

## Fast Recovery Diodes (T-Modules), 40 A, 70 A, 85 A



D-55 (T-module)

### 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 
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### PRIMARY CHARACTERISTICS

|                       |                       |
|-----------------------|-----------------------|
| I <sub>F(AV)</sub>    | 40 A, 70 A, 85 A      |
| Type                  | Modules - diode, fast |
| V <sub>RRM</sub>      | 100 V to 1000 V       |
| Package               | D-55 (T-module)       |
| Circuit configuration | Single                |

### DESCRIPTION

The series of T-modules 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

| SYMBOL              | CHARACTERISTICS | VALUES      |        |        | UNITS            |
|---------------------|-----------------|-------------|--------|--------|------------------|
|                     |                 | T40HFL      | T70HFL | T85HFL |                  |
| I <sub>F(AV)</sub>  |                 | 40          | 70     | 85     | A                |
|                     | T <sub>C</sub>  | 70          | 70     | 70     | °C               |
| I <sub>F(RMS)</sub> |                 | 63          | 110    | 133    | A                |
| I <sub>FSM</sub>    | 50 Hz           | 475         | 830    | 1300   | A                |
|                     | 60 Hz           | 500         | 870    | 1370   |                  |
| I <sup>2</sup> t    | 50 Hz           | 1130        | 3460   | 8550   | A <sup>2</sup> s |
|                     | 60 Hz           | 1030        | 3160   | 7810   |                  |
| 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<br>V | V <sub>RSM</sub> , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | I <sub>RRM</sub> MAXIMUM AT T <sub>J</sub> = 25 °C<br>μA |
|-------------------------------------------|--------------|----------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------|
| VS_T40HFL..<br>VS_T70HFL..<br>VS_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                                            |                     |                                                                                                                                                                                                                          |                                  |                                                                       |        |        |        |                   |
|---------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|--------|--------|--------|-------------------|
| PARAMETER                                                     | SYMBOL              | TEST CONDITIONS                                                                                                                                                                                                          |                                  |                                                                       | VALUES |        |        | UNITS             |
|                                                               |                     |                                                                                                                                                                                                                          |                                  |                                                                       | T40HFL | T70HFL | T85HFL |                   |
| Maximum average forward current at case temperature           | I <sub>F(AV)</sub>  | 180° conduction, half sine wave                                                                                                                                                                                          |                                  |                                                                       | 40     | 70     | 85     | A                 |
|                                                               |                     |                                                                                                                                                                                                                          |                                  |                                                                       | 70     |        |        | °C                |
| Maximum RMS forward current                                   | I <sub>F(RMS)</sub> |                                                                                                                                                                                                                          |                                  |                                                                       | 63     | 110    | 133    | A                 |
| Maximum peak, one-cycle forward, non-repetitive surge current | I <sub>FSM</sub>    | t = 10 ms                                                                                                                                                                                                                | No voltage reapplied             | Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 475    | 830    | 1300   | A                 |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                               |                                  |                                                                       | 500    | 870    | 1370   |                   |
|                                                               |                     | t = 10 ms                                                                                                                                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 400    | 700    | 1100   |                   |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                               |                                  |                                                                       | 420    | 730    | 1150   |                   |
| Maximum I <sup>2</sup> t for fusing                           | I <sup>2</sup> t    | t = 10 ms                                                                                                                                                                                                                | No voltage reapplied             |                                                                       | 1130   | 3460   | 8550   | A <sup>2</sup> s  |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                               |                                  |                                                                       | 1030   | 3160   | 7810   |                   |
|                                                               |                     | t = 10 ms                                                                                                                                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 800    | 2450   | 6050   |                   |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                               |                                  |                                                                       | 730    | 2230   | 5520   |                   |
| Maximum I <sup>2</sup> √t for fusing                          | I <sup>2</sup> √t   | t = 0.1 ms to 10 ms, no voltage reapplied                                                                                                                                                                                |                                  |                                                                       | 11 300 | 34 600 | 85 500 | A <sup>2</sup> √s |
| Low level value of threshold voltage                          | V <sub>F(TO)1</sub> | T <sub>J</sub> = 25 °C, (16.7 % x π x I <sub>F(AV)</sub> < I < π x I <sub>F(AV)</sub> )                                                                                                                                  |                                  |                                                                       | 0.82   | 0.87   | 0.84   | V                 |
| High level value of threshold voltage                         | V <sub>F(TO)2</sub> | T <sub>J</sub> = 25 °C, (I > π x I <sub>F(AV)</sub> )                                                                                                                                                                    |                                  |                                                                       | 0.84   | 0.90   | 0.86   |                   |
| Low level value of forward slope resistance                   | r <sub>f1</sub>     | T <sub>J</sub> = 25 °C, (16.7 % x π x I <sub>F(AV)</sub> < I < π x I <sub>F(AV)</sub> )                                                                                                                                  |                                  |                                                                       | 7.0    | 2.77   | 2.15   | mΩ                |
| High level value of forward slope resistance                  | r <sub>f2</sub>     | T <sub>J</sub> = 25 °C, (I > π x I <sub>F(AV)</sub> )                                                                                                                                                                    |                                  |                                                                       | 6.8    | 2.67   | 2.07   |                   |
| Maximum forward voltage drop                                  | V <sub>FM</sub>     | I <sub>FM</sub> = π x I <sub>F(AV)</sub> , T <sub>J</sub> = 25 °C, t <sub>p</sub> = 400 μs square wave<br>Average 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> |                                  |                                                                       | 1.60   | 1.73   | 1.55   | V                 |

| REVERSE RECOVERY CHARACTERISTICS |          |                                                                                                                            |        |     |      |        |     |      |        |     |      |       |
|----------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------|--------|-----|------|--------|-----|------|--------|-----|------|-------|
| PARAMETER                        | SYMBOL   | TEST CONDITIONS <sup>(1)</sup>                                                                                             | T40HFL |     |      | T70HFL |     |      | T85HFL |     |      | UNITS |
|                                  |          |                                                                                                                            | S02    | S05 | S10  | S02    | S05 | S10  | S02    | S05 | S10  |       |
| Maximum reverse recovery time    | $t_{rr}$ | $T_J = 25\text{ °C}$ , $-dI_F/dt = 100\text{ A/μs}$<br>$I_F = 1\text{ A}$ to $V_R = 30\text{ V}$                           | 70     | 110 | 270  | 70     | 110 | 270  | 80     | 120 | 290  | ns    |
|                                  |          | $T_J = 25\text{ °C}$ , $-dI_F/dt = 25\text{ A/μs}$<br>$I_{FM} = \pi \times \text{rated } I_{F(AV)}$ , $V_R = -30\text{ V}$ | 200    | 500 | 1000 | 200    | 500 | 1000 | 200    | 500 | 1000 |       |
| Maximum reverse recovery charge  | $Q_{rr}$ | $T_J = 25\text{ °C}$ , $-dI_F/dt = 100\text{ A/μs}$<br>$I_F = 1\text{ A}$ to $V_R = 30\text{ V}$                           | 0.25   | 0.4 | 1.35 | 0.25   | 0.4 | 1.35 | 0.3    | 0.6 | 1.6  | μC    |
|                                  |          | $T_J = 25\text{ °C}$ , $-dI_F/dt = 25\text{ A/μs}$<br>$I_{FM} = \pi \times \text{rated } I_{F(AV)}$ , $V_R = -30\text{ V}$ | 0.55   | 2.0 | 8.0  | 0.6    | 2.1 | 8.5  | 0.8    | 3.5 | 1.5  |       |

