BEST TECHNOLOGY CO., LIMITED
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硅橡胶按键(Rubber Key)设计&确认参考

Rubber Key Design Guide & Reference

While most of our metal dome, metal dome array, polyester dome, Polydome, were used in membrane switch, keyboard, keypad as a switch, there's still one type of switch which didn't need extra dome array or polyester dome, but print the conducting material on itself, to save cost and space. That is rubber key with conductive ink.

The conductive ink will be printed under the bottom rubber key, so that it'll the electronic contacting parts as a switch, and working method is similar like polyester dome (Polydome), see How Polydome Works.

By avoiding assembling metal dome array or polyester dome (Polydome), you can save assembly time while using rubber key with conductive ink, but the clicking feeling is the worst comparing with dome array or Polydome.

Here you can see basic structure of rubber key, feature and application, parameters such as stroke, trip force, dimension tolerance, design guide point, assembly with plastic shell, housing, how to choose rubber key, rubber key conductive area design and PCB pad design, life cycle and testing, and so on.

All the information listed here is for reference only, customer should prepare and check their own rubber key design, to make sure it'll workable to meet their requirements, and suitable fitting with our metal dome array, Polyester dome, membrane switch.

Please contact us any time, if you need any supporting, or comments for rubber key design.

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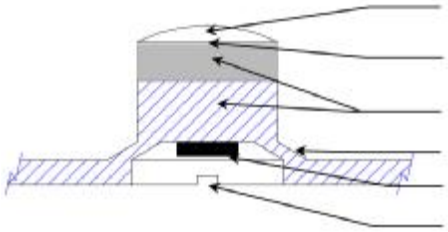
一. 硅橡胶按键概述

I. Overview for Rubber key

1. Rubber Key 按键基本结构

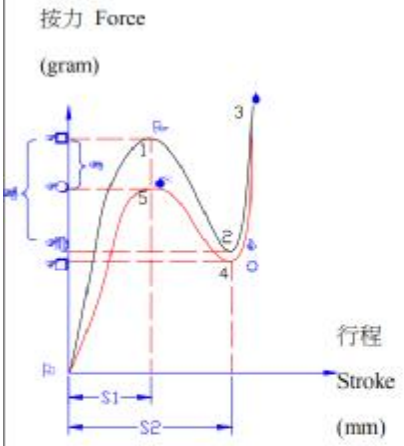
1. Basic structure for rubber key



塑料面 Plastic Cap
键 面 Key Top (激光雕刻、滴胶、喷 /Laser Etching、Potting、Coating)
可选择颜色按键 Optional Color Key
斜壁 Wall
导电部份(接触) Conductive Part (Contacting)
气坑 Air Path

2. 硅橡胶按键按力----行程曲线图

2. Trip force for rubber key - stroke curve



按力 Force	F_P	峰值控力(Fmax)	Peak Force (Fmax)
	F_C	接触點按力	Contact Force
	F_R	最小回彈力(Fmin)	Min. Return Force(Fmin)
	F_M	最大回彈力	Max. Return Force
	F_D	落差力($F_D = F_P - F_C$)	Drop Force ($F_D = F_P - F_C$)
	F_G	損耗力($F_G = F_P - F_M$)	Gap Force ($F_G = F_P - F_M$)
行程 Stroke	S1	峰值行程	Peak Stroke
	S2	接触點行程	Contact Stroke
位置 Location	O	起始點	Original Point
	P	峰值點	Peak Point
	C	接触點	Contact Point
	R	回彈點	Return Point
	M	最高回彈力點	Max. Return Point
位移 Travel	O-P	預載位移	Pre-load Travel
	P-C	至接触點位移	Travel To Contact
	C-S	壓縮段位移	Post Travel
	S-R-M-O	回彈位移	Return Travel

