Reverse Blocking Triode Thyristor

Features and Benefits

- Exceptional reliability
- Small fully-molded SIP package with heatsink mounting for high thermal dissipation and long life
- Operating junction temperature to 150°C
- V_{DRM} of 700 or 800 V
- 8.0 A_{RMS} on-state current
- 7 mA typical gate trigger current
- Uniform switching
- UL Recognized Component (File No.: E118037) (suffix I)

Package: 3-pin SIP (TO-220F)

Not to scale

Description

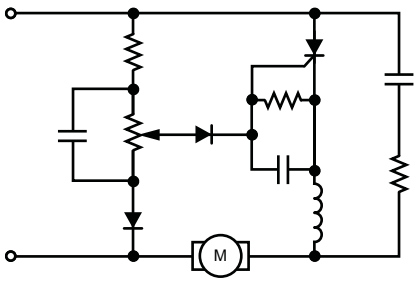
This Sanken reverse blocking triode thyristor is designed for AC power control, providing reliable, uniform switching for half-cycle AC applications.

In comparison with other products on the market, the TFA8x series provides increased isolation voltage (1800 VAC_{RMS}), guaranteed for up to 1 minute. In addition, commutation dv/dt is improved.

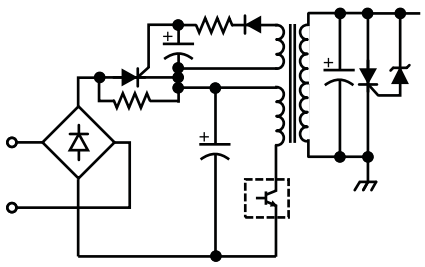
Applications

- Motor control for small tools
- Temperature control, light dimmers, electric blankets
- General use switching mode power supplies (SMPS)

Typical Applications



Single-phase motor control (for example, electric tool)



In-rush current control (for example, SMPS)

TFA8x Series

Reverse Blocking Triode Thyristor

Selection Guide

Part Number	V_{DRM} (V)	UL-Recognized Component	Package	Packing
TFA87(I)	700	Yes	3-pin fully molded SIP with heatsink mount	50 pieces per tube
TFA87S	700	–		
TFA88(I)	800	Yes		
TFA88S	800	–		

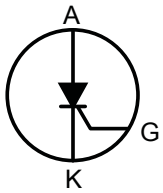
Absolute Maximum Ratings

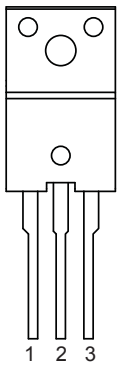
Characteristic	Symbol	Notes		Rating	Units
Peak Repetitive Off-State Voltage	V_{DRM}	TFA87x	T_J = –40°C to 150°C, R_{GREF} = 1 kΩ	700	V
		TFA88x		800	V
Isolation Voltage	V_{ISO}	AC RMS applied for 1 minute between lead and case		1800	V
Average On-State Current	$I_{T(AV)}$	50 Hz half cycle sine wave, Conduction angle (α) = 180°, continuous operation, T_C = 98°C		8.0	A
RMS On-State Current	$I_{T(RMS)}$			12.6	A
Surge On-State Current	I_{TSM}	f = 60 Hz	Half cycle sine wave, single, non-repetitive	132	A
		f = 50 Hz		120	A
I^2t Value for Fusing	I^2t	Value for 50 Hz half cycle sine wave, 1 cycle, I_{TSM} = 120 A		72	$A^2 \cdot s$
Critical Rising Rate of On-State Current	di/dt	$I_T = I_{T(RMS)} \times \pi$, $V_D = V_{DRM} \times 0.5$, f ≤ 60 Hz, $t_{gw} \geq 10$ µs, $t_{gr} \leq 250$ ns, $i_{gp} \geq 30$ mA (refer to Gate Trigger Circuit diagram)		50	A/µs
Peak Forward Gate Current	I_{FGM}	f ≥ 50 Hz, duty cycle ≤ 10%		2.0	A
Peak Forward Gate Voltage	V_{FGM}	f ≥ 50 Hz, duty cycle ≤ 10%		10	V
Peak Reverse Gate Current	V_{RGM}	f ≥ 50 Hz		5.0	V
Peak Gate Power Dissipation	P_{GM}	f ≥ 50 Hz, duty cycle ≤ 10%		5.0	W
Average Gate Power Dissipation	$P_{GM(AV)}$	$T_J < T_J$(max)		0.5	W
Junction Temperature	T_J			–40 to 150	°C
Storage Temperature	T_{stg}			–40 to 150	°C

