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IGBT Chips

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S-Series, SCSOA Capability, Fast Types	600 V	10 ... 20 A	6
E-Series, Improved NPT ³ technology	1200 ... 1700 V	20 ... 150 A	7

MOSFET Chips

	V_{DSS}	$R_{DS(on)}$	
HiPerFET™ Power MOSFET	70 ... 1200 V	0.005 ... 4.5 Ω	8-10
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Symbols and Definitions

C_{ies}	Input capacitance of IGBT
C_{iss}	Input capacitance of MOSFET
$-di/dt$	Rate of decrease of forward current
I_C	DC collector current
I_D	Drain current
I_F	Forward current of diode
$I_{F(AV)M}$	Maximum average forward current at specified T_h
I_{FSM}	Peak one cycle surge forward current
I_{GT}	Gate trigger current
I_R	Reverse current
I_{RM}	Maximum peak recovery current
I_T	Forward current of thyristor
$I_{T(AV)M}$	Maximum average on-state current of a thyristor at specified T_h
I_{TSM}	Maximum surge current of a thyristor
$R_{DS(on)}$	Static drain-source on-state resistance
R_{thjc}	Thermal resistance junction to case
r_T	Slope resistance of a thyristor or diode (for power loss calculations)
T_{case}	Case temperature
T_h	Heatsink temperature
t_{fi}	Current fall time with inductive load
$T_j, T_{(vj)}$	Junction temperature
$T_{jm}, T_{(vj)m}$	Maximum junction temperature
t_{rr}	Reverse recovery time of a diode
$V_{CE(sat)}$	Collector-emitter saturation voltage
V_{CES}	Maximum collector-emitter voltage
V_{DRM}	Maximum repetitive forward blocking voltage of thyristor
V_{DSS}	Drain-source break-down voltage
V_F	Forward voltage of diode
V_R	Reverse voltage
V_{RRM}	Maximum peak reverse voltage of thyristor or diode
V_T	On-state voltage of thyristor
V_{T0}	Threshold voltage of thyristors or diodes (for power loss calculation only)



Registration No.:
001947 TS2/765/17557



Registration No.:
001947

Chip and DCB Ceramic Substrates Data book
Edition 2004

Published by IXYS Semiconductor GmbH
Marketing Communications
Edisonstraße 15, D-68623 Lampertheim

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Nomenclature

IGBT and MOSFET Discrete

IXSD 40N60A	(Example)
IX	IXYS
	Die technology
E	NPT ³ IGBT
F	HiPerFETTM Power MOSFET
G	Fast IGBT
S	IGBT with SCSOA capability
T	Standard Power MOSFET
D	Unassembled chip (die)
40	Current rating, 40 = 40 A
N	N-channel type
P	P-channel type
60	Voltage class, 60 = 600 V
xx	
	MOSFET
A	Prime RDS(on) for standard MOSFET
Q	Low gate charge die
Q2	Low gate charge die, 2nd generation
P	PolarHTTM Power MOSFET
L	Linear Mode MOSFET
	IGBT
--	No letter, low VCE(sat)
A	Or A2, std speed type
B	Or B2, high speed type
C	Or C2, very high speed type

Diode and Thyristor Chips

C-DWEP 69-12	(Diode Example)
C	Package type
D	Chip function D = Silicon rectifier diode
W	Unassembled chip
EP	Process designator EP = Epitaxial rectifier diode N = Rectifier diode, cathode on top P = Rectifier diode, anode on top FN = Fast Rectifier diode, cathode on top FP = Fast Rectifier diode, anode on top
69	Current rating value of one chip in A
-12	Voltage class, 12 = 1200 V
W-CWP 55-12/18	(Thyristor Example)
W	Package type
C	Chip function C = Silicon phase control thyristor
W	Unassembled chip
P	Process designator P = Planar passivated chip cathode on top
55	Current rating value of one chip in A
12/18	Voltage class, 12/18 = 1200 up to 1800 V



General Informations for Chips

When mounting Power Semiconductor chips to a header, ceramic substrate or hybrid thick film circuit, the solder system and the chip attach process are very important to the reliability and performance of the final product. This brochure provides several guidelines that describe recommended chip attachment procedures. These methods have been used successfully for many years at IXYS.

Available forms of chip packings

IXYS offers various options.

Please order from one of the following possibilities:

Packaging Options	Delivery form
C-...*	Chips in tray (Waffle Pack); Electrically tested
T-...*	Chips in wafer, unsawed; Bipolar = 5" (125 mmØ) wafer; Electrically tested, rejects are inked
W-...*	Chips in wafer on foil, sawed; Bipolar = 5" (125 mmØ) wafer; Electrically tested, rejects are inked

...* must be amended by the exact chip type designation.

Packing, Storage and Handling

Chips should be transported in their original containers. All chip transfer to other containers or for assembly should be done only with rubber-tipped vacuum pencils. Contact with human skin (or with a tool that has been touched by hand) leaves an oily residue that may adversely impact subsequent chip attach or reliability.

At temperatures below 104°F (40°C), there is no limitation on storage time for chips in sealed original packages. Chips removed from original packages should be assembled immediately. The wetting ability of the contact metallization with solder can be preserved by storage in a clean and dry nitrogen atmosphere.

The IGBT and MOSFET Chips are electrostatic discharge (ESD) sensitive. Normal ESD precautions for handling must be observed. Prior to chip attach, all testing and handling of the chips must be done at ESD safe work stations according to DIN IEC 47(CO) 701. Ionized air blowers are recommended for added ESD protection.

Contamination of the chips degrades the assembly results. Finger prints, dust or oily deposits on the surface of the chips have to be absolutely avoided.

Rough mechanical treatment can cause damage to the chip.

Electrical Tests

The electrical properties listed in the data sheet presume correctly assembled chips. Testing of **non**-assembled chips requires the following precautions:

- High currents have to be supplied homogeneously to the whole metallized contact area.
- Kelvin probes must be used to test voltages at high currents
- Applying the full specified blocking or reverse voltage may cause arcing across the glass passivated junction termination, because the electrical field on top of the passivation glass causes ionization of the surrounding air. This phenomenon can be avoided by using inert fluids or by increasing the pressure of the gas surrounding the chip to values above 30 psig (2 bars).

General Rules for Assembly

The linear thermal expansion coefficient of silicon is very small compared to usual contact metals. If a large area metallized silicon chip is directly soldered to a metal like copper, enormous shear stress is caused by temperature changes (e.g. when cooling down from the solder temperature or by heating during working conditions) which can disrupt the solder mountdown.

If it is found that larger chips are cracking during mountdown or in the application, then the use of a low thermal expansion coefficient buffer layer, e.g. tungsten, molybdenum or Trimetal®, for strain relief should be considered. An alternative solution is to soft-solder these larger chips to DCB ceramic substrates because of their matching thermal expansion coefficients.



Assembly Instructions

MOS/IGBT Chips

Recommended Solder System

IXYS recommends a soft solder chip attach using a solder composition of 92.5 % Pb, 5 % Sn and 2.5 % Ag. The maximum chip attach temperature is 460°C for MOSFET and 360°C for HiPerFET™ and IGBT.