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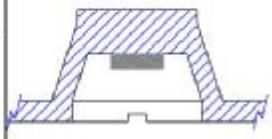
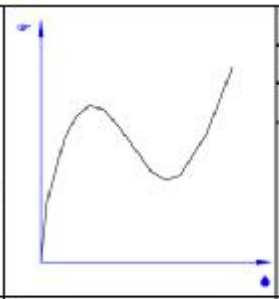
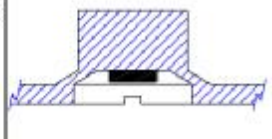
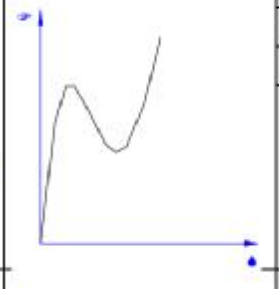
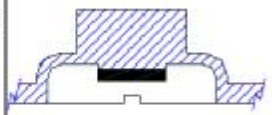
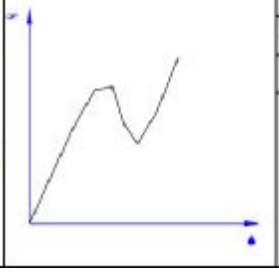
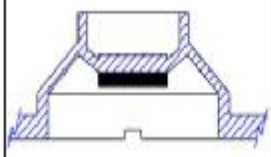
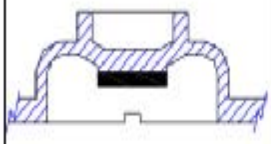
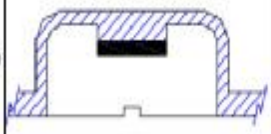
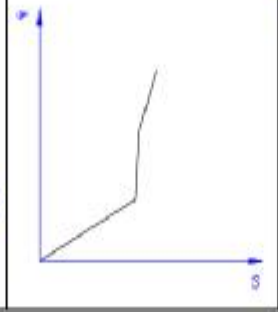
3. 不同结构硅橡按键特征性能及用途

3. Features and application for rubber key with different structures

类型 **Rubber key style**	图示 **Reference image**	行程、压力曲线 **Stroke Pressure curve**	特性 **Rubber key features**

Flat Cone Type			Force Range 按力範圍	0 ~ 350grams
			Stroke Range 行程範圍	0.5 ~ 3.0mm
			Cycle Life 壽命 ($\times 10^5$)	500 ~ 2,000
			Typical Uses 主要用途	Telephone, Remote Control, Automotive, Radio, Toys, Calculator,....etc. 電話、搖控器、收音機、玩具、計算器等。
Top Cylindrical Type			Force Range 按力範圍	0 ~ 250grams
			Stroke Range 行程範圍	0.7 ~ 1.5mm
			Cycle Life 壽命 ($\times 10^5$)	500 ~ 2,000
			Typical Uses 主要用途	Telephone, Remote Control, Toys, Games, Calculator,..... etc. 電話、搖控器、玩具、遊戲機、計算器等。
Flat Dome Type			Force Range 按力範圍	30 ~ 150grams
			Stroke Range 行程範圍	0.5 ~ 3.0mm
			Cycle Life 壽命 ($\times 10^5$)	1,000 ~ 3,000
			Typical Uses 主要用途	Telephone, Remote Control, Toys, Measuring Instruments, Office Machine. 電話、搖控器、微型測量儀、辦公室設備。

Double Cone			Force Range 按力範圍	30 ~ 80grams
			Stroke Range 行程範圍	2.0 ~ 4.0mm
			Cycle Life 壽命 ($\times 10^3$)	5,000 ~ 20,000
			Typical Uses 主要用途	Computer, Typewriter,.... etc 電腦, 打字機等。
Ring Dome			Force Range 按力範圍	30 ~ 200grams
			Stroke Range 行程範圍	1.0 ~ 2.5mm
			Cycle Life 壽命 ($\times 10^3$)	500 ~ 3,000
			Typical Uses 主要用途	Telephone, Typewriter, Test Instruments, ... etc. 電話、打字機、試驗儀器等。
Ring Dome Top			Force Range 按力範圍	20 ~ 80grams
			Stroke Range 行程範圍	0.2 ~ 1.0mm
			Cycle Life 壽命 ($\times 10^3$)	500 ~ 10,000
			Typical Uses 主要用途	Remote Control, Calculator, Typewriter, Computer,...etc. 搖控器、計算器、打字機、電腦等。

