

## Single-Line ESD-Protection Diode in SOD-523



20278



19344

### MARKING (example only)



20279

Bar = cathode marking

X = date code

Y = type code (see table below)

### DESIGN SUPPORT TOOLS [click logo to get started](#)



### FEATURES

- Compact SOD-523 package
- Low package height < 0.7 mm
- 1-line unidirectional ESD-protection
- AEC-Q101 qualified available
- Working range 1 V to 33 V
- ESD immunity acc. IEC 61000-4-2  
±15 kV to ±30 kV contact discharge  
±15 kV to ±30 kV air discharge
- Lead plating: Sn (e3)  
- soldering can be checked by standard vision inspection  
- AOI = Automated Optical Inspection
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

 AUTOMOTIVE  
GRADE  
Available

**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

ORDERING INFORMATION					
PART NUMBER (EXAMPLE)	AEC-Q101 QUALIFIED	ENVIRONMENTAL AND QUALITY CODE			ORDERING CODE (EXAMPLE)
		RoHS COMPLIANT + LEAD (Pb)-FREE TERMINATIONS	TIN PLATED	8K PER 7" REEL (8 mm TAPE)	
		GREEN		MOQ = 8K/BOX	
VESD05C1-02V	-	G	3	-08	VESD05C1-02V-G3-08
VESD05C1-02V	H	G	3	-08	VESD05C1-02VHG3-08

PACKAGE DATA						
DEVICE NAME	PACKAGE NAME	TYPE CODE	WEIGHT	MOLDING COMPOUND FLAMMABILITY RATING	MOISTURE SENSITIVITY LEVEL	SOLDERING CONDITIONS
VESD01C1-02V	SOD-523	. V	1.32 mg	UL 94 V-0	MSL level 1 (according J-STD-020)	Peak temperature max. 260 °C
VESD03C1-02V		. B				
VESD05C1-02V		. C				
VESD08C1-02V		. D				
VESD012C1-02V		. E				
VESD016C1-02V		. G				
VESD026C1-02V		. X				
VESD033C1-02V		A				



<b>ABSOLUTE MAXIMUM RATINGS</b> VESD01C1-02V (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 μs/single shot	I <sub>PPM</sub>	14.6	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 μs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	30	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		30	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C

<b>ABSOLUTE MAXIMUM RATINGS</b> VESD03C1-02V (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 μs/single shot	I <sub>PPM</sub>	11.6	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 μs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	30	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		30	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C

<b>ABSOLUTE MAXIMUM RATINGS</b> VESD05C1-02V (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 μs/single shot	I <sub>PPM</sub>	8.7	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 μs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	30	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		30	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C

<b>ABSOLUTE MAXIMUM RATINGS</b> VESD08C1-02V (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 μs/single shot	I <sub>PPM</sub>	6.60	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 μs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	30	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		30	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C



<b>ABSOLUTE MAXIMUM RATINGS VESD12C1-02V</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 µs/single shot	I <sub>PPM</sub>	4.4	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 µs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	30	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		30	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C

<b>ABSOLUTE MAXIMUM RATINGS VESD16C1-02V</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 µs/single shot	I <sub>PPM</sub>	3.6	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 µs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	30	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		30	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C

<b>ABSOLUTE MAXIMUM RATINGS VESD26C1-02V</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 µs/single shot	I <sub>PPM</sub>	2.1	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 µs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	20	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		20	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C

<b>ABSOLUTE MAXIMUM RATINGS VESD33C1-02V</b> (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITIONS	SYMBOL	VALUE	UNIT
Peak pulse current	Acc. IEC 61000-4-5, 8/20 µs/single shot	I <sub>PPM</sub>	1.6	A
Peak pulse power	Acc. IEC 61000-4-5, 8/20 µs/single shot	P <sub>PP</sub>	100	W
ESD immunity	Contact discharge acc. IEC 61000-4-2; 10 pulses	V <sub>ESD</sub>	15	kV
	Air discharge acc. IEC 61000-4-2; 10 pulses		15	kV
Operating temperature	Junction temperature	T <sub>J</sub>	-55 to +150	°C
Storage temperature		T <sub>stg</sub>	-55 to +150	°C



<b>ELECTRICAL CHARACTERISTICS VESD01C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	1	V
Reverse voltage	at $I_R = 100\text{ }\mu\text{A}$	$V_R$	1	1.2	-	V
Reverse current	at $V_R = 1\text{ V}$	$I_R$	-	20	100	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 20\text{ mA}$	$V_{BR}$	2.5	2.65	2.8	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 14.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	6.2	6.9	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 14.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	3	3.92	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	0.13	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	153	192	230	pF

<b>ELECTRICAL CHARACTERISTICS VESD03C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	3	V
Reverse voltage	at $I_R = 20\text{ }\mu\text{A}$	$V_R$	3	-	-	V
Reverse current	at $V_R = 3\text{ V}$	$I_R$	-	8	20	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 1\text{ mA}$	$V_{BR}$	4.4	4.65	4.9	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 11.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	7.8	8.70	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 11.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	2.6	3.32	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	0.19	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	89	112	135	pF

