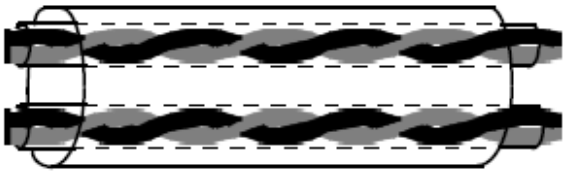
Tech Talk January 2012

Drive Wiring for Immunity — Guidelines

Since this is the beginning of a New Year I thought it would be a good idea to go over some safe practices for wiring industrial controls and in particular AC Drives.
All AC & DC Drives have a dual nature. They are 'noise' generators and create EMI (Electromagnetic Interference) while at the same time they are susceptible to 'noise' and need immunity from it. The guidelines below will increase the drive immunity by following these time tested rules. If you have never experienced nuisance tripping of a drive due to some form of noise you are indeed fortunate and those that have experienced this will attest to the absolute inconvenience of of it when it happens. 'Noise' can affect microprocessor controlled devices,analog devices and encoder and registration interfaces.

1.Control Wiring

All control signals (4-20mA, 0-10v,dc tachs) must use twisted shielded cable. I recommend a double shielded twisted pair cable as the best selection for low voltage digital and analog signals. See Alpha Xtra-Guard cable #5162C (18 ga, 2cond,braid + foil) or Belden #8760 (18 ga,2 cond, foil). Twisting the signal wire with its return wire reduces disturbances caused by inductive coupling.
Pairs should be twisted as close to terminals as possible.



Note: Never mix 24 VDC and 115/230 VAC in the same cable. All control signals must be separated from power wiring. Power wiring includes any AC and DC voltages with a current potential of greater than 1 amp or voltage greater than 24 volts,such as 115 VAC, 230 VAC, 460 VAC, armatures, fields, and ignition wires. Never use a shielded cable with leftover conductors. These act as antennae. Attempting to tie them to ground or other signals just creates different antenna configurations. Always ensure that a shielded cable with the correct number of conductors is pulled.
Always connect the shields of the control cables to a ground terminal at both ends of the control cable.

2.Encoders

Encoder cables should be twisted pair ,with overall shield. Individual shielded twisted pair with overall shield would provide the highest level of noise immunity. Try to use the encoder cable recommended by the encoder manufacturer.

Typical Wire Selection Chart for 18 ga,multiple pair,individually shielded		
	Belden	Alpha
2 pair	9368	5620B 1802
3 pair	9773 or 9369	6445
4 pair	9388	6444
3 conductor	9365	5640B 1801

Or equivalent in another Manufacturer

continued……. ⟶

3.Conduits and Wires in Enclosure

Encoder cables should always be run in a separate conduit from power cables.
Best practices call for a separate conduit for signal cables, a separate conduit for power cables.
Run wires along the metal surface and avoid wires hanging in free air,which can become an antenna.
Do not bundle cables and power wiring within the same Panduit,Conduit or Wire Trays.
Keep power and control wiring separate, avoid parallel running of power cables and signal cables. The distance between power and control cables should be 300 mm at least. When control cables must cross power cables, make sure this is done at an angle as near to 90 degrees as possible.

4.Enclosures

Do not use the enclosure as a ground. The enclosure should be properly connected to a ground line. Remove all paint or finish from the enclosure at any point that will be for metal-to-metal contact of the equipment inside the enclosure. I recommend the use of enclosure back panels made of unpainted galvanized or zinc plated steel plate. This type of back plate provides an equipotential mass connection between all devices on the enclosure.

5.Terminal Blocks

Keep wires twisted as near the terminal as possible.
Earthing connections should be as short as possible in flat strip,multi stranded or braided flexible conductors for low RFI impedance. Use bare grounding terminals similar to Woertz .

6.Suppressors

AC operated relays, contactors and solenoid valves in the panel or close by must be fitted with R-C Snubbers (spark quenchers) across their coils or inline contacts (a better solution) to suppress the inductive kick when these devices are de-energized. A good general purpose snubber we use is a part No. 104M06QC100, for Mouser it is #539-104M06QC100
For 24 VDC contact suppression, on their solenoid, contactor and relay coils we should use a flyback diode. Schottky diodes are preferred in flyback diode applications, because they have the lowest forward drop ((~0.2 V rather than >0.7 V for low currents) . The diode should br reverse-biased.

7.Motors

Motor cabling should have a ground lead connected from the frame of the motor to the ground connection on the drive. In some cases the motor conduit box does not provide a sufficient ground connection to the frame of the motor. A properly sized ground conductor should be connected from a motor frame bolt to the common ground termination point in the motor conduit box.

