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集積回路パッケージデザインガイド クワッドフラットノンリードパッケージ

Design guideline of integrated circuits for Quad Flat Non-leaded packages (QFN)

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Design guideline of integrated circuits for Quad Flat Non-leaded packages (QFN)

1. Scope of Application

This technical report covers the requirements for the outline drawings and dimensions of the Quad Flat Non-Leaded Packages(hereinafter referred to as QFNs),especially ceramic packages ,among the packages classified as form A in the **EIAJ ED-7300** [Recommended practice on Standard for the preparation of outline drawings of semicomductor packages]

2. Definition of the Technical Terms

The definition of the technical terms used in this design guideline is in conformity with **EIAJ ED-7300**,and the definition of technical terms appearing a new are given within the text of this design guideline.

3. Background

Cramming and speeding up of LSI chips is progressing all the way in correspondence to the recent demands of compactification and sophistication of electronic equipment. Moreover, there is an increasing demand for high-density construction of the mounting device as well as the package shape to be compact ,slim ,with multi-terminal.The popularity of the surface mounting device is increasing rapidly to cope with the said demands. This design guideline is intended to standardize the outer dimensions of QFNs and ensure compatibility between products.This standard shows the standard design values on the concept of the design center as far as possible for standardization.

4. Definition of QFN

QFN are defined a ceramic package with formed terminals which are led out of itself in four directions and make a metalized notch , making it possible to surface mount to the printed circuit board. There are square and rectangle to package.

There is not of notch that it do mount through a socket on printed circuit board is defined for Leadless package , limited it for soldering by this report

5. Numbering of Terminals

Numbering of terminals complies with the **EIAJ ED-7300.**

6. Nominal Dimensions

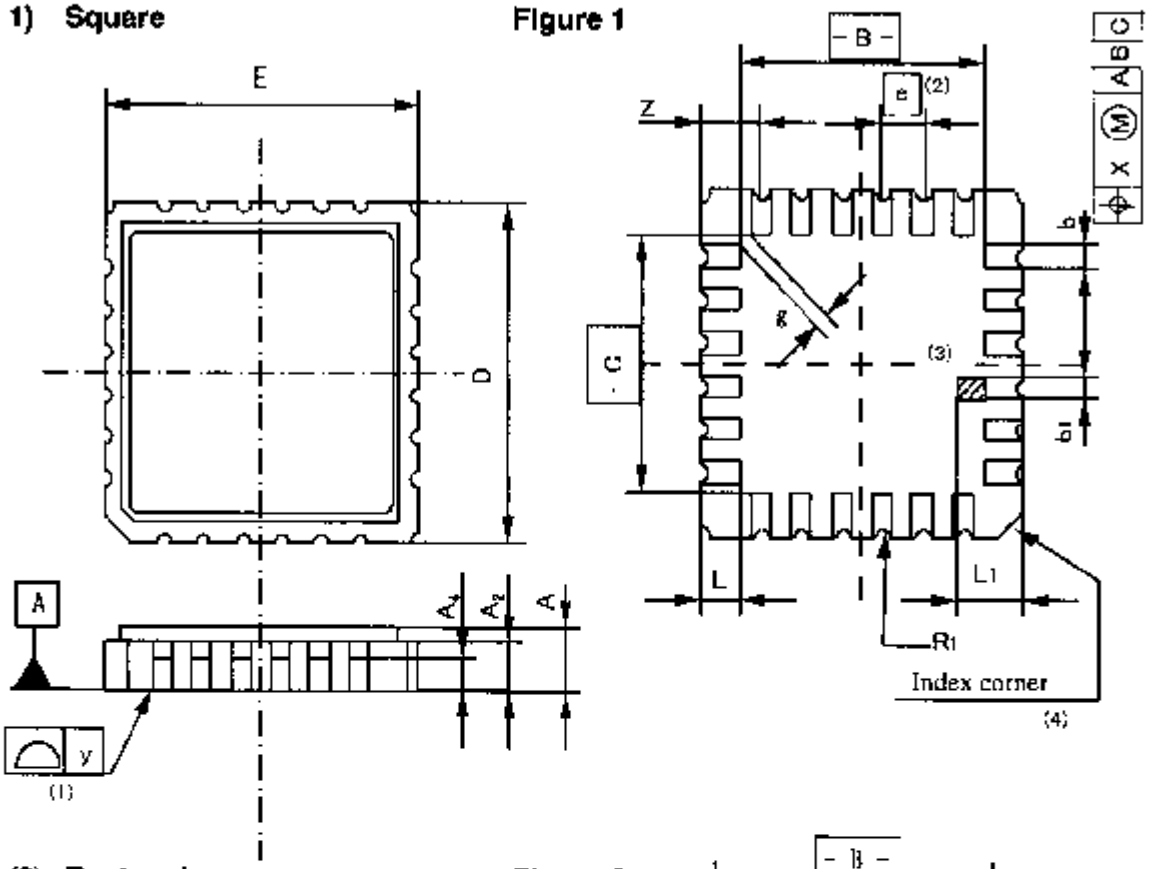
The dimensions of Square package body (Package width E or Package length D) are applied to Nomonal Dimensions. And The dimensions of rectangle package body (Package width E x Package length D) are applied to Nominal Dimensions.