Thermal Characteristics May require derating at maximum conditions

Characteristic	Symbol	Test Conditions	Value	Units
Package Thermal Resistance (Junction to Case)	$R_{\theta JC}$	For AC	3.5	°C/W

Pin-out Diagram





Terminal List Table

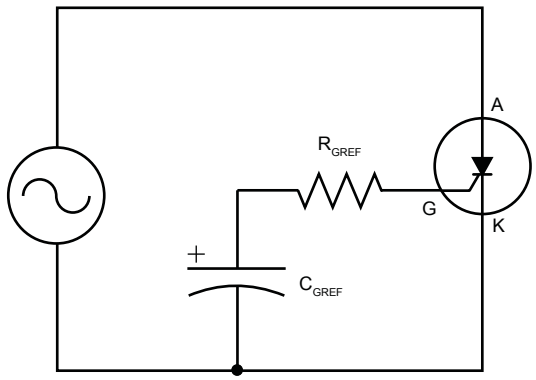
Number	Name	Function
1	K	Cathode terminal
2	A	Anode terminal
3	G	Gate control

All performance characteristics given are typical values for circuit or system baseline design only and are at the nominal operating voltage and an ambient temperature, T_A, of 25°C, unless otherwise stated.

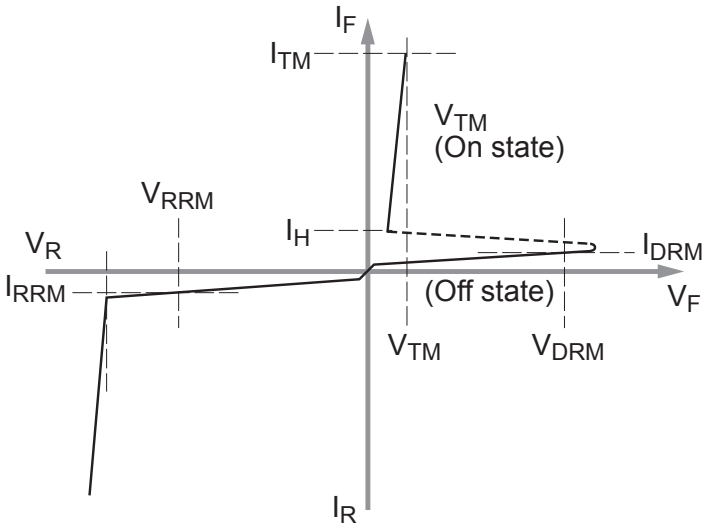
ELECTRICAL CHARACTERISTICS

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Off-State Leakage Current	I_{DRM}	$V_D = V_{DRM}$, T_J = 150°C, R_{GREF} = 1 kΩ	–	–	2.0	mA
Reverse Leakage Current	I_{RRM}	$V_D = V_{DRM}$, T_J = 150°C, R_{GREF} = 1 kΩ	–	–	2.0	mA
On-State Voltage	V_{TM}	I_{TM} = 20 A, T_C = 25°C	–	–	1.4	V
Gate Trigger Voltage	V_{GT}	V_D = 6 V, R_L = 10 Ω, T_C = 25°C	–	–	1.0	V
Gate Trigger Current	I_{GT}	V_D = 6 V, R_L = 10 Ω, T_C = 25°C	–	7	15	mA
Gate Non-trigger Voltage	V_{GD}	$V_D = V_{DRM} \times 0.5$, R_{GREF} = 1 kΩ, T_J = 125°C	0.2	–	–	V
Holding Current	I_H	R_{GREF} = 1 kΩ, T_J = 25°C	–	20	–	mA
Critical Rising Rate of Off-State Voltage	dv/dt	$V_D = V_{DRM} \times 0.5$, T_J = 125°C, R_{GREF} = 1 kΩ, C_{GREF} = 0.033 µF	–	300	–	V/µs

