

Appendix B: 'PZT' PROGRAM

This program is a part of the RSIM software and operates on the HP4192A Impedance Analyzer with a primary address of H-17. It resides in the 'PZT-Program' sheet in the file 'PZT-ALL' and is written in Visual Basic for Applications (VBA).

```
'  
' PZT Macro  
' Operates on the HP4192A with primary address as H-17.  
'  
Sub PZT()  
    Sheets("Settings").Select  
    Range("B9").Select  
    ActiveCell.FormulaR1C1 = ""  
    Range("B6").Select  
,  
    Application.Run "GPIB", "LOCAL"           'Puts the instrument in LOCAL mode  
    Application.Run "GPIB", "CLEAR"           'Clears the instrument  
    Application.Run "GPIB", "STEP Frequency"   'Sets the STEP frequency  
    Application.Run "GPIB", "STOP Frequency"   'Sets the STOP frequency  
    Application.Run "GPIB", "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", "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", "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", "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", "SpeedShort"
ElseIf Speed = "Med" Then
    Application.Run "GPIB", "SpeedMed"
ElseIf Speed = "High" Then
    Application.Run "GPIB", "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", "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", "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", "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", "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", "AUTO"
    Application.Run "GPIB", "TASK1a", "Copy1!A5:B405"
  ElseIf Datapoints = 500 Then
    Application.Run "GPIB", "AUTO"
    Application.Run "GPIB", "TASK1a", "Copy1!A5:B505"
  ElseIf Datapoints = 1000 Then
    Application.Run "GPIB", "AUTO"
    Application.Run "GPIB", "TASK1a", "Copy1!A5:B1005"
  ElseIf Datapoints = 1500 Then
    Application.Run "GPIB", "AUTO"
    Application.Run "GPIB", "TASK1a", "Copy1!A5:B1505"
  ElseIf Datapoints = 2000 Then
    Application.Run "GPIB", "AUTO"
    Application.Run "GPIB", "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", "AUTO"
    Application.Run "GPIB", "TASK1b", "Copy1!A5:B405"
  ElseIf Datapoints = 500 Then
    Application.Run "GPIB", "AUTO"
    Application.Run "GPIB", "TASK1b", "Copy1!A5:B505"
  ElseIf Datapoints = 1000 Then
```

```

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

```

```

Application.Run "GPIB", "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

```