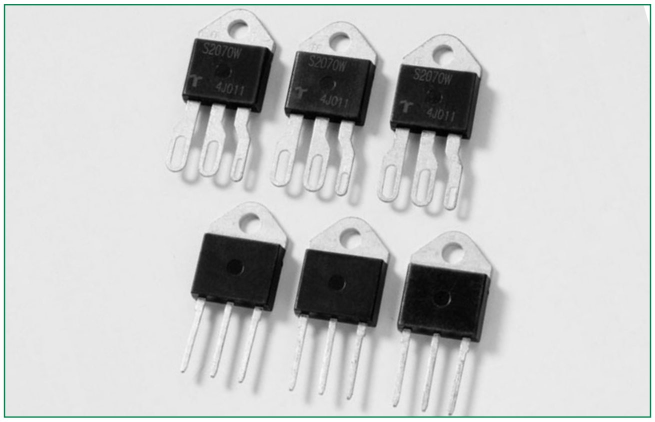
Thyristors

40 Amp Alternistor (High Commutation) and Standard Triacs

Qxx40xx Series

RoHS



Description

The 40 Amp bi-directional solid state switch series is designed for AC switching and phase control applications such as motor speed, temperature modulation controls, lighting controls, and static switching relays.

Alternistor type components only operate in quadrants I, II, & III and are used in circuits requiring high dv/dt capability.

Standard type devices operate in quadrants I,II,III & IV.

Agency Approval

Agency	Agency File Number
UL	E71639*

* - K and J Packages

Features & Benefits

- RoHS Compliant
- Glass – passivated junctions
- Voltage capability up to 1000V
- Surge capability up to 400A
- Electrically isolated K & J -Packages are UL Recognized for 2500Vrms

Main Features

Symbol	Value	Unit
$I_{T(RMS)}$	40	A
V_{DRM}/V_{RRM}	400 to 1000	V
$I_{GT\ (Q1)}$	35 to 100	mA

Applications

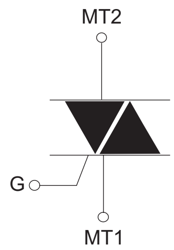
Excellent for AC switching and phase control applications such as heating, lighting, and motor speed controls.

Typical applications are AC solid-state switches, industrial power tools, exercise equipment, white goods and commercial appliances.

Alternistor Triacs (no snubber required) are used in applications with extremely inductive loads requiring highest commutation performance.

Internally constructed isolated packages are offered for ease of heat sinking with highest isolation voltage.

Schematic Symbol



Revised: GD. 12/17/20

Absolute Maximum Ratings – Alternistor Triac (3 Quadrants)

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	RMS on-state current (full sine wave)	Qxx40x7 Qxx40xH6	T_C = 75 °C	40	A
I_{TSM}	Non repetitive surge peak on-state current (full cycle, TJ initial = 25°C)	f = 50 Hz	t = 20 ms	335	A
		f = 60 Hz	t = 16.7 ms	400	
I^2t	I2t Value for fusing		t_p = 8.3 ms	664	A^2s
di/dt	Critical rate of rise of on-state current (IG = 2 x IGT, tr ≤ 100 ns)	f = 120 Hz	T_J = 125 °C	150	A/μs
I_{GTM}	Peak gate trigger current	t_p=20μs	T_J = 125 °C	4	A
$P_{G(AV)}$	Average gate power dissipation		T_J = 125 °C	0.5	W
T_{stg}	Storage temperature range			-40 to 150	°C
T_J	Operating junction temperature range			-40 to 125	°C

Absolute Maximum Ratings – Standard Triac (4 Quadrants)

