


```

ax2.set_xlabel("F (Hz)", fontsize=20)
ax2.set_ylabel("-Phase (°)", fontsize=20)
ax2.grid(color='lightgrey', linestyle='-', linewidth=0.5)
ax2.set_title('Phase vs Frequency', fontsize = 16)

#Create the Rs, Rct, and C canvas (1 row, 3 columns)
fig2, (ax3, ax4, ax5) = plt.subplots(1, 3, figsize=(21, 7), constrained_layout=True)

ax3.set_xlabel("Day", fontsize=20)
ax3.set_ylabel("Rs (Ω)", fontsize=20)
ax3.grid(color='lightgrey', linestyle='-', linewidth=0.5)
ax3.set_title('Surface Resistance', fontsize = 16)

ax4.set_xlabel("Day", fontsize=20)
ax4.set_ylabel("Rct (Ω)", fontsize=20)
ax4.grid(color='lightgrey', linestyle='-', linewidth=0.5)
ax4.set_title('Charge Transfer Resistance', fontsize = 16)

ax5.set_xlabel("Day", fontsize=20)
ax5.set_ylabel("C (F)", fontsize=20)
ax5.grid(color='lightgrey', linestyle='-', linewidth=0.5)
ax5.set_title('Capacitance', fontsize = 16)

i = 0
j = 0
day_idx = 0

#Distinguish mutual vs shunt (mutual has dry, shunt doesn't)
if date_list[0] == "dry":
    start = date_list[1]
else:
    start = date_list[0]

start = self.getDatetime(start)

day_actual_list = []

while j < len(df):
    #iterate over df
    i += 1 # ith is Title, Data starts from i+1
    j = i + 25
    x_freq = df.iloc[i:j,0].astype(float) #frequency
    y_imped = df.iloc[i:j,1].astype(float) #impedance
    y_phase = df.iloc[i:j,2].astype(float) #phase
    date = date_list[day_idx]

    if date == "dry":
        # The device is mutual
        prefix = "Day-0 (dry)"
        day_actual_list.append(0)
    else:
        # The device is shunt
        date = self.getDatetime(date)
        day_diff = date - start
        day_actual = self.getActualDates(day_diff.days, 70.5, 37.0)

        if day_diff.days == 0:
            prefix = "Day-0 (wet)"
        else:
            prefix = "Day-0 (" + str(day_diff.days) + " (" + str(day_actual) + ")"

        date = date_list[day_idx]
        day_actual_list.append(1 + day_actual)

    # Graph 1: Impedance Z(Ω) vs Frequency(Hz) - labeled by dates
    ax1.plot(x_freq, y_imped, 'o-', label = prefix)

    # Graph 2: -Phase(°) vs Frequency(Hz) - labeled by dates
    ax2.plot(x_freq, y_phase, 'o-', label = prefix)

    i = j
    day_idx += 1

if 'm' in file:
    df_open = pd.read_csv("m-open.csv")
    df_short = pd.read_csv("m-wet-short.csv")
elif 's' in file:
    df_open = pd.read_csv("s-open.csv")
    df_short = pd.read_csv("s-wet-short.csv")

x_freq_open = df_open.iloc[:, 0].astype(float) #frequency
y_imped_open = df_open.iloc[:, 1].astype(float) #impedance
y_phase_open = df_open.iloc[:, 2].astype(float) #phase

x_freq_short = df_short.iloc[:, 0].astype(float) #frequency
y_imped_short = df_short.iloc[:, 1].astype(float) #impedance
y_phase_short = df_short.iloc[:, 2].astype(float) #phase

print(y_imped_open.values)
print(y_imped_short.values)

# Get the threshold of open and short for shunt
ax1.plot(x_freq_open, y_imped_open, '^', label = "Open", color= 'black')
ax1.plot(x_freq_short, y_imped_short, '^', label = "Short", color= 'black')

ax2.plot(x_freq_open, y_phase_open, '^', label = "Open", color= 'black')
ax2.plot(x_freq_short, y_phase_short, '^', label = "Short", color= 'black')

ax3.plot(day_actual_list, Rs, marker='o')

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ax4.plot(day_actual_list, Rct, marker='o')
ax5.plot(day_actual_list, C, marker='o')

ax1.legend(loc='upper right', fontsize = 15)
ax2.legend(loc='upper right', fontsize = 15)

for label in (ax1.get_xticklabels() + ax1.get_yticklabels()):
    label.set_fontsize(16)
for label in (ax2.get_xticklabels() + ax2.get_yticklabels()):
    label.set_fontsize(16)
for label in (ax3.get_xticklabels() + ax3.get_yticklabels()):
    label.set_fontsize(16)
for label in (ax4.get_xticklabels() + ax4.get_yticklabels()):
    label.set_fontsize(16)
for label in (ax5.get_xticklabels() + ax5.get_yticklabels()):
    label.set_fontsize(16)

ax4.yaxis.offsetText.set_fontsize(16)
ax5.yaxis.offsetText.set_fontsize(16)

# Extract impedance only at 1K Hz.
self.plot_impe_freq(file, df, [1000, 100, 215.44, 10000], day_actual_list)

plt.show()
return None

def extractImped(self, df, freq):
    """
    Extract certain freq's impedance result for Z/Z0 ratio.
    df: Panda dataframe, from data file e.g 12-8-m.csv
    freq: int, wanted frequency
    """
    impe_freq = []
    for idx, row, in df.iterrows():
        # idx is the index of the row
        # row is a Series: Frequency f = row[0], Impedance Z = row[1], -Phase = row[2]
        # Resistance Rs = row[3], Rct = row[4], Capacitance C = row[5]
        if "Frequency" not in row[0]:
            if float(row[0]) == freq:
                impe_freq.append(float(row[1]))
    return impe_freq

def plot_impe_freq(self, file, df, freq_list, day_actual_list):
    """
    file: the file name
    df: Panda dataframe, from data file e.g 12-8-m.csv
    freq_list: list of frequency we want to compare.
    """
    # Plot impedance change with respect to time
    fig, (ax1, ax2, ax3) = plt.subplots(1, 3, figsize=(21, 7), constrained_layout=True)
    ax1.set_xlabel("Day", fontsize=20)
    ax1.set_ylabel("Z (Ω)", fontsize=20)
    ax1.grid(color='lightgrey', linestyle='-', linewidth=0.5)
    ax1.set_title('Impedance Change At Different Frequency', fontsize = 16)

    ax2.set_xlabel("Day", fontsize=20)
    ax2.set_ylabel("Z / Z0", fontsize=20)
    ax2.grid(color='lightgrey', linestyle='-', linewidth=0.5)
    ax2.set_title('Impedance Change At 1000 Hz, IDE Specific Criteria', fontsize = 16)

    ax3.set_xlabel("Day", fontsize=20)
    ax3.set_ylabel("Z / Z0", fontsize=20)
    ax3.grid(color='lightgrey', linestyle='-', linewidth=0.5)
    ax3.set_title('Impedance Change At 1000 Hz, Universal Criteria', fontsize = 16)

    imped_freq_1K = []
    ratio = []
    GLOBAL_ratio = []

    for freq in freq_list:
        imped_freq = self.extractImped(df, freq)
        if freq == 1000:
            imped_freq_1K = imped_freq
            ax1.plot(day_actual_list, imped_freq, label = str(freq) + " Hz", marker='o')

    if 'm' in file:
        start_wet = imped_freq_1K[1]
        GLOBAL_Z0_m_dry.append(imped_freq_1K[0])
        GLOBAL_Z0_m_wet.append(start_wet)
    elif 's' in file:
        start_wet = imped_freq_1K[0]
        GLOBAL_Z0_s_wet.append(start_wet)

    for imped in imped_freq_1K:
        ratio.append(imped / start_wet)
        GLOBAL_ratio.append(imped / GLOBAL_wet)

    ax2.plot(day_actual_list, ratio, label = "1000 Hz", marker='o')
    ax2.axhline(y = 1, label = "1", color = 'r', linestyle='dotted')
    ax2.axhline(y = 1.2, label = "1.2", color = 'b', linestyle='dotted')
    ax2.axhline(y = 0.33, label = "0.33", color = 'g', linestyle='dotted')

    ax3.plot(day_actual_list, GLOBAL_ratio, label = "1000 Hz", marker='o')
    ax3.axhline(y = 1, label = "1", color = 'r', linestyle='dotted')
    ax3.axhline(y = 1.2, label = "1.2", color = 'b', linestyle='dotted')
    ax3.axhline(y = 0.33, label = "0.33", color = 'g', linestyle='dotted')

    for label in (ax1.get_xticklabels() + ax1.get_yticklabels()):
        label.set_fontsize(16)

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for label in (ax2.get_xticklabels() + ax2.get_yticklabels()):
    label.set_fontsize(16)
for label in (ax3.get_xticklabels() + ax3.get_yticklabels()):
    label.set_fontsize(16)

ax1.yaxis.offsetText.set_fontsize(16)

ax1.legend(loc='upper right', fontsize = 20)
ax2.legend(loc='upper right', fontsize = 20)
ax3.legend(loc='upper right', fontsize = 20)

plt.show()
print('\n\n')

def getRC(self, df, value):
    """
    Get the table of R / C over time
    df: Panda dataframe
    value: Rs, Rct, or C
    """
    data = []
    idx = 0

    if value == "Rs":
        idx = 3
    if value == "Rct":
        idx = 4
    if value == "C":
        idx = 5
    # remove strings

    j = 1
    while j <= len(df):
        data.append(float(df.iloc[j, idx]))
        j = j + 26
    return data

def getActualDates(self, day_diff, room_temp, device_temp):
    """
    Convert experimental dates to real dates.

    day_diff: day, number of days since Day-0-wet
    room_temp: C°, room temperature
    device_temp: C°, device temperature
    """
    # Accelerated Aging Test Formula
    exp = (room_temp - device_temp)/10.0
    factor = 2**exp
    day_real = day_diff * factor
    return int(day_real)

def getDatetime(self, m_d_y):
    """
    Convert a string time to a datetime variable to get date difference.
    m_d_y: a string in month, day, year format
    """
    #print(m_d_y)
    time_list = str(m_d_y).split("/")
    #print(time_list)
    date = datetime.date(2022, int(time_list[0]), int(time_list[1]))
    return date

def addNewIDE(start, end):
    """
    Create a list of new IDE with names.
    start: the start number of IDE
    end: the end number of IDE
    """
    L = []
    for i in range(start, end):
        L.append(str(i) + "-2-m")
        L.append(str(i) + "-2-s")
        L.append(str(i) + "-4-m")
        L.append(str(i) + "-4-s")
        L.append(str(i) + "-8-m")
        L.append(str(i) + "-8-s")
        L.append(str(i) + "-16-m")
        L.append(str(i) + "-16-s")

    df_new_IDE = pd.DataFrame(L, columns=['new IDE name'])

    #Export a csv file with new IDEs
    df_new_IDE.to_csv("new_IDE.csv", index=False)
    return df_new_IDE

Matplotlib Version 3.3.4

```

```

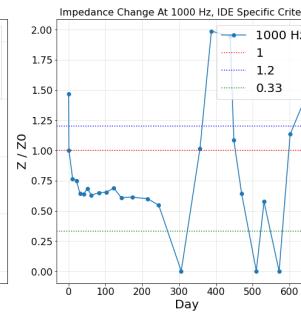
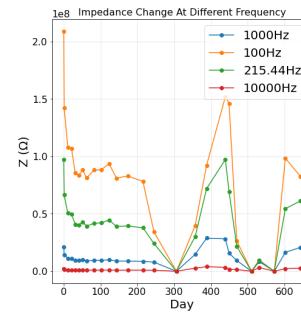
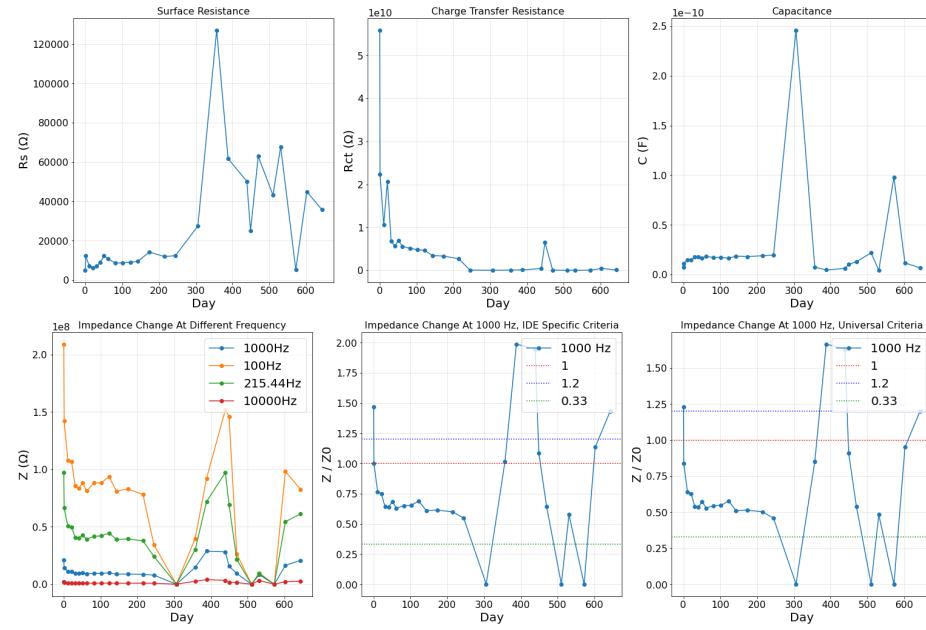
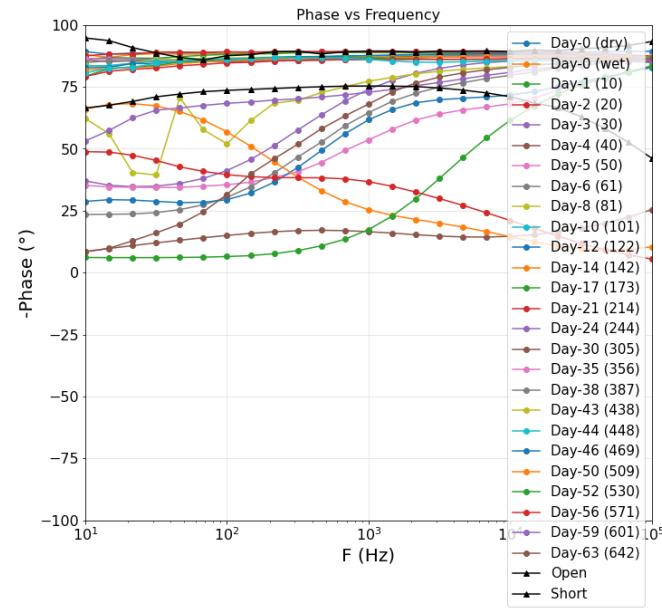
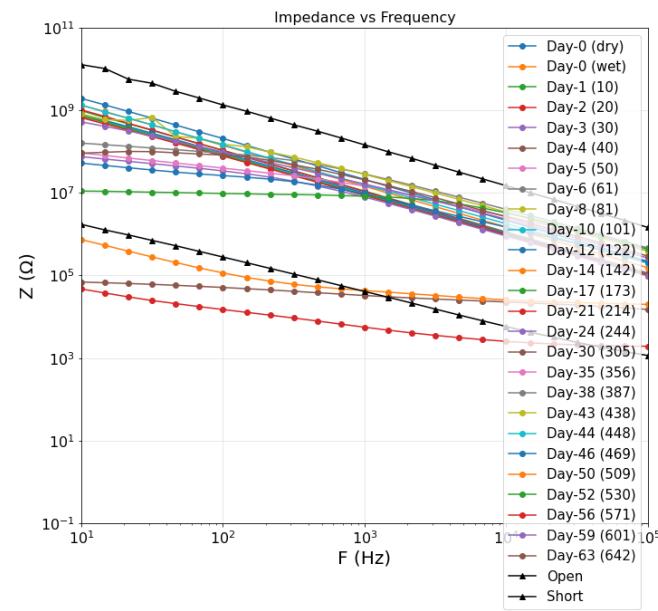
In [2]: # Step 2: Initialize tested IDEs

# Read experiment date file.
date = "date.csv"
df_date = pd.read_csv(date)

# Initialize IDEs
#Old Devices
IDE_12 = IDE(12, [8], ["m","s"], "csv")
# IDE_14 = IDE(14, [2,4,8,16], ["m","s"], "csv")
IDE_16 = IDE(16, [2,4,8,16], ["m","s"], "csv") #,16
IDE_20 = IDE(20, [2,16], ["m","s"], "csv")

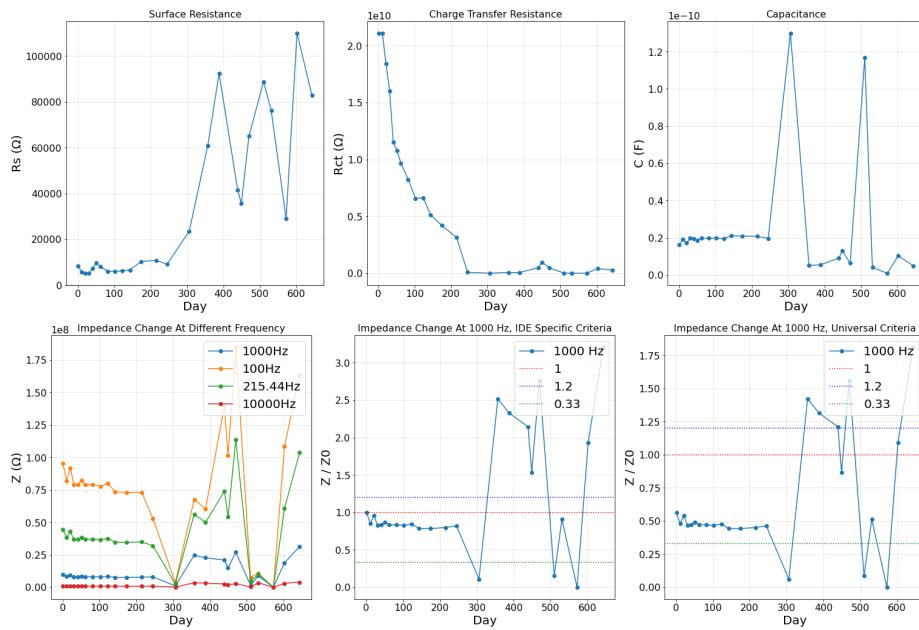
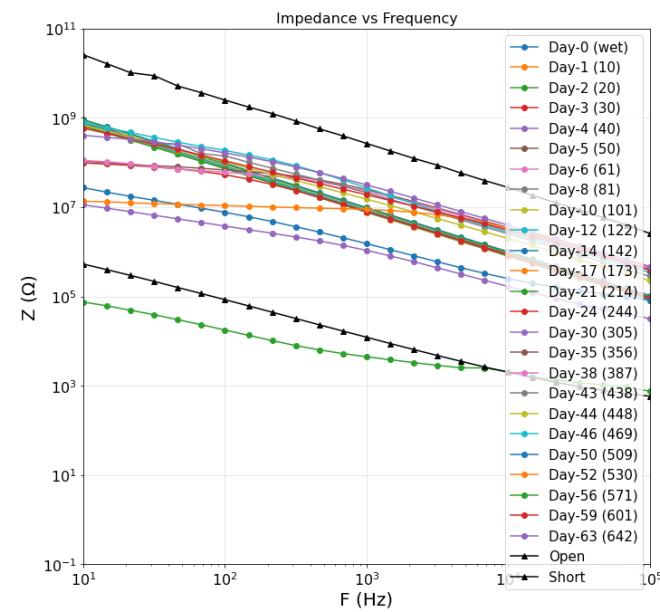
```

IDE-12-8-m

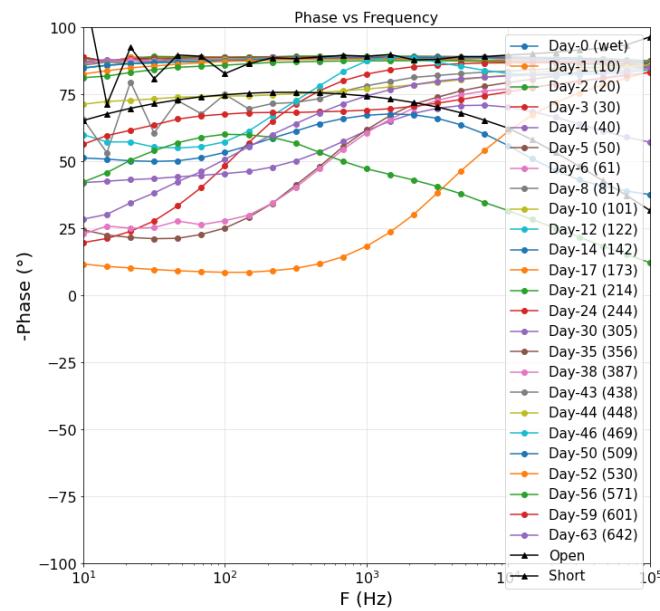


```
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.9319588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.642022209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

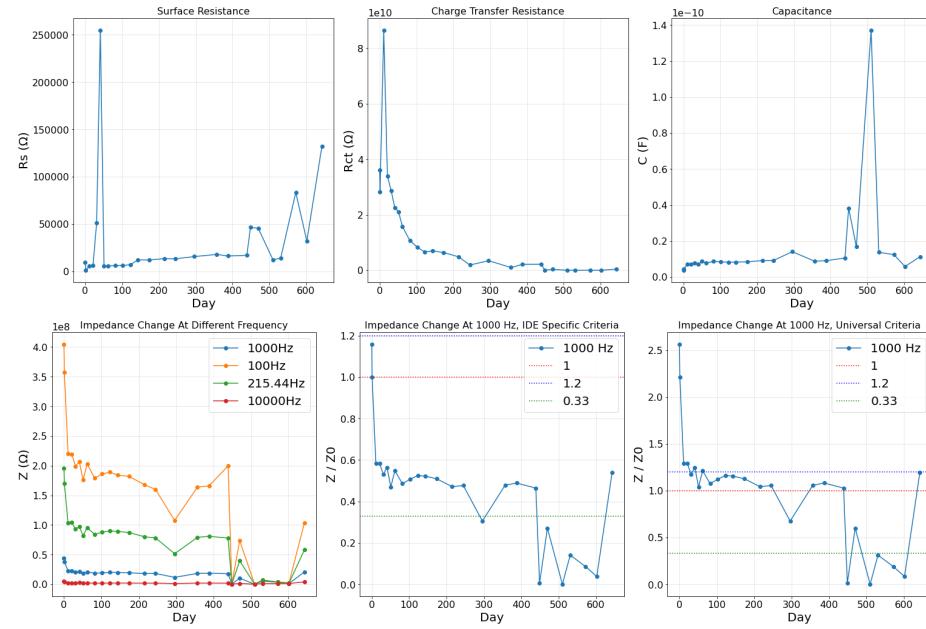
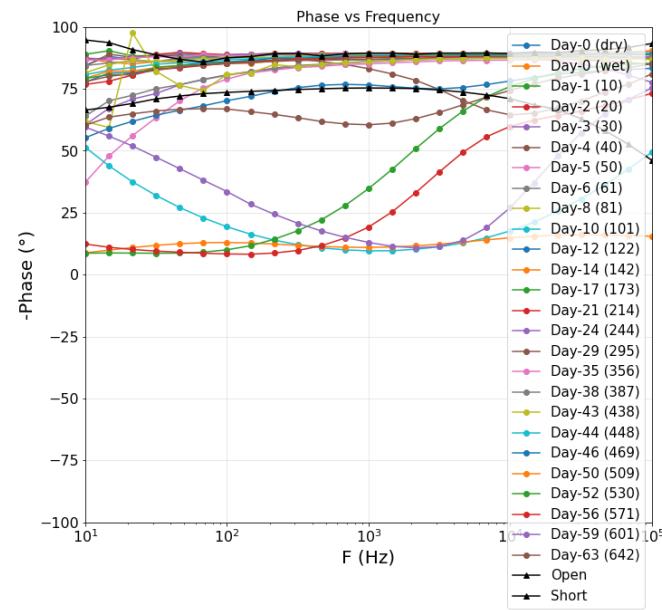
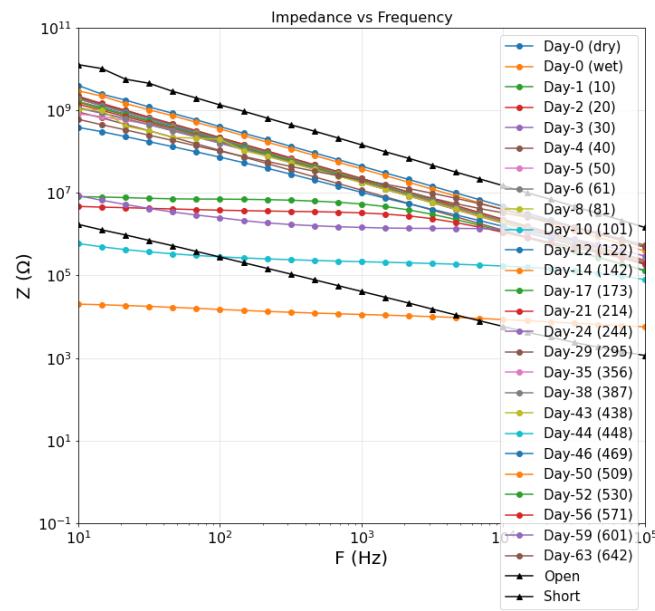
IDE-12-8-S



```
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3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
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1.28418826e+10]
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3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045727e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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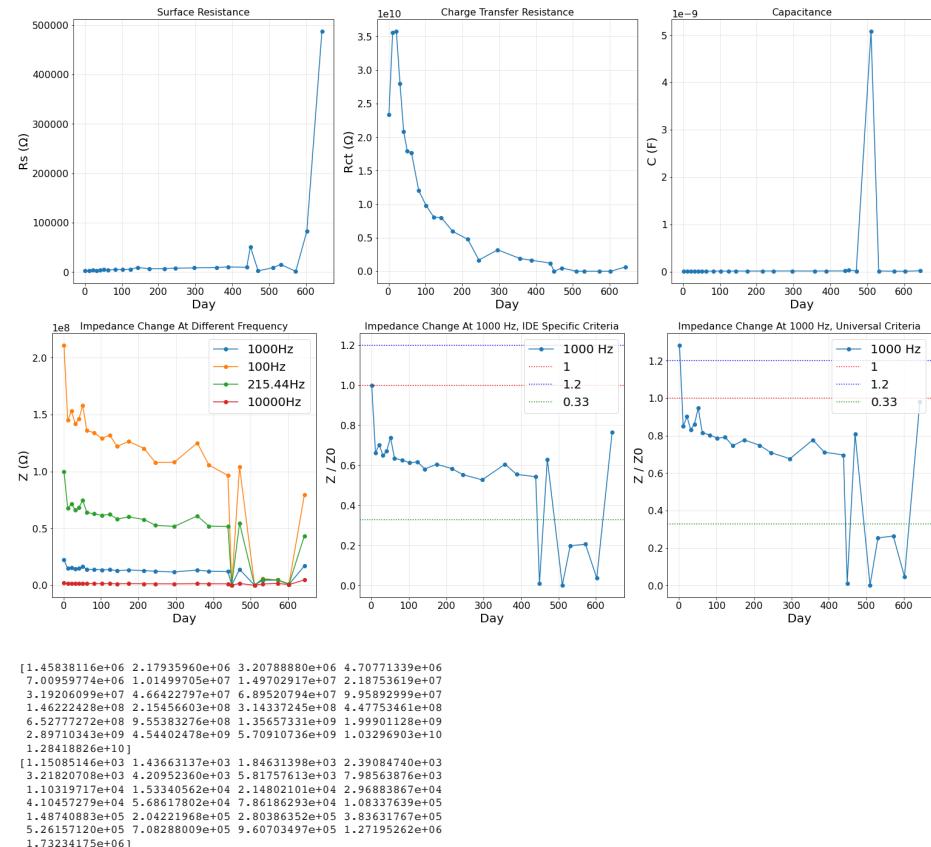
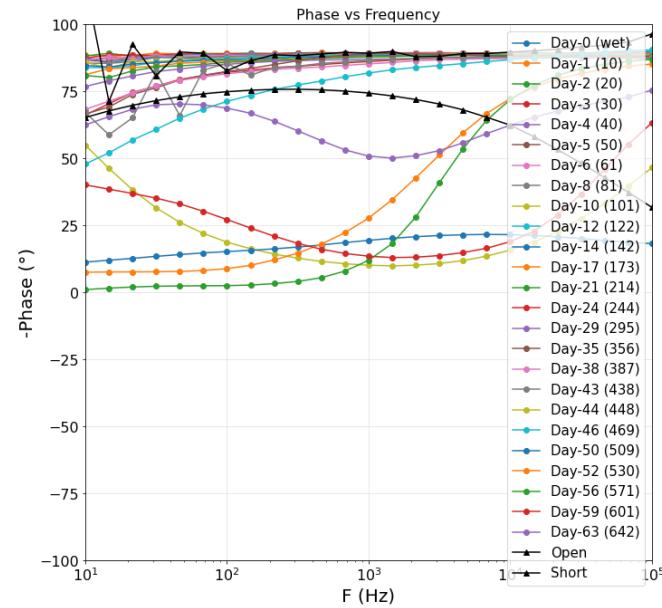
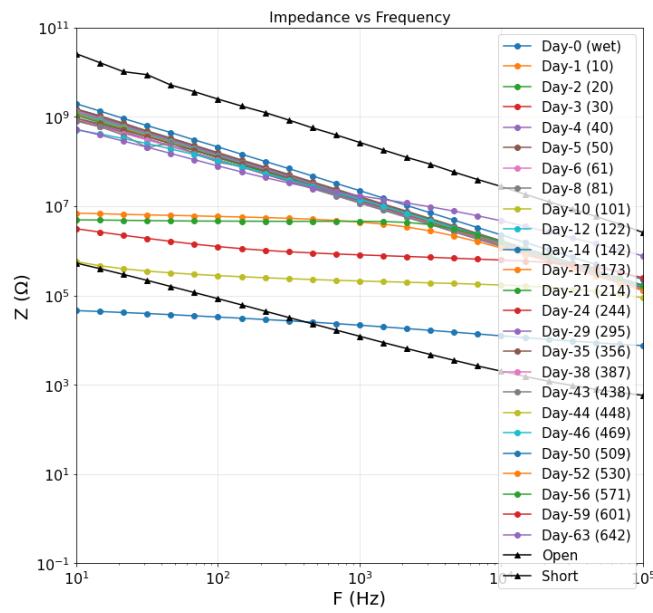


IDE-16-2-m

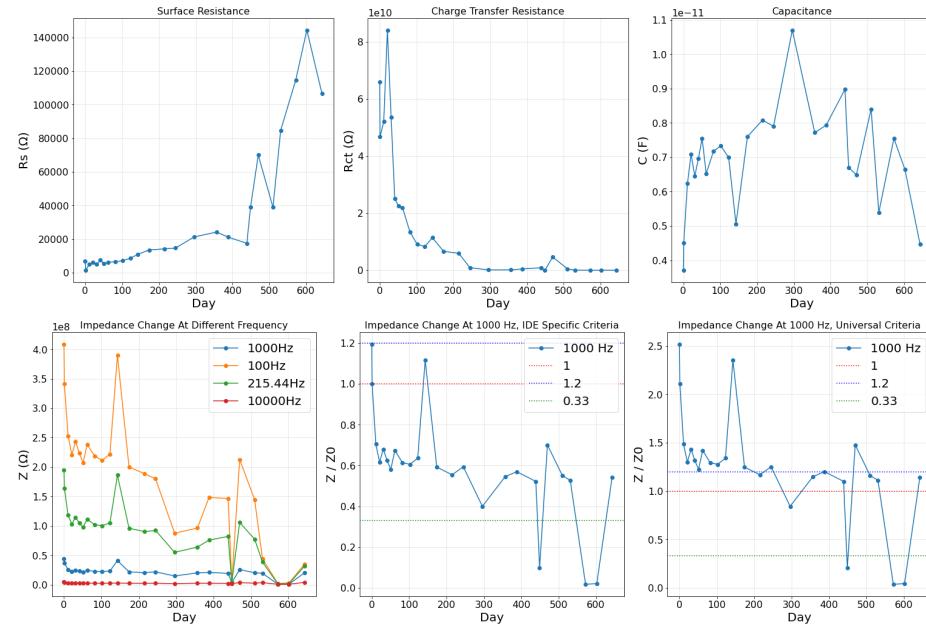
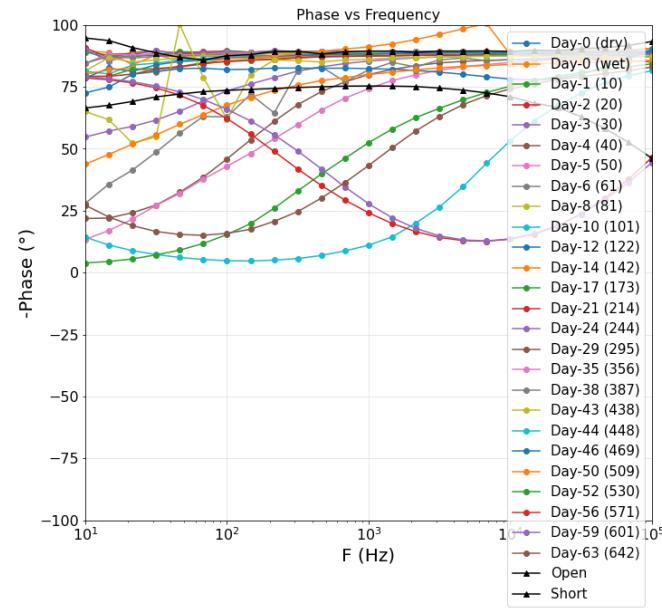
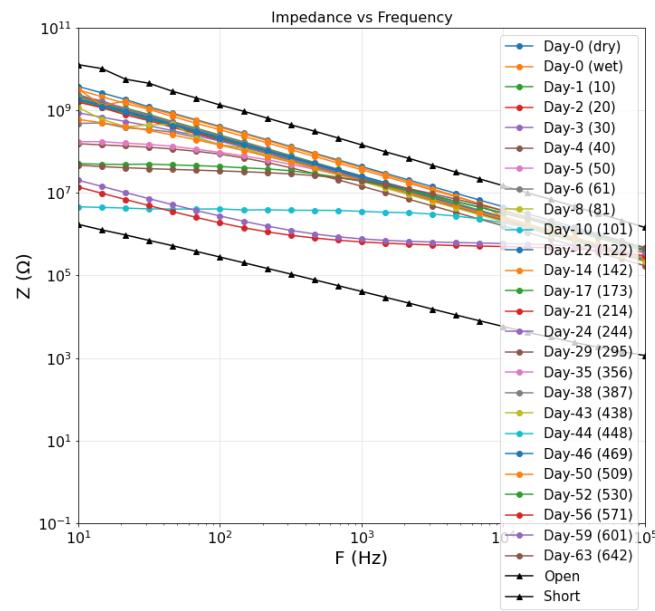