Wire Bonding

It is recommended to use wire of diameter not greater than 0.38 mm (0.015") for bonding to the source emitter and gate pads. Multiple wires should be used in place of thicker wire to handle high drain or emitter currents. See tables for number of recommended wire bonds. At smaller gate pads 0.15 mm is recommended.

Thermal Response Testing

To assure good chip attach processing, thermal response testing per MIL STD 750, Method 3161 or equivalent should be performed.

Bipolar Chips

Assembling

IXYS bipolar semiconductor chips have a soft-solderable, multi-layer metallization (Ti/Ni/Ag) on the bottom side and, on top, either the same metallization scheme or an aluminium layer sufficiently thick for ultrasonic bonding. Note that the last layer of metal for soldering is pure silver.

Regardless of their type all chips possess the same glass passivated junction termination system on top of the chip. For that reason they can be easily chip bonded or they can all be simply soldered to a flat contacting electrode in accordance to the General Rules on Page 3. All kinds of the usual soft solders with melting points below 660°F (350°C) can be used thanks to their pure silver top metal. Solders with high melting points are preferable due to their better power cycling capability, i.e. they are more resistant to thermal fatigue.

Soldering temperature should not exceed 750°F (400°C). The maximum temperature should not be applied for more than five minutes.

As already mentioned above the electrical properties quoted in the data sheets can only be obtained with properly assembled chips. This is only possible when all contact materials to be soldered together are well wetted and the solder is practically free of voids.

A simple means to achieve good solder connections is to use a belt furnace running with a process gas containing at least 10 % Hydrogen in Nitrogen.

Other approved methods are also allowed, provided that the above mentioned temperature-time-limits are not exceeded and temperature shocks above 930°F/min (500 K/min) are avoided.

We do not recommend the use of fluxes for soldering!

Ultrasonic Wire Bonding

Chips provided with a thick aluminium layer are designed for ultrasonic wire bonding. Wire diameters up to 500 µm can be used dependent on chip types. Setting wires in parallel and application of stitch bonding lead to surge current ratings comparable to soldered chips.

Coating

Although the chips are glass passivated, they must be protected against arcing and environmental influences. The coating material that is in contact with the chip surface must have the following properties:

- elasticity (to prevent mechanical stress)
- high purity, no contamination with alkali metals
- good adhesion to metals and glass passivation.

FRED, Rectifier Diode and Thyristor Chips in Planar Design

Fast Recovery Epitaxial Diodes (FRED)

Power switches (IGBT, MOSFET, BJT, GTO) for applications in electronics are only as good as their associated free-wheeling diodes. At increasing switching frequencies, the proper functioning and efficiency of the power switch, aside from conduction losses, is determined by the turn-off behavior of the diode (characterized by Q_{rr} , I_{RM} and t_{rr} - Fig. 1).

The reverse current characteristic following the peak reverse current I_{RM} is another very important property. The slope of the decaying reverse current di_{rr}/dt results from design parameters (technology and diffusion) of the FRED chip Fig. 2. In a circuit this current slope, in conjunction with parasitic inductances (e.g. connecting leads, causes over-voltage spikes and high frequency interference voltages. The higher the di_{rr}/dt ("hard recovery" or "snap-off" behavior) the higher is the resulting additional stress for both the diode and the paralleled switch. A slow decay of the reverse current ("soft recovery" behavior), is the most desirable characteristic, and this is designed into all FRED. The wide range of available blocking voltages makes it possible to apply these FRED as output rectifiers in switch-mode power supplies (SMPS) as well as protective and free-wheeling diodes for power switches in inverters and welding power supplies.

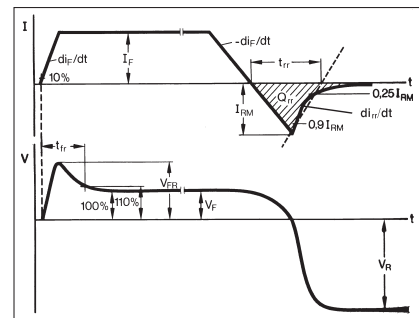


Fig. 1: Current and voltage during turn-on and turn-off switching of fast diodes

Rectifier Diode and Thyristor Chips

The figures 3 a-c show cross sectional views of the diode and thyristor chips in the passivation area. All thyristor and diode chips (DWN, DWFN, CWP) are fabricated using separation diffusion processes so that all junctions terminate on the topside of the chip. Now the entire bottom surfaces of all chips are available for soldering onto a DCB or other ceramic substrate without a molybdenum strain buffer. The elimination of the strain buffer and its solder joint reduces thermal resistance and increases blocking voltage stability. The junction termination areas are passivated with glass, whose thermal expansion coefficient matches that of silicon. All silicon chips increasingly use planar technology with guard rings and channel stoppers to reduce electric fields on the chip surface. The contact areas of the chips have vapor deposited metal layers which contribute substantially to their high power cycle capability. All chips are processed on silicon wafers of 5" diameter and diced after a wafer sample test which automatically marks chips not meeting the electrical specification. The chip geometry is square or rectangular.

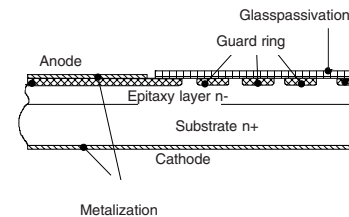
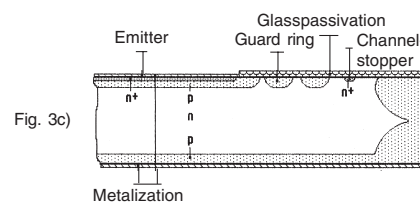
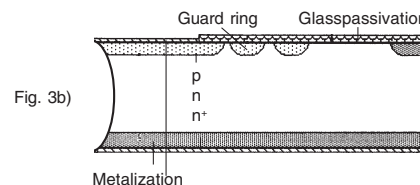
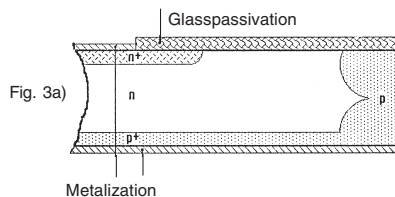


Fig. 2: Cross section of glassivated planar epitaxial diode chip with separation diffusion (type DWEP)

- Fig. 3a-c
Cross sections of Chips in the passivation area
a) Diode chip, type DWN, DWFN
b) Diode chip, type DWP, DWFP
c) Thyristor chip, type CWP



Rectifier Diodes

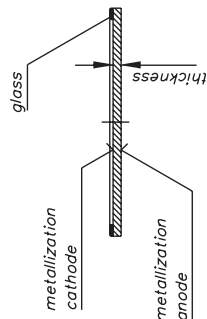
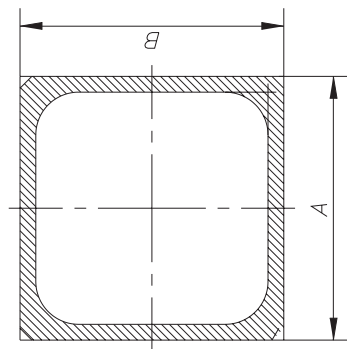


