

## FAST SOFT-RECOVERY RECTIFIER DIODES

## ● With controlled avalanche

Also available to BS9333-F002

Diffused silicon diodes in DO-4 metal envelopes, capable of absorbing transients. They are primarily intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications.

The series consists of the following types:

Normal polarity (cathode to stud): BYX30-200 to BYX30-600

Reverse polarity (anode to stud): BYX30-200R to BYX30-600R.

## QUICK REFERENCE DATA

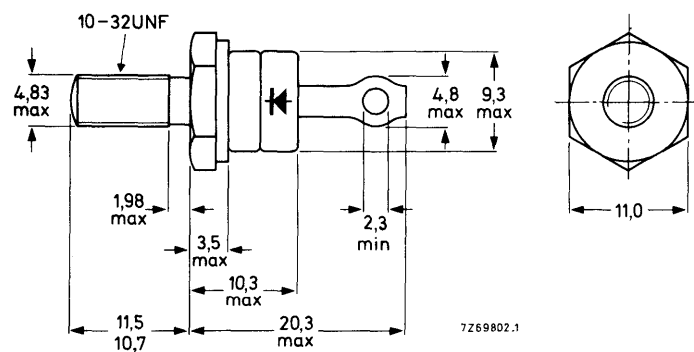
|                                     |             | BYX30-200(R) | 300(R) | 400(R) | 500(R) | 600(R) |
|-------------------------------------|-------------|--------------|--------|--------|--------|--------|
| Crest working reverse voltage       | $V_{RWM}$   | max. 200     | 300    | 400    | 500    | 600 V  |
| Reverse avalanche breakdown voltage | $V_{(BR)R}$ | > 250        | 375    | 500    | 625    | 750 V  |
| Average forward current             | $I_{F(AV)}$ |              | max.   | 14     |        | A      |
| Non-repetitive peak forward current | $I_{FSM}$   |              | max.   | 250    |        | A      |
| Non-repetitive peak reverse power   | $P_{RSM}$   |              | max.   | 18     |        | kW     |
| Reverse recovery time               | $t_{rr}$    |              | <      | 200    |        | ns     |

## MECHANICAL DATA

Dimensions in mm

DO-4; Supplied with device: 1 nut, 1 lock-washer

Nut dimensions across the flats: 9.5 mm



Net mass: 7g

Diameter of clearance hole: max. 5.2 mm

Accessories supplied on request:

56295 (PTFE bush, 2 mica washers, plain washer, tag)

Torque on nut: min. 0.9 Nm  
(9 kg cm)

max. 1.7 Nm  
(17 kg cm)

The mark shown applies to the normal polarity types.

## BYX30 SERIES

**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC134)

| Voltages <sup>1)</sup>        |           | BYX30-200(R) | 300(R) | 400(R) | 500(R) | 600(R) |
|-------------------------------|-----------|--------------|--------|--------|--------|--------|
| Crest working reverse voltage | $V_{RWM}$ | max. 200     | 300    | 400    | 500    | 600 V  |
| Continuous reverse voltage    | $V_R$     | max. 200     | 300    | 400    | 500    | 600 V  |

### Currents

|                                                                                                                                                 |  |              |      |                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------|------|----------------------|
| Average forward current (averaged over any 20 ms period) up to $T_{mb} = 100^\circ\text{C}$<br>at $T_{mb} = 125^\circ\text{C}$                  |  | $I_{F(AV)}$  | max. | 14 A                 |
|                                                                                                                                                 |  | $I_{F(AV)}$  | max. | 7.5 A                |
| R.M.S. forward current                                                                                                                          |  | $I_{F(RMS)}$ | max. | 22 A                 |
| Repetitive peak forward current                                                                                                                 |  | $I_{FRM}$    | max. | 310 A                |
| Non-repetitive peak forward current<br>( $t = 10$ ms; half-sinewave) $T_j = 150^\circ\text{C}$ prior to surge;<br>with reapplied $V_{RWM}$ max. |  | $I_{FSM}$    | max. | 250 A                |
| $I^2t$ for fusing ( $t = 10$ ms)                                                                                                                |  | $I^2t$       | max. | 312 A <sup>2</sup> s |