7. Reference Symbols and Schematics

7.1 Outline Drawings

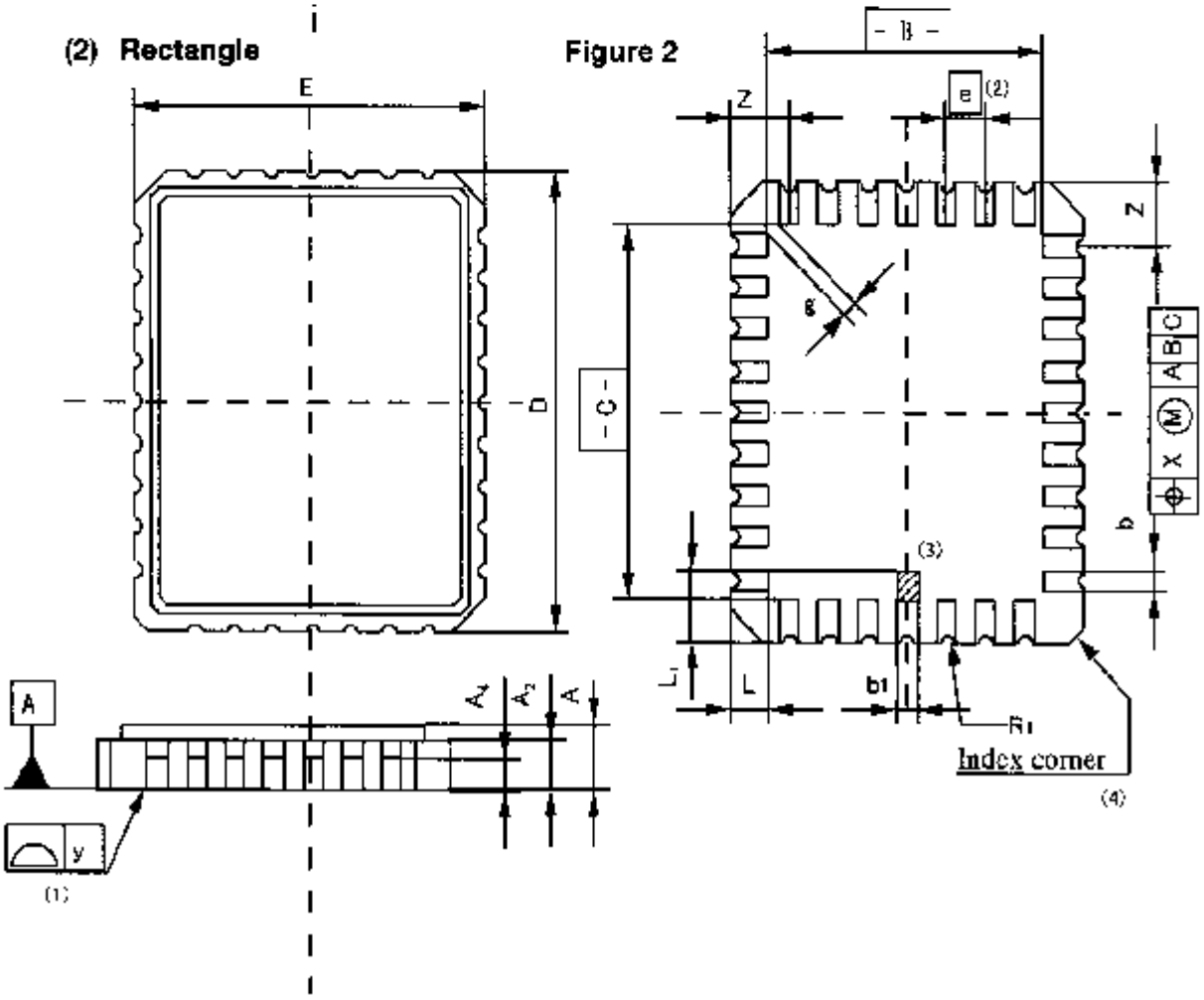
1) Square

Figure 1



(2) Rectangle

Figure 2



Notes:

