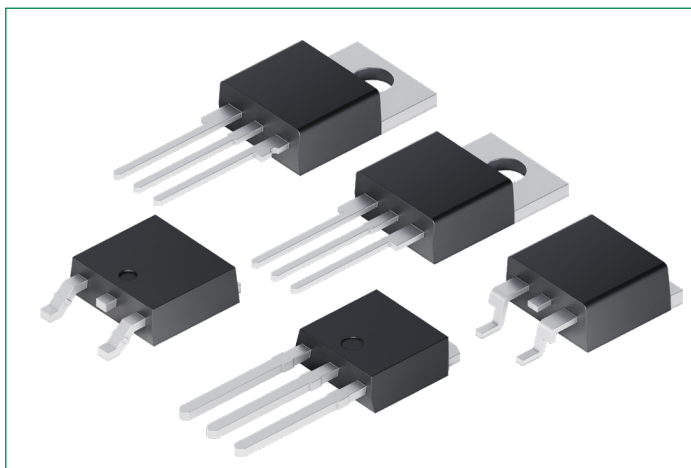


QVxx12xHx Series

12 A High-Temperature Alternistor TRIACs



Description

This 12 A high-temperature Alternistor TRIAC, offered in TO-220AB, TO-220 isolated, TO-251, TO-252, and TO-263 packages, has rated 150 °C maximum junction temperature, $T_{vj(max)}$ and 153 A non-repetitive surge peak on-state current, I_{TSM} at 60 Hz.

This series enables easier thermal management and increases surge handling capability in AC power control applications such as heater control, motor speed control, and lighting controls.

This QV series TRIAC operates in quadrants I, II, and III, and offers high performance in applications requiring high commutation capability without a snubber circuit.

Features

- Blocking voltage up to 800 V
- Mechanically and thermally robust clip-attach assembly
- Internally-isolated TO-220 package
- Maximum virtual junction temperature, $T_{vj(max)}$ of 150 °C
- Halogen-free and RoHS-compliant
- UL 1557 recognized as an Electrically Isolated Semiconductor Device (L package: file number E71639)

Benefits

- High dv/dt up to 1000 V/μs for improved noise immunity
- 3Q technology for high commutation capability, resulting in smoother switching transitions and reduced EMI
- Internally isolated TRIAC packages offer improved thermal management and high electrical isolation, simplifying mounting and enhancing safety.

Applications

TRIAC is an excellent AC switch in heating, lighting, and motor speed control applications.

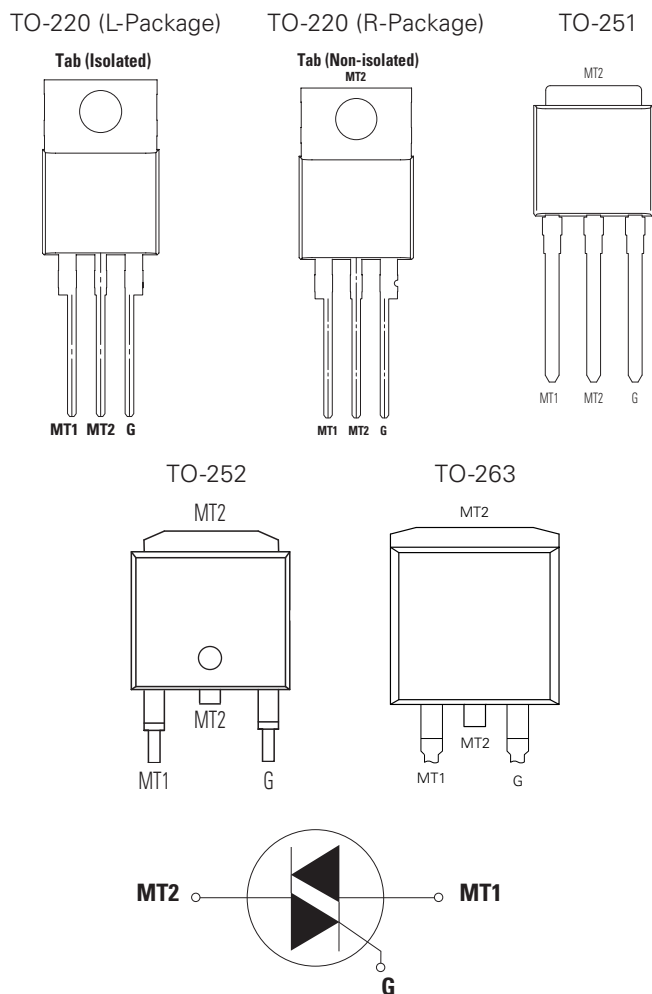
Typical applications are:

- Heater control such as coffee brewer, tankless water heater, and infrared heater
- AC solid-state relays
- Light dimmers including incandescent and LED lighting
- Motor speed control in kitchen appliances, white goods, home electronics, power tools, and light industrial applications such as compressor motor control

Product Summary

Characteristic	Value	Unit
$I_{T(RMS)}$	12	A
V_{DRM}/V_{RRM}	600 or 800	V
$I_{GT(Q1)}$	20, 35, or 50	mA

