



# 5SDF 90Z0401

## High Frequency Housingless Welding Diode

### Properties

- High forward current capability
- Low forward and reverse recovery losses

### Applications

- Welding equipment
- High current application up to 10 kHz

### Key Parameters

$V_{RRM}$	=	400	V
$I_{FAVm}$	=	9 041	A
$I_{FSM}$	=	48 000	A
$V_{TO}$	=	0.979	V
$r_T$	=	0.032	mΩ

### Types

	$V_{RRM}$
<b>5SDF 90Z0401</b>	<b>400 V</b>
Conditions:	$T_j = -40 \div 190 \text{ }^\circ\text{C}$ , half sine waveform, $f = 50 \text{ Hz}$

### Mechanical Data

$F_m$	Mounting force	22 ÷ 50 kN
$m$	Weight	0.10 kg
$D_s$	Surface creepage distance	2 mm
$D_a$	Air strike distance	2 mm

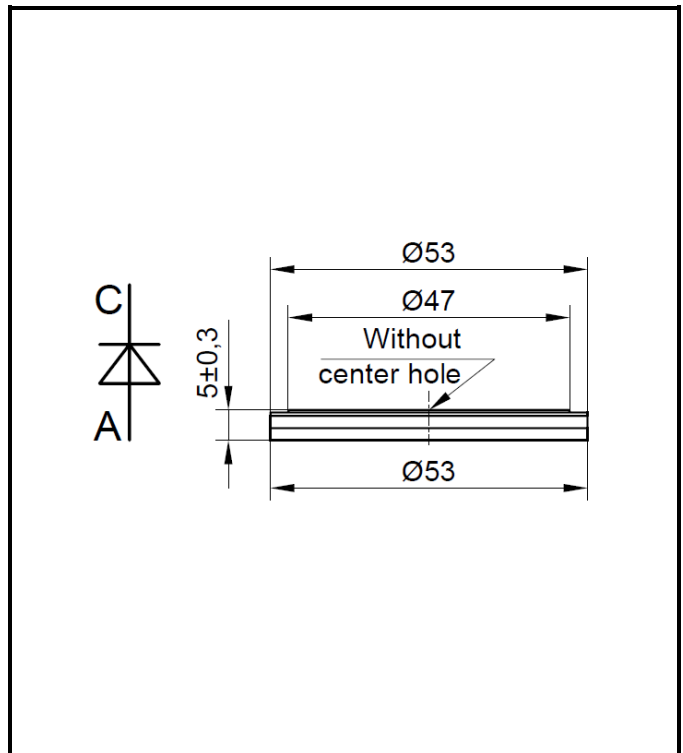


Fig. 1 Case



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<b>Maximum Ratings</b>			<b>Maximum Limits</b>	<b>Unit</b>
$V_{RRM}$	<b>Repetitive peak reverse voltage</b> $T_j = -40 \div 190 \text{ }^\circ\text{C}$		<b>400</b>	<b>V</b>
$I_{FAVM}$	<b>Average forward current</b>	$T_c = 85 \text{ }^\circ\text{C}$	<b>9 041</b>	<b>A</b>
		$T_c = 110 \text{ }^\circ\text{C}$	<b>7 440</b>	
$I_{FRMS}$	<b>RMS forward current</b>	$T_c = 85 \text{ }^\circ\text{C}$	<b>14 202</b>	<b>A</b>
		$T_c = 110 \text{ }^\circ\text{C}$	<b>11 687</b>	
$I_{RRM}$	<b>Repetitive reverse current</b> $V_R = V_{RRM}$		<b>200</b>	<b>mA</b>
$I_{FSM}$	<b>Non repetitive peak surge current</b> $V_R = 0 \text{ V}$ , half sine pulse	$t_p = 8.3 \text{ ms}$	<b>51 000</b>	<b>A</b>
		$t_p = 10 \text{ ms}$	<b>48 000</b>	
$Pt$	<b>Limiting load integral</b> $V_R = 0 \text{ V}$ , half sine pulse	$t_p = 8.3 \text{ ms}$	<b>10 911 000</b>	<b>A<sup>2</sup>s</b>
		$t_p = 10 \text{ ms}$	<b>11 520 000</b>	
$T_{jmin} - T_{jmax}$	<b>Operating temperature range</b>		<b>- 40 <math>\div</math> 190</b>	<b>°C</b>
$T_{stgmin} - T_{stgmax}$	<b>Storage temperature range</b>		<b>- 40 <math>\div</math> 190</b>	

