SCHOTTKY-BARRIER RECTIFIER DIODES

High-efficiency schottky-barrier rectifier diodes in DO-4 metal envelopes, featuring low forward voltage drop, low capacitance, absence of stored charge and high temperature stability. They are intended for use in low output voltage switched-mode power supplies and high-frequency circuits in general, where both low conduction losses and zero switching losses are important. They can also withstand reverse voltage transients. The series consists of normal polarity (cathode to stud) types. A version with guaranteed reverse surge capability, BYV20–40A, is also available.

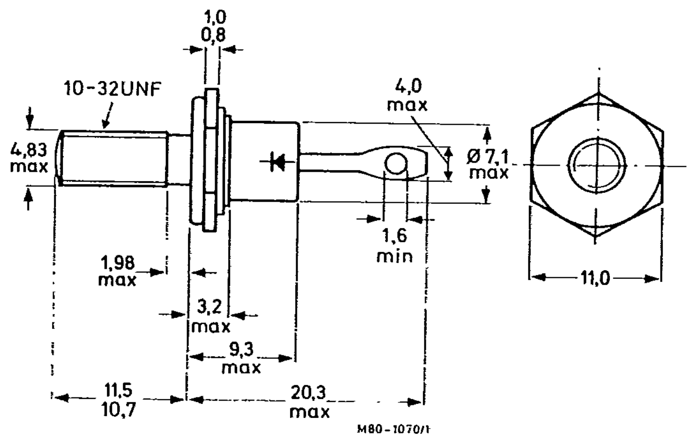
QUICK REFERENCE DATA

			BYV20–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current	$I_{F(AV)}$	max.		15			A
Forward voltage	V_F	<		0.6			V
Junction temperature	T_j	max.		150			°C

MECHANICAL DATA

Dimensions in mm

Fig.1 DO-4 with 10-32 UNF stud (φ4.83 mm) as standard.
Metric M5 stud (φ5 mm) is available on request, eg. BYV20–30M.



Net mass: 6 g

Diameter of clearance hole: 5.2 mm

Accessories supplied on request:
56295a (mica washer); 56295b (PTFE ring);
56295c (insulating bush).

Supplied with device: 1 nut, 1 lock washer.
Torque on nut:
min. 0.9 Nm (9 kg cm),
max. 1.7 Nm (17 kg cm).
Nut dimensions across the flats:
10-32 UNF, 9.5 mm; M5, 8.0 mm.

Products approved to CECC 50 009-033 available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134).

Voltages			BYV20–30	35	40(A)	45	
Non-repetitive peak reverse voltage	V_{RSM}	max.	36	42	48	54	V
Repetitive peak reverse voltage (note 1)	V_{RRM}	max.	30	35	40	45	V
Crest working reverse voltage	V_{RWM}	max.	30	35	40	45	V
Continuous reverse voltage	V_R	max.	30	35	40	45	V

Currents				
Average forward current square wave; δ = 0.5; up to T_{mb} = 121 °C (note 2)	$I_{F(AV)}$	max.	15	A
sinusoidal; up to T_{mb} = 124 °C (note 2)	$I_{F(AV)}$	max.	12.5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	21	A
Repetitive peak forward current t_p = 20 μs; δ = 0.02	I_{FRM}	max.	260	A
Non-repetitive peak forward current half sine-wave; T_j = 125 °C prior to surge; with reapplied $V_{RWM\,max}$; t = 10 ms	I_{FSM}	max.	300	A
t = 8.3 ms	I_{FSM}	max.	330	A
I^2t for fusing (t = 10 ms)	I^2t	max.	450	A^2s
Reverse surge current (BYV20-40A only) t_p = 100 μs	I_{RSM}	max.	1.0	A

Temperatures				
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

MOUNTING INSTRUCTIONS

The top connector should be neither bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering, the heat conduction to the junction should be kept to a minimum.