**Note**<sup>(1)</sup> Tested on LEM 300 A diodometer tester

| BLOCKING                             |            |                                                                                           |        |        |        |       |
|--------------------------------------|------------|-------------------------------------------------------------------------------------------|--------|--------|--------|-------|
| PARAMETER                            | SYMBOL     | TEST CONDITIONS                                                                           | T40HFL | T70HFL | T85HFL | UNITS |
| Maximum peak reverse leakage current | $I_{RRM}$  | $T_J = 125\text{ °C}$                                                                     | 20     |        |        | mA    |
| RMS isolation voltage                | $V_{ISOL}$ | 50 Hz, circuit to base, all terminals shorted,<br>$T_J = 25\text{ °C}$ , $t = 1\text{ s}$ | 3500   |        |        | V     |

**THERMAL AND MECHANICAL SPECIFICATIONS**

| PARAMETER                                                        | SYMBOL             | TEST CONDITIONS                               | VALUES                              | UNITS |
|------------------------------------------------------------------|--------------------|-----------------------------------------------|-------------------------------------|-------|
| Junction operating temperature range                             | $T_J$              |                                               | -40 to +125                         | °C    |
| Storage temperature range                                        | $T_{Stg}$          |                                               | -40 to +150                         |       |
| Maximum internal thermal resistance, junction to case per module | $R_{thJC}$         | DC operation                                  | 0.85                                | K/W   |
| T40HFL                                                           |                    |                                               | 0.53                                |       |
| T70HFL                                                           |                    |                                               | 0.46                                |       |
| T85HFL                                                           |                    |                                               |                                     |       |
| Thermal resistance, case to heatsink per module                  | $R_{thCS}$         | Mounting surface, flat, smooth and greased    | 0.2                                 |       |
| Mounting torque $\pm 10\%$                                       | base to heatsink   | Non-lubricated threads                        | M3.5 mounting screws <sup>(1)</sup> | Nm    |
|                                                                  | busbar to terminal |                                               | M5 screws terminals                 |       |
| Approximate weight                                               |                    | See dimensions - link at the end of datasheet | 54                                  | g     |
|                                                                  |                    |                                               | 19                                  | oz.   |
| Case style                                                       |                    |                                               | D-55 (T-module)                     |       |

**Note**

- <sup>(1)</sup> 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**

| DEVICES | SINUSOIDAL CONDUCTION AT $T_J$ MAXIMUM |      |      |      |      | RECTANGULAR CONDUCTION AT $T_J$ MAXIMUM |      |      |      |       | 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 |       |

