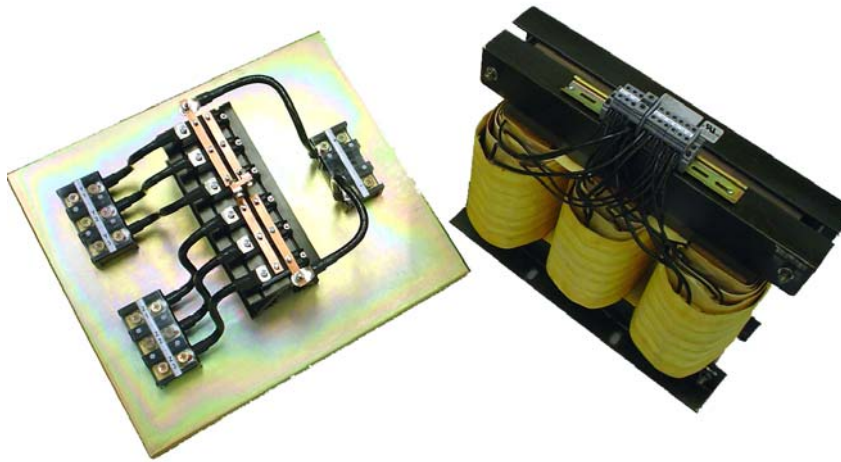


12-pulse & 18-pulse Rectifier Upgrade Kits



For OEMs and System Integrators



**Easily upgrade your VFD
from 6-pulse to either
12-pulse or 18-pulse**

Ideal for Variable Frequency Drives

- Retrofits
- New installations



**Type PCK
Power Conversion Kits**



The Natural Way to Eliminate Harmonics

12-pulse and 18-pulse rectifier technology can now be employed in almost any standard six-pulse variable frequency motor drive.

Type PCK converter upgrade kits enable you to reduce the amount of harmonics produced by electronic motor drives and other rectifiers, while maximizing total power factor. With our Type PCK Power Conversion Kits, you can upgrade most standard 6-pulse variable frequency motor drives to your choice of either 12-pulse or 18-pulse rectification.

Benefits of using ARTECHE PQ Type PCK Multi-pulse Rectifier Upgrade Kits:

- Easily upgrade new and existing motor drives to 12-pulse or 18-pulse
- Minimize harmonics right at their source
- Nearly eliminate specific harmonics as depicted by the chart to the right
- Eliminate the need for harmonic filters
- No concerns about power system resonance
- Meet IEEE—519, G5/4, and AS-2279
- Diode transient protection is enhanced
- Improves total power factor to within 1% of displacement power factor

Which harmonics are produced by various rectifier types?

Harmonic Number	Typical Harmonics by Rectifier Type		
	6-pulse	12-pulse	18-pulse
5th	√		
7th	√		
11th	√	√	
13th	√	√	
17th	√		√
19th	√		√
23rd	√	√	
25th	√	√	
29th	√		
31st	√		
35th	√	√	√
37th	√	√	√

Basic Components

Type PCK Power Conversion Upgrade Kits are constructed using a phase shifting, isolation transformer and a power electronics panel.



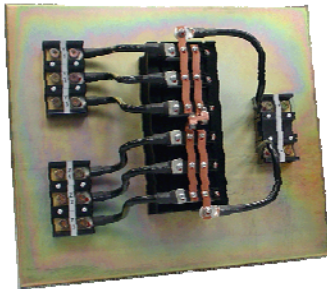
Transformer

Transformers are K-4 rated so they can handle the losses associated with the 6-pulse harmonics that will be present on each of the secondary windings. Transformer secondary winding voltages are accurately balanced and phase displaced so they can achieve maximum cancellation of harmonics in a multi-pulse (12 or 18-pulse) circuit.

Power Electronics Panel

The power electronics panel is comprised of either one (for 12-pulse) or two (for 18-pulse) bridge rectifier assemblies which provide the power conversion from AC to DC with the desired number of pulses. This panel is used in conjunction with the existing rectifiers in the drive.

Special design considerations do more than just improve harmonics!



