

## Ceramic Disc Capacitors Class 1 and 2, 1 kV<sub>DC</sub>, 2 kV<sub>DC</sub>, 3 kV<sub>DC</sub> and 6 kV<sub>DC</sub>, General Purpose



Capacitors with 5 mm (0.20"), 7.5 mm (0.30") and  
10 mm (0.40") lead spacing

QUICK REFERENCE DATA		
DESCRIPTION	CLASS 1 (SL0, S3N)	CLASS 2 (Y5P, X7R, Z5U, Y5V, X5F)
Voltage (V <sub>DC</sub> )	1000, 2000, 3000, 6000	
Min. Capacitance (pF)	10	100
Max. Capacitance (pF)	220	33 000
Mounting	Through hole	

### MARKING

Straight and kinked leaded versions are gold coloured  
Marking indicates capacitance value and tolerance in  
accordance with "EIA 198" and voltage:

### OPERATING TEMPERATURE RANGE

Class 1 SL0, S3N, - 55 °C to + 125 °C

Class 2, X7R - 55 °C to + 125 °C

Class 2, Y5P, Z5U, Y5V, - 30 °C to + 85 °C

Class 2, X5F - 55 °C to + 85 °C

### TEMPERATURE COEFFICIENTS

Class 1 SL0, S3N

Class 2 X7R, Y5P, Z5U, Y5V, X5F

### SECTIONAL SPECIFICATIONS

Class 1, IEC 60 384-8,

Class 2, IEC 60 384-9,

EIA 198

### CLIMATIC CATEGORY

Class 1, SL0, 55/125/21

Class 2, X7R, 55/125/21

Class 2, Y5P, Z5U, Y5V, 30/85/21

Class 2, X5F, 55/85/21

### FEATURES

- Low losses
- High stability
- High capacitance in small size
- Kinked (preferred) or straight leads
- Compliant to RoHS directive 2002/95/EC



**RoHS**  
COMPLIANT

### APPLICATIONS

- DC high voltage
- Pulse high voltage
- SMPS
- HV power supply
- HF ballast

### DESIGN

The capacitors consist of a ceramic disc both sides of which are silver-plated. Connection leads are made of tinned copper having a diameter of 0.6 mm or 0.8 mm up to 3 kV and 0.8 mm for 6 kV.

The capacitors may be supplied with kinked or straight leads with a lead spacing of 5 mm (0.20"), 7.5 mm (0.30") or 10 mm (0.40") and a lead length from 4 mm to 30 mm. The standard tolerance on capacitance is 5 % or 10 % for class 1 capacitors and ± 10 % or ± 20 % for class 2 capacitors. Encapsulation is made of gold-colored epoxy-resin, flammable resistant in accordance with "UL 94 V-0"

### CAPACITANCE RANGE

Class 1, at 1 MHz, 1.2 V<sub>RMS</sub>; 10 pF to 220 pF

1 kHz, 1 V<sub>RMS</sub> ± 0.2 V<sub>RMS</sub> for capacitance values higher than 1000 pF

Class 2, at 1 kHz, 1 V<sub>RMS</sub> ± 0.2 V<sub>RMS</sub>; 100 pF to 33 000 pF

### RATED DC VOLTAGE

1 kV; 2 kV; 3 kV; 6 kV

### DIELECTRIC STRENGTH

200 % of rated voltage

### INSULATION RESISTANCE AT 500 V<sub>DC</sub>

≥ 10 000 MΩ

### TOLERANCE ON CAPACITANCE

± 5 %; ± 10 %; ± 20 %; + 80/- 20 %

Other tolerances available on request

### DISSIPATION FACTOR

Class 1, C ≤ 30 pF; ≤ 20 x (10/C + 0.7) x 10<sup>-4</sup> max.

