

# FACTS

from Ronk Electrical Industries, Inc.

Bulletin 11981

# Rotary Phase Converters



# FREQUENTLY ASKED QUESTION & ANSWERS

## What are the ROTO-CON® and ROTOVERTER® power converters?

The ROTO-CON® and ROTOVERTER® are rotary phase converters. These converters manufacture 3-phase current from a single-phase supply. This allows use of 3-phase motors and equipment where installation of a commercial 3-phase supply is impractical or too expensive. The ROTO-LOAD CENTER® is a customized converter system using either one of these rotaries for special applications.

## Why use a ROTO-CON® and ROTOVERTER® with 3-phase motors rather than single-phase motors?

Single-phase motors are available only in limited types and may not be applicable to some machinery. Many machines are supplied with 3-phase motors already installed. Single-phase motors are mechanically more complex and are generally more expensive than 3-phase motors. Many single-phase motors cannot match performance characteristics the load requires, and are not as efficient as a 3-phase motor operated by a converter would be.

A properly applied phase converter allows operation of 3-phase equipment from a single-phase service. The simplicity of the 3-phase motors and controls are maintained. If 3-phase service later becomes available, all equipment is ready for operation.

## How would you describe the ROTO-CON® and ROTOVERTER®?

A rotary converter consists of a rotary base unit and one or more capacitor panels. The base unit appears similar to an integral horsepower 3-phase motor, but with no shaft extending from the endbell. One capacitor panel is connected to the base unit. The panel and base function together to provide 3-phase power. Additional capacitor panels may be connected on the load side of the starter(s) for the larger motor(s). The base unit's induction rotor, with its two bearings, is the only moving part. The base has no brushes or switches and is virtually maintenance free, other than lubrication of the bearings.

## How does the ROTOVERTER® differ from other rotary phase converters?

The patented ROTOVERTER® is the only rotary phase converter employing a tapped winding. The tap adjustment feature allows currents to be balanced better than with standard rotary converters, thereby providing maximum equipment performance. Converters without a tapped winding, such as the RONK ROTO-CON, are suitable for applications where motors are not fully loaded and/or 3-phase current balancing is not critical.

## Why does RONK manufacture both rotary and static converters?

Satisfactory operation requires application of the best converter for the job. Only RONK provides the broad product line and experience necessary to provide the best converter for any application.

Autotransformer-capacitor type static converters are generally recommended for constant load applications, like most fans or pumps, with one or two motors. The ADD-A-PHASE® offers very good starting torque, high efficiency, easily accommodates automated controls, and allows operation of the motor at its rated load.

The ROTO-CON® and ROTOVERTER® are usually recommended for the operation of a group of motors, or motors with considerable load variations. Use of a single converter in multiple-motor applications can result in lower initial cost and better load flexibility. The ROTO-CON® can also be used to power resistive heating loads. The ROTO-LOAD CENTER®, which uses a rotary converter, is usually recommended for rectifier or electronic loads, such as CNC machine tools.

## SELECTION & APPLICATION

### How is a properly sized ROTO-CON® or ROTOVERTER® selected?

The selection of a converter depends on the load to be operated. RONK sales engineers should be consulted for recommendations on any application, based upon a listing of the loads to be operated.

### What is the total horsepower which can be operated from a ROTO-CON® or ROTOVERTER®?

The ROTO-CON® and ROTOVERTER® are rated in KVA. Approximately 1 HP may be operated for each KVA of the converter's rating.

### What is the largest motor size which may be operated from a ROTO-CON® or ROTOVERTER®?

An individual motor having a horsepower rating of one-half the KVA rating may be operated on a Type P ROTO-CON® or a Type C ROTOVERTER®. Type D ROTOVERTERs® and Type D-1 ROTO-CONs® are capable of starting single motors of horsepower nearly equal to the converter's KVA rating.

### What if more than one "large motor" is involved?

Many applications involved two or three large motors and a number of small motors. A relatively simple option (split capacitor panels) is available to maintain good 3-phase balance under these conditions.

### What is the smallest motor load which may be operated on a ROTO-CON® or ROTOVERTER®?

If the converter is set up to run maximum load, the smallest horsepower load should be at least 15% of the converter's Total HP rating. The ROTO-CON® and ROTOVERTER® are designed to provide good 3-phase balance as motor loads are varied from this minimum to the full rating of the converter. Motors with lower horsepower ratings than this 15% minimum may be operated if another motor rated above the 15% minimum will be operating at the same time. For electronic loads or other non-motor loads, consult the factory.

