INTEGRATED CIRCUITS

Integrated Circuit Packages

1998

Data Handbook IC26

Let's make things better.

Philips Semiconductors

PHILIPS

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.

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Preface

INTRODUCTION

Welcome to the second 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.

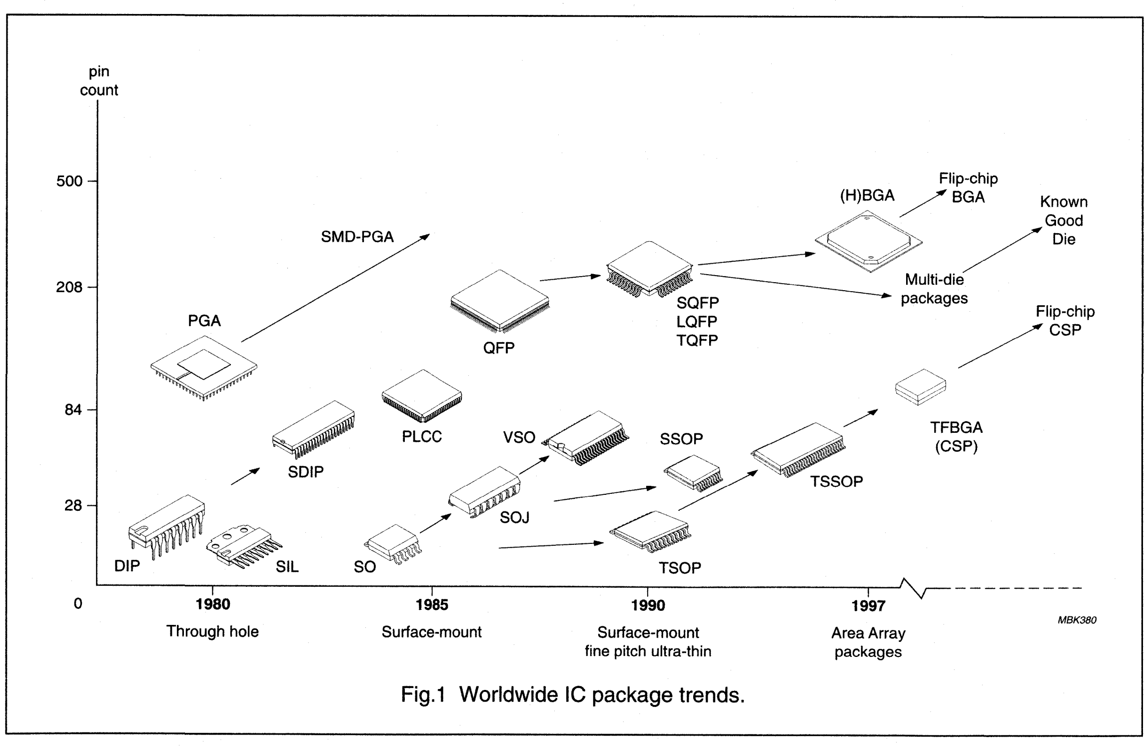

Fig.1 Worldwide IC package trends.

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.

Philips Semiconductors is currently involved in several areas of advanced packaging include multi-die, area array, advanced power management (through-hole and SMD), Chip Scale Packages (CSP) and flip chips.

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 IC 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:

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CHAPTER 1

OVERVIEW OF IC PACKAGES

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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 and 1 - 7.

Overview of IC packages

Chapter 1

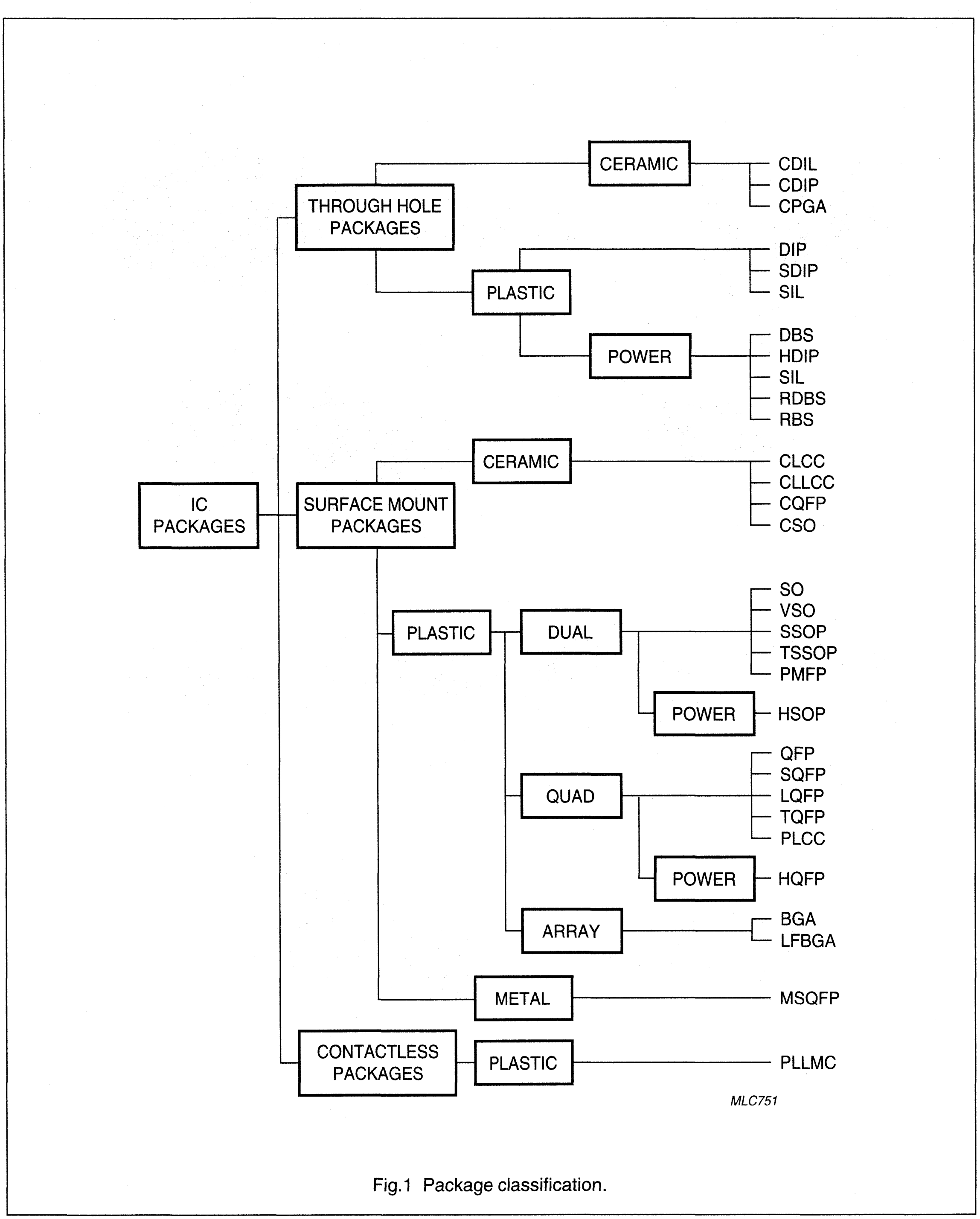
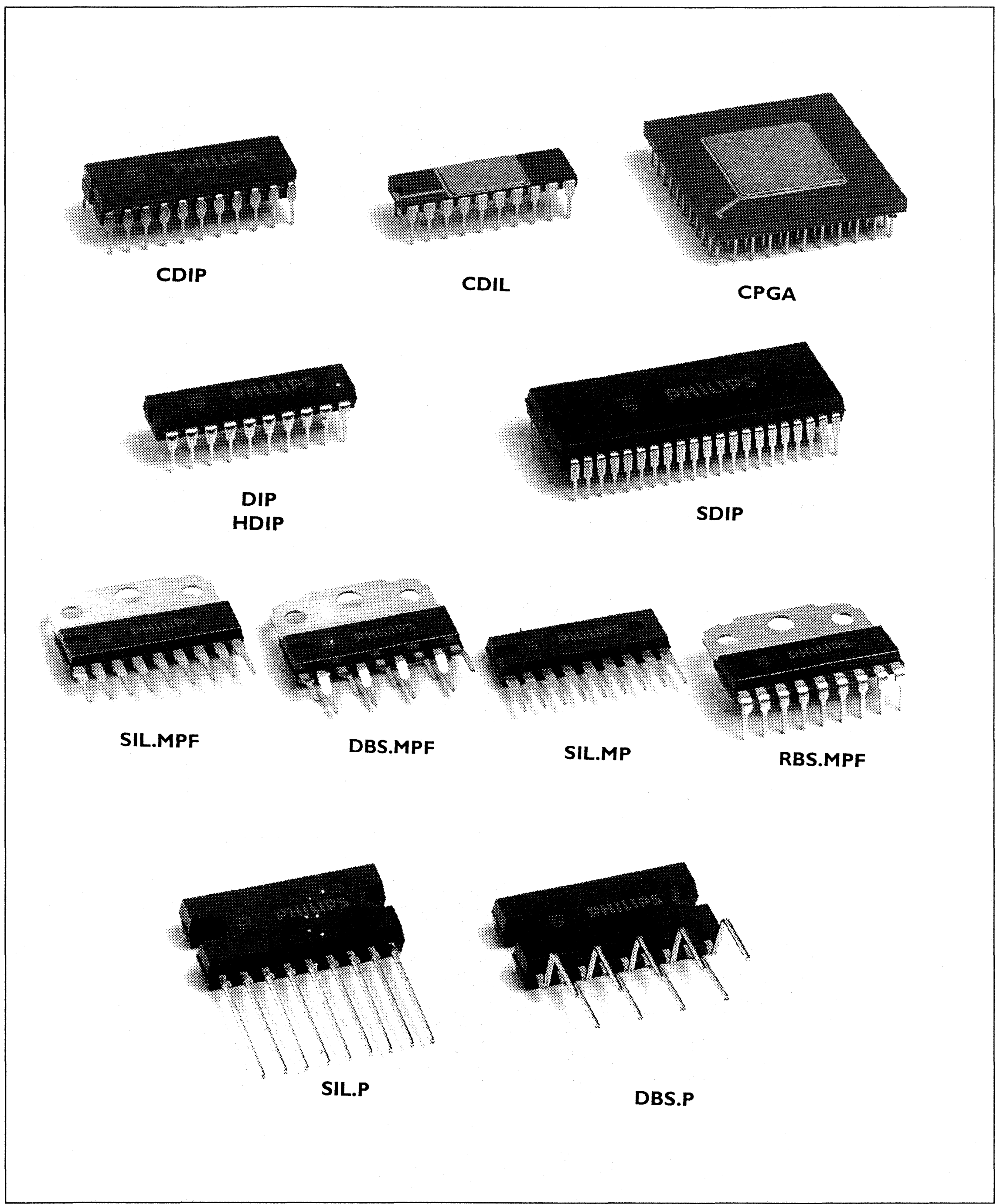


Fig.1 Package classification.

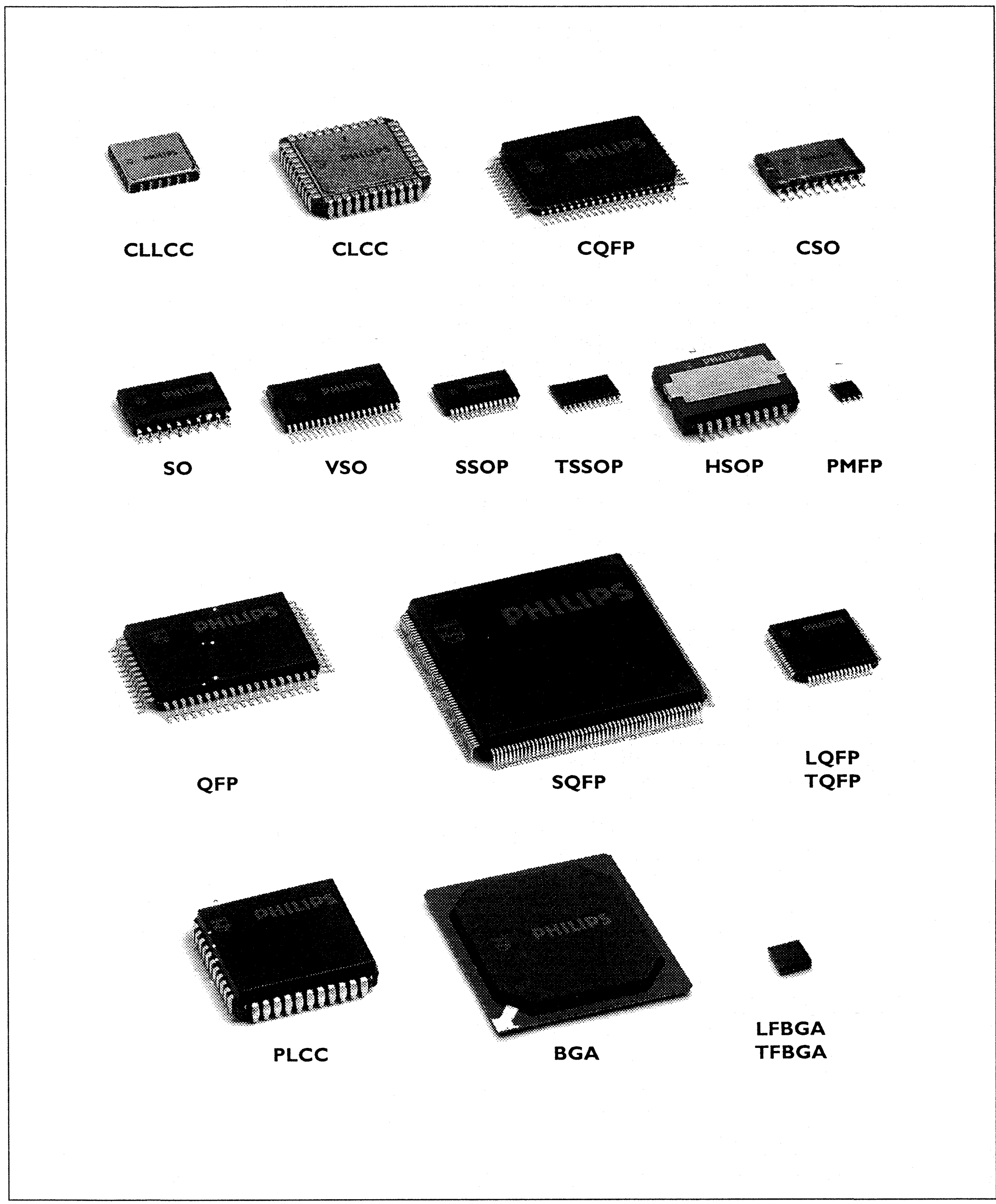
Overview of IC packages Chapter 1

TROUGH-HOLE MOUNT PACKAGES



Overview of IC packages Chapter 1

SURFACE MOUNT PACKAGES



Overview of IC packages Chapter 1

PACKAGE TYPE OVERVIEW WITH LEAD COUNT

Trough-Hole Mount Packages

PACKAGE NAME	NUMBER OF LEADS																											
	3	8	9	13	14	16	17	18	20	22	23	24	28	32	40	42	44	48	50	52	56	63	64	68	84	108	120	144
CDIL						X		X	X			X	X		X													
CDIP		X			X	X		X	X	X		X	X		X													
CPGA																	X					X	X	X	X	X	X	X
DBS.P			X	X			X				X																	
DBS.MPF			X																									
DIP		X			X	X		X	X	X		X	X	X	X			X	X				X					
HDIP								X																				
RBS.MPF			X																									
RDBS.P				X																								
SDIP									X			X		X		X				X	X		X					
SIL.P			X	X																								
SIL.MP			X																									
SIL.MPF			X																									
TO-92	X																											

Overview of IC packages

Chapter 1

Surface Mount Packages

PACKAGE NAME	8	9	14	16	20	24	28	32	36	40	44	48	52	56	64	68	80	84	100	120	128	132	156	160	208	240	256
BGA																							X				X
CLCC											X					X		X									
CLLCC					X	X	X																				
CQFP								X		X		X			X		X					X					
CSO				X	X	X	X																				
HLQFP																			X								
HSOP					X																						
HSQFP																										X	
LFBGA					X			X				X															
LQFP								X			X	X			X		X		X		X			X	X		
PLCC					X		X	X			X		X			X		X									
PMFP	X																										
QFP											X		X		X		X		X	X	X			X			
SO	X		X	X	X	X	X	X																			
SOJ										X																	
SQFP																									X		
SSOP			X	X	X	X	X		X			X		X													
TQFP											X				X		X		X								
TSSOP			X	X	X	X		X				X		X													
VSO										X				X													

(Column header group: NUMBER OF LEADS)

CHAPTER 2

IC PACKAGE RANGE AND DIMENSIONS

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Packages in ascending order of Philips outline code (SOT number)	2 - 10
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IC package range and dimensions Chapter 2

PACKAGES IN ASCENDING ORDER OF PACKAGE NAME

The following table lists our IC packages in alphanumeric order, 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			
BGA156	SOT472-1	plastic ball grid array package; 156 balls; body 15 × 15 × 1.15 mm	2 - 16
BGA256	SOT471-1	ball grid array; 256 balls; body 27 × 27 mm	2 - 17
Ceramic dual in-line packages (CDIL)			
CDIL16	SOT84-2	ceramic dual in-line package; 16 leads; metal seal	see note 1
CDIL16	SOT84-4	ceramic dual in-line package; 16 leads; metal seal	see note 1
CDIL18	SOT85-1	ceramic dual in-line package; 18 leads; metal seal	see note 1
CDIL20	SOT154-1	ceramic dual in-line package; 20 leads; metal seal	see note 1
CDIL24	SOT86-2	ceramic dual in-line package; 24 leads; metal seal	see note 1
CDIL28	SOT87-2	ceramic dual in-line package; 28 leads; metal seal	see note 1
CDIL28	SOT217-1	ceramic piggy-back dual in-line package; 28 leads; metal seal	see note 1
CDIL40	SOT88-2	ceramic dual in-line package; 40 leads; metal seal	see note 1
Ceramic dual in-line package (CDIP)			
CDIP8	SOT151-1	ceramic dual in-line package; 8 leads; glass seal	see note 1
CDIP8	SOT151-2	ceramic dual in-line package; 8 leads; glass seal	see note 1
CDIP14	SOT73-1	ceramic dual in-line package; 14 leads; glass seal	see note 1
CDIP14	SOT73-2	ceramic dual in-line package; 14 leads; glass seal	see note 1
CDIP14	SOT73-3	ceramic dual in-line package; 14 leads; glass seal	see note 1
CDIP16	SOT74-1	ceramic dual in-line package; 16 leads; glass seal	see note 1
CDIP16	SOT74-2	ceramic dual in-line package; 16 leads; glass seal	see note 1
CDIP16	SOT74-3	ceramic dual in-line package; 16 leads; glass seal	see note 1
CDIP18	SOT133-1	ceramic dual in-line package; 18 leads; glass seal	see note 1
CDIP20	SOT152-2	ceramic dual in-line package; 20 leads; glass seal	see note 1
CDIP22	SOT134-1	ceramic dual in-line package; 22 leads; glass seal	see note 1
CDIP24	SOT94-1	ceramic dual in-line package; 24 leads; glass seal	see note 1
CDIP24	SOT94-2	ceramic dual in-line package; 24 leads; glass seal	see note 1
CDIP28	SOT135-1	ceramic dual in-line package; 28 leads; glass seal	see note 1
CDIP40	SOT145-1	ceramic dual in-line package; 40 leads; glass seal	see note 1
CDIP40	SOT145-2	ceramic dual in-line package; 40 leads; glass seal	see note 1
Ceramic leaded chip carrier			
CLCC44	SOT326-1	ceramic leaded chip carrier; 44 leads	see note 1
CLCC68	SOT327-1	ceramic leaded chip carrier; 68 leads	see note 1

IC package range and dimensions Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
CLCC68	SOT327-2	ceramic leaded chip carrier; 68 leads	see note 1
CLCC68	SOT327-3	ceramic leaded chip carrier; 68 leads	see note 1
CLCC84	SOT335-1	ceramic leaded chip carrier; 84 leads	see note 1
Ceramic leadless chip carrier			
CLLCC20	SOT256-1	ceramic leadless chip carrier; 20 connecting pads	see note 1
CLLCC24	SOT175-1	ceramic leadless chip carrier; 24 connecting pads	see note 1
CLLCC28	SOT255-1	ceramic leadless chip carrier; 28 connecting pads	see note 1
Ceramic pin grid array			
CPGA44	SOT309-1	ceramic pin grid array; 44 pins	see note 1
CPGA63	SOT293-1	ceramic pin grid array; 63 pins; face down	see note 1
CPGA63	SOT293-3	ceramic pin grid array; 63 pins; face down	see note 1
CPGA63	SOT293-4	ceramic pin grid array; 63 pins; face down	see note 1
CPGA64	SOT169-1	ceramic pin grid array; 64 pins	see note 1
CPGA64	SOT245-1	ceramic pin grid array; 64 pins; face down	see note 1
CPGA68	SOT257-1	ceramic pin grid array; 68 pins	see note 1
CPGA84	SOT258-1	ceramic pin grid array; 84 pins	see note 1
CPGA108	SOT265-1	ceramic pin grid array; 108 pins	see note 1
CPGA120	SOT259-1	ceramic pin grid array; 120 pins	see note 1
CPGA144	SOT260-1	ceramic pin grid array; 144 pins	see note 1
Ceramic quad flat package			
CQFP32	SOT345-1	ceramic quad flat package; 32 leads	see note 1
CQFP40	SOT328-1	ceramic quad flat package; 40 leads	see note 1
CQFP48	SOT292-1	ceramic quad flat package; 48 leads	see note 1
CQFP64	SOT329-1	ceramic quad flat package; 64 leads	see note 1
CQFP80	SOT351-1	ceramic quad flat package; 80 leads	see note 1
CQFP132	SOT356-1	ceramic quad flat package; 132 leads	see note 1
Ceramic small outline package			
CSO16	SOT249-1	ceramic small outline package; 16 leads; large body	see note 1
CSO20	SOT250-1	ceramic small outline package; 20 leads; large body	see note 1
CSO24	SOT251-1	ceramic small outline package; 24 leads; large body	see note 1
CSO28	SOT252-1	ceramic small outline package; 28 leads; large body	see note 1
DIL-bent-SIL power package			
DBS9P	SOT157-2	plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm)	2 - 18
DBS9P	SOT157-4	plastic DIL-bent-SIL power package; 9 leads (lead length 7.7 mm)	2 - 19
DBS13P	SOT141-6	plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	2 - 20
DBS13P	SOT141-8	plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm)	2 - 21
DBS17P	SOT243-1	plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm)	2 - 22
DBS17P	SOT243-3	plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)	2 - 23

IC package range and dimensions Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
DBS17P	SOT475-1	plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm)	2 - 24
DBS23P	SOT411-1	plastic DIL-bent-SIL power package; 23 leads (straight lead length 3.2 mm)	2 - 25
DBS23P	SOT411-2	plastic DIL-bent-SIL power package; 23 leads (lead length 12 mm)	2 - 26
DIL-bent-SIL medium power package with fin			
DBS9MPF	SOT111-1	plastic DIL-bent-SIL medium power package with fin; 9 leads	2 - 27
Dual in-line package			
DIP8	SOT97-1	plastic dual in-line package; 8 leads (300 mil)	2 - 28
DIP14	SOT27-1	plastic dual in-line package; 14 leads (300 mil)	2 - 29
DIP16	SOT38-1	plastic dual in-line package; 16 leads (300 mil); long body	2 - 30
DIP16	SOT38-4	plastic dual in-line package; 16 leads (300 mil)	2 - 31
DIP16	SOT38-9	plastic dual in-line package; 16 leads (300 mil)	2 - 32
DIP18	SOT102-1	plastic dual in-line package; 18 leads (300 mil)	2 - 33
DIP18	SOT102-2	plastic dual in-line package; 18 leads (300 mil); slim corner leads	2 - 34
DIP18	SOT102-4	plastic dual in-line package; 18 leads (300 mil); slim corner leads; long body	2 - 35
DIP20	SOT146-1	plastic dual in-line package; 20 leads (300 mil)	2 - 36
DIP22	SOT116-1	plastic dual in-line package; 22 leads (400 mil)	2 - 37
DIP24	SOT101-1	plastic dual in-line package; 24 leads (600 mil)	2 - 38
DIP24	SOT101-2	plastic dual in-line package; 24 leads (600 mil); short leads	2 - 39
DIP24	SOT222-1	plastic dual in-line package; 24 leads (300 mil)	2 - 40
DIP24	SOT248-1	plastic dual in-line package; 24 leads (400 mil)	2 - 41
DIP28	SOT117-1	plastic dual in-line package; 28 leads (600 mil)	2 - 42
DIP28	SOT117-2	plastic dual in-line package; 28 leads (600 mil); long body	2 - 43
DIP28	SOT394-1	plastic dual in-line package; 28 leads (300 mil)	2 - 44
DIP32	SOT201-1	plastic dual in-line package; 32 leads (600 mil)	2 - 45
DIP40	SOT129-1	plastic dual in-line package; 40 leads (600 mil)	2 - 46
DIP48	SOT240-1	plastic dual in-line package; 48 leads (600 mil)	2 - 47
DIP50	SOT396-1	plastic dual in-line package; 50 leads (900 mil)	2 - 48
DIP64	SOT395-1	plastic dual in-line package; 64 leads (900 mil)	2 - 49
Heat-dissipating small outline package			
HDIP18	SOT398-1	plastic heat-dissipating dual in-line package; 18 leads	2 - 50
Heat-dissipating quad flat package			
HLQFP100	SOT470-1	plastic heat-dissipating low profile quad flat package; 100 leads; body 14 × 14 × 1.4 mm	2 - 51
Heat-dissipating small outline package			
HSOP20	SOT397-1	heat-dissipating small outline package; 20 leads	2 - 52

IC package range and dimensions Chapter 2

PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
HSOP20	SOT418-1	heat-dissipating small outline package; 20 leads	2 - 53
HSOP20	SOT418-2	heat-dissipating small outline package; 20 leads; low stand-off	see note 1
Heatsink shrink quad flat package			
HSQFP240	SOT464-2	heatsink shrink quad flat package; 240 leads; body 32 × 32 × 3.4 mm	2 - 54
Low profile fine pitch ball grid array			
LFBGA32	SOT478-1	low profile fine pitch ball grid array; 32 balls	see note 1
LFBGA20	SOT479-1	low profile fine pitch ball grid array; 20 balls	see note 1
LFBGA48	SOT488-1	low profile fine pitch ball grid array; 48 balls	see note 1
LFBGA48	SOT491-1	low profile fine pitch ball grid array; 48 balls	see note 1
Low profile quad flat package			
LQFP32	SOT358-1	plastic low profile quad flat package; 32 leads; body 7 × 7 × 1.4 mm	2 - 55
LQFP32	SOT401-1	plastic low profile quad flat package; 32 leads; body 5 × 5 × 1.4 mm	2 - 56
LQFP44	SOT389-1	plastic low profile quad flat package; 44 leads; body 10 × 10 × 1.4 mm	2 - 57
LQFP48	SOT313-2	plastic low profile quad flat package; 48 leads; body 7 × 7 × 1.4 mm	2 - 58
LQFP64	SOT314-2	plastic low profile quad flat package; 64 leads; body 10 × 10 × 1.4 mm	2 - 59
LQFP64	SOT414-1	plastic low profile quad flat package; 64 leads; body 7 × 7 × 1.4 mm	2 - 60
LQFP80	SOT315-1	plastic low profile quad flat package; 80 leads; body 12 × 12 × 1.4 mm	2 - 61
LQFP100	SOT407-1	plastic low profile quad flat package; 100 leads; body 14 × 14 × 1.4 mm	2 - 62
LQFP128	SOT420-1	plastic low profile quad flat package; 128 leads; body 14 × 14 × 1.4 mm	2 - 63
LQFP128	SOT425-1	plastic low profile quad flat package; 128 leads; body 14 × 20 × 1.4 mm	2 - 64
LQFP160	SOT435-1	plastic low profile quad flat package; 160 leads; body 24 × 24 × 1.4 mm	2 - 65
LQFP208	SOT459-1	plastic low profile quad flat package; 208 leads; body 28 × 28 × 1.4 mm	2 - 66
Plastic leaded chip carrier			
PLCC20	SOT380-1	plastic leaded chip carrier; 20 leads	2 - 67
PLCC28	SOT261-2	plastic leaded chip carrier; 28 leads	2 - 68
PLCC28	SOT261-3	plastic leaded chip carrier; 28 leads; pedestal	2 - 69
PLCC32	SOT381-1	plastic leaded chip carrier; 32 leads	2 - 70
PLCC44	SOT187-2	plastic leaded chip carrier; 44 leads	2 - 71
PLCC52	SOT238-2	plastic leaded chip carrier; 52 leads	2 - 72
PLCC52	SOT238-3	plastic leaded chip carrier; 52 leads; pedestal	2 - 73
PLCC52	SOT433-1	plastic leaded chip carrier; 52 leads; thin version	2 - 74
PLCC68	SOT188-2	plastic leaded chip carrier; 68 leads	2 - 75
PLCC68	SOT188-3	plastic leaded chip carrier; 68 leads; pedestal	2 - 76
PLCC84	SOT189-2	plastic leaded chip carrier; 84 leads	2 - 77
PLCC84	SOT189-3	plastic leaded chip carrier; 84 leads; pedestal	2 - 78

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PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
Plastic micro flat package			
PMFP8	SOT144-1	plastic micro flat package; 8 leads (straight)	2 - 79
Quad flat package			
QFP44	SOT205-1	plastic quad flat package; 44 leads (lead length 2.35 mm); body 14 × 14 × 2.2 mm	2 - 80
QFP44	SOT307-2	plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 × 10 × 1.75 mm	2 - 81
QFP52	SOT379-1	plastic quad flat package; 52 leads (lead length 1.6 mm); body 10 × 10 × 2.0 mm	2 - 82
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 - 83
QFP64	SOT319-2	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 84
QFP64	SOT319-3	plastic quad flat package; 64 leads (lead length 2.35 mm); body 14 × 20 × 2.8 mm	2 - 85
QFP64	SOT393-1	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm	2 - 86
QFP64	SOT393-2	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm	2 - 87
QFP80	SOT310-1	plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 × 20 × 3.0 mm	2 - 88
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 - 89
QFP80	SOT318-2	plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 90
QFP80	SOT318-3	plastic quad flat package; 80 leads (lead length 2.35 mm); body 14 × 20 × 2.8 mm	2 - 91
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 - 92
QFP100	SOT317-2	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 93
QFP100	SOT317-3	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 94
QFP100	SOT382-1	plastic quad flat package; 100 leads (lead length 1.6 mm); body 14 × 20 × 2.8 mm	2 - 95
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 - 96
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 - 97
QFP120	SOT383-1	plastic quad flat package; 120 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm	2 - 98

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PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
QFP128	SOT320-1	plastic quad flat package; 128 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 99
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 - 100
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 - 101
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 - 102
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 - 103
Rectangular-DIL-bent-SIL power package			
RDBS13P	SOT462-1	plastic rectangular-DIL-bent-SIL (reverse bent) power package; 13 leads	2 - 104
Shrink dual in-line package			
SDIP20	SOT325-1	plastic shrink dual in-line package; 20 leads (300 mil)	2 - 105
SDIP24	SOT234-1	plastic shrink dual in-line package; 24 leads (400 mil)	2 - 106
SDIP32	SOT232-1	plastic shrink dual in-line package; 32 leads (400 mil)	2 - 107
SDIP42	SOT270-1	plastic shrink dual in-line package; 42 leads (600 mil)	2 - 108
SDIP52	SOT247-1	plastic shrink dual in-line package; 52 leads (600 mil)	2 - 109
SDIP56	SOT400-1	plastic shrink dual in-line package; 56 leads (600 mil)	2 - 110
SDIP64	SOT274-1	plastic shrink dual in-line package; 64 leads (750 mil)	2 - 111
Single in-line medium power package			
SIL9MP	SOT142-1	plastic single in-line medium power package; 9 leads	2 - 112
Single in-line medium power package with fin			
SIL9MPF	SOT110-1	plastic single in-line medium power package with fin; 9 leads	2 - 113
Single in-line power package			
SIL9P	SOT131-2	plastic single in-line power package; 9 leads	2 - 114
SIL13P	SOT193-2	plastic single in-line power package; 13 leads	2 - 115
Small outline package			
SO8	SOT96-1	plastic small outline package; 8 leads; body width 3.9 mm	2 - 116
SO8	SOT96-2	plastic small outline package; 8 leads (straight); body width 3.9 mm	2 - 117
SO8	SOT176-1	plastic small outline package; 8 leads; body width 7.5 mm	2 - 118
SO14	SOT108-1	plastic small outline package; 14 leads; body width 3.9 mm	2 - 119
SO16	SOT109-1	plastic small outline package; 16 leads; body width 3.9 mm	2 - 120
SO16	SOT109-2	plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height	2 - 121
SO16	SOT162-1	plastic small outline package; 16 leads; body width 7.5 mm	2 - 122
SO20	SOT163-1	plastic small outline package; 20 leads; body width 7.5 mm	2 - 123

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PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
SO24	SOT137-1	plastic small outline package; 24 leads; body width 7.5 mm	2 - 124
SO28	SOT136-1	plastic small outline package; 28 leads; body width 7.5 mm	2 - 125
SO32	SOT287-1	plastic small outline package; 32 leads; body width 7.5 mm	2 - 126
Small outline (J-bent) package			
SOJ40	SOT449-1	plastic small outline package; 40 leads (J-bent); body width 10.16 mm	2 - 127
Shrink quad flat package			
SQFP208	SOT316-1	plastic shrink quad flat package; 208 leads (lead length 1.3 mm); body 28 × 28 × 3.4 mm	2 - 128
Shrink small outline package			
SSOP14	SOT337-1	plastic shrink small outline package; 14 leads; body width 5.3 mm	2 - 129
SSOP16	SOT338-1	plastic shrink small outline package; 16 leads; body width 5.3 mm	2 - 130
SSOP16	SOT369-1	plastic shrink small outline package; 16 leads; body width 4.4 mm	2 - 131
SSOP20	SOT266-1	plastic shrink small outline package; 20 leads; body width 4.4 mm	2 - 132
SSOP20	SOT339-1	plastic shrink small outline package; 20 leads; body width 5.3 mm	2 - 133
SSOP24	SOT340-1	plastic shrink small outline package; 24 leads; body width 5.3 mm	2 - 134
SSOP28	SOT341-1	plastic shrink small outline package; 28 leads; body width 5.3 mm	2 - 135
SSOP36	SOT378-1	plastic shrink small outline package; 36 leads; body width 7.5 mm; lead pitch 0.8 mm	2 - 136
SSOP48	SOT370-1	plastic shrink small outline package; 48 leads; body width 7.5 mm	2 - 137
SSOP56	SOT371-1	plastic shrink small outline package; 56 leads; body width 7.5 mm	2 - 138
Transistor outline package			
TO-92	SOT465-1	TO-92 package; 3 leads; body diameter 4.7 mm	2 - 139
Thin quad flat package			
TQFP44	SOT376-1	plastic thin quad flat package; 44 leads; body 10 × 10 × 1.0 mm	2 - 140
TQFP64	SOT357-1	plastic thin quad flat package; 64 leads; body 10 × 10 × 1.0 mm	2 - 141
TQFP80	SOT375-1	plastic thin quad flat package; 80 leads; body 12 × 12 × 1.0 mm	2 - 142
TQFP100	SOT386-1	plastic thin quad flat package; 100 leads; body 14 × 14 × 1.0 mm	2 - 143
Thin shrink small outline package			
TSSOP14	SOT402-1	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	2 - 144
TSSOP16	SOT403-1	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	2 - 145
TSSOP20	SOT360-1	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	2 - 146
TSSOP24	SOT355-1	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	2 - 147
TSSOP32	SOT487-1	plastic thin shrink small outline package; 32 leads; body width 6.1 mm; lead pitch 0.65 mm	2 - 148
TSSOP48	SOT362-1	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	2 - 149

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PACKAGE NAME	PHILIPS OUTLINE CODE	DESCRIPTION	PAGE
TSSOP48	SOT480-1	plastic thin shrink small outline package; 48 leads; body width 4.4 mm; lead pitch 0.4 mm	2 - 150
TSSOP56	SOT364-1	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	2 - 151
TSSOP56	SOT481-1	plastic thin shrink small outline package; 56 leads; body width 4.4 mm; lead pitch 0.4 mm	2 - 152
Very small outline package			
VSO40	SOT158-1	plastic very small outline package; 40 leads	2 - 153
VSO40	SOT158-2	plastic very small outline package; 40 leads; face down	2 - 154
VSO56	SOT190-1	plastic very small outline package; 56 leads	2 - 155
VSO56	SOT190-2	plastic very small outline package; 56 leads; face down	2 - 156

Note

1. Although an outline drawing is not given in this databook, it is available on request.

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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 - 29
SOT38-1	DIP16	plastic dual in-line package; 16 leads (300 mil); long body	2 - 30
SOT38-4	DIP16	plastic dual in-line package; 16 leads (300 mil)	2 - 31
SOT38-9	DIP16	plastic dual in-line package; 16 leads (300 mil)	2 - 32
SOT73-1	CDIP14	ceramic dual in-line package; 14 leads; glass seal	see note 1
SOT73-2	CDIP14	ceramic dual in-line package; 14 leads; glass seal	see note 1
SOT73-3	CDIP14	ceramic dual in-line package; 14 leads; glass seal	see note 1
SOT74-1	CDIP16	ceramic dual in-line package; 16 leads; glass seal	see note 1
SOT74-2	CDIP16	ceramic dual in-line package; 16 leads; glass seal	see note 1
SOT74-3	CDIP16	ceramic dual in-line package; 16 leads; glass seal	see note 1
SOT84-2	CDIL16	ceramic dual in-line package; 16 leads; metal seal	see note 1
SOT84-4	CDIL16	ceramic dual in-line package; 16 leads; metal seal	see note 1
SOT85-1	CDIL18	ceramic dual in-line package; 18 leads; metal seal	see note 1
SOT86-2	CDIL24	ceramic dual in-line package; 24 leads; metal seal	see note 1
SOT87-2	CDIL28	ceramic dual in-line package; 28 leads; metal seal	see note 1
SOT88-2	CDIL40	ceramic dual in-line package; 40 leads; metal seal	see note 1
SOT94-1	CDIP24	ceramic dual in-line package; 24 leads; glass seal	see note 1
SOT94-2	CDIP24	ceramic dual in-line package; 24 leads; glass seal	see note 1
SOT96-1	SO8	plastic small outline package; 8 leads; body width 3.9 mm	2 - 116
SOT96-2	SO8	plastic small outline package; 8 leads (straight); body width 3.9 mm	2 - 117
SOT97-1	DIP8	plastic dual in-line package; 8 leads (300 mil)	2 - 28
SOT101-1	DIP24	plastic dual in-line package; 24 leads (600 mil)	2 - 38
SOT101-2	DIP24	plastic dual in-line package; 24 leads (600 mil); short leads	2 - 39
SOT102-1	DIP18	plastic dual in-line package; 18 leads (300 mil)	2 - 33
SOT102-2	DIP18	plastic dual in-line package; 18 leads (300 mil); slim corner leads	2 - 34
SOT102-4	DIP18	plastic dual in-line package; 18 leads (300 mil); slim corner leads; long body	2 - 35
SOT108-1	SO14	plastic small outline package; 14 leads; body width 3.9 mm	2 - 119
SOT109-1	SO16	plastic small outline package; 16 leads; body width 3.9 mm	2 - 120
SOT109-2	SO16	plastic small outline package; 16 leads; body width 3.9 mm; low stand-off height	2 - 121
SOT110-1	SIL9MPF	plastic single in-line medium power package with fin; 9 leads	2 - 113
SOT111-1	DBS9MPF	plastic DIL-bent-SIL medium power package with fin; 9 leads	2 - 27
SOT116-1	DIP22	plastic dual in-line package; 22 leads (400 mil)	2 - 37
SOT117-1	DIP28	plastic dual in-line package; 28 leads (600 mil)	2 - 42
SOT117-2	DIP28	plastic dual in-line package; 28 leads (600 mil); long body	2 - 43
SOT129-1	DIP40	plastic dual in-line package; 40 leads (600 mil)	2 - 46
SOT131-2	SIL9P	plastic single in-line power package; 9 leads	2 - 114
SOT133-1	CDIP18	ceramic dual in-line package; 18 leads; glass seal	see note 1

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PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT134-1	CDIP22	ceramic dual in-line package; 22 leads; glass seal	see note 1
SOT135-1	CDIP28	ceramic dual in-line package; 28 leads; glass seal	see note 1
SOT136-1	SO28	plastic small outline package; 28 leads; body width 7.5 mm	2 - 125
SOT137-1	SO24	plastic small outline package; 24 leads; body width 7.5 mm	2 - 124
SOT141-6	DBS13P	plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	2 - 20
SOT141-8	DBS13P	plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm)	2 - 21
SOT142-1	SIL9MP	plastic single in-line medium power package; 9 leads	2 - 112
SOT144-1	PMFP8	plastic micro flat package; 8 leads (straight)	2 - 79
SOT145-1	CDIP40	ceramic dual in-line package; 40 leads; glass seal	see note 1
SOT145-2	CDIP40	ceramic dual in-line package; 40 leads; glass seal	see note 1
SOT146-1	DIP20	plastic dual in-line package; 20 leads (300 mil)	2 - 36
SOT151-1	CDIP8	ceramic dual in-line package; 8 leads; glass seal	see note 1
SOT151-2	CDIP8	ceramic dual in-line package; 8 leads; glass seal	see note 1
SOT152-2	CDIP20	ceramic dual in-line package; 20 leads; glass seal	see note 1
SOT154-1	CDIL20	ceramic dual in-line package; 20 leads; metal seal	see note 1
SOT157-2	DBS9P	plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm)	2 - 18
SOT157-4	DBS9P	plastic DIL-bent-SIL power package; 9 leads (lead length 7.7 mm)	2 - 19
SOT158-1	VSO40	plastic very small outline package; 40 leads	2 - 153
SOT158-2	VSO40	plastic very small outline package; 40 leads; face down	2 - 154
SOT162-1	SO16	plastic small outline package; 16 leads; body width 7.5 mm	2 - 122
SOT163-1	SO20	plastic small outline package; 20 leads; body width 7.5 mm	2 - 123
SOT169-1	CPGA64	ceramic pin grid array; 64 pins	see note 1
SOT175-1	CLLCC24	ceramic leadless chip carrier; 24 connecting pads	see note 1
SOT176-1	SO8	plastic small outline package; 8 leads; body width 7.5 mm	2 - 118
SOT187-2	PLCC44	plastic leaded chip carrier; 44 leads	2 - 71
SOT188-2	PLCC68	plastic leaded chip carrier; 68 leads	2 - 75
SOT188-3	PLCC68	plastic leaded chip carrier; 68 leads; pedestal	2 - 76
SOT189-2	PLCC84	plastic leaded chip carrier; 84 leads	2 - 77
SOT189-3	PLCC84	plastic leaded chip carrier; 84 leads; pedestal	2 - 78
SOT190-1	VSO56	plastic very small outline package; 56 leads	2 - 155
SOT190-2	VSO56	plastic very small outline package; 56 leads; face down	2 - 156
SOT193-2	SIL13P	plastic single in-line power package; 13 leads	2 - 115
SOT201-1	DIP32	plastic dual in-line package; 32 leads (600 mil)	2 - 45
SOT205-1	QFP44	plastic quad flat package; 44 leads (lead length 2.35 mm); body 14 × 14 × 2.2 mm	2 - 80
SOT217-1	CDIL28	ceramic piggy-back dual in-line package; 28 leads; metal seal	see note 1
SOT222-1	DIP24	plastic dual in-line package; 24 leads (300 mil)	2 - 40
SOT232-1	SDIP32	plastic shrink dual in-line package; 32 leads (400 mil)	2 - 107
SOT234-1	SDIP24	plastic shrink dual in-line package; 24 leads (400 mil)	2 - 106

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PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT238-2	PLCC52	plastic leaded chip carrier; 52 leads	2 - 72
SOT238-3	PLCC52	plastic leaded chip carrier; 52 leads; pedestal	2 - 73
SOT240-1	DIP48	plastic dual in-line package; 48 leads (600 mil)	2 - 47
SOT243-1	DBS17P	plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm)	2 - 22
SOT243-3	DBS17P	plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)	2 - 23
SOT245-1	CPGA64	ceramic pin grid array; 64 pins; face down	see note 1
SOT247-1	SDIP52	plastic shrink dual in-line package; 52 leads (600 mil)	2 - 109
SOT248-1	DIP24	plastic dual in-line package; 24 leads (400 mil)	2 - 41
SOT249-1	CSO16	ceramic small outline package; 16 leads; large body	see note 1
SOT250-1	CSO20	ceramic small outline package; 20 leads; large body	see note 1
SOT251-1	CSO24	ceramic small outline package; 24 leads; large body	see note 1
SOT252-1	CSO28	ceramic small outline package; 28 leads; large body	see note 1
SOT255-1	CLLCC28	ceramic leadless chip carrier; 28 connecting pads	see note 1
SOT256-1	CLLCC20	ceramic leadless chip carrier; 20 connecting pads	see note 1
SOT257-1	CPGA68	ceramic pin grid array; 68 pins	see note 1
SOT258-1	CPGA84	ceramic pin grid array; 84 pins	see note 1
SOT259-1	CPGA120	ceramic pin grid array; 120 pins	see note 1
SOT260-1	CPGA144	ceramic pin grid array; 144 pins	see note 1
SOT261-2	PLCC28	plastic leaded chip carrier; 28 leads	2 - 68
SOT261-3	PLCC28	plastic leaded chip carrier; 28 leads; pedestal	2 - 69
SOT265-1	CPGA108	ceramic pin grid array; 108 pins	see note 1
SOT266-1	SSOP20	plastic shrink small outline package; 20 leads; body width 4.4 mm	2 - 132
SOT270-1	SDIP42	plastic shrink dual in-line package; 42 leads (600 mil)	2 - 108
SOT274-1	SDIP64	plastic shrink dual in-line package; 64 leads (750 mil)	2 - 111
SOT287-1	SO32	plastic small outline package; 32 leads; body width 7.5 mm	2 - 126
SOT292-1	CQFP48	ceramic quad flat package; 48 leads	see note 1
SOT293-1	CPGA63	ceramic pin grid array; 63 pins; face down	see note 1
SOT293-3	CPGA63	ceramic pin grid array; 63 pins; face down	see note 1
SOT293-4	CPGA63	ceramic pin grid array; 63 pins; face down	see note 1
SOT307-2	QFP44	plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 × 10 × 1.75 mm	2 - 81
SOT309-1	CPGA44	ceramic pin grid array; 44 pins	see note 1
SOT310-1	QFP80	plastic quad flat package; 80 leads (lead length 1.6 mm); body 14 × 20 × 3.0 mm	2 - 88
SOT313-2	LQFP48	plastic low profile quad flat package; 48 leads; body 7 × 7 × 1.4 mm	2 - 58
SOT314-2	LQFP64	plastic low profile quad flat package; 64 leads; body 10 × 10 × 1.4 mm	2 - 59
SOT315-1	LQFP80	plastic low profile quad flat package; 80 leads; body 12 × 12 × 1.4 mm	2 - 61
SOT316-1	SQFP208	plastic shrink quad flat package; 208 leads (lead length 1.3 mm); body 28 × 28 × 3.4 mm	2 - 128

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PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
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 - 92
SOT317-2	QFP100	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 93
SOT317-3	QFP100	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 94
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 - 89
SOT318-2	QFP80	plastic quad flat package; 80 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 90
SOT318-3	QFP80	plastic quad flat package; 80 leads (lead length 2.35 mm); body 14 × 20 × 2.8 mm	2 - 91
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 - 83
SOT319-2	QFP64	plastic quad flat package; 64 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	2 - 84
SOT319-3	QFP64	plastic quad flat package; 64 leads (lead length 2.35 mm); body 14 × 20 × 2.8 mm	2 - 85
SOT320-1	QFP128	plastic quad flat package; 128 leads (lead length 1.95 mm); body 28 × 28 × 3.4 mm; high stand-off height	2 - 99
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 - 100
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 - 101
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 - 102
SOT325-1	SDIP20	plastic shrink dual in-line package; 20 leads (300 mil)	2 - 105
SOT326-1	CLCC44	ceramic leaded chip carrier; 44 leads	see note 1
SOT327-1	CLCC68	ceramic leaded chip carrier; 68 leads	see note 1
SOT327-2	CLCC68	ceramic leaded chip carrier; 68 leads	see note 1
SOT327-3	CLCC68	ceramic leaded chip carrier; 68 leads	see note 1
SOT328-1	CQFP40	ceramic quad flat package; 40 leads	see note 1
SOT329-1	CQFP64	ceramic quad flat package; 64 leads	see note 1
SOT335-1	CLCC84	ceramic leaded chip carrier; 84 leads	see note 1
SOT337-1	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	2 - 129
SOT338-1	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	2 - 130
SOT339-1	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	2 - 133
SOT340-1	SSOP24	plastic shrink small outline package; 24 leads; body width 5.3 mm	2 - 134
SOT341-1	SSOP28	plastic shrink small outline package; 28 leads; body width 5.3 mm	2 - 135
SOT345-1	CQFP32	ceramic quad flat package; 32 leads	see note 1
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 - 96

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PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
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 - 97
SOT351-1	CQFP80	ceramic quad flat package; 80 leads	see note 1
SOT352-1	RBS9MPF	plastic rectangular-bent single in-line medium power package with fin; 9 leads	2 - 103
SOT355-1	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	2 - 147
SOT356-1	CQFP132	ceramic quad flat package; 132 leads	see note 1
SOT357-1	TQFP64	plastic thin quad flat package; 64 leads; body 10 × 10 × 1.0 mm	2 - 141
SOT358-1	LQFP32	plastic low profile quad flat package; 32 leads; body 7 × 7 × 1.4 mm	2 - 55
SOT360-1	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	2 - 146
SOT362-1	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	2 - 149
SOT364-1	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	2 - 151
SOT369-1	SSOP16	plastic shrink small outline package; 16 leads; body width 4.4 mm	2 - 131
SOT370-1	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	2 - 137
SOT371-1	SSOP56	plastic shrink small outline package; 56 leads; body width 7.5 mm	2 - 138
SOT375-1	TQFP80	plastic thin quad flat package; 80 leads; body 12 × 12 × 1.0 mm	2 - 142
SOT376-1	TQFP44	plastic thin quad flat package; 44 leads; body 10 × 10 × 1.0 mm	2 - 140
SOT378-1	SSOP36	plastic shrink small outline package; 36 leads; body width 7.5 mm; lead pitch 0.8 mm	2 - 136
SOT379-1	QFP52	plastic quad flat package; 52 leads (lead length 1.6 mm); body 10 × 10 × 2.0 mm	2 - 82
SOT380-1	PLCC20	plastic leaded chip carrier; 20 leads	2 - 67
SOT381-1	PLCC32	plastic leaded chip carrier; 32 leads	2 - 70
SOT382-1	QFP100	plastic quad flat package; 100 leads (lead length 1.6 mm); body 14 × 20 × 2.8 mm	2 - 95
SOT383-1	QFP120	plastic quad flat package; 120 leads (lead length 1.6 mm); body 28 × 28 × 3.4 mm	2 - 98
SOT386-1	TQFP100	plastic thin quad flat package; 100 leads; body 14 × 14 × 1.0 mm	2 - 143
SOT389-1	LQFP44	plastic low profile quad flat package; 44 leads; body 10 × 10 × 1.4 mm	2 - 57
SOT393-1	QFP64	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm	2 - 86
SOT393-2	QFP64	plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm	2 - 87
SOT394-1	DIP28	plastic dual in-line package; 28 leads (300 mil)	2 - 44
SOT395-1	DIP64	plastic dual in-line package; 64 leads (900 mil)	2 - 49
SOT396-1	DIP50	plastic dual in-line package; 50 leads (900 mil)	2 - 48
SOT397-1	HSOP20	heat-dissipating small outline package; 20 leads	2 - 52
SOT398-1	HDIP18	plastic heat-dissipating dual in-line package; 18 leads	2 - 50
SOT400-1	SDIP56	plastic shrink dual in-line package; 56 leads (600 mil)	2 - 110
SOT401-1	LQFP32	plastic low profile quad flat package; 32 leads; body 5 × 5 × 1.4 mm	2 - 56
SOT402-1	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	2 - 144

IC package range and dimensions Chapter 2

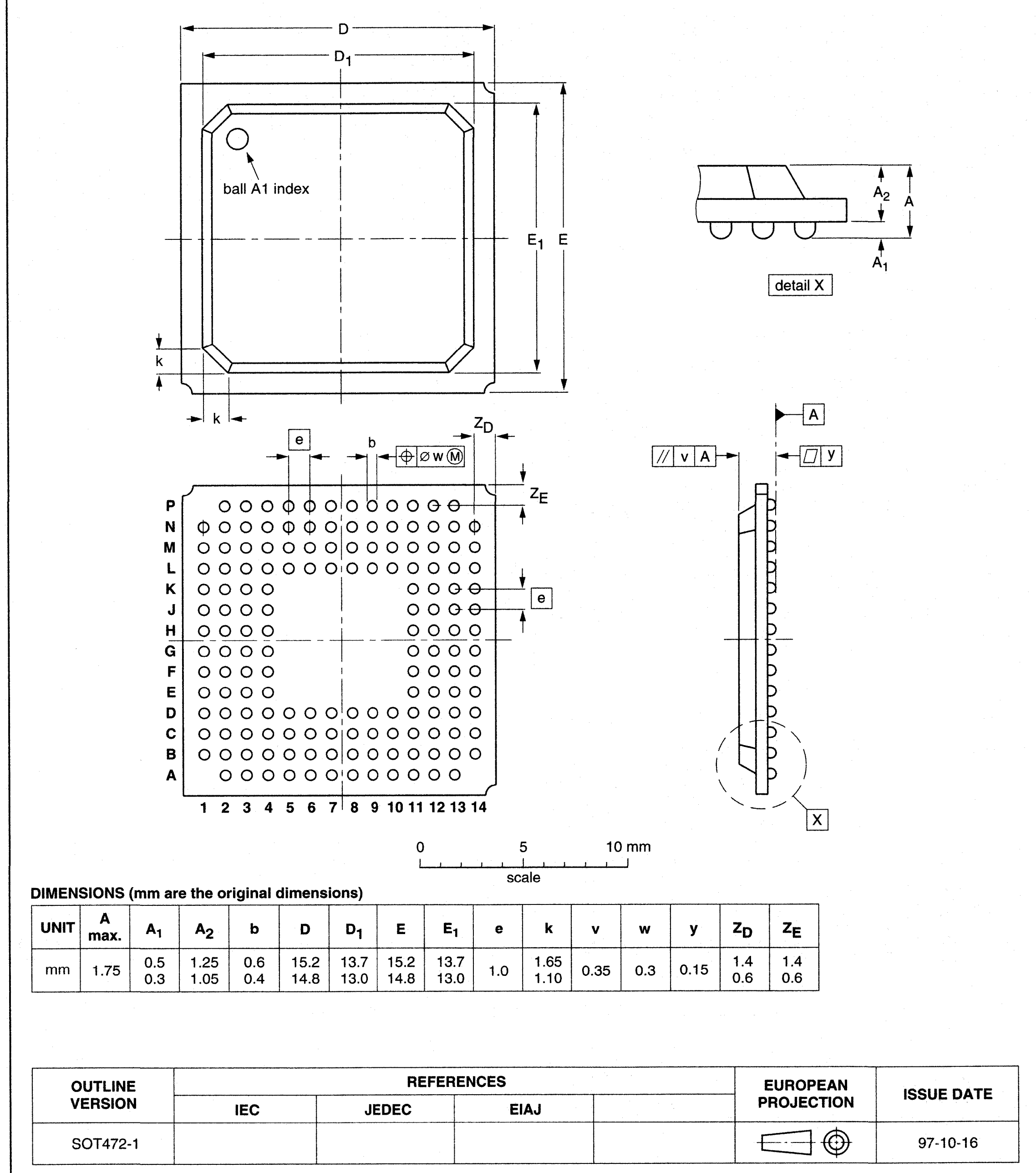
PHILIPS OUTLINE CODE	PACKAGE NAME	DESCRIPTION	PAGE
SOT403-1	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	2 - 145
SOT407-1	LQFP100	plastic low profile quad flat package; 100 leads; body 14 × 14 × 1.4 mm	2 - 62
SOT411-1	DBS23P	plastic DIL-bent-SIL power package; 23 leads (straight lead length 3.2 mm)	2 - 25
SOT411-2	DBS23P	plastic DIL-bent-SIL power package; 23 leads (lead length 12 mm)	2 - 26
SOT414-1	LQFP64	plastic low profile quad flat package; 64 leads; body 7 × 7 × 1.4 mm	2 - 60
SOT418-1	HSOP20	heat-dissipating small outline package; 20 leads	2 - 53
SOT418-2	HSOP20	heat-dissipating small outline package; 20 leads; low stand-off	see note 1
SOT420-1	LQFP128	plastic low profile quad flat package; 128 leads; body 14 × 14 × 1.4 mm	2 - 63
SOT425-1	LQFP128	plastic low profile quad flat package; 128 leads; body 14 × 20 × 1.4 mm	2 - 64
SOT433-1	PLCC52	plastic leaded chip carrier; 52 leads; thin version	2 - 74
SOT435-1	LQFP160	plastic low profile quad flat package; 160 leads; body 24 × 24 × 1.4 mm	2 - 65
SOT449-1	SOJ40	plastic small outline package; 40 leads (J-bent); body width 10.16 mm	2 - 127
SOT459-1	LQFP208	plastic low profile quad flat package; 208 leads; body 28 × 28 × 1.4 mm	2 - 66
SOT462-1	RDBS13P	plastic rectangular-DIL-bent-SIL (reverse bent) power package; 13 leads	2 - 104
SOT464-2	HSQFP240	heatsink shrink quad flat package; 240 leads; body 32 × 32 × 3.4 mm	2 - 54
SOT465-1	TO-92	TO-92 package; 3 leads; body diameter 4.7 mm	2 - 139
SOT470-1	HLQFP100	plastic heat-dissipating low profile quad flat package; 100 leads; body 14 × 14 × 1.4 mm	2 - 51
SOT471-1	BGA256	ball grid array; 256 balls; body 27 × 27 mm	2 - 17
SOT472-1	BGA156	plastic ball grid array package; 156 balls; body 15 × 15 × 1.15 mm	2 - 16
SOT475-1	DBS17P	plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm)	2 - 24
SOT478-1	LFBGA32	low profile fine pitch ball grid array; 32 balls	see note 1
SOT479-1	LFBGA20	low profile fine pitch ball grid array; 20 balls	see note 1
SOT480-1	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 4.4 mm; lead pitch 0.4 mm	2 - 150
SOT481-1	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 4.4 mm; lead pitch 0.4 mm	2 - 152
SOT487-1	TSSOP32	plastic thin shrink small outline package; 32 leads; body width 6.1 mm; lead pitch 0.65 mm	2 - 148
SOT488-1	LFBGA48	low profile fine pitch ball grid array; 48 balls	see note 1
SOT491-1	LFBGA48	low profile fine pitch ball grid array; 48 balls	see note 1

Note

1. Although an outline drawing is not given in this databook, it is available on request.

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**



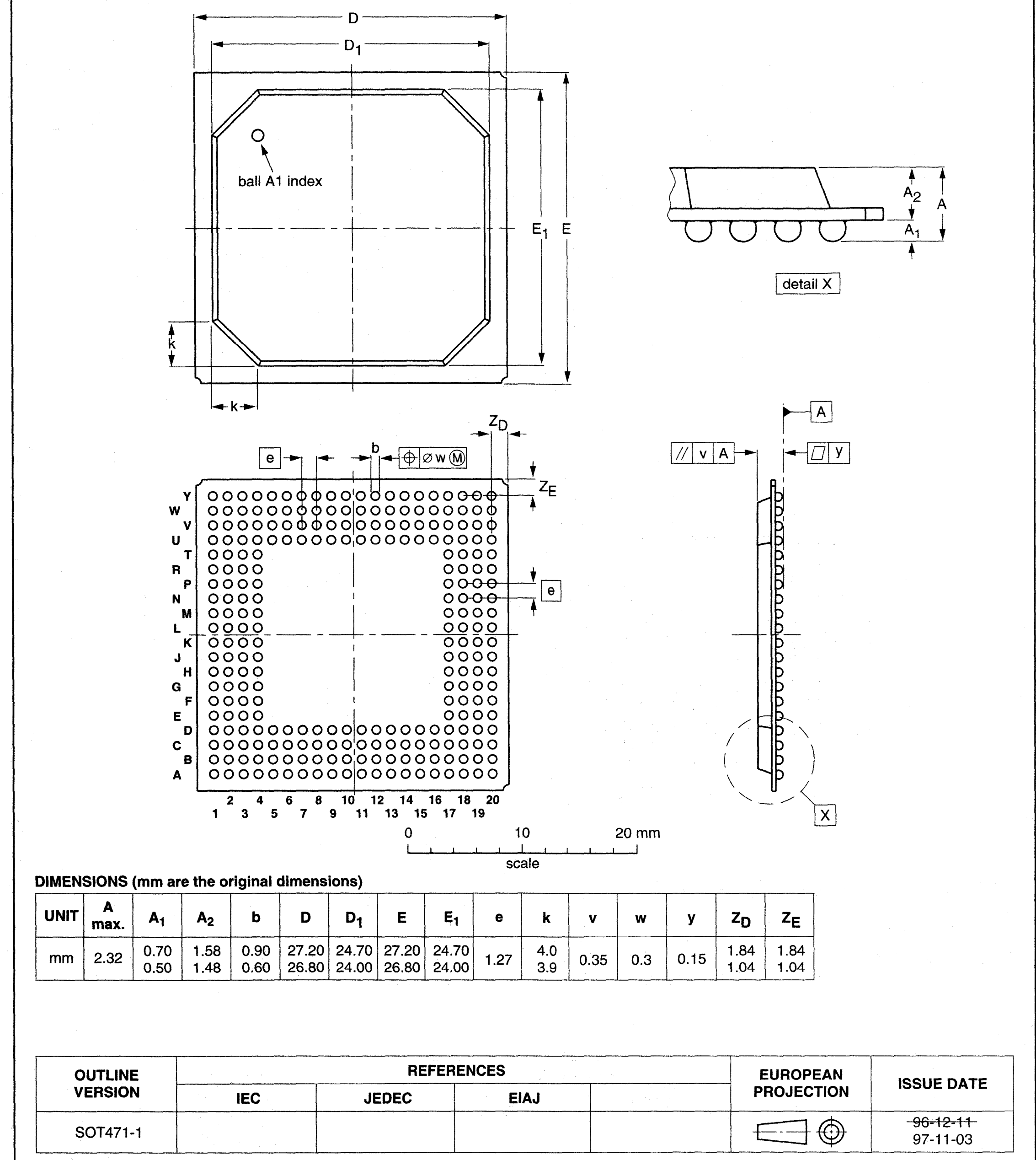
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	b	D	D_1	E	E_1	e	k	v	w	y	Z_D	Z_E
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	1.65 1.10	0.35	0.3	0.15	1.4 0.6	1.4 0.6

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT472-1						97-10-16

IC package range and dimensions Chapter 2

BGA256: plastic ball grid array package; 256 balls; body 27 x 27 x 1.55 mm **SOT471-1**



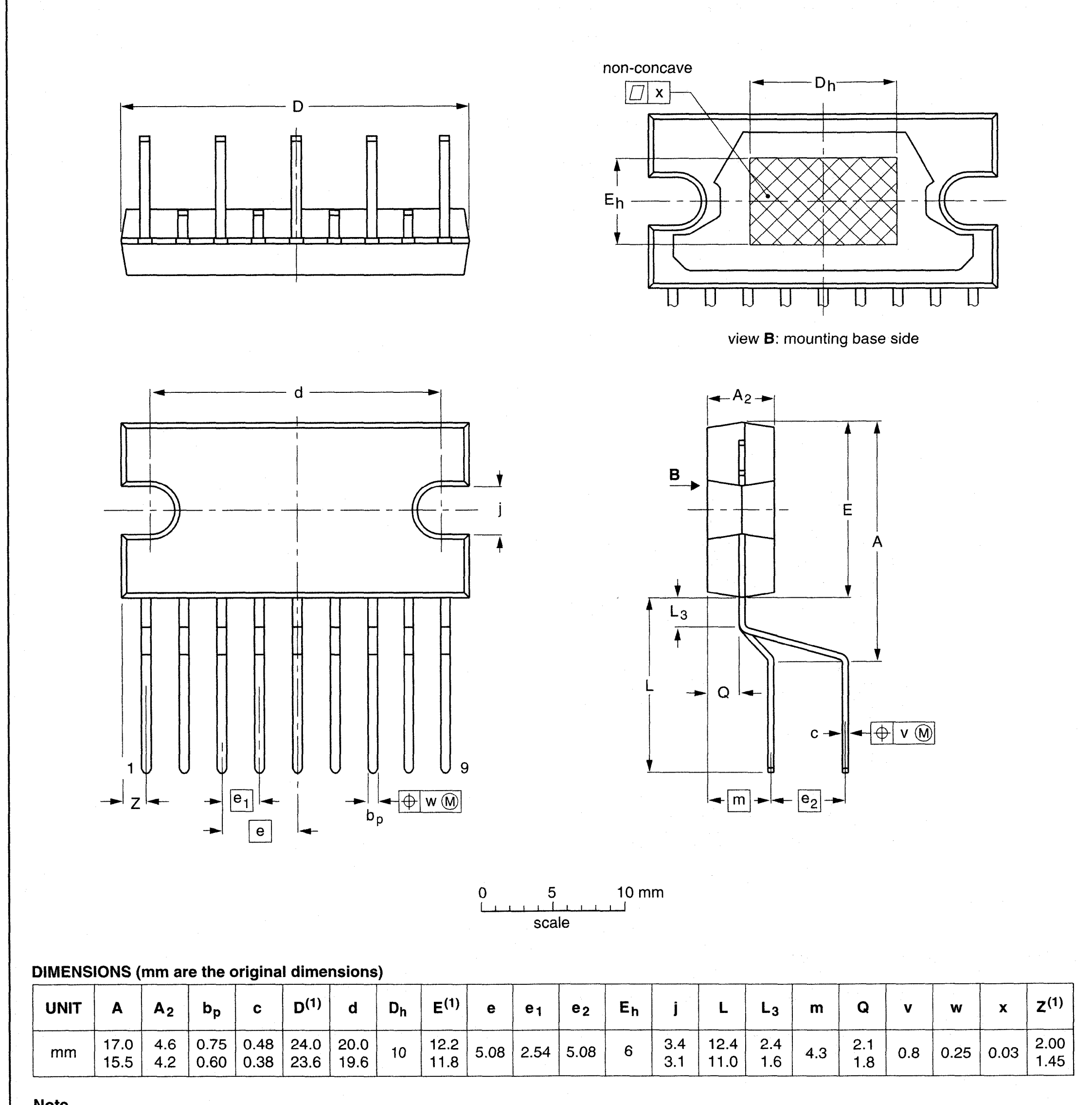
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	b	D	D_1	E	E_1	e	k	v	w	y	Z_D	Z_E
mm	2.32	0.70 0.50	1.58 1.48	0.90 0.60	27.20 26.80	24.70 24.00	27.20 26.80	24.70 24.00	1.27	4.0 3.9	0.35	0.3	0.15	1.84 1.04	1.84 1.04

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT471-1						~~96-12-11~~ 97-11-03

IC package range and dimensions Chapter 2

DBS9P: plastic DIL-bent-SIL power package; 9 leads (lead length 12 mm) SOT157-2



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 4.2	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	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	2.00 1.45

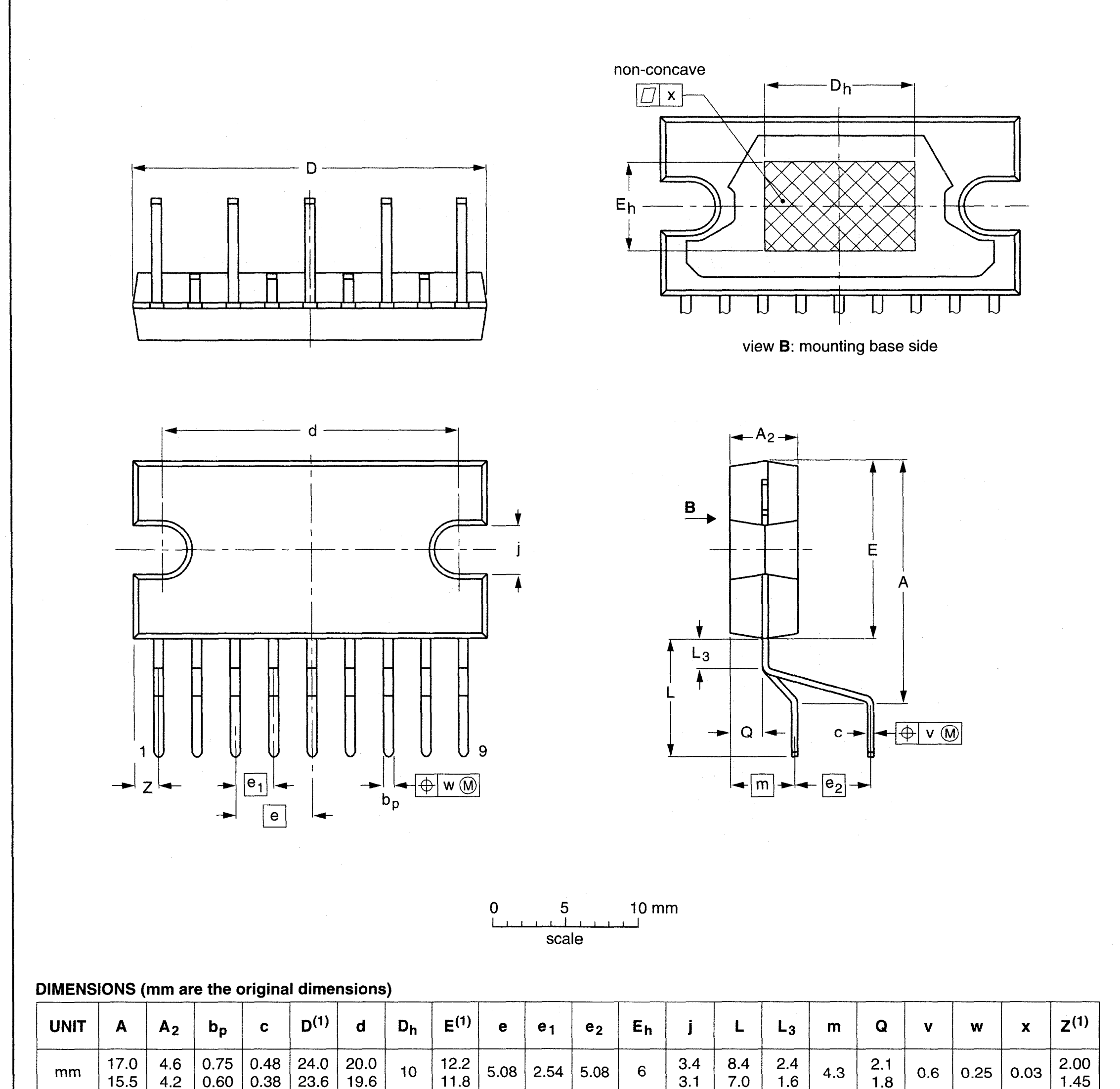
Note

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			
SOT157-2						~~95-03-11~~ 97-12-16

IC package range and dimensions Chapter 2

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 4.2	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

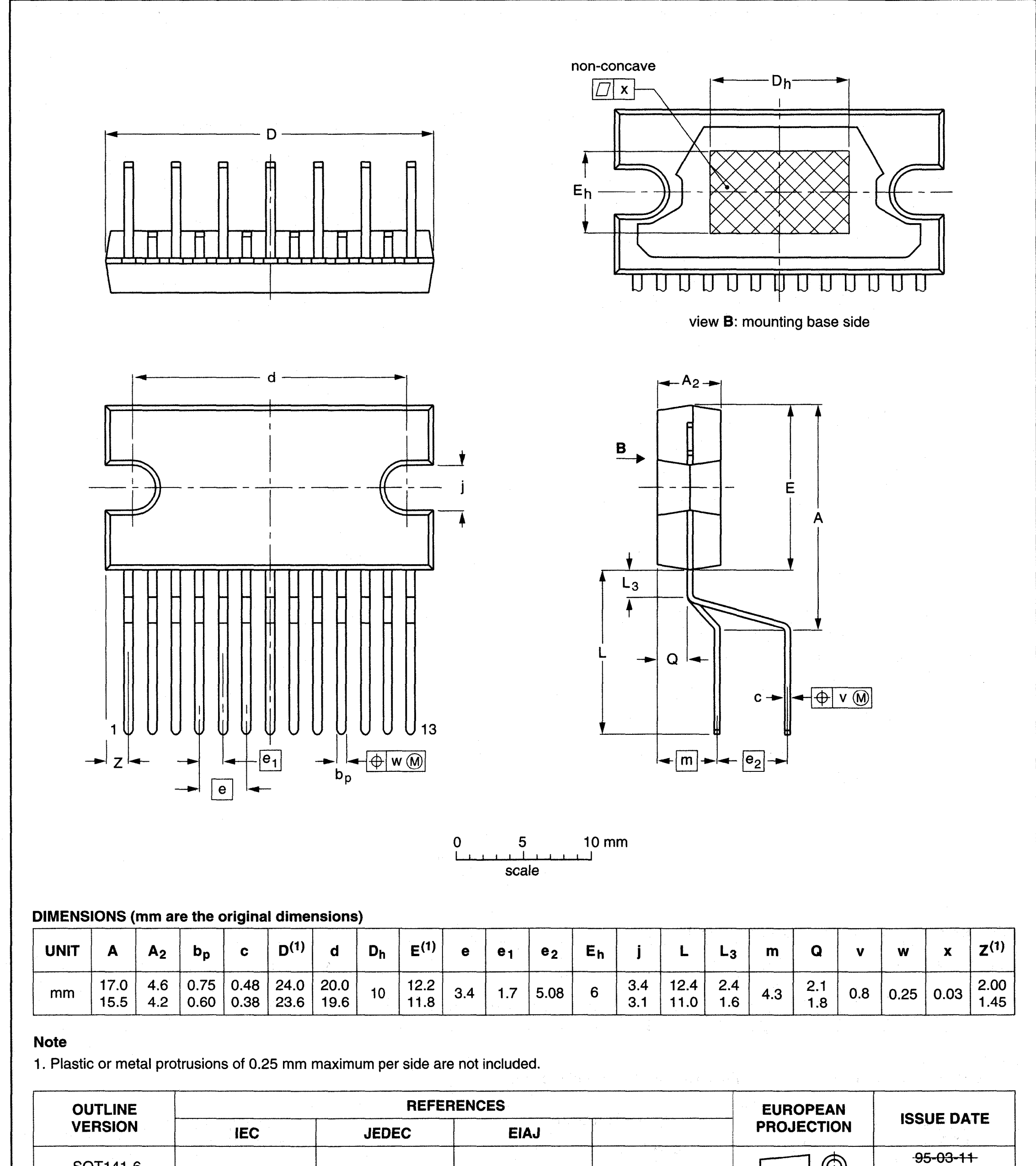
Note

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						~~95-03-11~~ 97-12-16

IC package range and dimensions Chapter 2

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm) SOT141-6



DIMENSIONS (mm are the original dimensions)

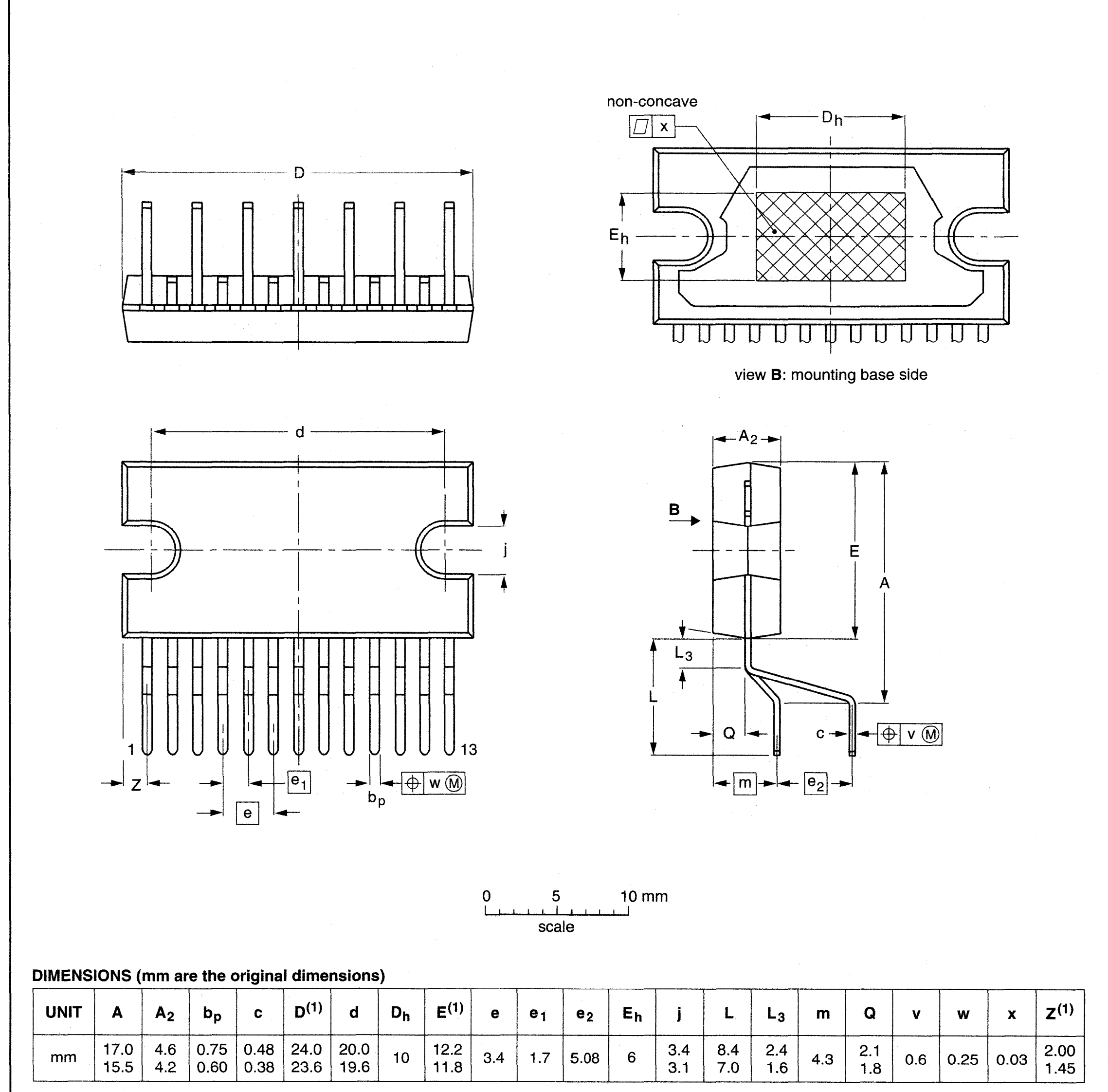
UNIT	A	A_2	b_p	c	D(1)	d	D_h	E(1)	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	Z(1)
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	2.00 1.45

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						~~95-03-11~~ 97-12-16

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 7.7 mm) **SOT141-8**



DIMENSIONS (mm are the original dimensions)

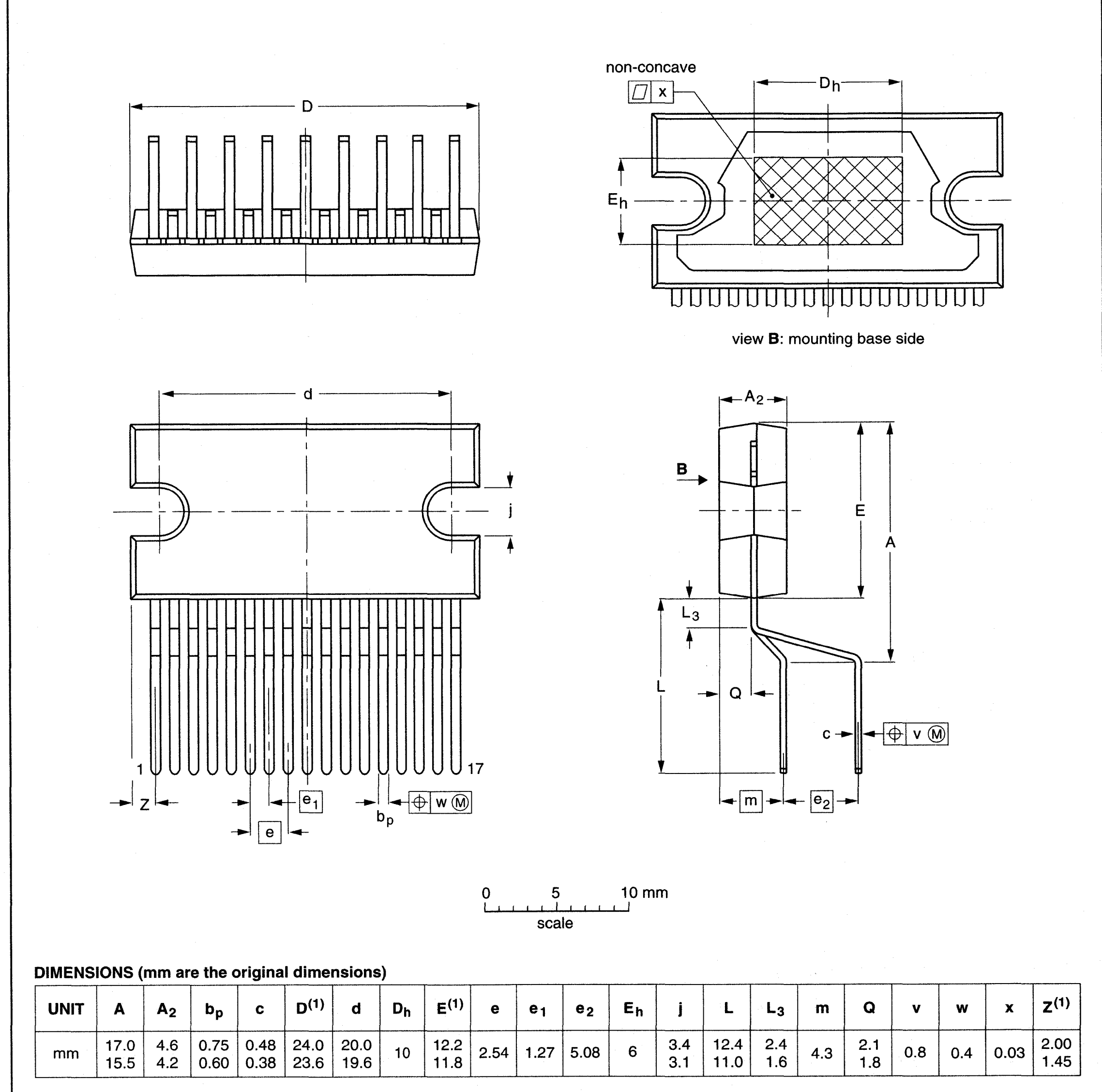
UNIT	A	A_2	b_p	c	D[(1)]	d	D_h	E[(1)]	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	Z[(1)]
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	8.4 7.0	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	2.00 1.45

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						~~95-03-11~~ 97-12-16

DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 12 mm) SOT243-1



DIMENSIONS (mm are the original dimensions)

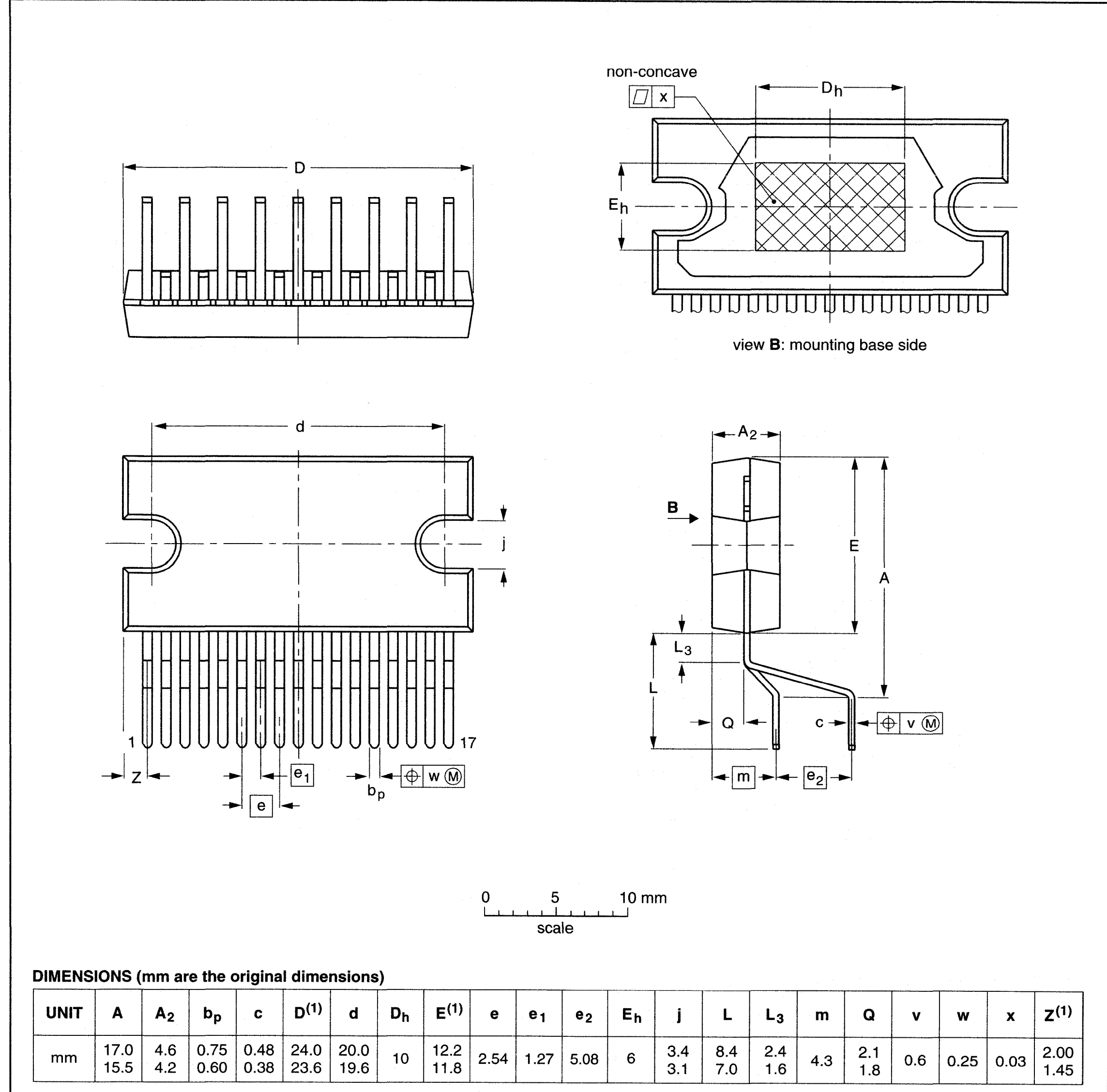
UNIT	A	A_2	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	$Z^{(1)}$
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	1.27	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.4	0.03	2.00 1.45

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						~~95-03-11~~ 97-12-16

DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm) **SOT243-3**



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 4.2	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	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

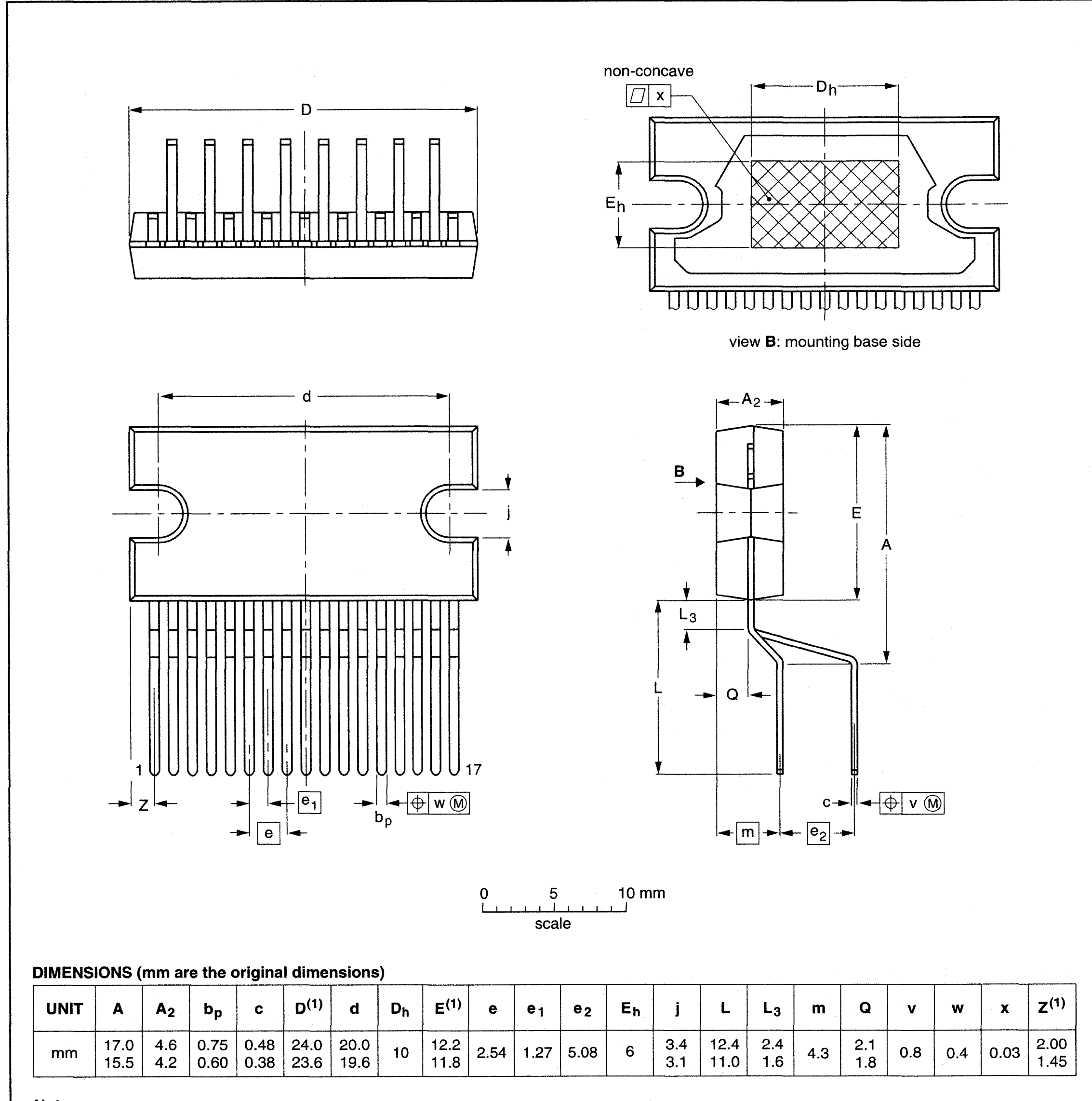
1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT243-3						~~95-03-11~~ 97-12-16

IC package range and dimensions

Chapter 2

DBS17P: plastic DIL-bent-SIL (special bent) power package; 17 leads (lead length 12 mm) SOT475-1



DIMENSIONS (mm are the original dimensions)

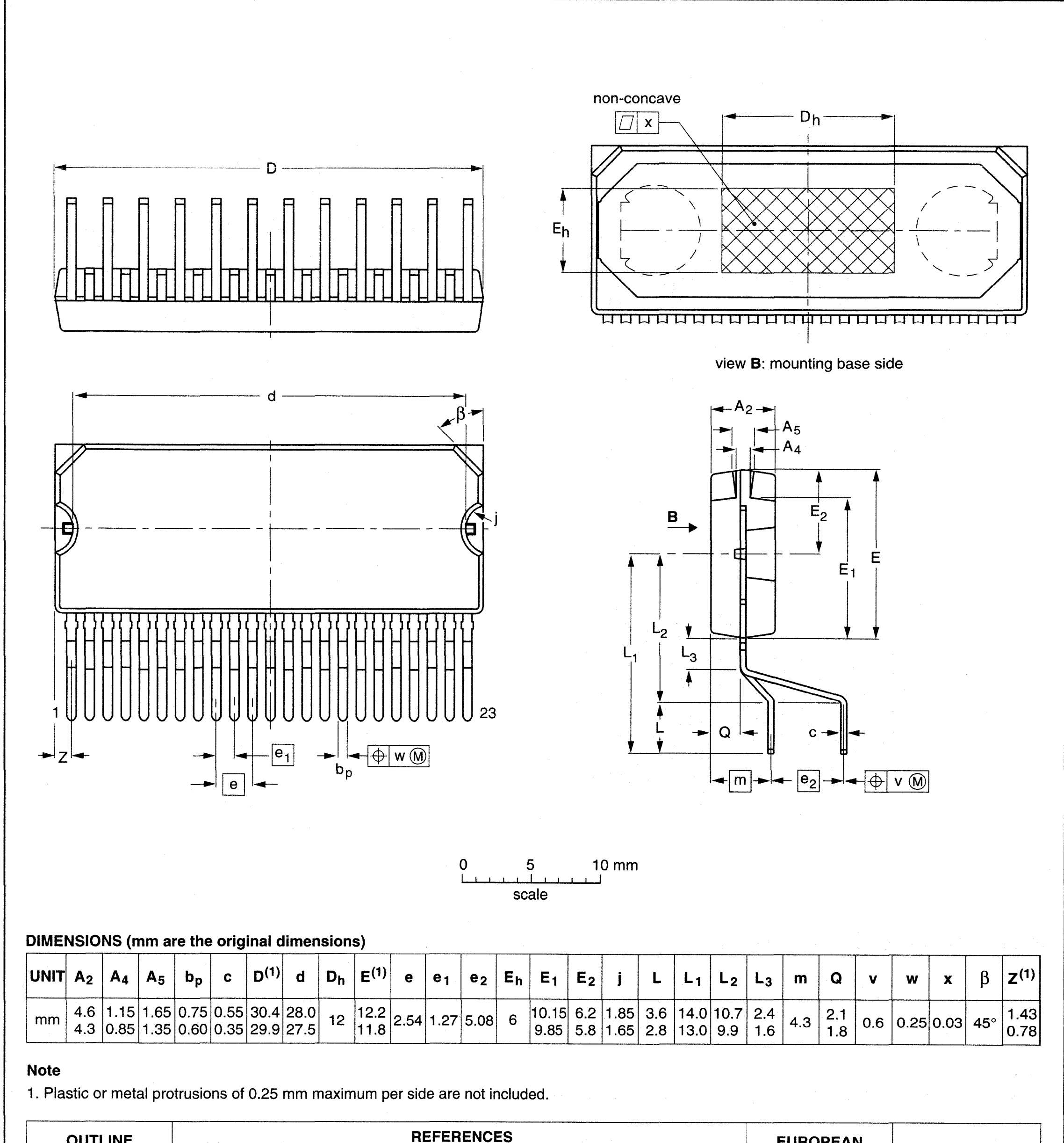
UNIT	A	A_2	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	$Z^{(1)}$
mm	17.0 15.5	4.6 4.2	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	1.27	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.4	0.03	2.00 1.45

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

DBS23P: plastic DIL-bent-SIL power package; 23 leads (straight lead length 3.2 mm) **SOT411-1**



DIMENSIONS (mm are the original dimensions)

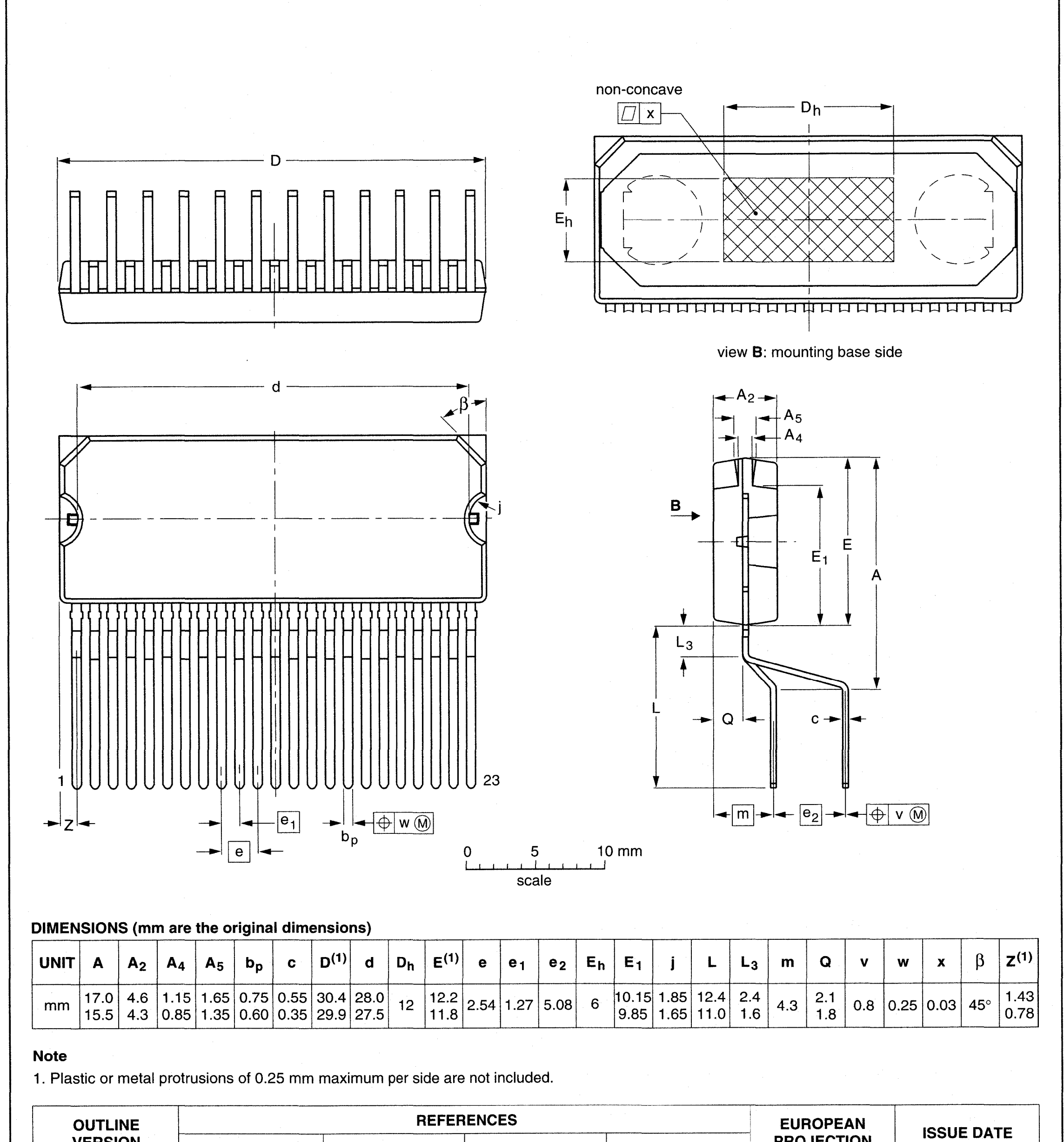
UNIT	A_2	A_4	A_5	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	e_1	e_2	E_h	E_1	E_2	j	L	L_1	L_2	L_3	m	Q	v	w	x	β	$Z^{(1)}$
mm	4.6 4.3	1.15 0.85	1.65 1.35	0.75 0.60	0.55 0.35	30.4 29.9	28.0 27.5	12	12.2 11.8	2.54	1.27	5.08	6	10.15 9.85	6.2 5.8	1.85 1.65	3.6 2.8	14.0 13.0	10.7 9.9	2.4 1.6	4.3	2.1 1.8	0.6	0.25	0.03	45°	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

DBS23P: plastic DIL-bent-SIL power package; 23 leads (lead length 12 mm) SOT411-2



DIMENSIONS (mm are the original dimensions)

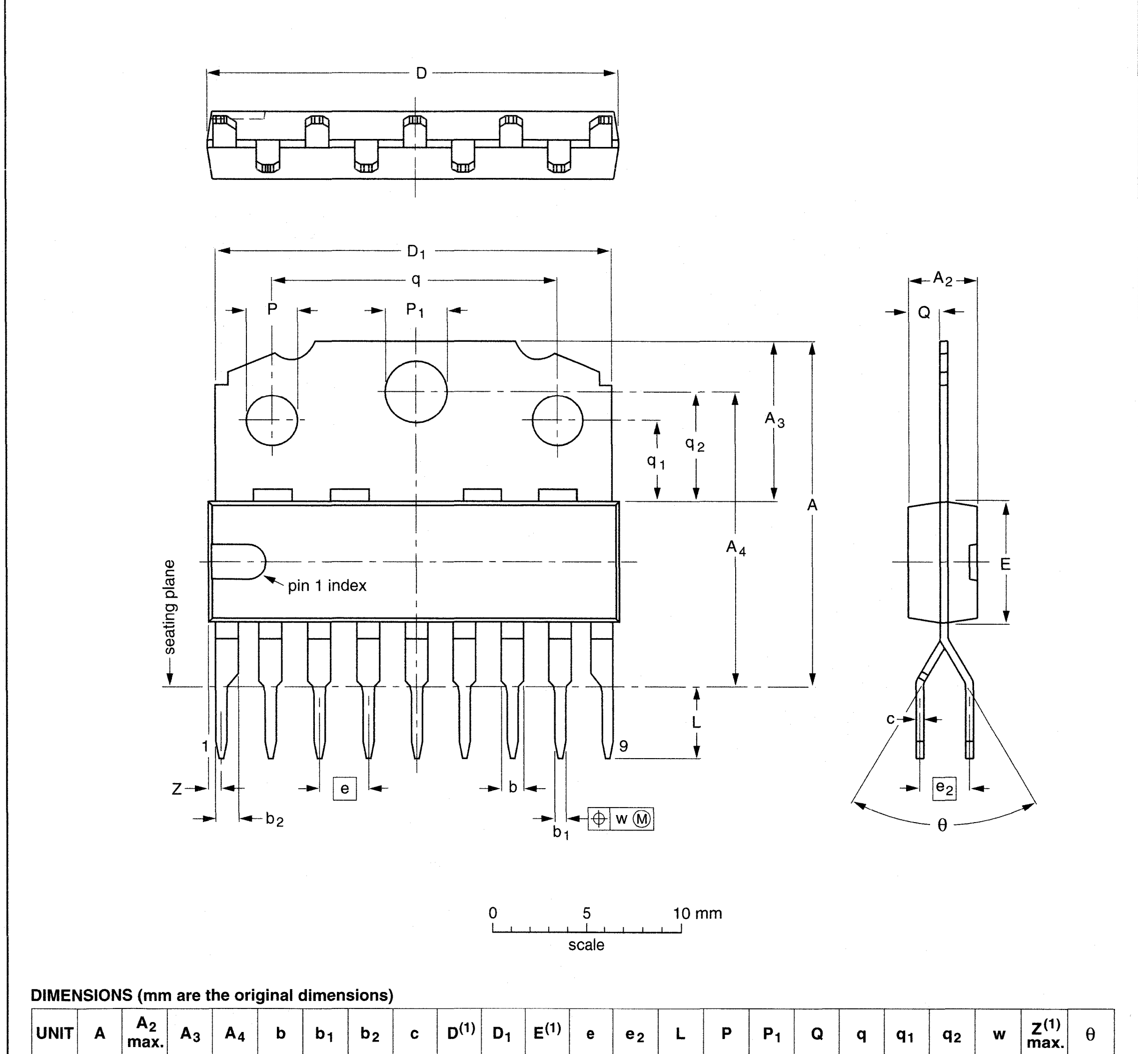
UNIT	A	A_2	A_4	A_5	b_p	c	D(1)	d	D_h	E(1)	e	e_1	e_2	E_h	E_1	j	L	L_3	m	Q	v	w	x	β	Z(1)
mm	17.0 15.5	4.6 4.3	1.15 0.85	1.65 1.35	0.75 0.60	0.55 0.35	30.4 29.9	28.0 27.5	12	12.2 11.8	2.54	1.27	5.08	6	10.15 9.85	1.85 1.65	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	0.25	0.03	45°	1.43 0.78

