INSTRUCTIONS
for
STABILINE ®
Automatic Voltage Regulator

RVK40038B

15KVA
Single Phase
450 Volt, 400 Hz Input
115 Volt Output
Single Control

Superior Electric reserves the right to make engineering changes on all its products. Such refinements may affect information given in the instructions. Therefore, USE ONLY THE INSTRUCTIONS THAT ARE PACKED WITH THE PRODUCT.

WARNING: **High voltages are present inside this unit during operation. Do not operate this unit unless all covers are in place.** Installation and servicing should only be done by qualified personnel.

Superior Electric

213709-216 Rev. H

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1.0. INSPECTION

1.1. UNPACKING

When unpacking the unit, examine it carefully for any shipping damage. The "Damage and Shortage" instructions packed with the unit outlines the procedure to follow if any parts are missing or damaged.

2.0. DESCRIPTION

2.1. GENERAL

RVK40038B STABILINE® Automatic Voltage Regulators are fast acting, fully isolated step down regulators which provide regulated output power for sensitive loads. These voltage regulators are designed for a 450 volt, 400 Hz, single phase input and a 115 volt, single phase output. These voltage regulators incorporate an analog electronic control section and a power section consisting of one or more motor driven POWERSTAT® Variable Transformers which control the voltage to the primary side of the isolation transformer. See the rating sections and unit nameplate for complete specifications.

Advantages of the RVK40038B voltage regulators include high efficiency (>90%), high overload capacity and low impedance. These voltage regulators are insensitive to the magnitude and power factor of the load, and have little to no effect on system power factor. This means these units can be used with any type load.

2.2. THEORY OF OPERATION

The RVK40038B STABILINE® Voltage Regulators maintain a constant regulated AC output voltage by simulating an infinite number of taps, between two real taps, on the input of an isolation transformer. This is accomplished automatically by adjusting a POWERSTAT® Variable Transformers connected between a boost tap and a buck tap of the isolation transformer. Using the brush of the POWERSTAT as the input point, the “input tap” and thus the output voltage can be controlled with great accuracy.

A solid-state control unit detects the output voltage and continually compares it with output and accuracy settings selected by the user. If the voltage is out of specification, the control unit drives the POWERSTAT Variable Transformer, by means of a stepping motor circuit, to the required new position.

There is a control circuit override that will place the unit in a full boost condition to give the maximum output voltage possible. This override is activated by applying 24 VDC to terminals 5 and 6 of TB1.

The main isolation transformer provides input to output isolation. This transformer also produces the required step down voltage.

3.0. INSTALLATION

3.1. TRANSPORTING THE VOLTAGE REGULATOR

These units are shipped on skids and should not be stacked. Due to its weight the proper procedures must

be followed when transporting the unit and moving it into the location where it is to be installed.

The proper method for moving these units is to use a forklift under the skid. These units can be stood up on their bottom if the outside enclosure is completely bolted in place. Without the enclosure cover in place the unit must be placed on the back.

To mount the unit to a wall or bulkhead it is recommended that the unit be carried into position by a lift under the unit with the enclosure cover in place. After bolting the unit in place the lift can be removed.

3.2. MECHANICAL INSTALLATION

The voltage regulator is designed for wall or bulkhead mounting. To mount the unit it is recommended that the unit be carried into position using a lift under the unit with the enclosure cover in place. **Do not lift unit by the top cover.** After bolting the unit in place the lift can be removed. All internal components and wiring connections are accessible with the enclosure cover removed.

3.3. ELECTRICAL INSTALLATION

The RVK40038B voltage regulators are designed to be hard-wired to the input power and the load using copper wire. Maximum rated input and output currents for each unit are given in the enclosed rating chart and on the nameplate. Select a wire size that is adequate to carry the maximum rated current as specified by local and national code requirements.

The front cover of the voltage regulator must be removed to allow access to the input and load terminals. To remove the cover remove the ¼ inch hardware (12) along the side and bottom of the unit, which hold the front cover in place, and lift it off the base or backplane. Entry panels are provided on each side of the unit for wire entry and exit. These panels are removable so the user can modify them with any hole pattern required.

The input power connections are labeled L1 and L2 for the two hot lines and the load connections are labeled T1 and T2. Each unit can be connected for a single phase application or three units can be connected for a three phase Delta input Wye output configuration.
When used in a Delta to Wye application T2 would be NEUTRAL for the Wye output. Refer to the connection Diagram page 15.

The outputs of the RVK40038B voltage regulators are floating (not referenced grounded). If any connection to ground is required it must be made by the user.

To use the optional full boost override function an external 24 volt DC source must be connected to terminals 5(+) and 6(-) of TB1. When the 24 volts is applied to these terminals the unit no long regulates to the set voltage but provides the maximum AC output voltage possible.

4.0. START UP

The Output Voltage Adjustment and the Sensitivity potentiometers are set at the factory for nominal output voltage and approximately 1% accuracy, and should not be readjusted until the power conditioner is initially energized.

After all input and output connections are completed and checked, place the front cover(s) in position and bolt in place.

Energize the regulator power source. The output voltage should be 115 volts ±1%.

5.0. OPERATION

5.1. CONTROLS

5.1.1. General

The control board contains the circuitry that senses the output voltage and determines if correction is needed. When correction is required this circuit sends a raise or lower signal to the motor drive control which steps the motor driven variable transformer in the proper direction.

5.1.2. Output Voltage Potentiometers

This potentiometer sets the output voltage (T1-T2). The adjustment range is approximately ±10% of nominal output voltage.

5.1.3. Sensitivity Potentiometers (A1-R43)

This potentiometer adjusts the output voltage accuracy and therefore sets how much the output voltage will change before the unit will correct. The accuracy is increase with clockwise rotation of the SENSITIVITY potentiometer. This 10 turn pot located on the control board is preset at the factory and should not require readjustment under normal circumstances.

5.2. FUSE (F1)

One fuse, located under the motor drive cover, is provided to protect for any motor drive transformer failure. If there is no power to the motor drive transformer, check for a blown fuse.

5.3. SETTING OUTPUT VOLTAGE AND SENSITIVITY POTENTIOMETERS

Normally, the RVK40038B voltage regulator should not be operated without the front cover in place. However, if required, during the initial operation the front cover can be removed to allow setting of the SENSITIVITY potentiometer. Again this should not be required under normal circumstances.

5.3.1. Energize Regulator

Energize the conditioner's power source. The output voltage should regulate at 115 volts.