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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.9319588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.642022209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-16-2-s

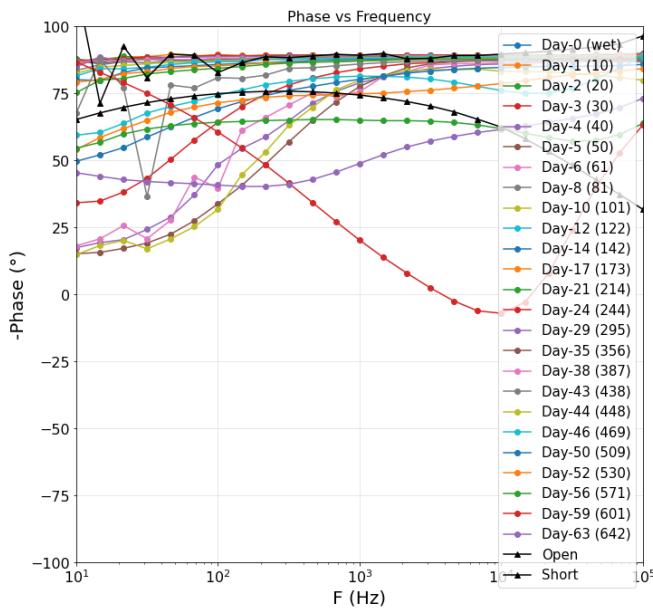
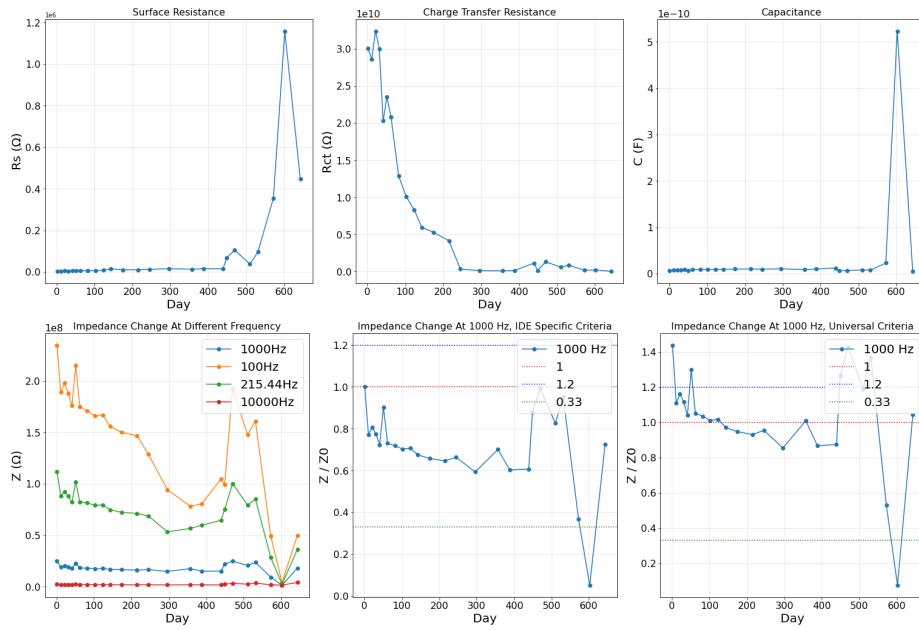
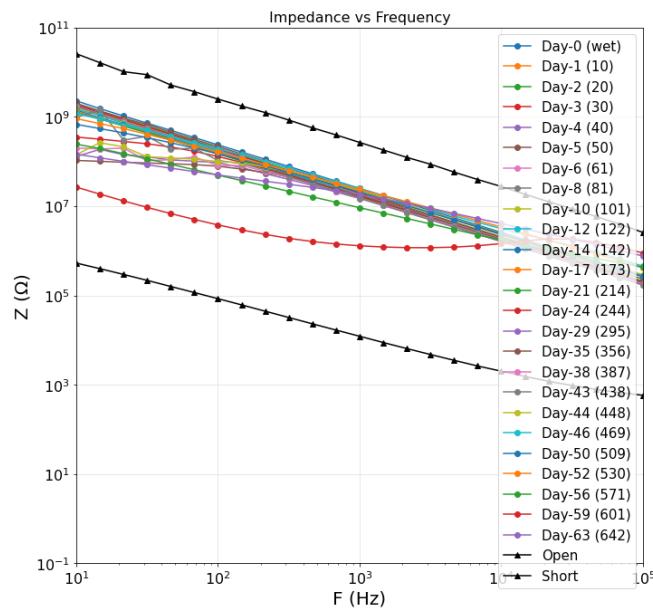


IDE-16-4-m



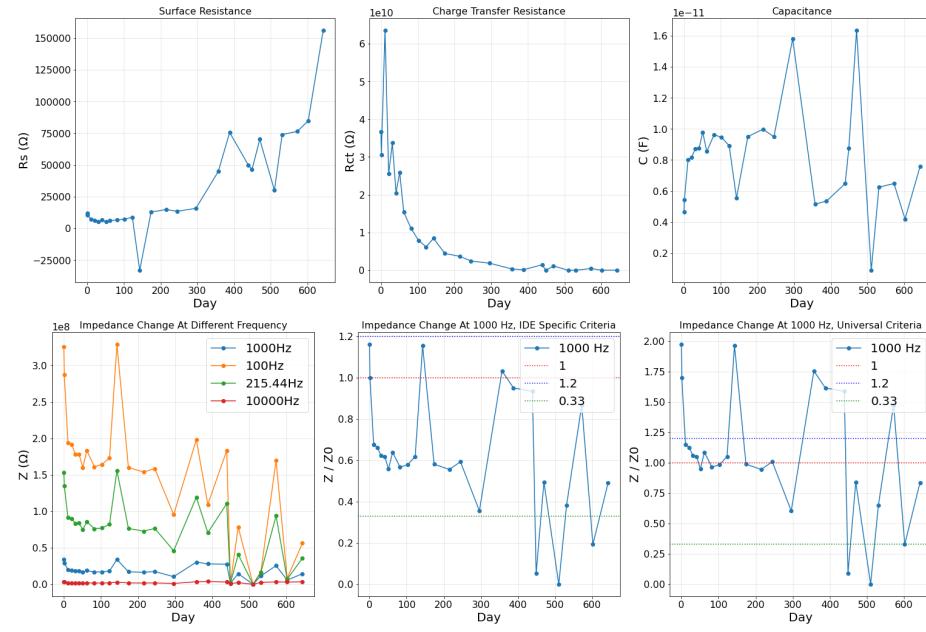
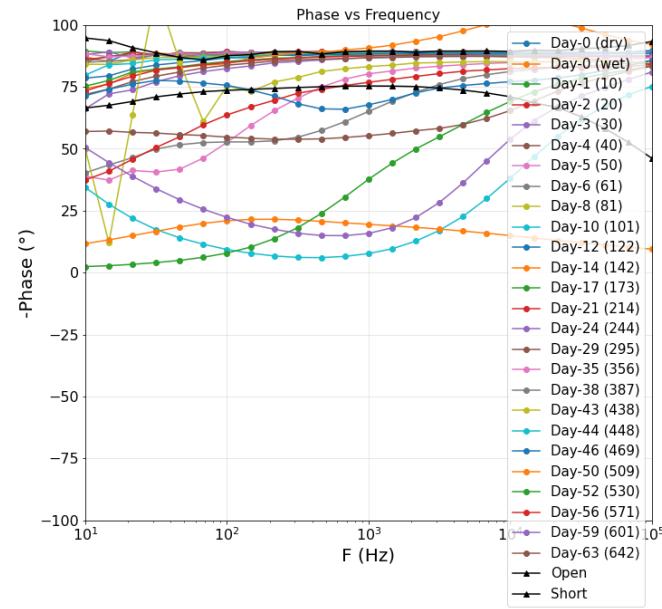
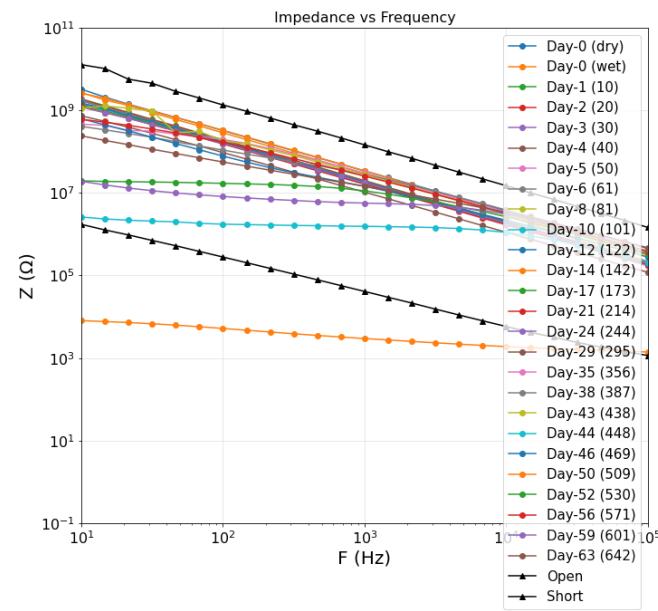
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.9319588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-16-4-S



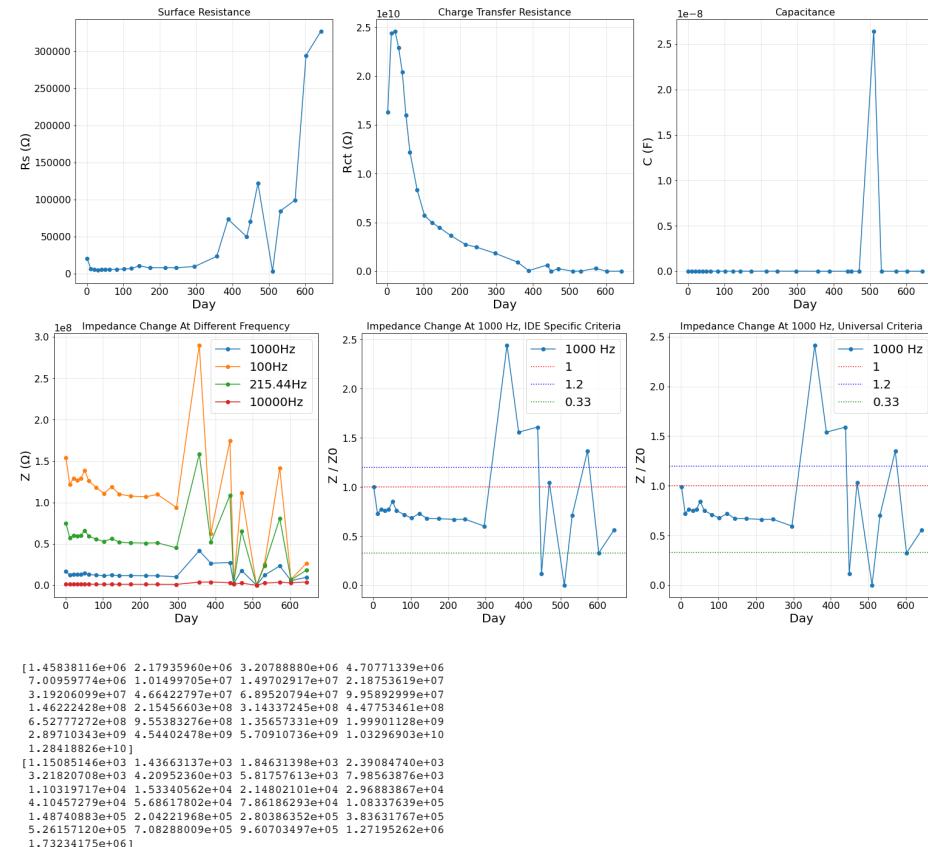
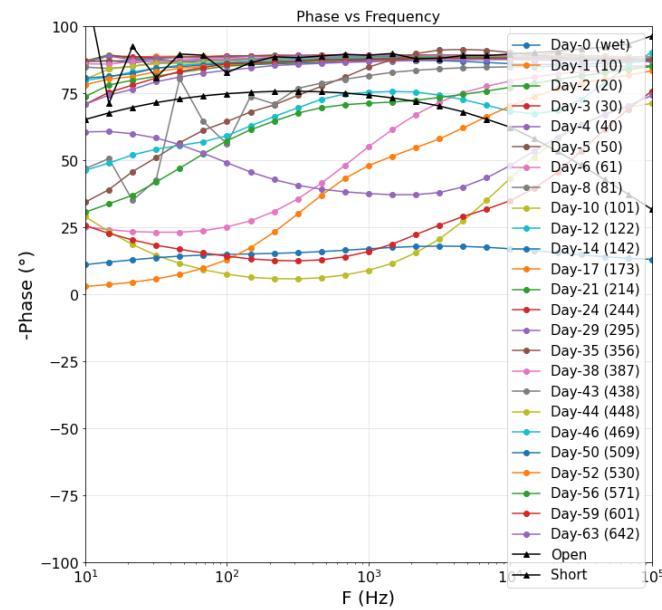
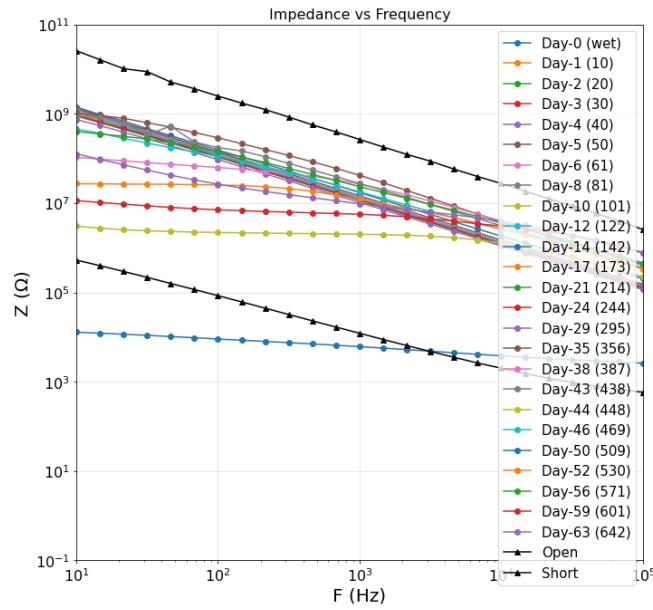
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3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-16-8-m

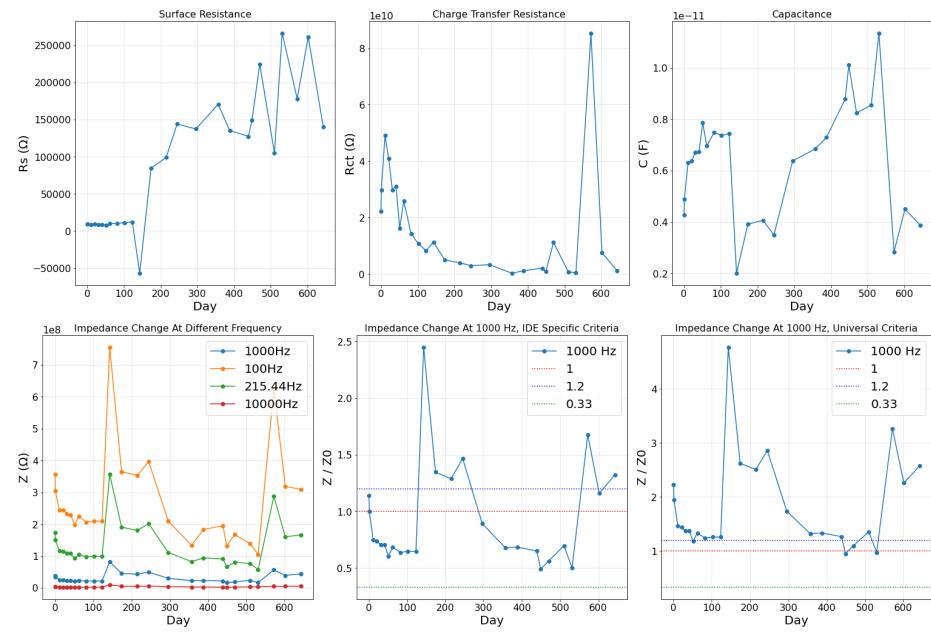
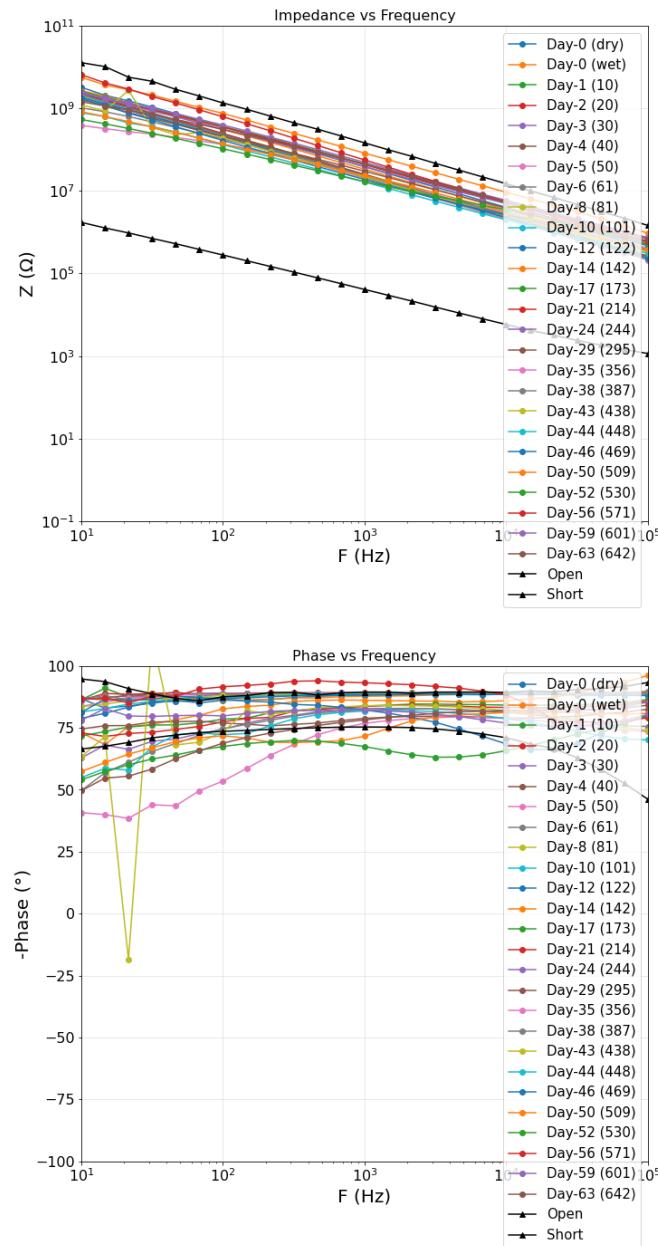


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5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
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IDE-16-8-s

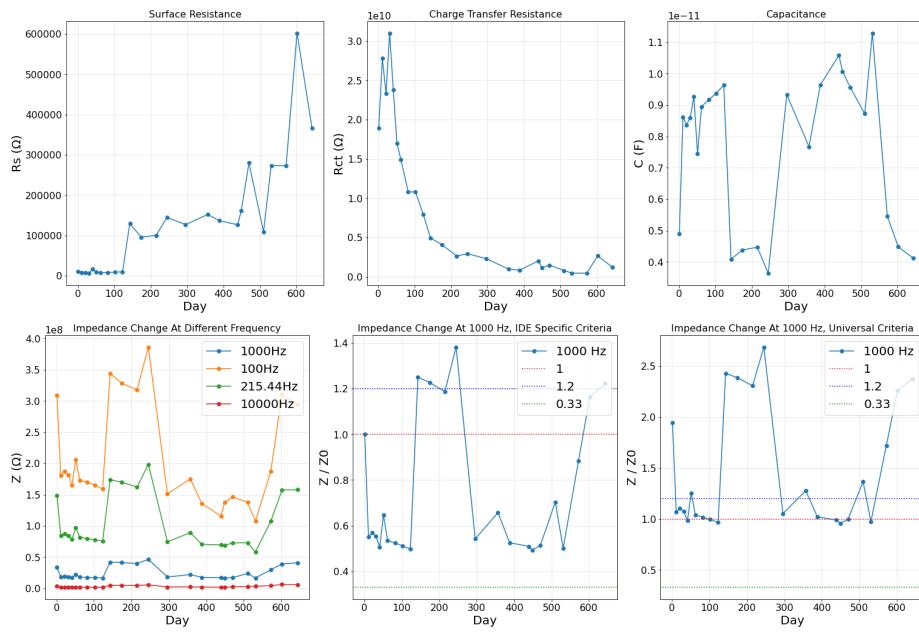
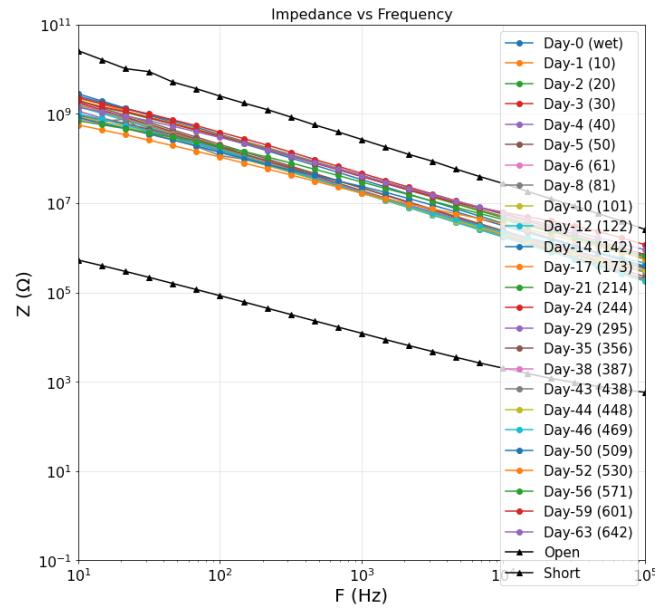


IDE-16-16-m

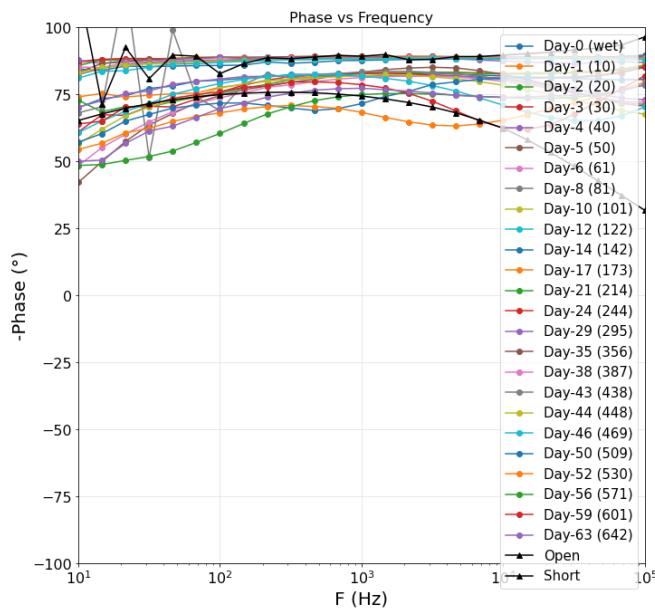


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5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.642022209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.437228 4753.233777 6445.621553 8815.649483
12180.1192 16734.98326 23096.4336 32005.16833
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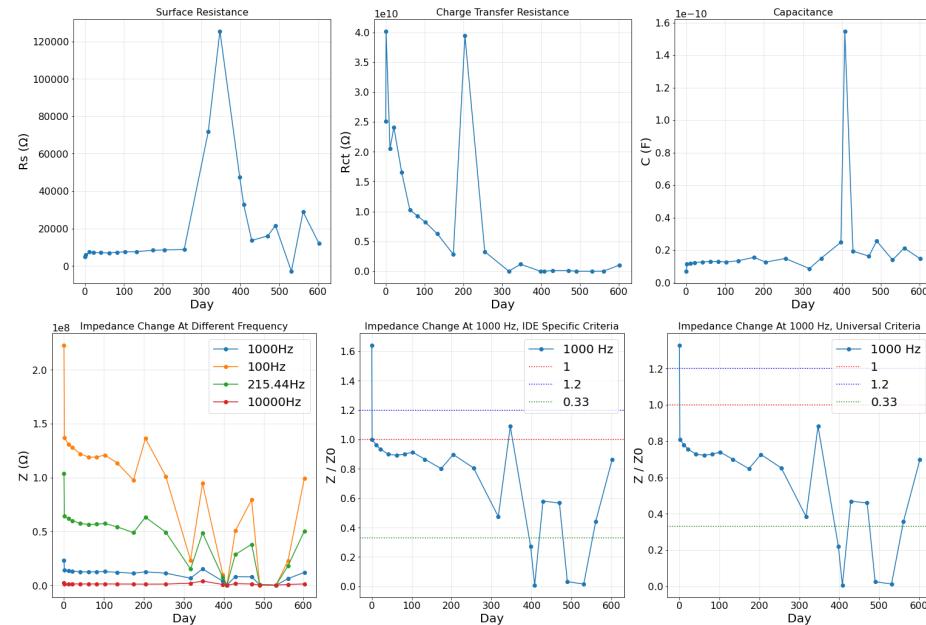
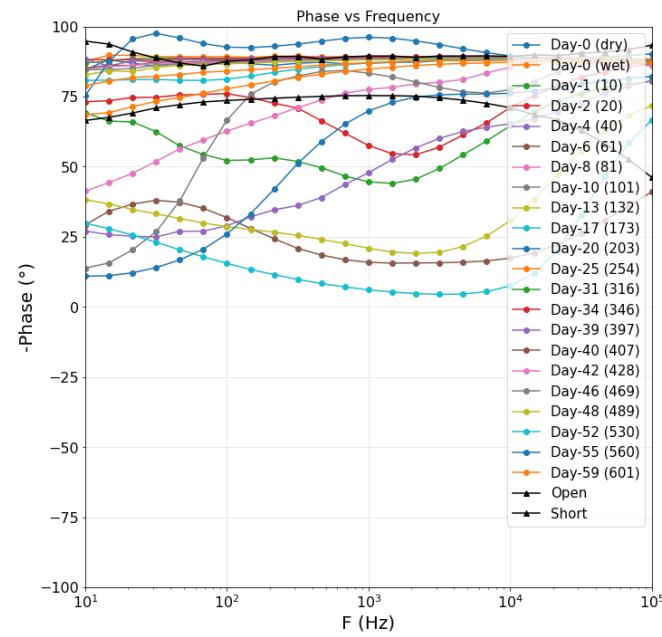
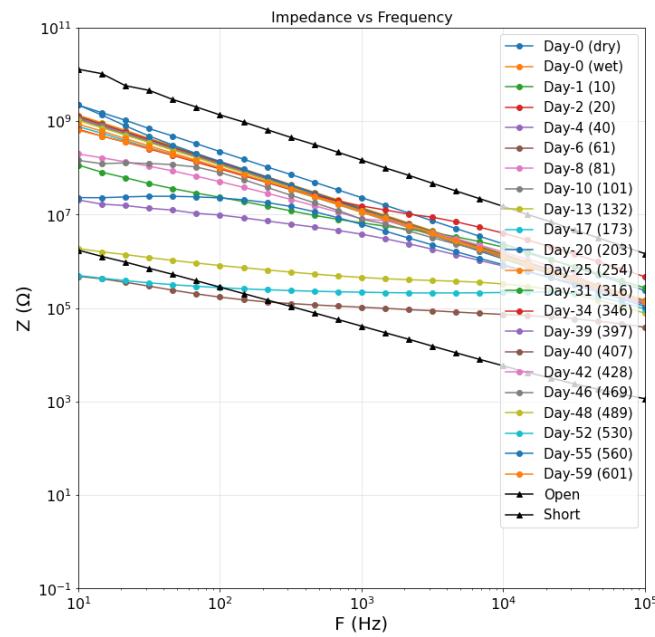
IDE-16-16-s



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3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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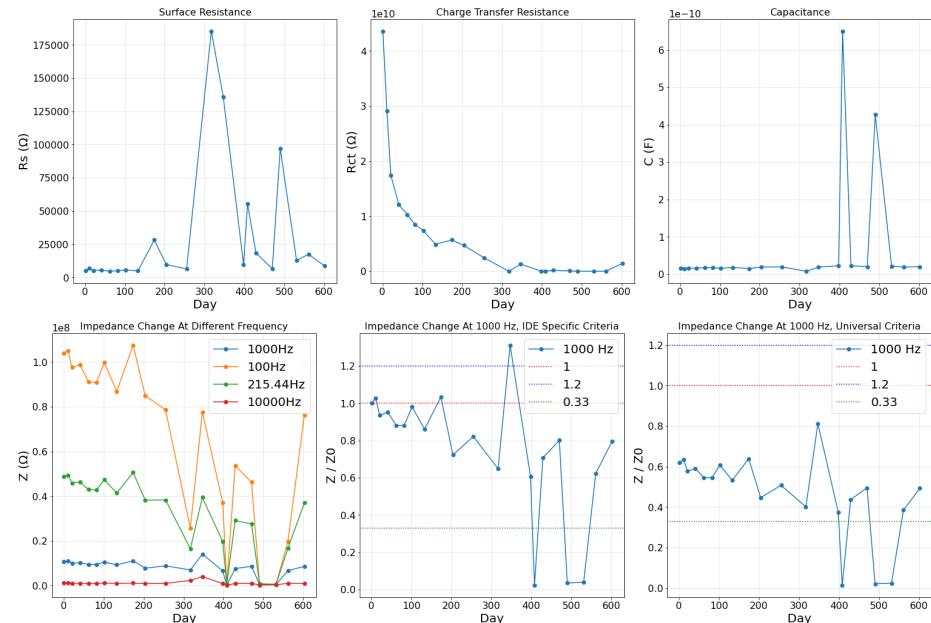
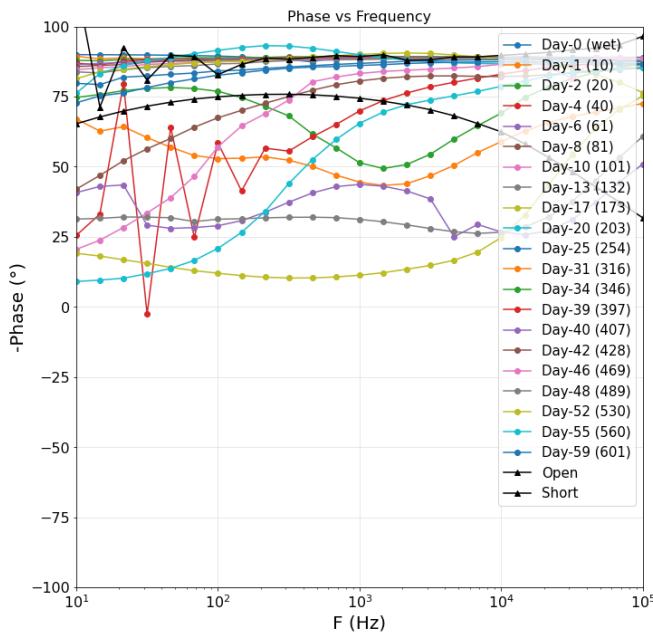
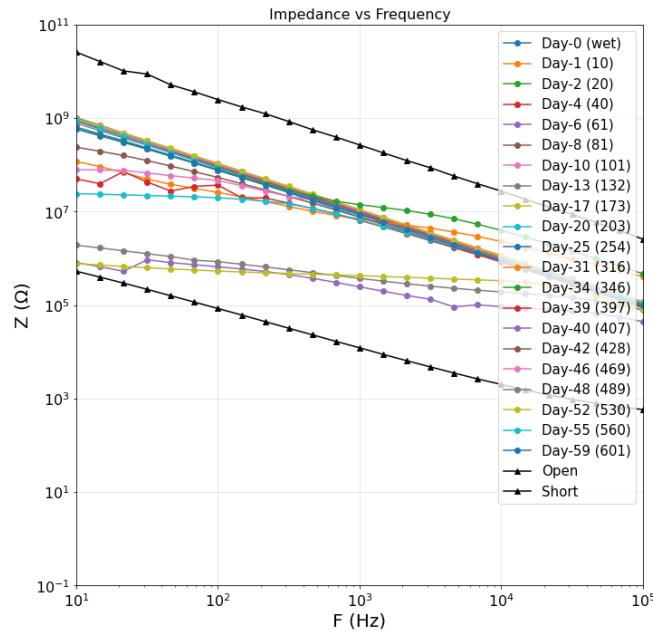


