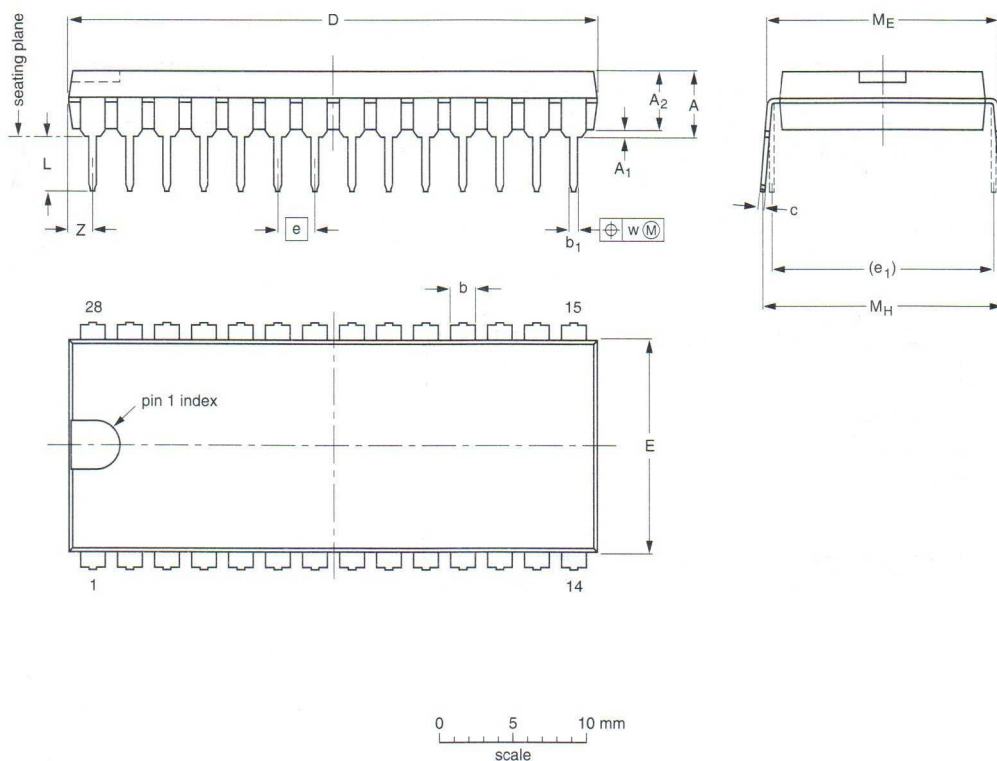
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT101-1	051G02	MO-015	SC-509-24			95-01-23 99-12-27

IC package range and dimensions

Chapter 2

DIP28: plastic dual in-line package; 28 leads (600 mil)

SOT117-1



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	5.1	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	36.0 35.0	14.1 13.7	2.54	15.24	3.9 3.4	15.80 15.24	17.15 15.90	0.25	1.7
inches	0.20	0.020	0.16	0.066 0.051	0.020 0.014	0.013 0.009	1.41 1.34	0.56 0.54	0.10	0.60	0.15 0.13	0.62 0.60	0.68 0.63	0.01	0.067

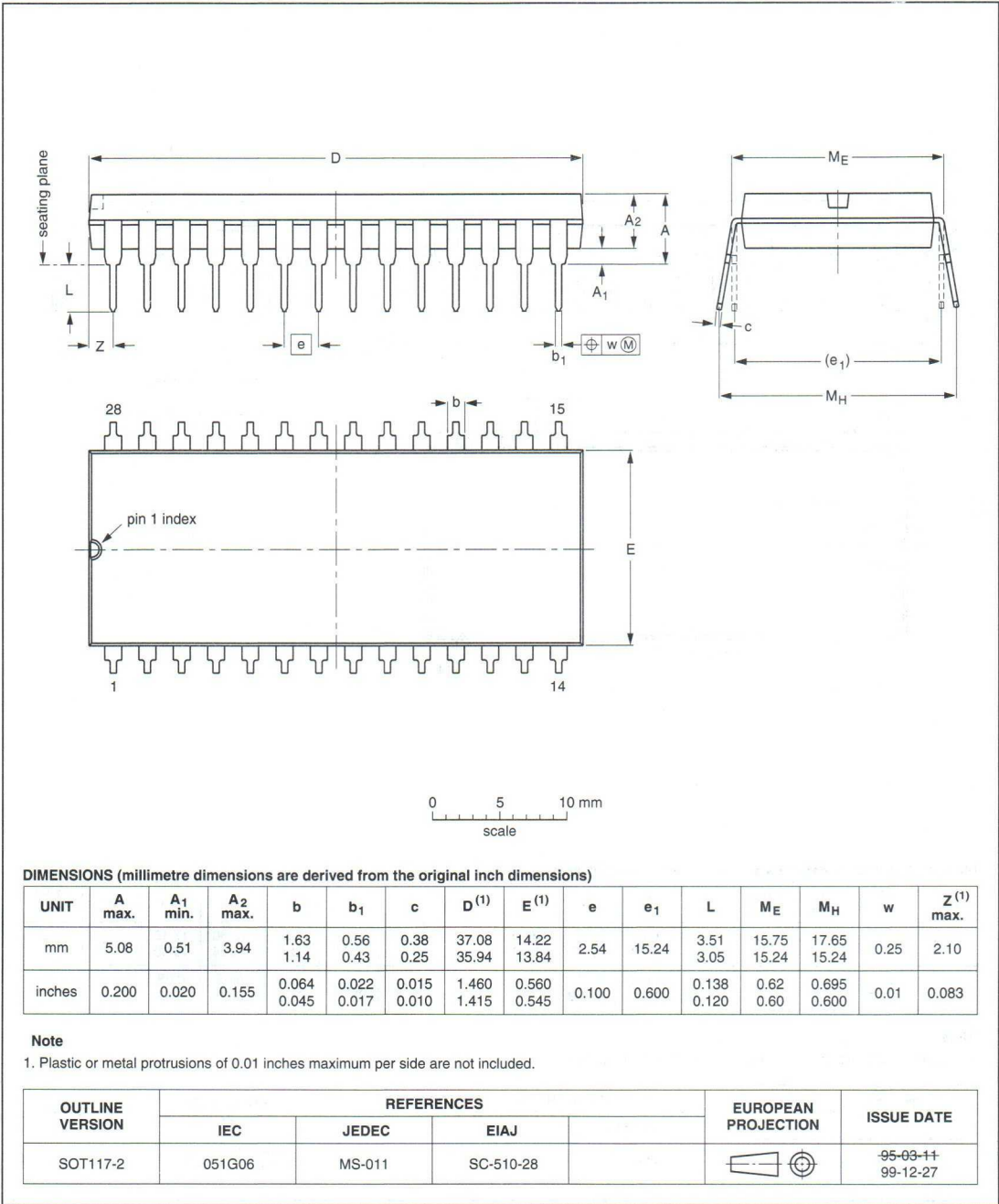
Note

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			
SOT117-1	051G05	MO-015	SC-510-28			95-01-14 99-12-27

DIP28: plastic dual in-line package; 28 leads (600 mil); long body

SOT117-2

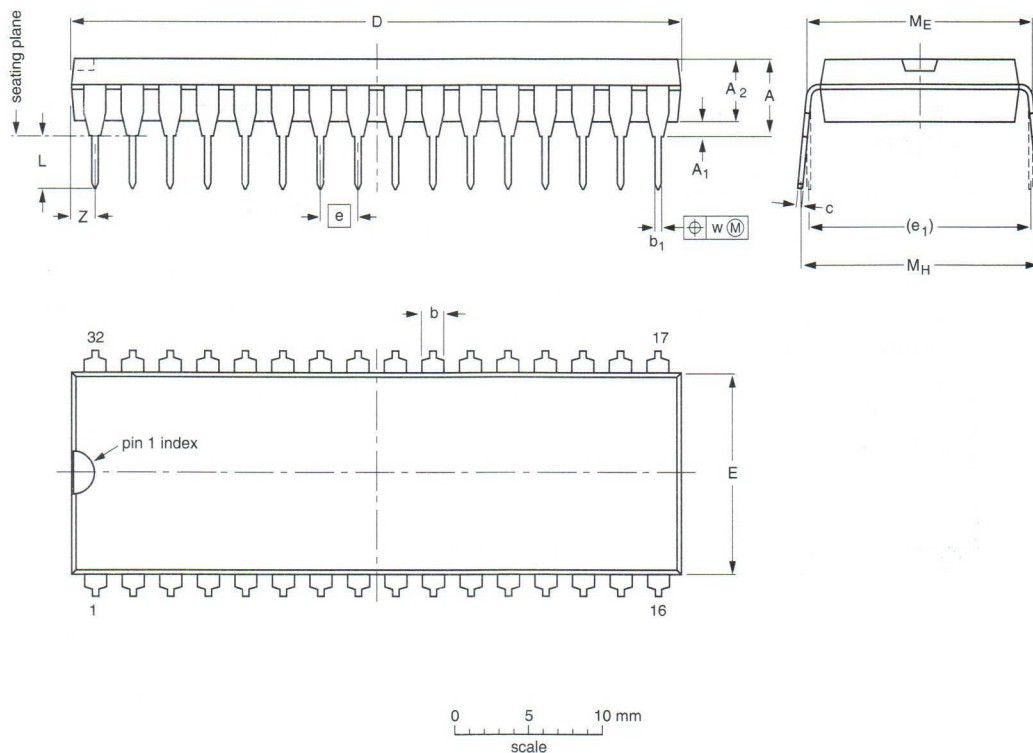


IC package range and dimensions

Chapter 2

DIP32: plastic dual in-line package; 32 leads (600 mil)

SOT201-1



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	5.0	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	41.6 40.6	14.2 13.8	2.54	15.24	3.6 3.2	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.20	0.020	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.64 1.60	0.56 0.54	0.10	0.60	0.14 0.13	0.62 0.60	0.68 0.63	0.01	0.087

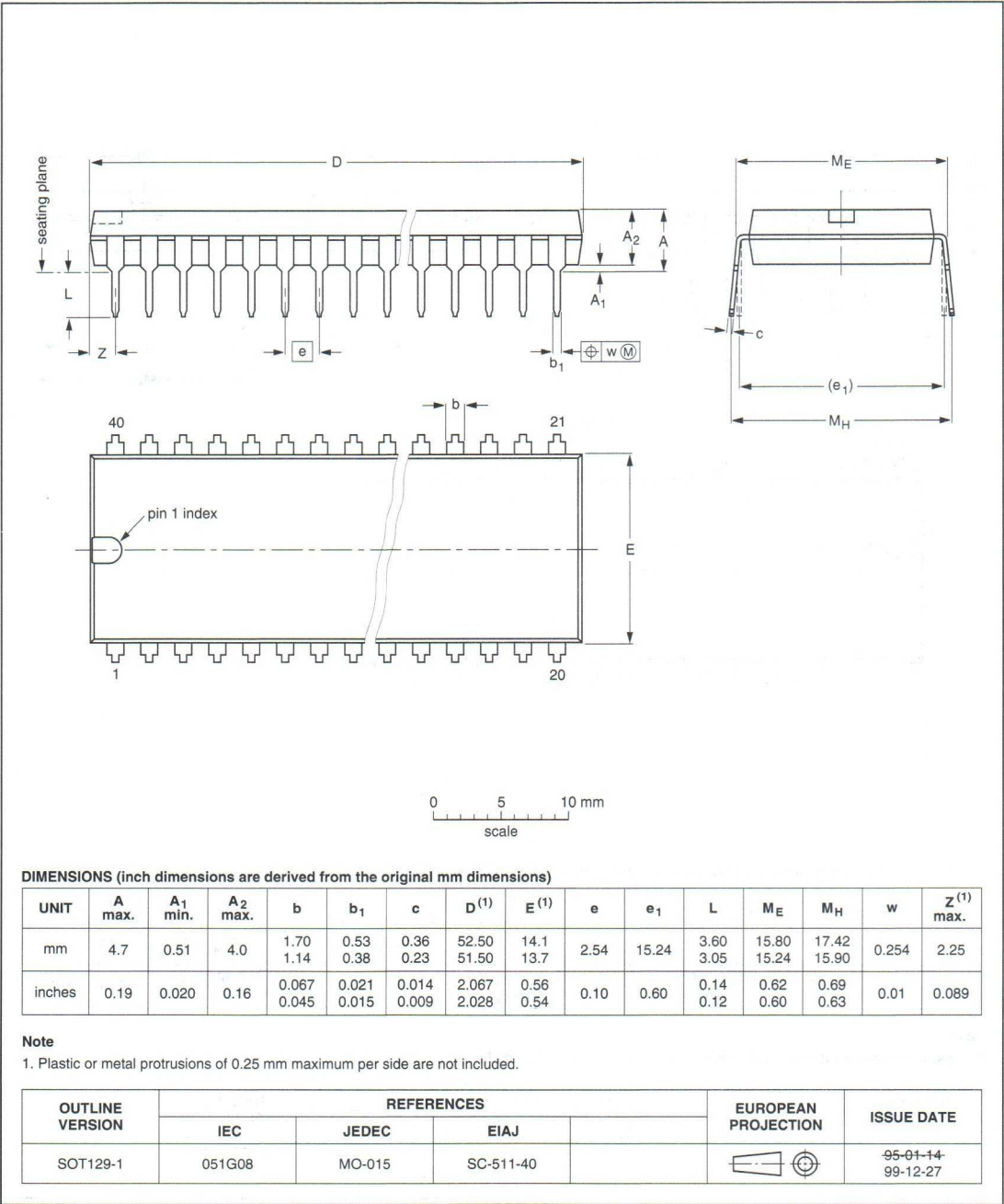
Note

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			
SOT201-1		MO-015				95-01-25 99-12-27

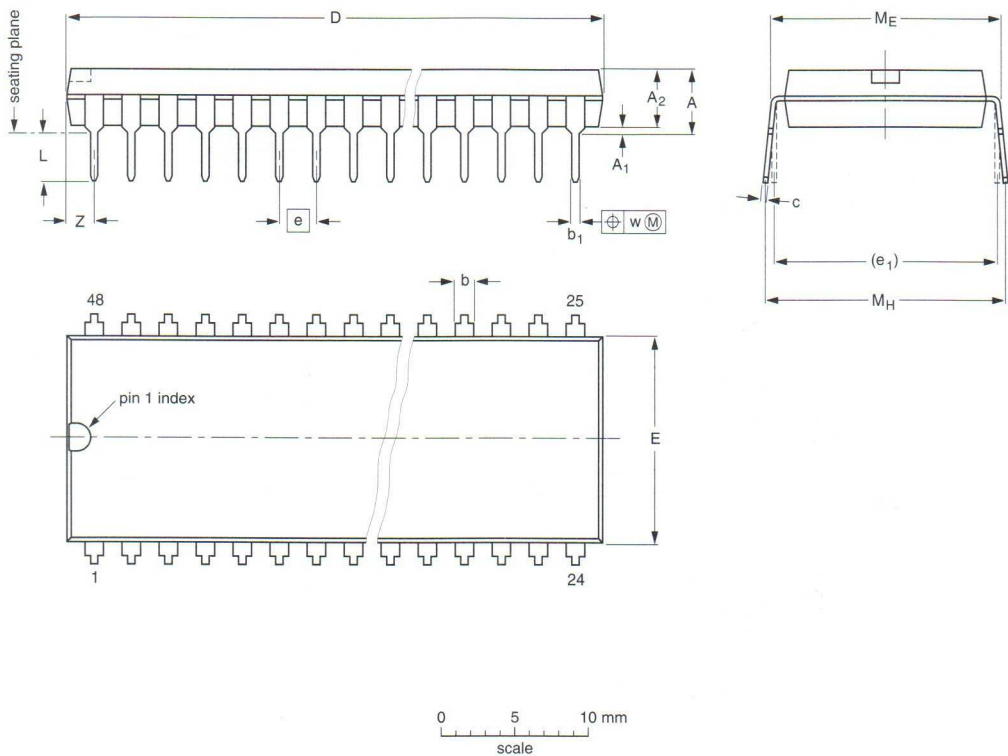
DIP40: plastic dual in-line package; 40 leads (600 mil)

SOT129-1



DIP48: plastic dual in-line package; 48 leads (600 mil)

SOT240-1



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

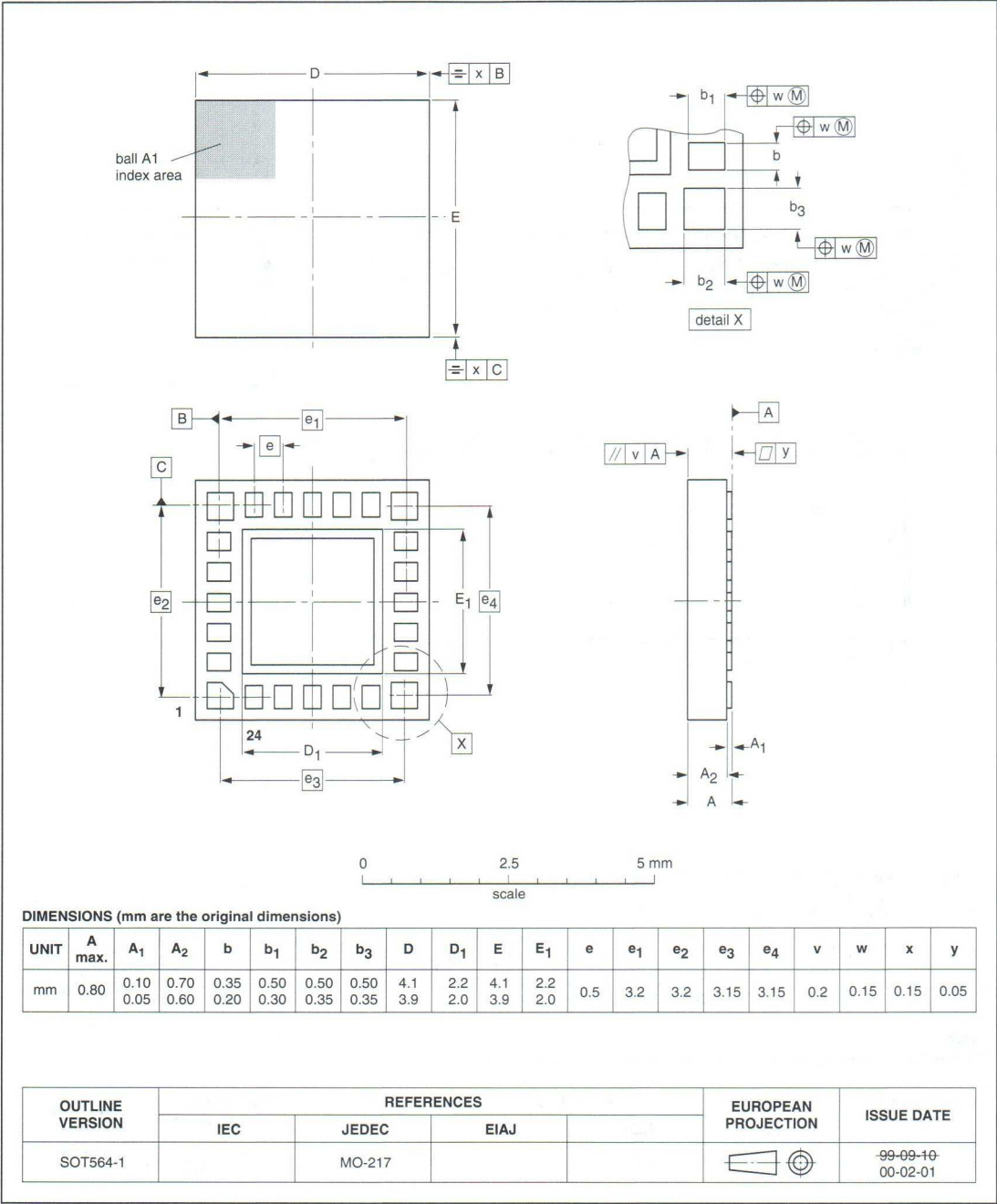
UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ max.
mm	4.9	0.36	4.06	1.4 1.14	0.53 0.38	0.36 0.23	62.60 61.60	14.22 13.56	2.54	15.24	3.90 3.05	15.88 15.24	18.46 15.24	0.254	2.1
inches	0.19	0.014	0.16	0.055 0.045	0.021 0.015	0.014 0.009	2.46 2.42	0.56 0.53	0.10	0.60	0.15 0.12	0.63 0.60	0.73 0.60	0.01	0.083

Note

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

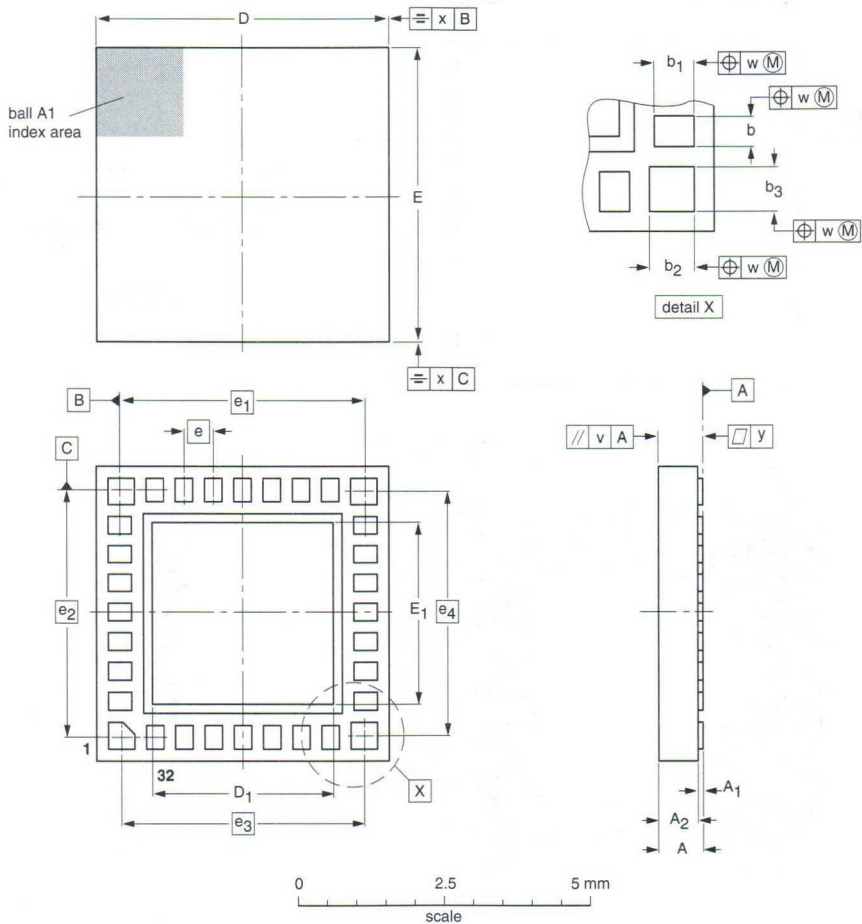
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT240-1		MS-011				95-01-25 99-12-27

HBCC24: plastic, heatsink bottom chip carrier; 24 terminals; body 4 x 4 x 0.65 mm SOT564-1



HBCC32: plastic, heatsink bottom chip carrier; 32 terminals; body 5 x 5 x 0.65 mm

SOT560-1



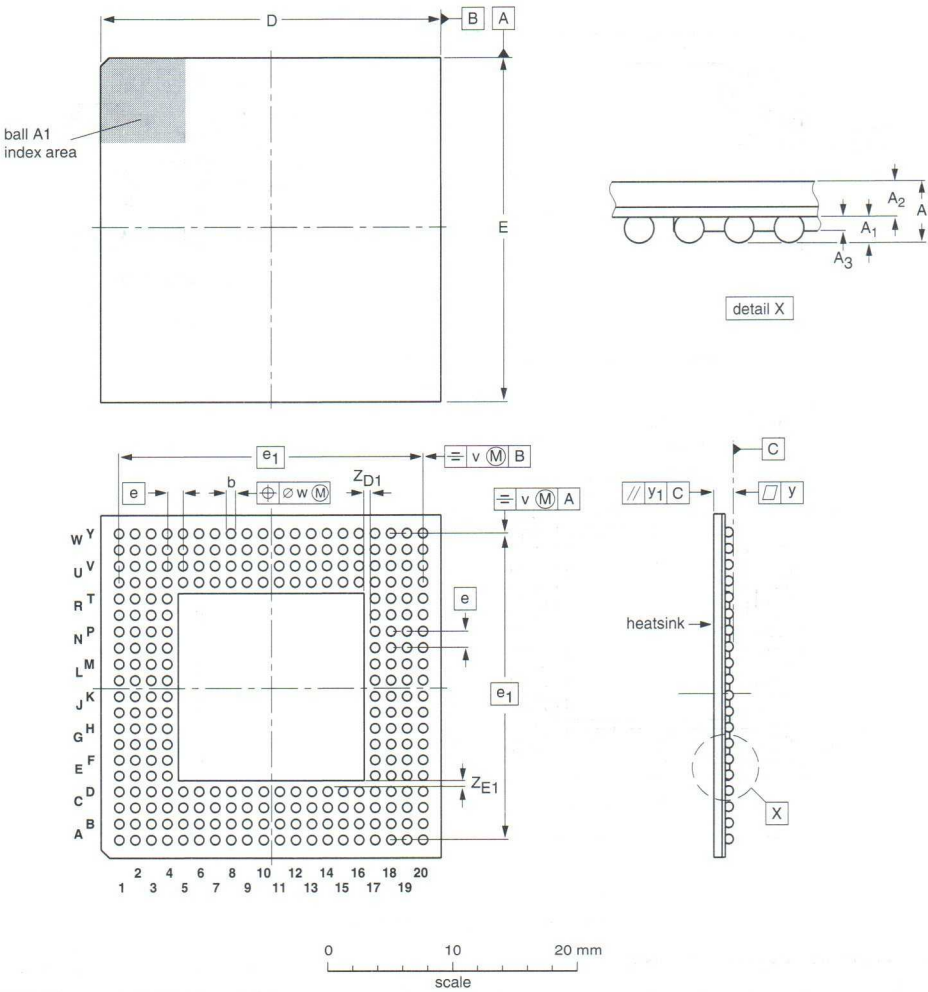
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	b ₁	b ₂	b ₃	D	D ₁	E	E ₁	e	e ₁	e ₂	e ₃	e ₄	v	w	x	y
mm	0.80	0.10 0.05	0.70 0.60	0.35 0.20	0.50 0.30	0.50 0.35	0.50 0.35	5.1 4.9	3.2 3.0	5.1 4.9	3.2 3.0	0.5	4.2	4.2	4.15	4.15	0.2	0.15	0.15	0.05

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT560-1		MO-217				99-09-10 00-02-01

HBGA256: plastic, heatsink ball grid array package; 256 balls; body 27 x 27 x 0.9 mm

SOT602-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃ max.	b	D	E	e	e ₁	v	w	y	y ₁	Z _{D1} min.	Z _{E1} min.
mm	1.65	0.7 0.6	1.0 0.8	0.42	0.85 0.65	27.2 26.8	27.2 26.8	1.27	24.13	0.3	0.1	0.15	0.15	0.5	0.5

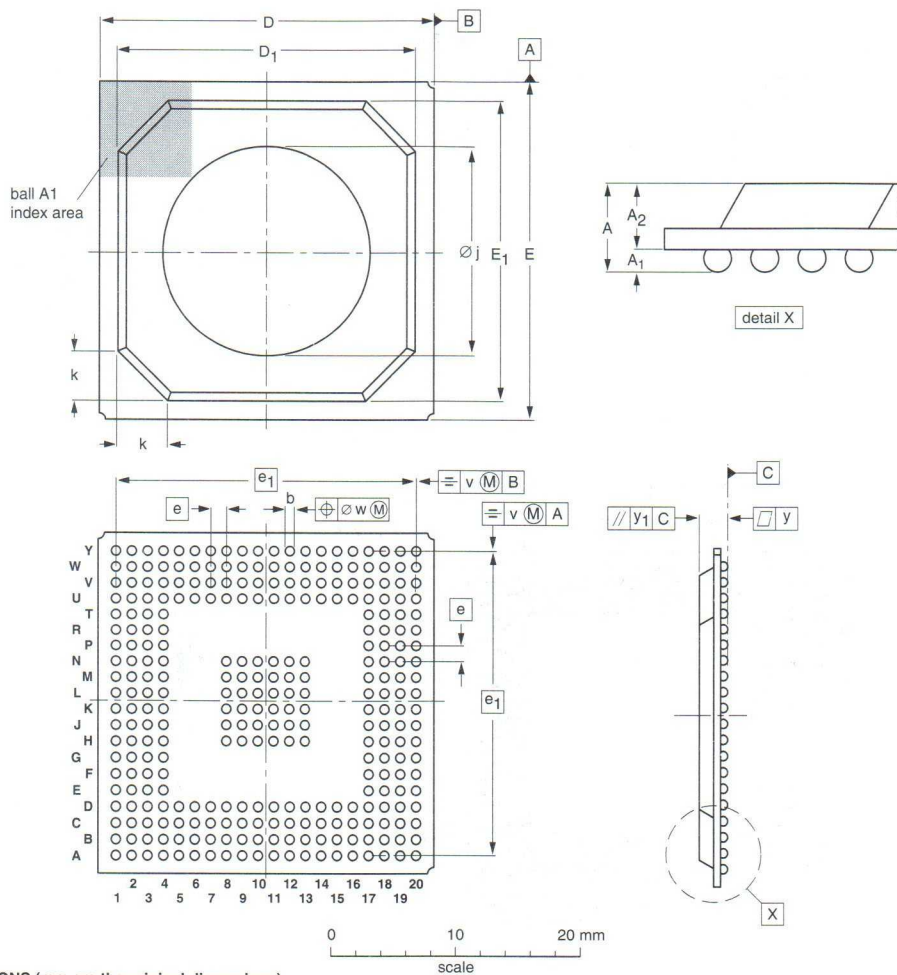
OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT602-1					-00-02-24- 00-03-04

IC package range and dimensions

Chapter 2

HBGA292: plastic, heatsink ball grid array package; 292 balls; body 27 x 27 x 1.75 mm

SOT553-1



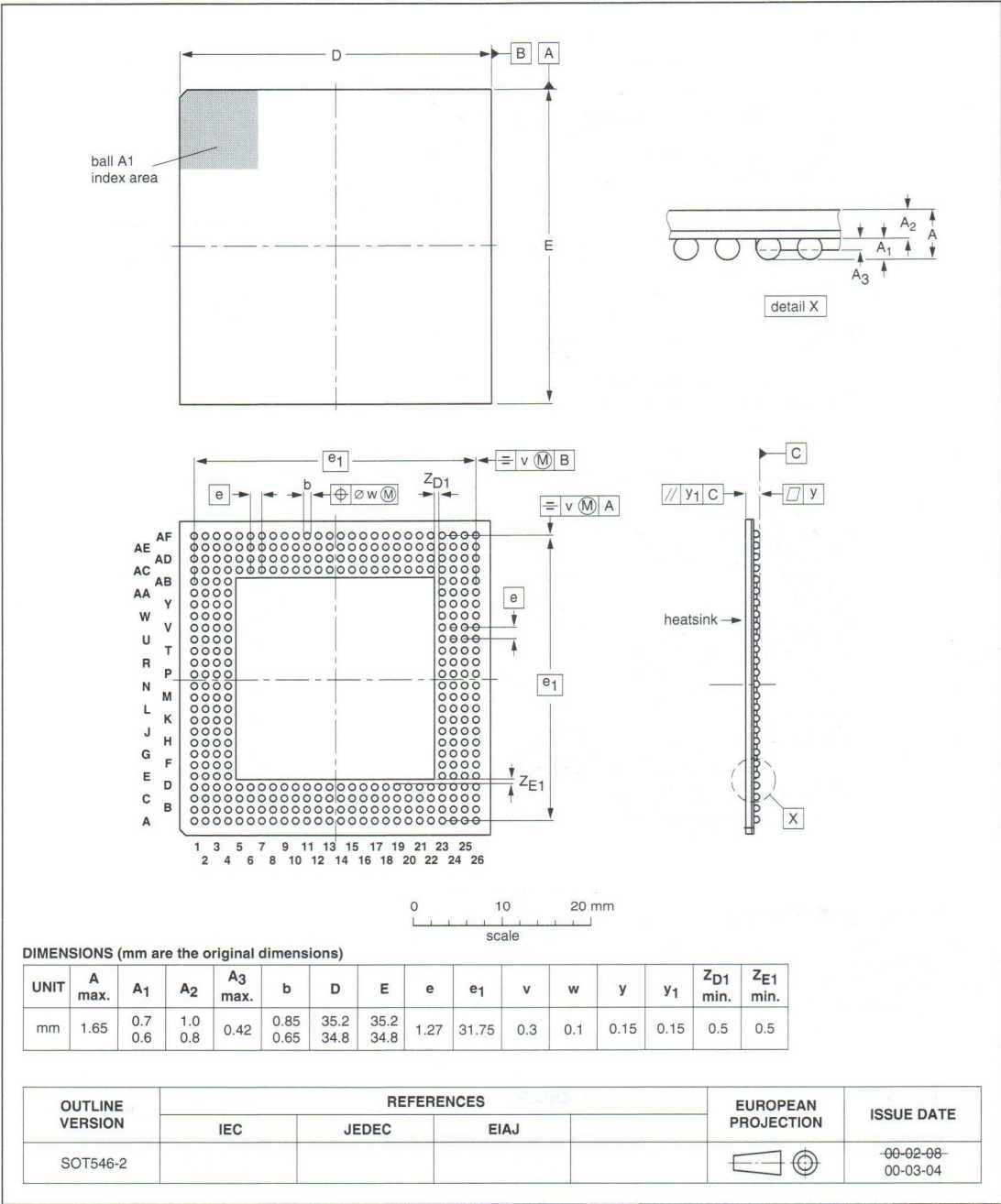
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	$\varnothing J$	k	v	w	y	y ₁
mm	2.51	0.70 0.50	1.83 1.63	0.90 0.60	27.2 26.8	24.1 23.9	27.2 26.8	24.1 23.9	1.27	24.13	21.0 15.4	4.2 3.8	0.2	0.2	0.15	0.25

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT553-1						00-02-01 00-03-04

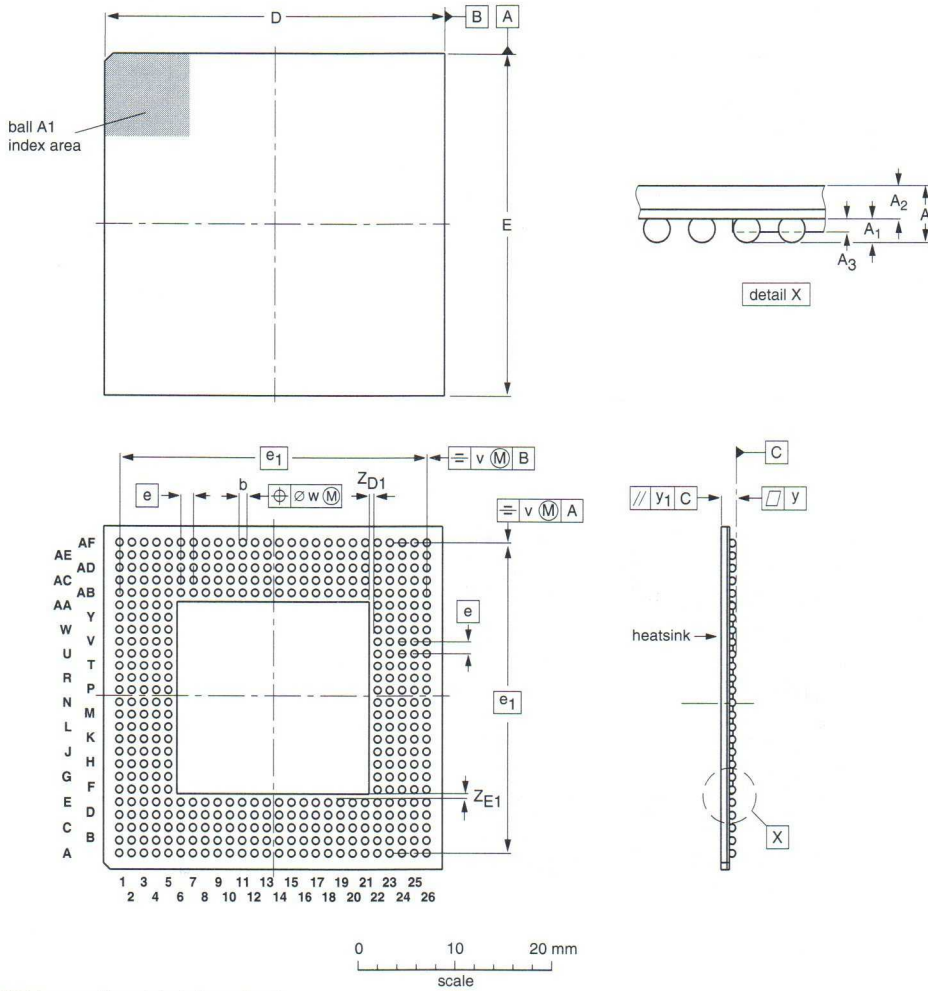
HBGA352: plastic, heatsink ball grid array package; 352 balls; body 35 x 35 x 0.9 mm

SOT546-2



HBGA420: plastic, heatsink ball grid array package; 420 balls; body 35 x 35 x 0.9 mm

SOT603-1



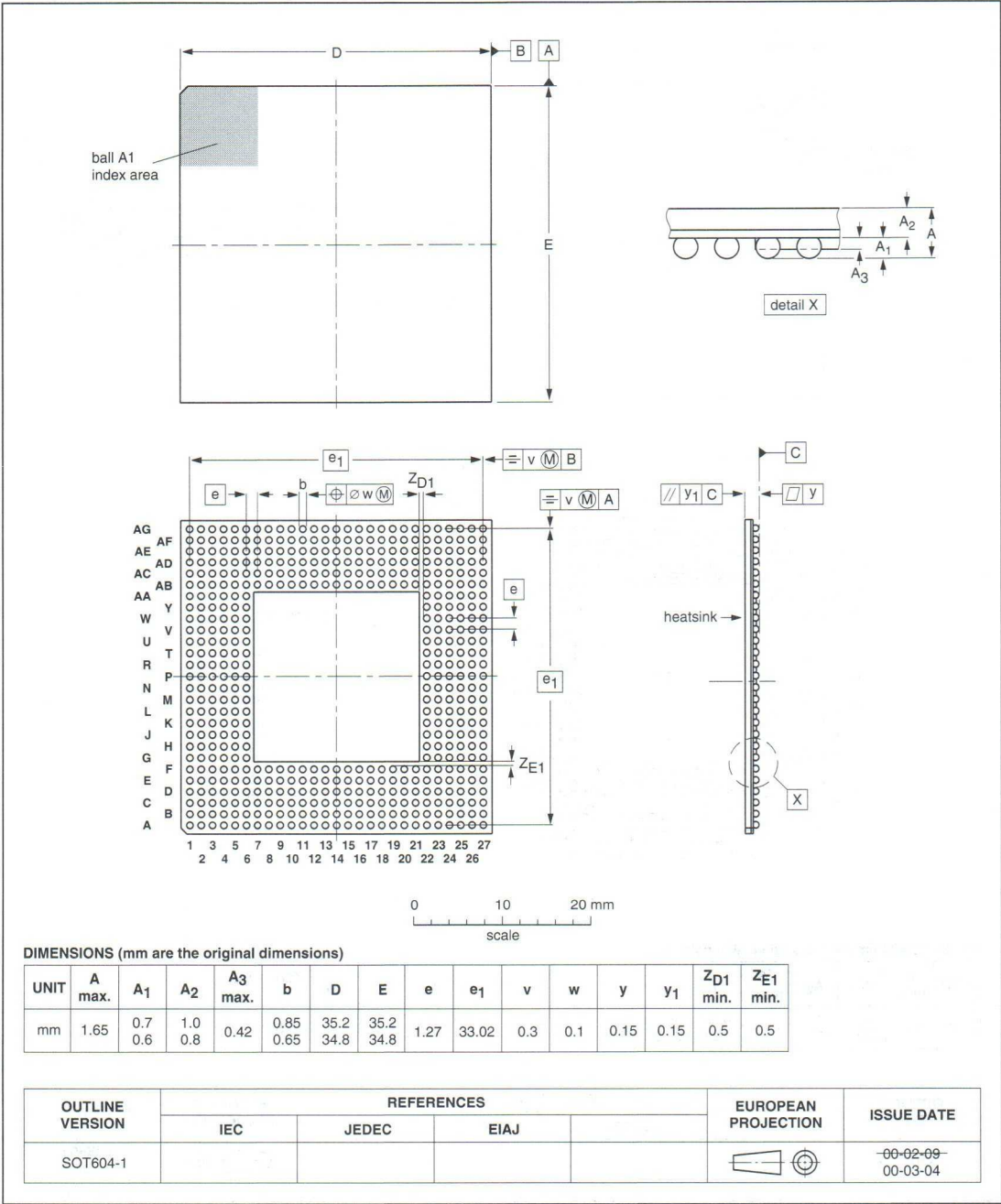
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃ max.	b	D	E	e	e ₁	v	w	y	y ₁	Z _{D1} min.	Z _{E1} min.
mm	1.65	0.7 0.6	1.0 0.8	0.42	0.85 0.65	35.2 34.8	35.2 34.8	1.27	31.75	0.3	0.1	0.15	0.15	0.5	0.5

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT603-1						00-02-09 00-03-04

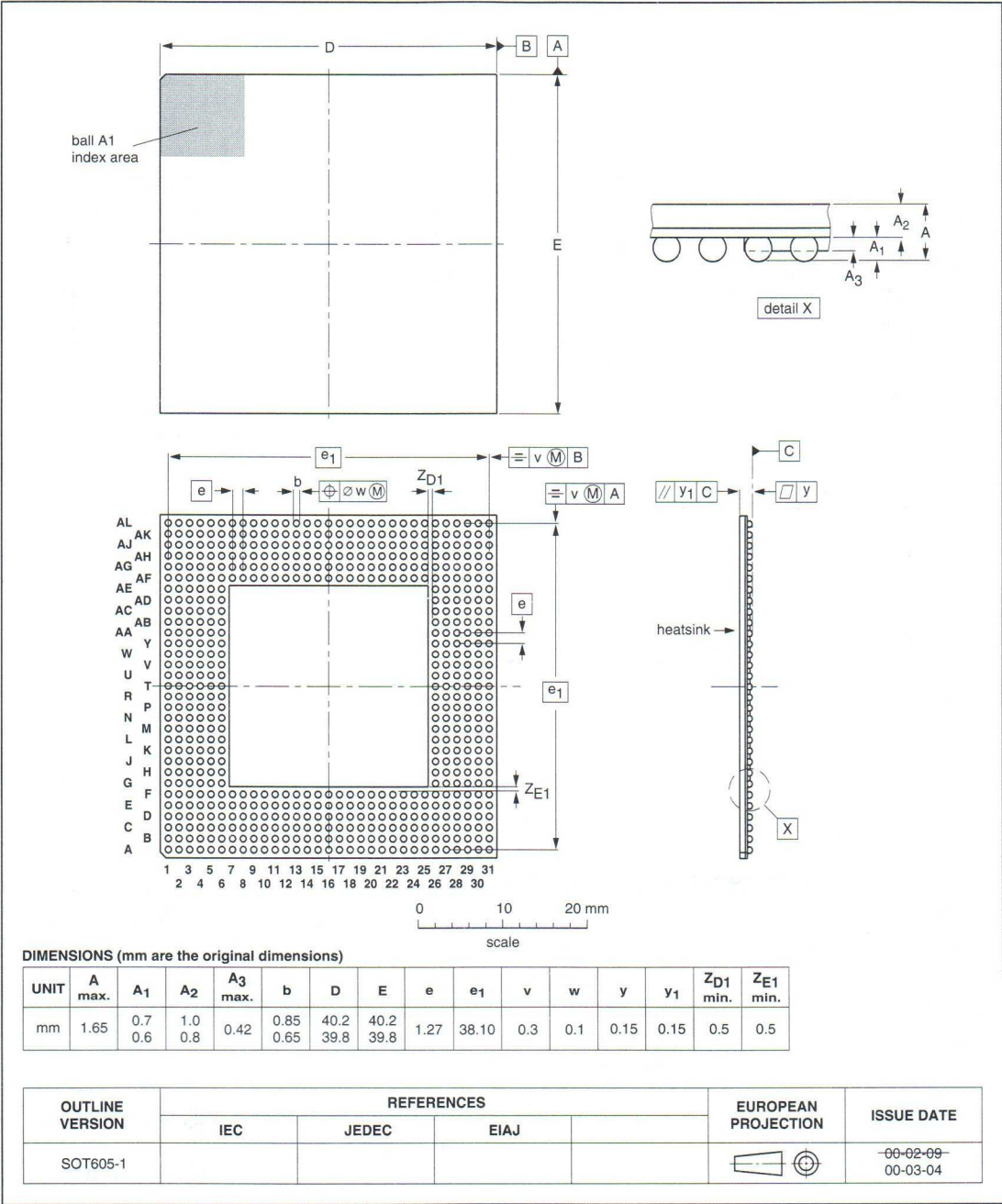
HBGA504: plastic, heatsink ball grid array package; 504 balls; body 35 x 35 x 0.9 mm

SOT604-1



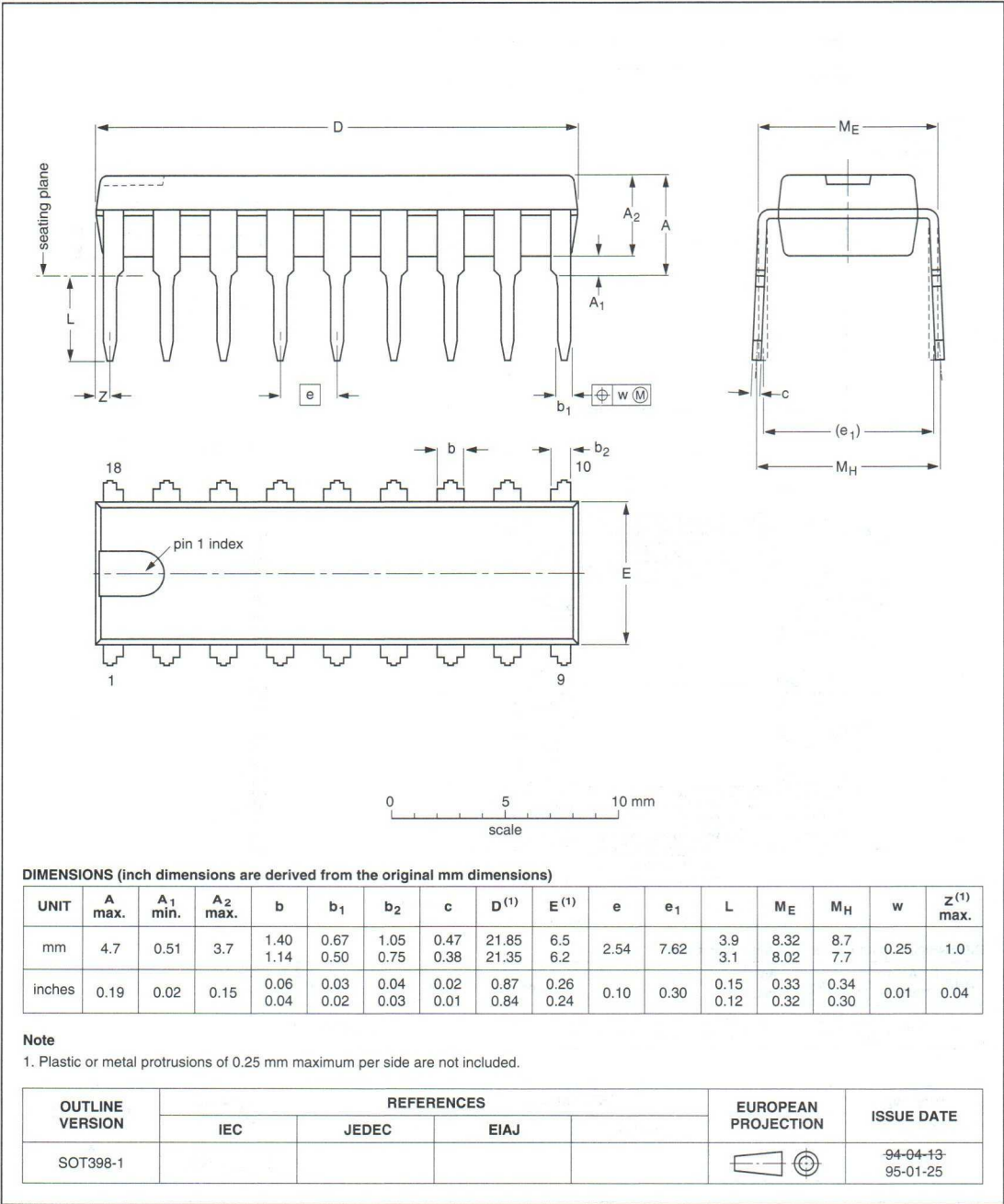
HBGA600: plastic, heatsink ball grid array package; 600 balls; body 40 x 40 x 0.9 mm

SOT605-1



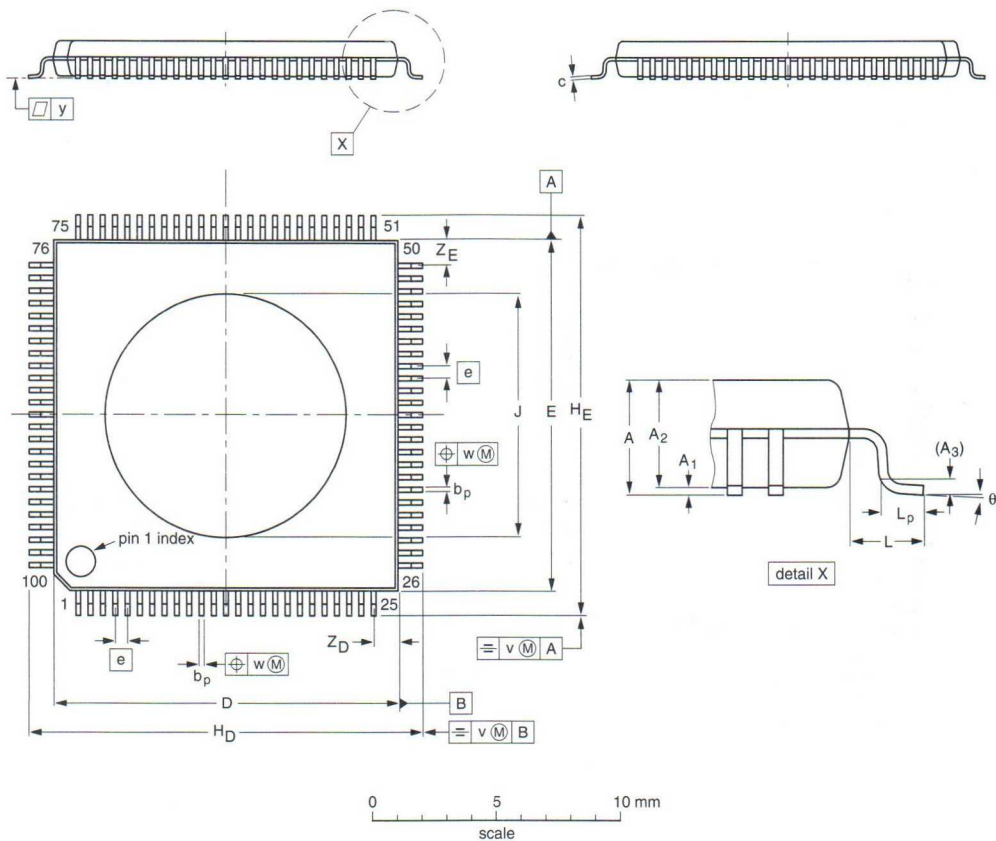
HDIP18: plastic heat-dissipating dual in-line package; 18 leads

SOT398-1



HLQFP100: plastic heat-dissipating low profile quad flat package;
100 leads; body 14 x 14 x 1.4 mm

SOT470-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	J ⁽²⁾	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.20 0.05	1.5 1.3	0.25	0.28 0.16	0.18 0.12	14.1 13.9	14.1 13.9	0.5	16.25 15.75	16.25 15.75	10.15 9.15	1.0	0.75 0.45	0.2	0.12	0.1	1.15 0.85	1.15 0.85	7° 0°

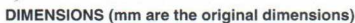
Notes

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.
2. Heatsink intrusion 0.0127 maximum.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT470-1						97-01-13

Chapter 2

SOT612-1



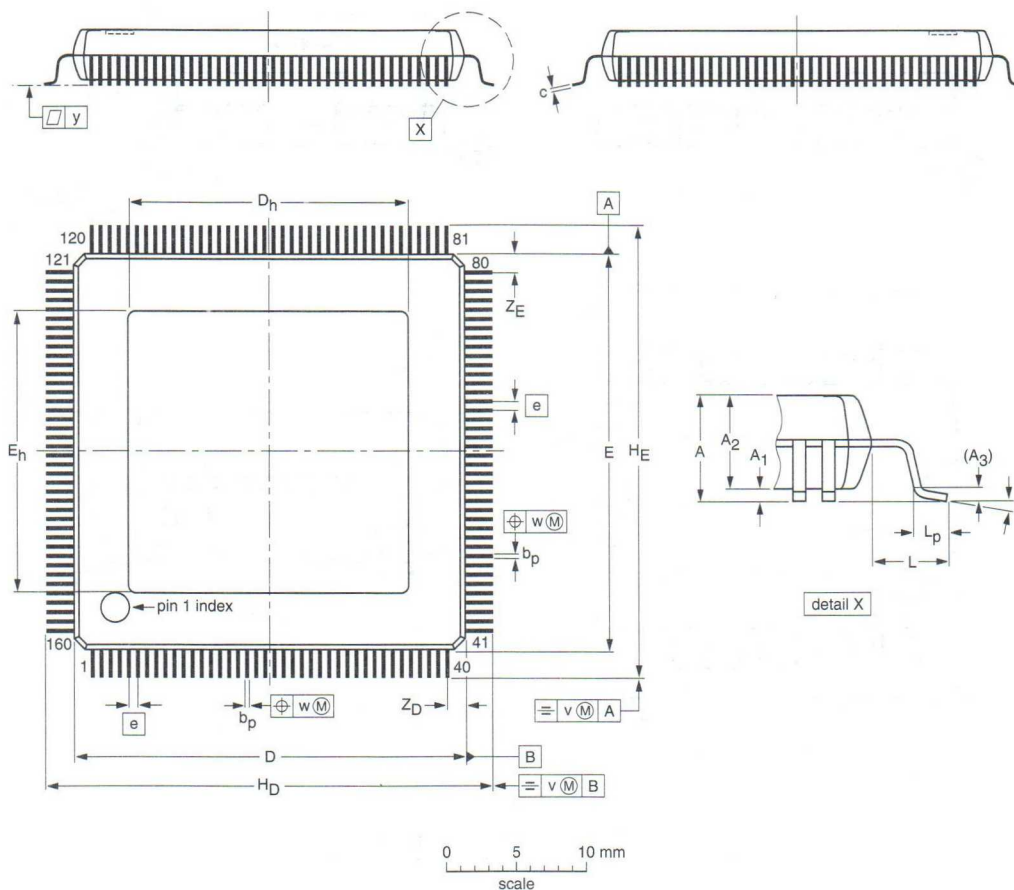
Note

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

2 - 82

HQFP160: plastic, heatsink quad flat package;
160 leads (lead length 1.6 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT576-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D _h	E ⁽¹⁾	E _h	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	4.07	0.50 0.25	3.60 3.20	0.25	0.38 0.22	0.23 0.13	28.1 27.9	21.0	28.1 27.9	21.0	0.65	31.45 30.95	31.45 30.95	1.6	0.95 0.65	0.2	0.12	0.1	1.52 1.14	1.52 1.14	7° 0°

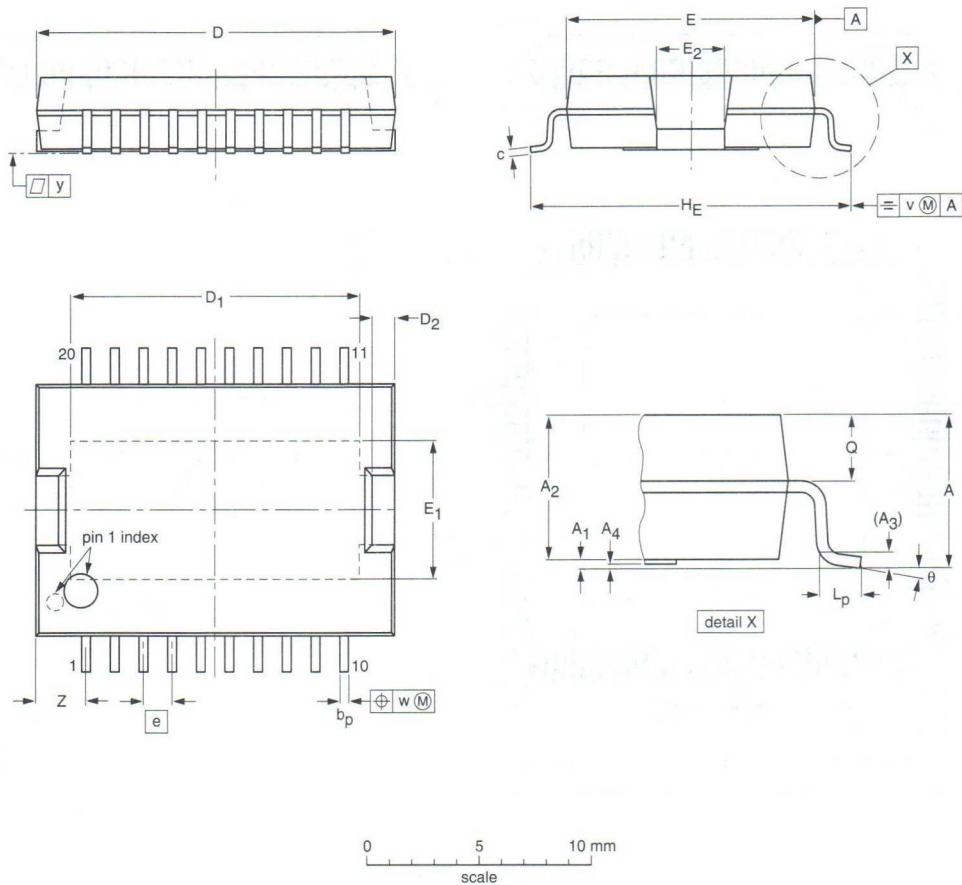
Note

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			
SOT576-1						00-01-20- 00-01-25

HSOP20: plastic, heatsink small outline package; 20 leads

SOT397-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	A ₄	b _p	c	D ⁽¹⁾	D ₁	D ₂	E ⁽¹⁾	E ₁	E ₂	e	H _E	L _p	Q	v	w	y	Z	θ
mm	3.6	0.3 0.1	3.3 3.0	0.35	0.1 0	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.27	14.5 13.9	1.1 0.8	1.5 1.4	0.25	0.25	0.1	2.5 2.0	8° 0°

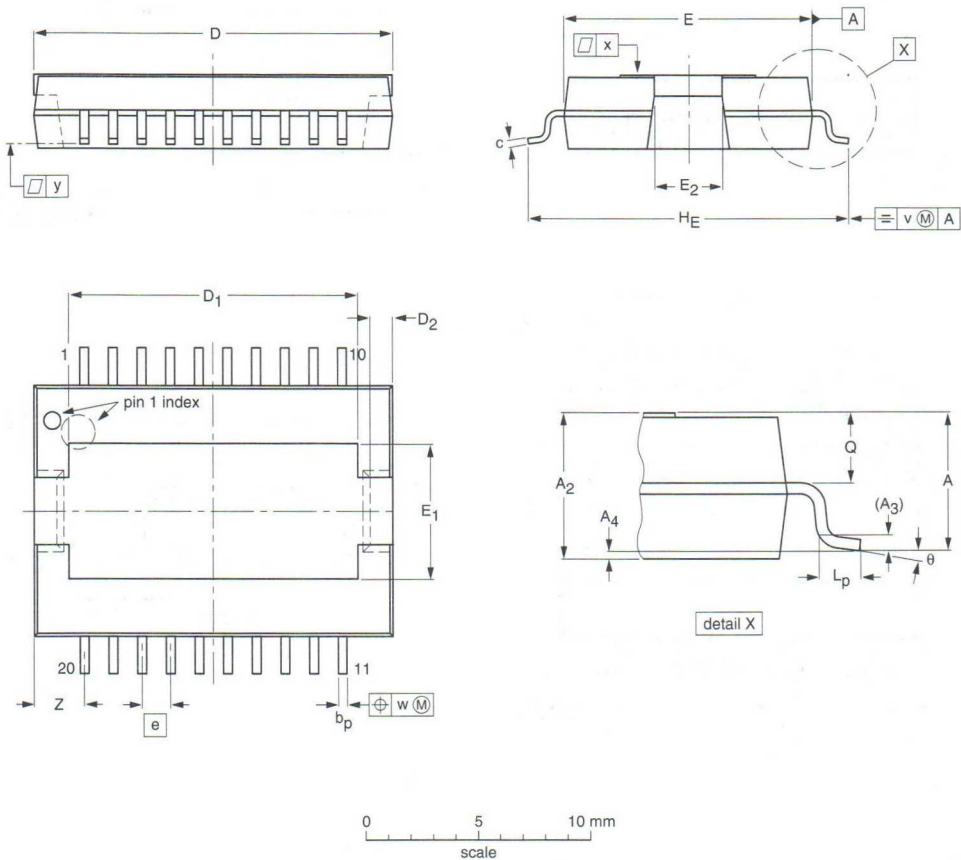
Note

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			
SOT397-1						97-11-03 99-11-12

HSOP20: plastic, heatsink small outline package; 20 leads; low stand-off height

SOT418-2



DIMENSIONS (mm are the original dimensions)

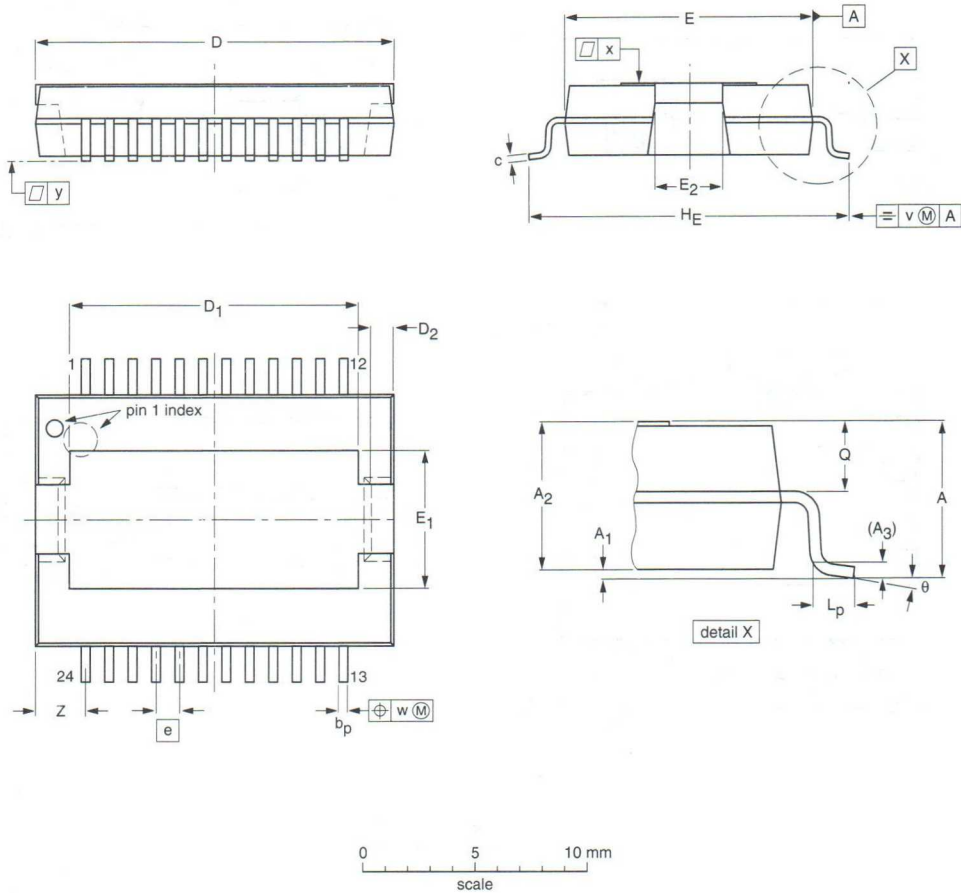
UNIT	A max.	A ₂	A ₃	A ₄ (1)	b _p	c	D(2)	D ₁	D ₂	E(2)	E ₁	E ₂	e	H _E	L _p	Q	v	w	x	y	Z	θ
mm	3.5	3.5 3.2	0.35	+0.12 -0.02	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.27	14.5 13.9	1.1 0.8	1.7 1.5	0.25	0.25	0.03	0.07	2.5 2.0	8° 0°

- Notes
- Limits per individual lead.
 - Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT418-2						98-02-25 99-11-12

HSOP24: plastic, heatsink small outline package; 24 leads

SOT566-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D ₁	D ₂	E ⁽¹⁾	E ₁	E ₂	e	H _E	L _p	Q	v	w	x	y	Z	θ
mm	3.7	0.3 0.1	3.5 3.2	0.35	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.0	14.5 13.9	1.1 0.8	1.7 1.5	0.25	0.25	0.03	0.1	2.7 2.2	8° 0°

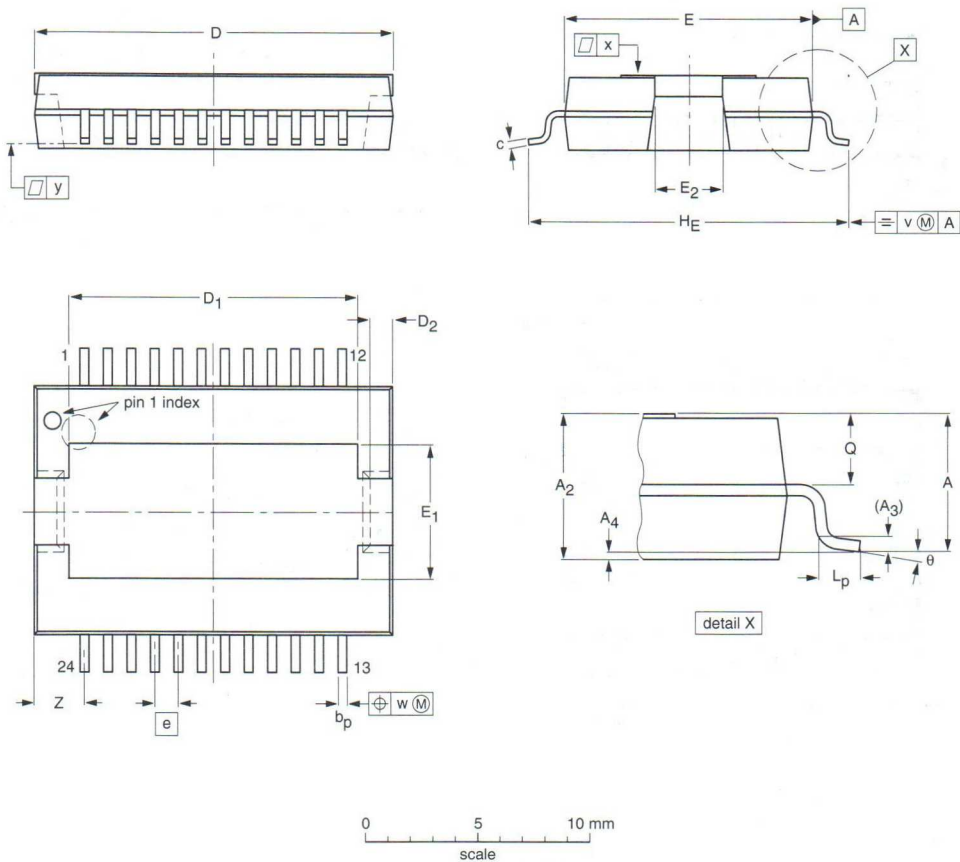
Note

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			
SOT566-1						00-03-24

HSOP24: plastic, heatsink small outline package; 24 leads; low stand-off height

SOT566-2



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₂	A ₃	A ₄ (1)	b _p	c	D(2)	D ₁	D ₂	E(2)	E ₁	E ₂	e	H _E	L _p	Q	v	w	x	y	Z	θ
mm	3.5	3.5 3.2	0.35	+0.12 -0.02	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.0	14.5 13.9	1.1 0.8	1.7 1.5	0.25	0.25	0.03	0.07	2.7 2.2	8° 0°

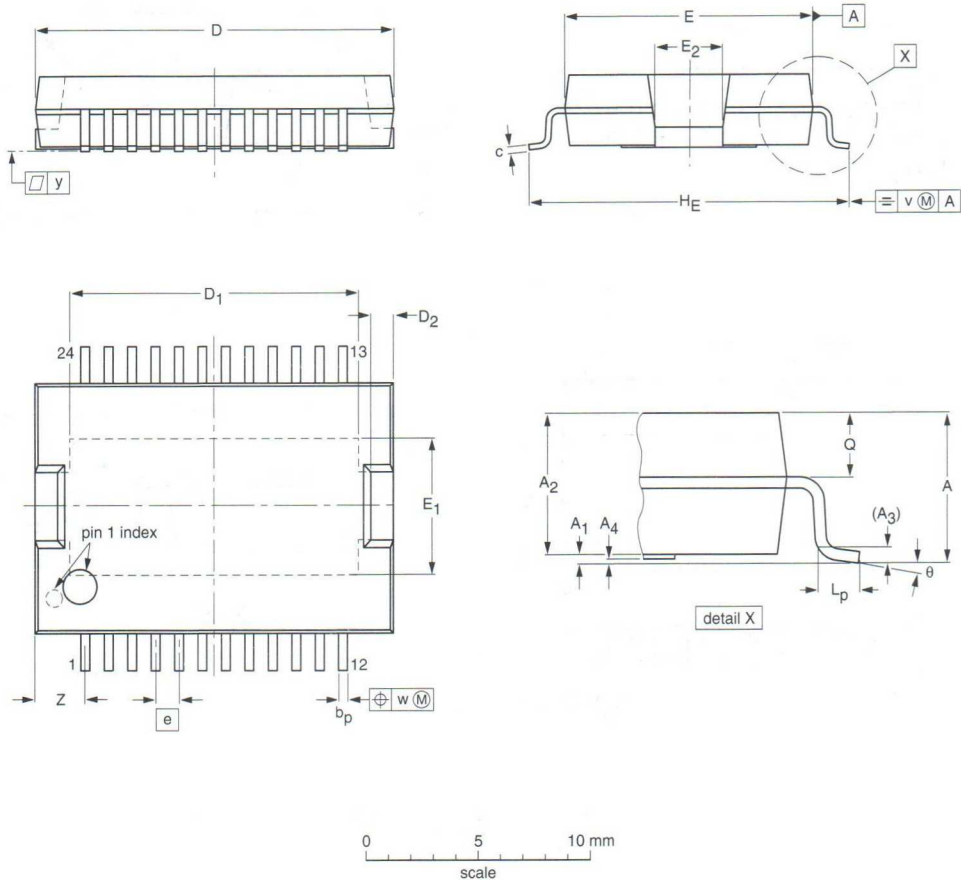
Notes

- Limits per individual lead.
- Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT566-2						00-03-24

HSOP24: plastic, heatsink small outline package; 24 leads

SOT592-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	A ₄	b _p	c	D ⁽¹⁾	D ₁	D ₂	E ⁽¹⁾	E ₁	E ₂	e	H _E	L _p	Q	v	w	y	Z	θ
mm	3.6	0.3 0.1	3.3 3.0	0.35	0.1 0	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.0	14.5 13.9	1.1 0.8	1.5 1.4	0.25	0.25	0.1	2.7 2.2	8° 0°

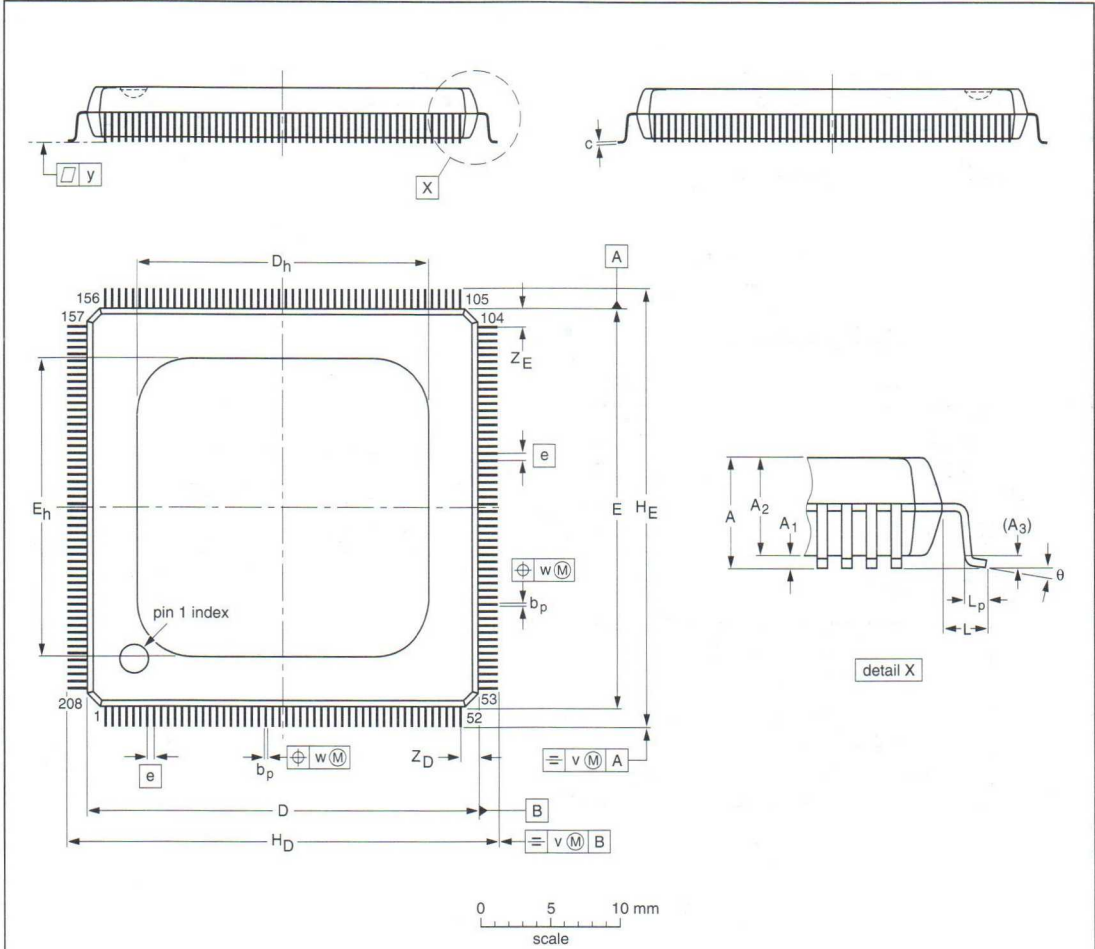
Note

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			
SOT592-1						00-03-24

HSQFP208: plastic, heatsink shrink quad flat package;
208 leads (lead length 1.3 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT431-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D _H	E ⁽¹⁾	E _H	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	4.10	0.40 0.25	3.60 3.20	0.25	0.27 0.17	0.23 0.13	28.1 27.9	21.0	28.1 27.9	21.0	0.5	30.9 30.3	30.9 30.3	1.3	0.75 0.45	0.2	0.08	0.08	1.45 1.05	1.45 1.05	8° 0°

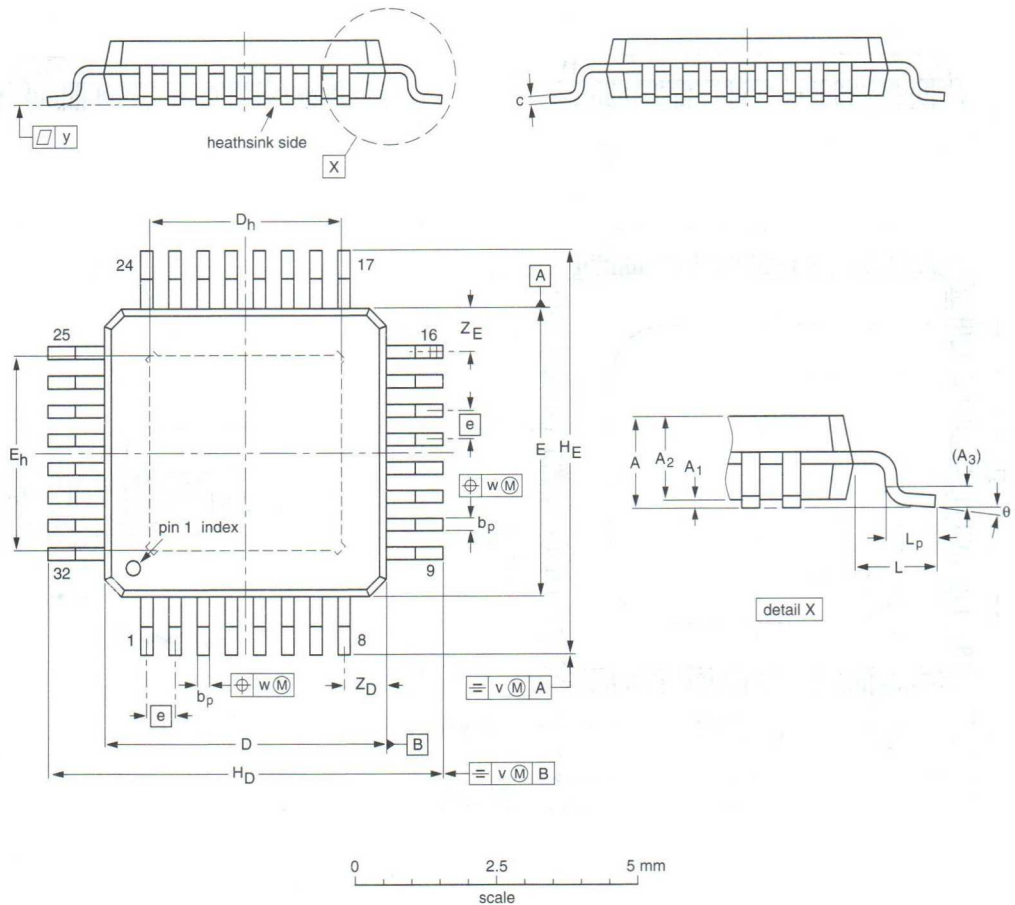
Note

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			
SOT431-1						00-01-25- 00-02-23

HTQFP32: plastic, heatsink thin quad flat package; 32 leads; body 5 x 5 x 1.0 mm

SOT547-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D _h	E ⁽¹⁾	E _h	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.27 0.17	0.20 0.09	5.1 4.9	3.5 3.1	5.1 4.9	3.5 3.1	0.5	7.1 6.9	7.1 6.9	1.0	0.75 0.45	0.2	0.08	0.08	0.89 0.61	0.89 0.61	7° 0°

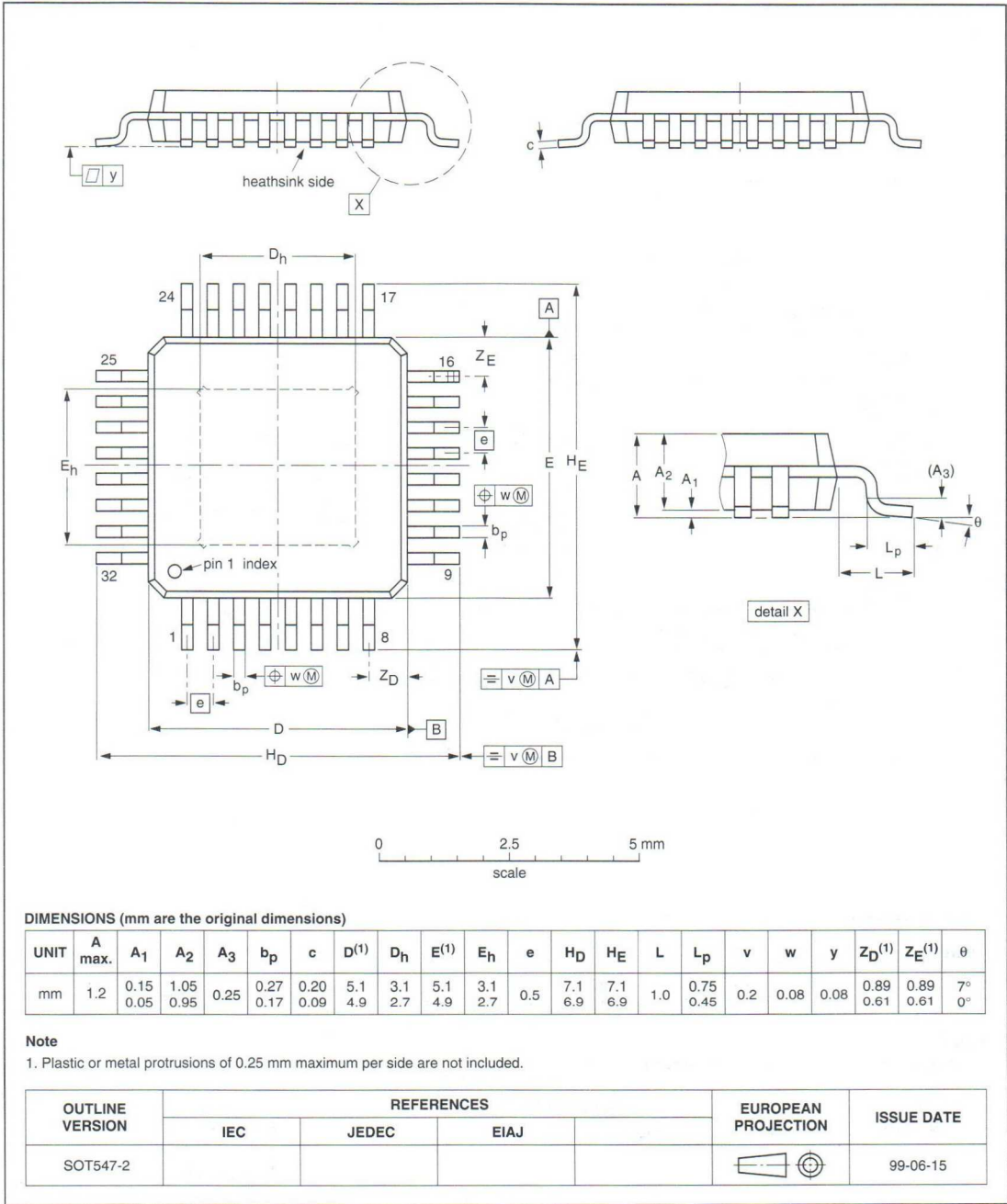
Note

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			
SOT547-1						99-03-10

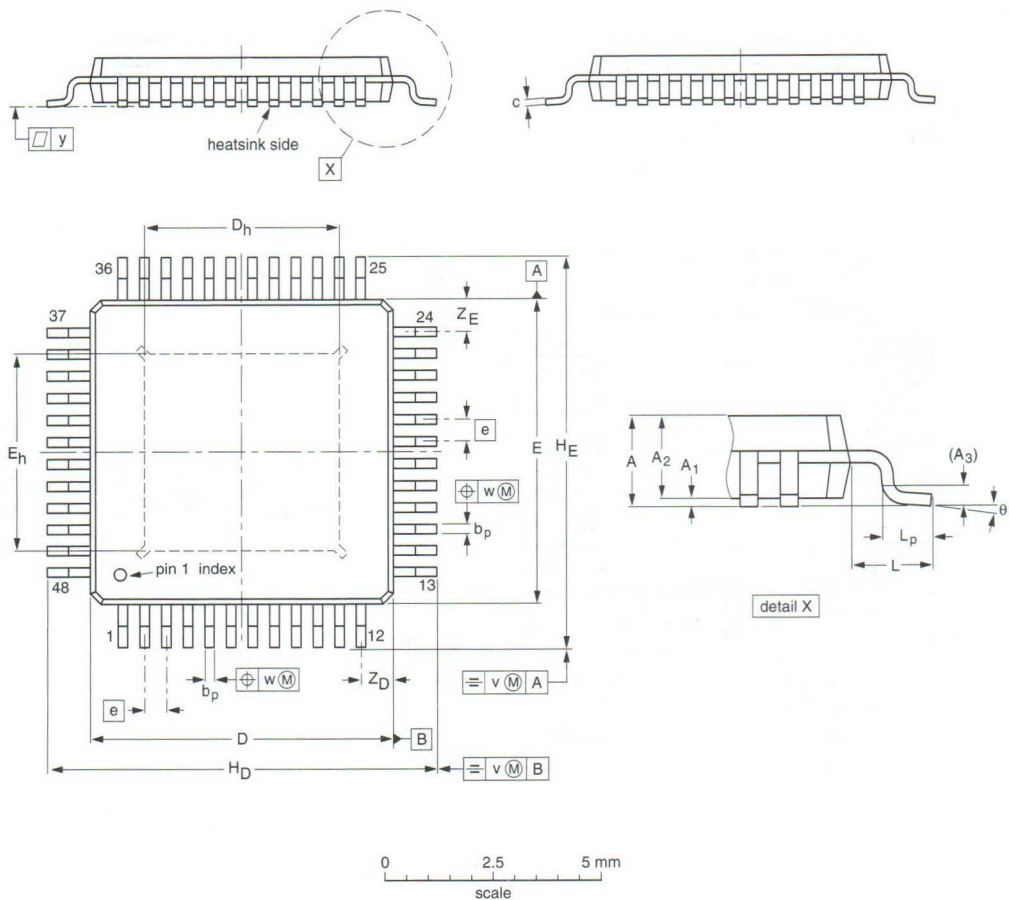
HTQFP32: plastic, heatsink thin quad flat package; 32 leads; body 5 x 5 x 1.0 mm

SOT547-2



HTQFP48: plastic, heatsink thin quad flat package; 48 leads; body 7 x 7 x 1.0 mm

SOT545-2



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D _h	E ⁽¹⁾	E _h	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.27 0.17	0.20 0.09	7.1 6.9	4.6 4.4	7.1 6.9	4.6 4.4	0.5	9.1 8.9	9.1 8.9	1.0	0.75 0.45	0.2	0.08	0.08	0.89 0.61	0.89 0.61	7° 0°

Note

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

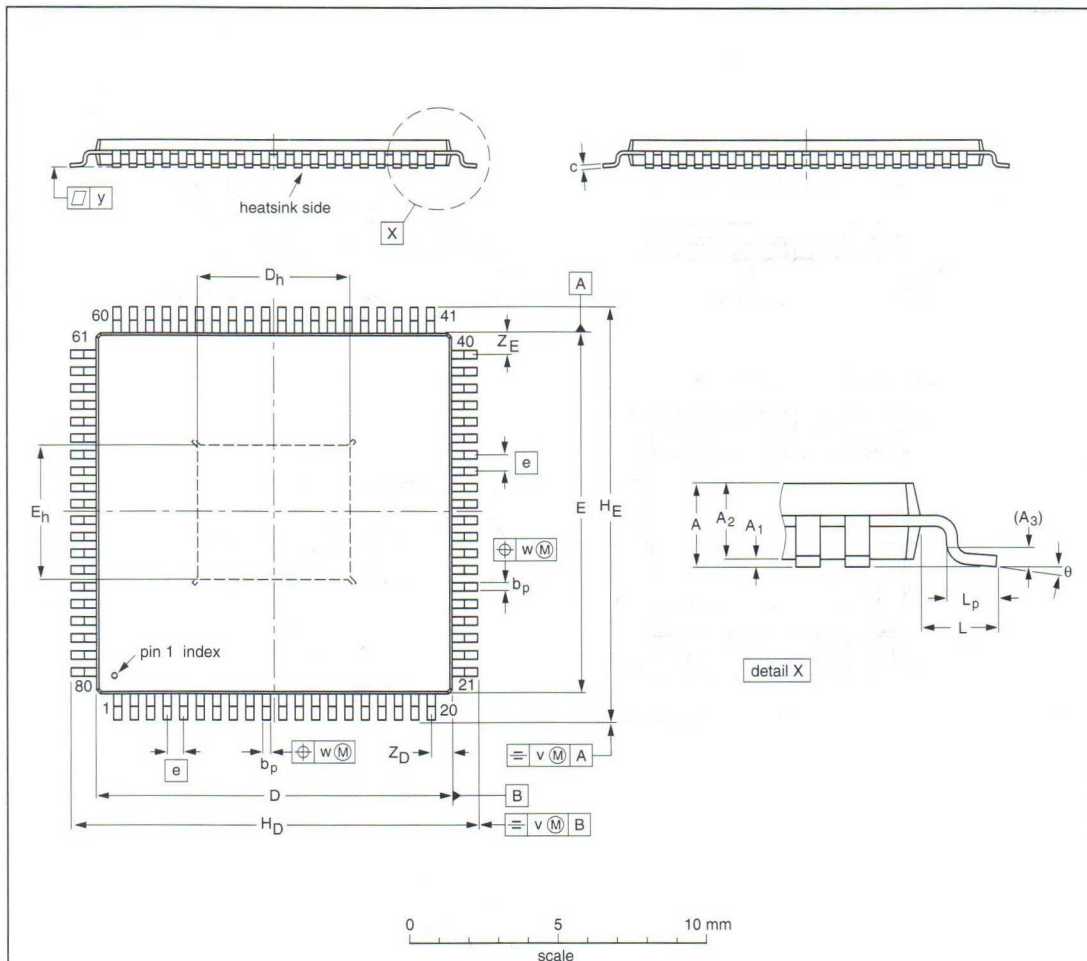
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT545-2						99-08-04

IC package range and dimensions

Chapter 2

HTQFP80: plastic, heatsink thin quad flat package; 80 leads; body 14 x 14 x 1.0 mm

SOT513-1



DIMENSIONS (mm are the original dimensions)

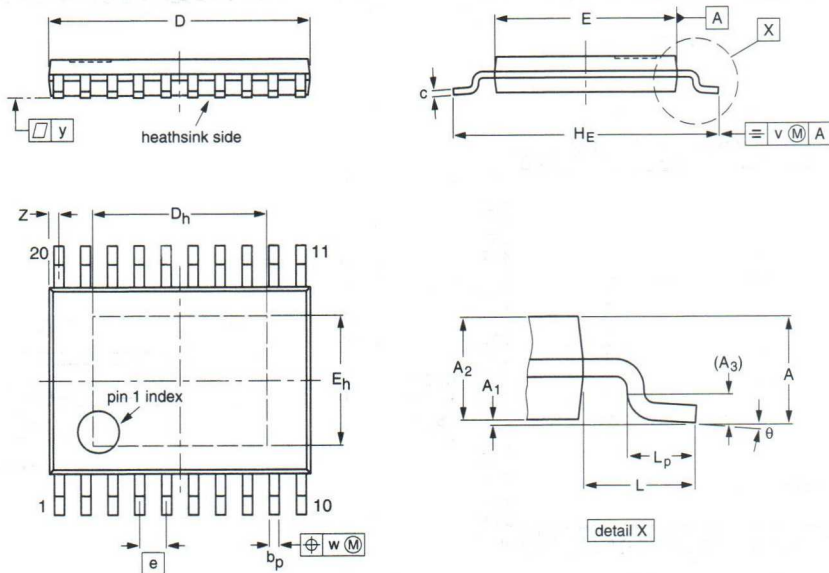
UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D _h	E ⁽¹⁾	E _h	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.38 0.22	0.20 0.09	14.1 13.9	6.5 5.5	14.1 13.9	5.8 4.8	0.65	16.15 15.85	16.15 15.85	1.0	0.75 0.45	0.2	0.13	0.1	1.02 0.63	1.02 0.63	7° 0°

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			
SOT513-1						-99-02-06 99-11-23

HTSSOP20: plastic, heatsink thin shrink small outline package; 20 leads; body width 4.4 mm SOT527-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D _h	E ⁽²⁾	E _h	e	H _E	L	L _p	v	w	y	Z ⁽¹⁾	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.20 0.09	6.6 6.4	4.3 4.1	4.5 4.3	3.10 2.90	0.65	6.6 6.2	1.0	0.75 0.50	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.

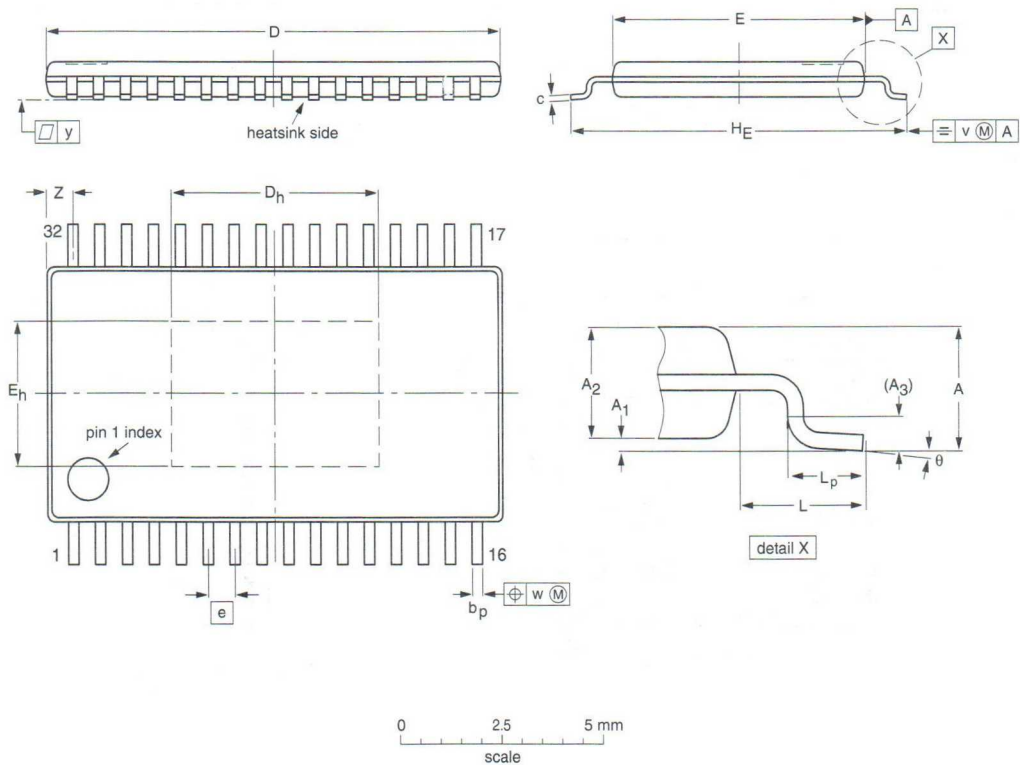
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT527-1						99-02-06- 99-11-12

IC package range and dimensions

Chapter 2

HTSSOP32: plastic, heatsink thin shrink small outline package; 32 leads; body width 6.1 mm; lead pitch 0.65 mm

SOT549-1



DIMENSIONS (mm are the original dimensions).