High
Transient
Immunity
Rectifiers

Balanced
Output
Isolation
Transformer



High Efficiency Transformer = Low Operating Costs

Our transformers are designed and constructed for minimal power loss so that your system can achieve the highest level of energy efficiency. Our typical transformer efficiency ratings are:

250HP and higher => 97.1% to 98% efficiency
50Hp to 200HP => 94.6 to 97% efficiency

Electrostatic Shield = Reduced EMI/RFI

Our phase shifting transformer includes an electrostatic shield so that you can attenuate EMI/RFI in addition to mitigating harmonics.

Balanced Secondary Voltages = Lowest Residual Harmonic Distortion

Special care is taken to assure that our transformer output voltages are all balanced within one percent so that proper cancellation of harmonics will occur.

Isolated Transformer Windings = Ground Fault Current Limiting

Isolated transformer windings are instrumental to achieving balanced voltages at each of the individual transformer secondary winding terminals. Ground fault current is minimized through the use of isolated windings as opposed to an auto-transformer.

Series Connected Bridge Rectifiers = Lower Harmonic Distortion

Compared to the traditional methods of connecting bridge rectifiers in parallel to achieve 12 or 18 pulse operation, series connected bridge rectifiers naturally share current equally resulting in the best cancellation of harmonics.

Low Rectifier Operating Voltage = Extended Rectifier Life

Series rectifier configuration allows lower transformer voltage that sums to the total rated VFD input voltage. This reduces the applied voltage to individual diodes by either 50% (12-pulse) or 67% (18-pulse), improves their immunity to voltage transients and increases rectifier life.



Theory of Operation

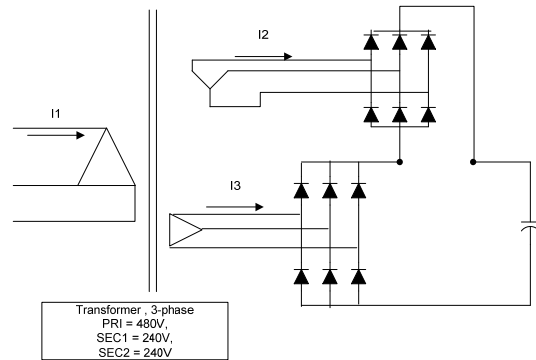
The basic concepts of phase multiplication and phase shifting are used, in the **ARTECHE PQ** multi-pulse rectifier upgrade kits, to cancel specific harmonics normally associated with three phase rectifier applications such as adjustable speed drives (ASDs) and uninterruptible power supplies (UPSs). The harmonic frequencies that are cancelled depend on the number of phase shifted transformer windings, rectifiers and degrees of phase shift.

Standard 6-pulse Rectifiers

A standard ASD supplied by a transformer with three outputs (phases) uses a full wave bridge rectifier that contains six diodes and the DC bus voltage will have six pulses occurring during one cycle of AC input voltage. Given this six pulse rectifier, one will experience the stream of harmonics that includes 5th, 7th, 11th, 13th, 17th, 19th, 23rd, 25th, etc.). The 5th harmonic is typically the largest harmonic component, followed by the 7th harmonic. The total input harmonic current distortion will typically vary between 100% THD-I to 35%THD-I for individual loads with effective source impedance between 0.5% and 5% impedance.

12-Pulse Rectifiers

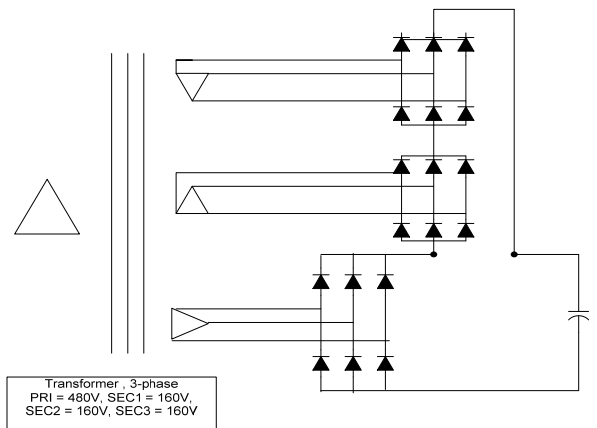
When two individual six pulse bridge rectifiers are combined in a way such that each is fed from a separate transformer winding and each of these windings are phase shifted by 30 electrical degrees from each other, then the 5th and 7th harmonics are theoretically cancelled. This configuration uses twelve total diodes and the DC bus voltage has twelve distinct pulses during one cycle of input voltage. This twelve pulse configuration will experience the harmonic stream containing the 11th,13th, 23rd, 25th, etc. harmonics. The total input harmonic current distortion for twelve pulse rectifiers will typically vary between 10% to 20% THD-I for individual loads depending upon loading condition, pre-existing system voltage distortion, and percent of line voltage unbalance.



