



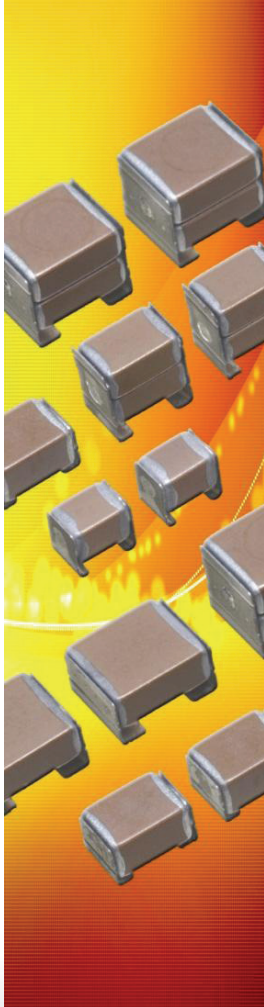
## MULTILAYER CERAMIC CHIP CAPACITORS

### CKG Series Commercial Grade MEGACAP Type

Type:

CKG32K [EIA CC1210]  
CKG45K [EIA CC1812]  
CKG45N [EIA CC1812]  
CKG57K [EIA CC2220]  
CKG57N [EIA CC2220]

Issue date:  
January 2013



Version A13

## REMINDERS

Please read before using this product

### SAFETY REMINDERS

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Notice : Effective January 2013, TDK will use a new catalog part number which adds product thickness and packaging specification detail. This new part number should be referenced on all catalog orders going forward, and is not applicable for OEM part number orders. Please be aware the last five digits of the TDK catalog part number will differ from the TDK item description (internal control number) on the product label. Contact your local TDK Sales representative for more information.

(Example)

Catalog Issued date	TDK Part Number (In Catalog)	TDK Item Description (On Delivery Label)
Prior to January 2013	C1608C0G1E103J	C1608C0G1E103JT000N
January 2013 and Later	C1608C0G1E103J080AA	C1608C0G1E103JT000N



## CKG Series MEGACAP Type

Type: CKG32K [EIA CC1210], CKG45K [EIA CC1812],  
CKG45N [EIA CC1812], CKG57K [EIA CC2220], CKG57N [EIA CC2220]



### Features



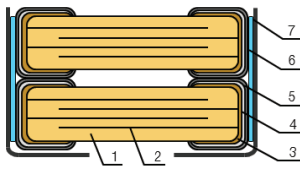
- Twice the capacitance on single capacitor foot print.
- Lower ESR and ESL than Al caps.
- Capable of absorbing thermal and mechanical stress.
- Improved vibration performance.

### Applications



- Automotive application (EPS, ABS, EV, HEV, LED lighting etc.)
- Smoothing circuits
- DC-DC converters
- LED, HID applications
- Temperature variable applications
- Piezoelectric-effect countermeasure

### Design Structure



No.	NAME	MATERIAL
		Class 2
(1)	Ceramic Dielectric	BaTiO <sub>3</sub>
(2)	Internal Electrode	Nickel (Ni)
(3)		Copper (Cu)
(4)	Termination	Nickel (Ni)
(5)		Tin (Sn)
(6)	Metal Cap Joint	High Temp Solder
(7)	Metal Cap	42 Alloy

### Shape & Dimensions



Single Type



Stacked Type



L	Body Length
W	Body Width
T	Body Height

L	Body Length
W	Body Width
T	Body Height



### Part Number Construction

CKG • 57 • N • X7S • 1C • 107 • M • 500 • J • H

#### Series Name

#### Dimensions L x W (mm)

Code	Length	Width
32	3.60 ± 0.30	2.60 ± 0.30
45	5.00 ± 0.50	3.50 ± 0.50
57	6.00 ± 0.50	5.00 ± 0.50

#### Structure

Code	Description
K	Single Type
N	Stacked Type

#### Temperature Characteristics

Temperature Characteristics	Capacitance Change	Temperature Range
X5R	± 15%	-55 to +85°C
X7R	± 15%	-55 to +125°C
X7S	± 22%	-55 to +125°C
X7T	+ 22/-33%	-55 to +125°C

#### Rated Voltage (DC)

Code	Voltage (DC)
1C	16V
1E	25V
1H	50V
2A	100V
2E	250V
2W	450V
2J	630V

#### Nominal Capacitance (pF)

The capacitance is expressed in three digit codes and in units of pico Farads (pF). The first and second digits identify the first and second significant figures of the capacitance. The third digit identifies the multiplier. R designates a decimal point.

