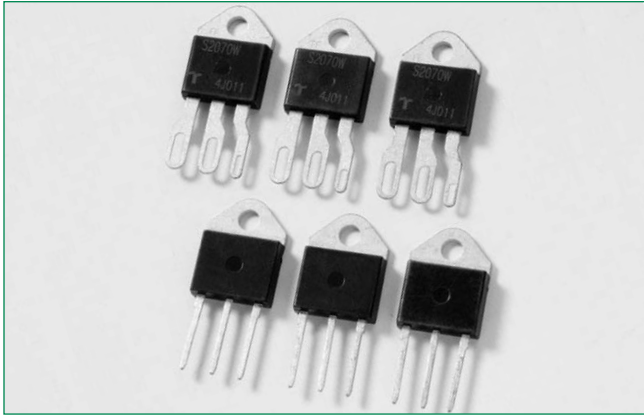


**Qxx40xx Series**



**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
	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**

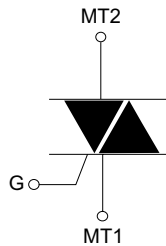
Excellent for AC switching and phase control applications such as heating, lighting, and motor speed controls.

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**



### Absolute Maximum Ratings – Alternistor Triac (3 Quadrants)

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

### Absolute Maximum Ratings – Standard Triac (4 Quadrants)

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

### Electrical Characteristics ( $T_J = 25^\circ\text{C}$ , unless otherwise specified) – Alternistor Triac (3 Quadrants)

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

### Electrical Characteristics ( $T_J = 25^\circ\text{C}$ , unless otherwise specified) — Standard Triac (4 Quadrants)

Symbol	Test Conditions	Quadrant		Qxx40x3	Value		Unit
					Qxx40x4		
$I_{GT}$	$V_D = 12\text{ V}; R_L = 60\ \Omega$	I – II – III	MAX.	35	50	mA	
		IV	MAX.	70	100		
$V_{GT}$	$V_D = 12\text{ V}; R_L = 60\ \Omega$	ALL	MAX.	1.3	1.3	V	
$V_{GD}$	$V_D = V_{DRM}; R_L = 3.3\text{ k}\Omega; T_J = 125^\circ\text{C}$	ALL	MIN.	0.2	0.2	V	
$I_H$	$I_T = 400\text{mA (initial)}$		MAX.	80	80	mA	
dv/dt	$V_D = V_{DRM}; \text{Gate Open}; T_J = 125^\circ\text{C}$	400V	MIN.	400	400	V/ $\mu\text{s}$	
		600V		400	400		
		800V		400	400		
(dv/dt)c	(di/dt)c = 4.3 A/ms; $T_J = 125^\circ\text{C}$		MIN.	10	10	V/ $\mu\text{s}$	
$t_{gt}$	$I_G = 2 \times I_{GT}; \text{PW} = 15\ \mu\text{s}; I_T = 35.4\text{ A}$		TYP.	5	5	$\mu\text{s}$	
dv/dt	$V_D = V_{DRM}, \text{Gate Open}, T_J = 100^\circ\text{C}$		-	-	300	V/ $\mu\text{s}$	

### Static Characteristics

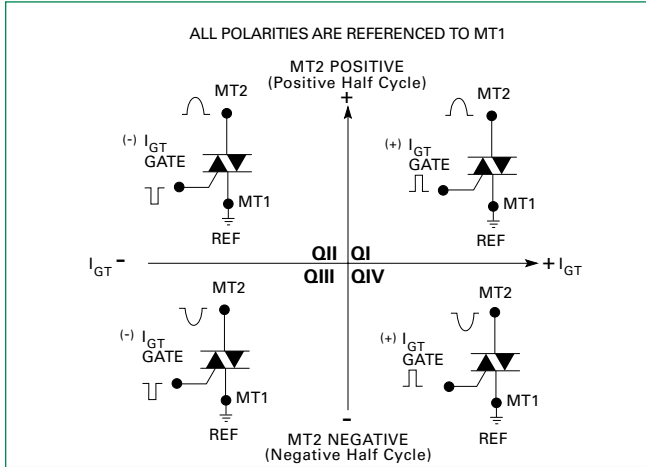
Symbol	Test Conditions			Value	Unit	
$V_{TM}$	$I_{TM} = 56.6\text{ A}; t_p = 380\ \mu\text{s}$	$T_J = 25^\circ\text{C}$	MAX.	1.8	V	
$I_{DRM}$ $I_{RRM}$	$V_D = V_{DRM} / V_{RRM}$	$T_J = 25^\circ\text{C}$	400 – 1000V	MAX.	20	$\mu\text{A}$
		$T_J = 125^\circ\text{C}$	400 – 800V	MAX.	5	mA
		$T_J = 100^\circ\text{C}$	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	$^\circ\text{C/W}$
		Qxx40JH6 Qxx40J7	0.95	