### Reverse power dissipation

|                                                                                                                                                                           |  |           |      |        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------|------|--------|
| Repetitive peak reverse power dissipation<br>$t = 10$ $\mu\text{s}$ (square wave; $f = 50$ Hz) $T_j = 150^\circ\text{C}$                                                  |  | $P_{RRM}$ | max. | 5.5 kW |
| Non-repetitive peak reverse power dissipation<br>$t = 10$ $\mu\text{s}$ (square wave) $T_j = 25^\circ\text{C}$ prior to surge<br>$T_j = 150^\circ\text{C}$ prior to surge |  | $P_{RSM}$ | max. | 18 kW  |
|                                                                                                                                                                           |  | $P_{RSM}$ | max. | 5.5 kW |

### Temperatures

|                      |           |                              |
|----------------------|-----------|------------------------------|
| Storage temperature  | $T_{stg}$ | -55 to +150 $^\circ\text{C}$ |
| Junction temperature | $T_j$     | max. 150 $^\circ\text{C}$    |

### THERMAL RESISTANCE

|                                      |               |   |                        |
|--------------------------------------|---------------|---|------------------------|
| From junction to ambient in free air | $R_{th j-a}$  | = | 50 $^\circ\text{C/W}$  |
| From junction to mounting base       | $R_{th j-mb}$ | = | 1.3 $^\circ\text{C/W}$ |
| From mounting base to heatsink       | $R_{th mb-h}$ | = | 0.5 $^\circ\text{C/W}$ |

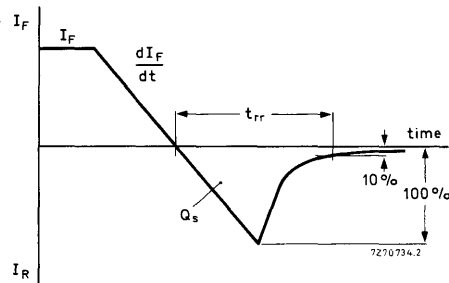
<sup>1)</sup> To ensure thermal stability:  $R_{th j-a} < 2.5^\circ\text{C/W}$  (continuous reverse voltage) or  $< 5^\circ\text{C/W}$  (a.c.).

For smaller heatsinks  $T_j$  max should be derated. For a.c. see page 5.

For continuous reverse voltage: if  $R_{th j-a} = 5^\circ\text{C/W}$ , then  $T_j$  max = 135  $^\circ\text{C}$ .  
if  $R_{th j-a} = 10^\circ\text{C/W}$ , then  $T_j$  max = 120  $^\circ\text{C}$ .

## CHARACTERISTICS

|                                                                                                                       |             | BYX30-200(R)    | 300(R)      | 400(R)      | 500(R)      | 600(R)      |                 |
|-----------------------------------------------------------------------------------------------------------------------|-------------|-----------------|-------------|-------------|-------------|-------------|-----------------|
| <u>Forward voltage</u>                                                                                                |             |                 |             |             |             |             |                 |
| $I_F = 50 \text{ A}; T_j = 25^\circ\text{C}$                                                                          | $V_F$       | < 3.2           | 3.2         | 3.2         | 3.2         | 3.2         | V <sup>1)</sup> |
| <u>Reverse breakdown voltage</u>                                                                                      |             |                 |             |             |             |             |                 |
| $I_R = 5 \text{ mA}; T_j = 25^\circ\text{C}$                                                                          | $V_{(BR)R}$ | > 250<br>< 1050 | 375<br>1050 | 500<br>1050 | 625<br>1050 | 750<br>1050 | V<br>V          |
| <u>Reverse current</u>                                                                                                |             |                 |             |             |             |             |                 |
| $V_R = V_{RWMmax}; T_j = 125^\circ\text{C}$                                                                           | $I_R$       | < 4.0           | 4.0         | 4.0         | 4.0         | 4.0         | mA              |
| <u>Reverse recovery charge when switched from</u>                                                                     |             |                 |             |             |             |             |                 |
| $I_F = 2 \text{ A to } V_R \geq 30 \text{ V};$<br>with $-dI_F/dt = 100 \text{ A}/\mu\text{s}; T_j = 25^\circ\text{C}$ |             |                 |             | $Q_s$       | < 0.70      |             | $\mu\text{C}$   |
| <u>Reverse recovery time when switched from</u>                                                                       |             |                 |             |             |             |             |                 |
| $I_F = 1 \text{ A to } V_R \geq 30 \text{ V};$<br>$-dI_F/dt = 50 \text{ A}/\mu\text{s}; T_j = 25^\circ\text{C}$       |             |                 |             | $t_{rr}$    | < 200       |             | ns              |



## OPERATING NOTES

## 1. Square-wave operation

When  $I_F$  has been flowing sufficiently long for the steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during fall time as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graphs on page 10.

