Power Correction Systems, Inc.

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TimesOne ™

The Energy Efficiency Company

Special points of interest:

- **Treats all major harmonics generated by Variable Speed Drives, and other 3-phase rectifier loads (5th, 7th, 11th, 13th…)**
- **Easily applied to input of a single VSD. No need to phase shift against other VSD's. No need for costly harmonic studies.**
- **Suitable for application on multiple VSD's provided only VSD's are connected.**
- **Will meet IEEE 519 standard for both current and voltage distortion.**
- **Input current demand distortion ,8% over entire operating range.**
- **Power factor 0.98 lagging to 0.95 leading over the normal operating range.**
- **Compatible with engine generators since capacitive reactance is<15% of rated kVA even under light loads.**
- **Will not resonate with other power system components or attract line side harmonics.**
- **Suppresses overvoltages caused by capacitor switching and other fast changing loads.**
- **Eliminates need for drive isolation transformers, AC line reactors and DC link chokes.**
- **Removal of harmonics improves overall system power factor.**

UNIVERSAL HARMONIC FILTER (UHF)

ENERGY EFFICIENT 18-PULSE PERFORMANCE FROM STANDARD 6-PULSE VARIABLE SPEED DRIVES

PRODUCT CODE:

Motor Horsepower	Frequency	Enclosure
5 to 1500 HP	50 to 60 Hz	EO= No Enclosure E1= Nema 2 (5 to 20HP) Nema 3 Ventialted (25 to 1500HP)

UHF HP VVV Hz Dn En O

Line Voltage	Load Type	Optional
All standard voltages up to 600 VAC	DO=Diode Bridge Rectifier DL= DBR with AC Line Rectifier DD= DBR with DC Choke	E=Nema 3R Enhanced (25 to 1500HP) W=Enclosed Wall Mtg Kit (5 to 125HP)

The use of Variable Speed Drives and other static power conversion equipment has grown rapidly in recent years. With this growth has come concern over the level of current harmonics generated by such equipment. Harmonic currents and the voltage distortion these currents create can have devastating effects on a power distribution system and its connected equipment.

Present methods of harmonic treatment (line reactors, multi-pulsed systems, tuned or broadband passive filters)

Are moderately effective or more costly. Active filters are used with mixed loads of motors and drives. The innovative Time One ™ is a proven advance in the area of passive harmonic mitigation. No other devise on the market can meet the most stringent limits of IEEE STD 519 at an equivalent size and cost.

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The front-end rectifiers of 3-phase, 6-pulse static power converters (AC-DC), such as those found in variable speed drives, are considered non-linear because they draw current in a non-sinusoidal manner. The current harmonics they generate are predominantly the 5th and 7th, 13th and other higher orders also present, but at lower levels.

Power distortion systems that carry a heavy non-linear load component will often experience problems due to excessive harmonic currents.

Problems that can arise include:

- Power factor correction capacitor failures
- Overheating cables, transformers and other distribution equipment
- Distortion of the voltage waveform (typically flat-topping) especially when operating on emergency standby generators
- False tripping of circuit breakers
- Premature failure of motor, generators and other rotating equipment
- Misoperation of component failure in PLC's, computer and other sensitive loads

HARMONIC TREATMENT OPTIONS

There are various methods presently available for treatment of VSD harmonics. Each has the advantages and disadvantages, but none can achieve the price performance level of **TIMES ONE ™ .**

Reactors and chokes are a relatively low cost solution, but are only moderately effective and their high impedance can introduce troublesome voltage drops.

Conventional **tuned or trap filters**, as their name implies, require turning into a specific harmonic frequency. Their effectiveness is marginal unless multiple tuned elements are incorporated. Also, they are prone to problems such as resonance with other system components, importation of harmonics from upstream non-linear loads and a leading power factor.

By treating a wider spectrum of harmonics, **broad-band filters** are more effective than tuned filters, but can also be more expensive. Although, they address, some of the issues associated with tuned filters, they are not trouble-free. Specifically, their large capacitor banks create a leading power factor which has been known to cause excitation control problems with generators.

In **multi-pulsed systems**, the drive manufacturer will phase shift between multiple front-end rectifiers to cancel harmonics. Some 18 and 24 pulsed systems can achieve Total Harmonic Current Distortion (THID) of , 8%, but they have a larger footprint, lower efficiency and a higher cost , and this increases to over 50% THDI at half motor speed.

Phase shifting transformers can be a very cost effective method of harmonic treatment,, but require multiple 6-pulse rectifier loads operating simultaneously. A quasi 12-pulse scheme (ie, cancellation of 5th and 7th harmonics) can be created by phase shifting one VSD against a second similar VSD. 18 abd 24 pulse schemes require three and four VSD's respectively.

