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LAMPIRAN

Lampiran 1. *Script* program Arduino IDE, MCP4725, dan ADS1115

```
#include <Adafruit_MCP4725.h>
#include <Wire.h>
#include <Adafruit_ADS1X15.h>

Adafruit_ADS1115 ads;
Adafruit_MCP4725 dac;

String input;
char d1;
String x;

uint32_t real;
int counter;
int scanrate = 1;
int range = 1000;
int tegangan;
int16_t results;
float MCP4725;
float VinA0;
float Iin;
float multiplier = 0.03125F;

void setup() {
  // put your setup code here, to run once:
  Wire.begin();
  Serial.begin(9600);

  // The ADC input range (or gain) can be changed via the following
  // functions, but be careful never to exceed VDD +0.3V max, or to
  // exceed the upper and lower limits if you adjust the input range!
  // Setting these values incorrectly may destroy your ADC!
  //                                                ADS1015  ADS1115
  //                                                -------  -------
  // ads.setGain(GAIN_TWOTHIRDS);  // 2/3x gain +/- 6.144V  1 bit = 3mV
0.1875mV (default)
  // ads.setGain(GAIN_ONE);        // 1x gain   +/- 4.096V  1 bit = 2mV      0.125mV
  // ads.setGain(GAIN_TWO);        // 2x gain   +/- 2.048V  1 bit = 1mV      0.0625mV
   ads.setGain(GAIN_FOUR);          // 4x gain     +/- 1.024V  1 bit = 0.5mV
0.03125mV
  // ads.setGain(GAIN_EIGHT);       // 8x gain     +/- 0.512V  1 bit = 0.25mV
0.015625mV
```

```
  // ads.setGain(GAIN_SIXTEEN);     // 16x gain  +/- 0.256V  1 bit = 0.125mV 0.0078125mV

  dac.begin (0x60);
  ads.begin (0x48);

}

void loop() {
  Serial.print(0);Serial.print(",");
  dac.setVoltage(0, false);
  results = ads.readADC_Differential_2_3();
        VinA0 = results*multiplier;
        if (VinA0 > 0){
          // VinA0 = 0.02 - VinA0;
          Iin = VinA0/10000; // persamaan yang digunakan untuk menghasilkan nilai arus listrik pada rangkaian I to V, dengan data input tegangan dari pin A2.
          Iin = Iin*10000;
          // Nilai Y
          Serial.print(Iin, 0);Serial.println(",");
        }
        else{
          results = ads.readADC_Differential_0_1();
          VinA0 = results*multiplier;
          Iin = ((2*0.01)-VinA0)/10000; // persamaan yang digunakan untuk menghasilkan nilai arus listrik pada rangkaian I to V, dengan data input tegangan dari pin A2.
          Iin = Iin*10000;
          // Nilai Y
          Serial.print(Iin, 0);Serial.println(",");
        }
        delay(500);
  // put your main code here, to run repeatedly:
if(Serial.available()){
    input = Serial.readString();
    d1 = input.charAt(0);
    switch(d1){
      case 'S':
      x = input.substring(1);
      scanrate = x.toInt();
      break;
      case 'A':
      x = input.substring(1);
      range = x.toInt();
      break;
      case 'T':
```

```
    for (counter = scanrate; counter <= range; counter = counter + scanrate){
      // NIlai X
      tegangan = counter;
      real = (counter*4096.0)/5000.0;
      Serial.print(tegangan);Serial.print(",");
      dac.setVoltage(real, false); // Tegangan dikirim dari MCP4725 ke rangkaian

      results = ads.readADC_Differential_2_3();
      VinA0 = results*multiplier;
      if (VinA0 > 0){
        // VinA0 = 0.02 - VinA0;
        Iin = VinA0/10000; // persamaan yang digunakan untuk menghasilkan nilai arus listrik pada rangkaian I to V, dengan data input tegangan dari pin A2.
        Iin = Iin*10000;
        // Nilai Y
        Serial.print(Iin, 0);Serial.println(",");
      }
      else{
        results = ads.readADC_Differential_0_1();
        VinA0 = results*multiplier;
        Iin = ((2*0.01)-VinA0)/10000; // persamaan yang digunakan untuk menghasilkan nilai arus listrik pada rangkaian I to V, dengan data input tegangan dari pin A2.
        Iin = Iin*10000;
        // Nilai Y
        Serial.print(Iin, 0);Serial.println(",");
      }
      //delay(1000);

      input = Serial.readString ();
      d1 = input.charAt(0);
      if (d1 == 'U'){
        break;
      }
    }

    if (tegangan == range){
      int henti = 0 - scanrate;
      for (counter = range; counter != henti; counter = counter - scanrate){
      // NIlai X
      tegangan = counter ;
      real = (counter*4096.0)/5000.0;
      Serial.print(tegangan);Serial.print(",");
      dac.setVoltage(real, false); // Tegangan dikirim dari MCP4725 ke rangkaian

      results = ads.readADC_Differential_2_3();
```

```
      VinA0 = results*multiplier;
      if (VinA0 > 0){
        // VinA0 = 0.02 - VinA0;
        Iin = VinA0/10000; // persamaan yang digunakan untuk menghasilkan nilai arus listrik pada rangkaian I to V, dengan data input tegangan dari pin A2.
        Iin = Iin*10000;
        // Nilai Y
        Serial.print(Iin, 0);Serial.println(",");
      }
      else{
        results = ads.readADC_Differential_0_1();
        VinA0 = results*multiplier;
        Iin = ((2*0.01)-VinA0)/10000; // persamaan yang digunakan untuk menghasilkan nilai arus listrik pada rangkaian I to V, dengan data input tegangan dari pin A2.
        Iin = Iin*10000;
        // Nilai Y
        Serial.print(Iin, 0);Serial.println(",");
      }
      //delay(1000);


      input = Serial.readString ();
      d1 = input.charAt(0);
      if (d1 == 'U'){
        break;
      }
    }
    }
    break;
  }
 }
}
```

