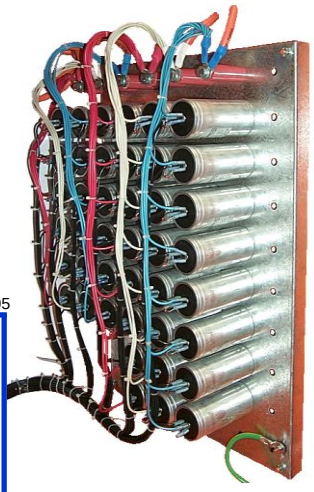
Quality System

Quality Endorsed Company
ISO 9001
Lic QEC8416

CAP TECH
CAPACITOR TECHNOLOGIES
POWER QUALITY SOLUTIONS

FILTERS AND REACTORS CATALOGUE



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Harmonics Pollution

- Invisible But Co$tly

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Harmonics are Invisible But Co$tly?

If one looks up the meaning of '*harmonics*' in any one of several technical dictionaries, it is normally defined as being '*A sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency*'. Total harmonic distortion is the contribution of all the harmonic frequency components to the fundamental.

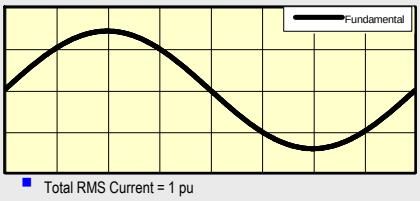
Harmonics are the by-products of modern electronics. They are produced by any non-linear loads such as:

- Variable Speed Drives (AC and DC),
- Switch mode power supplies from personal computers,
- Uninterruptible Power Supplies (UPS),
- Most low-energy lighting systems, or
- Any electronic device using solid-state power switching supplies to convert incoming AC to DC.

Non-linear loads generate harmonics by drawing current in abrupt short pulses, rather than in a smooth sinusoidal manner.

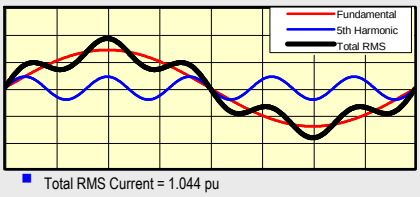
HARMONICS IS A VERY COSTLY OVERHEAD. Its effect can range from spurious operation of equipment to a complete shutdown of important plant equipment, such as machines or assembly lines. All will be revealed on next section.

Fundamental Component Only



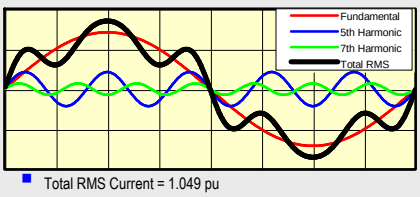
- Total RMS Current = 1 pu

Fund With 30% 5th Harmonic



- Total RMS Current = 1.044 pu
- Equivalent to 20% Power Wasted

Fund With 30% 5th & 10% 7th Harmonics



- Total RMS Current = 1.049 pu
- Equivalent to 25% Power Wasted

Harmonics Pollution

- Harmful to Equipments

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Effects of Harmonics are Similar to High Blood Pressure

With the advent of power electronics and proliferation of non-linear loads in industrial applications, power harmonics and their effects on power quality are a topic of concern. Effects of three-phase harmonics on circuits are similar to effects of stress and high blood pressure on human body. High level of stress or harmonic distortion can lead to problems for the utility's distribution system, plant distribution system and any other equipment serviced by that distribution system.

Harmonics can lead to power system inefficiency. Some of the negative ways that harmonics may affect plant equipments include:

- **Conductor Overheating**. A function of square RMS current per unit volume of conductor. Harmonic currents on undersized conductors or cables can cause 'skin effect', which increases with frequency and is similar to centrifugal force.
- **Transformer Overheating**. In presence of current harmonics, transformers will have increased iron and copper losses or Eddy currents due to stray flux losses. This causes excessive overheating in the transformer windings.
- **Generator Instability**. In addition to similar problems to transformer, excessive harmonic voltage distortion will affect timing of voltage regulator, causing 'zero-crossing' interference and operation instability.
- **Capacitor Rupture**. If Power Factor Correction (PFC) equipment is connected to system with harmonics, the inevitably rapid heat rise will reduce service life of capacitor drastically. If capacitor is tuned to one of the characteristic harmonics (such as 5^{th} or 7^{th}), over-voltage and resonance can occur, causing dielectric failure or rupture of capacitor.
- **Malfunction of Fuses & Circuit Breakers**. Harmonics can cause false or spurious operation and trips, damaging or blowing components for no apparent reasons.
- **Malfunction of Utility Meters**. May record measurements incorrectly, resulting in higher billings to consumers.
- **Drives Failure**. Harmonics can cause failure of commutation circuits found in DC/AC drives with silicon-controlled rectifiers (SCRs).
- **Telephone Interference**. Harmonics may cause interference in telecommunications systems.