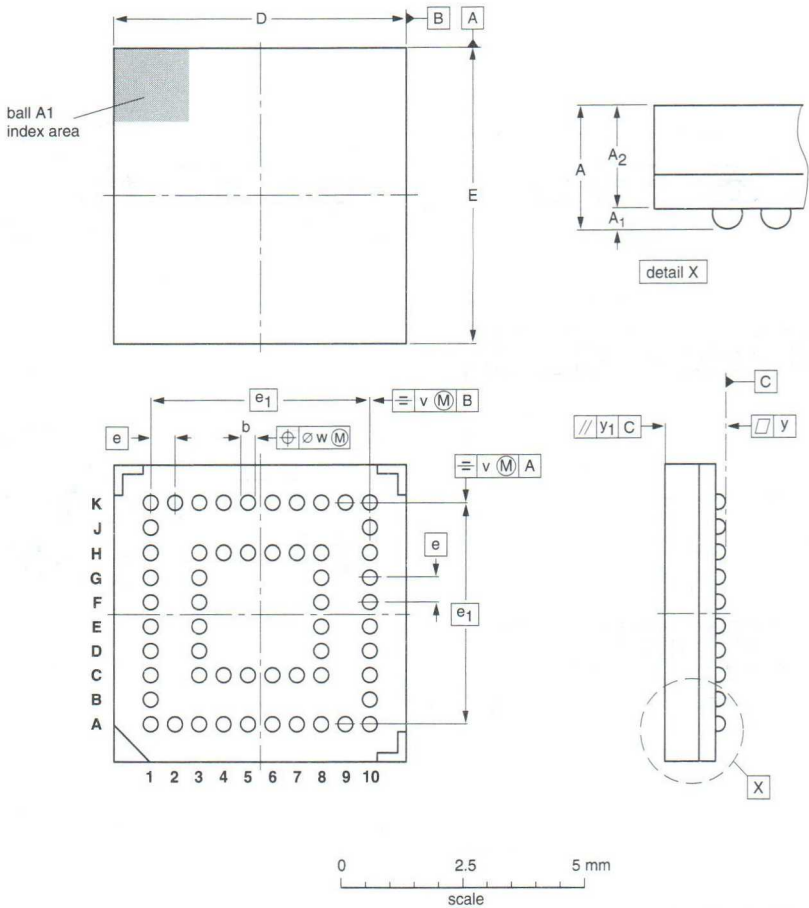
UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	D _h	E ⁽²⁾	E _h	e	H _E	L	L _p	v	w	y	Z	θ
mm	1.10	0.15 0.05	0.95 0.85	0.25	0.30 0.19	0.20 0.09	11.10 10.90	5.10 4.90	6.20 6.00	3.60 3.40	0.65	8.30 7.90	1.00	0.75 0.50	0.20	0.10	0.10	0.78 0.48	8° 0°

- 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			
SOT549-1						99-03-04

LFBGA56: plastic low profile fine-pitch ball grid array package; 56 balls; body 6 x 6 x 1.05 mm

SOT516-1

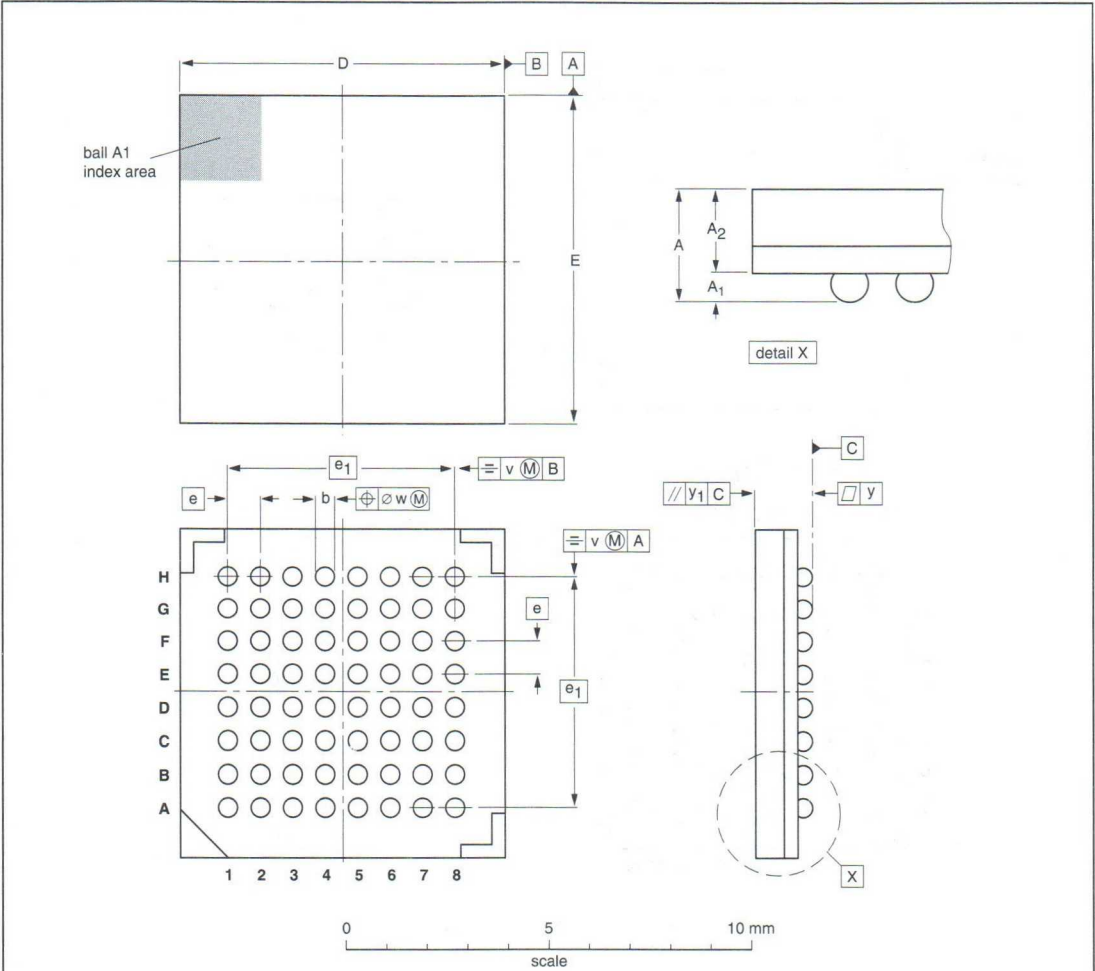


DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.35	0.25 0.15	1.2 0.9	0.35 0.25	6.1 5.9	6.1 5.9	0.5	4.5	0.15	0.1	0.1	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT516-1						99-12-02- 00-03-04

LFBGA64: plastic low profile fine-pitch ball grid array package; 64 balls; body 8 x 8 x 1.05 mm SOT534-1

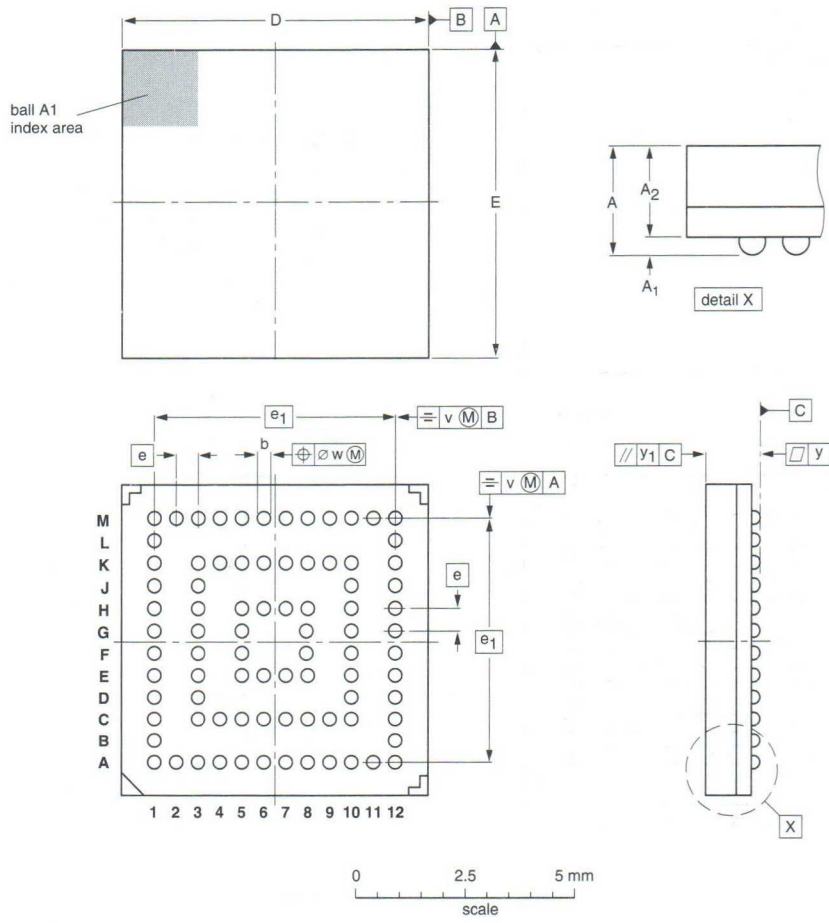


DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.50	0.41 0.31	1.2 0.9	0.51 0.41	8.1 7.9	8.1 7.9	0.8	5.6	0.15	0.1	0.1	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT534-1						-99-12-02- 00-03-04

LFBGA84: plastic low profile fine-pitch ball grid array package; 84 balls; body 7 x 7 x 1.05 mm SOT518-1



DIMENSIONS (mm are the original dimensions)

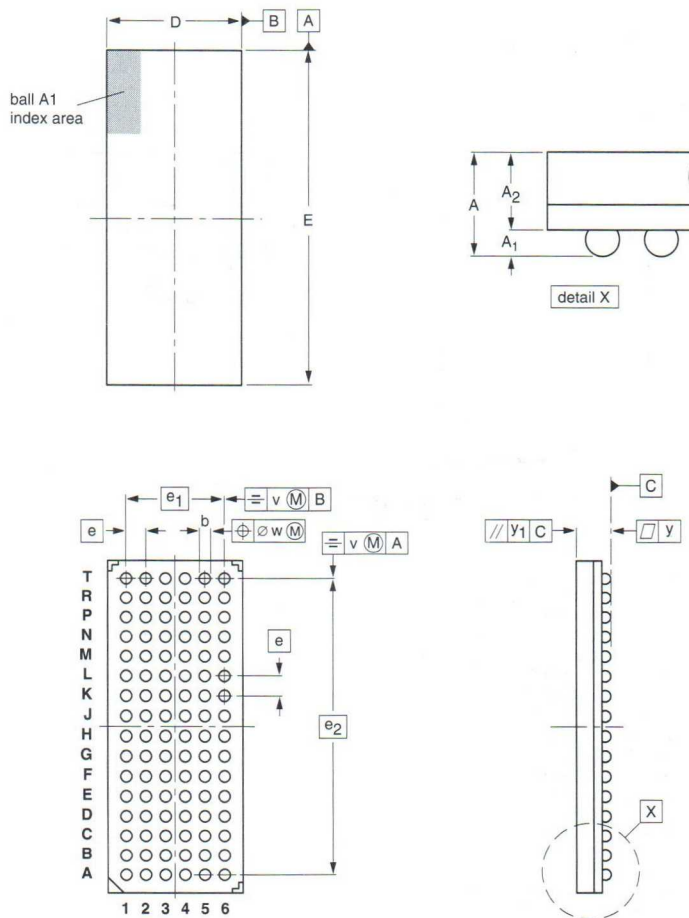
UNIT	A max.	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.35	0.25 0.15	1.2 0.9	0.35 0.25	7.1 6.9	7.1 6.9	0.5	5.5	0.15	0.1	0.1	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT518-1						99-12-02 00-03-04

IC package range and dimensions

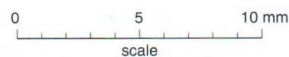
Chapter 2

LFBGA96: plastic low profile fine-pitch ball grid array package; 96 balls; body 13.5 x 5.5 x 1.05 mm SOT536-1



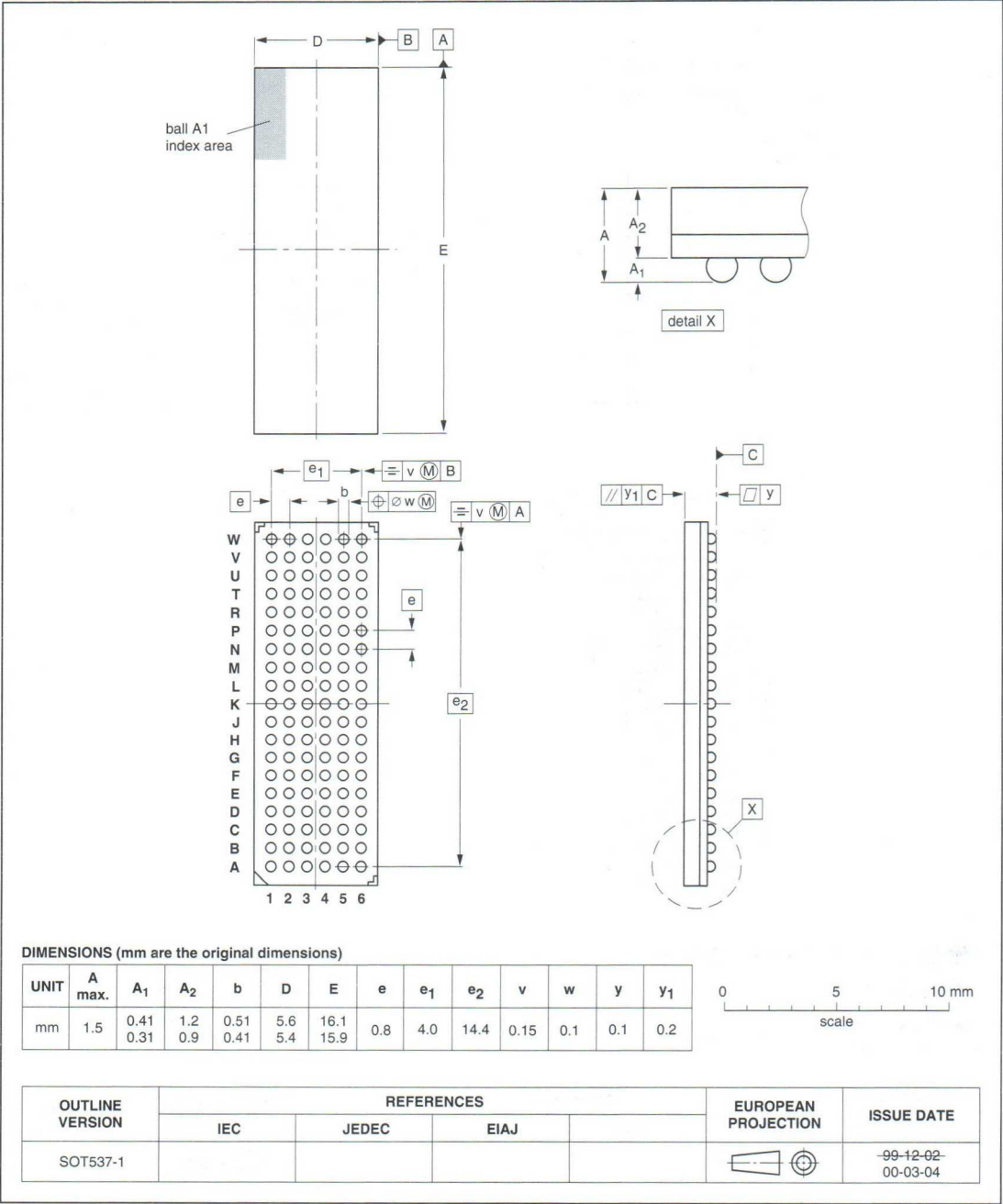
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	E	e	e ₁	e ₂	v	w	y	y ₁
mm	1.5	0.41 0.31	1.2 0.9	0.51 0.41	5.6 5.4	13.6 13.4	0.8	4.0	12.0	0.15	0.1	0.1	0.2

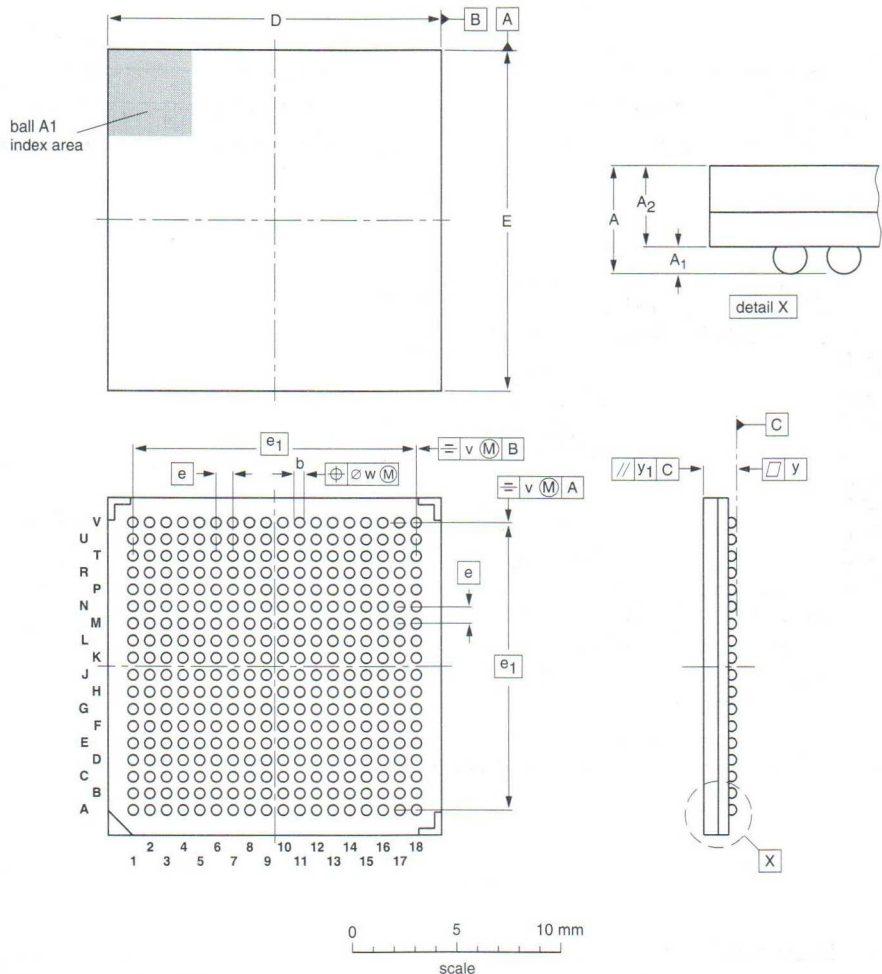


OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT536-1						-99-12-02- 00-03-04

LFBGA114: plastic low profile fine-pitch ball grid array package; 114 balls; body 16 x 5.5 x 1.05 mm SOT537-1



LFBGA324: plastic low profile fine-pitch ball grid array package; 324 balls; body 16 x 16 x 1.2 mm SOT571-1



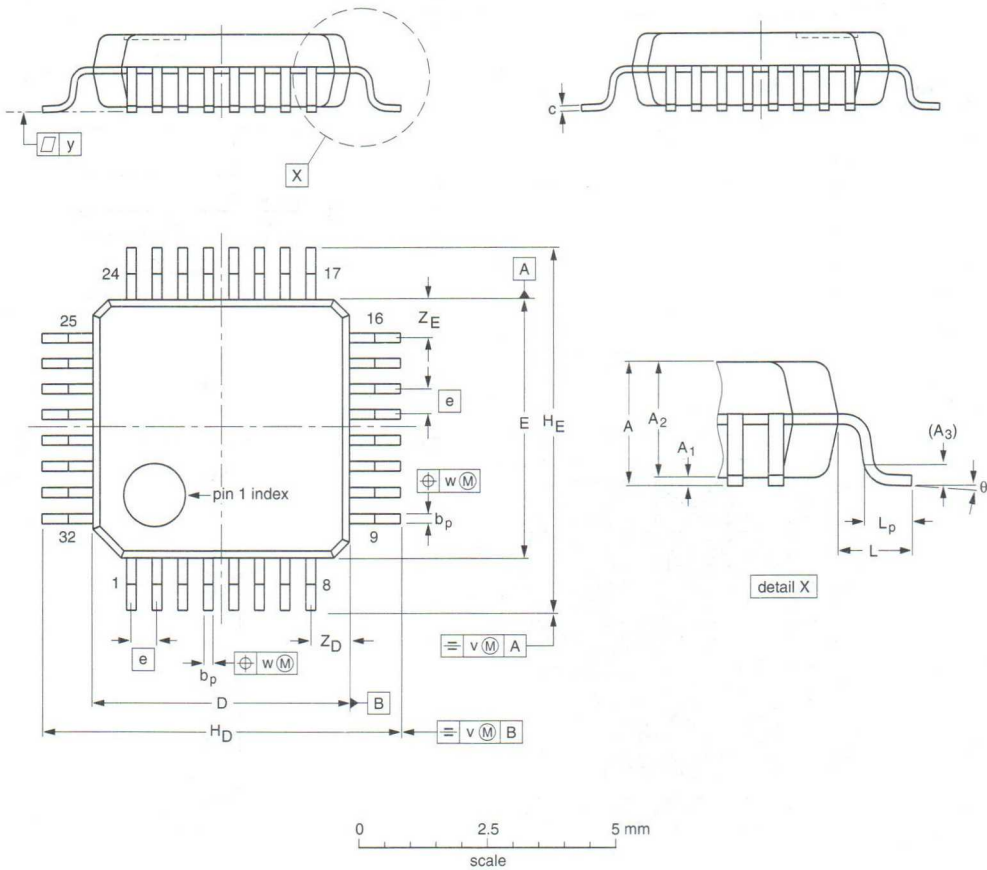
DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.70	0.45 0.35	1.35 1.05	0.55 0.45	16.1 15.9	16.1 15.9	0.8	13.6	0.15	0.1	0.12	0.10

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT571-1		MO-205				-00-01-20- 00-03-04

LQFP32: plastic low profile quad flat package; 32 leads; body 5 x 5 x 1.4 mm

SOT401-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.15 0.05	1.5 1.3	0.25	0.27 0.17	0.18 0.12	5.1 4.9	5.1 4.9	0.5	7.15 6.85	7.15 6.85	1.0	0.75 0.45	0.2	0.12	0.1	0.95 0.55	0.95 0.55	7° 0°

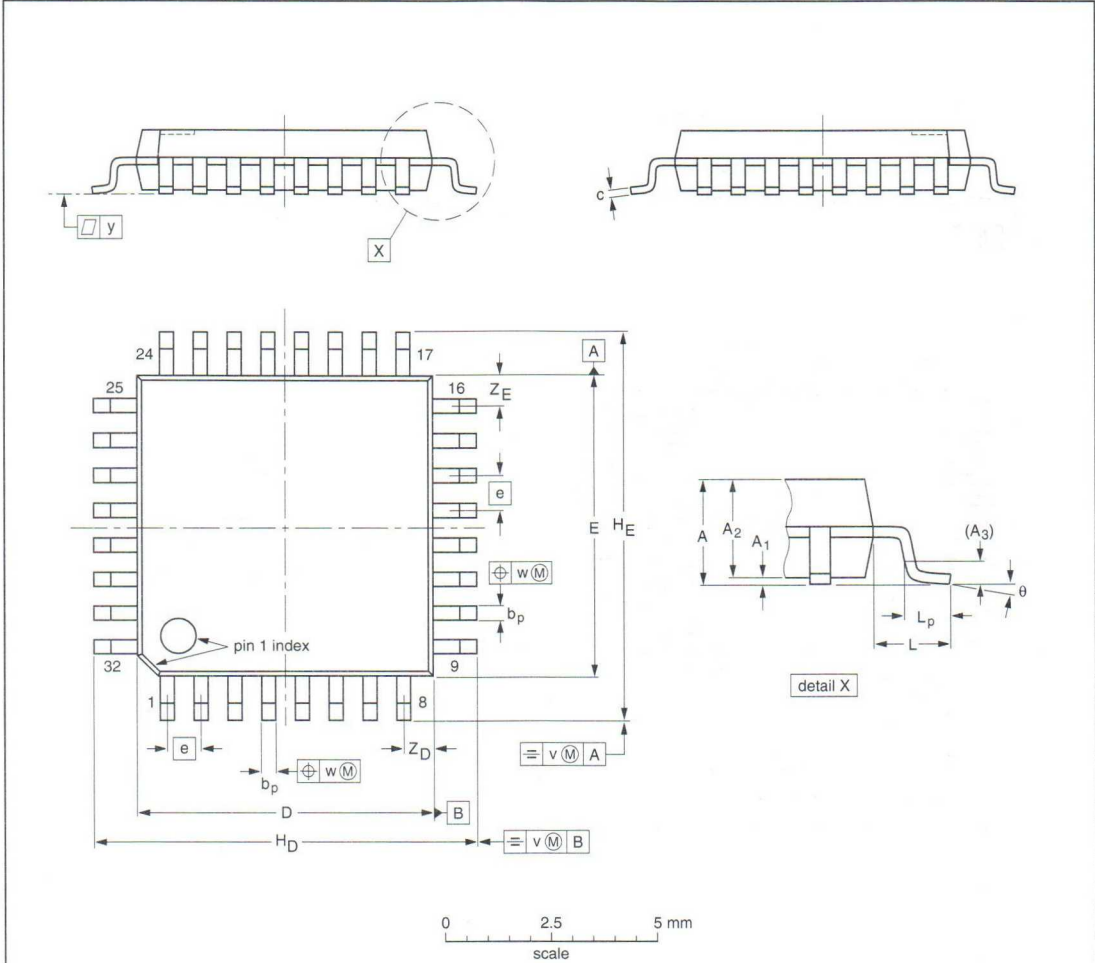
Note

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			
SOT401-1	136E01	MS-026				99-12-27- 00-01-19

LQFP32: plastic low profile quad flat package; 32 leads; body 7 x 7 x 1.4 mm

SOT358-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.4 0.3	0.18 0.12	7.1 6.9	7.1 6.9	0.8	9.15 8.85	9.15 8.85	1.0	0.75 0.45	0.2	0.25	0.1	0.9 0.5	0.9 0.5	7° 0°

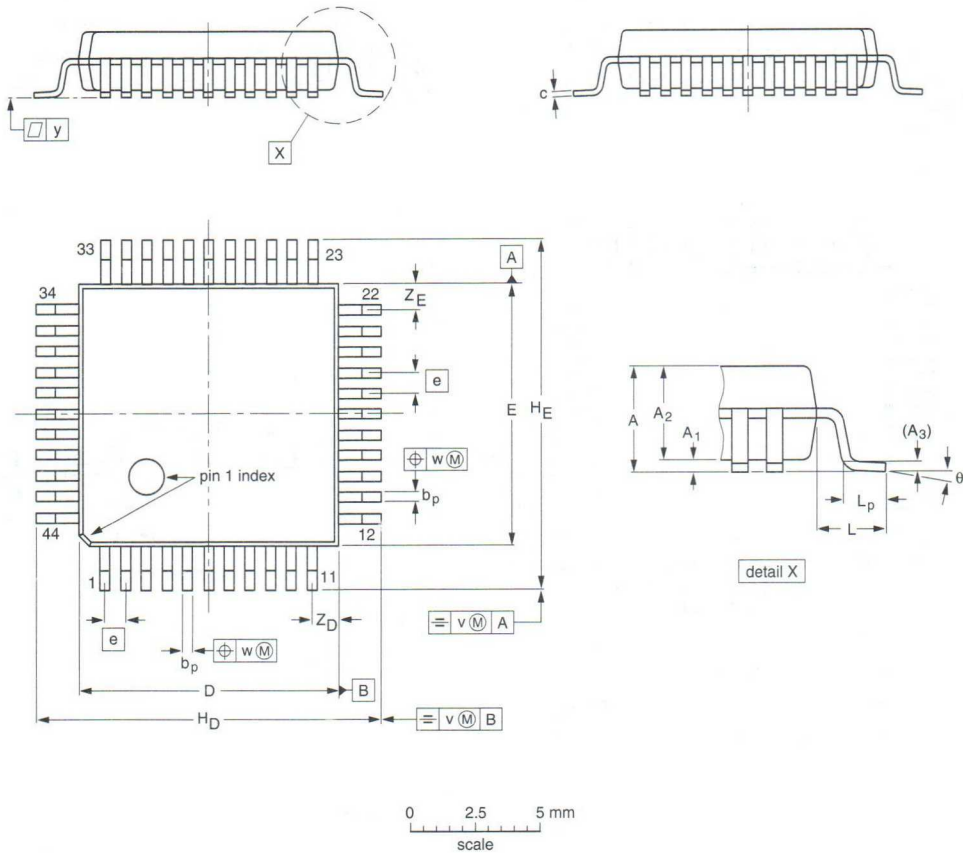
Note

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			
SOT358 -1	136E03	MS-026				99-12-27 00-01-19

LQFP44: plastic low profile quad flat package; 44 leads; body 10 x 10 x 1.4 mm

SOT389-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.15 0.05	1.45 1.35	0.25	0.45 0.30	0.20 0.12	10.10 9.90	10.10 9.90	0.80	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.20	0.20	0.10	1.14 0.85	1.14 0.85	7° 0°

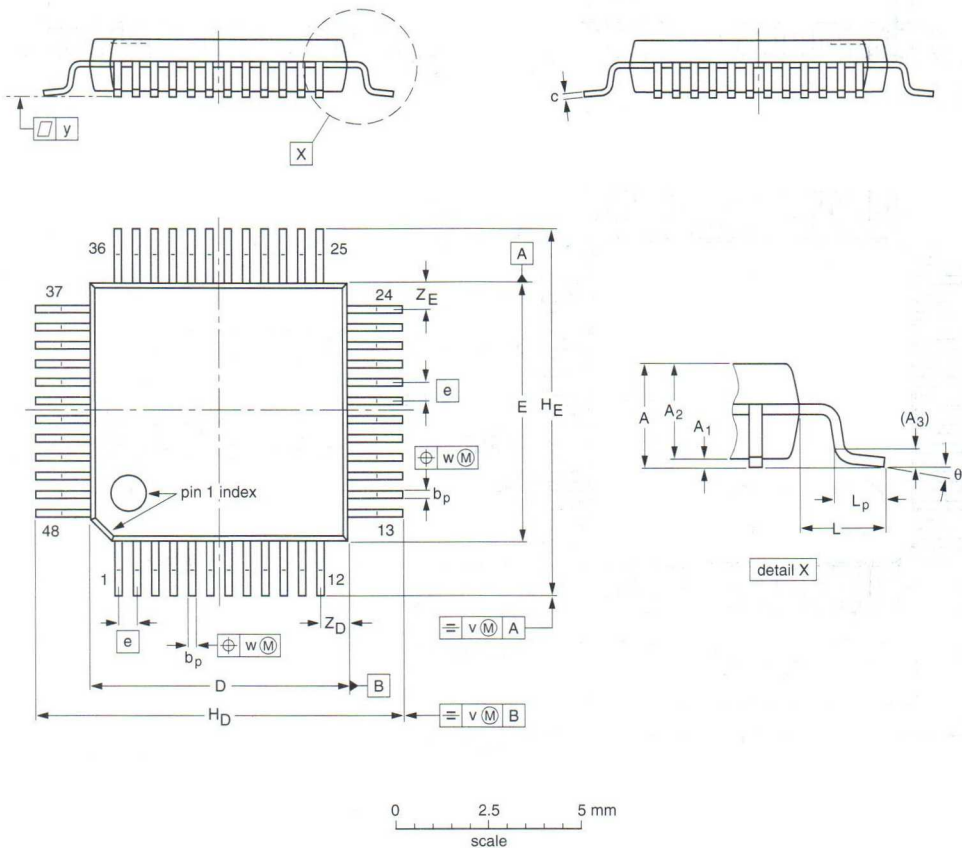
Note

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			
SOT389-1	136E08	MS-026				99-12-17 00-01-19

LQFP48: plastic low profile quad flat package; 48 leads; body 7 x 7 x 1.4 mm

SOT313-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.27 0.17	0.18 0.12	7.1 6.9	7.1 6.9	0.5	9.15 8.85	9.15 8.85	1.0	0.75 0.45	0.2	0.12	0.1	0.95 0.55	0.95 0.55	7° 0°

Note

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

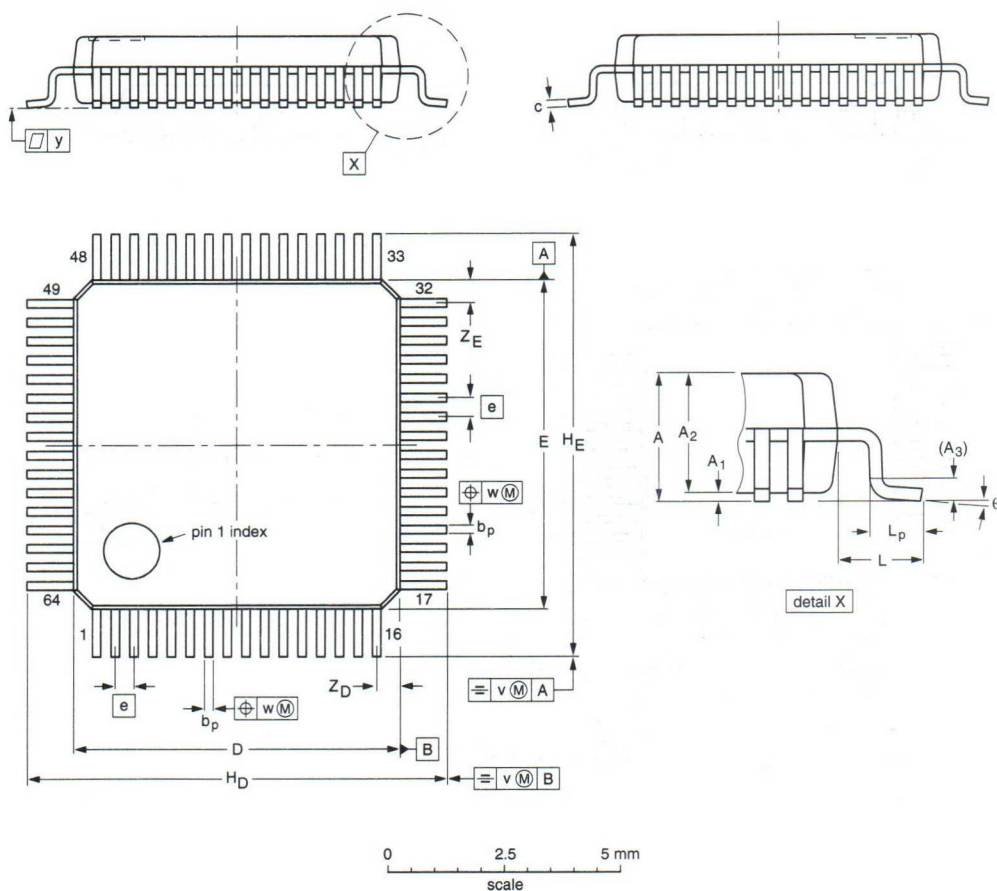
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT313-2	136E05	MS-026				99-12-27 00-01-19

IC package range and dimensions

Chapter 2

LQFP64: plastic low profile quad flat package; 64 leads; body 7 x 7 x 1.4 mm

SOT414-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.23 0.13	0.20 0.09	7.1 6.9	7.1 6.9	0.4	9.15 8.85	9.15 8.85	1.0	0.75 0.45	0.2	0.08	0.08	0.64 0.36	0.64 0.36	7° 0°

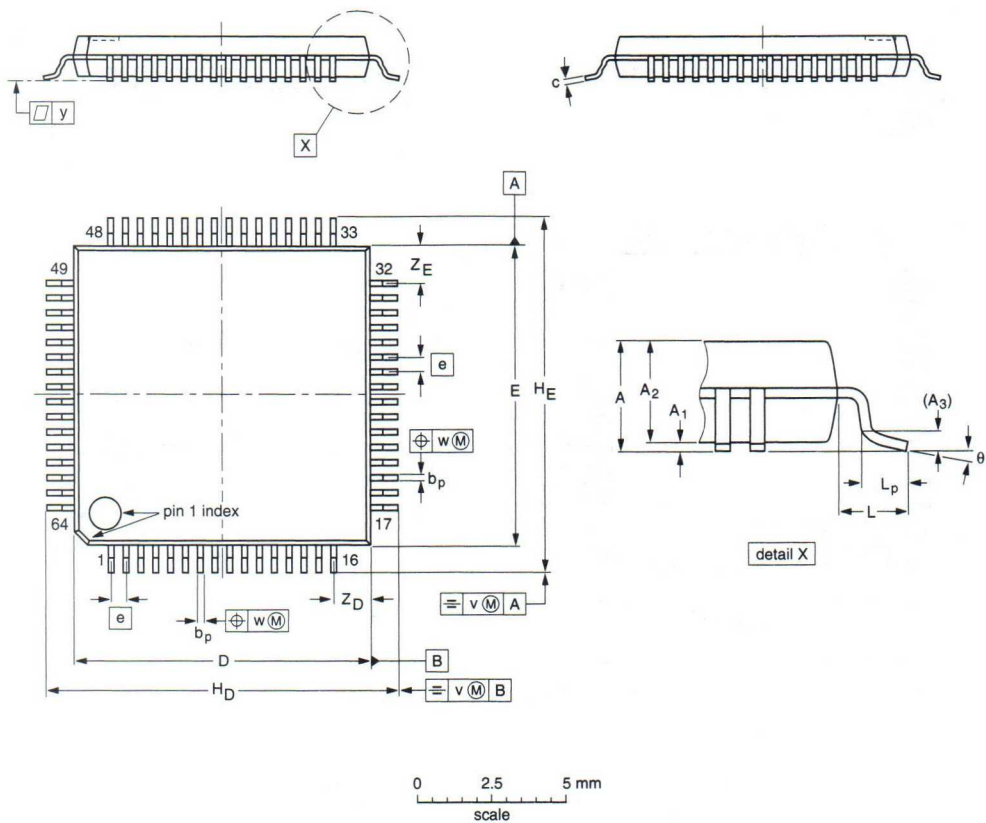
Note

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			
SOT414-1	136E06	MS-026				99-12-27 00-01-19

LQFP64: plastic low profile quad flat package; 64 leads; body 10 x 10 x 1.4 mm

SOT314-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.27 0.17	0.18 0.12	10.1 9.9	10.1 9.9	0.5	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.2	0.12	0.1	1.45 1.05	1.45 1.05	7° 0°

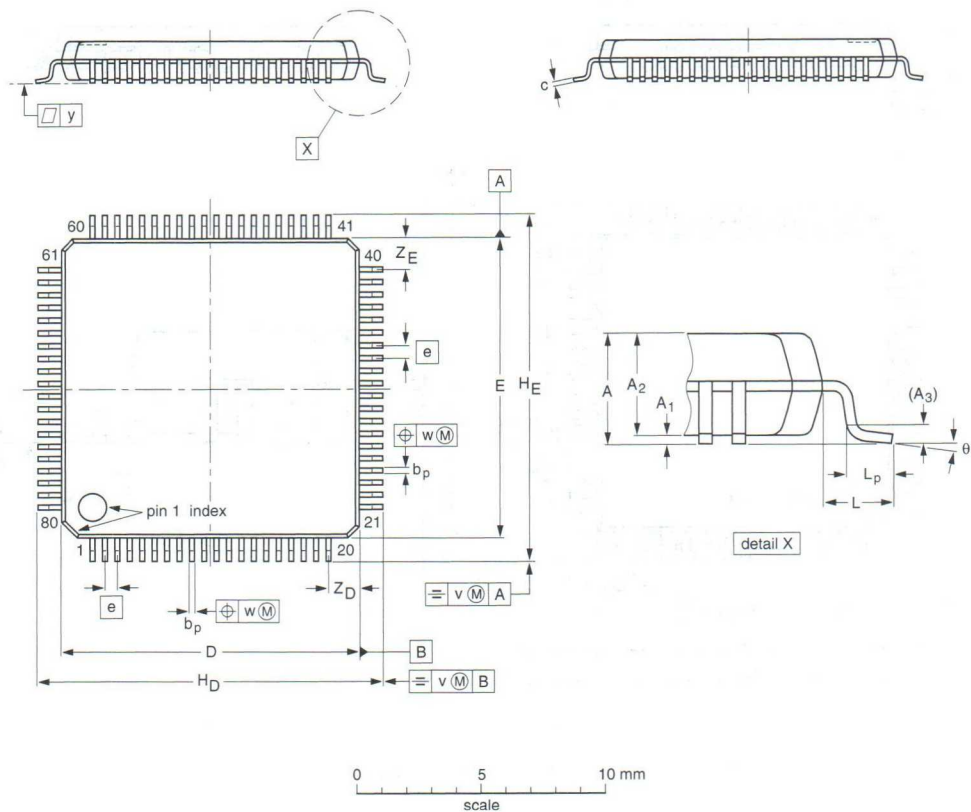
Note

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			
SOT314-2	136E10	MS-026				99-12-27 00-01-19

LQFP80: plastic low profile quad flat package; 80 leads; body 12 x 12 x 1.4 mm

SOT315-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.16 0.04	1.5 1.3	0.25	0.27 0.13	0.18 0.12	12.1 11.9	12.1 11.9	0.5	14.15 13.85	14.15 13.85	1.0	0.75 0.30	0.2	0.15	0.1	1.45 1.05	1.45 1.05	7° 0°

Note

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

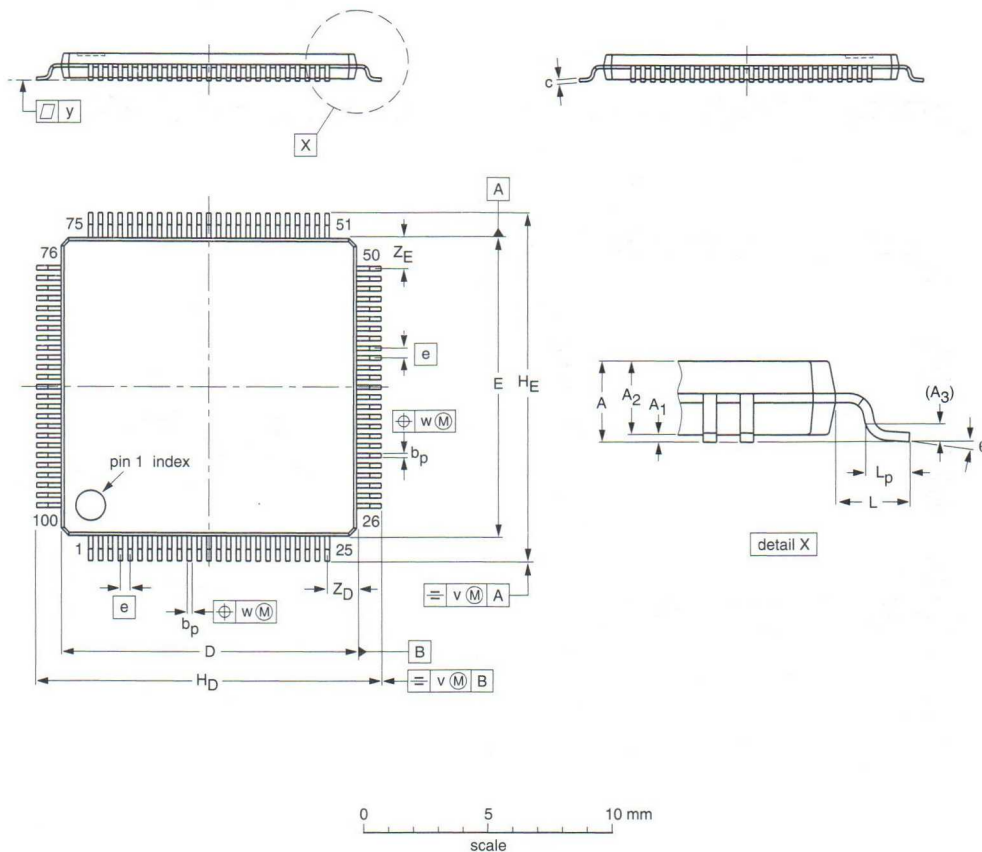
OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT315-1	136E15	MS-026			99-12-27 00-01-19

IC package range and dimensions

Chapter 2

LQFP100: plastic low profile quad flat package; 100 leads; body 12 x 12 x 1.4 mm

SOT572-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.15 0.05	1.45 1.35	0.25	0.23 0.13	0.20 0.09	12.1 11.9	12.1 11.9	0.4	14.15 13.85	14.15 13.85	1.0	0.75 0.45	0.2	0.07	0.08	1.3 1.1	1.3 1.1	7° 0°

Note

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

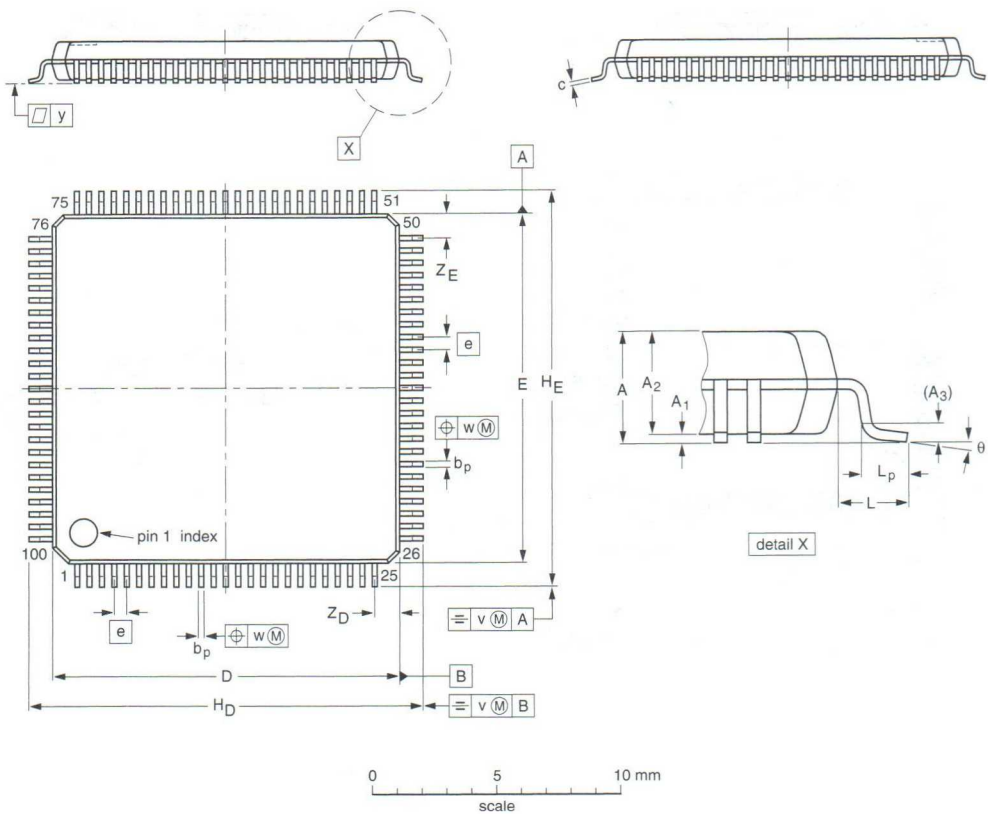
OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT572-1		MS-026			1999-12-08

IC package range and dimensions

Chapter 2

LQFP100: plastic low profile quad flat package; 100 leads; body 14 x 14 x 1.4 mm

SOT407-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.27 0.17	0.20 0.09	14.1 13.9	14.1 13.9	0.5	16.25 15.75	16.25 15.75	1.0	0.75 0.45	0.2	0.08	0.08	1.15 0.85	1.15 0.85	7° 0°

Note

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

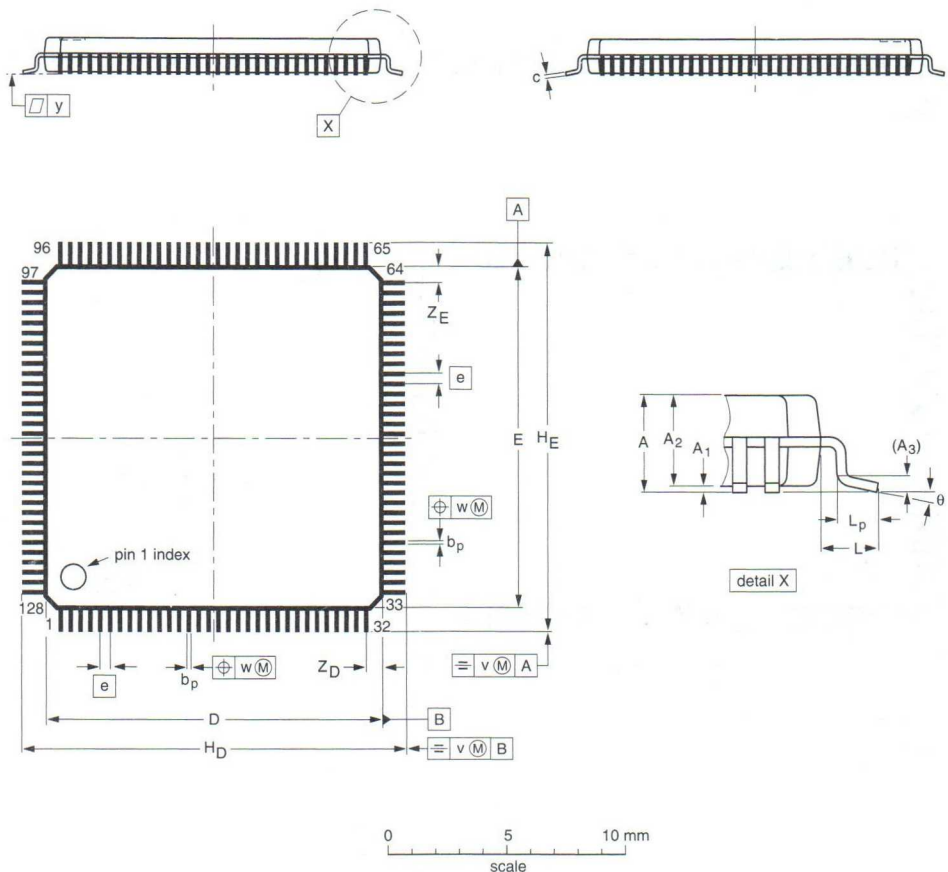
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT407-1	136E20	MS-026				00-01-19 00-02-01

IC package range and dimensions

Chapter 2

LQFP128: plastic low profile quad flat package; 128 leads; body 14 x 14 x 1.4 mm

SOT420-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.23 0.13	0.20 0.09	14.1 13.9	14.1 13.9	0.4	16.15 15.85	16.15 15.85	1.0	0.75 0.45	0.2	0.07	0.08	0.95 0.65	0.95 0.65	7° 0°

Note

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

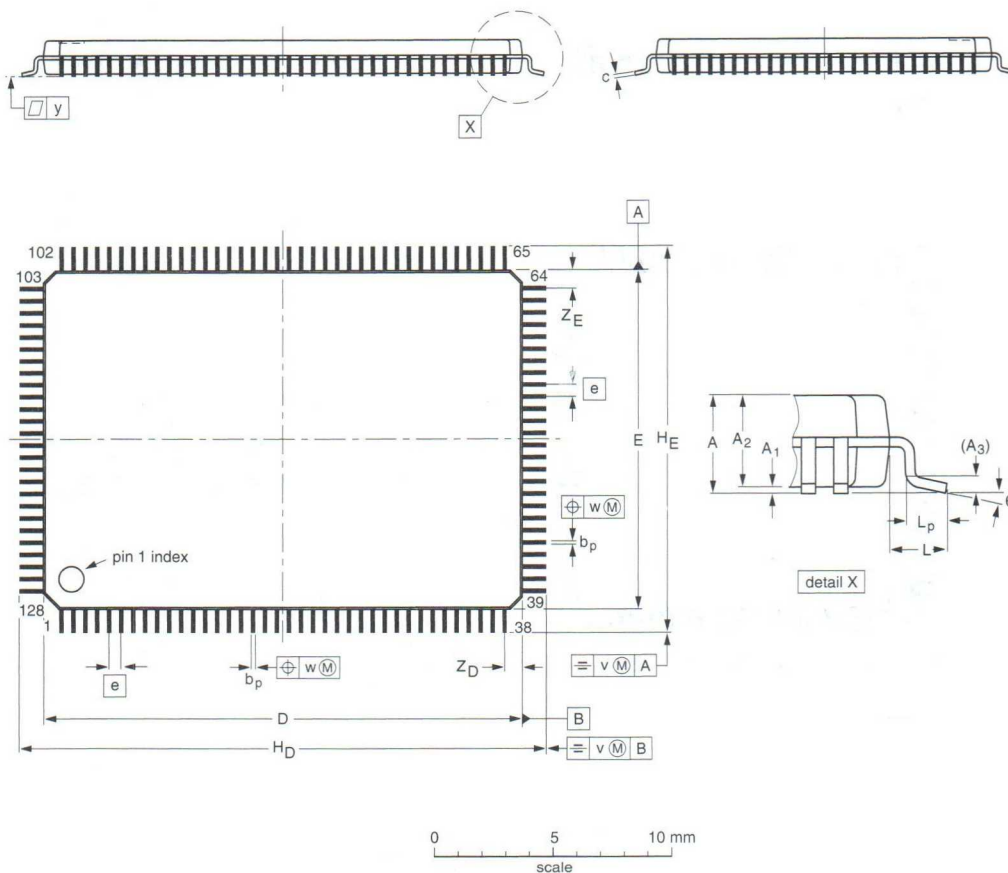
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT420-1		MS-026				-97-08-14 99-11-03

IC package range and dimensions

Chapter 2

LQFP128: plastic low profile quad flat package; 128 leads; body 14 x 20 x 1.4 mm

SOT425-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.15 0.05	1.45 1.35		0.25 0.17	0.20 0.09	20.1 19.9	14.1 13.9	0.5	22.15 21.85	16.15 15.85	1.0	0.75 0.45	0.2	0.12	0.1	0.81 0.59	0.81 0.59	7° 0°

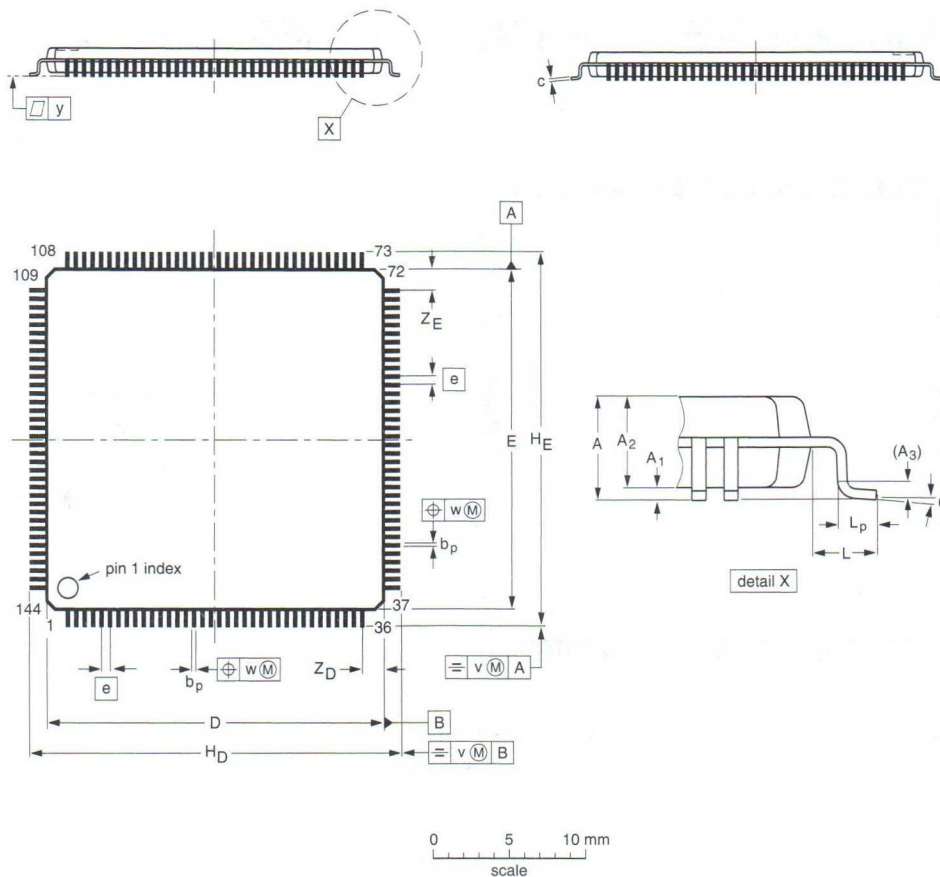
Note

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		
SOT425-1	136E28	MS-026			99-12-27 00-01-19

LQFP144: plastic low profile quad flat package; 144 leads; body 20 x 20 x 1.4 mm

SOT486-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.27 0.17	0.20 0.09	20.1 19.9	20.1 19.9	0.50	22.15 21.85	22.15 21.85	1.0	0.75 0.45	0.2	0.08	0.08	1.40 1.10	1.40 1.10	7° 0°

Note

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

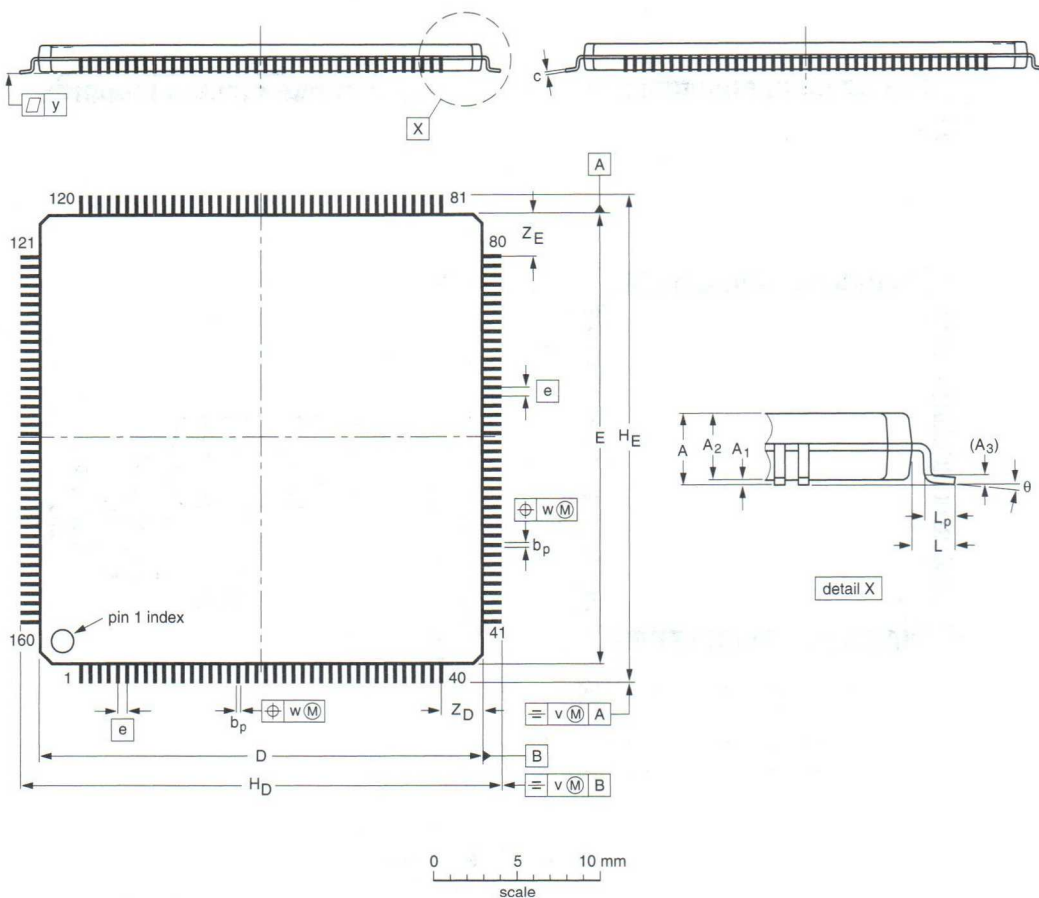
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT486-1	136E23	MS-026				00-01-19- 00-03-14

IC package range and dimensions

Chapter 2

LQFP160: plastic low profile quad flat package; 160 leads; body 24 x 24 x 1.4 mm

SOT435-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D	Z _E	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.27 0.17	0.20 0.09	24.1 23.9	24.1 23.9	0.5	26.15 25.85	26.15 25.85	1.0	0.75 0.45	0.12	0.15	0.1	2.45 2.05	2.45 2.05	7° 0°

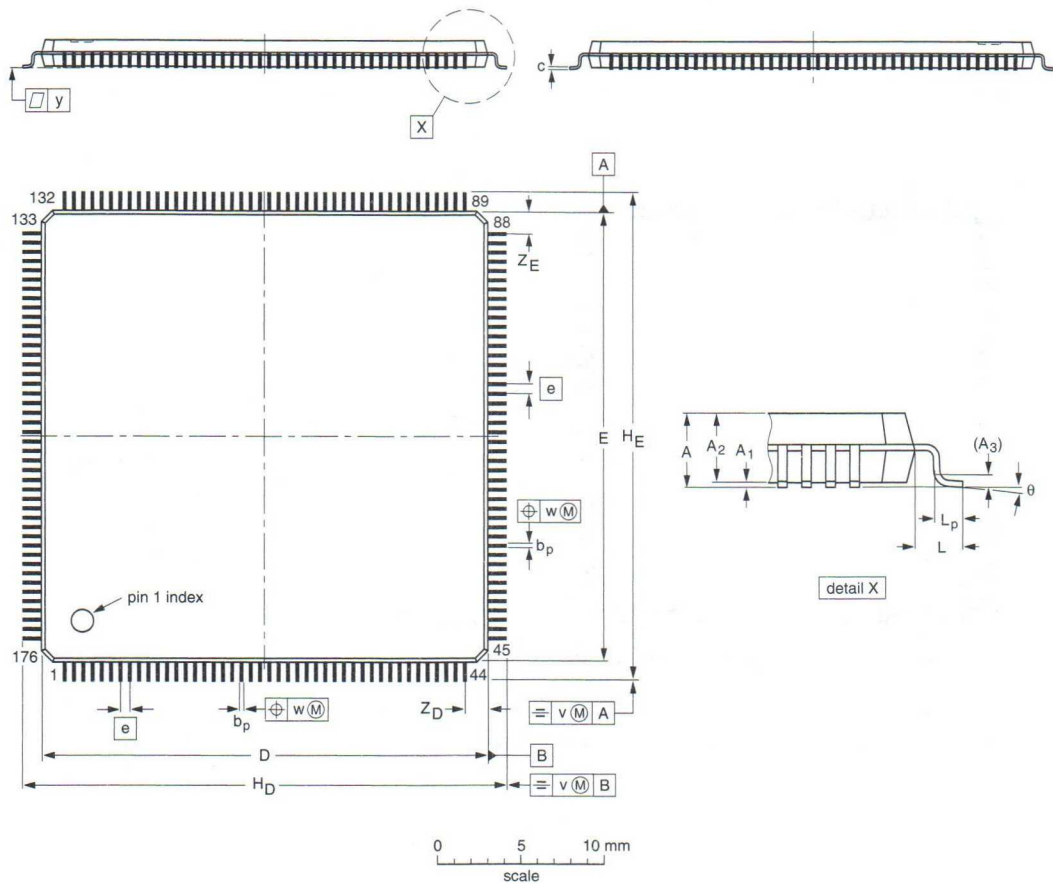
Note

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			
SOT435-1						97-08-04 97-10-02

LQFP176: plastic low profile quad flat package; 176 leads; body 24 x 24 x 1.4 mm

SOT506-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D	Z _E	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.27 0.17	0.20 0.09	24.1 23.9	24.1 23.9	0.5	26.15 25.85	26.15 25.85	1.0	0.75 0.45	0.12	0.08	0.08	1.43 1.08	1.43 1.08	7° 0°

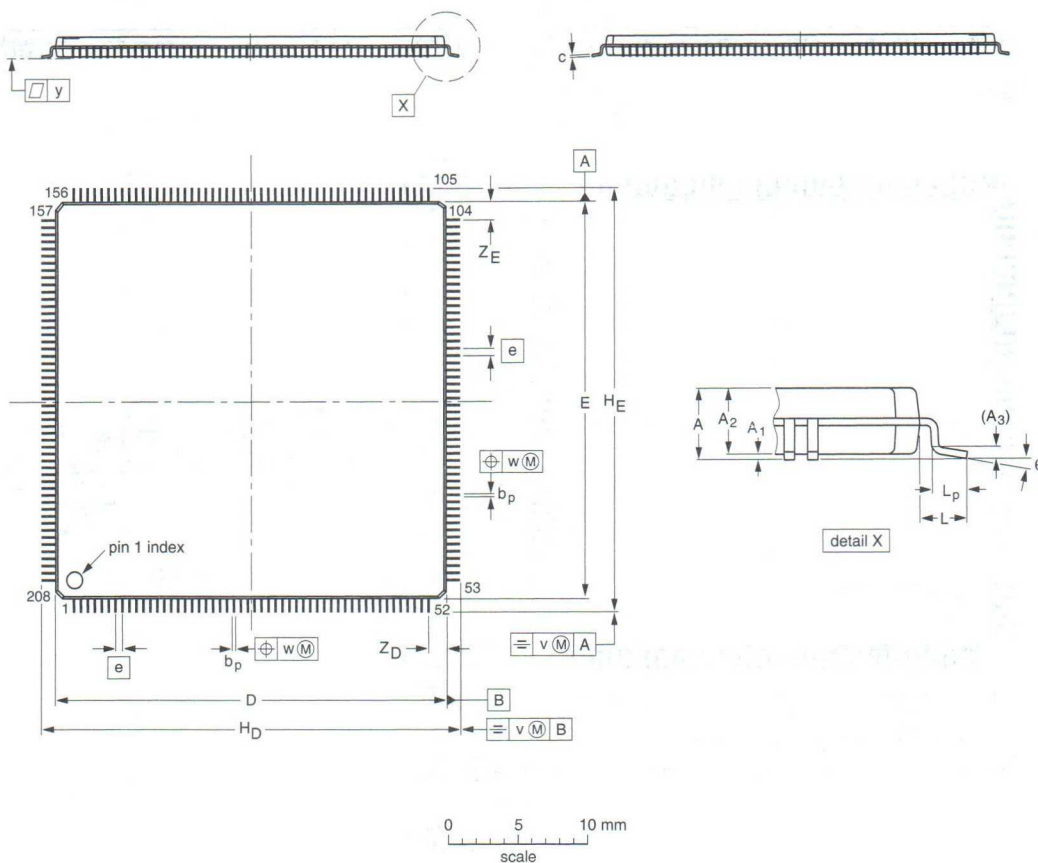
Note

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			
SOT506-1	136E25	MS-026				00-01+19 00-02-01

LQFP208; plastic low profile quad flat package; 208 leads; body 28 x 28 x 1.4 mm

SOT459-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D	Z _E	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.27 0.17	0.20 0.09	28.1 27.9	28.1 27.9	0.5	30.15 29.85	30.15 29.85	1.0	0.75 0.45	0.12	0.08	0.08	1.43 1.08	1.43 1.08	7° 0°

Note

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

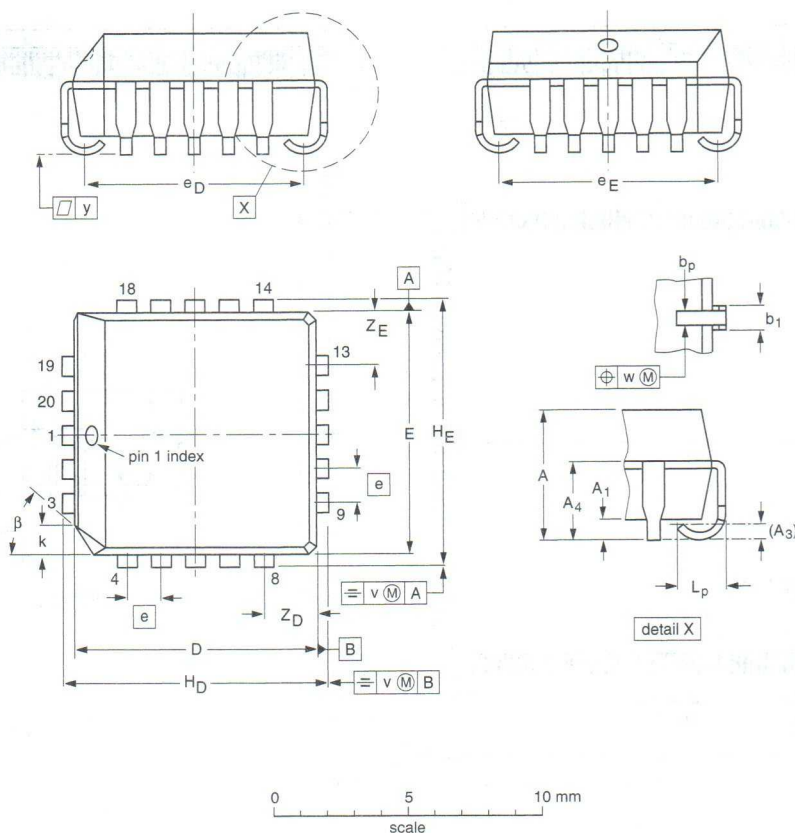
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT459-1	136E30	MS-026				00-01-19 00-02-06

IC package range and dimensions

Chapter 2

PLCC20: plastic leaded chip carrier; 20 leads

SOT380-1



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	L _p	v	w	y	Z _D ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	9.04 8.89	9.04 8.89	1.27	8.38 7.37	8.38 7.37	10.03 9.78	10.03 9.78	1.22 1.07	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.356 0.350	0.356 0.350	0.05	0.330 0.290	0.330 0.290	0.395 0.385	0.395 0.385	0.048 0.042	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

Note

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

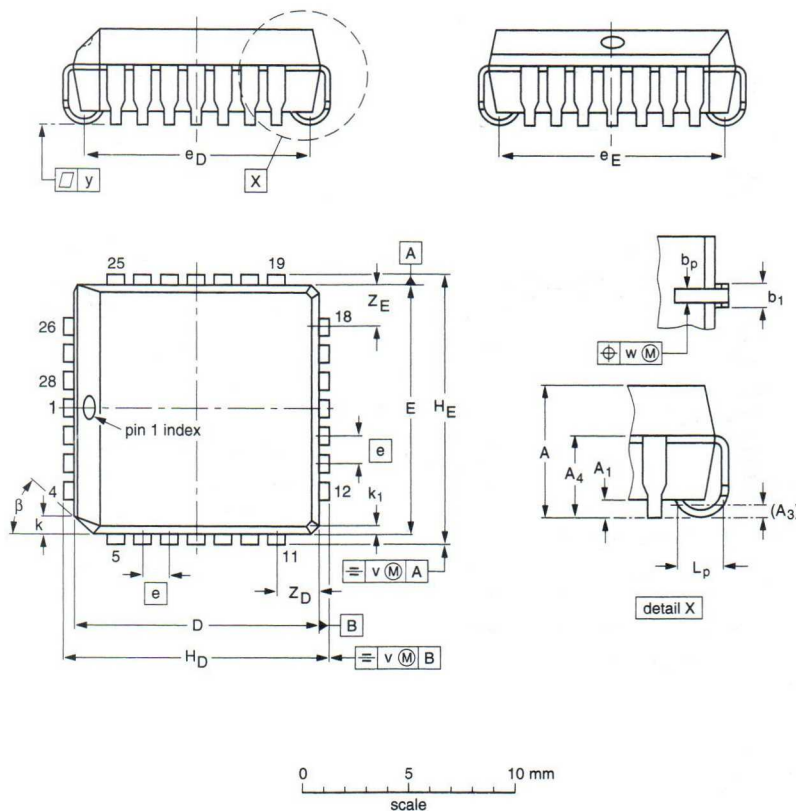
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT380-1	112E04	MO-047				97-12-16 99-12-27

IC package range and dimensions

Chapter 2

PLCC28: plastic leaded chip carrier; 28 leads

SOT261-2



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	k ₁ max.	L _p	v	w	y	Z _p ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	11.58 11.43	11.58 11.43	1.27	10.92 9.91	10.92 9.91	12.57 12.32	12.57 12.32	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.456 0.450	0.456 0.450	0.05	0.430 0.390	0.430 0.390	0.495 0.485	0.495 0.485	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

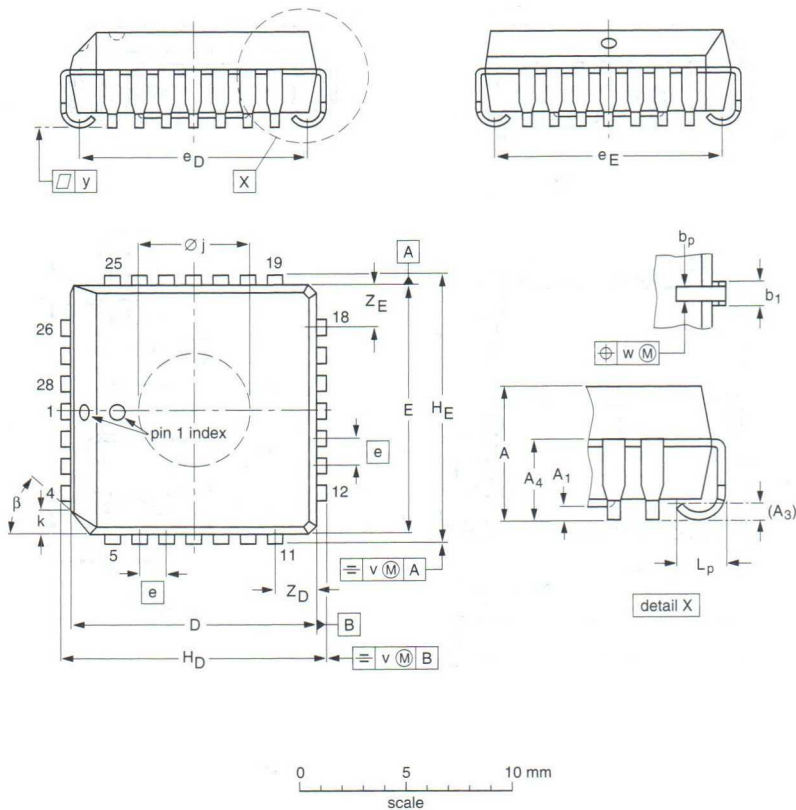
Note

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		
SOT261-2	112E08	MS-018			95-02-25 99-12-27

PLCC28: plastic leaded chip carrier; 28 leads; pedestal

SOT261-3



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	ØJ	L _p	v	w	y	Z _D ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	11.58 11.43	11.58 11.43	1.27	10.92 9.91	10.92 9.91	12.57 12.32	12.57 12.32	1.22 1.07	5.69 5.54	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	0.456 0.450	0.456 0.450	0.05	0.430 0.390	0.430 0.390	0.495 0.485	0.495 0.485	0.048 0.042	0.224 0.218	0.057 0.040	0.007	0.007	0.004	0.081	0.081	

Note

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

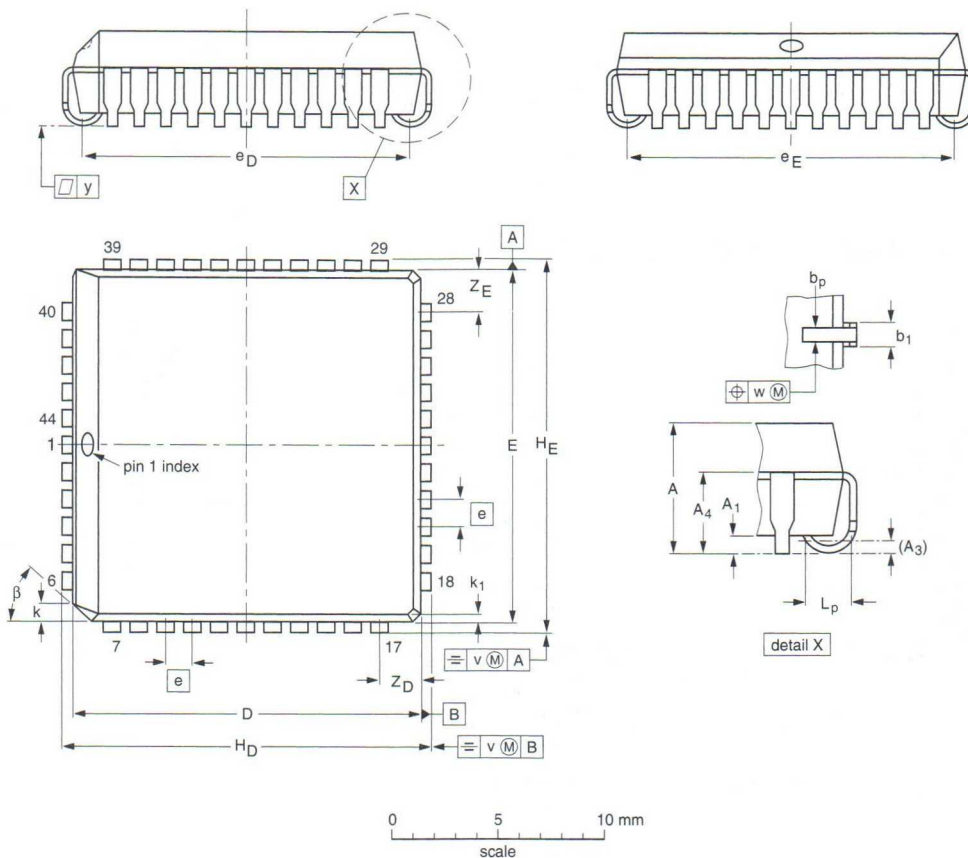
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT261-3	112E08	MO-047				97-12-16- 99-12-27

IC package range and dimensions

Chapter 2

PLCC44: plastic leaded chip carrier; 44 leads

SOT187-2



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	k ₁ max.	L _p	v	w	y	Z _p ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	16.66 16.51	16.66 16.51	1.27	16.00 14.99	16.00 14.99	17.65 17.40	17.65 17.40	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.656 0.650	0.656 0.650	0.05	0.630 0.590	0.630 0.590	0.695 0.685	0.695 0.685	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

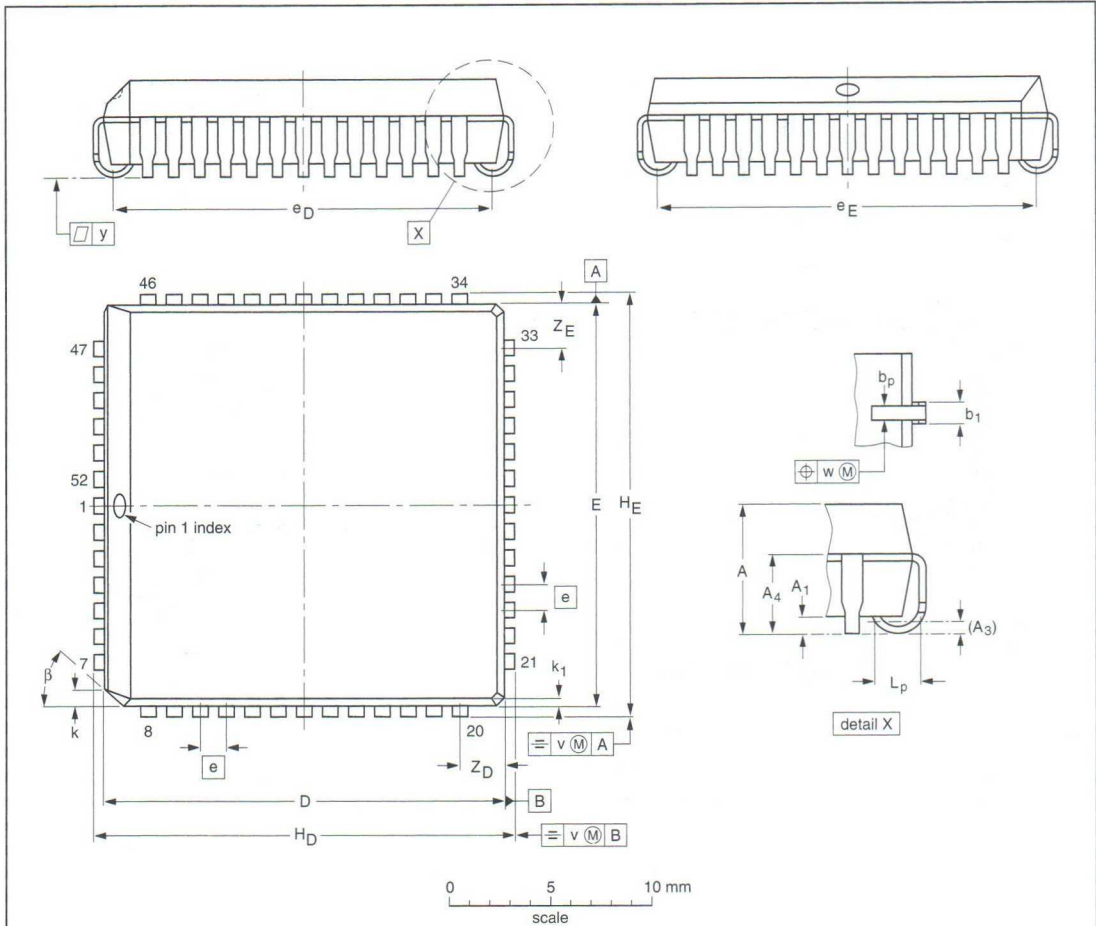
Note

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			
SOT187-2	112E10	MO-047				97-12-16 99-12-27

PLCC52: plastic leaded chip carrier; 52 leads

SOT238-2



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	k ₁ max.	L _p	v	w	y	Z _D ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	19.20 19.05	19.20 19.05	1.27	18.54 17.53	18.54 17.53	20.19 19.94	20.19 19.94	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.756 0.750	0.756 0.750	0.05	0.730 0.690	0.730 0.690	0.795 0.785	0.795 0.785	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

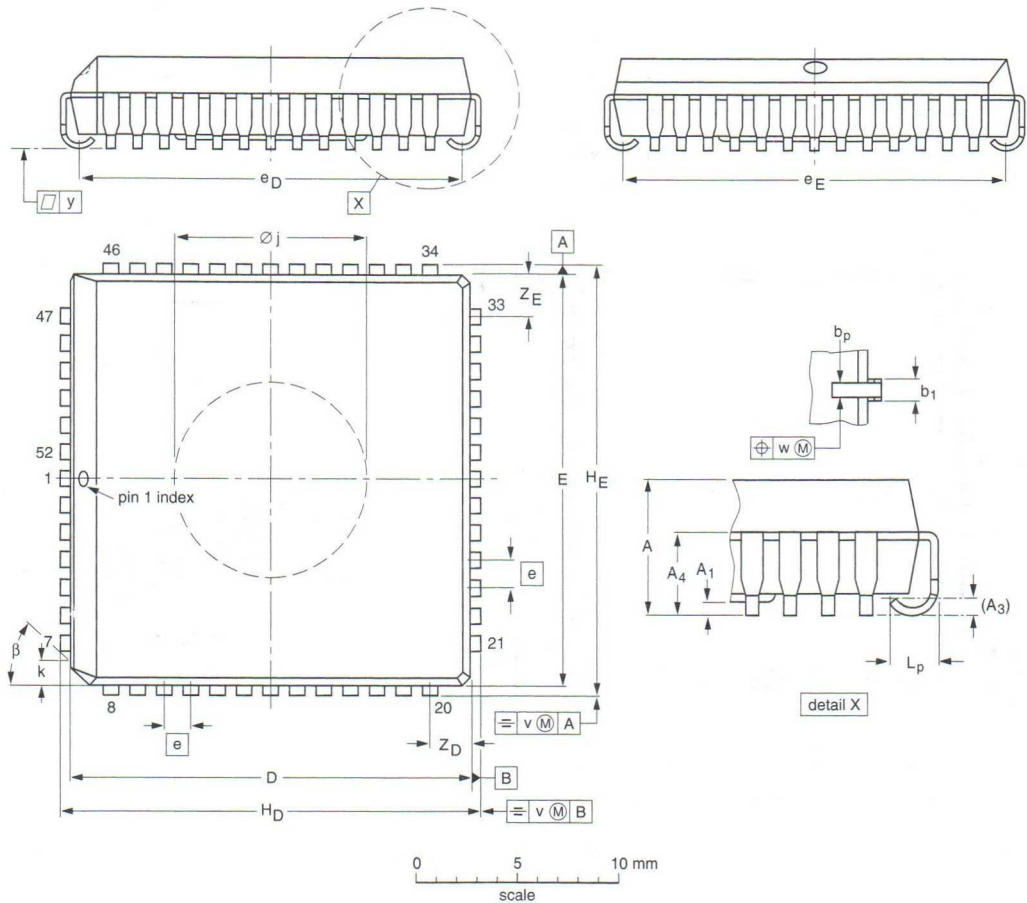
Note

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		
SOT238-2		MS-018			95-02-25 99-12-27

PLCC52: plastic leaded chip carrier; 52 leads; pedestal

SOT238-3



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	Øj	L _p	v	w	y	Z _p ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	19.20 19.05	19.20 19.05	1.27	18.54 17.53	18.54 17.53	20.19 19.94	20.19 19.94	1.22 1.07	9.25 9.09	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	0.756 0.750	0.756 0.750	0.05	0.730 0.690	0.730 0.690	0.795 0.785	0.795 0.785	0.048 0.042	0.364 0.358	0.057 0.040	0.007	0.007	0.004	0.081	0.081	

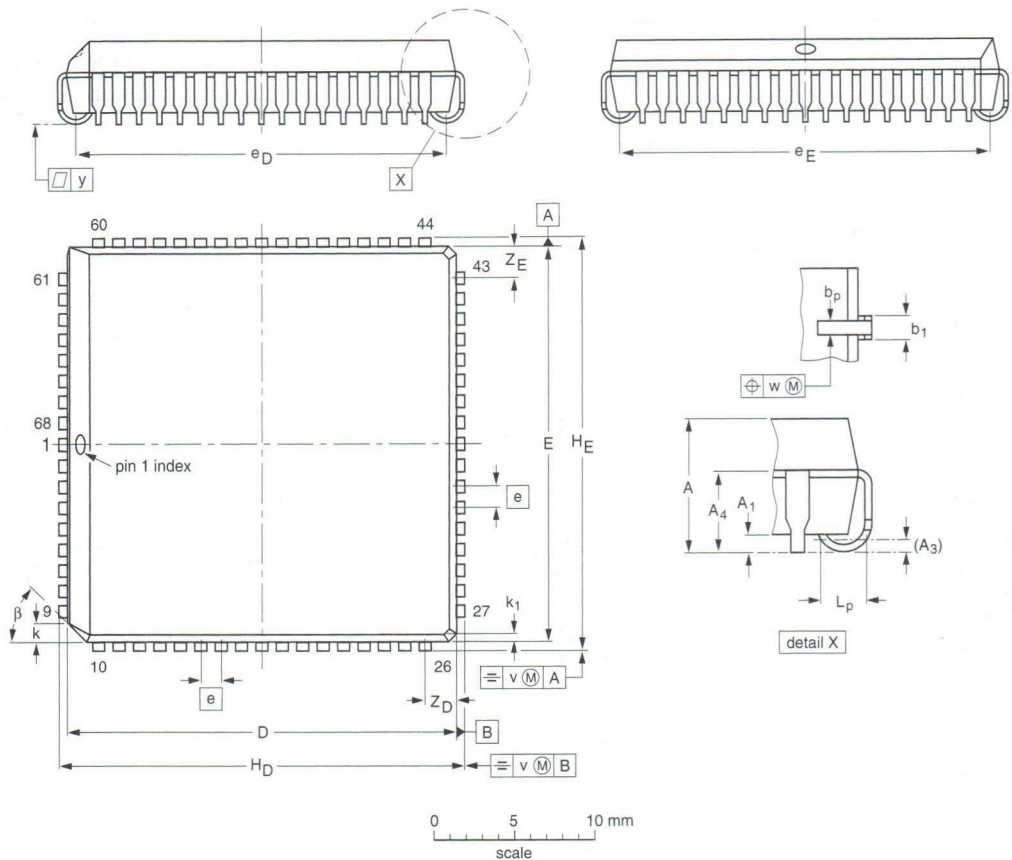
Note

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		
SOT238-3	112E11	MO-047			97-12-16 99-12-27

PLCC68: plastic leaded chip carrier; 68 leads

SOT188-2



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	k ₁ max.	L _p	v	w	y	Z _D ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.51	0.25	3.30	0.53 0.33	0.81 0.66	24.33 24.13	24.33 24.13	1.27	23.62 22.61	23.62 22.61	25.27 25.02	25.27 25.02	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.13	0.021 0.013	0.032 0.026	0.958 0.950	0.958 0.950	0.05	0.930 0.890	0.930 0.890	0.995 0.985	0.995 0.985	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

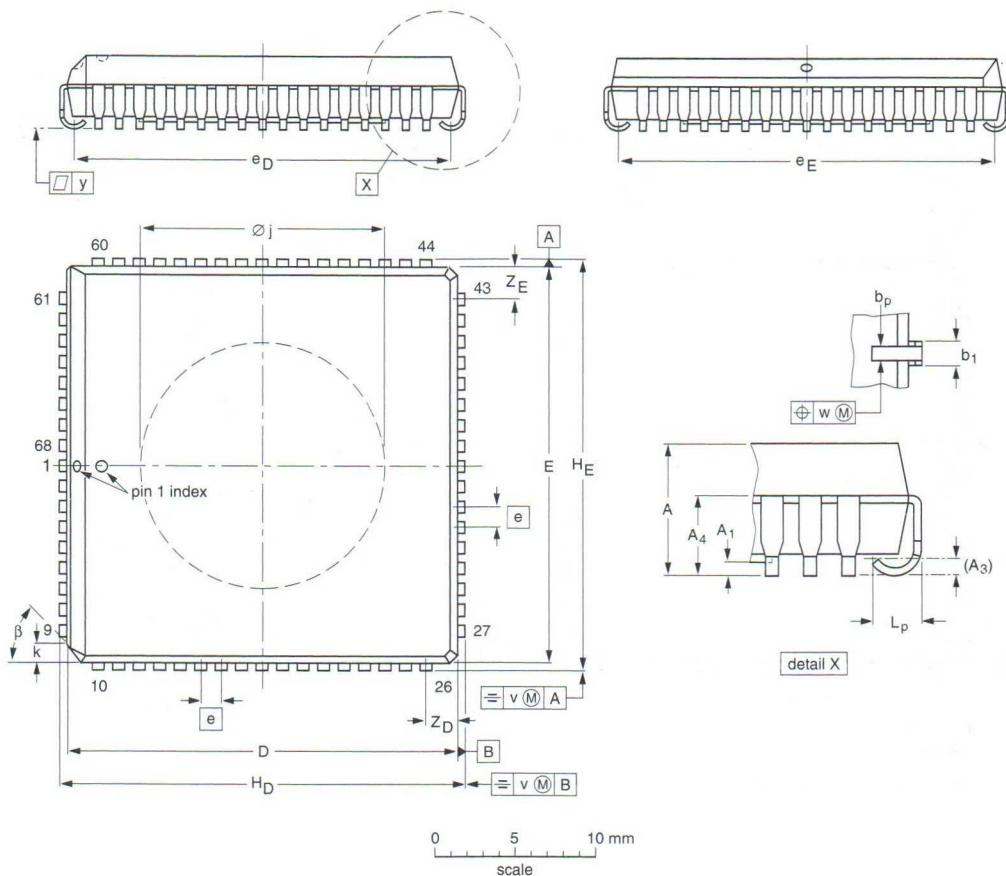
Note

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			
SOT188-2	112E10	MO-047				95-03-11 99-12-27

PLCC68: plastic leaded chip carrier; 68 leads; pedestal

SOT188-3



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	Ø _j	L _p	v	w	y	Z _p ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	24.33 24.13	24.33 24.13	1.27	23.62 22.61	23.62 22.61	25.27 25.02	25.27 25.02	1.22 1.07	15.34 15.19	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	0.958 0.950	0.958 0.950	0.05	0.930 0.890	0.930 0.890	0.995 0.985	0.995 0.985	0.048 0.042	0.604 0.598	0.040 0.040	0.007	0.007	0.004	0.081	0.081	

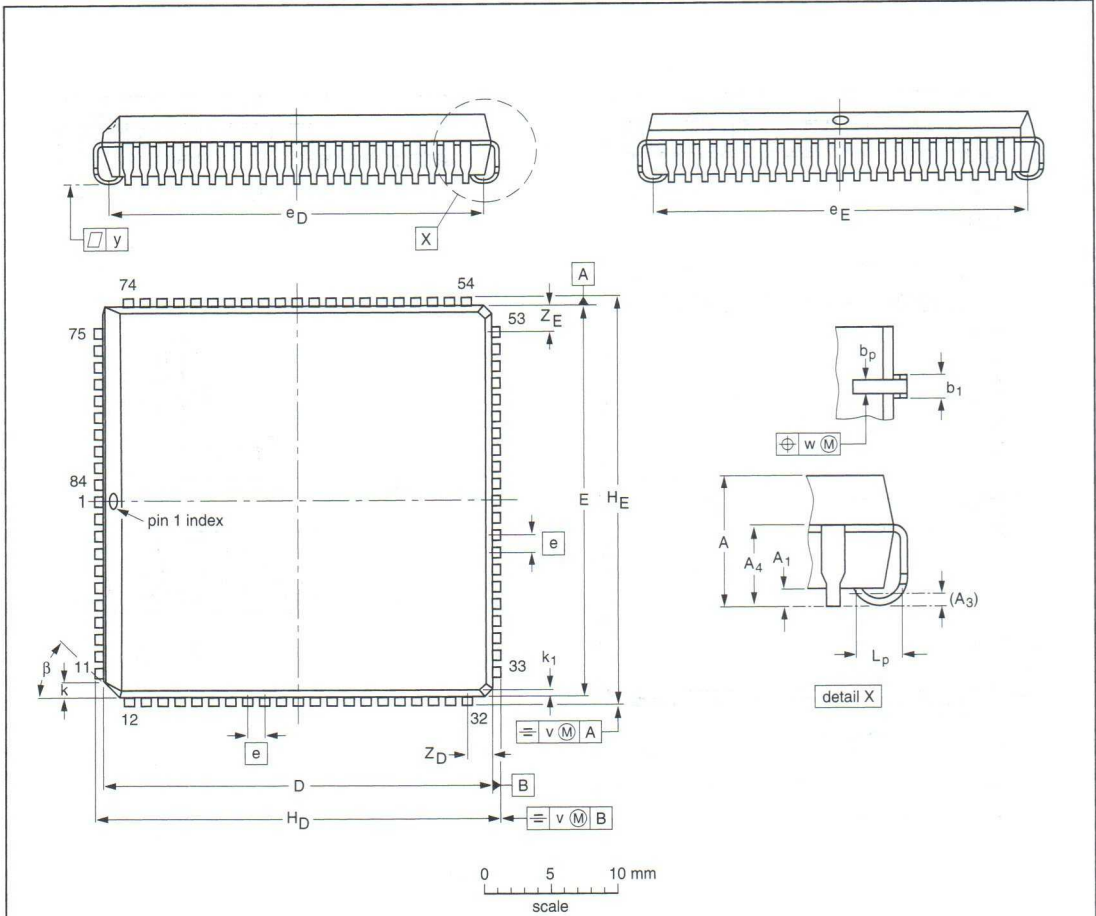
Note

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			
SOT188-3	112E10	MO-047				97-12-16 99-12-27