Lampiran 2. *Scrip* Program Aplikasi *Dekstop*

```
Imports System.Linq
Imports System.Data.SqlClient
Imports System.Data.OleDb
Imports Microsoft.Office.Core
Imports Excel = Microsoft.Office.Interop.Excel
Imports ExcelAutoFormat = Microsoft.Office.Interop.Excel.XlRangeAutoFormat
Imports Microsoft.Office.Interop
Imports System.IO
Imports System.Xml.XPath
Imports System.Data
Imports System.Xml

Public Class Form1
    Private readBuffer As String = String.Empty
    Private Bytenumber As Integer
    Private BytetoRead As Integer
    Private byteEnd(2) As Char

    Dim strinput As String
    Dim prosesoff As Boolean = False
    Dim disconnect As Boolean = False
    Dim data(2) As String 'ganti angka 2 dengan inputan arduino yang akan digunakan

    'Dim StrParse, tegangan, arus As String
    'Dim teganganL, arusL As Integer
    Dim Limit As Integer = 10
    Dim FilePathAndName As String

    Private Sub ComboBoxScanRate_SelectedIndexChanged(sender As Object, e As EventArgs) Handles ComboBoxScanrate.SelectedIndexChanged
        Dim i1 As String
        i1 = "S" + ComboBoxScanrate.SelectedItem
        SerialPort1.Write(i1)
    End Sub

    Private Sub Form1_Load(sender As Object, e As EventArgs) Handles MyBase.Load
        Me.CenterToScreen()
        ButtonDisconnect.Enabled = False
        ButtonConnect.Enabled = False
        ButtonStartRecording.Enabled = False
        ButtonStopRecording.Enabled = False
        ComboBoxRange.Enabled = False
        ComboBoxScanrate.Enabled = False
```

```
        ComboBox1.Enabled = False
        PictureBoxRecordInd.Visible = False
        ComboBoxBaudRate.SelectedIndex = 3


        'ButtonSaveToExcel.Height = 23
        Chart1.ChartAreas.Clear()
        Chart1.ChartAreas.Add("Default")
        With Chart1.ChartAreas("Default")
            .AxisX.Title = "Voltage (mV)"
            .AxisX.MajorGrid.LineColor = Color.SkyBlue
            .AxisY.MajorGrid.LineColor = Color.SkyBlue
            .AxisY.Title = "Current (10^(-1) uA)"
        End With


        'Chart1.ChartAreas("Default").AxisX.Interval = 1
        'Chart1.ChartAreas("Default").AxisY.Interval = 1

        Chart1.Series.Clear()
        Chart1.Series.Add("Charge")
        Chart1.Series("Charge").Color = Color.Red
        Chart1.Series("Charge").ChartType                                    =
DataVisualization.Charting.SeriesChartType.Point

        Chart1.Series.Add("Discharge")
        Chart1.Series("Discharge").Color = Color.Black
        Chart1.Series("Discharge").ChartType                                 =
DataVisualization.Charting.SeriesChartType.Point

        Chart1.Series("Charge").Points.AddY(0)
        Chart1.ChartAreas(0).AxisY.Maximum = 10
        Chart1.ChartAreas(0).AxisX.Maximum = 1000
    End Sub

    Private Sub ButtonScanPort_Click(sender As Object, e As EventArgs) Handles
ButtonScanPort.Click
        ComboBoxPort.Items.Clear()
        Dim myPort As Array
        Dim i As Integer
        myPort = IO.Ports.SerialPort.GetPortNames()
        ComboBoxPort.Items.AddRange(myPort)
        i = ComboBoxPort.Items.Count
        i = i - i
        Try
            ComboBoxPort.SelectedIndex = i
```

```
            ButtonConnect.Enabled = True
        Catch ex As Exception
            MsgBox("Com port not detected", MsgBoxStyle.Critical, "Warning !!!")
            ComboBoxPort.Text = ""
            ComboBoxPort.Items.Clear()
            ButtonConnect.Enabled = False
            ButtonStartRecording.Enabled = False
            Return
        End Try
        ComboBoxPort.DroppedDown = True
    End Sub

    Private Sub ButtonConnect_Click(sender As Object, e As EventArgs) Handles
ButtonConnect.Click
        SerialPort1.BaudRate = ComboBoxBaudRate.SelectedItem
        SerialPort1.PortName = ComboBoxPort.SelectedItem
        SerialPort1.Open()
        TimerSerial.Start()
        ComboBoxBaudRate.Enabled = False
        ButtonScanPort.Enabled = False
        ButtonConnect.Enabled = False
        ButtonDisconnect.Enabled = True
        ButtonStartRecording.Enabled = True
        ComboBoxRange.Enabled = True
        ComboBoxScanrate.Enabled = True
        ComboBoxScanrate.SelectedIndex = 0
        ComboBoxRange.SelectedIndex = 1

        PictureBoxConnectionInd.Image = My.Resources.green_dot
        LabelStatus.Text = "Status : Connected"
    End Sub

    Private Sub ButtonDisconnect_Click(sender As Object, e As EventArgs)
Handles ButtonDisconnect.Click
        PictureBoxConnectionInd.Image = My.Resources.red_dot
        PictureBoxConnectionInd.Visible = True
        LabelStatus.Text = "Status : Disconnect"

        ComboBoxPort.Enabled = True
        LabelBaudRate.Enabled = True
        ComboBoxBaudRate.Enabled = True
        ButtonScanPort.Enabled = True
        ButtonConnect.Enabled = True