Industries and Telecommunications are Two Sectors Highly Polluted by Harmonics

Motor Failure

- Common Drive Application Problems

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What Causes Motor Failure?

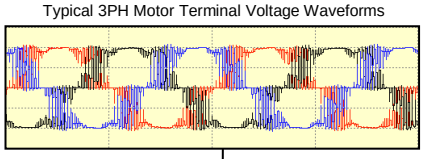
Variable Speed Drives (VSDs) are one of the most popular and widely used pieces of equipments for DC/AC motor control. They are found in virtually every sector of industries, in applications as diverse as pumps, air conditioning systems, elevators, cranes, conveyors, machine tools, alternative energy production and in a vast array of other industrial and domestic automation.

Example of Burnt Electric Motor due to Excessive Insulation Stress

Recent advancements in power electronic switching devices have enabled high-frequency switching operation and have improved the performance of Pulse-Width Modulated (PWM) inverters in VSDs. While the high switching speeds and advanced PWM schemes significantly improve the performance and hence results in huge energy savings, the generation of fast rise-time voltage pulses has adverse effects on the motor insulation.

These extremely steep rising and falling pulses lead to uneven distribution of voltages within motor especially during switching transitions, and contributes to insulation deterioration and subsequent failure of motor. In many cases where long cable is employed between VSD and motor, damped high frequency ringing at motor terminal occurs resulting in excessive over-voltage which further stresses motor insulation.

Typical 3PH Motor Terminal Voltage Waveforms



Power Transformer

VSD

Long cable run
(Typically >100m)

Industrial Motor

Some problems associated to these include:

- **Excessive motor overheating**, leading to insulation breakdown.
- **Increased motor audible noise**, degrading working environment.
- **Reduce motor service life**, especially when long cable run is used.

"We Are More Than A PFC Specialist,

We Provide TOTAL FILTERING SOLUTIONS To Suit Any Installations And Budgets"

We Provide Total Filtering Solutions… LOCALLY!

In most cases, several phenomena previously discussed occur in the same system, a fact which underlines the idea of combined components and total filtering solutions. As leading filter solution provider in Australia, CapTech can help against all these problems by offering the followings:

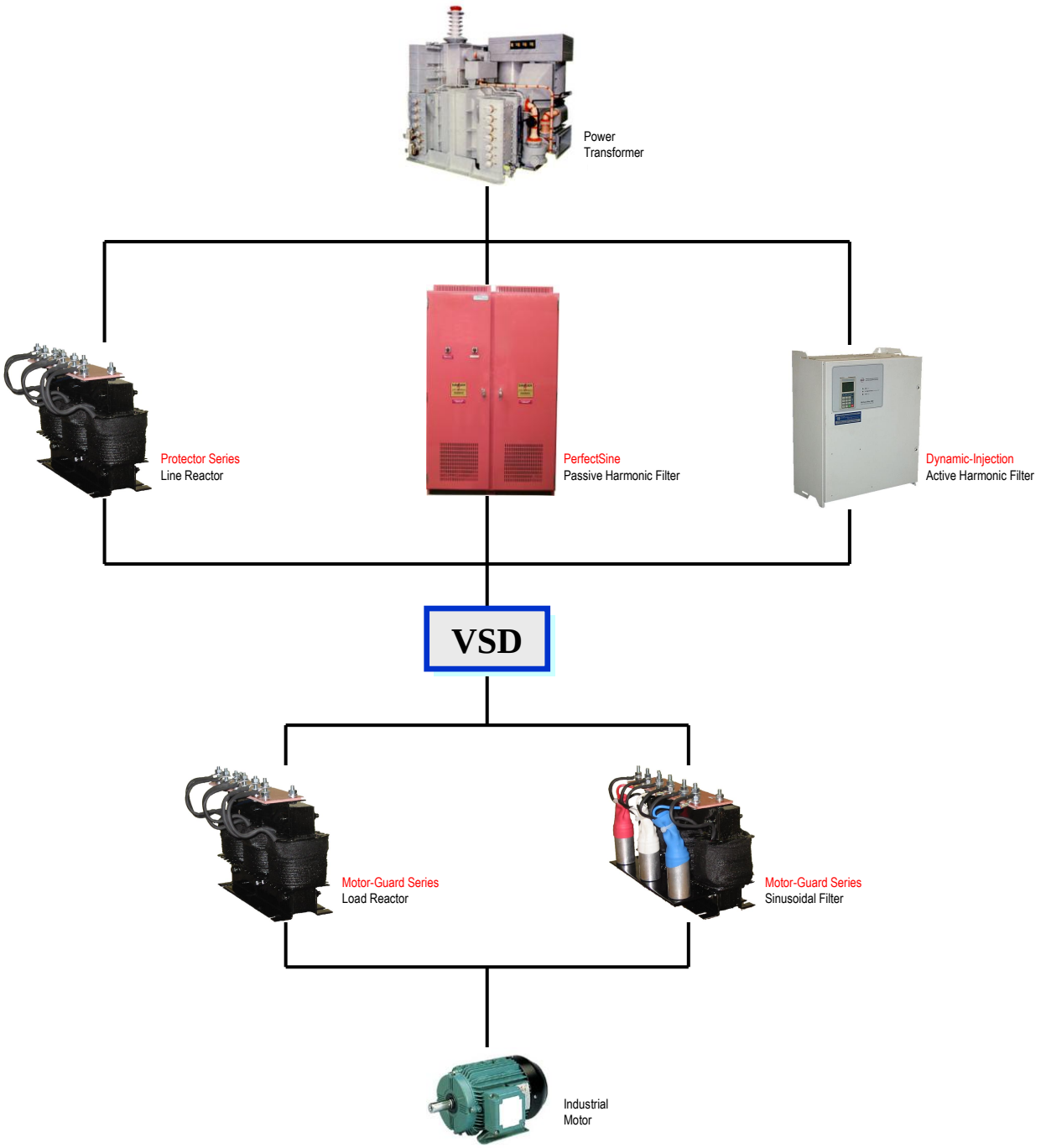
- *Protector Series* Line Reactor
- *Motor-Guard Series* Load Reactor
- *Motor-Guard Series* Sinusoidal Filter
- *Dynamic-Injection* Active Harmonic Filter
- *PerfectSine* Passive Harmonic Filter

