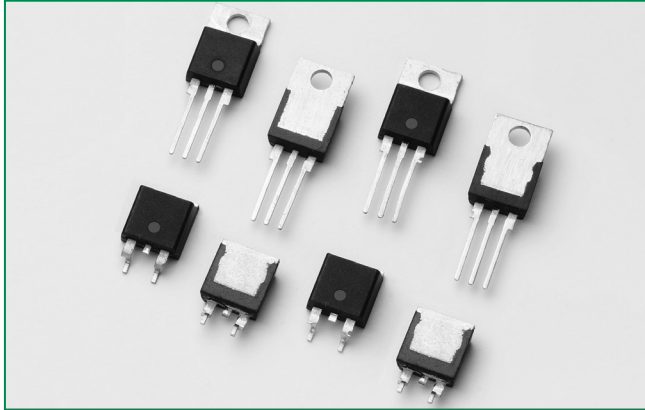


## HS4040xAQx Series

**AUTOMOTIVE GRADE**

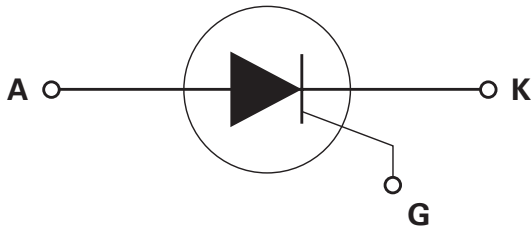
**RoHS**



### Main Features

Symbol	Value	Unit
$I_{T(RMS)}$	40	A
$V_{DRM}/V_{RRM}$	400	V
$I_{GT}$	15 to 65	mA

### Schematic Symbol



### Description

The HS4040xAQx series of SCRs offer fast turn-off time (tq) characteristics required for applications such as power inverters, switching regulator, and high frequency pulse circuits.

These fast turn-off time SCRs offer high dv/dt and high di/dt characteristics required in higher frequency (>1000 PPS) switching circuits and a higher temperature environment.

### Features & Benefits

- RoHS compliant
- Voltage capability up to 400 V
- Surge capability up to 520 A
- TO-220 and TO-263 packages
- AEC-Q101 Fully compliant
- 150°C maximum junction temperature

### Applications

Fast turn-off time SCRs are ideal for multi phase voltage regulator circuits, DC/AC inverters, and higher frequency pulsing power supplies.

### Absolute Maximum Ratings

Symbol	Parameter	Test Conditions	Value	Unit
$I_{T(RMS)}$	RMS on-state current	$T_c = 115^\circ\text{C}$	40	A
$I_{T(AV)}$	Average on-state current	$T_c = 115^\circ\text{C}$	25.0	A
$I_{TSM}$	Peak non-repetitive surge current	single half cycle; f = 50Hz; $T_j$ (initial) = 25°C	430	A
		single half cycle; f = 60Hz; $T_j$ (initial) = 25°C	520	
$I^2t$	$I^2t$ Value for fusing	$t_p = 8.3$ ms	1122	A <sup>2</sup> s
di/dt	Critical rate of rise of on-state current	f = 60Hz; $T_j = 150^\circ\text{C}$	175	A/μs
$I_{GM}$	Peak gate current	$T_j = 150^\circ\text{C}$	3.5	A
$P_{G(AV)}$	Average gate power dissipation	$T_j = 150^\circ\text{C}$	0.8	W
$T_{stg}$	Storage temperature range		-40 to 150	°C
$T_j$	Operating junction temperature range		-40 to 150	°C
$V_{DSM}/V_{RSM}$	Peak non-repetitive blocking voltage	Pw=100 μs	500	V

