AN023 - C60 Application Note

Custom Control of the C60

The CypherGraph software uses an ActiveX control (ZapUsb.ocx) to control the C60. The methods exposed by the ActiveX control allow ASCII commands to be sent to and received from the instrument. The commands used are those used by the script language described in Appendix C of the user manual. To use the ActiveX control the CypherGraph software must be installed.

There are eight methods and three events that are required to control the C60. Only these methods and events should be used. The following gives a brief outline of the ActiveX control interface.

ActiveX Methods

1. BOOL Open(void)

This method opens the communications link to the C60. The return value is True if the device was found. The function will return False if there is a communications link to the C60 already open.

2. void Close(void)

This method closes the communications link to the C60.

3. long Available(void)

This method returns the number of characters that are available to be read from the C60.

4. long ReadString(BSTR FAR* pszDestinationString, long lMaxLength)

This method reads a string from the device.

OUT pszDestinationString - Pointer to the destination wide string memory

IN lMaxLength - The length of the destination wide string memory

Returns the number of wide characters delivered to the destination memory

5. BOOL WriteString(LPCTSTR pszString)

This method writes a string to the C60.

IN pszString - Pointer to the destination zero terminated wide character string

Returns True if the write to the C60 was successful

6. BOOL IsOpen(void)

This method returns True if the communication link to the C60 is open.

7. void DisableDataReceived(void)

This method disables DataReceived events.

8. void EnableDataReceived(void)

This method enables DataReceived events.

ActiveX Events

1. void Connect(void)

This event is fired when the communications link to the C60 is opened.

2. void Disconnect(void)

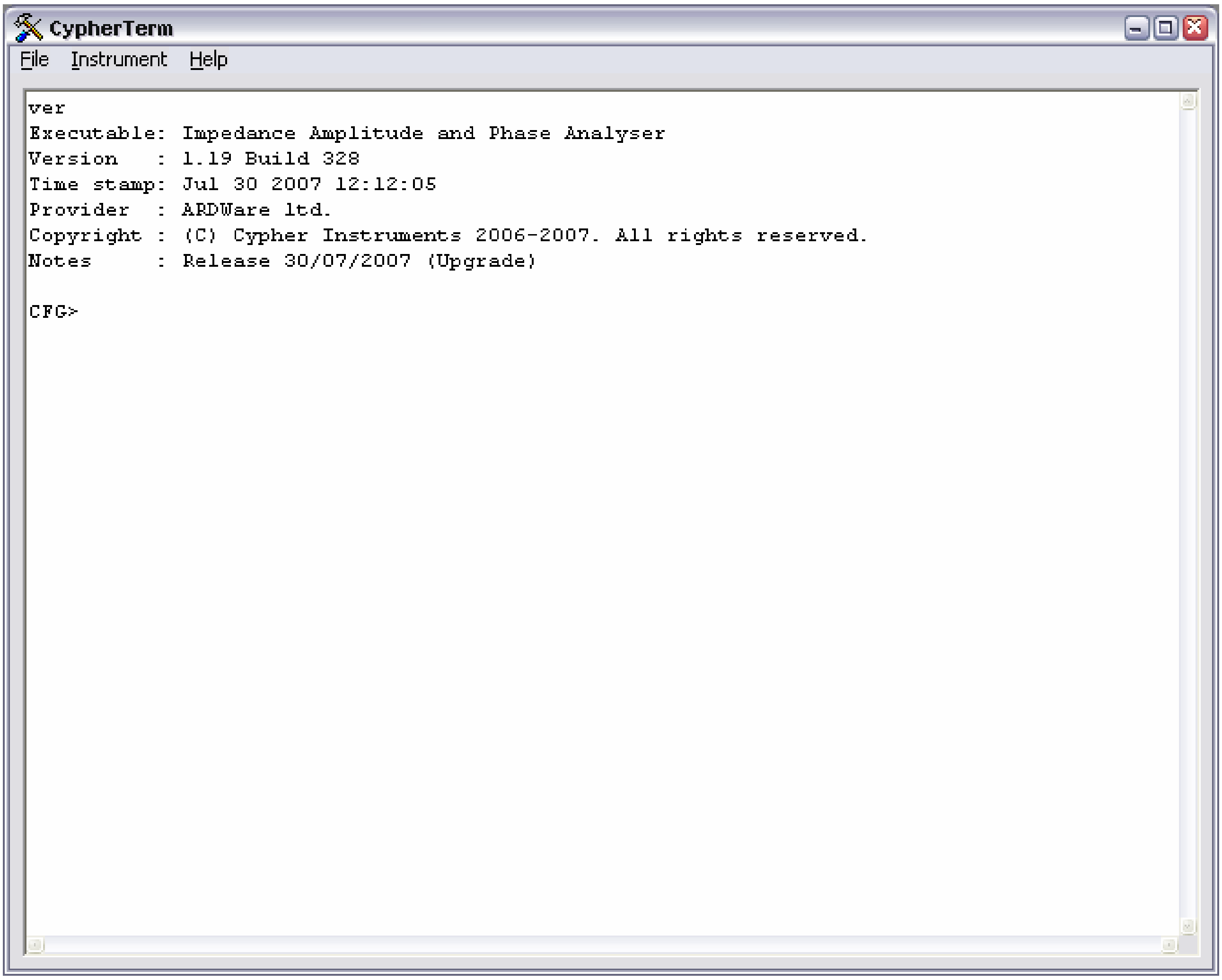
This event is fired when the communication link to the C60 is closed. Because the C60 is a PNP device, this event will be fired when the USB cable is disconnected (surprise remove). It is expected that if the device is open when this event is fired, then the Close method will be called.

3. void DataReceived(void)

This event is fired when data has been received from the C60. If message processing is performed in this event, then it is expected that further DataReceived events will be suppressed until the exit of the event handler by calling the DisableDataReceived method. The ActiveX control will fire this event again when the EnableDataReceived method is called, if there are messages still waiting to be read.