Unless otherwise specified  $T_j = 190 \text{ }^\circ\text{C}$

<b>Characteristics</b>			<b>Value</b>			<b>Unit</b>
			<i>min</i>	<i>typ</i>	<i>max</i>	
$V_{T0}$	<b>Threshold voltage</b>				<b>0.979</b>	<b>V</b>
$r_T$	<b>Forward slope resistance</b> $I_{F1} = 7\,000 \text{ A}$ , $I_{F2} = 21\,000 \text{ A}$				<b>0.032</b>	<b>mΩ</b>
$V_{FM}$	<b>Maximum forward voltage</b>	$I_{FM} = 5\,000 \text{ A}$			<b>1.130</b>	<b>V</b>
		$I_{FM} = 8\,000 \text{ A}$			<b>1.240</b>	
$Q_{rr}$	<b>Recovered charge</b> $I_{FM} = 2\,000 \text{ A}$ , $di/dt = -30 \text{ A}/\mu\text{s}$ , $V_R = 50 \text{ V}$				<b>200</b>	<b>μC</b>

Unless otherwise specified  $T_j = 190 \text{ }^\circ\text{C}$

Thermal Parameters			Value	Unit
$R_{thjc}$	Thermal resistance junction to case	double side cooling	5.6	K/kW
		anode side cooling	7.4	
		cathode side cooling	23.5	
$R_{thch}$	Thermal resistance case to heatsink	double side cooling	3.6	K/kW
		anode side cooling	6.7	
		cathode side cooling	8.0	

**Transient Thermal Impedance**

Analytical function for transient thermal impedance

$$Z_{thjc} = \sum_{i=1}^4 R_i (1 - \exp(-t / \tau_i))$$

Conditions:  
 $F_m = 22 \div 50$  kN, Double side cooled

Correction for periodic waveforms

180° sine:	1.3 K/kW
120° sine:	1.6 K/kW
60° sine:	2.7 K/kW
180° rectangular:	1.1 K/kW
120° rectangular:	1.8 K/kW
60° rectangular:	3.0 K/kW

$i$	1	2	3	4
$\tau_i$ (s)	0.0461	0.0241	0.0045	0.0006
$R_i$ (K/kW)	3.8860	1.1830	0.3610	0.1700