Class 1, C > 30 pF; ≤ 0.2 %

Class 2, ≤ 3.0 %

ORDERING INFORMATION 1 kV <sub>DC</sub> , STRAIGHT								
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE			
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT			
<b>CLASS 1 SLO</b>								
10	± 5	6.5	5.0	4.0	S100J25SL0N6.J5.			
	± 10				S100K25SL0N6.J5.			
12	± 5				S120J25SL0N6.J5.			
	± 10				S120K25SL0N6.J5.			
15	± 5				S150J25SL0N6.J5.			
	± 10				S150K25SL0N6.J5.			
18	± 5				S180J25SL0N6.J5.			
	± 10				S180K25SL0N6.J5.			
22	± 5				S220J25SL0N6.J5.			
	± 10				S220K25SL0N6.J5.			
27	± 5				S270J25SL0N6.J5.			
	± 10				S270K25SL0N6.J5.			
33	± 5				S330J25SL0N6.J5.			
	± 10				S330K25SL0N6.J5.			
39	± 5				S390J25SL0N6.J5.			
	± 10				S390K25SL0N6.J5.			
47	± 5				S470J25SL0N6.J5.			
	± 10				S470K25SL0N6.J5.			
56	± 5	7.5	5.0	4.0	S560J29SL0N6.J5.			
	± 10				S560K29SL0N6.J5.			
68	± 5				S680J29SL0N6.J5.			
	± 10				S680K29SL0N6.J5.			
82	± 5				S820J29SL0N6.J5.			
	± 10				S820K29SL0N6.J5.			
100	± 5				S101J29SL0N6.J5.			
	± 10				S101K29SL0N6.J5.			
120	± 5				S121J33SL0N6.J5.			
	± 10				S121K33SL0N6.J5.			
150	± 10				8.5	5.0	4.0	S151K33SL0N6.J5.
220								S221K39SL0N6.J5.
<b>CLASS 2 X7R</b>								
100	± 10	6.5	5.0	4.0	S101K25X7RN6.J5.			
150					S151K25X7RN6.J5.			
220					S221K25X7RN6.J5.			
330					S331K25X7RN6.J5.			
470					S471K29X7RN6.J5.			
680					S681K29X7RN6.J5.			
1000		8.5	7.5	4.8	S102K33X7RN6.J5.			
1500		10			S152K39X7RN6.J5.			
2200		11			S222K43X7RN6.J5.			
3 300		12	S332K47X7RN6.J7.					
4 700		15	S472K59X7RN6.J7.					
<b>CLASS 2 Y5P</b>								
100	± 10	6.5	5.0	4.0	S101K25Y5PN6.J5.			
150					S151K25Y5PN6.J5.			
220					S221K25Y5PN6.J5.			
330					S331K25Y5PN6.J5.			
470					S471K25Y5PN6.J5.			
680					S681K29Y5PN6.J5.			
1000		7.5	8.5	S102K29Y5PN6.J5.				
1500		8.5		S152K33Y5PN6.J5.				



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Vishay BCcomponents

<b>ORDERING INFORMATION 1 kV<sub>DC</sub>, STRAIGHT</b>					
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT
<b>CLASS 2 Y5P</b>					
2200	± 10	10	5.0	4.0	S222K39Y5PN6.J5.
3300		11			S332K43Y5PN6.J5.
4700		13.5	7.5	4.8	S472K53Y5PN63J7.
6800		15			S682K59Y5PN63J7.
10 000		19			10
<b>CLASS 2 Z5U</b>					
1000	± 20	6.5	5.0	4.0	S102M25Z5UN6.J5.
1500					S152M29Z5UN6.J5.
2200					S222M29Z5UN6.J5.
3300					S332M33Z5UN6.J5.
4700		8.5	S472M39Z5UN6.J5.		
6800		10	S682M43Z5UN6.J5.		
10 000		11	7.5	4.8	S103M47Z5UN63J7.
15 000		12			S153M59Z5UN63J7.
22 000		15			S223M75Z5UN83J0.
33 000		19	10		
<b>CLASS 2 Y5V</b>					
1000	+ 80/- 20	6.5	5.0	4.0	S102Z25Y5VN6.J5.
1500					S152Z25Y5VN6.J5.
2200					S222Z29Y5VN6.J5.
3300					S332Z29Y5VN6.J5.
4700		7.5	S472Z33Y5VN6.J5.		
6800		8.5	S682Z39Y5VN6.J5.		
10 000		10	S103Z43Y5VN6.J5.		
15 000		11	7.5	4.8	S153Z53Y5VN6.J7.
22 000		13.5			S223Z59Y5VN6.J7.
33 000		15			S333Z75Y5VN8.J0.
		19	10		

