

Appendix C: 'CERL' PROGRAM

This program is a part of the RSIM software and operates on the HP4192A Impedance Analyzer with a primary address of H-01. It resides in the 'CERL' sheet in the file 'PZT-ALL' and is written in Visual Basic for Applications (VBA).

```
'  
' CERL Macro  
' Operates on the HP4192A with primary address as H-01.  
'  
Sub CERL()  
    Sheets("Settings").Select  
    Range("B9").Select  
    ActiveCell.FormulaR1C1 = ""  
    Range("B6").Select  
,  
    Application.Run "GPIB", "C-LOCAL"      'Puts the instrument in LOCAL mode  
    Application.Run "GPIB", "C-CLEAR"      'Clears the instrument  
    Application.Run "GPIB", "C-STEP Frequency" 'Sets the STEP frequency  
    Application.Run "GPIB", "C-STOP Frequency" 'Sets the STOP frequency  
    Application.Run "GPIB", "C-START Frequency" 'Sets the START frequency  
,  
'The following block establishes the TYPE of measurement that the instrument will  
make.  
'Presently, only "R-X" and "Z-Theta" measurements are defined.  
    Display = Worksheets("Settings").Cells(7, "B")  
    If Display = "A2B1C2" Then  
        Sheets("Data(A)").Select  
        Range("F4").Select  
        ActiveCell.FormulaR1C1 = "R0"  
        Range("F4").Select  
        Selection.AutoFill Destination:=Range("F4:IV4"), Type:=xlFillDefault  
        Range("F4:IV4").Select  
        Range("F4").Select  
        Sheets("Data(B)").Select  
        Range("F4").Select  
        ActiveCell.FormulaR1C1 = "X0"  
        Range("F4").Select  
        Selection.AutoFill Destination:=Range("F4:IV4"), Type:=xlFillDefault  
        Range("F4:IV4").Select  
        Range("F4").Select
```

```

    Application.Run "GPIB", "C-Display1"
ElseIf Display = "A1B1C2" Then
    Sheets("Data(A)").Select
    Range("F4").Select
    ActiveCell.FormulaR1C1 = "Z0"
    Range("F4").Select
    Selection.AutoFill Destination:=Range("F4:IV4"), Type:=xlFillDefault
    Range("F4:IV4").Select
    Range("F4").Select
    Sheets("Data(B)").Select
    Range("F4").Select
    ActiveCell.FormulaR1C1 = "Theta 0"
    Range("F4").Select
    Selection.AutoFill Destination:=Range("F4:IV4"), Type:=xlFillDefault
    Range("F4:IV4").Select
    Range("F4").Select
    Application.Run "GPIB", "C-Display2"
Else
    Sheets("Settings").Select
    Range("B7").Select
    Msg = "Measurement TYPE has to be 'A1B1C2' or 'A2B1C2'"
    DialogStyle = vbOKOnly + vbExclamation + vbDefaultButton1
    Title = "ERROR"
    MsgBox Msg, DialogStyle, Title
    Application.Run "GPIB", "C-LOCAL"
End
End If

```

'The following block establishes the SPEED with which the measurement will be made.

'The options are "Short", "Med" and "High".

```

Speed = Worksheets("Settings").Cells(5, "B")
If Speed = "Short" Then
    Application.Run "GPIB", "C-SpeedShort"
ElseIf Speed = "Med" Then
    Application.Run "GPIB", "C-SpeedMed"
ElseIf Speed = "High" Then
    Application.Run "GPIB", "C-SpeedHigh"
Else
    Sheets("Settings").Select
    Range("B5").Select
    Msg = "SPEED has to be 'Short', 'Med' or 'High'"
    DialogStyle = vbOKOnly + vbExclamation + vbDefaultButton1
    Title = "ERROR"
    MsgBox Msg, DialogStyle, Title

