


### FAST RECOVERY DIODES

### T-Modules

#### Features

- Fast recovery time characteristics
- Electrically isolated base plate
- 3500 V<sub>RMS</sub> isolating voltage
- Standard JEDEC package
- Simplified mechanical designs,  
rapid assembly
- Large creepage distances
- UL E78996 approved 
- RoHS Compliant

40 A  
70 A  
85 A

#### Description

This serie of T-module uses fast recovery power diodes in a single diode configuration. The semiconductors are electrically isolated from the metal base, allowing common heatsink and compact assemblies to be built.

These single diode modules can be used in conjunction with the thyristor modules as a freewheel diode. Application includes self-commutated inverters, DC choppers, motor control, inductive heating and electronic welders. These modules are intended for those applications where very fast recovery characteristics are required and for general power switching applications.

#### Major Ratings and Characteristics

Parameters	T40HFL	T70HFL	T85HFL	Units
$I_{F(AV)}$	40	70	85	A
$I_{F(RMS)}$	63	110	133	A
$I_{FSM}$	50Hz	475	830	A
	60Hz	500	870	A
$i^2t$	50Hz	1130	3460	A <sup>2</sup> s
	60Hz	1030	3160	A <sup>2</sup> s
$V_{RRM}$ range	100 to 1000			V
$t_{rr}$ range	200 to 1000			ns
$T_J$ range	-40 to 125			°C

**ELECTRICAL SPECIFICATIONS**

**Voltage Ratings**

Type number	Voltage Code	t <sub>tr</sub> Code	V <sub>RRM</sub> , maximum repetitive peak reverse voltage V	V <sub>RSM</sub> , maximum non-repetitive peak reverse voltage V	I <sub>RRM</sub> max. T <sub>J</sub> = @25°C μA
T40HFL.. T70HFL.. T85HFL..	10	S02, S05, S10	100	150	100
	20	S02, S05, S10	200	300	
	40	S02, S05, S10	400	500	
	60	S02, S05, S10	600	700	
	80	S05, S10	800	900	
	100	S05, S10	1000	1100	

**Forward Conduction**

Parameters	T40HFL	T70HFL	T85HFL	Units	Conditions
I <sub>F(AV)</sub> Max. average fwd current @ Case temperature	40	70	85	A	180° conduction, half sine wave
	70	70	70	°C	
I <sub>F(RMS)</sub> Max. RMS forward current	63	110	133	A	
I <sub>FSM</sub> Max. peak, one-cycle forward, non-repetitive surge current	475	830	1300	A	t = 10ms No voltage reappplied
	500	870	1370		t = 8.3ms
	400	700	1100		t = 10ms 100% V <sub>RRM</sub>
	420	730	1150		t = 8.3ms reappplied
I <sup>2</sup> t Maximum I <sup>2</sup> t for fusing	1130	3460	8550	A <sup>2</sup> s	t = 10ms No voltage reappplied
	1030	3160	7810		t = 8.3ms
	800	2450	6050		t = 10ms 100% V <sub>RRM</sub>
	730	2230	5520		t = 8.3ms reappplied
I <sup>2</sup> √t Maximum I <sup>2</sup> √t for fusing	11300	34600	85500	A <sup>2</sup> √s	t = 0.1 to 10ms, no voltage reappplied
V <sub>F(TO)1</sub> Low level value of threshold voltage	0.82	0.87	0.84	V	T <sub>J</sub> = 25 °C, (16.7% x π x I <sub>F(AV)</sub> ) < I < π x I <sub>F(AV)</sub> )
V <sub>F(TO)2</sub> High level value of threshold voltage	0.84	0.90	0.86	V	T <sub>J</sub> = 25 °C, (I > π x I <sub>F(AV)</sub> )
r <sub>f1</sub> Low level value of forward slope resistance	7.0	2.77	2.15	mΩ	T <sub>J</sub> = 25 °C, (16.7% x π x I <sub>F(AV)</sub> ) < I < π x I <sub>F(AV)</sub> )
r <sub>f2</sub> High level value of forward slope resistance	6.8	2.67	2.07	mΩ	T <sub>J</sub> = 25 °C, (I > π x I <sub>F(AV)</sub> )
V <sub>FM</sub> Max. forward voltage drop	1.60	1.73	1.55	V	I <sub>FM</sub> = π x I <sub>F(AV)</sub> , T <sub>J</sub> = 25 °C, tp = 400μs square wave Av. power = V <sub>F(TO)</sub> x I <sub>F(AV)</sub> + r <sub>f</sub> x (I <sub>F(RMS)</sub> ) <sup>2</sup>

**Blocking**

Parameters	T40HFL	T70HFL	T85HFL	Units	Conditions
I <sub>RRM</sub> Max. peak rev. leak. current	20			mA	T <sub>J</sub> = 125 °C
V <sub>INS</sub> RMS isolation voltage	3500			V	50Hz, circuit to base, all terminals shorted T <sub>J</sub> = 25 °C, t = 1 s

### Thermal and Mechanical Specifications

Parameters	T40HFL	T70HFL	T85HFL	Units	Conditions
$T_J$ Junction operating temp.	-40 to 125			°C	
$T_{stg}$ Storage temperature range	-40 to 150			°C	
$R_{thJC}$ Max. internal thermal resistance junction to case	0.85	0.53	0.46	K/W	Per module, DC operation
$R_{thC-S}$ Thermal resistance, case to heatsink	0.2			K/W	Mounting surface flat, smooth and greased. Per module
T Mounting Base to torque $\pm 10\%$ heatsink	1.3 $\pm 10\%$			Nm	M3.5 mounting screws (2) Non-lubricated threads
Busbar to Terminal	3 $\pm 10\%$			Nm	M5 screws terminals; non-lubricated threads
wt Approximate weight	54 (19)			g (oz)	See outline table
Case style	D-56			T-MODULE	

(2) A mounting compound is recommended and the torque should be rechecked after a period of about 3 hours to allow for the spread of the compound

### $\Delta R$ Conduction

(The following table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC)

Devices	Sinusoidal conduction @ $T_J$ max.					Rectangular conduction @ $T_J$ max.					Units
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
T40HFL	0.06	0.08	0.10	0.14	0.24	0.05	0.08	0.10	0.15	0.24	K/W
T70HFL	0.05	0.06	0.08	0.11	0.19	0.04	0.06	0.08	0.12	0.19	
T85HFL	0.04	0.05	0.06	0.09	0.15	0.03	0.05	0.07	0.09	0.015	

### Reverse Recovery Characteristics

Parameter	T40HFL			T70HFL			T85HFL			Units	Conditions (*)
	S02	S05	S10	S02	S05	S10	S02	S05	S10		
$t_{rr}$ Maximum reverse recovery time	70	110	270	70	110	270	80	120	290	ns	$T_J = 25^\circ\text{C}$ , $-di_F/dt = 100\text{A}/\mu\text{s}$ $I_F = 1\text{A}$ to $V_R = 30\text{V}$
	200	500	1000	200	500	1000	200	500	1000	ns	$T_J = 25^\circ\text{C}$ , $-di_F/dt = 25\text{A}/\mu\text{s}$ $I_{FM} = \pi \times \text{rated } I_{F(AV)}$ , $V_R = -30\text{V}$
$Q_{rr}$ Maximum reverse recovered charge	0.25	0.4	1.35	0.25	0.4	1.35	0.3	0.6	1.6	$\mu\text{C}$	$T_J = 25^\circ\text{C}$ , $-di_F/dt = 100\text{A}/\mu\text{s}$ $I_F = 1\text{A}$ to $V_R = 30\text{V}$
	0.55	2.0	8.0	0.6	2.1	8.5	0.8	3.5	1.5	$\mu\text{C}$	$T_J = 25^\circ\text{C}$ , $-di_F/dt = 25\text{A}/\mu\text{s}$ $I_{FM} = \pi \times \text{rated } I_{F(AV)}$ , $V_R = -30\text{V}$

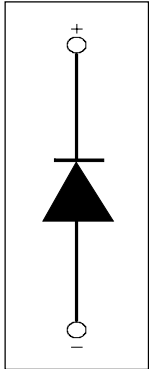
(\*) Tested on LEM 300A Diode Tester

**Ordering Information Table**

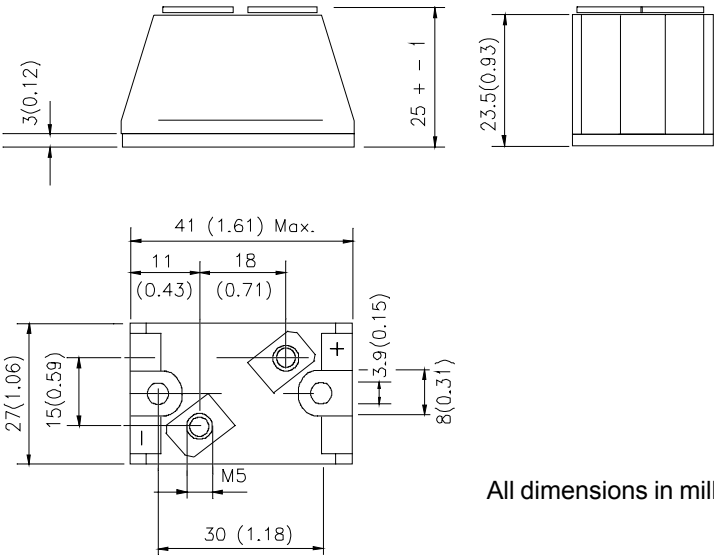
Device Code				
<b>T</b>	<b>40</b>	<b>HFL</b>	<b>100</b>	<b>S10</b>
①	②	③	④	⑤

