EE 330 Laboraory 8

Thyristor Device Characterization and Applications

Fall 2010

Objective:

The objective of this laboratory experiment is to become familiar with the operation thyristors, to develop methods for measuring key parameters of thyristors, , and to investigate some basic applications of these devices.

Components Needed:

Q4015L5 Triac, Q4010LS2 SCR, STGF7NC60HD Insulated Gate npn transistor, XE2410 24V-0.5A incandescent lamp, and other standard electronic components.

Background:

Thyristors are devices commonly used in high power applications and are used extensively throughout the power electronics field. These devices are unique in that a small gate current or gate voltage can trigger a large current flow, regardless of whether that base current remains on or not.   In their most ideal form, they are electronic switches where a logic-level signal can rapidly turn the switch ON or OFF. Thyristors are designed to operate as switches over a wide range of voltage and current levels and can be used to switch resistive loads but more commonly they are used to switch reactive loads. In this experiment emphasis will be placed only on switching resistive loads. Some additional circuit design issues become relevant when switching large reactive loads due to the extreme voltages or currents that are inherent when rapidly switching energy storage elements.

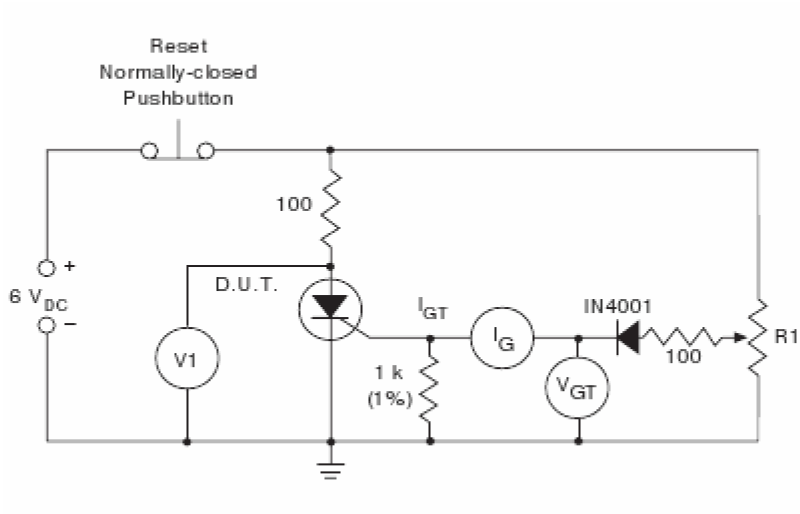
Specified voltage ratings of thyristors range from a few tens of volts up to multiple kV levels and rated current levels range from the sub 1A range up to kA level currents. In higher power applications thyristors will dissipate considerable energy when in the conducting state so heatsinks are required to keep the operating temperature low enough to avoid damaging or destroying the devices.

There are many types of thyristors available today with the major distinctions being in how the devices can be turned off. The most basic units are the SCR and the Triac and will be the focus of this experiment. The acronyms for some of the other types of thyristors, often considered more advanced devices, are BCTs, LASCR, RCT, GTO, FET-CTH, MTO, ETO, IGCT,MCT, and SITH. Regardless of whether working with the basic SCR or Triac or the more advanced devices, they all still use a 4-layer pnpn silicon stack comprising three series-connected pn junctions as the basic element that is used to switch large loads.

For safety reasons, we will restrict the investigations in this experiment to the 24V level though the devices used and the circuits discussed would work well at much higher voltage levels.

Part One: Extract Vgt and Igt

Extract the parameters V_{GT} and I_{GT} for the thyristors provided. The datasheet for the S4010LS2 provides a simple test circuit for extracting these parameters. It notes that in order to measure the values, use the potentiometer to slowly increase V_{GT} until the reading at V1 drops from 6V to 1V (signifying that the thyristor is on). The reading of V_{GT} just prior to the drop is the gate trigger voltage. If you miss the value use the switch to reset the circuit. I_{GT} can be computed from the equation



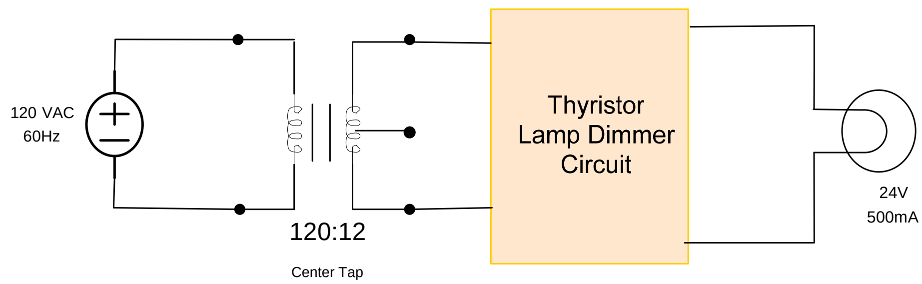
$$I_{GT} = I_G - \frac{V_{GT}}{1000} \quad \text{Amps}$$

Compare your values with groups around you. What do these values mean? Do they agree with what is given in the datasheet?

Note: The gate terminal should always be controlled with a gate voltage that varies between 0 and some positive value.

Part Two: Light Dimmer

Build a circuit using the thyristors that can serve as a light dimmer for lights driven by an AC voltage. Design your circuit so that it can drive a 24V, 0.5mA incandescent lamp.



You should be able to continuously adjust the brightness of the bulb from no light output to full intensity. Since you are not controlling a large amount of current, the thyristors that have been specified for this experiment can operate safely without adding a heat sink. But be sure not to touch these devices when operating or immediately after turning off the power as they may be hot.

Comment on the effectiveness of your circuit. Why is a circuit like this used commercially for dimming a lamp instead of using a voltage divider or modulator? How much voltage is lost across your thyristor?

WARNING: When the transformer is plugged in the red and black ports on back are HOT with 120V. DO NOT TOUCH, SHORT, OR HOOK UP TO THESE PLUGS. Use the green and black ports on front.

Hooking up to green-black will give you 6.3V RMS (10Vpeak). To increase the power a bit, hook up green-green, which will give you 12.6V RMS. **Only put this high voltage across the light and thyristor. It will destroy any other devices in your circuit. If you would like to hook it up to anything else you must reduce the voltage.**

Part Three: Burglar Alarm

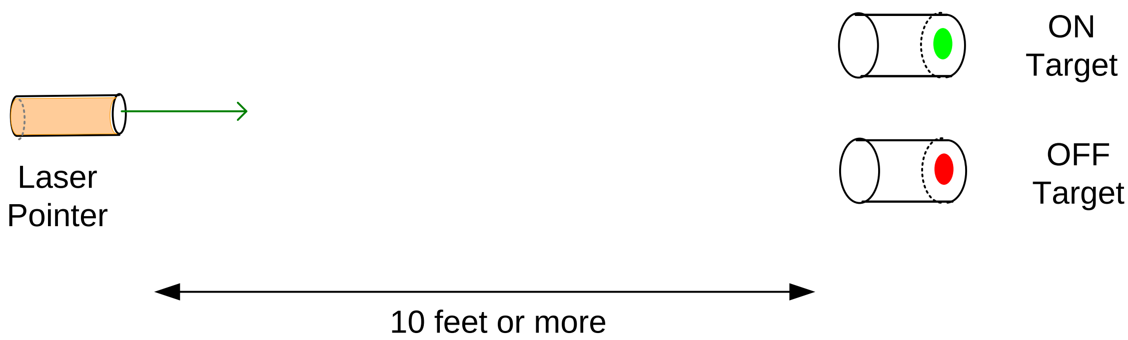
Build a light-sensitive burglar alarm. This circuit should trigger an LED (in real life this would trigger a siren, police, etc) that signals the alarm has been tripped. This should require a hard reset (a switch) to turn off. By default the circuit should remain off in the dark and trigger when light is detected. Use a photodiode for this purpose.

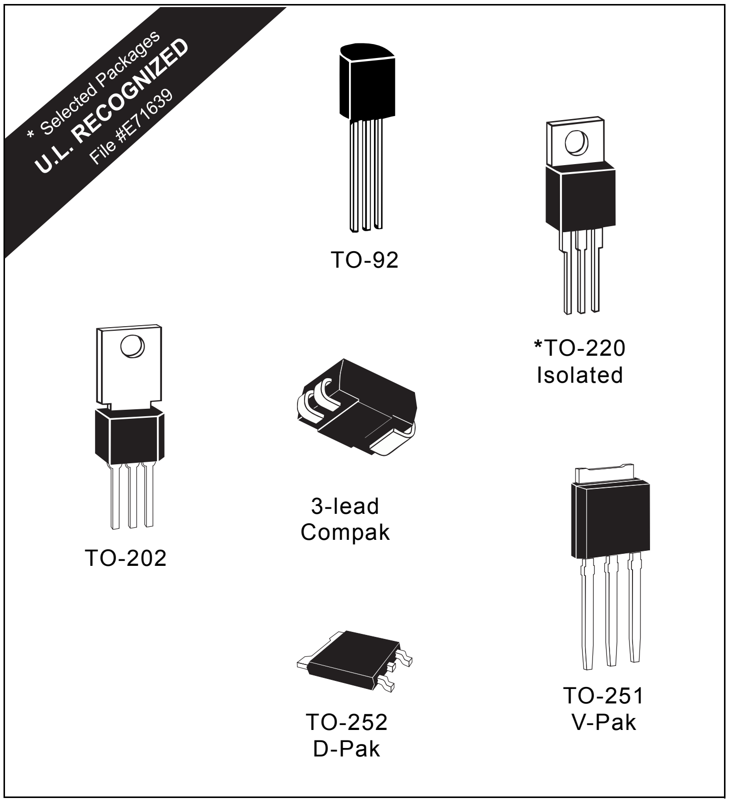
Part Four: Light Controlled Light Dimmer

Design, build, and test a circuit where the input to a separate photodetector (such as a photo resistor or photo diode) can be used to modulate the intensity of the incandescent lamp. The intensity of the incandescent lamp should be adjustable from off to full brightness as the light level into the photodetector is varied between the minimum and maximum values.

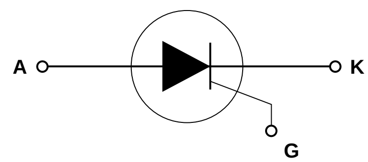
Part Five: Laser Pointer Controlled Load

Design, build, and test a circuit whereby an incandescent lamp can be turned on or turned off with a laser pointer. When the laser pointer is directed to the ON Target (depicted in green) the lamp should be turned on. When the laser pointer is directed at the OFF Target (depicted in red), the lamp should be turned off. The laser pointer targets should not be adversely affected by ambient light in the room and should be separated from the laser pointer by 10 feet or more.





E5



Sensitive SCRs

(0.8 A to 10 A) RoHS

General Description

The Teccor line of sensitive SCR semiconductors are half-wave unidirectional, gate-controlled rectifiers (SCR-thyristor) which complement Teccor's line of power SCRs. This group of packages offers ratings of 0.8 A to 10 A, and 200 V to 600 V with gate sensitivities of 12 µA to 500 µA. For gate currents in the 10 mA to 50 mA ranges, see “SCRs” section of this catalog.

The TO-220 and TO-92 are electrically isolated where the case or tab is internally isolated to allow the use of low-cost assembly and convenient packaging techniques.

Teccor's line of SCRs features glass-passivated junctions to ensure long-term device reliability and parameter stability. Teccor's glass offers a rugged, reliable barrier against junction contamination.

Tape-and-reel packaging is available for the TO-92 package. Consult the factory for more information.

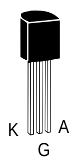
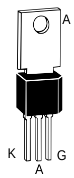
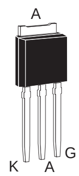
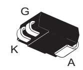
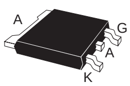
Variations of devices covered in this data sheet are available for custom design applications. Consult the factory for more information.

Features

- **RoHS Compliant**
- **Electrically-isolated TO-220 package**
- **High voltage capability — up to 600 V**
- **High surge capability — up to 100 A**
- **Glass-passivated chip**

Compak Features

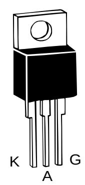
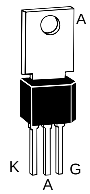
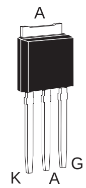
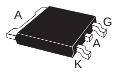
- **Surface mount package — 0.8 A series**
- **New small-profile three-leaded Compak package**
- **Four gate sensitivities available**
- **Packaged in embossed carrier tape with 2,500 devices per reel**
- **Can replace SOT-223**

TYPE	Part Number					I_T		V_{DRM} & V_{RRM}	I_{GT}	I_{DRM} & I_{RRM}			V_{TM}
	Non-isolated					(1)			(2) (12) (14) (18)	(20) (21)			(3) (10)
													