**Note**

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

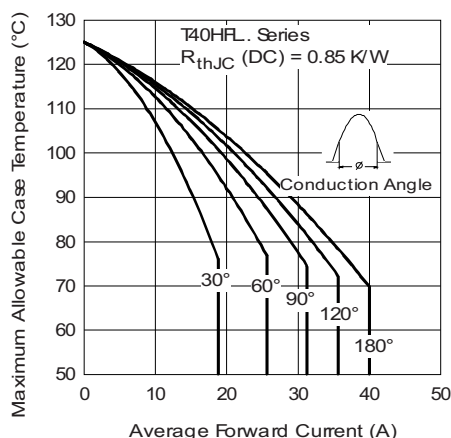


Fig. 1 - Current Ratings Characteristics

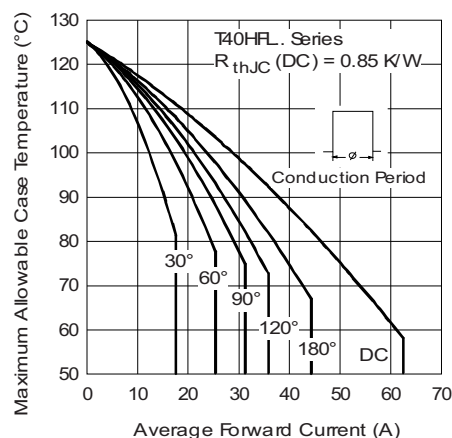


Fig. 2 - Current Ratings Characteristics

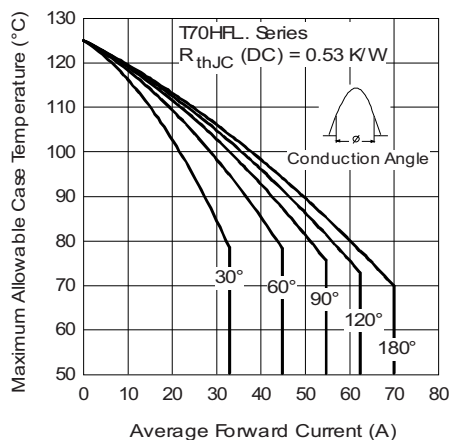


Fig. 3 - Current Ratings Characteristics

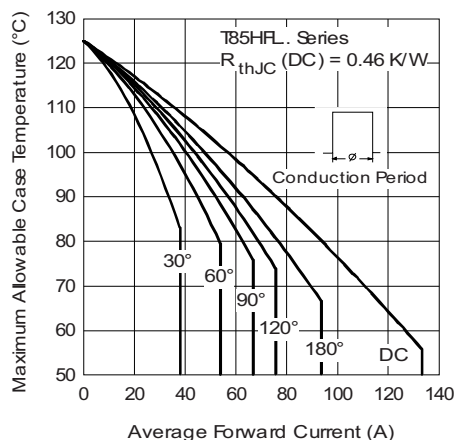


Fig. 6 - Current Ratings Characteristics

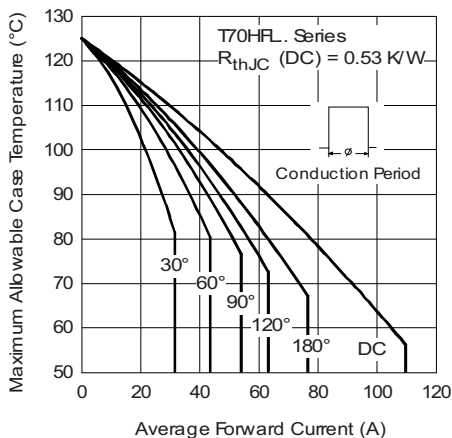


Fig. 4 - Current Ratings Characteristics

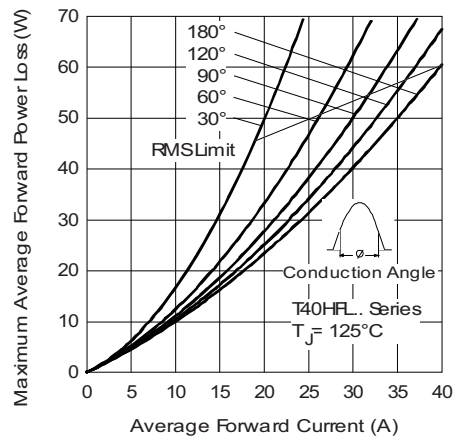


Fig. 7 - Forward Power Loss Characteristics

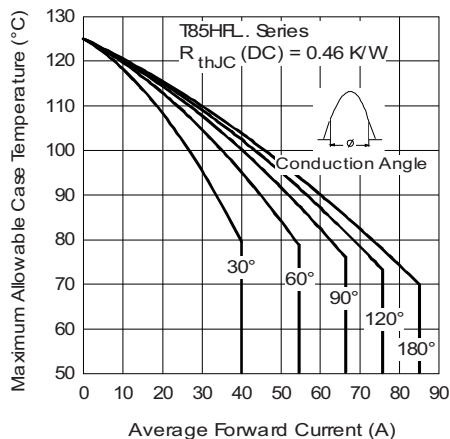


Fig. 5 - Current Ratings Characteristics

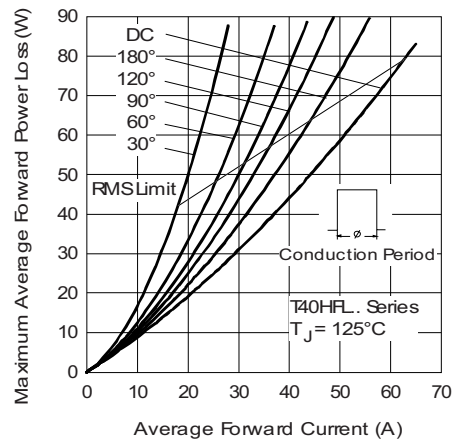


Fig. 8 - Forward Power Loss Characteristics

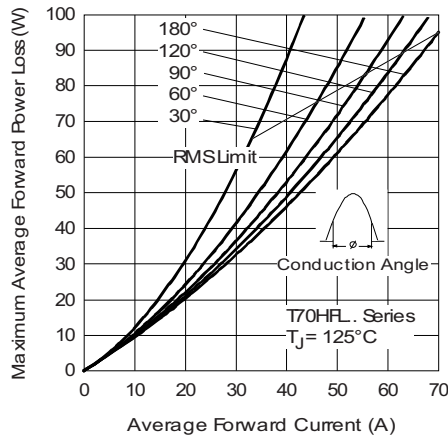


Fig. 9 - Forward Power Loss Characteristics

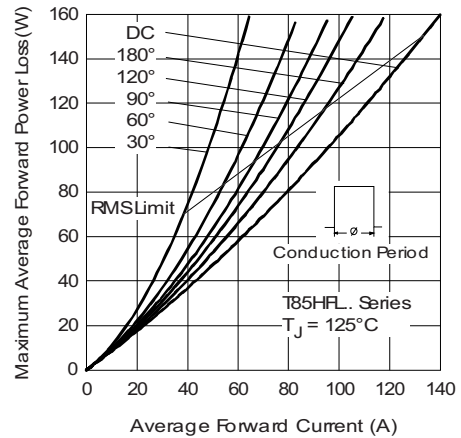


Fig. 12 - Forward Power Loss Characteristics

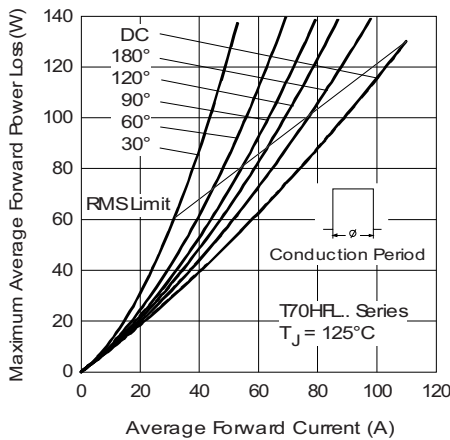


Fig. 10 - Forward Power Loss Characteristics

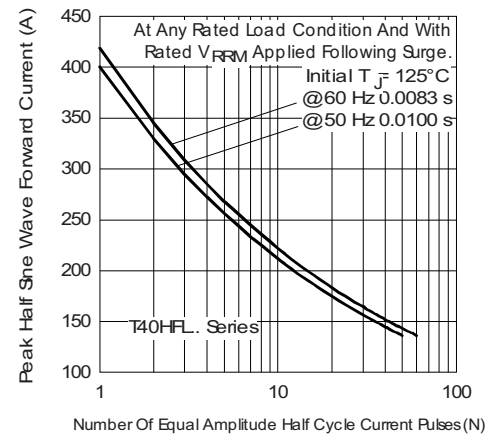


Fig. 13 - Maximum Non-Repetitive Surge Current