Fig. 2 Dependence transient thermal impedance junction to case on square pulse

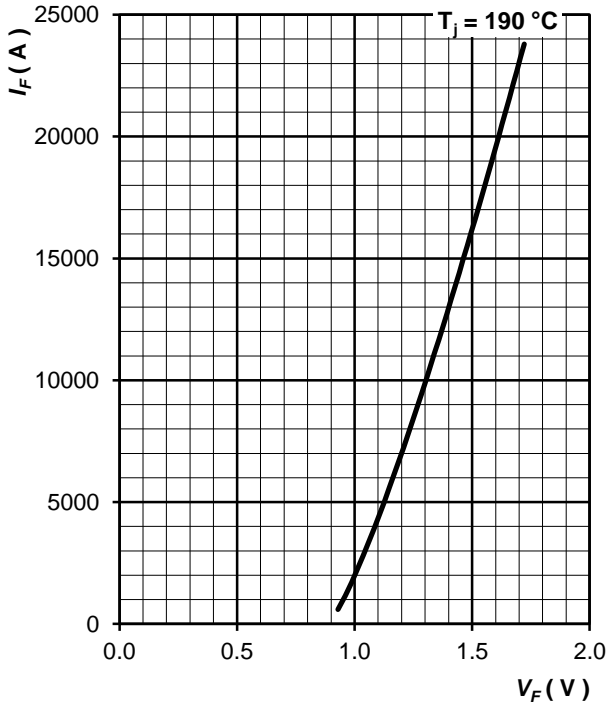


Fig. 3 Maximum forward voltage drop characteristics

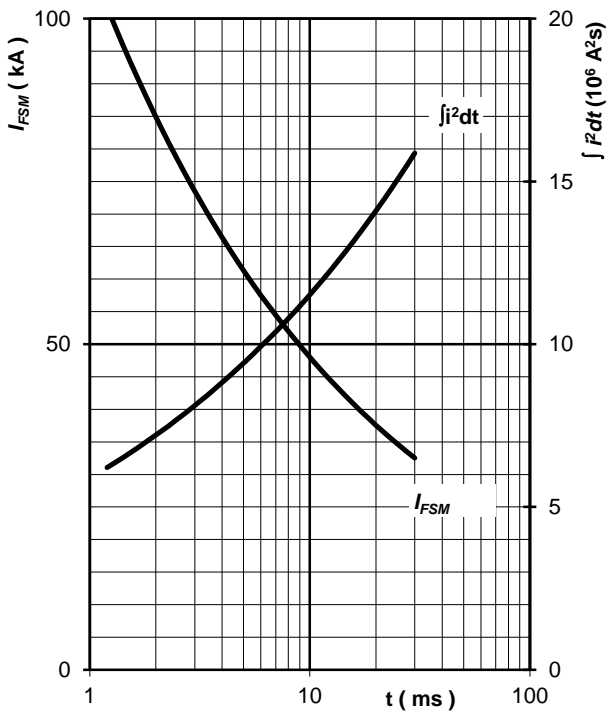


Fig. 4 Surge forward current vs. pulse length, half sine wave, single pulse,  $V_R = 0 \text{ V}$ ,  $T_j = T_{jmax}$

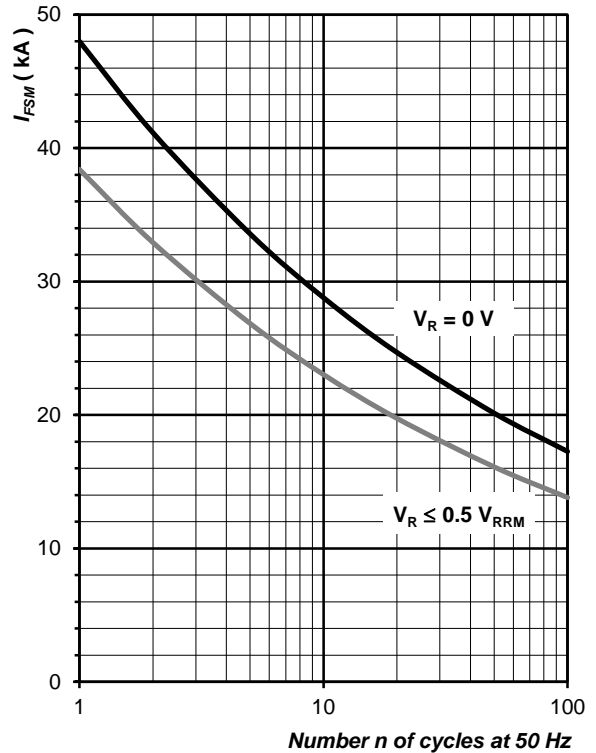


Fig. 5 Surge forward current vs. number of pulses, half sine wave,  $T_j = T_{jmax}$

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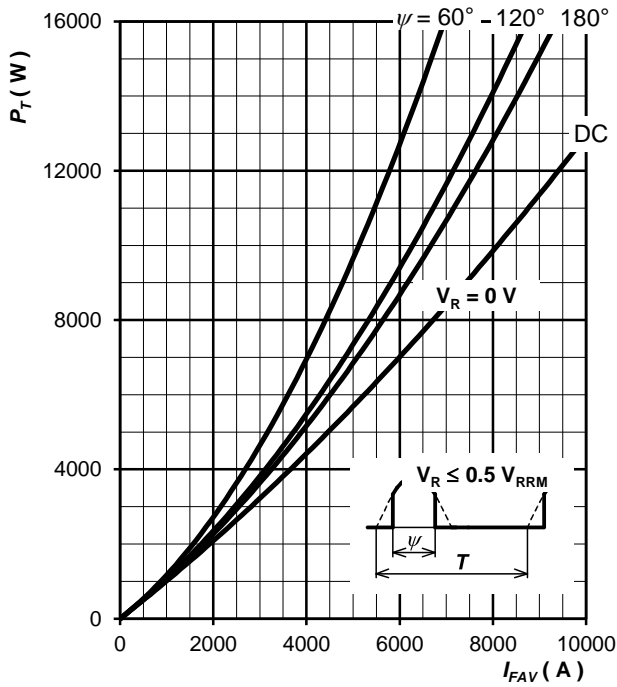


Fig. 6 Forward power loss vs. average forward current, sine waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