**Electrical Characteristics (T<sub>J</sub> = 25°C, unless otherwise specified)**

Symbol	Test Conditions		HS4040xAQ	HS4040xAQ2	HS4040xAQ3	Unit
I <sub>GT</sub>	V <sub>D</sub> = 12V; R <sub>L</sub> = 30 Ω	MAX.	35	45	65	mA
		MIN.	15	30	38	
V <sub>GT</sub>		MAX.	1.5			V
I <sub>GT</sub>	V <sub>D</sub> = 12V; R <sub>L</sub> = 30Ω; T <sub>J</sub> = -40°C	MAX.	75	95	160	mA
dv/dt	V <sub>D</sub> = V <sub>DRM'</sub> ; gate open; T <sub>J</sub> = 150°C	MIN.	550			V/μs
V <sub>GD</sub>	V <sub>D</sub> = V <sub>DRM'</sub> ; R <sub>L</sub> = 3.3 kΩ; T <sub>J</sub> = 150°C	MIN.	0.2			V
I <sub>H</sub>	I <sub>T</sub> = 400mA (initial)	MAX.	70	120	200	mA
t <sub>q</sub>	I <sub>T</sub> =0.5A; t <sub>p</sub> =50μs; dv/dt=5V/μs; di/dt=-30A/μs	MAX.	15	12	5	μs
t <sub>gt</sub>	I <sub>G</sub> = 2 x I <sub>GT</sub> ; PW = 15μs; I <sub>T</sub> = 80A	TYP.	3.0			μs

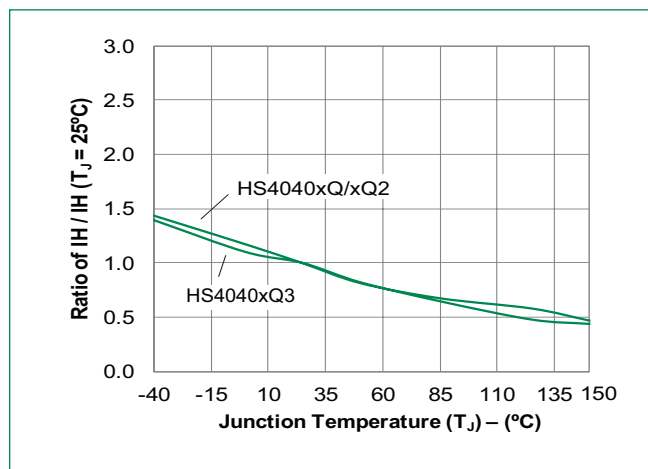
**Static Characteristics**

Symbol	Test Conditions		HS4040xAQ	HS4040xAQ2	HS4040xAQ3	Unit
V <sub>TM</sub>	I <sub>T</sub> = 80A; t <sub>p</sub> = 380μs	MAX.	1.6		1.8	V
I <sub>DRM</sub> / I <sub>RRM</sub>	V <sub>DRM</sub> / V <sub>RRM</sub>	T <sub>J</sub> = 25°C	10			μA
		T <sub>J</sub> = 125°C	2000			
		T <sub>J</sub> = 150°C	4000			

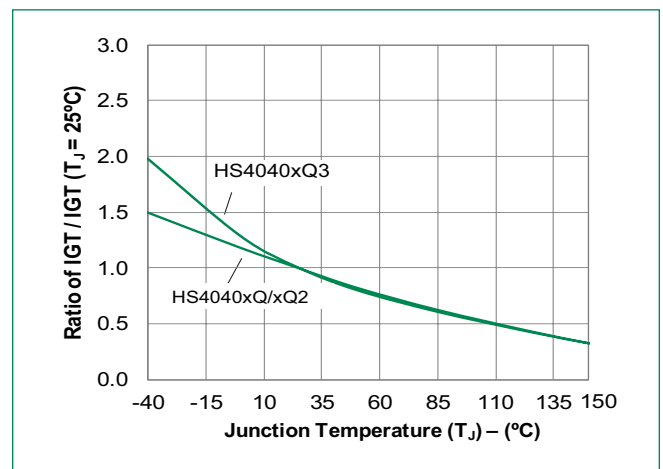
**Thermal Resistances**

Symbol	Parameter	Value	Unit
R <sub>θ(J-C)</sub>	Junction to case (AC)	0.6	°C/W

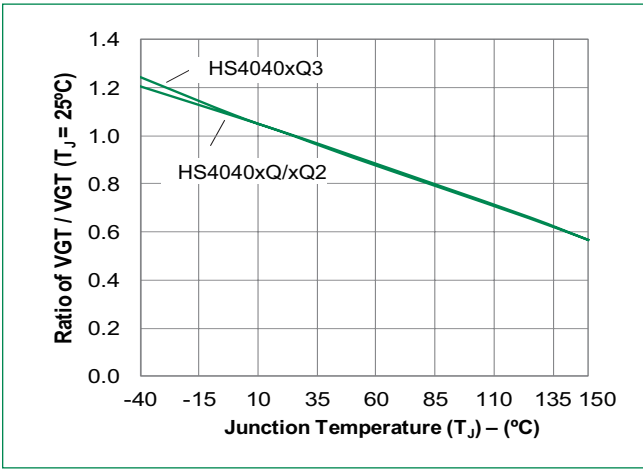
**Figure 1: Normalized DC Holding Current vs. Junction Temperature**