Pinout Diagram



MT1: Main Terminal 1; **MT2:** Main Terminal 2; **G:** Gate

Maximum Ratings – Alternistor TRIAC (3 Quadrants)

Symbol	Characteristics	Conditions			Value	Units	
V_{DSM}/V_{RSM}	Non-repetitive Surge Peak Off-state Voltage	QVxx12RH _y / QVxx12NH _y / QVxx12LH _y	$V_{DRM}/V_{RRM} = 600\text{ V}$	$P_W = 100\ \mu\text{s}$	$V_{DRM}/V_{RRM} + 100$	V	
		QVxx12DH _y / QVxx12VH _y	$T_{vj} = 25\ ^\circ\text{C}$				960
$I_{T(RMS)}$	On-state RMS Current	QVxx12LH _y			$T_C = 120\ ^\circ\text{C}$	12	A
		QVxx12RH _y / QVxx12NH _y	full sine wave		$T_C = 135\ ^\circ\text{C}$		
		QVxx12DH _y / QVxx12VH _y			$T_C = 133\ ^\circ\text{C}$		
I_{TSM}	Non-repetitive Surge Peak On-state Current	QVxx12RH _y / QVxx12NH _y / QVxx12LH _y	f = 50 Hz, t = 20 ms	full cycle; T_{vj} initial = 25 °C	140	A	
			f = 60 Hz, t = 16.7 ms				153
		QVxx12DH _y / QVxx12VH _y	f = 50 Hz, t = 20 ms				105
			f = 60 Hz, t = 16.7 ms				125
I^2t	I^2t Value for Fusing	QVxx12RH _y / QVxx12NH _y / QVxx12LH _y			$t_p = 8.3\ \text{ms}$	97	A ² s
		QVxx12DH _y / QVxx12VH _y				64	
di/dt	Critical Rate of Rise of On-state Current	$I_G = 50\ \text{mA}$ with 0.1 μs rise time	$f = 60\ \text{Hz}, T_{vj} = 150\ ^\circ\text{C}$			100	A/ μs
I_{GTM}	Peak Gate Trigger Current	QVxx12RH _y / QVxx12NH _y /QVxx12LH _y	$t_p \leq 10\ \mu\text{s}; I_{GT} \leq I_{GTM}, T_{vj} = 150\ ^\circ\text{C}$			4	A
		QVxx12DH _y / QVxx12VH _y				2	
$P_{G(AV)}$	Average Gate Power Dissipation	QVxx12RH _y / QVxx12NH _y /QVxx12LH _y	$T_{vj} = 150\ ^\circ\text{C}$			0.5	W
		QVxx12DH _y / QVxx12VH _y				0.1	
T_{stg}	Storage Temperature Range	-			-40 to 150	°C	
T_{vj}	Virtual Junction Temperature Range	-			-40 to 150	°C	

xx = voltage/10; y = sensitivity

Electrical Characteristics ($T_{vj} = 25\ ^\circ\text{C}$, unless otherwise specified) – Alternistor TRIAC (3 Quadrants)

Symbol	Characteristics	Conditions	QVxx12xH3			QVxx12xH4			QVxx12xH5			Units	
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_{GT}	DC Gate Trigger Current	$V_D = 12\ \text{V}, R_L = 60\ \Omega$	I – II – III	-	-	20	-	-	35	-	-	50	mA
V_{GT}	DC Gate Trigger Voltage		I – II – III	-	-	1.3	-	-	1.2	-	-	1.2	V
V_{GD}	Gate Non-trigger Voltage	$V_D = V_{DRM}, R_L = 3.3\ \text{k}\Omega, T_{vj} = 150\ ^\circ\text{C}$	I – II – III	0.2	-	-	0.15	-	-	0.15	-	-	V
I_H	Holding Current	$I_T = 100\ \text{mA}$ Initial		-	-	30	-	-	50	-	-	60	mA
I_L	Latching Current	$V_D = 12\ \text{V}; I_G = 24\ \text{mA}$		-	-	80	-	-	-	-	-	-	mA
dv/dt	Critical Rate-of-rise of Off-stage Voltage	$V_D = V_{DRM}, \text{Gate Open}, T_{vj} = 150\ ^\circ\text{C}$		-	-	-	500	-	-	750	-	-	V/ μs
		$V_D = 2/3 V_{DRM}, \text{Gate Open}, T_{vj} = 150\ ^\circ\text{C}$		1000	-	-	1000	-	-	1000	-	-	μs
(dv/dt) _c	Critical Rate-of-rise of Commutation Voltage	$T_{vj} = 150\ ^\circ\text{C}, (di/dt)_c = 8.6\ \text{A/ms}$		25	-	-	50	-	-	50	-	-	V/ μs
t_{gt}	Turn-on Time	$I_G = 2 \times I_{GT}, P_W = 15\ \mu\text{s}, I_T = 22.6\ \text{A}_{pk}$	I	-	1	-	-	1	-	-	1	-	μs
			II	-	1.3	-	-	2	-	-	2	-	
			III	-	3	-	-	7	-	-	10	-	

xx = voltage/10; y = sensitivity

Thermal Characteristics

Symbol	Characteristics	Value	Units
$R_{th(j-c)}$	Thermal Resistance, Junction to Case	QVxx12RH _y / QVxx12NH _y	0.9
		QVxx12LH _y	1.85
		QVxx12DH _y / QVxx12VH _y	1.2
$R_{th(j-a)}$	Thermal Resistance, Junction to Ambient	QVxx12DH _y / QVxx12VH _y	70