6-Pulse ASD with 12-pulse Power Conversion Kit

18-Pulse Rectifiers

When three individual six pulse bridge rectifiers are combined in a way such that each is fed from a separate transformer winding and each of these windings are phase shifted by 20 electrical degrees from each other, then the 5th, 7th, 11th and 13th harmonics are theoretically cancelled. This configuration uses eighteen total diodes and the DC bus voltage has eighteen distinct pulses during one cycle of input voltage. This eighteen pulse configuration will experience the harmonic stream containing the 17th,19th, 35th, 37th, etc. harmonics. The total input harmonic current distortion for eighteen pulse rectifiers will typically vary between 5% to 8% THD-I for individual loads depending upon loading condition, pre-existing system voltage distortion, and percent of line voltage unbalance.



6-Pulse ASD with 18-pulse Power Conversion Kit



Easily upgrade a standard 6-pulse VFD to either 12-pulse or 18-pulse power conversion!

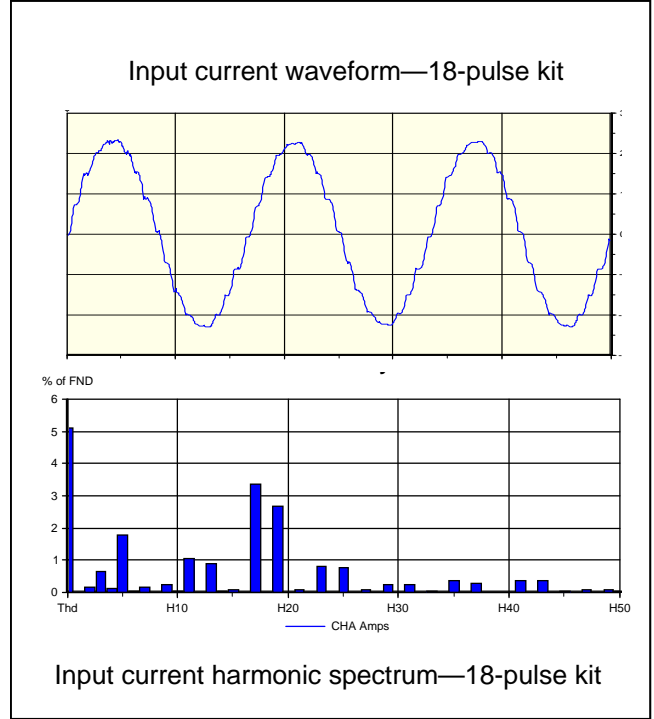
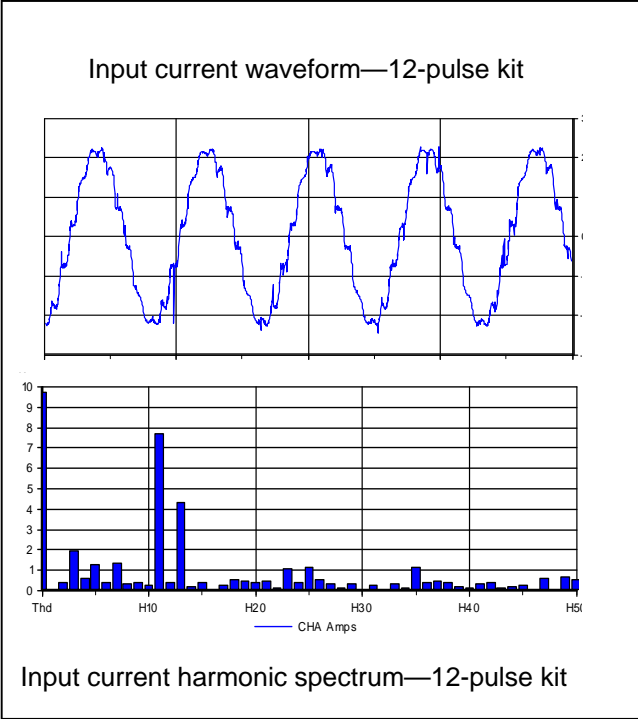