PLCC84: plastic leaded chip carrier; 84 leads

SOT189-2



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

UNIT	A	A ₁ min.	A ₃	A ₄ max.	b _p	b ₁	D ⁽¹⁾	E ⁽¹⁾	e	e _D	e _E	H _D	H _E	k	k ₁ max.	L _p	v	w	y	Z _p ⁽¹⁾ max.	Z _E ⁽¹⁾ max.	β
mm	4.57 4.19	0.51	0.25	3.30	0.53 0.33	0.81 0.66	29.41 29.21	29.41 29.21	1.27	28.70 27.69	28.70 30.10	30.35 30.10	30.35 30.10	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.13	0.021 0.013	0.032 0.026	1.158 1.150	1.158 1.150	0.05	1.130 1.090	1.130 1.090	1.195 1.185	1.195 1.185	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

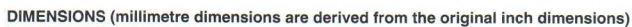
Note

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			
SOT189-2	112E13	MO-047				95-03-11 99-12-27

Chapter 2

SOT189-3



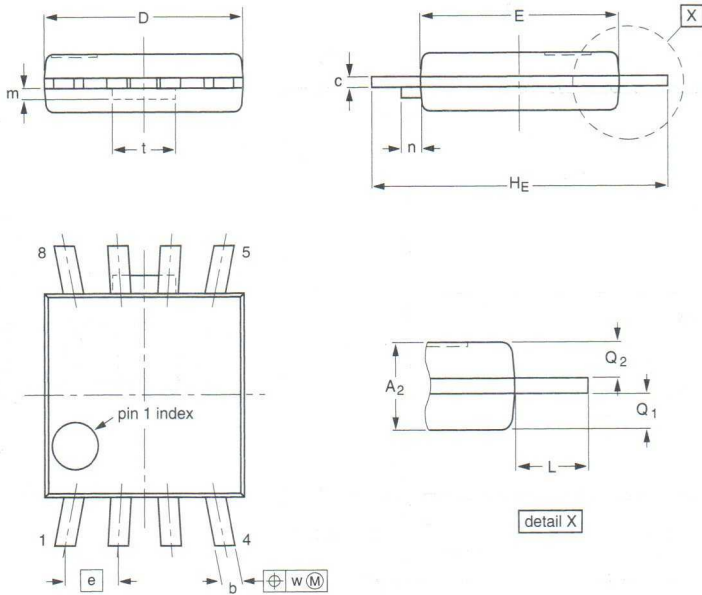
Note

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

2 - 127

PMFP8: plastic micro flat package; 8 leads (straight)

SOT144-1



DIMENSIONS (mm are the original dimensions)

UNIT	A ₂	b	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	m _{max.}	n _{max.}	Q ₁	Q ₂	t	w
mm	0.90 0.70	0.40 0.25	0.19 0.12	3.1 2.9	3.1 2.9	0.80	4.6 4.4	0.75	0.26	0.3	0.40 0.30	0.40 0.30	0.95	0.1

Note

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

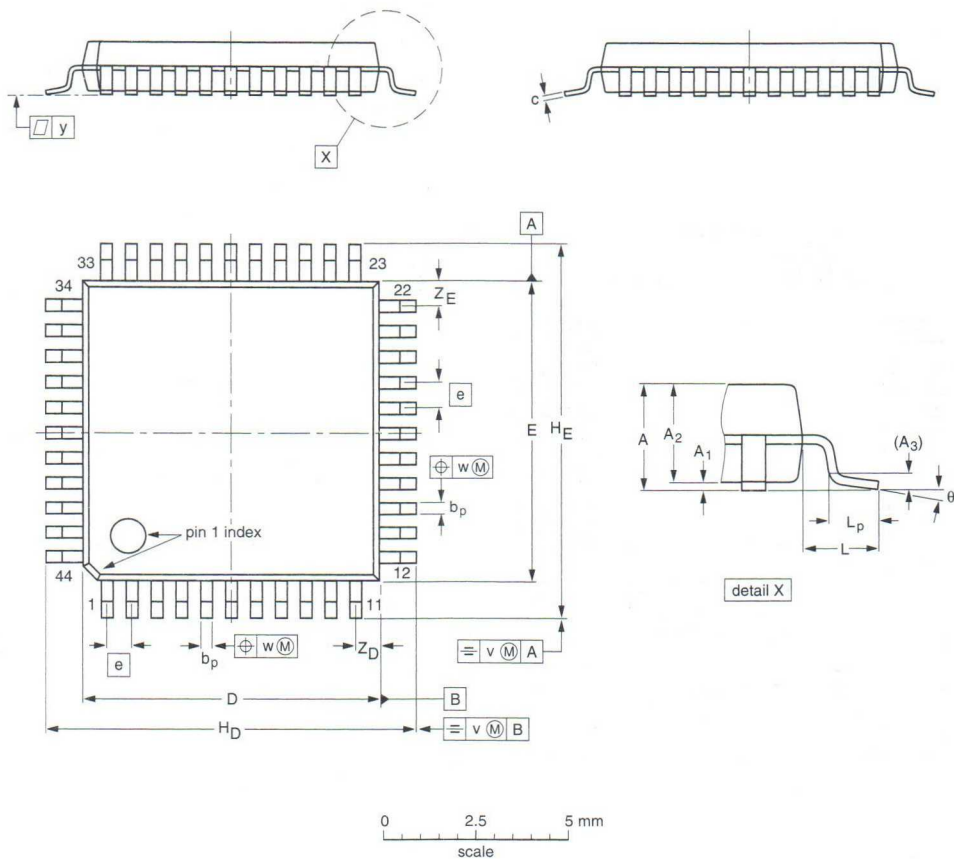
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT144-1						94-01-25 95-01-24

IC package range and dimensions

Chapter 2

QFP44: plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 x 10 x 1.75 mm

SOT307-2



DIMENSIONS (mm are the original dimensions)

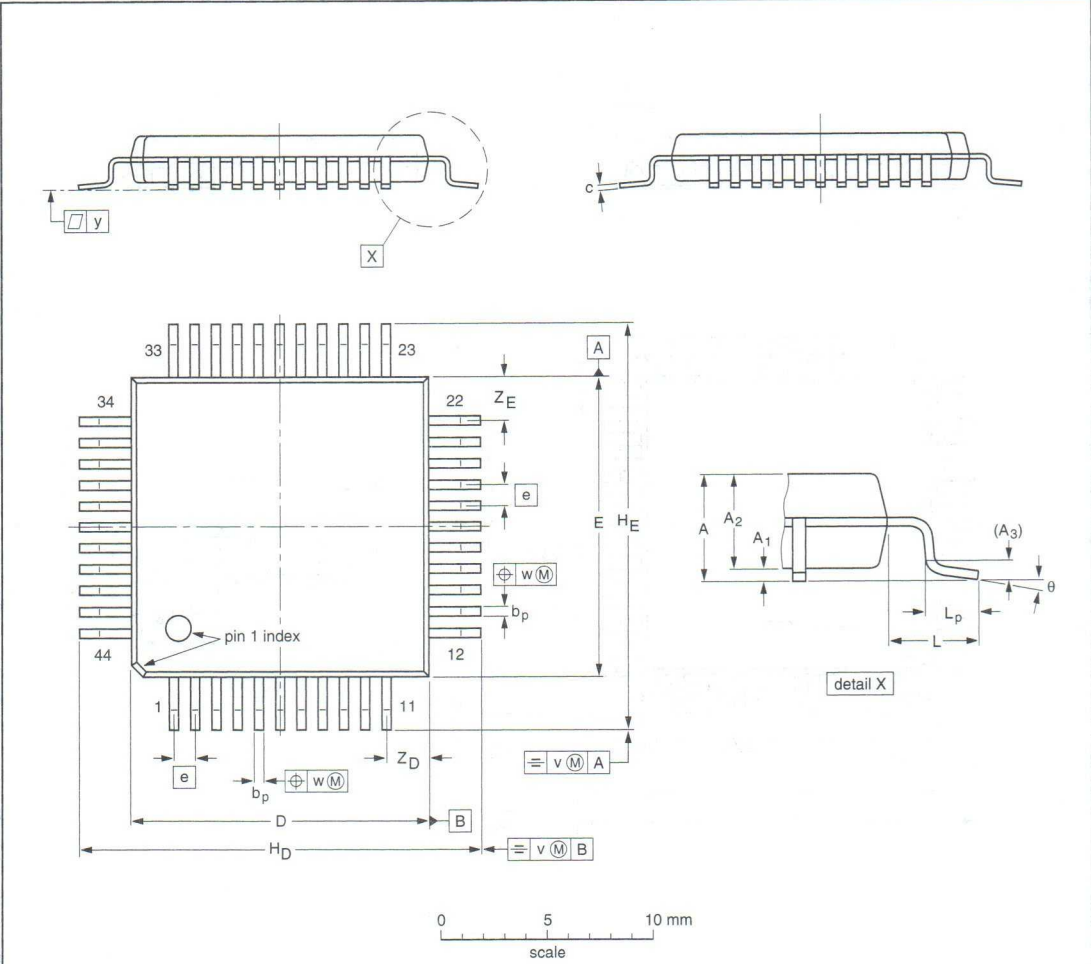
UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	2.10	0.25 0.05	1.85 1.65	0.25	0.40 0.20	0.25 0.14	10.1 9.9	10.1 9.9	0.8	12.9 12.3	12.9 12.3	1.3	0.95 0.55	0.15	0.15	0.1	1.2 0.8	1.2 0.8	10° 0°

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			
SOT307-2						95-02-04 97-08-01

QFP44: plastic quad flat package; 44 leads (lead length 2.35 mm); body 14 x 14 x 2.2 mm SOT205-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	2.60	0.25 0.05	2.3 2.1	0.25	0.50 0.35	0.25 0.14	14.1 13.9	14.1 13.9	1	19.2 18.2	19.2 18.2	2.35	2.0 1.2	0.3	0.15	0.1	2.4 1.8	2.4 1.8	7° 0°

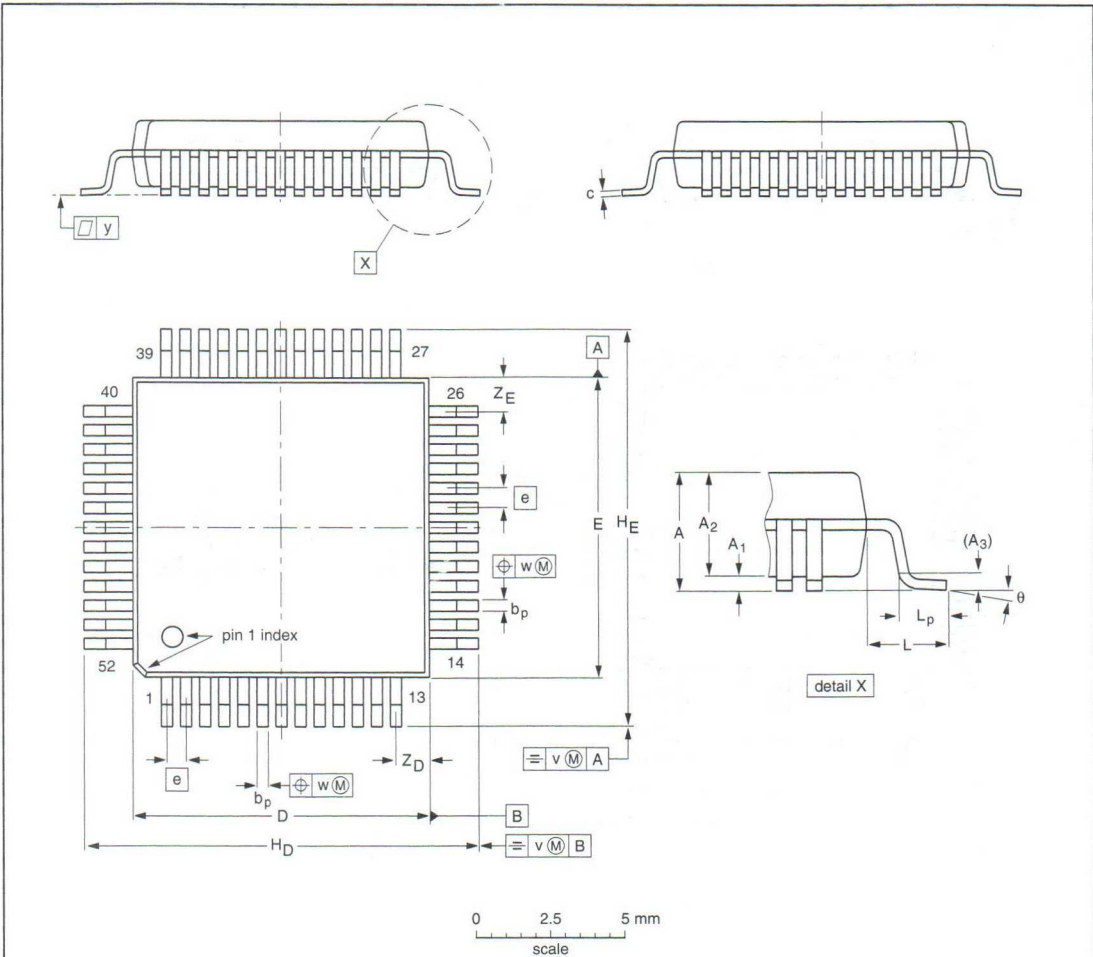
Note

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			
SOT205-1	133E01					97-06-01 99-12-27

QFP52: plastic quad flat package; 52 leads (lead length 1.6 mm); body 10 x 10 x 2.0 mm

SOT379-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	2.45	0.45 0.25	2.10 1.95	0.25	0.38 0.22	0.23 0.13	10.1 9.9	10.1 9.9	0.65	13.45 12.95	13.45 12.95	1.60	0.95 0.65	0.20	0.12	0.10	1.24 0.95	1.24 0.95	7° 0°

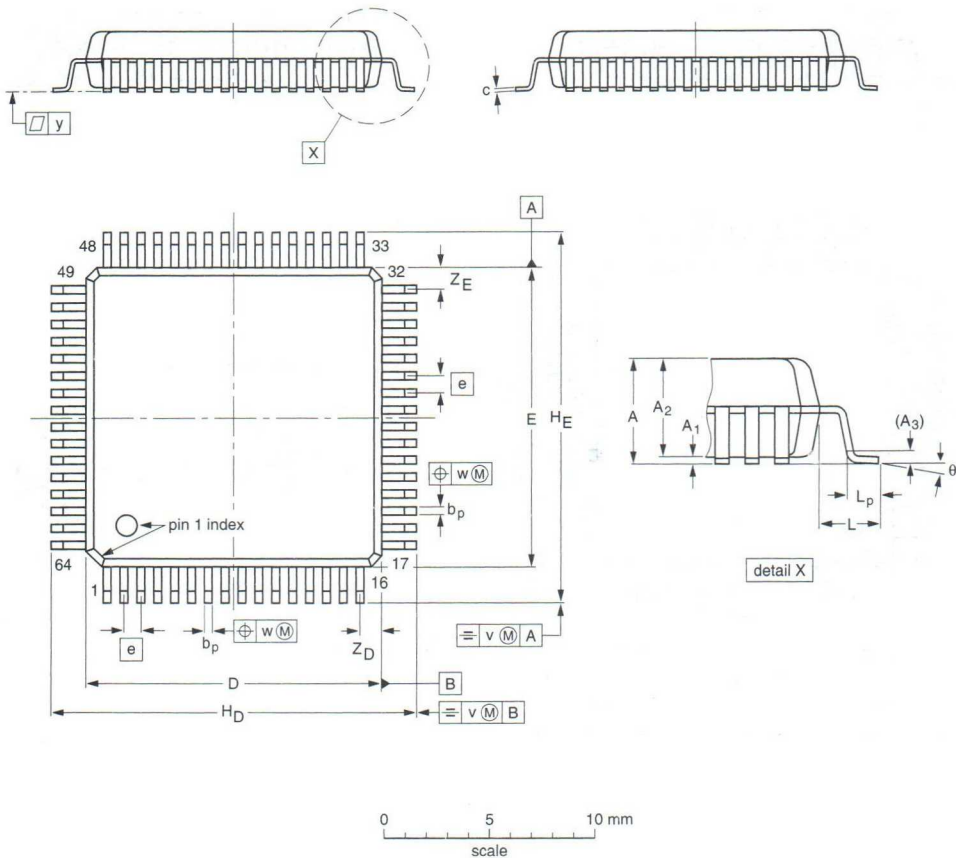
Note

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			
SOT379-1	135E04	MS-022				99-12-27 00-01-19

QFP64: plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 x 14 x 2.7 mm

SOT393-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.00	0.25 0.10	2.75 2.55	0.25	0.45 0.30	0.23 0.13	14.1 13.9	14.1 13.9	0.8	17.45 16.95	17.45 16.95	1.60	1.03 0.73	0.16	0.16	0.10	1.2 0.8	1.2 0.8	7° 0°

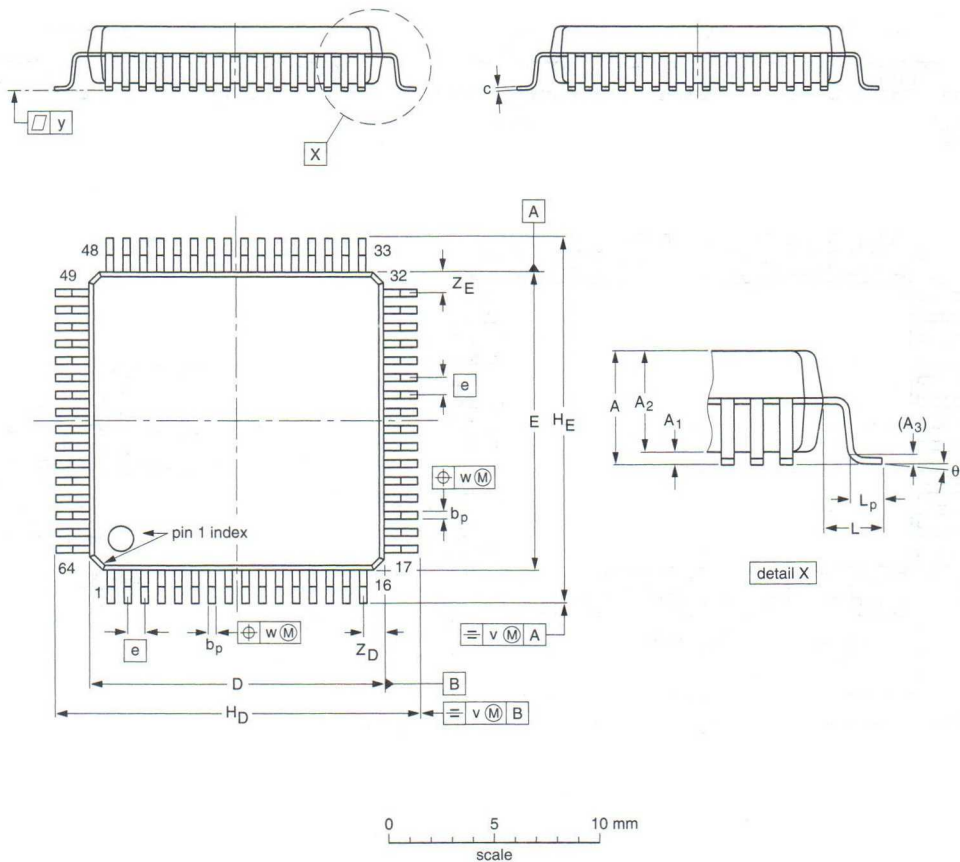
Note

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			
SOT393-1	134E07	MS-022				99-12-27 00-01-19

QFP64: plastic quad flat package; 64 leads (lead length 1.6 mm);
body 14 x 14 x 2.7 mm; high stand-off height

SOT393-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁ min.	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.4	0.25	3.05 2.55	0.25	0.45 0.30	0.23 0.13	14.1 13.9	14.1 13.9	0.8	17.45 16.95	17.45 16.95	1.60	1.03 0.73	0.20	0.20	0.10	1.20 0.80	1.20 0.80	7° 0°

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

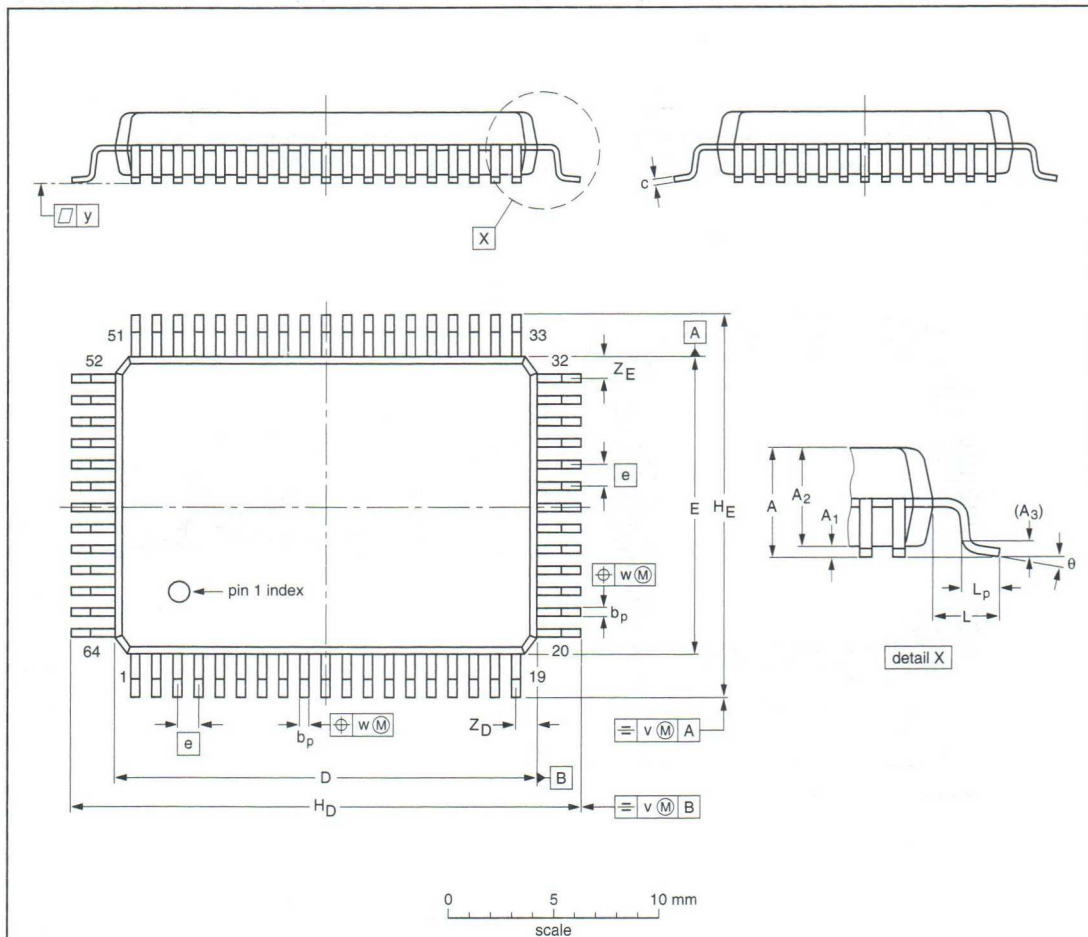
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT393-2		MO-108				-97-12-16 99-12-27

IC package range and dimensions

Chapter 2

QFP64: plastic quad flat package;
64 leads (lead length 1.95 mm); body 14 x 20 x 2.7 mm; high stand-off height

SOT319-1



DIMENSIONS (mm are the original dimensions)

UNIT	$A_{max.}$	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.50 0.35	0.25 0.13	20.1 19.9	14.1 13.9	1	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

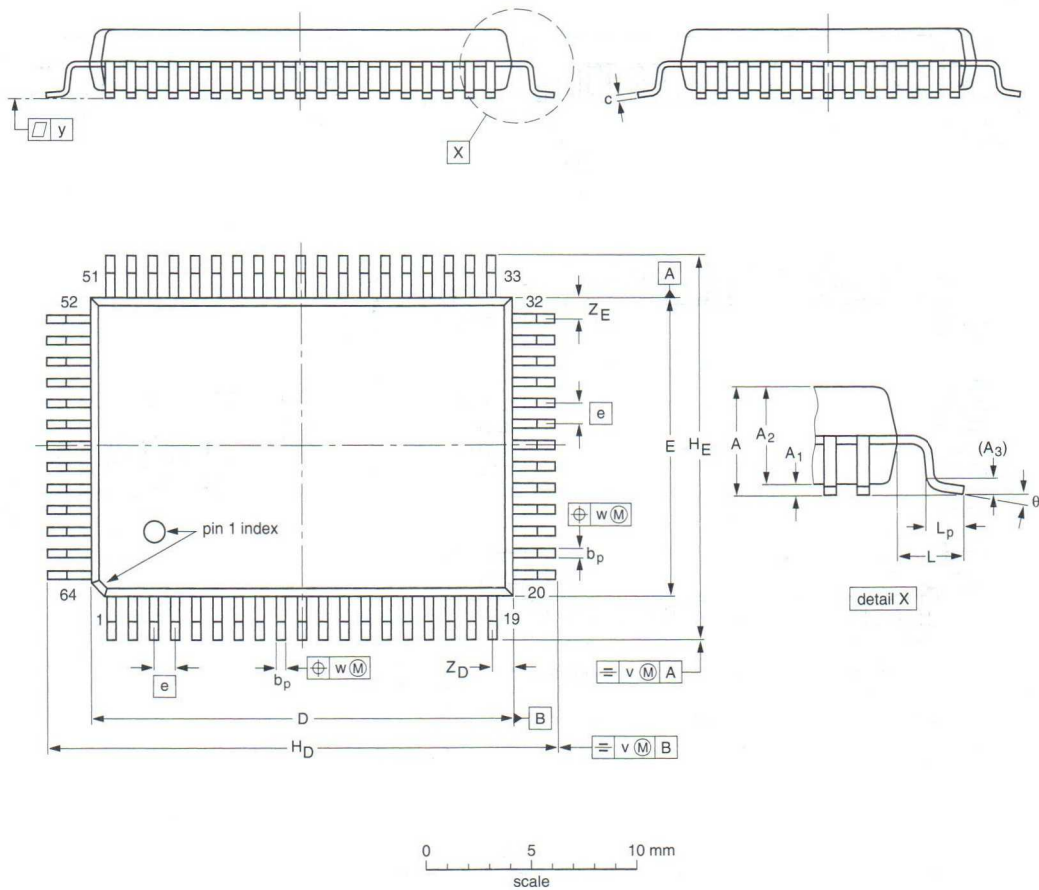
Note

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			
SOT319-1		MO-112				99-12-27- 00-01-19

QFP64: plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm

SOT319-2



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.20	0.25 0.05	2.90 2.65	0.25	0.50 0.35	0.25 0.14	20.1 19.9	14.1 13.9	1	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

Note

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

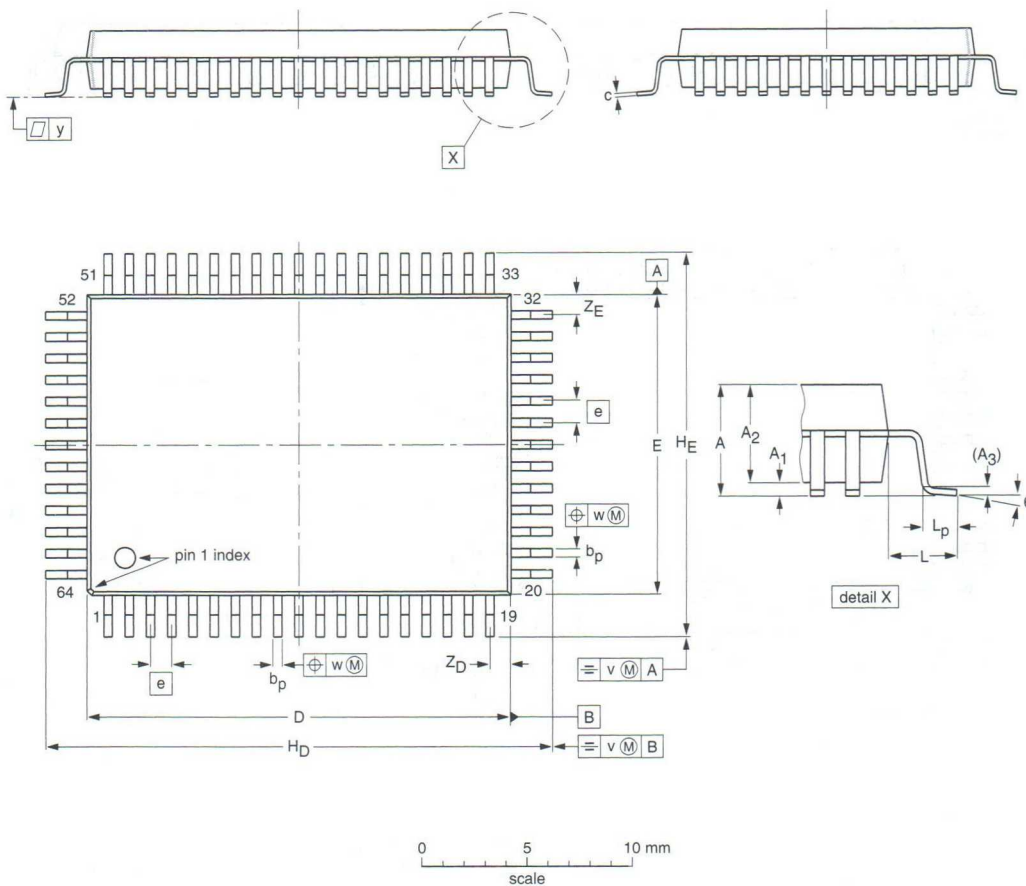
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT319-2		MO-112				97-08-01 99-12-27

IC package range and dimensions

Chapter 2

QFP64: plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm

SOT319-5



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.40	0.60 0.25	3.05 2.55	0.25	0.50 0.35	0.23 0.11	20.1 19.9	14.1 13.9	1.0	24.2 23.6	18.2 17.6	1.95	1.03 0.73	0.20	0.2	0.10	1.23 0.78	1.23 0.78	7° 0°

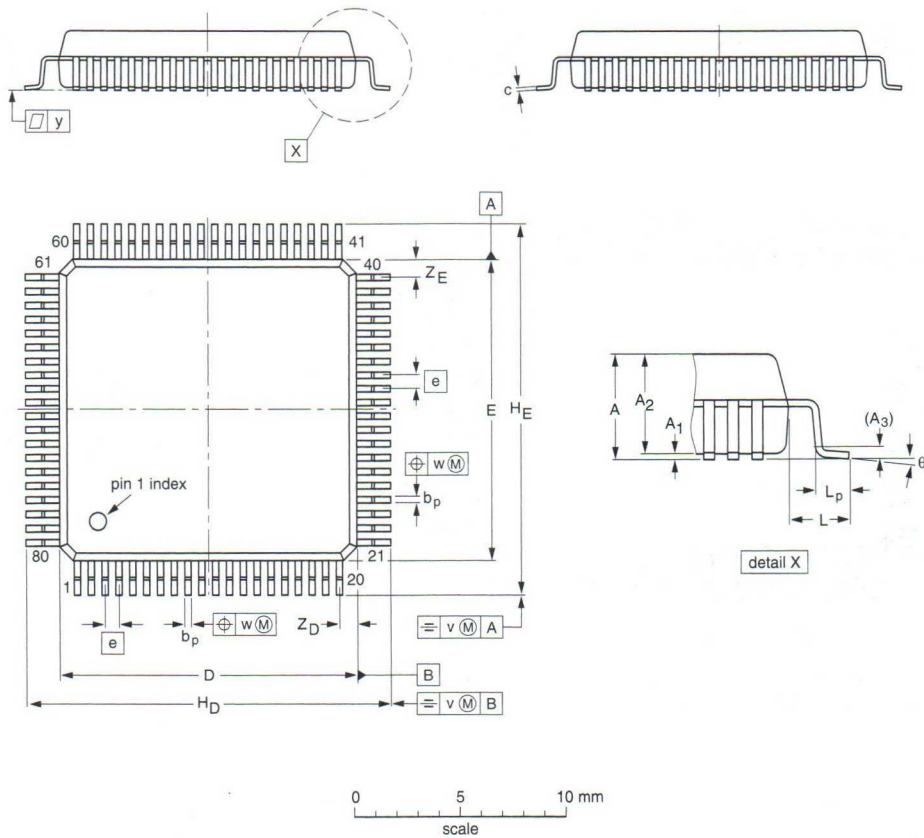
Note

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			
SOT319-5		MO-112CA1				99-06-03

QFP80: plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 x 14 x 2.67 mm

SOT496-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.0	0.25 0.10	2.75 2.55	0.25	0.38 0.22	0.23 0.13	14.1 13.9	14.1 13.9	0.65	17.45 16.95	17.45 16.95	1.6	1.03 0.73	0.2	0.12	0.075	1.02 0.64	1.02 0.64	7° 0°

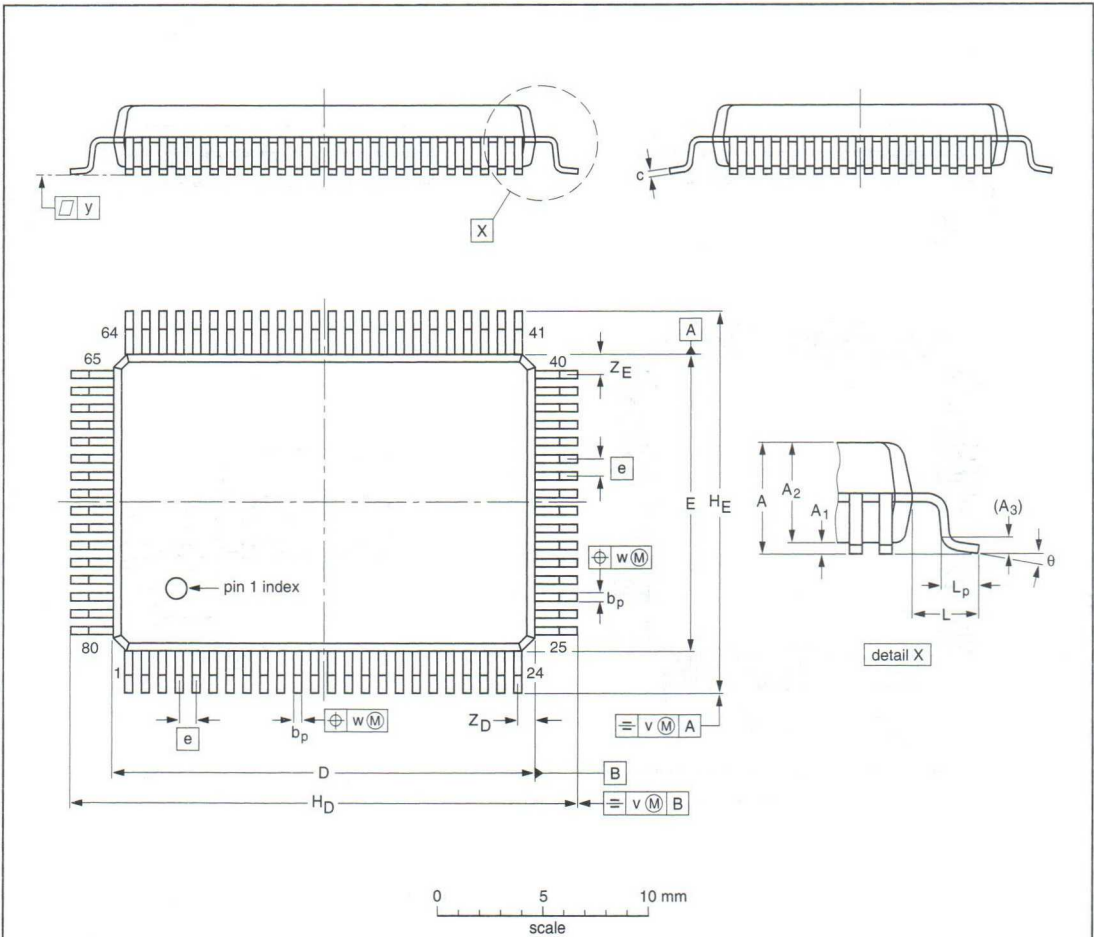
Note

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			
SOT496-1						98-07-01

QFP80: plastic quad flat package;
80 leads (lead length 1.95 mm); body 14 x 20 x 2.7 mm; high stand-off height

SOT318-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.45 0.30	0.25 0.13	20.1 19.9	14.1 13.9	0.8	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.2	0.1	1.0 0.6	1.2 0.8	7° 0°

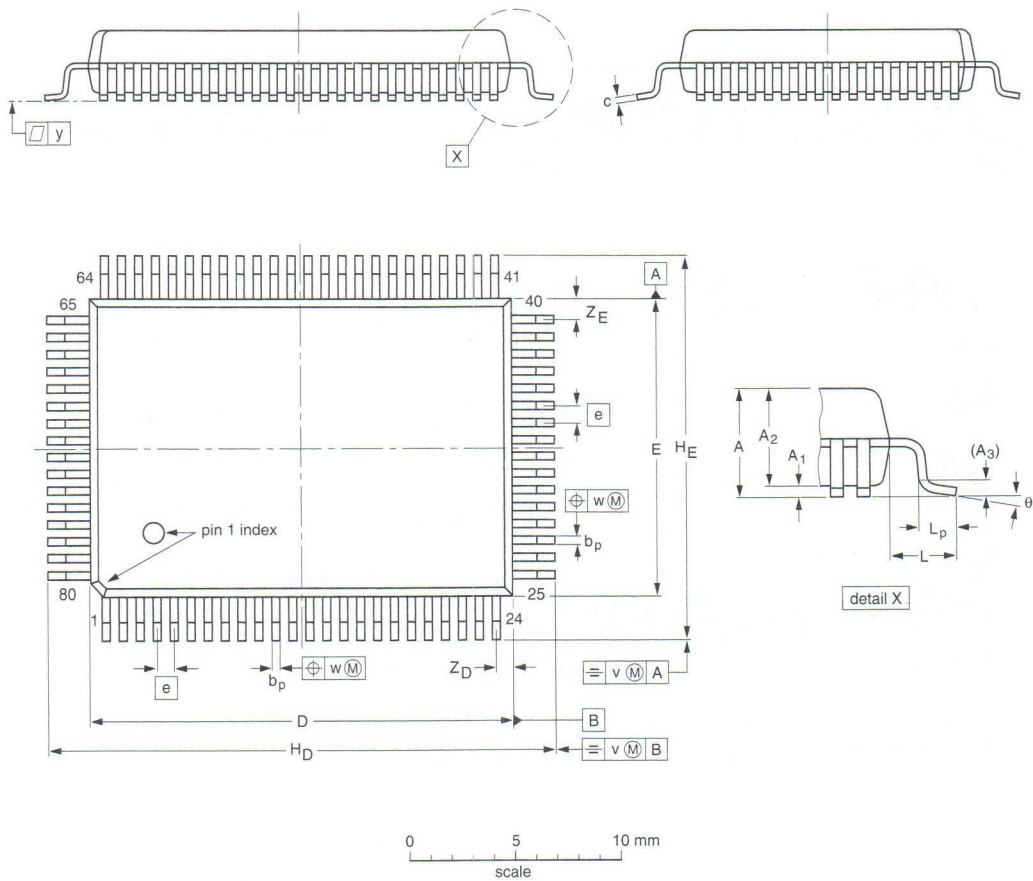
Note

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			
SOT318-1		MO-112				97-08-01 99-12-27

QFP80: plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm

SOT318-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.2	0.25 0.05	2.90 2.65	0.25	0.45 0.30	0.25 0.14	20.1 19.9	14.1 13.9	0.8	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.2	0.1	1.0 0.6	1.2 0.8	7° 0°

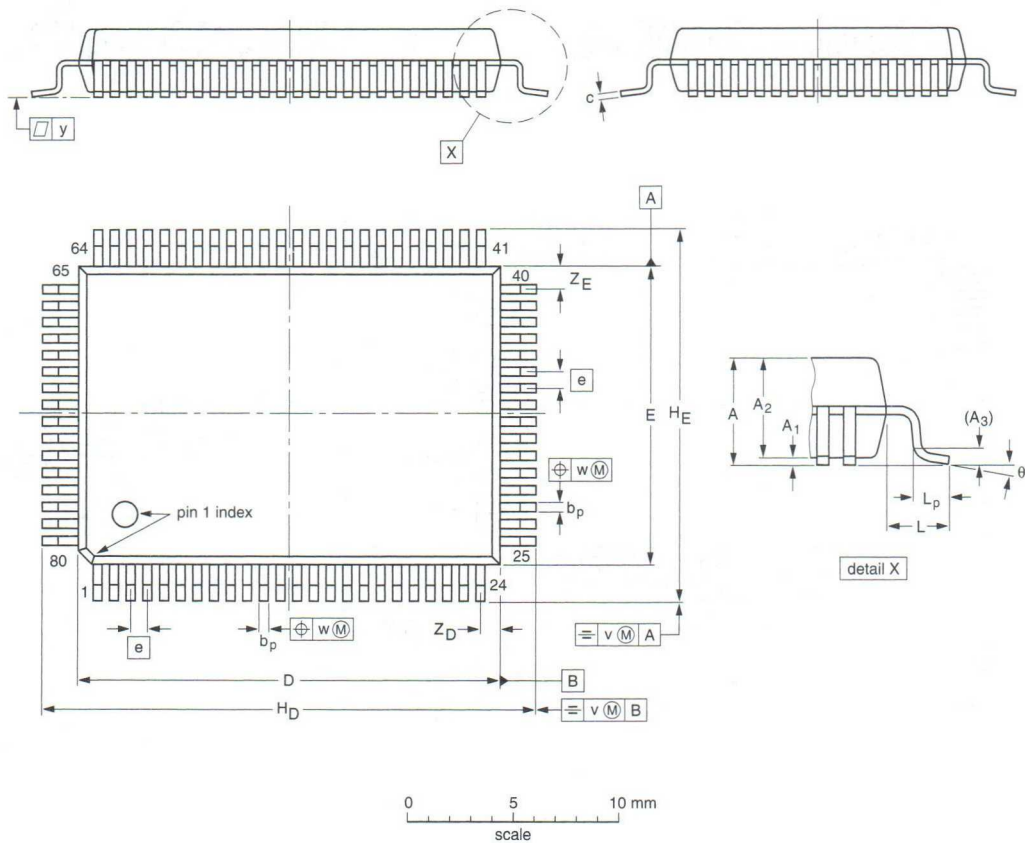
Note

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			
SOT318-2		MO-112				97-08-01 99-12-27

QFP80: plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 x 20 x 3.0 mm

SOT310-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.4	0.2 0	3.2 2.8	0.25	0.45 0.30	0.25 0.14	20.1 19.9	14.1 13.9	0.8	23.6 22.8	17.6 16.8	1.6	1.1 0.5	0.3	0.15	0.1	1.0 0.6	1.2 0.8	7° 0°

Note

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

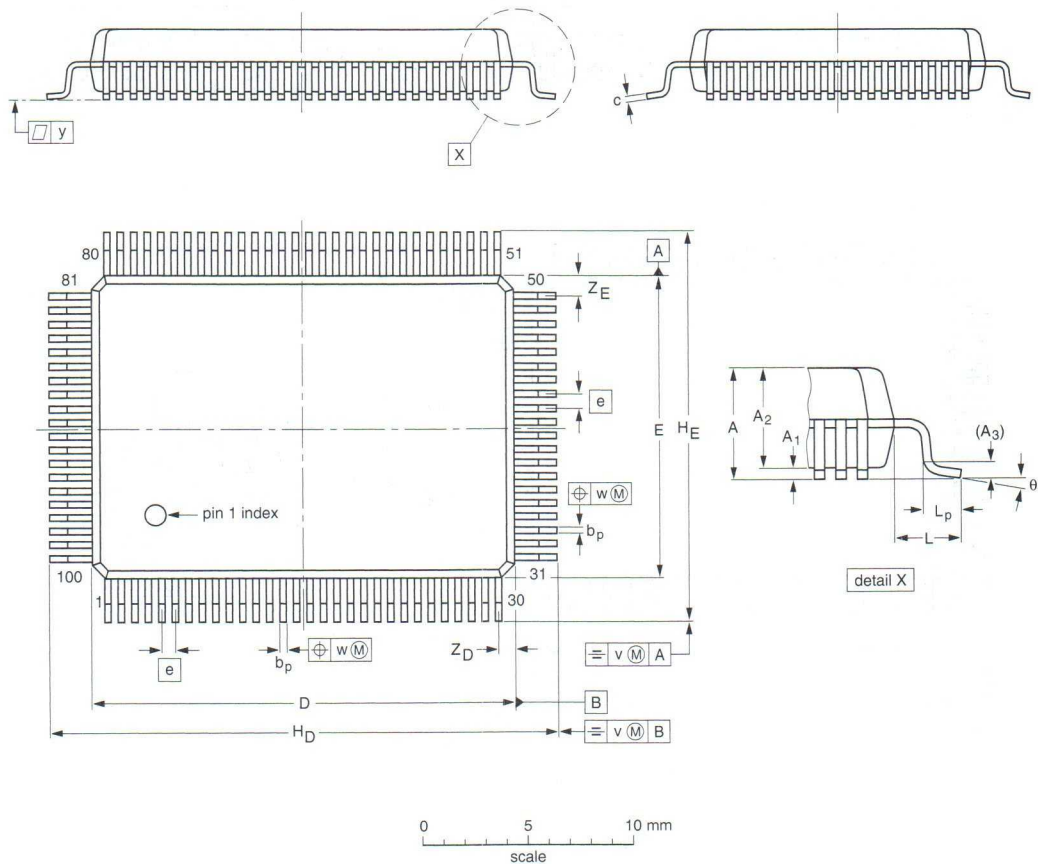
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT310-1	134E14	MS-022				99-12-27 00-01-19

IC package range and dimensions

Chapter 2

QFP100: plastic quad flat package;
100 leads (lead length 1.95 mm); body 14 x 20 x 2.7 mm; high stand-off height

SOT317-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.40 0.25	0.25 0.13	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.15	0.1	0.8 0.4	1.0 0.6	7° 0°

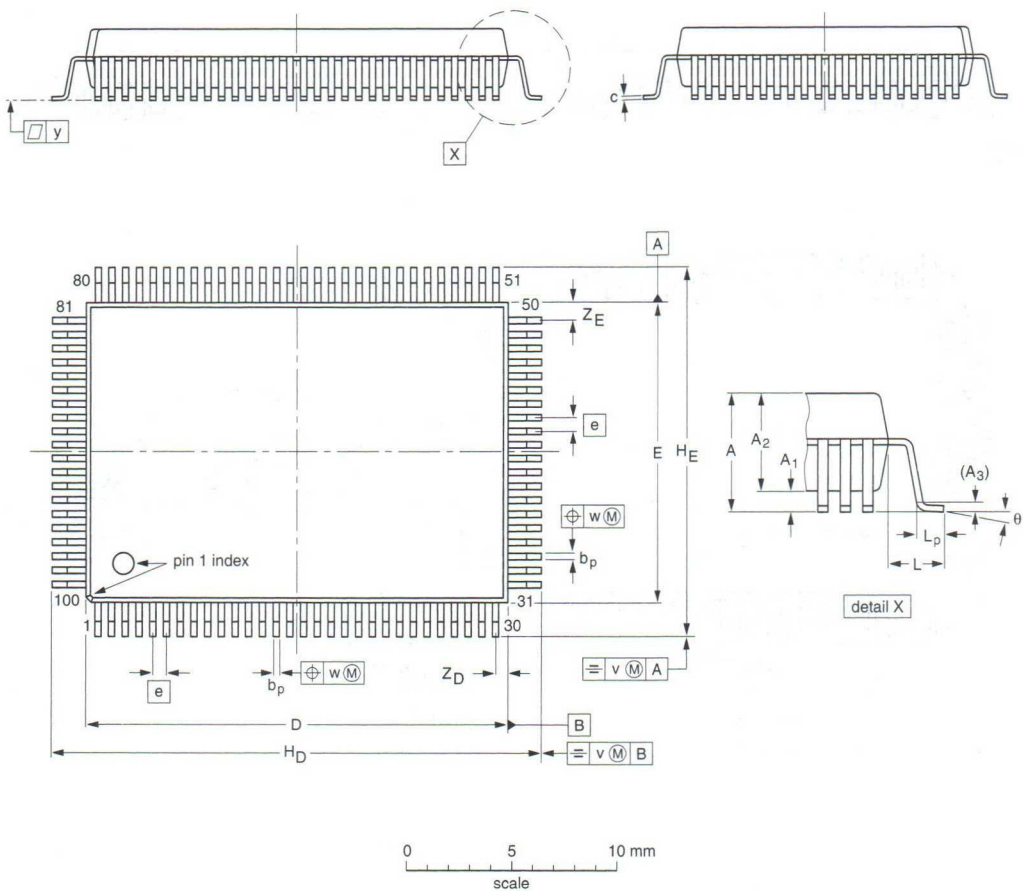
Note

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			
SOT317-1		MO-112				97-08-01- 99-12-27

QFP100: plastic quad flat package; 100 leads (lead length 1.6 mm); body 14 x 20 x 2.8 mm

SOT382-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.40	0.60 0.25	3.05 2.55	0.25	0.38 0.22	0.23 0.13	20.1 19.9	14.1 13.9	0.65	23.45 22.95	17.45 16.95	1.60	1.03 0.73	0.20	0.12	0.10	0.68 0.45	0.68 0.45	7° 0°

Note

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

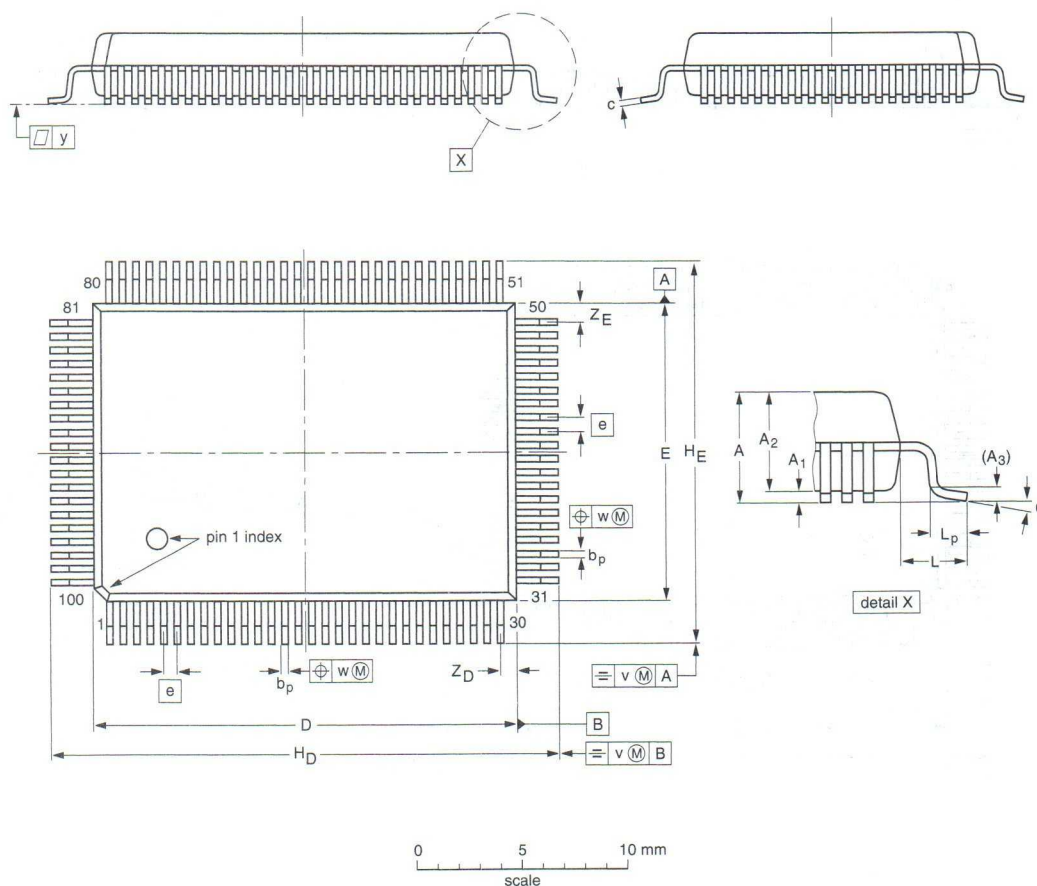
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT382-1	135E16	MS-022				99-12-27 00-01-19

IC package range and dimensions

Chapter 2

QFP100: plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm

SOT317-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.20	0.25 0.05	2.90 2.65	0.25	0.40 0.25	0.25 0.14	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.15	0.1	0.8 0.4	1.0 0.6	7° 0°

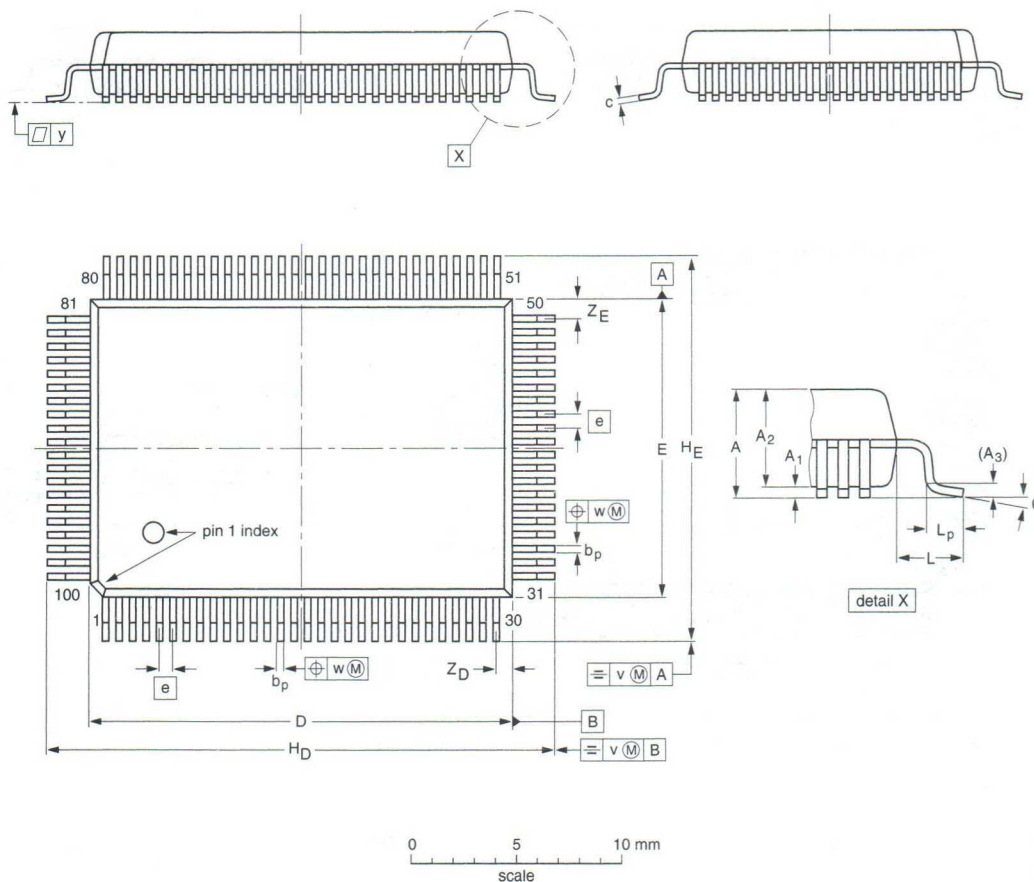
Note

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			
SOT317-2		MO-112				97-08-01 99-12-27

QFP100: plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm

SOT317-3



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.4	0.45 0.25	2.90 2.65	0.25	0.40 0.25	0.25 0.14	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.0 0.73	0.2	0.15	0.1	0.8 0.4	1.0 0.6	7° 0°

Note

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

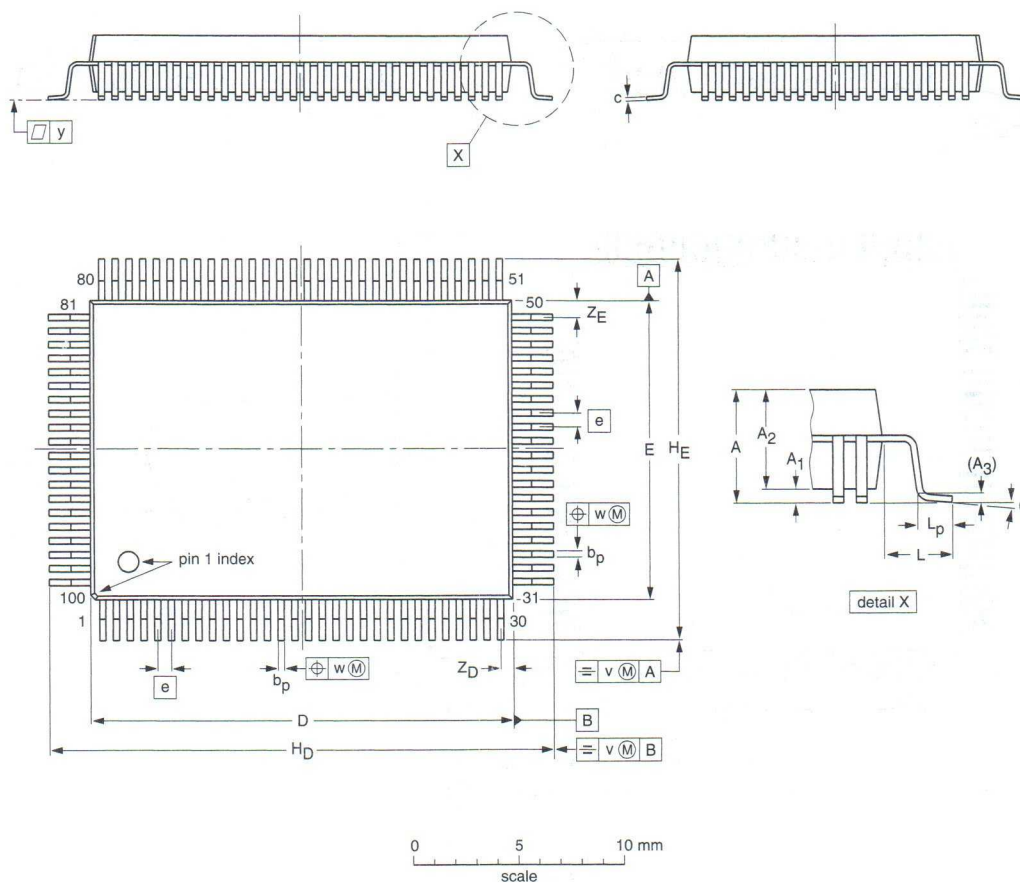
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT317-3		MO-112				97-08-01 99-12-15

IC package range and dimensions

Chapter 2

QFP100: plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm

SOT382-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.40	0.50 0.25	3.05 2.55	0.25	0.38 0.22	0.23 0.11	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.03 0.73	0.20	0.12	0.10	0.77 0.39	1.02 0.64	7° 0°

Note

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

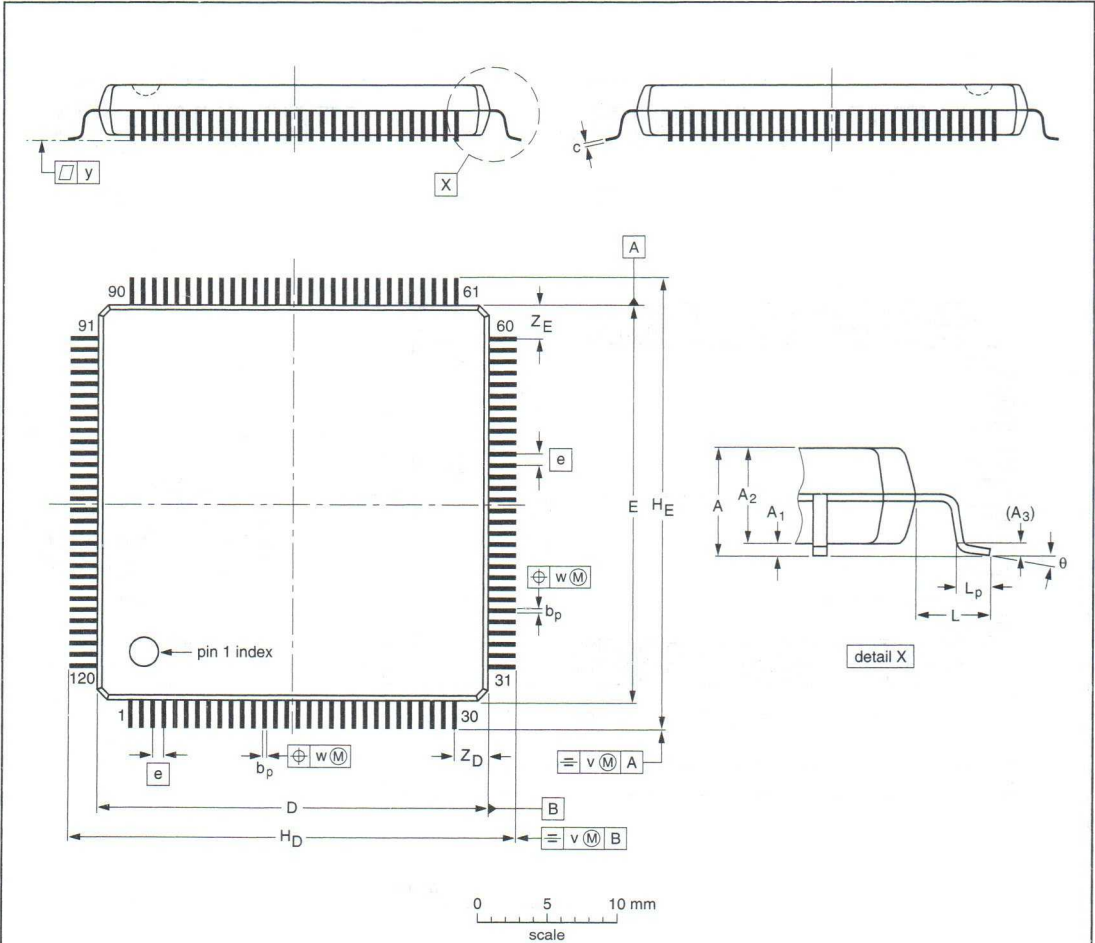
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT382-2		MO-112				99-09-08 99-12-27

IC package range and dimensions

Chapter 2

QFP120: plastic quad flat package;
120 leads (lead length 1.6 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT349-2



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	4.07	0.50 0.25	3.70 3.15	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	31.45 30.95	31.45 30.95	1.6	1.03 0.73	0.3	0.2	0.1	2.6 2.2	2.6 2.2	7° 0°

Note

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

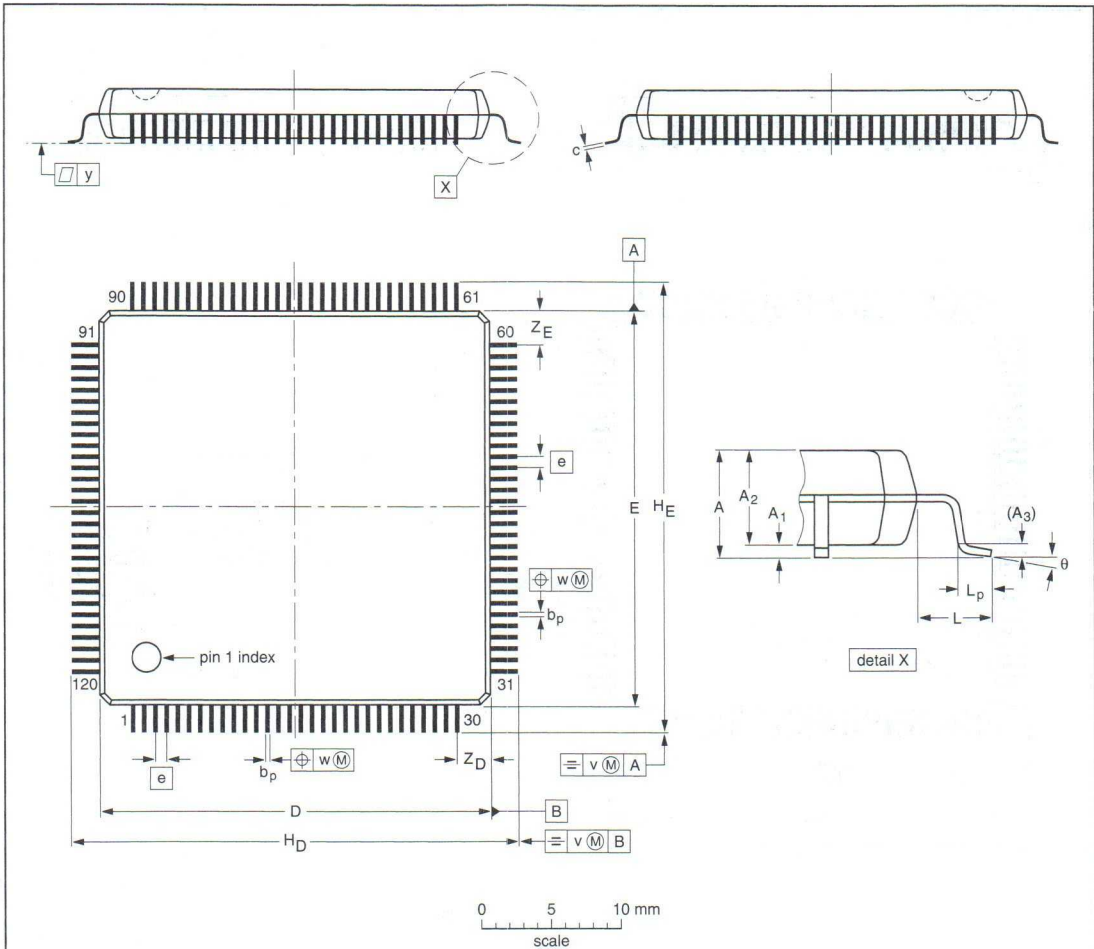
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT349-2	134E11	MS-022				99-12-27- 00-01-19

IC package range and dimensions

Chapter 2

QFP120: plastic quad flat package;
120 leads (lead length 1.95 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT349-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.95	0.40 0.25	3.70 3.15	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	32.2 31.6	32.2 31.6	1.95	1.1 0.7	0.3	0.2	0.1	2.6 2.2	2.6 2.2	8° 0°

Note

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

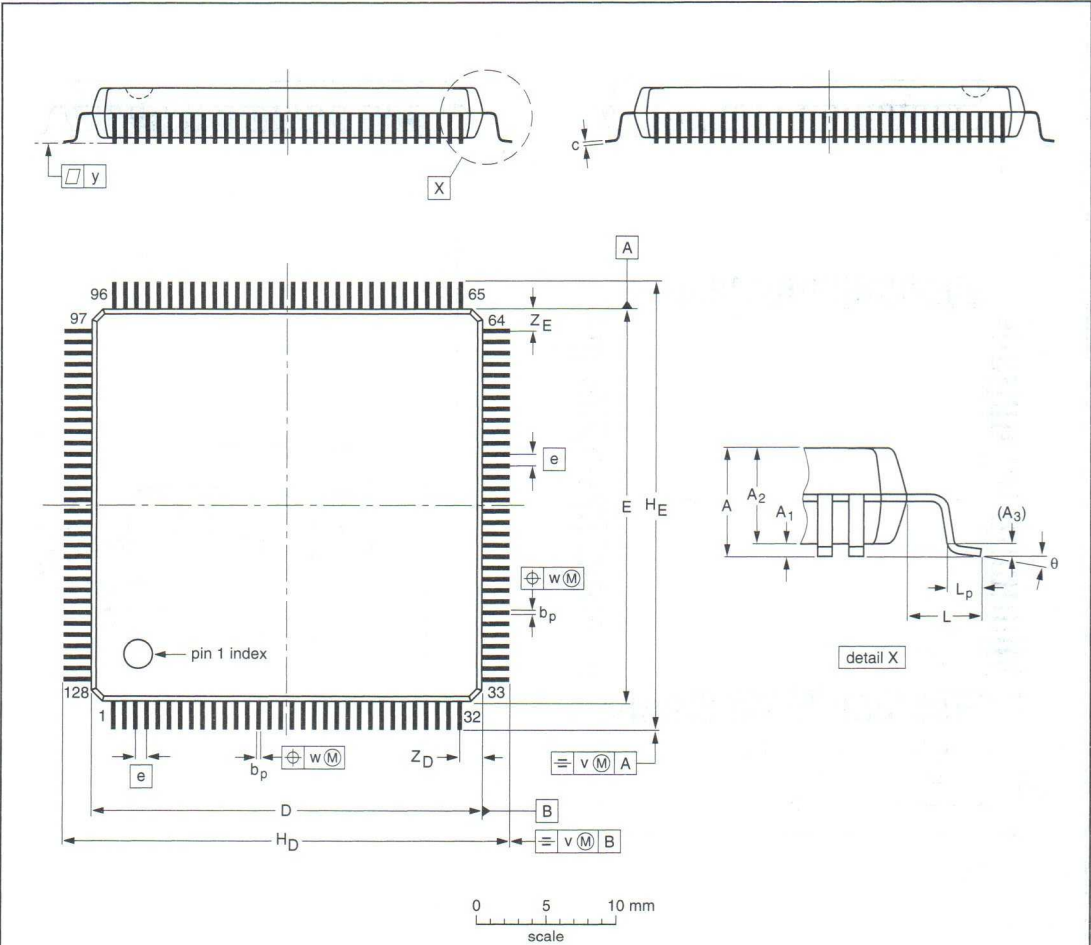
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT349-1		MO-112				97-08-04 99-12-27

IC package range and dimensions

Chapter 2

QFP128: plastic quad flat package;
128 leads (lead length 1.6 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT320-2



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	4.07	0.50 0.25	3.70 3.15	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	31.45 30.95	31.45 30.95	1.6	1.03 0.73	0.3	0.2	0.1	1.8 1.4	1.8 1.4	7° 0°

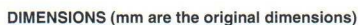
Note

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			
SOT320-2	134E13	MS-022				99-12-27 00-01-19

IC package range and dimensions

SOT573-1



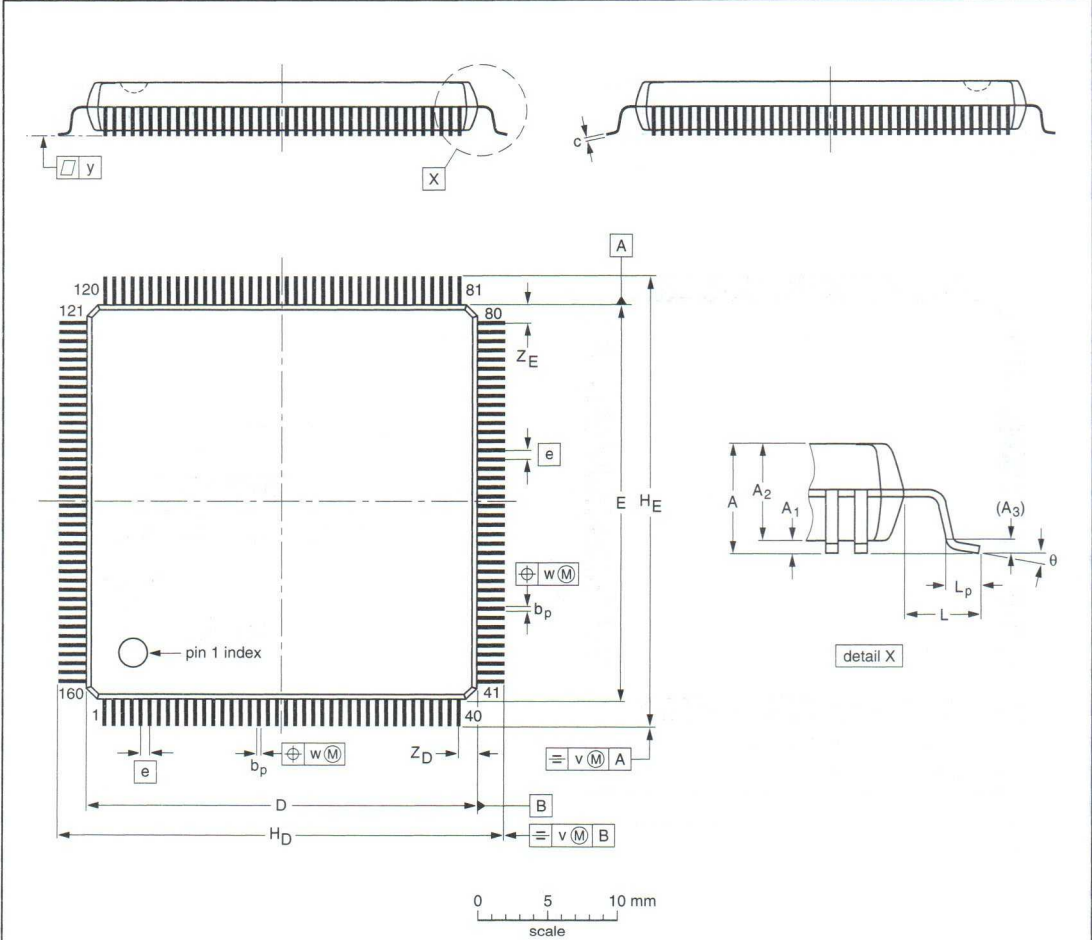
Note

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			
SOT573-1		MS-022				1999-12-08

QFP160: plastic quad flat package;
160 leads (lead length 1.6 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT322-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	4.07	0.50 0.25	3.60 3.20	0.25	0.38 0.22	0.23 0.13	28.1 27.9	28.1 27.9	0.65	31.45 30.95	31.45 30.95	1.6	1.03 0.73	0.3	0.13	0.1	1.5 1.1	1.5 1.1	7° 0°

Note

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

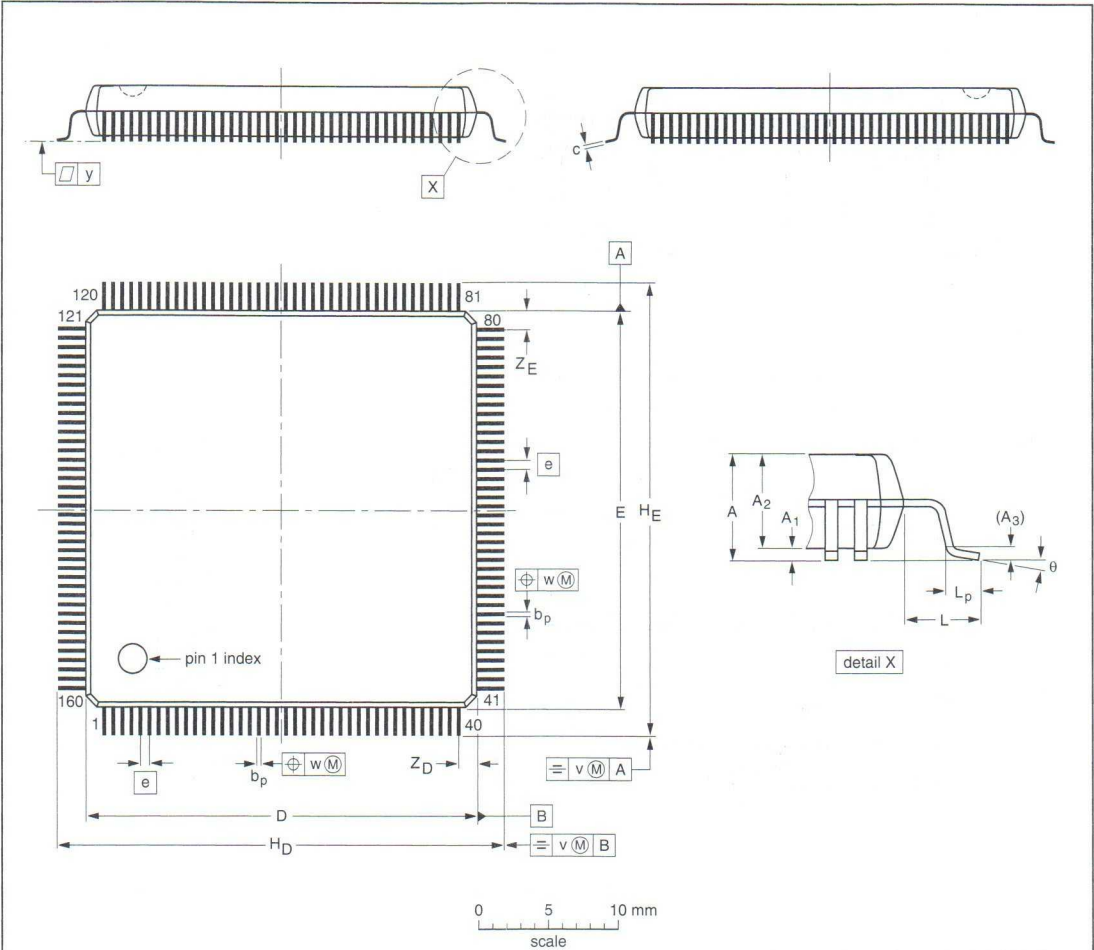
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT322-2	135E12	MS-022				99-11-03 00-01-19

IC package range and dimensions

Chapter 2

QFP160: plastic quad flat package;
160 leads (lead length 1.95 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT322-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	3.95	0.40 0.25	3.70 3.15	0.25	0.40 0.25	0.23 0.13	28.1 27.9	28.1 27.9	0.65	32.2 31.6	32.2 31.6	1.95	1.1 0.7	0.3	0.15	0.1	1.5 1.1	1.5 1.1	8° 0°

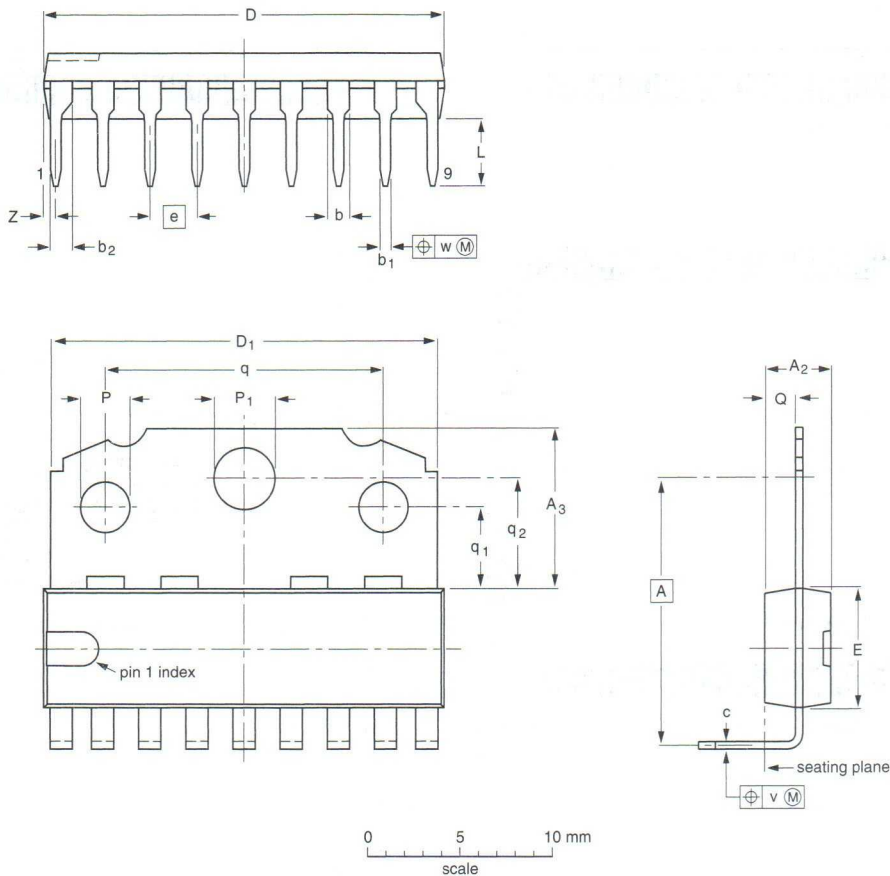
Note

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			
SOT322-1		MO-112				97-08-04 99-12-27

RBS9MPF: plastic rectangular-bent single in-line medium power package with fin; 9 leads

SOT352-1



DIMENSIONS (mm are the original dimensions)

UNIT	A ⁽¹⁾	A ₂ max.	A ₃	b	b ₁	b ₂	c	D ⁽²⁾	D ₁	E ⁽²⁾	e	L	P	P ₁	Q	q	q ₁	q ₂	v	w	Z ⁽²⁾ max.
mm	14.45 13.95	3.7	8.7 8.0	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	3.8 3.3	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.6	0.25	1.0

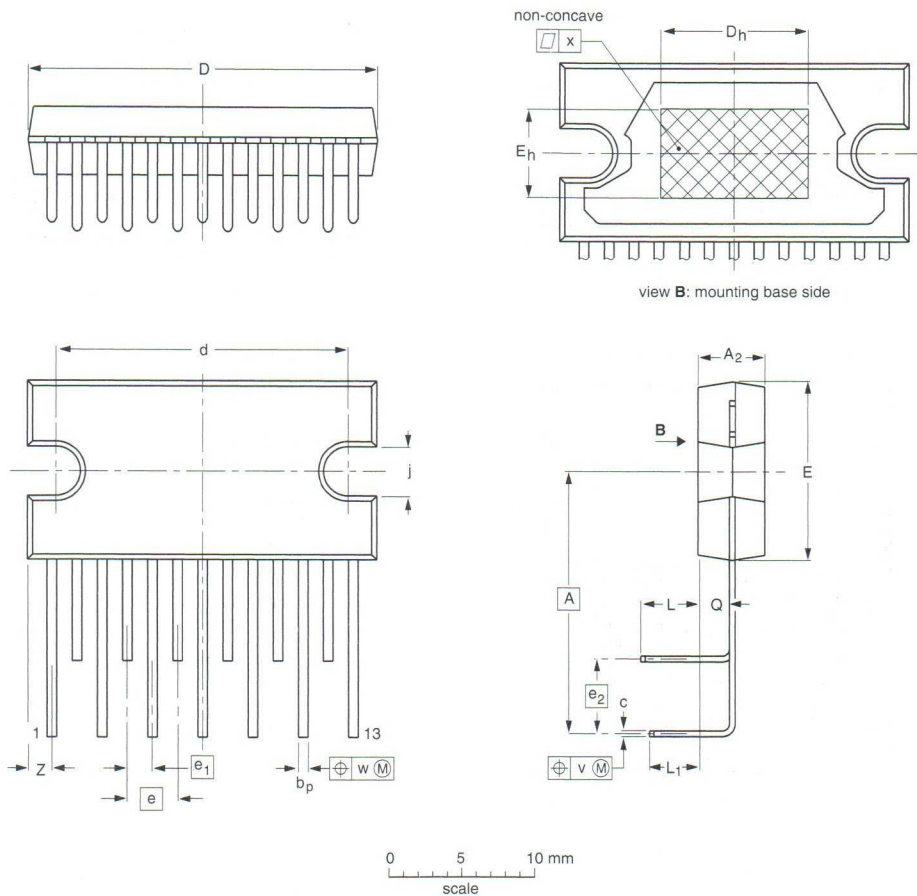
Notes

1. Dimension is specified at seating plane.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT352-1						95-03-11 97-12-16

RDBS13P: plastic rectangular-DIL-bent-SIL power package; 13 leads

SOT528-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₁	Q	v	w	x	Z ⁽¹⁾
mm	17.7	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	4.25 3.75	3.65 3.15	2.1 1.8	0.6	0.4	0.03	2.00 1.45

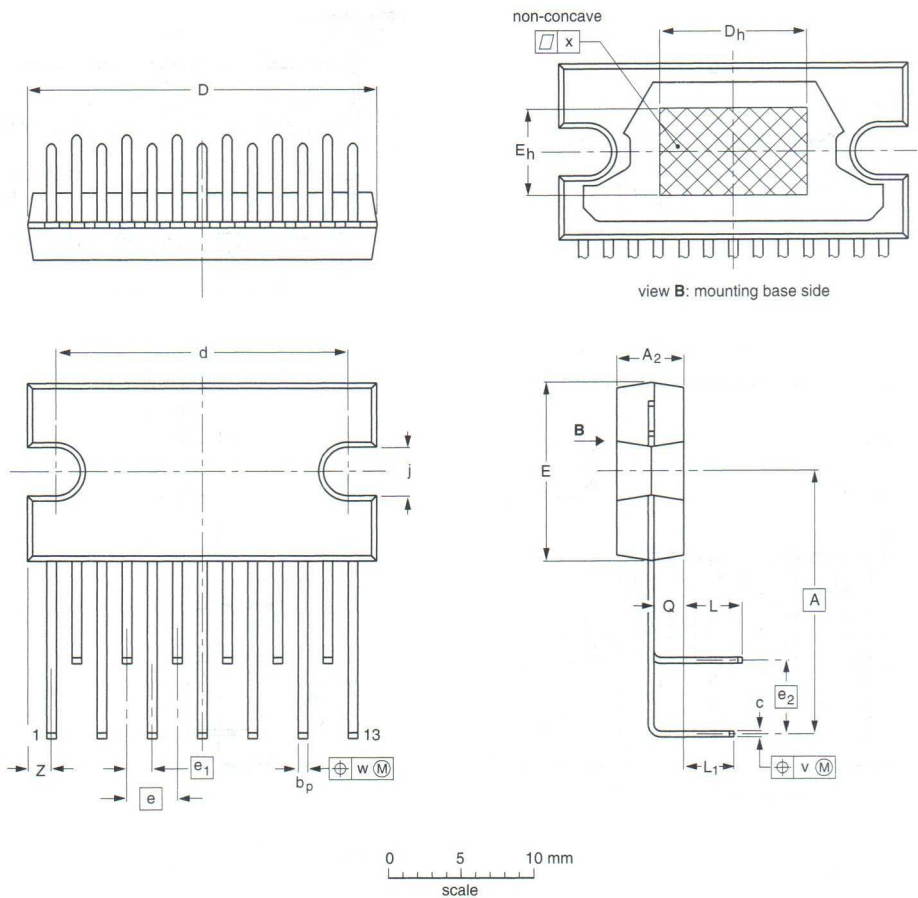
Note

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			
SOT528-1						00-03-29

RDBS13P: plastic rectangular-DIL-bent-SIL (reverse bent) power package; 13 leads

SOT462-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₁	Q	v	w	x	Z ⁽¹⁾
mm	17.7	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	4.25 3.75	3.65 3.15	2.1 1.9	0.6	0.4	0.03	2.00 1.45

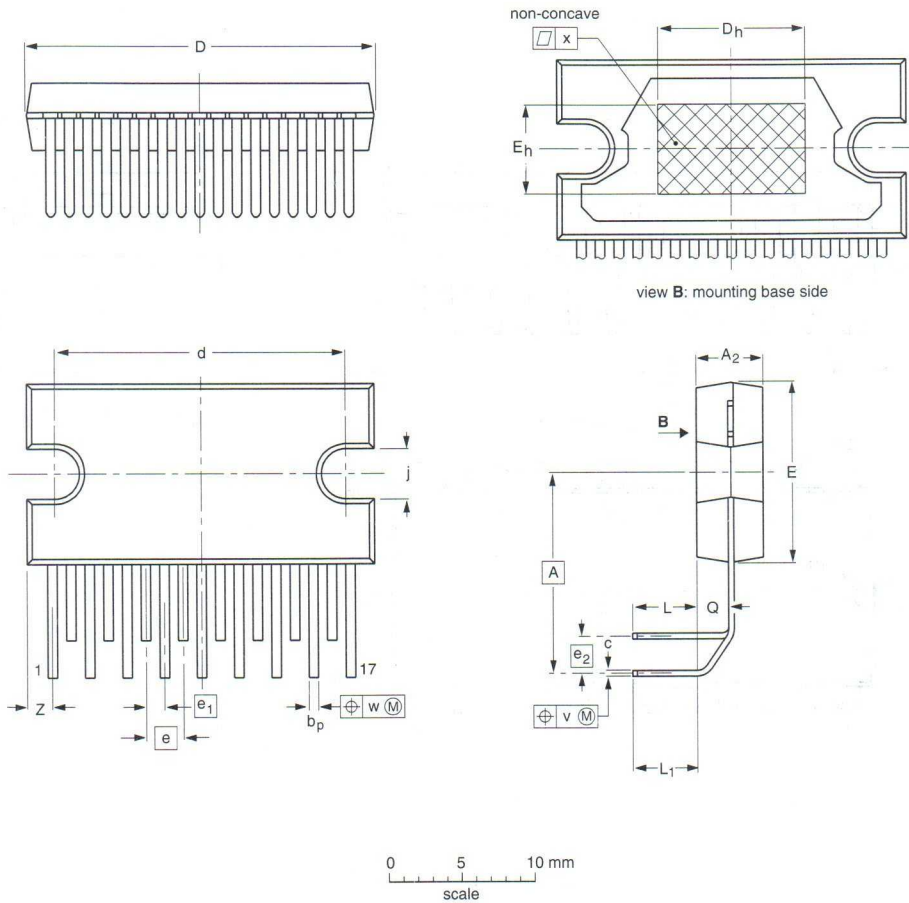
Note

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			
SOT462-1						99-12-17 00-03-02

RDBS17P: plastic rectangular-DIL-bent-SIL power package; 17 leads (row spacing 2.54 mm)

SOT577-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	E _h	j	L	L ₁	Q	v	w	x	z ⁽¹⁾
mm	13.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	1.27	2.54	6	3.4 3.1	4.7 4.1	4.7 4.1	2.1 1.8	0.6	0.4	0.03	2.00 1.45

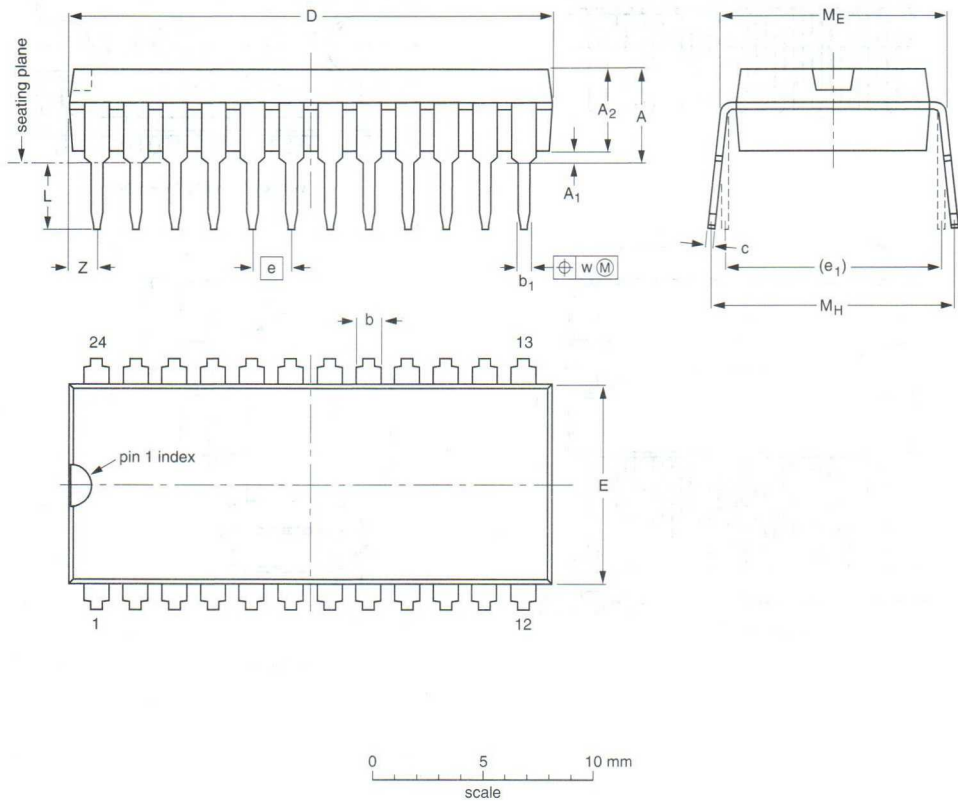
Note

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			
SOT577-1						00-01-19 00-03-15

SDIP24: plastic shrink dual in-line package; 24 leads (400 mil)

SOT234-1



DIMENSIONS (mm are the original 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	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	22.3 21.4	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

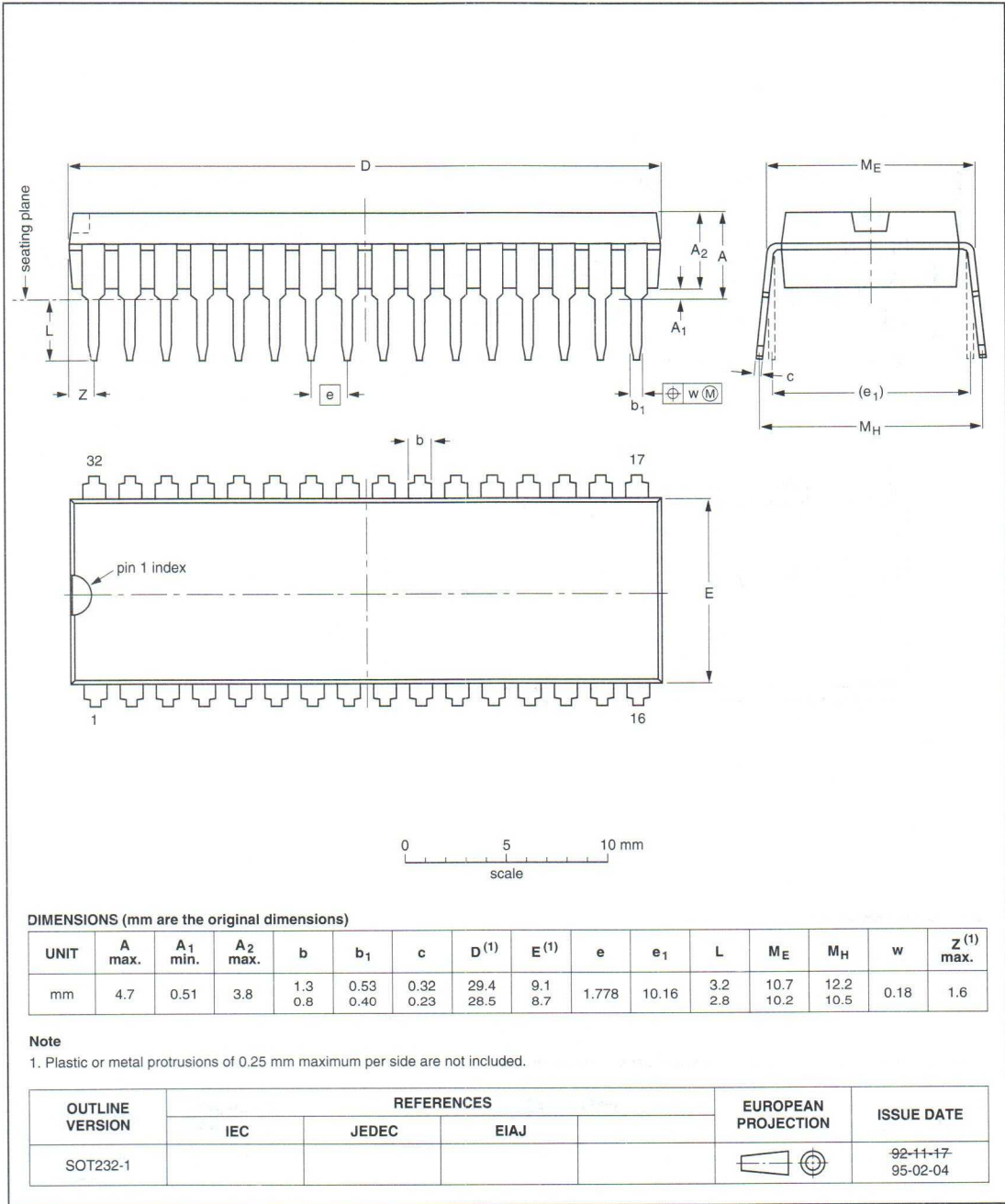
Note

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			
SOT234-1						92-11-17- 95-02-04

