

OPERATION MANUAL

**RS-232C INTERFACE
IF02-COR**

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KIKUSUI PART No. Z1-000-252 IA000871

ROM Version Number

This manual is applicable to the IF02-COR installed on a COR5500U series digital storage oscilloscope which has the following version of the ROM (read only memory):

1.10 or later

When making any inquiries on the IF02-COR, please mention the ROM version and the product number of the oscilloscope, and the product number of IF02-COR.

The product number of the oscilloscope is indicated on a sticker on the rear panel.

To find the oscilloscope ROM version, refer to Section 2.4 "Checking the Oscilloscope Operation" under Chapter 2 "PRECAUTIONS" in the operation manual of the oscilloscope.

The product number of IF02-COR is stamped inside the IF02-COR.

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Indications for Cautions and Warnings

For the maximum safety of the persons who may use the instrument, IF02-COR has been designed and manufactured for full safety features and is shipped after stringent inspection. And yet, as the IF02-COR is used in conjunction with the COR5500U series oscilloscope which has high voltages, it is unavoidable to request the persons to use the instrument carefully, in order to avoid damage to the instruments and hazards to the persons.

This manual gives notes and warnings which the operator must take heed of and observe. The types of notes and warnings are as follows:


NOTE

Means a matter that calls for special attention for correct and efficient use of the instruments.

WARNINGS

Means a matter which might lead to damage of the instruments themselves or of other instruments.

The following symbols may be posted on the instruments:

 **“DANGER! HIGH VOLTAGE”**

This symbol means that the item can be charged up to a hazardous high voltage and must not be touched with bare hands.

 **“Refer to the Corresponding Section”**

This symbol means that relative matters at other location of the manual should be referred to.

CAUTION

Means a matter which can lead to electric check hazards to the person who is operating the instruments or to damage of the instruments themselves or other instruments.

Cautions and Warnings for Oscilloscope

AC Line Voltage

Be sure to operate the oscilloscope on an AC line voltage within its correct range.

AC Power Cable

Be sure to use an AC power cable of the correct type for the oscilloscope.

AC Power Fuse

Be sure to use a power fuse of the correct ratings for the oscilloscope.

Do not remove the covers.

The oscilloscope has hazardous high voltages internally. Do not remove the covers of the oscilloscope lest you should expose yourself to such high voltages. The covers should be removed only by qualified experts.

Attaching and detaching the IF02-COR

Be sure to turn off the power of the oscilloscope when you attach or detach the IF02-COR.

Chapter 1. GENERAL

1.1 Introduction

The IF02-COR is an interface which is based on the EIA Standard RS-232C. It can be attached onto the COR5500U series oscilloscope (storage model only), and you can transfer data and waveforms among the devices. The interface function is available on the Storage Mode.

(1) Reading back of panel settings

The oscilloscope panel setting data can be read by a computer.

(2) Reading back of measured data

The oscilloscope measurement data, such as stored waveform data and cursor measurement data can be read by a computer.

(3) Copying screen data (Plotout)

From the oscilloscope operating in the storage mode, the screen data can be copied directly—without any external computer—to a plotter which supports HP-GL (Hewlett-Packard Graphics Language).

Chapter 2. PRECAUTIONS

2.1 Receiving Inspection

Prior to the shipment from our factory, the IF02-COR has been subjected to electrical and mechanical testing and guaranteed of satisfactory quality and performance. Nevertheless, you are kindly requested to make a receiving inspection to see if the IF02-COR has any in-transit damage. If you find any, inform the transportation company of such damages without delay.

Accessories provided: Mounting screws (2 pcs)

Operation manual (1 copy)

2.2 General Precautions

This section describes electrical and mechanical precautions for safe and correct use of the COR5500U series oscilloscope. Be sure to read this section before start using the oscilloscope and the interface.

(1) Checking the AC line voltage and frequency

Operate the oscilloscope on its rated AC input voltage of 100 through 240V, frequency 50 through 400 Hz, although it is permissible to operate the oscilloscope on an AC line voltage of 90 through 250 V, frequency 45 through 440 Hz.

(2) Checking the type and ratings of fuse

Before connecting the power cable to the AC inlet of the oscilloscope, check the type and ratings of the power fuse. The fuse holder of the oscilloscope is an integrated structure with the AC inlet. The fuse holder cap can be detached by a screwdriver or a pointed tool as shown below. Two fuses (one of which is for replacement spare) are put in the cap.