	TO-92	TO-202	TO-251 V-Pak	Compak	TO-252 D-Pak	Amps				µAmps			
	See "Package Dimensions" section for variations. (11)					$I_{T(RMS)}$	$I_{T(AV)}$	Volts	µAmps	T_C or T_L = 25 °C	T_C or T_L = 100 °C	T_C or T_L = 110 °C	Volts
						MAX		MIN	MAX	MAX			MAX
0.8 A				**S2S1**		**0.8**	**0.51**	**200**	**12**	**2**		**100**	**1.7**
				S4S1		**0.8**	**0.51**	**400**	**12**	**2**		**100**	**1.7**
				S6S1		**0.8**	**0.51**	**600**	**12**	**2**		**100**	**1.7**
				S2S2		**0.8**	**0.51**	**200**	**50**	**2**		**100**	**1.7**
				S4S2		**0.8**	**0.51**	**400**	**50**	**2**		**100**	**1.7**
				S6S2		**0.8**	**0.51**	**600**	**50**	**2**		**100**	**1.7**
				S2S		**0.8**	**0.51**	**200**	**200**	**2**		**100**	**1.7**
				S4S		**0.8**	**0.51**	**400**	**200**	**2**		**100**	**1.7**
				S6S		**0.8**	**0.51**	**600**	**200**	**2**		**100**	**1.7**
				S2S3		**0.8**	**0.51**	**200**	**500**	**2**		**100**	**1.7**
				S4S3		**0.8**	**0.51**	**400**	**500**	**2**		**100**	**1.7**
				S6S3		**0.8**	**0.51**	**600**	**500**	**2**		**100**	**1.7**
	EC103B					**0.8**	**0.51**	**200**	**200**	**1**	**50**		**1.7**
	EC103D					**0.8**	**0.51**	**400**	**200**	**1**	**50**		**1.7**
	EC103M					**0.8**	**0.51**	**600**	**200**	**2**	**100**		**1.7**
	EC103B1					**0.8**	**0.51**	**200**	**12**	**1**	**50**		**1.7**
	EC103D1					**0.8**	**0.51**	**400**	**12**	**1**	**50**		**1.7**
	EC103M1					**0.8**	**0.51**	**600**	**12**	**2**	**100**		**1.7**
	EC103B2					**0.8**	**0.51**	**200**	**50**	**1**	**50**		**1.7**
	EC103D2					**0.8**	**0.51**	**400**	**50**	**1**	**50**		**1.7**
	EC103M2					**0.8**	**0.51**	**600**	**50**	**2**	**100**		**1.7**
	EC103B3					**0.8**	**0.51**	**200**	**500**	**1**	**50**		**1.7**
	EC103D3					**0.8**	**0.51**	**400**	**500**	**1**	**50**		**1.7**
	EC103M3					**0.8**	**0.51**	**600**	**500**	**2**	**100**		**1.7**
	2N5064					**0.8**	**0.51**	**200**	**200**	**1**		**50**	**1.7**
	2N6565					**0.8**	**0.51**	**400**	**200**	**1**		**100**	**1.7**
1.5 A	**TCR22-4**					**1.5**	**0.95**	**200**	**200**	**1**		**100**	**1.5**
	TCR22-6					**1.5**	**0.95**	**400**	**200**	**1**		**100**	**1.5**
	TCR22-8					**1.5**	**0.95**	**600**	**200**	**2**		**100**	**1.5**
4 A		**T106B1**				**4**	**2.5**	**200**	**200**	**2**		**100**	**2.2**
		T106D1				**4**	**2.5**	**400**	**200**	**2**		**100**	**2.2**
		T106M1				**4**	**2.5**	**600**	**200**	**2**		**100**	**2.2**
		T107B1				**4**	**2.5**	**200**	**500**	**2**		**100**	**2.5**
		T107D1				**4**	**2.5**	**400**	**500**	**2**		**100**	**2.5**
		T107M1				**4**	**2.5**	**600**	**500**	**2**		**100**	**2.5**
			S2004VS1		**S2004DS1**	**4**	**2.5**	**200**	**50**	**2**		**100**	**1.6**
			S4004VS1		**S4004DS1**	**4**	**2.5**	**400**	**50**	**2**		**100**	**1.6**
			S6004VS1		**S6004DS1**	**4**	**2.5**	**600**	**50**	**2**		**100**	**1.6**
			S2004VS2		**S2004DS2**	**4**	**2.5**	**200**	**200**	**2**		**100**	**1.6**
			S4004VS2		**S4004DS2**	**4**	**2.5**	**400**	**200**	**2**		**100**	**1.6**
			S6004VS2		**S6004DS2**	**4**	**2.5**	**600**	**200**	**2**		**100**	**1.6**

See "General Notes" on page E5 - 4 and "Electrical Specifications Notes" on page E5 - 5

V_{GT}			I_H	I_{GM}	V_{GRM}	P_{GM}	$P_{G(AV)}$	I_{TSM}	dv/dt		di/dt	t_{gt}	t_q	I^2t
(4) (12) (22) Volts			(5) (15) (16) (19)	(17)		(17)		(6) (7) (13) Amps				(8)	(9)	
T_C or T_L = -40 °C	T_C or T_L = 25 °C	T_C or T_L = 110 °C	mAmps	Amps	Volts	Watts	Watts	60/50 Hz	Volts/µSec		Amps/µSec	µSec	µSec	Amps²/Sec
MAX			MAX		MIN				MIN	TYP (23)		TYP	MAX	
1.2	**0.8**	**0.2**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**20**		**50**	**2**	**60**	**1.6**
1.2	**0.8**	**0.2**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**20**		**50**	**2**	**60**	**1.6**
1.2	**0.8**	**0.2**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**10**		**50**	**2**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**25**		**50**	**3**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**25**		**50**	**3**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**10**		**50**	**3**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**30**		**50**	**4**	**50**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**30**		**50**	**4**	**50**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**15**		**50**	**4**	**50**	**1.6**
1.2	**0.8**	**0.25**	**8**	**1**	**5**	**1**	**0.1**	**20/16**	**40**		**50**	**5**	**45**	**1.6**
1.2	**0.8**	**0.25**	**8**	**1**	**5**	**1**	**0.1**	**20/16**	**40**		**50**	**5**	**45**	**1.6**
1.2	**0.8**	**0.25**	**8**	**1**	**5**	**1**	**0.1**	**20/16**	**20**		**50**	**5**	**45**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**30**		**50**	**3.5**	**50**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**30**		**50**	**3.5**	**50**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**15**		**50**	**3.5**	**50**	**1.6**
1.2	**0.8**	**0.2**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**20**		**50**	**2**	**60**	**1.6**
1.2	**0.8**	**0.2**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**20**		**50**	**2**	**60**	**1.6**
1.2	**0.8**	**0.2**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**10**		**50**	**2**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**25**		**50**	**3**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**25**		**50**	**3**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**10**		**50**	**3**	**60**	**1.6**
1.2	**0.8**	**0.25**	**8**	**1**	**5**	**1**	**0.1**	**20/16**	**40**		**50**	**5**	**45**	**1.6**
1.2	**0.8**	**0.25**	**8**	**1**	**5**	**1**	**0.1**	**20/16**	**40**		**50**	**5**	**45**	**1.6**
1.2	**0.8**	**0.25**	**8**	**1**	**5**	**1**	**0.1**	**20/16**	**20**		**50**	**5**	**45**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**5**	**1**	**0.1**	**20/16**	**25**		**50**	**2.2**	**60**	**1.6**
1.2	**0.8**	**0.25**	**5**	**1**	**6**	**1**	**0.1**	**20/16**	**25**		**50**	**2.2**	**60**	**1.6**
1	**0.8**	**0.25**	**5**	**1**	**6**	**1**	**0.1**	**20/16**	**60**		**50**	**3.5**	**50**	**1.6**
1	**0.8**	**0.25**	**5**	**1**	**6**	**1**	**0.1**	**20/16**	**40**		**50**	**3.5**	**50**	**1.6**
1	**0.8**	**0.25**	**5**	**1**	**6**	**1**	**0.1**	**20/16**	**30**		**50**	**3.5**	**50**	**1.6**
1	**0.8**	**0.2**	**5**	**1**	**6**	**1**	**0.1**	**20/16**		**8**	**50**	**4**	**50**	**1.6**
1	**0.8**	**0.2**	**5**	**1**	**6**	**1**	**0.1**	**20/16**		**8**	**50**	**4**	**50**	**1.6**
1	**0.8**	**0.2**	**5**	**1**	**6**	**1**	**0.1**	**20/16**		**8**	**50**	**4**	**50**	**1.6**
1	**0.8**	**0.2**	**6**	**1**	**6**	**1**	**0.1**	**20/16**		**8**	**50**	**5**	**45**	**1.6**
1	**0.8**	**0.2**	**6**	**1**	**6**	**1**	**0.1**	**20/16**		**8**	**50**	**5**	**45**	**1.6**
1	**0.8**	**0.2**	**6**	**1**	**6**	**1**	**0.1**	**20/16**		**8**	**50**	**5**	**45**	**1.6**
1	**0.8**	**0.2**	**4**	**1**	**6**	**1**	**0.1**	**30/25**		**8**	**50**	**3**	**50**	**3.7**
1	**0.8**	**0.2**	**4**	**1**	**6**	**1**	**0.1**	**30/25**		**8**	**50**	**3**	**50**	**3.7**
1	**0.8**	**0.2**	**4**	**1**	**6**	**1**	**0.1**	**30/25**		**8**	**50**	**3**	**50**	**3.7**
1	**0.8**	**0.2**	**6**	**1**	**6**	**1**	**0.1**	**30/25**		**8**	**50**	**4**	**50**	**3.7**
1	**0.8**	**0.2**	**6**	**1**	**6**	**1**	**0.1**	**30/25**		**8**	**50**	**4**	**50**	**3.7**
1	**0.8**	**0.2**	**6**	**1**	**6**	**1**	**0.1**	**30/25**		**8**	**50**	**4**	**50**	**3.7**

See “General Notes” on page E5 - 4 and “Electrical Specifications Notes” on page E5 - 5

TYPE	Part Number				I_T		V_{DRM} & V_{RRM}	I_{GT}	I_{DRM} & I_{RRM}		V_{TM}
	Isolated	Non-isolated			(1)			(2) (12)	(20) (21)		(3) (10)
	 TO-220	 TO-202	 TO-251 V-Pak	 TO-252 D-Pak	Amps				µAmps		
	See "Package Dimensions" section for variations. (11)				$I_{T(RMS)}$	$I_{T(AV)}$	Volts	µAmps	T_C = 25 °C	T_C = 110 °C	Volts
					MAX	MAX	MIN	MAX	MAX	MAX	MAX
6 A	**S2006LS2**	**S2006FS21**	**S2006VS2**	**S2006DS2**	**6**	**3.8**	**200**	**200**	**5**	**250**	**1.6**
	S4006LS2	**S4006FS21**	**S4006VS2**	**S4006DS2**	**6**	**3.8**	**400**	**200**	**5**	**250**	**1.6**
	S6006LS2	**S6006FS21**	**S6006VS2**	**S6006DS2**	**6**	**3.8**	**600**	**200**	**5**	**250**	**1.6**
	S2006LS3	**S2006FS31**	**S2006VS3**	**S2006DS3**	**6**	**3.8**	**200**	**500**	**5**	**250**	**1.6**
	S4006LS3	**S4006FS31**	**S4006VS3**	**S4006DS3**	**6**	**3.8**	**400**	**500**	**5**	**250**	**1.6**
	S6006LS3	**S6006FS31**	**S6006VS3**	**S6006DS3**	**6**	**3.8**	**600**	**500**	**5**	**250**	**1.6**
8 A	**S2008LS2**	**S2008FS21**	**S2008VS2**	**S2008DS2**	**8**	**5.1**	**200**	**200**	**5**	**250**	**1.6**
	S4008LS2	**S4008FS21**	**S4008VS2**	**S4008DS2**	**8**	**5.1**	**400**	**200**	**5**	**250**	**1.6**
	S6008LS2	**S6008FS21**	**S6008VS2**	**S6008DS2**	**8**	**5.1**	**600**	**200**	**5**	**250**	**1.6**
	S2008LS3	**S2008FS31**	**S2008VS3**	**S2008DS3**	**8**	**5.1**	**200**	**500**	**5**	**250**	**1.6**
	S4008LS3	**S4008FS31**	**S4008VS3**	**S4008DS3**	**8**	**5.1**	**400**	**500**	**5**	**250**	**1.6**
	S6008LS3	**S6008FS31**	**S6008VS3**	**S6008DS3**	**8**	**5.1**	**600**	**500**	**5**	**250**	**1.6**
10 A	**S2010LS2**	**S2010FS21**	**S2010VS2**	**S2010DS2**	**10**	**6.4**	**200**	**200**	**5**	**250**	**1.6**
	S4010LS2	**S4010FS21**	**S4010VS2**	**S4010DS2**	**10**	**6.4**	**400**	**200**	**5**	**250**	**1.6**
	S6010LS2	**S6010FS21**	**S6010VS2**	**S6010DS2**	**10**	**6.4**	**600**	**200**	**5**	**250**	**1.6**
	S2010LS3	**S2010FS31**	**S2010VS3**	**S2010DS3**	**10**	**6.4**	**200**	**500**	**5**	**250**	**1.6**
	S4010LS3	**S4010FS31**	**S4010VS3**	**S4010DS3**	**10**	**6.4**	**400**	**500**	**5**	**250**	**1.6**
	S6010LS3	**S6010FS31**	**S6010VS3**	**S6010DS3**	**10**	**6.4**	**600**	**500**	**5**	**250**	**1.6**

Specific Test Conditions

di/dt — Maximum rate-of-change of on-state current; I_{GT} = 50 mA pulse width ≥15 µsec with ≤0.1 µs rise time

dv/dt — Critical rate-of-rise of forward off-state voltage

I^2t — RMS surge (non-repetitive) on-state current for period of 8.3 ms for fusing

I_{DRM} and **I_{RRM}** — Peak off-state current at V_{DRM} and V_{RRM}

I_{GT} — DC gate trigger current V_D = 6 V dc; R_L = 100 Ω

I_{GM} — Peak gate current

I_H — DC holding current; initial on-state current = 20 mA

I_T — Maximum on-state current

I_{TSM} — Peak one-cycle forward surge current

$P_{G(AV)}$ — Average gate power dissipation

P_{GM} — Peak gate power dissipation

t_{gt} — Gate controlled turn-on time gate pulse = 10 mA; minimum width = 15 µS with rise time ≤0.1 µs

t_q — Circuit commutated turn-off time

V_{DRM} and **V_{RRM}** — Repetitive peak off-state forward and reverse voltage

V_{GRM} — Peak reverse gate voltage

V_{GT} — DC gate trigger voltage; V_D = 6 V dc; R_L = 100 Ω

V_{TM} — Peak on-state voltage

General Notes

- Teccor 2N5064 and 2N6565 Series devices conform to all JEDEC registered data. See specifications table on pages E5 - 2 and E5 - 3.
- The case lead temperature (T_C or T_L) is measured as shown on dimensional outline drawings in the "Package Dimensions" section of this catalog.
- All measurements (except I_{GT}) are made with an external resistor R_{GK} = 1 kΩ unless otherwise noted.
- All measurements are made at 60 Hz with a resistive load at an ambient temperature of +25 °C unless otherwise specified.
- Operating temperature (T_J) is -65 °C to +110 °C for EC Series devices, -65 °C to +125 °C for 2N Series devices, -40 °C to +125 °C for "TCR" Series, and -40 °C to +110 °C for all others.
- Storage temperature range (T_S) is -65 °C to +150 °C for TO-92 devices, -40 °C to +150 °C for TO-202 and Compak devices, and -40 °C to +125 °C for all others.
- Lead solder temperature is a maximum of +230 °C for 10 seconds maximum ≥1/16" (1.59 mm) from case.