```

```

        Application.Run "GPIB", "C-LOCAL"
    End
End If

```

'The following block establishes the MEASUREMENT Number that is currently being made.

```

'The Measurement number has to be between 1 and 251.
Measure = Worksheets("Settings").Cells(6, "B")
If Measure < 1 Or Measure > 251 Then
    Sheets("Settings").Select
    Range("B6").Select
    Msg = "Measurement Number has to be between 1 and 251"
    DialogStyle = vbOKOnly + vbExclamation + vbDefaultButton1
    Title = "ERROR"
    MsgBox Msg, DialogStyle, Title
    Application.Run "GPIB", "C-LOCAL"
End
End If

```

'The following block establishes the number of DATAPOINTS between start and stop frequency.

```

'The options are 400, 500, 1000, 1500 and 2000 DATAPOINTS.
Datapoints = Worksheets("Settings").Cells(3, "B")
If Datapoints <> 400 And Datapoints <> 500 And Datapoints <> 1000 And Datapoints
<> 1500 And Datapoints <> 2000 Then
    Sheets("Settings").Select
    Range("B3").Select
    Msg = "Datapoints has to be 400, 500, 1000, 1500 or 2000"
    DialogStyle = vbOKOnly + vbExclamation + vbDefaultButton1
    Title = "ERROR"
    MsgBox Msg, DialogStyle, Title
    Application.Run "GPIB", "C-LOCAL"
End
End If

```

'The following block calculates the frequency steps as defined by the user.

'The results are posted in the "Data(A)" and "Data(B)" worksheets.

```

    Sheets("Data(A)").Select
' A5 = (((ROW(E5) - 5) * $B$9) + $B$3)*1000
    Range("E5").Select
    Selection.Copy
    Selection.AutoFill Destination:=Range("E5:E2005"), Type:=xlFillDefault
    Sheets("Data(B)").Select
    Range("E5").Select

```

```

Selection.Copy
Selection.AutoFill Destination:=Range("E5:E2005"), Type:=xlFillDefault
'
Application.Run "GPIB", "C-LOCAL"           ' Puts the instrument in the LOCAL
mode
'
'The following block clears old data from the "Copy1" sheet.
Sheets("Copy1").Select
Range("A5").Select
Range("A5:B2005").Select
Application.CutCopyMode = False
Selection.ClearContents
Range("A5").Select
'
'Depending on the TYPE of measurement and DATAPOINTS, the acquired data is
posted onto "Copy1".
If Display = "A1B1C2" Then
  If Datapoints = 400 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1a", "Copy1!A5:B405"
  ElseIf Datapoints = 500 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1a", "Copy1!A5:B505"
  ElseIf Datapoints = 1000 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1a", "Copy1!A5:B1005"
  ElseIf Datapoints = 1500 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1a", "Copy1!A5:B1505"
  ElseIf Datapoints = 2000 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1a", "Copy1!A5:B2005"
  End If
End If
'
'Depending on the TYPE of measurement and DATAPOINTS, the acquired data is
posted onto "Copy1".
If Display = "A2B1C2" Then
  If Datapoints = 400 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1b", "Copy1!A5:B405"
  ElseIf Datapoints = 500 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1b", "Copy1!A5:B505"

```

```

ElseIf Datapoints = 1000 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1b", "Copy1!A5:B1005"
ElseIf Datapoints = 1500 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1b", "Copy1!A5:B1505"
ElseIf Datapoints = 2000 Then
    Application.Run "GPIB", "C-AUTO"
    Application.Run "GPIB", "C-TASK1b", "Copy1!A5:B2005"
End If
End If

```

'Depending on the number of DATAPOINTS and the MEASUREMENT number, the acquired

'data is posted appropriately onto the "Data(A)" and "Data(B)" worksheets.

```

Sheets("COPY1").Select
Range("A5").Select
Range(Cells(5, 1), Cells(Datapoints + 5, 1)).Select
Selection.Copy
Sheets("Data(A)").Select
Cells(5, Measure + 5).Select
Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
    SkipBlanks:=False, Transpose:=False
Sheets("COPY1").Select
Range("B5").Select
Range(Cells(5, 2), Cells(Datapoints + 5, 2)).Select
Selection.Copy
Sheets("Data(B)").Select
Cells(5, Measure + 5).Select
Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
    SkipBlanks:=False, Transpose:=False