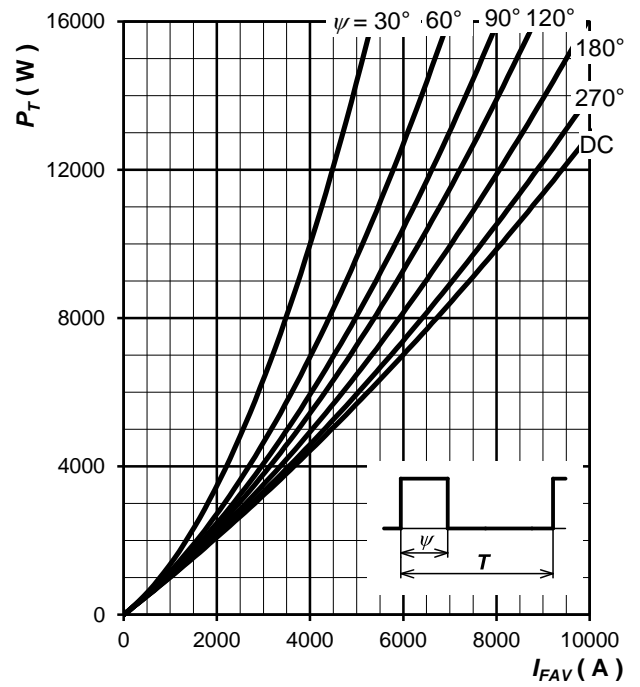


Fig. 7 Forward power loss vs. average forward current, square waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

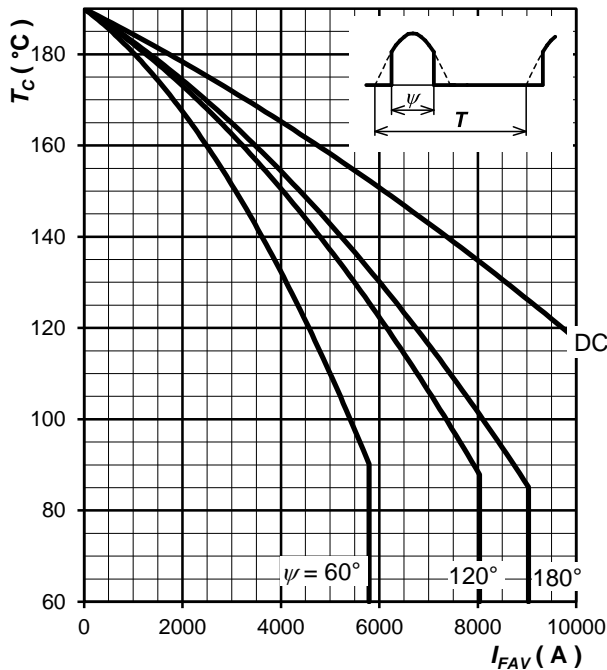


Fig. 8 Max. case temperature vs. aver. forward current, sine waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

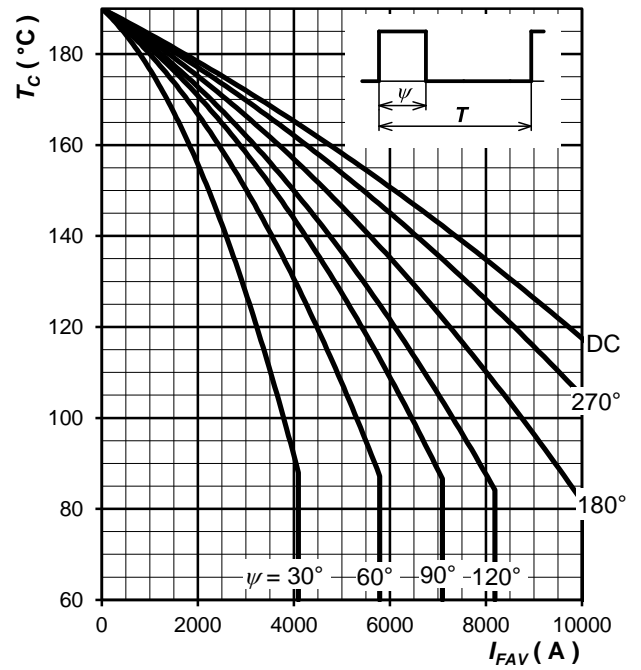


Fig. 9 Max. case temperature vs. aver. forward current, square waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

Note 2: Figures number 6 ÷ 9 have been calculated without considering any forward and reverse recovery losses. They are valid for  $f = 50$  or  $60 \text{ Hz}$  operation.

