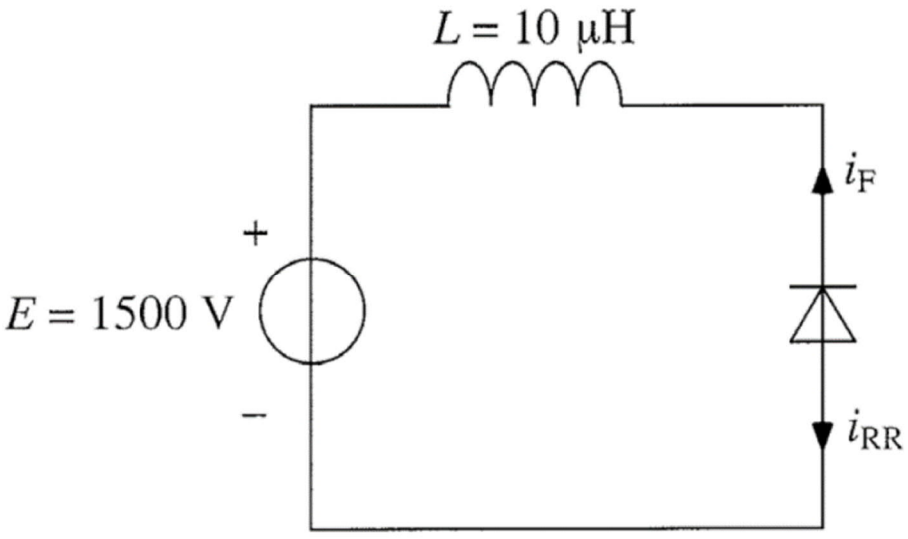
Exercise 1

1- Using the following datasheets, select the diodes taken under closer consideration when the required current rating is $I_{\_FAV}$ = 90 A and required voltage withstand is 1100 V. Operation frequency is 50 Hz.

2- Single phase diode bridge module SKB 26 (datasheet attached) cooling is done with a cooling element that has a thermal resistance R_{thsa} = 5 K/W (sink to air). How large direct current can the bridge feed when the ambient cooling temperature is 65 C. Bridge is equipped with a large filtering capacitor.

3- a) Commutation circuit as shown below has a diode 5SDF05D2505. Calculate the Reverse recovery current peak value and reverse recovery duration time, when the current before commutation is 300 A.

b) Determine the magnitude of the diode voltage stress, when indeed the overvoltage protection is not present (like in the picture). Can the diode withstand this kind of use? What other effects are caused by not having overvoltage protection?



Kurzzeichen
Glossary of terms and symbols
Les symboles

	Die Kurzzeichen entsprechen den Internationalen Empfehlungen (IEC) und DIN 41781, 41782	Terms and symbols largely correspond to the international recommendations (IEC) and DIN 41781, 41782	Les symboles sont conformes aux recommandations internationales (CEI) et à DIN 41781, 41782
U_{RRM}	= Höchstzulässige, periodische Spitzensperrspannung	= Repetitive peak reverse voltage, instantaneous value	= Valeur limite de la tension inverse de pointe répétitive
I_{FRMS}	= Höchstzulässiger Effektivwert des Durchlaßstromes	= Maximum permissible forward current, RMS value	= Courant efficace maximum admissible en sens direct
I_{FAV}	= Höchstzulässiger Dauergrenzstrom für Sinushalbwelle bei T_C	= Maximum allowable mean forward current of one halfsine wave at T_C	= Valeur maximum per mise du courant direct moyen pour demieonde sinusoïdale à T_C
I_{FAVM}	= Dauergrenzstrom, arithmetischer Mittelwert, 40 bis 1000 Hz Sinushalbwelle Die Werte gelten für: T_A = 45° C Umgebungstemperatur bei R_{thJA}, oder T_C = 100° C Gehäusetemperatur bei R_{thJC}	= Mean forward current, 40 to 1000 Hz of one halfsine wave at T_A = 45° C, convection cooling and R_{thJA}, resp. T_C = 100° C and R_{thJC}	= Valeur limite du courant direct moyen, 40 à 1000 Hz sin. 180° angle de conduction Ces valeurs sont valables pour: T_A = 45° C température ambiante avec R_{thJA} ou T_C = 100 ° C température du boîtier avec R_{thJC}
I_{DAVM}	= Dauergleichstrom der Gleichrichter-Schaltung bei angegebener Kühlbedingung	= DC-output current of the rectifier circuit at rated cooling conditions	= Courant redressé permanent à la sortie du circuit correspondant aux conditions de refroidissement indiquées
I_{FSM}	= Stoßstromgrenzwert für 10 ms	= Peak one cycle surge forward current, 10 ms	= Valeur limite du courant direct non répétitif à 10 ms (de surchage accidentelle)
$\int i^2dt$	= Grenzlastintegral für 10 ms	= I^2t for fusing, 10 ms	= Charge maximum en courant pendant 10 ms
I_R	= Oberer Sperrstrom bei T_{VJM} und U_{RRM}	= Maximum reverse current at T_{VJM} and U_{RRM}	= Courant inverse à T_{VJM} et U_{RRM}
u_F	= Durchlaßspannung bei Durchlaßstrom i_F	= Forward voltage drop, maximum value at rated i_F	= Tension directe pour la valeur du courant direct indiqué i_F
$U_{(TO)}$	= Schleusenspannung	= Threshold voltage	= Tension de seuil
r_F	= Ersatzwiderstand	= Slope resistance	= Résistance apparente à l'état passant
	= Stoßsperrverlustleistung bei T_{VJM} und 10 µs Stromdauer	= Maximum reverse power surge at T_{VJM} and 10 µs pulse width	= Puissance de perte inverse de pointe, non répétitive à T_{VJM} et 10 µs
T_{VJ}	= Sperrschichttemperatur	= Virtual junction temperature	= Température de la jonction
T_{VJM}	= Maximal zulässige Sperrschichttemperatur	= Maximum junction temperature	= Température maximum de la jonction
T_A	= Umgebungstemperatur	= Ambient temperature	= Température ambiante
T_C	= Gehäusetemperatur	= Case temperature	= Température du boîtier
R_{thJC}	= Thermischer Widerstand Sperrschicht – Gehäuse	= Thermal resistance junction to case	= Résistance thermique, jonction-boîtier
R_{thJA}	= Thermischer Widerstand, Sperrschicht – Umgebung	= Thermal resistance junction to ambient	= Résistance thermique, jonction-ambiante
R_{thCK}	= Thermischer Widerstand, Gehäuse – Kühlkörper	= Thermal resistance case to heatsink	= Résistance thermique, boîtier-radiateur
R_{thKA}	= Thermischer Widerstand, Kühlkörper – Umgebung	= Thermal resistance heatsink to ambient	= Résistance thermique, radiateur-ambiante
t_{rr}	= Sperrverzogerungszeit bei T_{VJ} = 25° C, typischer Wert	= Reverse recovery time at T_{VJ} = 25° C, typical value	= Temps de recouvrement à T_{VJ} = 25° C, valeur typique
Q_{rr}	= Sperrverzogerungsladung bei T_{VJ} = 25° C, typischer Wert	= Reverse recovered charge at T_{VJ} = 25° C, typical value	= Charge de recouvrement à T_{VJ} = 25° C, valeur typique
DS(A,D)	= Anode am Sockel	= Anode on stud	= Anode au boîtier
DS(A,D)I	= Kathode am Sockel	= Cathode on stud	= Cathode au boîtier

Part Number	V_{RRM} (V)	$I_{F(AV)}$ (A) @ T_C (°C)	I_{FSM} (2) 50 Hz (A)	I_{FSM} (2) 60 Hz (A)	VFM @ π X $I_{F(AV)}$ (V)	R_{thJC} DC (°C/W)	Notes	Fax-on-Demand Number	Case Style, (Case Outline) (1)
Standard Recovery									
40HF100	1000	40 @ 140	480	500	1.3	1.00	(6)(8)(9)(10)	20014	DO-203AB (DO-5) (R8)
40HF120	1200	40 @ 140	480	500	1.3	1.00	(6)(8)(9)(10)	20014	
40HF140	1400	40 @ 110	480	500	1.3	1.00	(6)(8)(9)(10)	20014	
40HF160	1600	40 @ 110	480	500	1.3	1.00	(6)(8)(9)(10)	20014	
1N1183A	50	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N1184A	100	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N1185A	150	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N1186A	200	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N1187A	300	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N1188A	400	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N1189A	500	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N1190A	600	40 @ 150	765	800	1.3	1.1	(6)(8)	20087	
1N2128A	50	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
1N2129A	100	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
1N2130A	150	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
1N2131A	200	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
1N2133A	300	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
1N2135A	400	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
1N2137A	500	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
1N2138A	600	60 @ 140	860	900	1.3	0.65	(6)(8)	20087	
70HF10	100	70 @ 140	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF20	200	70 @ 140	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF40	400	70 @ 140	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF60	600	70 @ 140	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF80	800	70 @ 140	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF100	1000	70 @ 140	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF120	1200	70 @ 140	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF140	1400	70 @ 110	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
70HF160	1600	70 @ 110	1000	1050	1.35	0.45	(6)(8)(9)(10)	20014	
85HF10	100	85 @ 140	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	(R7)
85HF20	200	85 @ 140	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
85HF40	400	85 @ 140	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
85HF60	600	85 @ 140	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
85HF80	800	85 @ 140	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
85HF100	1000	85 @ 140	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
85HF120	1200	85 @ 140	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
85HF140	1400	85 @ 110	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
85HF160	1600	85 @ 110	1450	1500	1.2	0.35	(6)(8)(9)(10)	20014	
88HF10	100	85 @ 140	1450	1500	1.2	0.35	(6)(8)	20014	(R8)
88HF20	200	85 @ 140	1450	1500	1.2	0.35	(6)(8)	20014	
88HF40	400	85 @ 140	1450	1500	1.2	0.35	(6)(8)	20014	
88HF60	600	85 @ 140	1450	1500	1.2	0.35	(6)(8)	20014	
88HF80	800	85 @ 140	1450	1500	1.2	0.35	(6)(8)	20014	
88HF100	1000	85 @ 140	1450	1500	1.2	0.35	(6)(8)	20014	
88HF120	1200	85 @ 140	1450	1500	1.2	0.35	(6)(8)	20014	