二. 硅橡胶按键结构设计

II. Rubber key structure design

1. Rubber Key 设计的功能要求

1. Function requirement for rubber key design:

1）按动按键时能达到设定的功能;

1) The designed function can be achieved by pressing the rubber key.

2）撤除外力后，按键能自动、完全复位;

2) The rubber key can be reset automatically and completely after removing external force;

3）按键在按动和复位过程中有良好的手感，无阻、滞、涩的感觉;

3) Good hand clicking feeling without any blocking, delaying feeling, during the process of pressing and resetting for rubber key;

4）保证按下按键边缘位置时亦有作用。

4) Guaranteed the working even pressing edge of rubber key.

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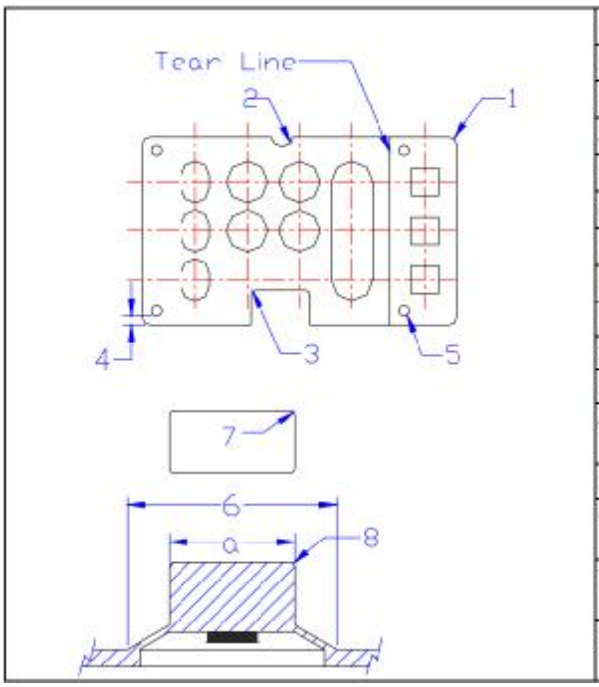
2. Rubber Key 结构设计要点

2. Rubber key structure design point

1) 图示 Reference image



1. 外圓每半徑爲 1.0 至 1.5mm.
2. 最小半徑爲 0.3mm.
3. 最小內圓角半徑爲 0.2mm.
4. 定位孔至斜壁邊緣線不小於 1.0mm.
5. 最小定位孔徑爲 1.0mm
6. 斜壁底間距比 a 大 2.0mm.
7. 鍵面圓角半徑不小於 0.25mm.
8. 鍵面頂邊圓角半徑不小於 0.2mm.
1. Typical outside radius is 1.0 to 1.5mm.
2. Minimum radius is 0.3mm.
3. Minimum inside radius is 0.2mm.
4. Spacing between the edges of a rubber dome and a guide hole is 1.0mm or more.
5. Guide holes are a min. 1.0mm in diameter.
6. The width of a rubber dome base is typically 2.0mm more than a.
7. The minimum radius for the side edges of key top is 0.25mm.
8. The minimum radius for the top edges of key top is 0.2mm.

2）. 技术要求（图纸中供参考,任选）

2) Technical requirements (in drawing sheet, for your reference, optionally)

a. Actuation force: 130±35 grams
b. Tactile feedback required.
c. Expected life cycle: 100,000 times minimum
d. Silicone rubber hardness: 50 ~ 60°.
e. Contact resistance less than 200 ohms
f. Stroke = 1.0 (or1.5) mm.
g. Thickness of carbon pill = 1.0mm.
h. Contact bounce less than 12m seconds.
i. Pad color: optionally.
j. Graphic printing: optionally.