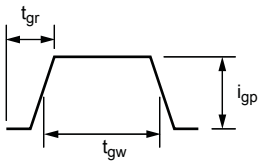
Test Circuit 1



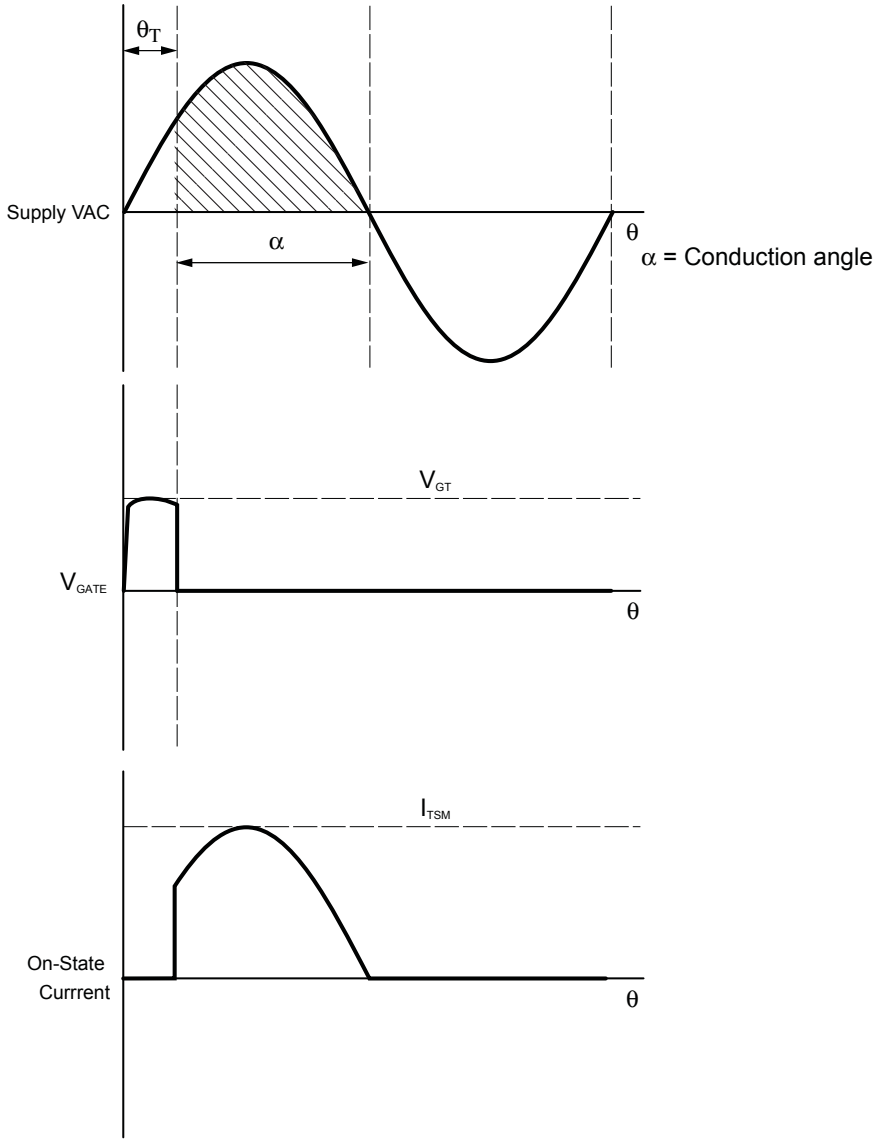
Voltage-Current Characteristic



Gate Trigger Current

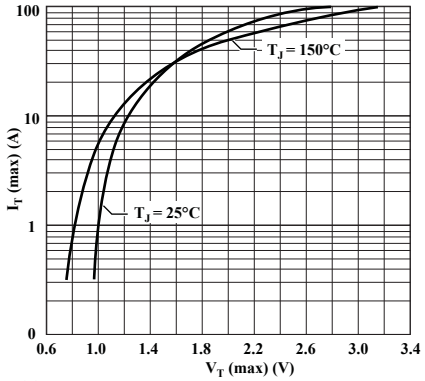


Commutation Timing Diagrams

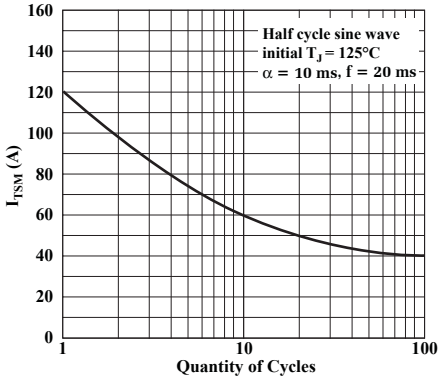


Performance Characteristics at T_A = 25°C

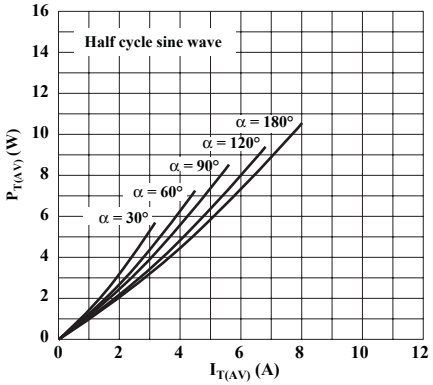
Maximum On-State Current versus Maximum On-State Voltage



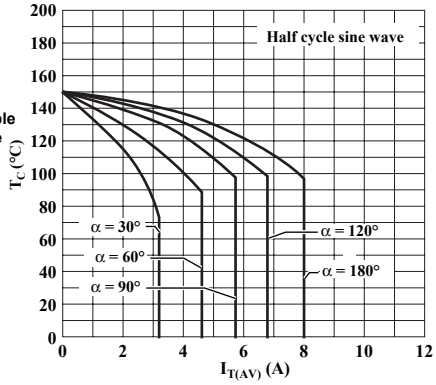
Surge On-State Current versus Quantity of Cycles



