# WESTCODE SEMICONDUCTORS

Technical Publication
**DFC220**
Issue 1
February 1981

# Fast Recovery Capsule Diode Type CXC220
# 860 amperes average: up to 1600 volts $V_{RRM}$

## Ratings (Maximum values at Tj 125°C unless stated otherwise)

| RATING | CONDITIONS | | SYMBOL | |
|---|---|---|---|---|
| Average forward current | Half sine wave | 55°C heatsink temperature (double side cooled) | $I_{F(AV)}$ | 860A |
| | | 100°C heatsink temperature (single side cooled) | $I_{F(AV)}$ | 212A |
| R.M.S. current (max.) | $T_{HS}$ = 25°C | | $I_{F(RMS)}$ | 1745A |
| D.C. forward current (max.) | $T_{HS}$ = 25°C | | $I_F$ | 1404A |
| Peak one-cycle surge non-repetitive | 8.3ms sine pulse | 60% $V_{RRM}$ re-applied (max.) | $I_{FSM(1)}$ | 10460A |
| | | $V_{RM} \leq$ 10 volts | $I_{FSM(2)}$ | 11500A |
| Maximum surge $I^2t$ | 8.3ms sine pulse | 60% $V_{RRM}$ re-applied (max.) | $I^2t_{(1)}$ | 477000A²s |
| | | $V_{RM} \leq$ 10 volts | $I^2t_{(2)}$ | 578000A²s |
| | 3ms sine pulse | $V_{RM} \leq$ 10 volts | $I^2t_{(3)}$ | 460000A²s |
| Operating temperature range | | | $T_{hs}$ | −40 +125°C |
| Storage temperature range | | | $T_{stg}$ | −40 +150°C |

## Characteristics (Maximum values at Tj 125°C unless stated otherwise)

| CHARACTERISTIC | CONDITIONS | SYMBOL | |
|---|---|---|---|
| Peak forward volt drop | At 1200A $I_{FM}$ | $V_{FM}$ | 1.55V |
| Forward conduction threshold voltage | | $V_O$ | 1.17V |
| Forward conduction slope resistance | | r | 0.32mΩ |
| Peak reverse current | $V_{RM} = V_{RRM}$ (max.) | $I_{RRM}$ | 50mA |
| Thermal resistance junction to heatsink | Double side cooled | $R_{th(j-hs)}$ | 0.044°C/W |
| | Single side cooled | $R_{th(j-hs)}$ | 0.088°C/W |
| Reverse recovered charge | $I_{FM}$ = 800A, di/dt = 50 A/μs, $V_{RM}$ = 50V | $Q_{rr}$ | 140μC |

| VOLTAGE CODE | | 08 | 10 | 12 | 14 | 16 | |
|---|---|---|---|---|---|---|---|
| Repetitive voltage | $V_{RRM}$ | 800 | 1000 | 1200 | 1400 | 1600 | |
| Non-repetitive voltage | $V_{RSM}$ | 900 | 1100 | 1300 | 1500 | 1700 | |

### Ordering Information (Please quote device code as explained below – 10 digits)

| S M | ● ● | C X C | 2 2 0 |
|---|---|---|---|
| FIXED BASIC CODE | VOLTAGE CODE (see above) | FIXED OUTLINE CODE | FIXED TYPE CODE |

Typical code: SM12CXC220 = 1200$V_{RRM}$ capsule diode

## 1. INTRODUCTION

The SM08-16CXC220 diode series comprises fast recovery cold-weld capsules with 32mm all diffused silicon slices. All these diodes have controlled reverse recovery characteristics with good 'S' factors.

## 2. NOTES ON THE RATINGS

(a) **Square wave ratings**
These ratings are given for leading edge linear rates of rise of forward current of 100 and 200A/$\mu$s.

(b) **Energy per pulse characteristics**
These curves, when used in conjunction with those for the appropriate junction temperature rise, enable maximum operating frequencies and dissipations to be obtained.

