High Energy Gamma Radiation Effects on Commercially Available Silicon Carbide Power JFET Transistors

by

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Abstract

An investigation of high power commercially available semiconductors made with compounds such as, silicon carbide (SiC), are being investigated for space applications and other harsh environments. The research involves observing the electrical characteristics of two types of 4H-SiC vertical depletion-mode trench junction field effect transistors (JFETs) before and after irradiation from a ^{60}Co gamma ray source. The normally-on trench vertical JFETs have a nominal blocking voltage of 1200V and a forward current rating 52A, while the normally-off trench vertical JFETs have a nominal blocking voltage of 1200V and a forward current rating 17A prior to radiation. The on-state and blocking I-V characteristics were measured before the devices were irradiated, then measured again afterwards for comparison.

During irradiation and annealing, the JFETs were biased with a positive gate voltage of 3V with source, drain, and substrate tied to ground. The test batch was irradiated using the ^{60}Co source at the Auburn University Leach Science Center. Samples were irradiated at a dose rate of 69.9 rad(Si) for a total accumulated dose of 7Mrad. The evaluated SiC devices performed well following extremely large gamma ray exposures. In this paper, it is demonstrated that the evaluated SiC transistors have the potential to operate satisfactorily in high gamma radiation environments, including commercial and high altitude/space applications. No significant degradation in the device characteristics was observed after a total ionizing dose of 7 Mrads.

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List of Abbreviations

SiC	Silicon Carbide
IC	Integrated Circuit
FET	Field Effect Transistor
JFET	Junction Field Effect Transistor
TID	Total Ionizing Dose
VLSI	Very Large Scale Integration
MESFET	Metal-Semiconductor Field-Effect Transistors
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
LED	Light Emitting Diode
UV	Ultra Violet
PCB	Printed Circuit Board
GaN	Gallium Nitride
GaAs	Gallium Arsenide
DUT	Device Under Test

Chapter 1

Introduction

Silicon-based semiconductor devices are still the foundation of the electronics industry, with applications ranging from small chips in personal computers to large, high power switching devices. However, silicon (Si) has faced more recent challenges for applications at high frequency, high voltage, and in high temperature environments. In order to work under these demanding conditions, silicon-based devices must be used with complex and often expensive cooling systems and electrical add-ons that complicate the circuit design for switching applications. Solutions for these problems have been sought for years, and one potential solution is the replacement of Si with a wide band-gap semiconductor material such as silicon carbide (SiC). It has been over 20 years since research groups started to investigate SiC as a candidate technology to replace silicon. Many advantages of SiC over silicon have been well recognized.

SiC is a very promising semiconductor material for the development of electronics that must operate in a high temperature environment and it is less sensitive to radiation than Si or GaAs [1]. Its wide band-gap (3.3eV vs. 1.1eV for silicon) allows SiC to operate at higher temperature than silicon. This technology has been used to produce Junction Field-Effect transistors (JFETs), Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs), Metal-Semiconductor Field-Effect Transistors (MESFETs), P/N junction diodes, Schottky diodes, Light Emitting Diodes (LEDs), and Ultra Violet (UV) photo detectors which have been demonstrated to operate at temperatures as high as 650°C [6,7]. This new high-temperature semiconductor technology has the potential for use in control circuits, sensor circuits, solar inverters, and signal multiplexers for commercial nuclear reactor and space nuclear power application [19]. SiC JFETs are of particular importance for power supplies designed to operate in harsh environments.

To complement the extreme environment testing, testing has also occurred for ionizing radiation environments. To test the electrical response after extreme radiation dose, SiC JFETs have been tested by gamma irradiation over 6 Mrad of total ionizing dose (TID). Irradiation can introduce fixed charges in the insulating layers and interfaces [20, 21, 22] of semiconductors, reducing their response through voltage shifts or increasing leakage currents. After 7 Mrad of TID, the JFET demonstrated no measurable change in performance characteristics.

A variety of SiC devices have been evaluated in various radiation environments in past studies [12, 19, 22, 23, 24, 25]. Under this evaluation, however, gamma ray testing was conducted on commercially available SiC JFETs [32] to evaluate their response to radiation exposure. Under these tests, gate biasing was employed to evaluate if biasing the gate voltage would result in a measurable enhancement of radiation damage and to verify the TID hardness of the modern design. These SiC

JFET devices were selected for evaluation under this study because they had not previously been evaluated in a gamma ray radiation environment. Preproduction SiC JFET devices had been evaluated and performed well under an earlier study [12]. However, the design and/or fabrication processes for the commercially produced SiC JFETS investigated under this study are different from the design and fabrication processes used for the preproduction JFETs evaluated in the earlier study.

Chapter 2

Literature Review of Previous Research

2.1 Silicon Carbide Properties

When the material properties of a substance are analyzed, the structural properties, such as the lattice structure is examined. In this section, the material properties of silicon carbide (SiC) are discussed. Also, some basic electrical properties of SiC will be examined for their use in high power semiconductors.

2.1.1 Material Properties

In the last few years, SiC has received notable attention because of its attractive material properties for high power semiconductor devices. With its wide energy bandgap, high thermal conductivity, high saturated electron drift velocities, and high breakdown electric fields, SiC may be the perfect candidate for high temperature and power applications. Some numerical values of these positive attributes include a high electric breakdown field strength of 4×10^6 V/cm, high saturated electron drift velocity of 2×10^7 cm/s, and a high thermal conductivity of 4.9 W/cm-$^{\circ}$K [6]. Additionally, an important note to add is that SiC is also hard, chemically stable, and resistant to radiation [2]. The Young's modulus is approximately 190GPA for Si and

700GPA for SiC, while the thermal conductivity is approximately 1.57 W/ cm-$^{\circ}$K for Si and 3.5 for SiC [30]. Therefore SiC is harder and better conductor of heat than Si, which can be useful properties for devices that must operate in harsh environments.

2.1.2 Structural Properties

The basic building block of a SiC crystal consists of a stacking tetrahedral units that is composed of four carbon atoms covalently bonded to a silicon atom that is positioned in the center. Figure 2.1 shows the basic structural unit.

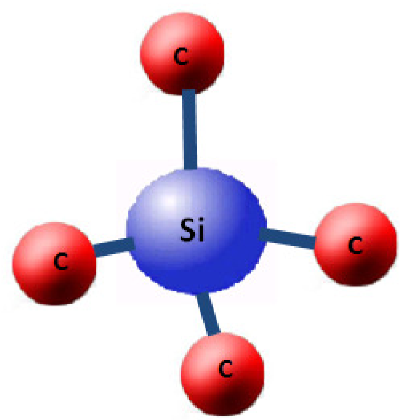

Figure 2.1: Illustration of a SiC tetrahedron that forms the basis for all SiC crystals.

SiC crystals are then formed when multiple corners of this basic tetrahedron are joined together forming crystal planes. However, some disorder can occur in the stacking periodicity of the planes during crystal formation and may result in defective material formed by dissimilar crystal structures called polytypes. Many compound materials exhibit polymorphism, which means they can exist in different structures called a polytype or polymorph. SiC is unique because it has more than 250 polymorphs of silicon carbide that has been identified, some of them having a lattice constant as long as 301.5nm, and about one thousand times the usual SiC lattice spacing [3].

2.1.3 Categorizing the Polytypes

Among all the polytypes, there are only three possible crystal lattice structures that are known to exist: cubic (C), hexagonal (H), and rhombohedral (R) [2]. While a variety of SiC polytypes is extensive, only a few are commonly used for electronic applications. There are three SiC polytypes that are related to the high power semiconductor industry: 3C-SiC, 4H-SiC, and 6H-SiC. Figure 2.2 shows the stacking sequence for the most common SiC polytypes. The designation of each polytype follows a widely adopted nomenclature that classifies both crystalline symmetry (letter) and stacking periodicity (number).

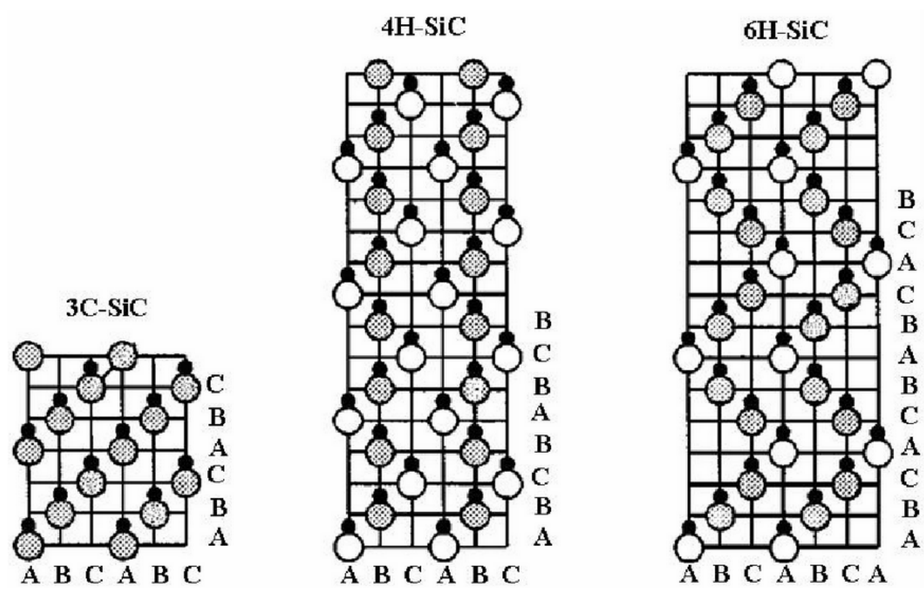

Figure 2.2: Stacking sequence for the most common SiC polytypes

Table 2.1 shows a comparison of silicon to 3H-SiC, 4H-SiC, and 6H-SiC. The main difference in the two types is that the electron mobility in 4H-SiC is two times that of 6H-SiC perpendicular to the c-axis and almost 10 times that of 6H-SiC parallel to the c-axis [5]. This is the reason there is more importance placed on 4H-SiC and also why this paper focuses on such devices only.

Table 2.1: Comparison of SiC polytypes and Si basic parameters at 300K [4]

Property	3C-SiC	4H-SiC	6H-SiC	Si
Melting Point (^oC)	2827*	2827*	2827*	1415
Physical stability	Excellent	Excellent	Excellent	Good
Thermal conductivity (W/cm-^oC)	3.6	3.7	4.9	1.5
Thermal expansion coefficient($10^{-6}/^oC$)	3.8	N/A	4.3 ⊥ c-axis 4.7 ‖ c-axis	1.0
Energy gap (eV)	2.4	3.2	3.0	1.1
Electron mobility (cm^2/V-s)	800	900	400	1400
Hole Mobility(cm^2/V-s)	320	120	90	471
Critical breakdown electric field (MV/cm)	2.1	2.2	2.5	0.25
Saturated electron velocity (10^7 m/s)	2.5	2.0	2.0	1.0

*sublimation temperature

As can be seen in the table, many properties of SiC are superior to that of Si except for the mobility parameter. The properties listed above are excellent reasons to choose SiC as a semiconductor material. Many high temperature, high frequency, or high-power applications are possible for the most part because SiC possesses a wide bandgap, which dictates the energy needed to break covalent bonds in the material and thus generate electrons in the conduction band.

The wide bandgap and the thermal ionization of electrons from the valence band to the conduction band makes the device able to operate in a high-temperature environment. At these high temperatures the concentration of the electron-hole pairs can be higher than the free carrier concentration from intentional impurity doping. When this happens the material will become intrinsic which results in device failure because the voltages cannot be blocked due to the lack of p-n junction [4].

Some researchers may say that replacing Si devices with SiC devices could help with the heating problems Si experiences in small device electronics due to the increased operating temperature. Also, another argument implies that SiC technology allows for a 50% increase in power and a 90% decrease in weight and volume in power modules when comparing it to Si [8]. Additionally, when compared with other wide bandgap materials, such as GaN and diamond, the 4H-SiC material technology is by far the most mature. Currently, companies such as Cree, SemiSouth, ST Microelectronics, Infineon, and GeneSiC produce commercially available SiC power semiconductor devices such as diodes and FETs.

Another appealing aspect of SiC is the high breakdown voltage and high thermal conductivity for high-power, high-voltage, and high-frequency applications. The breakdown voltage is important because it determines the maximum field that can be applied before the material breaks down. Also, the thermal conductivity is the measure of the material's ability to conduct and dissipate the heat it experiences. This is a very important to aspects such as device reliability and operating lifetime.

In silicon carbide, the breakdown voltage is about an order of magnitude higher and the thermal conductivity is about 2 to 3 times higher than that of Si (from Table 2.1). The combination of these properties allows lower losses and higher power densities with a smaller on-resistance for high power devices. For high-frequency applications, the high electric field strength implies that devices can be made smaller and therefore faster but also be able to maintain a large voltage thus achieving high power output. Some of these high frequency devices could be MOSFETs, BJTs, and JFETs.

2.2 Semiconductor Properties

In recent years, there has been an increase in the demand for two compound semiconductor materials, such as gallium arsenide, silicon carbide, and gallium nitride. With their appealing properties for the use in high power systems, it is worth discussing how semiconductors operate and also how they would benefit the current semiconductor manufacturing industry. The basic operation of a semiconductor is summarized in the next few sections, specifically looking at the SiC material and JFET operation.

As temperature is very low (~0K) in the semiconductor crystal, all the covalent bonds are intact and the material is actually an insulator. However, when temperature starts to increase the covalent bonds start to break. The total amount of energy required to break the bond is equal to the bandgap energy (E_g). When that covalent bond is broken, the result is two charge carriers are formed, one positive and one negative, also known as holes (p) and electrons (n), respectfully. The hole and electron concentration can be significantly altered by replacing small numbers of atoms in the original crystal with impurity atoms. The ability to add these impurities to change the conductivity type and to control the electron and hole concentrations is what makes high-performance, solid-state devices and high density integrated circuits possible to fabricate [9]. More about the semiconductors, specifically SiC transistors, will be addressed in section 2.2.2.

2.2.1 JFETs

Junction field effect transistors (JFETs) offer many attractive applications in analog switching, high-input-impedance amplifiers, microwave amplifiers, and integrated circuits (ICs). The FET's properties include a positive temperature coefficient at high current levels, which translates to the on-state voltage increasing as the temperature increases at a constant current level. This property allows a uniform temperature distribution over the device area and prevents thermal runaway or second breakdown, which can occur in bipolar transistors. These kinds of devices are thermally stable, even when the active area is very large or when there are many devices connected in parallel [7].

The JFET was first proposed by Shockley in 1952 [10]. However, Dacey and Ross were the first to physically make the device in 1955. This device is a majority carrier device in that only the majority carrier participates in the conduction. [10]. Therefore, since there is only one kind of carrier, either electrons or holes but not both, it is an active participant it can also be called the unipolar transistor. Fundamentally, the operation of the JFET consists of a bar of semiconductor material whose resistance can be controlled by the application of a bias voltage to the gate. Figure 2.3 shows the physical structure of a JFET.

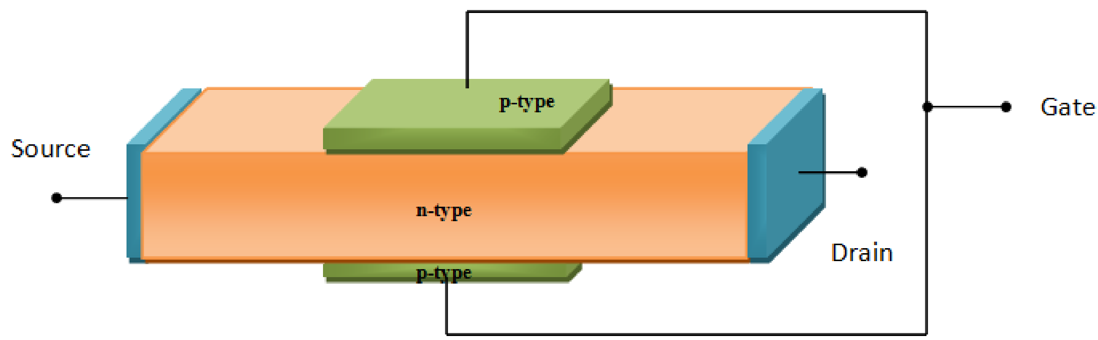

Figure 2.3: Structure of the idealized symmetric junction FET

It can be seen that the device has a source, drain, and gate region. The two gate regions which are tied together and considered to be one extended gate region. If a potential difference is applied to the ends, current will start flowing through the channel. And because the bar is made up of n-type silicon, the current will be carried by electrons (this is an n-channel JFET). It is customary for the source potential to be zero. Electrons enter the bar at the source (and hence the name signifying *source* of electrons) and leave at the other positive end of the bar, the drain (and hence the name signifying a drain or electrons.) The layers of the p-type material are known as the gate as stated above. If the gate is at 0 V or a slightly more positive potential, it will be in equilibrium and will have no effect on the flow of electrons. But if the gate is made more negative than the source, an important effect will follow: The gate and the bar form a p-n junction with the junction being reverse biased. This results in a depletion region which will make the channel through which electrons flow from source to drain narrower (see Figure 2.4). The channel current increases as the drain voltage increase. In effect, the resistance of the bar is increased.

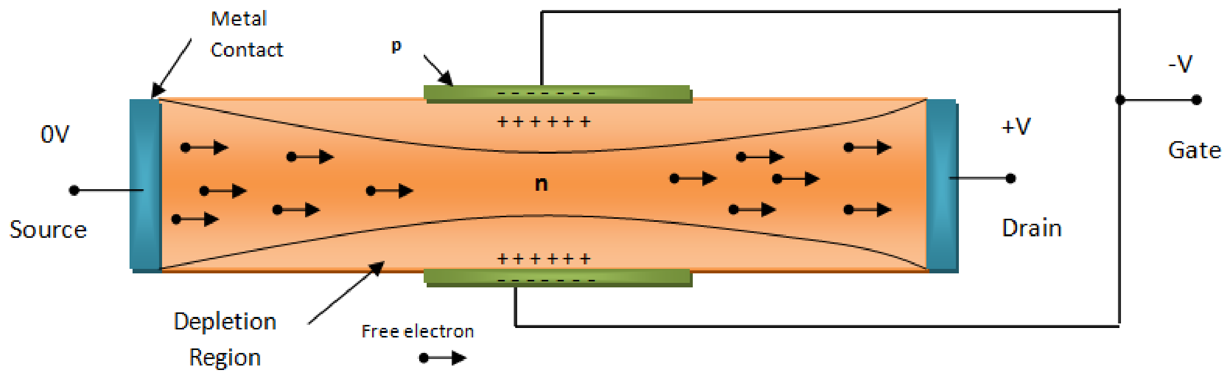

Figure 2.4: Representation of how the electron flow is narrower because of depletion region

Therefore, the field effect of the p-n junction reduces flow of electrons. There are two ways of using this field effect:

- **Switching**

  If the potential difference between the gate and the source is too high, the depletion region will extend through the whole width of the bar causing flow of electrons to be cut off. Used this way, the JFET is a *voltage controlled switch*.

- **Current Control**

  With smaller gate potentials that do not completely cut-off the current across the channel, the width of the channel is proportional to the gate potential. The greater the gate potential, the narrower the channel (bigger resistance), and the lesser the gate potential, the wider the channel (smaller resistance). Used this way, the JFET is a *voltage controlled resistor*. In other words, *a JFET can be used to convert a change in potential to a change in current*.

A JFET is always operated with the p-n junction reverse biased so current never flows from the gate to the n-type silicon bar. JFETs have many applications and are useful in potential-measuring circuits since they draw virtually no current through the gate and therefore do not affect the potentials they are measuring.

The JFET described above is an n-channel JFET because the bar is n-type silicon. A p-channel JFET has the same structure except that the bar is made of p-type silicon and the gates are made from n-type silicon. For p-channel JFETs, the gate is made positive with respect to the source to reverse bias the p-n junction. The electrical symbols for p-channel and n-channel JFETs are shown below:

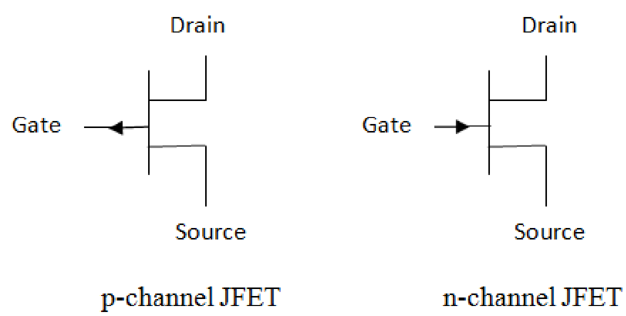

Figure 2.5: Schematic symbols for p-type and n-type JFETs

2.2.2 SiC Transistors

One of the most important attributes to a transistor is its threshold voltage, V_{th}, which separates the above-threshold regime (or on-state) where the charge induced in the device channel is proportional to the gate voltage swing, V_g-V_{th}, and the below-threshold regime (or offs-state). Below threshold, the source and drain contact are separated by a potential barrier. The barrier effectively turns off most of the channel conduction current. The height of the barrier, which sets the transistor off current, and also its on-to-off ratio, is greatly determined by the semiconductor bandgap. Figure 2.6 shows the schematic conduction band profiles in the channel of a FET below threshold. The barrier heights shown are proportional to the energy gaps for Si, GaAs, SiC, and GaN, respectively.

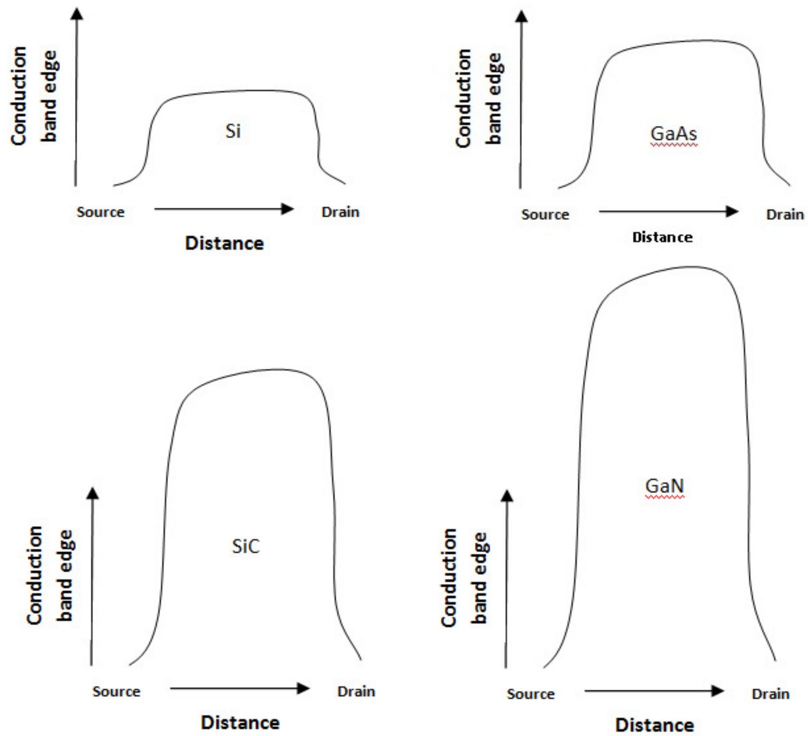

Figure 2.6: Schematic conduction band profiles in the channel of a FET below threshold, illustrating barrier heights between source and drain at zero bias

One may think that MOSFETs are the most promising switching device using SiC because the breakdown electric field for SiC is 10 times higher than for Si, so the doping density in the drain region can be increased. However, the voltage drop for a high-voltage MOSFET will be orders of magnitude lower than for a corresponding Si MOSFET. There also exists a big problem when manufacturing SiC MOSFETs. It is the incompatibility of the SiO_2-SiC interface that exists in the gate region, and it may take some time before this problem is solved. However, the JFET has no SiO_2-SiC interface and could therefore be useful as a commercial power device.

2.2.3 SiC JFETs

SiC JFETs are excellent candidates to fully exploit the SiC potential since they are voltage-controlled devices. They are free of gate oxide high-temperature reliability issues and forward bias voltage degradation. SiC JFETs are quickly becoming one of the most robust devices for high temperature power applications. These devices are available in either normally-off (N-off) or normally-on (N-on) modes. Regardless of their exceptional qualities such as low on-state voltage, low switching loss, high temperature capability, and radiation hardness, there is one downfall of JFETs, is that they are not easy to drive due to the small range of gate control voltage. Therefore, the gate control circuitry requires special attention to ensure reliable operation [11].

SiC JFETs can be fabricated using epitaxial or ion-implantation processes. Some of the drawbacks of SiC JFETs fabricated using the ion-implantation method are the shallowness of the implanted region, the introduced crystallographic damage, and the necessity of very fine widths when defining the channel. The implantation damage could cause an increased reverse leakage current and a non-abrupt junction could result in a reduced value of the built-in voltage [11]. The limited ion implantation depths, as well as the difficulty in doping the trench sidewalls in order to extend the channel are crucial limitations in the realization of N-off type SiC JFETs.

Normally-Off JFETS

The normally-off (N-off) SiC JFET is an excellent choice for several switching applications that require high frequency and high temperature. In order to realize this structure, the channel of the JFET has to be fully depleted by the gate to source potential with no applied voltage [11]. In other words, the threshold voltage, V_{th} has to be equal or larger than zero ($V_{th} \geq 0V$). The potential at the *p-n* junction at zero applied voltage is equal to the built-in voltage, V_{bi}, being the function of the material's bandgap, E_g, and the acceptor donor doping densities, N_A and N_D, at both sides of the junction. Equation 1 shows how to determine the built-in voltage, V_{bi}:

$$V_{bi} = \frac{kT}{q} \ln\left(\frac{N_A \cdot N_D}{N_V \cdot N_C}\right) + \frac{E_g}{q} \qquad \text{(Eq. 1)}$$

The built-in voltage V_{bi} is used to characterize a wide-bandgap material such as SiC. For 4H-SiC V_{bi} is at least 2.5V compared to that of Si which is 0.6V [11]. Low on-state resistance and high output current density are two pertinent demands for a N-off JFET design. It requires as large as possible channel doping and width, and gate control voltage. However, maximizing both the channel width and channel doping is not possible with respect to V_{th} condition, but must be performed with respect to the specific R_{ON} and V_{th}. The normally-off structure is preferred for practical applications because it is fail-safe.

Normally-On JFETS

When a JFET is characterized as a normally-on JFET is means that the JFET conducts if there is no voltage applied to the gate. A gate voltage has to be applied for it to stop conduction. However, these devices provide some challenges and problems when compared to normally-off JFETS. There could exist large transient current flows at system power-up because of the normally-on state. Also, it requires additional protection circuitry to prevent a DC bus short if the gate signal fails, which in turn leads to increased complexity of design [29].

One advantage for these JFETs is that the normally-on could actually conduct a higher current density and provide a lower specific on-resistance than the normally-off devices because of their wider channel opening. The primary benefit is the low voltage drop and the high switching speed these devices can provide. Another important benefit is that no anti-parallel diodes are necessary, which means that the complexity is reduced and the reverse recovery problem is solved [28].

Some of the disadvantages that come along with normally-on JFETs an increased complexity of the gate driver circuit, which is a property of the JFET that requires a negative voltage to turn off the device and also requires a larger gate power when compared to the MOSFET. To avoid the large transient current flows at power-up, the gate drive circuit has to be modified. Another disadvantage is the circuit may have high over voltages due to fast switching and negative voltages when used as a diode. Also due to fast switching speeds, there may be a problem with electromagnetic interference (EMI) and electromagnetic compatibility (EMC) [28].

2.2.4 Vertical Junction Field Effect Transistors (VJFETs)

In terms of the device structure, JFETs can be designed to be lateral. As previously discussed, where the source, gate, and drain terminals are all on the wafer front-side, or vertical, where the source and gate terminals are on the wafer front-side while the drain terminal is placed on the wafer backside. The SiC Vertical JFET, or VJFET, is a very promising technology that can provide high power/temperature switching as it uses the *p-n* junction depletion regions as a current control mechanism and therefore can fully exploit the high temperature range of SiC in a gate-voltage controlled switching device. As long as the gate-to-source junction of the VJFET is biased below its built-in potential, a negligible gate leakage current is needed to drive the device and voltage controlled switching is realized. An advantage of VJFETs is that they are free of MOS native oxide problems such as low channel mobility and the lack of reliability at elevated temperatures. They have demonstrated electrostatic discharge immunity to 16kV and as a unipolar device; they do not suffer from forward voltage degradation [11]. Also, the VJFET structure allows higher cell packing density, and therefore, has a lower on-resistance.

A simplified cross sectional schematic of a high-voltage p^+ ion-implanted 4H-SiC VJFET is shown in Figure 2.7. The basic device dimensions are the channel length L, the channel width 2B, the drift region width W_{DRIFT} and the drain length L_{DRIFT}. The channel layer is independently designed and typically doped around 10^{16} cm^{-3} to reduce the on-state resistance. The drift layer is usually doped at 10^{15} cm^{-3} and has a thickness of 12μm to ensure the 1200V blocking voltage. During the on-state, majority carriers (electrons) flow from the source to the drain. To control the current through the device the gates could be subjected to a voltage, which would adjust the width of the depletion regions between the *p*-type gates and the *n*-type channel. In the normally-off VJFETs, the p^+ implanted regions overlap at 0V gate bias.

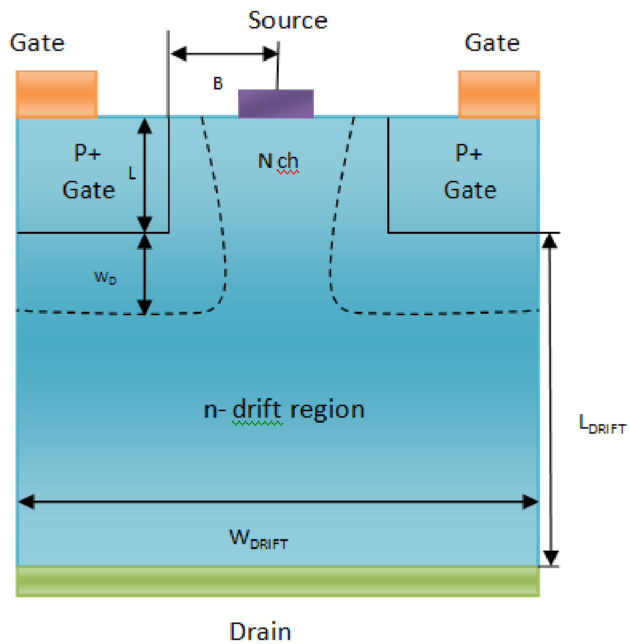

Figure 2.7: Cross-section of a vertical trench JFET

2.2.5 Device Selection for Experiment

The transistors used in this experiment, vertical depletion mode trench JFETs, are based on a patented vertical channel trench structure [12, 13]. The transistors are fabricated on 4H-SiC n^+ substrates. N-type drift and channels layers were epitaxially grown onto the substrate. A dry etching process was used to etch source finger structures. After etching, Al^+ ions were ion implanted into the trenches to form p^+ gate regions. Next, the trenches were passivated with oxide, followed by the formation of Ohmic contact pads for electrical connection. After dicing, the JFETs were packaged in TO-247 packages.

SemiSouth Laboratories [13] supplies a variety of commercially available SiC VJFETs (normally off or normally on). These VJFETs are based on a patented vertical-channel, trench structure. This design allows no current to flow laterally in the device therefore very high current densities are achieved. With precise control of the variation in the device threshold voltage, the normally-on VJFETs require low negative bias for blocking as well as with the normally-off JFETs requiring no negative bias for full blocking. Since the device does not possess a p-n junction between the drain and source, it does not have an intrinsic body diode.

For the gamma ray exposure experiments, the devices that were chosen from SemiSouth Laboratories were the SJDP120R085 and the SJEP120R100 JFETs. The SJEP120R100 (with an Rds(on) of 100mΩ) enables extremely fast switching with no ‘tail’ current up to its maximum operating temperature of 175ºC, and the SJEP120R085 offers the same features as the normally-off SJEP120R100 JFET, plus a higher saturation current (50A), lower on-resistance per unit area (85mΩ total), and the same or better switching performance. The SJDP120R085 device is a depletion–mode device that is rated at 1200V, $R_{ds\text{-}on}$ of 85mΩ, and a current of 52A. The SJEP120R100 device is an enhancement–mode device that is rated at 1200V, $R_{ds\text{-}on}$ of 100mΩ, and a continuous current of 17A. Figure 2.8 shows the picture of the JFET soldered to a 2 $^3/_8$” by 2 $^3/_8$” printed circuit board (PCB).

