


### 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 

40 A  
70 A  
85 A

#### Description

This series 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 <sub>F(AV)</sub>	40	70	85	A	
I <sub>F(RMS)</sub>	63	110	133	A	
I <sub>FSM</sub>	50Hz	475	830	1300	A
	60Hz	500	870	1370	A
I <sup>2</sup> t	50Hz	1130	3460	8550	A <sup>2</sup> s
	60Hz	1030	3160	7810	A <sup>2</sup> s
V <sub>RRM</sub> range	100 to 1000			V	
t <sub>rr</sub> range	200 to 1000			ns	
T <sub>J</sub> range	-40 to 125			°C	

**ELECTRICAL SPECIFICATIONS**

**Voltage Ratings**

Type number	Voltage Code	t <sub>rr</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 μ A
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	70 70	85 70	A °C	180° conduction, half sine wave
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	475 500 400 420	830 870 700 730	1300 1370 1100 1150	A	t = 10ms t = 8.3ms t = 10ms t = 8.3ms No voltage reappplied 100% V <sub>RRM</sub> reappplied Sinusoidal half wave, Initial T <sub>J</sub> = T <sub>J</sub> max.
I <sup>2</sup> t Maximum I <sup>2</sup> t for fusing	1130 1030 800 730	3460 3160 2450 2230	8550 7810 6050 5520	A <sup>2</sup> s	t = 10ms t = 8.3ms t = 10ms t = 8.3ms No voltage reappplied 100% V <sub>RRM</sub> 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 = 400 μs 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 <sub>J</sub> Junction operating temp.	-40 to 125			°C	
T <sub>stg</sub> Storage temperature range	-40 to 150			°C	
R <sub>thJC</sub> Max. internal thermal resistance junction to case	0.85	0.53	0.46	K/W	Per module, DC operation
R <sub>thC-S</sub> Thermal resistance, case to heatsink	0.2			K/W	Mounting surface flat, smooth and greased. Per module
T Mounting Base to torque ±10% heatsink	1.3±10%			Nm	M3.5 mounting screws (2) Non-lubricated threads
Busbar to Terminal	3±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

ΔR Conduction

(The following table shows the increment of thermal resistance R<sub>thJC</sub> when devices operate at different conduction angles than DC)

Devices	Sinusoidal conduction @ T <sub>J</sub> max.					Rectangular conduction @ T <sub>J</sub> 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 <sub>rr</sub> Maximum reverse recovery time	70	110	270	70	110	270	80	120	290	ns	T <sub>J</sub> = 25 °C, -di <sub>F</sub> /dt = 100A/μs I <sub>F</sub> = 1 A to V <sub>R</sub> = 30V
	200	500	1000	200	500	1000	200	500	1000	ns	T <sub>J</sub> = 25 °C, -di <sub>F</sub> /dt = 25A/μs I <sub>FM</sub> = π x rated I <sub>F(AV)</sub> , V <sub>R</sub> = -30 V
Q <sub>rr</sub> Maximum reverse recovered charge	0.25	0.4	1.35	0.25	0.4	1.35	0.3	0.6	1.6	μC	T <sub>J</sub> = 25 °C, -di <sub>F</sub> /dt = 100A/μs I <sub>F</sub> = 1 A to V <sub>R</sub> = 30V
	0.55	2.0	8.0	0.6	2.1	8.5	0.8	3.5	1.5	μC	T <sub>J</sub> = 25 °C, -di <sub>F</sub> /dt = 25A/μs I <sub>FM</sub> = π x rated I <sub>F(AV)</sub> , V <sub>R</sub> = -30 V

(\*) Tested on LEM 300A Diode Tester

## T..HFL Series

Bulletin I27107 rev. A 09/97

International  
**IR** Rectifier

### Ordering Information Table

Device Code				
T	40	HFL	100	S10
①	②	③	④	⑤

- 1** - Module type
- 2** - Current rating: 40 = 40A (avg)  
70 = 70A (avg)  
85 = 85A (avg)
- 3** - Fast recovery 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)

