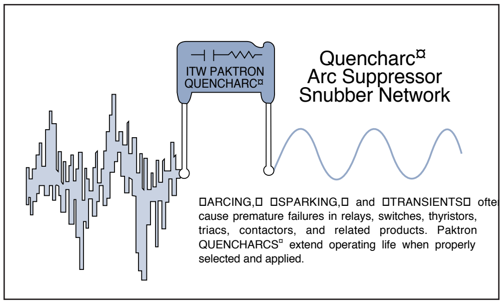
Arc Suppressor
Snubber Network

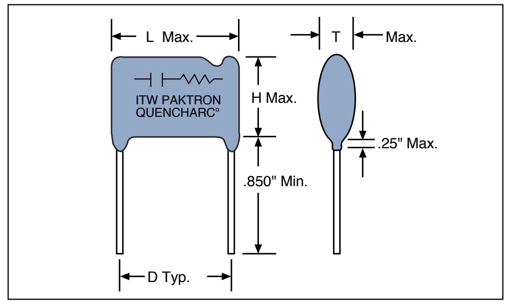
Q/QRL

UL/CSA version

QUENCHARC®

- **Relay contact protection • Noise reduction on controllers/drivers**
- **dv/dt suppression on thyristor and triacs • EMI/RFI reduction**
- **No lag time in suppression • Available voltages: 125 VAC - 660 VAC**
- **Type QRL – UL/CSA version**

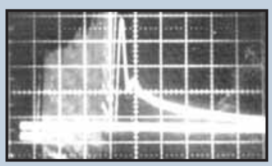




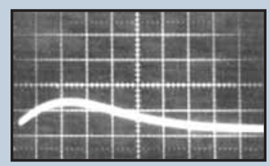
PF CODE	µF ± 20%	VOLTAGE	TYPE	OHMS ±10%	WATT	T	H	L	D
104	.1	600 VDC/250 VAC	QC	**22** ,**47**, **100**, 150, 220, 330	1/2	.39	.66	1.08	.82
104	.1	1200 VDC/480VAC	QH	**39**	2	.64	1.04	1.60	1.29
104	.1	1600 VDC/660VAC	QV	**39**	2	.54	1.00	2.18	1.80
254	.25	600 VDC/250 VAC	QD	22, 47, 100, 150	1/2	.42	.75	1.45	1.20
504	.5	600 VDC/250 VAC	QE	22, 47, 100, 150	1/2	.59	.92	1.45	1.20
504	.5	200 VDC/125 VAC	QA	22, 47, **100**, **220**	1/2	.37	.64	1.08	.82
105	1.0	200 VDC/125 VAC	QB	22, **47**	1/2	.39	.66	1.45	1.20
UL/CSA Recognized Across-the-Line Application				NOTE: Type QRL complies with UL1414/CSA-C22.2 No. 1					
104	.1	125 VAC	QRL	**150**, 680	1/2	.44	.66	1.08	.82

Preferred values available from stock are shown in **bold** type.

VOLTAGE WAVEFORM

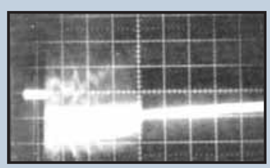


UNSUPPRESSED
100V/div .1ms/div

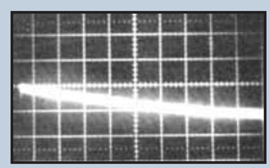


SUPPRESSED
100V/div .5ms/div

CURRENT WAVEFORM



UNSUPPRESSED
100V/div .1ms/div



SUPPRESSED
100V/div .1ms/div

HOW TO ORDER

EXAMPLE: .1 µF ± 20% 600 VDC 100 Ohms =

QA QB QC QD QE QH QV

PF CODE	TOLERANCE	VOLTAGE	TYPE		RESISTOR	
104	M	06	QC		100	
	M = ± 20%	02 = 200 VDC/125 VAC	QA	QD	22	150
		06 = 600 VDC/250 VAC	QB	QE	39	220
		48 = 1200 VDC/480 VAC	QC	QV	47	330
		66 = 1600 VDC/660 VAC	QH		100	

HOW TO ORDER

EXAMPLE: .1 µF ± 20% 125 VAC 150 Ohms =

QRL

PF CODE	TOLERANCE	VOLTAGE	TYPE	RESISTOR
104	M	AC	QRL	150
104	M = ± 20%	AC = 125 VAC	QRL	150 680

Type QRL: UL Recognized for 125 VAC across-the-line. UL File No. E33628.
CSA Certified for 125 VAC across-the-line. CSA File No. LR32208.

HOW QUENCHARC® WORKS

The most popular and commonly used method of arc suppression is to connect a resistor-capacitor network as shown in Figures A and B. The preferred method of connection is across the contacts it wants to protect. However, the network can be hooked across the load, as is shown by the dashed line, when all inductance of the load circuit is considered lumped together.