(c) **Junction temperature rise per pulse**
Single pulse junction temperature rises are given for all rating conditions.

Let: Ep be the Energy per pulse for a given current and pulse width, in Joules

T be the appropriate junction temperature rise, in degrees Centigrade

$R_\theta$ be the steady-state thermal resistance (junction to sink)

and $T_{SINK}$ be the heat sink temperature

the operating frequency may be obtained from

$$f = \frac{125 - T - t_{SINK}}{E_p R_\theta}$$

and the dissipation will be

$$W_{AV} = Ep\, f$$

## 3. REVERSE RECOVERY LOSS

On account of the number of circuit variables affecting reverse recovery voltage, no allowance for reverse recovery loss has been made in the forward ratings. The following procedure is suggested when it is necessary to include reverse recovery loss.

(a) **Determination by Measurement**
From waveforms of recovery current obtained from a high frequency shunt (see Note 1) and reverse voltage present during recovery, an instantaneous reverse recovery loss waveform must be constructed. Let the area under this waveform be A microjoules per pulse. An additional junction temperature rise per pulse can then be evaluated from:

$$\text{Total } T_J \text{ rise per pulse} = \text{Forward } T_J \text{ rise per pulse} + \frac{A\, r_t}{t}$$

where $r_t = 8.1 \times 10^{-5} \sqrt{t}$

where t = duration of reverse recovery loss per pulse in microseconds

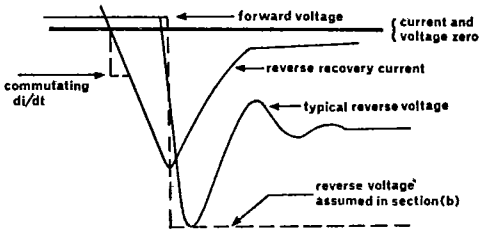
where A = Area under reverse loss waveform per pulse in microjoules

The Energy per pulse must also be modified to include the reverse recovery loss by adding

$A \times 10^{-6}$ Joules

to the forward energy per pulse values.

(b) **Determination without measurement**
Junction temperature rise per pulse per volt and Reverse Recovery Energy per pulse per volt curves are given for cases where it is not possible to measure the voltage and current conditions during reverse recovery. The Figure below shows the idealised situation during reverse recovery. In practice the reverse voltage has an initial overshoot (by an amount inversely proportional to the 'S' Factor) and then settles to a steady state during the recovery 'tail'. This method assumes that full voltage is present throughout the recovery.




The values obtained from these curves must be multiplied by the reverse voltage.

## 4. NOTE 1

**REVERSE RECOVERY LOSS BY MEASUREMENT**

When measuring the reverse recovered charge care must be taken to ensure that:

(a) a.c. coupled devices such as current transformers are avoided, as they tend to exaggerate the apparent charge (due to the prior passage of forward current).

(b) The measuring oscilloscope has adequate dynamic range – typically 100 screen heights – to cope with the initial forward current without overload.