IDE-20-2-m



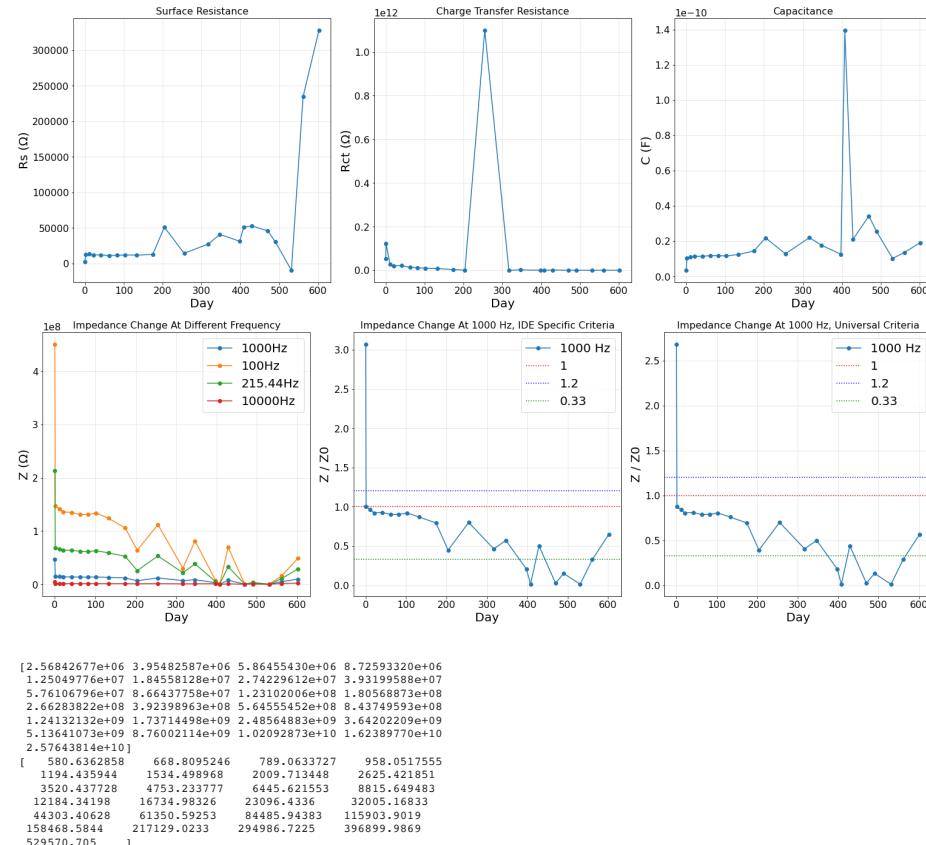
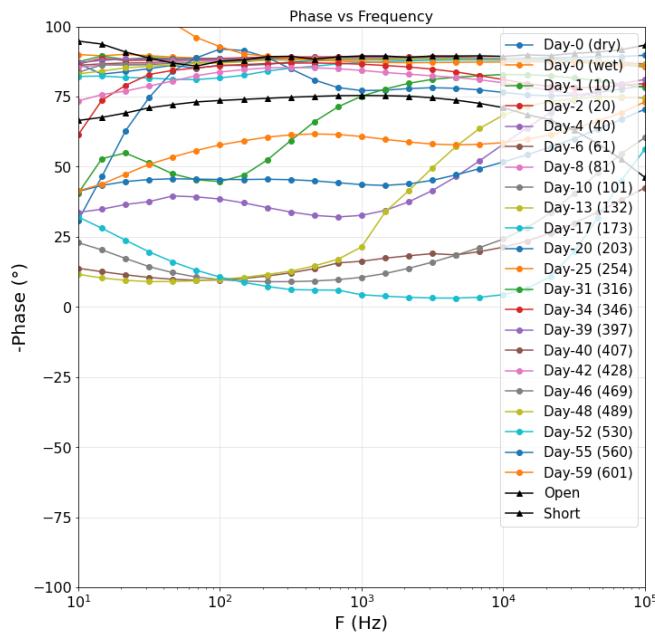
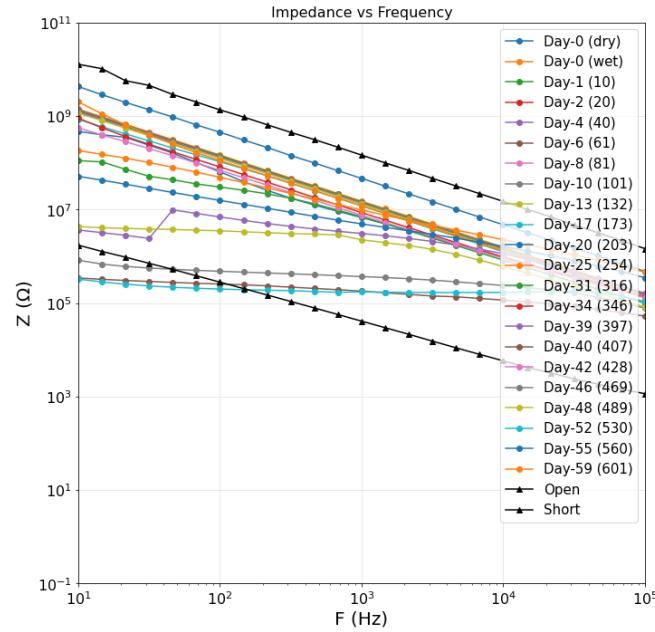
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5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5044 217129.0233 294986.7225 396899.9869
529570.705 ]
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IDE-20-2-s



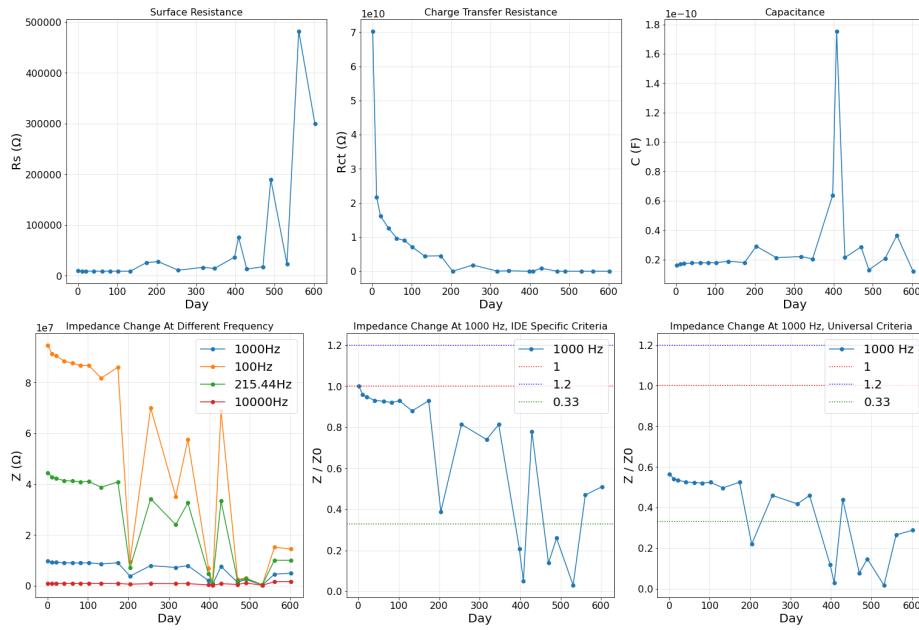
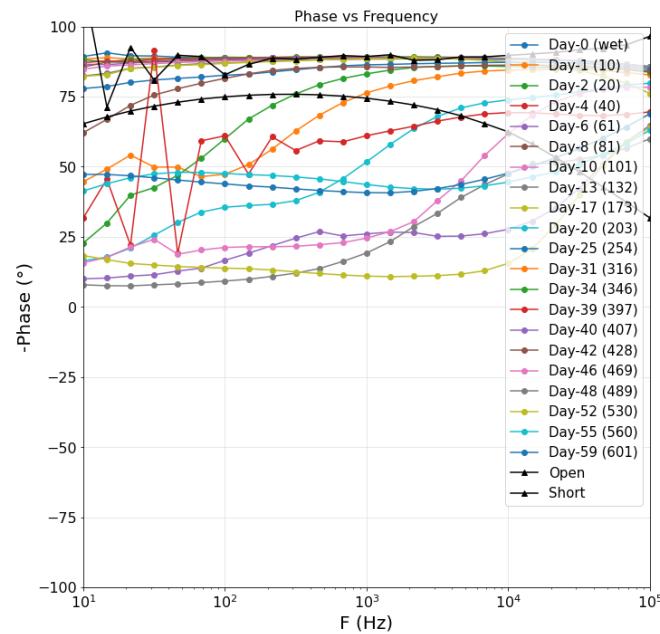
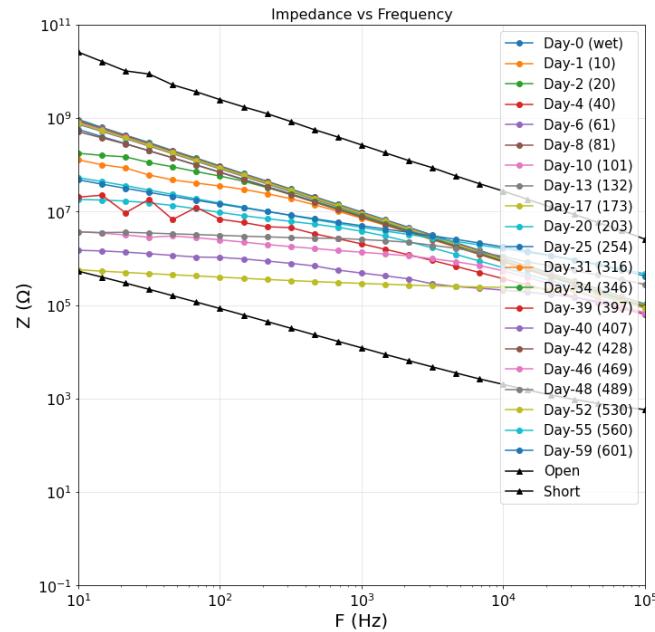
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-20-16-m



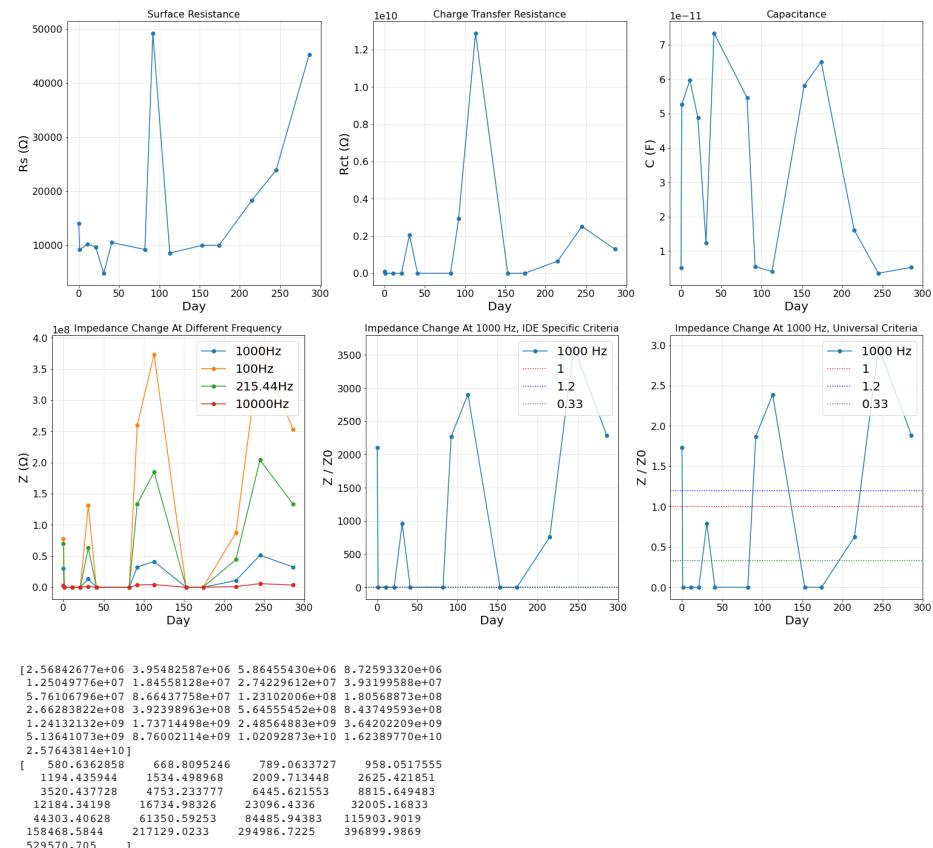
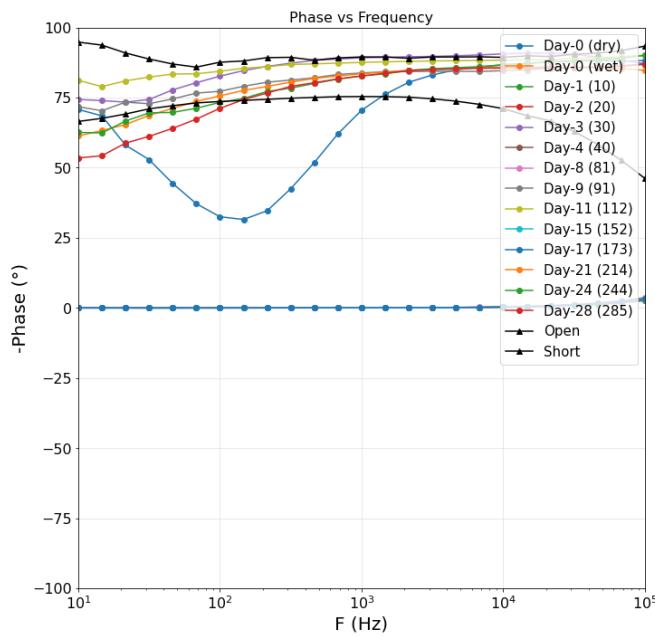
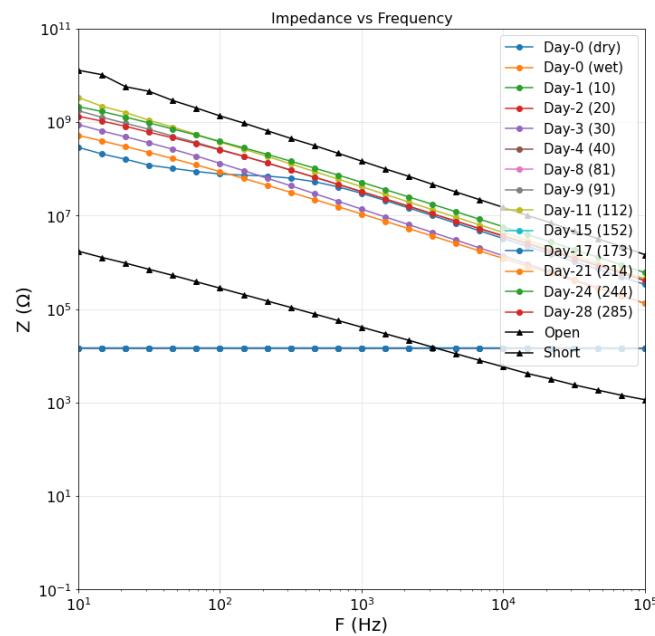
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5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.642022209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.1928 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
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IDE-20-16-s



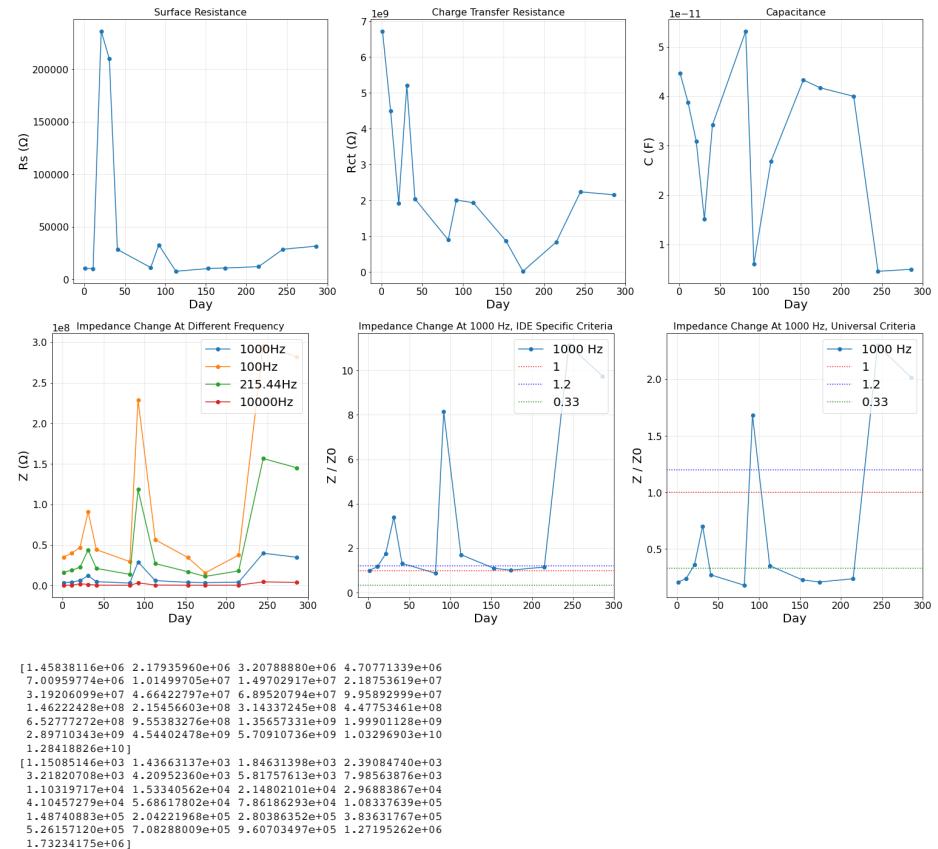
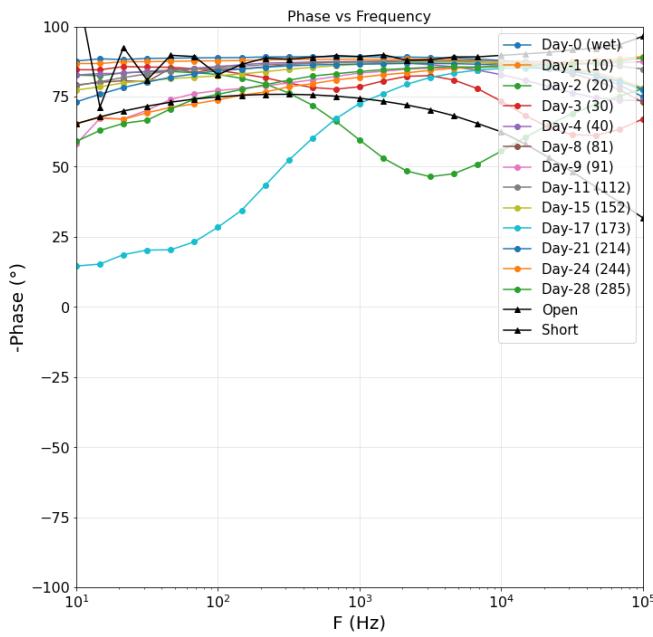
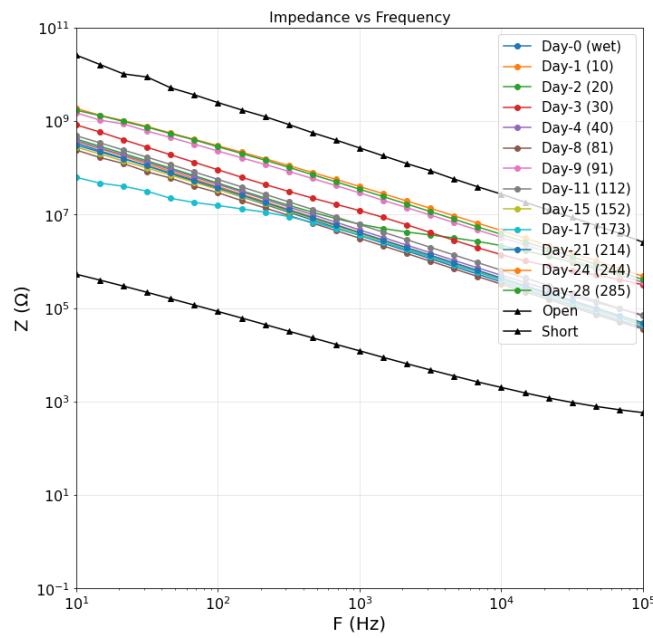
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3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
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1.73234175e+06]
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IDE-22-2-m

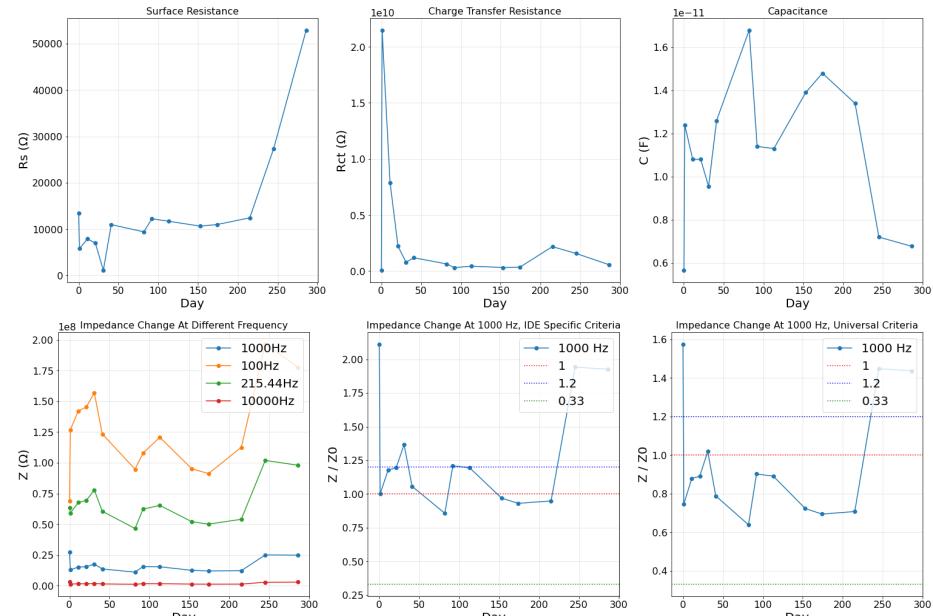
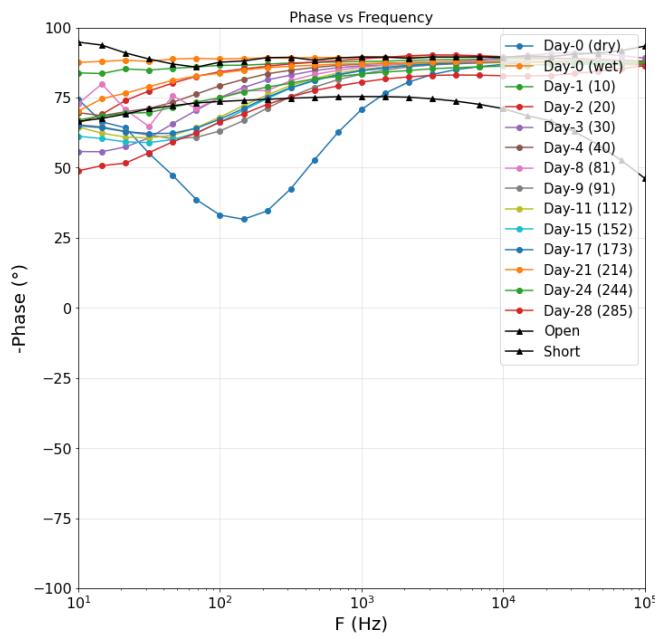
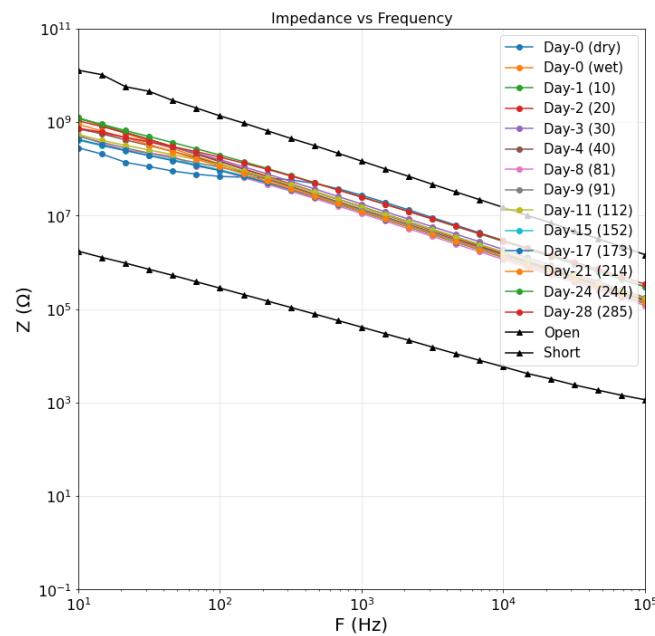


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5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.437228 4753.233777 6445.621553 8815.649483
12180.4198 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-22-2-S

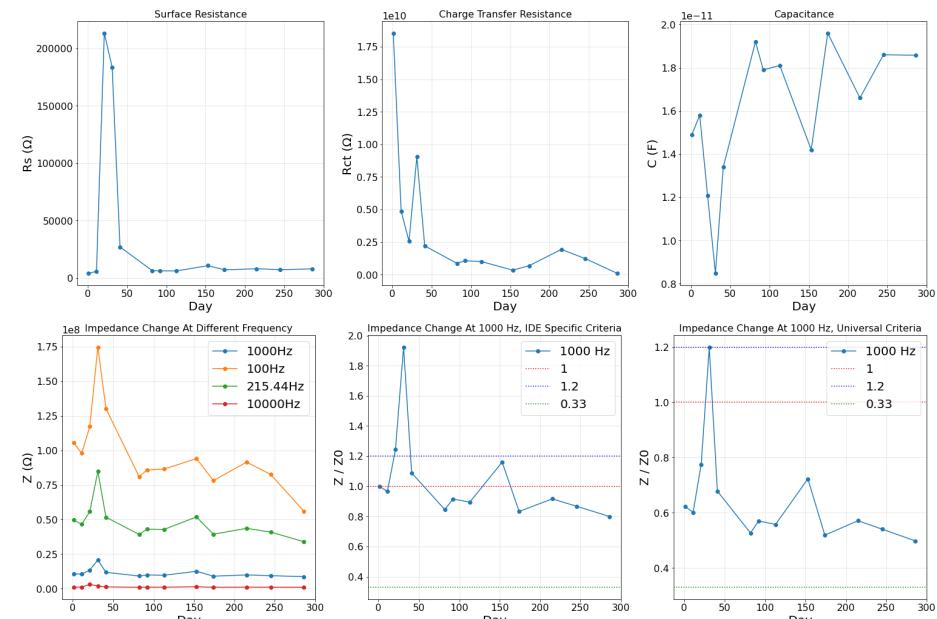
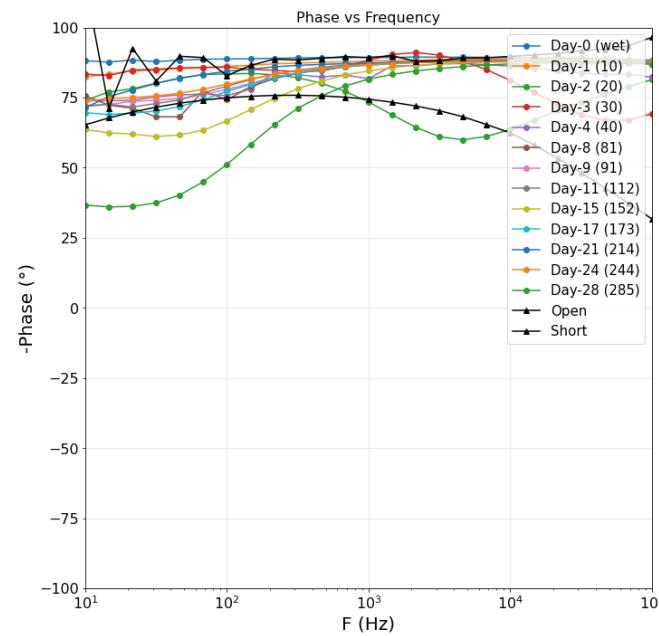
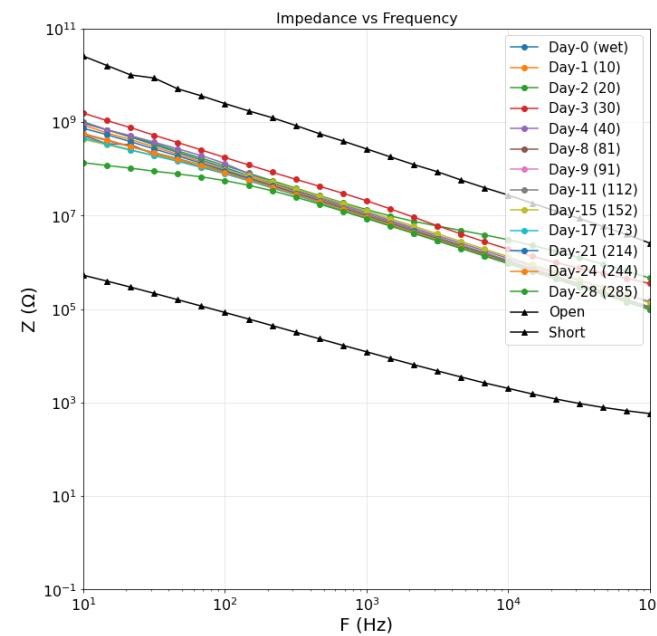


IDE-22-4-m



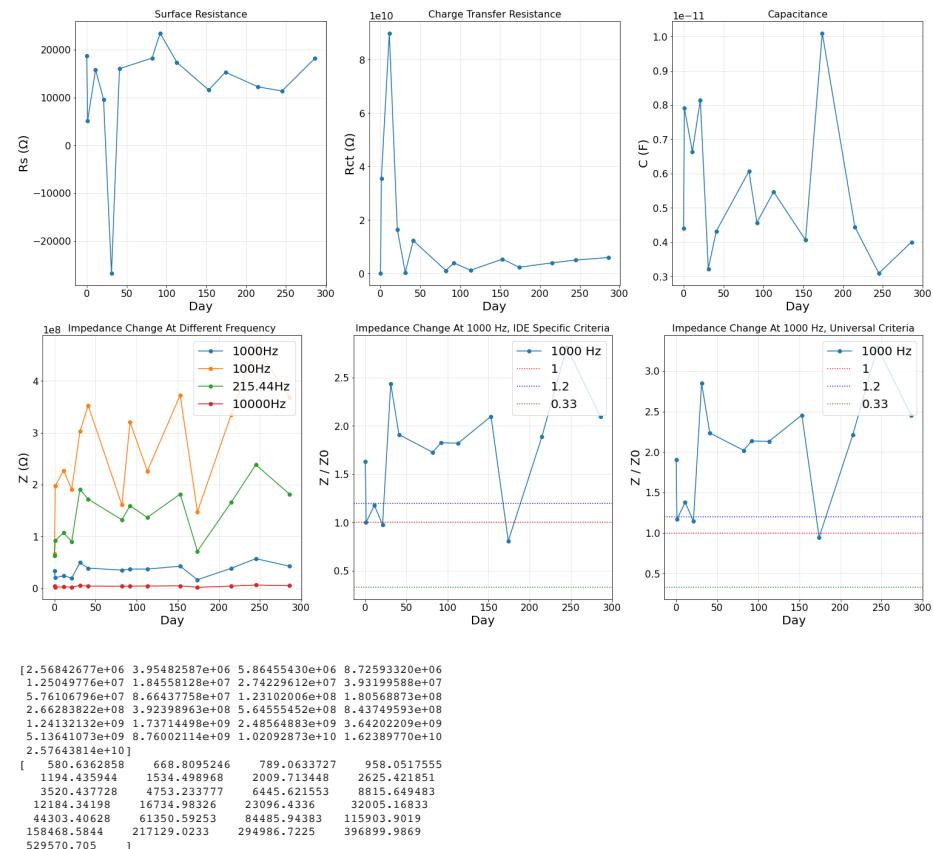
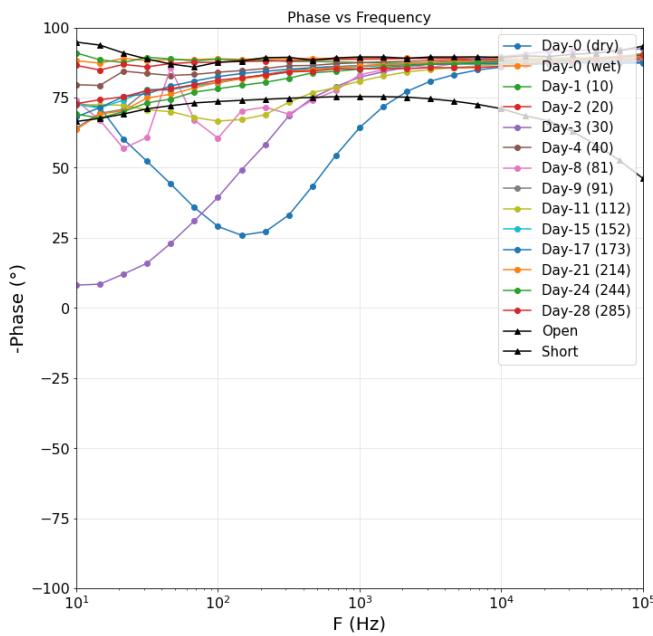
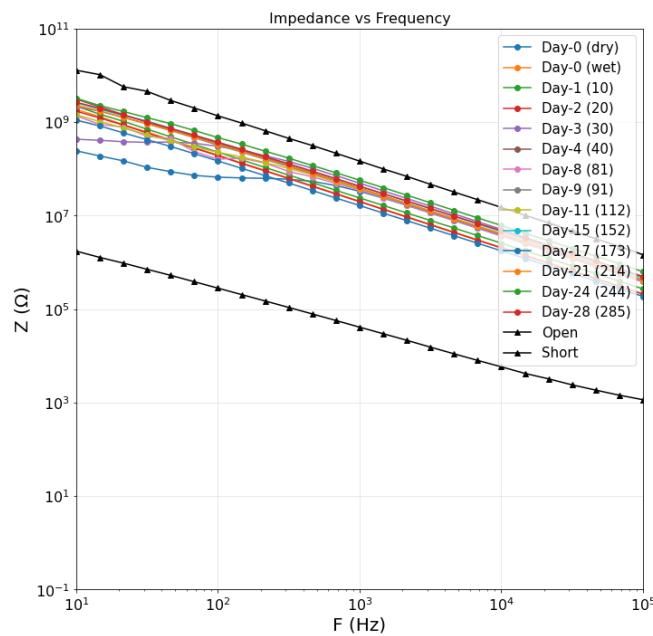
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5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
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IDE-22-4-S