        ButtonDisconnect.Enabled = False

        TimerSerial.Stop()
```

```
        TimerDataLogRecord.Stop()

        ButtonSaveToExcel.Enabled = True
        ButtonStopRecording.Enabled = False

        SerialPort1.Close()
    End Sub


    Private Sub ButtonStartRecording_Click(sender As Object, e As EventArgs)
Handles ButtonStartRecording.Click
        ButtonStartRecording.Enabled = False
        ButtonStopRecording.Enabled = True
        ButtonSaveToExcel.Enabled = False
        SerialPort1.Write("T")
        TimerSerial.Start()
        'SerialPort1.Write("T")
        TimerDataLogRecord.Start()
        'SerialPort1.Write("T")
        PictureBoxRecordInd.Visible = True
    End Sub

    Private Sub ButtonClear_Click(sender As Object, e As EventArgs) Handles
ButtonClear.Click

        Chart1.Series.Clear()
        Chart1.Series.Add("Charge")
        Chart1.Series("Charge").Color = Color.Red
        Chart1.Series("Charge").ChartType                                    =
DataVisualization.Charting.SeriesChartType.Point

        Chart1.Series.Add("Discharge")
        Chart1.Series("Discharge").Color = Color.Black
        Chart1.Series("Discharge").ChartType                                 =
DataVisualization.Charting.SeriesChartType.Point
        'Chart1.ChartAreas(0).AxisY.Maximum = 10
        'Chart1.ChartAreas(0).AxisX.Maximum = 1000

        DataGridView1.Rows.Clear()

        TextBox1.Text = "0.00"
        TextBox2.Text = "0.00"
        TextBox3.Text = "0.00"

    End Sub
```

```
    Private Sub ButtonSaveToExcel_Click(sender As Object, e As EventArgs) Handles ButtonSaveToExcel.Click
        ButtonSaveToExcel.Height = 23
        ButtonSaveToExcel.Text = "Please Wait..."
        ButtonSaveToExcel.Enabled = False
        ButtonStartRecording.Enabled = False
        ProgressBarProcess.Visible = True
        ProgressBarProcess.Value = 1

        Dim xlApp As Microsoft.Office.Interop.Excel.Application
        Dim xlWorkBook As Microsoft.Office.Interop.Excel.Workbook
        Dim xlWorkSheet As Microsoft.Office.Interop.Excel.Worksheet
        Dim misValue As Object = System.Reflection.Missing.Value
        Dim i As Integer
        Dim j As Integer

        ProgressBarProcess.Value = 3

        xlApp = New Microsoft.Office.Interop.Excel.Application
        xlWorkBook = xlApp.Workbooks.Add(misValue)
        xlWorkSheet = xlWorkBook.Sheets("sheet1")

        ProgressBarProcess.Value = 5

        For i = 0 To DataGridView1.RowCount - 2
            For j = 0 To DataGridView1.ColumnCount - 1
                For k As Integer = 1 To DataGridView1.Columns.Count
                    xlWorkSheet.Cells(1, k) = DataGridView1.Columns(k - 1).HeaderText
                    xlWorkSheet.Cells(i + 2, j + 1) = DataGridView1(j, i).Value.ToString()
                Next
            Next
        Next

        ProgressBarProcess.Value = 8

        FilePathAndName = Application.StartupPath & "\" & Now.Day & "-" & Now.Month & "-" & Now.Year & ".xlsx"
        If File.Exists(FilePathAndName) Then File.Delete(FilePathAndName)

        xlWorkSheet.SaveAs(FilePathAndName)
        xlWorkBook.Close()
        xlApp.Quit()
```

```
        releaseObject(xlApp)
        releaseObject(xlWorkBook)
        releaseObject(xlWorkSheet)

        ProgressBarProcess.Value = 10

        MsgBox("Successfully saved" & vbCrLf & "File are saved at : " & FilePathAndName, MsgBoxStyle.Information, "Information")

        ProgressBarProcess.Visible = False

        Process.Start(FilePathAndName)

        ButtonSaveToExcel.Height = 23
        ButtonSaveToExcel.Text = "Save To MS Excel"
        ButtonSaveToExcel.Enabled = True
        ButtonStartRecording.Enabled = True
    End Sub

    Private Sub ComboBoxRange_SelectedIndexChanged(sender As Object, e As EventArgs) Handles ComboBoxRange.SelectedIndexChanged
        Dim i2 As String
        i2 = "A" + ComboBoxRange.SelectedItem
        SerialPort1.Write(i2)
        'Chart1.ChartAreas(0).AxisX.Maximum = ComboBoxRange.SelectedItem
    End Sub

    Private Sub releaseObject(ByVal obj As Object)
        Try
            System.Runtime.InteropServices.Marshal.ReleaseComObject(obj)
            obj = Nothing
        Catch ex As Exception
            obj = Nothing
        Finally
            GC.Collect()
        End Try
    End Sub

    Private Sub ButtonStopRecording_Click(sender As Object, e As EventArgs) Handles ButtonStopRecording.Click
        ButtonStartRecording.Enabled = True
        ButtonStopRecording.Enabled = False
        ButtonSaveToExcel.Enabled = True
        SerialPort1.Write("U")
        TimerDataLogRecord.Stop()
        Timer1.Stop()
```

```
        'SerialPort1.Close()
        TimerSerial.Stop()
        PictureBoxRecordInd.Visible = True
    End Sub