5.3.2. Set Output

Adjust the output voltage by turning the OUTPUT VOLTAGE potentiometer clockwise to increase or counterclockwise to decrease the output voltage. Turning the voltage slightly above the required setting and then decreasing it to the high end of the band is recommended because the unit tends to take smaller steps in this direction.

5.3.3. Set Sensitivity

The sensitivity must be adjusted if the voltage regulator hunts (motor driven variable transformer section of the voltage regulator continually cycles back and forth) or if the regulator allows too great a change from the set voltage before correction occurs.

Turning the SENSITIVITY control clockwise increases the sensitivity to maximum. For maximum sensitivity, turn the SENSITIVITY control clockwise to the point where the POWERSTAT begins to hunt. Turn the control counterclockwise (CCW) until the hunting stops. Turn the control an additional 3/4 turn CCW.

5.4. OUTPUT LINE DROP COMPENSATION

This unit is equipped with a line drop compensation circuit. This circuit monitors the output current and forces the detector circuit to increase the output voltage proportional to the current drawn. The user must set the amount of compensation.

Both resistive and inductive compensation are provided. Set the line drop compensation using the following steps:

1. Insure the two line drop compensation potentiometers are full CCW.
2. If required set the output voltage at no load to the desired output voltage (ex. 115 volts).
3. Connect a full resistive (1.0 P.F.) load at the end of the load lines and adjust the RESISTIVE LINE DROP COMPENSATION POTENTIOMETER until the voltage at the load is again the desired output voltage (ex. 115 volts).
4. Connect a full inductive (0.0 P.F. lag) load at the end of the load lines and adjust the INDUCTIVE LINE DROP COMPENSATION POTENTIOMETER until the voltage at the load is again the desired output voltage (ex. 115 volts).
5. At this point the line drop compensation is set. However, repeating steps 3 and 4 again can help to find tune (tighten the accuracy) the circuit.

5.5. REMOTE SENSING

Normally, these voltage regulators sense and regulate the voltage at the output terminals. In some cases better control can be obtained by regulating the voltage at another point, such as at the end of long lines between the regulator and the load. This is known as remote sensing.

If remote sensing is desired, move the wire (black) connected to terminal #1 to terminal #2 and the wire (white) connected to terminal #3 to terminal #4 on TB1 terminal strip located near the input terminals, inside the unit. This will disconnect the controls sense terminals from the output terminals of the regulator. Connect remote sensing wires to terminals #1 and #3 on the terminal strip. Output terminal T1 and sensing terminal #1 should correspond as should T2 and terminal #3.

5.6. FULL BOOST OVERRIDE

By applying 24 volts DC to terminals #5(+) and #6(-) of terminal strip TB1 the regulator is forced to boost the output voltage as much as possible. The regulator's control circuit is overridden and the Variable Transformer is driven to the maximum output voltage position. Removing the DC voltage allows the control circuit to resume it automatic regulating function.

5.6.1. Close

Replace the front cover.

6.0. MAINTENANCE

To ensure maximum life of the equipment, the following should be part of an **annual** maintenance program.

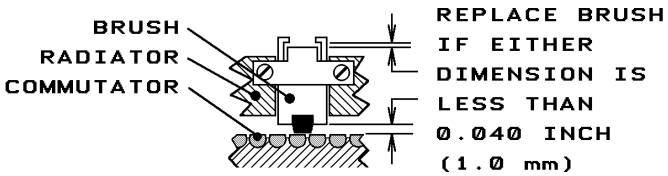
Warning

De-energize unit before performing maintenance. Voltages are present inside this unit which can cause injury. Therefore, only personnel qualified to service electrical equipment should perform maintenance on this unit.

6.1. Vacuum the voltage regulator inside and out to remove accumulated dirt, which could lead to overheating or insulation failure.

6.2. Tighten all electrical connections, particularly all power wiring to, and in, the unit.

6.3. Inspect all variable transformer brushes and commutators for signs of wear or pitting. Replace as required. See diagram.



Do not attempt to clean a commutator with an abrasive such as sandpaper or a file. This will ruin the soft precious metal plating on the commutator and will shorten the life of the unit. It is normal for commutators to become black due to carbon brush tracking. If a commutator is to be cleaned, use denatured alcohol and a soft cloth.

6.4. Inspect the variable transformer drive belts, sprockets, gears, cams, etc. for signs of slippage or wear and adjust as required.

6.5. Check the variable transformer radiator(s) (the die cast part that holds the brush assembly) for signs of slippage, and see if all brushes driven by the same motor are aligned with each other. The alignment of the radiator and brushes depends on the setscrews that hold the variable transformer center tube(s) to the shaft and the setscrews that hold the radiator to the center tube. Adjust and tighten as needed. The radiators and gears in the RVK40038B are pinned and if there is any sign of slippage a pin must have failed.

6.6. Lubrication of the RVK40038B voltage regulator is not required since it has been lubricated at the factory for its lifetime.

7.0. BRUSH ASSEMBLY REPLACEMENT

The brushes in the RVK40038B Automatic Voltage Regulator should last the lifetime of the unit. In the event there is an overload condition or a failure of the brush the brush may need to be replaced.

7.1. The following instructions detail how to replace the brushes on the unit.

1. Power off the unit using the appropriate lock out/tag out procedure.

2. Remove the unit cover from the regulator by removing the twelve (12) 7/16” nuts that secure the cover.

3. Locate the variable transformer stack.

4. Rotate the radiator that holds the brush assembly until the brush assembly is visible.

5. Remove the two (2) screws holding the brush assembly in place and discard the old brush assembly.

6. Insert the new brush assembly in the radiator slot.

7. Replace the two (2) screws holding the brush assembly and tighten them to the radiator.

8. Rotate the brush over the full range several times to ensure that the brush has smooth travel. Be sure to check that the brush fits flat on the commutator over the entire range of the coil.

9. Re install the unit cover using the twelve (12) 7/16 nuts that secure it.

10. Power the unit on and ensure it operates satisfactorily.

8.0. TROUBLESHOOTING

The RVK40038B Automatic Voltage Regulator will provide long, reliable service with little attention. Unless the unit is overloaded, there is little likelihood of component failure.

Warning

Voltages are present inside this unit which can cause injury. Therefore, only personnel qualified to service electrical equipment should perform trouble-shooting procedures on this unit.

If the regulator fails to operate correctly, the following checks will help locate and correct the problem. Refer to the schematic, rating chart and replacement parts list for further information.

8.1. Check the load connected to the voltage regulator to be sure the unit's output current rating is not being exceeded.

8.2. See if there is power to the unit and T5 power transformer. If there is no power to T5 check the fuse (F1) to insure it is not blown.