(1) See page 105 for Case Outline information
(2) Tj = Tj max; 100% V_{RRM} reapplied
(6) V_{FM} measured at Tj = 25°C
(8) Cathode to stud. To order anode to stud, append 'R' to part letters, e.g. 88HF**R**10.
(9) Available leaded. To order, add 1 to second digit of part number, e.g. 4**1**HF10. To order leaded and sleeved, add 2 to second digit of part number, e.g. 8**7**HF10.
(10) Available with metric stud. To order, add 'M' to part number, e.g. 6F10**M**.
(11) V_{FM} for JEDEC type is registered value at max Tj.

DO-203AB
(DO-5)

Diodes

Part Number	V_{RRM} (V)	$I_{F(AV)}$ @ T_C (A) (°C)	I_{FSM} (2) 50 Hz (A)	I_{FSM} (2) 60 Hz (A)	V_{FM} @ I_{FM} (V) (A)	R_{thJC} (°C/W)	Notes	Fax-on-Demand Number	Case Style, (Cas (1)
Standard Recovery									
1N3288A	100	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	DO-205AA (DO
1N3289A	200	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	
1N3290A	300	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	
1N3291A	400	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	
1N3292B	500	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	
1N3293A	600	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	
1N3294A	800	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	
1N3295A	1000	100 130	2200	2300	1.50 314	0.4	(8)(11)(12)	20016	
150K5A	50	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150K10A	100	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150K20A	200	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150K30A	300	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150K40A	400	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150K60A	600	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150K80A	800	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150K100A	1000	150 150	3000	3140	1.33 470	0.25	(6)(8)(10)(14)	20088	
150KS5	50	150 150	3000	3140	1.33 470	0.25	(6)(8)	20088	B-4
150KS10	100	150 150	3000	3140	1.33 470	0.25	(6)(8)	20088	
150KS20	200	150 150	3000	3140	1.33 470	0.25	(6)(8)	20088	
150KS40	400	150 150	3000	3140	1.33 470	0.25	(6)(8)	20088	
150KS60	600	150 150	3000	3140	1.33 470	0.25	(6)(8)	20088	
150KS80	800	150 150	3000	3140	1.33 470	0.25	(6)(8)	20088	
150KS100	1000	150 150	3000	3140	1.33 470	0.25	(6)(8)	20088	
130HF40PV	400	130 125	1680	1760	1.50 500	0.3	(6)(8)	82019	DO-205AC (DO-3
130HF80PV	800	130 125	1680	1760	1.50 500	0.3	(6)(8)	82019	
130HF120PV	1200	130 125	1680	1760	1.50 500	0.3	(6)(8)	82019	
1N3111	50	150 150	2850	3000	1.20 470	0.25	(15)	20089	DO-205AA (DO-3
1N3085	100	150 150	2850	3000	1.20 470	0.25	(15)	20089	
1N3086	200	150 150	2850	3000	1.20 470	0.25	(15)	20089	
1N3087	300	150 150	2850	3000	1.20 470	0.25	(15)	20089	
1N3088	400	150 150	2850	3000	1.20 470	0.25	(15)	20089	
1N3089	500	150 150	2850	3000	1.20 470	0.25	(15)	20089	
1N3090	600	150 150	2850	3000	1.20 470	0.25	(15)	20089	
1N3091	800	150 150	2850	3000	1.20 470	0.25	(15)	20089	
1N3092	1000	150 150	2850	3000	1.20 470	0.25	(15)	20089	
150L5A	50	150 150	3000	3140	1.33 470	0.25	(6)(10)(14)	20088	
150L10A	100	150 150	3000	3140	1.33 470	0.25	(6)(10)(14)	20088	
150L20A	200	150 150	3000	3140	1.33 470	0.25	(6)(10)(14)	20088	
150L40A	400	150 150	3000	3140	1.33 470	0.25	(6)(10)(14)	20088	
150L60A	600	150 150	3000	3140	1.33 470	0.25	(6)(10)(14)	20088	
150L80A	800	150 150	3000	3140	1.33 470	0.25	(6)(10)(14)	20088	
150L100A	1000	150 150	3000	3140	1.33 470	0.25	(6)(10)(14)	20088	
45L10	100	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	
45L20	200	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	
45L40	400	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	
45L60	600	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	
45L80	800	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	
45L100	1000	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	
45L120	1200	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	
45L160	1600	150 150	3000	3140	1.33 470	0.25	(6)(10)	20088	

(1) See page 105 for Case Outline information

(2) Tj = Tj max; 100% V_{RRM} re-applied

(6) V_{FM} measured at Tj = 25°C

(8) Cathode to stud. To order anode to stud, append 'R' to part letters, e.g. 1N3291**R**A, 130HF**R**40PV

(10) Available with metric stud. To order, add 'M' to part number, e.g. 150K5A**M**.

(12) 1N3288 series also available.

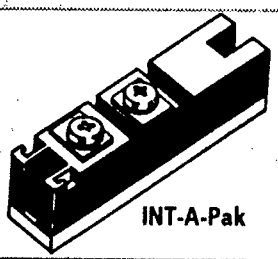
(13) 100% V_{RRM} re-applied.

(14) Available with stud top case or flag terminal. To order s case, add 2 to second digit of part number, e.g. 15**2**L5A. To flag terminal, add 4 to second digit of part number, e.g. 15**4**

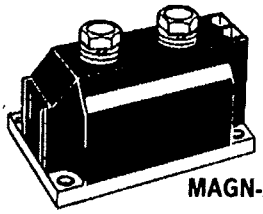
(15) V_{FM} measured at Tj = Tj max

Part Number	V_{RRM} (V)	$I_{F(AV)}$ @ T_C (A) (°C)	I_{FSM} (23) 50 Hz (A)	I_{FSM} (23) 60 Hz (A)	V_{FM} (24) (V)	R_{thJC} DC (21) (K/W)	Notes	Fax-on-Demand Number	Case Style, (Case Outline) (1)
Power Modules - Diode									
T40HF10	100	40 85	480	500	1.30	1.36	(22)	20094	T-MODULE (M3)
T40HF20	200	40 85	480	500	1.30	1.36	(22)	20094	
T40HF40	400	40 85	480	500	1.30	1.36	(22)	20094	
T40HF60	600	40 85	480	500	1.30	1.36	(22)	20094	
T40HF80	800	40 85	480	500	1.30	1.36	(22)	20094	
T40HF100	1000	40 85	480	500	1.30	1.36	(22)	20094	
T40HF120	1200	40 85	480	500	1.30	1.36	(22)	20094	
T40HF140	1400	40 85	480	500	1.30	1.36	(22)	20094	
T40HF160	1600	40 85	480	500	1.30	1.36	(22)	20094	
T70HF10	100	70 85	1000	1050	1.35	0.69	(22)	20094	
T70HF20	200	70 85	1000	1050	1.35	0.69	(22)	20094	
T70HF40	400	70 85	1000	1050	1.35	0.69	(22)	20094	
T70HF60	600	70 85	1000	1050	1.35	0.69	(22)	20094	
T70HF80	800	70 85	1000	1050	1.35	0.69	(22)	20094	
T70HF100	1000	70 85	1000	1050	1.35	0.69	(22)	20094	
0HF120	1200	70 85	1000	1050	1.35	0.69	(22)	20094	
T70HF140	1400	70 85	1000	1050	1.35	0.69	(22)	20094	
T70HF160	1600	70 85	1000	1050	1.35	0.69	(22)	20094	
T85HF10	100	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF20	200	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF40	400	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF60	600	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF80	800	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF100	1000	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF120	1200	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF140	1400	85 85	1450	1500	1.27	0.62	(22)	20094	
T85HF160	1600	85 85	1450	1500	1.27	0.62	(22)	20094	
T110HF10	100	110 85	1700	1780	1.35	0.47	(22)	20094	
T110HF20	200	110 85	1700	1780	1.35	0.47	(22)	20094	
T110HF40	400	110 85	1700	1780	1.35	0.47	(22)	20094	
T110HF60	600	110 85	1700	1780	1.35	0.47	(22)	20094	
T110HF80	800	110 85	1700	1780	1.35	0.47	(22)	20094	
T110HF100	1000	110 85	1700	1780	1.35	0.47	(22)	20094	
T110HF120	1200	110 85	1700	1780	1.35	0.47	(22)	20094	
T110HF140	1400	110 85	1700	1780	1.35	0.47	(22)	20094	
10HF160	1600	110 85	1700	1780	1.35	0.47	(22)	20094	
IRKE56/04	400	55 100	1350	1420	1.35	0.65	(22)	27140	ADD-A-Pak (M4)
IRKE56/06	600	55 100	1350	1420	1.35	0.65	(22)	27140	
IRKE56/08	800	55 100	1350	1420	1.35	0.65	(22)	27140	
IRKE56/10	1000	55 100	1350	1420	1.35	0.65	(22)	27140	
IRKE56/12	1200	55 100	1350	1420	1.35	0.65	(22)	27140	
IRKE56/14	1400	55 100	1350	1420	1.35	0.65	(22)	27140	
IRKE56/16	1600	55 100	1350	1420	1.35	0.65	(22)	27140	
IRKE71/04	400	70 100	1500	1570	1.30	0.57	(22)	27140	