C60 Command list

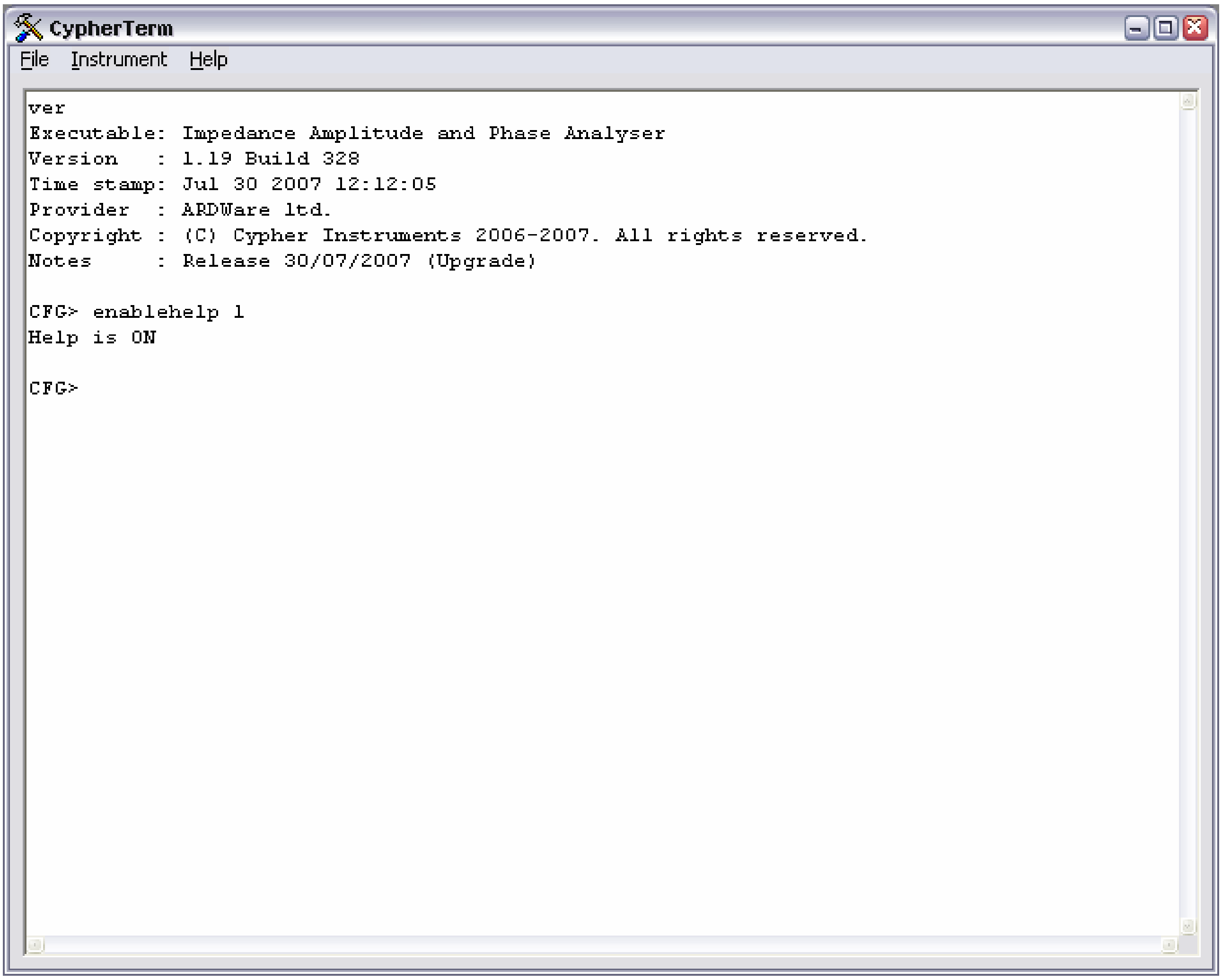
CypherGraph contains a terminal window which provides a console style control interface to the C60. The command console can be used to see how the C60 responds to commands. The C60 has many more commands available than those listed in appendix C of the user manual. The command list supported by your device can be seen with the "?" command. To open the control console, connect a C60 to the computer and open CypherGraph. Then press Ctrl+D to open the About Device dialog box, then click the console button.



```
ver
Executable: Impedance Amplitude and Phase Analyser
Version    : 1.19 Build 328
Time stamp: Jul 30 2007 12:12:05
Provider   : ARDWare ltd.
Copyright : (C) Cypher Instruments 2006-2007. All rights reserved.
Notes      : Release 30/07/2007 (Upgrade)

CFG>
```

To enable the help facilities, type enablehelp 1<CR>.



```
ver
Executable: Impedance Amplitude and Phase Analyser
Version   : 1.19 Build 328
Time stamp: Jul 30 2007 12:12:05
Provider  : ARDWare ltd.
Copyright : (C) Cypher Instruments 2006-2007. All rights reserved.
Notes     : Release 30/07/2007 (Upgrade)

CFG> enablehelp 1
Help is ON

CFG>
```

Type ?<CR> for a list of control commands.

NOTE:

The commands available and command syntax will vary with different versions of firmware.

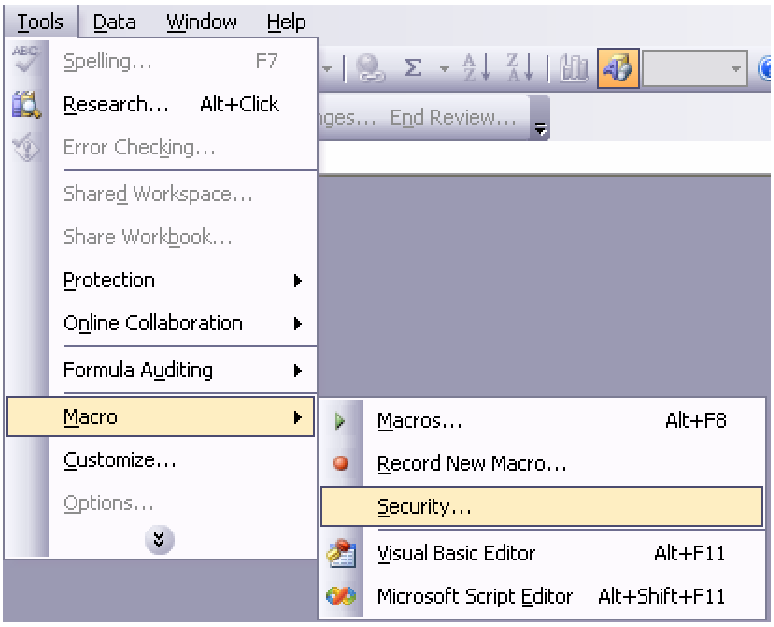
Do not use calibration or other configuration commands such as "setfreqcomp", "setserial", "setvdut", "setvref", "savecal", "pretestcal" and "phasecal". Incorrect use of these commands could result in loss of calibration information.

Sample control using Excel

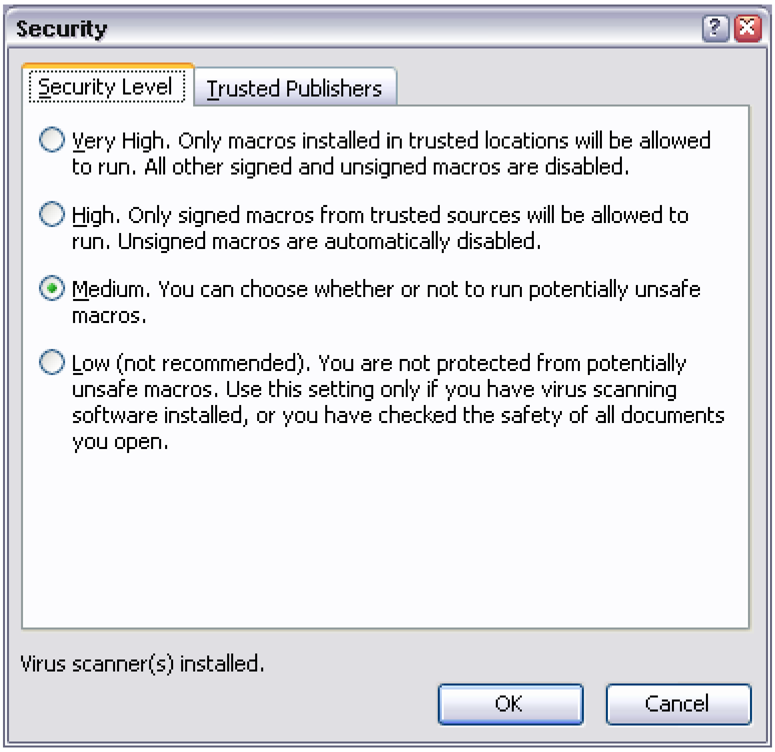
The ActiveX control can be used in an Excel spread sheet to acquire data directly into a Worksheet. This can be customised for any application specific network analysis. The spread sheet (ExcelSample.xls) is supplied with this application note. For this sample to work you require a Windows PC with both Microsoft Excel and CypherGraph installed.

Enabling Macros in Excel

Before the sample spread sheet can be opened, Excel must have the macro facility enabled. This can be found in the Tools->Macro->Security dialog.



The security level should be set to Medium.



○ Very High. Only macros installed in trusted locations will be allowed to run. All other signed and unsigned macros are disabled.