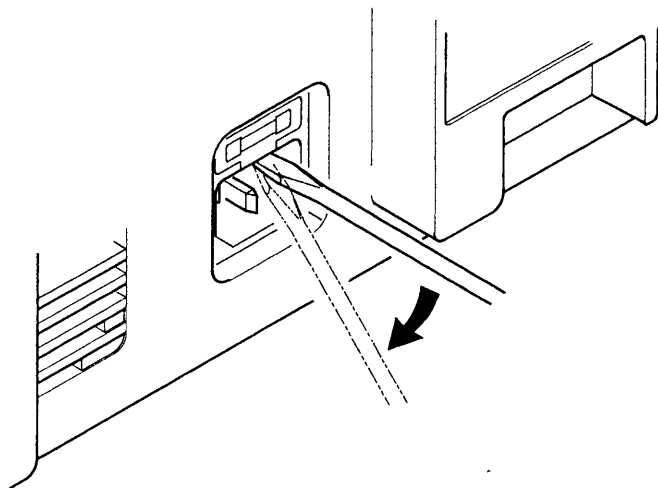


Figure 2-1. Fuse replacement

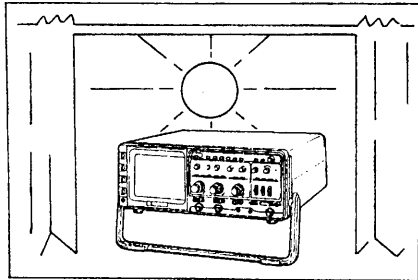
Take out the fuse and check that it is a slow-blow fuse of 250V AC, 2A. Return the fuse and cap to the original positions by following the take out procedure in the reverse order. Fully insert the cap until it clicks.

(3) Environments

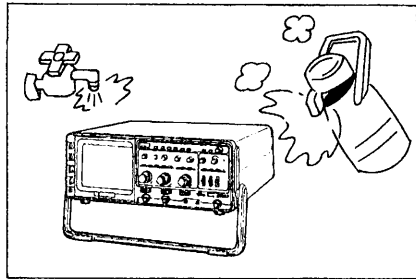
Avoid to use the oscilloscope in environments as mentioned below.

(a) High temperature

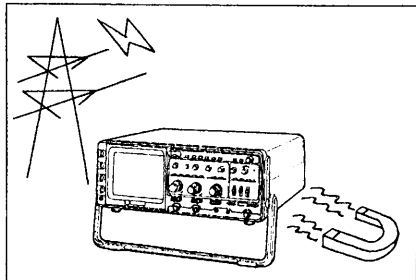
Do not expose the oscilloscope to direct sunlight or other source of heat. (The ambient temperature range for the guaranteed performance is 10 to 40°C or 50 to 104°F.)

**(b) High humidity**

Do not use the oscilloscope in high humidity. (The humidity range for the guaranteed performance is up to 75% RH.)

**(c) Electric or magnetic field**

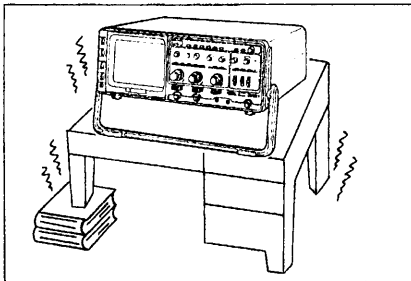
Do not use the oscilloscope in strong electric or magnetic field, lest the displayed images should be distorted or otherwise adversely affected.



PRECAUTIONS

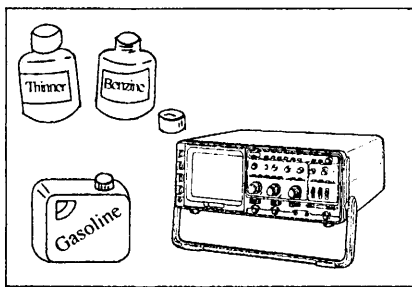
(d) Unstable position

Do not put the oscilloscope on a swaying bench or in other unstable position.



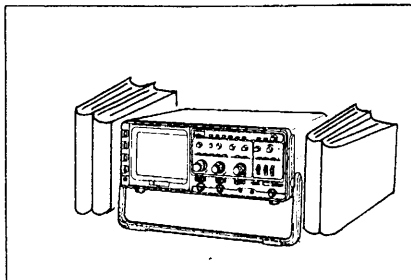
(e) Flammable atmosphere

Do not use the oscilloscope in flammable or explosive atmosphere, to prevent fire and explosion hazards.