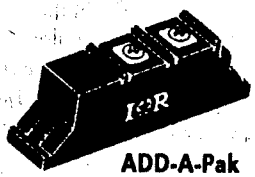
T-Module



INT-A-Pak



MAGN-A-Pak

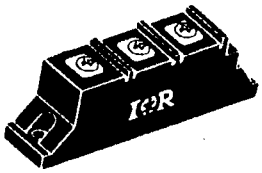


ADD-A-Pak

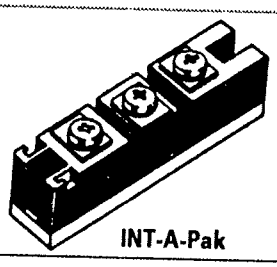
UL RECOGNIZED
File no. E78996

Diodes

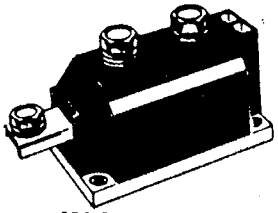
PART NUMBER													
Doubler	Center Tap » Common Cathode	Center Tap » Common Anode	V_{RRM} (V)	$I_{F(AV)}$ @ T_C (A)	($^\circ$C)	I_{FSM} (23) 50 Hz (A)	60 Hz (A)	(24) V_{FM} (V)	(21) R_{thJC} DC (K/W)	Notes	Fax-on-Demand Number	Case Style, (Case Ou (1)
Power Modules - Diode/Diode												
IRKD56/04	IRKC56/04	IRKJ56/04	400	60	100	1350	1420	1.35	0.325	(22)	27140	ADD-A-Pak (M
IRKD56/06	IRKC56/06	IRKJ56/06	600	60	100	1350	1420	1.35	0.325	(22)	27140	
IRKD56/08	IRKC56/08	IRKJ56/08	800	60	100	1350	1420	1.35	0.325	(22)	27140	
IRKD56/10	IRKC56/10	IRKJ56/10	1000	60	100	1350	1420	1.35	0.325	(22)	27140	
IRKD56/12	IRKC56/12	IRKJ56/12	1200	60	100	1350	1420	1.35	0.325	(22)	27140	
IRKD56/14	IRKC56/14	IRKJ56/14	1400	60	100	1350	1420	1.35	0.325	(22)	27140	
IRKD56/16	IRKC56/16	IRKJ56/16	1600	60	100	1350	1420	1.35	0.325	(22)	27140	
IRKD71/04	IRKC71/04	IRKJ71/04	400	80	100	1500	1570	1.30	0.285	(22)	27140	
IRKD71/06	IRKC71/06	IRKJ71/06	600	80	100	1500	1570	1.30	0.285	(22)	27140	
IRKD71/08	IRKC71/08	IRKJ71/08	800	80	100	1500	1570	1.30	0.285	(22)	27140	
IRKD71/10	IRKC71/10	IRKJ71/10	1000	80	100	1500	1570	1.30	0.285	(22)	27140	
IRKD71/12	IRKC71/12	IRKJ71/12	1200	80	100	1500	1570	1.30	0.285	(22)	27140	
IRKD71/14	IRKC71/14	IRKJ71/14	1400	80	100	1500	1570	1.30	0.285	(22)	27140	
IRKD71/16	IRKC71/16	IRKJ71/16	1600	80	100	1500	1570	1.30	0.285	(22)	27140	
IRKD91/04	IRKC91/04	IRKJ91/04	400	100	100	1700	1780	1.30	0.22	(22)	27141	
IRKD91/06	IRKC91/06	IRKJ91/06	600	100	100	1700	1780	1.30	0.22	(22)	27141	
IRKD91/08	IRKC91/08	IRKJ91/08	800	100	100	1700	1780	1.30	0.22	(22)	27141	
IRKD91/10	IRKC91/10	IRKJ91/10	1000	100	100	1700	1780	1.30	0.22	(22)	27141	
IRKD91/12	IRKC91/12	IRKJ91/12	1200	100	100	1700	1780	1.30	0.22	(22)	27141	
IRKD91/14	IRKC91/14	IRKJ91/14	1400	100	100	1700	1780	1.30	0.22	(22)	27141	
IRKD91/16	IRKC91/16	IRKJ91/16	1600	100	100	1700	1780	1.30	0.22	(22)	27141	
IRKD166-04	IRKC166-04	IRKJ166-04	400	165	100	3350	3500	1.69	0.10	(25)(26)	87096	INT-A-Pak (M
IRKD166-08	IRKC166-08	IRKJ166-08	800	165	100	3350	3500	1.69	0.10	(25)(26)	87096	
IRKD166-12	IRKC166-12	IRKJ166-12	1200	165	100	3350	3500	1.69	0.10	(25)(26)	87096	
IRKD166-16	IRKC166-16	IRKJ166-16	1600	165	100	3350	3500	1.69	0.10	(25)(26)	87096	
IRKD166-20	IRKC166-20	IRKJ166-20	2000	165	100	3350	3500	1.69	0.10	(25)(26)	87096	
IRKD196-04	IRKC196-04	IRKJ196-04	400	195	100	4000	4200	1.38	0.10	(25)(26)	87096	
IRKD196-08	IRKC196-08	IRKJ196-08	800	195	100	4000	4200	1.38	0.10	(25)(26)	87096	
IRKD196-12	IRKC196-12	IRKJ196-12	1200	195	100	4000	4200	1.38	0.10	(25)(26)	87096	
IRKD196-16	IRKC196-16	IRKJ196-16	1600	195	100	4000	4200	1.38	0.10	(25)(26)	87096	
IRKD196-20	IRKC196-20	IRKJ196-20	2000	195	100	4000	4200	1.38	0.10	(25)(26)	87096	
IRKD196-24	IRKC196-24	IRKJ196-24	2400	195	100	4000	4200	1.38	0.10	(25)(26)	87096	
IRKD236-04	IRKC236-04	IRKJ236-04	400	230	100	5500	5700	1.27	0.085	(25)(26)	87096	
IRKD236-08	IRKC236-08	IRKJ236-08	800	230	100	5500	5700	1.27	0.085	(25)(26)	87096	
IRKD236-12	IRKC236-12	IRKJ236-12	1200	230	100	5500	5700	1.27	0.085	(25)(26)	87096	
IRKD236-16	IRKC236-16	IRKJ236-16	1600	230	100	5500	5700	1.27	0.085	(25)(26)	87096	
IRKD236-20	IRKC236-20	IRKJ236-20	2000	230	100	5500	5700	1.27	0.085	(25)(26)	87096	
IRKD236-22	IRKC236-22	IRKJ236-22	2200	230	100	5500	5700	1.27	0.085	(25)(26)	87096	
IRKD236-24	IRKC236-24	IRKJ236-24	2400	230	100	5500	5700	1.27	0.085	(25)(26)	87096	



ADD-A-Pak



INT-A-Pak

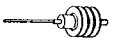
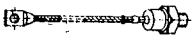
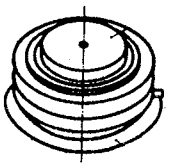


