3540 mΩ HiTESTER

Users guide
Applied ways of usage

Thank you for using HIOKI *instruments.*

Model **3540 mΩ HiTESTER** has been designed to accurately measure coil resistance, motor, transformer and contact resistance for relays, switches, connectors and pattern resistance for printed boards through the 4-terminal method.

The sales guide introduces various applications and explanations about external control which are not described in the instruction manual. In addition, many questions from users are gathered in the Q&A corner. We trust this Users Guide will help you to use the HiTESTER smoothly and efficiently.

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Contents

1. Principles of Measurement

-1. Canceling harmonic noise

Harmonic noise is noise coming from an AC line that is sent out from not only fluorescent lamps but also from home electric appliances. The frequency of the power source, 50Hz or 60Hz, affects the occurrence of harmonic noise. Model 3540 measures resistance by running DC current. However, since harmonic noise is carried on the resistance, the input signal of Model 3540 is as follows

Input signal running harmonic noise

Ideal input signal (DC)

One period of the power line

+A

-A

Integral results
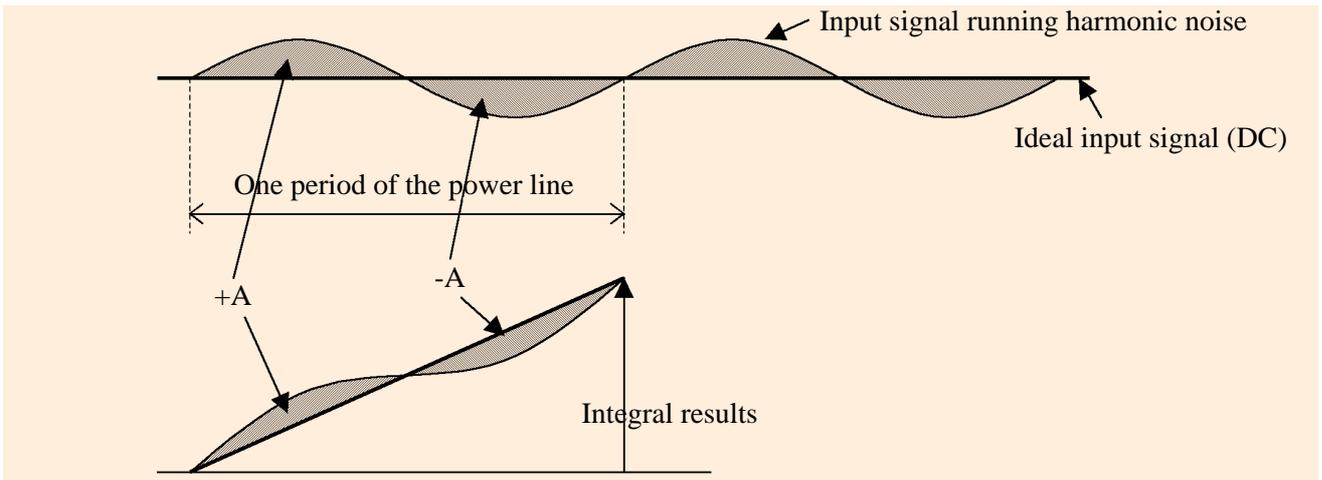
Model 3540 uses an integral A/D converter to cancel harmonic noise carried on the input signal. The integral A/D converter cancels the influence of the harmonic noise. Influence of harmonic noise is calculated at $+A+(-A)=0$

Therefore, Model 3540 must be able to measure at appropriate integral intervals to cancel harmonic noise. Even if you power the 3540 using batteries, it is important and necessary to set the frequency of the power as soon as you receive the unit, so that you can receive stable measurement by canceling the harmonic noise from the fluorescent lamp.

-2. Withstanding Input Voltage

Model 3540 is often used as test equipment for coils along the HIOKI Withstanding Voltage HiTESTER, Model 3158. However, it is important to pay special attention when using these two instruments together because when used in combination, not only fuse trouble but also the problems with the 3540 may occur because the capacity of the coil may flow the moment it is connected.

For example, the following is the procedure for using Model 3450 with the Withstanding Voltage HiTESTER:

Withstanding tester

①
②
③
Coil
①
②
③
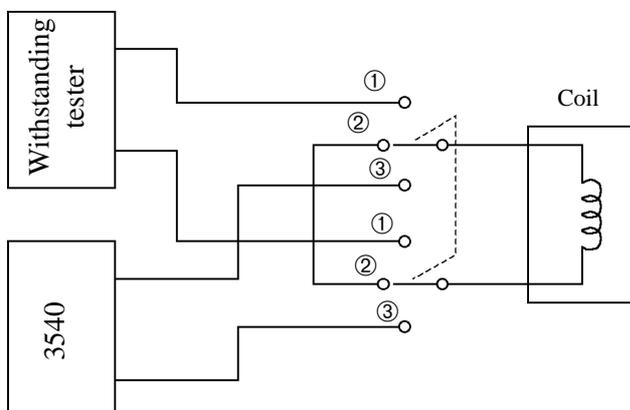
3540

① First, connect the Withstanding Voltage HiTESTER with coil and conduct the withstanding test.

② Short-circuit both sides of the coil and discharge electricity.

③ Connect with the 3540 and measure the resistance.

For your reference, Model 3540 is protected by a fuse and surge absorber, so it is designed to endure higher voltage of more than 3 times the previous products.

-3. When Using Multiple Units of Model 3540

How do you use multiple units of Model 3540 to measure an object that needs to be to tested at several points, such as a rotary switch?
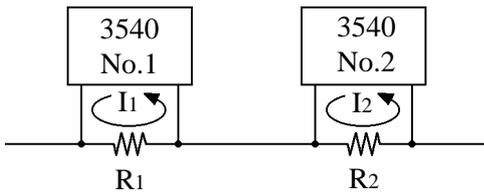
The 3540 measures resistance by running constant current against the resistance. However, if multiple probes are connected at one point, correct measurement may not be possible due to interference from other resistance sources.

For example, as shown in the figure on the left, when two resistance values are measured using two HiTESTERs, the current value of R_1 is I_1 and R_2 is I_2. However, minute current may run from units No.1 to No.2, which may not result in accurate measurement.

It is important to note that correct measurement means absolute accuracy, meaning that the test instrument will display 100Ω when measuring resistance of 100Ω. If the accuracy of the another 3540 is normal, the relative accuracy may be maintained. Relative accuracy means that if the resistance of 100Ω is measured, it must show 100Ω. However, this cannot be guaranteed because the measurement environment may cause the values to change.

Therefore, for your reference, the following is the procedure for effective measurement using multiple units of Model 3540 :
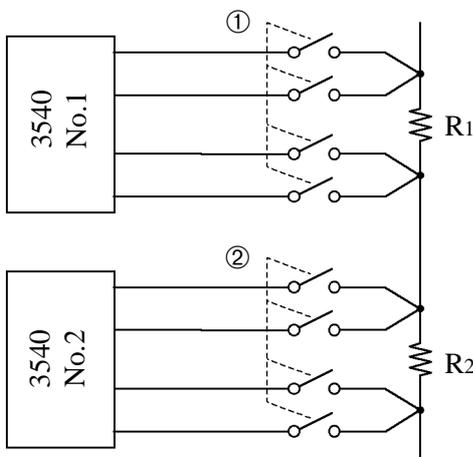
① In order to measure R_1, turn on and measure the scanner (a switch or relay) that is connected to the 3540 No.1. At this time, the scanner that is connected to Model 3540 No.2 should be off.

② To measure R_2, turn on and measure the scanner that is connected to the 3540 No.2. At this time, the scanner that is connected to Model 3540 No.1 should be off.

-4．4-Terminal Measurement

In order to measure minute resistance, the Model 3540 adapts the 4-terminal measurement method. This method cancels resistance that causes error in accuracy while allowing it to check minute resistance such the wiring resistance and contact resistance of the probes. The details are described in the instruction manual of the 3540 mΩ HiTESTER. When minute resistance is measured, it is recommended to connect the test points to the 4 terminals.

If it is impossible to use the 4-terminal method, please pay attention to the following during testing :

① Be sure to use as thick and as short a wire as possible for the wire part of the 2 terminal lead.
② Decrease the connection resistance of the chucking part of a 2-terminal wire lead to as low as possible. Be sure the chucking strength is the same at all points.
③ Short-circuit the chucking area and perform zero adjustment.

