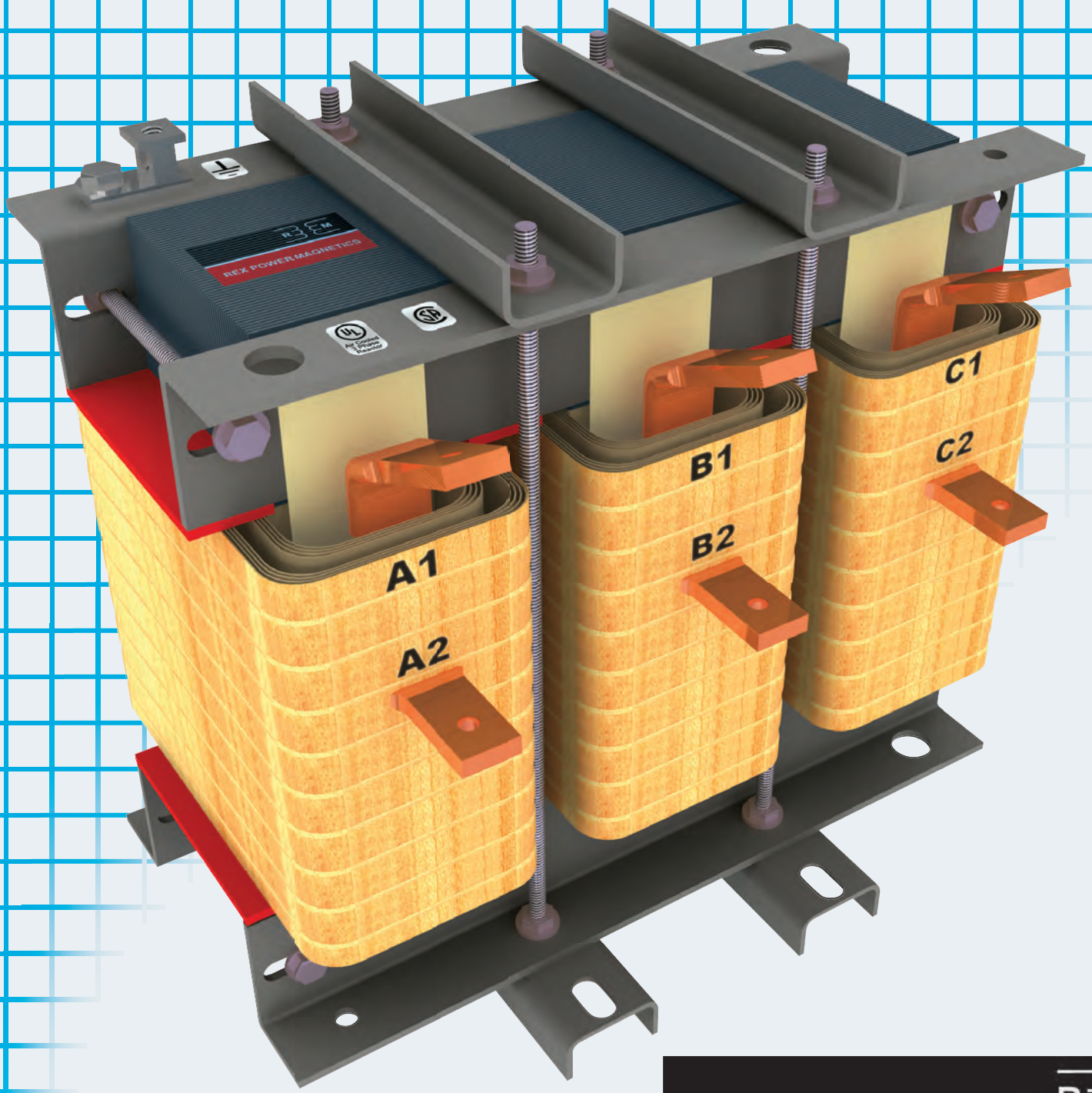
LINE REACTORS

INPUT REACTORS
OUTPUT REACTORS
MOTOR GUARDING TRANSIENT FILTERS



ISO 9001:2008

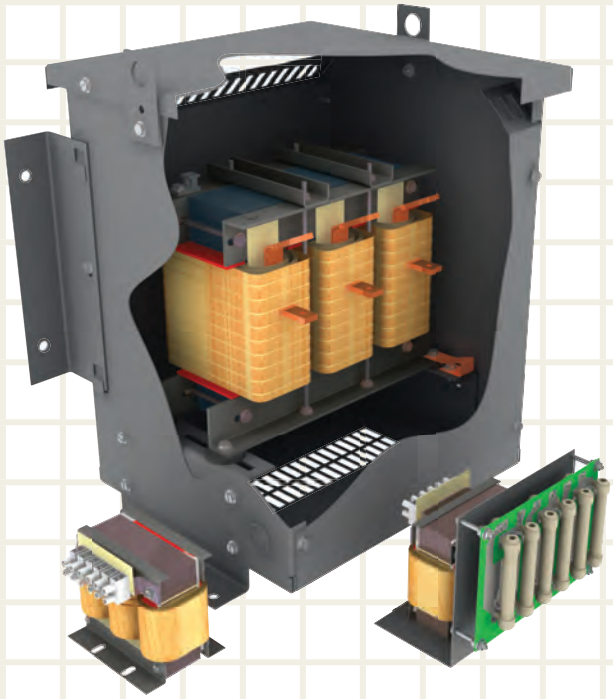
REM

A Division of Transfactor Industries Inc.
Concord, Ontario, Canada

REX POWER MAGNETICS

AC LINE REACTORS AND MOTOR GUARDING TRANSIENT FILTERS

REX POWER MAGNETICS LINE REACTORS ARE TODAY'S SOLUTION TO SCR DRIVE / INVERTER APPLICATION PROBLEMS



Inductors placed at the input and output of electrical equipment can provide protection and improve performance. Line Reactors absorb many power line disturbances which could damage or shut down your inverters, variable speed controllers, or other voltage-sensitive equipment.

- **Rex** Line Reactor designs conform to UL, CSA, and IEC international standards.
- Three phase AC line reactors when used as input or output filters on inverter electronic speed drive applications provide several significant benefits which are explained in this catalogue.
- **Rex** Motor Guarding Transient Filters incorporate reactors and resistors. When these devices are placed on the output of adjustable frequency drives they protect the motor windings from the damaging voltage spikes associated with the fast switching effects of IGBT's and long lines and cables.