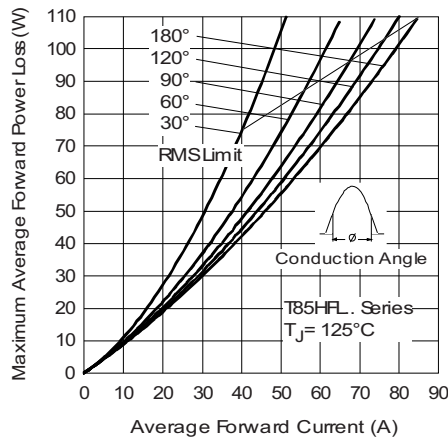


Fig. 11 - Forward Power Loss Characteristics

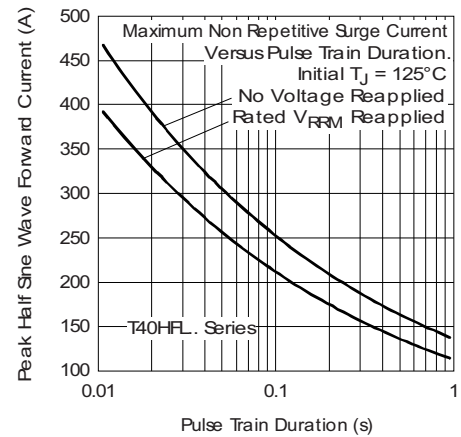


Fig. 14 - Maximum Non-Repetitive Surge Current

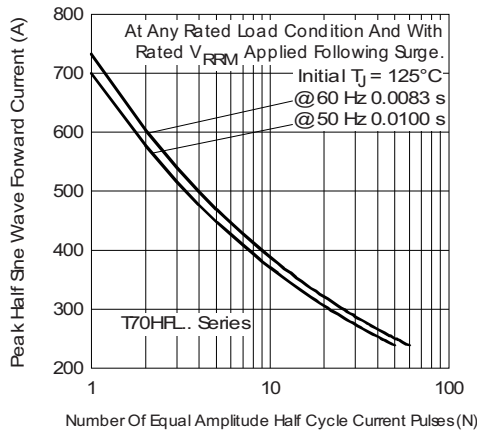


Fig. 15 - Maximum Non-Repetitive Surge Current

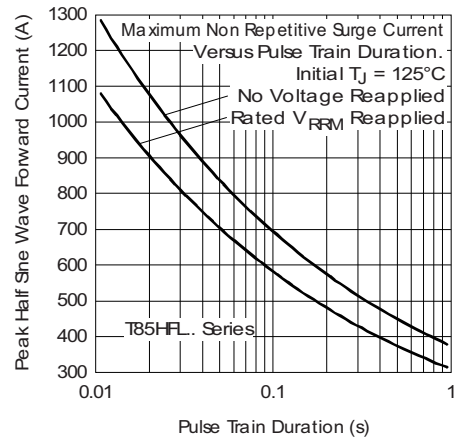


Fig. 18 - Maximum Non-Repetitive Surge Current

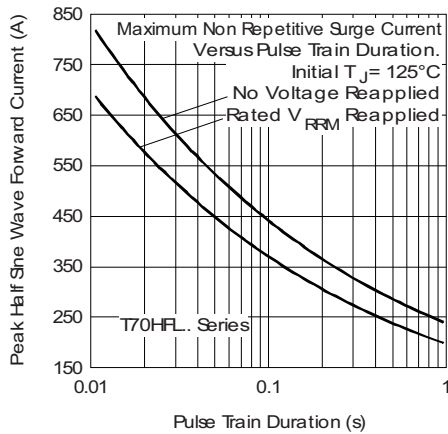


Fig. 16 - Maximum Non-Repetitive Surge Current

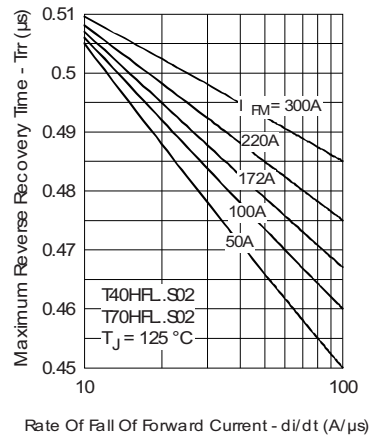


Fig. 19 - Recovery Time Characteristics

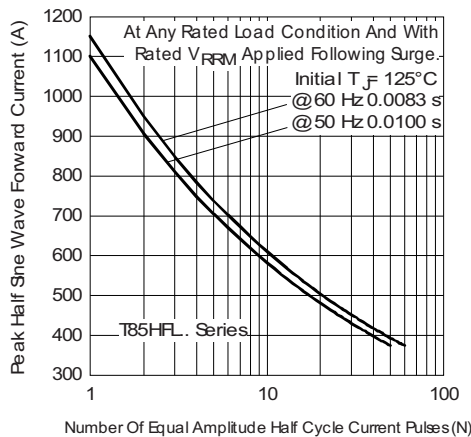


Fig. 17 - Maximum Non-Repetitive Surge Current

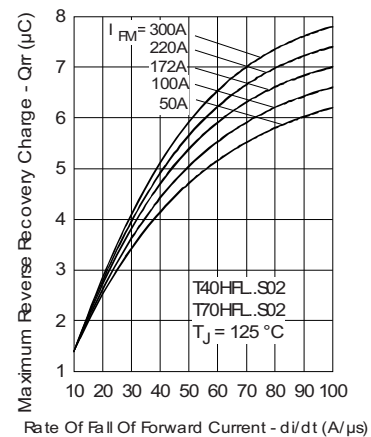


Fig. 20 - Recovery Charge Characteristics

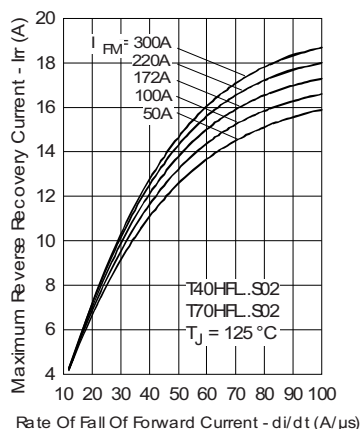


Fig. 21 - Recovery Current Characteristics

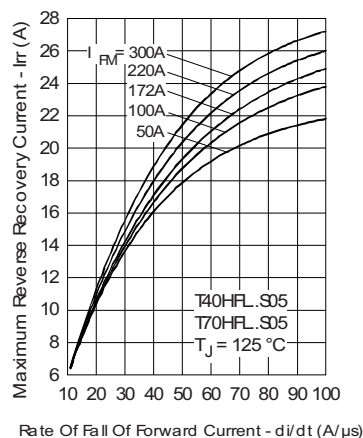


Fig. 24 - Recovery Current Characteristics

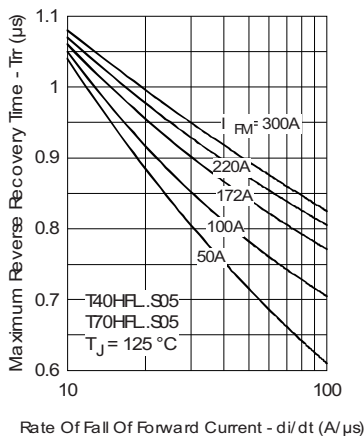


Fig. 22 - Recovery Time Characteristics

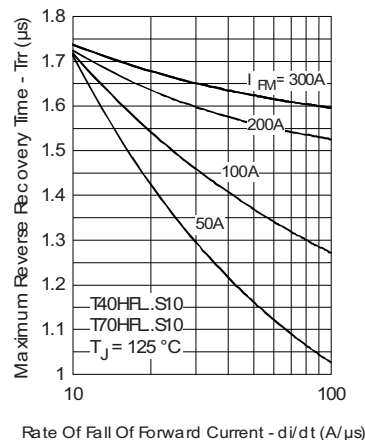


Fig. 25 - Recovery Time Characteristics