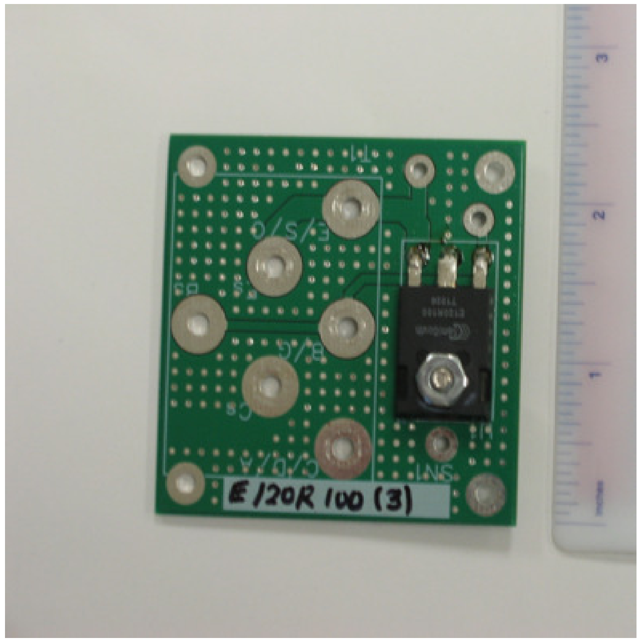

Figure 2.8: Picture of the PCB used to test the SemiSouth JFETs

The SemiSouth Laboratories' JFETs are finding applications in power electronic circuits for use as the forward switch. A typical example application for this type of switch is the buck converter, which is a DC-DC switching converter [31]. Example uses of SemiSouth Laboratories' JFETs include buck converters [32], photovoltaic inverters [33] and power factor correction [34].

Previous to this study, the performance of these devices to gamma ray radiation exposure had not been investigated. Therefore, this test is the first of its kind on these commercially available SiC devices.

2.3 Radiation Process

In a radiation process, the object being evaluated is placed in the vicinity of a radiation source, such as the cobalt-60 gamma ray source, for a fixed time interval where the object is exposed to the radiation emanating from the source. A fraction of the radiation energy that actually reaches the material is absorbed. The amount absorbed is dependent on the mass, composition, and time of exposure. For each type of object, a certain amount of radiation energy is needed to realize the desired effect and the exact value is determined through research.

This section addresses the effects of ionizing dose, primarily from gamma rays, on electronic devices. Gamma rays are members of the family of photons that are quantized manifestations of electromagnetic energy [14]. Other members of this family include ultraviolet, x, visible, and infrared rays. These rays are characterized by their wavelength which can be up to a few miles for radio waves. All of these photons travel with the speed of light, are uncharged, and usually just interact with free electrons or electrons that are bound to an atomic system.

Gamma ray sources use radioactive isotopes to provide substantial amounts of radiation exposure. For gamma rays, the popular isotope is ^{60}Co, which emits two characteristic gamma rays of 1.17 and 1.33eV [14]. ^{60}Co is produced by neutron irradiation of stable ^{59}Co, then ultimately decaying to stable ^{60}Ni, emitting the two gamma rays mentioned before in the process. ^{60}Co has a half-life of 5.27 years. This relatively short half-life precludes ^{60}Co from being found in nature. In addition to use as a gamma ray source, ^{60}Co is used in nuclear medicine, for sterilizing equipment and food, and as a radioactive tracer.

The main ionization-induced changes in semiconductor materials are that the conductivity increases through the production of excess charged carriers (electrons and holes). Also, there are trapped charges in insulators, production of electric and magnetic fields, and chemical effects could occur [14]. After being released from an ionized atom, free electrons with sufficient energy can be excited from the valence band and span the gap to reach the conduction energy band, therefore creating hole-electron pairs. The energy difference that the electron has is converted into creating secondary hole-electron pairs, or is transferred to the lattice as thermal energy (phonons). For semiconductors, the hole-electron pair creation energy is two to three times that of the corresponding bandgap energy.

Some of the electrons from the electron-hole pairs can escape by leaking from the surface of the material. Therefore, the material now has a net positive charge due to the positive ion excess. However, if those electrons are captured in the material, the result would be an excess negative charge, causing an electric field to be generated due to the charge separation between the negative electrons in the adjacent material and the positive ions in the parent material. This electric field can give rise to a potential difference across the interface between the two materials. This causes current to flow across the interface, as a function of the potential difference and the material conductivity, satisfying Ohm's law [14].

2.3.1 Gamma Radiation Effects on Semiconductors

In the modern semiconductor industry, there is a growing need to understand and combat potential radiation damage problems. Space applications are the obvious case, but, beyond that, today's device and circuit fabrication rely increasingly on steps that involve an aggressive environment where inadvertent radiation damage could occur. Other terrestrial applications where electronics may be exposed to radiation include nuclear power generation, nuclear medicine, and military environments.

When gamma rays penetrate a material, they transfer their energy into the material specifically through three processes which depend on their initial energy. These three processes are the photoelectric effect, the Compton effect, and pair production, represented here in the order of increasing radiation energy [14]. In all these processes, the photon energy that is absorbed mainly causes ionization and excitation of the resulting electrons, with the corresponding generation of hole-electron pairs in the material. Energy absorbed by the material from the radiation is usually represented in units of absorbed dose called rads. One rad is defined as the absorption of 100 ergs of radiation energy per gram of material. Because the given photon fluence is absorbed to a greater or lesser degree in each material, is it important that the specified material be stated, such as 100 rads (Si).

Semiconductor devices that experience ionizing radiation, such as neutrons or gamma rays, may suffer from damage. Some of these damages could lead to catastrophic failure, whereas others could show up as tolerable variations in electrical parameters. The radiation induced charges undergo redistribution and annihilation as time passes [15]. This process is known as annealing, since it can also by caused by heating.

For JFETs, the gate-to-source leakage current is one of the most sensitive parameters involved with respect to ionizing dose. P-channel JFETs are more resistant than n-channel JFETs to ionizing dose radiation. The ionizing dose damage can be seen in Si devices between 0.05-0.3 Mrad (Si) [14]. SiC has a capability to withstand higher ionizing doses than Si. Relativity large radiation-induced leakage currents can affect the operation of JFETs, due to their high input impedance. JFET leakage currents can increase by two orders of magnitude over their pre-radiation measurements after an exposure of 10-100krad (Si) of ionizing radiation.

The annealing of radiation damages in semiconductor devices usually follows one of three different approaches: rapid annealing, slow annealing, and thermal annealing [15]. For this research, the slow annealing approach was used. This annealing occurred at ambient room temperature for one week after final exposure.

Chapter 3

Experimental Procedure for Device Exposure

The experimental test procedure was developed with the help of Mr. Altstatt and Mr. Blair from ASI, Inc. in Huntsville, AL. The dose-rate of the Auburn University Leach Science Center, along with the instrumentation was taken into consideration when determining the exposure time for the SiC JFET devices. The drain current (I_{ds}) versus drain-to-source (V_{ds}) and gate (V_{gs}) were measured before, during, and after the irradiation at ambient room temperature. These measurements were later used in analyzing and comparing the data. Results are thoroughly discussed in Section 4.1.3.

3.1 Radiation Testing Procedure

The irradiation and annealing were performed on commercially available n-channel SiC JFET devices. The test plan was developed with the military standard handbook named MIL-STD-883H, Test Method Standard, Microcircuits as a guide [16]. The section of ionizing radiation (total dose) test procedure outlines the requirements for testing packaged semiconductor ICs for ionizing radiation effects from a cobalt-60 (or ^{60}Co) gamma ray source.

It is also important to use proper radiation safety techniques when in a radiation environment such as the Leach Science Center. To ensure safety, the facility has many precautions it takes including thick concrete walls, a safety interlock alarm system, and radiation monitors. Also, there was always a radiation specialist overseeing and operating the ion chamber, which would open and close the chamber after each dose, as well as use a Geiger counter to ensure that the environment is safe to enter for other people involved in the experiment. Some sources of radiation safety and operation can be found in other literature [35, 36].

The test plan was developed according to the MIL-STD 833 regarding the total ionizing dose section. The steps taken are outlined below:

1. Pre-radiation Electrical Characterization
2. Develop exposure plan
3. Expose SiC JFETs in Co60 for set exposure plan
4. Test each part after each dose of radiation
5. Record time in between tests
6. Continue exposure until finished with exposure plan
7. Allow a week for annealing
8. Test devices again
9. Data analysis

The next few sections will take each of these steps and describe the procedure involved in detail, outlining the main points and figures needed to realize the set out test plan.

3.1.1 Pre-radiation Electrical Characterization

The electrical characterization of the SiC JFETs was necessary before the devices were irradiated to obtain an initial baseline I-V curve. The test setup consisted of a Tektronics 371 High Power Curve Tracer, its test fixture accessory, and a personal computer connected via a GPIB adapter to control the test and record data. The power device being tested was soldered to a test board that was then plugged directly into the test fixture. A photograph of the test setup of the curve tracer and computer are presented in Figure 3.1.

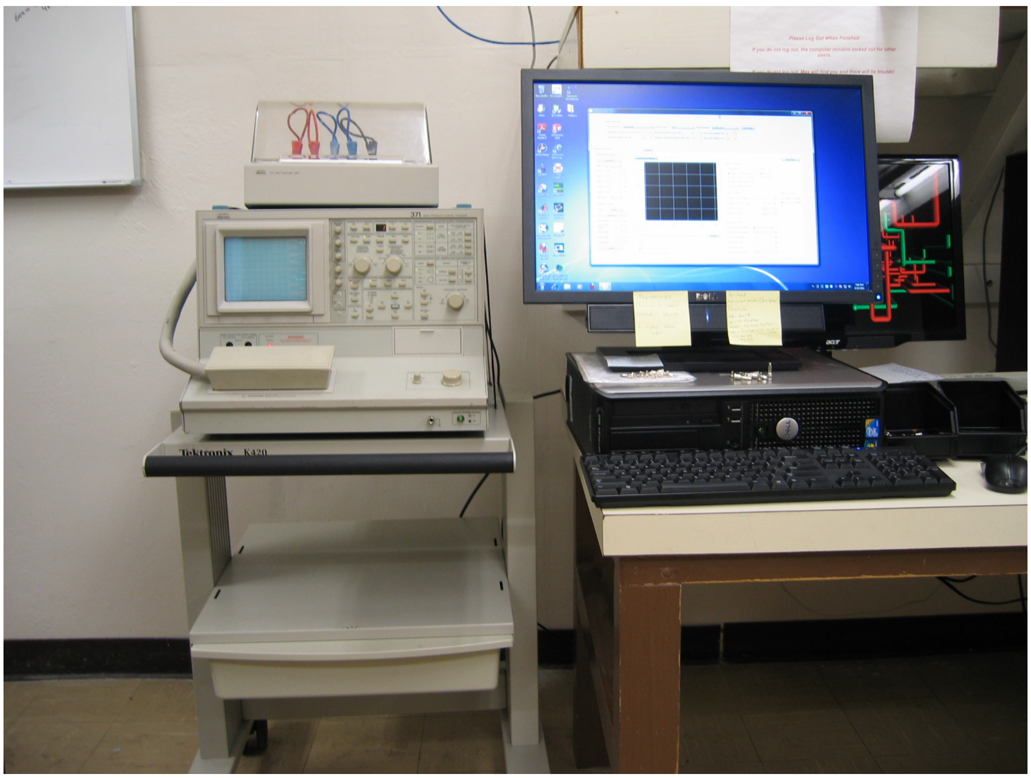

Figure 3.1: A picture of the electrical characterization setup

3.1.2 Develop Exposure Plan

As stated in the MIL-STD-883H ionizing radiation (total dose) test procedure, the apparatus should consist of a radiation source, electrical test instrumentation, test circuit boards, cabling, an appropriate dosimetry measurement system, and an environmental chamber. Also, adequate precautions such as grounding, insulation, and proper shielding should be taken.

The Auburn University Leach Science Center testing facility uses a cobalt-60 source that is located in an approximately 20-25 foot deep well of radioactive water that is used for shielding purposes during non-exposure. The Co-60 source is remotely brought out of the water-filled radiation shielding tank for irradiating the device under test. Prior to device exposure it was necessary to measure the dose-rate of the test facility. The test procedure states that the radiation source used in the test shall be the uniform field of a ^{60}Co gamma ray source. The uniformity of the radiation field in the volume where the devices are irradiated should be within ±10 percent as measured by the dosimetry system. Field uniformity and intensity can be affected by changes in the location of the device with respect to the radiation source, as well as the presence of radiation absorption and scattering materials. The American Society for Testing and Materials (ASTM) standard and guidelines are used to define the proper dosimetry system. A Keithley 616 Digital Electrometer in conjunction with Keithley M/N 6169 Ion Chamber Interface to obtain the dose-rate. The ^{60}Co gamma ray facility measured a dose-rate of 69.9 +/- 1.1 rad (Si)/s. Also, it is important to note the entire system was calibrated by K&S Labs on July 27, 2011.

Total Ionizing Dose (TID) testing shall be performed to characterize the effects of radiation on the device. These effects may include threshold voltage shifts, increased device leakage or power consumption, timing changes, or some other cause of failure or form of decreased functionality. In addition to the short term environment response testing, device functional measurements shall be repeated one week after radiation exposure to determine what effect ambient room temperature annealing may have on the device.

The Co-60 facility produces a dose rate of 81 rad/s in the test cylinder and approximately 8 rad/s in the open air chamber at the edge of the pool. Radiation dose can be applied in increments as low as 30 seconds, and as long as more than a week. For short duration exposure, total dose uncertainty is significantly increased.

Dosimetry provided by the Auburn facility is calibrated by comparison to a NIST source using a scintillation detector. The detector will measure the exposure rate at the appropriate locations prior to placing the test articles. Figure 3.2 shows the view of the pool source. The test tube can be observed as a long cylinder hanging over the pool.

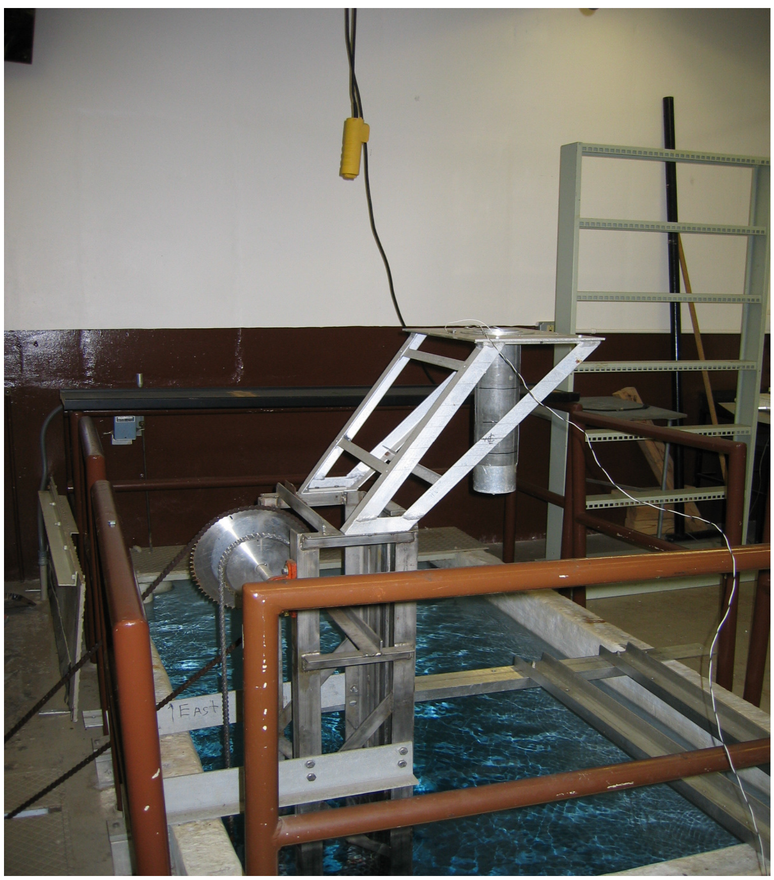

Figure 3.2: Aluminum tube suspended over radiation source

During exposure, the Co-60 source is remotely raised up out of the water and around the aluminum tube containing the devices under test. As shown in Figure 3.2, the device under test can be electrically connected to test/measurement equipment residing in a shielded area, using twisted pair cable. The exposure plan is outlined in Table 3.1. The plan accumulates doses of 100K, 300K, 600K, 1M, 2M, and 7Mrads at room temperature.

Table 0.1: Radiation Exposure Plan

DATE	TIME	ACTIVITY	DOSE ADDITION	TOTAL DOSE (RAD)	TIME REQUIRED (S)
8/8/2011	7:00 AM	Begin preparation	0	0	3600
8/8/2011	8:00 AM	First dose	100	100	1234.567901
8/8/2011	8:20 AM	Test parts @ 100	0	100	7200
8/8/2011	10:20 AM	Second dose	200	300	2469.135802
8/8/2011	11:01 AM	Test parts	0	300	7200
8/8/2011	1:01 PM	Third dose	300	600	3703.703704
8/8/2011	2:03 PM	Test parts @ 600	0	600	7200
8/8/2011	4:03 PM	Fourth dose	400	1000	4938.271605
8/8/2011	5:25 PM	Test parts @ 1000	0	1000	7200
8/9/2011	7:00 AM	Fifth dose	1000	2000	12345.67901
8/9/2011	10:25 AM	Test parts @ 2000	0	2000	7200
8/9/2011	12:25 PM	Sixth dose	2000	4000	24691.35802
8/9/2011	7:17 PM	Test parts @ 4000	0	4000	7200
8/10/11	7:00 AM	Seventh dose	3000	7000	37037.03704
8/10/11	5:17 AM	Test parts @ 7000	0	7000	7200

To assure the proper operation and stability of the test setup, pre-irradiation electrical measurements were performed. All of the electrical measurements, both pre-and post-irradiations, were performed on the Sony Tektronics 371 curve tracer. The printed circuit board was designed to directly plug into the curve tracer through a banana plug connector. Figure 3.3 shows the front and back side of the device assembled to the PCB designed for the curve tracer.

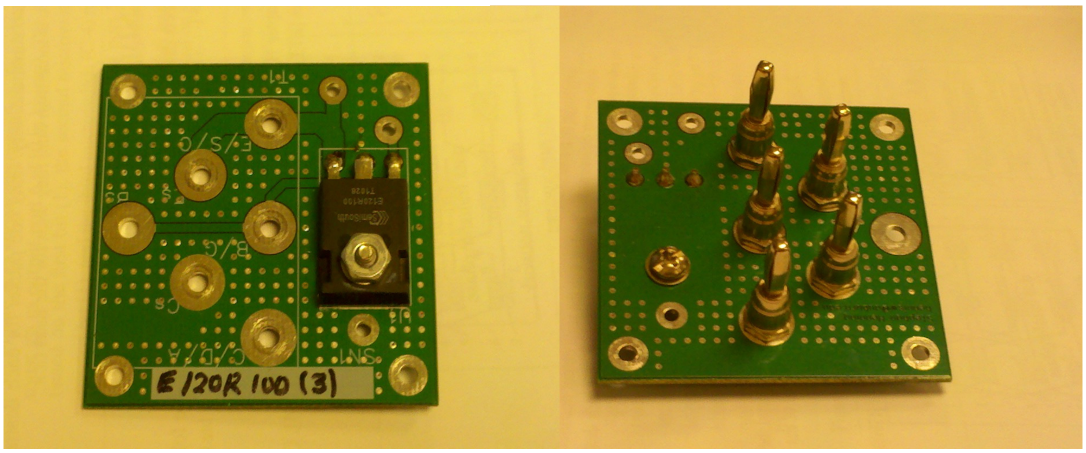

Figure 3.3: Front and backside of assembled device on PCB

The bias applied to the test devices was selected to produce the greatest radiation induced damage. This specific bias was maintained to each device and was verified pre- and post-irradiation for each exposure event. The bias used for the JFETs was set at 3V. The cable used was a 25 foot long with both the load line and ground. To minimize time dependent effects, time intervals between irradiating the device and subsequent irradiation was as short as possible, and the sequence of parameter measurements was maintained constant throughout the test series.

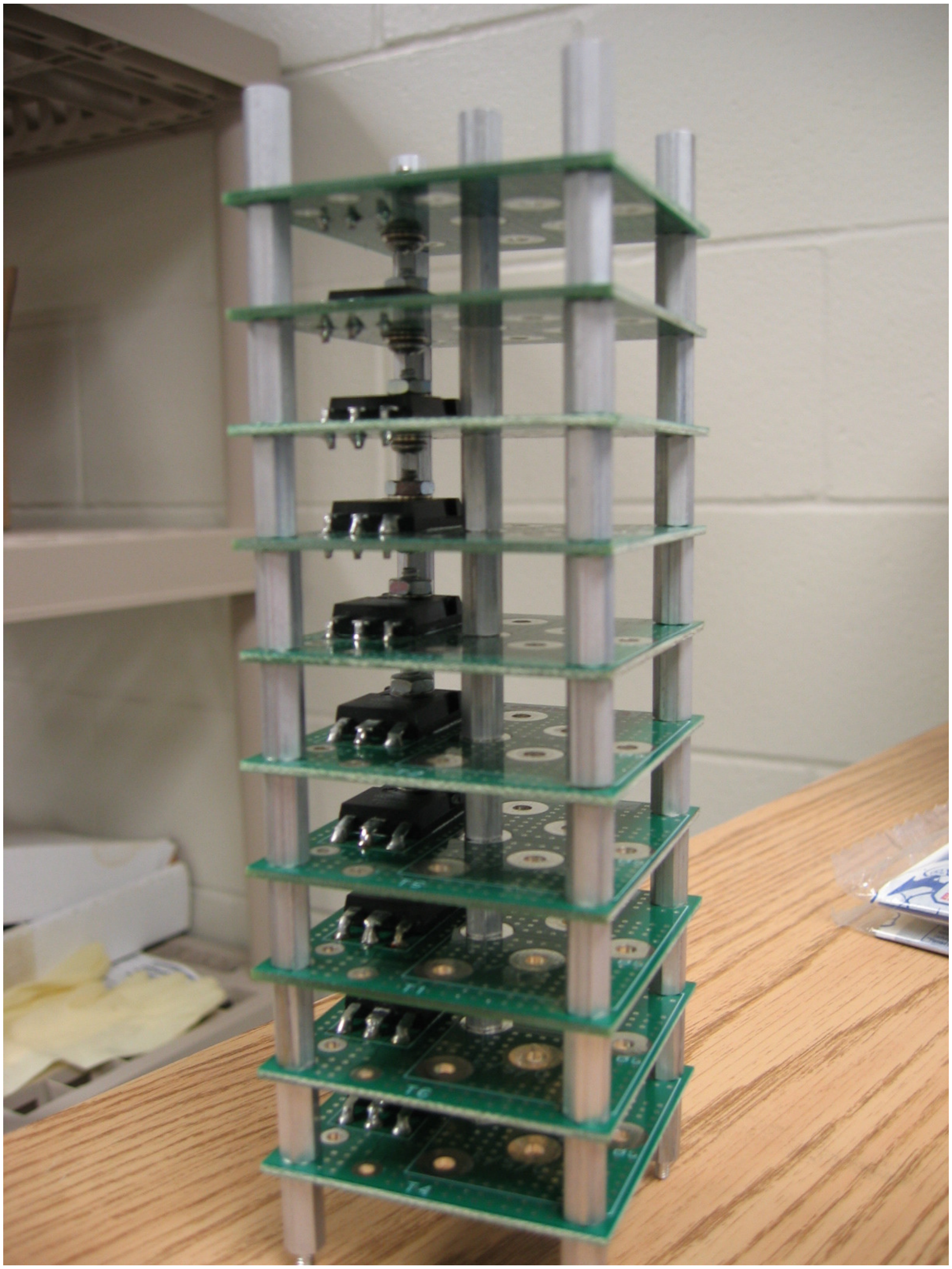

Figure 3.4: SemiSouth JFETs together as a tower to fit into the cylinder

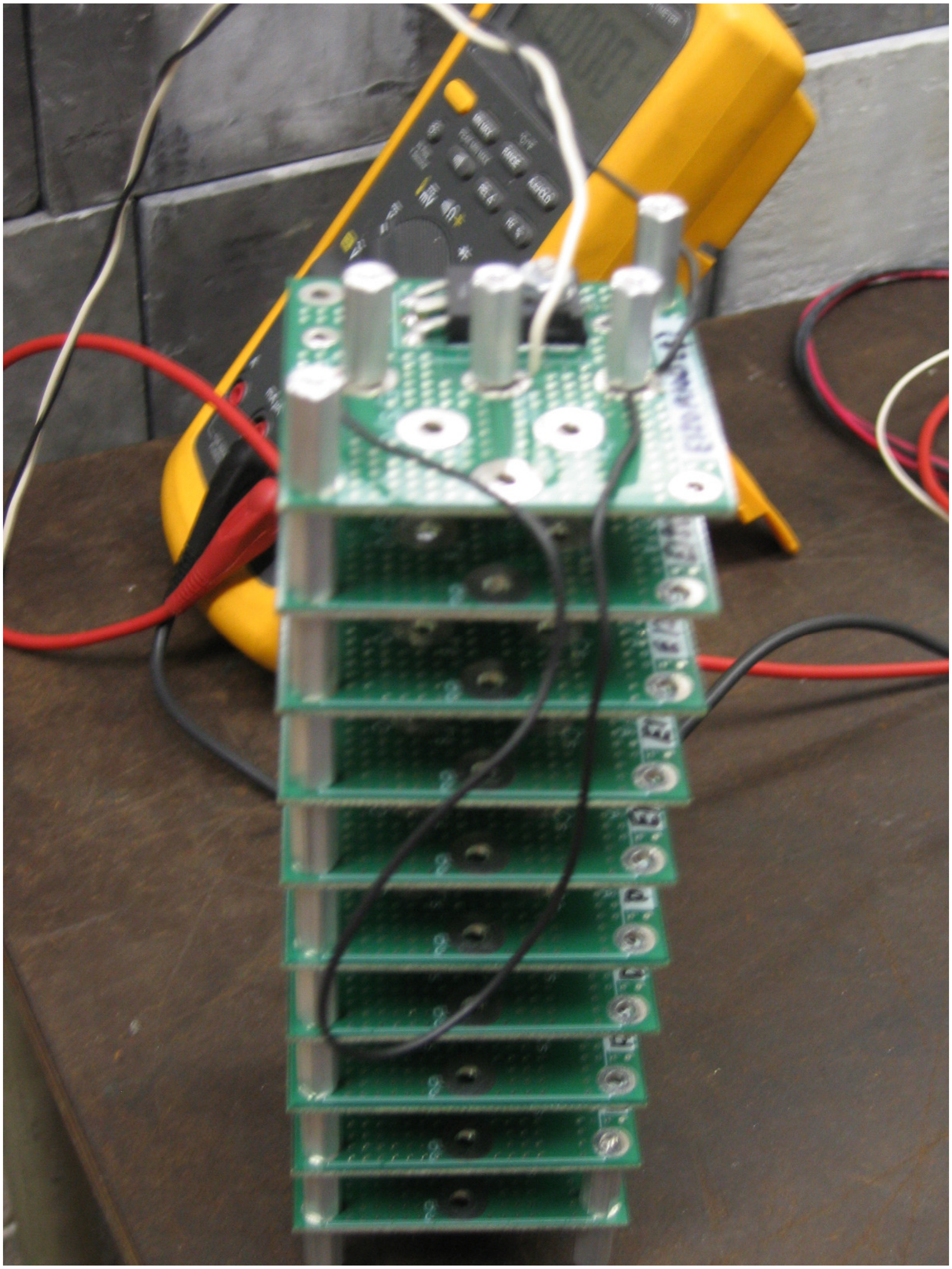

Figure 3.5: Electrical connections on the JFETs

3.1.3 Setup and preparations

A Kikusui PAD 16-10L power supply was used to supply the devices with 3V to turn the devices on while being irradiated. This power supply was located behind a concrete and lead wall to ensure the device was being shielded from any radiation.

3.1.4 Expose SiC JFETs in Co-60 for set exposure plan.

According to the test procedure, the devices need to be connected together so that the device biasing can be performed during irradiation, and no terminals should be left floating. Also, the geometry and materials of the devices should allow uniform irradiation to obtain accurate measurements.

Before the tube was irradiated, the source and drain were grounded, while the gate source was given a 3V bias using an appropriately shielded power source. The wiring can be seen in each figure, attached to the source (Fig. 3.5), extended off the side of the test device (Fig. 3.6) and attached to the power supply (Fig. 3.7).

Figure 3.5 shows the stack of JFET test boards which were wired together and placed inside a four inch diameter aluminum tube with an inside diameter of approximately 3.7 inches. The outside of the tube was wrapped with 0.062 inch lead foil, to satisfy the spectral requirements of MIL-STD 883 Method 1019. Enclosing the stack in the aluminum container minimizes dose enhancement effects caused by low-energy, scattered radiation. The structure was aligned in the tube with a stack of foam blocks so that the middle of the stack would line up with the middle of the holding tube and the center of the Co-60 array. As shown in Figure 3.6, the holding tube was placed in the support rack and suspended over the radiation source. As shown in Figure 3.7, the devices were continually biased to approximately 3.0 Volts throughout irradiation.