Type PCK Multipulse Rectifier upgrade kits enable OEMs and system integrators to upgrade a typical six pulse drive to either 12-pulse or 18-pulse rectification. This brings the typical six pulse drive into compliance with industry specifications that demand either 12-pulse or 18-pulse drives, and into compliance with **IEEE-519**. 12-pulse drives are frequently specified in the HVAC industry, while 18-pulse drives are popular in the wastewater industry.

Type PCK rectifier upgrade kits are suitable for variable frequency drives (VFDs) in variable torque applications such as fans and pumps. Multipulse rectifier upgrade kits are intended only for those VFDs having a removable DC link that will allow a connection in series with the positive DC bus.

Actual Waveform Measurements	
6-pulse VFD with ARTECHE PQ 18-pulse rectifier upgrade kit. Actual THD-I is 5.13%.	
6-pulse VFD with 5% impedance line reactor. Actual THD-I = 35.2%	
6-pulse VFD without line reactor, with 0.5% effective source impedance. Actual THD-I = 99.9%	

Typical Performance of VFDs with 12 and 18 Pulse Upgrade kits



Saves valuable engineering time- Make the upgrade without the development costs!



12-pulse and 18-pulse Applications

Nearly any six pulse VFD can be converted into either 12-pulse or 18-pulse rectification. This enables OEMs and system integrators to participate in bids that exclusively demand 12- or 18-pulse rectification methods. **ARTECHE PQ** 12-pulse rectifier upgrade kits enable OEMs and system integrators to convert standard 6-pulse VFDs to either 12-pulse or 18-pulse power conversion. Total harmonic current distortion (THD-I) can be reduced to as low as 5% to 8% for 18-pulse and 10% to 20% for 12-pulse power conversion. Background voltage distortion, caused by other loads on the system may add to this level of current distortion. Additionally, if the three line voltages are unbalanced, then harmonic current distortion will also be higher than normally expected because less than ideal cancellation will take place and there may be a measurable third harmonic which normally does not appear in balanced three phase systems.

Suitable for Retrofit Applications

ARTECHE PQ upgrade kits are ideal for retrofit applications, as well as new applications. As more and more non-linear loads are added to a facility electrical system, the cumulative effects of harmonics can begin to cause power integrity and reliability problems. The 12- and 18-pulse upgrade kits may be added to existing VFDs (having a removable DC link) in order to reduce the distortion levels associated with the existing VFDs and to increase the available capacity from existing transformers.

Effects of Background Voltage Distortion

When other non-linear loads are already connected to a system, it is likely there will be pre-existing harmonic voltage distortion on the common bus which supplies both the new 12-pulse rectifier and the other loads. The 12-pulse rectifier can only reduce harmonics caused by its loads and will not attenuate harmonics caused by other loads. Pre-existing loads that cause voltage to be distorted will also increase the harmonic current distortion flowing into all other loads on the system, including the 12-pulse rectifier. Normally, pre-existing voltage distortion will increase the residual harmonic current distortion by the algebraic amount of the voltage distortion. If the voltage distortion on a bus is 2.5% THD-V, you can expect the current distortion to increase by this amount. Therefore, a 12-pulse rectifier that contributes only 10% THD-I, may actually measure 12.5% THD-I if the background voltage distortion is 2.5% THD-V.