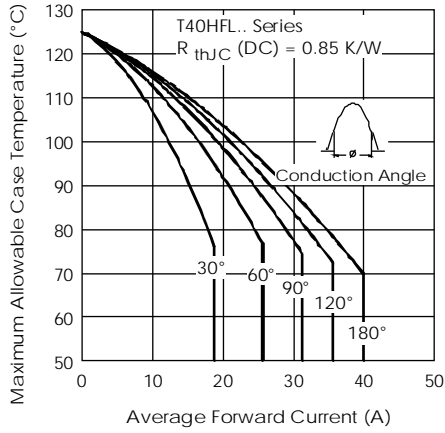


Fig. 1 - Current Ratings Characteristics

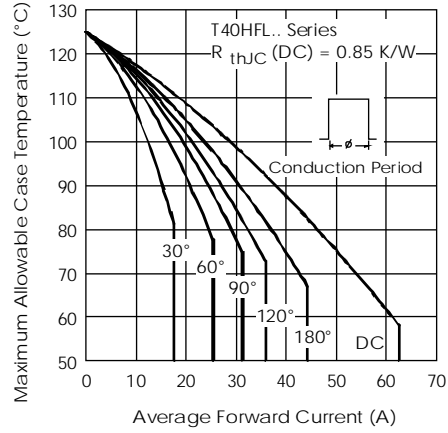


Fig. 2 - Current Ratings Characteristics

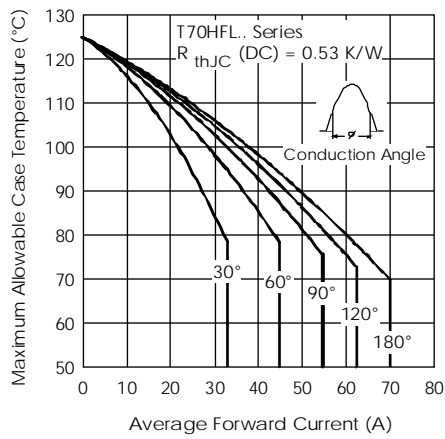


Fig. 3 - Current Ratings Characteristics

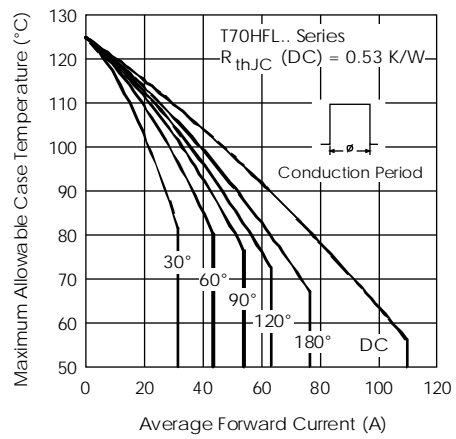


Fig. 4 - Current Ratings Characteristics

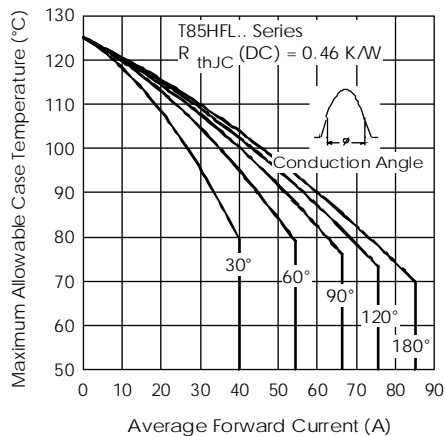


Fig. 5 - Current Ratings Characteristics

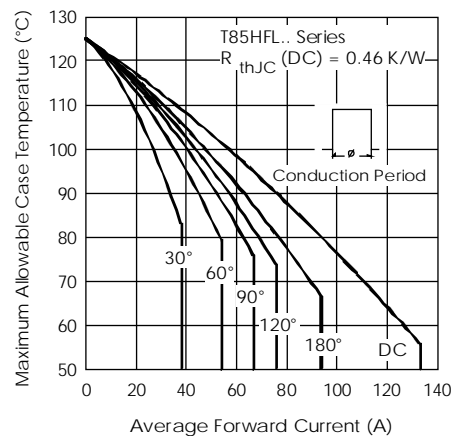


Fig. 6 - Current Ratings Characteristics

**T..HFL Series**

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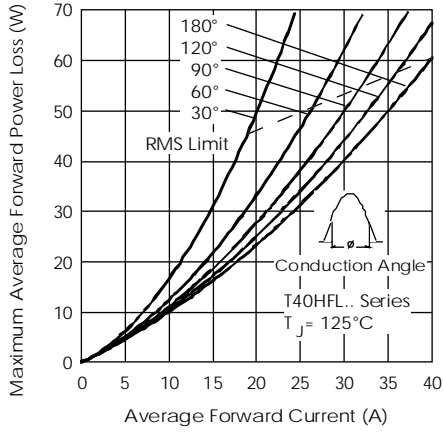