Type	V_{RRM}	I_R V_{RRM} T_{VJM} typ. mA	T_{VJM} °C	I_{FAVM} rect. d = 0.5 $T_C = 100^\circ\text{C}$ A	R_{thJC} ① typ. KW	V_F $T_{VJ} =$		$@ I_F$	I_{FSM}	Reverse Recovery		$@ -dI/dt$
						25°C	125°C			I_{RM} 25°C; $V_R = 100\text{ V}$ A	$@ I_F$	
DWN 5 DWP 5	800 - 1200	0.7 0.7	150	12 12	2.80 2.80	1.14 1.14	1.14 1.14	7 7	140 140	tb tb	tb tb	A/ μs tb tb
DWN 2 DWN 9 DWN 17 DWP 17 DWN 21 DWP 21 DWN 35 DWP 35 DWN 50 DWP 50 DWN 75 DWP 75 DWN 110 DWP 110 DWN 340	1200 - 1800	0.7 1.0 1.5 1.5 3.0 3.0 1.5 1.5 2.0 2.0 2.0 2.0 3.5 3.5 15.0		12 20 31 31 42 41 59 58 78 76 115 118 253 253 416	2.80 1.80 1.10 1.10 0.90 0.90 0.65 0.65 0.50 0.50 0.33 0.35 0.16 0.16 0.10	1.14 1.28 1.34 1.37 1.33 1.35 1.24 1.25 1.31 1.33 1.26 1.27 1.18 1.18 1.09	1.14 1.28 1.34 1.37 1.33 1.35 1.24 1.25 1.31 1.33 1.26 1.27 1.18 1.18 1.09	7 30 50 50 80 80 80 80 150 150 200 200 300 300 300	150 300 320 320 500 500 630 630 900 900 1500 1500 3200 3200 5900	tb tb tb tb tb tb 11 11 12 12 24 24 45 45 235	tb tb tb tb tb tb 50 50 50 50 50 50 30	tb tb tb tb tb tb 0.64 0.64 1 1 3 3 6 6 50
DWN 108 DWN 347	1600 - 2200	3.5 3.5		253 788	0.16 0.05	1.18 1.10	1.18 1.10	300 600	3200 10500	45 45	50 40	6 50

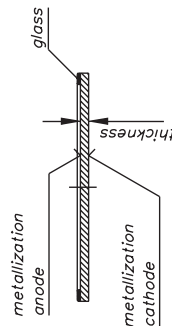
① Mounted on DCB

Rectifier Diodes

Type	solderable	bondable	Chips per Wafer	Dimensions		Si- thickn.
				A	B	mm
DWN 5		•	1123	4.40	2.10	0.265
DWP 5		•	716	4.40	2.10	0.265
DWN 2	•	•	1204	2.95	2.95	0.265
DWN 9	•	•	684	3.90	3.90	0.265
DWN 17	•	•	518	4.45	4.45	0.265
DWP 17	•	•	518	4.45	4.45	0.265
DWN 21	•	•	346	5.40	5.40	0.265
DWP 21	•	•	346	5.40	5.40	0.265
DWN 35	•	•	259	6.20	6.20	0.265
DWP 35	•	•	259	6.20	6.20	0.265
DWN 50	•	•	198	7.10	7.10	0.265
DWP 50	•	•	198	7.10	7.10	0.265
DWN 75	•	•	125	8.70	8.70	0.265
DWP 75	•	•	125	8.70	8.70	0.265
DWN 110	•	•	58	12.30	12.30	0.265
DWP 110	•	•	58	12.30	12.30	0.265
DWN 340	•	•	32	16.20	16.20	0.265
DWN 108	•	•	58	12.30	12.30	0.315
DWN 347	•	•	16	25.30	18.50	0.315
Tolerance				-0.1	-0.1	±5%



DWN



DWP

FRED - Fast Recovery Epitaxial Diodes

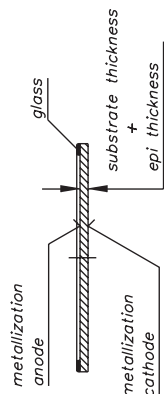
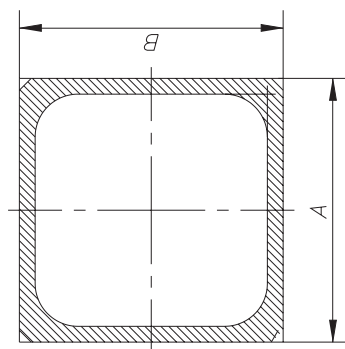


Type	V _{RRM}	I _R V _{RRM} 125°C mA	T _{VJM} °C	I _{F(AV)M} rect. d = 0.5 T _C = 100°C A	R _{thJC} ① typ. KW	V _F			@ I _F		I _{FSM}	Reverse Recovery			@ I _F	@-di/dt
						T _{VJ} = 25°C V	V	@ °C	@ I _F	I _{RM} 25°C; V _R = 100 V A		@-di/dt V _R = 30 V typ. ns	t _{rr}			
DWEP 27-02	200	5.0	150	54	0.9	1.09	0.84	150	30	300	4	50	100	35	1	100
DWEP 37-02		11.0		91	tbd	1.03	0.87	150	100	475	4	100	100	35	1	200
DWEP 77-02		20.0		244	0.4	1.12	0.87	150	125	1200	2	12.5	25	tbd	1	350
DWEP 8-06	600	1.5		tbd	2.5	1.65	1.48	150	8	50	5	12	100	tbd	tbd	tbd
DWEP 12-06		1.5	8	2.5	1.45	1.31	150	8	100	5	25	100	35	1	50	
DWEP 15-06		3.0	12	1.6	1.65	1.48	150	16	100	5	25	100	35	1	50	
DWEP 23-06		7.0	30	0.9	1.53	1.33	150	30	250	5	50	100	35	1	100	
DWEP 25-06		7.0	30	0.9	1.53	1.38	150	43	300	5	50	100	35	1	100	
DWEP 35-06		14.0	60	0.8	1.73	1.48	150	70	550	5	100	100	35	1	200	
DWEP 55-06		17.0	80	0.7	1.58	1.38	125	75	600	5	100	100	35	1	200	
DWEP 75-06		20.0		162	0.4	1.31	1.10	125	75	1000	20	80	200	35	1	350
DWEP 3-10	1000	2.0		tbd	2.5	2.65	2.09	150	6	40	7	12	100	tbd	tbd	tbd
DWEP 10-10		4.0	12	1.6	2.65	2.09	150	12	75	5	25	100	35	1	50	
DWEP 18-10		7.0	30	0.9	2.43	2.04	150	30	200	7	50	100	35	1	100	
DWEP 20-10		7.0	30	0.9	2.35	1.99	150	36	200	7	50	100	35	1	100	
DWEP 30-10		14.0	60	0.8	2.24	1.79	150	60	500	7	100	100	35	1	200	
DWEP 50-10		17.0	82	0.7	2.12	1.68	125	50	500	6	50	120	35	1	200	
DWEP 70-10		20.0		129	0.4	1.89	1.57	125	75	800	14	80	200	35	1	350
DWEP 6-12	1200	2.0		tbd	2.5	2.55	2.19	150	5	80	7	10	100	tbd	tbd	tbd
DWEP 9-12		4.0	12	1.6	2.55	2.19	150	12	75	5	25	100	50	1	50	
DWEP 17-12		7.0	30	0.9	2.60	2.19	150	30	200	7	50	100	40	1	100	
DWEP 19-12		7.0	30	0.9	2.50	2.19	150	30	200	7	50	100	40	1	100	
DWEP 29-12		14.0	60	0.7	2.35	1.94	150	60	500	7	100	100	40	1	200	
DWEP 49-12		17.0	77	0.7	2.19	1.89	125	50	500	9	50	100	40	1	200	
DWEP 69-12		20.0		123	0.4	1.77	1.54	125	75	800	20	75	200	40	1	350