<sup>1)</sup> Measured under pulse conditions to avoid excessive dissipation.

## BYX30 SERIES

### OPERATING NOTES (continued)

#### 2. Sine wave operation

Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of  $I_{RRM}$ ), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

#### 3. Determination of the heatsink thermal resistance

Example:

Assume a diode, used in an inverter.

|                     |                  |   |     |                    |
|---------------------|------------------|---|-----|--------------------|
| frequency           | $f$              | = | 20  | kHz                |
| duty cycle          | $\delta$         | = | 0.5 |                    |
| ambient temperature | $T_{amb}$        | = | 45  | $^{\circ}\text{C}$ |
| switched from       | $I_F$            | = | 12  | A                  |
| to                  | $V_R$            | = | 400 | V                  |
| at a rate           | $-\frac{dI}{dt}$ | = | 20  | A/ $\mu\text{s}$   |

At a duty cycle  $\delta = 0.5$  the average forward current  $I_{FAV} = 6$  A.

From the upper graph on page 5 it follows, that at  $I_{FAV} = 6$  A the average forward power + average leakage power = 15 W (point A).

The additional power losses due to switching-off can be read from the nomogram on page 10 (the example being based on optimum use, i.e.  $T_j = 150$   $^{\circ}\text{C}$ ). Starting from  $I_F = 12$  A on the horizontal scale trace upwards until the appropriate line

$-\frac{dI}{dt} = 20$  A/ $\mu\text{s}$ . From the intersection trace horizontally to the right until the line for  $f = 20$  kHz. Then trace downwards to the line  $V_R = 400$  V and ultimately trace horizontally to the left and on the vertical axis read the additional average power dissipation  $P_{RAV} = 4$  W.

Therefore the total power dissipation  $P_{Tot} = 15$  W + 4 W = 19 W (point B of the upper graph on page 5). From the right hand part follows the thermal resistance, required at  $T_{amb} = 45$   $^{\circ}\text{C}$ .

$$R_{th\ mb-a} \approx 4\ ^{\circ}\text{C/W}$$

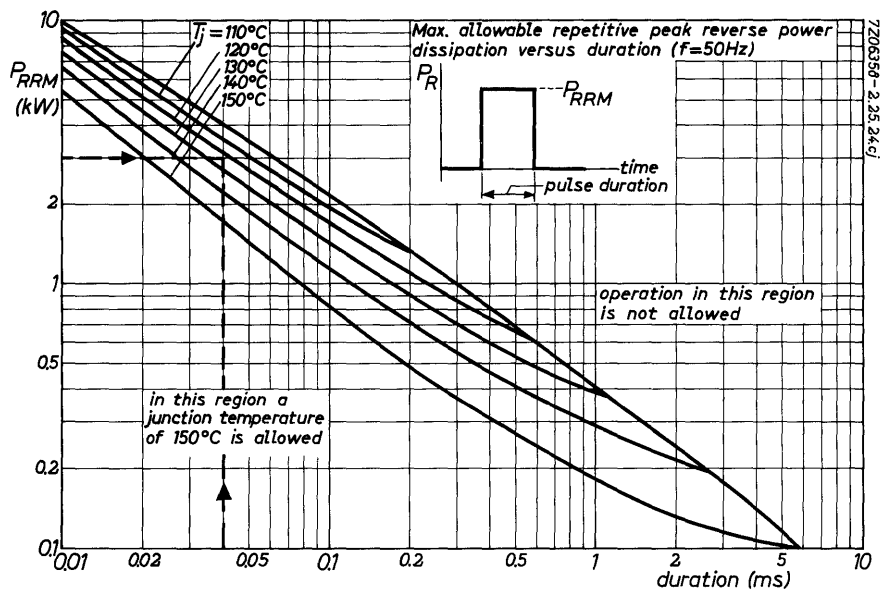
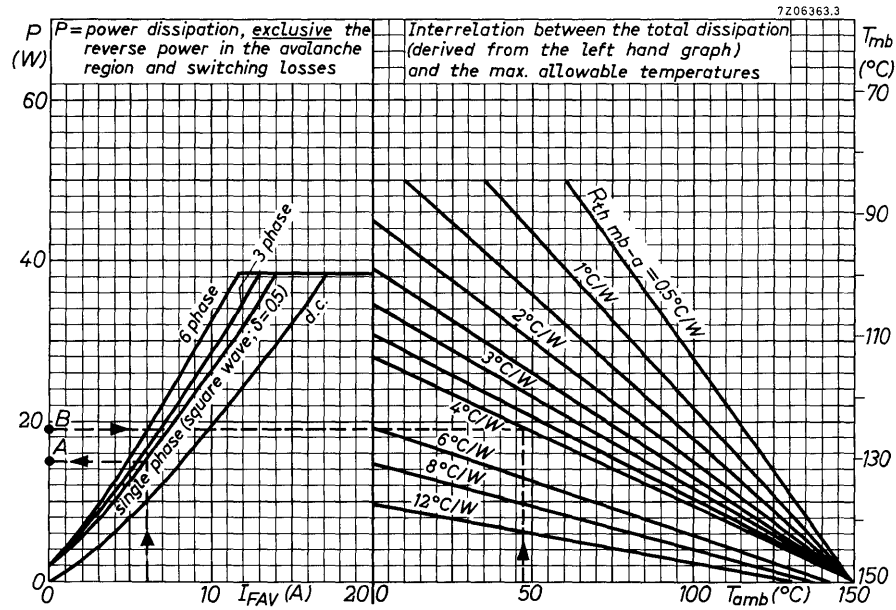
The contact thermal resistance  $R_{th\ mb-h} = 0.5$   $^{\circ}\text{C/W}$ .