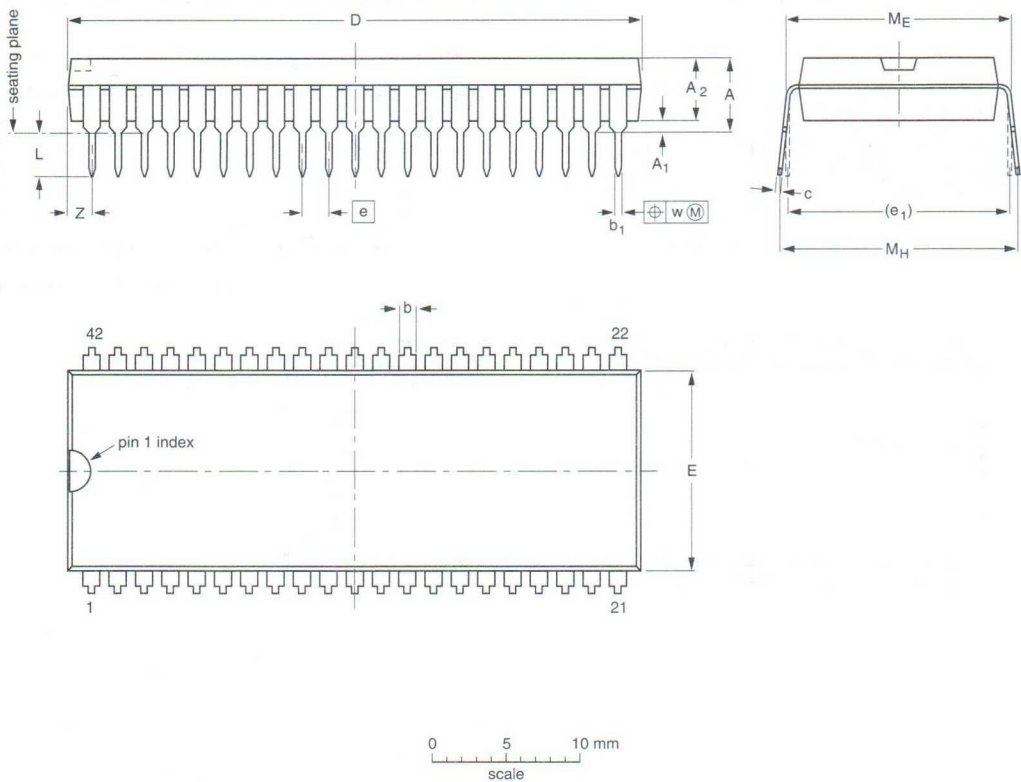
SDIP32: plastic shrink dual in-line package; 32 leads (400 mil)

SOT232-1



SDIP42: plastic shrink dual in-line package; 42 leads (600 mil)

SOT270-1



DIMENSIONS (mm are the original 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	5.08	0.51	4.0	1.3 0.8	0.53 0.40	0.32 0.23	38.9 38.4	14.0 13.7	1.778	15.24	3.2 2.9	15.80 15.24	17.15 15.90	0.18	1.73

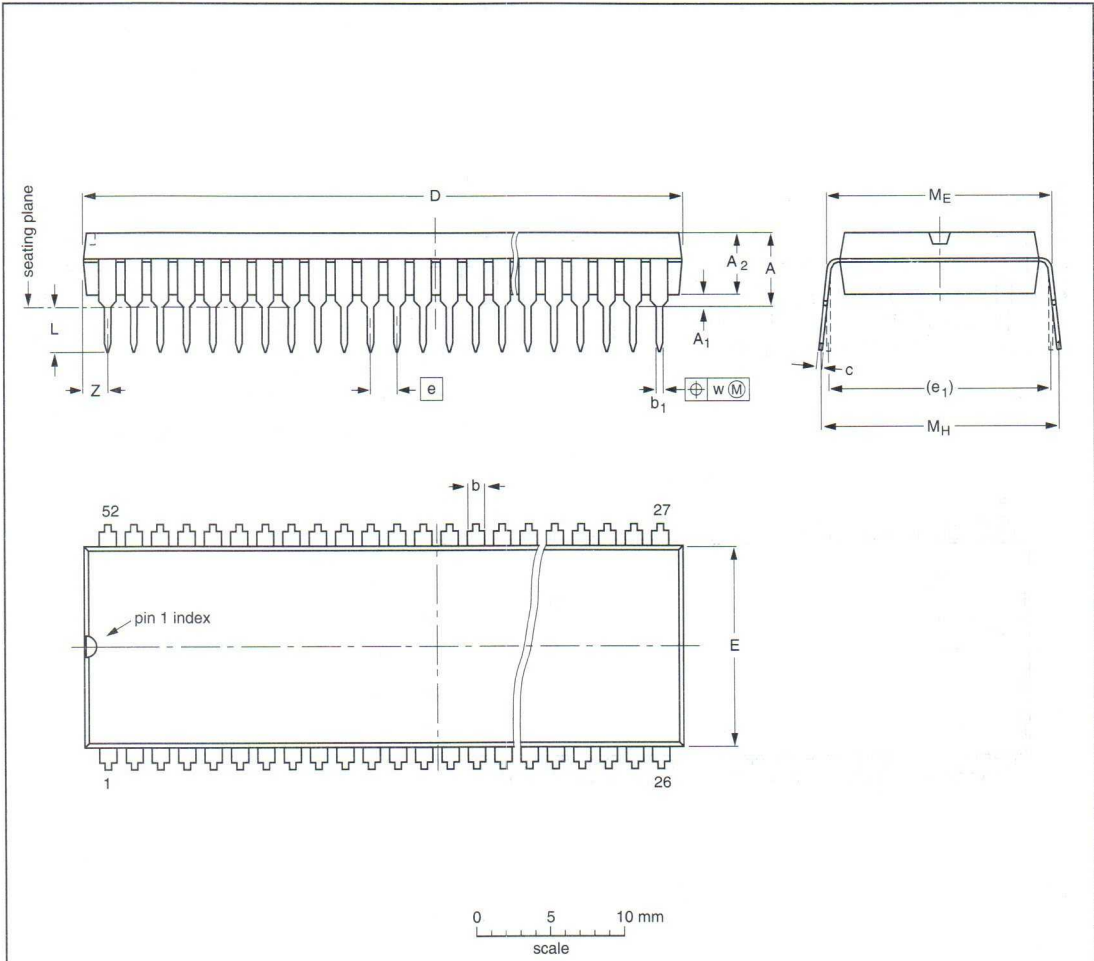
Note

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		
SOT270-1		MS-020			-95-02-04- 99-12-27

SDIP52: plastic shrink dual in-line package; 52 leads (600 mil)

SOT247-1



DIMENSIONS (mm are the original 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	5.08	0.51	4.0	1.3 0.8	0.53 0.40	0.32 0.23	47.9 47.1	14.0 13.7	1.778	15.24	3.2 2.8	15.80 15.24	17.15 15.90	0.18	1.73

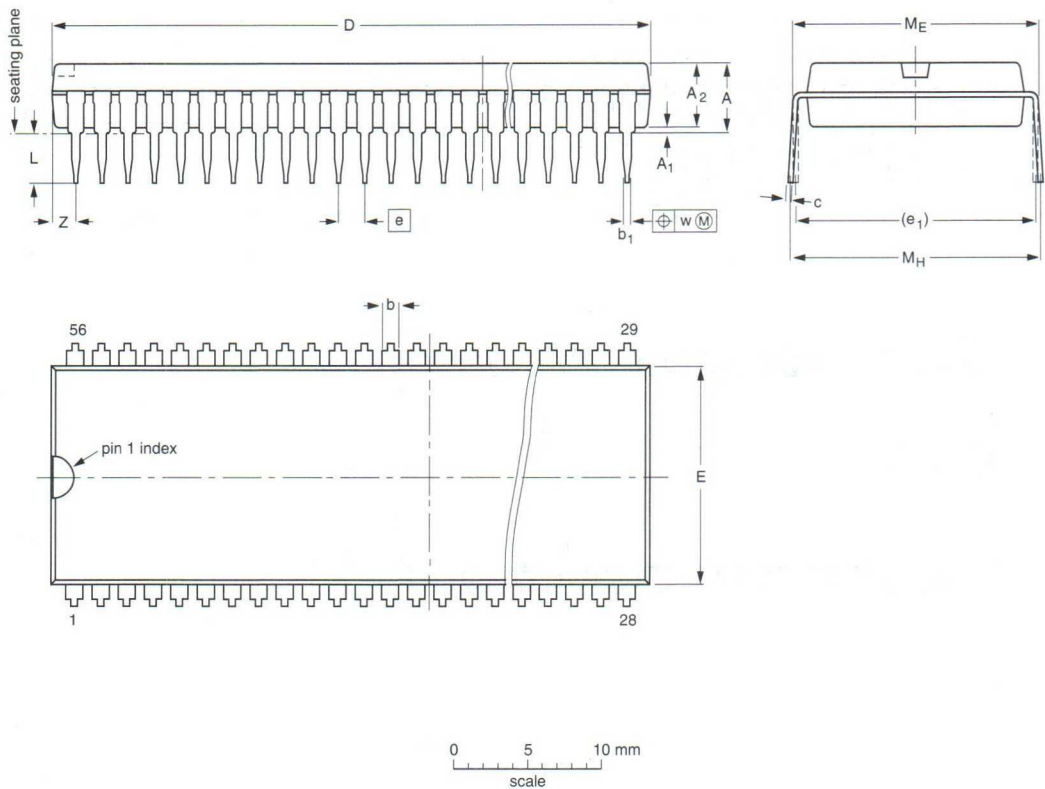
Note

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			
SOT247-1		MS-020				95-03-11- 99-12-27

SDIP56: plastic shrink dual in-line package; 56 leads (600 mil)

SOT400-1



DIMENSIONS (mm are the original 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	5.08	0.51	4.0	1.3 0.8	0.53 0.40	0.32 0.23	52.4 51.6	14.0 13.6	1.778	15.24	3.2 2.8	15.80 15.24	17.15 15.90	0.18	2.3

Note

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

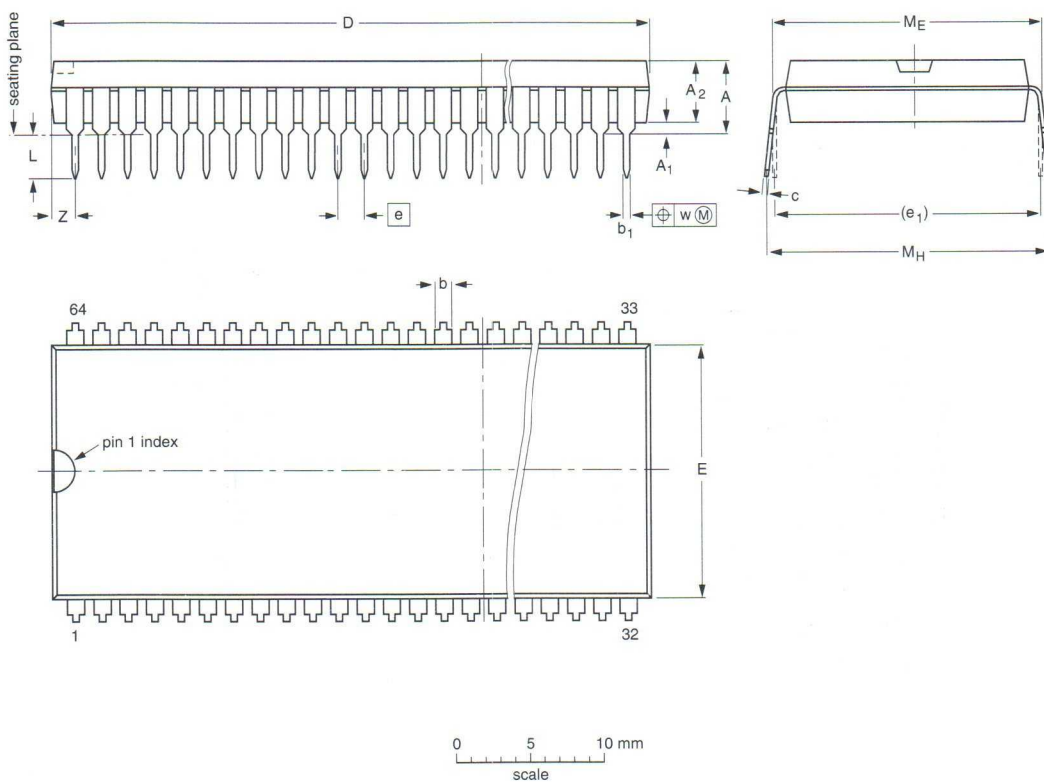
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT400-1						95-12-06

IC package range and dimensions

Chapter 2

SDIP64: plastic shrink dual in-line package; 64 leads (750 mil)

SOT274-1



DIMENSIONS (mm are the original 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	5.84	0.51	4.57	1.3 0.8	0.53 0.40	0.32 0.23	58.67 57.70	17.2 16.9	1.778	19.05	3.2 2.8	19.61 19.05	20.96 19.71	0.18	1.73

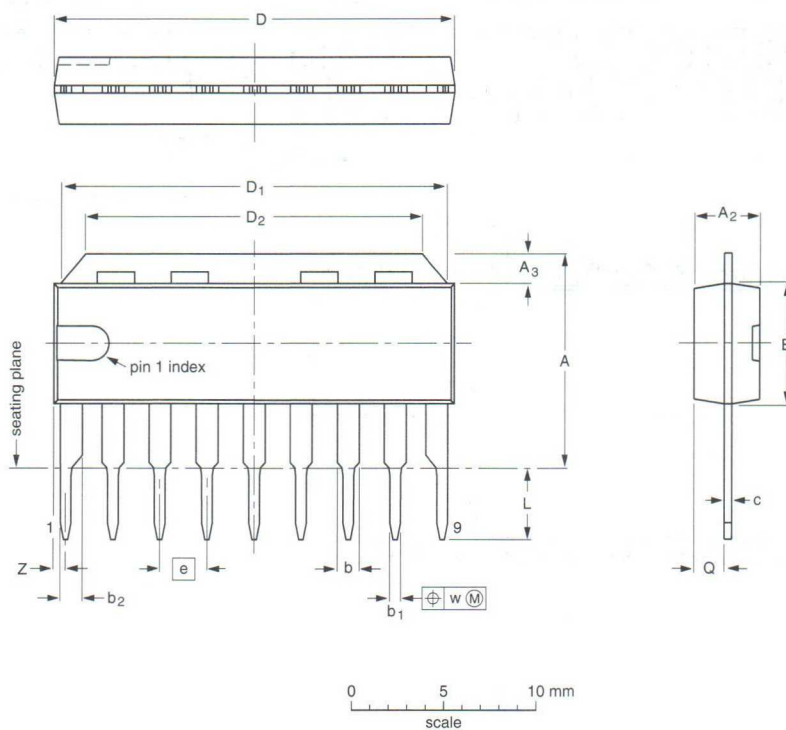
Note

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			
SOT274-1		MS-021				-95-02-04- 99-12-27

SIL9MP: plastic single in-line medium power package; 9 leads

SOT142-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂ max.	A ₃	b	b ₁	b ₂	c	D ⁽¹⁾	D ₁	D ₂	E ⁽¹⁾	e	L	Q	w	Z ⁽¹⁾ max.
mm	12 11	3.7	1.8 1.4	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	18.6 18.2	6.48 6.20	2.54	3.9 3.4	1.75 1.55	0.25	1.0

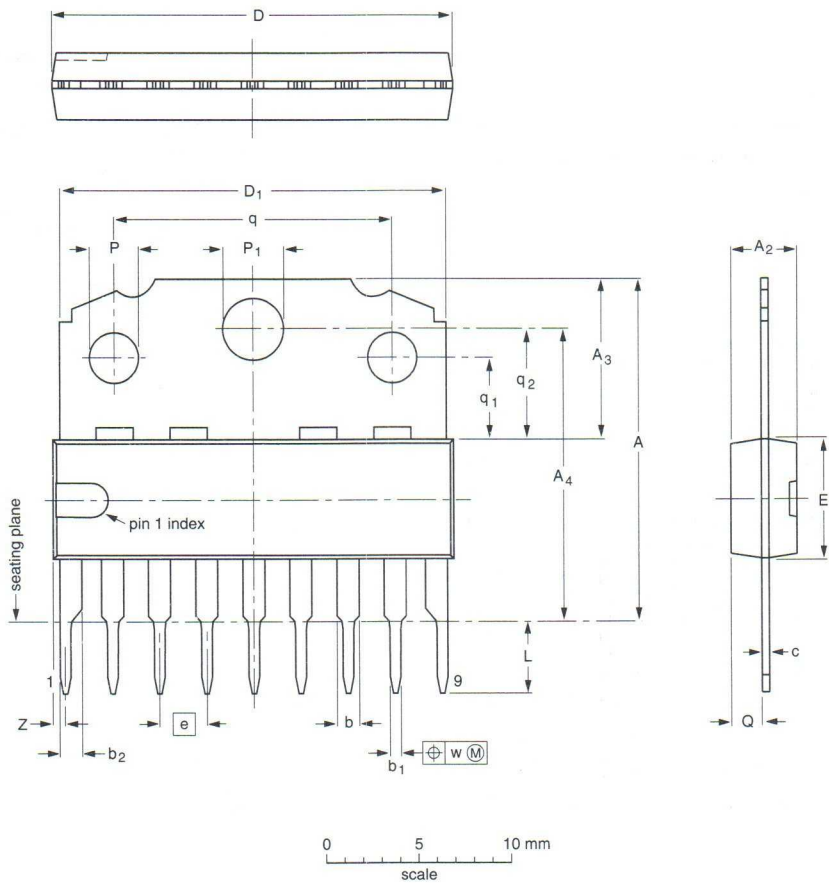
Note

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			
SOT142-1						95-02-09 97-12-16

SIL9MPF: plastic single in-line medium power package with fin; 9 leads

SOT110-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂ max.	A ₃	A ₄	b	b ₁	b ₂	c	D ⁽¹⁾	D ₁	E ⁽¹⁾	e	L	P	P ₁	Q	q	q ₁	q ₂	w	Z ⁽¹⁾ max.
mm	18.5 17.8	3.7	8.7 8.0	15.8 15.4	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	3.9 3.4	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.25	1.0

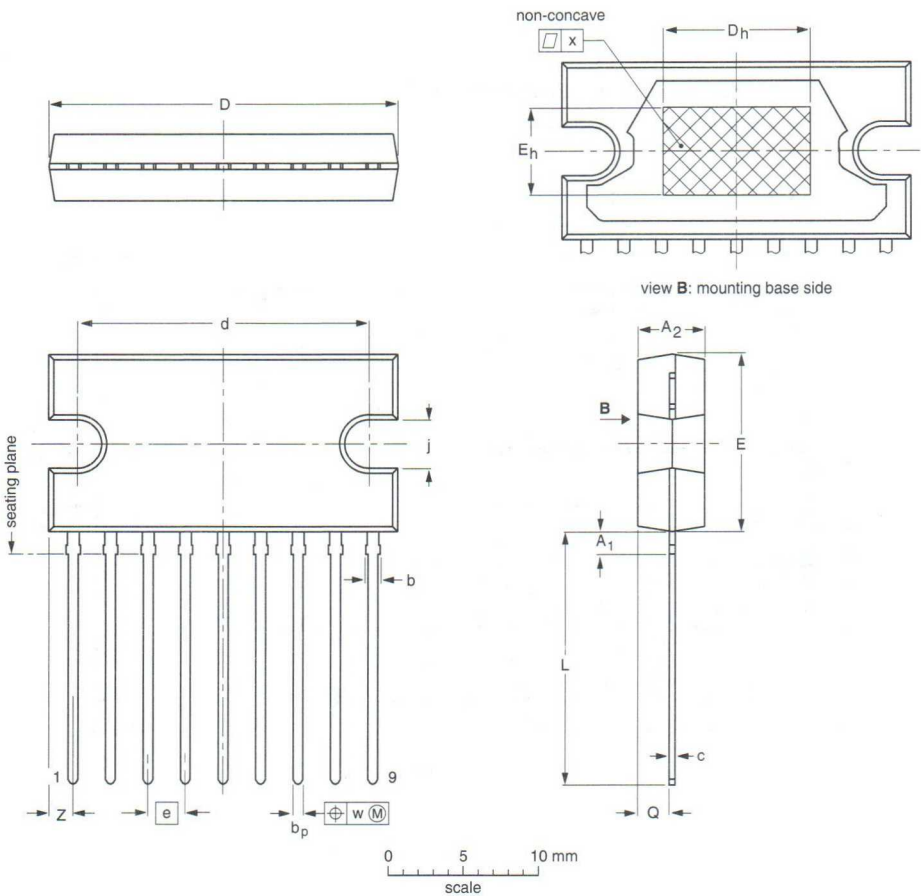
Note

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			
SOT110-1						92-11-17 95-02-25

SIL9P: plastic single in-line power package; 9 leads

SOT131-2



DIMENSIONS (mm are the original dimensions)

UNIT	A ₁ max.	A ₂	b max.	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	E _h	j	L	Q	w	x	z ⁽¹⁾
mm	2.0	4.6 4.4	1.1	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	6	3.4 3.1	17.2 16.5	2.1 1.8	0.25	0.03	2.00 1.45

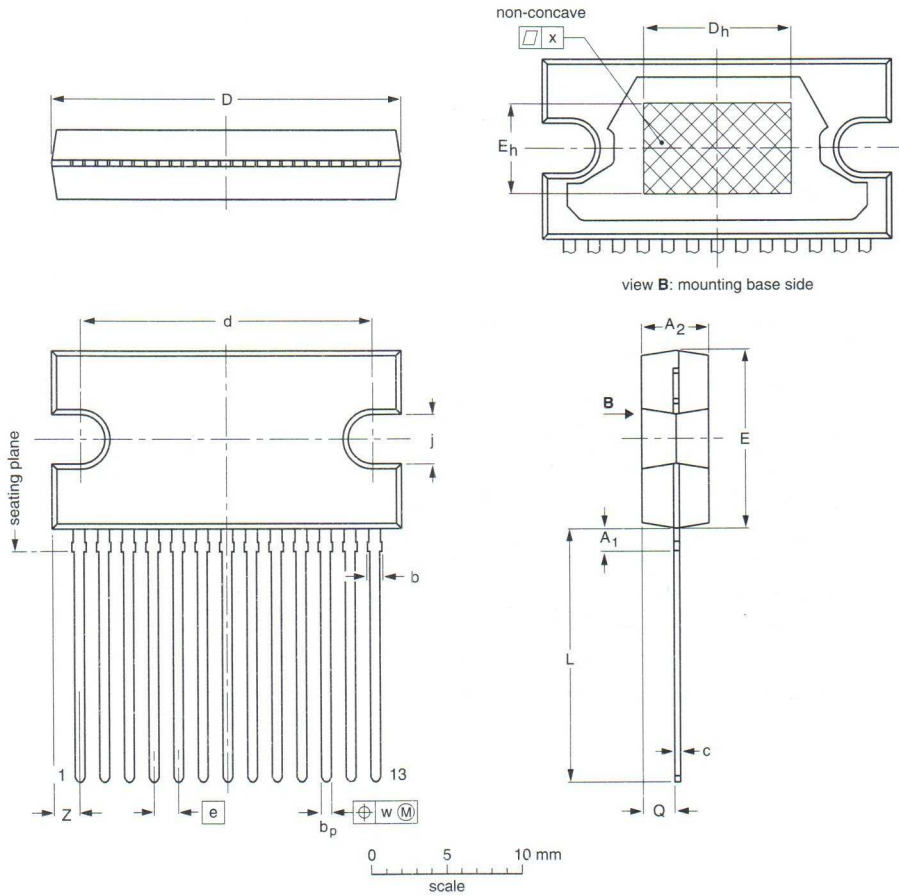
Note

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			
SOT131-2						95-03-11 99-12-17

SIL13P: plastic single in-line power package; 13 leads

SOT193-2



DIMENSIONS (mm are the original dimensions)

UNIT	A ₁ max.	A ₂	b max.	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	E _h	j	L	Q	w	x	z ⁽¹⁾
mm	2.0	4.6 4.4	1.1	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	1.7	6	3.4 3.1	17.2 16.5	2.1 1.8	0.25	0.03	2.00 1.45

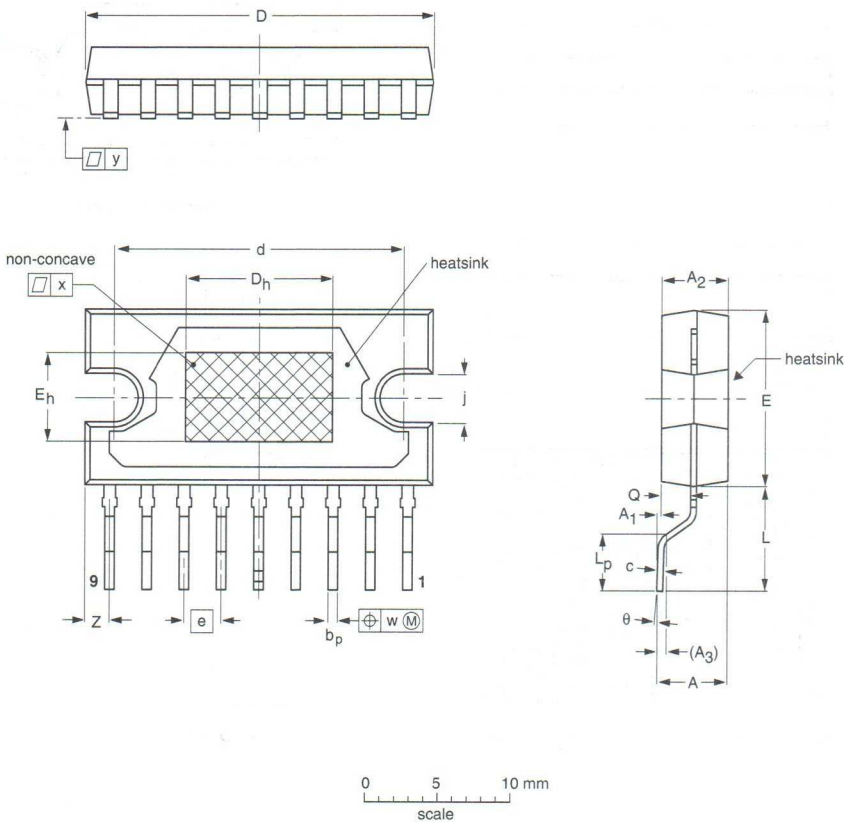
Note

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			
SOT193-2						97-05-22 99-12-17

SMS9P: plastic surface mounted single in-line power package; 9 leads

SOT354-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	E _h	j	L	L _p	Q	w	x	y	Z ⁽¹⁾	θ
mm	4.9 4.2	0.35 0.05	4.6 4.4	0.25	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	6	3.4 3.1	7.4 6.6	3.4 2.8	2.1 1.9	0.25	0.03	0.15	2.00 1.45	3° 0°

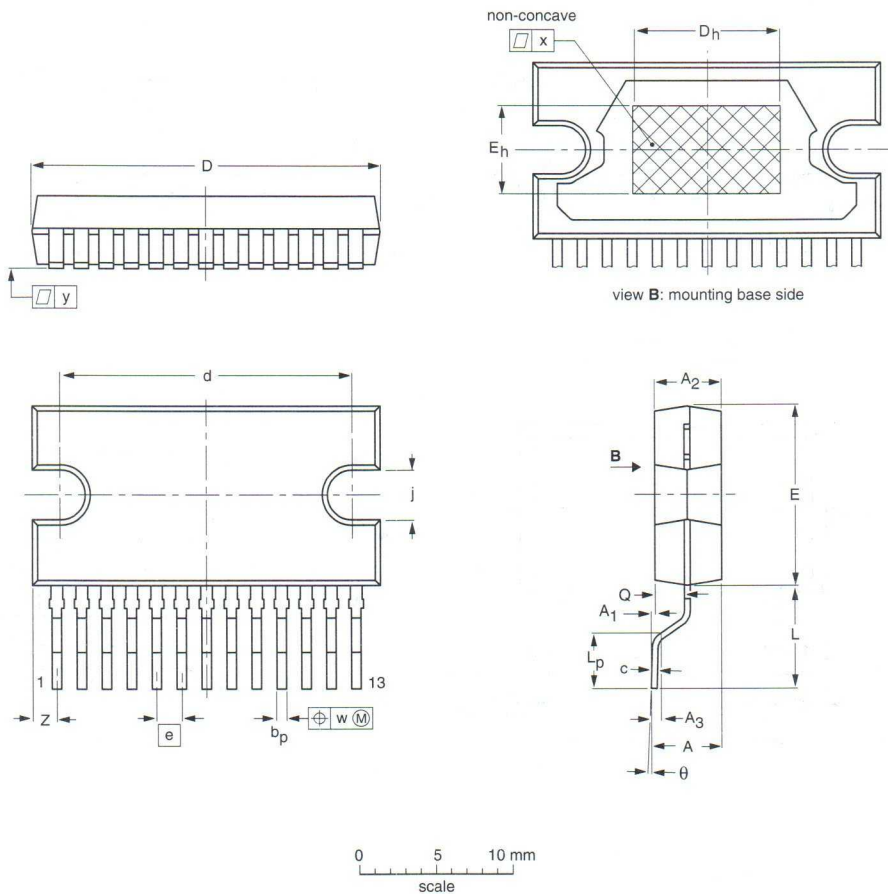
Note

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			
SOT354-1						98-10-08 99-12-17

SMS13P: plastic surface mounted single in-line power package; 13 leads

SOT517-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	E _h	j	L	L _p	Q	w	x	y	z ⁽¹⁾	θ
mm	4.9 4.2	0.3 0.0	4.6 4.4	0.25	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	1.7	6	3.4 3.1	7.4 6.6	3.4 2.8	2.1 1.8	0.25	0.03	0.15	2.00 1.45	3° 0°

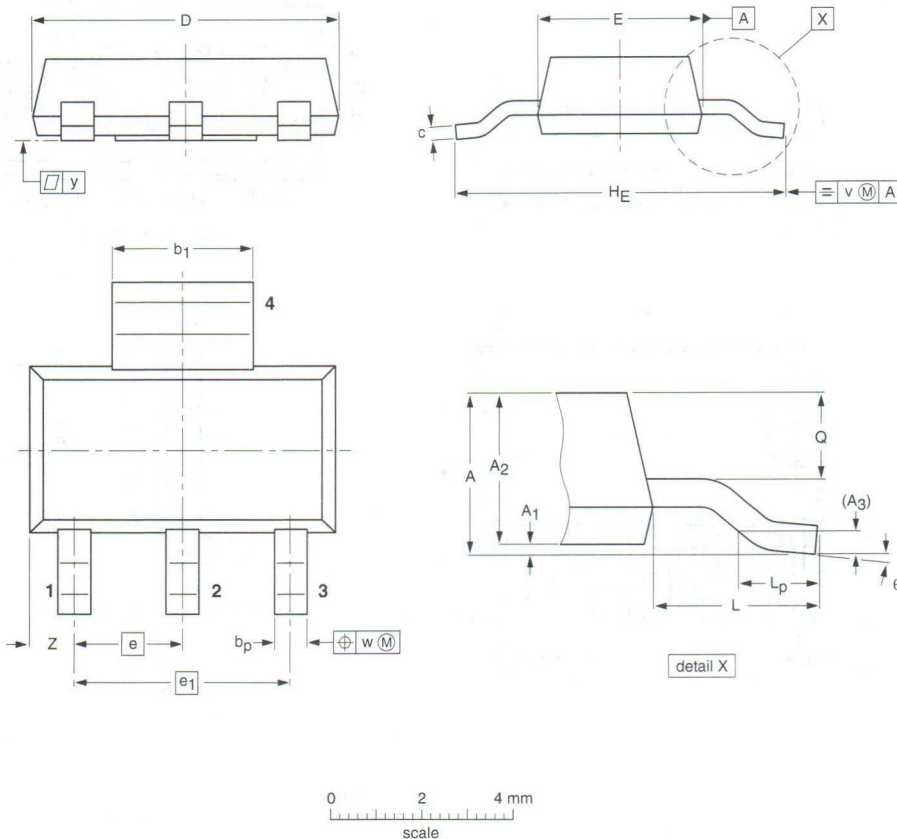
Note

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			
SOT517-1						98-07-10 99-12-17

SO4: plastic small outline package; 4 leads; body width 3.5 mm

SOT223-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	H _E	L	L _p	Q	v	w	y	z	θ
mm	1.8	0.10 0.02	1.7 1.5	0.25	0.85 0.65	3.15 2.95	0.35 0.25	6.7 6.3	3.7 3.3	2.3	4.6	7.3 6.7	1.75	1.02 0.62	1.0 0.8	0.2	0.1	0.1	1.2 0.7	10° 0°

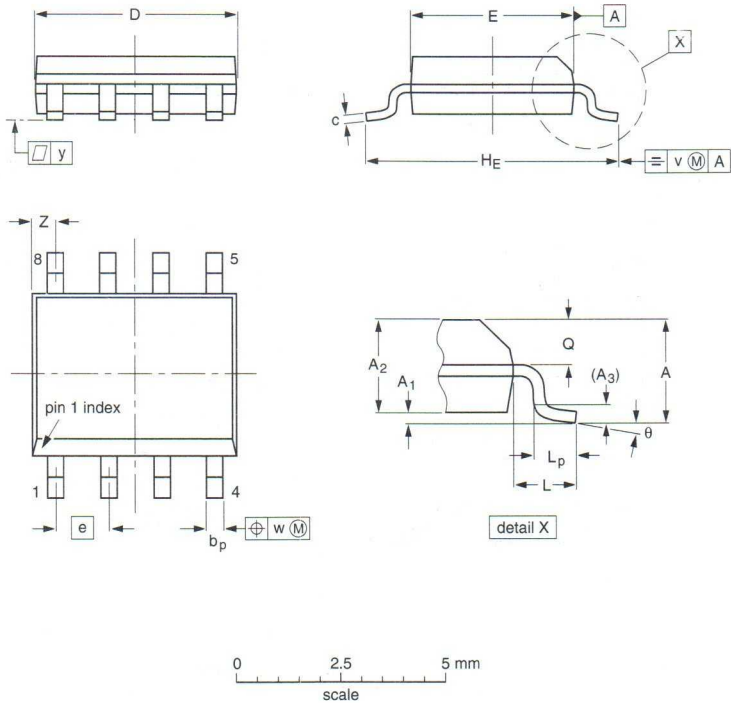
Note

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		
SOT223-1		TO-261			99-08-04 99-12-15

S08: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1



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

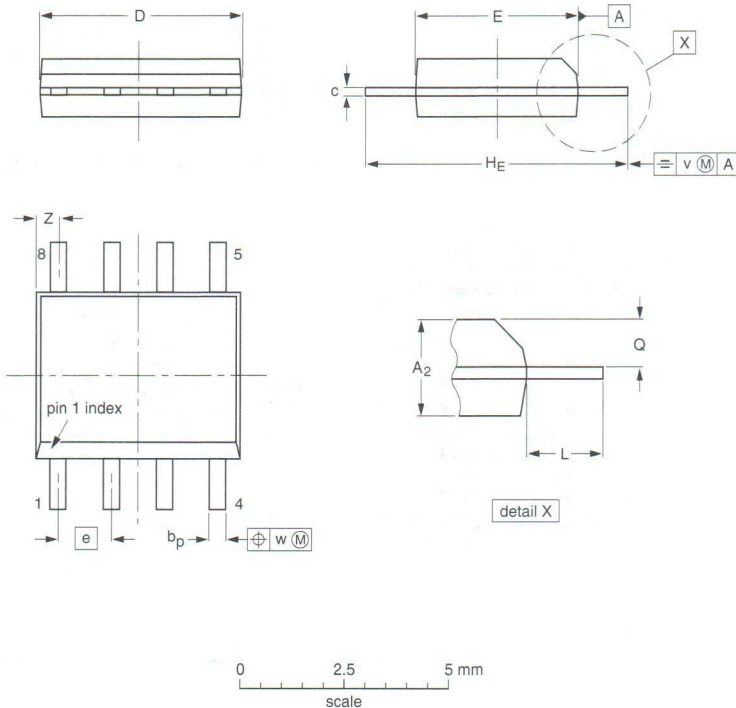
UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

- Notes
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03	MS-012				97-05-22 99-12-27

SO8: plastic small outline package; 8 leads (straight); body width 3.9 mm

SOT96-2



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

UNIT	A ₂	b _p	c	D ⁽¹⁾	E ⁽²⁾	e	H _E	L	Q	v	w	Z ⁽¹⁾
mm	1.45 1.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.4 6.2	1.2	0.7 0.6	0.25	0.25	0.7 0.3
inches	0.057 0.049	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.252 0.244	0.047	0.028 0.024	0.01	0.01	0.028 0.012

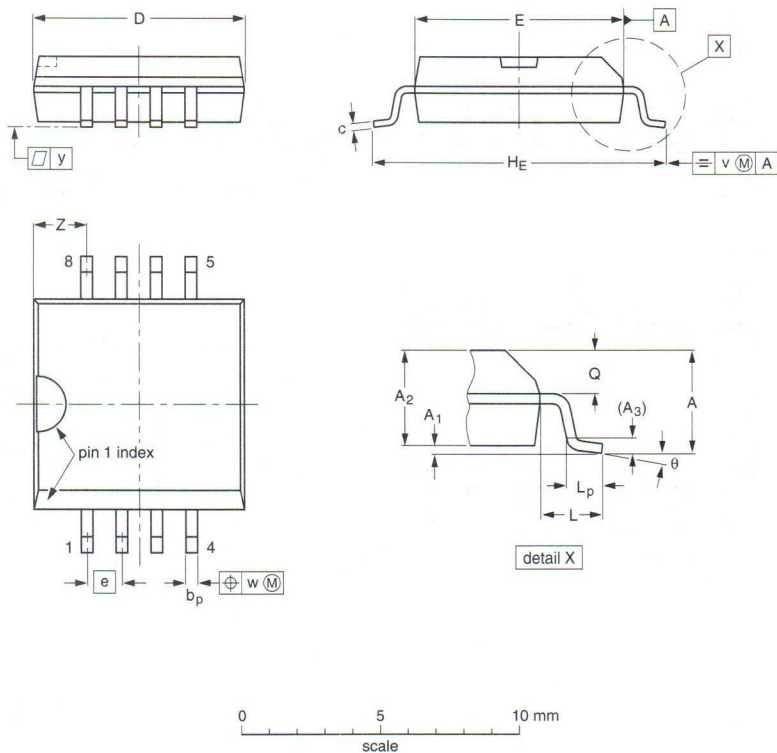
Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-2						95-02-04 97-05-22

SO8: plastic small outline package; 8 leads; body width 7.5 mm

SOT176-1



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	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	7.65 7.45	7.6 7.4	1.27	10.65 10.00	1.45	1.1 0.45	1.1 1.0	0.25	0.25	0.1	2.0 1.8	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.30 0.29	0.30 0.29	0.050	0.419 0.394	0.057	0.043 0.018	0.043 0.039	0.01	0.01	0.004	0.079 0.071	

Note

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

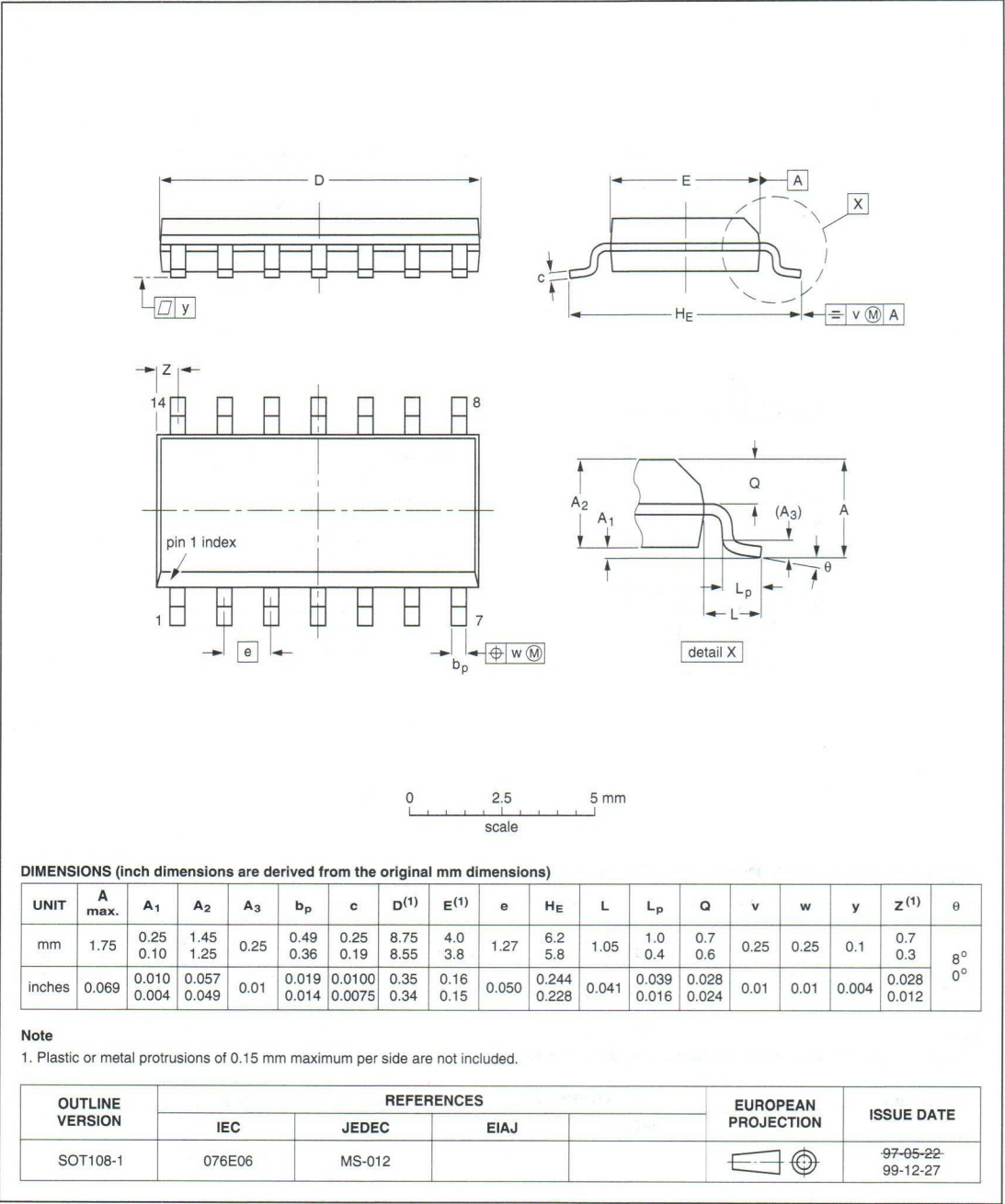
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT176-1						-95-02-25 97-05-22

IC package range and dimensions

Chapter 2

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

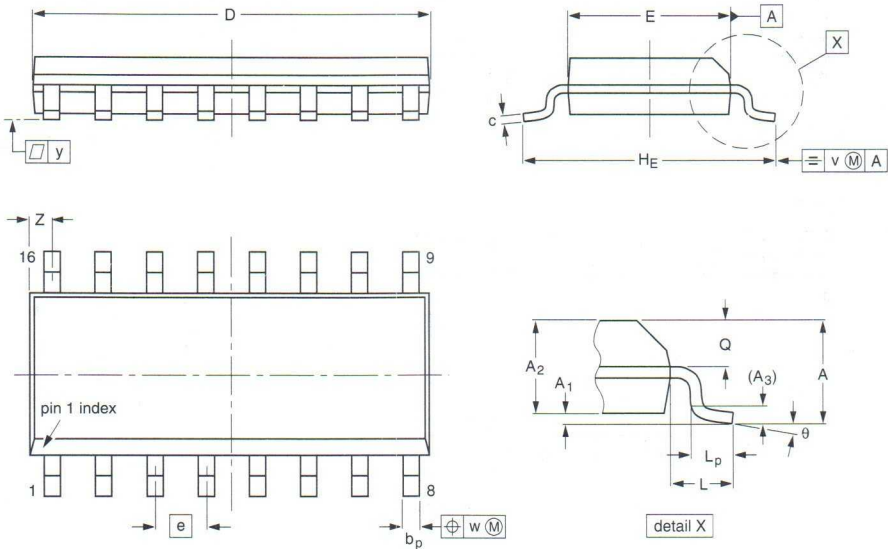


IC package range and dimensions

Chapter 2

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

SOT109-1



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

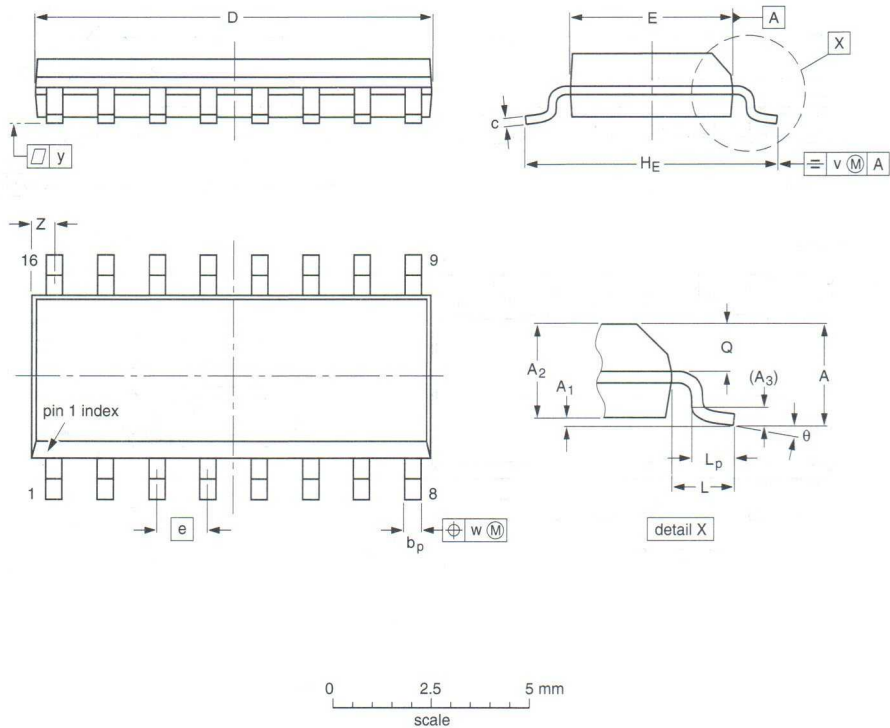
UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 0.228	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.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT109-1	076E07	MS-012			97-05-22- 99-12-27

SO16: plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height SOT109-2



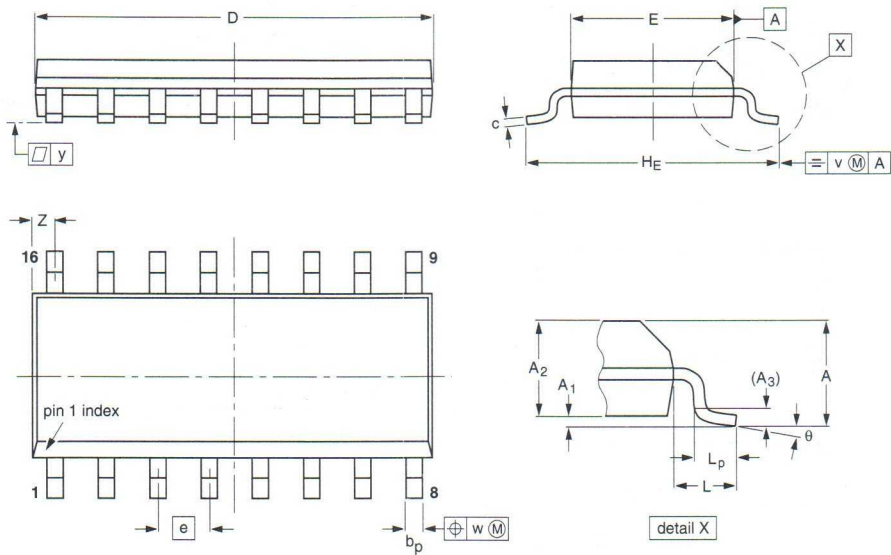
DIMENSIONS (inch dimensions are derived from the original mm dimensions)

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	1.65	0.20 0.05	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	0.065	0.008 0.002	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	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.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-2	076E07	MS-012				97-05-22 99-12-27

SO16: plastic small outline package; 16 leads; body width 3.9 mm; body thickness 1.47 mm SOT109-3



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	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.55 1.40	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	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.061 0.055	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	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.

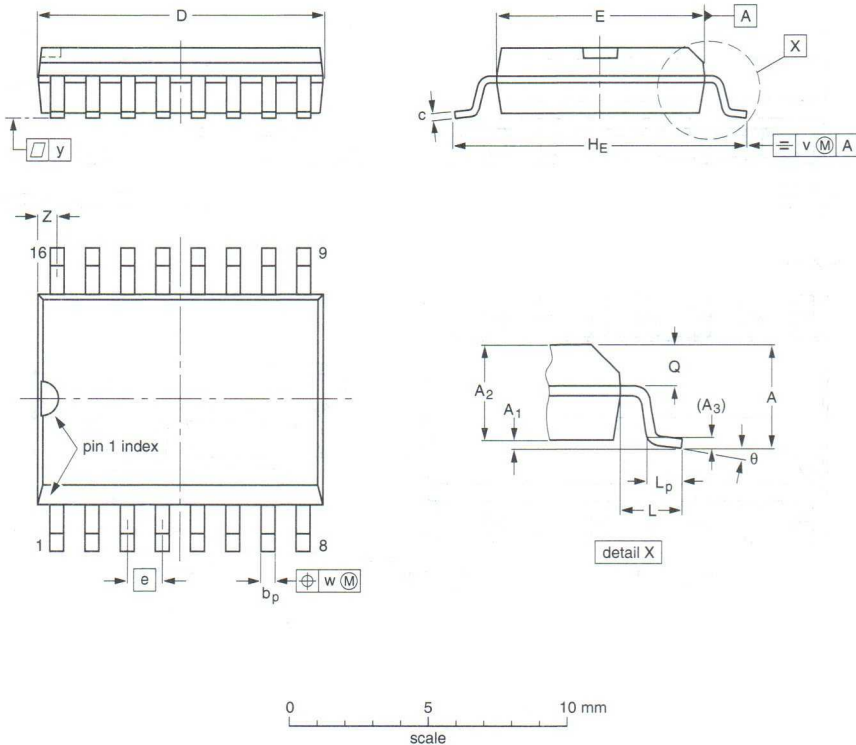
OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT109-3		MS-012AC			98-12-23

IC package range and dimensions

Chapter 2

SO16: plastic small outline package; 16 leads; body width 7.5 mm

SOT162-1



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	10.5 10.1	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	0.41 0.40	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	

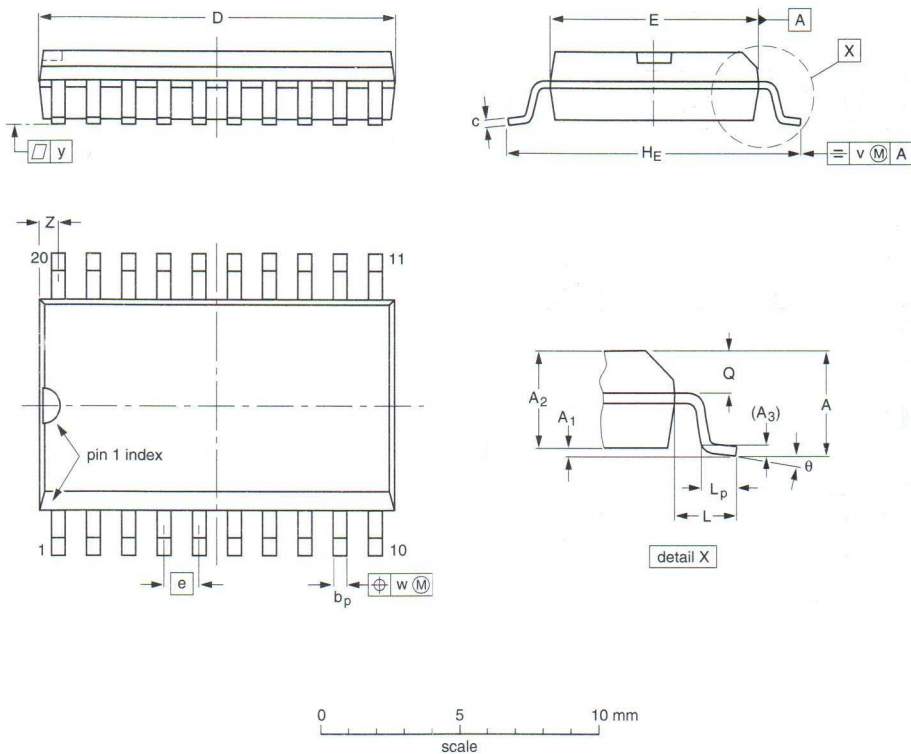
Note

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			
SOT162-1	075E03	MS-013				-97-05-22 99-12-27

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° 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.

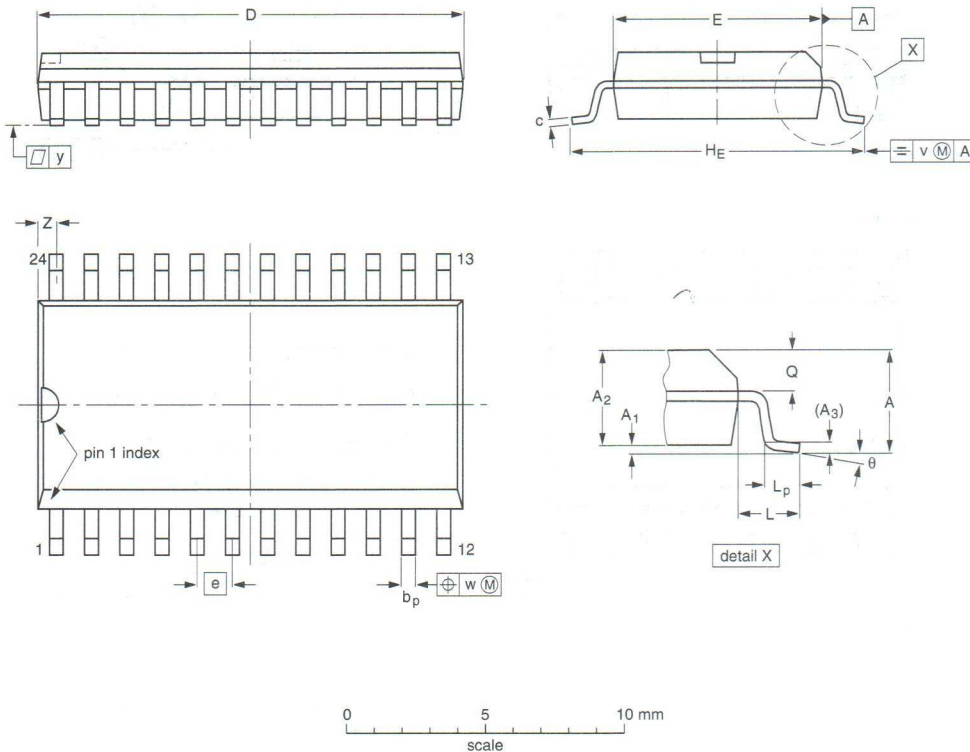
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013				-97-05-22 99-12-27

IC package range and dimensions

Chapter 2

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 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	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	

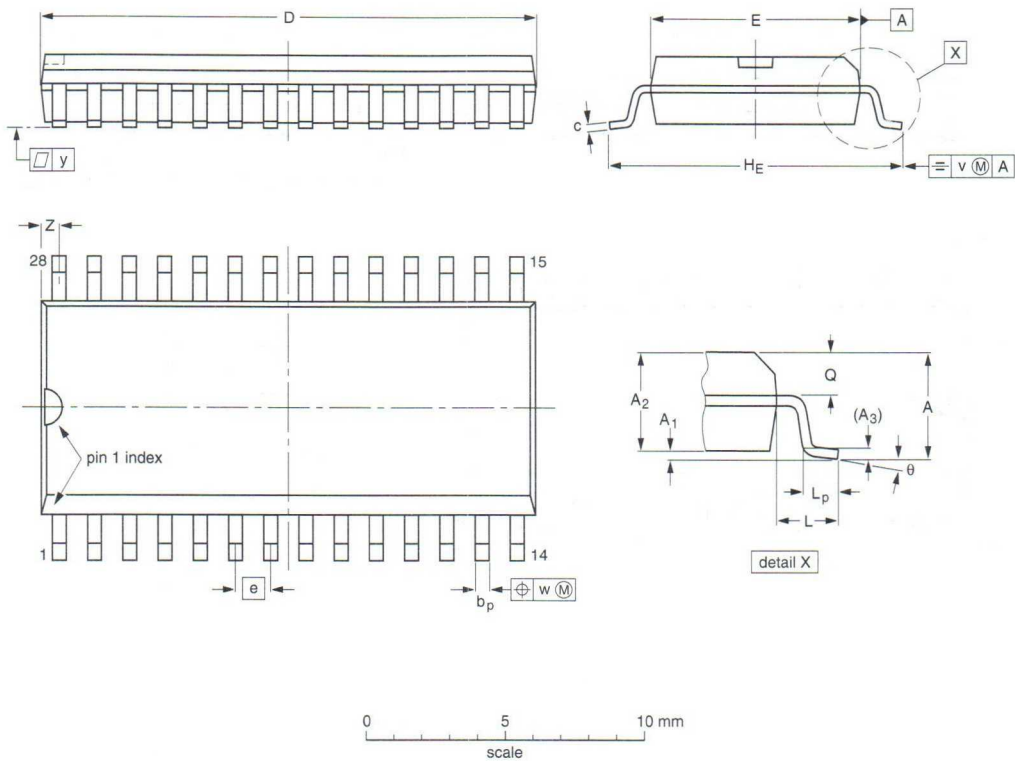
Note

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-013				97-05-22 99-12-27

SO28: plastic small outline package; 28 leads; body width 7.5 mm

SOT136-1



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	18.1 17.7	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	0.71 0.69	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	

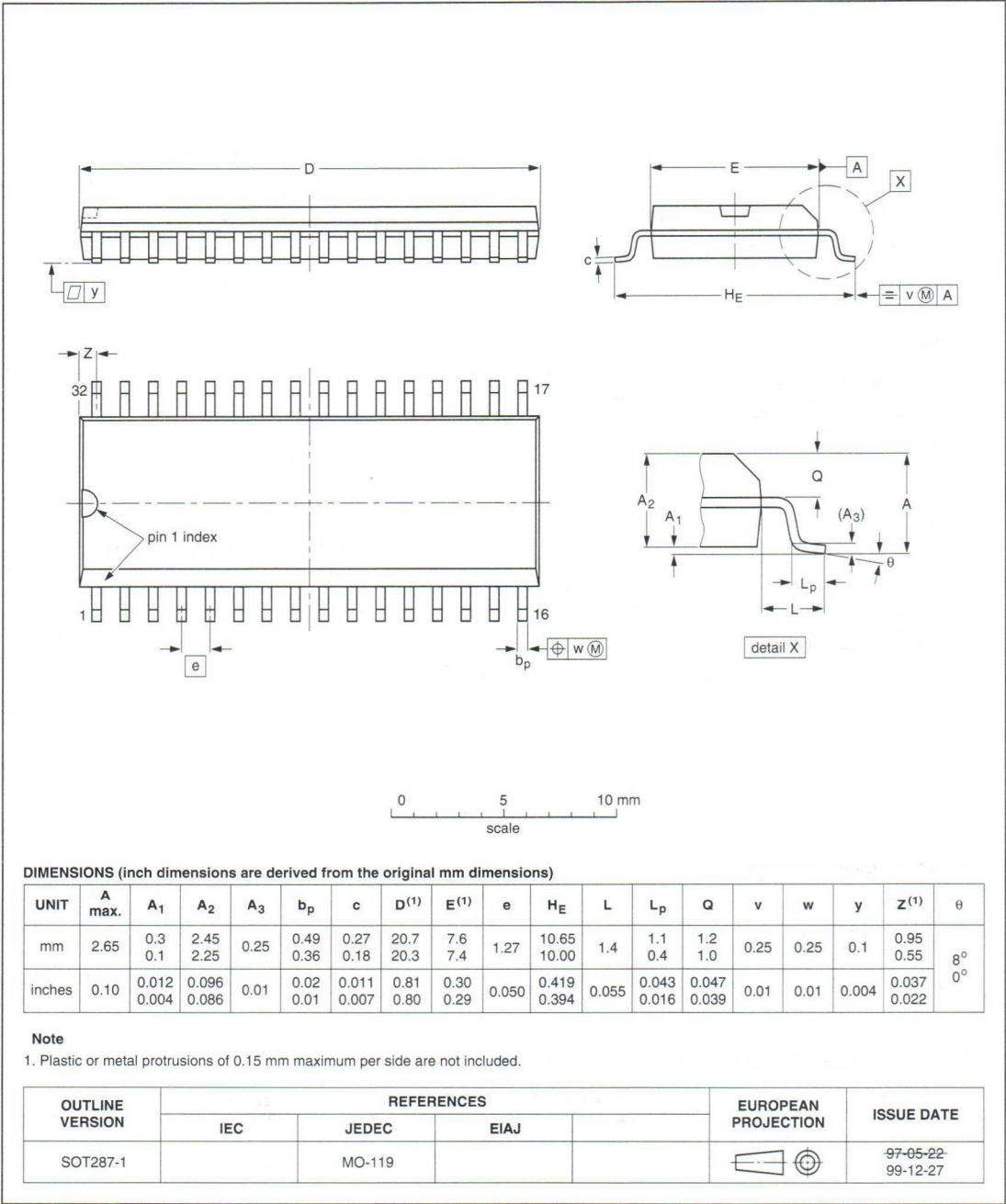
Note

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			
SOT136-1	075E06	MS-013				97-05-22 99-12-27

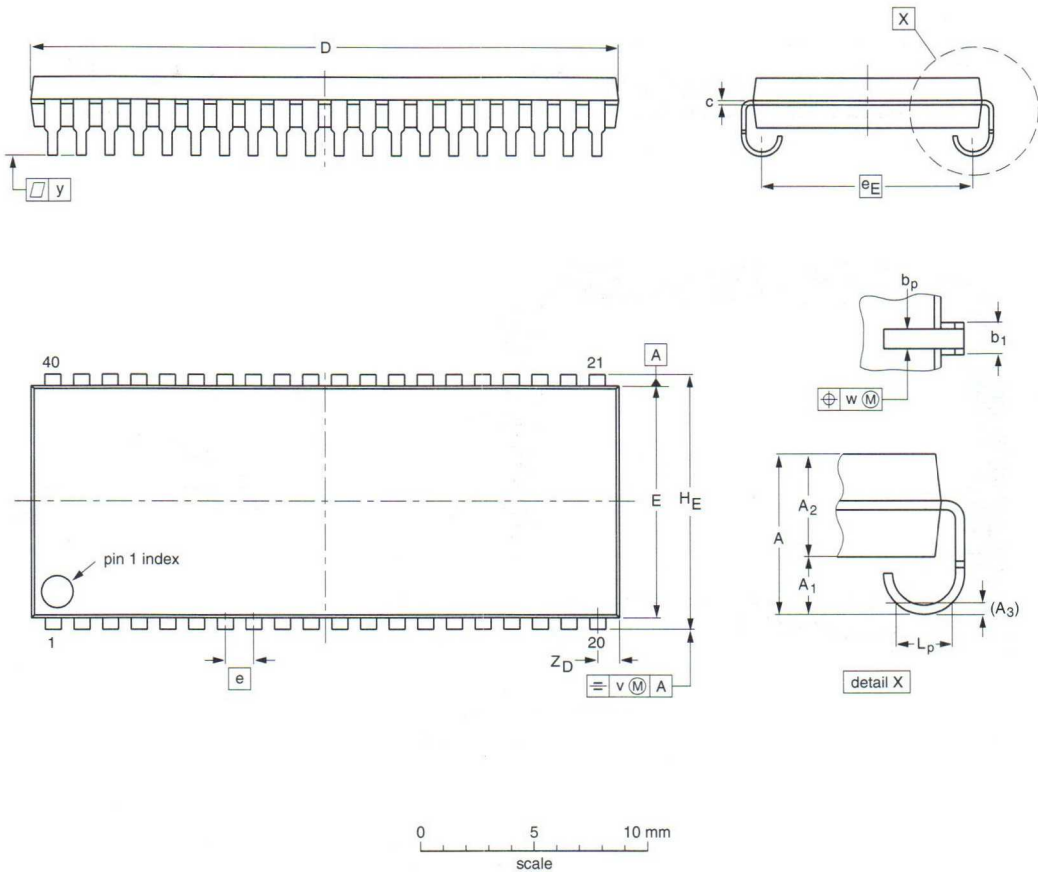
SO32: plastic small outline package; 32 leads; body width 7.5 mm

SOT287-1



SOJ40: plastic small outline package; 40 leads (J-bent); body width 10.16 mm

SOT449-1



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

UNIT	A max.	A ₁	A ₂	A ₃	b _p	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e _E	H _E	L _p	v	w	y	Z _D ⁽¹⁾
mm	3.68	1.40 1.14	2.29 2.18	0.25	0.51 0.38	0.81 0.66	0.32 0.18	26.2 25.9	10.3 10.0	1.27	9.4	11.30 11.05	1.4 1.1	0.18	0.18	0.1	1.19 0.73

Note

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

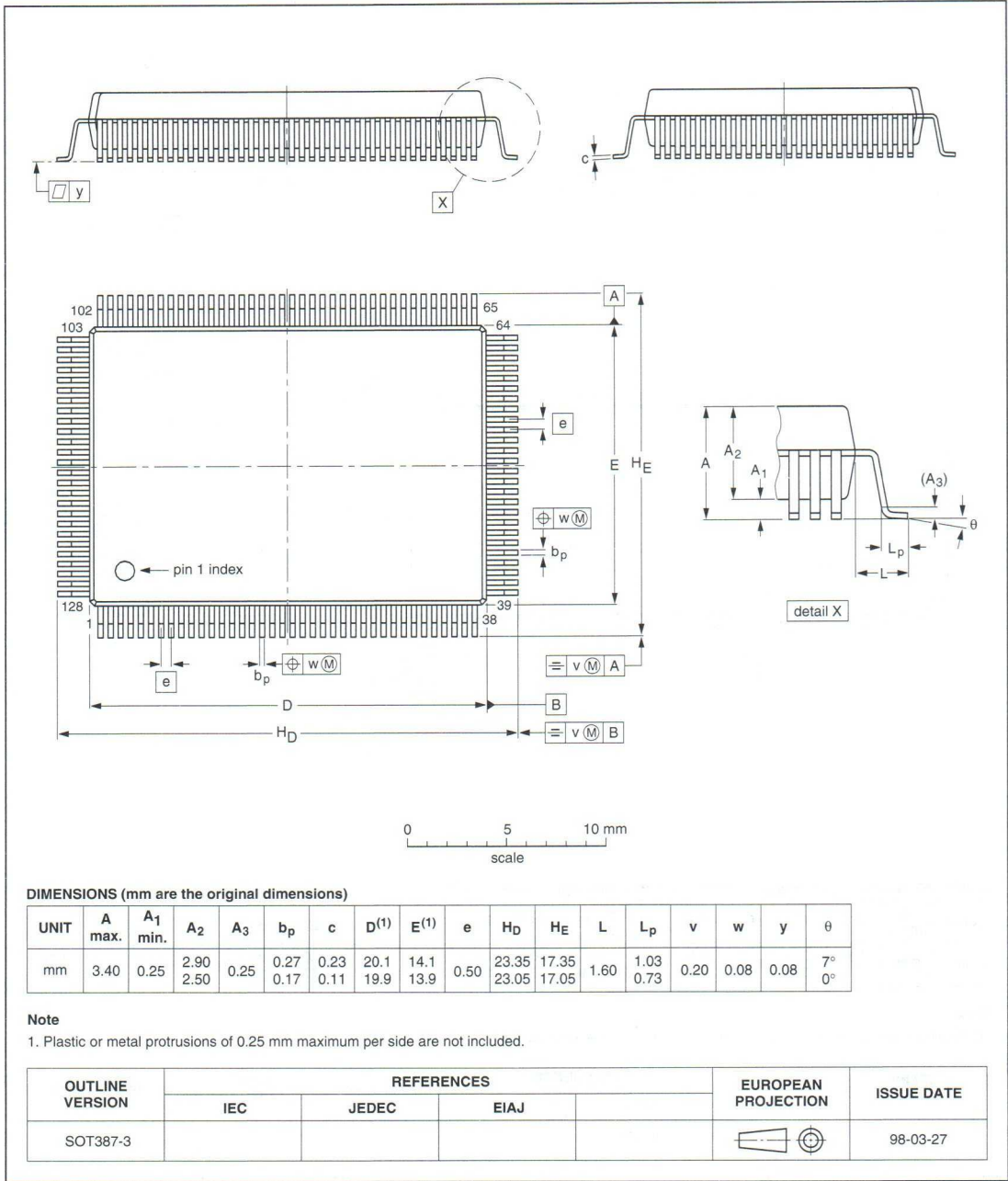
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT449-1		MS-027				97-06-02 99-12-27

IC package range and dimensions

Chapter 2

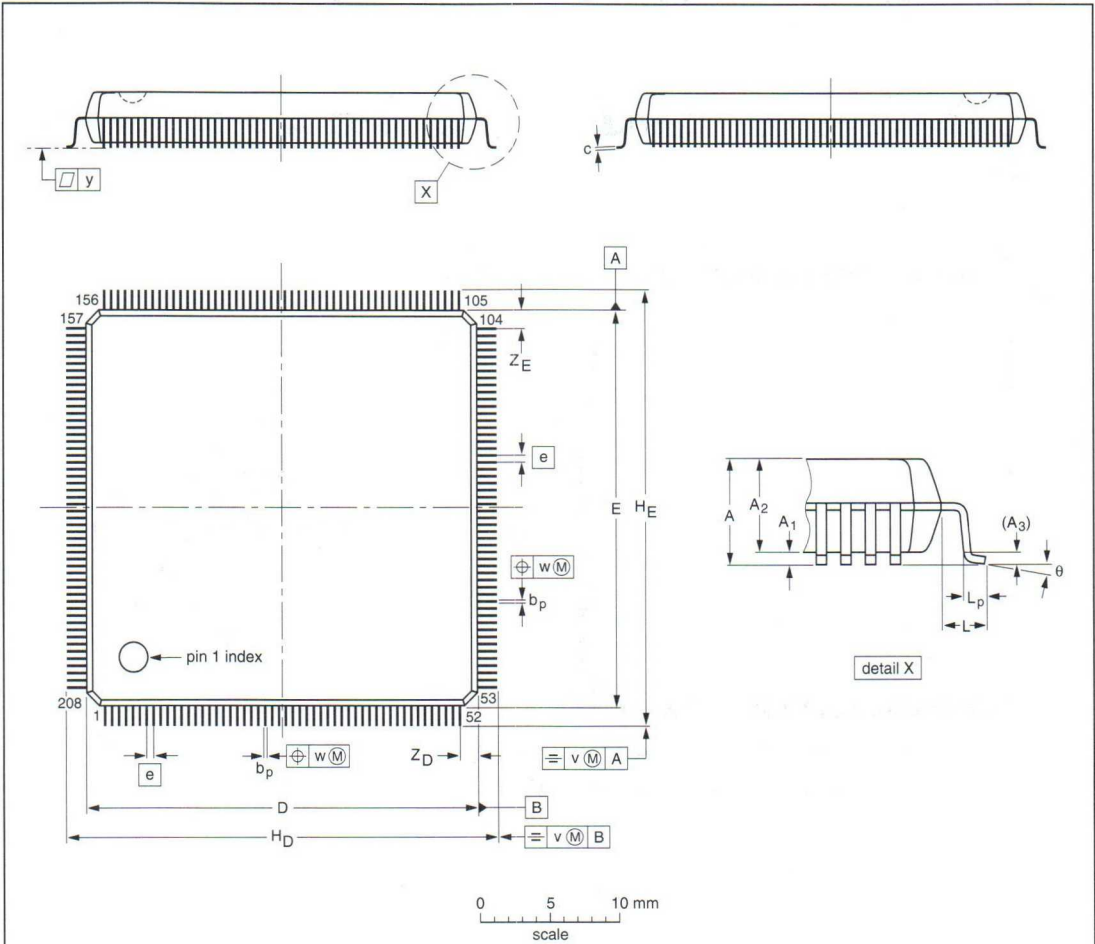
SQFP128: plastic shrink quad flat package;
128 leads (lead length 1.6 mm); body 14 x 20 x 2.72 mm

SOT387-3



SQFP208: plastic shrink quad flat package;
208 leads (lead length 1.3 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT316-1



DIMENSIONS (mm are the original dimensions)

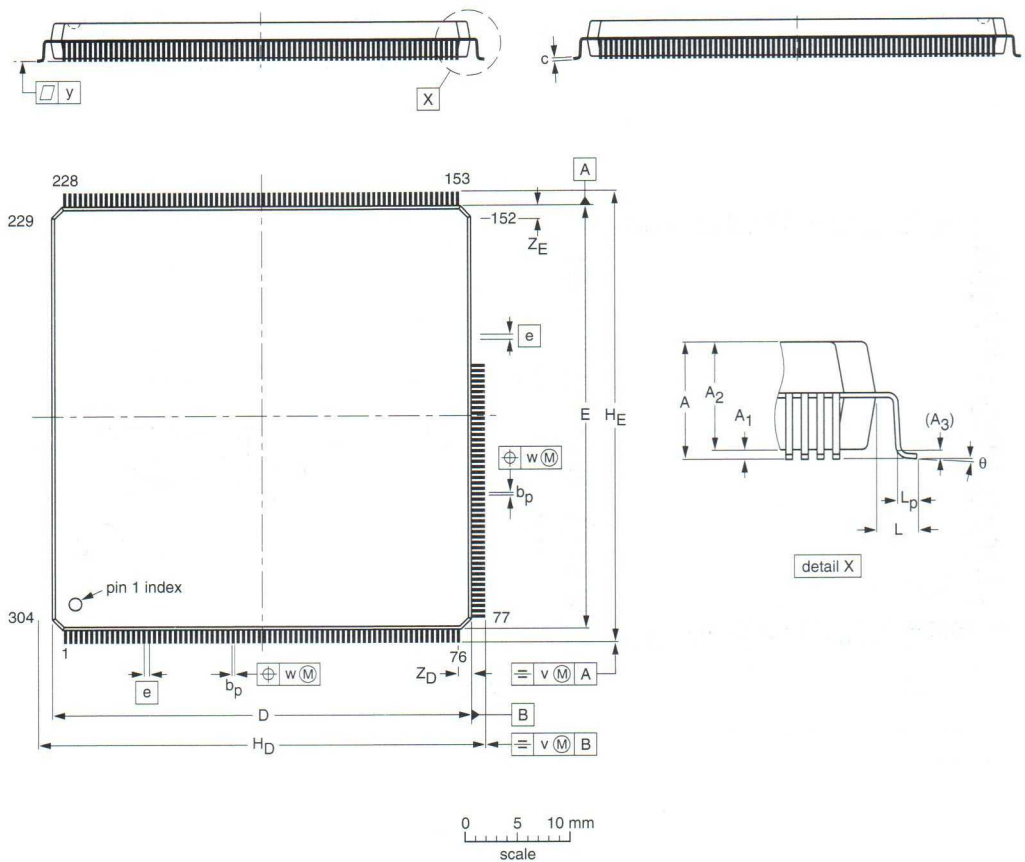
UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	4.10	0.50 0.25	3.6 3.2	0.25	0.27 0.17	0.20 0.09	28.1 27.9	28.1 27.9	0.5	30.9 30.3	30.9 30.3	1.3	0.75 0.45	0.2	0.08	0.08	1.39 1.11	1.39 1.11	8° 0°

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			
SOT316-1		MS-029				99-12-27 00-01-25

SQFP304: plastic shrink quad flat package;
304 leads; (lead length 1.3 mm), body 40 x 40 x 3.8 mm

SOT575-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D	Z _E	θ
mm	4.50	0.50 0.25	4.05 3.55	0.25	0.27 0.17	0.20 0.09	40.1 39.9	40.1 39.9	0.5	42.85 42.35	42.85 42.35	1.3	0.75 0.45	0.25	0.08	0.08	1.39 1.11	1.39 1.11	8° 0°

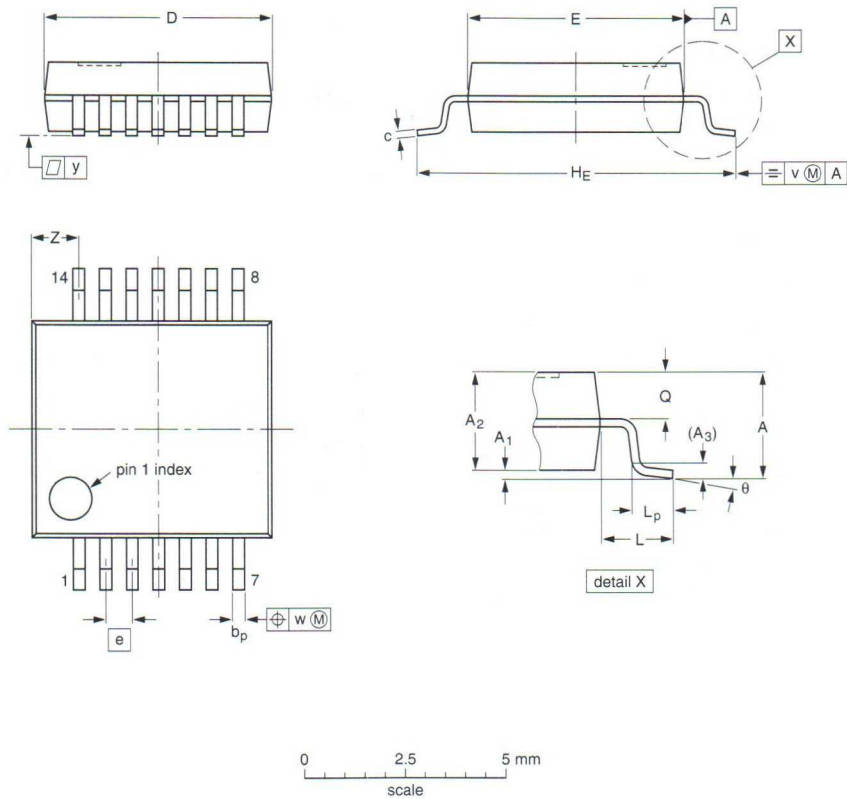
Note

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			
SOT575-1		MS-029				1999-12-08

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1



DIMENSIONS (mm are the original dimensions)

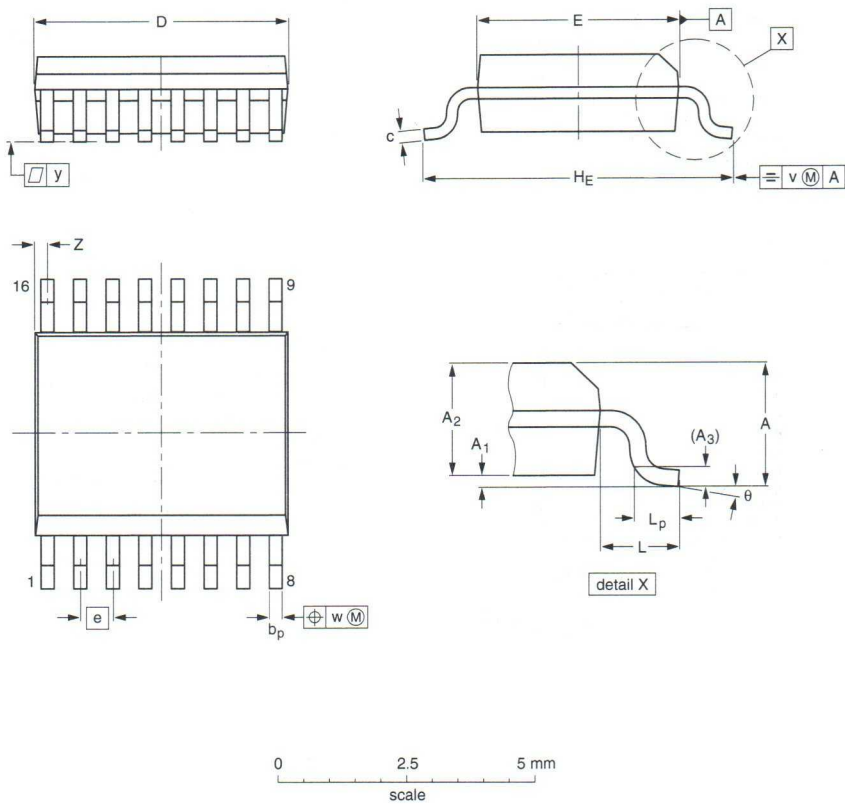
UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8° 0°

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			
SOT337-1		MO-150				96-01-18 99-12-27

SSOP16: plastic shrink small outline package; 16 leads; body width 3.9 mm; lead pitch 0.635 mm SOT519-1



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	v	w	y	Z ⁽¹⁾	θ
mm	1.73	0.25 0.10	1.55 1.40	0.25	0.31 0.20	0.25 0.18	5.0 4.8	4.0 3.8	0.635	6.2 5.8	1.0	0.89 0.41	0.2	0.18	0.09	0.18 0.05	8° 0°

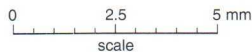
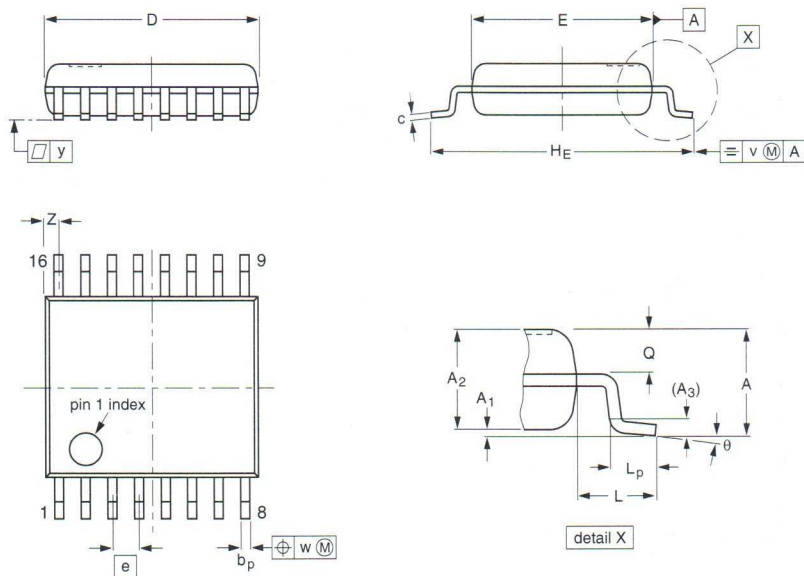
Note

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			
SOT519-1						99-05-04

SSOP16: plastic shrink small outline package; 16 leads; body width 4.4 mm

SOT369-1



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	1.5	0.15 0.00	1.4 1.2	0.25	0.32 0.20	0.25 0.13	5.30 5.10	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

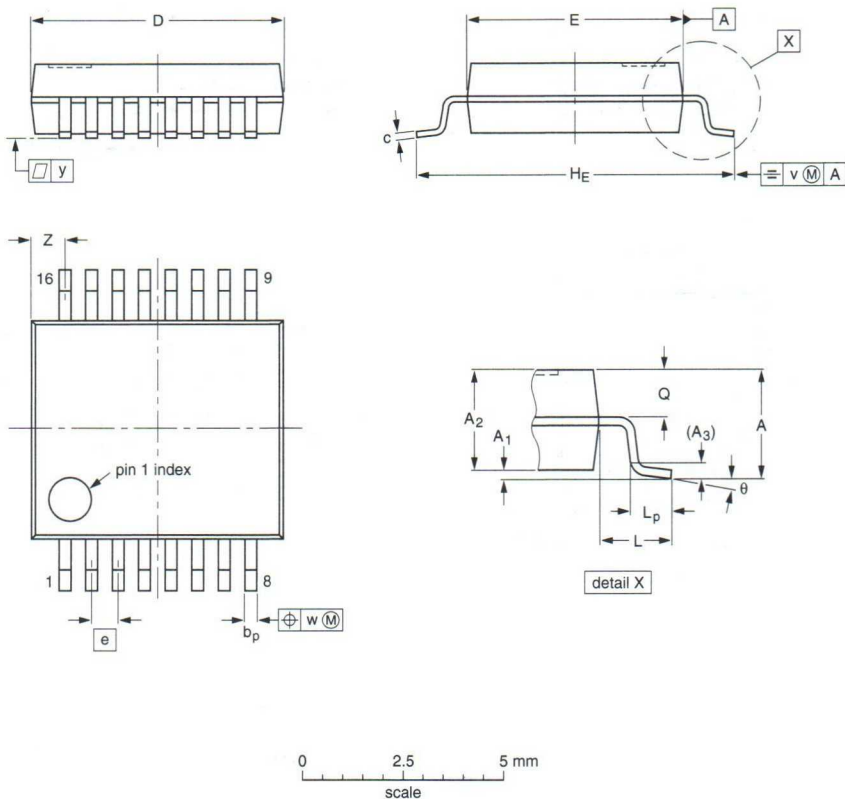
Note

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			
SOT369-1		MO-152				95-02-04 99-12-27

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°

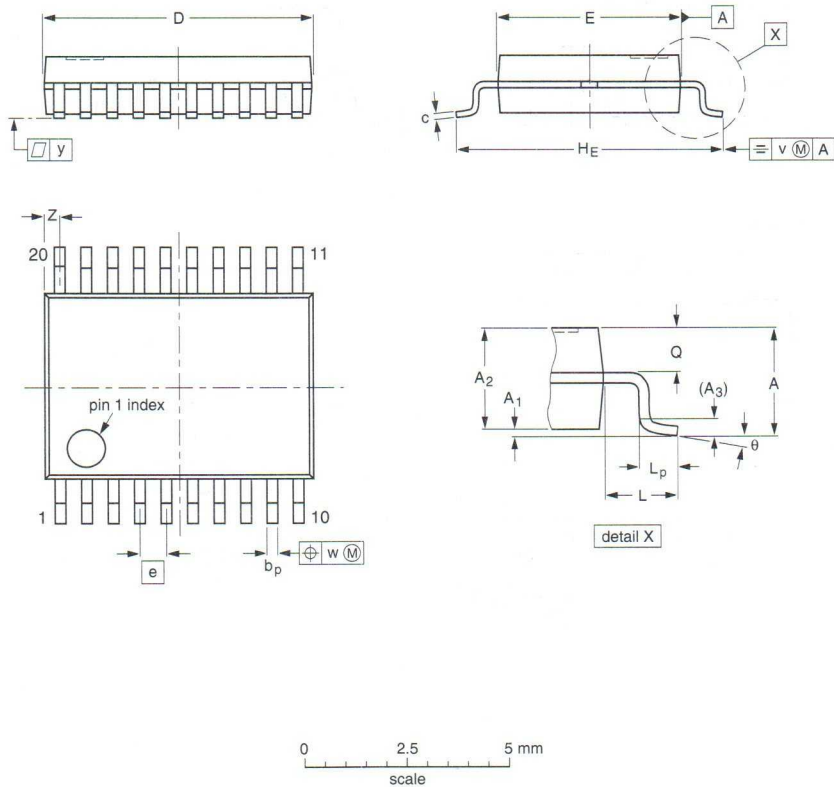
Note

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

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT338-1		MO-150			95-02-04 99-12-27

SSOP20: plastic shrink small outline package; 20 leads; body width 4.4 mm

SOT266-1



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	1.5	0.15 0	1.4 1.2	0.25	0.32 0.20	0.20 0.13	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

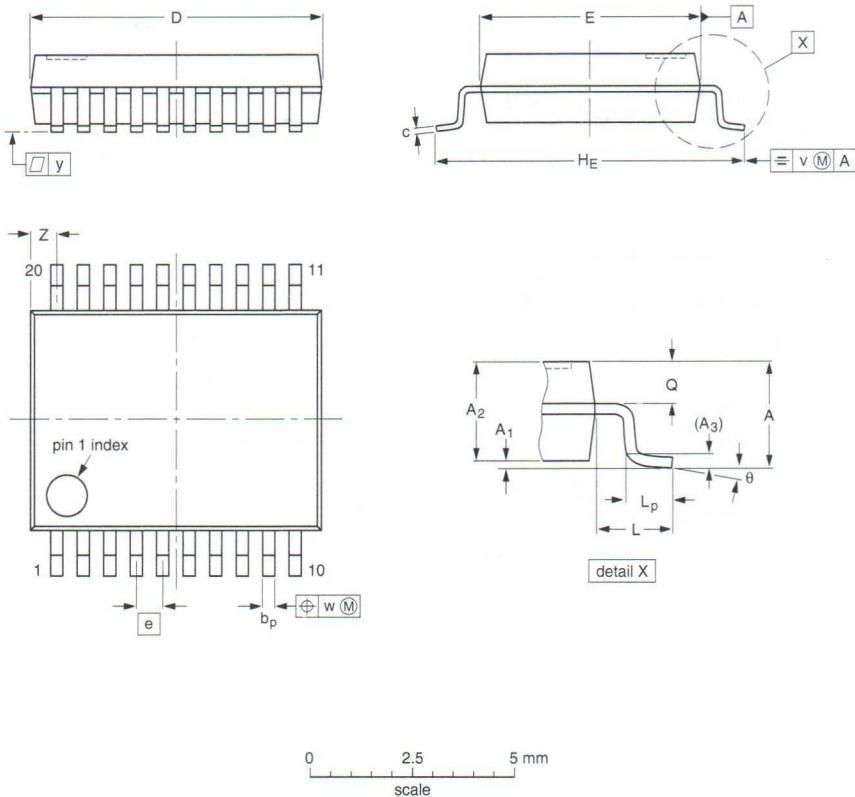
Note

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			
SOT266-1		MO-152				95-02-22- 99-12-27

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1



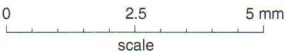
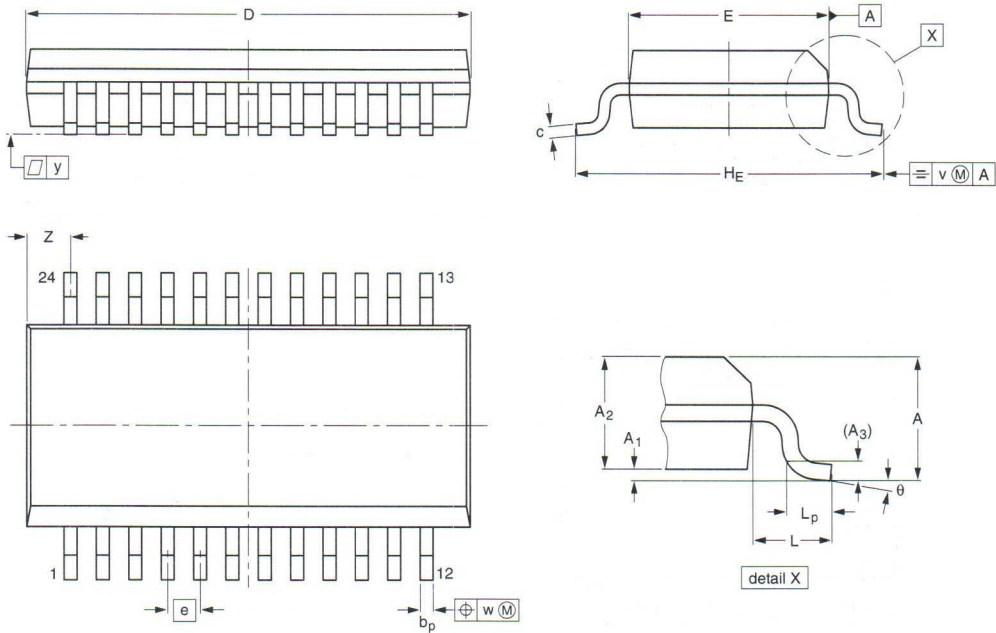
DIMENSIONS (mm are the original dimensions)

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-150				95-02-04 99-12-27

SSOP24: plastic shrink small outline package; 24 leads; body width 3.9 mm; lead pitch 0.635 mm SOT556-1



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

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	v	w	y	Z ⁽¹⁾	θ
mm	1.73	0.25 0.10	1.55 1.40	0.25	0.31 0.20	0.25 0.18	8.8 8.6	4.0 3.8	0.635	6.2 5.8	1.0	0.89 0.41	0.25	0.18	0.1	1.05 0.66	8° 0°
inches	0.068	0.0098 0.0040	0.061 0.055	0.010	0.012 0.008	0.0098 0.0075	0.344 0.337	0.157 0.150	0.025	0.244 0.228	0.041	0.035 0.016	0.010	0.007	0.004	0.040 0.026	8° 0°

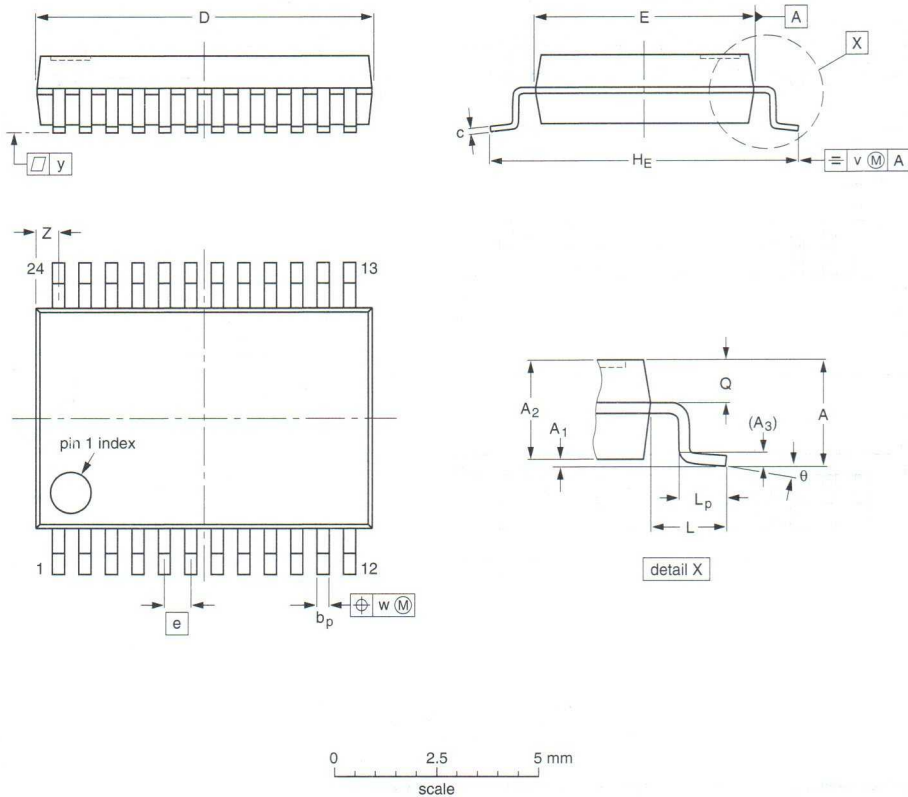
Note

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			
SOT556-1		MO-137				99-05-05 99-12-27

SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm

SOT340-1



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	8.4 8.0	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	0.8 0.4	8° 0°

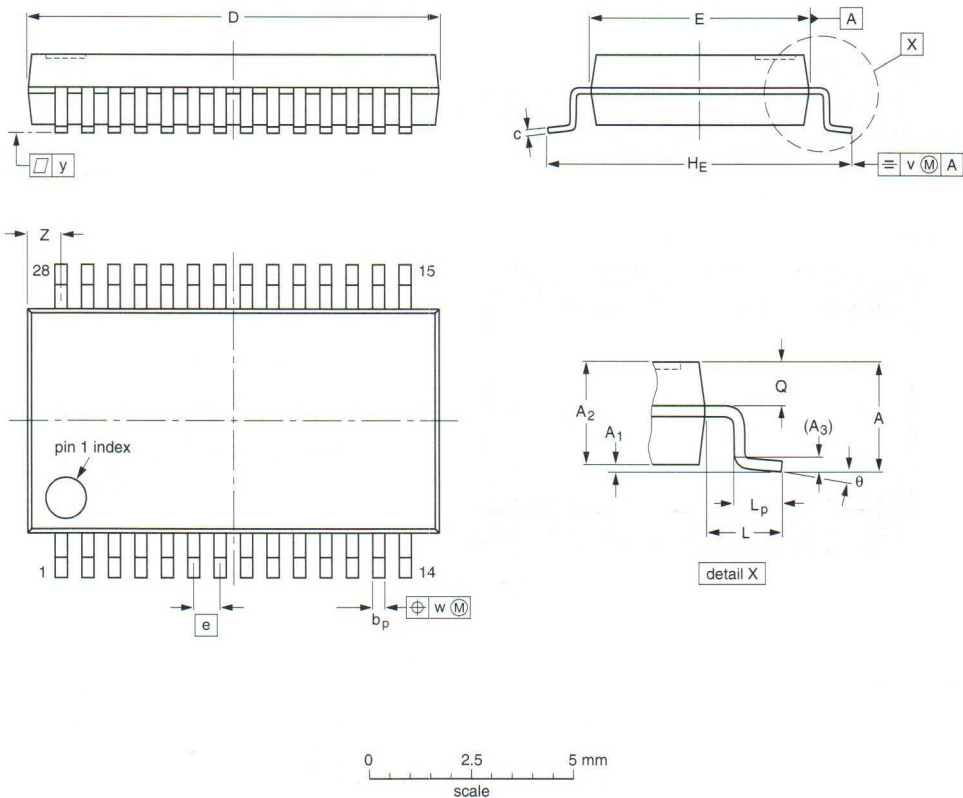
Note

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			
SOT340-1		MO-150				95-02-04 99-12-27

SSOP28: plastic shrink small outline package; 28 leads; body width 5.3 mm

SOT341-1



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	10.4 10.0	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	1.1 0.7	8° 0°

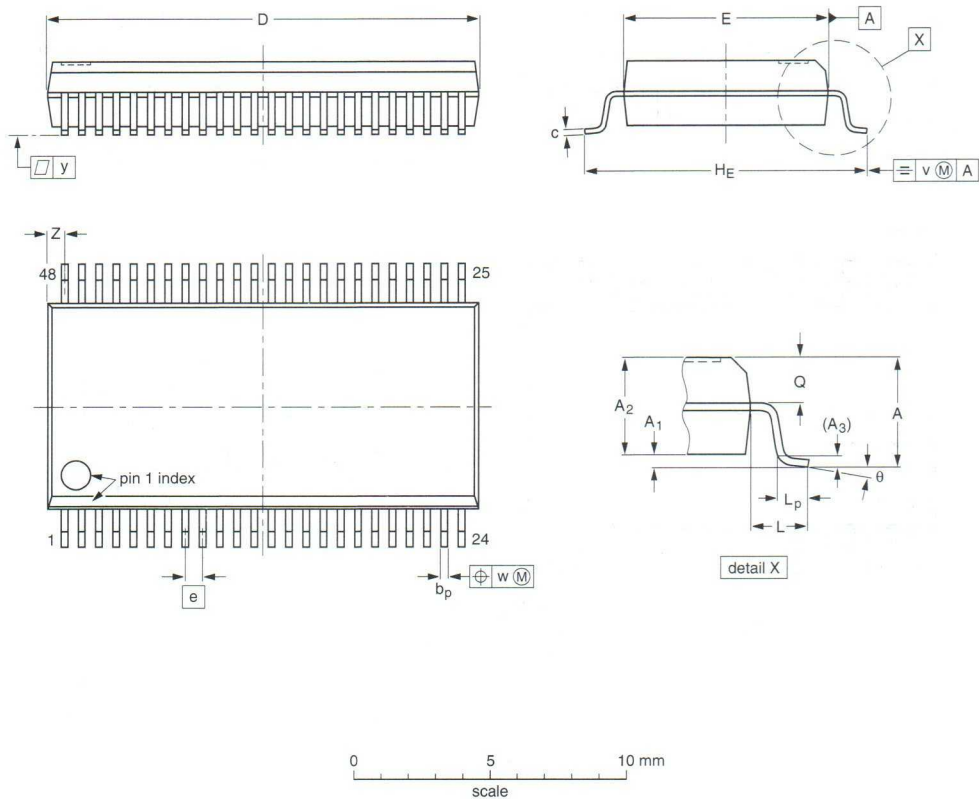
Note

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			
SOT341-1		MO-150				95-02-04 99-12-27

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm

SOT370-1



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	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	16.00 15.75	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

Note

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

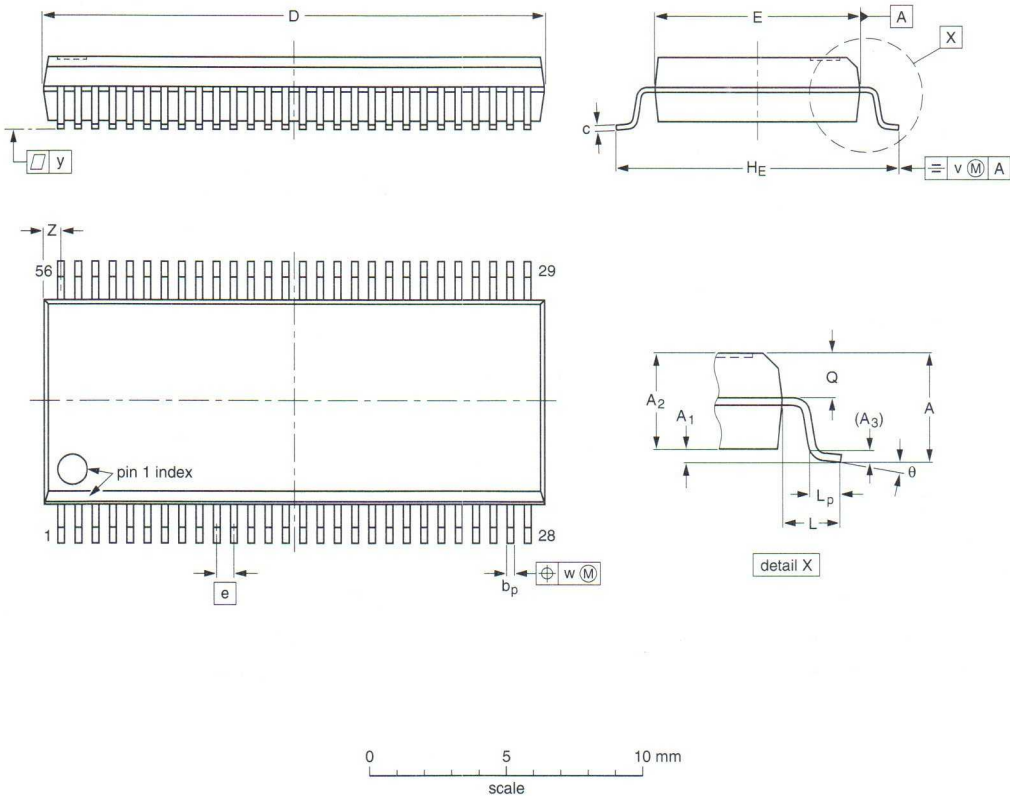
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT370-1		MO-118				95-02-04 99-12-27

IC package range and dimensions

Chapter 2

SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm

SOT371-1



DIMENSIONS (mm are the original dimensions)

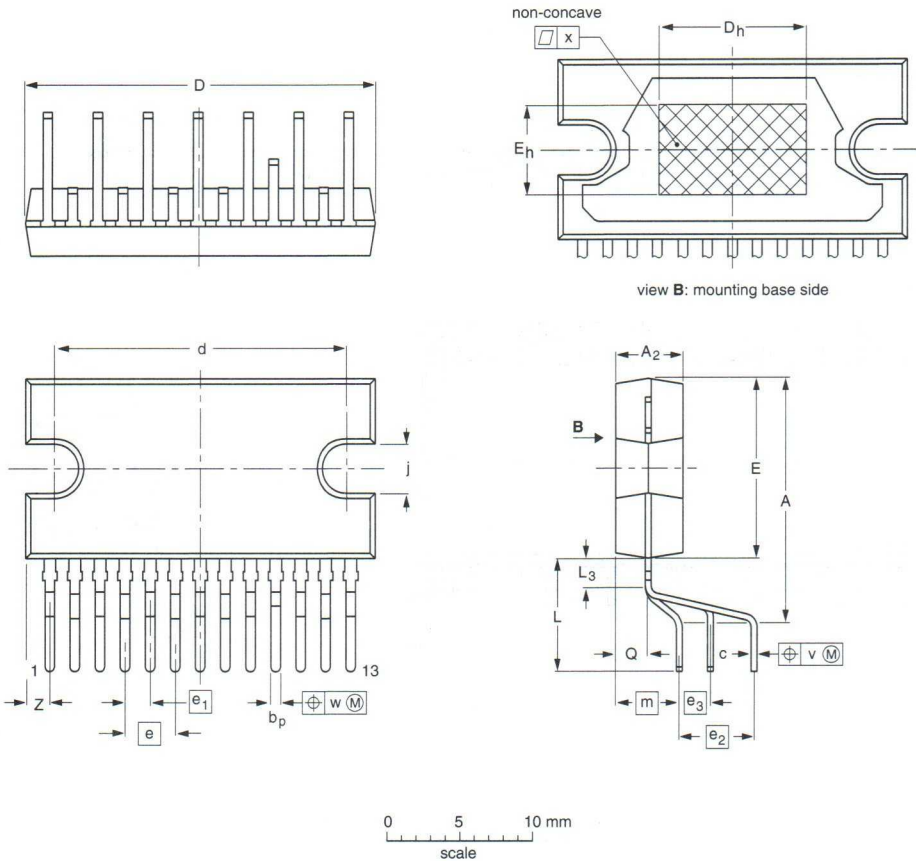
UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	18.55 18.30	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

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			
SOT371-1		MO-118				95-02-04 99-12-27

TBS13P: plastic Triple-bent-SIL power package; 13 leads (lead length 7.7 mm)

SOT578-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₂	b _p	c	D ⁽¹⁾	d	D _h	E ⁽¹⁾	e	e ₁	e ₂	e ₃	E _h	j	L	L ₃	m	Q	v	w	x	Z ⁽¹⁾
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	2.1	6	3.4 3.1	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	2.00 1.45

Note

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

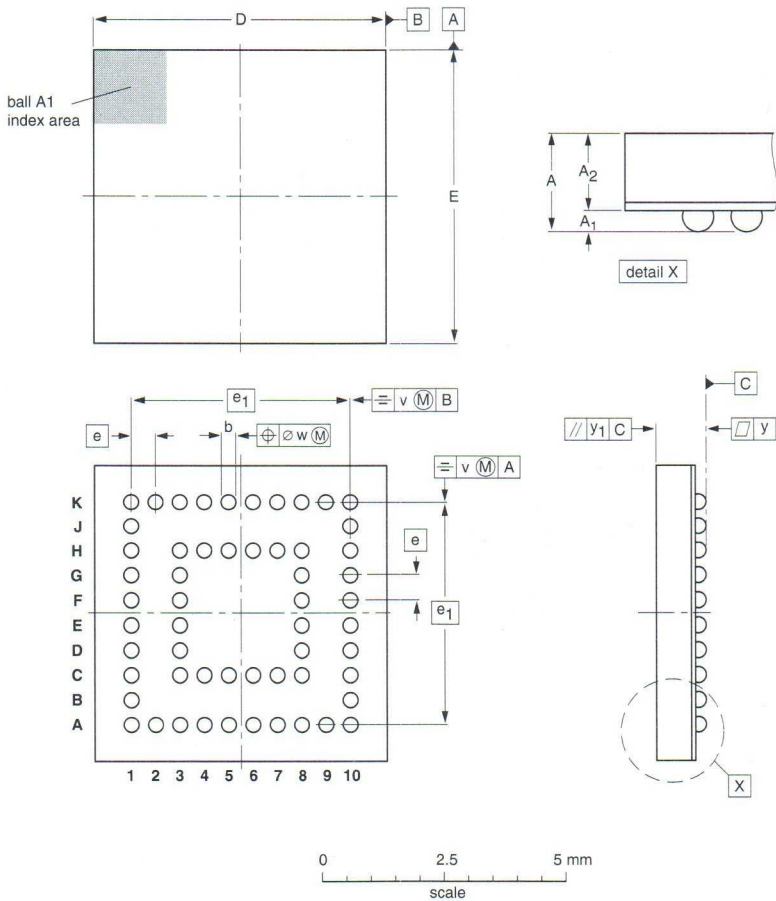
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT578-1						00-01-19

IC package range and dimensions

Chapter 2

TFBGA56: plastic thin fine-pitch ball grid array package; 56 balls; body 6 x 6 x 0.8 mm

SOT542-1



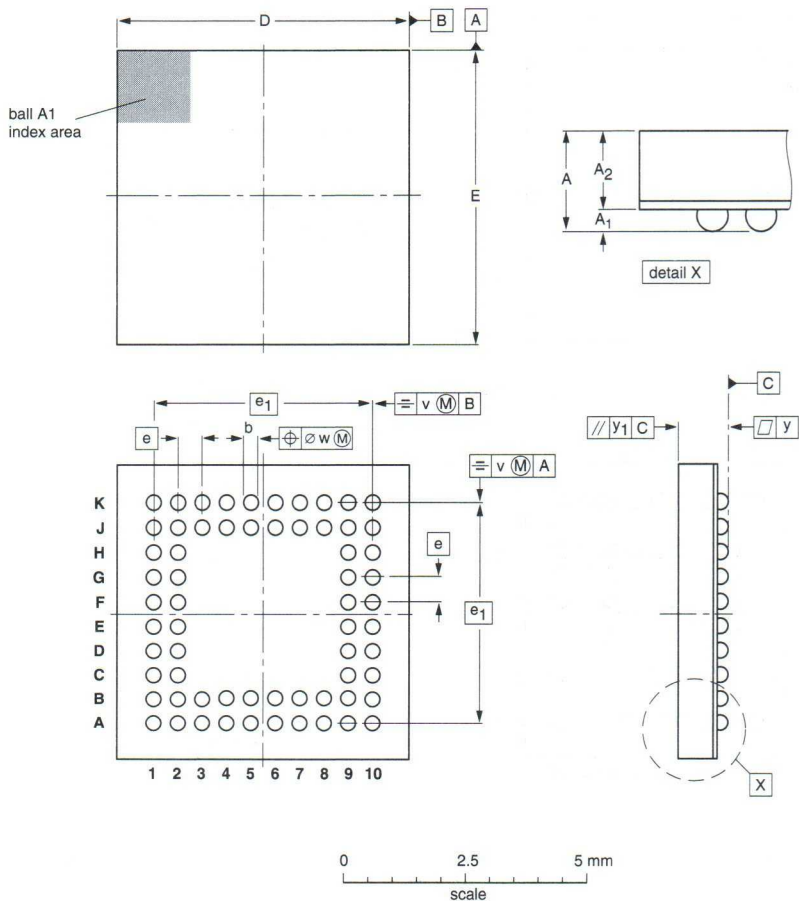
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.12	0.28 0.16	0.84 0.76	0.37 0.27	6.1 5.9	6.1 5.9	0.5	4.5	0.15	0.1	0.1	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT542-1						99-12-02 00-03-04

TFBGA64: plastic thin fine-pitch ball grid array package; 64 balls; body 6 x 6 x 0.8 mm

SOT543-1



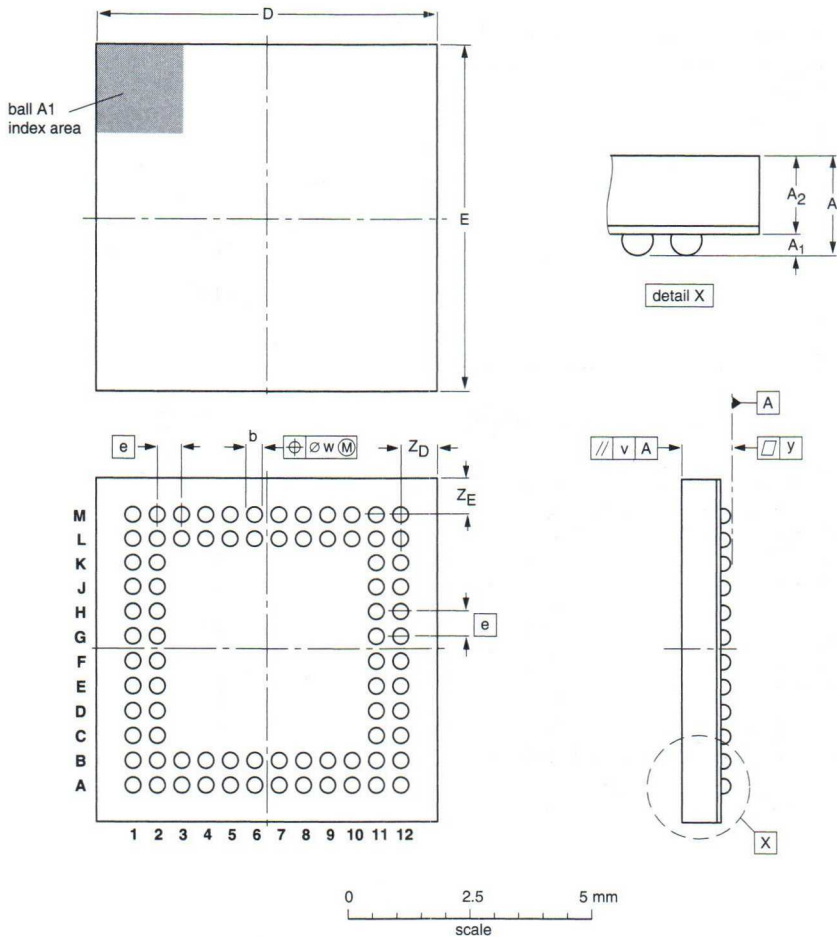
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.12	0.28 0.16	0.84 0.76	0.37 0.27	6.1 5.9	6.1 5.9	0.5	4.5	0.15	0.1	0.12	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT543-1						99-12-02- 00-03-04

TFBGA80: plastic thin fine-pitch ball grid array package; 80 balls; body 7 x 7 x 0.8 mm

SOT557-1



DIMENSIONS (mm are the original dimensions)

UNIT	A _{max.}	A ₁	A ₂	b	D	E	e	v	w	y	Z _D	Z _E
mm	1.12	0.26 0.14	0.84 0.76	0.37 0.27	7.1 6.9	7.1 6.9	0.5	0.1	0.15	0.12	0.93 0.58	0.93 0.58

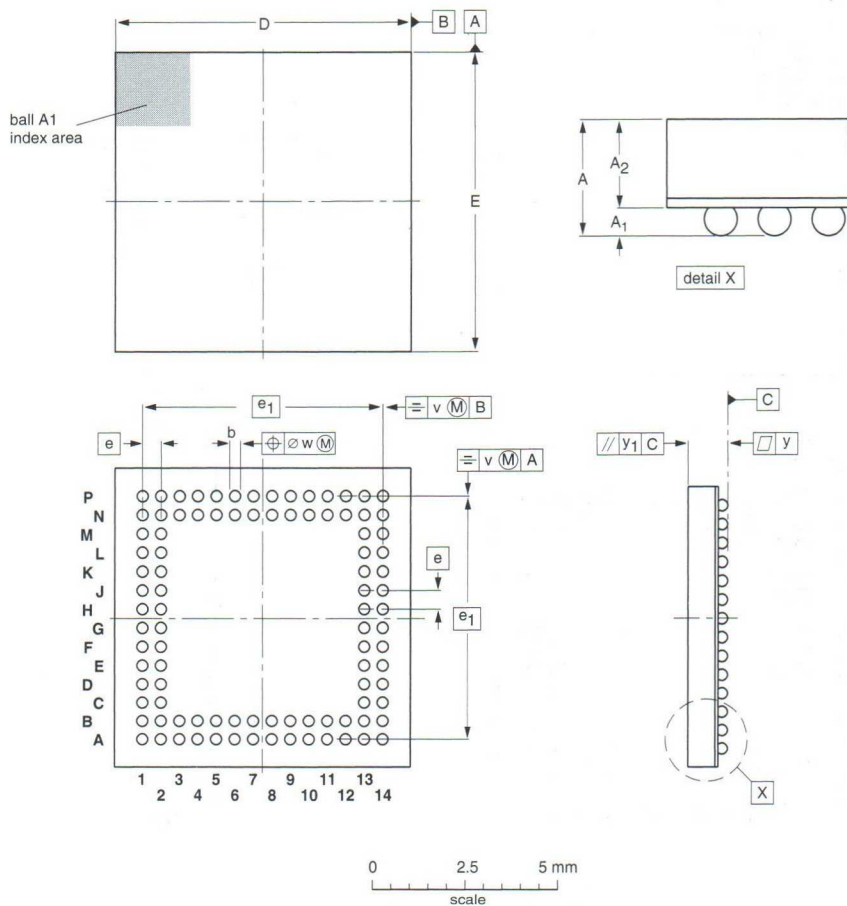
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT557-1						99-06-03 00-02-01

IC package range and dimensions

Chapter 2

TFBGA96: plastic thin fine-pitch ball grid array package; 96 balls; body 8 x 8 x 0.8 mm

SOT597-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.20	0.36 0.24	0.84 0.76	0.37 0.27	8.2 7.8	8.2 7.8	0.5	6.5	0.15	0.08	0.1	0.1

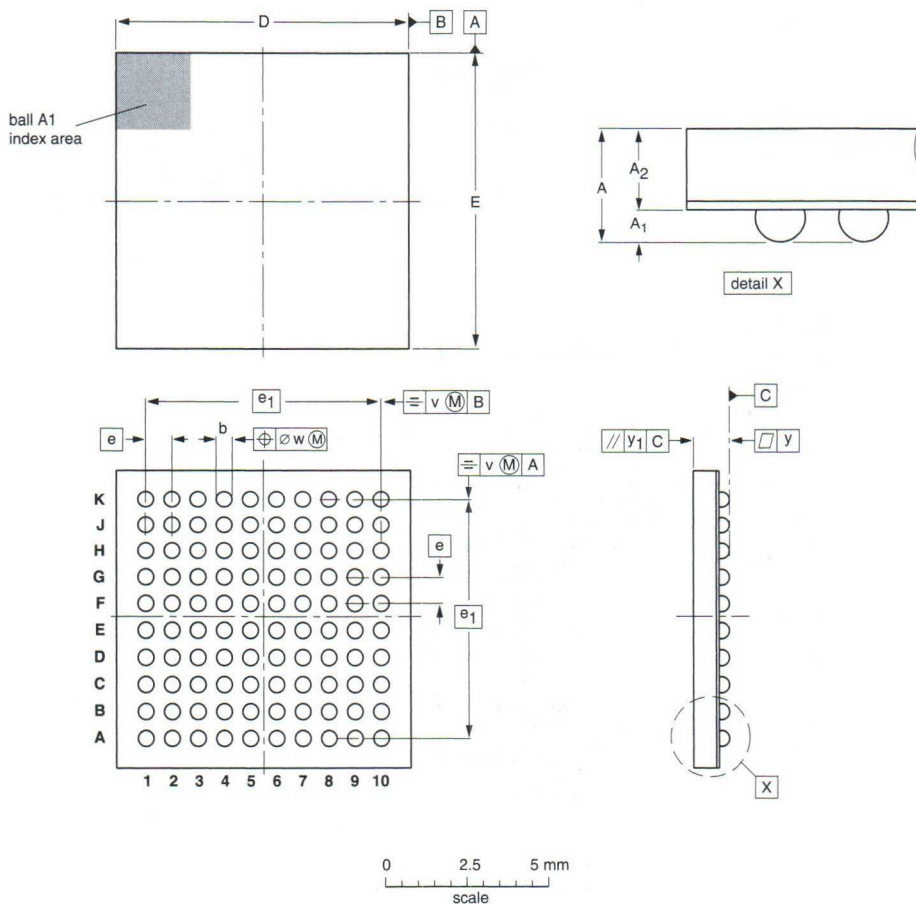
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT597-1						00-02-24 00-03-04

IC package range and dimensions

Chapter 2

TFBGA100: plastic thin fine-pitch ball grid array package; 100 balls; body 9 x 9 x 0.8 mm

SOT598-1



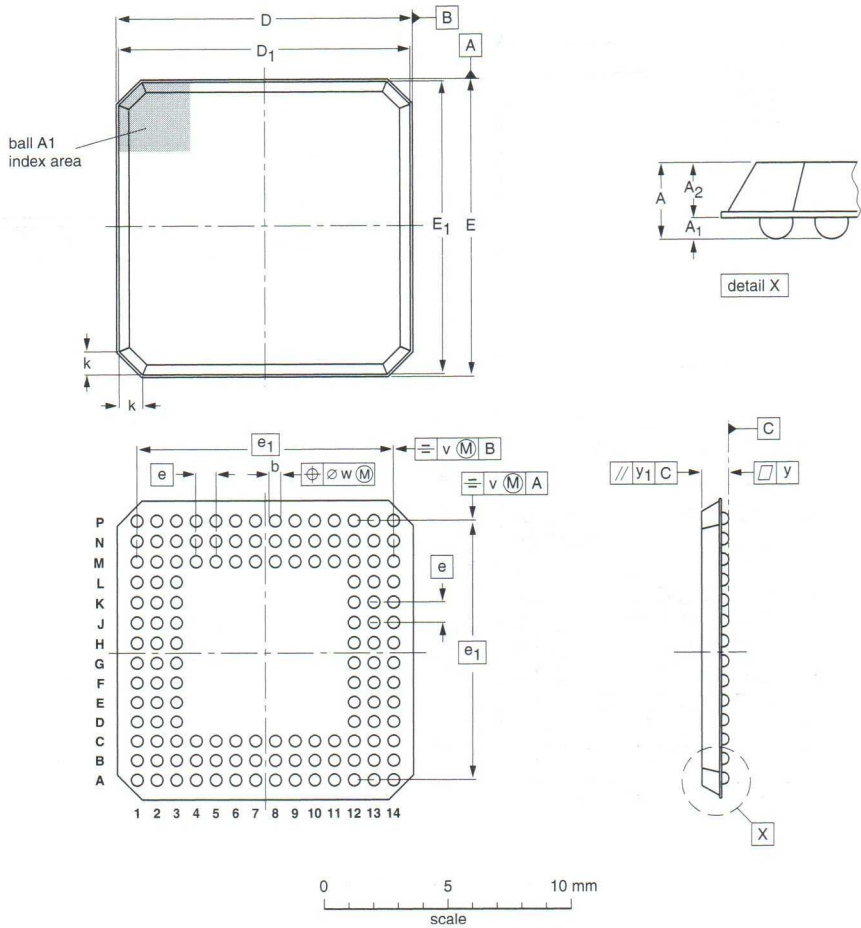
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	E	e	e ₁	v	w	y	y ₁
mm	1.2	0.36 0.24	0.84 0.76	0.53 0.43	9.2 8.8	9.2 8.8	0.8	7.2	0.15	0.08	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT598-1						00-02-24 00-03-04

TFBGA132: plastic thin fine-pitch ball grid array package; 132 balls; body 12 x 12 x 0.8 mm

SOT599-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k max.	v	w	y	y ₁
mm	1.20	0.36 0.24	0.84 0.76	0.53 0.43	12.2 11.8	11.9 11.7	12.2 11.8	11.9 11.7	0.8	10.4	1.0	0.15	0.08	0.10	0.10

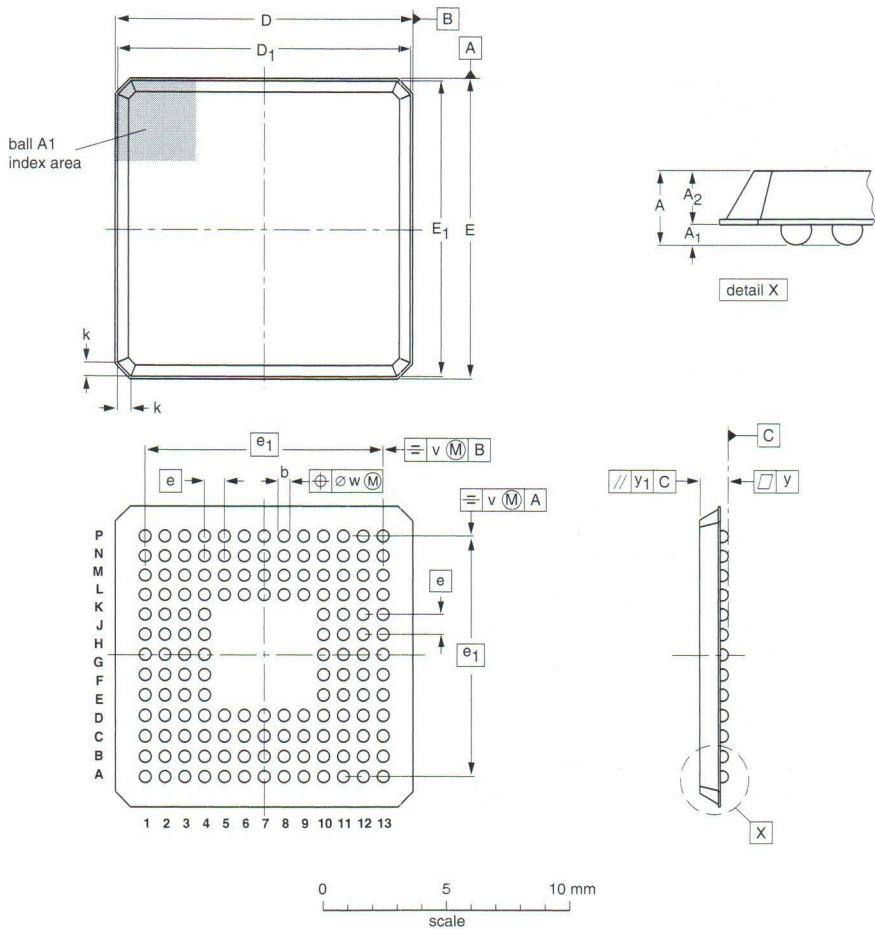
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT599-1						00-02-24 00-03-04

IC package range and dimensions

Chapter 2

TFBGA144: plastic thin fine-pitch ball grid array package; 144 balls; body 12 x 12 x 0.8 mm

SOT569-1



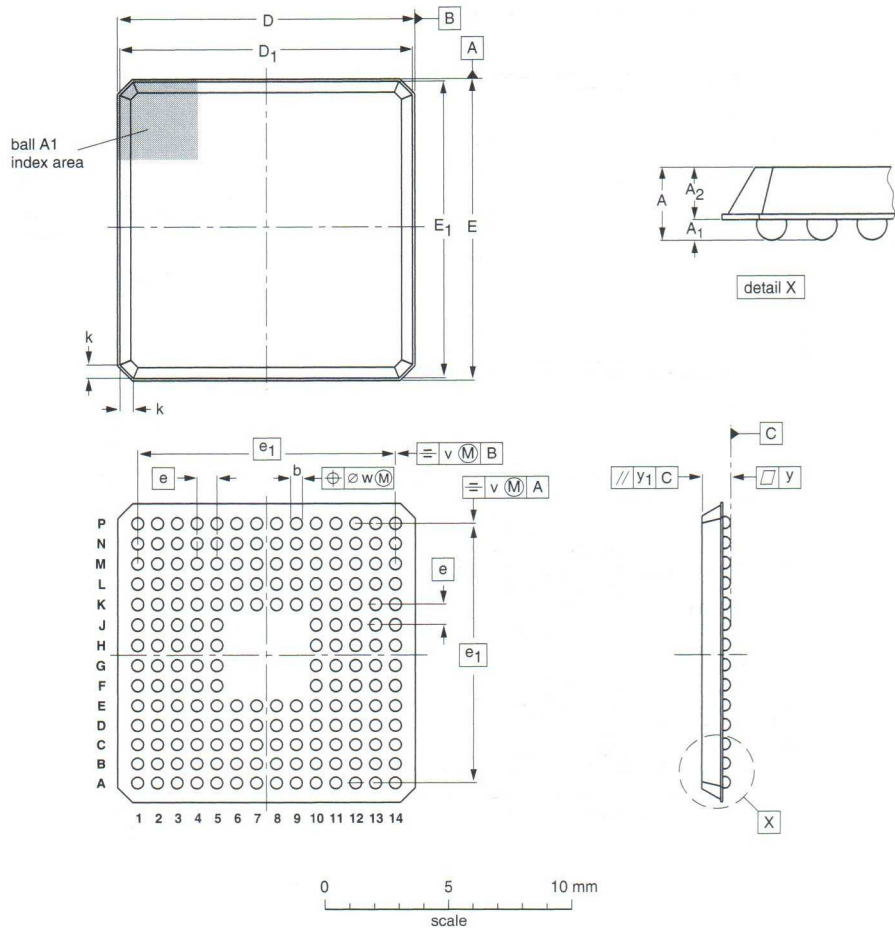
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k max.	v	w	y	y ₁
mm	1.20	0.36 0.24	0.84 0.74	0.53 0.43	12.20 11.80	11.90 11.70	12.20 11.80	11.90 11.70	0.80	9.6	1.0	0.15	0.08	0.10	0.10

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT569-1						00-02-08- 00-03-04

TFBGA180: plastic thin fine-pitch ball grid array package; 180 balls; body 12 x 12 x 0.8 mm

SOT570-1



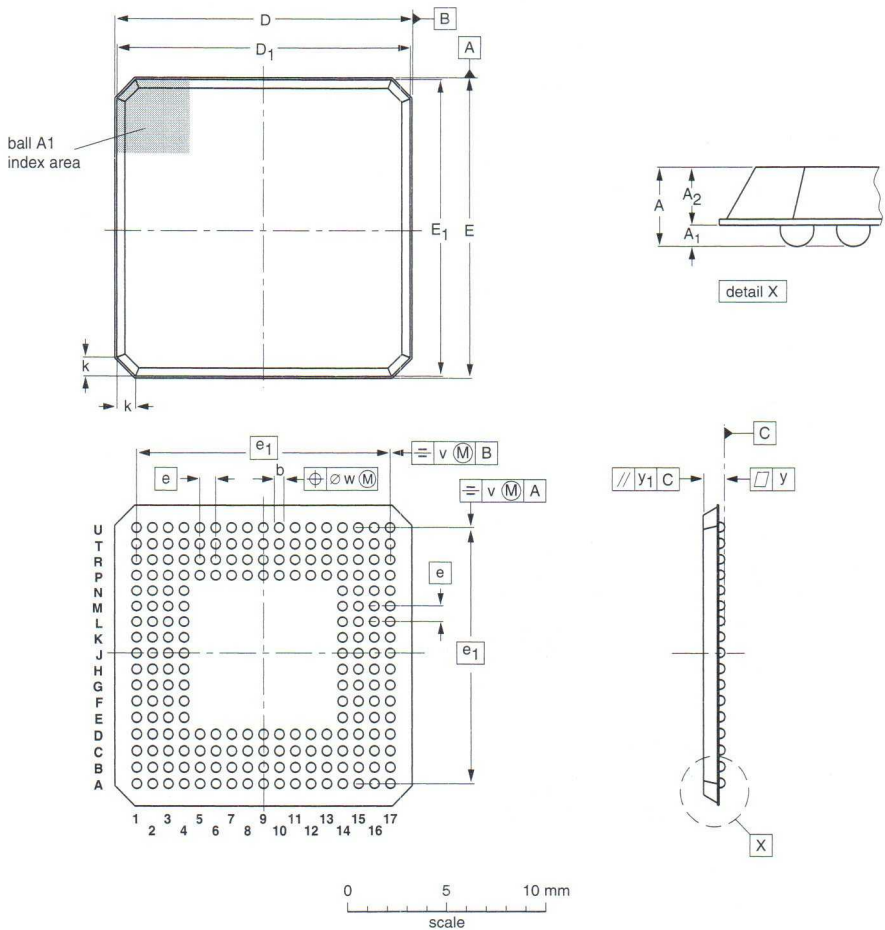
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k max.	v	w	y	y ₁
mm	1.20	0.36 0.24	0.84 0.74	0.53 0.43	12.20 11.80	11.90 11.70	12.20 11.80	11.90 11.70	0.80	10.4	1.0	0.15	0.08	0.10	0.10

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT570-1						00-02-08 00-03-04

TFBGA208: plastic thin fine-pitch ball grid array package; 208 balls; body 15 x 15 x 0.8 mm

SOT600-1



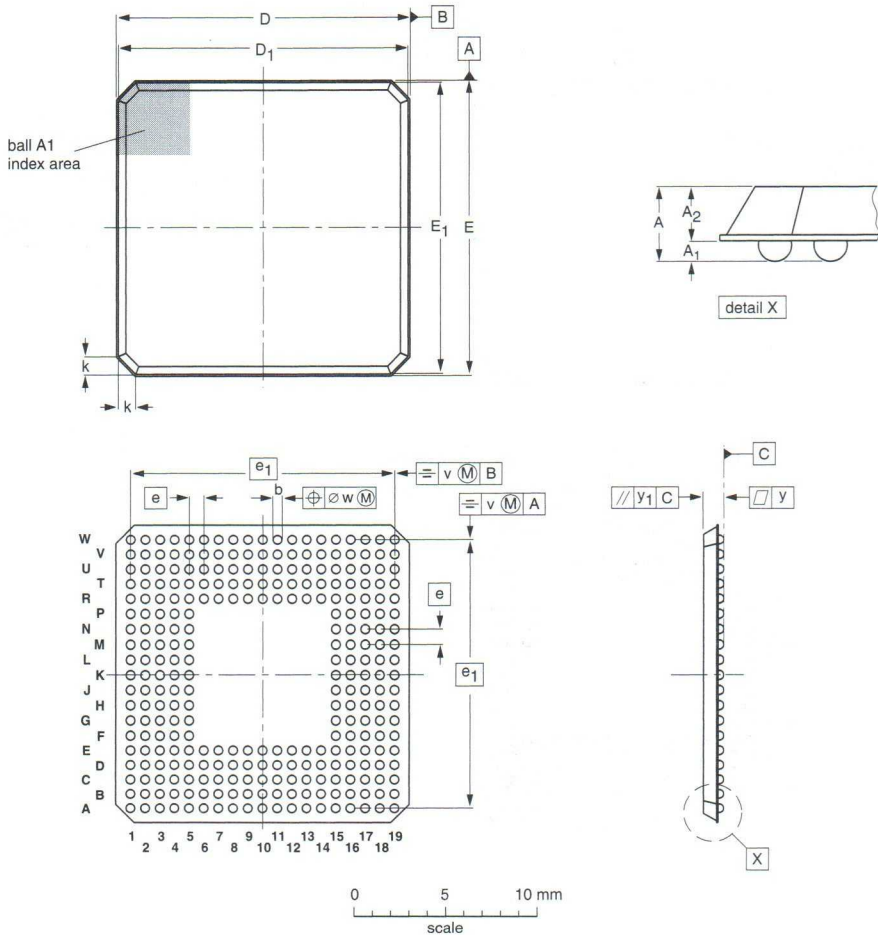
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k max.	v	w	y	y ₁
mm	1.20	0.36 0.24	0.84 0.76	0.53 0.43	15.2 14.8	14.9 14.7	15.2 14.8	14.9 14.7	0.8	12.8	1.0	0.15	0.08	0.15	0.10

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT600-1						00-02-24- 00-03-04

TFBGA280: plastic thin fine-pitch ball grid array package; 280 balls; body 16 x 16 x 0.8 mm

SOT601-1



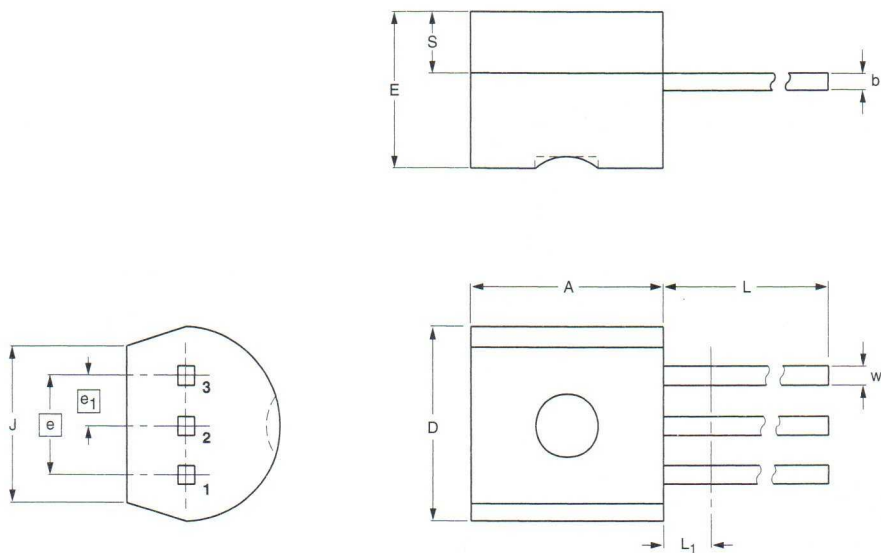
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	b	D	D ₁	E	E ₁	e	e ₁	k max.	v	w	y	y ₁
mm	1.20	0.36 0.24	0.84 0.76	0.53 0.43	16.2 15.8	15.9 15.7	16.2 15.8	15.9 15.7	0.8	14.4	1.0	0.15	0.08	0.15	0.10

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT601-1						00-02-06 00-03-04

TO-92: 3 leads; body diameter 4.7 mm

SOT465-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	b	D	E	e	e ₁	J min.	L	L ₁ ⁽¹⁾ max.	S	w
mm	4.95 4.32	0.51 0.36	4.95 4.45	3.94 3.30	2.54	1.27	3.4	15.40 12.70	1.27	1.52 1.14	0.56 0.41

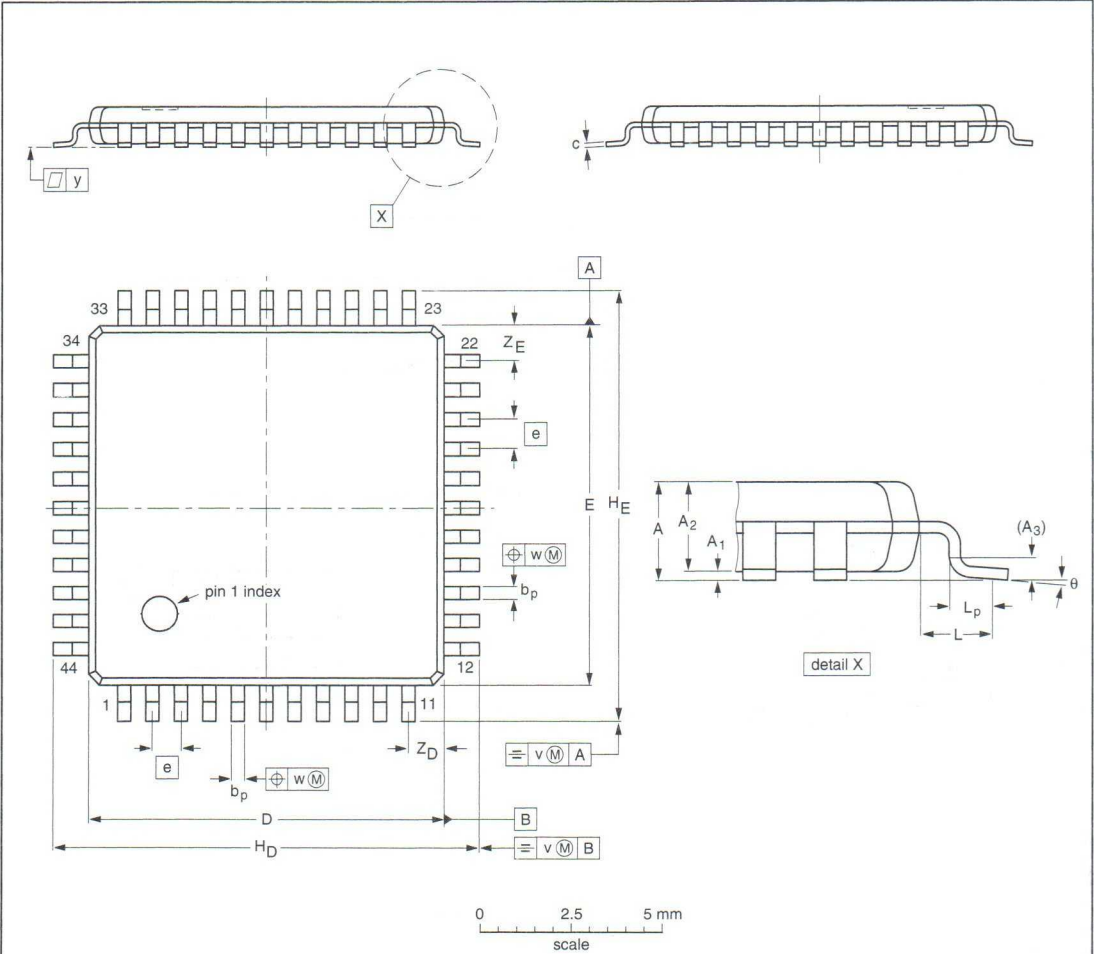
Note

1. Dimensions 'w' and 'b' are uncontrolled in L₁.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT465-1						96-11-22

TQFP44: plastic thin quad flat package; 44 leads; body 10 x 10 x 1.0 mm

SOT376-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.45 0.30	0.18 0.12	10.1 9.9	10.1 9.9	0.8	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

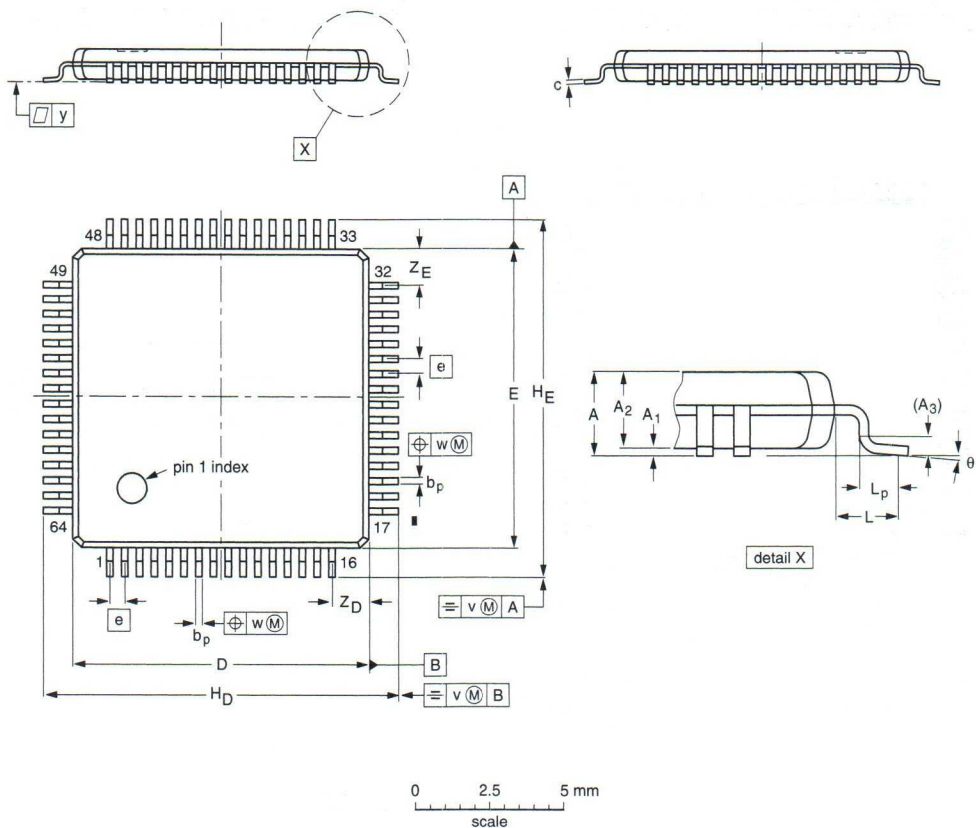
Note

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			
SOT376-1	137E08	MS-026				-99-12-27- 00-01-19

TQFP64: plastic thin quad flat package; 64 leads; body 10 x 10 x 1.0 mm

SOT357-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.27 0.17	0.18 0.12	10.1 9.9	10.1 9.9	0.5	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.2	0.08	0.1	1.45 1.05	1.45 1.05	7° 0°

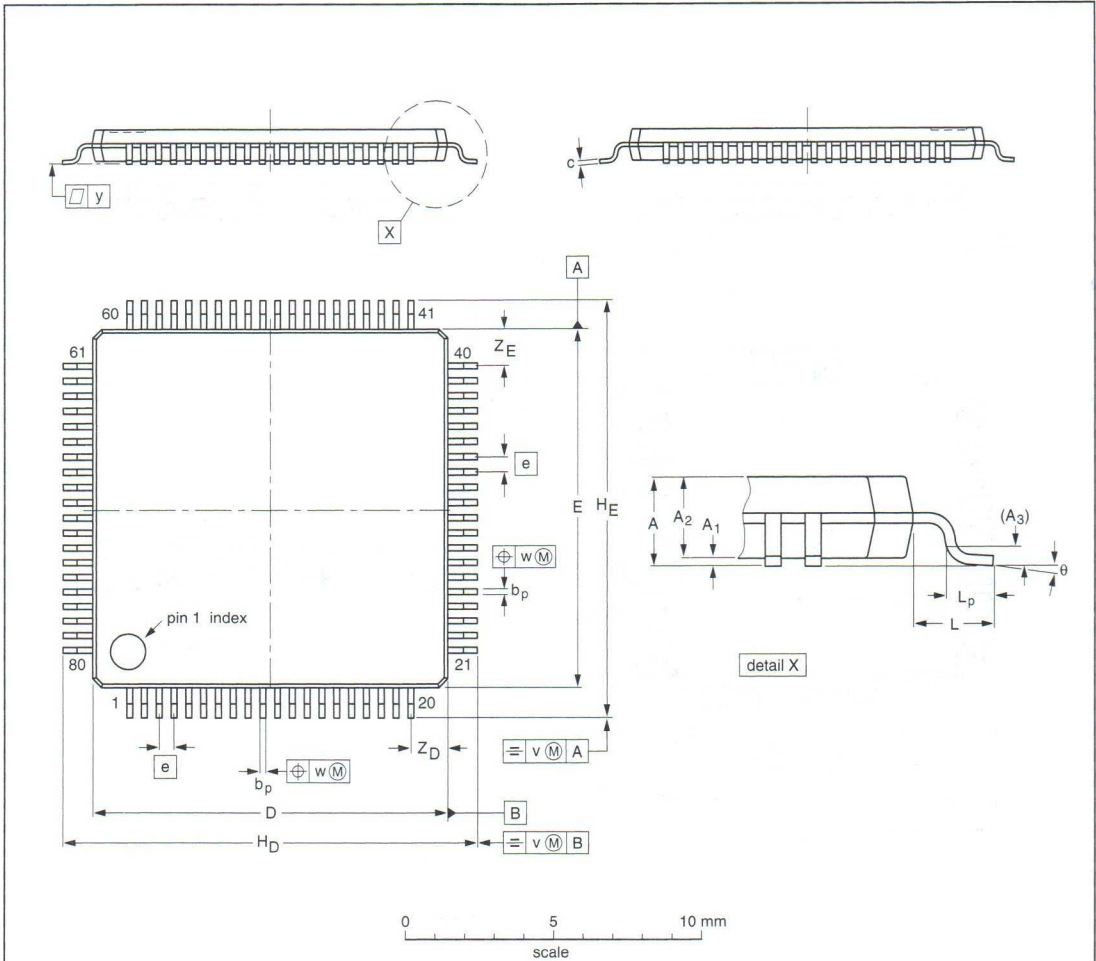
Note

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		
SOT357-1	137E10	MS-026			99-12-27- 00-01-19

TQFP80: plastic thin quad flat package; 80 leads; body 12 x 12 x 1.0 mm

SOT375-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.27 0.17	0.18 0.12	12.1 11.9	12.1 11.9	0.5	14.15 13.85	14.15 13.85	1.0	0.75 0.45	0.2	0.08	0.1	1.45 1.05	1.45 1.05	7° 0°

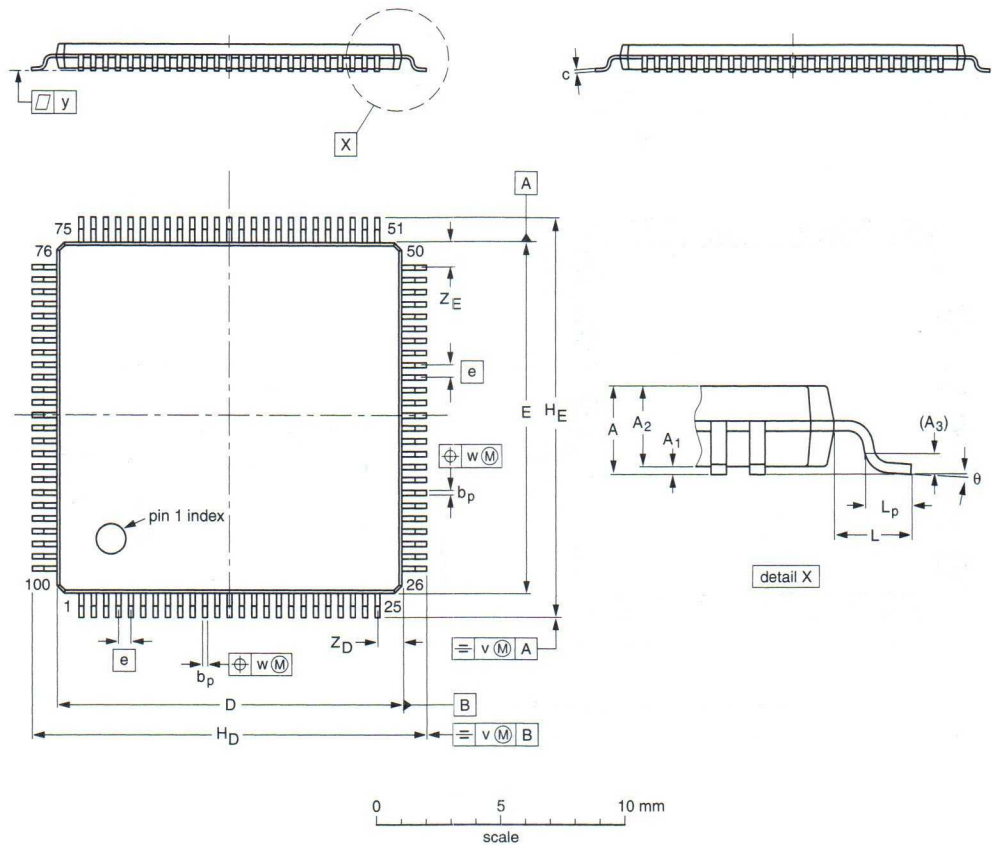
Note

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			
SOT375-1		MS-026				97-08-04 99-12-27

TQFP100: plastic thin quad flat package; 100 leads; body 14 x 14 x 1.0 mm

SOT386-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.27 0.17	0.18 0.12	14.1 13.9	14.1 13.9	0.5	16.15 15.85	16.15 15.85	1.0	0.75 0.45	0.2	0.08	0.08	1.15 0.85	1.15 0.85	7° 0°

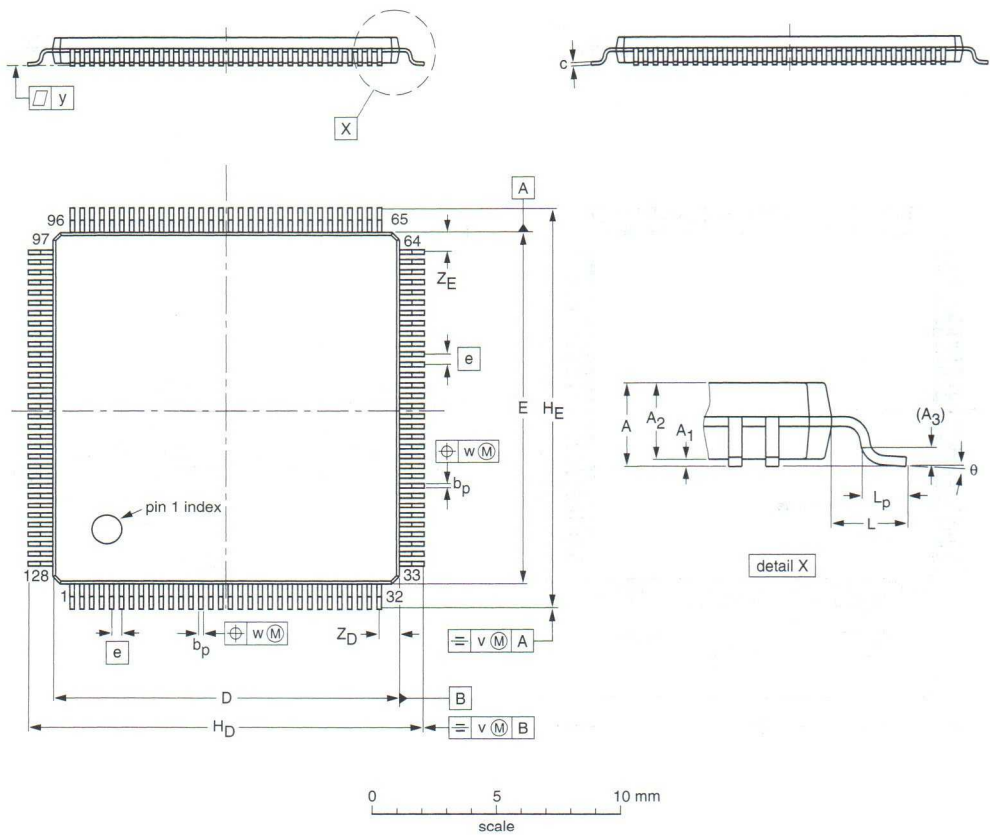
Note

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			
SOT386-1	137E20	MS-026				00-01-19- 00-02-01

TQFP128: plastic thin quad flat package; 128 leads; body 14 x 14 x 1.0 mm

SOT574-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	v	w	y	Z _D	Z _E	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.23 0.13	0.18 0.10	14.1 13.9	14.1 13.9	0.4	16.15 15.85	16.15 15.85	1.0	0.75 0.45	0.2	0.07	0.08	0.94 0.67	0.94 0.67	7° 0°

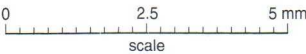
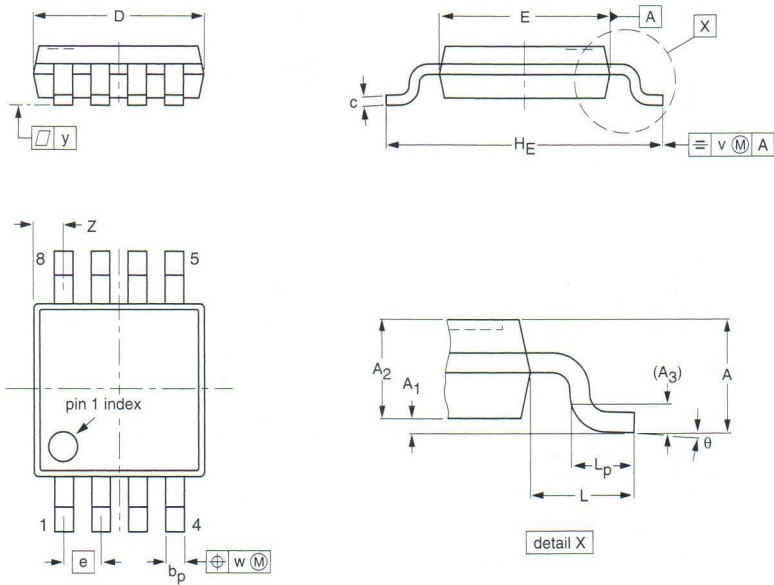
Note

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			
SOT574-1						1999-12-08

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm

SOT505-1



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	v	w	y	Z ⁽¹⁾	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.45 0.25	0.28 0.15	3.10 2.90	3.10 2.90	0.65	5.10 4.70	0.94	0.70 0.40	0.1	0.1	0.1	0.70 0.35	6° 0°

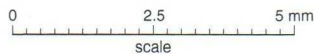
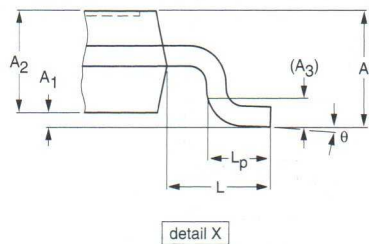
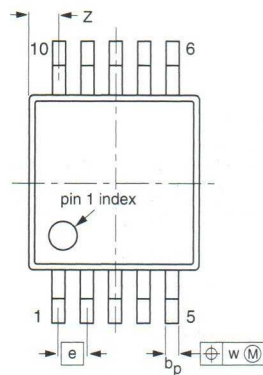
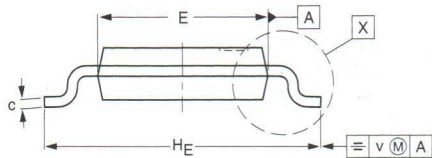
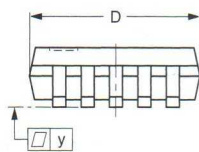
Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT505-1						99-04-09

TSSOP10: plastic thin shrink small outline package; 10 leads; body width 3 mm

SOT552-1



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	v	w	y	Z ⁽¹⁾	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.15	0.23 0.15	3.10 2.90	3.10 2.90	0.50	5.00 4.80	0.95	0.70 0.40	0.1	0.1	0.1	0.67 0.34	6° 0°

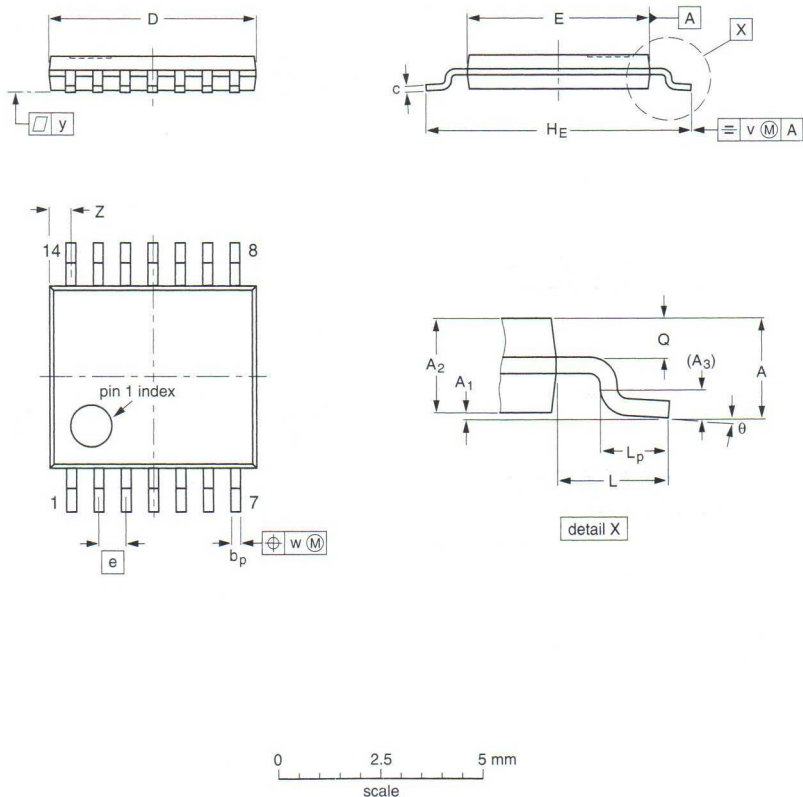
Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT552-1						99-07-29

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



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	0.72 0.38	8° 0°

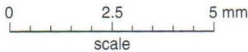
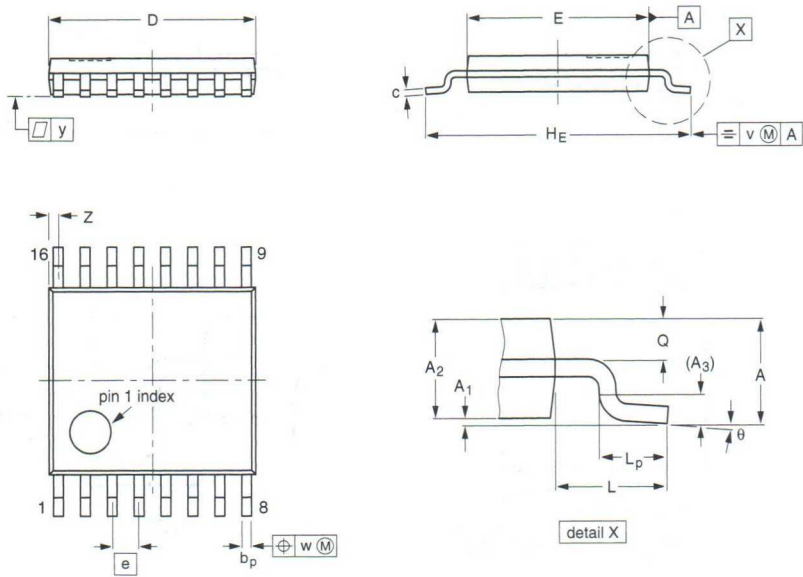
Notes

- 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			
SOT402-1		MO-153				95-04-04 99-12-27

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°

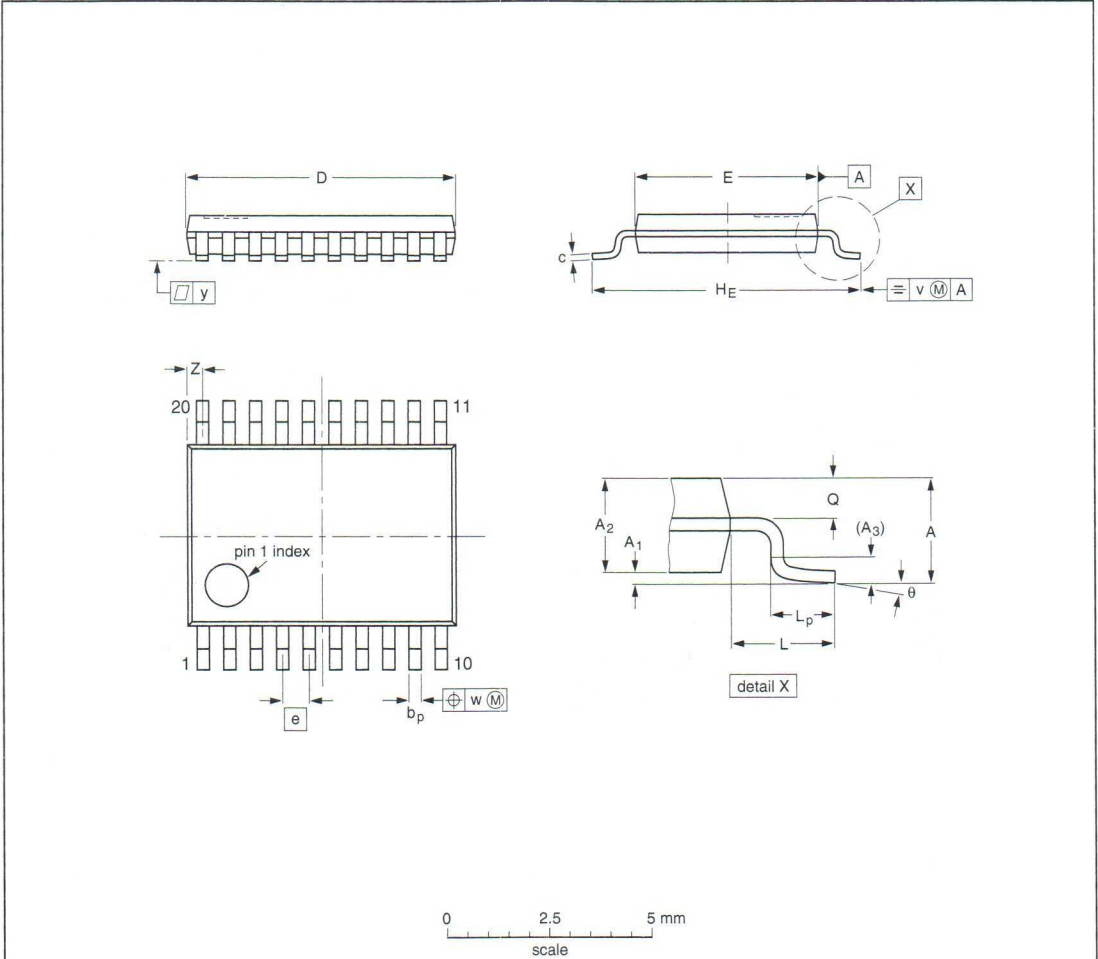
Notes

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				95-04-04- 99-12-27

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°

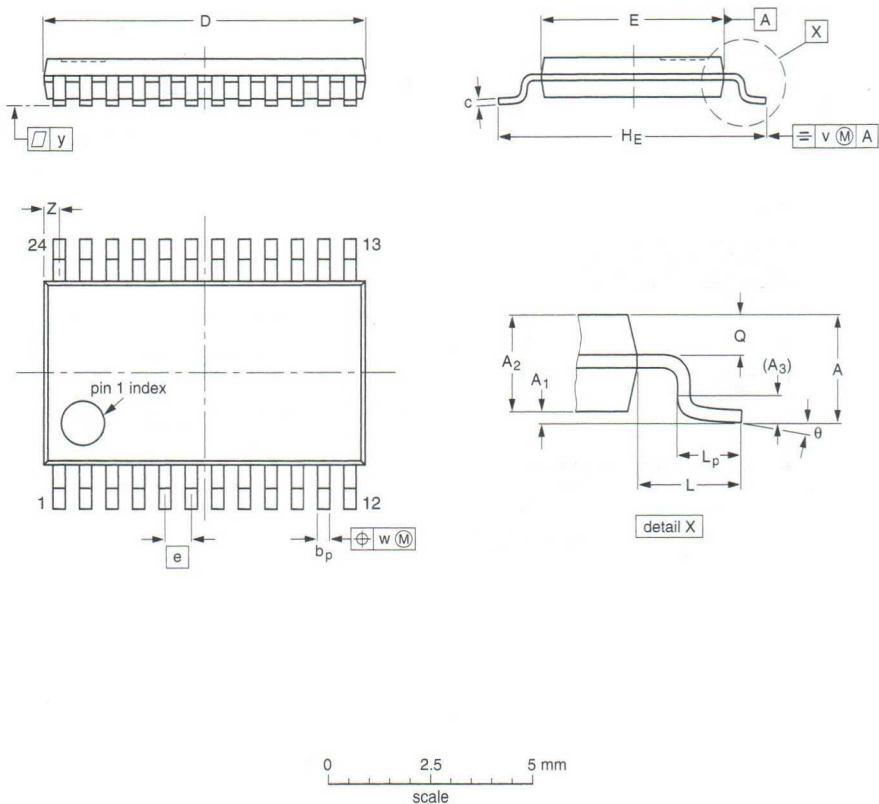
Notes

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-153				95-02-04 99-12-27

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1



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	7.9 7.7	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°

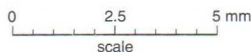
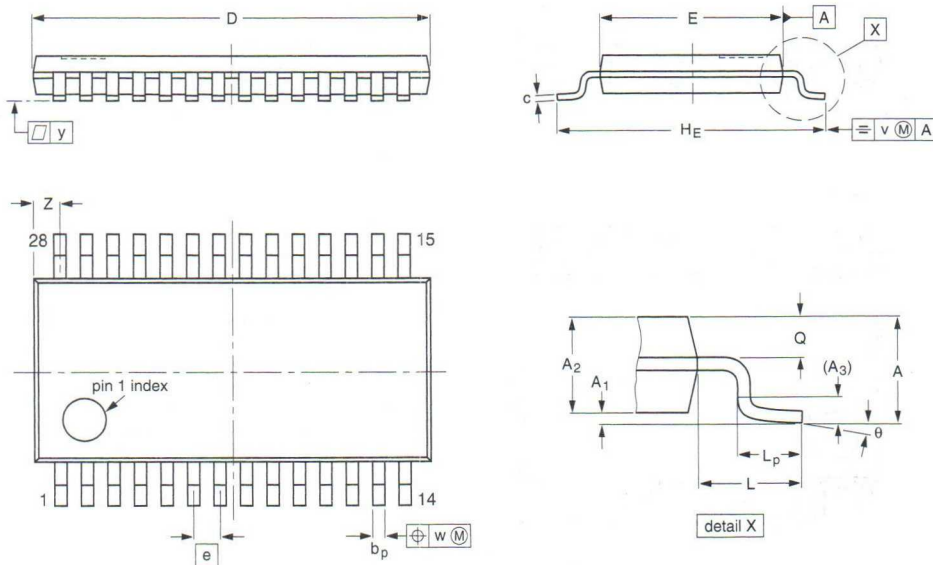
Notes

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			
SOT355-1		MO-153				95-02-04 99-12-27

TSSOP28: plastic thin shrink small outline package; 28 leads; body width 4.4 mm

SOT361-1



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	9.8 9.6	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	0.8 0.5	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.

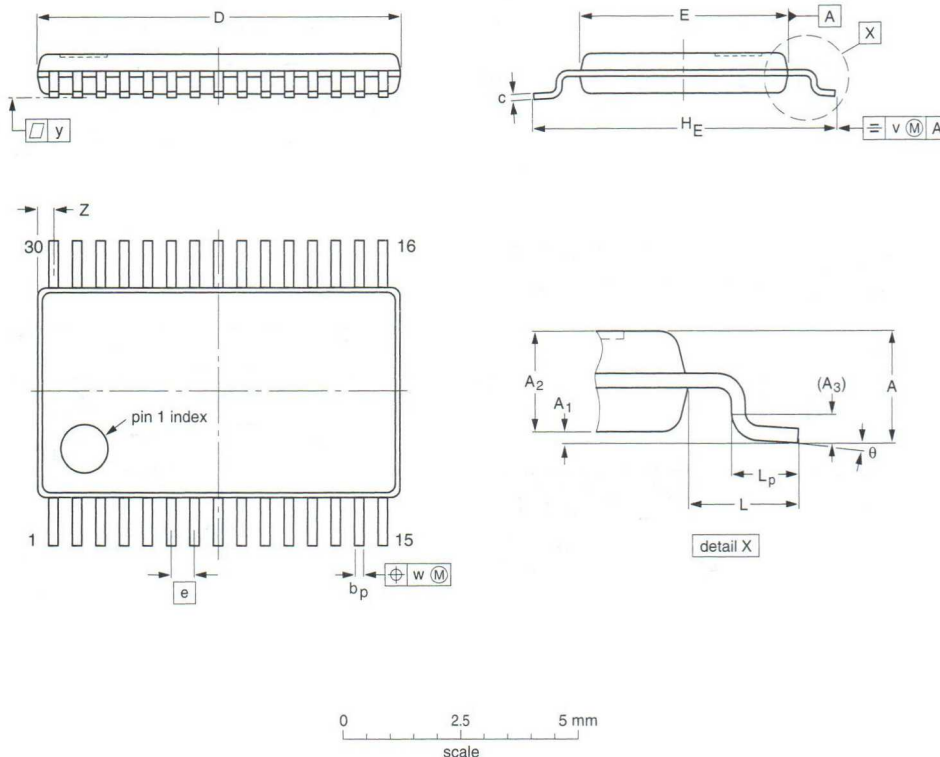
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT361-1		MO-153				-95-02-04 99-12-27

IC package range and dimensions

Chapter 2

TSSOP30: plastic thin shrink small outline package; 30 leads; body width 4.4 mm; lead pitch 0.5 mm

SOT607-1



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	v	w	y	Z ⁽¹⁾	θ
mm	1.10	0.15 0.05	0.95 0.85	0.25	0.27 0.17	0.20 0.09	7.90 7.70	4.50 4.30	0.50	6.40	1.00	0.70 0.50	0.20	0.08	0.08	0.54 0.26	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.

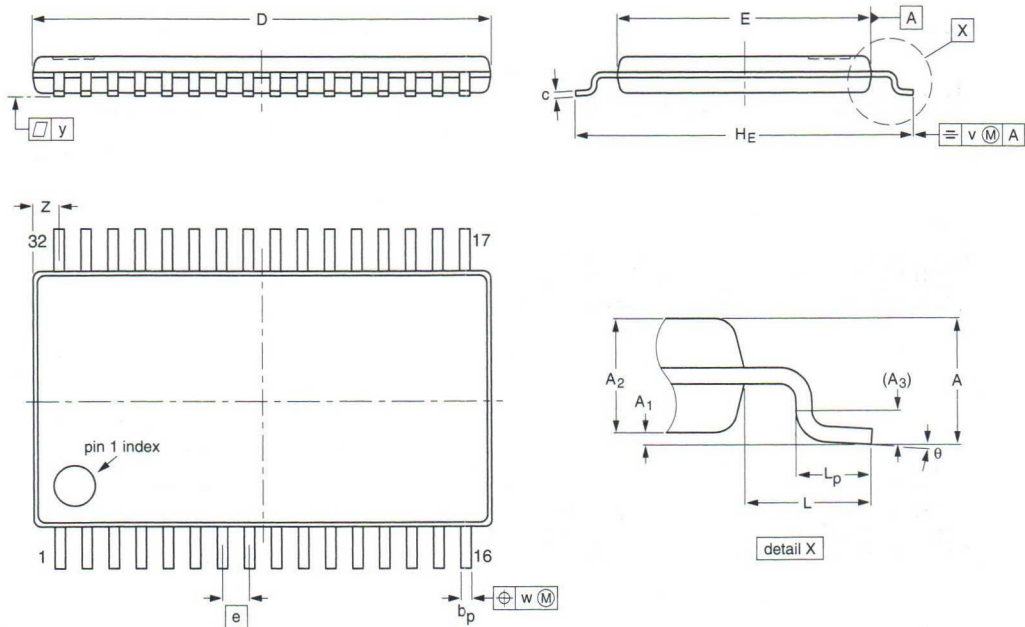
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT607-1		MO-153				00-02-06

IC package range and dimensions

Chapter 2

**TSSOP32: plastic thin shrink small outline package; 32 leads; body width 6.1 mm;
lead pitch 0.65 mm**

SOT487-1



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	v	w	y	Z	θ
mm	1.10	0.15 0.05	0.95 0.85	0.25	0.30 0.19	0.20 0.09	11.10 10.90	6.20 6.00	0.65	8.30 7.90	1.00	0.75 0.50	0.20	0.10	0.10	0.78 0.48	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.

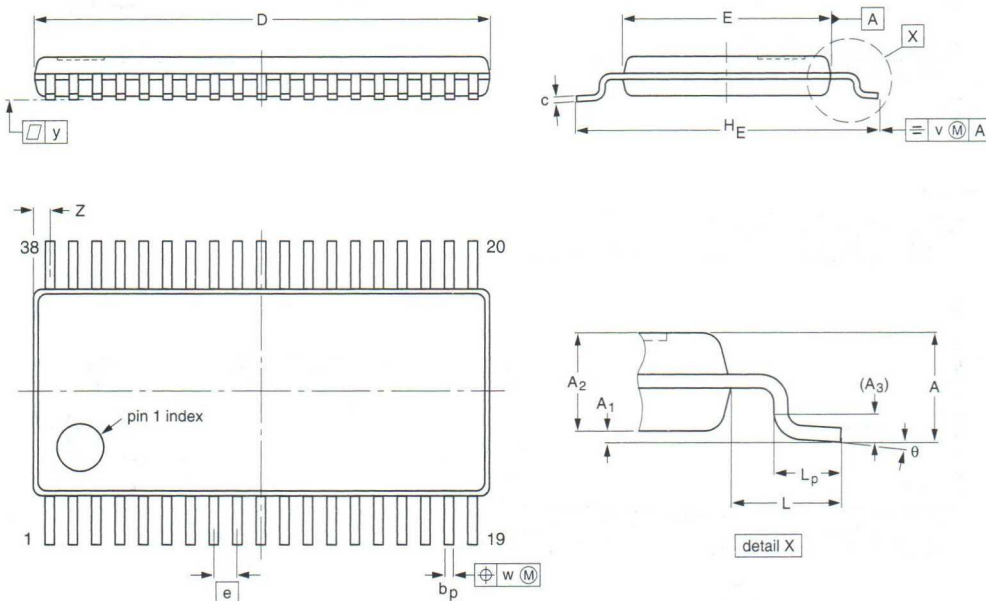
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT487-1		MO-153				97-06-11 99-12-27

IC package range and dimensions

Chapter 2

**TSSOP38: plastic thin shrink small outline package; 38 leads; body width 4.4 mm;
lead pitch 0.5 mm**

SOT510-1



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	v	w	y	Z ⁽¹⁾	θ
mm	1.10	0.15 0.05	0.95 0.85	0.25	0.27 0.17	0.20 0.09	9.80 9.60	4.50 4.30	0.50	6.40	1.00	0.70 0.50	0.20	0.08	0.08	0.49 0.21	8° 0°

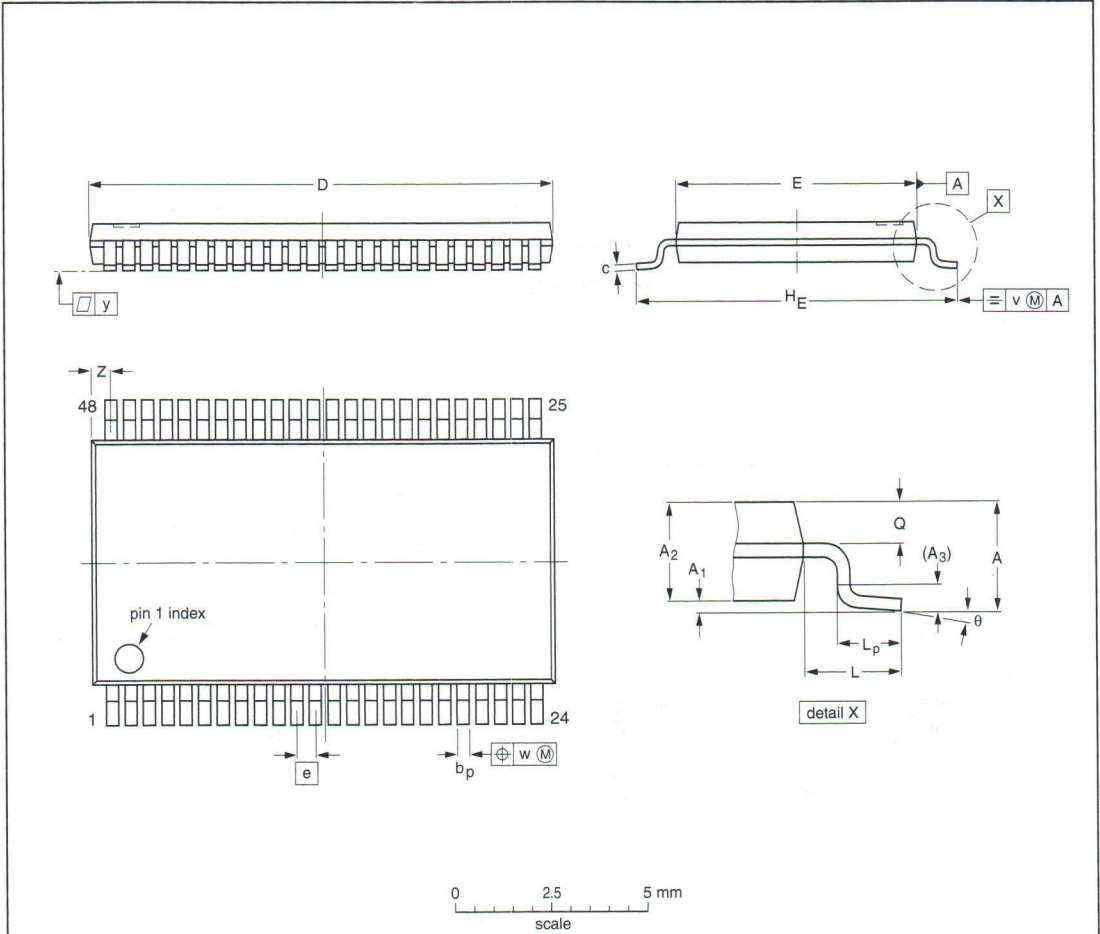
Notes

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			
SOT510-1						98-09-16

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm

SOT362-1



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	θ
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	0.2 0.1	12.6 12.4	6.2 6.0	0.5	8.3 7.9	1	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.8 0.4	8° 0°

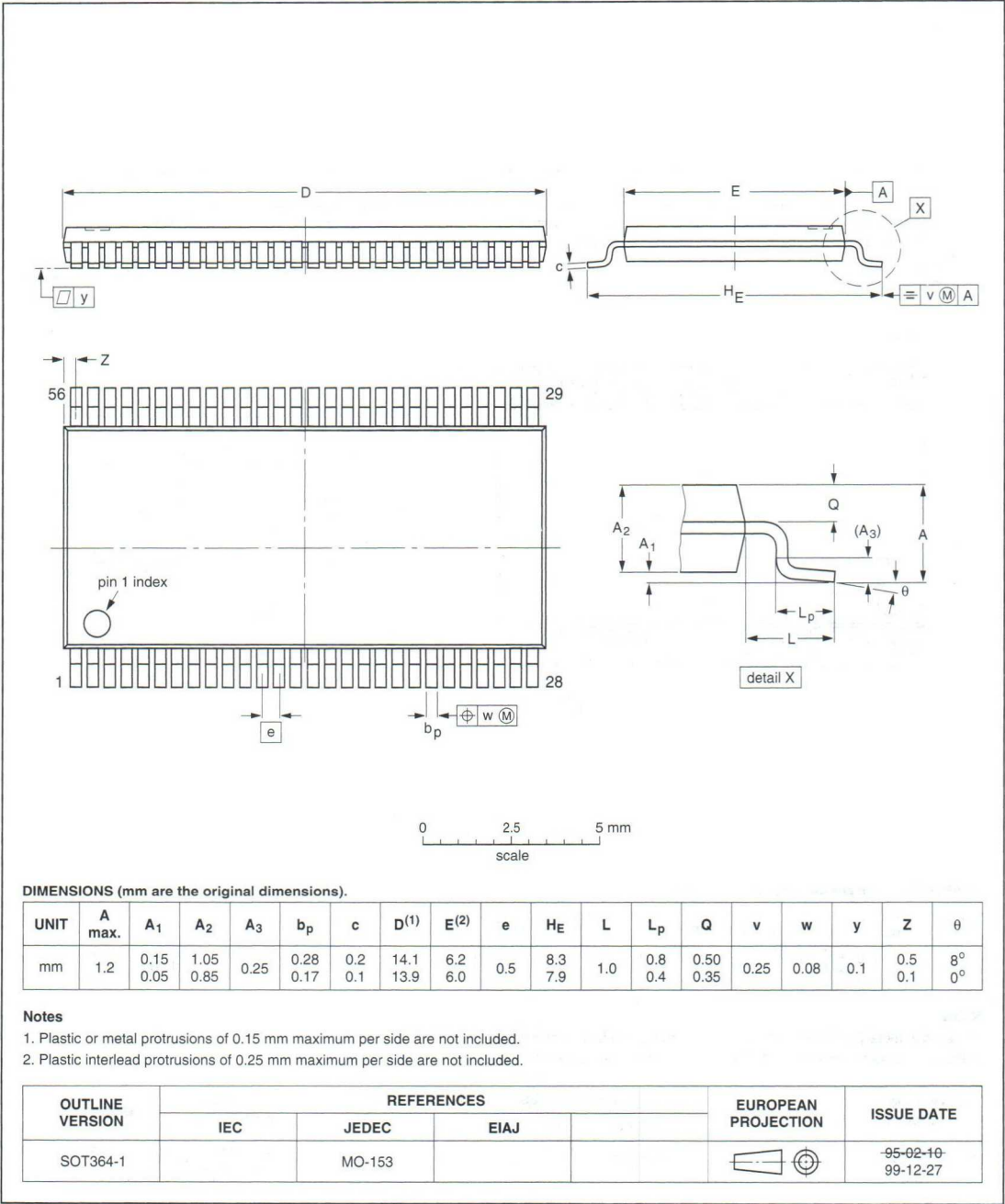
Notes

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			
SOT362-1		MO-153				-95-02-10 99-12-27

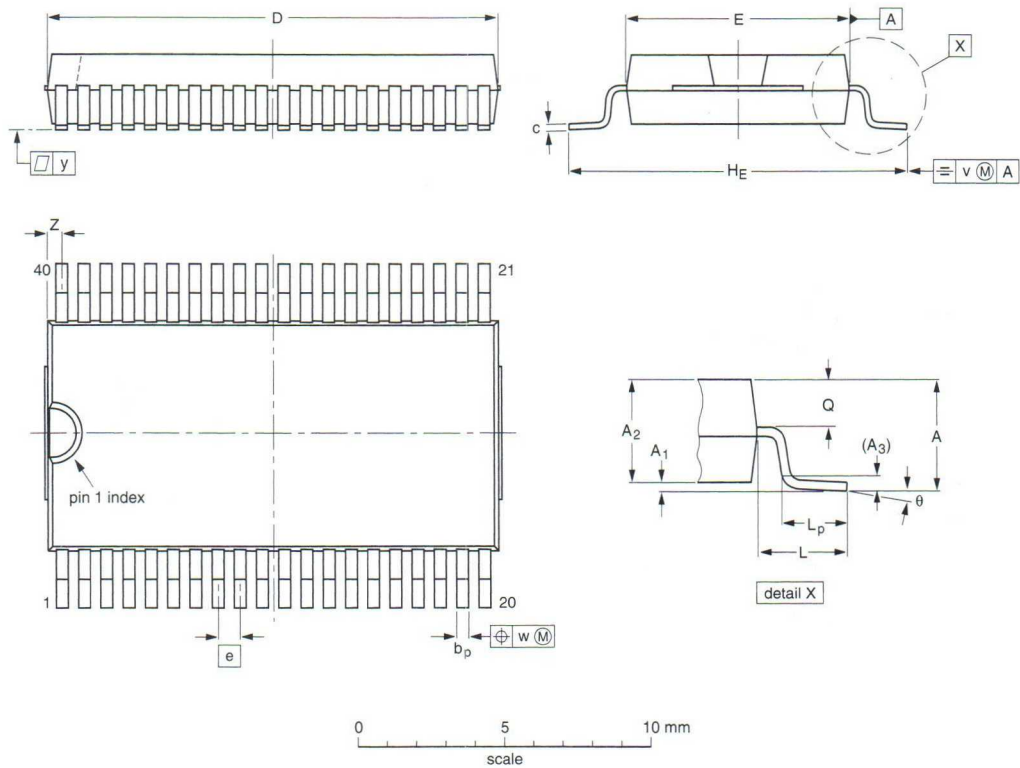
TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm

SOT364-1



VSO40: plastic very small outline package; 40 leads

SOT158-1



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 ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	2.70	0.3 0.1	2.45 2.25	0.25	0.42 0.30	0.22 0.14	15.6 15.2	7.6 7.5	0.762	12.3 11.8	2.25	1.7 1.5	1.15 1.05	0.2	0.1	0.1	0.6 0.3	7° 0°
inches	0.11	0.012 0.004	0.096 0.089	0.010	0.017 0.012	0.0087 0.0055	0.61 0.60	0.30 0.29	0.03	0.48 0.46	0.089	0.067 0.059	0.045 0.041	0.008	0.004	0.004	0.024 0.012	

Notes

1. Plastic or metal protrusions of 0.4 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

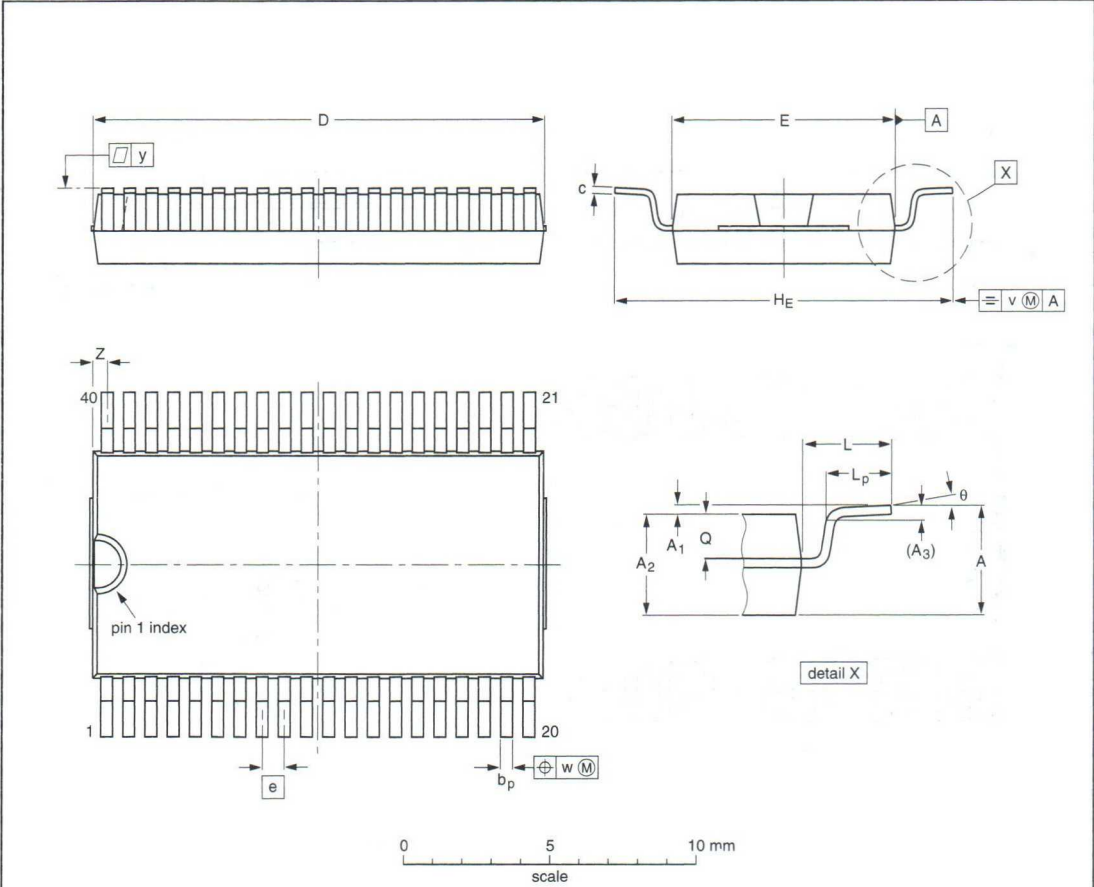
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT158-1						92-11-17 95-01-24

IC package range and dimensions

Chapter 2

VSO40: plastic very small outline package; 40 leads; face down

SOT158-2



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 ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	z ⁽¹⁾	θ
mm	2.70	0.3 0.1	2.45 2.25	0.25	0.42 0.30	0.22 0.14	15.6 15.2	7.6 7.5	0.762	12.3 11.8	2.25	1.7 1.5	1.15 1.05	0.2	0.1	0.1	0.6 0.3	7° 0°
inches	0.11	0.012 0.004	0.096 0.089	0.010	0.017 0.012	0.0087 0.0055	0.61 0.60	0.30 0.29	0.03	0.48 0.46	0.089	0.067 0.059	0.045 0.041	0.008	0.004	0.004	0.024 0.012	

- Note
- 1. Plastic or metal protrusions of 0.4 mm maximum per side are not included.
 - 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

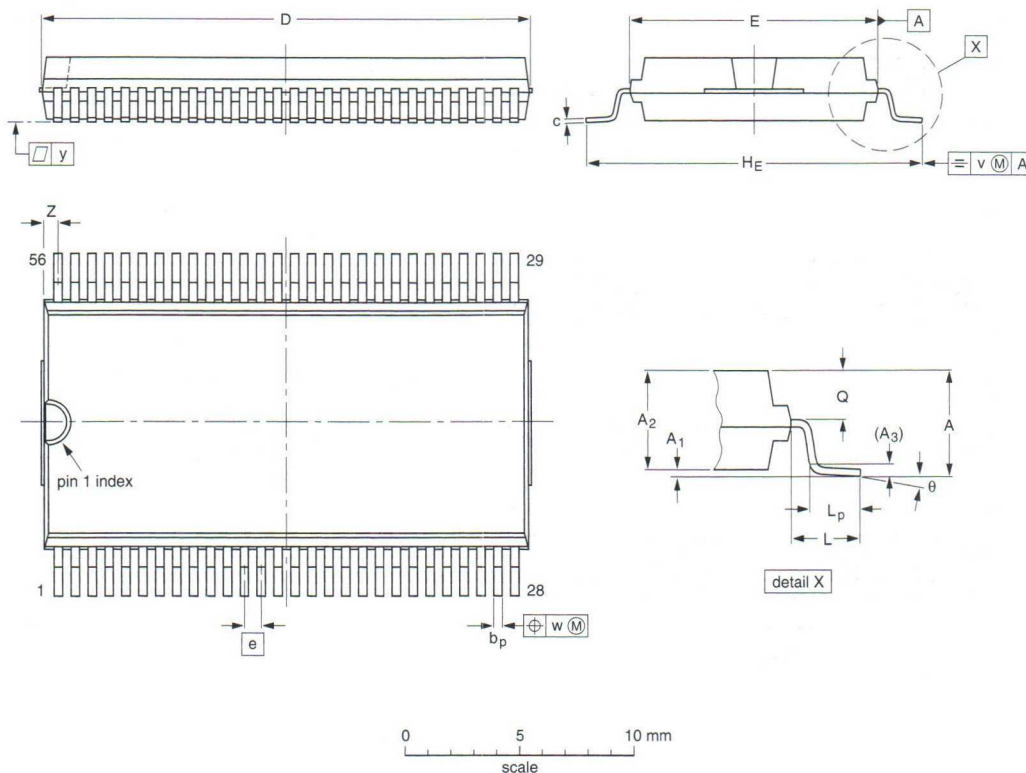
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT158-2						92-11-17 95-01-24

IC package range and dimensions

Chapter 2

VSO56: plastic very small outline package; 56 leads

SOT190-1



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 ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	3.3	0.3 0.1	3.0 2.8	0.25	0.42 0.30	0.22 0.14	21.65 21.35	11.1 11.0	0.75	15.8 15.2	2.25	1.6 1.4	1.45 1.30	0.2	0.1	0.1	0.90 0.55	7° 0°
inches	0.13	0.012 0.004	0.12 0.11	0.01	0.017 0.012	0.0087 0.0055	0.85 0.84	0.44 0.43	0.0295	0.62 0.60	0.089	0.063 0.055	0.057 0.051	0.008	0.004	0.004	0.035 0.022	

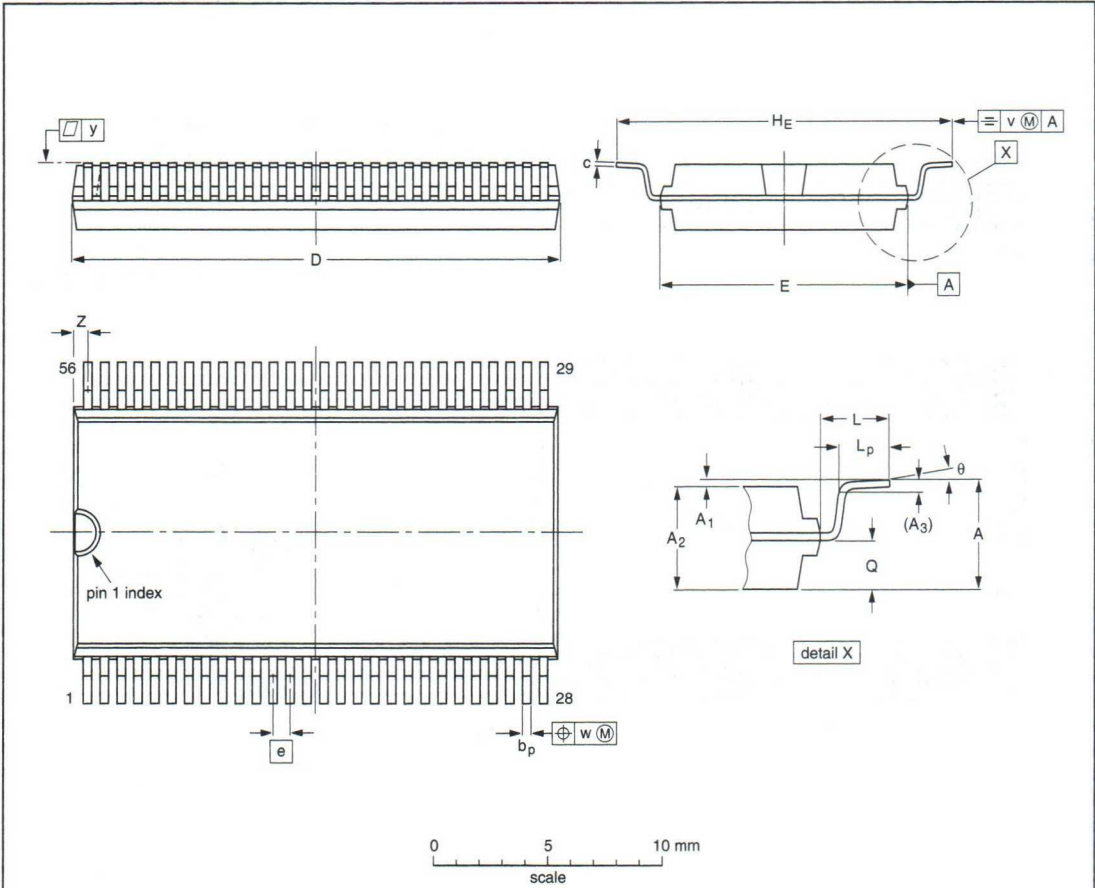
Note

1. Plastic or metal protrusions of 0.3 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			
SOT190-1						96-04-02 97-08-11

VSO56: plastic very small outline package; 56 leads; face down

SOT190-2



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 ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	z ⁽¹⁾	θ
mm	3.3	0.3 0.1	3.0 2.8	0.25	0.42 0.30	0.22 0.14	21.65 21.35	11.1 11.0	0.75	15.8 15.2	2.25	1.6 1.4	1.45 1.30	0.2	0.1	0.1	0.90 0.55	7° 0°
inches	0.13	0.012 0.004	0.12 0.11	0.01	0.017 0.012	0.0087 0.0055	0.85 0.84	0.44 0.43	0.0295	0.62 0.60	0.089	0.063 0.055	0.057 0.051	0.008	0.004	0.004	0.035 0.022	

Note

1. Plastic or metal protrusions of 0.3 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			
SOT190-2						96-04-02 97-08-11

CHAPTER 3

HANDLING PRECAUTIONS

	page
Electrostatic charges	3 - 2
Workstation for handling electrostatic-sensitive devices	3 - 2
Receipt and storage of components	3 - 2
PCB assembly	3 - 2
Testing PCBs	3 - 2

Handling precautions

Chapter 3

ELECTROSTATIC CHARGES

Electrostatic charges can be stored in many things; for example, man-made fibre clothing, moving machinery, objects with air blowing across them, plastic storage bins, sheets of paper stored in plastic envelopes, paper from electrostatic copying machines, and people (see Fig.1). The charges are caused by friction between two surfaces, at least one of which is non-conductive. The magnitude and polarity of the charges depend on the different affinities for electrons of the two materials rubbing together, the friction force and the humidity of surrounding air.