① Mounted on DCB

FRED - Fast Recovery Epitaxial Diodes

Type	solderable	bondable	Chips per Wafer	Dimensions		Si- thickn.	
				A	B		
				mm	mm	mm	mm
DWEP 27-02	•	•	518	4.45	4.45	0.35	0.35
DWEP 37-02	•	•	257	6.20	6.20	0.35	0.35
DWEP 77-02	•	•	151	8.91	7.22	0.35	0.35
DWEP 8-06	•	•	1612	3.60	1.80	0.35	0.35
DWEP 12-06	•	•	1851	2.40	2.40	0.35	0.35
DWEP 15-06	•	•	990	3.25	3.25	0.35	0.35
DWEP 23-06	•	•	531	5.50	3.50	0.35	0.35
DWEP 25-06	•	•	518	4.45	4.45	0.35	0.35
DWEP 35-06	•	•	257	6.20	6.20	0.35	0.35
DWEP 55-06	•	•	230	8.65	4.95	0.35	0.35
DWEP 75-06	•	•	151	8.91	7.22	0.35	0.35
DWEP 3-10	•	•	1612	1.80	3.60	0.35	0.35
DWEP 10-10	•	•	990	3.25	3.25	0.35	0.35
DWEP 18-10	•	•	531	5.50	3.50	0.35	0.35
DWEP 20-10	•	•	518	4.45	4.45	0.35	0.35
DWEP 30-10	•	•	257	6.20	6.20	0.35	0.35
DWEP 50-10	•	•	230	8.65	4.95	0.35	0.35
DWEP 70-10	•	•	151	8.91	7.22	0.35	0.35
DWEP 6-12	•	•	1851	2.40	2.40	0.35	0.35
DWEP 9-12	•	•	990	3.25	3.25	0.35	0.35
DWEP 17-12	•	•	531	5.50	3.50	0.35	0.35
DWEP 19-12	•	•	518	4.45	4.45	0.35	0.35
DWEP 29-12	•	•	257	6.20	6.20	0.35	0.35
DWEP 49-12	•	•	230	8.65	4.95	0.35	0.35
DWEP 69-12	•	•	151	8.91	7.22	0.35	0.35
Tolerance				-0.1	-0.1	±5%	±5%



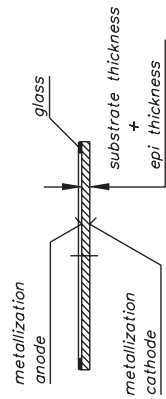
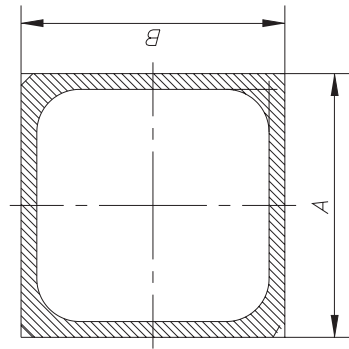
Low Leakage Fast Recovery Epitaxial Diodes

Type	V _{RRM} V	I _R V _{RRM} T _{VJM} mA	T _{VJM} °C	I _{F(AV)M} rect. d = 0.5 T _C = 100°C A	R _{thJC} ① typ. K/W	V _F T _{VJ} = 175°C		@I _F A	I _{FSM} A	I _{RM} 25°C; V _R = 100 V A	Reverse Recovery		@I _F A	t _{rr} V _R = 30 V typ. ns	@-di/dt A/μs
						25°C V	175°C V				@I _F A	@-di/dt			
DWLP 4-02 DWLP 15-02 DWLP 15-02B DWLP 25-02	200	0.20 0.50 0.50 0.20	175	14 29 25 46	2.50 1.60 1.60 0.90	1.21 0.99 1.13 1.10	0.75 0.74 0.78 0.80	5 12 12 30	80 140 140 325	2.4 2.4 1.1 2.0	100 100 100 100	10 25 25 50	1 1 1 1	25 25 25 25	50 100 100 200
DWLP 4-03 DWLP 8-03 DWLP 15-03 DWLP 15-03A DWLP 23-03 DWLP 23-03A DWLP 55-03 DWLP 75-03	300	0.20 0.25 0.50 0.50 1.00 1.00 2.50 4.00		13 15 25 29 51 41 72 117	2.80 2.50 1.60 1.60 0.90 0.90 0.65 0.40	1.63 1.45 1.44 1.26 1.19 1.49 1.42 1.43	0.96 0.95 0.94 0.60 0.77 0.99 0.91 0.92	5 6 12 12 30 30 60 100	40 60 110 110 300 300 600 1000	1.3 1.4 1.4 1.4 3.0 1.9 2.8 3.2	100 100 100 100 100 100 100 100	10 12 25 25 50 50 130 200	1 1 1 1 1 1 1 1	30 30 30 30 25 30 30 30	50 50 100 100 200 200 300 400
DWLP 8-04 DWLP 15-04 DWLP 23-04 DWLP 55-04 DWLP 75-04 DWLP 150-04	400	0.25 0.50 1.00 2.50 4.00 8.50		14 24 46 67 117 148	2.50 1.60 0.90 0.65 0.40 0.35	1.40 1.40 1.43 1.12 1.39 6.14	0.91 0.90 0.93 0.81 0.89 9.72	6 12 30 60 100 300	60 110 300 600 1000 1200	1.4 2.5 2.5 3.5 4.0 9.5	100 100 100 100 100 100	12 25 50 130 200 200	1 1 1 1 1 1	30 30 30 30 30 30	50 100 200 300 400 800
DWLP 4-06 DWLP 8-06A DWLP 8-06B DWLP 15-06A DWLP 15-06B DWLP 23-06A DWLP 23-06B DWLP 55-06 DWLP 75-06	600	0.20 0.25 0.25 0.50 0.50 1.00 2.00 2.50 4.00		11 12 11 21 16 40 30 62 99	2.80 2.50 2.50 1.60 1.60 0.90 0.90 0.65 0.40	1.97 1.95 2.39 1.95 2.38 1.10 2.45 1.92 1.93	1.14 1.13 1.25 1.12 1.23 1.54 1.35 1.10 1.11	5 6 6 12 12 30 30 60 100	40 50 50 110 110 250 250 600 1000	2.6 2.6 1.4 2.9 1.5 3.5 2.0 4.0 4.5	100 100 100 100 100 100 100 100	10 12 12 25 25 50 50 130 200	1 1 1 1 1 1 1 1	30 35 30 35 35 35 30 35 35	50 50 50 100 100 200 200 300 400
DWLP 8-12 DWLP 15-12 DWLP 23-12 DWLP 55-12 DWLP 75-12	1200	0.25 0.50 1.00 2.50 4.00		9 14 29 48 78	2.50 1.60 0.90 0.65 0.40	2.61 2.45 2.68 2.54 2.56	1.46 1.52 1.52 1.40 1.42	6 12 30 60 100	40 90 200 500 800	5.0 5.7 6.0 7.0 7.4	100 100 100 100 100	12 25 50 130 200	1 1 1 1 1	40 40 40 40 40	50 100 200 300 400