Symbol	Parameter	Test Conditions		Value	Unit
$I_{T(RMS)}$	RMS on-state current	Qxx40x3/Qxx40x4	T_C = 75 °C	40	A
I_{TSM}	Peak non-repetitive surge current	f = 50 Hz	t = 20 ms	335	A
		f = 60 Hz	t = 16 ms	400	
I^2t	I^2t Value for fusing		t_p = 8.3 ms	664	A^2s
di/dt	Critical rate-of-rise of on-state current	f = 120 Hz; T_J =125 °C		150	A/μs
I_{GTM}	Peak gate current	t_p=20μs	T_J = 125 °C	4	A
$P_{G(AV)}$	Average gate power dissipation	T_J = 125°C		0.5	W
T_{stg}	Storage temperature range			-40 to 150	°C
T_J	Operating junction temperature range			-40 to 125	°C

Electrical Characteristics (T_J = 25°C, unless otherwise specified) — Alternistor Triac (3 Quadrants)

Symbol	Test Conditions	Quadrant		Value			Unit
				Qxx40xH6	Qxx40K5	Qxx40x7	
I_{GT}	V_D = 12V R_L = 60 Ω	I – II – III	MAX.	80	50	100	mA
V_{GT}	V_D = 12V R_L = 60 Ω	I – II – III	MAX.	1.3	1.3	2.0	V
V_{GD}	$V_D = V_{DRM}$ R_L = 3.3 kΩ T_J = 125°C	I – II – III	MIN.	0.2			V
I_H	I_T = 400mA		MAX.	80	75	100	mA
dv/dt	$V_D = V_{DRM}$ Gate Open T_J = 125°C	400V	MIN.	600	500	700	V/μs
		600V		500	475	625	
		800V		475	400	575	
		1000V		1000	800	1200	
(dv/dt)c	(di/dt)c = 21.6 A/ms T_J = 125°C		MIN.	30	20	50	V/μs
t_{gt}	I_G = 2 x I_{GT} PW = 15μs I_T = 56.6A(pk)		TYP.	5			μs

Electrical Characteristics (T_J = 25°C, unless otherwise specified) — Standard Triac (4 Quadrants)

Symbol	Test Conditions	Quadrant		Qxx40x3	Value	Unit
					Qxx40x4	
I_{GT}	V_D = 12 V; R_L = 60 Ω	I – II – III	MAX.	35	50	mA
		IV	MAX.	70	100	
V_{GT}	V_D = 12 V; R_L = 60 Ω	ALL	MAX.	1.3	1.3	V
V_{GD}	$V_D = V_{DRM}$; R_L = 3.3 kΩ ; T_J = 125 °C	ALL	MIN.	0.2	0.2	V
I_H	I_T = 400mA (initial)		MAX.	80	80	mA
dv/dt	$V_D = V_{DRM}$; Gate Open; T_J = 125 °C	400V	MIN.	400	400	V/μs
		600V		400	400	
		800V		400	400	
(dv/dt)c	(di/dt)c = 4.3 A/ms; T_J = 125 °C		MIN.	10	10	V/μs
t_{gt}	I_G = 2 x I_{GT}; PW = 15μs; I_T = 35.4 A		TYP.	5	5	μs
dv/dt	VD=VDRM,Gate Open, TJ=100˚C 1000V		-	-	300	V/μs

Static Characteristics

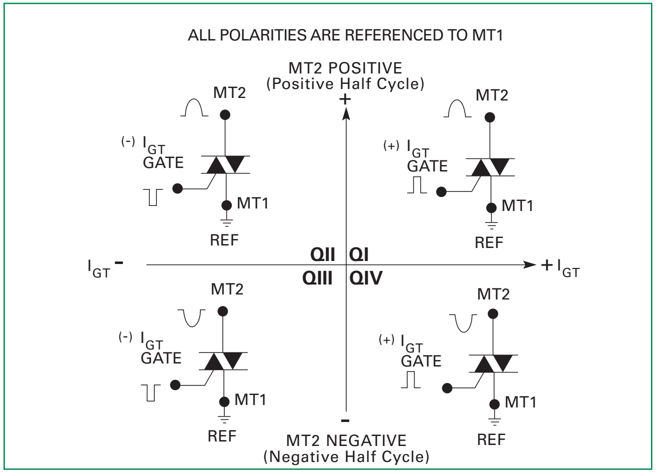
Symbol	Test Conditions				Value	Unit
V_{TM}	I_{TM} = 56.6A t_p = 380 μs	T_J = 25°C	MAX.		1.8	V
I_{DRM} I_{RRM}	$V_D = V_{DRM} / V_{RRM}$	T_J = 25°C	400 –1000V	MAX.	20	μA
		T_J = 125°C	400 – 800V	MAX.	5	mA
		T_J = 100°C	1000V	MAX.	5	mA