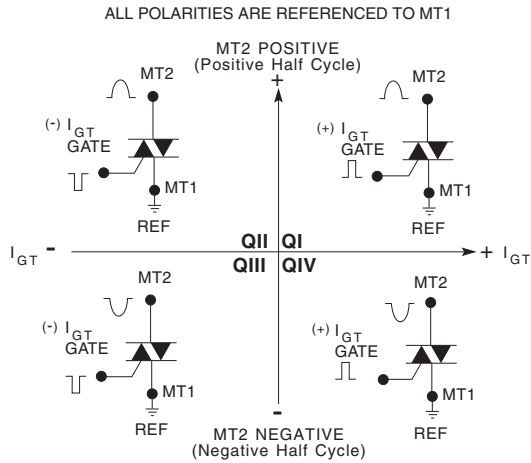
xx = voltage/10; y = sensitivity

Static Characteristics

Symbol	Characteristics	Conditions	Value			Units	
			Min.	Typ.	Max.		
V_{TM}	Peak On-state Voltage	$I_T = 17\text{ A}$, $t_p = 380\ \mu\text{s}$	-	-	1.6	V	
I_{DRM}/I_{RRM}	Peak Repetitive Off-state Current	$V_D = V_{DRM}/V_{RRM}$, $T_{vj} = 25\text{ }^\circ\text{C}$	-	-	5	μA	
		$V_D = V_{DRM}/V_{RRM}$, $T_{vj} = 150\text{ }^\circ\text{C}$	-	-	3	mA	
V_{T0}	Threshold Voltage	$T_{vj} = 150\text{ }^\circ\text{C}$	-	-	0.85	V	
R_D	Slope Resistance	$T_{vj} = 150\text{ }^\circ\text{C}$	600 V	-	-	23	m Ω
			800 V	-	-	38	

Characteristic Curves

Figure 1. Definition of Quadrants



Note: Alternistors will not operate in QIV

Fig. 2. Normalized DC Gate Trigger Current for all Quadrants vs. Junction Temperature

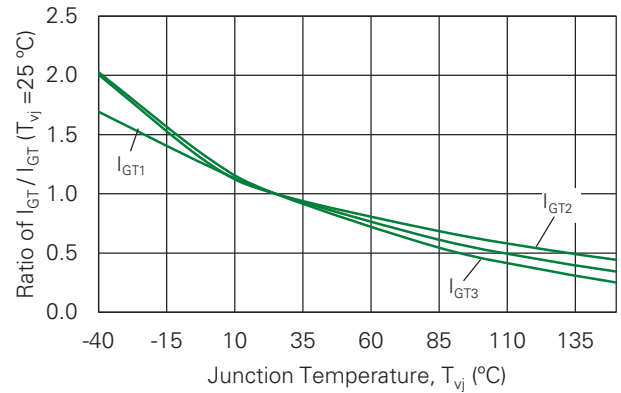


Fig. 3. Normalized DC Holding Current vs. Junction Temperature

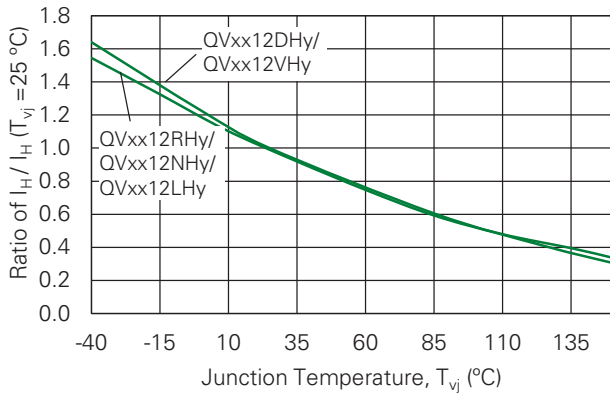


Fig. 4. Normalized DC Gate Trigger Voltage for all Quadrants vs. Junction Temperature