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						~~96-10-10~~ 96-10-25

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°

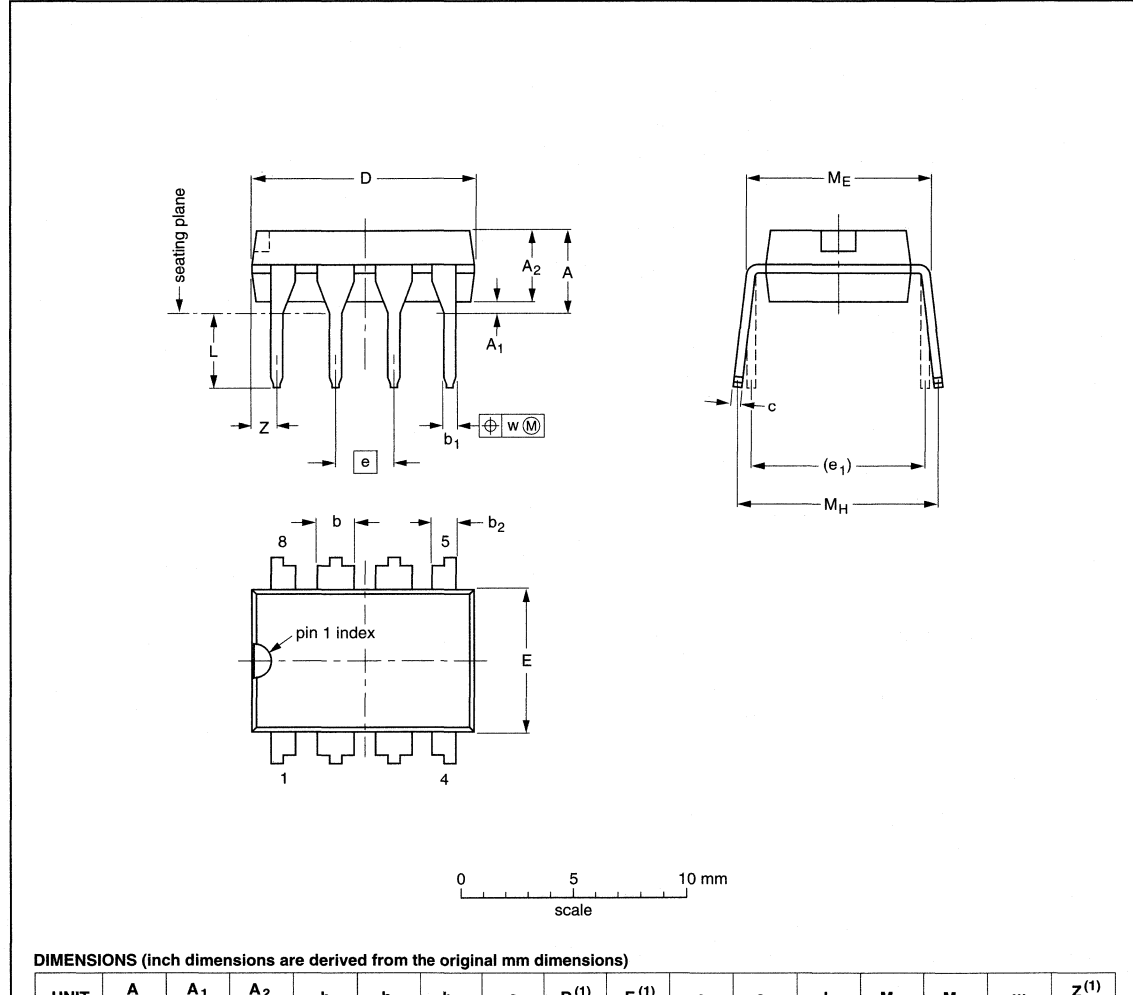
Note

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

IC package range and dimensions Chapter 2

DIP8: plastic dual in-line package; 8 leads (300 mil) **SOT97-1**



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

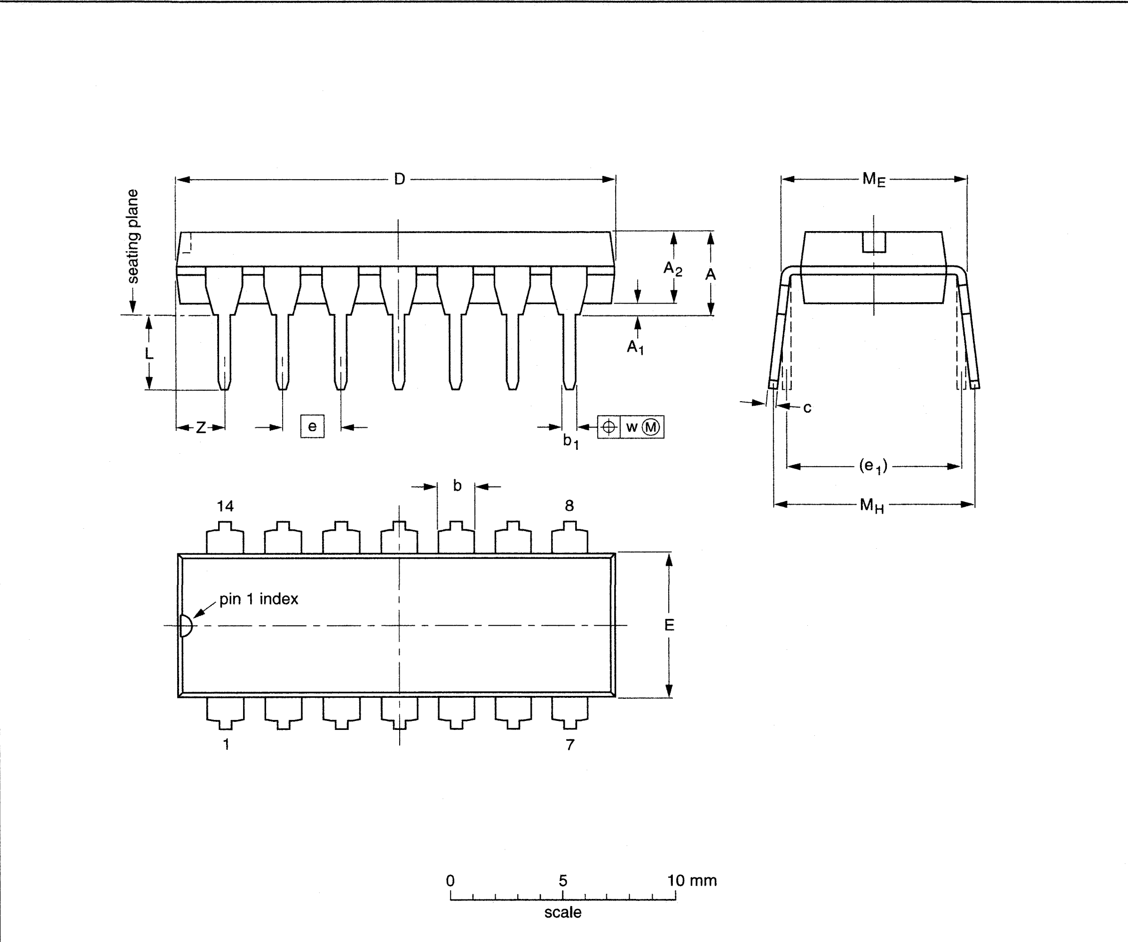
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.14	0.53 0.38	1.07 0.89	0.36 0.23	9.8 9.2	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	1.15
inches	0.17	0.020	0.13	0.068 0.045	0.021 0.015	0.042 0.035	0.014 0.009	0.39 0.36	0.26 0.24	0.10	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-001AN				~~92-11-17~~ 95-02-04

DIP14: plastic dual in-line package; 14 leads (300 mil) **SOT27-1**



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

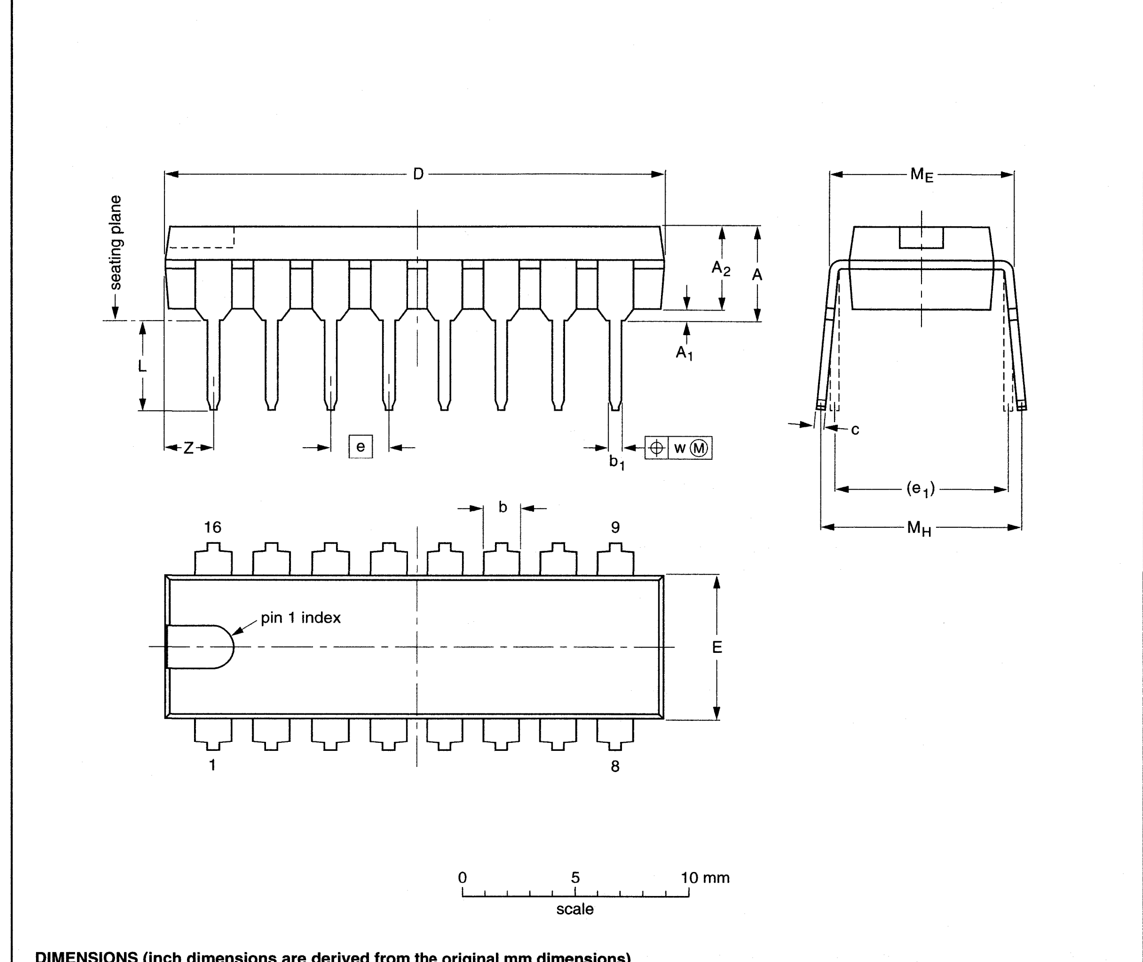
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	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-001AA				~~92-11-17~~ 95-03-11

DIP16: plastic dual in-line package; 16 leads (300 mil); long body **SOT38-1**



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

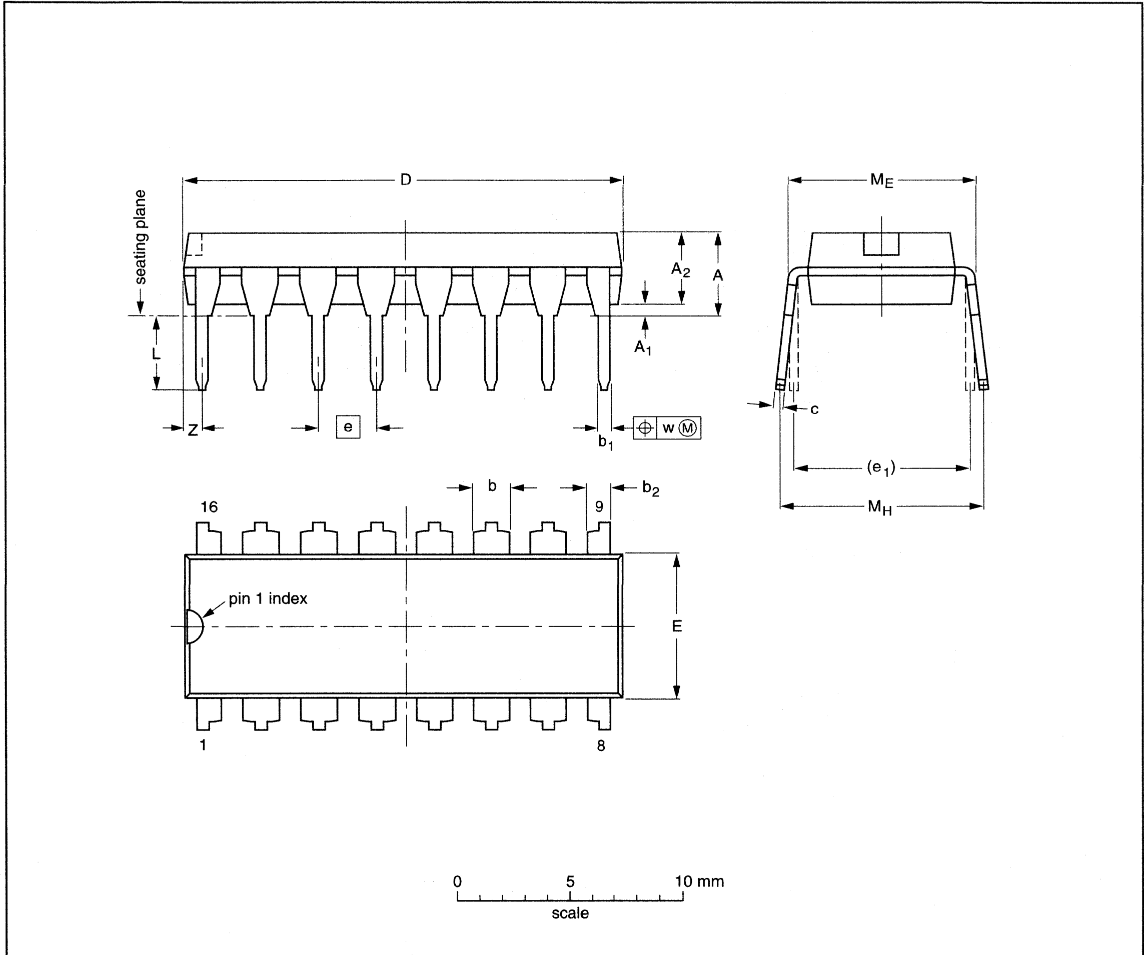
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 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-001AE				~~92-10-02~~ 95-01-19

DIP16: plastic dual in-line package; 16 leads (300 mil) **SOT38-4**



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

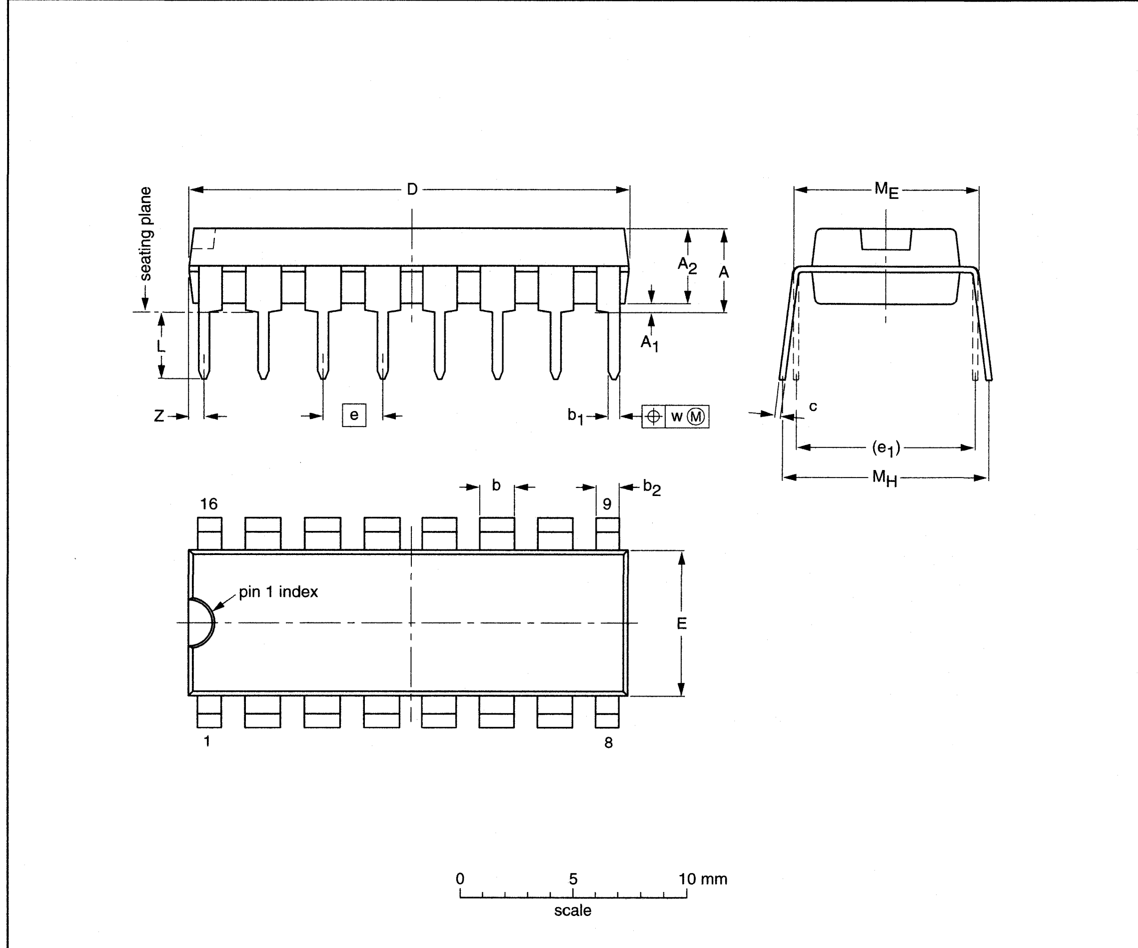
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D[(1)]	E[(1)]	e	e_1	L	M_E	M_H	w	Z[(1)] max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	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

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

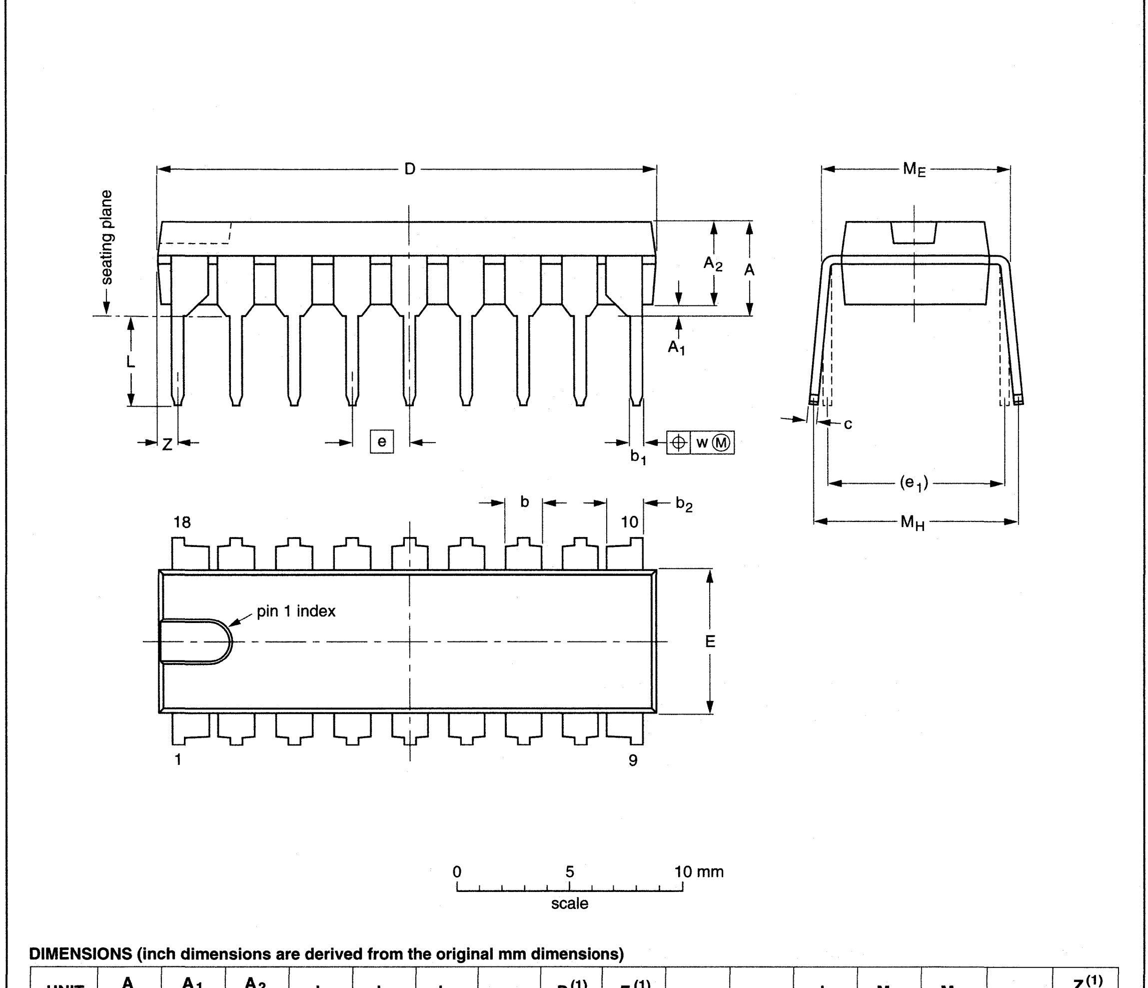
Note

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

IC package range and dimensions Chapter 2

DIP18: plastic dual in-line package; 18 leads (300 mil) **SOT102-1**



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

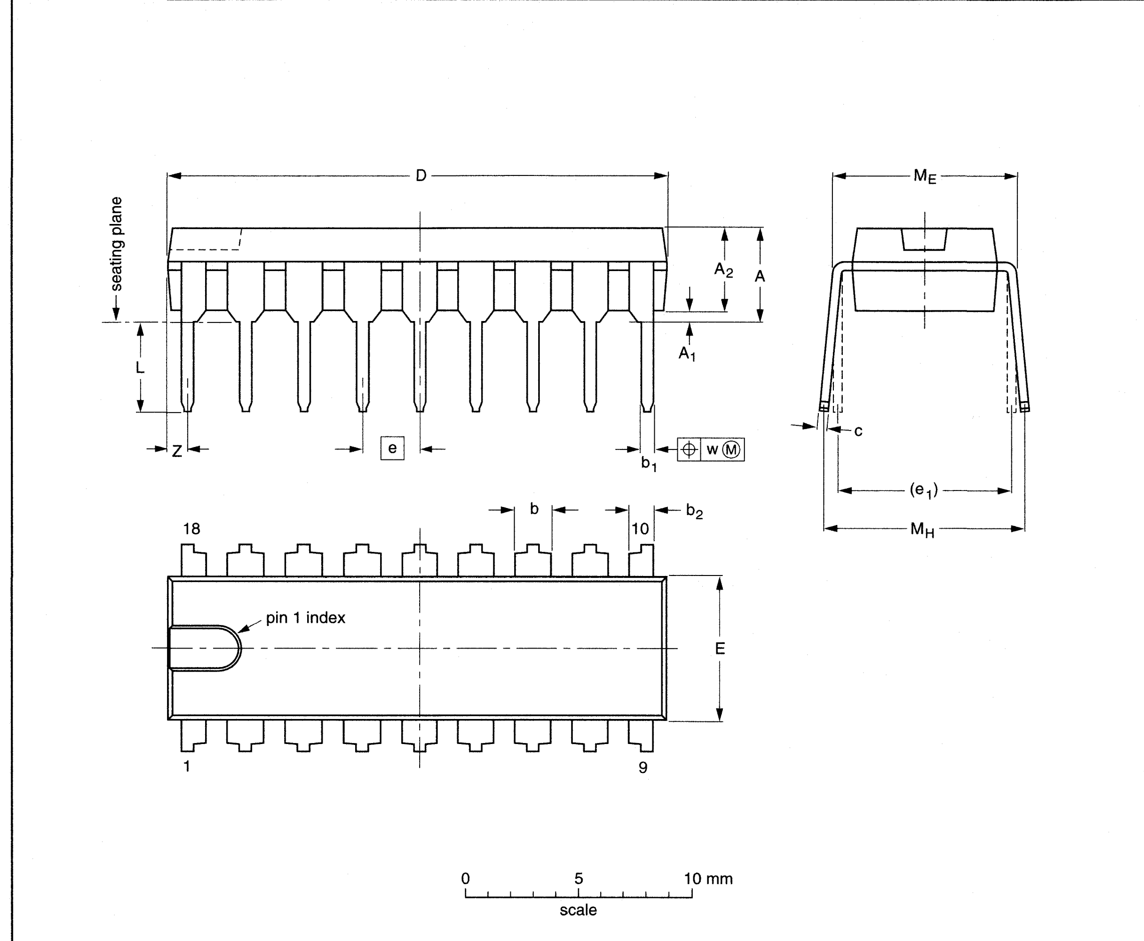
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D(1)	E(1)	e	e_1	L	M_E	M_H	w	Z(1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.40 1.14	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.044	0.021 0.015	0.055 0.044	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	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						~~93-10-14~~ 95-01-23

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)

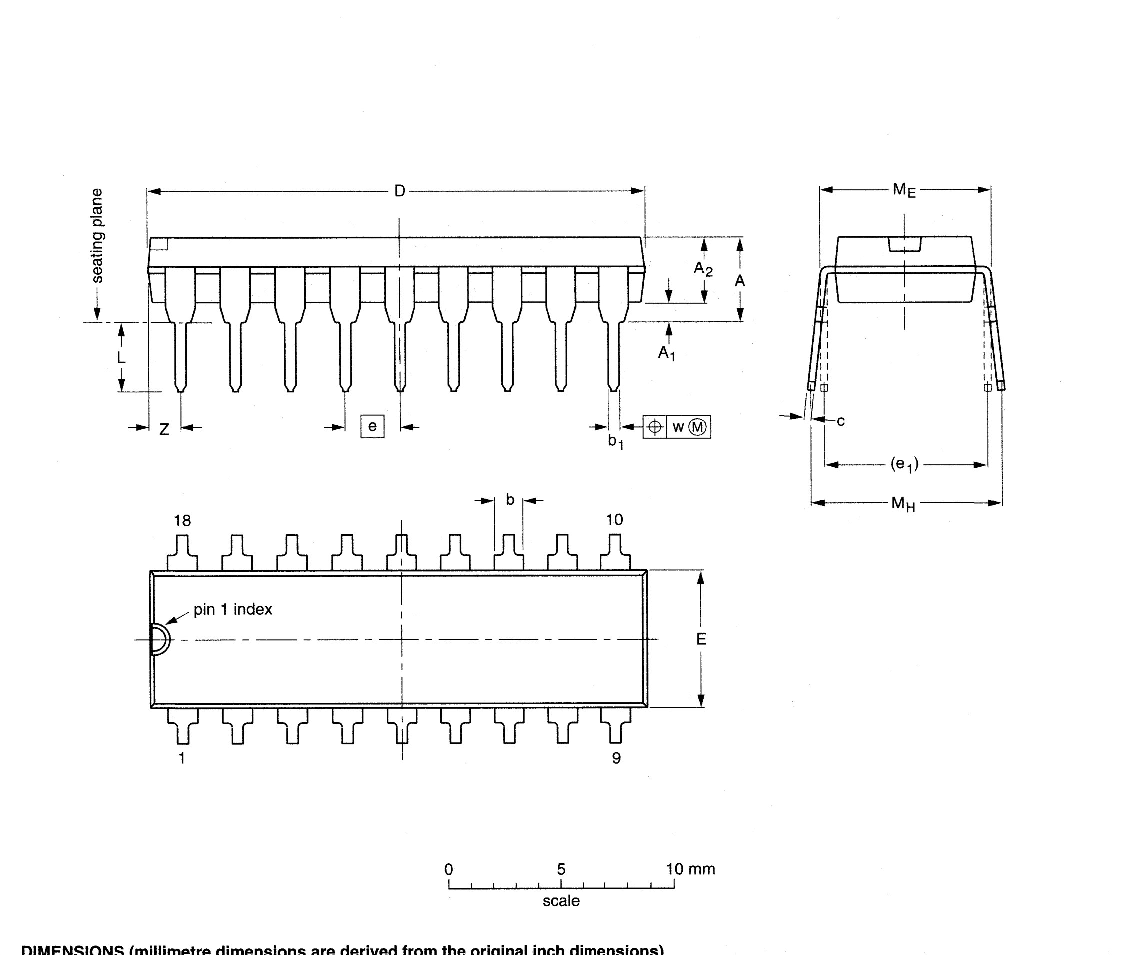
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.05 0.75	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.041 0.030	0.013 0.009	0.86 0.84	0.26 0.24	0.10	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						~~93-10-14~~ 95-01-23

DIP18: plastic dual in-line package; 18 leads (300 mil); long body **SOT102-4**



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

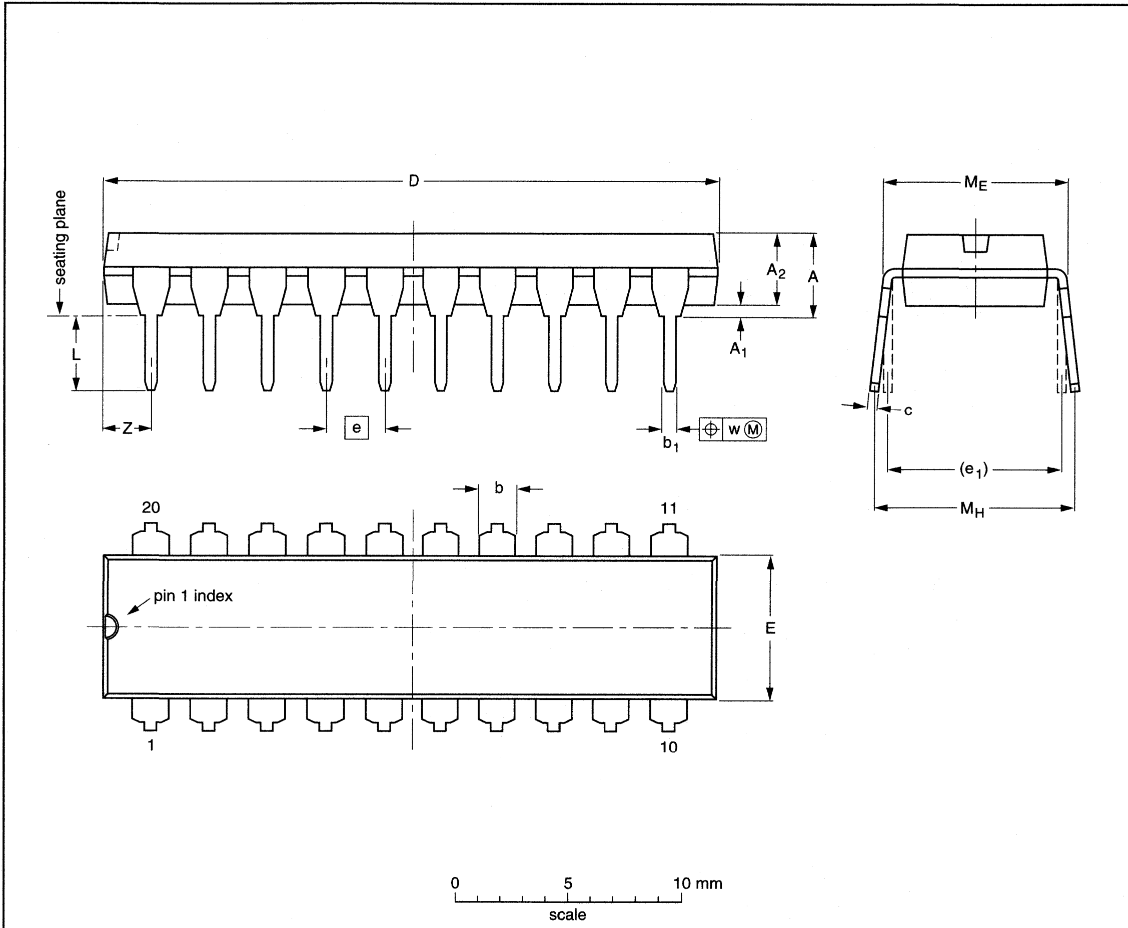
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	4.06	0.51	3.18	1.63 1.14	0.56 0.43	0.36 0.25	23.50 23.24	6.48 6.22	2.54	7.62	3.51 3.05	8.13 7.62	10.03 7.62	0.25	1.65
inches	0.160	0.020	0.125	0.064 0.045	0.022 0.017	0.014 0.010	0.925 0.915	0.255 0.245	0.100	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-001AD				95-03-11

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



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

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

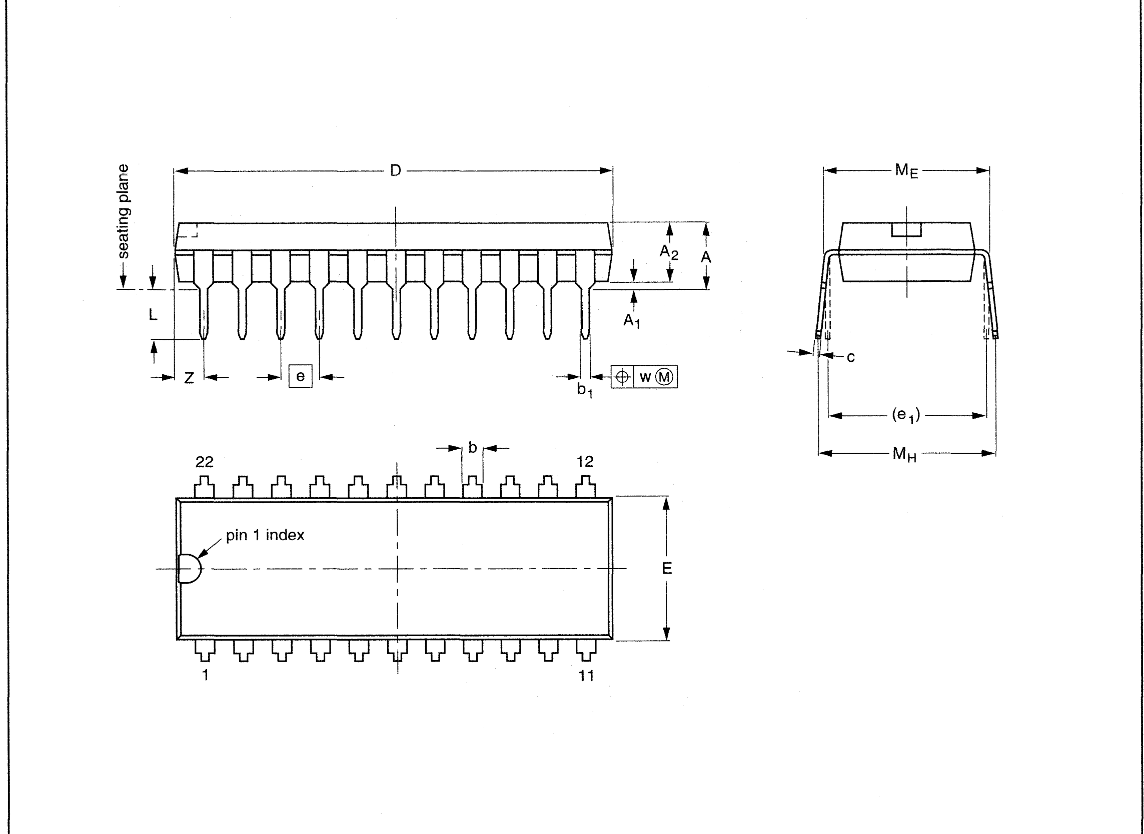
Note

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

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

IC package range and dimensions Chapter 2

DIP22: plastic dual in-line package; 22 leads (400 mil) SOT116-1



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

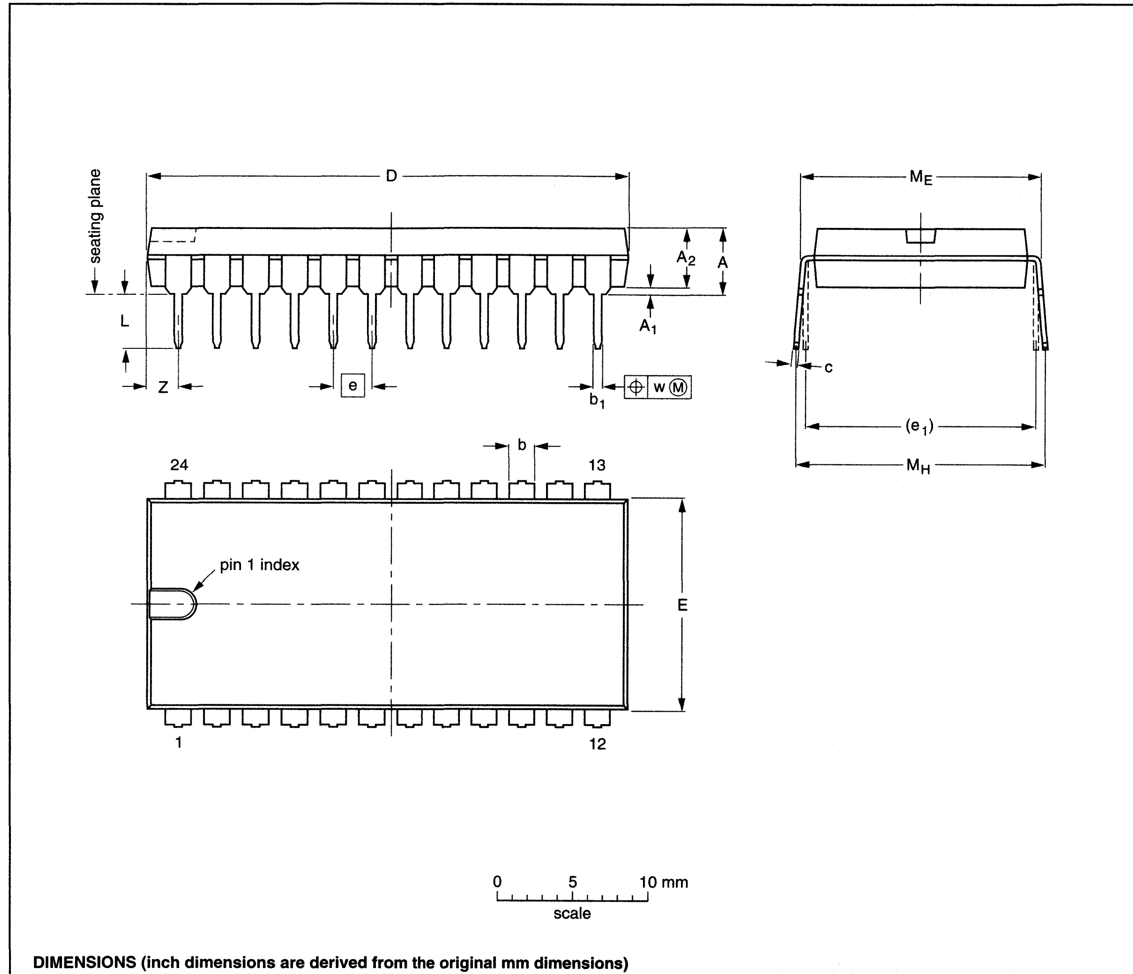
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D [(1)]	E [(1)]	e	e_1	L	M_E	M_H	w	Z [(1)] max.
mm	4.83	0.38	3.81	1.65 1.12	0.53 0.38	0.36 0.23	28.19 27.69	9.02 8.38	2.54	10.16	3.60 3.05	10.80 10.16	12.45 10.16	0.254	1.4
inches	0.19	0.015	0.15	0.064 0.044	0.021 0.015	0.014 0.009	1.11 1.09	0.36 0.33	0.10	0.40	0.14 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	MO-026AA				~~92-11-17~~ 95-01-23

DIP24: plastic dual in-line package; 24 leads (600 mil) **SOT101-1**



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

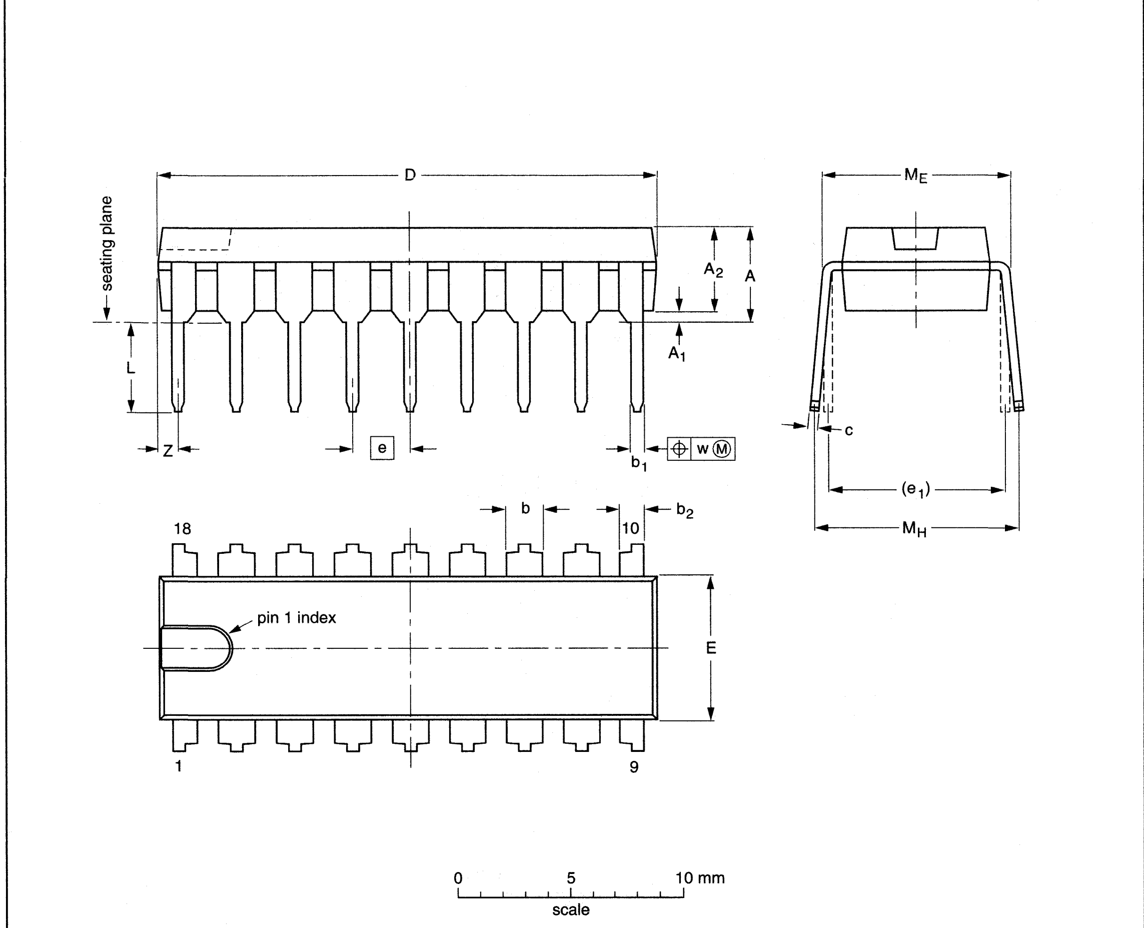
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.1	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	32.0 31.4	14.1 13.7	2.54	15.24	3.9 3.4	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.20	0.020	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.26 1.24	0.56 0.54	0.10	0.60	0.15 0.13	0.62 0.60	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-015AD				~~92-11-17~~ 95-01-23

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)

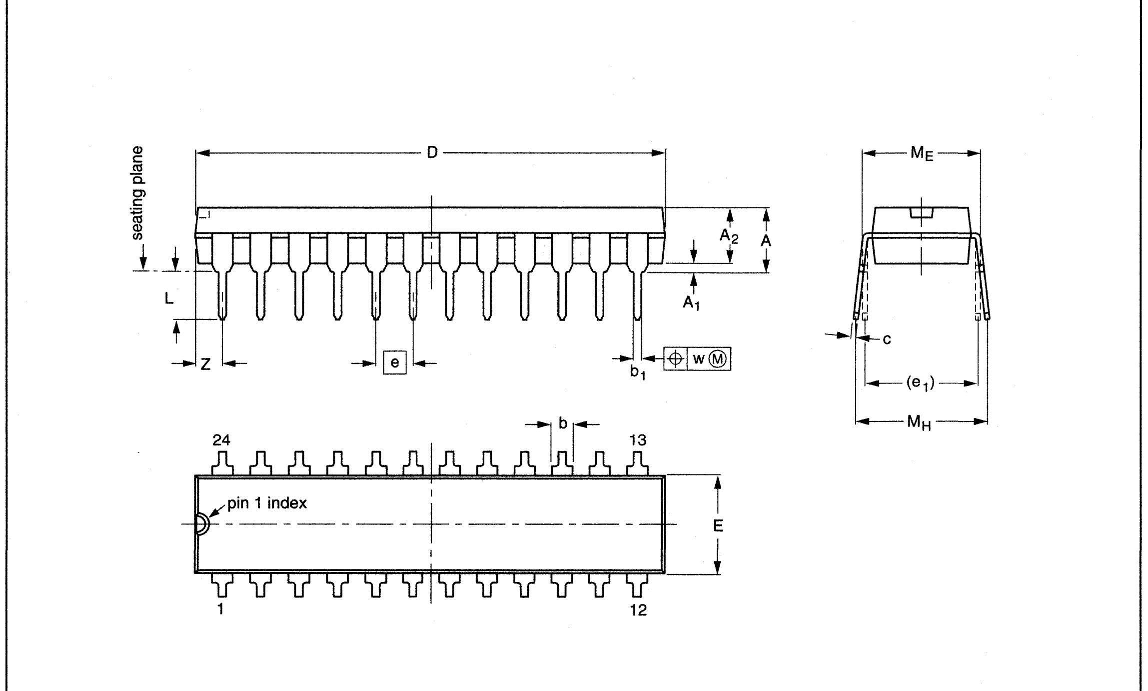
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.05 0.75	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.041 0.030	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

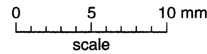
Note

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						~~93-10-14~~ 95-01-23

DIP24: plastic dual in-line package; 24 leads (300 mil) **SOT222-1**





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

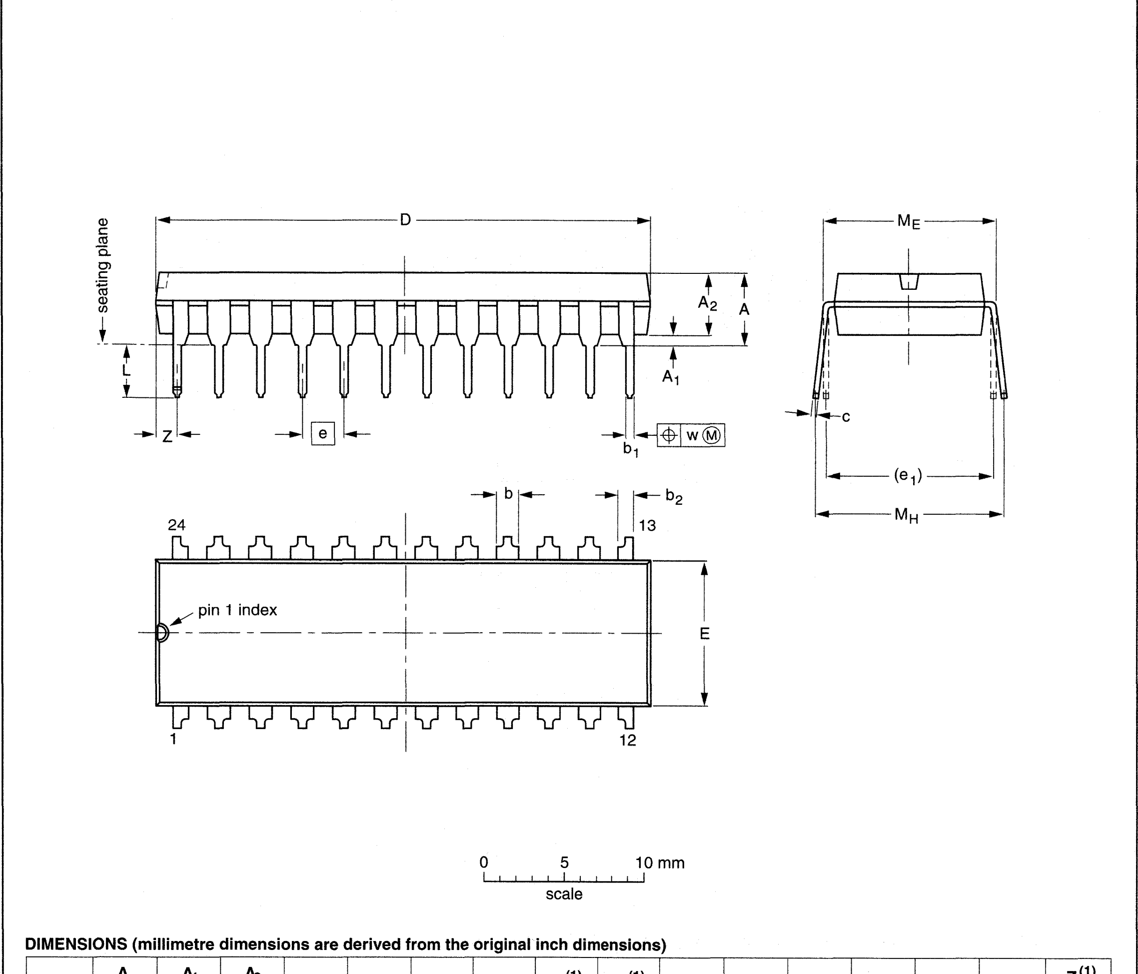
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.70	0.38	3.94	1.63 1.14	0.56 0.43	0.36 0.25	31.9 31.5	6.73 6.48	2.54	7.62	3.51 3.05	8.13 7.62	10.03 7.62	0.25	2.05
inches	0.185	0.015	0.155	0.064 0.045	0.022 0.017	0.014 0.010	1.256 1.240	0.265 0.255	0.100	0.300	0.138 0.120	0.32 0.30	0.395 0.300	0.01	0.081

Note

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

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

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

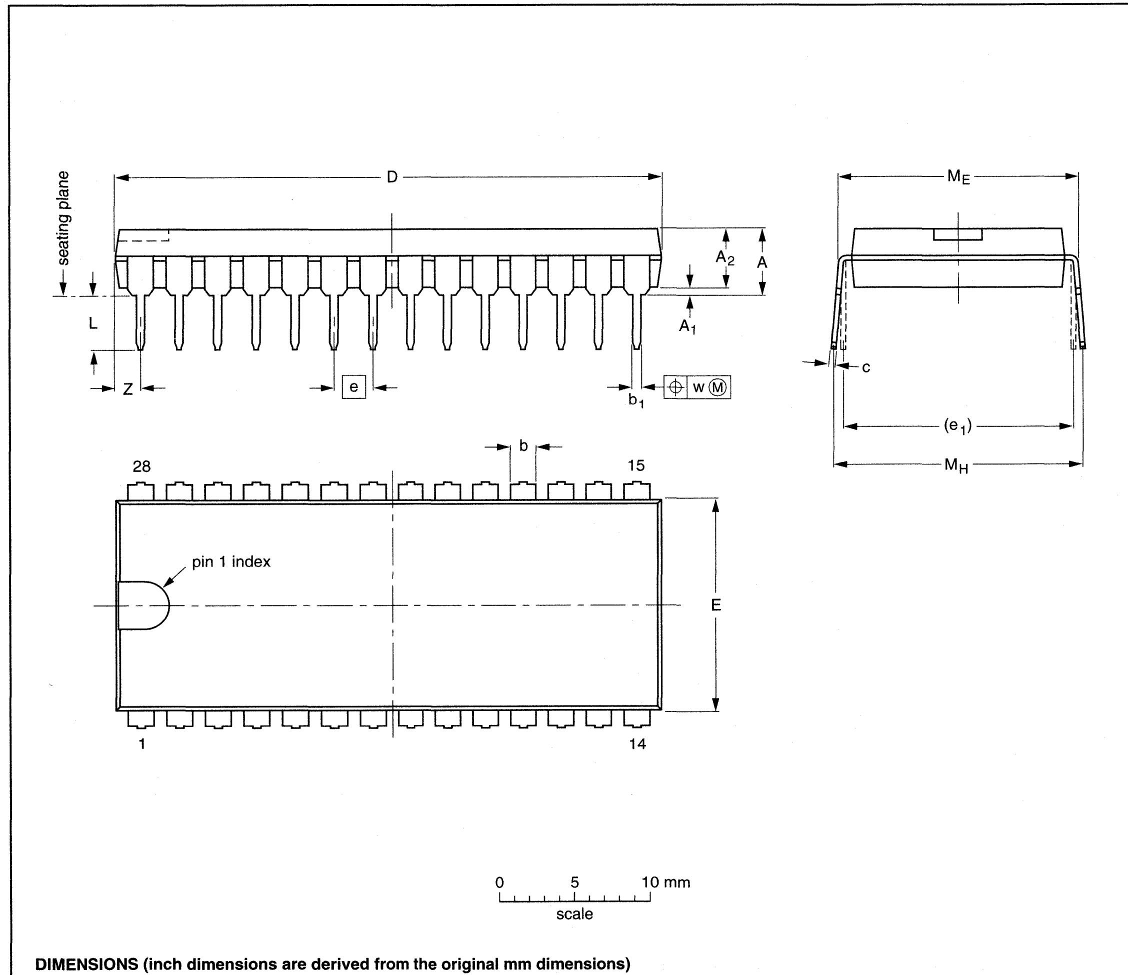
Note

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						95-03-11

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

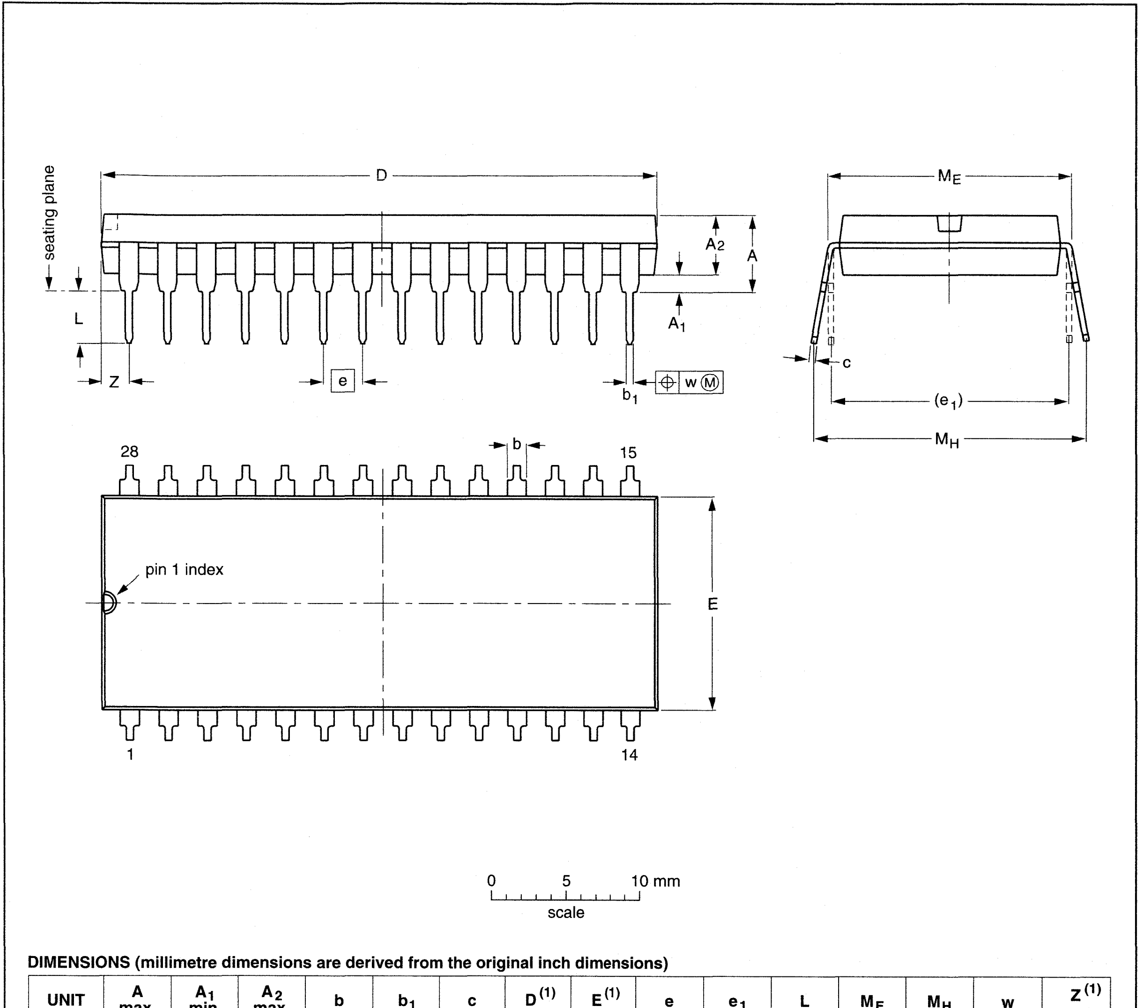
Note

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-015AH				~~92-11-17~~ 95-01-14

IC package range and dimensions Chapter 2

DIP28: plastic dual in-line package; 28 leads (600 mil); long body SOT117-2



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

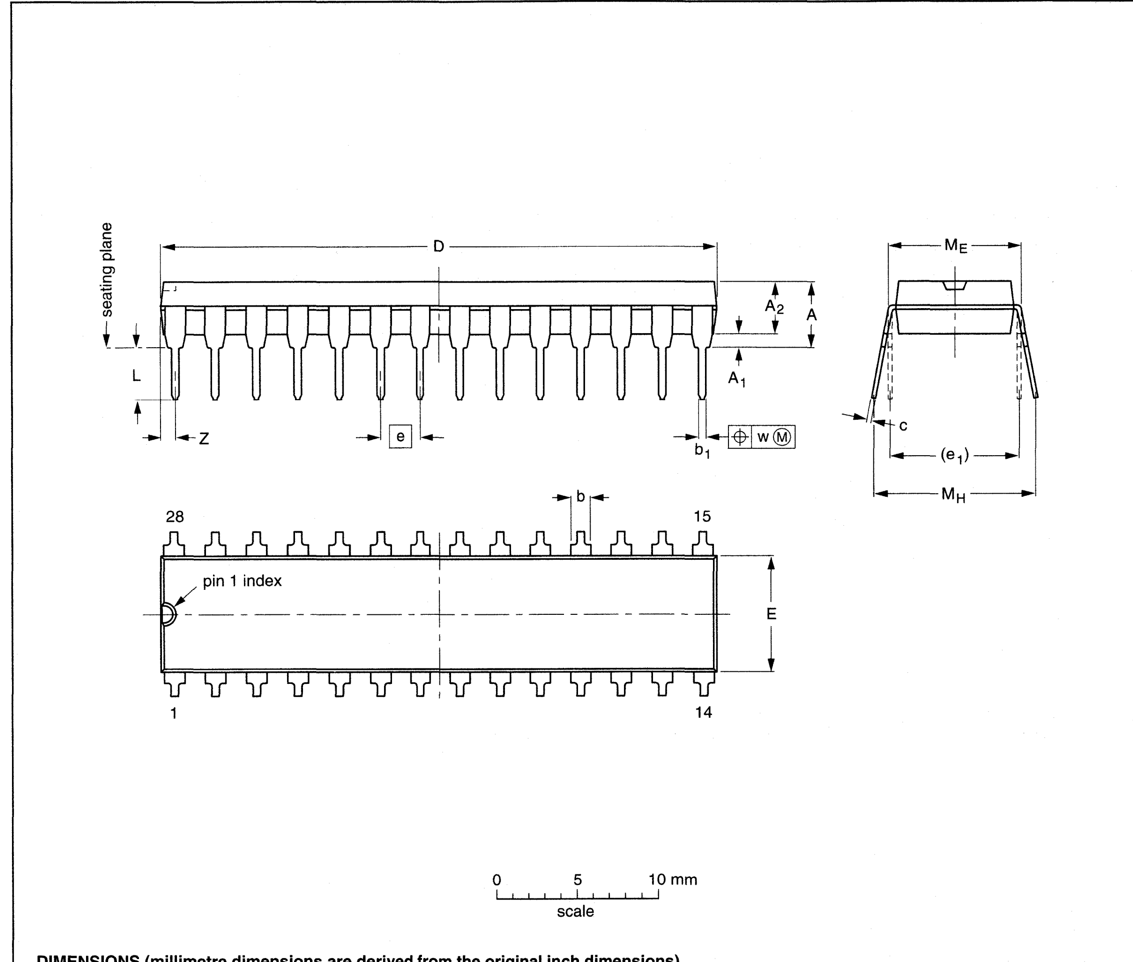
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.08	0.51	3.94	1.63 1.14	0.56 0.43	0.38 0.25	37.08 35.94	14.22 13.84	2.54	15.24	3.51 3.05	15.75 15.24	17.65 15.24	0.25	2.10
inches	0.200	0.020	0.155	0.064 0.045	0.022 0.017	0.015 0.010	1.460 1.415	0.560 0.545	0.100	0.600	0.138 0.120	0.62 0.60	0.695 0.600	0.01	0.083

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			
SOT117-2		MS-011AB				95-03-11

DIP28: plastic dual in-line package; 28 leads (300 mil) SOT394-1



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	5.33	0.25	3.81	1.40 1.14	0.53 0.38	0.36 0.20	35.63 35.38	7.11 6.48	2.54	7.62	3.51 3.05	8.62 7.62	10.03 7.62	0.25	1.67
inches	0.21	0.010	0.15	0.055 0.045	0.021 0.015	0.014 0.008	1.425 1.415	0.280 0.255	0.100	0.300	0.138 0.120	0.325 0.300	0.395 0.300	0.01	0.066

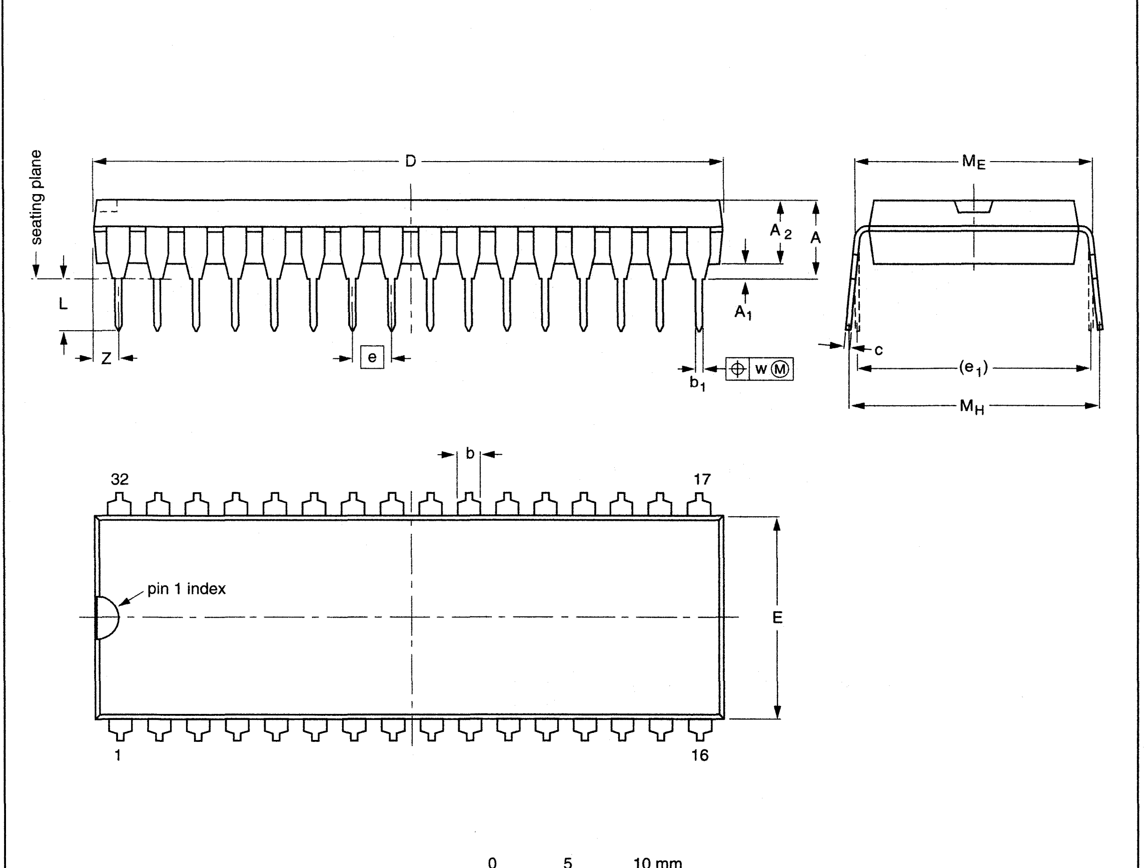
Note

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			
SOT394-1						95-03-11

IC package range and dimensions

DIP32: plastic dual in-line package; 32 leads (600 mil) SOT201-1



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

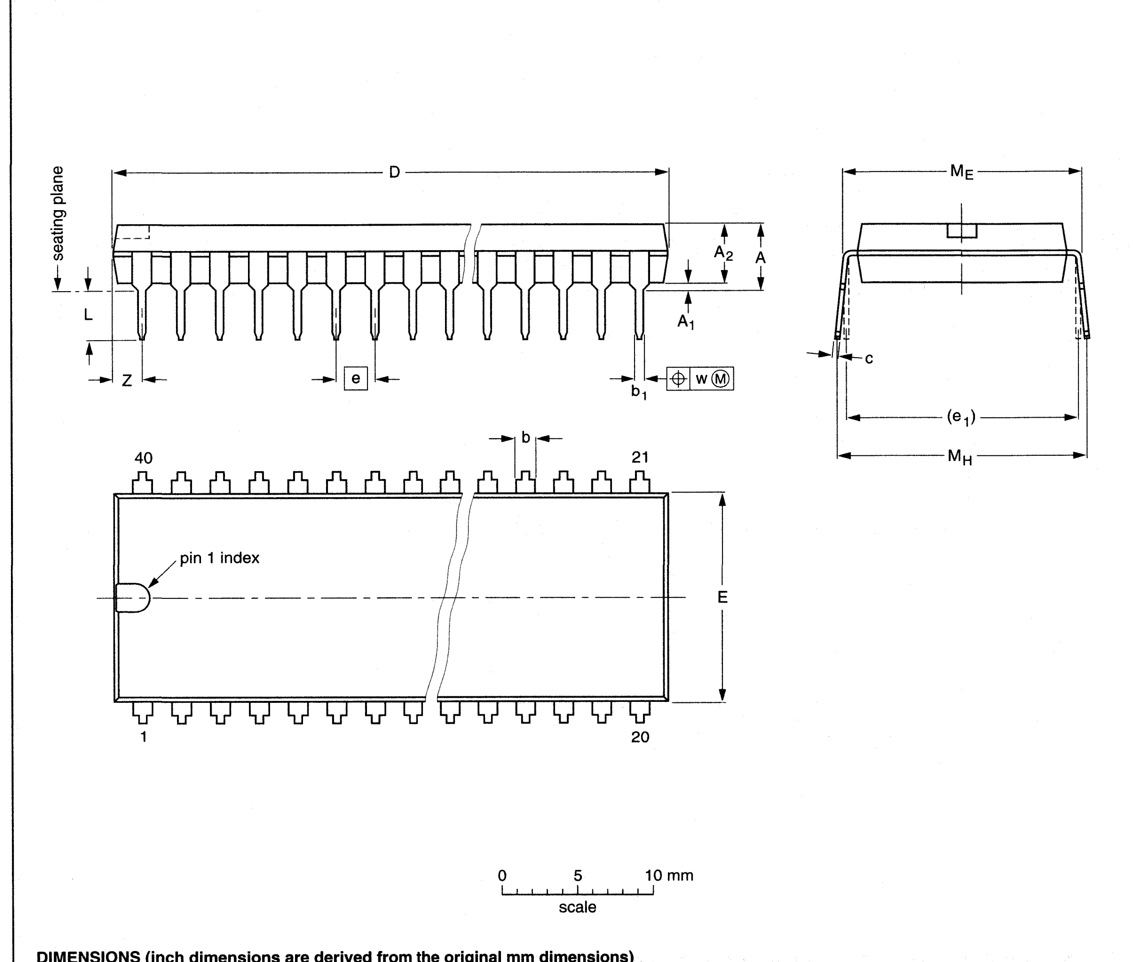
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	5.0	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	41.6 40.6	14.2 13.8	2.54	15.24	3.6 3.2	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.20	0.020	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.64 1.60	0.56 0.54	0.10	0.60	0.14 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						~~90-01-22~~ 95-01-25

DIP40: plastic dual in-line package; 40 leads (600 mil) **SOT129-1**



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	4.0	1.70 1.14	0.53 0.38	0.36 0.23	52.50 51.50	14.1 13.7	2.54	15.24	3.60 3.05	15.80 15.24	17.42 15.90	0.254	2.25
inches	0.19	0.020	0.16	0.067 0.045	0.021 0.015	0.014 0.009	2.067 2.028	0.56 0.54	0.10	0.60	0.14 0.12	0.62 0.60	0.69 0.63	0.01	0.089

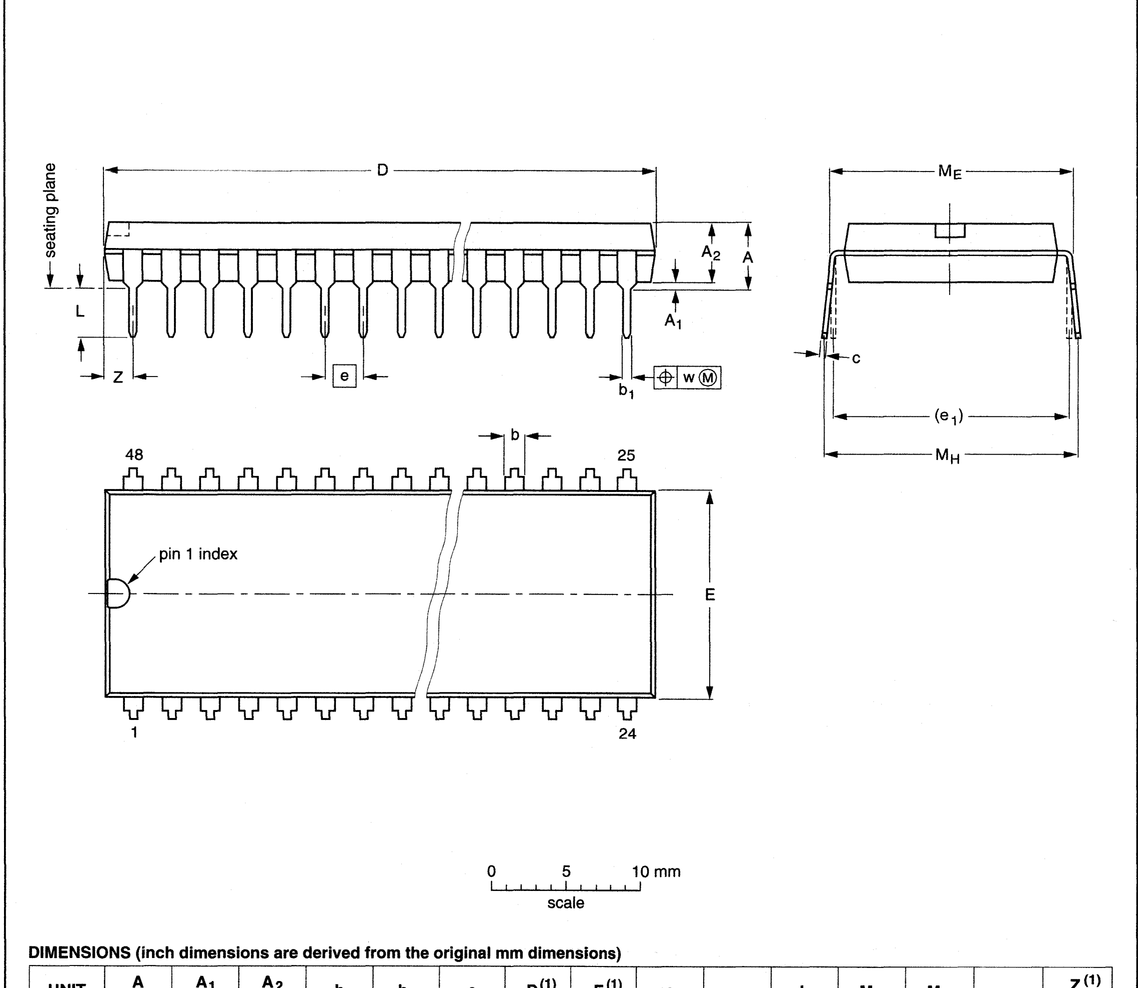
Note

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			
SOT129-1	051G08	MO-015AJ				~~92-11-17~~ 95-01-14

IC package range and dimensions Chapter 2

DIP48: plastic dual in-line package; 48 leads (600 mil) SOT240-1



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

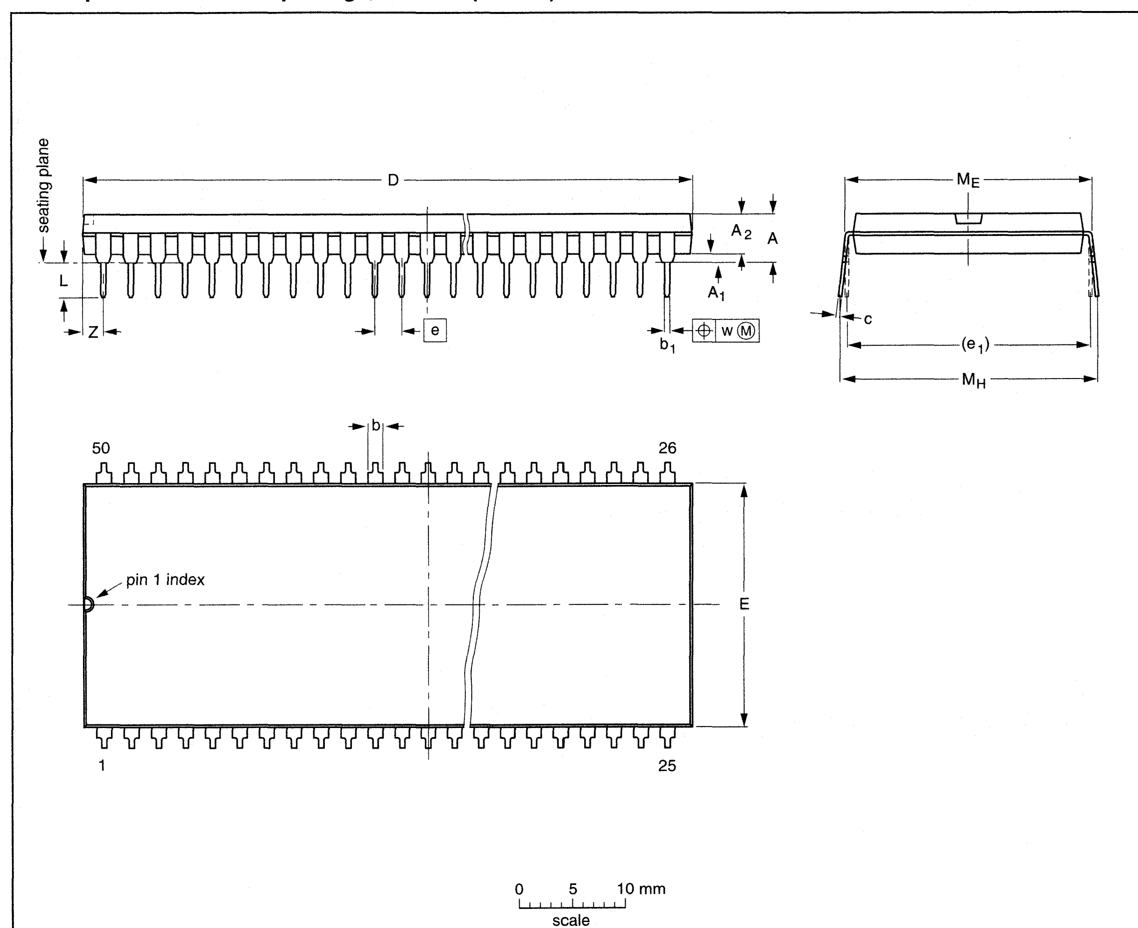
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D [1]	E [1]	e	e_1	L	M_E	M_H	w	Z [1] max.
mm	4.9	0.36	4.06	1.4 1.14	0.53 0.38	0.36 0.23	62.60 61.60	14.22 13.56	2.54	15.24	3.90 3.05	15.88 15.24	18.46 15.24	0.254	2.1
inches	0.19	0.014	0.16	0.055 0.045	0.021 0.015	0.014 0.009	2.46 2.42	0.56 0.53	0.10	0.60	0.15 0.12	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						~~92-11-17~~ 95-01-25

DIP50: plastic dual in-line package; 50 leads (900 mil) **SOT396-1**



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	5.08	0.51	3.94	1.63 1.14	0.56 0.38	0.38 0.25	63.88 63.37	21.84 21.46	2.54	22.86	3.43 2.92	23.37 22.61	25.27 22.86	0.25	1.55
inches	0.200	0.020	0.155	0.064 0.045	0.022 0.015	0.015 0.010	2.515 2.495	0.860 0.845	0.100	0.900	0.135 0.115	0.92 0.89	0.995 0.900	0.01	0.061

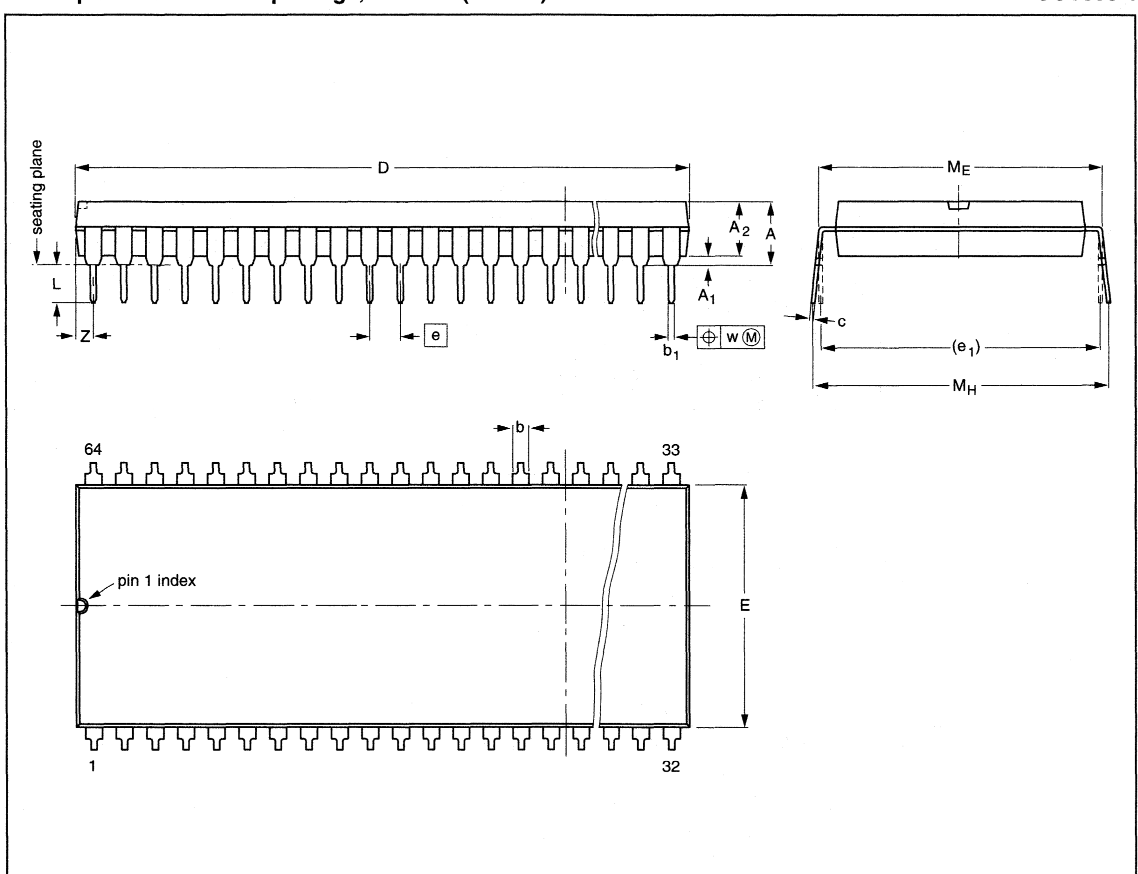
Note

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			
SOT396-1						~~95-03-11~~ 95-04-25

IC package range and dimensions Chapter 2

DIP64: plastic dual in-line package; 64 leads (900 mil) SOT395-1



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	5.84	0.38	4.70	1.65 1.14	0.56 0.38	0.38 0.25	81.92 81.41	20.57 20.19	2.54	22.86	3.43 2.92	23.50 22.61	25.27 22.86	0.25	1.65
inches	0.23	0.015	0.185	0.065 0.045	0.022 0.015	0.015 0.010	3.225 3.205	0.810 0.795	0.100	0.900	0.135 0.115	0.925 0.890	0.995 0.900	0.01	0.065

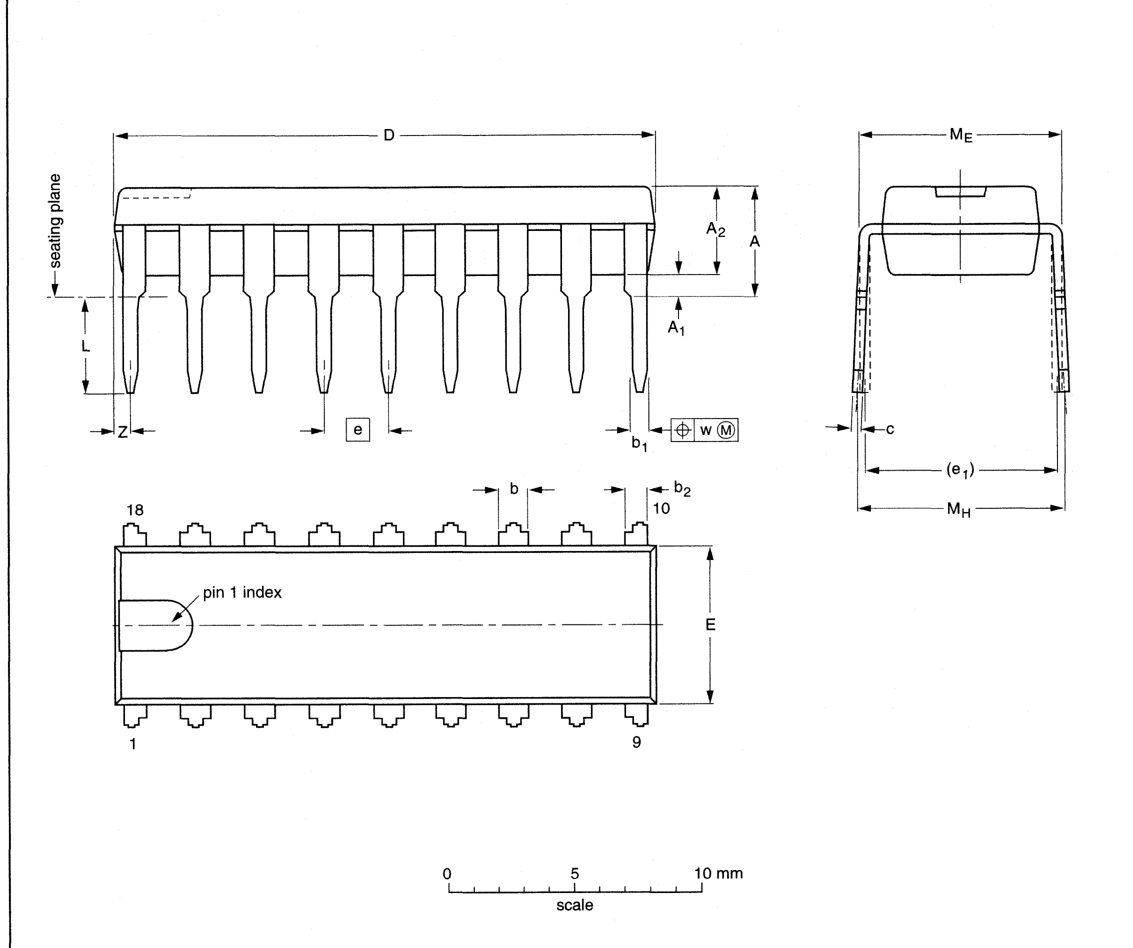
Note

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			
SOT395-1						~~95-03-11~~ 95-04-25

IC package range and dimensions Chapter 2

HDIP18: plastic heat-dissipating dual in-line package; 18 leads SOT398-1



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	0.67 0.50	1.05 0.75	0.47 0.38	21.85 21.35	6.5 6.2	2.54	7.62	3.9 3.1	8.32 8.02	8.7 7.7	0.25	1.0
inches	0.19	0.02	0.15	0.06 0.04	0.03 0.02	0.04 0.03	0.02 0.01	0.87 0.84	0.26 0.24	0.10	0.30	0.15 0.12	0.33 0.32	0.34 0.30	0.01	0.04

Note

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

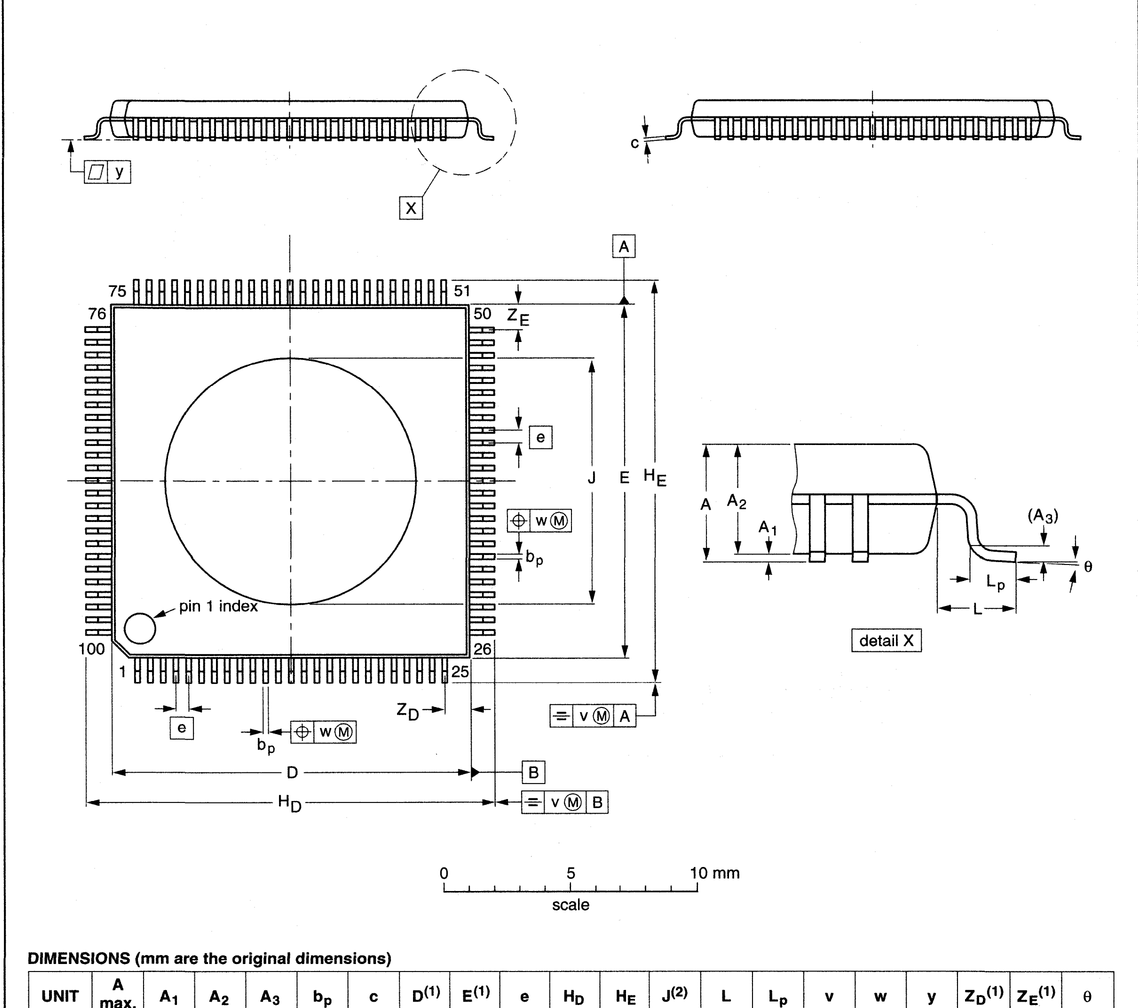
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT398-1						~~94-04-13~~ 95-01-25

IC package range and dimensions

Chapter 2

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.

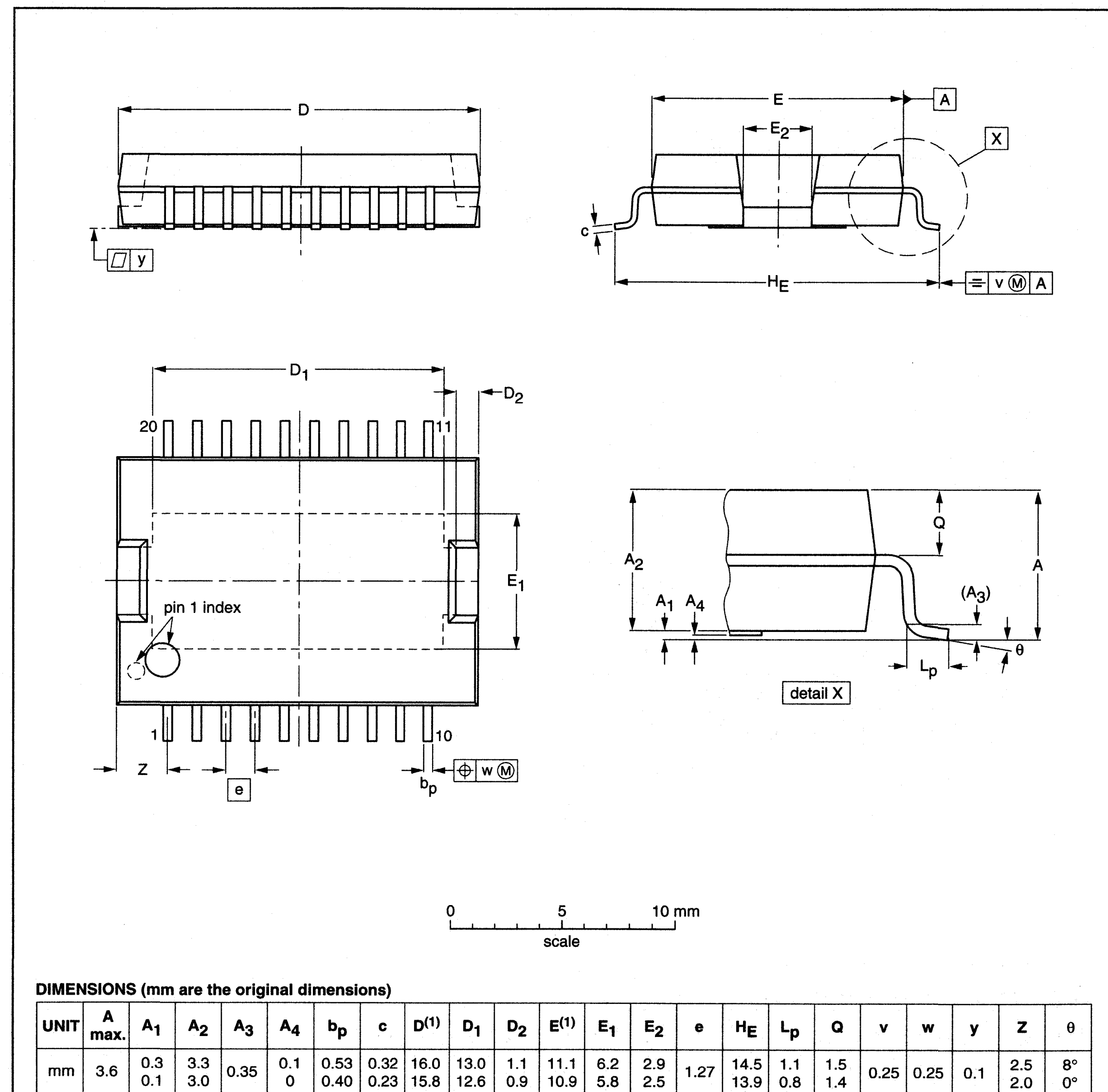
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT470-1						97-01-13

IC package range and dimensions

Chapter 2

HSOP20: heatsink small outline package; 20 leads

SOT397-1



DIMENSIONS (mm are the original dimensions)

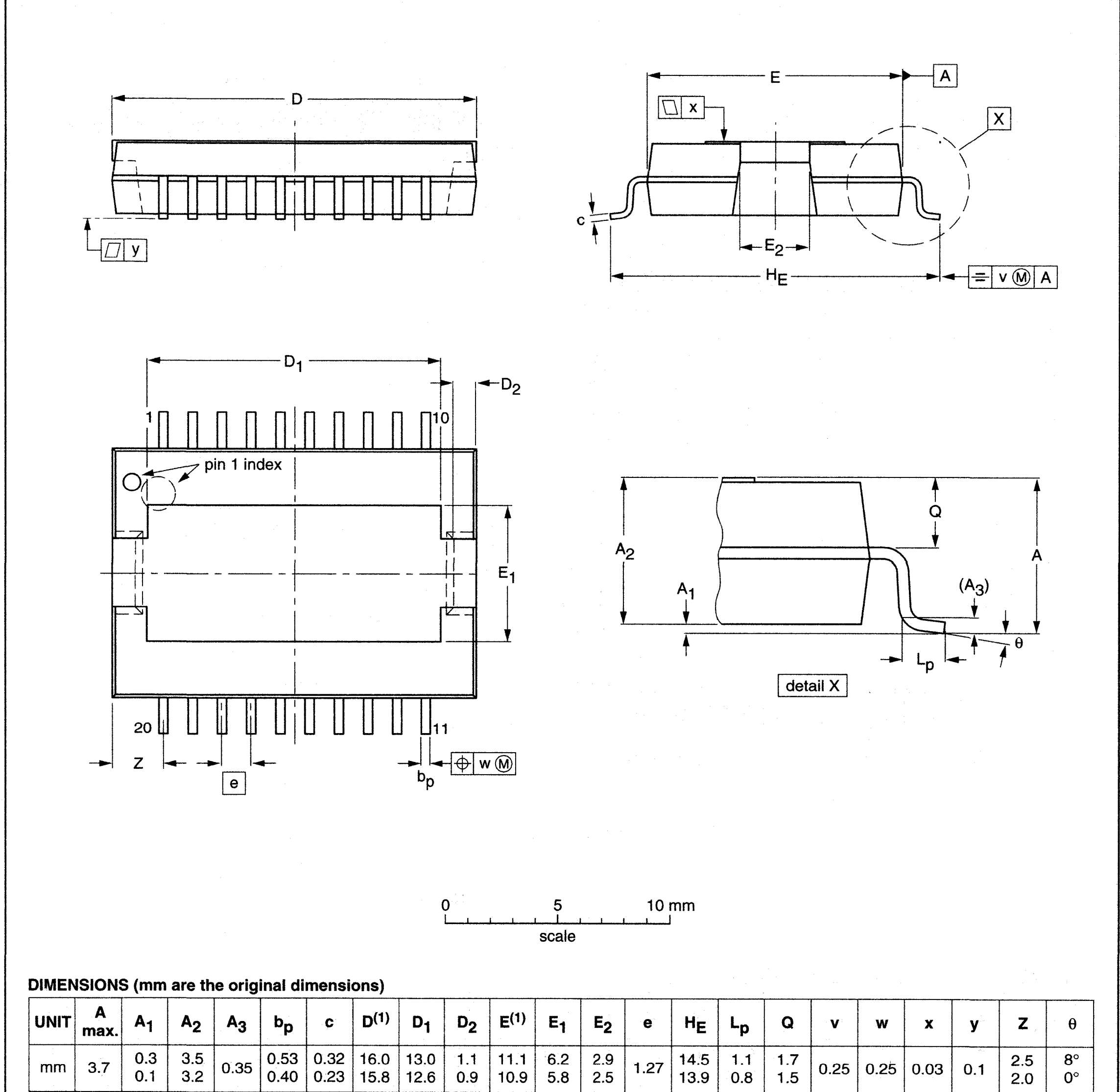
UNIT	A max.	A_1	A_2	A_3	A_4	b_p	c	$D^{(1)}$	D_1	D_2	$E^{(1)}$	E_1	E_2	e	H_E	L_p	Q	v	w	y	Z	θ
mm	3.6	0.3 0.1	3.3 3.0	0.35	0.1 0	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.27	14.5 13.9	1.1 0.8	1.5 1.4	0.25	0.25	0.1	2.5 2.0	8° 0°

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						~~96-11-06~~ 97-11-03

HSOP20: heatsink small outline package; 20 leads SOT418-1



DIMENSIONS (mm are the original dimensions)

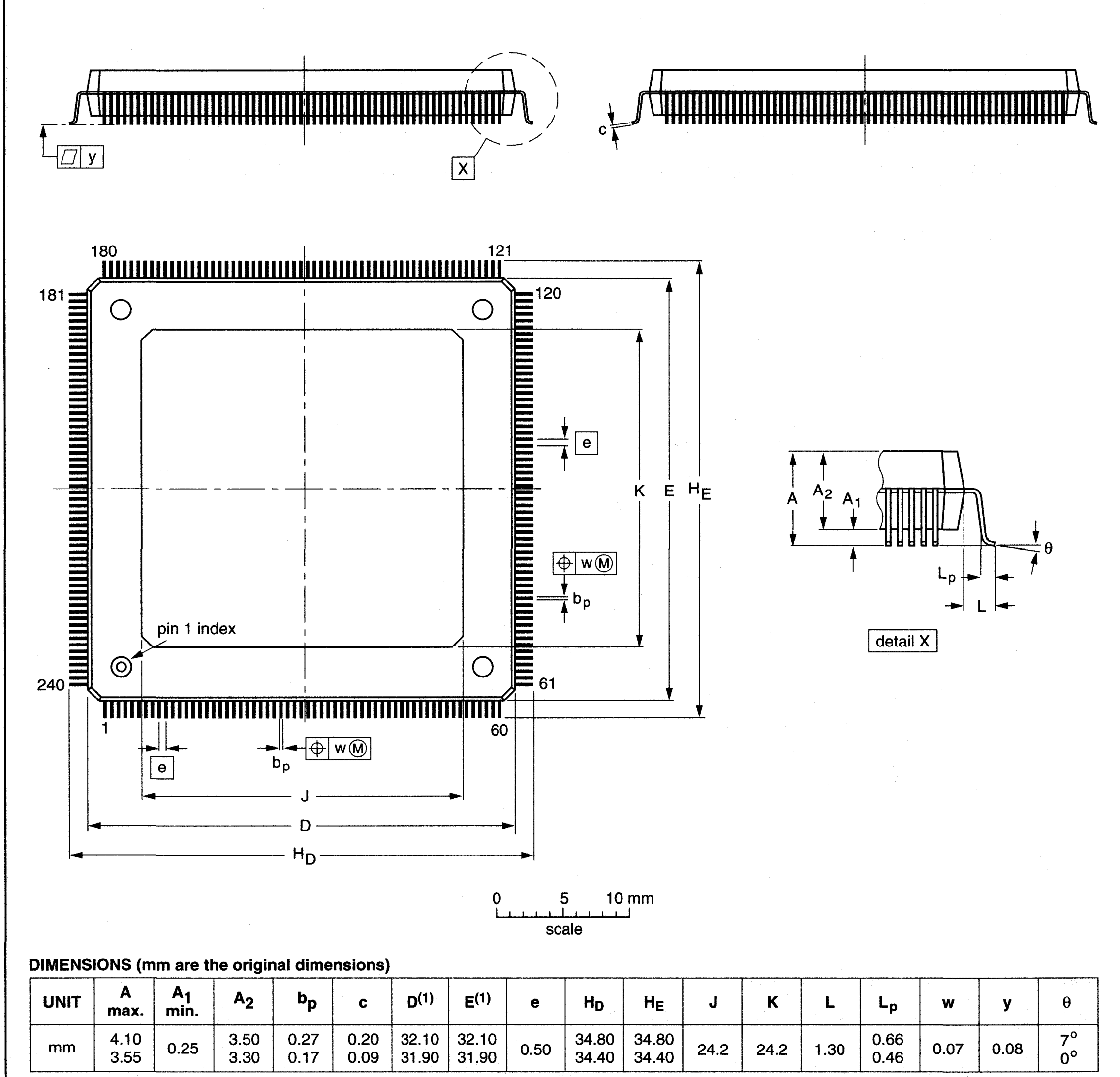
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	D_1	D_2	$E^{(1)}$	E_1	E_2	e	H_E	L_p	Q	v	w	x	y	Z	θ
mm	3.7	0.3 0.1	3.5 3.2	0.35	0.53 0.40	0.32 0.23	16.0 15.8	13.0 12.6	1.1 0.9	11.1 10.9	6.2 5.8	2.9 2.5	1.27	14.5 13.9	1.1 0.8	1.7 1.5	0.25	0.25	0.03	0.1	2.5 2.0	8° 0°

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			
SOT418-1						~~96-11-18~~ 97-11-03

HSQFP240: heatsink shrink quad flat package; 240 leads; body 32 x 32 x 3.4 mm **SOT464-2**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1 min.	A_2	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	J	K	L	L_p	w	y	θ
mm	4.10 3.55	0.25	3.50 3.30	0.27 0.17	0.20 0.09	32.10 31.90	32.10 31.90	0.50	34.80 34.40	34.80 34.40	24.2	24.2	1.30	0.66 0.46	0.07	0.08	7° 0°

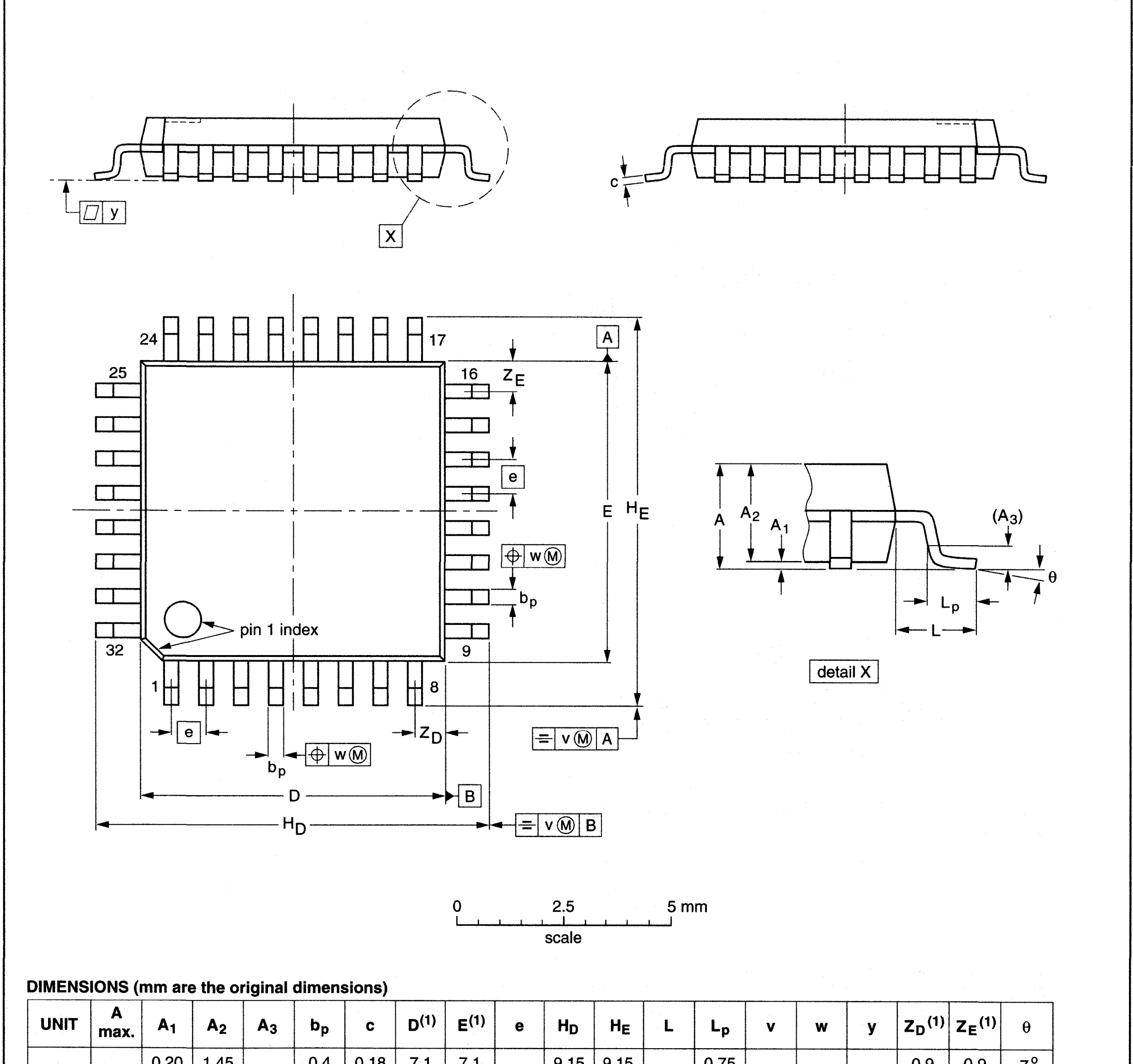
Note

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			
SOT464-2						97-01-13

IC package range and dimensions — Chapter 2

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°

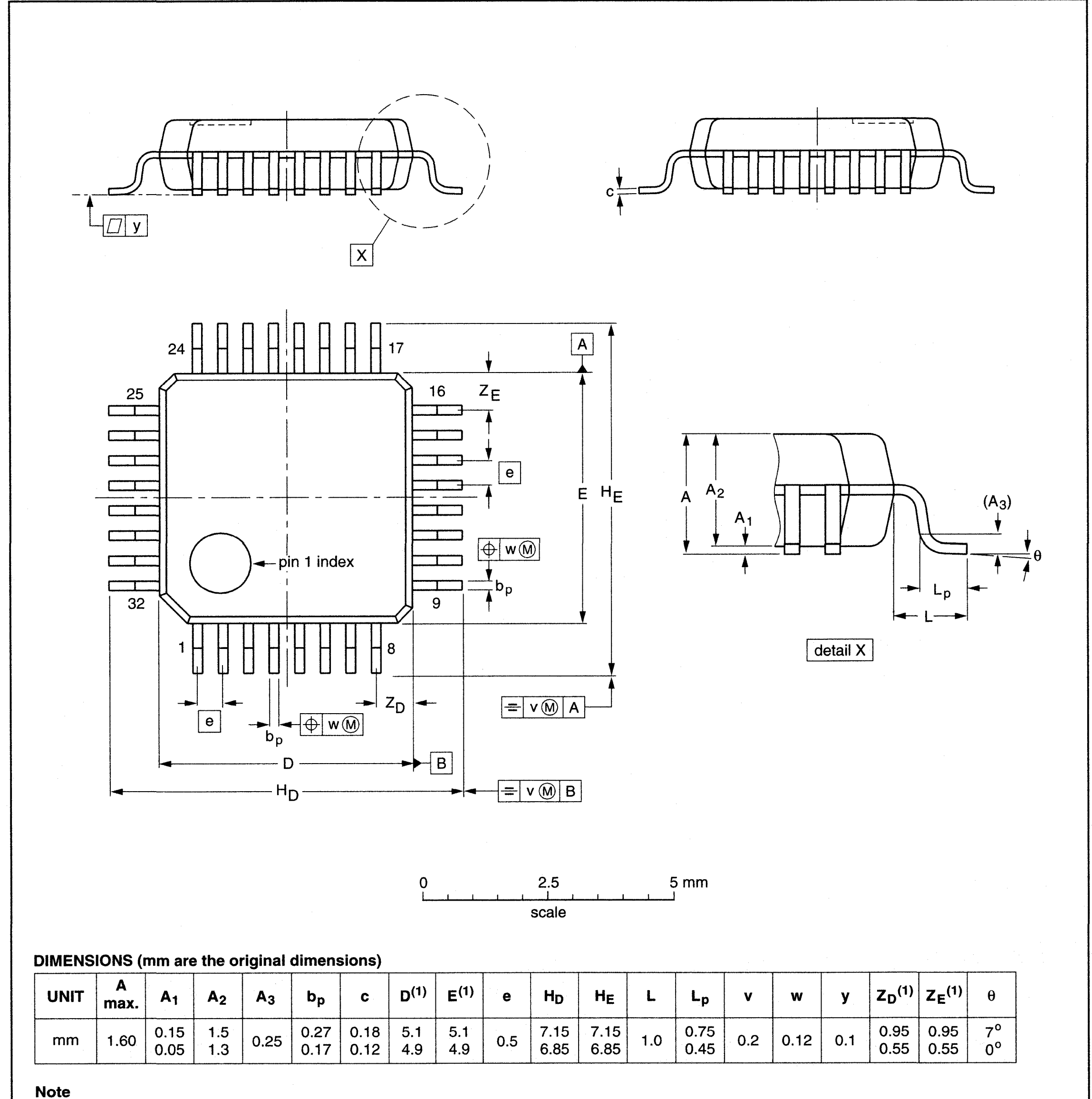
Note

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						~~95-12-19~~ 97-08-04

IC package range and dimensions Chapter 2

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)