Thermal Resistances

Symbol	Parameter			Value	Unit
$R_{\Theta(J-C)}$	Junction to case (AC)		Qxx40KH6 Qxx40K5/7 Qxx40K4/J4 Qxx40K3	0.97	°C/W
			Qxx40JH6 Qxx40J7	0.95	

Note: xx = voltage

Figure 1: Definition of Quadrants



Note: Alternistors will not operate in QIV

Figure 2: Normalized DC Gate Trigger Current for All Quadrants vs. Junction Temperature

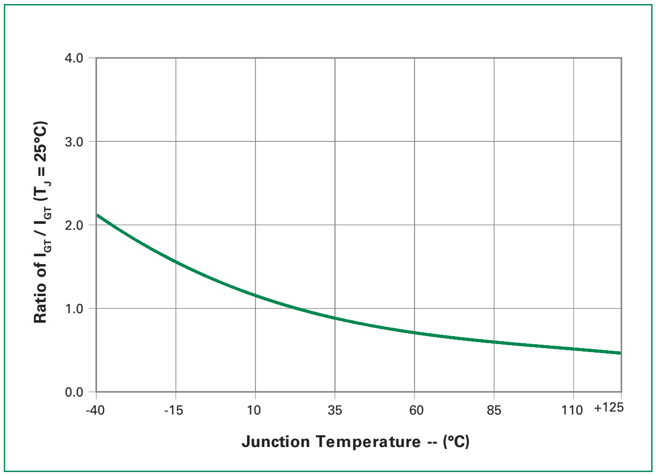


Figure 3: Normalized DC Holding Current vs. Junction Temperature

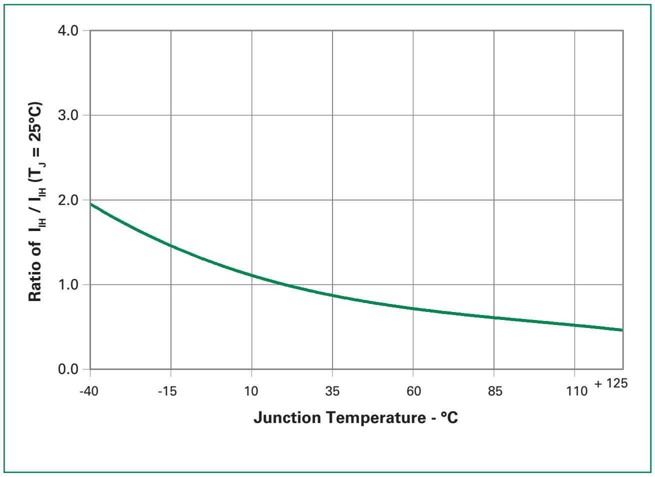


Figure 4: Normalized DC Gate Trigger Voltage for All Quadrants vs. Junction Temperature