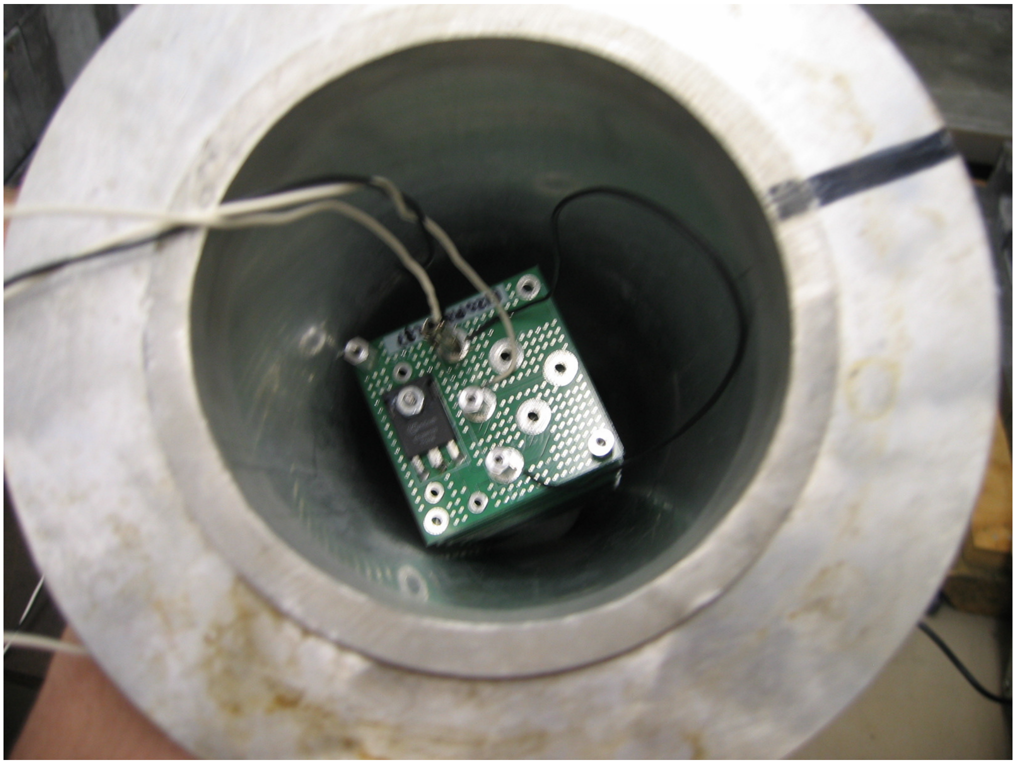

Figure 3.6: Devices in the aluminum cylinder

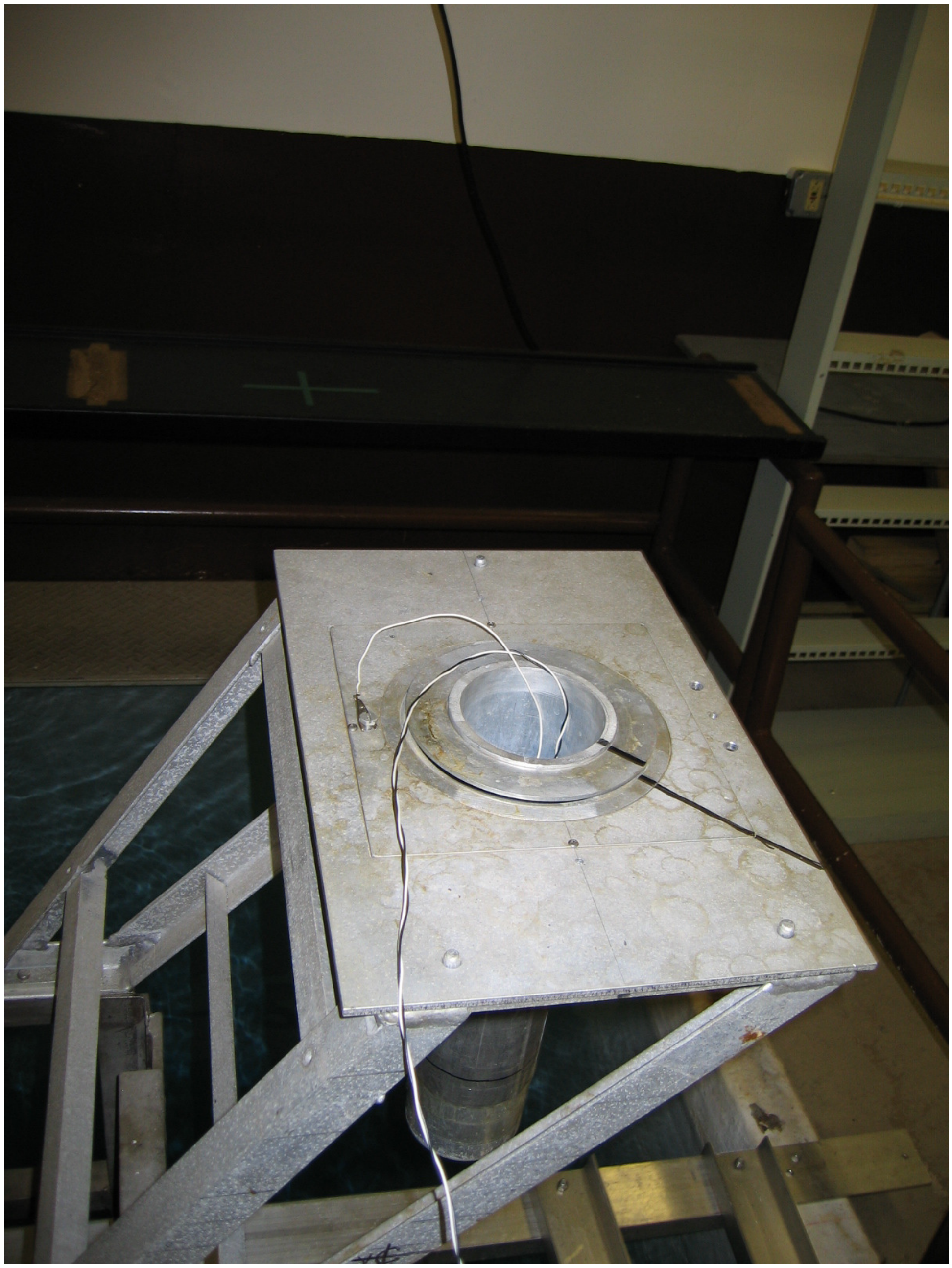

Figure 3.7: Device tube suspended over irradiation source

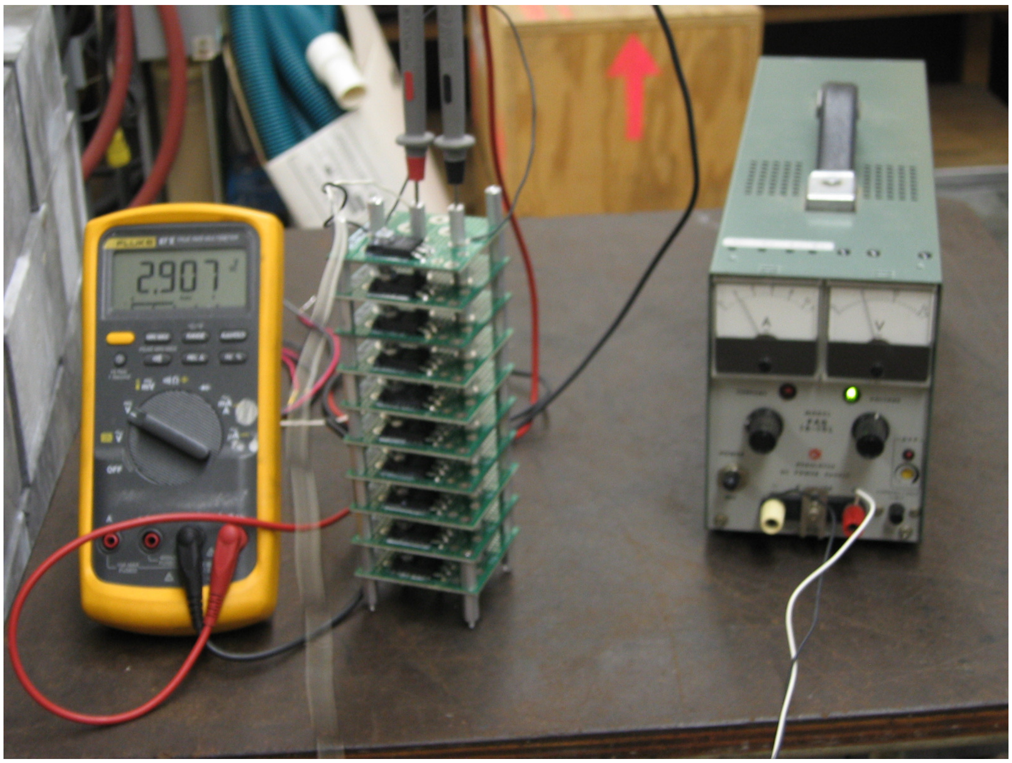

Figure 3.8: Devices connected to power supply and biased at 2.9V

3.1.5 Test Each Device after Each Dose of Radiation

The devices were all remotely tested, which means that the electrical measurements were made on the devices once they were physically removed from the radiation source. Also, the accumulation of doses requires multiple irradiations; so to comply with the test procedure, the post-irradiation electrical parameterization was performed after each irradiation.

After the devices had been irradiated for the set time interval, the parts in the tower are then disassembled and tested one by one using the Tektronics 371 curve tracer. Although the devices were irradiated with gamma rays, they do not become radioactive like the cobalt-60 source is, and thus can be handled normally.

3.1.6 Record Time in Between Tests

It was important to record the time in between the radiation intervals for reference. The time span allocated for testing between ionizing doses was two hours to ensure that there was enough time to characterize all the devices on the curve tracer. There were some issues in consistency when measuring some of the devices with the Tektronics 371; therefore, some of the devices had to be tested numerous times to obtain the output characteristic that was needed. The source of the problem was merely a parsing problem in the comma-separated values (.csv) file saving incorrectly, i.e. a later discovered software glitch in the data saving software that was not relevant to the test. When switching to different V_{gs} values, the values would sometime be added to the adjacent column prematurely instead of waiting to the correct count in the number of points to change columns. This problem was easily corrected with manually editing the file back to the correct format.

3.1.7 Continue Exposure until Finished with Exposure Plan

The devices under test should follow the test plan outlined in Table 3.1 shown in section 3.1 of this paper. The device exposure time was observed carefully to ensure that the proper dose was used to irradiate each device. The total time for the entire exposure plan was over a period of three consecutive days.

3.1.8 Allow a Week for Annealing

The MIL-STD 883H standard for ionizing radiation (total dose) test procedure provides a test method for estimating the low dose-rate ionizing radiation effects on the devices. This annealing test is important for low dose-rate or any other applications where devices may show significant time-dependent effects. The experiment allowed the devices to sit a week from the last exposure at ambient room temperature in order to test for any damage over time. If significant degradation in the electrical properties of the irradiated devices happens, then it should be considered a destructive test. This could be the cause of annealing or growth or both of radiation-induced trapped charges after the irradiation event [16].

The test plan called for an extended room temperature anneal test for the JFETs. This test provided an estimate of the performance of a device in a very low dose rate even though the testing was performed at a relativity high dose rate (e.g. 50-300 rad(Si)/s). The procedure involved irradiating the devices as called for in the test plan, and post-irradiation subjecting the device under test to a room temperature anneal for an appropriate period of time to allow leakage-related parameters that may have exceeded the pre-radiation specifications to return to within the specifications.

Following the irradiation and testing, the device under test was placed in a room temperature environment to anneal under a static bias condition of 3V. Figure 3.9 shows how the device structure was left to anneal for a week.

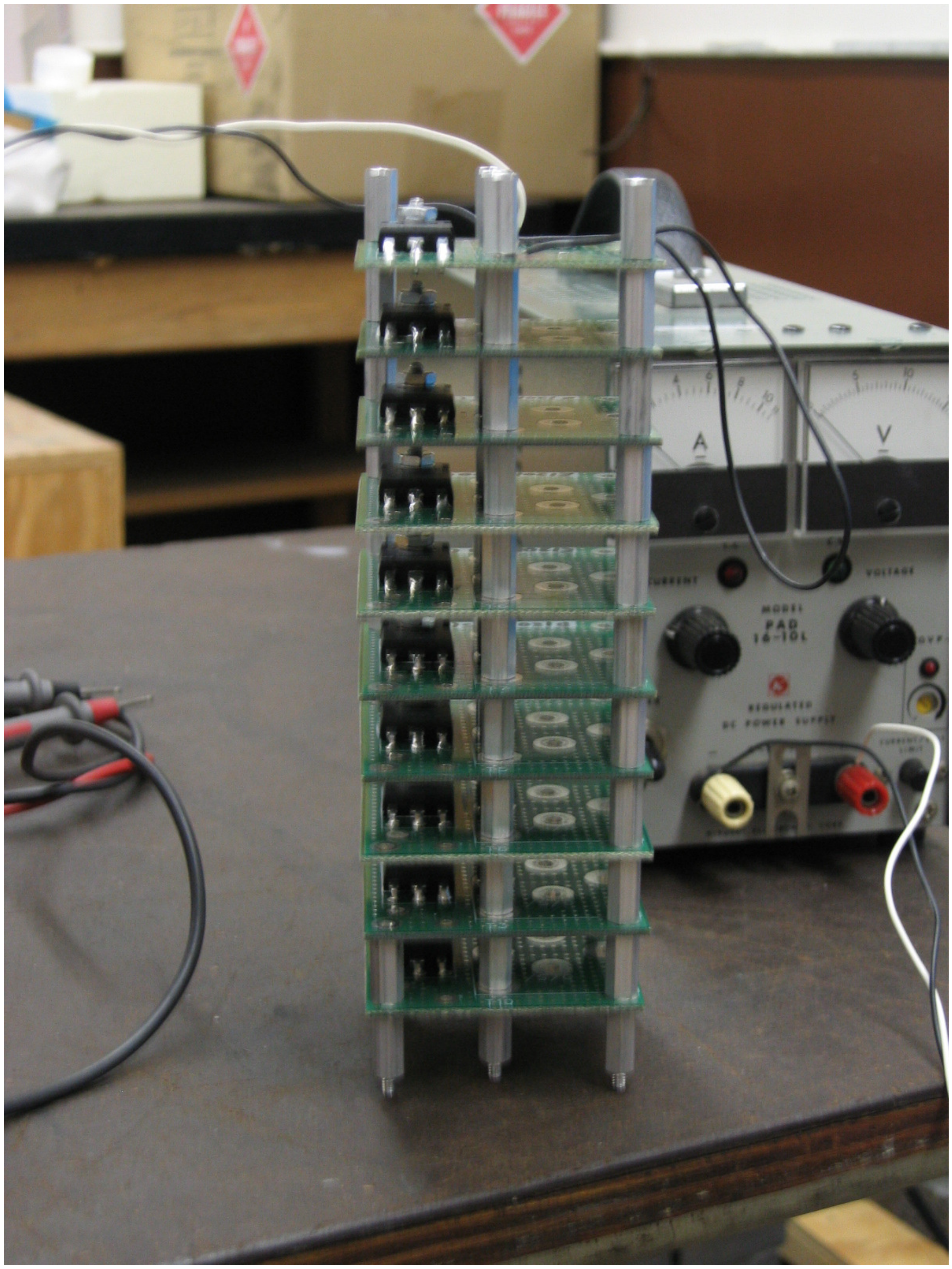

Figure 3.9: Device stack that was left for one week to anneal

3.1.9 Test devices again

After the devices were left untouched for one week's time, the annealing testing was performed. These devices were characterized in the same exact manner as the others were during their irradiation exposure using the Tektronics 371 curve tracer.

3.1.10 Data Analysis

The data was then taken from the comma-separated (.csv) files that was produced and recorded by the Tektronics 371, and the data was plotted using MATLAB. The first comparison was to examine each part one by one with each of the exposure times, including the baseline, pre-irradiation, and annealing together. This will determine if the part suffered any degradation or trapped charges. After the data was analyzed in this manner, the average of the 5 devices of each kind was then created to see if the result was the same in all of the samples selected. A discussion on the results is presented in the next chapter.

Chapter 4

Device Characterizations and Results

This section will cover the experimental results obtained from both the normally-on and normally-off JFETs received from SemiSouth Laboratories. Static measurements were performed using a Tektronics 371 curve tracer and the previously discussed test fixture. First, the pre-irradiation results will be presented, followed by the averages of five devices that show the comparison between pre-irradiation, 1st dose, 2nd dose, baseline 1, 3rd dose, 4th dose, 5th dose, baseline 2, 6th dose, 7th dose, and annealing. This will show the radiation hardness of these JFET devices.

4.1 Pre-irradiation Results

The pre-irradiation results from the Tektronics 371 curve tracer for the SJEP120R100 and SJDP120R085 are shown in Figures 4.1 and 4.2, respectively. These measurements were taken a week before irradiation took place. They average each device after doing the I-V characterization three times starting at V_{gs}= 5V and incrementing by 2V each step to reach a V_{gs} value of 15V. Also, Tables 4.1 and 4.2 represent the on-resistance for each V_{gs} value. This characteristic is to give a baseline before the actually radiation process was to be performed. There is also another pre-irradiation measurement taken the day of the gamma ray irradiation, and that data is shown along with the post-irradiation results for comparison reasons.

- **SemiSouth SiC JFET SJEP120R100 (1200V, 17A, 100 mΩ)**

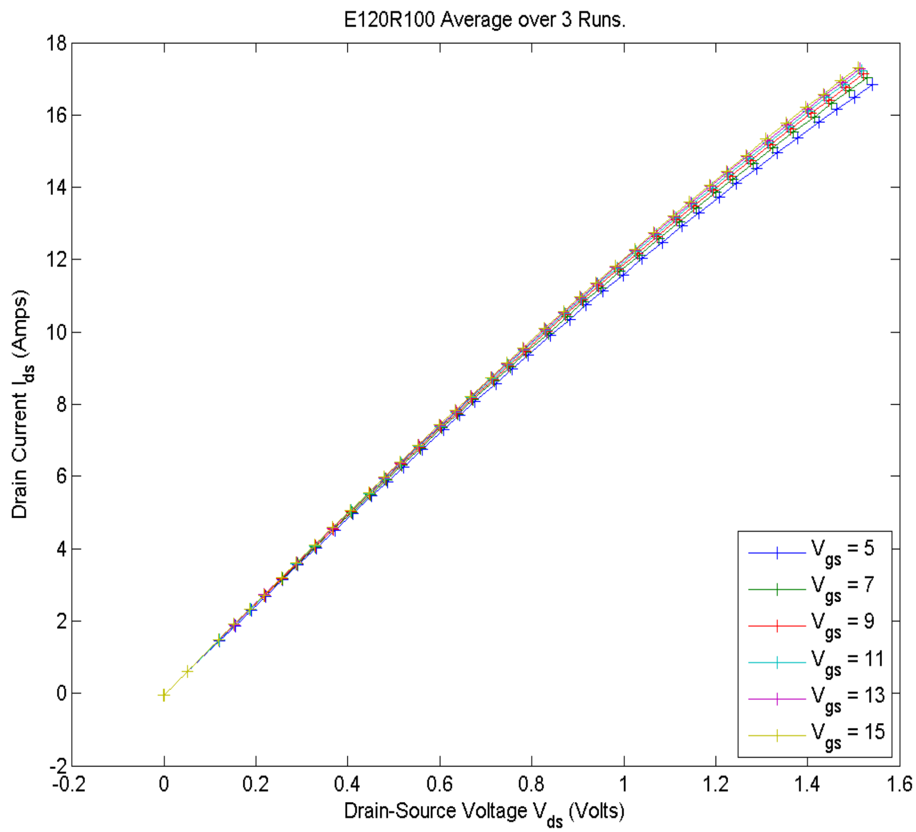

Figure 4.1: Measured pre-radiation I-V characteristic for the SemiSouth E120R100 SiC JFET.

Table 4.1: SemiSouth E120R100 Rds(on) resistance vs Vgs.

Vgs	5V	7V	9V	11V	13V	15V
Rds(on)	91.5mΩ	89.8mΩ	88.9mΩ	88.1mΩ	87.7mΩ	87.2mΩ

- **SemiSouth SiC JFET SJDP120R085 (1200V, 52A, 85 mΩ)**

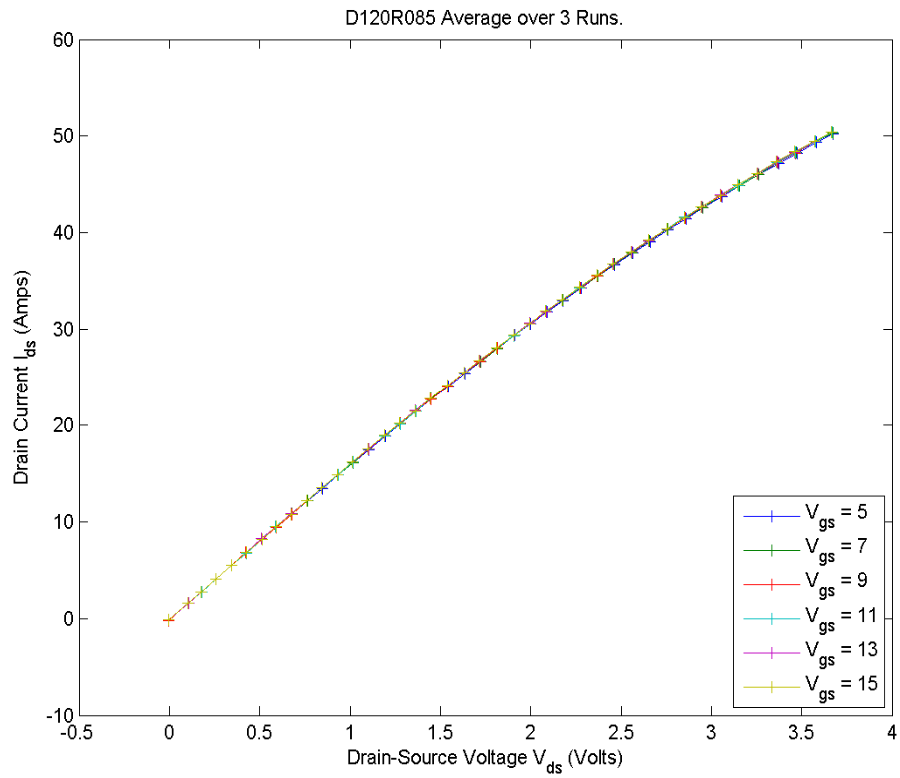

Figure 4.2: Measured pre-radiation I-V characteristic for the SemiSouth D120R085 SiC JFET

Table 4.2: SemiSouth D120R085 Rds(on) resistance vs Vgs.

Vgs	5V	7V	9V	11V	13V	15V
Rds(on)	73.1mΩ	72.9mΩ	72.8mΩ	72.8mΩ	72.7mΩ	72.7mΩ

4.2 Post-irradiation Results

The post-irradiation results for SJDP120R085 and SJEP120R100 are presented in Figures 4.3-4.8 and Figures 4.8-4.14 respectively. Each device has their I-V characteristic/radiation response with baseline and pre-radiation data included in each graph. The experiment started at V_{gs}= 2V and incremented each V_{gs} by 2V to reach a maximum voltage of 12V. The curve tracer had issues during the days we were irradiating the parts, so we could not test the devices up to the 15V as the pre-irradiation results did the week before. However, the response will be unaffected as the graphs show no degradation after irradiation anyway.

The devices were tested one by one; however the data is represented as an average of the values of each of the five devices by each V_{gs} value. The data represented in the legend as shown as 1st dose, 2nd dose, etc., therefore I have presented a chart to make the doses related to the rad value of each dose in Table 4.3.

Table 4.3: Graph Representations and the Corresponding Dose Rates

Graph Representation	**Total Ionizing Dose**
Pre-rad	0 rad
1st dose	100 krads
2nd dose	300 krads
Baseline 1	-
3rd Dose	700 krads
4th Dose	1 Mrad
5th Dose	2 Mrad
Baseline 2	-
6th Dose	4 Mrad
7th Dose	7 Mrad
Anneal	-

4.2.1 SJDP120R085

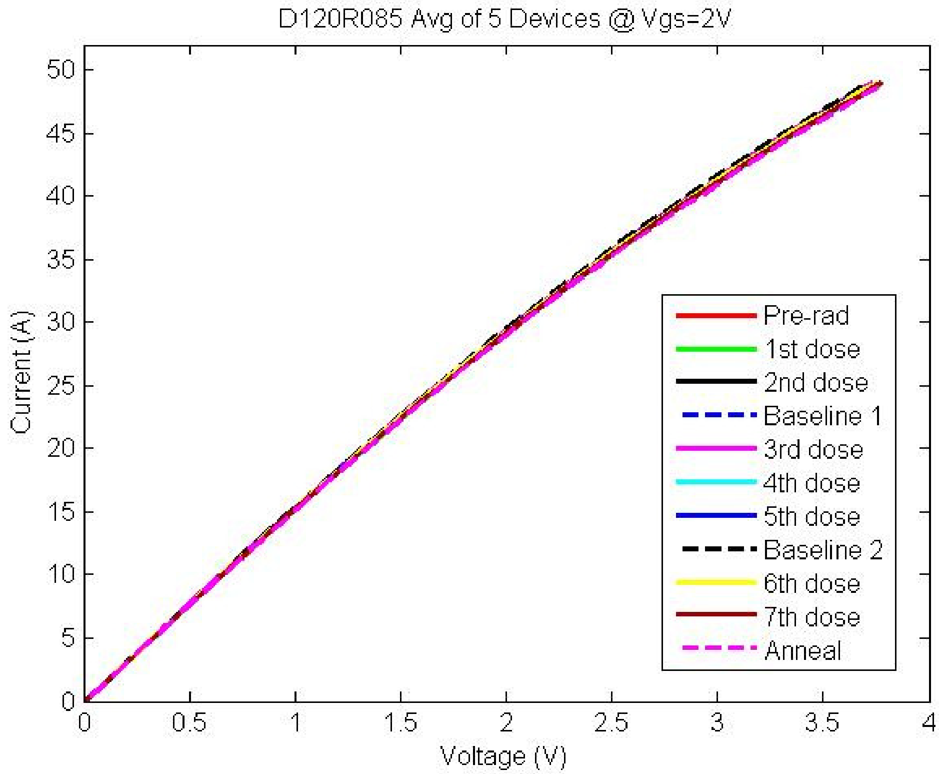

Figure 4.3: Average of five D120R085 devices for all doses of radiation @ V_{gs}= 2V

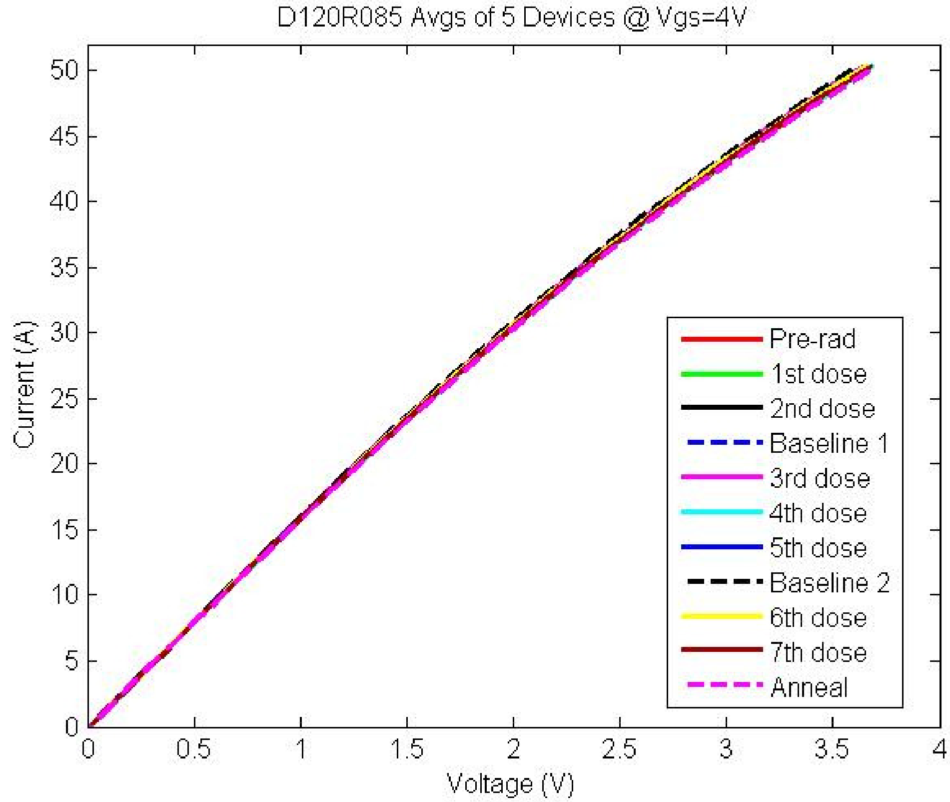

Figure 4.4: Average of five D120R085 devices for all doses of radiation @ V_{gs}= 4V

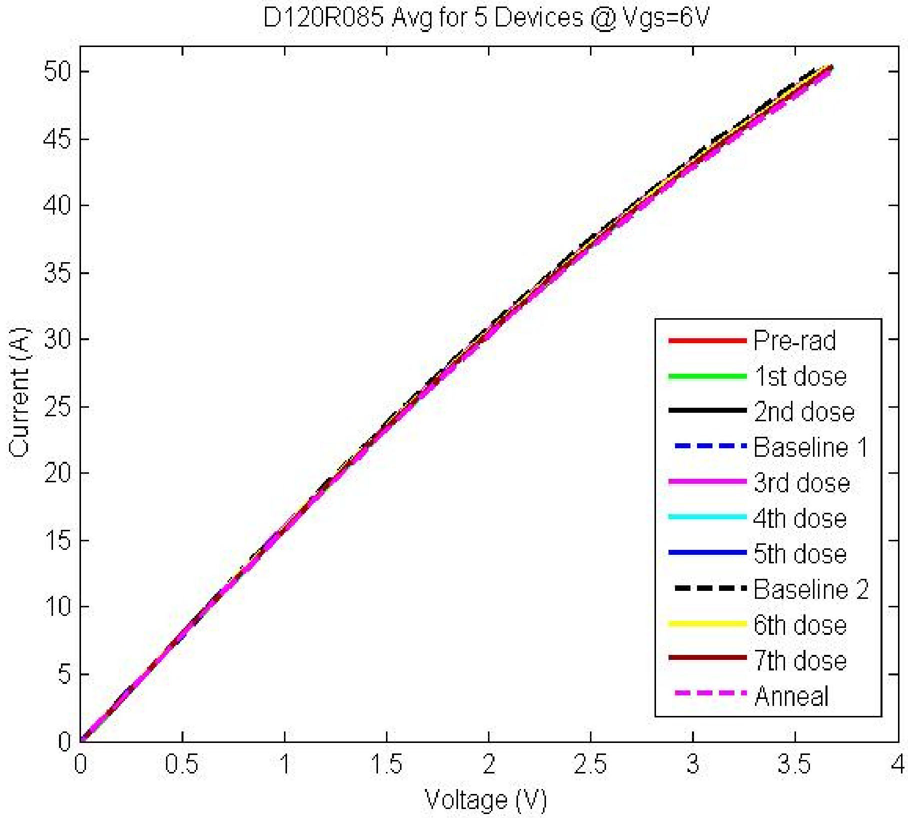

Figure 4.5: Average of five D120R085 devices for all doses of radiation @ V_{gs}=6V

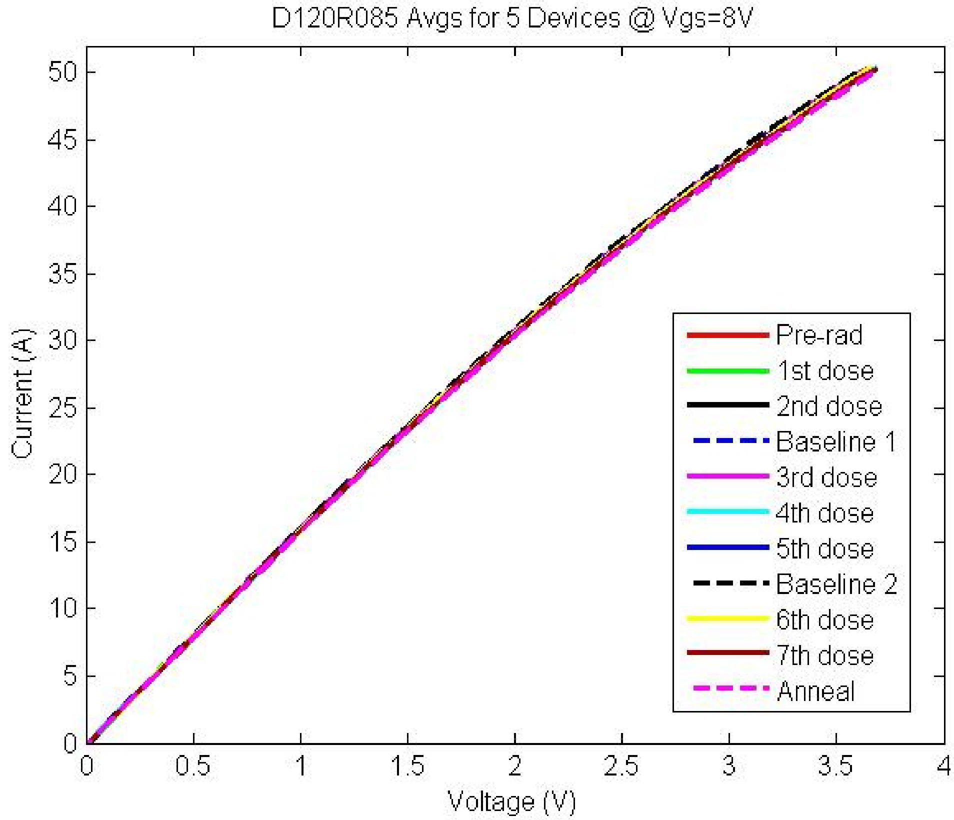

Figure 4.6: Average of five D120R085 devices for all doses of radiation @ V_{gs}= 8V

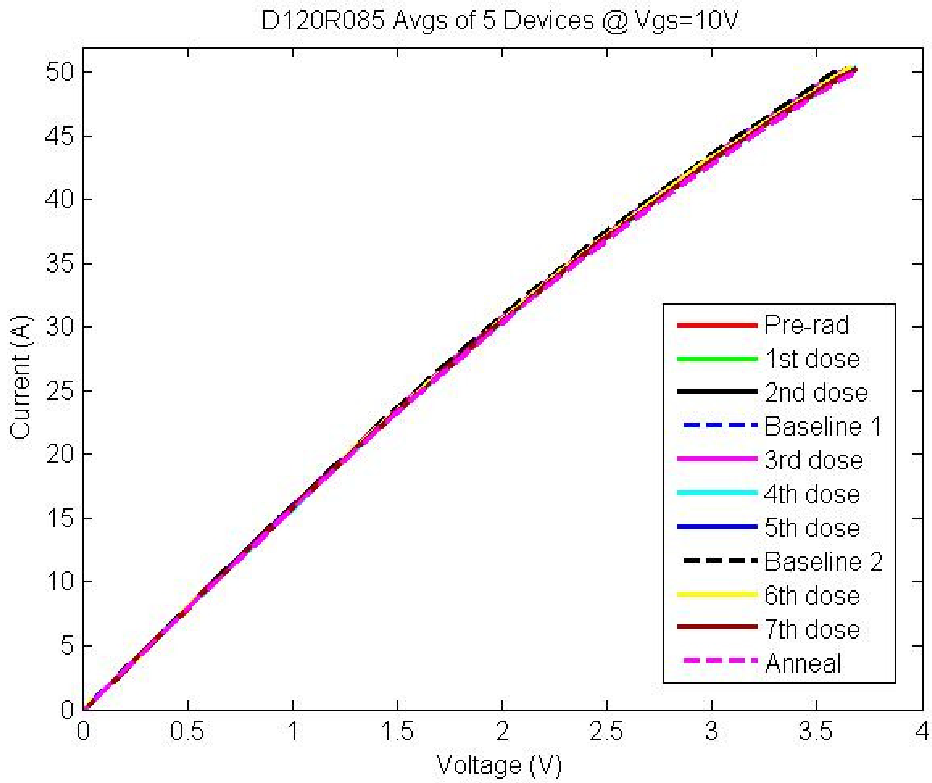

Figure 4.7: Average of five D120R085 devices for all doses of radiation @ V_{gs}= 10V