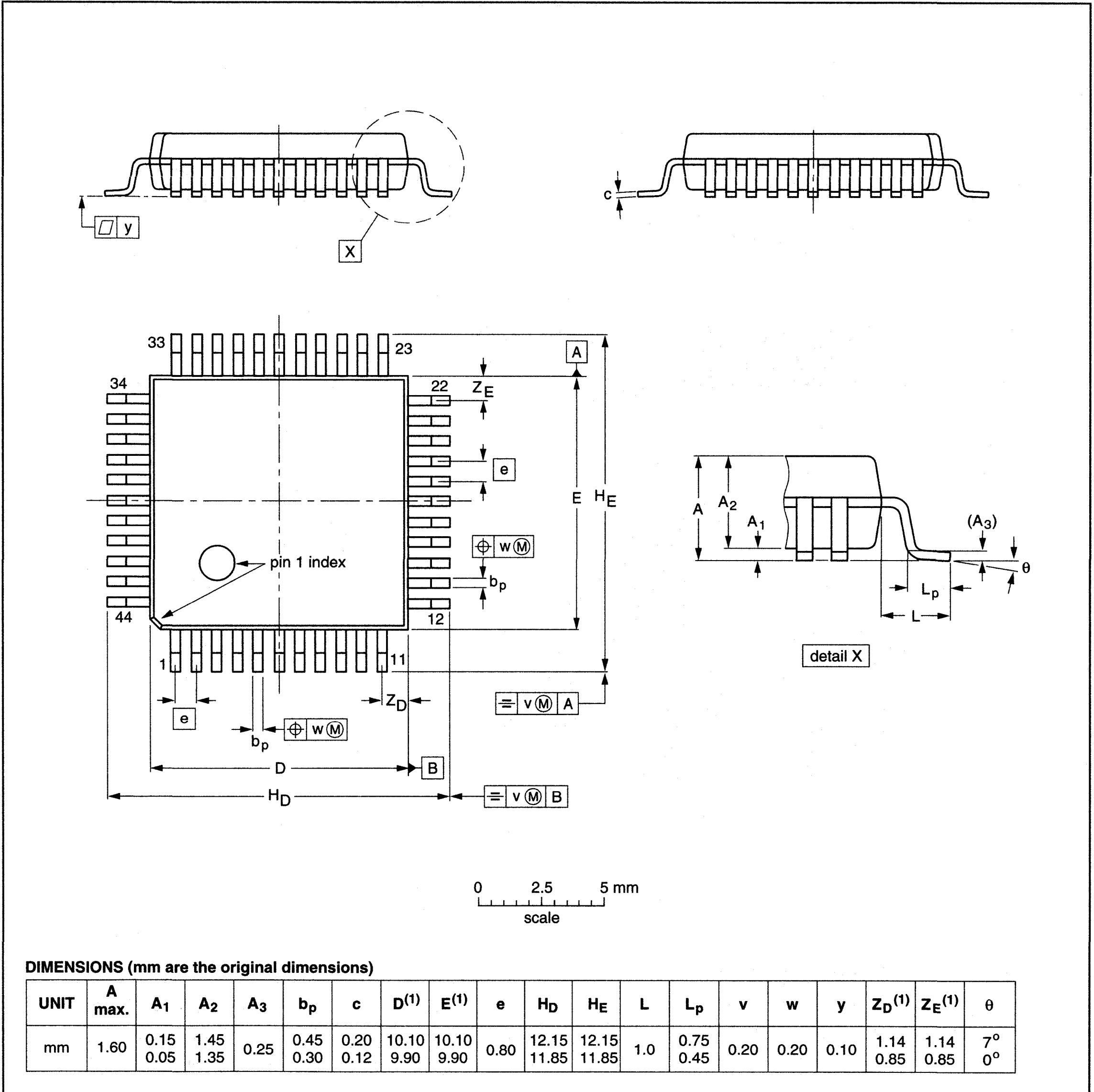
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_D	H_E	L	L_p	v	w	y	Z_D(1)	Z_E(1)	θ
mm	1.60	0.15 0.05	1.5 1.3	0.25	0.27 0.17	0.18 0.12	5.1 4.9	5.1 4.9	0.5	7.15 6.85	7.15 6.85	1.0	0.75 0.45	0.2	0.12	0.1	0.95 0.55	0.95 0.55	7° 0°

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						~~95-12-19~~ 97-08-04

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)

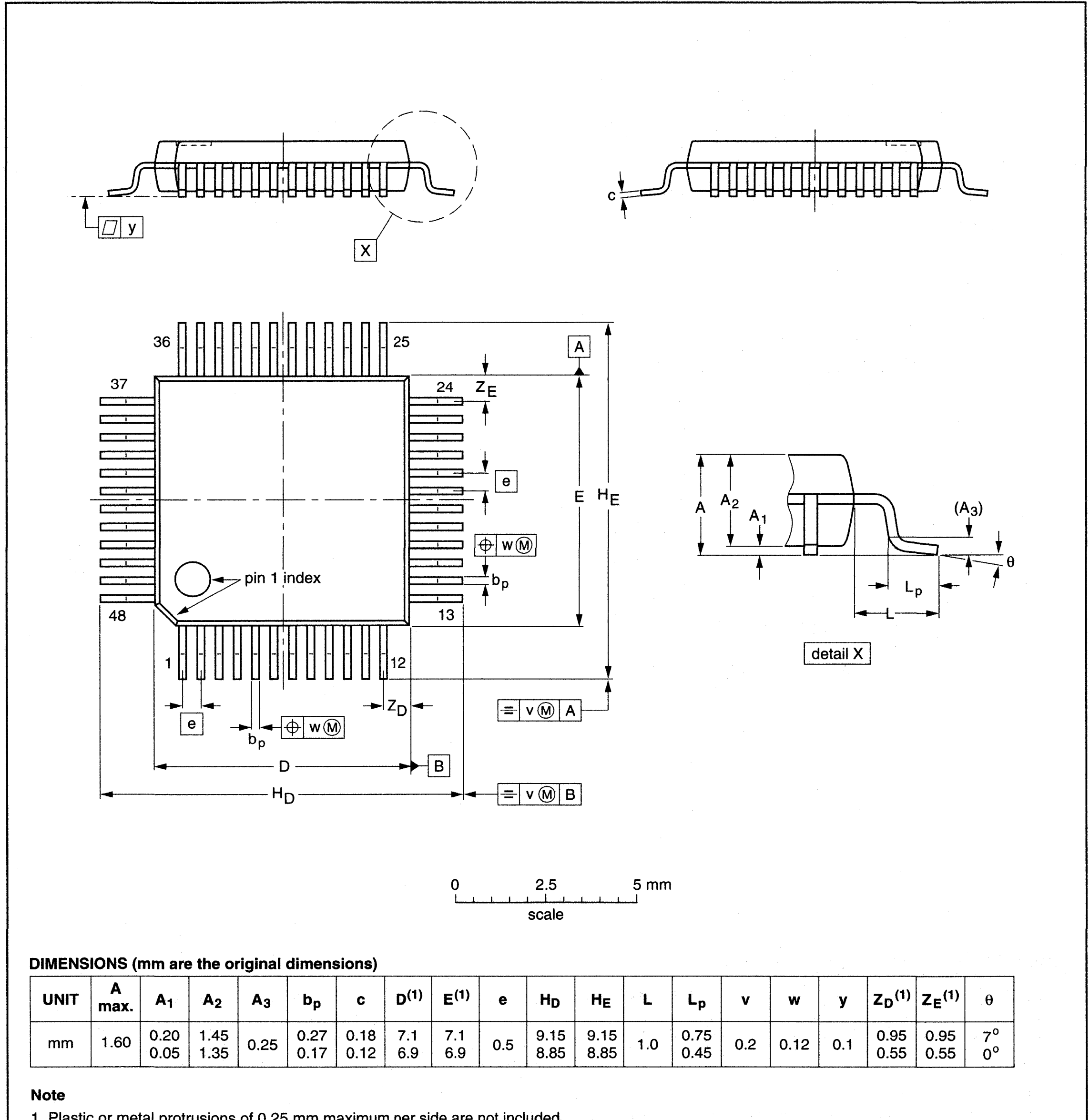
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.60	0.15 0.05	1.45 1.35	0.25	0.45 0.30	0.20 0.12	10.10 9.90	10.10 9.90	0.80	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.20	0.20	0.10	1.14 0.85	1.14 0.85	7° 0°

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						~~95-12-19~~ 97-08-04

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)

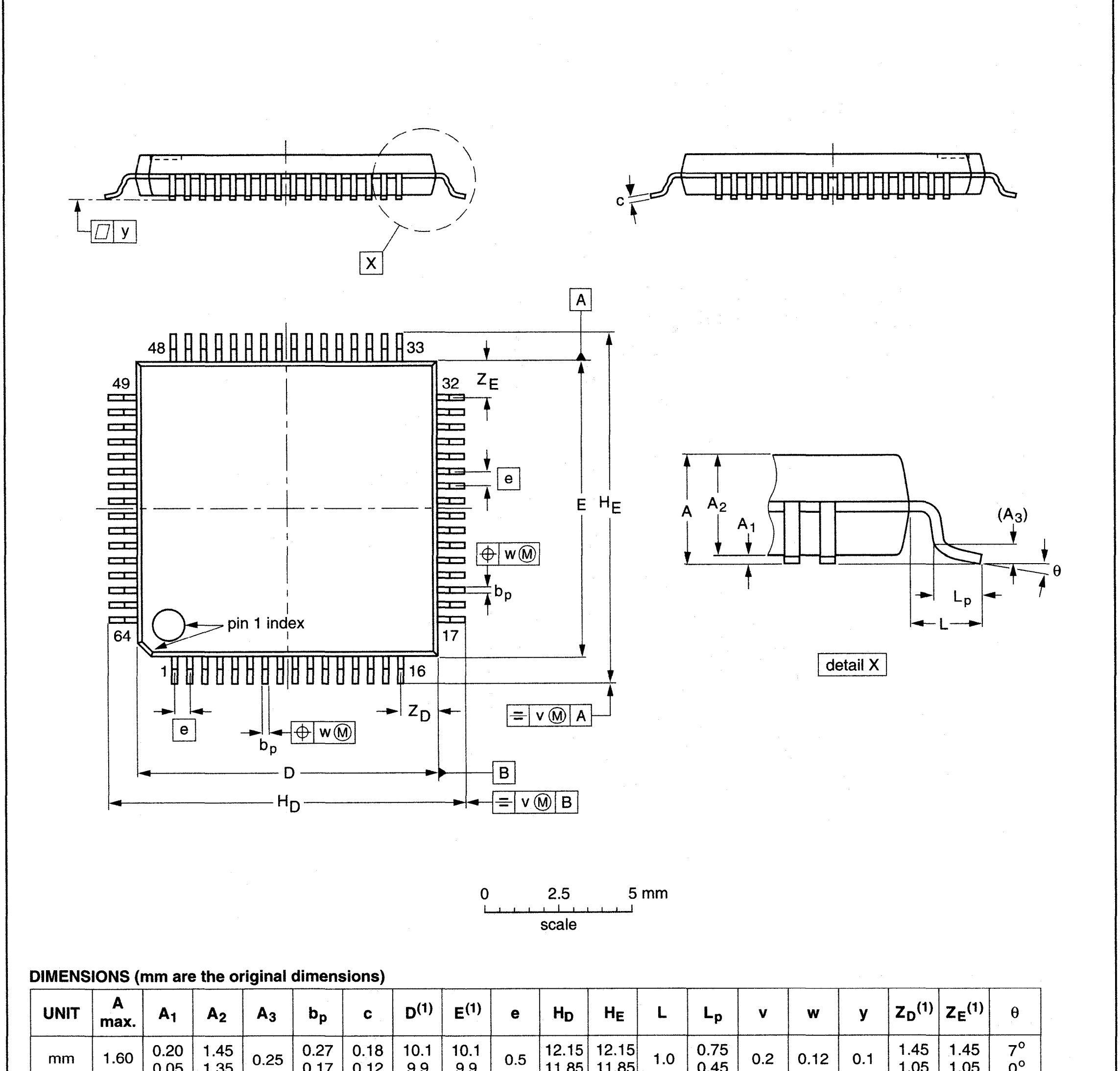
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.27 0.17	0.18 0.12	7.1 6.9	7.1 6.9	0.5	9.15 8.85	9.15 8.85	1.0	0.75 0.45	0.2	0.12	0.1	0.95 0.55	0.95 0.55	7° 0°

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						~~94-12-19~~ 97-08-01

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°

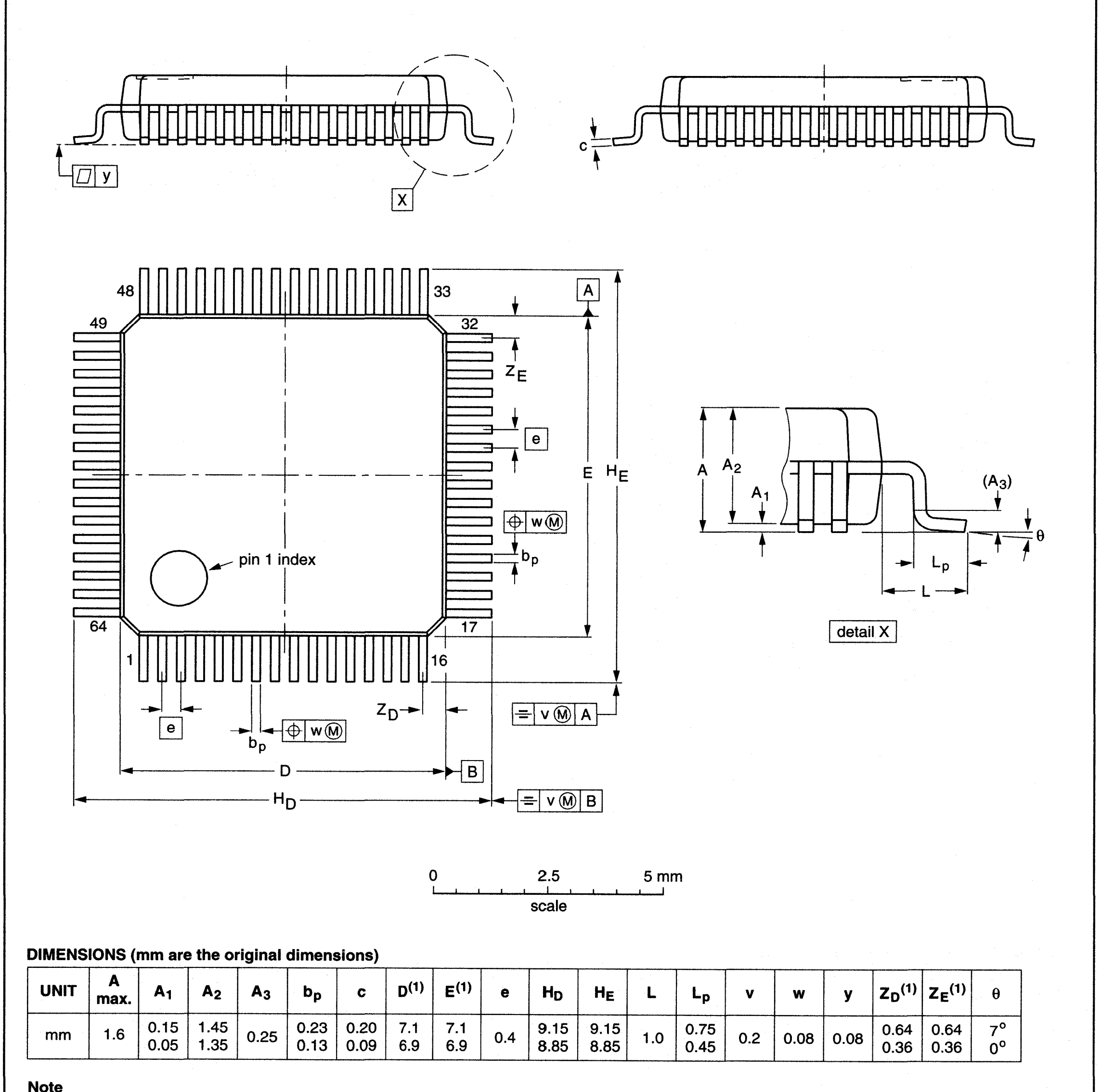
Note

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						~~95-12-19~~ 97-08-01

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°

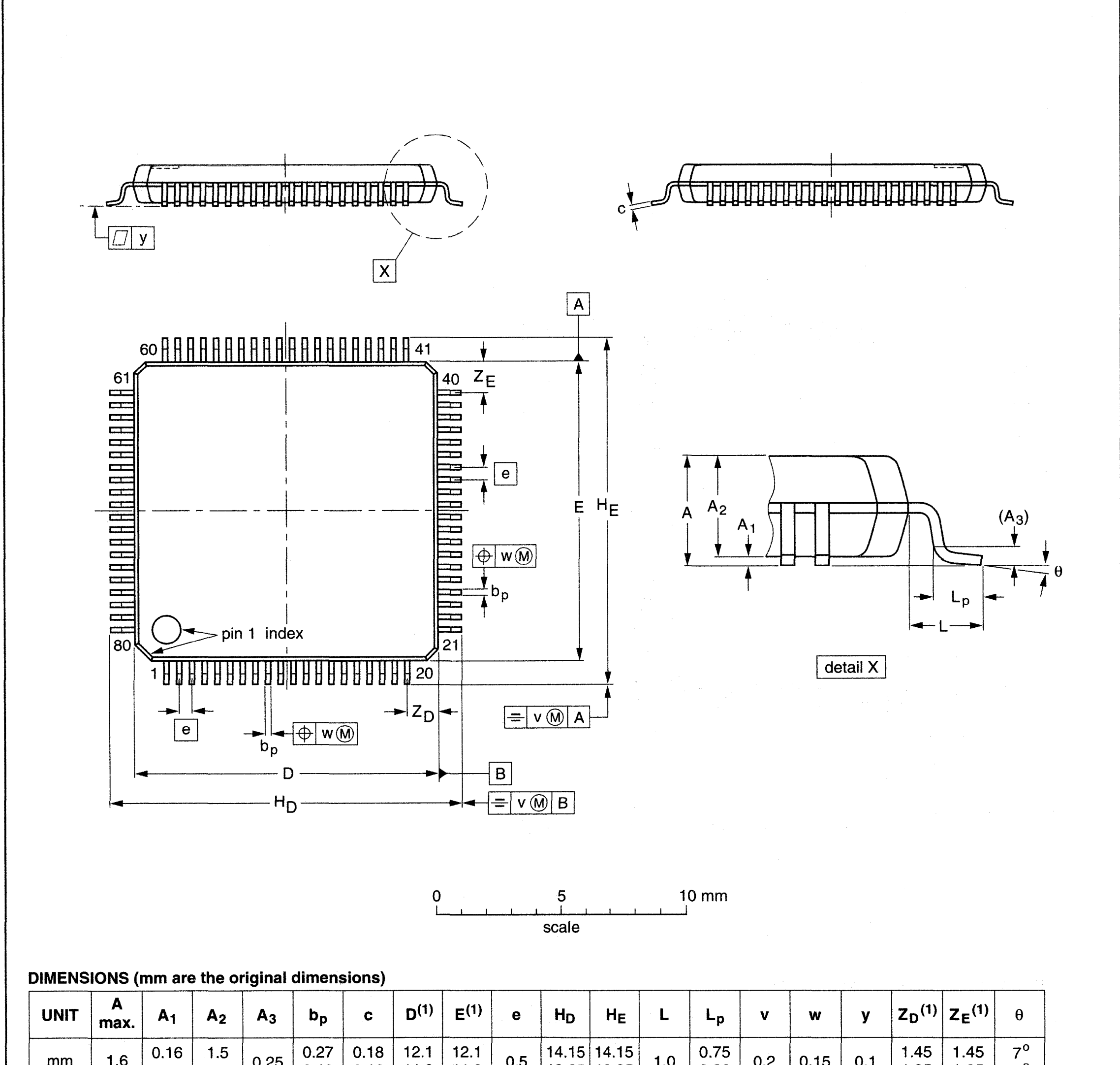
Note

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						~~97-08-06~~ 97-08-14

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)

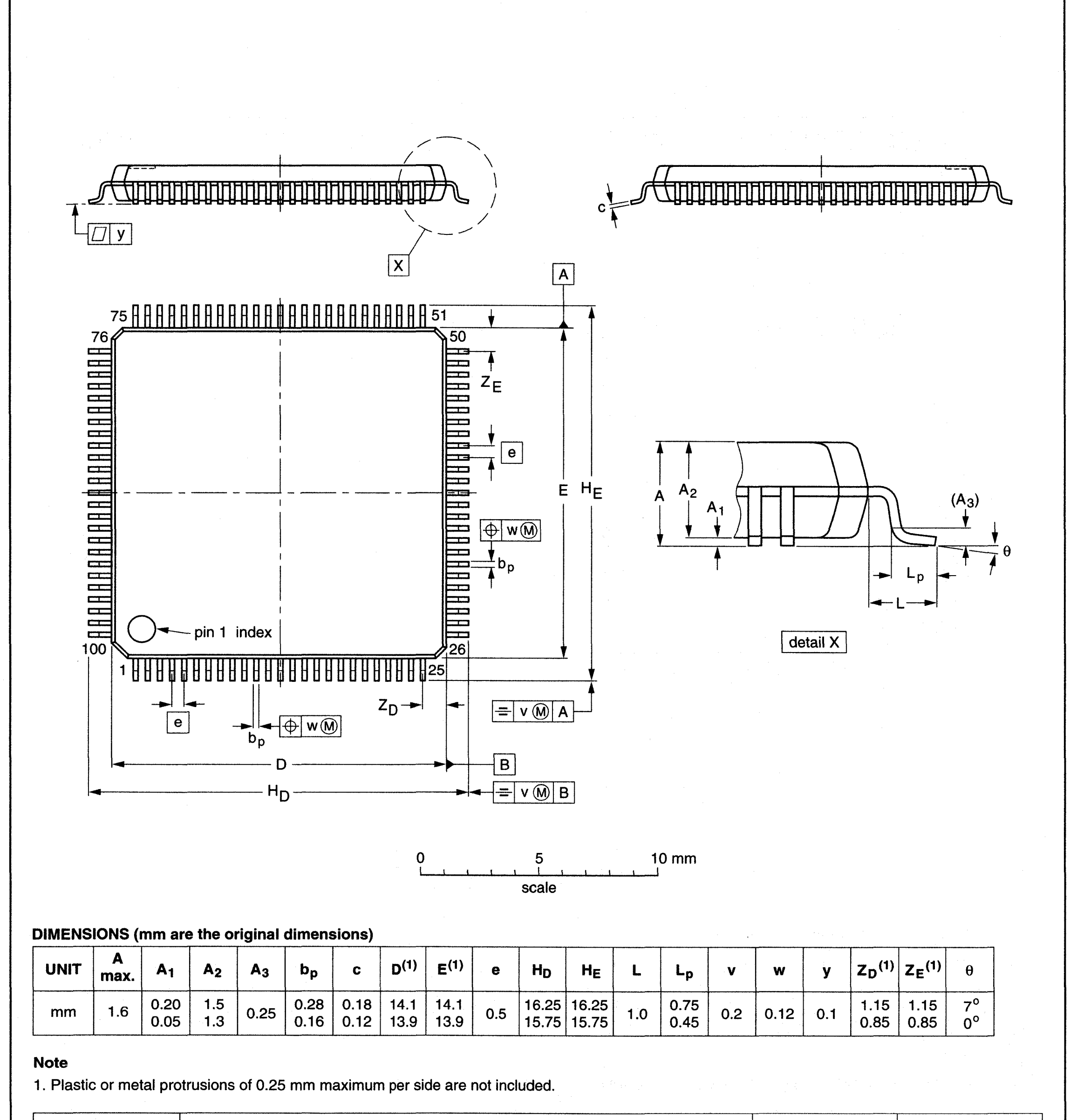
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.6	0.16 0.04	1.5 1.3	0.25	0.27 0.13	0.18 0.12	12.1 11.9	12.1 11.9	0.5	14.15 13.85	14.15 13.85	1.0	0.75 0.30	0.2	0.15	0.1	1.45 1.05	1.45 1.05	7° 0°

Note

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

OUTLINE VERSION	REFERENCES IEC	JEDEC	EIAJ		EUROPEAN PROJECTION	ISSUE DATE
SOT315-1						~~95-12-19~~ 97-07-15

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	0.20 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	1.0	0.75 0.45	0.2	0.12	0.1	1.15 0.85	1.15 0.85	7° 0°

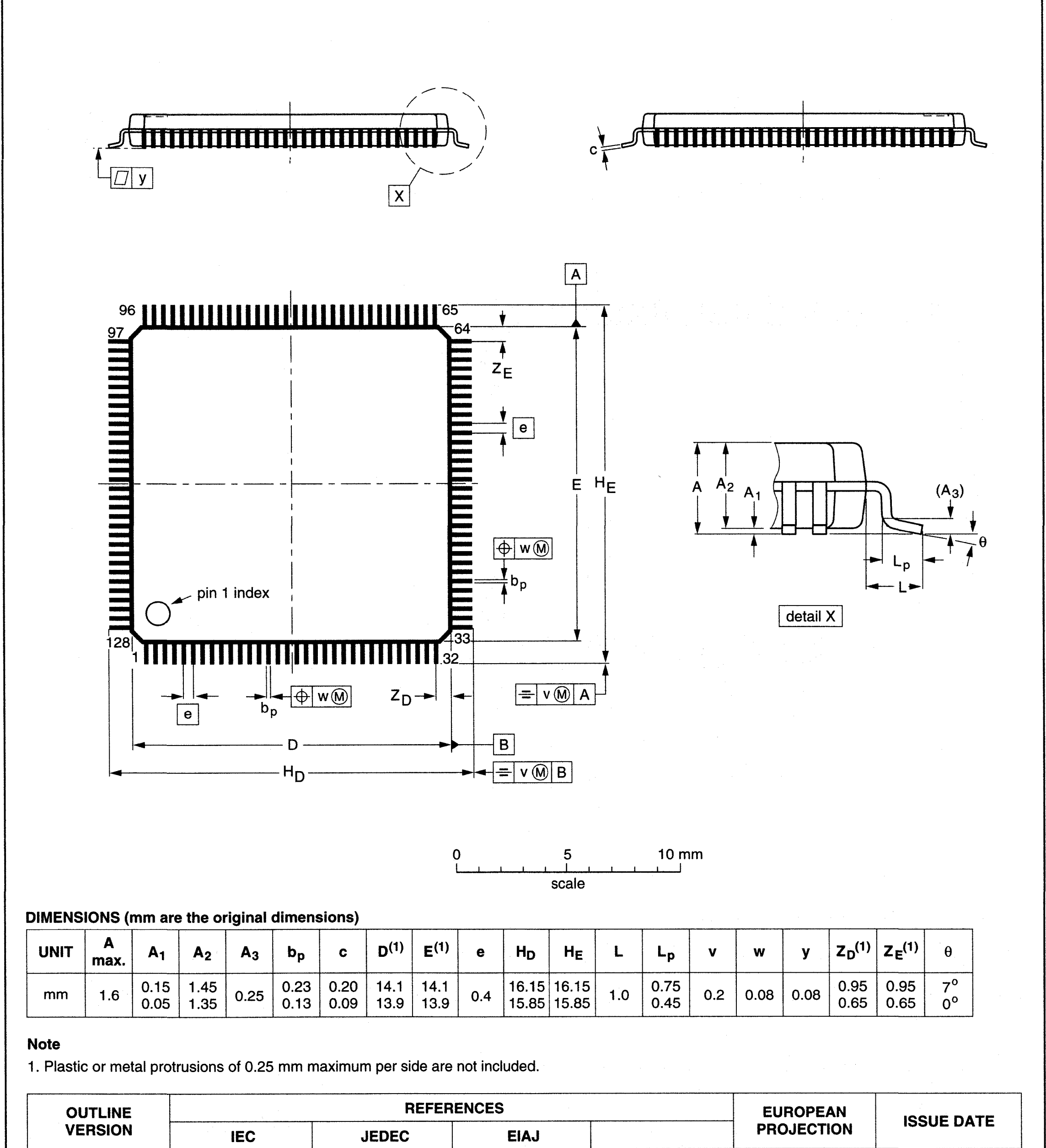
Note

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						~~95-12-19~~ 97-08-04

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	0.08	0.08	0.95 0.65	0.95 0.65	7° 0°

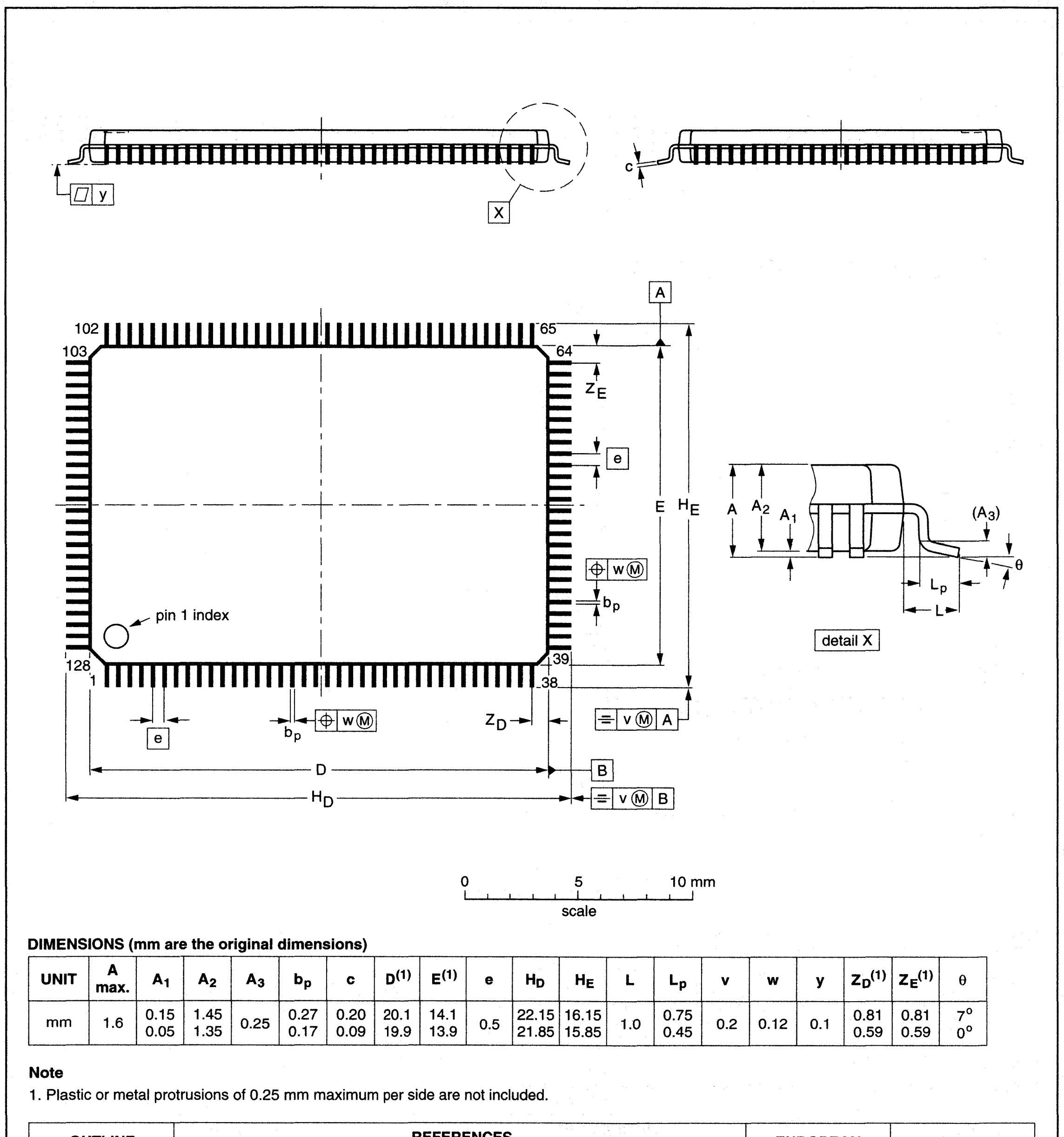
Note

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						~~97-08-04~~ 97-08-14

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	0.27 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°

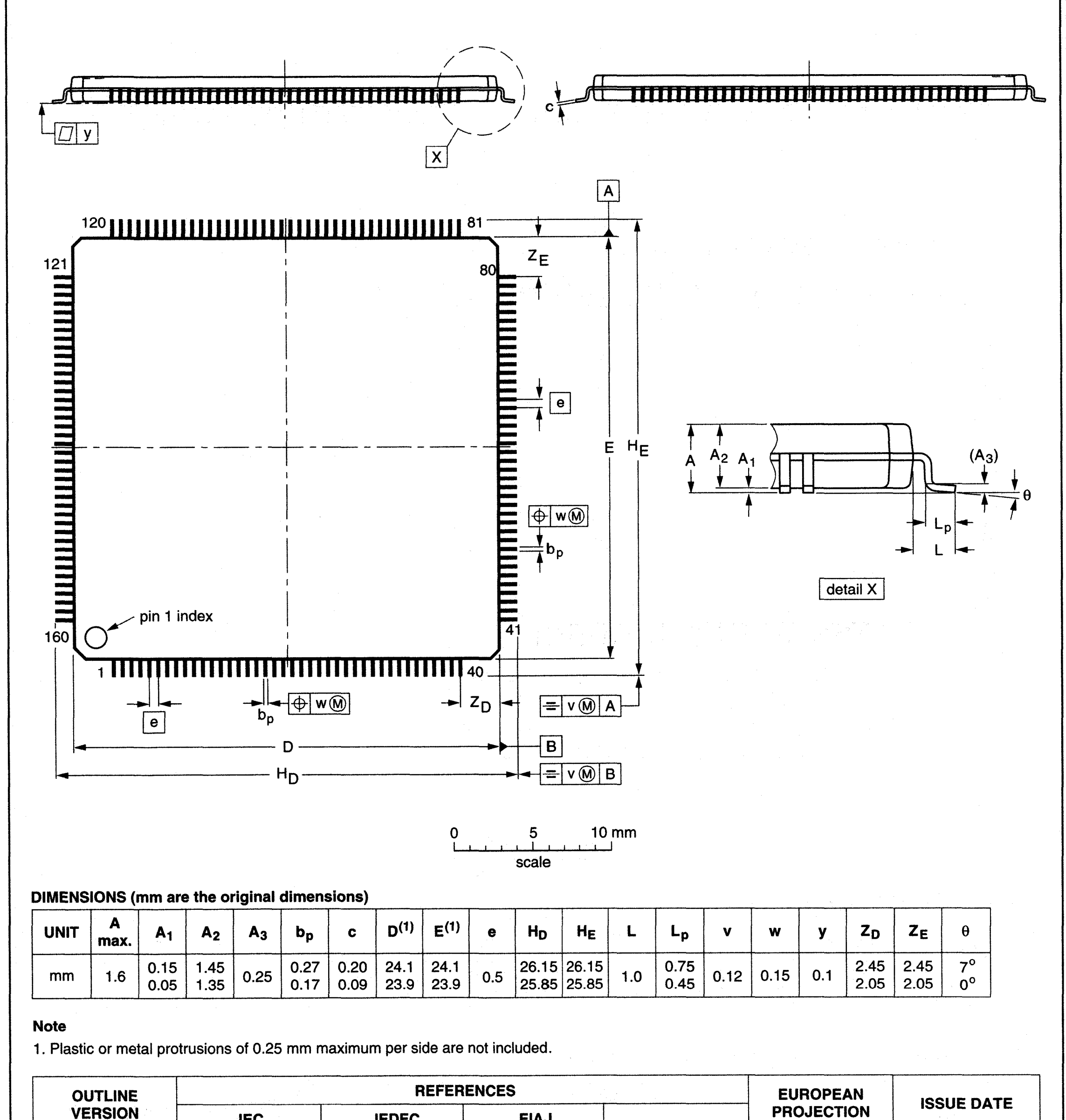
Note

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						~~96-04-02~~ 97-08-04

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.

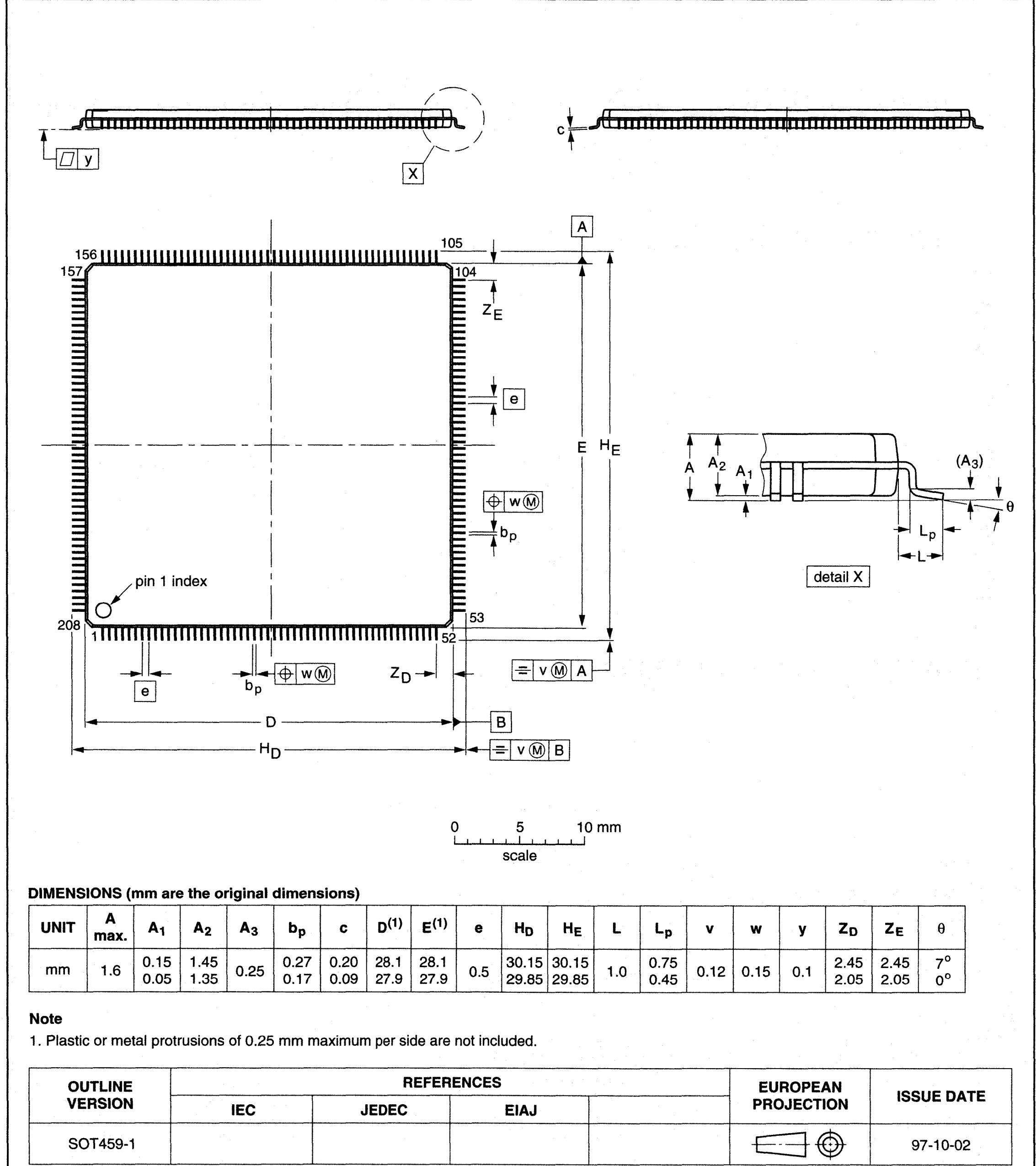
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT435-1						~~97-08-04~~ 97-10-02

IC package range and dimensions

Chapter 2

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)

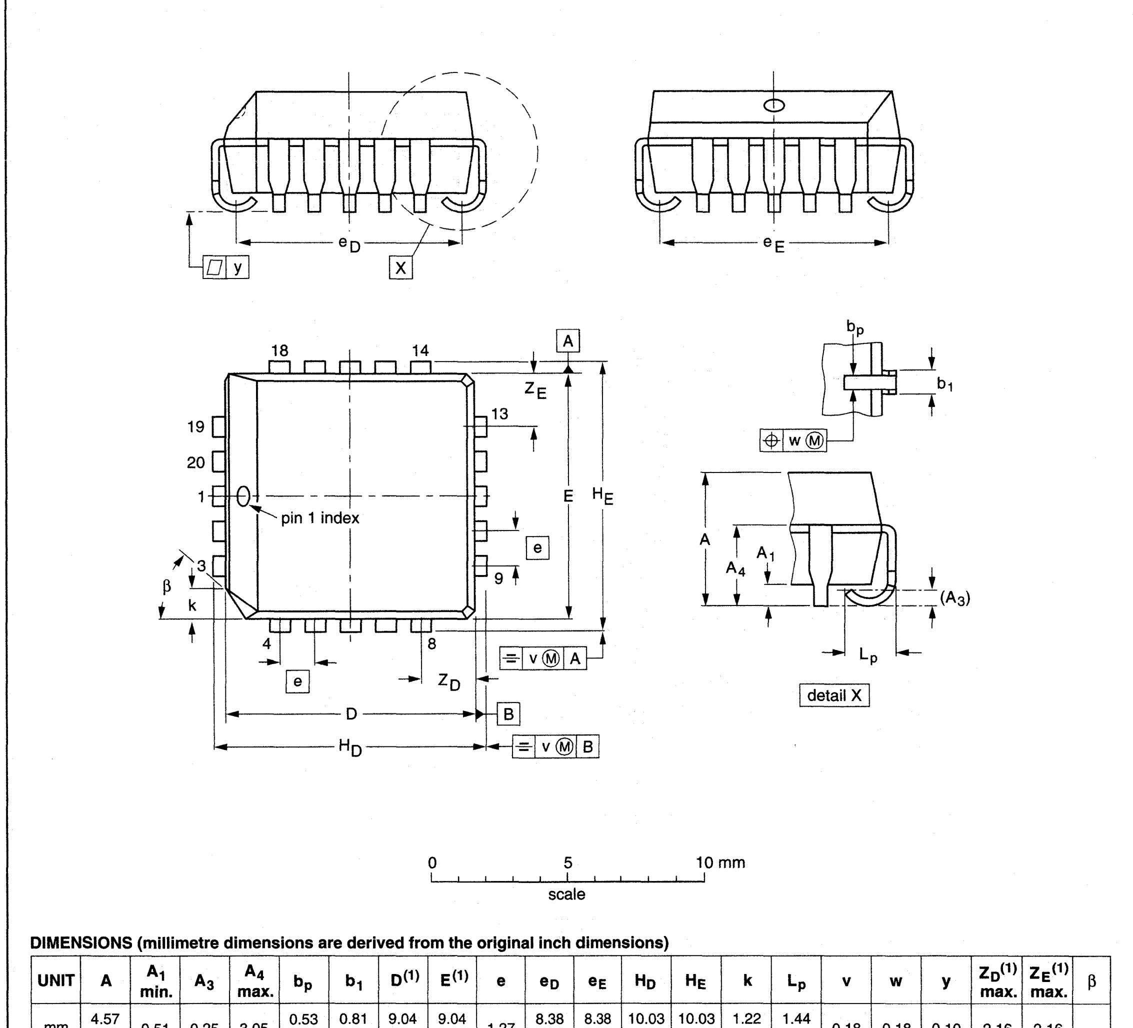
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_D	H_E	L	L_p	v	w	y	Z_D	Z_E	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.27 0.17	0.20 0.09	28.1 27.9	28.1 27.9	0.5	30.15 29.85	30.15 29.85	1.0	0.75 0.45	0.12	0.15	0.1	2.45 2.05	2.45 2.05	7° 0°

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			
SOT459-1						97-10-02

PLCC20: plastic leaded chip carrier; 20 leads SOT380-1



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

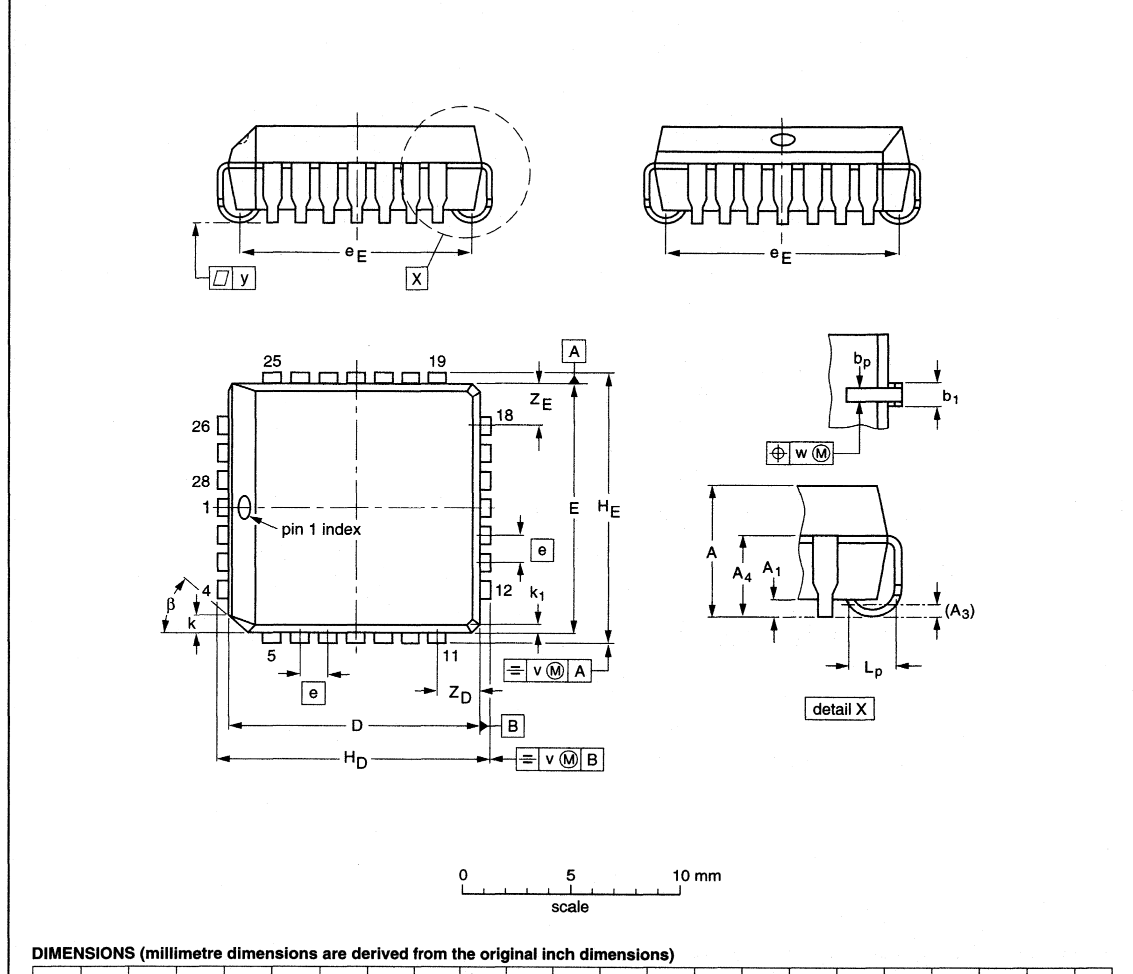
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	D(1)	E(1)	e	e_D	e_E	H_D	H_E	k	L_p	v	w	y	Z_D(1) max.	Z_E(1) max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	9.04 8.89	9.04 8.89	1.27	8.38 7.37	8.38 7.37	10.03 9.78	10.03 9.78	1.22 1.07	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	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		MO-047AA				~~95-02-25~~ 97-12-16

PLCC28: plastic leaded chip carrier; 28 leads SOT261-2



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

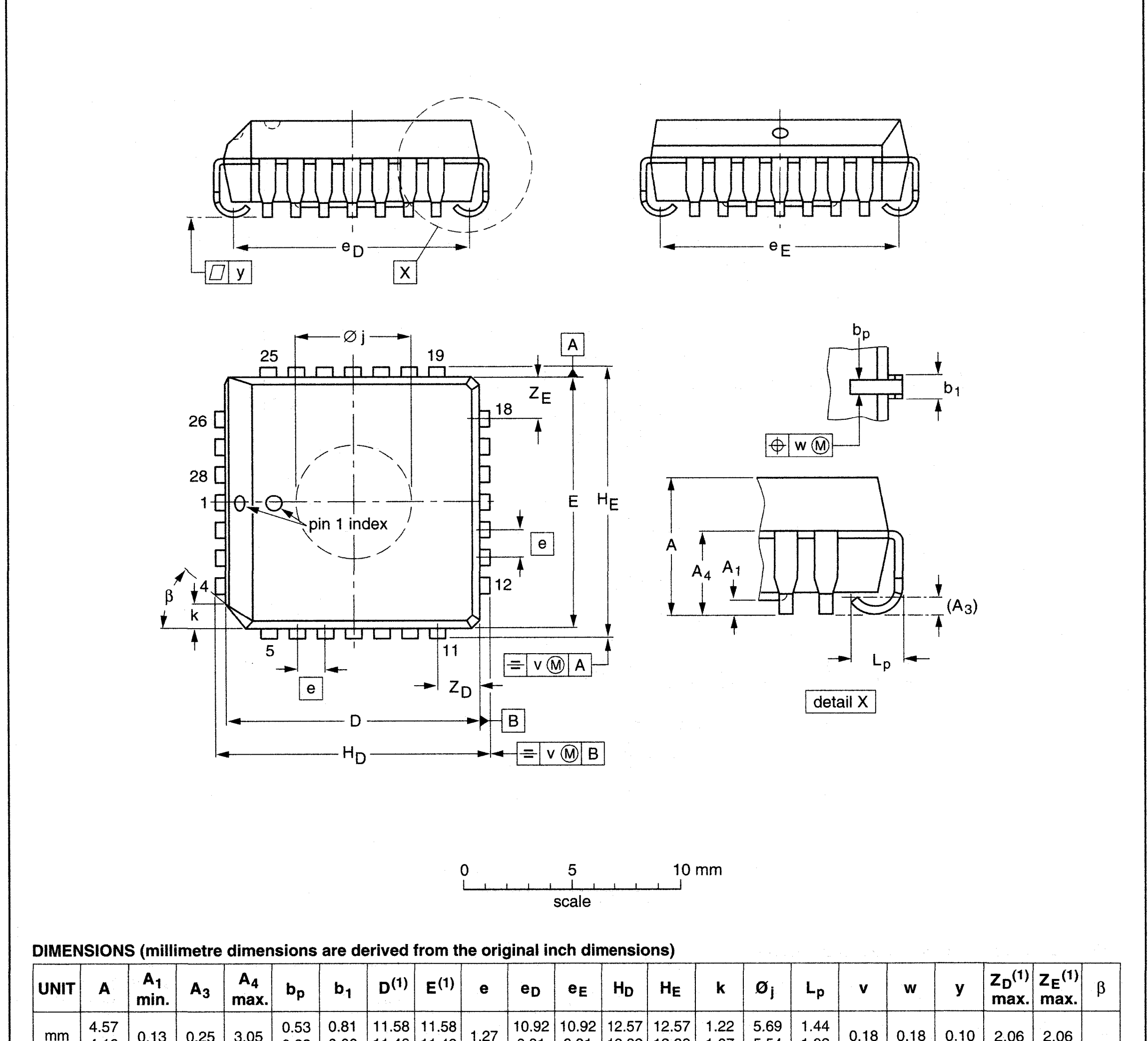
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	11.58 11.43	11.58 11.43	1.27	10.92 9.91	10.92 9.91	12.57 12.32	12.57 12.32	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	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						~~92-11-17~~ 95-02-25

PLCC28: plastic leaded chip carrier; 28 leads; pedestal **SOT261-3**



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

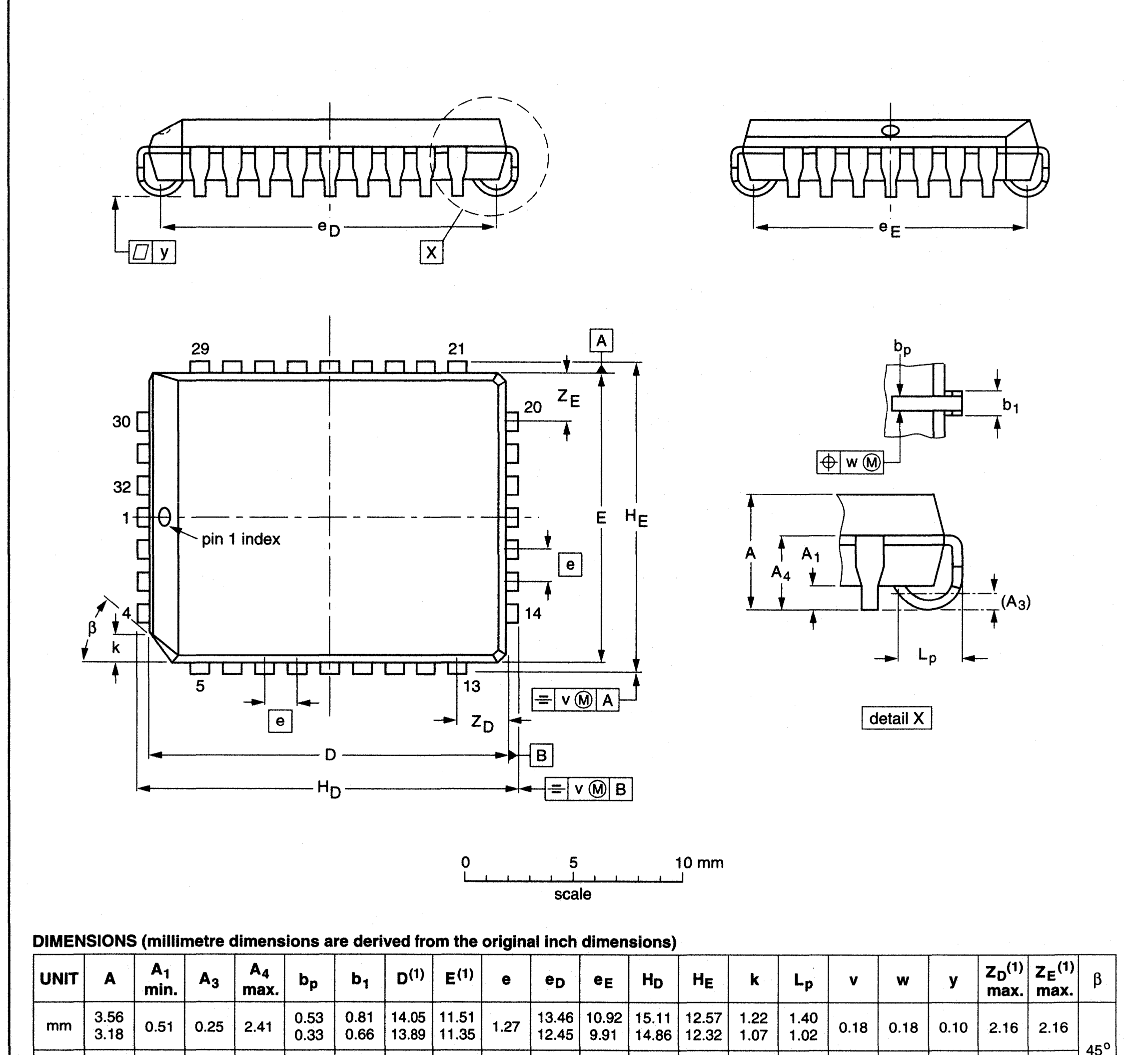
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	$Ø_j$	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	11.58 11.43	11.58 11.43	1.27	10.92 9.91	10.92 9.91	12.57 12.32	12.57 12.32	1.22 1.07	5.69 5.54	1.44 1.02	0.18	0.18	0.10	2.06	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		MO-047AB				~~95-02-25~~ 97-12-16

PLCC32: plastic leaded chip carrier; 32 leads **SOT381-1**



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

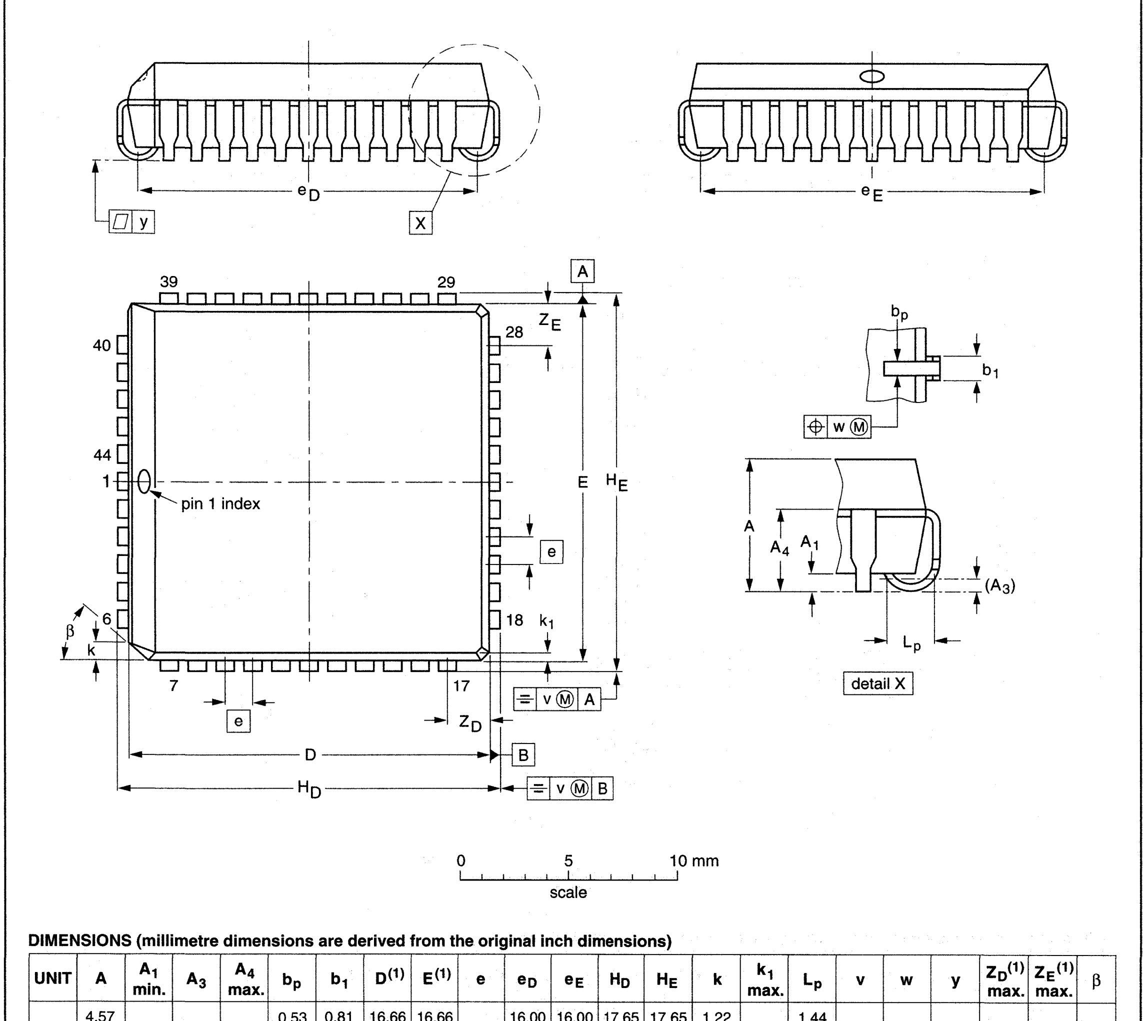
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	3.56 3.18	0.51	0.25	2.41	0.53 0.33	0.81 0.66	14.05 13.89	11.51 11.35	1.27	13.46 12.45	10.92 9.91	15.11 14.86	12.57 12.32	1.22 1.07	1.40 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.140 0.125	0.020	0.01	0.095	0.021 0.013	0.032 0.026	0.553 0.547	0.453 0.447	0.05	0.530 0.490	0.430 0.390	0.595 0.585	0.495 0.485	0.048 0.042	0.055 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			
SOT381-1		MS-016AE				~~95-03-11~~ 97-12-16

PLCC44: plastic leaded chip carrier; 44 leads **SOT187-2**



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

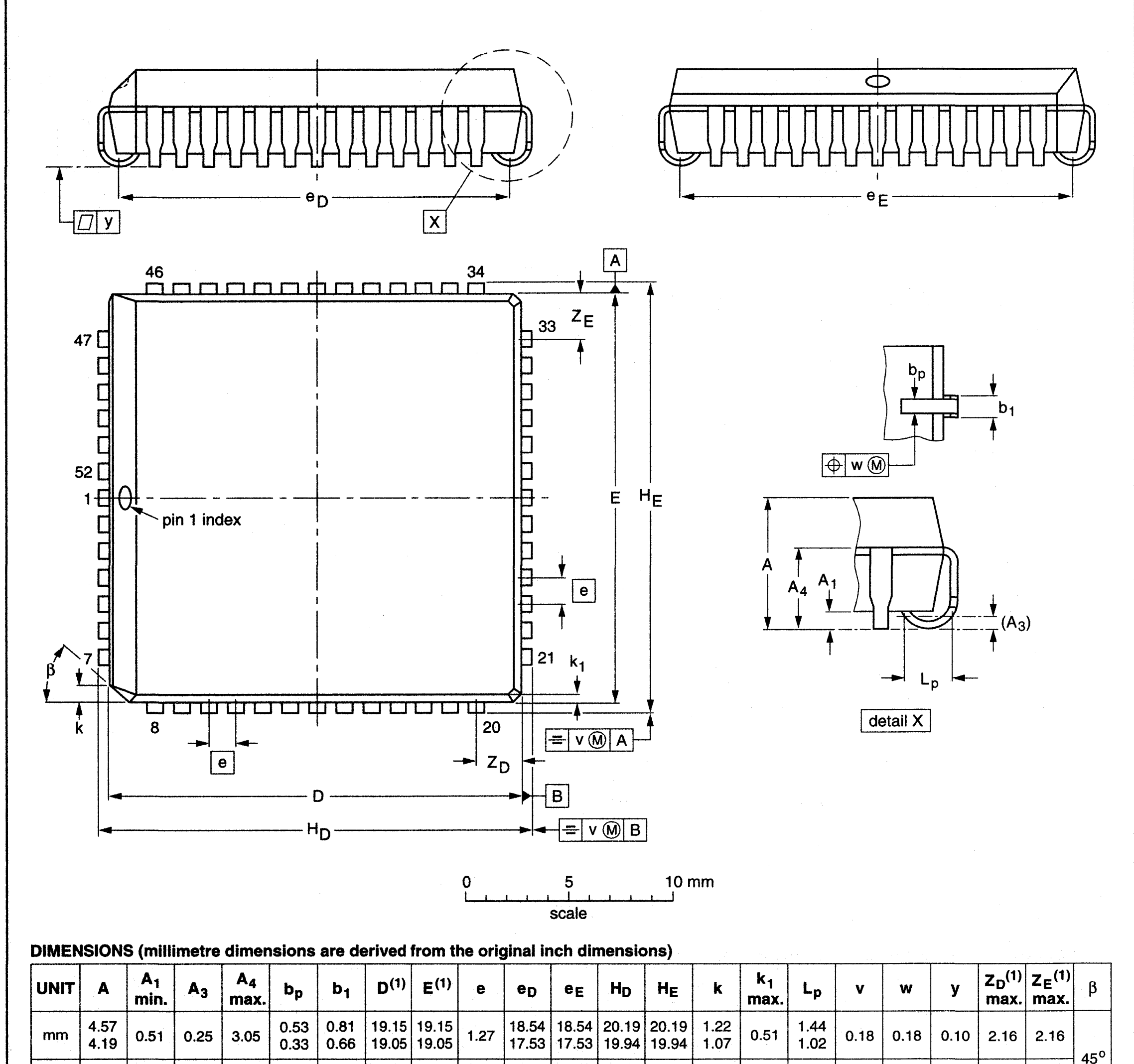
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	16.66 16.51	16.66 16.51	1.27	16.00 14.99	16.00 14.99	17.65 17.40	17.65 17.40	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	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-047AC				~~95-02-25~~ 97-12-16

PLCC52: plastic leaded chip carrier; 52 leads **SOT238-2**



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

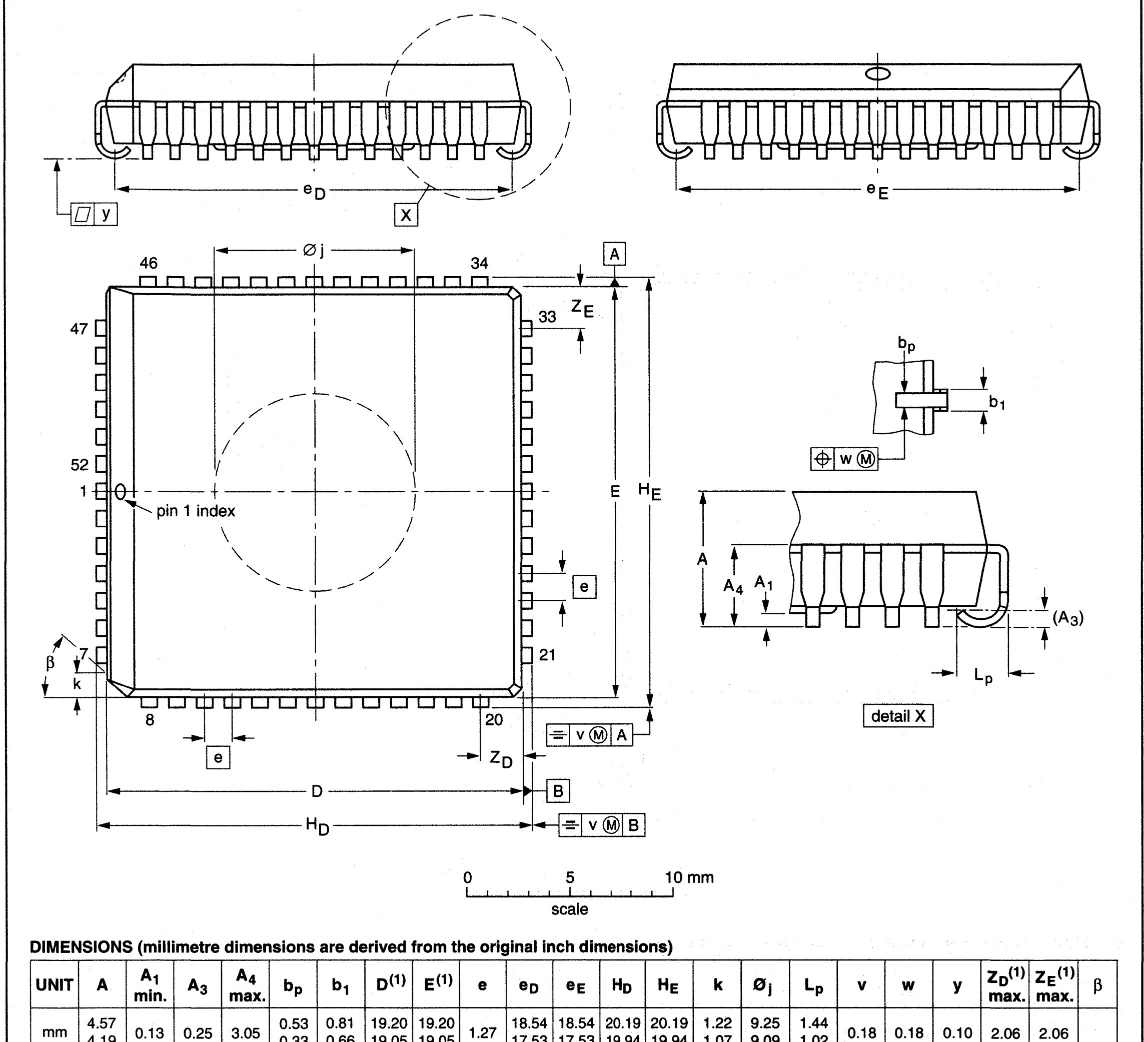
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	19.15 19.05	19.15 19.05	1.27	18.54 17.53	18.54 17.53	20.19 19.94	20.19 19.94	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.754 0.750	0.754 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						~~92-10-08~~ 95-02-25

PLCC52: plastic leaded chip carrier; 52 leads; pedestal SOT238-3



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

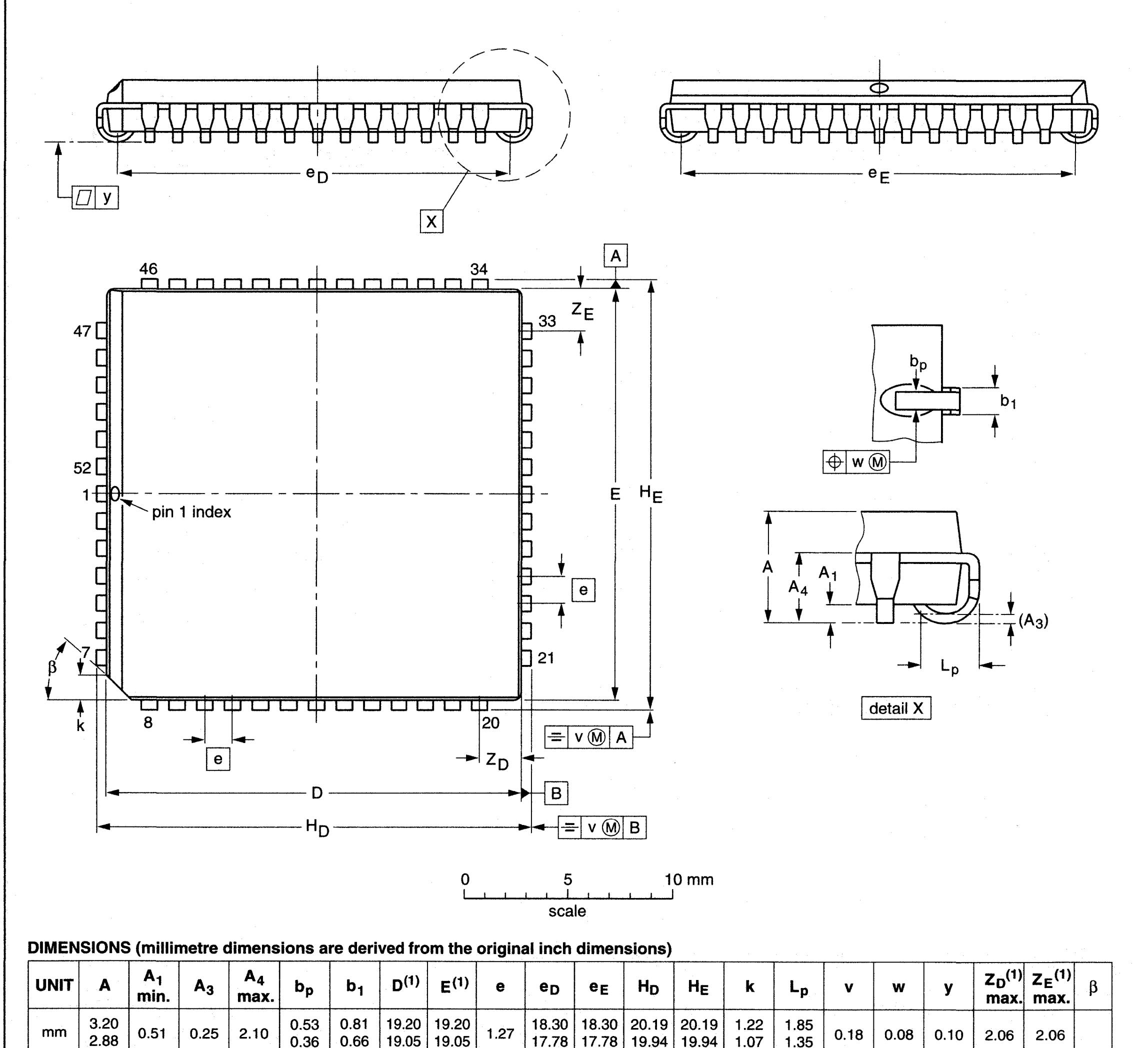
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	$Ø_j$	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	19.20 19.05	19.20 19.05	1.27	18.54 17.53	18.54 17.53	20.19 19.94	20.19 19.94	1.22 1.07	9.25 9.09	1.44 1.02	0.18	0.18	0.10	2.06	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		MO-047AD				~~95-02-25~~ 97-12-16

PLCC52: plastic leaded chip carrier; 52 leads; thin version **SOT433-1**



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

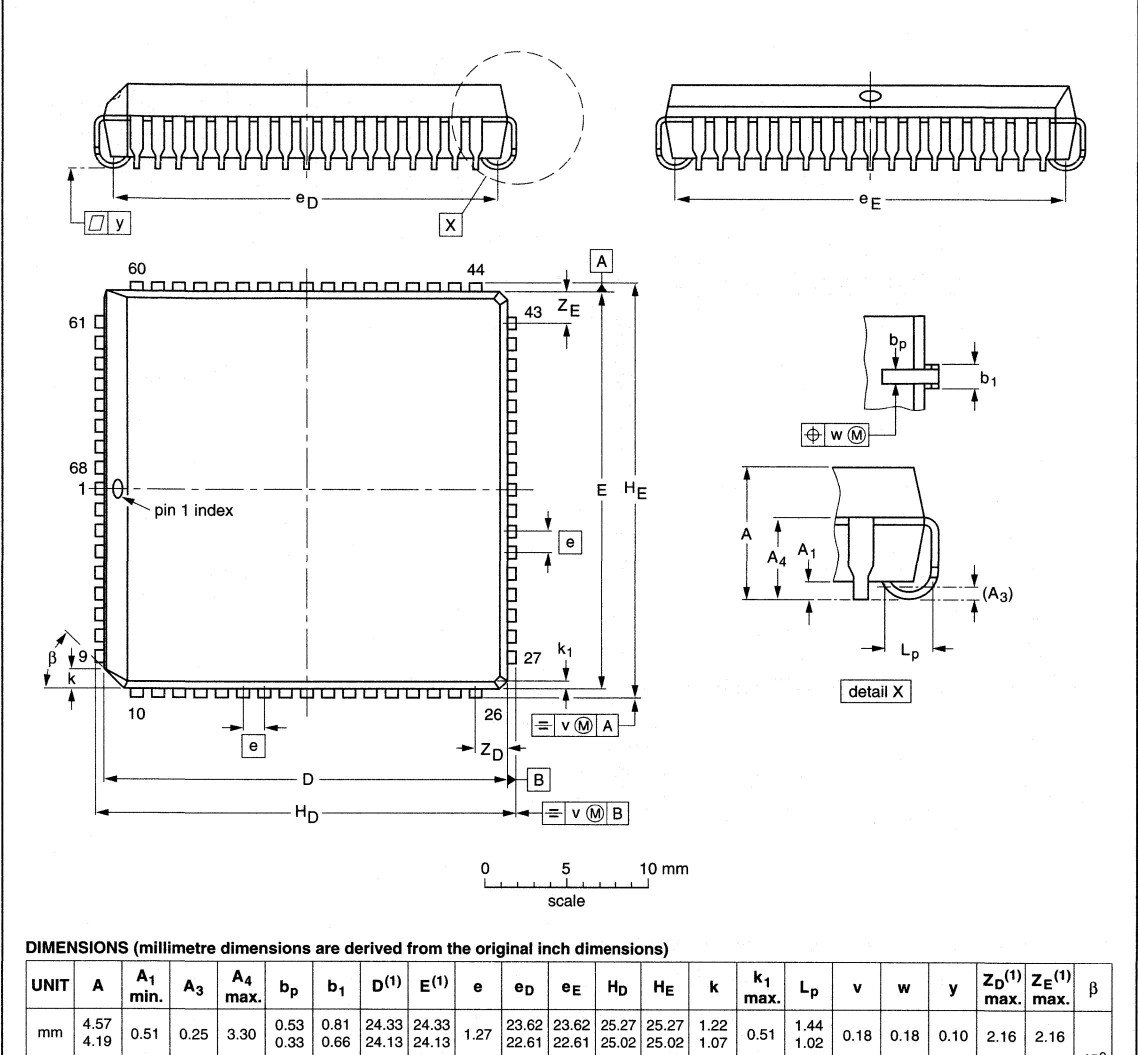
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	D(1)	E(1)	e	e_D	e_E	H_D	H_E	k	L_p	v	w	y	Z_D(1) max.	Z_E(1) max.	β
mm	3.20 2.88	0.51	0.25	2.10	0.53 0.36	0.81 0.66	19.20 19.05	19.20 19.05	1.27	18.30 17.78	18.30 17.78	20.19 19.94	20.19 19.94	1.22 1.07	1.85 1.35	0.18	0.08	0.10	2.06	2.06	45°
inches	0.126 0.113	0.020	0.01	0.083	0.021 0.014	0.032 0.026	0.756 0.750	0.756 0.750	0.05	0.720 0.700	0.720 0.700	0.795 0.785	0.795 0.785	0.048 0.042	0.073 0.053	0.007	0.003	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			
SOT433-1						96-09-02

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	

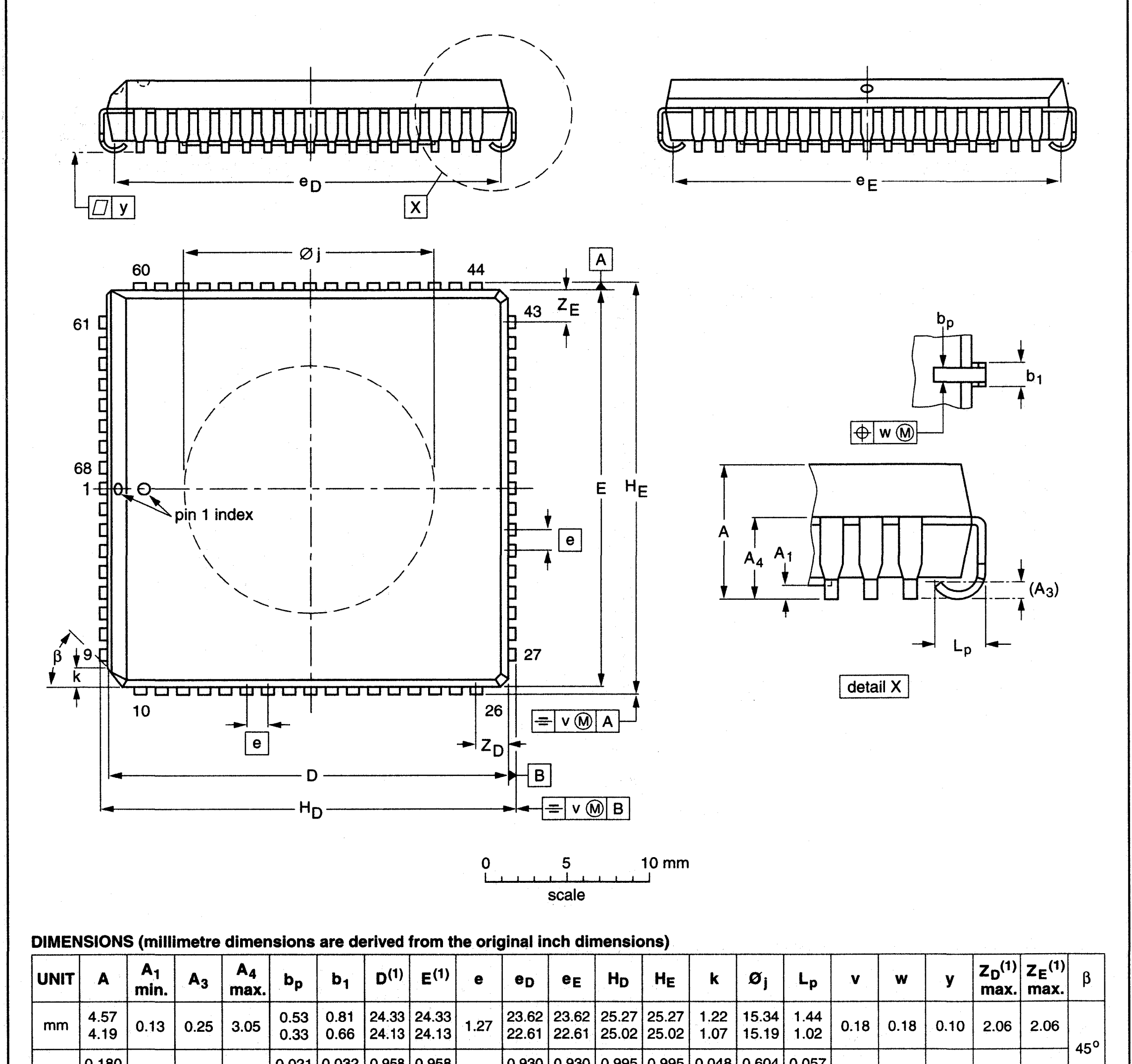
Note

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-047AC				~~92-11-17~~ 95-03-11

IC package range and dimensions Chapter 2

PLCC68: plastic leaded chip carrier; 68 leads; pedestal **SOT188-3**



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

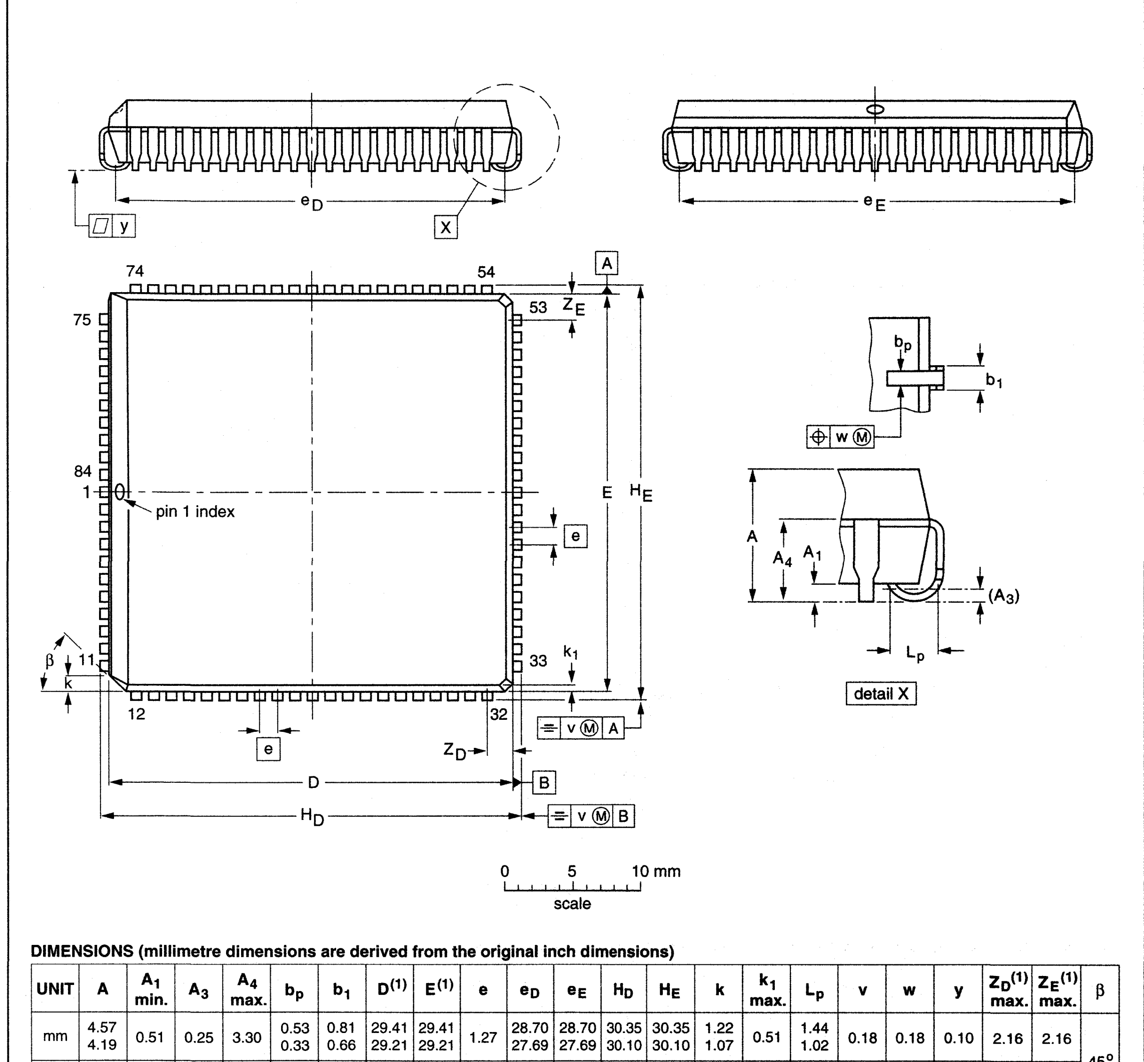
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	D(1)	E(1)	e	e_D	e_E	H_D	H_E	k	Øj	L_p	v	w	y	Z_D(1) max.	Z_E(1) max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	24.33 24.13	24.33 24.13	1.27	23.62 22.61	23.62 22.61	25.27 25.02	25.27 25.02	1.22 1.07	15.34 15.19	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 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	0.057 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			
SOT188-3	112E10	MO-047AE				~~95-02-25~~ 97-12-16

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_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	29.41 29.21	29.41 29.21	1.27	28.70 27.69	28.70 27.69	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	

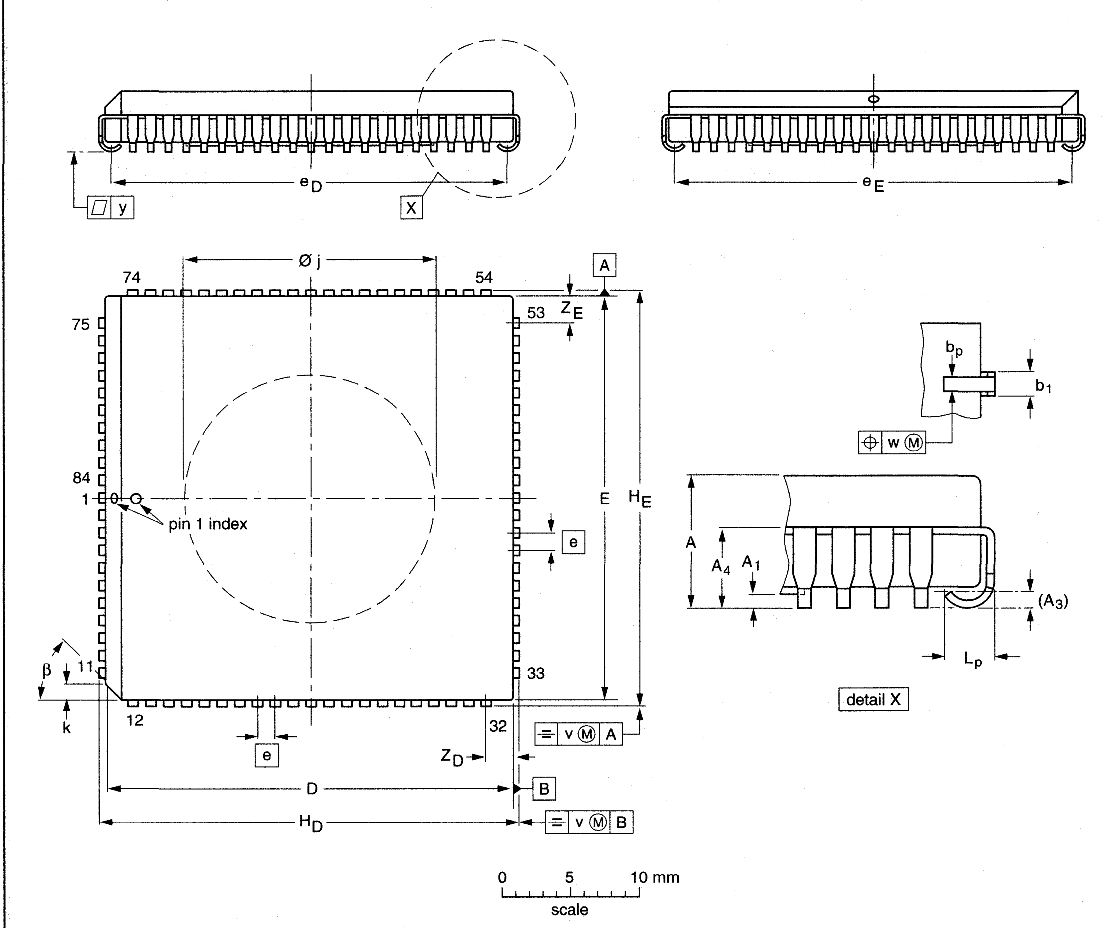
Note

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

OUTLINE VERSION	REFERENCES: IEC	REFERENCES: JEDEC	REFERENCES: EIAJ	REFERENCES	EUROPEAN PROJECTION	ISSUE DATE
SOT189-2						~~92-11-17~~ 95-03-11

IC package range and dimensions Chapter 2

PLCC84: plastic leaded chip carrier; 84 leads; pedestal SOT189-3



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

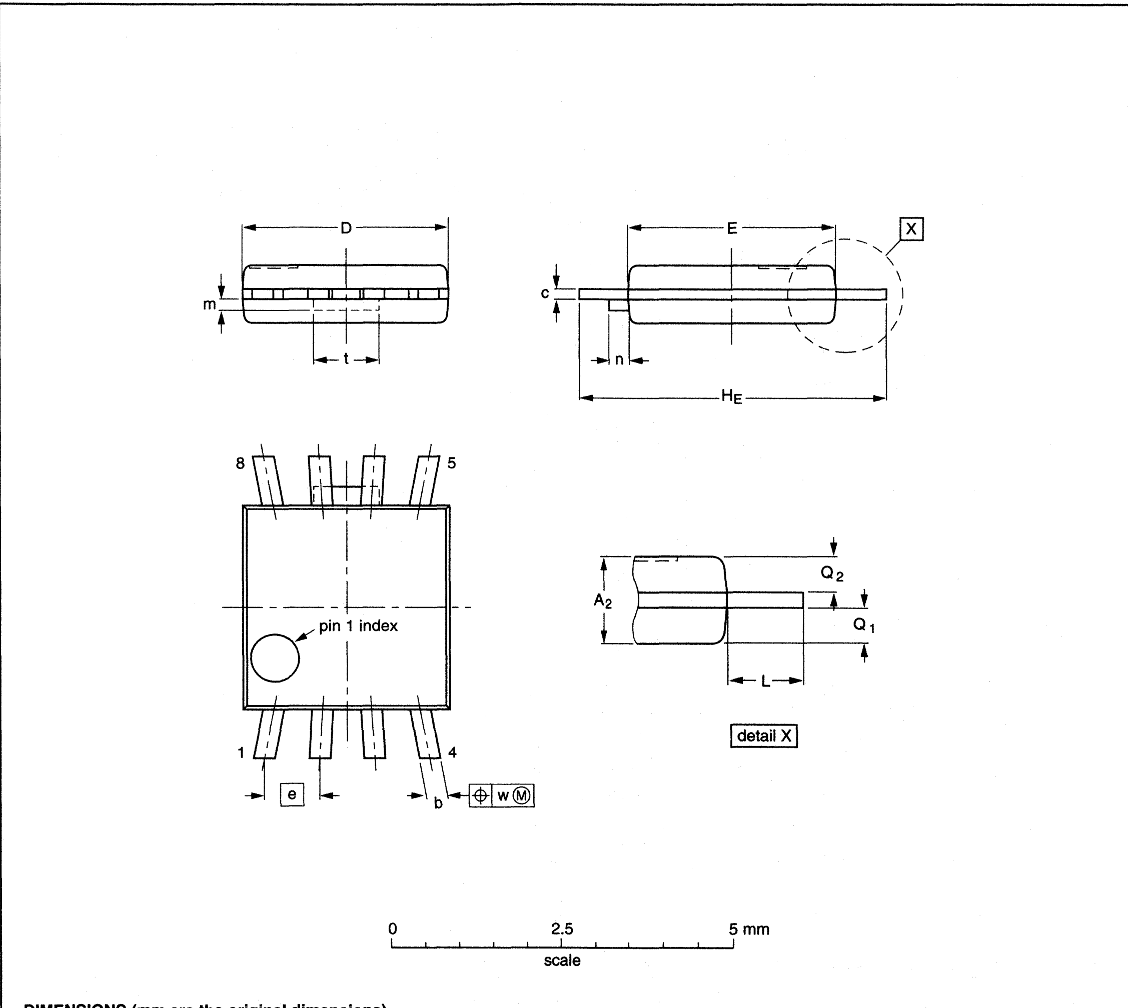
UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	D(1)	E(1)	e	e_D	e_E	H_D	H_E	k	$Ø_j$	L_p	v	w	y	Z_D(1) max.	Z_E(1) max.	β
mm	4.57 4.19	0.13	0.25	3.05	0.53 0.33	0.81 0.66	29.41 29.21	29.41 29.21	1.27	28.70 27.69	28.70 27.69	30.35 30.10	30.35 30.10	1.22 1.07	15.34 15.19	1.44 1.02	0.18	0.18	0.10	2.06	2.06	45°
inches	0.180 0.165	0.005	0.01	0.12	0.021 0.013	0.032 0.026	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	0.057 0.040	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			
SOT189-3		MO-047AF				~~92-11-17~~ 95-02-25

PMFP8: plastic micro flat package; 8 leads (straight) **SOT144-1**



DIMENSIONS (mm are the original dimensions)

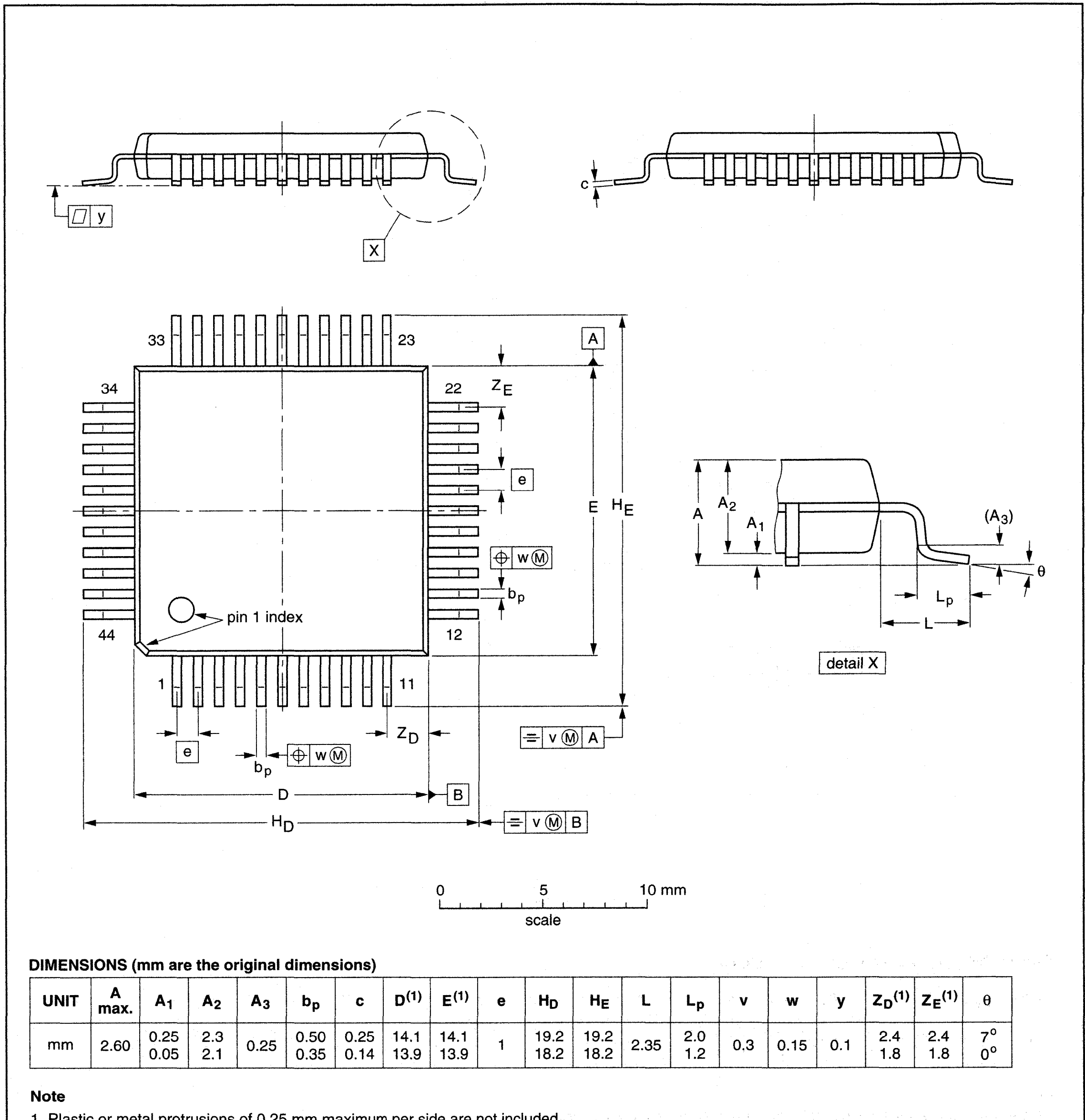
UNIT	A_2	b	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	m max.	n max.	Q_1	Q_2	t	w
mm	0.90 0.70	0.40 0.25	0.19 0.12	3.1 2.9	3.1 2.9	0.80	4.6 4.4	0.75	0.26	0.3	0.40 0.30	0.40 0.30	0.95	0.1

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

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°

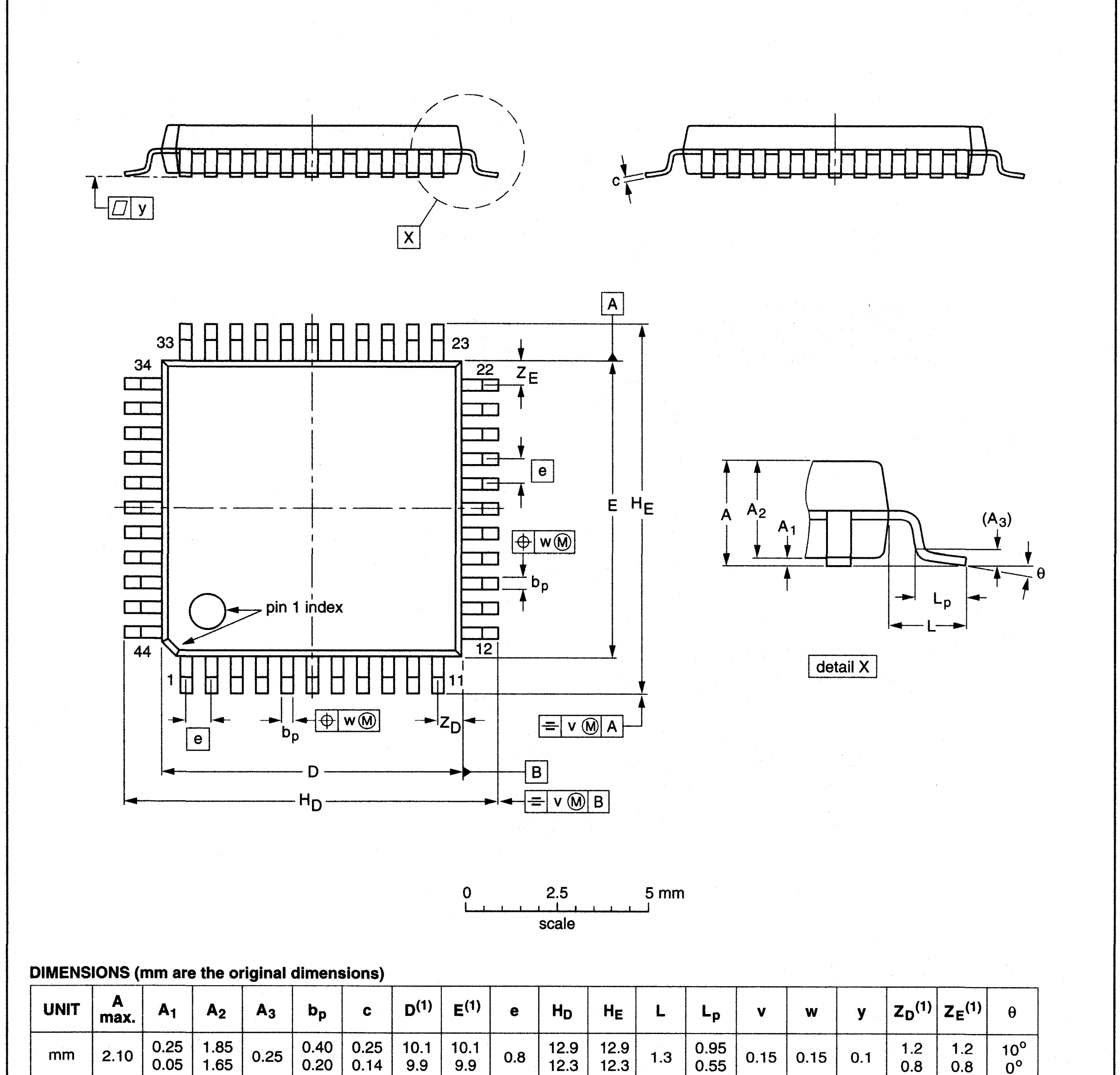
Note

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	133E01A					~~95-02-04~~ 97-08-01

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)

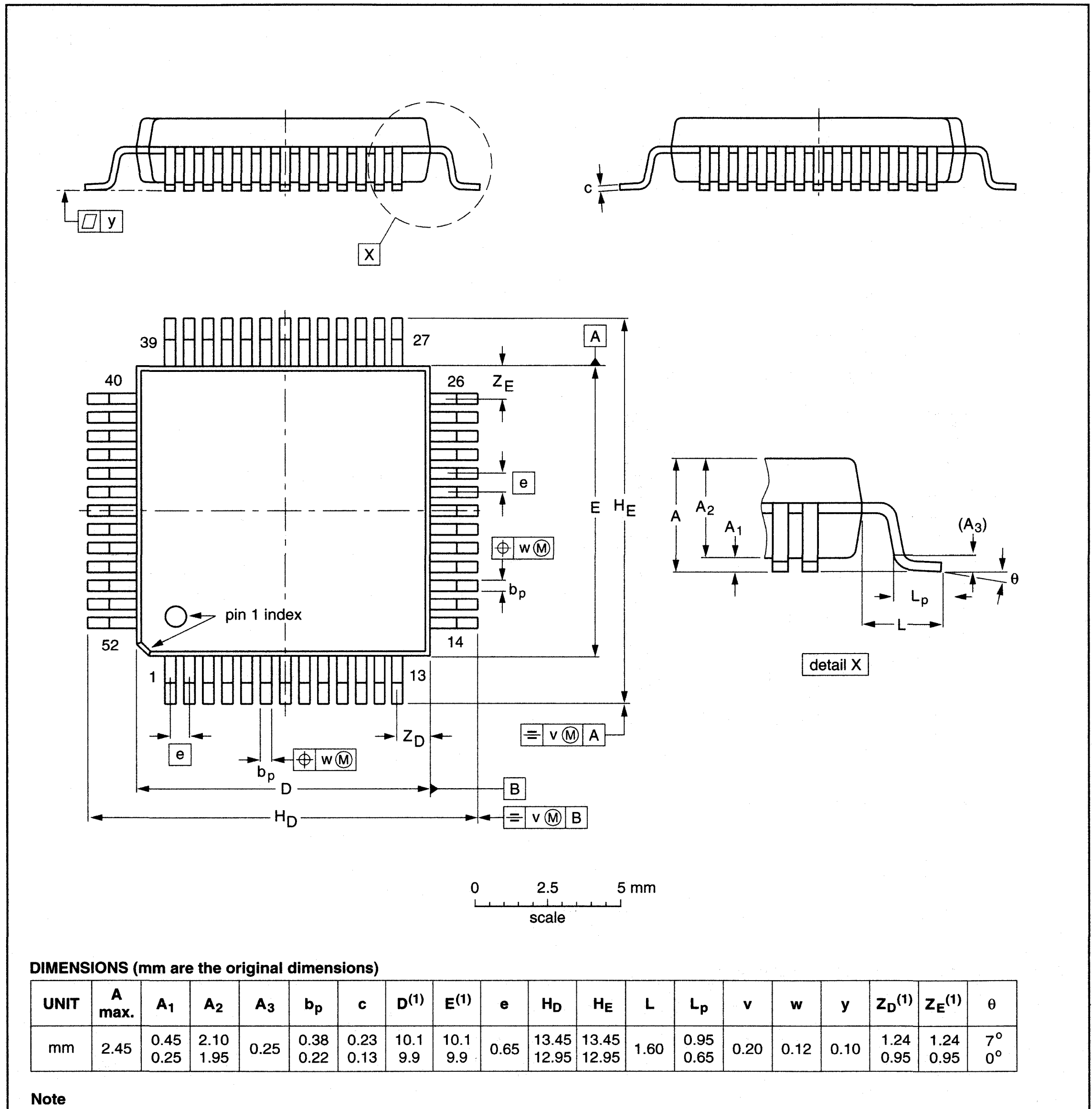
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	2.10	0.25 0.05	1.85 1.65	0.25	0.40 0.20	0.25 0.14	10.1 9.9	10.1 9.9	0.8	12.9 12.3	12.9 12.3	1.3	0.95 0.55	0.15	0.15	0.1	1.2 0.8	1.2 0.8	10° 0°