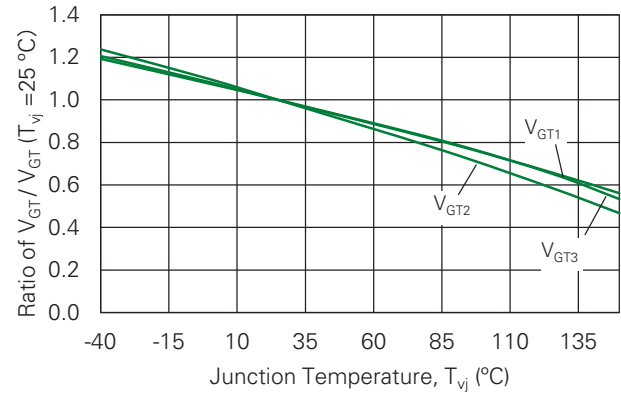


Fig. 5. Typical Power Dissipation vs. RMS On-state Current

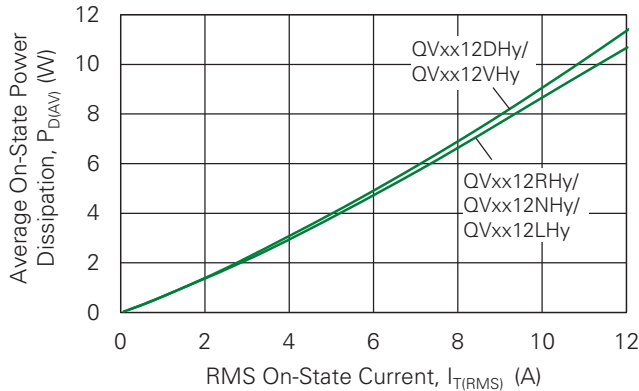


Fig. 6. Typical On-state Current vs. On-state Voltage

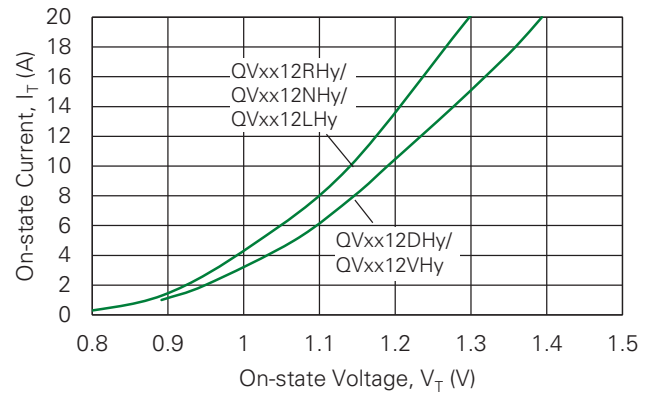


Fig. 7. Maximum Allowable Case Temperature vs. RMS On-state Current

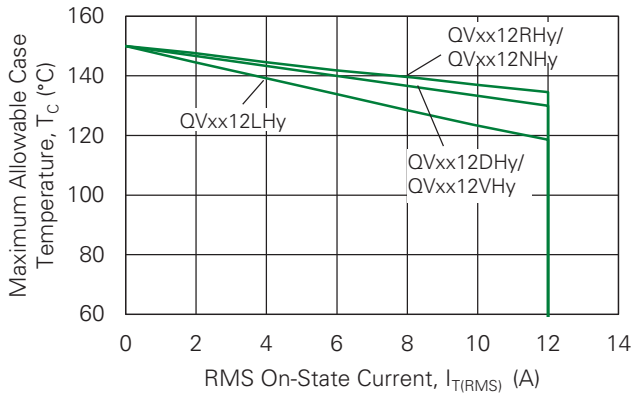


Figure 8. Junction to Case Transient Thermal Impedance (only for QVxx12DHx/QVxx12VHy)

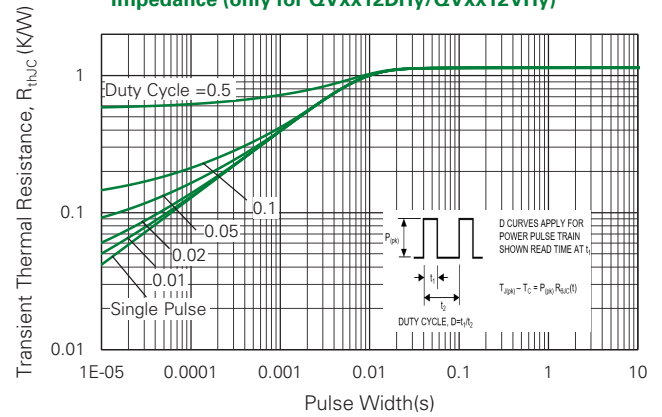


Figure 9. Junction to Ambient Transient Thermal Impedance (only for QVxx12DHx/QVxx12VHy)

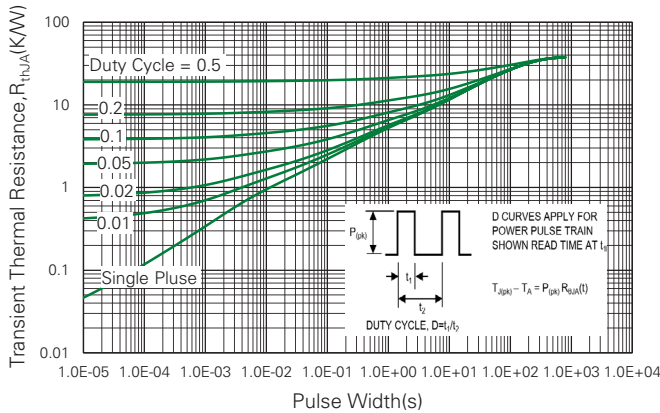
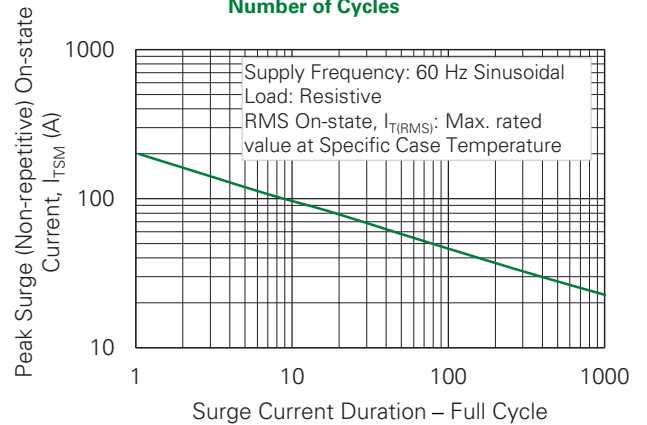