Active filters treat harmonics by measuring the level of harmonic current present in the system and injecting currents of opposite polarity to cancel them. Excellent performance can be achieved, so that distortion as low as 2.5% is possible, which saves more energy than 6%. The active filter sells for approximately 35% more. It can save space when one large filter is used for many VSD and motors combined. Lower distortion is maintained as load varies from 100% to 10%.

TIMES ONE ™ will treat all of the major harmonics and achieve results previously only attainable through active filtering or multi-pulse systems 18 or higher.

Actual test results comparing the harmonics generated by a 60 HP VSD with various passive harmonic treatments show that **TIMES ONE ™** reduce current distortion by more than 10X and brought the power factor to unity. The net result is essentially a linear load, with harmonics no longer at a level for concern,

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"THE HIGH LET-THROUGH IMPEDANCE OF TIMES ONE ™ WILL PROVIDE MANY OF THE SAME BENEFITS AS THE DRIVE ISOLATION TRANSFORMER, WHILE ALSO, DRAMATICALLY REDUCING THE HARMONICS INJECTED INTO THE POWER SYSTEM BY THE DRIVE. IT ACCOMPLISHES THIS IN A MUCH SMALLER FOOTPRINT AND WITH IMPROVED EFFICIENCY. THERFORE, THE USE OF THE TIME ONE TM WILL ELIMINATE THE NEED FOR DRIVE ISOLATION TRANSFORMERS. IN ADDITION, ANY UPSTREAM TRANSFORMER PROVIDING VOLTAGE TRANSFORMATION WILL NOT NEED A K-FACTOR RATING."

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UNIVERSAL HARMONIC FILTER (UHF)

ADVANTAGES OF TIMES ONE ™ OVER OTHER PASSIVE FILTERS

Eliminates Need For Drive Isolation Transformers

Poor field experiences have led many engineers to specify drive isolation transformers on every VSD installation. The belief is that by isolating the drive from the supply many power related problems are eliminated. Although the inherent impedance and galvanic isolation of a drive isolation transformer will provide some protection for the drive against power induced problems, such as capacitor switching overvoltages and high frequency noise. It does very little to protect the supply bus from the harmonics generated by the drive. The high let-through impedance of TIMES ONE ™ will provide many of the same benefits, as the drive isolation transformer, while also, dramatically reducing the harmonics injected into the power system by the drive.

TIIMES ONE ™ is a purely passive device consisting of a revolutionary new inductor combined with a relatively small capacitor bank. It's innovative design achieves cancellation of all the major harmonic currents (including AM Band RFI) generated by VSD's and other similar 3-phase, 6-pulse rectifier loads. The resulting THID is reduced to < 8% and often as low as 6%.

HARMONICS FROM OTHER SOURCES

As a parallel connected device, the conventional trap filter has no directional properties. It therefore, can easily be overloaded by attracting harmonics from upstream non-linear loads. TIIMES ONE ™ on the other hand, will present a high impedance to line side harmonics eliminating the possibility of inadvertent importation and overloading.

SYSTEM RESONANCE

As frequencies below its tuned frequency, a conventional filter will appear capacitive. This capacitance has the potential of resonating with the power systems natural inductance. When a filter is tuned to a higher order harmonic, such as the 11th, it could easily resonate at a lower harmonic frequency, such as the 5th or 7th. The natural resonance frequency of TIIMES ONE ™ below that of any predominant harmonic, therefore inadvertent resonance is avoided.

LEADING POWER FACTOR

The large capacitor banks in both trap filters and broadband filters present a capacitive reactance to the system, especially under light loads. This can be a beneficial feature where inductive loads require a compensating reactance to improve a low displacement power factor. However, in most VSD applications, displacement power factor is quite high even though over all power factor is low due to the harmonic content. Compensation for inductive loads is not necessary and, in fact, can cause problems especially when supplied by an emergency standby generator. To address this, more sophisticated filters will be equipped with a mechanism for switching out the capacitors under light loads, increasing cost and complexity. Even under no load, conditions, the capacitive reactance (KVAR) of TIIMES ONE ™ remains below 15% of it's kVA rating. This ensures compatibility with engine generators, without the need to switch out capacitors.

HARMONIC DISTORTION

The filtering effectiveness of a trap filter is dependent upon the amount of harmonics present at untuned frequencies as well as the residual at the tuned frequency. To obtain performance better than 15% THID , multiple tuned branches are often required. Broadband filters claim 8 % to 12% THID, but require relatively large capacitor banks to achieve this. Even larger capacitors are required, if further reduction in THID is desired. TIIMES ONE ™ will reduce current distortion to < 8% and often achieves levels near 5% THID at full load.

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General Specifications:

HP/KW RATING: available for motor/drive system sizes up to 1500HP/1100 kW

VOLTAGE: standard voltages up to 600V

FREQUENCY: select 60 or 50 Hz

HARMONICS TREATED: 5th, 7th, 11th, 13th...