FEATURES

- Easy to install
- High saturation levels
- Smaller and less expensive than isolation transformers
- Reduce harmful surge current
- Available in open or NEMA 1 enclosed construction
- Conforms to CSA, UL, and IEC standards
- Available in a wide range of standard ratings
- IS0 9001 registered quality system
- CE marking available

BENEFITS

- Reduce electrical line noise
- Protect and extend the life of S.C.R.'s and transistors
- Filter power line disturbances
- Limit short circuit currents
- Important in achieving compliance to IEEE 519
- Reduce harmonic distortion
- Reduce nuisance tripping
- Reduce Telephone Influence Factor (TIF)
- DIN rail mounting available in some ratings

INDEX

REX POWER MAGNETICS

Rex Power Magnetics, established in 1972 is an ISO 9001 registered **leading manufacturer** of CSA certified and UL listed **custom dry type Transformers.** Rex is **driven by technology, innovation, and customer service,** and has a track record of sustained profitable growth. With a central and integrated engineering, manufacturing, and customer service facility located just north of Toronto, Ontario, Canada, and warehouses throughout Canada and the United States, the company offers a **broad range of dry type power magnetic products** to markets throughout North America and internationally.

The Rex product line includes custom designed specialty transformers, Power Transformers up to 15 MVA and 35,000 Volts, distribution transformers, reactors, autotransformers, control and machine tool transformers, custom enclosures, custom cut electrical steel cores, and other power magnetic products and services. Supported by considerable and **sustained investment in research and development,** new and automated equipment, and efficient processes Rex Power Magnetics continually expands and enhances its product and service offering.

We pride ourselves: firstly in our **superior delivery responsiveness** supported by our passion for customer service and our vertically integrated in-house design, manufacture, and testing capabilities; and secondly in our **Technology leadership** supported by our industry leading R&D effort, engineering expertise, technical competence, and manufacturing know-how.

CONSTRUCTION

GENERAL

Traditionally the construction of Line Reactors has presented a challenge for manufacturers because, by the nature of their application, reactors are regularly subjected to overload conditions and severe power disturbances.

To control their impedance, Line Reactors are manufactured with gaps in their magnetic flux path. Maintaining the mechanical integrity and the consistency of these gaps requires particular care during engineering, design, and construction.

Rex Power Magnetics through years of experience in reactor applications has developed a unique combination of design techniques, utilizing materials and assembly practices that result in a product with reduced losses and low audible sound levels, providing years of reliable service under adverse conditions.

CORE

Manufactured from low loss, grain oriented silicon steel shunts, and assembled to reduce audible sound and minimize core losses.

WINDINGS & INSULATION

Class 220, 185, or 155 insulation is utilized depending on the size. All reactors have a standard 115°C temperature rise. The windings are of all copper construction, with terminals that are brazed or brought to terminal blocks depending on the size. The complete unit is impregnated with high temperature polyester varnish, and baked.

GAP

The impedance of the reactor is controlled and tuned by accurately maintaining the gap in the flux path. This is achieved using high temperature withstanding Nomex™ and fiberglass spacers, which are reinforced by an epoxy baked compound to reduce sound levels.

ASSEMBLY & BRACKETS

The reactor windings are secured to the core by high temperature fiberglass pultrusions. The core is framed at the top and bottom by formed steel brackets and braced by non-magnetic (stainless steel or bronze) tie bolts to minimize losses, reduce noise (hum), and provide exceptional mechanical strength.

ENCLOSURES

Reactor enclosures are manufactured from 14 gage formed steel panels which are washed, rinsed, corrosion coated and painted with ASA 61 grey powder paint suitable for most industrial and commercial applications. When ordering an enclosure alone for use with an open-type (core & coil) unit, a special bracket is required for mounting. Contact our office for details.

STANDARD TECHNICAL SPECIFICATIONS

- Max ambient temperature 40° C.
- Insulation class 155°C—Temperature rise up to 100°C.
- Insulation class 185°C—Temperature rise up to 115°C.
- Insulation class 220° C—150°C rise maximum.
- CSA certified / UL listed
- Current overload capability: 150% for 1 min.
- Saturation rating: not less than 250% of rated current (50% rated inductance min. at 350% rated current).

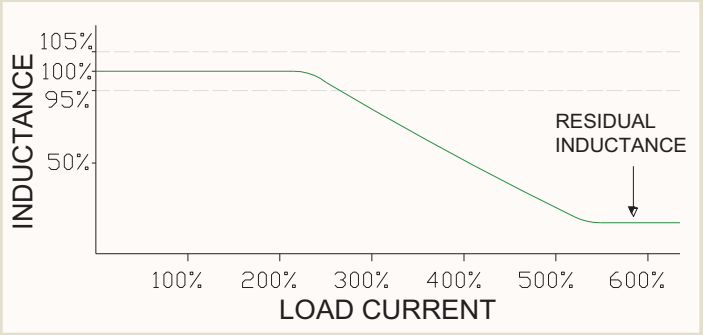


Figure 1. Excellent saturation characteristics of Rex reactors

- Audible sound level: 0—15 amp. 60dB. Max.
  16—100 amp. 65dB. Max.
  101—350 amp. 70dB. Max.
  351—600 amp. 75dB. Max.
- Harmonic compensation: suitable for operation with non-sinusoidal load currents with up to 50% total harmonic distortion.

TEST AND QUALITY INSPECTION

- Dimensions (core & coil, and enclosure)
- Mechanical security of assembly, terminals, hardware
- Appearance (core & coil, enclosure, paint and finishing)
- Electrical wiring, grounding and markings
- Impulse: 4000 V for one min. winding to winding and winding to core ground.
- Impedance measurement and tolerances.
- Audible sound at rated current.
- **ISO 9001 quality assurance.**

APPLICATIONS & BENEFITS OF LINE REACTORS AS INPUT REACTORS

GENERAL

Line Reactors are placed in series with electrical equipment to introduce a specific controlled impedance to the circuit. This inserted impedance acts to **reduce line harmonics**, **moderate line transients**, or to isolate **the harmonic sensitive elements** (such as power factor correction capacitors, harmonic filters, etc.) from the rest of the system. In the case of particular equipment such as AC drives, the line reactors may be an integral and essential part of the drive acting primarily as an input filter. Other specialized roles for reactors with drives are described below.

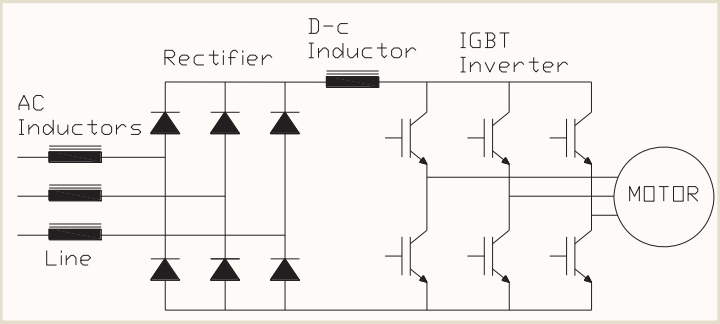


Figure 2. The IGBT Adjustable Frequency Drive with AC and DC Smoothing

1. LINE HARMONIC SUPPRESSION

Figure 2 displays a typical AC drive topology demonstrating AC and DC line current smoothing. DC smoothing is optional and is obtained by a DC reactor built into the drive as shown. Frequently, DC smoothing is eliminated for economy, relying only on the filtering effects of AC impedance. Regardless of what mix of DC and AC smoothing is used, inserting a specific amount of line reactance can reduce the line harmonics produced.