<b>ORDERING INFORMATION 1 kV<sub>DC</sub>, KINKED</b>					
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(2)</sup> (mm)	CLEAR TEXT CODE
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT
<b>CLASS 2 X5F</b>					
100	± 10	6.5	5.0	4.0	S101K25X5FN6.J5R
220					S221K25X5FN6.J5R
270					S271K25X5FN6.J5R
330					S331K25X5FN6.J5R
390					S391K25X5FN6.J5R
470					S471K25X5FN6.J5R
680					S681K29X5FN6.J5R
820		7.5	S821K29X5FN6.J5R		
1000		11	S102K29X5FN6.J5R		
2200		13.5	S222K43X5FN6.J5R		
3300		16	7.5	4.8	S332K53X5FN6.J7R
4700					S472K63X5FN63J7R

**Notes**

- <sup>(1)</sup> SH = seated height
- Maximum thickness 4.0 mm
- Lead style codes refer to inward kinked leads. Other styles available on request

ORDERING INFORMATION 2 kV <sub>DC</sub> , KINKED								
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE			
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT			
<b>CLASS 1 SLO</b>								
10	± 5	6.5	5.0	4.0	S100J25SLOP6.K5.			
	± 10				S100K25SLOP6.K5.			
12	± 5				S120J25SLOP6.K5.			
	± 10				S120K25SLOP6.K5.			
15	± 5				S150J25SLOP6.K5.			
	± 10				S150K25SLOP6.K5.			
18	± 5				S180J25SLOP6.K5.			
	± 10				S180K25SLOP6.K5.			
22	± 5				S220J25SLOP6.K5.			
	± 10				S220K25SLOP6.K5.			
27	± 5				S270J25SLOP6.K5.			
	± 10				S270K25SLOP6.K5.			
33	± 5	7.5	5.0	4.0	S330J29SLOP6.K5.			
	± 10				S330K29SLOP6.K5.			
39	± 5				S390J29SLOP6.K5.			
	± 10				S390K29SLOP6.K5.			
47	± 5				S470J29SLOP6.K5.			
	± 10				S470K29SLOP6.K5.			
56	± 5				S560J29SLOP6.K5.			
	± 10				S560K29SLOP6.K5.			
68	± 5				8.5	5.0	4.0	S680J33SLOP6.K5.
	± 10							S680K33SLOP6.K5.
82	± 5							S820J33SLOP6.K5.
	± 10							S820K33SLOP6.K5.
100	± 5	10	5.0	4.0				S101J39SLOP6.K5.
	± 10							S101K39SLOP6.K5.
120	± 5				S121J39SLOP6.K5.			
	± 10				S121K39SLOP6.K5.			
150	± 10	11	5.0	4.0	S151K43SLOP6.K5.			
<b>CLASS 2 X7R</b>								
100	± 10	6.5	5.0	4.0	S101K25X7RP6.K5.			
150					S151K25X7RP6.K5.			
220					S221K25X7RP6.K5.			
330					S331K25X7RP6.K5.			
470					S471K29X7RP6.K5.			
680					S681K33X7RP6.K5.			
1000		10	7.5	4.8	S102K39X7RP6.K5.			
1500		11			S152K43X7RP6.K5.			
2200		13.5			S222K53X7RP6.K7.			
3300		15			S332K59X7RP6.K7.			
<b>CLASS 2 Y5P</b>								
100		± 10			6.5	5.0	4.0	S101K25Y5PP6.K5.
150	S151K25Y5PP6.K5.							
220	S221K25Y5PP6.K5.							
330	S331K25Y5PP6.K5.							
470	S471K29Y5PP6.K5.							
680	S681K29Y5PP6.K5.							
1000	8.5		7.5	4.8	S102K33Y5PP6.K5.			
1500	10				S152K39Y5PP6.K5.			
2200	11				S222K43Y5PP6.K5.			
3300	13.5				S332K53Y5PP63K7.			
4700	17.5				S472K69Y5PP63K7.			



Ceramic Disc Capacitors Class 1 and 2,  
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Vishay BCcomponents