    Private Sub ComboBox1_SelectedIndexChanged(sender As Object, e As
EventArgs) Handles ComboBox1.SelectedIndexChanged
        If ComboBox1.SelectedIndex = 0 Then
            Chart1.ChartAreas("Default").AxisX.IsReversed = False
            Chart1.Series("Charge").Enabled = True
            Chart1.Series("Discharge").Enabled = False
        ElseIf ComboBox1.SelectedIndex = 1 Then
            Chart1.ChartAreas("Default").AxisX.IsReversed = True
            Chart1.Series("Discharge").Enabled = True
            Chart1.Series("Charge").Enabled = False
        End If
    End Sub

    Private Sub DataGridView1_CellContentClick(sender As Object, e As
DataGridViewCellEventArgs) Handles DataGridView1.CellContentClick

    End Sub

    Private Sub SerialPort1_DataReceived(sender As Object, e As
Ports.SerialDataReceivedEventArgs) Handles SerialPort1.DataReceived
        If SerialPort1.IsOpen Then
            Try
                byteEnd = SerialPort1.NewLine.ToCharArray
                Bytenumber = SerialPort1.BytesToRead
                readBuffer = SerialPort1.ReadLine()

                Me.Invoke(New EventHandler(AddressOf DoUpdate))
            Catch ex As Exception
                'MsgBox ("READ" & ex.Message)
            End Try
        End If
    End Sub

    Private Sub DoUpdate(ByVal sender As Object, ByVal e As System.EventArgs)
        TimerSerial.Enabled = True
        Call proses_fix()

        If disconnect Then
            prosesoff = True
        End If
    End Sub
```

```
    Private Sub proses_fix()
        strinput = TextBox1.Text
        Dim panjang_data As Integer
        Dim x As Integer
        Dim z As Integer
        strinput = TextBox2.Text
        panjang_data = Len(TextBox2.Text)

        Dim i As Integer
        i = 0
        z = 0

        For x = 1 To Len(readBuffer$)
            If Mid(readBuffer$, x, 1) = "," Then
                z = z + 1
                Data(i) = Mid(readBuffer$, z, x - z)
                i = i + 1
                z = x
            End If
        Next x
    End Sub

    Private Sub TimerSerial_Tick(sender As Object, e As EventArgs) Handles
TimerSerial.Tick
        If SerialPort1.IsOpen Then
            TextBox1.Text = readBuffer
            TextBox2.Text = data(0)
            TextBox3.Text = data(1)
        End If
    End Sub

    Private Sub TimerDataLogRecord_Tick(sender As Object, e As EventArgs)
Handles TimerDataLogRecord.Tick

        Dim X = TextBox2.Text
        Dim Y = CDbl(TextBox3.Text)
        Dim DT As DateTime = Now
        DataGridView1.Rows.Add(New String() {DataGridView1.RowCount, X, Y,
DT.ToLongTimeString, DT.ToString("dd-MM-yyyy")})
        Me.DataGridView1.FirstDisplayedScrollingRowIndex                =
Me.DataGridView1.RowCount - 1

        Y = Y * 0.001
        Chart1.ChartAreas("Default").AxisX.IsReversed = False
```

```
        Chart1.Series("Charge").XAxisType                                    =
DataVisualization.Charting.AxisType.Secondary
        Chart1.Series("Charge").Points.AddXY(X, Y)

        If PictureBoxRecordInd.Visible = True Then
            PictureBoxRecordInd.Visible = False
        ElseIf PictureBoxRecordInd.Visible = False Then
            PictureBoxRecordInd.Visible = True
        End If

        If X = ComboBoxRange.SelectedItem Then
            TimerDataLogRecord.Stop()
            Chart1.Series("Charge").Enabled = False
            Timer1.Start()
        End If
    End Sub

    Private Sub Timer1_Tick(sender As Object, e As EventArgs) Handles
Timer1.Tick

        Dim X = TextBox2.Text
        Dim Y = CDbl(TextBox3.Text)
        Dim DT As DateTime = Now
        DataGridView1.Rows.Add(New String() {DataGridView1.RowCount, X, Y,
DT.ToLongTimeString, DT.ToString("dd-MM-yyyy")})
        Me.DataGridView1.FirstDisplayedScrollingRowIndex                     =
Me.DataGridView1.RowCount - 1

        Y = Y * 0.001
        Chart1.ChartAreas("Default").AxisX.IsReversed = True
        Chart1.Series("Discharge").Points.AddXY(X, Y)

'Chart1.ChartAreas("Default").GetSeriesZPosition("Discharge").Points.AddXY(X
, Y)

        If PictureBoxRecordInd.Visible = True Then
            PictureBoxRecordInd.Visible = False
        ElseIf PictureBoxRecordInd.Visible = False Then
            PictureBoxRecordInd.Visible = True
        End If

        If X = "0" Then
            'TimerDataLogRecord.Stop()
            'Timer1.Stop()
            ButtonStartRecording.Enabled = True
            ButtonStopRecording.Enabled = False
```

```
            ButtonSaveToExcel.Enabled = True
            ComboBox1.Enabled = True
            TimerDataLogRecord.Stop()
            Timer1.Stop()
            Chart1.Series("Charge").Enabled = True
            'TimerSerial.Stop()
            PictureBoxRecordInd.Visible = True
        End If
    End Sub
End Class
```