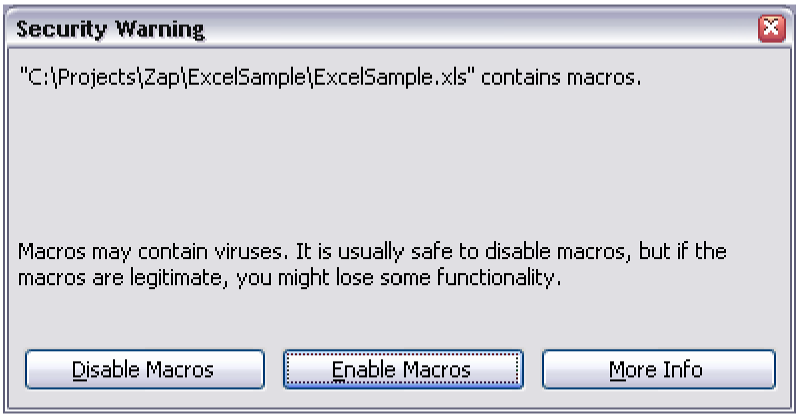
○ High. Only signed macros from trusted sources will be allowed to run. Unsigned macros are automatically disabled.

● Medium. You can choose whether or not to run potentially unsafe macros.

○ Low (not recommended). You are not protected from potentially unsafe macros. Use this setting only if you have virus scanning software installed, or you have checked the safety of all documents you open.

Virus scanner(s) installed.

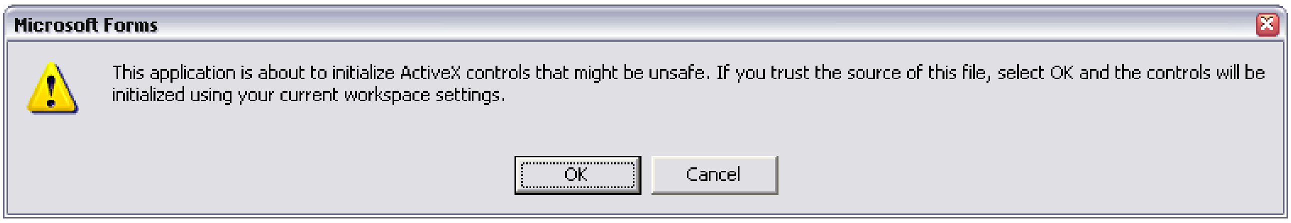
When the spread sheet is opened you will be prompted to enable macros, then click the “Enable Macros” button.



"C:\Projects\Zap\ExcelSample\ExcelSample.xls" contains macros.

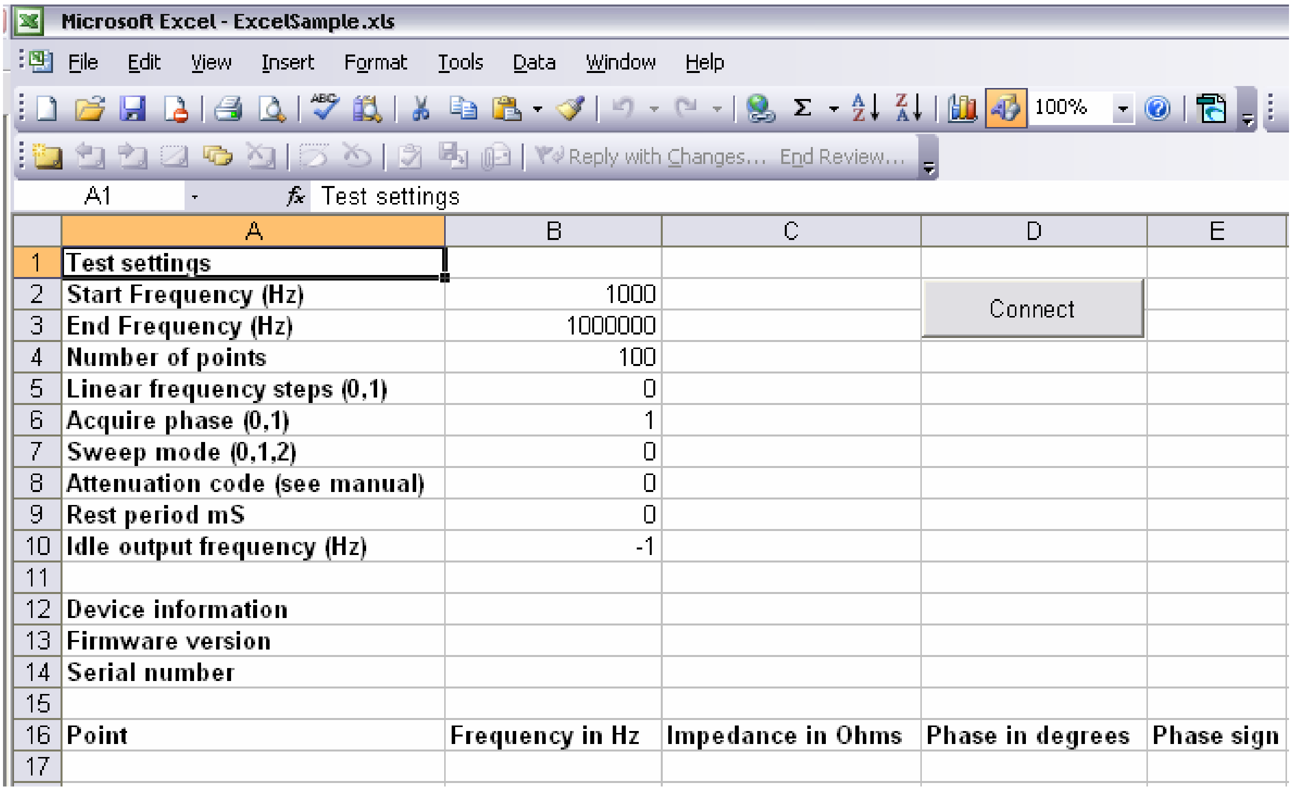
Macros may contain viruses. It is usually safe to disable macros, but if the macros are legitimate, you might lose some functionality.

Click OK to the ActiveX control warning dialog.



This application is about to initialize ActiveX controls that might be unsafe. If you trust the source of this file, select OK and the controls will be initialized using your current workspace settings.

The spread sheet contains the test settings. Adjust these as required, then click the connect button. Refer to appendix C of the user manual for sweep mode, phase and idle output frequency parameters.

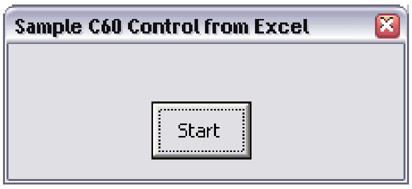


A1 Test settings

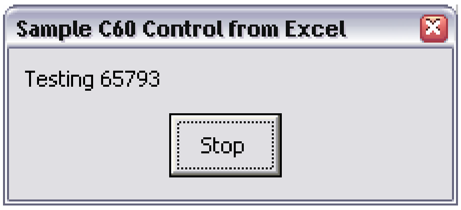
	A	B	C	D	E
1	Test settings				
2	Start Frequency (Hz)	1000			
3	End Frequency (Hz)	1000000			
4	Number of points	100			
5	Linear frequency steps (0,1)	0			
6	Acquire phase (0,1)	1			
7	Sweep mode (0,1,2)	0			
8	Attenuation code (see manual)	0			
9	Rest period mS	0			
10	Idle output frequency (Hz)	-1			
11					
12	Device information				
13	Firmware version				
14	Serial number				
15					
16	Point	Frequency in Hz	Impedance in Ohms	Phase in degrees	Phase sign
17					

NOTE: The maximum number of columns supported by Excel is 65536 and the zero based point index returned with an amplitude or impedance result has a limit of 65536 (0 to 65535). Care should be taken when setting the number of points to a value greater than 65536, since it will exceed the limits of Excel and the point index will wrap from 65535 to 0. With this sample code the number of points should be less than 65518.