8.Incoming AC Line

To protect the drive from abnormalities in the incoming power to the drive, it is recommended to use a Drive Isolation Transformer if it is equipped with one or more electrostatic shields, or at a minimum an input line reactor. See here for previous article on line reactors
If drive is not fitted with an input line filter for RFI suppression, then one should be used, similar to these offered by Block Model HLD 810 or HLD 110.

- *****Always read the drive manufacturers manual for specific wiring details prior to wiring of the drive.**

Holland Industrial, 518 West Montgomery Street, Henderson, NC., 27536
Tel: 1-800-232-7541,Fax 1-252-492-2444, E-Mail: sales @ hollandindustrial.com

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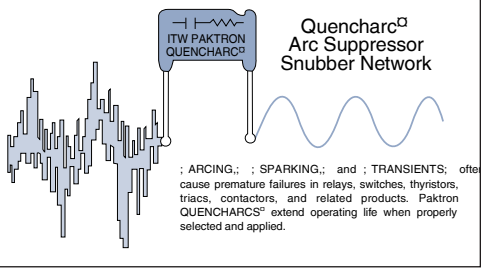
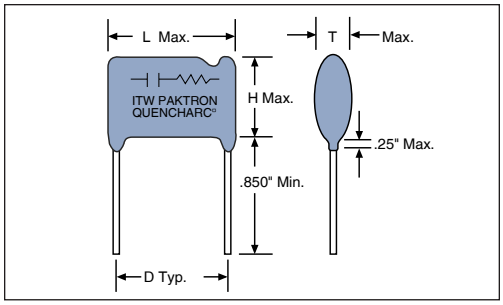
Arc Suppressor
Snubber Network

Q/QRL

UL/CSA version

- 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

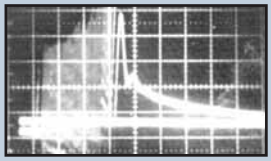




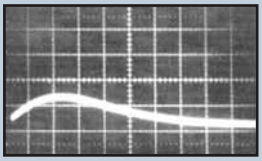
PF CODE	F ± 20%	VOLTAGE	TYPE	OHMS ± 10%	WATT	T	H	L	D
104	.1	600 VDC/250 VAC	QC	22 ,47, 100, 150, 220, 330					
	1/2 .39		.66	1.08	.82				
104	.1 1.29	1200 VDC/480VAC	QH	39	2	.64	1.04	1.60	
104	.1 1.80	1600 VDC/660VAC	QV	39	2	.54	1.00	2.18	
254	.25 .75	600 VDC/250 VAC 1.45	1.20	QD	22, 47, 100, 150	1/2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

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

VOLTAGE

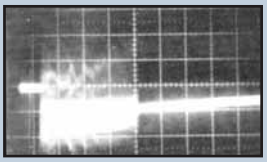


UNSUPPRESSED
100V/div .1ms/div

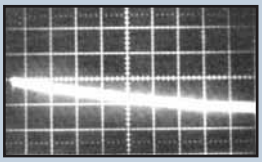


SUPPRESSED
100V/div .5ms/div

CURRENT



UNSUPPRESSED
100V/div .1ms/div



SUPPRESSED
100V/div .1ms/div

HOW TO ORDER EXAMPLE: .1 ßF ± 20% 600 VDC 100 Ohms =

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

HOW TO ORDER EXAMPLE: .1 ßF ± 20% 125 VAC 150 Ohms =

QRL	104	M	AC	QRL	150
	PF CODE	**TOLERANCE**	**VOLTAGE**	**TYPE**	**RESISTOR**
	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.

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HOW

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.

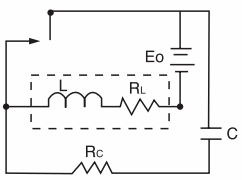


Figure A

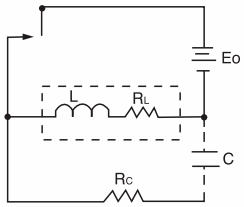


Figure B

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

$$V = Rc = \frac{Rc}{RL} E_o \qquad (1)$$

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:

$$V(t) = L\frac{di}{dt} + (RL + Rc)i + E_o + \frac{1}{C}\int_o^t i\,dt$$

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

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

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

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

where
C = capacitance in F
= 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 the contact protection at all. If you spot arcing, connect a .1 F + 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 F + 220 ohms or a .5 F + 330 ohms range. If you need a higher capacitance than 1.0 F, you may be better off with a Zener or a varistor in terms of cost and space. For most relays and triacs .1 F + 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

MALLORY Metallized Polyester Film Capacitors

CDE CORNELL DUBILIER

RoHS Compliant This product is RoHS compliant.