Fig. 10. Surge Peak On-state Current vs. Number of Cycles

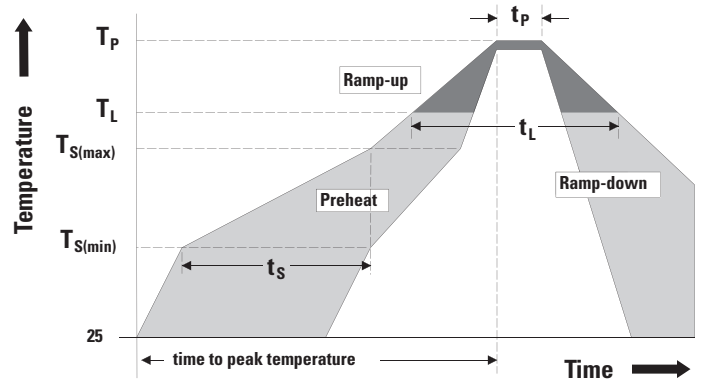


Notes:

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

Soldering Parameters

Characteristic		Value
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 – 120 secs
Average ramp up rate (Liquidus Temp)(T_L) to peak		3°C/second max
$T_{s(max)}$ to T_L - Ramp-up Rate		3°C/second max
Reflow	Temperature (T_L) (Liquidus)	217°C
	Time (t_L)	60 – 150 seconds
Peak Temperature (T_p)		260 ^{+0/-5} °C
Time within 5°C of actual peak Temperature (t_p)		30 seconds max.
Ramp-down Rate		5°C/second max
Time 25°C to peak Temperature (T_p)		6 minutes max
Do Not Exceed		260°C



Environmental Specifications

Test	Specifications and Conditions
AC Blocking	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 150°C for 1008 hours
Temperature/Humidity	EIA / JEDEC, JESD22-A101, 1008 hours; 160 V - DC: 85°C; 85% relative humidity
Temperature Cycling	MIL-STD-750, M-1051, 1000 cycles; -55°C to +150°C; 15-min dwell-time
UHAST	JESD22A-118, 96 hrs, 130°C/ 85% RH
IOL	MIL-STD-750 Method 1037
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
Moisture Sensitivity Level	Level 1, JEDEC-J-STD-020

Physical Specifications

Characteristic	Value
Terminal Finish	100% Matte Tin-plated
Body Material	UL Recognized compound meeting flammability rating 94 V-0
Terminal Material	Copper Alloy

Product Selector

Part Number	Voltage		Gate Sensitivity Quadrants	Type	Package
	600 V	800 V	I-II-III		
QVxx12DH3	–	X	20 mA	Alternistor TRIAC	TO-252 (DPAK)
QVxx12VH3	–	X	20 mA	Alternistor TRIAC	TO-251 (VPAK)
QVxx12LH4	X	–	35 mA	Alternistor TRIAC	TO-220AB (L package)
QVxx12RH4	X	–	35 mA	Alternistor TRIAC	TO-220AB (R package)
QVxx12NH4	X	–	35 mA	Alternistor TRIAC	TO-263 (D ² PAK)
QVxx12LH5	X	–	50 mA	Alternistor TRIAC	TO-220AB (L package)
QVxx12RH5	X	–	50 mA	Alternistor TRIAC	TO-220AB (R package)
QVxx12NH5	X	–	50 mA	Alternistor TRIAC	TO-263 (D ² PAK)