If a C60 is connected then the following dialog will show. Click Start to begin the test.

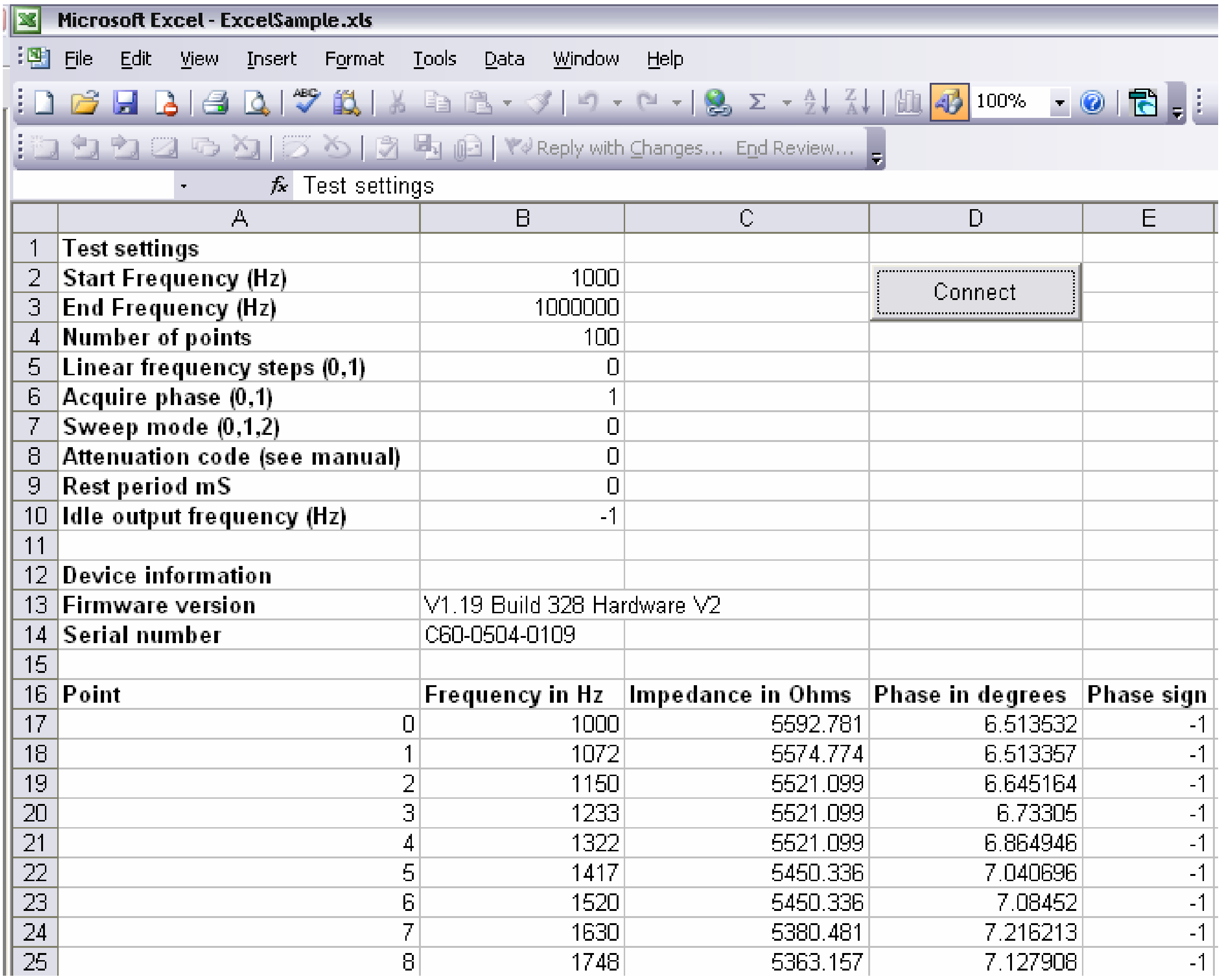


Progress is shown on the dialog as the C60 performs the test.



Testing 65793

The data is displayed in the spread sheet as it is sent from the C60.

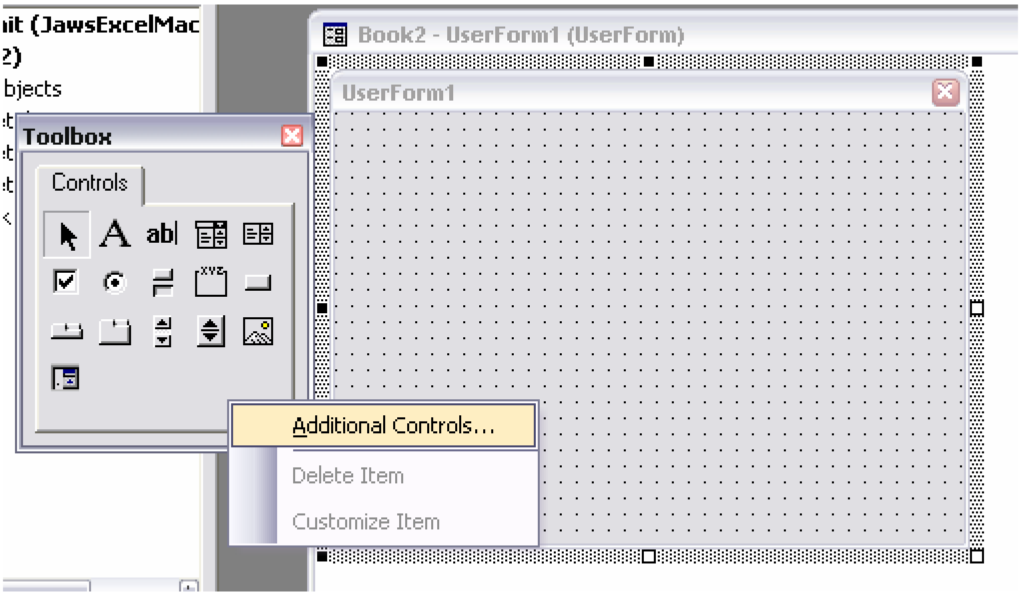

Microsoft Excel - ExcelSample.xls
File Edit View Insert Format Tools Data Window Help
100%
Reply with Changes... End Review...
Connect

Test settings

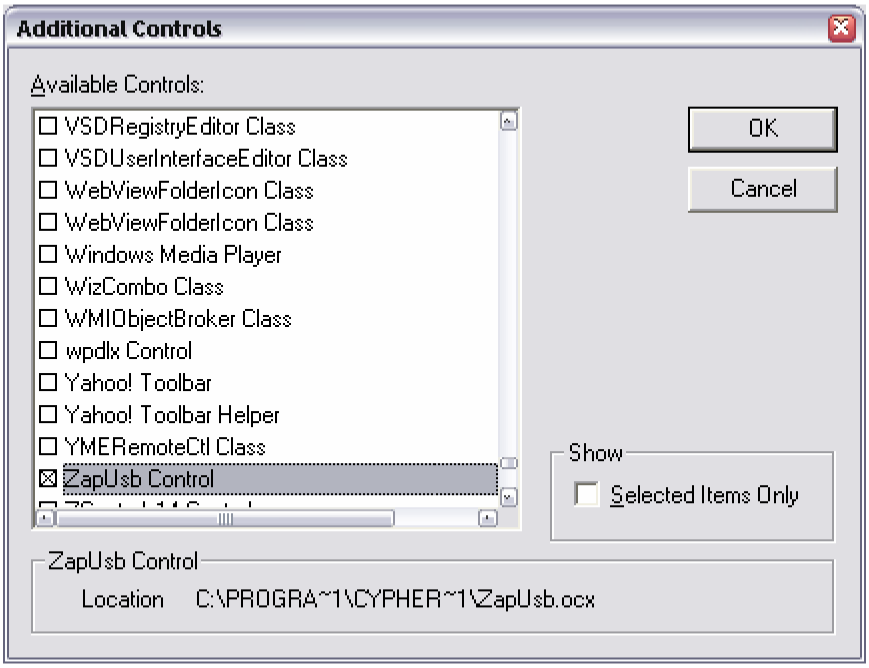
	A	B	C	D	E
1	Test settings				
2	Start Frequency (Hz)	1000			
3	End Frequency (Hz)	1000000			
4	Number of points	100			
5	Linear frequency steps (0,1)	0			
6	Acquire phase (0,1)	1			
7	Sweep mode (0,1,2)	0			
8	Attenuation code (see manual)	0			
9	Rest period mS	0			
10	Idle output frequency (Hz)	-1			
11					
12	Device information				
13	Firmware version	V1.19 Build 328 Hardware V2			
14	Serial number	C60-0504-0109			
15					
16	Point	Frequency in Hz	Impedance in Ohms	Phase in degrees	Phase sign
17	0	1000	5592.781	6.513532	-1
18	1	1072	5574.774	6.513357	-1
19	2	1150	5521.099	6.645164	-1
20	3	1233	5521.099	6.73305	-1
21	4	1322	5521.099	6.864946	-1
22	5	1417	5450.336	7.040696	-1
23	6	1520	5450.336	7.08452	-1
24	7	1630	5380.481	7.216213	-1
25	8	1748	5363.157	7.127908	-1