- 1** - Module type
- 2** - Current rating: 40 = 40A (avg)  
70 = 70A (avg)  
85 = 85A (avg)
- 3** - Fastrecovery diode
- 4** - Voltage code : code x 10 =  $V_{RRM}$
- 5** - trr code: S02 = 200ns  
S05 = 500ns  
S10 = 1000ns



**Outline Table**



All dimensions in millimeters (inches)

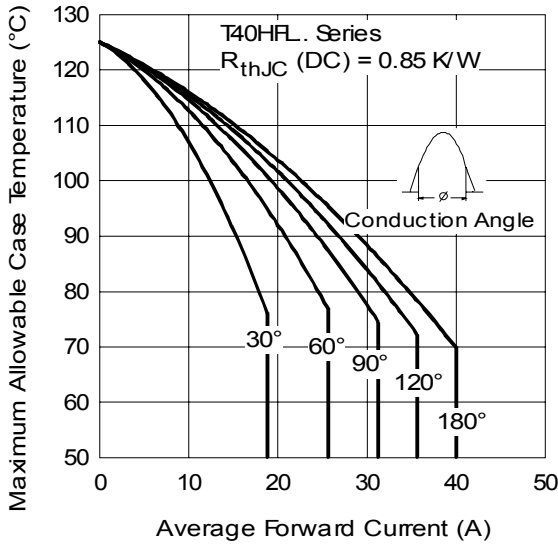


Fig. 1 - Current Ratings Characteristics

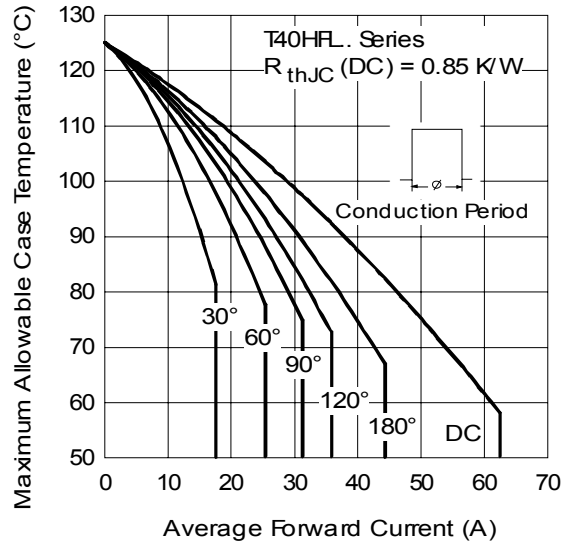


Fig. 2 - Current Ratings Characteristics

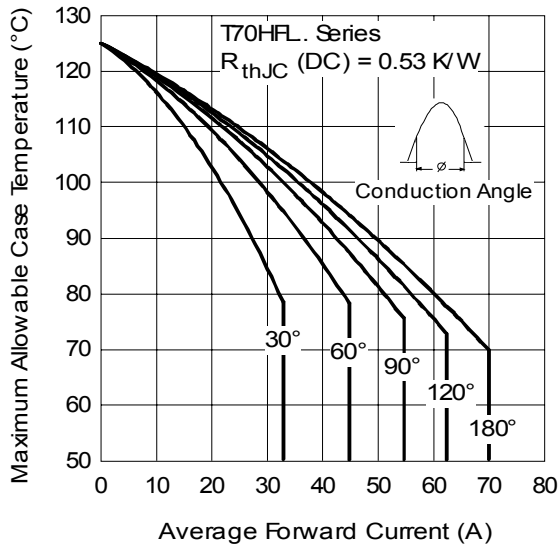


Fig. 3 - Current Ratings Characteristics

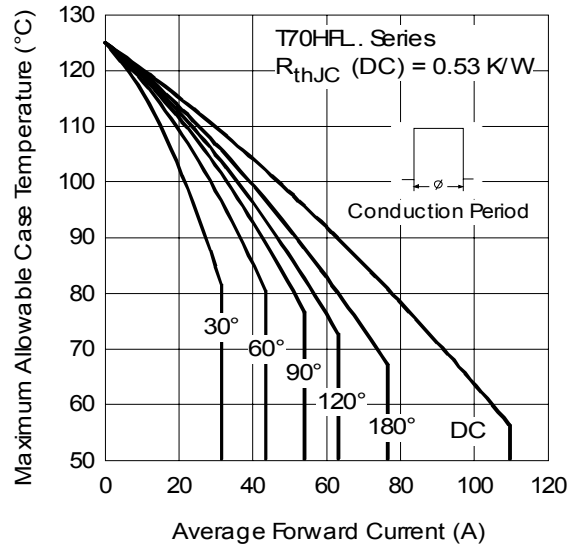


Fig. 4 - Current Ratings Characteristics

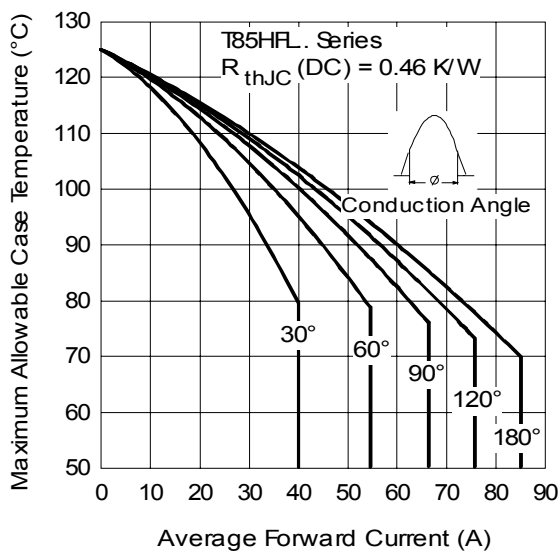


Fig. 5 - Current Ratings Characteristics

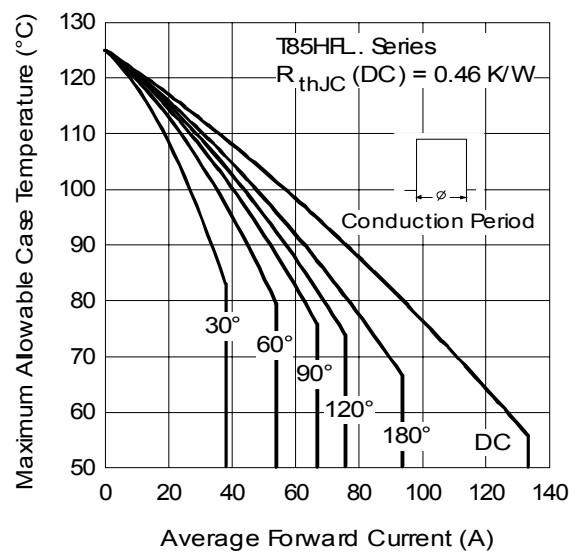


Fig. 6 - Current Ratings Characteristics

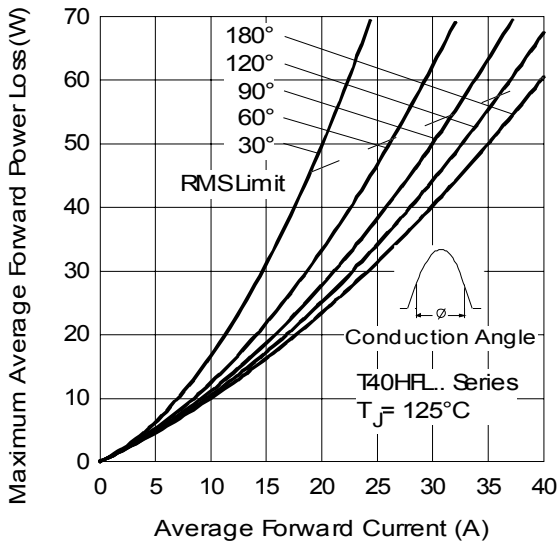


Fig. 7 - Forward Power Loss Characteristics

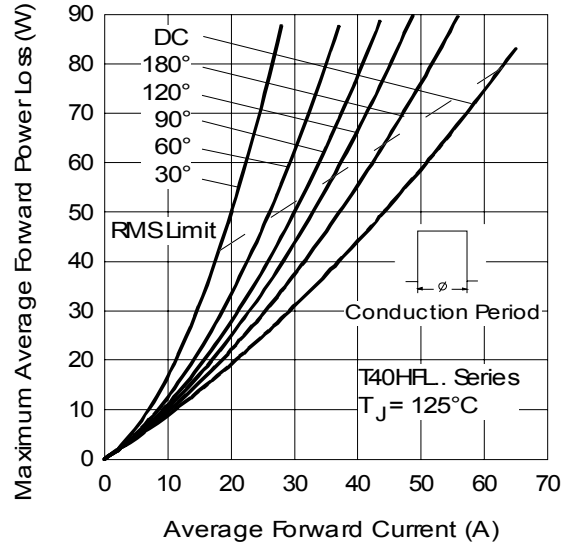


Fig. 8 - Forward Power Loss Characteristics

