



* "A" phase shall be identified in all accessible locations with a distinctive marking per NEC 455-6 (b). Do not connect control circuits or other single-phase loads to "A" phase (phase with highest voltage to ground when running) from the converter.

** T1 and T2 control leads connect to the load side of the motor starter on the "C" and "B" phases (equivalent single-phase) from the converter.

Power Leads

Control Leads

EGC = Equipment Grounding Conductor

VOLTAGE CHART FOR 240 (480) VOLT 1Ø

Location	Voltage Between	Motor Off - No Current	Motor On - Balanced 3Ø Currents
1Ø Input	L1 to L2	240 (480) Volts +	240 (480) Volts +
At 3Ø Magnetic Starter	L1 to L2 (C-B)	240 (480) Volts ++	240 (480) Volts
	L1 to L3 (C-A)	240 (480) Volts ++	Approx. 240 (480) Volts
	L2 to L3 (B-A)	0 (0) Volts ++	Approx. 240 (480) Volts

- + Line voltage may vary from nominal 240 (480) volts, other voltages will vary proportionally.
- ++ Phase identification can be verified by measuring the motor off voltages on the line side of the motor starters. The phase-to-phase voltage from B-A is 0 volts, so the other phase is "C". With the motor running, "A" phase will always have the highest phase-to-ground voltage. Otherwise, the phase conductors have to be traced from the ECONO-PHASE SHIFTER to the starter.

CONNECTION CHECKLIST

Single-Phase to L1 & L2	<input checked="" type="checkbox"/>
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At 3Ø Motor Starter			
A to L3	<input type="checkbox"/>	EGC(s)	<input type="checkbox"/>
B to L2	<input type="checkbox"/>	T2 to T2	<input type="checkbox"/>
C to L1	<input type="checkbox"/>	T1 to T1	<input type="checkbox"/>

WIRING

- Size A, B, and C leads according to Article 430 of NEC®.
- Size L1 and L2 for 125% MIN of the 1Ø FLA on the ECONO-PHASE SHIFTER nameplate.
- Size EGC (see above) according to Article 250 of NEC.
- Size control leads - #16 MIN.
- See Article 455 of NEC for rules governing phase converter installations.

INTERCONNECTION DIAGRAM FOR ECONO-PHASE® SHIFTER						TYPE AZ or PS-OF
REVISIONS					RONK ELECTRICAL INDUSTRIES, INC. NOKOMIS, ILLINOIS	
	DATE	BY		DATE	BY	DRAWN - NCL DATE - 2/20/08 APP'D - PG DRWG. NO. 2-5345-1
A			F			
B			G			
C			H			
D			I			
E			J			

ECONO-PHASE[®] SHIFTER

240 (480) Volt Input & Output TYPE 2(4)AZ/PS-OF

GETTING STARTED

Before installing the ECONO-PHASE SHIFTER power converter, verify that the single-phase supply voltage matches the converter rating; 240(480) Volts, 60 Hz. Consult the converter nameplate for input voltage and amperage requirements.

The single-phase supply should be connected to the unit through a disconnecting means (a circuit breaker or fused disconnect switch), utilizing a time-delay type breaker or fuses. The ampere rating of the disconnecting means shall not be less than 115% of the single-phase ampere rating of the ECONO-PHASE SHIFTER. A three pole across-the-line starter with appropriately sized overloads is highly recommended for proper motor operation and protection. All wiring should be done by a qualified electrician in accordance with all applicable electrical codes. See Article 455 of the NEC[®] (and other applicable Articles) for rules governing phase converter installations.

The following connections need to be made (**see diagram on reverse side for more details**).

- Equipment ground(s):
 - All equipment must be properly grounded. See Article 250 of the NEC for proper grounding and bonding.
- Input: (L1, L2)
 - Connect incoming single-phase service to L1 and L2.
- Motor Starter: (C, B, A) and (T1, T2)
 - Connect the power leads C to L1, B to L2, and A to L3 on the **line** side of the starter.
 - "A" phase must be distinctly marked at all accessible locations.
 - Connect the control leads T1 to T1 and T2 to T2 on the **load** side of the starter (with the motor leads).

Do not connect starter coils, control transformers, or single-phase loads to "A" phase (manufactured phase) from the converter. "A" phase may only be used to power the three-phase motor.

STARTING THE MOTORS

Close the single-phase disconnecting means, applying voltage to the ECONO-PHASE SHIFTER. Measure and record the voltages on the line side of the motor starter. The measured voltage from B-A will be 0 volts and the "A" phase conductor should have been distinctly marked at the time of installation. The third phase conductor is "C". You should now be ready to start the motor.

When starting the motor, observe the following sequence of events.

- 1) The motor is energized.
- 2) The ECONO-PHASE SHIFTER auxiliary relay should energize immediately and remain closed.
- 3) The ECONO-PHASE SHIFTER start contactor should engage.
- 4) The motor should accelerate to full speed within 1 to 3 seconds.
- 5) The start contactor will drop out and motor will continue running.

IF THE MOTOR DOES NOT REACH FULL SPEED WITHIN 10 SECONDS, SHUT OFF POWER TO STARTER. Place a voltmeter across T1 and T2 of the starter and reenergize the starter long enough to read this voltage. The indicated phase-to-phase voltage on T1-T2 must be above 220 (440) volts for the motor to start properly. If the voltage is adequate and the motor does not start, if feasible, disconnect the motor from its load and attempt to run the motor again. If the motor is okay, it should start almost immediately. **DO NOT ALLOW THE START CONTACTOR TO REMAIN CLOSED FOR MORE THAN 10 SECONDS – LONGER PERIODS CAN DAMAGE THE START CAPACITORS OR OTHER EQUIPMENT!**

BALANCING CURRENTS

In order to use these balancing procedures, the "C", "B", and "A" phases must be properly identified. Phase identification can be verified by measuring the motor off voltages on the line side of the motor starters. The phase-to-phase voltage from B-A is 0 volts, so the other phase conductor is "C". With the motor running, "A" phase will always have the highest phase-to-ground voltage. Otherwise, the phase conductors have to be traced from the ECONO-PHASE SHIFTER to the starter.

The three motor currents ("C", "B", and "A") should be checked with a clamp-on ammeter and balanced if necessary. The motor must be under normal operating load when taking the readings. To balance the currents, follow these procedures.

- 1) Identify the phases at the motor starters as stated above. Then measure the three running amperages on the motor leads.
- 2) If closer balance is desired, shut off and lock out the single-phase disconnecting means for the converter. Discharge all capacitors before beginning to adjust the unit for better current balance.
- 3) If "A" current is considerably higher than "C", a light load condition is indicated. If "A" is near FLA and "B" and "C" currents are higher, an overload condition is indicated. If either of these conditions exists, verify load is correct before proceeding with balancing.
- 4) If "A" is high with "C" low and you have verified the motor is lightly loaded, disconnect some capacitance to bring "A" down and "C" up. Keep "A" current equal or above "C".
- 5) If "A" is lower than "C", more capacitance needs to be connected.
- 6) The "B" phase current cannot be directly adjusted. If "B" current remains significantly high or low, consult RONK.
- 7) For future reference, record the final phase-to-phase voltages, phase currents, and motor off voltages.

Note: If this is a pump jack application, balance the weights to minimize load swing.

If you have any questions about these procedures or need assistance with balancing, call RONK at (217) 563-8333.