Hence the heatsink thermal resistance should be:

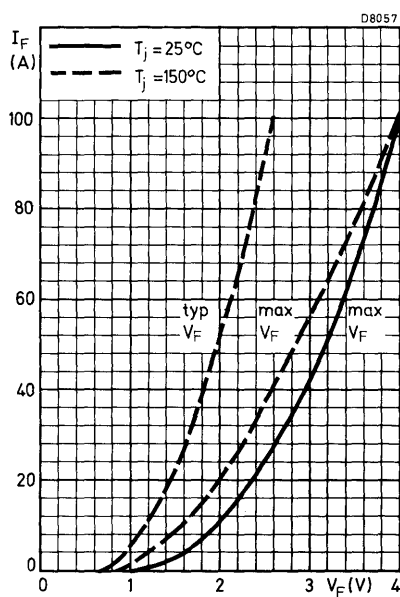
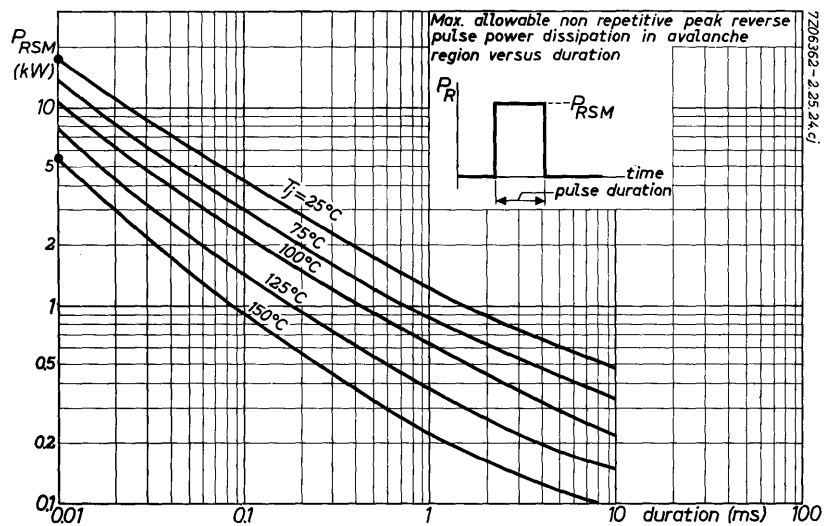
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (4 - 0.5)\ ^{\circ}\text{C/W} = 3.5\ ^{\circ}\text{C/W}.$$