<b>ELECTRICAL CHARACTERISTICS VESD05C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	5	V
Reverse voltage	at $I_R = 1\text{ }\mu\text{A}$	$V_R$	5	-	-	V
Reverse current	at $V_R = 5\text{ V}$	$I_R$	-	0.01	0.1	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 1\text{ mA}$	$V_{BR}$	6.85	7.26	7.65	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 8.7\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	10.3	11.5	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 8.7\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	2.2	2.74	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	0.2	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	53	67	81	pF



<b>ELECTRICAL CHARACTERISTICS VESD08C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	8	V
Reverse voltage	at $I_R = 0.1\text{ }\mu\text{A}$	$V_R$	8	-	-	V
Reverse current	at $V_R = 8\text{ V}$	$I_R$	-	0.01	0.1	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 1\text{ mA}$	$V_{BR}$	9.5	10	10.5	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 6.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	13.7	15.3	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 6.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	1.9	2.32	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	0.23	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	37	47	57	pF

<b>ELECTRICAL CHARACTERISTICS VESD12C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	12	V
Reverse voltage	at $I_R = 0.1\text{ }\mu\text{A}$	$V_R$	12	-	-	V
Reverse current	at $V_R = 12\text{ V}$	$I_R$	-	0.01	0.1	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 1\text{ mA}$	$V_{BR}$	13.9	14.7	15.5	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 4.4\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	20.5	22.7	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 4.4\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	1.6	1.88	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	0.4	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	26	33	40	pF

<b>ELECTRICAL CHARACTERISTICS VESD16C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	16	V
Reverse voltage	at $I_R = 0.1\text{ }\mu\text{A}$	$V_R$	16	-	-	V
Reverse current	at $V_R = 16\text{ V}$	$I_R$	-	0.01	0.1	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 1\text{ mA}$	$V_{BR}$	17	17.9	18.8	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 3.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	25.3	28	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 3.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	1.5	1.72	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	0.53	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	21	27	33	pF



<b>ELECTRICAL CHARACTERISTICS VESD26C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	26	V
Reverse voltage	at $I_R = 0.1\text{ }\mu\text{A}$	$V_R$	26	-	-	V
Reverse current	at $V_R = 26\text{ V}$	$I_R$	-	< 0.01	0.1	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 1\text{ mA}$	$V_{BR}$	27.6	29.1	30.6	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 2.1\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	43	48	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 2.1\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	1.3	1.42	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	1.9	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	14	17.5	21	pF

<b>ELECTRICAL CHARACTERISTICS VESD33C1-02V</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITIONS / REMARKS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Protection paths	Number of lines which can be protected	$N_{channel}$	-	-	1	lines
Reverse stand off voltage	Max. reverse working voltage	$V_{RWM}$	-	-	33	V
Reverse voltage	at $I_R = 0.1\text{ }\mu\text{A}$	$V_R$	33	-	-	V
Reverse current	at $V_R = 33\text{ V}$	$I_R$	-	< 0.01	0.1	$\mu\text{A}$
Reverse breakdown voltage	at $I_R = 1\text{ mA}$	$V_{BR}$	35.5	37.4	39.3	V
Reverse clamping voltage	at $I_{PP} = I_{PPM} = 1.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_C$	-	56	62.5	V
Forward clamping voltage	at $I_{PP} = 1\text{ A}$ , $t_p = 300\text{ }\mu\text{s}$	$V_F$	0.9	1.1	1.2	V
	at $I_{PP} = I_{PPM} = 1.6\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$	$V_F$	-	1.22	1.32	V
Dynamic resistance	$t_p = 100\text{ ns}$ (TLP; pin 2-1)	$r_{dyn}$	-	3.6	-	$\Omega$
Capacitance	at $V_R = 0\text{ V}$ ; $f = 1\text{ MHz}$	$C_D$	12	15	18	pF



Fig. 1 - ESD Discharge Current Wave Form acc. IEC 61000-4-2 (330 Ω / 150 pF)



Fig. 4 - Typical Capacitance vs. Reverse Voltage



Fig. 2 - 8/20 μs Peak Pulse Current Wave Form acc. IEC 61000-4-5



Fig. 5 - Typical Reverse Voltage vs. Reverse Current



Fig. 3 - Typical Peak Clamping Voltage vs. Peak Pulse Current



Fig. 6 - Typical Clamping Voltage vs. Peak Pulse Current



Fig. 7 - Typical Forward Voltage vs. Forward Current



Fig. 8 - Typical Forward Voltage vs. Forward Current

### PACKAGE DIMENSIONS in millimeters (Inches): SOD-523



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 23093





## CARRIER TAPE SOD-523



S8-V-3717.03-005 (4)  
05.07.2018  
22959

## ORIENTATION IN CARRIER TAPE SOD-523



S8-V-3717.03-006 (4)  
05.07.2018  
22958



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- 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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