Ex. 0R2 = 0.2pF; 103 = 10,000pF; 105 = 1,000,000pF = 1,000nF = 1μF

#### Capacitance Tolerance

Code	Tolerance
K	± 10%
M	± 20%

#### Nominal Thickness

Code	Thickness
290	2.90 mm
335	3.35 mm
500	5.00 mm

#### Packaging Style

Code	Style
A	178" Reel, 4mm Pitch
J	330" Reel, 8mm Pitch

#### Special Reserved Code

Code	Description
H	MEGACAP (Std)



## Capacitance Range Chart

## CKG32K [EIA CC1210]

### Capacitance Range Chart

Temperature Characteristics: X7R ( $\pm 15\%$ ), X7S ( $\pm 22\%$ ), X7T (+22/-33%)  
 Rated Voltage: 630V (2J), 400V (2W), 250V (2E), 100V (2A), 50V (1H), 25V (1E)

Capacitance (pF)	Code	Tolerance	X7R					X7S		X7T		
			2J (630V)	2E (250V)	2A (100V)	1H (50V)	1E (25V)	2A (100V)	1H (50V)	2J (630V)	2W (450V)	2E (250V)
47,000	473	K: $\pm 10\%$ M: $\pm 20\%$	■									
100,000	104				■					■		
150,000	154											
220,000	224			■							■	
330,000	334											■
470,000	474				■							
1,000,000	105				■	■						
2,200,000	225							■				
3,300,000	335								■			
4,700,000	475							■	■			
6,800,000	685											
10,000,000	106							■				

Standard Thickness

■ 3.35 mm



## Capacitance Range Chart

## CKG45K [EIA CC1812]

### Capacitance Range Chart

Temperature Characteristics: X7R ( $\pm 15\%$ ), X7S ( $\pm 22\%$ ), X7T (+22/-33%)  
 Rated Voltage: 630V (2J), 450V (2W), 250V (2E), 100V (2A), 50V (1H), 25V (1E), 16V (1C)

Capacitance (pF)	Code	Tolerance	X7R						X7S			X7T		
			2J (630V)	2E (250V)	2A (100V)	1H (50V)	1E (25V)	1C (16V)	2A (100V)	1H (50V)	1C (16V)	2J (630V)	2W (450V)	2E (250V)
100,000	104	K: $\pm 10\%$ M: $\pm 20\%$	■											
150,000	154												■	
220,000	224			■										
330,000	334												■	
470,000	474			■										
680,000	684													■
1,000,000	105				■									
1,500,000	155					■								
2,200,000	225						■							
3,300,000	335							■						
4,700,000	475								■					
10,000,000	106									■				
22,000,000	226										■			

Standard Thickness

■ 2.90 mm



## Capacitance Range Chart

## CKG57K [EIA CC2220]

### Capacitance Range Chart

Temperature Characteristics: X7R ( $\pm 15\%$ ), X7S ( $\pm 22\%$ ), X7T (+ 22/-33%)

Rated Voltage: 630V (2J), 450V (2W), 250V (2E), 100V (2A), 50V (1H), 25V (1E), 16V (1C)

Capacitance (pF)	Code	Tolerance	X7R						X7S			X7T		
			2J (630V)	2E (250V)	2A (100V)	1H (50V)	1E (25V)	1C (16V)	2A (100V)	1H (50V)	1C (16V)	2J (630V)	2W (450V)	2E (250V)
20,000	224	K: $\pm 10\%$ M: $\pm 20\%$	■											
330,000	334											■		
470,000	474			■								■		
680,000	684												■	
1,000,000	105			■	■								■	
1,500,000	155												■	
2,200,000	225				■								■	
3,300,000	335												■	
4,700,000	475				■	■								
6,800,000	685								■					
10,000,000	106							■		■				
15,000,000	156								■					
22,000,000	226							■						
47,000,000	476										■			