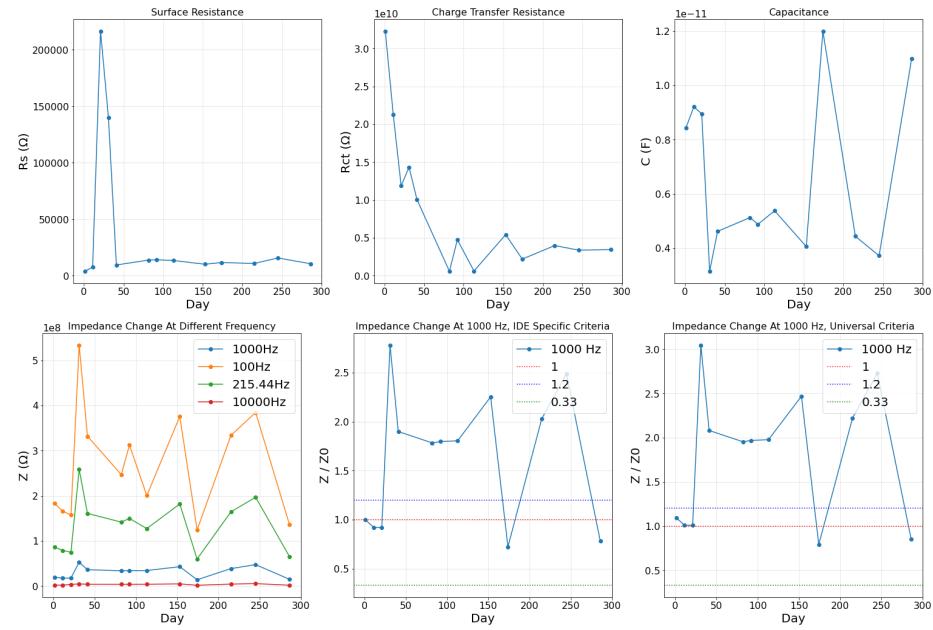
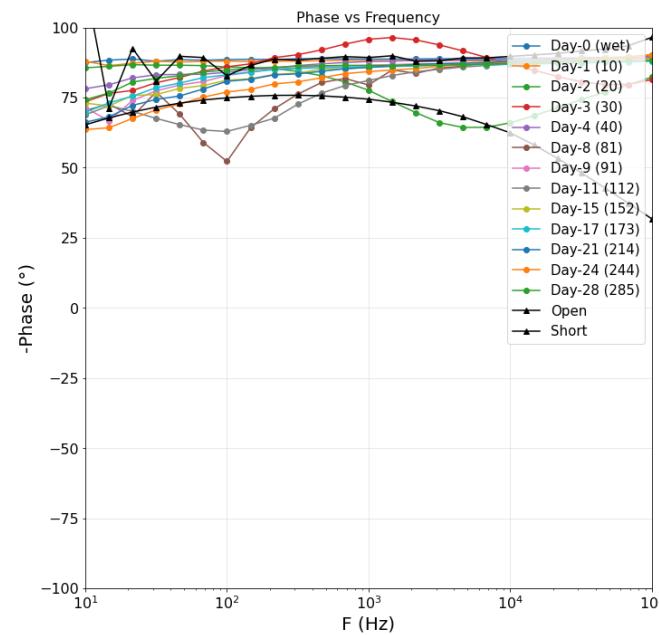
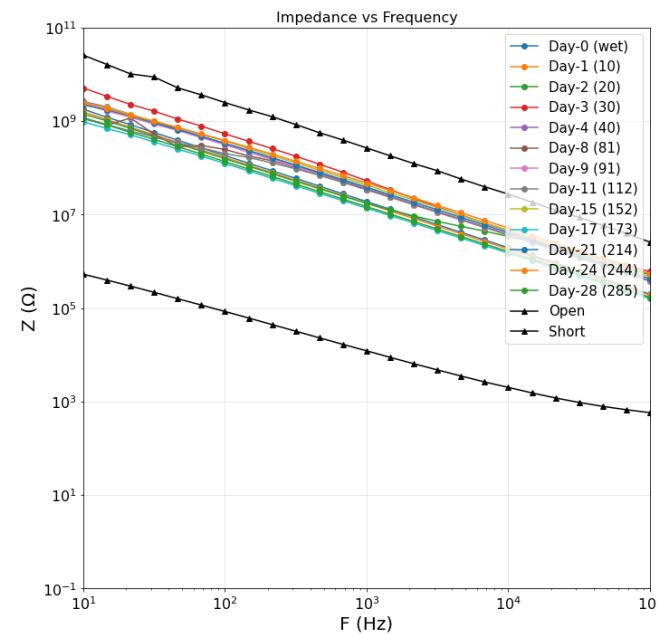


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3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-22-8-m

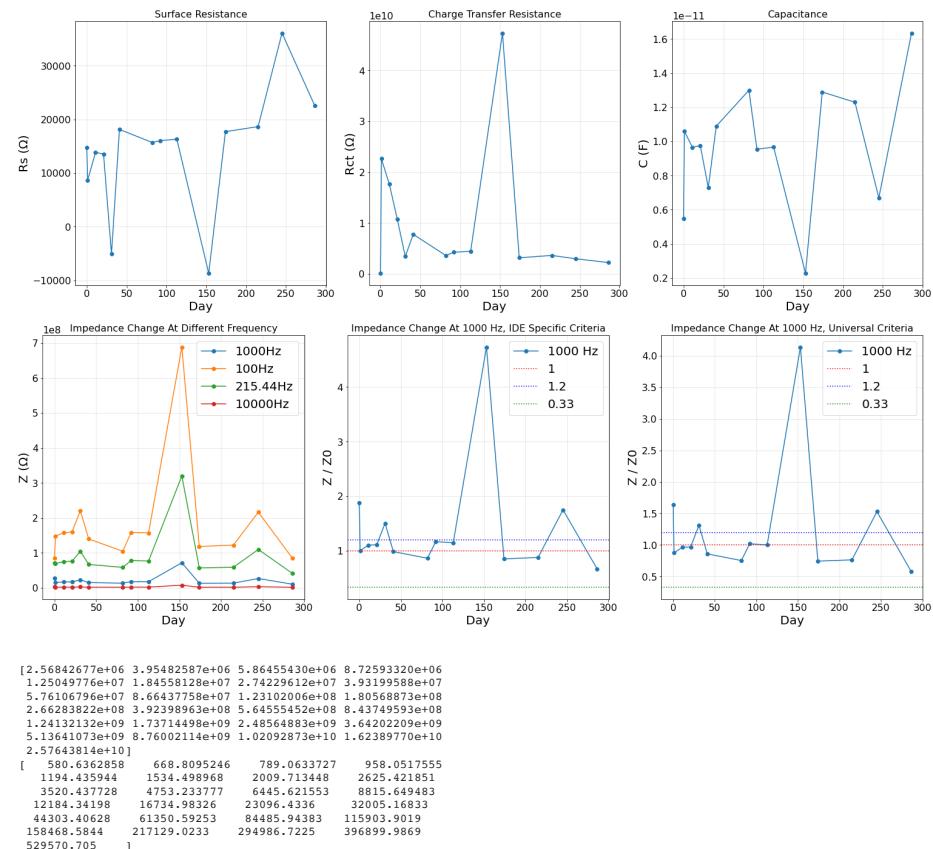
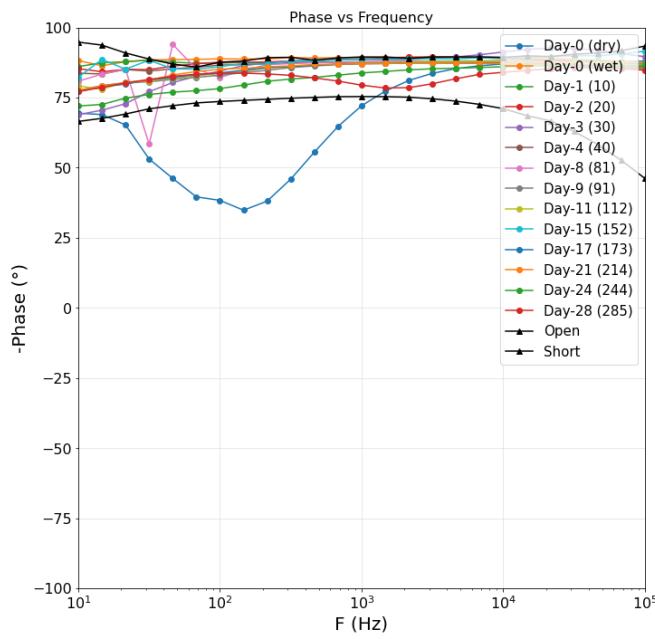
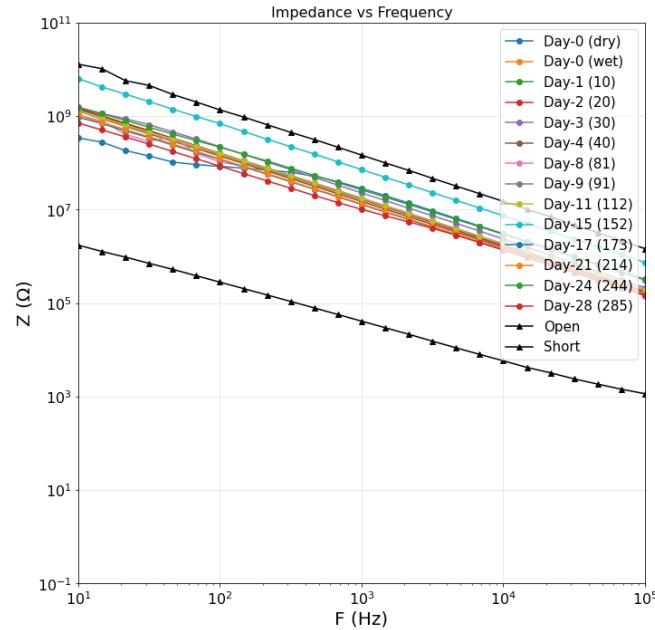


IDE-22-8-S

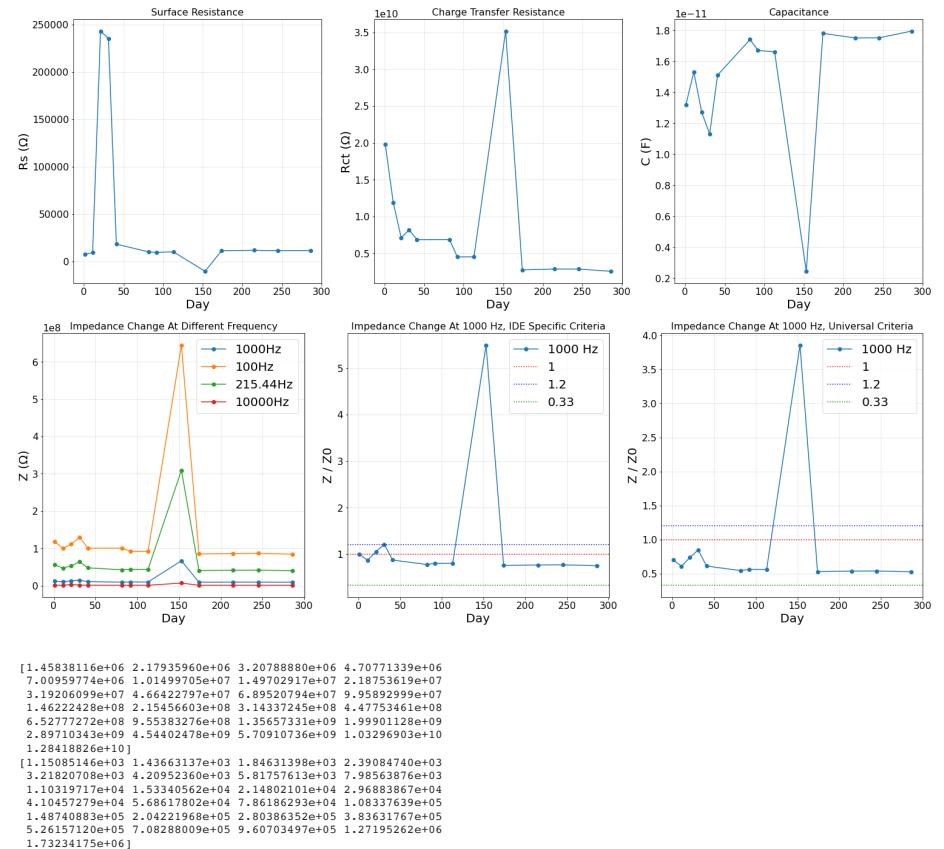
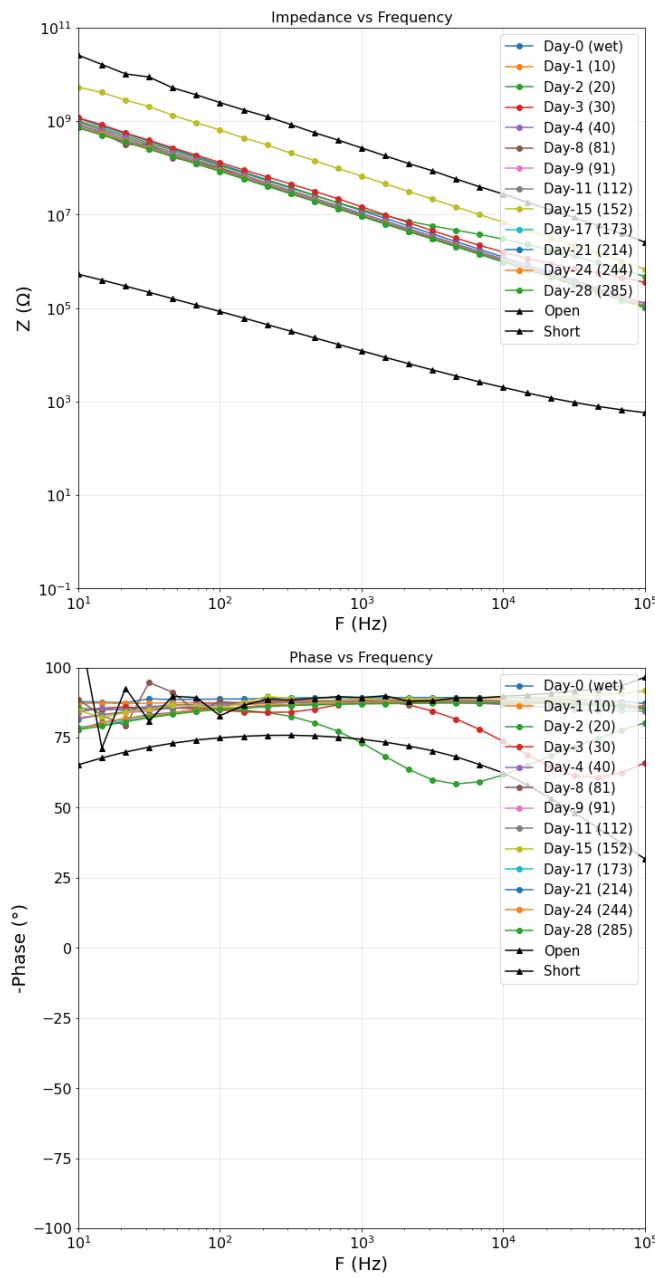


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3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19044779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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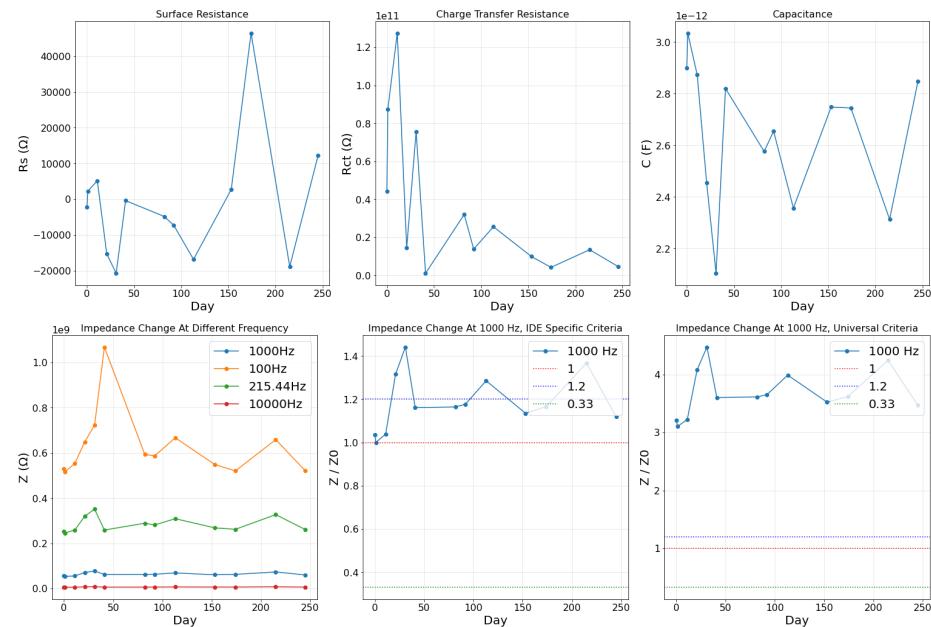
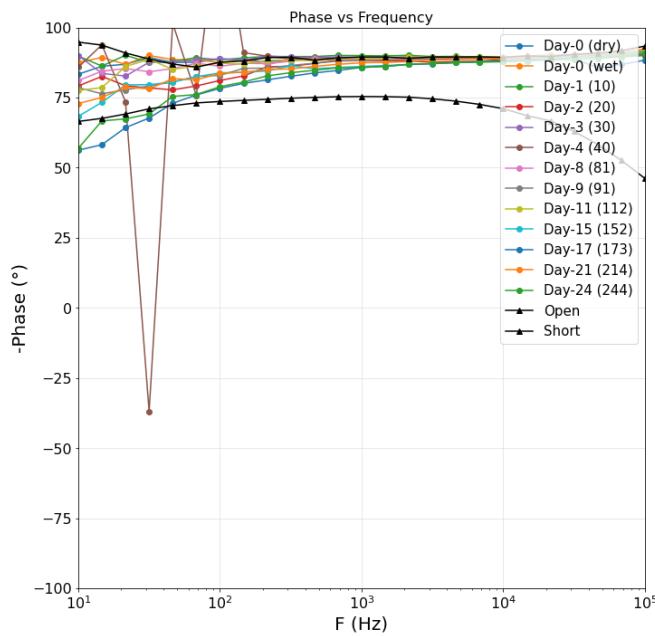
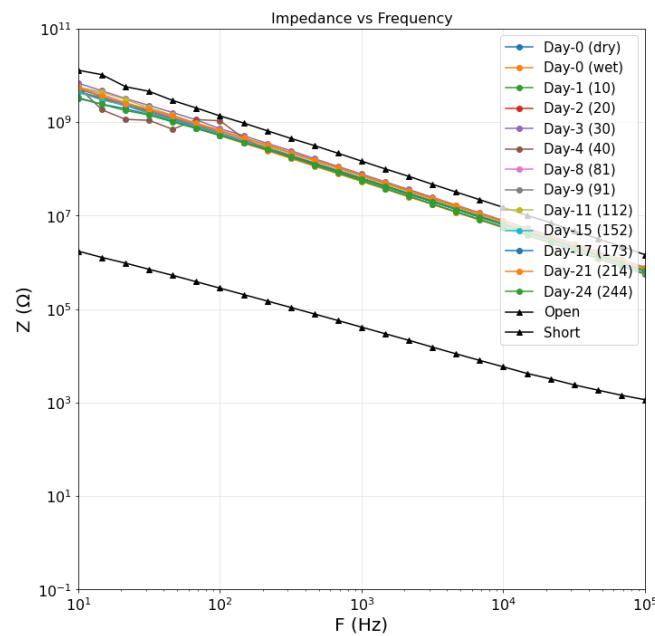
IDE-22-16-m



IDE-22-16-s

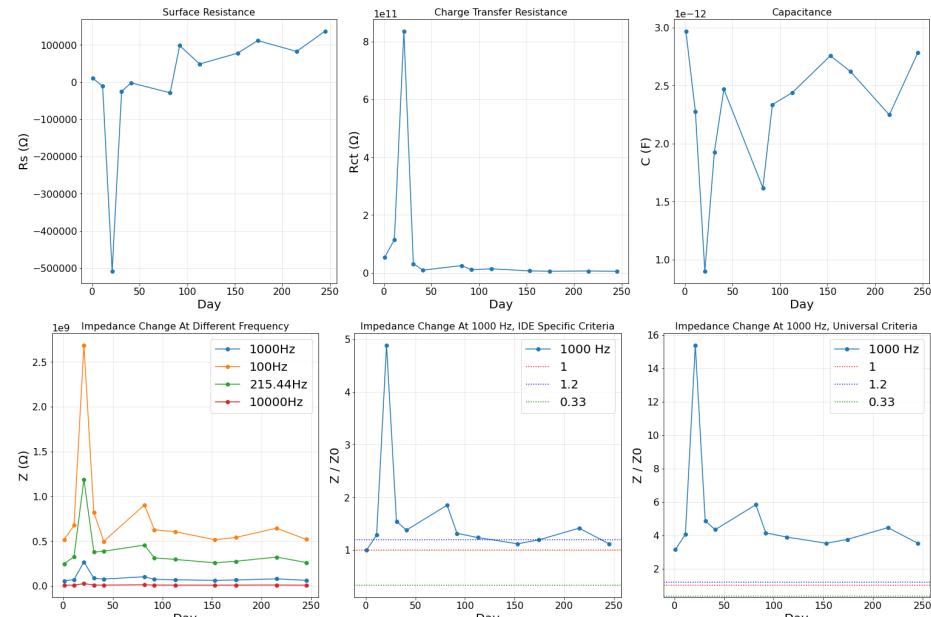
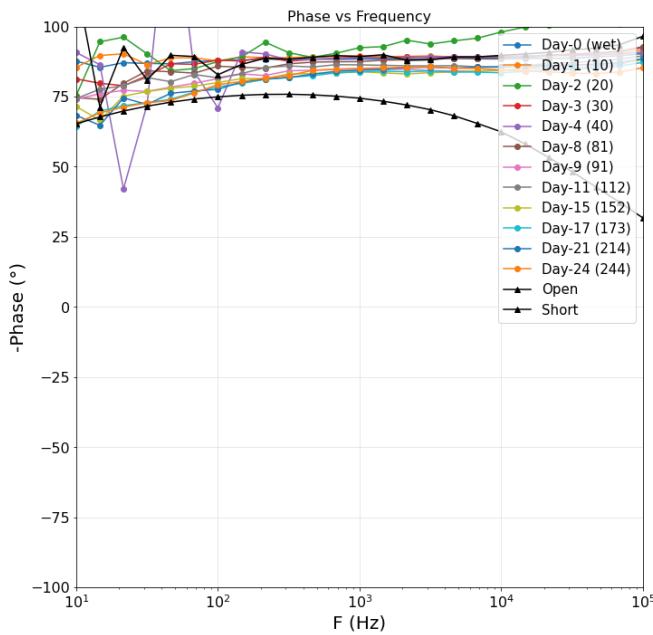
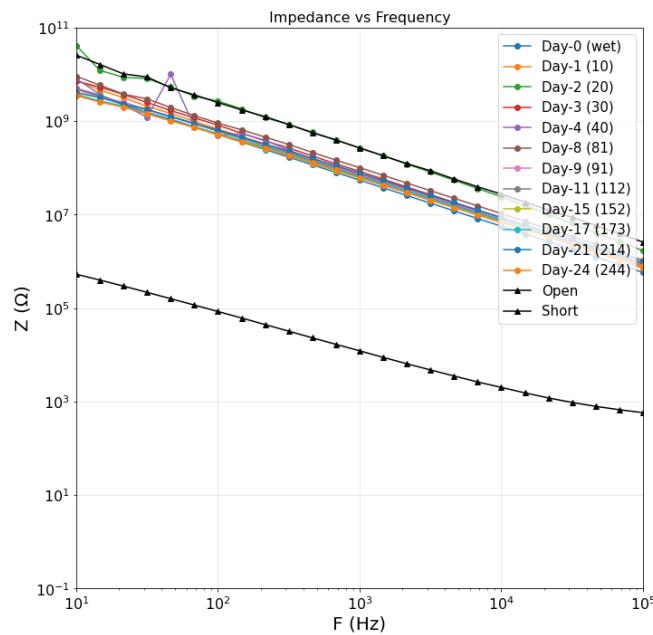


IDE-26-2-m



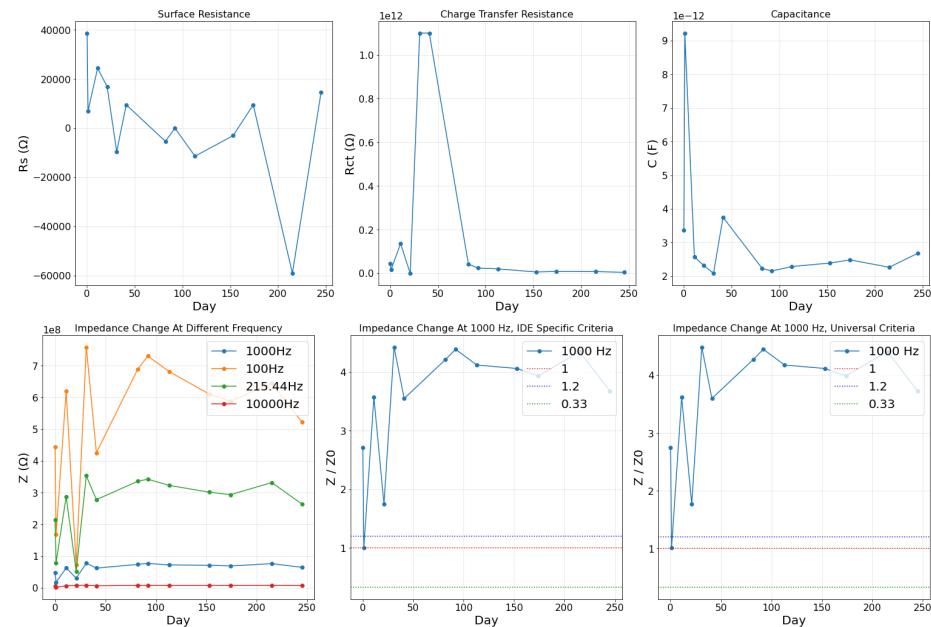
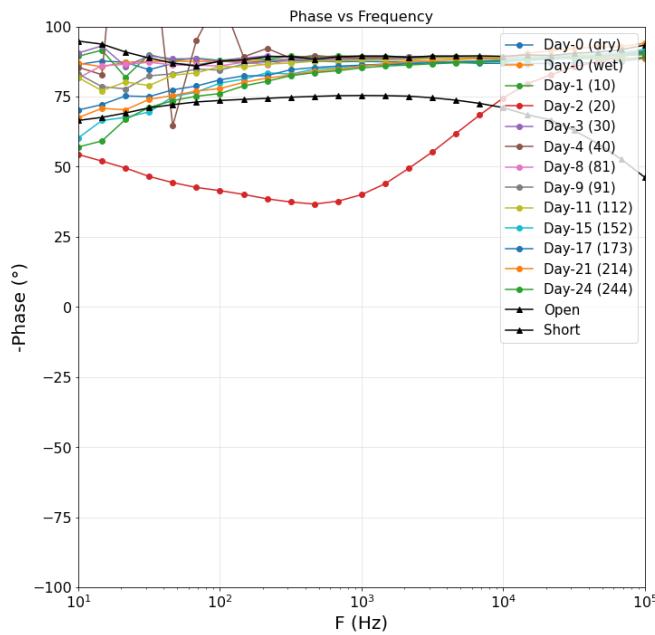
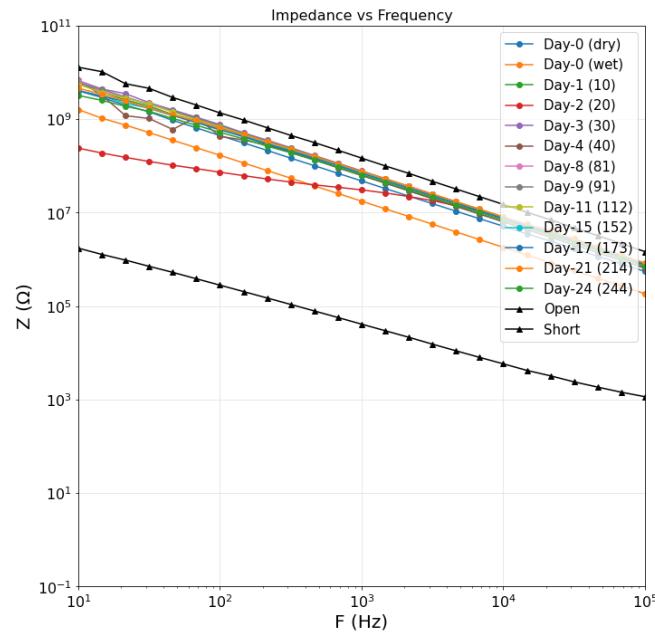
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.437228 4753.233777 6445.621553 8815.649483
12180.1192 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-26-2-S



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7.00959774e+06 1.0149705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045727e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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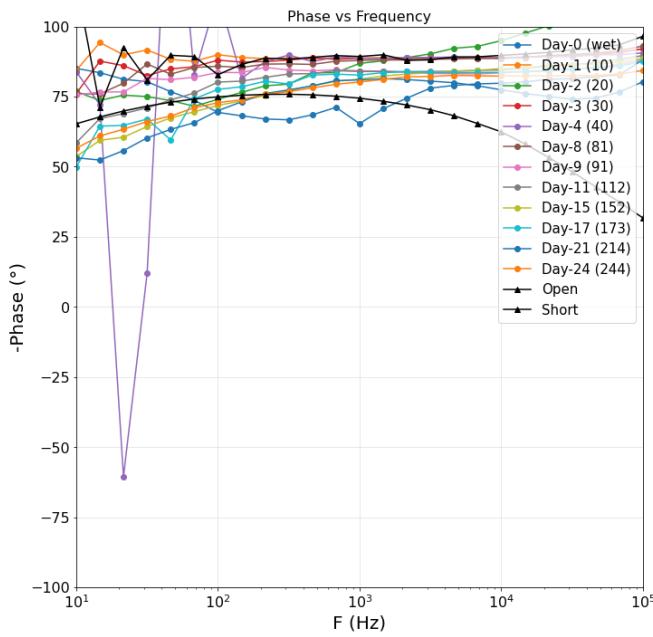
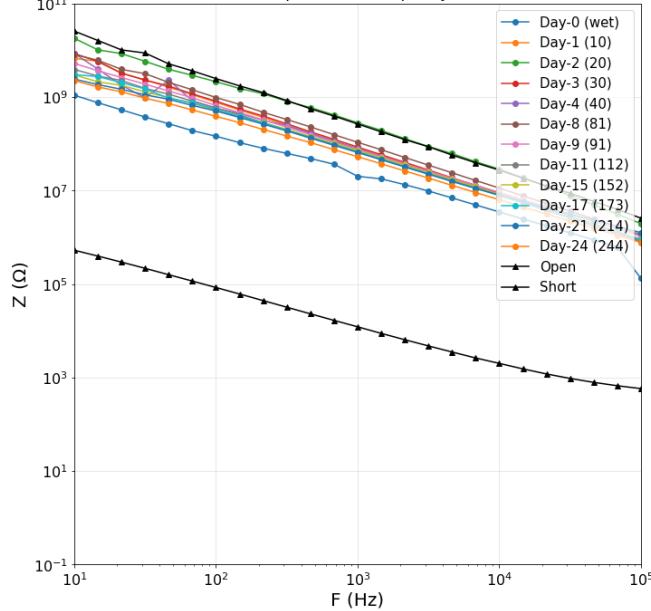
IDE-26-4-m



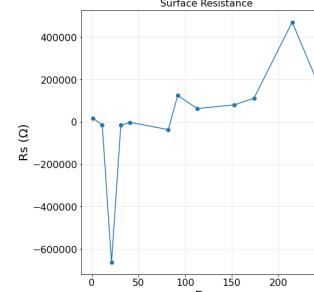
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.93195988e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.192 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-26-4-S

