**GENERATOR POWER SUPPLY**

The three phases power supply is carried in the generator through a 3 phase cable and a ground cable. The cable is connected directly on the top of the line filter in the right side of the generator.

The ground is connected on the right side of the filter.

The cables enters in the generator from the rear window and it is suggested to be tied on the inverter’s frame.

**TUBE CONNECTION**

**HIGH VOLTAGE CABLES**

The high voltage is carried out through a pair of high voltage cable connected in the high voltage transformer.

The high voltage transformer is located in the front, top, of the generator.
Put silicon grease on headings before plugging in to stop moisture going inside the high voltage plug.

It is recommended to connect ground cables from the high voltage plug directly on the top of the transformer, on the ground node.

In case the high voltage plug is not equipped with the screw to connect the ground cable, it is recommended to make a little cut, close to the high voltage plug, on the external rubber envelope to reach the screen of the cable, and solder the ground wire. On tube side, grounding the high voltage cables screen is not required.

**GROUND PROTECTION CABLE**

Connect on transformer's ground node a 6mm$^2$ ground cable to be connected directly to the tube, in anode side.
**TUBE STATOR CONNECTION**

Tube rotation is provided by alternate current flowing through two windings present in the tube housing.

The windings are in series and provides a 90° shifting angle.

The lowest impedance winding provides the rotor torque, the other winding provides the rotation moment.

Depending on the tube manufacturer the windings configuration are fixed or composable, but in any case the wire to provide tube rotation power are three.

![Tube stator connection](image)

Depending on tube’s manufacturer the name of the contact are different:

the center of the windings is known as

COMMON - C

The lowest impedance winding is known as

MAIN – PRINCIPAL – M – INDUCTIVE - I

The highest impedance is known as

SHIFT – AUXILIAIRE – S – A

In case none of the name is provided, measure the resistance of the three contacts provided with an ohmmeter and follow this rule:

COMMON <-> MAIN RESISTENCE

is generally LOWER than

COMMON <-> SHIFT

and lower than

MAIN <-> SHIFT

For example:

COMMON <-> MAIN = 15ohm

COMMON <-> SHIFT = 35ohm

MAIN <-> SHIFT = 50ohm (the sum of COMMON<>MAIN and COMMON<>SHIFT because the windings are in series)

The winding connection are made directly on the anode rotor board inside the generator.

There are two kind of anode rotor board in the generator:
NORMAL SPEED STARTER

NORMAL/HIGH SPEED STARTER

NORMAL SPEED STARTER CONNECTION
No special shielded cable are required for this kind of rotor board.

Normal speed starter board is located in the rear of the generator, low, left position.

It uses the line Alternate Current to drive the rotor, so the tube rotation speed is the line frequency: 50Hz of line frequency will drive the rotor to 3000rpm.

The MAIN, SHIFT and COMMON connection are made with a screw connector, the position, on the board, of the three point of connection are shown on a label placed on the right side of the rotor board, and, as always, on the generator's manual in the schematics section provided on the CDROM.

NORMAL/HIGH SPEED STARTER CONNECTION
A special doubled shielded cable is required for this kind of rotor board, and is provided directly by ODEL.

The Normal/High speed starter is an option and generally is located in the top of the generator, over the high voltage transformer.

The connection is shown on a label on the left side of the generator.

Read the relative paragraph in chapter 3 of the manual to select the correct tube characteristics on jumpers strips on the Normal/High Speed Starter computer board.
The Normal/High Speed Starter is composed by two board: the Computer Board located on the right side of the generator, and the Power Board located on the left side.

The Power Board used the rectified three phases power to produce a sinusoidal current pwm drive.

The Computer board controls the driving current and the driving frequency: Normal speed is driven at 3600rpm, high speed is driven at 11800rpm.

Check jumper configuration and the fuses present on Safety Supervisor board (middle position on the rear of the generator) in case of tube rotation failure (error 133).

**TUBE THERMAL PROTECTION**

Depending on the type of tube several thermal protection can be found:

The common protection is on cathode side, it is made by a microswitch activated by oil dilatation through the rubber enclosure.

In this case connect the common pin of the microswitch to GTB106 and the Normally Closed (NC) contact to GTB109 removing the factory bridge.