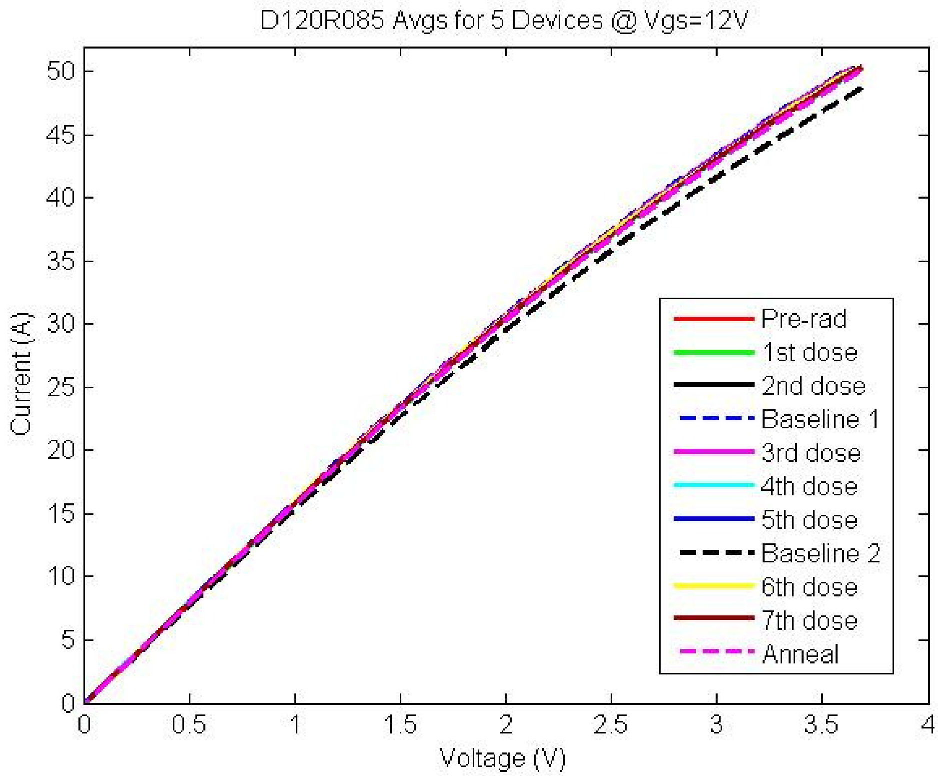

Figure 4.8: Average of five D120R085 devices for all doses of radiation @ V_{gs}= 12V

4.2.2 SJEP120R100

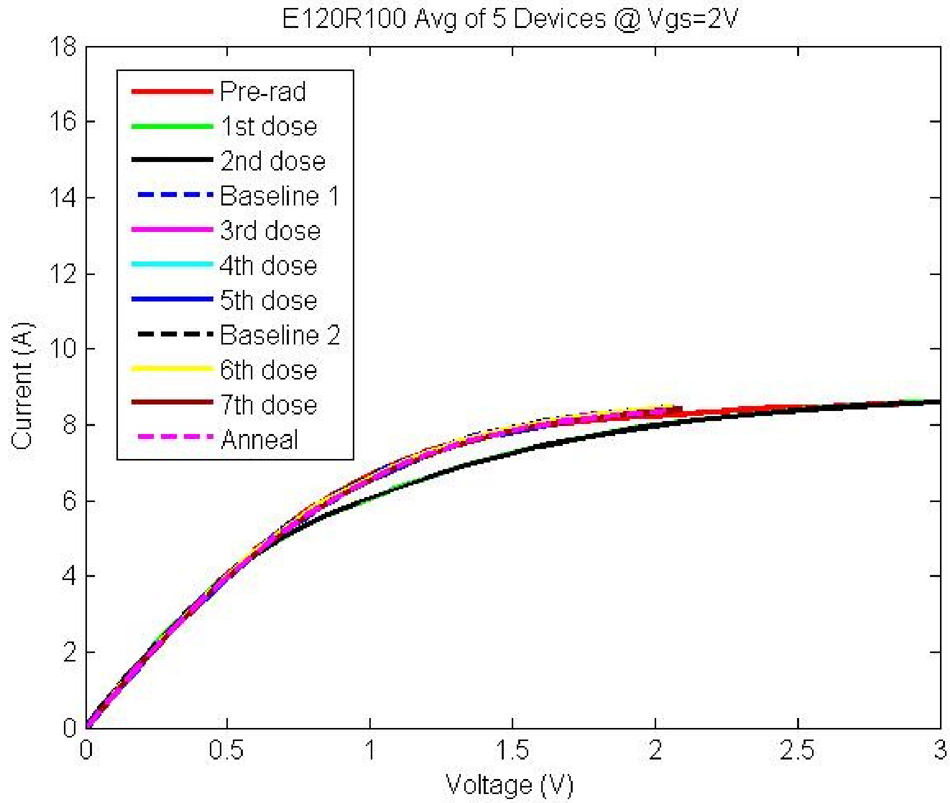

Figure 4.9: Average of five E120R100 devices for all doses of radiation @ V_{gs}= 2V

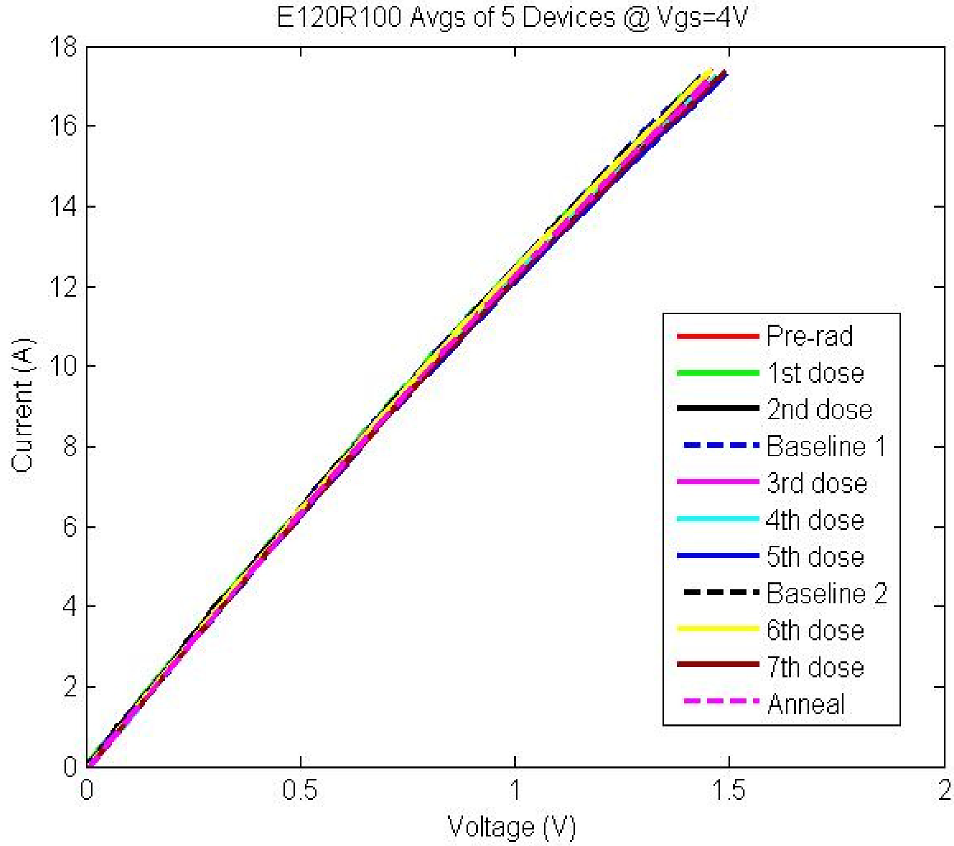

Figure 4.10: Average of five E120R100 devices for all doses of radiation @ V_{gs}= 4V

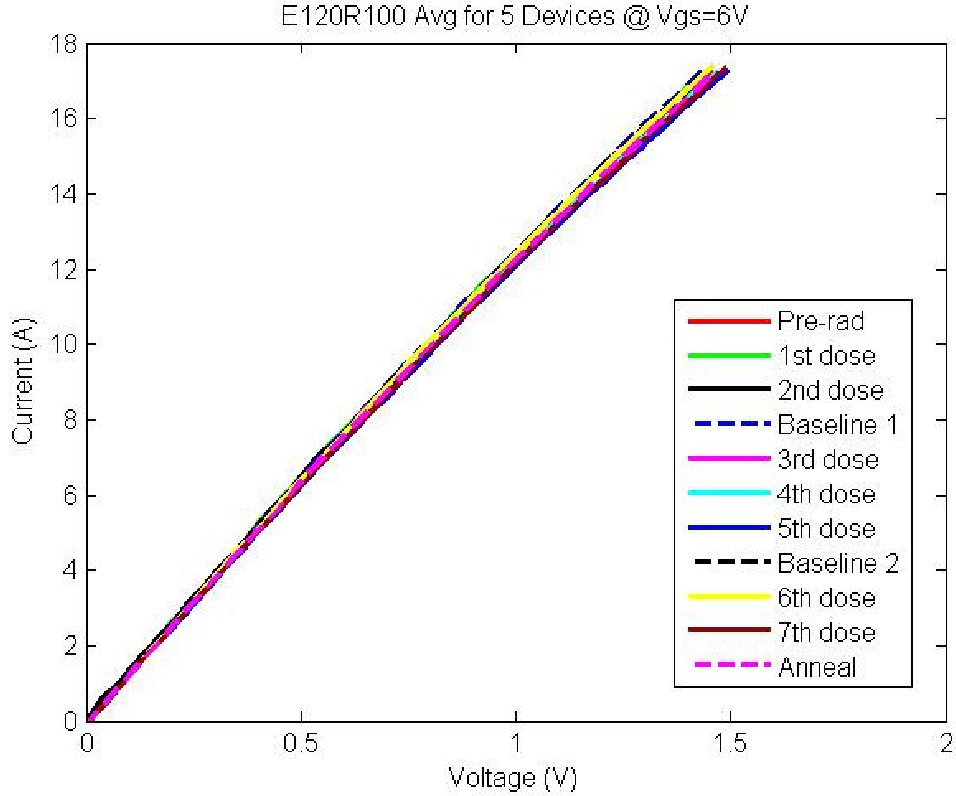

Figure 4.11: Average of five E120R100 devices for all doses of radiation @ V_{gs}= 6V

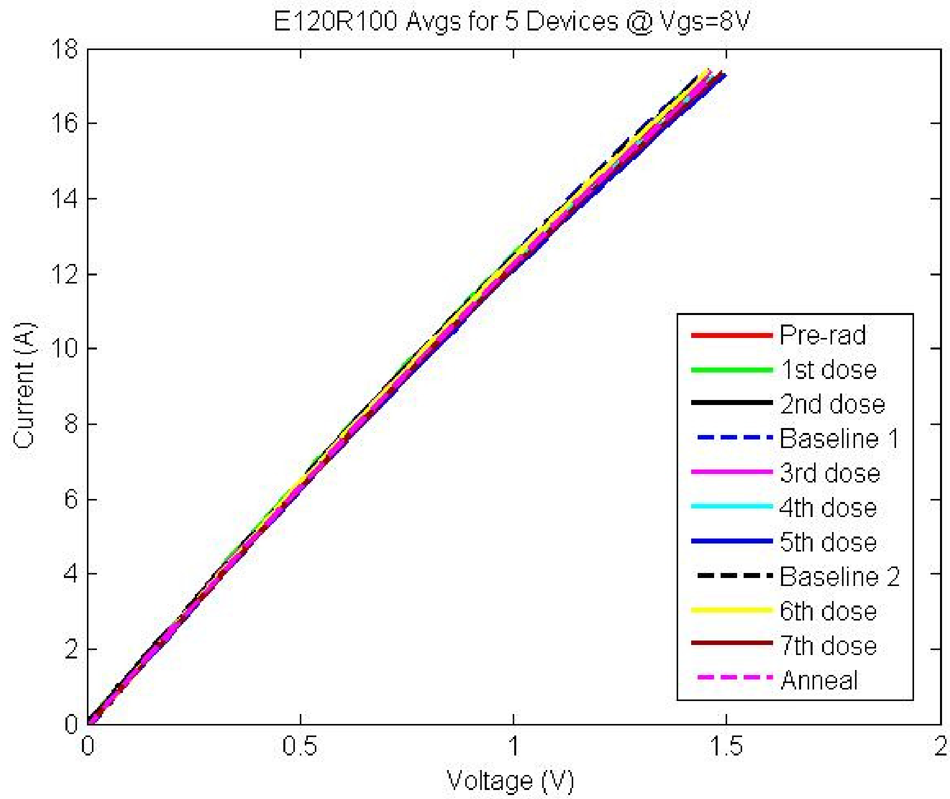

Figure 4.12: Average of five E120R100 devices for all doses of radiation @ V_{gs}= 8V

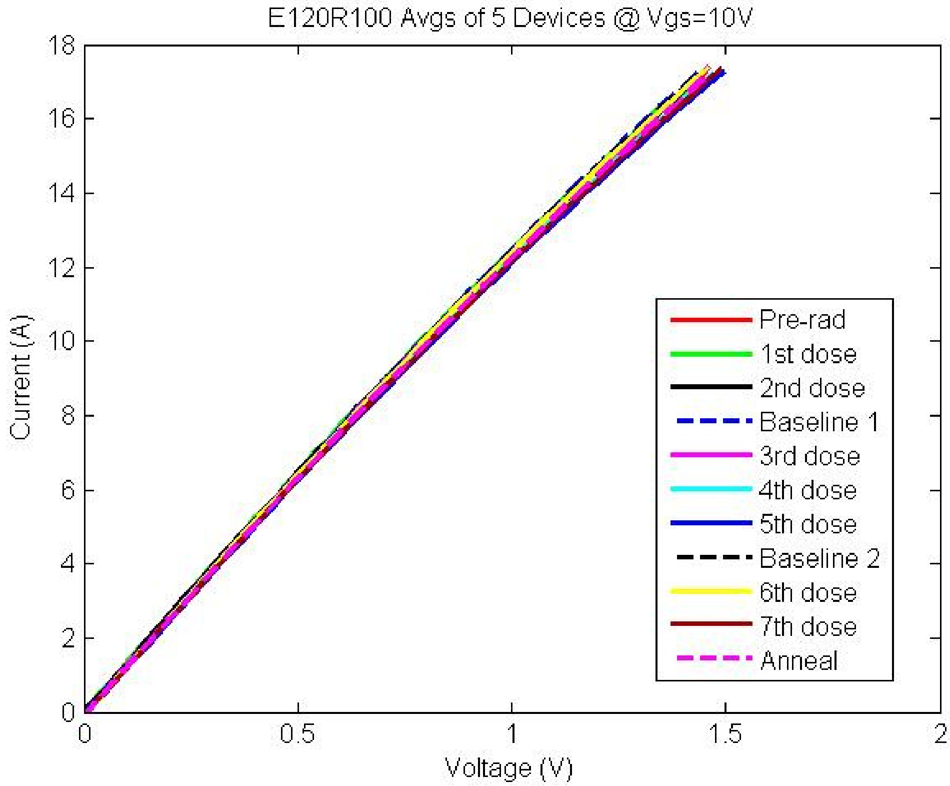

Figure 4.13: Average of five E120R100 devices for all doses of radiation @ V_{gs}= 10V

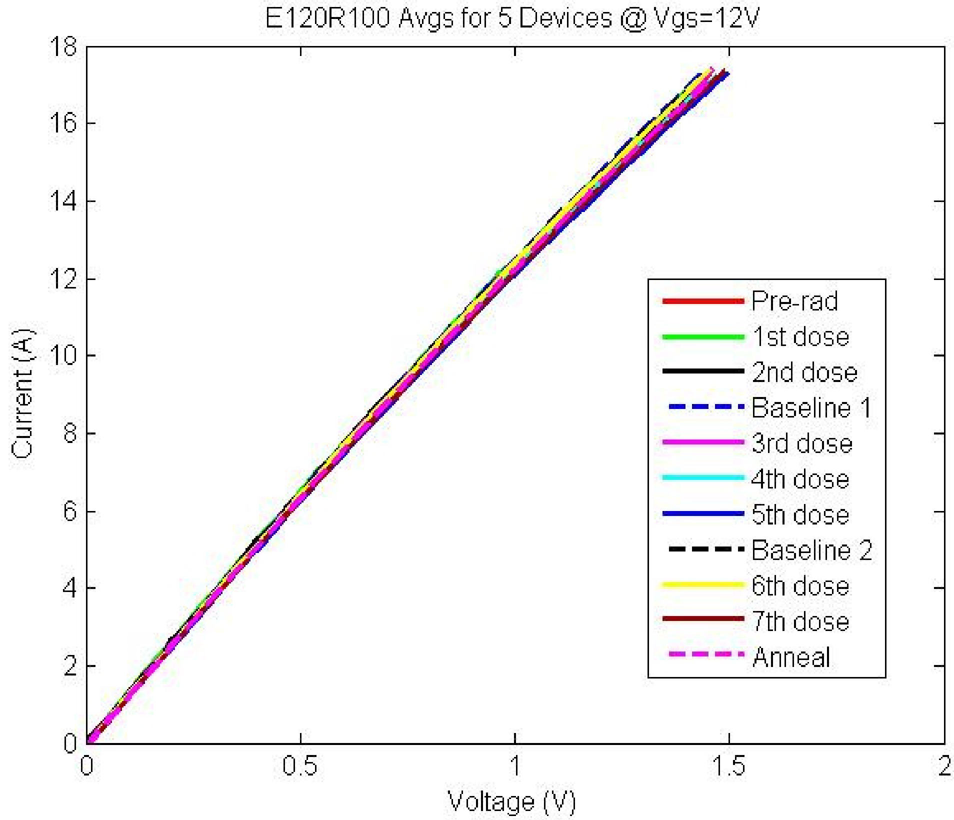

Figure 4.14: Average of five E120R100 devices for all doses of radiation @ V_{gs}= 12V

4.1.3 Discussion

Two of the main fundamental mechanisms that the experiment was looking for were lattice displacement and ionization effects. For lattice displacement, the high energy gamma rays may interact with the crystal lattice structure, creating lasting crystal damage, which in turn increases the number of recombination centers, depletes the minority carries, and worsens the analog properties in the junctions. This device, however, it does not rely on minority carriers. Therefore, it does not really see the effect of the losses caused by recombination and transistor gain. Ionization effects are caused by charged particles, which can even include the lower energy particles with too low of energy to cause lattice effects.

These effects are dependent on several variables such as type of radiation, total dose, radiation flux, combination of types of radiation, and even the operating properties (frequency, voltage, state, etc.). With just using gamma ray irradiation and a wide band gap material, the devices show that they can withstand up to 7Mrads of irradiation. When compared to Si in which there is slow gradual degradation seen after a total dose 5krads, these devices are very robust and durable when placed in such environments. Through this investigation, these commercially available SiC JFET devices have been shown to demonstrate near-ideal behavior throughout this testing procedure.

Conclusions

There is no doubt that SiC technology development could be widely utilized in today's electronic industry. It could very well impact a multitude of applications in sectors such as aerospace, military defense, automotive, nuclear power instrumentation, satellites, etc. Therefore, the continued study of SiC devices and their reliability is crucial to achieving the much needed scientific breakthrough that will launch SiC to become the preferred semiconductor material for harsh environment applications.

Transistor switches based on 4H-SiC in power electronic circuits bring significant advantages. The ability to operate at high blocking voltages with reduced specific on-resistances due to the thinner and shorter drift layers are made possible by the high electric breakdown field. The superiority of the dynamic behavior can be seen if compared with minority carrier devices like IGBTs [26].

Gamma rays from Co-60 are widely used to study ionization induced damage in devices incorporating dielectrics, such as MOSFETs [27]. SiC devices perform well following extremely large gamma ray exposures. In this paper, it is shown that commercially available JFET SiC transistors have the potential to operate in this high radiation environment, as potentially encountered in some terrestrial and space applications. No significant degradation in the device characteristics was observed after a total ionizing dose of 7 Mrads. There are numerous applications that could benefit from these devices, such as switching power supplies for high altitude and space applications, electronics for nuclear medicine and radiation monitoring electronics.

Future Work

Although the gamma ray exposure to the SiC JFETs was overall a successful experiment, there is some room for improvement to ensure the radiation hardness of these devices. Environments with high ionizing radiation create special challenges, such as particles knocking many electrons loose, causing electronic noise and signal spikes. All of these ionizing environments were not discussed in this paper; therefore, there are several other kinds of irradiation that can be performed to these devices other than just gamma ray radiation.

Since these systems can go into artificial satellites, spacecraft, nuclear power station, and nuclear weapons, it is very important to test all of these environments using the proper test methods. Nuclear reactors produce gamma and neutron radiation, which can affect sensor and control circuits in power plants. Cosmic rays come from every direction and consist of protons, alpha particles, and heavy ion, as well as x-rays and gamma ray radiation. Also, solar particles events come from the sun and consist of large fluxes of high-energy protons and heavy ions. They provide a continuous low-flux of particles consisting of about 85% protons, 14% alpha particles and 1% heavier nuclei of various energies [37]. So it is imperative that these kinds of different radiation variations are taken into account when testing devices for space applications.

Another suggestion for future work on the gamma ray irradiation portion of the paper would be to irradiate some other high power semiconductor devices made of other compound materials as well. Some of these compounds that are emerging from the semiconductor industry are GaAs, GaN, and SiGe that can be analyzed under high ionizing radiation. Additionally, further testing should include complete circuits that utilize these components. There is still much advancement needed in this field, and with proper testing techniques these devices could very well be the answer to the space industry's problems when it comes to harsh environments involving temperature and irradiation.