Lampiran 3. Tabel data Kalibrasi Alat *Cyclic Voltammetry*

1. Superkapasitor Daun Jahe Merah 0,5 M

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
1.	238	0,000196	238	0,001285
2.	239	0,000196	239	0,0012916
3.	240	0,000197	240	0,0012978
4.	241	0,000197	241	0,0013038
5.	242	0,000197	242	0,0013009
6.	243	0,000198	243	0,0013138
7.	244	0,000198	244	0,0013206
8.	245	0,000198	245	0,0013138
9.	246	0,000198	246	0,0013219
10.	247	0,000199	247	0,0013328
11.	248	0,000199	248	0,0013366
12.	249	0,0002	249	0,0013425
13.	250	0,000197	250	0,0013516
14.	251	0,000201	251	0,0013516
15.	252	0,000201	252	0,0013644
16.	253	0,000206	253	0,0013678
17.	254	0,000201	254	0,0013763
18.	255	0,000206	255	0,0013816
19.	256	0,000197	256	0,0013906
20.	257	0,000204	257	0,0013913
21.	258	0,000204	258	0,0013959
22.	259	0,000205	259	0,0014009
23.	260	0,00021	260	0,0014009
24.	261	0,000204	261	0,0014156
25.	262	0,000203	262	0,0014116
26.	263	0,000207	263	0,0014222

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
27.	262	-0,000119	262	0,0010722
28.	261	-0,000116	261	0,0010634
29.	260	-0,000118	260	0,0010569
30.	259	-0,000118	259	0,0010578
31.	258	-0,000121	258	0,0010491
32.	257	-0,000119	257	0,0010409
33.	256	-0,000121	256	0,0010356
34.	255	-0,000121	255	0,0010269
35.	254	-0,000122	254	0,0010263
36.	253	-0,000123	253	0,0010241
37.	252	-0,000124	252	0,0010122
38.	251	-0,000125	251	0,0010103
39.	250	-0,000125	250	0,0010009
40.	249	-0,000126	249	0,0009959
41.	248	-0,000127	248	0,0009878
42.	247	-0,000128	247	0,0009794
43.	246	-0,000131	246	0,0009809
44.	245	-0,000129	245	0,0009734
45.	244	-0,00013	244	0,0009566
46.	243	-0,000131	243	0,0009663
47.	242	-0,000131	242	0,0009556
48.	241	-0,000132	241	0,0009584
49.	240	-0,000132	240	0,0009409
50.	239	-0,000133	239	0,0009434
51.	238	-0,000134	238	0,0009369
52.	237	-0,000135	237	0,0009381

2. Superkapasitor Daun Serai 0,5 M

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
1.	238	0,000248	238	0,0021244
2.	239	0,00025	239	0,0021347
3.	240	0,00025	240	0,0021444
4.	241	0,000252	241	0,0021538
5.	242	0,000252	242	0,0021625
6.	243	0,000252	243	0,0021753
7.	244	0,000251	244	0,0021734
8.	245	0,000254	245	0,0021831
9.	246	0,000252	246	0,0021928
10.	247	0,000254	247	0,0022022
11.	248	0,000253	248	0,0022113
12.	249	0,000256	249	0,0022103
13.	250	0,000252	250	0,00222
14.	251	0,000254	251	0,0022303
15.	252	0,000254	252	0,0022409
16.	253	0,000255	253	0,0022516
17.	254	0,000254	254	0,0022606
18.	255	0,000255	255	0,0022606
19.	256	0,000254	256	0,0022706
20.	257	0,000256	257	0,0022794
21.	258	0,000255	258	0,0022891
22.	259	0,000256	259	0,0022984
23.	260	0,000285	260	0,0022978
24.	261	0,000244	261	0,0023066
25.	262	0,00028	262	0,0023163
26.	263	0,000241	263	0,0023266

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
27.	262	-0,00007	262	0,0018588
28.	261	-0,000067	261	0,0018497
29.	260	-0,000068	260	0,0018394
30.	259	-0,000068	259	0,0018406
31.	258	-0,000066	258	0,00183
32.	257	-0,000066	257	0,0018194
33.	256	-0,000067	256	0,0018097
34.	255	-0,000067	255	0,0017975
35.	254	-0,000068	254	0,0017978
36.	253	-0,000067	253	0,00179
37.	252	-0,000069	252	0,0017784
38.	251	-0,000067	251	0,0017675
39.	250	-0,000068	250	0,0017575
40.	249	-0,000067	249	0,0017459
41.	248	-0,00007	248	0,0017478
42.	247	-0,00007	247	0,0017381
43.	246	-0,00007	246	0,0017269
44.	245	-0,00007	245	0,0017159
45.	244	-0,000072	244	0,0017066
46.	243	-0,000071	243	0,0017075
47.	242	-0,000072	242	0,0016969
48.	241	-0,000069	241	0,0016869
49.	240	-0,000072	240	0,0016763
50.	239	-0,000072	239	0,001665
51.	238	-0,000073	238	0,001655
52.	237	-0,000072	237	0,0016553

3. Superkapasitor Buah Rimbang 0,7 M

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
1.	238	0,000232	238	0,0017388
2.	239	0,000232	239	0,0017484
3.	240	0,000231	240	0,0017584
4.	241	0,000231	241	0,0017688
5.	242	0,000232	242	0,0017797
6.	243	0,000233	243	0,0017897
7.	244	0,000236	244	0,0017884
8.	245	0,000238	245	0,0017994
9.	246	0,000239	246	0,0018106
10.	247	0,000242	247	0,0018213
11.	248	0,00024	248	0,0018303
12.	249	0,000237	249	0,0018294
13.	250	0,000239	250	0,00184
14.	251	0,000237	251	0,0018513
15.	252	0,00024	252	0,0018606
16.	253	0,000244	253	0,0018713
17.	254	0,000245	254	0,0018794
18.	255	0,000243	255	0,0018803
19.	256	0,000245	256	0,0018916
20.	257	0,000243	257	0,0019003
21.	258	0,000239	258	0,0019106
22.	259	0,00024	259	0,0019216
23.	260	0,000242	260	0,0019194
24.	261	0,000243	261	0,0019306
25.	262	0,000246	262	0,0019403
26.	263	0,000245	263	0,0019516