Other kind of protection can be present on the tube such as a thermal switch.

In this case the thermal switch can be put in series to the dilatation microswitch to make a better safety.
Another protection present in tube is a thermal switch directly connected inside the stator winding. This protection is embedded in stator connection and do not need further cables. This connection provides the opening of the common leg, stopping the current flowing in stator windings. In this case the generator will sense that there is no current flowing through the tube windings and will stop any x-ray emission gene rating a 133 error. In this case simply wait for tube cooling down.

**CONTROL CONSOLE CONNECTION**

Locate Main Computer Board (MCU) in the front of the generator, bottom side.

Connect the CANNON DB9 connector in J6 on MCU.

Connect the provided 6mm² ground cable in the high voltage transformer’s ground node.

**SWITCHING ON THE GENERATOR**

Turn all the magnetic-thermal switch on the switch-bar in the generator OFF.
Turn the room power switch ON.

Check on top screw connector of Si1 for the presence of the three phases voltage (nominal 400Vac) between the three phases.

In case of presence of the three phases turn ON the magnetic thermal switch and check on the lower screws for the presence of the three phases.

Measure the three phases presence on the upper screws of Si2 magnetic thermal switches.

Switch ON Si2 and measure the voltage (400Vac) in the AC/DC converter line input screws, check also the GREEN LED on the AC/DC converter is ON.
In case of Normal Speed Starter option, check the single phase presence on Si3 (single phase 400Vac) and turn Si3 ON.

On Main Computer Board (MCU) located in the front of the generator, bottom side, turn the switch in SETUP position to prevent the automatic DCRail charge.

Switch ON the generator pressing the “I” key on the control console.

Press “OKEY” key in the screen.

BE CAREFULLY, NOW THE LIVE ACCESSIBLE PARTS ARE UNDER TENSION, i.e. the SAFETY SUPERVISOR LINE SECTION and the MAIN FREQUENCY INVERTER, as well as the POWER CONNECTIONS ON THE HIGH VOLTAGE TRANSFORMER.
On Safety Supervisor Board, there is a module called IR1110 module, mounted in a SIMM socket.

There are three led over it, when this 3 leds are lit, there is live voltage on the boards, DO NOT TOUCH the left side of the Safety Supervisor board, including the IR1110 module.

Locate the BLACK and the RED power cable in the rear of the generator that connects the Safety Supervisor three-phase bridge to Main Frequency converter.

Wait 10 seconds and measure the voltage on the main frequency inverter: Measure in DC, voltage is 560Vdc for 400Vac line voltage.

Switch OFF the generator pressing the “O” key.

Locate J16 connector and connect your computer serial port to J16 using a straight cable, male to female, 1to1 cable.

Refer to NAVIGATOR REFERENCE MANUAL CHAPTER in your generator’s manual for NAVIGATOR Service Software.
EXPOSING IN DIRECT MODE

Before connection the external accessories such as horizontal or vertical bucky, it is possible to check for tube rotation and tube x-ray emission in DIRECT MODE.

Direct mode is selected on the control console pressing the DIRECT WORKING PLACE ICON (a grid crossed in the rightest position of the working place section (middle, low position on the screen).

CHECK TUBE ROTATION

Press the I STEP KEY (a circle with a Dot over located in the right side of the control console)

Release the I STEP KEY after a couple of second and listen to the tube: You should listen to the tube rotation.

CHECK TUBE EMISSION

Select 70kV, 100mA, 100ms, Large Focus in radiographic section on the control console

Press I STEP KEY and wait a couple of second

Keep I STEP KEY and press II STEP KEY (the camera icon key located on the right side of the I STEP KEY)

Keep both I STEP and II STEP KEYS pressed until:
The radiography is done and you listen a beep from the control console

An error appear (in case of preparation errors, it can happen after 1 minute, so be patient keeping the two keys pressed).

In case of errors refer to user manual for error meaning and section 6 of the technical manual to understand the path of the error.
EXTERNAL ACCESSORIES CONNECTION

Connection to external accessories are made on General Terminal Board.

GTB provides a Power 24Vdc on GTB3xx connector for bucky motor suppli and the same 24Vdc for bucky grid release command and bucky grid movement sense.