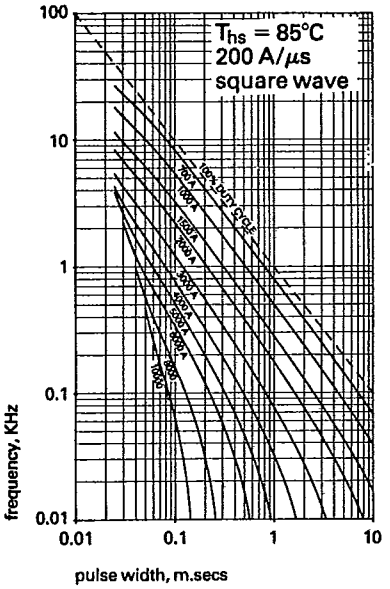



**Figure 1 Frequency v. pulse width**

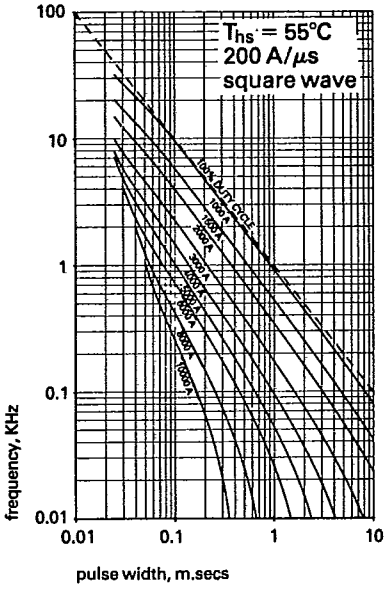



**Figure 2 Frequency v. pulse width**

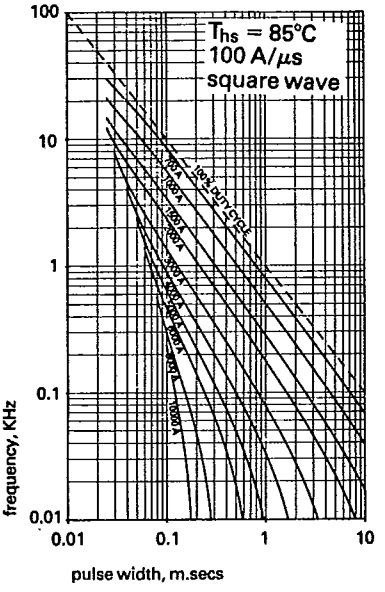



**Figure 5 Frequency v. pulse width**

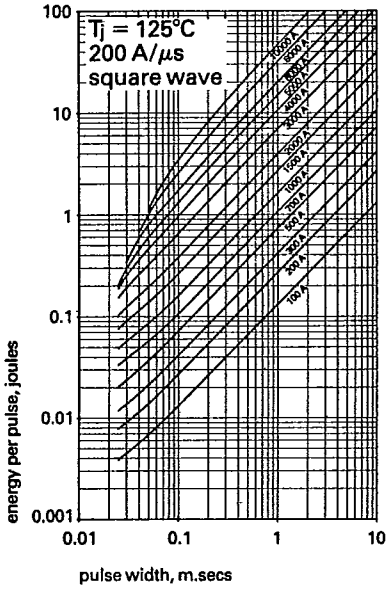



**Figure 3 Energy per pulse v. pulse width**

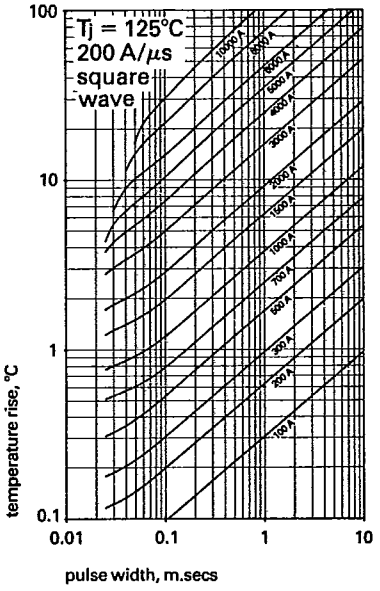



**Figure 4 Temperature rise per pulse v. pulse width**

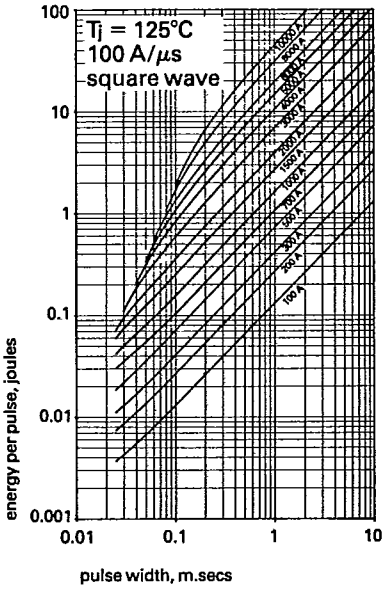