MAGN-A-Pak

UL RECOGNIZED File no. E78996

Section 8: Rectifier Diodes

Summary of Types

Type	V_{RRM} V_{RSM} V	I_{FRMS} A	I_{FAV} sin. 180 A	@T_{case} °C	I_{FSM} 10 ms 25 °C A	i^2t 10 ms 25 °C A^2s	Case		Page
SK 1	1 000 ... 1 600	3	1,15	45[1)]	60	18	E 33		B 8-5
SK 3	1 000 ... 1 600	6,7	1,8	45[1)]	180	162	E 34		
SKN 2,5	400 ... 1 600	5	2,5	45[1)]	180	160	E 5		B 8-9
SKN 5	200 ... 1 600	10	5	45[1)]	190	180	E 6		
SKN 20 **SKR 20**	200 ... 1 600	40	20	125	375	700	E 9		B 8-13
SKN 26 **SKR 26**	200 ... 1 600	40	20	125	375	700	E 8		
SKN 45 **SKR 45**	200 ... 1 600	80	45	125	700	2 500	E 12		B 8-17
SKN 70 **SKR 70**	200 ... 1 600	150	70	125	1 150	6 600	E 12		
SKN 71 **SKR 71**	200 ... 1 600	150	70	125	1 150	6 600	E 11		
SKN 100 **SKR 100**	200 ... 1 800	200	100	125	1 750	15 000	E 13		B 8-21
SKN 130 **SKR 130**	200 ... 1 800	260	130	125	2 500	31 000	E 14		
SKN 240 **SKR 240**	200 ... 1 800	500	240	125	6 000	180 000	E 15		B 8-25
SKN 320 **SKR 320**	200 ... 1 600	700	320	125	9 000	400 000	E 16		
SKN 400	1 800 ... 3 000	700	400	100	9 000	400 000	E 17		
SKN 450	1 800 ... 2 200		450	95	6 000	180 000	E 18		B 8-29
SKN 501	400 ... 1 800		500	125	7 000	245 000	E 18		
SKN 870	400 ... 2 400		870	105	13 000	850 000	E 19		B 8-33
SKN 1500	400 ... 2 900		1 500	78	19 000	$1,8 \cdot 10^6$	E 20		
SKN 2000	600 ... 2 400		2 000	75	30 000	$4,5 \cdot 10^6$	E 21		B 8-37
SKN 3000	2 200 ... 3 600		3 100	75	38 500	$7,4 \cdot 10^6$	E 37		
SKN 3400	1 200 ... 1 800		3 425	75	51 500	$13,25 \cdot 10^6$	E 37		
SKN 4000	200 ... 600	6 300	4 000	50	60 000	$18 \cdot 10^6$	E 22		

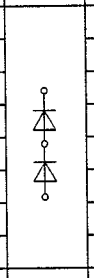
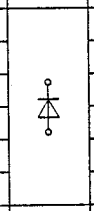
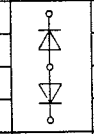
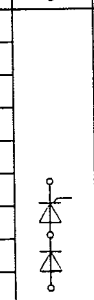
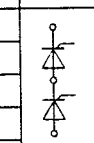
1) T_{amb}

SKN
(Anode to stud)

SKR
(Cathode to stud)

continued next page

Section 1: SEMIPACK® Thyristor/Diode Modules
Summary of Types

Type	Circuit	V_{DRM} V_{RRM}	I_{TRMS} I_{FRMS}	I_{TAV} @ T_{case} I_{FAV}		I_{TSM} I_{FSM} 25 °C; 10 ms	i^2t	T_{vj} max.	R_{thjc} sin. 180	Page
• New type		V	A	A	°C	A	A^2s	°C	°C	
SKKD 15		600 ... 1600	28	15	82	320	510	126	2,0	B 1 - 7
SKKD 26		1200 ... 1600	60	31	85	550	1 500	125	1,0	
SKKD 46		400 ... 1800	90	45	86	700	2 450	125	0,60	B 1 - 11
SKKD 81		400 ... 2200	140	80	87	2 000	20 000	125	0,40	
SKKD 100		400 ... 1800	175	100	85	2 500	31 250	125	0,35	B 1 - 15
SKKD 162		800 ... 2200	250	160	95	6 000	180 000	135	0,18	
SKKD 201		800 ... 2200	315	200	85	6 000	180 000	130	0,19	B 1 - 21
SKKD 260		800 ... 2200	410	260	85	11 000	605 000	130	0,14	
SKKE 15		400 ... 1600	28	15	82	320	510	125	2,0	B 1 - 7
SKKE 81		400 ... 2200	140	80	87	2 000	20 000	125	0,40	B 1 - 11
SKKE 162		800 ... 2200	250	160	95	6 000	180 000	135	0,18	B 1 - 15
SKKE 201		800 ... 2200	315	200	85	6 000	180 000	130	0,19	B 1 - 21
SKKE 260		1200 ... 2200	410	260	85	11 000	605 000	130	0,14	
• SKKE 400		1200 ... 2400	825	525	85	12 000	720 000	150	0,090	B 1 - 25
• SKMD 100		400 ... 1800	175	100	85	2 500	31 250	125	0,35	B 1 - 15
• SKMD 260		800 ... 2200	410	260	85	11 000	605 000	130	0,14	B 1 - 21
• SKND 46		400 ... 1800	90	45	86	700	2 450	125	0,60	B 1 - 11
• SKND 81		400 ... 2200	140	80	87	2 000	20 000	125	0,40	
• SKND 162		800 ... 2200	250	160	95	6 000	180 000	135	0,18	B 1 - 15
SKND 165		400 ... 1200	350	220	100	5 000	125 000	150	0,15	B 1 - 19
SKKH 15		400 ... 1600	28	15	75	320	510	125	1,7	B 1 - 27
SKKH 26, 27		400 ... 1600	50	25	85	550	1 500	125	0,95	B 1 - 39
SKKH 41, 42		400 ... 1800	75	40	85	1 000	5 000	125	0,69	B 1 - 43
SKKH 56, 57		400 ... 2200	95	55	80	1 500	11 000	125	0,60	B 1 - 47
SKKH 71, 72		800 ... 2200	125	70	85	1 600	13 000	125	0,37	B 1 - 51
SKKH 91, 92		400 ... 1800	150	95	85	2 000	20 000	125	0,30	B 1 - 55
SKKH 105, 106		400 ... 1800	180	106	85	2 250	25 000	130	0,30	B 1 - 59
SKKH 131		800 ... 2200	240	130	92	4 700	110 000	130	0,20	B 1 - 71
SKKH 132		800 ... 2200	220	130	87	4 700	110 000	125	0,19	B 1 - 65
SKKH 162		800 ... 1800	250	160	83	5 400	145 000	125	0,18	
SKKH 161		800 ... 1800	270	160	85	5 400	145 000	130	0,20	B 1 - 71
• SKKH 210		1200 ... 2200	350	220	88	8 500	361 000	130	0,15	B 1 - 77
• SKKH 213		1200 ... 2200	370	230	85	8 500	361 000	130	0,115	B 1 - 83
SKKH 250		1200 ... 2200	420	250	85	9 000	405 000	130	0,15	B 1 - 77
• SKKH 253		800 ... 1800	420	250	85	9 000	405 000	130	0,115	B 1 - 83
• SKKL 42		400 ... 1800	75	40	85	1 000	5 000	125	0,69	B 1 - 43
• SKKL 92		400 ... 1800	150	95	85	2 000	20 000	125	0,30	B 1 - 55
SKKT 15		400 ... 1600	28	15	75	320	510	125	1,7	B 1 - 27
SKKT 19, 20, 20 B		600 ... 1600	40	18	85	320	510	125	1,3	B 1 - 35
SKKT 26, 27, 27 B		600 ... 1600	50	25	85	550	1 500	125	0,95	B 1 - 39
SKKT 41, 42, 42 B		600 ... 2200	75	40	85	1 000	5 000	125	0,69	B 1 - 43
SKKT 56, 57, 57 B		600 ... 2200	95	55	80	1 500	11 000	125	0,60	B 1 - 47

continued next page

SKB 26

V_{RSM}, V_{RRM} V	V_{VRMS} V	I_D = 18 A (T_c = 75 °C) Types	C_{max} µF	R_{min} Ω
200	60	SKB 26/02		0,15
400	125	SKB 26/04		0,3
600	185	SKB 26/06		0,4
800	250	SKB 26/08		0,5
1000	310	SKB 26/10		0,65
1200	380	SKB 26/12		0,75
1400	440	SKB 26/14		0,9
1600	500	SKB 26/16		1

Power Bridge Rectifiers

SKB 26

Features

- Square plastic case with isolated metal base plate and wire leads
- Ideal for printed circuit boards
- Blocking voltage up to 1600 V
- High surge currents
- Notch moulded in casing for easy polarity identification
- Easy chassis mounting

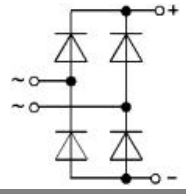
Typical Applications*

- Single phase rectifiers for power supplies
- Input rectifiers for variable frequency drives
- Rectifiers for DC motor field supplies
- Battery charge rectifiers
- Recommended snubber network: RC: 0.1 µF, 50 Ω (P_R = 1 W)

1) Soldered directly onto a p.c.b. of 100 x 160 mm with tinned tracking of min. 2.5 mm