Fig. 7 - Forward Power Loss Characteristics

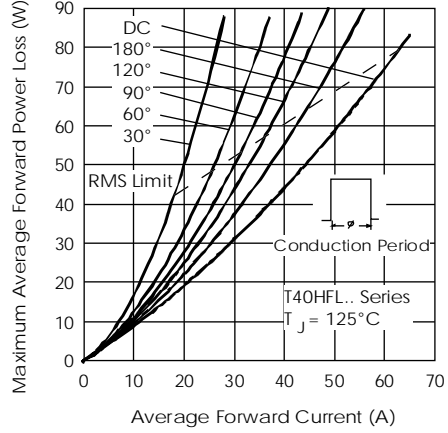


Fig. 8 - Forward Power Loss Characteristics

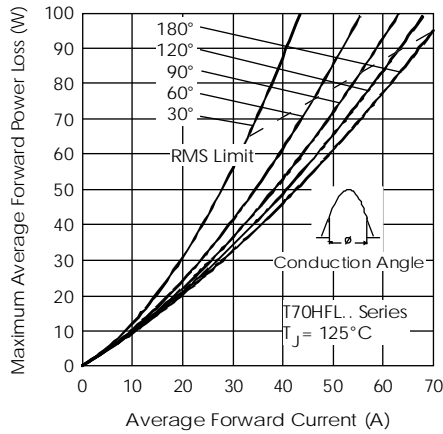


Fig. 9 - Forward Power Loss Characteristics

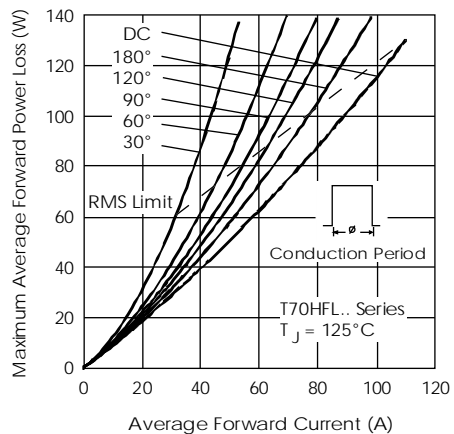


Fig. 10 - Forward Power Loss Characteristics

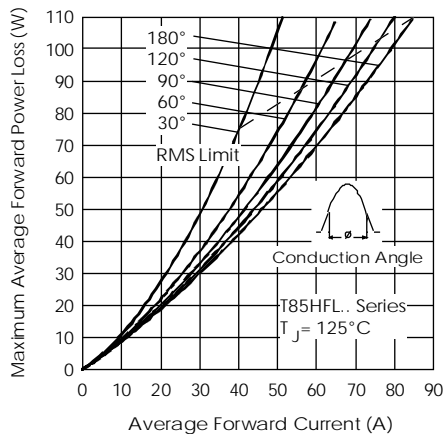


Fig. 11 - Forward Power Loss Characteristics

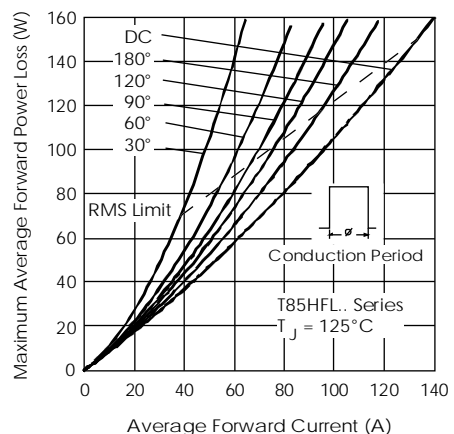


Fig. 12 - Forward Power Loss Characteristics

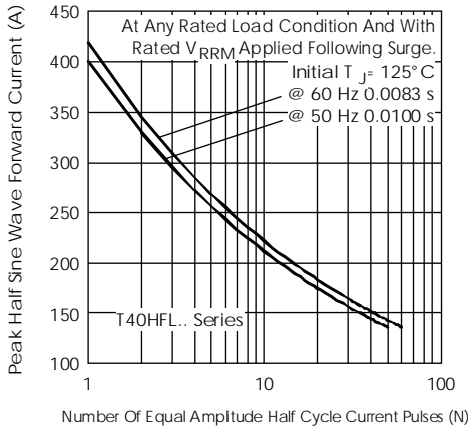


Fig. 13 - Maximum Non-Repetitive Surge Current

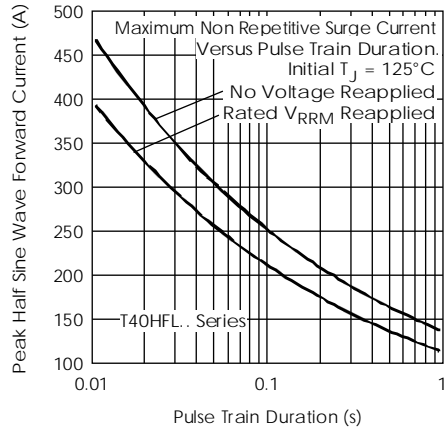


Fig. 14 - Maximum Non-Repetitive Surge Current

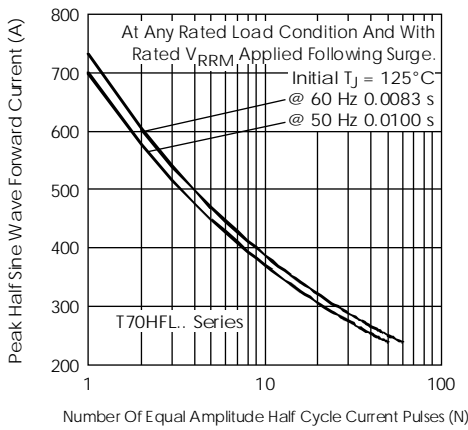


Fig. 15 - Maximum Non-Repetitive Surge Current

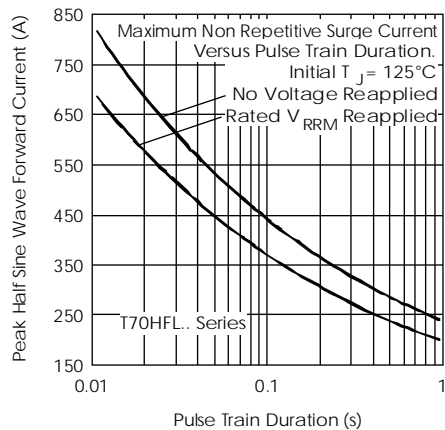


Fig. 16 - Maximum Non-Repetitive Surge Current

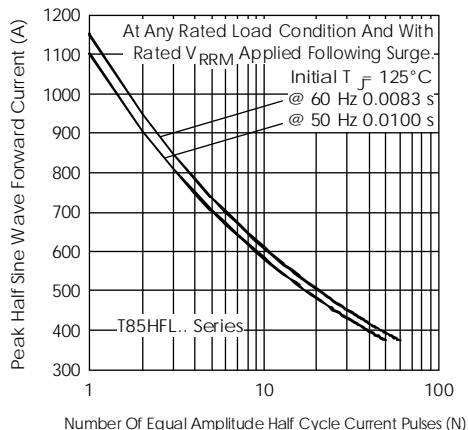


Fig. 17 - Maximum Non-Repetitive Surge Current

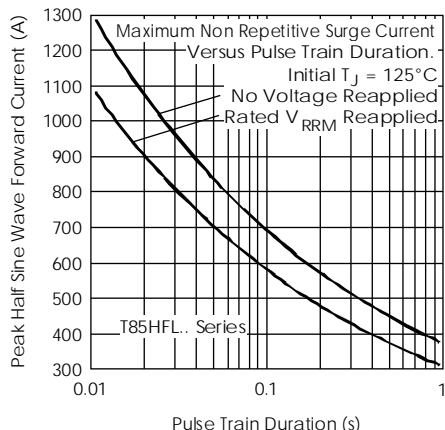


Fig. 18 - Maximum Non-Repetitive Surge Current

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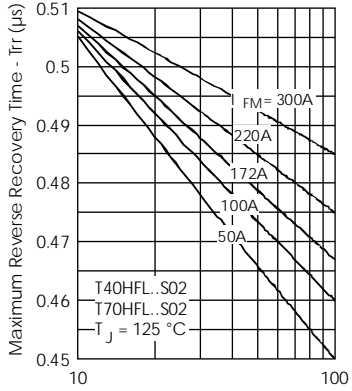