① Mounted on DCB

Low Leakage Fast Recovery Epitaxial Diodes

Type	solderable	bondable	Chips per Wafer	Dimensions		Si- thickn.
				A mm	B mm	mm
DWLP 4-02		•	1960	3.00	1.80	0.37
DWLP 15-02		•	990	3.25	3.25	0.37
DWLP 15-02B		•	990	3.25	3.25	0.37
DWLP 25-02		•	518	4.45	4.45	0.37
DWLP 4-03		•	1960	3.00	1.80	0.37
DWLP 8-03		•	1612	3.60	1.80	0.37
DWLP 15-03		•	990	3.25	3.25	0.37
DWLP 15-03A		•	990	3.25	3.25	0.37
DWLP 23-03		•	531	5.50	3.50	0.37
DWLP 23-03A		•	531	5.50	3.50	0.37
DWLP 55-03	•	•	230	8.65	4.95	0.37
DWLP 75-03		•	151	8.91	7.22	0.37
DWLP 8-04		•	1612	3.60	1.80	0.38
DWLP 15-04		•	990	3.25	3.25	0.38
DWLP 23-04		•	531	5.50	3.50	0.38
DWLP 55-04	•	•	230	8.65	4.95	0.38
DWLP 75-04	•	•	151	8.91	7.22	0.38
DWLP 150-04	•	•	74	13.00	9.77	0.38
DWLP 4-06		•	1960	3.00	1.80	0.40
DWLP 8-06A		•	1612	3.60	1.80	0.40
DWLP 8-06B		•	1612	3.60	1.80	0.40
DWLP 15-06A		•	990	3.25	3.25	0.40
DWLP 15-06B		•	990	3.25	3.25	0.40
DWLP 23-06A		•	531	5.50	3.50	0.40
DWLP 23-06B		•	531	5.50	3.50	0.40
DWLP 55-06	•	•	230	8.65	4.95	0.40
DWLP 75-06	•	•	151	8.91	7.22	0.40
DWLP 8-12		•	1612	3.60	1.80	0.46
DWLP 15-12		•	990	3.25	3.25	0.46
DWLP 23-12		•	531	5.50	3.50	0.46
DWLP 55-12	•	•	230	8.65	4.95	0.46
DWLP 75-12		•	151	8.91	7.22	0.46
Tolerance				-0.1	-0.1	±5%



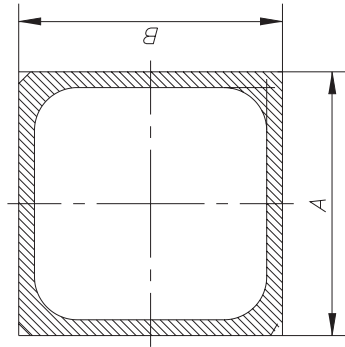
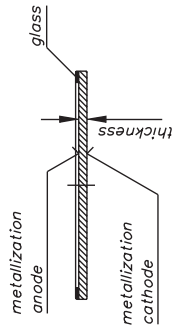


Type	V _{RRM} V	I _R V _{RRM} 125°C typ. mA	T _{VJM} °C	I _{F(AVM)} rect. d = 0.5 T _C = 100°C A	R _{thJC} ① typ. KW	V _F T _{UJ} =		I _{FSM} A	Reverse Recovery		
						25°C V	150°C V		t _{rr} typ. ns	@ I _F A	@ -di/dt A/μs
DWHP 8-06 F	in design 600	tbd	150	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
DWHP 15-06 F		tbd		tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
DWHP 23-06 F		tbd		tbd	0.90	1.94	1.68	tbd	tbd	20	200
DWHP 56-06 F		tbd		tbd	0.65	2.04	1.78	200	tbd	60	450
DWHP 69-06 F	in design	tbd		tbd	0.40	2.05	1.80	450	tbd	100	750
DWHP 150-06 F		tbd		tbd	tbd	tbd	tbd	750	tbd	tbd	tbd
DWHP 15-12 F		0.1		12	0.90	3.08	2.61	100	tbd	10	100
DWHP 23-12 F		0.2		17	0.90	2.97	2.49	200	tbd	20	200
DWHP 56-12 F		0.6		29	0.65	3.15	2.70	450	7	60	450
DWHP 56-12 S		0.6		37	0.65	2.12	1.98	450	18	60	tbd
DWHP 69-12 F		1		47	0.40	3.17	2.72	750	28	100	750
DWHP 69-12 S		1		60	0.40	2.13	1.99	750	36	100	750
DWHP 150-12 S		1.5		150	tbd	2.00	1.87	1150	53	100	1150
DLFP 55-17 S	1700	0.6		31	0.65	2.35	2.46	350	54	150	400
DLFP 68-17 S		1		51	0.40	2.34	2.44	650	30	60	600
DLFP 150-17 S		1.8		tbd	0.22	1.95	2.03	1150	50	100	1150
DLFP 200-17 S		tbd		tbd	tbd	tbd	tbd	tbd	78	150	tbd
DLFP 15-16/18 F	1600- 1800	0.1		12	0.90	3.01	3.08	50	tbd	10	50
DLFP 25-16/18 F		0.2		16	0.90	2.86	2.90	150	tbd	20	450
DLFP 55-16/18 F		0.6		27	0.65	2.90	2.94	350	21	60	450
DLFP 68-16/18 F		1		44	0.40	2.89	2.93	650	30	100	800