8.3. If there is output voltage but the motor does not regulate this voltage, check the fuse on the drive transformer. If applicable, check the remote sense wiring.

8.4. If the motor hunts (cycles continuously), readjust the SENSITIVITY control.

8.5. If a motor drives a POWERSTAT variable transformer to one end of its travel, and the voltage decreases when it should increase or increases when it should decrease, check to see if the input and output power connections to the voltage conditioner are reversed. If applicable, check the remote sense wiring.

8.6. If the motor has driven to one end or does not drive at all, check to ensure the motor drive is functioning correctly.

Disconnect the plug on control board 227412-004. With power supplied to the input, short the plug terminal JP1-3 to JP1-1 to drive the motor CW or short JP1-2 to JP1-1 to drive it CCW. If this does not drive there is a problem with the motor board circuit. If the motor operates successfully in this test the problem may be with the control board.

8.7. Inspect the POWERSTAT Variable Transformer brush(s) and commutator(s) for signs of wear or damage. The brush assemblies on the variable transformer section will not need replacement under normal conditions. When excessive brush wear or commutator damage occurs, it is usually the result of an overload. If either condition exists, the POWERSTAT Variable Transformer section or the brush must be replaced or repaired. Check the load to be sure the output current rating of the voltage conditioner is not being exceeded.

Do not attempt to clean a commutator with an abrasive such as sandpaper or a file. This will ruin the soft precious metal plating on the commutator surface and will shorten the life of the unit. It is normal for commutators to become black due to carbon brush tracking. If a commutator is to be cleaned, use denatured alcohol and a soft cloth.

8.8. Check the variable transformer radiator(s) (the die cast part that holds the brush assembly) for signs of slippage, and see if all brushes driven by the same motor are aligned with each other. The alignment of the radiator and brushes depends on the setscrews that hold the variable transformer center tube(s) to the shaft and the setscrews that hold the radiator to the center tube. Adjust and tighten as needed.

9.0. INSTALLING NEW DRIVE BELT

9.1. The following instructions and pictures are as viewed from the bottoms of the unit. These instructions are applicable on units **above serial # 35978**. Units below that serial # motor board assembly must removed.

1. Turn off power to the unit using lock out/tag out procedure.

2. Remove the unit cover from the LVR by removing the twelve (12) 7/16" nuts that secure the cover.

3. Remove the motor board assembly bottom cover by removing the six (6) retaining screws. The two (2) on the variable transformer side will require a stubby blade screwdriver to remove. Do not remove the three (3) screws that secure the line compensation **plate to the master plate.**

4. Remove the drive motor by removing the four (4) fasteners. A 5/32" Allen wrench and a 3/8" socket or box wrench will be required. Rotate the motor out of the way and reinstall one set of mounting hardware so the motor is not hanging on the wiring. It is not necessary to disconnect any wiring or other components.

5. Remove the three (3) screws holding the bushing plate in place. See picture #1

6. Place the new belt half way through the large opening showing before the bushing plate is moved.

7. Rotate the bushing plate counter clockwise through the opening of the belt allowing one side of the belt to go over the shaft and cams. See picture #2.

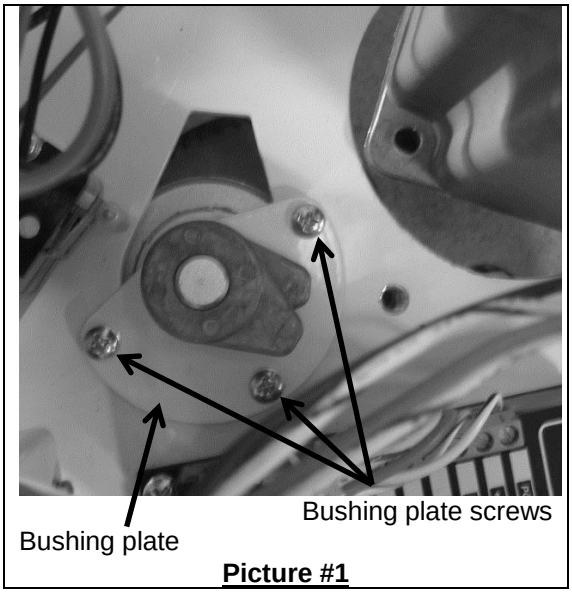
8. Continue rotating the bushing plate counter clockwise until the plate is again lined up with the mounting holes.

9. The belt is now wrapped around the variable transformer center shaft and can be pushed to the pulley side of the motor board.

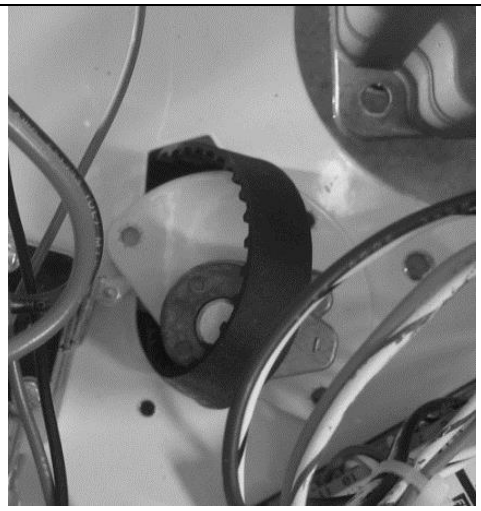
10. Replace the three (3) screws to hold the bushing plate in place and tighten.

11. Re-install the drive motor while placing the newly installed drive belt on the variable transformer and motor pulleys. Tighten the drive motor mounting hardware.

12. Move the radiator of the variable transformer by hand to verify the motor and new drive belt rotate smoothly over the full range in both directions.



Picture #1


Picture #2

13. Re-install the motor board assembly bottom cover using the six (6) retaining screws.

14. Re-install the overall LVR shroud cover using the twelve (12) 7/16" nuts.

15. Turn power to unit back on and test the LVR's performance.

10.0. RATING

10.1. POWER RATINGS

The following ratings apply to **RVK40038B** Voltage regulator

INPUT:

VOLTAGE:	450 (427-464)
FREQUENCY:	400 Hz
CONNECTION:	1 Phase, 2 Wire
MAX AMPS	40

OUTPUT:

VOLTAGE:	115
MAX. KVA:	15
MAX. AMPS:	130
CONNECTION:	1 Phase, 2 wire

10.2. GENERAL SPECIFICATIONS

Electrical:

Output Accuracy	Adjustable to ±1%
Response Time	14.0 milliseconds
Load Capacity	100% rated continuous 200% rated 60 seconds 400% rated 3 seconds 600% rated 1 second 800% rated 0.5 second 1000% to 2500% 1/2 cycle inrush
Load Power Factor	0 lagging to 0 leading
Load Crest Factor	6 Max (I peak / I RMS)
Efficiency	95% typical
Harmonic Distortion	Less than 1% added
Surge Withstand Capability	6000 volts per IEEE C62.41, location category B
Impedance	4% (typical)

Environmental:

Service Conditions	Units are housed in NEMA 3R ventilated enclosures, intended for indoor use under usual service conditions.
Temperature	
Operating	Average ambient temperature for any 24 hour period not to exceed 30°C (86°F), and maximum temperature not to exceed 40°C (104°F). Average ambient temperature for any 24 hour period may be increased to 40°C (104°F),and the maximum temperature may be increased to 50°C (122°F),if the load is decreased to 90%of standard rating. Minimum temperature is 0°C (32°F).
Storage	-40°C to +70°C (-40°F to +158°F)
Humidity (Operating and Storage)	10 to 75% average relative humidity for any 7 day period, and maximum relative humidity not to exceed 95% non-condensing.
Altitude	
Operating	

Maximum Altitude	Derating
6,600 Ft.(2,000 meters)	No de-rating
10,000 Ft.(3,000 meters)	load to 95%,ambient 30°C (86°F)
15,000 Ft.(4,500 meters)	load to 90%,ambient 20°C (68°F)

Storage	50,000 Ft.(15,000 meters)max
Physsical	
Weight	
Unit	179 lbs.
Shipping	297 lbs.
Size & Center of Gravity	See page 14

11.0. REPLACEMENT PARTS

11.1. ORDERING

It is impractical to provide a full list of replacement parts in this manual. To order a part not listed in this manual, provide the unit model number, serial number, and date code.

11.2. MOTOR DRIVEN POWERSTAT ASSEMBLY ✶

The complete motor driven POWERSTAT® assembly which includes the Variable Transformer deck, the motor board drive parts and the motor is part number **228920-001**. This assembly includes all of the control cards mounted to top bracket.

11.3. REPLACEMENT BRUSH ASSEMBLY ✶✶

Each POWERSTAT® Variable Transformer contains a durable brush assembly. These assemblies are designed to reduce the need for attention or replacement; however, because these are moving parts that rely on contact friction to operate properly, an annual inspection is suggested. Refer to the maintenance section of this manual for details. Part number for a replacement brush assembly is listed below.

REPLACEMENT BRUSH ASSEMBLY FOR T1:
176012-005

11.4. MOTOR BOARD ASSEMBLY, A1

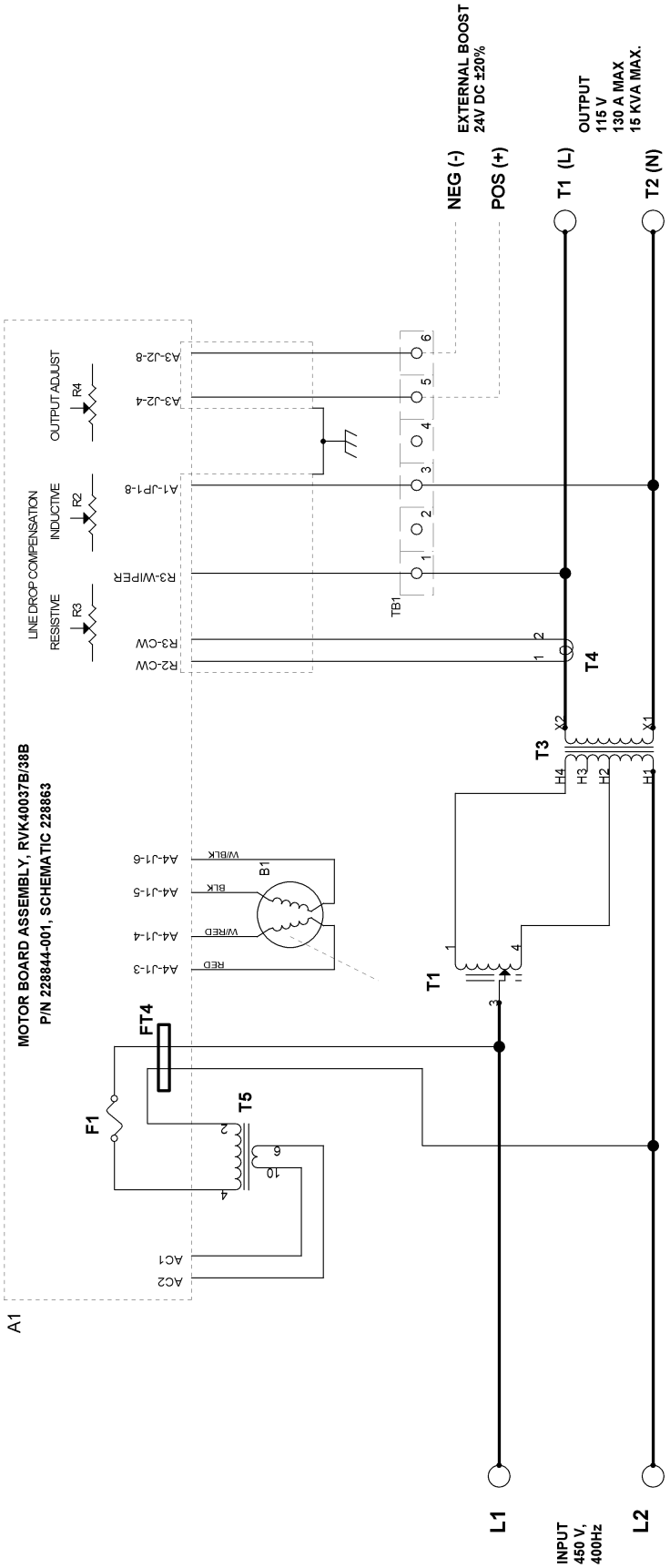
The complete motor board assembly is part number **228844-001**. This assembly is shown on page 13 of this manual.