Effects of Unbalanced Line Voltage

Phase multiplication techniques rely upon balanced line currents for proper cancellation of harmonics. **Arteche PQ** uses series connection of the bridge rectifiers to assure balanced currents flow in all rectifier bridges, and maximum attenuation of harmonics is achieved. However, when the 12-pulse transformer is supplied by unbalanced line voltages, the effectiveness of the harmonic cancellation system is reduced. Theoretically, a 12-pulse rectifier system will cancel 5th, 7th, 17th and 19th harmonics. In real life operating conditions they will still be present but to a much lesser degree. The total harmonic current distortion (THD-I) at the transformer primary will normally be between 10% to 15% THD-I under full load operating conditions. As with most harmonic mitigation solutions, the percentage of THD-I may increase under light load conditions. The existence of unbalanced line voltage will cause non-characteristic harmonics to be present on the system and will increase the residual total harmonic current distortion above the predicted values. Additionally, triplen harmonics, which are normally not present in balanced three phase systems, may appear in an unbalanced system, adding significantly to the residual harmonic current distortion. The user should make every effort to balance the three line voltages.



Your Choice of Rectifier Configurations

Component Kits for System Integrators or Nema 1 Assemblies

ARTECHE PQ gives you the choice—use one of our fully assembled rectifier conversion kits or assemble and wire it yourself by using one of our Do-It-Yourself component kits. Choose from either 12-pulse or 18-pulse depending on the power quality objectives for the application.

Basic Components Kit

The basic kit consists of the phase shifting transformer and a power electronics panel.

12-pulse

The Basic (12-pulse) Component Kit consists of the phase shifting, shielded isolation transformer plus a panel consisting of one six pulse bridge rectifier. Transformer output voltage is one-half of the applied input line voltage, so the series connection of two DC bridges adds up to full and normal DC bus voltage.

18-pulse

The Basic (18-pulse) Component Kit consists of the phase shifting, shielded isolation transformer plus a panel consisting of two six pulse bridge rectifier. Transformer output voltage is one-half of the applied input line voltage, so the series connection of two DC bridges adds up to full and normal DC bus voltage.

PCK Rectifier Conversion Kits utilize phase multiplication techniques to achieve cancellation of specific harmonics and reduction of total harmonic current distortion. When properly selected and applied, the typical total harmonic current distortion at the transformer input terminals can be 5% THD (18-pulse) and less than 12% THD for 12-pulse. Therefore, the distortion at the utility metering point can be well under 5% THD-I when other linear loads are operating. Actual distortion levels may vary for unbalanced line voltage and for voltage distortion caused by other loads.

Enclosed Upgrade Kits

ARTECHE PQ will completely assemble and wire the rectifier into a NEMA style enclosure of your choice. This version makes it convenient for you to drop ship a complete filter right to the job site.

Improved Transient Protection of input diodes

Arteche PQ Multipulse Rectifier Conversion kits achieve 12 or 18 pulse rectification through the series connection of multiple bridge rectifiers. Each bridge rectifier consists of high voltage rated diodes and is supplied with only one-half (12-pulse) or one-third (18-pulse) of the line voltage. The series addition of the bridge rectifiers achieve full and normal DC bus voltage. Since under normal operating conditions each diode is supplied with only a fraction of its rated voltage, making them less susceptible to overvoltage transients.



Selection is easy!

Type PCK Multi-pulse Rectifier Upgrade kits are suitable for 6-pulse type variable frequency drives that provide access, through a removable DC link, for connection in series with the positive DC bus. Type PCK rectifier upgrade kits are intended for variable torque applications such as fans and pumps.

For variable torque applications: (Fans and pumps operated by variable frequency drives)

Determine the total load horsepower, KW or current rating. Select the appropriate filter based on either HP, KW or full load current.

For other voltages and load ratings:

Consult factory for 50Hz ratings, other voltage ratings and higher load ratings.