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

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)

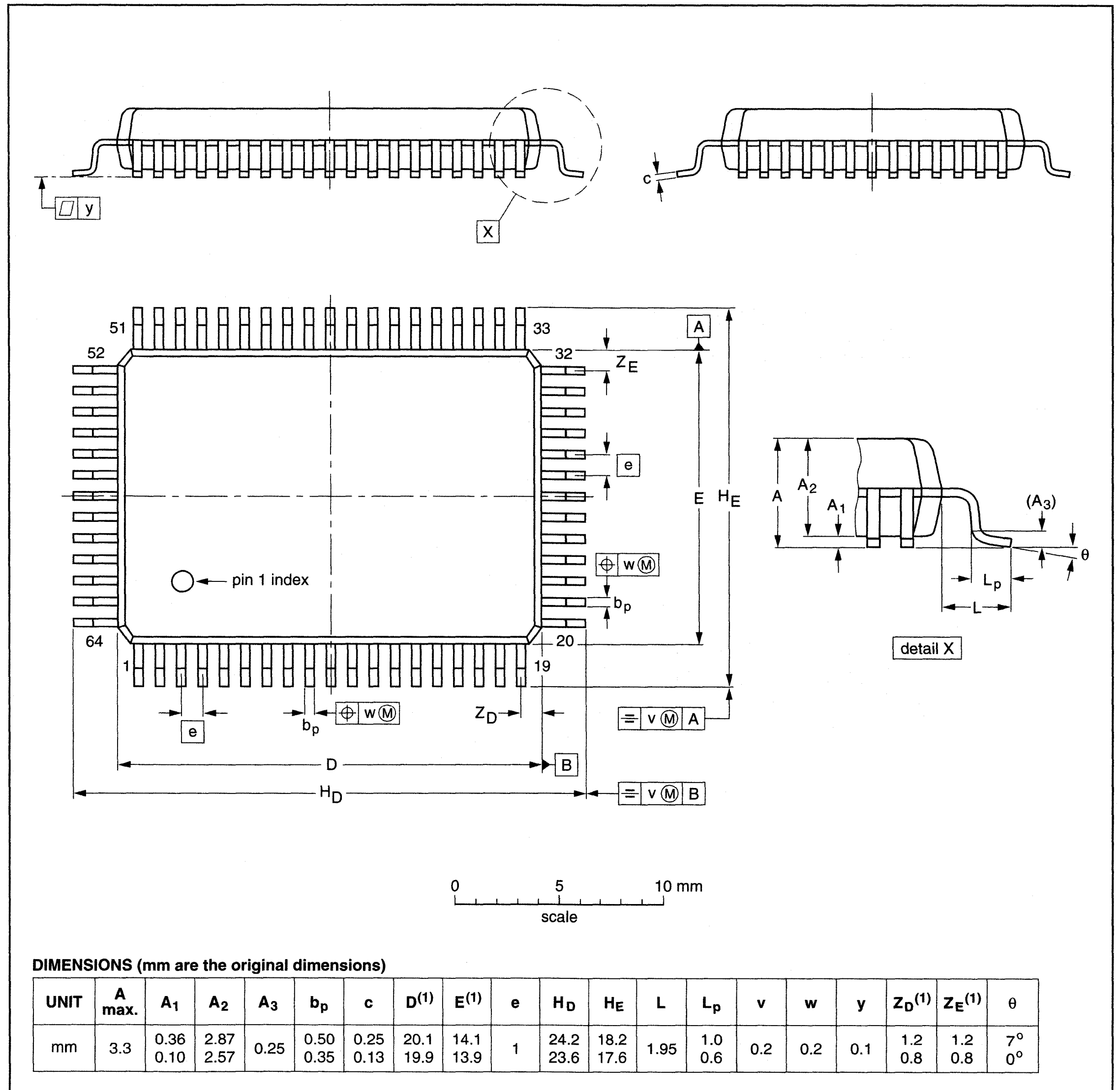
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	2.45	0.45 0.25	2.10 1.95	0.25	0.38 0.22	0.23 0.13	10.1 9.9	10.1 9.9	0.65	13.45 12.95	13.45 12.95	1.60	0.95 0.65	0.20	0.12	0.10	1.24 0.95	1.24 0.95	7° 0°

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		MO-108				~~95-02-04~~ 97-08-04

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)

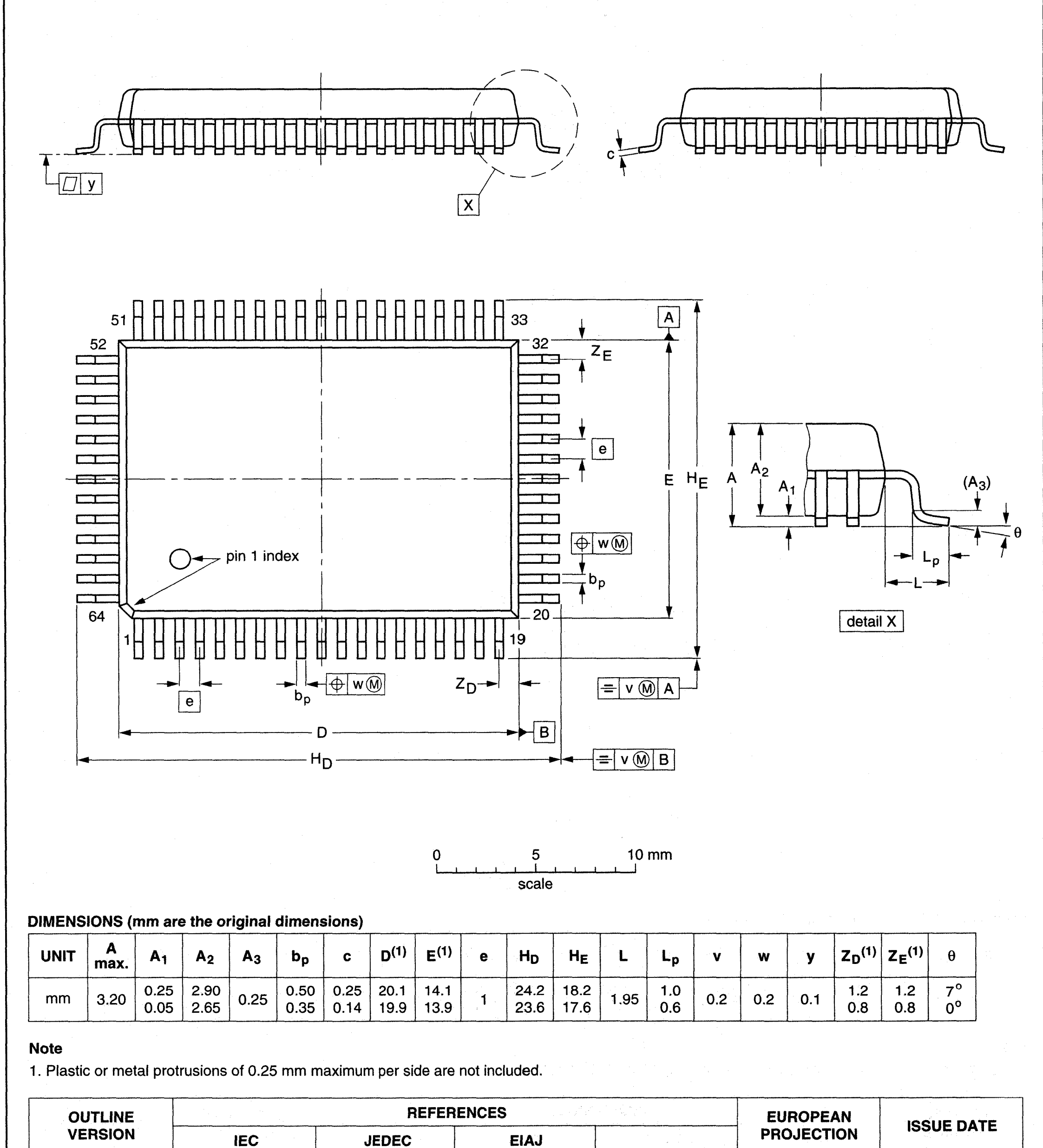
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_D	H_E	L	L_p	v	w	y	Z_D(1)	Z_E(1)	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.50 0.35	0.25 0.13	20.1 19.9	14.1 13.9	1	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

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						~~95-02-04~~ 97-08-01

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)

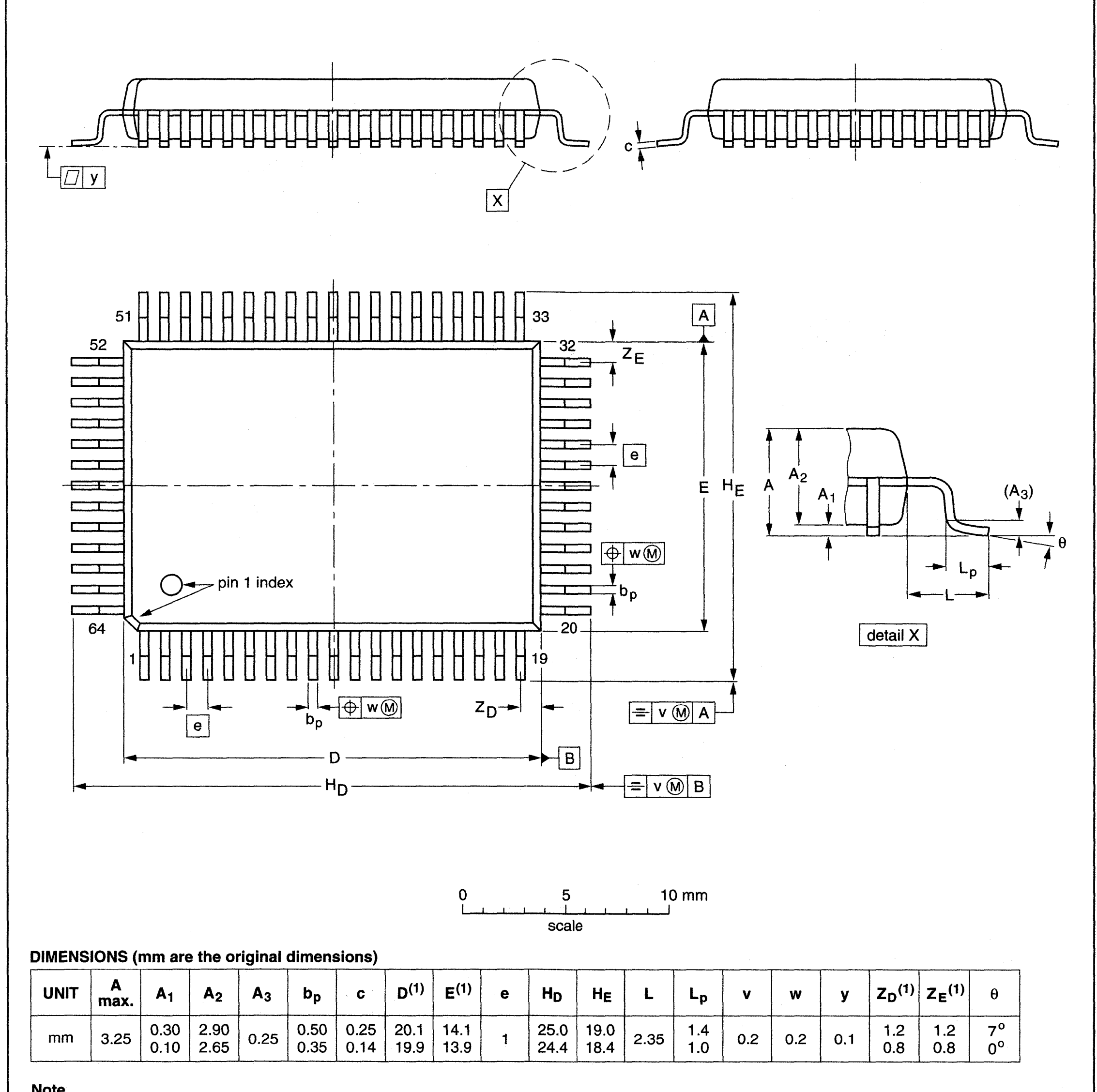
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.20	0.25 0.05	2.90 2.65	0.25	0.50 0.35	0.25 0.14	20.1 19.9	14.1 13.9	1	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

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						~~95-02-04~~ 97-08-01

QFP64: plastic quad flat package; 64 leads (lead length 2.35 mm); body 14 x 20 x 2.8 mm **SOT319-3**



DIMENSIONS (mm are the original dimensions)

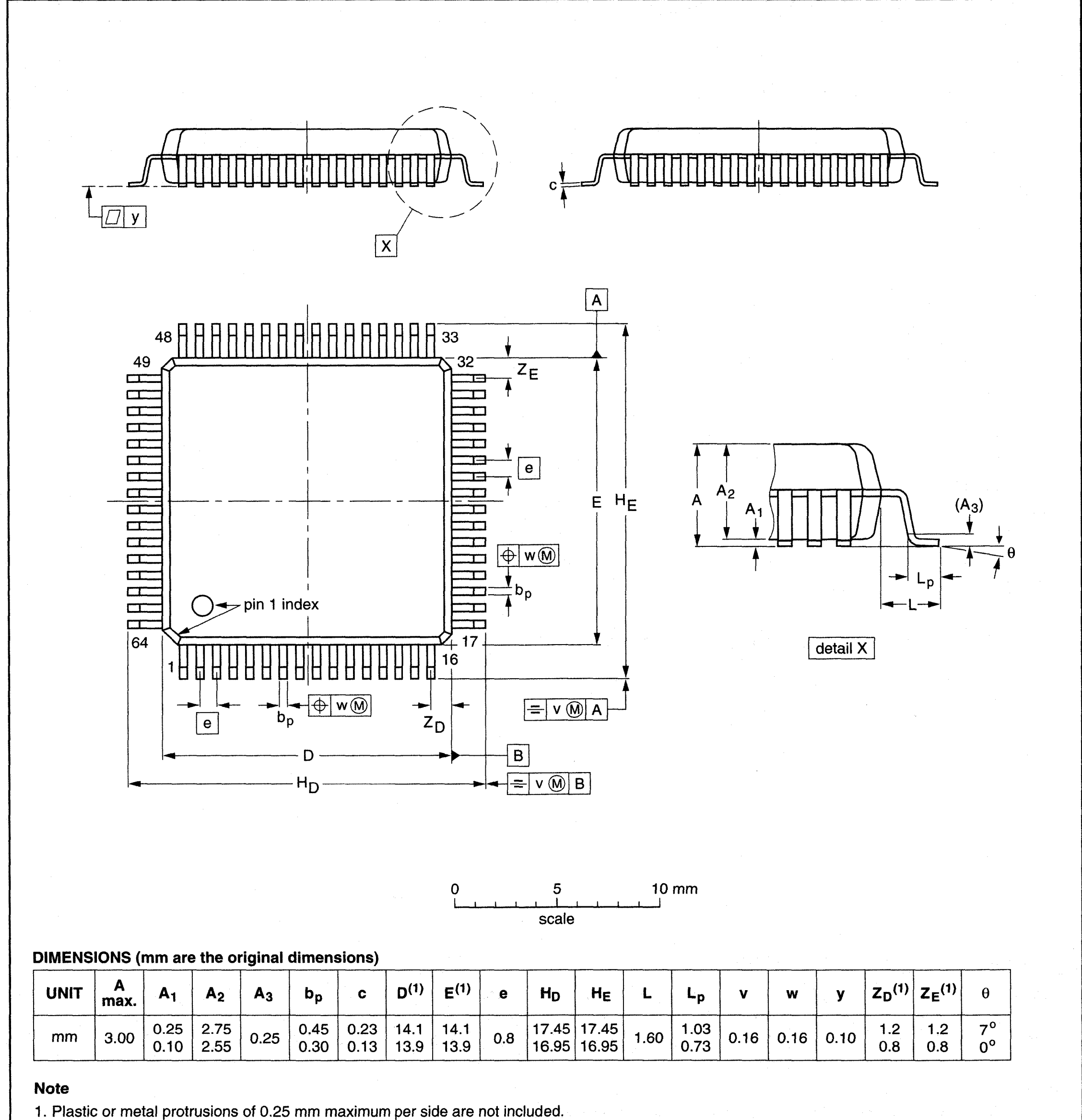
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.25	0.30 0.10	2.90 2.65	0.25	0.50 0.35	0.25 0.14	20.1 19.9	14.1 13.9	1	25.0 24.4	19.0 18.4	2.35	1.4 1.0	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

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			
SOT319-3						~~95-02-04~~ 97-08-01

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)

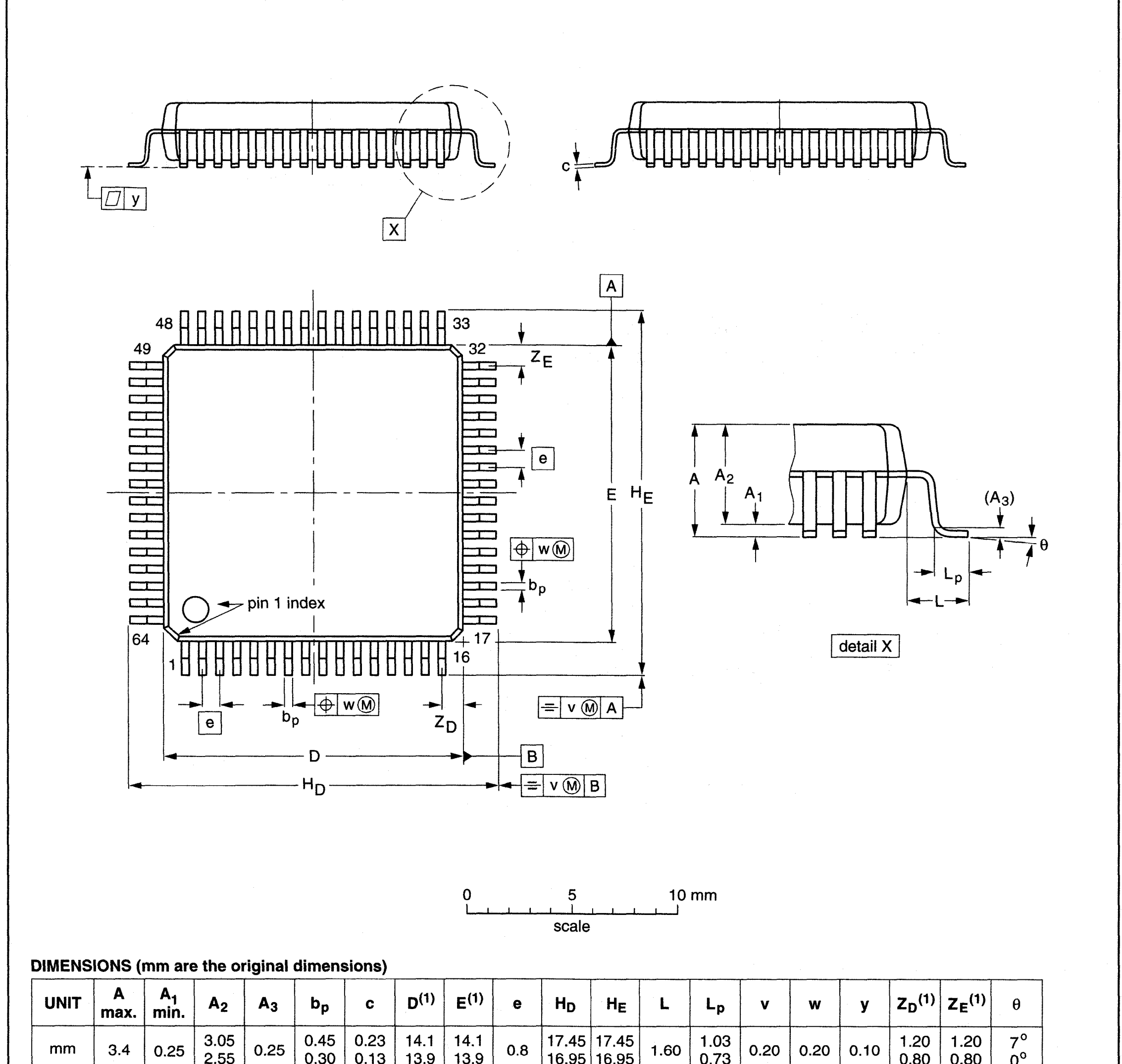
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.00	0.25 0.10	2.75 2.55	0.25	0.45 0.30	0.23 0.13	14.1 13.9	14.1 13.9	0.8	17.45 16.95	17.45 16.95	1.60	1.03 0.73	0.16	0.16	0.10	1.2 0.8	1.2 0.8	7° 0°

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		MS-022				~~96-05-21~~ 97-08-04

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)

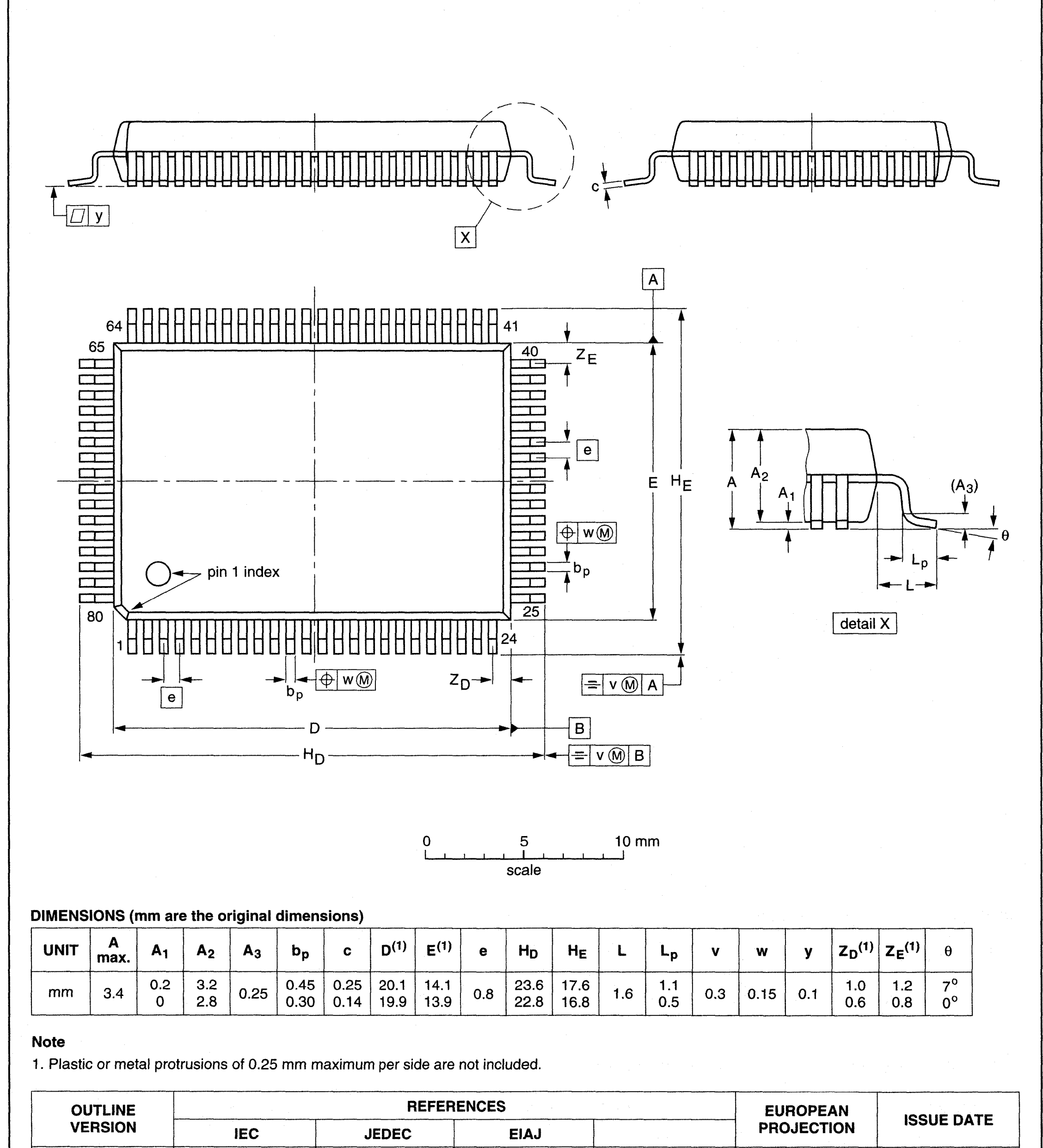
UNIT	A max.	A_1 min.	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.4	0.25	3.05 2.55	0.25	0.45 0.30	0.23 0.13	14.1 13.9	14.1 13.9	0.8	17.45 16.95	17.45 16.95	1.60	1.03 0.73	0.20	0.20	0.10	1.20 0.80	1.20 0.80	7° 0°

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-108BD-1				97-12-16

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)

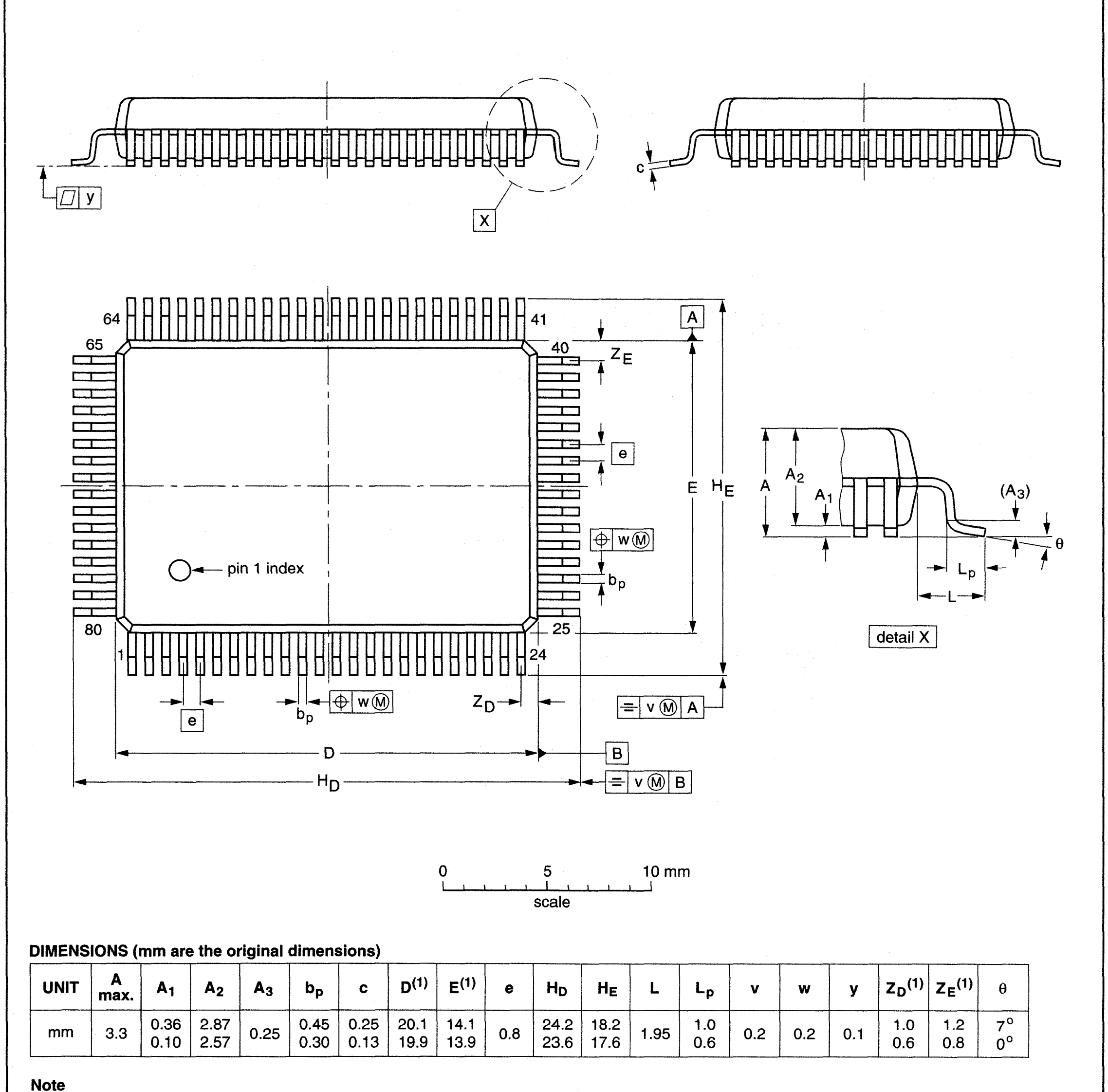
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.4	0.2 0	3.2 2.8	0.25	0.45 0.30	0.25 0.14	20.1 19.9	14.1 13.9	0.8	23.6 22.8	17.6 16.8	1.6	1.1 0.5	0.3	0.15	0.1	1.0 0.6	1.2 0.8	7° 0°

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						~~95-02-04~~ 97-08-01

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)

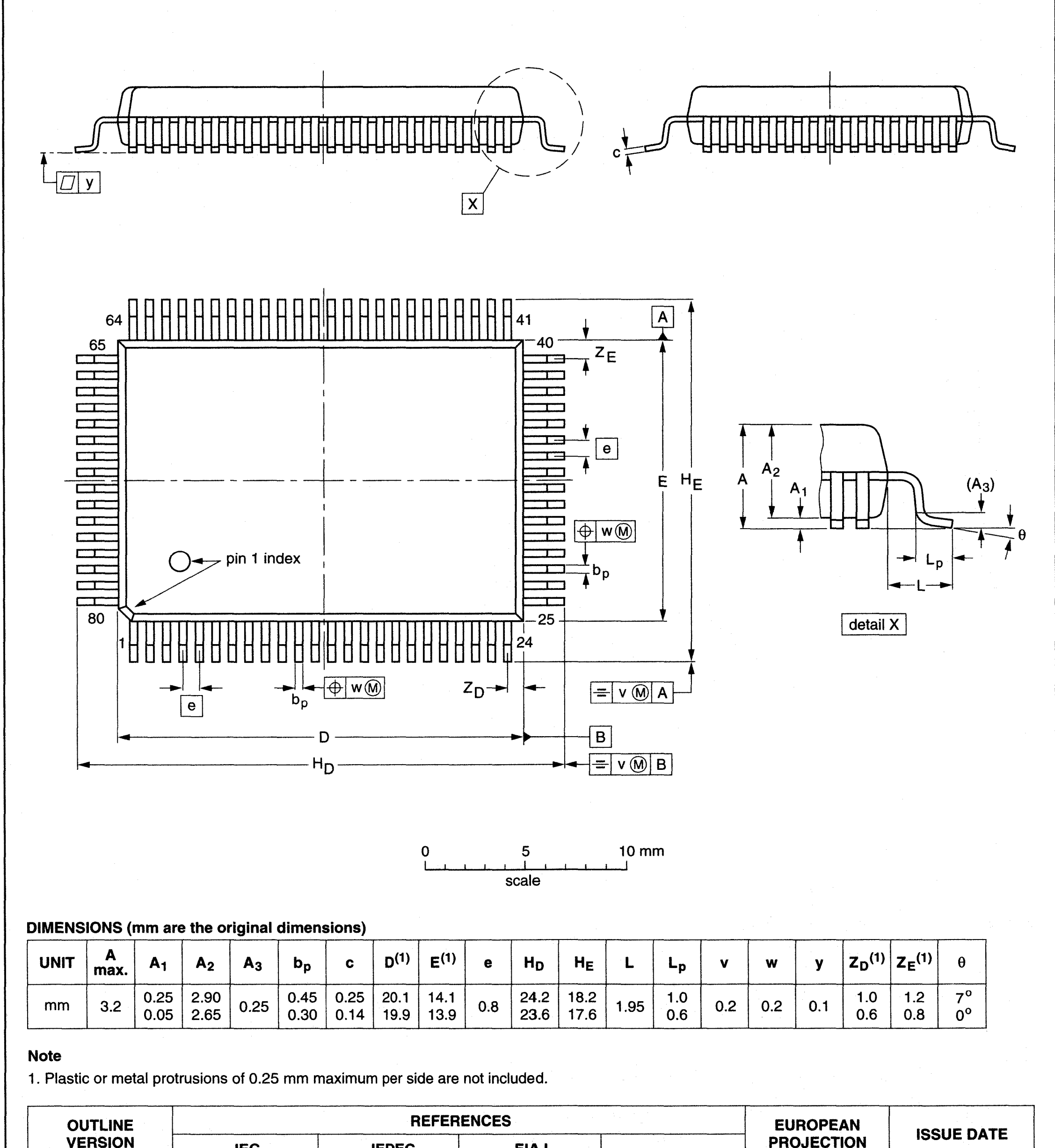
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.45 0.30	0.25 0.13	20.1 19.9	14.1 13.9	0.8	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.2	0.1	1.0 0.6	1.2 0.8	7° 0°

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						~~95-02-04~~ 97-08-01

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°

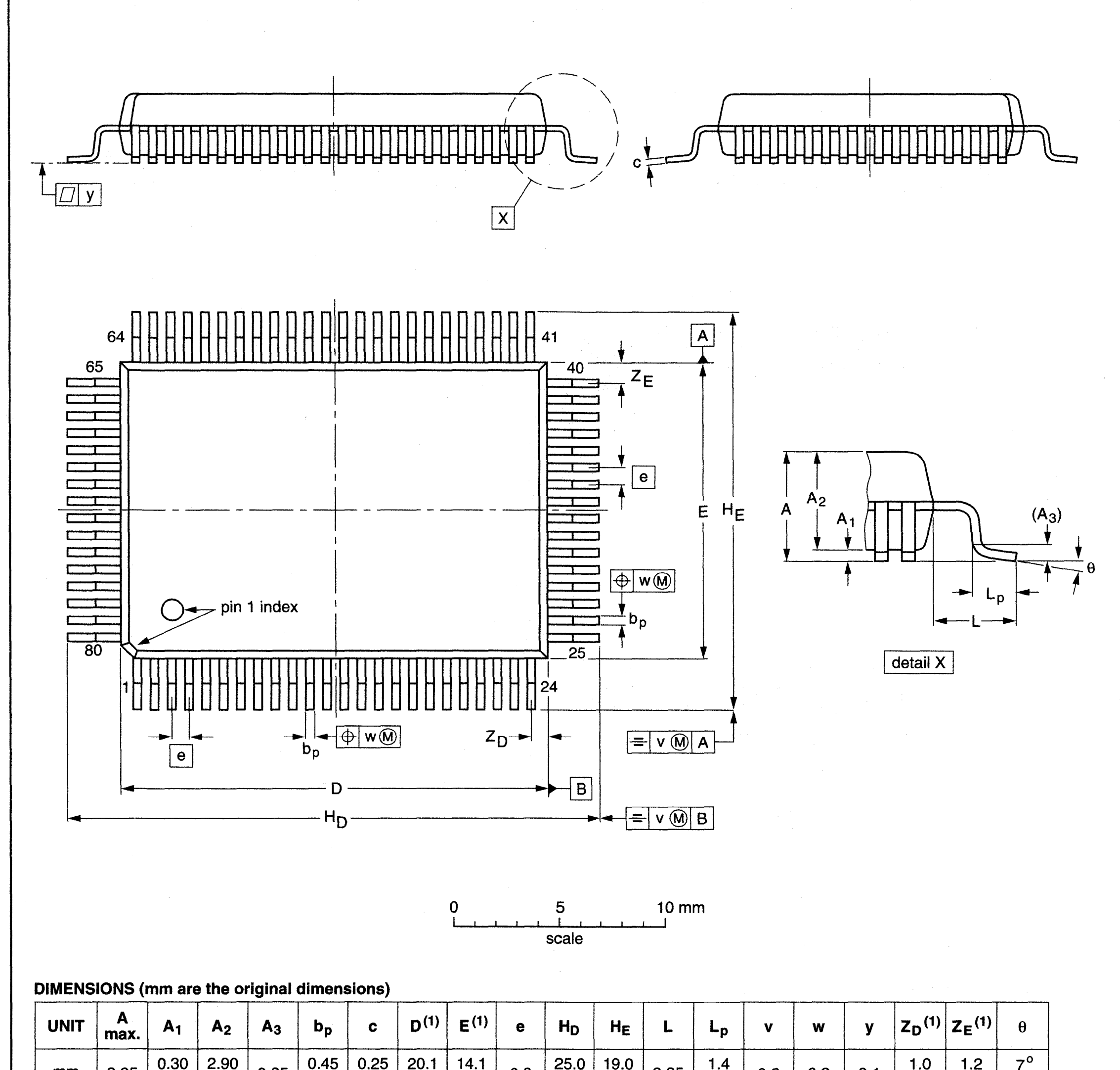
Note

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						~~95-02-04~~ 97-08-01

IC package range and dimensions Chapter 2

QFP80: plastic quad flat package; 80 leads (lead length 2.35 mm); body 14 x 20 x 2.8 mm **SOT318-3**



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	3.25	0.30 0.10	2.90 2.65	0.25	0.45 0.30	0.25 0.14	20.1 19.9	14.1 13.9	0.8	25.0 24.4	19.0 18.4	2.35	1.4 1.0	0.2	0.2	0.1	1.0 0.6	1.2 0.8	7° 0°

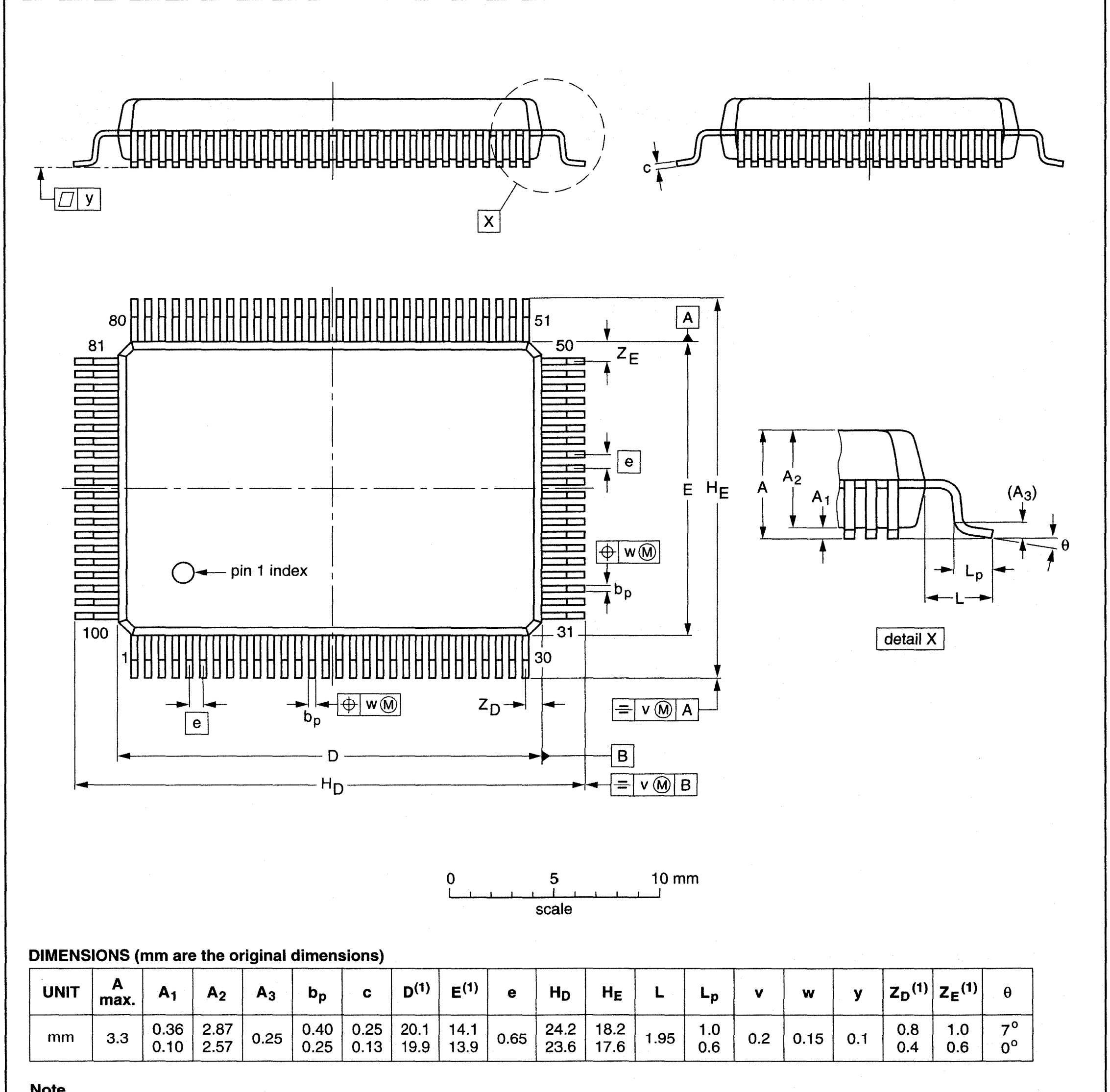
Note

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			
SOT318-3						~~95-04-25~~ 97-08-01

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)

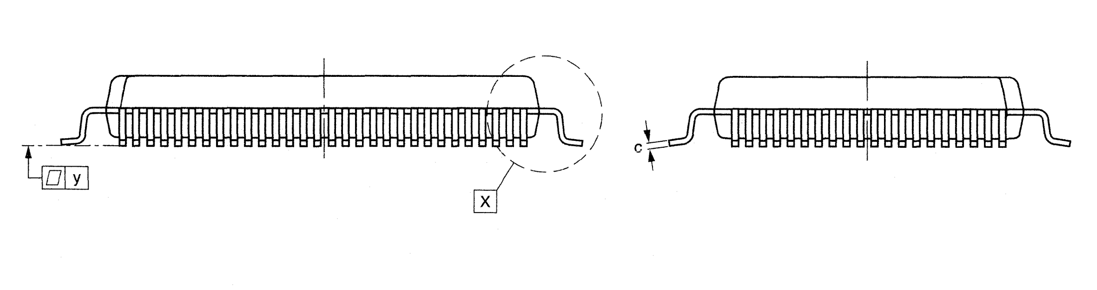
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.3	0.36 0.10	2.87 2.57	0.25	0.40 0.25	0.25 0.13	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.15	0.1	0.8 0.4	1.0 0.6	7° 0°

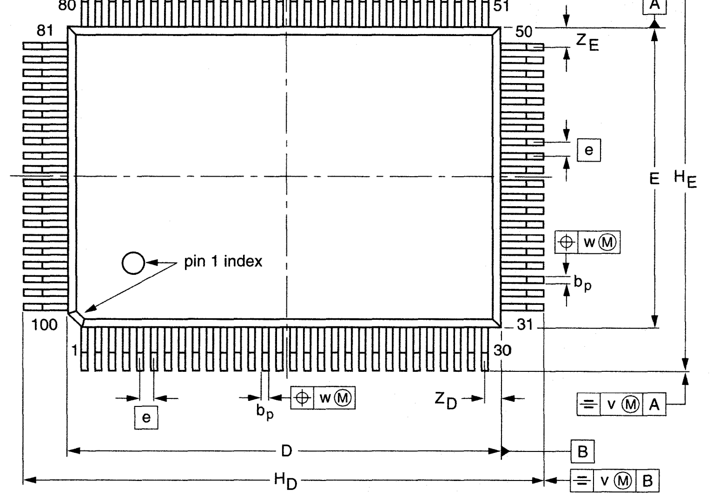
Note

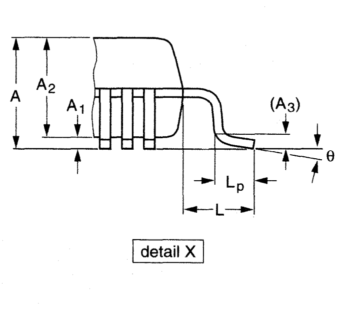
1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT317-1						~~95-02-04~~ 97-08-01

QFP100: plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm **SOT317-2**







0 5 10 mm
scale

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°

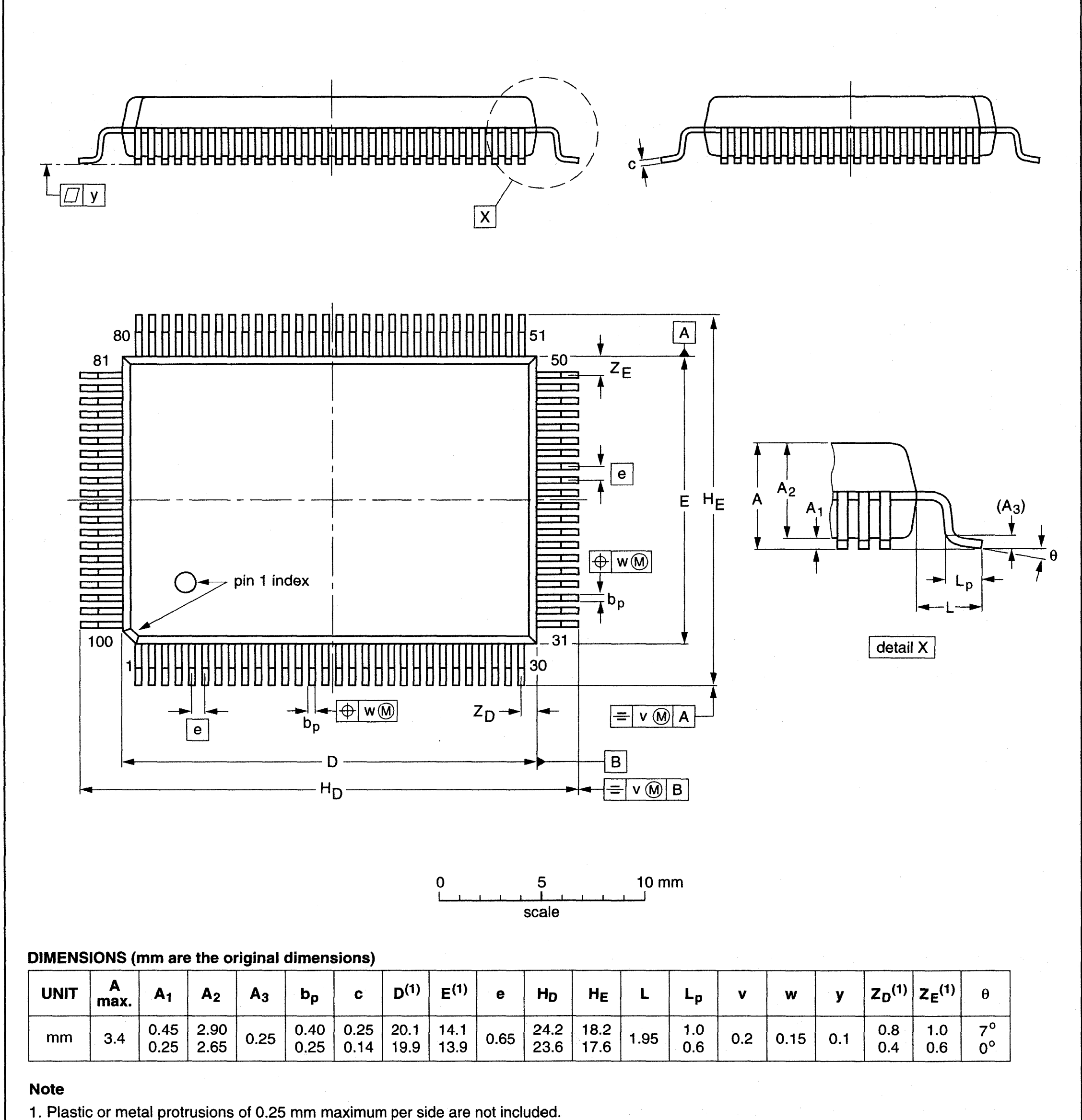
Note

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						~~95-02-04~~ 97-08-01

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 **SOT317-3**



DIMENSIONS (mm are the original dimensions)

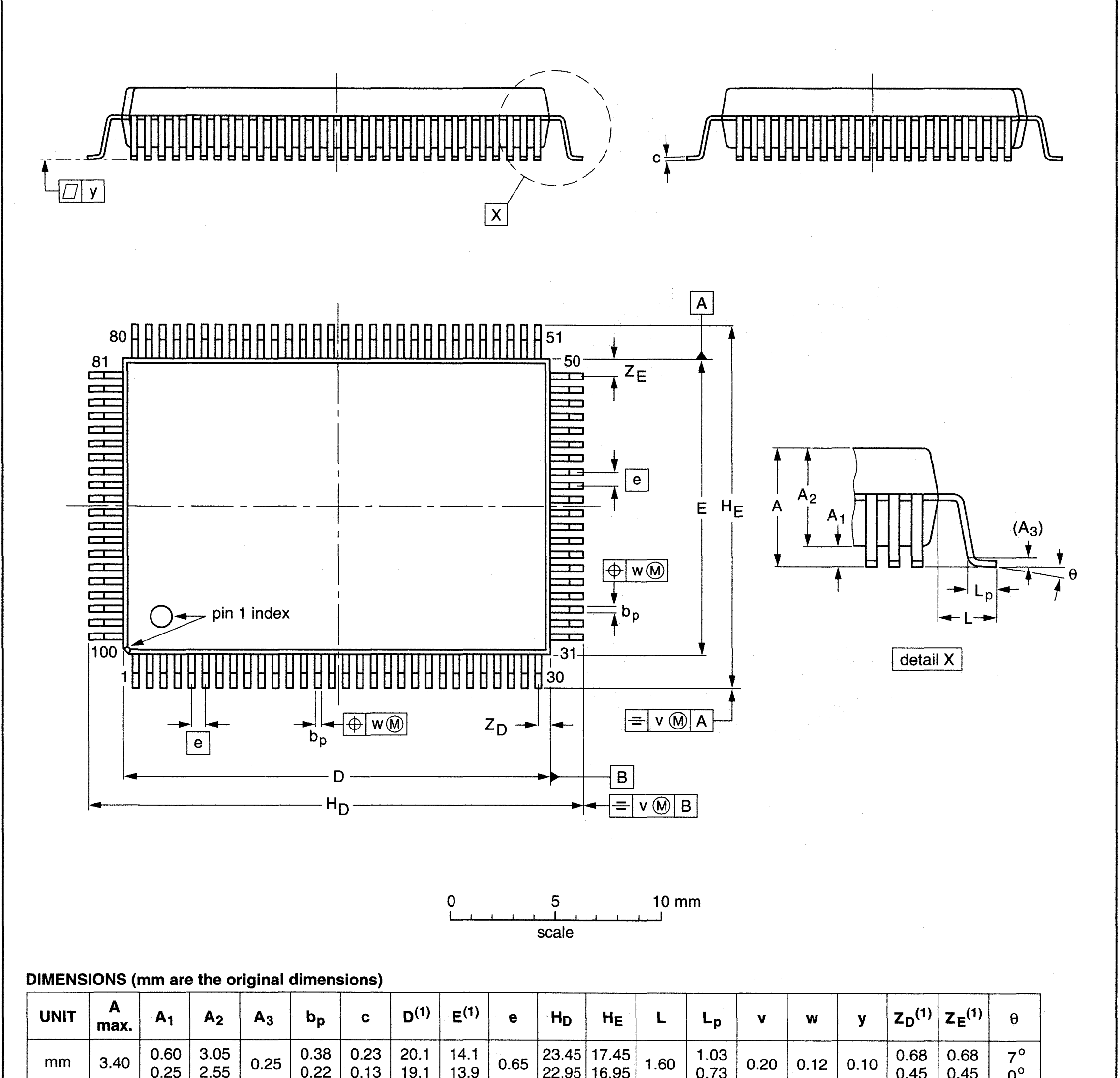
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	3.4	0.45 0.25	2.90 2.65	0.25	0.40 0.25	0.25 0.14	20.1 19.9	14.1 13.9	0.65	24.2 23.6	18.2 17.6	1.95	1.0 0.6	0.2	0.15	0.1	0.8 0.4	1.0 0.6	7° 0°

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			
SOT317-3						~~96-04-04~~ 97-08-01

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)

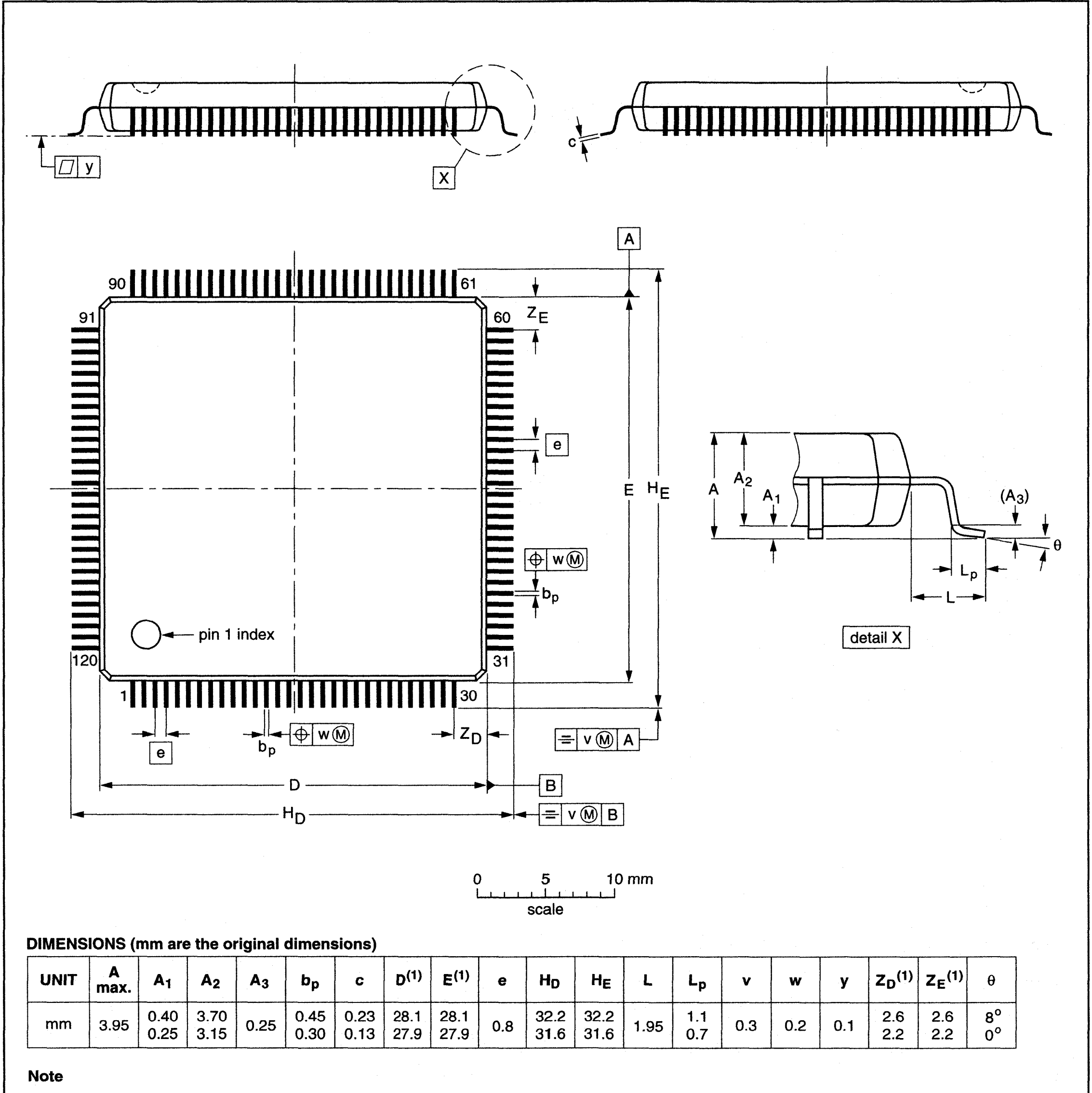
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_D	H_E	L	L_p	v	w	y	Z_D(1)	Z_E(1)	θ
mm	3.40	0.60 0.25	3.05 2.55	0.25	0.38 0.22	0.23 0.13	20.1 19.1	14.1 13.9	0.65	23.45 22.95	17.45 16.95	1.60	1.03 0.73	0.20	0.12	0.10	0.68 0.45	0.68 0.45	7° 0°

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		MO-108CC-1				~~95-02-04~~ 97-08-04

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°

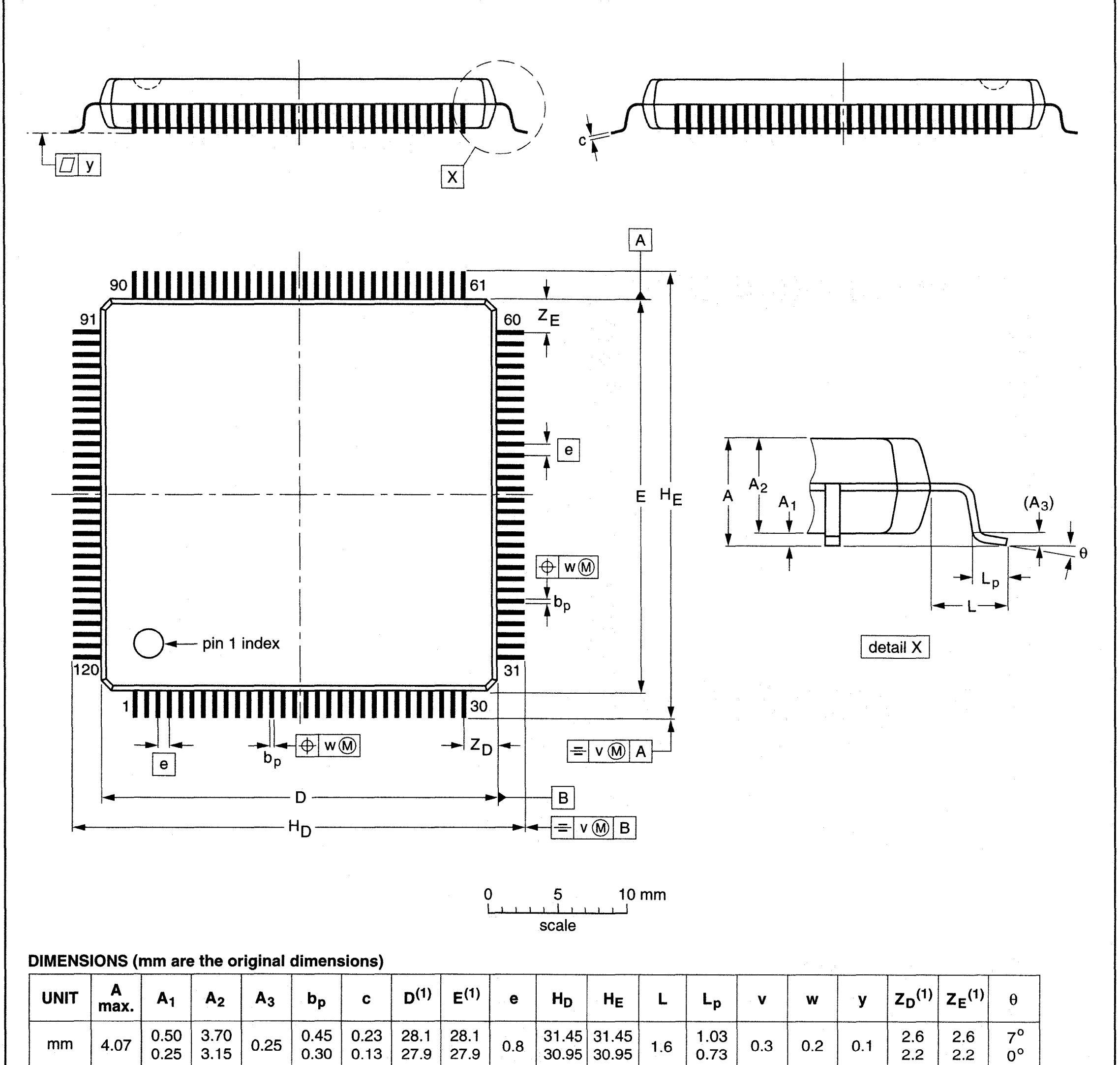
Note

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						~~95-02-04~~ 97-08-04

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)

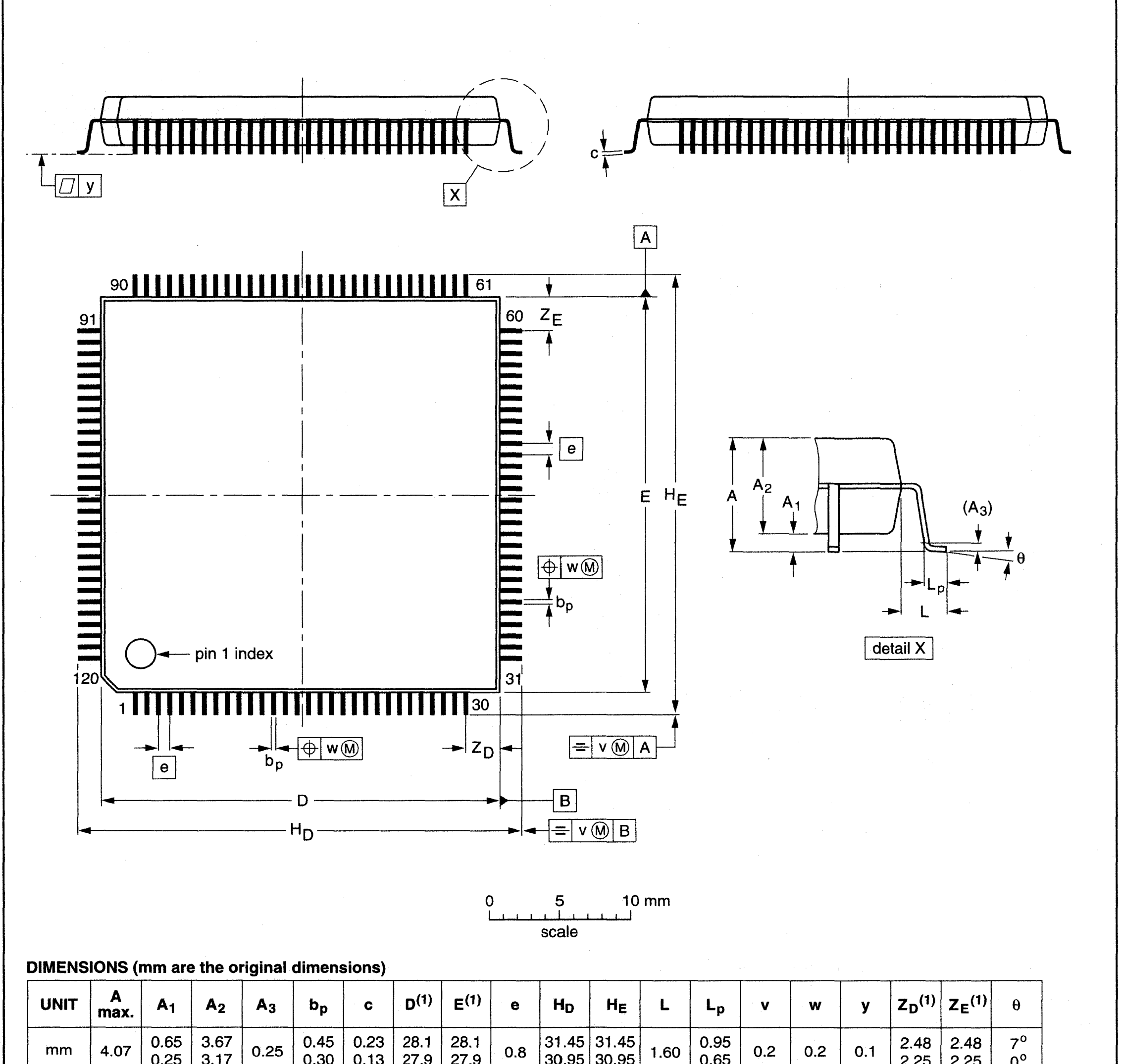
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	4.07	0.50 0.25	3.70 3.15	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	31.45 30.95	31.45 30.95	1.6	1.03 0.73	0.3	0.2	0.1	2.6 2.2	2.6 2.2	7° 0°

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						~~96-03-14~~ 97-08-04

QFP120: plastic quad flat package;
120 leads (lead length 1.6 mm); body 28 x 28 x 3.4 mm **SOT383-1**



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	4.07	0.65 0.25	3.67 3.17	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	1.60	0.95 0.65	0.2	0.2	0.1	2.48 2.25	2.48 2.25	7° 0°

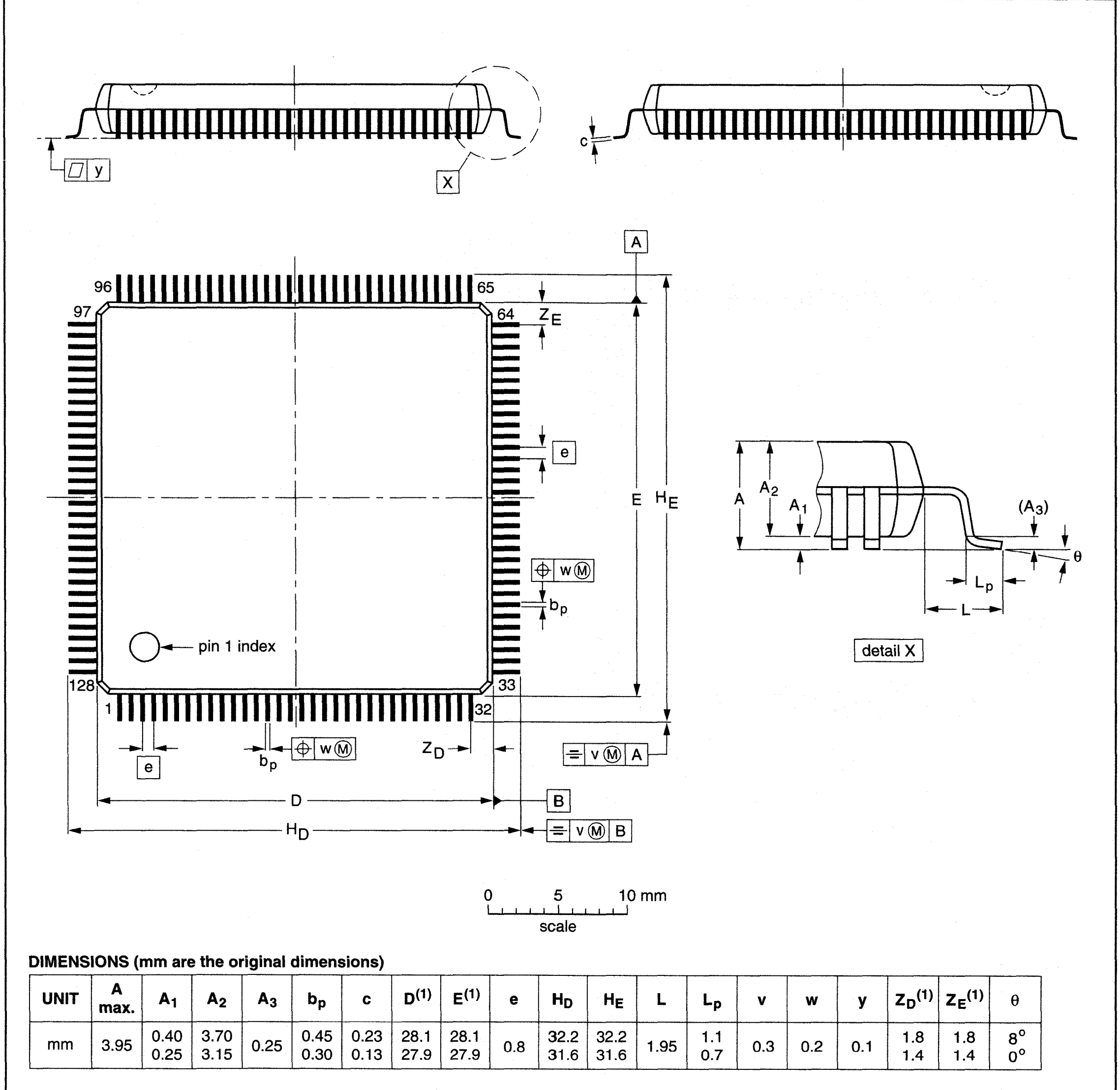
Note

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			
SOT383-1		MO-108-1990				~~95-02-25~~ 97-08-04

QFP128: plastic quad flat package; 128 leads (lead length 1.95 mm); body 28 x 28 x 3.4 mm; high stand-off height

SOT320-1



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	1.8 1.4	1.8 1.4	8° 0°

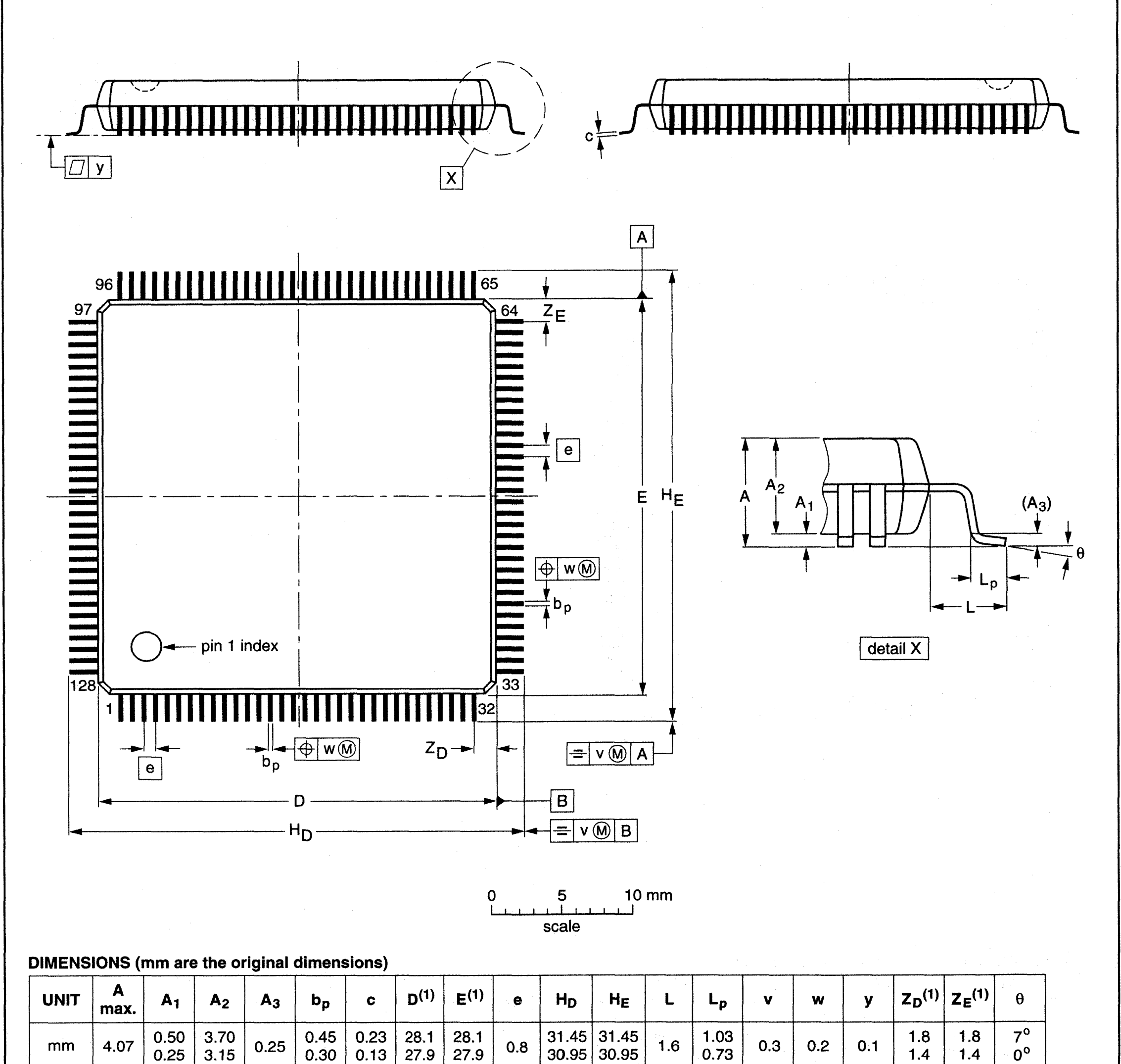
Note

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			
SOT320-1						~~95-02-04~~ 97-08-01

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)

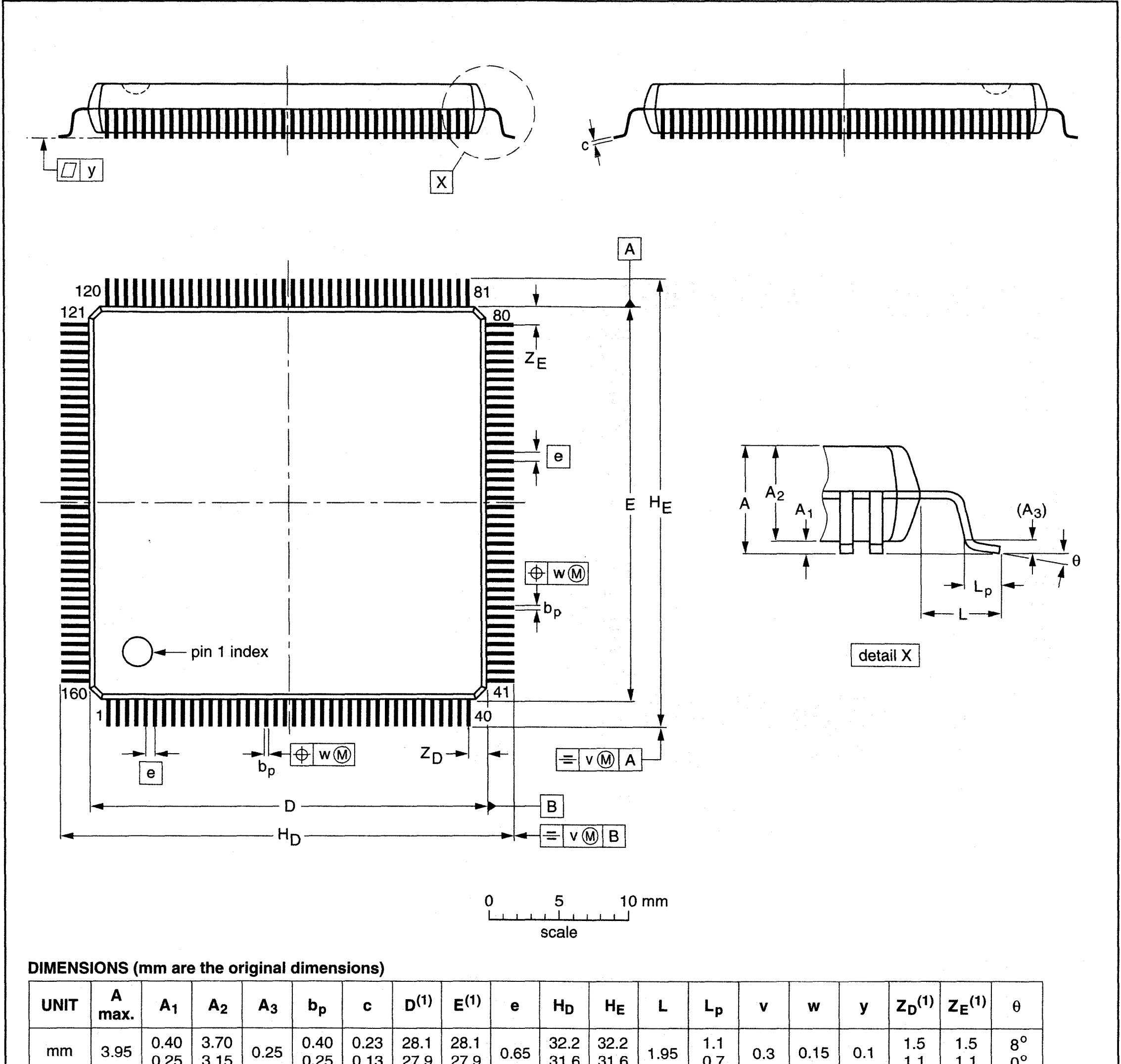
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	4.07	0.50 0.25	3.70 3.15	0.25	0.45 0.30	0.23 0.13	28.1 27.9	28.1 27.9	0.8	31.45 30.95	31.45 30.95	1.6	1.03 0.73	0.3	0.2	0.1	1.8 1.4	1.8 1.4	7° 0°

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						~~96-03-14~~ 97-08-04

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)

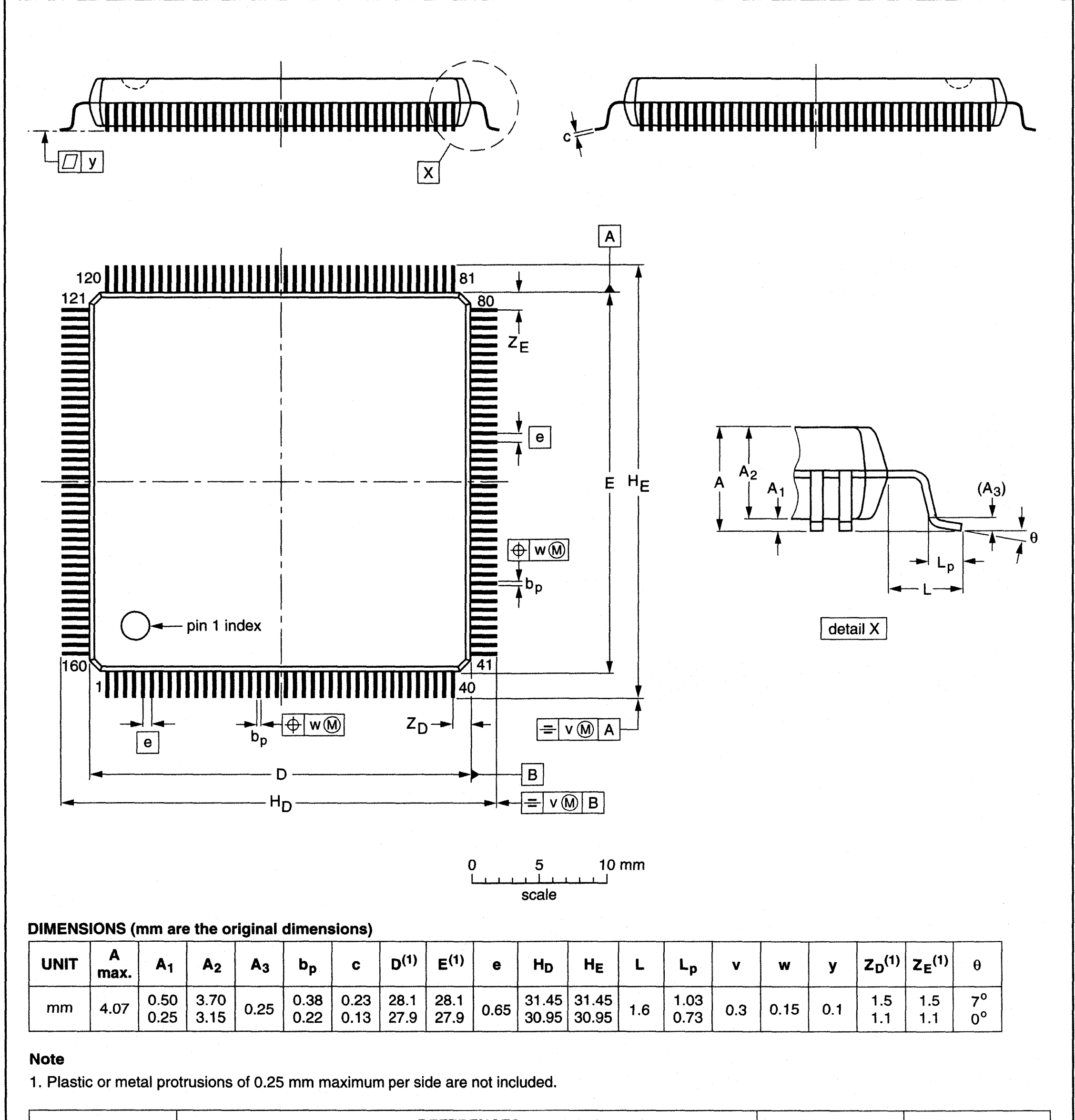
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_D	H_E	L	L_p	v	w	y	Z_D(1)	Z_E(1)	θ
mm	3.95	0.40 0.25	3.70 3.15	0.25	0.40 0.25	0.23 0.13	28.1 27.9	28.1 27.9	0.65	32.2 31.6	32.2 31.6	1.95	1.1 0.7	0.3	0.15	0.1	1.5 1.1	1.5 1.1	8° 0°

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		MO112DD1				~~95-02-04~~ 97-08-04

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)

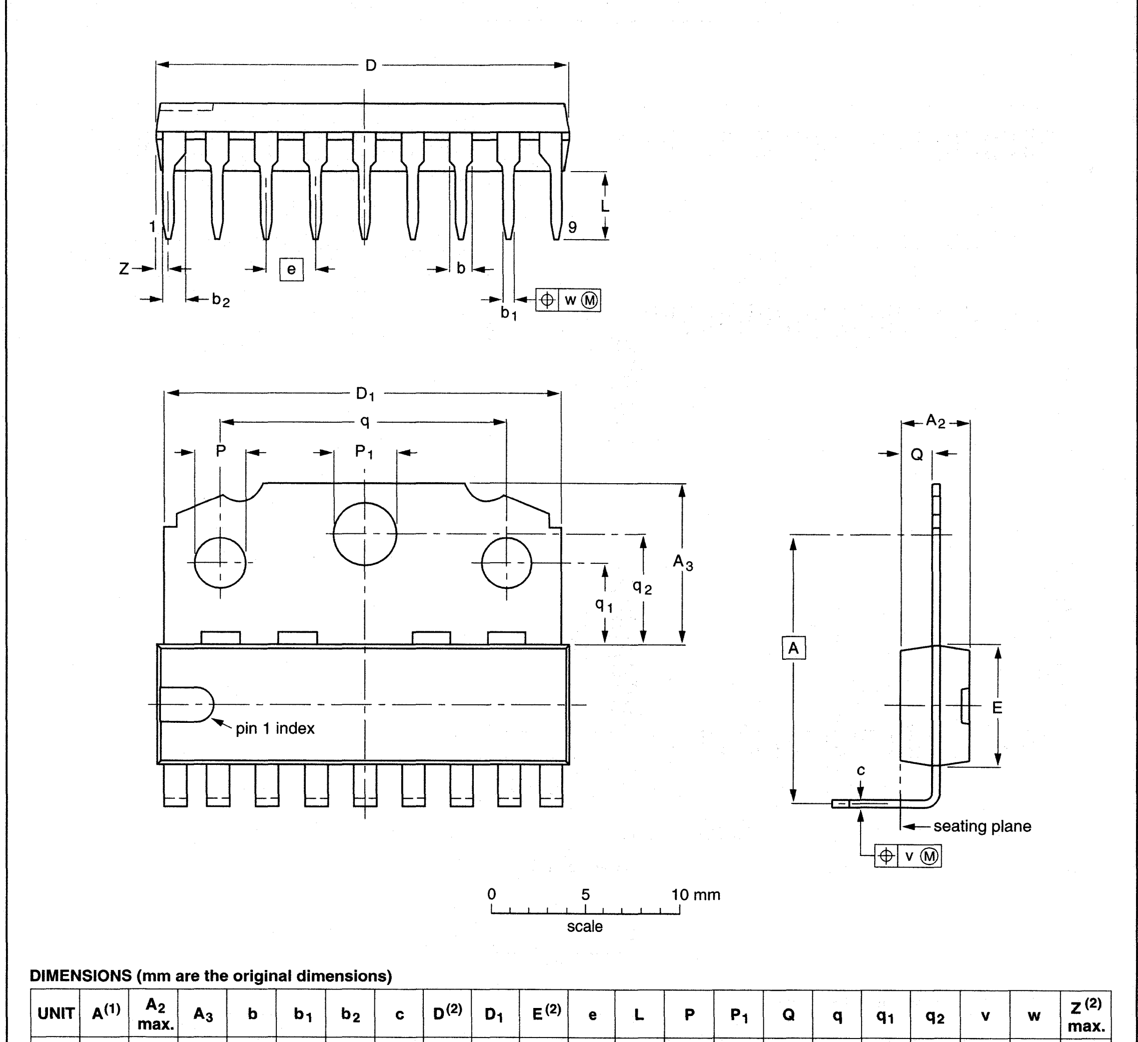
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	4.07	0.50 0.25	3.70 3.15	0.25	0.38 0.22	0.23 0.13	28.1 27.9	28.1 27.9	0.65	31.45 30.95	31.45 30.95	1.6	1.03 0.73	0.3	0.15	0.1	1.5 1.1	1.5 1.1	7° 0°

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		MO112DD1				~~96-03-14~~ 97-08-04

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

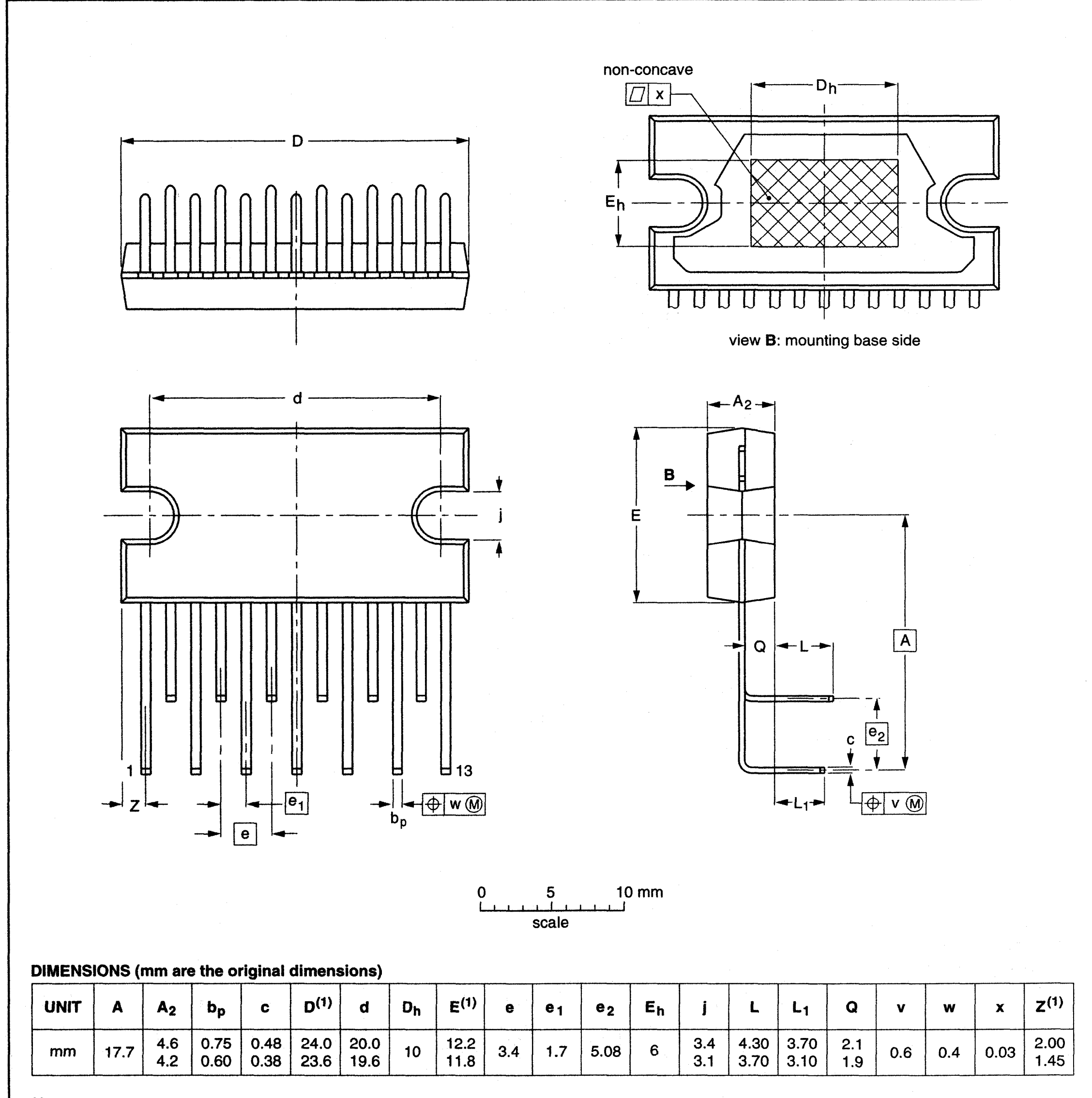
Note

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

IC package range and dimensions Chapter 2

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 4.2	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	4.30 3.70	3.70 3.10	2.1 1.9	0.6	0.4	0.03	2.00 1.45

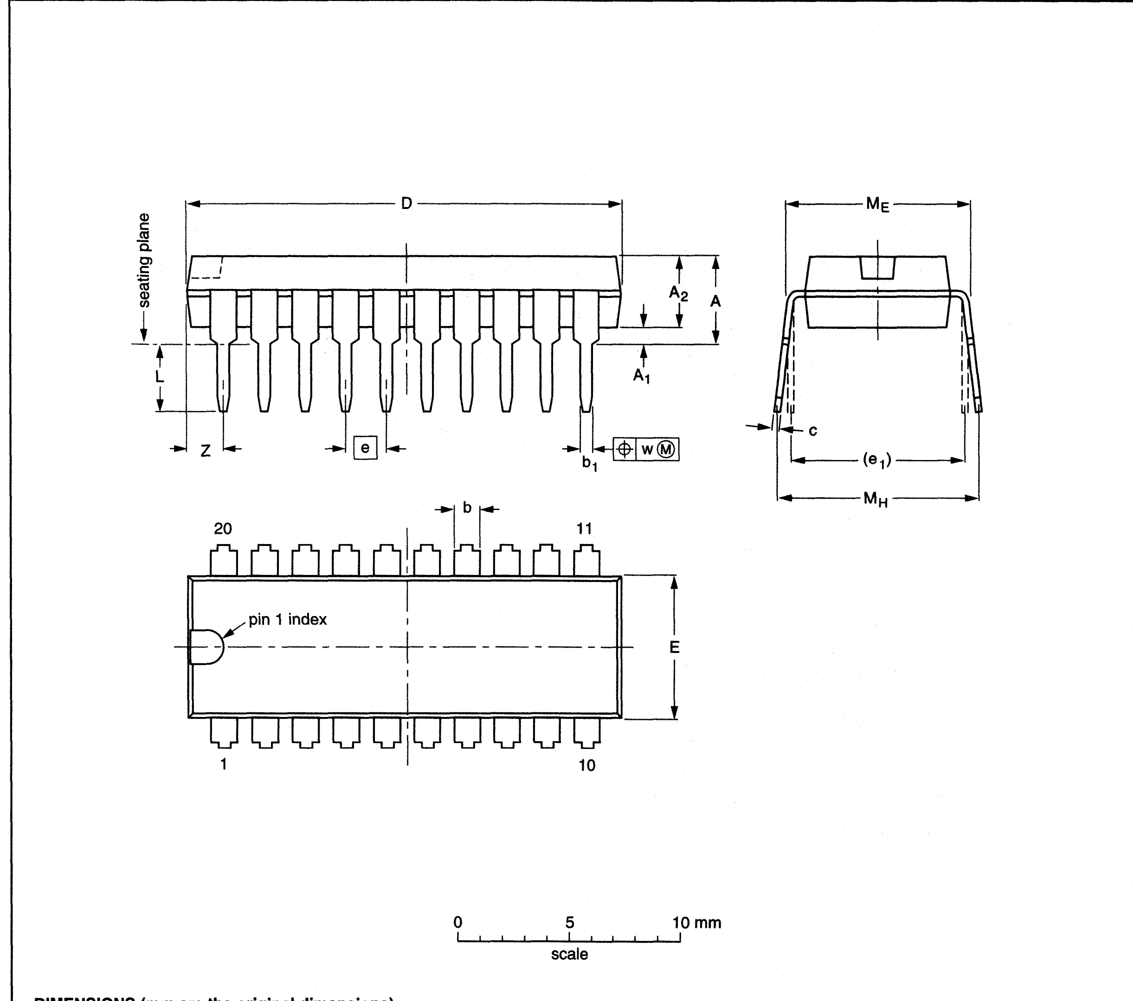
Note

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						97-06-05

IC package range and dimensions Chapter 2

SDIP20: plastic shrink dual in-line package; 20 leads (300 mil) SOT325-1



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	4.2	0.51	3.2	1.3 1.0	0.53 0.38	0.32 0.20	19.50 18.55	6.48 6.14	1.778	7.62	3.2 2.8	8.25 7.80	10.0 8.3	0.18	1.9

Note

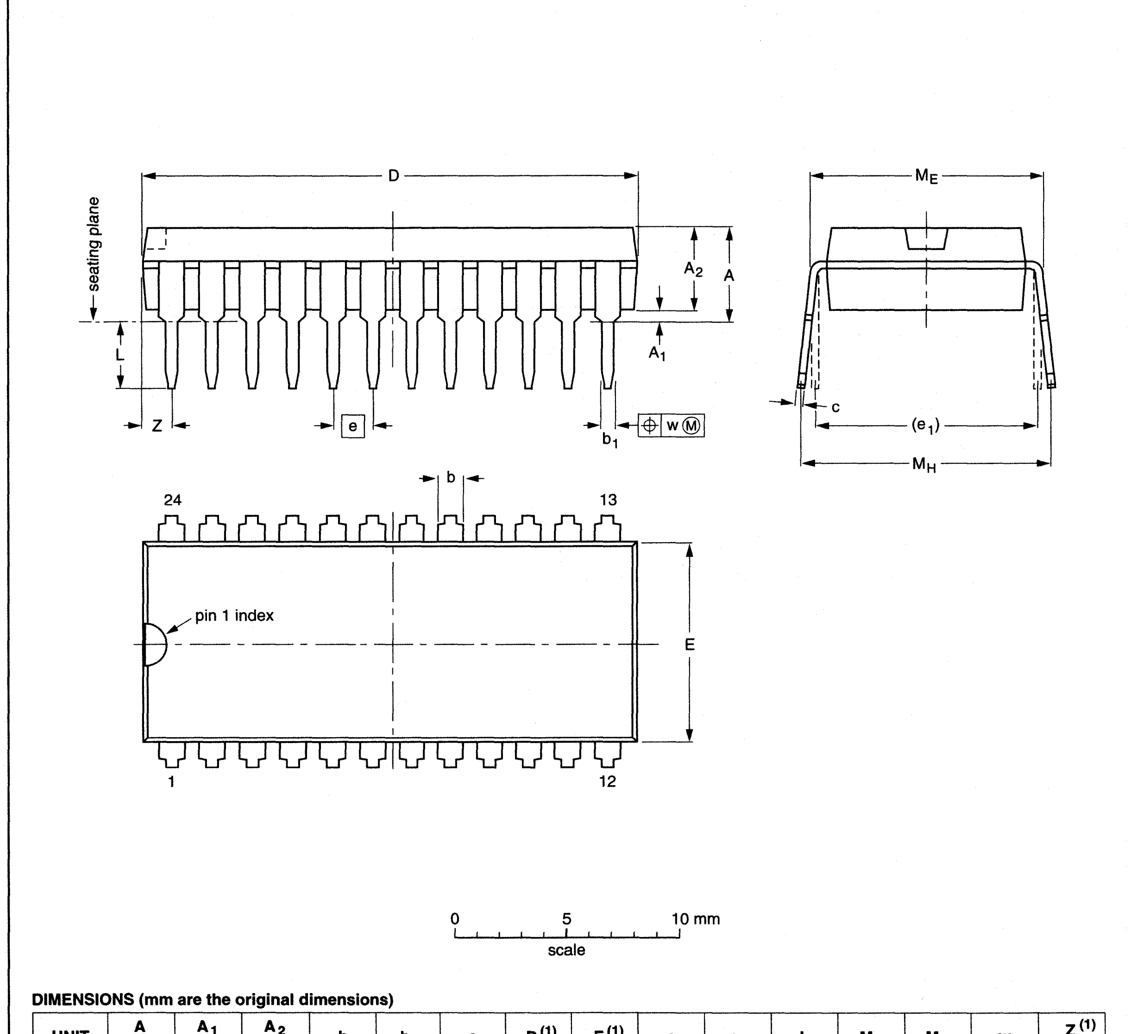
1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT325-1						~~92-10-13~~ 95-02-04

IC package range and dimensions

Chapter 2

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

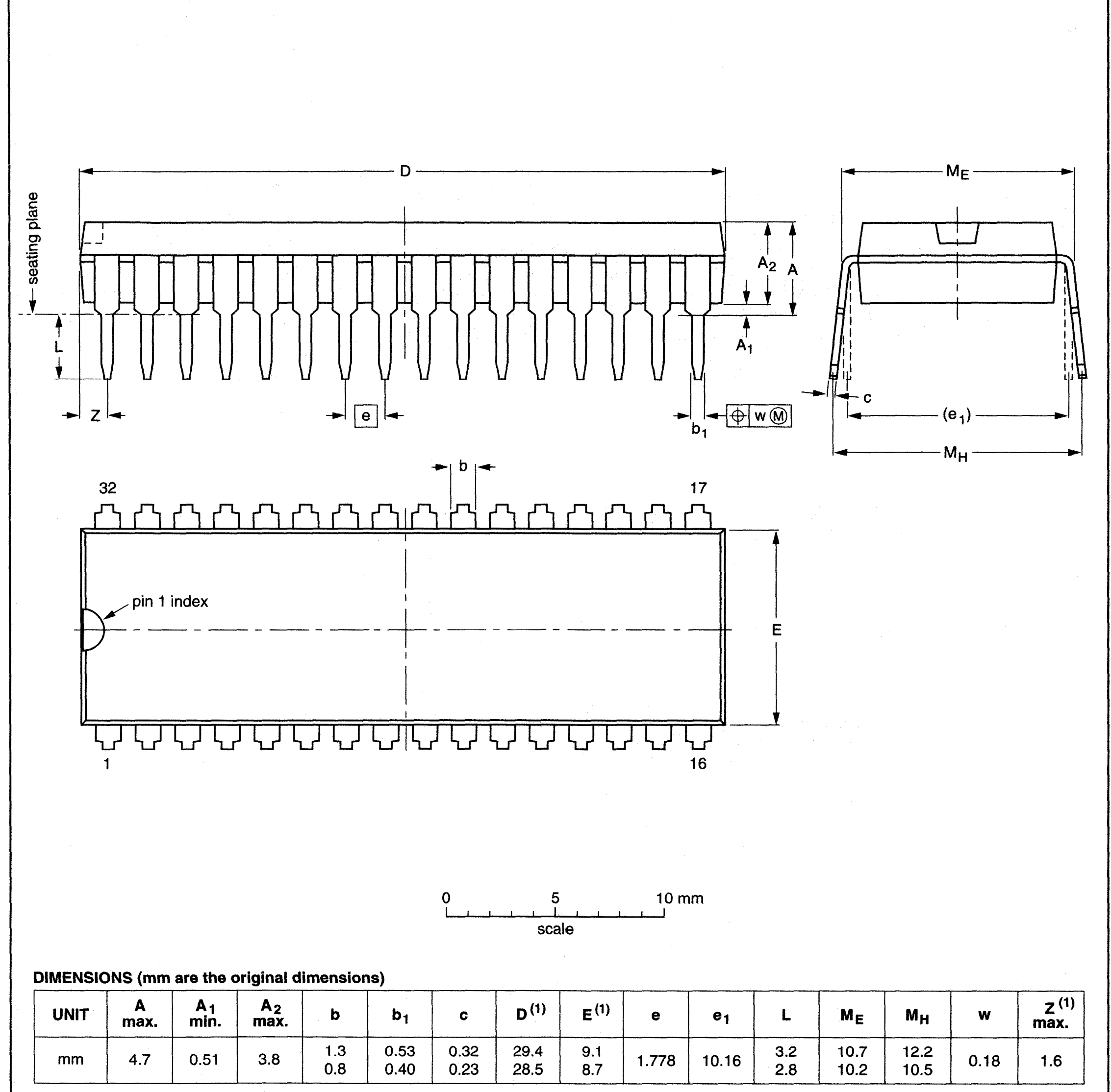
Note

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

IC package range and dimensions | Chapter 2

SDIP32: plastic shrink dual in-line package; 32 leads (400 mil) | SOT232-1



DIMENSIONS (mm are the original dimensions)

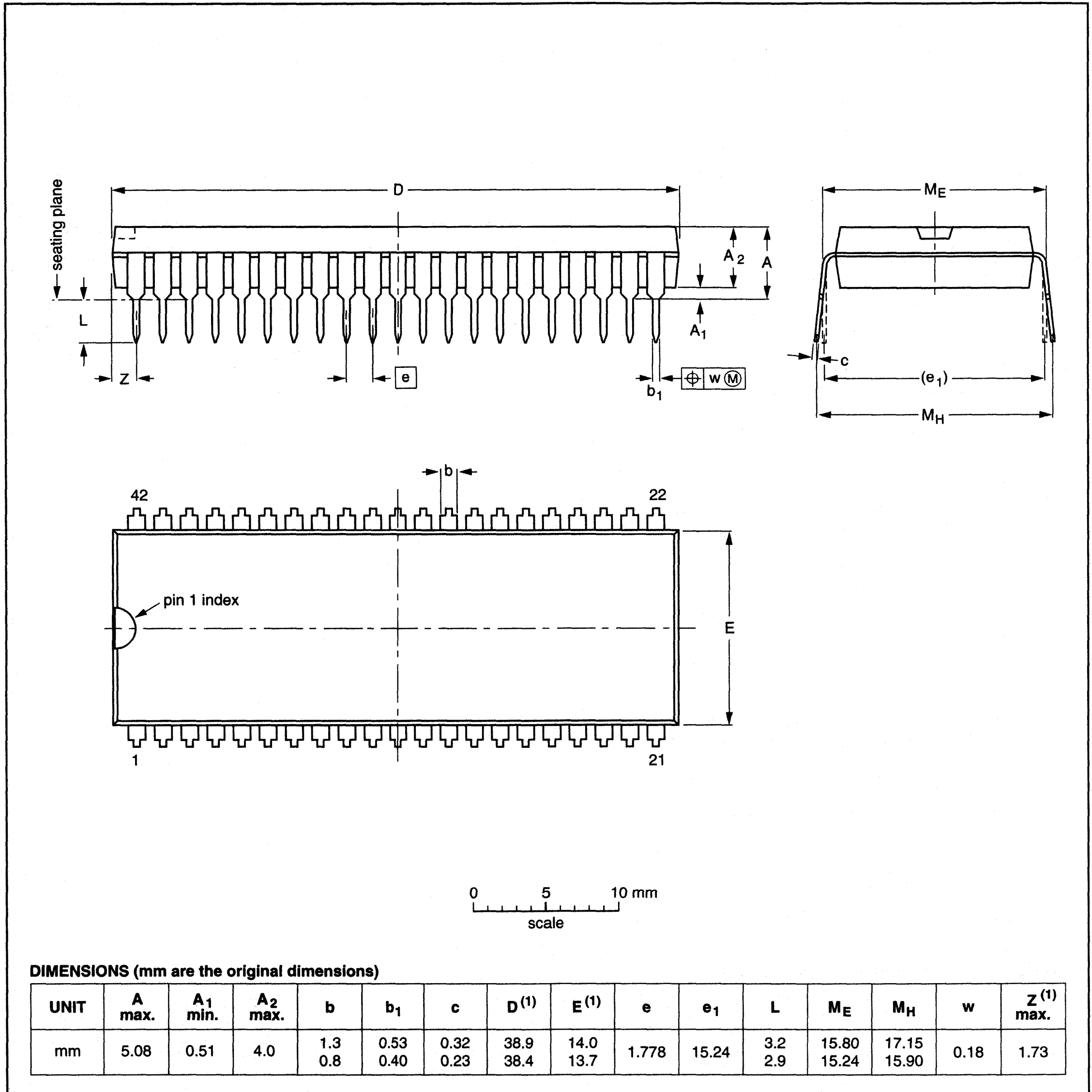
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	29.4 28.5	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

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			
SOT232-1						~~92-11-17~~ 95-02-04

SDIP42: plastic shrink dual in-line package; 42 leads (600 mil) SOT270-1



DIMENSIONS (mm are the original dimensions)