V_{GT}			I_H	I_{GM}	V_{GRM}	P_{GM}	$P_{G(AV)}$	I_{TSM}	dv/dt	di/dt	t_{gt}	t_q	I^2t
(4) (12) (22)			(5) (19)	(17)		(17)		(6) (13)			(8)	(9)	
Volts									Volts/µSec				
T_C = -40 °C	T_C = 25 °C	T_C = 110 °C	mAmps	Amps	Volts	Watts	Watts	Amps	T_C = 110 °C	Amps/µSec	µSec	µSec	$Amps^2Sec$
MAX			MAX		MIN			60/50 Hz	TYP		TYP	MAX	
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**10**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**10**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**10**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**10**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**10**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**6**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**4**	**50**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**10**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**5**	**45**	**41**
1	**0.8**	**0.25**	**8**	**1**	**6**	**1**	**0.1**	**100/83**	**8**	**100**	**5**	**45**	**41**

Electrical Specifications Notes

(1) See Figure E5.1 through Figure E5.9 for current ratings at specified operating temperatures.

(2) See Figure E5.10 for I_{GT} versus T_C or T_L.

(3) See Figure E5.11 for instantaneous on-state current (i_T) versus on-state voltage (v_T) TYP.

(4) See Figure E5.12 for V_{GT} versus T_C or T_L.

(5) See Figure E5.13 for I_H versus T_C or T_L.

(6) For more than one full cycle, see Figure E5.14.

(7) 0.8 A to 4 A devices also have a pulse peak forward current on-state rating (repetitive) of 75 A. This rating applies for operation at 60 Hz, 75 °C maximum tab (or anode) lead temperature, switching from 80 V peak, sinusoidal current pulse width of 10 µs minimum, 15 µs maximum. See Figure E5.20 and Figure E5.21.

(8) See Figure E5.15 for t_{gt} versus I_{GT}.

(9) Test conditions as follows:
– T_C or T_L ≤80 °C, rectangular current waveform
– Rate-of-rise of current ≤10 A/µs
– Rate-of-reversal of current ≤5 A/µs
– I_{TM} = 1 A (50 µs pulse), Repetition Rate = 60 pps
– V_{RRM} = Rated
– V_R = 15 V minimum, V_{DRM} = Rated
– Rate-of-rise reapplied forward blocking voltage = 5 V/µs
– Gate Bias = 0 V, 100 Ω (during turn-off time interval)

(10) Test condition is maximum rated RMS current except TO-92 devices are 1.2 A_{PK}; T106/T107 devices are 4 A_{PK}.

(11) See package outlines for lead form configurations. When ordering special lead forming, add type number as suffix to part number.

(12) V_D = 6 V dc, R_L = 100 Ω (See Figure E5.19 for simple test circuit for measuring gate trigger voltage and gate trigger current.)

(13) See Figure E5.1 through Figure E5.9 for maximum allowable case temperature at maximum rated current.

(14) I_{GT} = 500 µA maximum at T_C = -40 °C for T106 devices

(15) I_H = 10 mA maximum at T_C = -65 °C for 2N5064 Series and 2N6565 Series devices

(16) I_H = 6 mA maximum at T_C = -40 °C for T106 devices

(17) Pulse Width ≤10 µs

(18) I_{GT} = 350 µA maximum at T_C = -65 °C for 2N5064 Series and 2N6565 Series devices

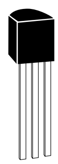
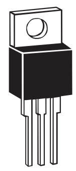
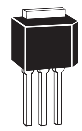
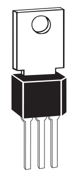
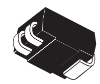
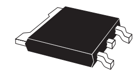
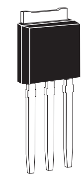
(19) Latching current can be higher than 20 mA for higher I_{GT} types. Also, latching current can be much higher at -40 °C. See Figure E5.18.

(20) T_C or T_L = T_J for test conditions in off state

(21) I_{DRM} and I_{RRM} = 50 µA for 2N5064 and 100 µA for 2N6565 at 125 °C

(22) TO-92 devices specified at -65 °C instead of -40 °C

(23) T_C = 110 °C

Thermal Resistance (Steady State) $R_{\theta JC}$ [$R_{\theta JA}$] °C/W (TYPICAL)							
Package Code	E	L	F2	F	C	D	V
Type	 TO-92	 TO-220	 TO-202 Type 2, 4, & 41	 TO-202 Type 1 & 3	 Compak	 TO-252 D-Pak	 TO-251 V-Pak
0.8 A	**75 [160]**				**60***		
1.5 A	**50 [160]**						
4.0 A			**10 [100]**	**6.2 [80]**		**3.0**	**3.8 [85]**
6.0 A		**4.0 [65]**		**4.3**		**1.8**	**2.4**
8.0 A		**3.4**		**3.9**		**1.5**	**2.1**
10.0 A		**3.0**		**3.4**		**1.45**	**1.72**

*Mounted on 1 cm^2 copper foil surface; two-ounce copper foil

Electrical Isolation

Teccor's isolated sensitive SCRs will withstand a minimum high potential test of 2500 V ac rms from leads to mounting tab over the device's operating temperature range. The following table shows other standard and optional isolation ratings.

Electrical Isolation * from Leads to Mounting Tab	
V AC RMS	**TO-220**
2500	**Standard**
4000	**Optional ****

*UL Recognized File #E71639
**For 4000 V isolation, use "V" suffix in part number.

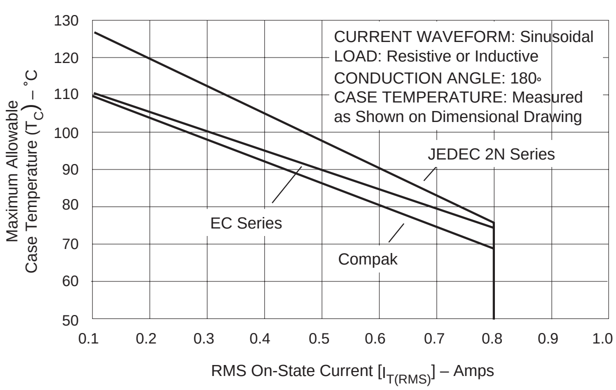


Figure E5.1 Maximum Allowable Case Temperature versus RMS On-state Current

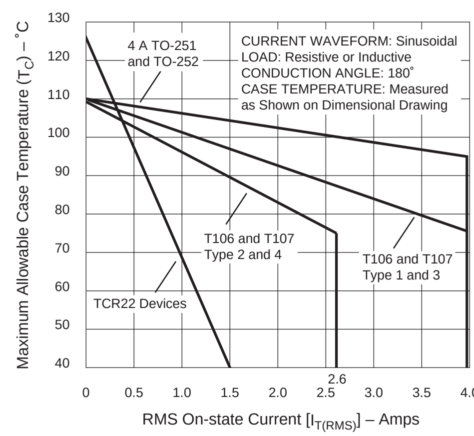


Figure E5.2 Maximum Allowable Case Temperature versus RMS On-state Current

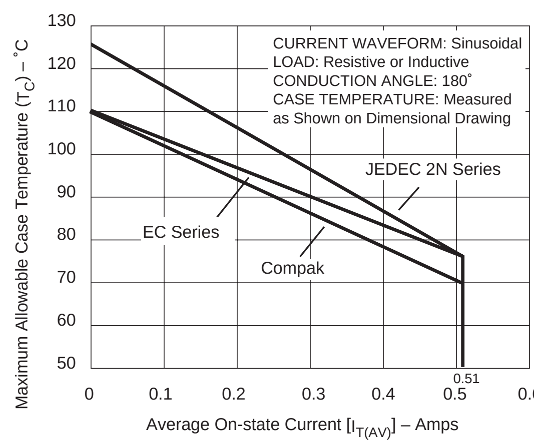


Figure E5.3 Maximum Allowable Case Temperature versus Average On-state Current

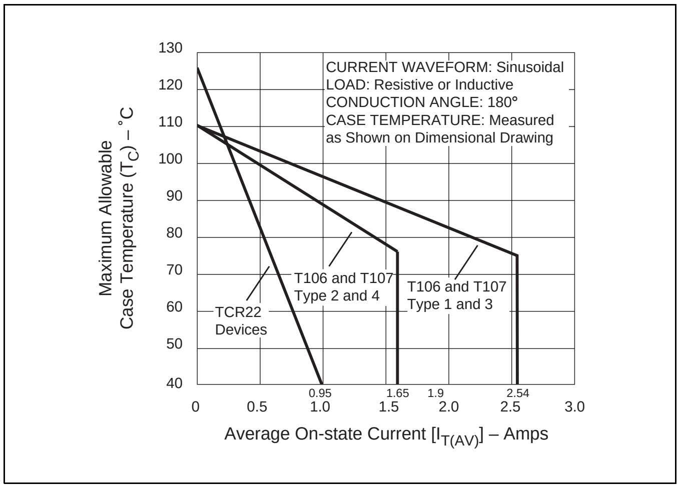


Figure E5.4 Maximum Allowable Case Temperature versus Average On-state Current

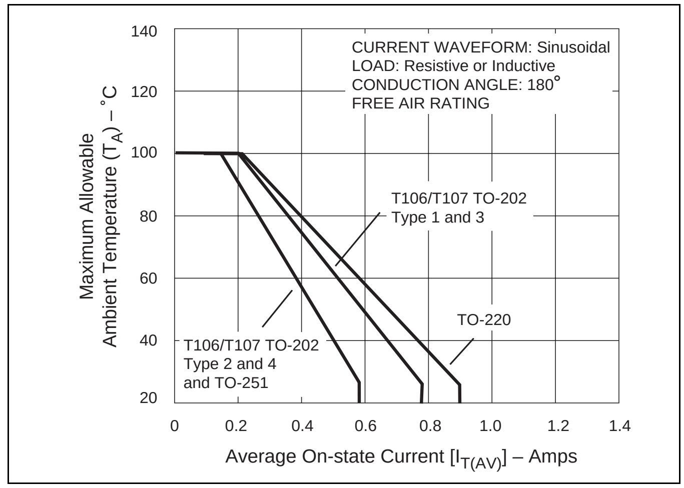


Figure E5.7 Maximum Allowable Ambient Temperature versus Average On-state Current