① Mounted on DCB

SONIC-FRD™ Diodes

Type	solderable	bondable	Chips per Wafer	Dimensions		Si- thickn.
				A mm	B mm	mm
DWHP 8-06 F		•	1bd	3.60	1.80	0.180
DWHP 15-06 F		•	968	3.25	3.25	
DWHP 23-06 F		•	532	5.50	3.50	
DWHP 56-06 F		•	231	8.65	4.95	
DWHP 69-06 F		•	152	8.91	7.22	
DWHP 150-06 F		•	88	11.40	9.40	
DWHP 15-12 F		•	968	3.25	3.25	
DWHP 23-12 F		•	532	5.50	3.50	
DWHP 56-12 F		•	231	8.65	4.95	
DWHP 56-12 S		•	231	8.65	4.95	
DWHP 69-12 F		•	152	8.91	7.22	
DWHP 69-12 S		•	152	8.91	7.22	
DWHP 150-12 S		•	88	11.40	9.40	
DLFP 55-17 S		•	231	8.65	4.95	0.265
DLFP 68-17 S		•	152	8.91	7.22	
DLFP 150-17 S		•	88	11.40	9.40	
DLFP 200-17 S		•	59	12.40	12.40	
DLFP 15-16/18 F		•	968	3.25	3.25	
DLFP 25-16/18 F		•	532	4.45	4.45	
DLFP 55-16/18 F		•	231	8.65	4.95	
DLFP 68-16/18 F		•	152	8.91	7.22	
Tolerance				-0.1	-0.1	±5%



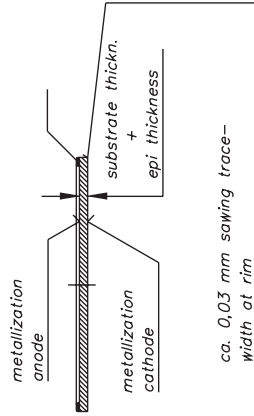
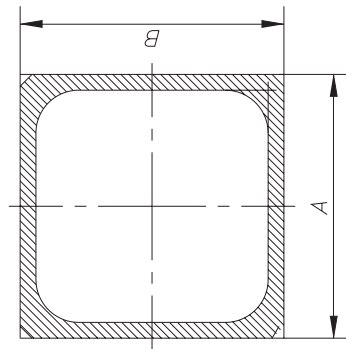
GaAs Schottky Diodes



Type	V _{RRM}	T _{VJM}	I _{F(AVIM)} rect. d = 0.5	R _{thJC} T _C = 90°C typ.	V _{F typ} T _{VJ} =		@I _F	I _{R typ} @ V _{RRM} 125°C	C _i 0.5*V _{RRM} 125°C	I _{FSM}
DWGS04-01A DWGS10-01C	100	175	8.5 25.0	10.12 5.20	25°C V	125°C V	A	μA	pF	A
DWGS04-018A DWGS10-018A DWGS10-018C DWGS20-018A DWGS20-018C	180		5.0 8.4 11.0 15.0 17.0 23.0	10.12 10.12 5.20 5.20 3.70 3.70	0.85 1.25 0.80 1.21 0.80 1.24	0.54 0.94 0.85 1.02 0.80 1.04 0.80 1.07	2.0 4.0 5.0 10.0 7.5 20.0	700 <10 700 1300 <10 2000 <10	19.0 19.0 8.8 8.8 22.0 22.0 33.0 33.0	12.5 80.0 12.5 32.0 30.0 80.0 50.0 120.0
DWGS04-025A DWGS04-025C DWGS10-025A DWGS10-025C DWGS20-025A DWGS20-025C	250		3.9 7.8 9.0 14.0 13.0 20.0	10.12 10.12 5.20 5.20 3.70 3.70	1.30 1.26 1.25 1.26 1.25 1.24	1.30 1.05 1.25 1.07 1.25 1.10	2.0 4.0 5.0 10.0 7.5 20.0	700 <10 1300 <10 2000 <10	6.4 6.4 18.0 18.0 26.0 26.0	12.5 32.0 30.0 80.0 50.0 120.0
DWGS04-03A DWGS04-03C DWGS10-03A DWGS10-03C DWGS20-03C	300		3.5 6.0 8.0 17.5 25.0	10.12 10.12 5.20 5.20 3.70	1.60 1.56 1.60 1.56 1.56	1.60 1.10 1.60 1.11 1.14	2.0 4.0 5.0 10.0 20.0	700 <10 1300 10 15	3.7 3.7 9.0 9.0 14.0	12.5 32.0 30.0 80.0 120.0

GaAs Schottky Diodes

	solderable	bondable	Chips per Wafer	Dimensions	
				A mm	B mm
DWGS04-01A		•	4060	1.30	1.30
DWGS10-01C		•	2126	2.10	1.60
DWGS04-018A		•	4060	1.30	1.30
DWGS04-018C		•	4060	1.30	1.30
DWGS10-018A		•	2126	2.10	1.60
DWGS10-018C		•	2126	2.10	1.60
DWGS20-018A		•	1480	3.00	1.60
DWGS20-018C		•	1480	3.00	1.60
DWGS04-025A		•	4060	1.30	1.30
DWGS04-025C		•	4060	1.30	1.30
DWGS10-025A		•	2126	2.10	1.60
DWGS10-025C		•	2126	2.10	1.60
DWGS20-025A		•	1480	3.00	1.60
DWGS20-025C		•	1480	3.00	1.60
DWGS04-03A		•	4060	1.30	1.30
DWGS04-03C		•	4060	1.30	1.30
DWGS10-03A		•	2126	2.10	1.60
DWGS10-03C		•	2126	2.10	1.60
DWGS20-03C		•	1480	3.00	1.60
Tolerance				-0.1	-0.1



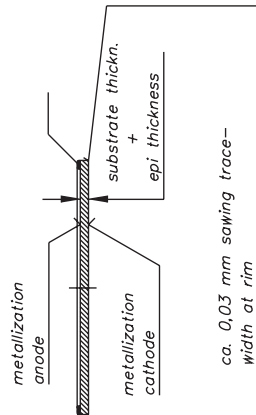
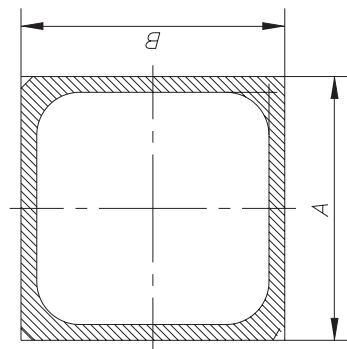


Type	V _{RRM}	I _R V _{RRM} 125°C 1) = 100°C mA	T _{VJM} °C	I _{F(AV)M} rect d = 0.5 T _C = 125°C 1) = 100°C A	R _{thJC} ① typ. KW	V _F T _{VJ} = 25°C V A version: 150°C B version: 125°C V		I _{FSM}	Reverse Recovery	
									t _r typ.	@ I _F A
DWS 39-08D	8	145 1)	150	145 1)	0.8	0.31	0.18	1000	ns	A
DWS 9-15B	15	tbd	150	tbd	1.7	0.40	0.28	160	tbd	tbd
DWS 19-15B		65 1)	150	65 1)	1.4	0.39	0.24	350	tbd	20
DWS 29-15B		98 1)	150	98 1)	1.1	0.39	0.25	660	tbd	40
DWS 7-30B	30	tbd	tbd	tbd	tbd	0.63	0.43	tbd	tbd	tbd
DWS 17-30B		tbd	150	tbd	1.4	tbd	tbd	330	tbd	20
DWS 27-30B		82 1)	150	82 1)	1.1	0.42	0.29	520	tbd	40
DWS 37-30B		102 1)	150	102 1)	0.8	0.40	0.27	800	tbd	50
DWS 217-30B		65 1)	150	65 1)	1.2	0.41	0.30	420	tbd	30
DWS 3-45B	45	28 1)	150	28 1)	1.7	0.48	0.41	160	tbd	10
DWS 4-45A		32	175	32	1.7	0.66	0.50	140	tbd	10
DWS 13-45B		42 1)	150	42 1)	1.4	0.48	0.41	320	tbd	20
DWS 14-45A		47	175	47	1.4	0.66	0.50	280	tbd	20
DWS 23-45B		63 1)	150	63 1)	1.1	0.48	0.42	640	tbd	40
DWS 24-45A		68	175	68	1.1	0.66	0.50	550	tbd	40
DWS 33-45B		89 1)	150	89 1)	0.8	0.48	0.41	900	tbd	50
DWS 34-45A		95	175	95	0.8	0.66	0.51	800	tbd	50