The decision to favour a certain solution above another depends entirely on system requirements and should be backed by technical and economic analysis.

As we design and manufacture reactors in-house, we can custom-make filter and reactor units to a quality and performance suited to customer's specifications. Hence you will receive all the local technical supports you need. No more long lead times! No more high overseas freight costs! All filter and reactor units are fully tested in accordance to our **Quality Assurance Policy**.

Our Factory

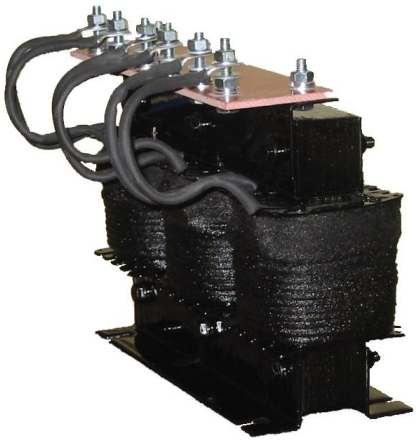
Filters and Reactors in Industrial System



Line Reactors

Protector Series

Specifications



- Rated Line Voltage : 415V (3-Phase)
- Voltage Range : 380V ~ 480V (3-Phase)
- Rated Line Current : 3A ~ 2300A RMS (Refer to Table)
- Rated Frequency : 50Hz
- Impedance % : 3% at Rated Voltage and Current
- Typical Overload : Up to 150% of Rated Current for 2 Minutes
- Inductive Tolerance : ±8% (±3% for I_{rated}>142A)
- Protection Category : IP00 (Open Type) or IP42 Enclosure
- Temperature Class : +50°C
- Impregnation Class : Class H – 180°C
- Country of Manufacture : Australia
- Manufactured to Standard : AS1028 – 1992

Design

Protector Series Line Reactors are 3-phase gapped iron-core reactors. Low temperature rise and low losses are achieved through their unique & innovative design. This means that heat dissipation requirements are reduced and system efficiency is greatly improved.

Special impregnation minimises audible noise in the reactors and hence enhances structural integrity.

Applications

Protector Series Line Reactors provide efficient and economical solutions to inverter and drive application problems. As current-limiting devices, reactors oppose rapid changes in current and hence reduce any current spikes & limit any peak currents. Reactors prolong the life of power/electronic equipments by absorbing many of the power line disturbances which otherwise may damage or shut down inverters, variable speed drives, or other sensitive equipments.

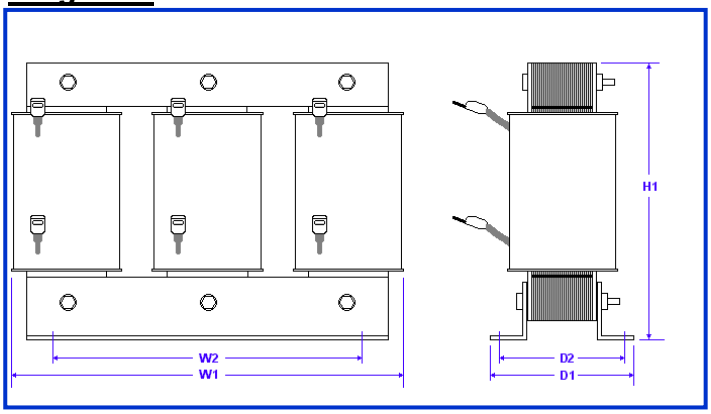
Protector Series Line Reactors are fully *harmonic compensated* units and are specially designed to handle severe waveform distortions. They are effective at reducing harmonics generated by inverters and drives, and in most cases will help to comply with IEEE 519.