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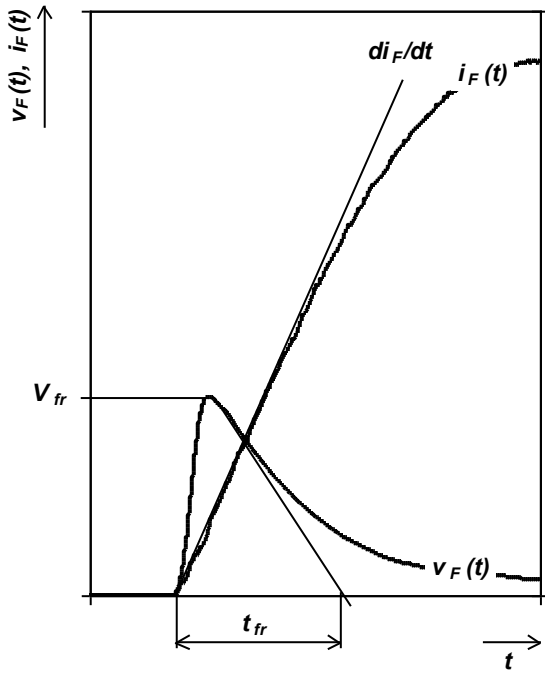


Fig. 10 Typical forward recovery voltage waveform when the diode is turned on with high  $di_F/dt$

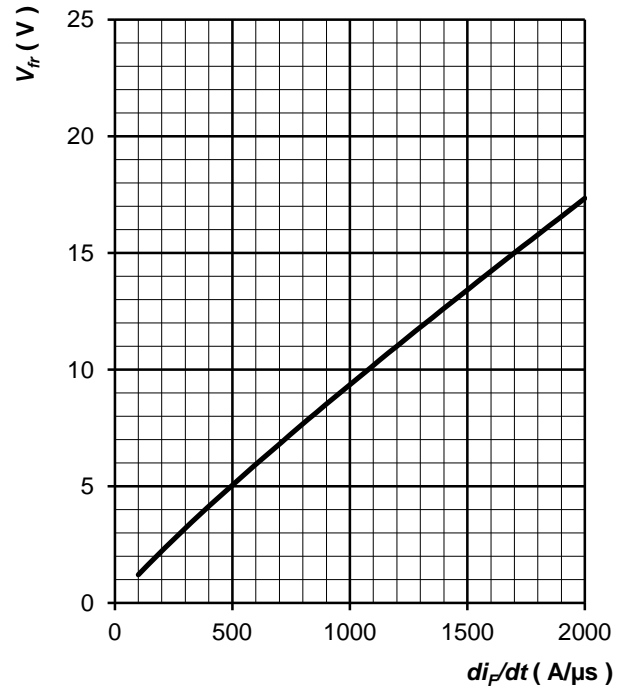


Fig. 11 Max. forward recovery voltage vs. rate of rise forward current, trapezoid pulse,  $T_j = T_{jmax}$ ,  $t_{fr} \leq 10 \mu s$