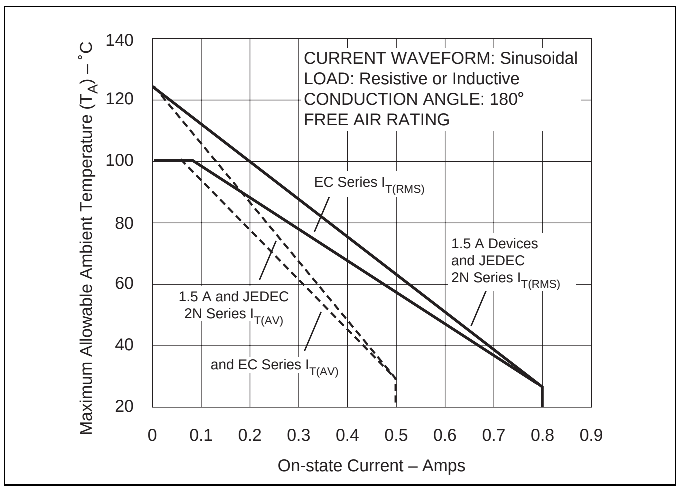


Figure E5.5 Maximum Allowable Ambient Temperature versus On-state Current

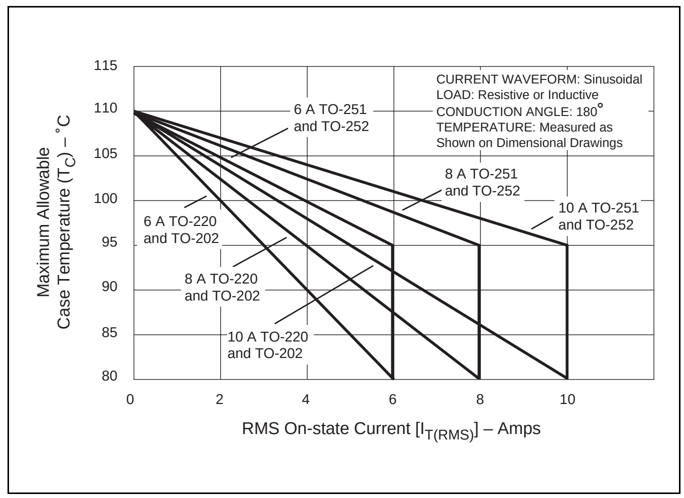


Figure E5.8 Maximum Allowable Case Temperature versus RMS On-state Current

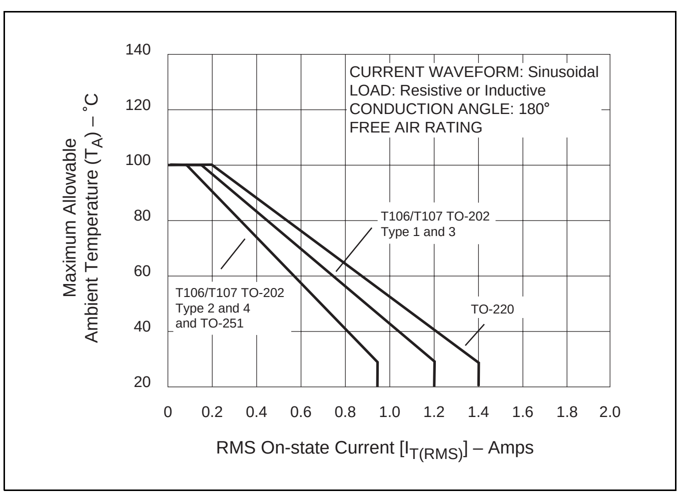


Figure E5.6 Maximum Allowable Ambient Temperature versus RMS On-state Current

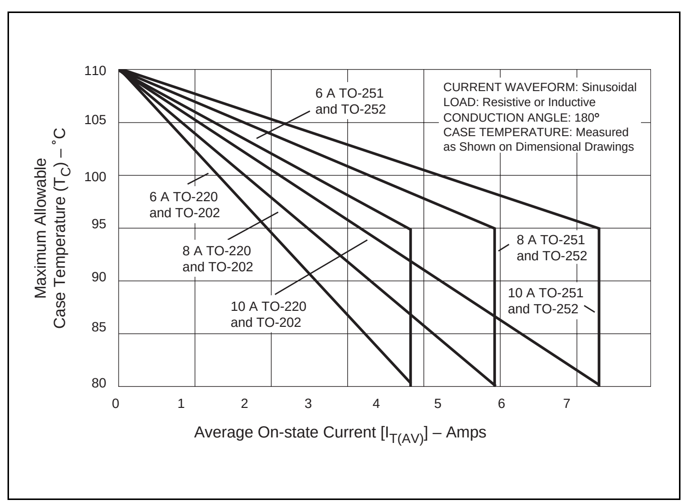


Figure E5.9 Maximum Allowable Case Temperature versus Average On-state Current

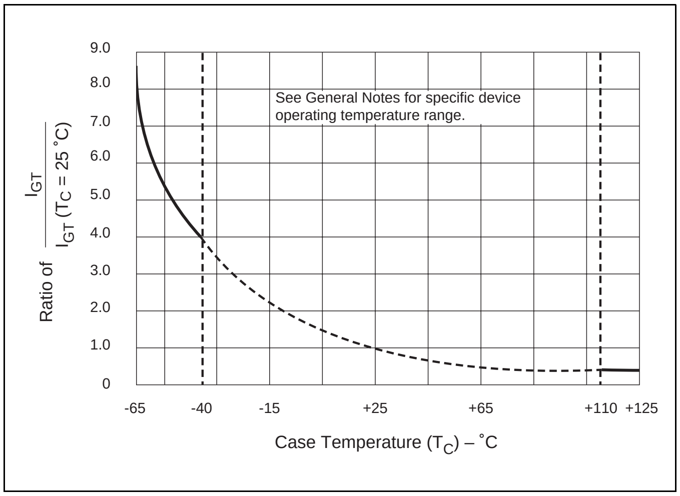


Figure E5.10 Normalized DC Gate-Trigger Current versus Case Temperature

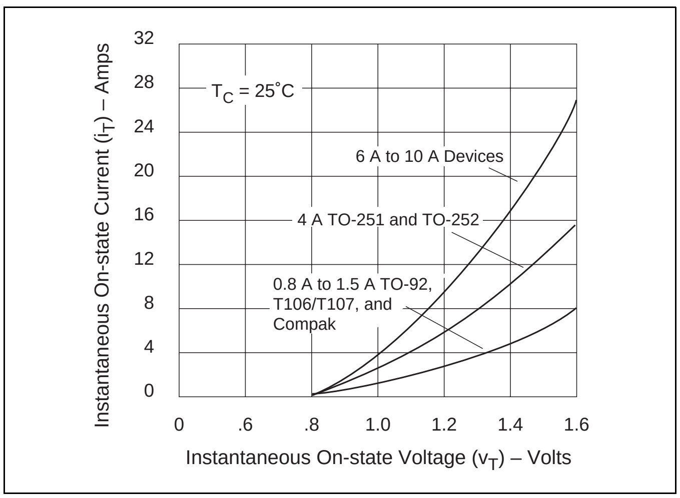


Figure E5.11 Instantaneous On-state Current versus On-state Voltage (Typical)

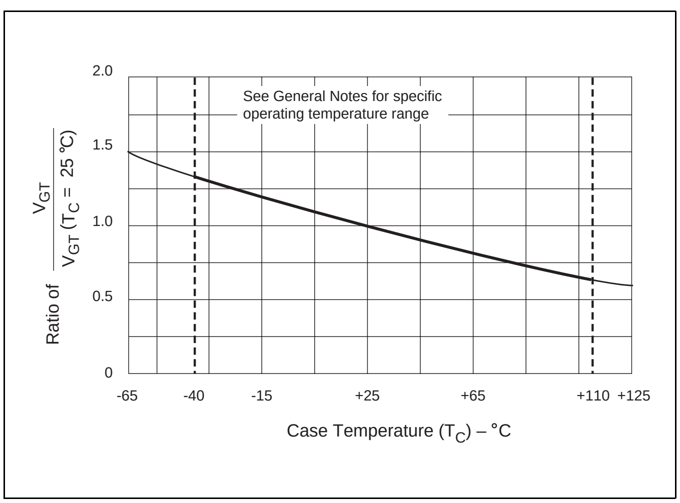


Figure E5.12 Normalized DC Gate-Trigger Voltage versus Case Temperature

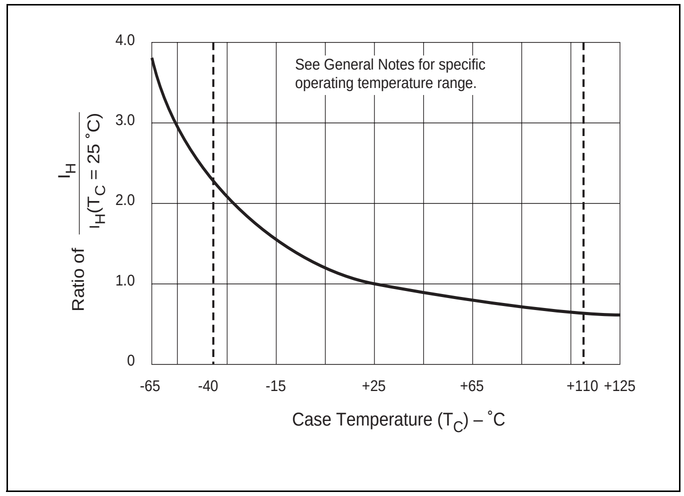


Figure E5.13 Normalized DC Holding Current versus Case Temperature

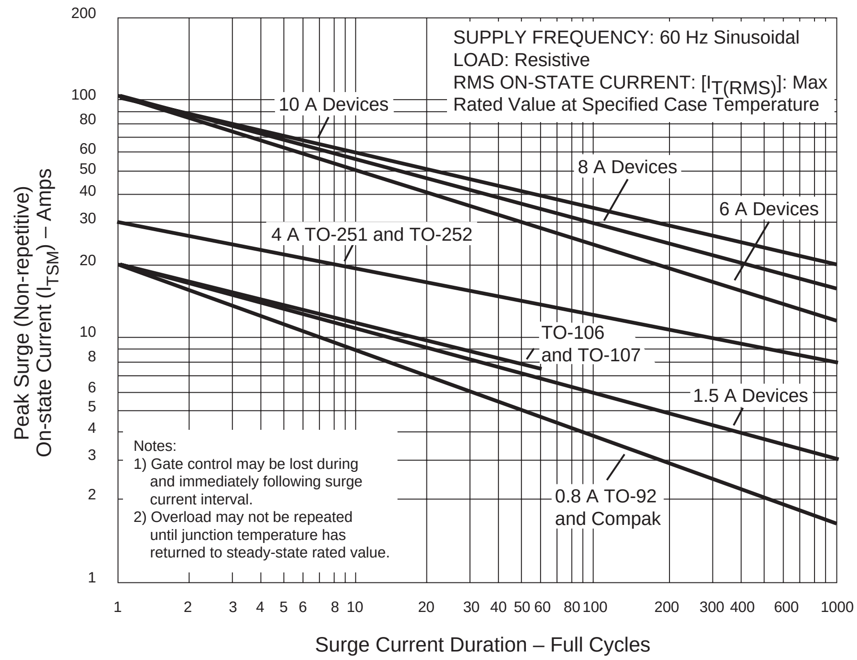


Figure E5.14 Peak Surge On-state Current versus Surge Current Duration

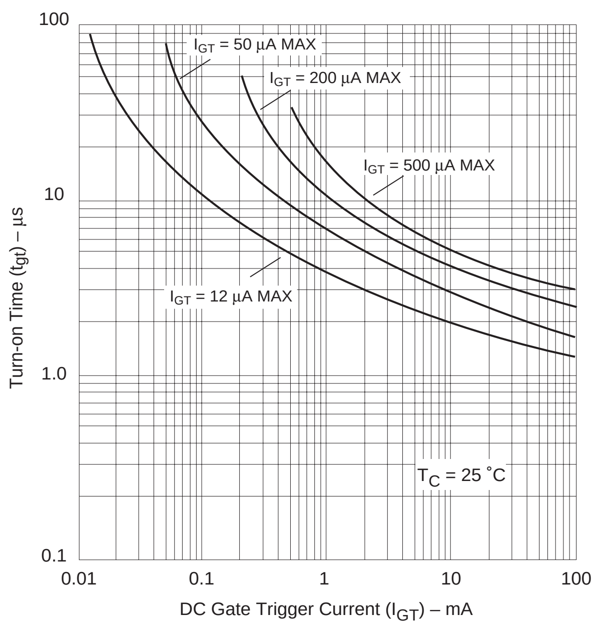


Figure E5.15 Typical Turn-on Time versus Gate Trigger Current

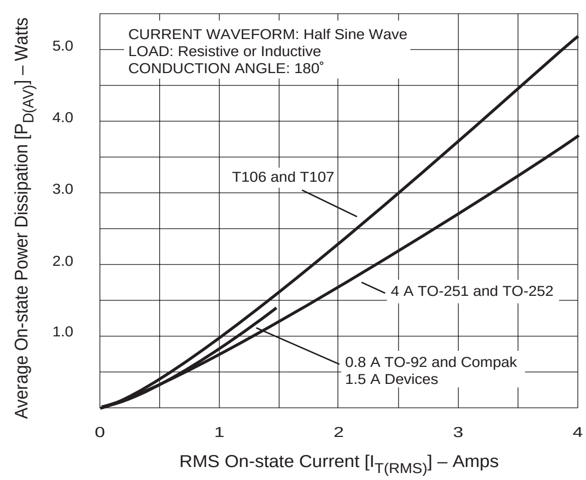


Figure E5.16 Power Dissipation (Typical) versus RMS On-state Current

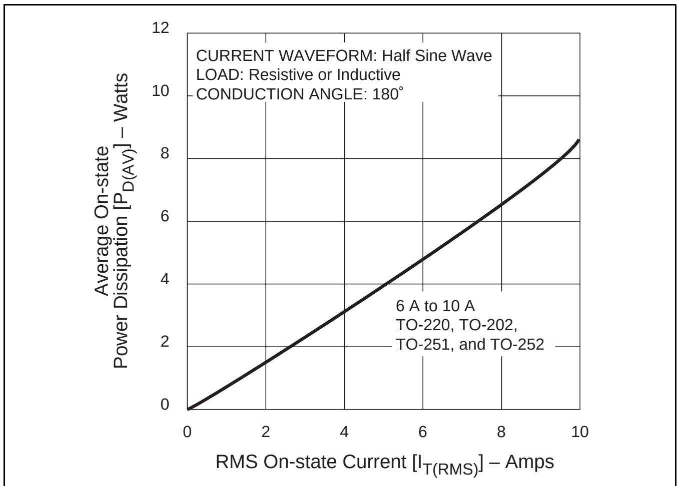


Figure E5.17 Power Dissipation (Typical) versus RMS On-state Current

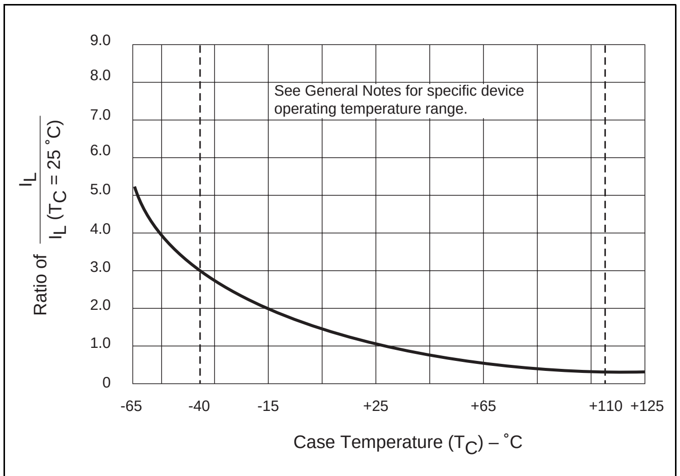


Figure E5.18 Normalized DC Latching Current versus Case Temperature

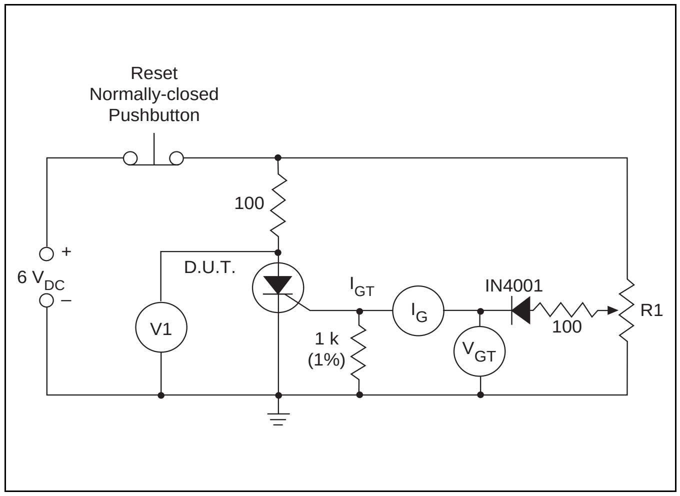


Figure E5.19 Simple Test Circuit for Gate Trigger Voltage and Current Measurement

Note: V1 — 0 V to 10 V dc meter
V_{GT} — 0 V to 1 V dc meter
I_G — 0 mA to 1 mA dc milliammeter
R1 — 1 k potentiometer

To measure gate trigger voltage and current, raise gate voltage (V_{GT}) until meter reading V1 drops from 6 V to 1 V. Gate trigger voltage is the reading on V_{GT} just prior to V1 dropping. Gate trigger current I_{GT} can be computed from the relationship

$$I_{GT} = I_G - \frac{V_{GT}}{1000} \text{ Amps}$$

where I_G is reading (in amperes) on meter just prior to V1 dropping.