**Figure 7 Energy per pulse v. pulse width**

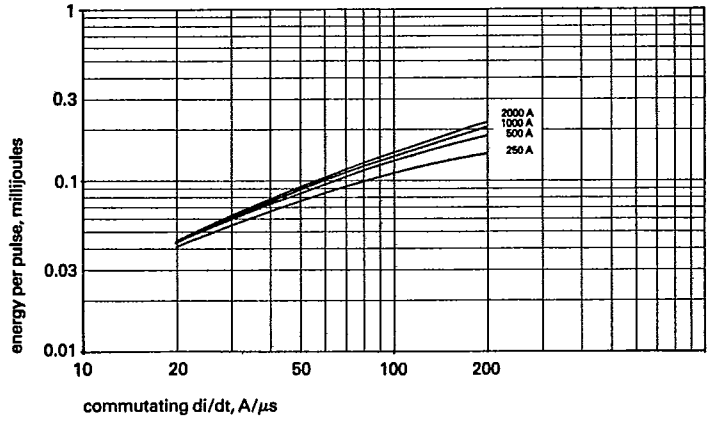



**Figure 13 Max. reverse energy loss per pulse per recovery volt at $T_j$ 125°C**

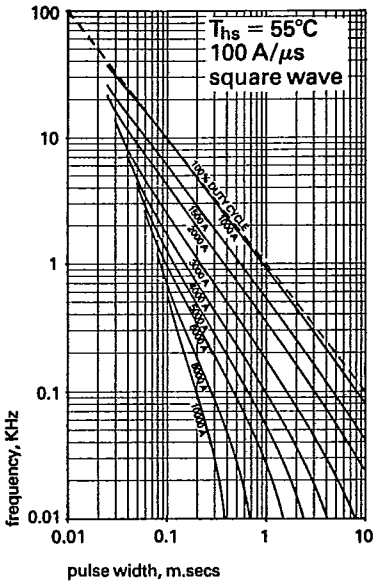



**Figure 6 Frequency v. pulse width**

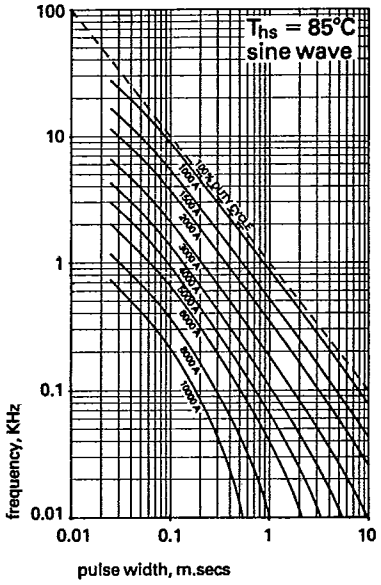



**Figure 9 Frequency v. pulse width**

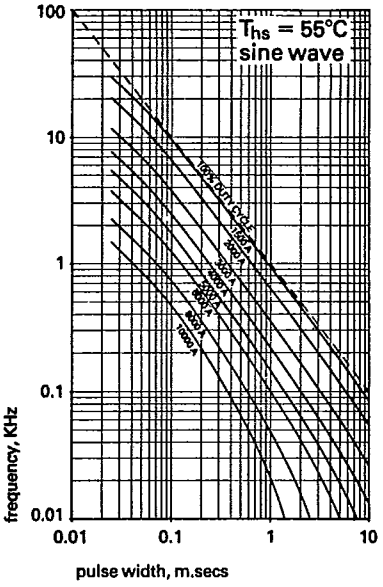



**Figure 10 Frequency v. pulse width**

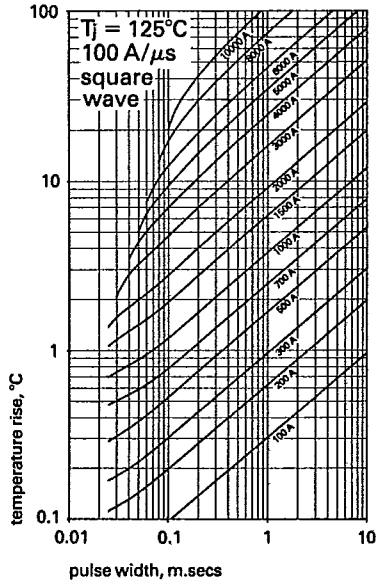