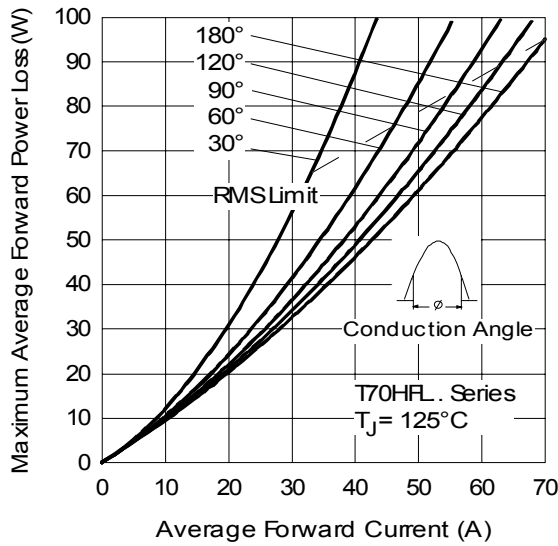


Fig. 9 - Forward Power Loss Characteristics

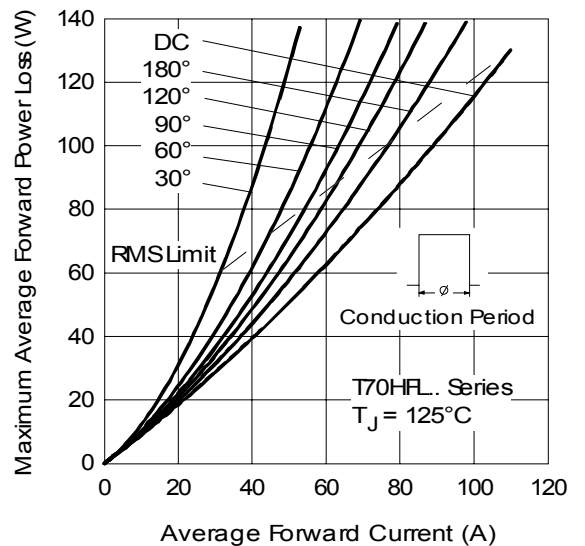


Fig. 10 - Forward Power Loss Characteristics

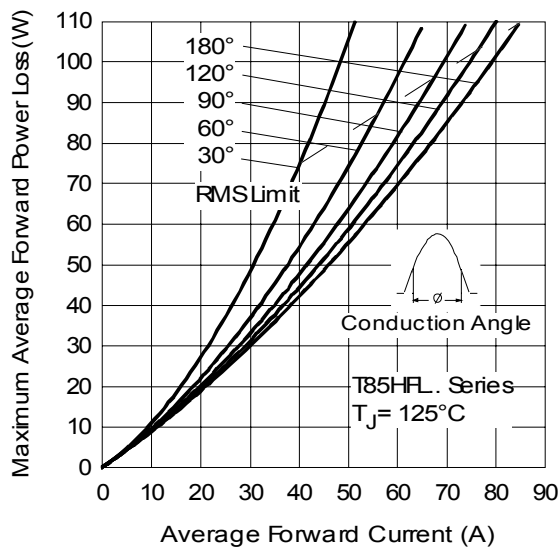


Fig. 11 - Forward Power Loss Characteristics

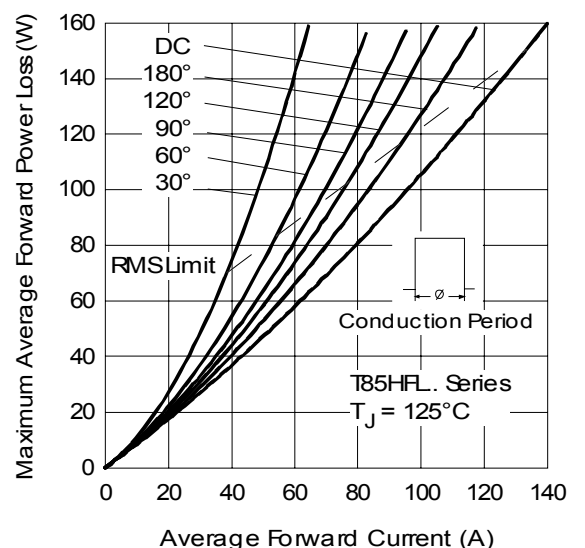


Fig. 12 - Forward Power Loss Characteristics

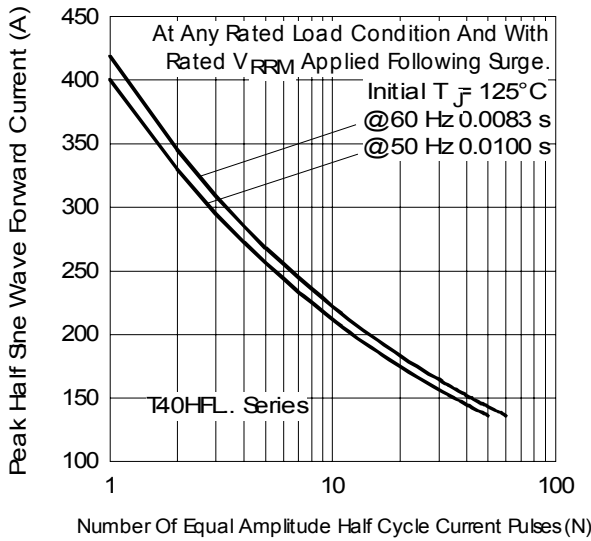


Fig. 13 - Maximum Non-Repetitive Surge Current

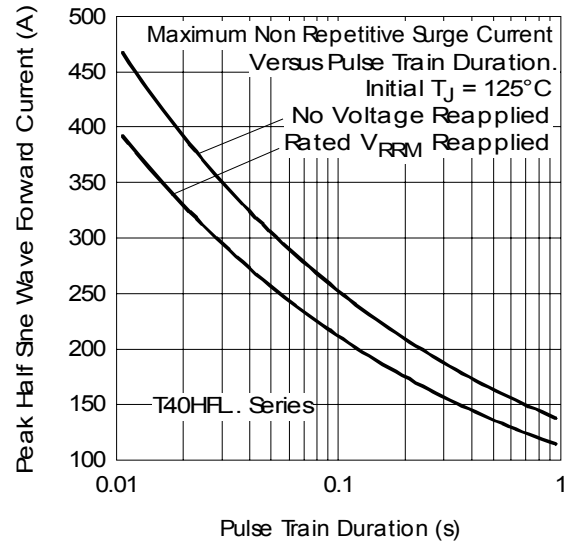


Fig. 14 - Maximum Non-Repetitive Surge Current

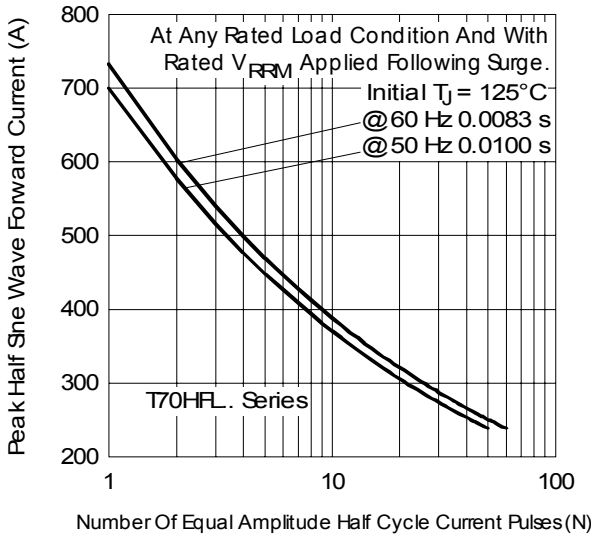


Fig. 15 - Maximum Non-Repetitive Surge Current

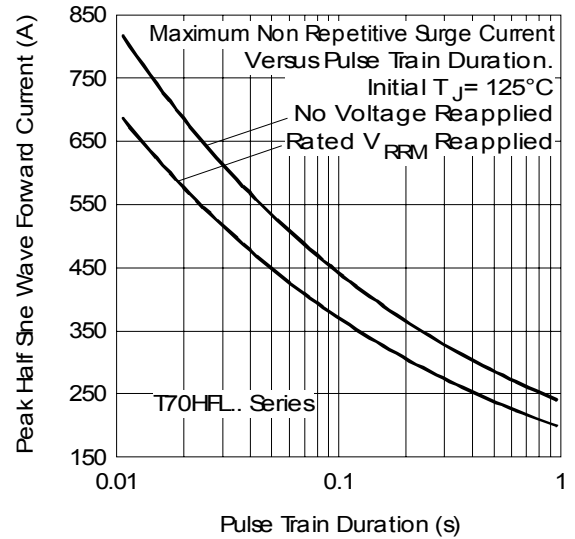


Fig. 16 - Maximum Non-Repetitive Surge Current

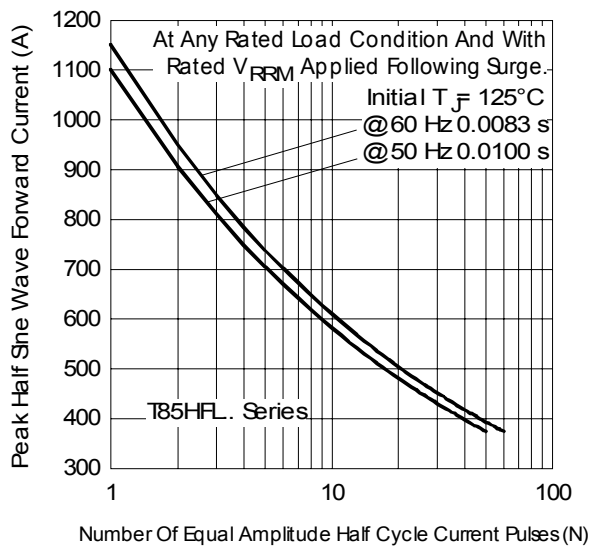


Fig. 17 - Maximum Non-Repetitive Surge Current

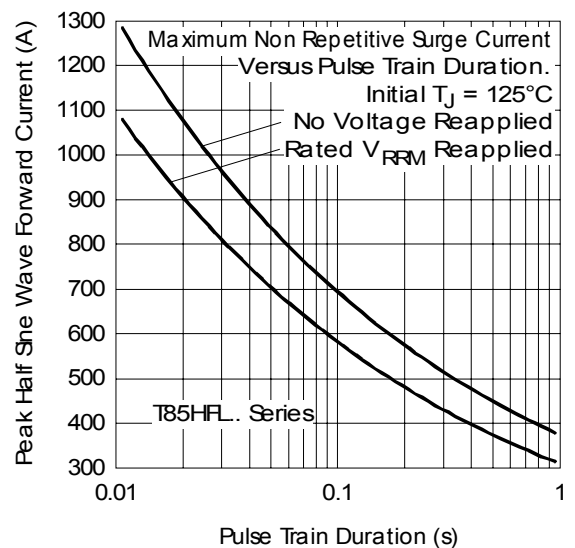


Fig. 18 - Maximum Non-Repetitive Surge Current

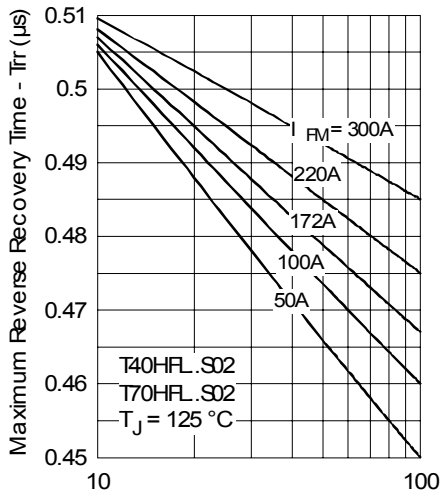