Notes:
1. For t_p = 200 ns a 20% increase in V_{RRM} is allowed.
2. Assuming no reverse leakage current losses.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.2	K/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.85	K/W ←

CHARACTERISTICS

Forward voltage				
I_F = 15 A; T_j = 100 °C	V_F	<	0.6	V*
I_F = 40 A; T_j = 25 °C	V_F	<	1.0	V*
Rate of rise of reverse voltage $V_R = V_{RWMmax}$	$\frac{dV_R}{dt}$	<	1500	V/μs ←
Reverse current $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	70	mA
Capacitance at f = 1 MHz V_R = 5 V; T_j = 25 to 125 °C	C_d	typ.	520	pF

*Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

Dissipation and Heatsink Calculations

The various components of junction temperature rise above ambient are shown below:

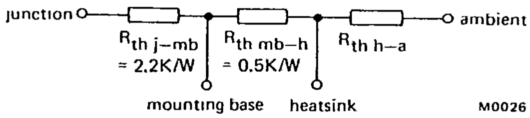


Fig.2

Overall thermal resistance, $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$

To choose a suitable heatsink, the following information is required:
- (i) maximum operating ambient temperature
- (ii) duty cycle or form factor of forward current (δ or a)
- (iii) average forward current
- (iv) crest working reverse voltage (V_{RWM})

The total power dissipation in the diode has two components:

P_R — reverse leakage dissipation

$$P_{tot} = P_R + P_F \quad \text{.......... 1).}$$

P_F — forward conduction dissipation

From the above it can be seen that:

$$R_{th\ h\text{-}a} = \frac{T_{jmax} - T_{amb}}{P_R + P_F} - (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h}) \quad \text{.......... 2).}$$

Values for $R_{th\ j\text{-}mb}$ and $R_{th\ mb\text{-}h}$ can be found under Thermal Resistance. P_R and P_F are derived from Figs.3 and 4 for square-wave operation (and Figs.5 and 6 for sine-wave) as follows:
Starting at the V_{RWM} axis of Fig.3 (or Fig.5), and from a knowledge of the required V_{RWM}, trace upwards to meet the curve that matches the required T_{jmax}. From this point trace horizontally left until the curve of the voltage grade of the device being used is met. From this point trace downwards to meet the required duty cycle (δ) or form factor (a). From this point trace right and read the actual reverse power dissipation on the P_R axis.
Forward conduction dissipation (P_F) for the known average current $I_{F(AV)}$ and duty cycle (or form factor) is easily derived from Fig.4 (or Fig.6).
Substituting the values of P_R and P_F into equation 2) enables the calculation of the required heatsink.

To ensure thermal stability, $(R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}) \times P_R$ must be less than 12 °C. If the calculated value of $R_{th\ h\text{-}a}$ does not permit this, then it must be reduced (heatsink size increased or $R_{th\ mb\text{-}h}$ improved) to enable this criterion to be met.

EXAMPLE: square-wave operation, using BYV20-35 and heatsink compound;
$T_{amb} = 50$ °C; $\delta = 0.5$; $I_{F(AV)} = 12$ A
$V_{RWM} = 12$ V; voltage grade of device = 35 V
From data, $R_{th\ j\text{-}mb} = 2.2$ K/W and $R_{th\ mb\text{-}h} = 0.5$ K/W.
From Fig.4, it is found that $P_F = 9.2$ W
If the desired T_{jmax} is chosen to be 130 °C, then from Fig.3, $P_R = 0.3$ W
Using equation 2) we have:

$$R_{th\ h\text{-}a} = \frac{130\ °C - 50\ °C}{9.2\ W + 0.3\ W} - (2.2 + 0.5) = 5.7\ K/W$$

To check for thermal stability:

$$(R_{th\ j\text{-}a}) \times P_R = (2.2 + 0.5 + 5.7) \times 0.3 = 2.5\ °C.$$

This is less than 12 °C, hence thermal stability is ensured.

SQUARE-WAVE OPERATION (Figs.3 and 4)