2) Mounted on a painted metal sheet of min. 250 x 250 x 1 mm

Symbol	Conditions	Values	Units
I_D	T_a = 45 °C, isolated[1)]	3,5	A
	T_a = 45 °C, chassis[2)]	10	A
I_{DCL}	T_a = 45 °C, isolated[1)]	3	A
	T_a = 45 °C, chassis[2)]	9,5	A
	T_a = 45 °C, P1A/120	14	A
I_{FSM}	T_{vj} = 25 °C, 10 ms	370	A
	T_{vj} = 150 °C, 10 ms	320	A
i^2t	T_{vj} = 25 °C, 8,3 ... 10 ms	680	A²s
	T_{vj} = 150 °C, 8,3 ... 10 ms	500	A²s
V_F	T_{vj} = 25°C, I_F = 150 A	max. 2,2	V
$V_{(TO)}$	T_{vj} = 150°C	max. 0,85	V
r_T	T_{vj} = 150°C	max. 12	mΩ
I_{RD}	T_{vj} = 25°C, V_{RD}=V_{RRM}	300	µA
	T_{vj} = °C, V_{RD}=V_{RRM} ≥ V		µA
I_{RD}	T_{vj} = 150°C, V_{RD}=V_{RRM}	5	mA
	T_{vj} = °C, V_{RD}=V_{RRM} ≥ V		mA
t_{rr}	T_{vj} = 25°C	10	µs
f_G		2000	Hz
$R_{th(j-a)}$	isolated[1)]	15	K/W
	chassis[2)]	4,7	K/W
$R_{th(j-c)}$	total	1,9	K/W
$R_{th(c-s)}$	total	0,15	K/W
T_{vj}		- 40 ... + 150	°C
T_{stg}		- 55 ... + 150	°C
V_{isol}	a. c. 50 ... 60 Hz; r.m.s.; 1 s / 1 min.	3000 / 2500	V~
M_s	to heatsink	2 ± 15 %	Nm
M_t			Nm
a			m/s²
w		20	g
Fu		20	A
Case		G 50a	



SKB

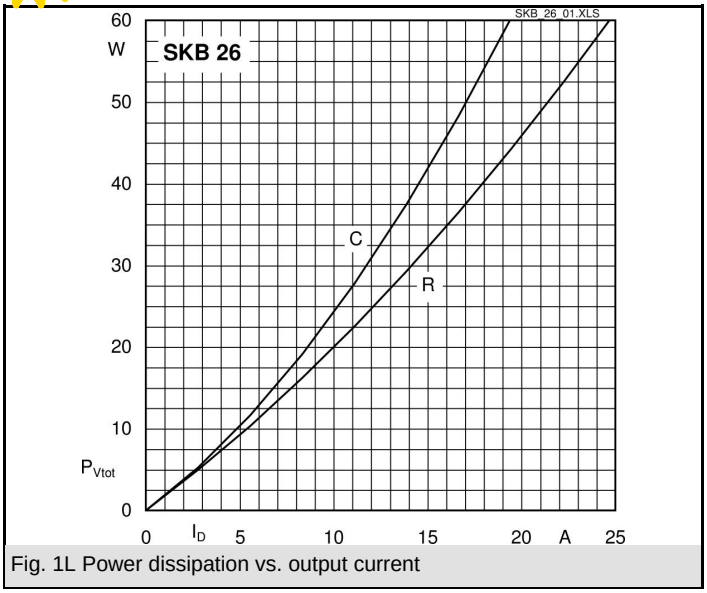


Fig. 1L Power dissipation vs. output current

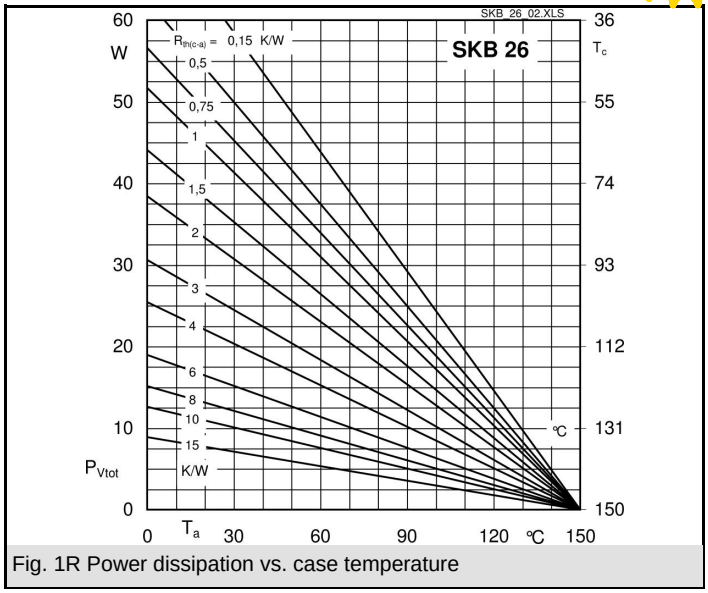


Fig. 1R Power dissipation vs. case temperature

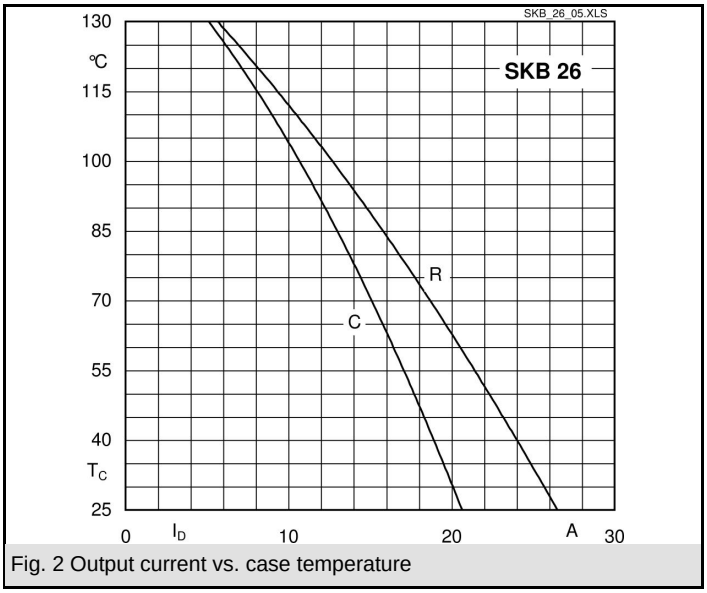


Fig. 2 Output current vs. case temperature

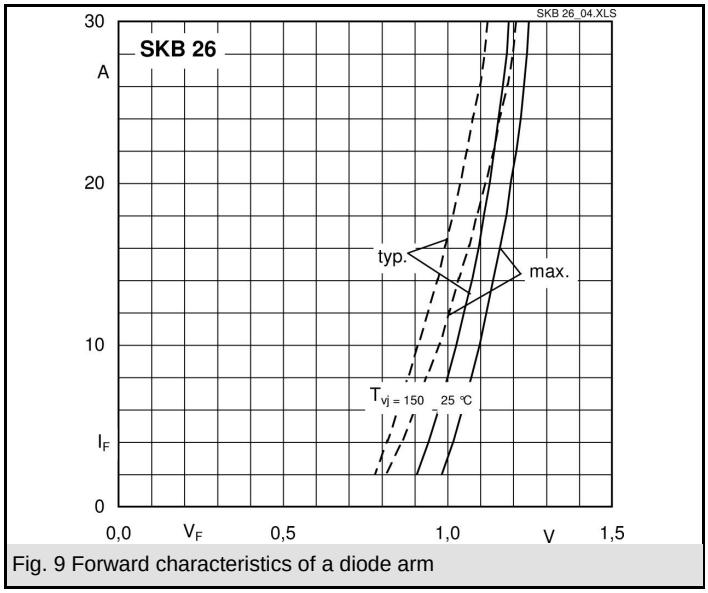
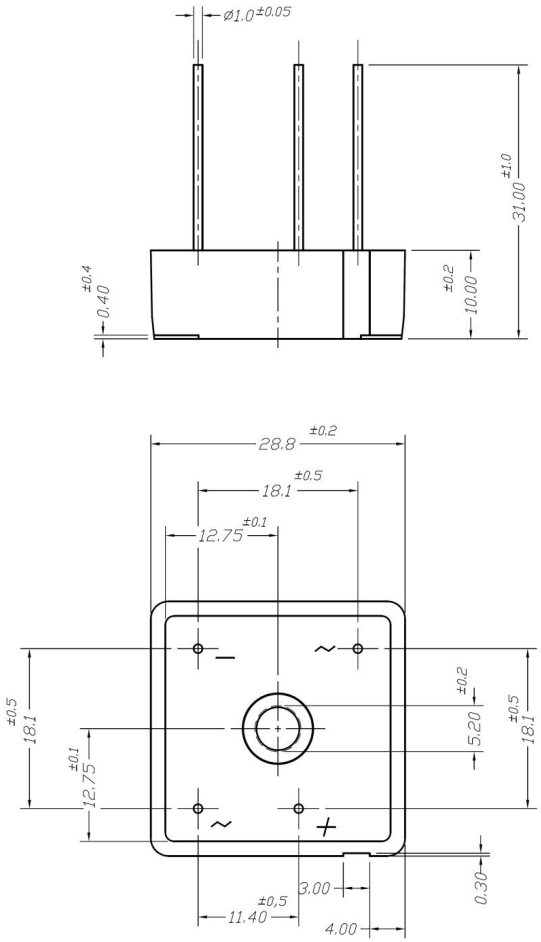


Fig. 9 Forward characteristics of a diode arm

Dimensions



Case G 50a

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our personal.