Electrostatic discharge (ESD) is the transfer of an electrostatic charge between bodies at different potentials and occurs with direct contact or when induced by an electrostatic field. All pins of Philips Semiconductors' devices are protected against electrostatic discharge. However we recommend that the following ESD precautions are complied with when handling such components.

WORKSTATION FOR HANDLING ELECTROSTATIC-SENSITIVE DEVICES

Figure 2 shows a working area suitable for safely handling electrostatic-sensitive devices. It has a workbench, the surface of which is conductive and anti-static. The floor should also be covered with anti-static material.

The following precautions should be observed:

- Persons at a workbench should be earthed via a wrist strap and a resistor.
- All mains-powered equipment should be connected to the mains via an earth-leakage switch.
- Equipment cases should be grounded.
- Relative humidity should be maintained between 40% and 50%.
- An ionizer should be used to neutralize objects with immobile static charges in case other solutions fail.
- Keep static materials, such as plastic envelopes and plastic trays etc., away from the workbench. If there are any such static materials on the workbench, remove them before handling the semiconductor devices.
- Refer to the current version of the handbook EN 100015 (CECC 00015) "*Protection of Electrostatic Sensitive Devices*", which explains in more detail how to arrange an ESD protective area for handling ESD sensitive devices.

RECEIPT AND STORAGE OF COMPONENTS

Electrostatic-sensitive devices are packed for despatch in anti-static/conductive containers, usually boxes, tubes or blister tape. Warning labels on both primary and secondary packing show that the contents are sensitive to electrostatic discharge.

Such devices should be kept in their original packing whilst in storage. If a bulk container is partially unpacked, the unpacking should be done at a protected workstation. Any components that are stored temporarily should be packed in conductive or anti-static packing or carriers.

PCB ASSEMBLY

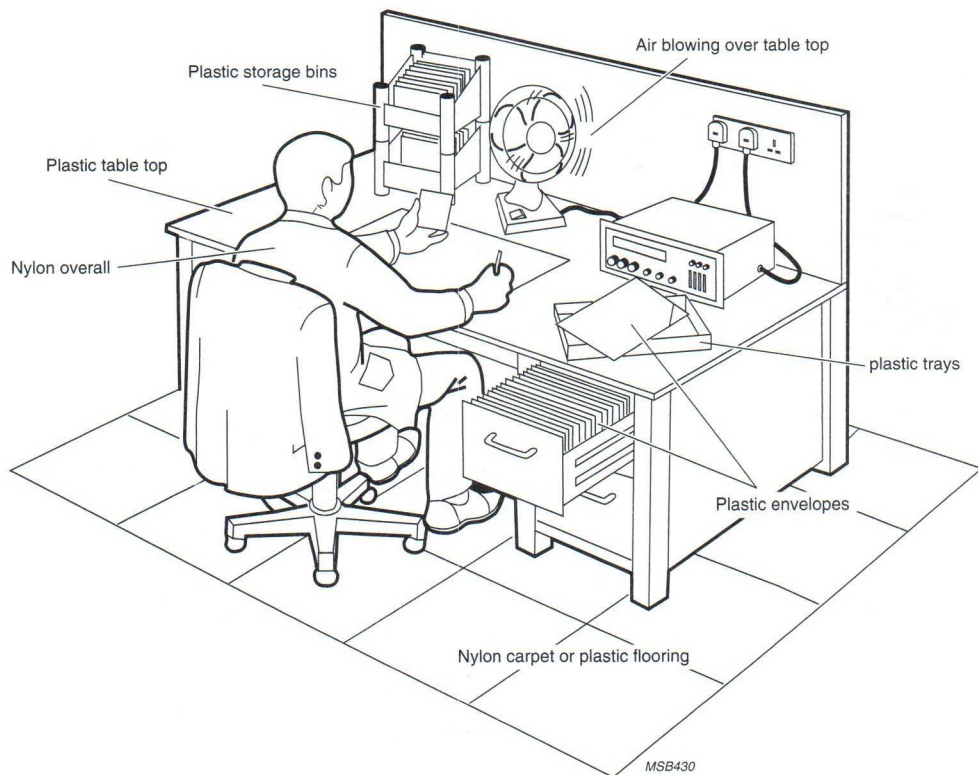
Electrostatic-sensitive devices must be removed from their protective packing with grounded component-pincers or short-circuit clips. Short-circuit clips must remain in place during mounting, soldering and cleansing/drying processes. Don't remove more components from the storage packing than are needed at any one time. Production/assembly documents should state that the product contains electrostatic sensitive devices and that special precautions need to be taken. During assembly, ensure that the electrostatic-sensitive devices are the last of the components to be mounted and that this is done at a protected workstation.

All tools used during assembly, including soldering tools and solder baths, must be grounded. All hand-tools should be of conductive or anti-static material and, where possible, should not be insulated.

TESTING PCBs

Completed PCBs must be tested at a protected workstation. Place the soldered side of the circuit board on conductive or anti-static foam and remove the short-circuit clips. Remove the circuit board from the foam, holding the board only at the edges. Make sure the circuit board doesn't touch the conductive surface of the workbench. After testing, replace the PCB on the conductive foam to await packing.

Assembled circuit boards containing electrostatic-sensitive devices should always be handled in the same way as unmounted components. They should also carry warning labels and be packed in conductive or anti-static packing.



This is a dangerous situation!

Fig.1 Typical working environment for electronic component handling showing potential ESD hazards.

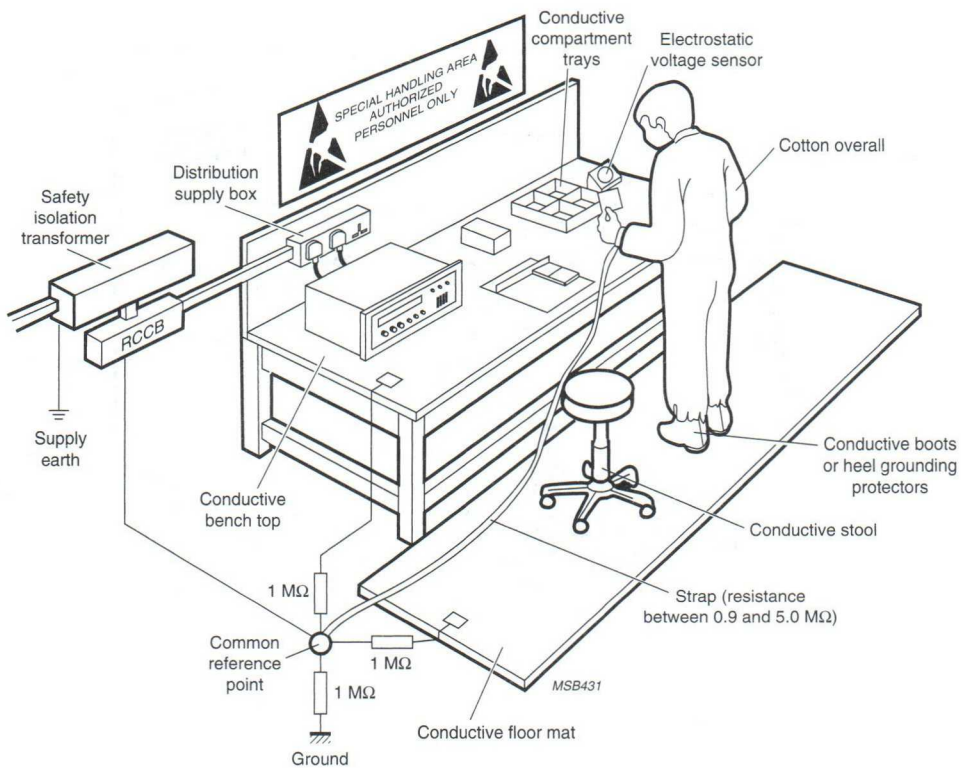


Fig.2 Essential features of an ESD-protected workstation.

CHAPTER 4

THROUGH-HOLE MOUNTING METHODS

	page
Soldering by dipping or solder wave	4 - 2
Repairing soldered joints	4 - 2

Through-hole mounting methods

Chapter 4

SOLDERING BY DIPPING OR SOLDER WAVE

The maximum temperature of the solder must not exceed 260 °C, and the solder joint should not be exposed to such a temperature for more than 5 s. If the solder wave method is used, the total contact time of successive solder waves should not exceed 5 s. For more information on solder wave methods, refer to *Chapter 5*.

The IC may be mounted up to its seating plane, as long as the temperature of the plastic body doesn't exceed the specified storage maximum. If the PC board has been preheated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

The risk of solder bridging (i.e. short circuiting) between adjacent leads of an IC increases as the lead pitch decreases. So, for example, SDIP ICs with a 1.778 mm lead pitch have a higher risk of solder bridging than DIP ICs with their 2.54 mm lead pitch. This risk can be significantly reduced by mounting the component on the PC board so that its body length (and hence its row of leads) is parallel to the board's transport direction through the wave soldering machine (see Fig.1).

REPAIRING SOLDERED JOINTS

Apply the soldering iron to the IC pin(s) either below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is below 300 °C, it may remain in contact for up to 10 s. If it is between 300 °C and 400 °C, it may only remain in contact for up to 5 s.

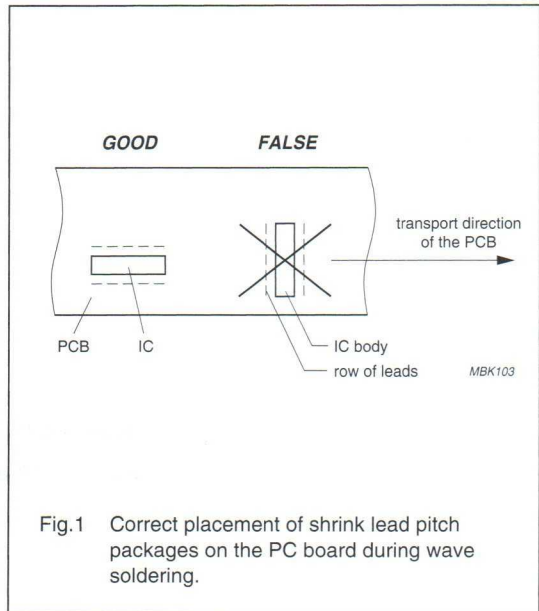


Fig.1 Correct placement of shrink lead pitch packages on the PC board during wave soldering.

CHAPTER 5

SMD MOUNTING METHODS

	page
Introduction	5 - 2
Double-wave soldering	5 - 2
Reflow soldering	5 - 4
Replacing a soldered IC	5 - 9
Assessment of soldered joint quality	5 - 9
SMD footprints	5 - 10
BGA, HBGA, LFBGA & TFBGA footprint (reflow soldering)	5 - 12
SO & SOJ footprint (reflow soldering)	5 - 14
SO & SOJ footprint (wave soldering)	5 - 16
HTSSOP footprint (reflow soldering)	5 - 18
SSOP, TSSOP & VSO footprint (reflow soldering)	5 - 20
HTSSOP, SSOP, TSSOP & VSO footprint (wave soldering)	5 - 22
HTQFP, HLQFP footprint (reflow soldering)	5 - 24
LQFP, MSQFP, QFP, SQFP & TQFP footprint (reflow soldering)	5 - 26
HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP footprint (wave soldering)	5 - 28
PLCC footprint (reflow soldering)	5 - 32
PLCC footprint (wave soldering)	5 - 34

SMD mounting methods

Chapter 5

INTRODUCTION

There is no one soldering method ideal for all IC packages. Many manufacturers still use, and will continue to use for some time to come, a mixture of surface-mount and through-hole components and so may prefer the wave soldering method. But for SMD types, which represent the majority of components in production today, reflow soldering may well be the preferred process. Indeed for many of the newer SMD types, such as the ball grid array (BGA) and low profile ball grid array (LFBGA) packages, reflow soldering is the only suitable method. This is because BGA packages have their ball-shaped terminals underneath the package body. These (LF)BGA are a widely used alternative for leaded high pin count devices with fine pitch (< 0.4 mm).

Table 1 gives an overview of which IC packages are suitable for the various soldering methods.

DOUBLE-WAVE SOLDERING

Although conventional wave soldering can still be used for certain circuits, it is not recommended for soldering SMDs, or PC board with a high component density, as solder bridging and non-wetting can present major problems. The double-wave soldering method, which was specifically developed to overcome such problems, is a much better soldering technique, although even this method is not suitable for ICs with closely-spaced leads.

If wave soldering is used, the following conditions must be observed:

- the PC board footprint must incorporate solder thieves on the downstream end
- the longitudinal axis of the IC must be parallel to the direction of the solder flow.

Suitable PC board footprints for double-wave soldering are given later in this chapter.

Table 1 Suitability of ICs for various soldering methods

	(LF)BGA	SO	SSOP	VSO	TSSOP	QFP	SQFP	LQFP	TQFP	PLCC
standard		IEC/ JEDEC				IEC/ JEDEC				JEDEC
number of leads	56-776	4-32	14-56	40-56	8-56	44-160	128-304	32-208	44-128	20-84
suitability for wave soldering ⁽¹⁾	not suitable	4	2 ⁽²⁾	3	1 ⁽²⁾	2 (at 45°) ⁽²⁾	1 ⁽²⁾	1 ⁽²⁾	1 ⁽²⁾	3
suitability for reflow soldering ⁽¹⁾										
Convection/IR	4	4	4	3	3	3	3	3	3	2
hot belt	—	4	4	3	3	3	3	3	3	3
hot gas	1	4	4	4	3	4	4	4	4	3
vapour phase	—	4	2	3	2	2	2	2	2	1
resistance	—	1	1	4	1	4	1	1	1	1
ease of assessing soldered joint quality	difficult	good	good	good	good	good	good	good	good	difficult

Notes

1. Rating from 1 to 4 (1 indicates that soldering is very difficult; 4 that soldering is straightforward)
2. Wave soldering is not suitable for certain types, refer to footprint data at the end of this chapter for more details.

SMD mounting methods

Chapter 5

Applying adhesive

To prevent movement of the IC packages during wave soldering, it is necessary to bond the IC to the PC board with a high green-strength adhesive (such as thermosetting epoxy resin Heraeus PD944 or Amicon D125F DR for small components, or Heraeus PD945 or Amicon D125F3 DR for large components) and cure it. The adhesive can be applied either by syringe, pin transfer or screen/stencil printing. The preferred method is by syringe since this allows a precisely measured amount of solder to be applied at each position.

Typical curing times for an SMD adhesive are 30 minutes at 85 °C (starting from ambient temperature), or as little as 3 minutes at 125 °C (see Fig.1).

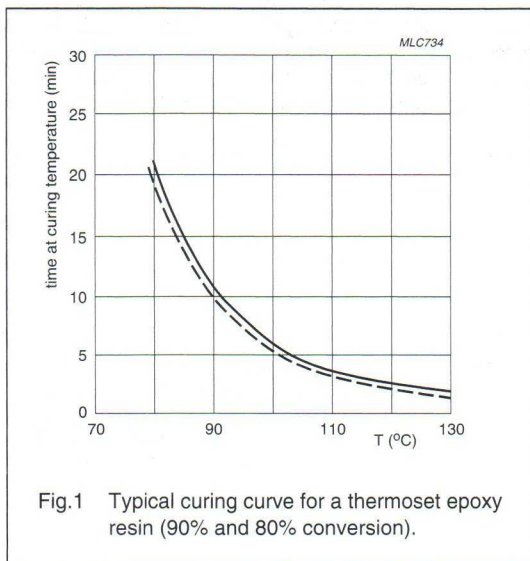


Fig.1 Typical curing curve for a thermoset epoxy resin (90% and 80% conversion).

Positioning the IC on the PC board

ICs are usually positioned on a PC board by placement machine, however, dimensional tolerances of the IC package and PC board, combined with inaccuracy of the placement machine can lead to component misalignment. Total misalignment is expressed as the sum of deviations in the x, y directions (see Fig.2) and in component misalignment with respect to the footprint position ϕ . Small variations in ϕ have large effects on placement accuracy, so the positioning of the leads is crucial for large multi-leaded ICs with a small pitch.

The maximum placement deviations for each IC are given with the footprint design later in this chapter.

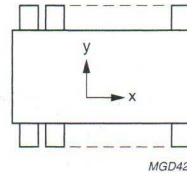


Fig.2 Alignment of SO package on the PC board.

Double-wave soldering method

After applying adhesive, placing the ICs and curing the adhesive, the areas to be soldered are coated with a thin layer of mildly activated flux, applied by spraying or as a foam. The flux assures good wetting of the soldering surfaces.

The PC board is then preheated to around 85 °C for solvent-based fluxes, or to 115 °C for water-soluble fluxes (temperatures on the solder side of the board). Preheating serves several purposes: it reduces the flux to the required viscosity, it heats the PC board and components to reduce thermal shock and promote faster wetting, and it minimizes the time spent at soldering temperature, which prevents dissolution of component metallization (leaching).

In a double-wave soldering machine, the solder is applied by moving the inclined PC board across two successive waves of solder. It's important to note that the PC board must be loaded into the machine in such a way that the SMDs on the board come into direct contact with the solder wave (see Fig.3).

The PC board first passes over a turbulent wave of solder, which has a high vertical velocity and constant height. This ensures good solder contact with the edges of the IC and prevents joints from being missed. The second, smoother laminar wave of solder completes formation of the solder fillet and reduces bridging. A little activated oil in the second solder wave helps to prevent formation of oxide skins on the surface of the solder, thereby reducing bridging as the PC board leaves the wave. Typically, the double-wave method uses common solder alloys (such as tin 60/lead 40), a soldering temperature of 250 ± 3 °C and dwell times of 0.5 to 1 s in the turbulent wave and 2 to 2.2 s in the smooth wave. To prevent board warping during soldering, the clamping force on its longer sides exerted by the transport system must not exceed 0.5 N/cm.

SMD mounting methods

Chapter 5

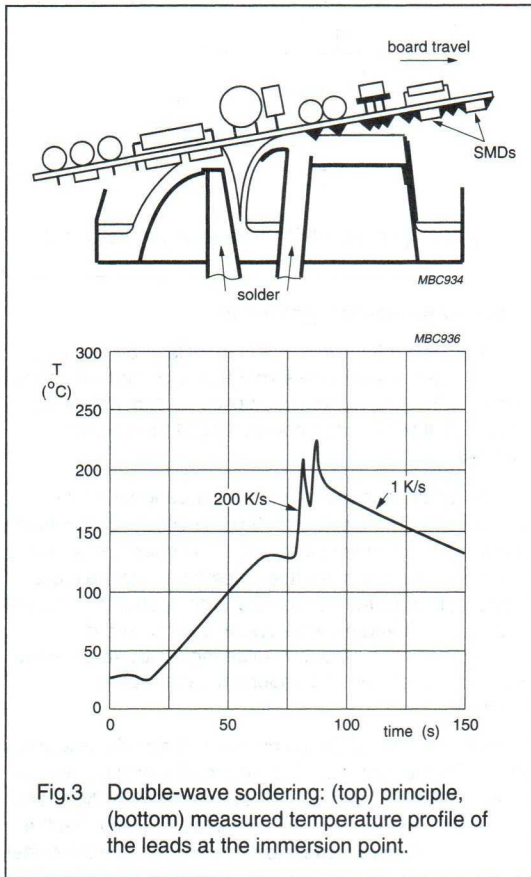


Fig.3 Double-wave soldering: (top) principle, (bottom) measured temperature profile of the leads at the immersion point.

REFLOW SOLDERING

The reflow soldering environment

It's recommended that for solder pasting, the equipment is located in a controlled environment maintained at a temperature of $22 \pm 2^{\circ}\text{C}$, and a relative humidity of $55 \pm 5\%$.

Applying solder paste to the PC board

Reflow soldering uses a paste consisting of small nodules of solder and a flux with binder, solvents and additives to control rheological properties. The paste is applied to the solder lands, and the ICs positioned on the PC board. On heating to a temperature above the melting point of the solder alloy, the mixture reflows to form soldered joints.

Solder paste is applied to the PC board by one of either three methods: screen printing, stencilling or dispensing syringe.

SCREEN PRINTING

A fine-mesh screen coated with emulsion, except the areas where paste is required, is placed over the PC board (see Fig.4). A squeegee is then passed across the screen to force solder paste through the areas in the emulsion and onto the solder lands on the PC board. An 80-mesh screen is normally used, and 0.5 to 0.7 mg/mm^2 of solder paste should be applied to the solder lands of the PC board.

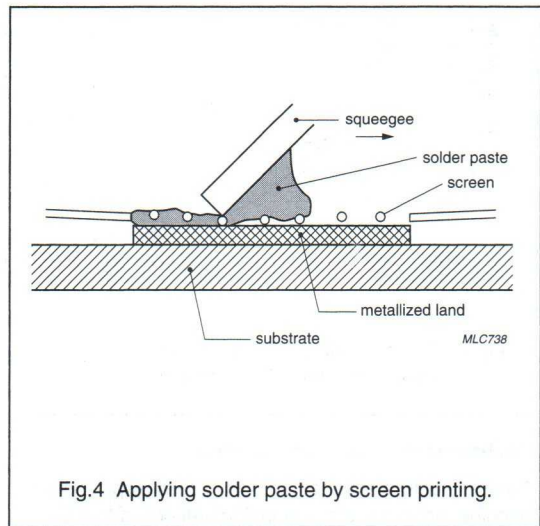


Fig.4 Applying solder paste by screen printing.

SMD mounting methods

Chapter 5

STENCILLING

This is similar to screen printing, except that a metal stencil is used instead of a fine-mesh screen.

The stencil is usually made of stainless steel or bronze and should be 200 μm thick with a step-etched pattern 125 μm thick formed by chemical etching. To ensure that the edges of the openings in the stencil are always positioned within the solder lands, the dimensions of the openings should be about 10% smaller than those of the lands.

The stencil thickness is 150 μm for the application of (LF)BGA packages. The apertures in the stencil are electro-formed or laser cut. For LFBGA packages with a ball pitch of 0.5 mm, a stencil thickness of 100 μm will result in a larger process window.

DISPENSING SYRINGE

This method uses an air- or mechanically-driven syringe to deposit paste to each solder land (see Fig.5). Although it is comparatively slow, it allows a precisely measured amount of paste to be deposited at each position.

Table 2 shows the amount of paste required per joint for various IC packages.

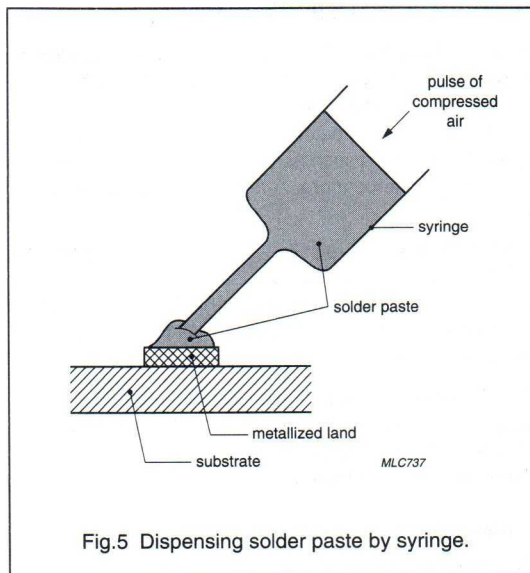


Fig.5 Dispensing solder paste by syringe.

Table 2 Amount of dispensed paste per solder joint for various IC packages.

PACKAGE	SOLDER PASTE/JOINT (mg)
SO (6.60 mm)	0.5 to 0.7
SO (11.00 mm)	0.75
SSOP	0.25
VSO	0.5
TSSOP	0.25
QFP	0.7 to 1.0
SQFP	0.25
LQFP	0.25
TQFP	0.25
PLCC	1.0

SMD mounting methods

Chapter 5

Positioning the IC on the PC board

Positioning ICs on the PC board is identical in practice as for wave soldering, except it is the tackiness (tack strength) of the solder paste and not an adhesive, that holds the IC in place before soldering. Tack strength depends on factors such as paste composition, drying conditions, placement pressure, dwell time and contact area.

(LF)BGA packages are self-aligning, i.e. during reflow, an (LF)BGA that has not been properly placed will float back to its normal position on the solder land due to surface tension forces. Misaligned components (BGA up to 350 μm) move to their normal position during reflow.

The placement force is not a critical factor for BGA placement and can range from 2 N to 10 N depending on the type of board support and construction of the placement force control unit.

Reflow soldering methods

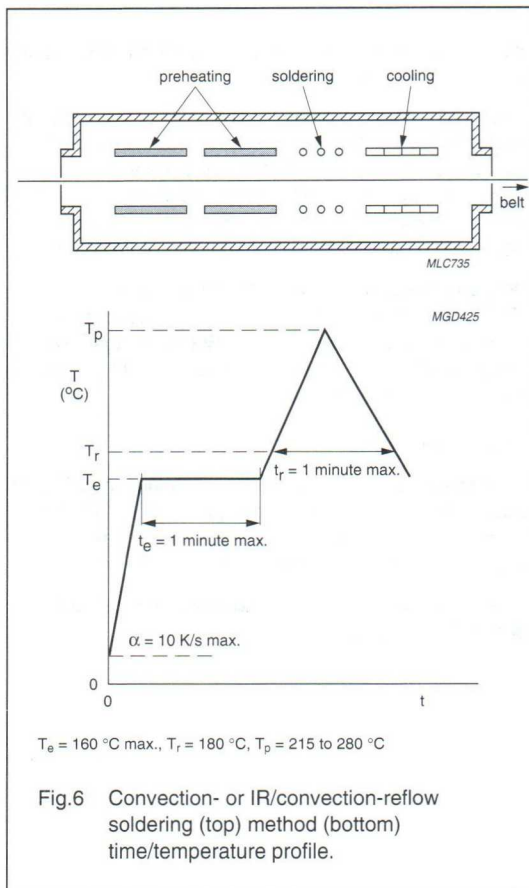
There are several methods available to provide the heat to reflow the solder paste. The main systems used at the present time are: infrared/convection, hot belt, hot gas, vapour phase and resistance soldering.

INFRARED/CONVECTION REFLOW

In mass production lines, the reflow process is usually performed in ovens fitted with conveyor belts. Heat transfer is either by heat convection, infrared radiation, or a combination of the two.

Infra ovens usually have different types of heating element, operating in the mid- to far-IR regions, normally above and below the moving belt. There are three zones: for preheating, soldering and cooling, and total throughput time is about 100 to 200 s (see Fig.6). The main limitation of IR reflow is that the components and materials used in the construction of the PC board absorb, transmit and reflect IR radiation at different rates. For example, IC leads are good IR reflectors, whereas the black IC packages make excellent IR absorbers. This results in an uneven temperature profile across the board. However, extending the exposure time can reduce this effect.

A variation on the infrared oven is the combined IR/convection oven. These ovens generally produce a lower temperature difference than IR ovens, which results in a more uniform heat distribution between board and components. In an IR/convection oven, the components' peak temperature can be 20 $^{\circ}\text{C}$ lower than in an infrared only oven.



The components and the solder paste are heated as quickly as possible to a temperature just above the solder's melting point. After a short time, the assembly is cooled rapidly; the molten solder solidifies, and the soldered joints are formed. This process can be complex in cases where a mix of small and large SMDs on the same PC board are reflow soldered. When the solder paste for the small components starts to melt, the temperature near the larger components is still far below melting point. By the time the paste for the larger components starts melting, the temperature of the small components may already have reached damaging levels. To prevent such large temperature differences, it is advisable to use a temperature profile as shown in Fig.6, and an oven with forced heat convection, which solves the problem of uneven temperatures between the substrate, and small and large SMDs.

SMD mounting methods

Chapter 5

To guarantee good soldering at the lead tips/solder joints, the peak temperature (T_p) in the final heating zone should be at least 215 °C. This temperature, however, must not exceed the maximum temperature for glass epoxy boards which is 265 °C for double-sided reflow soldering or 280 °C for single-sided reflow soldering. Furthermore, the top-surface temperature of the packages should preferably be kept below 220 °C for thick/large packages, and below 235 °C for small/thin packages.

Many plastic SMDs are sensitive to moisture and can be damaged if stored incorrectly then soldered. If sufficient moisture is present in the plastic package during soldering, it can turn into steam, expand rapidly and, in the more severe cases, result in internal or external package cracks (the popcorn effect). To help prevent this, we assign a Moisture Sensitivity Level (MSL) to each plastic SMD package type. Packages that are sensitive to moisture are stored and shipped in a specialized sealed dry packing and provided with advice on the time allowed between unpacking the devices and soldering.

For more information on moisture sensitive devices and their packing/storage requirements, refer to *Chapter 7: IC packing methods*.

HOT BELT SOLDERING

With hot belt (or thermal conduction) soldering, the assembled PC boards are heated from below through a thin Teflon/fibreglass transfer belt, which is in contact with temperature-controlled hot plates. Boards lying on the moving belt pass over three or more hot plates for preheating, soldering and cooling. Overhead infrared lamps can also be used to supply additional heat during the soldering stage to ensure a more even distribution of heat. Belt speed depends on the substrate used, but is typically 25 cm/min for a 1.6 mm glass-epoxy board, and 120 cm/min for a 0.6 mm ceramic substrate.

HOT GAS SOLDERING

With this method, a small gun with a nozzle diameter of about 2.5 mm, issues air, nitrogen or other suitable gas at a temperature of around 400 °C and a flow rate of 1.5 litres/min. The jet should be continually move along the package leads to avoid overheating the PC board. To limit thermal stresses in the ICs, the temperature of the package should be kept below 250 °C. Ceramic substrates should be preheated to around 150 °C and the gas jet directed to each IC lead in turn.

Although this method is slow, it is useful in small production runs, in laboratory applications, for de-soldering individual ICs and for rework/repair.

SMD mounting methods

Chapter 5

VAPOUR PHASE REFLOW

In vapour phase reflow, vapour from a suitable boiling liquid transfers latent heat of condensation to the substrate. Provided the liquid boils at a temperature higher than the melting point of the solder, the paste will reflow. Normally, a liquid that boils around 215 °C is used. The boiling liquid provides precise temperature control, a fast heating rate, uniform heating over the whole substrate, and an inert atmosphere. Vapour phase reflow uses an in-line or batch system. With an in-line system (see Fig.7) the belt travels at around 1 m/min, has a throughput time of 200 s and a dwell time in the hot vapour of about 30 s.

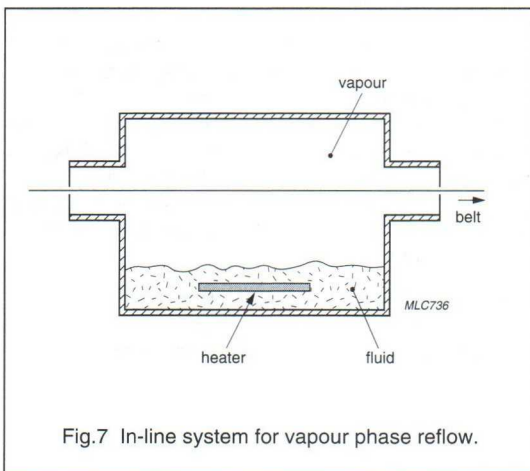


Fig.7 In-line system for vapour phase reflow.

A batch of assembled substrates is lowered into the vapour for 20 to 40 s, and then cooled by raising it into the upper vapour for 30 to 50 s. Duration depends on the batch size. Flux residues that build up in the system are removed by filtering, either continually or at the end of each day. Acid, which is a decomposition product of the secondary fluid, is removed by passing the condensate through a scrubber.

Since leads heat more quickly than the substrate, solder tends to flow onto the lands and not onto the joint (the wick effect). So if the gap between lead and solder land is more than 100 µm the soldered joint may be incomplete, or it may not form at all. Because the temperature difference between leads and substrate is less in IR/convection heating than it is in vapour-phase heating, the gap between leads and solder can be larger (150 µm).

In the past, CFC liquids were used in this process. However, such chemicals are now banned because of their harmful effect on the environment. New Cl-free liquids have been developed for vapour phase reflow, which are readily available

RESISTANCE SOLDERING

Resistance soldering uses a heated element in contact with the joint to reflow the solder. However, solder paste should not be used with this method as the solder tends to spatter during rapid heating. Instead, an extra thick layer (15 to 30 µm) of tin/lead solder is plated directly on to the leads.

As each IC package type and size requires its own heating element, this method is slow and will probably be restricted to development work. Soldering ICs, such as SOs and PLCCs, is also very difficult as they have leads that are too short and stiff to bend and fit the tool. However, it is an excellent tool for de-soldering and soldering QFPs, VSOs and other IC with long, flexible gull-wing leads.

SMD mounting methods

Chapter 5

REPLACING A SOLDERED IC

De-soldering the IC

ICs can be removed from a PC board by heating the IC leads with a heating element (see "Resistance soldering") or by heating the leads on both sides of the package with a hot air gun with a small orifice nozzle (see "Hot gas soldering"). The IC can then be removed with a pair of tweezers. However, care must be taken not to damage the solder lands or any other components on the PC board.

An important factor for the successful removal of (LF)BGA components from a board is the uniform heating of the board. If the board is heated only locally, the board will warp. On the top-side, only the component must be heated. When all the solder joints are molten, the component can be removed with (in most systems) a vacuum nozzle. Excessive solder should be removed with a solder sucker or wick. Remaining flux can be removed by brushing with a cleaning agent.

Applying solder paste to the PC board

Before replacing the IC, a dispenser is used to place a small dot (see Table 2) of a suitable solder paste on each solder land. The application of new solder paste for (LF)BGA packages is probably not necessary. In such cases, only a required amount flux should be applied with a brush or spray.

Positioning the new IC

The new IC can now be placed manually on the PC board. See the relevant footprint diagram for the placement accuracy of the IC.

A touchdown force of 30 N (except (LF)BGA components) distributed over the total surface area of the IC is sufficient to ensure that all its leads contact the solder lands.

For (LF)BGA components, the placement force must not exceed 10 N.

Soldering the new IC

The solder paste can be reflowed by either a resistance element or by hot air (see "Resistance soldering" and "Hot gas soldering").

For (LF)BGA components, hot gas (air or nitrogen), IR, or laser heating can be applied (the latter system is relatively expensive).

ASSESSMENT OF SOLDERED JOINT QUALITY

The quality of a soldered joint is assessed by inspecting the shape and appearance of the joint. This inspection is normally done with either a low-powered magnifier or microscope, however where ultra-high reliability is required, video, X-ray or laser inspection equipment should be considered.

Both sides of the PC board should be carefully examined: there should be no misaligned, missing or damaged components, soldered joints should be clean and have a similar appearance, there should be no solder bridging or residue, the length of through-hole component terminations must be within prescribed limits, and the PC board should be assessed for general cleanliness.

Unlike leaded component joints where the lead also provides added mechanical strength, the SMD relies on the quality of the soldering for both electrical and mechanical integrity. It is therefore necessary that the inspector is trained to make a visual assessment with regard to long-term reliability. Criteria used to assess the quality of an SMD solder joint include:

- correct positioning of the IC on the solder lands
- good wetting of the surfaces
- correct amount of solder
- a sound, smooth joint surface.

Positioning - if a lead projects over its solder land too far, an unreliable joint is obtained, which is obviously not acceptable. A projection of less than half the width of the lead can be acceptable depending on factors such as the electrical insulation distance that needs to be maintained (typically 0.2 mm for low-voltage applications). Shifting in the longitudinal direction is not a problem, provided the whole foot of the lead and the meniscus (the curved surface of the solder caused by surface tension) in the heel is on the solder land.

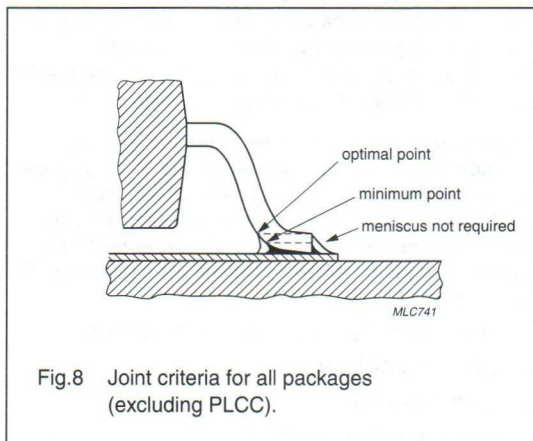
Good wetting - this produces an even flow of solder over the surface land and component lead, and thinning towards the edges of the joint. The metallic interaction that takes place during soldering should give a smooth, unbroken, adherent layer of solder on the joint.

Correct amount of solder - a good soldered joint should have neither too much nor too little solder: there should be enough solder to ensure electrical and mechanical integrity, but not so much that it causes solder bridging.

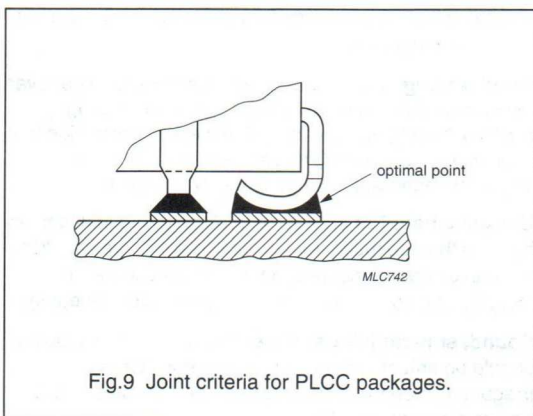
Sound, smooth joint surface - the surface of the solder should be smooth, shiny and continuous. Small irregularities on the solder surface are acceptable, but cracks are unacceptable.

All packages (excluding PLCC and (LF)BGA)

An optimum joint should have the wedge-shape space between the underside of the lead and the solder land filled with solder, with a meniscus height equal to the thickness of the lead (Fig.8). The acceptable minimum is a meniscus height at least half the lead thickness. The sides of the lead should be wetted, and although it is not necessary for the cut end of the foot to be wetted, a meniscus is usually present.

**PLCC packages**

In an ideal joint, the sides of the lead should be wetted and the area between the outside bend and solder land should be filled with solder to a height equal to the thickness of the lead (Fig.8). A meniscus extending to half the lead thickness is the acceptable minimum.

**(LF)BGA packages**

An optimum (LF)BGA joint is void-free and has a spherical shape between the solder land on the component and the solder land on the board. Experimentation has shown that solder joints between copper-defined solder lands are more reliable than solder joints between solder resist-defined solder lands, on both the component and board (for symmetrical solder joints).

For more information on (LF)BGA packages, ask for a copy of our (LF)BGA Application Note.

SMD FOOTPRINTS

A footprint pattern can be represented as a set of nominal coordinates and dimensions. The actual values are distributed around the nominal values owing to positional and processing tolerances, dimensional tolerances, and placement machine tolerances.

Calculation of these patterns, using simple worst-case parameters, is impractical. A better approach is to apply statistical analysis.

The figures on the following pages show footprints for most of our IC packages. There are also details on some figures that are specific to wave soldering such as the indicated transport direction of the PC board and the location of solder thieves. The use of solder thieves (areas of metallization in addition to, or attached to, the downstream pair of solder lands of the IC footprint) is recommended for wave soldering as they reduce the likelihood of solder bridging on these lands.

Optimum solder flow during wave soldering is obtained when SO, VSO, SSOP and TSSOP packages are mounted lengthwise (central axis parallel to the direction of travel over the wave, as shown in Fig.10). If board space is limited, mounting SO packages transversely (central axis at 90° to the direction of travel over the wave) is possible, see Fig.11. However, we do not recommend this mounting method for packages with lead pitches below 1.0 mm, and is unsuitable for packages with lead pitches of 0.5 mm or less. QFP, SQFP, LQFP and TQFP packages can only be soldered if placed at a 45° angle to the solder wave direction.

ICs have no orientation preference for reflow soldering.

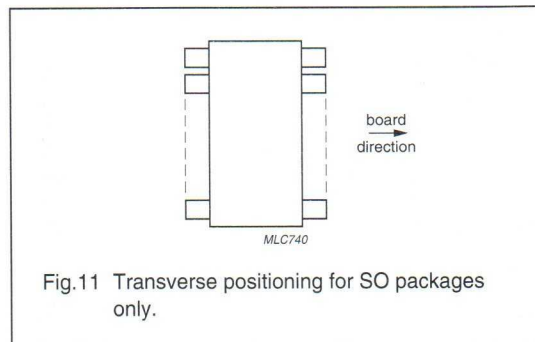
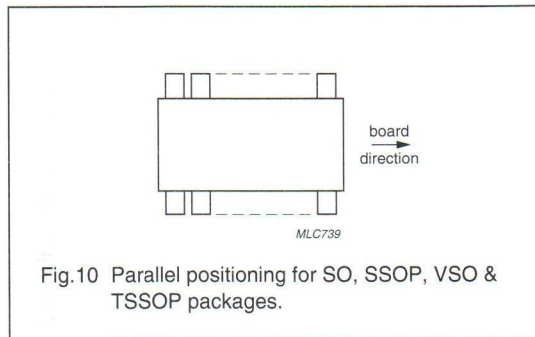
Although the ideal would be to locate an IC exactly in its correct position on the solder lands, in practice some tolerance is allowed. This tolerance is usually expressed as the placement accuracy, that is, the deviation of a component lead from its nominal position on the solder lands.

SMD mounting methods

Chapter 5

The maximum placement deviations for each IC are given with the relevant footprint design.

All footprint dimensions are based on our experience with both development and production boards, and are reproduced for guidance only.



Solder resist patterns

The footprint diagrams on the following pages also include recommended solder resist patterns for each package type. Solder resist serves two functions: it prevents solder flowing away from the solder lands during soldering, thus reducing the possibility of short circuits, and it increases the insulation resistance between adjacent circuit details. As such, solder lands must be completely free of solder resist while tracks must be fully covered.

The dimensions of the solder resist cut-outs depend on the print technique used to product the circuit board. If the photo-defined technique is used, the solder resist pattern must be at least 0.15 mm larger than the relevant solder land and have a minimum width of 0.2 mm. If the screen-print technique is used, the solder resist pattern must be at least 0.4 mm larger than the relevant solder land and have a minimum width of 0.3 mm.

Although the dimensions of the solder resist patterns are not given in the footprint diagrams on the following pages, they can be calculated from these guidelines.

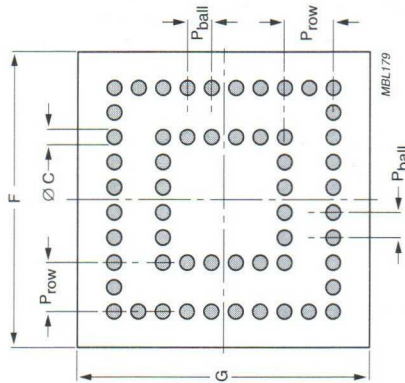


Fig.12 PC board footprint for mounting BGA, HBGA, LFBGA & TFBGA packages (reflow soldering).

Reflow soldering⁽¹⁾

PACKAGE NAME	PHILIPS OUTLINE CODE	FOOTPRINT DIMENSIONS (mm)						PLACEMENT ACCURACY
		P _{ball}	P _{row}	P _{ball} dia	C	F	G	
BGA15 6	SOT472-1	1.00	1.00	0.50	0.45	15.30	15.30	±0.10
BGA256	SOT466-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
BGA256	SOT471-1	1.27	1.27	0.50	0.60	27.30	27.30	±0.10
BGA292	SOT489-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
BGA316	SOT531-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
BGA388	SOT532-1	1.27	1.27	0.75	0.60	35.50	35.50	±0.10
BGA492	SOT514-1	1.27	1.27	0.75	0.60	35.40	35.40	±0.10
HGA292	SOT553-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
LFBA40	SOT515-1	0.50	1.00	0.30	0.255	5.20	5.20	±0.10
LFBA48	SOT488-1	0.50	1.00	0.30	0.255	5.75	5.75	±0.10
LFBA56	SOT516-1	0.50	1.00	0.30	0.255	6.20	6.20	±0.10
LFBA64	SOT534-1	0.80	0.80	0.46	0.425	8.30	8.30	±0.10
LFBA84	SOT518-1	0.50	1.00	0.30	0.255	7.20	7.20	±0.10
LFBA96	SOT536-1	0.80	0.80	0.46	0.425	5.80	13.80	±0.10
LFBA114	SOT537-1	0.80	0.80	0.46	0.425	5.80	16.30	±0.10
LFBA144	SOT512-1	0.80	0.80	0.40	0.425	10.30	10.30	±0.10
TFBA56	SOT542-1	0.50	1.00	0.32	0.275	6.20	6.20	±0.10
TFBA64	SOT543-1	0.50	0.50	0.32	0.275	6.20	6.20	±0.10

Note

1. The BGA family of packages are not suitable for wave soldering.

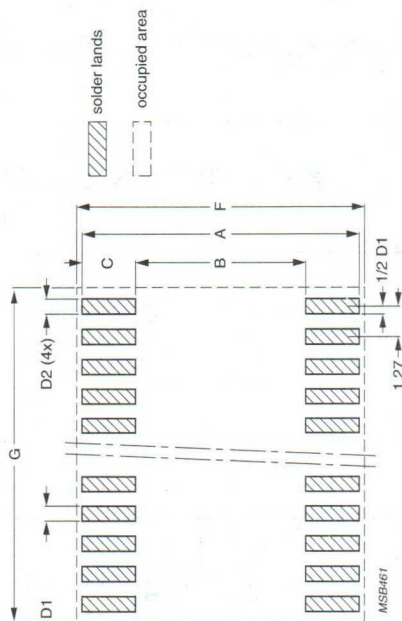


Fig. 13 PC board footprint for mounting SO & SOJ packages (reflow soldering).

Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)								PLACEMENT ACCURACY
			A	B	C	D1	D2	F	G		
For footprint and dimensions, refer to Data Handbook SC18.											
SO4	SOT223-1	4	6.60	4.00	1.30	0.60	0.60	7.00	5.50	±0.25	
SO8	SOT96-1	8	11.00	8.00	1.50	0.60	0.60	11.40	8.40	±0.25	
SO8	SOT176-1	8	6.60	4.00	1.30	0.60	0.60	7.00	9.30	±0.25	
SO14	SOT108-1	14	6.60	4.00	1.30	0.60	0.60	7.00	10.50	±0.25	
SO16	SOT109-1	16	6.60	4.00	1.30	0.60	0.60	7.00	10.50	±0.25	
SO16	SOT109-2	16	6.60	4.00	1.30	0.60	0.60	7.00	10.50	±0.25	
SO16	SOT109-3	16	6.60	4.00	1.30	0.60	0.60	7.00	10.50	±0.25	
SO16	SOT162-1	16	11.00	8.00	1.50	0.60	0.60	11.40	10.90	±0.25	
SO20	SOT163-1	20	11.00	8.00	1.50	0.60	0.60	11.40	13.40	±0.25	
SO24	SOT137-1	24	11.00	8.00	1.50	0.60	0.60	11.40	16.00	±0.25	
SO28	SOT136-1	28	11.00	8.00	1.50	0.60	0.60	11.40	18.50	±0.25	
SO32	SOT287-1	32	11.00	8.00	1.50	0.60	0.60	11.40	21.20	±0.25	
SOJ40	SOT449-1	40	12.10	7.30	2.40	0.70	0.85	12.35	26.50	±0.25	

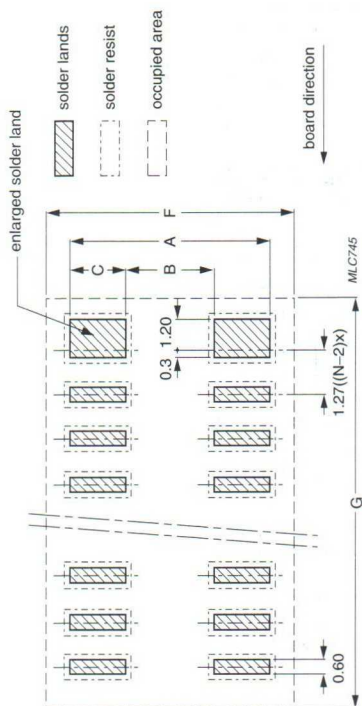


Fig.14 PC board footprint for mounting SO & SOJ packages (wave soldering).

SMD mounting methods

Chapter 5

Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)					PLACEMENT ACCURACY
			A	B	C	F	G	
For footprint and dimensions, refer to Data Handbook SC18.								
SO4	SOT223-1	4						
SO8	SOT96-1	8	6.60	4.00	1.30	7.00	5.50	±0.25
SO8	SOT176-1	8	11.00	8.00	1.50	11.40	8.40	±0.25
SO14	SOT108-1	14	6.60	4.00	1.30	7.00	9.30	±0.25
SO16	SOT109-1	16	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT109-2	16	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT109-3	16	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT162-1	16	11.00	8.00	1.50	11.40	10.90	±0.25
SO20	SOT163-1	20	11.00	8.00	1.50	11.40	13.40	±0.25
SO24	SOT137-1	24	11.00	8.00	1.50	11.40	16.00	±0.25
SO28	SOT136-1	28	11.00	8.00	1.50	11.40	18.50	±0.25
SO32	SOT287-1	32	11.00	8.00	1.50	11.40	21.20	±0.25
SOJ40	SOT449-1	40	Not suitable for wave soldering.					

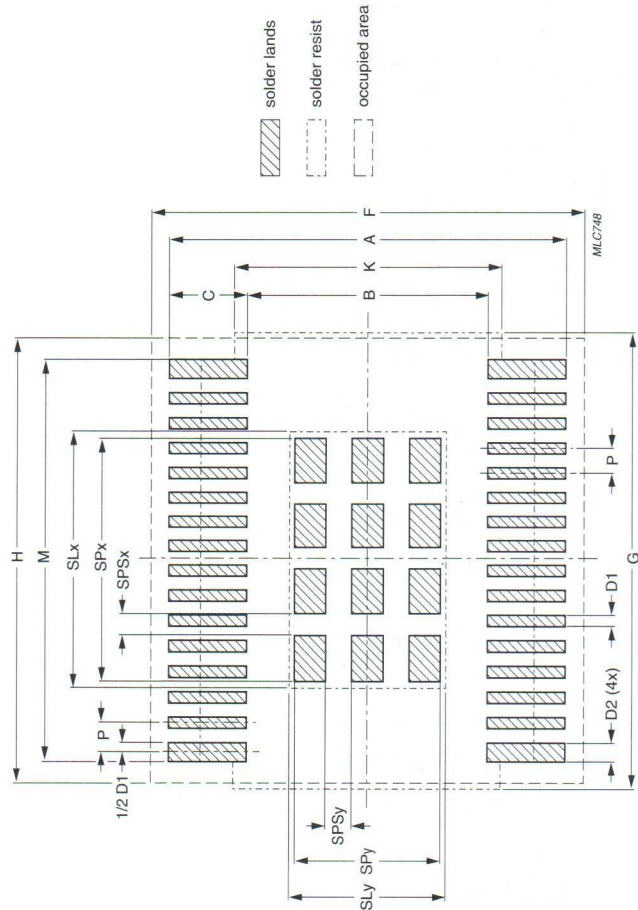


Fig.15 PC board footprint for mounting HTSSOP packages (reflow soldering).

Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)											PLACEMENT ACCURACY
			P	A	B	C	D1	D2	F	G	H	K	M	
HTSSOP20 ⁽¹⁾	SOT527-1	20	0.65	6.80	4.40	1.20	0.40	0.40	7.05	6.75	6.75	7.05	6.25	±0.15
HTSSOP32 ⁽¹⁾	SOT549-1	32	0.65	8.50	6.10	1.20	0.40	0.50	8.75	11.25	10.446	6.40	10.15	±0.15

Note

1. These packages have a heatsink soldered to the board. The dimensions of these solder lands are given in the following table.

PACKAGE NAME	PHILIPS OUTLINE CODE	SOLDER LAND DIMENSIONS (mm)						
		SLx	SLy	SPx	SPy	SPSx	SPSy	
HTSSOP20	SOT527-1	4.20	3.00	4.10	2.90	0.30	0.30	
HTSSOP32	SOT549-1	5.20	3.80	5.10	3.70	0.30	0.65	

SSOP, TSSOP & VSO FOOTPRINT (REFLOW SOLDERING)

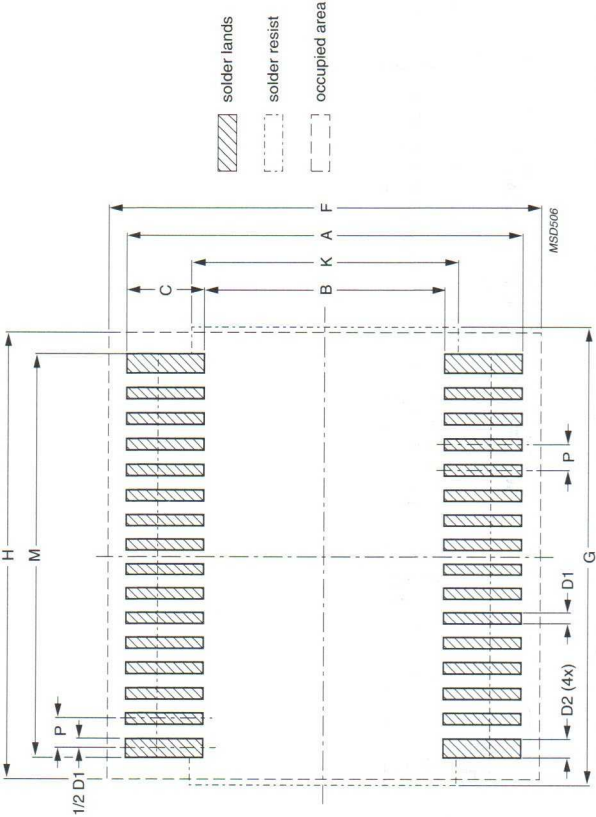


Fig.16 PC board footprint for mounting SSOP, TSSOP & VSO packages (reflow soldering).

SMD mounting methods

Chapter 5

Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)											PLACEMENT ACCURACY
			P	A	B	C	D1	D2	F	G	H	K	M	
SSOP14	SOT337-1	14	0.65	8.10	5.70	1.20	0.40	0.40	8.35	6.50	4.55	5.55	4.30	±0.15
SSOP16	SOT338-1	16	0.65	8.10	5.70	1.20	0.40	0.40	8.35	6.50	5.20	5.55	4.95	±0.15
SSOP16	SOT369-1	16	0.65	6.80	4.80	1.00	0.40	0.40	7.05	5.55	5.55	7.05	4.95	±0.15
SSOP16	SOT519-1	16	0.635	6.40	4.00	1.20	0.40	0.40	6.65	5.151	5.151	6.65	4.845	±0.15
SSOP20	SOT266-1	20	0.65	6.80	4.80	1.00	0.40	0.40	6.65	6.85	6.85	7.05	6.25	±0.15
SSOP20	SOT339-1	20	0.65	8.10	5.90	1.10	0.40	0.40	8.35	7.50	6.50	5.55	6.25	±0.15
SSOP24	SOT340-1	24	0.65	8.10	5.90	1.10	0.40	0.40	8.35	8.50	7.80	5.55	7.55	±0.15
SSOP24	SOT556-1	24	0.635	6.40	4.00	1.20	0.40	0.40	6.65	8.95	7.70	6.65	7.385	±0.15
SSOP28	SOT341-1	28	0.65	8.10	5.90	1.10	0.40	0.40	8.35	10.50	9.10	5.60	8.85	±0.15
SSOP48	SOT370-1	48	0.635	10.60	8.20	1.20	0.40	0.40	10.85	16.15	15.255	7.80	15.005	±0.15
SSOP56	SOT371-1	56	0.635	10.60	8.20	1.20	0.40	0.40	10.85	18.70	17.795	7.80	17.545	±0.15
TSSOP8	SOT505-1	8	0.65	5.40	3.20	1.10	0.40	0.50	6.00	3.60	3.15	3.70	2.55	±0.15
TSSOP10	SOT552-1	10	0.50	5.40	3.20	1.10	0.25	0.40	6.00	3.70	3.15	3.90	2.50	±0.15
TSSOP14	SOT402-1	14	0.65	6.80	4.60	1.10	0.40	0.40	7.05	5.25	4.55	4.65	4.30	±0.15
TSSOP16	SOT403-1	16	0.65	6.80	4.60	1.10	0.40	0.40	7.05	5.25	5.25	7.05	4.95	±0.15
TSSOP20	SOT360-1	20	0.65	6.80	4.60	1.10	0.40	0.40	7.05	6.75	6.75	7.05	6.25	±0.15
TSSOP24	SOT355-1	24	0.65	6.80	4.60	1.10	0.40	0.40	7.05	8.05	8.05	7.05	7.55	±0.15
TSSOP28	SOT361-1	28	0.65	6.80	4.60	1.10	0.40	0.40	7.05	9.95	9.10	4.70	8.85	±0.15
TSSOP32	SOT487-1	32	0.65	8.50	6.10	1.20	0.40	0.40	8.75	11.25	10.446	6.40	10.15	±0.10
TSSOP38	SOT510-1	38	0.50	6.80	4.60	1.10	0.285	0.285	7.05	9.90	9.90	7.05	9.29	±0.10
TSSOP48	SOT362-1	48	0.50	8.50	6.50	1.00	0.285	0.285	9.75	13.035	13.035	9.75	11.785	±0.10
TSSOP56	SOT364-1	56	0.50	8.50	6.50	1.00	0.285	0.285	9.75	15.035	15.035	9.75	13.785	±0.10
VSO40	SOT158-1	40	0.762	12.60	8.20	2.20	0.40	0.40	13.00	16.20	—	—	—	±0.10
VSO40	SOT158-2	40	0.762	12.60	8.20	2.20	0.40	0.40	13.00	16.20	—	—	—	±0.10
VSO56	SOT190-1	56	0.75	16.10	11.90	2.10	0.40	0.40	16.50	22.20	—	—	—	±0.10
VSO56	SOT190-2	56	0.75	16.10	11.90	2.10	0.40	0.40	16.50	22.20	—	—	—	±0.10

HTSSOP, SSOP, TSSOP & VSO FOOTPRINT (WAVE SOLDERING)

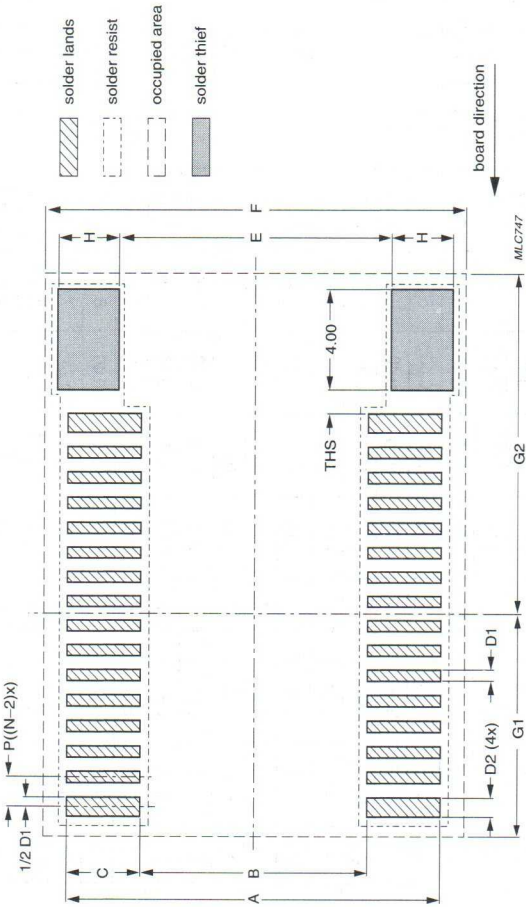


Fig.17 PC board footprint for mounting HTSSOP, SSOP, TSSOP & VSO packages (wave soldering).

SMD mounting methods

Chapter 5

Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)										THS	PLACEMENT ACCURACY
			P	A	B	C	D1	D2	E	F	G1	G2	H	
HTSSOP20	SOT527-1		Not suitable for wave soldering.											
HTSSOP32	SOT549-1		Not suitable for wave soldering.											
SSOP14	SOT337-1	14	0.65	9.15	5.35	1.90	0.30	0.30	6.15	10.65	4.25	6.75	2.00	0.40 ±0.10
SSOP16	SOT338-1	16	0.65	9.15	5.35	1.90	0.30	0.30	6.15	10.65	4.25	7.075	2.00	0.40 ±0.10
SSOP16	SOT369-1	16	0.65	8.30	4.50	1.90	0.30	0.30	5.30	9.80	3.55	7.075	2.00	0.40 ±0.15
SSOP16	SOT519-1		Not suitable for wave soldering.											
SSOP20	SOT266-1	20	0.65	8.30	4.50	1.90	0.30	0.30	5.30	9.80	4.20	7.725	2.00	0.40 ±0.15
SSOP20	SOT339-1	20	0.65	9.15	5.55	1.80	0.30	0.30	6.30	10.80	4.75	7.725	2.00	0.40 ±0.10
SSOP24	SOT340-1	24	0.65	9.15	5.55	1.80	0.30	0.30	6.30	10.80	5.25	8.375	2.00	0.40 ±0.10
SSOP24	SOT556-1		Not suitable for wave soldering.											
SSOP28	SOT341-1	28	0.65	9.15	5.55	1.80	0.30	0.30	6.30	10.80	6.25	9.025	2.00	0.40 ±0.10
SSOP48	SOT370-1		Not suitable for wave soldering.											
SSOP56	SOT371-1		Not suitable for wave soldering.											
TSSOP8	SOT505-1		Not suitable for wave soldering.											
TSSOP10	SOT552-1		Not suitable for wave soldering.											
TSSOP14	SOT402-1	14	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	3.20	6.75	2.075	0.40 ±0.15
TSSOP16	SOT403-1	16	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	3.20	7.075	2.075	0.40 ±0.15
TSSOP20	SOT360-1	20	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	3.95	7.725	2.075	0.40 ±0.15
TSSOP24	SOT355-1	24	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	4.60	8.375	2.075	0.40 ±0.15
TSSOP28	SOT361-1	28	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	5.55	9.025	2.075	0.40 ±0.15
TSSOP32	SOT487-1	32	0.65	10.40	6.35	2.025	0.30	0.50	6.35	13.75	7.50	9.875	3.20	0.30 ±0.15
TSSOP38	SOT510-1		Not suitable for wave soldering.											
TSSOP48	SOT362-1		Not suitable for wave soldering.											
TSSOP56	SOT364-1		Not suitable for wave soldering.											
VSO40	SOT158-1	40	0.762	12.80	8.20	2.30	0.35	0.35	9.20	14.30	9.50	12.10	2.30	0.40 ±0.10
VSO40	SOT158-2	40	0.762	12.80	8.20	2.30	0.35	0.35	9.20	14.30	9.50	12.10	2.30	0.40 ±0.10
VSO56	SOT190-1	56	0.75	16.20	11.80	2.20	0.35	0.35	12.80	17.70	12.70	15.00	2.20	0.40 ±0.10
VSO56	SOT190-1	56	0.75	16.20	11.80	2.20	0.35	0.35	12.80	17.70	12.70	15.00	2.20	0.40 ±0.10

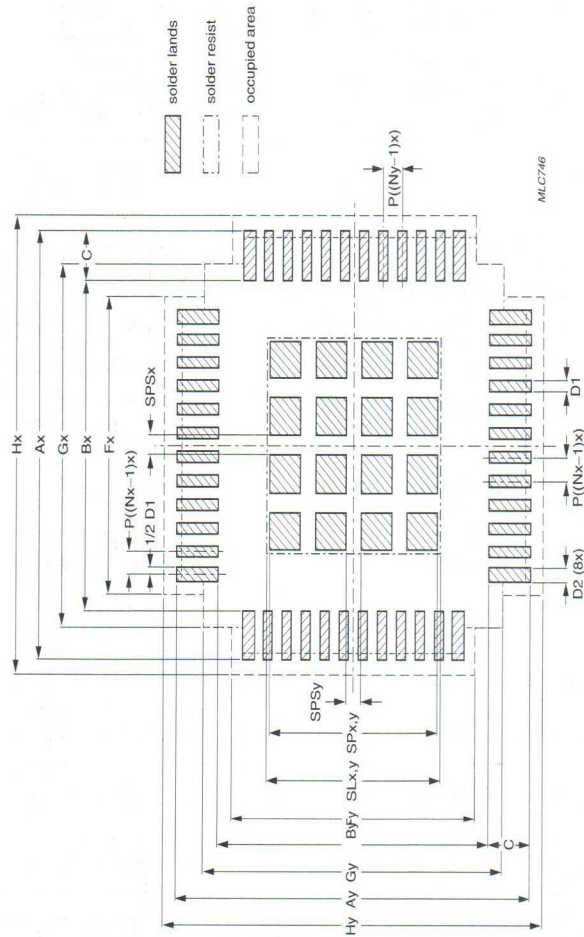


Fig.18 PC board footprint for mounting HTQFP, HLQFP packages (reflow soldering).

SMD mounting methods

Chapter 5

Reflow soldering (Table 1 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)														PLACEMENT ACCURACY	
				P	Ax	Ay	Bx	By	C	D1	D2	Fx	Fy	Gx	Gy	Hx	Hy		
HTQFP32 ⁽¹⁾	SOT547-1	8	8	0.50	7.40	7.40	5.50	5.50	0.95	0.25	0.30	4.45	4.45	5.90	5.90	8.00	8.00	±0.10	
HTQFP32 ⁽¹⁾	SOT547-2	8	8	0.50	7.40	7.40	5.30	5.30	1.05	0.28	0.40	4.65	4.65	5.90	5.90	8.00	8.00	±0.10	
HTQFP48 ⁽¹⁾	SOT545-2	12	12	0.50	9.50	9.50	7.30	7.30	1.10	0.25	0.30	7.20	7.20	7.20	7.20	10.75	10.75	±0.10	
HTQFP80 ⁽¹⁾	SOT513-1	20	20	0.65	16.35	16.35	14.15	14.15	1.10	0.40	0.40	13.11	13.11	14.25	14.25	16.60	16.60	±0.10	
HLQFP100 ⁽¹⁾	SOT470-1	25	25	0.50	16.50	16.50	14.20	14.20	1.15	0.30	0.40	12.75	12.75	14.90	14.90	16.75	16.75	±0.10	
LQFP32	SOT358-1	8	8	0.80	9.50	9.50	7.30	7.30	1.10	0.40	0.40	6.40	6.40	7.25	7.25	9.75	9.75	±0.15	
LQFP32	SOT401-1	8	8	0.50	7.40	7.40	5.20	5.20	1.10	0.30	0.40	4.25	4.25	5.90	5.90	7.65	7.65	±0.15	
LQFP44	SOT389-1	11	11	0.80	12.35	12.35	10.35	10.35	1.00	0.40	0.40	8.80	8.80	10.25	10.25	12.60	12.60	±0.15	
LQFP48	SOT313-2	12	12	0.50	9.50	9.50	7.30	7.30	1.10	0.285	0.285	7.20	7.20	7.20	7.20	10.75	10.75	±0.10	
LQFP64	SOT314-2	16	16	0.50	12.50	12.50	10.30	10.30	1.10	0.285	0.285	9.035	9.035	10.20	10.20	13.75	13.75	±0.10	
LQFP64	SOT414-1	16	16	0.40	9.40	9.40	7.20	7.20	1.10	0.23	0.30	6.62	6.62	6.90	6.90	9.65	9.65	±0.10	
LQFP80	SOT315-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	0.285	11.04	11.035	12.20	12.20	15.75	15.75	±0.10	
LQFP100	SOT407-1	25	25	0.50	16.50	16.50	14.20	14.20	1.15	0.300	0.40	12.75	12.75	14.90	14.90	16.75	16.75	±0.10	
LQFP128	SOT420-1	32	32	0.40	16.40	16.40	14.20	14.20	1.10	0.23	0.30	13.02	13.02	14.90	14.90	16.65	16.65	±0.10	
LQFP128	SOT425-1	38	26	0.50	22.50	16.50	20.30	14.30	1.10	0.285	0.285	20.04	14.035	20.20	14.20	23.75	17.75	±0.10	
LQFP144	SOT486-1	36	36	0.50	22.35	22.35	20.15	20.15	1.10	0.285	0.285	18.11	18.11	20.20	20.20	22.60	22.60	±0.10	
LQFP160	SOT435-1	40	40	0.50	26.35	26.35	24.15	24.15	1.10	0.285	0.285	20.11	20.11	24.20	24.20	26.60	26.60	±0.10	
LQFP176	SOT506-1	44	44	0.50	26.35	26.35	24.15	24.15	1.10	0.285	0.285	20.11	20.11	24.20	24.20	26.60	26.60	±0.10	

Note

1. These packages have a heatsink soldered to the board. The dimensions of these solder lands are given in the following table.

PACKAGE NAME	PHILIPS OUTLINE CODE	SOLDER LAND DIMENSIONS (mm)					
		SLx	SLy	SPx	SPy	SPSx	SPSy
HTQFP32	SOT547-1	3.60	3.60	3.50	3.50	0.55	0.55
HTQFP32	SOT547-2	3.20	3.20	3.10	3.10	0.50	0.50
HTQFP48	SOT545-2	4.70	4.70	4.60	4.60	0.40	0.40
HTQFP80	SOT513-1	5.30	6.00	5.20	5.90	0.20	0.25

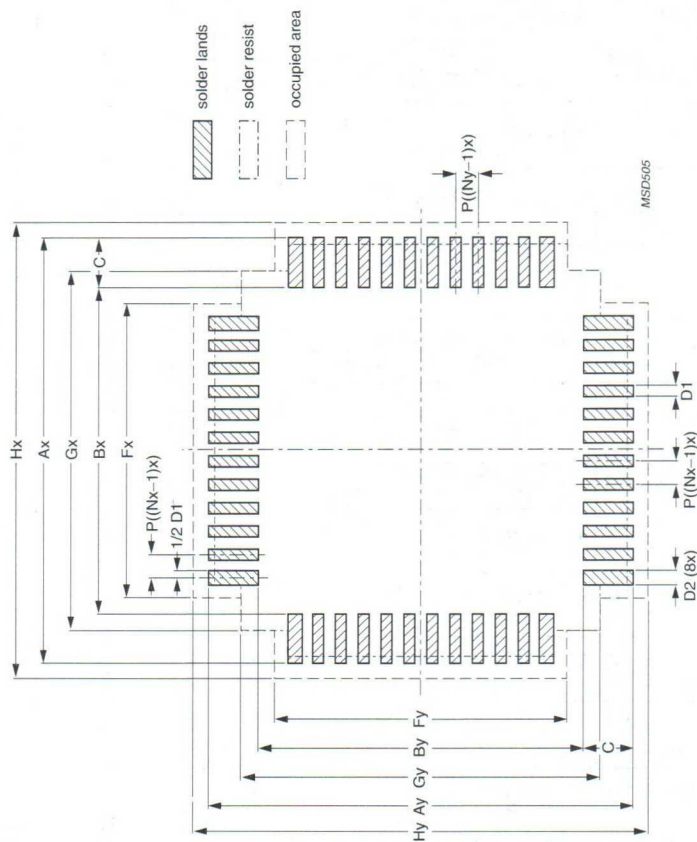


Fig. 19 PC board footprint for mounting LQFP, MSQFP, QFP, SQFP & TQFP packages (reflow soldering).

SMD mounting methods

Chapter 5

Reflow soldering (Table 2 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)												PLACEMENT ACCURACY	
				P	Ax	Ay	Bx	By	C	D1	D2	Fx	Fy	Gx	Gy	Hx	Hy
LQFP208	SOT459-1	52	52	0.50	30.35	30.35	28.15	28.15	1.10	0.285	0.285	26.11	26.11	28.20	28.20	30.60	30.60
MSQFP240	SOT474-2	60	60	0.50	35.00	35.00	32.80	32.80	1.10	0.285	0.285	30.13	30.13	31.95	31.95	35.25	35.25
QFP44	SOT205-1	11	11	1.00	19.40	19.40	14.80	14.80	2.30	0.60	0.60	11.00	11.00	14.40	14.40	19.65	19.65
QFP44	SOT307-2	11	11	0.80	13.50	13.50	10.50	10.50	1.50	0.40	0.40	8.75	8.75	10.25	10.25	13.35	13.35
QFP52	SOT379-1	13	13	0.65	13.65	13.65	10.85	10.85	1.40	0.40	0.40	8.45	8.45	10.25	10.25	13.90	13.90
QFP64	SOT319-1	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	0.60	19.00	13.00	20.40	14.40	24.65	18.65
QFP64	SOT319-2	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	0.60	19.00	13.00	20.40	14.40	24.65	18.65
QFP64	SOT319-5	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	0.60	19.00	13.00	20.40	14.40	24.65	18.65
QFP64	SOT393-1	16	16	0.80	17.65	17.65	14.85	14.85	1.40	0.40	0.40	12.80	12.80	14.25	14.25	17.90	17.90
QFP64	SOT393-2	16	16	0.80	17.65	17.65	14.85	14.85	1.40	0.40	0.40	12.80	12.80	14.25	14.25	17.90	17.90
QFP80	SOT310-1	24	16	0.80	23.80	17.80	21.00	15.00	1.40	0.40	0.40	19.20	12.80	20.25	14.25	24.05	18.05
QFP80	SOT318-1	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65
QFP80	SOT318-2	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65
QFP80	SOT496-1	20	20	0.65	17.65	17.65	14.85	14.85	1.40	0.40	0.40	13.11	13.11	14.25	14.25	17.90	17.90
QFP100	SOT317-1	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65
QFP100	SOT317-2	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65
QFP100	SOT317-3	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65
QFP100	SOT382-1	30	20	0.65	23.65	17.65	20.85	14.85	1.40	0.40	0.40	19.50	13.00	20.25	14.25	23.90	17.90
QFP100	SOT382-2	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65
QFP120	SOT349-2	30	30	0.80	33.90	33.90	28.00	28.00	1.50	0.50	0.60	24.50	24.50	28.50	28.50	32.50	32.50
QFP128	SOT320-2	32	32	0.80	31.70	31.70	28.60	28.60	1.55	0.50	0.60	26.10	26.10	28.60	28.60	32.40	32.40
QFP160	SOT322-2	40	40	0.65	31.65	31.65	28.85	28.85	1.40	0.40	0.40	26.05	26.05	28.20	28.20	31.90	31.90
SQFP128	SOT387-3	36	28	0.50	23.70	17.70	20.90	14.90	1.40	0.285	0.285	20.20	14.20	20.20	20.20	24.95	18.95
SQFP208	SOT316-1	52	52	0.50	31.10	31.10	28.70	28.70	1.20	0.285	0.285	27.03	27.03	28.20	28.20	32.35	32.35
TQFP44	SOT376-1	11	11	0.80	12.40	12.40	10.40	10.40	1.00	0.40	0.40	8.70	8.70	10.30	10.30	12.65	12.65
TQFP64	SOT357-1	16	16	0.50	12.40	12.40	10.40	10.40	1.00	0.285	0.285	9.035	9.035	10.25	10.25	13.65	13.65
TQFP80	SOT375-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	0.285	11.035	11.035	12.20	12.20	15.75	15.75
TQFP100	SOT386-1	25	25	0.50	16.50	16.50	14.30	14.30	1.10	0.285	0.285	13.535	13.535	14.20	14.20	17.75	17.75

SMD mounting methods

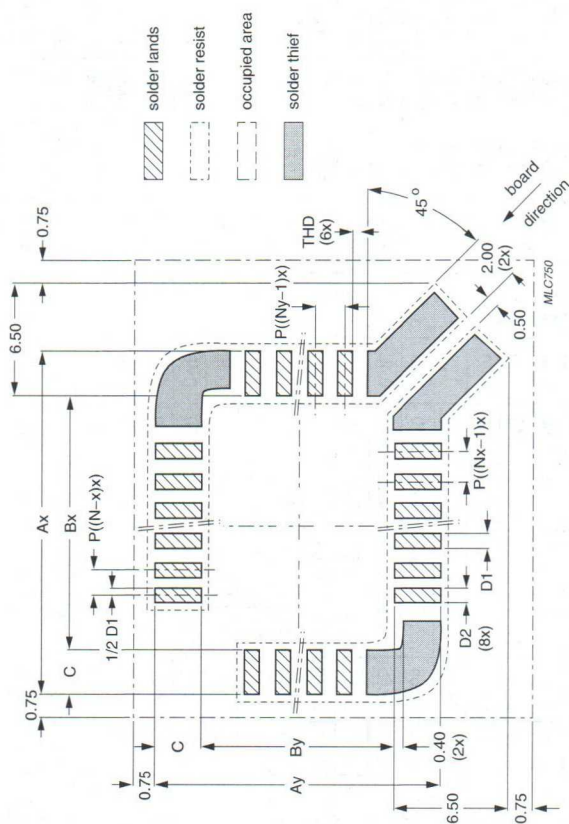


Fig.20 PC board footprint for mounting HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP packages (wave soldering).

SMD mounting methods

Chapter 5

Wave soldering (Table 1 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)							D2	THS	PLACEMENT ACCURACY	
				P	Ax	Ay	Bx	By	C	D1				
HTQFP32	SOT547-1													
HTQFP32	SOT547-2													
HTQFP48	SOT545-2													
HTQFP80	SOT513-1													
HLQFP100	SOT470-1													
LQFP32	SOT358-1	8	8	0.80	10.95	10.95	7.15	7.15	1.90	0.40	0.40	0.40	0.20	±0.15
LQFP32	SOT401-1													
LQFP44	SOT389-1	11	11	0.80	13.90	13.90	10.10	10.10	1.90	0.40	0.40	0.40	0.20	±0.15
LQFP48	SOT313-2													
LQFP64	SOT314-2													
LQFP64	SOT414-1													
LQFP80	SOT315-1													
LQFP100	SOT407-1													
LQFP128	SOT420-1													
LQFP128	SOT425-1													
LQFP144	SOT486-1													
LQFP160	SOT435-1													
LQFP176	SOT506-1													
LQFP208	SOT459-1													
MSQFP240	SOT474-2													

HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP FOOTPRINT (WAVE SOLDERING)

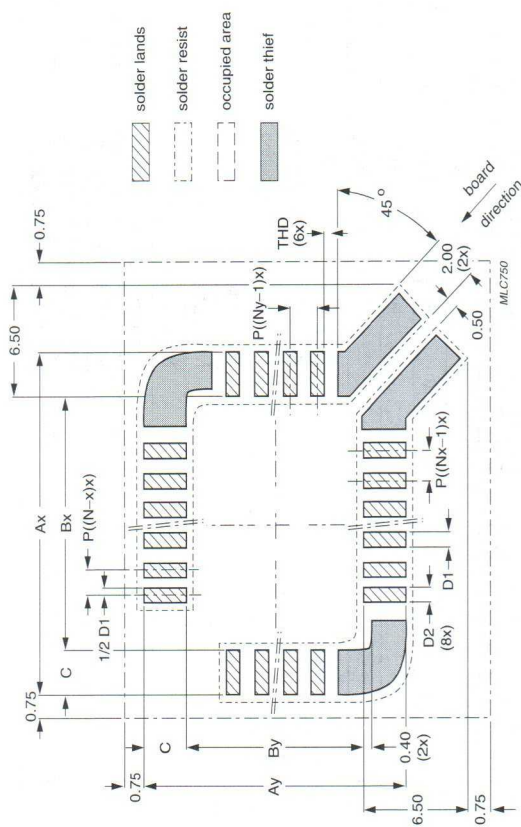


Fig.21 PC board footprint for mounting HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP packages (wave soldering).

SMD mounting methods

Chapter 5

Wave soldering (Table 2 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)						D1	D2	THS	W	PLACEMENT ACCURACY
				P	Ax	Ay	Bx	By	C					
QFP44	SOT205-1	11	11	1.00	19.80	19.80	14.40	14.40	2.70	0.50	0.50	0.40	2.00	±0.25
QFP44	SOT307-2	11	11	0.80	13.90	13.90	10.30	10.30	1.80	0.40	0.40	0.40	2.00	±0.15
QFP52	SOT379-1			Not suitable ^{1,2} for wave soldering.										
QFP64	SOT319-1	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	0.50	0.40	2.00	±0.25
QFP64	SOT319-2	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	0.50	0.40	2.00	±0.25
QFP64	SOT319-5	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	0.50	0.40	2.00	±0.25
QFP64	SOT393-1	16	16	0.80	17.95	17.95	14.75	14.75	1.60	0.40	0.40	0.40	2.00	±0.15
QFP64	SOT393-2	16	16	0.80	17.95	17.95	14.75	14.75	1.60	0.40	0.40	0.40	2.00	±0.15
QFP80	SOT310-1	16	24	0.80	18.10	24.10	14.70	20.70	1.70	0.40	0.40	0.40	2.00	±0.15
QFP80	SOT318-1	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	0.40	0.40	2.00	±0.15
QFP80	SOT318-2	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	0.40	0.40	2.00	±0.15
QFP80	SOT496-1	20	20	0.65	18.65	18.65	14.50	14.50	1.875	0.30	0.50	0.30	2.30	±0.15
QFP100	SOT317-1			Not suitable for wave soldering.										
QFP100	SOT317-2			Not suitable for wave soldering.										
QFP100	SOT317-3			Not suitable for wave soldering.										
QFP100	SOT382-1			Not suitable for wave soldering.										
QFP100	SOT382-2			Not suitable for wave soldering.										
QFP120	SOT349-2	30	30	0.80	32.65	32.65	28.90	28.90	1.875	0.40	0.60	0.30	2.30	±0.15
QFP128	SOT320-2	32	32	0.80	32.70	32.70	29.30	29.30	1.70	0.40	0.40	0.40	2.00	±0.15
QFP160	SOT322-2	40	40	0.65	32.65	32.65	28.90	28.90	1.875	0.30	0.50	0.30	2.30	±0.15
SQFP128	SOT387-3			Not suitable for wave soldering.										
SQFP208	SOT316-1			Not suitable for wave soldering.										
TQFP44	SOT376-1	11	11	0.80	13.95	13.95	10.15	10.15	1.90	0.40	0.40	0.40	2.00	±0.15
TQFP64	SOT357-1			Not suitable for wave soldering.										
TQFP80	SOT375-1			Not suitable for wave soldering.										
TQFP100	SOT386-1			Not suitable for wave soldering.										

PLCC FOOTPRINT (REFLOW SOLDERING)

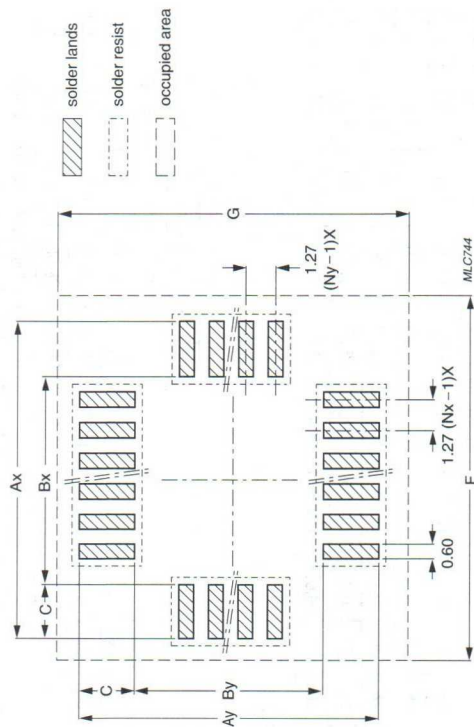


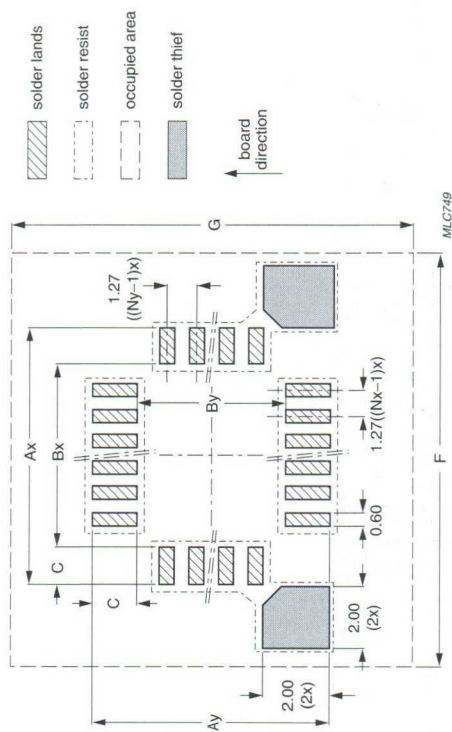
Fig.22 PC board footprint for mounting PLCC packages (reflow soldering).