Note: I_{GT} may turn out to be a negative quantity (trigger current flows out from gate lead). If negative current occurs, I_{GT} value is not a valid reading. Remove 1 k resistor and use I_G as the more correct I_{GT} value. This will occur on 12 µA gate products.

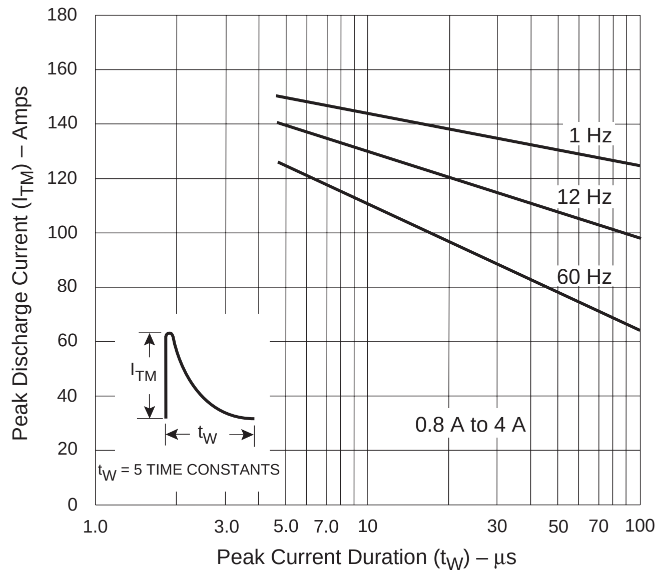


Figure E5.20 Peak Repetitive Capacitor Discharge Current

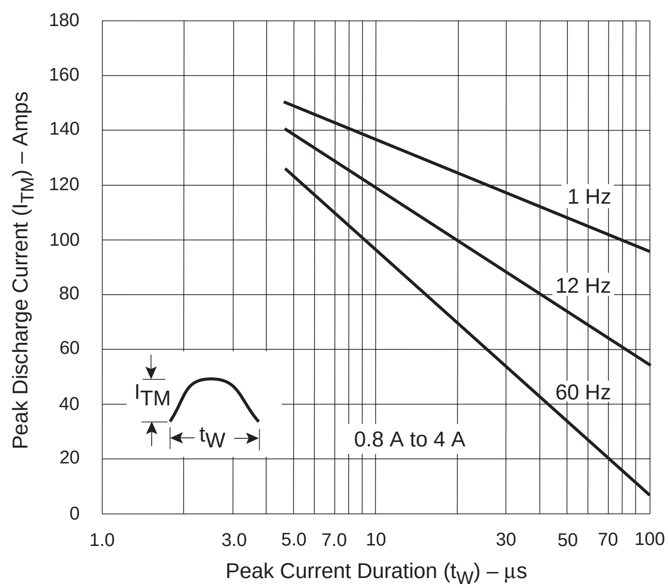
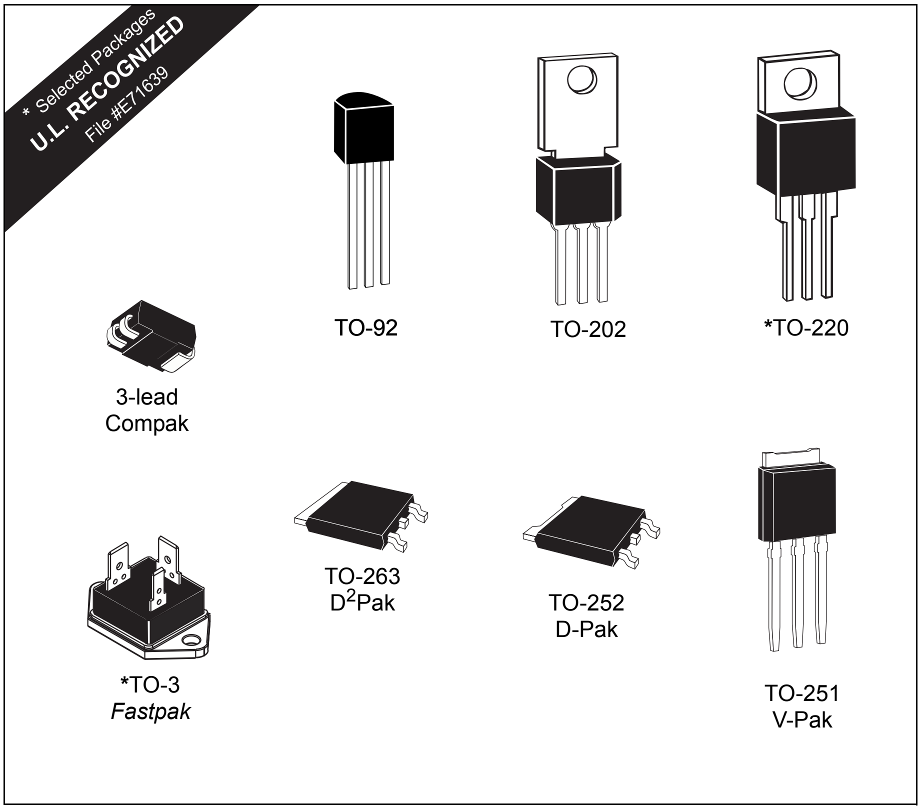
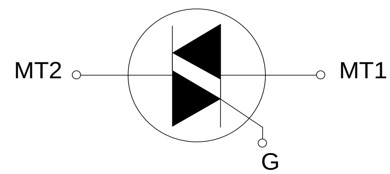


Figure E5.21 Peak Repetitive Sinusoidal Curve

Notes





Triacs

(0.8 A to 35 A) RoHS

General Description

These gated triacs from Teccor Electronics are part of a broad line of bidirectional semiconductors. The devices range in current ratings from 0.8 A to 35 A and in voltages from 200 V to 1000 V.

The triac may be gate triggered from a blocking to conduction state for either polarity of applied voltage and is designed for AC switching and phase control applications such as speed and temperature modulation controls, lighting controls, and static switching relays. The triggering signal is normally applied between the gate and MT1.

Isolated packages are offered with internal construction, having the case or mounting tab electrically isolated from the semiconductor chip. This feature facilitates the use of low-cost assembly and convenient packaging techniques. Tape-and-reel capability is available. See “Packing Options” section of this catalog.

All Teccor triacs have glass-passivated junctions to ensure long-term device reliability and parameter stability. Teccor's glass-passivated junctions offer a rugged, reliable barrier against junction contamination.

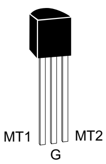
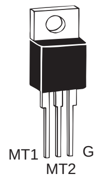
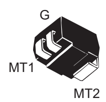
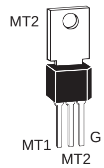
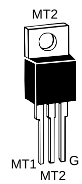
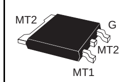
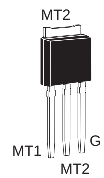
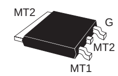
Variations of devices covered in this data sheet are available for custom design applications. Consult factory for more information.

Features

- **RoHS Compliant**
- **Electrically-isolated packages**
- **Glass-passivated junctions**
- **Voltage capability — up to 1000 V**
- **Surge capability — up to 200 A**

Compak Package

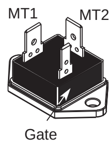
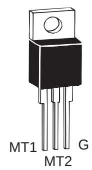
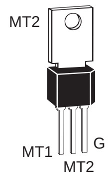
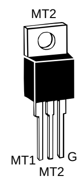
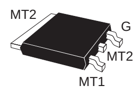
- **Surface mount package — 0.8 A and 1 A series**
- **New small profile three-leaded Compak package**
- **Packaged in embossed carrier tape with 2,500 devices per reel**
- **Can replace SOT-223**

$I_{T(RMS)}$	Part Number								V_{DRM}	I_{GT}				
		Isolated		Non-isolated										
(4)									(1)	(3) (7) (15)				
	TO-92	TO-220	Compak	TO-202	TO-220	TO-252 D-Pak	TO-251 V-Pak	TO-263 D^2Pak	Volts	mAmps				
										QI	QII	QIII	QIV	QIV
MAX	See "Package Dimensions" section for variations. (11)								MIN	MAX				TYP
0.8 A	**Q2X8E3**		**Q2X3**						**200**	**10**	**10**	**10**		**25**
	Q4X8E3		**Q4X3**						**400**	**10**	**10**	**10**		**25**
	Q6X8E3		**Q6X3**						**600**	**10**	**10**	**10**		**25**
	Q2X8E4		**Q2X4**						**200**	**25**	**25**	**25**		**50**
	Q4X8E4		**Q4X4**						**400**	**25**	**25**	**25**		**50**
	Q6X8E4		**Q6X4**						**600**	**25**	**25**	**25**		**50**
1 A	**Q201E3**		**Q2N3**						**200**	**10**	**10**	**10**		**25**
	Q401E3		**Q4N3**						**400**	**10**	**10**	**10**		**25**
	Q601E3		**Q6N3**						**600**	**10**	**10**	**10**		**25**
	Q201E4		**Q2N4**						**200**	**25**	**25**	**25**		**50**
	Q401E4		**Q4N4**						**400**	**25**	**25**	**25**		**50**
	Q601E4		**Q6N4**						**600**	**25**	**25**	**25**		**50**
4 A		**Q2004L3**		**Q2004F31**		**Q2004D3**	**Q2004V3**		**200**	**10**	**10**	**10**		**25**
		Q4004L3		**Q4004F31**		**Q4004D3**	**Q4004V3**		**400**	**10**	**10**	**10**		**25**
		Q6004L3		**Q6004F31**		**Q6004D3**	**Q6004V3**		**600**	**10**	**10**	**10**		**25**
		Q2004L4		**Q2004F41**		**Q2004D4**	**Q2004V4**		**200**	**25**	**25**	**25**		**50**
		Q4004L4		**Q4004F41**		**Q4004D4**	**Q4004V4**		**400**	**25**	**25**	**25**		**50**
		Q6004L4		**Q6004F41**		**Q6004D4**	**Q6004V4**		**600**	**25**	**25**	**25**		**50**
		Q8004L4				**Q8004D4**	**Q8004V4**		**800**	**25**	**25**	**25**		**50**
		QK004L4				**QK004D4**	**QK004V4**		**1000**	**25**	**25**	**25**		**50**
6 A		**Q2006L4**		**Q2006F41**	**Q2006R4**			**Q2006N4**	**200**	**25**	**25**	**25**		**50**
		Q4006L4		**Q4006F41**	**Q4006R4**			**Q4006N4**	**400**	**25**	**25**	**25**		**50**
		Q6006L5		**Q6006F51**	**Q6006R5**			**Q6006N5**	**600**	**50**	**50**	**50**		**75**
		Q8006L5			**Q8006R5**			**Q8006N5**	**800**	**50**	**50**	**50**		**75**
		QK006L5			**QK006R5**			**QK006N5**	**1000**	**50**	**50**	**50**		**75**
8 A		**Q2008L4**		**Q2008F41**	**Q2008R4**			**Q2008N4**	**200**	**25**	**25**	**25**		**50**
		Q4008L4		**Q4008F41**	**Q4008R4**			**Q4008N4**	**400**	**25**	**25**	**25**		**50**
		Q6008L5		**Q6008F51**	**Q6008R5**			**Q6008N5**	**600**	**50**	**50**	**50**		**75**
		Q8008L5			**Q8008R5**			**Q8008N5**	**800**	**50**	**50**	**50**		**75**
		QK008L5			**QK008R5**			**QK008N5**	**1000**	**50**	**50**	**50**		**75**

See "General Notes" on page E2 - 4 and "Electrical Specification Notes" on page E2 - 5.