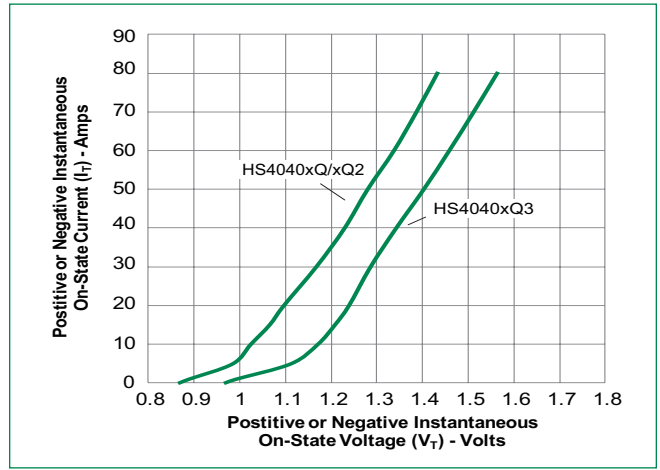
**Figure 2: Normalized DC Gate Trigger Current vs. Junction Temperature**



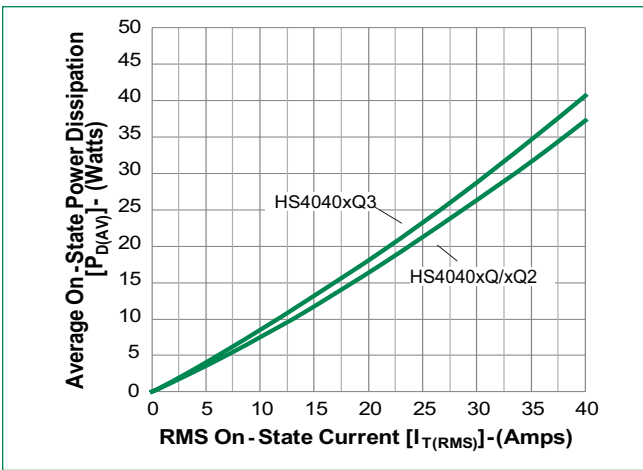
**Figure 3: Normalized DC Gate Trigger Voltage vs. Junction Temperature**



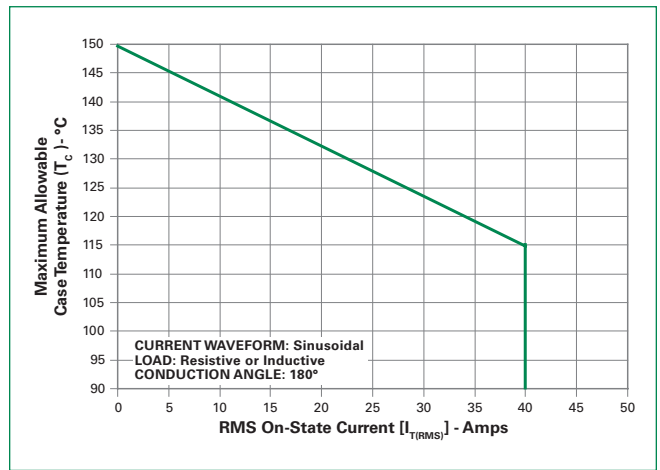
**Figure 4: On-State Current vs. On-State Voltage (Typical)**