Fig. 19 - Recovery Time Characteristics

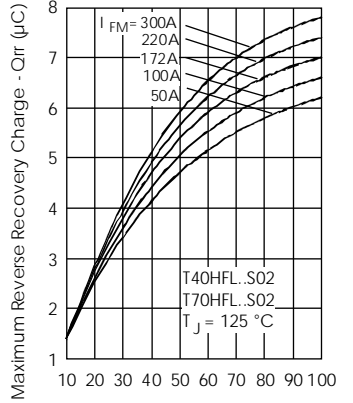


Fig. 20 - Recovery Charge Characteristics

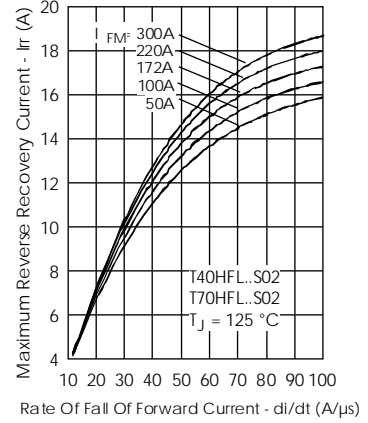


Fig. 21 - Recovery Current Characteristics

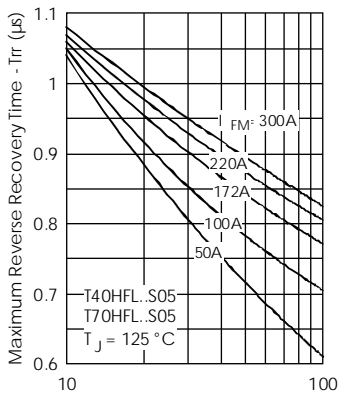


Fig. 22 - Recovery Time Characteristics

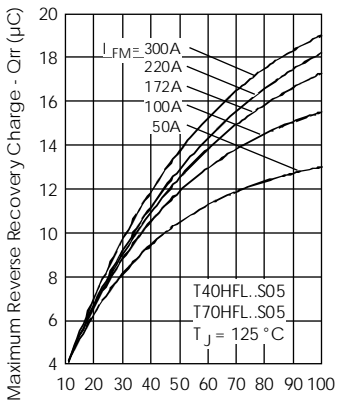


Fig. 23 - Recovery Charge Characteristics

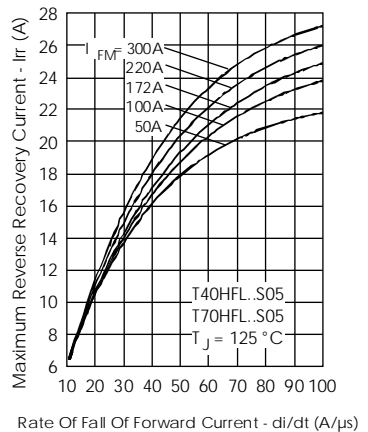


Fig. 24 - Recovery Current Characteristics

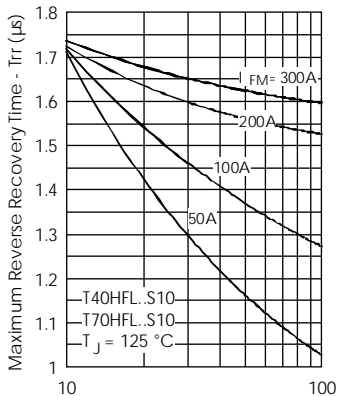


Fig. 25 - Recovery Time Characteristics

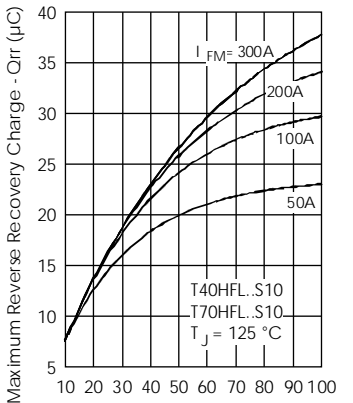


Fig. 26 - Recovery Charge Characteristics

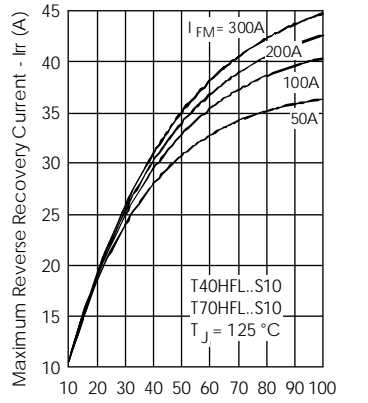
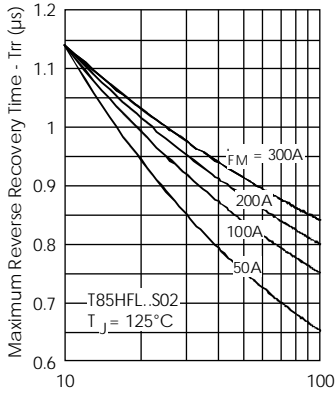