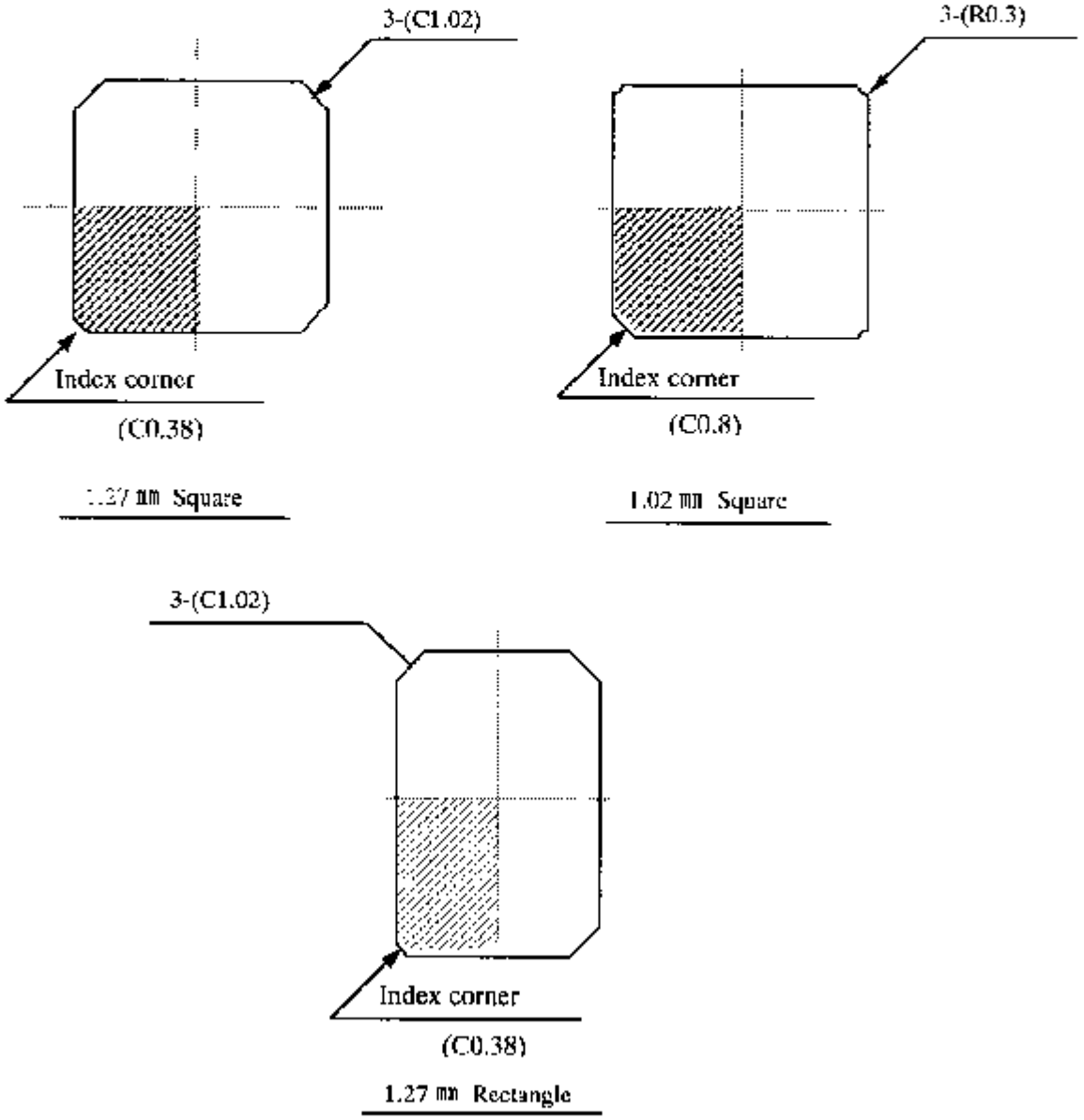
(1) Indicates seating plane. Seating plane is defined by the plane that the carrier contacts to the its mount surface.