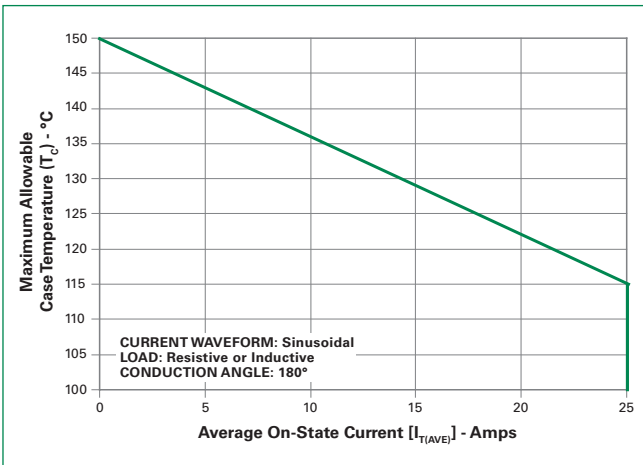
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



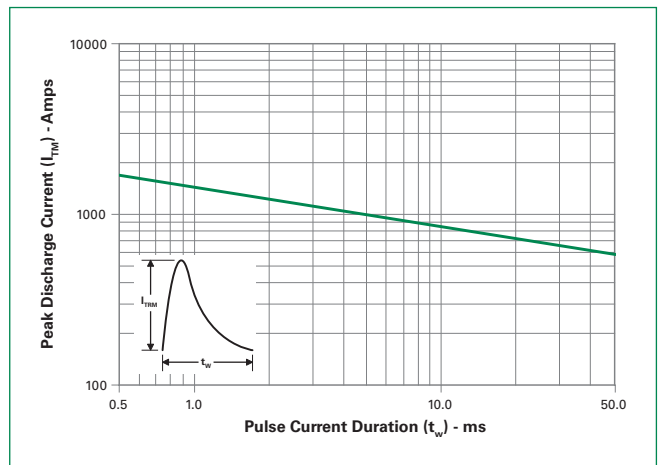
**Figure 6: Maximum Allowable Case Temperature vs. RMS On-State Current**



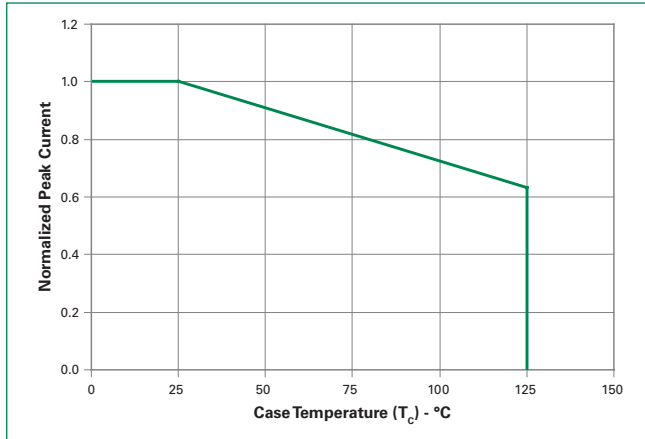
**Figure 7: Maximum Allowable Case Temperature vs. Average On-State Current**



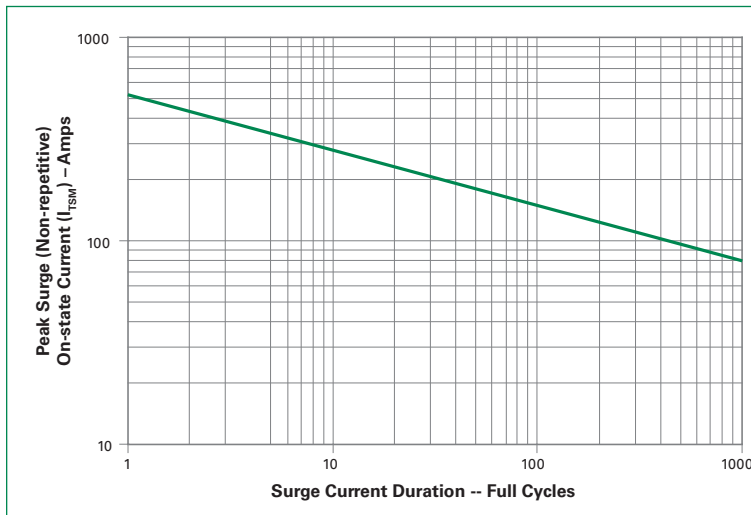
**Figure 8: Peak Capacitor Discharge Current**