```

'The values for the two kinds of Damage Metric are calculated and pasted.

```

If Measure > 1 Then
    Sheets("Data(A)").Select
    Range("G2:G3").Select
    Selection.Copy
    Range(Cells(2, Measure + 5), Cells(3, Measure + 5)).Select
    Selection.PasteSpecial Paste:=xlFormulas, Operation:=xlNone, _
        SkipBlanks:=False, Transpose:=False
    Sheets("Data(B)").Select
    Range("G2:G3").Select
    Selection.Copy
    Range(Cells(2, Measure + 5), Cells(3, Measure + 5)).Select

```

```

Selection.PasteSpecial Paste:=xlFormulas, Operation:=xlNone, _
    SkipBlanks:=False, Transpose:=False
End If

```

'The Frequency charts and Damage Metric charts are automatically named and resized.
'The following block establishes the parameters for these changes.

```

Startt = Worksheets("Settings").Cells(2, "B")
Startts = (Startt * 1000)
Stopp = Worksheets("Settings").Cells(4, "B")
Stopp = (Stopp * 1000)
If Display = "A2B1C2" Then
    X = "Frequency"
    Ya = "R"
    Yb = "X"
    Za = "R Vs. Frequency"
    Zb = "X Vs. Frequency"
    Zc = "Damage Metric - R (1-Correlation)"
    Zd = "Damage Metric - R (Average Square Difference)"
ElseIf Display = "A1B1C2" Then
    X = "Frequency"
    Ya = "Z (magnitude)"
    Yb = "Theta, deg"
    Za = "Z Vs. Frequency"
    Zb = "Theta Vs. Frequency"
    Zc = "Damage Metric - Z (1-Correlation)"
    Zd = "Damage Metric - Z (Average Square Difference)"
End If

```

'If the Measurement number is more than 1, the following block constructs the
'Damage Metric chart based on the Average Square Difference method.

```

If Measure > 1 Then
    Sheets("Metric-ASD").Select
    Selection.Delete
    Sheets("Data(A)").Select
    Range(Cells(1, 7), Cells(2, Measure + 5)).Select
    ActiveSheet.ChartObjects.Add(250.5, 24.75, 474.75, 276.75).Select
    Application.CutCopyMode = False
    ActiveChart.ChartWizard Source:=Range(Cells(1, 7), Cells(2, Measure + 5)),
    Gallery:=xlColumn, _
        Format:=2, PlotBy:=xlRows, CategoryLabels:=1, SeriesLabels _
            :=0, HasLegend:=1, Title:=Zd, CategoryTitle="", ValueTitle _
                :="Metric", ExtraTitle=""
    Selection.Cut
    Sheets("Metric-ASD").Select

```

```
Range("A1").Select
ActiveSheet.Paste
```

'If the Measurement number is more than 1, the following block constructs the
'Damage Metric chart based on the Correlation method.

```
Sheets("Metric-CORR").Select
Selection.Delete
Sheets("Data(A)").Select
Range(Cells(1, 7), Cells(1, Measure + 5)).Range(Cells(3, 7), Cells(3, Measure +
5)).Select
Range("G3").Activate
ActiveSheet.ChartObjects.Add(244.5, 16.5, 476.25, 284.25).Select
Application.CutCopyMode = False
ActiveChart.ChartWizard Source:=Union(Range(Cells(1, 7), Cells(1, Measure + 5)),
Range(Cells(3, 7), Cells(3, Measure + 5))), Gallery:=xlColumn, _
Format:=2, PlotBy:=xlRows, CategoryLabels:=1, SeriesLabels _
:=0, HasLegend:=1, Title:=Zc, CategoryTitle:="", ValueTitle _
:="Metric", ExtraTitle:=""
Selection.Cut
Sheets("Metric-CORR").Select
Range("A2").Select
ActiveSheet.Paste
End If
```