-5. The diference between AC measurement and DC measurement of resistance

● AC measurement: 3560 AC mΩ HiTESTER
● DC measurement: 3227, 3540 mΩ HiTESTER

HIOKI is releasing two type of resistance testers, AC measurement and DC measurement. It is important to use the type that corresponds to the parts or units. A DC resistance meter is used for measuring resistance value like resistance or coil. An AC resistance meter is used for measuring contact resistance, internal resistance of batteries and chemical resistance. The diference between AC measurement and DC measurement of resistance is as follows:

DC Measurement	Measurement principle	AC Measurement
Model 3540,3227	Model Name	Model 3560
DC 4 terminal	Measurement method	AC 4 terminal
●Permits measurement of resistance values without the effects of inductance or capacitance; therefore, the lead wire resistance of coils can be measured	Advantages	●Very small current measurements ●DC superposed measurement ●Internal resistance measurement ●No heating effects
●Heating effects are received	Drawbacks	●Resistance value of components including Inductance and capacitance, e.g., coils cannot be measured. (These are impedance measurements)
●Conductor resistance measurement of coils ●Contact resistance measurements of power supply switches(under conducting conditions) ●Resistance measurements of leads or conductors ●General resistance measurements	Use	●Switches used in very low current circuits, e.g., contact resistance measurements of electronic part.s. ●Internal resistance measurements (operating resistance) of batteries and semiconductors) ●Conductor resistance measurements of differing types of bonded metals

2. External control

3540-01, 02, 03 are attached with an external connector (3450-01 only) and external terminal at the rear panel. These models can allow the user to input measurement values and the results of the comparator, and control the testing and range by connecting to an external PC or sequencer. Details about how to use the external control signal are explained as follows:

-1. Control signal

(1) Power supply
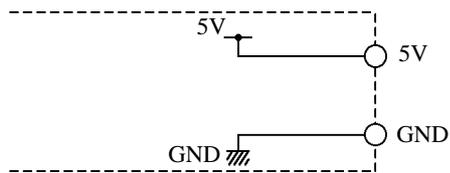
Signal name : 5V, GND

Standard : DC5V, 200mA MAX.

Caution:
● In case it is necessary to exceed the standard current range, be sure to prepare an external power source. If a current over the standard is supplied, the operation of the 3540 may be unstable.
● The control signal circuit of the 3540 and the measurement circuit is isolated. Never connect the GND connected to control signal to the GND for the measurement.
● If rush current is needed, please insert an electric condenser between the 5V line and GND. (470uF/10V MIN.)
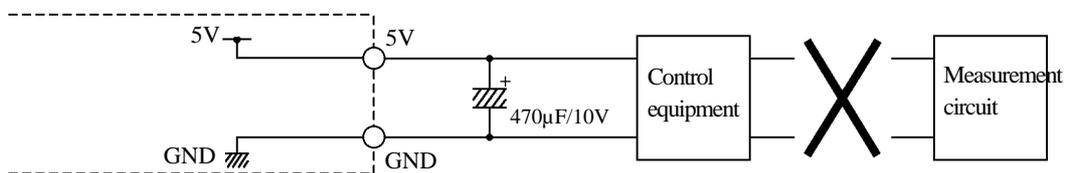
(2) TTL Input Signal
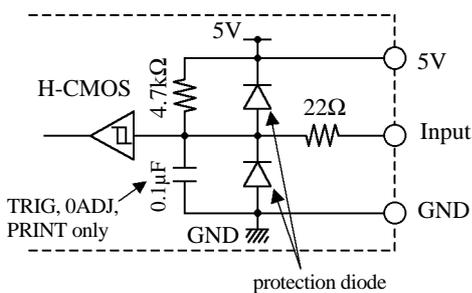
Signal name: TRIG, MANU, 0ADJ,PRINT, RANGE0 to 2, COMP0 to2

Standard: DC5V, 20mA MAX

Logic: 0V-valid, 5V-invalid

*TRIG, 0ADJ, and PRINT signals move along the downward edge (5V to 0V). A condenser (0.1uF) is inserted in the circuit to avoid wrong movement caused by noise.

(3) TTL Output Signal
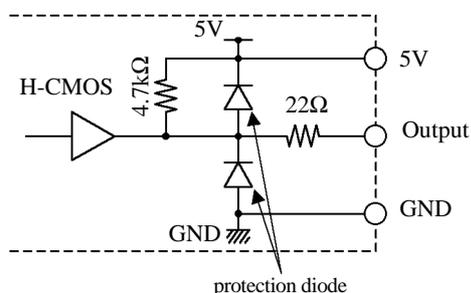
Signal name: CCERR, EOC, DP0 to2, BCD output
                    * CCERR, EOC are signals of the external connector

Standard: DC5V, 20mA MAX.

Logic: 5V-valid   0V-invalid

(4) Output signal of the open corrector
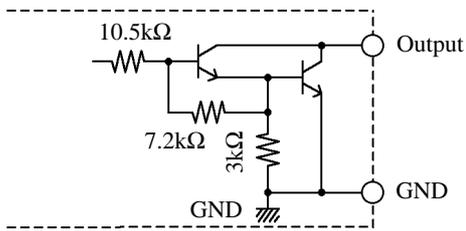
Signal name : Hi, IN, Lo, CCERR, EOC

*The CCERR and EOC are signals of the external terminal

Standard : DC35V, 50mA MAX.

Logic : ON valid, OFF-invalid

* The function of the open corrector output is to switch between the output signal and the GND. If the output signal is valid, the switch is on and the current will run from the output signal within the 3540 to GND.

-2. Various Connection Methods of the Signal

(1) Input signal of the TTL

① Connecting with a switch
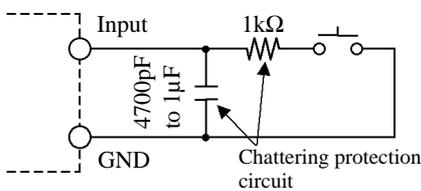
The input signal will be valid when the switch turns on. In order to avoid error when the switch is on or off, insert the chattering protection circuit.

② Connecting to a relay
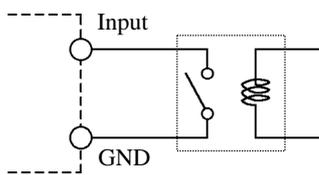
When the input signal flows through the coil of the relay, relay contact will be on and made valid.

③ Connecting to a transistor
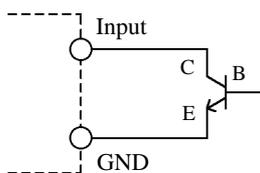
The transistor serves as the switch between the corrector (C) and emitter (E). When voltage reaches the base (B) of the transistor, the input signal will be valid.

④ Connecting to an IC (TTL, etc.)
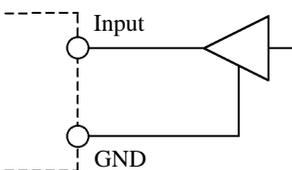
When connecting with IC such as TTL or C-MOS, the output signal of the IC should be set to operate at 0 to 5 V. If the output voltage of the IC is 0, the input signal will be valid.

(2) Output signal of the TTL

① Connection with an IC (TTL, etc.)
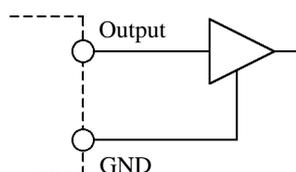
When connecting with IC such as TTL or C-MOS, the input signal of the IC should be set to operate at 0 to 5 V. The output signal of the 3540 will be valid at 5V.

② Connecting to a transistor
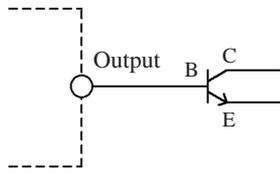
Output B C
             E

When the TTL output of Model 3540 is connected to the transistor, it can be used like the open corrector output signal of the HiTESTER. For information on how to connect the open corrector output signal, please refer to (3) Open corrector output signal.

③ Connecting to an LED or lamp

Output   Regulated resistance

GND
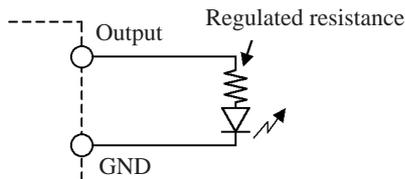
When an LED or lamp is connected to the TTL and the output signal is valid, the LED can be lit. In this case, please apply a regulated resistance to the circuit according to the current flowing in the LED. The regulation resistance is calculated by the formula, (3/current value). For example, if 10mA of current is flowing, please apply a regulated resistance of 300Ω to the circuit. However, please connect an LED or lamp that lights at or under 5V/20mA.

(3) Open corrector output signal

① Connecting to an LED or lamp

5V   Regulated resistance
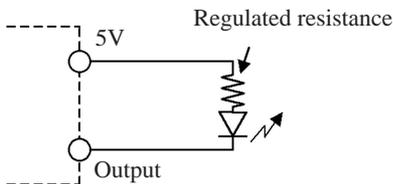
Output

When an LED or lamp is connected to the TTL and the output signal is valid, the LED can be lit. When the voltage over 5V is needed, please use an external power supply. However, please use an LED and lamp that lights at or under 35V/50mA.