**Figure 8 Temperature rise per pulse v. pulse width**

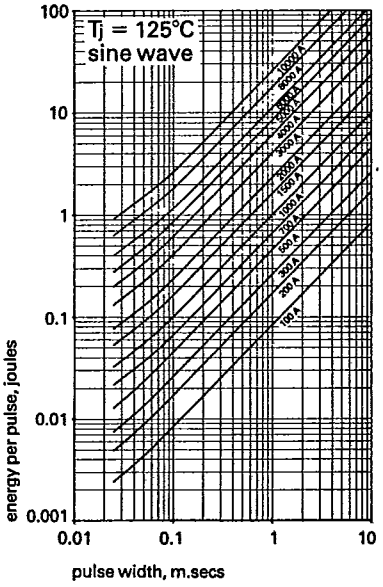



**Figure 11 Energy per pulse v. pulse width**

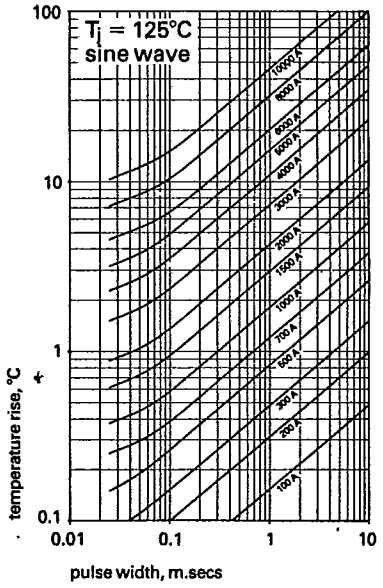



**Figure 12 Temperature rise per pulse v. pulse width**

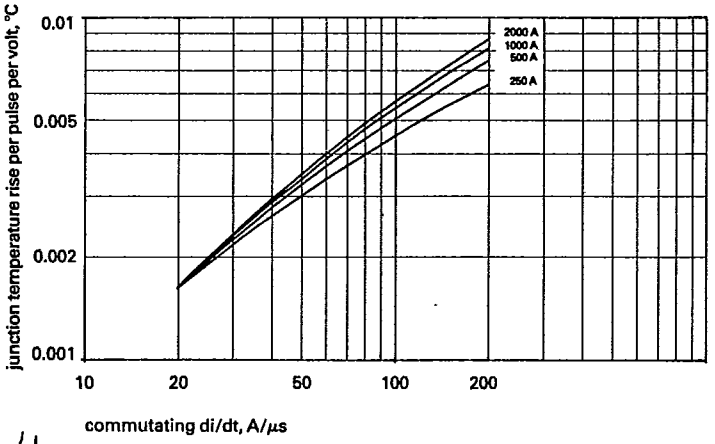



**Figure 14 Max. junction temperature rise per pulse per recovery volt at $T_j$ 125°C**

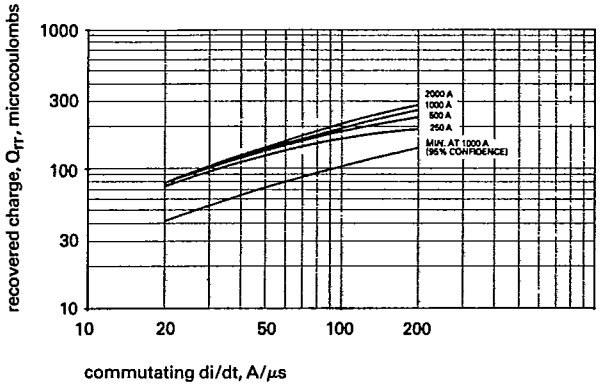



**Figure 15 Maximum recovered charge at $T_j$ 125°C**

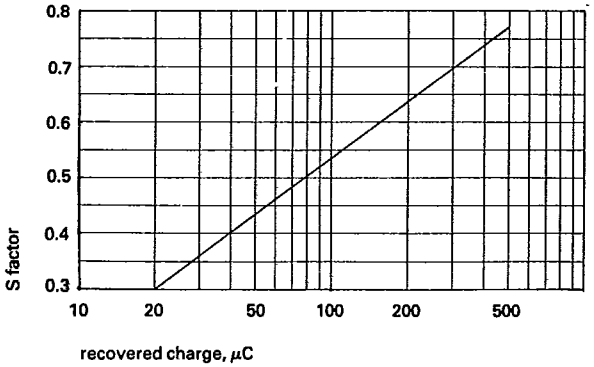