MALLORY® Cornell Dubilier Electronics, Inc.

QUENCHARC® ARC SUPPRESSOR / SNUBBER NETWORKS

RoHS Compliant

Features:

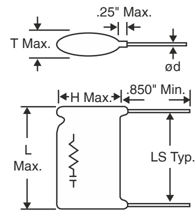
- L ds' kkydc Onkxdr sdq B' o' blsnq hmr dqhdr v hsg ' b' qanmbnl onrhshnmqdr hrsnq
- Ek l d Qds' qc' ms donwx bn' sdc b' r d

Specifications:

- Nodq shmf Sdl odq st qd9-44¯B sn +74¯B
- B' o' bhs' mbd Snkdq mbd9 ı 1/ %
- Qdr hrs' mbd Snkdq mbd9 ı 0/ %

Applications:

- Mnhrd ' mc @qb Rt oqdr r hnm
- QB Rmt aadq Mdsv nqj
- Qdk' x Bnms' bs Oqnsdbshnm
- DL H.QEH Qdct bshnm
- Mnhrd qdct bshnmnm Bnmsqnkdqr .Cqhudqr



DIMENSIONS: in.

For quantities of 200 and up, call for quote.

MOUSER STOCK NO.	Mallory Part No.	U' kt d (ße)	Qdr hrsnq		Chl dmrhmmr9l l				Price Each			
			V ' ssr	()	V	S	G	KR	1	25	50	100
200 VDC (125VAC)												
539504M02QA100	4/ 3L / 1P @0/ /	4/	/ 4	0/ /	163	83	052	1/ 7	6.66	5.29	5.05	4.51
539504M02QA220	4/ 3L / 1P @11/	4/	/ 4	11/	163	83	052	1/ 7	6.66	5.29	5.05	4.51
539105M02QB47	0/ 4L / 1P A36	0	/ 4	36	257	88	057	2/ 4	7.77	6.61	5.90	5.74
600 VDC (250VAC)												
539104M06QC22	0/ 3L / 5P B11	0/	/ 4	11	163	88	057	1/ 7	5.08	4.65	4.29	4.05
539104M06QC47	0/ 3L / 5P B36	0/	/ 4	36	163	88	057	1/ 7	5.08	4.65	4.29	4.05
539104M06QC100	0/ 3L / 5P B0/ /	0/	/ 4	0/ /	163	88	057	1/ 7	5.08	4.65	4.29	4.05
539104M06QC150	0/ 3L / 5P B04/	0/	/ 4	04/	163	88	057	1/ 7	6.47	5.49	4.92	4.78
539104MACQRL150	0/ 3L @BP QK04/	0/	/ 4	04/	163	001	057	1/ 7	6.80	5.78	5.17	5.03

MALLORY® Cornell Dubilier Electronics, Inc.

SUPPRESSOR METALLIZED POLYESTER FILM 158X SERIES TYPE X2

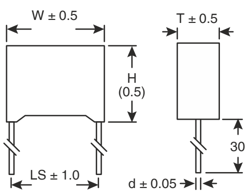
RoHS Compliant

Features:

- TK ' mc BR@ @oqnudc
- Ek l d qpls' qc' ms b' r d l dds TK 83U/
- Onkxt qdsg' md dmc êkkl dds TK 83U/
- Trdc hm ' ookhb' shnmr v gdqd c' l ' f d sn sgd b' o' bhsnq v hkk mns kd' c sn sgd c' mf dq nedkdbsqhb' kr gnbj

Specifications:

- Nodq shmf sdl odq st qd9 -3/ ¯B sn +0/ / ¯B
- Unks' f d q mf d9 14/ U r ms
- Snkdq mbd9 ı 1/ %
- Kd' c l ' sdqh k9 shmmdc bnoodq bk' c r sddk



For quantities of 1000 and up, call for quote.