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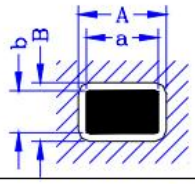
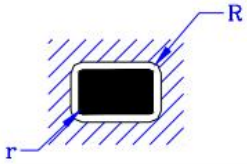
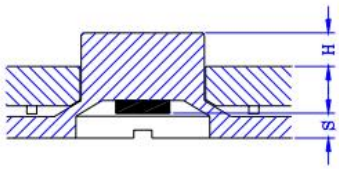
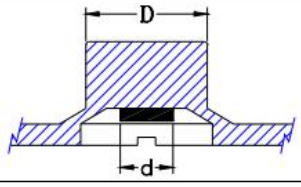
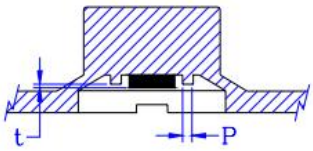
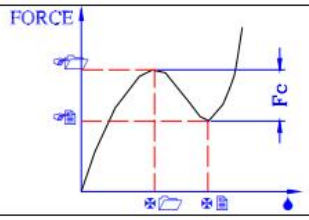
3. Rubber Key 与塑料壳配合

3. Fitting between rubber key and plastic housing

1）一般设计规则

1). General design rules

	A & B : dimensions of plastic 塑膠殼鍵孔的尺寸 a & b : dimensions rubber 矽橡膠鍵鈕的尺寸 合理比例爲 A – a ≧ 0.3mm, B – b > 0.2mm (**具體取值見下表**)
	R : the corner radius of plastic 塑膠鍵孔圓角的半徑 r : the corner radius of rubber 矽橡膠鍵鈕圓角的半徑 1mm ≦ R ≦ 1.25mm, 0.75mm ≦ r ≦ 1mm is better 合理比例爲 1mm ≦ R ≦ 1.25mm, 0.75mm ≦ r ≦ 1mm
	H : the dimension of key tops & plastic 鍵鈕露出膠殼的高度 S : the stroke of key pad 鍵鈕的行程 合理比例爲 H – S ≧ 0.5mm
	D-d = 1.5 ~ 2.0mm is preferred 合理比例爲 D-d = 1.5 ~ 2.0mm
	P : diameter of post 小柱直徑 t : the gap between post & conductive pill 小柱與導電粒頂部之間的的距離. P: 1.0mm is preferred 標准尺寸 1.0mm. t = 0.1 ~ 0.15mm is preferred 標准尺寸 t=0.1 ~ 0.15mm
	Fc : click force 接触點動 Fc= F1 - F2 >25g is preferred 標准數据 Fc=F1 - F2 >25g

2)间隙值推荐选择表

Recommended selection table for gap value

按键外形、尺寸、行程大小是影响按键设计间隙值大小的主要因素，一般情况下，外形简单，尺寸、行程小，配合间隙取值就小，反之则大。Rubber Key 与塑料壳配合间隙值见下表:

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Rubber key shape, size and stroke are the main factors influencing gap value of rubber key. In general, if the shape is simple, size is small, and stroke is short, then the gap value will be small, and vice versa. The fitting gap value between rubber key and plastic housing is shown in the below table:

Rubber Key *与塑料壳配合间隙推荐值表*(*全部为**单边间隙***)
Below table shows the recommended gap value of fitting between rubber key and plastic housing (all are unilated gap)

a. Rubber 行程为 1.0mm
a. When the stroke of rubber key is 1.0mm:

style \ size	1 ~ 10	10 ~ 20	20 ~ 30	30 ~ 40	40 ~ 50	50 ~
	0.10	0.10	0.12	0.15	0.30	-----
	0.10	0.12	0.15	-----	-----	-----
	0.10	0.12	0.15	0.18	0.20	-----
	-----	-----	0.18	0.30	0.35	-----
abnormal	-----	0.15	0.20	-----	-----	-----

b. Rubber 行程为 1.5mm
b. When the stroke of rubber key is 1.5mm:

style \ Size	0 ~ 10	10 ~ 20	20 ~ 30	30 ~ 40	40 ~ 50	50 ~
	0.10	0.12	0.14	0.16	-----	-----
	0.12	0.14	0.16	-----	-----	-----
	0.12	0.14	0.16	----	-----	-----
polygon	-----	-----	0.20	0.30	-----	-----
abnormal	-----	0.16	0.20	-----	-----	-----

c. Rubber 行程为 2.0mm
c. When the stroke of rubber key is 2.0mm

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size / style	0 ~ 10	10 ~ 20	20 ~ 30	30 ~ 40	40 ~ 50	50 ~
	0.10	0.12	0.14	0.16	-----	-----
	0.12	0.16	0.18	-----	-----	-----
	0.12	0.16	0.18	----	-----	-----
	-----	-----	0.25	0.35	-----	-----
abnormal	-----	0.18	0.22	-----	-----	-----

3) 一般尺寸公差

3) Tolerance of normal dimension

Length(mm)	< 10	20	30	40	50	> 50
Tolerance (mm)	± 0.1	± 0.15	± 0.2	± 0.25	± 0.3	0.6 %

4) 弹力范围的一般精度

4) Tolerance of trip force

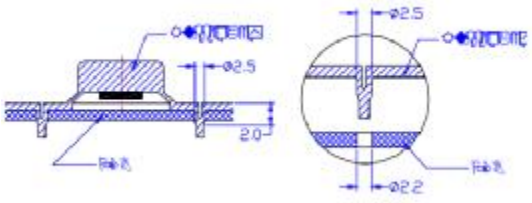
Force (g)	50	70	90	100	120	150	170	200 ~ 250
Tolerance (g)	± 15 ~ 20	± 20 ~ 25	± 20 ~ 30	± 25 ~ 35	± 25 ~ 35	± 30 ~ 40	± 35 ~ 40	± 50

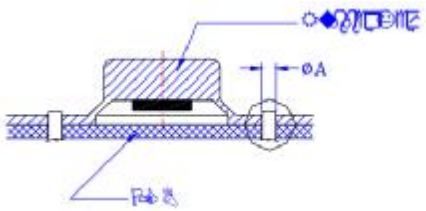
三. Rubber 与 PCB 的装配方式

III. Method of assembling rubber key on PCB:

1. Rubber Key 的装配方式

1. Assembly method of rubber key

示 意 图 **Image**	说 明 **Illustration**
	a. 采用拉脚固定 a. Securing to use the feet b. 拉脚与 PCB 之间采用过盈配合 b. Interference fit between feet and PCB c. 一般过盈最量取 0.3mm c. The biggest exceeding value of interference is 0.3mm d. 拉脚过盈部分高度取 2.0mm d. The height of feet exceeding the interference part

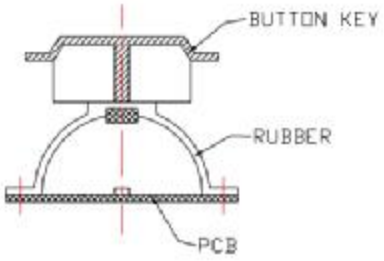
	is 2.0mm e. Rubber Key 与面壳配合间隙一般取单边 0.2 ~0.3mm e. The fitting gap between rubber key and face housing is 0.2 to 0.3mm on single side
	a. 采用柱仔定位,用 PCB 将 Rubber key 压在胶壳上 a. Adopt posts to locate, and use PCB to press the rubber key on plastic housing b. Rubber key 上定位孔ΦA≧2mm b. The diameter of location hole on the rubber key: ΦA≧2mm c. 与柱仔间采用间隙配合，△一般取 0.5mm; c. Clearance fitting with posts, △ normal value is 0.5mm; d. PCB 相应位置冲孔与定位柱仔间也采用间隙配合，△≧0.15mm. d. Clearance fitting between punching holes of PCB and location posts, △≧0.15 mm.