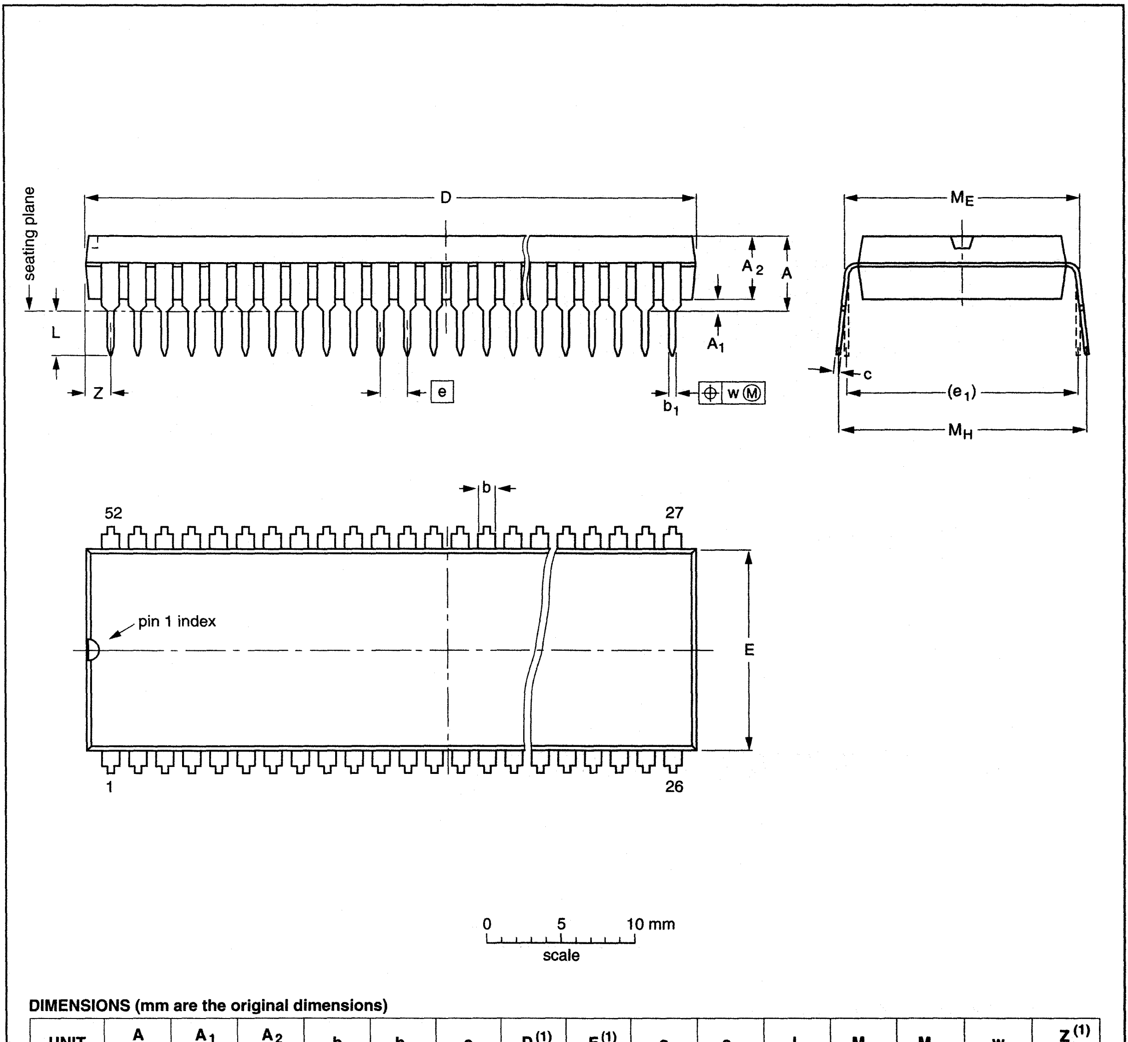
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	$D^{(1)}$	$E^{(1)}$	e	e_1	L	M_E	M_H	w	$Z^{(1)}$ max.
mm	5.08	0.51	4.0	1.3 0.8	0.53 0.40	0.32 0.23	38.9 38.4	14.0 13.7	1.778	15.24	3.2 2.9	15.80 15.24	17.15 15.90	0.18	1.73

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						~~90-02-13~~ 95-02-04

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

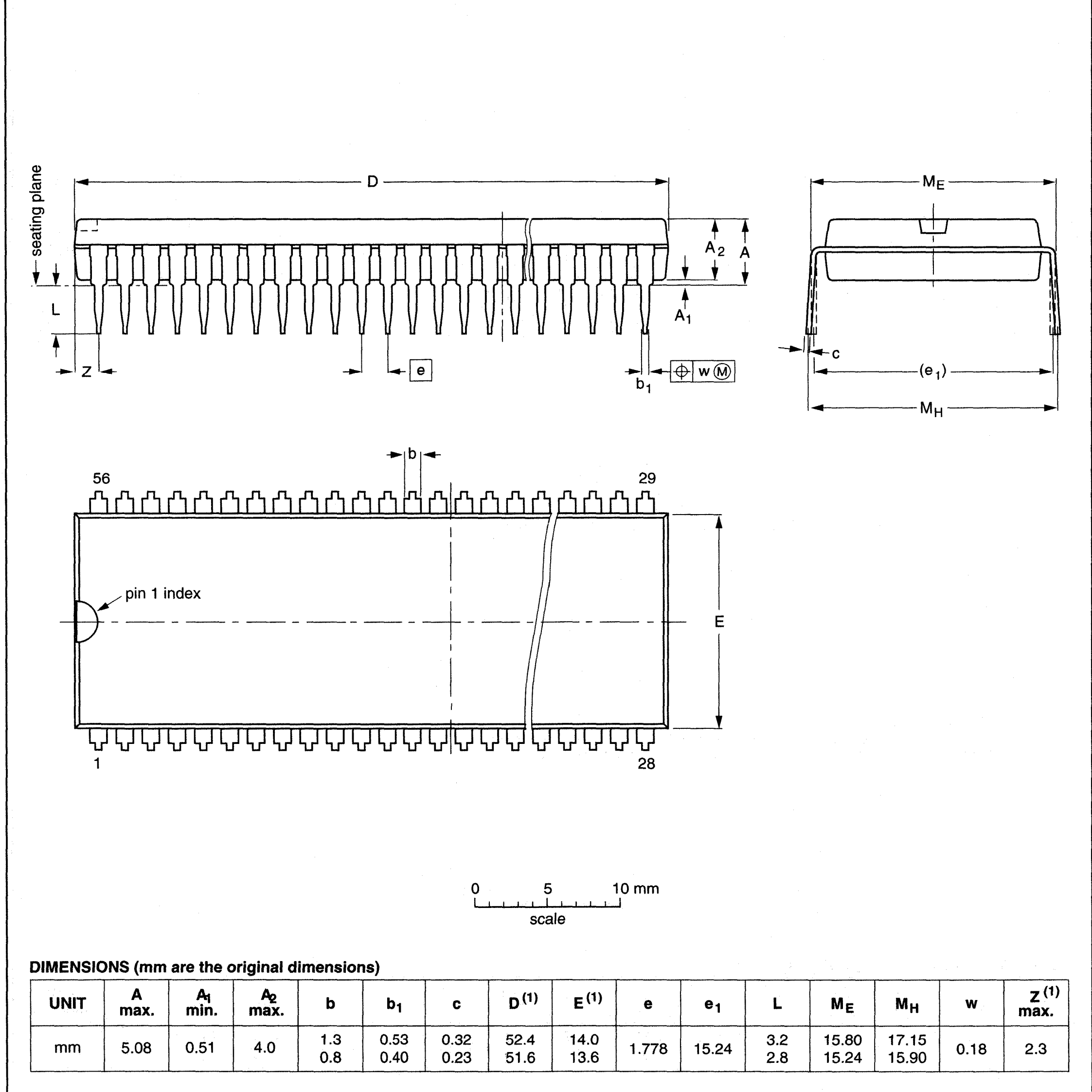
Note

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						~~90-01-22~~ 95-03-11

IC package range and dimensions Chapter 2

SDIP56: plastic shrink dual in-line package; 56 leads (600 mil) SOT400-1



DIMENSIONS (mm are the original dimensions)

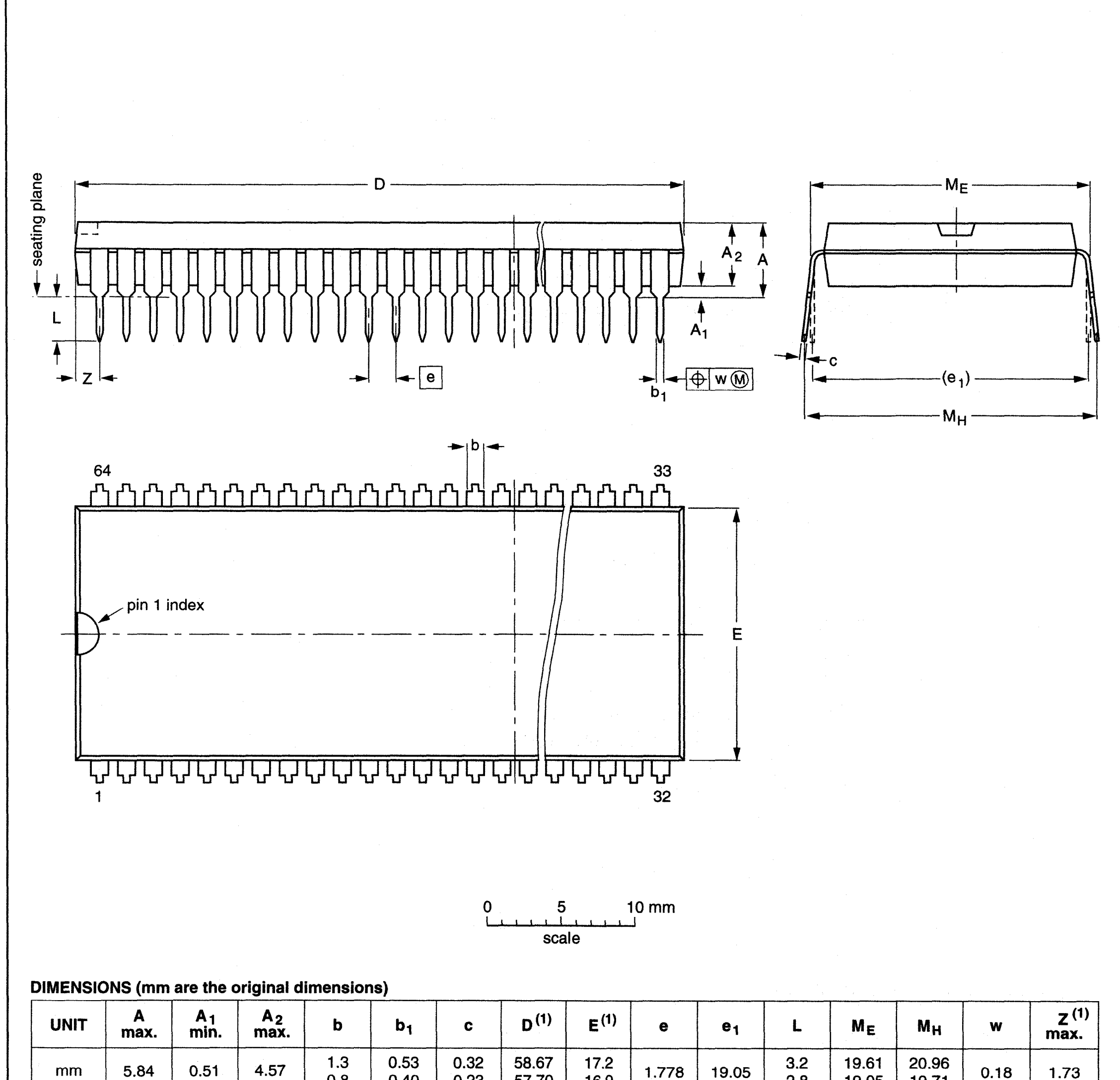
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.08	0.51	4.0	1.3 0.8	0.53 0.40	0.32 0.23	52.4 51.6	14.0 13.6	1.778	15.24	3.2 2.8	15.80 15.24	17.15 15.90	0.18	2.3

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

SDIP64: plastic shrink dual in-line package; 64 leads (750 mil) **SOT274-1**



DIMENSIONS (mm are the original dimensions)

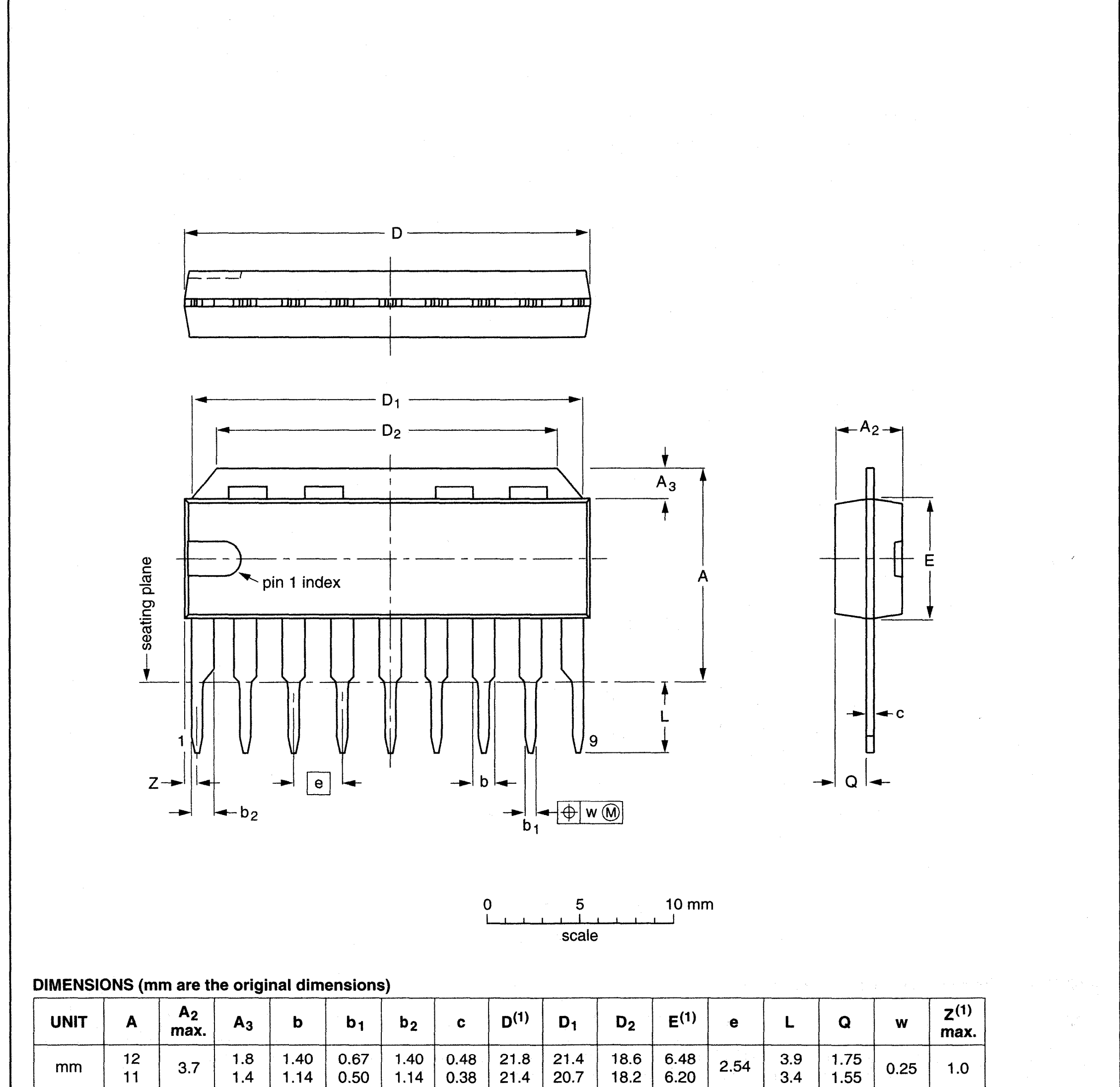
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.84	0.51	4.57	1.3 0.8	0.53 0.40	0.32 0.23	58.67 57.70	17.2 16.9	1.778	19.05	3.2 2.8	19.61 19.05	20.96 19.71	0.18	1.73

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						~~92-10-13~~ 95-02-04

SIL9MP: plastic single in-line medium power package; 9 leads **SOT142-1**



DIMENSIONS (mm are the original dimensions)

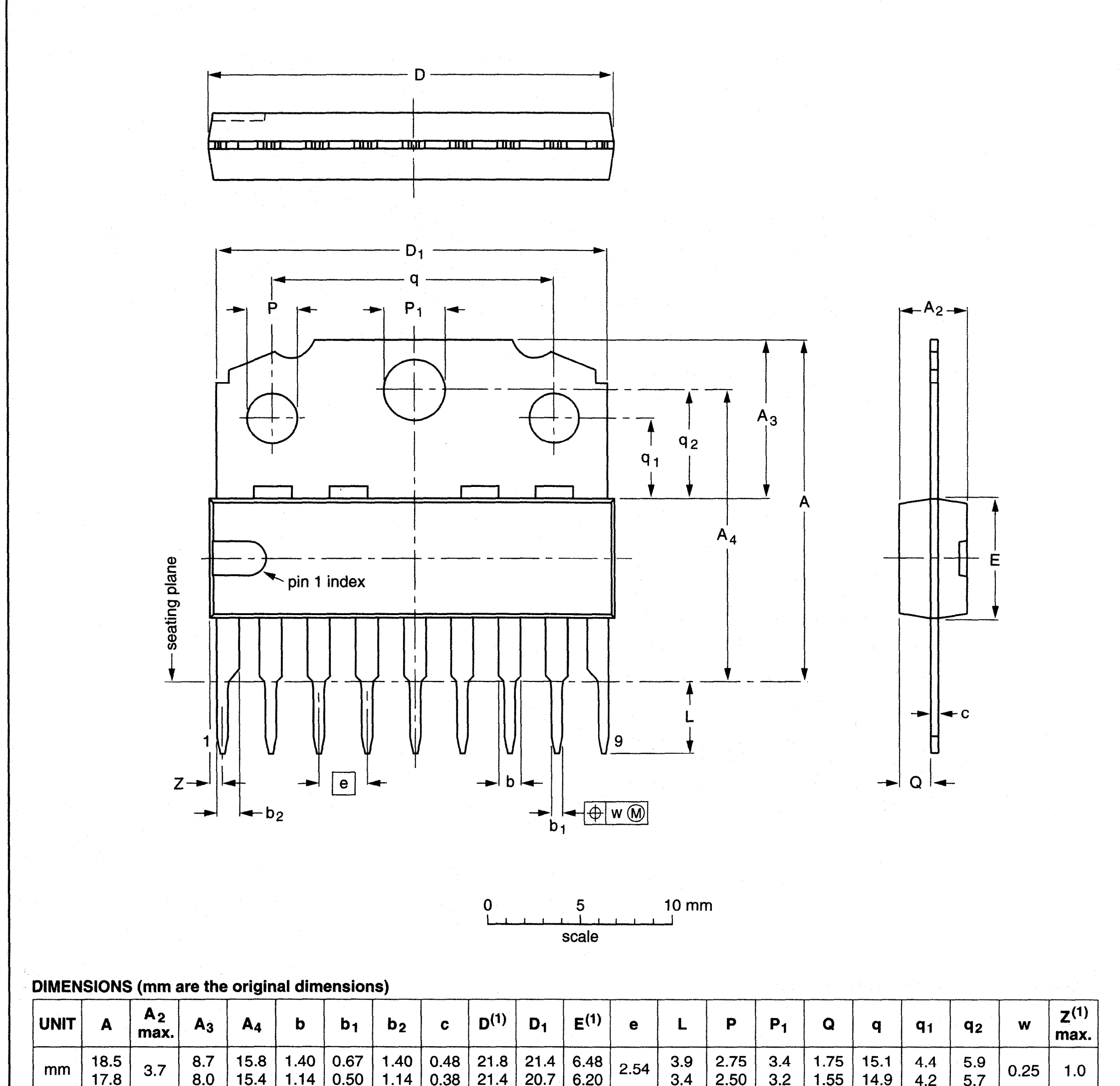
UNIT	A	A_2 max.	A_3	b	b_1	b_2	c	D(1)	D_1	D_2	E(1)	e	L	Q	w	Z(1) max.
mm	12 11	3.7	1.8 1.4	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	18.6 18.2	6.48 6.20	2.54	3.9 3.4	1.75 1.55	0.25	1.0

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)

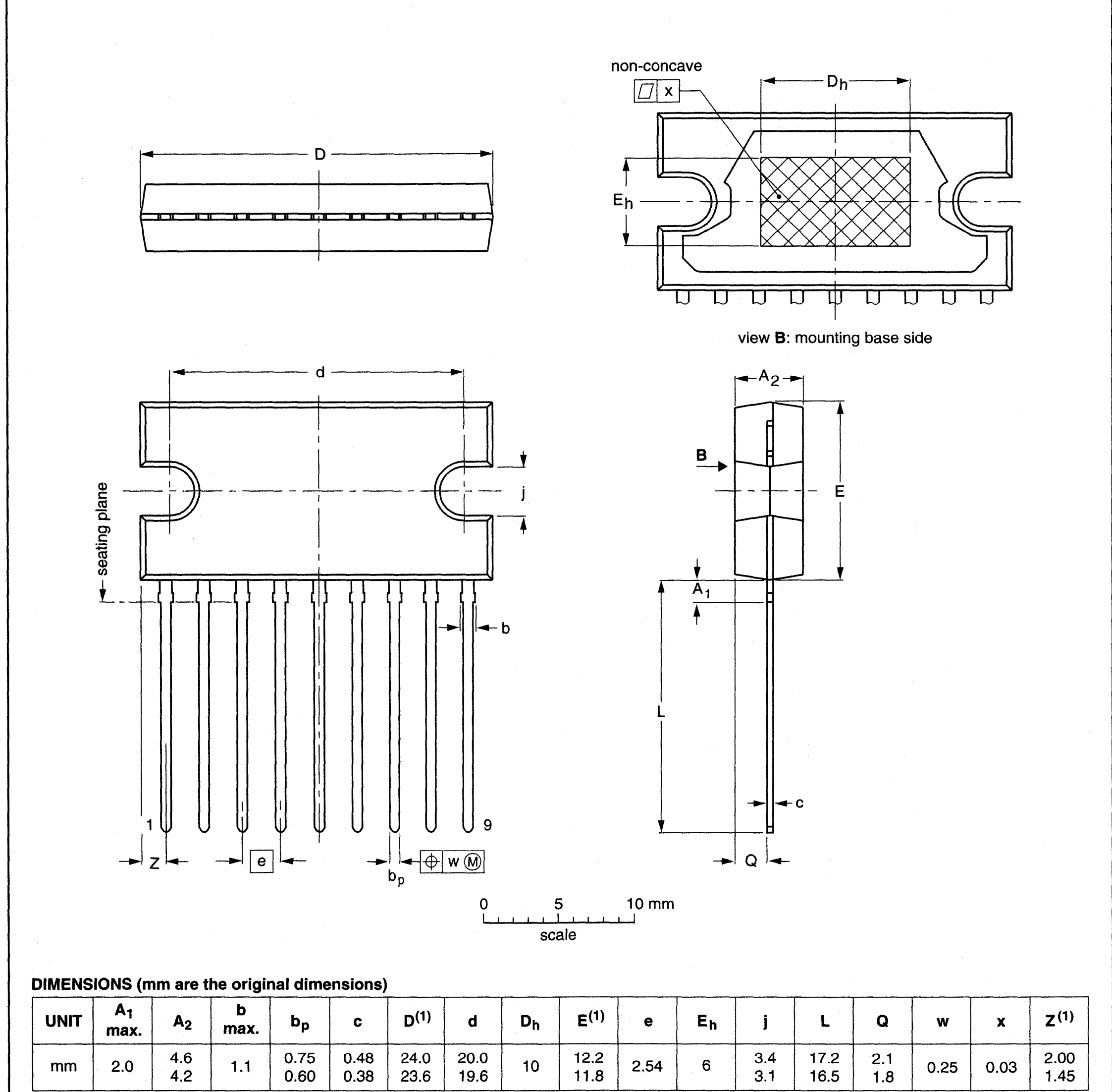
UNIT	A	A_2 max.	A_3	A_4	b	b_1	b_2	c	$D^{(1)}$	D_1	$E^{(1)}$	e	L	P	P_1	Q	q	q_1	q_2	w	$Z^{(1)}$ max.
mm	18.5 17.8	3.7	8.7 8.0	15.8 15.4	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	3.9 3.4	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.25	1.0

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)

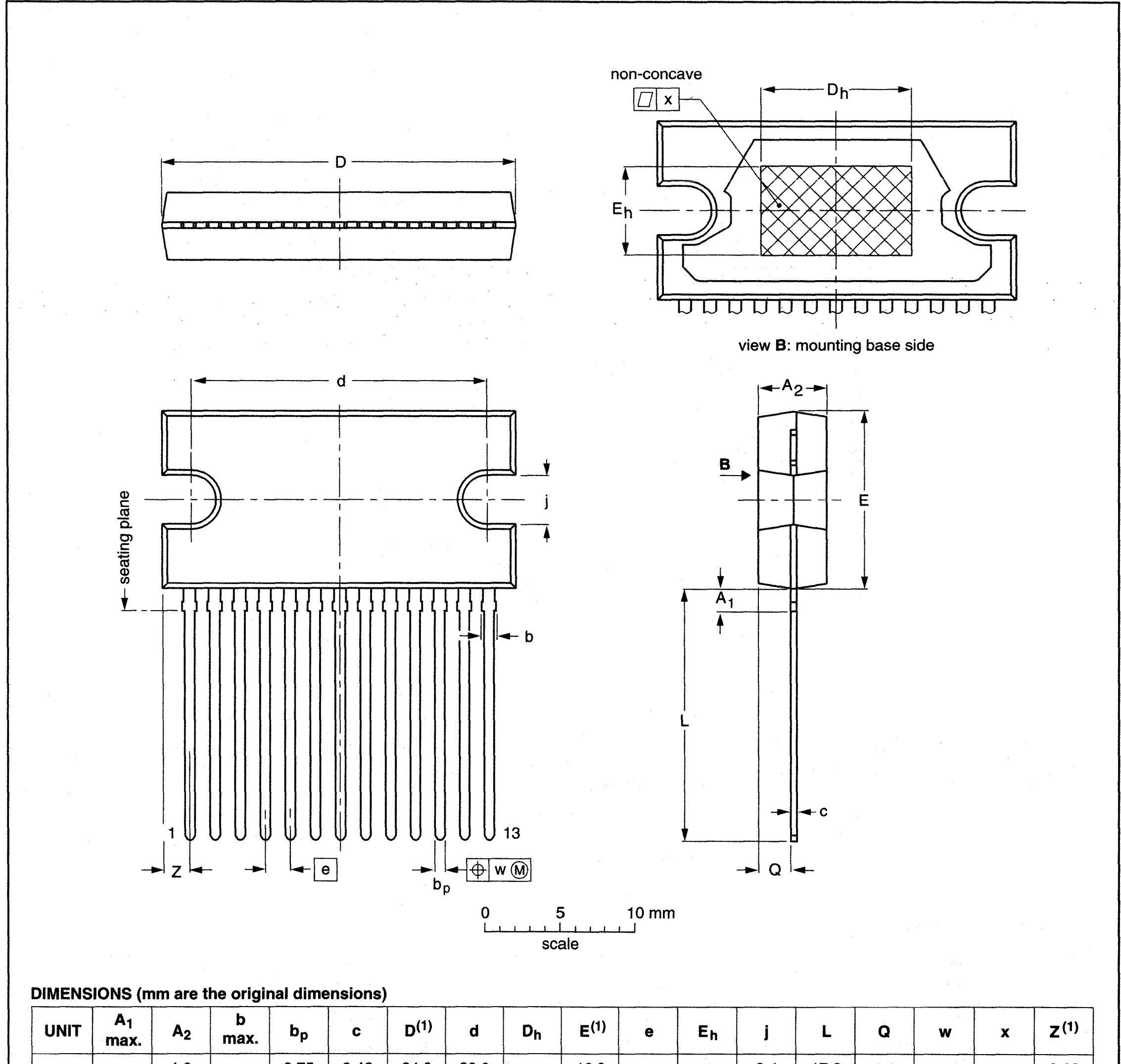
UNIT	A_1 max.	A_2	b max.	b_p	c	D(1)	d	D_h	E(1)	e	E_h	j	L	Q	w	x	Z(1)
mm	2.0	4.6 4.2	1.1	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	6	3.4 3.1	17.2 16.5	2.1 1.8	0.25	0.03	2.00 1.45

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						~~92-11-17~~ 95-03-11

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 4.2	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

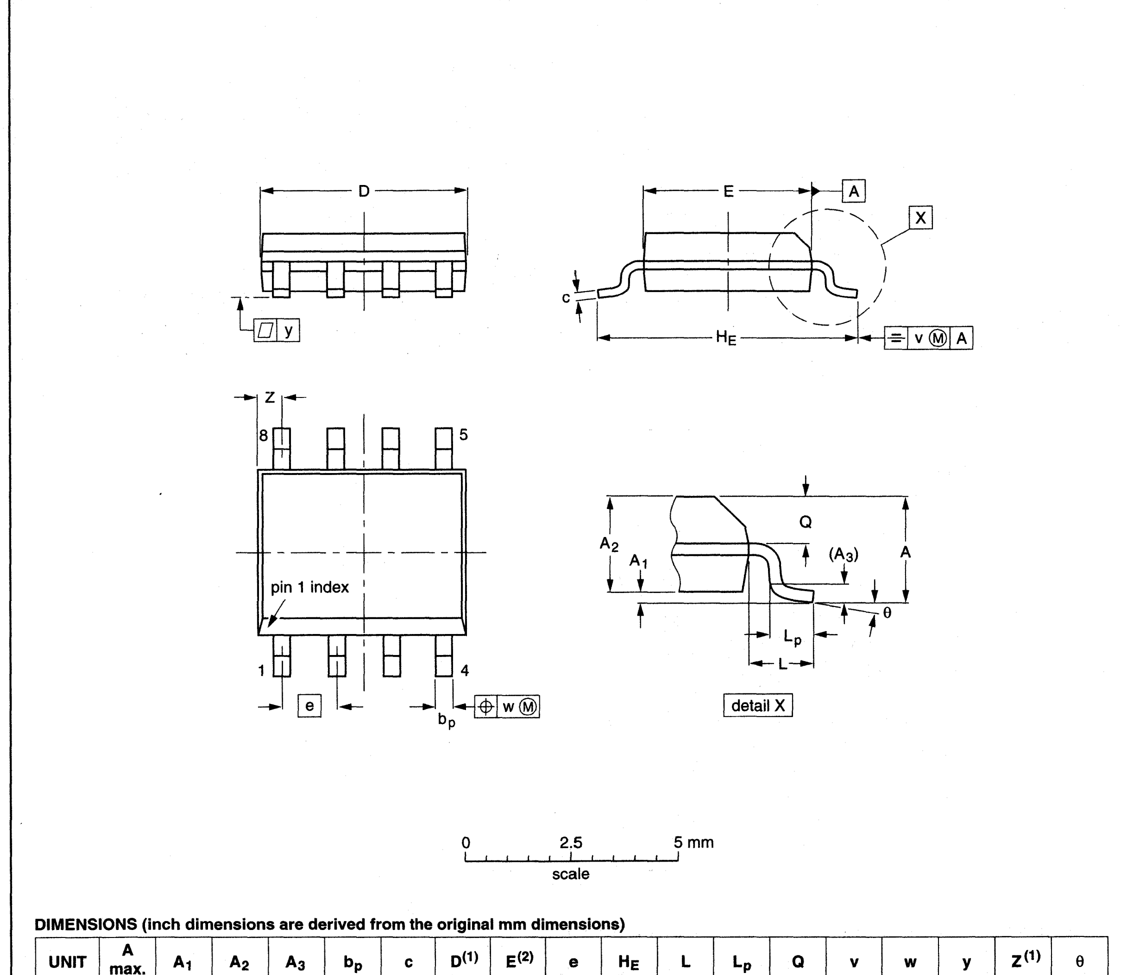
Note

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						~~95-03-11~~ 97-05-22

IC package range and dimensions Chapter 2

SO8: plastic small outline package; 8 leads; body width 3.9 mm **SOT96-1**



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

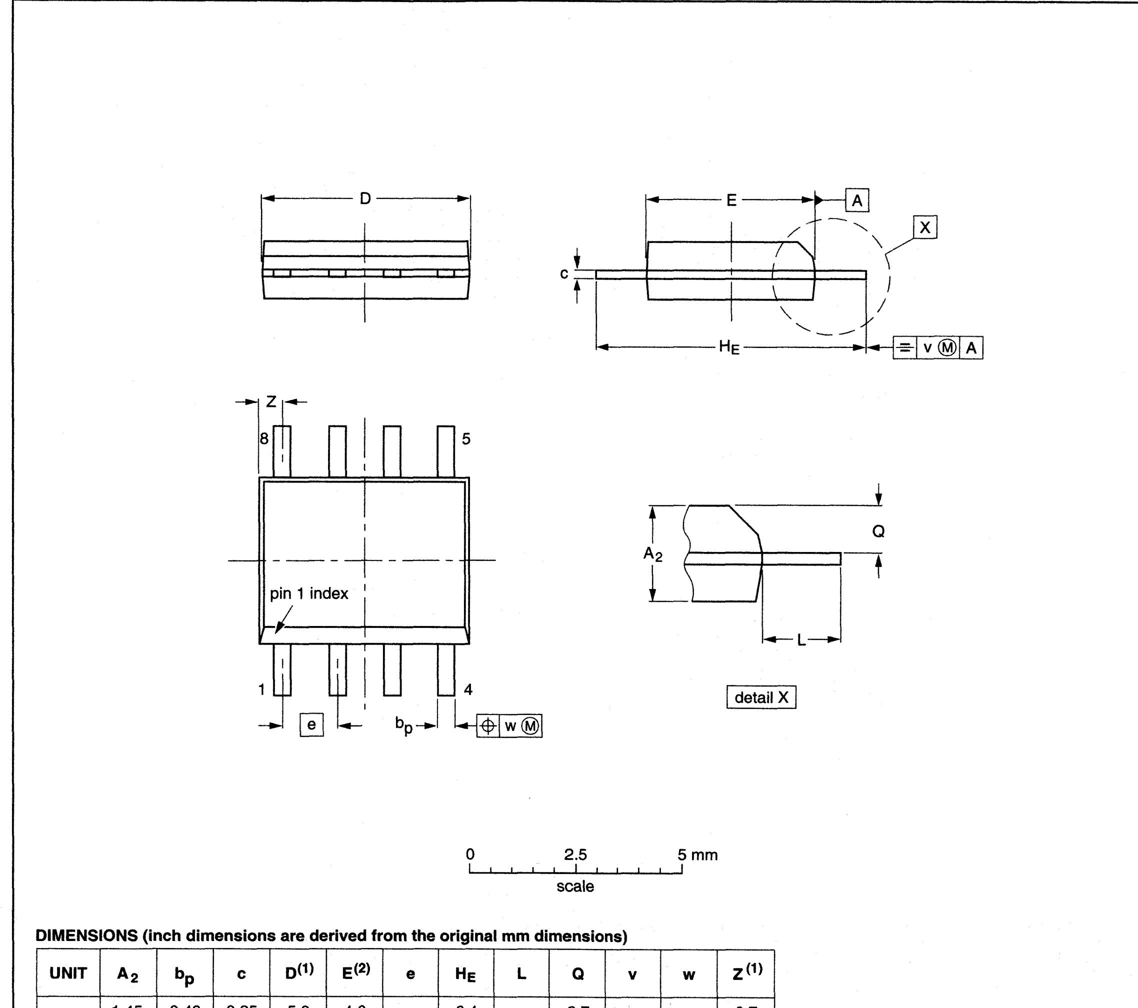
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	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	076E03S	MS-012AA				~~95-02-04~~ 97-05-22

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)

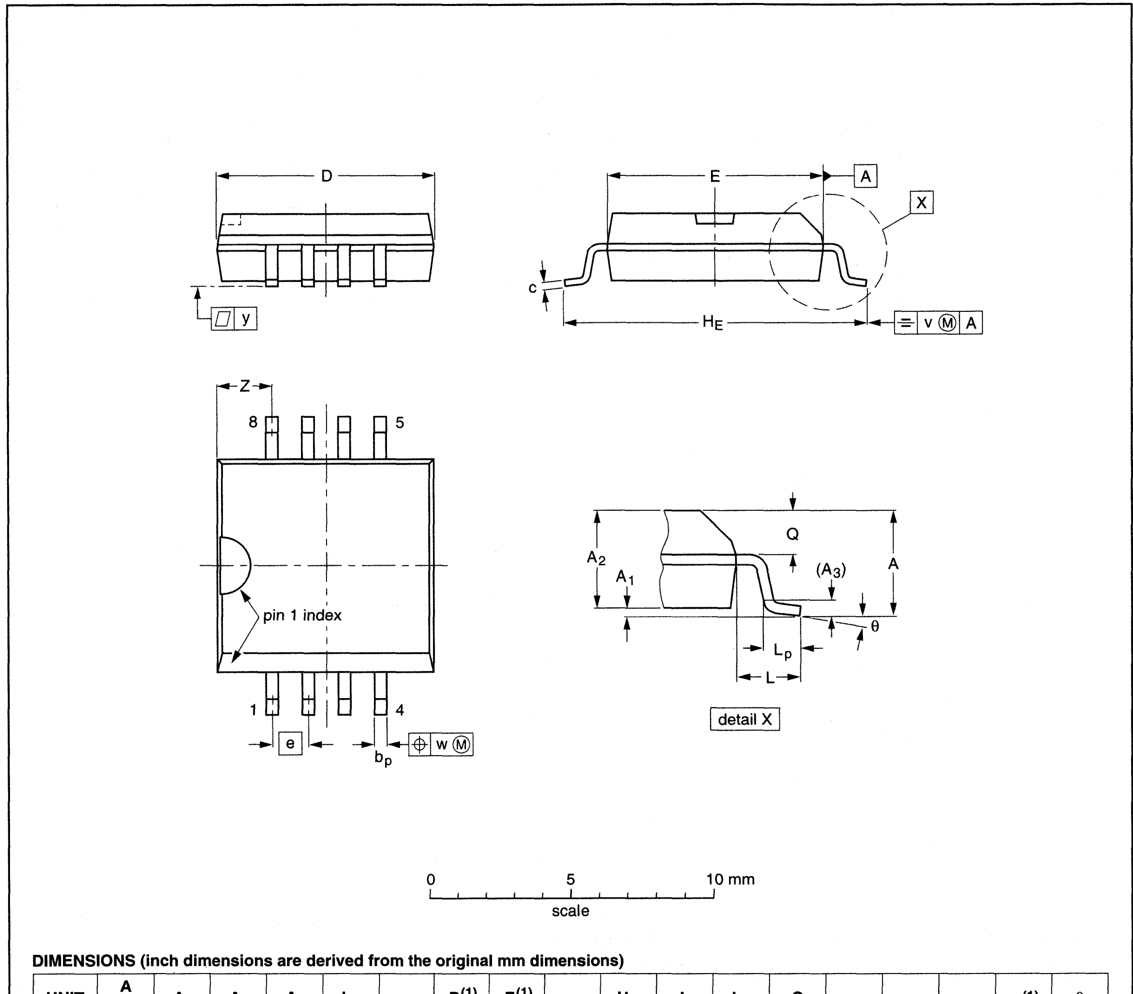
UNIT	A_2	b_p	c	D(1)	E(2)	e	H_E	L	Q	v	w	Z(1)
mm	1.45 1.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.4 6.2	1.2	0.7 0.6	0.25	0.25	0.7 0.3
inches	0.057 0.049	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.252 0.244	0.047	0.028 0.024	0.01	0.01	0.028 0.012

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)

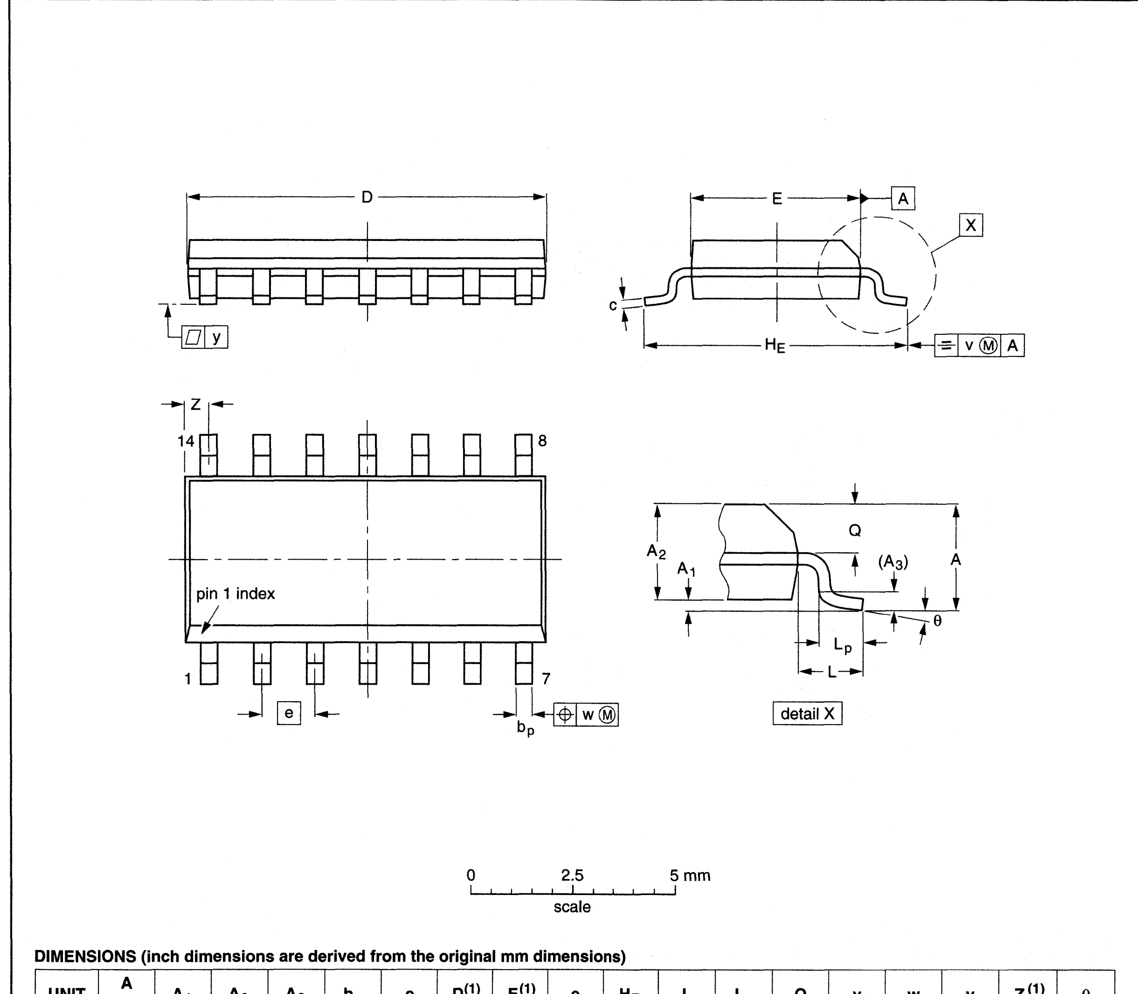
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	7.65 7.45	7.6 7.4	1.27	10.65 10.00	1.45	1.1 0.45	1.1 1.0	0.25	0.25	0.1	2.0 1.8	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.30 0.29	0.30 0.29	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

SO14: plastic small outline package; 14 leads; body width 3.9 mm — SOT108-1



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

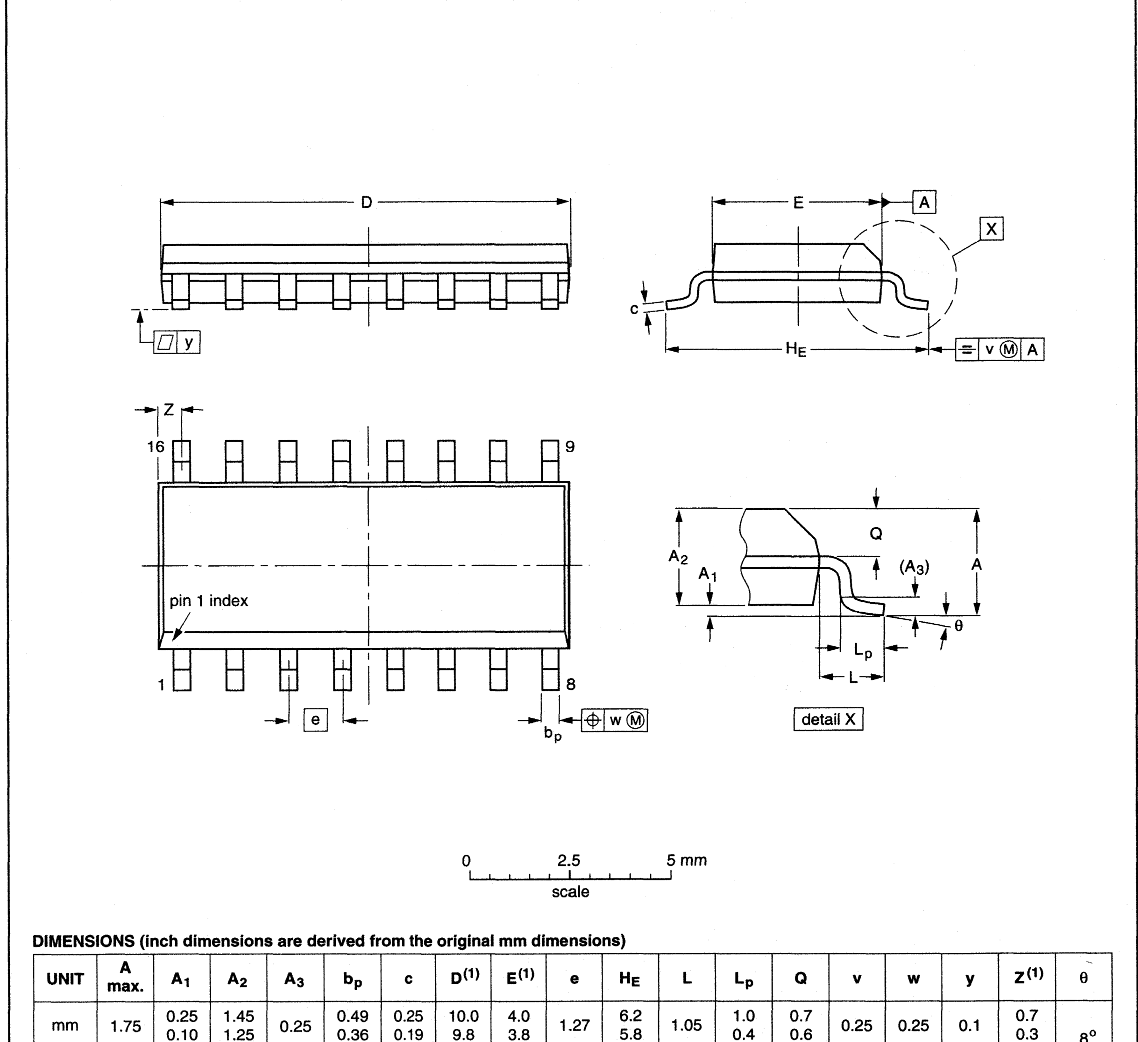
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.050	0.244 0.228	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			
SOT108-1	076E06S	MS-012AB				~~95-01-23~~ 97-05-22

SO16: plastic small outline package; 16 leads; body width 3.9 mm SOT109-1



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

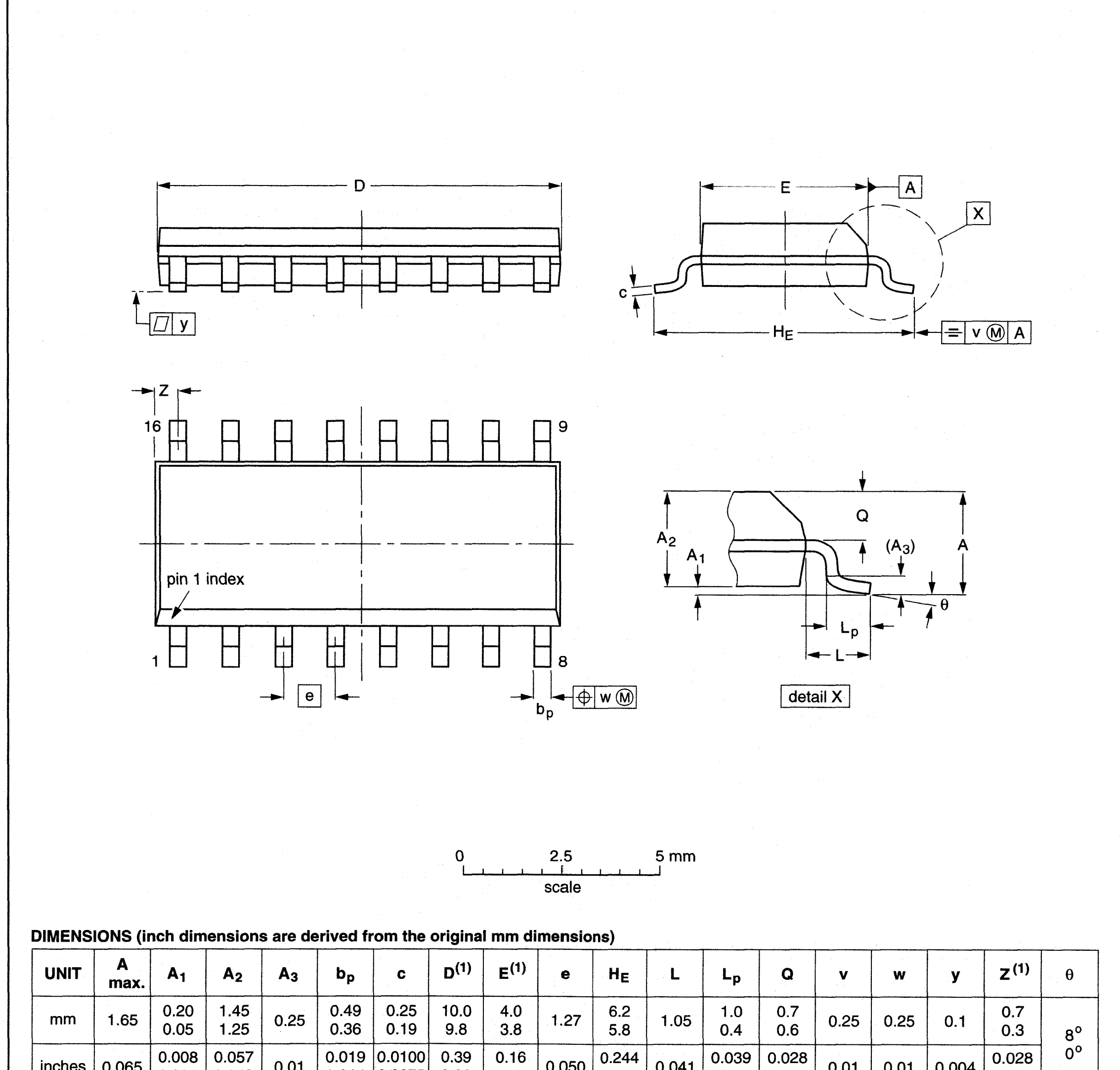
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	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	076E07S	MS-012AC				~~95-01-23~~ 97-05-22

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)

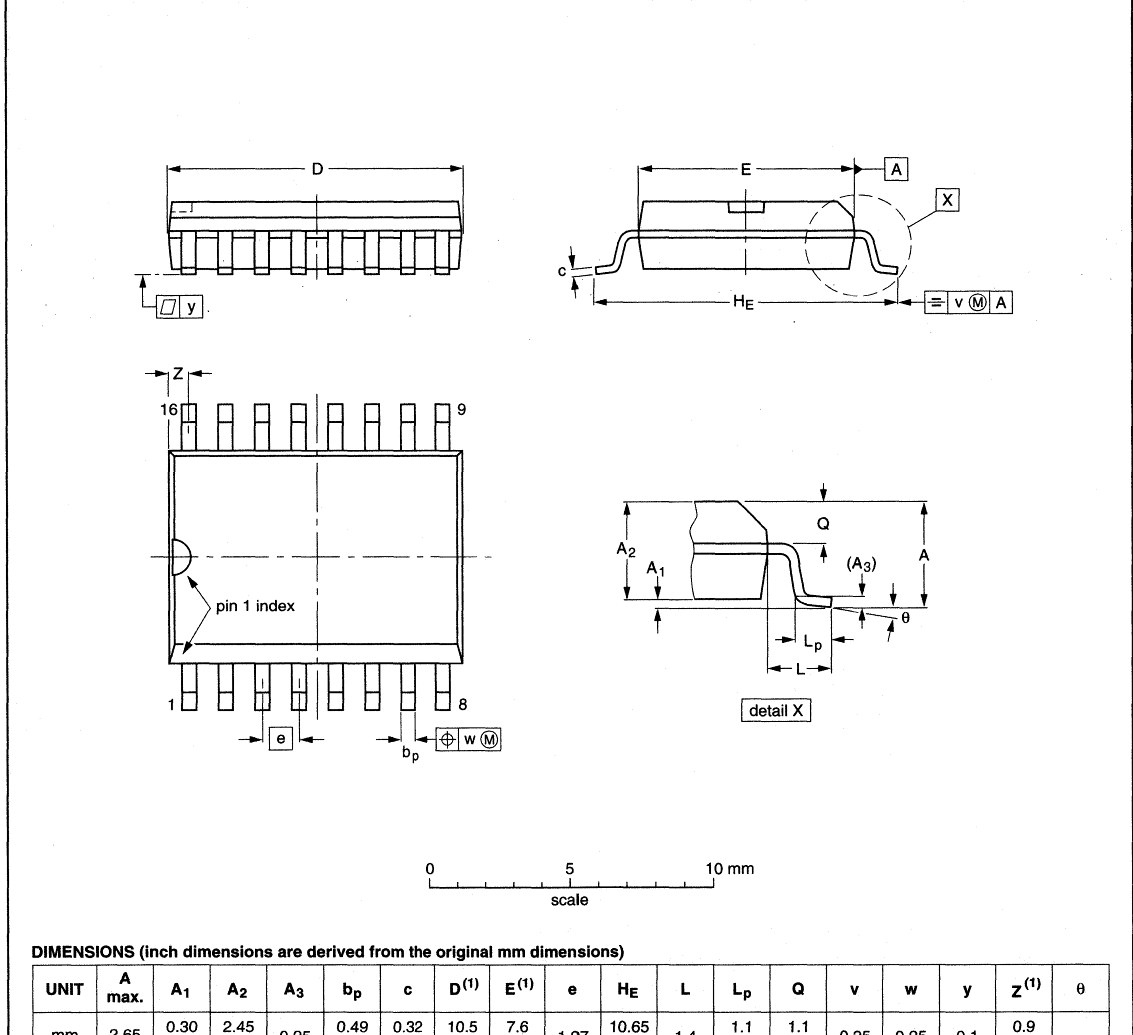
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	1.65	0.20 0.05	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.065	0.008 0.002	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 0.228	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: IEC	REFERENCES: JEDEC	REFERENCES: EIAJ		EUROPEAN PROJECTION	ISSUE DATE
SOT109-2						~~95-01-23~~ 97-05-22

SO16: plastic small outline package; 16 leads; body width 7.5 mm **SOT162-1**



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

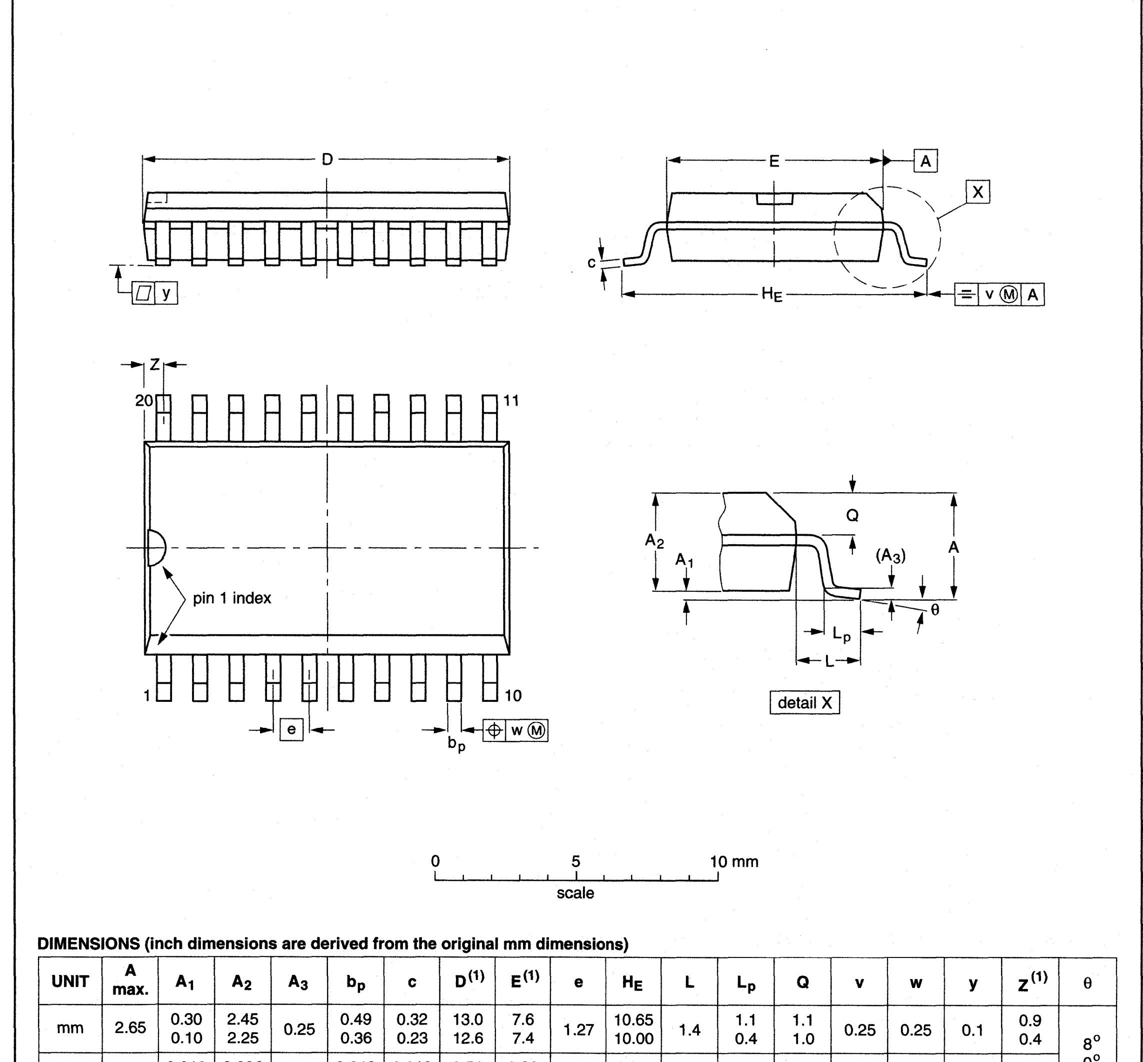
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	10.5 10.1	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.41 0.40	0.30 0.29	0.050	0.419 0.394	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-013AA				~~95-01-24~~ 97-05-22

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	

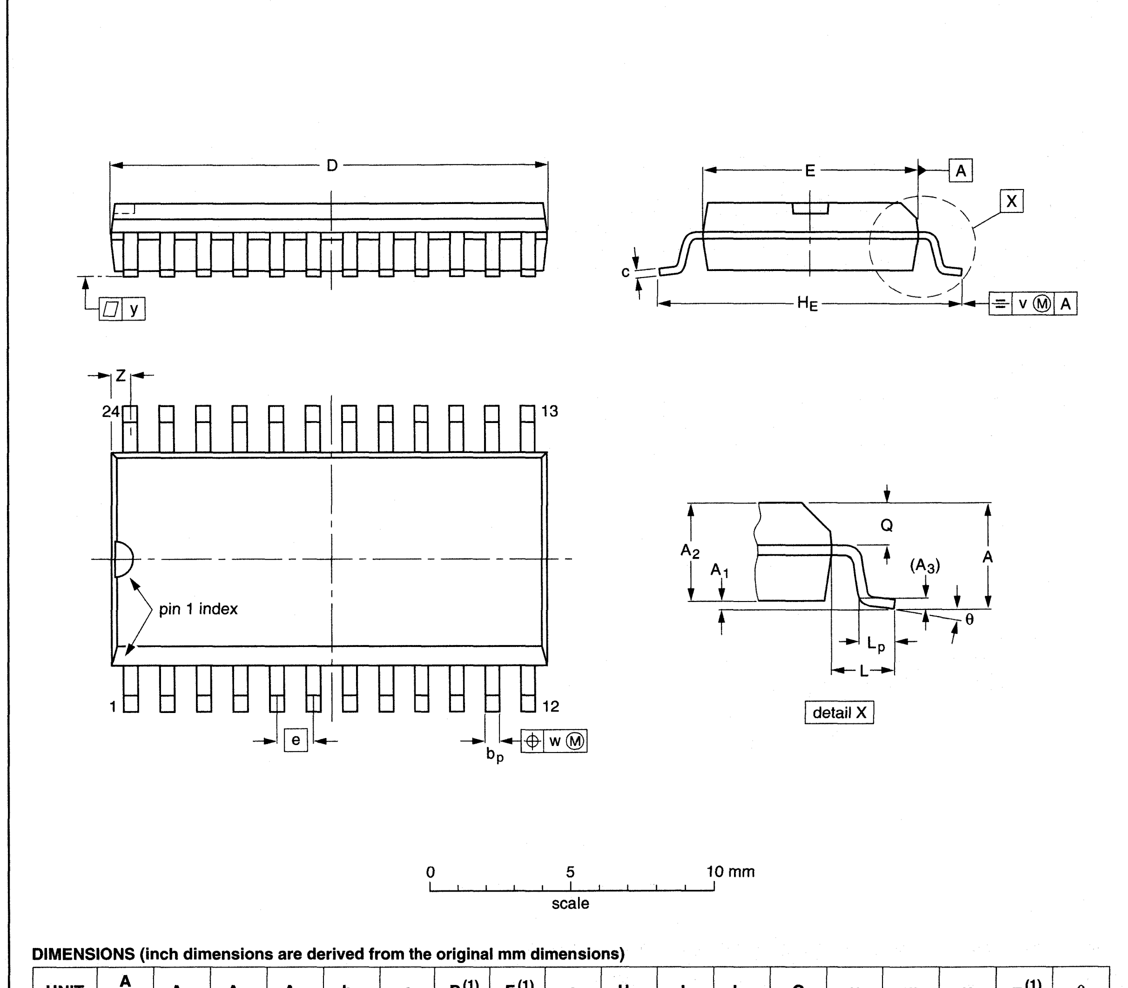
Note

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-013AC				~~95-01-24~~ 97-05-22

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)

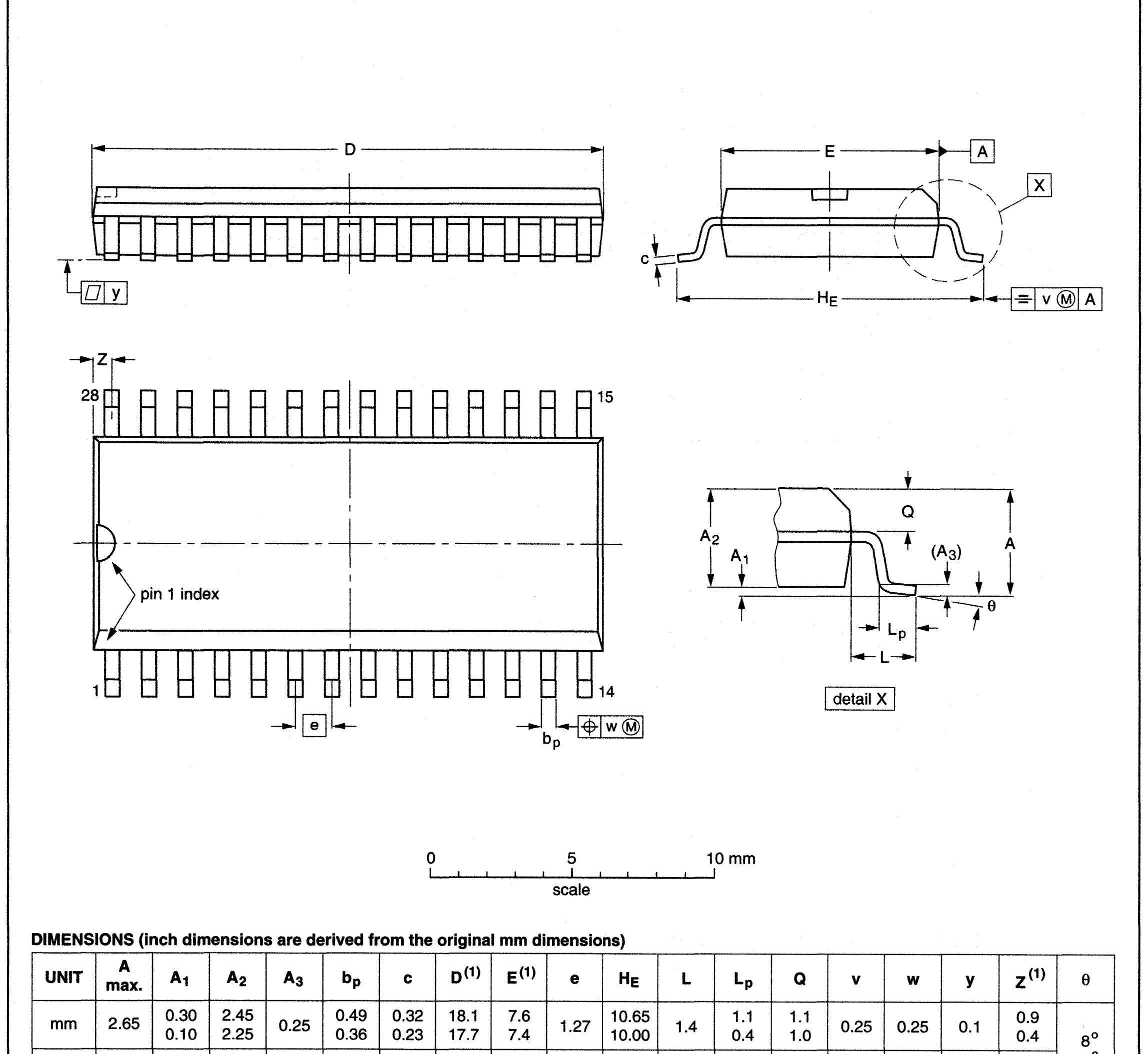
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	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-013AD				~~95-01-24~~ 97-05-22

SO28: plastic small outline package; 28 leads; body width 7.5 mm **SOT136-1**



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

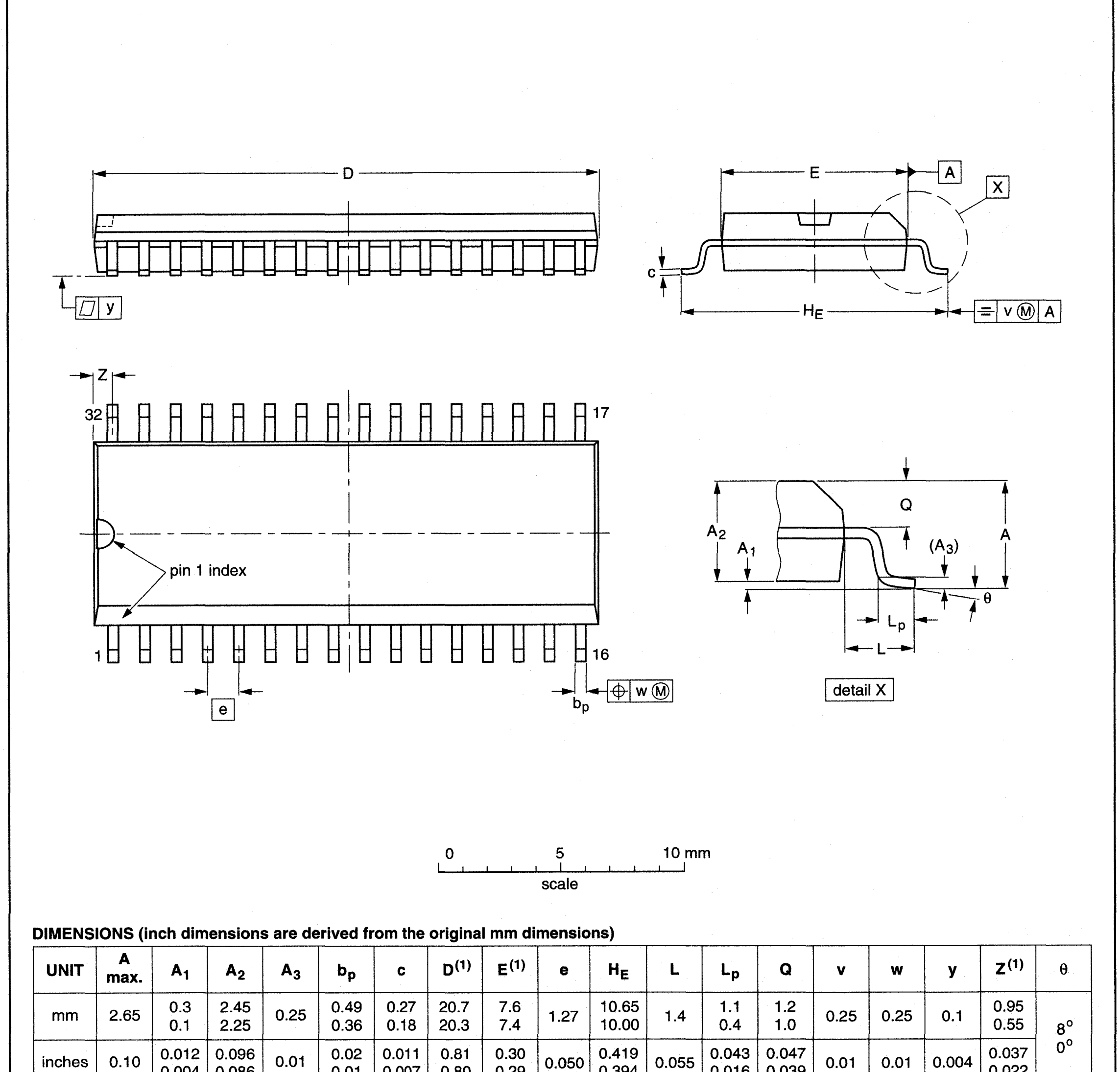
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	18.1 17.7	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.71 0.69	0.30 0.29	0.050	0.419 0.394	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-013AE				~~95-01-24~~ 97-05-22

SO32: plastic small outline package; 32 leads; body width 7.5 mm SOT287-1



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

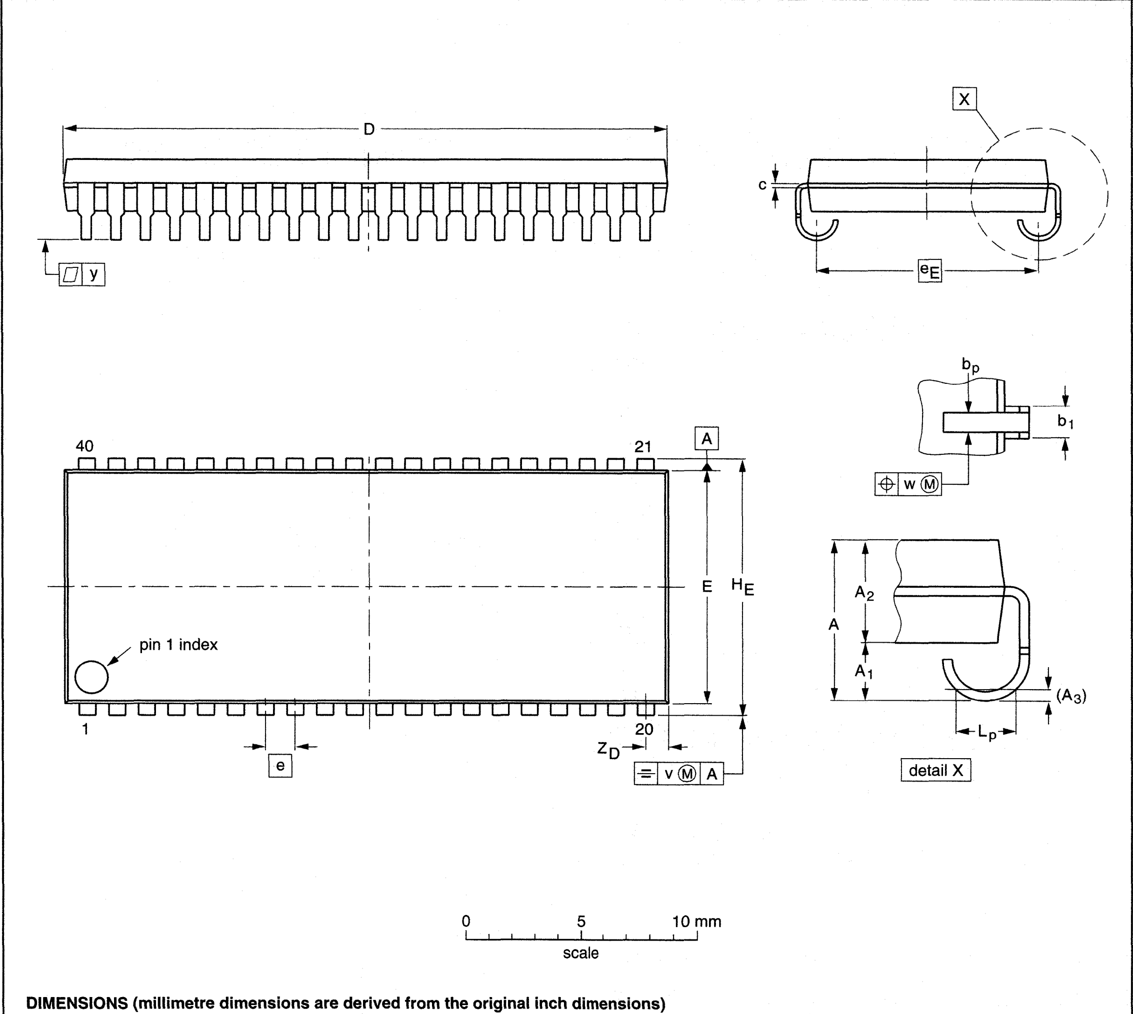
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.27 0.18	20.7 20.3	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.2 1.0	0.25	0.25	0.1	0.95 0.55	8° 0°
inches	0.10	0.012 0.004	0.096 0.086	0.01	0.02 0.01	0.011 0.007	0.81 0.80	0.30 0.29	0.050	0.419 0.394	0.055	0.043 0.016	0.047 0.039	0.01	0.01	0.004	0.037 0.022	

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			
SOT287-1						~~95-01-25~~ 97-05-22

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

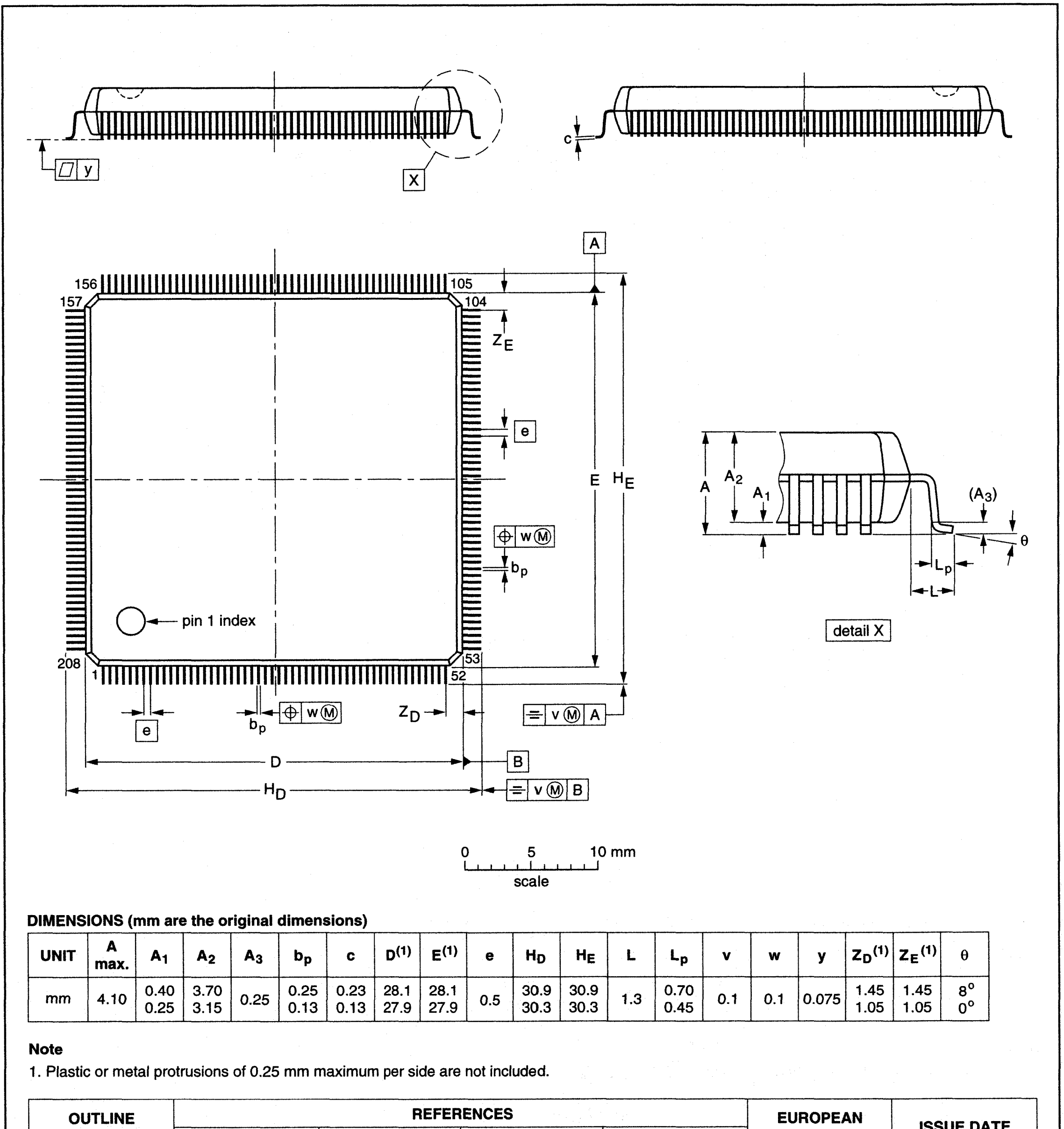
Note

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		MS027				97-06-02

IC package range and dimensions Chapter 2

SQFP208: plastic shrink quad flat package; 208 leads (lead length 1.3 mm); body 28 x 28 x 3.4 mm **SOT316-1**



DIMENSIONS (mm are the original dimensions)

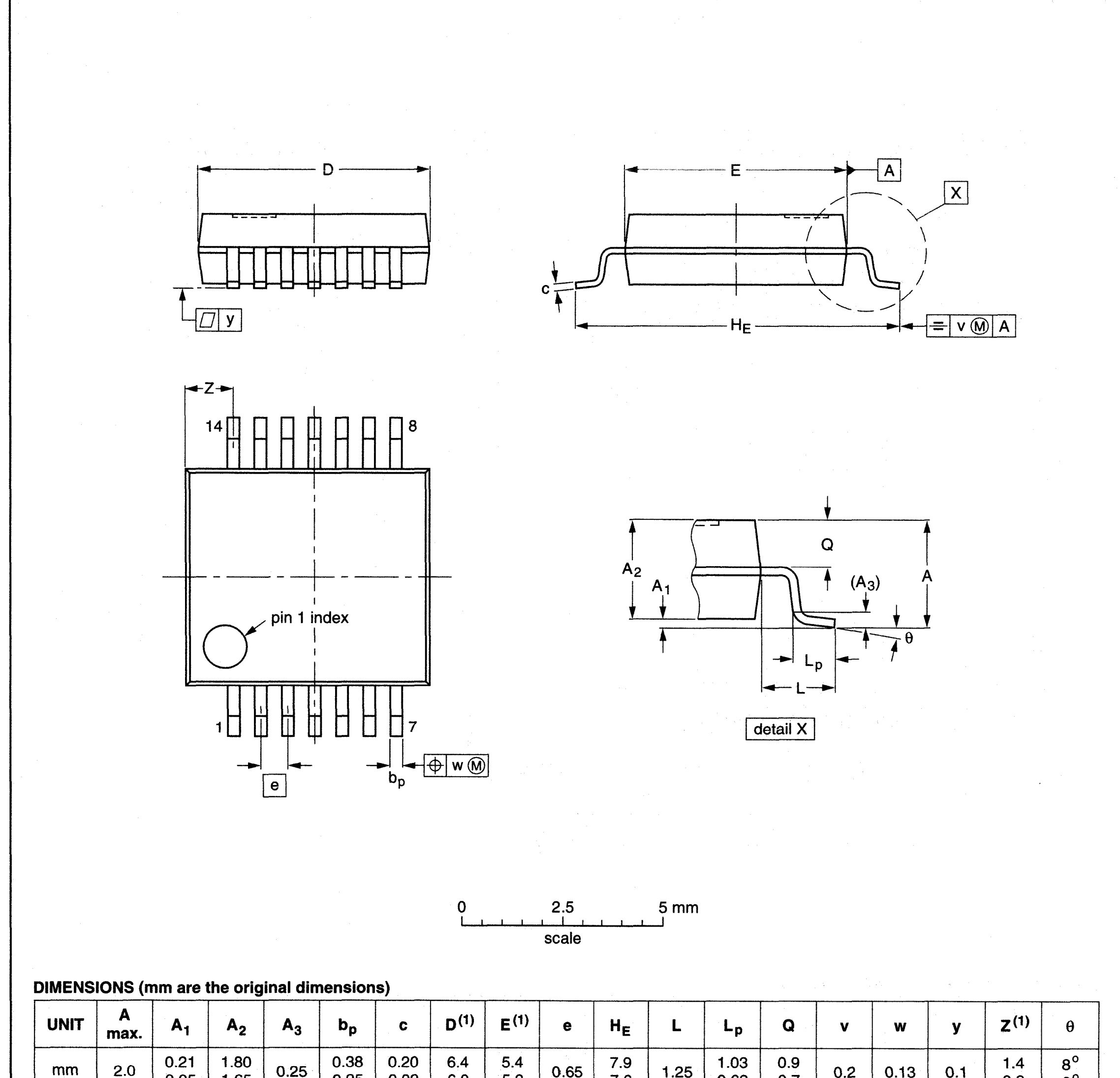
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	4.10	0.40 0.25	3.70 3.15	0.25	0.25 0.13	0.23 0.13	28.1 27.9	28.1 27.9	0.5	30.9 30.3	30.9 30.3	1.3	0.70 0.45	0.1	0.1	0.075	1.45 1.05	1.45 1.05	8° 0°

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			
SOT316-1						~~97-04-08~~ 97-08-01

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°

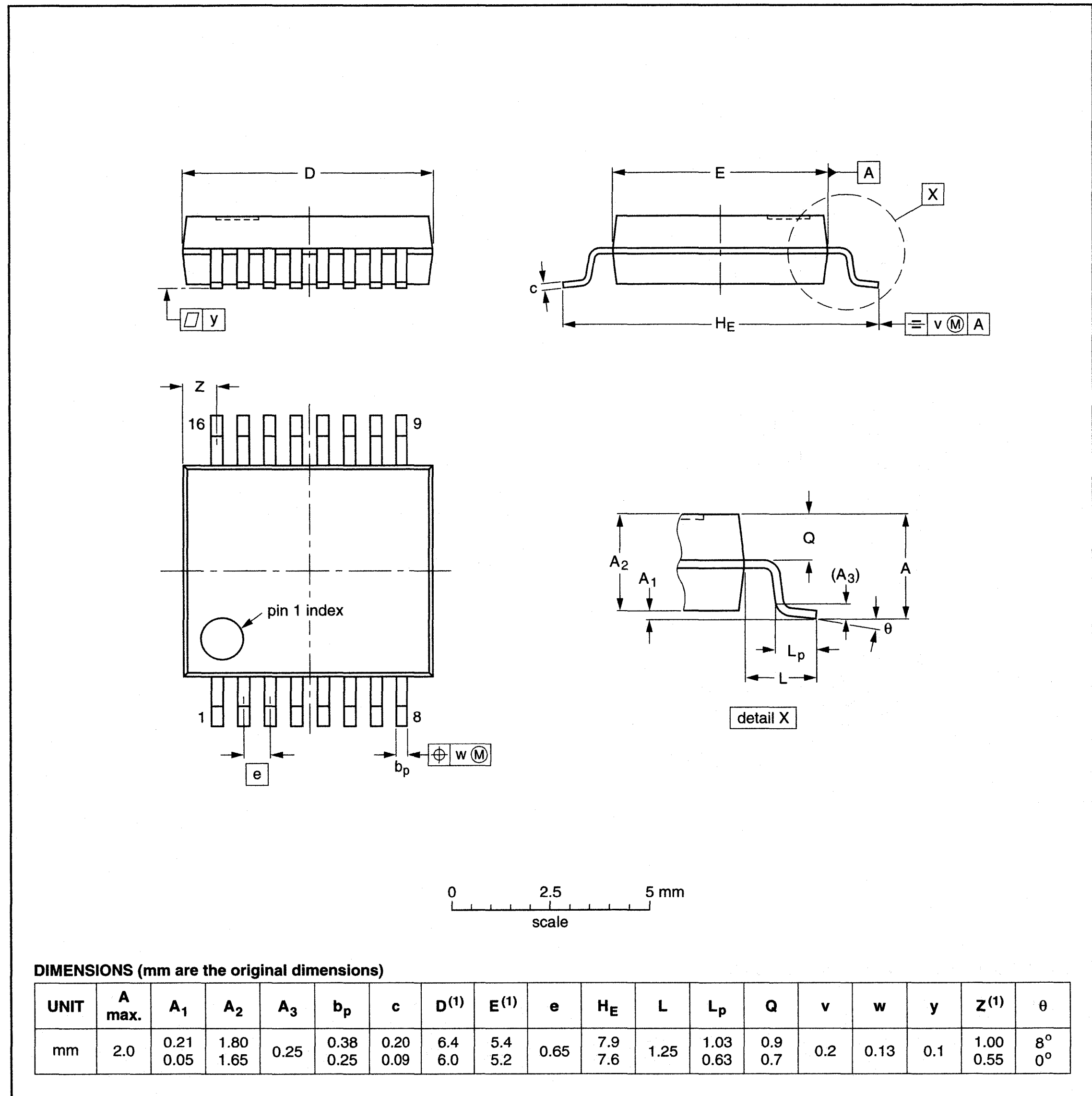
Note

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-150AB				~~95-02-04~~ 96-01-18

IC package range and dimensions Chapter 2

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°

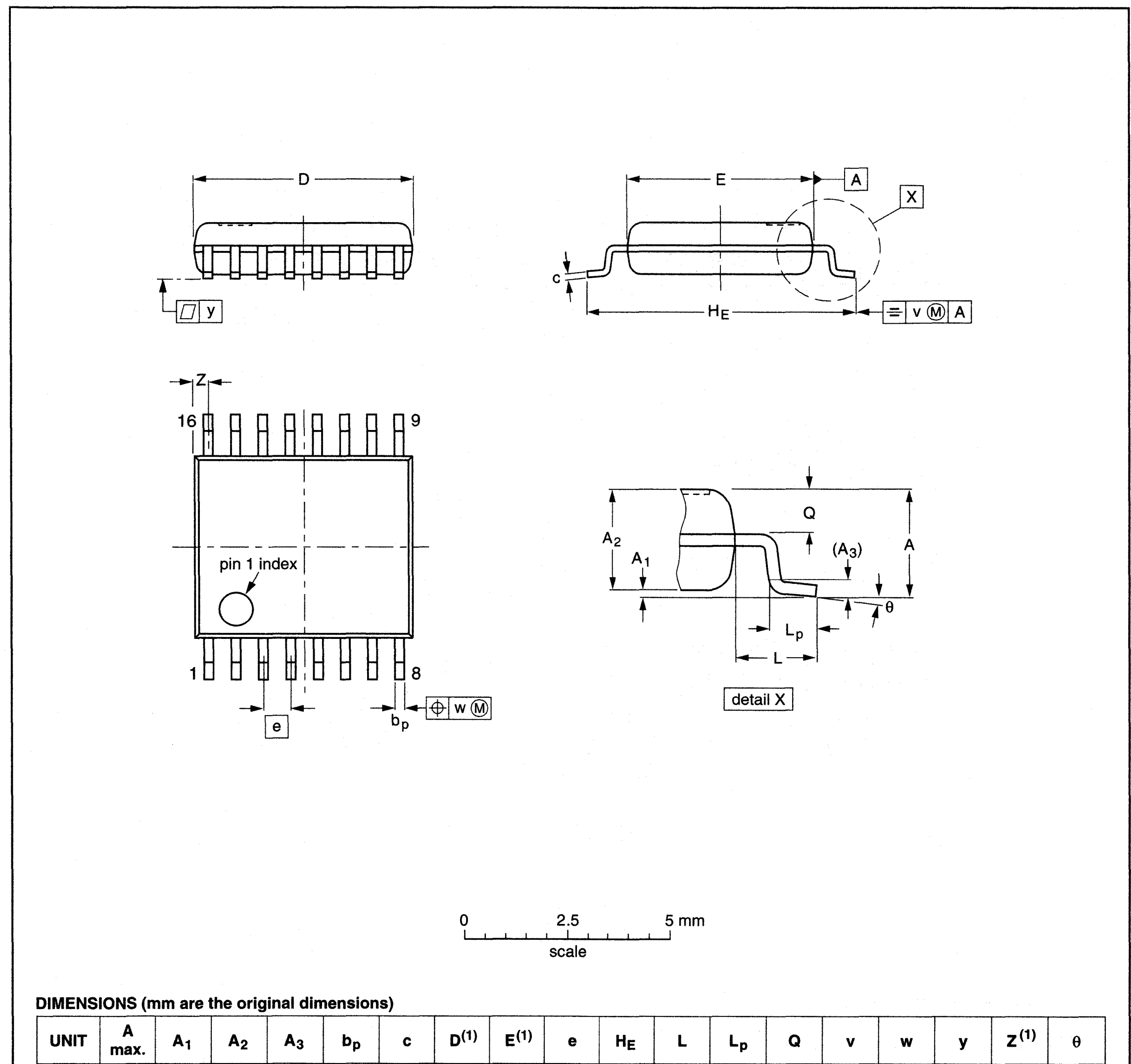
Note

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-150AC				~~94-01-14~~ 95-02-04

IC package range and dimensions Chapter 2

SSOP16: plastic shrink small outline package; 16 leads; body width 4.4 mm SOT369-1



DIMENSIONS (mm are the original dimensions)

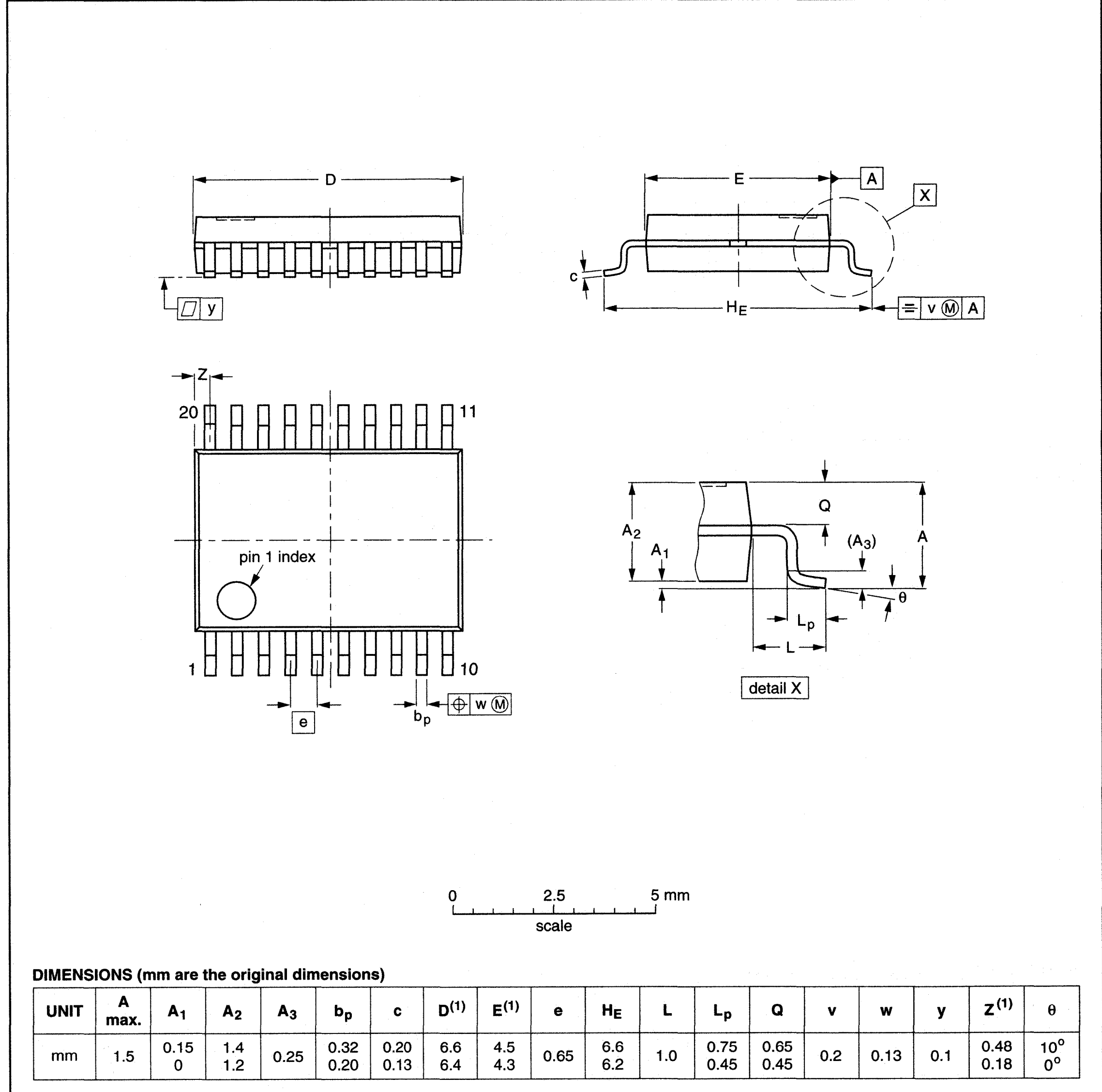
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.5	0.15 0.00	1.4 1.2	0.25	0.32 0.20	0.25 0.13	5.30 5.10	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

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						~~94-04-20~~ 95-02-04

SSOP20: plastic shrink small outline package; 20 leads; body width 4.4 mm **SOT266-1**



DIMENSIONS (mm are the original dimensions)

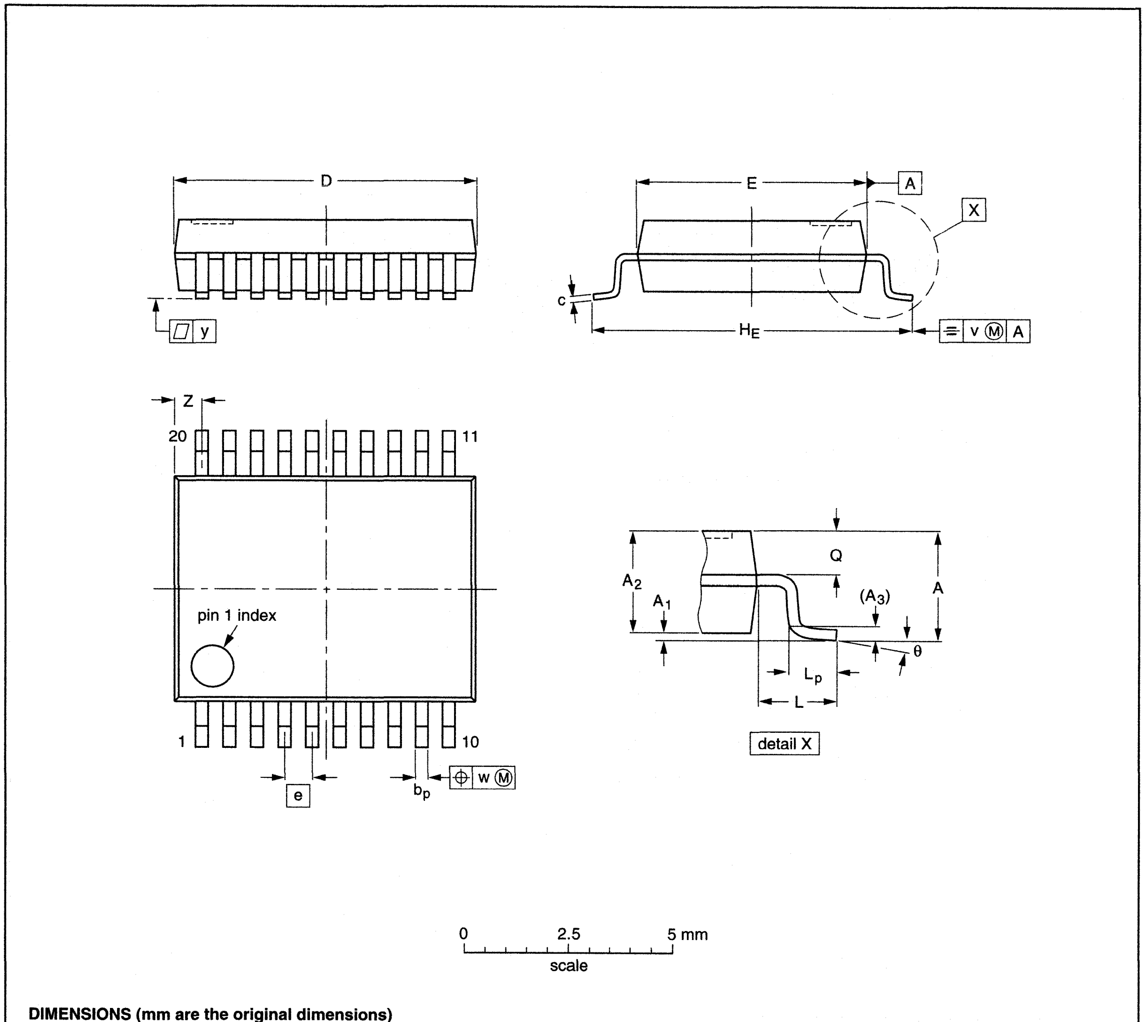
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.5	0.15 0	1.4 1.2	0.25	0.32 0.20	0.20 0.13	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

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						~~90-04-05~~ 95-02-25

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm **SOT339-1**



DIMENSIONS (mm are the original dimensions)

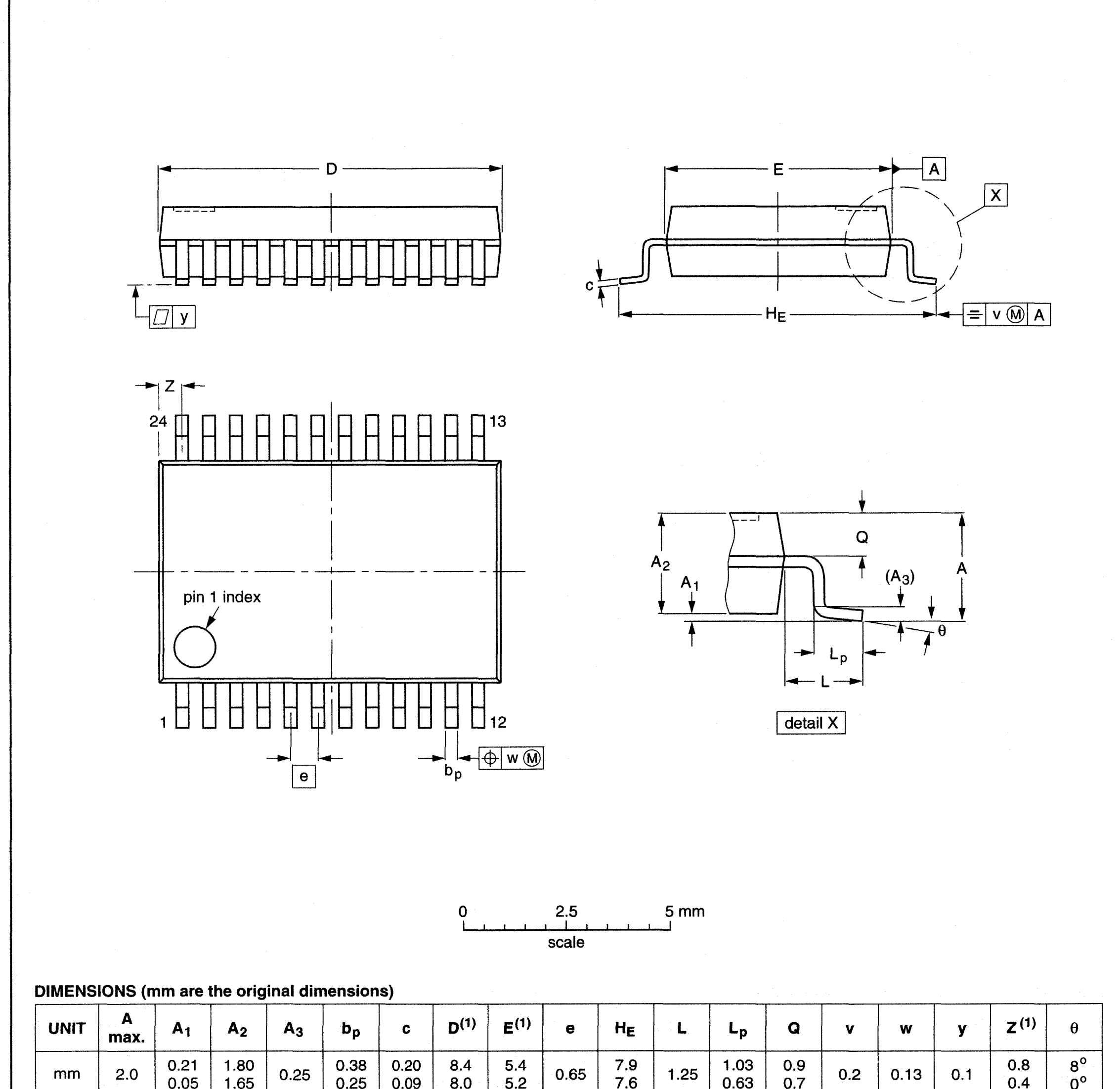
UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT339-1		MO-150AE				~~93-09-08~~ 95-02-04

SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm | **SOT340-1**



DIMENSIONS (mm are the original dimensions)

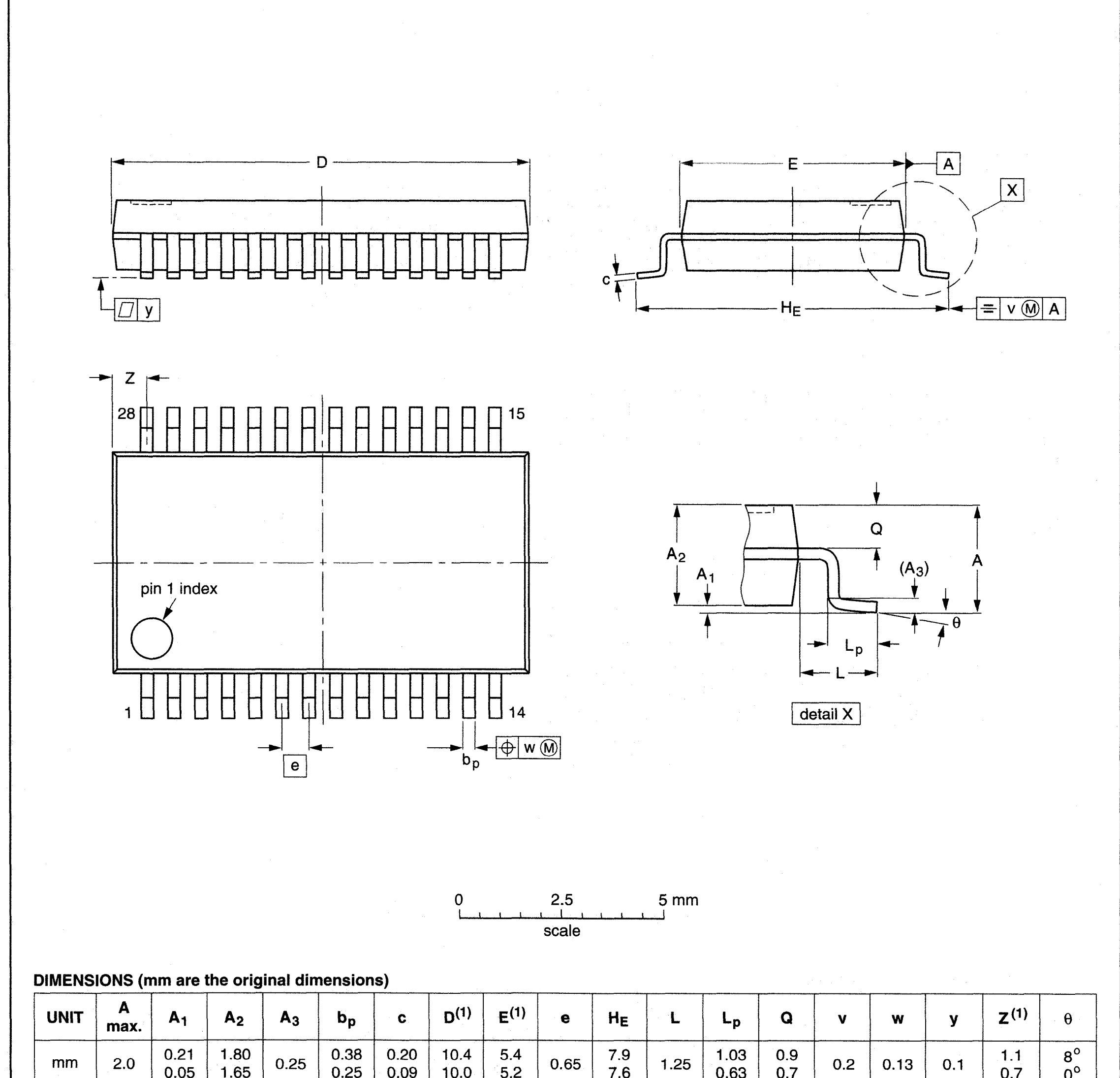
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	8.4 8.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.8 0.4	8° 0°