MOUSER STOCK NO.	Mallory Part No.	U' kt d (ße)	Chl dmrhmmr9l l					Price Each			
			V	S	G	KR	c	1	50	100	500
539158X103	047W0/ 2	/ 0/	06/	4/	01/	04/	/ 5	.83	.73	.671	.523
539158X223	047W112	/ 11	06/	4/	01/	04/	/ 5	.83	.73	.671	.523
539158X333	047W222	/ 22	06/	4/	01/	04/	/ 5	1.00	.91	.808	.647
539158X473	047W362	/ 36	06/	44	014	04/	/ 7	.86	.77	.693	.543
539158X104	047W0/ 3	0/ /	06/	7/	04/	04/	/ 7	.81	.75	.717	.682
539158X224	047W113	11/	14/	7/	064	114	/ 7	1.46	1.31	1.17	.931
539158X334	047W223	22/	14/	0/ /	084	114	/ 7	2.06	1.87	1.66	1.32
539158X474	047W363	36/	2/ /	00/	11/	164	/ 7	2.14	1.93	1.71	1.46
539158X684	047W573	57/	2/ /	024	134	164	/ 7	3.06	2.76	2.44	1.97
539158X105	047W0/ 4	0/	2/ 4	04/	134	164	0/	4.53	4.07	3.63	2.90
539158X225	047W114	11	30/	064	217	264	0/	9.07	8.17	7.25	5.79

MALLORY® Cornell Dubilier Electronics, Inc.

METALLIZED POLYESTER FILM, RADIAL

Dwbdkkdms bgnhbd enq f dmdq kot qpnrd ' ookhb' shnmr rt bg ' r aknbj hmf , axo' rr, cdbnt okhmf , rl nnsghmf ' mc rnl d sh hmf , dmdqf x rsnq f d.chrbg' qf d ' mc ' qb rt ooqdr rhnm

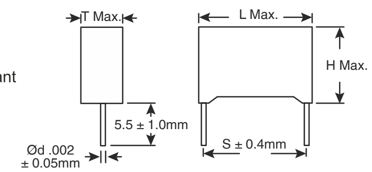
Features:

- Mnm-Onk' q
- Knv kd' j ' f d
- Mnmhmct bshudkx v nt mc
- Donwx Dmb' ort kdms l dds TK83U-/
- Ek l d qpls' qc' ms b' r d l dds TK83U-/

Specifications:

- Unks' f d q mf d905/ rdqhdr - 52U sn 54/ U
  057 rdqhdr - 4/ sn 3/ / U
- B' o' bhs' mbd q mf d905/ rdqhdr - / / 22t E sn 22t E
  057 rdqhdr - / / 0t E sn 0t E
- Nodq shmf sdl odq st qd9-44¯B sn +014¯B
- Snkdq mbd94%,0/ %

RoHS Compliant



For quantities of 1000 and up, call for quote.