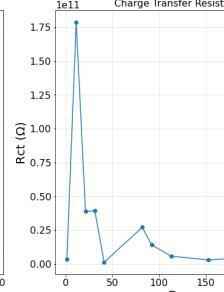
Impedance vs Frequency



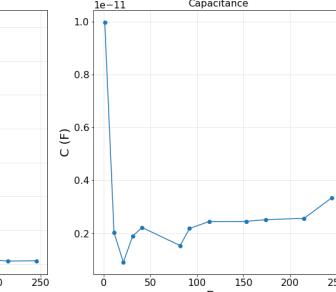
Surface Resistance



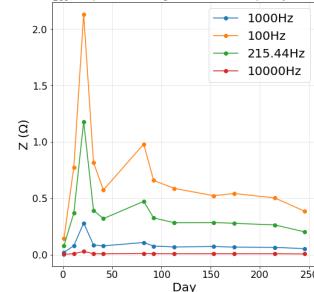
Charge Transfer Resistance



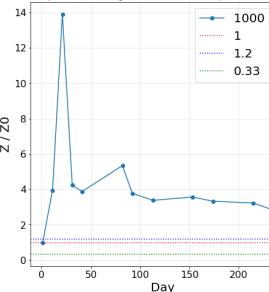
Capacitance



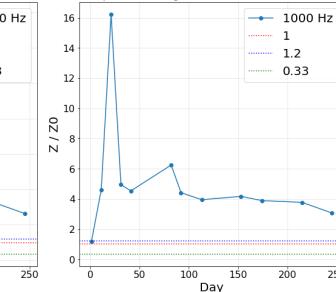
Impedance Change At Different Frequency



Impedance Change At 1000 Hz, IDE Specific Criteria

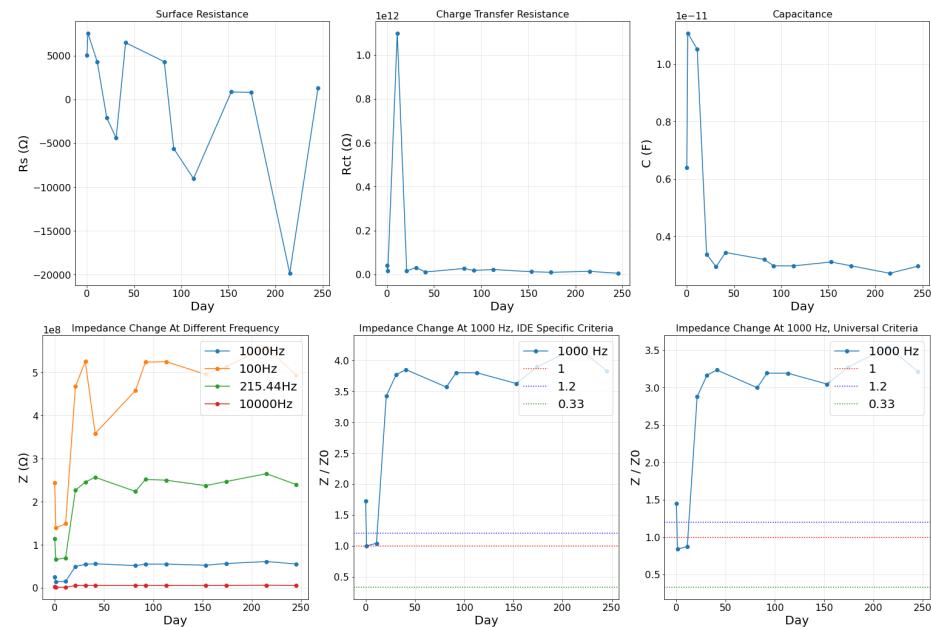
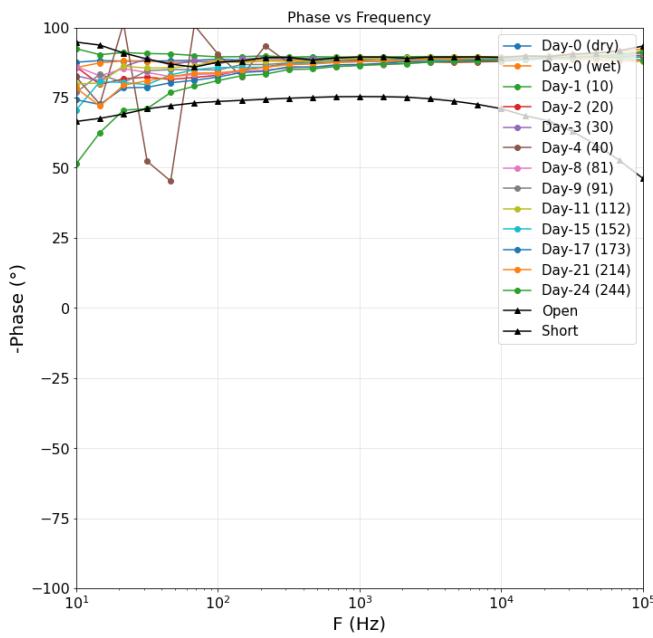
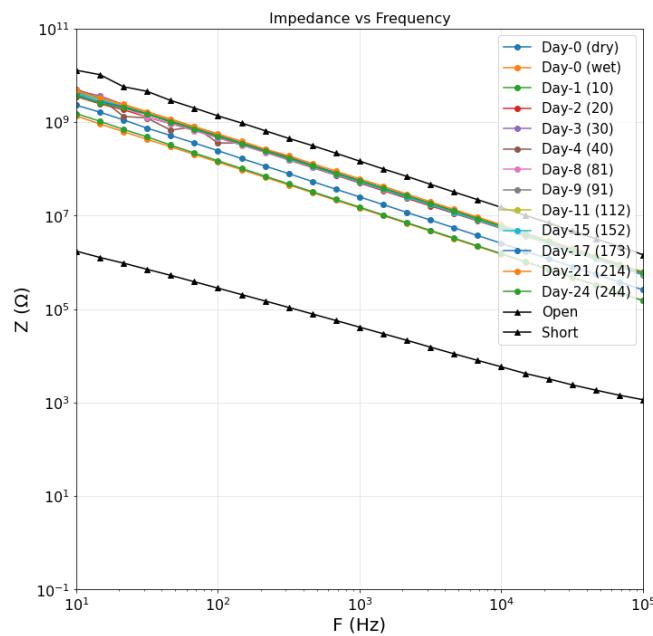


Impedance Change At 1000 Hz, Universal Criteria



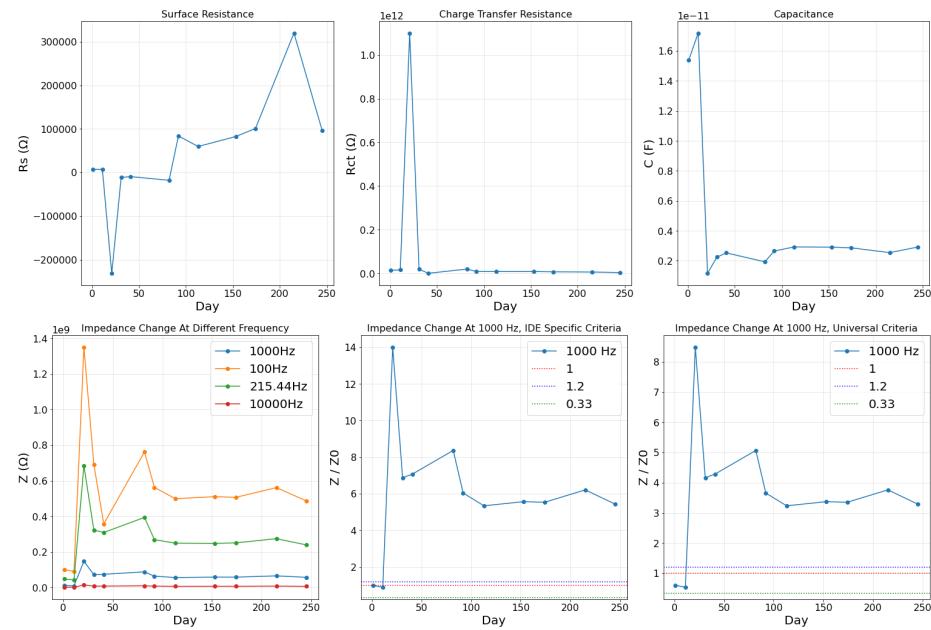
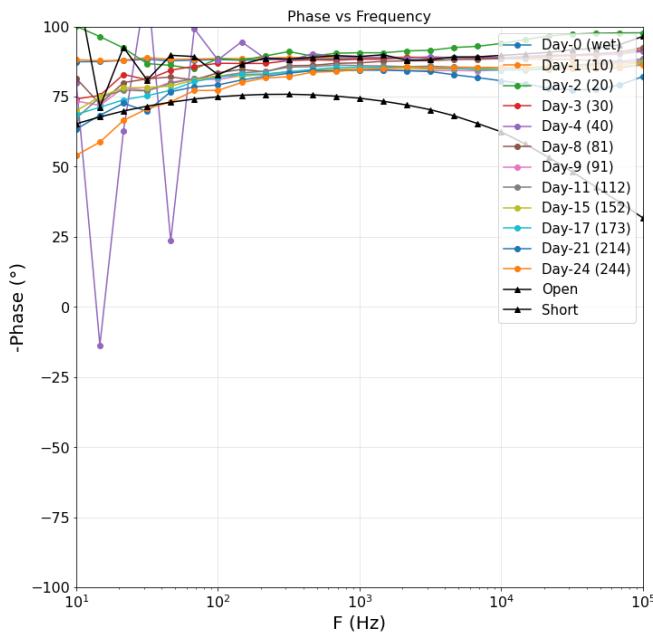
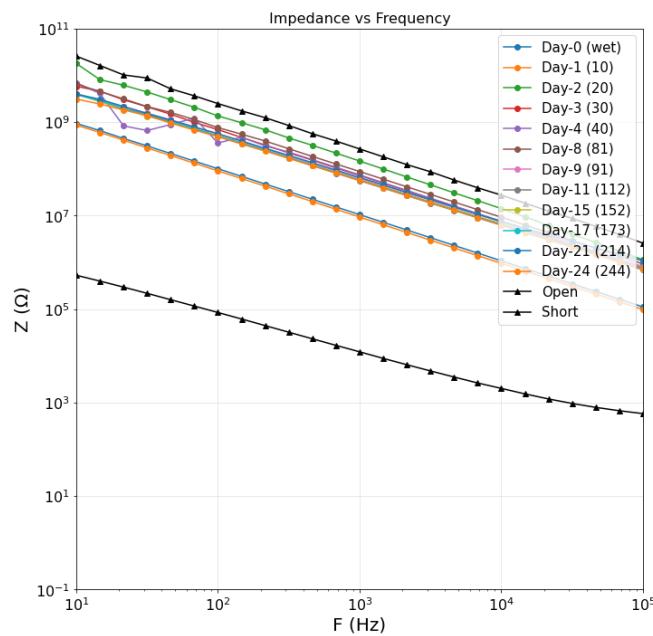
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[1.45838116e+06 2.179335960e+06 3.20788880e+06 4.70771339e+06
7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-26-8-m



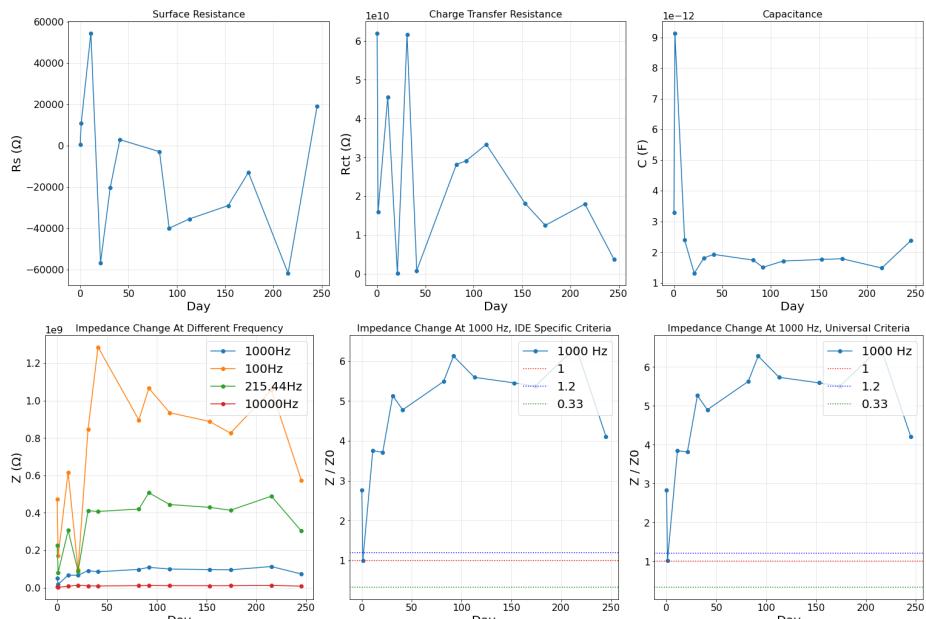
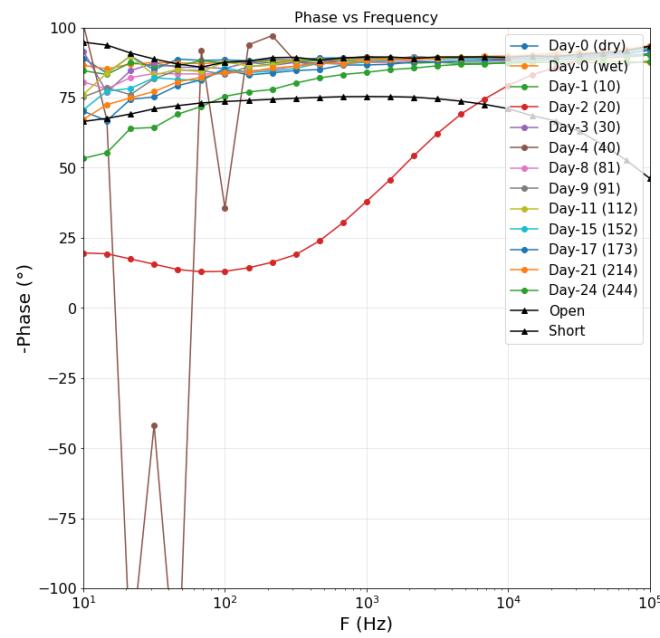
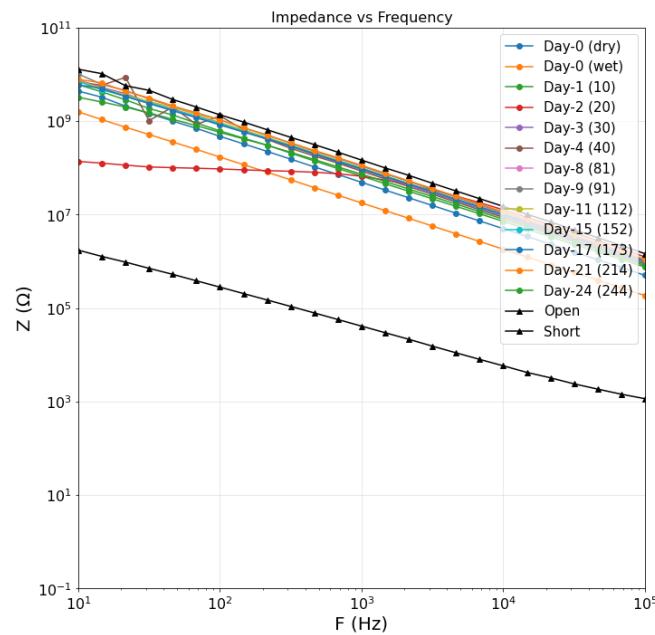
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.642022209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-26-8-s



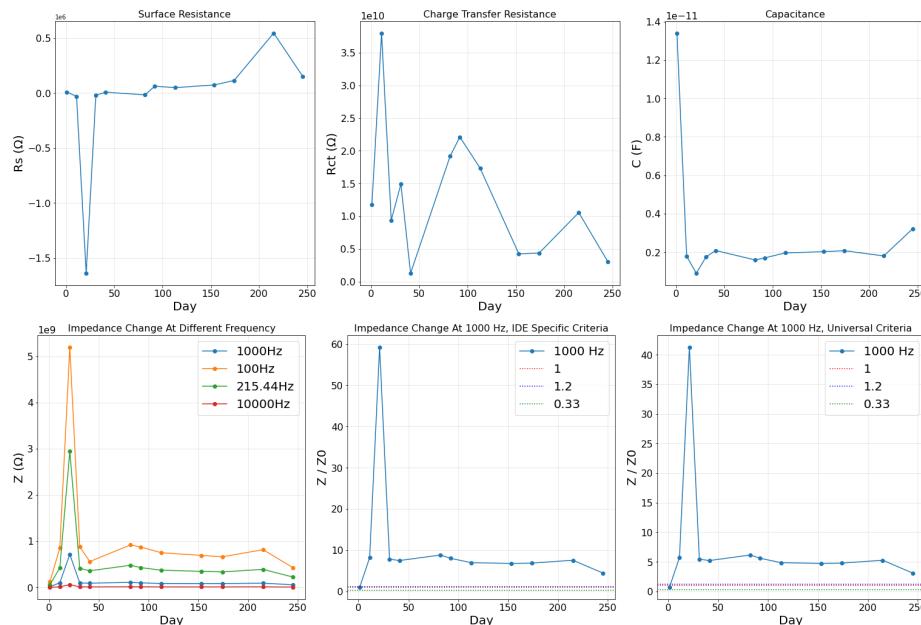
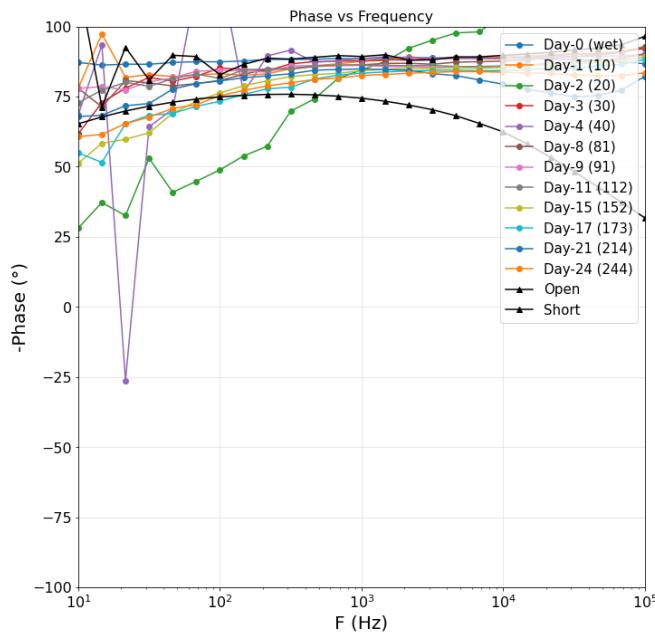
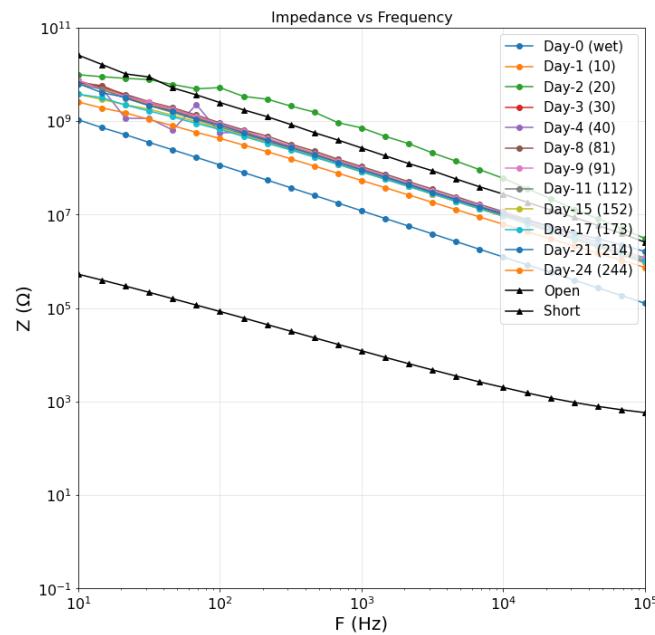
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-26-16-m



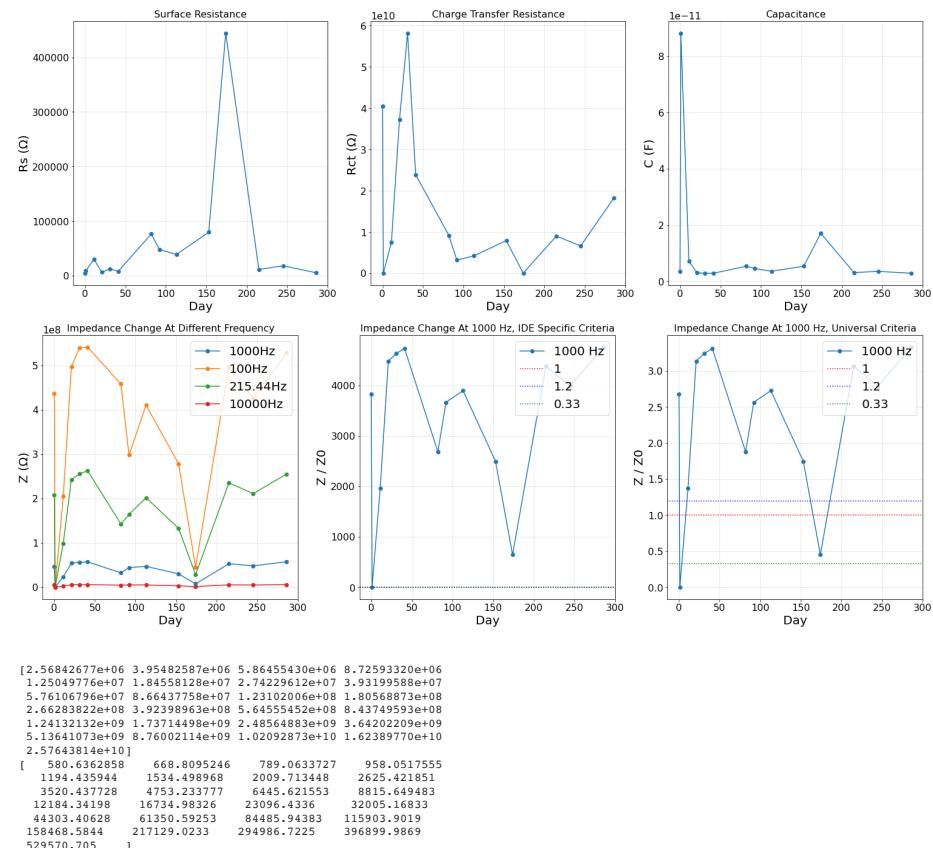
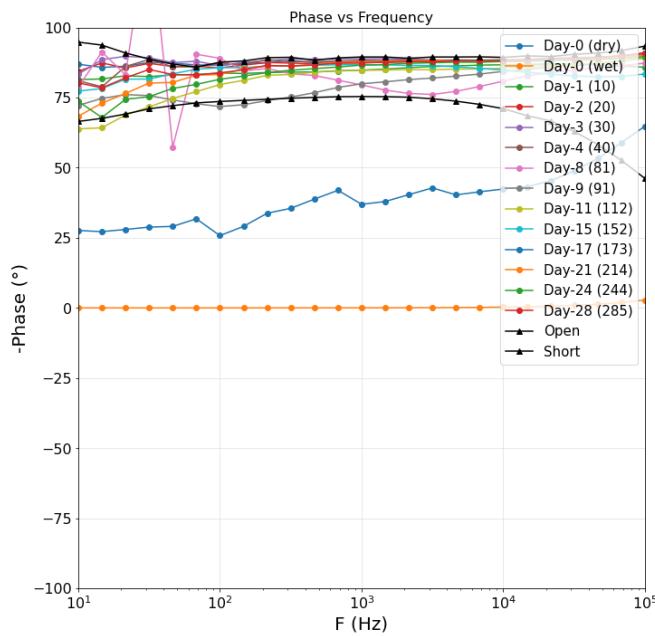
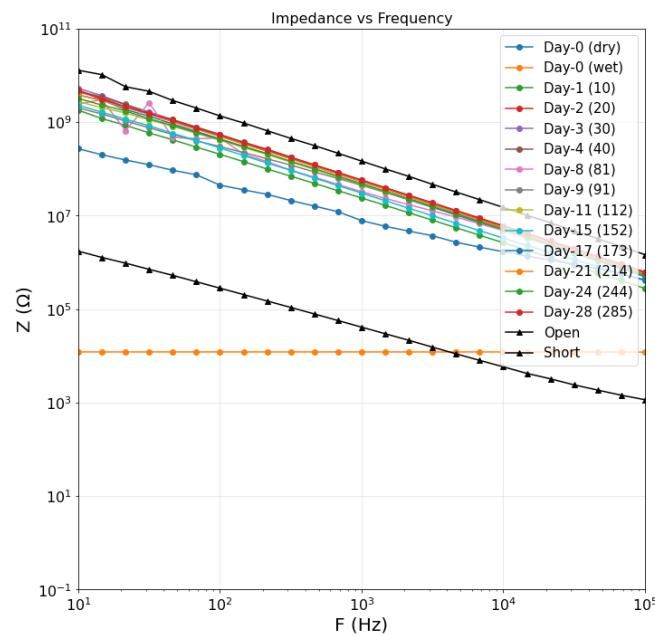
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.437128 4753.233777 6445.621553 8815.649483
12180.1192 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-26-16-s



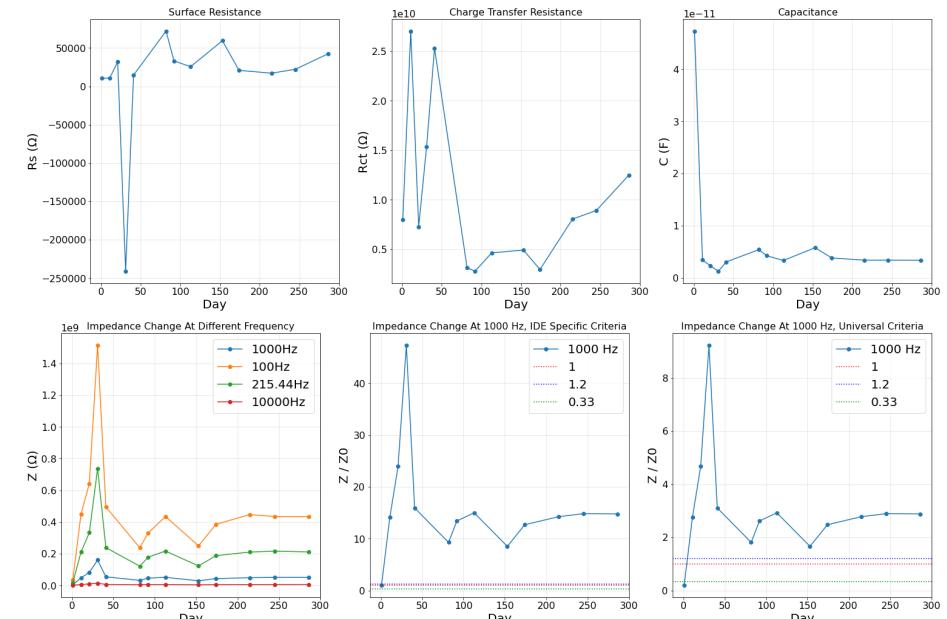
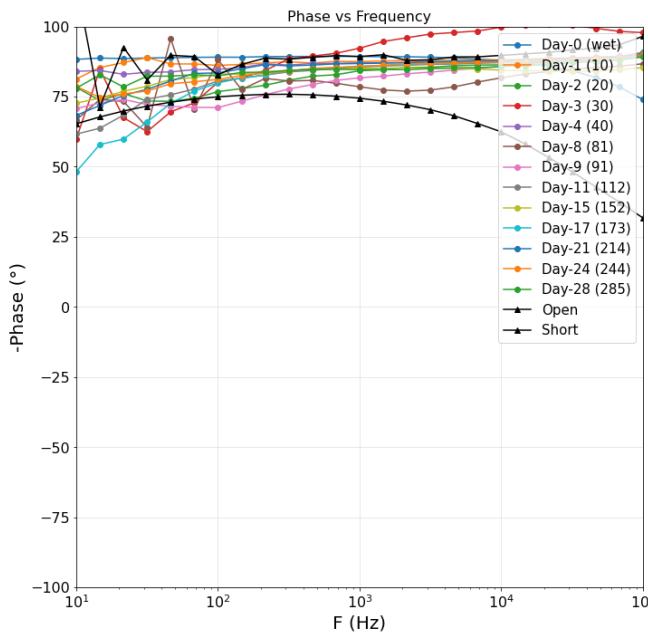
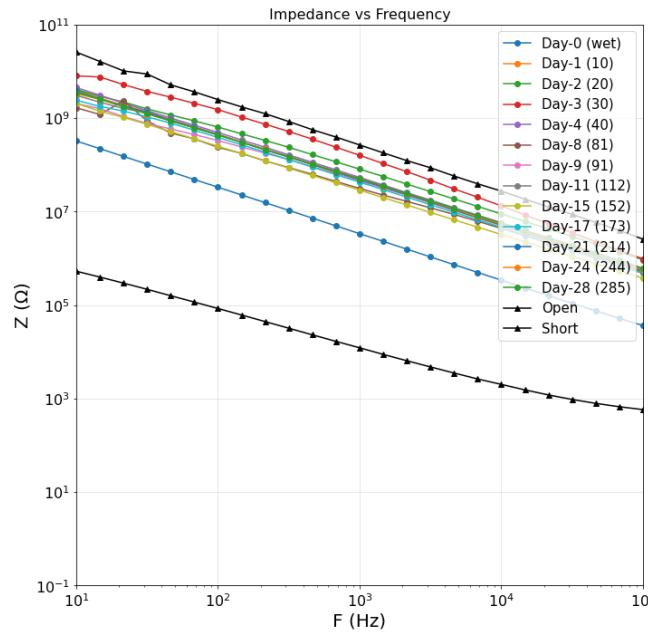
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19044779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-27-2-m



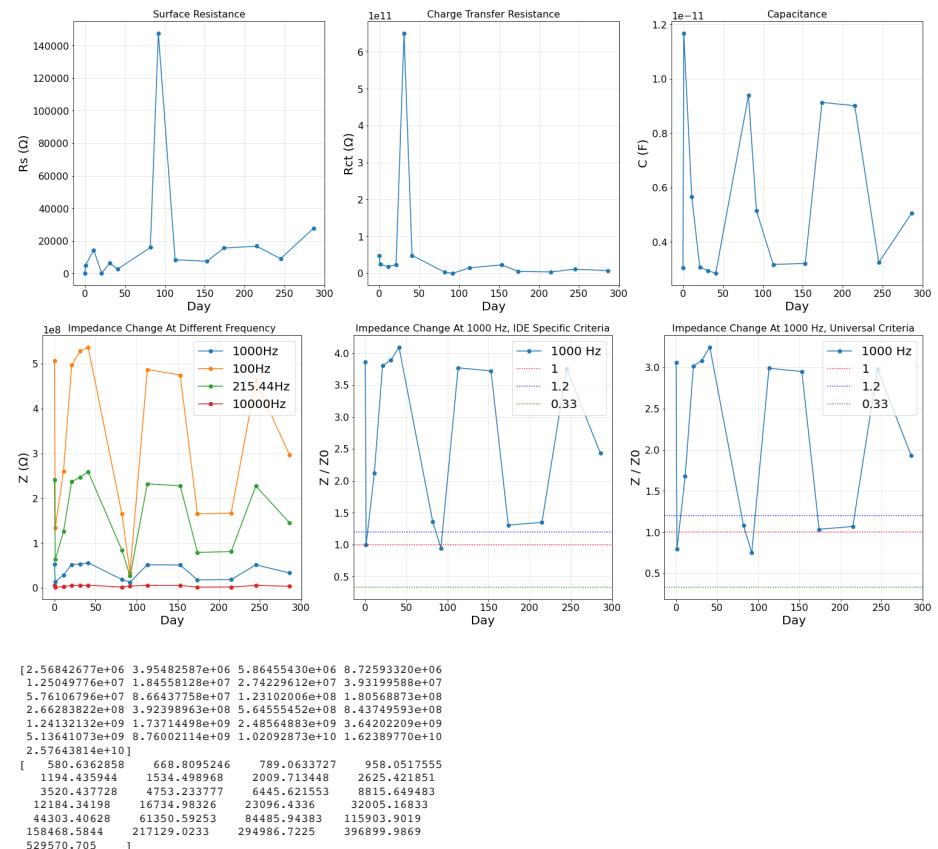
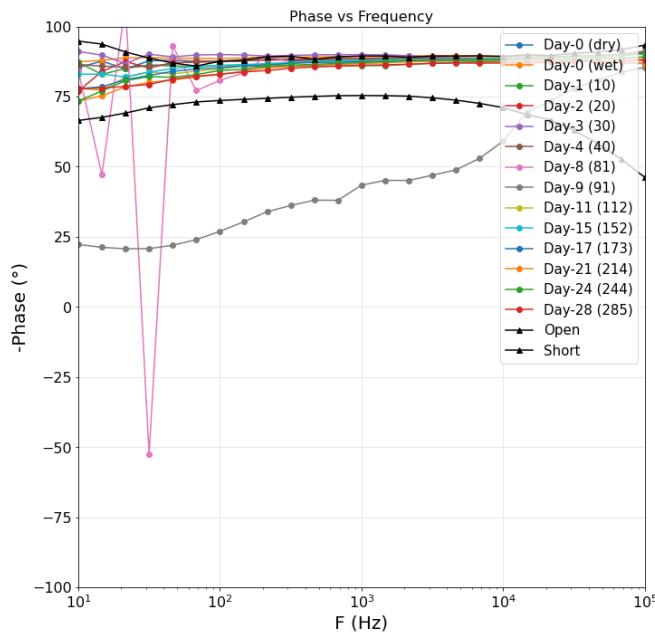
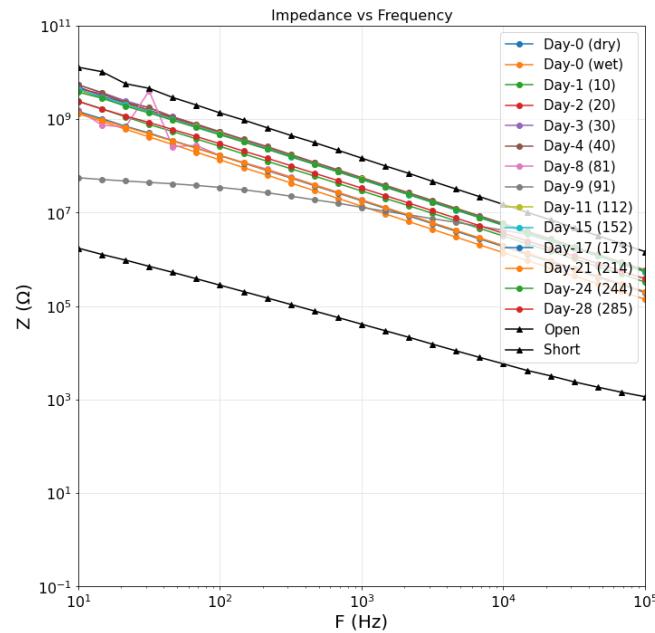
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.9319588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.1928 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-27-2-S