K- FACTOR SUITABILITY: up to 20%

IMPUT K-FACTOR: reduced to <1.5%

IMPUT CURRENT DEMAND DISTOR-TION: <8%

EFFICIENCY: >99%

VENTALATION: convection air cooled

WINDING MATERIAL: copper

ENCLOSURE: NEMA 2 GRAY (5 to 20HP); NEMA 3R Grey (25 to 1500HP)

OPTIONS: NEMA 3R ENHANCED (25 TO 1500HP); WALL MTG. KIT (5 TO 125HP)

*** Approximate Values**

Case Style	H in. (mm)	W in. (mm))	D in. (mm)	Mtg. Hole Center W	Mtg. Hole Center D
SN2	12.00 (305)	14.00 (356)	14.00 (356)	10.00 (254)	10.50 (267)
MN1	22.00 (559)	16.75 (425)	15.00 (381)	13.75 (349)	13.00 (330)
MN2	29.00 (737)	21.50 (546)	19.50 (495)	17.00 (432)	17.50 (445)
MN3	38.00 (965)	26.00 (661)	21.00 (534)	21.50 (546)	19.00 (483)
MN4	41.00 (1041)	32.00 (813)	25.50 (648)	23.50 (546)	23.50 (597)
LN1	51.50 (1308)	39.50 (1003)	30.00 (762)	24.00 (610)	32.00 (813)
LN2	59.00 (1499)	48.50 (1232)	34.00 (864)	27.50 (699)	36.00 (915)
LN3	66.00 (1677)	51.50 (1308)	39.00 (991)	34.00 (864)	41.00 (1042)
LN6	70.00 (1778)	64.00 (1626)	40.00 (1016)	40.00 (1016)	42.00 (1067)

Motor Size		Lineator 480VAC 3Ph/60Hz	Rating 600VAC 3Ph/60Hz		Losses	Enclosed	Open Style		
HP	kW	Input Amps	Output kVA	Full Load Watts*	Case Style	Weight* Lbs/kg	Dimensions H"xW"xD"	Weight* lbs /kg
5	4	7	5	7.5	120	SN2	55 (25)	9x9x8.5	45 (20)
7.5	5.5	10	8	11	180	SN2	70 (32)	9x9x8.5	60 (27)
10	7.5	13	10	14	200	SN2	80 (36)	11x11x10	70 (32)
15	11	19	15	20	250	SN2	90 (41)	11x11x10	80 (36)
20	15	25	20	27	280	SN2	110 (50)	11x11x10	100 (45)
35	18.5	32	25	34	345	MN1	170 (77)	15x15x13	130 (59)
40	22	38	30	40	365	MN1	180 (82)	15x15x13	140 (64)
40	30	50	40	51	450	MN1	205 (93)	15x15x13	165 (75)
50	37.5	63	50	63	525	MN2	245 (111)	15x18.5x15	185 (84)
60	45	75	60	75	565	MN2	260 (118)	15x18.5x15	200 (91)
75	55	88	70	93	630	MN2	295 (134)	16x18.5x17	235 (107
100	75	113	90	118	710	MN2	400 (182)	17x20x16	340 (154)
125	90	144	115	145	850	MN2	460 (209)	17x20x18	400 (182)
150	110	170	135	175	1100	MN3	580 (263)	20x22x19	510 (232)
200	150	225	180	220	1310	MN3	670 (304)	23x23x16	600 (272)
250	200	282	225	275	1650	MN4	860 (390)	24x27x18	770 (350)
300	250	340	270	330	1960	MN4	1065	34x27x23	965 (438)
350	270	397	320	385	2470	MN4	1165	34x27x23	1065 (483)
400	315	453	365	440	2775	LN1	1550	34x27x24	1350 (613)
500	400	565	455	550	3615	LN1	1900	35X30X25	1700 (771)
600	450	695	560	660	4620	LN2	2200	37X35X27	1000 (817))
700	510	800	640	770	5725	LN2	2600	39x43x28	2300 (1043)
800	630	910	730	880	6600	LN2	3000	39x44x30	2700 (1225)
900	710	1018	815	990	7425	LN3	3200	40x46x30	2850 (1293)
1000	800	1130	905	1100	8150	LN3	3400	40x48x30	3050 (1383)
1100	900	1300	1040	1210	9210	LN6	3650	50x48x36	3300 (1497)
1200	950	1420	1135	1320	10380	LN6	3800	50x52x36	3400 (1542)
1300	1000	1500	1200	1430	10740	LN6	4050	50x52x36	3650 (1792)
1400	1150	1610	1270	1540	11000	LN6	4350	50x58x38	3950 (1792)
1500	1100	1725	1330	1650	11490	LN6	4500	50x58x38	4200 (1905)