<b>ORDERING INFORMATION 2 kV<sub>DC</sub>, KINKED</b>						
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE	
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT	
<b>CLASS 2 Z5U</b>						
1000	± 20	7.5	5.0	4.0	S102M29Z5UP6.K5.	
1500					S152M29Z5UP6.K5.	
2200					8.5	S222M33Z5UP6.K5.
3300						S332M43Z5UP6.K5.
4700		12	7.5	4.8	S472M47Z5UP63K7.	
6800		13.5			S682M53Z5UP63K7.	
10 000		17.5			S103M69Z5UP63K7.	
<b>CLASS 2 Y5V</b>						
1000	+ 80/- 20	7.5	5.0	4.0	S102Z29Y5VP6.K5.	
1500					S152Z29Y5VP6.K5.	
2200					8.5	S222Z33Y5VP6.K5.
3300						S322Z39Y5VP6.K5.
4700		11	7.5	4.8	S472Z43Y5VP6.K5.	
6800		12			S682Z47Y5VP6.K7.	
10 000		15			S103Z59Y5VP6.K7.	
<b>CLASS 2 X5F</b>						
1 00	± 10	6.5	5.0	4.0	S101K25X5FP6.K5R	
220					S221K25X5FP6.K5R	
330					7.5	S331K29X5FP6.K5R
470						S471K31X5FP6.K5R
680		10	7.5	4.8	S681K39X5FP6.K5R	
1000		11			S102K43X5FP6.K5R	
2200		15			S222K59X5FP6.K7R	
3300		16.5			S332K65X5FP63K7R	

**Notes**

<sup>(1)</sup> SH = seated height

- Maximum thickness 4.0 mm
- Lead style codes refer to inward kinked leads. Other styles available on request

<b>ORDERING INFORMATION CLASS 3 kV<sub>DC</sub>, KINKED</b>							
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE		
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT		
<b>CLASS 1 SL</b>							
10	± 10	8.5	7.5	4.0	S100K33SL0R63K7.		
15					S150K33SL0R63K7.		
22					S220K33SL0R63K7.		
33					S330K33SL0R63K7.		
47					S470K33SL0R63K7.		
68					10	S680K39SL0R63K7.	
<b>CLASS 2 X7R</b>							
100	± 10	8.5	7.5	4.0	S101K33X7RR63K7.		
150					S151K33X7RR63K7.		
220					S221K33X7RR63K7.		
330					S331K33X7RR63K7.		
470					S471K33X7RR63K7.		
680					10	4.8	S681K39X7RR63K7.
1000					11		S102K43X7RR63K7.
1500					13.5		S152K53X7RR63K7.
2200		17.5	S222K59X7RR83K7.				

ORDERING INFORMATION CLASS 3 kV <sub>DC</sub> , KINKED					
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT
<b>CLASS 2 Y5P</b>					
100	± 10	8.5	7.5	4.0	S101K33Y5PR63K7.
150					S151K33Y5PR63K7.
220					S221K33Y5PR63K7.
330					S331K33Y5PR63K7.
470					S471K33Y5PR63K7.
680					S681K39Y5PR63K7.
1000				4.8	S102K43Y5PR63K7.
1500					S152K47Y5PR63K7.
2200					S222K59Y5PR63K7.
3 300					S332K75Y5PR83K0.
<b>CLASS 2 Z5U</b>					
470	± 20	8.5	7.5	4.0	S471M33Z5UR63K7.
680					S681M33Z5UR63K7.
1000					S102M33Z5UR63K7.
1500					S152M39Z5UR63K7.
2200				S222M43Z5UR63K7.	
3300				4.8	S332M53Z5UR63K7.
4700	S472M69Z5UR83K7.				
<b>CLASS 2 Y5V</b>					
1000	+ 80/- 20	8.5	7.5	4.0	S102Z33Y5VR63K7.
1500					S152Z33Y5VR63K7.
2200					S222Z39Y5VR63K7.
3300					S322Z43Y5VR63K7.
4700				4.8	S472Z47Y5VR63K7.
6800					S682Z59Y5VR63K7.

**Notes**

- <sup>(1)</sup> SH = seated height
- Maximum thickness 4.0 mm
- Lead style codes refer to inward kinked leads. Other styles available on request

ORDERING INFORMATION CLASS 6 kV <sub>DC</sub> , KINKED					
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT
<b>CLASS 1 SL</b>					
10	± 20	10	10	3.0	S100M39SL0U83L0.
15					S150M43SL0U83L0.
22					S220M43SL0U83L0.
33					S330M53SL0U83L0.
<b>CLASS 1 S3N</b>					
47	± 20	11	10	3.0	S470M43S3NU83L0.
68		13.5			S680M53S3NU83L0.
100		15			S101M59S3NU83L0.
150		15			S151M59S3NU83L0.
<b>CLASS 2 Z5U</b>					
220	± 20	10	10	3.0	S221M39Z5UU83L0.
330		11			S331M43Z5UU83L0.
470		12			S471M47Z5UU83L0.