SMD mounting methods

Chapter 5

Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)							PLACEMENT ACCURACY
				Ax	Ay	Bx	By	C	F	G	
PLCC20	SOT380-1	5	5	10.30	10.30	6.60	6.60	1.85	10.70	10.70	±0.25
PLCC28	SOT261-2	7	7	12.80	12.80	9.10	9.10	1.85	13.20	13.20	±0.25
PLCC28	SOT261-3	7	7	12.80	12.80	9.10	9.10	1.85	13.20	13.20	±0.25
PLCC44	SOT187-2	11	11	17.90	17.90	14.20	14.20	1.85	18.30	18.30	±0.25
PLCC52	SOT238-2	13	13	20.40	20.40	16.70	16.70	1.85	20.80	20.80	±0.25
PLCC52	SOT238-3	13	13	20.40	20.40	16.70	16.70	1.85	20.80	20.80	±0.25
PLCC68	SOT188-2	17	17	25.50	25.50	21.80	21.80	1.85	25.90	25.90	±0.25
PLCC68	SOT188-3	17	17	25.50	25.50	21.80	21.80	1.85	25.90	25.90	±0.25
PLCC84	SOT189-2	21	21	30.60	30.60	26.90	26.90	1.85	31.00	31.00	±0.25
PLCC84	SOT189-3	21	21	30.60	30.60	26.90	26.90	1.85	31.00	31.00	±0.25



SMD mounting methods

Chapter 5

Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)								PLACEMENT ACCURACY
				Ax	Ay	Bx	By	C	F	G		
PLCC20	SOT380-1	5	5	9.70	9.70	6.60	6.60	1.55	15.35	15.35	±0.25	
PLCC28	SOT261-2	7	7	12.20	12.20	9.10	9.10	1.55	17.85	17.85	±0.25	
PLCC28	SOT261-3	7	7	12.20	12.20	9.10	9.10	1.55	17.85	17.85	±0.25	
PLCC44	SOT187-2	11	11	17.30	17.30	14.20	14.20	1.55	22.95	22.95	±0.25	
PLCC52	SOT238-2	13	13	19.80	19.80	16.70	16.70	1.55	25.50	25.50	±0.25	
PLCC52	SOT238-3	13	13	19.80	19.80	16.70	16.70	1.55	25.50	25.50	±0.25	
PLCC68	SOT188-2	17	17	24.30	24.30	21.80	21.80	1.55	30.55	30.55	±0.25	
PLCC68	SOT188-3	17	17	24.30	24.30	21.80	21.80	1.55	30.55	30.55	±0.25	
PLCC84	SOT189-2	21	21	30.00	30.00	26.90	26.90	1.55	35.65	35.65	±0.25	
PLCC84	SOT189-3	21	21	30.00	30.00	26.90	26.90	1.55	35.65	35.65	±0.25	

CHAPTER 6

THERMAL DESIGN CONSIDERATIONS

	page
Introduction	6 - 2
Thermal resistance	6 - 2
Junction temperature	6 - 2
Factors affecting $R_{th(j-a)}$	6 - 2
Thermal resistance test methods	6 - 3
Test procedure	6 - 3
Forced air factors for thermal resistance	6 - 4
Thermal resistance data - assumptions and precautions	6 - 5
Thermal resistance ($R_{th(j-a)}$) data	6 - 6
Thermal resistance ($R_{th(j-c)}$) data tables - power packages	6 - 24

Thermal design considerations

Chapter 6

INTRODUCTION

The ability to describe the thermal performance characteristics of a semiconductor IC package is becoming increasingly crucial. With increased power densities, improved reliability and shrinking system sizes, the cooling of IC packages has become a challenging task for design engineers. The situation is further exacerbated by the demand for ever decreasing sizes of electronic devices because, in general, decreasing the size of an electronic package decreases the thermal performance. The designer must carefully balance the benefits of miniaturization and performance against the potential reduction in reliability of electronic components resulting from high operating temperatures.

THERMAL RESISTANCE

The ability of a particular semiconductor package to dissipate heat to its environment is expressed in terms of thermal resistance ($R_{th(j-a)}$). This single entity describes the heat path impedance from the active surface of the semiconductor device (junction) to the ambient operating environment. $R_{th(j-a)}$ can be expressed by its constituents as follows:

$$R_{th(j-a)} = R_{th(j-c)} + R_{th(c-a)}$$

$R_{th(j-c)}$ is the impedance from junction to case (outside surface of package) and $R_{th(c-a)}$ is the impedance from case to ambient. It is sometimes useful to use only the $R_{th(c-a)}$ to describe high performance packages where case temperatures are important and externally attached heat radiators may need to be attached. In these cases the overall $R_{th(j-a)}$ will also include the contribution of the heat radiator.

JUNCTION TEMPERATURE

With the $R_{th(j-a)}$ of a package known, the rise in junction temperature (T_j) with respect to the ambient temperature (T_{amb}) can be determined at a given power dissipation (P_d) of the semiconductor device:

$$T_j = (R_{th(j-a)} \times P_d) + T_{amb}$$

Where:

- T_j = junction temperature ($^{\circ}\text{C}$)
- $R_{th(j-a)}$ = thermal resistance junction to ambient (K/W)
- P_d = power dissipated (W)
- T_{amb} = ambient temperature ($^{\circ}\text{C}$)

It's important to note that a lower $R_{th(j-a)}$ indicates a higher thermal performance.

FACTORS AFFECTING $R_{th(j-a)}$

There are several factors which affect the characteristic thermal resistance of IC packages. Some of the more significant of these include the test board configuration, the lead frame material, the design of the lead frame and the moulding compound.

Test board configuration

An IC package's thermal resistance highly depends on the Printed Circuit Board (PCB) on which the package is mounted. The copper traces and thermal vias on the PCB provide the major heat dissipation path of the package, therefore the configuration and the size of the copper traces play a significant role in affecting $R_{th(j-a)}$. For test purpose, JEDEC standards (EIA/JEDEC51-3 and others) specify two categories of test boards: low effective thermal conductivity test board (low K board) and high effective thermal conductivity test board (high K board). The low K board is a single sided board with only fine signal traces, the high K board is a board with two signal layers and two power (or ground) layers. The real application board is almost always different from the standard test boards, however, the thermal resistance measured from the standard test board provides basic comparable information of the IC package thermal resistance.

Lead frame material

The lead frame material is one of the more important factors in IC package thermal resistance. In early dual in-line packages (DIPs), a Ni/Fe alloy (A42) was the material of choice for lead frames as it provided a good combination of strength and formability as well as assembly process compatibility. However, with the continued miniaturization of IC packages and the need for increased electrical conductivity for advanced ICs, a switch to sophisticated copper alloys was required. Copper alloy lead frames offer several advantages over A42:

- they have a high thermal conductivity which reduces thermal resistance, essential for packages such as the Shrink Small Outline Package (SSOP) and Thin Shrink Small Outline Package (TSSOP)
- their improved electrical conductivity enhances the electrical performance of a package

Most plastic encapsulated packages produced by Philips Semiconductors incorporate copper alloy lead frames into their design.

Thermal design considerations

Chapter 6

Lead frame design

The design of a lead frame is another significant contributing factor to thermal resistance. The most important design aspect is the IC attach-pad size and tie bar design. However, the lead frame designer is often faced with fixed parameters such as die size and wire bonding limitations, which reduce lead frame design flexibility.

Moulding compound

Moulding compounds also determine IC package thermal resistance. The mould compounds used by Philips Semiconductors are optimized for high purity and quality to provide good thermal performance and reliability.

Heat spreaders

The option of a heat spreader, or heat slug, within some packages can improve thermal behaviour by spreading the heat over a larger area of the package, and so improve $R_{th(j-a)}$ or $R_{th(j-c)}$.

Adhesive and plating type

Other package related factors include die attach adhesive and lead frame plating type, but the actual influence on thermal resistance is small owing to the fine geometry of these factors.

THERMAL RESISTANCE TEST METHODS

Philips Semiconductors uses what is commonly called the Temperature Sensitive Parameter (TSP) method which meets EIA/JEDEC Standards EIA/JESD51-1, EIA/JESD51-2 and EIA/JESD51-3. A typical test fixture in still air is shown in Fig.1. The enclosure is a box with an inside dimension of 1 ft³ (0.0283 m³). The enclosure and fixtures are constructed from an insulating material with a low thermal conductance, and all seams thoroughly sealed to ensure there is no airflow through the enclosure. The IC package is then positioned in the geometric center of the enclosure.

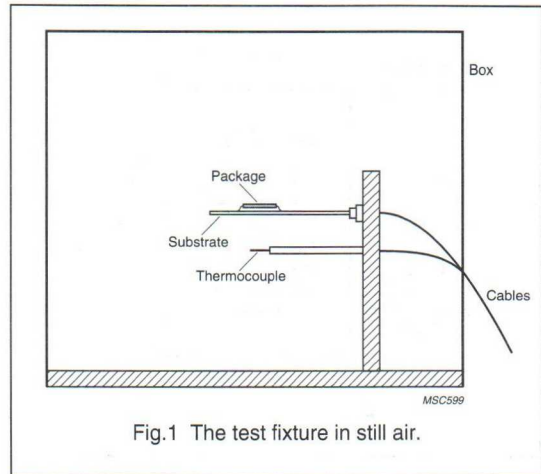


Fig.1 The test fixture in still air.

The forward voltage drop of a calibrated diode incorporated into a special IC is used to correlate a junction temperature change in the IC package to be tested. As the power dissipation is known, the thermal resistance can be calculated using the following equation:

$$R_{th(j-a)} = \frac{\Delta T_j}{P_d} = \frac{(T_j - T_{amb})}{P_d}$$

Where:

$R_{th(j-a)}$ = thermal resistance junction to ambient (K/W)

T_j = junction temperature (°C)

P_d = power dissipated (W)

T_{amb} = ambient temperature (°C)

TEST PROCEDURE

The TSP diode on the semiconductor device is calibrated using a constant temperature oil bath and a constant current power supply (see Fig.2). Calibration temperatures are typically 25 °C and 100 °C with a measured accuracy of ±0.1 °C. The calibration current must be kept low and constant to avoid significant junction heating. The temperature coefficient (K-factor) shown in Fig.3 is calculated using the following equation:

$$K = \frac{(T_2 - T_1)}{(V_{F2} - V_{F1})}$$

Where:

K = temperature coefficient (K/mV)

T_2 = high test temperature (°C)

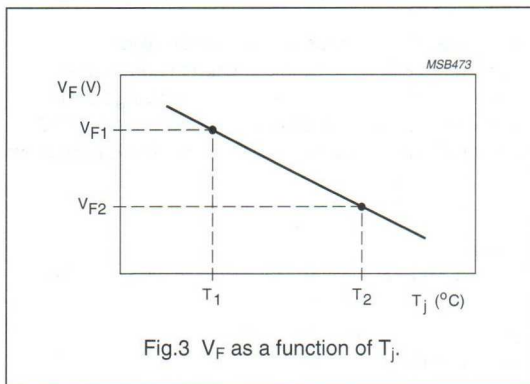
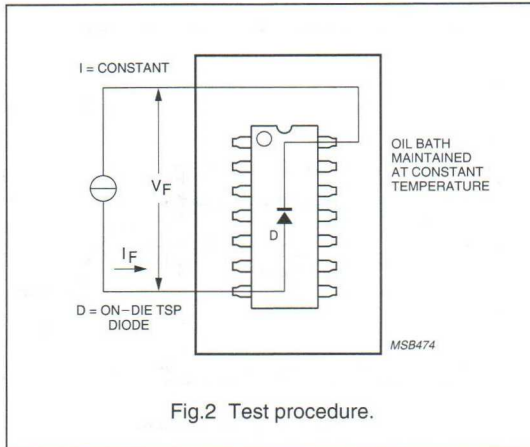
T_1 = low test temperature (°C)

V_{F2} = forward voltage at T_2 (mV)

V_{F1} = forward voltage at T_1 (mV)

Thermal design considerations

Chapter 6



With the K-factor determined, $R_{th(j-a)}$ can be calculated by powering up the device at ambient conditions and measuring the forward voltage drop across the TSP diode after temperature equilibrium. Manipulating the original thermal resistance equation with the K-factor, the $R_{th(j-a)}$ of the package can be determined:

$$R_{th(j-a)} = \frac{\Delta T_j}{P_d} = \frac{(T_j - T_{amb})}{P_d} = \frac{K(V_{F(amb)} - V_{F(s)})}{V_H \times I_H}$$

Where:

$V_{F(amb)}$ = forward voltage of TSP at ambient temperature (mV)

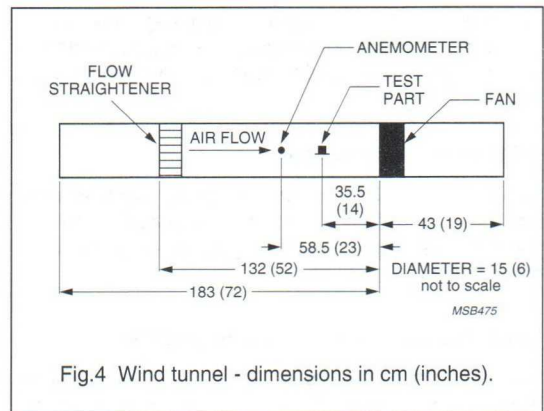
$V_{F(s)}$ = forward voltage of TSP at steady-state temperature (mV)

V_H = heating voltage (V)

I_H = heating current (A)

FORCED AIR FACTORS FOR THERMAL RESISTANCE

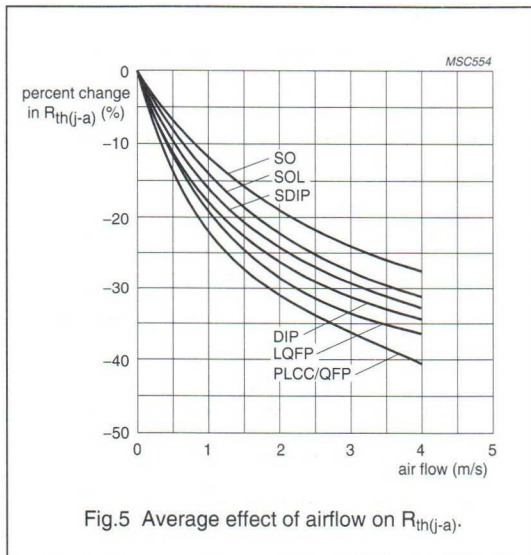
Many applications with ICs have the benefit of forced air cooling by fans or other means. The junction to moving-air thermal resistance can be measured by placing the test setup inside a low velocity wind tunnel (see Fig.4). The test board and device under test are supported with minimal obstruction to the air flow.



The average effect of airflow on thermal resistance for package types at a particular air flow rate can be determined using a "derating" curve (see Fig.5). When using derating curves, it's important to note that the variety of sizes in a package type group has been averaged. See the following section on "Thermal resistance data - assumptions and precautions" concerning airflow.

Thermal design considerations

Chapter 6



THERMAL RESISTANCE DATA - ASSUMPTIONS AND PRECAUTIONS

The graphical data presented in this section are based on **measurements, modelling and estimations**. As with all data, some assumptions and contributing factors should be noted:

1. The "measured" thermal resistance of an IC package is highly dependent on the configuration and size of the test board. Data may not be comparable between different semiconductor manufacturers because the test boards may not be the same. Also, the thermal performance of packages for a specific application may be different than presented here because the configuration of the application boards may be different than the test boards. Philips Semiconductors uses low conductive JEDEC test boards for most of the measurements. These low conductive boards are also assumed for modelling.
2. Device standoff is a factor in determining thermal resistance especially for surface mounted packages such as SO and QFP packages. The same package from two different manufacturers will often have different standoff from the test boards. In general, high standoff corresponds to a higher thermal resistance.
3. The operating environment temperature must be used as the ambient temperature when calculating junction temperatures in an application. The temperatures inside an electronic enclosure are generally higher than the room temperature.
4. When using airflow derating curves (see Fig.5), please note that in actual applications where airflow is available, the flow dynamics may be more complex and turbulent than in a wind tunnel. Also, the many different sizes of packages in a package family such as QFP have been averaged to give one curve for ease-of-use. Lastly, the test boards used in the wind tunnel contribute significantly to forced convection heat transfer and may not be similar to an actual application PC board, especially its size.
5. Thermal resistance will vary slightly as a function of input power. Generally, as the power input increases, thermal resistance decreases. Thermal resistance changes approximately 5% for a 100% power change.
6. Thermal resistance data for some packages were not available at the time of publication. Please contact Philips Semiconductors for information on packages not listed in this handbook.
7. All data presented are accurate to approximately $\pm 15\%$. For more specific information regarding an application, please contact Philips Semiconductors.
8. Philips Semiconductors is also able to provide compact models according to the DELPHI philosophy. In case you need these models or you would like to have more information, please contact the ATO-Innovation office in Nijmegen, the Netherlands tel. +31-24-3533085 or fax +31-24-3533350.

Thermal design considerations

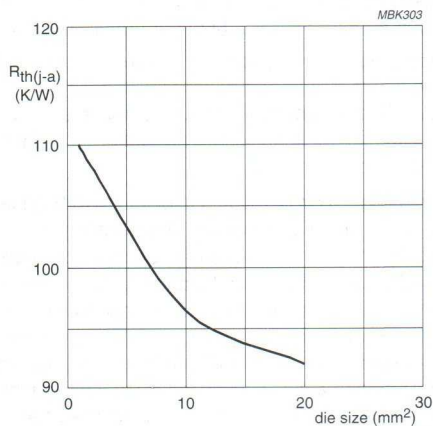
THERMAL RESISTANCE ($R_{th(j-a)}$) DATA

Fig.6 DIP8 (300 mil).

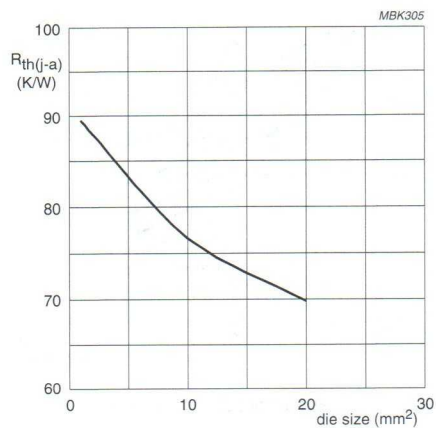


Fig.7 DIP14/16 (300 mil).

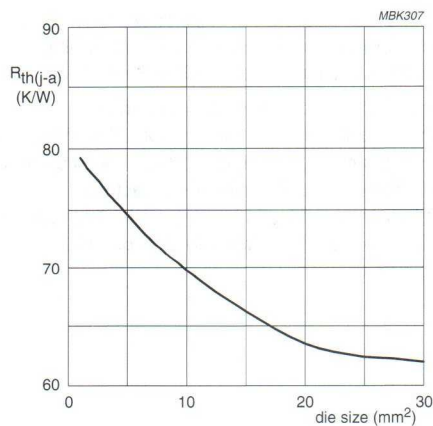


Fig.8 DIP18 (300 mil).

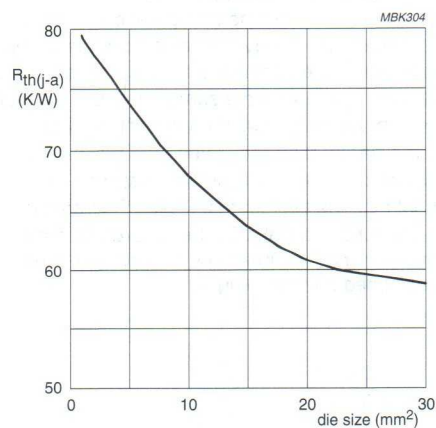
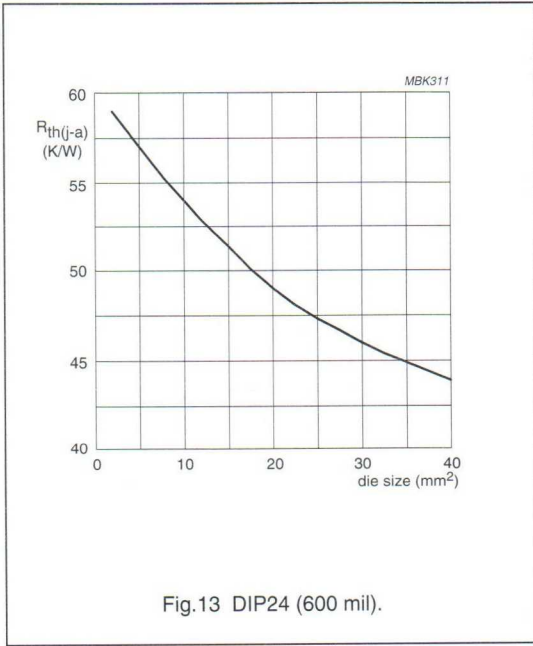
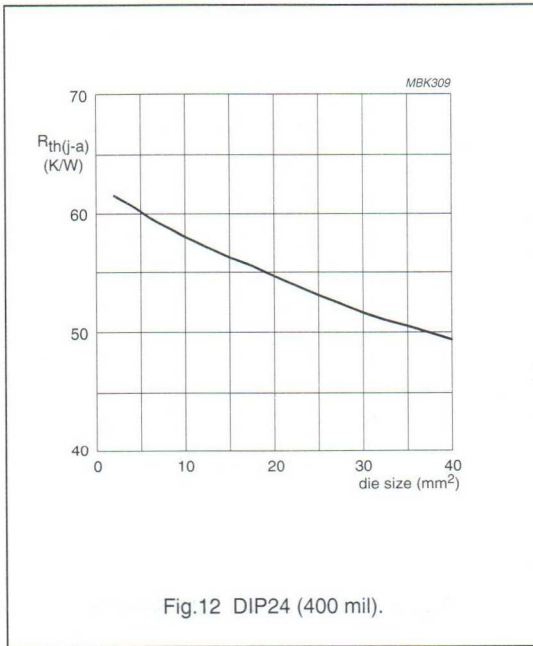
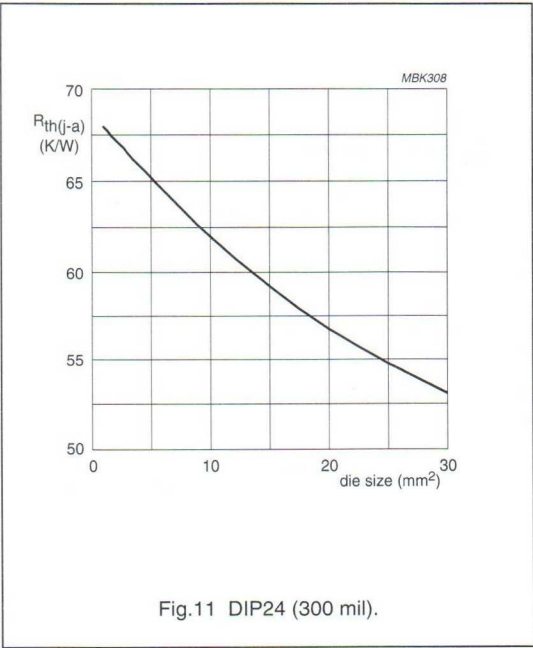
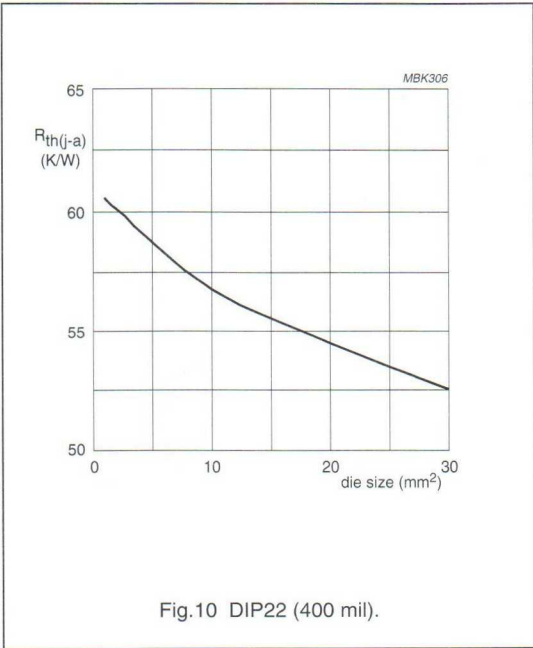


Fig.9 DIP20 (300 mil).



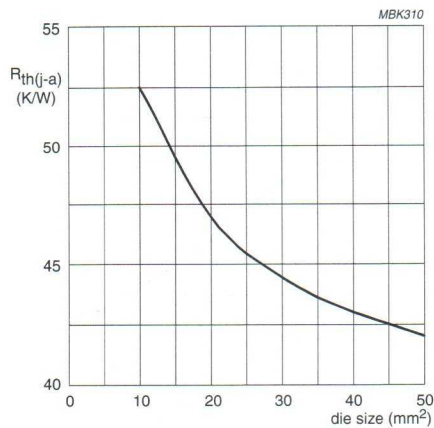


Fig.14 DIP28 (600 mil).

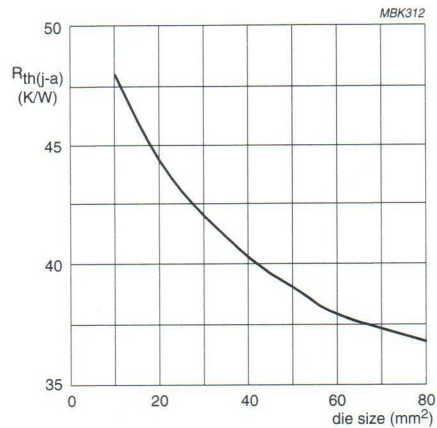


Fig.15 DIP40 (600 mil).

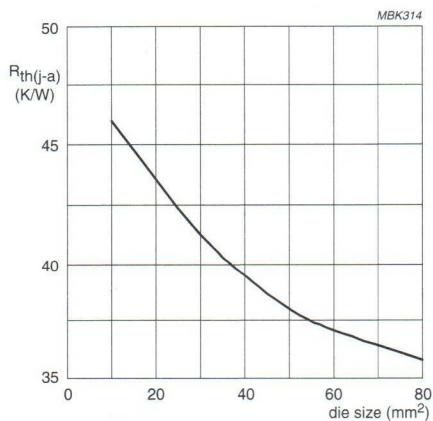


Fig.16 DIP48 (600 mil).

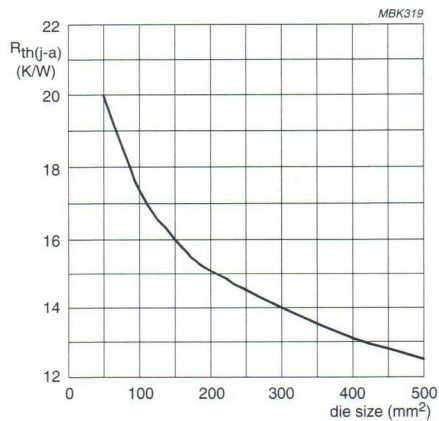


Fig.17 HSQFP240 (32 x 32 x 3.4 mm).

Thermal design considerations

Chapter 6

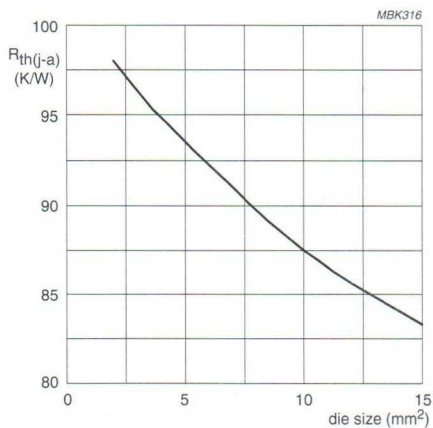


Fig.18 LQFP32 (5 × 5 × 1.4 mm)

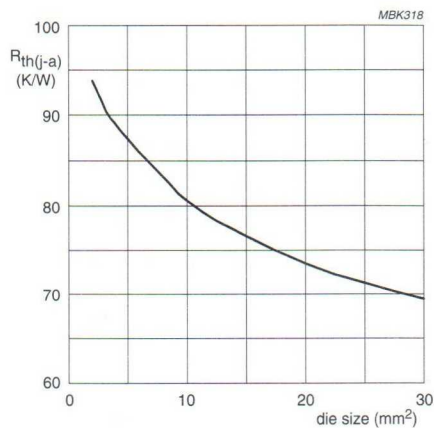


Fig.19 LQFP32 (7 × 7 × 1.4 mm).

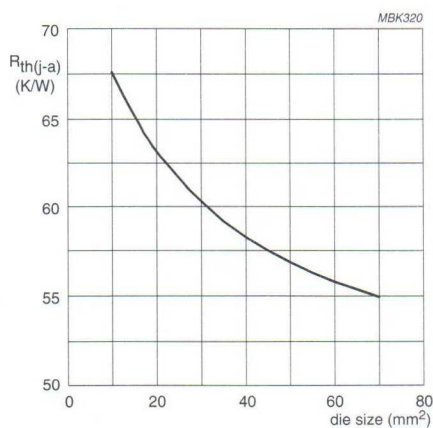


Fig.20 LQFP44 (10 × 10 × 1.4 mm)

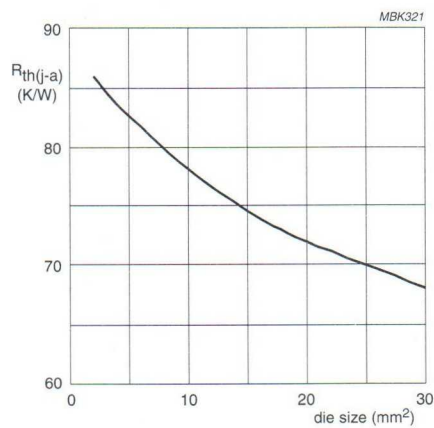


Fig.21 LQFP48 (7 × 7 × 1.4 mm).

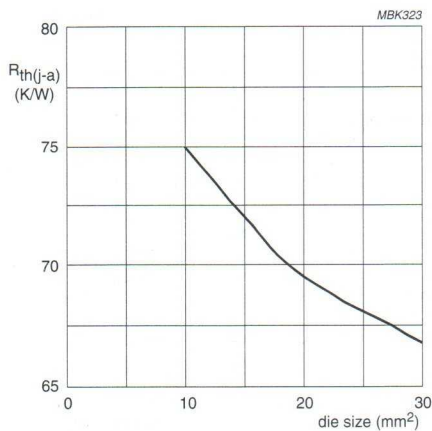


Fig.22 LQFP64 (7 × 7 × 1.4 mm).

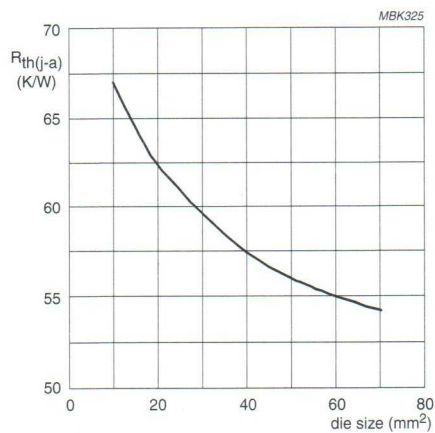


Fig.23 LQFP64 (10 × 10 × 1.4 mm).

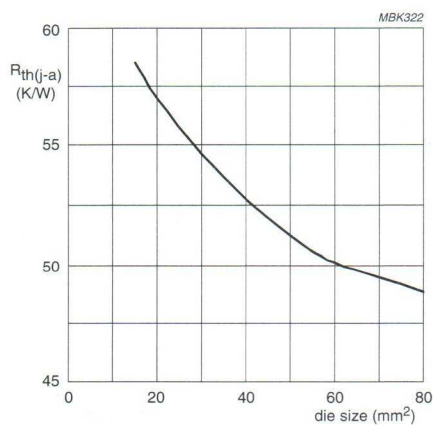


Fig.24 LQFP80 (12 × 12 × 1.4 mm).

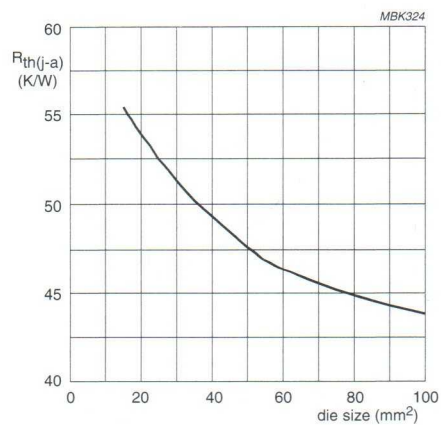


Fig.25 LQFP100 (14 × 14 × 1.4 mm).

Thermal design considerations

Chapter 6

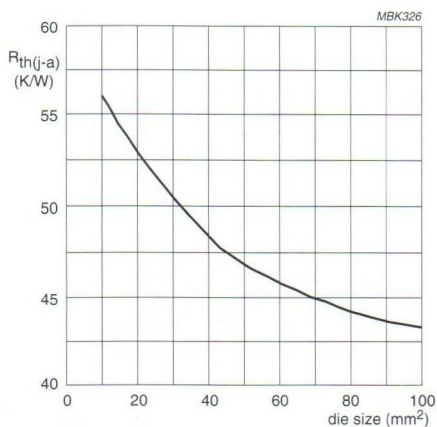


Fig.26 LQFP128 (14 × 14 × 1.4 mm).

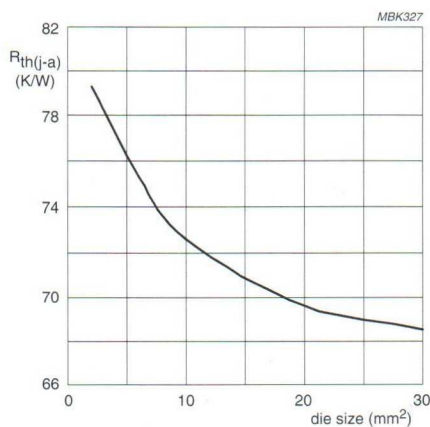


Fig.27 PLCC20 (310 mil).

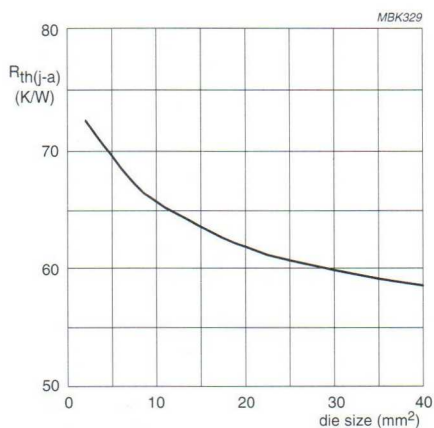


Fig.28 PLCC28 (410 mil).

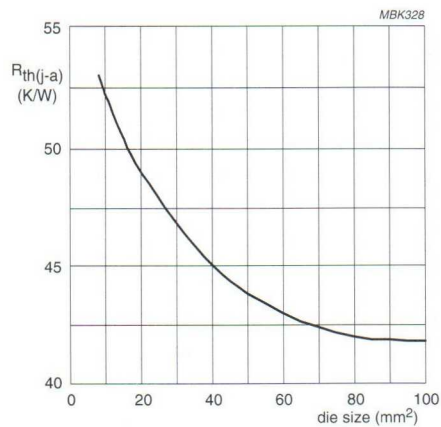


Fig.29 PLCC44 (610 mil).

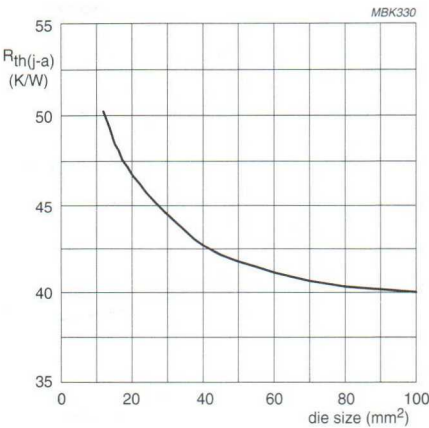


Fig.30 PLCC52 (710 mil).

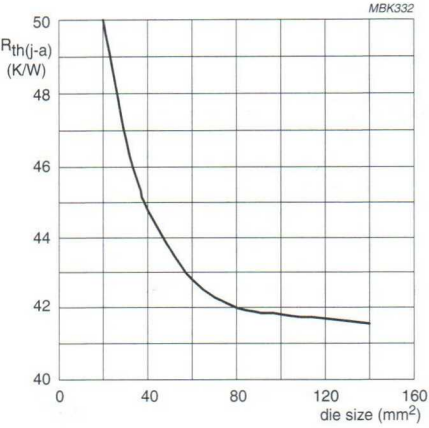


Fig.31 PLCC68 (910 mil).

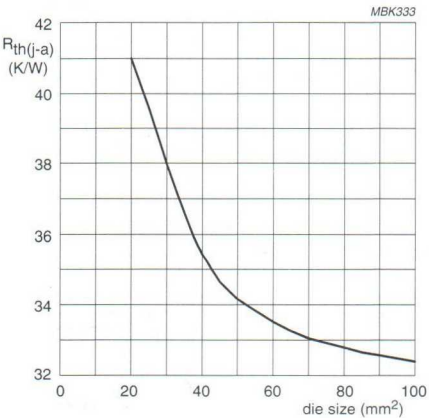


Fig.32 PLCC84 (1110 mil).

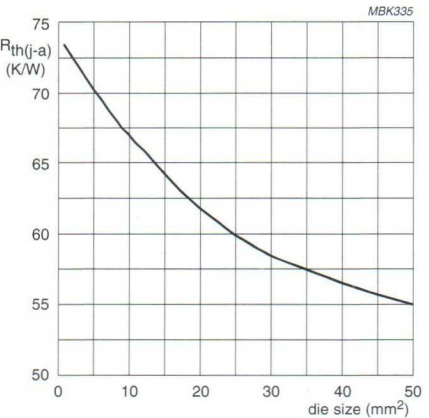
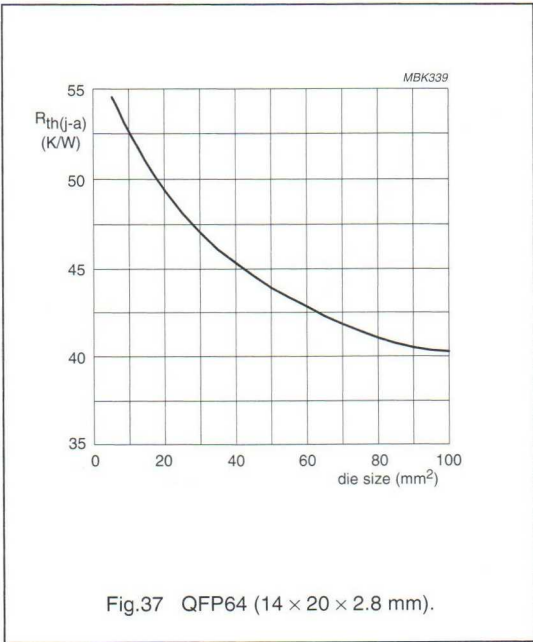
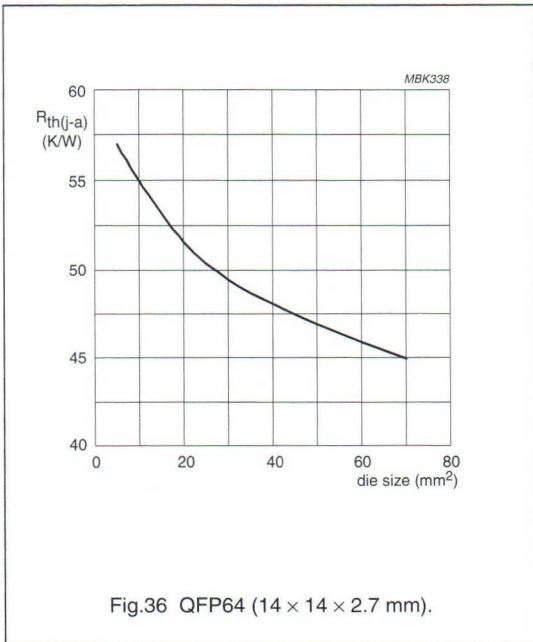
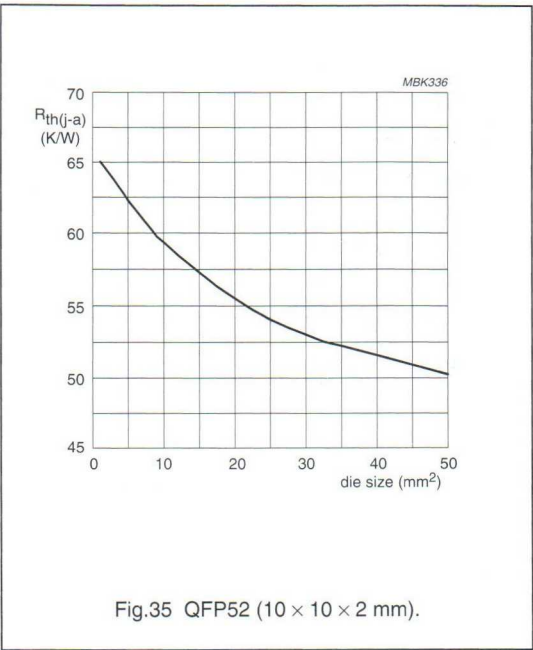
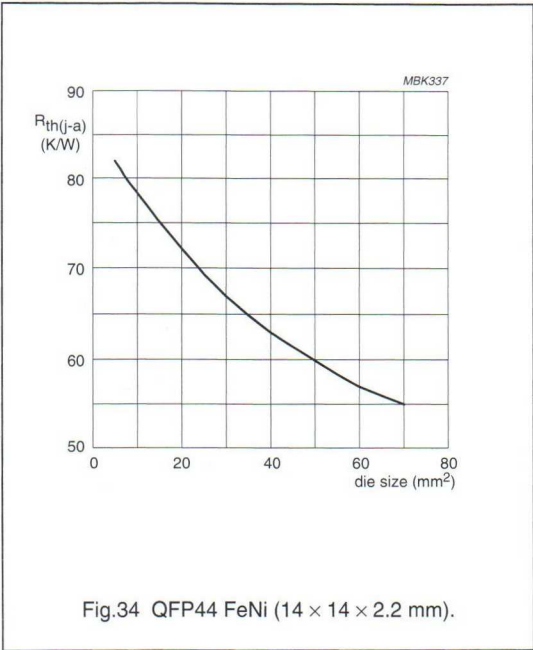


Fig.33 QFP44 (10 × 10 × 1.75 mm).

Thermal design considerations

Chapter 6



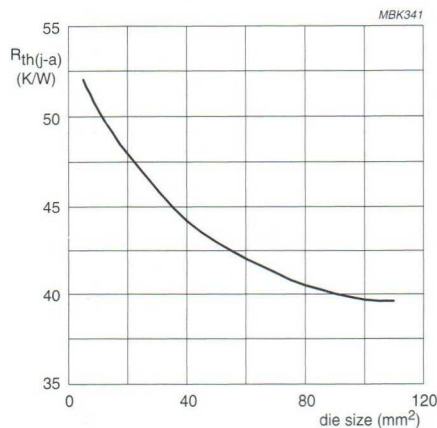


Fig.38 QFP80 (14 × 20 × 2.8 mm).

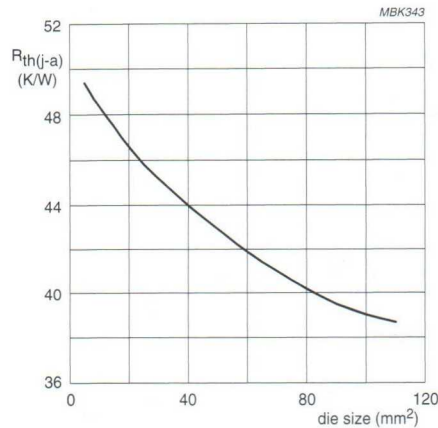


Fig.39 QFP100 (14 × 20 × 2.8 mm).

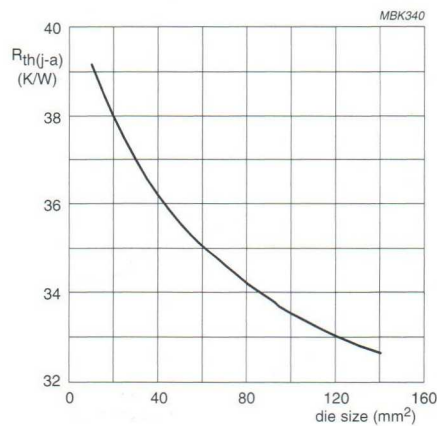


Fig.40 QFP120 (28 × 28 × 3.4 mm).

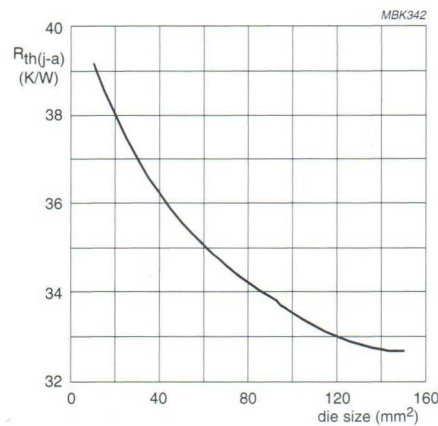


Fig.41 QFP128 (28 × 28 × 3.4 mm).

Thermal design considerations

Chapter 6

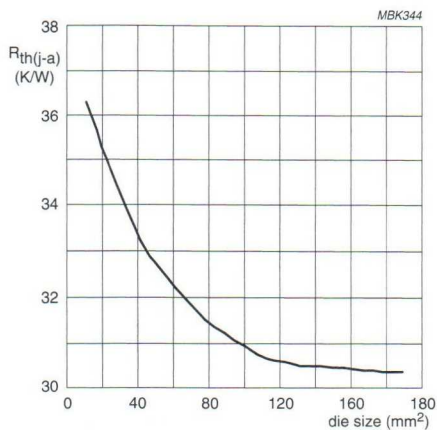


Fig.42 QFP160 (28 × 28 × 3.4 mm).

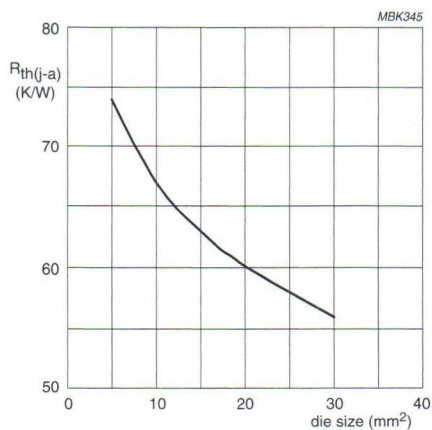


Fig.43 SDIP24 (400 mil).

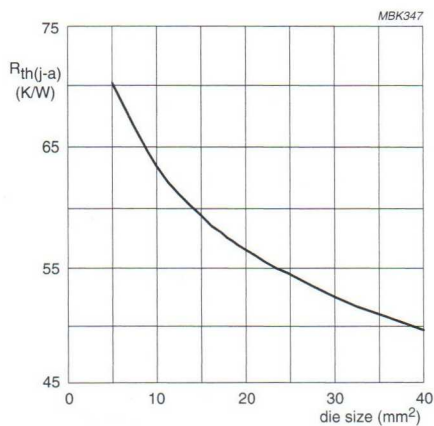


Fig.44 SDIP32 (400 mil).

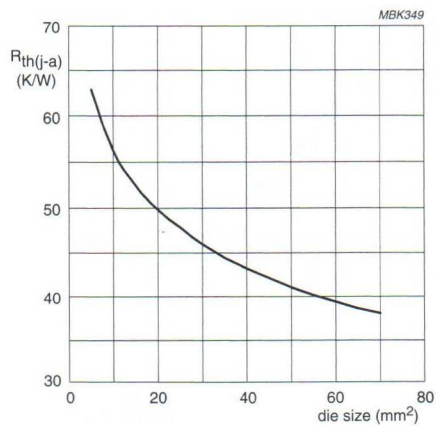
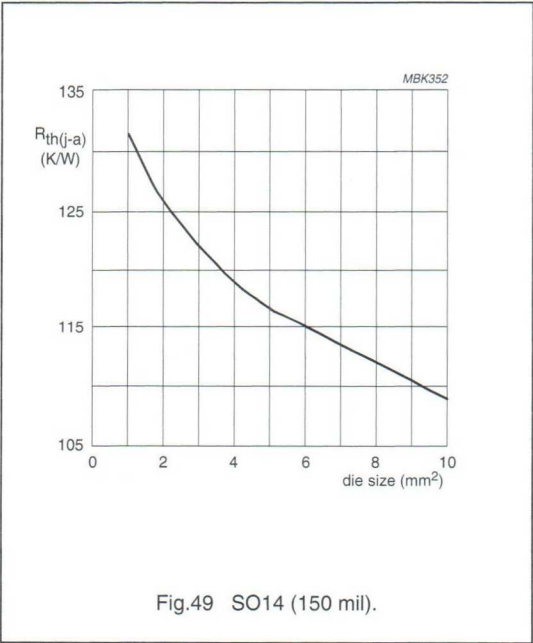
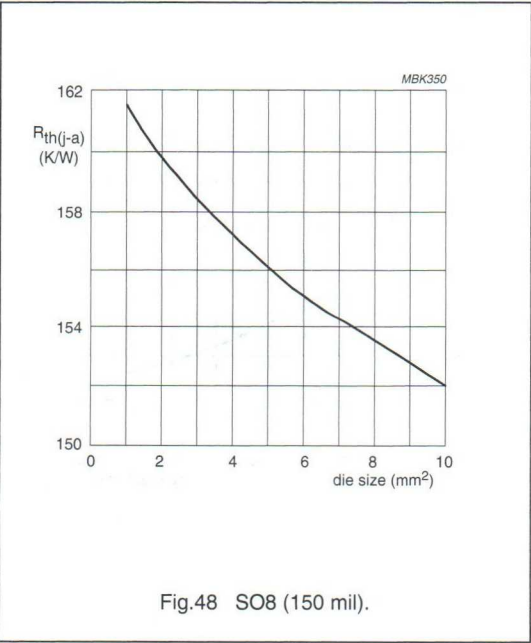
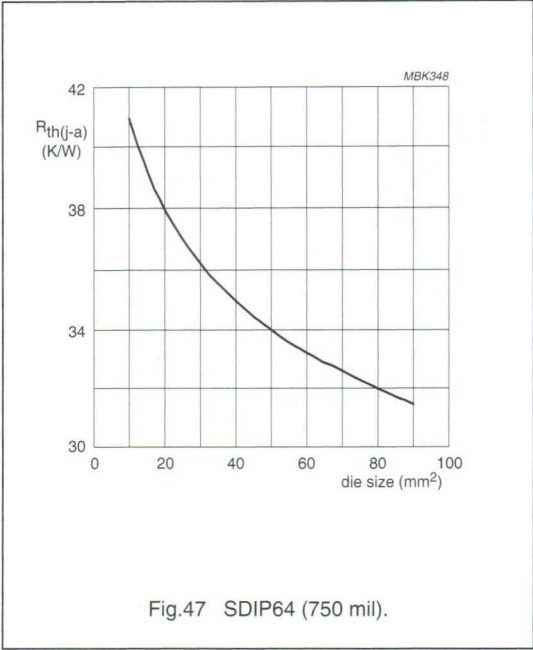
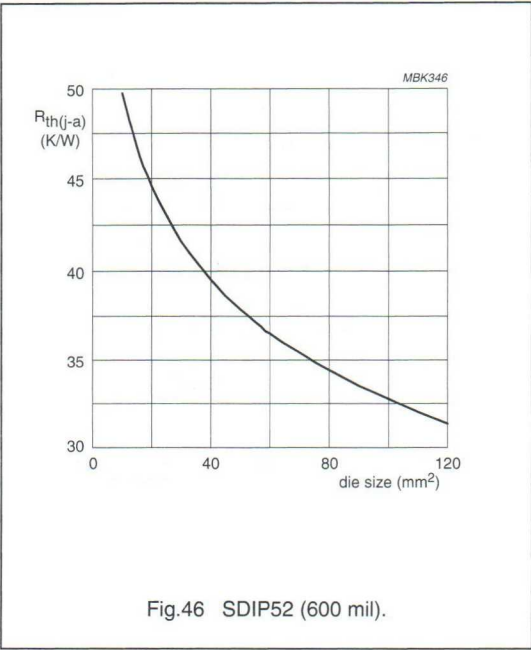


Fig.45 SDIP42 (600 mil).

Thermal design considerations

Chapter 6



Thermal design considerations

Chapter 6

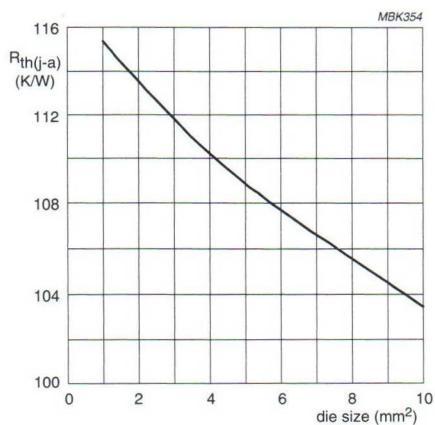


Fig.50 SO16 (150 mil).

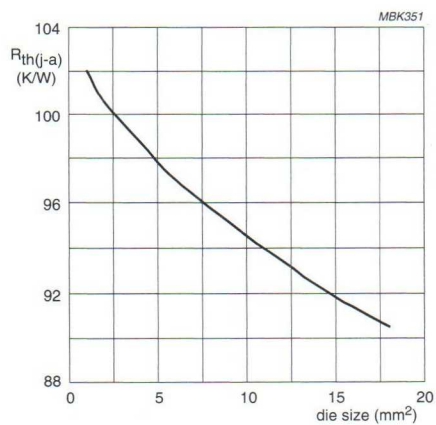


Fig.51 SO16 (300 mil).

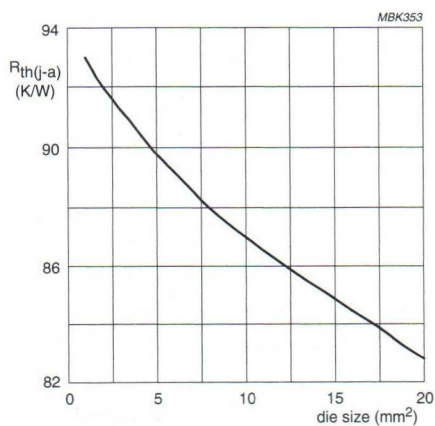


Fig.52 SO20 (300 mil).

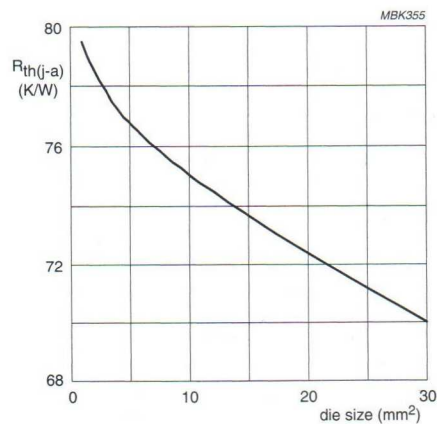


Fig.53 SO24 (300 mil).

Thermal design considerations

Chapter 6

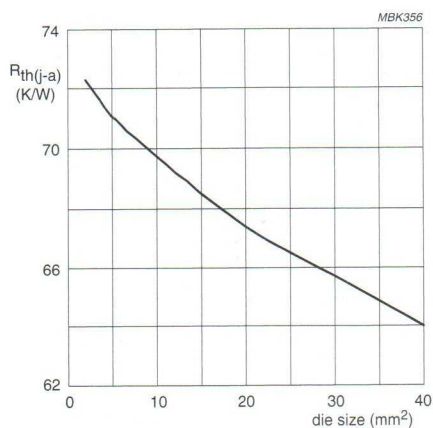


Fig.54 SO28 (300 mil).

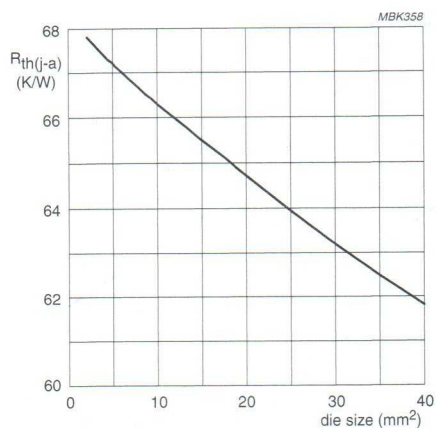


Fig.55 SO32 (300 mil).

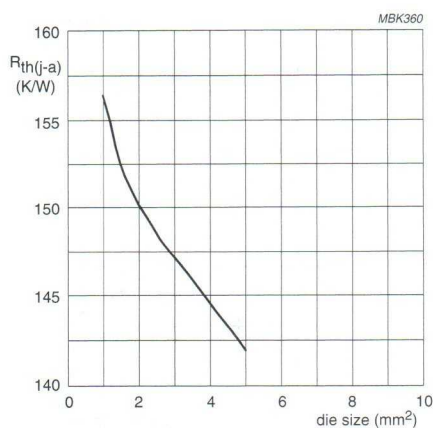


Fig.56 SSOP14 (5.3 mm).

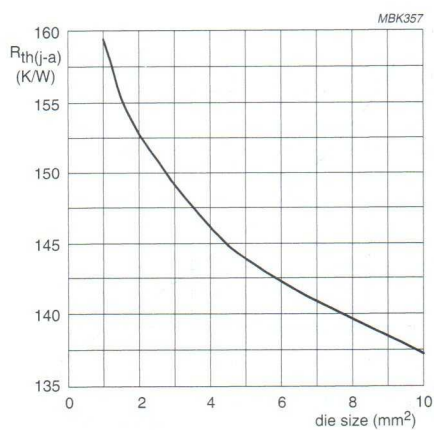


Fig.57 SSOP16 (4.4 mm).

Thermal design considerations

Chapter 6

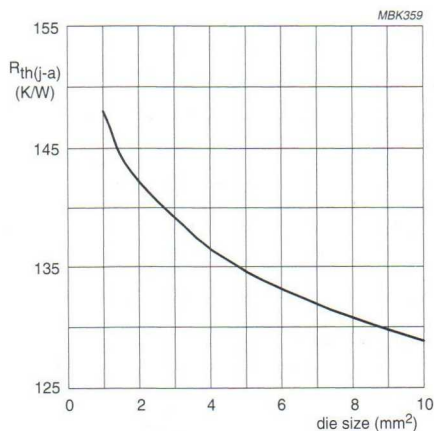


Fig.58 SSOP16 (5.3 mm).

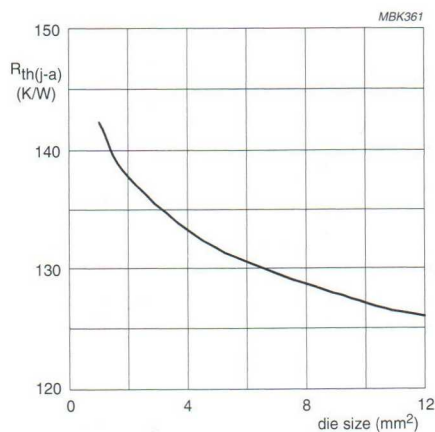


Fig.59 SSOP20 (4.4 mm).

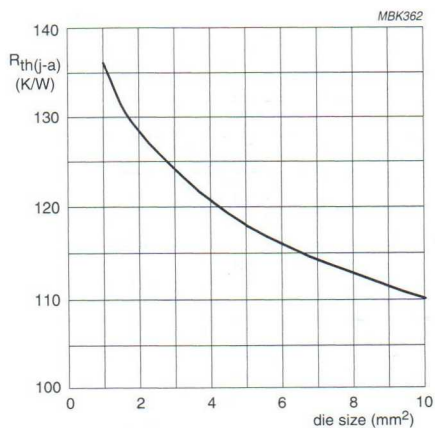


Fig.60 SSOP20 (5.3 mm).

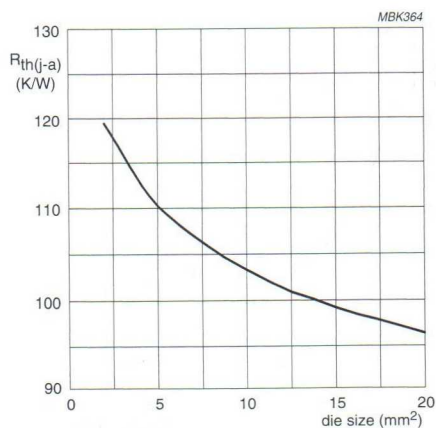


Fig.61 SSOP24 (5.3 mm).

Thermal design considerations

Chapter 6

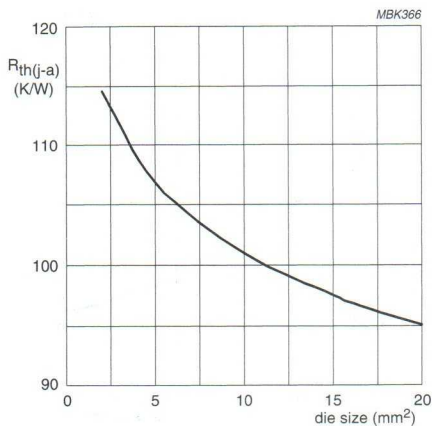


Fig.62 SSOP28 (5.3 mm).

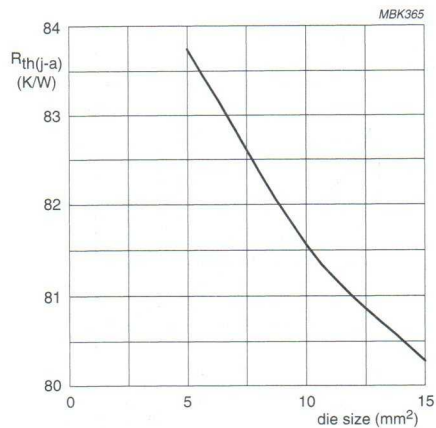


Fig.63 SSOP56 (7.5 mm).

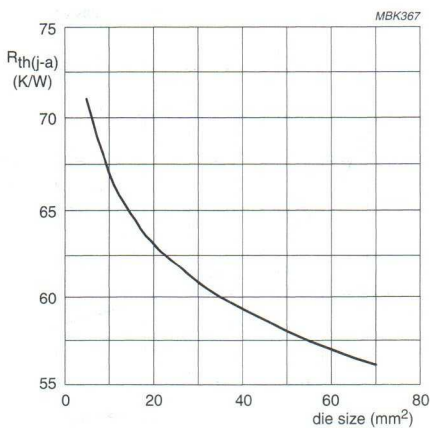


Fig.64 TQFP44 (10 × 10 × 1 mm).

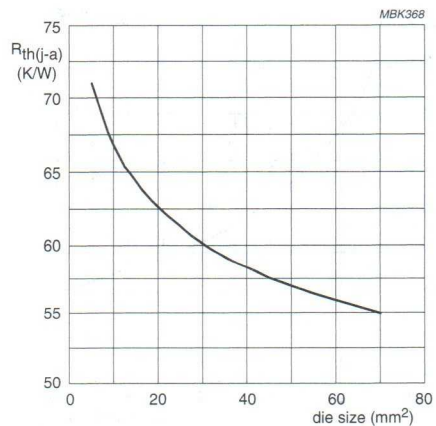


Fig.65 TQFP64 (10 × 10 × 1 mm).

Thermal design considerations

Chapter 6

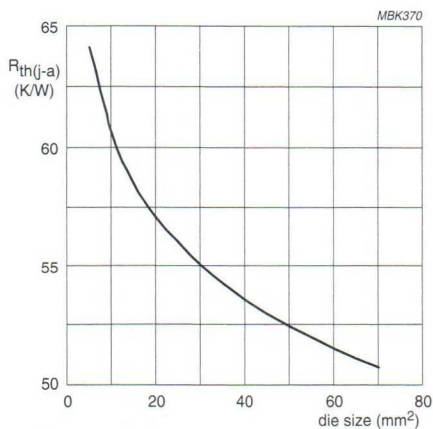


Fig.66 TQFP80 (12 × 12 × 1 mm).

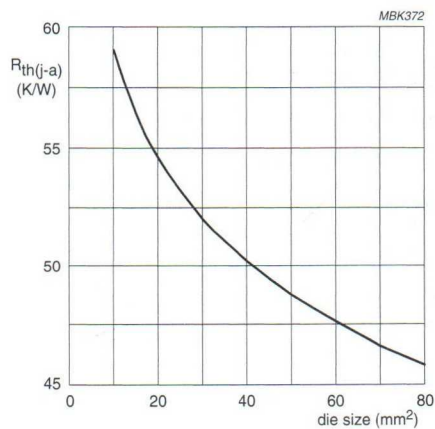


Fig.67 TQFP100 (14 × 14 × 1 mm).

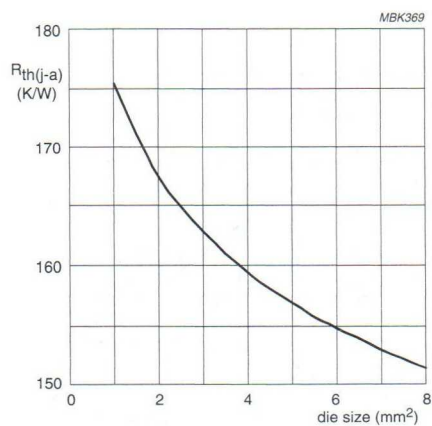


Fig.68 TSSOP14 (4.4 mm).

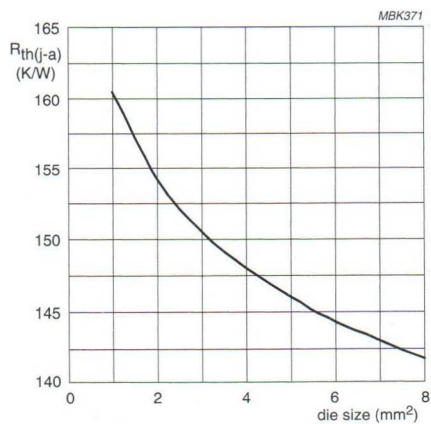


Fig.69 TSSOP16 (4.4 mm).

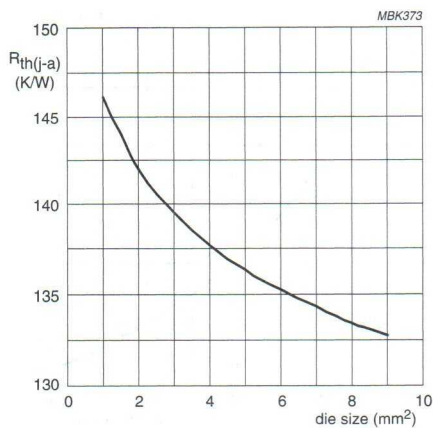


Fig.70 TSSOP20 (4.4 mm).

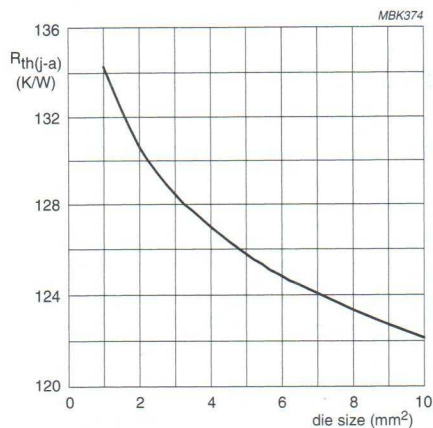


Fig.71 TSSOP24 (4.4 mm).

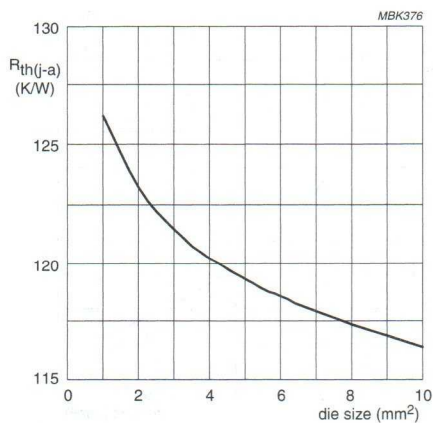


Fig.72 TSSOP28 (4.4 mm).

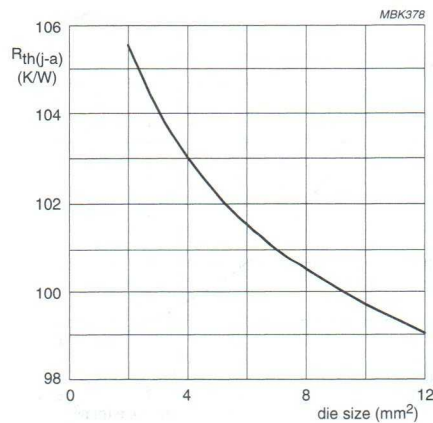
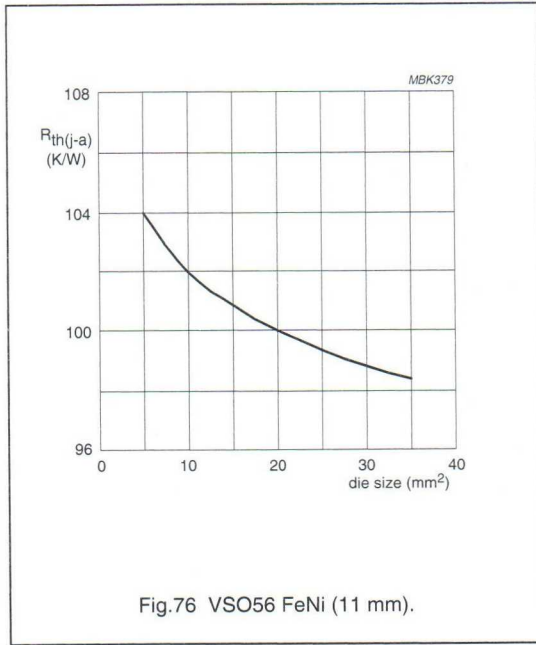
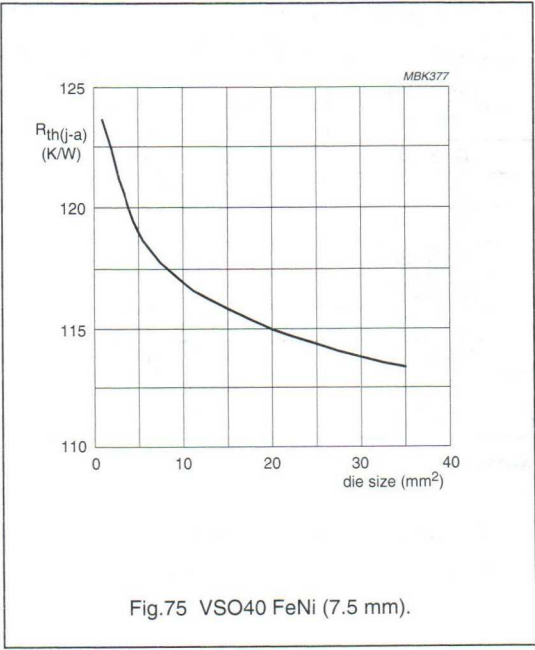
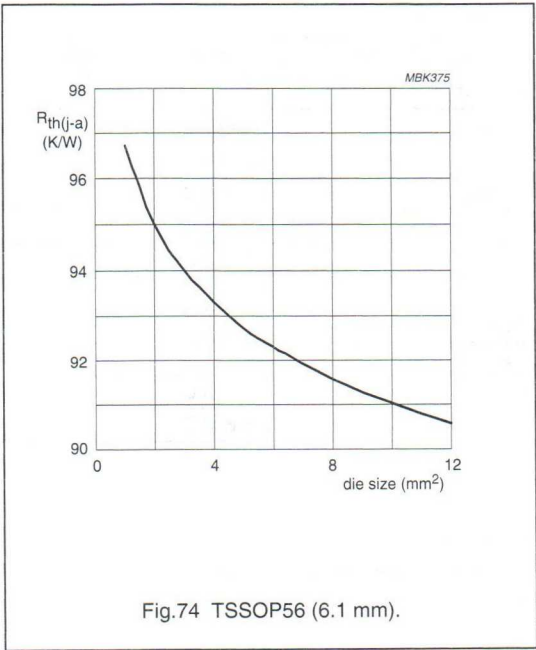


Fig.73 TSSOP48 (6.1 mm).



Thermal design considerations

Chapter 6

THERMAL RESISTANCE ($R_{th(j-c)}$) DATA TABLES - POWER PACKAGES⁽¹⁾

PACKAGE NAME	PHILIPS OUTLINE CODE	$R_{th(j-c)}$ (K/W) GLUED DIE	$R_{th(j-c)}$ (K/W) SOLDERED DIE
DBS9MPF	SOT111-1	6.0 to 12.0	n.a.
DBS9P	SOT157-2	1.0 to 4.0	0.8 to 3.0
DBS13P	SOT141-6	1.0 to 4.0	0.8 to 3.0
DBS17P	SOT243-1	1.0 to 4.0	0.8 to 3.0
DBS23P	SOT411-1	n.a.	0.8 to 3.0
HSOP20	SOT418-2	1.0 to 4.0	0.8 to 3.0
RBS9MPF	SOT352-1	6.0 to 12.0	n.a.
RDBS13P	SOT462-1	1.0 to 4.0	0.8 to 3.0
SIL9MPF	SOT110-1	6.0 to 12.0	n.a.
SIL9P	SOT131-2	1.0 to 4.0	0.8 to 3.0
SIL13P	SOT193-2	1.0 to 4.0	0.8 to 3.0

Note

1.

- Almost all of the values in the table were determined with measurements.
- Low values should be used with a large die, high values should be used with a small die.

CHAPTER 7

PACKING METHODS

	page
Introduction	7 - 2
Glossary of terms	7 - 2
Drypack for moisture sensitive SMDs	7 - 3
Survey of IC packing methods	7 - 5
Packing methods in exploded view	7 - 6
Packing quantities, box dimensions and carrier shapes	7 - 13

Packing methods

Chapter 7

INTRODUCTION

The chapter contains a survey of the packing methods most frequently used by Philips Semiconductors. It includes information that may be important to customers when making their purchasing decisions, for example the main dimensions, shapes, and packing quantities.

Standardization

For semiconductors, packing serves two important functions. The first and most obvious function is protection during storage and transport to customers. This, of course, applies to all products, not just semiconductors.

The second is to act as a delivery medium for automatic placement machines during equipment manufacture.

To do this effectively, the reels, trays and tubes that components are packed in must meet recognized standards. In this respect, Philips Semiconductors actively cooperates with standardization authorities throughout the world.

In addition, its packing methods meet all major international standards, including those of IEC (International Electrotechnical Commission), JEDEC (Joint Electron Device Engineering Council, USA) and NEDA (National Electronic Distributor Association, USA).

Environmental care

Nowadays, an important issue is environmental impact. Component and equipment manufacturers are continuously working to improve the environment friendliness of their products and packing, and have devoted much effort to eliminating the use of toxic materials and to looking at ways in which materials can be recycled.

In these respects, Philips Semiconductors has taken several important steps on the packing front. These include:

- Reducing the amount of packing material by switching to 'one piece' boxes (instead of boxes with upper and lower parts)
- Changing to 'mono material' to aid recycling. For example, from aluminium-lined boxes to carbon-coated boxes.
- Changing from white boxes to natural brown boxes to eliminate the use of bleach (chlorine) in their manufacture.

The aim is minimum waste and minimum environmental impact. We have already gone a long way towards this in the development of our packing methods. And future developments will take us even further along this route.

For more information relating to environmental issues, refer to Chapter 8 - Environmental data on ICs.

GLOSSARY OF TERMS

Through-hole	mounted onto a PCB by insertion of leads into holes
Surface mount	mounted on the surface of a PCB
Package	container with terminals for an IC chip (also known as an envelope or outline)
Carrier	plastic tube, tray or tape with cavities, which can contain semiconductor products
Packing method	combination of a carrier and a box to protect products during transport and storage
Pin	rigid plastic pin that closes a tube for DIPs by insertion through holes in its end
Plug	flexible plastic plug that closes a tube for PLCCs or SILs by insertion into its end
Turnlock	rigid plastic pin that closes a tube for SOs by insertion into its end and turning to lock in place
SPQ	Smallest Packing Quantity, in one carrier
PQ	Packing Quantity, in a box containing one or more SPQs

For a full definition of IC package abbreviations and their suffixes, refer to *Chapter 2 - IC Package range and dimensions*.

Packing methods

Chapter 7

DRYPACK FOR MOISTURE SENSITIVE SMDs

If packed or stored incorrectly, moisture-sensitive plastic SMDs can easily be damaged after a prolonged exposure to the high temperatures associated with certain soldering methods. If any moisture is present in the plastic package during soldering, it may turn into steam and expand rapidly. Under certain circumstances, the force exerted by this expansion can cause internal delamination or, in the most severe cases, may result in internal or external package cracks (the popcorn effect). This effect is more prominent with infrared and vapour-phase reflow soldering methods when soldering temperatures can reach severe levels.

To avoid this problem, and ensure trouble-free soldering, we deliver moisture-sensitive ICs in a resealable moisture-resistant plastic packing called a DRYPACK.

Moisture sensitivity level

Not all plastic packages are equally sensitive to moisture. To differentiate between types, we assign each IC package a moisture sensitivity level (MSL). The MSL of an IC's package is influenced by:

- chip area and size of the die-pad
- package body size
- package material properties
- moisture content of the package
- temperature and duration of the soldering process.

Determining MSL

We determine moisture sensitivity levels by testing batches of each package according to a detailed specification, which includes moisturizing and infrared-reflow soldering. This soldering method is used as infrared radiation is readily absorbed by the black IC packages and therefore is the most critical soldering process when testing for the popcorn effect.

After moisturizing to predetermined levels, the packages pass through an oven where they are first preheated, then heated to a soldering temperature, and finally cooled. The convection solder reflow requirements are given in Table 1.

To reduce any moisture-related stresses within the packages, they are first preheated to around 125 °C to allow them to dry before they reach their maximum temperature. The longer this preheating time, therefore, the smaller the chance of packages being damaged during the high temperatures associated with soldering.

Although the profile has a low maximum temperature, the packages are exposed to 183 °C and above for a relatively long time. If this maximum temperature is higher than that given in Table 1, the effect of soldering will be more severe compared with the test on which the MSL of the specific IC package is based. If, however, the package is soldered well within its specified floor life limit (see Table 2), a higher soldering temperature can be used as the package's moisture content will be much less.

Table 1 Convection solder reflow requirements⁽¹⁾

PROFILE PARAMETER	REQUIREMENTS
Ramp-up rate (183 °C to peak)	3 K/s max.
Preheat temperature (125 °C ± 25 °C)	120 s max.
Temperature maintained above 183 °C	60 to 150 s
Time within 5 °C of actual peak temperature	10 to 20 s
Peak temperature range ⁽²⁾	220 °C +5 /-0 °C or 235 °C +5 /-0 °C
Ramp down rate	6 K/s max.
Time from 25 °C to peak temperature	6 minutes. max.

Notes

1. All temperatures refer to the top side of the package as measured on the centre of the plastic body surface.
2. Peak temperature requirements:
 - a) Packages with a thickness ≥ 2.5 mm and all BGA packages: peak temp. 220 °C +5/ -0 °C.
 - b) Packages with a thickness < 2.5 mm and all with a package volume ≥ 350mm³: peak temp. 220 °C +5 /-0 °C.
 - c) Packages with a thickness < 2.5 mm and all with a package volume < 350mm³: 235 °C +5 /-0 °C. (Package volume is defined as body-height × width × length, but excludes external leads and non-integral heatsinks).

Packing methods

Chapter 7

Table 2 Floor life versus moisture sensitivity levels⁽¹⁾

MSL	CONDITIONS	FLOOR LIFE
1	30 °C / 90% RH	unlimited
2	30 °C / 60% RH	1 year
2a	30 °C / 60% RH	4 weeks
3	30 °C / 60% RH	168 hours
4	30 °C / 60% RH	72 hours
5	30 °C / 60% RH	48 hours
5a	30 °C / 60% RH	24 hours
6 ⁽²⁾	30 °C / 60% RH	6 hours

Notes

1. Packages that are not sensitive to moisture do not require DRYPACK.
2. MSL 6 packages must be baked before use, after which they have a 6-hour floor life.

No problems are associated with wave soldering as the components are only exposed to high temperatures for a short time.

All Philips test centres perform these MSL investigations to the same rigorous specification, and classify the moisture sensitivity of packages into levels ranging from 1 (not sensitive to moisture) to 6 (very sensitive to moisture).

In addition, and as part of our Reliability Monitoring Program, we conduct regular stress tests on our SMDs. As part of these tests, the packages are exposed to a simulated moisturizing and soldering run to reproduce a typical production process, then they are checked both visually and electronically for any signs of deterioration. As a result, we guarantee that if the packages are stored correctly, IC reliability will not be affected after soldering.

Philips DRYPACK

The Philips DRYPACK is a laminated plastic packing that prevents the moisture content of the IC plastic packages rising above 0.1% by weight for up to one year. The DRYPACK must be stored at normal room temperature (between 10 °C and 30 °C), and in an atmosphere of less than 60% relative humidity (RH).

The DRYPACK contains a desiccant and a humidity indicator, used to monitor the moisture content when the bag is opened.

Using ICs from a DRYPACK

Before using ICs from a DRYPACK, it's essential that the humidity indicator is checked. If it shows that the RH has remained below 20% (the colour of the 20% dot is blue), the ICs are ready for use.

As soon as the ICs are removed from the DRYPACK, however, they are immediately exposed to moisture in the atmosphere. To prevent them absorbing excessive moisture, they must be soldered onto the PCB within the specified floor life period given in Table 2. These times are related to the MSL of the package.

If the humidity indicator in a DRYPACK shows an RH of more than 20% (the colour of the 20% dot has changed from blue to pink), the DRYPACK has been damaged, opened, or stored incorrectly. To prevent the popcorn effect in such a situation, the ICs that were in the DRYPACK must first be dried before soldering.

For example, the minimum drying time to reduce the moisture content of an IC package from an initial level of 0.3% by weight to around 0.05% by weight, is given by:

Drying time (hours) = $5 \times \text{package thickness (mm)}$ at a drying temperature of $125 \text{ °C} \pm 5 \text{ °C}$.

Note: High temperatures may deteriorate solderability. It is strongly recommended to dry at a maximum $125 \text{ °C} \pm 5 \text{ °C}$, and not to dry longer than required.

Resealing a DRYPACK

If some ICs from an opened DRYPACK are not used, the desiccant and the humidity indicator should be reinserted into the DRYPACK and the DRYPACK resealed within half an hour after opening using commercially available heat-sealing equipment

The time a resealed DRYPACK can be stored depends on the time since it was originally packed, and how long it was open before being resealed.

Packing methods

Chapter 7

SURVEY OF IC PACKING METHODS

PACKAGE NAME	CARRIER TYPE		
	TUBE	TAPE/REEL	TRAY
BGA	–	X	X
DBS	X	–	–
DIP	X	–	–
HBCC	–	X	X
HBGA	–	X	X
HDIP	X	–	–
HLQFP	–	X	X
HQFP	–	X	X
HSOP	X	X	–
HSQFP	–	–	X
HTQFP	–	X	X
HTSSOP	X	X	–
LFBGA	–	X	X
LQFP	–	X	X
MSQFP	–	–	X
PLCC	X	X	–
PMFP	–	X	–
QFP	–	X	X
RBS	X	–	–
SDIP	X	–	–
SIL	X	–	–
SMS	X	X	–
SO	X	X	–
SOJ	X	X	–
SQFP	–	–	X
SSOP	X	X	–
TBS	X	–	–
TFBGA	–	X	X
TO	–	X	–
TQFP	–	X	X
TSSOP	X	X	–
VSO	X	X	–

Packing methods

Chapter 7

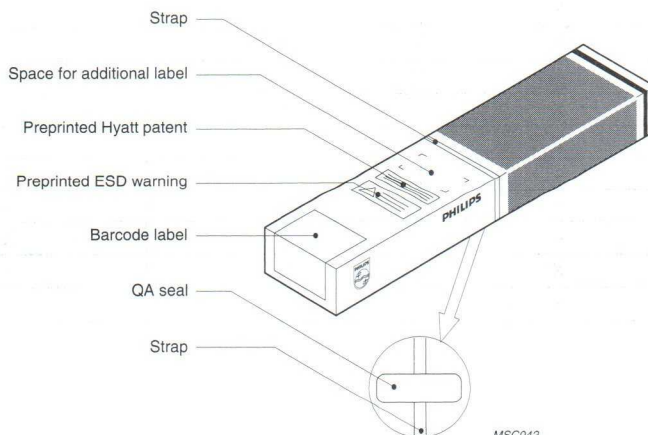
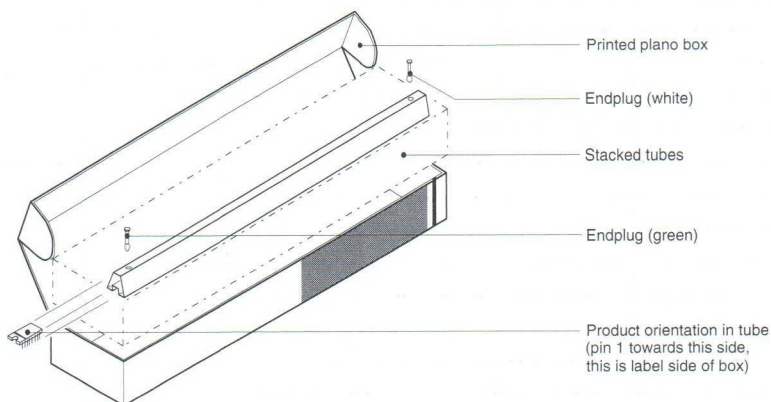
PACKING METHODS IN EXPLODED VIEW

Packing for DIP (tube/pin)



Stacking method

Item	Material	Weight ⁽¹⁾ (g)
Box	Cardboard carbon coated	145
Seal	Acrylate	0.2
Labels	Paper	1.65
Endstops	Polyvinylchloride	5.6
Tubes	Polyvinylchloride	840
Strap	Polypropylene	0.7

⁽¹⁾ For DIP, row pitch 0.6"

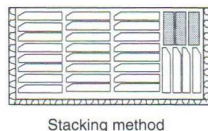
MSC042

Fig.1 Packing for DIP (tube/pin).

Packing methods

Chapter 7

Packing for PLCC/SIL (tube/plug)



Item	Material	Weight ⁽¹⁾ (g)
Box	Cardboard carbon coated	145
Seal	Acrylate	0.2
Labels	Paper	1.65
Endstops	Polyvinylchloride soft	115
Tubes	Polyvinylchloride	1190
Strap	Polypropylene	0.7
Foam	Polyethylene	9
Foam	Ethylenevinylacetate	1

(1) For PLCC84

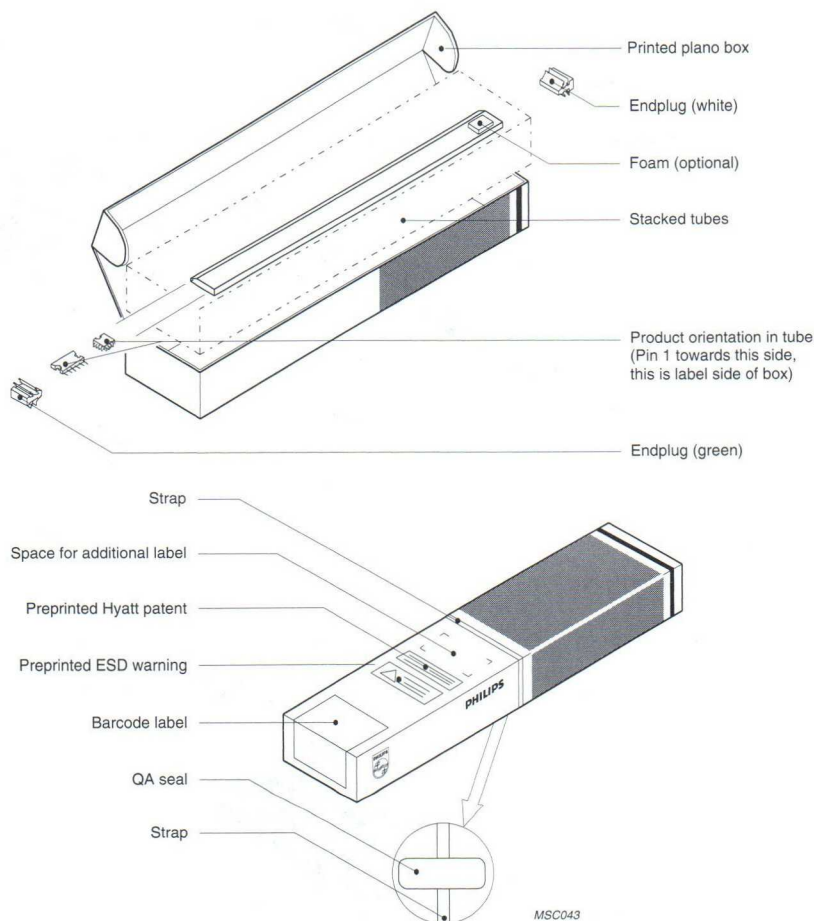


Fig.2 Packing for PLCC/SIL (tube/plug).

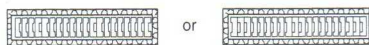
Packing methods

Chapter 7

Packing for SO (tube/turnlock)

Item	Material	Weight ⁽¹⁾ (g)
Box	Cardboard carbon coated	61
Seal	Acrylate	0.2
Labels	Paper	1.65
Endstops	Polyvinylchloride	4
Tubes	Polyvinylchloride	164

(¹) For SO, row pitch 0.15"



Stacking method

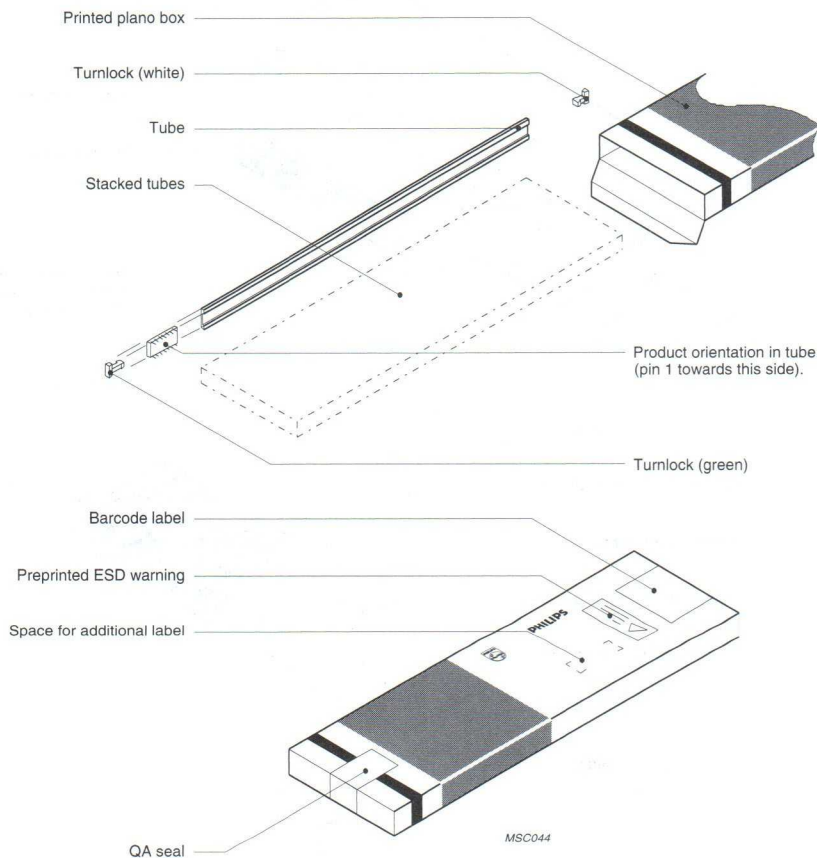


Fig.3 Packing for SO (tube/turnlock).

Packing methods

Chapter 7

Packing for SO/PLCC/QFP (tape/reel)

Item	Material	Weight ⁽¹⁾ (g)
Box	Cardboard carbon coated	165
Reel	Polystyrene	310
Cover tape	Polyester	10
Carrier tape	Polystyrene	73
Seals	Acrylate	0.2
Tape	Paper	0.15
Labels	Paper	1.77

(1) For SO large 8/16 pins

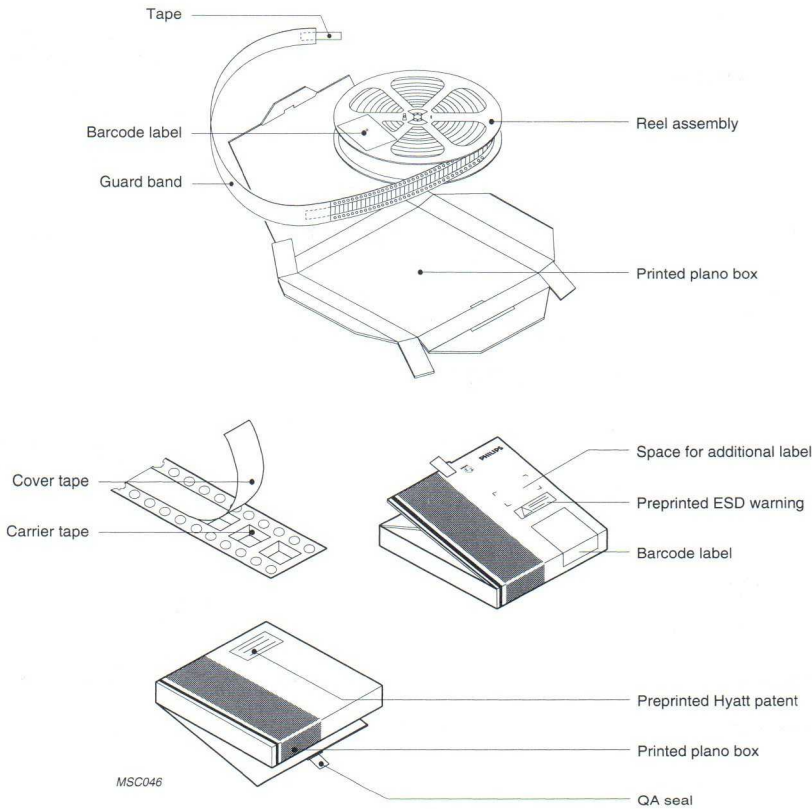


Fig.4 Packing for SO/PLCC/QFP (tape/reel).

Packing methods

Chapter 7

Drypack for tube-packing

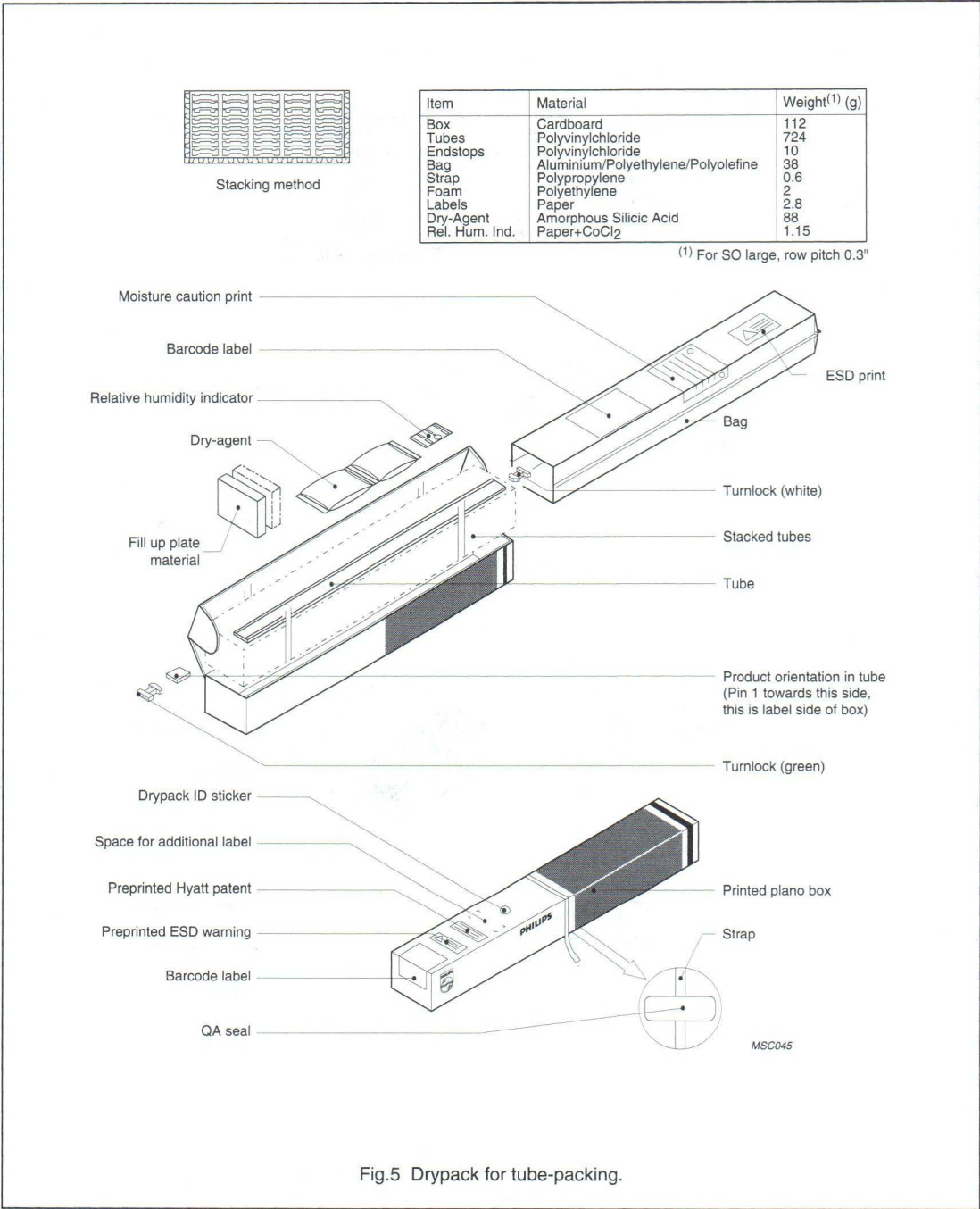


Fig.5 Drypack for tube-packing.