MOUSER STOCK NO.	Mallory Part No.	Ucb.U' b	U' kt d (ßE)	Snk ı	Chl dmrhmmr9l l					Price Each			
					K	H	G	R	÷c	1	50	100	500
160 Series													
539160474K63DF	05/ 363J 52C-E	52.3/	/ 36	0/ %	02	4	00	0/	/ 7	.81	.75	.676	.575
539160105J63EF	05/ 0/ 4I 52D-E	52.3/	0/	4%	02	5	01	0/	/ 7	1.50	1.39	1.26	1.08
539160104K100CF	05/ 0/ 3J 0/ / B-E	0/ / .52	/ 0	0/ %	02	3	84	0/	/ 7	.65	.61	.547	.48
539160224K100DF	05/ 113J 0/ / C-E	0/ / .52	/ 11	0/ %	02	4	00	0/	/ 7	.55	.51	.47	.402
539160224J100DF	05/ 113I 0/ / C-E	0/ / .52	/ 11	4%	02	4	00	0/	/ 7	.57	.53	.468	.40
539160334J100EF	05/ 223I 0/ / D-E	0/ / .52	/ 22	4%	02	5	01	0/	/ 7	.66	.61	.56	.476
539160474K100FF	05/ 363J 0/ / E-E	0/ / .52	/ 36	0/ %	02	5	01	0/	/ 7	.81	.76	.679	.564
539160105K100HF	05/ 0/ 4J 0/ / G-E	0/ / .52	0/	0/ %	07	64	024	04	/ 7	1.28	1.20	1.08	.923
539160335K100OF	05/ 224J 0/ / N-E	0/ / .52	22	0/ %	154	0/	08	114	/ 7	2.80	2.34	2.12	1.91
539160333K250CF	05/ 222J 14/ B-E	14/ .05/	/ / 22	0/ %	02	3	824	0/	/ 7	.66	.63	.55	.47
539160473K250CF	05/ 362J 14/ B-E	14/ .05/	/ / 36	0/ %	02	3	824	0/	/ 7	.69	.66	.583	.503
539160104J250DF	05/ 0/ 3I 14/ C-E	14/ .05/	/ 0	4%	02	4	00	0/	/ 7	.51	.48	.398	.362
539160104K250DF	05/ 0/ 3J 14/ C-E	14/ .05/	/ 0	0/ %	02	4	00	0/	/ 7	.49	.43	.397	.349
539160224J250FF	05/ 113I 14/ E-E	14/ .05/	/ 11	4%	07	4	00	04	/ 7	.67	.64	.576	.485
539160334J250GF	05/ 223I 14/ F -E	14/ .05/	/ 22	4%	07	5	01	04	/ 7	.88	.82	.733	.64
539160105K250NF	05/ 0/ 4J 14/ M-E	14/ .05/	0/	0/ %	154	74	06	114	/ 7	1.70	1.58	1.44	1.22
539160335J250QF	05/ 224I 14/ P-E	14/ .05/	22	4%	21	02	114	164	/ 7	4.32	3.59	3.27	2.94
539160104J400GF	05/ 0/ 3I 3/ / F -E	3/ / .1/ /	/ 0	4%	07	5	01	04	/ 7	.81	.75	.68	.578
539160103K630CF	05/ 0/ 2J 52/ B-E	52/ .11/	/ / 0	0/ %	02	3	84	0/	/ 7	.69	.65	.591	.50
539160103J630CF	05/ 0/ 2I 52/ B-E	52/ .11/	/ / 0	4%	02	3	84	0/	/ 7	.77	.71	.649	.545
539160104J630LF	05/ 0/ 3I 52/ K-E	52/ .11/	/ 0	4%	154	5	04	114	/ 7	1.46	1.36	1.24	1.05
539160222J1000CF	05/ 111I 0/ / / B-E	0/ / / .14/	/ / / 11	4%	02	3	84	0/	/ 7	.44	.40	.362	.316
539160104J1000NF	05/ 0/ 3I 0/ / / M-E	0/ / / .14/	/ 0	4%	154	74	06	114	/ 7	1.78	1.67	1.50	1.27
168 Series													
539168224J50CF	057113I 4/ B-E	4/ .2/	/ 11	4%	61	24	64	4	/ 5	.55	.50	.452	.384
539168105J50GF	0570/ 4I 4/ F -E	4/ .2/	0	4%	61	5	00	4	/ 5	1.20	1.11	.973	.856
539168104J63AF	0570/ 3I 52@E	52.3/	/ 0	4%	61	14	54	4	/ 5	.38	.36	.314	.278
539168224J63CF	057113I 52B-E	52.3/	/ 11	4%	61	24	64	4	/ 5	.60	.53	.486	.452
539168334K63HF	057223J 52G-E	52.3/	/ 22	0/ %	61	34	74	4	/ 5	.70	.60	.502	.377
539168474J63HF	057363I 52G-E	52.3/	/ 36	4%	61	34	74	4	/ 5	.96	.81	.689	.52
539168332J100AF	057221I 0/ / @E	0/ / .52	/ / / 22	4%	61	14	54	4	/ 5	.48	.42	.352	.273
539168472J100AF	057361I 0/ / @E	0/ / .52	/ / / 36	4%	61	14	54	4	/ 5	.35	.31	.284	.261
539168103J100AF	0570/ 2I 0/ / @E	0/ / .52	/ / 0	4%	61	14	54	4	/ 5	.41	.36	.302	.233
539168223J100AF	057112I 0/ / @E	0/ / .52	/ / 11	4%	61	14	54	4	/ 5	.46	.39	.33	.248
539168333J100CF	057222I 0/ / B-E	0/ / .52	/ / 22	4%	61	24	64	4	/ 5	.39	.36	.318	.273
539168473J100CF	057362I 0/ / B-E	0/ / .52	/ / 36	4%	61	24	64	4	/ 5	.58	.49	.413	.304
539168104J100HF	0570/ 3I 0/ / G-E	0/ / .52	/ 0	4%	61	34	74	4	/ 5	.48	.45	.383	.338

—Bnoxqfi gs 1/ 00 L nt r dq Dkdbsqnmbr

—Bnoxqfi gs 1/ 00 L nt r dq Dkdbsqnmbr

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Woertz-USA
151 Discovery Drive #111; Colmar, PA 18915
Tel: (215) 997-8855; Fax (800) 522-3868
email: woertz1@erols.com
www.woertz-usa.com