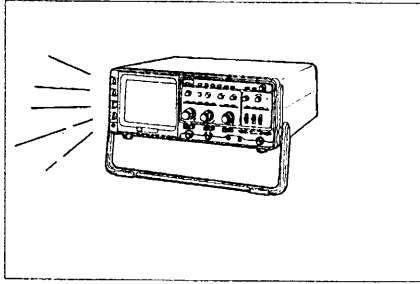
(f) Blocked ventilation holes

Do not block the ventilation holes. The ventilation fan of the COR5501U/COR5561U is installed on the rear panels and that of the COR5502U on the right-hand side panel. Provide ample spaces adjacent to these panels lest the ventilation air flow should be blocked.

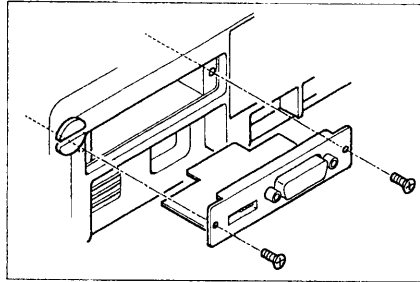


(4) Others**(a) CRT intensity**

In order to prevent permanent damage to the CRT phosphor, do not make the CRT trace excessively bright or leave the beam spot stationary for an unreasonably long time.

**(b) Caution before installing or detaching the IF02-COR**

Be sure to turn off the power switch and disconnect the power cable of the oscilloscope when you attach or detach the IF02-COR.



Chapter 3. PREPARATION

3.1 Installation

Before attaching the IF02-COR onto the oscilloscope, turn off the power of the oscilloscope and disconnect the power cable from the AC line receptacle.

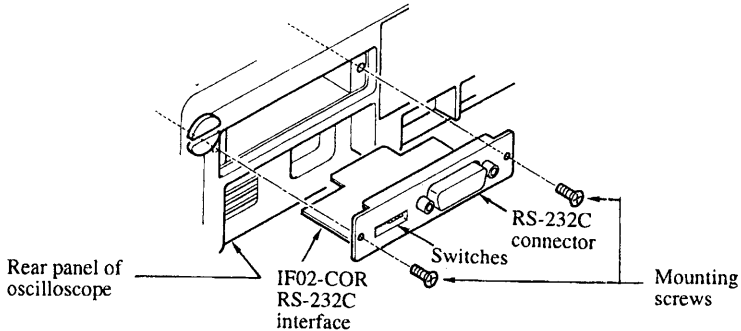


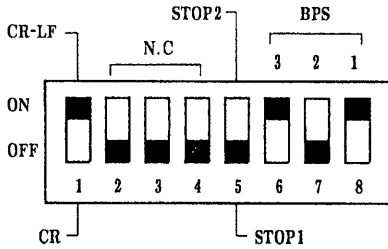
Figure 3-1. Installing the IF02-COR

Insert the IF02-COR RS-232C Interface into the option slot on the rear panel of oscilloscope to the deepest position. And, fix it to the oscilloscope with the two mounting screws.

3.2 Description of Components

- Switches:** The switches select communication protocols for the IF02-COR.
- RS-232C connector:** The connector is to connect the IF02-COR through an RS-232C cable to a computer or a plotter of an HP-GL compatible type. To connect an RS-232C cable, securely mate the connectors and fix them with the screws.

3.3 Setting of Switches



These switches are to set communication protocols for the IF02-COR. The items which can be set are delimiter, stop bit size, and transfer rate.

This switch setting is read only once when the power of the oscilloscope is turned ON. To let the setting be read after it has been changed, turn OFF once the power of the oscilloscope and then turn it ON again.

(1) Setting a transfer rate

You can select one of the transfer rates shown in the below table, by a combination of switches BPS1 through BPS3.

Switches (BPS)			Transfer rate
3	2	1	
OFF	OFF	OFF	110 BPS
OFF	OFF	ON	150 BPS
OFF	ON	OFF	300 BPS
OFF	ON	ON	600 BPS
ON	OFF	OFF	1200 BPS
ON	OFF	ON	2400 BPS

* Factory-default is 2400 BPS.

(2) Setting a stop bit size

If you set the STOP switch to OFF, the stop bit size is set to one bit. If you set it to ON, the size is set to two bits.