### When is the Type D ROTOVERTER or Type D-1 ROTO-CON recommended?

The Type D ROTOVERTER® is generally recommended for a single piece of equipment with varying loads or where a large number of small motors, relative to the total load, are involved. The Type D-1 ROTO-CONs® most often operate electronic and rectifier loads requiring 3-phase. Some electronic loads may require a customized converter, such as our ROTO-LOAD CENTER®.

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Service & Support: 1-217-563-8333

# FREQUENTLY ASKED QUESTION & ANSWERS

## **When is the Type C ROTOVERTER recommended?**

The Type C ROTOVERTER® should be considered if the majority of the load consists of one or two larger motors that operate continuously near full load, where good current balance between phases is necessary, but other motors also may run simultaneously. Grain drying fans operating continuously, with grain handling equipment also running at times, would be an example.

## **When is the economical ROTO-CON® recommended?**

The ROTO-CON® is recommended for loads where current balance is not as critical, such as machine tools, woodworking equipment, welders, grain handling, or center pivot irrigation systems. Current balance is generally not as critical on these loads because the motors generally are not operating near their full load rating or come on intermittently. They are also applicable for most electronic or resistive heat loads.

## **Can variable or multiple speed motors be operated satisfactorily from a ROTO-CON® or ROTOVERTER®?**

Multiple speed motors have different characteristics when operated at different speeds and thus appear to be different motors. Multiple speed motors may be thought of as being several motors built into one frame. The ROTO-CON® & ROTOVERTER® will operate these types of motors. Variable speed motor drives are a rectifier load and require special consideration, consult the factory for a recommendation.

## **May motors on applications requiring high starting torque be operated from the ROTO-CON® or ROTOVERTER®?**

Motors applied to loads which require high starting torque may require use of an auxiliary starting panel. The starting panel, connected to the load side of the motor starter, will provide as much as 200% of the full load torque during starting. Standard starting panels are limited to twenty starts per hour. Special panels are available if more starts per hour are required. Without the panel, starting torque will be approximately equal to the full load torque, which may be inadequate for loads requiring high starting torque, or high inertia loads. Additional starting torque may also be gained by using an oversized converter, or by starting other motors prior to starting the hard starting load.

## **Can the ROTO-CON® or ROTOVERTER® be used for reversing duty electric motors?**

Standard ROTO-CON® and ROTOVERTERS® may be used on a reversing application, since there is no limit on motor starts per hour. Care needs to be taken to provide proper phasing of control circuits and capacitors (if any) on the load side of the starter. Plug reversing, however, requires special compensation and the factory should be consulted.

## **Will the ROTO-CON® or ROTOVERTER® operate both delta and wye wound motors?**

Yes. The type of winding is immaterial as far as operation of the ROTO-CON® or ROTOVERTER® is concerned.

## **Can single-phase loads be supplied from the ROTO-CON® or ROTOVERTER®?**

If single-phase loads, such as control circuits, are applied in addition to the motors, these should be connected to the "B" and "C" phases only. "B" and "C" are the single-phase coming through the unit. Ronk uses "A" as the labeling convention for the converter's manufactured phase. Large single-phase loads may be connected to phase "B" and "C" if the additional current from these loads is taken into account during wiring. Connection of single-phase loads to "A" phase is not recommended. If the application requires such a connection, the factory should be consulted.

## **How should converters be selected for non-motor loads?**

Although converters are primarily applied with motor loads, the design of the ROTO-CON and the Type D ROTOVERTER® offer very good performance with non-motor loads. Due to the wide variety of load characteristics, however, it is advisable to consult the factory for recommendations. To ensure proper sizing for electronic loads, the maximum and minimum load and voltage tolerances should be specified. The ROTO-LOAD CENTER®, using either of these rotaries, may be recommended for applications with special considerations.

## **What options are available for the ROTO-CON® and ROTOVERTER®?**

RONK has the ability to provide converter modifications that allow satisfactory operation of any load. The most common ROTOVERTER modification is split panels on Type C ROTOVERTERS® for multiple large motors. Converters may also be supplied with contactors for starting the converter or integrating the converter into automated control circuits. ROTO-LOAD CENTERS® can be designed to provide improved voltage regulation for electronic loads or for other types of customized packages.