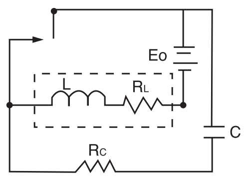


Figure A

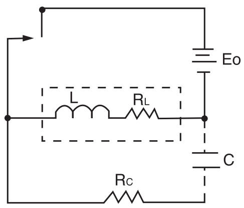


Figure B

When the contacts open, the voltage across the uncharged capacitor is zero and the transient voltage starts charging the capacitor. In the meantime, the gap of the contact is steadily widened, and by the time the capacitor is charged to its full potential, the contact gap is widened well beyond the minimum breakdown potential of air, thus preventing the arcing. When the contact closes, the inrush current from the capacitor may damage the contact, and here resistance is needed to limit the maximum current to Eo/Rc during the contact closure.

The induced voltage on opening the contact is

$$V = IR_C = \frac{R_C}{R_L} E_o \qquad (1)$$

and, as can be seen, the larger the value of a series resistor, the higher the induced voltage. On the other hand, the lower series resistance makes the current on contact closure higher. The time dependence of the voltage is given by:

$$V(t) = L\frac{di}{dt} + (R_L + R_C)i + E_o + \frac{1}{C}\int_0^t i\,dt$$

and the rate of voltage change, which is important in transient suppression of triac switching, is:

$$\frac{dv}{dt} = L\frac{d^2 i}{dt^2} + (R_L + R_C)\frac{di}{dt} + \frac{i}{C}$$

Equation (3) tells us that by knowing the circuit conditions with given values of L and coil resistance that limit the current prior to contact opening, the rate of voltage rise is inversely proportional to capacitance. In other words, the larger the capacitance, the greater is the transient suppression. However, when the contact closes, the additional energy stored in the capacitor has to be discharged through the contact. Hence, a compromise has to be made in the selection of both resistance and capacitance.

In an effort to provide a simple answer to designers' requests for proper values of resistance and capacitance, some relay manufacturers came out with empirical formulas and nomographs. For instance, C.C. Bates[1] gives the equations

$$C = \frac{I^2}{10} \qquad R = \frac{E_o}{10I\left(1 + \frac{50}{E_o}\right)}$$

where
C = capacitance in µF
I = load current in amperes prior to contact opening
R = resistance in ohms in series with capacitor
E_o = source voltage

The choice of resistance and capacitance value however, is quite flexible. In fact, the choice is so simple that one does not need a nomograph at all. Besides, a nomograph published by a certain relay manufacturer may be for the particular relays the firm manufactures, not necessarily universal.

[1] Bates, C.C., "Contact Protection of Electromagnetic Relays." *Electro-mechanical Design*, August, 1966.

CHOOSING A QUENCHARC®

In choosing a Quencharc®, first of all, check the maximum switching current rating of the contacts to be protected. This value differs for different types of contact materials and different types of relays. The maximum current during the contact closure with an RC network is E_O/R_C, where E_O is the source voltage and R_C is the resistance value of the network. The quantity E_O/R_C must be lower than the maximum switching current for obvious reasons. Next, the selection of capacitance is best done with an oscilloscope.

Connect the oscilloscope probe to the relay wiper and ground the other plate of the contact. Without an RC network across the contacts, check the amplitude of the transient voltage on contact break and the amplitude of the current on contact make. If the voltage is less than 300V and the current less than the maximum switching current rating of the relay, and if you don't see any arcing, you may not need the contact protection at all. If you spot arcing, connect a .1 µF + 100 ohm, 250 VAC, QC100 (our most widely used Quencharc®), across the contacts, and observe the levels of suppression, voltage on break and current on make. The suppressed voltage should be below 250V, which provides 70 volts of safety margin from the breakdown potential of air. If the voltage is still above 250V, try a .25 µF + 220 ohms or a .5 µF + 330 ohms range. If you need a higher capacitance than 1.0 µF, you may be better off with a Zener or a varistor in terms of cost and space. For most relays and triacs .1 µF + 100 ohms provides a satisfactory suppression.

When protecting contacts in AC circuits, the same general guidelines as for DC circuits can be used, but the wattage of the resistor must be considered if current flow is sustained for a long enough period of time to heat the component. Compute the impedance of the RC unit to obtain a current value, then use I^2R and time considerations to determine whether the standard network resistor is adequate.

OPERATING

TEMPERATURE RANGE
–55°C to +85°C at full rated voltage.

DISSIPATION FACTOR
The nominal dissipation factor is determined from the following equation:
$DF = 2\pi fCR + .006$
where:
f = test frequency in hertz
C = nominal capacitance value in farads
R = nominal value of series resistor in ohms.

DIELECTRIC WITHSTANDING VOLTAGE
Unit shall withstand a DC potential of 1.6 times the DC voltage rating. Testing conducted at 25°C.

DC LIFE TEST
Unit shall withstand a test potential of 125% of the rated voltage for a period of 500 hours at a temperature of 85°C. A failure shall consist of:
- Capacitance change greater than 5%.
- Dissipation factor greater than original limits.

LONG TERM STABILITY
The capacitance shall not change more than 2% when stored at ambient temperature and humidity for a period of 2 years or less.

PHYSICAL

TOLERANCE
Capacitor ± 20%, Resistor ± 10%.

CONSTRUCTION*
Metallized polyester capacitor in series with a carbon composition resistor.

CASE
Coated with a UL94V-0 flame retardant epoxy.

WIRE LEADS
100% Tin plated lead wires. #20 AWG (.032") capacitor end. #22 AWG (.025") resistor end.

MARKING
ITW, Quencharc®, capacitance, resistance, voltage.

* 39 ohm resistors are power wire-wound