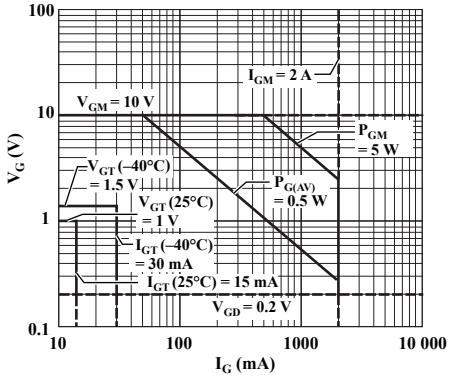
Maximum Average Power Dissipation versus Average On-State Current



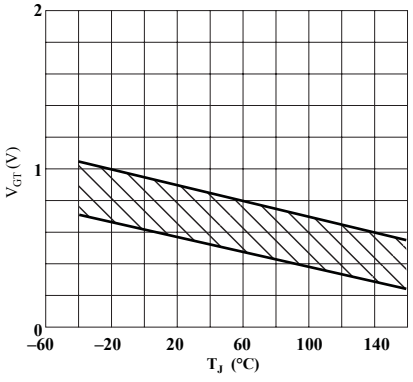
Maximum Allowable Case Temperature versus Average On-State Current



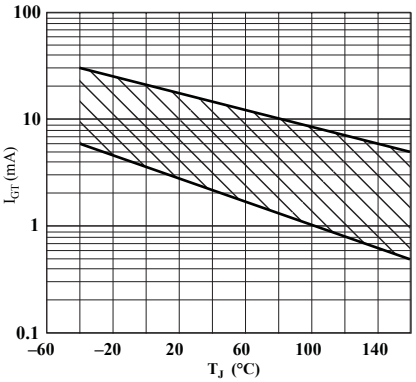
Gate Voltage versus Gate Current



Typical Gate Trigger Voltage versus Junction Temperature at V_D = 6 V and R_L = 10 Ω

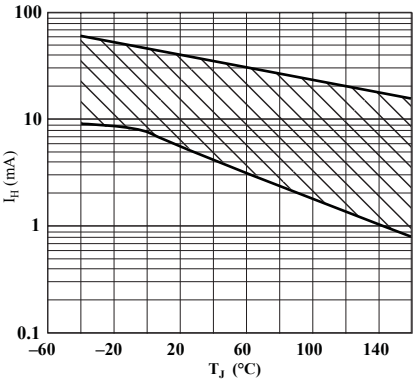


Typical Gate Trigger Current versus Junction Temperature at V_D = 6 V and R_L = 10 Ω