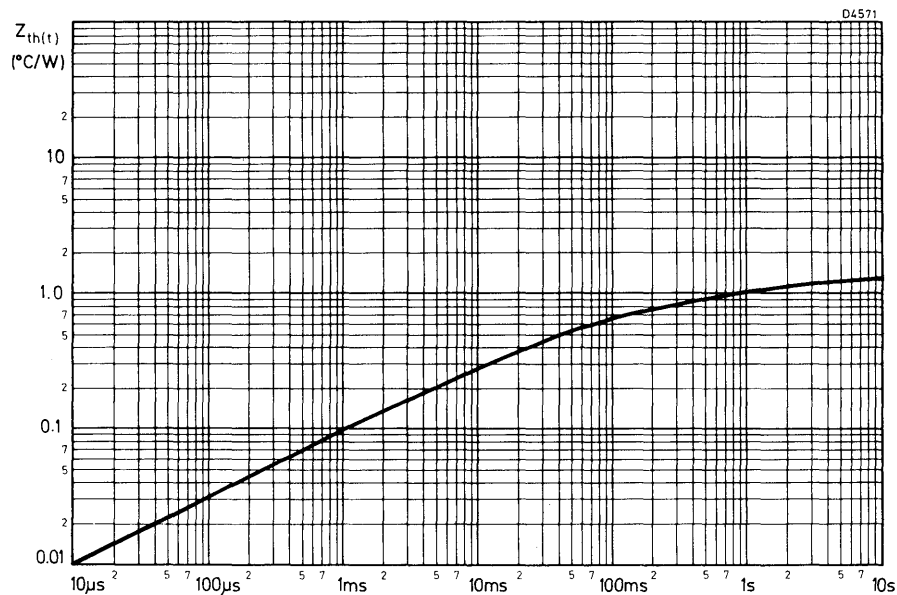
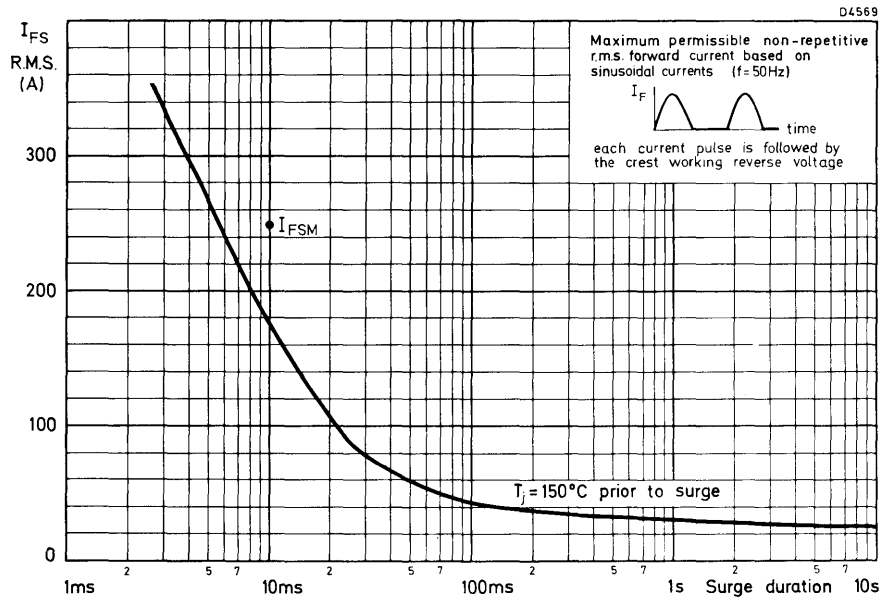
The applicable heatsink(s) may then be found in the Section HEATSINKS.