Packing methods

Chapter 7

Drypack for tape/reel-packing

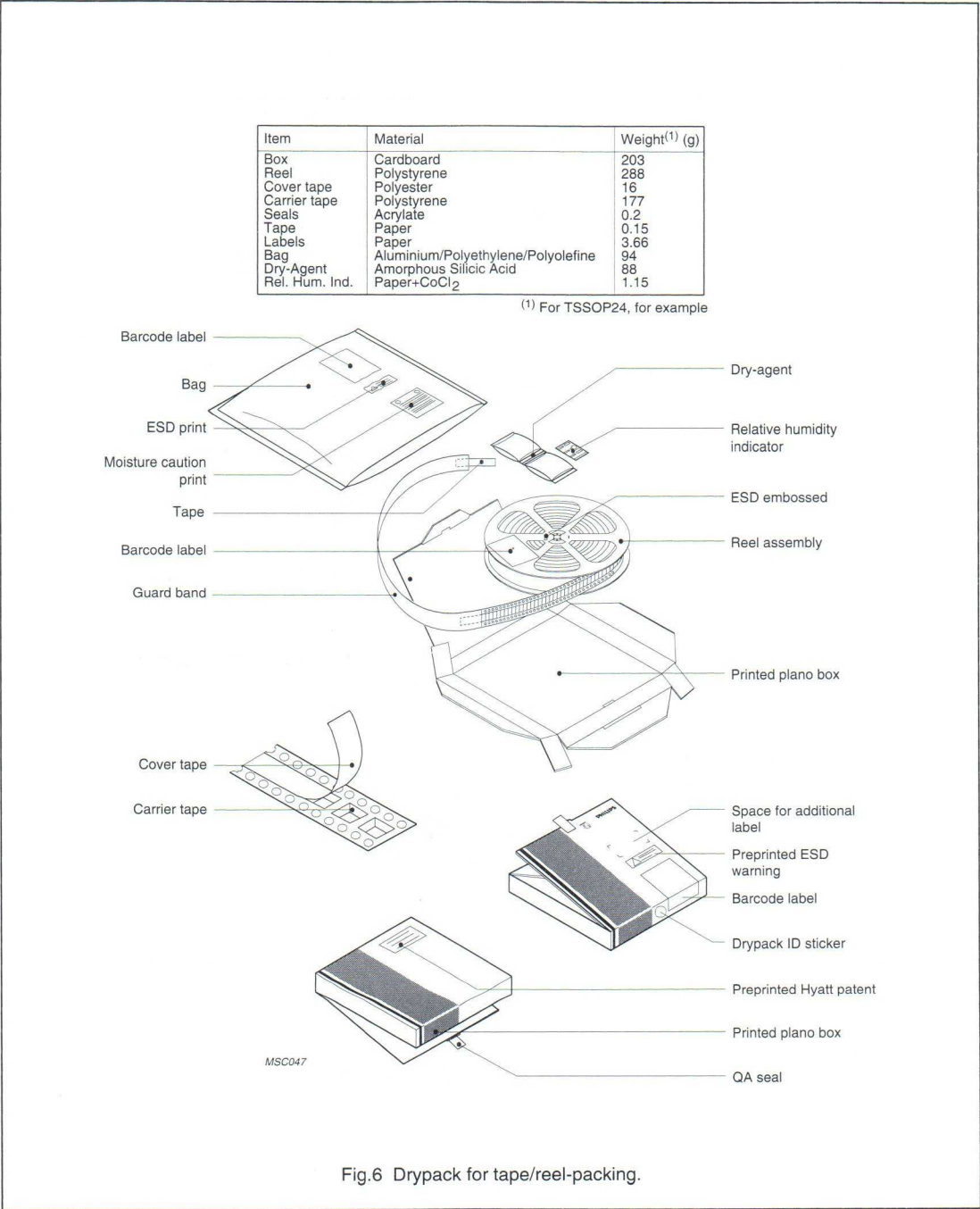


Fig.6 Drypack for tape/reel-packing.

Packing methods

Chapter 7

Drypack for tray-packing

Item	Material	Weight ⁽¹⁾ (g)
Box	Cardboard	113
Tray Bakeable	Polyethersulfone (PES)	654
Seal	Acrylate	0.15
Strap	Polypropylene	2.2
Labels	Paper	2.55
Bag	Aluminium/Polyether/Polyolefine	47
Dry-Agent	Amorphous Silicic Acid	88
Rel. Hum. Ind.	Paper + CoCl ₂	1.15

(1) For QFP 14 × 20 mm body

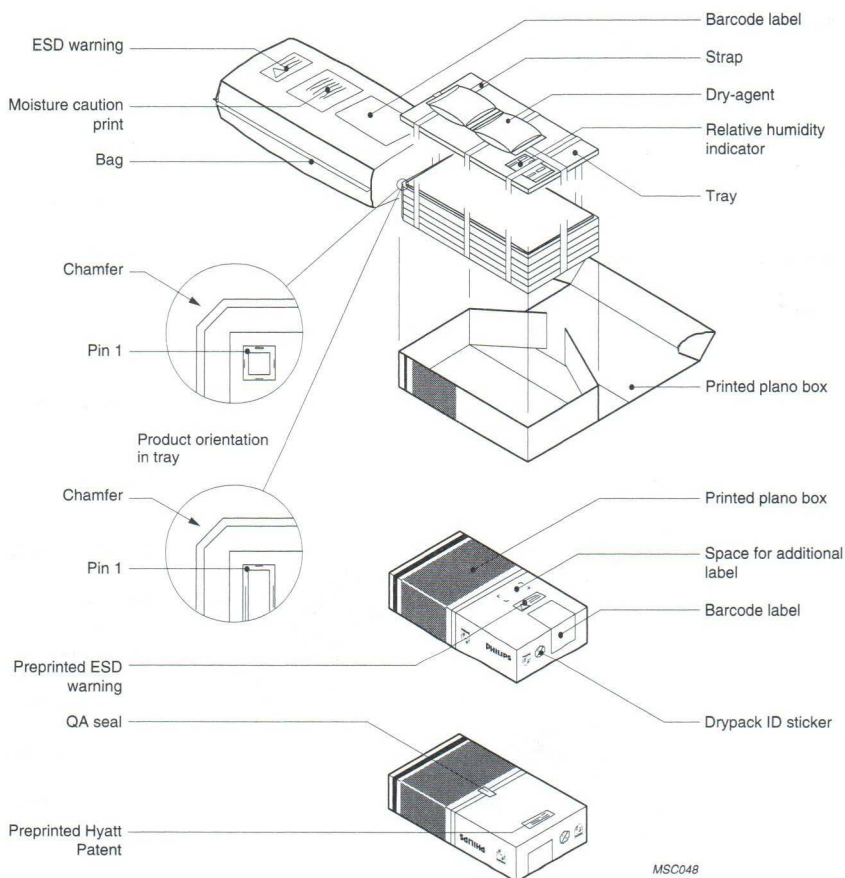


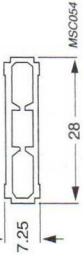
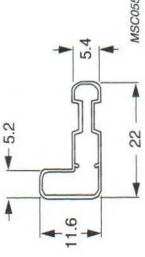
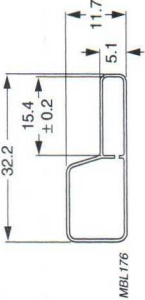
Fig.7 Drypack for tray-packing.

Packing methods

Chapter 7

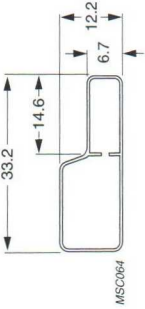
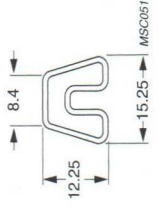
PACKING QUANTITIES, BOX DIMENSIONS AND CARRIER SHAPES

Tube - through hole devices

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER LENGTH (mm)	END STOP	SPQ	CARRIERS PER BOX	PQ	OUTER BOX DIMENSIONS L × W × H (mm)	CARRIER PROFILE
DBS9MPF	SOT111	501	turnlock	22	34	748	530 × 136 × 65	
SIL9MP	SOT142	501	turnlock	22	34	748	530 × 136 × 65	
SIL9MPF	SOT110	501	turnlock	22	34	748	530 × 136 × 65	
RBS9MPF	SOT352	501	turnlock	22	42	924	530 × 136 × 65	
DBS7P	SOT524	501	turnlock	36	24	864	530 × 136 × 65	
DBS9P	SOT523	501	turnlock	36	24	864	530 × 136 × 65	
								

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER LENGTH (mm)	END STOP	SPQ	CARRIERS PER BOX	PQ	OUTER BOX DIMENSIONS L × W × H (mm)	CARRIER PROFILE
DBS9P	SOT157	575	plug	23	24	552	595 × 137 × 68	
SMS9P	SOT354	575	plug	23	24	552	595 × 137 × 68	
RDBS13P	SOT462	575	plug	23	24	552	595 × 137 × 68	
RDBS13P	SOT528	575	plug	23	24	552	595 × 137 × 68	
DBS13P	SOT141	575	plug	23	24	552	595 × 137 × 68	
TBS13	SOT578	575	plug	23	24	552	595 × 137 × 68	
DBS17P	SOT243	575	plug	23	24	552	595 × 137 × 68	
DBS17P	SOT475	575	plug	23	24	552	595 × 137 × 68	
RDBS17P	SOT577	575	plug	23	24	552	595 × 137 × 68	
DBS23P	SOT411	575	plug	18	24	432	595 × 137 × 68	
DBS27P	SOT521	575	plug	18	24	432	595 × 137 × 68	
SIL9P	SOT131	575	plug	23	24	552	595 × 137 × 68	
SIL13P	SOT193	575	plug	23	24	552	595 × 137 × 68	
DIP8	SOT97	501	pin	50	40	2000	532 × 142 × 63	

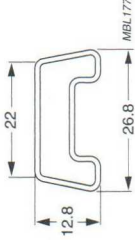
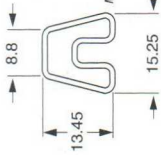
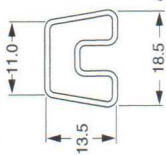
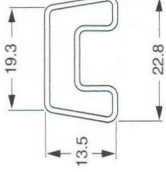
Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER LENGTH (mm)	END STOP	SPQ	CARRIERS PER BOX	PQ	OUTER BOX DIMENSIONS L × W × H (mm)	CARRIER PROFILE
DIP14	SOT27	501	pin	25	40	1000	532 × 142 × 63	
DIP16	SOT38-1	501	pin	22	40	880	532 × 142 × 63	
DIP16	SOT38-4	501	pin	25	40	1000	532 × 142 × 63	
DIP18	SOT102-1	501	pin	22	40	880	532 × 142 × 63	
DIP18	SOT102-2	501	pin	20	40	800	532 × 142 × 63	
DIP18	SOT102-4	501	pin	20	40	800	532 × 142 × 63	
HDIP18	SOT398	501	pin	22	40	880	532 × 142 × 63	
DIP20	SOT146	501	pin	18	40	720	532 × 142 × 63	
DIP22	SOT116	501	pin	17	32	544	530 × 136 × 65	
SDIP24	SOT234	501	pin	21	32	672	532 × 142 × 63	
SDIP32	SOT232	501	pin	16	32	512	532 × 142 × 63	
DIP24	SOT101	501	pin	15	24	360	532 × 142 × 63	
DIP24	SOT222	501	pin	15	40	600	532 × 142 × 63	
DIP24	SOT248	501	pin	15	32	480	530 × 136 × 65	
DIP28	SOT117	501	pin	13	24	312	532 × 142 × 63	
DIP32	SOT201	501	pin	11	24	264	532 × 142 × 63	
DIP40	SOT129	501	pin	9	24	216	532 × 142 × 63	
SDIP42	SOT270	501	pin	12	24	288	532 × 142 × 63	
DIP48	SOT240	501	pin	7	24	168	532 × 142 × 63	
SDIP52	SOT247	501	pin	10	24	240	532 × 142 × 63	
SDIP56	SOT400	501	pin	9	24	216	532 × 142 × 63	

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER LENGTH (mm)	END STOP	SPQ	CARRIERS PER BOX	PQ	OUTER BOX DIMENSIONS L × W × H (mm)	CARRIER PROFILE
SDIP64	SOT274	501	pin	8	20	160	532 × 142 × 63	
DIP14	SOT27	575	pin	28	40	1120	595 × 137 × 68	
DIP16	SOT38-1	575	pin	25	40	1000	595 × 137 × 68	
DIP16	SOT38-4	575	pin	28	40	1120	595 × 137 × 68	
DIP18	SOT102-1	575	pin	25	40	1000	595 × 137 × 68	
HDIP18	SOT398	575	pin	25	40	1000	595 × 137 × 68	
DIP20	SOT146	575	pin	20	40	800	595 × 137 × 68	
DIP22	SOT116	575	pin	21	40	840	595 × 137 × 68	
SDIP24	SOT234	575	pin	25	40	1000	595 × 137 × 68	
DIP24	SOT101	575	pin	17	30	510	595 × 137 × 68	
DIP28	SOT117	575	pin	15	30	450	595 × 137 × 68	
DIP32	SOT201	575	pin	13	30	390	595 × 137 × 68	
SDIP32	SOT232	575	pin	19	40	760	595 × 137 × 68	
DIP40	SOT129	575	pin	10	30	300	595 × 137 × 68	
SDIP42	SOT270	575	pin	14	30	420	595 × 137 × 68	
SDIP52	SOT247	575	pin	11	30	330	595 × 137 × 68	

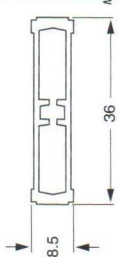
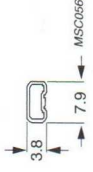
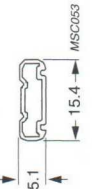
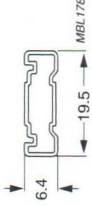
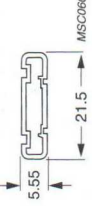
Note

1. If only a package type code is given, the data supplied is applicable to all its outline versions.

Packing methods

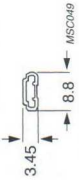
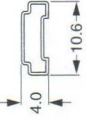
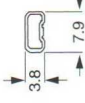
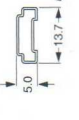
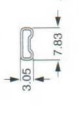
Chapter 7

Tube - surface mount devices

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER LENGTH (mm)	END STOP	SPQ	CARRIERS PER BOX	PQ	OUTER BOX DIMENSIONS L × W × H		CARRIER PROFILE (mm)
							NON-DRYPACK (mm)	DRYPACK (mm)	
SMS13P	SOT517	575	plug	23	24	552	—	595 × 137 × 68	
SO8	SOT96	515	turnlock	100	20	2000	525 × 83 × 15	528 × 101 × 23	
SO14	SOT108	515	turnlock	57	20	1140	525 × 83 × 15	528 × 101 × 23	
SO16	SOT109	515	turnlock	50	20	1000	525 × 83 × 15	528 × 101 × 23	
SO8	SOT176	515	turnlock	64	40	2560	551 × 90 × 46	572 × 94 × 54	
SO16	SOT162	515	turnlock	48	40	1920	551 × 90 × 46	572 × 94 × 54	
SO20	SOT163	515	turnlock	38	40	1520	551 × 90 × 46	572 × 94 × 54	
SO24	SOT137	515	turnlock	30	40	1200	551 × 90 × 46	572 × 94 × 54	
SO28	SOT136	515	turnlock	27	40	1080	551 × 90 × 46	572 × 94 × 54	
SO32	SOT287	515	turnlock	24	40	960	551 × 90 × 46	572 × 94 × 54	
VSO40	SOT158	515	turnlock	31	40	1240	551 × 90 × 46	572 × 94 × 54	
HSOP20	SOT397	515	turnlock	30	24	720	551 × 90 × 46	572 × 94 × 54	
HSOP20	SOT418	515	turnlock	30	24	720	551 × 90 × 46	572 × 94 × 54	
VSO56	SOT190	495	turnlock	22	28	616	551 × 90 × 46	572 × 94 × 54	

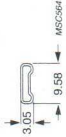
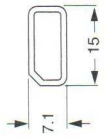
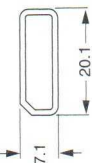
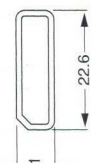
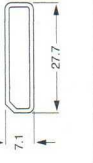
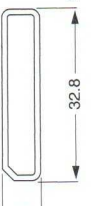
Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER LENGTH (mm)	END STOP	SPQ	CARRIERS PER BOX	PQ	OUTER BOX DIMENSIONS L × W × H		CARRIER PROFILE (mm)
							NON-DRYPACK (mm)	DRYPACK (mm)	
SSOP16	SOT369	511	turnlock	93	18	1674	525 × 83 × 20	530 × 103 × 29	 MSC049
SSOP20	SOT266	511	turnlock	75	18	1350	525 × 83 × 20	530 × 103 × 29	
SSOP14	SOT337	508	turnlock	78	14	1092	525 × 83 × 20	530 × 103 × 29	 MSD504
SSOP16	SOT338	508	turnlock	78	14	1092	525 × 83 × 20	530 × 103 × 29	
SSOP20	SOT339	508	turnlock	66	14	924	525 × 83 × 20	530 × 103 × 29	
SSOP24	SOT340	508	turnlock	59	14	826	525 × 83 × 20	530 × 103 × 29	
SSOP28	SOT341	508	turnlock	47	14	658	525 × 83 × 20	530 × 103 × 29	
SSOP16	SOT519	515	turnlock	100	20	2000	525 × 83 × 15	530 × 101 × 23	 MSD556
SSOP24	SOT556	515	turnlock	57	20	1140	525 × 83 × 15	530 × 101 × 23	
SSOP48	SOT370	515	turnlock	31	51	1581	551 × 90 × 46	572 × 94 × 54	 MSC562
SSOP56	SOT371	515	turnlock	26	51	1326	551 × 90 × 46	572 × 94 × 54	
TSSOP14	SOT402	510	plug	96	25	2400	525 × 83 × 15	528 × 101 × 23	 MSC563
TSSOP16	SOT403	510	plug	96	25	2400	525 × 83 × 15	528 × 101 × 23	
TSSOP20	SOT360	510	plug	75	25	1875	525 × 83 × 15	528 × 101 × 23	
HTSSOP20	SOT527	510	plug	75	25	1875	525 × 83 × 15	528 × 101 × 23	
TSSOP24	SOT355	510	plug	63	25	1575	525 × 83 × 15	528 × 101 × 23	
TSSOP28	SOT361	510	plug	51	25	1275	525 × 83 × 15	528 × 101 × 23	
TSSOP30	SOT607	510	plug	63	25	1575	525 × 83 × 15	528 × 101 × 23	
TSSOP38	SOT510	510	plug	51	25	1275	525 × 83 × 15	528 × 101 × 23	

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER LENGTH (mm)	END STOP	SPQ	CARRIERS PER BOX	PQ	OUTER BOX DIMENSIONS L × W × H		CARRIER PROFILE (mm)
							NON-DRYPACK (mm)	DRYPACK (mm)	
TSSOP32	SOT487	510	plug	44	25	1100	525 × 83 × 15	528 × 101 × 23	
HTSSOP32	SOT549	510	plug	44	25	1100	525 × 83 × 15	528 × 101 × 23	
TSSOP48	SOT362	510	plug	39	25	975	525 × 83 × 15	528 × 101 × 23	
TSSOP56	SOT364	510	plug	35	25	875	525 × 83 × 15	528 × 101 × 23	
PLCC28	SOT261	491	plug	34	64	2176	530 × 136 × 65	554 × 136 × 81	
PLCC44	SOT187	491	plug	26	50	1300	530 × 136 × 65	554 × 136 × 81	
PLCC44	SOT187	491	plug	26	48	1248	530 × 136 × 65	554 × 136 × 81	
PLCC52	SOT238	491	plug	23	44	1012	—	554 × 136 × 81	
PLCC68	SOT188	491	plug	18	36	648	530 × 136 × 65	554 × 136 × 81	
PLCC84	SOT189	491	plug	15	28	420	530 × 136 × 65	554 × 136 × 81	

Note

1. If only a package type code is given, the data supplied is applicable to all its outline versions.

Packing methods

Chapter 7

Tape and reel - surface mount devices

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER DIMENSIONS D × W (mm)	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
				NON-DRYPACK (mm)	DRYPACK (mm)
HBCC					
HBCC24	SOT564	330 × 12	3500	341 × 338 × 30	341 × 338 × 39
HBCC32	SOT560	330 × 12	3500	341 × 338 × 30	341 × 338 × 39
LFBGA					
LFBGA56	SOT516	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
LFBGA64	SOT534	330 × 16	t.b.d.	341 × 338 × 30	341 × 338 × 39
LFBGA84	SOT518	330 × 16	t.b.d.	341 × 338 × 30	341 × 338 × 39
LFBGA96	SOT536	330 × 24	3500	341 × 338 × 39	341 × 338 × 49
LFBGA114	SOT537	330 × 24	3500	341 × 338 × 39	341 × 338 × 49
LFBGA156	SOT472	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
TFBGA					
TFBGA56	SOT542	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
TFBGA64	SOT543	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
TFBGA80	SOT557	330 × 16	t.b.d.	341 × 338 × 30	341 × 338 × 39
PLCC					
PLCC28	SOT261	180 × 24	300	191 × 188 × 39	209 × 206 × 48
PLCC28	SOT261	330 × 24	750	341 × 338 × 39	341 × 338 × 49
PLCC44	SOT187	330 × 32	500	341 × 338 × 49	341 × 338 × 68
PLCC52	SOT238	330 × 32	500	341 × 338 × 49	341 × 338 × 61
PLCC68	SOT188	330 × 44	250	341 × 338 × 61	341 × 338 × 68
PLCC84	SOT189	330 × 44	250	341 × 338 × 61	341 × 338 × 68
PMFP					
PMFP8	SOT144	180 × 8 (2 reels)	10000	185 × 185 × 32	—
QFP					
QFP44	SOT307	330 × 24	1500	341 × 338 × 39	341 × 338 × 49
QFP44	SOT205	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
QFP52	SOT379	330 × 24	600	n.a.	341 × 338 × 49
QFP64	SOT319	330 × 44	500	341 × 338 × 61	341 × 338 × 68
QFP64	SOT393	330 × 32	600	341 × 338 × 49	341 × 338 × 61
QFP80	SOT310	330 × 44	500	341 × 338 × 61	341 × 338 × 68
QFP80	SOT318	330 × 44	500	341 × 338 × 61	341 × 338 × 68
QFP80	SOT496	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
QFP100	SOT317	330 × 44	500	341 × 338 × 61	341 × 338 × 68
QFP100	SOT382	330 × 44	500	341 × 338 × 61	341 × 338 × 68

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER DIMENSIONS D × W (mm)	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
				NON-DRYPACK (mm)	DRYPACK (mm)
LQFP					
LQFP32	SOT358	330 × 16	2000	341 × 338 × 30	341 × 338 × 39
LQFP32	SOT401	330 × 16	2000	341 × 338 × 30	341 × 338 × 39
LQFP44	SOT389	330 × 24	1500	341 × 338 × 39	341 × 338 × 49
LQFP48	SOT313	330 × 16	2000	341 × 338 × 30	341 × 338 × 39
LQFP64	SOT314	330 × 24	1500	341 × 338 × 39	341 × 338 × 49
LQFP64	SOT414	330 × 16	2000	341 × 338 × 30	341 × 338 × 39
LQFP80	SOT315	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
LQFP100	SOT407	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
LQFP128	SOT420	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
LQFP144	SOT486	330 × 44	1750	341 × 338 × 61	341 × 338 × 68
HLQFP					
HLQFP100	SOT470	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
TQFP					
TQFP44	SOT376	330 × 24	1500	341 × 338 × 39	341 × 338 × 49
TQFP80	SOT375	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
HTQFP					
HTQFP32	SOT547	330 × 16	2000	341 × 338 × 30	341 × 338 × 39
HTQFP48	SOT545	330 × 16	2500	341 × 338 × 39	341 × 338 × 49
HTQFP80	SOT513	330 × 24	t.b.d.	341 × 338 × 39	341 × 338 × 49
SMS (SIL power)					
SMS13P	SOT517	330 × 44	500	—	341 × 338 × 68
SO					
SO4	SOT223	330 × 12	4000	341 × 338 × 26	341 × 338 × 39
SO8	SOT96	180 × 12	1000	191 × 188 × 26	209 × 206 × 36
SO8	SOT96	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
SO8	SOT176	180 × 16	500	191 × 188 × 30	209 × 206 × 40
SO8	SOT176	330 × 16	1000	341 × 338 × 30	341 × 338 × 39
SO14	SOT108	180 × 16	1000	191 × 188 × 30	209 × 206 × 40
SO14	SOT108	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
SO16	SOT109	180 × 16	1000	191 × 188 × 30	209 × 206 × 40
SO16	SOT109	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
SO16	SOT162	180 × 16	500	191 × 188 × 30	209 × 206 × 40
SO16	SOT162	330 × 16	1000	341 × 338 × 30	341 × 338 × 39
SO20	SOT163	180 × 24	500	191 × 188 × 39	209 × 206 × 48
SO20	SOT163	330 × 24	2000	341 × 338 × 39	341 × 338 × 49
SO24	SOT137	180 × 24	500	191 × 188 × 39	209 × 206 × 48

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER DIMENSIONS D × W (mm)	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
				NON-DRYPACK (mm)	DRYPACK (mm)
SO24	SOT137	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
SO28	SOT136	180 × 24	500	191 × 188 × 39	209 × 206 × 48
SO28	SOT136	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
SO32	SOT287	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
SOJ					
SOJ40	SOT449	330 × 44	750	—	341 × 338 × 68
VSO					
VSO40	SOT158	180 × 24	300	191 × 188 × 39	209 × 206 × 48
VSO40	SOT158	330 × 24	500	341 × 338 × 39	341 × 338 × 49
VSO56	SOT190	330 × 32	500	341 × 338 × 49	341 × 338 × 61
SSOP					
SSOP14	SOT337	330 × 16	2000	341 × 338 × 30	341 × 338 × 39
SSOP16	SOT338	330 × 16	2000	341 × 338 × 30	341 × 338 × 39
SSOP16	SOT369/SOT519	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
SSOP20	SOT266	180 × 16	1000	191 × 188 × 30	209 × 206 × 40
SSOP20	SOT266	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
SSOP20	SOT339	330 × 16	1000	341 × 338 × 30	341 × 338 × 39
SSOP24	SOT340	330 × 16	1000	341 × 338 × 30	341 × 338 × 39
SSOP24	SOT556	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
SSOP28	SOT341	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
SSOP36	SOT378	330 × 24	1000	—	341 × 338 × 49
SSOP48	SOT370	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
SSOP56	SOT371	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
HSSOP					
HSSOP20	SOT397/SOT418	330 × 24	500	341 × 338 × 39	341 × 338 × 49
TSSOP					
TSSOP8	SOT505	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
TSSOP10	SOT552	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
TSSOP14	SOT402	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
TSSOP16	SOT403	330 × 12	2500	341 × 338 × 26	341 × 338 × 39
TSSOP20	SOT360	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
TSSOP24	SOT355	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
TSSOP28	SOT361	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
TSSOP30	SOT607	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
TSSOP32	SOT487	330 × 24	2000	341 × 338 × 39	341 × 338 × 49
TSSOP48	SOT362	330 × 24	2000	341 × 338 × 39	341 × 338 × 49
TSSOP56	SOT364	330 × 24	2000	341 × 338 × 39	341 × 338 × 49

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾)	CARRIER DIMENSIONS D × W (mm)	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
				NON-DRYPACK (mm)	DRYPACK (mm)
HTSSOP					
HTSSOP20	SOT527	330 × 16	2500	341 × 338 × 30	341 × 338 × 39
HTSSOP32	SOT549	330 × 24	2000	341 × 338 × 39	341 × 338 × 49
TO					
TO-92	SOT465	Ammo pack	2000	341 × 260 × 30	—

Note

1. If only a package type code is given, the data supplied is applicable to all its outline versions.

Packing methods

Chapter 7

Carrier tape dimensions - surface mount devices

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER TAPE DIMENSIONS IN mm (see Fig.8)					
		A0	B0	K0	P1	W	TYPE
HBCC							
HBCC24	SOT564	4.4	4.4	1.1	8	12	A
HBCC32	SOT560	5.4	5.4	1.1	8	12	A
BGA							
BGA156	SOT472	15.3	15.3	2.2	20	24	A
LFBGA							
LFBGA56	SOT516	6.5	6.5	1.7	8	12	A
LFBGA64	SOT534	t.b.d.	t.b.d.	t.b.d.	12	16	A
LFBGA84	SOT518	7.3	7.3	2.3	12	16	A
LFBGA96	SOT536	5.9	13.9	2.2	8	24	A
LFBGA114	SOT537	5.9	16.4	2.2	8	24	A
TFBGA							
TFBGA56	SOT542	6.5	6.5	1.7	8	12	A
TFBGA64	SOT543	6.5	6.5	1.7	8	12	A
TFBGA80	SOT557	7.3	7.3	2.3	12	16	A
PLCC							
PLCC28	SOT261	13.0	13.0	4.9	16	24	A
PLCC44	SOT187	18.0	18.0	5.7	24	32	B
PLCC52	SOT238	20.5	20.5	5.3	24	32	B
PLCC68	SOT188	25.6	25.6	5.8	32	44	B
PLCC84	SOT189	30.7	30.7	5.8	36	44	B
PMFP							
PMFP8	SOT144	specific taping					
QFP							
QFP44	SOT307	13.1	13.1	2.8	24	24	A
QFP52	SOT379	14.2	14.2	2.8	24	24	A
QFP44	SOT205	19.2	19.2	3.0	24	32	B
QFP64	SOT319	19.0	25.0	3.7	32	44	B
QFP64	SOT393	18.0	18.0	3.6	24	32	B
QFP80	SOT310	19.0	25.0	3.7	32	44	B
QFP80	SOT318	19.0	25.0	3.7	32	44	B
QFP80	SOT496	19.2	19.2	3.0	24	32	B
QFP100	SOT317	19.0	25.0	3.7	32	44	B
QFP100	SOT382	19.0	25.0	3.7	32	44	B
LQFP							
LQFP32	SOT358	9.6	9.6	2.2	12	16	A
LQFP32	SOT401	7.4	7.4	1.75	12	16	A

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER TAPE DIMENSIONS IN mm (see Fig.8)					
		A0	B0	K0	P1	W	TYPE
LQFP44	SOT389	12.35	12.35	2.2	16	24	A
LQFP48	SOT313	9.6	9.6	2.2	12	16	A
LQFP64	SOT314	12.35	12.35	2.2	16	24	A
LQFP64	SOT414	9.6	9.6	2.2	12	16	A
LQFP80	SOT315	14.4	14.4	2.1	20	24	A
LQFP100	SOT407	16.5	16.5	1.9	20	24	A
LQFP128	SOT420	16.5	16.5	1.9	20	24	A
LQFP144	SOT486	22.6	22.6	2.15	32	44	B
HLQFP							
HLQFP100	SOT470	16.5	16.5	1.9	20	24	A
TQFP							
TQFP44	SOT376	12.35	12.35	1.85	16	24	A
TQFP48	SOT545	9.3	9.3	1.8	12	26	A
TQFP80	SOT375	14.4	14.4	2.1	20	24	A
SMS (SIL power)							
SMS13P	SOT517	20.0	24.5	5.2	24	44	B
SO							
SO4	SOT223	7.0	7.4	1.9	8	12	A
SO8	SOT96	6.65	5.4	1.8	8	12	A
SO8	SOT176	10.5	8.0	3.0	12	16	A
SO14	SOT108	6.65	9.65	1.8	8	16	A
SO16	SOT109	6.65	10.45	1.8	8	16	A
SO16	SOT162	11.1	10.95	2.7	12	16	A
SO20	SOT163	11.1	13.5	2.7	12	24	A
SO24	SOT137	11.1	16.1	2.7	12	24	A
SO28	SOT136	11.1	18.5	2.7	12	24	A
SO32	SOT287	10.9	21.2	3.1	16	32	B
SOJ							
SOJ40	SOT449	11.6	26.55	4.4	16	44	B
VSO							
VSO40	SOT158	12.8	16.3	3.0	16	24	A
VSO56	SOT190	16.0	22.3	3.15	20	32	B
SSOP							
SSOP14	SOT337	8.2	6.6	2.5	12	16	A
SSOP16	SOT338	8.2	6.6	2.5	12	16	A
SSOP16	SOT369	6.9	5.4	2.0	8	12	A
SSOP20	SOT266	7.1	7.2	2.0	12	16	A
SSOP20	SOT339	8.2	7.5	2.5	12	16	A

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	CARRIER TAPE DIMENSIONS IN mm (see Fig.8)					
		A0	B0	K0	P1	W	TYPE
SSOP24	SOT340	8.2	8.8	2.5	12	16	A
SSOP24	SOT556	6.65	9.65	1.8	8	16	A
SSOP28	SOT341	8.4	10.9	2.4	12	24	A
SSOP36	SOT378	11.1	16.1	2.7	12	24	A
SSOP48	SOT370	12.0	16.2	3.2	16	32	B
SSOP56	SOT371	12.0	18.7	3.2	16	32	B
HSSOP							
HSSOP20	SOT397	14.7	16.4	4.0	20	32	B
HSSOP20	SOT418	14.7	16.4	4.0	20	32	B
TSSOP							
TSSOP8	SOT505	5.2	3.3	1.6	8	12	A
TSSOP10	SOT552	5.2	3.3	1.6	8	12	A
TSSOP14	SOT402	6.95	5.6	1.6	8	12	A
TSSOP16	SOT403	6.95	5.6	1.6	8	12	A
TSSOP20	SOT360	6.95	7.1	1.6	8	16	A
TSSOP24	SOT355	6.95	8.3	1.6	8	16	A
TSSOP28	SOT361	6.8	10.2	1.6	8	16	A
TSSOP30	SOT607	6.95	8.3	1.6	8	16	A
TSSOP32	SOT487	8.6	11.5	1.5	12	24	A
TSSOP48	SOT362	8.35	13.0	1.6	16	24	A
TSSOP56	SOT364	8.6	14.5	1.8	12	24	A
HTSSOP							
HTSSOP20	SOT527	6.95	7.1	1.6	8	16	A
HTSSOP32	SOT549	8.6	11.5	1.5	12	24	A

Note

1. If only a package type code is given, the data supplied is applicable to all its outline versions.

Packing methods

Chapter 7

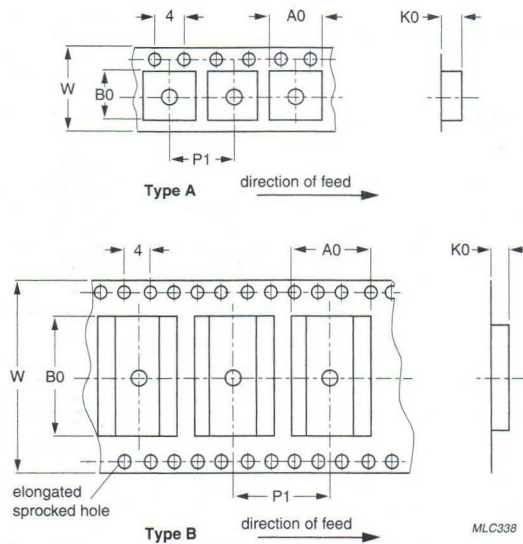


Fig.8 Carrier tape (dimensions in mm).

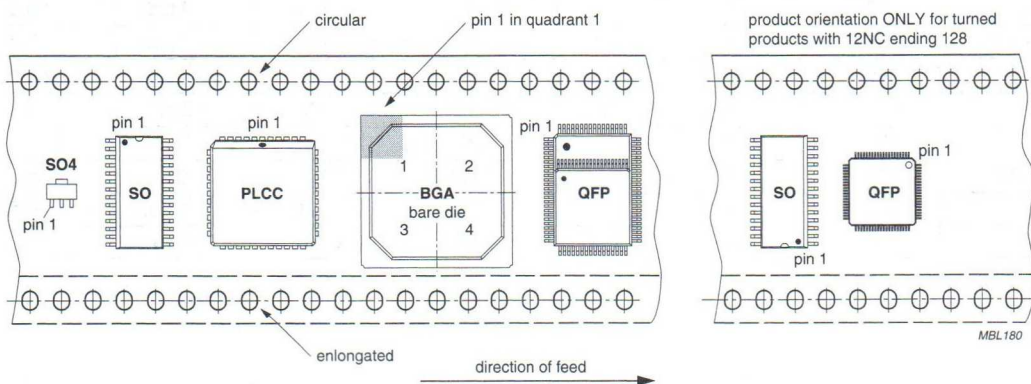


Fig.9 Product orientation in tape.

Packing methods

Chapter 7

JEDEC tray dimensions - surface mount devices (see Fig.10)

BODY SIZE (mm)	POCKETS	COLUMNS	ROWS	COLUMN DIMENSIONS (mm)		ROW DIMENSIONS (mm)	
				C _m	C _s	R _m	R _s
QFP trays							
40 × 40	12	2	6	77.46	29.22	50.56	31.10
32 × 32	24	3	8	41.38	26.57	37.82	25.13
28 × 28	24	3	8	37.02	30.93	37.02	27.93
24 × 24	40	4	10	31.50	20.70	30.40	20.70
20 × 20	60	5	12	25.20	17.55	25.40	17.80
14 × 20	66	6	11	21.00	15.45	27.00	22.50
14 × 20	72	6	12	21.00	15.45	25.40	17.80
14 × 14	84	6	14	21.00	15.45	21.50	17.75
14 × 14	90	6	15	21.00	15.45	20.30	15.40
12 × 12	119	7	17	18.00	13.95	17.90	14.30
10 × 10	96	6	16	19.86	18.30	18.70	17.25
10 × 10	160	8	20	15.70	13.00	15.20	13.10
7 × 7	250	10	25	12.60	11.25	12.60	11.10
5 × 5	360	12	30	10.50	10.20	10.10	11.05
BGA trays							
35 × 35	24	3	8	38.00	29.95	38.00	29.95
27 × 27	40	4	10	29.20	24.15	29.20	26.10
16 × 16	84	6	14	21.40	14.45	22.00	14.50
15 × 15	126	7	18	17.20	16.35	17.20	11.30
10 × 10	184	8	23	13.15	21.92	12.40	21.10
5.5 × 16	240	15	16	t.b.d.	t.b.d.	t.b.d.	t.b.d.
5.5 × 13.5	285	15	19	t.b.d.	t.b.d.	t.b.d.	t.b.d.
8 × 8	348	12	29	t.b.d.	t.b.d.	t.b.d.	t.b.d.
7 × 7	416	13	32	9.40	11.55	9.40	11.80
6 × 6	429	13	33	8.75	15.45	8.85	15.90
5.5 × 5.5	570	15	38	t.b.d.	t.b.d.	t.b.d.	t.b.d.
5 × 5	640	16	40	t.b.d.	t.b.d.	t.b.d.	t.b.d.
4 × 4	810	18	45	6.50	12.70	6.50	14.50

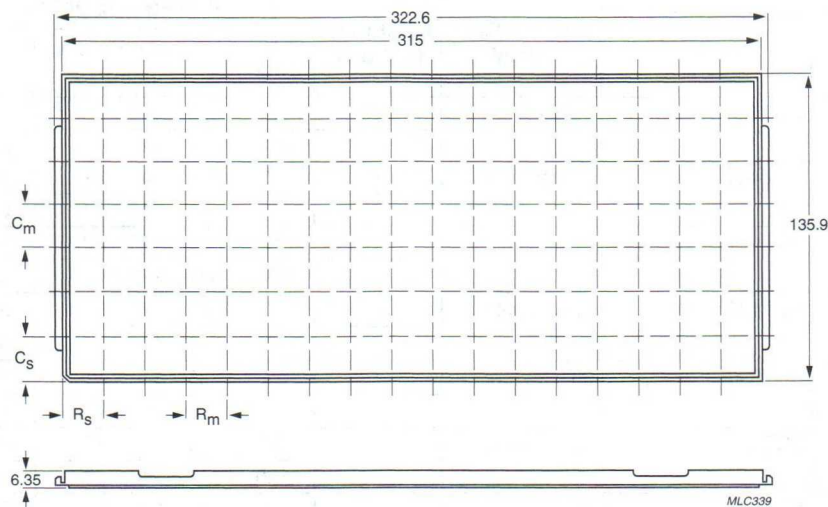


Fig.10 Tray (dimensions in mm).

Packing methods

Chapter 7

Trays - surface mount devices

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	PACKAGE BODY	CARRIERS PER BOX	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
					NON-DRYPACK (mm)	DRYPACK (mm)
BGA156	SOT472	15 × 15 mm	1	126	325 × 145 × 22	352 × 183 × 27
			5	630	348 × 148 × 47	356 × 161 × 56
BGA256	SOT466	27 × 27 mm	1	40	325 × 145 × 22	352 × 183 × 27
			5	200	348 × 148 × 47	356 × 161 × 56
BGA256	SOT471	27 × 27 mm	1	40	325 × 145 × 22	352 × 183 × 27
			5	200	348 × 148 × 47	356 × 161 × 56
BGA292	SOT489	27 × 27 mm	1	40	325 × 145 × 22	352 × 183 × 27
			5	200	348 × 148 × 47	356 × 161 × 56
BGA304	SOT550	35 × 35 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
BGA316	SOT531	35 × 35 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
BGA388	SOT532	35 × 35 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
BGA492	SOT514	35 × 35 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
HBCC24	SOT564	4 × 4 mm	1	810	325 × 145 × 22	352 × 183 × 27
			5	4050	348 × 148 × 47	356 × 161 × 56
HBCC32	SOT560	5 × 5 mm	1	640	325 × 145 × 22	352 × 183 × 27
			5	3200	348 × 148 × 47	356 × 161 × 56
HBCC292	SOT553	27 × 27 mm	1	40	325 × 145 × 22	352 × 183 × 27
			5	200	348 × 148 × 47	356 × 161 × 56
HBCC352	SOT546	35 × 35 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
HLQFP100	SOT470	14 × 14 mm	1	90	325 × 145 × 22	352 × 183 × 27
			5	450	348 × 148 × 47	356 × 161 × 56
HSQFP208	SOT431	28 × 28 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
HSQFP240	SOT464	32 × 32 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
HTQFP32	SOT547	5 × 5 mm	1	360	325 × 145 × 22	352 × 183 × 27
			5	1800	348 × 148 × 47	356 × 161 × 56
HTQFP48	SOT545	7 × 7 mm	1	250	325 × 145 × 22	352 × 183 × 27
			5	1250	348 × 148 × 47	356 × 161 × 56
HTQFP80	SOT513	14 × 14 mm	1	90	325 × 145 × 22	352 × 183 × 27
			5	450	348 × 148 × 47	356 × 161 × 56
LFBGA56	SOT516	6 × 6 mm	1	429	325 × 145 × 22	352 × 183 × 27
			5	2145	348 × 148 × 47	356 × 161 × 56

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	PACKAGE BODY	CARRIERS PER BOX	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
					NON-DRYPACK (mm)	DRYPACK (mm)
LFBGA64	SOT534	8 × 8 mm	1	348	325 × 145 × 22	352 × 183 × 27
			5	1740	348 × 148 × 47	356 × 161 × 56
LFBGA84	SOT518	7 × 7 mm	1	416	325 × 145 × 22	352 × 183 × 27
			5	2080	348 × 148 × 47	356 × 161 × 56
LFBGA96	SOT536	5.5 × 13.5 mm	1	285	325 × 145 × 22	352 × 183 × 27
			5	1425	348 × 148 × 47	356 × 161 × 56
LFBGA114	SOT537	5.5 × 16 mm	1	240	325 × 145 × 22	352 × 183 × 27
			5	1200	348 × 148 × 47	356 × 161 × 56
LFBGA324	SOT571	16 × 16 mm	1	84	325 × 145 × 22	352 × 183 × 27
			5	420	348 × 148 × 47	356 × 161 × 56
LQFP32	SOT358	7 × 7 mm	1	250	325 × 145 × 22	352 × 183 × 27
			5	1250	348 × 148 × 47	356 × 161 × 56
LQFP32	SOT401	5 × 5 mm	1	360	325 × 145 × 22	352 × 183 × 27
			5	1800	348 × 148 × 47	356 × 161 × 56
LQFP44	SOT389	10 × 10 mm	1	160	325 × 145 × 22	352 × 183 × 27
			5	800	348 × 148 × 47	356 × 161 × 56
LQFP48	SOT313	7 × 7 mm	1	250	325 × 145 × 22	352 × 183 × 27
			5	1250	348 × 148 × 47	356 × 161 × 56
LQFP64	SOT314	10 × 10 mm	1	160	325 × 145 × 22	352 × 183 × 27
			5	800	348 × 148 × 47	356 × 161 × 56
LQFP64	SOT414	7 × 7 mm	1	250	325 × 145 × 22	352 × 183 × 27
			5	1250	348 × 148 × 47	356 × 161 × 56
LQFP80	SOT315	12 × 12 mm	1	119	325 × 145 × 22	352 × 183 × 27
			5	595	348 × 148 × 47	356 × 161 × 56
LQFP100	SOT407	14 × 14 mm	1	90	325 × 145 × 22	352 × 183 × 27
			5	450	348 × 148 × 47	356 × 161 × 56
LQFP128	SOT420	14 × 14 mm	1	90	325 × 145 × 22	352 × 183 × 27
			5	450	348 × 148 × 47	356 × 161 × 56
LQFP128	SOT425	14 × 20 mm	1	72	325 × 145 × 22	352 × 183 × 27
			5	360	348 × 148 × 47	356 × 161 × 56
LQFP144	SOT486	20 × 20 mm	1	60	325 × 145 × 22	352 × 183 × 27
			5	300	348 × 148 × 47	356 × 161 × 56
LQFP160	SOT435	24 × 24 mm	1	40	325 × 145 × 22	352 × 183 × 27
			5	200	348 × 148 × 47	356 × 161 × 56
LQFP176	SOT506	24 × 24 mm	1	40	325 × 145 × 22	352 × 183 × 27
			5	200	348 × 148 × 47	356 × 161 × 56
LQFP208	SOT459	28 × 28 mm	1	36	325 × 145 × 22	352 × 183 × 27
			5	180	348 × 148 × 47	356 × 161 × 56

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	PACKAGE BODY	CARRIERS PER BOX	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
					NON-DRYPACK (mm)	DRYPACK (mm)
MSQFP240	SOT474	32 × 32 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
QFP44	SOT205	14 × 14 mm	1	84	325 × 145 × 22	352 × 183 × 27
			5	420	348 × 148 × 47	356 × 161 × 56
QFP44	SOT307	10 × 10 mm	1	96	325 × 145 × 22	352 × 183 × 27
			5	480	348 × 148 × 47	356 × 161 × 56
QFP52	SOT379	10 × 10 mm	5	480	348 × 148 × 47	356 × 161 × 56
QFP64	SOT319	14 × 20 mm	1	66	325 × 145 × 22	352 × 183 × 27
			5	330	348 × 148 × 47	356 × 161 × 56
QFP64	SOT393	14 × 14 mm	1	84	325 × 145 × 22	352 × 183 × 27
			5	420	348 × 148 × 47	356 × 161 × 56
QFP80	SOT310	14 × 20 mm	1	66	325 × 145 × 22	352 × 183 × 27
			5	330	348 × 148 × 47	356 × 161 × 56
QFP80	SOT318	14 × 20 mm	1	66	325 × 145 × 22	352 × 183 × 27
			5	330	348 × 148 × 47	356 × 161 × 56
QFP80	SOT496	14 × 14 mm	1	84	325 × 145 × 22	352 × 183 × 27
			5	420	348 × 148 × 47	356 × 161 × 56
QFP100	SOT317	14 × 20 mm	1	66	325 × 145 × 22	352 × 183 × 27
			5	330	348 × 148 × 47	356 × 161 × 56
QFP100	SOT382	14 × 20 mm	1	66	325 × 145 × 22	352 × 183 × 27
			5	330	348 × 148 × 47	356 × 161 × 56
QFP120	SOT349	28 × 28 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
QFP128	SOT320	28 × 28 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
QFP144	SOT573	28 × 28 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
QFP160	SOT322	28 × 28 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
SQFP128	SOT387	14 × 20 mm	1	66	325 × 145 × 22	352 × 183 × 27
			5	330	348 × 148 × 47	356 × 161 × 56
SQFP208	SOT316	28 × 28 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
SQFP240	SOT334	32 × 32 mm	1	24	325 × 145 × 22	352 × 183 × 27
			5	120	348 × 148 × 47	356 × 161 × 56
SQFP304	SOT575	40 × 40 mm	1	12	325 × 145 × 22	352 × 183 × 27
			5	60	348 × 148 × 47	356 × 161 × 56
TFBGA56	SOT542	6 × 6 mm	1	429	325 × 145 × 22	352 × 183 × 27
			5	2145	348 × 148 × 47	356 × 161 × 56

Packing methods

Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE ⁽¹⁾	PACKAGE BODY	CARRIERS PER BOX	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H	
					NON-DRYPACK (mm)	DRYPACK (mm)
TFBGA64	SOT543	6 × 6 mm	1	429	325 × 145 × 22	352 × 183 × 27
			5	2145	348 × 148 × 47	356 × 161 × 56
TFBGA80	SOT557	7 × 7 mm	1	416	325 × 145 × 22	352 × 183 × 27
			5	2580	348 × 148 × 47	356 × 161 × 56
TQFP44	SOT376	10 × 10 mm	1	160	325 × 145 × 22	352 × 183 × 27
			5	800	348 × 148 × 47	356 × 161 × 56
TQFP64	SOT357	10 × 10 mm	1	160	325 × 145 × 22	352 × 183 × 27
			5	800	348 × 148 × 47	356 × 161 × 56
TQFP80	SOT375	12 × 12 mm	1	119	325 × 145 × 22	352 × 183 × 27
			5	595	348 × 148 × 47	356 × 161 × 56
TQFP100	SOT386	14 × 14 mm	1	90	325 × 145 × 22	352 × 183 × 27
			5	450	348 × 148 × 47	356 × 161 × 56

Note

1. If only a package type code is given, the data supplied is applicable to all its outline versions.

CHAPTER 8

ENVIRONMENTAL DATA ON ICs

	page
Introduction	8 - 2
Explanation of the tables	8 - 2
Substances not used by Philips Semiconductors	8 - 5
Disposal	8 - 6
Recycling	8 - 6
General warnings	8 - 6
Plastic ball grid array packages	8 - 7
Low profile fine pitch ball grid array package	8 - 8
Dual in-line packages	8 - 9
Shrink dual in-line packages	8 - 10
Small outline packages	8 - 11
Shrink small outline packages	8 - 12
Thin shrink small outline packages	8 - 13
Plastic leaded carrier packages	8 - 14
Quad flat packages	8 - 15
Low profile quad flat packages	8 - 16
Through hole power packages	8 - 17
Through hole medium power packages	8 - 18
Heatslug small outline packages	8 - 19
Thin quad flat packages	8 - 20

Environmental data on ICs

Chapter 8

INTRODUCTION

Nowadays, everyone must accept responsibility for keeping the environment clean, from individuals adopting a responsible attitude to their own waste disposal, however small that may be, to big industries who must take proper precautions to avoid releasing large amounts of damaging waste into the environment.

As a leading electronic components manufacturer, Philips Semiconductors has always regarded environmental protection as a major issue. The electronics industry, like many others, produces its share of toxic and hazardous materials, and we have long made it our policy to follow working practices that cut the chance of these materials passing into the environment to the absolute minimum.

Products supplied by Philips Semiconductors today offer no hazard to the environment in normal operation and when stored according to the instructions given in our data sheets. Inevitably, some products contain substances that are potentially hazardous to health if exposed by accident or misuse, but we ensure that users of these components receive clear warning of this in the data sheets. And where necessary, the warning notices contain safety precautions and disposal instructions.

This Chapter supplements these notices and instructions by providing clear and comprehensive information on the composition of representative examples of ICs manufactured by Philips Semiconductors. This information should form a basis for answering questions on product safety and disposal and should, moreover, help to increase awareness of these aspects, not only throughout the Philips Semiconductors organization but throughout the semiconductor industry in general.

EXPLANATION OF THE TABLES

The following pages provide the chemical constituents of representative groups of IC packages down to minor percentages and traces, as far as these constituents may be important to the use, destruction or disposal of the components.

The tables contain information about the materials used in the semiconductor devices themselves and in the packing used for storage, transport and assembly.

Whenever possible, the devices have been grouped into families based on the similarity in composition, construction and packing method. In this way we were able to limit the number of tables. For each group, one representative is specified in mass percentages of its parts.

In many cases, a single encapsulation type will contain a range of differing leadframes with different die-pad dimensions to accommodate the active devices. This, however, leads to only minor changes in the mass percentages. Different materials or techniques are sometimes used to assemble one encapsulation type, and whenever possible, alternative materials are included in the tables. In other cases only the standard or high-volume process is described.

Per page, the product family is defined and the types identified by the Philips package code number. Additionally, reference is made to usual names or to the JEDEC code (when applicable). The mass (grams) and body dimensions (mm) and the packing quantity are also specified.

The table itself shows the composition of the group representative broken down into the device-parts:

- metal parts
- crystal
- encapsulation (plastic, glass or ceramic)
- packing materials

The device-parts are specified in milligrams (mg). These figures are as accurate as possible for the group representative shown. Other devices from the same group may differ considerably in mass. The amount of packing material, specified in grams, per device can be found by dividing the weight of the packing material by the packing quantity. For more detailed information on packing, refer to *Chapter 7, Packing methods*.

Metal parts

The composition of the leadframe material is indicated, when appropriate, by the method commonly used for alloys, e.g.:

- FeNi42 means iron alloy containing 42% of nickel (alloy 42).
- CuZn15 means copper alloy containing 15% zinc (tombac).
- Cu alloy indicates copper with a small amount of alloying elements such as Fe, Ni, Zn or Ag or combinations of some elements.

Crystal

The active device is usually a silicon chip doped with very small amounts of elements such as boron, arsenic or phosphorus. The back may be metallized with thin layers of titanium, nickel, platinum, gold or silver to enhance die-bonding to the leadframe.

Environmental data on ICs

Chapter 8

Encapsulation

The chip is protected by a ceramic, plastic, glass or metal encapsulation.

Glass will contain SiO_2 plus a number of oxides of Ba, K, Pb, Zn and Mn. These elements are, however, immobilized and will not be extracted by acids, unless the glass is ground.

The plastic encapsulation is usually based on ortho cresol novolac (OCN) -epoxy or on biphenyl-epoxy, filled with quartz particles (fused or crystalline) up to approximately 70 mass percent. In all cases (except SOT54), antimony trioxide and tetrabromobisphenol-A (TBBA) are present as flame retardants. The TBBA will be incorporated in the epoxy-polymer after curing so that no TBBA is present in the finished device. It has become a partially brominated epoxy. The flammability of all moulding compounds rates typically UL94-V0 at 1/8 inch.

Packing material

Cardboard and paper consist mainly of natural fibres. The carbon layer for ESD protection does not hamper the recyclability of the cardboard.

Polyethylene, polypropylene and polystyrene are synthetic polymers made from hydrocarbons.

Polyvinylchloride (PVC), a synthetic polymer made from chlorinated hydrocarbons, is used for the tubes in which many semiconductors are packed. PVC is hazardous to the environment when burned under certain, ill-controlled conditions. PVC is, however, readily recyclable when the material is collected separately (as a mono-material). Therefore the endpins, turnlocks and soft rubber stoppers in the PVC-tubes are now replaced by PVC to enhance recycling.

The reuse of the polystyrene (PS) reels is encouraged by requesting all our customers to return the reels after use to Semi-cycle. Information and addresses are printed on the boxes in which the reels are delivered. Philips Semiconductors' intention is to buy used reels, when available, thus closing the product life circle to lower the amount of wasted packing materials.

To encourage recycling, Philips Semiconductors marks the packing materials according to ISO 11469 using the recycling symbols shown in Figs 1 to 8. Figure 1 shows the symbol for paper and cardboard, Figs 2 to 8 show the symbols for various plastics.



Fig.1 Paper and cardboard.



Fig.2 Polyethylene terephthalate.



Fig.3 Polyethylene, high density.



Fig.4 Polyvinylchloride.



Fig.5 Polyethylene, low density.



Fig.6 Polypropylene.



Fig.7 Polystyrene.



Fig.8 Other plastics. The acronym of the plastic is put under the recycling symbol. In this example: PA = polyamide.

SUBSTANCES NOT USED BY PHILIPS SEMICONDUCTORS

Below are listed the materials and substances that are **not** present in Philips Semiconductors' products and processes. This information supplements the chemical contents tables that follow and is provided to enable equipment manufacturers to make a complete and confident assessment of the environmental impact of selecting products manufactured by Philips Semiconductors.

Substances not used in products

- 4-aminodiphenyl and its salts
- ammonium salts
- arsenic
- asbestos
- benzene
- cadmium and compounds
- creosote
- cyantes
- cyanides
- 4,4-diaminophenyl methane
- dibenzofurans
- epichlorhydrine
- ethylene glycol ethers
- formaldehyde
- halogenated aliphatic hydrocarbons
- hydrazine
- mercury and compounds
- N-nitrosoamines
- 2-naphthylamine and its salts
- nickel tetracarbonyl
- N,N-dimethylformamide
- N,N-dimethylacetamide
- oils and greases
- organometallic compounds (e.g. org. tin compounds)
- ozone-depleting compounds
- pentachlorophenol
- phenol compounds
- (nonyl)-phenol ethoxylates
- phtalates
- picric acid
- polybrominated biphenyl oxides (PBBO)
- polybrominated biphenyls (PBB/PBBE)
- polychlorinated triphenyls (PCT)
- polychlorinated naphthalenes
- polychlorinated biphenyls (PCB)
- polycyclic compounds
- polyhalogenated dibenzofurans/dioxins
- polyhalogenated bi/triphenyl ethers
- selenium
- tellurium
- tetrabromobenzylimidazole
- tetrabromoethylene
- toluene
- triethylamine
- tris (aziridiny) phosphin oxide
- tris (2,3-dibromopropyl) phosphate
- vinyl chloride monomer
- xylene

Substances not used in manufacturing processes

Philips Semiconductors has eliminated all Ozone Depleting Substances, referred to as Class I and II in the Montreal Protocol and its amendments. This means that our products, in compliance with the US Clean Air Act, do not have to be labelled.

We have also eliminated, voluntarily, the use of chlorinated hydrocarbons such as perchloroethylene and trichloro-ethylene from our manufacturing processes.

Below is a summary of the ozone-depleting substances we have eliminated.

Class I substances:

- fully halogenated chlorofluorocarbons (CFC)
- halons
- carbontetrachloride
- 1,1,1-trichloroethane

Class II substances:

- partially halogenated hydrocarbons (HCFC)

Substances not used in packing materials

- laminates with paper
- bleached paper
- polystyrene flakes (EPS)

Environmental data on ICs

Chapter 8

DISPOSAL

Old or used products must be disposed of in accordance to national and local regulations.

The products and packing materials must be disposed of as special waste. This is required, in particular, for parts containing environmentally hazardous materials, for example beryllium oxide, present in some RF-devices.

Smaller quantities of material may be disposed of as domestic waste, provided national or local regulations permit this.

RECYCLING

Where legally required, we accept packing materials and products for recycling and/or disposal. However, since the cost of returning these materials to us must be borne by the customers, it is often more cost effective for them to look for a local recycle company. To assist in this we can provide customers with the names and addresses of local recycle companies in their areas.

GENERAL WARNINGS

Products

Under the specified operating conditions, no hazardous materials will be liberated from the products. The general warnings describe phenomena that can be expected with

abnormal use (outside the product's specification). For example:

- If a product is exposed to strong acids, metals contained within it may be partially extracted.
- If a product with an epoxy moulded encapsulation is exposed to organic solvents, these may extract part of the resin contained in the encapsulation.
- If the product is incinerated, degradation and condensation reactions in the organic material it contains may cause a number of hazardous substances to be released into the air in unpredictable amounts. Moreover, metal oxides will be formed and may be released into the air as dust particles.
- If products with beryllium heatsinks (RF transistors) are damaged, toxic beryllium oxide dust may be released into the air.

Packing material

- With adequate oxygen supply, packing materials will give off mainly carbon dioxide and water if burned. However, if they are burned in a limited oxygen supply (the general case in a fire), hazardous compounds (for example carbon monoxide) may be emitted.
- PVC will form hydrochloric acid gas when incinerated. It will also generate a number of other chlorine compounds, among them the toxic dioxin, when the conditions (temperature, oxygen) are not well controlled.

Environmental data on ICs

Chapter 8

PLASTIC BALL GRID ARRAY PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
BGA156	SOT472	0.5	15.00 × 15.00 × 1.15	630
BGA492	SOT514	4.7	35.00 × 35.00 × 1.75	120

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT514 (BGA492)

Device parts

SOURCE	SUBSTANCE	MASS (g)
substrate	epoxy glass filled, with Cu, Ni, Au plated pattern	2.059
solder balls	SnPb37	0.945
encapsulation	epoxy polymer (SiO ₂ approx. 78%, Sb < 1%, Br < 0.6%)	1.449
die-attach	epoxy, Ag filled	0.072
active device	doped silicon	0.147

Packing material (tray pack, dry pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard	113
JEDEC trays	copolymer, carbon loaded	846
bag	aluminium laminated polyethylene	47
drying agent	silica gel	88
humidity indicator	paper + CoCl ₂	1.2
strap	polypropylene	2.2
labels	paper	6.8
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

LOW PROFILE FINE PITCH BALL GRID ARRAY PACKAGE

REFERENCE	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
LFBGA64	SOT534	0.2	8.0 × 8.0 × 1.1	1740
LFBGA96	SOT536	0.2	13.50 × 5.50 × 1.05	1425

Chemical content

SOT536 (LFBGA96)

Device parts

SOURCE	SUBSTANCE	MASS (mg)
substrate	epoxy glass filled, with Cu, Ni, Au plated pattern	46
solder balls	SnPb37	26
encapsulation	OCN-epoxy polymer (SiO ₂ < 72%, Sb < 4%, Br < 0.6%)	79
die attach	epoxy, Ag filled	1
active device	doped silicon	8

Packing material (tray pack, dry pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard	113
trays	copolymer, carbon loaded	846
bag	aluminium laminated polyethylene	35
drying agent	silica gel	85
labels	paper	7

Environmental data on ICs

Chapter 8

DUAL IN-LINE PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
DIP8	SOT97	0.5	6.35 × 9.40 × 3.05	2000
DIP14	SOT27	1.0	6.35 × 19.02 × 3.04	1000
DIP16	SOT38	1.2	6.35 × 21.60 × 3.55	1000
DIP18	SOT102	1.2	6.35 × 23.37 × 3.05	800
DIP20	SOT146	1.3	6.35 × 26.60 × 3.04	720
DIP22	SOT116	2.2	8.64 × 27.80 × 3.81	720
DIP24	SOT101	3.8	13.80 × 31.70 × 3.85	360
DIP28	SOT117	4.3	13.80 × 35.70 × 3.85	312
DIP32	SOT201	4.7	13.97 × 41.10 × 3.81	264
DIP40	SOT129	6.2	13.80 × 52.00 × 3.85	216
DIP48	SOT240	7.7	14.02 × 61.70 × 4.10	168
HDIP18	SOT398	1.5	6.35 × 21.60 × 3.55	1000

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT129 (DIP40)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy ⁽¹⁾	1294
	Sn plating	20
active device	doped Si	30
encapsulation	OCN-epoxy polymer (SiO ₂ < 72%, Sb < 4%, Br < 0.6%)	4870

Note

1. Alternative: SnPb plated.

Packing material (tube pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	145
tubes	polyvinylchloride	840
end pins	polyvinylchloride	5.6
strap	polypropylene	0.7
labels	paper	1.7
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

SHRINK DUAL IN-LINE PACKAGES

REFERENCE	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
SDIP24	SOT234	1.7	$8.90 \times 21.86 \times 3.65$	1000
SDIP32	SOT232	2.2	$8.90 \times 28.89 \times 3.65$	760
SDIP42	SOT270	4.5	$13.80 \times 38.60 \times 3.85$	420
SDIP52	SOT247	5.6	$13.80 \times 47.50 \times 3.85$	330
SDIP56	SOT400	6.1	$13.80 \times 52.00 \times 3.85$	216
SDIP64	SOT274	9.0	$17.00 \times 58.16 \times 4.25$	160

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT270 (SDIP42)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	1000
	Sn plating ⁽¹⁾	20
active device	doped Si	30
chip coating	silicon gel ⁽²⁾	10
encapsulation	OCN-epoxy polymer ($\text{SiO}_2 < 72\%$, $\text{Sb} < 4\%$, $\text{Br} < 0.6\%$)	3520

Notes

1. Optional: SnPb plating.
2. Not used for all packages.

Packing material (tube pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	165
tubes	polyvinylchloride	1200
end pins	polyvinylchloride	6.8
strap	polypropylene	1
labels	paper	1.7
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

SMALL OUTLINE PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (mg)	BODY (mm)	PACKING QUANTITY
SO8	SOT96	0.1	3.90 × 4.90 × 1.35	2500
SO8	SOT176	0.3	7.50 × 7.50 × 2.35	1000
SO14	SOT108	0.1	3.90 × 8.65 × 1.35	2500
SO16	SOT109	0.1	3.90 × 9.90 × 1.47	2500
SO16	SOT162	0.4	7.50 × 10.20 × 2.35	1000
SO20	SOT163	0.5	7.50 × 12.70 × 2.35	1000
SO24	SOT137	0.6	7.50 × 15.30 × 2.35	1000
SO28	SOT136	0.7	7.50 × 17.90 × 2.35	1000
SO32	SOT287	0.8	7.50 × 20.50 × 2.35	1000
VSO40	SOT158	0.6	7.50 × 15.30 × 2.35	500
VSO56	SOT190	1.3	11.00 × 21.50 × 2.85	500

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT163 (SO20)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	130
	SnPb15 plating ⁽¹⁾	5
active device	doped Si	15
chip coating	silicone gel ⁽²⁾	5
encapsulation	OCN-epoxy polymer (SiO ₂ < 72%, Sb < 4%, Br < 0.6%)	370

Notes

1. Leadframe for VSO is FeNi.
 2. Not used for all packages.

Packing material (reel pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	174
reel	polystyrene	260
carrier tape	polystyrene, carbon loaded	112
cover tape	polyester	17
labels	paper	1
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

SHRINK SMALL OUTLINE PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (mg)	BODY (mm)	PACKING QUANTITY
SSOP14	SOT337	0.1	5.30 × 6.20 × 1.75	2000
SSOP16	SOT338	0.1	5.30 × 6.20 × 1.75	2000
SSOP16	SOT369	0.1	4.40 × 5.20 × 1.25	2500
SSOP20	SOT266	0.1	4.40 × 6.50 × 1.25	2500
SSOP20	SOT339	0.1	5.30 × 7.20 × 1.73	2500
SSOP24	SOT340	0.2	5.30 × 8.20 × 1.73	2000
SSOP28	SOT341	0.2	5.30 × 10.20 × 1.73	2000
SSOP48	SOT370	0.6	7.50 × 15.90 × 2.30	1000
SSOP56	SOT371	0.7	7.50 × 18.40 × 2.30	1000

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT339 (SSOP20)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	40
	SnPb15 plating	4.5
active device	doped Si	2.5
encapsulation	biphenyl-epoxy polymer (SiO ₂ approx. 80%, Sb < 2%, Br < 0.6%)	107

Packing material (reel pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	165
reel	polystyrene	250
carrier tape	polystyrene, carbon loaded	177
cover tape	polyester	25
labels	paper	1
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

THIN SHRINK SMALL OUTLINE PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (mg)	BODY (mm)	PACKING QUANTITY
TSSOP14	SOT402	0.1	4.40 × 5.00 × 0.90	2500
TSSOP16	SOT403	0.1	4.40 × 5.00 × 0.90	2500
TSSOP20	SOT360	0.1	4.40 × 6.50 × 0.90	2500
TSSOP24	SOT355	0.1	4.40 × 7.80 × 0.90	2500
TSSOP28	SOT361	0.1	4.40 × 9.70 × 0.90	2500
TSSOP32	SOT487	0.2	6.10 × 11.00 × 0.90	2000
TSSOP48	SOT362	0.2	6.10 × 12.50 × 0.90	2000
TSSOP56	SOT364	0.2	6.10 × 14.00 × 0.90	2000

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT355 (TSSOP24)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	CuNi3	32
	SnPb15 plating	8
active device	doped Si	6
encapsulation	biphenyl-epoxy polymer (SiO ₂ approx. 80%, Sb < 2%, Br < 0.6%)	48

Packing material (reel pack, dry pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard	203
reel	polystyrene	288
carrier tape	polystyrene, carbon loaded	177
cover tape	polyester	16
bag	aluminium laminated polyethylene	94
drying agent	silica gel	88
humidity indicator	paper + CoCl ₂	1.2
labels	paper	3.7

Environmental data on ICs

Chapter 8

PLASTIC LEADED CHIP CARRIER PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (mg)	BODY (mm)	PACKING QUANTITY
PLCC28	SOT261	1.2	11.48 × 11.48 × 3.86	2368
PLCC44	SOT187	2.3	16.56 × 16.56 × 3.86	1300
PLCC52	SOT238	2.9	19.15 × 19.15 × 3.86	1012
PLCC52	SOT433	1.9	19.05 × 19.05 × 2.43	1242
PLCC68	SOT188	2.3	24.18 × 24.18 × 3.81	648
PLCC84	SOT189	6.7	29.24 × 29.24 × 3.68	420

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT187 (PLCC44)

Device parts

DEVICE	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	390
	SnPb15 plating	25
active device	doped Si	70
chip coating	silicone gel ⁽¹⁾	25
encapsulation	OCN-epoxy polymer (SiO ₂ < 72%, Sb < 1.2%, Br < 1.3%)	1770

Note

1. Not used for all packages.

Packing material (tube pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	145
tubes	polyvinylchloride	1050
end plugs	polyvinylchloride	126
strap	polypropylene	0.7
labels	paper	1.8
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

QUAD FLAT PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
QFP44	SOT205	0.9	14.00 × 14.00 × 2.20	420
QFP44	SOT307	0.4	10.00 × 10.00 × 1.75	480
QFP52	SOT379	0.5	10.00 × 10.00 × 2.00	600
QFP64	SOT319	1.7	14.00 × 20.00 × 2.75	330
QFP64	SOT393	1.2	14.00 × 14.00 × 2.67	600
QFP80	SOT310	1.8	14.00 × 20.00 × 3.00	330
QFP80	SOT318	1.8	14.00 × 20.00 × 2.75	330
QFP100	SOT317	1.7	14.00 × 20.00 × 2.75	330
QFP100	SOT382	1.8	14.00 × 20.00 × 2.80	330
QFP128	SOT320	5.1	28.00 × 28.00 × 3.35	120
QFP160	SOT322	5.1	28.00 × 28.00 × 3.35	120
SQFP128	SOT387	1.7	14.00 × 20.00 × 2.72	500
SQFP208	SOT316	5.1	28.00 × 28.00 × 3.35	120

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT319 (QFP64)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	320
	SnPb15 plating	10
active device	doped Si	20
chip coating	silicone gel ⁽¹⁾	10
encapsulation	biphenyl-epoxy polymer (SiO ₂ approx. 80%, Sb < 2%, Br < 0.6%)	1360

Note

1. Not used for all packages.

Packing material (tray pack, dry pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard	113
JEDEC trays	copolymer, carbon loaded	850
bag	aluminium laminated polyethylene	47
drying agent	silica gel	88
humidity indicator	paper + CoCl ₂	1.2
strap	polypropylene	2.2
labels	paper	2.6
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

LOW PROFILE QUAD FLAT PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (mg)	BODY (mm)	PACKING QUANTITY
LQFP32	SOT358	0.2	7.00 × 7.00 × 1.40	2000
LQFP32	SOT401	0.1	5.00 × 5.00 × 1.40	2000
LQFP44	SOT389	2.6	10.00 × 10.00 × 1.40	1500
LQFP48	SOT313	0.2	7.00 × 7.00 × 1.40	2000
LQFP64	SOT314	0.4	10.00 × 10.00 × 1.40	1500
LQFP64	SOT414	0.3	7.00 × 7.00 × 1.40	1250
LQFP80	SOT315	0.5	12.00 × 12.00 × 1.40	1000
LQFP100	SOT407	0.7	14.00 × 14.00 × 1.40	1000
LQFP128	SOT420	0.6	14.00 × 14.00 × 1.40	1000
LQFP128	SOT425	0.8	14.00 × 20.00 × 1.40	1000
LQFP144	SOT486	1.2	20.00 × 20.00 × 1.40	300
LQFP160	SOT435	1.8	24.00 × 24.00 × 1.40	200
LQFP176	SOT506	1.9	24.00 × 24.00 × 1.40	200
LQFP208	SOT459	2.4	28.00 × 28.00 × 1.40	180

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT315 (LQFP80)

Device parts

SOURCE	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	140
	SnPb15 plating	50
active device	doped Si	40
chip coating	silicone gel ⁽¹⁾	10
encapsulation	biphenyl-epoxy polymer (SiO ₂ approx. 80%, Sb < 2%, Br < 0.6%)	220

Note

1. Not used for all packages.

Packing material (reel pack, dry pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard	203
reel	polystyrene	348
bag	aluminium laminated polyethylene	68
drying agent	silica acid	88
humidity indicator	paper + CoCl ₂	1.2
carrier tape	polystyrene	165
cover tape	polyester	16
labels	paper	3.7

Environmental data on ICs

Chapter 8

THROUGH HOLE POWER PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
DBS9P	SOT157	4.8	12.00 × 23.70 × 4.40	552
DBS13P	SOT141	4.8	12.00 × 23.70 × 4.40	552
DBS17P	SOT243	4.7	12.00 × 23.70 × 4.40	552
DBS17P	SOT475	4.7	12.00 × 23.70 × 4.40	552
DBS23P	SOT411	6.0	12.00 × 30.20 × 4.45	432
RDBS13P	SOT462	4.8	12.00 × 23.70 × 4.40	552
SIL9P	SOT131	4.3	12.00 × 23.70 × 4.40	552
SIL13P	SOT193	3.0	12.00 × 23.70 × 4.40	552
SMS9P	SOT354	4.7	12.00 × 23.70 × 4.40	552
SMS13P	SOT517	4.7	1.002 × 23.70 × 4.40	552

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT243 (DBS17P)

Device parts

SOURCE	SUBSTANCE	MASS (mg)
leadframe ⁽¹⁾	Cu alloy	900
	Sn plating	20
heatsink	Cu	2350
die attach	SnAg25Sb10 ⁽¹⁾	25
active device	doped Si	30
chip coating	silicone gel ⁽²⁾	10
encapsulation	OCN-epoxy polymer (SiO ₂ < 72%, Sb < 4%, Br < 0.6%)	1375

Notes

1. Alternative: epoxy, Ag filled.
 2. Not used for all packages.

Packing material (tube pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	145
tubes	polyvinylchloride	792
end plugs	polyvinylchloride	21.6
strap	polypropylene	0.7
labels	paper	1.7
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

THROUGH HOLE MEDIUM POWER PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
DBS9MPF	SOT111	1.8	6.35 × 21.60 × 3.55	748
RBS9MPF	SOT352	1.8	6.35 × 21.60 × 3.55	924
SIL9MP	SOT142	1.4	6.35 × 21.60 × 3.55	748
SIL9MPF	SOT110	1.8	6.35 × 21.60 × 3.55	748

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT110 (SIL9MPF)

Device parts

SOURCE	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	1000
	Sn plating	20
active device	doped Si	30
chip coating	silicone gel ⁽¹⁾	10
encapsulation	OCN-epoxy polymer (SiO ₂ < 72%, Sb < 4%, Br < 0.6%)	1375

Note

1. Not used for all packages.

Packing material (tube pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	145
tubes	polyvinylchloride	1925
end plugs	polyvinylchloride	27.2
foam	polyethylene	7.5
strap	polypropylene	15
labels	paper	1.8
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

HEATSLUG SMALL OUTLINE PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
HSOP20	SOT397	2.1	11.00 × 15.90 × 3.15	500
HSOP20	SOT418	2.1	11.00 × 15.90 × 3.15	500

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT418 (HSOP20)

Device parts

SOURCE	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	130
	SnPb15 plating	13
heatsink	Cu	1190
die attach	SnAg25Sb10 ⁽¹⁾	10
active device	doped Si	30
chip coating	silicone gel ⁽²⁾	10
encapsulation	OCN-epoxy polymer (SiO ₂ < 72%, Sb < 4%, Br < 0.6%)	700

Notes

1. Alternative: epoxy, Ag filled.
2. Not used for all packages.

Packing material (reel)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	174
reel	polystyrene	260
carrier tape	polystyrene, carbon loaded	150
cover tape	polyester	14
labels	paper	1.3
seal	acrylate	0.2

Environmental data on ICs

Chapter 8

THIN QUAD FLAT PACKAGES

REFERENCE ⁽¹⁾	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
TQFP44	SOT376	0.3	10.00 × 10.00 × 1.00	1500
TQFP64	SOT357	0.3	10.00 × 10.00 × 1.00	1500
TQFP80	SOT375	0.4	12.00 × 12.00 × 1.00	595
TQFP100	SOT386	0.5	14.00 × 14.00 × 1.00	450
HTQFP80	SOT513	0.5	14.00 × 14.00 × 1.00	450

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT376 (TQFP44)

Device parts

SOURCE	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	90
	SnPb15 plating	15
active device	doped Si	8
encapsulation	biphenyl-epoxy polymer (SiO ₂ approx. 80%, Sb <2%, Br < 0.6%)	180

Packing material (reel dry pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard, carbon coated	139
reel	polystyrene	280
carrier tape	polystyrene, carbon loaded	180
cover tape	polyester	39
labels	paper	1
seal	acrylate	0.2

DATA HANDBOOK SYSTEM

Data handbook system

Chapter 9

DATA HANDBOOK SYSTEM

Philips Semiconductors data handbooks contain all pertinent data available at the time of publication and each is revised and reissued regularly.

Loose data sheets are sent to subscribers to keep them up-to-date on additions or alterations made during the lifetime of a data handbook.

Catalogues are available for selected product ranges (some catalogues are also on floppy discs).

Our data handbook titles are listed here.

Integrated circuits

Book	Title
IC03	Semiconductors for Wired Telecom Systems
IC04	HE4000B Logic Family CMOS
IC05	Advanced Low-power Schottky (ALS) Logic
IC06	High-speed CMOS Logic Family
IC11	General-purpose/Linear ICs
IC12	I ² C Peripherals
IC14	8048-based 8-bit Microcontrollers
IC15	FAST TTL Logic Series
IC16	CMOS ICs for Clocks, Watches and Real Time Clocks
IC17	Semiconductors for Wireless Communications
IC19	ICs for Data Communications
IC23	BiCMOS Bus Interface Logic
IC24	Low Voltage CMOS & BiCMOS Logic
IC26	Integrated Circuit Packages
IC28	80C51 and XA Microcontrollers

Discrete semiconductors

Book	Title
SC03	Power Thyristors and Triacs
SC06	Power Bipolar Transistors
SC07	Small-signal Field-effect Transistors and Diodes
SC10	Small-signal Transistors and Diodes
SC11	Power Diodes
SC13	PowerMOS Transistors
SC14	RF Wideband Transistors
SC16	Wideband Hybrid Amplifier Modules for CATV
SC17	Semiconductor Sensors
SC18	Discrete Semiconductor Packages
SC19	RF & Microwave Power Transistors and RF Power Modules

MORE INFORMATION FROM PHILIPS SEMICONDUCTORS?

For more information about Philips Semiconductors data handbooks, catalogues and subscriptions contact your nearest Philips Semiconductors national organization, select from the **address list on the back cover of this handbook**. Product specialists are at your service and enquiries are answered promptly.

Data handbook system

Chapter 9

OVERVIEW OF PHILIPS COMPONENTS
DATA HANDBOOKS

Our sister product division, Philips Components, also has a comprehensive data handbook system to support their products. Their data handbook titles are listed here.

Display Components

Book	Title
DC01	Colour Television and Multimedia Tubes
DC02	Monochrome Monitor Tubes and Deflection Units
DC03	Television Tuners, Coaxial Aerial Input Assemblies
DC04	Colour Monitor and Multimedia Tubes
DC05	Wire Wound Components

Advanced Ceramics & Modules

ACM1 (MA01)	Soft Ferrites
ACM2	Discrete Ceramics
ACM3 (MA03)	Piezoelectric Ceramics and Specialty Ferrites

BC Components

BC01	Electrolytic Capacitors
BC02	Varistors, Thermistors and Sensors
BC03	Potentiometers
PA04	Variable Capacitors
PA05	Film Capacitors
BC06	Leaded Ceramic Capacitors
PA06a	Surface Mounted Ceramic Multilayer Capacitors
PA06b	Leaded Ceramic Capacitors
PA08	Fixed Resistors
PA10	Quartz Crystals
PA11	Quartz Oscillators

MORE INFORMATION FROM
PHILIPS COMPONENTS?

For more information contact your nearest Philips Components national organization shown in the following list.

Australia: Homebush, Tel. +61 2 9704 8141, Fax. +61 2 9704 8139
Austria: Wien, Tel. +43 1 60 101 12 41, Fax. +43 1 60 101 12 11
Belarus: Minsk, Tel. +375 172 200 924/733, Fax. +375 172 200 773
Benelux: Eindhoven, Tel. +31 40 25 90 772, Fax. +31 40 25 90 777
Brazil: São Paulo, Tel. +55 11 3841 2338, Fax. +55 11 829 1849
Canada: Scarborough, Tel. 1 416 292 5161, Fax. 1 416 754 6248
China: Shanghai, Tel. +86 21 6354 1088, Fax. +86 21 6354 1060
Denmark: Copenhagen, Tel. +45 3329 3333, Fax. +45 3329 3905
Finland: Espoo, Tel. 358 9 615 800, Fax. 358 9 615 80510
France: Suresnes, Tel. +33 1 4099 6161, Fax. +33 1 4099 6493
Germany: Hamburg, Tel. +49 40 2489-0, Fax. +49 40 2489 1400
Hong Kong: Kowloon, Tel. +852 2784 3000, Fax. +852 2784 3003
India: Mumbai, Tel. +91 22 4930 311, Fax. +91 22 4930 966/4950 304
Indonesia: Jakarta, Tel. +62 21 794 0040, Fax. +62 21 794 0080
Ireland: Dublin, Tel. +353 1 7640 203, Fax. +353 1 7640 210
Israel: Tel Aviv, Tel. +972 3 6450 444, Fax. +972 3 6491 007
Italy: Milano, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557
Japan: Tokyo, Tel. +81 3 3740 5135, Fax. +81 3 3740 5035
Korea (Republic of): Seoul, Tel. +82 2 709 1472, Fax. +82 2 709 1480
Malaysia: Pulau Pinang, Tel. +60 3 750 5213, Fax. +60 3 757 4880
Mexico: El Paso, Tel. +52 915 772 4020, Fax. +52 915 772 4332
New Zealand: Auckland, Tel. +64 9 815 4000, Fax. +64 9 849 7811
Norway: Stockholm, Tel. +46 8 5985 2000, Fax. +46 8 5985 2745
Pakistan: Karachi, Tel. +92 21 587 4641-49, Fax. +92 21 577 035/+92 21 587 4546
Philippines: Manila, Tel. +63 2 816 6345, Fax. +63 2 817 3474
Poland: Warszawa, Tel. +48 22 5710 000, Fax. +48 22 5710 001
Portugal: Linda-A-Velha, Tel. +351 1 416 3160/416 3333, Fax. +351 1 416 3174/416 3366
Russia: Moscow, Tel. +7 95 755 6918, Fax. +7 95 755 6919
Singapore: Singapore, Tel. +65 350 2000, Fax. +65 355 1758
South Africa: Johannesburg, Tel. +27 11 470 5911, Fax. +27 11 470 5494
Spain: Barcelona, Tel. +34 93 301 63 12, Fax. +34 93 301 42 43
Sweden: Stockholm, Tel. +46 8 5985 2000, Fax. +46 8 5985 2745
Switzerland: Zürich, Tel. +41 1 488 22 11, Fax. +41 1 481 7730
Taiwan: Taipei, Tel. +886 2 2134 2900, Fax. +886 2 2134 2929
Turkey: Istanbul, Tel. +90 216 522 1800, Fax. +90 216 522 1814
United Kingdom: Dorking, Tel. +44 1306 512 000, Fax. +44 1306 512 345
United States:

- San Jose, Tel. +1 408 570 5600, Fax. +1 408 570 5700
- Ann Arbor, Tel. +1 734 996 9400, Fax. +1 734 761 2776
- El Paso, Tel. +1 877 250 5996 / +1 915 860 3267, Fax. +1 915 860 3270
- Roswell, Tel. +1 877 443 77483, Fax. +1 770 992 0725

Yugoslavia (Federal Republic of): Belgrade, Tel. +381 11 3341 299, Fax. +381 11 3342 553

Internet:

- Discrete and Ferrite Ceramics: www.acm.components.philips.com
- Display Components: www.philipsdisplay.com

For all other countries apply to:

Philips Components, Marketing Communications, Building BAE-1,
P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands,
Fax. +31-40-2722599

North American Sales Offices, Representatives and Distributors

PHILIPS SEMICONDUCTORS

811 East Arques Avenue
P.O. Box 3409
Sunnyvale, CA 94088-3409

ALABAMA

Huntsville

Philips Semiconductors
Phone: (256) 464-9101
(256) 464-0111

Elcom, Inc.
Phone: (256) 830-4001

ARIZONA

Tempe

Philips Semiconductors
Phone: (602) 820-2225
Centaur Corporation
Phone: (480) 839-2320

CALIFORNIA

Calabasas

Centaur Corporation
Phone: (818) 878-5800

El Dorado

Aspen Technologies, Inc.
Phone: (916) 939-9797

Irvine

Philips Semiconductors
Phone: (949) 453-0770
Centaur Corporation
Phone: (949) 261-2123

San Diego

Philips Semiconductors
Phone: (619) 560-0242
Centaur Corporation
Phone: (619) 278-4950

San Jose/Sunnyvale

B.A.E. Sales, Inc.
Phone: (408) 452-8133

Santa Clara

Aspen Technologies, Inc.
Phone: (408) 988-1300

Woodland Hills

Philips Semiconductors
Phone: (818) 710-1954

COLORADO

Englewood

Philips Semiconductors
Phone: (303) 792-9011
Thom Luke Sales, Inc.
Phone: (303) 649-9717

CONNECTICUT

(Burlington, Massachusetts)

New Tech Solutions, Inc.
Phone: (781) 229-8888

FLORIDA

Clearwater

Elcom, Inc.
Phone: (727) 524-1334

GEORGIA

Duluth

Elcom, Inc.
Phone: (770) 447-8200

IDAHO

(Englewood, Colorado)

Thom Luke Sales, Inc.
Phone: (303) 649-9717

ILLINOIS

Itasca

Philips Semiconductors
Phone: (630) 250-0050

INDIANA

Indianapolis

Mohrfield Marketing, Inc.
Phone: (317) 546-6969

Kokomo

Philips Semiconductors
Phone: (765) 459-5355

Leo

Mohrfield Marketing, Inc.
Phone: (219) 627-5355

KANSAS

(Bloomington, Minnesota)

High Technology Sales, Inc.
Phone: (612) 844-9933

KENTUCKY

(Indianapolis, Indiana)

Mohrfield Marketing, Inc.
Phone: (317) 546-6969

MARYLAND

(Falls Church, Virginia)

S-J Associates, Inc.
Phone: (703) 533-2233

MASSACHUSETTS

Burlington

New Tech Solutions, Inc.
Phone: (781) 229-8888

Chelmsford

Philips Semiconductors
Phone: (978) 367-9000

MICHIGAN

Farmington Hills

Philips Semiconductors
Phone: (248) 848-7600

Novi

Mohrfield Marketing, Inc.
Phone: (248) 380-8100

MINNESOTA

Bloomington

High Technology Sales, Inc.
Phone: (612) 844-9933

MISSOURI

(Bloomington, Minnesota)

High Technology Sales, Inc.
Phone: (612) 844-9933

NEBRASKA

(Bloomington, Minnesota)

High Technology Sales, Inc.
Phone: (612) 844-9933

NEVADA

(Tempe, Arizona)

Centaur Corporation
Phone: (480) 839-2320

NEW JERSEY

Mt. Laurel

S-J Associates, Inc.
Phone: (856) 866-1234

Toms River

Philips Semiconductors
Phone: (732) 505-1200
(732) 240-1479

NEW MEXICO

(Tempe, Arizona)

Centaur Corporation
Phone: (480) 839-2320

NEW YORK

Rockville Centre

S-J Associates, Inc.
Phone: (516) 536-4242

NORTH CAROLINA

Cary

Philips Semiconductors
Phone: (919) 677-7900

Elcom, Inc.

Phone: (919) 678-9301

OHIO

Columbus

Mohrfield Marketing, Inc.
Phone: (614) 481-5451

Dayton

Mohrfield Marketing, Inc.
Phone: (937) 298-7322

Solon

Mohrfield Marketing, Inc.
Phone: (440) 349-2700

OKLAHOMA

(Richardson, Texas)

OM Associates, Inc.
Phone: (972) 690-6746

OREGON

Beaverton

Cascade-Tech
Phone: (503) 645-9660

PENNSYLVANIA

Ambridge

Mohrfield Marketing, Inc.
Phone: (724) 251-0576

(Mt. Laurel, New Jersey)

S-J Associates, Inc.
Phone: (856) 866-1234

TENNESSEE

Dandridge

Philips Semiconductors
Phone: (423) 397-5557

TEXAS

Austin

OM Associates, Inc.
Phone: (512) 794-9971

El Paso

OM Associates, Inc.
Phone: (915) 591-9123

Houston

Philips Semiconductors
Phone: (281) 251-8144

OM Associates, Inc.
Phone: (281) 376-6400

Richardson

Philips Semiconductors
Phone: (972) 705-2481

OM Associates, Inc.
Phone: (972) 690-6746

VIRGINIA

Falls Church

S-J Associates, Inc.
Phone: (703) 533-2233

WASHINGTON

Kirkland

Cascade-Tech
Phone: (425) 822-7299

WISCONSIN

Browndeer

High Technology Sales, Inc.
Phone: (414) 354-9029

CANADA

PHILIPS

SEMICONDUCTORS

CANADA, LTD.

Calgary, Alberta

Tech-Trek, Ltd.
Phone: (403) 291-6866

Kanata, Ontario

Tech-Trek, Ltd.
Phone: (613) 599-8787

Mississauga, Ontario

Tech-Trek, Ltd.
Phone: (905) 238-0366

Richmond, B.C.

Tech-Trek, Ltd.
Phone: (604) 276-8735

Ville St. Laurent, Quebec

Tech-Trek, Ltd.
Phone: (514) 337-7540

MEXICO

Guadalajara

OM Associates de Mexico,
SA de CV
Phone: +52-3-647-7881

El Paso, TX

OM Associates, Inc.
Phone: +1 (915) 591-9123

Nogales

(Tempe, Arizona)

Centaur Corporation
Phone: (480) 839-2320

PUERTO RICO

(Clearwater, Florida)

Elcom, Inc.
Phone: (727) 524-1334

DISTRIBUTORS

Contact one of our
local distributors:
Arrow Electronics, Inc.
Avnet EMG
Future Electronics
Pioneer Standard
Electronics, Inc.

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 3 Figtree Drive, HOMEBUSH, NSW 2140,
Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213, Tel. +43 1 60 101 1248,
Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 20 0733, Fax. +375 172 20 0773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoprojekt, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 68 9211, Fax. +359 2 68 9102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Sydhavnsgade 23, 1780 COPENHAGEN V,
Tel. +45 33 29 3333, Fax. +45 33 29 3905

Finland: Sinkikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615 800, Fax. +358 9 6158 0920

France: 51 Rue Carnot, BP317, 92156 SURESNES Cedex,
Tel. +33 1 4099 6161, Fax. +33 1 4099 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 2353 60, Fax. +49 40 2353 6300

Hungary: see Austria

India: Philips INDIA Ltd, Band Box Building, 2nd floor,
254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025,
Tel. +91 22 493 8541, Fax. +91 22 493 9966

Indonesia: PT Philips Development Corporation, Semiconductors Division,
Gedung Philips, Jl. Buncit Raya Kav.99-100, JAKARTA 12510,
Tel. +62 21 794 0040 ext. 2501, Fax. +62 21 794 0080

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Via Casati, 23 - 20052 MONZA (MI), Tel.
+39 039 203 6838, Fax +39 039 203 6800

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Pakistan: see Singapore

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI, Metro MANILA,
Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Al. Jerozolimskie 195 B, 02-222 WARSAW,
Tel. +48 22 5710 000, Fax. +48 22 5710 001

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 319762,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 58088 Newville 2114,
Tel. +27 11 471 5401, Fax. +27 11 471 5398

South America: Al. Vicente Pinzon, 173, 6th floor, 04547-130 SÃO PAULO, SP,
Brazil, Tel. +55 11 821 2333, Fax. +55 11 821 2382

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 93 301 6312, Fax. +34 93 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2741 Fax. +41 1 488 3263

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1, TAIPEI,
Taiwan Tel. +886 2 2134 2886, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

Turkey: Yukari Dudullu, Org. San. Blg., 2.Cad. Nr. 28 81260 Umraniye,
ISTANBUL, Tel. +90 216 522 1500, Fax. +90 216 522 1813

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 208 730 5000, Fax. +44 208 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 3341 299, Fax. +381 11 3342 553



TEXIM electronics

P.O. BOX 172, NL-7480 AD HAAKSBERGEN
TEL.: +31-535733333, FAX: +31-535733888

Marketing & Sales Communications,
+31 40 27 24825

Internet: <http://www.semiconductors.philips.com>

© Philips Electronics N.V. 2000

SCH69

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in USA

853503/24300/03/368

Date of release: May 2000

Document order number: 9398 652 90011

Philips Semiconductors



PHILIPS

Let's make things better.