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Appendix

```
%File Reader for .csv files used in semiconductor analysis
%for radiation testing
%
%Part #:D120R085 Avgs
%

clear;
%%
%%Vgs=2V
%Read in .csv file
%Part 1
Vgs2pre1 = csvread('D120R085-1-3-prerad.csv',3,3,[3 3 44 3]);
Igs2pre1 = csvread('D120R085-1-3-prerad.csv',3,4,[3 4 44 4]);
Vgs211 = csvread('D120R085-1-1-1stdose.csv',3,3,[3 3 44 3]);
Igs211 = csvread('D120R085-1-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs221 = csvread('D120R085-1-1-2nddose.csv',3,3,[3 3 44 3]);
Igs221 = csvread('D120R085-1-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base11 = csvread('D120R085-1-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base11 = csvread('D120R085-1-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs231 = csvread('D120R085-1-1-3rddose.csv',3,3,[3 3 44 3]);
Igs231 = csvread('D120R085-1-1-3rddose.csv',3,4,[3 4 44 4]);
Vgs241 = csvread('D120R085-1-1-4thdose.csv',3,3,[3 3 44 3]);
Igs241 = csvread('D120R085-1-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs251 = csvread('D120R085-1-1-5thdose.csv',3,3,[3 3 44 3]);
Igs251 = csvread('D120R085-1-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base21= csvread('D120R085-1-1-baseline2.csv',3,3,[3 3 44 3]);
Igs2base21 = csvread('D120R085-1-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs261 = csvread('D120R085-1-1-6thdose.csv',3,3,[3 3 44 3]);
Igs261 = csvread('D120R085-1-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs271 = csvread('D120R085-1-1-7thdose.csv',3,3,[3 3 44 3]);
Igs271 = csvread('D120R085-1-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal1 = csvread('D120R085-1-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal1 = csvread('D120R085-1-1-annealing.csv',3,4,[3 4 44
4]);
%part 2
Vgs2pre2 = csvread('D120R085-2-1-prerad.csv',3,3,[3 3 44 3]);
Igs2pre2 = csvread('D120R085-2-1-prerad.csv',3,4,[3 4 44 4]);
Vgs212 = csvread('D120R085-2-1-1stdose.csv',3,3,[3 3 44 3]);
Igs212 = csvread('D120R085-2-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs222 = csvread('D120R085-2-1-2nddose.csv',3,3,[3 3 44 3]);
Igs222 = csvread('D120R085-2-1-2nddose.csv',3,4,[3 4 44 4]);
```

```
Vgs2base12 = csvread('D120R085-2-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base12 = csvread('D120R085-2-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs232 = csvread('D120R085-2-1-3rddose.csv',3,3,[3 3 44 3]);
Igs232 = csvread('D120R085-2-1-3rddose.csv',3,4,[3 4 44 4]);
Vgs242 = csvread('D120R085-2-1-4thdose.csv',3,3,[3 3 44 3]);
Igs242 = csvread('D120R085-2-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs252 = csvread('D120R085-2-1-5thdose.csv',3,3,[3 3 44 3]);
Igs252 = csvread('D120R085-2-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base22 = csvread('D120R085-2-2-baseline2.csv',3,3,[3 3 44
3]);
Igs2base22 = csvread('D120R085-2-2-baseline2.csv',3,4,[3 4 44
4]);
Vgs262 = csvread('D120R085-2-1-6thdose.csv',3,3,[3 3 44 3]);
Igs262 = csvread('D120R085-2-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs272 = csvread('D120R085-2-1-7thdose.csv',3,3,[3 3 44 3]);
Igs272 = csvread('D120R085-2-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal2 = csvread('D120R085-2-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal2 = csvread('D120R085-2-1-annealing.csv',3,4,[3 4 44
4]);
%part 3
Vgs2pre3 = csvread('D120R085-3-2-prerad.csv',3,3,[3 3 44 3]);
Igs2pre3 = csvread('D120R085-3-2-prerad.csv',3,4,[3 4 44 4]);
Vgs213 = csvread('D120R085-3-1-1stdose.csv',3,3,[3 3 44 3]);
Igs213 = csvread('D120R085-3-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs223 = csvread('D120R085-3-1-2nddose.csv',3,3,[3 3 44 3]);
Igs223 = csvread('D120R085-3-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base13 = csvread('D120R085-3-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base13 = csvread('D120R085-3-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs233 = csvread('D120R085-3-1-3rddose.csv',3,3,[3 3 44 3]);
Igs233 = csvread('D120R085-3-1-3rddose.csv',3,4,[3 4 44 4]);
Vgs243 = csvread('D120R085-3-2-4thdose.csv',3,3,[3 3 44 3]);
Igs243 = csvread('D120R085-3-2-4thdose.csv',3,4,[3 4 44 4]);
Vgs253 = csvread('D120R085-3-1-5thdose.csv',3,3,[3 3 44 3]);
Igs253 = csvread('D120R085-3-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base23= csvread('D120R085-3-2-baseline2.csv',3,3,[3 3 44 3]);
Igs2base23 = csvread('D120R085-3-2-baseline2.csv',3,4,[3 4 44
4]);
Vgs263 = csvread('D120R085-3-1-6thdose.csv',3,3,[3 3 44 3]);
Igs263 = csvread('D120R085-3-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs273 = csvread('D120R085-3-1-7thdose.csv',3,3,[3 3 44 3]);
Igs273 = csvread('D120R085-3-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal3 = csvread('D120R085-3-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal3 = csvread('D120R085-3-1-annealing.csv',3,4,[3 4 44
4]);
%part 4
Vgs2pre4 = csvread('D120R085-4-1-prerad.csv',3,3,[3 3 44 3]);
Igs2pre4 = csvread('D120R085-4-1-prerad.csv',3,4,[3 4 44 4]);
Vgs214 = csvread('D120R085-4-1-1stdose.csv',3,3,[3 3 44 3]);
```

```
Igs214 = csvread('D120R085-4-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs224 = csvread('D120R085-4-1-2nddose.csv',3,3,[3 3 44 3]);
Igs224 = csvread('D120R085-4-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base14 = csvread('D120R085-4-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base14 = csvread('D120R085-4-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs234 = csvread('D120R085-4-1-3rddose.csv',3,3,[3 3 44 3]);
Igs234 = csvread('D120R085-4-1-3rddose.csv',3,4,[3 4 44 4]);
Vgs244 = csvread('D120R085-4-1-4thdose.csv',3,3,[3 3 44 3]);
Igs244 = csvread('D120R085-4-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs254 = csvread('D120R085-4-1-5thdose.csv',3,3,[3 3 44 3]);
Igs254 = csvread('D120R085-4-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base24= csvread('D120R085-4-1-baseline2.csv',3,3,[3 3 44 3]);
Igs2base24 = csvread('D120R085-4-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs264 = csvread('D120R085-4-1-6thdose.csv',3,3,[3 3 44 3]);
Igs264 = csvread('D120R085-4-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs274 = csvread('D120R085-4-1-7thdose.csv',3,3,[3 3 44 3]);
Igs274 = csvread('D120R085-4-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal4 = csvread('D120R085-4-2-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal4 = csvread('D120R085-4-2-annealing.csv',3,4,[3 4 44
4]);
%part 5
Vgs2pre5 = csvread('D120R085-5-3-prerad.csv',3,3,[3 3 44 3]);
Igs2pre5 = csvread('D120R085-5-3-prerad.csv',3,4,[3 4 44 4]);
Vgs215 = csvread('D120R085-5-1-1stdose.csv',3,3,[3 3 44 3]);
Igs215 = csvread('D120R085-5-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs225 = csvread('D120R085-5-2-2nddose.csv',3,3,[3 3 44 3]);
Igs225 = csvread('D120R085-5-2-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base15 = csvread('D120R085-5-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base15 = csvread('D120R085-5-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs235 = csvread('D120R085-5-1-3rddose.csv',3,3,[3 3 44 3]);
Igs235 = csvread('D120R085-5-1-3rddose.csv',3,4,[3 4 44 4]);
Vgs245 = csvread('D120R085-5-1-4thdose.csv',3,3,[3 3 44 3]);
Igs245 = csvread('D120R085-5-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs255 = csvread('D120R085-5-1-5thdose.csv',3,3,[3 3 44 3]);
Igs255 = csvread('D120R085-5-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base25= csvread('D120R085-5-1-baseline2.csv',3,3,[3 3 44 3]);
Igs2base25 = csvread('D120R085-5-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs265 = csvread('D120R085-5-1-6thdose.csv',3,3,[3 3 44 3]);
Igs265 = csvread('D120R085-5-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs275 = csvread('D120R085-5-1-7thdose.csv',3,3,[3 3 44 3]);
Igs275 = csvread('D120R085-5-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal5 = csvread('D120R085-5-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal5 = csvread('D120R085-5-1-annealing.csv',3,4,[3 4 44
4]);

 %plot them against each other
```

```
figure(1)
%set(hfig,'Units','Normalized','OuterPosition',[0 0 1 1]);
%subplot(2,3,1)
Vgs2pre = (Vgs2pre1+Vgs2pre2+Vgs2pre3+Vgs2pre4+Vgs2pre5)/5;
Igs2pre = (Igs2pre1+Igs2pre2+Igs2pre3+Igs2pre4+Igs2pre5)/5;
plot(Vgs2pre,Igs2pre,'r','LineWidth',2)
hold on
Vgs21 = (Vgs211+Vgs212+Vgs213+Vgs214+Vgs215)/5;
Igs21 = (Igs211+Igs212+Igs213+Igs214+Igs215)/5;
plot(Vgs21,Igs21,'g','LineWidth',2)
hold on
Vgs22 = (Vgs221+Vgs222+Vgs223+Vgs224+Vgs225)/5;
Igs22 = (Igs221+Igs222+Igs223+Igs224+Igs225)/5;
plot(Vgs22,Igs22,'k','LineWidth',2)
hold on
Vgs2base1 =
(Vgs2base11+Vgs2base12+Vgs2base13+Vgs2base14+Vgs2base15)/5;
Igs2base1 =
(Igs2base11+Igs2base12+Igs2base13+Igs2base14+Igs2base15)/5;
plot(Vgs2base1, Igs2base1,'--b','LineWidth',2)
hold on
Vgs23 = (Vgs231+Vgs232+Vgs233+Vgs234+Vgs235)/5;
Igs23 = (Igs231+Igs232+Igs233+Igs234+Igs235)/5;
plot(Vgs23,Igs23,'m','LineWidth',2)
hold on
Vgs24 = (Vgs241+Vgs242+Vgs243+Vgs244+Vgs245)/5;
Igs24 = (Igs241+Igs242+Igs243+Igs244+Igs245)/5;
plot(Vgs24,Igs24,'c','LineWidth',2)
hold on
Vgs25 = (Vgs251+Vgs252+Vgs253+Vgs254+Vgs255)/5;
Igs25 = (Igs251+Igs252+Igs253+Igs254+Igs255)/5;
plot(Vgs25,Igs25,'b','LineWidth',2)
hold on
Vgs2base2 =
(Vgs2base21+Vgs2base22+Vgs2base23+Vgs2base24+Vgs2base25)/5;
Igs2base2 =
(Igs2base21+Igs2base22+Igs2base23+Igs2base24+Igs2base25)/5;
plot(Vgs2base2, Igs2base2,'--k','LineWidth',2)
hold on
Vgs26 = (Vgs261+Vgs262+Vgs263+Vgs264+Vgs265)/5;
Igs26 = (Igs261+Igs262+Igs263+Igs264+Igs265)/5;
plot(Vgs26,Igs26,'y','LineWidth',2)
hold on
Vgs27 = (Vgs271+Vgs272+Vgs273+Vgs274+Vgs275)/5;
Igs27 = (Igs271+Igs272+Igs273+Igs274+Igs275)/5;
plot(Vgs27,Igs27,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs2anneal =
(Vgs2anneal1+Vgs2anneal2+Vgs2anneal3+Vgs2anneal4+Vgs2anneal5)/5;
Igs2anneal =
(Igs2anneal1+Igs2anneal2+Igs2anneal3+Igs2anneal4+Igs2anneal5)/5;
plot(Vgs2anneal,Igs2anneal,'--m','LineWidth',2)
```

```
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('D120R085 Avg of 5 Devices @ Vgs=2V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,4])
ylim([0 52])
%%
%
%%Vgs=4V
%Read in .csv file
%Part 1
Vgs4pre1 = csvread('D120R085-1-3-prerad.csv',3,5,[3 5 44 5]);
Igs4pre1 = csvread('D120R085-1-3-prerad.csv',3,6,[3 6 44 6]);
Vgs411 = csvread('D120R085-1-1-1stdose.csv',3,5,[3 5 44 5]);
Igs411 = csvread('D120R085-1-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs421 = csvread('D120R085-1-1-2nddose.csv',3,5,[3 5 44 5]);
Igs421 = csvread('D120R085-1-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base11 = csvread('D120R085-1-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base11 = csvread('D120R085-1-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs431 = csvread('D120R085-1-1-3rddose.csv',3,5,[3 5 44 5]);
Igs431 = csvread('D120R085-1-1-3rddose.csv',3,6,[3 6 44 6]);
Vgs441 = csvread('D120R085-1-1-4thdose.csv',3,5,[3 5 44 5]);
Igs441 = csvread('D120R085-1-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs451 = csvread('D120R085-1-1-5thdose.csv',3,5,[3 5 44 5]);
Igs451 = csvread('D120R085-1-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base21= csvread('D120R085-1-1-baseline2.csv',3,5,[3 5 44 5]);
Igs4base21 = csvread('D120R085-1-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs461 = csvread('D120R085-1-1-6thdose.csv',3,5,[3 5 44 5]);
Igs461 = csvread('D120R085-1-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs471 = csvread('D120R085-1-1-7thdose.csv',3,5,[3 5 44 5]);
Igs471 = csvread('D120R085-1-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal1 = csvread('D120R085-1-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal1 = csvread('D120R085-1-1-annealing.csv',3,6,[3 6 44
6]);
%part 2
Vgs4pre2 = csvread('D120R085-2-1-prerad.csv',3,5,[3 5 44 5]);
Igs4pre2 = csvread('D120R085-2-1-prerad.csv',3,6,[3 6 44 6]);
Vgs412 = csvread('D120R085-2-1-1stdose.csv',3,5,[3 5 44 5]);
Igs412 = csvread('D120R085-2-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs422 = csvread('D120R085-2-1-2nddose.csv',3,5,[3 5 44 5]);
Igs422 = csvread('D120R085-2-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base12 = csvread('D120R085-2-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base12 = csvread('D120R085-2-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs432 = csvread('D120R085-2-1-3rddose.csv',3,5,[3 5 44 5]);
Igs432 = csvread('D120R085-2-1-3rddose.csv',3,6,[3 6 44 6]);
Vgs442 = csvread('D120R085-2-1-4thdose.csv',3,5,[3 5 44 5]);
```

```
Igs442 = csvread('D120R085-2-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs452 = csvread('D120R085-2-1-5thdose.csv',3,5,[3 5 44 5]);
Igs452 = csvread('D120R085-2-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base22 = csvread('D120R085-2-2-baseline2.csv',3,5,[3 5 44
5]);
Igs4base22 = csvread('D120R085-2-2-baseline2.csv',3,6,[3 6 44
6]);
Vgs462 = csvread('D120R085-2-1-6thdose.csv',3,5,[3 5 44 5]);
Igs462 = csvread('D120R085-2-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs472 = csvread('D120R085-2-1-7thdose.csv',3,5,[3 5 44 5]);
Igs472 = csvread('D120R085-2-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal2 = csvread('D120R085-2-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal2 = csvread('D120R085-2-1-annealing.csv',3,6,[3 6 44
6]);
%part 3
Vgs4pre3 = csvread('D120R085-3-2-prerad.csv',3,5,[3 5 44 5]);
Igs4pre3 = csvread('D120R085-3-2-prerad.csv',3,6,[3 6 44 6]);
Vgs413 = csvread('D120R085-3-1-1stdose.csv',3,5,[3 5 44 5]);
Igs413 = csvread('D120R085-3-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs423 = csvread('D120R085-3-1-2nddose.csv',3,5,[3 5 44 5]);
Igs423 = csvread('D120R085-3-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base13 = csvread('D120R085-3-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base13 = csvread('D120R085-3-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs433 = csvread('D120R085-3-1-3rddose.csv',3,5,[3 5 44 5]);
Igs433 = csvread('D120R085-3-1-3rddose.csv',3,6,[3 6 44 6]);
Vgs443 = csvread('D120R085-3-2-4thdose.csv',3,5,[3 5 44 5]);
Igs443 = csvread('D120R085-3-2-4thdose.csv',3,6,[3 6 44 6]);
Vgs453 = csvread('D120R085-3-1-5thdose.csv',3,5,[3 5 44 5]);
Igs453 = csvread('D120R085-3-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base23= csvread('D120R085-3-2-baseline2.csv',3,5,[3 5 44 5]);
Igs4base23 = csvread('D120R085-3-2-baseline2.csv',3,6,[3 6 44
6]);
Vgs463 = csvread('D120R085-3-1-6thdose.csv',3,5,[3 5 44 5]);
Igs463 = csvread('D120R085-3-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs473 = csvread('D120R085-3-1-7thdose.csv',3,5,[3 5 44 5]);
Igs473 = csvread('D120R085-3-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal3 = csvread('D120R085-3-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal3 = csvread('D120R085-3-1-annealing.csv',3,6,[3 6 44
6]);
%part 4
Vgs4pre4 = csvread('D120R085-4-1-prerad.csv',3,5,[3 5 44 5]);
Igs4pre4 = csvread('D120R085-4-1-prerad.csv',3,6,[3 6 44 6]);
Vgs414 = csvread('D120R085-4-1-1stdose.csv',3,5,[3 5 44 5]);
Igs414 = csvread('D120R085-4-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs424 = csvread('D120R085-4-1-2nddose.csv',3,5,[3 5 44 5]);
Igs424 = csvread('D120R085-4-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base14 = csvread('D120R085-4-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base14 = csvread('D120R085-4-1-baseline1.csv',3,6,[3 6 44
6]);
```

```
Vgs434 = csvread('D120R085-4-1-3rddose.csv',3,5,[3 5 44 5]);
Igs434 = csvread('D120R085-4-1-3rddose.csv',3,6,[3 6 44 6]);
Vgs444 = csvread('D120R085-4-1-4thdose.csv',3,5,[3 5 44 5]);
Igs444 = csvread('D120R085-4-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs454 = csvread('D120R085-4-1-5thdose.csv',3,5,[3 5 44 5]);
Igs454 = csvread('D120R085-4-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base24= csvread('D120R085-4-1-baseline2.csv',3,5,[3 5 44 5]);
Igs4base24 = csvread('D120R085-4-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs464 = csvread('D120R085-4-1-6thdose.csv',3,5,[3 5 44 5]);
Igs464 = csvread('D120R085-4-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs474 = csvread('D120R085-4-1-7thdose.csv',3,5,[3 5 44 5]);
Igs474 = csvread('D120R085-4-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal4 = csvread('D120R085-4-2-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal4 = csvread('D120R085-4-2-annealing.csv',3,6,[3 6 44
6]);
%part 5
Vgs4pre5 = csvread('D120R085-5-3-prerad.csv',3,5,[3 5 44 5]);
Igs4pre5 = csvread('D120R085-5-3-prerad.csv',3,6,[3 6 44 6]);
Vgs415 = csvread('D120R085-5-1-1stdose.csv',3,5,[3 5 44 5]);
Igs415 = csvread('D120R085-5-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs425 = csvread('D120R085-5-2-2nddose.csv',3,5,[3 5 44 5]);
Igs425 = csvread('D120R085-5-2-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base15 = csvread('D120R085-5-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base15 = csvread('D120R085-5-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs435 = csvread('D120R085-5-1-3rddose.csv',3,5,[3 5 44 5]);
Igs435 = csvread('D120R085-5-1-3rddose.csv',3,6,[3 6 44 6]);
Vgs445 = csvread('D120R085-5-1-4thdose.csv',3,5,[3 5 44 5]);
Igs445 = csvread('D120R085-5-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs455 = csvread('D120R085-5-1-5thdose.csv',3,5,[3 5 44 5]);
Igs455 = csvread('D120R085-5-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base25= csvread('D120R085-5-1-baseline2.csv',3,5,[3 5 44 5]);
Igs4base25 = csvread('D120R085-5-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs465 = csvread('D120R085-5-1-6thdose.csv',3,5,[3 5 44 5]);
Igs465 = csvread('D120R085-5-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs475 = csvread('D120R085-5-1-7thdose.csv',3,5,[3 5 44 5]);
Igs475 = csvread('D120R085-5-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal5 = csvread('D120R085-5-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal5 = csvread('D120R085-5-1-annealing.csv',3,6,[3 6 44
6]);

 %plot them against each other
figure(2)
%set(hfig,'Units','Normalized','OuterPosition',[0 0 1 1]);
%subplot(2,3,1)
Vgs4pre = (Vgs4pre1+Vgs4pre2+Vgs4pre3+Vgs4pre4+Vgs4pre5)/5;
Igs4pre = (Igs4pre1+Igs4pre2+Igs4pre3+Igs4pre4+Igs4pre5)/5;
plot(Vgs4pre,Igs4pre,'r','LineWidth',2)
hold on
```

```
Vgs41 = (Vgs411+Vgs412+Vgs413+Vgs414+Vgs415)/5;
Igs41 = (Igs411+Igs412+Igs413+Igs414+Igs415)/5;
plot(Vgs41,Igs41,'g','LineWidth',2)
hold on
Vgs42 = (Vgs421+Vgs422+Vgs423+Vgs424+Vgs425)/5;
Igs42 = (Igs421+Igs422+Igs423+Igs424+Igs425)/5;
plot(Vgs42,Igs42,'k','LineWidth',2)
hold on
Vgs4base1 =
(Vgs4base11+Vgs4base12+Vgs4base13+Vgs4base14+Vgs4base15)/5;
Igs4base1 =
(Igs4base11+Igs4base12+Igs4base13+Igs4base14+Igs4base15)/5;
plot(Vgs4base1, Igs4base1,'--b','LineWidth',2)
hold on
Vgs43 = (Vgs431+Vgs432+Vgs433+Vgs434+Vgs435)/5;
Igs43 = (Igs431+Igs432+Igs433+Igs434+Igs435)/5;
plot(Vgs43,Igs43,'m','LineWidth',2)
hold on
Vgs44 = (Vgs441+Vgs442+Vgs443+Vgs444+Vgs445)/5;
Igs44 = (Igs441+Igs442+Igs443+Igs444+Igs445)/5;
plot(Vgs44,Igs44,'c','LineWidth',2)
hold on
Vgs45 = (Vgs451+Vgs452+Vgs453+Vgs454+Vgs455)/5;
Igs45 = (Igs451+Igs452+Igs453+Igs454+Igs455)/5;
plot(Vgs45,Igs45,'b','LineWidth',2)
hold on
Vgs4base2 =
(Vgs4base21+Vgs4base22+Vgs4base23+Vgs4base24+Vgs4base25)/5;
Igs4base2 =
(Igs4base21+Igs4base22+Igs4base23+Igs4base24+Igs4base25)/5;
plot(Vgs4base2, Igs4base2,'--k','LineWidth',2)
hold on
Vgs46 = (Vgs461+Vgs462+Vgs463+Vgs464+Vgs465)/5;
Igs46 = (Igs461+Igs462+Igs463+Igs464+Igs465)/5;
plot(Vgs46,Igs46,'y','LineWidth',2)
hold on
Vgs47 = (Vgs471+Vgs472+Vgs473+Vgs474+Vgs475)/5;
Igs47 = (Igs471+Igs472+Igs473+Igs474+Igs475)/5;
plot(Vgs47,Igs47,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs4anneal =
(Vgs4anneal1+Vgs4anneal2+Vgs4anneal3+Vgs4anneal4+Vgs4anneal5)/5;
Igs4anneal =
(Igs4anneal1+Igs4anneal2+Igs4anneal3+Igs4anneal4+Igs4anneal5)/5;
plot(Vgs4anneal,Igs4anneal,'--m','LineWidth',2)
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('D120R085 Avgs of 5 Devices @ Vgs=4V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,4])
ylim([0 52])
```

```
%%
%%Vgs=6V
%Read in .csv file
%part 1
Vgs6pre1 = csvread('D120R085-1-3-prerad.csv',3,7,[3 7 44 7]);
Igs6pre1 = csvread('D120R085-1-3-prerad.csv',3,8,[3 8 44 8]);
Vgs611 = csvread('D120R085-1-1-1stdose.csv',3,7,[3 7 44 7]);
Igs611 = csvread('D120R085-1-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs621 = csvread('D120R085-1-1-2nddose.csv',3,7,[3 7 44 7]);
Igs621 = csvread('D120R085-1-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base11 = csvread('D120R085-1-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base11 = csvread('D120R085-1-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs631 = csvread('D120R085-1-1-3rddose.csv',3,7,[3 7 44 7]);
Igs631 = csvread('D120R085-1-1-3rddose.csv',3,8,[3 8 44 8]);
Vgs641 = csvread('D120R085-1-1-4thdose.csv',3,7,[3 7 44 7]);
Igs641 = csvread('D120R085-1-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs651 = csvread('D120R085-1-1-5thdose.csv',3,7,[3 7 44 7]);
Igs651 = csvread('D120R085-1-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base21= csvread('D120R085-1-1-baseline2.csv',3,7,[3 7 44 7]);
Igs6base21 = csvread('D120R085-1-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs661 = csvread('D120R085-1-1-6thdose.csv',3,7,[3 7 44 7]);
Igs661 = csvread('D120R085-1-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs671 = csvread('D120R085-1-1-7thdose.csv',3,7,[3 7 44 7]);
Igs671 = csvread('D120R085-1-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal1 = csvread('D120R085-1-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal1 = csvread('D120R085-1-1-annealing.csv',3,8,[3 8 44
8]);
%part 2
Vgs6pre2 = csvread('D120R085-2-1-prerad.csv',3,7,[3 7 44 7]);
Igs6pre2 = csvread('D120R085-2-1-prerad.csv',3,8,[3 8 44 8]);
Vgs612 = csvread('D120R085-2-1-1stdose.csv',3,7,[3 7 44 7]);
Igs612 = csvread('D120R085-2-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs622 = csvread('D120R085-2-1-2nddose.csv',3,7,[3 7 44 7]);
Igs622 = csvread('D120R085-2-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base12 = csvread('D120R085-2-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base12 = csvread('D120R085-2-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs632 = csvread('D120R085-2-1-3rddose.csv',3,7,[3 7 44 7]);
Igs632 = csvread('D120R085-2-1-3rddose.csv',3,8,[3 8 44 8]);
Vgs642 = csvread('D120R085-2-1-4thdose.csv',3,7,[3 7 44 7]);
Igs642 = csvread('D120R085-2-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs652 = csvread('D120R085-2-1-5thdose.csv',3,7,[3 7 44 7]);
Igs652 = csvread('D120R085-2-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base22= csvread('D120R085-2-2-baseline2.csv',3,7,[3 7 44 7]);
Igs6base22 = csvread('D120R085-2-2-baseline2.csv',3,8,[3 8 44
8]);
Vgs662 = csvread('D120R085-2-1-6thdose.csv',3,7,[3 7 44 7]);
Igs662 = csvread('D120R085-2-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs672 = csvread('D120R085-2-1-7thdose.csv',3,7,[3 7 44 7]);
```

```
Igs672 = csvread('D120R085-2-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal2 = csvread('D120R085-2-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal2 = csvread('D120R085-2-1-annealing.csv',3,8,[3 8 44
8]);
%part 3
Vgs6pre3 = csvread('D120R085-3-2-prerad.csv',3,7,[3 7 44 7]);
Igs6pre3 = csvread('D120R085-3-2-prerad.csv',3,8,[3 8 44 8]);
Vgs613 = csvread('D120R085-3-1-1stdose.csv',3,7,[3 7 44 7]);
Igs613 = csvread('D120R085-3-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs623 = csvread('D120R085-3-1-2nddose.csv',3,7,[3 7 44 7]);
Igs623 = csvread('D120R085-3-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base13 = csvread('D120R085-3-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base13 = csvread('D120R085-3-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs633 = csvread('D120R085-3-1-3rddose.csv',3,7,[3 7 44 7]);
Igs633 = csvread('D120R085-3-1-3rddose.csv',3,8,[3 8 44 8]);
Vgs643 = csvread('D120R085-3-2-4thdose.csv',3,7,[3 7 44 7]);
Igs643 = csvread('D120R085-3-2-4thdose.csv',3,8,[3 8 44 8]);
Vgs653 = csvread('D120R085-3-1-5thdose.csv',3,7,[3 7 44 7]);
Igs653 = csvread('D120R085-3-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base23= csvread('D120R085-3-2-baseline2.csv',3,7,[3 7 44 7]);
Igs6base23 = csvread('D120R085-3-2-baseline2.csv',3,8,[3 8 44
8]);
Vgs663 = csvread('D120R085-3-1-6thdose.csv',3,7,[3 7 44 7]);
Igs663 = csvread('D120R085-3-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs673 = csvread('D120R085-3-1-7thdose.csv',3,7,[3 7 44 7]);
Igs673 = csvread('D120R085-3-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal3 = csvread('D120R085-3-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal3 = csvread('D120R085-3-1-annealing.csv',3,8,[3 8 44
8]);
%part 4
Vgs6pre4 = csvread('D120R085-4-1-prerad.csv',3,7,[3 7 44 7]);
Igs6pre4 = csvread('D120R085-4-1-prerad.csv',3,8,[3 8 44 8]);
Vgs614 = csvread('D120R085-4-1-1stdose.csv',3,7,[3 7 44 7]);
Igs614 = csvread('D120R085-4-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs624 = csvread('D120R085-4-1-2nddose.csv',3,7,[3 7 44 7]);
Igs624 = csvread('D120R085-4-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base14 = csvread('D120R085-4-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base14 = csvread('D120R085-4-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs634 = csvread('D120R085-4-1-3rddose.csv',3,7,[3 7 44 7]);
Igs634 = csvread('D120R085-4-1-3rddose.csv',3,8,[3 8 44 8]);
Vgs644 = csvread('D120R085-4-1-4thdose.csv',3,7,[3 7 44 7]);
Igs644 = csvread('D120R085-4-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs654 = csvread('D120R085-4-1-5thdose.csv',3,7,[3 7 44 7]);
Igs654 = csvread('D120R085-4-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base24= csvread('D120R085-4-1-baseline2.csv',3,7,[3 7 44 7]);
Igs6base24 = csvread('D120R085-4-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs664 = csvread('D120R085-4-1-6thdose.csv',3,7,[3 7 44 7]);
```

```
Igs664 = csvread('D120R085-4-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs674 = csvread('D120R085-4-1-7thdose.csv',3,7,[3 7 44 7]);
Igs674 = csvread('D120R085-4-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal4 = csvread('D120R085-4-2-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal4 = csvread('D120R085-4-2-annealing.csv',3,8,[3 8 44
8]);
%part 5
Vgs6pre5 = csvread('D120R085-5-3-prerad.csv',3,7,[3 7 44 7]);
Igs6pre5 = csvread('D120R085-5-3-prerad.csv',3,8,[3 8 44 8]);
Vgs615 = csvread('D120R085-5-1-1stdose.csv',3,7,[3 7 44 7]);
Igs615 = csvread('D120R085-5-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs625 = csvread('D120R085-5-2-2nddose.csv',3,7,[3 7 44 7]);
Igs625 = csvread('D120R085-5-2-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base15 = csvread('D120R085-5-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base15 = csvread('D120R085-5-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs635 = csvread('D120R085-5-1-3rddose.csv',3,7,[3 7 44 7]);
Igs635 = csvread('D120R085-5-1-3rddose.csv',3,8,[3 8 44 8]);
Vgs645 = csvread('D120R085-5-1-4thdose.csv',3,7,[3 7 44 7]);
Igs645 = csvread('D120R085-5-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs655 = csvread('D120R085-5-1-5thdose.csv',3,7,[3 7 44 7]);
Igs655 = csvread('D120R085-5-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base25= csvread('D120R085-5-1-baseline2.csv',3,7,[3 7 44 7]);
Igs6base25 = csvread('D120R085-5-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs665 = csvread('D120R085-5-1-6thdose.csv',3,7,[3 7 44 7]);
Igs665 = csvread('D120R085-5-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs675 = csvread('D120R085-5-1-7thdose.csv',3,7,[3 7 44 7]);
Igs675 = csvread('D120R085-5-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal5 = csvread('D120R085-5-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal5 = csvread('D120R085-5-1-annealing.csv',3,8,[3 8 44
8]);

 %plot them against each other
%subplot(2,3,3)
figure(3)
Vgs6pre = (Vgs6pre1+Vgs6pre2+Vgs6pre3+Vgs6pre4+Vgs6pre5)/5;
Igs6pre = (Igs6pre1+Igs6pre2+Igs6pre3+Igs6pre4+Igs6pre5)/5;
plot(Vgs6pre,Igs6pre,'r','LineWidth',2)
hold on
Vgs61 = (Vgs611+Vgs612+Vgs613+Vgs614+Vgs615)/5;
Igs61 = (Igs611+Igs612+Igs613+Igs614+Igs615)/5;
plot(Vgs61,Igs61,'g','LineWidth',2)
hold on
Vgs62 = (Vgs621+Vgs622+Vgs623+Vgs624+Vgs625)/5;
Igs62 = (Igs621+Igs622+Igs623+Igs624+Igs625)/5;
plot(Vgs62,Igs62,'k','LineWidth',2)
hold on
Vgs6base1 =
(Vgs6base11+Vgs6base12+Vgs6base13+Vgs6base14+Vgs6base15)/5;
```

```
Igs6base1 =
(Igs6base11+Igs6base12+Igs6base13+Igs6base14+Igs6base15)/5;
plot(Vgs6base1, Igs6base1,'--b','LineWidth',2)
hold on
Vgs63 = (Vgs631+Vgs632+Vgs633+Vgs634+Vgs635)/5;
Igs63 = (Igs631+Igs632+Igs633+Igs634+Igs635)/5;
plot(Vgs63,Igs63,'m','LineWidth',2)
hold on
Vgs64 = (Vgs641+Vgs642+Vgs643+Vgs644+Vgs645)/5;
Igs64 = (Igs641+Igs642+Igs643+Igs644+Igs645)/5;
plot(Vgs64,Igs64,'c','LineWidth',2)
hold on
Vgs65 = (Vgs651+Vgs652+Vgs653+Vgs654+Vgs655)/5;
Igs65 = (Igs651+Igs652+Igs653+Igs654+Igs655)/5;
plot(Vgs65,Igs65,'b','LineWidth',2)
hold on
Vgs6base2 =
(Vgs6base21+Vgs6base22+Vgs6base23+Vgs6base24+Vgs6base25)/5;
Igs6base2 =
(Igs6base21+Igs6base22+Igs6base23+Igs6base24+Igs6base25)/5;
plot(Vgs6base2, Igs6base2,'--k','LineWidth',2)
hold on
Vgs66 = (Vgs661+Vgs662+Vgs663+Vgs664+Vgs665)/5;
Igs66 = (Igs661+Igs662+Igs663+Igs664+Igs665)/5;
plot(Vgs66,Igs66,'y','LineWidth',2)
hold on
Vgs67 = (Vgs671+Vgs672+Vgs673+Vgs674+Vgs675)/5;
Igs67 = (Igs671+Igs672+Igs673+Igs674+Igs675)/5;
plot(Vgs67,Igs67,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs6anneal =
(Vgs6anneal1+Vgs6anneal2+Vgs6anneal3+Vgs6anneal4+Vgs6anneal5)/5;
Igs6anneal =
(Igs6anneal1+Igs6anneal2+Igs6anneal3+Igs6anneal4+Igs6anneal5)/5;
plot(Vgs6anneal,Igs6anneal,'--m','LineWidth',2)
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('D120R085 Avg for 5 Devices @ Vgs=6V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,4])
ylim([0 52])
%%
%%Vgs=8V
%Read in .csv file
%part 1
Vgs8pre1 = csvread('D120R085-1-3-prerad.csv',3,9,[3 9 44 9]);
Igs8pre1 = csvread('D120R085-1-3-prerad.csv',3,10,[3 10 44 10]);
Vgs811 = csvread('D120R085-1-1-1stdose.csv',3,9,[3 9 44 9]);
Igs811 = csvread('D120R085-1-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs821 = csvread('D120R085-1-1-2nddose.csv',3,9,[3 9 44 9]);
Igs821 = csvread('D120R085-1-1-2nddose.csv',3,10,[3 10 44 10]);
```

```
Vgs8base11 = csvread('D120R085-1-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base11 = csvread('D120R085-1-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs831 = csvread('D120R085-1-1-3rddose.csv',3,9,[3 9 44 9]);
Igs831 = csvread('D120R085-1-1-3rddose.csv',3,10,[3 10 44 10]);
Vgs841 = csvread('D120R085-1-1-4thdose.csv',3,9,[3 9 44 9]);
Igs841 = csvread('D120R085-1-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs851 = csvread('D120R085-1-1-5thdose.csv',3,9,[3 9 44 9]);
Igs851 = csvread('D120R085-1-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base21= csvread('D120R085-1-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base21 = csvread('D120R085-1-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs861 = csvread('D120R085-1-1-6thdose.csv',3,9,[3 9 44 9]);
Igs861 = csvread('D120R085-1-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs871 = csvread('D120R085-1-1-7thdose.csv',3,9,[3 9 44 9]);
Igs871 = csvread('D120R085-1-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal1 = csvread('D120R085-1-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal1 = csvread('D120R085-1-1-annealing.csv',3,10,[3 10 44
10]);
%part 2
Vgs8pre2 = csvread('D120R085-2-1-prerad.csv',3,9,[3 9 44 9]);
Igs8pre2 = csvread('D120R085-2-1-prerad.csv',3,10,[3 10 44 10]);
Vgs812 = csvread('D120R085-2-1-1stdose.csv',3,9,[3 9 44 9]);
Igs812 = csvread('D120R085-2-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs822 = csvread('D120R085-2-1-2nddose.csv',3,9,[3 9 44 9]);
Igs822 = csvread('D120R085-2-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base12 = csvread('D120R085-2-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base12 = csvread('D120R085-2-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs832 = csvread('D120R085-2-1-3rddose.csv',3,9,[3 9 44 9]);
Igs832 = csvread('D120R085-2-1-3rddose.csv',3,10,[3 10 44 10]);
Vgs842 = csvread('D120R085-2-1-4thdose.csv',3,9,[3 9 44 9]);
Igs842 = csvread('D120R085-2-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs852 = csvread('D120R085-2-1-5thdose.csv',3,9,[3 9 44 9]);
Igs852 = csvread('D120R085-2-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base22= csvread('D120R085-2-2-baseline2.csv',3,9,[3 9 44 9]);
Igs8base22 = csvread('D120R085-2-2-baseline2.csv',3,10,[3 10 44
10]);
Vgs862 = csvread('D120R085-2-1-6thdose.csv',3,9,[3 9 44 9]);
Igs862 = csvread('D120R085-2-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs872 = csvread('D120R085-2-1-7thdose.csv',3,9,[3 9 44 9]);
Igs872 = csvread('D120R085-2-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal2 = csvread('D120R085-2-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal2 = csvread('D120R085-2-1-annealing.csv',3,10,[3 10 44
10]);
%part 3
Vgs8pre3 = csvread('D120R085-3-2-prerad.csv',3,9,[3 9 44 9]);
Igs8pre3 = csvread('D120R085-3-2-prerad.csv',3,10,[3 10 44 10]);
Vgs813 = csvread('D120R085-3-1-1stdose.csv',3,9,[3 9 44 9]);
Igs813 = csvread('D120R085-3-1-1stdose.csv',3,10,[3 10 44 10]);
```

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Vgs823 = csvread('D120R085-3-1-2nddose.csv',3,9,[3 9 44 9]);
Igs823 = csvread('D120R085-3-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base13 = csvread('D120R085-3-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base13 = csvread('D120R085-3-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs833 = csvread('D120R085-3-1-3rddose.csv',3,9,[3 9 44 9]);
Igs833 = csvread('D120R085-3-1-3rddose.csv',3,10,[3 10 44 10]);
Vgs843 = csvread('D120R085-3-2-4thdose.csv',3,9,[3 9 44 9]);
Igs843 = csvread('D120R085-3-2-4thdose.csv',3,10,[3 10 44 10]);
Vgs853 = csvread('D120R085-3-1-5thdose.csv',3,9,[3 9 44 9]);
Igs853 = csvread('D120R085-3-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base23= csvread('D120R085-3-2-baseline2.csv',3,9,[3 9 44 9]);
Igs8base23 = csvread('D120R085-3-2-baseline2.csv',3,10,[3 10 44
10]);
Vgs863 = csvread('D120R085-3-1-6thdose.csv',3,9,[3 9 44 9]);
Igs863 = csvread('D120R085-3-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs873 = csvread('D120R085-3-1-7thdose.csv',3,9,[3 9 44 9]);
Igs873 = csvread('D120R085-3-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal3 = csvread('D120R085-3-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal3 = csvread('D120R085-3-1-annealing.csv',3,10,[3 10 44
10]);
%part 4
Vgs8pre4 = csvread('D120R085-4-1-prerad.csv',3,9,[3 9 44 9]);
Igs8pre4 = csvread('D120R085-4-1-prerad.csv',3,10,[3 10 44 10]);
Vgs814 = csvread('D120R085-4-1-1stdose.csv',3,9,[3 9 44 9]);
Igs814 = csvread('D120R085-4-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs824 = csvread('D120R085-4-1-2nddose.csv',3,9,[3 9 44 9]);
Igs824 = csvread('D120R085-4-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base14 = csvread('D120R085-4-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base14 = csvread('D120R085-4-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs834 = csvread('D120R085-4-1-3rddose.csv',3,9,[3 9 44 9]);
Igs834 = csvread('D120R085-4-1-3rddose.csv',3,10,[3 10 44 10]);
Vgs844 = csvread('D120R085-4-1-4thdose.csv',3,9,[3 9 44 9]);
Igs844 = csvread('D120R085-4-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs854 = csvread('D120R085-4-1-5thdose.csv',3,9,[3 9 44 9]);
Igs854 = csvread('D120R085-4-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base24= csvread('D120R085-4-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base24 = csvread('D120R085-4-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs864 = csvread('D120R085-4-1-6thdose.csv',3,9,[3 9 44 9]);
Igs864 = csvread('D120R085-4-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs874 = csvread('D120R085-4-1-7thdose.csv',3,9,[3 9 44 9]);
Igs874 = csvread('D120R085-4-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal4 = csvread('D120R085-4-2-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal4 = csvread('D120R085-4-2-annealing.csv',3,10,[3 10 44
10]);
%part 5
Vgs8pre5 = csvread('D120R085-5-3-prerad.csv',3,9,[3 9 44 9]);
Igs8pre5 = csvread('D120R085-5-3-prerad.csv',3,10,[3 10 44 10]);
```

```
Vgs815 = csvread('D120R085-5-1-1stdose.csv',3,9,[3 9 44 9]);
Igs815 = csvread('D120R085-5-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs825 = csvread('D120R085-5-2-2nddose.csv',3,9,[3 9 44 9]);
Igs825 = csvread('D120R085-5-2-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base15 = csvread('D120R085-5-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base15 = csvread('D120R085-5-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs835 = csvread('D120R085-5-1-3rddose.csv',3,9,[3 9 44 9]);
Igs835 = csvread('D120R085-5-1-3rddose.csv',3,10,[3 10 44 10]);
Vgs845 = csvread('D120R085-5-1-4thdose.csv',3,9,[3 9 44 9]);
Igs845 = csvread('D120R085-5-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs855 = csvread('D120R085-5-1-5thdose.csv',3,9,[3 9 44 9]);
Igs855 = csvread('D120R085-5-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base25= csvread('D120R085-5-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base25 = csvread('D120R085-5-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs865 = csvread('D120R085-5-1-6thdose.csv',3,9,[3 9 44 9]);
Igs865 = csvread('D120R085-5-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs875 = csvread('D120R085-5-1-7thdose.csv',3,9,[3 9 44 9]);
Igs875 = csvread('D120R085-5-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal5 = csvread('D120R085-5-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal5 = csvread('D120R085-5-1-annealing.csv',3,10,[3 10 44
10]);