In this case, please apply a regulated resistance to the circuit according to the current flowing in the LED. The regulated resistance is calculated by the formula, ((power supply voltage value -2)÷current value). For example, if the power supply is provided at 5V from the 3540, and current is flowing at 10mA, apply a regulated resistance of 300Ω.

② Connecting to a relay

5V   Protect of opposite power
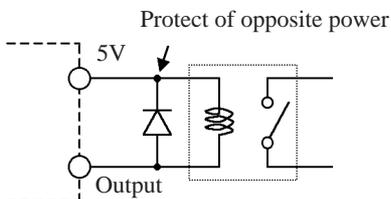
Output

When a relay is connected to the open corrector and the output signal is valid, the relay can be switched on. If ON voltage at or above 5V is needed, please use an external power supply. However, please connect a relay that can be switched ON at or below 35V/50mA.

Please note that there is fear that counter electromotive force may occur the moment the relay is switched ON, which may damage the internal circuitry of the 3540. To prevent this from happening, be sure to apply a diode used to prevent counter electromotive force as shown in the figure.

③ Connecting to a buzzer

Protect of opposite power

5V
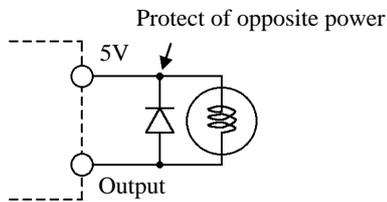
Output

Connecting to buzzer can allow the buzzer to sound when the output signal is valid. If voltage over 5V is needed, please use an external power supply.

However, be sure to connect a buzzer that can operate at or under 35V/50mA. Please note that there is fear that counter electromotive force may occur the moment the buzzer sounds, which may damage the internal circuitry of the 3540. To prevent this from happening, be sure to apply a diode used to prevent counter electromotive force as shown in the figure.

④ Connecting to an IC(TTL)

5V   Pulled up resistance
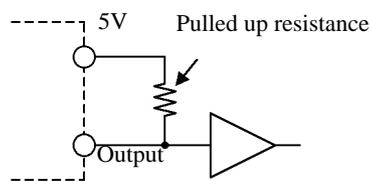
Output

To connect the open corrector output to an IC such as TTL or C-MOS, used the open corrector output signal pulled up at 5V. In this case, 0V is output when the output signal is valid, and 5V is output when the output signal is invalid. Please use a pulled up resistance with a value from 1kΩ to 10kΩ.

⑤ Wired OR connection

Output   wired OR
            Output

Output

GND
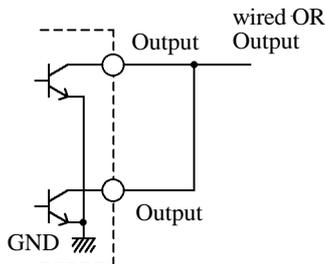
By shorting the output of the open correctors, it can be used as an OR (logic sum) output. In this case, as long as one of the shorted output signals is valid, wired OR output will be valid. For example, the wired OR output signal which shorted the Hi and Lo signals of the comparator results can be used to represent a defective product, and likewise a good product can be represented as an IN output signal.

(4) Connecting to a sequencer

If a production line is to be constructed, a sequencer may be used. Although many types of sequencers are sold, the basic internal input and output circuits depend on the combination of ICs and transistors.

To connect to a sequencer, please refer to the internal circuitry as indicated in the specifications for the sequencer and the various connecting methods explained above.

However, in order not to surpass the output signal of the 3540 or the standard limit of the power supply, please select a sequencer that is within the range of the 3540.

-3. Timing Chart

(1) Hold State
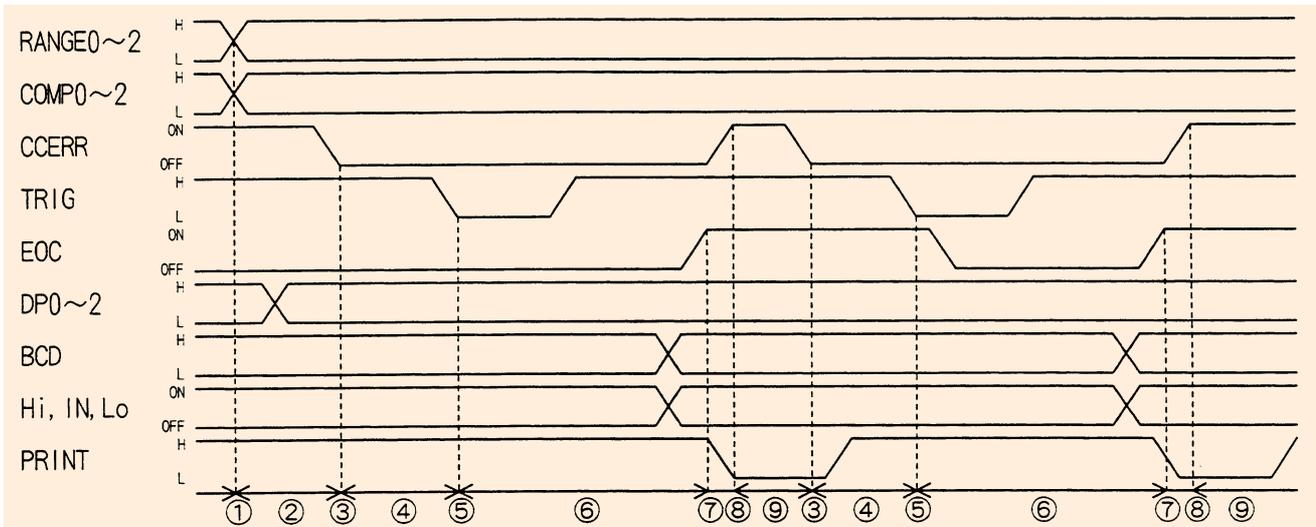
(2) Free-Run State
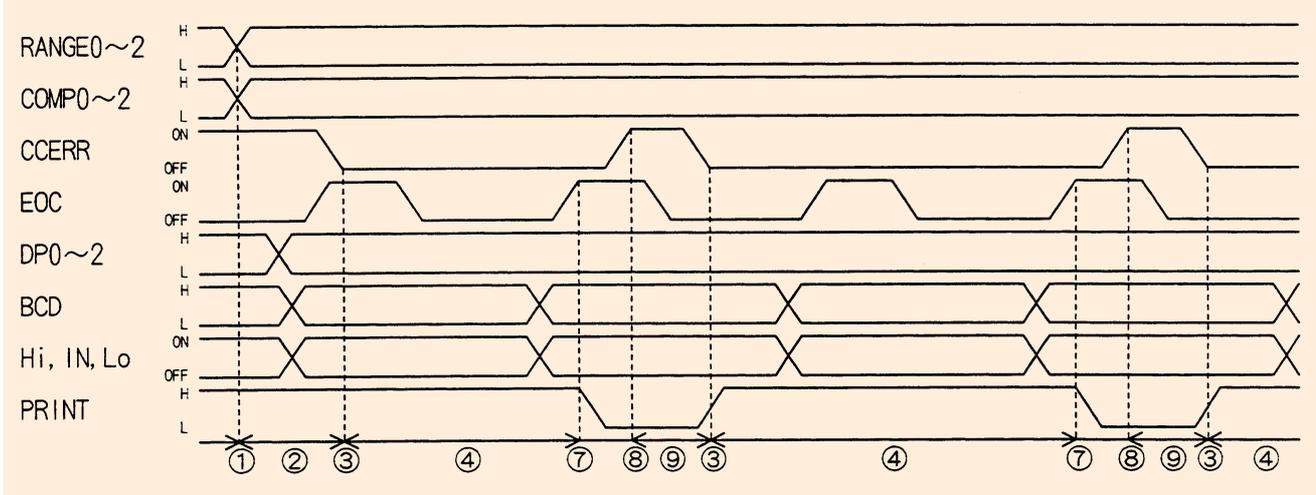
① RANGE0 - 2 or COMP0 - 2 change when an external signal switches the measurement range or comparator table. After switching the range or comparator, the signal should be held in that state.

② Wait until the measurement range switches and the setting stabilizes (FAST: 550 ms, SLOW: 550 ms).

③ Chuck (connect resistance to the test probe) the resistance to be measured.

④ Wait for stabilization period.

   In the Hold state, wait for about 40 ms in FAST mode, or 60 ms in SLOW mode. In Free-Run state, wait 100 ms in FAST mode, or about 300 ms in SLOW mode.

   These values are for reference when measuring pure resistance. The actual type of resistance under test produces different values, so if significant instability occurs during actual testing, these value should be increased.

⑤ TRIG signal is output (only in the Hold state: invalid in Free-Run state).

⑥ Wait for EOC signal output.