Adding ZapUsb control to an Excel worksheet

If you want to control the C60 from an existing spread sheet you will need to add the ZapUsb ActiveX control to it. Open Excel and the Visual Basic Editor (Alt+F11). Right click on the VBAProject in the project browser window. Left click Insert->User Form. Right click on the toolbox and left click "Additional Controls…".



Select ZapUsb Control from the list and click OK.



Available Controls:

- ☐ VSDRegistryEditor Class
- ☐ VSDUserInterfaceEditor Class
- ☐ WebViewFolderIcon Class
- ☐ WebViewFolderIcon Class
- ☐ Windows Media Player
- ☐ WizCombo Class
- ☐ WMIObjectBroker Class
- ☐ wpdlx Control
- ☐ Yahoo! Toolbar
- ☐ Yahoo! Toolbar Helper
- ☐ YMERemoteCtl Class
- ☒ ZapUsb Control

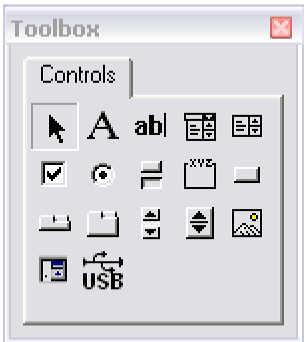
Show

☐ Selected Items Only

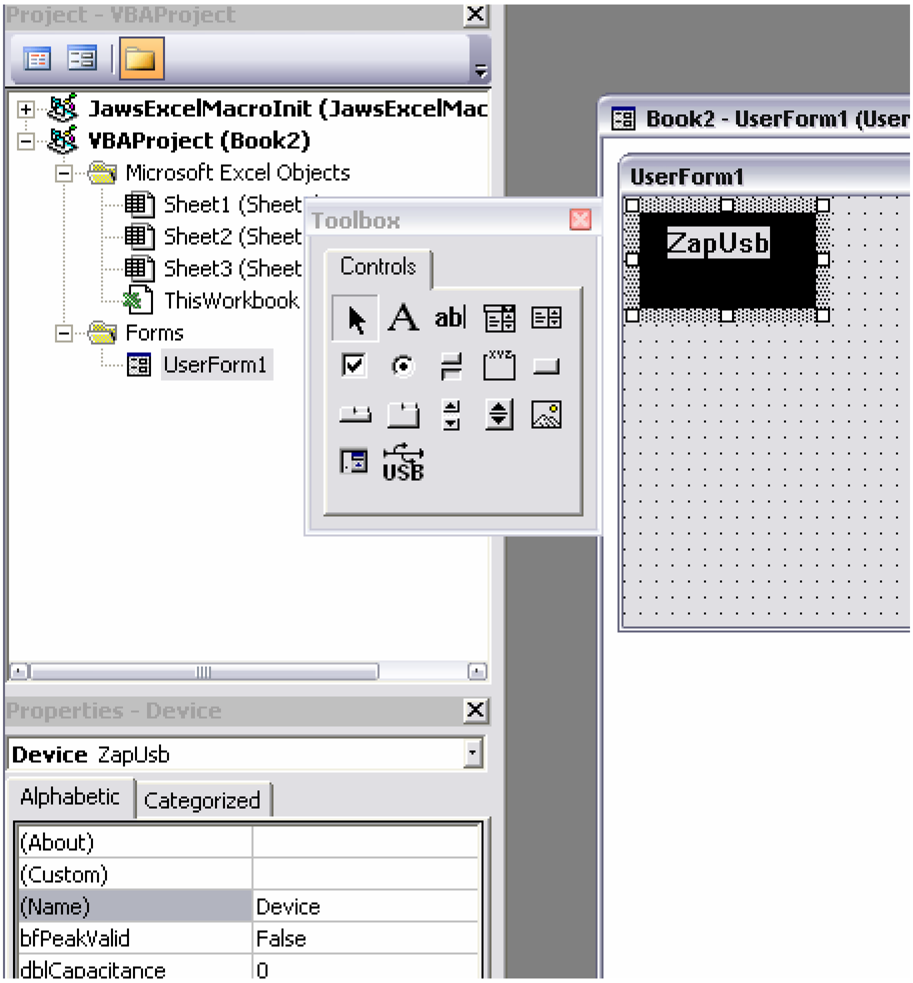
ZapUsb Control

Location C:\PROGRA~1\CYPHER~1\ZapUsb.ocx

This will add the ZapUsb control to the Excel tool box.



To add the control to the form click the ZapUsb icon, then draw a rectangle on the user form like you were adding a button. So you can cut and paste the Excel Visual Basic macro listing into the form's code, change the name from ZapUsb1 to Device.

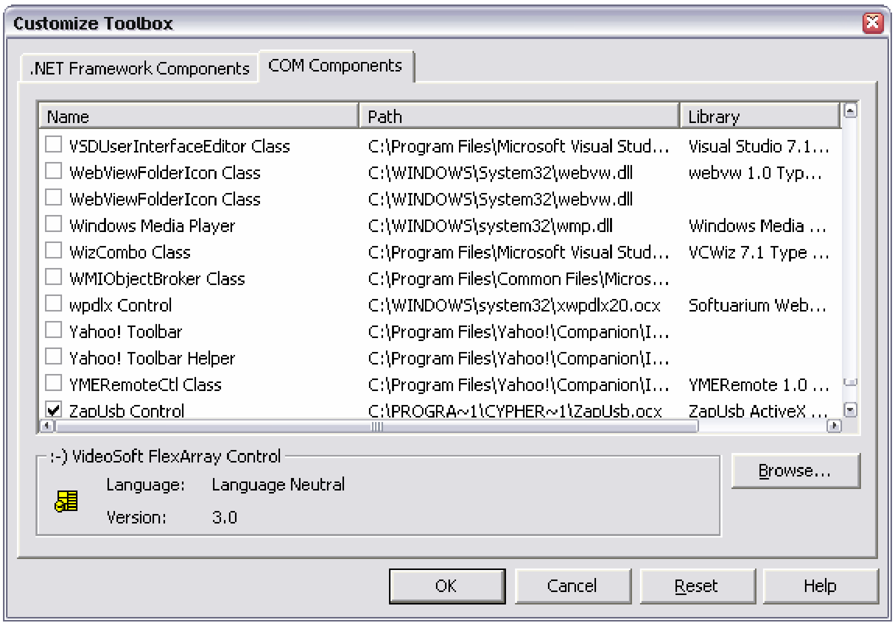


Device ZapUsb

(About)	
(Custom)	
(Name)	Device
bfPeakValid	False
dblCapacitance	0

The control is invisible at run-time so don’t worry about the size or shape of it since it has no graphical function.