(2) Stipulates ture geometric position of the terminals.

(3) Indicates positional tolerance of the index mark. Index mark should be completely within the shaded area . And In the case of odd number , A No1 terminal dose it with a existing terminal aloft the center line. And In the case of even number , A No1 terminal dose it with the terminal that an index corner side is most near by the center.

(4) The chamfering of corner is option of C or R , the following figure is recommended.

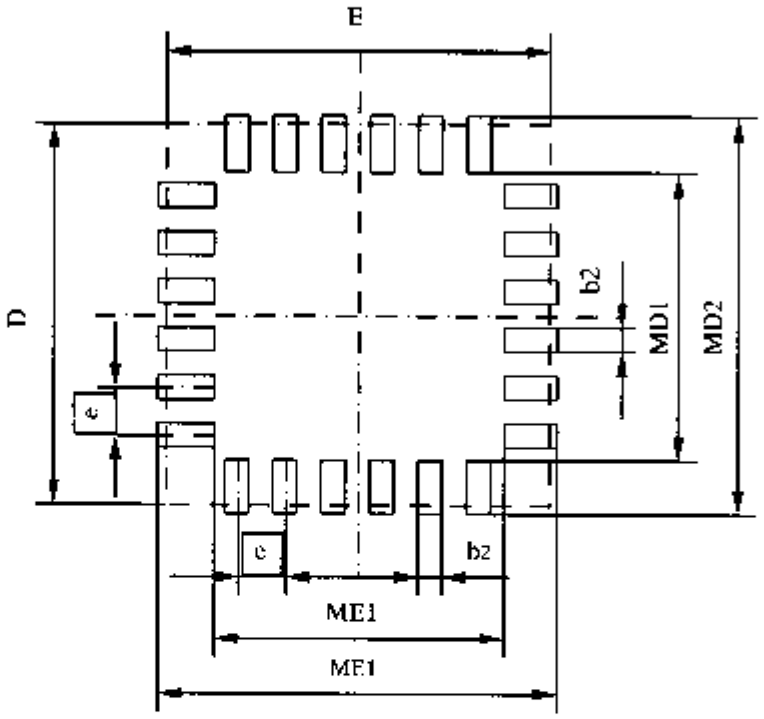
Figure 3



Remarks : Mount pad dimension

The range where the terminals to be soldered can exist is shown in **Figure 4** as reference for foot print design.

Figure 4



$MD1 \leqq D - 2 \times L$

$MD2 \geqq D + 2 \times \alpha$ ($\alpha = 0.2$)

$ME1 \leqq E - 2 \times L$

$ME2 \leqq E + 2 \times \alpha$

$b \leqq b2 \leqq \boxed{e} - \beta$ ($\beta = 0.3$)

8. Outline Dimension

From **Table1** to **Table 4** shows the standard dimension . Combinations of the standard dimension shown below a number of package variation . If package are designed newly , their dimensions shall be selected in the Table of Standard Package Dimension List in the Appendix.

