Agilent Technologies

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Virtual Lab 3: Direct I/O Communication

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Purpose:

- Acquiring data with Direct I/O
- Using Until Break loops and If/Then/Else conditionals in Agilent VEE
- Design of preliminary components for an improved Bode plot generator

Equipment:

- Agilent 34401A Multimeter
- Agilent 54601A Oscilloscope with Agilent 54657A Measurement/Storage Module
- Agilent 8116A Pulse/Function Generator or Agilent 33120A Function/Arb Generator
- Agilent 6236B Triple-output Power Supply
- Connectix Video Camera
- Intel 100MHz Pentium computer, 32MB Ram with GPIB Card
- HP VEE for Windows software, Version 3.2
- Timbuktu (remote access) software
- QuickPICT software
- Text: Robert Helsel, “Graphical Programming: A Tutorial for HP VEE”, Prentice Hall, 1995
- Download Agilent VEE executable files

Introduction:

Phase information was not determinable using the multimeter, but using the oscilloscope allows us to read phase information. It also will analyze signals beyond the 300 kHz limit of the multimeter. By using the multiple channels of the oscilloscope, we will create an improved Bode plot with magnitude and phase. However, due to oscilloscope shortcomings, we are going to redesign the Autoscale function using Agilent VEE.

Direct I/O:

Of all the tools at Agilent VEE’s disposal, the Direct I/O object allows for the most efficient and flexible communication with GPIB devices. In order to use it, select **I/O→Instruments** as if you were going to choose a component driver. Instead, choose **Direct I/O**.

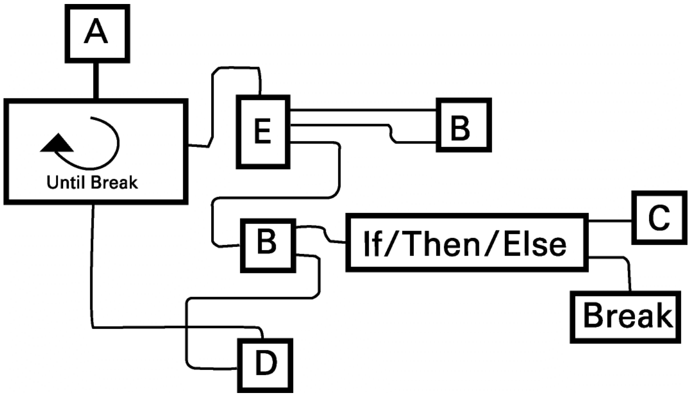
The benefits and drawbacks of Direct I/O spawn from the details of its use. Data inputs and outputs may be added to both Direct I/O and Component drivers, but the function of a Direct I/O controller is determined by lines of code directly entered by the user. This is a hindrance to fast code development. Most lines of text must be entered after referencing the Programmer’s Guide for the appropriate instrument. However, the use of such code allows the user to interface with instruments that do not have component drivers written, such as the Agilent 54657A Measurement and Storage Module attached to the back of the oscilloscope.

As a side note, it is possible to write your own component drivers. However, Direct I/O uses the least processing overhead of any communications object in Agilent VEE, thus enabling programs to run faster.

Until Break... If/Then... Break:

The **Flow→Until Break** object repeatedly activates a thread until a **Break** object is executed. To create such a loop, simply wire the data output of the **Until Break** object to the first object to be executed repeatedly. All objects using data output from that initial point will also be repeated. The sequence out pin of the Until Break object is activated once the loop is broken by input to a Break object from that thread. Therefore, Break objects not located within the propagation from an Until Break will not cause that loop to exit.

The **Flow→If/Then/Else** object uses conditionals to analyze data inputs (you can add more). If the conditional evaluation is non-zero, the **Then** pin is activated with that non-zero number. If the expression produces a result of zero, the **Else** pin produces a zero output. The two pin outputs are mutually exclusive. If/Then/Else objects are handy in setting conditionals to trigger a Break object within an Until Break loop.



The picture above illustrates the flow of data in a While Break and If/Then/Else network. The while loop executes when the A sequence out pin is activated. E, both Bs, and the If/Then/Else objects will then execute repeatedly. C will also repeatedly execute if the contents of the If/Then/Else object are non-zero. If, at any point, the If/Then/Else object produces a zero result, zero will be output to its Else pin, and the Break object will exit the loop. Only after the Break function is performed, will the sequence out pin of the Until Break object be activated, thus allowing object D to run.

Notes on Using Autoscale:

Every time you use the Autoscale function on the Agilent 54601A oscilloscope, it automatically performs the following functions (whether you like it or not):

- If two signals are present, it offsets each so they do not overlap on the screen. This reduces the maximum possible voltage sensitivity without losing the signal off the top/bottom of the screen.
- Channel coupling is set to DC.
- Band Width Limiting is turned off.
- If two signals are present, it triggers on the higher channel number.