12-pulse Basic OEM Kit			
HP	KW	Rated Motor FLA	Catalog Number
10	7.5	14	PCK 12 0010 436 OPN
15	11	21	PCK 12 0015 436 OPN
20	15	27	PCK 12 0020 436 OPN
25	18.5	34	PCK 12 0025 436 OPN
30	22	40	PCK 12 0030 436 OPN
40	30	52	PCK 12 0040 436 OPN
50	37	65	PCK 12 0050 436 OPN
60	45	77	PCK 12 0060 436 OPN
75	55	96	PCK 12 0075 436 OPN
100	75	124	PCK 12 0100 436 OPN
125	93	156	PCK 12 0125 436 OPN
150	112	180	PCK 12 0150 436 OPN
200	150	240	PCK 12 0200 436 OPN
250	186	302	PCK 12 0250 436 OPN
300	225	361	PCK 12 0300 436 OPN
350	261	414	PCK 12 0350 436 OPN
400	300	480	PCK 12 0400 436 OPN
450	336	515	PCK 12 0450 436 OPN
500	375	596	PCK 12 0500 436 OPN

12-pulse Nema 1 Assembly			
HP	KW	Rated Motor FLA	Catalog Number
10	7.5	14	PCK 12 0010 436 N1
15	11	21	PCK 12 0015 436 N1
20	15	27	PCK 12 0020 436 N1
25	18.5	34	PCK 12 0025 436 N1
30	22	40	PCK 12 0030 436 N1
40	30	52	PCK 12 0040 436 N1
50	37	65	PCK 12 0050 436 N1
60	45	77	PCK 12 0060 436 N1
75	55	96	PCK 12 0075 436 N1
100	75	124	PCK 12 0100 436 N1
125	93	156	PCK 12 0125 436 N1
150	112	180	PCK 12 0150 436 N1
200	150	240	PCK 12 0200 436 N1
250	186	302	PCK 12 0250 436 N1
300	225	361	PCK 12 0300 436 N1
350	261	414	PCK 12 0350 436 N1
400	300	480	PCK 12 0400 436 N1
450	336	515	PCK 12 0450 436 N1
500	375	596	PCK 12 0500 436 N1

Typical residual harmonic current distortion with ARTECHE PQ 12-pulse rectifier upgrade is 10% - 12% THD-I, at full load and with balanced line voltages.

Selection is easy!

Type LPF filters are suitable for one or more 6-pulse type non-linear loads. LPF filters are not intended for use with linear loads.

For variable torque applications: (Fans and pumps operated by variable frequency drives)

Determine the total load horsepower, KW or current rating. Select the appropriate filter based on either HP, KW or full load current.

For constant torque applications: (Non—fan and pump applications)

Determine the maximum current (ampere) requirement. Select the appropriate filter based on the maximum required current in amperes. Example: a 100HP, 124FLA motor drive, to be operated temporarily at 130% over current requires a filter rated for at least 161 amps (LPF 125 480 KS).

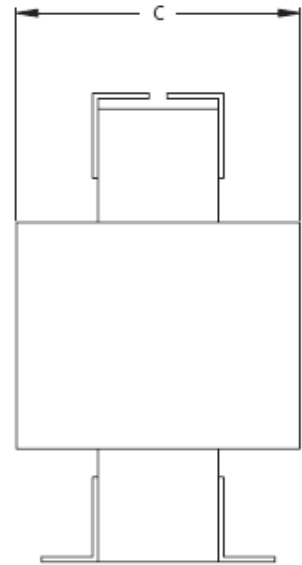
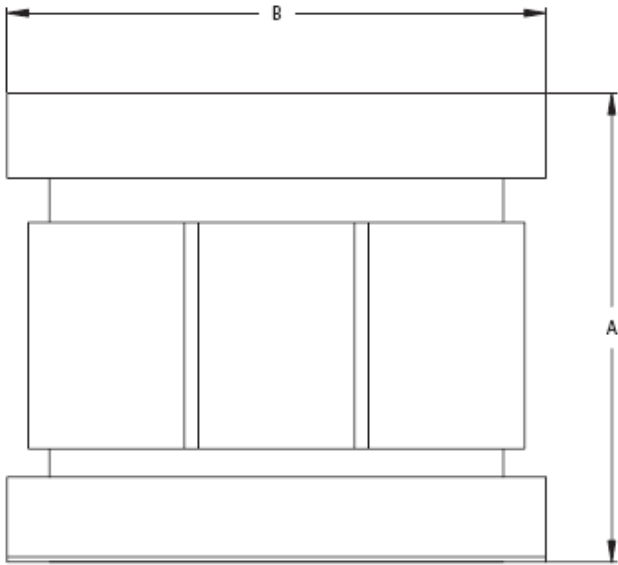
18-Pulse Basic OEM Kit			
HP	KW	Rated Motor FLA)	Catalog Number
10	7.5	14	PCK 18 0010 436 OPN
15	11	21	PCK 18 0015 436 OPN
20	15	27	PCK 18 0020 436 OPN
25	18.5	34	PCK 18 0025 436 OPN
30	22	40	PCK 18 0030 436 OPN
40	30	52	PCK 18 0040 436 OPN
50	37	65	PCK 18 0050 436 OPN
60	45	77	PCK 18 0060 436 OPN
75	55	96	PCK 18 0075 436 OPN
100	75	124	PCK 18 0100 436 OPN
125	93	156	PCK 18 0125 436 OPN
150	112	180	PCK 18 0150 436 OPN
200	150	240	PCK 18 0200 436 OPN
250	186	302	PCK 18 0250 436 OPN
300	225	361	PCK 18 0300 436 OPN
350	261	414	PCK 18 0350 436 OPN
400	300	480	PCK 18 0400 436 OPN
450	336	515	PCK 18 0450 436 OPN
500	375	596	PCK 18 0500 436 OPN