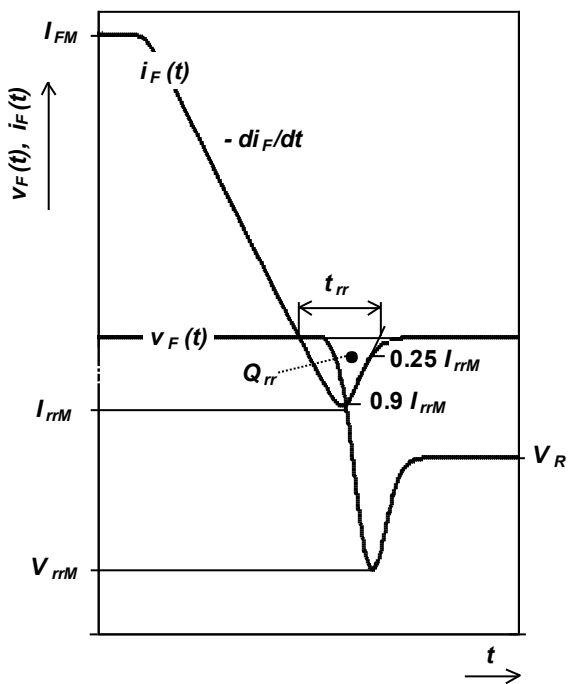


Fig. 12 Definition of reverse recovery parameters

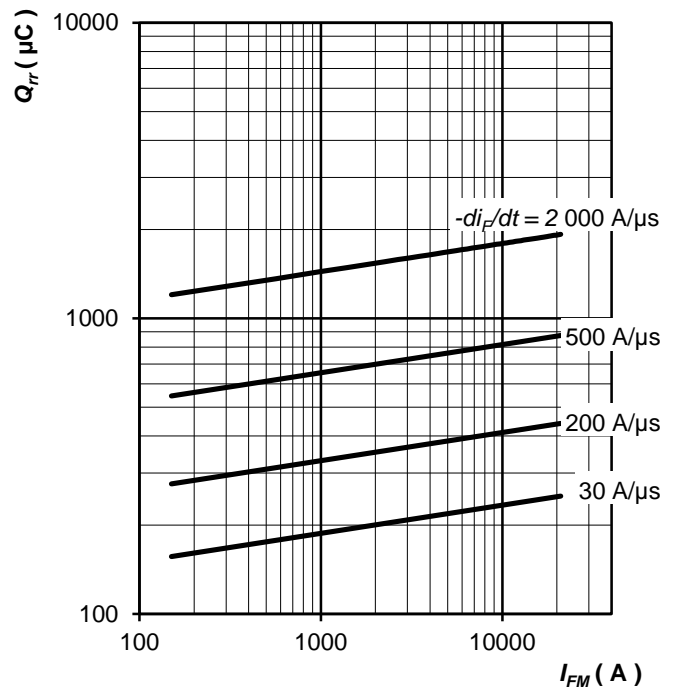


Fig. 13 Max. recovered charge vs. forward current, trapezoid pulse,  $T_j = T_{jmax}$

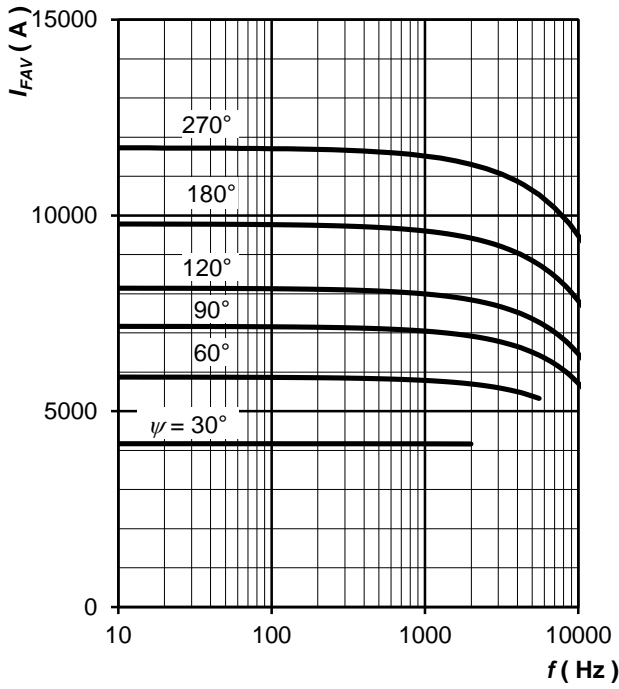


Fig. 14 Average forward current vs. frequency, trapezoid waveform,  $T_C = 85^\circ\text{C}$ ,  $di_F/dt = \pm 2\,000\text{ A}/\mu\text{s}$ ,  $V_R = 50\text{ V}$

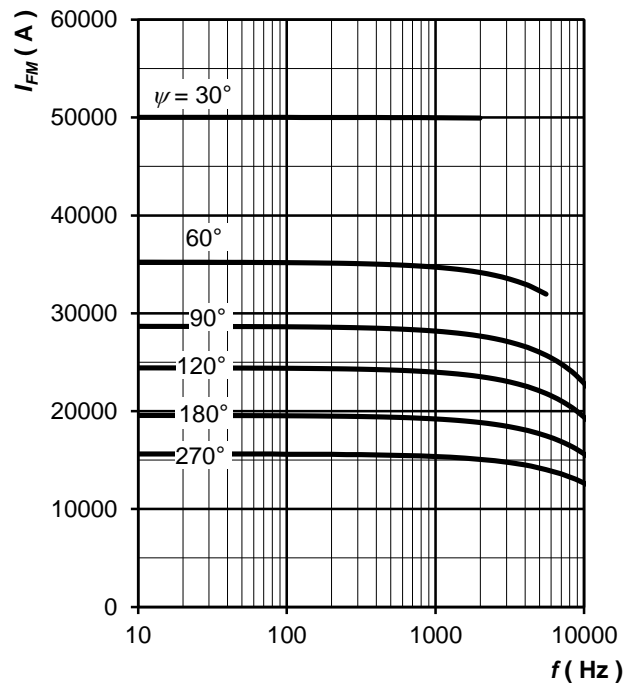


Fig. 15 Maximum forward current vs. frequency, trapezoid waveform,  $T_C = 85^\circ\text{C}$ ,  $di_F/dt = \pm 2\,000\text{ A}/\mu\text{s}$ ,  $V_R = 50\text{ V}$