Fig. 19 - Recovery Time Characteristics

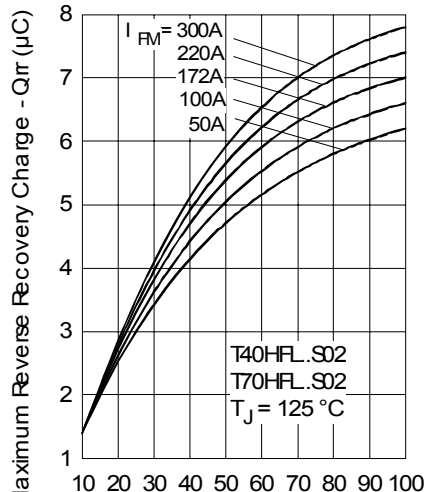


Fig. 20 - Recovery Charge Characteristics

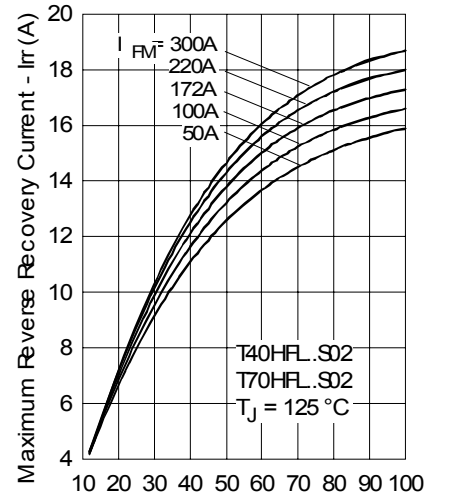


Fig. 21 - Recovery Current Characteristics

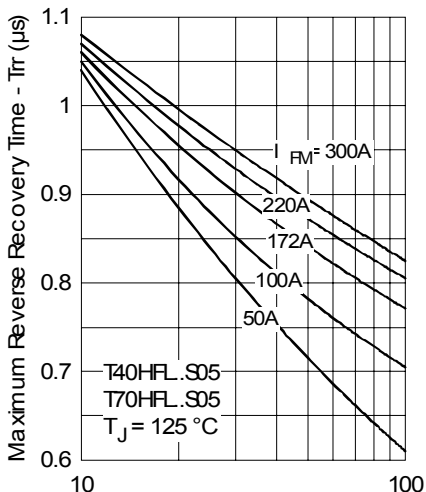


Fig. 22 - Recovery Time Characteristics

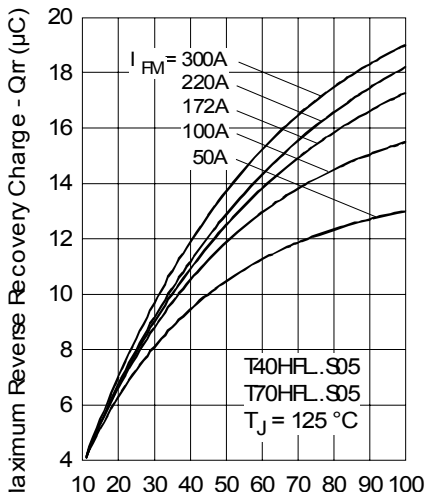


Fig. 23 - Recovery Charge Characteristics

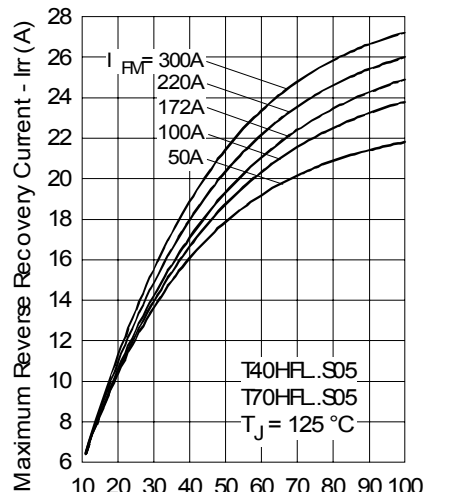


Fig. 24 - Recovery Current Characteristics

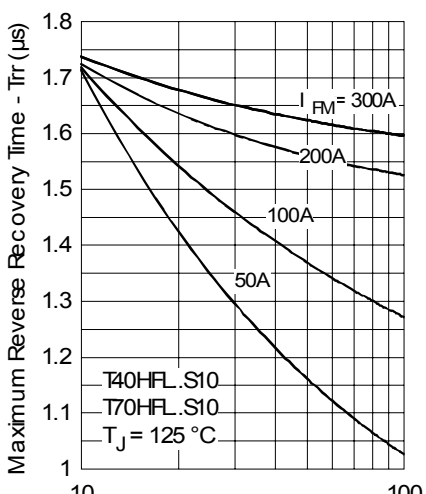


Fig. 25 - Recovery Time Characteristics

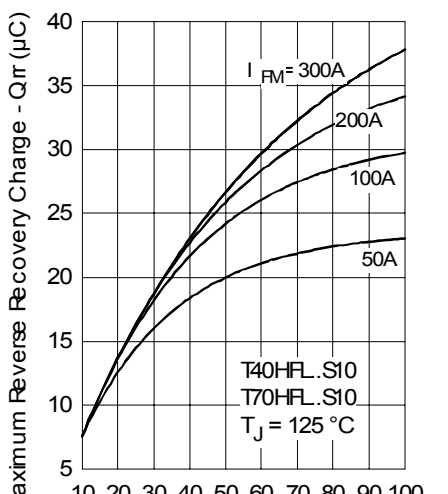


Fig. 26 - Recovery Charge Characteristics

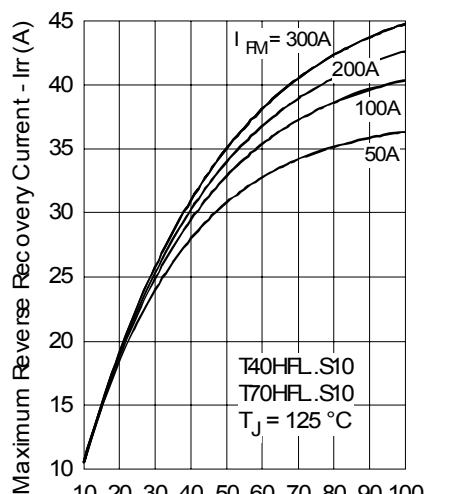
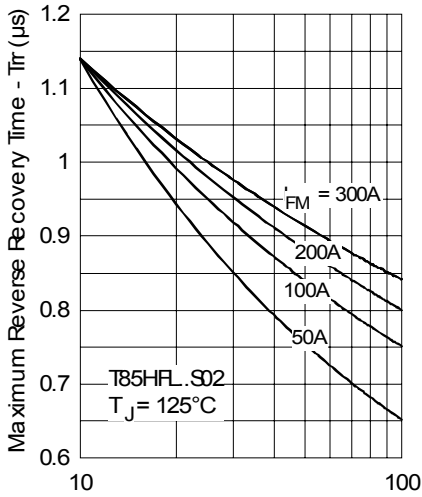


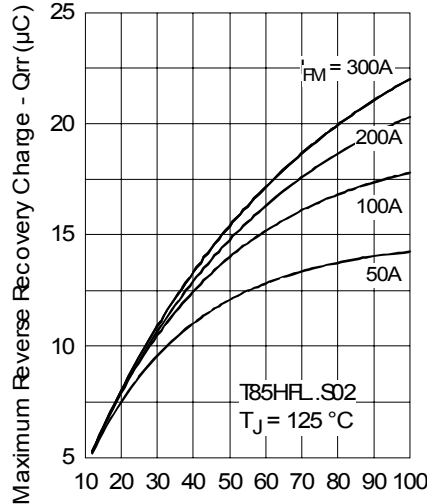
Fig. 27 - Recovery Current Characteristics





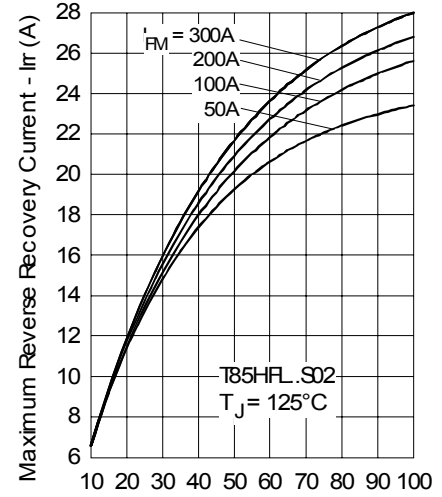
Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 28 - Recovery Time Characteristics