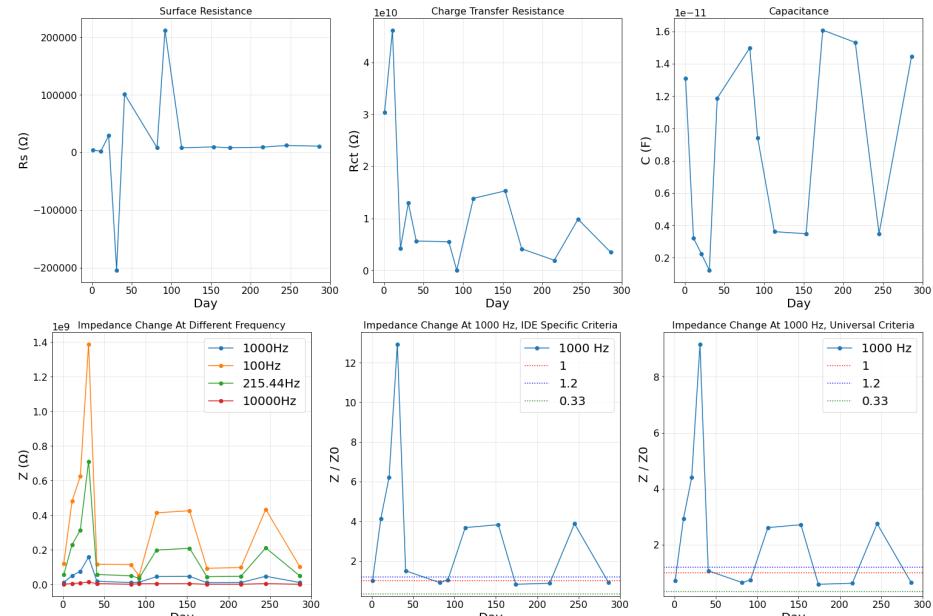
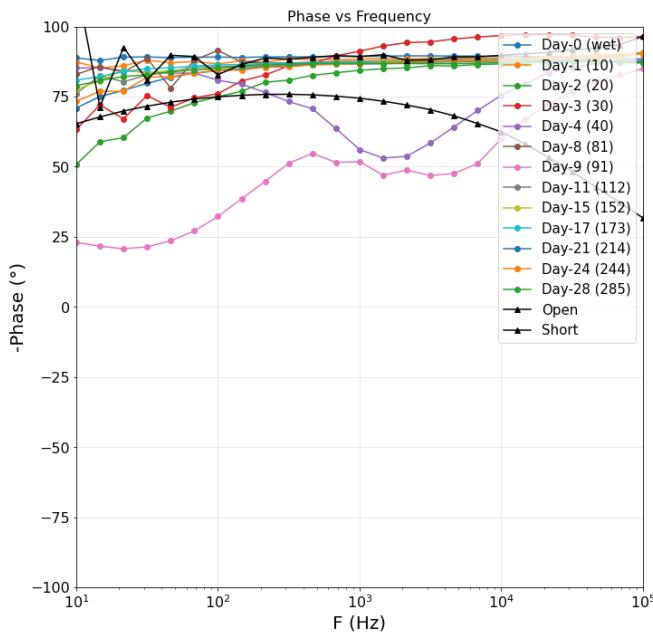
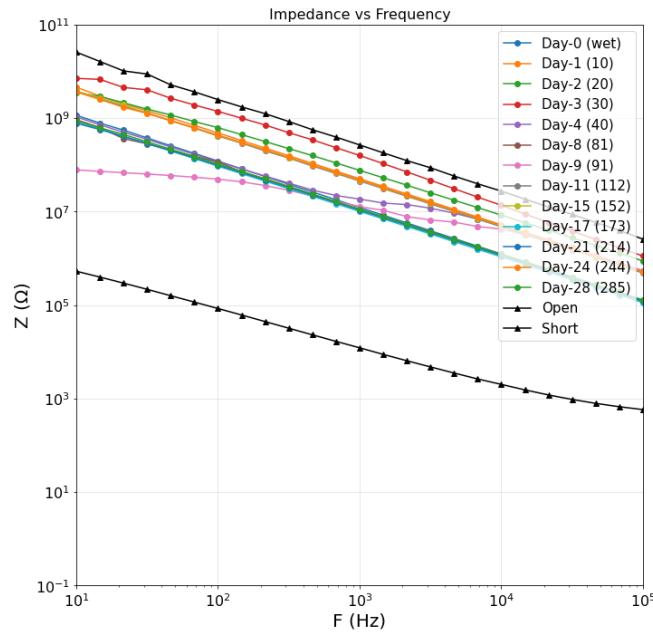


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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-27-4-m

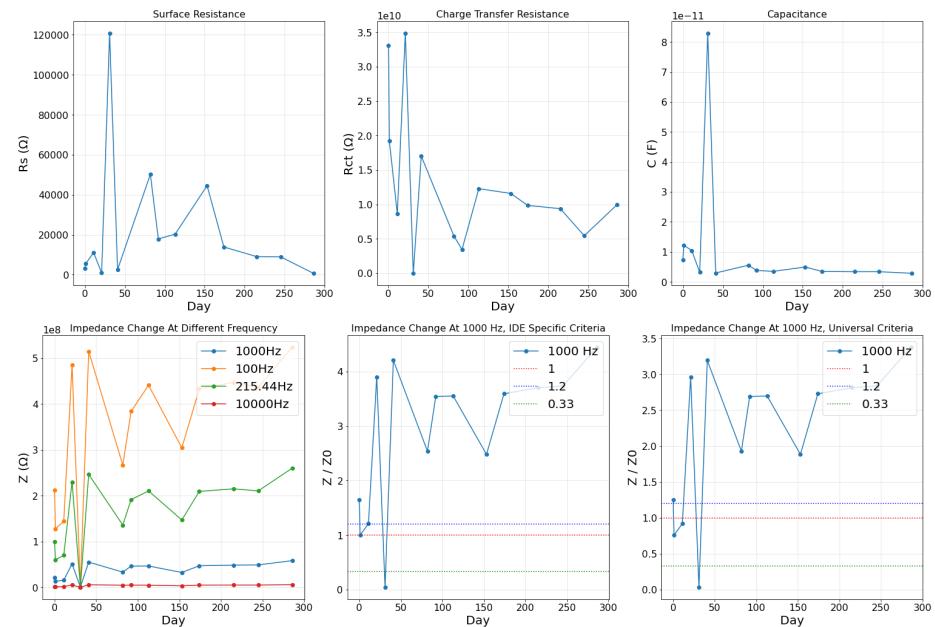
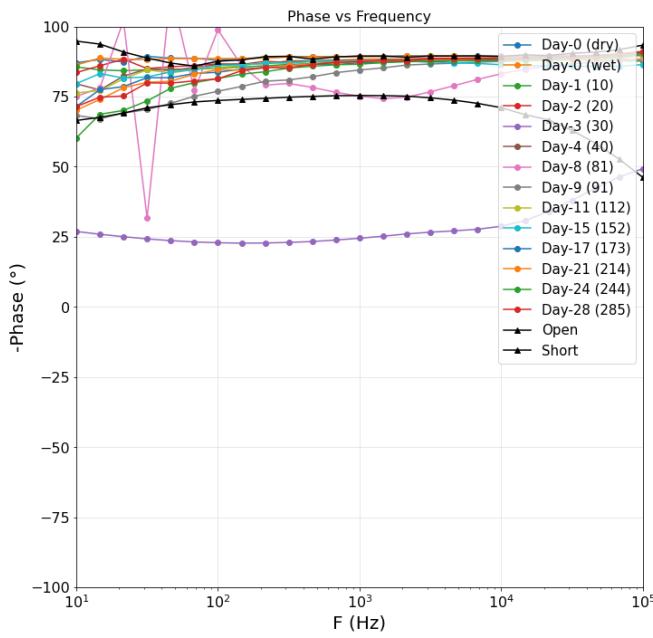
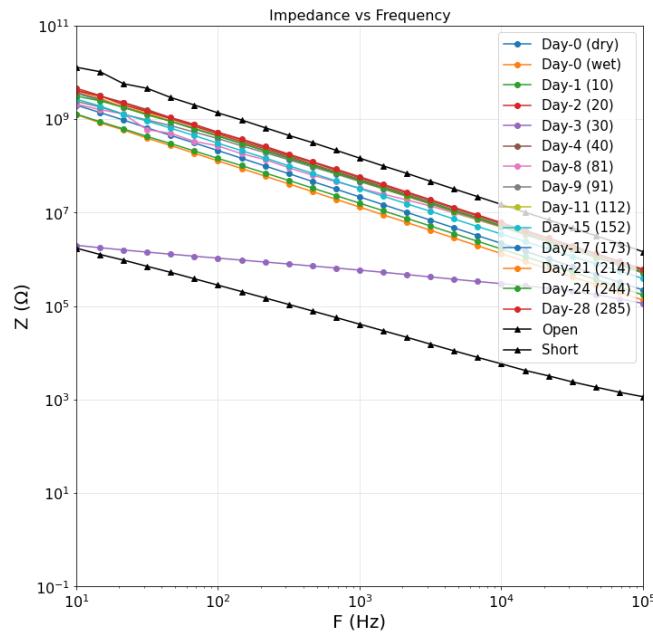


IDE-27-4-S



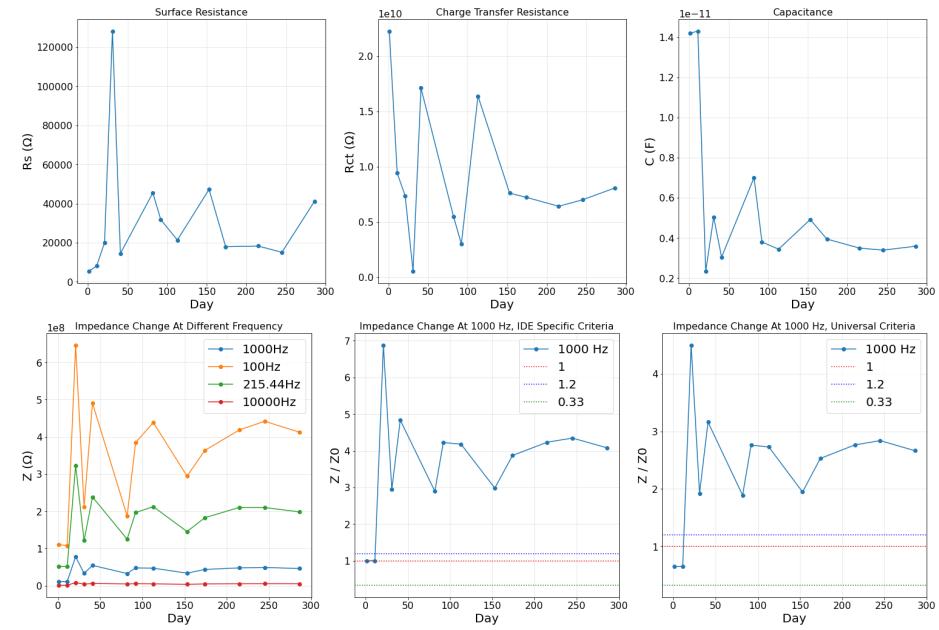
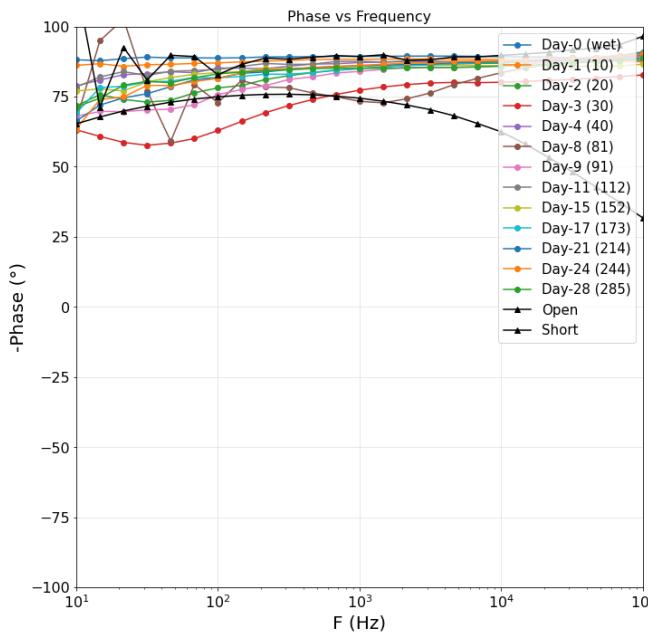
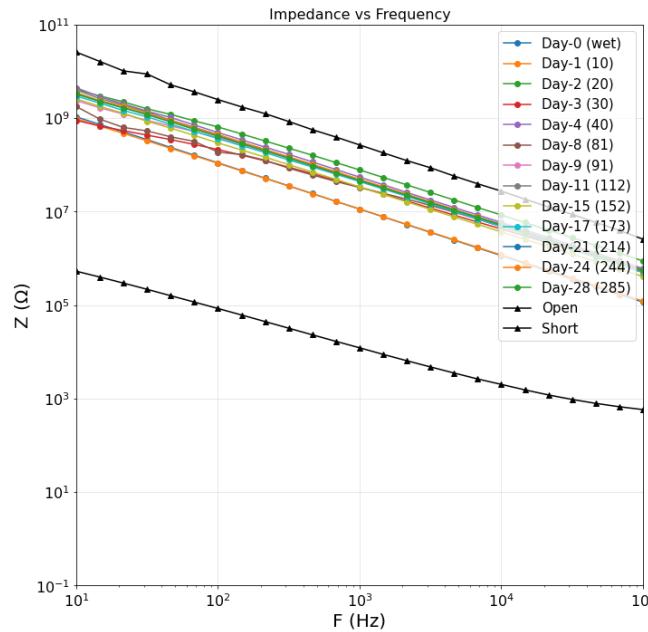
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045727e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-27-8-m



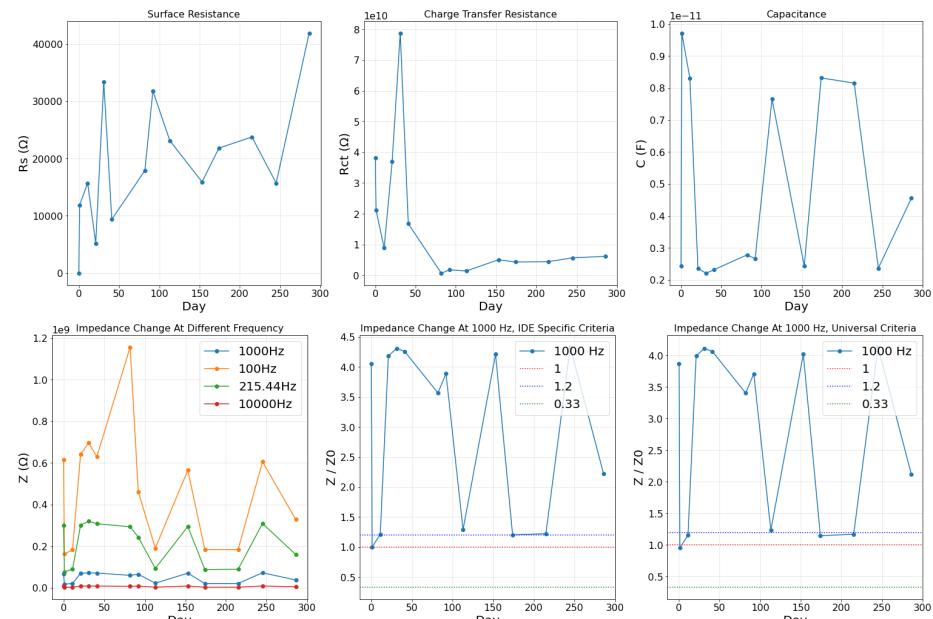
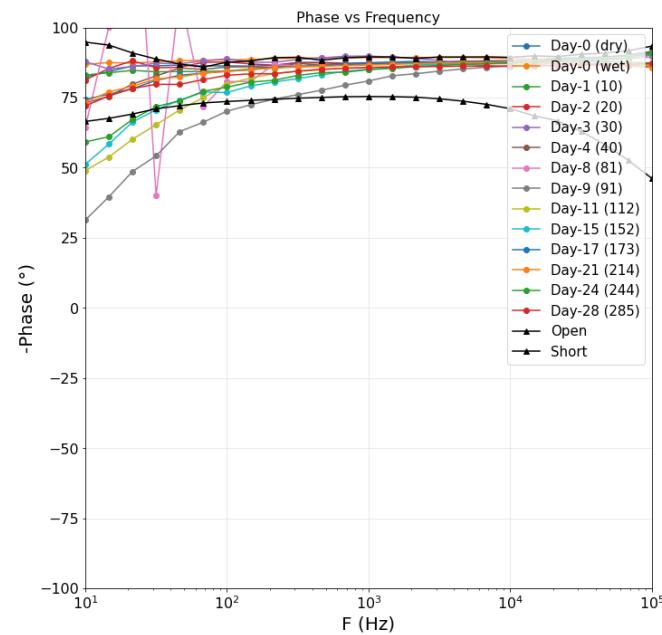
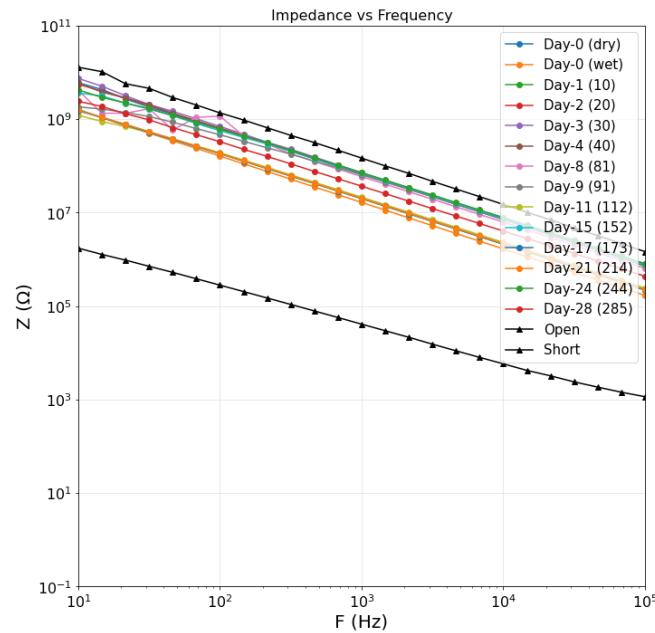
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.192 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
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IDE-27-8-S



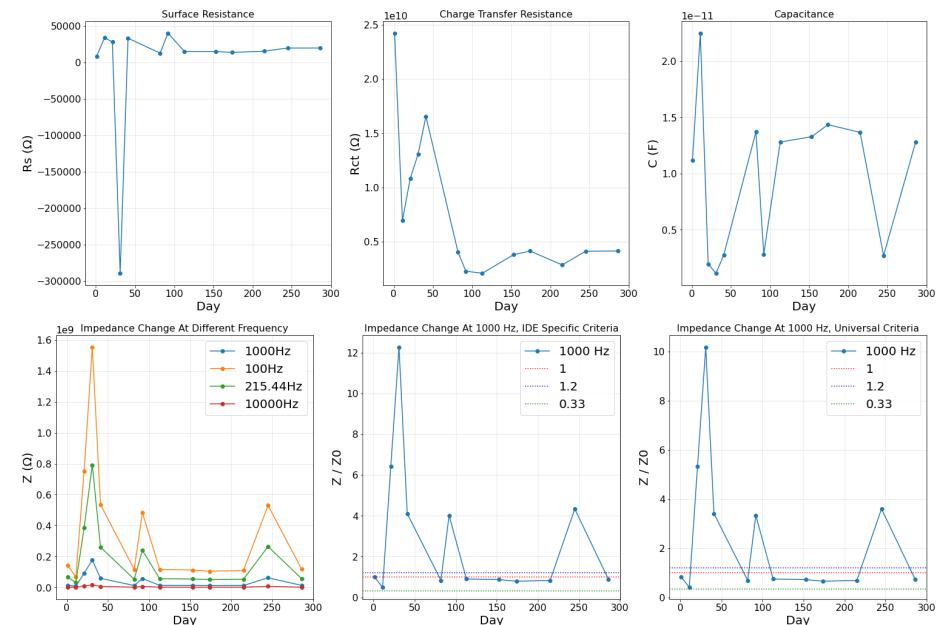
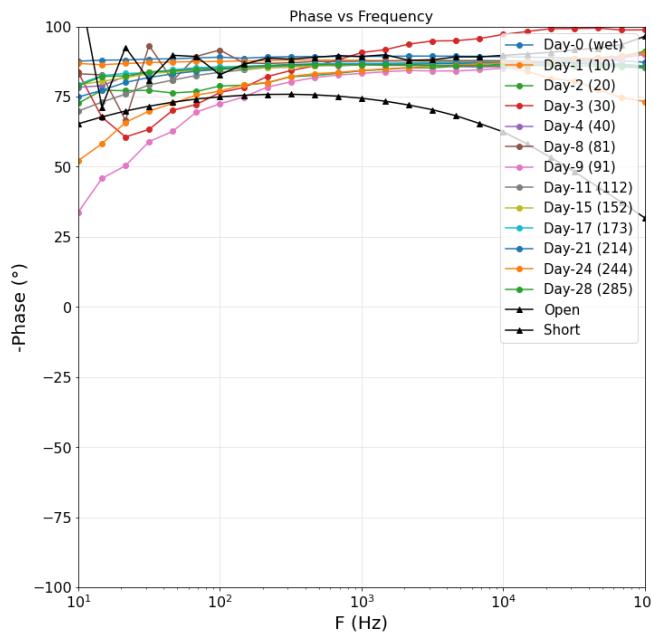
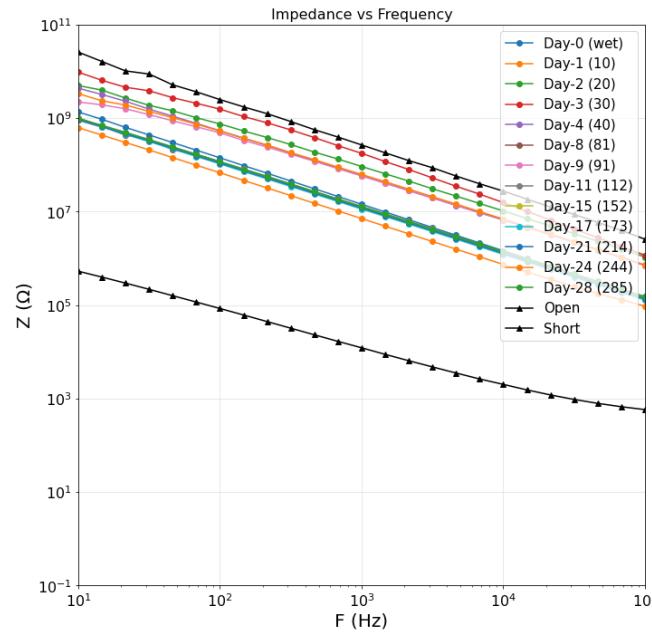
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3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-27-16-m



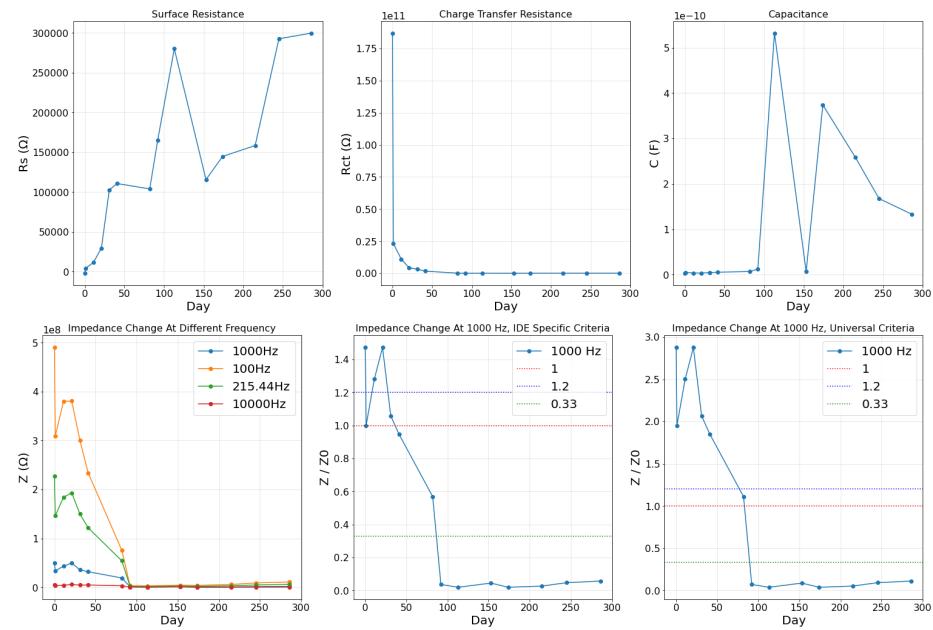
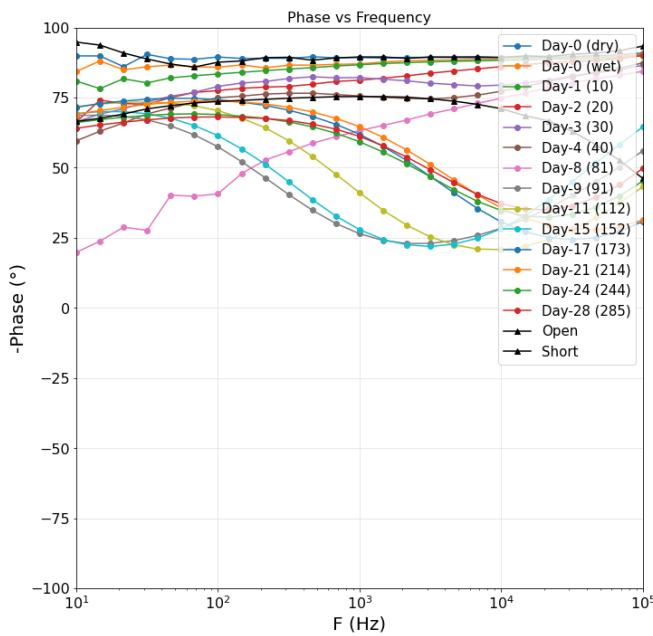
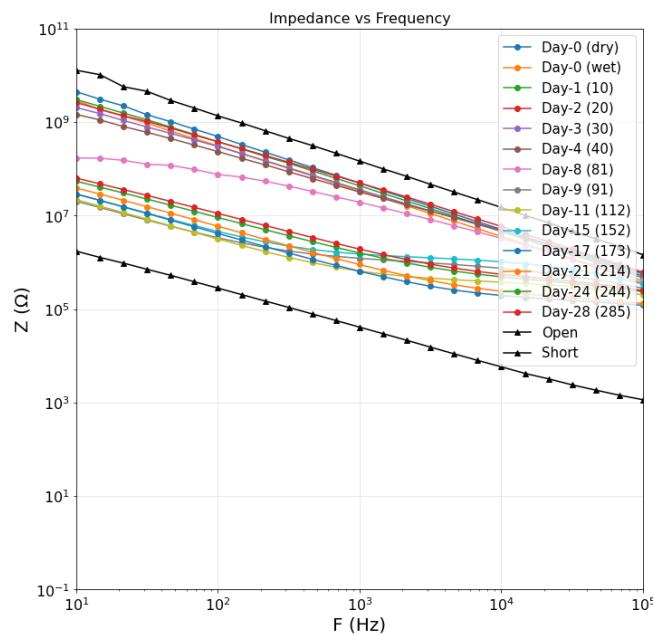
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.642022209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.1928 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
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IDE-27-16-s



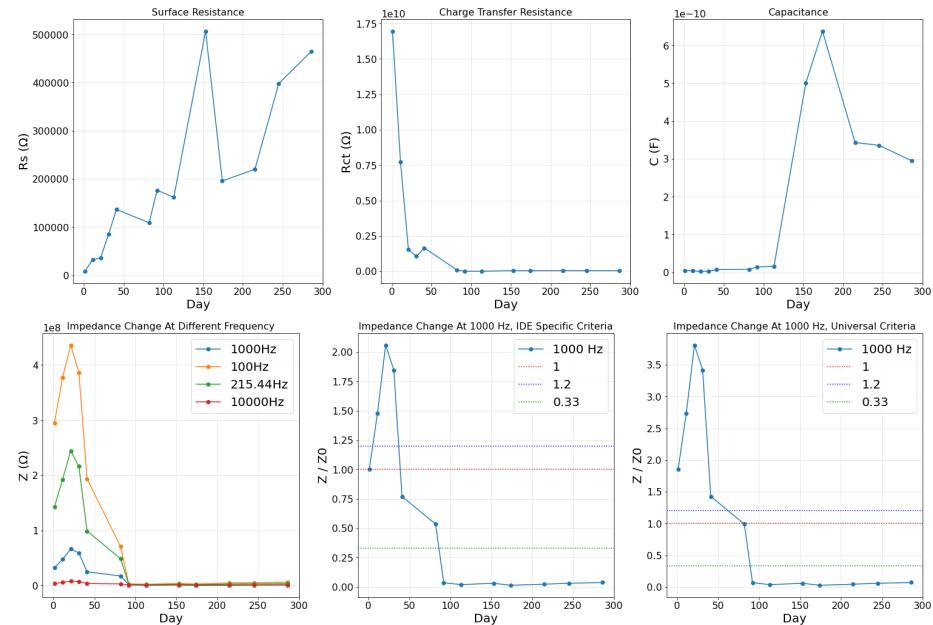
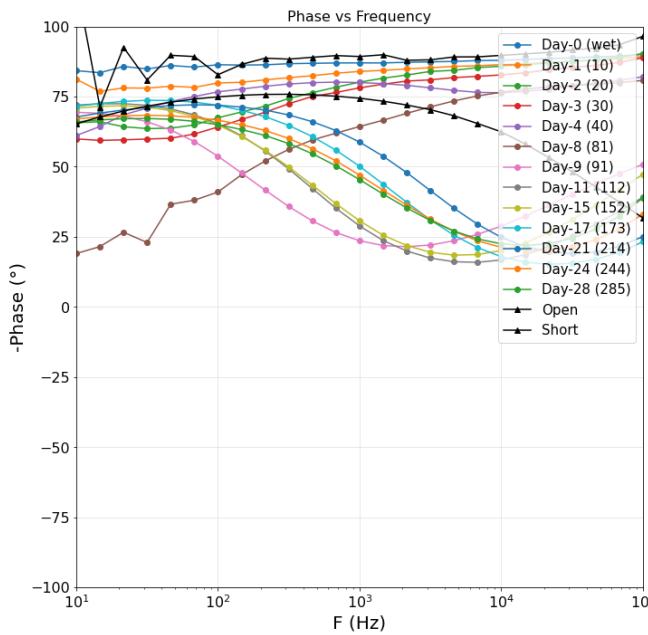
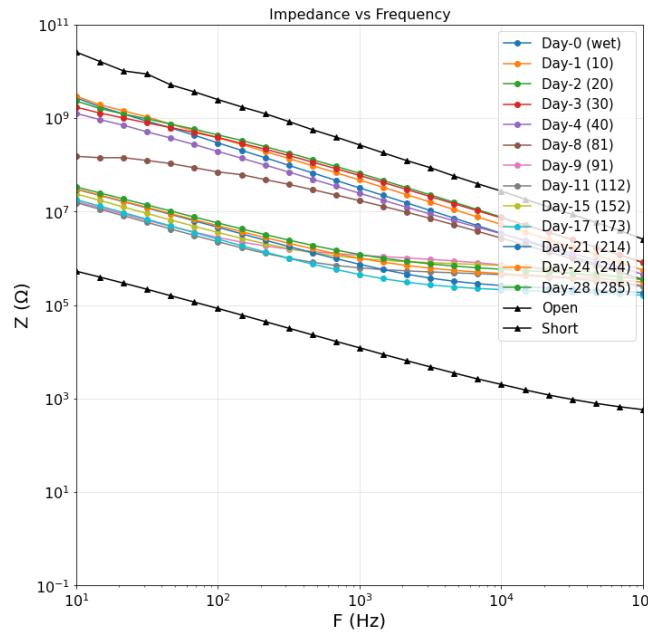
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-28-2-m