# **BYX30 SERIES**

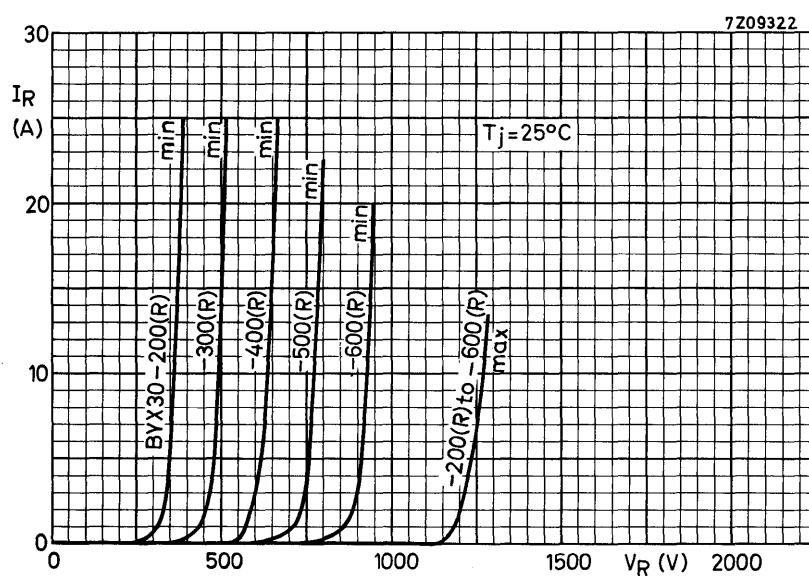
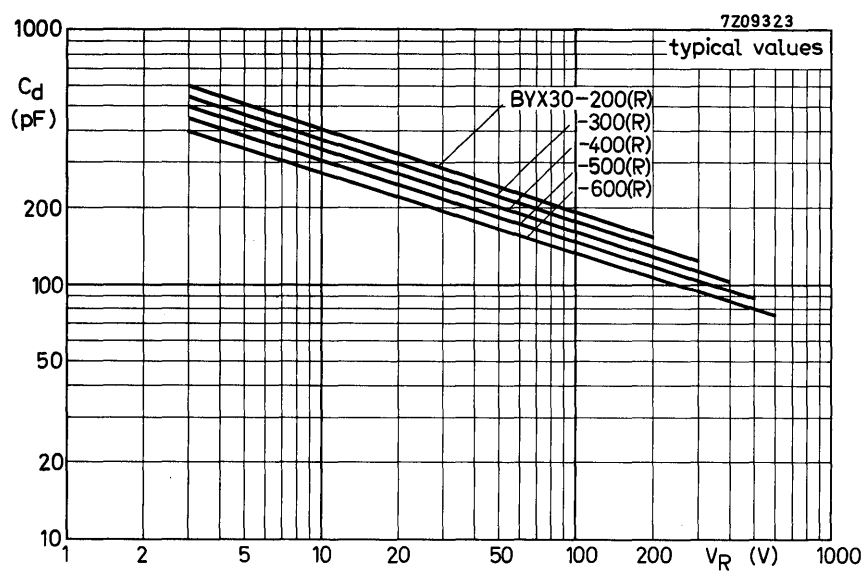


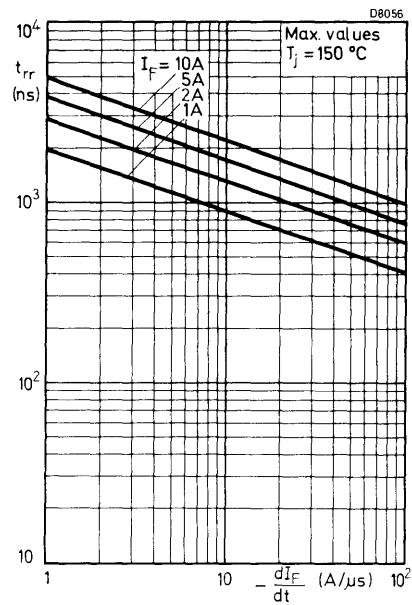
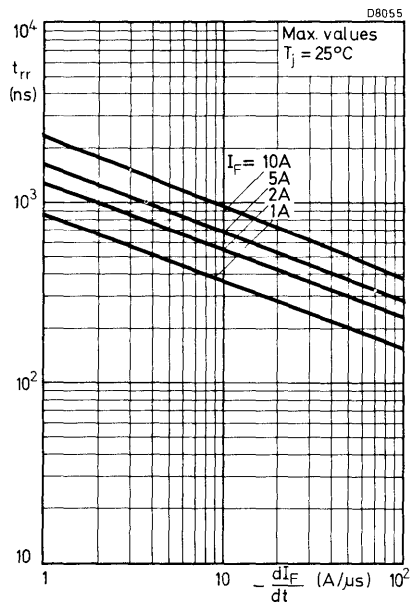
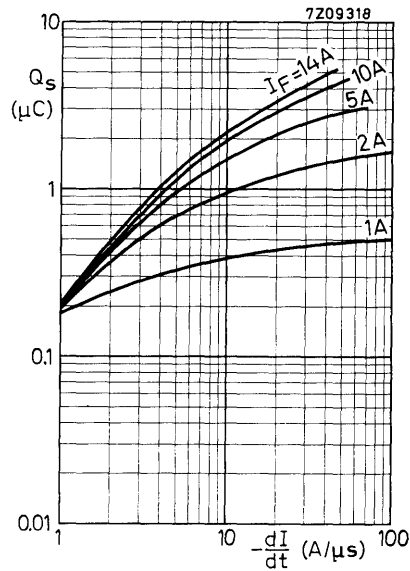
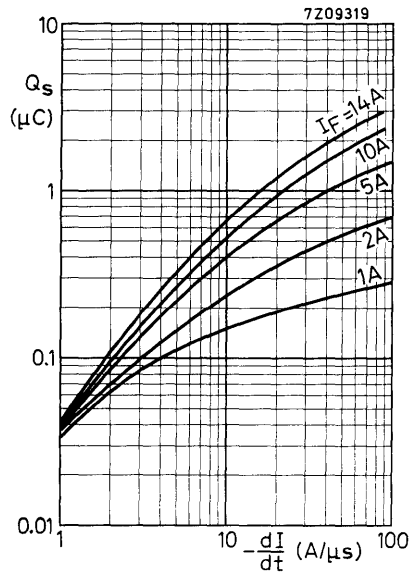
# BYX30 SERIES