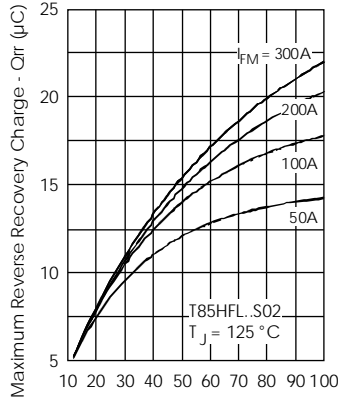
Fig. 27 - Recovery Current Characteristics





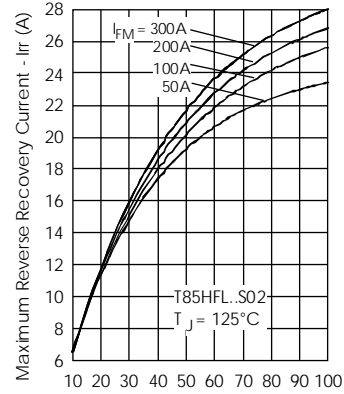
Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 28 - Recovery Time Characteristics



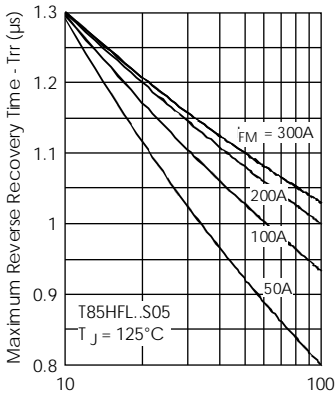
Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 29 - Recovery Charge Characteristics



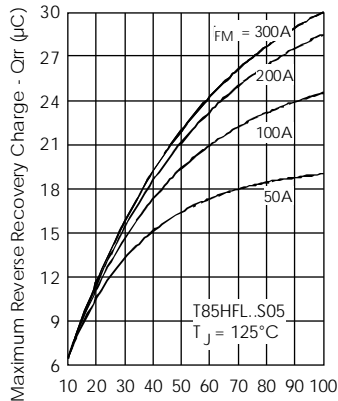
Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 30 - Recovery Current Characteristics



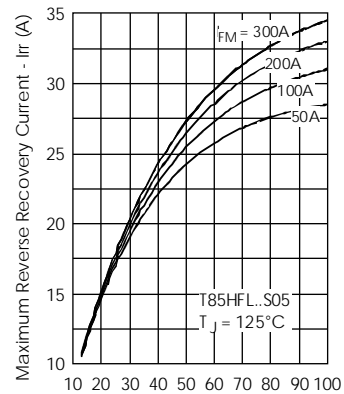
Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 31 - Recovery Time Characteristics



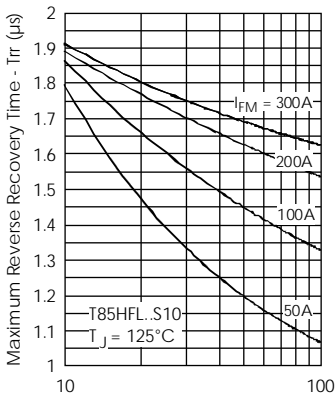
Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 32 - Recovery Charge Characteristics



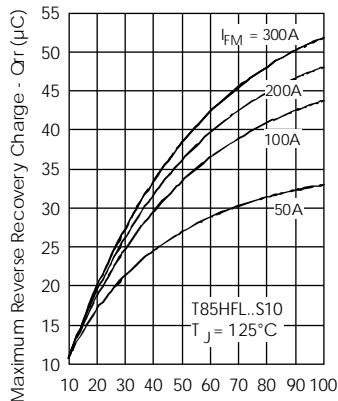
Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 33 - Recovery Current Characteristics



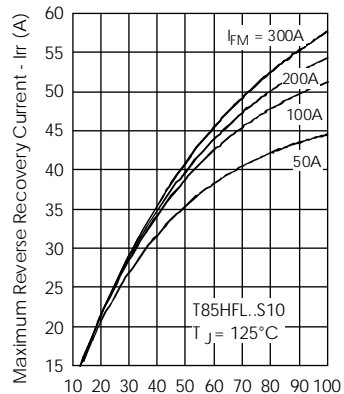
Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 34 - Recovery Time Characteristics



Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 35 - Recovery Charge Characteristics



Rate Of Fall Of Forward Current - di/dt (A/µs)