Down to Earth with Woertz

Heavy Duty Grounding Terminals

for Field and Factory Wiring

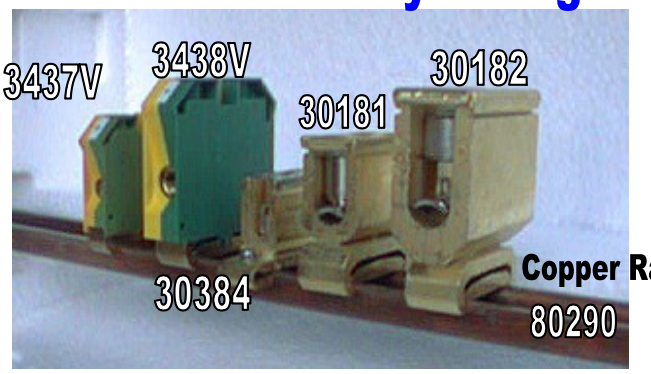
Features:

Ground blocks are made of solid brass with stainless steel screws and springs.

Wire sizes range from 24 AWG-300MCM

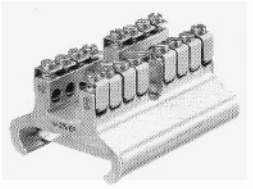
Insulated and Non-insulated terminals . available

UL and CE approvals *



Part No. 3433
Collector Terminal

Specifications on Featured Grounding Terminals

Please refer to the Woertz Catalog for additional grounding terminals. Pg.28-30 Pg.42-45 Pg.67-69 & 72,73	**Insulated**		**Non-insulated Collector Ground Terminals**				
			For Multi Conductors 				
AWG Connecting capacity	10-4 AWG	6-1/O AWG	4 x 6 AWG 2 x 4 AWG 2 x 2 AWG	3x2AWG 2x1/O AWG 2x2/O AWG	3x2/O AWG 2x3/O AWG 2x250MCM	1 terminal up to 4 AWG **8** additional connections up to 10AWG	1 terminal up to 4 AWG **16** additional connections up to 10AWG
			Strands or rigid stranded conductors			Strands or rigid stranded conductors	
			With pressure plat, with Allen screws				
Part No.	**3437V**	**3438V**	**30384**	**30181**	**30182**	**3433**	**3434**
Rated Current	AWG 4 2450A during 6 seconds	AWG 1/O 5050A during 9 seconds	AWG 2 3900A during 6 sec.	Exceeds Industry Standards		Exceeds Industry Standards	
Dimensions: (mm)							
Width	13	18	17	22	29	37	63.5
Length	55	60	34 (top); 50 (base)	42	58	48	48
Height	55	71	36.5	48.5	63.5	33.5	33.5
Accessories							
Marking accessories (see pg.. 1.80-1.90)	3958/.. RB/6x12	3958/.. RB/6x12					
Allen Key				**80243**	**80244**		

DIN 35 mm Rail Part No.: **80290;** Deep Copper Rail ; Dimensions: 35mmx15mm
(sold in 2 meter Lengths)

* Our line of Stringent Demand grounding blocks are UL approved for hazardous locations: Class I, Zones 0,1, and 2.

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HLD 110

Funk-Entstörfilter

ü Dreiphasig

ü Für erhöhte

HLD 110

Funk-Entstörfilter nach DIN EN 60939-2, UL 1283, CSA 22.2 No. 8

Umgebungstemperatur max. 50° C

Schutzklasse IP 20

C-UL-US Prüfzeichen

SCCR = 100 kA

Effiziente Filterwirkung gegen leitungsgeführte Störemissionen

Für die netzseitige Entstörung von Einzelgeräten, Frequenzumrichtern oder als Sammelentstörer

Störfestigkeitserhöhung der angeschlossenen Verbraucher

Sättigungsfeste Induktivitäten für

Radio interference suppression filter

ü Three-phase

ü For increased requirements

Radio interference suppression filter to DIN EN 60939-2, UL 1283, CSA 22.2 No. 8

Ambient temperature max. 50° C

Protection index IP 20

C-UL-US Approval

SCCR = 100 kA

Efficient filter effect against EMI

For the interference suppression on the line side of discrete equipments, frequency inverters or complex systems

Reduced interference for the connected consumer equipment and systems

Produktbez. Product Name	Bemessungs-Rated	Spannungs-Voltage	Bemessungs-Rated	Maße Dimensions
HLD 110-500/8	3 x 520 V 75/45/190	0 - 3 x 520 V	3 x 8 A	
HLD 110-500/12	3 x 520 V 75/45/220	0 - 3 x 520 V	3 x 12 A	
HLD 110-500/16	3 x 520 V 75/45/250	0 - 3 x 520 V	3 x 16 A	
HLD 110-500/30	3 x 520 V 95/55/270	0 - 3 x 520 V	3 x 30 A	
HLD 110-500/42	3 x 520 V 95/55/310	0 - 3 x 520 V	3 x 42 A	
HLD 110-500/55	3 x 520 V	0 - 3 x 520 V	3 x 55 A	