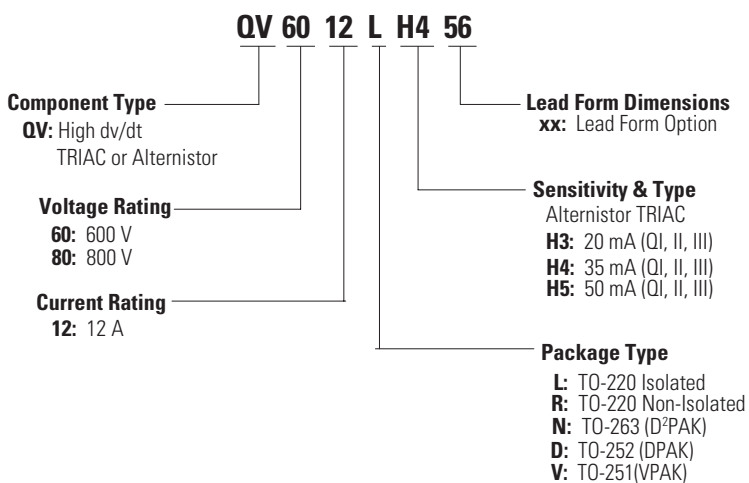
xx = voltage/10; y = sensitivity

Packing Options

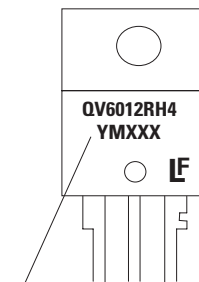
Part Number	Marking	Weight	Packing Mode	Base Quantity
QVxx12LHyTP	QVxx12LHy	2.2 g	Tube Pack	1000
QVxx12RHyTP	QVxx12RHy	2.2 g	Tube Pack	1000
QVxx12NHyTP	QVxx12NHy	1.6 g	Tube Pack	1000
QVxx12NHyRP	QVxx12NHy	1.6 g	Embossed Carrier	500
QVxx12DHyTP	QVxx12DHy	0.3 g	Tube Pack	750 (75 per tube)
QVxx12DHyRP	QVxx12DHy	0.3 g	Embossed Carrier	2500
QVxx12VHyTP	QVxx12VHy	0.4 g	Tube Pack	750 (75 per tube)

xx = voltage/10; y = sensitivity

Part Numbering and Marking

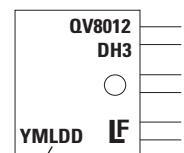


TO-220 AB - (L and R Package)
TO-263 - (N Package)



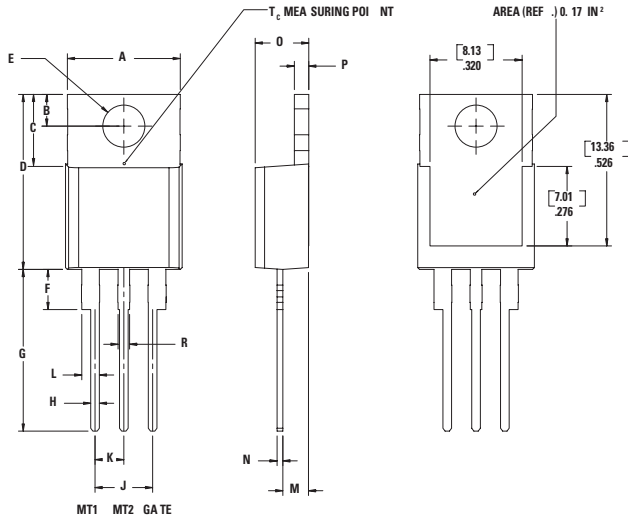
Date Code Marking
Y: Year Code
M: Month Code
XXX: Lot Trace Code

TO-252 (DPAK)
TO-251 (VPAK)



Date Code Marking
Y: Year Code
M: Month Code
L: Location Code
DD: Calendar Code

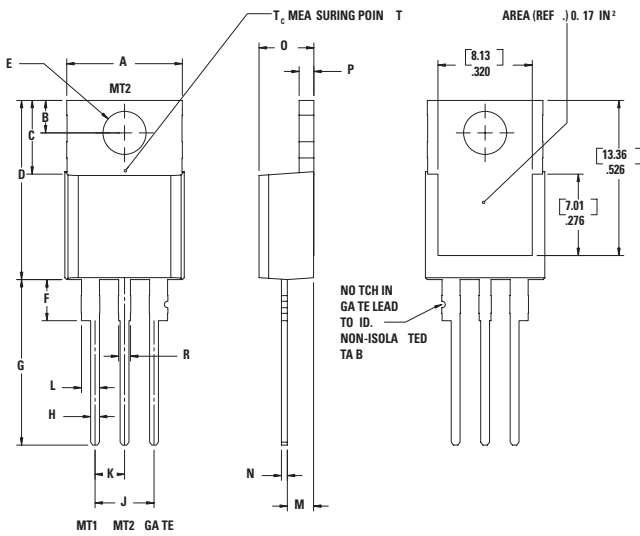
Package Dimensions TO-220AB (L-Package) – Isolated Mounting Tab



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

Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max
A	9.65	10.67	0.380	0.420
B	2.67	2.92	0.105	0.115
C	5.84	6.35	0.230	0.250
D	14.99	15.75	0.590	0.620
E	3.61	3.73	0.142	0.147
F	2.79	3.30	0.110	0.130
G	13.72	14.60	0.540	0.575
H	0.64	0.89	0.025	0.035
J	4.95	5.21	0.195	0.205
K	2.41	2.67	0.095	0.105
L	1.52	1.91	0.060	0.075
M	2.16	2.41	0.085	0.095
N	0.46	0.61	0.018	0.024
O	4.52	4.78	0.178	0.188
P	1.14	1.52	0.045	0.060
R	0.97	1.22	0.038	0.048