   Output of the EOC signal indicates measurement is finished. At this time, BCD output and the comparator result (Hi, IN or Lo) are stable. In the Hold state, the EOC signal is saved until the next TRIG signal is received. When a printer is used, the PRINT signal is generated from this timing event.

⑦ Test resistance removed.

⑧ Preparation for next measurement, and repeat processing from 3), or if necessary, from 1).

(3) Measurement Control Notes

●To acquire measurement results, the EOC signal state should be continuously monitored, and measurement results should be acquired only after the EOC signal is output.

If the EOC signal is not monitored, measurement results can be acquired only after sufficient time has passed since the measurement was started (about 65 ms for FAST mode, or about 260 ms for SLOW mode).

●The comparator result (Hi, IN, Lo) is not output in the following cases:

o If the rear panel AUTO/MANU switch is in the MANU position and no MANU signal is output.

o If CCERR (abnormal current) occurs (when not chucking).

●When the 9203 is used as a printer connected to the 3540 and measurement values are printed by the 9203 synchronized with 3540 measurements, the 9425 connection cable must be used for the connection between the 3540 and 9203.

Printing of measurement values occurs when the 3540 PRINT signal is input according to the timing on the previous page (after measurement is finished).

Attempting to print measurement values using the 9203 PRINT signal, or by an interval print function, cannot allow for synchronization between measurement and printing, so problems such as printing of previous measurement values may occur.

● The above timing chart is only intended to show the processing sequence: there are no specific restrictions regarding actual timing values.

Also, although the timing chart shows a typical processing sequence, the sequence in actual customer applications may differ.

If unusual behavior or unstable measurement values occur during actual application, consider whether custom changes may be needed. For example, the wait times or pulse width of the signal may need to be set differently.

If optimizing code for speed, we recommend initially setting parameters such as wait times longer than anticipated to confirm operation, then decrement each parameter, retesting operation each time.

● If no problem is found with settings in the code, but errors still occur, it may be caused by noise in the environment, in which case we recommend the following countermeasures:

o Install a filter in the power supplied to the 3540 or control device.

o Supply power to the 3540 and the control device separately (such as by an isolation transformer).

o Separate the test probes, control cable and power cables.

o Shorten the test probe wires and the control cable.

o Ensure that the control cable and test probe wires are located as far as possible from noise sources such as control devices.

o Ensure that no wires are connected to unused control signal terminals.

o When a control cable is connected from the device controlling the 3540 to another device, make certain to separate the 3540 control cable from any other control cables.

-4. External Device Connectors

(1) Standard Accessory Plug

A standard accessory socket (Hirose FDCD-37P) is provided for connection to the 3540-01. This is a cold-welded socket that accepts flat cable with 37 conductors having 1.27- or 1.38-mm pitch, as follows:

① Prepare a 37-conductor flat cable with 1.27 or 1.38-mm pitch, as required.

② Insert the standard accessory socket (FDCD-37P) for the external connector into the cold-welding tool.

③ Insert one end of the cable into the contacts of the connector, and cold weld with the tool.

   If using 1.27-mm pitch flat cable, split the cable into 2-3-3-3-... 3-2 bundles when inserting.

   Note: Refer to the Hirose Catalog for details about the cold-welding tool.

(2) Other Plug

In addition to the cold-welding standard accessory socket for flat cable, crimp and solder sockets are available from various connector manufacturers. Connectors compatible with the 3540-01 are listed below according to manufacturer and connection type, for reference.

■ Compatible Sockets

Connection Type	Model	Mfgr.	Remarks
Flat Cable: cold-welding connections (1.27- or 1.38-mm pitch)	FDCD-37P	Hirose	Standard Accessory
	DCSP-JB37P	JAE	
	GMC-37M	Honda	
Flat Cable: cold-welding connections (1.27-mm pitch)	FDC-37P	Hirose	
	GMC-A37M	Honda	
Solder connections	HDCB-37P	Hirose	
	DC-37P-N	JAE	
	17JE-23370-02 (D1)	DDK	
	GM-37M	Honda	
Crimp connections	CDC-37M	Hirose	
	DCU-37P-F0	JAE	
	17DE-23370-C	DDK	
	GMP-37M	Honda	

(3) Compatibility with the 3226

Pin configuration of the 3540-01 BCD output matches the pin configuration of the data output signals of our 3226 mΩ HiTester, so you can easily replace the 3226 with the 3540-01 using the 20-wire flat cable for the 3226. The procedure is as follows.

① Cut the cable near the connector at the end closest to the 3226.

② Insert the standard accessory socket (FDCD-37P) for the external connector into the cold-welding tool.

③ Insert the end of the cable into the contacts of the connector, and cold weld with the tool.

   As the 3226 cable has only 20 conductors, the first wire should be connected to the first pin of the socket, and the unused 17 pins of the socket remain empty. Also, as the 3226 cable is 1.27-mm pitch, split the cable into 2-3-3-3-... -3 bundles when inserting.

   Note: Refer to the Hirose Catalog for details about the cold-welding tool.

3. Model 3540-03 RS-232C Interface

The 3540-03 allows controlling the 3540 and acquiring measurements by RS-232C interface to a PC.
Procedures to control the 3540 and acquire data are described below and on the following pages using Visual
Basic 5.0 for Windows 95/NT4.0 development language, and the Excel 97 spreadsheet program.
*Windows 95/NT4.0, Visual Basic 5.0 and Excel 97 are registered trademarks of Microsoft Corporation.

-1. Visual Basic 5.0

(1) Development Procedure

The following procedure describes how to create a program using Visual Basic 5.0. Visual Basic is afterwards
referred to as VB.

① Run VB, select "Standard.EXE" from the New
tab (a), and click the Open button (b).
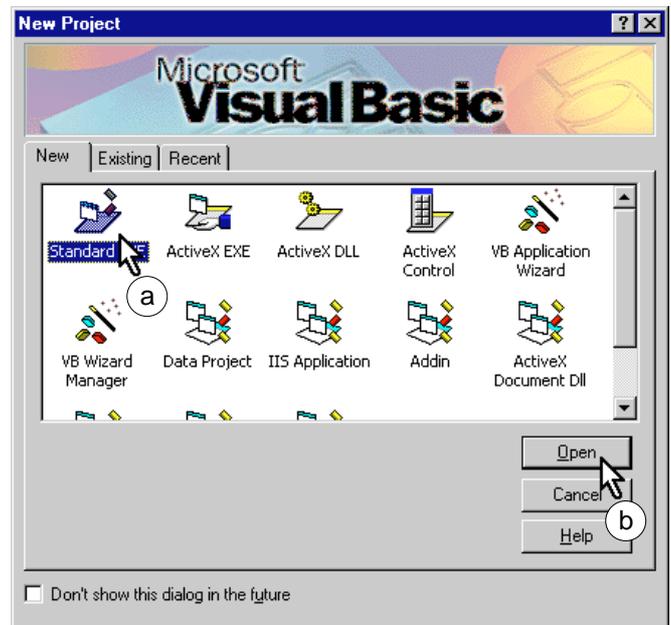
② Select Project-Components from the menu bar
(a).
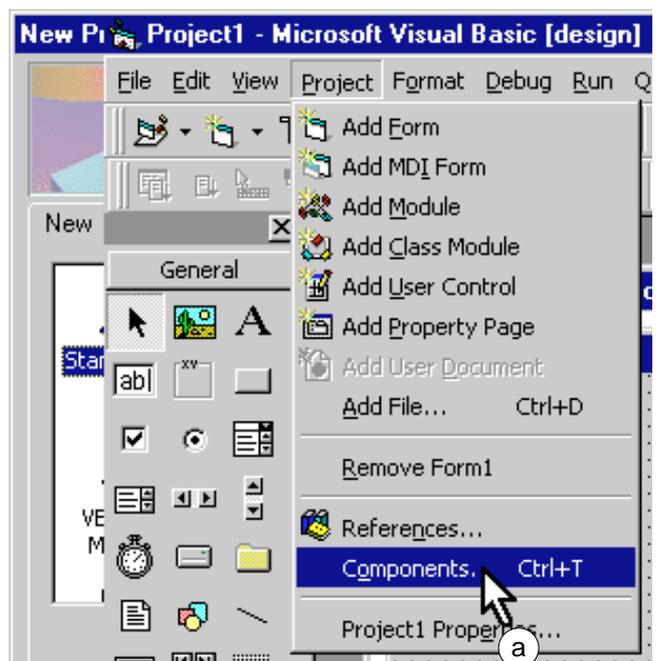
③ Check the "Microsoft Comm Control 5.0" item in the list on the Controls tab of the Components (a), and click the OK button (b).
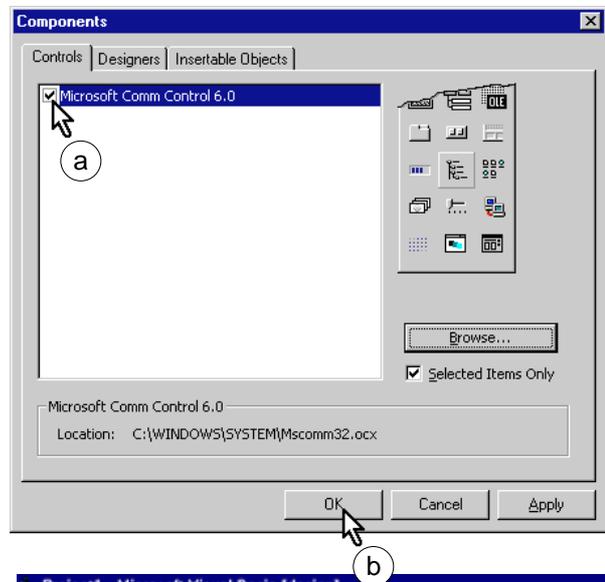
④ The previous step creates a telephone icon in the toolbox. Click that icon (a), then click the mouse in the form layout screen (b), and drag and release the mouse button (c). The telephone icon now appears in the form layout screen (d).
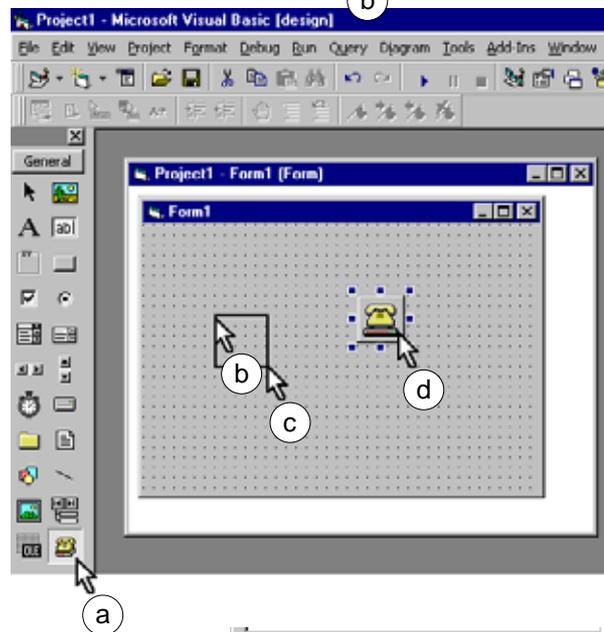
⑤ The telephone icon created by the previous step is a VB object that uses the RS-232C port. This object is named "MSComm1" when it is created. Afterwards, the MSComm1 name is used when accessing RS-232C from VB. When this icon is in the selected state, the settings of the Properties window must be set to match the 3540. Specifically, the following settings are required:

CommPort : The port to be used for the 3540 (ex., "1" to use COM1)
DTREnable : False
Handshaking : 0-comNone
RTSEnable : False
Settings : 9600, n, 8, 1
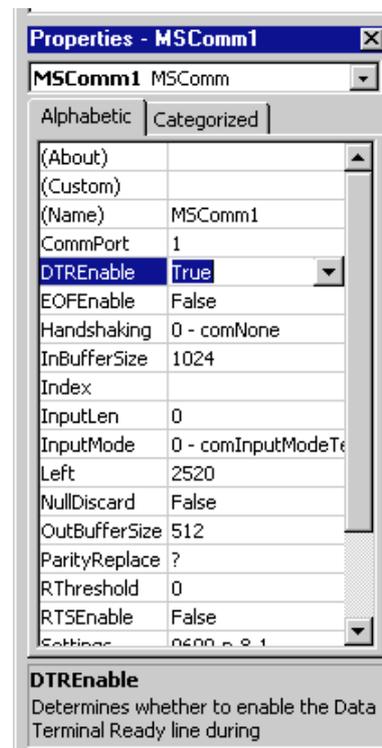
⑥ In the Project window, right click on "Form1" (a),

and select "View Code" from the menu (b).
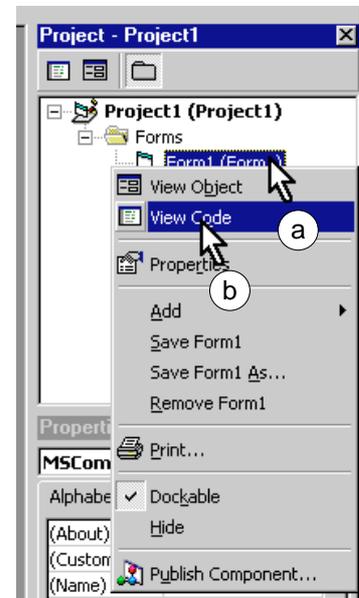
The steps up to this point should result in the Visual Basic window appearing as below. Next, place the buttons and other objects onto Form1 as at (a), and enter the program code in the window at (b). Refer to "(2) Sample Program" for an example.

Execute the created program using the Visual Basic Run command.
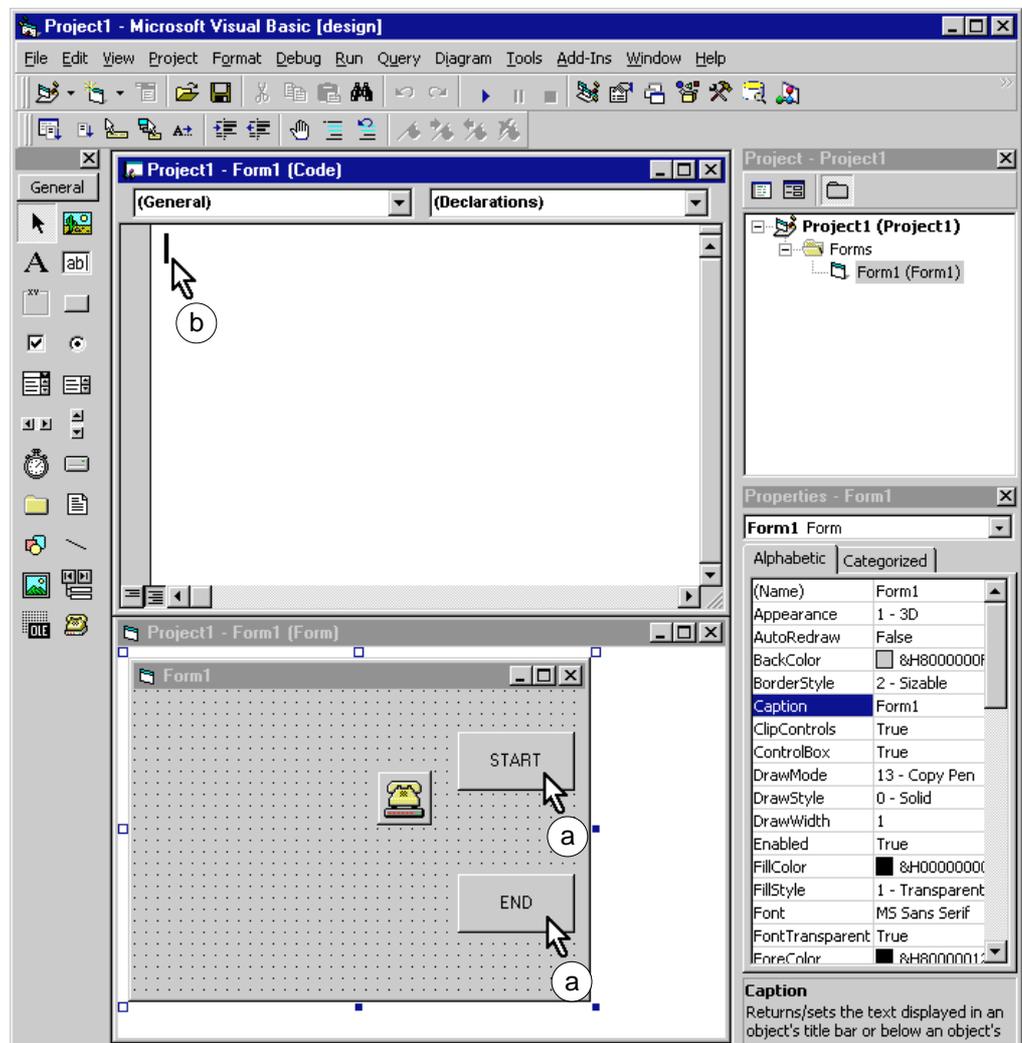
Note: The description may vary somewhat depending on the operating environment. Refer to the Visual Basic help for details about Visual Basic.

(2) Sample Program
Below is a sample Visual Basic program for RS-232C communications. Note that the RS-232C object name created in "(1) Development Procedure" is "MSComm1", and the name of the command button (the Start Measurement button on the previous page) created to start measurement is named the "OK" button.