Another problem of the Agilent Autoscale algorithm results when an extremely weak signal is being monitored at the same time as a strong one. The Autoscale will display the strong signal appropriately, but show the low amplitude waveform as ground. Due to these sometimes undesirable effects, it may be helpful not to take the easy route by pressing Autoscale.

Procedure:

Part 1: Direct I/O -- Break Until -- If/Then/Else loops.

1. Choose an oscilloscope **`Direct I/O`** object from the **`I/O→Instrument`** dialog.
2. Open its object menu and choose **`Add Terminal→Data Output`**. Double click on the data output terminal and rename it anything you would like.
3. Using the same pop-up menu, choose **`Add Transaction`**. A dialog box should appear. It should be configured to WRITE TEXT, and Default Format should be selected. In the top, rightmost box enter ":MEAS:VPP?" (with the quotation marks). This is the code sent over the GPIB to the scope. The question mark lets the scope know you want it to send data back. MEAS means measure, and VPP indicates peak-to-peak voltage. Look up other functions from the cover page of the Oscilloscope Programmer's Quick Reference Manual to see how to make other measurements (attached to this handout). Hit **`OK`**. Note: the Measurement/Storage Module adds additional functions; see the Measurement/Storage Module User's Guide.
4. **`Add Transaction`** again. This time switch to READ, and in the top, rightmost box, enter the variable name with which you labeled the output terminal. The remaining formats should read TEXT, REAL FORMAT, and SCALAR. Look at the other options, but do not choose them. Hit **`OK`**.
5. Wire an **`AlphaNumeric`** indicator up to the output terminal you created. Connect a probe from Ch. 1 of the the scope to the calibration input (located below the oscilloscope screen). Press **`Autoscale`** on the scope and then **`Run`** your program. What happens?
6. Now wire a **`Flow→Repeat→Until Break`** object to the sequence in of the **`Direct I/O`**. Make sure to use the data out pin of the **`Until Break`**!
7. Connect a **`Flow→Start`** object to the sequence-in pin of the **`Until Break`** object.
8. Choose **`Flow→If/Then/Else`** and wire up the Vpp data to its input (labeled "A"). Within the conditional text box, type "A<4".
9. Wire **`Display→Beep`** to the Then output. Wire up a **`Break`** object (**`Flow→Repeat→Break`**) to the **`Else`** output. Leave the AlphaNumeric indicator hooked up so that you can see what is happening.
10. Disconnect the Channel 1 probe from the oscilloscope calibration hookup. Press **`Run`**. What happens? What happens if you replace the probe? Save your program in lab3pt1.vee.

Part 2: Designing Autoscale and Phase Functions

Autoscale:

1. Using Direct I/O, design a User Object that will take a given input frequency, and set the oscilloscope up so that only two periods of the waveform will be displayed on the screen. Save this object in lab3pt2a.vee.
2. Using Direct I/O, design a User Object that will adjust voltage sensitivity on the oscilloscope so that a signal on Channel 2 does not leave the bounds of the screen. Also, if the signal amplitude is smaller than the V/div., then increase the sensitivity. This measure ensures the accuracy of Vpp measurements we will make, which is dependent on how the signal is displayed on the screen. Save this object in lab3pt2b.vee.

Phase measurements:

1. Using Direct I/O, measure the phase change between Channels 1&2 on the scope. If the phase is not between 180 and -180, then convert it to such. Create a user object producing the desired output, given the appropriate input. Design your object so that the phase is negative if channel 2 is delayed from channel 1. Save this object in lab3pt2c.vee.

Hints:

- Vmax, Vmin, Vpp, Vtop, and Vbase might be useful. These measurements return 99E36 if the signal leaves the screen.
- Scope display sensitivities for time and voltage are separate functions. The values can be anything (the scope just uses 10, 20, 50 multiples for convenience).
- The Agilent manual page describing phase measurements is included in this lab.
- Confirm that the scope is reading Channel 2 (syntax: **`":MEAS:SOUR CHAN2"`**)**.**
- Spaces are very important when giving Direct I/O commands. For example, to set the full scale time range of the scope to the value of the input variable A, the text should be **`":TIM:RANG ",A," S"`** Note the spaces after **`RANG`** and before the unit **`S`**.

You Should be able to:

- Demonstrate your “beep” program saved as lab3pt1.vee (1.10).
- Demonstrate the time-base autoscale object saved as lab3pt2a.vee (2.1).
- Demonstrate the voltage-scale autoscale object saved as lab3pt2b.vee (2.2).
- Demonstrate the phase measurement object saved as lab3pt2c.vee (2.3).

To Make Phase Measurements Automatically

Phase shift between two signals can be measured using the Lissajous method. Refer to the Agilent *54600 - Series Oscilloscopes User and Service Guide* for more information.