Standard Thickness

■ 3.35 mm



## Capacitance Range Chart

## CKG45N [EIA CC1812]

### Capacitance Range Chart

Temperature Characteristics: X5R ( $\pm 15\%$ ), X7R ( $\pm 15\%$ ), X7S ( $\pm 22\%$ ), X7T ( $+ 22/-33\%$ )  
 Rated Voltage: 630V (2J), 450V (2W), 250V (2E), 100V (2A), 50V (1H), 25V (1E), 16V (1C)

Capacitance (pF)	Code	Tolerance	X5R			X7R					
			1H (50V)	1C (16V)	2J (630V)	2E (250V)	2A (100V)	1H (50V)	1E (25V)	1C (16V)	
220,000	224	M: $\pm 20\%$			■						
470,000	474					■					
1,000,000	105						■				
2,200,000	225							■			
3,300,000	335								■		
4,700,000	475							■			
6,800,000	685								■		
10,000,000	106			■						■	
22,000,000	226										■
47,000,000	476				■						

Capacitance (pF)	Code	Tolerance	X7S			X7T		
			2A (100V)	1H (50V)	1C (16V)	2J (630V)	2W (450V)	2E (250V)
330,000	334	M: $\pm 20\%$				■		
470,000	474						■	
680,000	684							■
1,000,000	105							
1,500,000	155							■
2,200,000	225							
6,800,000	685			■				
10,000,000	106				■			
22,000,000	226							
47,000,000	476					■		

Standard Thickness  
 5.00 mm



## Capacitance Range Chart

## CKG57N [EIA CC2220]

### Capacitance Range Chart

Temperature Characteristics: X5R ( $\pm 15\%$ ), X7R ( $\pm 15\%$ ), X7S ( $\pm 22\%$ ), X7T ( $+ 22/-33\%$ )  
 Rated Voltage: 630V (2J), 450V (2W), 250V (2E), 100V (2A), 50V (1H), 25V (1E), 16V (1C)

Capacitance (pF)	Code	Tolerance	X5R				X7R				
			2A (100V)	1H (50V)	1E (25V)	1C (16V)	2J (630V)	2E (250V)	2A (100V)	1H (50V)	1E (25V)
470,000	474	M: $\pm 20\%$					■				
1,000,000	105							■			
2,200,000	225								■		
4,700,000	475									■	
10,000,000	106		■							■	
22,000,000	226			■							■
33,000,000	336										■
47,000,000	476					■					
100,000,000	107					■					

Capacitance (pF)	Code	Tolerance	X7S				X7T		
			2A (100V)	1H (50V)	1E (25V)	1C (16V)	2J (630V)	2W (450V)	2E (250V)
680,000	684	M: $\pm 20\%$					■		
1,000,000	105							■	
1,500,000	155								■
2,200,000	225								
3,300,000	335								
22,000,000	226		■	■					
47,000,000	476				■				
100,000,000	107					■			

Standard Thickness  
 5.00 mm



## Capacitance Range Table

### Class 2 (Temperature Stable)

Temperature Characteristics: X5R (-55 to +85°C, ±15%)

Capacitance	Size	Thickness (mm)	Capacitance Tolerance	TDK Part Number			
				Rated Voltage Edc: 100V	Rated Voltage Edc: 50V	Rated Voltage Edc: 25V	Rated Voltage Edc: 16V
10 µF	4532	5.00 ± 0.50	± 20%		CKG45NX5R1H106M500JH		
	5750	5.00 ± 0.50	± 20%	CKG57NX5R2A106M500JH			
22 µF	5750	5.00 ± 0.50	± 20%		CKG57NX5R1H226M500JH		
47 µF	4532	5.00 ± 0.50	± 20%				CKG45NX5R1C476M500JH
	5750	5.00 ± 0.50	± 20%			CKG57NX5R1E476M500JH	
100 µF	5750	5.00 ± 0.50	± 20%				CKG57NX5R1C107M500JH