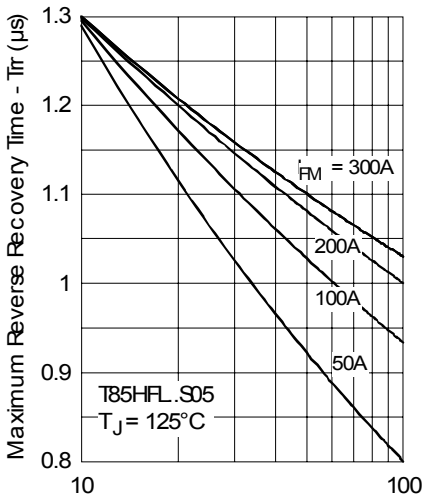
Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 29 - Recovery Charge Characteristics



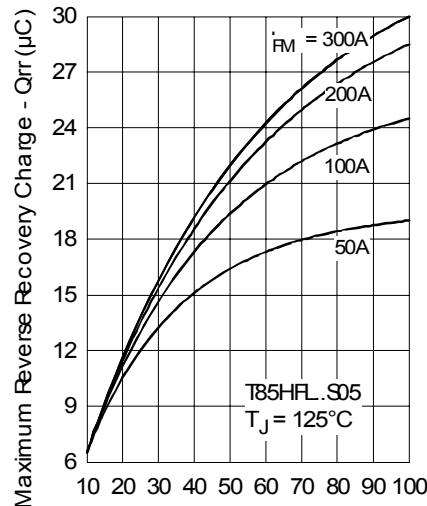
Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 30 - Recovery Current Characteristics



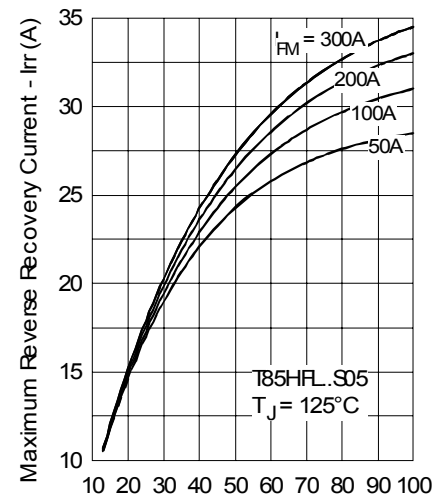
Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 31 - Recovery Time Characteristics



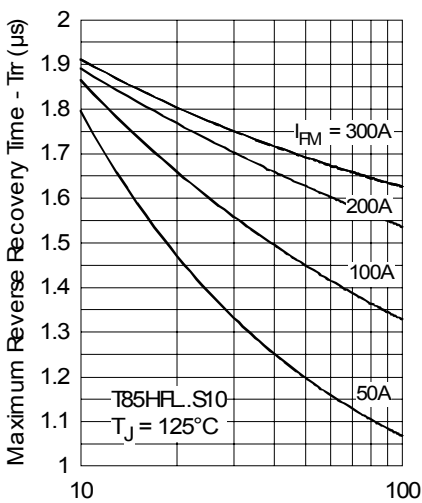
Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 32 - Recovery Charge Characteristics



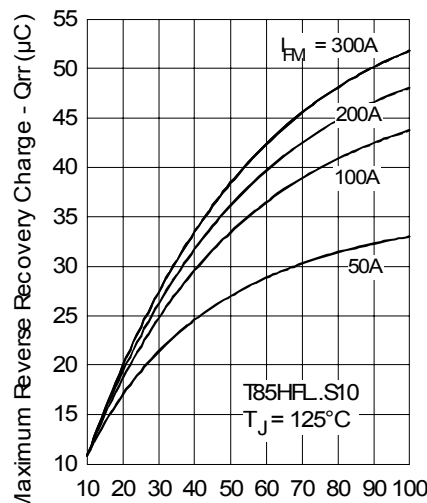
Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 33 - Recovery Current Characteristics



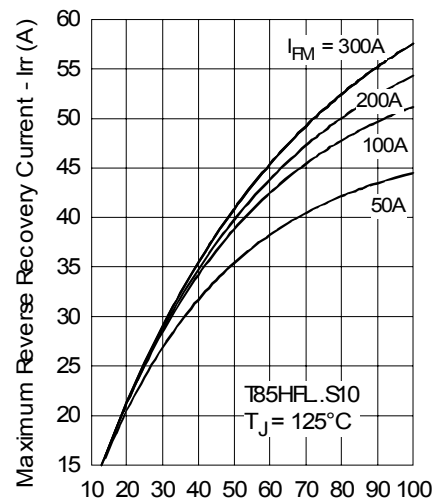
Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 34 - Recovery Time Characteristics



Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 35 - Recovery Charge Characteristics



Rate Of Fall Of Forward Current -  $di/dt$  (A/ $\mu$ s)