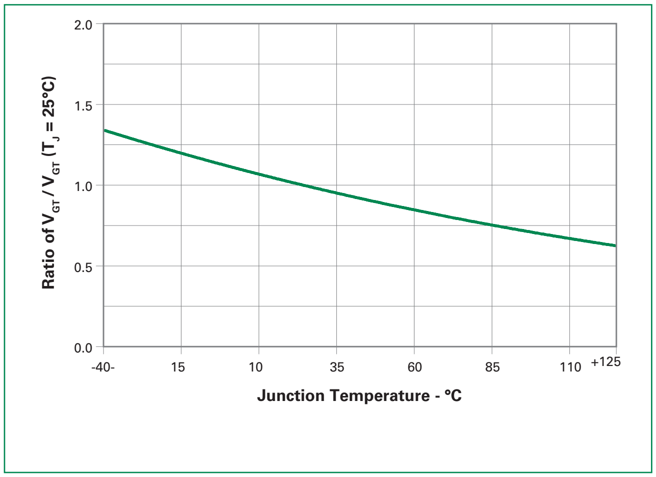


Figure 5: Power Dissipation (Typical) vs. RMS On-State Current

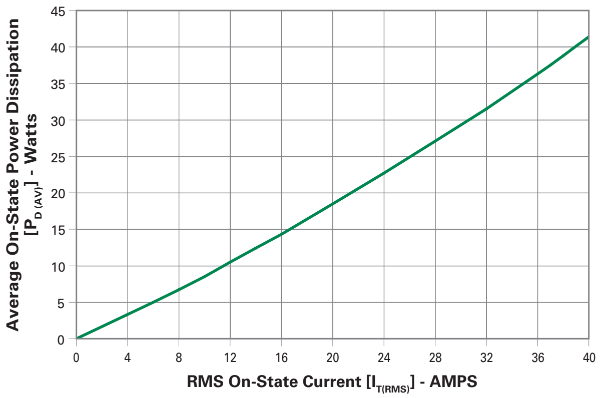


Figure 6: Maximum Allowable Case Temperature vs. On-State Current

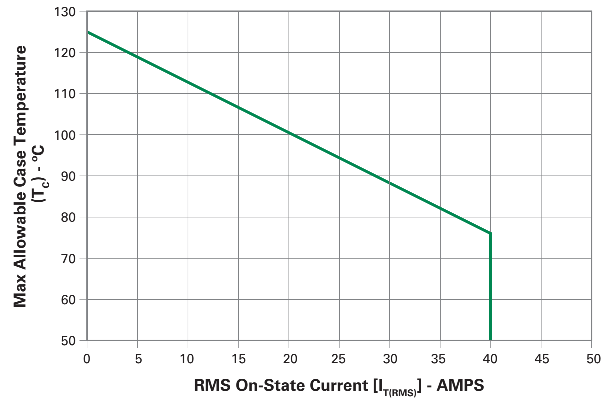


Figure 7: On-State Current vs. On-State Voltage (Typical)

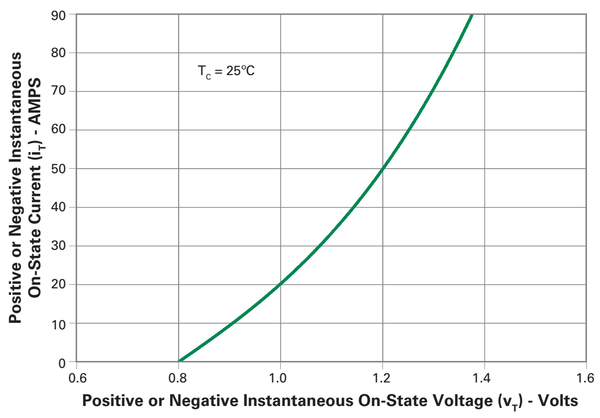
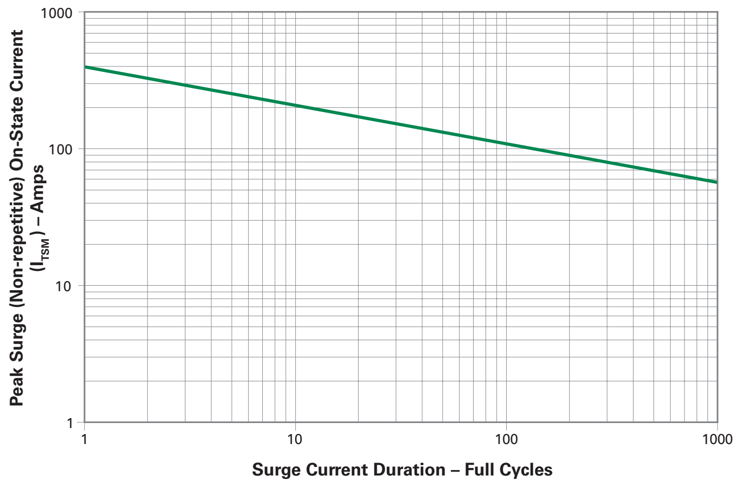