**Figure 16 Minimum S factor at $T_j$ 125°C**

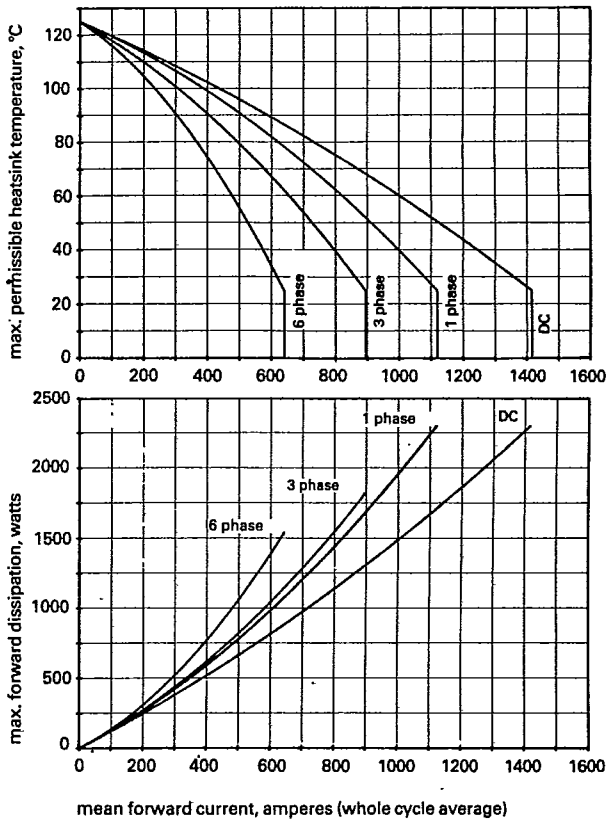



**Figure 17 Dissipation and heatsink temperature v. current (double side cooled), 50Hz**

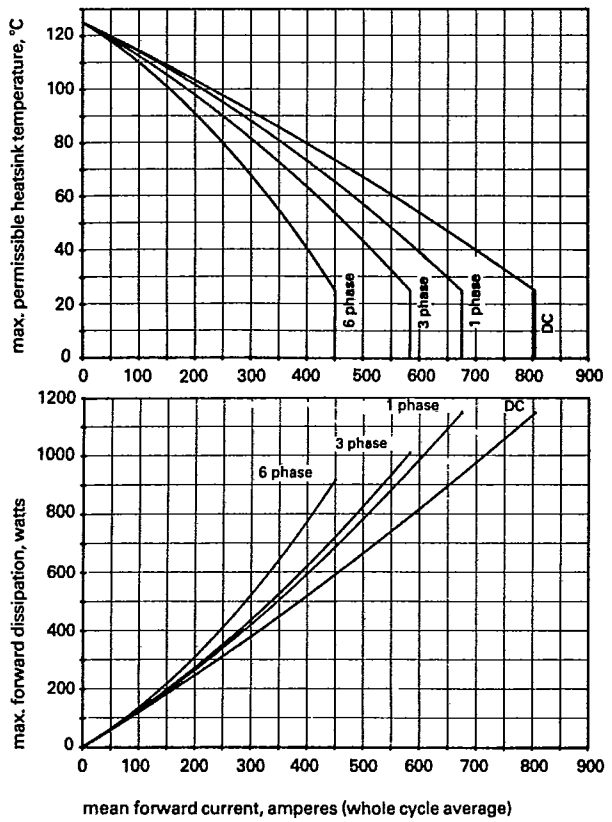



**Figure 18 Dissipation and heatsink temperature v. current (single side cooled), 50Hz**

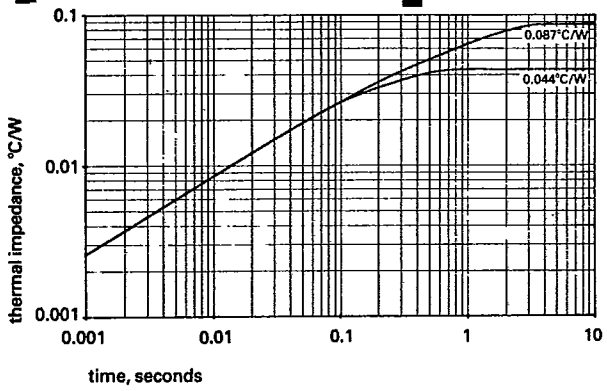



**Figure 19 Junction to heatsink transient thermal impedance**

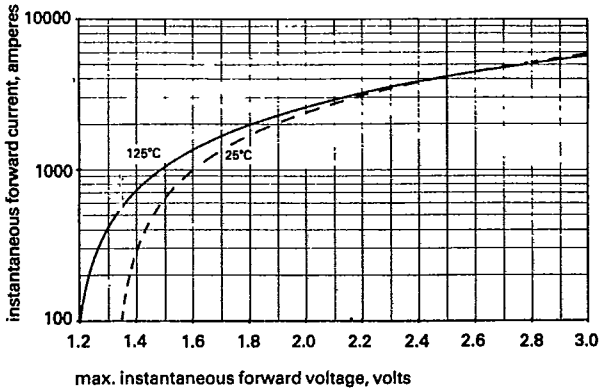