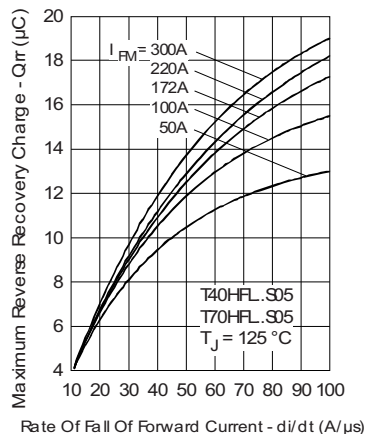


Fig. 23 - Recovery Charge Characteristics

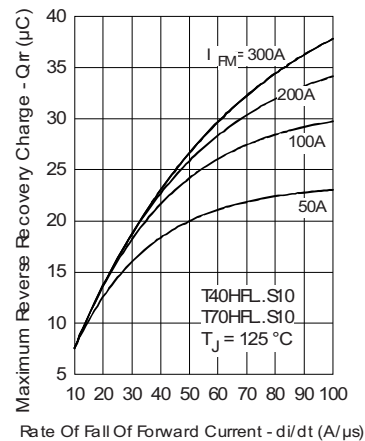


Fig. 26 - Recovery Charge Characteristics

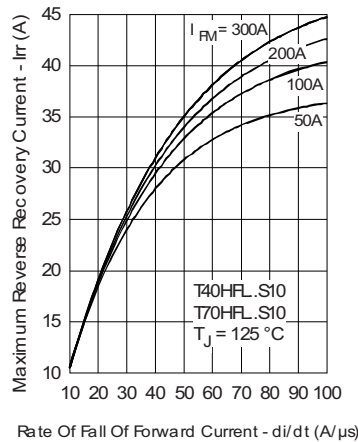


Fig. 27 - Recovery Current Characteristics

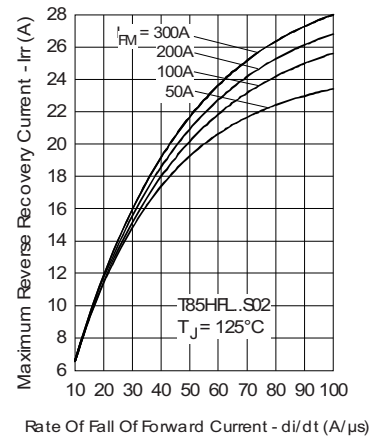


Fig. 30 - Recovery Current Characteristics

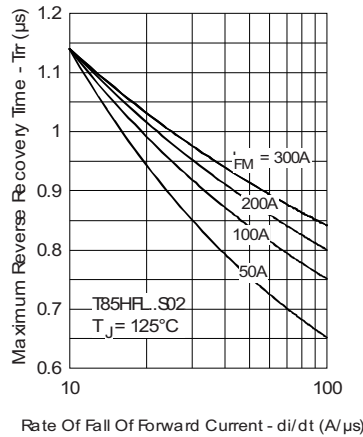


Fig. 28 - Recovery Time Characteristics

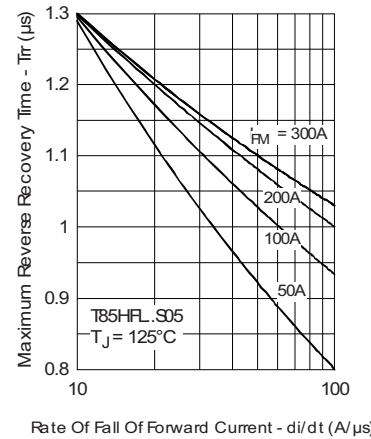


Fig. 31 - Recovery Time Characteristics

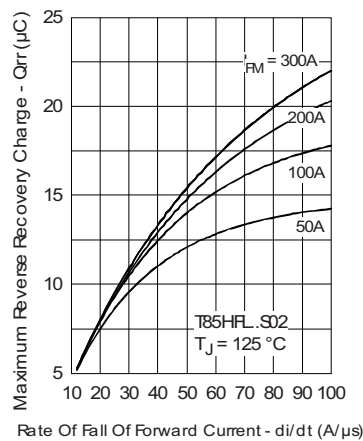


Fig. 29 - Recovery Charge Characteristics

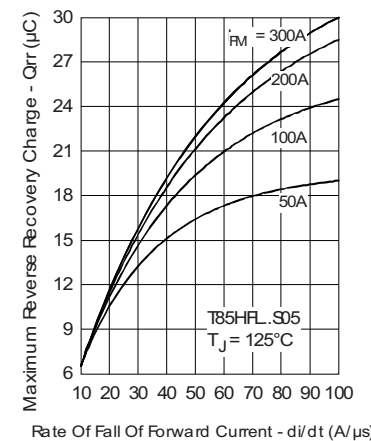


Fig. 32 - Recovery Charge Characteristics

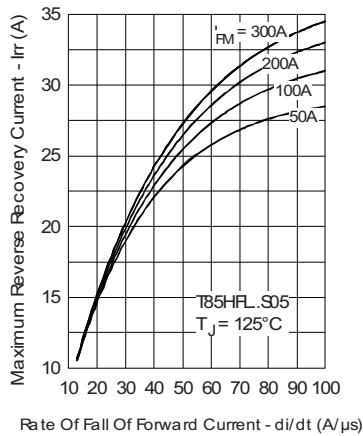


Fig. 33 - Recovery Current Characteristics

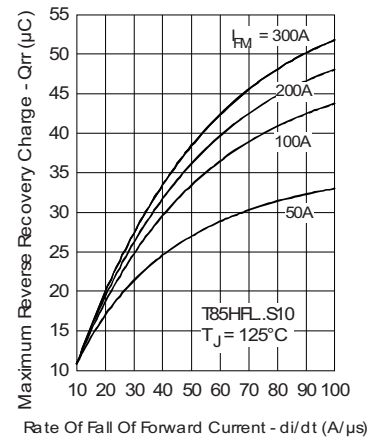


Fig. 35 - Recovery Charge Characteristics

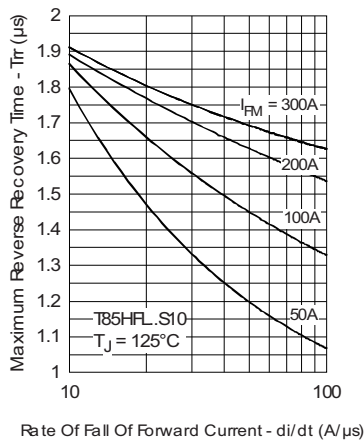


Fig. 34 - Recovery Time Characteristics

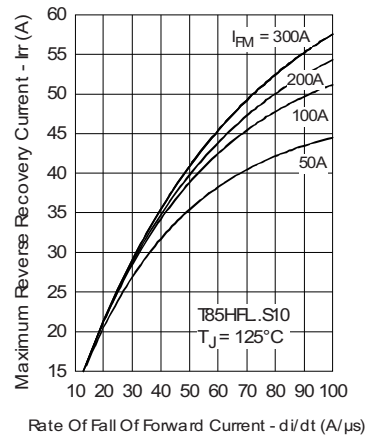


Fig. 36 - Recovery Current Characteristics

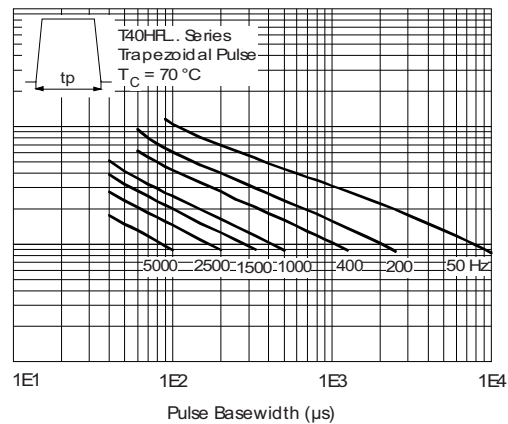
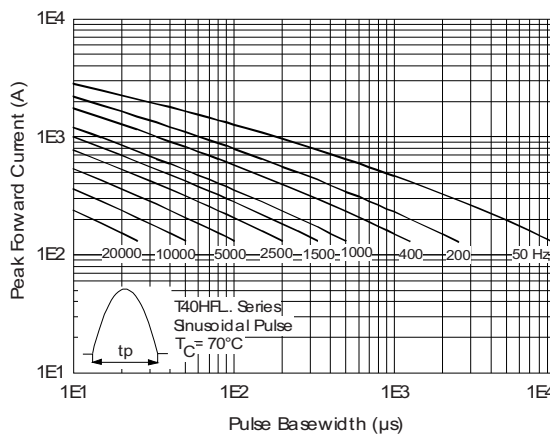