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-150AG				~~93-09-08~~ 95-02-04

SSOP28: plastic shrink small outline package; 28 leads; body width 5.3 mm SOT341-1



DIMENSIONS (mm are the original dimensions)

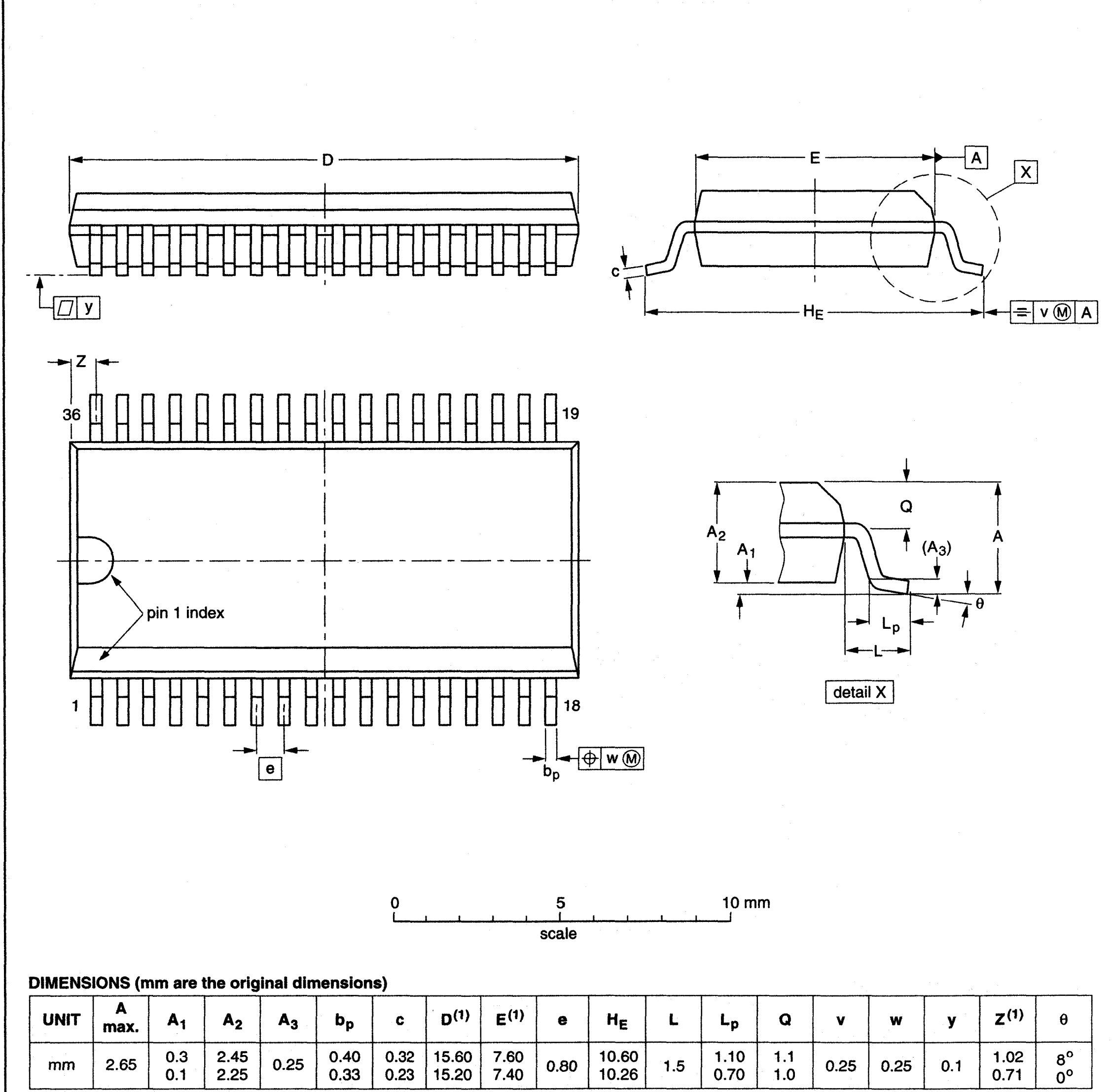
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	10.4 10.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.1 0.7	8° 0°

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-150AH				~~93-09-08~~ 95-02-04

SSOP36: plastic shrink small outline package; 36 leads; body width 7.5 mm; lead pitch 0.8 mm **SOT378-1**



DIMENSIONS (mm are the original dimensions)

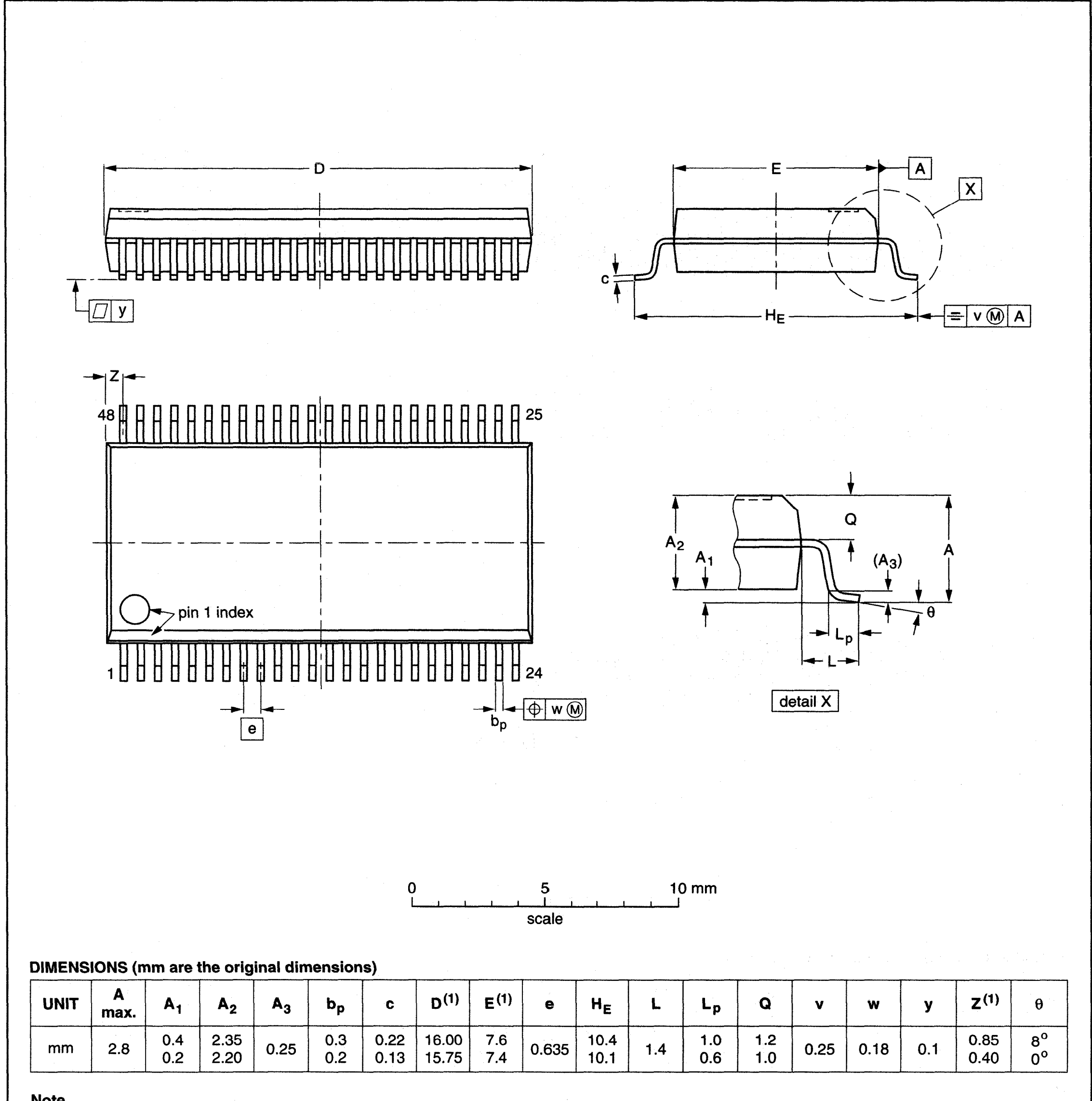
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.40 0.33	0.32 0.23	15.60 15.20	7.60 7.40	0.80	10.60 10.26	1.5	1.10 0.70	1.1 1.0	0.25	0.25	0.1	1.02 0.71	8° 0°

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			
SOT378-1			ED-7402-2			95-02-25

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm SOT370-1



DIMENSIONS (mm are the original dimensions)

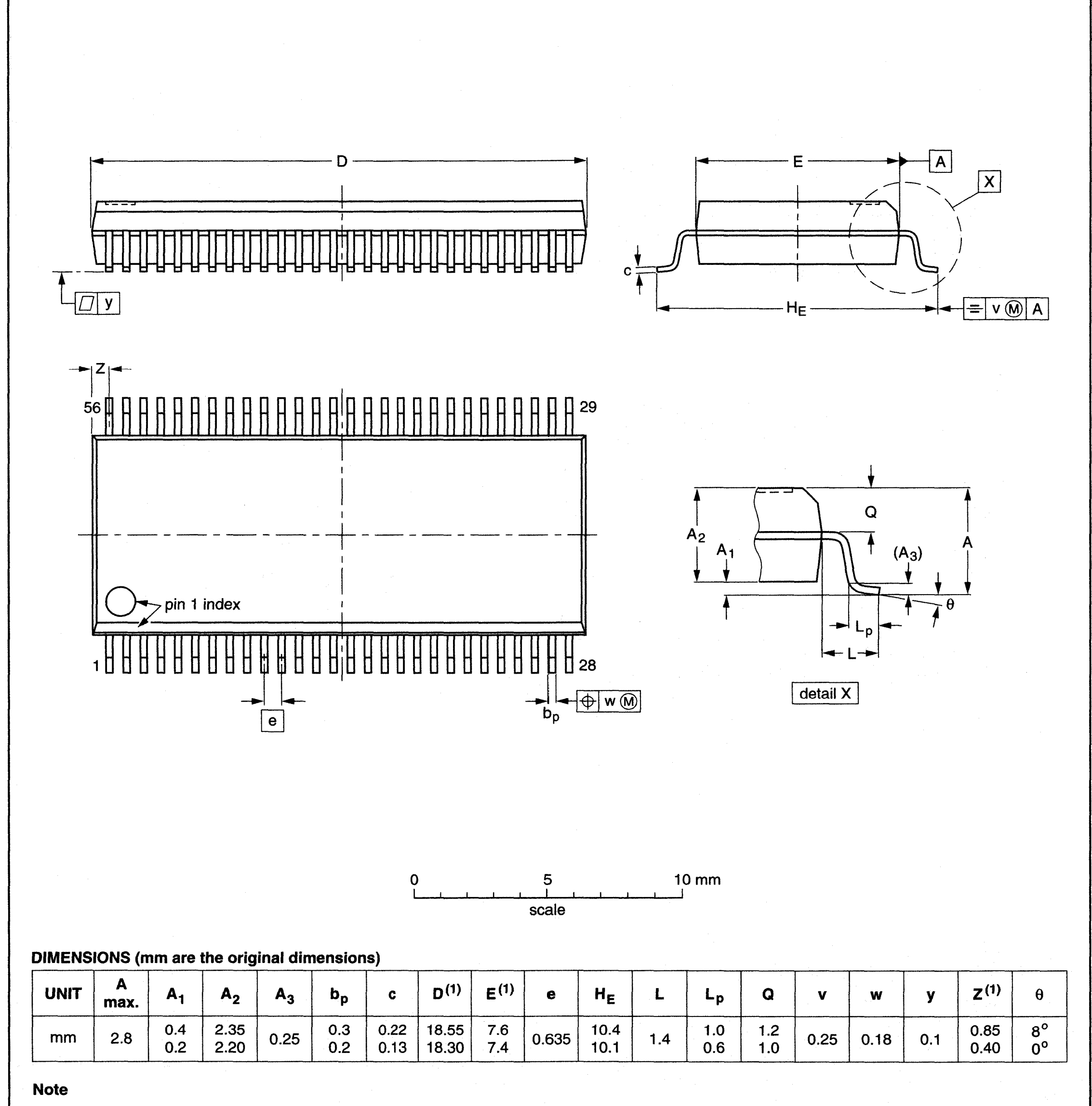
UNIT	A max.	A_1	A_2	A_3	b_p	c	D[1]	E[1]	e	H_E	L	L_p	Q	v	w	y	Z[1]	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	16.00 15.75	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

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-118AA				~~93-11-02~~ 95-02-04

SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm **SOT371-1**



DIMENSIONS (mm are the original dimensions)

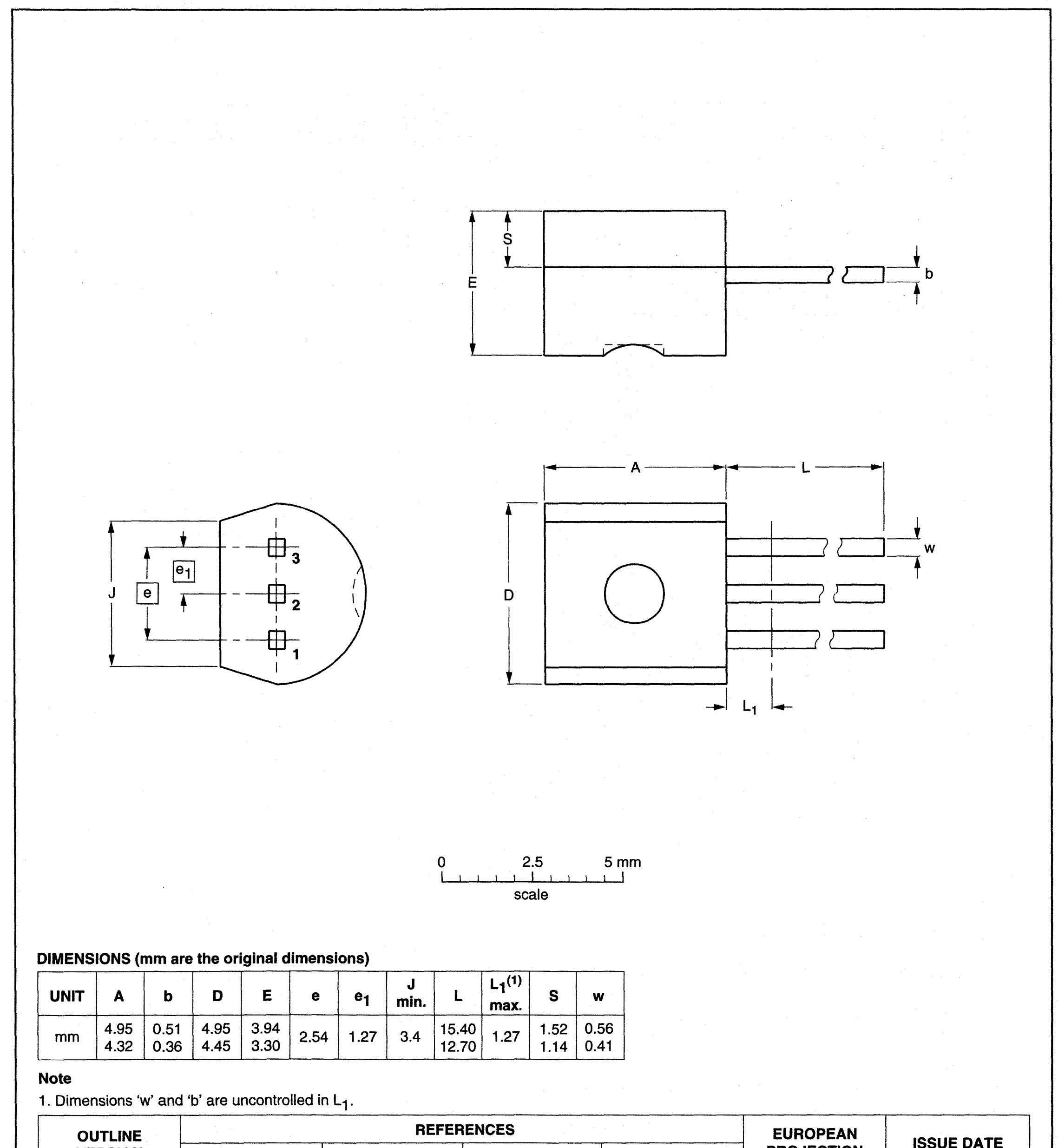
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.8	0.4 0.2	2.35 2.20	0.25	0.3 0.2	0.22 0.13	18.55 18.30	7.6 7.4	0.635	10.4 10.1	1.4	1.0 0.6	1.2 1.0	0.25	0.18	0.1	0.85 0.40	8° 0°

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-118AB				~~93-11-02~~ 95-02-04

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

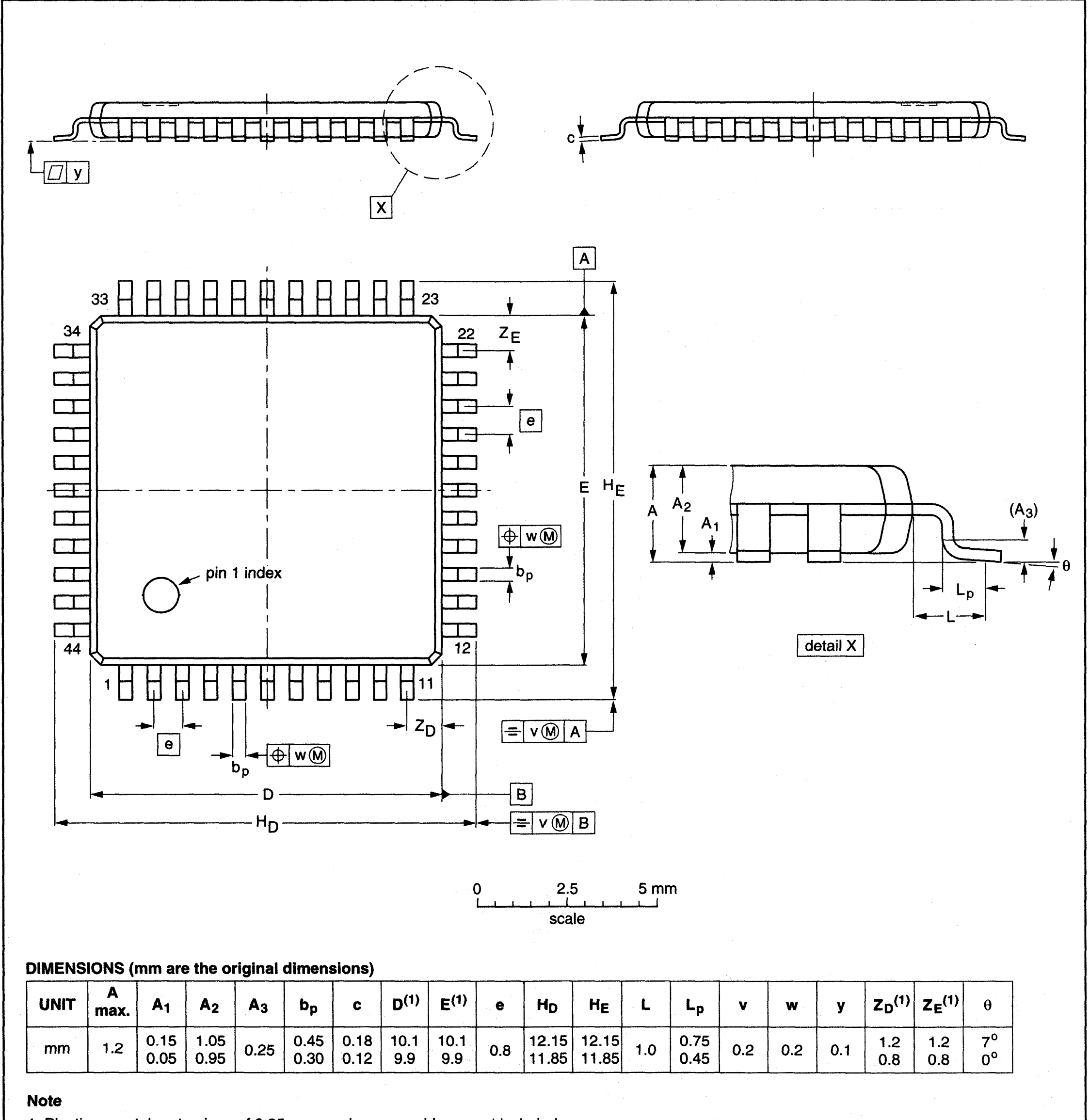
Note

1. Dimensions ‘w’ and ‘b’ are uncontrolled in L_1.

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

IC package range and dimensions Chapter 2

TQFP44: plastic thin quad flat package; 44 leads; body 10 x 10 x 1.0 mm **SOT376-1**



DIMENSIONS (mm are the original dimensions)

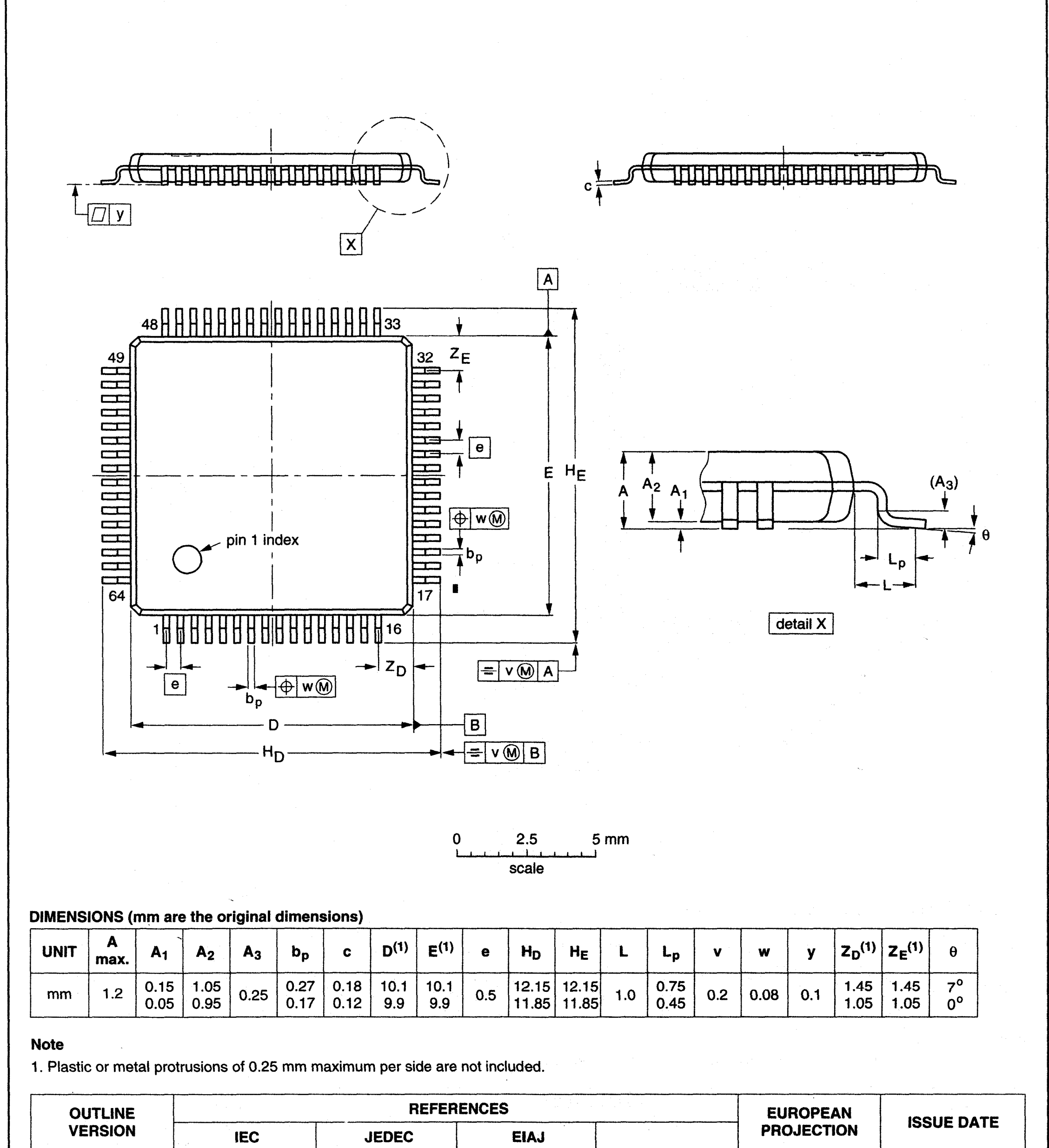
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.45 0.30	0.18 0.12	10.1 9.9	10.1 9.9	0.8	12.15 11.85	12.15 11.85	1.0	0.75 0.45	0.2	0.2	0.1	1.2 0.8	1.2 0.8	7° 0°

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						~~96-04-02~~ 97-08-04

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°

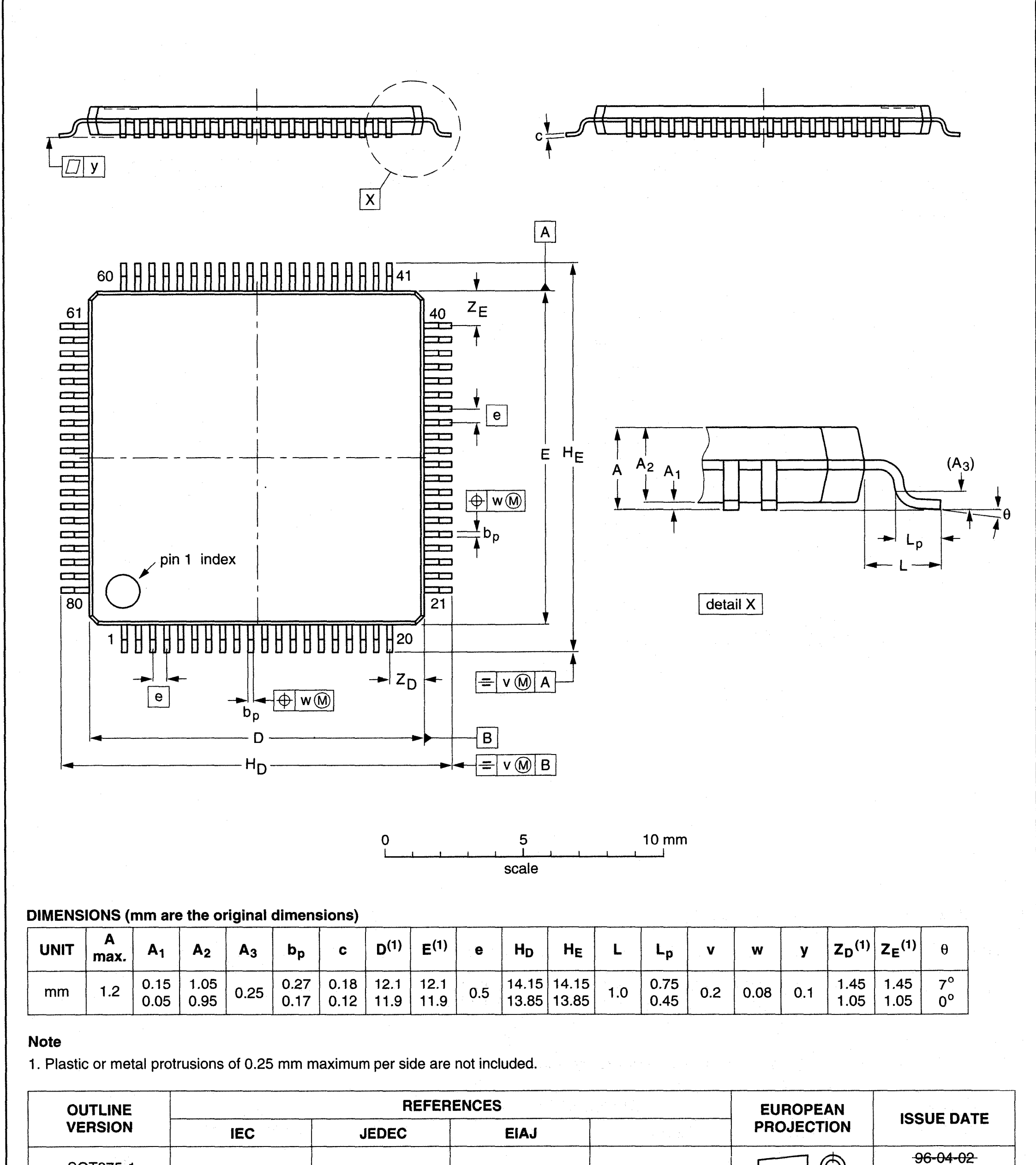
Note

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						~~96-04-02~~ 97-08-04

IC package range and dimensions Chapter 2

TQFP80: plastic thin quad flat package; 80 leads; body 12 x 12 x 1.0 mm SOT375-1



DIMENSIONS (mm are the original dimensions)

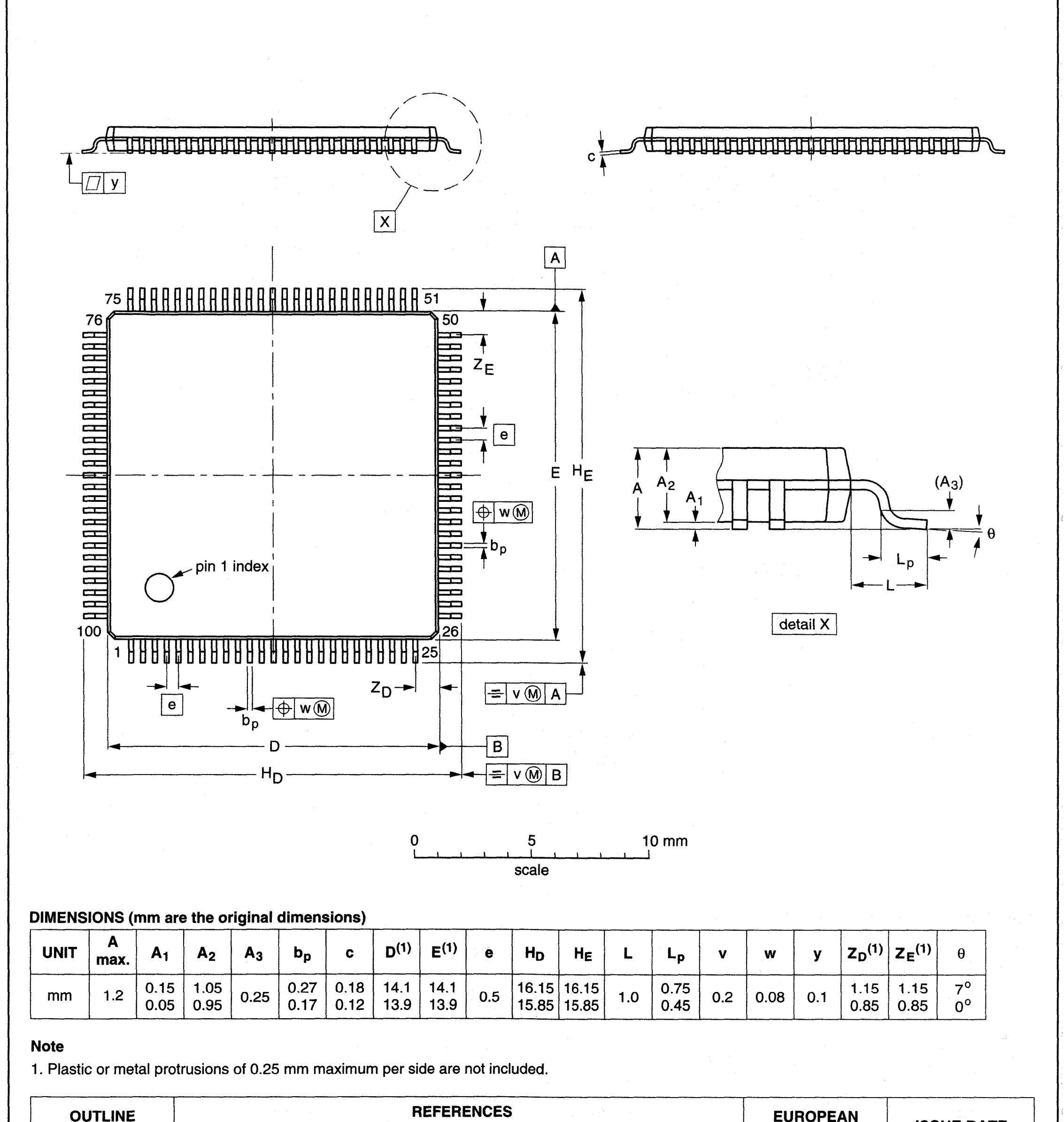
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.27 0.17	0.18 0.12	12.1 11.9	12.1 11.9	0.5	14.15 13.85	14.15 13.85	1.0	0.75 0.45	0.2	0.08	0.1	1.45 1.05	1.45 1.05	7° 0°

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						~~96-04-02~~ 97-08-04

TQFP100: plastic thin quad flat package; 100 leads; body 14 x 14 x 1.0 mm **SOT386-1**



DIMENSIONS (mm are the original dimensions)

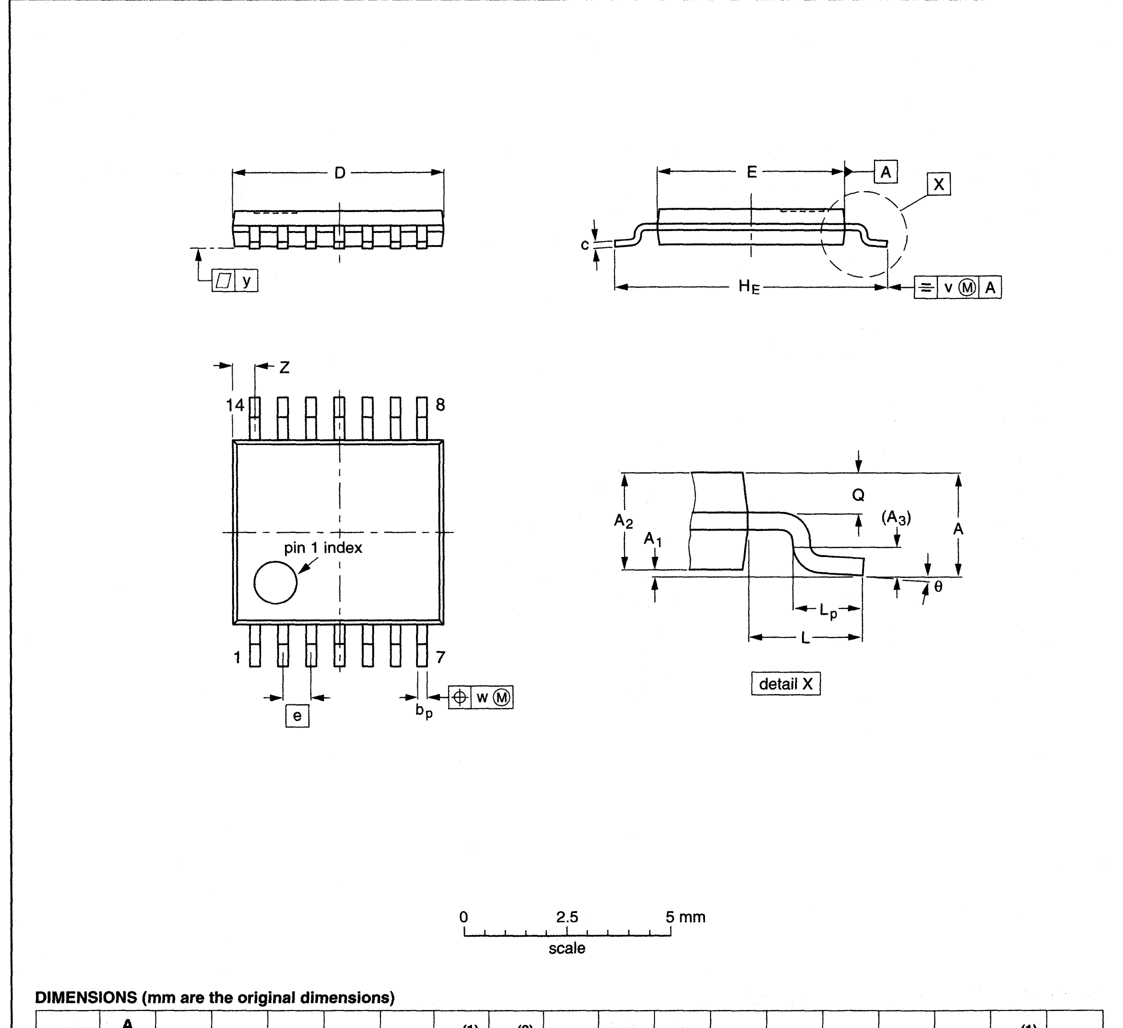
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_D	H_E	L	L_p	v	w	y	$Z_D^{(1)}$	$Z_E^{(1)}$	θ
mm	1.2	0.15 0.05	1.05 0.95	0.25	0.27 0.17	0.18 0.12	14.1 13.9	14.1 13.9	0.5	16.15 15.85	16.15 15.85	1.0	0.75 0.45	0.2	0.08	0.1	1.15 0.85	1.15 0.85	7° 0°

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						~~96-04-02~~ 97-08-04

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm **SOT402-1**



DIMENSIONS (mm are the original dimensions)

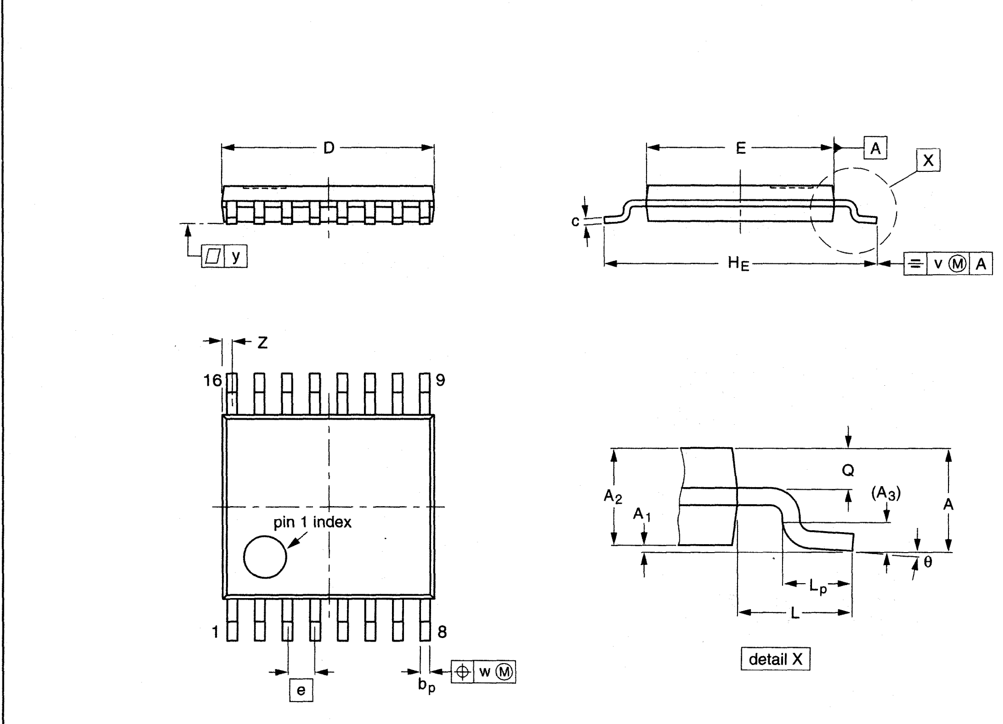
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

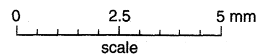
Notes

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				~~94-07-12~~ 95-04-04

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°

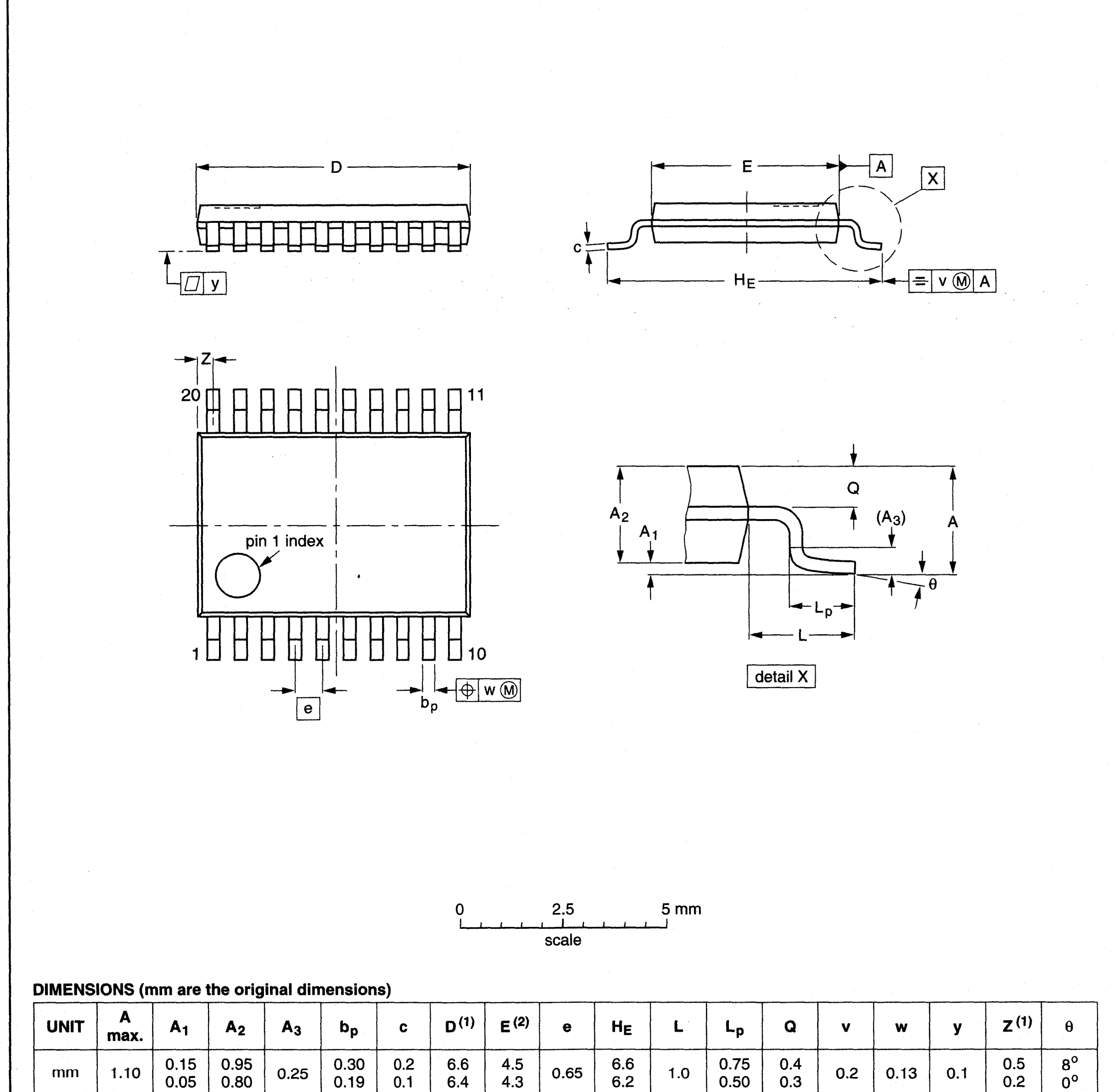
Notes

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				~~94-07-12~~ 95-04-04

IC package range and dimensions Chapter 2

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm **SOT360-1**



DIMENSIONS (mm are the original dimensions)

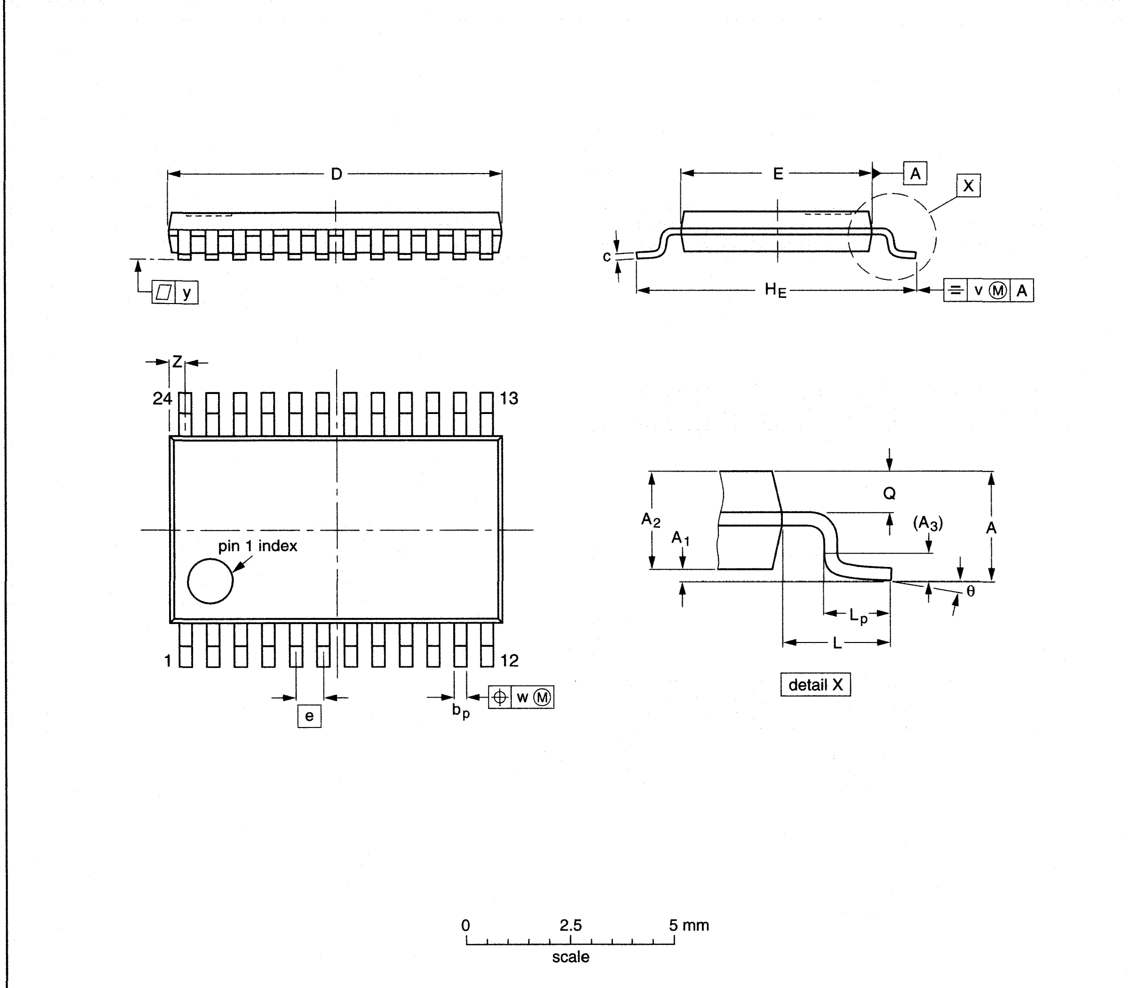
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8° 0°

Notes

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT360-1		MO-153AC				~~93-06-16~~ 95-02-04

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm **SOT355-1**



DIMENSIONS (mm are the original dimensions)

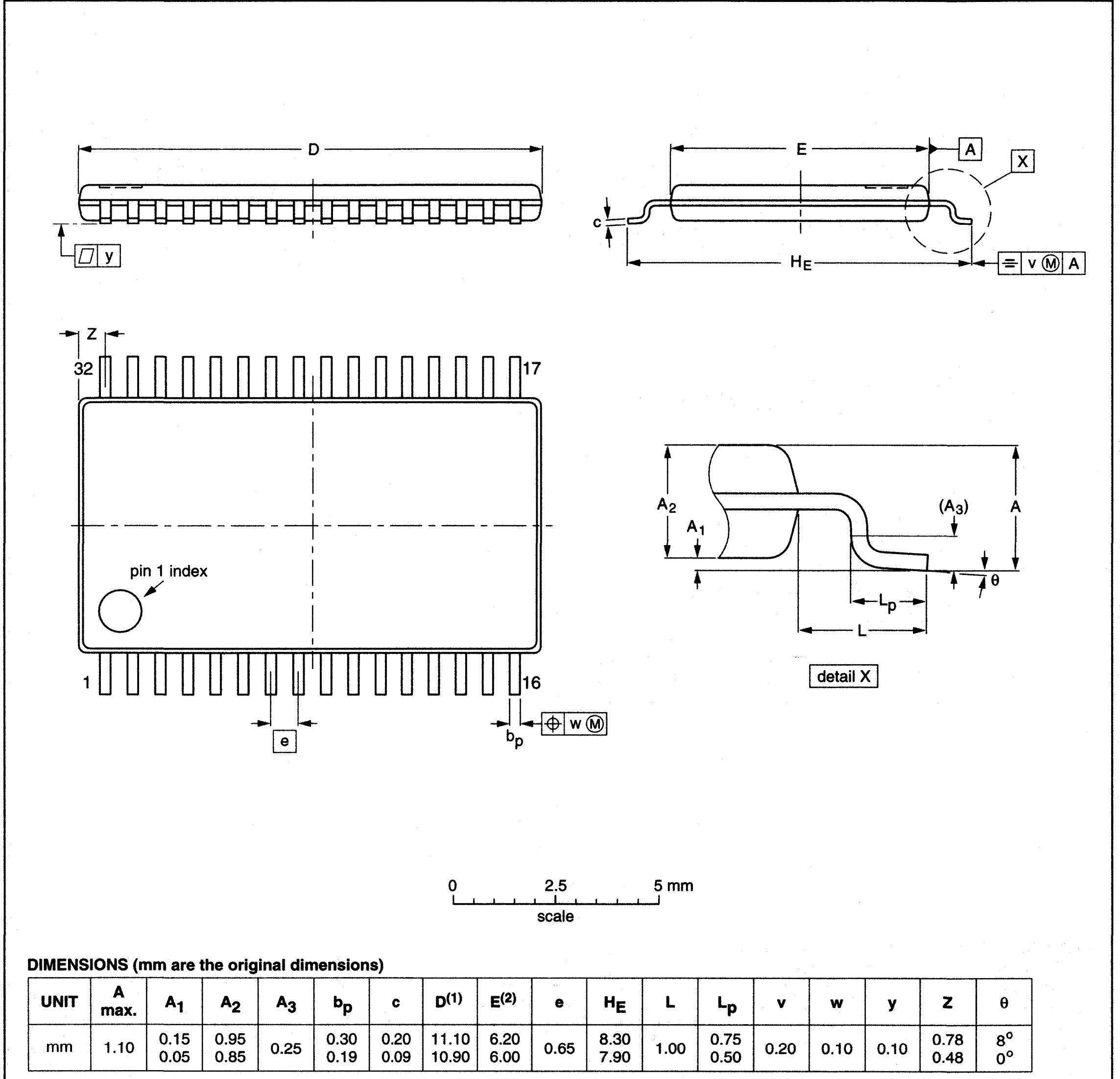
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	7.9 7.7	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8° 0°

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-153AD				~~93-06-16~~ 95-02-04

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)

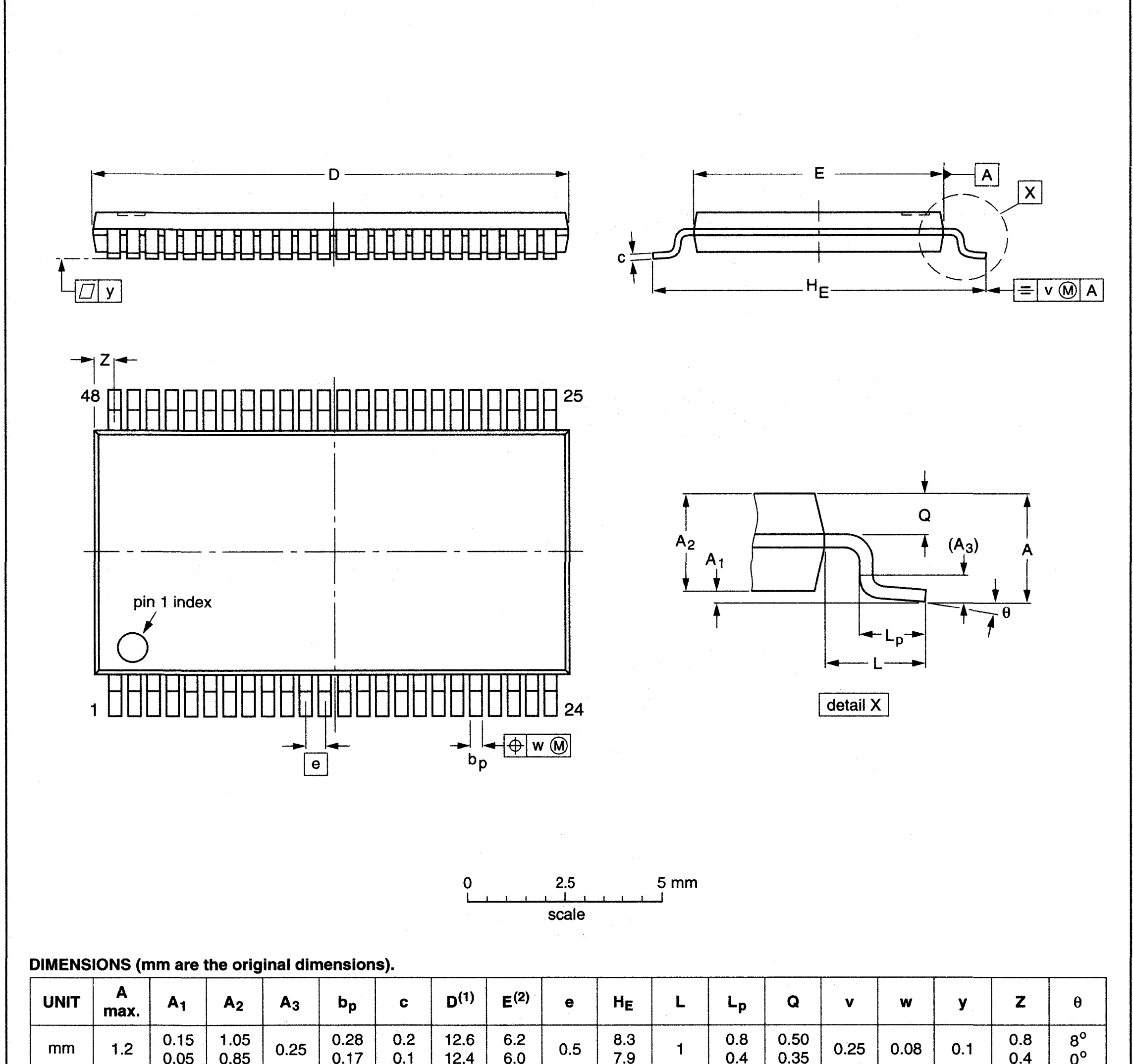
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	v	w	y	Z	θ
mm	1.10	0.15 0.05	0.95 0.85	0.25	0.30 0.19	0.20 0.09	11.10 10.90	6.20 6.00	0.65	8.30 7.90	1.00	0.75 0.50	0.20	0.10	0.10	0.78 0.48	8° 0°

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

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°

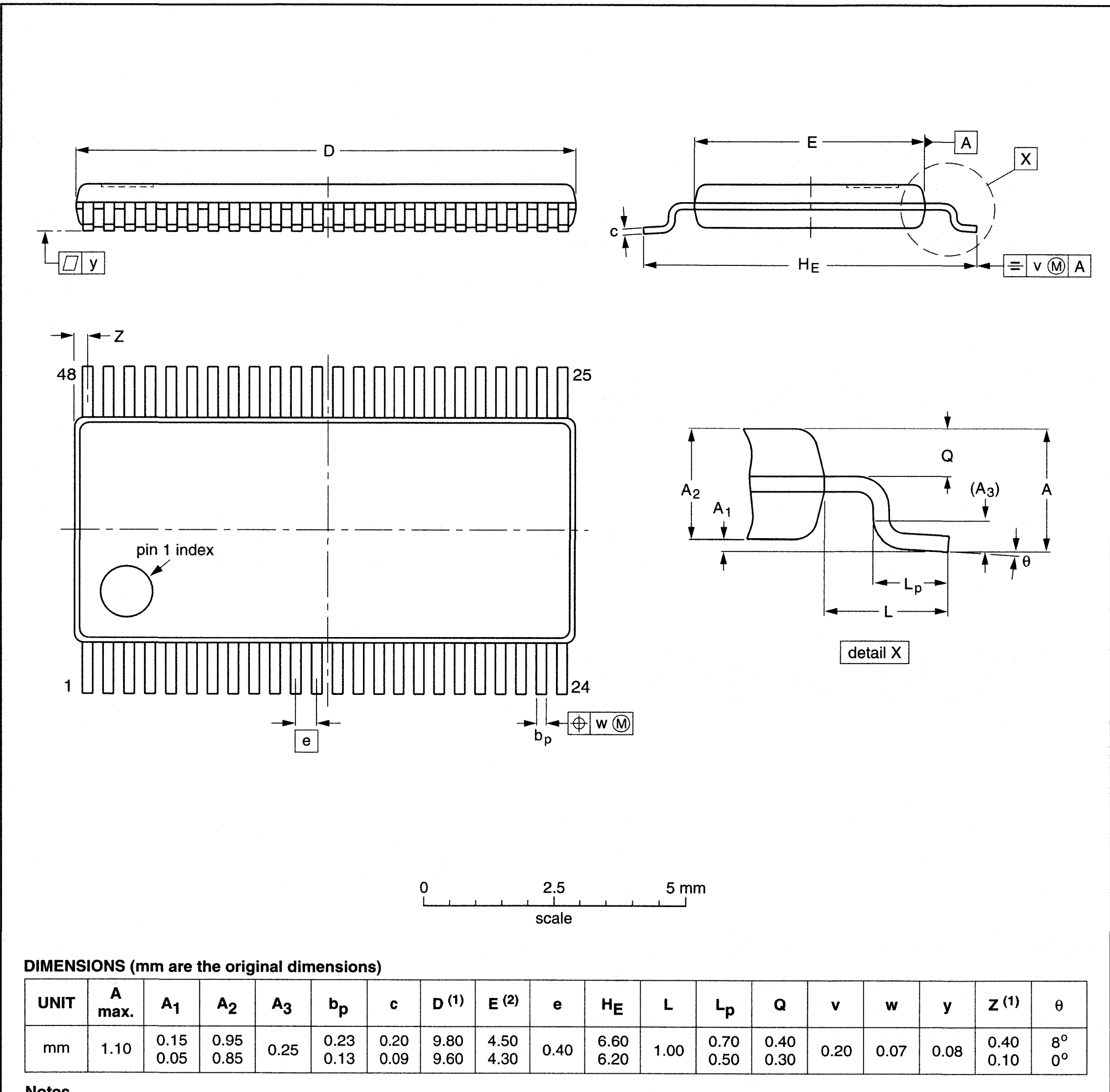
Notes

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-153ED				~~93-02-03~~ 95-02-10

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 4.4 mm; lead pitch 0.4 mm

SOT480-1



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 0.85	0.25	0.23 0.13	0.20 0.09	9.80 9.60	4.50 4.30	0.40	6.60 6.20	1.00	0.70 0.50	0.40 0.30	0.20	0.07	0.08	0.40 0.10	8° 0°

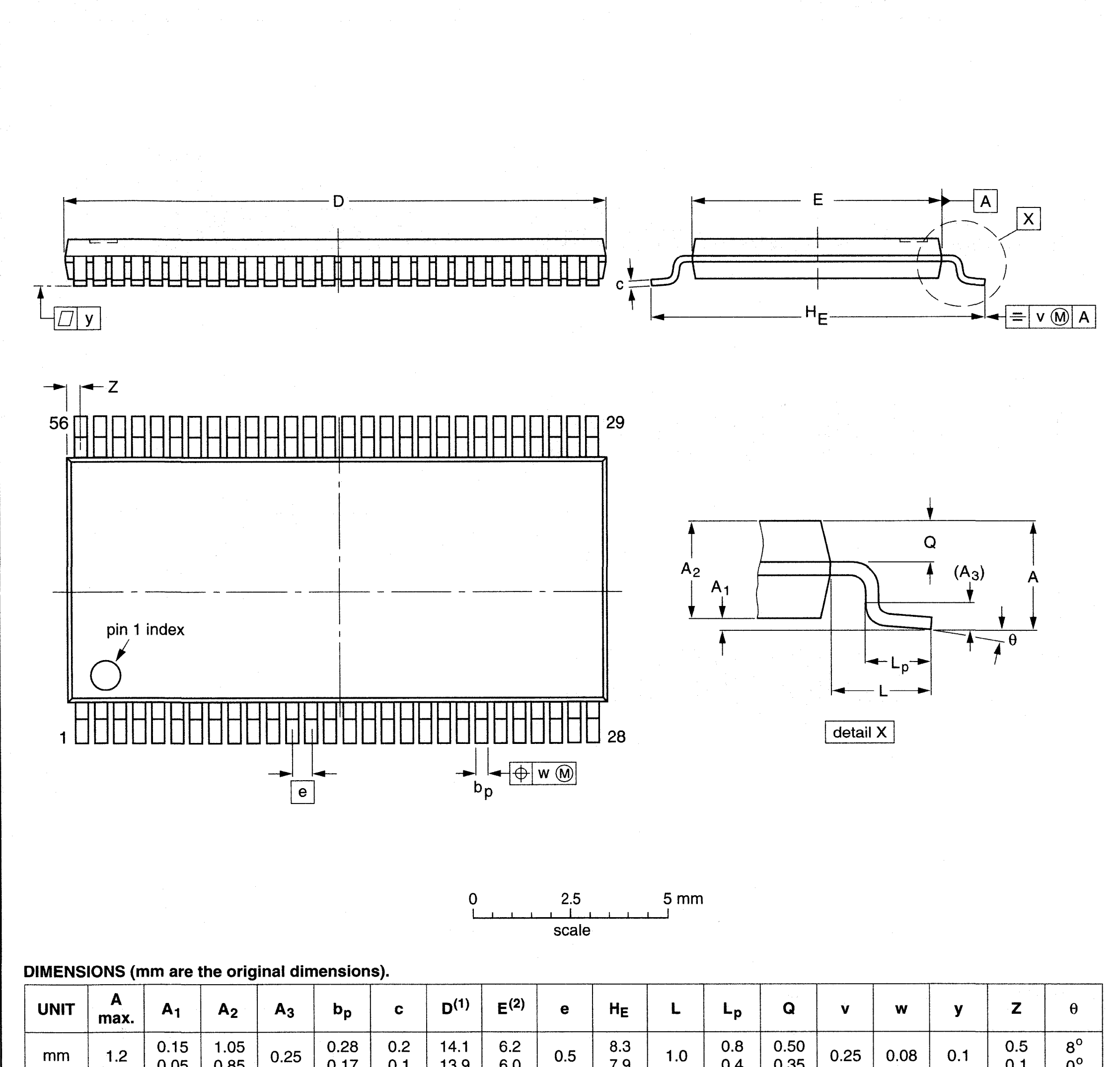
Notes

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			
SOT480-1		MO-153				97-03-20

IC package range and dimensions Chapter 2

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm SOT364-1



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	14.1 13.9	6.2 6.0	0.5	8.3 7.9	1.0	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.5 0.1	8° 0°

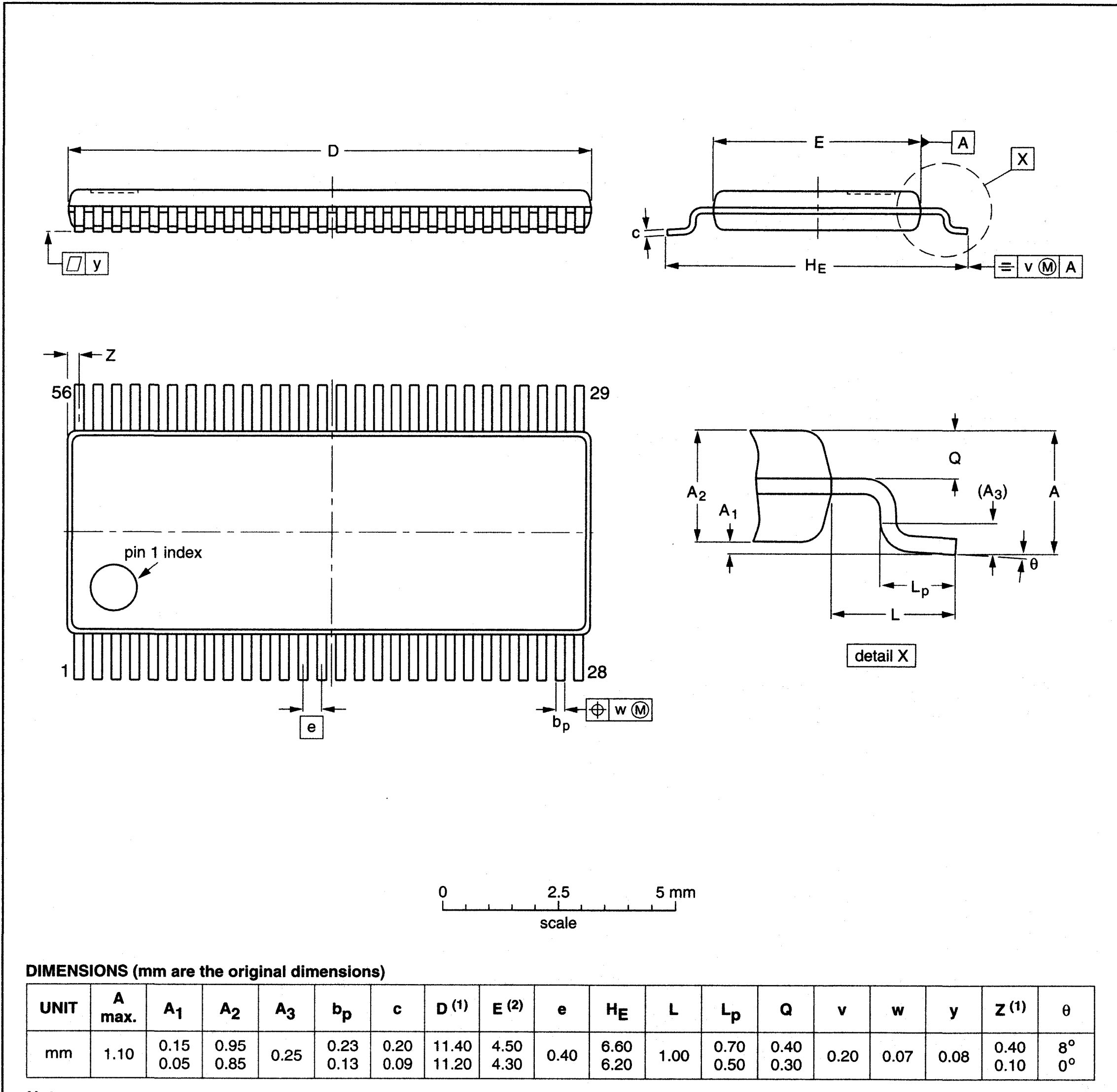
Notes

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			
SOT364-1		MO-153EE				~~93-02-03~~ 95-02-10

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 4.4 mm; lead pitch 0.4 mm

SOT481-1



DIMENSIONS (mm are the original dimensions)

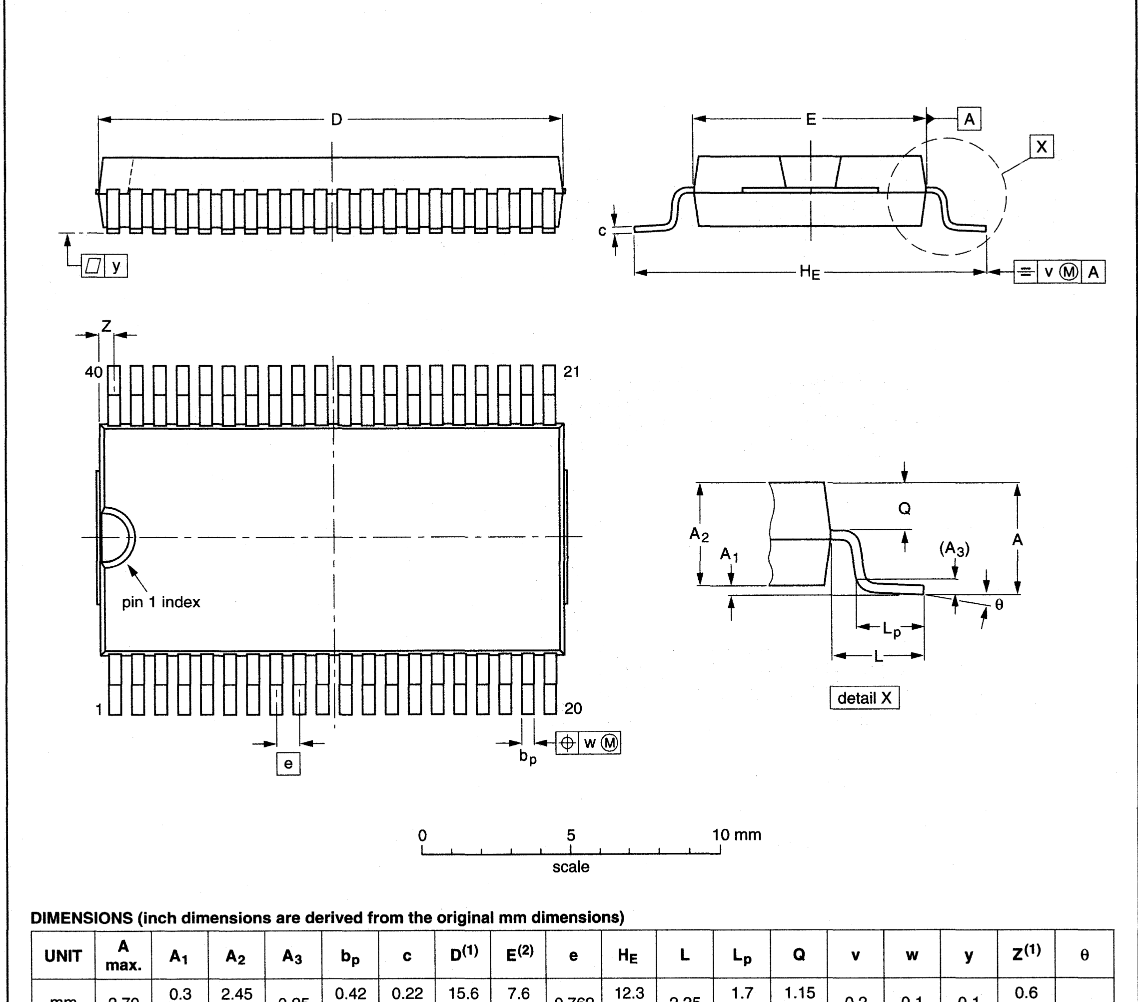
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.10	0.15 0.05	0.95 0.85	0.25	0.23 0.13	0.20 0.09	11.40 11.20	4.50 4.30	0.40	6.60 6.20	1.00	0.70 0.50	0.40 0.30	0.20	0.07	0.08	0.40 0.10	8° 0°

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			
SOT481-1		MO-194				97-03-20

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	

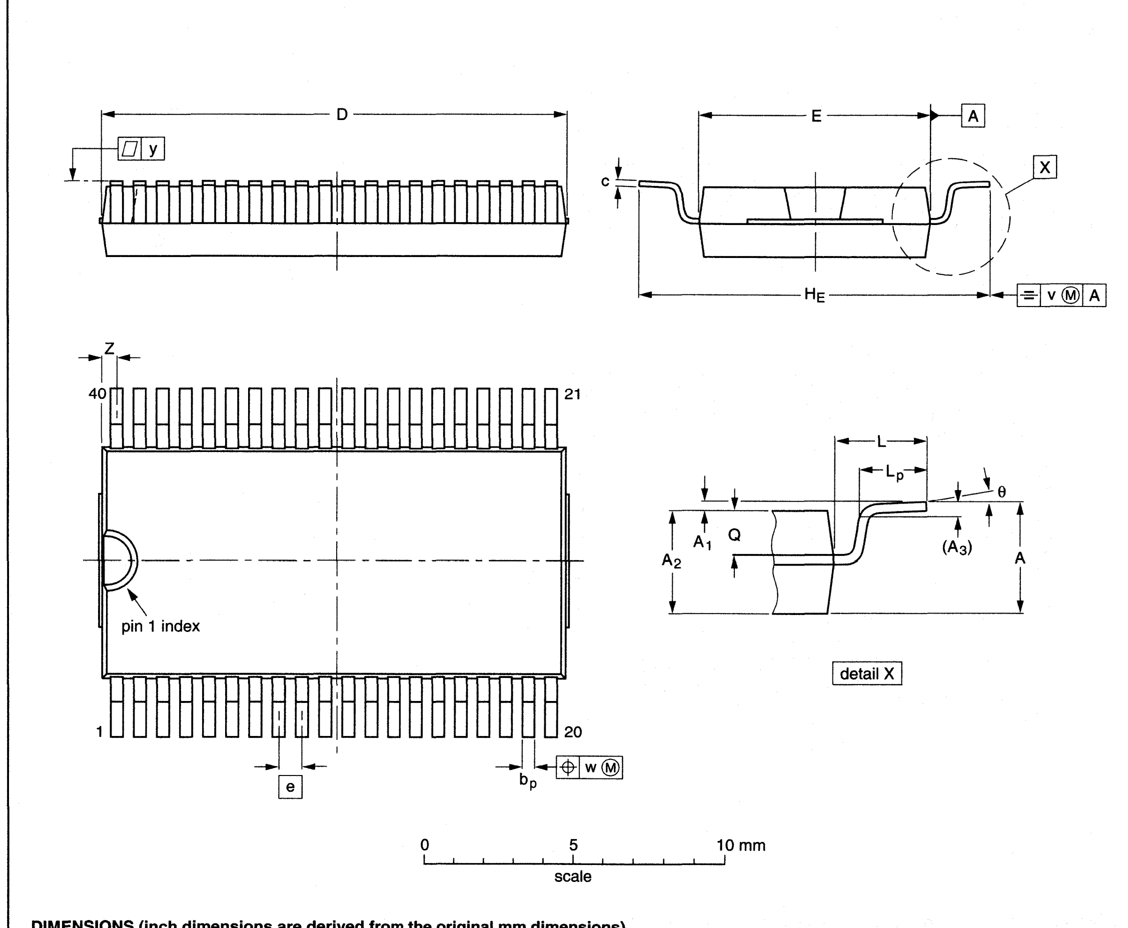
Notes

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)

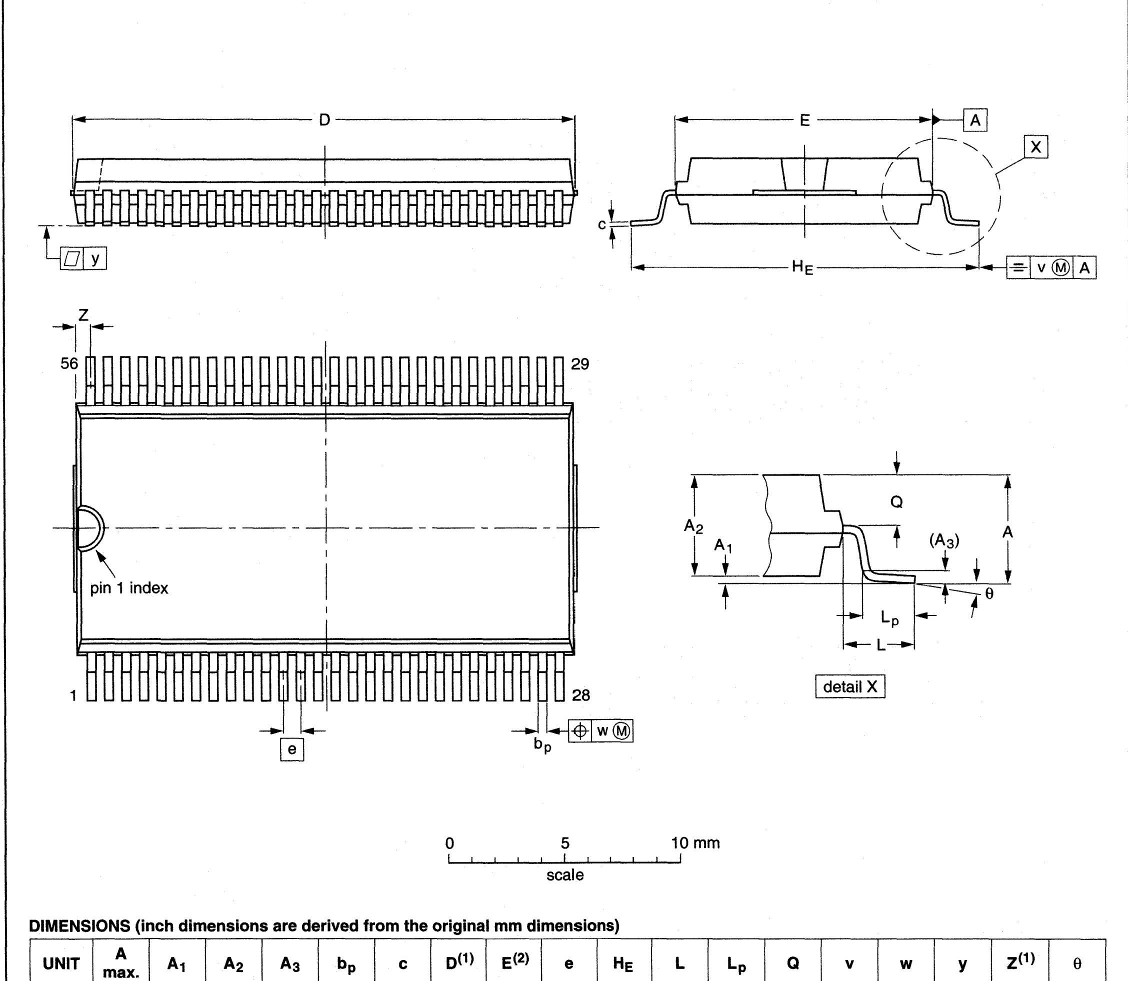
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.70	0.3 0.1	2.45 2.25	0.25	0.42 0.30	0.22 0.14	15.6 15.2	7.6 7.5	0.762	12.3 11.8	2.25	1.7 1.5	1.15 1.05	0.2	0.1	0.1	0.6 0.3	7° 0°
inches	0.11	0.012 0.004	0.096 0.089	0.010	0.017 0.012	0.0087 0.0055	0.61 0.60	0.30 0.29	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

VSO56: plastic very small outline package; 56 leads **SOT190-1**



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

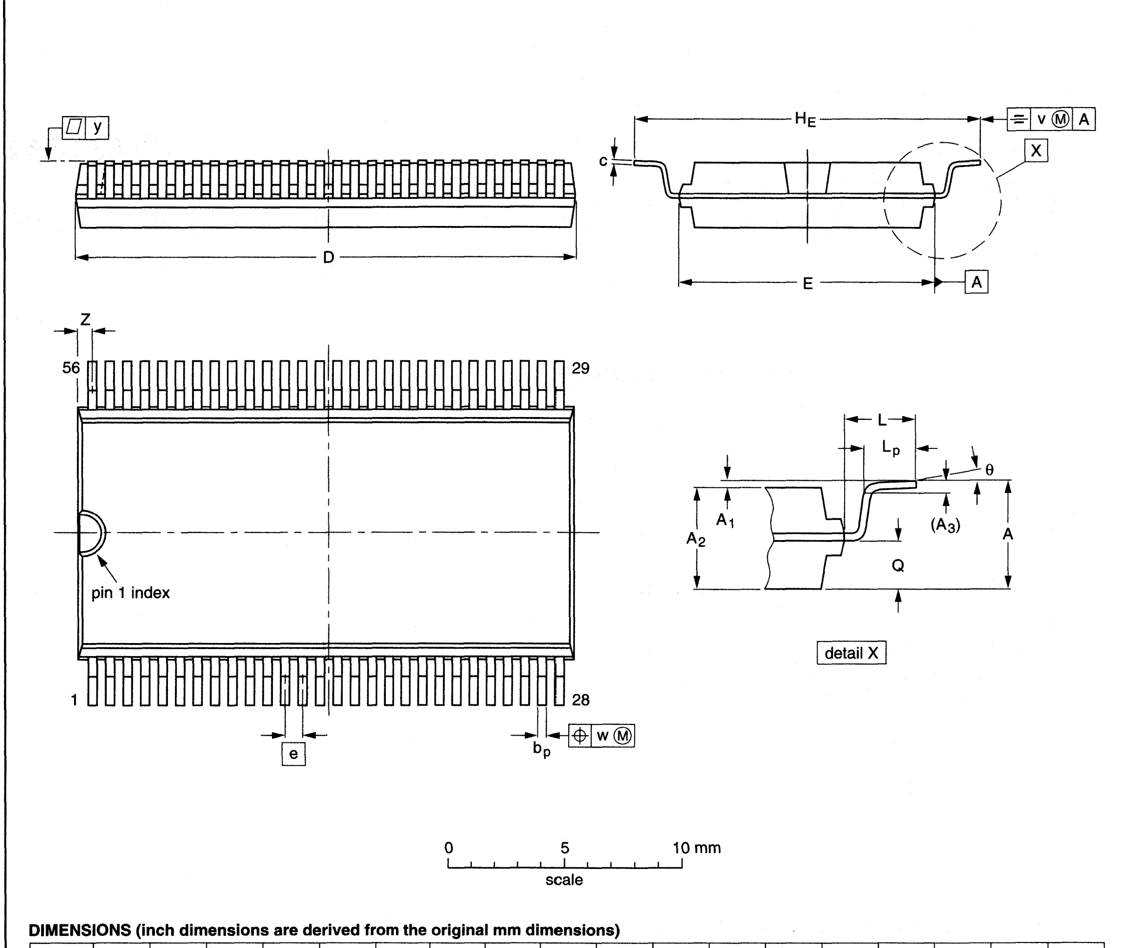
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	3.3	0.3 0.1	3.0 2.8	0.25	0.42 0.30	0.22 0.14	21.65 21.35	11.1 11.0	0.75	15.8 15.2	2.25	1.6 1.4	1.45 1.30	0.2	0.1	0.1	0.90 0.55	7° 0°
inches	0.13	0.012 0.004	0.12 0.11	0.01	0.017 0.012	0.0087 0.0055	0.85 0.84	0.44 0.43	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.
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OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT190-2						~~96-04-02~~ 97-08-11

CHAPTER 3

HANDLING PRECAUTIONS

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Receipt and storage of ICs	3 - 2
Assembling PC boards	3 - 2
Testing PC boards	3 - 2

Handling Precautions Chapter 3

ELECTROSTATIC CHARGES

Electrostatic charges can be stored in many things; for example, manmade fibre clothing, moving machinery, objects with air blowing across them, plastic storage bins, sheets of paper in plastic envelopes, paper from copying machines, and on people (see Fig.1). 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 is the transfer of an electrostatic charge between bodies at different potentials and occurs with direct contact or when induced by an electrostatic field. Although all pins of Philips ICs are protected against electrostatic discharge, we recommend the following ESD precautions are complied with when handling.

WORKSTATION FOR HANDLING MOS ICs

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 ICs

ICs 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.

The ICs 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 ICs that are stored temporarily should be packed in conductive or anti-static packing or carriers.

ASSEMBLING PC BOARDS

ICs 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 ICs 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 ICs 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 PC BOARDS

Completed PC boards 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 PC board on the conductive foam to await packing.

Assembled circuit boards containing ICs should always be handled in the same way as unmounted ICs. They should also carry warning labels and be packed in conductive or antistatic packing.

Handling Precautions Chapter 3

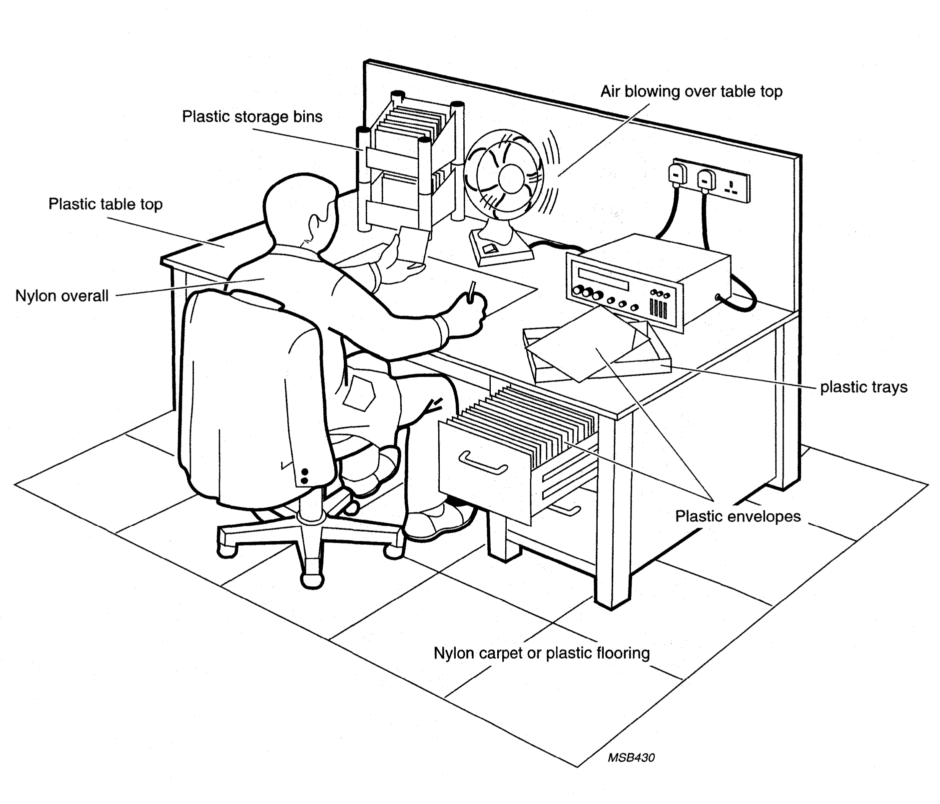

Fig.1 Typical working environment for electronic component handling showing potential ESD hazards.

Handling Precautions

Chapter 3

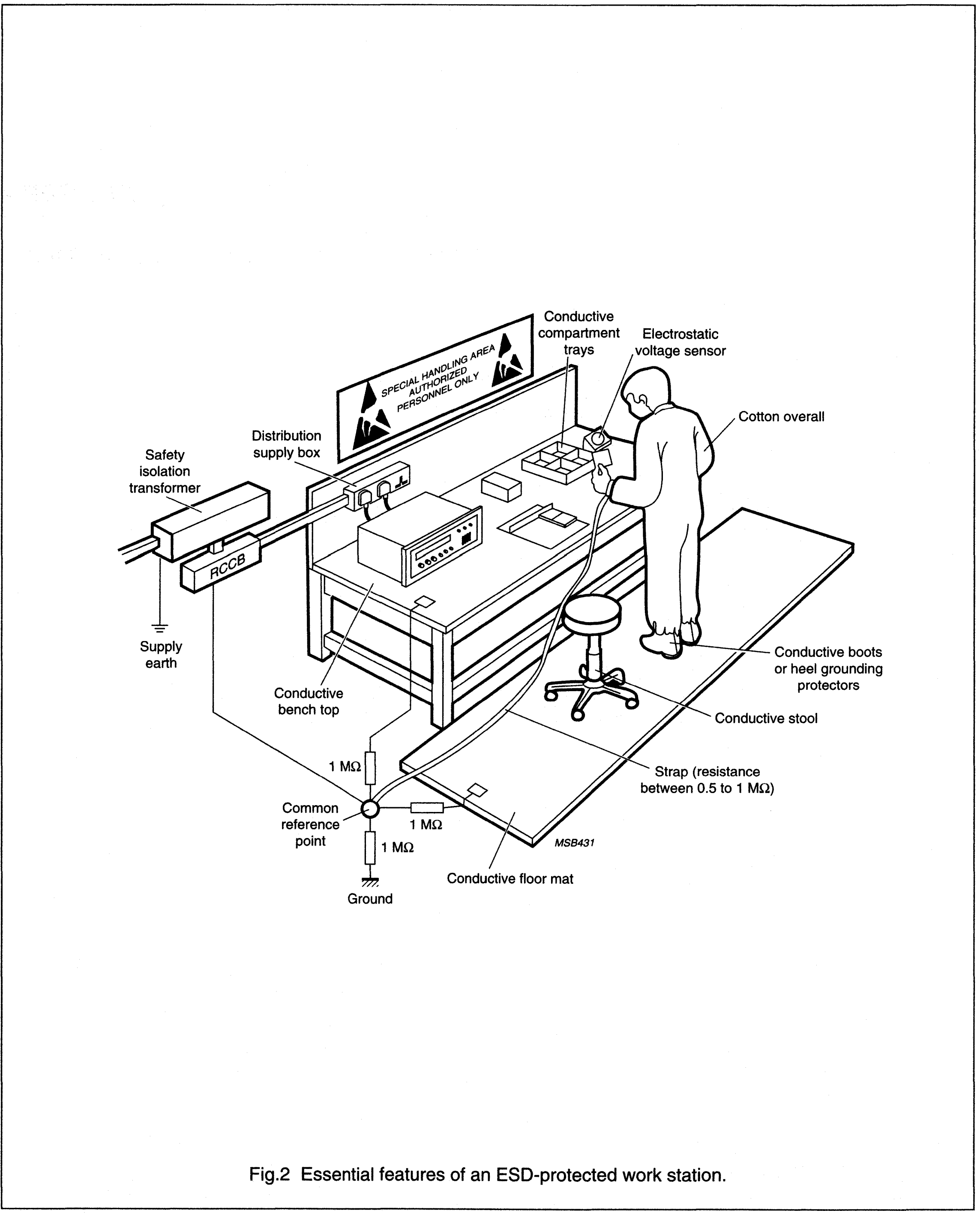

Fig.2 Essential features of an ESD-protected work station.

CHAPTER 4

THROUGH-HOLE MOUNTING METHODS

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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).

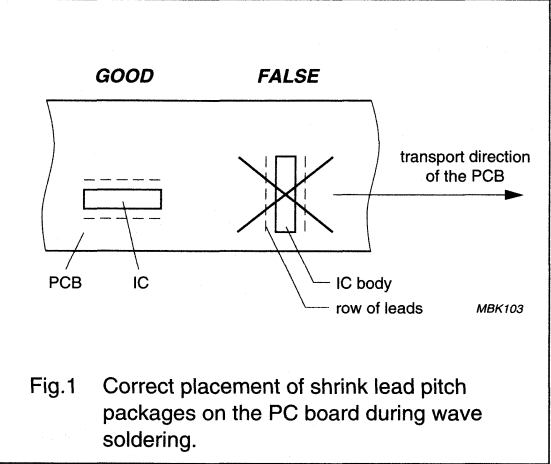

Fig.1 Correct placement of shrink lead pitch packages on the PC board during wave soldering.

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.

CHAPTER 5

SMD MOUNTING METHODS

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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. However, with an ever increasing variety of components becoming available as SMD types, reflow soldering is increasingly in popularity. 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.

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).

Table 1 Suitability of ICs for various soldering methods

	SO	SSOP	VSO	TSSOP	QFP	SQFP	LQFP	TQFP	PLCC
standard	IEC/JEDEC				IEC/JEDEC				JEDEC
number of leads	8-32	14-56	40-56	14-56	44-160	128-208	32-100	44-100	20-84
suitability for wave soldering(1)	4	2(2)	3	1(2)	2 (at 45°)(2)	1(2)	1(2)	1(2)	3
suitability for reflow soldering(1)									
IR	4	4	3	3	3	3	3	3	2
hot belt	4	4	3	3	3	3	3	3	3
hot gas	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	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.

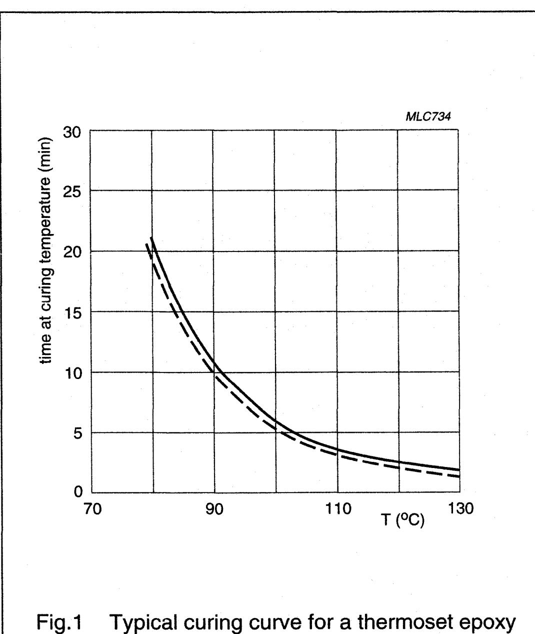


Fig.1 Typical curing curve for a thermoset epoxy resin (90% and 80% conversion).

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 rotation 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.

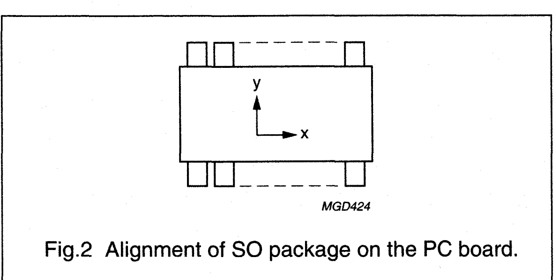


Fig.2 Alignment of SO package on the PC board.

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

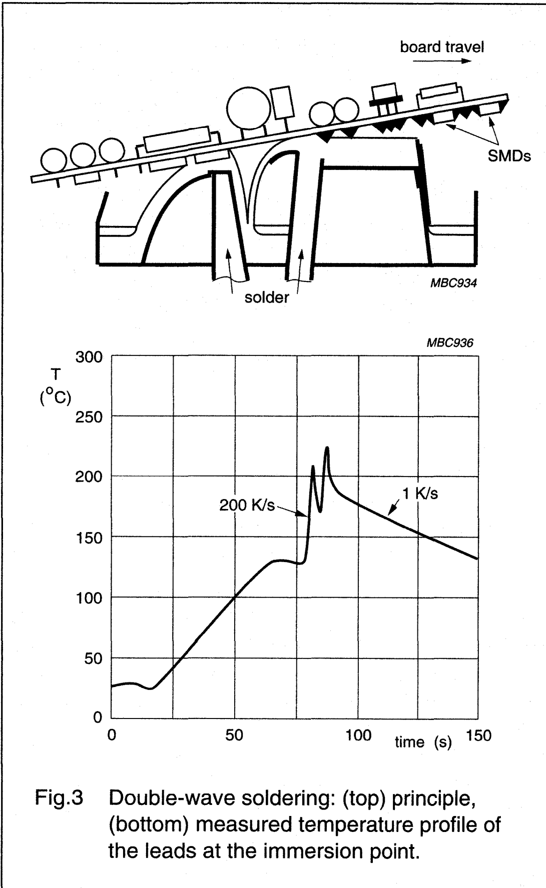


Fig.3 Double-wave soldering: (top) principle, (bottom) measured temperature profile of the leads at the immersion point.

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 ±2 °C, and a relative humidity of 55 +5/−10%.

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.

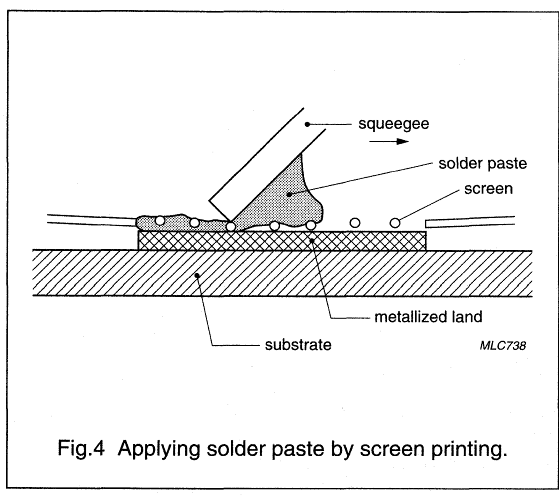


Fig.4 Applying solder paste by screen printing.

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.

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.

SMD mounting methods Chapter 5

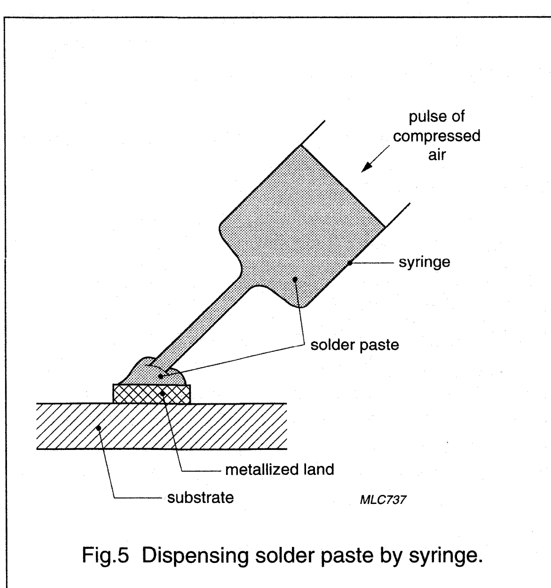


Fig.5 Dispensing solder paste by syringe.

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

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.

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

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

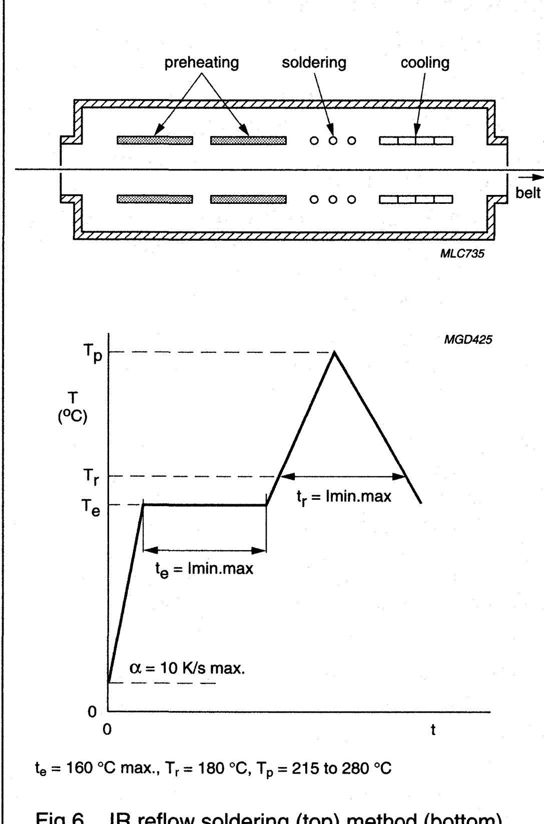
In mass production lines, the reflow process is usually performed in ovens fitted with conveyor belts. Heat transfer is either by infrared radition alone, or a combination of infrared radition and heat convection.

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.

IR reflow soldering is often used to solder ICs on glass-epoxy boards.

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 °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 prevents 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.



t_e = 160 °C max., T_r = 180 °C, T_p = 215 to 280 °C

Fig.6 IR reflow soldering (top) method (bottom) time/temperature profile.

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 wave soldering or 280 °C for single-sided wave soldering. Furthermore, the top-surface temperature of the packages should preferably be kept below 230 °C.

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 6: 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 and for de-soldering ICs.

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.

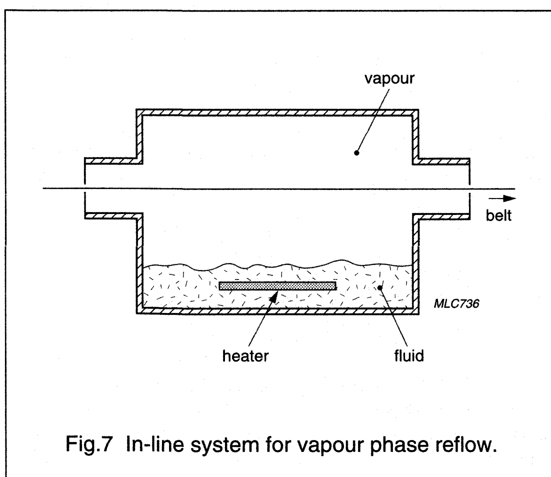


Fig.7 In-line system for vapour phase reflow.

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 heating than it is in vapour-phase heating, the gap between leads and solder can be larger (150 μm).

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.

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.

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.

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 distributed over the total surface area of the IC is sufficient to ensure that all its leads contact the solder lands.

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”)

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)

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.

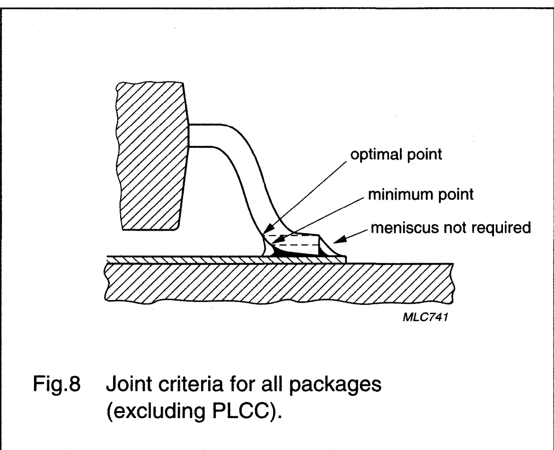


Fig.8 Joint criteria for all packages (excluding PLCC).

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.9). A meniscus extending to half the lead thickness is the acceptable minimum.

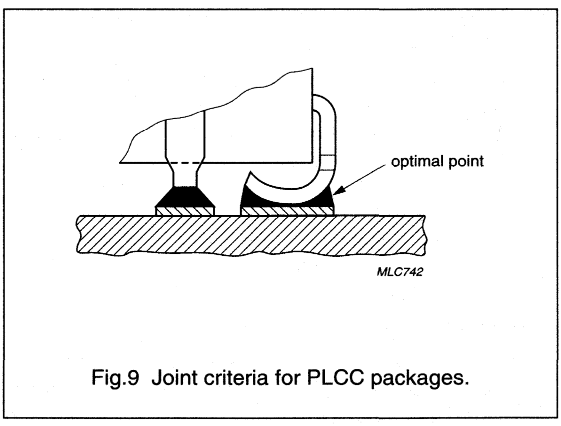


Fig.9 Joint criteria for PLCC packages.

SMD mounting methods Chapter 5

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. 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.

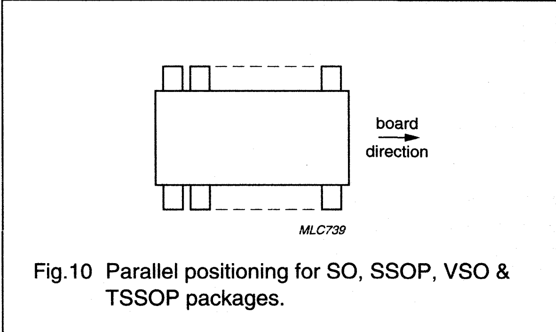


Fig.10 Parallel positioning for SO, SSOP, VSO & TSSOP packages.

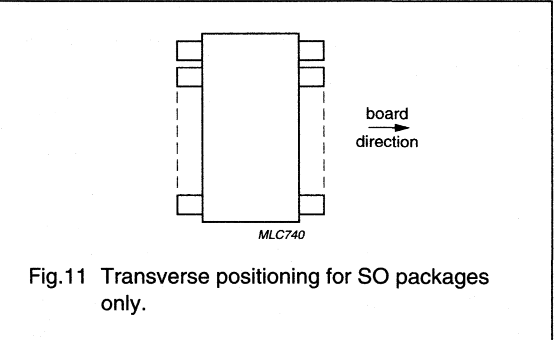


Fig.11 Transverse positioning for SO packages only.

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.

SO FOOTPRINT (REFLOW SOLDERING)

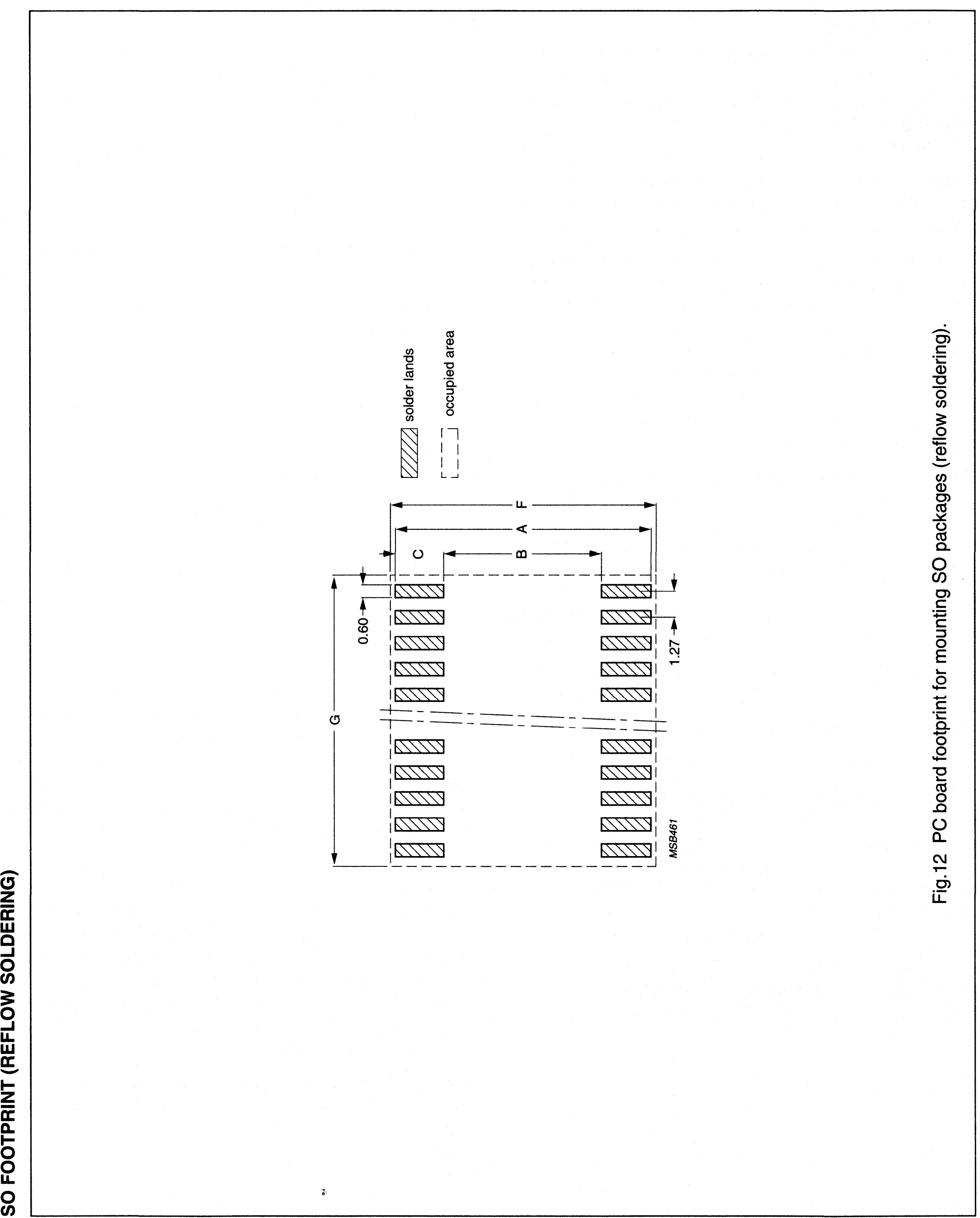


Fig.12 PC board footprint for mounting SO packages (reflow soldering).

Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	FOOTPRINT DIMENSIONS (mm)					PLACEMENT ACCURACY
		A	B	C	F	G	
SO8	SOT96-1	6.60	4.00	1.30	7.00	5.50	±0.25
SO8	SOT176-1	11.00	8.00	1.50	11.40	8.40	±0.25
SO14	SOT108-1	6.60	4.00	1.30	7.00	9.30	±0.25
SO16	SOT109-1	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT109-2	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT162-1	11.00	8.00	1.50	11.40	10.90	±0.25
SO20	SOT163-1	11.00	8.00	1.50	11.40	13.40	±0.25
SO24	SOT137-1	11.00	8.00	1.50	11.40	16.00	±0.25
SO28	SOT136-1	11.00	8.00	1.50	11.40	18.50	±0.25
SO32	SOT287-1	11.00	8.00	1.50	11.40	21.20	±0.25

SMD mounting methods

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SO FOOTPRINT (WAVE SOLDERING)

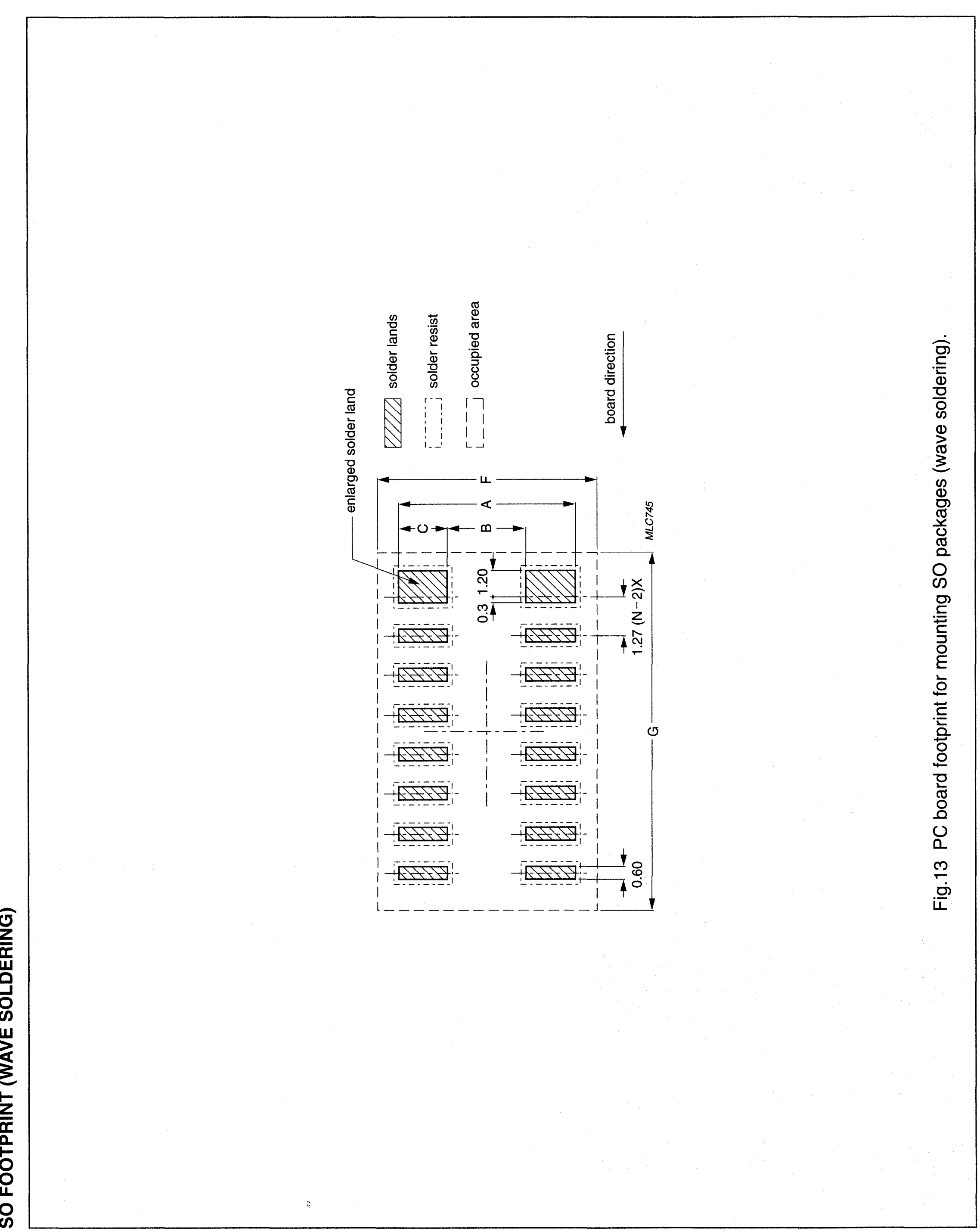

Fig.13 PC board footprint for mounting SO packages (wave soldering).

SMD mounting methods

Chapter 5

Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)					PLACEMENT ACCURACY
			A	B	C	F	G	
SO8	SOT96-1	8	8.00	3.80	2.10	9.40	7.10	±0.25
SO8	SOT176-1	8	11.50	7.90	1.80	13.00	10.90	±0.25
SO14	SOT108-1	14	8.00	3.80	2.10	9.40	10.80	±0.25
SO16	SOT109-1	16	8.00	3.80	2.10	9.40	12.10	±0.25
SO16	SOT109-2	16	8.00	3.80	2.10	9.40	12.10	±0.25
SO16	SOT162-1	16	11.50	7.90	1.80	13.00	13.40	±0.25
SO20	SOT163-1	20	11.50	7.90	1.80	13.00	15.90	±0.25
SO24	SOT137-1	24	11.50	7.90	1.80	13.00	18.50	±0.25
SO28	SOT136-1	28	11.50	7.90	1.80	13.00	21.00	±0.25
SO32	SOT287-1	32	11.60	7.60	2.00	13.10	23.70	±0.25

SMD mounting methods

Chapter 5

SSOP, VSO & TSSOP FOOTPRINT (REFLOW SOLDERING)

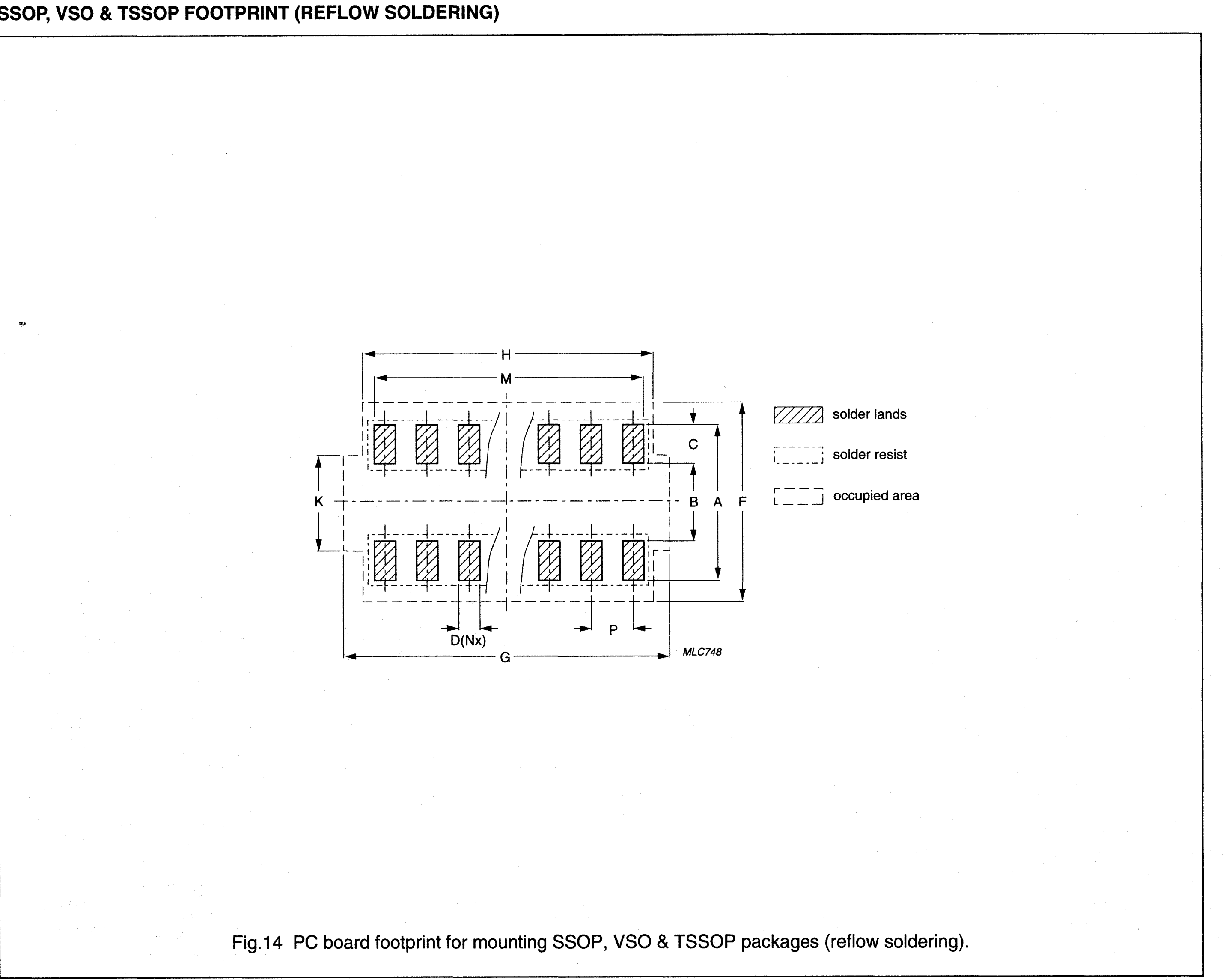

Fig.14 PC board footprint for mounting SSOP, VSO & TSSOP packages (reflow soldering).

Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)										PLACEMENT ACCURACY
			P	A	B	C	D	F	G	H	K	M	
SSOP14	SOT337-1	14	0.65	8.10	5.70	1.20	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	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	7.05	5.55	5.55	7.05	4.95	±0.15
SSOP20	SOT266-1	20	0.65	6.80	4.80	1.00	0.40	7.05	6.85	6.85	7.05	6.25	±0.15
SSOP20	SOT339-1	20	0.65	8.10	5.90	1.10	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	8.35	8.50	7.80	5.55	7.55	±0.15
SSOP28	SOT341-1	28	0.65	8.10	5.90	1.10	0.40	8.35	10.50	9.10	5.60	8.85	±0.15
SSOP36	SOT378-1	36	0.80	10.80	7.80	1.50	0.40	11.05	15.70	14.40	7.80	14.00	±0.15
SSOP48	SOT370-1	48	0.635	10.60	8.20	1.20	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	10.85	18.70	17.795	7.80	17.545	±0.15
VSO40	SOT158-1	40	0.762	12.60	8.20	2.20	0.40	13.00	16.20	–	–	–	±0.10
VSO40	SOT158-2	40	0.762	12.60	8.20	2.20	0.40	13.00	16.20	–	–	–	±0.10
VSO56	SOT190-1	56	0.75	16.10	11.90	2.10	0.40	16.50	22.20	–	–	–	±0.10
TSSOP14	SOT402-1	14	0.65	6.80	4.60	1.10	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	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	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	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	7.05	9.95	9.10	4.70	8.85	±0.15
TSSOP48	SOT362-1	48	0.50	8.50	6.50	1.00	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	9.75	15.035	15.035	9.75	13.785	±0.10

SSOP, VSO & TSSOP FOOTPRINT (WAVE SOLDERING)

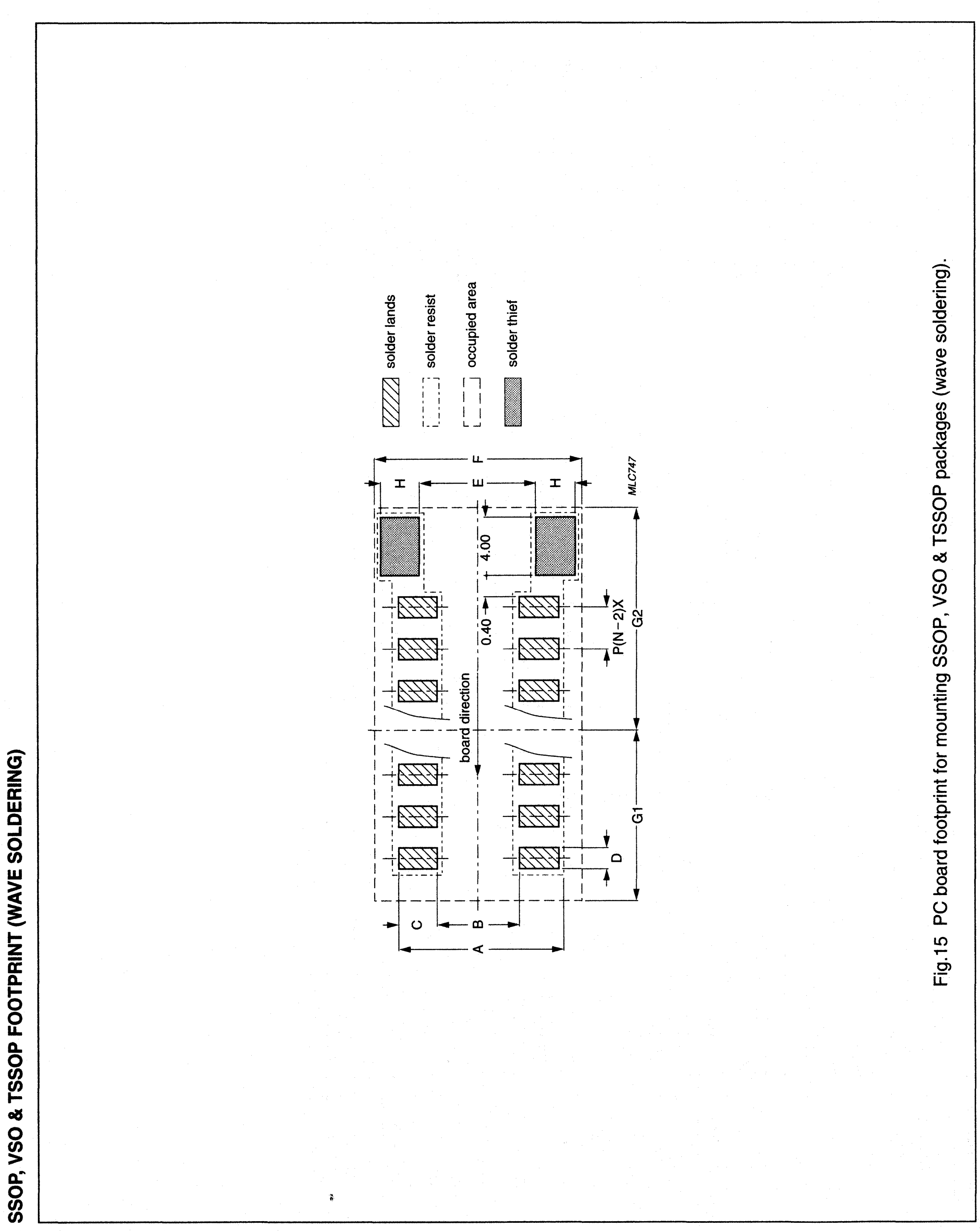

Fig.15 PC board footprint for mounting SSOP, VSO & TSSOP packages (wave soldering).

Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)										PLACEMENT ACCURACY
			P	A	B	C	D	E	F	G1	G2	H	
SSOP14	SOT337-1	14	0.65	9.15	5.35	1.90	0.30	6.15	10.65	4.25	6.75	2.00	±0.10
SSOP16	SOT338-1	16	0.65	9.15	5.35	1.90	0.30	6.15	10.65	4.25	7.075	2.00	±0.10
SSOP16	SOT369-1	16	0.65	8.30	4.50	1.90	0.30	5.30	9.80	3.55	7.075	2.00	±0.15
SSOP20	SOT266-1	20	0.65	8.30	4.50	1.90	0.30	5.30	9.80	4.20	7.725	2.00	±0.15
SSOP20	SOT339-1	20	0.65	9.15	5.55	1.80	0.30	6.30	10.80	4.75	7.725	2.00	±0.10
SSOP24	SOT340-1	24	0.65	9.15	5.55	1.80	0.30	6.30	10.80	5.25	8.375	2.00	±0.10
SSOP28	SOT341-1	28	0.65	9.15	5.55	1.80	0.30	6.30	10.80	6.25	9.025	2.00	±0.10
SSOP36	SOT378-1	36	0.80	11.40	7.60	1.90	0.40	8.50	13.30	9.20	11.65	2.15	±0.15
SSOP48	SOT370-1	Not suitable for wave soldering.											
SSOP56	SOT371-1	Not suitable for wave soldering.											
VSO40	SOT158-1	40	0.762	12.80	8.20	2.30	0.35	9.20	14.30	9.50	12.10	2.30	±0.10
VSO40	SOT158-2	40	0.762	12.80	8.20	2.30	0.35	9.20	14.30	9.50	12.10	2.30	±0.10
VSO56	SOT190-1	56	0.75	16.20	11.80	2.20	0.35	12.80	17.70	12.70	15.00	2.20	±0.10
TSSOP14	SOT402-1	14	0.65	8.30	4.50	1.90	0.30	5.15	9.80	3.20	6.75	2.075	±0.15
TSSOP16	SOT403-1	16	0.65	8.30	4.50	1.90	0.30	5.15	9.80	3.20	7.075	2.075	±0.15
TSSOP20	SOT360-1	20	0.65	8.30	4.50	1.90	0.30	5.15	9.80	3.95	7.725	2.075	±0.15
TSSOP24	SOT355-1	24	0.65	8.30	4.50	1.90	0.30	5.15	9.80	4.60	8.375	2.075	±0.15
TSSOP28	SOT361-1	28	0.65	8.30	4.50	1.90	0.30	5.15	9.80	5.55	9.025	2.075	±0.15
TSSOP48	SOT362-1	Not suitable for wave soldering.											
TSSOP56	SOT364-1	Not suitable for wave soldering.											

QFP, SQFP, LQFP & TQFP FOOTPRINT (REFLOW SOLDERING)

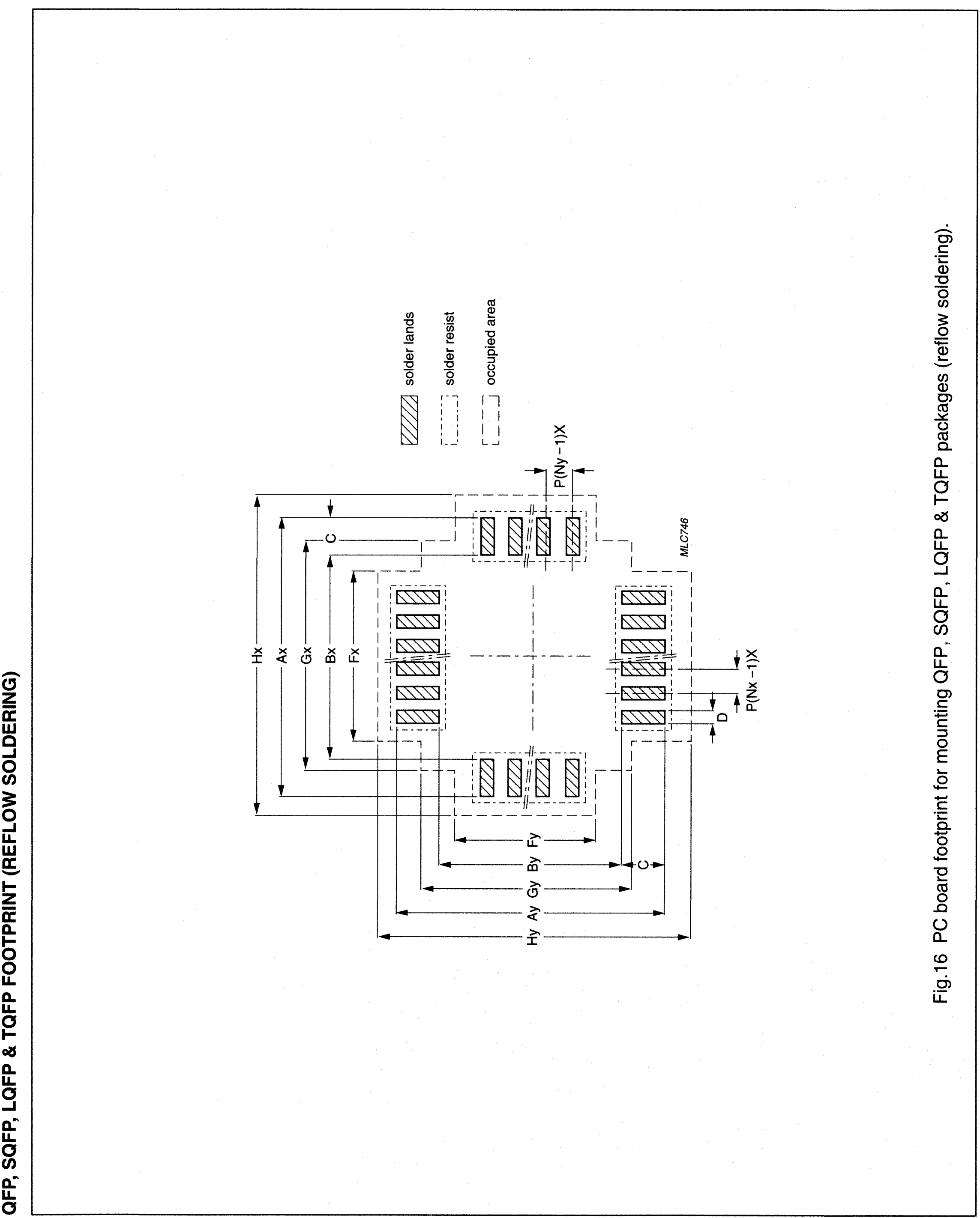

Fig.16 PC board footprint for mounting QFP, SQFP, LQFP & TQFP packages (reflow soldering).

Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)													PLACEMENT ACCURACY
				P	Ax	Ay	Bx	By	C	D	Fx	Fy	Gx	Gy	Hx	Hy	
QFP44	SOT205-1	11	11	1.00	19.40	19.40	14.80	14.80	2.30	0.60	11.00	11.00	14.40	14.40	19.65	19.65	±0.25
QFP44	SOT307-2	11	11	0.80	13.50	13.50	10.50	10.50	1.50	0.40	8.75	8.75	10.25	10.25	13.35	13.35	±0.15
QFP52	SOT379-1	13	13	0.65	13.65	13.65	10.85	10.85	1.40	0.40	8.45	8.45	10.25	10.25	13.90	13.90	±0.15
QFP64	SOT319-1	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	19.00	13.00	20.40	14.40	24.65	18.65	±0.25
QFP64	SOT319-2	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	19.00	13.00	20.40	14.40	24.65	18.65	±0.25
QFP64	SOT319-3	19	13	1.00	25.20	19.20	21.60	15.60	1.80	0.60	19.00	13.00	20.40	14.40	25.45	19.45	±0.25
QFP64	SOT393-1	16	16	0.80	17.65	17.65	14.85	14.85	1.40	0.40	12.80	12.80	14.25	14.25	17.90	17.90	±0.15
QFP80	SOT310-1	24	16	0.80	23.80	17.80	21.00	15.00	1.40	0.40	19.20	12.80	20.25	14.25	24.05	18.05	±0.15
QFP80	SOT318-1	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65	±0.15
QFP80	SOT318-2	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65	±0.15
QFP80	SOT318-3	24	16	0.80	25.20	20.20	21.60	15.60	1.80	0.40	19.20	12.80	20.25	14.25	25.45	19.45	±0.15
QFP100	SOT317-1	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP100	SOT317-2	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP100	SOT382-1	30	20	0.65	23.65	17.65	20.85	14.85	1.40	0.40	19.50	13.00	20.25	14.25	23.90	17.90	±0.15
QFP120	SOT349-1	30	30	0.80	32.40	32.40	29.40	29.40	1.50	0.40	24.00	24.00	28.25	28.25	32.65	32.65	±0.15
QFP120	SOT383-1	30	30	0.80	31.65	31.65	28.85	28.85	1.40	0.40	24.00	24.00	28.25	28.25	31.90	31.90	±0.15
QFP128	SOT320-1	32	32	0.80	32.40	32.40	29.40	29.40	1.50	0.40	25.60	25.60	28.25	28.25	32.65	32.65	±0.15
QFP160	SOT322-1	40	40	0.65	32.40	32.40	29.40	29.40	1.50	0.40	26.00	26.00	28.25	28.25	32.65	32.65	±0.15
SQFP128	SOT387-1	36	28	0.50	23.70	17.70	20.90	14.90	1.40	0.285	20.20	14.20	20.20	20.20	24.95	18.95	±0.10
SQFP208	SOT316-1	52	52	0.50	31.10	31.10	28.70	28.70	1.20	0.285	27.03	27.03	28.20	28.20	32.35	32.35	±0.10
LQFP32	SOT358-1	8	8	0.80	9.50	9.50	7.30	7.30	1.10	0.40	6.40	6.40	7.25	7.25	9.75	9.75	±0.15
LQFP44	SOT389-1	11	11	0.80	12.35	12.35	10.35	10.35	1.00	0.40	8.80	8.80	10.25	10.25	12.60	12.60	±0.15
LQFP48	SOT313-1	12	12	0.50	9.50	9.50	7.30	7.30	1.10	0.285	7.20	7.20	7.20	7.20	10.75	10.75	±0.10
LQFP48	SOT313-2	12	12	0.50	9.50	9.50	7.30	7.30	1.10	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	9.035	9.035	10.20	10.20	13.75	13.75	±0.10
LQFP80	SOT315-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	11.035	11.035	12.20	12.20	15.75	15.75	±0.10
LQFP128	SOT425-1	38	26	0.50	22.50	16.50	20.30	14.30	1.10	0.285	20.035	14.035	20.20	14.20	23.75	17.75	±0.10
TQFP44	SOT376-1	11	11	0.80	12.40	12.40	10.40	10.40	1.00	0.40	8.70	8.70	10.30	10.30	12.65	12.65	±0.15
TQFP64	SOT357-1	16	16	0.50	12.40	12.40	10.40	10.40	1.00	0.285	9.035	9.035	10.25	10.25	13.65	13.65	±0.10
TQFP80	SOT375-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	11.035	11.035	12.20	12.20	15.75	15.75	±0.10
TQFP100	SOT386-1	25	25	0.50	16.50	16.50	14.30	14.30	1.10	0.285	13.535	13.535	14.20	14.20	17.75	17.75	±0.10

QFP, SQFP, LQFP & TQFP FOOTPRINT (WAVE SOLDERING)

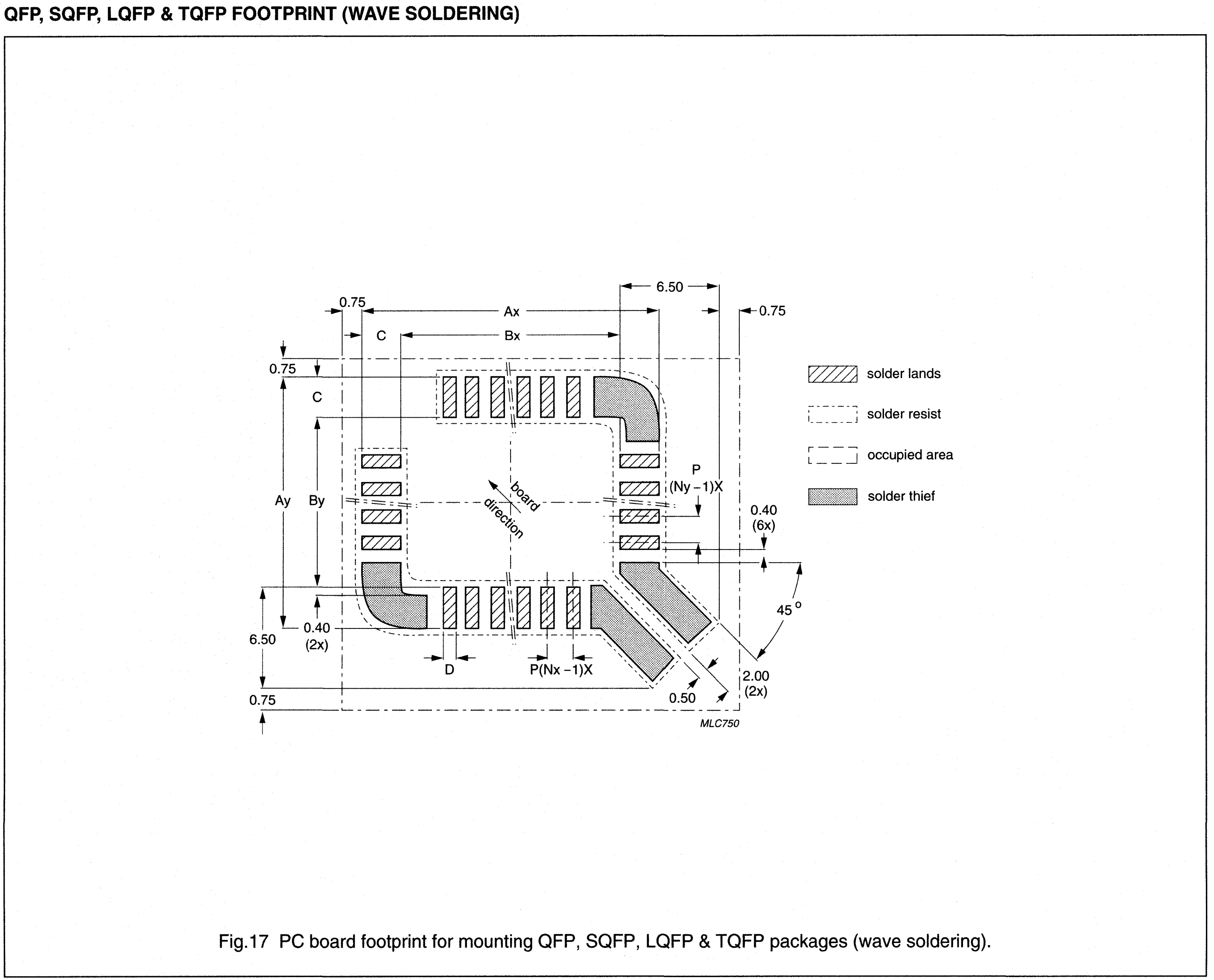

Fig.17 PC board footprint for mounting QFP, SQFP, LQFP & TQFP packages (wave soldering).

Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)							PLACEMENT ACCURACY
				P	Ax	Ay	Bx	By	C	D	
QFP44	SOT205-1	11	11	1.00	19.80	19.80	14.40	14.40	2.70	0.50	±0.25
QFP44	SOT307-2	11	11	0.80	13.90	13.90	10.30	10.30	1.80	0.40	±0.15
QFP52	SOT379-1	Not suitable for wave soldering.									
QFP64	SOT319-1	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	±0.25
QFP64	SOT319-2	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	±0.25
QFP64	SOT319-3	13	19	1.00	19.70	25.70	15.30	21.30	2.20	0.50	±0.25
QFP64	SOT393-1	16	16	0.80	17.95	17.95	14.75	14.75	1.60	0.40	±0.15
QFP80	SOT310-1	16	24	0.80	18.10	24.10	14.70	20.70	1.70	0.40	±0.15
QFP80	SOT318-1	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	±0.15
QFP80	SOT318-2	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	±0.15
QFP80	SOT318-3	16	24	0.80	19.50	25.50	15.50	21.50	2.00	0.40	±0.15
QFP100	SOT317-1	Not suitable for wave soldering.									
QFP100	SOT317-2	Not suitable for wave soldering.									
QFP100	SOT382-1	Not suitable for wave soldering.									
QFP120	SOT349-1	30	30	0.80	32.70	32.70	29.30	29.30	1.70	0.40	±0.15
QFP120	SOT383-1	30	30	0.80	31.95	31.95	28.95	28.95	1.50	0.40	±0.15
QFP128	SOT320-1	32	32	0.80	32.70	32.70	29.30	29.30	1.70	0.40	±0.15
QFP160	SOT322-1	Not suitable for wave soldering.									
SQFP128	SOT387-1	Not suitable for wave soldering.									
SQFP208	SOT316-1	Not suitable for wave soldering.									
LQFP32	SOT358-1	8	8	0.80	10.95	10.95	7.15	7.15	1.90	0.40	±0.15
LQFP44	SOT389-1	11	11	0.80	13.90	13.90	10.10	10.10	1.90	0.40	±0.15
LQFP48	SOT313-1	Not suitable for wave soldering.									
LQFP48	SOT313-2	Not suitable for wave soldering.									
LQFP64	SOT314-2	Not suitable for wave soldering.									
LQFP80	SOT315-1	Not suitable for wave soldering.									
LQFP128	SOT425-1	Not suitable for wave soldering.									
TQFP44	SOT376-1	11	11	0.80	13.95	13.95	10.15	10.15	1.90	0.40	±0.15
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 (REFOLW SOLDERING)

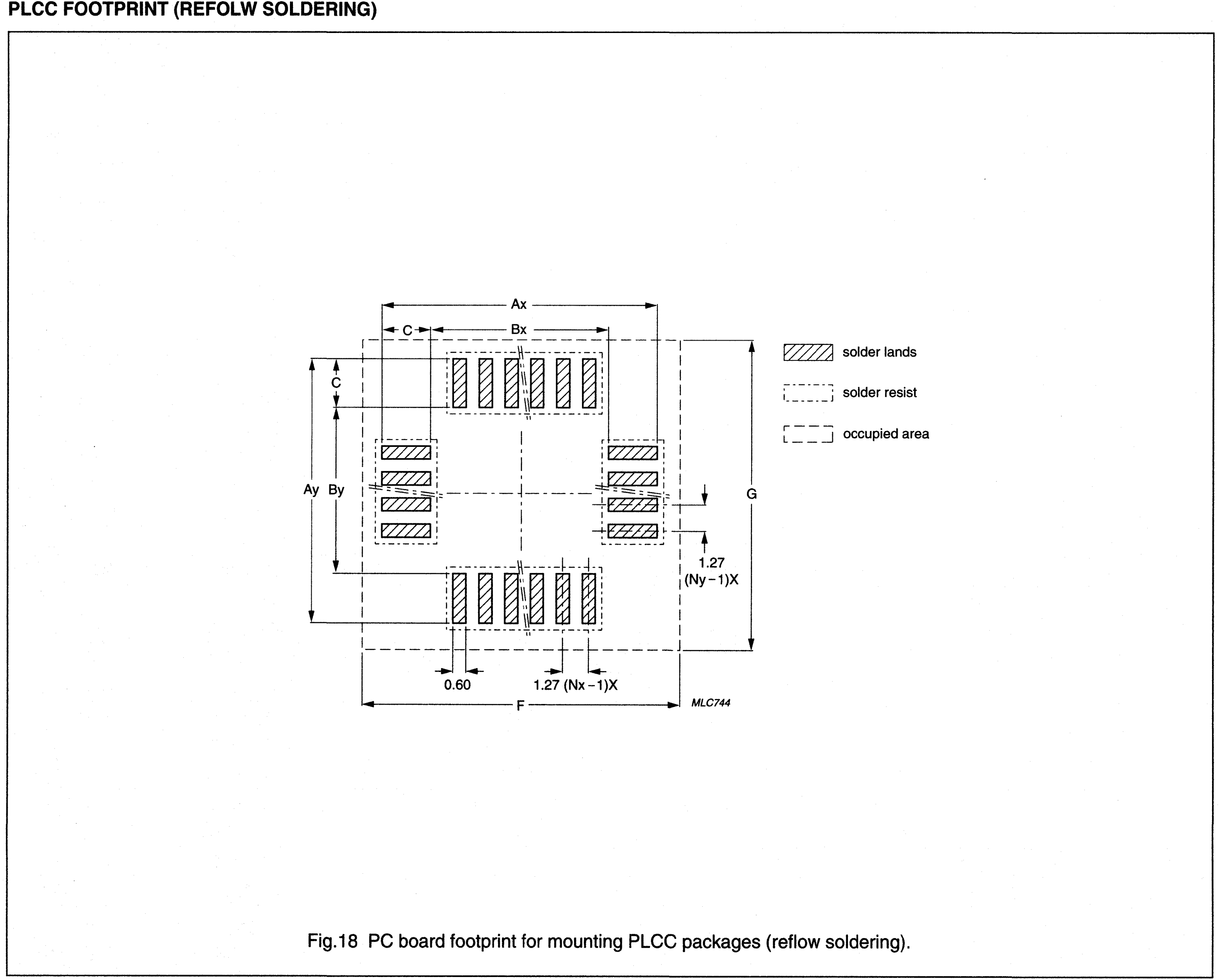

Fig.18 PC board footprint for mounting PLCC packages (reflow soldering).

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
PLCC32	SOT381-2	9	7	15.40	12.80	11.70	9.10	1.85	15.80	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

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PLCC FOOTPRINT (WAVE SOLDERING)

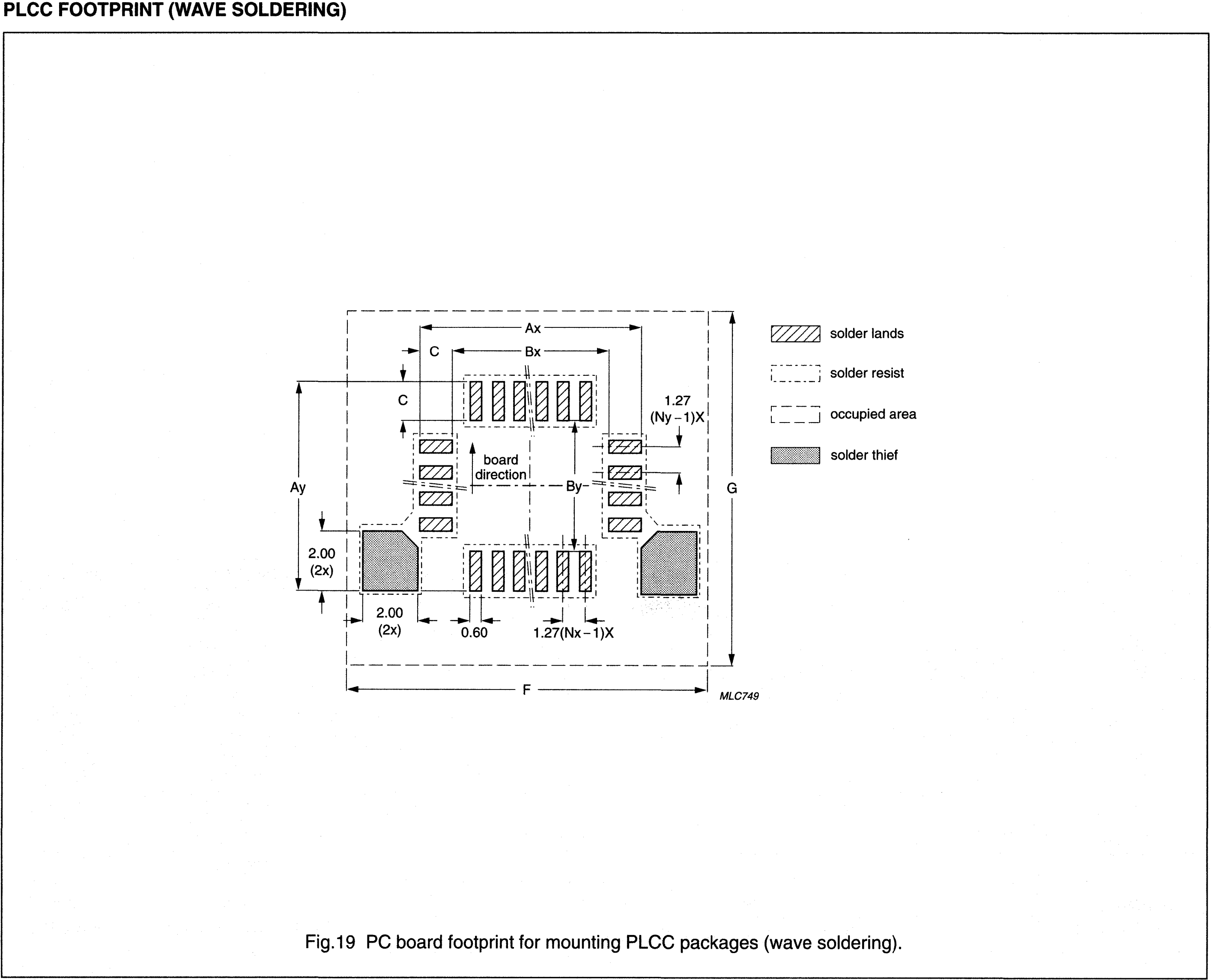

Fig.19 PC board footprint for mounting PLCC packages (wave soldering).

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
PLCC32	SOT381-2	9	7	14.80	12.20	11.70	9.10	1.55	19.40	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

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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 (°C)
$R_{th(j-a)}$ = thermal resistance junction to ambient (K/W)
P_d = power dissipated (W)
T_{amb} = ambient temperature (°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.

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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 $R_{th(j\text{-}a)}$ or $R_{th(j\text{-}c)}$.

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

Philip 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 ft^3 (0.0283 m^3). 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.

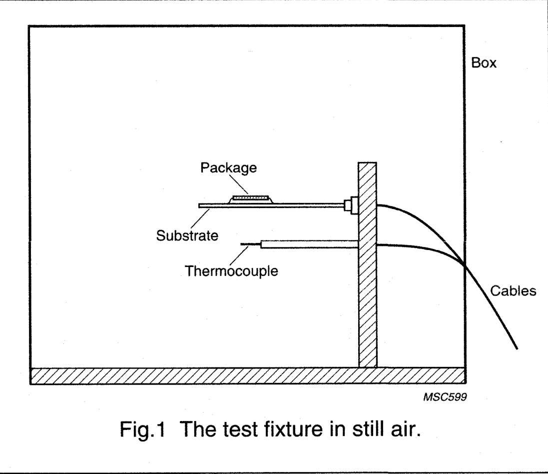

Fig.1 The test fixture in still air.

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:

$R_{th(j\text{-}a)}$ = thermal resistance junction to ambient (°C/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 (°C/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)

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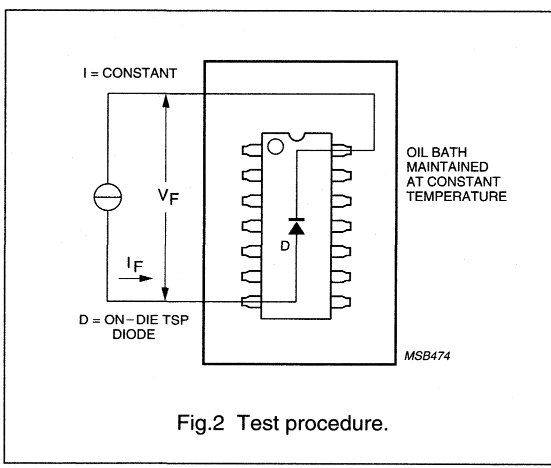

Fig.2 Test procedure.

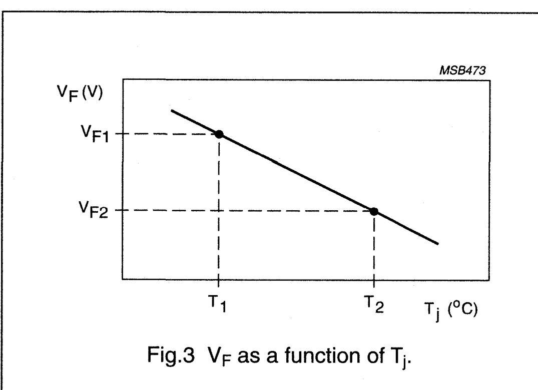

Fig.3 V_F as a function of T_j.

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.

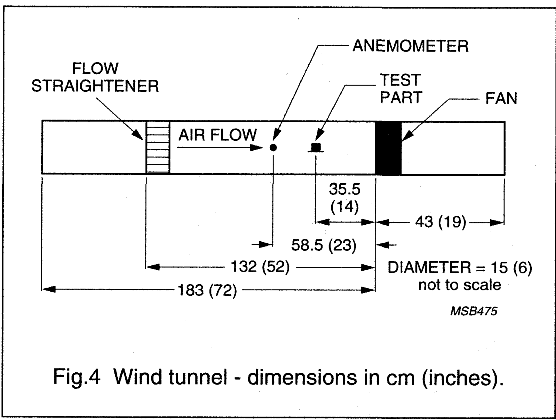

Fig.4 Wind tunnel - dimensions in cm (inches).

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.

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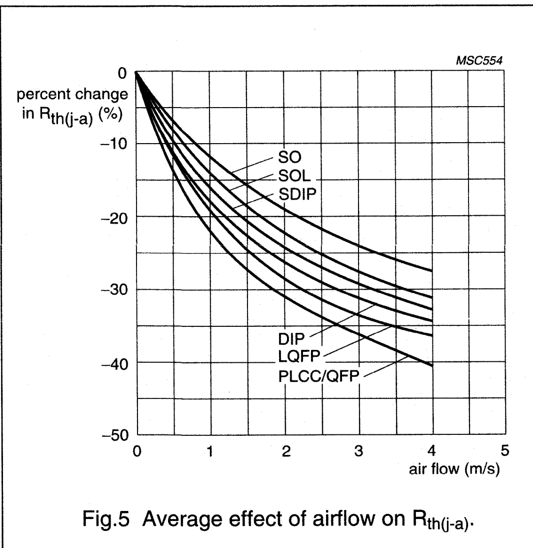

Fig.5 Average effect of airflow on $R_{th(j-a)}$.

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. Philip Semiconductors uses low effective thermal conductivity test boards for most of its packages.
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 ±15%. For more specific information regarding an application, please contact Philips Semiconductors.
8. Philips Semiconductors is evaluating a new technique, which was described in the ESPRIT project DELPHI, to thermally characterize IC packages. This results in a description of the package by means of a resistor network, the so-called compact model. This resistor network gives an accurate model of the package and is valid for all practical environments. It is expected that these models can be imported into system- and PCB-level analyses tools in the near future. If you require more information about compact models, please contact the ATO-Innovation office in Nijmegen, the Netherlands tel. +31-24-3533085 or fax +31-24-3533350.

THERMAL RESISTANCE ($R_{th(j-a)}$) DATA

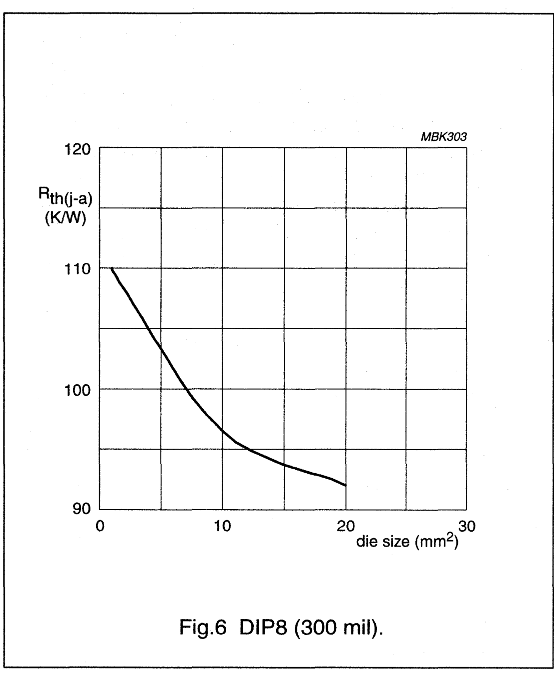

Fig.6 DIP8 (300 mil).

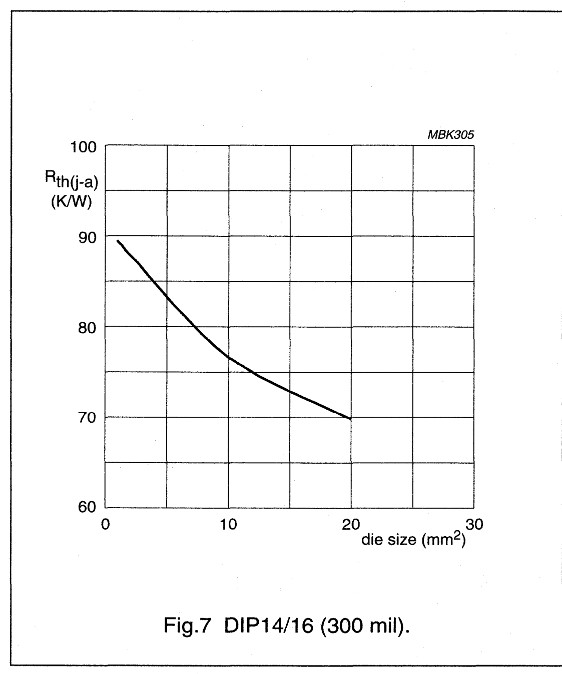

Fig.7 DIP14/16 (300 mil).

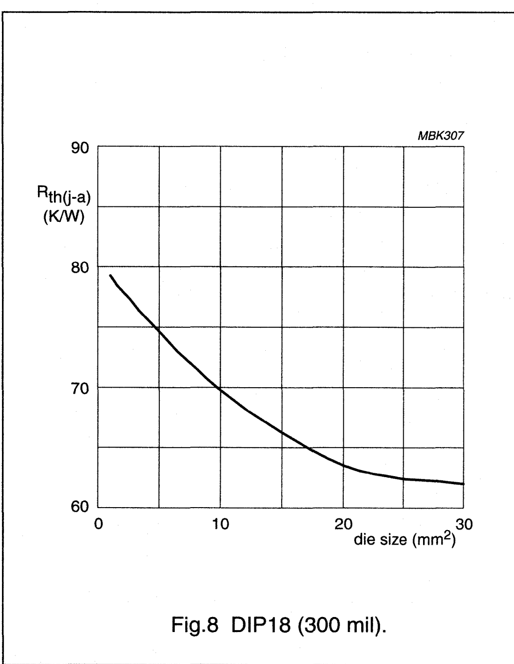

Fig.8 DIP18 (300 mil).

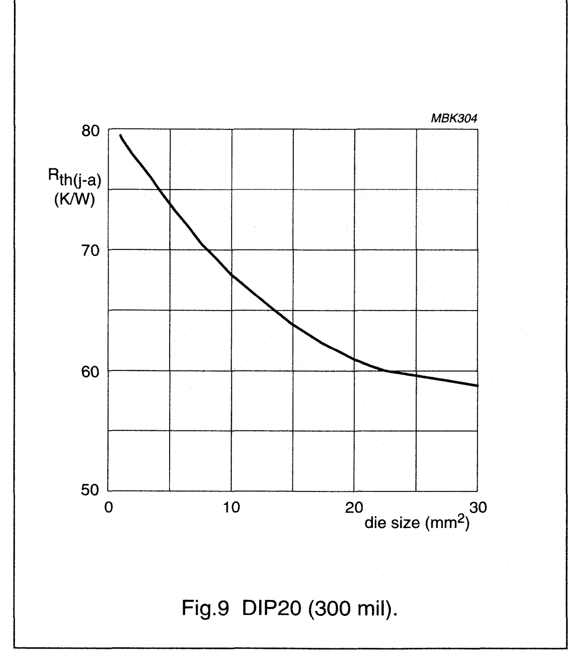

Fig.9 DIP20 (300 mil).

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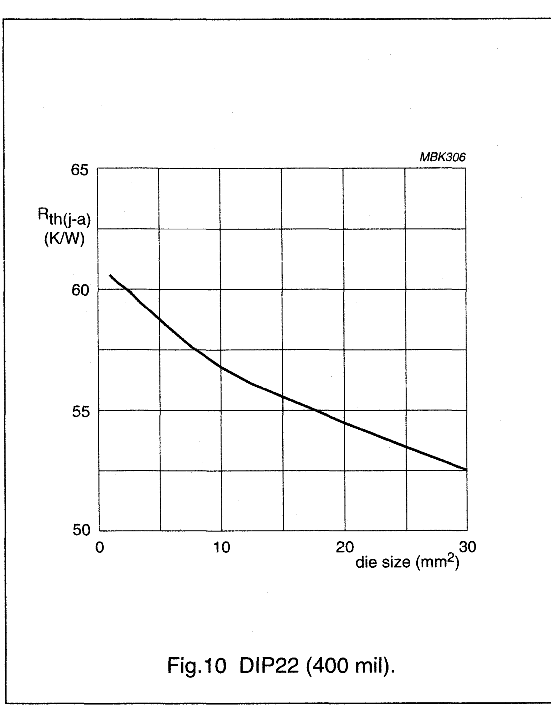

Fig.10 DIP22 (400 mil).

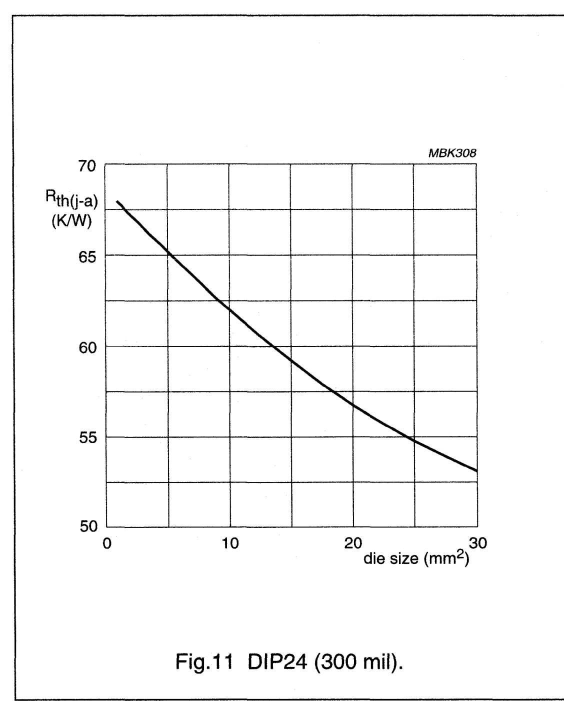

Fig.11 DIP24 (300 mil).

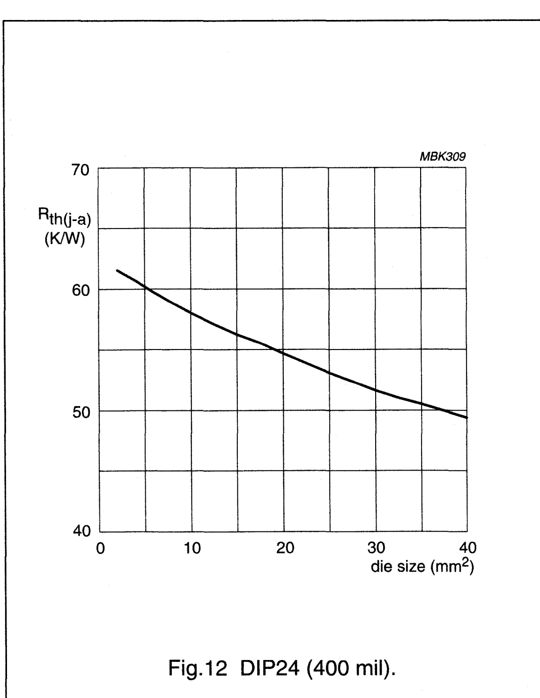

Fig.12 DIP24 (400 mil).

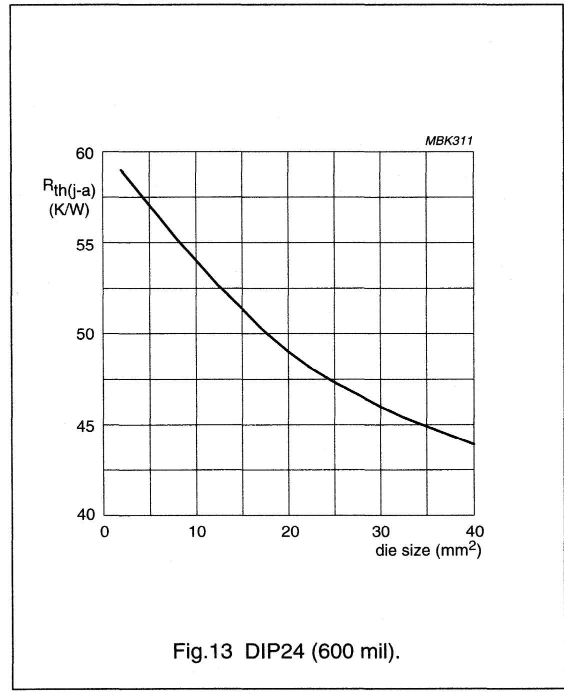

Fig.13 DIP24 (600 mil).

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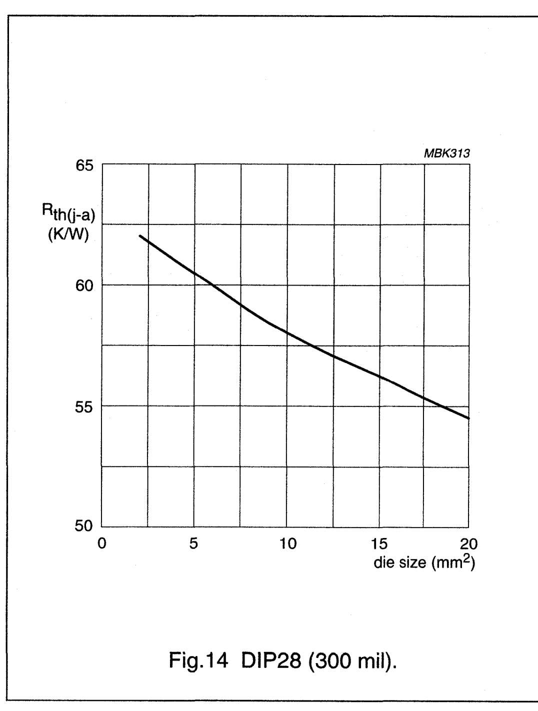

Fig.14 DIP28 (300 mil).

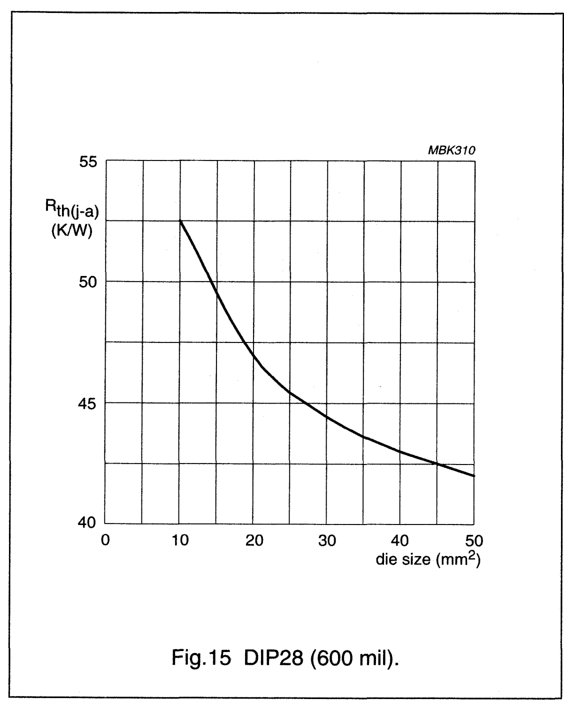

Fig.15 DIP28 (600 mil).

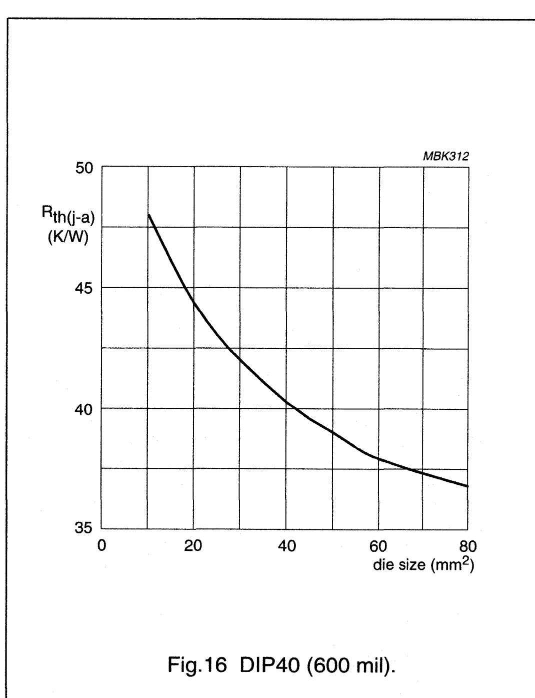

Fig.16 DIP40 (600 mil).

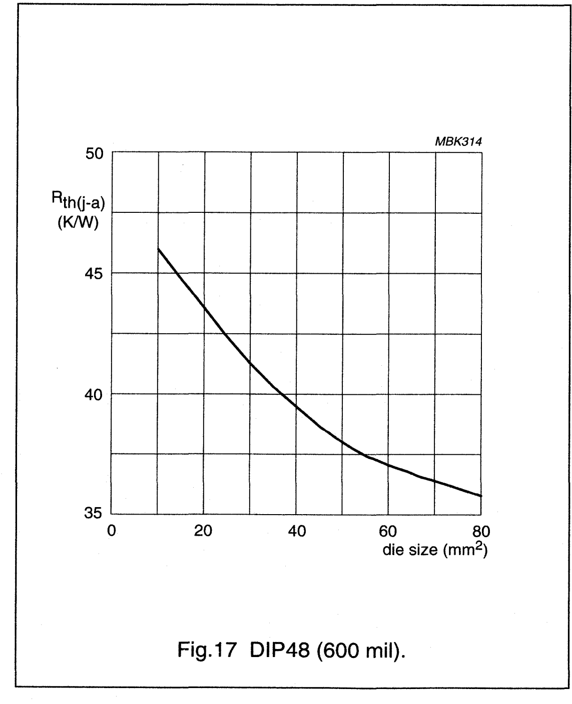

Fig.17 DIP48 (600 mil).

Thermal design considerations Chapter 6

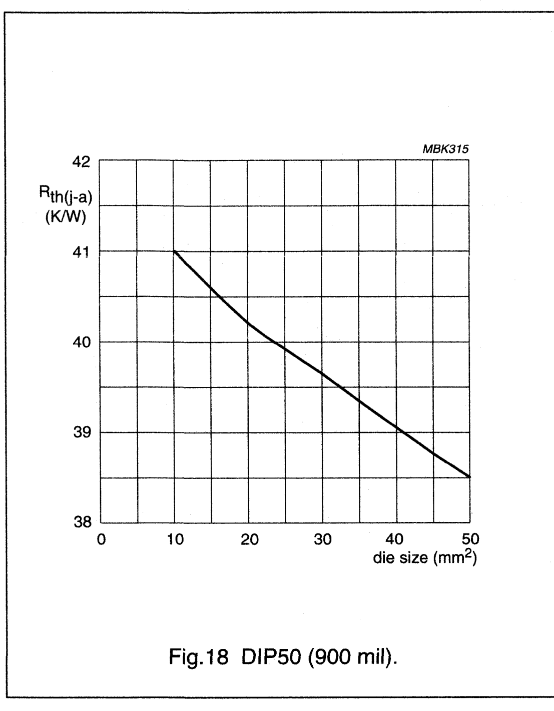

Fig.18 DIP50 (900 mil).

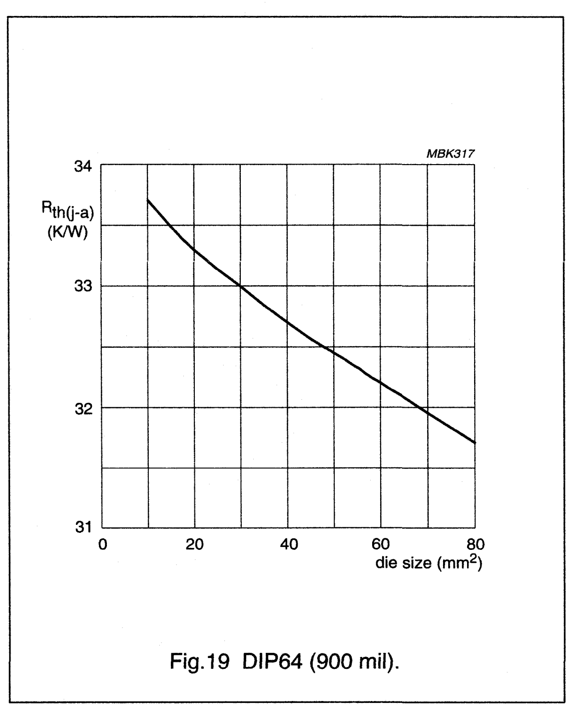

Fig.19 DIP64 (900 mil).

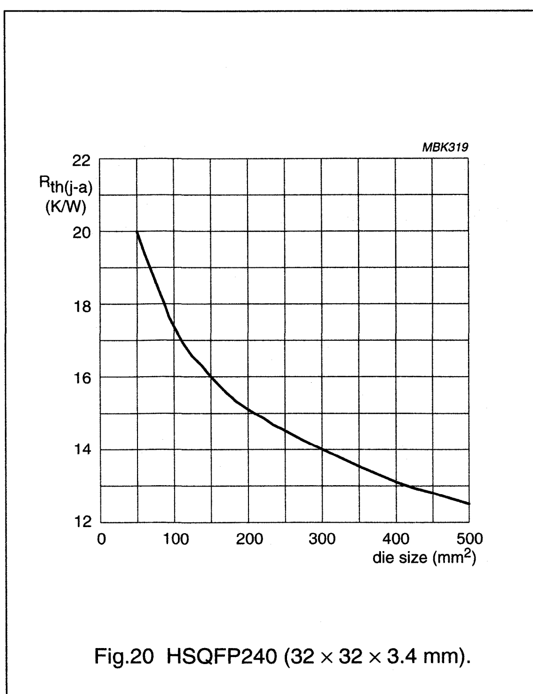

Fig.20 HSQFP240 (32 × 32 × 3.4 mm).

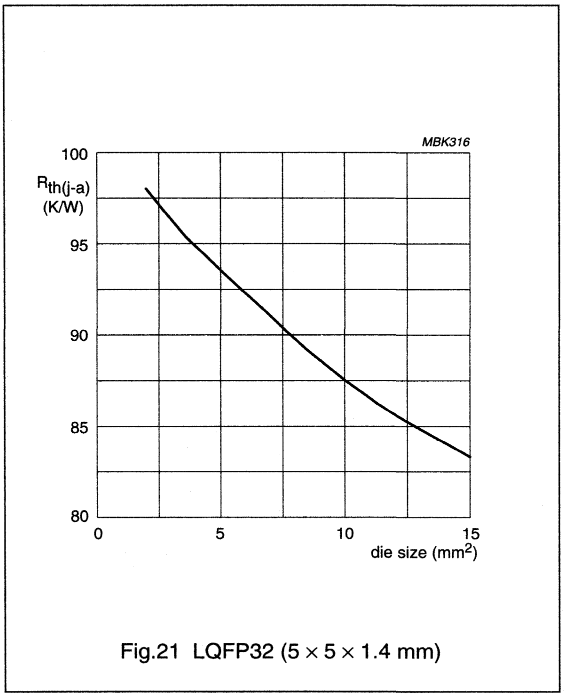

Fig.21 LQFP32 (5 × 5 × 1.4 mm)

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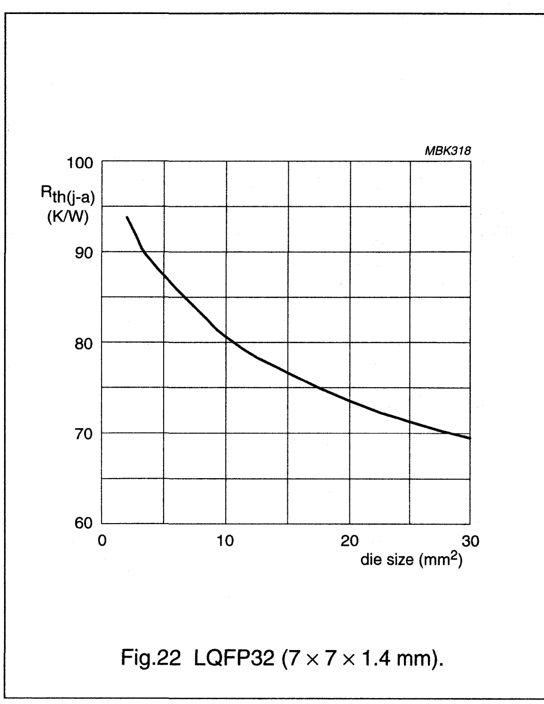

Fig.22 LQFP32 (7 × 7 × 1.4 mm).

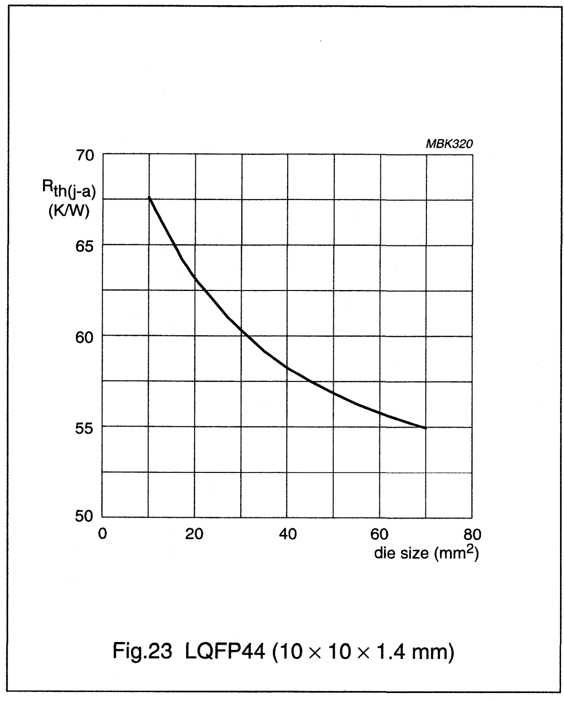

Fig.23 LQFP44 (10 × 10 × 1.4 mm)

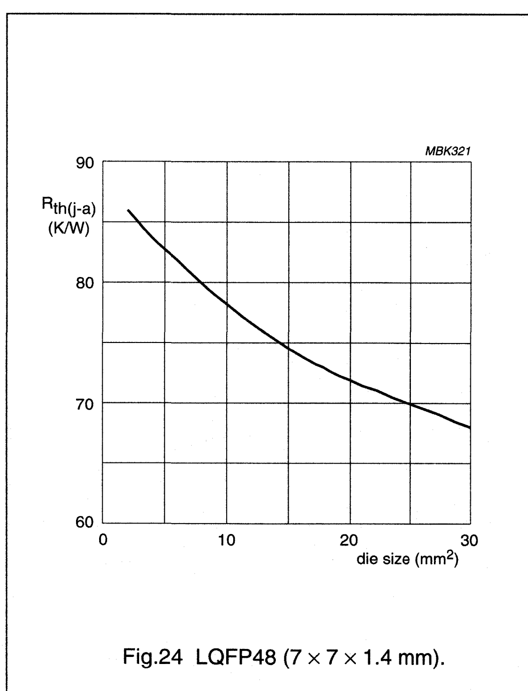

Fig.24 LQFP48 (7 × 7 × 1.4 mm).

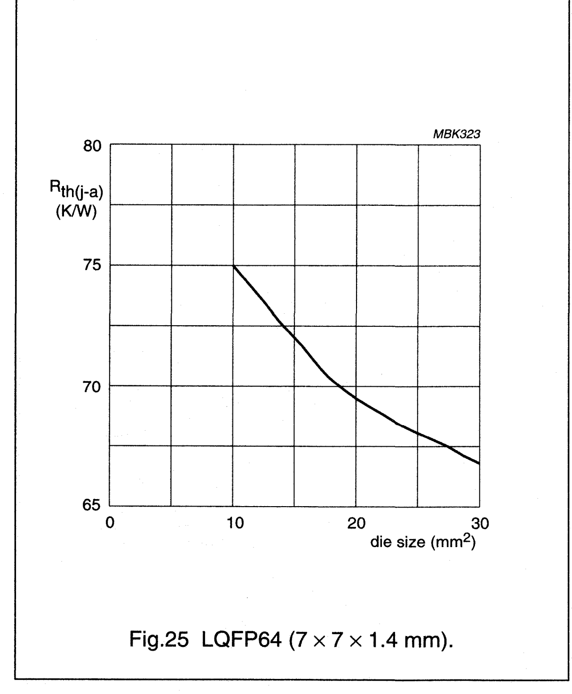

Fig.25 LQFP64 (7 × 7 × 1.4 mm).

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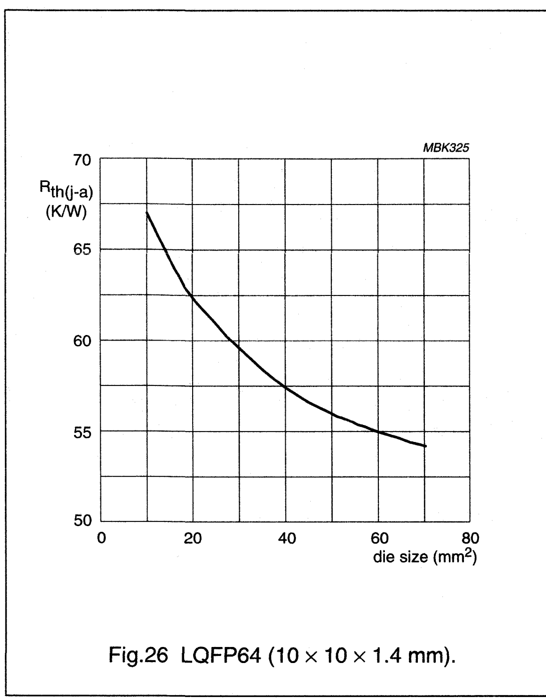

Fig.26 LQFP64 (10 × 10 × 1.4 mm).

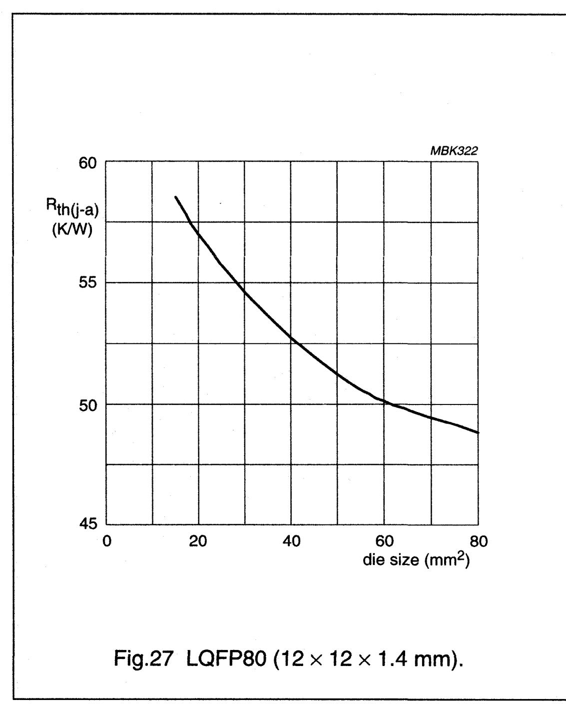

Fig.27 LQFP80 (12 × 12 × 1.4 mm).

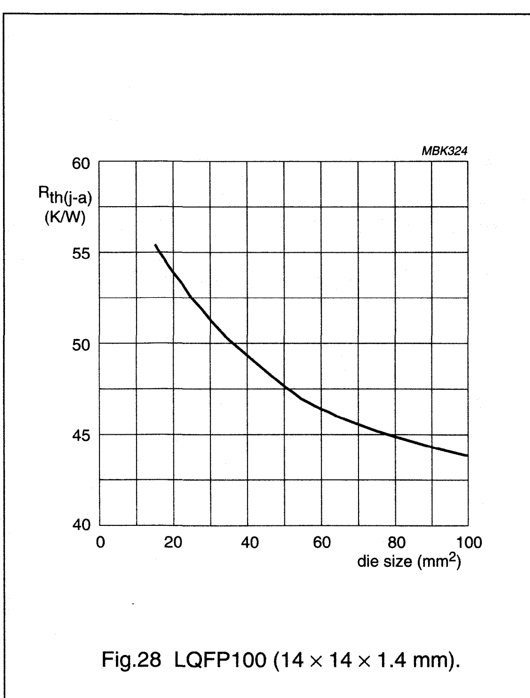

Fig.28 LQFP100 (14 × 14 × 1.4 mm).

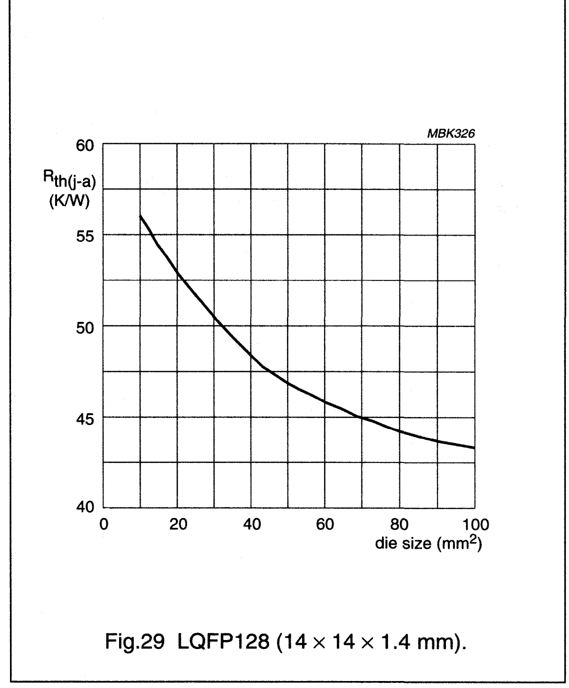

Fig.29 LQFP128 (14 × 14 × 1.4 mm).

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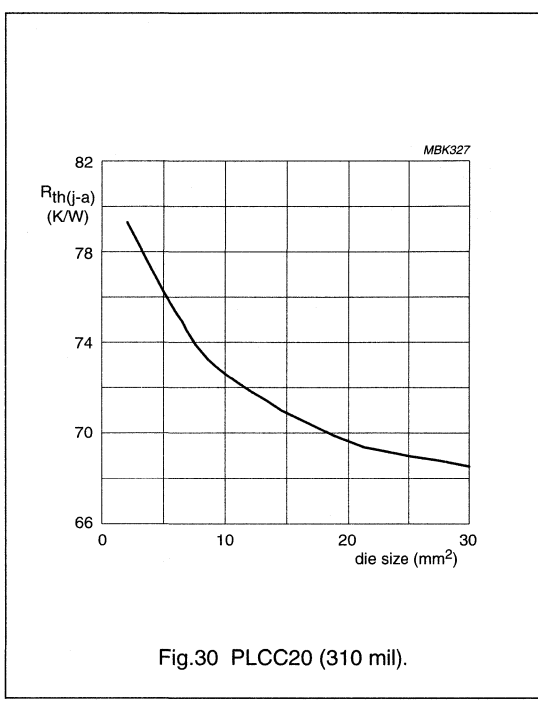

Fig.30 PLCC20 (310 mil).

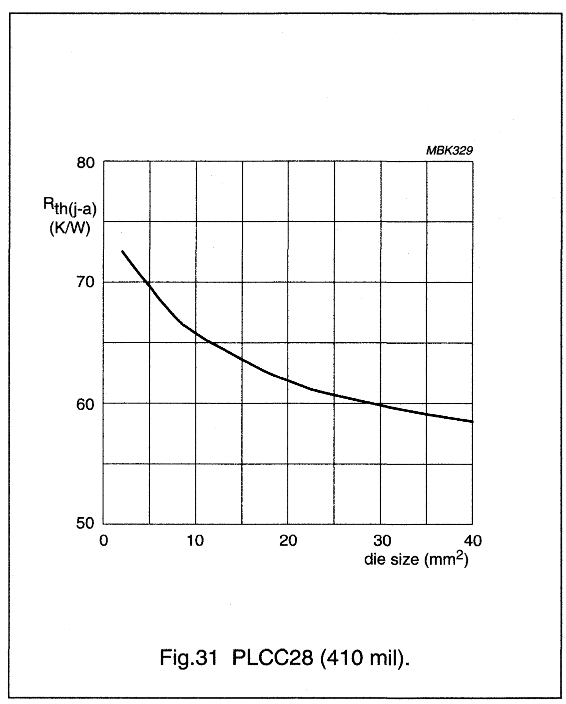

Fig.31 PLCC28 (410 mil).

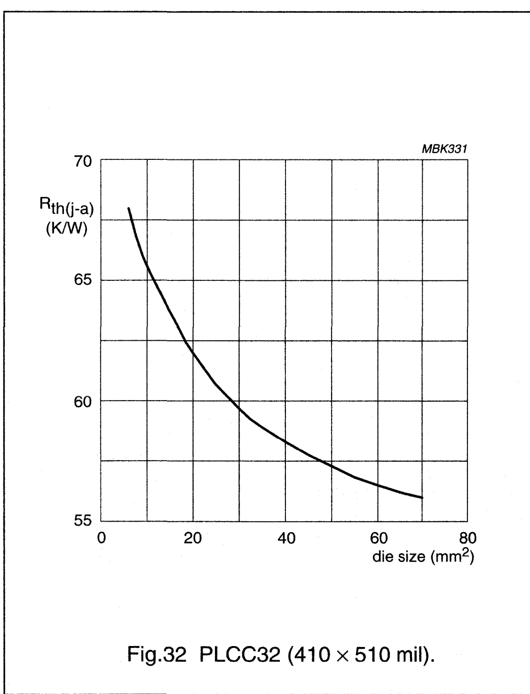

Fig.32 PLCC32 (410 × 510 mil).

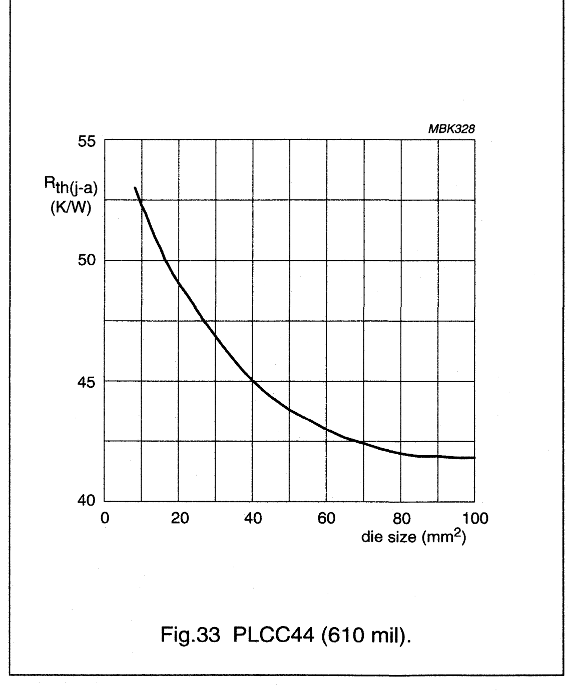

Fig.33 PLCC44 (610 mil).

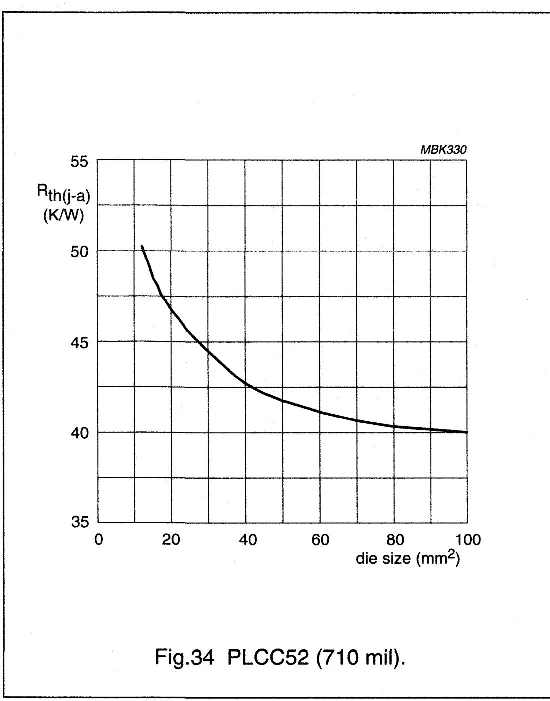

Fig.34 PLCC52 (710 mil).

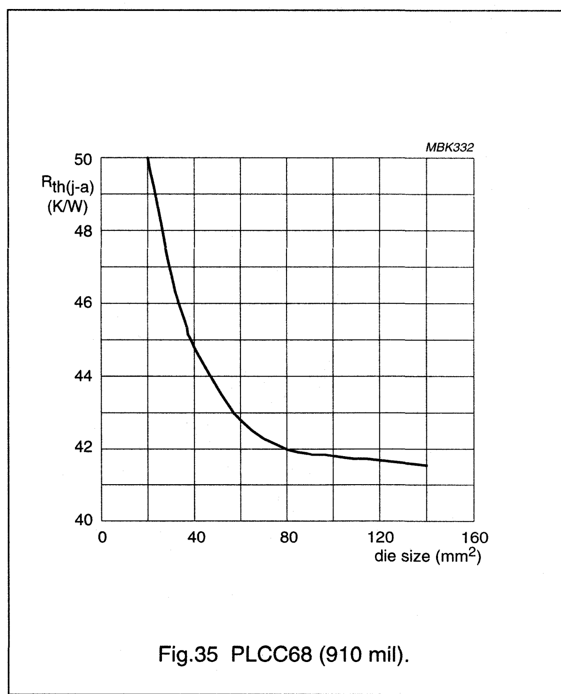

Fig.35 PLCC68 (910 mil).

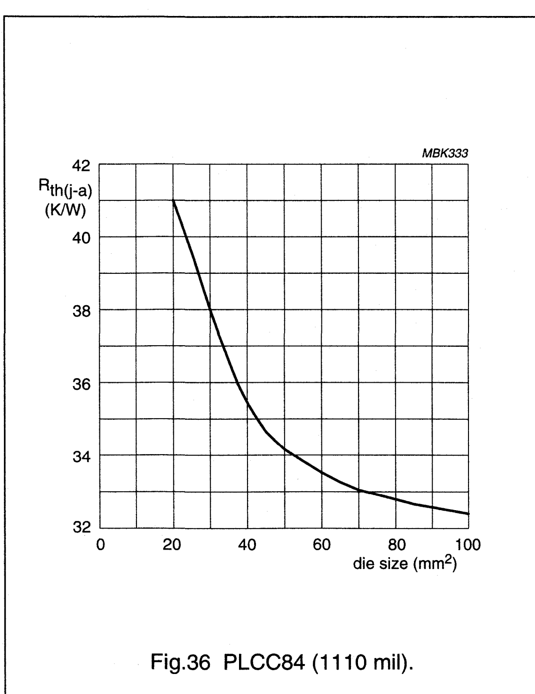

Fig.36 PLCC84 (1110 mil).

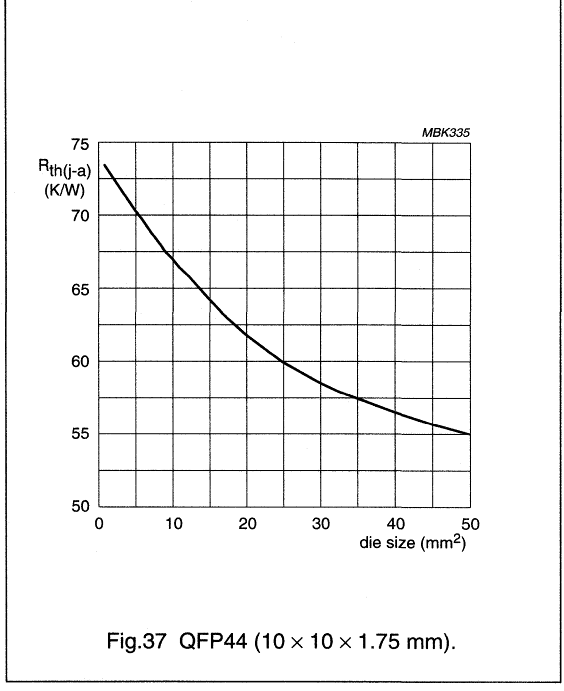

Fig.37 QFP44 (10 × 10 × 1.75 mm).

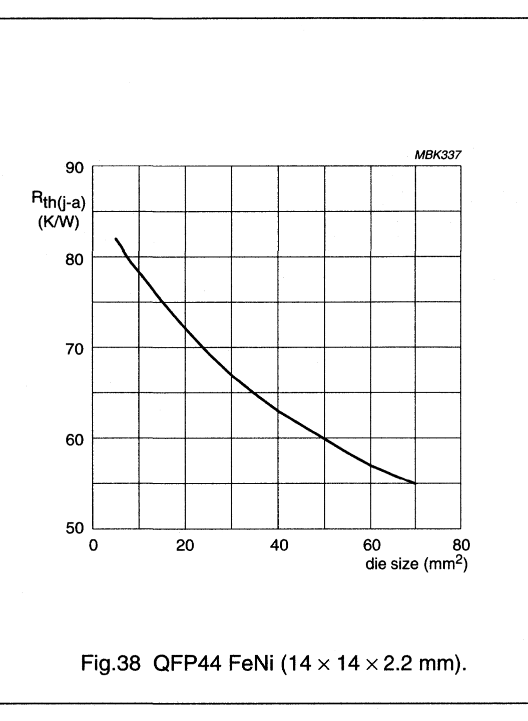

Fig.38 QFP44 FeNi (14 × 14 × 2.2 mm).

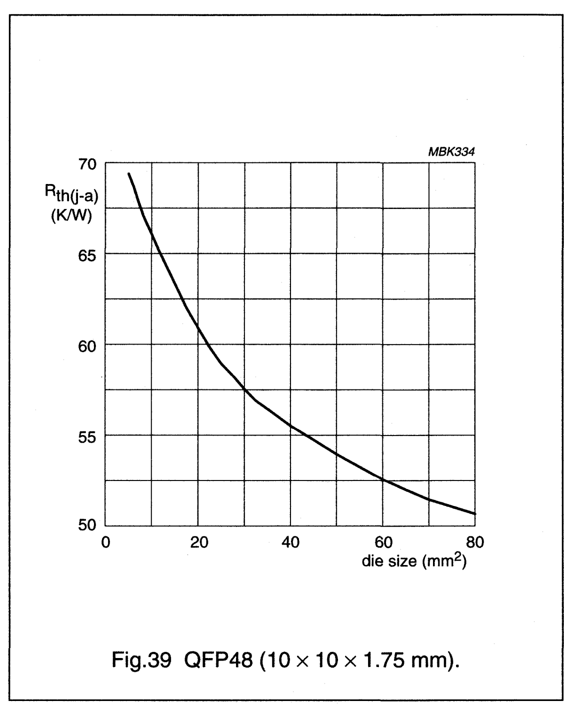

Fig.39 QFP48 (10 × 10 × 1.75 mm).

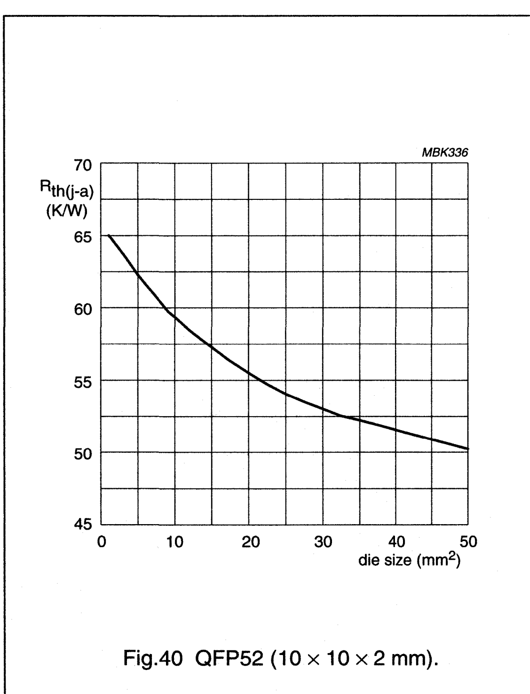

Fig.40 QFP52 (10 × 10 × 2 mm).

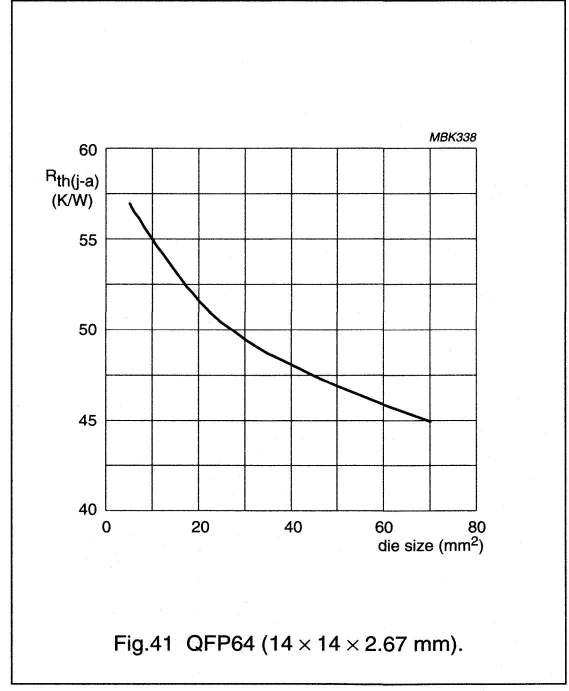

Fig.41 QFP64 (14 × 14 × 2.67 mm).

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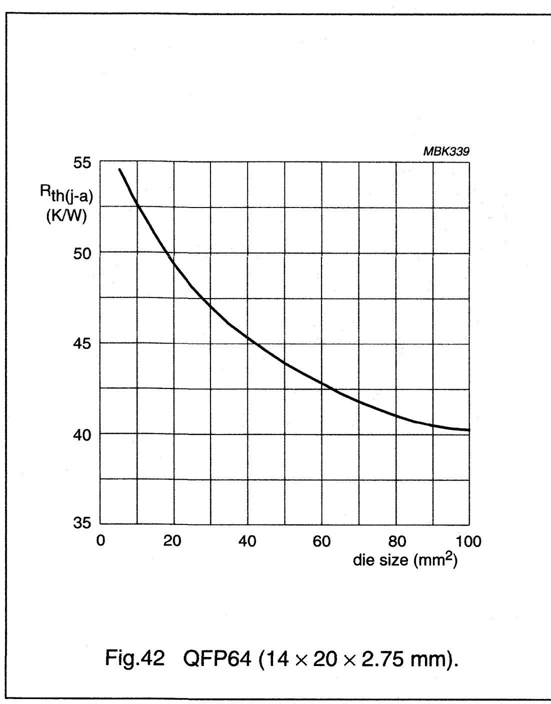

Fig.42 QFP64 (14 × 20 × 2.75 mm).

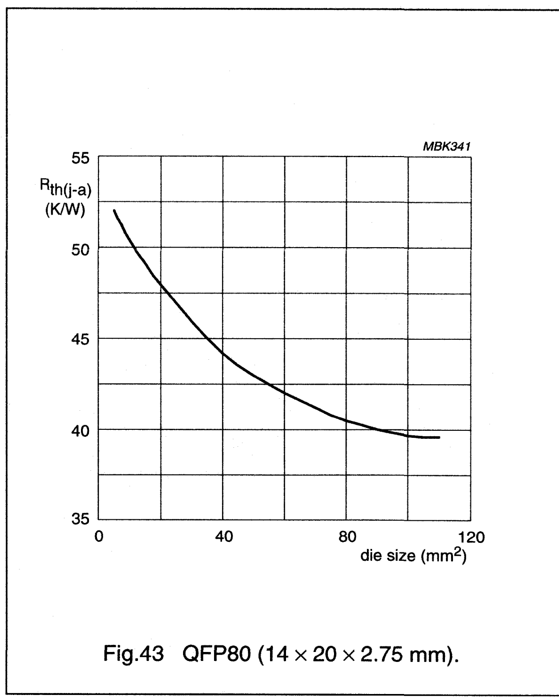

Fig.43 QFP80 (14 × 20 × 2.75 mm).

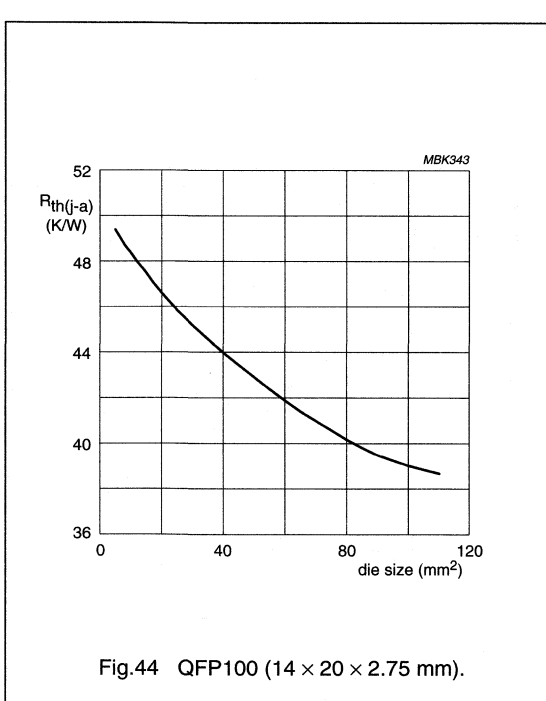

Fig.44 QFP100 (14 × 20 × 2.75 mm).

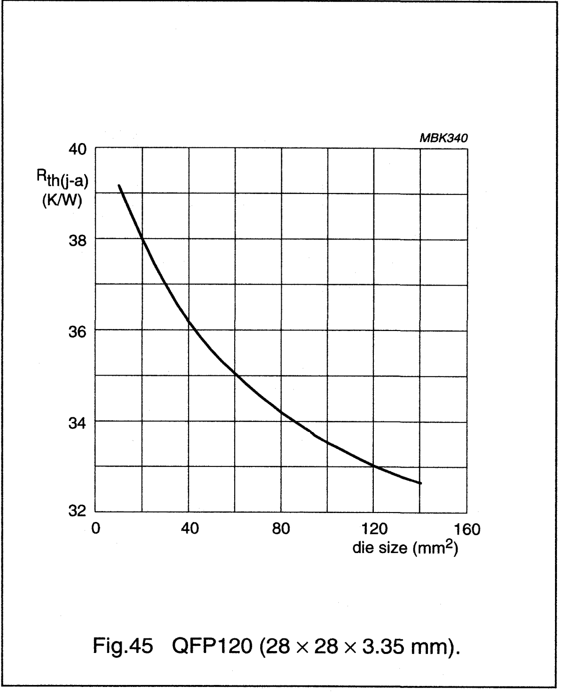

Fig.45 QFP120 (28 × 28 × 3.35 mm).

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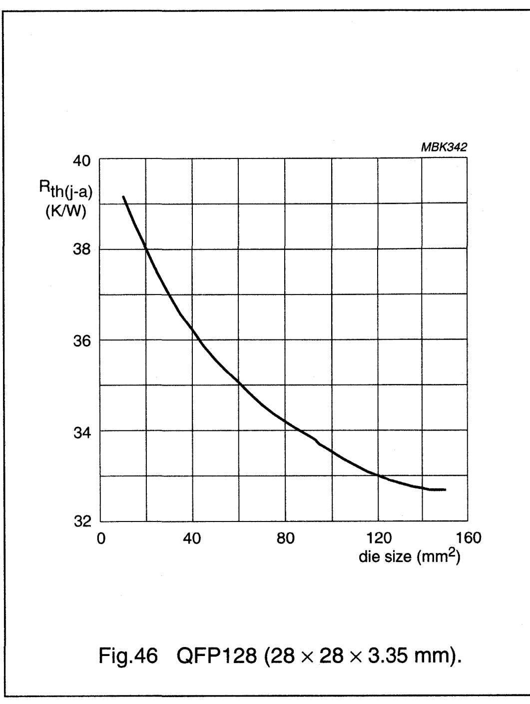

Fig.46 QFP128 (28 × 28 × 3.35 mm).

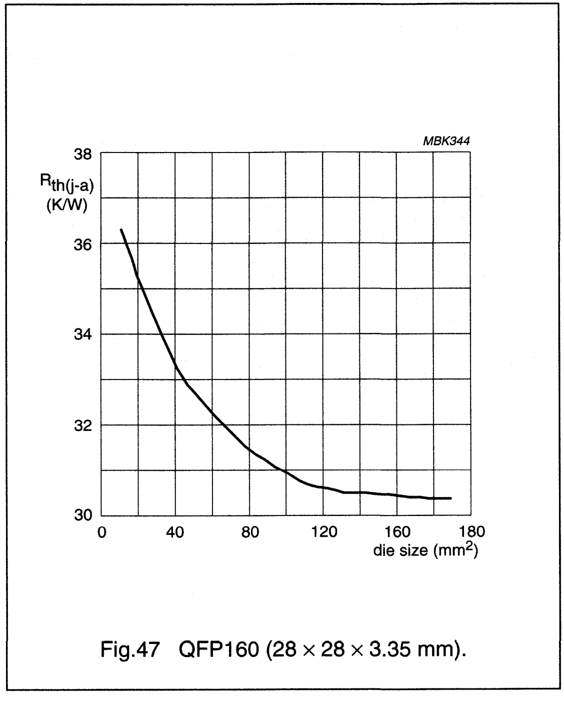

Fig.47 QFP160 (28 × 28 × 3.35 mm).

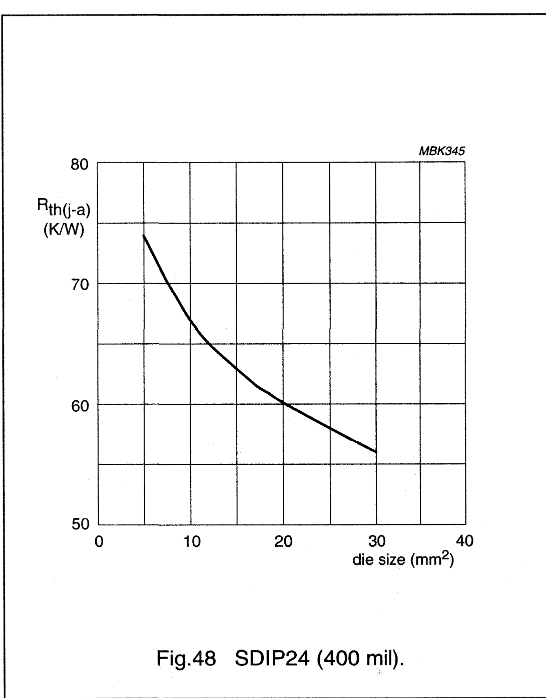

Fig.48 SDIP24 (400 mil).

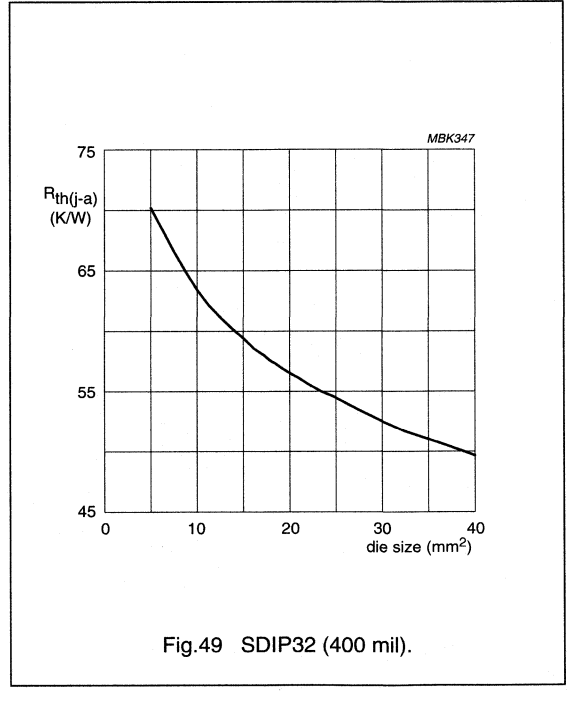

Fig.49 SDIP32 (400 mil).

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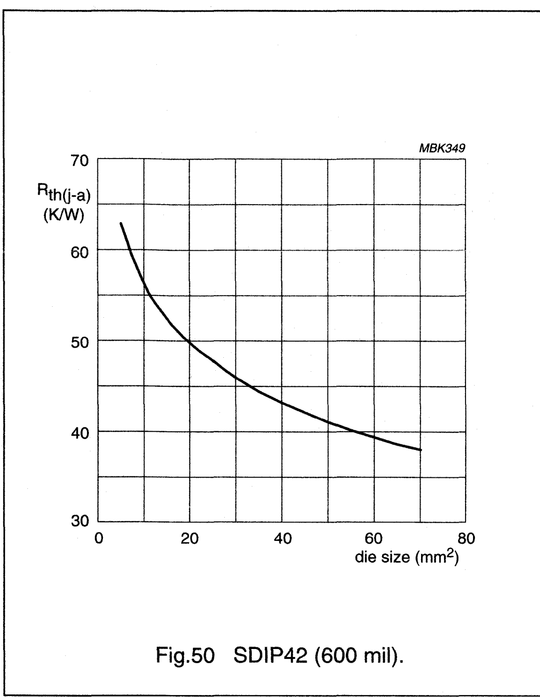

Fig.50 SDIP42 (600 mil).