**Figure 9: Peak Capacitor Discharge Current Derating**



**Figure 10: Surge Peak On-State Current vs. Number of Cycles**



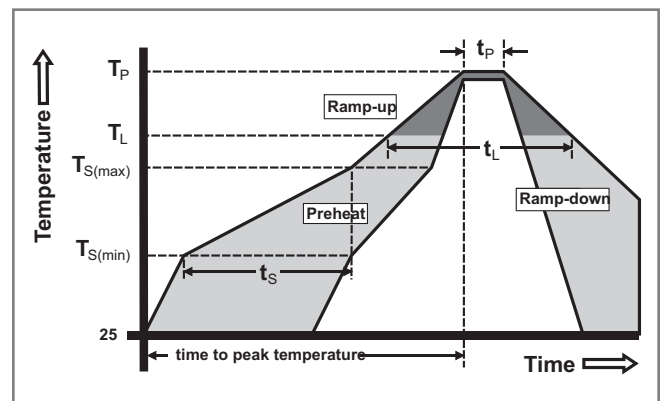
SUPPLY FREQUENCY: 60 Hz Sinusoidal  
LOAD: Resistive  
RMS On-State Current: [I<sub>T(RMS)</sub>]: Maximum Rated Value at Specified Case Temperature

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 <sub>s(min)</sub> )	150°C
	- Temperature Max (T <sub>s(max)</sub> )	200°C
	- Time (min to max) (t <sub>s</sub> )	60 – 180 secs
Average ramp up rate (Liquidus Temp (T <sub>L</sub> ) to peak)		5°C/second max
T <sub>s(max)</sub> to T <sub>L</sub> - Ramp-up Rate		5°C/second max
Reflow	- Temperature (T <sub>L</sub> ) (Liquidus)	217°C
	- Temperature (t <sub>L</sub> )	60 – 150 seconds
Peak Temperature (T <sub>p</sub> )		260 <sup>+0/-5</sup> °C
Time within 5°C of actual peak Temperature (t <sub>p</sub> )		20 – 40 seconds
Ramp-down Rate		5°C/second max
Time 25°C to peak Temperature (T <sub>p</sub> )		8 minutes Max.
Do not exceed		280°C



**Physical Specifications**

<b>Terminal Finish</b>	100% Matte Tin-plated
<b>Body Material</b>	UL recognized epoxy meeting flammability classification V-0
<b>Lead Material</b>	Copper Alloy

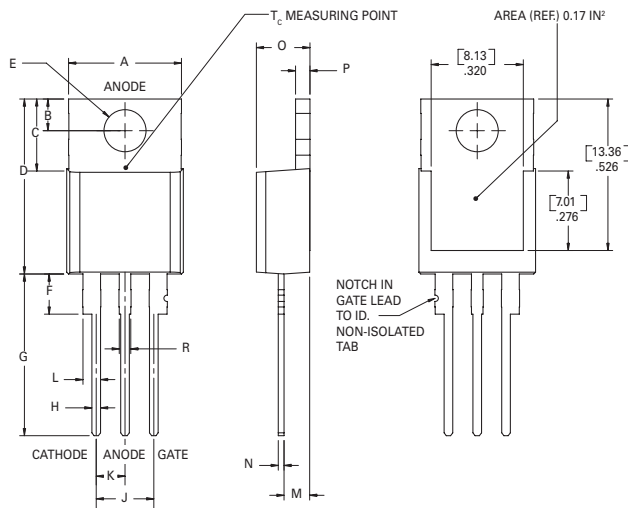
**Design Considerations**

Careful selection of the correct device 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 device 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**

Test	Specifications and Conditions
<b>AC Blocking</b>	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 150°C for 1008 hours
<b>Biased Temperature &amp; Humidity</b>	EIA / JEDEC, JESD22-A101 1008 hours; 320V - DC: 85°C; 85% rel humidity
<b>Temperature Cycling</b>	JESD22 A-104 Appendix 6 -55°C to 150°C, 15-minute dwell, 1000 cycles
<b>Intermittent Operational Life</b>	T <sub>A</sub> =25C, ΔT <sub>J</sub> ≥ 100°C, 1008hrs
<b>Autoclave (Pressure Cooker Test)</b>	EIA/JEDEC: JESD22-A102 121°C, 100%RH, 15psig, 96hours
<b>Resistance to Solder Heat</b>	JESD22 A-111: 260°C, 10 seconds
<b>Solderability</b>	ANSI/J-STD-002, category 3, Test A