Fig. 36 - Recovery Current Characteristics

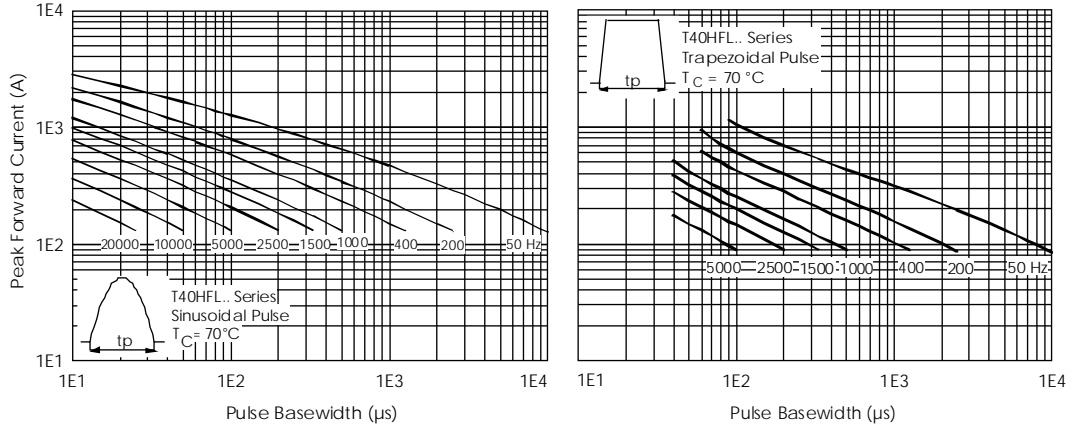


Fig. 37 - Frequency Characteristics

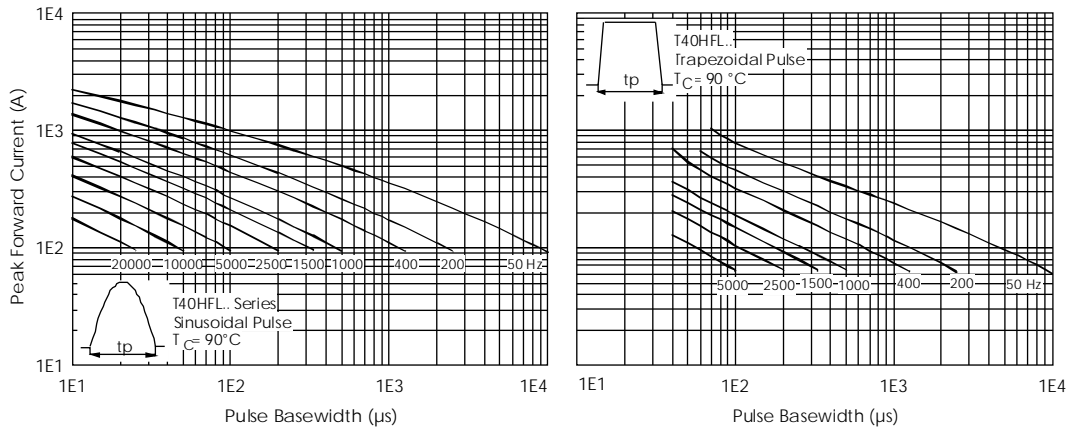


Fig. 38 - Frequency Characteristics

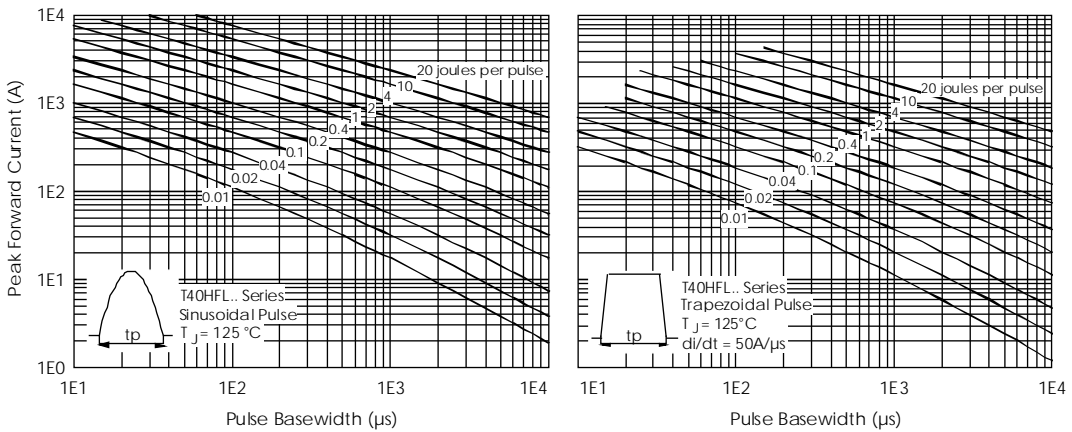


Fig. 39 - Maximum Forward Energy Power Loss Characteristics

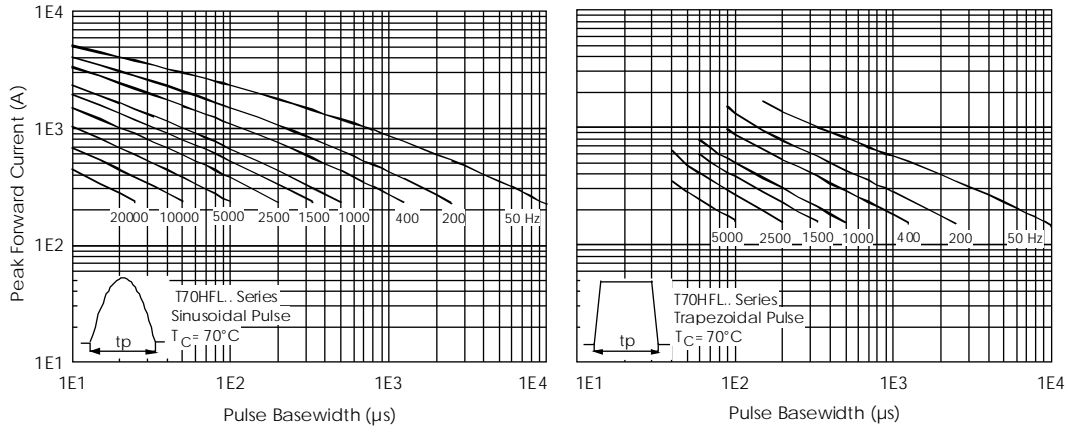