11.5. COMPONENTS PARTS LIST

REFERENCE SYMBOL	PART DESCRIPTION	SUPERIOR ELECTRIC PART NUMBER	QUANTITY PER UNIT
A1	MOTOR BOARD ASSEMBLY	228844-001	1
A1-A1	AC REGULATOR CONTROL BD ASSEMBLY	227412-004	1
A1-A2	DM CONTROL BOARD ASSEMBLY	228728-003	1
A1-A3	LV REGULATOR BOARD ASSEMBLY	228972-001	1
A1-A4	DRIVE, STEPPER	229248-001	1
A1-BR1	RECTIFIER ASSEMBLY	201498-001	1
A1-C1	CAPACITOR	222272-002	1
A1-F1	FUSE, TIME DELAY	223504-002	1
	FUSEHOLDER	214364-000	1
A1-FT1-FT4	FERRITE TOROID	229413-001	4
A1-L1	INDUCTOR, T6321	848347-001	1
A1-R1	RESISTOR, WIRE WOUND, 10 OHMS	229130-001	1
A1-R2,R3	RESISTOR, VARIABLE 50 OHMS	229256-500	2
A1-R4	RESISTOR, VARIABLE 100 OHMS	229256-101	1
A1-S1,S2	MICRO SWITCH	058743-001	2
B1 ① **Below serial #35978**			
	MOTOR & PULLEY ASSEMBLY, 3/8”	230548-001	1
	DRIVE BELT, 3/8”	116208-008	1
B1 ① **Above serial #35978**			
	MOTOR & PULLEY ASSEMBLY, 1/2”	230548-002	1
	DRIVE BELT, 1/2”	116208-010	1
T1	VARIABLE TRANSFORMER, RVK SERIES	228862-001	1
T3	TRANSFORMER, ISOLATION 400HZ	228932-001	1
T4	TRANSFORMER, CURRENT	229195-001	1
T5	TRANSFORMER, STEP DOWN 400HZ	228846-003	1
TB1	SCREW TERMINAL STRIP	228931-003	1
✶ ①	MOTOR DRIVEN POWERSTAT VT ASSEMBLY	228920-001	1
✶✶	POWERSTAT REPLACEMENT BRUSH RB647	176012-005	1

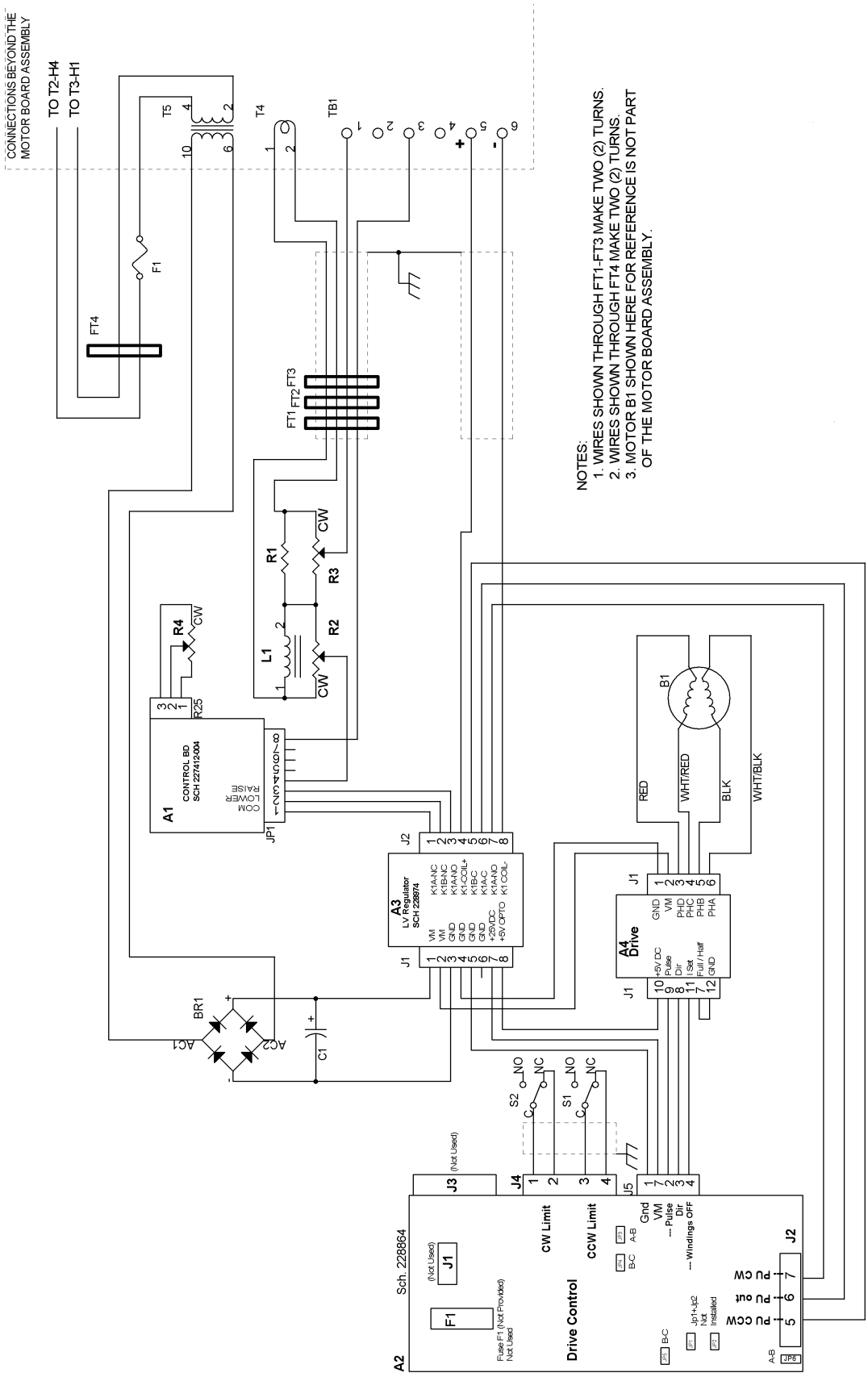
① Units made after July 2013, including replacement MOTOR DRIVEN POWERSTAT VT ASSEMBLY, have 1/2 inch drive belts. When ordering parts ensure both pulleys and the drive belt are the same size.