① RS-232C Handling Program

```
Private Sub COMOpen()
        MSComm1.PortOpen = True                                          (a)
End Sub


Private Sub COMClose()
        MSComm1.PortOpen = False                                         (b)
End Sub


Private Function COMCommand(CommandData As String) As String             (c)
Dim strbuf As String
        MSComm1.Output = CommandData & Chr(&HD)                          (d)
        strbuf = ""
        For i = 0 To 10000
                If MSComm1.InBufferCount > 0 Then
                        strbuf = strbuf & MSComm1.Input                  (e)
                        If Asc(Right(strbuf, 1)) = &HA Then
                                COMCommand = ""
                                For j = 1 To Len(strbuf)                 (f)
                                        l = Mid(strbuf, j, 1)
                                        If Asc(l) > 32 Then COMCommand = COMCommand & l
                                Next j
                                Exit Function
                        End If
                End If
        Next i
        COMCommand = "COMERROR"
End Function
```

Program Description
(a) Enable the RS-232C port.

(b) Disable the RS-232C port.

(c) Function to send a specified CommandData character string to the 3540 and to return the COMCommand string received by the PC from the 3540 as a result.
   If sending fails, the "COMERROR" string is returned.

(d) Send the specified CommandData string.

(e) Gets a string, if present, from the RS-232C.

(f) If the last character of a string sent from the 3540 is an LF (line feed), characters other than delimiters (CR and LF) are removed and stored as "COMCommand".

② Controlling the 3540

```
Private Sub SendSetting()                                          (a)
      COMCommand("HZ 0")
      COMCommand("FUNC 0")
      COMCommand("SMP 0")
      COMCommand("TC 0")
      COMCommand("RNG 0")
      COMCommand("AUTO 0")
      COMCommand("COMP 0")
      COMCommand("HOLD 1")
      End Function
```

Program Description

(a) Performs various settings on the 3540.

This example performs the following settings, in order: power frequency (50 Hz), resistance measurement mode, SLOW sampling, temperature compensation OFF, measurement range (30 mW), Auto Range OFF, Comparator OFF and Hold ON.

③ Acquire 3540 Measurement Data (File Save)

The following example acquires measurement data continuously ten times, and saves the results in the file "data.csv". The csv file extension denotes text files with "comma-separated values," which can be read directly by spreadsheet programs such as Excel.

```
Private Sub OKButton_Click()                                       (a)
      COMOpen
      SendSetting
      Open "data.csv" For Output As #1                            (b)
      For i=1 to 10
              COMCommand("TRG")
              strbuf = COMCommand("RMES")                         (c)
      Print #1, Str(i) & "," & strbuf;                            (d)
      Next i
      Close #1
      COMClose
End Sub
```

Program Description

(a) Clicking the OK button created to start measurement causes the various settings to be executed on the 3540, with the results of ten consecutive measurements stored in the "data.csv" file. "Object name_Click0" is a Visual Basic routine that executes the named object by clicking.

(b) Open the "data.csv" file.

If the "data.csv" file already exists, the existing file is deleted and replaced by the new file.

(c) Hold has been enabled (ON) by 3540 setting, so execute a trigger (start measurement) command and store the results in strbuf.

(d) The data count (i) and measurement values acquired in (c) are saved in the file opened in (b), separated by commas.

④ Acquire measurement values from the 3540 (to paste to Excel).

In the following example, the results of ten consecutive measurements are acquired and pasted to Excel.

```
Declare Function FindWindow Lib "user32" Alias "FindWindowA" (ByVal lpClassName As String,
                                              ByVal lpWindowName As Long) As Long
Declare Function SendMessage Lib "user32" Alias "SendMessageA" (ByVal hWnd As Long,
                ByVal wMsg As Long, ByVal wParam As Long, ByVal lParam As Long) As Long
Public Exl As Object

Private Sub DetectExcel()
Const WM_USER = 1024
        Dim hWnd As Long
        hWnd = FindWindow("XLMAIN", 0)
        If hWnd = 0 Then Exit Sub
        SendMessage hWnd, WM_USER + 18, 0, 0
End Sub

Private Sub OKButton_Click()                              (a)
Dim ExcelWasNotRunning As Boolean
        COMOpen
        SendSetting
        On Error Resume Next
        Set Exl = GetObject(, "Excel.Application")        (b)
        If Err.Number <> 0 Then
                ExcelWasNotRunning = True
                Set Exl = CreateObject("Excel.Application")
                Exl.Workbooks.Add                         (b)
                Err.Clear
        End If
        DetectExcel
        Exl.Application.Visible = True
        Exl.Application.WindowState = xlNormal
        For i=1 to 10
                COMCommand("TRG")
                strbuf = COMCommand("RMES")               (c)
                Exl.ActiveSheet.Cells(i + 1, 1).Value = i
                Exl.ActiveSheet.Cells(i + 1, 2).Value = strbuf   (d)
        Next i
        Set Exl = Nothing
        COMClose
End Sub
```

Program Description

(a) Clicking the OK button created to start measurement causes the various settings to be executed on the 3540, with the results of ten consecutive measurements pasted to Excel.

(b) Excel is run if not already running, and a new workbook is created. The variable Ex1 is created at the end to reference the Excel object from Visual Basic.

(c) Hold has been enabled (ON) by 3540 setting, so execute a trigger (start measurement) command and store the results in strbuf.

(d) The data count (i) and measurement values acquired in (c) are pasted into the selected Excel worksheet, sequentially.

-2. Excel 97

(1) Development Procedure

This procedure describes how to communicate with the 3540 via RS-232C using Excel 97, and how to paste measured values into a worksheet.

① Run Excel, and select Tools - Macro - Visual Basic Editor from the menu bar (a).
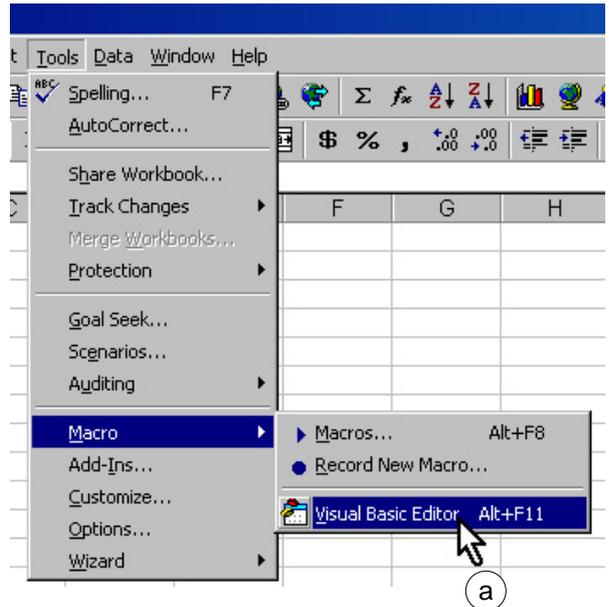
② The Visual Basic Editor runs.
Select and then right click a worksheet to be used from the Project window (a),
and select Insert -Module from the popup menu (b).
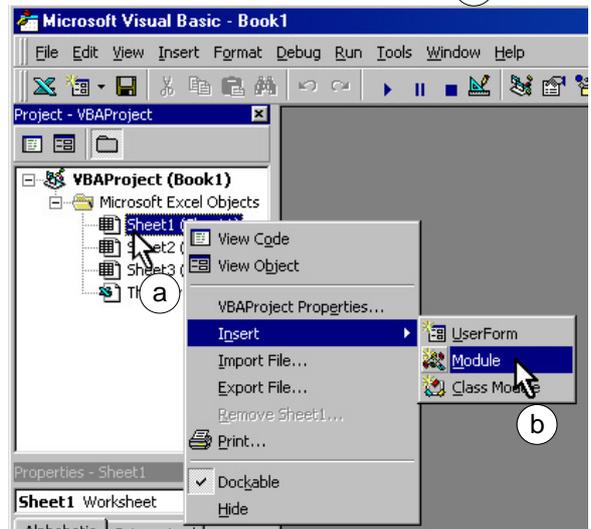
③ Again select and right click the worksheet to be used from the Project window (a),
and select Insert - UserForm from the popup menu (b).
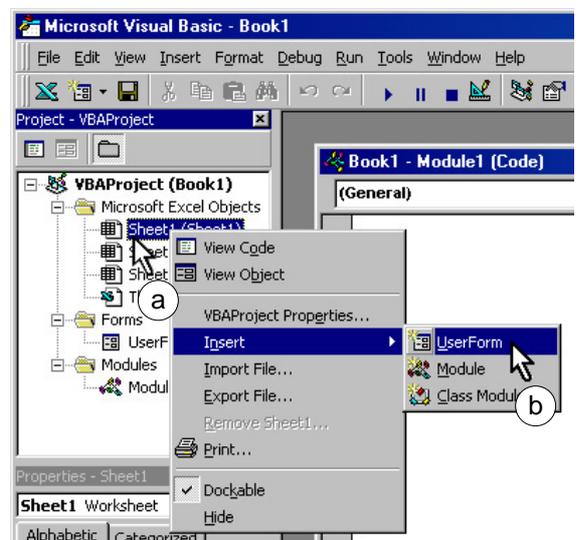
④ Select Tools - Additional Controls from the menu bar of the Visual Basic Editor.
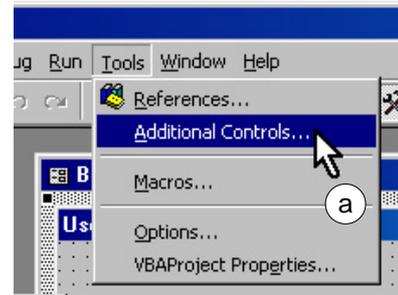
⑤ Next create the telephone icon and set its properties in the same manner as steps ④ through ⑤ under Part 1. "Visual Basic 5.0."