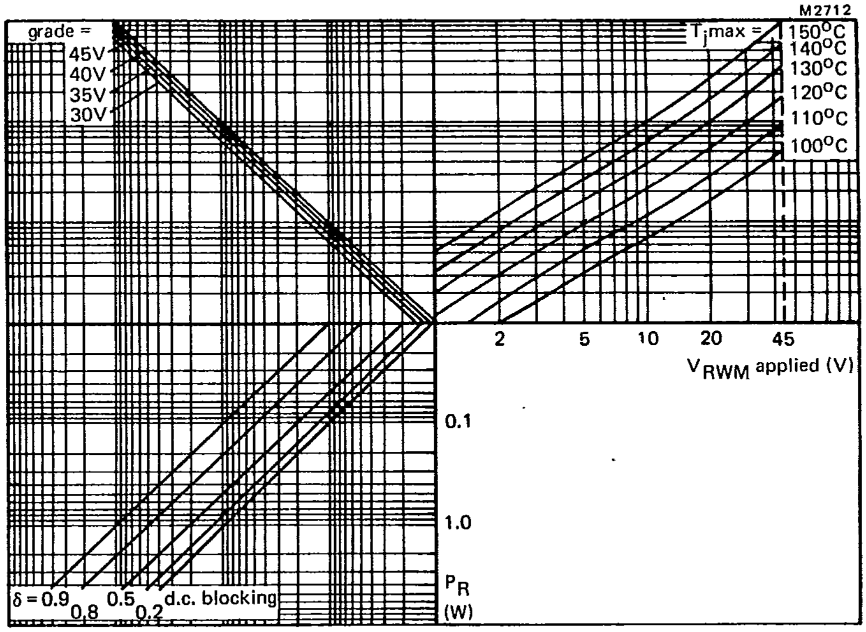
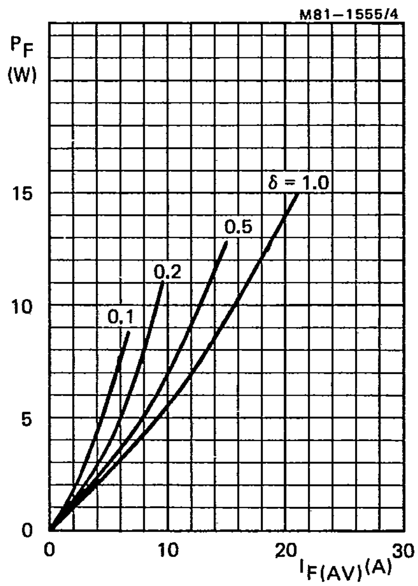
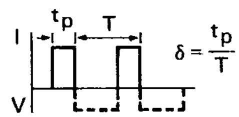


Fig.3 NOMOGRAM: for calculation of P_R (reverse leakage power dissipation) for a given T_j max., V_{RWM} applied, voltage grade and duty cycle.





$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

Fig.4.

SINE-WAVE OPERATION (Figs.5 and 6)

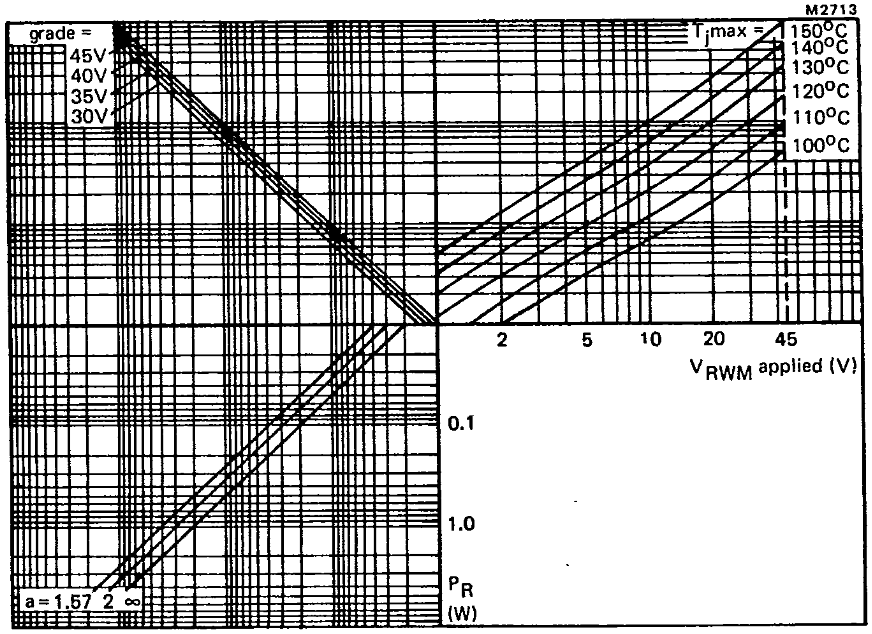


Fig.5 NOMOGRAM: for calculation of P_R (reverse leakage power dissipation) for a given T_j max., V_{RWM} applied, voltage grade and form factor.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