With the Measurement/Storage Module installed, phase is automatically measured and displayed. Measurement is made from the rising edge of the first full cycle on the input 1 signal, to the rising edge of the first full cycle on the input 2 signal. The method used to determine phase is to measure delay and period, then calculate phase as follows:

$$\text{Phase} = \frac{\text{delay}}{\text{period of input 1}} \text{ x } 360$$

1. Adjust controls so that a minimum of one full cycle of the signal connected to input 1 is displayed.
2. Press **Time**

3. Press the **Next menu** softkey until the **Define Thresholds** softkey is displayed on the far left side.
4. Press the **Measure Phase** softkey. Phase is measured and displayed on the screen.

Negative phase values indicate the displayed signal on channel 2 is leading the signal on channel 1.

Automatic Phase Measurement Hints:

If one full cycle of the signal connected to input 1 is not displayed, phase will not be measured.

User threshold has no effect on automatic phase measurements. Phase is always measured at the 50% transition point (threshold level).

When using the delayed timebase, the instrument will attempt to perform the measurement using the delayed window. If the selected channel 1 edge, channel 2 edge, and channel 1 period cannot be found in the delayed window, the main window is used. See “Time Measurements” in the *Agilent 54600 - Series Oscilloscopes User and Service Guide* for more information.

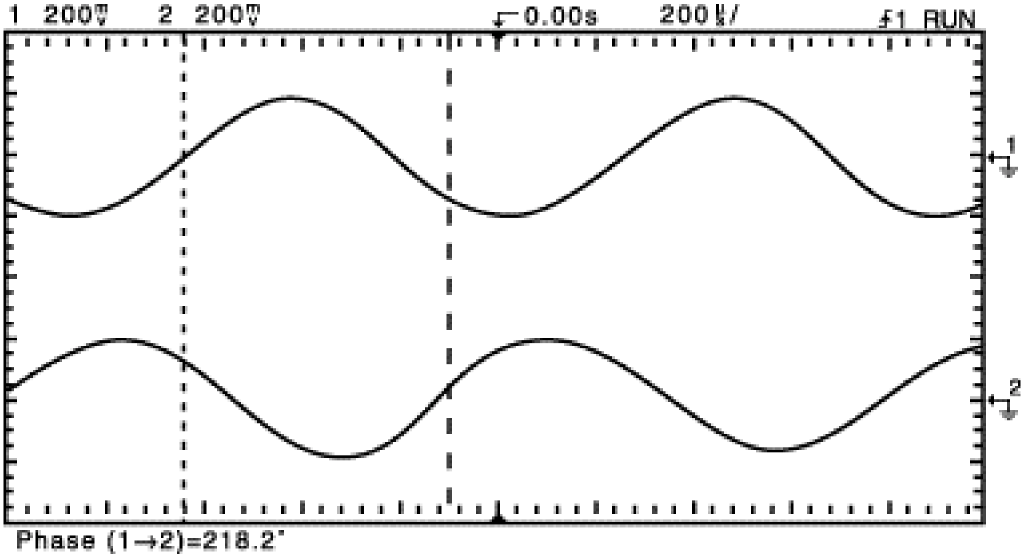


Figure 16

Automatic Phase Measurement:

:MEASure:PHASe

Command **:MEASure:PHASe**

The MEASUure:PHASe command places the instrument in the continuous measurement mode and starts a phase measurement.

Example OUTPUT 707; “MEAS:PHAS

Query :MEASure:PHASe?

