4.7 ION BEAM PULSING OPTIONS cont.

4.7.3 PULSING with FIXED / VARIABLE DUAL GRID POWER SUPPLY

This method of pulsing usually involves a main IGPS Power Supply unit containing two grid supplies which is ordered at time of purchase. A TTL (transistor-transistor logic) pulse source is required, such as a separate user-supplied pulse generator unit. Typically, beam pulse widths from 2 µsec to DC with a 500 nsec rise/fall time and repetition rates up to 5 kHz maximum can be achieved with appropriate TTL inputs.

With this dual grid pulsing option, beam pulsing is accomplished using a TTL signal to control the two Grid supplies: one fixed and the other variable. In a gun that produces positive ions, the grid voltages will be positive. The variable grid supply is the normal control grid supply which is varied by the user. The variable supply should be adjusted to a voltage which allows optimum beam current. The fixed grid supply is set at the factory to supply a single, fixed voltage which cuts off the ion beam. The block diagram (Fig. 4.7-6 shows the relation of the supplies; the fixed supply floats on the variable one.

A pulsing TTL (transistor-transistor-logic) signal rapidly switches the output voltage to the grid between the variable grid supply alone and the sum of the two supplies, which cuts off the beam. This pulses the beam on and off, as shown in Fig. 4.7-7 below. For example, if the fixed grid is +100 V and the variable grid supply is adjusted to +10 V, the grid element in the gun will be at +10 V when the TTL signal is +5 V, and the grid will be at -+110 V when the TTL signal is 0 V.

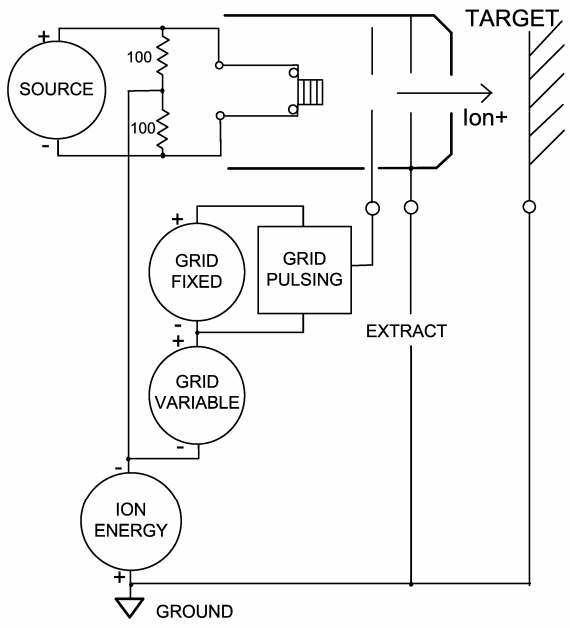

Fig. 4.7-6: Block Diagram for a typical alkali metal Ion Gun with Fixed / Variable Grid Pulsing (Other supplies will vary with gun model)

Note that whenever there is a zero volt TTL signal, the ion beam will be cut-off by the fixed grid. Even if the ion source is on and the variable grid is adjusted to zero, the grid element will be at the fixed supply voltage (+100 V in the example) and there will be no beam. When there is no TTL input, a pull -up resistor in the power supply will provide a +5 V signal, so that only the variable grid supply is enabled and the beam can be on. Thus for start-up and normal non-pulsed gun operation, the TTL generator must be disconnected or set for +5 V. Alternatively, if the default output on the generator is high (+5 V) when powered off, the generator could be connected but turned off for normal operation. Depending on the user's TTL pulse source, the output could be set to a constant 5+ V with a computer system.

The amount of beam current emitted by the gun is a function of the source voltage (source heater temperature), energy, and grid voltage. See the Data Section for graphs of Beam Current vs Source and Beam Current vs Grid at various Energy values. For guns with a variable extract supply, the beam also depends on the ion extraction voltage. Precise beam current levels vary with operating conditions, so the user must determine appropriate grid voltages for the specific operating conditions employed.

DESCRIPTION OF CONTROLS

Pulsing Input BNC: A BNC labeled **TTL IN** to receive a 0 to +5 VDC TTL from a user-supplied TTL pulse generator for optional grid pulsing. The TTL signal input controls the alternation between the variable and fixed grid supplies pulsing the beam on and off. A zero volt signal will cut off the ion beam. When the BNC is unterminated, an internal +5 V signal controls the grid supplies, allowing the beam to be on.

Variable Grid Control/ Meter: A FlexPanel control labeled **GRID**. When selected, the encoder wheel voltage programs the variable Grid power supply. The value displayed is the variable Grid voltage, not the combination of the fixed and variable Grid supplies. Alternatively, computer controls through the RS-232 port or analog external interface can voltage program the variable Grid supply.

NOTE: With pulsing, the metering does not monitor the total output to the gun, only the variable grid voltage.

4.7 ION BEAM PULSING OPTIONS cont.

PULSING with FIXED / VARIABLE DUAL GRID POWER SUPPLY: OPERATION

⚠ CAUTION

For gun start up or DC operation,
the TTL pulse generator must be DISCONNECTED
or the signal input must be a **CONSTANT +5 V**.

1. Set up:
   a. A separate, user-supplied 0 to +5 VDC TTL pulse generator is required for Dual Grid Pulsing. Alternatively, the TTL signal can be generated by the user's computer program.
   b. Using a user-supplied coaxial cable, connect the TTL source to the BNC labeled **TTL IN** on the back of the IGPS.