8.1 1.27 mm terminal pitch

8.1.1 GROUP 1

Table 1

Unit:mm

Description	Symbol	Standard	Recommended Values	Remarks
Nominal dimension	E X D	(1)Square E=D Ⅰ 7.62 Ⅱ 8.89 Ⅲ 10.16 Ⅳ 11.43 Ⅴ 16.51 Ⅵ 19.05 Ⅶ 24.13 Ⅷ 29.21 (2)rectangle E x D Ⅰ 7.24 x 8.89 Ⅱ 7.24 x 10.80 Ⅲ 7.37 x 12.45 Ⅳ 8.89 x 13.97 Ⅴ 11.43 x 13.97 Ⅵ 8.89 x 15.24 Ⅶ 8.89 x 16.51 Ⅷ 11.43 x 16.51	———	The nominal dimension series is equivalent to the body dimension series.
Package Width Package length	E D	The maximum and minimum values shoud be within the limits shown in the table below。 (1)Square		

Symbol / Nominal dimensions	E = D min	E = D max
7.62	7.45	7.80
8.89	8.70	9.10
10.16	10.05	10.40
11.43	11.25	11.65
16.51	16.30	16.75
19.05	18.80	19.30
24.13	23.85	24.40
29.21	28.85	29.55

Table 1 (continued)

Unit:mm

Description	Symbol	Standard	Recommended Values	Remarks
Package Width Package Length	E D	Rectangle		

Symbol / Nominal dimensions	E min	E max	D min	D max
7.24 x 8.89	7.00	7.45	8.65	9.25
7.24 x 10.80	7.00	7.75	10.45	11.15
7.37 x 12.45	7.00	7.75	12.20	12.80
8.89 x 13.97	8.65	9.10	13.75	14.20
11.43 x 13.97	11.20	11.65	13.75	14.20
8.89 x 15.24	8.65	9.10	15.00	15.45
8.89 x 16.51	8.65	9.10	16.25	16.75
11.43 x 16.51	11.20	11.65	16.25	16.75

Description	Symbol	Standard	Recommended Values	Remarks
Seated height	A	The maximum values of the seated height are caluculated with the following expressions. Amax = 0.50 x m M = 3, 4, 5, 6, 7, 8 *Amax 1.50 (m=3) 3.00 (m=6) 2.00 (m=4) 3.50 (m=7) 2.50 (m=5) 4.00 (m=8)		
Package Height	A_2	A_2min: 0.45; A_2nom: ----; A_2max: 2.50	A_1nom = 1.50	
Terminal pitch	e	e = 1.27		
Terminal Width	b	bmin: 0.55; bnom: ----; bmax: 0.70	bnom=0.64	
Terminal length	L	Lmin: 1.15; Lnom: ----; Lmax: 1.40	Lnom=1.27	
Index Terminal length	b	$b_1$min: 0.55; $b_1$nom: ----; $b_1$max: 0.70	$b_1$nom=0.64	

Table 1 (continued)

Unit: mm

Description	Symbol	Standard	Recommended Values	Remarks
Index Terminal length	L_1	L_1min: 1.95; L_1nom: ----; L_1max: 3.50	L_1nom=2.16	
Terminal R	R_1	R1nom=R0.23		
Tolerance of terminal center position	X	⌖ X Ⓜ A B C The tolerance of the terminal center shall be specified in the outline drawing. Xmax=0.25		The concept of the maximum mounting condition (MMC) shall be applied.
Coplanari-ty	y	⌓ y The coplanarity shall be specified in the outline drawing. ymax=0.10		
Total pitch	D_1, E_1	The nominal values are determined as follows. D_1=(nD-1) x 1.27 E_1=(nE-1) x 1.27		
The number of terminals along a side of a package	nD, nE	The number of terminals is determined as follows. (1) Square Symbol / Nominal dimension: ND=nE; n 7.62: 4; 16 8.89: 5; 20 10.16: 6; 24 11.43: 7; 28 16.51: 11; 44 19.05: 13; 52 24.13: 17; 68 29.21: 21; 84		

Table 1 (continued)