(3) Setting a delimiter

For the delimiter for the IF02-COR, you may select either CR+LF or CR.

The ON position of switch 8 is for CR+LF and the OFF position is for CR. You cannot select LF for the delimiter.

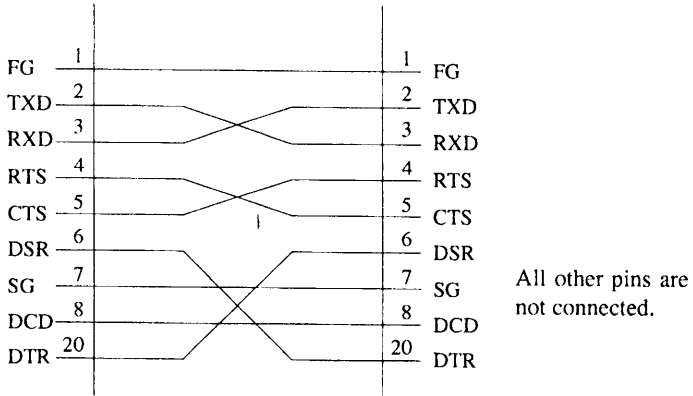
NOTE : Because waveform data is transmitted in binary, when it is transmitted, it does not include delimiters irrespective of the delimiter setting you have done here. Waveform data is transmitted in blocks delimited by the WAVE START and WAVE END commands. Refer to Item (3) “Reading Back of Waveform Data” under Section 4.5 “Basic Protocols for Communication Programs.”

3.4 Cables

For data communication via RS-232C, type of the cable to be used differs depending on the type of the connector used on the counterpart device of the communication. Select the correct type of cable.

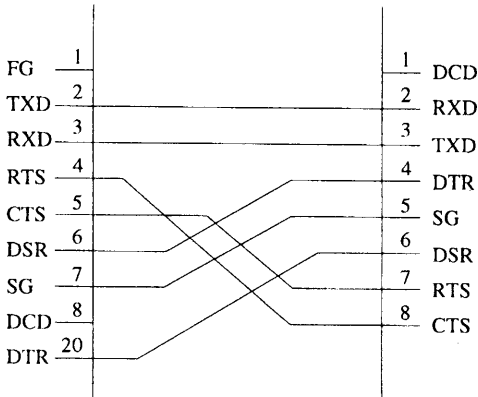
(1) For DTE to DTE connection (regular cross cable)

(Typically, for connection between IF02-COR and computer)



Pin assignment of connector of IF02-COR

Pin assignment of connector of counterpart device (25-pin type)

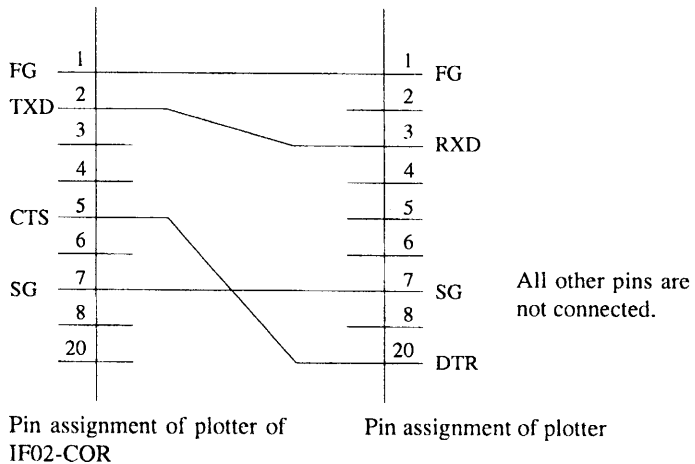


Pin assignment of connector of IF02-COR

Pin assignment of connector of counterpart device (9-pin type)

(2) For connection to a plotter

(For a typical case that the plotter is handshaked on the DTR line.)



NOTE : Even a plotter which claims to be based on RS-232C may not operate on the above-mentioned cable due to such reason that not all of the signal lines are in operation or that some performance specifications do not comply with the standard. If this is the case, use a cable which complies with the performance specifications and communication protocols of the counterpart device.

Chapter 4. FUNCTIONS OF DEVICE

4.1 Reading Back of Panel Setting

This function allows to read back the oscilloscope panel setting with a computer. For example, when you want to know the setting information of CH1 (Channel One), you may send a string "CH1?" from the computer. The oscilloscope will interpret the string and will return the setting information about CH1.