Fig. 37 - Frequency Characteristics

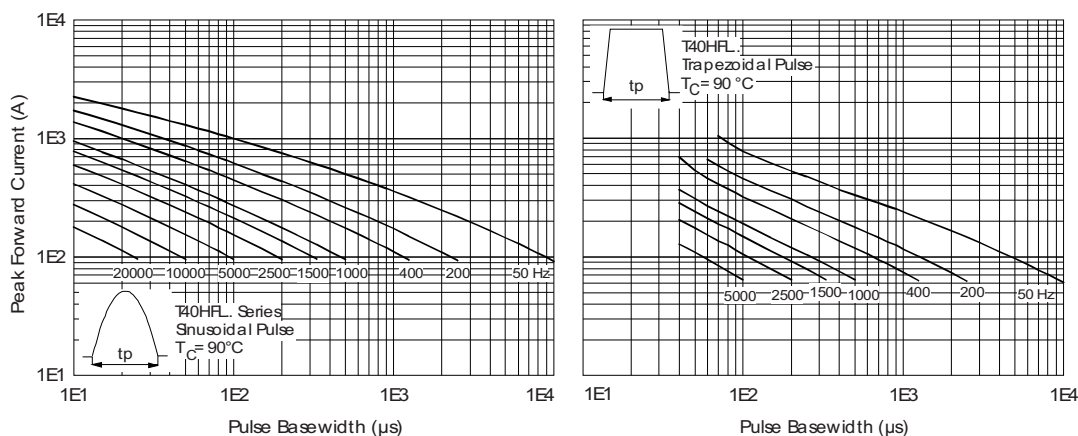


Fig. 38 - Frequency Characteristics

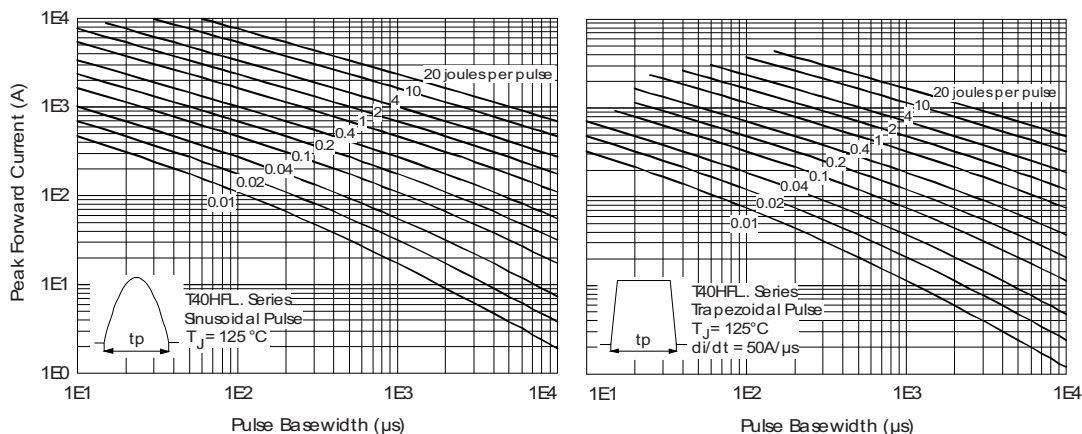


Fig. 39 - Maximum Forward Energy Power Loss Characteristics

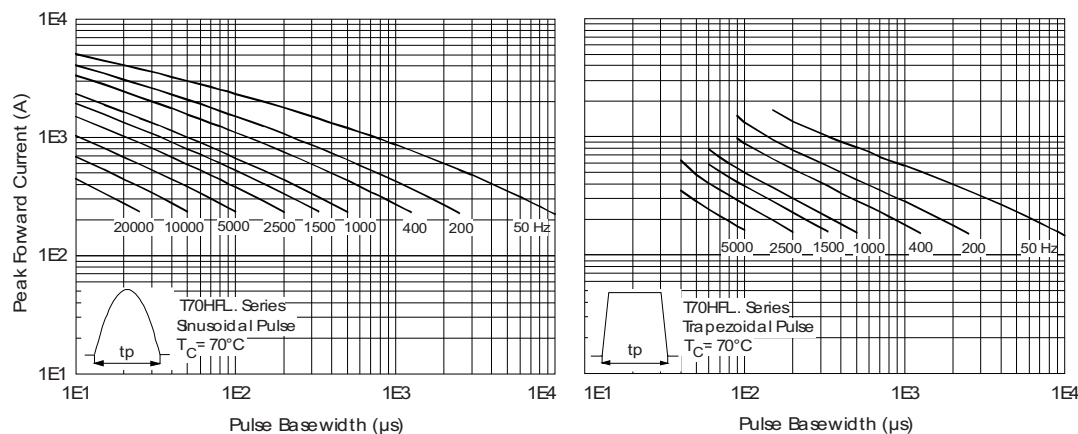


Fig. 40 - Frequency Characteristics

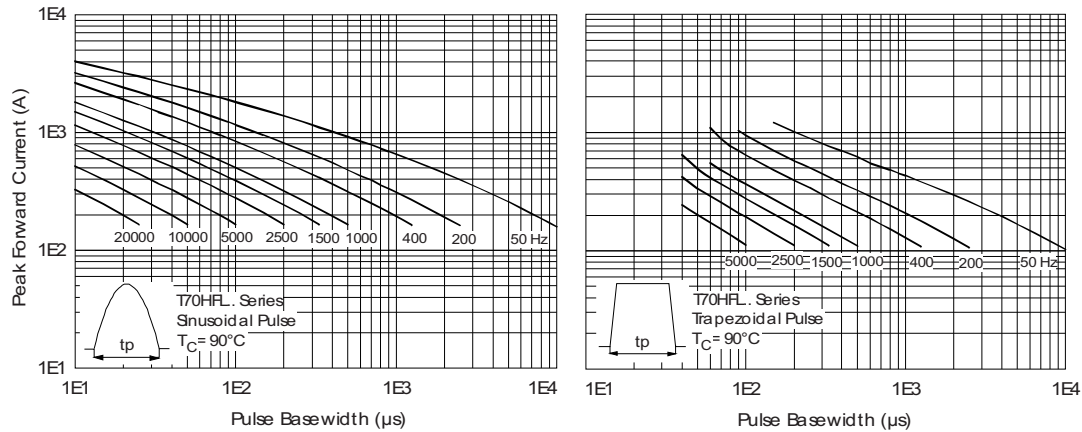


Fig. 41 - Frequency Characteristics

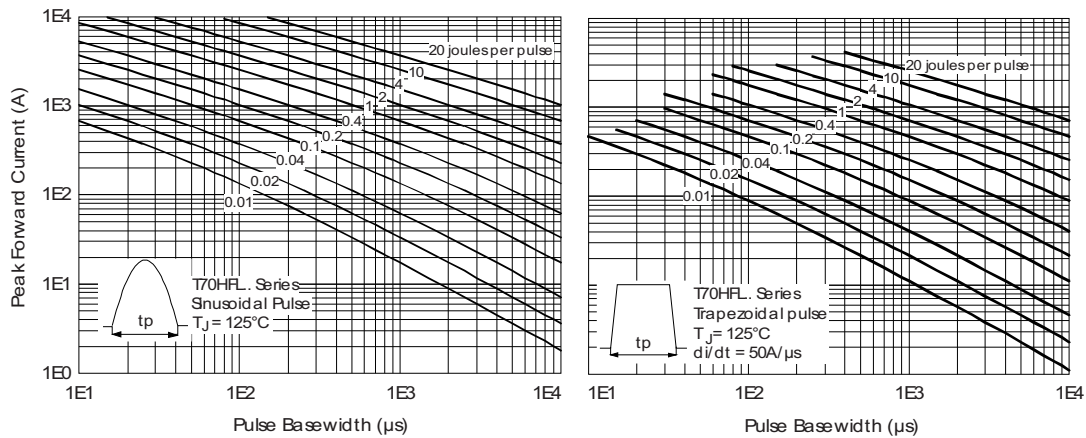


Fig. 42 - Maximum Forward Energy Power Loss Characteristics

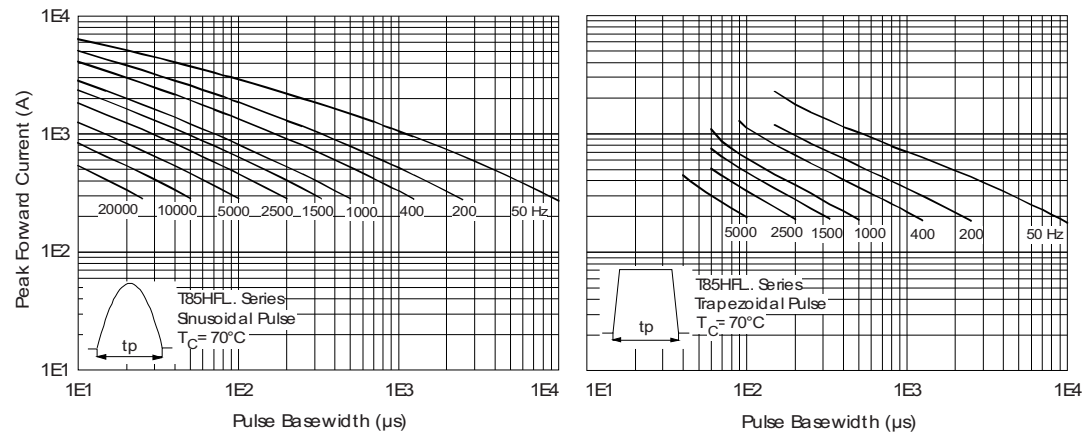


Fig. 43 - Frequency Characteristics

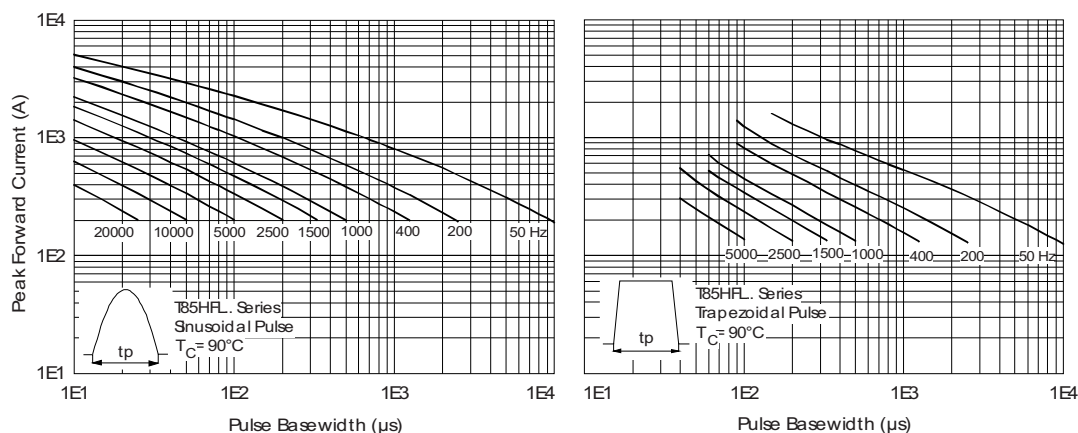


Fig. 44 - Frequency Characteristics

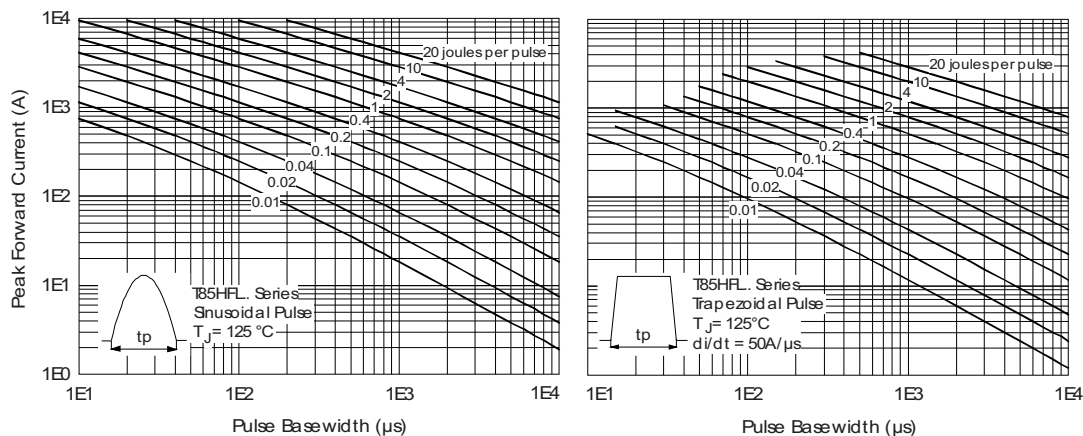


Fig. 45 - Maximum Forward Energy Power Loss Characteristics

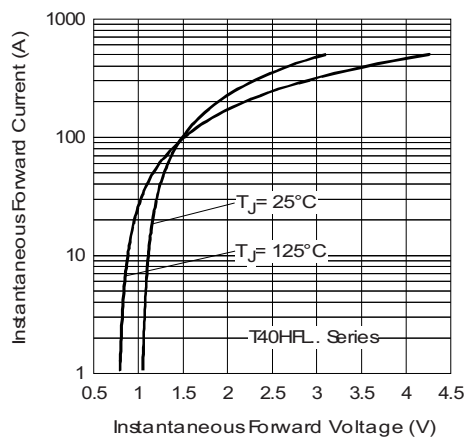


Fig. 46 - Forward Voltage Drop Characteristics

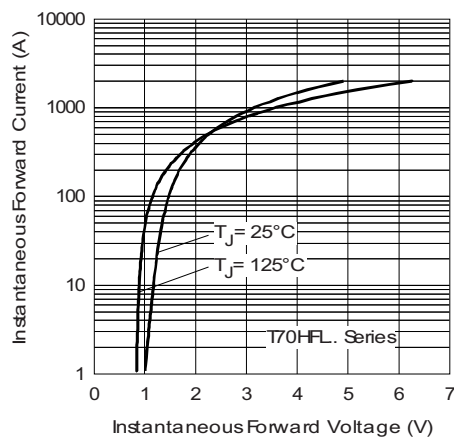


Fig. 47 - Forward Voltage Drop Characteristics

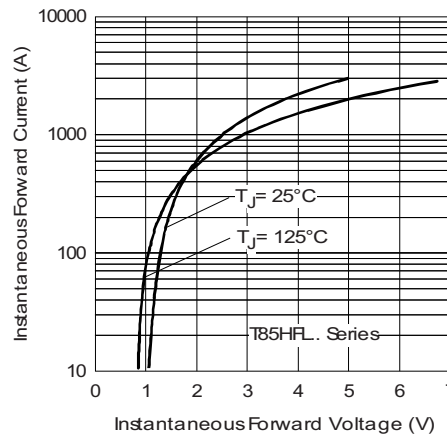
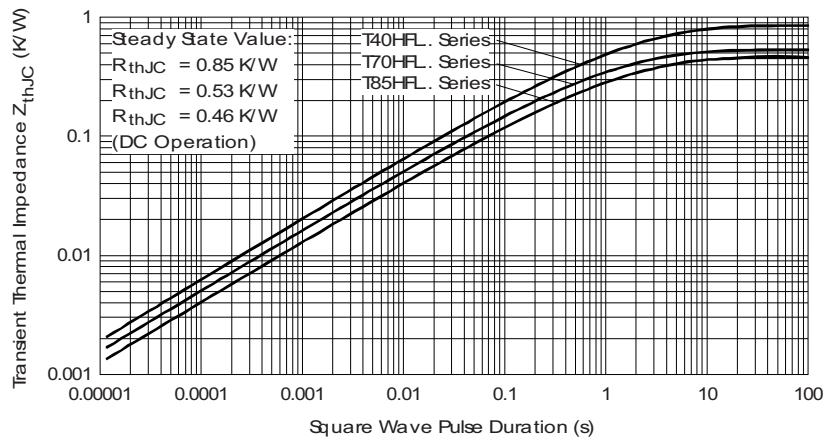


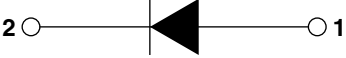
Fig. 48 - Forward Voltage Drop Characteristics


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