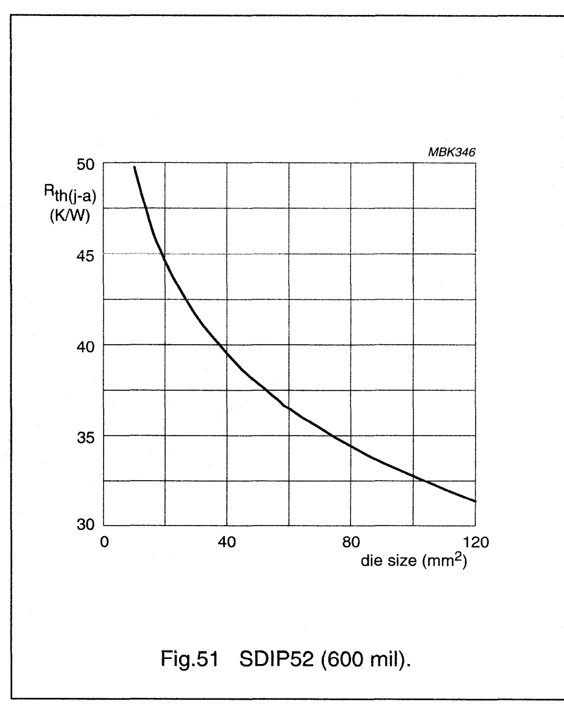

Fig.51 SDIP52 (600 mil).

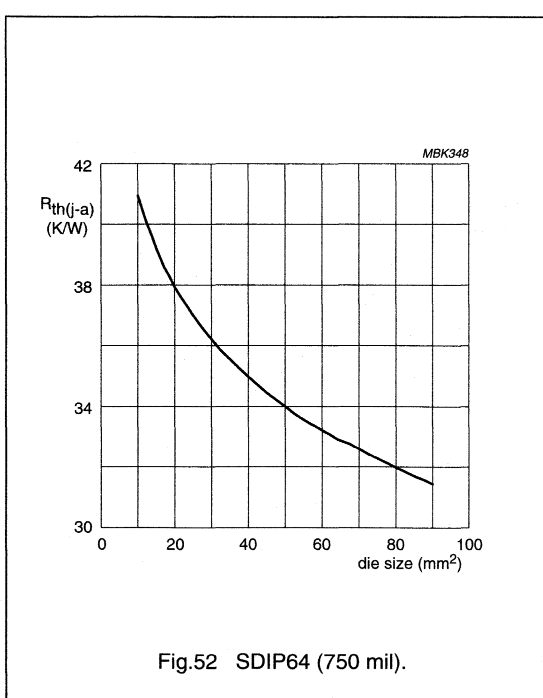

Fig.52 SDIP64 (750 mil).

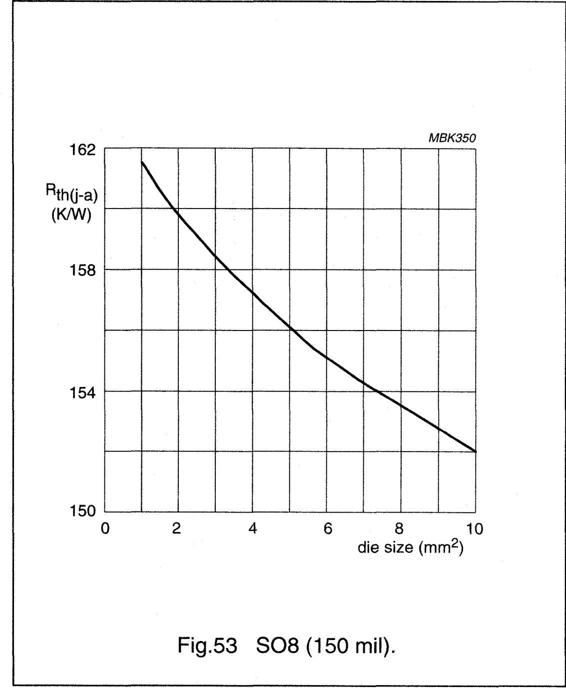

Fig.53 SO8 (150 mil).

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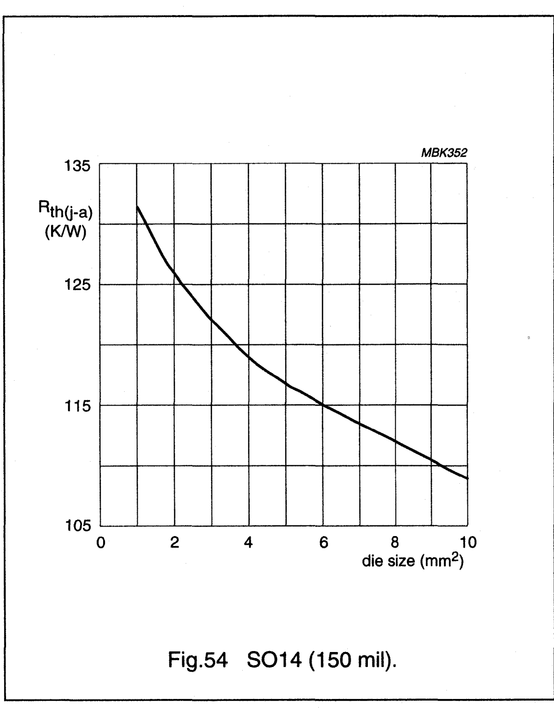

Fig.54 SO14 (150 mil).

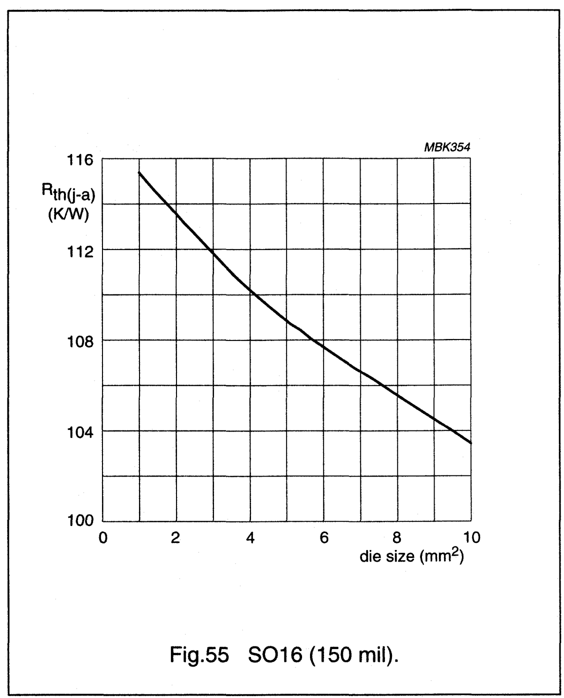

Fig.55 SO16 (150 mil).

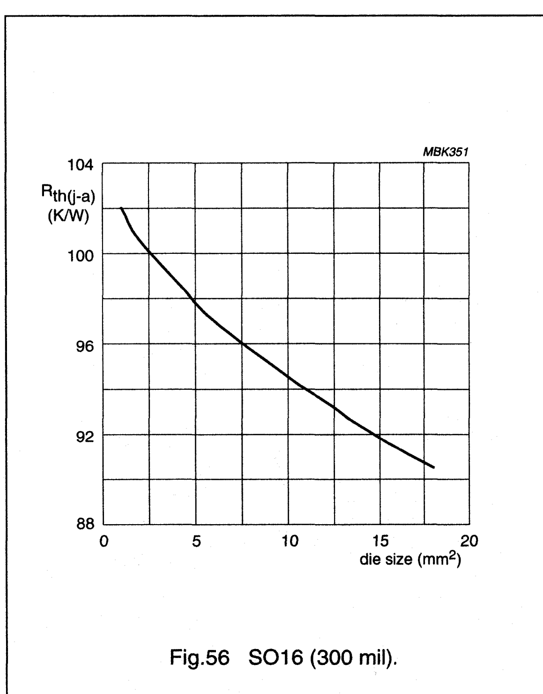

Fig.56 SO16 (300 mil).

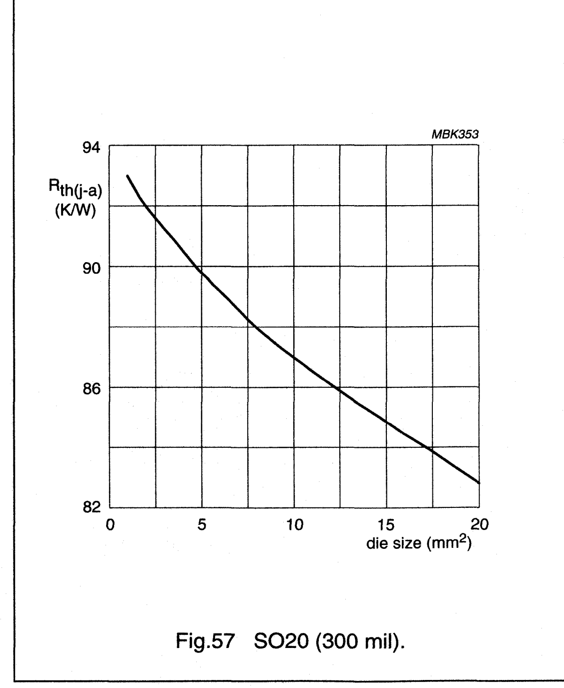

Fig.57 SO20 (300 mil).

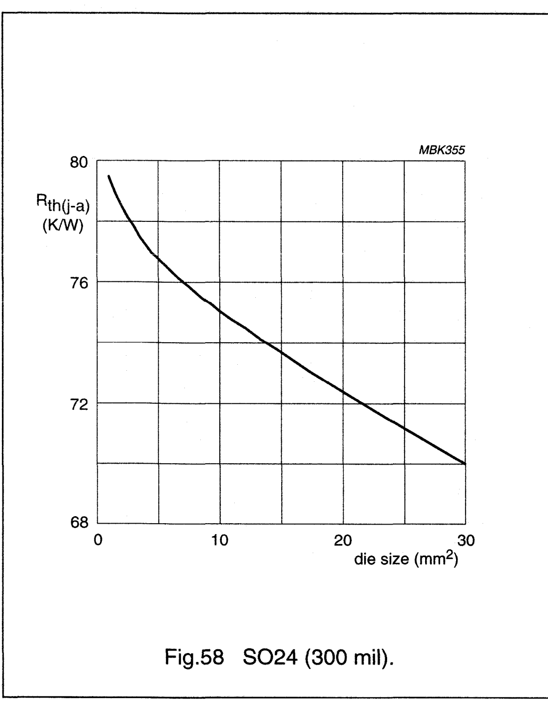

Fig.58 SO24 (300 mil).

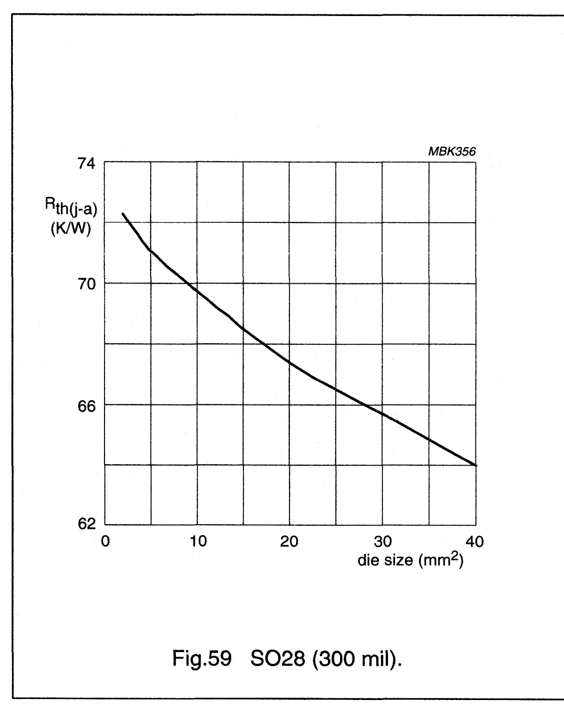

Fig.59 SO28 (300 mil).

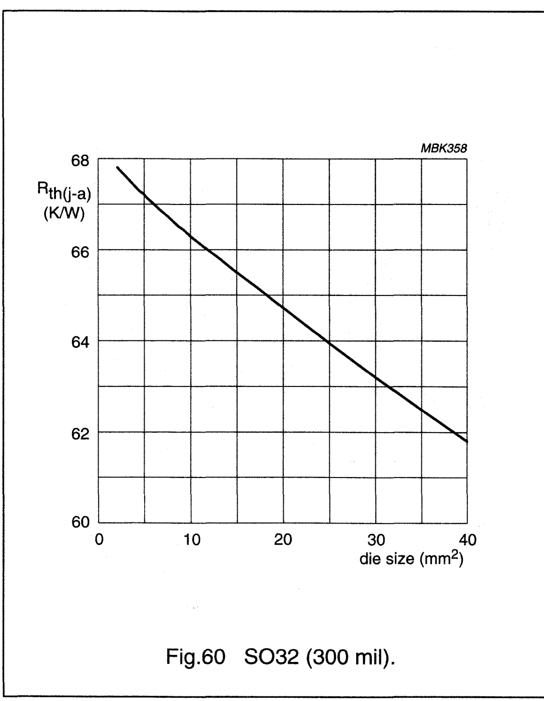

Fig.60 SO32 (300 mil).

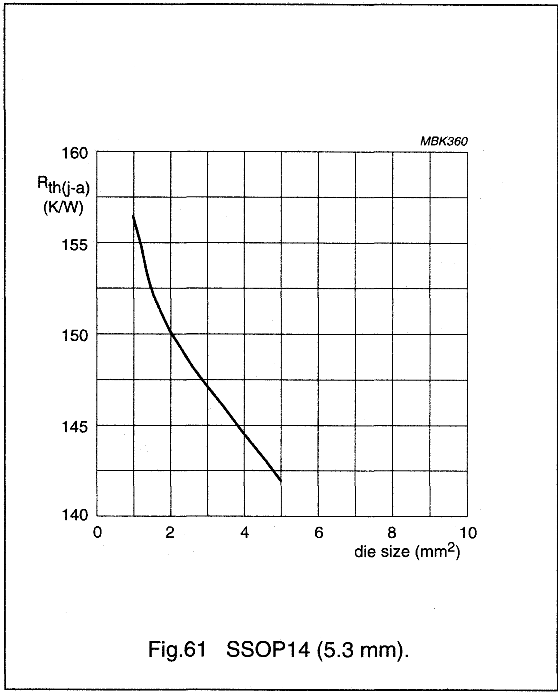

Fig.61 SSOP14 (5.3 mm).

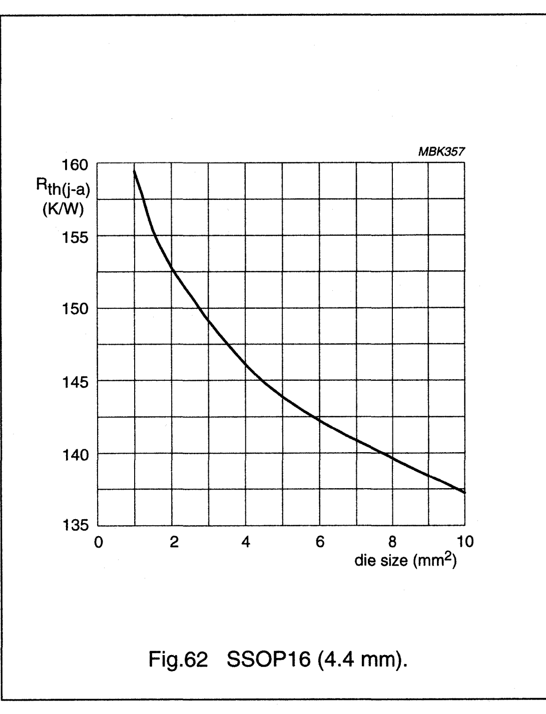

Fig.62 SSOP16 (4.4 mm).

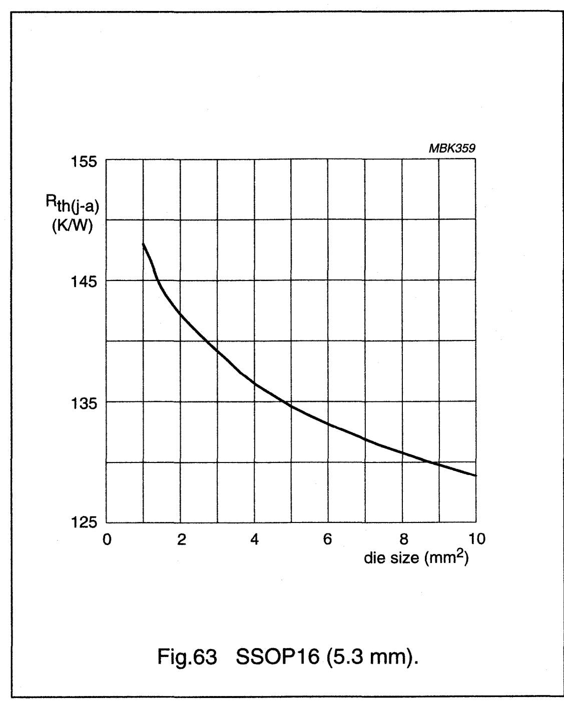

Fig.63 SSOP16 (5.3 mm).

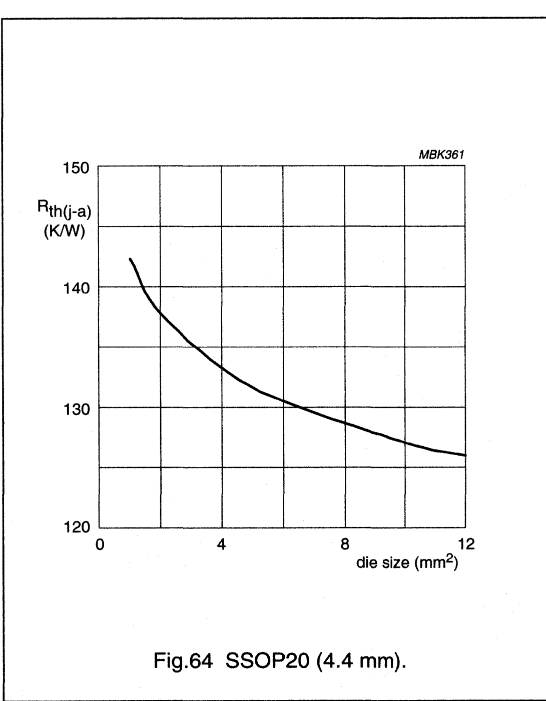

Fig.64 SSOP20 (4.4 mm).

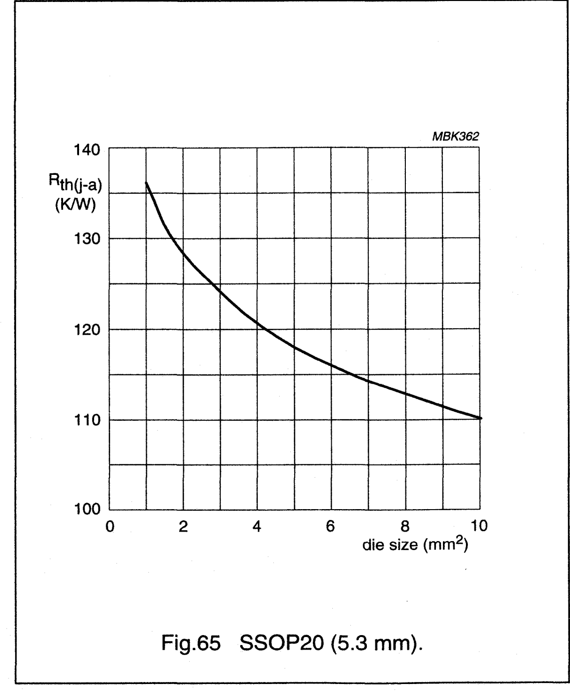

Fig.65 SSOP20 (5.3 mm).

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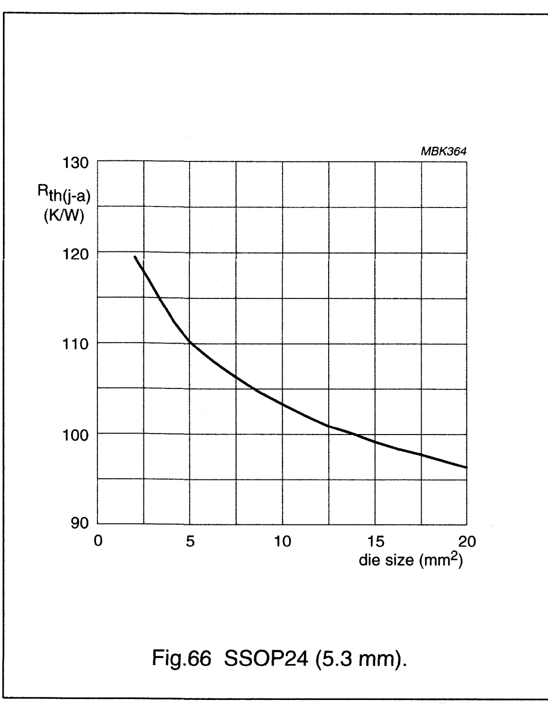

Fig.66 SSOP24 (5.3 mm).

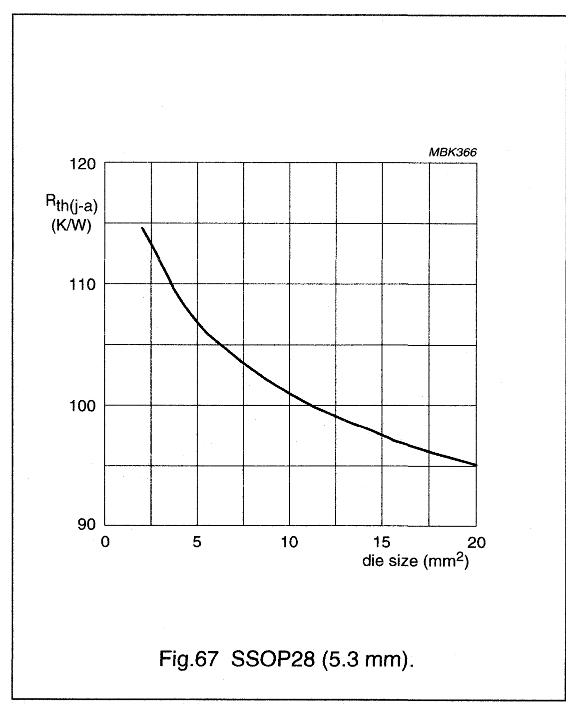

Fig.67 SSOP28 (5.3 mm).

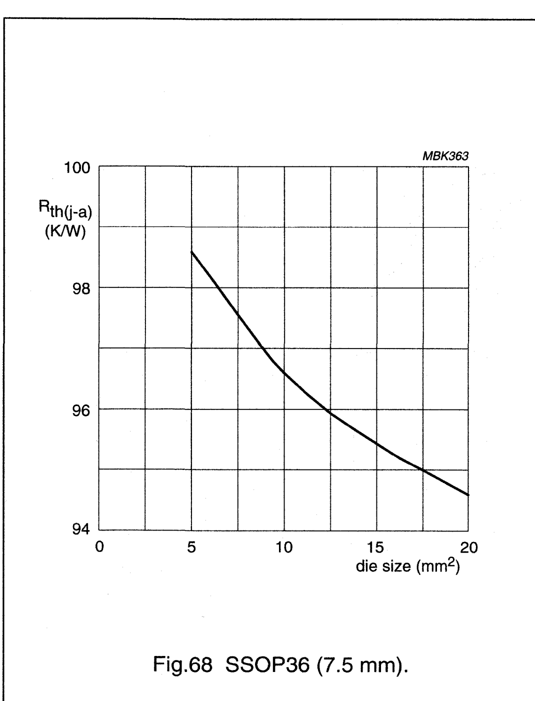

Fig.68 SSOP36 (7.5 mm).

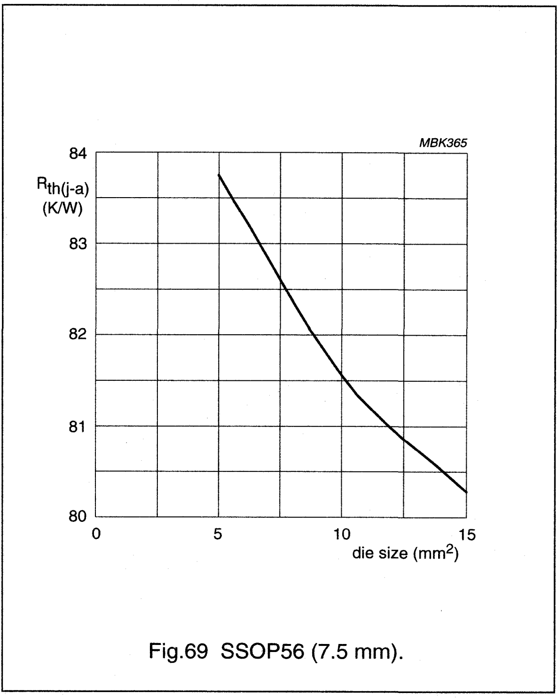

Fig.69 SSOP56 (7.5 mm).

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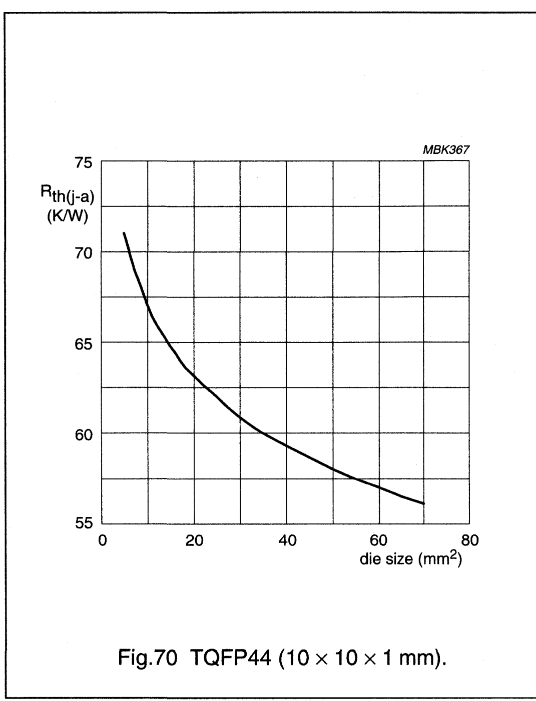

Fig.70 TQFP44 (10 × 10 × 1 mm).

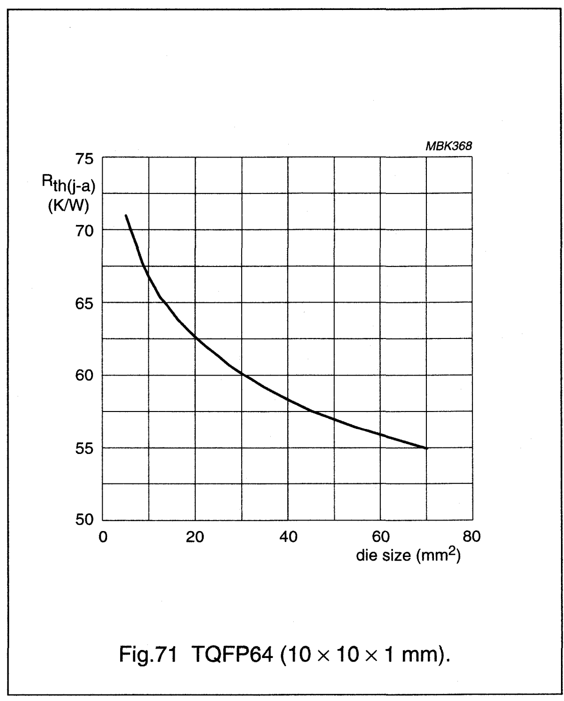

Fig.71 TQFP64 (10 × 10 × 1 mm).

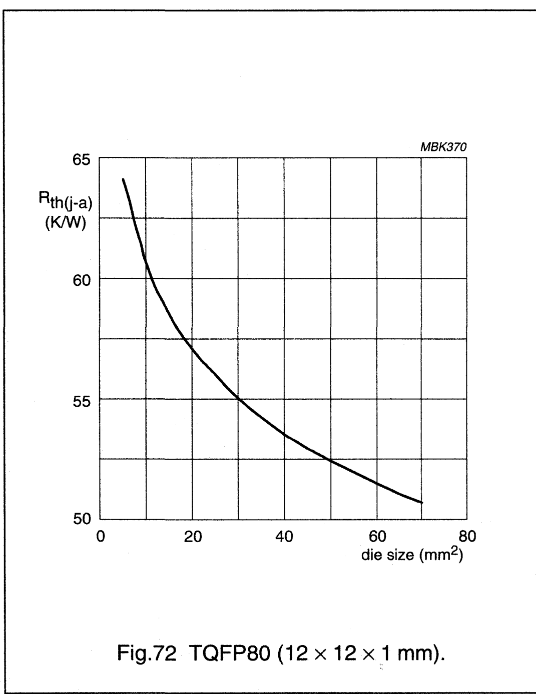

Fig.72 TQFP80 (12 × 12 × 1 mm).

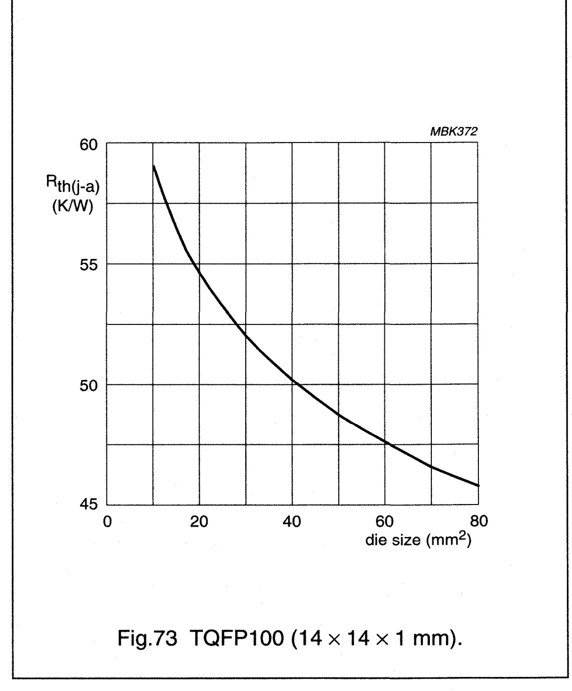

Fig.73 TQFP100 (14 × 14 × 1 mm).

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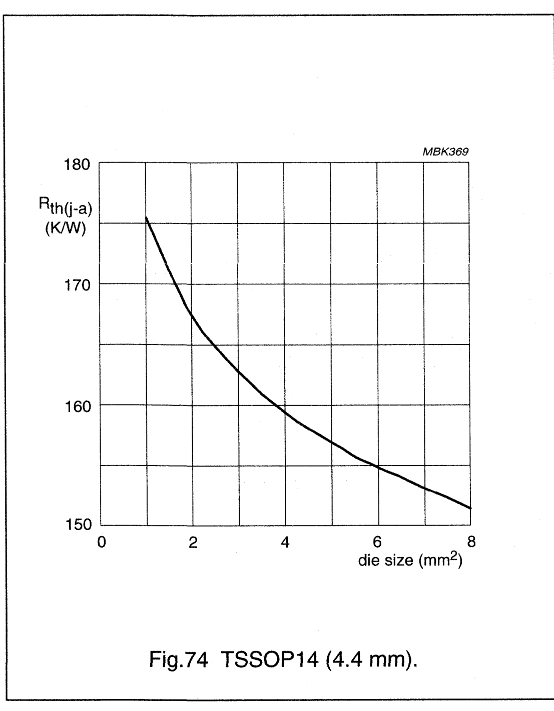

Fig.74 TSSOP14 (4.4 mm).

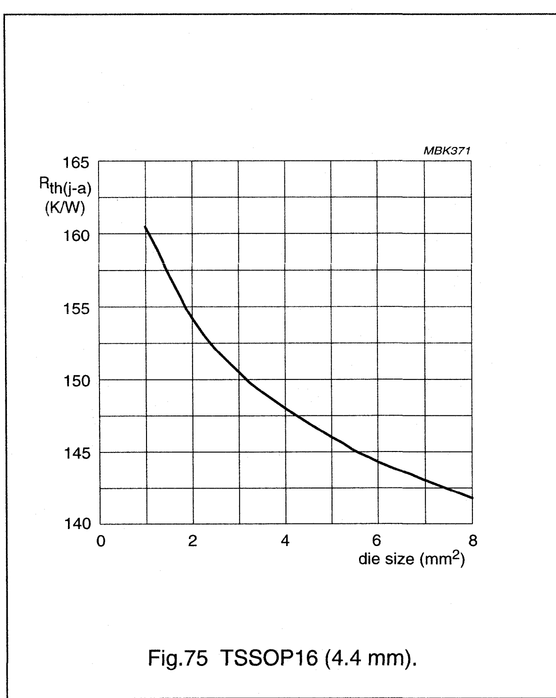

Fig.75 TSSOP16 (4.4 mm).

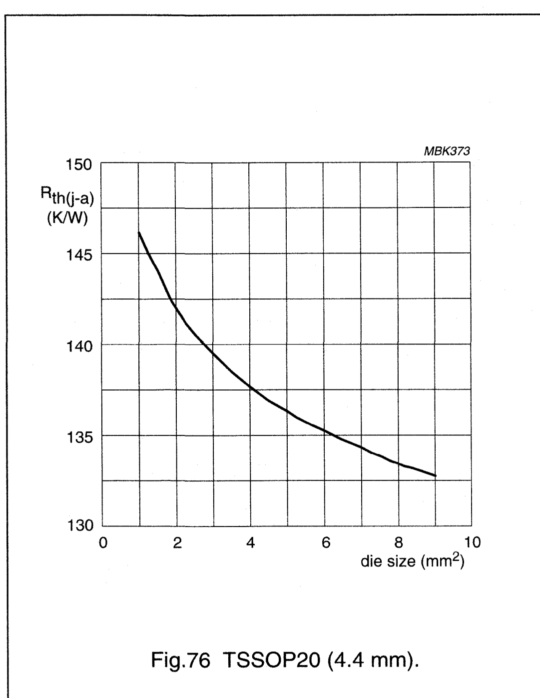

Fig.76 TSSOP20 (4.4 mm).

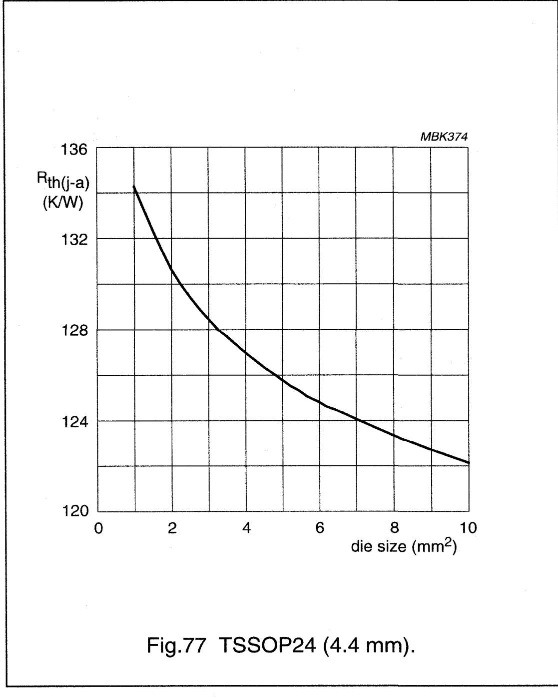

Fig.77 TSSOP24 (4.4 mm).

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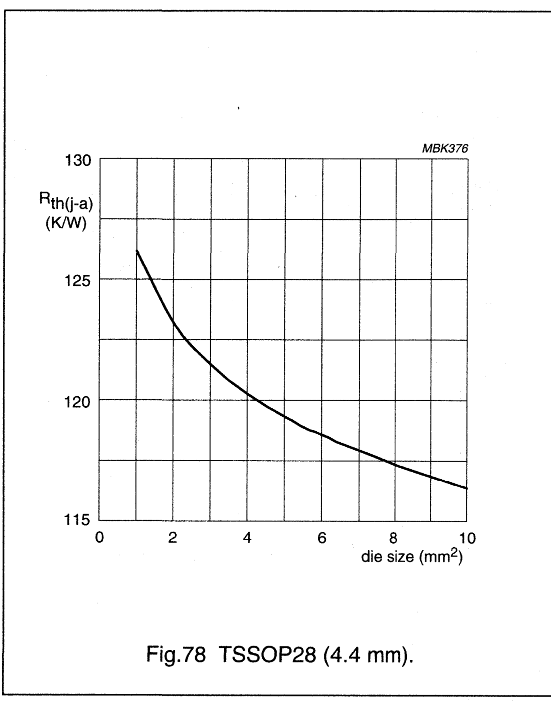

Fig.78 TSSOP28 (4.4 mm).

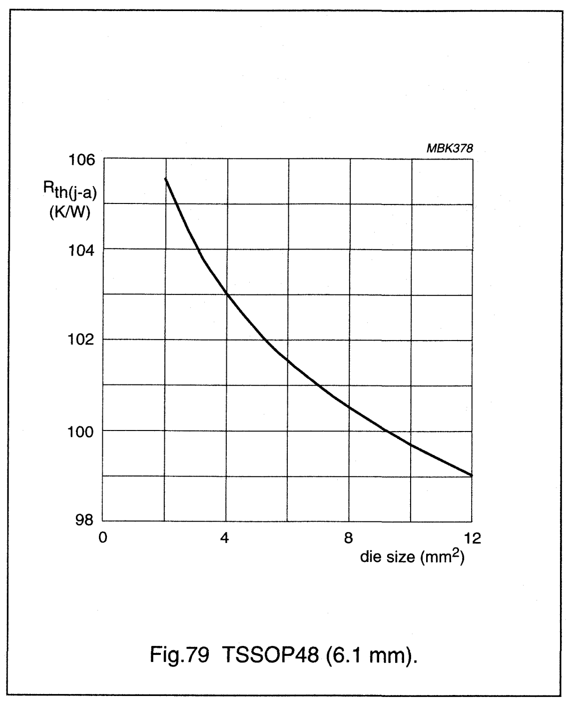

Fig.79 TSSOP48 (6.1 mm).

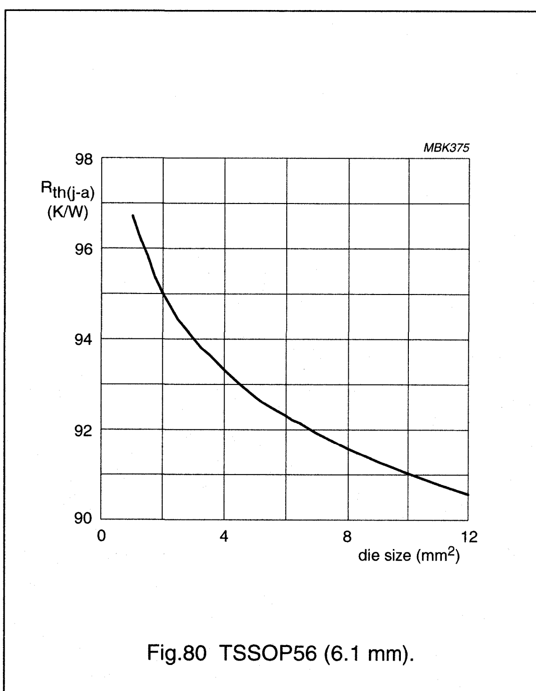

Fig.80 TSSOP56 (6.1 mm).

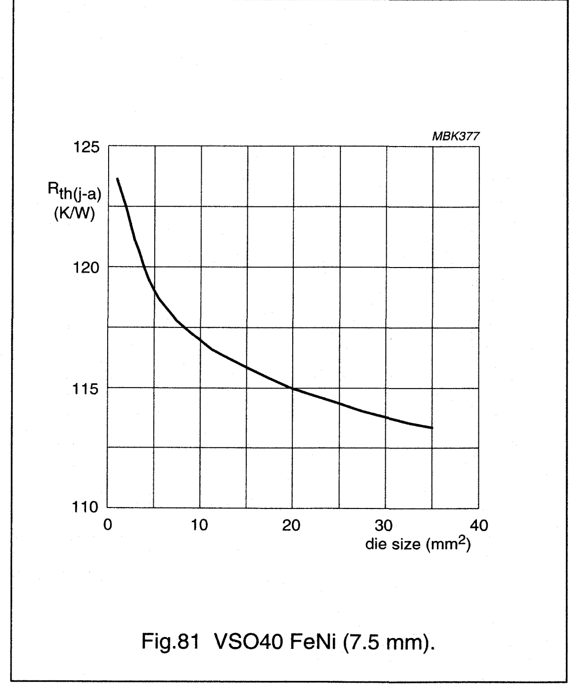

Fig.81 VSO40 FeNi (7.5 mm).

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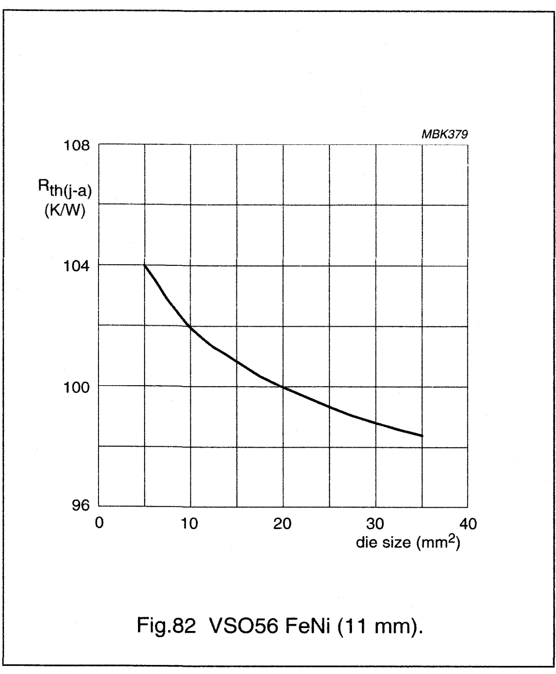

Fig.82 VSO56 FeNi (11 mm).

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.
   a) Almost all of the values in the table were determined with measurements.
   b) Low values should be used with a large die, high values should be used with a small die.

CHAPTER 7

PACKING METHODS

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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 leads 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 temperature profile of this solder simulation is shown in Fig.1. The temperature is measured on the top of the package body, and the profile is according to the relevant JEDEC standard.

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 180 °C and above for a relatively long time of around 2 minutes. If this maximum temperature is higher than that shown in Fig.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 1), a higher soldering temperature can be used as the package's moisture content will be much less.

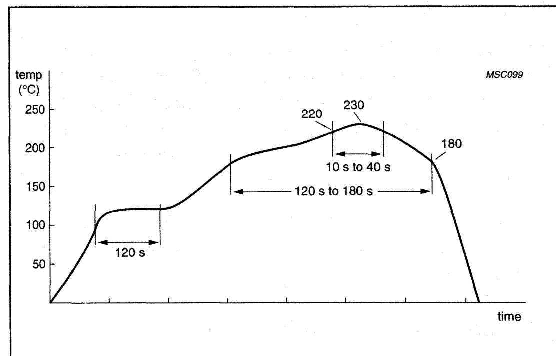

Fig.1 IR temperature profile requirements for MSL testing.

Table 1 Floor life versus moisture sensitivity levels(1)

MSL	CONDITIONS	FLOOR LIFE
1	30 °C / 90% RH	unlimited
2	30 °C / 60% RH	1 year
3	30 °C / 60% RH	168 hours
4	30 °C / 60% RH	72 hours
5	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 backed 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.

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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 1 °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 30% (the colour of the 30% dot is blue), the ICs are ready for use.

As soon as the ICs are removed for 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 1. These times are related to the MSL of the package.

If the humidity indicator in a DRYPACK shows an RH of more than 30% (the colour of the 30% 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 × package thickness (mm) at a drying temperature of 125 °C ± 5 °C.

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

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SURVEY OF IC PACKING METHODS

PACKAGE NAME	CARRIER TYPE		
	TUBE	TAPE/REEL	TRAY
DBS	X	–	–
DIP	X	–	–
HLQFP	–	X	X
HSOP	X	X	–
HSQFP	–	–	X
LQFP	–	X	X
MSQFP	–	–	X
PLCC	X	X	–
QFP	–	X	X
RBS	X	–	–
SDIP	X	–	–
SIL	X	–	–
SO	X	X	–
SOJ	X	X	–
SQFP	–	–	X
SSOP	X	X	–
TQFP	–	X	X
TSSOP	X	X	–
TPLCC	X	X	–
VSO	X	X	–

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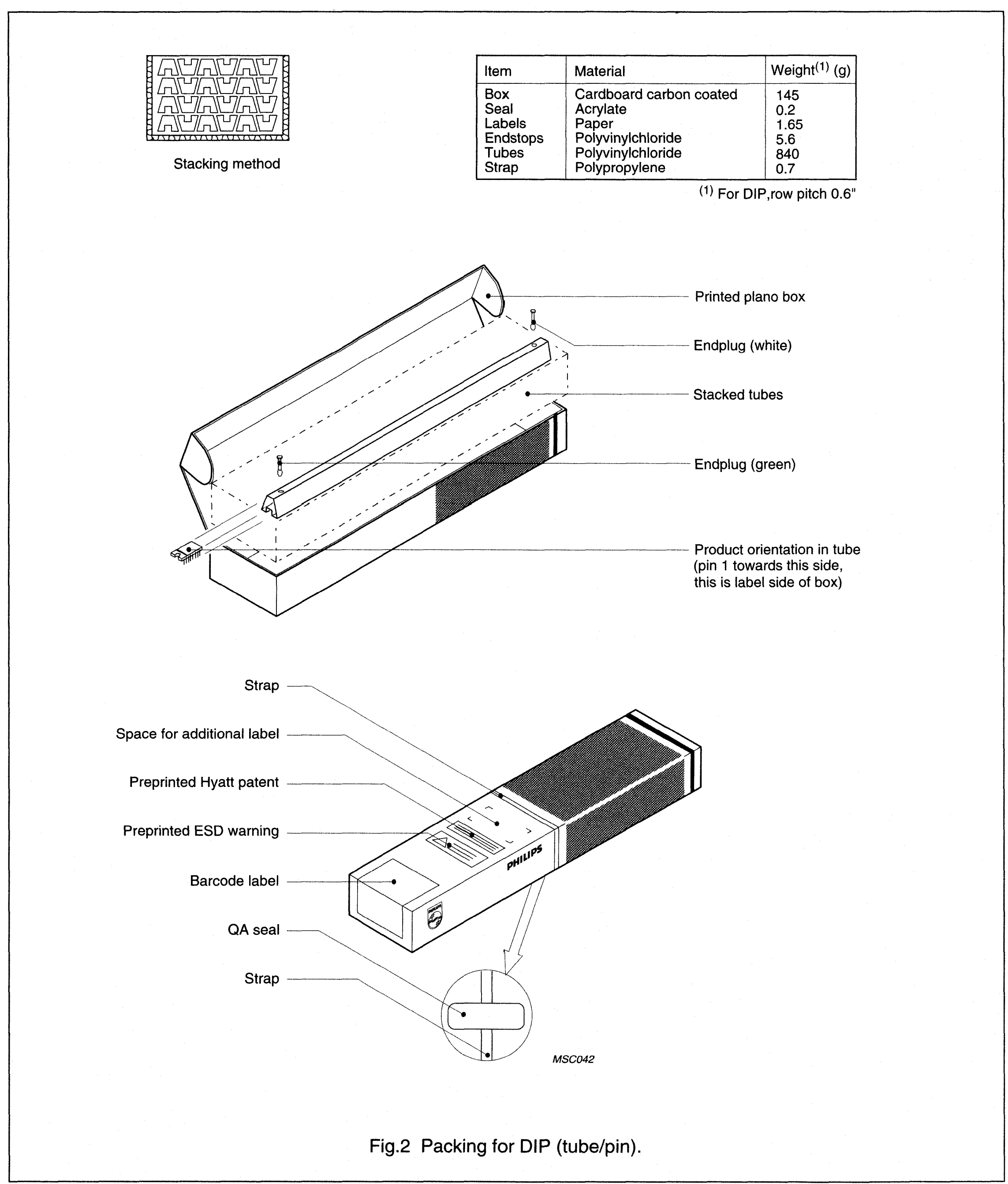
PACKING METHODS IN EXPLODED VIEW

Packing for DIP (tube/pin)



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"

Fig.2 Packing for DIP (tube/pin).

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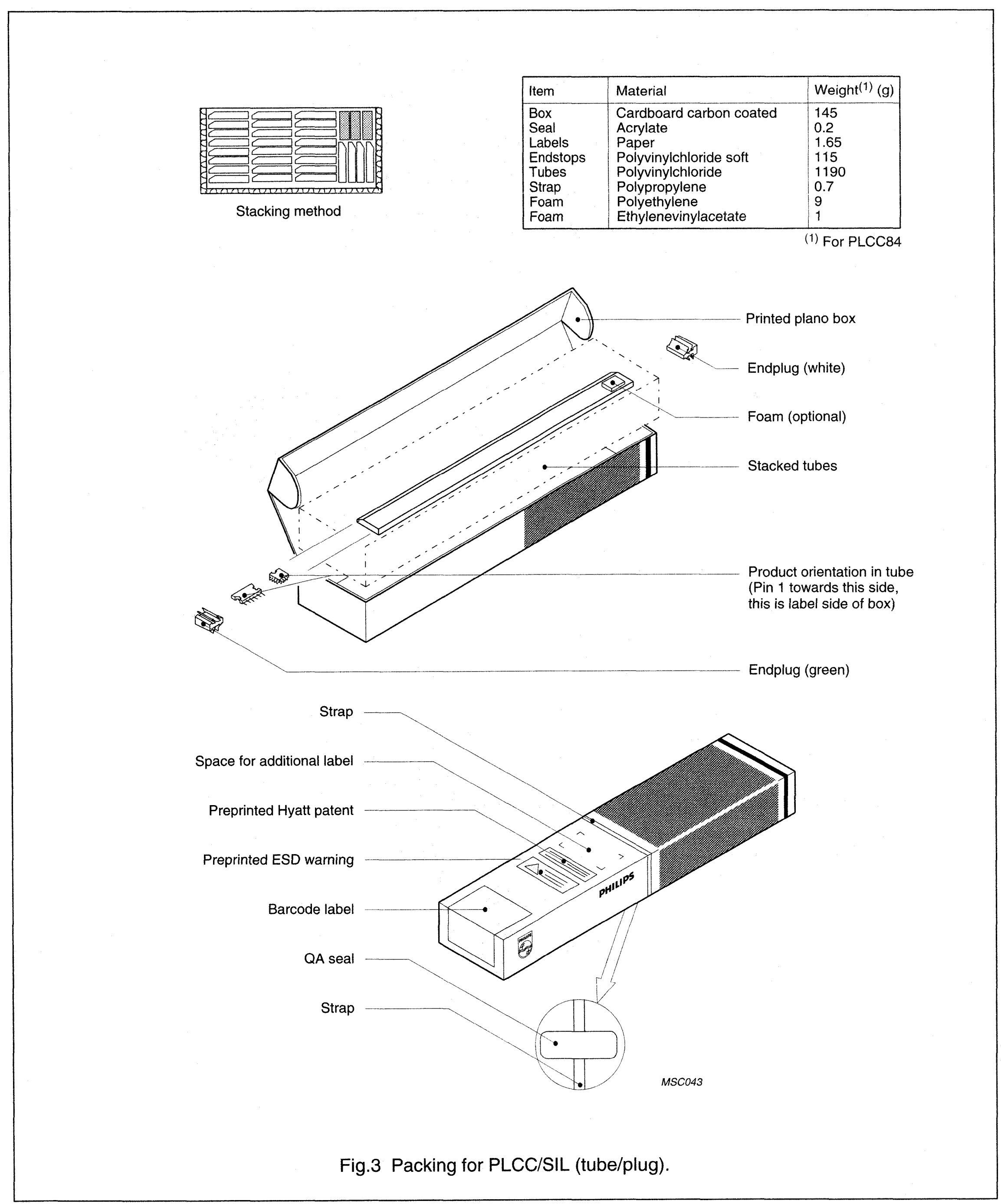
Packing for PLCC/SIL (tube/plug)



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.3 Packing for PLCC/SIL (tube/plug).

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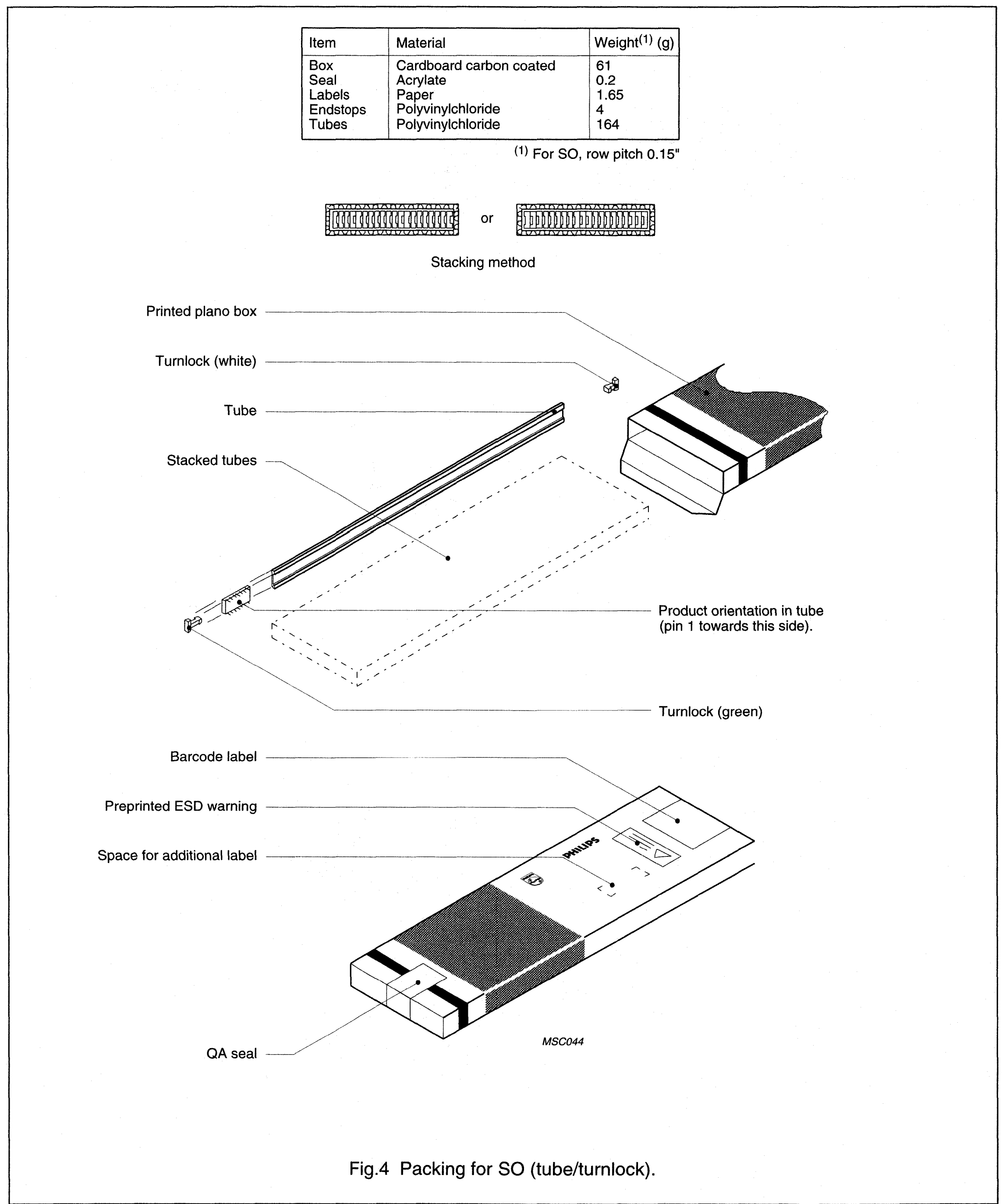
Packing for SO (tube/turnlock)



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"

Fig.4 Packing for SO (tube/turnlock).

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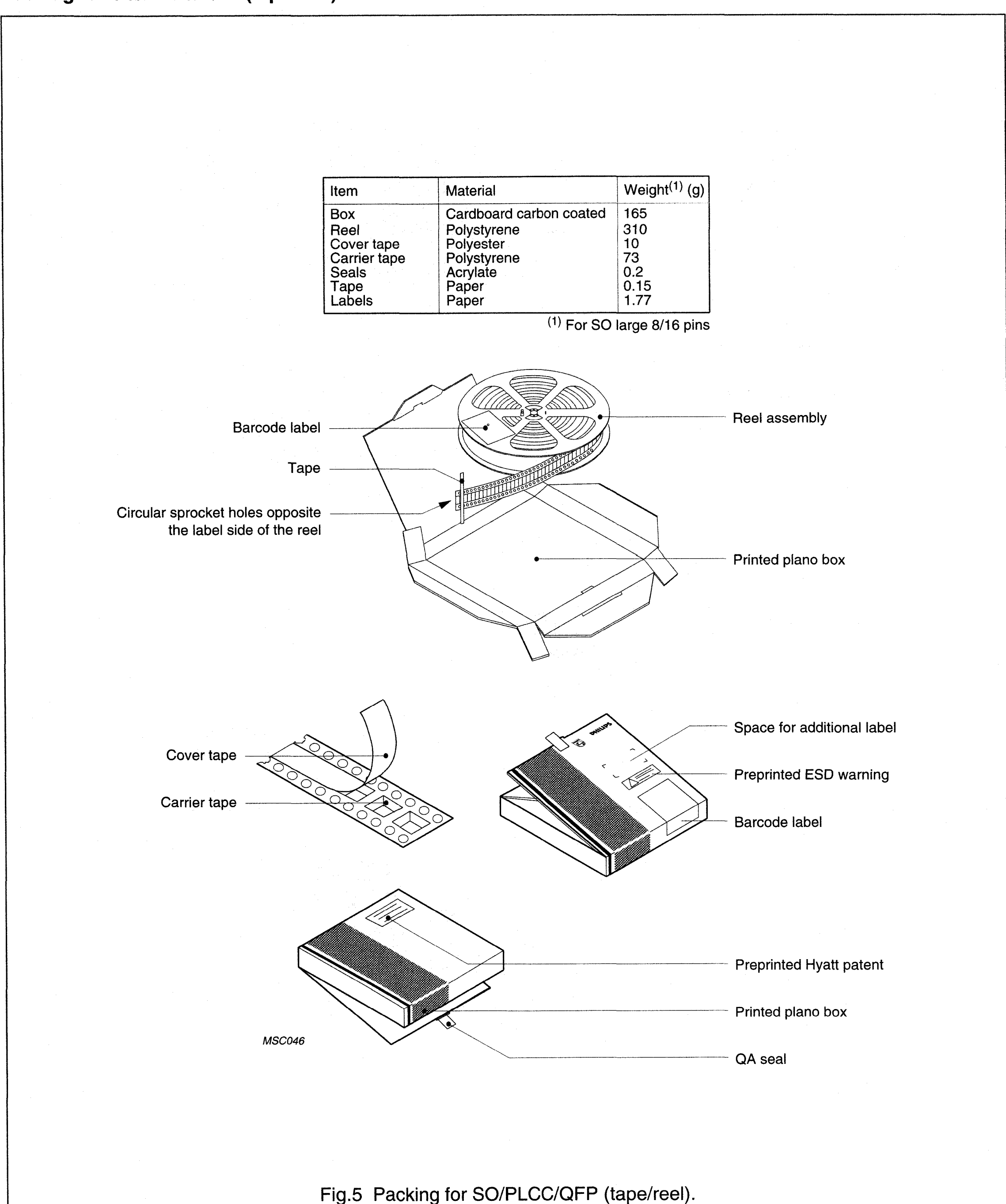
Packing for SO/PLCC/QFP (tape/reel)



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.5 Packing for SO/PLCC/QFP (tape/reel).

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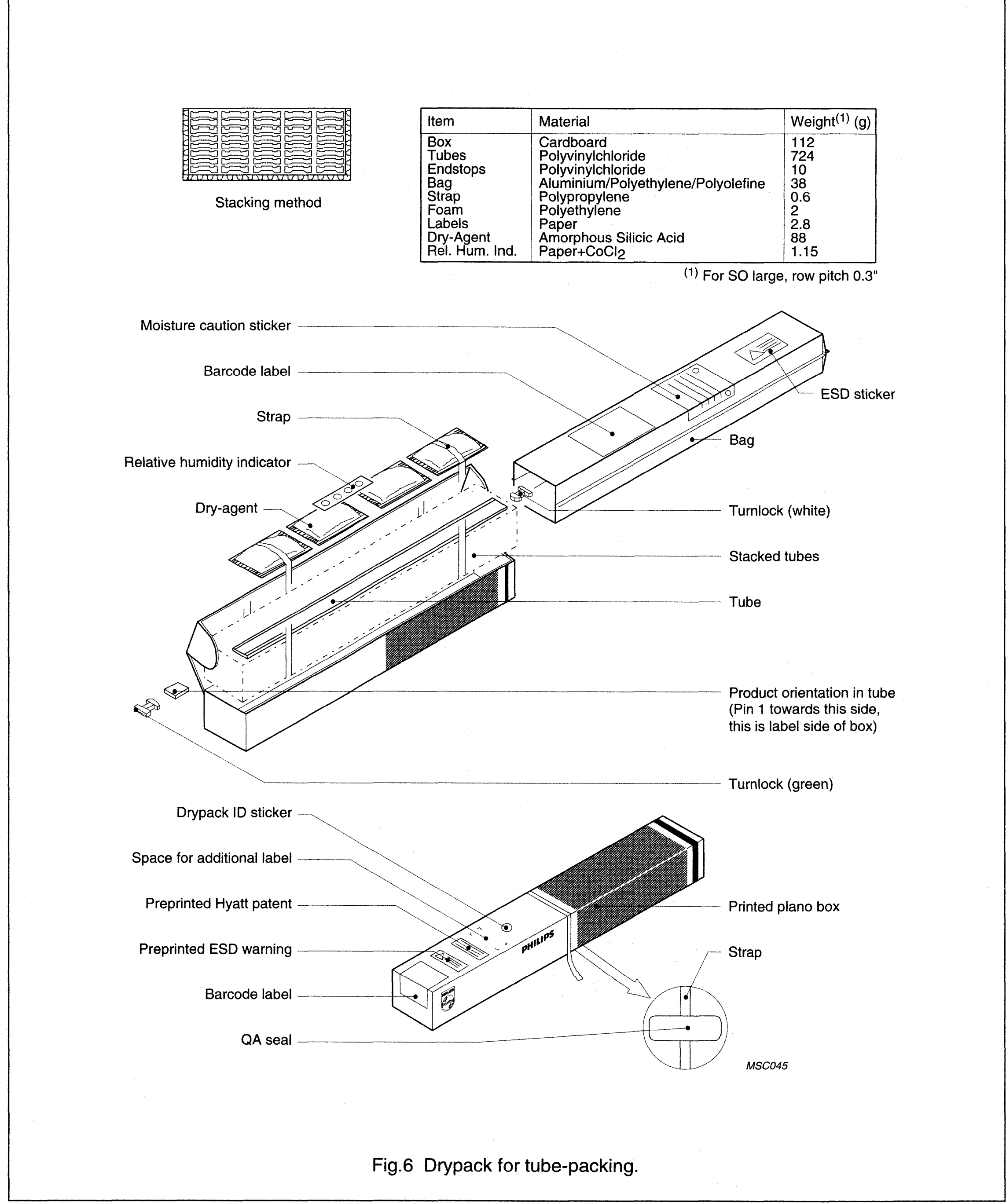
Drypack for tube-packing



Item	Material	Weight(1) (g)
Box	Cardboard	112
Tubes	Polyvinylchloride	724
Endstops	Polyvinylchloride	10
Bag	Aluminium/Polyethylene/Polyolefine	38
Strap	Polypropylene	0.6
Foam	Polyethylene	2
Labels	Paper	2.8
Dry-Agent	Amorphous Silicic Acid	88
Rel. Hum. Ind.	Paper+$CoCl_2$	1.15

(1) For SO large, row pitch 0.3"

Fig.6 Drypack for tube-packing.

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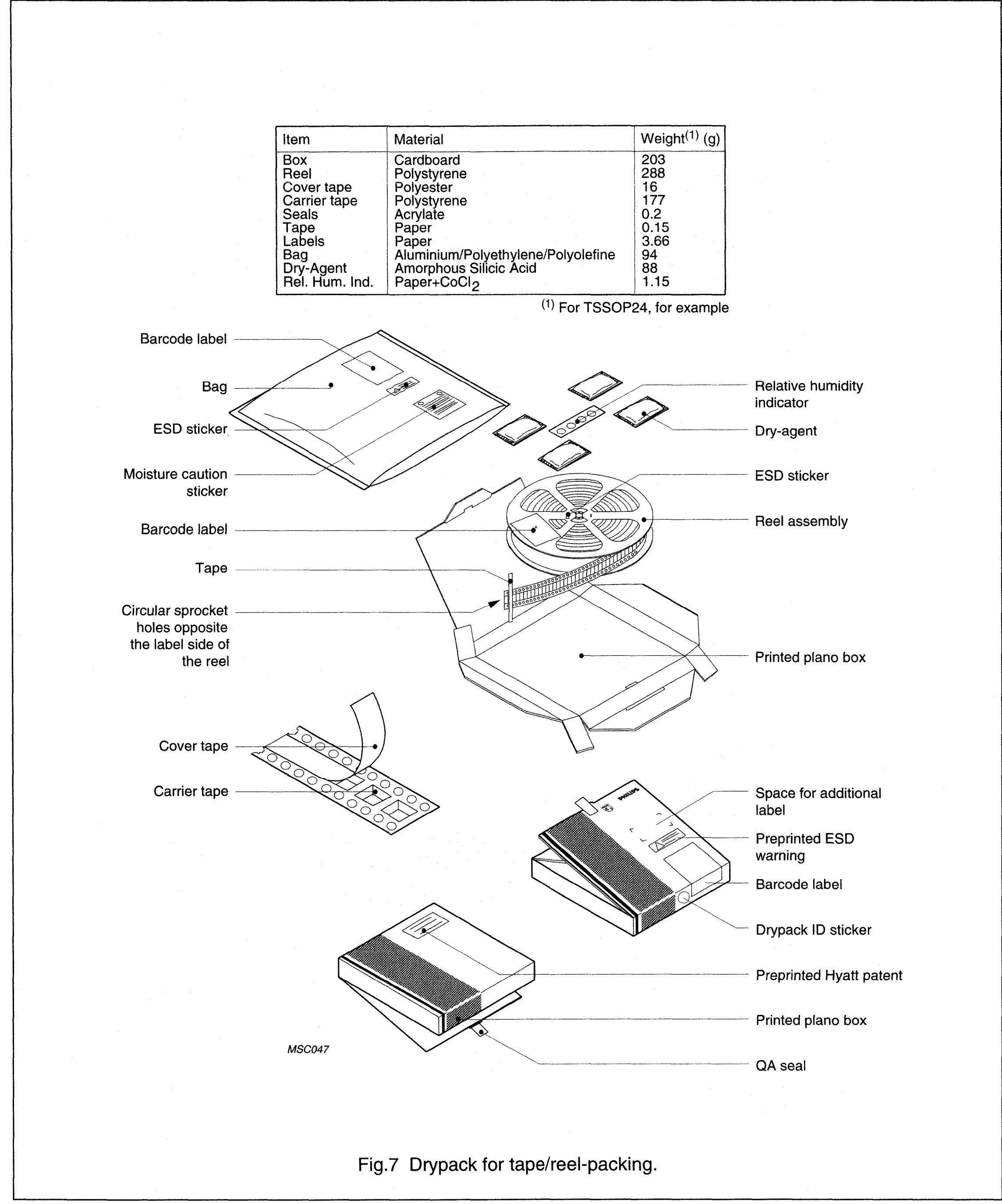
Drypack for tape/reel-packing

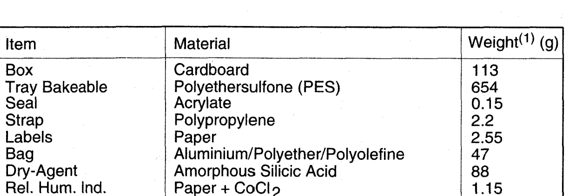


Item	Material	Weight[1] (g)
Box	Cardboard	203
Reel	Polystyrene	288
Cover tape	Polyester	16
Carrier tape	Polystyrene	177
Seals	Acrylate	0.2
Tape	Paper	0.15
Labels	Paper	3.66
Bag	Aluminium/Polyethylene/Polyolefine	94
Dry-Agent	Amorphous Silicic Acid	88
Rel. Hum. Ind.	Paper+$CoCl_2$	1.15

(1) For TSSOP24, for example

Fig.7 Drypack for tape/reel-packing.

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.8 Drypack for tray-packing.

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	plug	22	34	748	530 × 136 × 65	7.25; 28; MSC054
SIL9MP	SOT142	501	plug	22	34	748	530 × 136 × 65	
SIL9MPF	SOT110	501	plug	22	34	748	530 × 136 × 65	
SIL9P	SOT131	575	plug	23	24	552	595 × 137 × 68	8.5; 36; MSC052
SIL13P	SOT193	575	plug	23	24	552	595 × 137 × 68	
DBS9P	SOT157	575	plug	23	24	552	595 × 137 × 68	33.2; 14.6; 6.7; 12.2; MSC064
DBS13P	SOT141	575	plug	23	24	552	595 × 137 × 68	
DBS17P	SOT243	575	plug	23	24	552	595 × 137 × 68	
RBS9MPF	SOT352	501	plug	22	42	924	530 × 136 × 65	5.2; 11.6; 5.4; 22; MSC055
DIP22	SOT116	501	pin	17	32	544	530 × 136 × 65	12.2; 13.45; 18.46; MSC050
DIP22	SOT116	575	pin	21	40	840	595 × 137 × 68	
DIP24	SOT248	501	pin	15	32	480	530 × 136 × 65	
SDIP24	SOT234	575	pin	25	40	1000	595 × 137 × 68	
SDIP32	SOT232	575	pin	19	40	760	595 × 137 × 68	

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
DIP8	SOT97	501	pin	50	40	2000	532 × 142 × 63	8.4; 12.25; 15.25; MSC051
DIP14	SOT27	501	pin	25	40	1000	532 × 142 × 63	8.8; 13.45; 15.25; MSC058
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	
DIP20	SOT146	501	pin	18	40	720	532 × 142 × 63	
SDIP20	SOT325	501	pin	25	40	1000	532 × 142 × 63	
DIP24	SOT222	501	pin	15	40	600	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	
DIP18	SOT102-2	575	pin	23	40	920	595 × 137 × 68	
DIP20	SOT146	575	pin	20	40	800	595 × 137 × 68	

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
DIP24	SOT101	501	pin	15	24	360	532 × 142 × 63	19.3; 13.5; 22.8; MSC059
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	
SDIP48	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	
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	
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.

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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 NON-DRYPACKED (mm)	DRYPACKED (mm)	CARRIER PROFILE (mm)
SO8	SOT96	515	turnlock	100	20	2000	525 × 83 × 15	528 × 101 × 23	3.8; 7.9; MSC056
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	5.1; 15.4; MSC053
SO16	SOT162	515	turnlock	47	40	1880	551 × 90 × 46	572 × 94 × 54	
SO20	SOT163	515	turnlock	38	40	1520	551 × 90 × 46	572 × 94 × 54	
SO24	SOT137	515	turnlock	31	40	1240	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	
SSOP36	SOT378	508	plug	32	40	1280	–	572 × 94 × 54	
VSO40	SOT158	515	turnlock	31	40	1240	551 × 90 × 46	572 × 94 × 54	
SO28	SOT213	511	turnlock	27	28	756	551 × 90 × 46	572 × 94 × 54	5.7; 20; MSC061
VSO56	SOT190	495	turnlock	22	28	616	551 × 90 × 46	572 × 94 × 54	5.55; 21.5; MSC060
SSOP20	SOT266	511	turnlock	75	18	1350	525 × 83 × 20	530 × 103 × 29	3.45; 8.8; MSC049
SSOP20	SOT339	508	plug	66	14	924	525 × 83 × 20	530 × 103 × 29	
SSOP24	SOT340	508	plug	59	14	826	525 × 83 × 20	530 × 103 × 29	
PLCC28	SOT261	491	plug	34	64	2176	532 × 142 × 63	–	7.1; 15; MSC062

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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-DRYPACKED (mm)	DRYPACKED (mm)	
PLCC44	SOT187	491	plug	26	50	1300	532 × 142 × 63	541 × 129 × 67	7.1; 20.1; MSC063
PLCC68	SOT188	491	plug	18	36	648	532 × 142 × 63	541 × 129 × 67	7.1; 27.7; MSC057
PLCC84	SOT189	491	plug	15	28	420	532 × 142 × 63	541 × 129 × 67	7.1; 32.8; MSC065
SSOP48	SOT370	515	turnlock	31	51	1581	551 × 909 × 46	572 × 94 × 54	5.0; 13.7; MSC562
SSOP56	SOT371	515	turnlock	26	51	1326	551 × 909 × 46	572 × 94 × 54	
TSSOP14	SOT402	510	plug	96	25	2400	525 × 83 × 15	528 × 101 × 23	3.05; 7.83; 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	
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	
TSSOP48	SOT362	510	plug	39	25	975	525 × 83 × 15	528 × 101 × 23	3.05; 9.58; MSC564
TSSOP56	SOT364	510	plug	35	25	875	525 × 83 × 15	528 × 101 × 23	

Note

1. If only a package type code is given, the data supplied is applicable to all its outline versions.

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-DRYPACKED (mm)	DRYPACKED (mm)
SO					
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	1000	341 × 338 × 39	341 × 338 × 49
SO20	SOT336	330 × 24	2000	341 × 338 × 39	341 × 338 × 49
SO24	SOT137	180 × 24	500	191 × 188 × 39	209 × 206 × 48
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
SO28	SOT213	180 × 24	350	191 × 188 × 39	209 × 206 × 48
SO28	SOT213	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
SO32	SOT287	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
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	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
SSOP28	SOT341	330 × 24	1000	341 × 338 × 39	341 × 338 × 49
SSOP36	SOT378	330 × 24	1000	n.a.	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

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-DRYPACKED (mm)	DRYPACKED (mm)
PLCC					
PLCC20	SOT380	330 × 16	1000	341 × 338 × 30	n.a.
PLCC28	SOT261	180 × 24	300	191 × 188 × 39	209 × 206 × 48
PLCC28	SOT261	330 × 24	750	341 × 338 × 39	341 × 338 × 49
PLCC32	SOT381	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
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	SOT318	330 × 44	500	341 × 338 × 61	341 × 338 × 68
QFP80	SOT419	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
QFP100	SOT317	330 × 44	500	341 × 338 × 61	341 × 338 × 68
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
TSSOP					
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
TSSOP48	SOT362	330 × 24	2000	341 × 338 × 39	341 × 338 × 49
TSSOP56	SOT364	330 × 24	2000	341 × 338 × 39	341 × 338 × 49
HSOP					
HSSOP20	SOT397/418	330 × 24	500	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-DRYPACKED (mm)	DRYPACKED (mm)
SOJ					
SOJ40	SOT449	330 × 44	750	n.a.	341 × 338 × 68
TPLCC					
TPLCC52	SOT433	330 × 32	500	341 × 338 × 49	341 × 338 × 61
HLQFP					
HLQFP100	SOT470	330 × 32	1000	341 × 338 × 49	341 × 338 × 61
TQQFP					
TQFP44	SOT376	330 × 24	1500	341 × 338 × 39	341 × 338 × 49
TQFP80	SOT375	330 × 24	1000	341 × 338 × 39	341 × 338 × 49

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.9)					
		A0	B0	K0	P1	W	TYPE
SO							
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
SO20	SOT336	8.4	13.3	2.5	12.0	24.0	A
SO24	SOT137	11.1	16.1	2.7	12	24	A
SO28	SOT136	11.1	18.5	2.7	12	24	A
SO28	SOT213	12.8	18.0	3.05	16	24	A
SO32	SOT287	10.9	21.2	3.1	16.0	32.0	B
VSO							
VSO40	SOT158	12.8	16.3	3.0	16	24	A
VSO56	SOT190	16.0	22.3	3.15	20	32	B
PLCC							
PLCC20	SOT380	10.35	10.35	4.9	12.0	16.0	A
PLCC28	SOT261	13.0	13.0	4.9	16	24	A
PLCC32	SOT381	12.97	15.51	3.9	16.0	24.0	A
PLCC44	SOT187	18.0	18.0	5.7	24	32	B
PLCC52	SOT238	20.5	20.5	5.3	24.0	32.0	B
PLCC68	SOT188	25.6	25.6	5.8	32	44	B
PLCC84	SOT189	30.7	30.7	5.8	36	44	B
QFP							
QFP44	SOT307	13.1	13.1	2.8	24.0	24.0	A
QFP52	SOT379	14.2	14.2	2.8	24.0	24.0	A
QFP44	SOT205	19.2	19.2	3.0	24.0	32.0	B
QFP64	SOT319	19.0	25.0	3.7	32.0	44.0	B
QFP64	SOT393	18.0	18.0	3.6	24.0	32.0	B
QFP80	SOT318/310	19.0	25.0	3.7	32.0	44.0	B
QFP100	SOT317	19.0	25.0	3.7	32.0	44.0	B
LQFP							
LQFP32	SOT358	9.6	9.6	2.2	12.0	16.0	A
LQFP32	SOT401	7.4	7.4	1.75	12.0	16.0	A
LQFP44	SOT389	12.35	12.35	2.2	16.0	24.0	A
LQFP48	SOT313	9.6	9.6	2.2	12.0	16.0	A
LQFP64	SOT314	12.35	12.35	2.2	16.0	24.0	A

Packing Methods Chapter 7

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE[1]	CARRIER TAPE DIMENSIONS IN mm (see Fig.9)					
		A0	B0	K0	P1	W	TYPE
LQFP64	SOT414	9.6	9.6	2.2	12.0	16.0	A
LQFP80	SOT315	14.4	14.4	2.1	20.0	24.0	A
LQFP100	SOT407	16.5	16.5	1.9	20.0	24.0	A
LQFP128	SOT420	16.5	16.5	1.9	20.0	24.0	A
TSSOP							
TSSOP14	SOT402	6.95	5.6	1.6	8.0	12.0	A
TSSOP16	SOT403	6.95	5.6	1.6	8.0	12.0	A
TSSOP20	SOT360	6.9	10.6	1.8	12.0	16.0	A
TSSOP24	SOT355	6.9	11.8	1.8	12.0	16.0	A
TSSOP48	SOT362	8.35	13.0	1.6	16.0	24.0	A
TSSOP56	SOT364	8.6	14.5	1.8	12.0	24.0	A
HSSOP							
HSSOP20	SOT397/418	14.7	16.4	4.0	20.0	32.0	B
SOJ							
SOJ40	SOT449	11.6	26.55	4.4	16.0	44.0	B
TPLCC							
TPLCC52	SOT433	20.5	20.5	4.0	24.0	32.0	B
HLQFP							
HLQFP100	SOT470	16.5	16.5	1.9	20.0	24.0	A
TQFP							
TQFP44	SOT376	12.35	12.35	1.85	16.0	24.0	A
TQFP80	SOT375	14.4	14.4	2.1	20.0	24.0	A
SSOP							
SSOP14	SOT337	8.2	6.6	2.5	12	16.0	A
SSOP16	SOT338	8.2	6.6	2.5	12	16.0	A
SSOP16	SOT369	6.9	5.4	2.0	8.0	12.0	A
SSOP20	SOT266	7.1	7.2	2.0	12.0	16.0	A
SSOP20	SOT339	8.2	7.5	2.5	12.0	16.0	A
SSOP24	SOT340	8.2	8.8	2.5	12.0	16.0	A
SSOP28	SOT341	8.4	10.9	2.4	12.0	24.0	A
SSOP36	SOT378	11.1	16.1	2.7	12.0	24.0	A
SSOP48	SOT370	12.0	16.2	3.2	16.0	32.0	B
SSOP56	SOT371	12.0	18.7	3.2	16.0	32.0	B

Note

1. If only a package type code is given, the data supplied is applicable to all its outline versions.

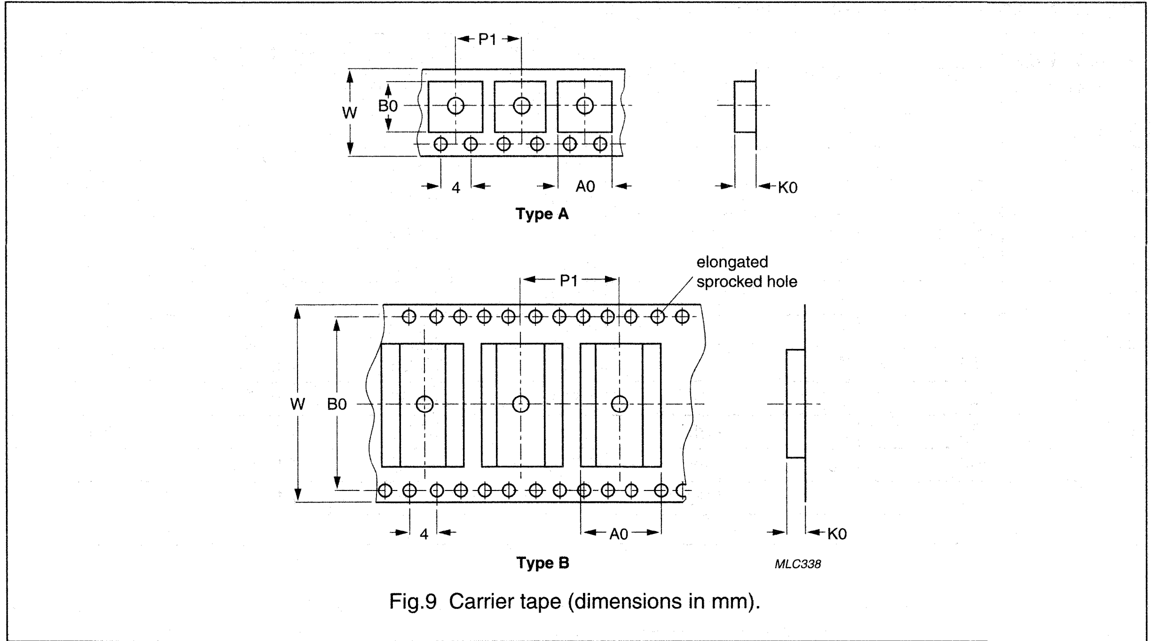

Fig.9 Carrier tape (dimensions in mm).

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
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
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

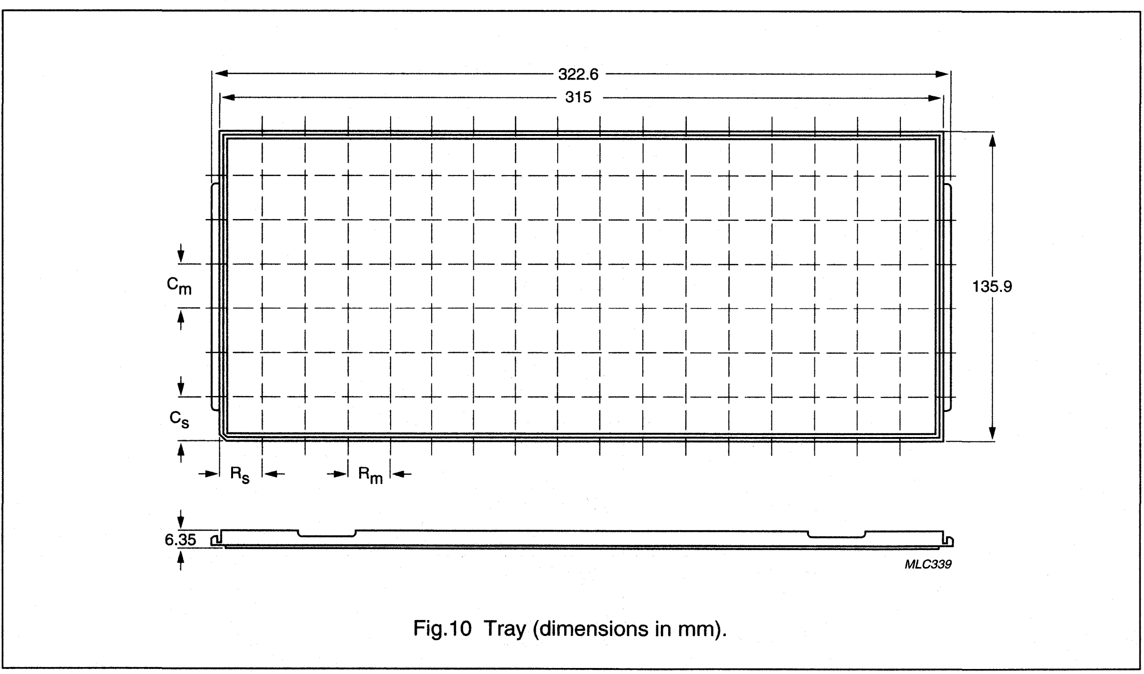

Fig.10 Tray (dimensions in mm).

Packing Methods Chapter 7

Trays (Drypack) - surface mount devices

PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE[1]	PACKAGE BODY	CARRIER DIMENSIONS L × W × H (mm)	CARRIERS PER BOX	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H (mm)
HLQFP100	SOT470	14 × 14 mm	315 × 135 × 7.0	1	90	352 × 183 × 27
				5	450	356 × 161 × 56
HSQFP208	SOT431	28 × 28 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
HSQFP240	SOT464	32 × 32 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
LQFP32	SOT358	7 × 7 mm	315 × 135 × 7.0	1	250	352 × 183 × 27
				5	1250	356 × 161 × 56
LQFP32	SOT401	5 × 5 mm	315 × 135 × 7.0	1	360	352 × 183 × 27
				5	1800	356 × 161 × 56
LQFP44	SOT376	10 × 10 mm	315 × 135 × 7.0	1	160	352 × 183 × 27
				5	800	356 × 161 × 56
LQFP44	SOT389	10 × 10 mm	315 × 135 × 7.0	1	160	352 × 183 × 27
				5	800	356 × 161 × 56
LQFP48	SOT313	7 × 7 mm	315 × 135 × 7.0	1	250	352 × 183 × 27
				5	1250	356 × 161 × 56
LQFP64	SOT314	10 × 10 mm	315 × 135 × 7.0	1	160	352 × 183 × 27
				5	800	356 × 161 × 56
LQFP64	SOT414	7 × 7 mm	315 × 135 × 7.0	1	250	352 × 183 × 27
				5	1250	356 × 161 × 56
LQFP80	SOT315	12 × 12 mm	315 × 135 × 7.0	1	119	352 × 183 × 27
				5	595	356 × 161 × 56
LQFP100	SOT407	14 × 14 mm	315 × 135 × 7.0	1	90	352 × 183 × 27
				5	450	356 × 161 × 56
LQFP128	SOT420	14 × 14 mm	315 × 135 × 7.0	1	90	352 × 183 × 27
				5	450	356 × 161 × 56
LQFP128	SOT425	14 × 20 mm	315 × 135 × 7.0	1	72	352 × 183 × 27
				5	360	356 × 161 × 56
LQFP160	SOT435	24 × 24 mm	315 × 135 × 7.0	1	40	352 × 183 × 27
				5	200	356 × 161 × 56
MSQFP240	SOT474	32 × 32 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
QFP44	SOT205	14 × 14 mm	315 × 135.9 × 7.6	1	84	352 × 183 × 27
				5	420	356 × 161 × 56
QFP44	SOT307	10 × 10 mm	315 × 135.9 × 7.6	1	96	352 × 183 × 27
				5	480	356 × 161 × 56
QFP52	SOT379	10 × 10 mm	315 × 135.9 × 7.6	5	480	356 × 161 × 56

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PACKAGE NAME	PHILIPS PACKAGE TYPE/OUTLINE CODE[(1)]	PACKAGE BODY	CARRIER DIMENSIONS L × W × H (mm)	CARRIERS PER BOX	SPQ AND PQ	OUTER BOX DIMENSIONS L × W × H (mm)
QFP64	SOT319	14 × 20 mm	315 × 135.9 × 7.6	1	66	352 × 183 × 27
				5	330	356 × 161 × 56
QFP64	SOT393	14 × 14 mm	315 × 135.9 × 7.6	1	84	352 × 183 × 27
				5	420	356 × 161 × 56
QFP80	SOT318	14 × 20 mm	315 × 135.9 × 7.6	1	66	352 × 183 × 27
				5	330	356 × 161 × 56
QFP80	SOT419	14 × 14 mm	315 × 135.9 × 7.6	1	84	352 × 183 × 27
				5	420	356 × 161 × 56
QFP100	SOT317	14 × 20 mm	315 × 135.9 × 7.6	1	66	352 × 183 × 27
				5	330	356 × 161 × 56
QFP120	SOT349	28 × 28 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
QFP120	SOT383	28 × 28 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
QFP128	SOT320	28 × 28 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
QFP160	SOT322	28 × 28 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
SQFP208	SOT316	28 × 28 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
SQFP240	SOT334	32 × 32 mm	315 × 135.9 × 7.6	1	24	352 × 183 × 27
				5	120	356 × 161 × 56
SQFP128	SOT387	14 × 20 mm	315 × 135.9 × 7.6	1	66	352 × 183 × 27
				5	330	356 × 161 × 56
TQFP64	SOT357	10 × 10 mm	315 × 135 × 7.0	1	160	352 × 183 × 27
				5	800	356 × 161 × 56
TQFP80	SOT375	12 × 12 mm	315 × 135 × 7.0	1	119	352 × 183 × 27
				5	595	356 × 161 × 56
TQFP100	SOT386	14 × 14 mm	315 × 135 × 7.0	1	90	352 × 183 × 27
				5	450	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

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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 envelope 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 envelope 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
- envelope (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

Envelope

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.

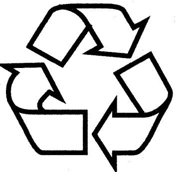

Fig.1 Paper and cardboard.

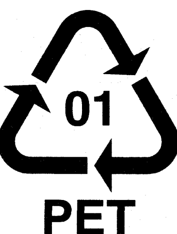

Fig.2 Polyethylene terephthalate.

Fig.3 Polyethylene, high density.

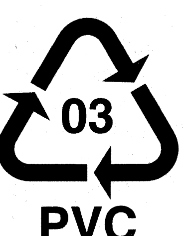

Fig.4 Polyvinylchloride.

Fig.5 Polyethylene, low density.

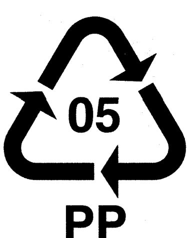

Fig.6 Polypropylene.

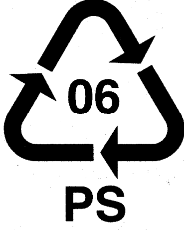

Fig.7 Polystyrene.

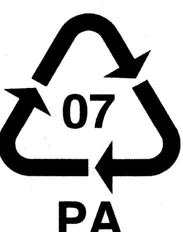

Fig.8 Other plastics. The acronym of the plastic is put under the recycling symbol. In this example: PA = polyamide.

Environmental data on ICs Chapter 8

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-dimethlformamide
- 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 napthalenes
- polychlorinated biphenyls (PCB)
- polycyclic compounds
- polyhalogenated dibenzofurans/dioxins
- polyhalogenated bi/triphenyl ethers
- selenium
- tellurium
- tetrabromobenzylimidazole
- tetrabromoethylene
- toluene
- triethylamine
- tris (aziridinyl) phosphinoxide
- 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 envelope is exposed to organic solvents, these may extract part of the resin contained in the envelope.
- 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

DUAL IN-LINE PACKAGES

REFERENCE[1]	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
DIP8	SOT97	0.480	6.4 × 9.3 × 3.2	2000
DIP14	SOT27	0.970	6.4 × 19.0 × 3.2	1000
DIP16	SOT38	1.180	6.4 × 19.0 × 3.2	1000
DIP18	SOT102	1.180	6.4 × 21.6 × 3.7	800
DIP20	SOT146	1.340	6.4 × 26.6 × 3.2	720
DIP22	SOT116	2.213	8.9 × 28.0 × 3.8	720
DIP24	SOT101	3.800	14.0 × 31.7 × 4.0	360
DIP28	SOT117	4.336	14.0 × 35.7 × 4.0	312
DIP32	SOT201	4.682	14.0 × 41.1 × 4.0	264
DIP40	SOT129	6.214	14.0 × 52.0 × 4.0	216
DIP48	SOT240	7.700	14.0 × 61.7 × 4.0	168

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOD129 (DIP40)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	FeNi42	1294
	Sn plated	20
active device	doped Si	30
encapsulation	OCN-epoxy polymer (SiO_2 < 72%, Sb < 4%, Br < 0.6%)	4870

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
lables	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
SDIP20	SOT325	0.93	6.4 × 19.0 × 3.2	1000
SDIP24	SOT234	1.65	8.9 × 21.9 × 3.8	1000
SDIP32	SOT232	2.2	8.9 × 29.0 × 3.8	760
SDIP42	SOT270	4.57	13.8 × 38.6 × 4.6	420
SDIP52	SOT247	5.55	13.8 × 47.5 × 4.0	330
SDIP64	SOT274	9.15	17.0 × 58.2 × 4.6	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 plated	20
active device	doped Si	30
envelope	OCN-epoxy polymer (SiO_2 < 72%, Sb < 4%, Br < 0.6%)	3520

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
lables	paper	1.7
seal	acrylate	0.2

Environmental data on ICs — Chapter 8

SINGLE IN-LINE MEDIUM POWER PACKAGES

REFERENCE[1]	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
DBS9MPF	SOT111	1.75	6.4 × 21.6 × 3.5	748
RBS9MPF	SOT352	1.75	6.4 × 21.6 × 3.5	924
SIL9MP	SOT142	1.39	6.4 × 21.6 × 3.5	748
SIL9MPF	SOT110	1.75	6.4 × 21.6 × 3.5	748

Note

1. All single in-line medium power type packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT110 (SIL9MPF)

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	1000
	Sn plated	20
active device	doped Si	30
envelope	OCN-epoxy polymer (SiO_2 < 72%, Sb < 4%, Br < 0.6%)	700

Packing material (tube pack)

SOURCE	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

SINGLE IN-LINE POWER PACKAGES

REFERENCE[1]	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
DBS9P	SOT157	4.8	12 × 23.7 × 4.4	552
DBS13P	SOT141	4.8	12 × 23.7 × 4.4	552
DBS17P	SOT243	4.7	12 × 23.7 × 4.4	552
SIL9P	SOT131	4.8	12 × 23.7 × 4.4	552
SIL13P	SOT193	3.0	12 × 23.7 × 4.4	552

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT243

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	CuZn15	900
	Ni + Sn plated	20
heatsink	Cu	2350
soft solder	SnAg25Sb10	25
active device	doped Si	30
encapsulation	OCN-epoxy polymer (SiO_2 < 72%, Sb < 4%, Br < 0.6%)	1375

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

SMALL OUTLINE PACKAGES

REFERENCE[1]	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
SO8	SOT96	0.080	3.9 × 4.9 × 1.3	2500
SO8	SOT176	0.290	7.5 × 7.6 × 2.3	1000
SO14	SOT108	0.130	3.9 × 8.7 × 1.3	2500
SO16	SOT109	0.152	3.9 × 9.9 × 1.3	2500
SO16	SOT162	0.400	7.5 × 10.2 × 2.3	1000
SO20	SOT163	0.520	7.5 × 12.7 × 2.3	1000
SO24	SOT137	0.600	7.5 × 15.3 × 2.3	1000
SO28	SOT136	0.740	7.5 × 17.8 × 2.3	1080
VSO40	SOT158	0.540	7.6 × 15.4 × 2.3	500
VSO56	SOT190	1.300	11.1 × 21.6 × 2.8	500

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT163

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy, SnPb20 plated	130
active device	doped Si	15
chip coating	silicone gel	5
encapsulation	OCN-epoxy polymer (SiO_2 < 72%, Sb < 4%, Br < 0.6%)	370

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 (g)	BODY (mm)	PACKING QUANTITY
SSOP14	SOT337	0.127	5.3 × 6.2 × 1.7	2000
SSOP16	SOT338	0.133	5.3 × 6.2 × 1.7	2000
SSOP20	SOT339	0.154	5.3 × 7.2 × 1.7	2500
SSOP24	SOT340	0.178	5.3 × 8.2 × 1.7	2000
SSOP28	SOT341	0.217	5.3 × 10.2 × 1.7	2000
SSOP48	SOT370	0.590	7.5 × 15.9 × 2.3	1000
SSOP56	SOT371	0.690	7.5 × 18.4 × 2.3	1000

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT339

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	40
	SnPb20 plated	4.5
active device	doped Si	2.5
encapsulation	biphenyl-epoxy polymer (SiO_2 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 (g)	BODY (mm)	PACKING QUANTITY
TSSOP14	SOT402	0.054	4.4 × 5.0 × 0.9	2500
TSSOP16	SOT403	0.054	4.4 × 5.0 × 0.9	2500
TSSOP20	SOT360	0.068	4.4 × 6.5 × 0.9	2500
TSSOP24	SOT355	0.086	4.4 × 7.8 × 0.9	2500
TSSOP48	SOT362	0.177	6.1 × 12.5 × 0.9	2000
TSSOP56	SOT364	0.201	6.1 × 14.0 × 0.9	2000

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT355

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	CuNi3, SnPb20 plated	32
active device	doped Si	6
encapsulation	biphenyl-epoxy polymer (SiO_2 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
dry agent	silicic acid	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 (g)	BODY (mm)	PACKING QUANTITY
PLCC28	SOT261	1.170	11.5 × 11.5 × 4.1	2368
PLCC44	SOT187	2.280	16.6 × 16.6 × 4.1	1300
PLCC52	SOT238	2.917	19.1 × 19.1 × 4.1	1012
PLCC68	SOT188	4.700	24.2 × 24.2 × 4.6	648
PLCC84	SOT189	6.680	29.3 × 29.3 × 4.6	420

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT187

Device parts

DEVICE	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	390
	SnPb20 plated	25
active device	doped Si	70
chip coating	silicone gel	25
envelope	OCN-epoxy polymer (SiO_2 < 72%, Sb < 1.2%, Br < 1.3%)	1770

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
lables	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	0.920	14 × 14 × 2.2	420
QFP44	SOT307	0.464	10 × 10 × 1.7	480
QFP64	SOT208	1.560	14 × 20 × 2.7	330
QFP80	SOT219	1.560	14 × 20 × 2.7	330
QFP100	SOT210	1.560	14 × 20 × 2.7	330
QFP120	SOT220	5.100	28 × 28 × 3.3	120
QFP128	SOT320	5.100	28 × 28 × 3.3	120
QFP160	SOT225	5.100	28 × 28 × 3.3	120

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT208

Device parts

DEVICE PART	SUBSTANCE	MASS (mg)
leadframe	FeNi42	320
	SnPb20 plated	10
active device	doped Si	20
chip coating	silicone gel	10
encapsulation	biphenyl-epoxy polymer (SiO_2 80%, Sb < 2%, Br < 0.6%)	1200

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	silicic acid	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, SHRINK & THIN QUAD FLAT PACKAGES

REFERENCE[1]	PACKAGE CODE	MASS (g)	BODY (mm)	PACKING QUANTITY
LQFP32	SOT358	0.117	7 × 7 × 1.4	2000
LQFP48	SOT313	0.18	7 × 7 × 1.4	2000
LQFP64	SOT314	0.32	10 × 10 × 1.4	1500
LQFP80	SOT315	0.45	12 × 12 × 1.4	1000
SQFP128	SOT387	1.3	14 × 20 × 2.0	500
TQFP44	SOT376	0.275	10 × 10 × 1.0	1500
TQFP64	SOT357	0.27	10 × 10 × 1.0	1500

Note

1. All packages have a similar composition, quantities may vary.

Chemical content

GROUP REPRESENTATIVE: SOT315

Device parts

SOURCE	SUBSTANCE	MASS (mg)
leadframe	Cu alloy	140
	SnPb20 plated	50
active device	doped Si	40
encapsulation	biphenyl-epoxy polymer (SiO_2 80%, Sb < 2%, Br < 0.6%)	220

Packing material (reel pack, dry pack)

PACKING PART	SUBSTANCE	MASS (g)
box	cardboard	203
reel	polystyrene	348
bag	aluminium laminated polyethylene	68
dry agent	silicic acid	88
humidity indicator	paper + $CoCl_2$	1.2
carrier tape	polystyrene, carbon loaded	165
cover tape	polyester	16
labels	paper	3.7

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*
IC01	Semiconductors for Radio, Audio and CD/DVD Systems
IC02	Semiconductors for Television and Video Systems
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^2C Peripherals
IC13	Programmable Logic Devices (PLD)
IC14	8048-based 8-bit Microcontrollers
IC15	FAST TTL Logic Series
IC16	CMOS ICs for Clocks and Watches
IC17	Semiconductors for Wireless Communications
IC18	Semiconductors for In-Car Electronics
IC19	ICs for Data Communications
IC20	80C51-based 8-bit Microcontrollers
IC22	Multimedia ICs
IC23	BiCMOS Bus Interface Logic
IC24	Low Voltage CMOS & BiCMOS Logic
IC25	16-bit 80C51XA Microcontrollers (eXtended Architecture)
IC26	Integrated Circuit Packages
IC27	Complex Programmable Logic Devices

Discrete semiconductors

Book	*Title*
SC01	Small-signal and Medium-power Diodes
SC02	Power Diodes
SC03	Power Thyristors and Triacs
SC04	Small-signal Transistors
SC05	Video Transistors and Modules for Monitors
SC06	High-voltage and Switching NPN Power Transistors
SC07	Small-signal Field-effect Transistors
SC13a	PowerMOS Transistors including TOPFETs and IGBTs
SC13b	Small-signal and Medium-power MOS Transistors
SC14	RF Wideband Transistors
SC16	Wideband Hybrid IC Modules
SC17	Semiconductor Sensors
SC18	Discrete Semiconductor Packages
SC19	RF & Microwave Power Transistors, RF Power Modules and Circulators/Isolators

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 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

Magnetic products

MA01	Soft Ferrites
MA03	Piezoelectric Ceramics Specialty Ferrites
MA04	Dry-reed Switches

Passive components

PA01	Electrolytic Capacitors
PA02	Varistors, Thermistors and Sensors
PA03	Potentiometers
PA04	Variable Capacitors
PA05	Film Capacitors
PA06	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: NORTH RYDE, Tel. (02) 9805 4455, Fax. (02) 9805 4466.
Austria: WIEN, Tel. (01) 601 01 12 41, Fax. (01) 60 101 12 11.
Belarus: MINSK, Tel. (5172) 200 924/733, Fax. (5172) 200 773.
Benelux: EINDHOVEN, Tel. (+31 40) 2783 749, Fax. (+31 40) 2788 399.
Brazil: SÃO PAULO, Tel. (011) 821 2333, Fax. (011) 829 1849.
Canada: SCARBOROUGH, Tel. (0416) 292 5161, Fax. (0416) 754 6248.
China: SHANGHAI, Tel. (021) 6354 1088, Fax. (021) 6354 1060.
Denmark: COPENHAGEN, Tel. (32) 883 333, Fax. (31) 571 949.
Finland: ESPOO, Tel. 9 (0)-615 800, Fax. 9 (0)-615 80510.
France: SURESNES, Tel. (01) 4099 6161, Fax. (01) 4099 6493.
Germany: HAMBURG, Tel. (040) 2489-0, Fax. (040) 2489 1400.
Greece: TAVROS, Tel. (01) 4894 339/(01) 4894 239, Fax. (01) 4814 240.
Hong Kong: KOWLOON, Tel. 2784 3000, Fax. 2784 3003.
India: MUMBAI, Tel. (022) 4930 311, Fax. (022) 4930 966/4950 304.
Indonesia: JAKARTA, Tel. (021) 794 0040, Fax. (021) 794 0080.
Ireland: DUBLIN, Tel. (01) 76 40 203, Fax. (01) 76 40 210.
Israel: TEL AVIV, Tel. (03) 6450 444, Fax. (03) 6491 007.
Italy: MILANO, Tel. (02) 6752 2531, Fax. (02) 6752 2557.
Japan: TOKYO, Tel. (0) 3 3740 5135, Fax. (0) 3 3740 5035.
Korea (Republic of): SEOUL, Tel. (02) 709 1472, Fax. (02) 709 1480.
Malaysia: PULAU PINANG, Tel. (03) 750 5213, Fax. (03) 757 4880.
Mexico: EL PASO, Tel. (915) 772 4020, Fax. (915) 772 4332.
New Zealand: AUCKLAND, Tel. (09) 815 4000, Fax. (09) 849 7811.
Norway: OSLO, Tel. (22) 74 8000, Fax. (22) 74 8341.
Pakistan: KARACHI, Tel. (021) 587 4641-49, Fax. (021) 577 035/(021) 587 4546.
Philippines: MANILA, Tel. (02) 816 6345, Fax. (02) 817 3474.
Poland: WARSZAWA, Tel. (022) 612 2594, Fax. (022) 612 2327.
Portugal: LINDA-A-VELHA, Tel. (01) 416 3160/416 3333, Fax. (01) 416 3174/416 3366.
Russia: MOSCOW, Tel. (095) 755 6918, Fax. (095) 755 6919.
Singapore: SINGAPORE, Tel. 350 2000, Fax. 355 1758.
South Africa: JOHANNESBURG, Tel. (011) 470 5911, Fax. (011) 470 5494.
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