## **INSTALLATION**

### **Should the power supplier be notified prior to purchasing a ROTO-CON® or ROTOVERTER®?**

The power supplier should be consulted before purchasing any equipment involving a significant increase in load. The power supplier should be furnished with the location of the equipment along with a list of motors involved. The horsepower of each motor should be furnished with the full load amperage, maximum starting amperage, and voltage.

### **What effect will the ROTO-CON® or ROTOVERTER® have on the power supplier's lines?**

The effect upon any power line will vary since power lines have different capacities and existing loads. However, the converters' high power factor and ability to limit inrush currents generally make them a good load for the power supplier's lines.

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# FREQUENTLY ASKED QUESTION & ANSWERS

## **What KVA single-phase supply transformer is required when a ROTO-CON® or a ROTOVERTER® is installed?**

The transformer should have a KVA rating as large as or larger than the rating of the converter, plus the KVA required to accommodate any additional single-phase loads that may be also connected to the transformer.

## **What fuse and wire sizes are required for installation?**

Full load current of the ROTO-CON® and ROTOVERTER® is noted on the converter nameplate (approximately 4.5 amps per KVA at 240V). Single-phase fuses should be sized for at least 115% of this current, and the wire size should be based on at least 125% of this current, unless excepted by Code (455-6,7). The wire must also be sized to prevent excessive voltage drop in long runs. For single panel units, 3-phase wiring to the load should be sized as it normally would be on standard three-phase. For two panel units, size the three-phase wire at 135% of the three-phase load's amperage. All fuses or breakers for the converter and motor loads should be time delay types to allow starting of the converter and motors. Fuse non-motor loads as you would on three-phase power. All wiring should be done by a competent electrician in accordance with applicable electrical safety codes. See Sect. 455 of the NEC for rules governing converter installations.

## **Must motors be located near the ROTO-CON® or ROTOVERTER®?**

The ROTOVERTER® serves as a 3-phase power source and should be considered in much the same manner that a 3-phase service would. When the motor is located a considerable distance from the ROTO-CON® or ROTOVERTER®, careful consideration must be given to the wire size used in order to avoid excessive voltage drop during motor starting.

## **Must motors be equipped with magnetic starters?**

All integral horsepower 3-phase electric motors should be protected with magnetic starters and suitable overload protection. Magnetic starters are also required to prevent simultaneous starting of the converter and load following a power interruption.

## **What special consideration should be taken in locating the ROTO-CON® or ROTOVERTER®?**

The standard rotary transformer and control panels are of drip proof design and may be mounted outdoors. The converter may be operated within an ambient temperature range of -30 to 40 C (-25 to 105 F). Shading from direct sunlight will result in cooler operation and provide longer life for all components. Care should be taken that dirt, snow, ice, or other material does not prevent rotation or impede ventilation of the rotary transformer. The converter must not be exposed to fertilizer or other corrosive chemicals. TEFC units are available, if environmental conditions warrant their use.

## **How are the ROTO-CON® and ROTOVERTER® affected by low voltage?**

The ROTO-CON® and ROTOVERTER® will start and operate below rated voltage. However, it should be noted that low voltage will result in lower motor starting torque and higher amperage for a given motor load. Most applications, therefore, require at least 220V (440V) at full load when operated from a 240V (480V) source. Consult Ronk if lower voltages will be present.

## **How are the ROTO-CON® and ROTOVERTER® affected by high voltage?**

Higher line voltage, above 255V (510V) can adversely affect the converter or load. Contact your power supplier if your single-phase voltage exceeds these limits, to see what can be done to lower it.

## **Are any field adjustments necessary after installation?**

The ROTOVERTER® differs from other rotary converters in that provisions are made for adjustments to optimize performance in any application. The ROTOVERTER® is factory adjusted to provide satisfactory operation for most applications. The phase currents and amperages should be checked under various loading conditions. Where required by particular load characteristics, the capacitance and tap connections should be adjusted according to installation instructions. The ROTO-CON does not have adjustable taps, therefore, only the capacitance can be adjusted on these units.

## **OPERATION & MAINTENANCE**

### **What are the operating fundamentals of the ROTO-CON® and the ROTOVERTER®?**

The rotary transformer is started by a single-phase power source and the capacitance of the connected panel. The converter must be started and reach full speed before any load is applied to it. The two single-phase input lines are connected directly to two of the three-phase output lines. The third line is manufactured by the combination of the rotary transformer and capacitors creating a three phase output with the proper phase angles.