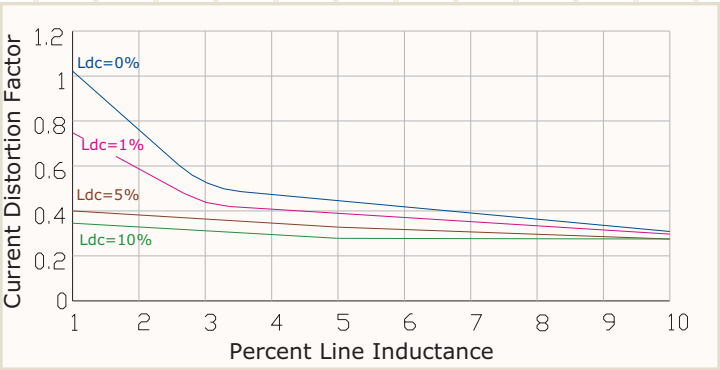


Figure 3. Current Distortion Factor versus Line and DC Link Inductance

Figure 3 demonstrates the effect of various amounts of line and DC inductance on line harmonics. The quality of the line current is measured on the basis of line current distortion factor (IDF) vs. percent of inserted line inductance and different DC inductances.

2. HIGHER FREQUENCY LINE HARMONIC SUPPRESSION, TELEPHONE INFLUENCE FACTOR (TIF)

In some instances higher frequency line harmonics must be suppressed to prevent possible interference with electrical equipment in proximity to the line. The most common examples of this are related to interference standards in telephone communications as described in IEEE-519. Telephone interference is characterized by a quantity defined as TIF. TIF is a current distortion factor calculated by applying specific weighting factors to each line harmonic, to emphasize the tendency of particular harmonics to cause interference in telephone audio band, in the vicinity of 3 KHz. **Series Line Reactors in combination with filter traps are effective in reducing such harmonics to the point that applicable standards can be met.**

3. LINE TRANSIENT SUPPRESSION

Frequently, severe transients are present on the line in the form of voltage spikes and over voltage excursions. Voltage spikes can produce different adverse effects. If the spike is of sufficient magnitude, it can cause the failure of the electrical components. In other circumstances, transients can cause the internal protective system to initiate nuisance trips making that equipment unreliable.
The introduction of series Line Reactors will reduce the effects of these transients to protect the equipment and improve reliability.

4. SPECIALIZED APPLICATIONS

Line Reactors are useful in other applications. For example, to assist in combining individual equipment as when paralleling rectifiers. In these roles, the reactors act to equalize impedance to achieve the balancing of currents. For these and other applications consult **Rex** Engineering staff for detailed application assistance.

SPECIFYING LINE REACTORS

It is common to specify the value of the impedance on the basis of a percentage (i.e. 5%) of the base impedance (at the rated line frequency i.e. 60Hz.) of the load.
Standard reactors are offered in sizes of 3% and 5% in specific current and voltage ratings. Depending on the requirements, custom reactors of other sizes and ratings can be supplied by consulting the factory.
The impedance rating is determined by the ratio of the voltage drop across the reactor to the supply voltage when operated at rated current.
Line reactor applications typically require an impedance of 2% or 3%. In some more severe applications (higher transients or where improved line current quality is required, etc.) an impedance of 4% to 5% could be specified.

APPLICATIONS & BENEFITS OF LINE REACTORS AS OUTPUT REACTORS

THE BENEFITS OF USING REACTORS IN THE OUTPUT OF ADJUSTABLE FREQUENCY DRIVES

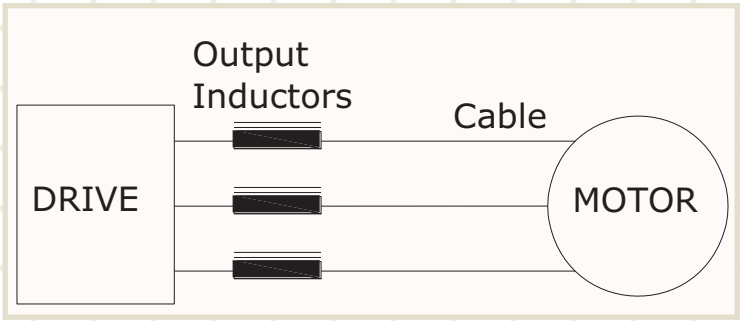


Figure 4. Typical Output Reactor Configuration

Line Reactors, placed on the output of drives, are effective in alleviating high frequency effects of long cables. The two principal benefits are:

1. Line Reactors will slope the edges of PWM waveforms applied to long cables and conductors, thereby reducing the dv/dt and stress due to uneven voltage distribution. However, Line Reactors used alone are only partially effective in reducing the peak voltage appearing at the end of long lines, see **Fig. 5a-5c.**
2. Long lines, particularly long cables, have capacitive effects producing charging currents in the order of 10 to 20 amperes which can cause spurious protective trips in small or low power drives. Reactors reduce cable charging current, producing higher reliability of operation and freedom from nuisance trips.

By using reactors alone on the output of PWM inverters, the potential spikes of 200% of the applied voltage due to reflections in long cables are reduced to typically less than 150% as shown in **Fig. 5c.** This and the combination of low dv/dt translate to safe operation even at 575 volts input. **NOTE:** Output reactors should be installed adjacent to the inverter output.

Combining Line Reactors with resistors results in the formation of highly effective motor guarding filters which further reduce dv/dt and the voltage peaks (to less than 125%) appearing at the motor, see Fig. 5d. The voltage stresses are reduced to levels well within the design limits of motor insulation thereby restoring full insulation life expectancy. The incremental cost of adding the filter components to the reactors in minimal. See page 9 for information on Rex Motor Guarding Output Filters

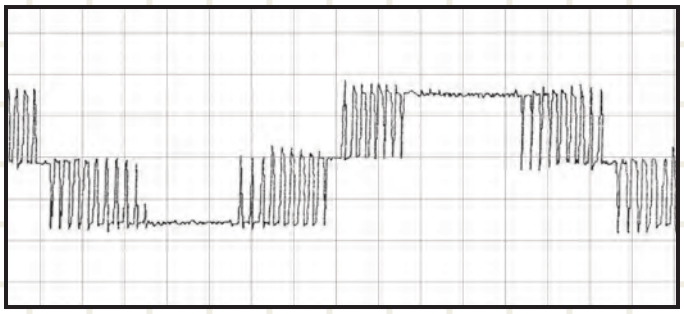


Figure 5a. depicts the voltage output of a PWM drive, measured directly at the drive terminals. Note the characteristic pattern of individual narrow pulses of fixed height and variable width. Note the steep leading and trailing edges representing high frequency content.