V_{RRM}	=	2500 V
I_{FAVM}	=	420 A
I_{FSM}	=	8.5 kA
V_{F0}	=	1.7 V
r_F	=	0.62 mΩ
V_{DClink}	=	1500 V

Fast Recovery Diode

5SDF 05D2505

Doc. No. 5SYA1114-03 Sep. 01

- **Patented free-floating silicon technology**
- **Low on-state and switching losses**
- **Optimized for use as freewheeling diode in GTO converters**
- **Standard press-pack housing, hermetically cold-welded**
- **Cosmic radiation withstand rating**

Blocking

V_{RRM}	Repetitive peak reverse voltage	2500 V	Half sine wave, t_P = 10 ms, f = 50 Hz	
I_{RRM}	Repetitive peak reverse current	≤ 50 mA	$V_R = V_{RRM}$, T_j = 125°C	
V_{DClink}	Permanent DC voltage for 100 FIT failure rate	1500 V	100% Duty	Ambient cosmic radiation at sea level in open air.
V_{DClink}	Permanent DC voltage for 100 FIT failure rate	V	5% Duty	

Mechanical data (see Fig. 12)

F_m	Mounting force	min.	10 kN	
		max.	12 kN	
a	Acceleration: Device unclamped Device clamped		 50 m/s² 200 m/s²	
m	Weight		0.25 kg	
D_S	Surface creepage distance		≥ 30 mm	
D_a	Air strike distance		≥ 20 mm	

n-state (see Fig. 2, 3)

I_{FAVM}	Max. average on-state current	420 A	Half sine wave, T_c = 85°C	
I_{FRMS}	Max. RMS on-state current	670 A		
I_{FSM}	Max. peak non-repetitive surge current	8.5 kA	tp = 10 ms	Before surge: $T_c = T_j$ = 125°C After surge: $V_R \approx 0$ V
		27 kA	tp = 1 ms	
$\int I^2dt$	Max. surge current integral	$0.36 \cdot 10^6$ A^2s	tp = 10 ms	
		$0.36 \cdot 10^6$ A^2s	tp = 1 ms	
V_F	Forward voltage drop	≤ 2.3 V	I_F = 1000 A	T_j = 125°C
V_{F0}	Threshold voltage	1.7 V	Approximation for	
r_F	Slope resistance	0.62 mΩ	I_F = 500…3500 A	

Turn-on (see Fig. 4, 5)

V_{fr}	Peak forward recovery voltage	≤ 16 V	di/dt = 500 A/µs, T_j = 125°C

Turn-off (see Fig. 6 to 11)

I_{rr}	Reverse recovery current	≤ 470 A	di/dt = 300 A/µs, I_F = 700 A, T_j = 125°C, V_{RM} = 2300 V, C_S = 2µF (GTO snubber circuit)
Q_{rr}	Reverse recovery charge	≤ 840 µC	
E_{rr}	Turn-off energy	≤ 0.34 J	

Thermal (see Fig. 1)

T_j	Operating junction temperature range	-40...125°C		
T_{stg}	Storage temperature range	-40...125°C		
R_{thJC}	Thermal resistance junction to case	≤ 80 K/kW	Anode side cooled	F_m = 10… 12 kN
		≤ 80 K/kW	Cathode side cooled	
		≤ 40 K/kW	Double side cooled	
R_{thCH}	Thermal resistance case to heatsink	≤ 16 K/kW	Single side cooled	
		≤ 8 K/kW	Double side cooled	

Analytical function for transient thermal impedance.

$$Z_{thJC}(t) = \sum_{i=1}^{n} R_i(1 - e^{-t/\tau_i})$$

i	1	2	3	4
R_i(K/kW)	20.95	10.57	7.15	1.33
τ_i(s)	0.396	0.072	0.009	0.0044
F_m = 10… 12 kN Double side cooled				

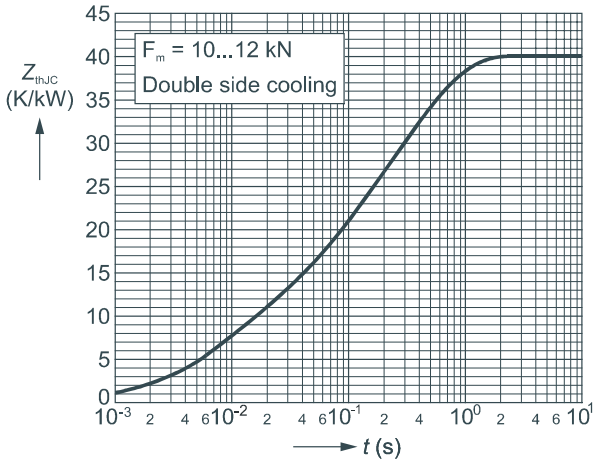


Fig. 1 Transient thermal impedance (junction-to-case) vs. time in analytical and graphical form (max. values).

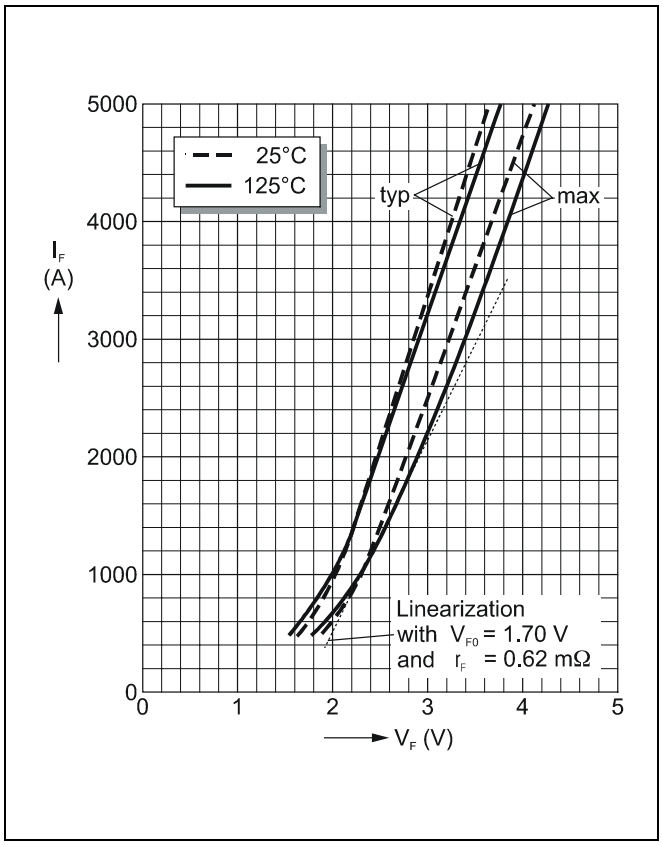


Fig. 2 Forward current vs. forward voltage (typ. and max. values) and linear approximation of max. curve at 125°C.

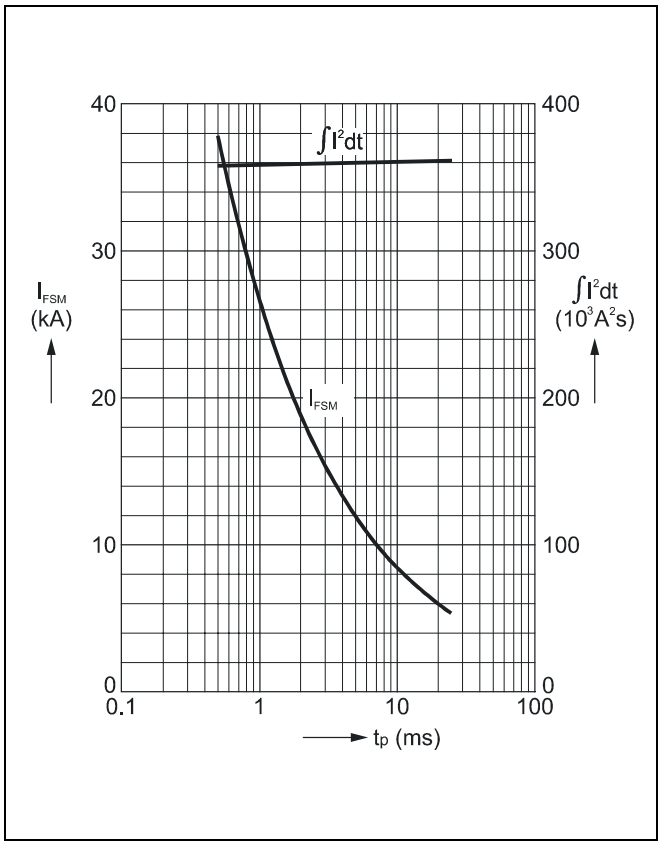


Fig. 3 Surge current and fusing integral vs. pulse width (max. values) for non-repetitive, half-sinusoidal surge current pulses.