Fig. 36 - Recovery Current Characteristics

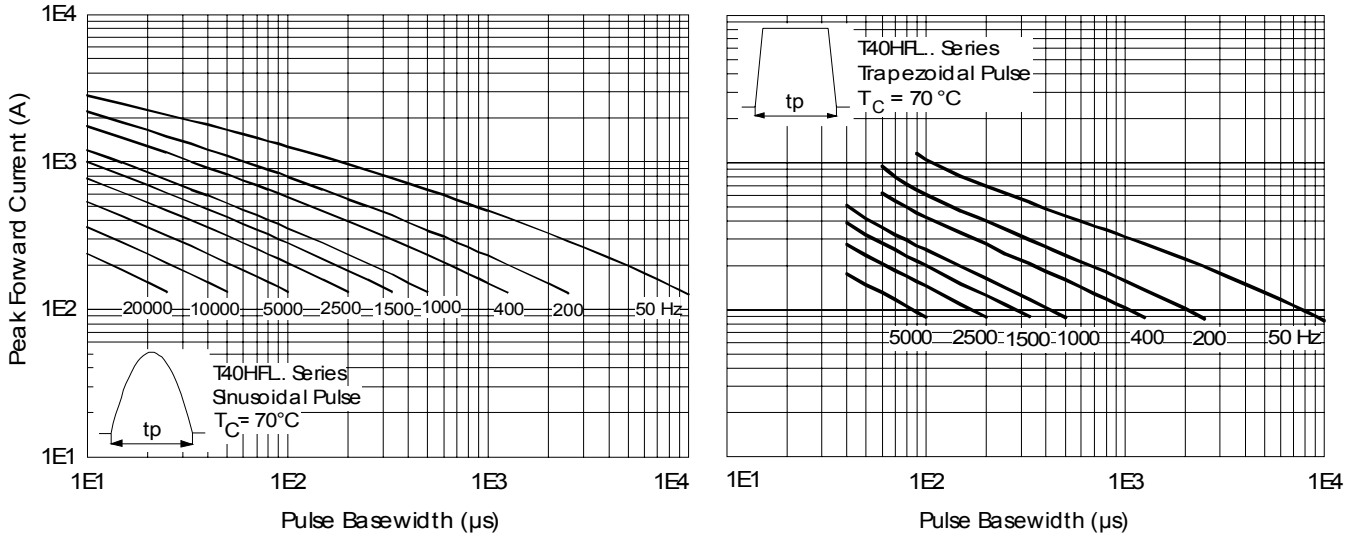


Fig. 37 - Frequency Characteristics

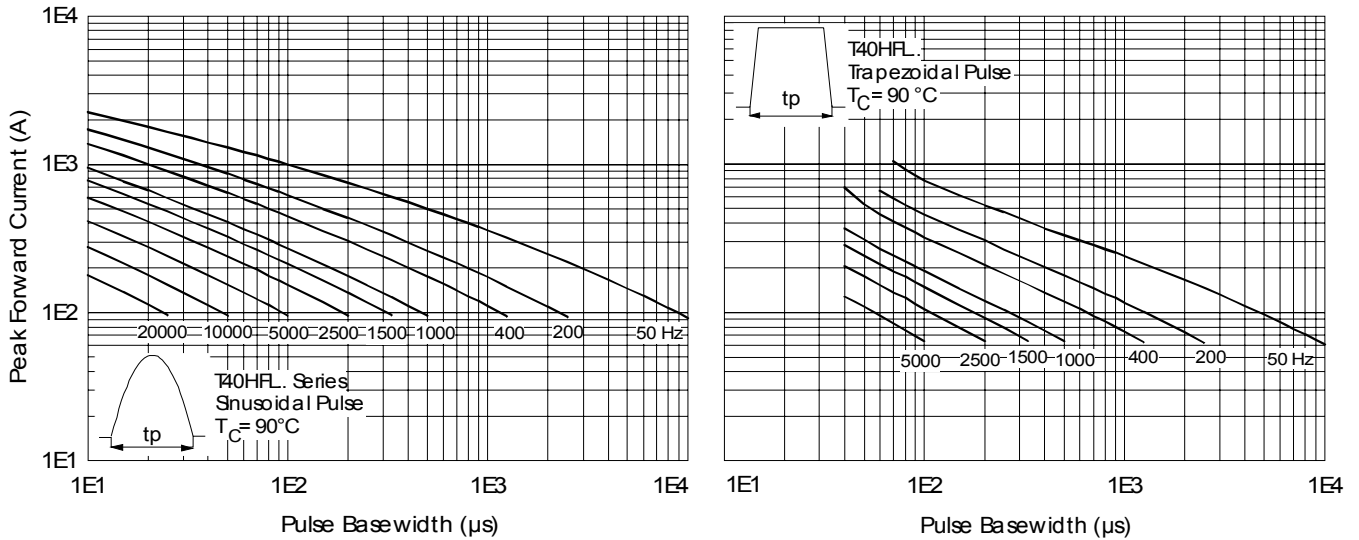