18-Pulse only Nema 1 Assembly			
HP	KW	Rated Motor FLA)	Catalog Number
10	7.5	14	PCK 18 0010 436 N1
15	11	21	PCK 18 0015 436 N1
20	15	27	PCK 18 0020 436 N1
25	18.5	34	PCK 18 0025 436 N1
30	22	40	PCK 18 0030 436 N1
40	30	52	PCK 18 0040 436 N1
50	37	65	PCK 18 0050 436 N1
60	45	77	PCK 18 0060 436 N1
75	55	96	PCK 18 0075 436 N1
100	75	124	PCK 18 0100 436 N1
125	93	156	PCK 18 0125 436 N1
150	112	180	PCK 18 0150 436 N1
200	150	240	PCK 18 0200 436 N1
250	186	302	PCK 18 0250 436 N1
300	225	361	PCK 18 0300 436 N1
350	261	414	PCK 18 0350 436 N1
400	300	480	PCK 18 0400 436 N1
450	336	515	PCK 18 0450 436 N1
500	375	596	PCK 18 0500 436 N1

Typical residual harmonic current distortion with ARTECHE PQ 18-pulse rectifier upgrade is 5% THD-I at full load, and with balanced line voltages.



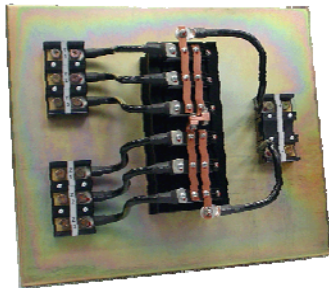
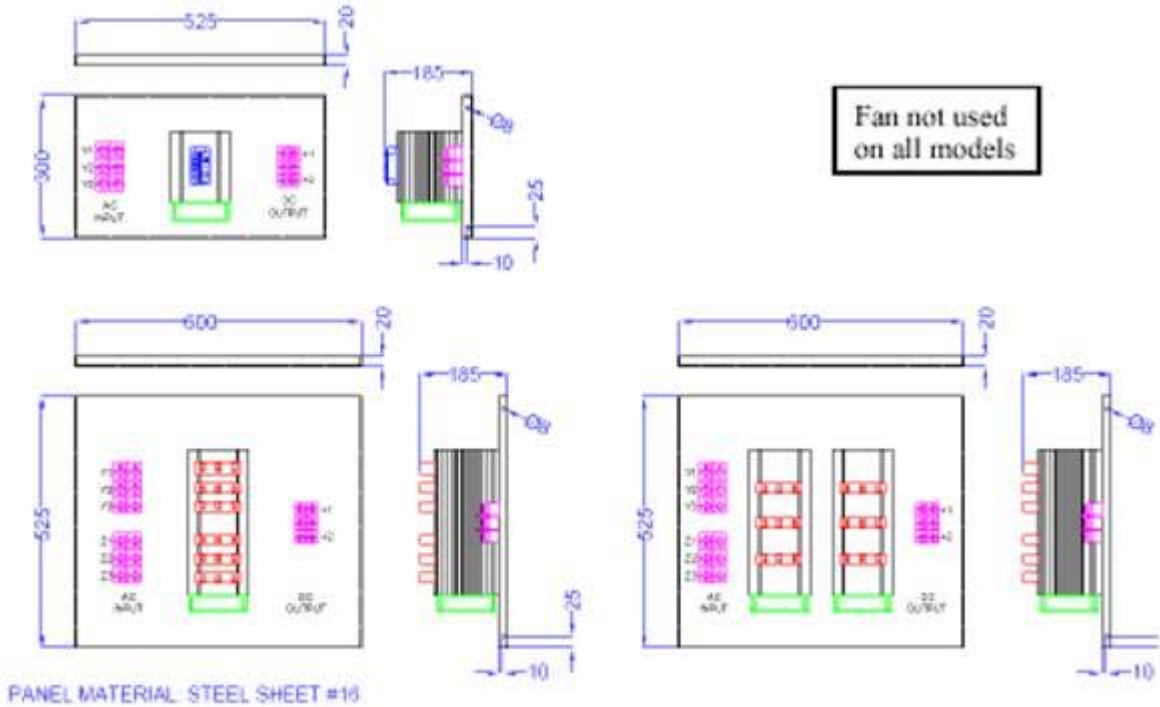
Transformer Data (12—Pulse & 18 – Pulse)



