Evans GROUP
PAKTRON

> For more information contact
paktron@evans-group.com

Quencharc Capacitor
RC Snubber Network
(Arc Suppression)

Q/QRL

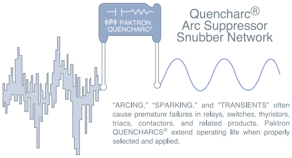
UL/CSA version

Energy Efficient Noise Suppression

- Relay contact protection
- dv/dt suppression on thyristor and triacs
- No lag time in suppression
- Type QRL – UL/CSA version
- Noise reduction on controllers/ drivers
- EMI/RFI reduction
- Available voltages: 125 VAC - 660 VAC
- RoHS-6 Compliant

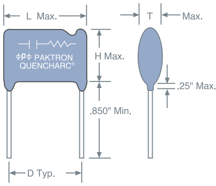
Electrical Schematic

Non-polarized

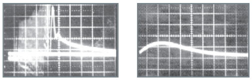


Quencharc®
Arc Suppressor
Snubber Network

"ARCING," "SPARKING," and "TRANSIENTS" often cause premature failures in relays, switches, thyristors, triacs, contactors, and related products. Paktron QUENCHARCS® extend operating life when properly selected and applied.



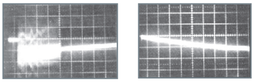
VOLTAGE WAVEFORM



UNSUPPRESSED
100V/div .1ms/div

SUPPRESSED
100V/div .5ms/div

CURRENT WAVEFORM



UNSUPPRESSED
100V/div .1ms/div

SUPPRESSED
100V/div .1ms/div

PF Code	Value µF	Voltage VDC/VAC	Type	Ohms ±10%	Watt	L MAX	T MAX	H MAX	D Typical	Part Number
104	0.1	600 / 250	QC	22	0.5	1.08 (27.4)	0.39(9.9)	0.66 (16.7)	0.82 (20.8)	104M06QC22
104	0.1	600 / 250	QC	47	0.5	1.08 (27.4)	0.39(9.9)	0.66 (16.7)	0.82 (20.8)	104M06QC47
104	0.1	600 / 250	QC	100	0.5	1.08 (27.4)	0.39(9.9)	0.66 (16.7)	0.82 (20.8)	104M06QC100
104	0.1	600 / 250	QC	150	0.5	1.08 (27.4)	0.39(9.9)	0.66 (16.7)	0.82 (20.8)	104M06QC150
104	0.1	600 / 250	QC	220	0.5	1.08 (27.4)	0.39(9.9)	0.66 (16.7)	0.82 (20.8)	104M06QC220
104	0.1	600 / 250	QC	330	0.5	1.08 (27.4)	0.39(9.9)	0.66 (16.7)	0.82 (20.8)	104M06QC330
104	0.1	1200 / 480	QH	39	2.0	1.60(40.6)	0.64(16.3)	1.04(26.4)	1.29(32.7)	104M48QH39
104	0.1	1600 / 660	QV	39	2.0	2.18(55.3)	0.54(13.7)	1.00(25.4)	1.80(45.7)	104M66QV39
254	0.25	600 / 250	QD	22	0.5	1.45(36.8)	0.42(10.6)	0.75(19.0)	1.20(30.5)	254M06QD22
254	0.25	600 / 250	QD	47	0.5	1.45(36.8)	0.42(10.6)	0.75(19.0)	1.20(30.5)	254M06QD47
254	0.25	600 / 250	QD	100	0.5	1.45(36.8)	0.42(10.6)	0.75(19.0)	1.20(30.5)	254M06QD100
254	0.25	600 / 250	QD	150	0.5	1.45(36.8)	0.42(10.6)	0.75(19.0)	1.20(30.5)	254M06QD150
504	0.5	600 / 250	QE	22	0.5	1.45(36.8)	0.59(15.0)	0.92(23.4)	1.20(30.5)	504M06QE22
504	0.5	600 / 250	QE	47	0.5	1.45(36.8)	0.59(15.0)	0.92(23.4)	1.20(30.5)	504M06QE47
504	0.5	600 / 250	QE	100	0.5	1.45(36.8)	0.59(15.0)	0.92(23.4)	1.20(30.5)	504M06QE100
504	0.5	600 / 250	QE	150	0.5	1.45(36.8)	0.59(15.0)	0.92(23.4)	1.20(30.5)	504M06QE150
504	0.5	200 / 125	QA	22	0.5	1.08(27.4)	0.37(9.4)	0.64(16.3)	0.82(20.8)	504M02QA22
504	0.5	200 / 125	QA	47	0.5	1.08(27.4)	0.37(9.4)	0.64(16.3)	0.82(20.8)	504M02QA47
504	0.5	200 / 125	QA	100	0.5	1.08(27.4)	0.37(9.4)	0.64(16.3)	0.82(20.8)	504M02QA100
504	0.5	200 / 125	QA	220	0.5	1.08(27.4)	0.37(9.4)	0.64(16.3)	0.82(20.8)	504M02QA220
105	1.0	200 / 125	QB	22	0.5	1.45(36.8)	0.39(9.9)	0.66(16.7)	1.20(30.5)	105M02QB22
105	1.0	200 / 125	QB	47	0.5	1.45(36.8)	0.39(9.9)	0.66(16.7)	1.20(30.5)	105M02QB47