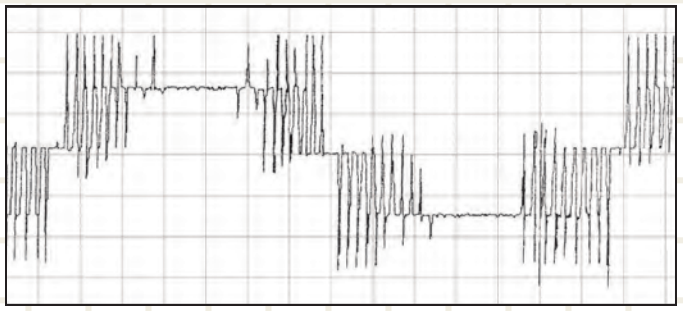


Figure 5b. is the voltage measured at the motor, at the end of a long cable feeding a motor. Note the spikes of double voltage (200%) at leading edges of the pulses.

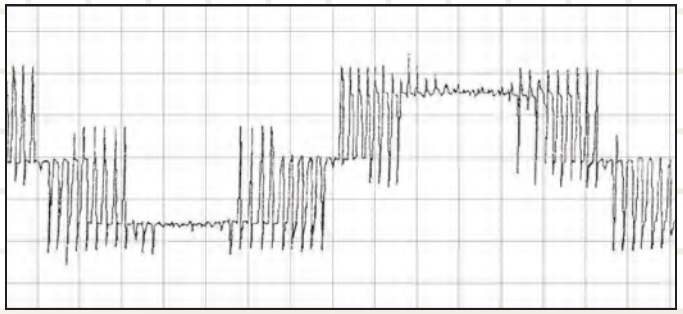


Figure 5c. depicts the result of using only a REX Line Reactor in the output. Note that the transients are reduced to approximately 150% of the applied voltage.

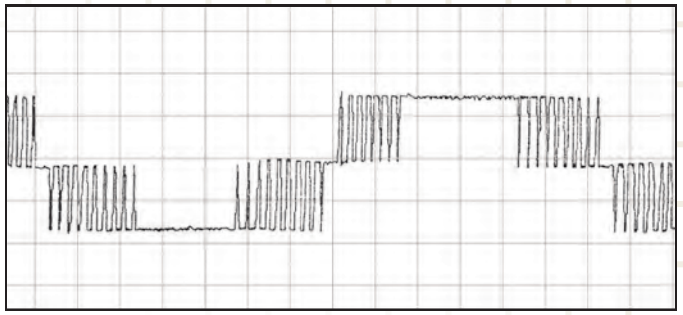


Figure 5d. demonstrates the effectiveness of REX Motor Guarding Output Filters in reducing spikes and overshoots.

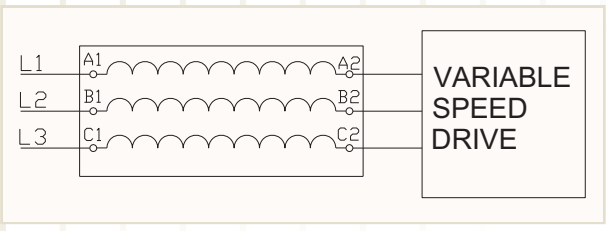
SELECTION GUIDE FOR LINE REACTORS

1. Determine the HP (horse power) rating or the current rating of the drive or motor.
2. Select the supply voltage. (208, 240, 480, or 600 Volts)
3. Determine the % impedance required for the application.
4. From the table below, select the Part No. of the reactor corresponding to the current/HP, Voltage and the % impedance.
5. For each Part No. selected, the inductance, dimensions, and the weight is given in the following two pages.

Rating HP	Voltage= 208 Volts			Voltage= 240 Volt		
	Maximum Current (Amps)	Impedance		Maximum Current (Amps)	Impedance	
		3%	5%		3%	5%
1 1.5 2	4 8 8	3PR-0004C3L 3PR-0008C3L 3PR-0008C3L	3PR-0004C5L 3PR-0008C5L 3PR-0008C5L	4 8 8	3PR-0004C3L 3PR-0008C3L 3PR-0008C3L	3PR-0004C5L 3PR-0008C5L 3PR-0008C5L
3 5 7.5	11 17 27	3PR-0011C3L 3PR-0017C3L 3PR-0027C3L	3PR-0011C5L 3PR-0017C5L 3PR-0027C5L	11 17 27	3PR-0011C3L 3PR-0017C3L 3PR-0027C3L	3PR-0011C5L 3PR-0017C5L 3PR-0027C5L
10 15 20	34 45 60	3PR-0034C3L 3PR-0045C3L 3PR-0060C3L	3PR-0034C5L 3PR-0045C5L 3PR-0060C5L	27 45 60	3PR-0027C3L 3PR-0045C3L 3PR-0060C3L	3PR-0027C5L 3PR-0045C5L 3PR-0060C5L
25 30 40	80 100 130	3PR-0080C3L 3PR-0100C3L 3PR-0130C3L	3PR-0080C5L 3PR-0100C5L 3PR-0130C5L	80 80 100	3PR-0080C3L 3PR-0080C3L 3PR-0100C3L	3PR-0080C5L 3PR-0080C5L 3PR-0100C5L
50 60 75	160 160 200	3PR-0160C3L 3PR-0160C3L 3PR-0200C3L	3PR-0160C5L 3PR-0160C5L 3PR-0200C5L	130 160 200	3PR-0130C3L 3PR-0160C3L 3PR-0200C3L	3PR-0130C5L 3PR-0160C5L 3PR-0200C5L
100 125 150	255 320 410	3PR-0255C3L 3PR-0320C3L 3PR-0410C3L	3PR-0255C5L 3PR-0320C5L 3PR-0410C5L	255 320 410	3PR-0255C3L 3PR-0320C3L 3PR-0410C3L	3PR-0255C5L 3PR-0320C5L 3PR-0410C5L
200 250 300	500 600 750	3PR-0500C3L 3PR-0600C3L 3PR-0750C3	3PR-0500C5L 3PR-0600C5L 3PR-0750C5	500 600 750	3PR-0500C3L 3PR-0600C3L 3PR-0750C3	3PR-0500C5L 3PR-0600C5L 3PR-0750C5
350 400 500	1000 1000 1250	3PR-1000C3 3PR-1000C3 3PR-1250C3	3PR-1000C5 3PR-1000C5 3PR-1250C5	1000 1000 1250	3PR-1000C3 3PR-1000C3 3PR-1250C3	3PR-1000C5 3PR-1000C5 3PR-1250C5

TYPICAL CONFIGURATIONS:

LINE REACTORS AS INPUT REACTOR



LINE REACTOR AS OUTPUT REACTOR

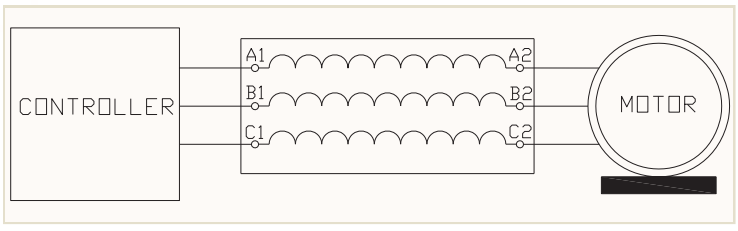


Figure 6. Configurations for reactors

SELECTION GUIDE FOR LINE REACTORS

Rating HP	Voltage= 480 Volts			Voltage= 600 Volt		
	Maximum Current (Amps)	Impedance		Maximum Current (Amps)	Impedance	
		3%	5%		3%	5%
1	2	3PR-0002C3H	3PR-0002C5H	2	3PR-0002C3H	3PR-0002C5H
1.5	4	3PR-0004C3H	3PR-0004C5H	2	3PR-0002C5L	3PR-0002C3H
2	4	3PR-0004C3H	3PR-0004C5H	4	3PR-0004C3H	3PR-0004C5H
3	8	3PR-0008C3H	3PR-0008C5H	4	3PR-0004C5L	3PR-0004C5H
5	8	3PR-0008C3H	3PR-0008C5H	8	3PR-0008C3H	3PR-0008C5H
7.5	11	3PR-0011C3H	3PR-0011C5H	11	3PR-0011C3H	3PR-0011C5H
10	17	3PR-0017C3H	3PR-0017C5H	11	3PR-0011C3H	3PR-0011C5H
15	27	3PR-0027C3H	3PR-0027C5H	17	3PR-0017C3H	3PR-0017C5H
20	27	3PR-0027C3H	3PR-0027C5H	27	3PR-0027C3H	3PR-0027C5H
25	34	3PR-0034C3H	3PR-0034C5H	27	3PR-0027C3H	3PR-0027C5H
30	45	3PR-0045C3H	3PR-0045C5H	34	3PR-0034C3H	3PR-0034C5H
40	60	3PR-0060C3H	3PR-0060C5H	45	3PR-0045C3H	3PR-0045C5H
50	80	3PR-0080C3H	3PR-0080C5H	60	3PR-0060C3H	3PR-0060C5H
60	80	3PR-0080C3H	3PR-0080C5H	60	3PR-0060C3H	3PR-0060C5H
75	100	3PR-0100C3H	3PR-0100C5H	80	3PR-0080C3H	3PR-0080C5H
100	130	3PR-0130C3H	3PR-0130C5H	100	3PR-0100C3H	3PR-0100C5H
125	160	3PR-0160C3H	3PR-0160C5H	130	3PR-0130C3H	3PR-0130C5H
150	200	3PR-0200C3H	3PR-0200C5H	160	3PR-0160C3H	3PR-0160C5H
200	255	3PR-0255C3H	3PR-0255C5H	200	3PR-0200C3H	3PR-0200C5H
250	320	3PR-0320C3H	3PR-0320C5H	255	3PR-0255C3H	3PR-0255C5H
300	410	3PR-0410C3H	3PR-0410C5H	320	3PR-0320C3H	3PR-0320C5H
350	410	3PR-0410C3H	3PR-0410C5H	320	3PR-0320C3H	3PR-0320C5H
400	500	3PR-0500C3H	3PR-0500C5H	410	3PR-0410C3H	3PR-0410C5H
500	600	3PR-0600C3H	3PR-0600C5H	500	3PR-0500C3H	3PR-0500C5H

Note: All Rex enclosures larger than #3 are standard NEMA 3R sprinkler proof. Boxes #7 and smaller can be floor or wall mounted. Consult the website or our engineering department for the most up-to-date information on enclosures.

Enclosure Dimensions

Dimensions are in inches

Size No.	Length	Depth	Height
0	*9.50*	*7.00*	*8.00*
1	*12.00*	*9.00*	*9.50*
2	*11.00*	*11.00*	*14.00*
3	*15.50*	*11.00*	*14.00*
4	*15.75*	*16.00*	*21.00*
5	*20.50*	*16.00*	*21.00*
6	*20.50*	*20.75*	*26.50*
7	*24.50*	*21.75*	*31.50*
8	*30.75*	*29.75*	*31.75*
9	*40.00*	*38.00*	*45.75*
10	*46.00*	*50.00*	*64.50*

REACTOR DIMENSIONS

Add the suffix /E at the end of the part number to denote enclosed style.

OPEN STYLE					ENCLOSED STYLE	
Catalogue No.	**Max. Amps**	**Inductance (mH)**	**Dimensions (Inches) A/B/C/D/E**	**Weight (Lbs)**	**Enclosure**	**Approx. Weight (Lbs)**
3PR-0002C5L	2	9.19	4.25/2.375/4.375/2.875/2.25	4.0	#0	13.0
3PR-0002C3H	2	13.78	4.25/2.75/4.375/2.875/2.50	4.5	#0	13.5
3PR-0002C5H	2	22.97	4.25/3.00/4.375/2.875/2.625	5.3	#0	14.3
3PR-0004C3L	4	2.78	4.25/2.25/4.375/2.875/2.125	5.8	#0	14.8
3PR-0004C5L	4	4.59	4.25/2.625/4.375/2.875/2.375	6.5	#0	15.5
3PR-0004C3H	4	6.89	4.25/3.00/4.375/2.875/2.50	7.0	#0	16.0
3PR-0004C5H	4	11.49	4.25/3.125/4.375/2.875/2.75	8.0	#0	17.0
3PR-0008C3L	8	1.38	6.00/3.375/4.875/2.00/2.375	6.8	#0	15.0
3PR-0008C5L	8	2.30	6.00/3.50/4.875/2.00/2.50	7.3	#0	16.3
3PR-0008C3H	8	3.45	6.00/4.00/4.875/2.00/2.75	9.0	#0	18.0
3PR-0008C5H	8	5.73	6.00/4.375/4.875/2.00/3.375	10.8	#0	19.8
3PR-0011C3L	11	1.00	6.00/3.375/4.875/2.00/2.625	7.3	#0	16.3
3PR-0011C5L	11	1.67	6.00/3.50/4.875/2.00/2.75	8.7	#0	17.7
3PR-0011C3H	11	2.50	6.00/3.75/4.875/2.00/2.875	10.1	#0	19.1
3PR-0011C5H	11	4.18	6.00/4.125/4.875/2.00/3.125	12.0	#0	21.0
3PR-0017C3L	17	0.65	6.00/3.875/4.875/2.00/3.00	10.0	#0	19.0
3PR-0017C5L	17	1.08	6.00/4.25/4.875/2.00/3.125	12.0	#0	21.0
3PR-0017C3H	17	1.62	6.00/4.375/4.875/2.00/3.25	13.8	#0	22.8
3PR-0017C5H	17	2.70	6.00/4.50/4.875/2.00/3.50	15.0	#0	24.0
3PR-0027C3L	27	0.41	7.00/4.00/6.00/3.25/2.75	14.6	#0	23.6
3PR-0027C5L	27	0.68	7.00/4.50/6.00/3.25/3.25	15.8	#0	24.8
3PR-0027C3H	27	1.02	7.00/4.75/6.00/3.25/3.375	18.6	#0	27.6
3PR-0027C5H	27	1.70	7.00/5.00/6.00/3.25/3.75	21.4	#0	30.4
3PR-0034C3L	34	0.32	7.00/4.625/6.00/3.25/3.00	16.4	#0	25.4
3PR-0034C5L	34	0.54	7.00/5.00/6.00/3.25/3.375	19.6	#0	28.6
3PR-0034C3H	34	0.81	7.00/5.25/6.00/3.25/3.625	22.6	#0	31.6
3PR-0034C5H	34	1.35	7.00/5.50/6.00/3.25/3.875	25.0	#0	34.0
3PR-0045C3L	45	0.25	9.00/4.25/7.00/3.00/2.625	25.0	#1	35.0
3PR-0045C5L	45	0.41	9.00/5.00/7.00/3.00/3.375	29.9	#1	40.9
3PR-0045C3H	45	0.61	9.00/5.25/7.00/3.00/3.625	34.5	#1	45.5
3PR-0045C5H	45	1.02	9.00/6.00/7.00/3.00/4.375	41.2	#1	52.2
3PR-0060C3L	60	0.18	9.00/4.75/7.00/3.00/3.125	25.5	#1	36.5
3PR-0060C5L	60	0.31	9.00/5.25/7.00/3.00/3.625	30.0	#1	41.0
3PR-0060C3H	60	0.46	9.00/6.00/7.00/3.00/4.375	40.0	#1	51.0
3PR-0060C5H	60	0.77	9.00/6.125/7.00/3.00/4.50	48.0	#1	59.0
3PR-0080C3L	80	0.14	9.00/6.00/7.00/3.00/3.125	28.3	#2	42.3
3PR-0080C5L	80	0.23	9.00/6.50/7.00/3.00/3.625	35.0	#2	49.0
3PR-0080C3H	80	0.35	9.00/7.00/7.00/3.00/4.50	40.0	#2	54.0
3PR-0080C5H	80	0.57	9.00/7.50/7.00/3.00/4.75	51.0	#2	65.0