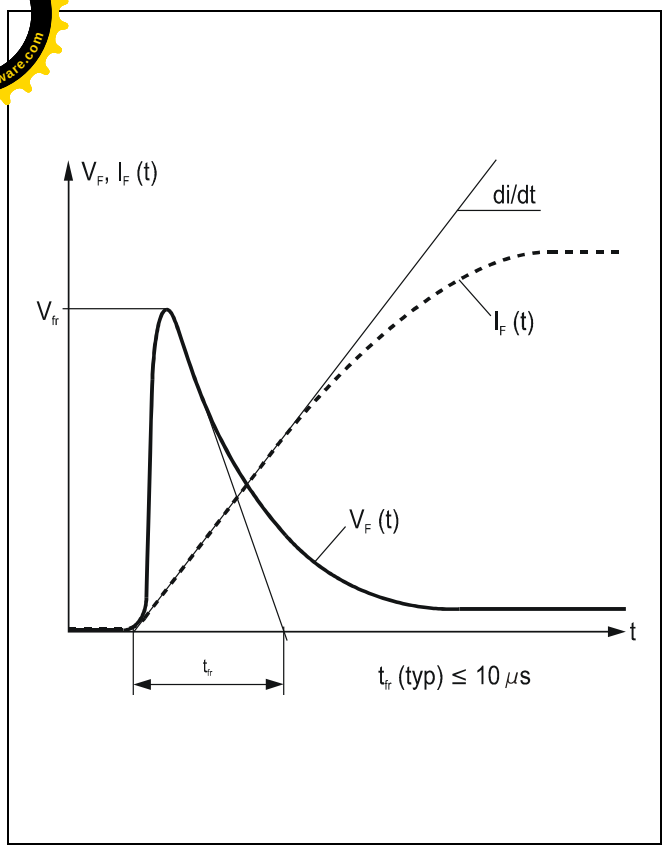


Fig. 4 Typical forward voltage waveform when the diode is turned on with a high di/dt.

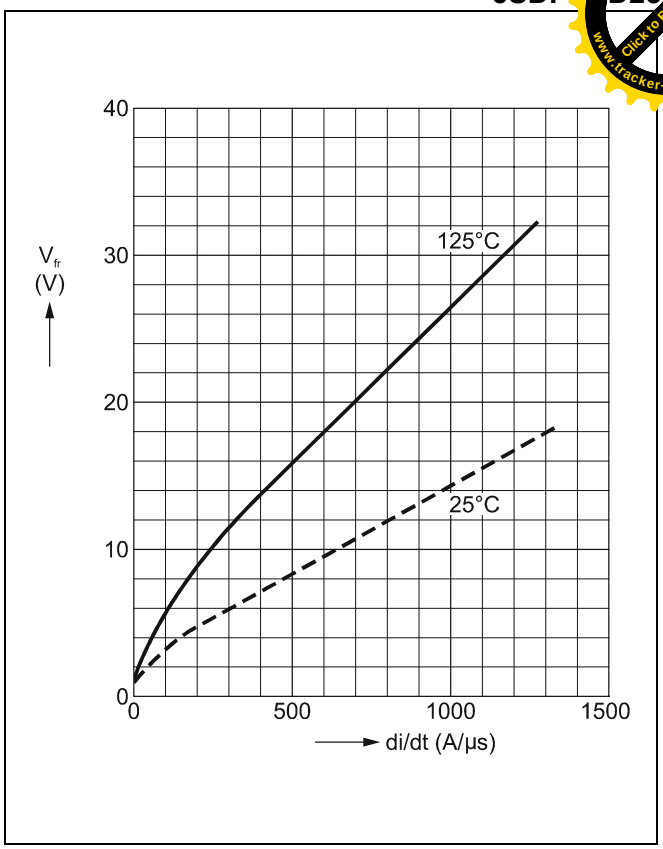


Fig. 5 Forward recovery voltage vs. turn-on di/dt (max. values).

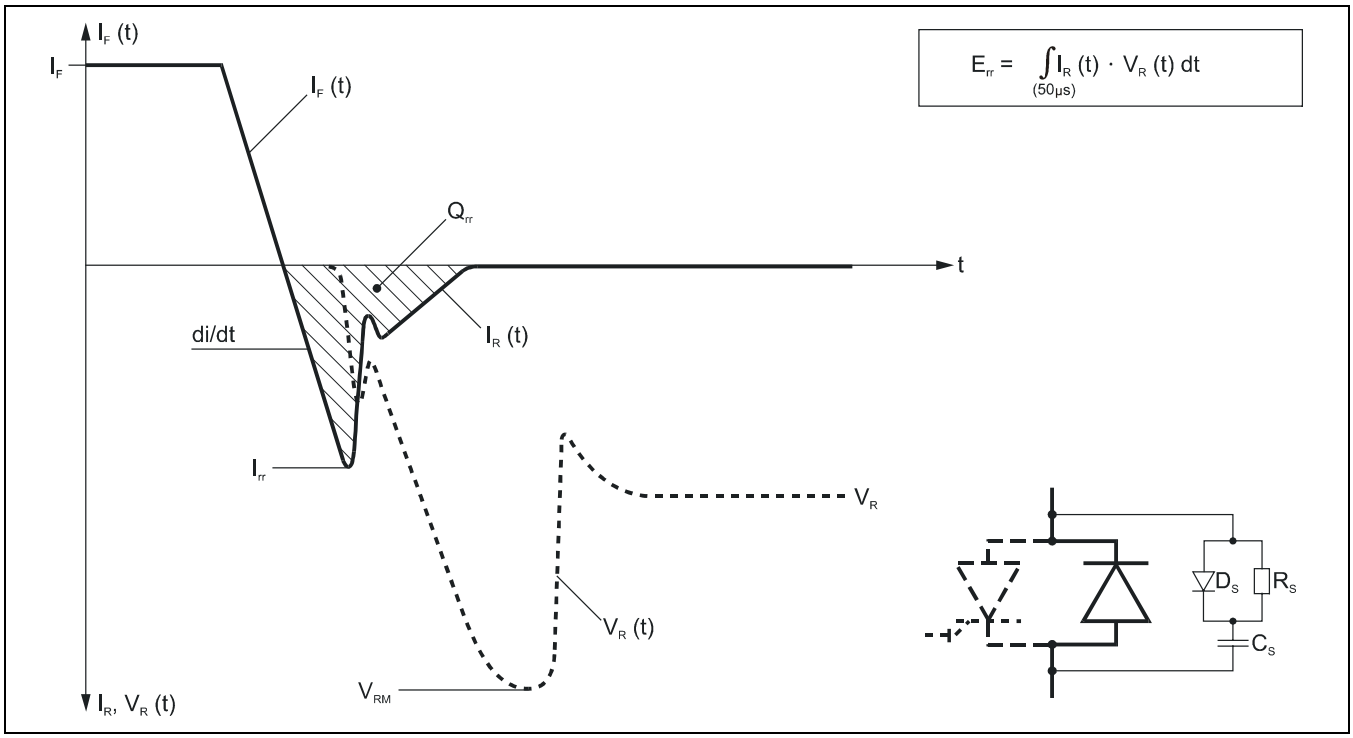


Fig. 6 Typical current and voltage waveforms at turn-off when the diode is connected to an RCD snubber, as often used in GTO circuits.

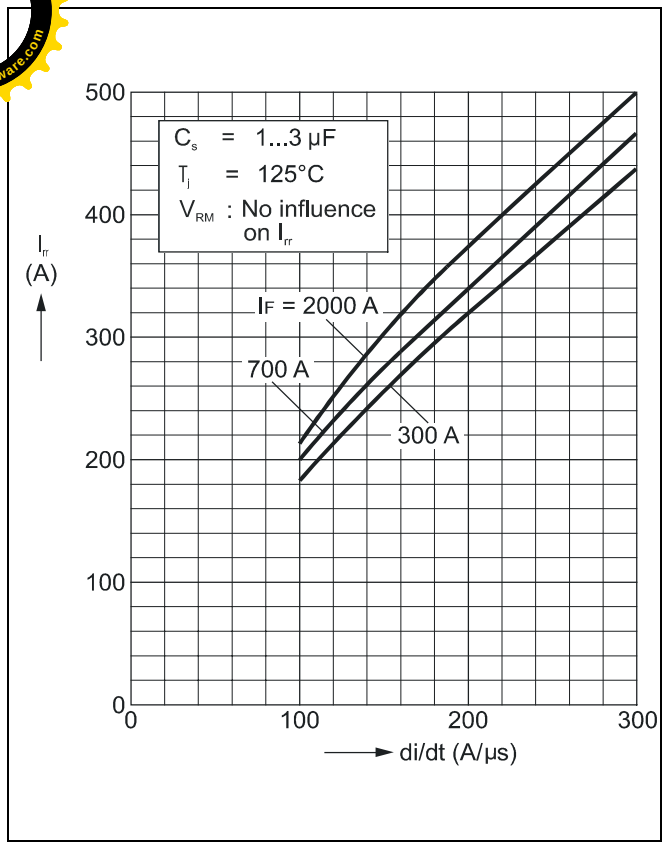


Fig. 7 Reverse recovery current vs. turn off di/dt (max. values).