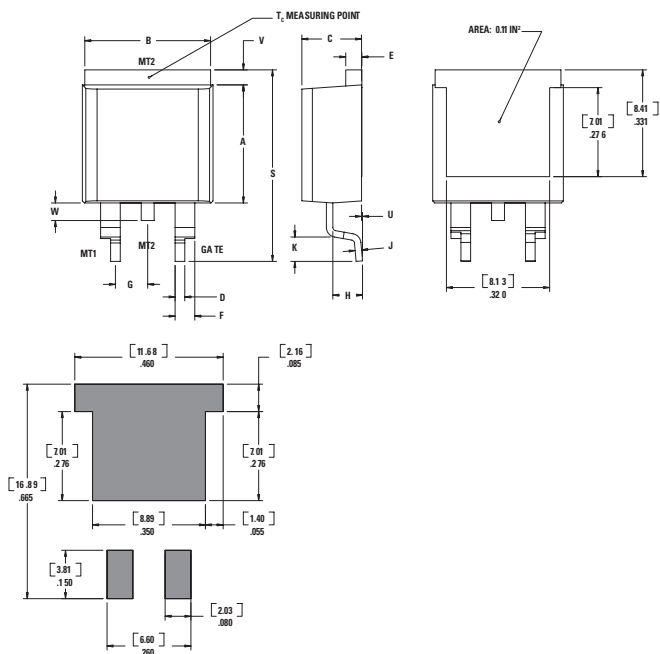
Package Dimensions TO-220AB (R Package) – Non-isolated Mounting Tab Common with Center Lead



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

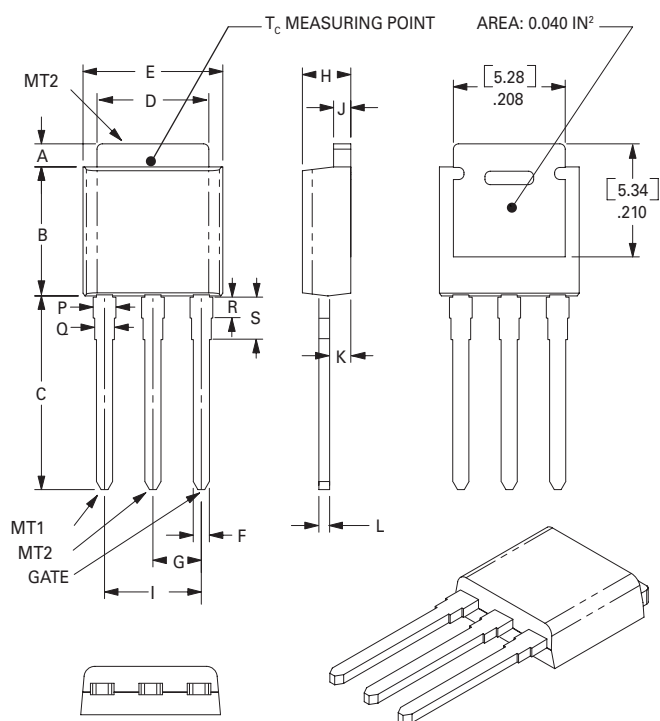
Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max
A	9.65	10.67	0.380	0.420
B	2.67	2.92	0.105	0.115
C	5.84	6.35	0.230	0.250
D	14.99	15.75	0.590	0.620
E	3.61	3.73	0.142	0.147
F	2.79	3.30	0.110	0.130
G	13.72	14.60	0.540	0.575
H	0.64	0.89	0.025	0.035
J	4.95	5.21	0.195	0.205
K	2.41	2.67	0.095	0.105
L	1.52	1.91	0.060	0.075
M	2.16	2.41	0.085	0.095
N	0.46	0.61	0.018	0.024
O	4.52	4.78	0.178	0.188
P	1.14	1.52	0.045	0.060
R	0.97	1.22	0.038	0.048

Package Dimensions TO-263 (N Package) – D²PAK Surface Mount



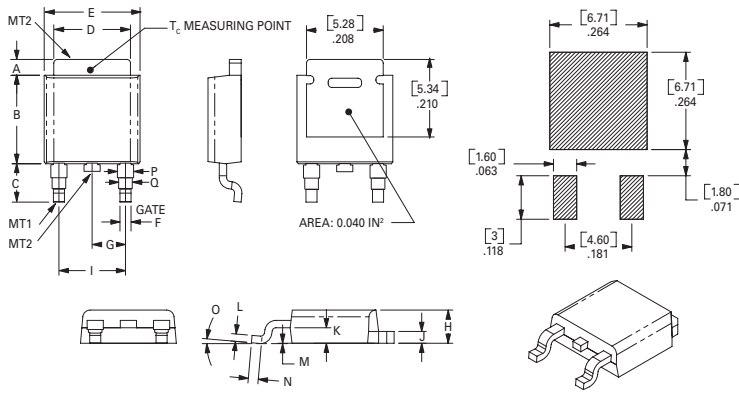
Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max
A	9.14	9.40	0.360	0.370
B	9.65	10.67	0.380	0.420
C	4.52	4.78	0.178	0.188
D	0.64	0.89	0.025	0.035
E	1.14	1.52	0.045	0.060
F	1.52	1.91	0.060	0.075
G	2.41	2.67	0.095	0.105
H	2.34	2.59	0.092	0.102
J	0.46	0.61	0.018	0.024
K	2.29	2.79	0.090	0.110
S	14.99	15.88	0.590	0.625
V	0.89	1.14	0.035	0.045
U	0.05	0.25	0.002	0.010
W	1.02	1.78	0.040	0.070