12.0. SCHEMATIC



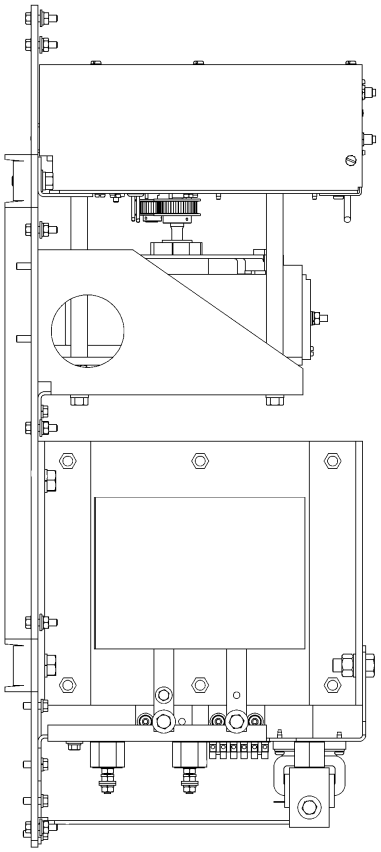
SCHEMATIC continues

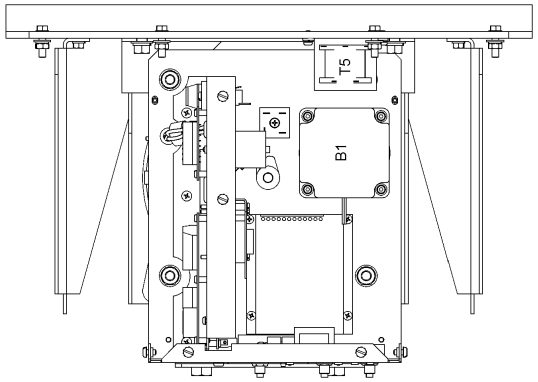
MOTOR BOARD ASSEMBLY A1

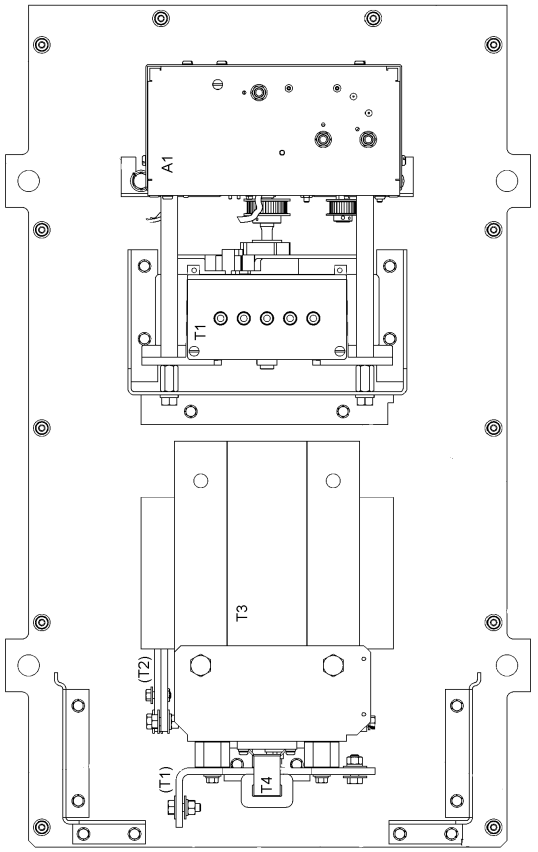


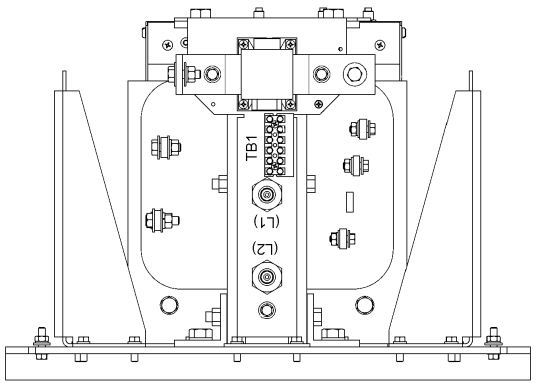
13.0. ASSEMBLY

Input and output labels are shown in parenthesis. Ex. (L1).