The control can be added to other development environments in a similar way. For example, to access the C60 from a VisualStudio project, right click on the toolbox and left click “Add/Remove Items…”. From the list of controls on the COM component tab select ZapUsb Control.



Name	Path	Library
☐ VSDUserInterfaceEditor Class	C:\Program Files\Microsoft Visual Stud…	Visual Studio 7.1…
☐ WebViewFolderIcon Class	C:\WINDOWS\System32\webvw.dll	webvw 1.0 Typ…
☐ WebViewFolderIcon Class	C:\WINDOWS\System32\webvw.dll	
☐ Windows Media Player	C:\WINDOWS\system32\wmp.dll	Windows Media …
☐ WizCombo Class	C:\Program Files\Microsoft Visual Stud…	VCWiz 7.1 Type …
☐ WMIObjectBroker Class	C:\Program Files\Common Files\Micros…	
☐ wpdlx Control	C:\WINDOWS\system32\xwpdlx20.ocx	Softuarium Web…
☐ Yahoo! Toolbar	C:\Program Files\Yahoo!\Companion\I…	
☐ Yahoo! Toolbar Helper	C:\Program Files\Yahoo!\Companion\I…	
☐ YMERemoteCtl Class	C:\Program Files\Yahoo!\Companion\I…	YMERemote 1.0 …
☑ ZapUsb Control	C:\PROGRA~1\CYPHER~1\ZapUsb.ocx	ZapUsb ActiveX …

:-) VideoSoft FlexArray Control
Language: Language Neutral
Version: 3.0

The C60 Message Format

The machine readable messages returned by the device are in the format shown below. Each message is an ASCII character string with a fixed length of 67 bytes. The message contains seven fields delimited by white space (ASCII code 0x20).

ASCII Field	Field Index	Length	Character Range	Function	Type
Field 1	**1**	**1**	**0..9, A..Z, a..z**	**Message Type**	**Character**
“:”	2	1		Field delimiter 1	Constant
Field 2	**3**	**1**	**0..9,A..F**	**Message Flag**	**Hexadecimal character**
“SPACE”	4	1		Field delimiter 2	Constant
Field 3	**5**	**2**	**-9..+9**	**Floating point data field 1**	**Signed numeric data**
“.”	7	1			
	8	**6**	**000000..999999**		
“e”	14	1			
	15	**3**	**-99..+99**		
“SPACE”	18	1		Field delimiter 3	Constant
Field 4	**19**	**2**	**-9..+9**	**Floating point data field 2**	**Signed numeric data**
“.”	21	1			
	22	**6**	**000000..999999**		
“e”	28	1			
	29	**3**	**-99..+99**		
“SPACE”	32	1		Field delimiter 4	Constant
Field 5	**33**	**2**	**-9..+9**	**Floating point data field 3**	**Signed numeric data**
“.”	35	1			
	36	**6**	**000000..999999**		
“e”	42	1			
	43	**3**	**-99..+99**		
“SPACE”	46	1		Field delimiter 5	Constant
Field 6	**47**	**2**	**-9..+9**	**Floating point data field 4**	**Signed numeric data**
“.”	49	1			
	50	**6**	**000000..999999**		
“e”	56	1			
	57	**3**	**-99..+99**		
“SPACE”	60	1		Field delimiter 6	Constant
Field 7	**61**	**5**	**000000..065535**	**Fixed point data**	**Unsigned numeric data**
“\r”	66	1		End of message marker	Constant
“\n”	67	1			

Figure 1 Machine readable message format

The first character of each message defines the message type. The message type defines the meaning of all the other fields in the message. However, there are three messages which don't use fields 3 to 7. Instead, the remaining fields are translated as one single ASCII character string. Figure 2 shows the character code and the field meanings for the most important messages. The C60 can return many more field character codes but these are reserved for use by CypherGraph.

Field							Command
1	**2**	**3**	**4**	**5**	**6**	**7**	**/ comment**
"A"	Attenuator support 1 = TRUE	Minimum attenuation in dB	Maximum attenuation in dB	Attenuation step size in dB	Current attenuation setting	Number of attenuation steps for use by user	"atten"
"B"	Internal loop-back relay state ON = 1 OFF = 0	Calibration frequency in Hz	Upper test point attenuation setting in dB	Lower test point attenuation setting in dB	Calibration slope in ADC counts / dB	Use graph extents to define start and stop frequencies	"zerocal"
"C"	N/A	Calibration frequency in Hz	Upper test point attenuation setting in dB	Lower test point attenuation setting in dB	VREF setting	VDUT setting	"phasecal"
"D"	Repeat 1 = ON 0 = OFF	Calibrate Before each test 1 = ON 0 = OFF	Oscillator start frequency in Hz	Oscillator end frequency in Hz	Sweep direction 1 = Reverse 0 = Forward	Linear test points 1 = linear 0 = Log	Start of test marker
"E"	Repeat 1 = ON 0 = OFF	Calibrate Before each test 1 = ON 0 = OFF	Oscillator start frequency in Hz	Oscillator end frequency in Hz	Sweep direction 1 = Reverse 0 = Forward	Linear test points 1 = linear 0 = Log	End of test marker
"F"	Redraw graph 1 = Redraw 0 = Don't	Frequency in Hz	Impedance in Ohms	Phase in degrees	Phase sign	Zero based test point index	"imptest"
"G"	N/A	Frequency in Hz	Impedance in Ohms	Phase in degrees	Phase sign	Zero based test count	"impspot"
"H"	Redraw graph 1 = Redraw 0 = Don't	Frequency in Hz	Amplitude in dB	Phase in degrees	Phase sign	Zero based test point index	"amptest"
"I"	N/A	Frequency in Hz	Amplitude in dB	Phase in degrees	Phase sign	Zero based test count	"ampspot"
"J"	Internal calibration relay state 1 = ON 0 = OFF	Input disable relay state 1 = ON 0 = OFF	Current Select switch state 1 = ON 0 = OFF	Impedance test relay state 1 = ON 0 = OFF	Calibrate DUT signal state 1 = ON 0 = OFF	Repeat 1 = ON 0 = OFF	"loopback"

"K"	Sweep direction 1 = Reverse 0 = Forward	Oscillator idle frequency in Hz -1 = start frequency	Oscillator start frequency in Hz	Oscillator end frequency in Hz	Oscillator spot frequency in Hz	Linear test points 1 = linear 0 = Log	"oscillator"
"L"	Amplitude support 1 = ON 2 = OFF	Minimum oscillator frequency in Hz	Maximum oscillator frequency in Hz	Minimum amplitude in dB	Maximum amplitude in dB	N/A	"limits"
"M"	Phase support 1 = ON 2 = OFF	Minimum oscillator frequency in Hz	Maximum oscillator frequency in Hz	Minimum phase shift in degrees	Maximum phase shift in degrees	N/A	"limits"
"N"	Impedance support 1 = ON 2 = OFF	Minimum oscillator frequency in Hz	Maximum oscillator frequency in Hz	Minimum impedance in Ohms	Maximum impedance in Ohms	N/A	"limits"
"O"	Debug Build 1 = Debug 0 = Release	Version	Release	Build	Hardware revision number	N/A	"mver"
"P"	Calibrate Before each test 1 = ON 0 = OFF	Number of test points	Number of samples per point	Number of voltage cycles per point	Number of current cycles per point	Number of cycles required for phase calibration	test point information
"Q"	N/A	Test start settling time	Test point settling time (Period)	Zero calibration settling time	Sweep speed setting	Number of sweep speeds	settling time information
"R"	Apply Calibration Curve	Phase calibration start settling time	Phase calibration settling time	System Calibrated	N/A	N/A	Phase calibration settling time information
"S"	N/A	Number of test points	Test point settling time (Period)	Number of voltage cycles per point	Number of current cycles per point	Zero based test point index	"retrace"
"T"	Message type 1 = Error 0 = Information	The remainder of the fields are all translated as one single fixed length string					
"U"	Document action 3 = Imp Vs T 2 = Amp Vs T 1 = Imp Vs F 0 = Amp Vs F	New document name – Load / Create a new document with this title and get ready to accept data					