Generally a 24Vdc bucky provides:

2 wires for motor power supply

1 wire for grid release command

2 wires providing a relay contact which closed to advise the generator that the grid is moving.

While the motor power supply can be directly connected to GTB311 and GTB316, the grid release signal and bucky grid movement sense need a special circuit:

The grid release signal have to be asserted by generator WHEN the generator is READY TO EXPOSE.

The grid moving signal have to be sensed by generator after the grid release signal is asserted by generator.

GRID RELEASE SIGNAL:

Working station 1 closes relay K2 on general terminal board when generator is ready to expose on WS1

Working station 2 closes relay K3 on general terminal board when generator is ready to expose on WS2

Working station 3 closes relay K4 on general terminal board when generator is ready to expose on WS3

Carrying a 24Vdc polarization through this relay it is possible to drive the GRID RELEASE INPUT of the bucky.

This is done taking 24Vdc from GTB316..320 passing through K2, for WS1, in GTB206 and sending the 24Vdc from 207 to the bucky.

This is done taking 24Vdc from GTB316..320 passing through K3, for WS2, in GTB211 and sending the 24Vdc from 212 to the bucky.

This is done taking 24Vdc from GTB316..320 passing through K4, for WS3, in GTB216 and sending the 24Vdc from 217 to the bucky.

GRID MOVING SIGNAL:

Grid moving signal is a contact that closes in the bucky when the grid is moving.

Generator provides an active circuit to sense it.

This circuit have to be polarized to work.

This is done carrying a fixed 24Vdc from GTB316..320 to GTB230.

The polarizing ground will pass through the bucky relay: one side of the relay is fixed connected to ground (GTB311..315) the other contact of the relay is connected to the other side of the bucky relay circuit, i.e. GTB226.

More than one buck are connected in PARALLEL.

Based on those information has been prepared a simplified schematic for Riviera table and vertical bucky connection are reported below.
According to ARCOM schematics, the power supply to the motor is produced directly in Riviera.

Here is the schematic of electrical start/reply:

**DRIVING THE BUCKY**

13.5 – *How to interface Potter and AIN/BPF/LIA table*

Polarizing M9-3 and M9-4 with 24Vdc the optocoupler IC2 will drive relay K1 that starts the grid movement.

Generator have to polarize those two pin when generator is ready to expose, this is done passing the +24Vdc through OBS (Output Bucky Start) relay.
In case we want to drive the bucky with WS1 selection we have to use relay K2, so a +24Vdc will be taken from GTB316 and connected to GTB207, will pass through the relay and will be carried to Riviera table through GTB206 connected to M9 connector.

The input optocoupler in the bucky electronics is a bidirectional optocoupler (TLP180), so GTB206 can be connected to both M9-3 or M9-4.

We connected GTB206 to M9-4 and fixed connected generator’s 0Vdc (GTB311) to M9-3.

SENSING THE BUCKY MOVEMENT

When motor run, K2 is driven, this will close contact M2-8 to M2-9 so M9-5 and M9-6 will be closed.

This is sensed by the generator in this way:

24Vdc, present when bucky request is closed (K2) is connected to pin M9-5.

When motor is moving, m9-6 is polarized to 24Vdc, so it polarize @ +24Vdc the input GTB226. GTB227 is fixed connected to ground, so when GTB226 is polarized the optocoupler is driven and the BUCKY MOVING information (IRP) is sent to generator’s computer.
The same path for vertical bucky, request is connected to GTB211-GTB221 and reply is in PARALLEL to horizontal bucky reply.

So the wiring expressed in IMI204:

**ENDEAVOUR to Riviera TABLES**

*Interface with Horizontal and Vertical Bucky*

*Generator configuration:*

**WORKING STATION 1 = HORIZONTAL TABLE**

**WORKING STATION 2 = VERTICAL BUCKY**

**WORKING STATION 3 = DISABLED**

**WORKING STATION 4 = DIRECT (NO BUCKY)**

*Bucky connection*

- GTB from 210 to 316
- +24 Vdc.

**HORIZONTAL TABLE**

- GTB 207
- MS-4

**VERTICAL BUCKY**

- GTB 211
- MS-6

**BUCKY REPLY**

- DL25
- IRF

- GTB 216
- GTB 200

**GTB from 311 to 318**