Unit:mm

Description	Symbol	Standard	Recommended Values	Remarks
The number of terminals along a side of a package	n_D, n_E	(2) Rectangle Symbol / Nominal dimension: nE, nD, n 7.24 x 8.89: 4, 5, 18 7.24 x 10.80: 4, 5, 18 7.24 x 10.80: 4, 6, 20 7.37 x 12.45: 4, 7, 22 7.37 x 12.45: 4, 8, 24 8.89 x 13.97: 5, 9, 28 11.43 x 13.97: 7, 9, 32 8.89 x 15.24: 5, 9, 28 8.89 x 16.51: 5, 11, 32 11.43 x 16.51: 7, 11, 36		
Metallize height	A_4	A_4min: 0.45 A_4nom: ---- A_4max: 2.50		
Terminal Gap of Package corner	g	The terminal gap of package corner are recommended as follows. gmin=0.38	gmin = 0.38	

8.1.2 GROUP 2

Table 2

Unit:mm

Description	Symbol	Standard	Recommended Values	Remarks
Package overhang	Z	Zmin: 1.55 Znom: ---- Zmax: 3.05	Znom = 1.91	

8.2 1.02 mm (40mil) Terminal pitch

8.2.1 GROUP 1

Table 3

Unit: mm

Description	Symbol	Standard	Recommended Values	Remarks
Nomical dimension	E X D	(1)Square E=D I 5.97 II 8.38 III 8.89 IV 10.67 V 12.19 VI 14.22 VII 18.29 VIII 23.37 IX 26.42	———	The nominal dimension series is equivalent to the body dimension series
Package Width Package length	E D	The maximum and minimum values shoud be within the limits shown in the table below Symbol / Nominal dimensions: E = D min / max 5.97: 5.85 / 6.20 8.38: 8.30 / 8.60 8.89: 8.80 / 9.10 10.67: 10.55 / 10.90 12.19: 12.10 / 12.50 14.22: 14.10 / 14.50 18.29: 18.10 / 18.60 23.37: 23.15 / 23.75 26.42: 26.20 / 26.80		
Seated height	A	The maximum values of the seated height are calculated with the following expressions. Amax = 0.50 x m M = 3, 4, 5, 6, 7, 8 *Amax 1.50 (m=3) 3.00 (m=6) 2.00 (m=4) 3.50 (m=7) 2.50 (m=5) 4.00 (m=8)		
Package Height	A_2	A_2min: 0.45 A_2nom: ---- A_2max: 2.50	A_1nom=1.50	

Table 3 (continued)

Unit:mm

Description	Symbol	Standard	Recommended Values	Remarks
Terminal pitch	e	e =1.02		
Terminal Width	b	bmin: 0.40; bnom: ----; bmax: 0.60	bnom=0.50	
Terminal length	L	Lmin: 0.80; Lnom: ----; Lmax: 1.20	Lnom=1.00	
Index Terminal length	b_1	$b_1$min: 0.40; $b_1$nom: ----; $b_1$max: 0.60	$b_1$nom=0.50	
Index Terminal length	L_1	L_1min: 1.95; L_1nom: ----; L_1max: 2.40	L_1nom=2.16	
Terminal R	R1	R1nom =R0.19		
Tolerance of terminal center position	X	⌖ X Ⓜ A B C The tolerance of the terminal center shall be specified in the outline drawing. Xmax=0.25(10mil)		The concept of the maximum mounting condition (MMC) shall be applied.
Coplanari-ty	y	⌓ y The coplanarity shall be specified in the outline drawing. Ymax=0.10		
Total pitch	D_1, E	D_1=(nD-1) x 1.02 E_1=(nE-1) x 1.02		

Table 3 (continued)

Unit:mm

Description	Symbol	Standard	Recommended Values	Remarks
The number of terminals along a side of a package	nD , nE	The number of terminals is determined as follows.		

Nominal dimension \ Symbol	nD=nE	n
5.97	4	16
8.38	5	20
8.89	6	24
10.67	8	32
12.19	10	40
14.22	12	48
18.29	16	64
23.37	21	84
26.42	24	96

Description	Symbol	Standard	Recommended Values	Remarks
Metallize height	A_1			

A_1min	A_1nom	A_1max
0.45	----	2.50

Description	Symbol	Standard	Recommended Values	Remarks
Terminal Gap of Package corner	g	The terminal gap of package corner are recommended as follows. gmin =0.38	gmin = 0.38	

8.2.2 GROUP 2

Table 4

Unit:mm

Description	Symbol	Standard	Recommended Values	Remarks
Package overhang	Z		Znom=1.52	

Zmin	Znom	Zmax
1.30	----	2.40

9. Standard Package List

To further clarify the combinations of part dimensions , the combinations of recommended Package classifications shall be indicated as shown below as assistance in the design and Development of new package in the future.