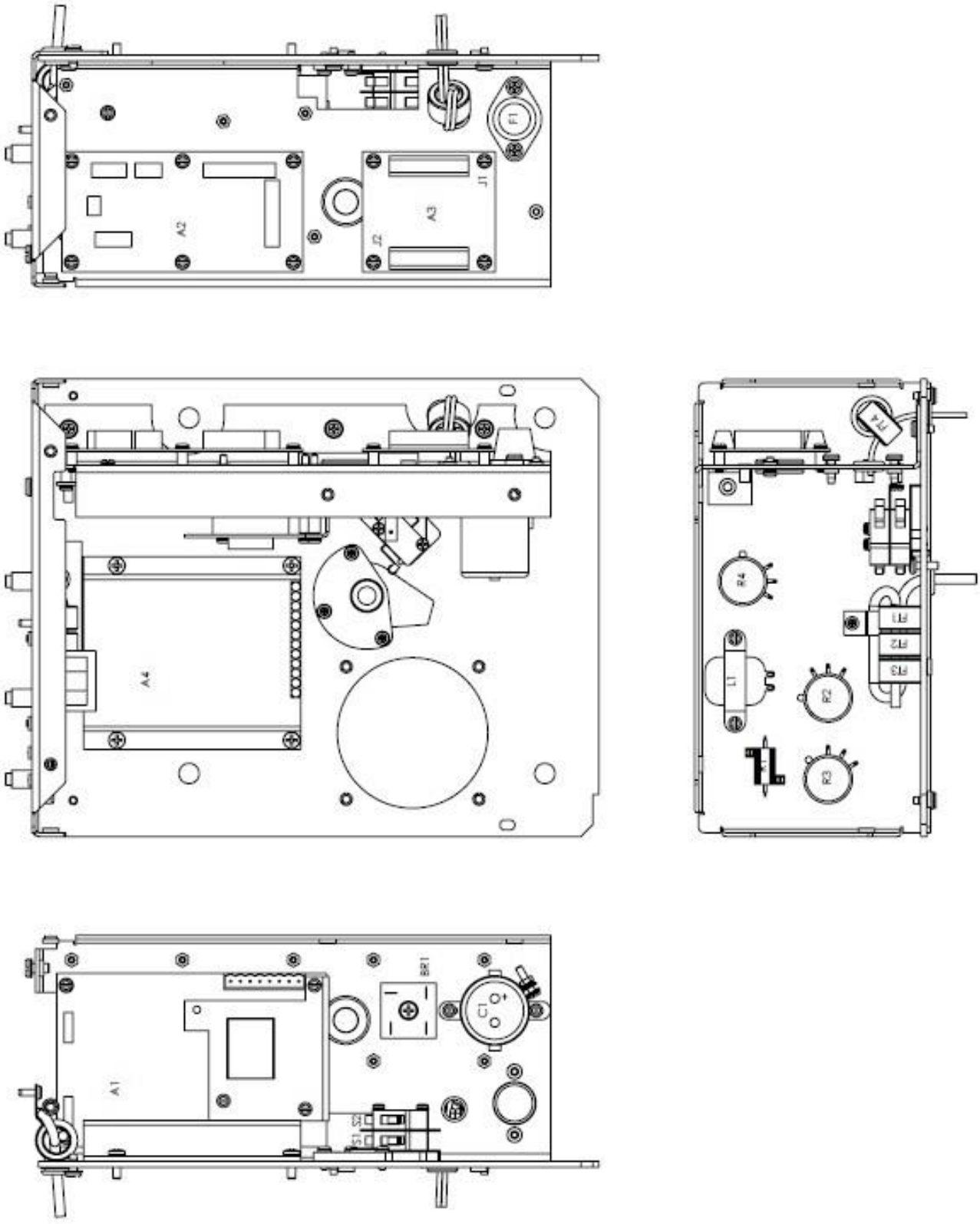




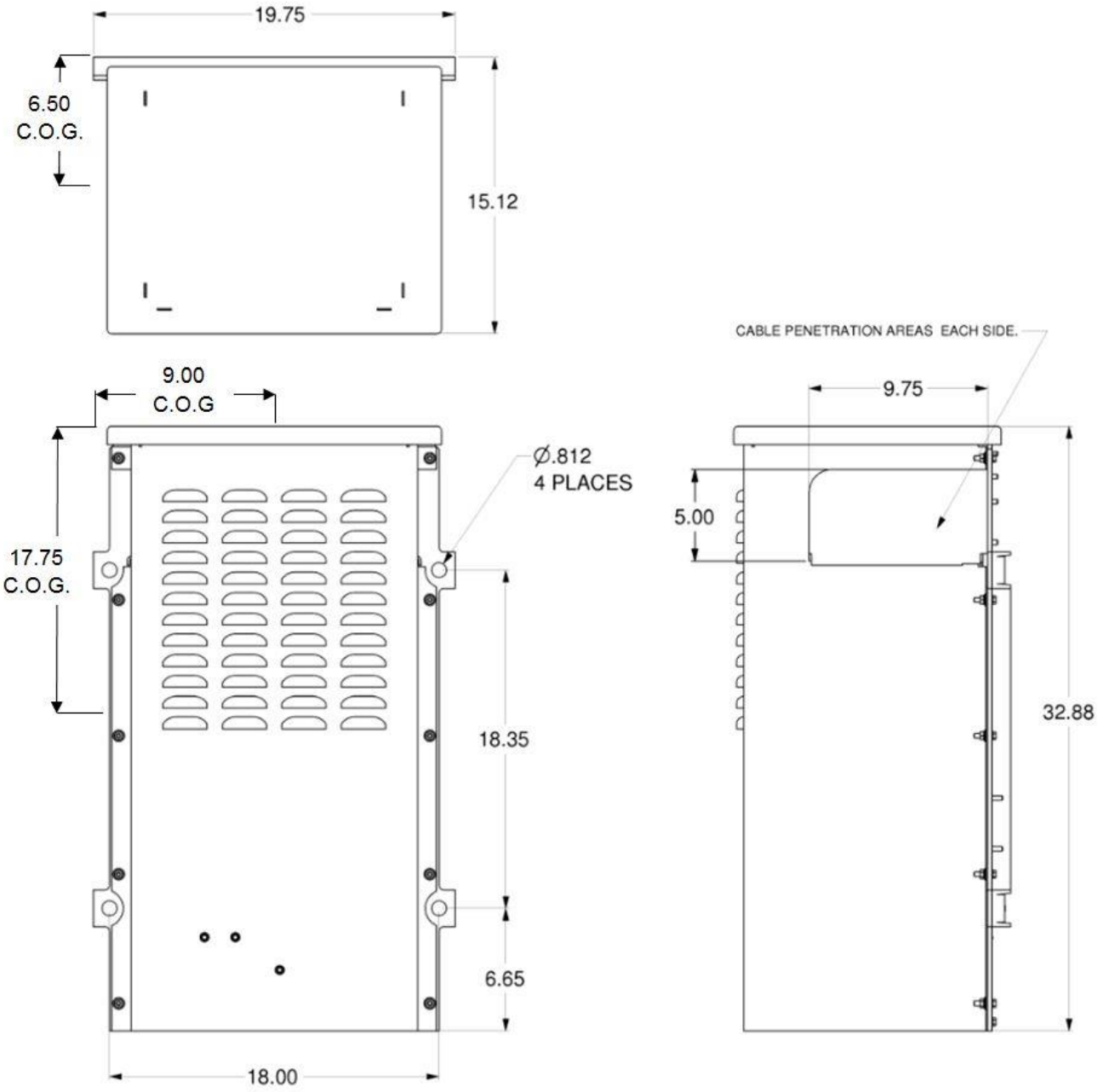


ASSEMBLY continues

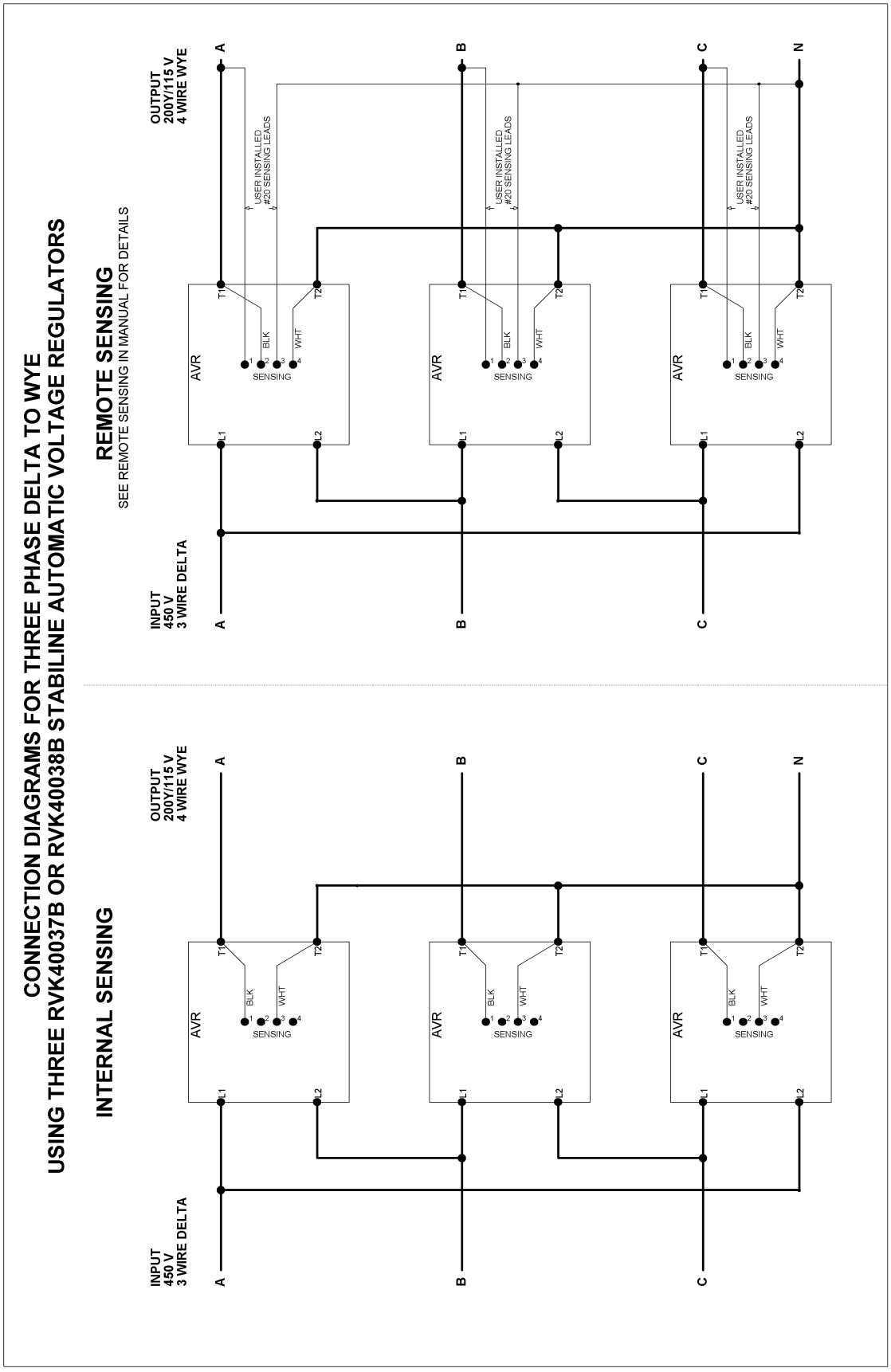
MOTOR BOARD ASSEMBLY A1



14.0. OUTLINE

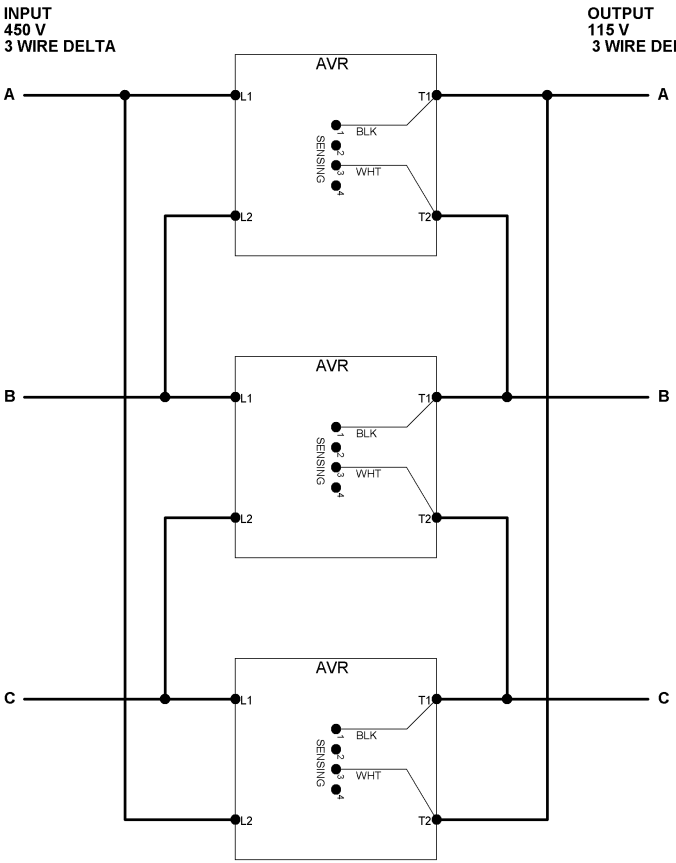

19.75
6.50
C.O.G.
15.12
9.00
C.O.G
Ø.812
4 PLACES
17.75
C.O.G.
18.35
6.65
18.00
CABLE PENETRATION AREAS EACH SIDE.