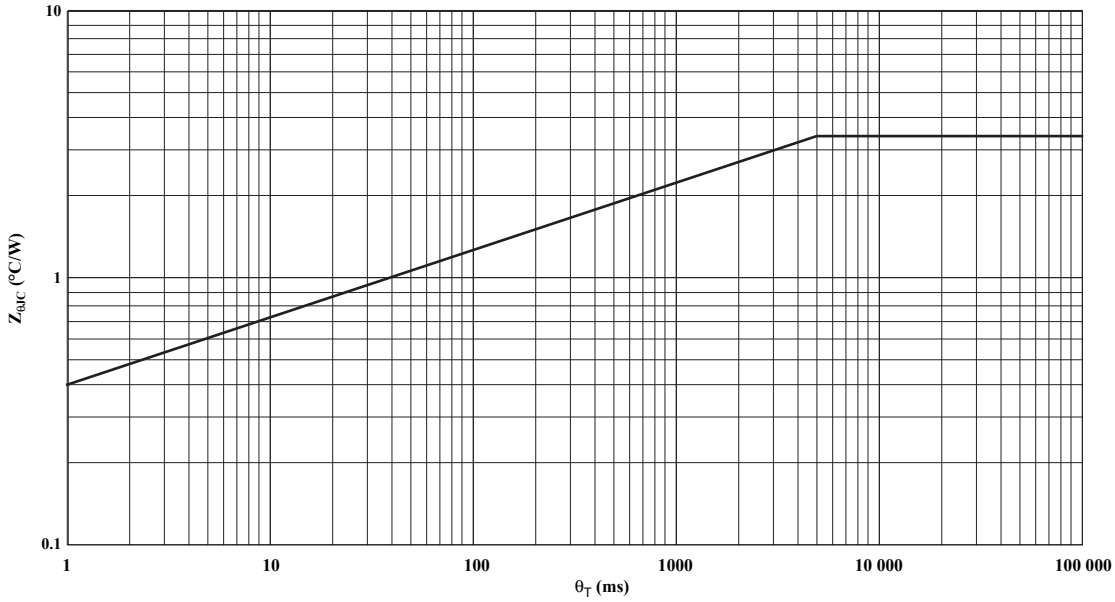
R_{GREF} = 10 kΩ

Typical Holding Current versus Junction Temperature at R_{GREF} = 10 kΩ

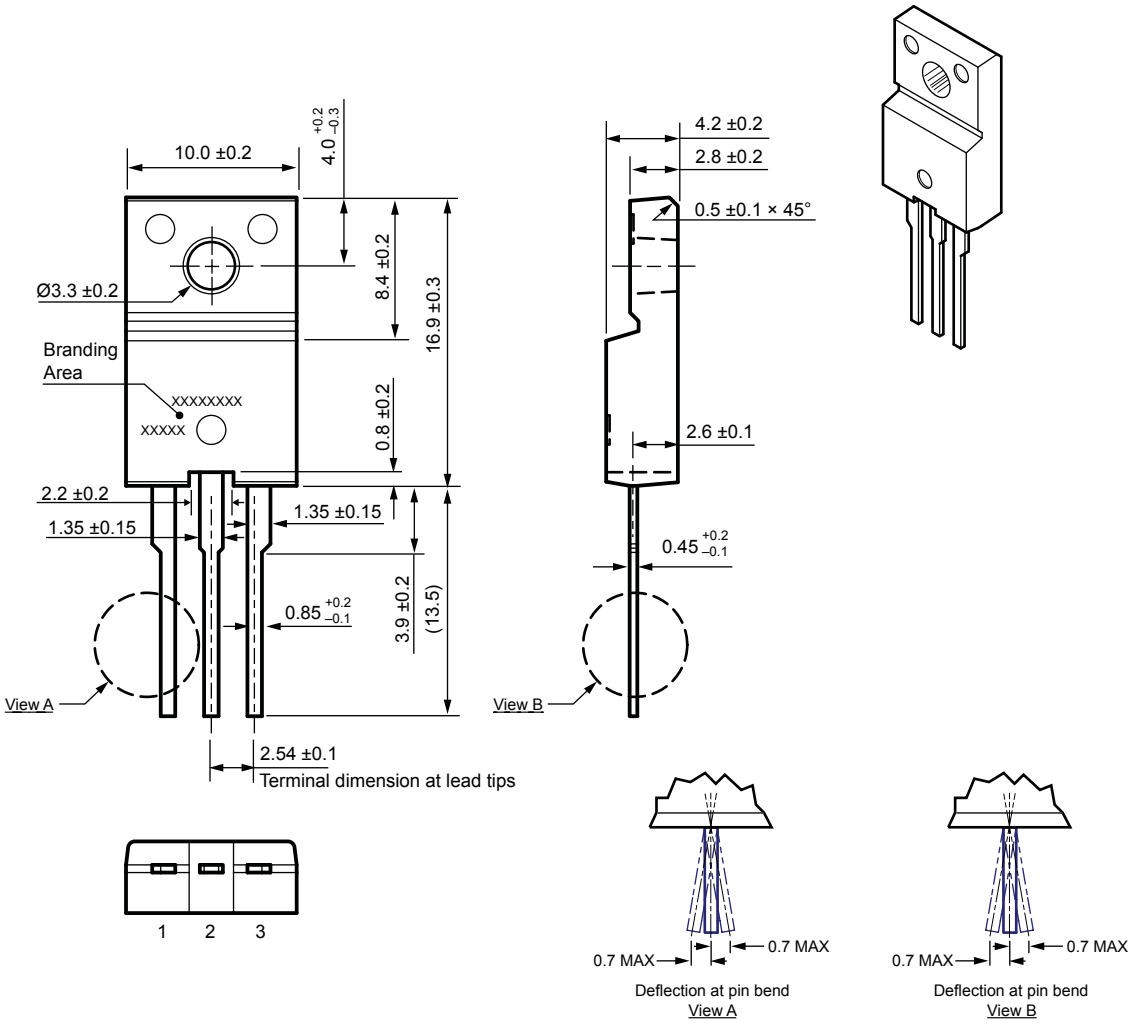


Transient Thermal Impedence versus Voltage Pulse Duration

For AC



TO-220F Package Outline Drawing



Gate burr: 0.3 mm (max.), mold flash may appear at opposite side
Terminal core material: Cu