In most applications, **Protector Series Line Reactors** provide solutions to the following nuisance problems:

- Current surges
- Voltage transient
- Voltage notching
- Drive nuisance tripping
- High voltage spikes from capacitor switching (especially back-to-back switching)
- Multiple motor applications on the same bus

Line Reactors

Diagrams



Note: These diagrams are NOT drawn to scale

Selections And Dimensions Table

Protector Series Line Reactors

Part No	Line Current Amp (RMS)	Impedance %	Inductance uH	Typical Loss Watt	Dimensions mm						Weight kg	Diagram No
					W1	W2	H1	H2	D1	D2		
CTFR-LIR041503-000304	3	4	10169	6	235	205	186	150	95	86	7.8	1
CTFR-LIR041503-000504	5	4	6101	11	235	205	186	150	95	86	7.9	1
CTFR-LIR041503-000904	9	4	3390	22	235	205	186	150	95	86	8.1	1
CTFR-LIR041503-001304	13	4	2347	24	235	205	186	150	95	86	8.6	1
CTFR-LIR041503-001604	16	4	1907	31	235	205	186	150	95	86	8.7	1
CTFR-LIR041503-002404	24	4	1271	44	235	205	186	150	95	86	9.6	1
CTFR-LIR041503-003004	30	4	1017	67	235	205	230	190	95	86	12.1	1
CTFR-LIR041503-003804	38	4	803	70	235	205	230	190	95	86	14.4	1
CTFR-LIR041503-004504	45	4	678	80	260	220	290	242	140	134	28.9	1
CTFR-LIR041503-005404	54	4	565	102	260	220	290	242	140	134	29.0	1
CTFR-LIR041503-006004	60	4	508	113	260	220	290	242	140	134	29.2	1
CTFR-LIR041503-007204	72	4	424	123	260	220	290	242	140	134	30.2	1
CTFR-LIR041503-008604	86	4	355	134	260	220	290	242	140	134	31.4	1
CTFR-LIR041503-010504	105	4	291	136	400	340	340	325	-	165	60.8	2
CTFR-LIR041503-013004	130	4	235	156	400	340	340	325	-	165	62.7	2
CTFR-LIR041503-014204	142	4	215	174	400	340	340	325	-	165	62.9	2
CTFR-LIR041503-017404	174	4	175	193	400	340	340	325	-	165	63.0	2
CTFR-LIR041503-018004	180	4	169	203	400	340	340	325	-	165	63.1	2
CTFR-LIR041503-020004	200	4	153	213	400	340	340	325	-	165	64.8	2
CTFR-LIR041503-024004	240	4	127	267	400	340	340	325	-	165	64.9	2

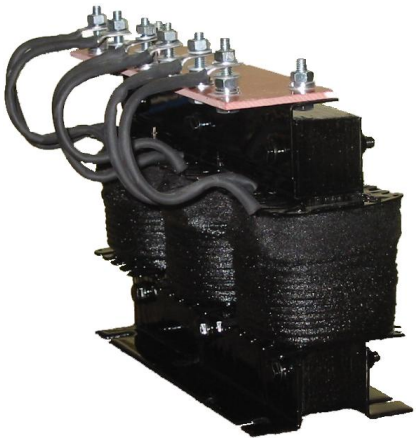
Footnote:

1) All dimensions and weights listed are approximate only and are subjected to change without notice. Please consult manufacturer for confirmation prior to placing orders.
2) Please consult manufacturer for price and delivery.
3) For other ratings or customisation to meet special requirements, please consult manufacturer.

Load Reactors

Motor-Guard Series

Specifications



- Rated Line Voltage : 415V (3-Phase)
- Voltage Range : 380V ~ 480V (3-Phase)
- Rated Line Current : 3A ~ 105A RMS (Refer to Table)
- Operating Frequency Range : Up to 120Hz
- Switching Frequency Range : 3kHz ~ 8kHz
- Impedance % : 5% at Rated Voltage and Current
- Inductive Tolerance : ±10%
- Protection Category : IP00 (Open Type) or IP42 Enclosure
- Ambient Temperature : +40°C
- Insulation Class : Class F – 155°C
- Impregnation Class : Class H – 180°C
- Country of Manufacture : Australia
- Manufactured to Standard : AS1028 – 1992

Design

Motor-Guard Series Load Reactors are 3-phase gapped iron-core reactors. Low temperature rise and low losses are achieved through their unique & innovative design. Special impregnation minimises audible noise in the reactors and hence enhances structural integrity.

Motor-Guard Series Load Reactors are fully *harmonic compensated* and *IGBT protected* to assure optimum performance in the presence of harmonics.