① Mounted on DCB

Schottky Diodes

Type	solderable	bondable	Chips per Wafer	Dimensions		Si- thickn.
				A	B	
DWS 39-08D	•		343	5.40	5.40	0.25/0.43
DWS 9-15B		•	1886	2.40	2.40	0.25/0.43
DWS 19-15B		•	990	3.25	3.25	
DWS 29-15B		•	515	4.45	4.45	
DWS 7-30B		•	2857	2.40	2.40	0.25
DWS 17-30B		•	990	3.25	3.25	
DWS 27-30B		•	515	4.45	4.45	
DWS 37-30B		•	515	5.40	5.40	
DWS 217-30B		•	729	3.25	4.45	
DWS 3-45B		•	2857	2.40	2.40	
DWS 4-45A		•	1886	2.40	2.40	
DWS 13-45B		•	1515	3.25	3.25	
DWS 14-45A		•	990	3.25	3.25	
DWS 23-45B	•	•	757	4.45	4.45	
DWS 24-45A		•	757	4.45	4.45	
DWS 33-45B	•	•	515	5.40	5.40	
DWS 34-45A		•	515	5.40	5.40	
Tolerance				-0.1	-0.1	±5%

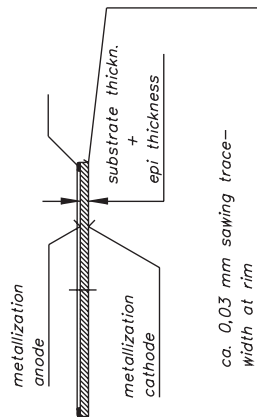
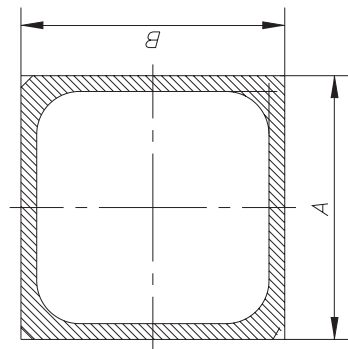




Type	V _{RRM}	I _R V _{RRM} 125°C 1) = 100°C mA	T _{JVM} °C	I _{F(AVM)} rect. d = 0.5 T _C = 125°C 1) = 100°C A	R _{thJC} ① typ. K/W	V _F T _{JJ} = 150°C		I _{FSM}	Reverse Recovery	
						25°C	V		t _{rr} typ.	@ I _F A
DWS 5-60A	60	tbd	175	tbd	1.7	tbd	tbd	A	ns	A
DWS 15-60B		43	150	43	1.4	0.60	0.60	170	tbd	tbd
DWS 25-60B		63 1)	150	63	1.1	0.59	0.50	320	tbd	20
DWS 35-60B		82 1)	150	82	0.8	0.53	0.48	660	tbd	40
DWS 25-80B	80	66 1)	150	66	1.1	0.70	0.55	900	tbd	50
DWS 36-80A		91	175	91	0.8	0.74	0.58	660	tbd	40
DWS 2-100A	100	32	175	32	1.7	0.77	0.57	700	tbd	200
DWS 12-100A		45	175	45	1.4	0.78	0.57	120	tbd	10
DWS 22-100A		65	175	65	1.1	0.78	0.58	230	tbd	20
DWS 32-100A		92	175	92	0.8	0.77	0.57	450	tbd	40
DWS 1-150A	150	30	175	30	1.7	0.81	0.62	700	tbd	50
DWS 11-150A		43	175	43	1.4	0.81	0.62	120	tbd	10
DWS 21-150A		60	175	60	1.1	0.81	0.63	200	tbd	20
DWS 31-150A		85	175	85	0.8	0.81	0.62	450	tbd	40
DWS 1-180A	180	30	175	30	1.7	0.81	0.62	700	tbd	50
DWS 30-200A	200	tbd	175	tbd	0.8	0.00	0.00	120	tbd	10
① Mounted on DCB									tbd	50
									tbd	200

Schottky Diodes

Type	solderable	bondable	Chips per Wafer	Dimensions		Si- thickn.
				A	B	
				mm	mm	mm
DWS 5-60A		•	2857	2.40	2.40	0.25
DWS 15-60B		•	990	3.25	3.25	
DWS 25-60B		•	757	4.45	4.45	
DWS 35-60B		•	515	5.40	5.40	
DWS 25-80B		•	515	4.45	4.45	0.25
DWS 36-80A		•	343	5.40	5.40	
DWS 2-100A		•	1886	2.40	2.40	0.25
DWS 12-100A		•	990	3.25	3.25	
DWS 22-100A		•	757	4.45	4.45	
DWS 32-100A	•	•	515	5.40	5.40	
DWS 1-150A		•	2857	2.40	2.40	0.25
DWS 11-150A		•	1515	3.25	3.25	
DWS 21-150A		•	757	4.45	4.45	
DWS 31-150A		•	515	5.40	5.40	
DWS 1-180A		•	1886	2.40	2.40	0.25
DWS 30-200A		•	515	5.40	5.40	
Tolerance				-0.1	-0.1	±5%



Phase Control Thyristors

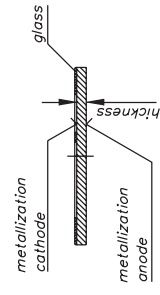
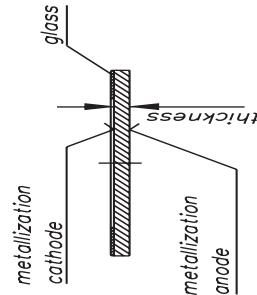