HLD 710

NEU N

Funk-Entstörfilter

ü Dreiphasig

ü Ableitstromarm <100 mA

ü Für höchste

HLD 710

Funk-Entstörfilter nach DIN EN 60939-2, UL 1283, CSA 22.2 No. 8

Umgebungstemperatur max. 50° C

Schutzklasse IP 20

C-UL-US Prüfzeichen

SCCR = 100 kA

Effiziente Filterwirkung gegen leitungsgeführte Störemissionen

Für die netzseitige Entstörung von Einzelgeräten, Frequenzumrichtern oder als Sammelentstörer

Störfestigkeitserhöhung der angeschlossenen Verbraucher

Sättigungsfeste Induktivitäten für

Radio interference suppression filter

ü Three-phase

ü Low leakage current <100 mA

ü For highest requirements

Radio interference suppression filter to DIN EN 60939-2, UL 1283, CSA 22.2 No. 8

Ambient temperature max. 50° C

Protection index IP 20

C-UL-US Approval

SCCR = 100 kA

Efficient filter effect against EMI

For the interference suppression on the line side of discrete equipments, frequency inverters or complex systems

Reduced interference for the connected consumer equipment and systems

Produktbez. Product Name	Bemessungs-Rated	Spannungs-Voltage	Bemessungs-Rated	Maße Dimensions
HLD 710-500/8	3 x 520 V 75/45/190	0 - 3 x 520 V	3 x 8 A	
HLD 710-500/12	3 x 520 V 75/45/220	0 - 3 x 520 V	3 x 12 A	
HLD 710-500/16	3 x 520 V 75/45/250	0 - 3 x 520 V	3 x 16 A	
HLD 710-500/30	3 x 520 V 95/55/270	0 - 3 x 520 V	3 x 30 A	
HLD 710-500/42	3 x 520 V 95/55/310	0 - 3 x 520 V	3 x 42 A	
HLD 710-500/55	3 x 520 V	0 - 3 x 520 V	3 x 55 A	

HLD 810

NEU N

Funk-Entstörfilter

ü Dreiphasig

ü für IT-Netze

ü Für hohe Anforderungen

HLD 810

Funk-Entstörfilter nach DIN EN 60939-2, UL 1283, CSA 22.2 No. 8

Umgebungstemperatur max. 50° C

Schutzklasse IP 20

C-UL-US Prüfzeichen

SCCR = 100 kA

Effiziente Filterwirkung gegen leitungsgeführte Störemissionen

Für die netzseitige Entstörung von Einzelgeräten, Frequenzumrichtern oder als Sammelentstörer im IT-Netz

Störfestigkeitserhöhung der angeschlossenen Verbraucher

Sättigungsfeste Induktivitäten für

Radio interference suppression filter

ü Three-phase

ü for IT-Networks

ü For high requirements

Radio interference suppression filter to DIN EN 60939-2, UL 1283, CSA 22.2 No. 8

Ambient temperature max. 50° C

Protection index IP 20

C-UL-US Approval

SCCR = 100 kA

Efficient filter effect against EMI

For the interference suppression on the line side of discrete equipments, frequency inverters or complex IT-Networks

Reduced interference for the connected consumer equipment and systems

Produktbez. Product Name	Bemessungs-Rated	Spannungs-Voltage	Bemessungs-Rated	Maße Dimensions
HLD 810-500/8	3 x 520 V 75/45/190	0 - 3 x 520 V	3 x 8 A	
HLD 810-500/12	3 x 520 V 75/45/220	0 - 3 x 520 V	3 x 12 A	
HLD 810-500/16	3 x 520 V 75/45/250	0 - 3 x 520 V	3 x 16 A	
HLD 810-500/30	3 x 520 V 95/55/270	0 - 3 x 520 V	3 x 30 A	
HLD 810-500/42	3 x 520 V 95/55/310	0 - 3 x 520 V	3 x 42 A	
HLD 810-500/55	3 x 520 V	0 - 3 x 520 V	3 x 55 A	

HFD 503

Funk-Entstörfilter

ü Dreiphasig

ü Für allgemeine

HFD 503

Funk-Entstörfilter nach DIN EN 60939-2

Umgebungstemperatur max 50° C

Effiziente Filterwirkung gegen leitungsgeführte Störemissionen

Für die netzseitige Entstörung von Einzelgeräten, Frequenzumrichtern oder als Sammelentstörer