Applications

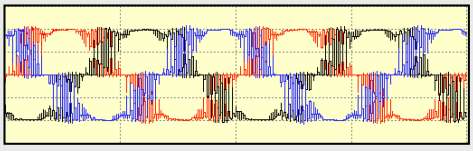
Motor-Guard Series Load Reactors provide efficient and economical solutions to motor-drive problems involving long cable runs. As current-limiting devices, reactors oppose rapid changes in current and hence effective at taming Pulse Width Modulated (PWM) waveforms generated by inverters. Reactors help to protect motors from potentially high voltage peaks and fast dv/dt experienced in many applications with long cable runs between inverter and motor. The resultant waveforms are friendlier to motor, resulting in reduced temperature, audible noise, and extended motor life.

Motor-Guard Series Load Reactors are fully *harmonic compensated* units and are specially designed to handle severe waveform distortions. They are effective at reducing harmonics generated by inverters, and in most cases will help to comply with IEEE 519.

To summarise, using **Motor-Guard Series Load Reactors** have the following benefits:

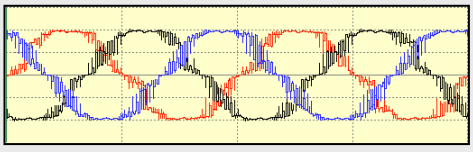
- Protect motor from effects of long cable runs
- Reduce high voltage peaks and fast dv/dt in motor
- Reduce motor temperature
- Reduce audible motor noise
- Extend motor life

Typical 3PH Motor Terminal Voltage
Without Motor-Guard Load Reactor



- Actual test results conducted with 20HP motor & VSD. Running at 85% load.

Typical 3PH Motor Terminal Voltage
With Motor-Guard Load Reactor



- Actual test results conducted with 20HP motor & VSD. Running at 85% load.

Load Reactors

Diagrams

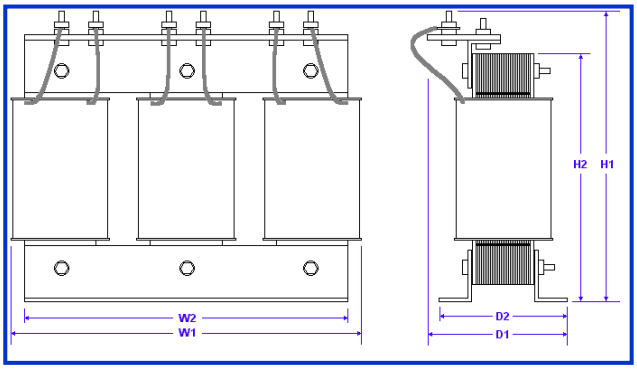


Diagram 1

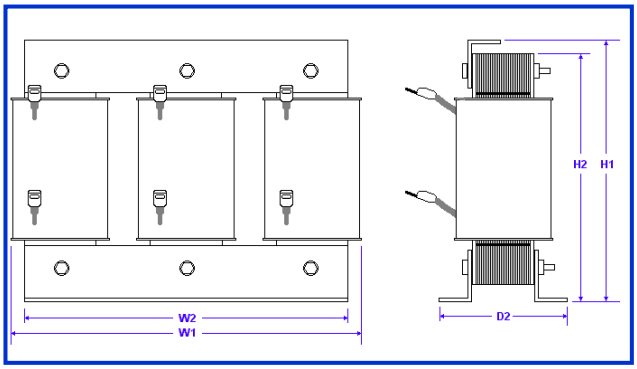


Diagram 2

Note: These diagrams are NOT drawn to scale

Selections And Dimensions Table

Drive switching frequency must be between 3kHz ~ 8kHz.

Motor-Guard Series Load Reactors

Part No	Line Current Amp (RMS)	Impedance %	Inductance uH	Typical Loss Watt	Dimensions mm						Weight kg	Diagram No
					W1	W2	H1	H2	D1	D2		
CTFR-LOR041503-000305	3	5	12711	9	235	205	186	150	95	86	8.9	1
CTFR-LOR041503-000505	5	5	7627	15	235	205	186	150	95	86	9.1	1
CTFR-LOR041503-000905	9	5	4237	31	235	205	186	150	95	86	9.4	1
CTFR-LOR041503-001305	13	5	2933	40	235	205	186	150	95	86	9.6	1
CTFR-LOR041503-001605	16	5	2383	51	235	205	186	150	95	86	9.8	1
CTFR-LOR041503-002405	24	5	1589	73	235	205	230	190	95	86	14.3	1
CTFR-LOR041503-003005	30	5	1271	101	235	205	230	190	95	86	14.5	1
CTFR-LOR041503-003805	38	5	1004	108	260	220	290	242	140	134	29.8	1
CTFR-LOR041503-004505	45	5	847	123	260	220	290	242	140	134	30.1	1
CTFR-LOR041503-006005	60	5	636	150	260	220	290	242	140	134	30.8	1
CTFR-LOR041503-007205	72	5	530	155	400	340	340	325	-	165	59.6	2
CTFR-LOR041503-008605	86	5	443	163	400	340	340	325	-	165	61.9	2
CTFR-LOR041503-010505	105	5	363	202	400	340	340	325	-	165	62.1	2