Type	V_{DRM} V_{RRM}	I_R V_{RRM} T_{VJM}	T_{VJM} °C	$I_{T(AVM)}$ rect. d = 0.5 $T_C = 100^\circ\text{C}$ ¹⁾ = 75°C	R_{thJC} ① max.	V_T $T_{VJ} = 25^\circ\text{C}$ 150°C	I_T @ I_T	I_{RSM} non-rep. $t_p = 10\text{ms}$	t_q $V_R = 100\text{V}$, $V_D = 2/3 V_{DRM}$ $t_p = 200\mu\text{s}$, $dI/dt = -10\text{A}/\mu\text{s}$ $T_{VJ} = T_{VJM}$	dV/dt V/ μs	@ I_T A	I_H $R_{GK} = \infty$ $V_D = 6\text{V}$ $T_{VJ} = 25^\circ\text{C}$	I_L $T_{VJ} = 25^\circ\text{C}$	@ t_p μs
CWP 7-CG	800 -	5	125	15 ¹⁾	1.7	1.55	1.41	20	200	tbd	tbd	50	75	10
CWP 8	1200	4	150	tbd	1.7	1.53	1.53	44	300	20	16	40	100	10
CWP 8-CG		4	150	tbd	1.7	1.53	1.53	44	300	20	16	80	100	10
CWP 35		20	150	tbd	0.7	1.46	1.49	150	1200	10	50	80	100	10
CWP 16-CG	1200 -	8	150	25	1.2	1.40	1.41	45	400	10	11	100	150	10
CWP 21-CG	1600 -	12		61	1.1	1.56	1.57	80	520	20	15	100	150	10
CWP 22-CG		12		36	0.9	1.55	1.57	80	520	15	20	100	450	10
CWP 24		20		tbd	0.9	1.33	tbd	60	600	20	25	100	200	10
CWP 25-CG		20		tbd	0.9	1.33	1.31	60	600	20	25	100	200	10
CWP 41	1200 -	20		125	0.5	1.53	1.58	200	1150	20	120	200	450	10
CWP 50	1800	20		tbd	0.6	1.38	1.38	200	1500	20	150	200	450	10
CWP 55		20		tbd	0.5	1.29	1.26	200	1900	20	150	200	450	10
CWP 71		20		tbd	0.4	1.35	1.35	300	2400	20	150	200	450	10
CWP 130		30		204	0.2	1.21	1.16	350	4750	20	160	200	300	30
CWP 180		40		372	0.2	1.22	1.17	450	5200	20	300	200	300	30
CWP 341		40		tbd	0.2	1.21	1.17	600	7000	50	300	150	200	30
CWP 347		60		540	0.1	1.17	1.11	600	9500	50	300	150	200	30
CWP 69	1600 -	20		tbd	0.2	1.55	tbd	300	1700	20	150	150	200	30
CWP 339	2200	40		tbd	0.2	1.26	tbd	300	6000	20	160	150	200	30
CWP 345		60		520	0.1	1.34	1.34	600	8000	50	300	150	200	30

① Mounted on DCB

Phase Control Thyristors

Type	solderable	bondable	Chips per Wafer	Dimensions							Si- thickn.
				A	B	F	G	J	L	M	
CWP 7-CG	•	•	518	4.45	4.45	-	-	0.2	1.1	1.6	0.38
CWP 8	•	•	375	5.20	5.20	1.80	0.90	-	-	-	0.38
CWP 8-CG	•	•	375	5.20	5.20	1.80	0.90	0.2	1.1	1.6	0.32
CWP 35	•	•	125	8.70	8.70	1.80	1.00	-	-	-	0.38
CWP 16-CG	•	•	239	6.50	6.50	-	-	0.2	1.1	1.6	0.38
CWP 21-CG	•	•	196	7.10	7.10	-	-	0.2	1.1	1.6	0.38
CWP 22-CG	•	•	196	7.10	7.10	-	-	0.2	1.1	1.6	0.38
CWP 24	•	•	196	7.10	7.10	1.80	1.00	-	-	-	0.32
CWP 25-CG	•	•	196	7.10	7.10	-	-	0.2	1.1	1.6	0.32
CWP 41	•	•	94	10.00	10.00	2.30	1.50	-	-	-	0.38
CWP 50	•	•	74	13.00	9.77	2.30	1.50	-	-	-	0.38
CWP 55	•	•	58	12.30	12.30	2.30	1.50	-	-	-	0.38
CWP 71	•	•	50	13.40	13.40	2.30	1.50	-	-	-	0.38
CWP 130	•	•	29	19.05	15.40	3.46	2.50	-	-	-	0.38
CWP 180	•	•	20	20.55	17.65	3.50	2.50	-	-	-	0.38
CWP 341	•	•	16	25.30	18.50	3.50	2.50	-	-	-	0.38
CWP 347	•	•	13	23.40	23.40	3.50	2.50	-	-	-	0.38
CWP 69	•	•	50	13.40	13.40	2.30	1.50	-	-	-	0.46
CWP 339	•	•	16	18.50	25.30	3.50	2.50	-	-	-	0.46
CWP 345	•	•	13	23.40	23.40	3.50	2.50	-	-	-	0.46
Tolerance				-0.1	-0.1	-0.1	+0.1	-0.1	+0.1	+0.1	±5%



...-CG types

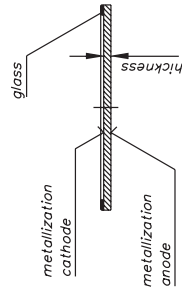
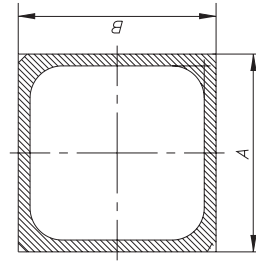
Fast Rectifier Diodes



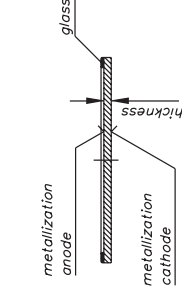
Type	V _{RRM}	I _R V _{RRM} T _{VJM} typ. mA	T _{VJM} °C	I _{RAVM} rect. d = 0.5 T _C = 75°C A	R _{thJC} ① typ. kW	V _F T _{VJ} =		I _{FSM}	Reverse Recovery				
						25°C V	125°C V		@ I _F	I _{RM} 25°C A	@ I _F	@ -di/dt typ. µs	@ -di/dt A/µs
DWFN 2-16/18	1600 - 1800	2	125	10	2.9	1.79	tbd	10	tbd	tbd	tbd	4	5
DWFN 9-16/18		4		16	1.6	1.98	tbd	30	tbd	tbd	tbd	8	5
DWFN 17-16/18		5		17	1.3	1.89	tbd	55	tbd	tbd	tbd	10	10
DWFP 17-16/18		5		17	1.3	2.10	tbd	55	tbd	tbd	tbd	10	10
DWFN 21-16/18		8		23	0.9	1.98	tbd	70	tbd	tbd	tbd	15	15
DWFN 35-16/18		10		26	0.7	1.88	tbd	80	tbd	tbd	tbd	25	25

① Mounted on DCB

Type	solderable	bondable	Chips per Wafer	Dimensions		Si- thickn. mm
				A mm	B mm	
DWFN 2-16/18		•	1204	2.95	2.95	0.265
DWFN 9-16/18		•	684	3.90	3.90	0.265
DWFN 17-16/18		•	518	4.45	4.45	0.265
DWFP 17-16/18	•	•	239	4.45	4.45	0.265
DWFN 21-16/18		•	346	5.40	5.40	0.265
DWFN 35-16/18		•	259	6.20	6.20	0.265
Tolerance				-0.1	-0.1	±5%



DWFN



DWFP