### Class 2 (Temperature Stable)

Temperature Characteristics: X7R (-55 to +125°C, ±15%)

Capacitance	Size	Thickness (mm)	Capacitance Tolerance	TDK Part Number				
				Rated Voltage Edc: 630V	Rated Voltage Edc: 250V	Rated Voltage Edc: 100V	Rated Voltage Edc: 50V	
47 nF	3225	3.35 ± 0.10	± 10%	CKG32KX7R2J473K335AH				
			± 20%	CKG32KX7R2J473M335AH				
100 nF	3225	3.35 ± 0.10	± 10%		CKG32KX7R2E104K335AH			
			± 20%		CKG32KX7R2E104M335AH			
	4532	2.90 ± 0.10	± 10%	CKG45KX7R2J104K290JH				
			± 20%	CKG45KX7R2J104M290JH				
220 nF	3225	3.35 ± 0.10	± 10%		CKG32KX7R2E224K335AH			
			± 20%		CKG32KX7R2E224M335AH			
	4532	2.90 ± 0.10	± 10%		CKG45KX7R2E224K290JH			
			± 20%		CKG45KX7R2E224M290JH			
		5750	3.35 ± 0.15	± 10%	CKG45NX7R2J224M500JH			
				± 20%	CKG57KX7R2J224M335JH			
470 nF	3225	3.35 ± 0.10	± 10%			CKG32KX7R2A474K335AH		
			± 20%			CKG32KX7R2A474M335AH		
	4532	2.90 ± 0.10	± 10%		CKG45KX7R2E474K290JH			
			± 20%		CKG45KX7R2E474M290JH			
			± 20%		CKG45NX7R2E474M500JH			
	5750	3.35 ± 0.15	± 10%		CKG57KX7R2E474K335JH			
			± 20%		CKG57KX7R2E474M335JH			
			± 20%	CKG57NX7R2J474M500JH				
1 µF	3225	3.35 ± 0.10	± 10%			CKG32KX7R2A105K335AH	CKG32KX7R1H105K335AH	
			± 20%			CKG32KX7R2A105M335AH	CKG32KX7R1H105M335AH	
	4532	2.90 ± 0.10	± 10%			CKG45KX7R2A105K290JH		
			± 20%			CKG45KX7R2A105M290JH		
	5750	3.35 ± 0.15	± 10%		CKG45NX7R2E105M500JH			
			± 20%		CKG57KX7R2E105K335JH	CKG57KX7R2A105K335JH		
± 20%		CKG57NX7R2E105M500JH						
1.5 µF	4532	2.90 ± 0.10	± 10%				CKG45KX7R1H155K290JH	
			± 20%				CKG45KX7R1H155M290JH	
2.2 µF	3225	3.35 ± 0.10	± 10%			CKG32KX7R2A225K335AH		
			± 20%			CKG32KX7R2A225M335AH		
	4532	2.90 ± 0.10	± 10%			CKG45KX7R2A225K290JH		
			± 20%			CKG45KX7R2A225M290JH		
			± 20%			CKG45NX7R2A225M500JH		
			± 10%			CKG57KX7R2A225K335JH		
5750	3.35 ± 0.15	± 20%		CKG57KX7R2A225M335JH				
		± 20%		CKG57NX7R2E225M500JH	CKG57NX7R2A225M500JH			
3.3 µF	4532	2.90 ± 0.10	± 10%				CKG45KX7R1H335K290JH	
			± 20%				CKG45KX7R1H335M290JH	
	5750	3.35 ± 0.15	± 20%				CKG45NX7R1H335M500JH	
			± 10%			CKG57KX7R2A335K335JH		
± 20%			CKG57KX7R2A335M335JH					





## Capacitance Range Table

### Class 2 (Temperature Stable)

Temperature Characteristics: X7R (-55 to +125°C, ±15%)