Fig. 38 - Frequency Characteristics

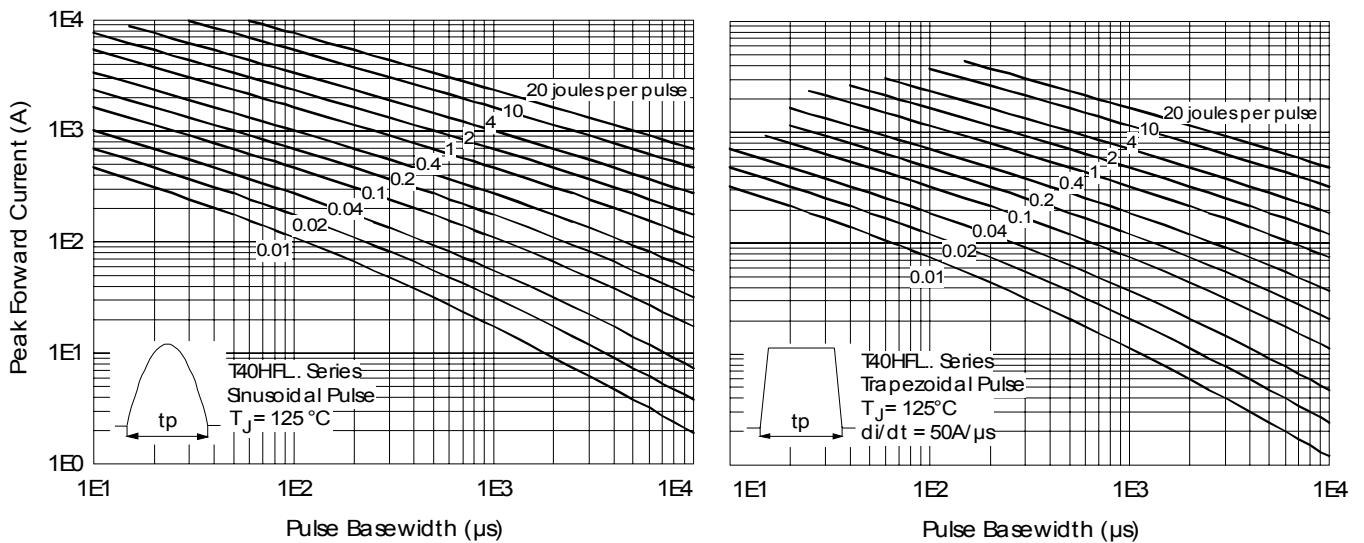
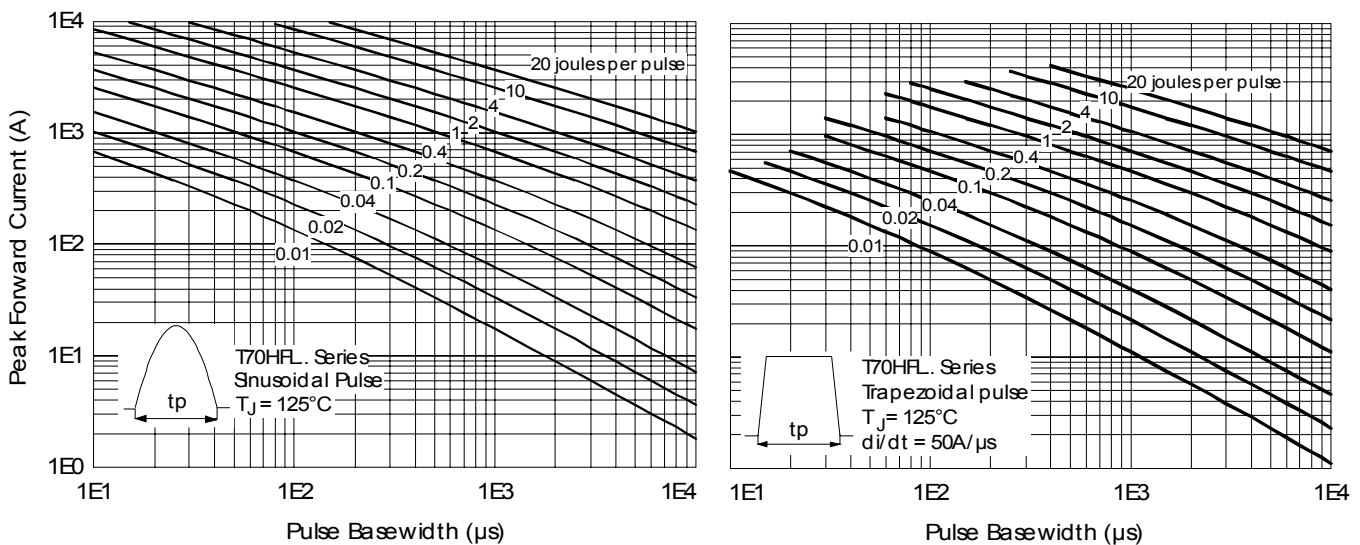
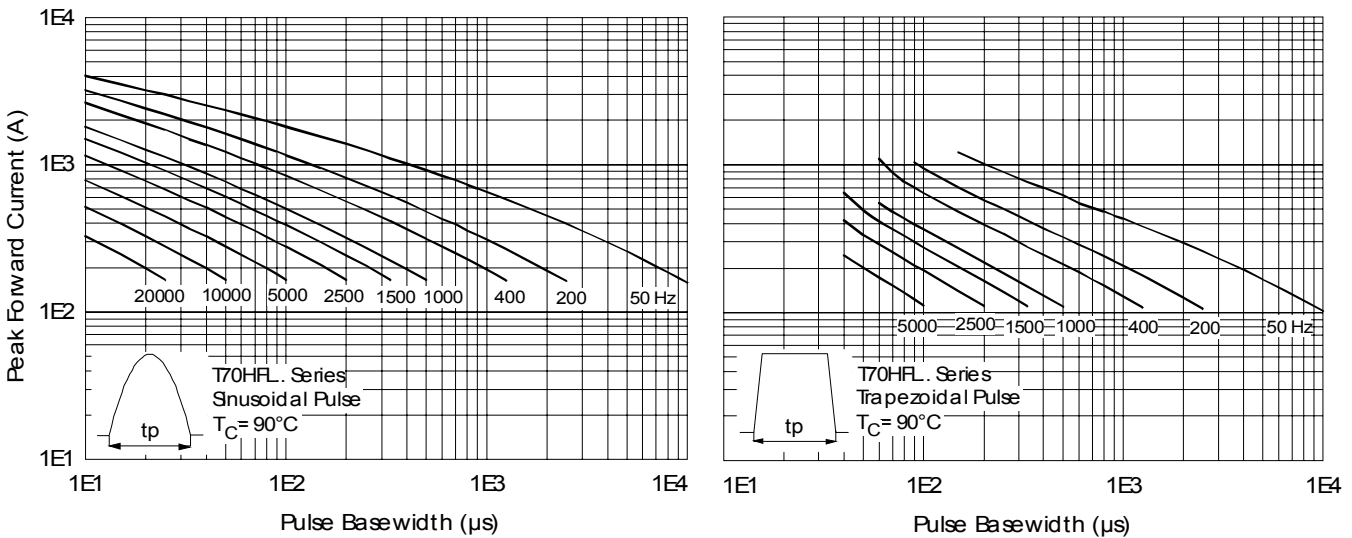
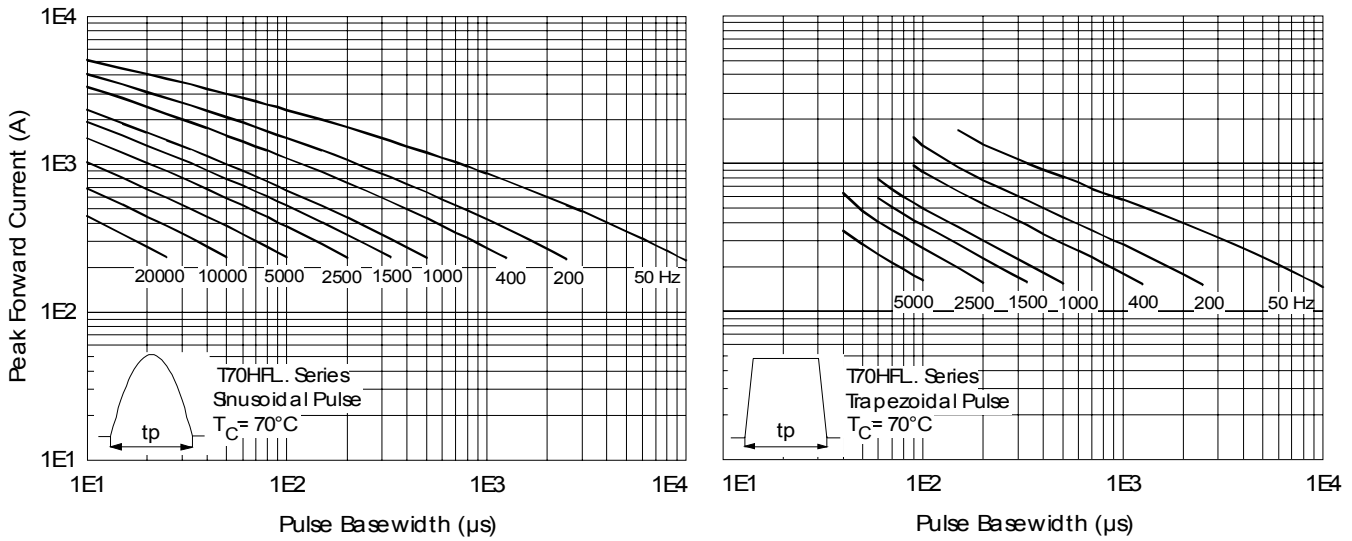