Dimensions in inches, metric (mm) in parenthesis.

UL/CSA Recognized Across-the-Line Application

Note: Complies with IEC 60384 1:2008 Ed. 4.0

104	0.1	125 VAC	QRL	150	0.5	1.08(27.4)	0.44(11.18)	0.66(16.7)	0.82(20.8)	104MACQRL150
104	0.1	125 VAC	QRL	680	0.5	1.08(27.4)	0.44(11.18)	0.66(16.7)	0.82(20.8)	104MACQRL680

Type QRL: ANSI/UL 60384 14 2017 in conjunction with as referenced in ANSI/UL 60384 14 2017 IEC 60384 1:2008 Ed. 4.0 UL File# E33628 Vol. 3 CSA Certified to CAN/CSA E60384 14:14 in conjunction with CAN/CSA E60384 1:14 CSA MC #169069

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.

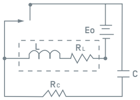


Figure A

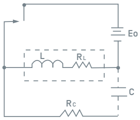


Figure B

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:

[1]

$$V = IR_C = \frac{R_C}{R_L} E_o$$

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:

[2]

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

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

[3]

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

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. Bates1 gives the equations:
where

[4]

$$C = \frac{I^2}{10} \qquad R = \frac{E_o}{10\,I\,[1 + \frac{50}{E_o}]}$$

C = capacitance in μF
I = load current in amperes prior to contact opening
R = resistance in ohms in series with capacitor
Eo = 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.

1Bates, C.C., "Contact Protection of Electro-magnetic 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_oR_c where E_o is the source voltage and Rc 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 0.1 μF + 100Ω, 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 0.25 μF + 220Ω or a 0.5 μF + 330Ω 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 0.1 μF + 100Ω 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.

Electrical

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

DISSIPATION FACTOR
The nominal dissipation factor is determined from the following equation:
DF = 2PifCR + 0.006
where:
f = test frequency in hertz
C= nominal capacitance value in farads
R = nominal value of series resistor in Ω.

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

Physical

TOLERANCE
Capacitor ± 20%, Resistor ± 10%.

CONSTRUCTION*
Metallized polyester capacitor
Legacy version resistor construction: Carbon composition updated version resistor construction: Carbon Film**
* 39Ω resistors are power wire-wound
**updated version indicated by "-" after value marking on part

CASE
Coated with a UL94V-0 flame retardant epoxy.

WIRE LEADS
#20 AWG (0.032") capacitor end.
Resistor end 0.025" to 0.032".

MARKING
╪P╪ Quencharc®, capacitance, resistance, voltage.

Evans GROUP Trusted Brands. Single Source.
Hi-Rel Capacitors for Mission Critical Systems.

Uniting four industry leaders—Evans, Paktron, UTC, and Eulex—Evans Group delivers the industry's most specialized and comprehensive capacitor portfolio.
Together, we provide power-dense, high-reliability solutions engineered for mission-critical environments across defense, aerospace, energy, and advanced RF systems.