Terminal treatment: Ni plating and Pb-free solder dip
Leadform: 600
Package: TO-220F (FM20)

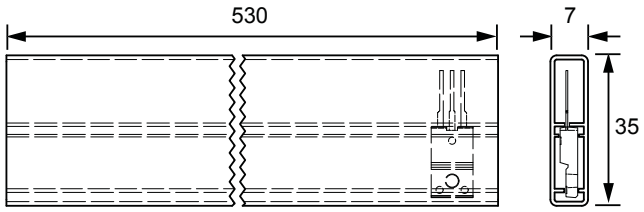
Dimensions in millimeters

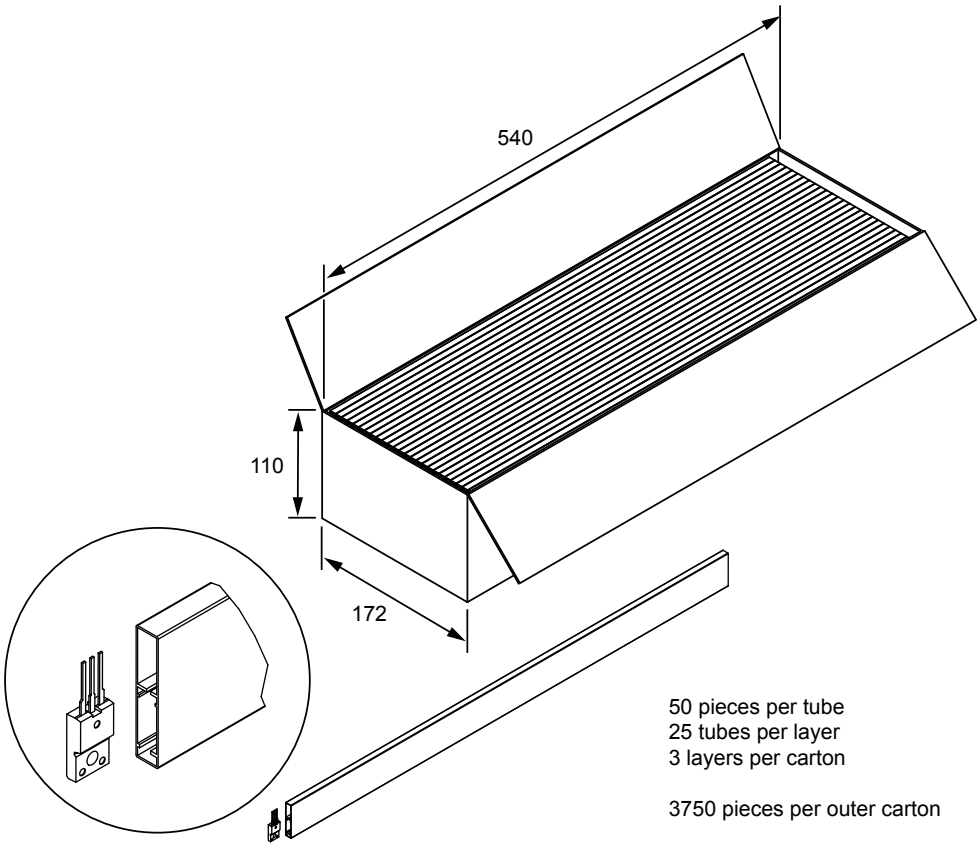
Branding codes (exact appearance at manufacturer discretion):
1st line, type: TFA8xx
2nd line, lot: *YM*
Where: Y is the last digit of the year of manufacture
M is the month (*1* to *9*, *O*, *N*, *D*)