### **May the ROTO-CON® and the ROTOVERTER® be operated without any load?**

This is usually impractical, since the converter will consume power and no work is being performed. Where required by the application, however, the converter can be operated continuously at no load. If considerable idle time is expected, the factory should be consulted.

### **How much power loss occurs in the ROTO-CON® and ROTOVERTER®?**

Maximum power loss occurs at converter idle; approximately 120 watts/KVA for Type D ROTOVERTERS® and D-1 ROTO-CONS®, and 40 watts/KVA for Type C ROTOVERTERS® and Type 2P ROTO-CONS®. Losses in the converter will be lower when the load is applied, typically about one-third the idle values. When the converter is properly balanced, no appreciable change of motor efficiency occurs.

### **What motor starting torque is available when operating from a ROTO-CON® or ROTOVERTER®?**

Motor starting torque is dependent on many factors, but will generally always be less than when started on a 3-phase line. The factory should be consulted with the details of any application requiring high inertia load or a high starting torque.

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# FREQUENTLY ASKED QUESTION & ANSWERS

## **Does the ROTO-CON® or ROTOVERTER® limit motor starts per hour?**

The ROTO-CON® and ROTOVERTER® place no limit on motor starts per hour. Standard auxiliary starting panels are limited to 20 starts per hour of each motor. The factory should be consulted if more starts per hour are required, and a start panel is needed.

## **What motor breakdown torque is available when using the ROTO-CON® or ROTOVERTER®?**

Motor breakdown torque, like starting torque, is dependent on several factors. The breakdown torque generally depends on the size of the motor relative to converter size and number of other motors running. Breakdown torque is typically around twice full load torque, but may be improved by using a Type D or D-1 converter, or by running other lightly loaded motors simultaneously.

## **What effect will changing load have on current balance?**

The ROTOVERTER® and ROTO-CON® are designed specifically for applications where a significant portion of the load may be switched on or off during operation. Balance will vary somewhat with loading, but is generally acceptable for total loads from 15% to 100% of the converter's rated total horsepower load. Balance with the ROTOVERTER® will be better than that of a ROTO-CON® in most applications, typically 10% or less compared with 15% or less for the ROTO-CON®.

Type D ROTOVERTERS® are often recommended for motor loads when a large number of relatively small motors are involved. Typically, good voltage balance can be achieved for total loads from 10% to 100% of the converter's rated total horsepower load. Current balance typically is 10% or less.

## **How will the ROTO-CON® and ROTOVERTER® perform with non-motor loads?**

A properly applied rotary converter is designed to provide acceptable 3-phase power to the equipment. Since many of these applications involve different loads on each phase it is desirable to measure voltages, rather than currents, when checking the converter's outputs for proper balance. Some electronic loads may require isolation transformers to provide improved voltage to the load.

## **If difficulty is encountered, what steps should be taken?**

If any operational problems arise, the troubleshooting guide in the service manual should be consulted. If the solution cannot be determined, contact the factory with the serial numbers of the unit, a complete description of the problem, along with the phase currents and voltage. The readings should be identified "A", "B", and "C", as identified in the converter.

## **Are most electricians qualified to service the ROTO-CON® or ROTOVERTER®?**

An electrician experienced in motor service work normally is qualified to perform service on a ROTO-CON® or ROTOVERTER®. The electrician should perform such service only after having read the connecting instructions, operating manual, and wiring diagram. Technical assistance and copies of service literature are available from the factory.

## **What general maintenance is required for the ROTO-CON® and ROTOVERTER®?**

The ROTO-CON® and ROTOVERTER® should operate for many years without any maintenance, since there are no moving parts except the rotor in the base unit. The rotor bearings are greased at the factory and should be lubricated per the recommendations for an equivalent frame motor according to hours of operation. Consult the factory or a local motor shop for specific recommendations. The oil capacitors in the capacitor panel are UL Recognized, non-PCB capacitors. These capacitors have a very long life, and require no maintenance.

## **What is the availability of ROTO-CON® or ROTOVERTER® replacement parts?**

Replacement parts and factory repair facilities are maintained by RONK for all ROTO-CONS and ROTOVERTERS. The factory must be consulted prior to any service or replacement of parts during the warranty period.

Parts employed in the converter are usually relatively common types, available locally through electrical distributors and motor repair shops. Most repairs to the converter may be handled locally. Technical assistance is available from the factory.