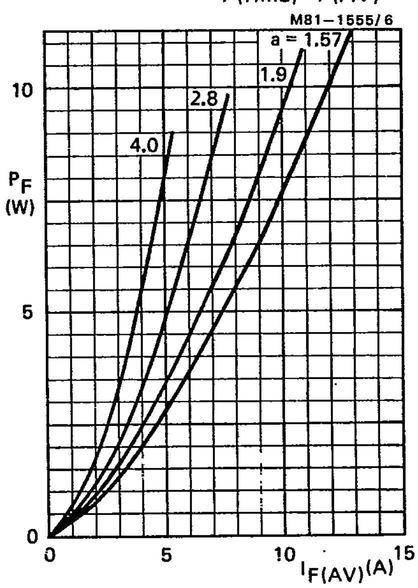


Fig.6.

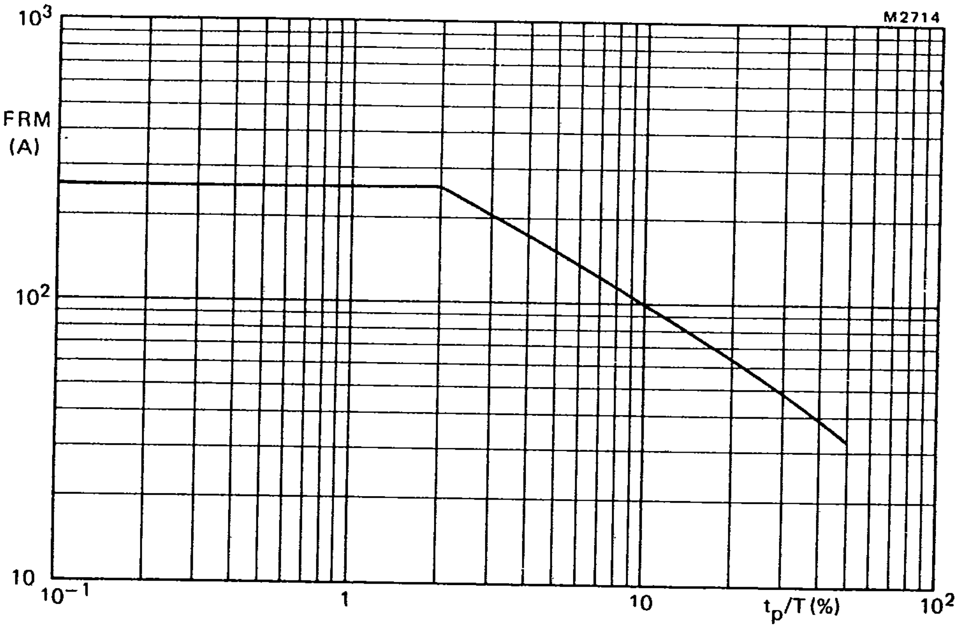
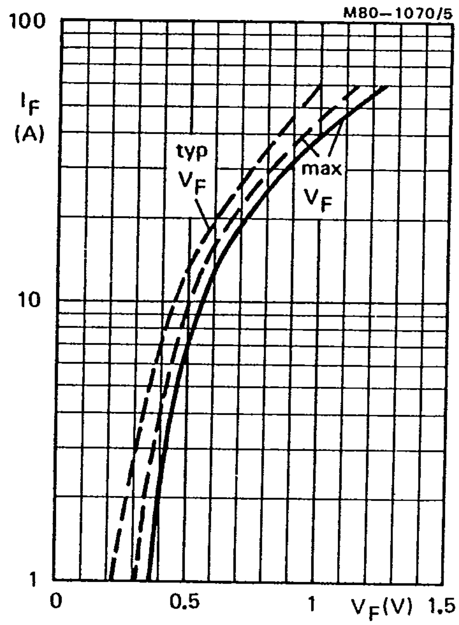
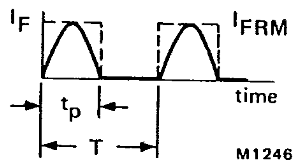


Fig.7 Maximum permissible repetitive peak forward current for either square or sinusoidal currents for 1 $\mu s < t_p <$ 1 ms.





Definition of I_{FRM} and t_p/T.

Fig.8 —— T_j = 25 °C; — — — T_j = 100 °C.