 %plot them against each other
%subplot(2,3,4)
figure(4)
Vgs8pre = (Vgs8pre1+Vgs8pre2+Vgs8pre3+Vgs8pre4+Vgs8pre5)/5;
Igs8pre = (Igs8pre1+Igs8pre2+Igs8pre3+Igs8pre4+Igs8pre5)/5;
plot(Vgs8pre,Igs8pre,'r','LineWidth',2)
hold on
Vgs81 = (Vgs811+Vgs812+Vgs813+Vgs814+Vgs815)/5;
Igs81 = (Igs811+Igs812+Igs813+Igs814+Igs815)/5;
plot(Vgs81,Igs81,'g','LineWidth',2)
hold on
Vgs82 = (Vgs821+Vgs822+Vgs823+Vgs824+Vgs825)/5;
Igs82 = (Igs821+Igs822+Igs823+Igs824+Igs825)/5;
plot(Vgs82,Igs82,'k','LineWidth',2)
hold on
Vgs8base1 =
(Vgs8base11+Vgs8base12+Vgs8base13+Vgs8base14+Vgs8base15)/5;
Igs8base1 =
(Igs8base11+Igs8base12+Igs8base13+Igs8base14+Igs8base15)/5;
plot(Vgs8base1, Igs8base1,'--b','LineWidth',2)
hold on
Vgs83 = (Vgs831+Vgs832+Vgs833+Vgs834+Vgs835)/5;
Igs83 = (Igs831+Igs832+Igs833+Igs834+Igs835)/5;
plot(Vgs83,Igs83,'m','LineWidth',2)
hold on
Vgs84 = (Vgs841+Vgs842+Vgs843+Vgs844+Vgs845)/5;
Igs84 = (Igs841+Igs842+Igs843+Igs844+Igs845)/5;
plot(Vgs84,Igs84,'c','LineWidth',2)
```

```
hold on
Vgs85 = (Vgs851+Vgs852+Vgs853+Vgs854+Vgs855)/5;
Igs85 = (Igs851+Igs852+Igs853+Igs854+Igs855)/5;
plot(Vgs85,Igs85,'b','LineWidth',2)
hold on
Vgs8base2 =
(Vgs8base21+Vgs8base22+Vgs8base23+Vgs8base24+Vgs8base25)/5;
Igs8base2 =
(Igs8base21+Igs8base22+Igs8base23+Igs8base24+Igs8base25)/5;
plot(Vgs8base2, Igs8base2,'--k','LineWidth',2)
hold on
Vgs86 = (Vgs861+Vgs862+Vgs863+Vgs864+Vgs865)/5;
Igs86 = (Igs861+Igs862+Igs863+Igs864+Igs865)/5;
plot(Vgs86,Igs86,'y','LineWidth',2)
hold on
Vgs87 = (Vgs871+Vgs872+Vgs873+Vgs874+Vgs875)/5;
Igs87 = (Igs871+Igs872+Igs873+Igs874+Igs875)/5;
plot(Vgs87,Igs87,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs8anneal =
(Vgs8anneal1+Vgs8anneal2+Vgs8anneal3+Vgs8anneal4+Vgs8anneal5)/5;
Igs8anneal =
(Igs8anneal1+Igs8anneal2+Igs8anneal3+Igs8anneal4+Igs8anneal5)/5;
plot(Vgs8anneal,Igs8anneal,'--m','LineWidth',2)
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('D120R085 Avgs for 5 Devices @ Vgs=8V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,4])
ylim([0 52])
%%
%%Vgs=10V
%Read in .csv file
%part 1
Vgs10pre1 = csvread('D120R085-1-3-prerad.csv',3,11,[3 11 44 11]);
Igs10pre1 = csvread('D120R085-1-3-prerad.csv',3,12,[3 12 44 12]);
Vgs1011 = csvread('D120R085-1-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1011 = csvread('D120R085-1-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1021 = csvread('D120R085-1-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1021 = csvread('D120R085-1-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base11 = csvread('D120R085-1-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base11 = csvread('D120R085-1-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1031 = csvread('D120R085-1-1-3rddose.csv',3,11,[3 11 44 11]);
Igs1031 = csvread('D120R085-1-1-3rddose.csv',3,12,[3 12 44 12]);
Vgs1041 = csvread('D120R085-1-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1041 = csvread('D120R085-1-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1051 = csvread('D120R085-1-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1051 = csvread('D120R085-1-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base21= csvread('D120R085-1-1-baseline2.csv',3,11,[3 11 44
11]);
```

```
Igs10base21 = csvread('D120R085-1-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1061 = csvread('D120R085-1-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1061 = csvread('D120R085-1-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1071 = csvread('D120R085-1-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1071 = csvread('D120R085-1-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal1 = csvread('D120R085-1-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal1 = csvread('D120R085-1-1-annealing.csv',3,12,[3 12 44
12]);
%part 2
Vgs10pre2 = csvread('D120R085-2-1-prerad.csv',3,11,[3 11 44 11]);
Igs10pre2 = csvread('D120R085-2-1-prerad.csv',3,12,[3 12 44 12]);
Vgs1012 = csvread('D120R085-2-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1012 = csvread('D120R085-2-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1022 = csvread('D120R085-2-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1022 = csvread('D120R085-2-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base12 = csvread('D120R085-2-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base12 = csvread('D120R085-2-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1032 = csvread('D120R085-2-1-3rddose.csv',3,11,[3 11 44 11]);
Igs1032 = csvread('D120R085-2-1-3rddose.csv',3,12,[3 12 44 12]);
Vgs1042 = csvread('D120R085-2-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1042 = csvread('D120R085-2-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1052 = csvread('D120R085-2-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1052 = csvread('D120R085-2-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base22= csvread('D120R085-2-2-baseline2.csv',3,11,[3 11 44
11]);
Igs10base22 = csvread('D120R085-2-2-baseline2.csv',3,12,[3 12 44
12]);
Vgs1062 = csvread('D120R085-2-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1062 = csvread('D120R085-2-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1072 = csvread('D120R085-2-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1072 = csvread('D120R085-2-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal2 = csvread('D120R085-2-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal2 = csvread('D120R085-2-1-annealing.csv',3,12,[3 12 44
12]);
%part 3
Vgs10pre3 = csvread('D120R085-3-2-prerad.csv',3,11,[3 11 44 11]);
Igs10pre3 = csvread('D120R085-3-2-prerad.csv',3,12,[3 12 44 12]);
Vgs1013 = csvread('D120R085-3-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1013 = csvread('D120R085-3-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1023 = csvread('D120R085-3-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1023 = csvread('D120R085-3-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base13 = csvread('D120R085-3-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base13 = csvread('D120R085-3-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1033 = csvread('D120R085-3-1-3rddose.csv',3,11,[3 11 44 11]);
Igs1033 = csvread('D120R085-3-1-3rddose.csv',3,12,[3 12 44 12]);
Vgs1043 = csvread('D120R085-3-2-4thdose.csv',3,11,[3 11 44 11]);
Igs1043 = csvread('D120R085-3-2-4thdose.csv',3,12,[3 12 44 12]);
```

```
Vgs1053 = csvread('D120R085-3-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1053 = csvread('D120R085-3-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base23= csvread('D120R085-3-2-baseline2.csv',3,11,[3 11 44
11]);
Igs10base23 = csvread('D120R085-3-2-baseline2.csv',3,12,[3 12 44
12]);
Vgs1063 = csvread('D120R085-3-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1063 = csvread('D120R085-3-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1073 = csvread('D120R085-3-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1073 = csvread('D120R085-3-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal3 = csvread('D120R085-3-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal3 = csvread('D120R085-3-1-annealing.csv',3,12,[3 12 44
12]);
%part 4
Vgs10pre4 = csvread('D120R085-4-1-prerad.csv',3,11,[3 11 44 11]);
Igs10pre4 = csvread('D120R085-4-1-prerad.csv',3,12,[3 12 44 12]);
Vgs1014 = csvread('D120R085-4-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1014 = csvread('D120R085-4-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1024 = csvread('D120R085-4-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1024 = csvread('D120R085-4-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base14 = csvread('D120R085-4-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base14 = csvread('D120R085-4-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1034 = csvread('D120R085-4-1-3rddose.csv',3,11,[3 11 44 11]);
Igs1034 = csvread('D120R085-4-1-3rddose.csv',3,12,[3 12 44 12]);
Vgs1044 = csvread('D120R085-4-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1044 = csvread('D120R085-4-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1054 = csvread('D120R085-4-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1054 = csvread('D120R085-4-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base24= csvread('D120R085-4-1-baseline2.csv',3,11,[3 11 44
11]);
Igs10base24 = csvread('D120R085-4-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1064 = csvread('D120R085-4-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1064 = csvread('D120R085-4-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1074 = csvread('D120R085-4-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1074 = csvread('D120R085-4-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal4 = csvread('D120R085-4-2-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal4 = csvread('D120R085-4-2-annealing.csv',3,12,[3 12 44
12]);
%part 5
Vgs10pre5 = csvread('D120R085-5-3-prerad.csv',3,11,[3 11 44 11]);
Igs10pre5 = csvread('D120R085-5-3-prerad.csv',3,12,[3 12 44 12]);
Vgs1015 = csvread('D120R085-5-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1015 = csvread('D120R085-5-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1025 = csvread('D120R085-5-2-2nddose.csv',3,11,[3 11 44 11]);
Igs1025 = csvread('D120R085-5-2-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base15 = csvread('D120R085-5-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base15 = csvread('D120R085-5-1-baseline1.csv',3,12,[3 12 44
12]);
```

```
Vgs1035 = csvread('D120R085-5-1-3rddose.csv',3,11,[3 11 44 11]);
Igs1035 = csvread('D120R085-5-1-3rddose.csv',3,12,[3 12 44 12]);
Vgs1045 = csvread('D120R085-5-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1045 = csvread('D120R085-5-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1055 = csvread('D120R085-5-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1055 = csvread('D120R085-5-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base25= csvread('D120R085-5-1-baseline2.csv',3,11,[3 11 44
11]);
Igs10base25 = csvread('D120R085-5-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1065 = csvread('D120R085-5-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1065 = csvread('D120R085-5-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1075 = csvread('D120R085-5-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1075 = csvread('D120R085-5-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal5 = csvread('D120R085-5-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal5 = csvread('D120R085-5-1-annealing.csv',3,12,[3 12 44
12]);

 %plot them against each other
%subplot(2,3,5)
figure(5)
Vgs10pre = (Vgs10pre1+Vgs10pre2+Vgs10pre3+Vgs10pre4+Vgs10pre5)/5;
Igs10pre = (Igs10pre1+Igs10pre2+Igs10pre3+Igs10pre4+Igs10pre5)/5;
plot(Vgs10pre,Igs10pre,'r','LineWidth',2)
hold on
Vgs101 = (Vgs1011+Vgs1012+Vgs1013+Vgs1014+Vgs1015)/5;
Igs101 = (Igs1011+Igs1012+Igs1013+Igs1014+Igs1015)/5;
plot(Vgs101,Igs101,'g','LineWidth',2)
hold on
Vgs102 = (Vgs1021+Vgs1022+Vgs1023+Vgs1024+Vgs1025)/5;
Igs102 = (Igs1021+Igs1022+Igs1023+Igs1024+Igs1025)/5;
plot(Vgs102,Igs102,'k','LineWidth',2)
hold on
Vgs10base1 =
(Vgs10base11+Vgs10base12+Vgs10base13+Vgs10base14+Vgs10base15)/5;
Igs10base1 =
(Igs10base11+Igs10base12+Igs10base13+Igs10base14+Igs10base15)/5;
plot(Vgs10base1, Igs10base1,'--b','LineWidth',2)
hold on
Vgs103 = (Vgs1031+Vgs1032+Vgs1033+Vgs1034+Vgs1035)/5;
Igs103 = (Igs1031+Igs1032+Igs1033+Igs1034+Igs1035)/5;
plot(Vgs103,Igs103,'m','LineWidth',2)
hold on
Vgs104 = (Vgs1041+Vgs1042+Vgs1043+Vgs1044+Vgs1045)/5;
Igs104 = (Igs1041+Igs1042+Igs1043+Igs1044+Igs1045)/5;
plot(Vgs104,Igs104,'c','LineWidth',2)
hold on
Vgs105 = (Vgs1051+Vgs1052+Vgs1053+Vgs1054+Vgs1055)/5;
Igs105 = (Igs1051+Igs1052+Igs1053+Igs1054+Igs1055)/5;
plot(Vgs105,Igs105,'b','LineWidth',2)
hold on
Vgs10base2 =
(Vgs10base21+Vgs10base22+Vgs10base23+Vgs10base24+Vgs10base25)/5;
```

```
Igs10base2 =
(Igs10base21+Igs10base22+Igs10base23+Igs10base24+Igs10base25)/5;
plot(Vgs10base2, Igs10base2,'--k','LineWidth',2)
hold on
Vgs106 = (Vgs1061+Vgs1062+Vgs1063+Vgs1064+Vgs1065)/5;
Igs106 = (Igs1061+Igs1062+Igs1063+Igs1064+Igs1065)/5;
plot(Vgs106,Igs106,'y','LineWidth',2)
hold on
Vgs107 = (Vgs1071+Vgs1072+Vgs1073+Vgs1074+Vgs1075)/5;
Igs107 = (Igs1071+Igs1072+Igs1073+Igs1074+Igs1075)/5;
plot(Vgs107,Igs107,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs10anneal =
(Vgs10anneal1+Vgs10anneal2+Vgs10anneal3+Vgs10anneal4+Vgs10anneal5
)/5;
Igs10anneal =
(Igs10anneal1+Igs10anneal2+Igs10anneal3+Igs10anneal4+Igs10anneal5
)/5;
plot(Vgs10anneal,Igs10anneal,'--m','LineWidth',2)

legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('D120R085 Avgs of 5 Devices @ Vgs=10V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,4])
ylim([0 52])


%%
%%Vgs=12V
%Read in .csv file
%Part 1
Vgs12pre1 = csvread('D120R085-1-3-prerad.csv',3,13,[3 13 44 13]);
Igs12pre1 = csvread('D120R085-1-3-prerad.csv',3,14,[3 14 44 14]);
Vgs1211 = csvread('D120R085-1-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1211 = csvread('D120R085-1-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1221 = csvread('D120R085-1-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1221 = csvread('D120R085-1-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base11 = csvread('D120R085-1-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base11 = csvread('D120R085-1-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1231 = csvread('D120R085-1-1-3rddose.csv',3,13,[3 13 44 13]);
Igs1231 = csvread('D120R085-1-1-3rddose.csv',3,14,[3 14 44 14]);
Vgs1241 = csvread('D120R085-1-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1241 = csvread('D120R085-1-1-4thdose.csv',3,14,[3 14 44 14]);
Vgs1251 = csvread('D120R085-1-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1251 = csvread('D120R085-1-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base21= csvread('D120R085-1-1-baseline2.csv',3,13,[3 13 44
13]);
Igs12base21 = csvread('D120R085-1-1-baseline2.csv',3,14,[3 14 44
14]);
```

```
Vgs1261 = csvread('D120R085-1-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1261 = csvread('D120R085-1-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1271 = csvread('D120R085-1-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1271 = csvread('D120R085-1-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal1 = csvread('D120R085-1-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal1 = csvread('D120R085-1-1-annealing.csv',3,14,[3 14 44
14]);
%part 2
Vgs12pre2 = csvread('D120R085-2-1-prerad.csv',3,13,[3 13 44 13]);
Igs12pre2 = csvread('D120R085-2-1-prerad.csv',3,14,[3 14 44 14]);
Vgs1212 = csvread('D120R085-2-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1212 = csvread('D120R085-2-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1222 = csvread('D120R085-2-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1222 = csvread('D120R085-2-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base12 = csvread('D120R085-2-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base12 = csvread('D120R085-2-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1232 = csvread('D120R085-2-1-3rddose.csv',3,13,[3 13 44 13]);
Igs1232 = csvread('D120R085-2-1-3rddose.csv',3,14,[3 14 44 14]);
Vgs1242 = csvread('D120R085-2-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1242 = csvread('D120R085-2-1-4thdose.csv',3,14,[3 14 44 14]);
Vgs1252 = csvread('D120R085-2-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1252 = csvread('D120R085-2-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base22 = csvread('D120R085-2-2-baseline2.csv',3,13,[3 13 44
13]);
Igs12base22 = csvread('D120R085-2-2-baseline2.csv',3,14,[3 14 44
14]);
Vgs1262 = csvread('D120R085-2-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1262 = csvread('D120R085-2-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1272 = csvread('D120R085-2-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1272 = csvread('D120R085-2-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal2 = csvread('D120R085-2-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal2 = csvread('D120R085-2-1-annealing.csv',3,14,[3 14 44
14]);
%part 3
Vgs12pre3 = csvread('D120R085-3-2-prerad.csv',3,13,[3 13 44 13]);
Igs12pre3 = csvread('D120R085-3-2-prerad.csv',3,14,[3 14 44 14]);
Vgs1213 = csvread('D120R085-3-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1213 = csvread('D120R085-3-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1223 = csvread('D120R085-3-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1223 = csvread('D120R085-3-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base13 = csvread('D120R085-3-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base13 = csvread('D120R085-3-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1233 = csvread('D120R085-3-1-3rddose.csv',3,13,[3 13 44 13]);
Igs1233 = csvread('D120R085-3-1-3rddose.csv',3,14,[3 14 44 14]);
Vgs1243 = csvread('D120R085-3-2-4thdose.csv',3,13,[3 13 44 13]);
Igs1243 = csvread('D120R085-3-2-4thdose.csv',3,14,[3 14 44 14]);
Vgs1253 = csvread('D120R085-3-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1253 = csvread('D120R085-3-1-5thdose.csv',3,14,[3 14 44 14]);
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```
Vgs12base23= csvread('D120R085-3-2-baseline2.csv',3,13,[3 13 44
13]);
Igs12base23 = csvread('D120R085-3-2-baseline2.csv',3,14,[3 14 44
14]);
Vgs1263 = csvread('D120R085-3-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1263 = csvread('D120R085-3-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1273 = csvread('D120R085-3-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1273 = csvread('D120R085-3-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal3 = csvread('D120R085-3-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal3 = csvread('D120R085-3-1-annealing.csv',3,14,[3 14 44
14]);
%part 4
Vgs12pre4 = csvread('D120R085-4-1-prerad.csv',3,13,[3 13 44 13]);
Igs12pre4 = csvread('D120R085-4-1-prerad.csv',3,14,[3 14 44 14]);
Vgs1214 = csvread('D120R085-4-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1214 = csvread('D120R085-4-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1224 = csvread('D120R085-4-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1224 = csvread('D120R085-4-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base14 = csvread('D120R085-4-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base14 = csvread('D120R085-4-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1234 = csvread('D120R085-4-1-3rddose.csv',3,13,[3 13 44 13]);
Igs1234 = csvread('D120R085-4-1-3rddose.csv',3,14,[3 14 44 14]);
Vgs1244 = csvread('D120R085-4-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1244 = csvread('D120R085-4-1-4thdose.csv',3,14,[3 14 44 14]);
Vgs1254 = csvread('D120R085-4-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1254 = csvread('D120R085-4-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base24= csvread('D120R085-4-1-baseline2.csv',3,13,[3 13 44
13]);
Igs12base24 = csvread('D120R085-4-1-baseline2.csv',3,14,[3 14 44
14]);
Vgs1264 = csvread('D120R085-4-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1264 = csvread('D120R085-4-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1274 = csvread('D120R085-4-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1274 = csvread('D120R085-4-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal4 = csvread('D120R085-4-2-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal4 = csvread('D120R085-4-2-annealing.csv',3,14,[3 14 44
14]);
%part 5
Vgs12pre5 = csvread('D120R085-5-3-prerad.csv',3,13,[3 13 44 13]);
Igs12pre5 = csvread('D120R085-5-3-prerad.csv',3,14,[3 14 44 14]);
Vgs1215 = csvread('D120R085-5-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1215 = csvread('D120R085-5-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1225 = csvread('D120R085-5-2-2nddose.csv',3,13,[3 13 44 13]);
Igs1225 = csvread('D120R085-5-2-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base15 = csvread('D120R085-5-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base15 = csvread('D120R085-5-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1235 = csvread('D120R085-5-1-3rddose.csv',3,13,[3 13 44 13]);
Igs1235 = csvread('D120R085-5-1-3rddose.csv',3,14,[3 14 44 14]);
```

```
Vgs1245 = csvread('D120R085-5-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1245 = csvread('D120R085-5-1-4thdose.csv',3,14,[3 14 44 14]);
Vgs1255 = csvread('D120R085-5-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1255 = csvread('D120R085-5-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base25= csvread('D120R085-5-1-baseline2.csv',3,13,[3 13 44
13]);
Igs12base25 = csvread('D120R085-5-1-baseline2.csv',3,14,[3 14 44
14]);
Vgs1265 = csvread('D120R085-5-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1265 = csvread('D120R085-5-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1275 = csvread('D120R085-5-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1275 = csvread('D120R085-5-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal5 = csvread('D120R085-5-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal5 = csvread('D120R085-5-1-annealing.csv',3,14,[3 14 44
14]);

 %plot them against each other
figure(6)
%set(hfig,'Units','Normalized','OuterPosition',[0 0 1 1]);
%subplot(2,3,1)
Vgs12pre = (Vgs12pre1+Vgs12pre2+Vgs12pre3+Vgs12pre4+Vgs12pre5)/5;
Igs12pre = (Igs12pre1+Igs12pre2+Igs12pre3+Igs12pre4+Igs12pre5)/5;
plot(Vgs12pre,Igs12pre,'r','LineWidth',2)
hold on
Vgs121 = (Vgs1211+Vgs1212+Vgs1213+Vgs1214+Vgs1215)/5;
Igs121 = (Igs1211+Igs1212+Igs1213+Igs1214+Igs1215)/5;
plot(Vgs121,Igs121,'g','LineWidth',2)
hold on
Vgs122 = (Vgs1221+Vgs1222+Vgs1223+Vgs1224+Vgs1225)/5;
Igs122 = (Igs1221+Igs1222+Igs1223+Igs1224+Igs1225)/5;
plot(Vgs122,Igs122,'k','LineWidth',2)
hold on
Vgs12base1 =
(Vgs12base11+Vgs12base12+Vgs12base13+Vgs12base14+Vgs12base15)/5;
Igs12base1 =
(Igs12base11+Igs12base12+Igs12base13+Igs12base14+Igs12base15)/5;
plot(Vgs12base1, Igs12base1,'--b','LineWidth',2)
hold on
Vgs123 = (Vgs1231+Vgs1232+Vgs1233+Vgs1234+Vgs1235)/5;
Igs123 = (Igs1231+Igs1232+Igs1233+Igs1234+Igs1235)/5;
plot(Vgs123,Igs123,'m','LineWidth',2)
hold on
Vgs124 = (Vgs1241+Vgs1242+Vgs1243+Vgs1244+Vgs1245)/5;
Igs124 = (Igs1241+Igs1242+Igs1243+Igs1244+Igs1245)/5;
plot(Vgs124,Igs124,'c','LineWidth',2)
hold on
Vgs125 = (Vgs1251+Vgs1252+Vgs1253+Vgs1254+Vgs1255)/5;
Igs125 = (Igs1251+Igs1252+Igs1253+Igs1254+Igs1255)/5;
plot(Vgs125,Igs125,'b','LineWidth',2)
hold on
Vgs12base2 =
(Vgs12base21+Vgs12base22+Vgs12base23+Vgs12base24+Vgs12base25)/5;
```

```
Igs12base2 =
(Igs12base21+Igs12base22+Igs12base23+Igs12base24+Igs12base25)/5;
plot(Vgs2base2, Igs2base2,'--k','LineWidth',2)
hold on
Vgs126 = (Vgs1261+Vgs1262+Vgs1263+Vgs1264+Vgs1265)/5;
Igs126 = (Igs1261+Igs1262+Igs1263+Igs1264+Igs1265)/5;
plot(Vgs126,Igs126,'y','LineWidth',2)
hold on
Vgs127 = (Vgs1271+Vgs1272+Vgs1273+Vgs1274+Vgs1275)/5;
Igs127 = (Igs1271+Igs1272+Igs1273+Igs1274+Igs1275)/5;
plot(Vgs127,Igs127,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs12anneal =
(Vgs12anneal1+Vgs12anneal2+Vgs12anneal3+Vgs12anneal4+Vgs12anneal5
)/5;
Igs12anneal =
(Igs12anneal1+Igs12anneal2+Igs12anneal3+Igs12anneal4+Igs12anneal5
)/5;
plot(Vgs12anneal,Igs12anneal,'--m','LineWidth',2)

legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('D120R085 Avgs for 5 Devices @ Vgs=12V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,4])
ylim([0 52])
```

```
%File Reader for .csv files used in semiconductor analysis
%for radiation testing
%
%Part #:E120R100 Avgs
%

clear;
%%
%%Vgs=2V
%Read in .csv file
%Part 1
Vgs2pre1 = csvread('E120R100-1-9-prerad.csv',3,3,[3 3 44 3]);
Igs2pre1 = csvread('E120R100-1-9-prerad.csv',3,4,[3 4 44 4]);
Vgs211 = csvread('E120R100-1-1-1stdose.csv',3,3,[3 3 44 3]);
Igs211 = csvread('E120R100-1-1-1stdose.csv',3,4,[3 4 44 4]);
```

```
Vgs221 = csvread('E120R100-1-1-2nddose.csv',3,3,[3 3 44 3]);
Igs221 = csvread('E120R100-1-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base11 = csvread('E120R100-1-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base11 = csvread('E120R100-1-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs231 = csvread('E120R100-1-2-3rddose.csv',3,3,[3 3 44 3]);
Igs231 = csvread('E120R100-1-2-3rddose.csv',3,4,[3 4 44 4]);
Vgs241 = csvread('E120R100-1-1-4thdose.csv',3,3,[3 3 44 3]);
Igs241 = csvread('E120R100-1-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs251 = csvread('E120R100-1-1-5thdose.csv',3,3,[3 3 44 3]);
Igs251 = csvread('E120R100-1-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base21= csvread('E120R100-1-1-baseline2.csv',3,3,[3 3 44 3]);
Igs2base21 = csvread('E120R100-1-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs261 = csvread('E120R100-1-2-6thdose.csv',3,3,[3 3 44 3]);
Igs261 = csvread('E120R100-1-2-6thdose.csv',3,4,[3 4 44 4]);
Vgs271 = csvread('E120R100-1-1-7thdose.csv',3,3,[3 3 44 3]);
Igs271 = csvread('E120R100-1-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal1 = csvread('E120R100-1-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal1 = csvread('E120R100-1-1-annealing.csv',3,4,[3 4 44
4]);
%part 2
Vgs2pre2 = csvread('E120R100-2-9-prerad.csv',3,3,[3 3 44 3]);
Igs2pre2 = csvread('E120R100-2-9-prerad.csv',3,4,[3 4 44 4]);
Vgs212 = csvread('E120R100-2-1-1stdose.csv',3,3,[3 3 44 3]);
Igs212 = csvread('E120R100-2-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs222 = csvread('E120R100-2-1-2nddose.csv',3,3,[3 3 44 3]);
Igs222 = csvread('E120R100-2-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base12 = csvread('E120R100-2-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base12 = csvread('E120R100-2-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs232 = csvread('E120R100-2-2-3rddose.csv',3,3,[3 3 44 3]);
Igs232 = csvread('E120R100-2-2-3rddose.csv',3,4,[3 4 44 4]);
Vgs242 = csvread('E120R100-2-1-4thdose.csv',3,3,[3 3 44 3]);
Igs242 = csvread('E120R100-2-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs252 = csvread('E120R100-2-1-5thdose.csv',3,3,[3 3 44 3]);
Igs252 = csvread('E120R100-2-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base22 = csvread('E120R100-2-1-baseline2.csv',3,3,[3 3 44
3]);
Igs2base22 = csvread('E120R100-2-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs262 = csvread('E120R100-2-1-6thdose.csv',3,3,[3 3 44 3]);
Igs262 = csvread('E120R100-2-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs272 = csvread('E120R100-2-1-7thdose.csv',3,3,[3 3 44 3]);
Igs272 = csvread('E120R100-2-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal2 = csvread('E120R100-2-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal2 = csvread('E120R100-2-1-annealing.csv',3,4,[3 4 44
4]);
%part 3
Vgs2pre3 = csvread('E120R100-3-9-prerad.csv',3,3,[3 3 44 3]);
```

```
Igs2pre3 = csvread('E120R100-3-9-prerad.csv',3,4,[3 4 44 4]);
Vgs213 = csvread('E120R100-3-1-1stdose.csv',3,3,[3 3 44 3]);
Igs213 = csvread('E120R100-3-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs223 = csvread('E120R100-3-1-2nddose.csv',3,3,[3 3 44 3]);
Igs223 = csvread('E120R100-3-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base13 = csvread('E120R100-3-5-baseline1.csv',3,3,[3 3 44
3]);
Igs2base13 = csvread('E120R100-3-5-baseline1.csv',3,4,[3 4 44
4]);
Vgs233 = csvread('E120R100-3-3-3rddose.csv',3,3,[3 3 44 3]);
Igs233 = csvread('E120R100-3-3-3rddose.csv',3,4,[3 4 44 4]);
Vgs243 = csvread('E120R100-3-2-4thdose.csv',3,3,[3 3 44 3]);
Igs243 = csvread('E120R100-3-2-4thdose.csv',3,4,[3 4 44 4]);
Vgs253 = csvread('E120R100-3-1-5thdose.csv',3,3,[3 3 44 3]);
Igs253 = csvread('E120R100-3-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base23= csvread('E120R100-3-1-baseline2.csv',3,3,[3 3 44 3]);
Igs2base23 = csvread('E120R100-3-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs263 = csvread('E120R100-3-1-6thdose.csv',3,3,[3 3 44 3]);
Igs263 = csvread('E120R100-3-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs273 = csvread('E120R100-3-1-7thdose.csv',3,3,[3 3 44 3]);
Igs273 = csvread('E120R100-3-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal3 = csvread('E120R100-3-2-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal3 = csvread('E120R100-3-2-annealing.csv',3,4,[3 4 44
4]);
%part 4
Vgs2pre4 = csvread('E120R100-4-1-prerad.csv',3,3,[3 3 44 3]);
Igs2pre4 = csvread('E120R100-4-1-prerad.csv',3,4,[3 4 44 4]);
Vgs214 = csvread('E120R100-4-1-1stdose.csv',3,3,[3 3 44 3]);
Igs214 = csvread('E120R100-4-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs224 = csvread('E120R100-4-1-2nddose.csv',3,3,[3 3 44 3]);
Igs224 = csvread('E120R100-4-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base14 = csvread('E120R100-4-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base14 = csvread('E120R100-4-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs234 = csvread('E120R100-4-1-3rddose.csv',3,3,[3 3 44 3]);
Igs234 = csvread('E120R100-4-1-3rddose.csv',3,4,[3 4 44 4]);
Vgs244 = csvread('E120R100-4-1-4thdose.csv',3,3,[3 3 44 3]);
Igs244 = csvread('E120R100-4-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs254 = csvread('E120R100-4-1-5thdose.csv',3,3,[3 3 44 3]);
Igs254 = csvread('E120R100-4-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base24= csvread('E120R100-4-1-baseline2.csv',3,3,[3 3 44 3]);
Igs2base24 = csvread('E120R100-4-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs264 = csvread('E120R100-4-1-6thdose.csv',3,3,[3 3 44 3]);
Igs264 = csvread('E120R100-4-1-6thdose.csv',3,4,[3 4 44 4]);
Vgs274 = csvread('E120R100-4-1-7thdose.csv',3,3,[3 3 44 3]);
Igs274 = csvread('E120R100-4-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal4 = csvread('E120R100-4-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal4 = csvread('E120R100-4-1-annealing.csv',3,4,[3 4 44
4]);
```

```
%part 5
Vgs2pre5 = csvread('E120R100-5-1-prerad.csv',3,3,[3 3 44 3]);
Igs2pre5 = csvread('E120R100-5-1-prerad.csv',3,4,[3 4 44 4]);
Vgs215 = csvread('E120R100-5-1-1stdose.csv',3,3,[3 3 44 3]);
Igs215 = csvread('E120R100-5-1-1stdose.csv',3,4,[3 4 44 4]);
Vgs225 = csvread('E120R100-5-1-2nddose.csv',3,3,[3 3 44 3]);
Igs225 = csvread('E120R100-5-1-2nddose.csv',3,4,[3 4 44 4]);
Vgs2base15 = csvread('E120R100-5-1-baseline1.csv',3,3,[3 3 44
3]);
Igs2base15 = csvread('E120R100-5-1-baseline1.csv',3,4,[3 4 44
4]);
Vgs235 = csvread('E120R100-5-1-3rddose.csv',3,3,[3 3 44 3]);
Igs235 = csvread('E120R100-5-1-3rddose.csv',3,4,[3 4 44 4]);
Vgs245 = csvread('E120R100-5-1-4thdose.csv',3,3,[3 3 44 3]);
Igs245 = csvread('E120R100-5-1-4thdose.csv',3,4,[3 4 44 4]);
Vgs255 = csvread('E120R100-5-1-5thdose.csv',3,3,[3 3 44 3]);
Igs255 = csvread('E120R100-5-1-5thdose.csv',3,4,[3 4 44 4]);
Vgs2base25= csvread('E120R100-5-1-baseline2.csv',3,3,[3 3 44 3]);
Igs2base25 = csvread('E120R100-5-1-baseline2.csv',3,4,[3 4 44
4]);
Vgs265 = csvread('E120R100-5-2-6thdose.csv',3,3,[3 3 44 3]);
Igs265 = csvread('E120R100-5-2-6thdose.csv',3,4,[3 4 44 4]);
Vgs275 = csvread('E120R100-5-1-7thdose.csv',3,3,[3 3 44 3]);
Igs275 = csvread('E120R100-5-1-7thdose.csv',3,4,[3 4 44 4]);
Vgs2anneal5 = csvread('E120R100-5-1-annealing.csv',3,3,[3 3 44
3]);
Igs2anneal5 = csvread('E120R100-5-1-annealing.csv',3,4,[3 4 44
4]);