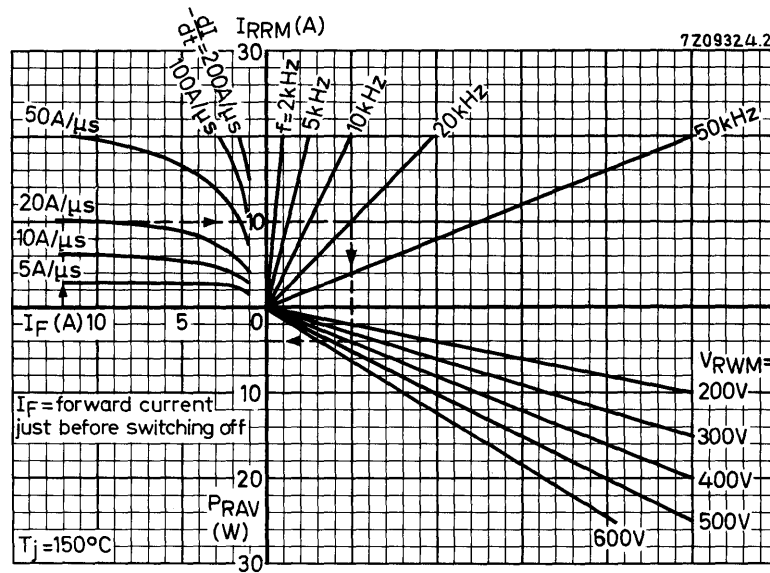
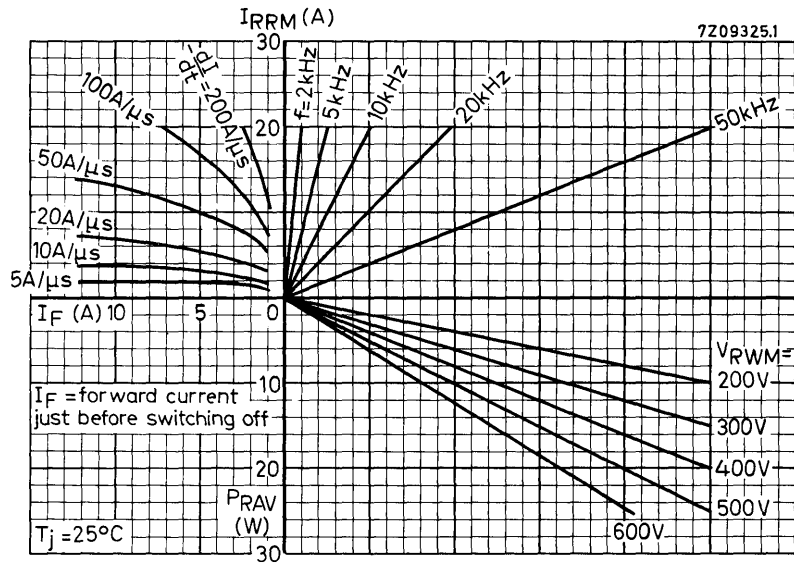


# **BYX30 SERIES**





**BYX30  
SERIES**



Nomogram: Power loss  $P_{RAV}$  due to switching only (square wave operation)