The steps up to this point should result in the Visual Basic Editor window appearing as below. Next, enter the program code in the window at (a). Refer to (2) Sample Program in part 1 for an example.
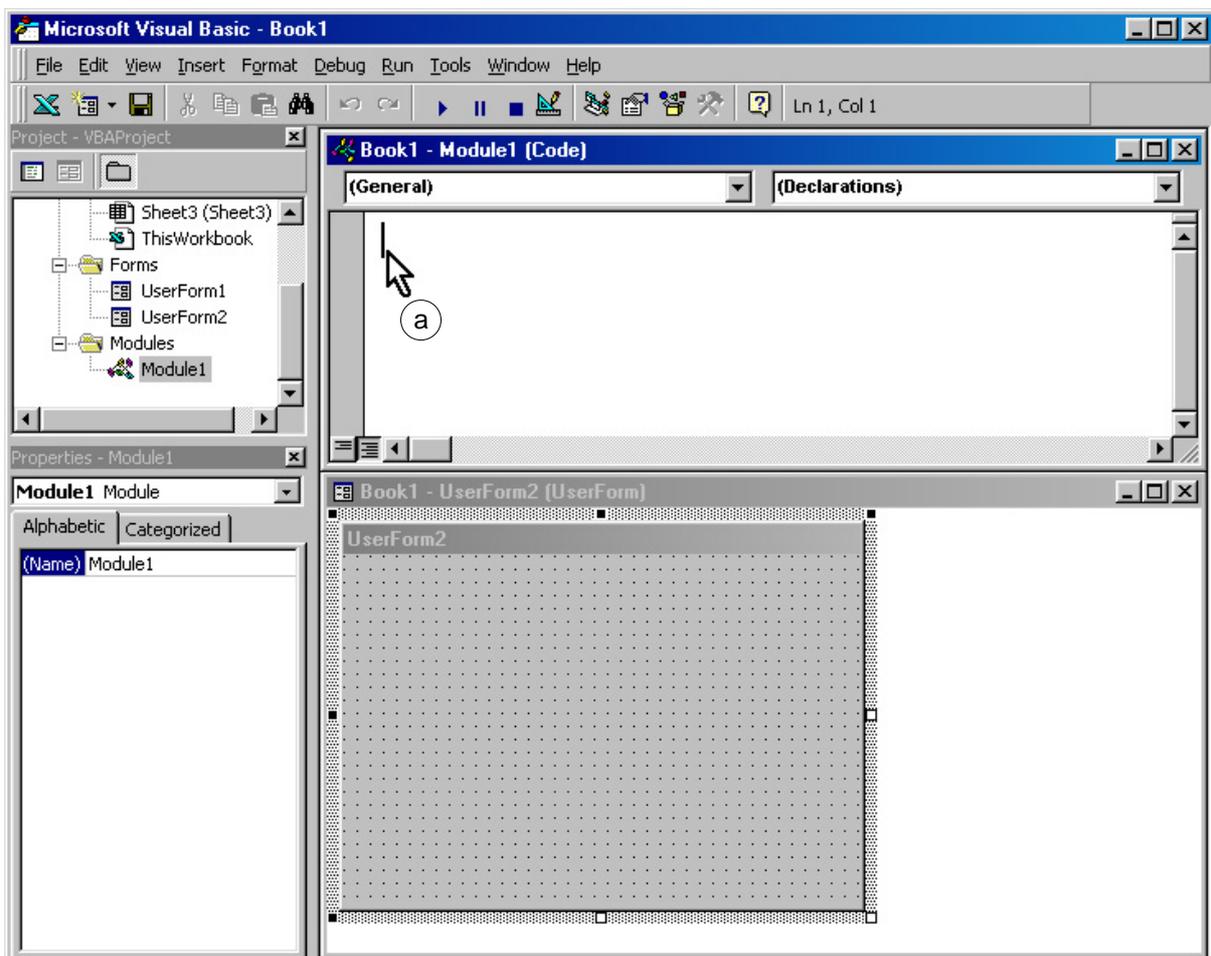
Note: The description may vary somewhat depending on the operating environment. Refer to the Excel Help for information about the Visual Basic Editor.

Now, the macro created by the preceding steps can be executed from Excel.

⑥ Select Tools - Macro - Macros from the menu
bar (a).
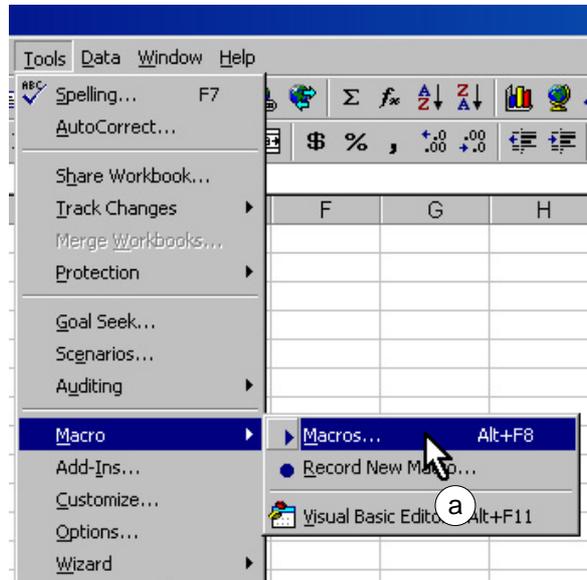
⑦ Select This Workbook for the "Macros in:" (a),
selection, and select the created macro name from
the list of macro names (b).
Then click the Run button (c).
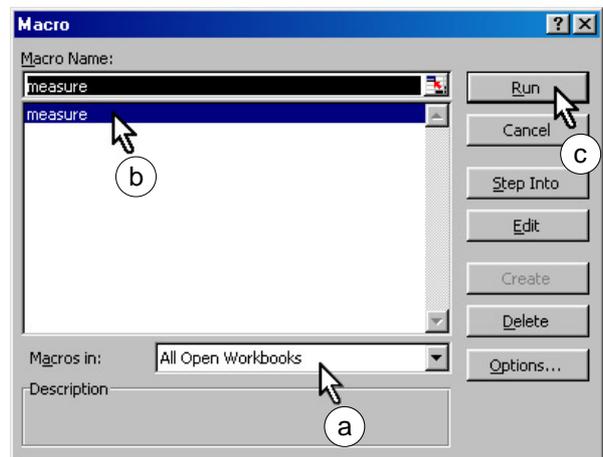
(2) Sample Program

Below is a sample Excel Visual Basic Editor program for RS-232C communications, which pastes acquired data into Excel. Note that the RS-232C object name created in the sample program under "(1) Development Procedure" is "MSComm1", and the name of the user form created for the telephone icon is "UserForm1".

① RS-232C Handling Program

```
Private Sub COMOpen()
        UserForm1.MSComm1.PortOpen = True                                    (a)
End Sub


Private Sub COMClose()
        UserForm1.MSComm1.PortOpen = False                                   (b)
End Sub


Private Function COMCommand(CommandData As String) As String                 (c)
Dim strbuf As String
        UserForm1.MSComm1.Output = CommandData & Chr(&HD)                     (d)
        strbuf = ""
        For i = 0 To 10000
                If UserForm1.MSComm1.InBufferCount > 0 Then
                        strbuf = strbuf & UserForm1.MSComm1.Input             (e)
                        If Asc(Right(strbuf, 1)) = &HA Then
                                COMCommand = ""
                                For j = 1 To Len(strbuf)    (f)
                                        l = Mid(strbuf, j, 1)
                                        If Asc(l) > 32 Then COMCommand = COMCommand & l
                                Next j
                                Exit Function
                        End If
                End If
        Next i
        COMCommand = "COMERROR"
End Function
```

Program Description

(a) Enable the RS-232C port.

(b) Disable the RS-232C port.

(c) Function to send a specified CommandData character string to the 3540 and to return the COMCommand string received by the PC from the 3540 as a result.
If sending fails, the "COMERROR" string is returned.