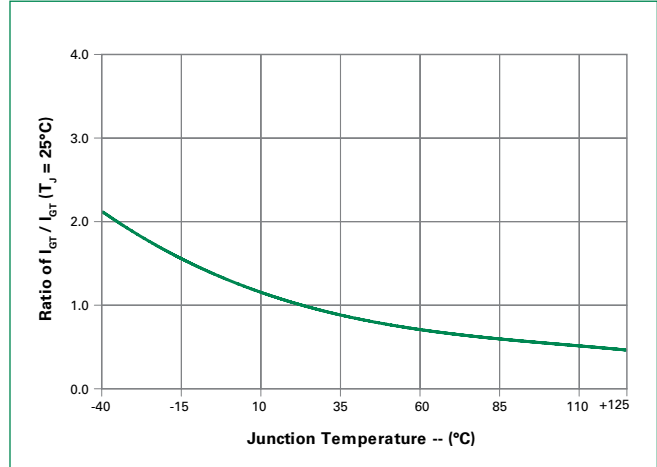
Note: xx = voltage

**Figure 1: Definition of Quadrants**

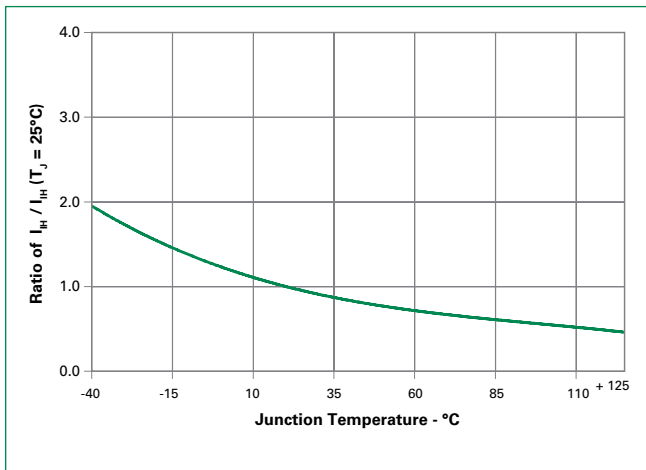


Note: Alternistors will not operate in QIV

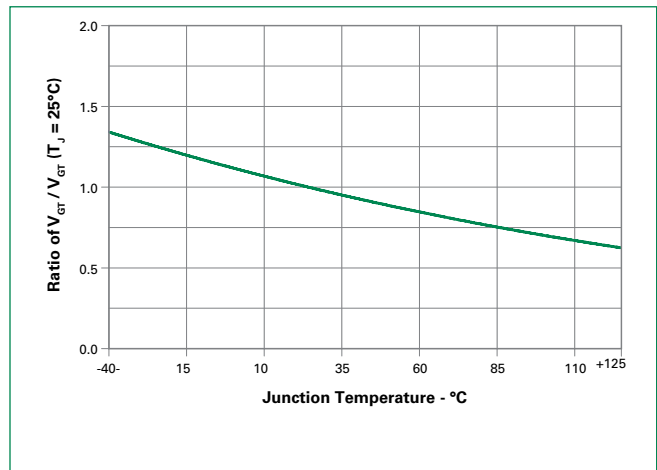
**Figure 2: Normalized DC Gate Trigger Current for All Quadrants vs. Junction Temperature**



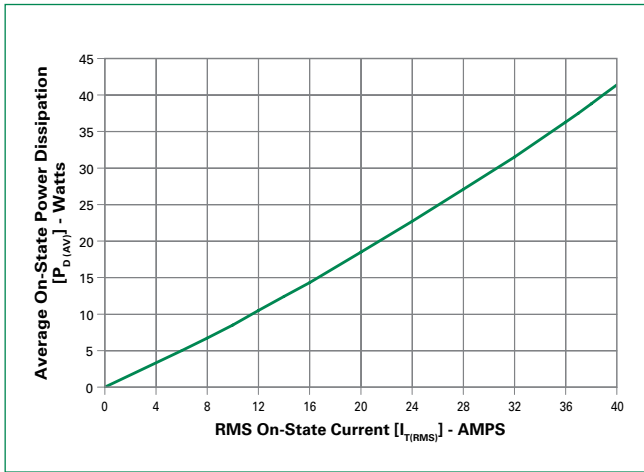
**Figure 3: Normalized DC Holding Current vs. Junction Temperature**



