4.3 ELECTRON CURRENT CONTROL (ECC)

This power supply offers the option of feedback stabilized Electron Current Control (ECC), which is especially useful in maintaining ion beam current with Ion Guns. Under normal circumstances, when a constant voltage source drives the filament heating, electron emission current varies over time. The electron emission current changes are due to variations in the filament's resistance as its temperature varies and physical changes such as evaporation and contamination. To provide a stable and constant electron emission current, the ECC option can be used. The ECC circuit maintains a constant electron emission current by using feedback control to adjust the source voltage.

Note that while the electron emission current is held constant, both the ion emission and the final ion beam current may still vary. The electrons emitted from the filament bombard the gas present in the region of the ion cage and ionize that gas to produce the ion emission. This ionization process is very dependent on the type of gas and on the pressure of the gas introduced. The gas inlet is controlled manually or automatically. Thus, although the electron emission is constant, the resulting ion emission may vary considerably. Many further factors can cause the ratio of final ion beam current to electron emission current to vary such as, but not limited to: Grid and Focus values, chamber pressure, Ion Gun and target contamination, and outgassing.

Although protection against excessive source current is built into the ECC circuitry, it is best to employ the ECC mode **after** the approximate operating parameters have been determined in Source mode. For example, if the Electron Energy is too low, the ECC feedback may call for more source current in order to maintain the chosen electron emission current value. This increased source current will raise the filament's temperature, thus reducing filament lifetime. **Ensure that the Electron Energy is at least 50 V when operating in ECC mode.**

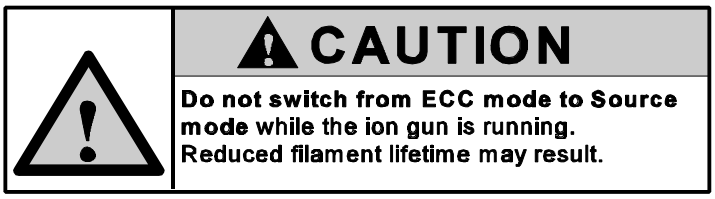
Do not switch from ECC Mode to Source Mode while the Ion Gun is running.

When operating in ECC mode, the number of turns of the **SOURCE/ECC** potentiometer determines the desired electron emission current level. Ten turns of the potentiometer will yield the maximum emission current. For example with an ECC range of 0 to 500 µA, 10 turns will yield the full 500 µA, while 5 turns will yield a half the range or 250 µA, etc. The electron emission current is read on the Electron Current meter, but the ECC range may be set to be less than the full meter range; see Table 4.3.1 below for the specific values which vary with the Ion Gun.

When operating in Source mode, the number of turns of the **SOURCE/ECC** potentiometer determines the source voltage; 10 turns of the potentiometer will yield the maximum source voltage. Such a high source current will result in short filament lifetime. If the **SOURCE/ECC** potentiometer is set to 10 turns while operating in ECC mode and the power supply is switched to Source mode, then source current will be switched to its maximum level, reducing filament lifetime.

The Zener limit, which controls the maximum source current, and the gain, which determines the maximum electron emission current, have been preset at the factory for the Source/ECC board. If, under normal operating conditions, the desired ion beam current range cannot be achieved while the ECC circuit is in use, please call the Engineering Department at Kimball Physics at (603) 878-1616. Note that the Zener limit is meant to protect the filament from high, life shortening, current. Achieving the full electron emission current range under all operating conditions will not be possible.

4.3 ELECTRON CURRENT CONTROL (ECC) cont.



OPERATING PROCEDURE FOR ECC MODE

1. Set-up:
   a. To assure low filament temperatures, determine initial operating parameters and **ensure that the Electron Energy is at least 50 V** before operating in ECC mode. Once operating in the ECC mode, the ion beam may be optimized by further adjusting the bias voltages (keeping Electron Energy at 50 V or more), while maintaining source current. Excessive source current will reduce filament lifetime.
   b. With the **SOURCE** pushbutton on, turn the **SOURCE/ECC** potentiometer to zero, fully counterclockwise.
   c. Switch the **ECC/SOURCE** toggle switch to **ECC**.

2. Adjusting Electron Current Control:
   a. Slowly turn the **SOURCE/ECC** potentiometer clockwise one turn and wait.
   b. In approximately 30 seconds the Source voltage and Source current will start to rise.
   c. Turn the **SOURCE/ECC** potentiometer until the desired electron current is achieved.
   d. Monitor the **ELECTRON CURRENT** using the appropriate electron current meter scale. See Table 4.3.1.
   e. The electron emission current called for is proportional to the number of turns of the **SOURCE/ECC** potentiometer. (For example, with a 0 to 500 µA ECC range, 10 turns will yield the maximum of 500 µA, while 5 turns will yield half the ECC range or 250 µA, etc.)

3. **For Remote Programing**: The ECC option can also be controlled by a 0 V to +10 V programming signal (such as might be provided by a D/A supply) into the back of the Power Supply. +10 V will yield the full-scale electron current reading. (For example, with a 0 to 500 µA ECC range, +10 V will yield 500 µA, while +5 volts will yield half the ECC range or 250 µA, etc.)

4. Turning off the ECC option:
   a. Turn the **SOURCE/ECC** potentiometer fully counterclockwise. Failure to do so could severely damage the filament and greatly shorten the filament's lifetime.
   b. Switch the **ECC/SOURCE** toggle switch to the **SOURCE** position.