4.3 EMISSION CURRENT CONTROL (ECC)

This power supply offers the option of feedback stabilized Emission Current Control (ECC). Under normal circumstances, when a constant voltage source drives the cathode, emission current varies over time. The emission current changes are due to variations in the cathode's resistance as its temperature varies and physical changes such as evaporation and contamination. To provide a stable and constant emission current, the ECC option can be used. The ECC circuit maintains a constant emission current by using feedback control to adjust the source voltage.

Note that while the emission current is held constant, the beam current may still vary. Many factors can cause the ratio of beam current to emission current to vary such as, but not limited to: Grid and Focus values, chamber pressure, Electron 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, as the grid voltage is increased toward beam cutoff, the ECC feedback will call for more source current in order to maintain the chosen emission current value. This increased source current will raise the cathode's temperature, thus reducing the cathode lifetime.

Do not switch from ECC Mode to Source Mode while the electron gun is running.

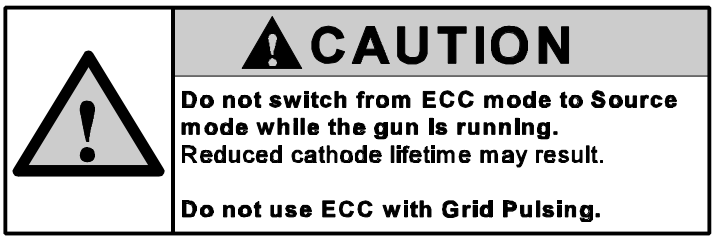
When operating in ECC mode, the number of turns of the **SOURCE/ECC** potentiometer determines the desired emission current level. Ten turns of the potentiometer will yield the maximum emission current. For example with an ECC range of 0 to 500 µA, 10 turns will yield the full 500 µA, while 5 turns will yield a half the range or 250 µA, etc. The Emission current is read on the Emission 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 Electron 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. For example, with a standard refractory metal cathode, a maximum voltage of 1.5 V corresponds to a source current of about 1.8 A (the V-I characteristics of cathodes vary with cathode type and size, cathode temperature and the slight variations in cathode geometry); such a high source current will result in short cathode 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 cathode lifetime.

For systems with the Grid Pulsing option, do not operate the electron gun in ECC mode if using the Grid Pulsing. Reduced cathode lifetime may result. The ECC circuitry is designed to be a DC feedback system. During grid pulsing, the average emission current is close to zero and the ECC feedback will raise cathode temperature to try to compensate for the lack of emission current while the gun is pulsed off.

The Zener limit, which controls the maximum source current, and the gain, which determines the maximum emission current, have been preset at the factory for the Source/ECC board. If, under normal operating conditions, the desired emission 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 cathode from high, life shortening, current. Achieving the full emission current range under all operating conditions will not be possible.

4.3 EMISSION CURRENT CONTROL (ECC) cont.



OPERATING PROCEDURE FOR ECC MODE

1. Set-up:
   a. To assure low cathode temperatures, initial emission current adjustment should be done with little or no grid bias. Once operating in the ECC mode, the beam may be optimized by slowly adjusting the grid bias while maintaining source current. Excessive source current will reduce cathode 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 Emission 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 Emission current is achieved.
   d. Monitor the Emission current using the appropriate Emission meter scale. See Table 4.3.1.
   e. The 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 emission current value, shown in Table 4.4.1.
   (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. **For Pulsing:** Do not use ECC mode; use normal Source mode.

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