   CAUTION: For initial start-up and non-pulsing DC gun operation, the TTL source must be disconnected or provide constant +5V. Depending on access, it may be easiest to connect the power supply end of the cable during power supply installation and just connect/disconnect the generator end later as needed.

2. For start up:
   a. Disconnect the user-supplied TTL source. Alternatively, provide a **constant +5 V** signal input.
   b. Follow the Normal Start Up Procedure, Section 4.2. to begin gun operation.
   c. Using the **GRID** control (encoder wheel or computer control), adjust the variable Grid (G-1) supply to the voltage that produces optimum beam current and uniformity. Monitor this supply with the Grid Voltage metering.

3. **For beam pulsing:**
   a. Reconnect and turn on the TTL source.
   b. On the TTL generator or on the computer, adjust the TTL input signal pulse rate, frequency and duty cycle as desired.

TTL input	Grid Voltage	Result
+5 V	Variable only	Beam ON
0 V	Fixed + Variable	Beam CUT-OFF

NOTE: With pulsing, the Emission Current metering may give a false reading, increasing as the pulse rate increases. Do not readjust the Source controls to compensate. To check the true emission, briefly turn off pulsing; the meter signal will return to the correct value immediately.
The Grid Voltage meter reads only the variable grid supply, not the net output to the gun.

4. **For constant beam operation (DC)**: Disconnect the user-supplied TTL source or provide a constant +5 V signal input.

CAUTION: If the TTL signal input is 0 V, the beam will be cut-off even if the ion source is on. This could cause the user to incorrectly increase the source current and burn out the ion source.

5. For shut down: Disconnect and turn off the TTL source.

4.7 ION BEAM PULSING OPTIONS cont.

PULSING with FIXED / VARIABLE DUAL GRID POWER SUPPLY cont.

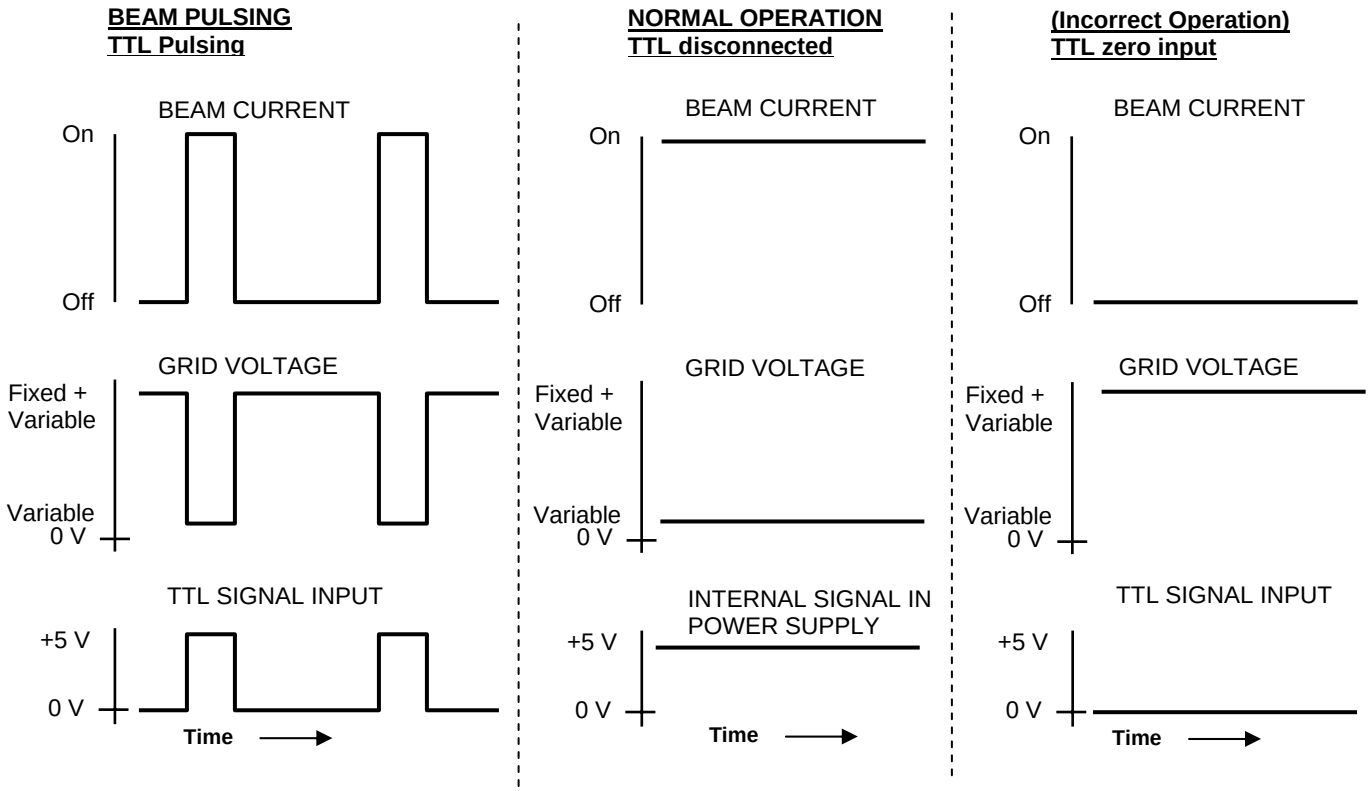

Fig. 4.7-7 Pulsing TTL Signal, alternating Fixed and Variable Grid Supplies, and Beam Current Response (for systems with only a TTL input)

This completes the Ion Beam Pulsing Instructions.