Capacitance	Size	Thickness (mm)	Capacitance Tolerance	TDK Part Number			
				Rated Voltage Edc: 100V	Rated Voltage Edc: 50V	Rated Voltage Edc: 25V	Rated Voltage Edc: 16V
4.7 µF	3225	3.35 ± 0.10	± 10%			CKG32KX7R1E475K335AH	
			± 20%			CKG32KX7R1E475M335AH	
	4532	2.90 ± 0.10	± 10%			CKG45KX7R1E475K290JH	
			± 20%			CKG45KX7R1E475M290JH	
	5750	5.00 ± 0.50	± 20%	CKG45NX7R2A475M500JH			
			± 10%	CKG57KX7R2A475K335JH	CKG57KX7R1H475K335JH		
		± 20%	CKG57KX7R2A475M335JH	CKG57KX7R1H475M335JH			
		± 20%	CKG57NX7R2A475M500JH				
6.8 µF	4532	5.00 ± 0.50	± 20%		CKG45NX7R1H685M500JH		
			± 10%			CKG32KX7R1E106K335AH	
10 µF	3225	3.35 ± 0.10	± 10%			CKG32KX7R1E106M335AH	
			± 20%				CKG45KX7R1C106K290JH
	4532	2.90 ± 0.10	± 10%				CKG45KX7R1C106M290JH
			± 20%				
	5750	5.00 ± 0.50	± 20%			CKG45NX7R1E106M500JH	
			± 10%			CKG57KX7R1E106K335JH	
		± 20%	CKG57KX7R1E106M335JH				
		± 20%	CKG57NX7R2A106M500JH	CKG57NX7R1H106M500JH			
15 µF	5750	3.35 ± 0.15	± 20%				CKG57KX7R1C156M335JH
			± 10%				CKG45KX7R1C226M290JH
22 µF	4532	2.90 ± 0.10	± 20%				CKG45NX7R1C226M500JH
			± 10%				
	5750	5.00 ± 0.50	± 20%			CKG57KX7R1E226M335JH	
			± 10%			CKG57NX7R1E226M500JH	
33 µF	5750	5.00 ± 0.50	± 20%				CKG57NX7R1C336M500JH

### Class 2 (Temperature Stable)

Temperature Characteristics: X7S (-55 to +125°C, ±22%)

Capacitance	Size	Thickness (mm)	Capacitance Tolerance	TDK Part Number			
				Rated Voltage Edc: 100V	Rated Voltage Edc: 50V	Rated Voltage Edc: 25V	Rated Voltage Edc: 16V
3.3 µF	3225	3.35 ± 0.10	± 10%	CKG32KX7S2A335K335AH			
			± 20%	CKG32KX7S2A335M335AH			
	4532	2.90 ± 0.10	± 10%	CKG45KX7S2A335K290JH			
			± 20%	CKG45KX7S2A335M290JH			
4.7 µF	3225	3.35 ± 0.10	± 10%	CKG32KX7S2A475K335AH	CKG32KX7S1H475K335AH		
			± 20%	CKG32KX7S2A475M335AH	CKG32KX7S1H475M335AH		
	4532	2.90 ± 0.10	± 10%	CKG45KX7S2A475K290JH	CKG45KX7S1H475K290JH		
			± 20%	CKG45KX7S2A475M290JH	CKG45KX7S1H475M290JH		
6.8 µF	3225	3.35 ± 0.10	± 10%		CKG32KX7S1H685K335AH		
			± 20%		CKG32KX7S1H685M335AH		
	4532	5.00 ± 0.50	± 20%	CKG45NX7S2A685M500JH			
			± 10%	CKG57KX7S2A685K335JH			
		± 20%	CKG57KX7S2A685M335JH				
10 µF	3225	3.35 ± 0.10	± 10%		CKG32KX7S1H106K335AH		
			± 20%		CKG32KX7S1H106M335AH		
	4532	5.00 ± 0.50	± 20%	CKG45NX7S2A106M500JH	CKG45NX7S1H106M500JH		
			± 10%	CKG57KX7S2A106K335JH	CKG57KX7S1H106K335JH		
		± 20%	CKG57KX7S2A106M335JH	CKG57KX7S1H106M335JH			
15 µF	5750	3.35 ± 0.15	± 20%	CKG57KX7S2A156M335JH			
22 µF	4532	2.90 ± 0.10	± 20%				CKG45KX7S1C226M290JH
			± 10%				
47 µF	5750	5.00 ± 0.50	± 20%				CKG45NX7S1C476M500JH
			± 10%				CKG57KX7S1C476M335JH
	5750	5.00 ± 0.50	± 20%			CKG57NX7S1E476M500JH	
			± 10%				
100 µF	5750	5.00 ± 0.50	± 20%				CKG57NX7S1C107M500JH