Störfestigkeitserhöhung der angeschlossenen Verbraucher

Sättigungsfestes Filterdesign für

Radio interference suppression filter

ü Three-phase

ü For generalised requirements

Radio interference suppression filter to DIN EN 60939-2

Ambient temperature max. 50° C

Efficient filter effect against EMI

For the interference suppression on the line side of discrete equipments, frequency inverters or complex systems

Reduced interference for the connected consumer equipment and systems

Produktbez. Product Name	Bemessungs-Rated	Spannungs-Voltage	Bemessungs-Rated	Maße Dimensions
HFD 503-500/250	3 x 500 V 300/160/610	0 - 3 x 520 V	3 x 250 A	
HFD 503-500/300	3 x 500 V 300/160/610	0 - 3 x 520 V	3 x 300 A	
HFD 503-500/400	3 x 500 V 300/160/610	0 - 3 x 520 V	3 x 400 A	
HFD 503-500/500	3 x 500 V	0 - 3 x 520 V	3 x 500 A	

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HLV 110

Funk-Entstörfilter

ü Dreiphasig mit Neutralleiter

ü Fü r erhö hte Anforderungen

HLV 110-500/30

Funk-Entstö rfilter nach DIN EN 60939-2, UL 1283, CSA 22.2 No. 8 (nur 16 A)

Umgebungstemperatur max. 50°C

Schutzklasse IP 20

Effiziente Filterwirkung gegen leitungsgefü hrte Stö remissionen

Fü r die netzseitige Entstö rung von Einzelgerä ten, Frequenzumrichtern oder als Sammelentstö rer

Stö rfestigkeitserhö hung der angeschlossenen Verbraucher

Radio interference suppression filter

ü Three-phase with neutral conductor

ü For increased requirements

Radio interference suppression filter to DIN EN 60939-2, UL 1283, CSA 22.2 No. 8 (only 16 A)

Ambient temperature max. 50°C

Protection index IP 20

Efficient filter effect against EMI

For the interference suppression on the line side of discrete equipments, frequency inverters or complex systems

Increase of interference resistance of connected consumers

Produktbez. Product Name	Bemessungs- Rated	Spannungs- Voltage	Bemessungs- Rated	Maße Dimensions
HLV 110-500/8	3 x 520 Vac 55/75/190	0 - 3 x 520 Vac	3 x 8 A+N	
HLV 110-500/12	3 x 520 Vac 55/75/220	0 - 3 x 520 Vac	3 x 12 A+N	
HLV 110-500/16	3 x 520 Vac 55/75/220	0 - 3 x 520 Vac	3 x 16 A+N	
HLV 110-500/30	3 x 520 Vac 70/95/270	0 - 3 x 520 Vac	3 x 30 A+N	
HLV 110-500/42	3 x 520 Vac 70/95/270	0 - 3 x 520 Vac	3 x 42 A+N	
HLV 110-500/55	3 x 520 Vac	0 - 3 x 520 Vac	3 x 55 A+N	

SFA 400

NEU N

Allpoliges Sinusfilter

ü Lange geschirmte Motorzuleitungen mö glich

ü Hohe Lebensdauer und geringe Gerä uschemmission des angeschlossenen Motors

SFA 400

Ausgangsdrossel mit Kondensator fü r Frequenzumrichter nach IEC 61558-2-20, DIN EN 61558-2-20, VDE 0570 Teil 2-20

C-UL-US Prü fzeichen (bis 60 A) in Vorbereitung

Schaltfrequenz >=8kHz

Drehfeldfrequenz 5 - 60 Hz

Umgebungstemperatur max. 45°C

Verhinderung von Ü berspannungen am Motor

Lange Leitungslä ngen

Reduzierung der Motorverluste

All-Pole sinusoidal filter

ü Possibility of long shielded motor cables

ü High life expectancy and low noise of the connected motor

Output reactor with capacitor for frequency inverter to IEC 61558-2-20, DIN EN 61558-2-20, VDE 0570 part 2-20

C-UL-US Approval in preparation

Switching frequency >=8kHz

Frequency range 5-60 HzAmbient temperature max. 45°C

Y

Produktbez. Product Name	Bemessungs- Rated	Spannungs- Voltage	Bemessungs- Rated	Maße Dimensions
SFA 400/1,3	3 x 400 V 150/250/80	0 - 480 V	1,30 A	
SFA 400/2,5	3 x 400 V 150/250/80	0 - 480 V	2,50 A	
SFA 400/4	3 x 400 V 170/290/80	0 - 480 V	4,00 A	