Fig. 39 - Maximum Forward Energy Power Loss Characteristics



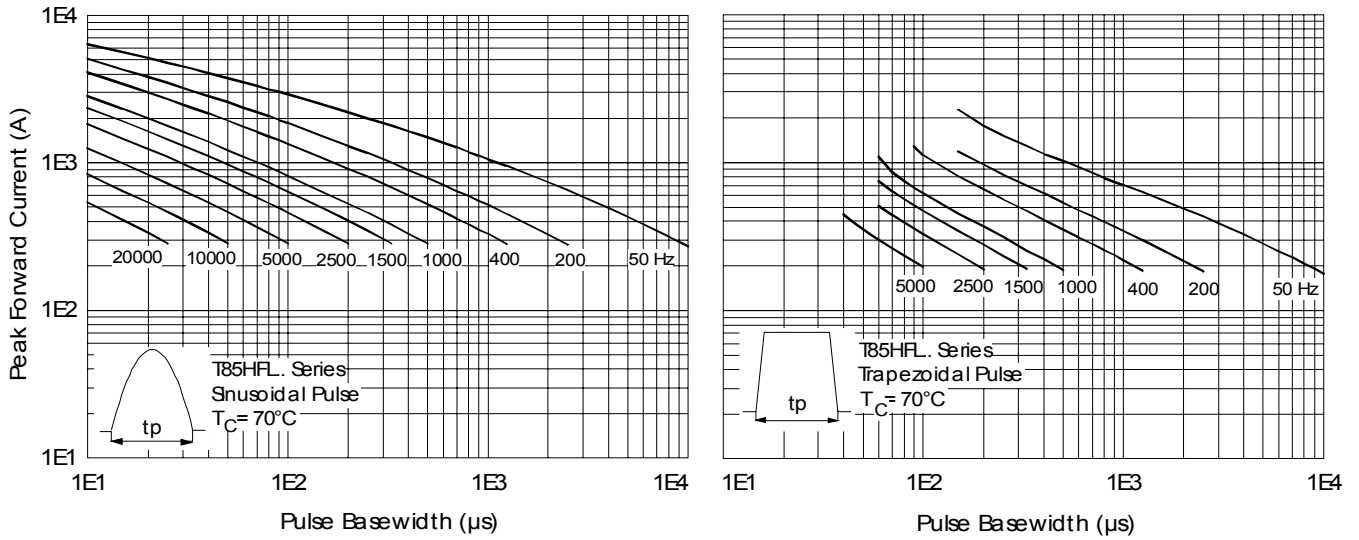


Fig. 43 - Frequency Characteristics

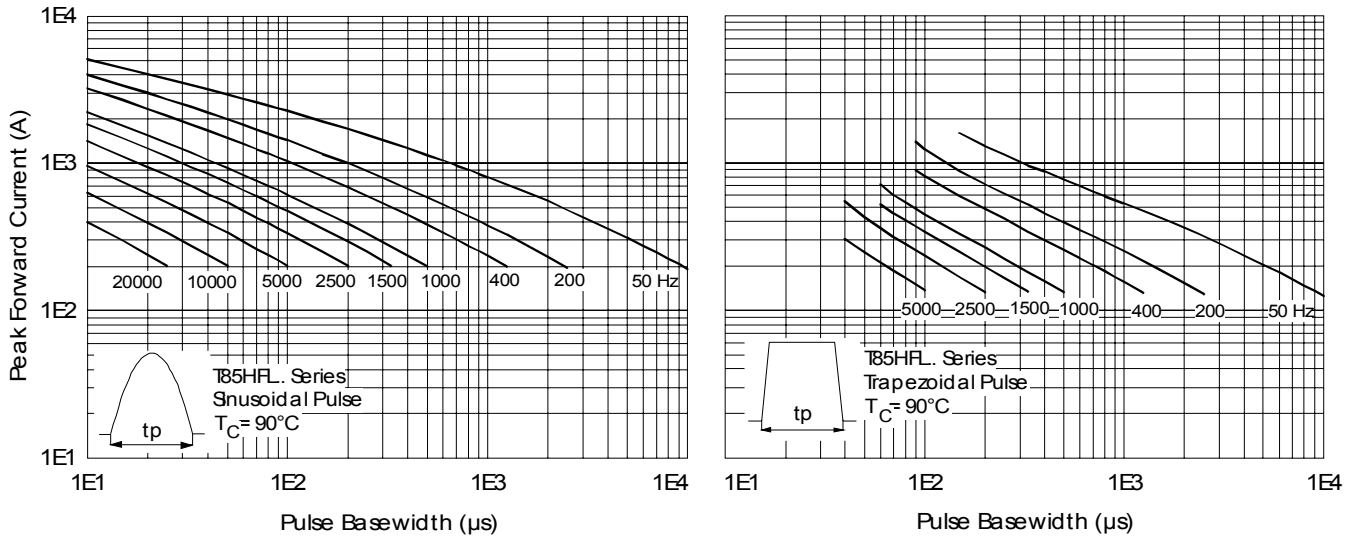


Fig. 44 - Frequency Characteristics

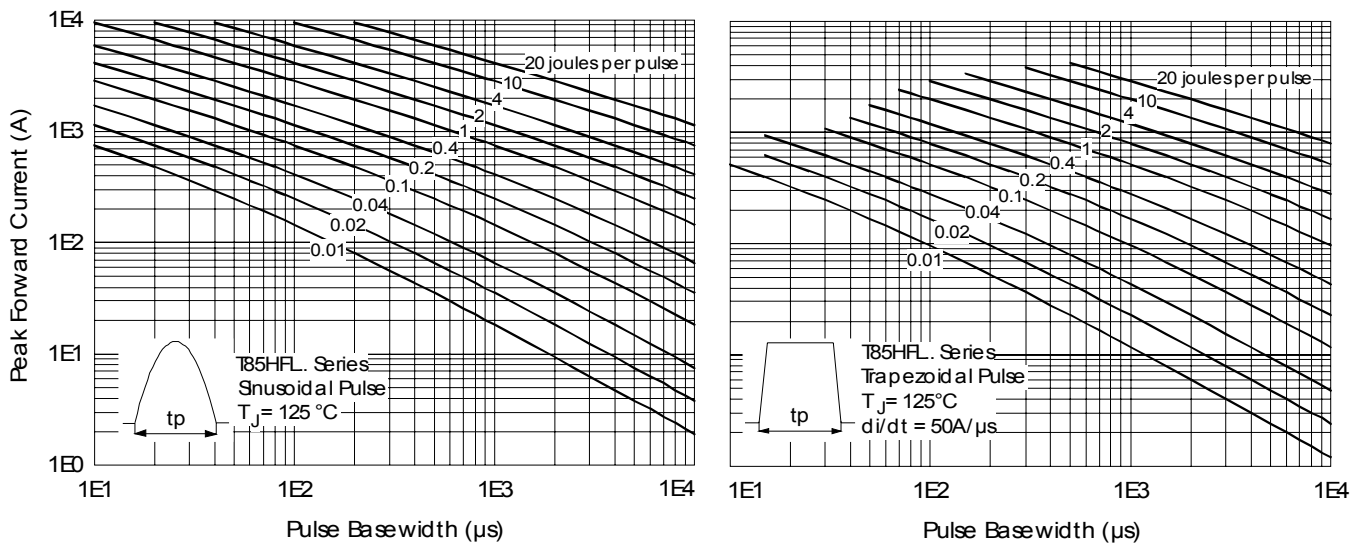


Fig. 45 - Maximum Forward Energy Power Loss Characteristics

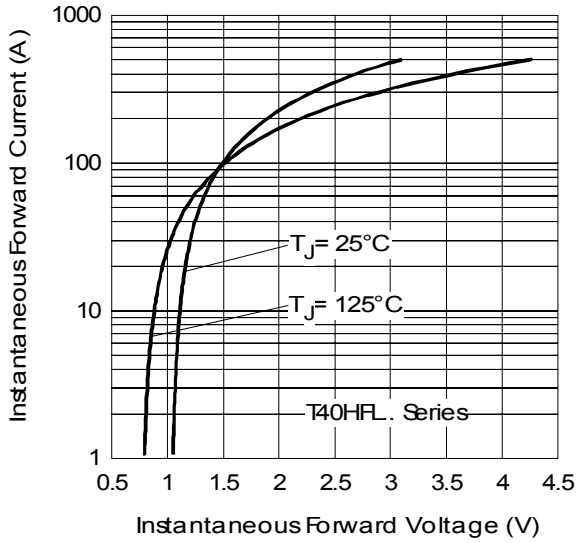


Fig. 46 - Forward Voltage Drop Characteristics

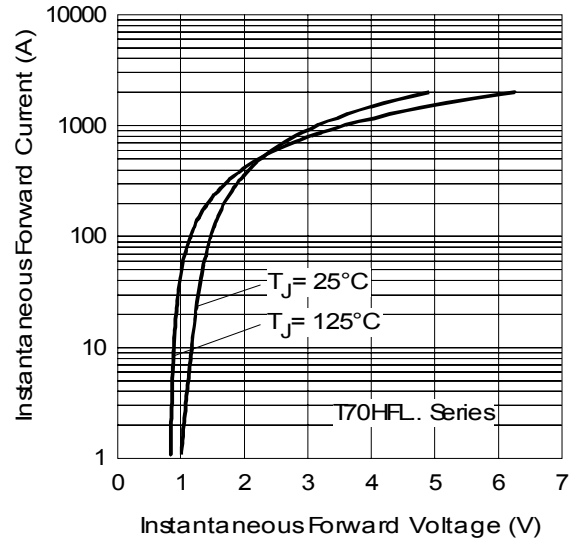


Fig. 47 - Forward Voltage Drop Characteristics

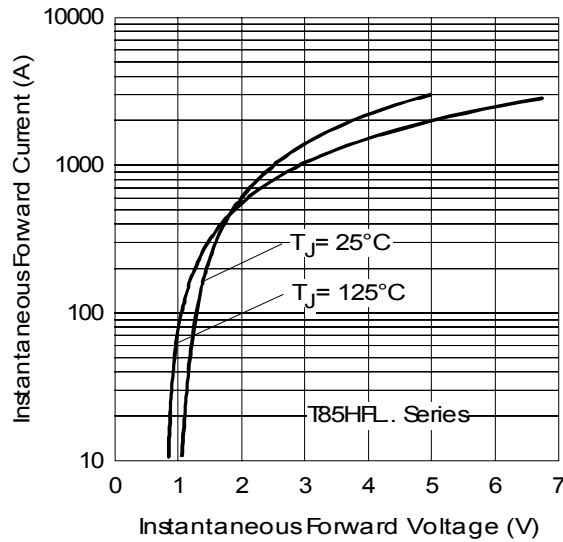


Fig. 48 - Forward Voltage Drop Characteristics

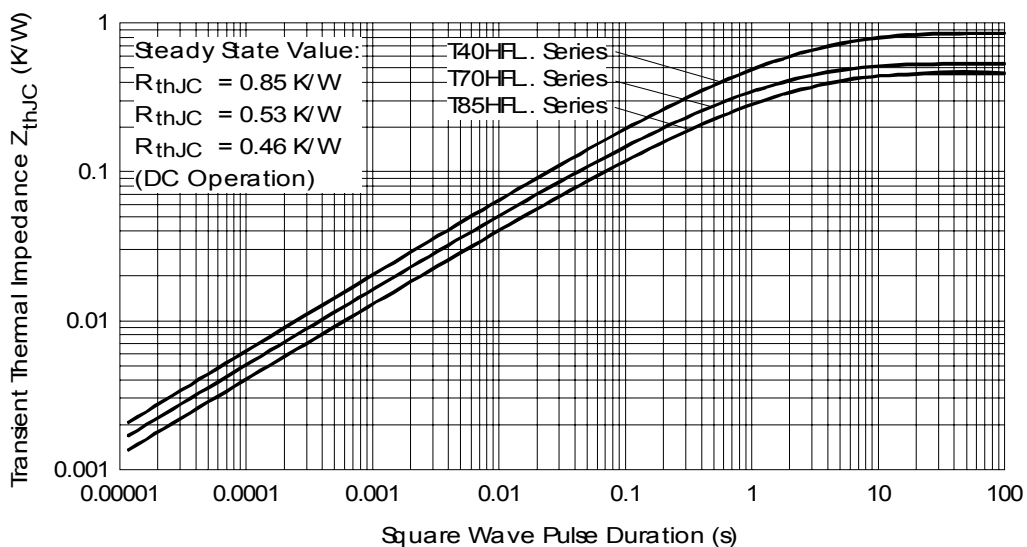


Fig. 49 - Thermal Impedance  $Z_{thJC}$  Characteristics

Data and specifications subject to change without notice.  
This product has been designed and qualified for Industrial Level.  
Qualification Standards can be found on IR's Web site.

International  
**IOR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7309

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