I_{DRM}			V_{TM}	V_{GT}	I_H	I_{GTM}	P_{GM}	$P_{G(AV)}$	I_{TSM}	dv/dt(c)	dv/dt		t_{gt}	I^2t	di/dt
(1) (16)			(1) (5)	(2) (6) (15) (18) (19)	(1) (8) (12)	(14)	(14)		(9) (13)	(1) (4) (13)	(1)		(10)		
mAmps			Volts	Volts	mAmps	Amps	Watts	Watts	Amps	Volts/µSec	Volts/µSec		µSec	Amp²Sec	Amps/µSec
T_C = 25 °C	T_C = 100 °C	T_C = 125 °C	T_C = 25 °C	T_C = 25 °C					60/50 Hz		T_C= 100 °C	T_C= 125 °C			
MAX			MAX	MAX	MAX					TYP	MIN		TYP		
0.02	**0.5**	**1**	**1.6**	**2**	**15**	**1**	**10**	**0.2**	**10/8.3**	**1**	**40**	**30**	**2.5**	**0.41**	**20**
0.02	**0.5**	**1**	**1.6**	**2**	**15**	**1**	**10**	**0.2**	**10/8.3**	**1**	**35**	**25**	**2.5**	**0.41**	**20**
0.02	**0.5**	**1**	**1.6**	**2**	**15**	**1**	**10**	**0.2**	**10/8.3**	**1**	**25**	**15**	**2.5**	**0.41**	**20**
0.02	**0.5**	**1**	**1.6**	**2.5**	**25**	**1**	**10**	**0.2**	**10/8.3**	**1**	**50**	**40**	**3**	**0.41**	**20**
0.02	**0.5**	**1**	**1.6**	**2.5**	**25**	**1**	**10**	**0.2**	**10/8.3**	**1**	**45**	**35**	**3**	**0.41**	**20**
0.02	**0.5**	**1**	**1.6**	**2.5**	**25**	**1**	**10**	**0.2**	**10/8.3**	**1**	**35**	**25**	**3**	**0.41**	**20**
0.02	**0.5**	**1**	**1.6**	**2**	**15**	**1**	**10**	**0.2**	**20/16.7**	**1**	**40**	**30**	**2.5**	**1.6**	**30**
0.02	**0.5**	**1**	**1.6**	**2**	**15**	**1**	**10**	**0.2**	**20/16.7**	**1**	**40**	**30**	**2.5**	**1.6**	**30**
0.02	**0.5**	**1**	**1.6**	**2**	**15**	**1**	**10**	**0.2**	**20/16.7**	**1**	**30**	**20**	**2.5**	**1.6**	**30**
0.02	**0.5**	**1**	**1.6**	**2.5**	**25**	**1**	**10**	**0.2**	**20/16.7**	**1**	**50**	**40**	**3**	**1.6**	**30**
0.02	**0.5**	**1**	**1.6**	**2.5**	**25**	**1**	**10**	**0.2**	**20/16.7**	**1**	**50**	**40**	**3**	**1.6**	**30**
0.02	**0.5**	**1**	**1.6**	**2.5**	**25**	**1**	**10**	**0.2**	**20/16.7**	**1**	**40**	**30**	**3**	**1.6**	**30**
0.05	**0.5**	**2**	**1.6**	**2**	**20**	**1.2**	**15**	**0.3**	**55/46**	**2**	**50**	**40**	**2.5**	**12.5**	**50**
0.05	**0.5**	**2**	**1.6**	**2**	**20**	**1.2**	**15**	**0.3**	**55/46**	**2**	**50**	**40**	**2.5**	**12.5**	**50**
0.05	**0.5**	**2**	**1.6**	**2**	**20**	**1.2**	**15**	**0.3**	**55/46**	**2**	**40**	**30**	**2.5**	**12.5**	**50**
0.05	**0.5**	**2**	**1.6**	**2.5**	**30**	**1.2**	**15**	**0.3**	**55/46**	**2**	**100**	**75**	**3**	**12.5**	**50**
0.05	**0.5**	**2**	**1.6**	**2.5**	**30**	**1.2**	**15**	**0.3**	**55/46**	**2**	**100**	**75**	**3**	**12.5**	**50**
0.05	**0.5**	**2**	**1.6**	**2.5**	**30**	**1.2**	**15**	**0.3**	**55/46**	**2**	**75**	**50**	**3**	**12.5**	**50**
0.05	**0.5**	**2**	**1.6**	**2.5**	**30**	**1.2**	**15**	**0.3**	**55/46**	**2**	**60**	**40**	**3**	**12.5**	**50**
0.05	**3**		**1.6**	**2.5**	**30**	**1.2**	**15**	**0.3**	**55/46**	**2**	**50**		**3**	**12.5**	**50**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.6**	**18**	**0.5**	**80/65**	**4**	**200**	**120**	**3**	**26.5**	**70**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.6**	**18**	**0.5**	**80/65**	**4**	**200**	**120**	**3**	**26.5**	**70**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.6**	**18**	**0.5**	**80/65**	**4**	**150**	**100**	**3**	**26.5**	**70**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.6**	**18**	**0.5**	**80/65**	**4**	**125**	**85**	**3**	**26.5**	**70**
0.05	**3**		**1.6**	**2.5**	**50**	**1.6**	**18**	**0.5**	**80/65**	**4**	**100**		**3**	**26.5**	**70**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.8**	**20**	**0.5**	**100/83**	**4**	**250**	**150**	**3**	**41**	**70**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.8**	**20**	**0.5**	**100/83**	**4**	**250**	**150**	**3**	**41**	**70**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.8**	**20**	**0.5**	**100/83**	**4**	**220**	**125**	**3**	**41**	**70**
0.05	**0.5**	**2**	**1.6**	**2.5**	**50**	**1.8**	**20**	**0.5**	**100/83**	**4**	**150**	**100**	**3**	**41**	**70**
0.05	**3**		**1.6**	**2.5**	**50**	**1.8**	**20**	**0.5**	**100/83**	**4**	**100**		**3**	**41**	**70**

See “General Notes” on page E2 - 4 and “Electrical Specification Notes” on page E2 - 5.

$I_{T(RMS)}$	Part Number					V_{DRM}	I_{GT}					I_{DRM}		
	Isolated		Non-isolated											
(4) (16)						(1)	(3) (7) (15) mAmps					(1) (16) mAmps		
	TO-3 Fastpak	TO-220	TO-202	TO-220	TO-263 D^2Pak	Volts	QI	QII	QIII	QIV	QIV	T_C = 25 °C	T_C = 100 °C	T_C = 125 °C
MAX	See “Package Dimensions” section for variations. (11)					MIN	MAX				TYP	MAX		
10 A		Q2010L4		Q2010R4	Q2010N4	200	25	25	25	50		0.05	1	
		Q4010L4		Q4010R4	Q4010N4	400	25	25	25	50		0.05	1	
		Q6010L4		Q6010R4	Q6010N4	600	25	25	25	50		0.05	1	
		Q8010L4		Q8010R4	Q8010N4	800	25	25	25	50		0.1	1	
		QK010L4		QK010R4	QK010N4	1000	25	25	25	50		0.1	3	
		Q2010L5	Q2010F51	Q2010R5	Q2010N5	200	50	50	50		75	0.05	0.5	2
		Q4010L5	Q4010F51	Q4010R5	Q4010N5	400	50	50	50		75	0.05	0.5	2
		Q6010L5	Q6010F51	Q6010R5	Q6010N5	600	50	50	50		75	0.05	0.5	2
		Q8010L5		Q8010R5	Q8010N5	800	50	50	50		75	0.1	0.5	2
		QK010L5		QK010R5	QK010N5	1000	50	50	50		75	0.1	3	
15 A		Q2015L5		Q2015R5	Q2015N5	200	50	50	50			0.05	0.5	2
		Q4015L5		Q4015R5	Q4015N5	400	50	50	50			0.05	0.5	2
		Q6015L5		Q6015R5	Q6015N5	600	50	50	50			0.05	0.5	2
		Q8015L5		Q8015R5	Q8015N5	800	50	50	50			0.1	1	3
		QK015L5		QK015R5	QK015N5	1000	50	50	50			0.1	3	
25 A				Q2025R5	Q2025N5	200	50	50	50			0.1	1	3
				Q4025R5	Q4025N5	400	50	50	50			0.1	1	3
				Q6025R5	Q6025N5	600	50	50	50			0.1	1	3
				Q8025R5	Q8025N5	800	50	50	50			0.1	1	3
				QK025R5	QK025N5	1000	50	50	50			0.1	3	
	Q6025P5					600	50	50	50		120	0.1		5
	Q8025P5					800	50	50	50		120	0.1		5
35 A	Q6035P5					600	50	50	50		120	0.1		5
	Q8035P5					800	50	50	50		120	0.1		5

Specific Test Conditions

di/dt — Maximum rate-of-change of on-state current; I_{GT} = 200 mA with ≤0.1 µs rise time

dv/dt — Critical rate-of-rise of off-state voltage at rated V_{DRM} gate open

dv/dt(c) — Critical rate-of-rise of commutation voltage at rated V_{DRM} and $I_{T(RMS)}$ commutating di/dt = 0.54 rated $I_{T(RMS)}$/ms; gate unenergized

I^2t — RMS surge (non-repetitive) on-state current for period of 8.3 ms for fusing

I_{DRM} — Peak off-state current, gate open; V_{DRM} = maximum rated value

I_{GT} — DC gate trigger current in specific operating quadrants; V_D = 12 V dc

I_{GTM} — Peak gate trigger current

I_H — Holding current (DC); gate open

$I_{T(RMS)}$ — RMS on-state current conduction angle of 360°

I_{TSM} — Peak one-cycle surge

$P_{G(AV)}$ — Average gate power dissipation

P_{GM} — Peak gate power dissipation; $I_{GT} \le I_{GTM}$

t_{gt} — Gate controlled turn-on time; I_{GT} = 200 mA with 0.1 µs rise time

V_{DRM} — Repetitive peak blocking voltage

V_{GT} — DC gate trigger voltage; V_D = 12 V dc; R_L = 60 Ω

V_{TM} — Peak on-state voltage at maximum rated RMS current

General Notes

- All measurements are made at 60 Hz with a resistive load at an ambient temperature of +25 °C unless specified otherwise.
- Operating temperature range (T_J) is -65 °C to +125 °C for TO-92, -25 °C to +125 °C for Fastpak, and -40 °C to +125 °C for all other devices.
- Storage temperature range (T_S) is -65 °C to +150 °C for TO-92, -40 °C to +150 °C for TO-202, and -40 °C to +125 °C for all other devices.
- Lead solder temperature is a maximum of 230 °C for 10 seconds, maximum; ≥1/16" (1.59 mm) from case.
- The case temperature (T_C) is measured as shown on the dimensional outline drawings. See “Package Dimensions” section of this catalog.

V_{TM}	V_{GT}	I_H	I_{GTM}	P_{GM}	$P_{G(AV)}$	I_{TSM}	dv/dt(c)	dv/dt		t_{gt}	I^2t	di/dt
(1) (5)	(2) (6) (15) (18) (19)	(1) (8) (12)	(14)	(14)		(9) (13)	(1) (4) (13)	(1)		(10) (17)		
Volts	Volts					Amps		Volts/µSec				
T_C = 25 °C	T_C = 25 °C	mAmps	Amps	Watts	Watts	60/50 Hz	Volts/µSec	T_C = 100 °C	T_C = 125 °C	µSec	Amps^{2}Sec	Amps/µSec
MAX	MAX	MAX					TYP	MIN		TYP		
1.6	**2.5**	**35**	**1.8**	**20**	**0.5**	**120/100**	**2**	**150**		**3**	**60**	**70**
1.6	**2.5**	**35**	**1.8**	**20**	**0.5**	**120/100**	**2**	**150**		**3**	**60**	**70**
1.6	**2.5**	**35**	**1.8**	**20**	**0.5**	**120/100**	**2**	**100**		**3**	**60**	**70**
1.6	**2.5**	**35**	**1.8**	**20**	**0.5**	**120/100**	**2**	**75**		**3**	**60**	**70**
1.6	**2.5**	**35**	**1.8**	**20**	**0.5**	**120/100**	**2**	**50**		**3**	**60**	**70**
1.6	**2.5**	**50**	**1.8**	**20**	**0.5**	**120/100**	**4**	**350**	**225**	**3**	**60**	**70**
1.6	**2.5**	**50**	**1.8**	**20**	**0.5**	**120/100**	**4**	**350**	**225**	**3**	**60**	**70**
1.6	**2.5**	**50**	**1.8**	**20**	**0.5**	**120/100**	**4**	**300**	**200**	**3**	**60**	**70**
1.6	**2.5**	**50**	**1.8**	**20**	**0.5**	**120/100**	**4**	**250**	**175**	**3**	**60**	**70**
1.6	**2.5**	**50**	**1.8**	**20**	**0.5**	**120/100**	**4**	**150**		**3**	**60**	**70**
1.6	**2.5**	**70**	**2**	**20**	**0.5**	**200/167**	**4**	**400**	**275**	**4**	**166**	**100**
1.6	**2.5**	**70**	**2**	**20**	**0.5**	**200/167**	**4**	**400**	**275**	**4**	**166**	**100**
1.6	**2.5**	**70**	**2**	**20**	**0.5**	**200/167**	**4**	**350**	**225**	**4**	**166**	**100**
1.6	**2.5**	**70**	**2**	**20**	**0.5**	**200/167**	**4**	**300**	**200**	**4**	**166**	**100**
1.6	**2.5**	**70**	**2**	**20**	**0.5**	**200/167**	**4**	**200**		**4**	**166**	**100**
1.8	**2.5**	**100**	**2**	**20**	**0.5**	**200/167**	**5**	**400**	**275**	**4**	**166**	**100**
1.8	**2.5**	**100**	**2**	**20**	**0.5**	**200/167**	**5**	**400**	**275**	**4**	**166**	**100**
1.8	**2.5**	**100**	**2**	**20**	**0.5**	**200/167**	**5**	**350**	**225**	**4**	**166**	**100**
1.8	**2.5**	**100**	**2**	**20**	**0.5**	**200/167**	**5**	**300**	**200**	**4**	**166**	**100**
1.8	**2.5**	**100**	**2**	**20**	**0.5**	**200/167**	**5**	**200**		**4**	**166**	**100**
1.4	**2.75**	**50**	**2**	**20**	**0.5**	**250/220**	**5**	**550**	**475**	**3**	**260**	**100**
1.4	**2.75**	**50**	**2**	**20**	**0.5**	**250/220**	**5**	**450**	**400**	**3**	**260**	**100**
1.5	**2.75**	**50**	**2**	**20**	**0.5**	**350/300**	**5**	**550**	**475**	**3**	**508**	**100**
1.5	**2.75**	**50**	**2**	**20**	**0.5**	**350/300**	**5**	**450**	**400**	**3**	**508**	**100**

Electrical Specification Notes

(1) For either polarity of MT2 with reference to MT1 terminal

(2) For either polarity of gate voltage (V_{GT}) with reference to MT1 terminal

(3) See Gate Characteristics and Definition of Quadrants.

(4) See Figure E2.1 through Figure E2.7 for current rating at specific operating temperature.

(5) See Figure E2.8 through Figure E2.10 for i_T versus v_T.

(6) See Figure E2.12 for V_{GT} versus T_C.

(7) See Figure E2.11 for I_{GT} versus T_C.

(8) See Figure E2.14 for I_H versus T_C.

(9) See Figure E2.13 for surge rating with specific durations.

(10) See Figure E2.15 for t_{gt} versus I_{GT}.

(11) See package outlines for lead form configurations. When ordering special lead forming, add type number as suffix to part number.