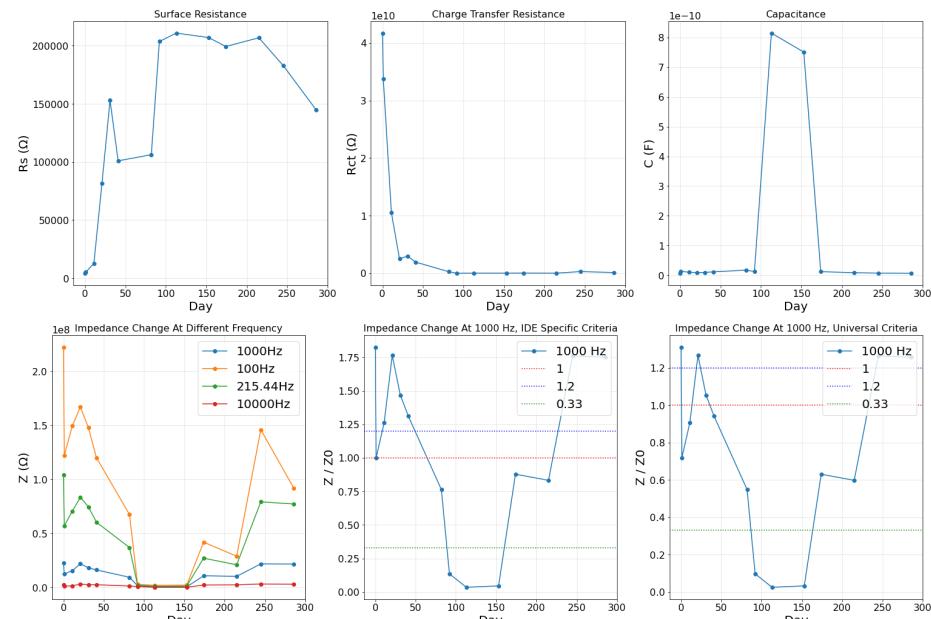
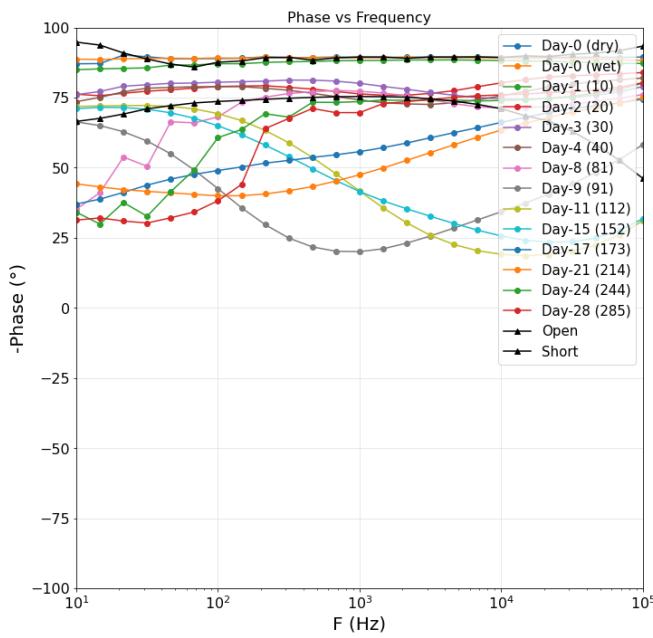
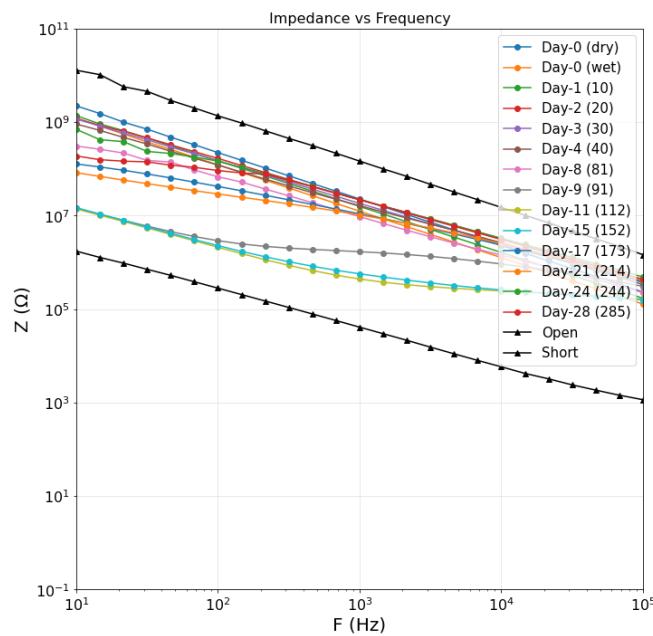
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.192 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
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IDE-28-2-S



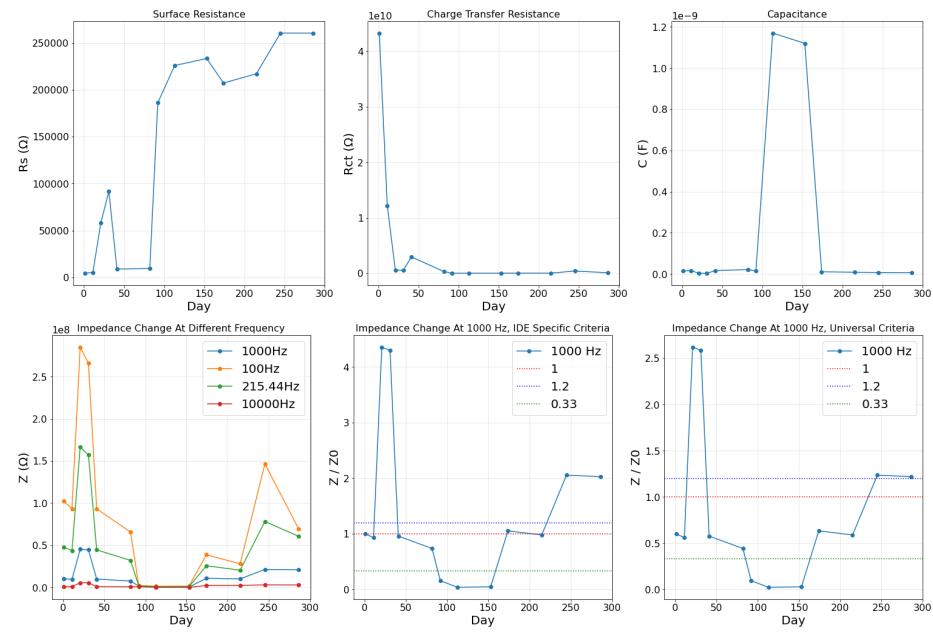
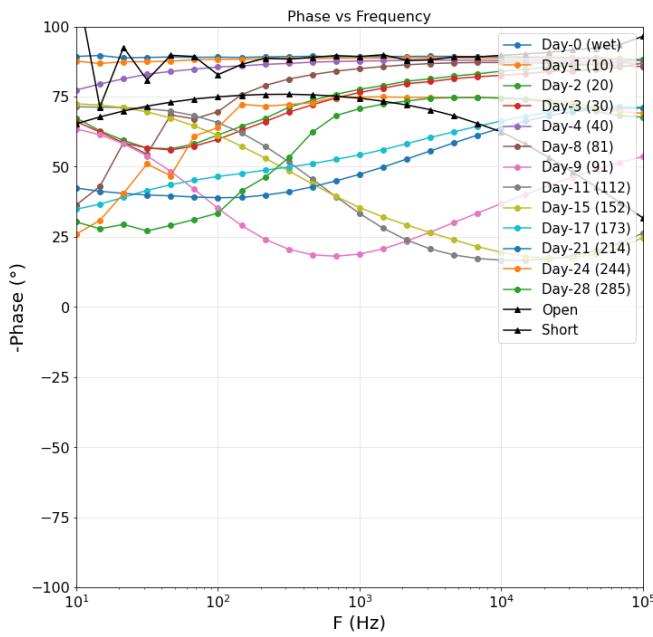
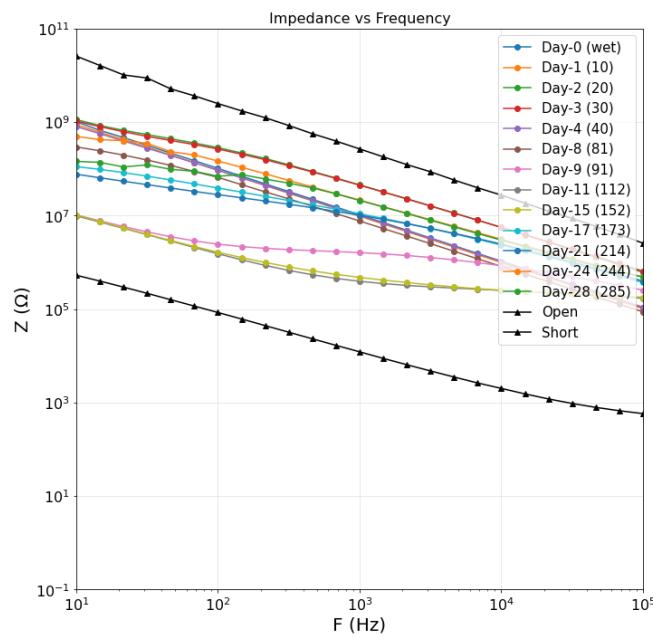
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-28-4-m



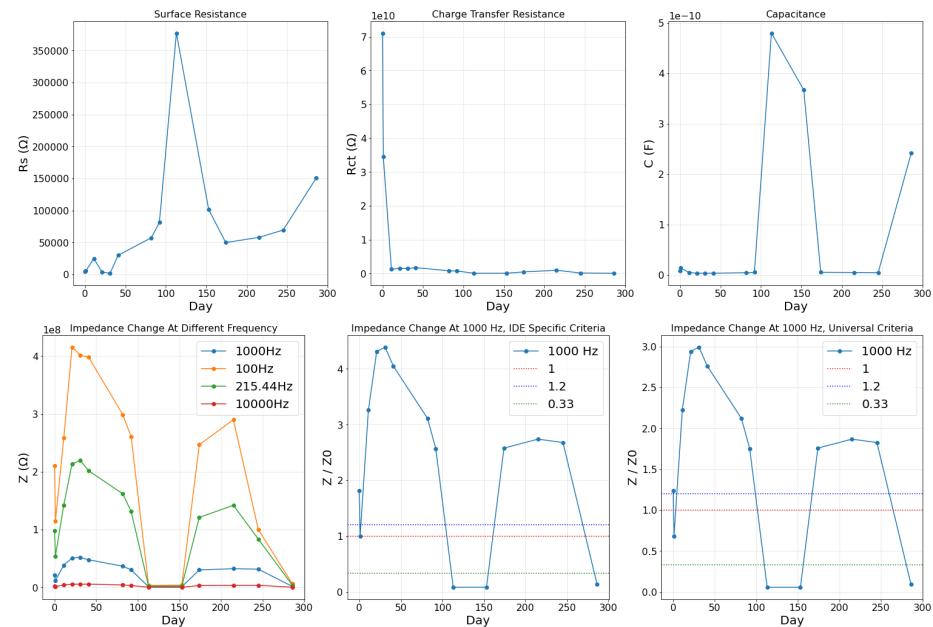
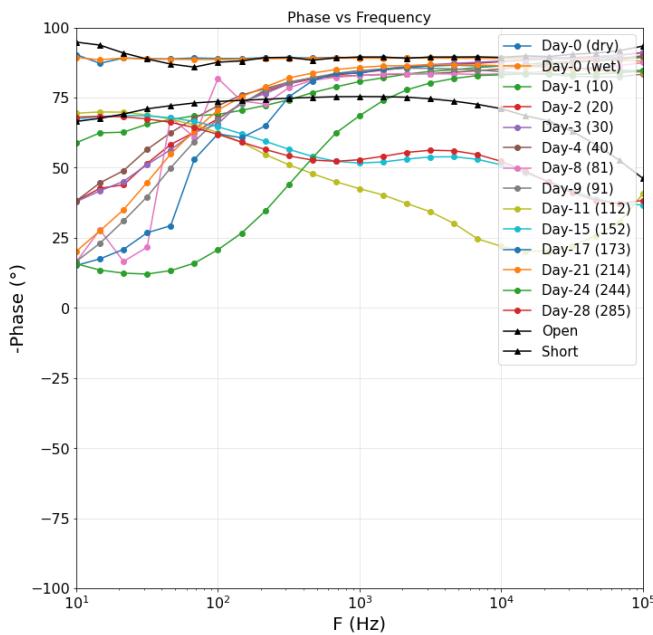
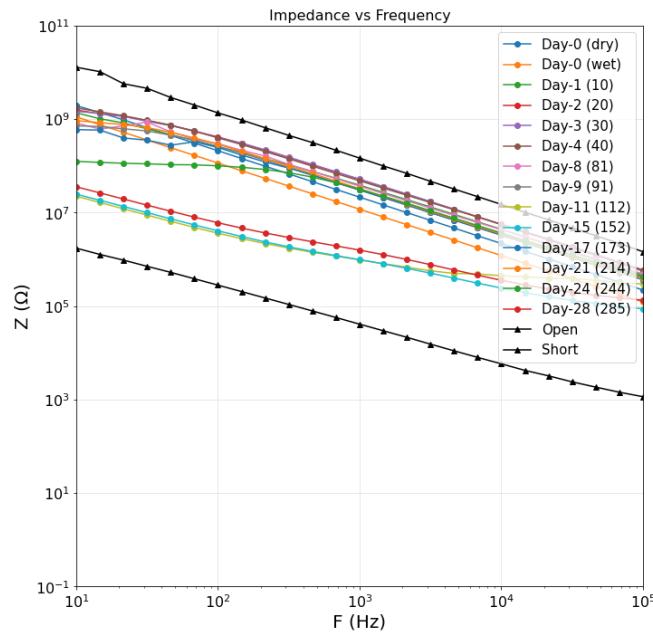
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5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.1928 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-28-4-S



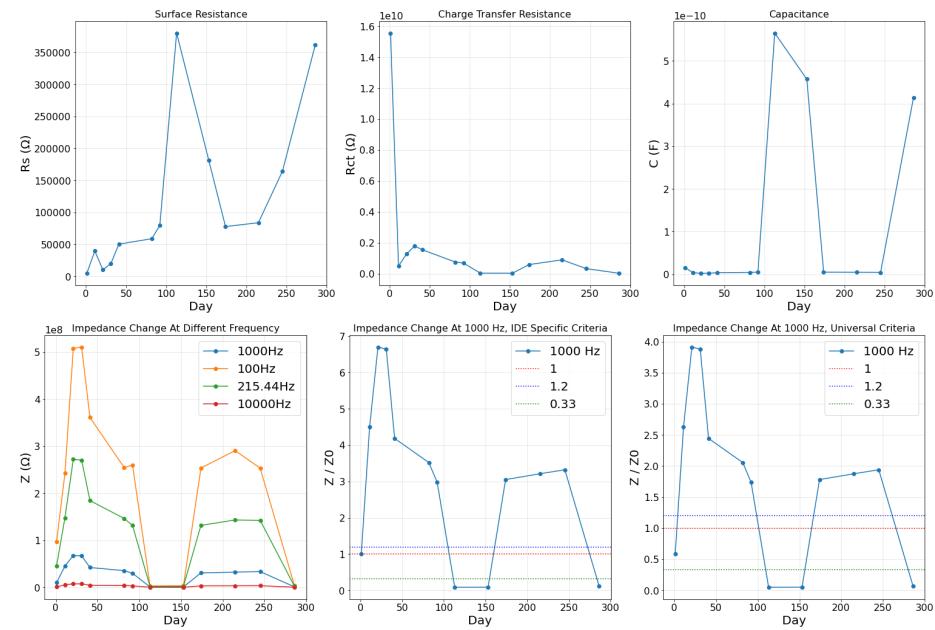
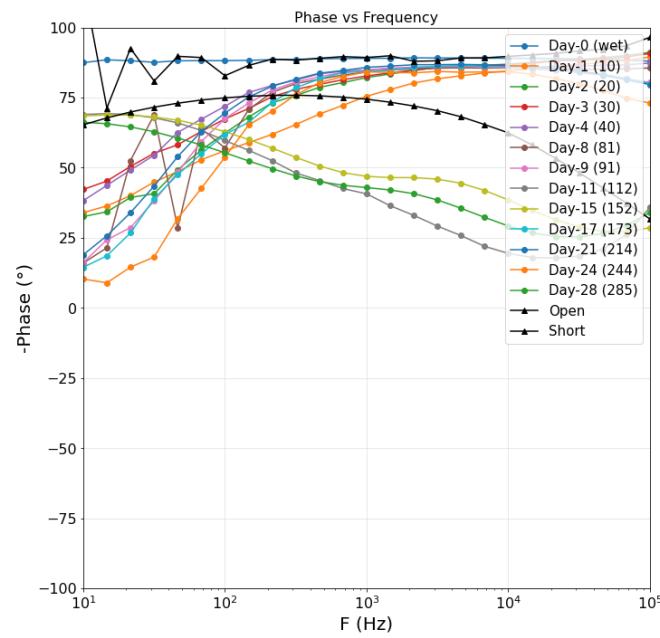
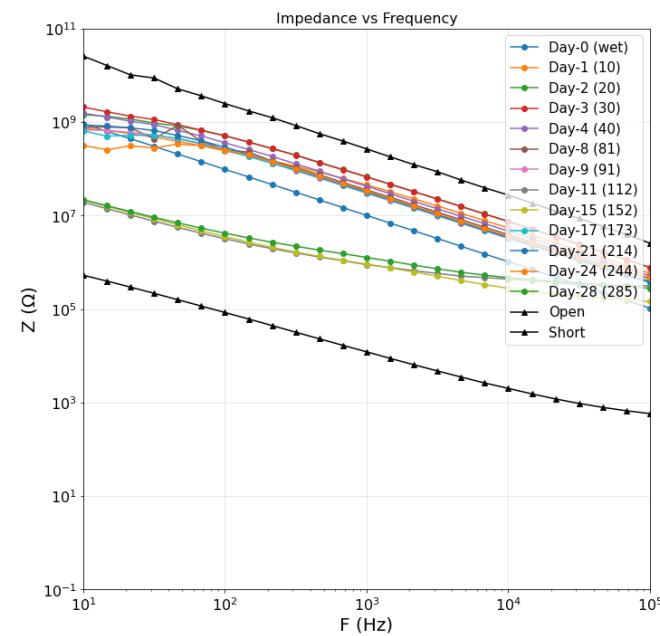
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-28-8-m



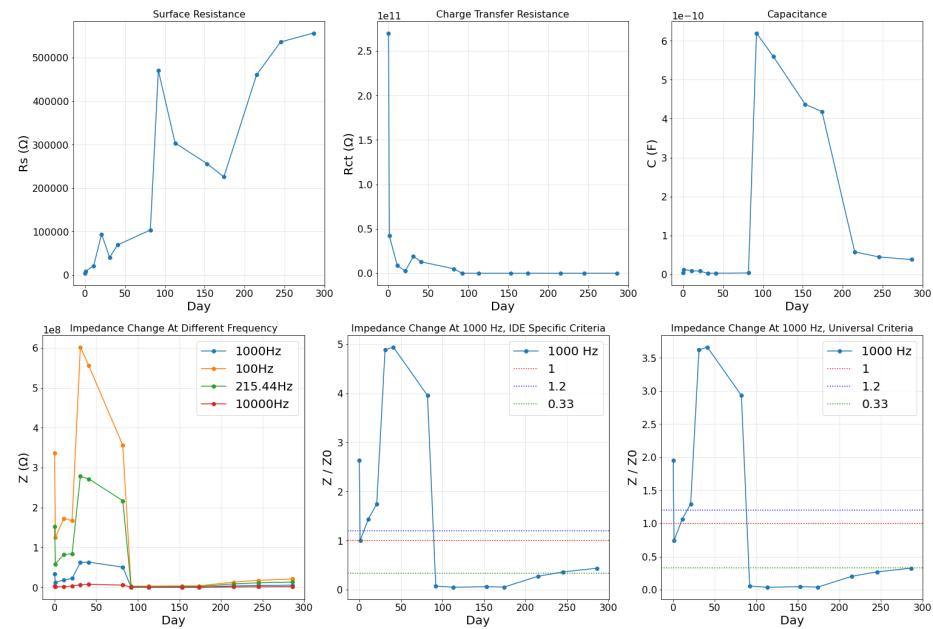
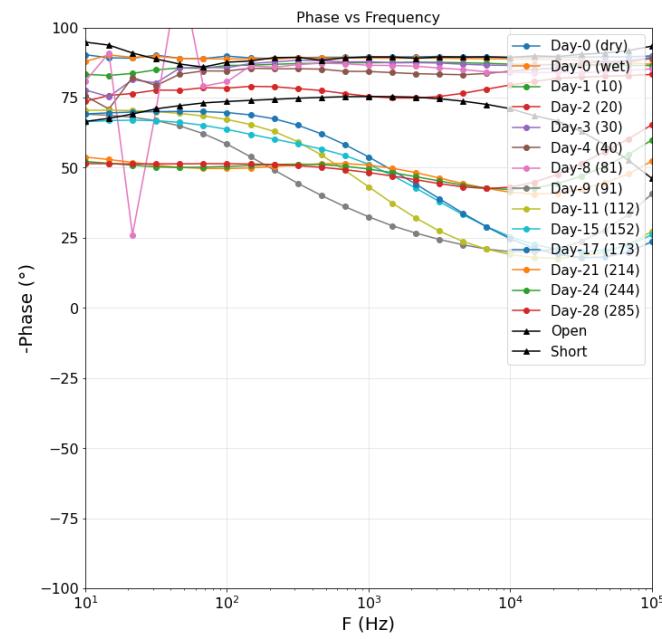
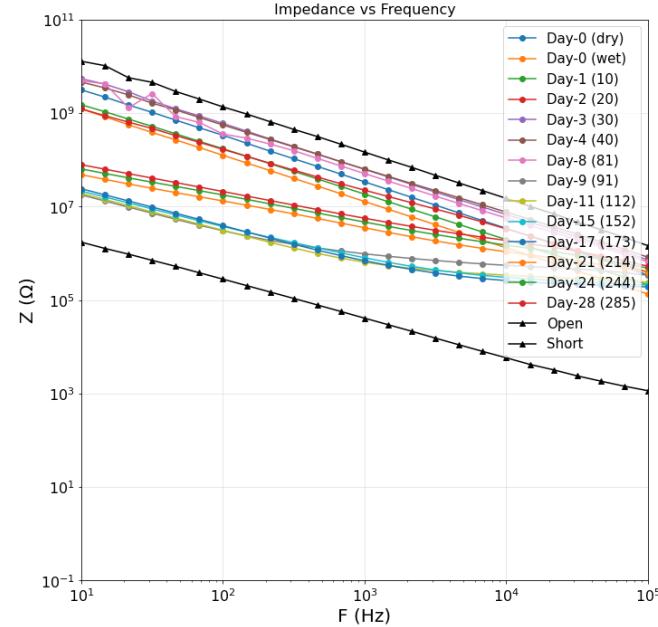
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1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.192 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-28-8-S



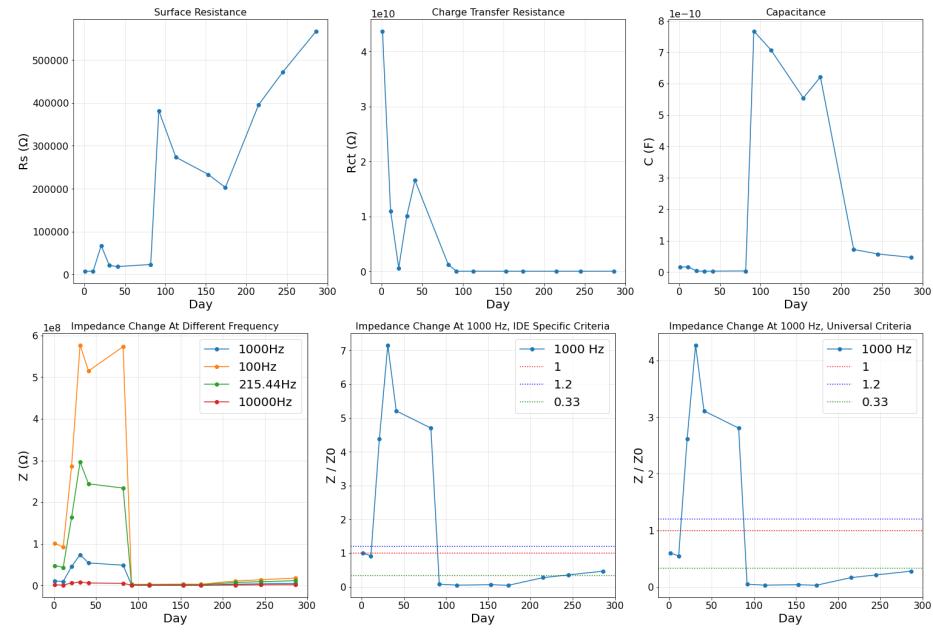
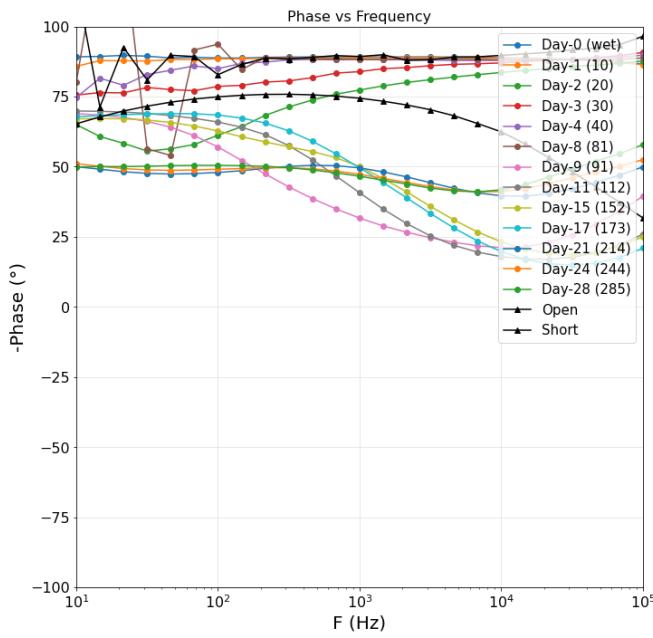
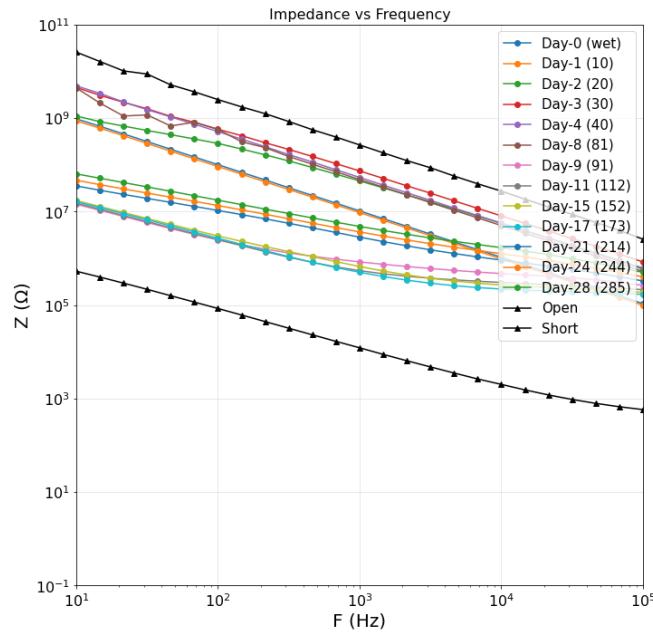
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7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
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IDE-28-16-m



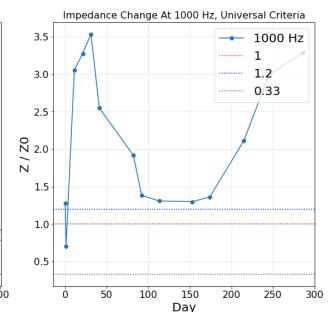
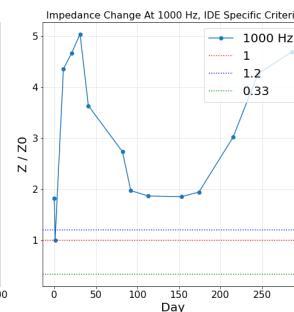
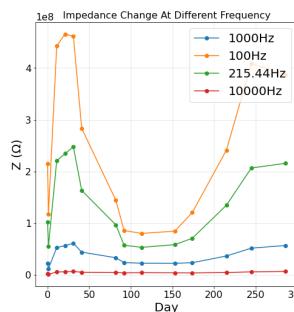
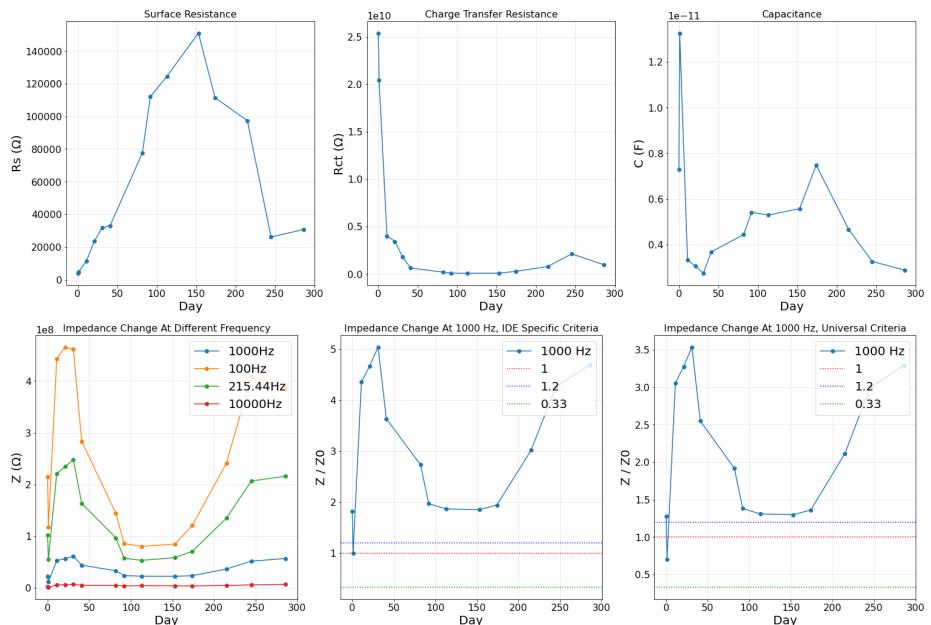
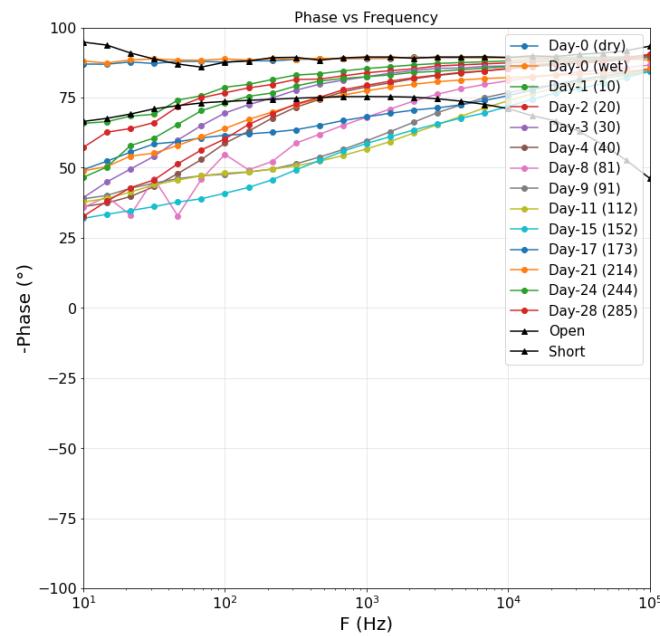
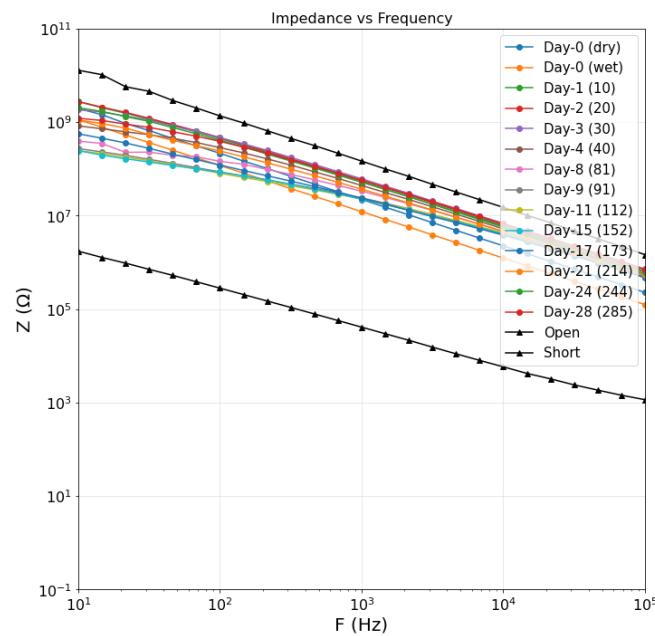
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[2.56842677e+06 3.95482587e+06 5.86455430e+06 8.72593320e+06
1.25049776e+07 1.84558128e+07 2.74229612e+07 3.9319588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.192 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-28-16-s