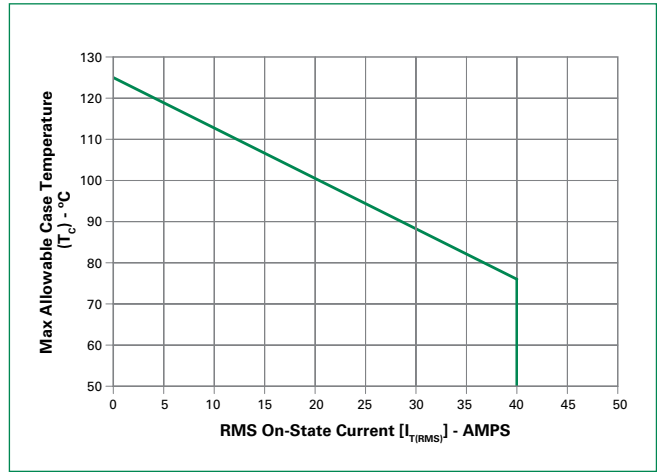
**Figure 4: Normalized DC Gate Trigger Voltage for All Quadrants vs. Junction Temperature**



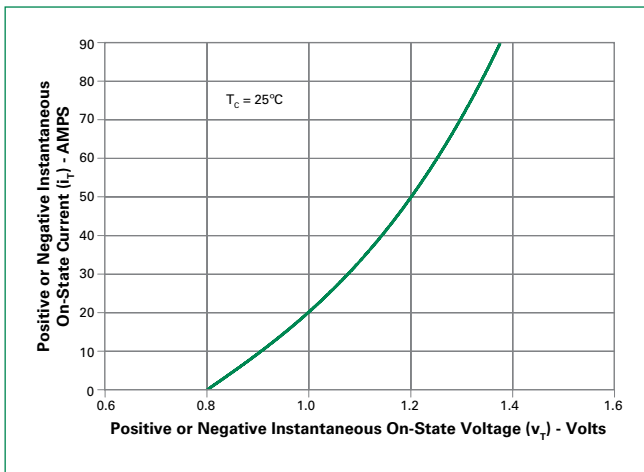
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



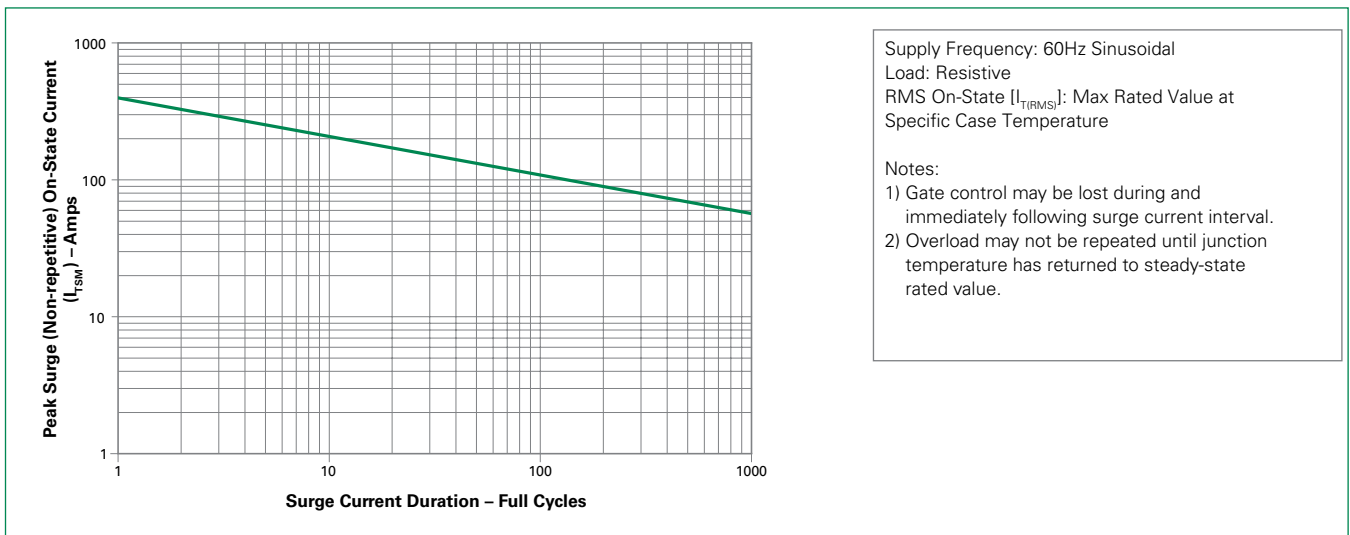
**Figure 6: Maximum Allowable Case Temperature vs. On-State Current**