(12) Initial on-state current = 200 mA dc for 0.8 A to10 A devices, 400 mA dc for 15 A to 35 A devices

(13) See Figure E2.1 through Figure E2.6 for maximum allowable case temperature at maximum rated current.

(14) Pulse width $\leq$10 µs; $I_{GT} \leq I_{GTM}$

(15) R_L = 60 Ω for 0.8 A to10 A triacs; R_L = 30 Ω for 15 A to 35 A triacs

(16) $T_C = T_J$ for test conditions in off state

(17) I_{GT} = 300 mA for 25 A and 35 A devices

(18) Quadrants I, II, III only

(19) Minimum non-trigger V_{GT} at 125 °C is 0.2 V for all except 50 mA MAX QIV devices which are 0.2 V at 110 °C.

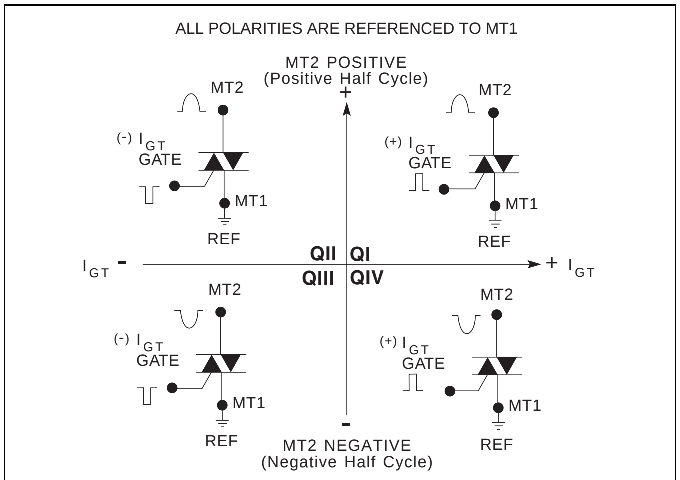
Gate Characteristics

Teccor triacs may be turned on between gate and MT1 terminals in the following ways:

- In-phase signals (with standard AC line) using Quadrants I and III
- Application of unipolar pulses (gate always positive or negative), using Quadrants II and III with negative gate pulses and Quadrants I and IV with positive gate pulses

  However, due to higher gate requirements for Quadrant IV, it is recommended that only negative pulses be applied. If positive pulses are required, see "Sensitive Triacs" section of this catalog or contact the factory. Also, see Figure AN1002.8, "Amplified Gate" Thyristor Circuit.

In all cases, if maximum surge capability is required, pulses should be a minimum of one magnitude above I_{GT} rating with a steep rising waveform (≤1 μs rise time).



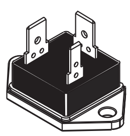
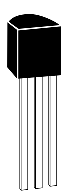
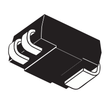
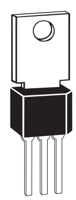
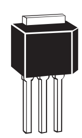
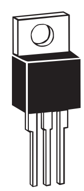
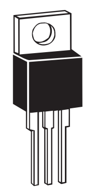
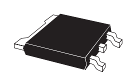
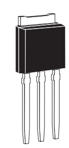
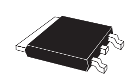
Definition of Quadrants

Electrical Isolation

Teccor's isolated triac packages will withstand a minimum high potential test of 2500 V ac rms from leads to mounting tab or base, over the operating temperature range of the device. The following isolation table shows standard and optional isolation ratings.

Electrical Isolation from Leads to Mounting Tab *		
V AC RMS	**TO-220 Isolated**	**Fastpak Isolated**
2500	**Standard**	**Standard**
4000	**Optional ****	**N/A**

* UL Recognized File E71639
** For 4000 V isolation, use V suffix in part number.

Thermal Resistance (Steady State) $R_{\theta JC}$ [$R_{\theta JA}$] (TYP.) °C/W										
Package Code	P	E	C	F	F2	L	R	D	V	N
Type	 TO-3 Fastpak	 TO-92	 Compak	 TO-202 Type 1	 TO-202 Type 2	 TO-220 Isolated	 TO-220 Non-isolated	 TO-252 D-Pak	 TO-251 V-Pak	 TO-263 D^2Pak
0.8 A		**60 [135]**	**60 ***							
1 A		**50 [95]**	**40 ***							
4 A				**3.5 [45]**	**6 [70]**	**3.6 [50]**		**3.5**	**6.0 [70]**	
6 A				**3.8**		**3.3**	**1.8 [45]**			**1.8**
8 A				**3.3**		**2.8**	**1.5**			**1.5**
10 A				**3.5**		**2.6**	**1.3**			**1.3**
15 A						**2.1**	**1.1**			**1.1**
25 A	**1.6**						**0.89**			**0.89**
35 A	**1.5**									

* Mounted on 1 cm^2 copper foil surface; two-ounce copper foil

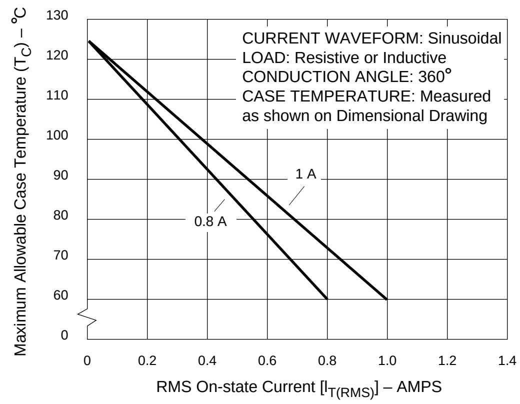


Figure E2.1 Maximum Allowable Case Temperature versus On-state Current (0.8 A and 1 A)

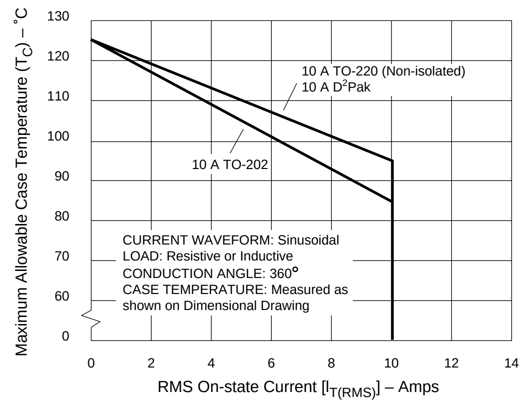


Figure E2.4 Maximum Allowable Case Temperature versus On-state Current (10 A)

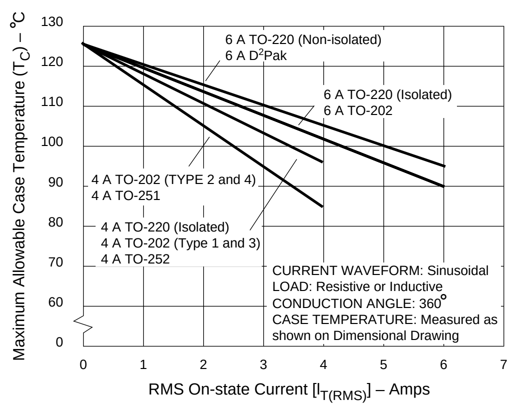


Figure E2.2 Maximum Allowable Case Temperature versus On-state Current (4 A and 6 A)

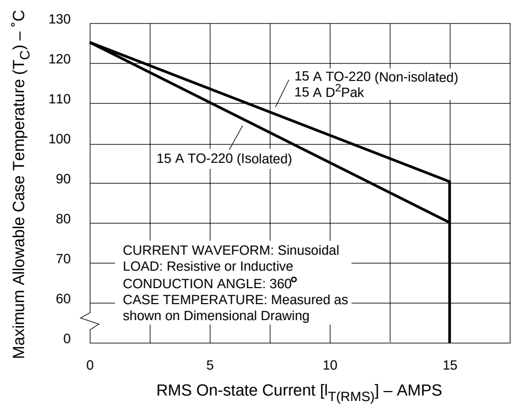


Figure E2.5 Maximum Allowable Case Temperature versus On-state Current (15 A)

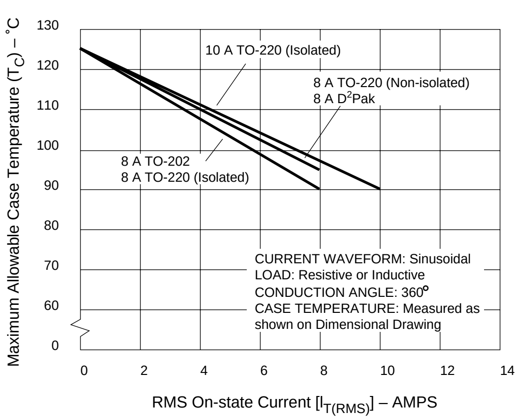


Figure E2.3 Maximum Allowable Case Temperature versus On-state Current (8 A and 10 A)

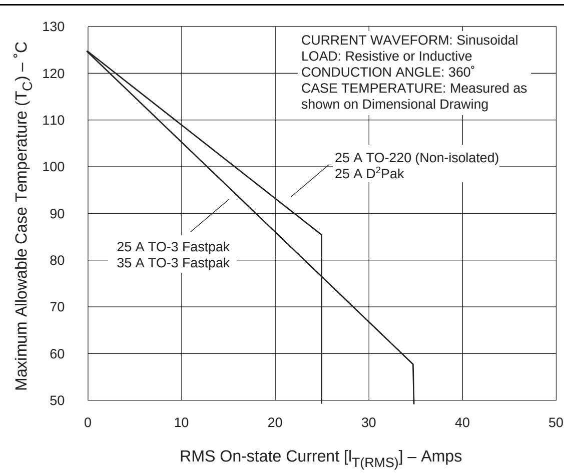


Figure E2.6 Maximum Allowable Case Temperature versus On-state Current (25 A and 35 A)

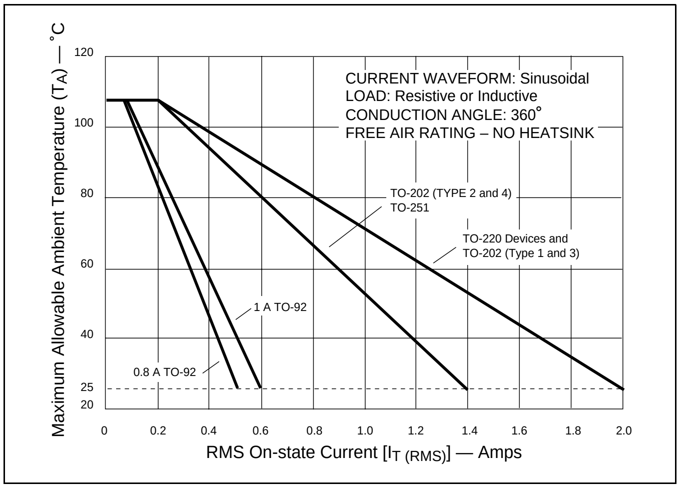


Figure E2.7 Maximum Allowable Ambient Temperature versus On-state Current

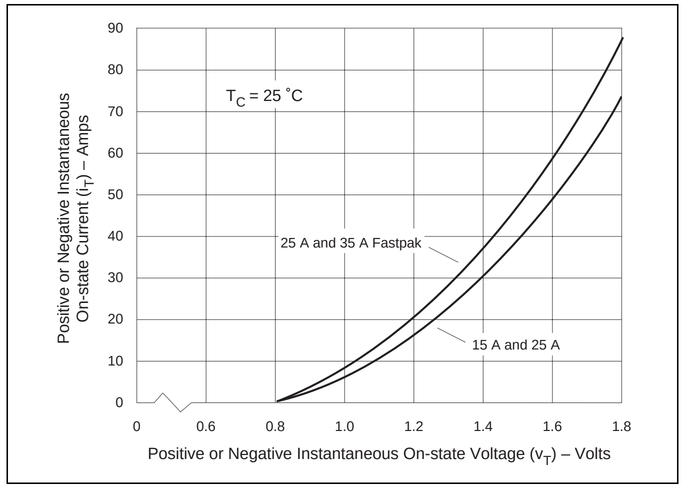


Figure E2.10 On-state Current versus On-state Voltage (Typical) (15 A and 25 A)

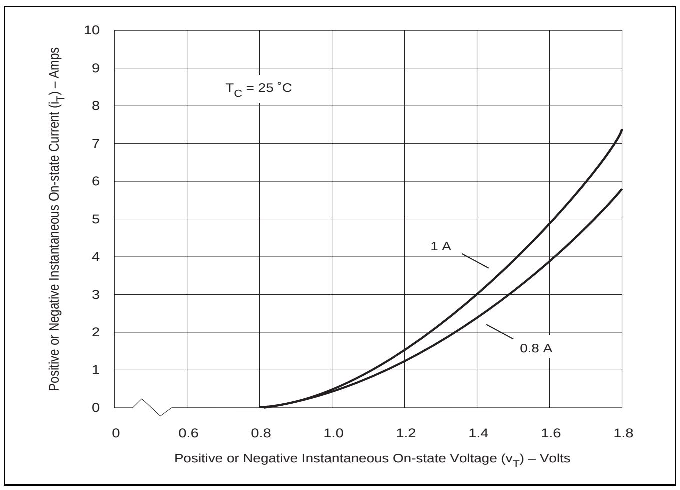


Figure E2.8 On-state Current versus On-state Voltage (Typical) (0.8 A and 1 A)

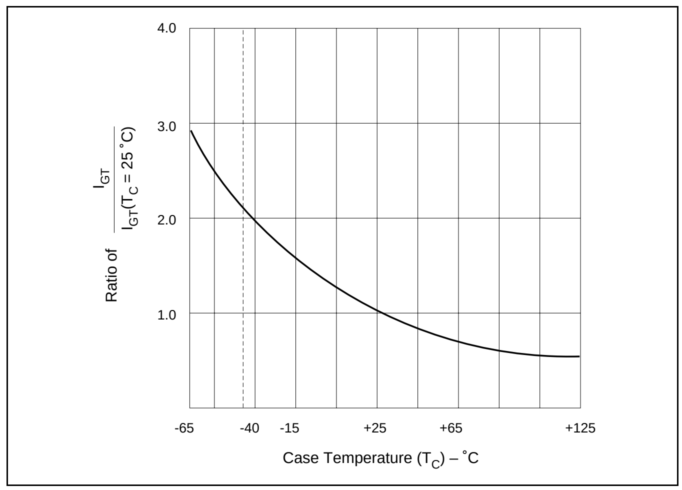


Figure E2.11 Normalized DC Gate Trigger Current for All Quadrants versus Case Temperature