9.75
5.00
32.88

15.0. CONNECTION DIAGRAMS



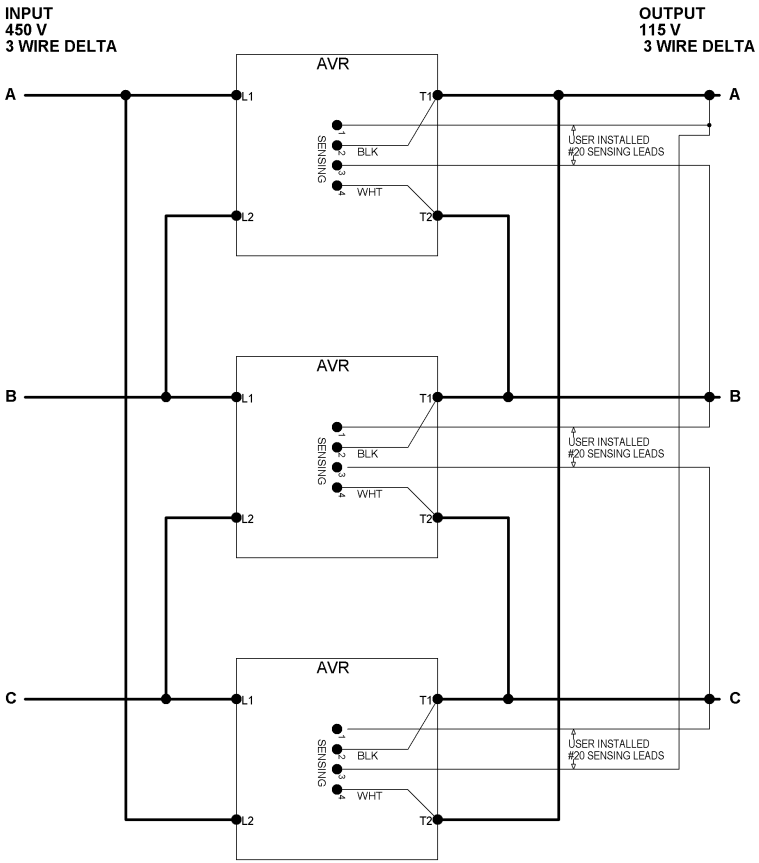
CONNECTION DIAGRAMS FOR THREE PHASE DELTA TO DELTA
USING THREE RVK40037B OR RVK40038B STABILINE AUTOMATIC VOLTAGE REGULATORS

INTERNAL SENSING



REMOTE SENSING

SEE REMOTE SENSING IN MANUAL FOR DETAILS



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