Leadframe plating Pb-free. Device meets RoHS requirements.

Packing Specification

Tube Packing



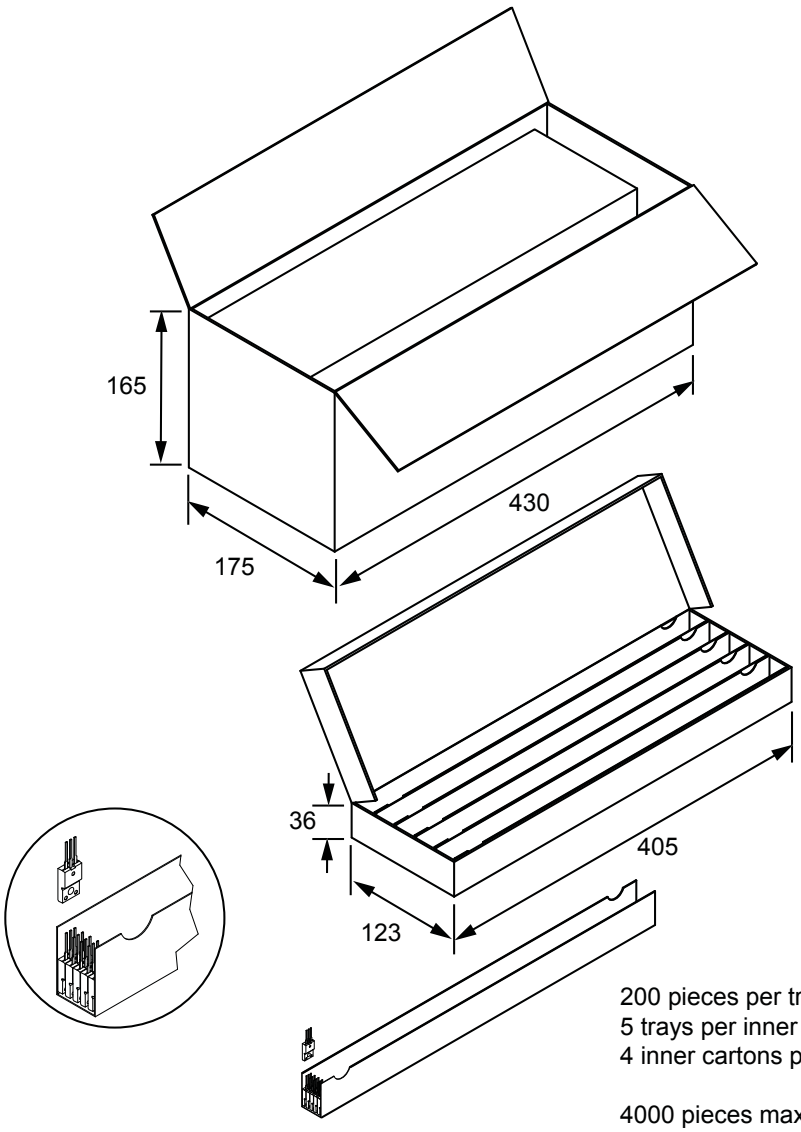


50 pieces per tube
25 tubes per layer
3 layers per carton

3750 pieces per outer carton

Dimensions in mm

Bulk Packing



200 pieces per tray
5 trays per inner carton
4 inner cartons per outer carton

4000 pieces maximum per outer carton

Dimensions in millimeters

WARNING — These devices are designed to be operated at lethal voltages and energy levels. Circuit designs that embody these components must conform with applicable safety requirements. Precautions must be taken to prevent accidental contact with power-line potentials. Do not connect grounded test equipment.

