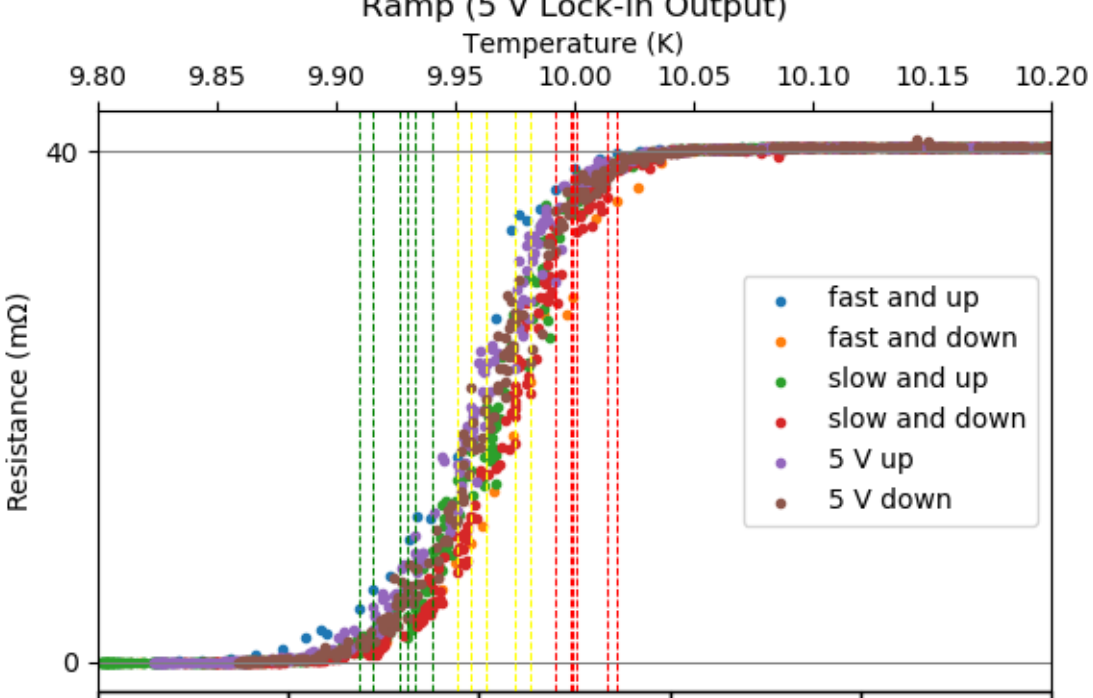

fast and up	$T_{10} = 9.909$	$T_{50} = 9.951$	$T_{90} = 9.992$	$T_{90} - T_{10} = 0.082$
fast and down	$T_{10} = 9.930$	$T_{50} = 9.982$	$T_{90} = 10.018$	$T_{90} - T_{10} = 0.088$
slow and up	$T_{10} = 9.933$	$T_{50} = 9.963$	$T_{90} = 9.998$	$T_{90} - T_{10} = 0.065$
slow and down	$T_{10} = 9.940$	$T_{50} = 9.975$	$T_{90} = 10.013$	$T_{90} - T_{10} = 0.073$
5 V up	$T_{10} = 9.915$	$T_{50} = 9.957$	$T_{90} = 9.999$	$T_{90} - T_{10} = 0.084$
5 V down	$T_{10} = 9.927$	$T_{50} = 9.963$	$T_{90} = 10.000$	$T_{90} - T_{10} = 0.074$

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd

temps = []
rows=[]
class voltemp:
    def __init__(self, filename):
        df = pd.read_csv(filename)
        self.times = np.array(df['Time (s)'])
        self.temps = np.array(df['Temperature (K)'])
        self.amps = np.array(1050*1000*df['Amplitude (V)'])

    def plot(self, ax, label):
        ax.scatter(self.temps, self.amps, label=label, marker='.')
        r1 = np.max(self.amps)
        r0 = np.min(self.amps)

        t10i = np.argmin(abs(self.amps - 0.1*r1))
        t10 = self.temps[t10i]
        ax.axvline(t10, linestyle = '--', linewidth=0.75,color = 'green')

        t50i = np.argmin(abs(self.amps - 0.5*r1))
        t50 = self.temps[t50i]
        ax.axvline(t50, linestyle = '--', linewidth=0.75,color='yellow')

        t90i = np.argmin(abs(self.amps - 0.9*r1))
        t90 = self.temps[t90i]
        ax.axvline(t90, linestyle = '--',linewidth=0.75,color='red')

        global temps
        temps.append([t10,t50,t90])
        global rows
        rows.append([label,r'$T_{10}=%.3f$'%t10,r'$T_{50}=%.3f$'%t50,r'$T_{90}=%.3f$'%t90,r'$T_{90}-T_{10}=%.3f$


fig, ax = plt.subplots()
plt.subplots_adjust(bottom=0.25)
ticks = [0,40]
ax.set_yticks(ticks)
for tick in ticks: ax.axhline(tick,color='grey',linewidth=0.75)
ax.set_xlim(9.8,10.2)
ax.set_title('Ramp (5 V Lock-In Output)')
ax.set_xlabel('Temperature (K)')
ax.xaxis.tick_top()
ax.xaxis.set_label_position('top')
ax.set_ylabel(r'Resistance (m$\Omega$)')

rampu = voltemp('rampu.csv')
rampd = voltemp('rampd.csv')
srampu = voltemp('srampu2.csv')
srampd = voltemp('srampd.csv')

rampu.plot(ax, 'fast and up')
rampd.plot(ax, 'fast and down')
srampu.plot(ax, 'slow and up')
srampd.plot(ax, 'slow and down')


vrampu = voltemp('5Vsrampu.csv')
vrampu.amps /= 5
vrampd = voltemp('5Vsrampd.csv')
vrampd.amps /=5

vrampu.plot(ax, '5 V up')
vrampd.plot(ax, '5 V down')

plt.table(cellText=rows,cellLoc='left')
plt.legend()
fig.savefig('./images/superchl.png')
```

```
plt.show()
```