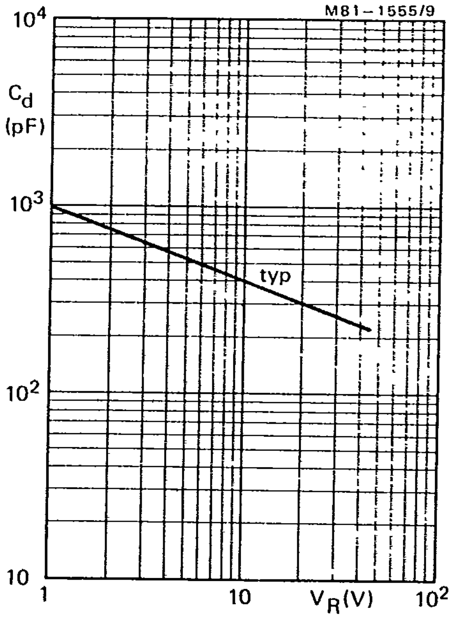


Fig.9 f = 1 MHz; T_j = 25 to 125 °C.

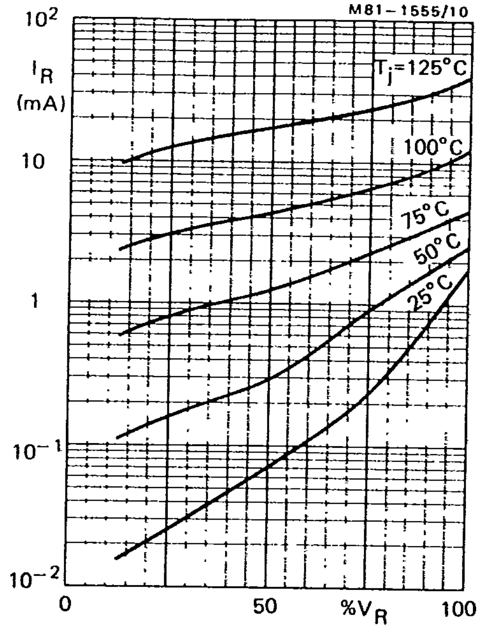


Fig.10 Typical values.

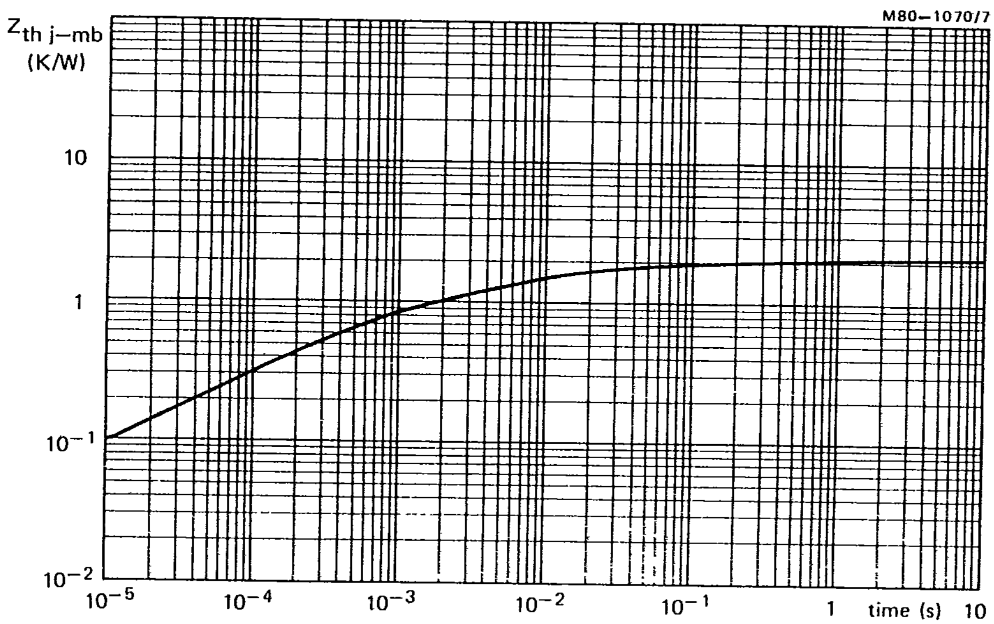


Fig.11 Transient thermal impedance.