Figure 2 Message field definitions

Excel Visual Basic macro listing

```
' Sample communications code with a C60 for impedance
' data acquisition directly into an excel spread sheet
' By Adam Fullerton

'
' Global constants
'~~~~~~~~~~~~~~~~~
'
'

Private Const DEV_RX_BUFFER_SIZE = 31200
Private Const DEV_RX_MESSAGE_SIZE = 67

'
' The position of the fields in the message string
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
'
'

Private Const DEV_FIELD2_INDEX = 3
Private Const DEV_FIELD2_SIZE = 1
Private Const DEV_FIELD3_INDEX = 5
Private Const DEV_FIELD4_INDEX = 19
Private Const DEV_FIELD5_INDEX = 33
Private Const DEV_FIELD6_INDEX = 47
Private Const DEV_FIELD7_INDEX = 61
Private Const DEV_FIELD7_SIZE = 5
Private Const DEV_STRING_FIELD_START = 4
Private Const DEV_STRING_FIELD_END = 65

'
' The position of the fields in the work sheet
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
'
'
' These are the cell addresses of the settings
Private Const WKS_START_FREQ_CELL = "B2"
Private Const WKS_END_FREQ_CELL = "B3"
Private Const WKS_POINTS_CELL = "B4"
Private Const WKS_STEPS_CELL = "B5"
Private Const WKS_PHASE_ACQ_CELL = "B6"
Private Const WKS_SWEEP_MODE_CELL = "B7"
Private Const WKS_ATTEN_CELL = "B8"
Private Const WKS_REST_PERIOD_CELL = "B9"
Private Const WKS_IDLE_FREQ_CELL = "B10"
' These are the destination cell addresses of the device info
Private Const WKS_FIRMWARE_VERSION = "B13"
Private Const WKS_SERIAL_NUMBER = "B14"
' These are the column addresses for the acquired data
Private Const WKS_POINT_COLUMN = "A"
Private Const WKS_FREQUENCY_COLUMN = "B"
Private Const WKS_IMPEDANCE_COLUMN = "C"
Private Const WKS_PHASE_COLUMN = "D"
Private Const WKS_PHASE_SIGN_COLUMN = "E"
' This is where the acquired data starts
Private Const WKS_FIRST_DATA_ROW = 17

'
' Private variables
'~~~~~~~~~~~~~~~~~~
'

Private g_sRxBuffer As String * DEV_RX_BUFFER_SIZE
' The test start button click
Private Sub cmdStart_Click()
    ' Check that the test has not already been started
    If cmdStart.Caption = "Start" Then
        With Device
            ' Ask the device for its version, serial number and other information
            .WriteString("enquire" + vbCr)
            ' With firmware V1.19.327 or higher 1/16th Hz frequency resolution is possible.
            ' The enquire command sets communications compatibility mode, if you are using
            ' firmware V1.19 or higher the following will enable the higher frequency resolution.
            '.WriteString "enquire 1.19" + vbCr
            ' Send the repeat setting 0 = off, 1 = repeat
```

```
            .WriteString("repeat " + Str(0) + vbCr)
            ' Send the start frequency
            .WriteString("startfreq " + Str(Worksheets(1).Range(WKS_START_FREQ_CELL)) + vbCr)
            ' Send the end frequency
            .WriteString("endfreq " + Str(Worksheets(1).Range(WKS_END_FREQ_CELL)) + vbCr)
            ' Send the number of points
            .WriteString("points " + Str(Worksheets(1).Range(WKS_POINTS_CELL)) + vbCr)
            ' Send the frequency steps
            .WriteString("linear " + Str(Worksheets(1).Range(WKS_STEPS_CELL)) + vbCr)
            ' Send the phase setting 1 = on 0 = 0ff
            .WriteString("phase " + Str(Worksheets(1).Range(WKS_PHASE_ACQ_CELL)) + vbCr)
            ' Send the sweep direction setting
            .WriteString("sweepmode " + Str(Worksheets(1).Range(WKS_SWEEP_MODE_CELL)) + vbCr)
            ' Send the attenuation
            .WriteString("atten " + Str(Worksheets(1).Range(WKS_ATTEN_CELL)) + vbCr)
            ' Send the rest period
            .WriteString("period " + Str(Worksheets(1).Range(WKS_REST_PERIOD_CELL)) + vbCr)
            ' Send the idle frequency -1 = start, 0 = off
            .WriteString("idlefreq " + Str(Worksheets(1).Range(WKS_IDLE_FREQ_CELL)) + vbCr)
            ' Start an impedance test
            .WriteString("imptest " + vbCr)
        End With
    ElseIf cmdStart.Caption = "Stop" Then
        ' Write the command to exit the test
        Device.WriteString("x" + vbCr)
    End If
End Sub
' The Data Received event
Private Sub Device_DataReceived()
    Dim l_lAvailable As Long
    Dim l_lCrPos As Long
    ' Using the device
    With Device
        ' Disable further DataReceived events
        .DisableDataReceived()
        ' While there is data available
        Do While .Available > DEV_RX_MESSAGE_SIZE - 1
            ' Get the length ready to read
            l_lAvailable = .Available
            ' Initialise the buffer
            g_sRxBuffer = String(DEV_RX_BUFFER_SIZE, 0)
            ' make sure that we don't read over
            ' the end of our string buffer
            If l_lAvailable < g_BufferSize - 1 Then
                l_lAvailable = g_BufferSize - 1
            End If
            ' Read the data
            .ReadString(g_sRxBuffer, l_lAvailable)
            Do
                ' look for <CR>
                l_lCrPos = InStr(1, g_sRxBuffer, vbCr, vbTextCompare)
                If l_lCrPos = 0 Then
                    ' exit if <CR> not found
                    Exit Do
                Else
                    l_lCrPos = l_lCrPos + 1
                    ' Show the responses from the device
                    Debug.Print(Left(g_sRxBuffer, l_lCrPos))
                    ' Pars the data line
                    ParsMessage(l_lCrPos)
                End If
                ' Chop off what we have parsed
                g_sRxBuffer = Right(g_sRxBuffer, (DEV_RX_BUFFER_SIZE - l_lCrPos))
                l_lAvailable = l_lAvailable - l_lCrPos
            Loop
        Loop
        ' Enable more DataReceived events
        .EnableDataReceived()
    End With
End Sub
' Subroutine to check for a machine readable message from the C60
Private Sub ParsMessage(ByVal lCrPos As Long)
    ' Machine readable commands are always
    ' DEV_RX_MESSAGE_SIZE chars long
    ' All other messages are human readable
    If lCrPos = DEV_RX_MESSAGE_SIZE Then
        ' Look for : as the second char as
        ' the sign of a machine readable message
        If InStr(1, g_sRxBuffer, ":", vbTextCompare) = 2 Then
```

```
            ' Pars the message
            ParsMessageType(Left(g_sRxBuffer, 1))
        End If
    End If
End Sub
' Subroutine to pars the message type
Private Sub ParsMessageType(ByVal sType As String)
    Select Case sType
        Case Is = "A"
            ' Attenuation setting
        Case Is = "B"
            ' Zero calibration results
        Case Is = "C"
            ' Phase calibration results
        Case Is = "D"
            cmdStart.Caption = "Stop"
        Case Is = "E"
            cmdStart.Caption = "Start"