 %plot them against each other
figure(1)
%set(hfig,'Units','Normalized','OuterPosition',[0 0 1 1]);
%subplot(2,3,1)
Vgs2pre = (Vgs2pre1+Vgs2pre2+Vgs2pre3+Vgs2pre4+Vgs2pre5)/5;
Igs2pre = (Igs2pre1+Igs2pre2+Igs2pre3+Igs2pre4+Igs2pre5)/5;
plot(Vgs2pre,Igs2pre,'r','LineWidth',2)
hold on
Vgs21 = (Vgs211+Vgs212+Vgs213+Vgs214+Vgs215)/5;
Igs21 = (Igs211+Igs212+Igs213+Igs214+Igs215)/5;
plot(Vgs21,Igs21,'g','LineWidth',2)
hold on
Vgs22 = (Vgs221+Vgs222+Vgs223+Vgs224+Vgs225)/5;
Igs22 = (Igs221+Igs222+Igs223+Igs224+Igs225)/5;
plot(Vgs22,Igs22,'k','LineWidth',2)
hold on
Vgs2base1 =
(Vgs2base11+Vgs2base12+Vgs2base13+Vgs2base14+Vgs2base15)/5;
Igs2base1 =
(Igs2base11+Igs2base12+Igs2base13+Igs2base14+Igs2base15)/5;
plot(Vgs2base1, Igs2base1,'--b','LineWidth',2)
hold on
Vgs23 = (Vgs231+Vgs232+Vgs233+Vgs234+Vgs235)/5;
Igs23 = (Igs231+Igs232+Igs233+Igs234+Igs235)/5;
plot(Vgs23,Igs23,'m','LineWidth',2)
```

```
hold on
Vgs24 = (Vgs241+Vgs242+Vgs243+Vgs244+Vgs245)/5;
Igs24 = (Igs241+Igs242+Igs243+Igs244+Igs245)/5;
plot(Vgs24,Igs24,'c','LineWidth',2)
hold on
Vgs25 = (Vgs251+Vgs252+Vgs253+Vgs254+Vgs255)/5;
Igs25 = (Igs251+Igs252+Igs253+Igs254+Igs255)/5;
plot(Vgs25,Igs25,'b','LineWidth',2)
hold on
Vgs2base2 =
(Vgs2base21+Vgs2base22+Vgs2base23+Vgs2base24+Vgs2base25)/5;
Igs2base2 =
(Igs2base21+Igs2base22+Igs2base23+Igs2base24+Igs2base25)/5;
plot(Vgs2base2, Igs2base2,'--k','LineWidth',2)
hold on
Vgs26 = (Vgs261+Vgs262+Vgs263+Vgs264+Vgs265)/5;
Igs26 = (Igs261+Igs262+Igs263+Igs264+Igs265)/5;
plot(Vgs26,Igs26,'y','LineWidth',2)
hold on
Vgs27 = (Vgs271+Vgs272+Vgs273+Vgs274+Vgs275)/5;
Igs27 = (Igs271+Igs272+Igs273+Igs274+Igs275)/5;
plot(Vgs27,Igs27,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs2anneal =
(Vgs2anneal1+Vgs2anneal2+Vgs2anneal3+Vgs2anneal4+Vgs2anneal5)/5;
Igs2anneal =
(Igs2anneal1+Igs2anneal2+Igs2anneal3+Igs2anneal4+Igs2anneal5)/5;
plot(Vgs2anneal,Igs2anneal,'--m','LineWidth',2)
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('E120R100 Avg of 5 Devices @ Vgs=2V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,2])
ylim([0 18])
%%
%
%%Vgs=4V
%Read in .csv file
%Part 1
Vgs4pre1 = csvread('E120R100-1-9-prerad.csv',3,5,[3 5 44 5]);
Igs4pre1 = csvread('E120R100-1-9-prerad.csv',3,6,[3 6 44 6]);
Vgs411 = csvread('E120R100-1-1-1stdose.csv',3,5,[3 5 44 5]);
Igs411 = csvread('E120R100-1-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs421 = csvread('E120R100-1-1-2nddose.csv',3,5,[3 5 44 5]);
Igs421 = csvread('E120R100-1-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base11 = csvread('E120R100-1-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base11 = csvread('E120R100-1-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs431 = csvread('E120R100-1-2-3rddose.csv',3,5,[3 5 44 5]);
Igs431 = csvread('E120R100-1-2-3rddose.csv',3,6,[3 6 44 6]);
Vgs441 = csvread('E120R100-1-1-4thdose.csv',3,5,[3 5 44 5]);
```

```
Igs441 = csvread('E120R100-1-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs451 = csvread('E120R100-1-1-5thdose.csv',3,5,[3 5 44 5]);
Igs451 = csvread('E120R100-1-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base21= csvread('E120R100-1-1-baseline2.csv',3,5,[3 5 44 5]);
Igs4base21 = csvread('E120R100-1-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs461 = csvread('E120R100-1-2-6thdose.csv',3,5,[3 5 44 5]);
Igs461 = csvread('E120R100-1-2-6thdose.csv',3,6,[3 6 44 6]);
Vgs471 = csvread('E120R100-1-1-7thdose.csv',3,5,[3 5 44 5]);
Igs471 = csvread('E120R100-1-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal1 = csvread('E120R100-1-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal1 = csvread('E120R100-1-1-annealing.csv',3,6,[3 6 44
6]);
%part 2
Vgs4pre2 = csvread('E120R100-2-9-prerad.csv',3,5,[3 5 44 5]);
Igs4pre2 = csvread('E120R100-2-9-prerad.csv',3,6,[3 6 44 6]);
Vgs412 = csvread('E120R100-2-1-1stdose.csv',3,5,[3 5 44 5]);
Igs412 = csvread('E120R100-2-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs422 = csvread('E120R100-2-1-2nddose.csv',3,5,[3 5 44 5]);
Igs422 = csvread('E120R100-2-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base12 = csvread('E120R100-2-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base12 = csvread('E120R100-2-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs432 = csvread('E120R100-2-2-3rddose.csv',3,5,[3 5 44 5]);
Igs432 = csvread('E120R100-2-2-3rddose.csv',3,6,[3 6 44 6]);
Vgs442 = csvread('E120R100-2-1-4thdose.csv',3,5,[3 5 44 5]);
Igs442 = csvread('E120R100-2-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs452 = csvread('E120R100-2-1-5thdose.csv',3,5,[3 5 44 5]);
Igs452 = csvread('E120R100-2-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base22 = csvread('E120R100-2-1-baseline2.csv',3,5,[3 5 44
5]);
Igs4base22 = csvread('E120R100-2-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs462 = csvread('E120R100-2-1-6thdose.csv',3,5,[3 5 44 5]);
Igs462 = csvread('E120R100-2-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs472 = csvread('E120R100-2-1-7thdose.csv',3,5,[3 5 44 5]);
Igs472 = csvread('E120R100-2-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal2 = csvread('E120R100-2-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal2 = csvread('E120R100-2-1-annealing.csv',3,6,[3 6 44
6]);
%part 3
Vgs4pre3 = csvread('E120R100-3-9-prerad.csv',3,5,[3 5 44 5]);
Igs4pre3 = csvread('E120R100-3-9-prerad.csv',3,6,[3 6 44 6]);
Vgs413 = csvread('E120R100-3-1-1stdose.csv',3,5,[3 5 44 5]);
Igs413 = csvread('E120R100-3-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs423 = csvread('E120R100-3-1-2nddose.csv',3,5,[3 5 44 5]);
Igs423 = csvread('E120R100-3-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base13 = csvread('E120R100-3-5-baseline1.csv',3,5,[3 5 44
5]);
Igs4base13 = csvread('E120R100-3-5-baseline1.csv',3,6,[3 6 44
6]);
```

```
Vgs433 = csvread('E120R100-3-3-3rddose.csv',3,5,[3 5 44 5]);
Igs433 = csvread('E120R100-3-3-3rddose.csv',3,6,[3 6 44 6]);
Vgs443 = csvread('E120R100-3-2-4thdose.csv',3,5,[3 5 44 5]);
Igs443 = csvread('E120R100-3-2-4thdose.csv',3,6,[3 6 44 6]);
Vgs453 = csvread('E120R100-3-1-5thdose.csv',3,5,[3 5 44 5]);
Igs453 = csvread('E120R100-3-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base23= csvread('E120R100-3-1-baseline2.csv',3,5,[3 5 44 5]);
Igs4base23 = csvread('E120R100-3-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs463 = csvread('E120R100-3-1-6thdose.csv',3,5,[3 5 44 5]);
Igs463 = csvread('E120R100-3-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs473 = csvread('E120R100-3-1-7thdose.csv',3,5,[3 5 44 5]);
Igs473 = csvread('E120R100-3-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal3 = csvread('E120R100-3-2-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal3 = csvread('E120R100-3-2-annealing.csv',3,6,[3 6 44
6]);
%part 4
Vgs4pre4 = csvread('E120R100-4-1-prerad.csv',3,5,[3 5 44 5]);
Igs4pre4 = csvread('E120R100-4-1-prerad.csv',3,6,[3 6 44 6]);
Vgs414 = csvread('E120R100-4-1-1stdose.csv',3,5,[3 5 44 5]);
Igs414 = csvread('E120R100-4-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs424 = csvread('E120R100-4-1-2nddose.csv',3,5,[3 5 44 5]);
Igs424 = csvread('E120R100-4-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base14 = csvread('E120R100-4-1-baseline1.csv',3,5,[3 5 44
5]);
Igs4base14 = csvread('E120R100-4-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs434 = csvread('E120R100-4-1-3rddose.csv',3,5,[3 5 44 5]);
Igs434 = csvread('E120R100-4-1-3rddose.csv',3,6,[3 6 44 6]);
Vgs444 = csvread('E120R100-4-1-4thdose.csv',3,5,[3 5 44 5]);
Igs444 = csvread('E120R100-4-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs454 = csvread('E120R100-4-1-5thdose.csv',3,5,[3 5 44 5]);
Igs454 = csvread('E120R100-4-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base24= csvread('E120R100-4-1-baseline2.csv',3,5,[3 5 44 5]);
Igs4base24 = csvread('E120R100-4-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs464 = csvread('E120R100-4-1-6thdose.csv',3,5,[3 5 44 5]);
Igs464 = csvread('E120R100-4-1-6thdose.csv',3,6,[3 6 44 6]);
Vgs474 = csvread('E120R100-4-1-7thdose.csv',3,5,[3 5 44 5]);
Igs474 = csvread('E120R100-4-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal4 = csvread('E120R100-4-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal4 = csvread('E120R100-4-1-annealing.csv',3,6,[3 6 44
6]);
%part 5
Vgs4pre5 = csvread('E120R100-5-1-prerad.csv',3,5,[3 5 44 5]);
Igs4pre5 = csvread('E120R100-5-1-prerad.csv',3,6,[3 6 44 6]);
Vgs415 = csvread('E120R100-5-1-1stdose.csv',3,5,[3 5 44 5]);
Igs415 = csvread('E120R100-5-1-1stdose.csv',3,6,[3 6 44 6]);
Vgs425 = csvread('E120R100-5-1-2nddose.csv',3,5,[3 5 44 5]);
Igs425 = csvread('E120R100-5-1-2nddose.csv',3,6,[3 6 44 6]);
Vgs4base15 = csvread('E120R100-5-1-baseline1.csv',3,5,[3 5 44
5]);
```

```
Igs4base15 = csvread('E120R100-5-1-baseline1.csv',3,6,[3 6 44
6]);
Vgs435 = csvread('E120R100-5-1-3rddose.csv',3,5,[3 5 44 5]);
Igs435 = csvread('E120R100-5-1-3rddose.csv',3,6,[3 6 44 6]);
Vgs445 = csvread('E120R100-5-1-4thdose.csv',3,5,[3 5 44 5]);
Igs445 = csvread('E120R100-5-1-4thdose.csv',3,6,[3 6 44 6]);
Vgs455 = csvread('E120R100-5-1-5thdose.csv',3,5,[3 5 44 5]);
Igs455 = csvread('E120R100-5-1-5thdose.csv',3,6,[3 6 44 6]);
Vgs4base25= csvread('E120R100-5-1-baseline2.csv',3,5,[3 5 44 5]);
Igs4base25 = csvread('E120R100-5-1-baseline2.csv',3,6,[3 6 44
6]);
Vgs465 = csvread('E120R100-5-2-6thdose.csv',3,5,[3 5 44 5]);
Igs465 = csvread('E120R100-5-2-6thdose.csv',3,6,[3 6 44 6]);
Vgs475 = csvread('E120R100-5-1-7thdose.csv',3,5,[3 5 44 5]);
Igs475 = csvread('E120R100-5-1-7thdose.csv',3,6,[3 6 44 6]);
Vgs4anneal5 = csvread('E120R100-5-1-annealing.csv',3,5,[3 5 44
5]);
Igs4anneal5 = csvread('E120R100-5-1-annealing.csv',3,6,[3 6 44
6]);

 %plot them against each other
figure(2)
%set(hfig,'Units','Normalized','OuterPosition',[0 0 1 1]);
%subplot(2,3,1)
Vgs4pre = (Vgs4pre1+Vgs4pre2+Vgs4pre3+Vgs4pre4+Vgs4pre5)/5;
Igs4pre = (Igs4pre1+Igs4pre2+Igs4pre3+Igs4pre4+Igs4pre5)/5;
plot(Vgs4pre,Igs4pre,'r','LineWidth',2)
hold on
Vgs41 = (Vgs411+Vgs412+Vgs413+Vgs414+Vgs415)/5;
Igs41 = (Igs411+Igs412+Igs413+Igs414+Igs415)/5;
plot(Vgs41,Igs41,'g','LineWidth',2)
hold on
Vgs42 = (Vgs421+Vgs422+Vgs423+Vgs424+Vgs425)/5;
Igs42 = (Igs421+Igs422+Igs423+Igs424+Igs425)/5;
plot(Vgs42,Igs42,'k','LineWidth',2)
hold on
Vgs4base1 =
(Vgs4base11+Vgs4base12+Vgs4base13+Vgs4base14+Vgs4base15)/5;
Igs4base1 =
(Igs4base11+Igs4base12+Igs4base13+Igs4base14+Igs4base15)/5;
plot(Vgs4base1, Igs4base1,'--b','LineWidth',2)
hold on
Vgs43 = (Vgs431+Vgs432+Vgs433+Vgs434+Vgs435)/5;
Igs43 = (Igs431+Igs432+Igs433+Igs434+Igs435)/5;
plot(Vgs43,Igs43,'m','LineWidth',2)
hold on
Vgs44 = (Vgs441+Vgs442+Vgs443+Vgs444+Vgs445)/5;
Igs44 = (Igs441+Igs442+Igs443+Igs444+Igs445)/5;
plot(Vgs44,Igs44,'c','LineWidth',2)
hold on
Vgs45 = (Vgs451+Vgs452+Vgs453+Vgs454+Vgs455)/5;
Igs45 = (Igs451+Igs452+Igs453+Igs454+Igs455)/5;
plot(Vgs45,Igs45,'b','LineWidth',2)
hold on
```

```
Vgs4base2 =
(Vgs4base21+Vgs4base22+Vgs4base23+Vgs4base24+Vgs4base25)/5;
Igs4base2 =
(Igs4base21+Igs4base22+Igs4base23+Igs4base24+Igs4base25)/5;
plot(Vgs4base2, Igs4base2,'--k','LineWidth',2)
hold on
Vgs46 = (Vgs461+Vgs462+Vgs463+Vgs464+Vgs465)/5;
Igs46 = (Igs461+Igs462+Igs463+Igs464+Igs465)/5;
plot(Vgs46,Igs46,'y','LineWidth',2)
hold on
Vgs47 = (Vgs471+Vgs472+Vgs473+Vgs474+Vgs475)/5;
Igs47 = (Igs471+Igs472+Igs473+Igs474+Igs475)/5;
plot(Vgs47,Igs47,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs4anneal =
(Vgs4anneal1+Vgs4anneal2+Vgs4anneal3+Vgs4anneal4+Vgs4anneal5)/5;
Igs4anneal =
(Igs4anneal1+Igs4anneal2+Igs4anneal3+Igs4anneal4+Igs4anneal5)/5;
plot(Vgs4anneal,Igs4anneal,'--m','LineWidth',2)
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('E120R100 Avgs of 5 Devices @ Vgs=4V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,2])
ylim([0 18])

%%
%%Vgs=6V
%Read in .csv file
%part 1
Vgs6pre1 = csvread('E120R100-1-9-prerad.csv',3,7,[3 7 44 7]);
Igs6pre1 = csvread('E120R100-1-9-prerad.csv',3,8,[3 8 44 8]);
Vgs611 = csvread('E120R100-1-1-1stdose.csv',3,7,[3 7 44 7]);
Igs611 = csvread('E120R100-1-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs621 = csvread('E120R100-1-1-2nddose.csv',3,7,[3 7 44 7]);
Igs621 = csvread('E120R100-1-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base11 = csvread('E120R100-1-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base11 = csvread('E120R100-1-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs631 = csvread('E120R100-1-2-3rddose.csv',3,7,[3 7 44 7]);
Igs631 = csvread('E120R100-1-2-3rddose.csv',3,8,[3 8 44 8]);
Vgs641 = csvread('E120R100-1-1-4thdose.csv',3,7,[3 7 44 7]);
Igs641 = csvread('E120R100-1-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs651 = csvread('E120R100-1-1-5thdose.csv',3,7,[3 7 44 7]);
Igs651 = csvread('E120R100-1-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base21= csvread('E120R100-1-1-baseline2.csv',3,7,[3 7 44 7]);
Igs6base21 = csvread('E120R100-1-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs661 = csvread('E120R100-1-2-6thdose.csv',3,7,[3 7 44 7]);
Igs661 = csvread('E120R100-1-2-6thdose.csv',3,8,[3 8 44 8]);
Vgs671 = csvread('E120R100-1-1-7thdose.csv',3,7,[3 7 44 7]);
```

```
Igs671 = csvread('E120R100-1-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal1 = csvread('E120R100-1-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal1 = csvread('E120R100-1-1-annealing.csv',3,8,[3 8 44
8]);
%part 2
Vgs6pre2 = csvread('E120R100-2-9-prerad.csv',3,7,[3 7 44 7]);
Igs6pre2 = csvread('E120R100-2-9-prerad.csv',3,8,[3 8 44 8]);
Vgs612 = csvread('E120R100-2-1-1stdose.csv',3,7,[3 7 44 7]);
Igs612 = csvread('E120R100-2-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs622 = csvread('E120R100-2-1-2nddose.csv',3,7,[3 7 44 7]);
Igs622 = csvread('E120R100-2-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base12 = csvread('E120R100-2-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base12 = csvread('E120R100-2-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs632 = csvread('E120R100-2-2-3rddose.csv',3,7,[3 7 44 7]);
Igs632 = csvread('E120R100-2-2-3rddose.csv',3,8,[3 8 44 8]);
Vgs642 = csvread('E120R100-2-1-4thdose.csv',3,7,[3 7 44 7]);
Igs642 = csvread('E120R100-2-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs652 = csvread('E120R100-2-1-5thdose.csv',3,7,[3 7 44 7]);
Igs652 = csvread('E120R100-2-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base22= csvread('E120R100-2-1-baseline2.csv',3,7,[3 7 44 7]);
Igs6base22 = csvread('E120R100-2-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs662 = csvread('E120R100-2-1-6thdose.csv',3,7,[3 7 44 7]);
Igs662 = csvread('E120R100-2-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs672 = csvread('E120R100-2-1-7thdose.csv',3,7,[3 7 44 7]);
Igs672 = csvread('E120R100-2-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal2 = csvread('E120R100-2-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal2 = csvread('E120R100-2-1-annealing.csv',3,8,[3 8 44
8]);
%part 3
Vgs6pre3 = csvread('E120R100-3-9-prerad.csv',3,7,[3 7 44 7]);
Igs6pre3 = csvread('E120R100-3-9-prerad.csv',3,8,[3 8 44 8]);
Vgs613 = csvread('E120R100-3-1-1stdose.csv',3,7,[3 7 44 7]);
Igs613 = csvread('E120R100-3-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs623 = csvread('E120R100-3-1-2nddose.csv',3,7,[3 7 44 7]);
Igs623 = csvread('E120R100-3-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base13 = csvread('E120R100-3-5-baseline1.csv',3,7,[3 7 44
7]);
Igs6base13 = csvread('E120R100-3-5-baseline1.csv',3,8,[3 8 44
8]);
Vgs633 = csvread('E120R100-3-3-3rddose.csv',3,7,[3 7 44 7]);
Igs633 = csvread('E120R100-3-3-3rddose.csv',3,8,[3 8 44 8]);
Vgs643 = csvread('E120R100-3-2-4thdose.csv',3,7,[3 7 44 7]);
Igs643 = csvread('E120R100-3-2-4thdose.csv',3,8,[3 8 44 8]);
Vgs653 = csvread('E120R100-3-1-5thdose.csv',3,7,[3 7 44 7]);
Igs653 = csvread('E120R100-3-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base23= csvread('E120R100-3-1-baseline2.csv',3,7,[3 7 44 7]);
Igs6base23 = csvread('E120R100-3-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs663 = csvread('E120R100-3-1-6thdose.csv',3,7,[3 7 44 7]);
```

```
Igs663 = csvread('E120R100-3-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs673 = csvread('E120R100-3-1-7thdose.csv',3,7,[3 7 44 7]);
Igs673 = csvread('E120R100-3-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal3 = csvread('E120R100-3-2-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal3 = csvread('E120R100-3-2-annealing.csv',3,8,[3 8 44
8]);
%part 4
Vgs6pre4 = csvread('E120R100-4-1-prerad.csv',3,7,[3 7 44 7]);
Igs6pre4 = csvread('E120R100-4-1-prerad.csv',3,8,[3 8 44 8]);
Vgs614 = csvread('E120R100-4-1-1stdose.csv',3,7,[3 7 44 7]);
Igs614 = csvread('E120R100-4-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs624 = csvread('E120R100-4-1-2nddose.csv',3,7,[3 7 44 7]);
Igs624 = csvread('E120R100-4-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base14 = csvread('E120R100-4-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base14 = csvread('E120R100-4-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs634 = csvread('E120R100-4-1-3rddose.csv',3,7,[3 7 44 7]);
Igs634 = csvread('E120R100-4-1-3rddose.csv',3,8,[3 8 44 8]);
Vgs644 = csvread('E120R100-4-1-4thdose.csv',3,7,[3 7 44 7]);
Igs644 = csvread('E120R100-4-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs654 = csvread('E120R100-4-1-5thdose.csv',3,7,[3 7 44 7]);
Igs654 = csvread('E120R100-4-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base24= csvread('E120R100-4-1-baseline2.csv',3,7,[3 7 44 7]);
Igs6base24 = csvread('E120R100-4-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs664 = csvread('E120R100-4-1-6thdose.csv',3,7,[3 7 44 7]);
Igs664 = csvread('E120R100-4-1-6thdose.csv',3,8,[3 8 44 8]);
Vgs674 = csvread('E120R100-4-1-7thdose.csv',3,7,[3 7 44 7]);
Igs674 = csvread('E120R100-4-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal4 = csvread('E120R100-4-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal4 = csvread('E120R100-4-1-annealing.csv',3,8,[3 8 44
8]);
%part 5
Vgs6pre5 = csvread('E120R100-5-1-prerad.csv',3,7,[3 7 44 7]);
Igs6pre5 = csvread('E120R100-5-1-prerad.csv',3,8,[3 8 44 8]);
Vgs615 = csvread('E120R100-5-1-1stdose.csv',3,7,[3 7 44 7]);
Igs615 = csvread('E120R100-5-1-1stdose.csv',3,8,[3 8 44 8]);
Vgs625 = csvread('E120R100-5-1-2nddose.csv',3,7,[3 7 44 7]);
Igs625 = csvread('E120R100-5-1-2nddose.csv',3,8,[3 8 44 8]);
Vgs6base15 = csvread('E120R100-5-1-baseline1.csv',3,7,[3 7 44
7]);
Igs6base15 = csvread('E120R100-5-1-baseline1.csv',3,8,[3 8 44
8]);
Vgs635 = csvread('E120R100-5-1-3rddose.csv',3,7,[3 7 44 7]);
Igs635 = csvread('E120R100-5-1-3rddose.csv',3,8,[3 8 44 8]);
Vgs645 = csvread('E120R100-5-1-4thdose.csv',3,7,[3 7 44 7]);
Igs645 = csvread('E120R100-5-1-4thdose.csv',3,8,[3 8 44 8]);
Vgs655 = csvread('E120R100-5-1-5thdose.csv',3,7,[3 7 44 7]);
Igs655 = csvread('E120R100-5-1-5thdose.csv',3,8,[3 8 44 8]);
Vgs6base25= csvread('E120R100-5-1-baseline2.csv',3,7,[3 7 44 7]);
```

```
Igs6base25 = csvread('E120R100-5-1-baseline2.csv',3,8,[3 8 44
8]);
Vgs665 = csvread('E120R100-5-2-6thdose.csv',3,7,[3 7 44 7]);
Igs665 = csvread('E120R100-5-2-6thdose.csv',3,8,[3 8 44 8]);
Vgs675 = csvread('E120R100-5-1-7thdose.csv',3,7,[3 7 44 7]);
Igs675 = csvread('E120R100-5-1-7thdose.csv',3,8,[3 8 44 8]);
Vgs6anneal5 = csvread('E120R100-5-1-annealing.csv',3,7,[3 7 44
7]);
Igs6anneal5 = csvread('E120R100-5-1-annealing.csv',3,8,[3 8 44
8]);

 %plot them against each other
%subplot(2,3,3)
figure(3)
Vgs6pre = (Vgs6pre1+Vgs6pre2+Vgs6pre3+Vgs6pre4+Vgs6pre5)/5;
Igs6pre = (Igs6pre1+Igs6pre2+Igs6pre3+Igs6pre4+Igs6pre5)/5;
plot(Vgs6pre,Igs6pre,'r','LineWidth',2)
hold on
Vgs61 = (Vgs611+Vgs612+Vgs613+Vgs614+Vgs615)/5;
Igs61 = (Igs611+Igs612+Igs613+Igs614+Igs615)/5;
plot(Vgs61,Igs61,'g','LineWidth',2)
hold on
Vgs62 = (Vgs621+Vgs622+Vgs623+Vgs624+Vgs625)/5;
Igs62 = (Igs621+Igs622+Igs623+Igs624+Igs625)/5;
plot(Vgs62,Igs62,'k','LineWidth',2)
hold on
Vgs6base1 =
(Vgs6base11+Vgs6base12+Vgs6base13+Vgs6base14+Vgs6base15)/5;
Igs6base1 =
(Igs6base11+Igs6base12+Igs6base13+Igs6base14+Igs6base15)/5;
plot(Vgs6base1, Igs6base1,'--b','LineWidth',2)
hold on
Vgs63 = (Vgs631+Vgs632+Vgs633+Vgs634+Vgs635)/5;
Igs63 = (Igs631+Igs632+Igs633+Igs634+Igs635)/5;
plot(Vgs63,Igs63,'m','LineWidth',2)
hold on
Vgs64 = (Vgs641+Vgs642+Vgs643+Vgs644+Vgs645)/5;
Igs64 = (Igs641+Igs642+Igs643+Igs644+Igs645)/5;
plot(Vgs64,Igs64,'c','LineWidth',2)
hold on
Vgs65 = (Vgs651+Vgs652+Vgs653+Vgs654+Vgs655)/5;
Igs65 = (Igs651+Igs652+Igs653+Igs654+Igs655)/5;
plot(Vgs65,Igs65,'b','LineWidth',2)
hold on
Vgs6base2 =
(Vgs6base21+Vgs6base22+Vgs6base23+Vgs6base24+Vgs6base25)/5;
Igs6base2 =
(Igs6base21+Igs6base22+Igs6base23+Igs6base24+Igs6base25)/5;
plot(Vgs6base2, Igs6base2,'--k','LineWidth',2)
hold on
Vgs66 = (Vgs661+Vgs662+Vgs663+Vgs664+Vgs665)/5;
Igs66 = (Igs661+Igs662+Igs663+Igs664+Igs665)/5;
plot(Vgs66,Igs66,'y','LineWidth',2)
hold on
```

```
Vgs67 = (Vgs671+Vgs672+Vgs673+Vgs674+Vgs675)/5;
Igs67 = (Igs671+Igs672+Igs673+Igs674+Igs675)/5;
plot(Vgs67,Igs67,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs6anneal =
(Vgs6anneal1+Vgs6anneal2+Vgs6anneal3+Vgs6anneal4+Vgs6anneal5)/5;
Igs6anneal =
(Igs6anneal1+Igs6anneal2+Igs6anneal3+Igs6anneal4+Igs6anneal5)/5;
plot(Vgs6anneal,Igs6anneal,'--m','LineWidth',2)
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('E120R100 Avg for 5 Devices @ Vgs=6V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,2])
ylim([0 18])
%%
%%Vgs=8V
%Read in .csv file
%part 1
Vgs8pre1 = csvread('E120R100-1-9-prerad.csv',3,9,[3 9 44 9]);
Igs8pre1 = csvread('E120R100-1-9-prerad.csv',3,10,[3 10 44 10]);
Vgs811 = csvread('E120R100-1-1-1stdose.csv',3,9,[3 9 44 9]);
Igs811 = csvread('E120R100-1-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs821 = csvread('E120R100-1-1-2nddose.csv',3,9,[3 9 44 9]);
Igs821 = csvread('E120R100-1-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base11 = csvread('E120R100-1-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base11 = csvread('E120R100-1-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs831 = csvread('E120R100-1-2-3rddose.csv',3,9,[3 9 44 9]);
Igs831 = csvread('E120R100-1-2-3rddose.csv',3,10,[3 10 44 10]);
Vgs841 = csvread('E120R100-1-1-4thdose.csv',3,9,[3 9 44 9]);
Igs841 = csvread('E120R100-1-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs851 = csvread('E120R100-1-1-5thdose.csv',3,9,[3 9 44 9]);
Igs851 = csvread('E120R100-1-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base21= csvread('E120R100-1-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base21 = csvread('E120R100-1-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs861 = csvread('E120R100-1-2-6thdose.csv',3,9,[3 9 44 9]);
Igs861 = csvread('E120R100-1-2-6thdose.csv',3,10,[3 10 44 10]);
Vgs871 = csvread('E120R100-1-1-7thdose.csv',3,9,[3 9 44 9]);
Igs871 = csvread('E120R100-1-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal1 = csvread('E120R100-1-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal1 = csvread('E120R100-1-1-annealing.csv',3,10,[3 10 44
10]);
%part 2
Vgs8pre2 = csvread('E120R100-2-9-prerad.csv',3,9,[3 9 44 9]);
Igs8pre2 = csvread('E120R100-2-9-prerad.csv',3,10,[3 10 44 10]);
Vgs812 = csvread('E120R100-2-1-1stdose.csv',3,9,[3 9 44 9]);
Igs812 = csvread('E120R100-2-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs822 = csvread('E120R100-2-1-2nddose.csv',3,9,[3 9 44 9]);
```