Figure 8: Surge Peak On-State Current vs. Number of Cycles

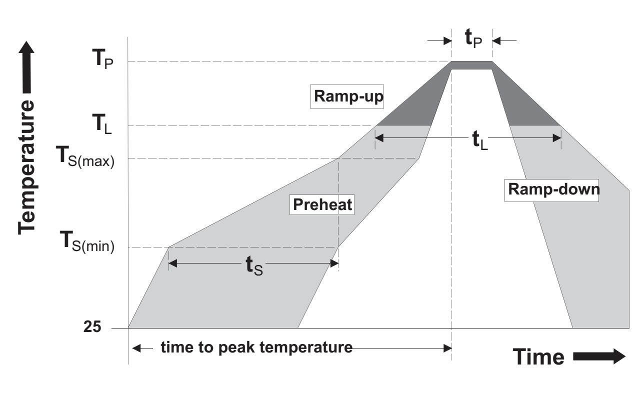


Supply Frequency: 60Hz Sinusoidal
Load: Resistive
RMS On-State [$I_{T(RMS)}$]: Max Rated Value at Specific Case Temperature

Notes:
1) Gate control may be lost during and immediately following surge current interval.
2) Overload may not be repeated until junction temperature has returned to steady-state rated value.

Soldering Parameters

Reflow Condition		Pb – Free assembly
Pre Heat	- Temperature Min ($T_{s(min)}$)	150°C
	- Temperature Max ($T_{s(max)}$)	200°C
	- Time (min to max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp) (T_L) to peak		5°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max
Reflow	- Temperature (T_L) (Liquidus)	217°C
	- Time (min to max) (t_s)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		20 – 40 seconds
Ramp-down Rate		5°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		280°C



Physical Specifications

Terminal Finish	100% Matte Tin-plated.
Body Material	UL Recognized compound meeting flammability rating V-0
Lead Material	Copper Alloy

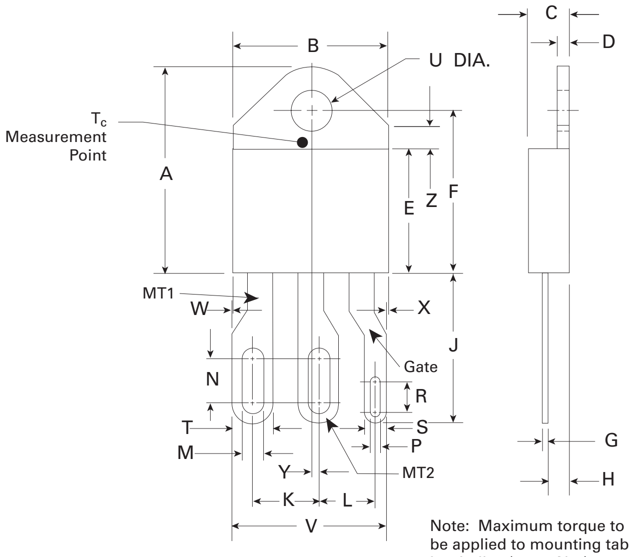
Design Considerations

Careful selection of the correct component for the application's operating parameters and environment will go a long way toward extending the operating life of the Thyristor. Good design practice should limit the maximum continuous current through the main terminals to 75% of the component rating. Other ways to ensure long life for a power discrete semiconductor are proper heat sinking and selection of voltage ratings for worst case conditions. Overheating, overvoltage (including dv/dt), and surge currents are the main killers of semiconductors. Correct mounting, soldering, and forming of the leads also help protect against component damage.