Fig. 40 - Frequency Characteristics

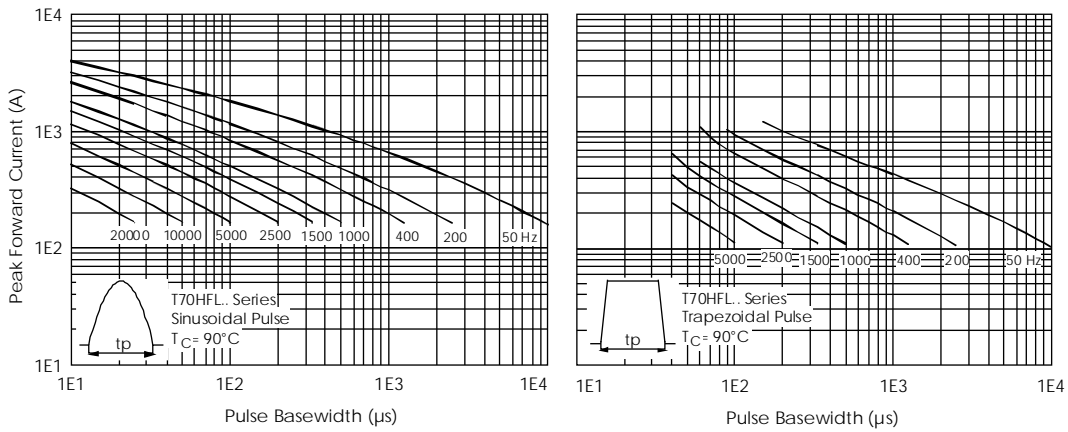


Fig. 41 - Frequency Characteristics

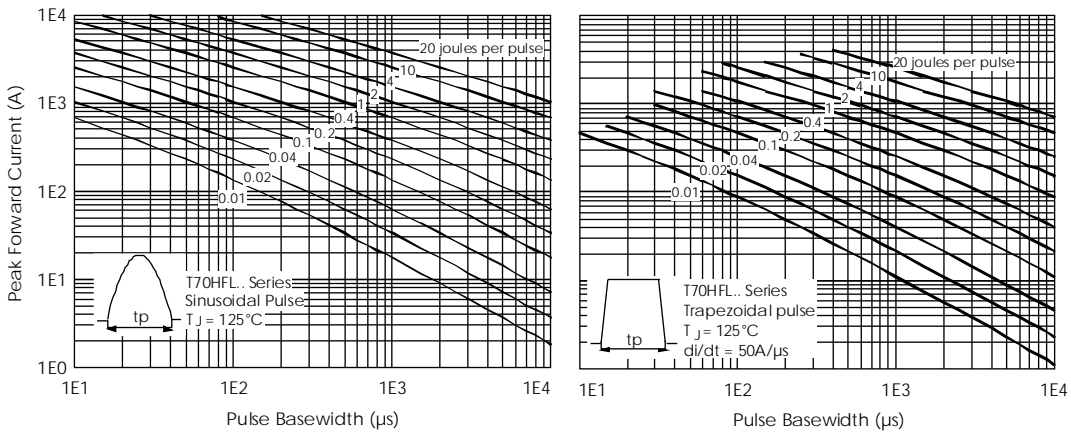


Fig. 42 - Maximum Forward Energy Power Loss Characteristics

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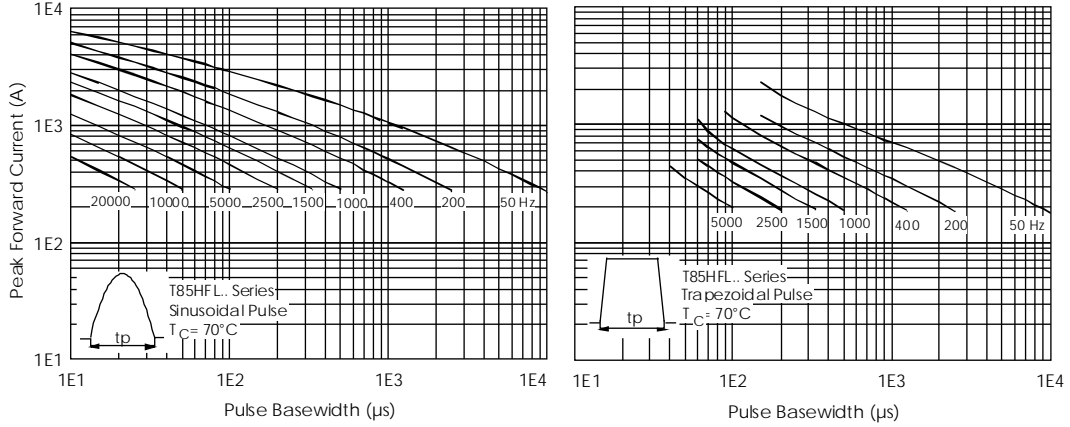