4. Rubber + Key Top (Button) **装配方式**

4. Assembly method of rubber + key top(button)

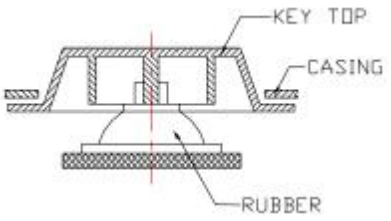
1)多粒 Rubber 的装配方式

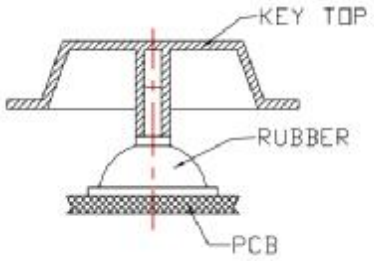
1) Assembly method of rubber more than one piece

	a. Rubber 与 PCB 采用拉脚固定或柱仔定位; a. Rubber and PCB are fixed with feet or positioned with posts.; b. Key Top 的十字形骨压在 Rubber 上，预压量 0.2mm. c. The crossed bone of key top is laminated on rubber and the pre-pressing amount is 0.2mm.

2) 单粒 Rubber 装配方式

2) Assembly method of single piece rubber

	a. Rubber 上开十字型槽, Key Top 上做十字型骨; a. Crossed slots are formed on rubber, and crossed bones are formed on the key top; b. Rubber 与 Key Top 配合稍带过盈，配装配后不致晃动; b. Rubber and Key Top have a slight interference, and will not shake after

	assembly; c. Rubber 预压量 0.2mm。 c. The pre-pressing amount of rubber is 0.2mm.
	a. 左图为单粒小 Rubber 与 Key Top 的配合方式; a.The left image shows the fitting way between single rubber and key top; b. Key Top 的 Boss 上有一小孔; b.There is a small hole in the boss of key top; c. Rubber 顶端小圆柱与 Key Top 为过盈配合，过温量: 0.1mm，保证小粒 Rubber 不晃动; c. Interference fit between small cylinder of rubber top and key top, Overloaded stroke: 0.1mm，so that small-scale rubber does not shake; d. Rubber 预压量: 0.2mm; d.Pre-pressing amount of rubber is 0.2mm; e. Rubber 与 PCB 采用拉脚固定。 e. Using feet to secure rubber on PCB.

四. Rubber Key 的选用

IV. How to choose rubber key

1. Rubber Key 在选用时应考虑以下三点

1. Below 3 points should be taken into consideration when choosing rubber key:

1) Rubber Key 行程

1) Rubber key stroke

2) 回弹力

2) Rebound force

3) 预压量(Rubber 受压部位的高度须大于按键与 PCB 之间的距离，以使按键常态时不致晃动，预压量一般取 0.2mm)。

3) Pre-pressing amount (The height of pressurized part of rubber must be greater than the distance between key and PCB so that key will not shake under normal circumstances. The pre-pressing amount is generally valued as 0.2 mm).

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下表为一般选用实例:

Below are some selective examples:

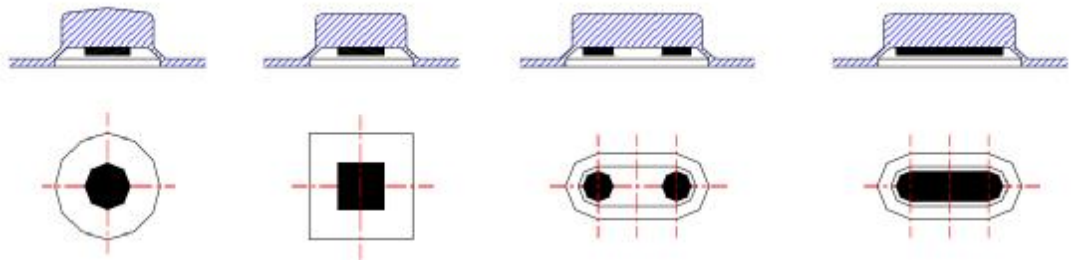
應用例子 Applications		行程 Stroke(mm)	按力 Actuation Force(g)	耐用力 Durability($x10^3$ cycles)
計算器	Calculators	0.2-3.5	30-80	300-1,000
音響設備	Audio Equipment	0.3-1.5	60-150	100-500
汽車音響	Car Radios & Stereos	0.3-1.0	60-200	100-500
電視及錄影機	TV & VTR	0.1-1.5	30-100	300-1,000
通話器	Transmitters	03.-1.5	80-150	300-1,000
按鈕電話	Push-button Telephones	1.2-3.5	70-200	1,000-3,000
電子遊戲	Electronic Games	0.2-1.5	30-150	500-1,000
音樂器材	Musical Instruments	0.7-3.5	30-70	1,000
電腦鍵盤	Computer Terminals	2.0-4.0	40-90	5,000-10,000
電動打字機	Electric Typewriters	3.0-4.0	40-70	5,000-10,000
印字機	Printer	1.0-3.5	30-80	500-1,000
測量儀器	Instrument Measuring	0.3-1.5	30-100	100-300
搖控器	Remote Control	0.3-1.5	50-150	300
影印/傳真機	Copy / Fax Machine	0.2-1.5	30-150	100

五. Rubber Key 附属设计部分

V. Affiliated design of rubber key

1. 导电粒一般设计规格

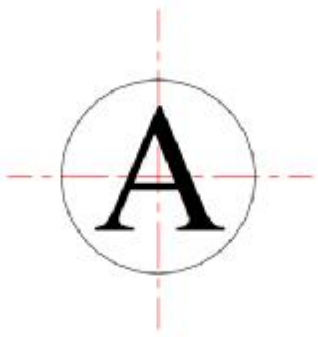
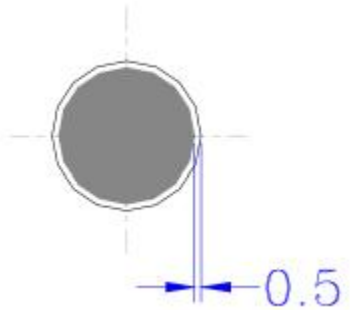
1. General design specifications of conductive particles



項目 Items	導電粒的標准尺寸 Standard Sizes
圓形 Circle	Φ2、Φ2.5、Φ3、Φ3.5、Φ4、Φ4.5、Φ5、Φ5.5、Φ6、Φ7、Φ8
方形 Square 橢圓形 Ellipse	適宜做絲印導電油墨,尺寸不限制 Conductive ink printings contact is recomended, size is flexible
導電粒電阻值	施加 100g 力之下,小于 150Ω
壽命	30,000,000
印刷型電阻值	施加 300g 力之下,小于 800Ω
壽命	1 x 10^6
Conductive Pill Resistance	Less than 150 ohms with 100 grams loading
Load	30 million
Print Type Resistance	Less than 800 ohms with 300 grams loading

2. 丝网印刷一般概念

2. General concept of silk-screen printing

键钮表面字体或图形丝印 Button Silkscreen & Graphics printing	键钮表面全色丝印 Full colorful Surface Printing
	
中心点公差为±0.3mm(Graphics Offset center ±0.3 mm)	
耐磨损能力：能抵受 RCA 丝印寿命测试仪按照 IU4001 PORA 5.3.1 e 之 2018664 规格摩擦 15 次 Abrasion Resistance: All must pass 15 cycles minimum wear on RCA Abrader, 2018664 per IU4001 PORA 5.3.1e	