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

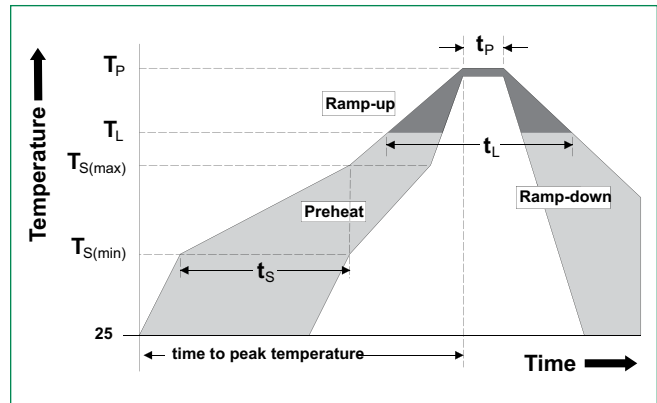


**Figure 8: Surge Peak On-State Current vs. Number of Cycles**



### Soldering Parameters

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



### Physical Specifications

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

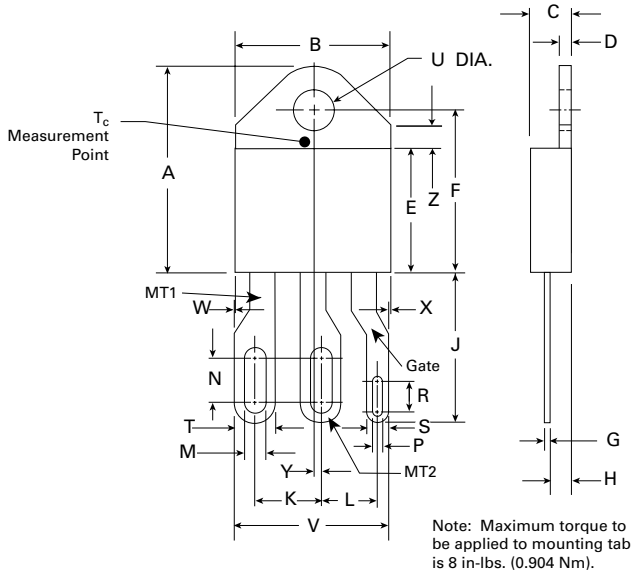
### Design Considerations

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

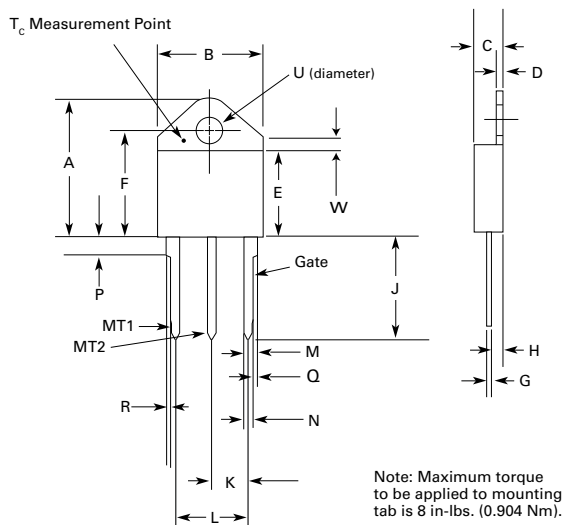
<b>AC Blocking</b>	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours
<b>Temperature Cycling</b>	MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time
<b>Temperature/Humidity</b>	EIA / JEDEC, JESD22-A101 1008 hours; 320V - DC: 85°C; 85% rel humidity
<b>High Temp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

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



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**



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	0.211	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