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
27.	262	-0,000113	262	0,0015047
28.	261	-0,000114	261	0,0014934
29.	260	-0,000115	260	0,0014816
30.	259	-0,000117	259	0,0014819
31.	258	-0,000118	258	0,0014709
32.	257	-0,000119	257	0,0014597
33.	256	-0,000121	256	0,0014469
34.	255	-0,000122	255	0,0014353
35.	254	-0,000124	254	0,0014363
36.	253	-0,000124	253	0,0014231
37.	252	-0,000127	252	0,0014122
38.	251	-0,000128	251	0,0014022
39.	250	-0,000129	250	0,0013897
40.	249	-0,00013	249	0,0013784
41.	248	-0,000132	248	0,0013772
42.	247	-0,000133	247	0,0013675
43.	246	-0,000135	246	0,0013559
44.	245	-0,000135	245	0,0013428
45.	244	-0,000137	244	0,0013334
46.	243	-0,000139	243	0,0013328
47.	242	-0,00014	242	0,00132
48.	241	-0,000141	241	0,0013084
49.	240	-0,000143	240	0,0012972
50.	239	-0,000144	239	0,0012863
51.	238	-0,000145	238	0,0012747
52.	237	-0,000146	237	0,0012734

4. Superkapasitor Daun Belimbing 0,3 M

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
1.	238	0,000455	238	0,004813
2.	239	0,000455	239	0,00495
3.	240	0,000456	240	0,005056
4.	241	0,000458	241	0,005163
5.	242	0,000457	242	0,0053
6.	243	0,000458	243	0,0054
7.	244	0,00046	244	0,005403
8.	245	0,000461	245	0,005509
9.	246	0,000461	246	0,005622
10.	247	0,000462	247	0,005753
11.	248	0,000462	248	0,005863
12.	249	0,000463	249	0,00585
13.	250	0,000463	250	0,005972
14.	251	0,000466	251	0,006088
15.	252	0,000477	252	0,006194
16.	253	0,000477	253	0,006303
17.	254	0,000467	254	0,006434
18.	255	0,00047	255	0,006428
19.	256	0,000471	256	0,006541
20.	257	0,000474	257	0,006653
21.	258	0,000481	258	0,006756
22.	259	0,000471	259	0,006884
23.	260	0,000484	260	0,006884
24.	261	0,000474	261	0,007003
25.	262	0,000484	262	0,007103
26.	263	0,000475	263	0,007222

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
27.	262	-0,000464	262	0,005672
28.	261	-0,000472	261	0,005553
29.	260	-0,000474	260	0,005422
30.	259	-0,000484	259	0,005441
31.	258	-0,000486	258	0,005325
32.	257	-0,000478	257	0,0052
33.	256	-0,000491	256	0,005078
34.	255	-0,000483	255	0,004981
35.	254	-0,000477	254	0,004978
36.	253	-0,000487	253	0,004853
37.	252	-0,000487	252	0,004741
38.	251	-0,000487	251	0,004634
39.	250	-0,000496	250	0,004528
40.	249	-0,000489	249	0,004406
41.	248	-0,000501	248	0,0044
42.	247	-0,000492	247	0,004281
43.	246	-0,000495	246	0,004166
44.	245	-0,000504	245	0,004069
45.	244	-0,000505	244	0,003947
46.	243	-0,000496	243	0,003938
47.	242	-0,000491	242	0,003838
48.	241	-0,000498	241	0,003713
49.	240	-0,0005	240	0,0036
50.	239	-0,000509	239	0,003472
51.	238	-0,00051	238	0,003353
52.	237	-0,0005	237	0,003369

5. Superkapasitor Jahe Merah O,3 M

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
1.	488	0,000579	488	0,00413
2.	489	0,000579	489	0,00414
3.	490	0,000604	490	0,00414
4.	491	0,000579	491	0,00416
5.	492	0,000604	492	0,00417
6.	493	0,000603	493	0,00417
7.	494	0,000579	494	0,00417
8.	495	0,000585	495	0,00419
9.	496	0,000607	496	0,0042
10.	497	0,000605	497	0,00421
11.	498	0,000582	498	0,00421
12.	499	0,000586	499	0,00422
13.	500	0,000611	500	0,00423
14.	501	0,000609	501	0,00424
15.	502	0,000587	502	0,00425
16.	503	0,000591	503	0,00426
17.	504	0,000612	504	0,00427
18.	505	0,00061	505	0,00428
19.	506	0,000588	506	0,00429
20.	507	0,000592	507	0,0043
21.	508	0,000614	508	0,0043
22.	509	0,000613	509	0,0043
23.	510	0,000591	510	0,00432
24.	511	0,000593	511	0,00433
25.	512	0,000594	512	0,00433
26.	513	0,000595	513	0,00434