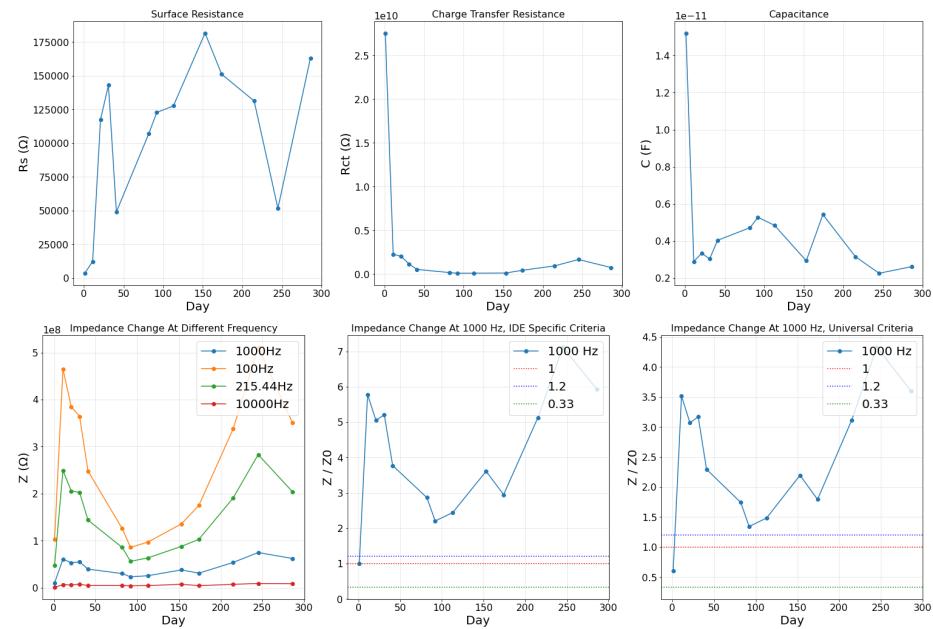
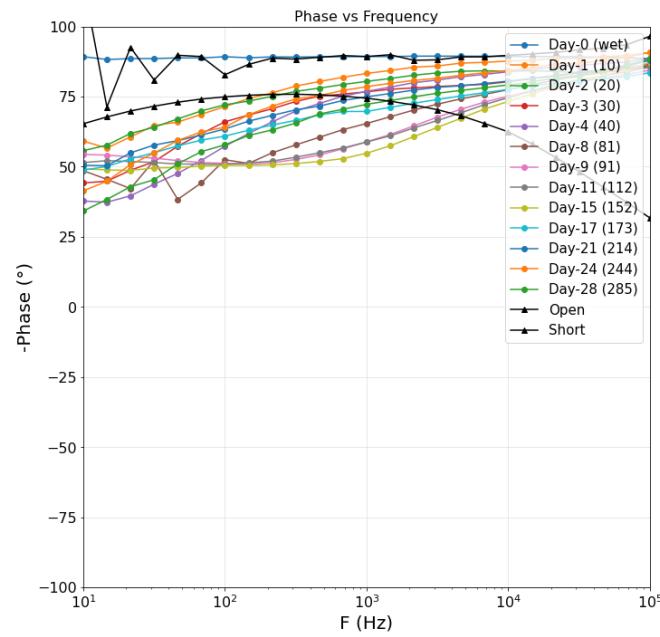
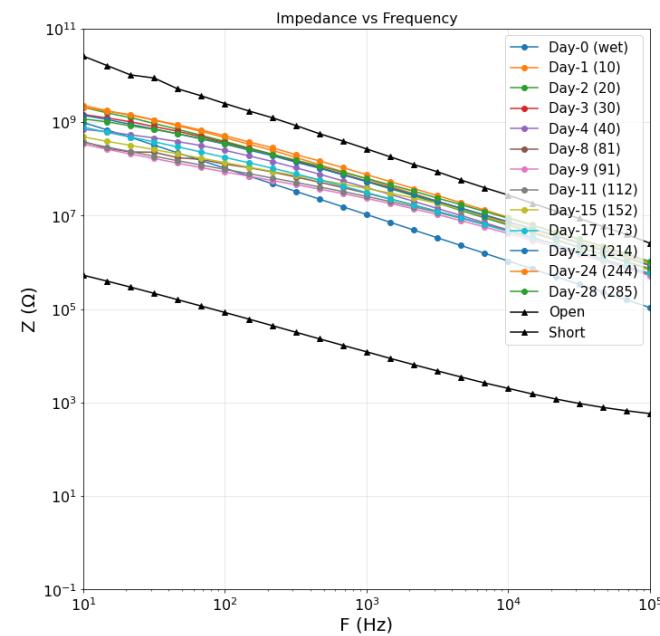
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[1.45838116e+06 2.179335960e+06 3.20788880e+06 4.70771339e+06
7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-31-2-m



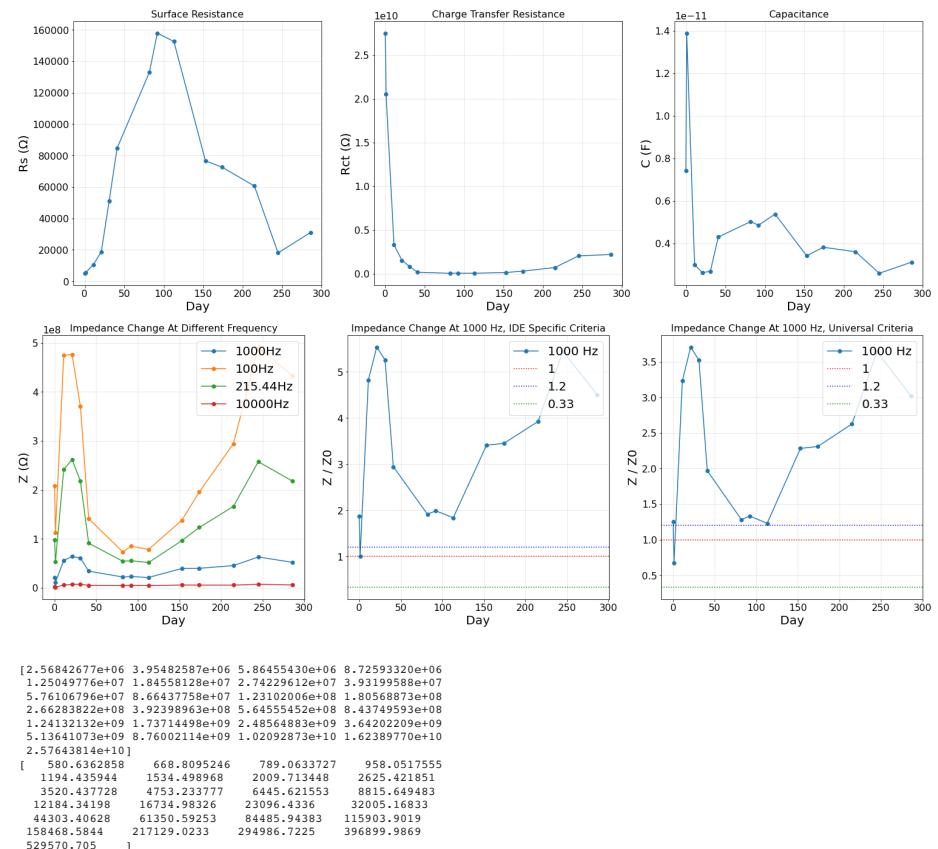
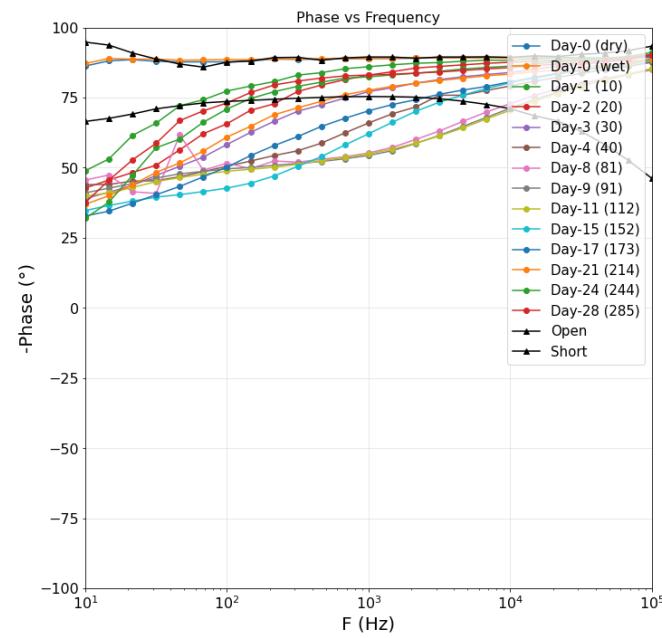
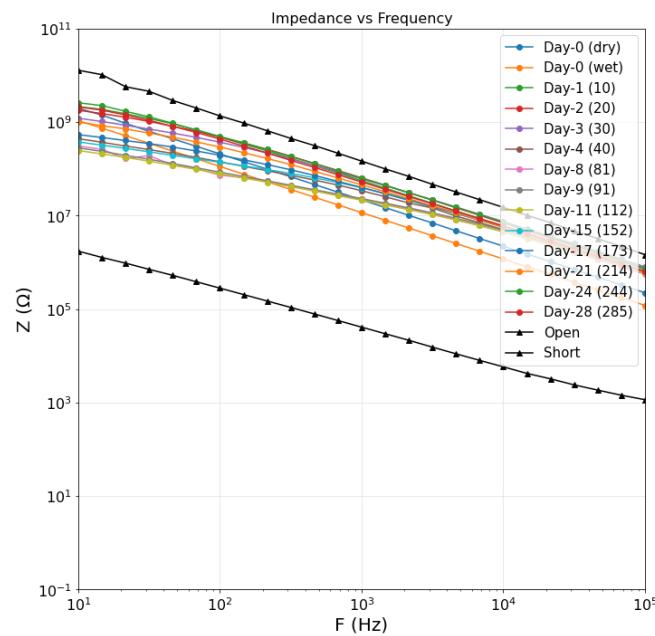
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[2.56842677e+06 3.95482587e+06 5.86455430e+06 8.72593320e+06
1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.119 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-31-2-s

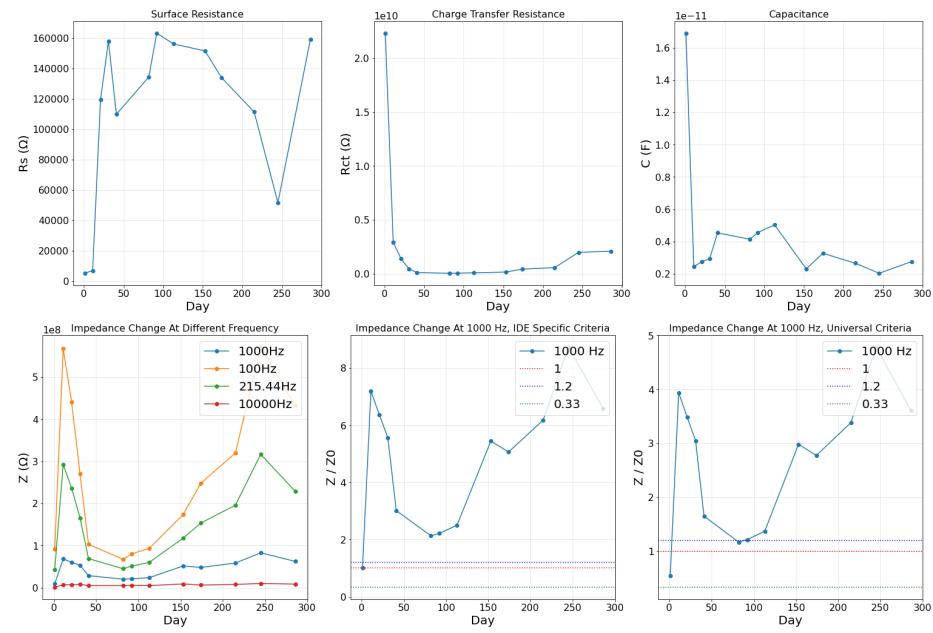
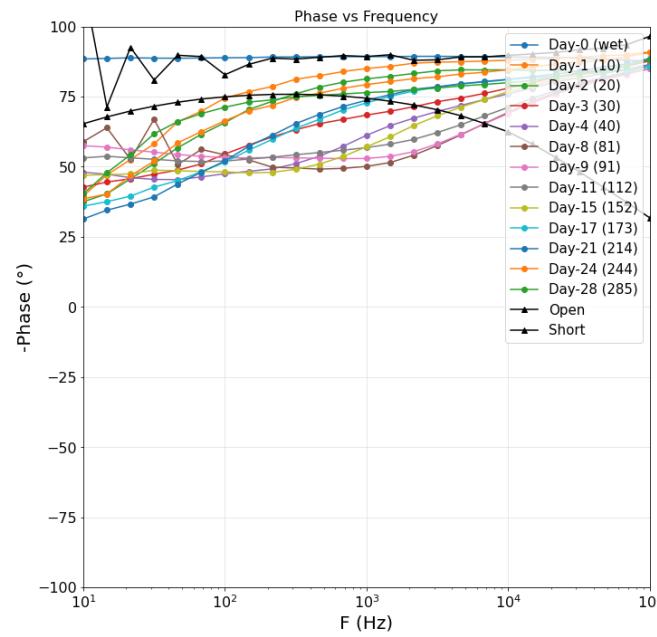
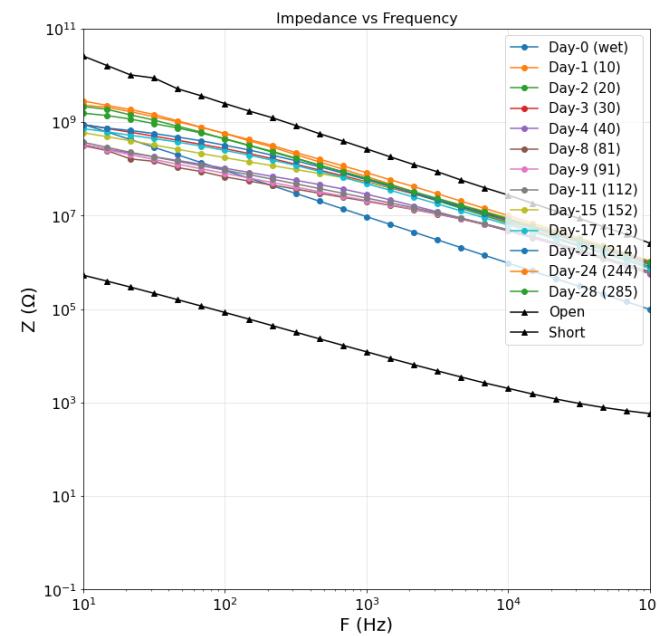


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[1.45838116e+06 2.179335960e+06 3.20788880e+06 4.70771339e+06
7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045727e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-31-4-m

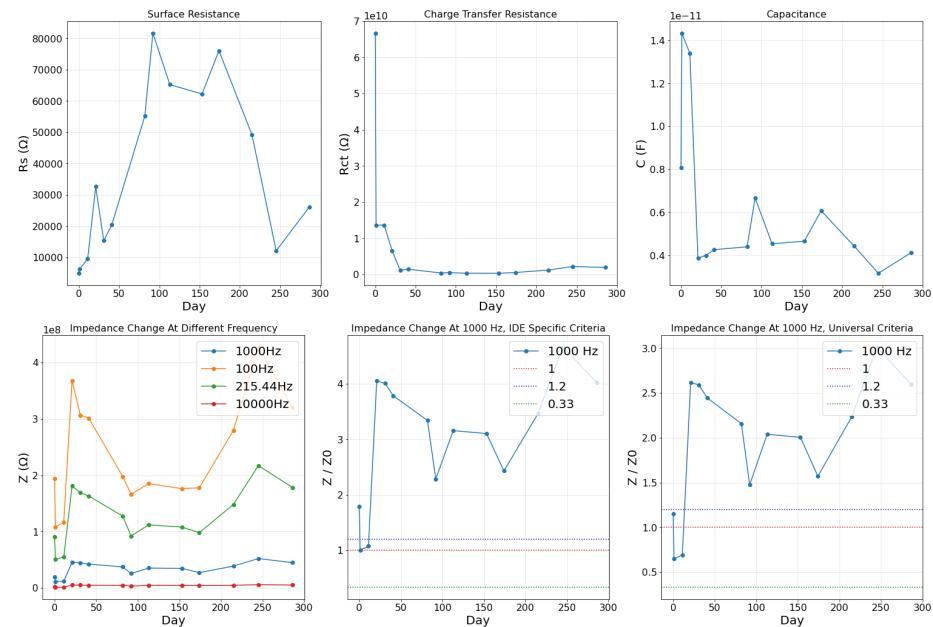
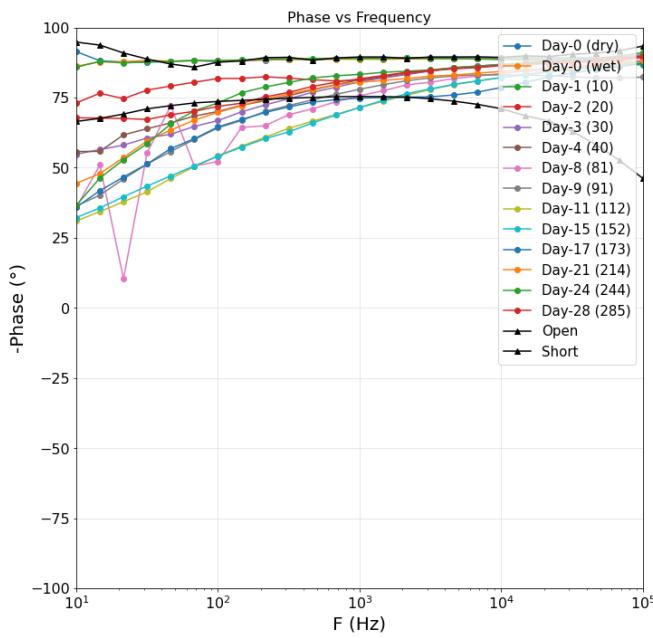
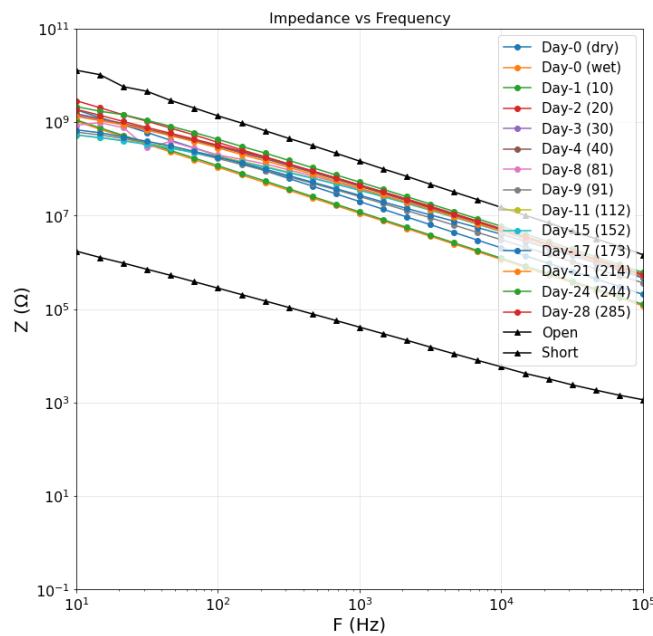


IDE-31-4-s



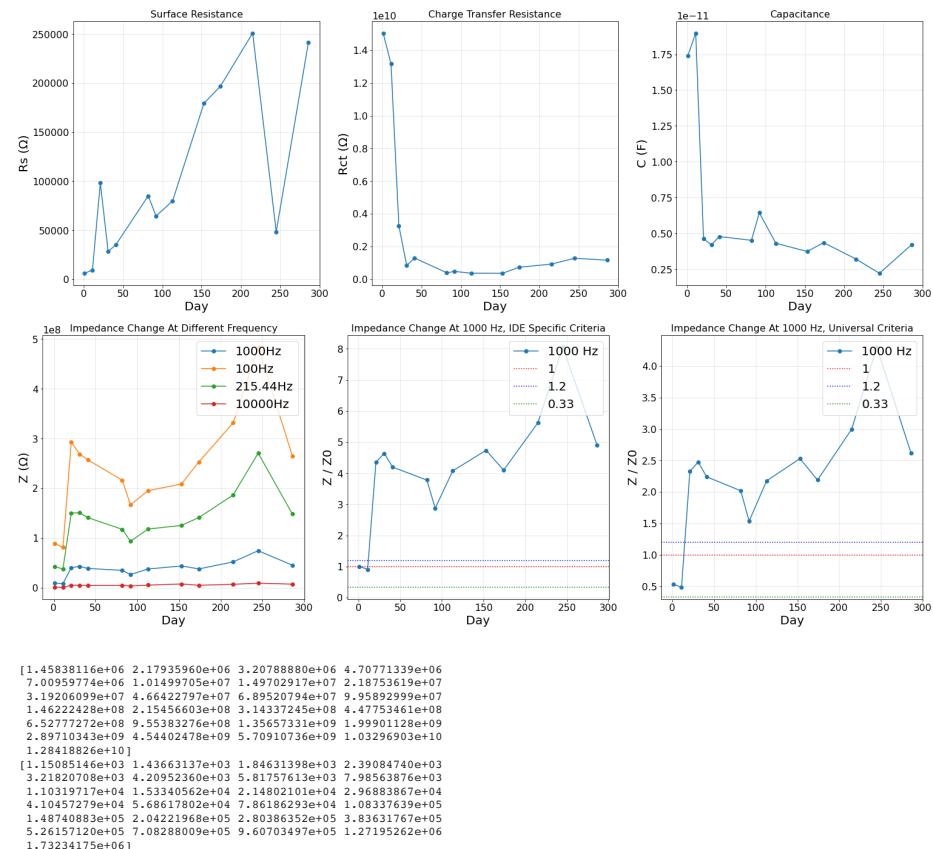
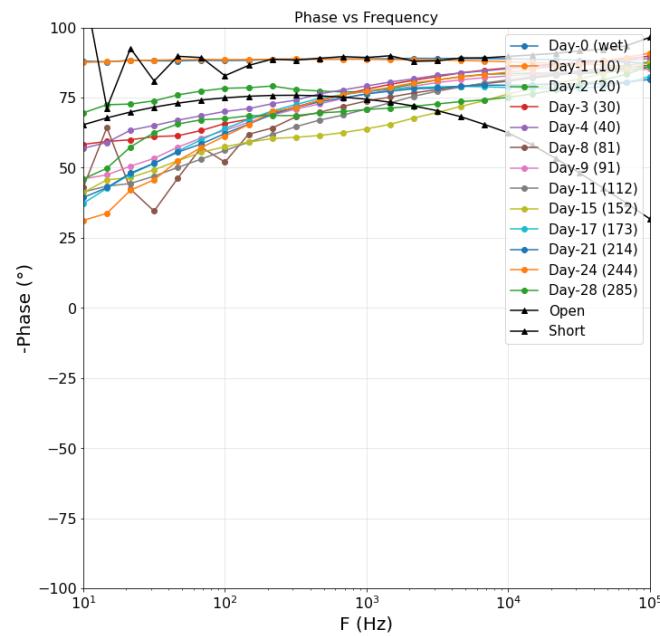
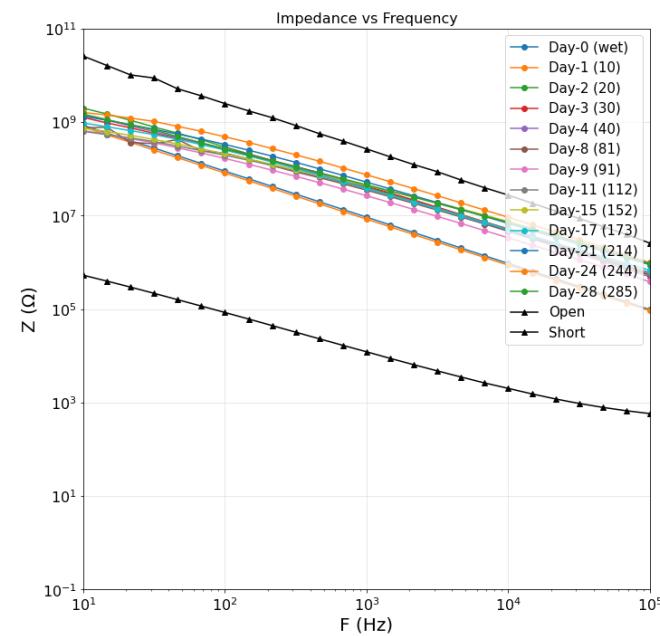
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[1.45838116e+06 2.179335960e+06 3.20788880e+06 4.70771339e+06
7.00959774e+06 1.01499705e+07 1.49702917e+07 2.18753619e+07
3.19206099e+07 4.66422797e+07 6.89520794e+07 9.95892999e+07
1.46222428e+08 2.15456603e+08 3.14337245e+08 4.47753461e+08
6.52777272e+08 9.55383276e+08 1.35657331e+09 1.99901128e+09
2.89710343e+09 4.54402478e+09 5.70910736e+09 1.03296903e+10
1.28418826e+10]
[1.15085146e+03 1.43663137e+03 1.84631398e+03 2.39084740e+03
3.21820708e+03 4.20952360e+03 5.81757613e+03 7.98563876e+03
1.19045779e+04 1.53340562e+04 2.14802101e+04 2.96883867e+04
4.10457279e+04 5.68617802e+04 7.86186293e+04 1.08337639e+05
1.48740883e+05 2.04221968e+05 2.80386352e+05 3.83631767e+05
5.26157120e+05 7.08288009e+05 9.60703497e+05 1.27195262e+06
1.73234175e+06]
```

IDE-31-8-m

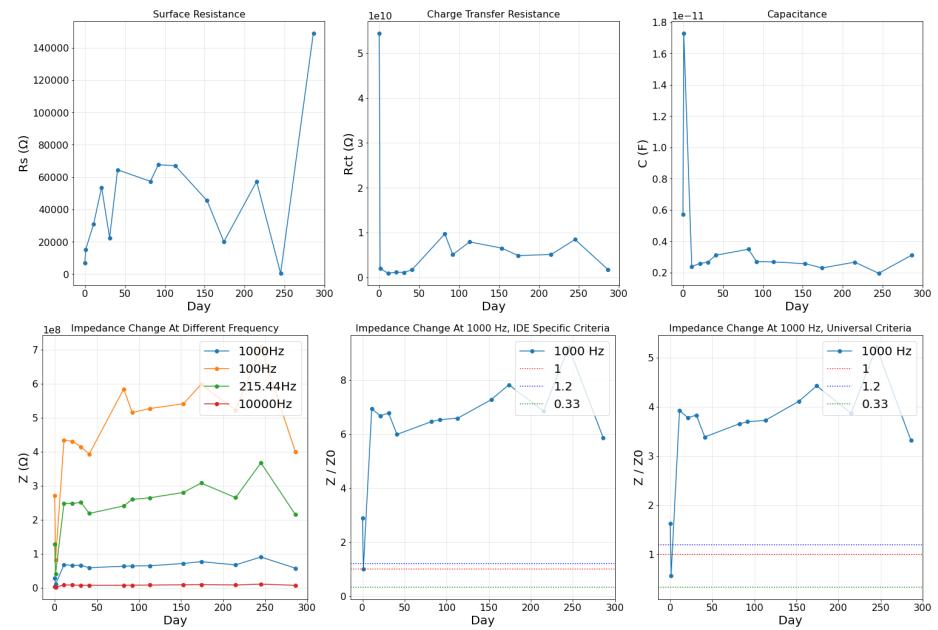
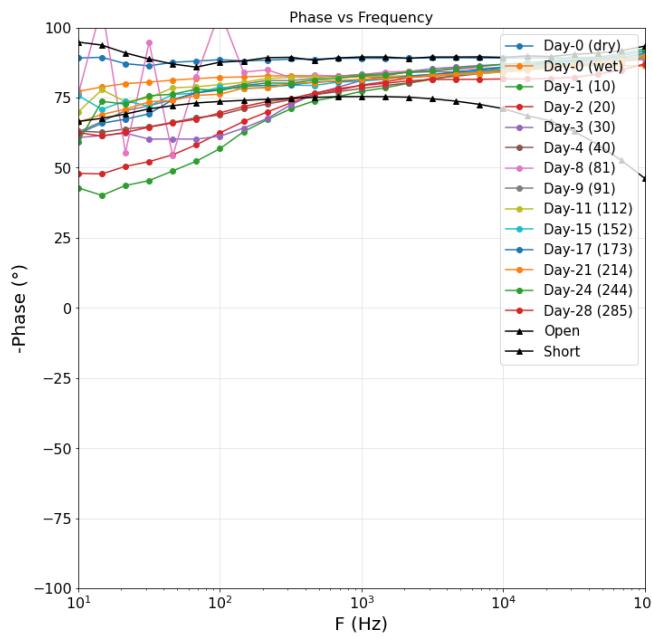
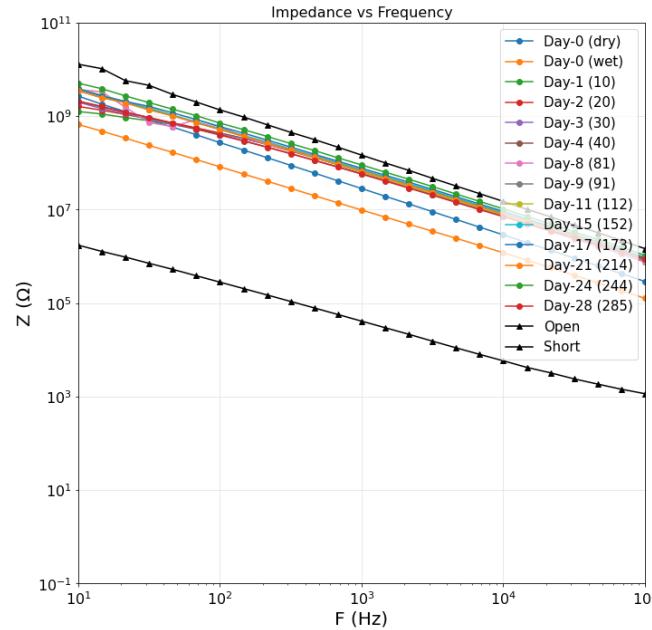


```
[2.56842677e+06 3.95482587e+06 5.86455430e+06 8.72593320e+06
1.25049776e+07 1.84558128e+07 2.74229612e+07 3.931959588e+07
5.76106796e+07 8.66437758e+07 1.23102006e+08 1.80568873e+08
2.66283822e+08 3.92398963e+08 5.64555452e+08 8.43749593e+08
1.24132132e+09 1.73714498e+09 2.48564883e+09 3.64202209e+09
5.13641073e+09 8.76002114e+09 1.02092873e+10 1.62389770e+10
2.57643814e+10]
[ 580.6362858 668.8095246 789.0633727 958.0517555
1194.435944 1534.498968 2009.713448 2625.421851
3520.43728 4753.233777 6445.621553 8815.649483
12180.1928 16734.98326 23096.4336 32005.16833
44303.40628 61350.59253 84485.94383 115901.9019
150468.5844 217129.0233 294986.7225 396899.9869
529570.705 ]
```

IDE-31-8-s



IDE-31-16-m



```

ValueError: invalid literal for int() with base 10: 'nan'
Traceback (most recent call last):
Input In [2], in <cell line: 38>()
  52     C = ide.getRC(df, "C")
  53     #Get the summary graph for each IDE
--> 54     ide.plot_imped_phase(file, df, df_date, date_idx, Rs, Rct, C)
  55     date_idx += 1
  56     print("GLOBAL_Z0_m_dry", GLOBAL_Z0_m_dry)

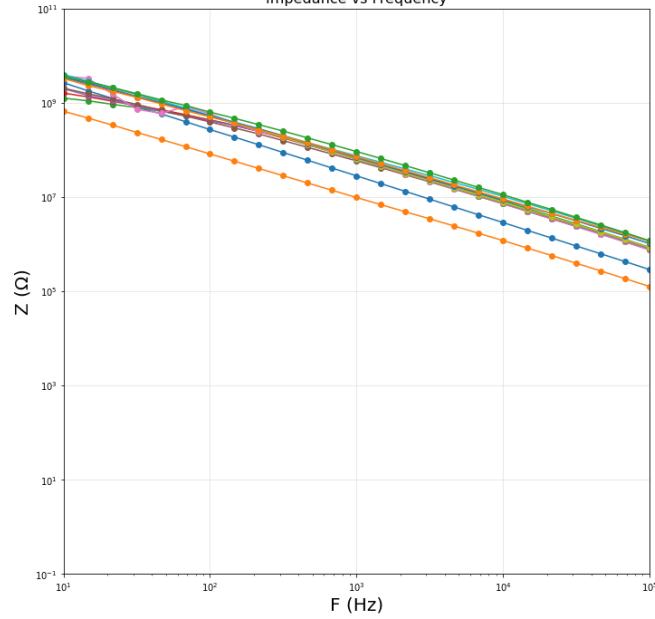
Input In [1], in IDE.plot_imped_phase(self, file, df, df_date, date_idx, Rs, Rct, C)
  175     day_actual_list.append(0)
  176 else:
  177     # The device is shunt
--> 178     date = self.getDatetime(date)
  179     day_diff = date - start
  180     day_actual = self.getActualDates(day_diff.days, 70.5, 37.0)

Input In [1], in IDE.getDateime(self, m_d_y)
  383 time_list = str(m_d_y).split("/")
  384 #print(time_list)
--> 385 date = datetime.date(2022, int(time_list[0]), int(time_list[1]))
  386 return date

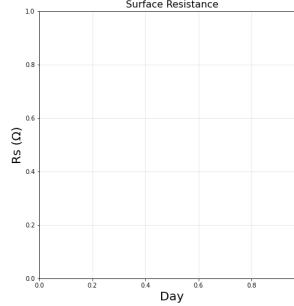
```

IDE-31-16-s

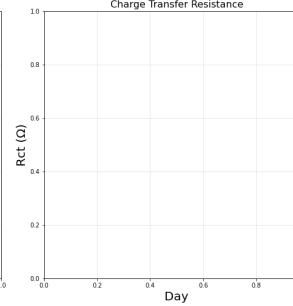
Impedance vs Frequency



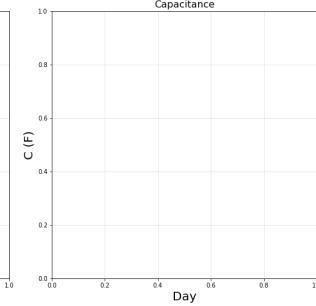
Surface Resistance



Charge Transfer Resistance



Capacitance



Phase vs Frequency