Table 5 Standard Package List

Nominal size E x D	Terminal pitch e 1.27	Terminal pitch e 1.02
5.97		16 - 2.5
7.62	16 - 2.5	
8.38		20 - 2.5
8.89	20 - 2.5	24 - 2.5
10.16	24 - 2.5	
10.67		32 - 2.5
11.43	28 - 2.5	
12.19		40 - 2.5
14.22		48 - 2.5
16.51	44 - 2.5	
18.29		64 - 2.5
19.05	52 - 2.5	
23.37		84 - 2.5
24.13	68 - 2.5	
26.42		96 - 2.5
29.21	84 - 2.5	
7.24 x 8.89	18 - 2.5	
7.24 x 10.80	18 - 2.5 20 - 2.5	
7.37 x 12.45	22 - 2.5 24 - 2.5	
8.89 x 13.97	28 - 2.5	
11.43 x 13.97	32 - 2.5	
8.89 x 15.24	28 - 2.5	
8.89 x 16.51	32 - 2.5	
11.43 x 16.51	36 - 2.5	

Note : The number in the table indicate
(terminal number n) - (package hight A2)

10. Standard registration

When you need to register a new outline specification on the standard,cpmplete the Appendix format 5 in Technical Standardization Committee on Semiconductor device Package steering rule , in compliance with the Standardization Rule.

In oder to make a package dimension table , which comes under Item2 , Appendix Format 5 , fill the dimension marked with (✓) in the following **Table6**.

Table 6

Serial Number				
External Type		C-QFN-○○○○−○○○○×○○○○−○. ○○		
Reference Symbol		min	nom	max
Group 1	E	✓		✓
	D	✓		✓
	A			✓
	A_1	✓		✓
	A_2	✓		✓
	$\boxed{e}$		✓	
	b	✓		✓
	L	✓		✓
	b_1	✓		✓
	L_t	✓		✓
	R_1		✓	
	x			✓
	y			✓
	D_1		✓	
	E_1		✓	
Group 2	Z	✓		✓

EXPLANATORY NOTES

1. Objectives of the Technical Report

The technical report has been prepared to show the industry standard and to offer a design guideline when developing the Quad Flat Non-Leaded Package (hereinafter referred to as the QFN) ,automatic mounting equipment for it ,and related parts.

2. History of Review

EIAJ ED-7412"General Rules for the Preparation of outline Drawings of Integrated Circuits ,Quad Flat Non-Leaded Package " have been issued prior to the technical report.

EIAJ ED-7412was established issued in November, 1988,respectively after the review made by the former "Technical Committee on Semiconductor Package Outlines" (currently "Special Technical Committee on semiconductor Package") To abolish **EIAJ ED-7412** in 1998 , this standard was reviewed by the Ceramic Package Subcommittee under "Technical Standardization Committee on Semiconductor Device Package".

During the review, the technical report has been assured the coherence between **EIAJ ED-7412**and JEDEC standard.

3. Committee Members

This standard was discussed mainly by Ceramic Package Subcommittee of Technical Standardization Committee on Semiconductor device Package.The members are as shown below.

<Technical Standardization Committee on Semiconductor Device Package>

Chairman	Shozo Minamide	Sharp Corporation

<Ceramic Package Subcommittee>

Chief Examiner	Jiro Nakano	Tishiba Corporation
Vice-Chief Examiner	Katsuaki Sugino	NGK Spark Plug Co.,Ltd
	Shigeru Yamada	OKI Electric Industry Co.,Ltd
	Shigeto Takeda	Kyocera Corporation
	Syuichi Matsuda	NEC Corporation
	Hiromichi Suzuki	Hitachi,Ltd
	Kaoru Tachibana	Fujitsu Limited
	Yoshinobu Kunitomo	Matsushita Electronics Corporation
	Katsuhiro Tomita	Mitsubishi Electric Corporation
	Nanahiro Hayakawa	Yamaichi Electronics Co.,Ltd

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