No.	Alat Physics UR Rad-Er 5841		Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)	Tegangan (mV)	Arus (A)
27.	512	-0,000375	512	0,00313
28.	511	-0,000376	511	0,00312
29.	510	-0,000375	510	0,00311
30.	509	-0,000376	509	0,0031
31.	508	-0,000377	508	0,00308
32.	507	-0,000375	507	0,00308
33.	506	-0,000376	506	0,00307
34.	505	-0,000376	505	0,00306
35.	504	-0,000375	504	0,00305
36.	503	-0,000374	503	0,00304
37.	502	-0,000376	502	0,00304
38.	501	-0,000376	501	0,00303
39.	500	-0,000376	500	0,00302
40.	499	-0,000375	499	0,00301
41.	498	-0,000377	498	0,003
42.	497	-0,000376	497	0,00299
43.	496	-0,000377	496	0,00298
44.	495	-0,000374	495	0,00297
45.	494	-0,000376	494	0,00296
46.	493	-0,000376	493	0,00295
47.	492	-0,000377	492	0,00293
48.	491	-0,000377	491	0,00293
49.	490	-0,000377	490	0,00291
50.	489	-0,000377	489	0,00291
51.	488	-0,000378	488	0,0029
52.	487	-0,000377	487	0,00289

Lampiran 4. Perhitungan Kapasitansi Spesifik Superkapasitor Biomassa

1. Superkapasitor Daun Jahe Merah 0,5 M

   a. Berdasarkan Tabel Kalibrasi Alat Physics UR Rad-Er 5841 pada Lampiran 3 diperoleh I_c = 0,000197 A (ketika tegangan charge = 250 mV), dan I_d = -0,000125 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,0101 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}000197 - (-0{,}000125)}{0{,}001\ x\ 0{,}0101}$$

$$C_{sp} = \frac{0{,}000322}{0{,}0000101}$$

$$C_{sp} = 31{,}88119\ F/g$$

   b. Berdasarkan Tabel Kalibrasi Alat *Cyclic Voltammetry* pada Lampiran 3 diperoleh I_c = 0,00013516 A (ketika tegangan charge = 250 mV), dan I_d = 0,00010009 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,0101 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}0013516 - 0{,}0010009}{0{,}001\ x\ 0{,}0101}$$

$$C_{sp} = \frac{0{,}0003507}{0{,}0000101}$$

$$C_{sp} = 34{,}7227\ F/g$$

2. Superkapasitor Daun Serai 0,5 M

   a. Berdasarkan Tabel Kalibrasi Alat Physics UR Rad-Er 5841 pada Lampiran 3 diperoleh I_c = 0,000252 A (ketika tegangan charge = 250 mV), dan I_d = -0,000068 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,008 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}000252 - (-0{,}000068)}{0{,}001\ x\ 0{,}008}$$

$$C_{sp} = \frac{0{,}00032}{0{,}000008}$$

$$C_{sp} = 40\ F/g$$

b. Berdasarkan Tabel Kalibrasi Alat *Cyclic Voltammetry* pada Lampiran 3 diperoleh I_c = 0,00222 A (ketika tegangan charge = 250 mV), dan I_d = 0,0017575 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,008 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}00222 - 0{,}0017575}{0{,}001\ x\ 0{,}008}$$

$$C_{sp} = \frac{0{,}0004625}{0{,}000008}$$

$$C_{sp} = 57{,}8125\ F/g$$

3. Superkapasitor Buah Rimbang 0,7 M

a. Berdasarkan Tabel Kalibrasi Alat Physics UR Rad-Er 5841 pada Lampiran 3 diperoleh I_c = 0,000239 A (ketika tegangan charge = 250 mV), dan I_d = -0,000129 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,008 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}000239 - (-0{,}000129)}{0{,}001\ x\ 0{,}008}$$

$$C_{sp} = \frac{0{,}000368}{0{,}000008}$$

$$C_{sp} = 46\ F/g$$

b. Berdasarkan Tabel Kalibrasi Alat *Cyclic Voltammetry* pada Lampiran 3 diperoleh I_c = 0,00184 A (ketika tegangan charge = 250 mV), dan I_d = 0,0013897 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,008 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}00184 - 0{,}0013897}{0{,}001\ x\ 0{,}0101}$$

$$C_{sp} = \frac{0{,}0004503}{0{,}000008}$$

$$C_{sp} = 56{,}2875\ F/g$$

4. Superkapasitor Daun Belimbing 0,3 M

a. Berdasarkan Tabel Kalibrasi Alat Physics UR Rad-Er 5841 pada Lampiran 3 diperoleh I_c = 0,000463 A (ketika tegangan charge = 250 mV), dan I_d = -0,000496 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,0107 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}000463 - (-0{,}000496)}{0{,}001\ x\ 0{,}0107}$$

$$C_{sp} = \frac{0{,}000959}{0{,}0000107}$$

$$C_{sp} = 89{,}62\ F/g$$

b. Berdasarkan Tabel Kalibrasi Alat *Cyclic Voltammetry* pada Lampiran 3 diperoleh I_c = 0,005972 A (ketika tegangan charge = 250 mV), dan I_d = 0,004528 A (ketika tegangan discharge = 250 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,0107 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}005972 - 0{,}004528}{0{,}001\ x\ 0{,}0107}$$

$$C_{sp} = \frac{0{,}001444}{0{,}0000107}$$

$$C_{sp} = 134{,}95\ F/g$$

5. Superkapasitor Jahe Merah O,3 M

a. Berdasarkan Tabel Kalibrasi Alat Physics UR Rad-Er 5841 pada Lampiran 3 diperoleh I_c = 0,000611 A (ketika tegangan charge = 500 mV), dan I_d = -0,000376 A (ketika tegangan discharge = 500 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,009 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}000611 - (-0{,}000376)}{0{,}001\ x\ 0{,}009}$$