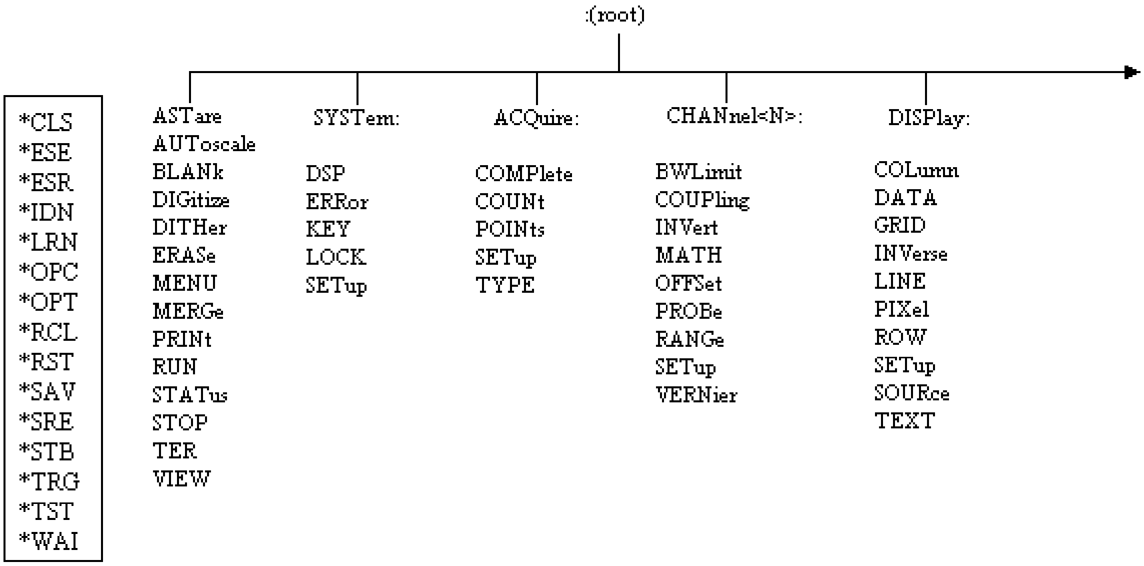
Returned Format <value> <NL>

The MEASure:PHASe? query measures and outputs the phase between channels 1 and 2. The phase measurement is made from the first rising edge of the signal connected to input 1, to the first rising edge of the signal connected to input 2. The method used to determine phase is to measure delay and period, then calculate phase as follows:

$$\text{Phase} = \frac{\text{delay}}{\text{period of input 1}} \text{ x } 360$$

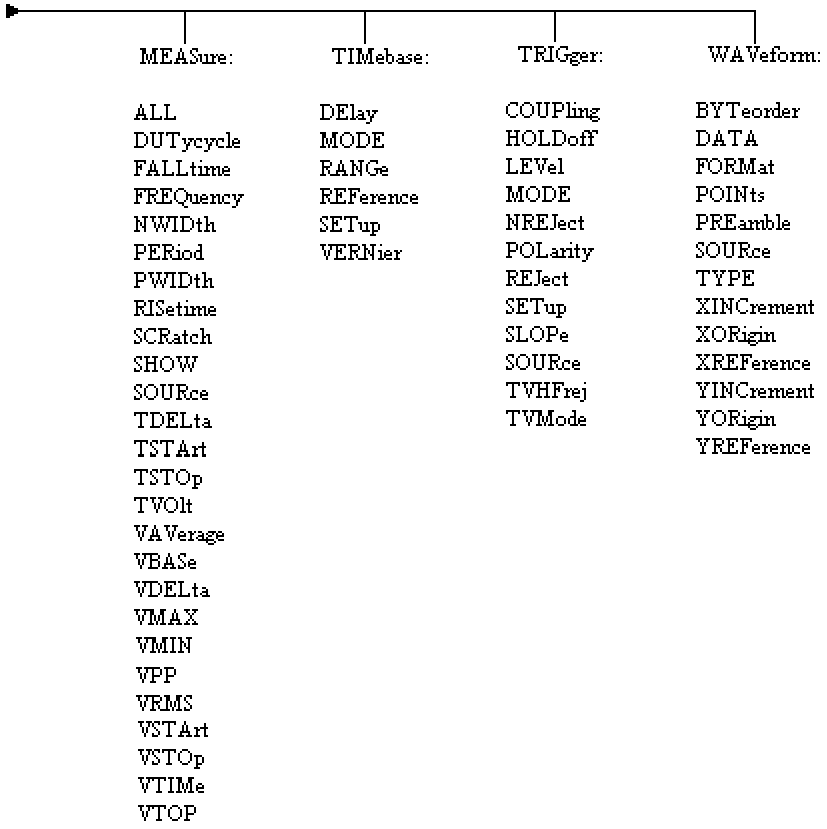
<value> The phase angle value in degrees (in exponential - NR3 format).

The operation of the :MEASure:PHASe command is identical to the **Measure Phase** softkey. Refer to "Make Phase Measurements Automatically" in chapter 2 for additional information.



Common Commands (IEEE 488.2)

The Agilent 54600A has two identical channel subsystems. The Agilent 54601A channels 1 and 2 are identical and fully attenuated. Channels 3 and 4 are identical and can be set for .1V or .5V/div with dc or ground coupling.



MEASure:

ALL
DUTycycle
FALLtime
FREQuency
NWIDth
PERiod
PWIDth
RISetime
SCRatch
SHOW
SOURce
TDELta
TSTArt
TSTOp
TVOlt
VAVerage
VBASe
VDELta
VMAX
VMIN
VPP
VRMS
VSTArt
VSTOp
VTIMe
VTOP

TIMebase:

DElay
MODE
RANGe
REFerence
SETup
VERNier

TRIGger:

COUPling
HOLDoff
LEVel
MODE
NREJect
POLarity
REJect
SETup
SLOPe
SOURce
TVHFrej
TVMode

WAVeform:

BYTeorder
DATA
FORMat
POINts
PREamble
SOURce
TYPE
XINCrement
XORigin
XREFerence
YINCrement
YORigin
YREFerence