ORDERING INFORMATION CLASS 6 kV <sub>DC</sub> , KINKED					
C (pF)	TOL. (%)	D <sub>MAX.</sub> (mm)	LEAD SPACING (mm)	SH <sup>(1)</sup> (mm)	CLEAR TEXT CODE
					13 <sup>TH</sup> DIGIT: T = REEL; U = AMMO; 3 = BULK 16 <sup>TH</sup> DIGIT: R = RoHS COMPLIANT
<b>CLASS 2 Z5U</b>					
680	± 20	13.5	10	3.0	S681M53Z5UU83L0.
1000		15			S102M59Z5UU83L0.
1500		17.5			S152M69Z5UU83L0.
2200		19			S222M75Z5UU83L0.

**Notes**

<sup>(1)</sup> SH = seated height

- Maximum thickness 4.0 mm
- Lead style codes refer to inward kinked leads. Other styles available on request

PACKAGING					
PACKAGING TYPE	SIZE CODE	LEAD SPACE (mm)	VOLTAGE (V <sub>DC</sub> )	SPQ	BOX DIMENSIONS L x W x H (mm)
Bulk (long lead L ≥ 25.4 mm)	20 to 47	all	all	1000	245 x 120 x 65
				1000	
	53 to 75			1000	
	84 to 96			500	
Tape and reel	≤ 47	≤ 6.40	< 500	2500	370 x 370 x 60
			500 ≤ WV ≤ 2000	2000	
			3000	1000	
		≥ 7.5	all	1000	
		≥ 7.5	all	1000	
Ammopack	≤ 47	≤ 6.40	< 500	2000	335 x 240 x 50
			500 ≤ WV < 2000	1500	335 x 290 x 50
		≥ 7.5	2000 and 3000	1500	335 x 290 x 50
			all	1500	360 x 330 x 55

**Note**

- The capacitors are supplied in bulk packaging (cardboard boxes), in tape on reel or in ammopack



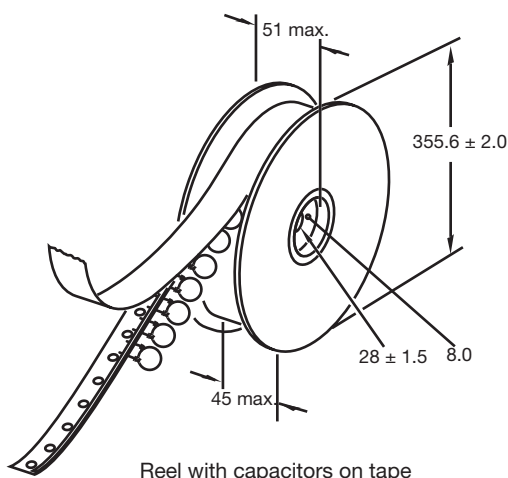
DIMENSIONS OF TAPE			
SYMBOL	PARAMETER	DIMENSIONS (mm)	
		NOMINAL	TOLERANCE
D	Body diameter	11.0 maximum	-
d	Lead diameter	0.6	± 0.05
P	Pitch between capacitors	12.7	± 1.0
P <sub>0</sub> <sup>(1)</sup>	Feed-hole pitch	12.7	± 0.3
ΔP	Plane deviation	1.0 maximum	-
P <sub>1</sub> <sup>(2)</sup>	Feed-hole center to lead center	3.85	± 0.7
P <sub>2</sub> <sup>(2)</sup>	Feed-hole center to component center	6.35	± 1.3
F	Lead spacing	5.0	0.6 - 0.4
Δh	Component alignment	0	± 1.0
W	Tape width	18.0	1.0 - 0.5
W <sub>0</sub>	Hold-down tape width	5.0 minimum	-
W <sub>1</sub>	Hole position	9.0	0.75 - 0.5
W <sub>2</sub>	Hold-down tape margin	3.0 maximum	-
H <sub>0</sub>	Height to seating plane	16.0	± 0.5
H <sub>1</sub>	Maximum component height	32.0	-
e	Lead end protrusion	1.0 maximum	-
L	Maximum length of snapped lead	11.0	-
D <sub>0</sub>	Feed-hole diameter	4.0	± 0.2
t	Total tape thickness	0.9 maximum	-
t <sub>1</sub>	Maximum thickness of tape and wires	1.5 maximum	-

**Notes**

(1) Cumulative pitch error:  $\pm \leq 1 \text{ mm}/20 \text{ pitches}$

(2) Obliquity maximum 3°

**REEL AND TAPE DATA** in millimeters







## Disclaimer

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Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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