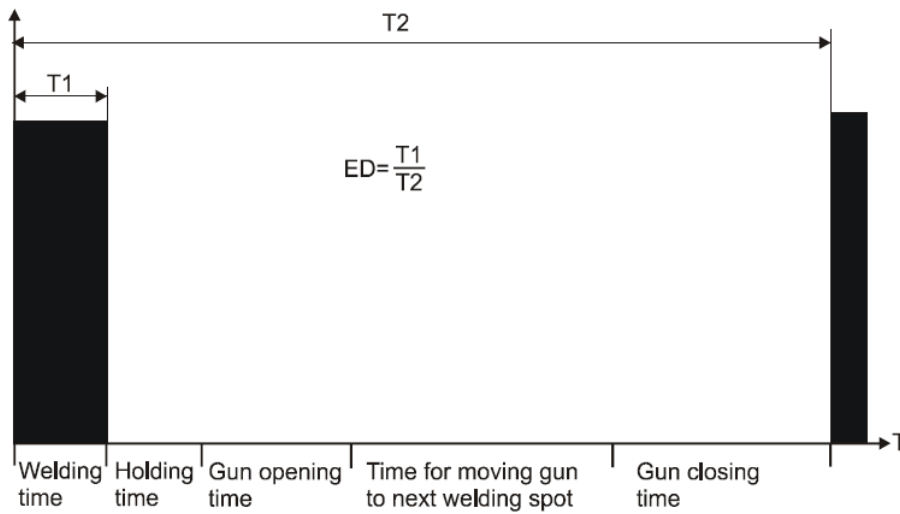


Fig. 16 Definition of ED for typical welding sequence

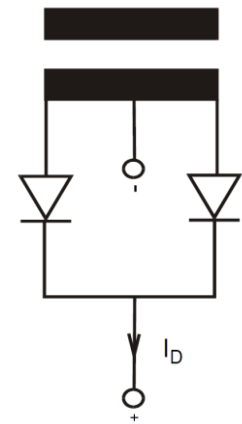


Fig. 17 Definition of  $I_D$  for single-phase centre tap

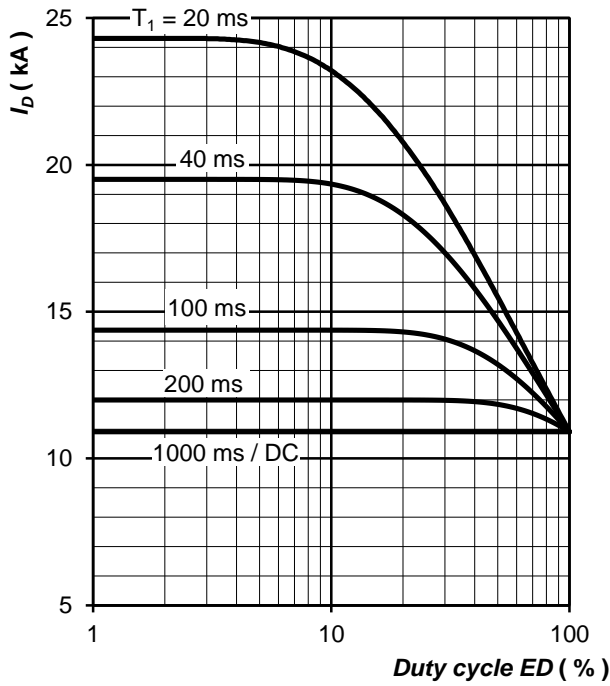


Fig. 18 Current load capacity, cont.,  
DC output welding current with single-phase  
centre tap vs. duty cycle  
 $f = 10 \text{ kHz}$ , square wave,  $\Delta T_j = 80 \text{ }^\circ\text{C}$