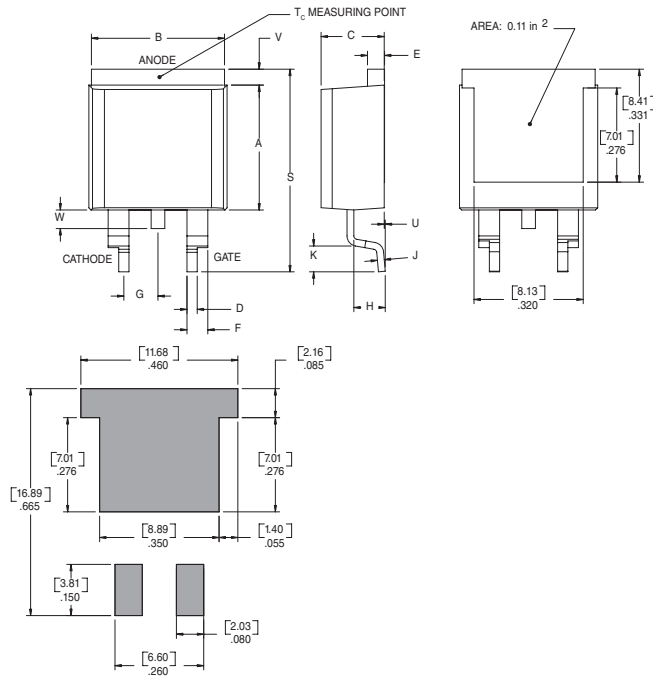
**Dimensions — TO-220AB (R-Package) — Non-Isolated Mounting Tab Common with Center Lead**



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

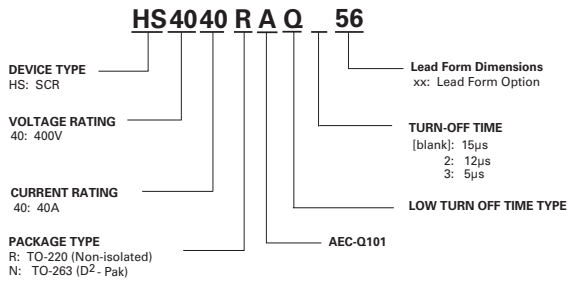
Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.380	0.420	9.65	10.67
B	0.105	0.115	2.67	2.92
C	0.230	0.250	5.84	6.35
D	0.590	0.620	14.99	15.75
E	0.142	0.147	3.61	3.73
F	0.110	0.130	2.79	3.30
G	0.540	0.575	13.72	14.61
H	0.025	0.035	0.64	0.89
J	0.195	0.205	4.95	5.21
K	0.095	0.105	2.41	2.67
L	0.060	0.075	1.52	1.91
M	0.085	0.095	2.16	2.41
N	0.018	0.024	0.46	0.61
O	0.178	0.188	4.52	4.78
P	0.045	0.060	1.14	1.52
R	0.038	0.048	0.97	1.22

**Dimensions – TO- 263 (N-package) – D<sup>2</sup>-Pak Surface Mount**



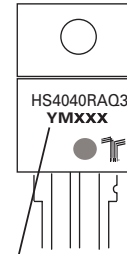
Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.360	0.370	9.14	9.40
B	0.380	0.420	9.65	10.67
C	0.178	0.188	4.52	4.78
D	0.025	0.035	0.63	0.89
E	0.048	0.055	1.22	1.40
F	0.060	0.075	1.52	1.91
G	0.095	0.105	2.41	2.67
H	0.083	0.093	2.11	2.36
J	0.018	0.024	0.46	0.61
K	0.090	0.110	2.29	2.79
S	0.590	0.625	14.99	15.87
V	0.035	0.045	0.89	1.14
U	0.002	0.010	0.05	0.25
W	0.040	0.070	1.02	1.78

**Part Numbering System**



**Part Marking System**

TO-220 AB - (R Package)  
TO-263 (N Package)



**Date Code Marking**  
Y: Year Code  
M: Month Code  
XXX: Lot Trace Code