Footnote:

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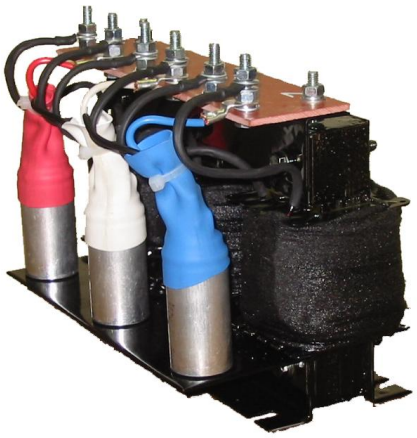
3) For other ratings or customisation to meet special requirements, please consult manufacturer.

Sinusoidal Filters

Motor-Guard Series

Specifications

- Rated Line Voltage : 415V (3-Phase)
- Voltage Range : 380V ~ 480V (3-Phase)
- Rated Line Current : 3A ~ 30A RMS (Refer to Table)
- Operating Frequency Range : Up to 120Hz
- Switching Frequency Range : 3kHz ~ 8kHz
- Ripple Voltage Distortion : Typically <10% Under Normal Condition
- Protection Category : IP00 (Open Type) or IP42 Enclosure
- Ambient Temperature : +40^{o}C
- Reactor Insulation Class : Class F – 155^{o}C
- Reactor Impregnation Class : Class H – 180^{o}C
- Country of Manufacture : Australia
- Maximum Cable Length : 400m *



* Max cable length is based on cable characteristic impedance of L=0.36uH/foot & C=0.01nF/foot.
For other cable length and characteristic, please consult manufacturer.

Design

Motor-Guard Series Sinusoidal Filters comprise of 3-phase gapped iron-core reactors and high-quality, high-voltage rating capacitors. Low temperature rise and low losses in reactors are achieved through their unique & innovative design. Special impregnation minimises audible noise in the reactors and hence enhances structural integrity.

Motor-Guard Series Sinusoidal Filters are fully *harmonic compensated* and *IGBT protected* units. They will not resonate at characteristic harmonic frequencies (ie 3rd, 5th, 7th, 11th, 13th etc) and provide excellent attenuation at switching frequency range.

Applications

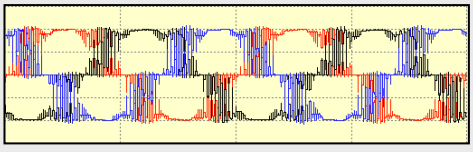
Motor-Guard Series Sinusoidal Filters provide efficient and economical solutions to motor-drive problems involving long cable runs. Being fully *harmonic compensated* and *IGBT protected* units, filters are extremely effective at taming Pulse Width Modulated (PWM) waveforms generated by inverters to **near sinusoidal** waveforms. Filters help to protect motors from potentially high voltage peaks and fast dv/dt experienced in many applications with long cable runs between inverter and motor. These near sinusoidal waveforms are much friendlier to motor, resulting in reduced temperature, audible noise, and extended motor life.

Motor-Guard Series Sinusoidal Filters also help to filter out high-frequency portion of inverter output voltage, such that voltage waveforms fed to motor terminals are essentially near sinusoidal with small harmonic ripple voltage distortion of typically less than 10% under normal condition.

To summarise, using **Motor-Guard Series Sinusoidal Filters** have the following benefits:

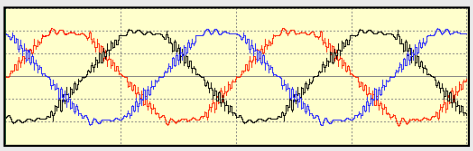
- Improve true power factor
- Protect motor from effects of long cable runs
- Reduce high voltage peaks and fast dv/dt in motor
- Reduce motor temperature
- Reduce audible motor noise
- Extend motor life

Typical 3PH Motor Terminal Voltage
Without Motor-Guard Sinus Filter



- Actual test results conducted with 20HP motor & VSD. Running at 85% load.

Typical 3PH Motor Terminal Voltage
With Motor-Guard Sinus Filter



- Actual test results conducted with 20HP motor & VSD. Running at 85% load.