The use of an isolation transformer is recommended during circuit development and breadboarding.

Because reliability can be affected adversely by improper storage environments and handling methods, please observe the following cautions.

Cautions for Storage

- Ensure that storage conditions comply with the standard temperature (5°C to 35°C) and the standard relative humidity (around 40 to 75%); avoid storage locations that experience extreme changes in temperature or humidity.
- Avoid locations where dust or harmful gases are present and avoid direct sunlight.
- Reinspect for rust on leads and solderability of products that have been stored for a long time.

Cautions for Testing and Handling

When tests are carried out during inspection testing and other standard test periods, protect the products from power surges from the testing device, shorts between adjacent products, and shorts to the heatsink.

Remarks About Using Silicone Grease with a Heatsink

- When silicone grease is used in mounting this product on a heatsink, it shall be applied evenly and thinly. If more silicone grease than required is applied, it may produce stress.
- Coat the back surface of the product and both surfaces of the insulating plate to improve heat transfer between the product and the heatsink.
- Volatile-type silicone greases may permeate the product and produce cracks after long periods of time, resulting in reduced heat radiation effect, and possibly shortening the lifetime of the product.
- Our recommended silicone greases for heat radiation purposes, which will not cause any adverse effect on the product life, are indicated below:

Type	Suppliers
G746	Shin-Etsu Chemical Co., Ltd.
YG6260	Momentive Performance Materials
SC102	Dow Corning Toray Silicone Co., Ltd.

Heatsink Mounting Method

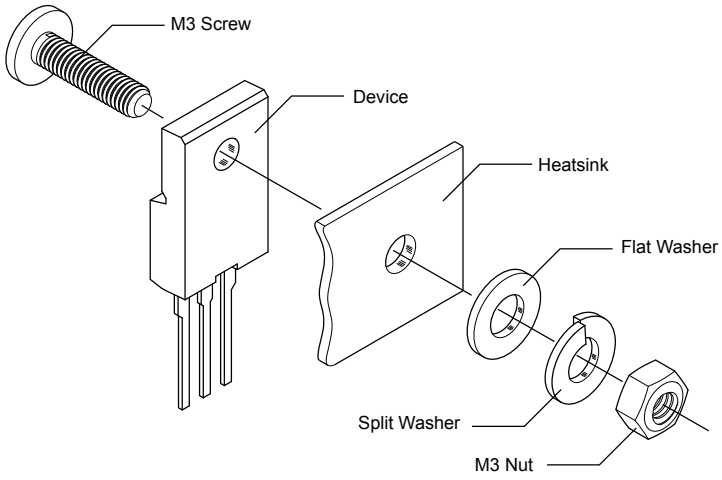
- Torque When Tightening Mounting Screws. Thermal resistance increases when tightening torque is low, and radiation effects are decreased. When the torque is too high, the screw can strip, the heatsink can be deformed, and distortion can arise in the product frame. To avoid these problems, observe the recommended tightening torques for this product package type 0.490 to 0.686 N•m (5 to 7 kgf•cm).
- For effective heat transfer, the contact area between the product and the heatsink should be free from burrs and metal fragments, and the heatsink should be flat and large enough to contact over the entire side of the product, including mounting flange and exposed thermal pad.
- The mounting hole in customer-supplied heatsink must be less than Ø4 mm; this includes the diameter of any dimple around punched holes. This is to prevent possible deflection and cracking of the product case when fastened to the heatsink.

Soldering

- When soldering the products, please be sure to minimize the working time, within the following limits:
  260±5°C 10 s
  350±5°C 3 s
- Soldering iron should be at a distance of at least 1.5 mm from the body of the products

Electrostatic Discharge

- When handling the products, operator must be grounded. Grounded wrist straps worn should have at least 1 MΩ of resistance to ground to prevent shock hazard.
- Workbenches where the products are handled should be grounded and be provided with conductive table and floor mats.
- When using measuring equipment such as a curve tracer, the equipment should be grounded.
- When soldering the products, the head of soldering irons or the solder bath must be grounded in other to prevent leak voltages generated by them from being applied to the products.
- The products should always be stored and transported in our shipping containers or conductive containers, or be wrapped in aluminum foil.



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Anti radioactive ray design is not considered for the products listed herein.

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This datasheet is based on Sanken datasheet SSE-24049

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