## ORDERING INFORMATION TABLE

| Device code | VS- | T                             | 40                                                                | HFL | 100                                           | S10 |
|-------------|-----|-------------------------------|-------------------------------------------------------------------|-----|-----------------------------------------------|-----|
|             | 1   | 2                             | 3                                                                 | 4   | 5                                             | 6   |
| 1           | -   | Vishay Semiconductors product |                                                                   |     |                                               |     |
| 2           | -   | Module type                   |                                                                   |     |                                               |     |
| 3           | -   | Current rating                | 40 = 40 A (average)<br>70 = 70 A (average)<br>85 = 85 A (average) |     |                                               |     |
| 4           | -   | Fast recovery diode           |                                                                   |     |                                               |     |
| 5           | -   | Voltage code x 10 = $V_{RRM}$ |                                                                   |     |                                               |     |
| 6           | -   | $t_{rr}$ code                 |                                                                   |     | S02 = 200 ns<br>S05 = 500 ns<br>S10 = 1000 ns |     |



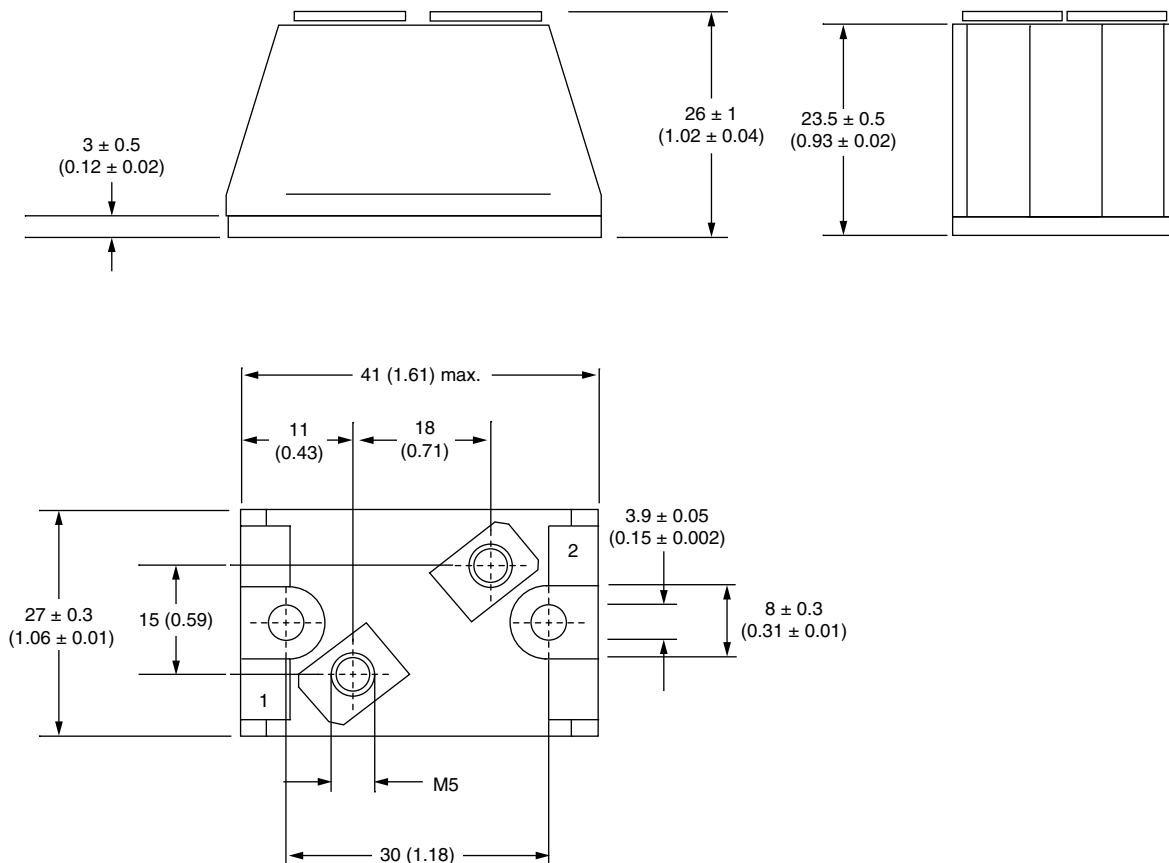
| CIRCUIT CONFIGURATION |                            |                                                                                     |
|-----------------------|----------------------------|-------------------------------------------------------------------------------------|
| CIRCUIT               | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING                                                                     |
| Single                | HFL                        |  |

| LINKS TO RELATED DOCUMENTS |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95313">www.vishay.com/doc?95313</a> |



## D-55 T-Module Diode Standard and Fast Recovery

**DIMENSIONS** in millimeters (inches)



### Note

- 1 = Anode
- 2 = Cathode



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