六. Rubber Key 性能及测试

VI. Performance and test for rubber key

1. 硅橡胶机械及电器性能

1. Mechanical and electrical performance of rubber key

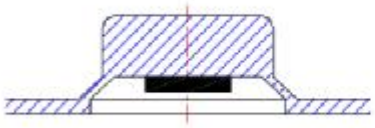
		非導電硅 Non-Conductive Silicone	導電硅 Conductive Silicone
使用溫度	Temperature For Use	- 50℃ ------ + 250℃	- 50℃ ------ + 250℃
單位比重	Specific Gravity	1.16	1.18
拉力強度	Tensile Strength	80 Kg /cm^2	50 Kg /cm^2
撕裂強度	Tear Strength	20 Kg / cm	12 Kg / cm
壓縮率	Compression Set	60% (180℃ × 22hrs.)	28% (150℃ × 22hrs.)
破壞伸度	Elongation At Break	310%	220%
電阻率	Specific Resistively	1 × 10^{15} Ω .cm	4 Ω .cm

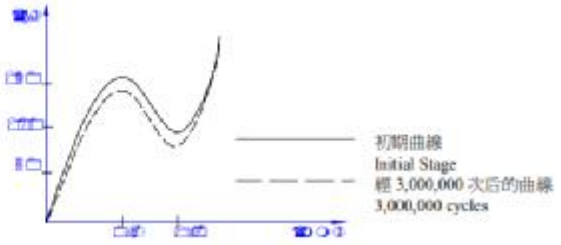
接触電阻	Contact Resistance	-----	< 100 Ω
接触電流量(DC)	Contact Rating (DC)	-----	12V – 30 mA
接触起彈時間	Contact Bounce	-----	< 20 msec.
諧震時間	Chattering	-----	< 5 msec.
絕緣度	Insulation Breakdown	26k V / mm	----
介質常數	Dielectric Constant	4.2 (50 Hz)	----
介質正切	Dielectric Tangent	13% (50 Hz)	----
顏色	Color	可選加顏色 Coloring Possible	黑色 Black

2.硅橡胶按键寿命测试

2. Life testing for rubber key

橡胶按键之寿命测试 (Life testing for rubber key)





寿命测试方法是用 15mA DC 以每秒三次的速度将键钮按下接触线路板

The durability testing was conducted by operating a key at a rate of 3 times/sec with a current of 15mA DC applied on the PAD of circuit board.

七 DA 设计评审内容

VII. DA design review

1. 从结构上检查其对应的性能,用途是否与设计要求一致.

1. Check the structure to see whether the performance, application is consistent with design requirement.

2. (1) 定位孔至斜壁边缘线距离不小于 1.0 mm;

2.(1) The distance from the positioning hole to the edge of the skew wall is not less than 1.0 mm;

(2) 定位孔不小于 1 mm;

(2) The positioning hole is not less than 1 mm in diameter;

(3) 键面圆角半径不小于 0.25 mm.

(3) The radius of key circular bead is not less than 0.25 mm.

3. (1) 塑料壳与 Rubber Key 的间际需满足表中规定.
3(1) The gap between plastic housing and rubber key needs to meet the specification in the table.
(2)H-S ≧0.5 mm
(2)H-S ≧0.5 mm

4. (1)与 PCB 的装配方式;
4(1) Assembly method with PCB;
(2) Rubber 预压量 (一般为 0.2 mm)
(2) Pre-pressing amount of rubber (0.2 mm in general)

5. Rubber Key 表面丝印测试参考 QAD-TEI-011.
5. QAD-TEI-011 should be taken as reference for surface silk-screen test of rubber key.

6. Rubber Key 寿命测试，能达到相应的寿命要求
6. Life test of rubber key can achieve the designed life requirement.

Above information is for reference only, customer should prepare and check their own rubber key design, to make sure it'll workable to meet their requirements, and suitable fitting with our metal dome array, Polyester dome, membrane switch.

If you need any supporting, of find any mistake in this article, please contact us any time.

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