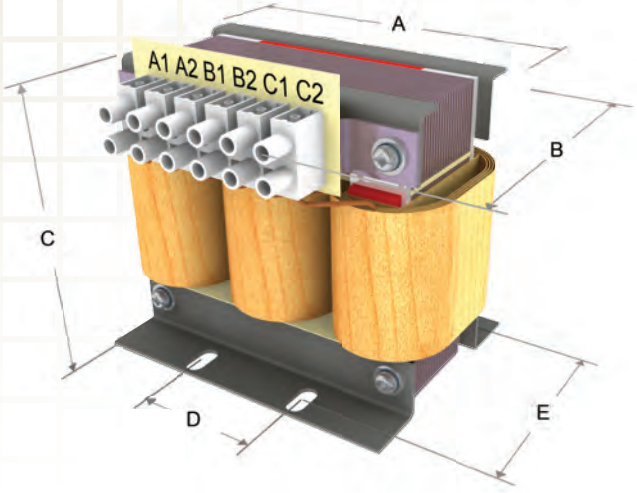


Figure 7. Dimensioned view for reactors rated up to 45 A

REACTOR DIMENSIONS

Add the suffix /E at the end of the part number to denote enclosed style.

OPEN STYLE					ENCLOSED STYLE	
Catalogue No.	Max. Amps	Inductance (mH)	Dimensions (Inches) A/B/C/D/E	Weight (Lbs)	Enclosure	Approx. Weight (Lbs)
3PR-0100C3L	100	0.11	12.00/4.50/8.50/3.50/3.25	38.8	#4	69.8
3PR-0100C5L	100	0.18	12.00/5.00/8.50/3.50/3.75	46.4	#4	77.4
3PR-0100C3H	100	0.28	12.00/7.00/8.50/3.50/4.50	58.0	#4	89.0
3PR-0100C5H	100	0.46	12.00/8.00/8.50/3.50/5.50	66.2	#4	97.2
3PR-0130C3L	130	0.09	12.00/6.00/8.50/3.50/3.75	37.0	#4	68.0
3PR-0130C5L	130	0.14	12.00/7.00/8.50/3.50/4.50	46.5	#4	77.5
3PR-0130C3H	130	0.21	12.00/7.50/8.50/3.50/4.75	56.0	#4	870.0
3PR-0130C5H	130	0.35	12.00/8.50/8.50/3.50/5.75	73.0	#4	104.0
3PR-0160C3L	160	0.07	12.00/7.50/8.50/3.50/4.00	45	#4	76
3PR-0160C5L	160	0.12	12.00/8.20/8.50/3.50/4.75	56	#4	87
3PR-0160C3H	160	0.17	12.00/9.25/8.50/3.50/5.75	74	#4	105
3PR-0160C5H	160	0.29	12.00/10.00/8.50/3.50/6.50	87	#4	118
3PR-0200C3L	200	0.06	12.00/7.50/8.50/3.50/4.50	56	#4	87
3PR-0200C5L	200	0.09	12.00/8.25/8.50/3.50/5.00	67	#4	98
3PR-0200C3H	200	0.14	12.00/9.25/8.50/3.50/6.25	99	#4	130
3PR-0200C5H	200	0.23	12.00/10.00/8.50/3.50/6.50	108	#4	139
3PR-0255C3L	255	0.04	12.00/8.00/8.50/3.50/5.50	66	#4	97
3PR-0255C5L	255	0.07	12.00/8.75/8.50/3.50/5.50	79	#4	110
3PR-0255C3H	255	0.11	12.00/9.25/8.50/3.50/6.50	105	#4	136
3PR-0255C5H	255	0.18	12.00/10.00/8.50/3.50/6.50	120	#4	151
3PR-0320C3L	320	0.03	12.00/8.00/14.00/4.50/4.00	80	#6	150
3PR-0320C5L	320	0.06	12.00/9.00/14.00/4.50/4.50	98	#6	168
3PR-0320C3H	320	0.09	12.00/10.00/14.00/4.50/5.25	113	#6	183
3PR-0320C5H	320	0.14	12.00/11.00/14.00/4.50/5.50	148	#6	218
3PR-0410C3L	410	0.03	12.00/8.50/14.00/4.60/4.25	82	#6	152
3PR-0410C5L	410	0.05	12.00/9.00/14.00/4.60/4.75	112	#6	182
3PR-0410C3H	410	0.07	18.00/9.50/14.00/4.60/4.75	160	#6	230
3PR-0410C5H	410	0.11	18.00/10.50/14.00/4.60/5.50	220	#6	290
3PR-0500C3L	500	0.02	18.00/9.00/18.00/9.75/15.50	126	#6	196
3PR-0500C5L	500	0.04	18.00/9.50/18.00/9.75/15.50	167	#6	237
3PR-0500C3H	500	0.06	18.00/10.50/18.00/9.75/15.50	194	#6	264
3PR-0500C5H	500	0.09	18.00/11.00/18.00/9.75/15.50	242	#6	312
3PR-0600C3L	600	0.02	18.00/10.50/18.00/9.75/15.50	144	#6	214
3PR-0600C5L	600	0.04	18.00/11.50/18.00/9.75/15.50	180	#6	250
3PR-0600C5H	600	0.08	18.00/12.50/18.00/9.75/15.50	253	#6	323
3PR-0750C3	750	0.03	18.00/11.00/19.00/7.25/6.50	207	#6	277
3PR-0750C5	750	0.05	18.00/11.50/19.00/7.25/7.00	254	#6	324
3PR-1000C3	1000	0.02	22.00/10.50/21.00/7.50/9.00	226	#7	306
3PR-1000C5	1000	0.04	22.00/11.50/21.00/7.50/9.00	270	#7	350
3PR-1250C3	1250	0.02	22.00/12.00/23.00/7.50/9.00	270	#8	350
3PR-1250C5	1250	0.03	22.00/13.50/23.00/7.50/9.00	310	#8	390