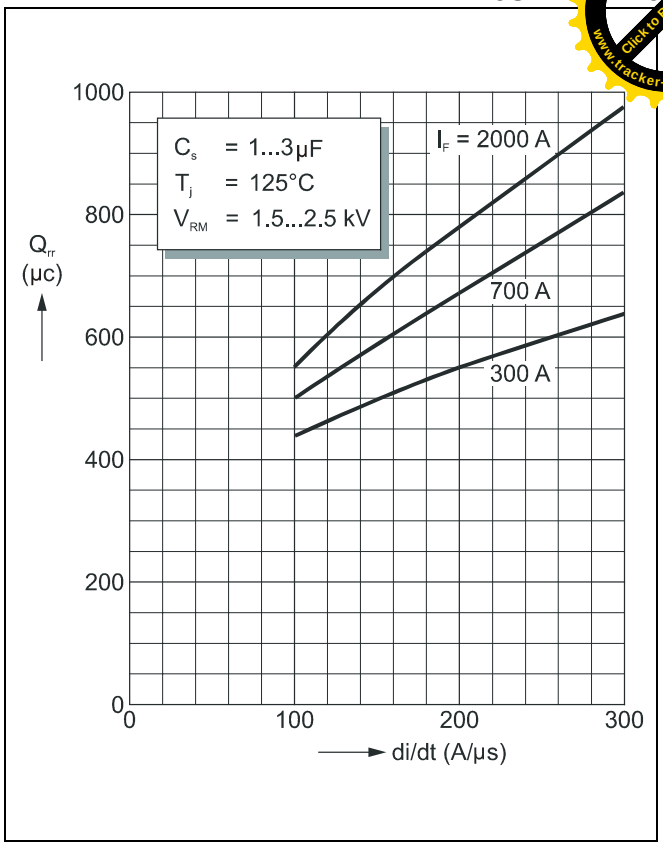


Fig. 8 Reverse recovery charge vs. turn off di/dt (max. values).

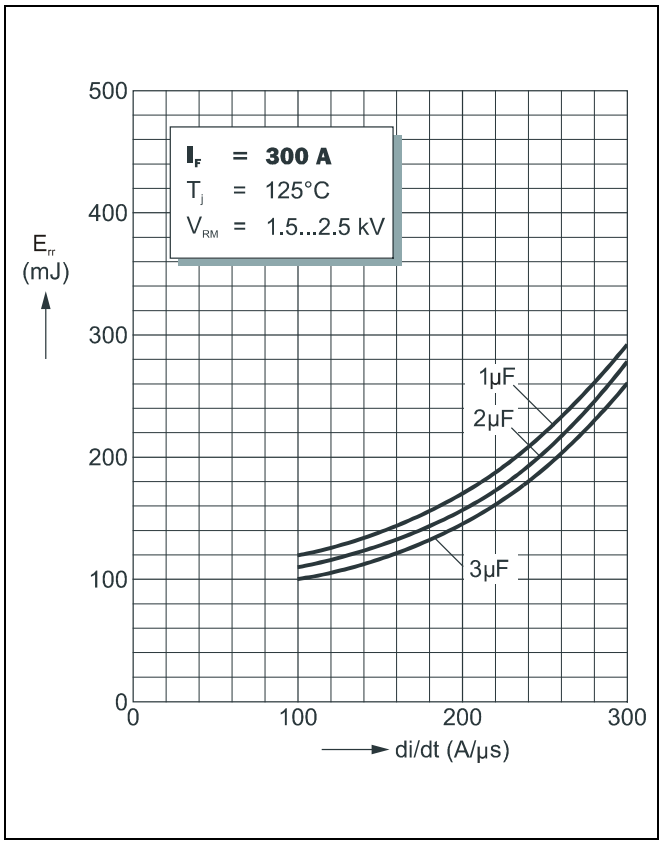


Fig. 9 Turn-off energy vs. turn-off di/dt for I_F = 300 A (max. values).

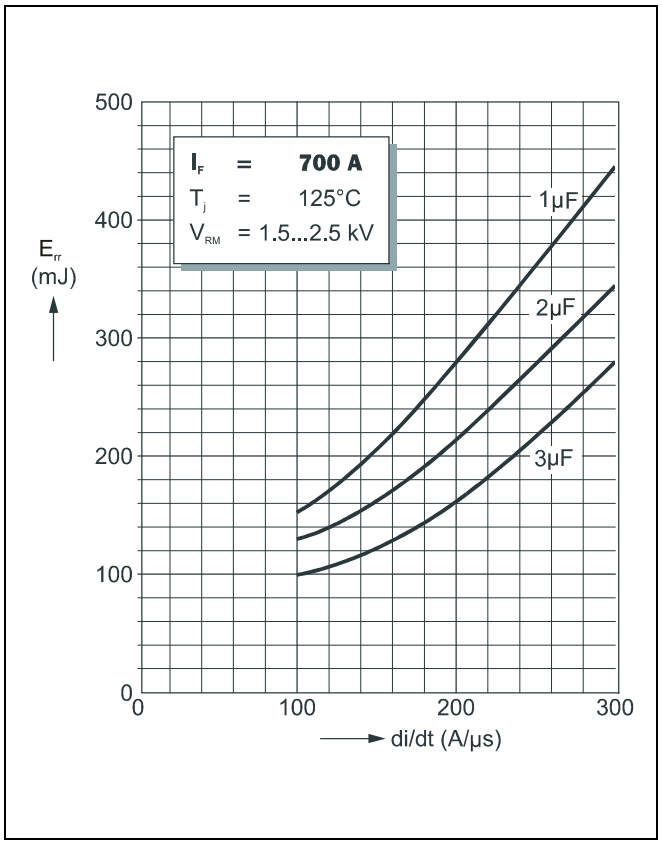


Fig. 10 Turn-off energy vs. turn-off di/dt for I_F = 700 A (max. values).

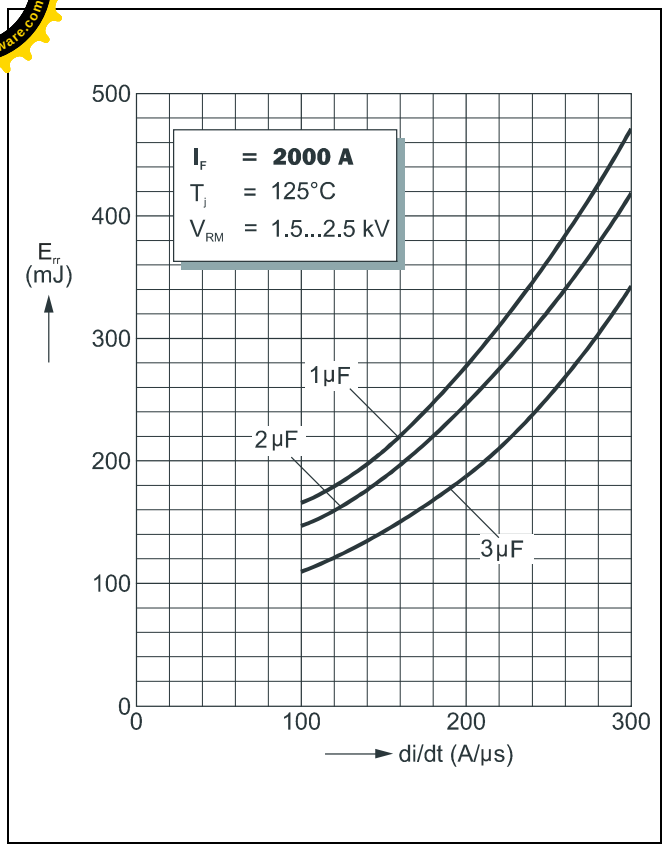


Fig. 11 Turn-off energy vs. turn-off di/dt for I_F = 2000 A (max. values).

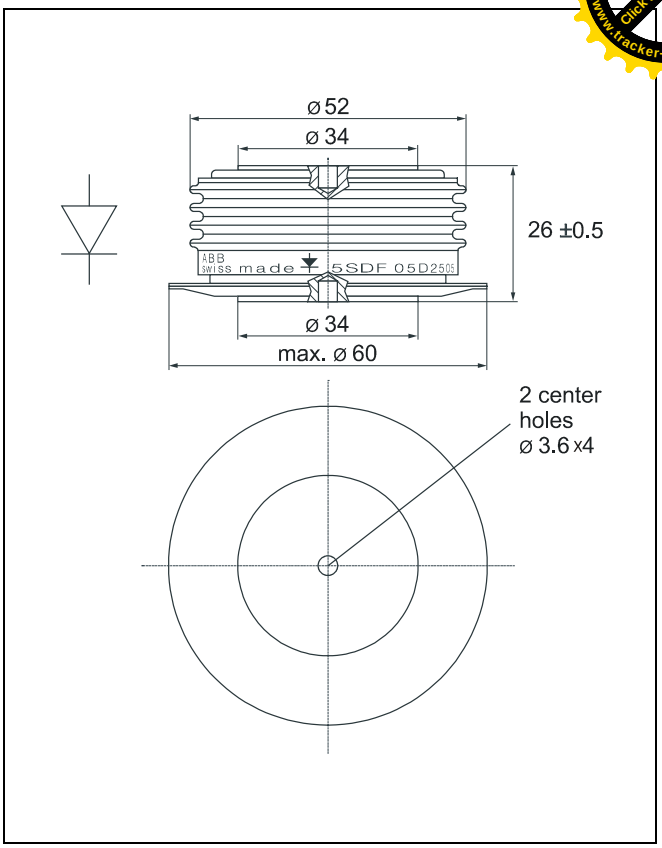


Fig. 12 Outline drawing. All dimensions are in millimeters and represent nominal values unless stated otherwise.

ABB Semiconductors AG reserves the right to change specifications without notice.

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