Environmental Specifications

AC Blocking	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours
Temperature Cycling	MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time
Temperature/Humidity	EIA / JEDEC, JESD22-A101 1008 hours; 320V - DC: 85°C; 85% rel humidity
High Temp Storage	MIL-STD-750, M-1031, 1008 hours; 150°C
Low-Temp Storage	1008 hours; -40°C
Resistance to Solder Heat	MIL-STD-750 Method 2031
Solderability	ANSI/J-STD-002, category 3, Test A
Lead Bend	MIL-STD-750, M-2036 Cond E

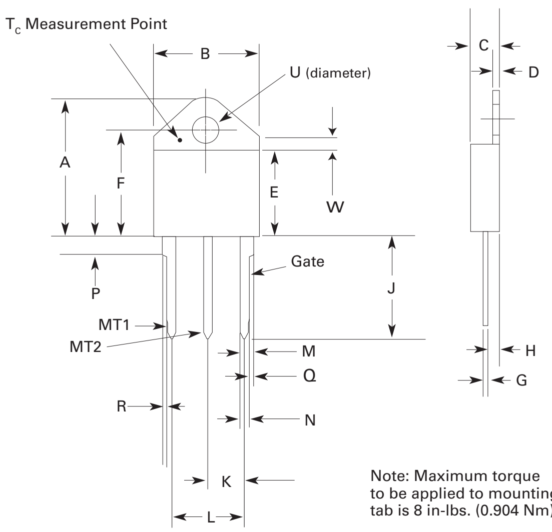
Dimensions — TO-218X (J Package) — Isolated Mounting Tab



Note: Maximum torque to be applied to mounting tab is 8 in-lbs. (0.904 Nm).

Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.810	0.835	20.57	21.21
B	0.610	0.630	15.49	16.00
C	0.178	0.188	4.52	4.78
D	0.055	0.070	1.40	1.78
E	0.487	0.497	12.37	12.62
F	0.635	0.655	16.13	16.64
G	0.022	0.029	0.56	0.74
H	0.075	0.095	1.91	2.41
J	0.575	0.625	14.61	15.88
K	0.256	0.264	6.50	6.71
L	0.220	0.228	5.58	5.79
M	0.080	0.088	2.03	2.24
N	0.169	0.177	4.29	4.49
P	0.034	0.042	0.86	1.07
R	0.113	0.121	2.87	3.07
S	0.086	0.096	2.18	2.44
T	0.156	0.166	3.96	4.22
U	0.161	0.165	4.10	4.20
V	0.603	0.618	15.31	15.70
W	0.000	0.005	0.00	0.13
X	0.003	0.012	0.07	0.30
Y	0.028	0.032	0.71	0.81
Z	0.085	0.095	2.17	2.42

Dimensions — TO-218AC (K Package) — Isolated Mounting Tab



Note: Maximum torque to be applied to mounting tab is 8 in-lbs. (0.904 Nm).

Dimension	Inches		Millimeters	
	Min	Max	Min	Max
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B	0.610	0.630	15.49	16.00
C	0.178	0.188	4.52	4.78
D	0.055	0.070	1.40	1.78
E	0.487	0.497	12.37	12.62
F	0.635	0.655	16.13	16.64
G	0.022	0.029	0.56	0.74
H	0.075	0.095	1.91	2.41
J	0.575	0.625	14.61	15.88
K	0.211	0.219	5.36	5.56
L	0.422	0.437	10.72	11.10
M	0.058	0.068	1.47	1.73
N	0.045	0.055	1.14	1.40
P	0.095	0.115	2.41	2.92
Q	0.008	0.016	0.20	0.41
R	0.008	0.016	0.20	0.41
U	0.161	0.165	4.10	4.20
W	0.085	0.095	2.17	2.42