$$C_{sp} = \frac{0{,}000987}{0{,}000009}$$

$$C_{sp} = 109{,}667\ F/g$$

b. Berdasarkan Tabel Kalibrasi Alat *Cyclic Voltammetry* pada Lampiran 3 diperoleh I_c = 0,00423 A (ketika tegangan charge = 500 mV), dan I_d = 0,00302 A (ketika tegangan discharge = 500 mV), s = 1 mV/s (atau s = 0,001 V/s) dan m = 0,009 g maka kapasitansi spesifiknya adalah:

$$C_{sp} = \frac{I_c - I_d}{s\ x\ m}$$

$$C_{sp} = \frac{0{,}00423 - 0{,}00302}{0{,}001\ x\ 0{,}009}$$

$$C_{sp} = \frac{0{,}00121}{0{,}000009}$$

$$C_{sp} = 134{,}44\ F/g$$

Lampiran 5. Tabel Data Pengukuran Superkapasitor dari Biomassa Batang Lengkuas $ZnCl_2$ 0,3 M

No.	Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)
1.	238	0,0012534
2.	239	0,0012641
3.	240	0,0012756
4.	241	0,0012866
5.	242	0,0012972
6.	243	0,0013078
7.	244	0,0013069
8.	245	0,0013181
9.	246	0,0013294
10.	247	0,0013403
11.	248	0,0013513
12.	249	0,00135
13.	250	0,0013613
14.	251	0,0013703
15.	252	0,0013819
16.	253	0,0013941
17.	254	0,0014022
18.	255	0,0014019
19.	256	0,0014125
20.	257	0,0014234
21.	258	0,0014334
22.	259	0,0014456
23.	260	0,0014428
24.	261	0,0014547
25.	262	0,0014659
26.	263	0,0014766

No.	Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)
27.	262	0,0009784
28.	261	0,0009653
29.	260	0,000955
30.	259	0,0009528
31.	258	0,0009434
32.	257	0,0009313
33.	256	0,0009203
34.	255	0,0009084
35.	254	0,0009094
36.	253	0,0008963
37.	252	0,0008853
38.	251	0,0008719
39.	250	0,0008638
40.	249	0,0008506
41.	248	0,0008506
42.	247	0,0008372
43.	246	0,0008269
44.	245	0,0008147
45.	244	0,0008038
46.	243	0,0008028
47.	242	0,0007906
48.	241	0,0007806
49.	240	0,0007688
50.	239	0,0007556
51.	238	0,0007453
52.	237	0,000745

Lampiran 6. Tabel Data Pengukuran Superkapasitor dari Biomassa Daun Lengkuas 0,5 M

No.	Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)
1.	238	0,000063
2.	239	0,000064
3.	240	0,000065
4.	241	0,000066
5.	242	0,000066
6.	243	0,000067
7.	244	0,000066
8.	245	0,000067
9.	246	0,000068
10.	247	0,000068
11.	248	0,000069
12.	249	0,000069
13.	250	0,00007
14.	251	0,00007
15.	252	0,000071
16.	253	0,000071
17.	254	0,000072
18.	255	0,000071
19.	256	0,000073
20.	257	0,000073
21.	258	0,000073
22.	259	0,000074
23.	260	0,000074
24.	261	0,000075
25.	262	0,000076
26.	263	0,000076

No.	Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)
27.	262	0,00006
28.	261	0,00006
29.	260	0,000059
30.	259	0,00006
31.	258	0,000059
32.	257	0,000058
33.	256	0,000057
34.	255	0,000057
35.	254	0,000057
36.	253	0,000056
37.	252	0,000056
38.	251	0,000055
39.	250	0,000054
40.	249	0,000054
41.	248	0,000054
42.	247	0,000053
43.	246	0,000053
44.	245	0,000052
45.	244	0,000051
46.	243	0,000052
47.	242	0,000051
48.	241	0,00005
49.	240	0,000049
50.	239	0,000049
51.	238	0,000048
52.	237	0,000049

Lampiran 7. Tabel Data Pengukuran Superkapasitor dari Biomassa Buah Rimbang $ZnCl_2$ 0,7 M

No.	Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)
1.	238	0,001121
2.	239	0,001133
3.	240	0,001144
4.	241	0,001154
5.	242	0,001165
6.	243	0,001176
7.	244	0,001177
8.	245	0,001187
9.	246	0,001196
10.	247	0,001208
11.	248	0,001218
12.	249	0,001218
13.	250	0,001228
14.	251	0,00124
15.	252	0,00125
16.	253	0,001261
17.	254	0,001269
18.	255	0,001269
19.	256	0,001281
20.	257	0,001293
21.	258	0,001302
22.	259	0,001312
23.	260	0,00131
24.	261	0,001323
25.	262	0,001334
26.	263	0,001344

No.	Alat *Cyclic Voltammetry*	
	Tegangan (mV)	Arus (A)
27.	262	0,000917
28.	261	0,000904
29.	260	0,000893
30.	259	0,000893
31.	258	0,000883
32.	257	0,000869
33.	256	0,000859
34.	255	0,000848
35.	254	0,000847
36.	253	0,000837
37.	252	0,000826
38.	251	0,000815
39.	250	0,000805
40.	249	0,000794
41.	248	0,000793
42.	247	0,000781
43.	246	0,00077
44.	245	0,00076
45.	244	0,000749
46.	243	0,000749
47.	242	0,000739
48.	241	0,000727
49.	240	0,000715
50.	239	0,000703
51.	238	0,000694
52.	237	0,000694