(d) Send the specified CommandData string.

(e) Gets a string, if present, from the RS-232C.

(f) If the last character of a string sent from the 3540 is an LF (line feed), characters other than delimiters (CR and LF) are removed and stored as "COMCommand".

② Control of the 3540

```
Private Sub SendSetting()                                                    (a)
        COMCommand("HZ 0")
        COMCommand("FUNC 0")
        COMCommand("SMP 0")
        COMCommand("TC 0")
        COMCommand("RNG 0")
        COMCommand("AUTO 0")
        COMCommand("COMP 0")
        COMCommand("HOLD 1")
End Function
```

Program Description

(a) Performs various settings on the 3540.

This example performs the following settings, in order: power frequency (50 Hz), resistance measurement mode, SLOW sampling, temperature compensation OFF, measurement range (30 mW), Auto Range OFF, Comparator OFF and Hold ON.

③ Acquire 3540 Measurement Data (to paste to Excel)

The following example acquires measurement data continuously ten times, and pastes the results to Excel.

```
Public Sub Measure()                                                         (a)
        COMOpen
        SendSetting
        For i=1 to 10
                COMCommand("TRG")
                strbuf = COMCommand("RMES")                                  (b)
                ActiveSheet.Cells(i + 1, 1).Value = i
                ActiveSheet.Cells(i + 1, 2).Value = strbuf                   (c)
        Next i
        COMClose
End Sub
```

Program Description

(a) When the macro is executed, the various settings are executed on the 3540, with the results of ten consecutive measurements pasted into Excel.

(b) Hold has been enabled (ON) by 3540 setting, so execute a trigger (start measurement) command and store the results in strbuf.

(c) The data count (i) and measurement values acquired in (c) are pasted into the selected Excel worksheet, sequentially.

4. Question & Answer

Q. LCD cannot be displayed even if the power is on. Why?

A.
♦ Please check that you are using HIOKI Model 9455 as an AC Adapter.
♦ If not, check that your AC Adapter satisfies the standard specifications (DC9V, 1.4A).
♦ Check that the battery has not been exhausted. If so, please change the batteries.
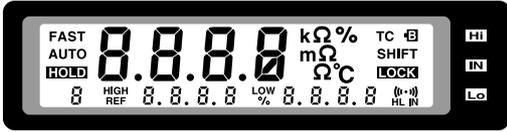
Q. Resistances cannot be measured. Why?

A.
♦ Is the electric current in an abnormal state, CCERR? In this case, the value shows "----". One possible reason is that the proper range wasn't chosen. The other may be that the probe is damaged.

Q. Temperature correction is not possible. Why?

A.
♦ Is the temperature probe connected properly? If the display shows "Err2" to show that the temperature correction function cannot be used, it may be that the probe is not connected properly.
♦ Is the temperature probe is properly plugged into the jack of the main unit? The sensor of the 3540 is based on resistance, which changes according to the temperature. If the temperature probe is not connected at all or improperly, temperature correction cannot be conducted as expected.

Q. I cannot measure temperature. Why?

A.
♦ Is the temperature probe connected? If not, the LCD shows "---", which means you cannot measure temperature.
♦ Is the temperature probe properly connected all the way into the jack? The 3540 measures resistance change by the temperate of the probe, so if the probe is not connected properly, you may not be able to measure correctly.

Q. I cannot change the measurement range. Why?

A. ◆ Is the measurement range under external control? The 3540 measurement range 3540 can be changed by external control. If signals are input into the external control signal, you cannot change the range by key input.

Q. Auto ranging has been cancelled. Why?

A. ◆ Is the comparator on? The auto range and comparator functions cannot be used simultaneously.

Q. I cannot receive a comparator configuration (LED display, outputting). Why?

A. ◆ Is MANU mode at the rear panel chosen? If the MANU is chosen, you are able to use the comparator decision output only when the MANU signal of the external signal is input.
◆ Is it in the abnormal current state, CCERR? If Model 3540 is in CCERR, you cannot use the comparator decision function.

Q. I cannot change the comparator tables. Why?

A. ◆ Is the external control signal connected to anything? The comparator table selection can be changed by external control. However, if some signal is input, you cannot use this function.

Q. I cannot use the external control features. Why?

A. ◆ Check that external control signal connected properly?
◆ Check that a part such as a lead connecting the external control signal is not damaged or cut.
◆ Please refer to the chapter "External Control Features" in this manual.

Q. I cannot get the correct resistance value. Why?

A.
- ♦ Is the resistance value too big? If you measure an object with two terminals, please perform zero adjustment since the measurement value includes the line resistance of the two terminals.
- ♦ Is the surrounding temperature kept steady? Resistance other than the copper line (temperature coefficientÅF3930ppm) cannot be measured correctly even if the temperature correction function is ON, because the temperature correction is done for the copper line. If the resistance is of a copper line and its resistance change is very big, please turn off the temperature correction function and keep the surrounding temperature steady to eliminate any influence.
- ♦ Is the temperature correction function turned on? If the function is on while measuring resistance of materials other than a copper line, you cannot measure correctly. Make sure that the LCD doesn't display the TC mark.

Q. The measurement value is unstable. Why?

A.
- ♦ Is the power supply frequency proper set? Since Model 3540 cancels ham noise emitting from power supply frequency, if the frequency is not properly set, the measurement range may be unstable. This applies even to batteries.
- ♦ Make sure that the 3540 itself, the 3540 probe and the AC adapter cable are not near any big electrical fields or equipment generating magnetic fields. Big electrical or magnetic fields sometimes influence the functionality of the 3540.
- ♦ Is the measurement object a transformer or a motor? If the noise reaches an open terminal of a transformer or the motor axis moves, enough conductance may be generated in the wires make the measurement range unstable. Pay attention to handling the open terminals of the transformer as well as motor swing.
- ♦ Is the measuring object a big transformer or similar equipment? Measurements using the Model 3540 may be unstable if you are measuring the resistance of such objects, which contains big L elements. In such case, please contact HIOKI.

Q. I cannot print out. Why?

A. ♦ Is the 3540 connected properly to the printer?
The Model 9425 cable or cables sold in the market have a locking structure to be used with the 3540 connector. Please plug in the cable securely until you hear a "click".

♦ Is the PRINT signal wiring connected properly?

♦ Is your the printer type Centronics? If you prefer not to use the HIOKI 9203 Digital Printer, please use a Centronics printer.

Q. RS-232C communication is not possible. Why?

A. ♦ Is the RS-232C cable connected properly? If your RS-232C cable is in a lock structure or must be fastened by screws, make sure the connector is securely fastened to the unit.

♦ Is your RS-232C cable a cross cable? Please use a cross cable to connect Model 3540 with other equipment. A cross cable is the one in which the RxD signal and TxD signal cross each other in their wiring.

♦ Is the RS-232C setting on the equipment side properly done? The 3540 setting is fixed and cannot be changed. The settings on the computer side must be as follows.

Transfer rate	9600
Parity	None
Data length	8
Stop bit	1
Hand shake	X flow, hardware flow and none

♦ Is the COM port used on the receiving side correct? In general, a DOS/V PC has RS-232C ports from COM1 to COM4. Check that the COM number of the connector to the RS-232C cable is correct.
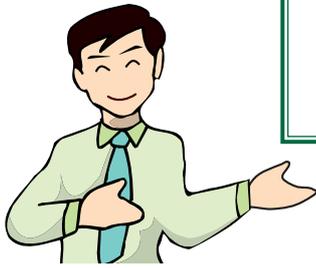
mΩ HiTESTER
Product Line Up

DC measurement type: 3227 mΩ HiTESTER

Low resistance measurement with fast response forimproved line efficiency
Data handling functions provided by optional printer with statistical processing functions

● Enables low resistance measurement to be carried out
  faster and at a higher resolution
● Maximum sampling rate of 90 times/second
  (five times faster than existing equipment *)
● Reduces manufacturing and testing line times
● Optional GP-IB interface for full remote control
● Statistical processing using the 9203 DIGITAL PRINTER
● Enables a range of functions from system use to data
  management

  *Comparison with HIOKI 3224 mΩ HiTESTER

AC measurement type: 3560 AC mΩ HiTESTER

Contact resistance meter with high-speed response
Covers measurement requirements from contact resistance to internal resistance and voltage of batteries.

● Comparator function and external interface utilizing
  4-terminal method
● Gives priority to line use and allows measurement
  offering high speed, high accuracy and high resolution
● External output terminal, external control terminal and
  RS-232C interface are standard features
● GP-IB interface and printer interface are optionally available
● Enables simultaneous measurement and comparison of
  battery internal resistance and open-circuit voltage
● Highly suitable for battery inspection lines as one unit can
  act as both a low-resistance meter and DMM

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