Fig. 43 - Frequency Characteristics

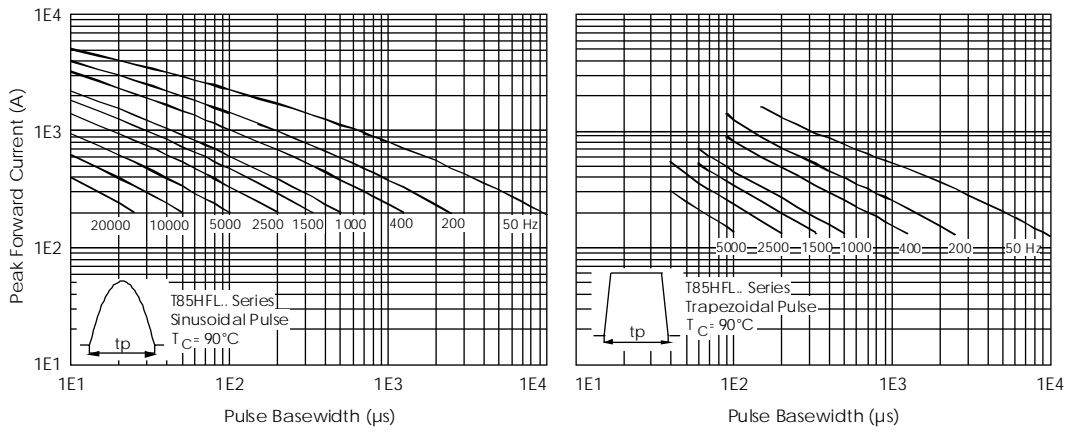


Fig. 44 - Frequency Characteristics

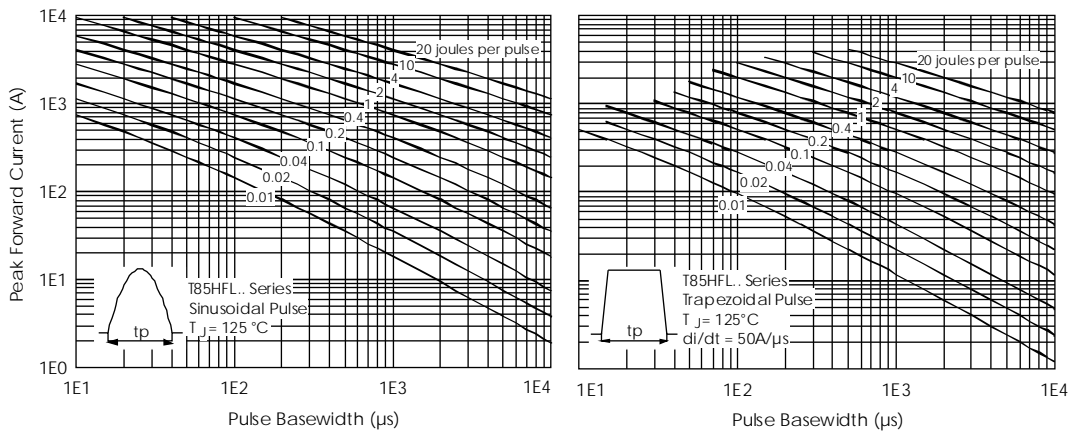


Fig. 45 - Maximum Forward Energy Power Loss Characteristics

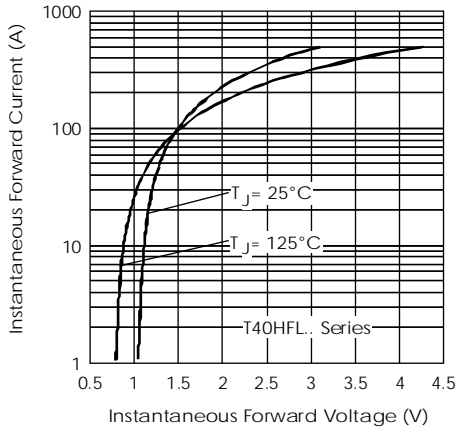


Fig. 46 - Forward Voltage Drop Characteristics

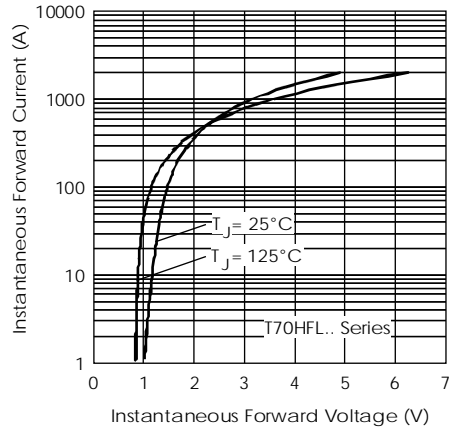


Fig. 47 - Forward Voltage Drop Characteristics

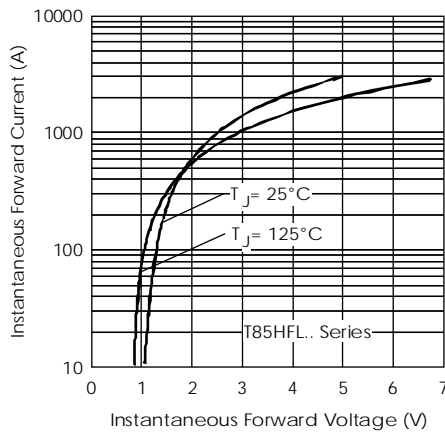


Fig. 48 - Forward Voltage Drop Characteristics

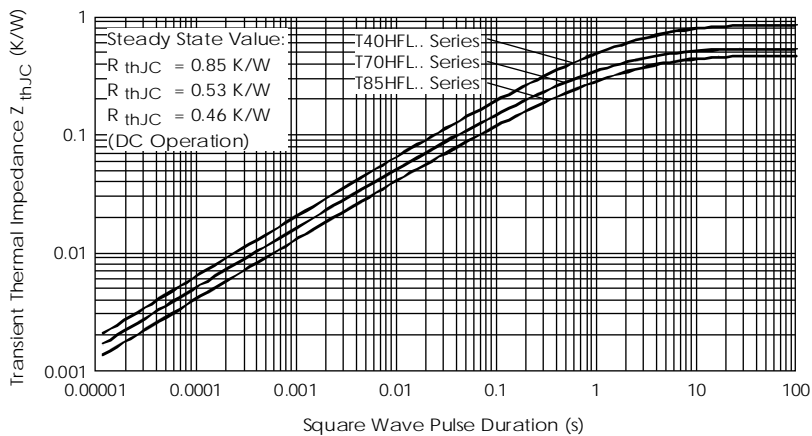


Fig. 49 - Thermal Impedance  $Z_{thJC}$  Characteristics