## Capacitance Range Table

### Class 2 (Temperature Stable)

Temperature Characteristics: X7T (-55 to +125°C, +22/-33%)

Capacitance	Size	Thickness (mm)	Capacitance Tolerance	TDK Part Number		
				Rated Voltage Edc: 630V	Rated Voltage Edc: 450V	Rated Voltage Edc: 250V
100 nF	3225	3.35 ± 0.10	± 10%	CKG32KX7T2J104K335AH		
			± 20%	CKG32KX7T2J104M335AH		
150 nF	3225	3.35 ± 0.10	± 10%	CKG32KX7T2J154K335AH		
			± 20%	CKG32KX7T2J154M335AH		
	4532	2.90 ± 0.10	± 10%	CKG45KX7T2J154K290JH		
			± 20%	CKG45KX7T2J154M290JH		
220 nF	3225	3.35 ± 0.10	± 10%	CKG32KX7T2W224K335AH		
			± 20%	CKG32KX7T2W224M335AH		
	4532	2.90 ± 0.10	± 10%	CKG45KX7T2J224K290JH		
			± 20%	CKG45KX7T2J224M290JH		
330 nF	3225	3.35 ± 0.10	± 10%	CKG32KX7T2E334K335AH		
			± 20%	CKG32KX7T2E334M335AH		
	4532	2.90 ± 0.10	± 10%	CKG45KX7T2W334K290JH		
			± 20%	CKG45KX7T2W334M290JH		
	5750	3.35 ± 0.15	± 10%	CKG45NX7T2J334M500JH		
			± 20%	CKG57KX7T2J334K335JH		
± 20%	CKG57KX7T2J334M335JH					
470 nF	4532	2.90 ± 0.10	± 10%	CKG45KX7T2W474K290JH		
			± 20%	CKG45KX7T2W474M290JH		
	5750	3.35 ± 0.15	± 10%	CKG45NX7T2J474M500JH		
			± 20%	CKG57KX7T2J474K335JH		
± 20%	CKG57KX7T2J474M335JH					
680 nF	4532	2.90 ± 0.10	± 10%	CKG45KX7T2E684K290JH		
			± 20%	CKG45KX7T2E684M290JH		
	5750	3.35 ± 0.15	± 10%	CKG45NX7T2W684M500JH		
			± 20%	CKG57KX7T2W684K335JH		
	5750	5.00 ± 0.50	± 10%	CKG57KX7T2W684M335JH		
			± 20%	CKG57NX7T2J684M500JH		
1 µF	4532	2.90 ± 0.10	± 10%	CKG45KX7T2E105K290JH		
			± 20%	CKG45KX7T2E105M290JH		
	5750	3.35 ± 0.15	± 10%	CKG45NX7T2W105M500JH		
			± 20%	CKG57KX7T2W105K335JH		
	5750	5.00 ± 0.50	± 10%	CKG57KX7T2W105M335JH		
			± 20%	CKG57NX7T2J105M500JH		
1.5 µF	4532	5.00 ± 0.50	± 10%	CKG45NX7T2E155M500JH		
			± 20%	CKG57KX7T2E155K335JH		
	5750	3.35 ± 0.15	± 20%	CKG57KX7T2E155M335JH		
			± 20%	CKG57NX7T2W155M500JH		
2.2 µF	4532	5.00 ± 0.50	± 20%	CKG45NX7T2E225M500JH		
			± 10%	CKG57KX7T2E225K335JH		
	5750	3.35 ± 0.15	± 20%	CKG57KX7T2E225M335JH		
			± 20%	CKG57NX7T2W225M500JH		
3.3 µF	5750	5.00 ± 0.50	± 20%	CKG57NX7T2E335M500JH		

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## 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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