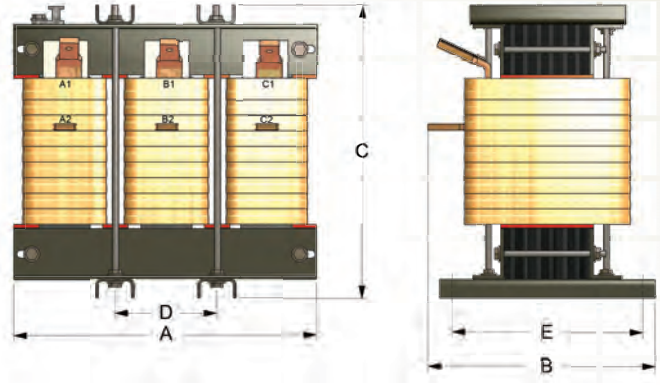


Figure 8. Dimensioned view for reactors rated 46 A and up

MOTOR GUARDING TRANSIENT FILTERS

THE PROBLEM

The steep voltage wave fronts of the Pulse Width Modulated (PWM) output of Adjustable Frequency Drives (AFD's) produce high frequency effects which may damage the insulation of motors operated by the equipment. The problems result from two distinct effects.

1. HIGH DV/DT EFFECTS

The rapid rate of voltage rise (dv/dt) at the leading edges of each output pulse of the PWM inverter, produces an uneven distribution of voltage within the motor windings. The result is a concentration of the voltage at particular points of the winding causing abnormal stress leading to breakdown of the insulation. This phenomenon has been described as "first coil breakdown" and is well documented.

2. REFLECTIONS IN LONG LINES AND CABLES

A long cable, in addition to resistance, has distributed inductance and capacitance, producing effects similar to a transmission line as shown below.

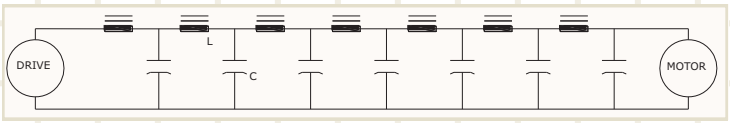


Figure 9. Electrical representation of a long transmission line

The high frequencies present in the output of PWM waveforms cause reflections in long conductors connecting the motors to the drives (see **Fig. 10a**). Harmful effects with conductors conductors as short as 10 meters have been observed. However, the effects are most severe with cables of lengths greater than 50 meters leading to the doubling of the applied voltage. This translates to voltage peaks approaching 1600 Volts in 575 Volt systems.

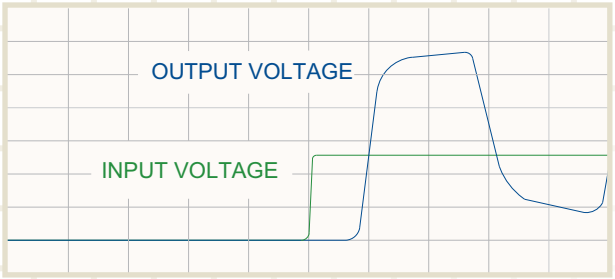


Figure. 10a. Output of a PWM inverter reaching 200% due to reflections in long cables

The combination of these two effects stresses the winding insulation considerably beyond design limits and has been known to shorten the insulation life and in some instances leads to early catastrophic failure of motors.

THE SOLUTION

It has been demonstrated that these transient effects can be reduced by using filters placed at the output of the AFD's thereby allowing safe operation of the motors and an expectation of full insulation life (see **Fig. 10b**). After years of experience and research, **Rex Power Magnetics** has developed a comprehensive line of state of the art output filters suitable for a wide range of prospective applications. The filters are constructed using optimized combinations of inductors and resistors.

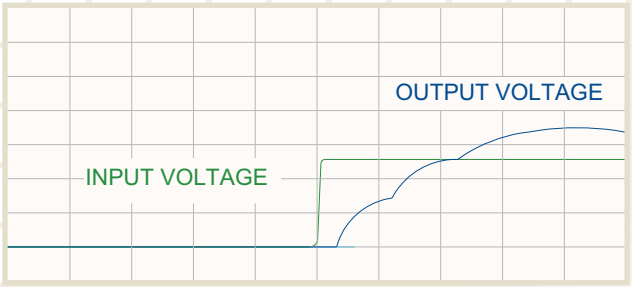


Figure 10b. Voltage peak reduced to less than 125% appearing at the motor, due to the addition of a Rex Motor Guarding Filter.