Sinusoidal Filters

Diagram

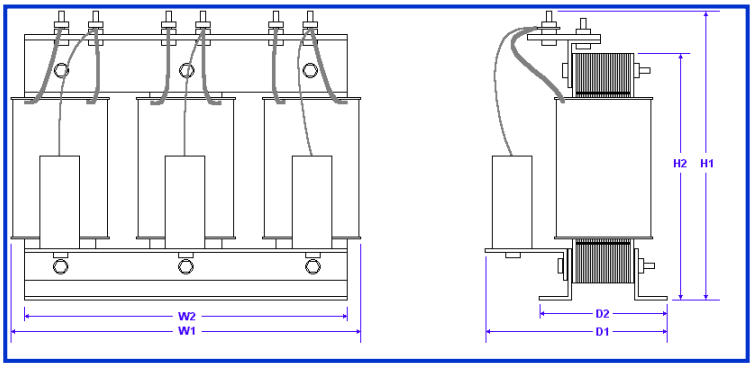


Diagram 1

Note: This diagram is NOT drawn to scale

Selections And Dimensions Table

- **Motor-Guard Series Sinusoidal Filters** must be sized according to motor kW rating.
- Drive switching frequency must be between 3kHz ~ 8kHz.
- Cable length should be <400m.

Motor-Guard Series Sinusoidal Filters

Part No	Line Current Amp (RMS)	Motor Size kW	Typical Loss Watt	Dimensions mm						Weight kg	Diagram No
				W1	W2	H1	H2	D1	D2		
CTFR-SIF041503-000305	3	7.5	32	235	205	186	150	140	86	10.17	1
CTFR-SIF041503-000505	5	11.0	48	235	205	230	190	140	86	13.7	1
CTFR-SIF041503-000905	9	15.0	76	260	220	290	242	200	134	30.0	1
CTFR-SIF041503-001305	13	18.0	80	260	220	290	242	200	134	31.1	1
CTFR-SIF041503-001605	16	22.0	105	260	220	290	242	200	134	32.5	1
CTFR-SIF041503-002405	24	30.0	182	400	340	360	325	260	165	66.2	1
CTFR-SIF041503-003005	30	37.0	224	400	340	360	325	260	165	67.0	1

Footnote:

1) All dimensions and weights listed are approximate only and are subjected to change without notice. Please consult manufacturer for confirmation prior to placing orders.
2) Please consult manufacturer for price and delivery.
3) For other ratings or customisation to meet special requirements, please consult manufacturer.
4) Max cable length is based on cable characteristic impedance of L=0.36uH/foot & C=0.01nF/foot. For other cable length and characteristic, please consult manufacturer.

Active Harmonic Filters

Dynamic-Injection

Features

- Compensation of harmonics: global or selected (parameter control)
- Compensation of DPF and PF (parameter control)
- Parameter control of load type: data processing, rectifier, etc…
- IGBT technology and control by DSP circuit
- 3 LEDs to show operation status
- 7-language alphanumeric display
- Diagnostic and maintenance system
- Configuration and parameter control menu
- Dry contacts for remote signalling
- Remote control (lockable)
- Complies with IEC standards and EC marking
- Redundancy and parallel configuration
- Wide range of current transformers
- Optional JBus/RS485 communication interface

Benefits

Impressive Harmonic Attenuation. Using state-of-the-art technologies, **Dynamic-Injection Active Harmonic Filters** reduce harmonic currents to about (10x) or in certain case to about (20x). Compensation covers 2nd to 25th order harmonics allowing a wide regulation span to cover every type of load. Also possible to choose between two operating modes:

- Global compensation
- Pre-selected order of compensation

Reduce Energy Bills. Active filters will improve DPF and PF, and hence results in reduction in energy bills.

Unrivalled Operator-Friendliness. Located on the front panel of the filter unit, the Man/Machine Interface (MMI) is written in seven standard languages (English, French, German, Spanish, Italian, Dutch and American). It provides:

- Assistance with commissioning and maintenance
- Parameter control (display language, harmonic compensation type, etc…)
- Operation (reports, audits, alarms and controls)

The detachable MMI has a 3 meter lead to enable installation on the front panel of the active filter unit housing. Additionally, dry contacts and optional RS485 serial connections are available for remote control.

Easy Installation.

Exceptional Operating Reliability, Safety, and Security.

Extended Equipment Life. The reduction in effective current by **Dynamic-Injection Active Harmonic Filters** prolongs equipment service life by up to 30%.