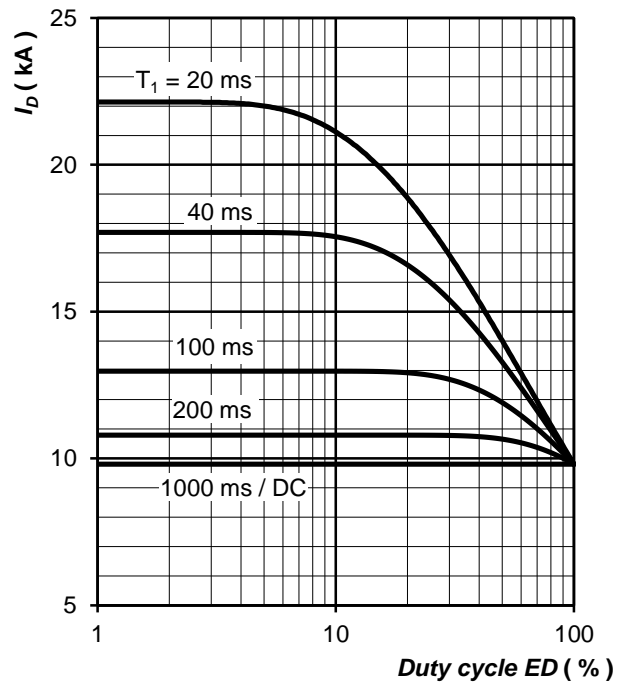


Fig. 19 Current load capacity, cont.,  
DC output welding current with single-phase  
centre tap vs. duty cycle  
 $f = 10 \text{ kHz}$ , square wave,  $\Delta T_j = 70 \text{ }^\circ\text{C}$

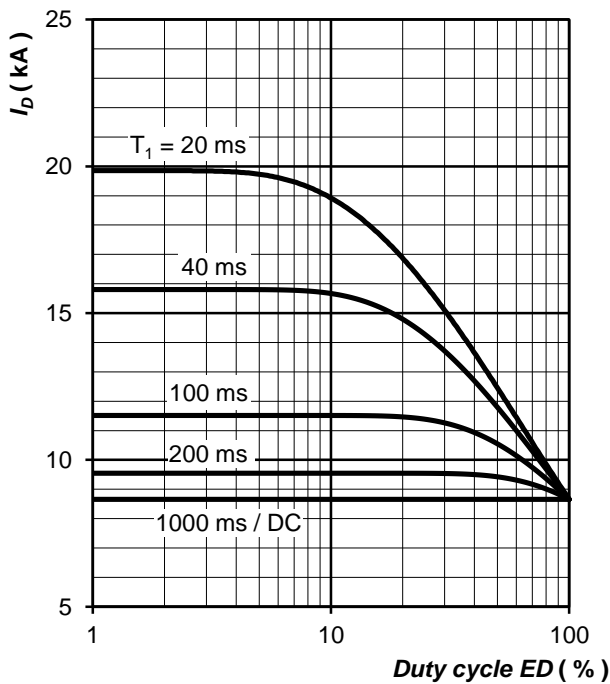


Fig. 20 Current load capacity, cont.,  
DC output welding current with single-phase  
centre tap vs. duty cycle  
 $f = 10 \text{ kHz}$ , square wave,  $\Delta T_j = 60 \text{ }^\circ\text{C}$

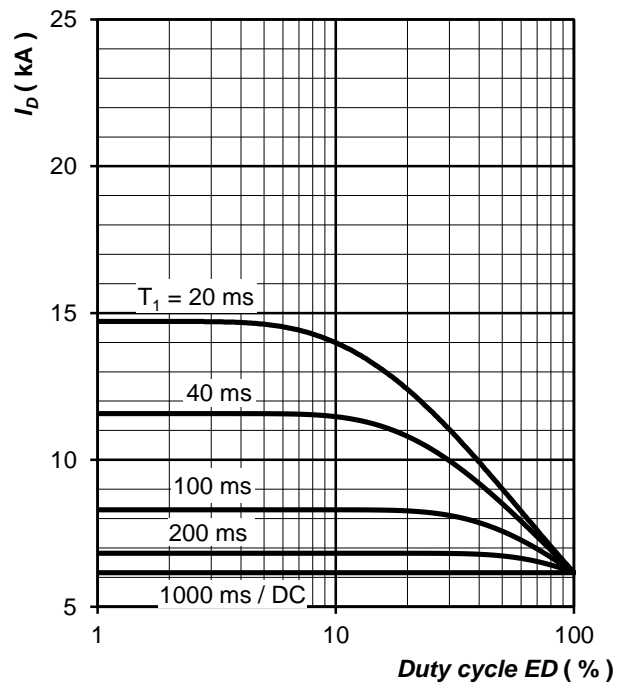


Fig. 21 Current load capacity, cont.,  
DC output welding current with single-phase  
centre tap vs. duty cycle  
 $f = 10 \text{ kHz}$ , square wave,  $\Delta T_j = 40 \text{ }^\circ\text{C}$

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Notes:

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