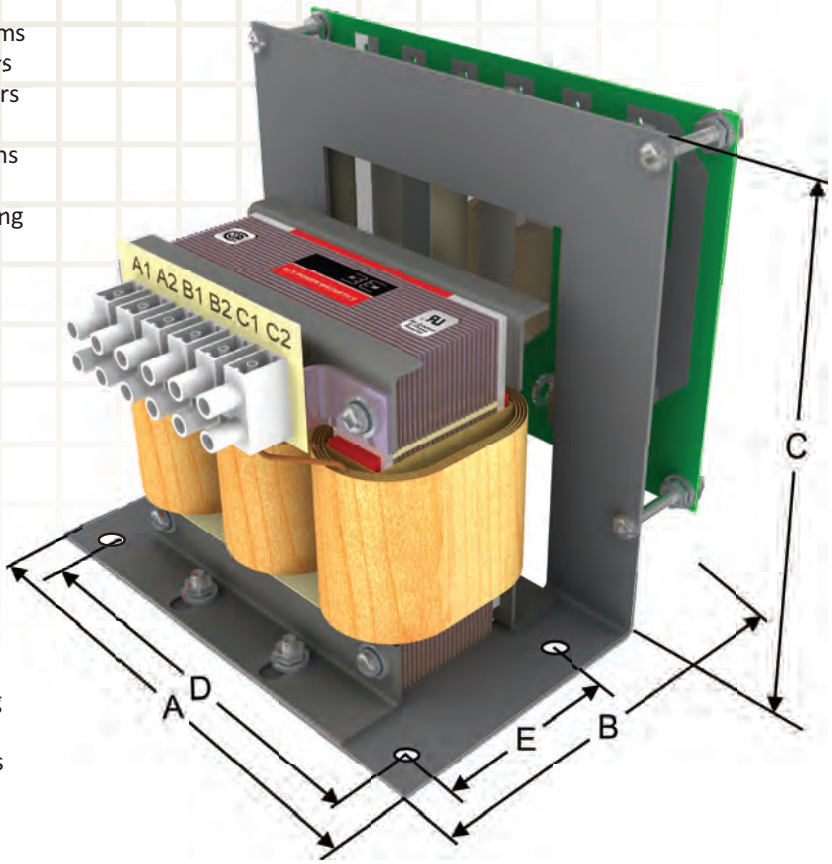


Figure 11. Dimensioned view of a Rex Motor Guarding Filter

MOTOR GUARDING TRANSIENT FILTERS

Filter Reactors					
Current Rating [A]	Part No.	Dimensions Open Core&Coil A/B/C/D/E	Enlosure # See Pg 6	Weight (Lbs)	
				Open	Enclosed
2	2C5LF	8.25/6.50/7.00/7.25/2.00	0	5	14
4	4C5LF	8.25/6.50/7.00/7.25/2.00	0	6	15
8	8C5LF	8.25/6.50/7.00/7.25/2.00	0	9	19
11	11C5LF	8.25/6.50/7.00/7.25/2.00	0	10	20
17	17C5LF	8.25/6.50/7.00/7.25/2.00	1	11	23
27	27C5LF	8.25/7.20/7.00/7.25/2.00	1	19	32
34	34C5LF	8.25/7.20/7.00/7.25/2.00	1	25	37
45	45C5LF	11.00/9.00/8.10/10.00/4.00	3	29	48
60	60C5LF	11.00/9.00/8.10/10.00/4.00	3	30	50
80	80C5LF	11.00/12.00/6.80/10.00/4.00	4	42	68
100	100C5LF	11.00/12.00/6.80/10.00/4.00	4	47	78
130	130C5LF	11.00/12.00/6.80/10.00/4.00	4	48	79
160	160C5LF	11.00/13.00/8.20/10.00/4.00	4	49	88
200	200C5LF	11.00/13.00/8.20/10.00/4.00	4	68	99
255	255C5LF	11.00/13.00/8.20/10.00/4.00	4	84	115
320	320C5LF	11.00/13.00/8.20/10.00/4.00	6	90	150
410	410C5LF	14.00/14.50/14.00/13.00/6.00	6	95	158
500	500C5LF	20.00/16.00/18.00/19.00/8.00	6	140	200
600	600C5LF	20.00/17.50/18.00/19.00/8.00	6	148	210

- Rex filters are current rated, therefore easy to specify. Simply use the total motor load current to select the appropriate filter rating.
- Filters are available enclosed or open style. Add the suffix /E at the end of the part number to denote enclosed style.

FEATURES OF REX OUTPUT FILTERS FOR ADJUSTABLE FREQUENCY DRIVES

1. The prospective voltage spike of 200% at the motor due to reflections in the cable is typically reduced to less than 125% as shown in Figure 6b. This is a significant improvement over using Line Reactors alone.
2. The dv/dt is reduced promoting more uniform voltage distribution among the motor windings.
3. Standard filter designs are suitable for a wide range of applications including line lengths of 100 meters and switching frequencies up to 5 kHz. A wider range and mix of applications and conditions are possible by consulting the office.
4. Filter designs are capable of reducing reflection transients even in the most severe cases involving cables with grounded metal casings.
5. The losses introduced with the use of these filters are small, approaching the losses experienced in using cables without filters. The use of Rex output filters generally introduces no additional losses but merely transfers the losses associated with charging and discharging the line capacitance from the cable to the filter. Thus the use of Rex filters has little effect on the efficiency of the system.
6. Components used in the filters are specified for specialized qualities and are operated at a fraction of their design limitations to reduce stress and provide reliability. These steps ensure that the filters will operate without overheating even at the limits of their specifications at the extremes of the longest metal-sheathed cables.

View or download all of our product catalogs and brochures from our website:

www.rexpowermagnetics.com

Contains up to date information on:

- *Drawings and engineering specifications*
- *Selection and efficiency calculation tools*
- *Ordering information*
- *Warranty and terms & conditions*

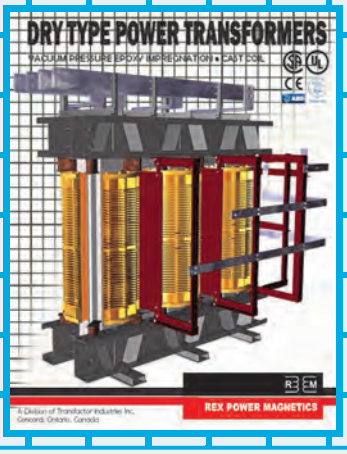
Contact and Sales info:

Tel 905.695.8844 or Fax 905.695.8855

TOLL FREE USA/CANADA 1-800-387-2840

E-mail: sales@rexpowermagnetics.com

65 Basaltic Road, Concord, ON, L4K 1G4



OUR FULL PRODUCT RANGE:

- **Power Transformers (Up to 15 MVA — 35 000 V)**
  Cast Coil, VPE and VPI Construction
  Substation Type complete with primary disconnects
  Traction Power, Rectifier, Crane Duty, Special Regulation, Service Station Distribution
- **Specialty Type and Special Voltage Transformers**
  K-Rated, Electrostatically Shielded
  Ultra Isolating Multiple Shielded
  Harmonic Mitigating
  Electromagnetic Field Shielded
  Epoxy Potted, Hazardous Location
  Marine Duty Types (with applicable certificates)
  Mini Power Centres
  High Efficiency and Ultra High Efficiency
  On Line Tap Switching and Auto Voltage Regulating Units
  Hazardous-Location Transformers (Class 1, Div 2)
- **Control & Machine Tool Transformers (50 VA to 7500 VA)**
  Enclosed, Open Style, or Potted
  DIN Rail Mountable Units
- **General Purpose Transformers**
  Distribution/Isolation, CE Marked Transformers
  Autotransformers
  Drive Isolation
  Motor Starting
- **Reactors**
  Input and Output Reactors
  Motor Guarding Transient Filters
  DC Chokes, Saturable-Core Reactors
  Inter-Bridge Reactors
  High Voltage Iron Core or Air Core Reactors
- **Enclosures**
  NEMA -1, -2, -3R, -4, -4x, -12
  Stainless Steel and Special Paint
  Custom Switchgear and Specialty Industrial Enclosures
- **Switchgear Components**
  Low and High voltage Standoffs and Insulators
  Surge (lightning) Arresters
- **Transformer Testing, Refurbishment, and Repair**
  Replacement of windings, core, insulation, etc.

Our 145,000 sq. ft. design, manufacturing, and customer service facility in Concord, north of Toronto, Ontario

CAT DATE: 11/11