            lblStatus.Caption = ""
        Case Is = "F"
            ' Swept impedance results
            ParsSweepZResult()
        Case Is = "G"
            ' Spot impedance results
        Case Is = "H"
            ' Swept amplitude results
            ParsSweepAResult()
        Case Is = "I"
            ' Spot amplitude results
        Case Is = "K"
            ' Oscillator settings
        Case Is = "L"
            ' Device characteristic limits 1
        Case Is = "M"
            ' Device characteristic limits 2
        Case Is = "N"
            ' Device characteristic limits 1
        Case Is = "O"
            ' Device version information
            ParsVersion()
        Case Is = "P"
            ' Point information
        Case Is = "T"
            ' String message from the device
        Case Is = "V"
            ' Serial number string of the device connected
            ParsSerialNumber()
        Case Is = "r"
            ParsProgress()
    End Select
End Sub
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
' Description: Sub to get an integer field
'
' Parameters :
'               IN  iLeft - The left offset
'               IN  iLength - The length
'               OUT lField - The data field value
'
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Private Sub GetLongField(ByVal iLeft As Integer, ByVal iLength As Integer, ByVal lField As Long)
    Dim l_sTemp As String
    l_sTemp = Left(g_sRxBuffer, (iLeft + iLength - 1))
    l_sTemp = Right(l_sTemp, iLength)
    lField = CLng(l_sTemp)
End Sub
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
' Description: Sub to get a double precision field
'
' Parameters :
'               IN  iStartIndex - The index where the double starts
'               OUT dblField - The data field value
'
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Private Sub GetDoubleField(ByVal iStartIndex As Integer, ByVal dblField As Double)
    Dim l_sTemp As String
    l_sTemp = Left(g_sRxBuffer, (iStartIndex + 12))
    l_sTemp = Right(l_sTemp, 13)
    dblField = Val(l_sTemp)
```

```
End Sub
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
' Description: Subroutine to extract a string
'
' Parameters :
'              OUT sMessage - The string
'
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Private Sub GetStringField(ByVal sMessage As String)
    sMessage = Left(g_sRxBuffer, DEV_STRING_FIELD_END)
    sMessage = Right(sMessage, DEV_STRING_FIELD_END - DEV_STRING_FIELD_START)
    ' Eat leading white space
    sMessage = Trim(sMessage)
End Sub
' Sub to pars the device version information
Private Sub ParsVersion()
    Dim l_dblValue As Double
    Dim l_lValue As Long
    Dim l_iVersion As Integer
    Dim l_iRelease As Integer
    Dim l_lBuild As Long
    Dim l_iHardware As Integer
    ' Device Version
    GetDoubleField(DEV_FIELD3_INDEX, l_dblValue)
    l_iVersion = CInt(l_dblValue)
    ' Device Release
    GetDoubleField(DEV_FIELD4_INDEX, l_dblValue)
    l_iRelease = CInt(l_dblValue)
    ' Device Build
    GetDoubleField(DEV_FIELD5_INDEX, l_dblValue)
    l_lBuild = CLng(l_dblValue)
    ' The hardware code
    GetDoubleField(DEV_FIELD6_INDEX, l_dblValue)
    l_iHardware = CInt(l_dblValue)
    ' Update the device information cell
    Worksheets(1).Range(WKS_FIRMWARE_VERSION) = "V" & l_iVersion & "." & l_iRelease & " Build " &
l_lBuild & " Hardware V" & l_iHardware
End Sub
' Subroutine to pars the serial number
Private Sub ParsSerialNumber()
    Dim l_sTemp As String
    ' Get the serial number
    GetStringField(l_sTemp)
    ' Update the serial number information cell
    Worksheets(1).Range(WKS_SERIAL_NUMBER) = l_sTemp
End Sub
' Subroutine to pars the progress messages
Private Sub ParsProgress()
    Dim l_sTemp As String
    ' Get the message string
    GetStringField(l_sTemp)
    ' Show the status string
    lblStatus.Caption = l_sTemp
End Sub
' Subroutine to pars the swept impedance result
Private Sub ParsSweepZResult()
    Dim l_lPointIndex As Long
    Dim l_dblPointFrequency As Double
    Dim l_dblImpedance As Double
    Dim l_dblPhase As Double
    Dim l_dblPhaseSign As Double
    ' Point frequency in Hz
    GetDoubleField(DEV_FIELD3_INDEX, l_dblPointFrequency)
    ' Impedance in Ohms
    GetDoubleField(DEV_FIELD4_INDEX, l_dblImpedance)
    ' Phase in degrees
    GetDoubleField(DEV_FIELD5_INDEX, l_dblPhase)
    ' Phase sign
    GetDoubleField(DEV_FIELD6_INDEX, l_dblPhaseSign)
    ' The zero based index of this point
    GetLongField(DEV_FIELD7_INDEX, DEV_FIELD7_SIZE, l_lPointIndex)
    ' Enter the point index
    Worksheets(1).Range(WKS_POINT_COLUMN & (l_lPointIndex + WKS_FIRST_DATA_ROW)) = l_lPointIndex
    ' Enter the frequency
    Worksheets(1).Range(WKS_FREQUENCY_COLUMN & (l_lPointIndex + WKS_FIRST_DATA_ROW)) =
l_dblPointFrequency
    ' Enter the impedance
    Worksheets(1).Range(WKS_IMPEDANCE_COLUMN & (l_lPointIndex + WKS_FIRST_DATA_ROW)) =
l_dblImpedance
```

```
    ' Enter the phase
    Worksheets(1).Range(WKS_PHASE_COLUMN & (l_lPointIndex + WKS_FIRST_DATA_ROW)) = l_dblPhase
    ' Enter the phase sign
    Worksheets(1).Range(WKS_PHASE_SIGN_COLUMN & (l_lPointIndex + WKS_FIRST_DATA_ROW)) =
l_dblPhaseSign
End Sub
' Subroutuine to pars the swept amplitude result
Private Sub ParsSweepAResult()
    Dim l_lPointIndex As Long
    Dim l_dblPointFrequency As Double
    Dim l_dblAmplitude As Double
    Dim l_dblPhase As Double
    Dim l_dblPhaseSign As Double
    Dim l_lValue As Long
    ' Point frequency in Hz
    GetDoubleField(DEV_FIELD3_INDEX, l_dblPointFrequency)
    ' Amplitude in dB
    GetDoubleField(DEV_FIELD4_INDEX, l_dblAmplitude)
    ' Phase in degrees
    GetDoubleField(DEV_FIELD5_INDEX, l_dblPhase)
    ' Phase sign
    GetDoubleField(DEV_FIELD6_INDEX, l_dblPhaseSign)
    ' The zero based index of this point
    GetLongField(DEV_FIELD7_INDEX, DEV_FIELD7_SIZE, l_lPointIndex)
    ' TODO: What you want with amplitude results

End Sub
' The surprise remove event
Private Sub Device_Disconnect()
    ' End the program
    UserForm_Terminate()
End Sub
' Form initialisation
Private Sub UserForm_Initialize()
    ' Activate the first worksheet
    Worksheets(1).Activate()
    ' Try to connect to the device
    If Device.Open() = False Then
        ' If it fais to open then show an error message
        MsgBox("No C60 connected", vbOKOnly, "Error opening the device")
        ' We can't get data without a C60 so end the program
        End
    End If
End Sub
' Form termination event
Private Sub UserForm_Terminate()
    On Error Resume Next
    ' Close the device
    Device.Close()
    ' End the program
    End
End Sub
```

[End of document]