**Figure 20 Forward voltage characteristic of limit diode**

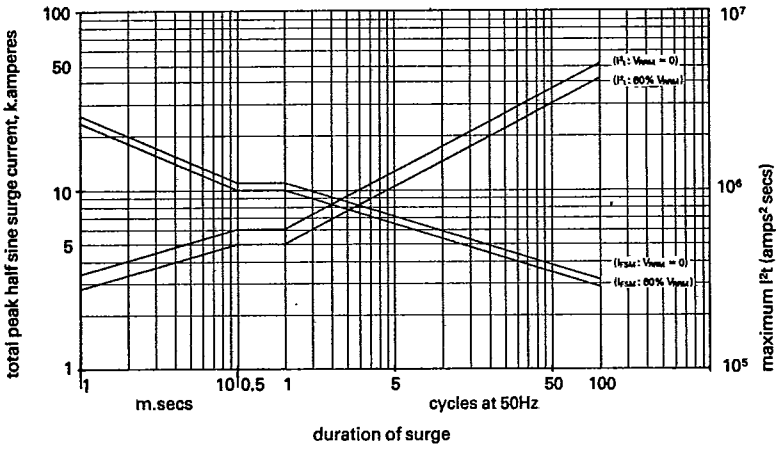
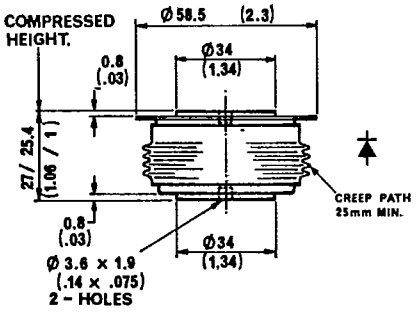



**Figure 21 Max. non-repetitive surge current at initial junction temperature 125°C**




**DO – 200AB**

dimensions in mm (inches)
mounting force: 1000-2000Kgf
weight: 340 grams

*In the interest of product improvement, Westcode reserves the right to change specifications at any time without notice.*

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