'Frequency charts are constructed based on Measurement number and the Datapoints.
'The charts are automatically titled and the scale is established based on the frequency.

```
Sheets("A Vs. Freq.").Select
Selection.Delete
Sheets("Data(A)").Select
Range(Cells(4, 5), Cells(Datapoints + 5, Measure + 5)).Select
ActiveSheet.ChartObjects.Add(27.75, 26.25, 471.75, 277.5).Select
Application.CutCopyMode = False
ActiveChart.ChartWizard Source:=Range(Cells(4, 5), Cells(Datapoints + 5, Measure +
5)), Gallery:= _
xlXYScatter, Format:=6, PlotBy:=xlColumns, CategoryLabels:=1, _
SeriesLabels:=1, HasLegend:=1, Title:=Za, CategoryTitle:= _
X, ValueTitle:=Ya, ExtraTitle:=""
With ActiveChart.Axes(xlCategory)
.MinimumScaleIsAuto = True
.MaximumScaleIsAuto = True
.MinimumScale = Startts
.MaximumScale = Stopps
End With
Selection.Cut
```

```

Sheets("A Vs. Freq.").Select
Application.Run Macro:="GPIBOnSheetAct"
Range("A1").Select
ActiveSheet.Paste
,

Sheets("B Vs. Freq.").Select
Selection.Delete
Sheets("Data(B)").Select
Range(Cells(4, 5), Cells(Datapoints + 5, Measure + 5)).Select
ActiveSheet.ChartObjects.Add(27.75, 26.25, 471.75, 277.5).Select
Application.CutCopyMode = False
ActiveChart.ChartWizard Source:=Range(Cells(4, 5), Cells(Datapoints + 5, Measure +
5)), Gallery:= _
    xlXYScatter, Format:=6, PlotBy:=xlColumns, CategoryLabels:=1, _
    SeriesLabels:=1, HasLegend:=1, Title:=Zb, CategoryTitle:= _
    X, ValueTitle:=Yb, ExtraTitle:=""
With ActiveChart.Axes(xlCategory)
    .MinimumScaleIsAuto = True
    .MaximumScaleIsAuto = True
    .MinimumScale = Startts
    .MaximumScale = Stopps
End With
Selection.Cut
Sheets("B Vs. Freq.").Select
Application.Run Macro:="GPIBOnSheetAct"
Range("A1").Select
ActiveSheet.Paste
,

'The instrument is checked for the STOP frequency; the actual and desired STOP
'frequencies are compared and results posted appropriately.
Application.Run "GPIB", "C-FrequencyCheck"
ActEndF = Worksheets("Settings").Cells(9, "B")
DesEndF = Worksheets("Settings").Cells(4, "B")
If ActEndF <> DesEndF Then
    Sheets("Settings").Select
    Range("B9").Select
    Msg = "Instrument Error: Desired and Actual STOP Frequencies differ"
    DialogStyle = vbOKOnly + vbExclamation + vbDefaultButton1
    Title = "ERROR"
    MsgBox Msg, DialogStyle, Title
    Application.Run "GPIB", "C-LOCAL"
End
End If
,

```

```

Application.Run "GPIB", "C-LOCAL"           ' Puts the instrument in LOCAL mode
,
If Measure = 1 Then
    Sheets("Settings").Select
Else
    Sheets("Metric-CORR").Select
End If
,
'The following block puts out a window to determine if the user wants to save the
worksheet.
Msg = "Do you want to SAVE the active workbook?"
DialogStyle = vbYesNoCancel + vbQuestion + vbDefaultButton1
Title = "SAVE?"
Response = MsgBox(Msg, DialogStyle, Title)
If Response = vbYes Then
    ActiveWorkbook.save
Else
    End
End If
,
End Sub

```