Package Dimensions TO-251AA (V Package) – VPAK Through Hole



Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max
A	0.94	1.09	0.037	0.043
B	5.97	6.22	0.235	0.245
C	8.89	9.53	0.350	0.375
D	5.21	5.41	0.205	0.213
E	6.48	6.73	0.255	0.265
F	0.69	0.84	0.027	0.033
G	2.21	2.36	0.087	0.093
H	2.16	2.41	0.085	0.095
I	4.47	4.67	0.176	0.184
J	0.46	0.58	0.018	0.023
K	0.90	1.00	0.035	0.039
L	0.46	0.58	0.018	0.023
P	1.06	1.32	0.042	0.052
Q	0.86	1.11	0.034	0.044
R	0.86	1.11	0.034	0.044
S	1.86	2.11	0.074	0.084

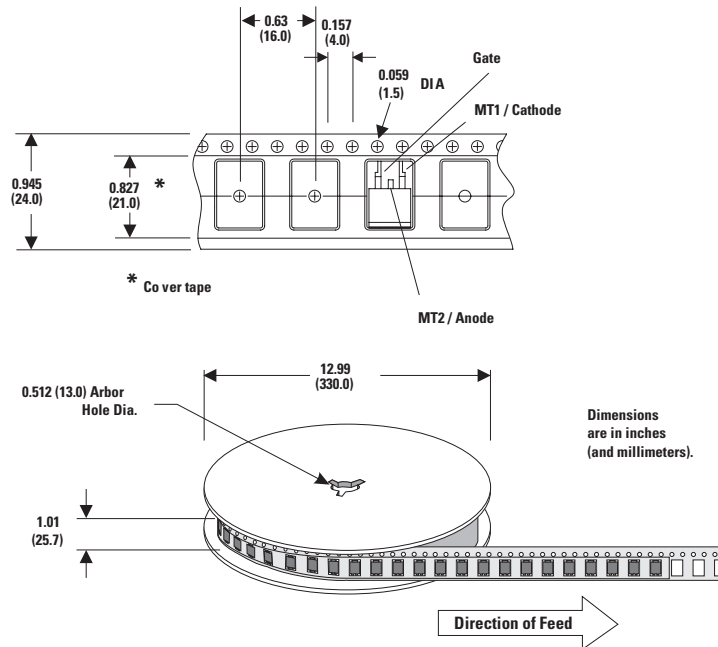
Package Dimensions TO-252AA (D Package) – DPAK Surface Mount



Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.94	1.09	0.037	0.043
B	5.97	6.22	0.235	0.245
C	2.69	2.87	0.106	0.113
D	5.21	5.41	0.205	0.213
E	6.48	6.73	0.255	0.265
F	0.69	0.84	0.027	0.033
G	2.21	2.36	0.087	0.093
H	2.16	2.41	0.085	0.095
I	4.47	4.67	0.176	0.184
J	0.46	0.58	0.018	0.023
K	0.90	1.00	0.035	0.039
L	0.46	0.58	0.018	0.023
M	0.00	0.10	0.000	0.004
N	0.53	0.69	0.021	0.027
O	0°	5°	0°	5°
P	1.06	1.32	0.042	0.052
Q	0.86	1.11	0.034	0.039

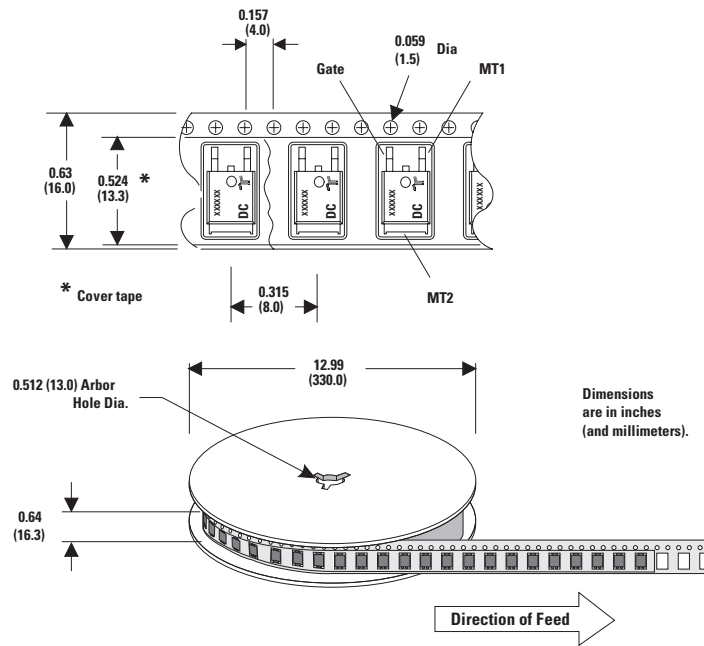
Reel Pack (RP) Specifications (TO-263 Embossed Carrier)

Meets all EIA-481-2 Standards



Reel Pack (RP) Specifications (TO-252 Embossed Carrier)

Meets all EIA-481-2 Standards



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