```
Igs822 = csvread('E120R100-2-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base12 = csvread('E120R100-2-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base12 = csvread('E120R100-2-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs832 = csvread('E120R100-2-2-3rddose.csv',3,9,[3 9 44 9]);
Igs832 = csvread('E120R100-2-2-3rddose.csv',3,10,[3 10 44 10]);
Vgs842 = csvread('E120R100-2-1-4thdose.csv',3,9,[3 9 44 9]);
Igs842 = csvread('E120R100-2-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs852 = csvread('E120R100-2-1-5thdose.csv',3,9,[3 9 44 9]);
Igs852 = csvread('E120R100-2-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base22= csvread('E120R100-2-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base22 = csvread('E120R100-2-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs862 = csvread('E120R100-2-1-6thdose.csv',3,9,[3 9 44 9]);
Igs862 = csvread('E120R100-2-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs872 = csvread('E120R100-2-1-7thdose.csv',3,9,[3 9 44 9]);
Igs872 = csvread('E120R100-2-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal2 = csvread('E120R100-2-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal2 = csvread('E120R100-2-1-annealing.csv',3,10,[3 10 44
10]);
%part 3
Vgs8pre3 = csvread('E120R100-3-9-prerad.csv',3,9,[3 9 44 9]);
Igs8pre3 = csvread('E120R100-3-9-prerad.csv',3,10,[3 10 44 10]);
Vgs813 = csvread('E120R100-3-1-1stdose.csv',3,9,[3 9 44 9]);
Igs813 = csvread('E120R100-3-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs823 = csvread('E120R100-3-1-2nddose.csv',3,9,[3 9 44 9]);
Igs823 = csvread('E120R100-3-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base13 = csvread('E120R100-3-5-baseline1.csv',3,9,[3 9 44
9]);
Igs8base13 = csvread('E120R100-3-5-baseline1.csv',3,10,[3 10 44
10]);
Vgs833 = csvread('E120R100-3-3-3rddose.csv',3,9,[3 9 44 9]);
Igs833 = csvread('E120R100-3-3-3rddose.csv',3,10,[3 10 44 10]);
Vgs843 = csvread('E120R100-3-2-4thdose.csv',3,9,[3 9 44 9]);
Igs843 = csvread('E120R100-3-2-4thdose.csv',3,10,[3 10 44 10]);
Vgs853 = csvread('E120R100-3-1-5thdose.csv',3,9,[3 9 44 9]);
Igs853 = csvread('E120R100-3-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base23= csvread('E120R100-3-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base23 = csvread('E120R100-3-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs863 = csvread('E120R100-3-1-6thdose.csv',3,9,[3 9 44 9]);
Igs863 = csvread('E120R100-3-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs873 = csvread('E120R100-3-1-7thdose.csv',3,9,[3 9 44 9]);
Igs873 = csvread('E120R100-3-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal3 = csvread('E120R100-3-2-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal3 = csvread('E120R100-3-2-annealing.csv',3,10,[3 10 44
10]);
%part 4
Vgs8pre4 = csvread('E120R100-4-1-prerad.csv',3,9,[3 9 44 9]);
Igs8pre4 = csvread('E120R100-4-1-prerad.csv',3,10,[3 10 44 10]);
Vgs814 = csvread('E120R100-4-1-1stdose.csv',3,9,[3 9 44 9]);
```

```
Igs814 = csvread('E120R100-4-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs824 = csvread('E120R100-4-1-2nddose.csv',3,9,[3 9 44 9]);
Igs824 = csvread('E120R100-4-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base14 = csvread('E120R100-4-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base14 = csvread('E120R100-4-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs834 = csvread('E120R100-4-1-3rddose.csv',3,9,[3 9 44 9]);
Igs834 = csvread('E120R100-4-1-3rddose.csv',3,10,[3 10 44 10]);
Vgs844 = csvread('E120R100-4-1-4thdose.csv',3,9,[3 9 44 9]);
Igs844 = csvread('E120R100-4-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs854 = csvread('E120R100-4-1-5thdose.csv',3,9,[3 9 44 9]);
Igs854 = csvread('E120R100-4-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base24= csvread('E120R100-4-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base24 = csvread('E120R100-4-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs864 = csvread('E120R100-4-1-6thdose.csv',3,9,[3 9 44 9]);
Igs864 = csvread('E120R100-4-1-6thdose.csv',3,10,[3 10 44 10]);
Vgs874 = csvread('E120R100-4-1-7thdose.csv',3,9,[3 9 44 9]);
Igs874 = csvread('E120R100-4-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal4 = csvread('E120R100-4-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal4 = csvread('E120R100-4-1-annealing.csv',3,10,[3 10 44
10]);
%part 5
Vgs8pre5 = csvread('E120R100-5-1-prerad.csv',3,9,[3 9 44 9]);
Igs8pre5 = csvread('E120R100-5-1-prerad.csv',3,10,[3 10 44 10]);
Vgs815 = csvread('E120R100-5-1-1stdose.csv',3,9,[3 9 44 9]);
Igs815 = csvread('E120R100-5-1-1stdose.csv',3,10,[3 10 44 10]);
Vgs825 = csvread('E120R100-5-1-2nddose.csv',3,9,[3 9 44 9]);
Igs825 = csvread('E120R100-5-1-2nddose.csv',3,10,[3 10 44 10]);
Vgs8base15 = csvread('E120R100-5-1-baseline1.csv',3,9,[3 9 44
9]);
Igs8base15 = csvread('E120R100-5-1-baseline1.csv',3,10,[3 10 44
10]);
Vgs835 = csvread('E120R100-5-1-3rddose.csv',3,9,[3 9 44 9]);
Igs835 = csvread('E120R100-5-1-3rddose.csv',3,10,[3 10 44 10]);
Vgs845 = csvread('E120R100-5-1-4thdose.csv',3,9,[3 9 44 9]);
Igs845 = csvread('E120R100-5-1-4thdose.csv',3,10,[3 10 44 10]);
Vgs855 = csvread('E120R100-5-1-5thdose.csv',3,9,[3 9 44 9]);
Igs855 = csvread('E120R100-5-1-5thdose.csv',3,10,[3 10 44 10]);
Vgs8base25= csvread('E120R100-5-1-baseline2.csv',3,9,[3 9 44 9]);
Igs8base25 = csvread('E120R100-5-1-baseline2.csv',3,10,[3 10 44
10]);
Vgs865 = csvread('E120R100-5-2-6thdose.csv',3,9,[3 9 44 9]);
Igs865 = csvread('E120R100-5-2-6thdose.csv',3,10,[3 10 44 10]);
Vgs875 = csvread('E120R100-5-1-7thdose.csv',3,9,[3 9 44 9]);
Igs875 = csvread('E120R100-5-1-7thdose.csv',3,10,[3 10 44 10]);
Vgs8anneal5 = csvread('E120R100-5-1-annealing.csv',3,9,[3 9 44
9]);
Igs8anneal5 = csvread('E120R100-5-1-annealing.csv',3,10,[3 10 44
10]);

 %plot them against each other
```

```
%subplot(2,3,4)
figure(4)
Vgs8pre = (Vgs8pre1+Vgs8pre2+Vgs8pre3+Vgs8pre4+Vgs8pre5)/5;
Igs8pre = (Igs8pre1+Igs8pre2+Igs8pre3+Igs8pre4+Igs8pre5)/5;
plot(Vgs8pre,Igs8pre,'r','LineWidth',2)
hold on
Vgs81 = (Vgs811+Vgs812+Vgs813+Vgs814+Vgs815)/5;
Igs81 = (Igs811+Igs812+Igs813+Igs814+Igs815)/5;
plot(Vgs81,Igs81,'g','LineWidth',2)
hold on
Vgs82 = (Vgs821+Vgs822+Vgs823+Vgs824+Vgs825)/5;
Igs82 = (Igs821+Igs822+Igs823+Igs824+Igs825)/5;
plot(Vgs82,Igs82,'k','LineWidth',2)
hold on
Vgs8base1 =
(Vgs8base11+Vgs8base12+Vgs8base13+Vgs8base14+Vgs8base15)/5;
Igs8base1 =
(Igs8base11+Igs8base12+Igs8base13+Igs8base14+Igs8base15)/5;
plot(Vgs8base1, Igs8base1,'--b','LineWidth',2)
hold on
Vgs83 = (Vgs831+Vgs832+Vgs833+Vgs834+Vgs835)/5;
Igs83 = (Igs831+Igs832+Igs833+Igs834+Igs835)/5;
plot(Vgs83,Igs83,'m','LineWidth',2)
hold on
Vgs84 = (Vgs841+Vgs842+Vgs843+Vgs844+Vgs845)/5;
Igs84 = (Igs841+Igs842+Igs843+Igs844+Igs845)/5;
plot(Vgs84,Igs84,'c','LineWidth',2)
hold on
Vgs85 = (Vgs851+Vgs852+Vgs853+Vgs854+Vgs855)/5;
Igs85 = (Igs851+Igs852+Igs853+Igs854+Igs855)/5;
plot(Vgs85,Igs85,'b','LineWidth',2)
hold on
Vgs8base2 =
(Vgs8base21+Vgs8base22+Vgs8base23+Vgs8base24+Vgs8base25)/5;
Igs8base2 =
(Igs8base21+Igs8base22+Igs8base23+Igs8base24+Igs8base25)/5;
plot(Vgs8base2, Igs8base2,'--k','LineWidth',2)
hold on
Vgs86 = (Vgs861+Vgs862+Vgs863+Vgs864+Vgs865)/5;
Igs86 = (Igs861+Igs862+Igs863+Igs864+Igs865)/5;
plot(Vgs86,Igs86,'y','LineWidth',2)
hold on
Vgs87 = (Vgs871+Vgs872+Vgs873+Vgs874+Vgs875)/5;
Igs87 = (Igs871+Igs872+Igs873+Igs874+Igs875)/5;
plot(Vgs87,Igs87,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs8anneal =
(Vgs8anneal1+Vgs8anneal2+Vgs8anneal3+Vgs8anneal4+Vgs8anneal5)/5;
Igs8anneal =
(Igs8anneal1+Igs8anneal2+Igs8anneal3+Igs8anneal4+Igs8anneal5)/5;
plot(Vgs8anneal,Igs8anneal,'--m','LineWidth',2)
legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
```

```
title('E120R100 Avgs for 5 Devices @ Vgs=8V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,2])
ylim([0 18])
%%
%%Vgs=10V
%Read in .csv file
%part 1
Vgs10pre1 = csvread('E120R100-1-9-prerad.csv',3,11,[3 11 44 11]);
Igs10pre1 = csvread('E120R100-1-9-prerad.csv',3,12,[3 12 44 12]);
Vgs1011 = csvread('E120R100-1-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1011 = csvread('E120R100-1-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1021 = csvread('E120R100-1-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1021 = csvread('E120R100-1-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base11 = csvread('E120R100-1-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base11 = csvread('E120R100-1-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1031 = csvread('E120R100-1-2-3rddose.csv',3,11,[3 11 44 11]);
Igs1031 = csvread('E120R100-1-2-3rddose.csv',3,12,[3 12 44 12]);
Vgs1041 = csvread('E120R100-1-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1041 = csvread('E120R100-1-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1051 = csvread('E120R100-1-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1051 = csvread('E120R100-1-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base21= csvread('E120R100-1-1-baseline2.csv',3,11,[3 11 44
11]);
Igs10base21 = csvread('E120R100-1-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1061 = csvread('E120R100-1-2-6thdose.csv',3,11,[3 11 44 11]);
Igs1061 = csvread('E120R100-1-2-6thdose.csv',3,12,[3 12 44 12]);
Vgs1071 = csvread('E120R100-1-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1071 = csvread('E120R100-1-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal1 = csvread('E120R100-1-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal1 = csvread('E120R100-1-1-annealing.csv',3,12,[3 12 44
12]);
%part 2
Vgs10pre2 = csvread('E120R100-2-9-prerad.csv',3,11,[3 11 44 11]);
Igs10pre2 = csvread('E120R100-2-9-prerad.csv',3,12,[3 12 44 12]);
Vgs1012 = csvread('E120R100-2-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1012 = csvread('E120R100-2-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1022 = csvread('E120R100-2-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1022 = csvread('E120R100-2-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base12 = csvread('E120R100-2-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base12 = csvread('E120R100-2-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1032 = csvread('E120R100-2-2-3rddose.csv',3,11,[3 11 44 11]);
Igs1032 = csvread('E120R100-2-2-3rddose.csv',3,12,[3 12 44 12]);
Vgs1042 = csvread('E120R100-2-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1042 = csvread('E120R100-2-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1052 = csvread('E120R100-2-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1052 = csvread('E120R100-2-1-5thdose.csv',3,12,[3 12 44 12]);
```

```
Vgs10base22= csvread('E120R100-2-1-baseline2.csv',3,11,[3 11 44
11]);
Igs10base22 = csvread('E120R100-2-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1062 = csvread('E120R100-2-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1062 = csvread('E120R100-2-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1072 = csvread('E120R100-2-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1072 = csvread('E120R100-2-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal2 = csvread('E120R100-2-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal2 = csvread('E120R100-2-1-annealing.csv',3,12,[3 12 44
12]);
%part 3
Vgs10pre3 = csvread('E120R100-3-9-prerad.csv',3,11,[3 11 44 11]);
Igs10pre3 = csvread('E120R100-3-9-prerad.csv',3,12,[3 12 44 12]);
Vgs1013 = csvread('E120R100-3-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1013 = csvread('E120R100-3-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1023 = csvread('E120R100-3-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1023 = csvread('E120R100-3-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base13 = csvread('E120R100-3-5-baseline1.csv',3,11,[3 11 44
11]);
Igs10base13 = csvread('E120R100-3-5-baseline1.csv',3,12,[3 12 44
12]);
Vgs1033 = csvread('E120R100-3-3-3rddose.csv',3,11,[3 11 44 11]);
Igs1033 = csvread('E120R100-3-3-3rddose.csv',3,12,[3 12 44 12]);
Vgs1043 = csvread('E120R100-3-2-4thdose.csv',3,11,[3 11 44 11]);
Igs1043 = csvread('E120R100-3-2-4thdose.csv',3,12,[3 12 44 12]);
Vgs1053 = csvread('E120R100-3-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1053 = csvread('E120R100-3-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base23= csvread('E120R100-3-1-baseline2.csv',3,11,[3 11 44
11]);
Igs10base23 = csvread('E120R100-3-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1063 = csvread('E120R100-3-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1063 = csvread('E120R100-3-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1073 = csvread('E120R100-3-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1073 = csvread('E120R100-3-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal3 = csvread('E120R100-3-2-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal3 = csvread('E120R100-3-2-annealing.csv',3,12,[3 12 44
12]);
%part 4
Vgs10pre4 = csvread('E120R100-4-1-prerad.csv',3,11,[3 11 44 11]);
Igs10pre4 = csvread('E120R100-4-1-prerad.csv',3,12,[3 12 44 12]);
Vgs1014 = csvread('E120R100-4-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1014 = csvread('E120R100-4-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1024 = csvread('E120R100-4-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1024 = csvread('E120R100-4-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base14 = csvread('E120R100-4-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base14 = csvread('E120R100-4-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1034 = csvread('E120R100-4-1-3rddose.csv',3,11,[3 11 44 11]);
Igs1034 = csvread('E120R100-4-1-3rddose.csv',3,12,[3 12 44 12]);
```

```
Vgs1044 = csvread('E120R100-4-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1044 = csvread('E120R100-4-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1054 = csvread('E120R100-4-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1054 = csvread('E120R100-4-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base24= csvread('E120R100-4-1-baseline2.csv',3,11,[3 11 44
11]);
Igs10base24 = csvread('E120R100-4-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1064 = csvread('E120R100-4-1-6thdose.csv',3,11,[3 11 44 11]);
Igs1064 = csvread('E120R100-4-1-6thdose.csv',3,12,[3 12 44 12]);
Vgs1074 = csvread('E120R100-4-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1074 = csvread('E120R100-4-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal4 = csvread('E120R100-4-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal4 = csvread('E120R100-4-1-annealing.csv',3,12,[3 12 44
12]);
%part 5
Vgs10pre5 = csvread('E120R100-5-1-prerad.csv',3,11,[3 11 44 11]);
Igs10pre5 = csvread('E120R100-5-1-prerad.csv',3,12,[3 12 44 12]);
Vgs1015 = csvread('E120R100-5-1-1stdose.csv',3,11,[3 11 44 11]);
Igs1015 = csvread('E120R100-5-1-1stdose.csv',3,12,[3 12 44 12]);
Vgs1025 = csvread('E120R100-5-1-2nddose.csv',3,11,[3 11 44 11]);
Igs1025 = csvread('E120R100-5-1-2nddose.csv',3,12,[3 12 44 12]);
Vgs10base15 = csvread('E120R100-5-1-baseline1.csv',3,11,[3 11 44
11]);
Igs10base15 = csvread('E120R100-5-1-baseline1.csv',3,12,[3 12 44
12]);
Vgs1035 = csvread('E120R100-5-1-3rddose.csv',3,11,[3 11 44 11]);
Igs1035 = csvread('E120R100-5-1-3rddose.csv',3,12,[3 12 44 12]);
Vgs1045 = csvread('E120R100-5-1-4thdose.csv',3,11,[3 11 44 11]);
Igs1045 = csvread('E120R100-5-1-4thdose.csv',3,12,[3 12 44 12]);
Vgs1055 = csvread('E120R100-5-1-5thdose.csv',3,11,[3 11 44 11]);
Igs1055 = csvread('E120R100-5-1-5thdose.csv',3,12,[3 12 44 12]);
Vgs10base25= csvread('E120R100-5-1-baseline2.csv',3,11,[3 11 44
11]);
Igs10base25 = csvread('E120R100-5-1-baseline2.csv',3,12,[3 12 44
12]);
Vgs1065 = csvread('E120R100-5-2-6thdose.csv',3,11,[3 11 44 11]);
Igs1065 = csvread('E120R100-5-2-6thdose.csv',3,12,[3 12 44 12]);
Vgs1075 = csvread('E120R100-5-1-7thdose.csv',3,11,[3 11 44 11]);
Igs1075 = csvread('E120R100-5-1-7thdose.csv',3,12,[3 12 44 12]);
Vgs10anneal5 = csvread('E120R100-5-1-annealing.csv',3,11,[3 11 44
11]);
Igs10anneal5 = csvread('E120R100-5-1-annealing.csv',3,12,[3 12 44
12]);

 %plot them against each other
%subplot(2,3,5)
figure(5)
Vgs10pre = (Vgs10pre1+Vgs10pre2+Vgs10pre3+Vgs10pre4+Vgs10pre5)/5;
Igs10pre = (Igs10pre1+Igs10pre2+Igs10pre3+Igs10pre4+Igs10pre5)/5;
plot(Vgs10pre,Igs10pre,'r','LineWidth',2)
hold on
Vgs101 = (Vgs1011+Vgs1012+Vgs1013+Vgs1014+Vgs1015)/5;
```

```
Igs101 = (Igs1011+Igs1012+Igs1013+Igs1014+Igs1015)/5;
plot(Vgs101,Igs101,'g','LineWidth',2)
hold on
Vgs102 = (Vgs1021+Vgs1022+Vgs1023+Vgs1024+Vgs1025)/5;
Igs102 = (Igs1021+Igs1022+Igs1023+Igs1024+Igs1025)/5;
plot(Vgs102,Igs102,'k','LineWidth',2)
hold on
Vgs10base1 =
(Vgs10base11+Vgs10base12+Vgs10base13+Vgs10base14+Vgs10base15)/5;
Igs10base1 =
(Igs10base11+Igs10base12+Igs10base13+Igs10base14+Igs10base15)/5;
plot(Vgs10base1, Igs10base1,'--b','LineWidth',2)
hold on
Vgs103 = (Vgs1031+Vgs1032+Vgs1033+Vgs1034+Vgs1035)/5;
Igs103 = (Igs1031+Igs1032+Igs1033+Igs1034+Igs1035)/5;
plot(Vgs103,Igs103,'m','LineWidth',2)
hold on
Vgs104 = (Vgs1041+Vgs1042+Vgs1043+Vgs1044+Vgs1045)/5;
Igs104 = (Igs1041+Igs1042+Igs1043+Igs1044+Igs1045)/5;
plot(Vgs104,Igs104,'c','LineWidth',2)
hold on
Vgs105 = (Vgs1051+Vgs1052+Vgs1053+Vgs1054+Vgs1055)/5;
Igs105 = (Igs1051+Igs1052+Igs1053+Igs1054+Igs1055)/5;
plot(Vgs105,Igs105,'b','LineWidth',2)
hold on
Vgs10base2 =
(Vgs10base21+Vgs10base22+Vgs10base23+Vgs10base24+Vgs10base25)/5;
Igs10base2 =
(Igs10base21+Igs10base22+Igs10base23+Igs10base24+Igs10base25)/5;
plot(Vgs10base2, Igs10base2,'--k','LineWidth',2)
hold on
Vgs106 = (Vgs1061+Vgs1062+Vgs1063+Vgs1064+Vgs1065)/5;
Igs106 = (Igs1061+Igs1062+Igs1063+Igs1064+Igs1065)/5;
plot(Vgs106,Igs106,'y','LineWidth',2)
hold on
Vgs107 = (Vgs1071+Vgs1072+Vgs1073+Vgs1074+Vgs1075)/5;
Igs107 = (Igs1071+Igs1072+Igs1073+Igs1074+Igs1075)/5;
plot(Vgs107,Igs107,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs10anneal =
(Vgs10anneal1+Vgs10anneal2+Vgs10anneal3+Vgs10anneal4+Vgs10anneal5
)/5;
Igs10anneal =
(Igs10anneal1+Igs10anneal2+Igs10anneal3+Igs10anneal4+Igs10anneal5
)/5;
plot(Vgs10anneal,Igs10anneal,'--m','LineWidth',2)

legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('E120R100 Avgs of 5 Devices @ Vgs=10V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,2])
```

```
ylim([0 18])


%%
%%Vgs=12V
%Read in .csv file
%Part 1
Vgs12pre1 = csvread('E120R100-1-9-prerad.csv',3,13,[3 13 44 13]);
Igs12pre1 = csvread('E120R100-1-9-prerad.csv',3,14,[3 14 44 14]);
Vgs1211 = csvread('E120R100-1-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1211 = csvread('E120R100-1-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1221 = csvread('E120R100-1-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1221 = csvread('E120R100-1-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base11 = csvread('E120R100-1-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base11 = csvread('E120R100-1-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1231 = csvread('E120R100-1-2-3rddose.csv',3,13,[3 13 44 13]);
Igs1231 = csvread('E120R100-1-2-3rddose.csv',3,14,[3 14 44 14]);
Vgs1241 = csvread('E120R100-1-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1241 = csvread('E120R100-1-1-4thdose.csv',3,14,[3 14 44 14]);
Vgs1251 = csvread('E120R100-1-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1251 = csvread('E120R100-1-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base21= csvread('E120R100-1-1-baseline2.csv',3,13,[3 13 44
13]);
Igs12base21 = csvread('E120R100-1-1-baseline2.csv',3,14,[3 14 44
14]);
Vgs1261 = csvread('E120R100-1-2-6thdose.csv',3,13,[3 13 44 13]);
Igs1261 = csvread('E120R100-1-2-6thdose.csv',3,14,[3 14 44 14]);
Vgs1271 = csvread('E120R100-1-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1271 = csvread('E120R100-1-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal1 = csvread('E120R100-1-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal1 = csvread('E120R100-1-1-annealing.csv',3,14,[3 14 44
14]);
%part 2
Vgs12pre2 = csvread('E120R100-2-9-prerad.csv',3,13,[3 13 44 13]);
Igs12pre2 = csvread('E120R100-2-9-prerad.csv',3,14,[3 14 44 14]);
Vgs1212 = csvread('E120R100-2-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1212 = csvread('E120R100-2-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1222 = csvread('E120R100-2-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1222 = csvread('E120R100-2-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base12 = csvread('E120R100-2-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base12 = csvread('E120R100-2-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1232 = csvread('E120R100-2-2-3rddose.csv',3,13,[3 13 44 13]);
Igs1232 = csvread('E120R100-2-2-3rddose.csv',3,14,[3 14 44 14]);
Vgs1242 = csvread('E120R100-2-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1242 = csvread('E120R100-2-1-4thdose.csv',3,14,[3 14 44 14]);
Vgs1252 = csvread('E120R100-2-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1252 = csvread('E120R100-2-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base22 = csvread('E120R100-2-1-baseline2.csv',3,13,[3 13 44
13]);
```

```
Igs12base22 = csvread('E120R100-2-1-baseline2.csv',3,14,[3 14 44
14]);
Vgs1262 = csvread('E120R100-2-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1262 = csvread('E120R100-2-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1272 = csvread('E120R100-2-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1272 = csvread('E120R100-2-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal2 = csvread('E120R100-2-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal2 = csvread('E120R100-2-1-annealing.csv',3,14,[3 14 44
14]);
%part 3
Vgs12pre3 = csvread('E120R100-3-9-prerad.csv',3,13,[3 13 44 13]);
Igs12pre3 = csvread('E120R100-3-9-prerad.csv',3,14,[3 14 44 14]);
Vgs1213 = csvread('E120R100-3-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1213 = csvread('E120R100-3-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1223 = csvread('E120R100-3-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1223 = csvread('E120R100-3-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base13 = csvread('E120R100-3-5-baseline1.csv',3,13,[3 13 44
13]);
Igs12base13 = csvread('E120R100-3-5-baseline1.csv',3,14,[3 14 44
14]);
Vgs1233 = csvread('E120R100-3-3-3rddose.csv',3,13,[3 13 44 13]);
Igs1233 = csvread('E120R100-3-3-3rddose.csv',3,14,[3 14 44 14]);
Vgs1243 = csvread('E120R100-3-2-4thdose.csv',3,13,[3 13 44 13]);
Igs1243 = csvread('E120R100-3-2-4thdose.csv',3,14,[3 14 44 14]);
Vgs1253 = csvread('E120R100-3-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1253 = csvread('E120R100-3-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base23= csvread('E120R100-3-1-baseline2.csv',3,13,[3 13 44
13]);
Igs12base23 = csvread('E120R100-3-1-baseline2.csv',3,14,[3 14 44
14]);
Vgs1263 = csvread('E120R100-3-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1263 = csvread('E120R100-3-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1273 = csvread('E120R100-3-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1273 = csvread('E120R100-3-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal3 = csvread('E120R100-3-2-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal3 = csvread('E120R100-3-2-annealing.csv',3,14,[3 14 44
14]);
%part 4
Vgs12pre4 = csvread('E120R100-4-1-prerad.csv',3,13,[3 13 44 13]);
Igs12pre4 = csvread('E120R100-4-1-prerad.csv',3,14,[3 14 44 14]);
Vgs1214 = csvread('E120R100-4-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1214 = csvread('E120R100-4-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1224 = csvread('E120R100-4-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1224 = csvread('E120R100-4-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base14 = csvread('E120R100-4-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base14 = csvread('E120R100-4-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1234 = csvread('E120R100-4-1-3rddose.csv',3,13,[3 13 44 13]);
Igs1234 = csvread('E120R100-4-1-3rddose.csv',3,14,[3 14 44 14]);
Vgs1244 = csvread('E120R100-4-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1244 = csvread('E120R100-4-1-4thdose.csv',3,14,[3 14 44 14]);
```

```
Vgs1254 = csvread('E120R100-4-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1254 = csvread('E120R100-4-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base24= csvread('E120R100-4-1-baseline2.csv',3,13,[3 13 44
13]);
Igs12base24 = csvread('E120R100-4-1-baseline2.csv',3,14,[3 14 44
14]);
Vgs1264 = csvread('E120R100-4-1-6thdose.csv',3,13,[3 13 44 13]);
Igs1264 = csvread('E120R100-4-1-6thdose.csv',3,14,[3 14 44 14]);
Vgs1274 = csvread('E120R100-4-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1274 = csvread('E120R100-4-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal4 = csvread('E120R100-4-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal4 = csvread('E120R100-4-1-annealing.csv',3,14,[3 14 44
14]);
%part 5
Vgs12pre5 = csvread('E120R100-5-1-prerad.csv',3,13,[3 13 44 13]);
Igs12pre5 = csvread('E120R100-5-1-prerad.csv',3,14,[3 14 44 14]);
Vgs1215 = csvread('E120R100-5-1-1stdose.csv',3,13,[3 13 44 13]);
Igs1215 = csvread('E120R100-5-1-1stdose.csv',3,14,[3 14 44 14]);
Vgs1225 = csvread('E120R100-5-1-2nddose.csv',3,13,[3 13 44 13]);
Igs1225 = csvread('E120R100-5-1-2nddose.csv',3,14,[3 14 44 14]);
Vgs12base15 = csvread('E120R100-5-1-baseline1.csv',3,13,[3 13 44
13]);
Igs12base15 = csvread('E120R100-5-1-baseline1.csv',3,14,[3 14 44
14]);
Vgs1235 = csvread('E120R100-5-1-3rddose.csv',3,13,[3 13 44 13]);
Igs1235 = csvread('E120R100-5-1-3rddose.csv',3,14,[3 14 44 14]);
Vgs1245 = csvread('E120R100-5-1-4thdose.csv',3,13,[3 13 44 13]);
Igs1245 = csvread('E120R100-5-1-4thdose.csv',3,14,[3 14 44 14]);
Vgs1255 = csvread('E120R100-5-1-5thdose.csv',3,13,[3 13 44 13]);
Igs1255 = csvread('E120R100-5-1-5thdose.csv',3,14,[3 14 44 14]);
Vgs12base25= csvread('E120R100-5-1-baseline2.csv',3,13,[3 13 44
13]);
Igs12base25 = csvread('E120R100-5-1-baseline2.csv',3,14,[3 14 44
14]);
Vgs1265 = csvread('E120R100-5-2-6thdose.csv',3,13,[3 13 44 13]);
Igs1265 = csvread('E120R100-5-2-6thdose.csv',3,14,[3 14 44 14]);
Vgs1275 = csvread('E120R100-5-1-7thdose.csv',3,13,[3 13 44 13]);
Igs1275 = csvread('E120R100-5-1-7thdose.csv',3,14,[3 14 44 14]);
Vgs12anneal5 = csvread('E120R100-5-1-annealing.csv',3,13,[3 13 44
13]);
Igs12anneal5 = csvread('E120R100-5-1-annealing.csv',3,14,[3 14 44
14]);

 %plot them against each other
figure(6)
%set(hfig,'Units','Normalized','OuterPosition',[0 0 1 1]);
%subplot(2,3,1)
Vgs12pre = (Vgs12pre1+Vgs12pre2+Vgs12pre3+Vgs12pre4+Vgs12pre5)/5;
Igs12pre = (Igs12pre1+Igs12pre2+Igs12pre3+Igs12pre4+Igs12pre5)/5;
plot(Vgs12pre,Igs12pre,'r','LineWidth',2)
hold on
Vgs121 = (Vgs1211+Vgs1212+Vgs1213+Vgs1214+Vgs1215)/5;
Igs121 = (Igs1211+Igs1212+Igs1213+Igs1214+Igs1215)/5;
```

```
plot(Vgs121,Igs121,'g','LineWidth',2)
hold on
Vgs122 = (Vgs1221+Vgs1222+Vgs1223+Vgs1224+Vgs1225)/5;
Igs122 = (Igs1221+Igs1222+Igs1223+Igs1224+Igs1225)/5;
plot(Vgs122,Igs122,'k','LineWidth',2)
hold on
Vgs12base1 =
(Vgs12base11+Vgs12base12+Vgs12base13+Vgs12base14+Vgs12base15)/5;
Igs12base1 =
(Igs12base11+Igs12base12+Igs12base13+Igs12base14+Igs12base15)/5;
plot(Vgs12base1, Igs12base1,'--b','LineWidth',2)
hold on
Vgs123 = (Vgs1231+Vgs1232+Vgs1233+Vgs1234+Vgs1235)/5;
Igs123 = (Igs1231+Igs1232+Igs1233+Igs1234+Igs1235)/5;
plot(Vgs123,Igs123,'m','LineWidth',2)
hold on
Vgs124 = (Vgs1241+Vgs1242+Vgs1243+Vgs1244+Vgs1245)/5;
Igs124 = (Igs1241+Igs1242+Igs1243+Igs1244+Igs1245)/5;
plot(Vgs124,Igs124,'c','LineWidth',2)
hold on
Vgs125 = (Vgs1251+Vgs1252+Vgs1253+Vgs1254+Vgs1255)/5;
Igs125 = (Igs1251+Igs1252+Igs1253+Igs1254+Igs1255)/5;
plot(Vgs125,Igs125,'b','LineWidth',2)
hold on
Vgs12base2 =
(Vgs12base21+Vgs12base22+Vgs12base23+Vgs12base24+Vgs12base25)/5;
Igs12base2 =
(Igs12base21+Igs12base22+Igs12base23+Igs12base24+Igs12base25)/5;
plot(Vgs2base2, Igs2base2,'--k','LineWidth',2)
hold on
Vgs126 = (Vgs1261+Vgs1262+Vgs1263+Vgs1264+Vgs1265)/5;
Igs126 = (Igs1261+Igs1262+Igs1263+Igs1264+Igs1265)/5;
plot(Vgs126,Igs126,'y','LineWidth',2)
hold on
Vgs127 = (Vgs1271+Vgs1272+Vgs1273+Vgs1274+Vgs1275)/5;
Igs127 = (Igs1271+Igs1272+Igs1273+Igs1274+Igs1275)/5;
plot(Vgs127,Igs127,'LineWidth',2,'Color',[.6 0 0])
hold on
Vgs12anneal =
(Vgs12anneal1+Vgs12anneal2+Vgs12anneal3+Vgs12anneal4+Vgs12anneal5
)/5;
Igs12anneal =
(Igs12anneal1+Igs12anneal2+Igs12anneal3+Igs12anneal4+Igs12anneal5
)/5;
plot(Vgs12anneal,Igs12anneal,'--m','LineWidth',2)

legend('Pre-rad','1st dose','2nd dose','Baseline 1','3rd
dose','4th dose','5th dose','Baseline 2','6th dose','7th
dose','Anneal')
title('E120R100 Avgs for 5 Devices @ Vgs=12V')
xlabel('Voltage (V)')
ylabel('Current (A)')
xlim([0,2])
ylim([0 18])
```