HP	KW	kVA	A Height (inches)	B Width (inches)	C Depth (inches)	Weight (Lbs)	Watts Loss
10	7.5	14	13	15	10	240	800
15	11	21	16	18	11	285	1500
20	15	27	16	19	11	285	1600
25	18.5	34	17	21	11	310	1650
30	22	40	17	21	11	310	1700
40	30	51	19	24	11	325	1800
50	37	63	19	24	13	355	2000
60	45	75	19	24	14	385	2400
75	55	93	22	28	15	475	2500
100	75	118	22	30	16	600	3500
125	93	145	24	30	15	700	3600
150	112	175	24	32	16	925	4700
200	150	220	25	34	17	1150	4900
250	186	275	25	34	19	1280	5400
300	225	330	30	38	21	1350	6300
350	261	385	34	45	18	1475	6800
400	300	440	34	45	18	1775	7300
500	375	550	34	45	21	2150	8500



Power Electronics Panel Data



HP	KW	Panel Size W x H (inches)	12-pulse Weight (Lbs)	12-pulse Watts Loss	18-pulse Weight (Lbs)	18-pulse Watts Loss
10	7.5	21 x 12	15	35	25	70
15	11	21 x 12	15	50	25	100
20	15	21 x 12	15	60	25	120
25	18.5	21 x 12	15	65	25	130
30	22	21 x 12	18	110	30	220
40	30	21 x 12	18	140	30	280
50	37	21 x 12	18	175	30	350
60	45	24 x 21	20	108	34	220
75	55	24 x 21	20	135	34	270
100	75	24 x 21	20	165	34	330
125	93	24 x 21	22	240	36	480
150	112	24 x 21	22	255	36	510
200	150	24 x 21	32	270	36	540
250	186	24 x 21	32	360	36	720
300	225	24 x 21	36	450	50	900
350	261	24 x 21	36	540	50	1000
400	300	24 x 21	40	600	55	1200
500	375	24 x 21	40	750	55	1500
600	450	24 x 21	40	930	55	1860

Contact ARTECHE PQ, INC. for solutions to Harmonic Distortion and Power Factor

Low Voltage, Medium Voltage and High Voltage Solutions



Harmonic Filters

Low Pass Harmonic Filters
Tuned Harmonic Filters
Active Filters
Automatic Harmonic Filters
Dynamic Harmonic Filters
Soft Switching Harmonic Filters
Hybrid Harmonic Filter Systems
Distributed Mitigation Solutions

Power Factor Improvement

Fixed Capacitor Systems
De-Tuned Capacitor
Active PF Compensation
Automatic Capacitors
Dynamic VAR Compensation
Soft Switching Capacitor Systems
Hybrid Capacitor Systems



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