Active Harmonic Filters

Dynamic-Injection

Specifications

Dynamic-Injection Active Harmonic Filters	CTFR-DIF20	CTFR-DIF30	CTFR-DIF45	CTFR-DIF60	CTFR-DIF90	CTFR-DIF120
Compensation capacity per phase						
	20A RMS	30A RMS	45A RMS	60A RMS	90A RMS	120A RMS
Compensation capacity in the neutral(1)						
	60A RMS	90A RMS	135A RMS	180A RMS	270A RMS	360A RMS
Approx weight and dimension						
Dimensions HxWxD (mm)	680x540x280		780x590x325		(2x) 780x590x325	
Weight (kg)	65		110		(2x) 110	
AC input						
Rated voltage	400V -20 +15%					
Rated frequency	50Hz, 60Hz, 8%					
Number of phases	3-phases with/without neutral					
Current transformers	Ratings from 300/1 to 4000/1					
Technical Specifications						
Harmonic current compensated	Orders 2 to 25, global compensation or specified harmonics					
Harmonic attenuation	THID load / THID greater than 10x at nominal conditioner capacity					
Current compensation of PF	Up to 1.0					
Response time	> 40 ms					
Overload	Current limited to rated current, continuous operation within these limits					
Inrush current	< double rated peak current					
Typical Losses	1000W	1300W	2100W	2600W	4200W	5200W
Noise Level (ISO 3748)	< 55dBA	< 55dBA	< 60dBA	< 60dBA	< 65dBA	< 65dBA
Colour	RAL 9002					
Environmental Conditions						
Operating temperature	0^0 to 40^0C continuous, < 25^0C recommended					
Relative humidity	0 to 95% non condensing					
Operating altitude	< 1000 m					
Reference standards						
Construction and safety	EN 50091-1					
Design	IEC 146					
Protection	IP30 according to IEC 529					
Electromagnetic compatibility (EMC)						
Conducted and radiated emission	EN 55011 Class A					
Immunity to electrostatic discharges	IEC 1000-4-2 level 3					
Immunity to electromagnetic fields	IEC 1000-4-3 level 3					
Immunity to impulse waves	IEC 1000-4-4 and IEC 1000-4-5 levels 4					

Footnote:

1) Maximum capacity on PC-type load and on balanced 3PH system.
2) All dimensions and weights listed are approximate only and are subjected to change without notice. Please consult manufacturer for confirmation prior to placing orders.
3) Please consult manufacturer for price and delivery.
4) For other ratings or customisation to meet special requirements, please consult manufacturer.

Passive Harmonic Filters

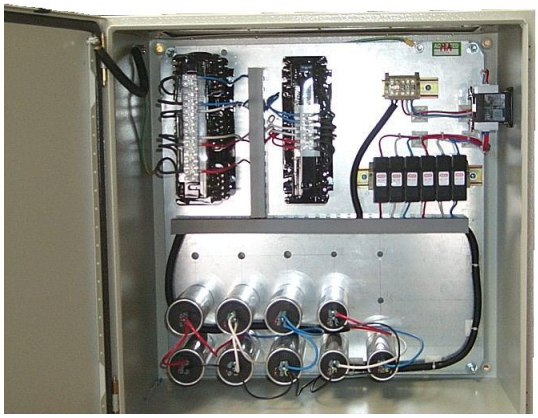
"The Ultimate Weapon in ELIMINATING HARMONICS"

- ***Reduce System Harmonics.*** Reduce major harmonics (5^{th}, 7^{th}, 11^{th}, 13^{th}…) generated by VSDs and other 3PH 6-pulse rectifier loads to negligible levels.

- ***Reduce Energy Bills.*** Virtually eliminates wasted energy associated with harmonics. Improves overall system power factor and potentially reduce energy bills.

- ***Increase System Reliability.*** Reduce the burden on electrical equipments. Treats nuisance problems like current surge, voltage transient, notching or spike, and malfunction of fuse, circuit breaker or utility meter. Increased reliability means higher productivity.

- ***Increase Equipment Life.*** Reduce true RMS current flowing through equipments feeding non-linear loads. This reduces overheating of upstream equipments such as conductor, transformer, circuit breaker, and fuse.



Variable Speed Drives (VSDs) are one of the most popular and widely used pieces of equipments for DC/AC motor control. They are found in virtually every sector of industries, in applications as diverse as pumps, air conditioning systems, elevators, cranes, conveyors, machine tools, alternative energy production and in a vast array of other industrial and domestic automation.

However, VSDs inadvertently generate harmonics due to the nature of their front-end rectifier design, leading to problems for the utility's distribution system, plant distribution system and any other equipment serviced by that distribution system.

There are various harmonic treatment options (line reactors, multi-pulsed systems, active filters, tuned or broadband filters) of which are either marginally effective or too costly. When it comes to a cost-effective harmonic solution, nothing comes close to the price/performance of PerfectSine Passive Harmonic Filters.

Passive Harmonic Filters

Design

- **PerfectSine Harmonic Filters** are sophisticated, purely passive equipments comprising of revolutionary reactors and high-quality, high-voltage rating capacitor banks. Their ingenious design will reduce major harmonics generated by VSDs to about (8x) or better, and in most cases will help to comply with IEEE-519 Standard.
- **PerfectSine Harmonic Filters** will not, in most cases, resonate with other power system components since their natural resonant frequency is below that of any predominant harmonics.
- **PerfectSine Harmonic Filters** present high impedance to line side harmonics and hence reduces the likelihood of harmonic importation from other non-linear sources.
- **PerfectSine Harmonic Filters** reduce RF interference generated by VSDs.

Real-Life Performance