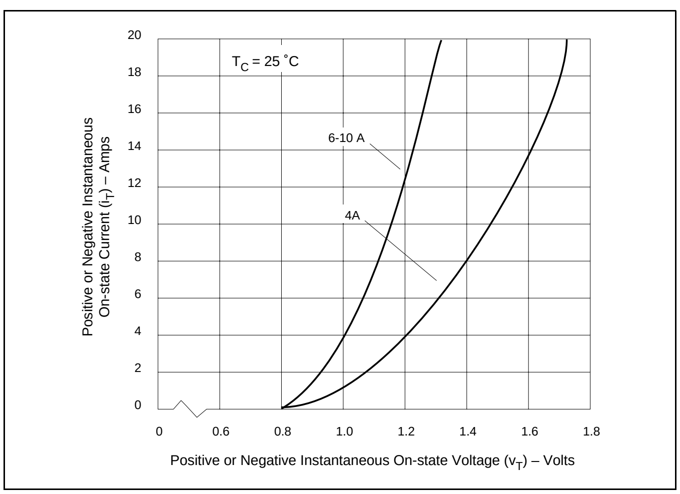


Figure E2.9 On-state Current versus On-state Voltage (Typical) (4 A, 6 A, 8 A, and 10 A)

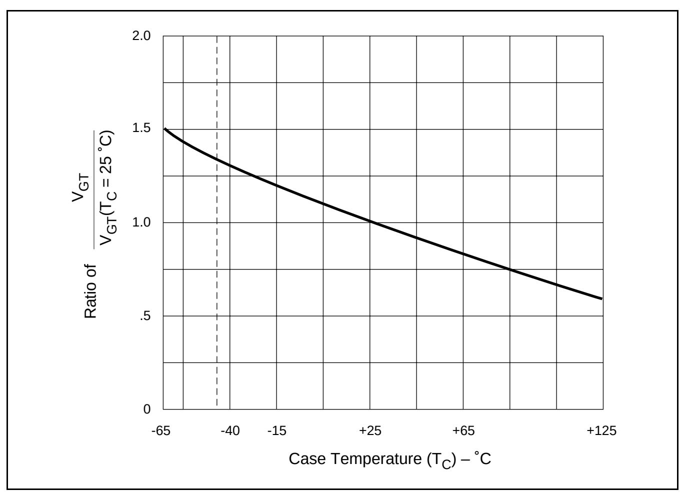


Figure E2.12 Normalized DC Gate Trigger Voltage for All Quadrants versus Case Temperature

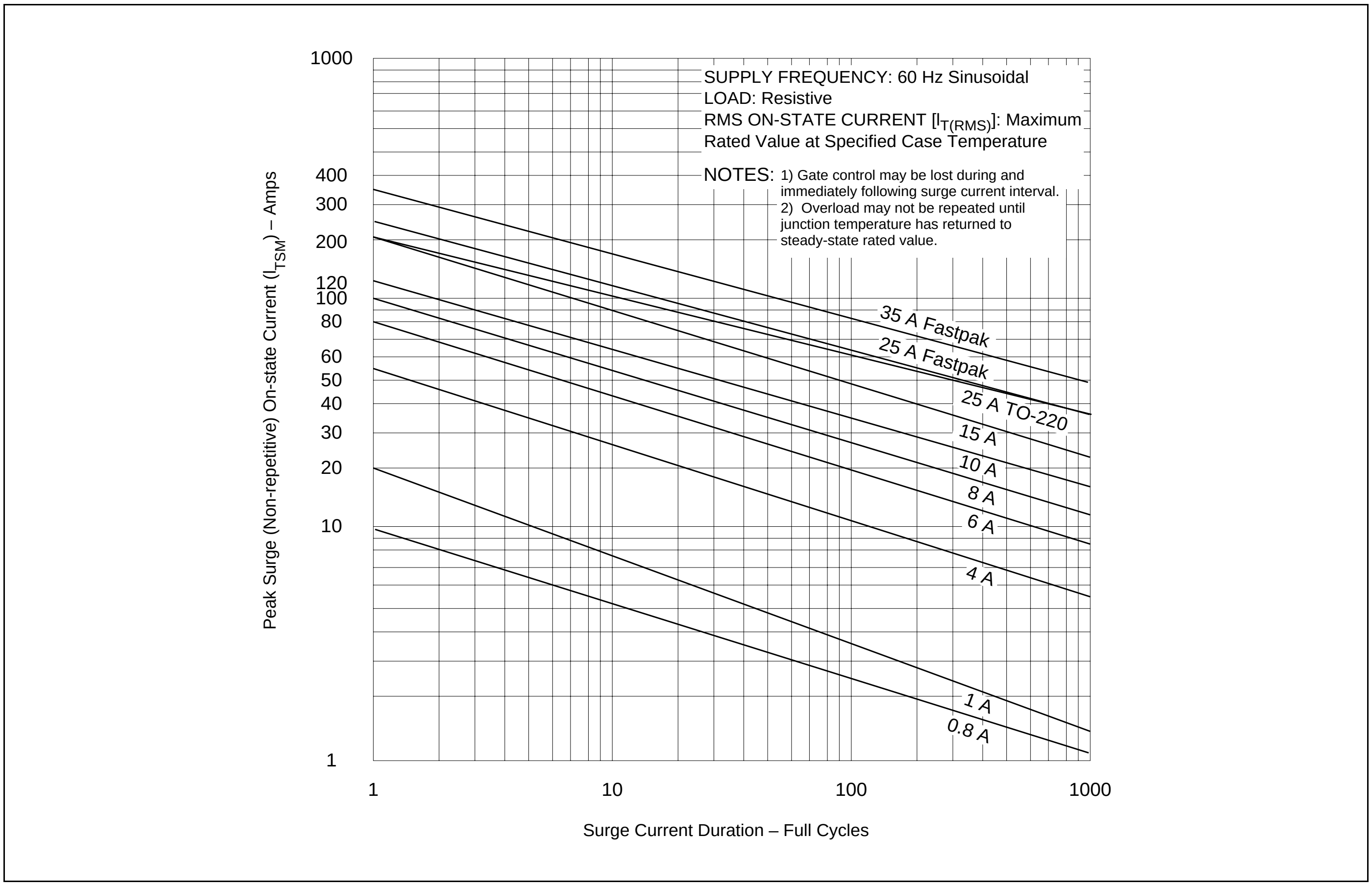


Figure E2.13 Peak Surge Current versus Surge Current Duration

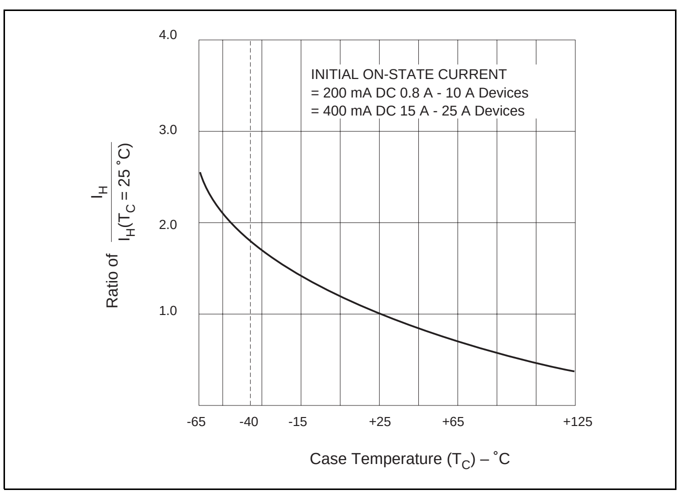


Figure E2.14 Normalized DC Holding Current versus Case Temperature

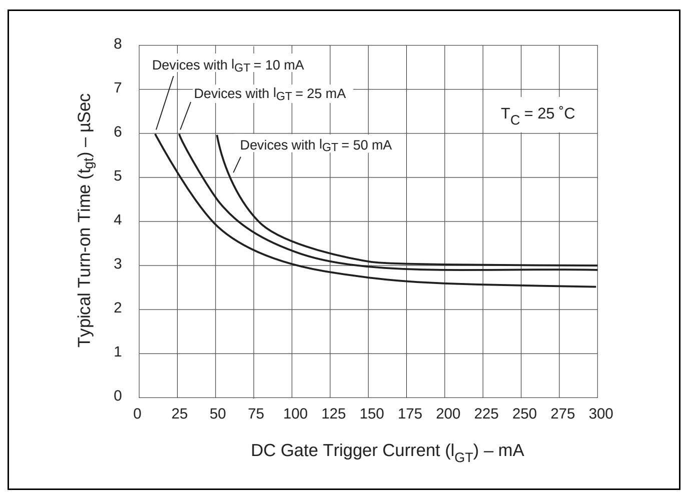


Figure E2.15 Turn-on Time versus Gate Trigger Current (Typical)

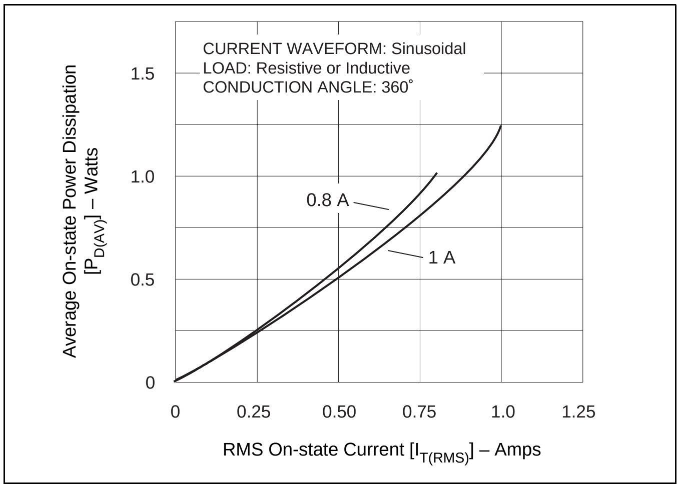


Figure E2.16 Power Dissipation (Typical) versus On-state Current (0.8 A and 1 A)

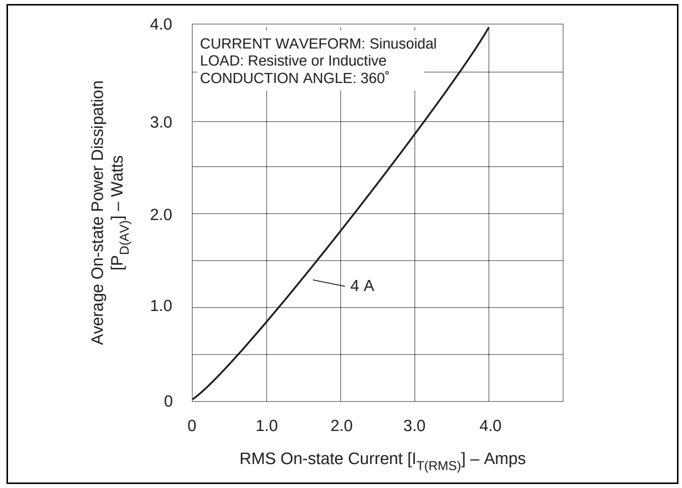


Figure E2.19 Power Dissipation (Typical) versus RMS On-state Current (4 A)

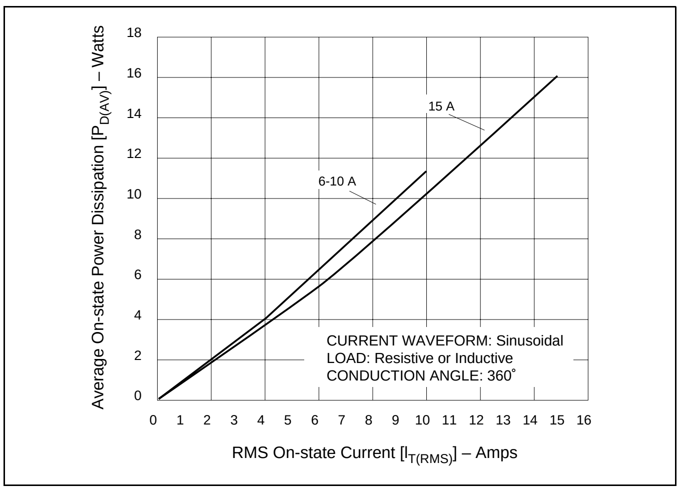


Figure E2.17 Power Dissipation (Typical) versus On-state Current (6 A to 10 A and 15 A)

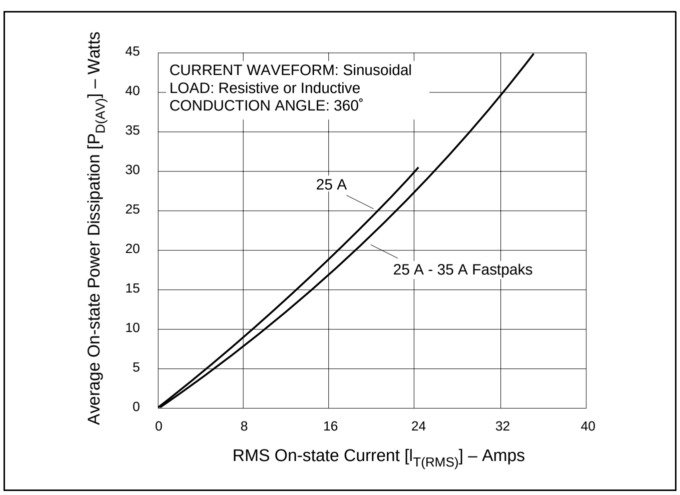


Figure E2.18 Power Dissipation (Typical) versus On-state Current (25 A to 35 A)