4.2 Reading Back of Waveform Data

The oscilloscope operating in the Storage Mode stores data of 4096 points per channel. The stored data can be transferred to a computer in a binary format. This function allows you to file waveform data externally without internal Saving Memory of the oscilloscope. Furthermore, by using an application program of the personal computer, you can send waveform data to a printer, plotter, and other devices around the computer.

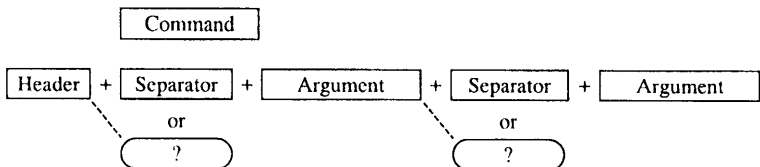
4.3 Command and Data Formats

To control the COR5500U series oscilloscope through RS-232C, you should send commands from the computer in the following format:



(1) Command

A command is an ASCII string and consists of a Header, Arguments, and Separators as illustrated below:

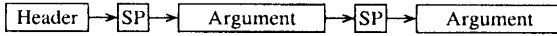


- Header

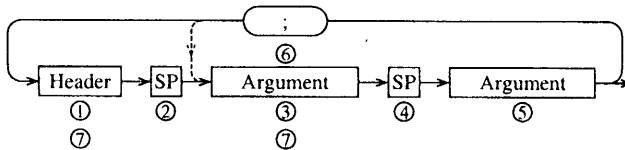
The Header specifies a category of the control or query function, such as CHANNEL1 or WAVE, for example.

- Separator

There are two types of separators: One is with two or more space characters and the other is a semicolon (;). The space characters are used for separation between a Header and an Argument or between two Arguments.



The semicolon (;) is used for separation between two commands. However, some commands do not allow a semicolon preceding a Header.



- Argument

There are two types of Arguments, namely, a character type such as “ON” and “AC,” and a numerical type such as “1” and “2.”

- “?” character

This character is used for the suffix of a command string which works as a query command. No characters can follow the “?” character, and you cannot place any blank before the “?” character.

(2) **Waveform Format and Block**

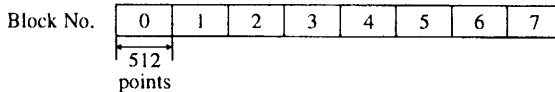
- BYTE Format

The Byte Format is a numerical sequence as follows:

Each numeral is an eight bit value for 0 to 255s

It is also possible to read a part of waveform, by separating the waveform data of 4k bytes (4096 bytes) into blocks as shown below.

Address



For example, when you want to read the waveform data between the point 512 through 2047, specify the Start Block "1" and End Block "3" in a "WAVE..." command.

- **HLWORD and LHWORd Format**

These formats are especially provided for recent microprocessors. With these formats, one point of waveform data is converted into two bytes (16 bits) of data. Each point of data can be transferred with a format as shown below:

Format	Even Byte	Odd Byte
HLWORD	High-Byte (Always 0)	Waveform data (00-FF)
LHWORd	Waveform data (00-FF)	High-Byte (Always 0)

Thus, data of each waveform consists of 8192 bytes (4096 words). Blocks can be specified similarly to the BYTE Format.

NOTE : The HLWORD supports the 16 bit integer sequence of Motorola family chips such as 68000 or 68020. Whereas, the LHWORd supports the integer sequence of Intel family chips such as 80286 or 80386. By employing a direct integer sequence assignment system, waveform data can be transferred very rapidly.

The default format of waveform transfer is set follows.

```
START 0
END 7
CODE BYTE
```

Refer to the Section 4-4-7 "Waveform Commands."

(3) Waveform Resolution

The storage system of COR5500U series employs an 8 bit D/A converter and a 4k byte memory for each channel. Therefore, a waveform on the CRT screen has 4096×256 resolution.

Each vertical division has 25 dot points, and the center of the graticule is defined at 128 (80 hex) as a digital waveform data. Thus, 28 (1C hex) is assigned to the lowest line of the graticule and 228 (E4 hex) is assigned to the highest line.

Each horizontal division has 400 address points, however, the starting point of waveform should be aligned with the left end of graticule. Thus, 0 is assigned to the left end and 4000 is assigned to the right end of graticule. Extra 96 points of waveform data overflow rightward the full scale of graticule.

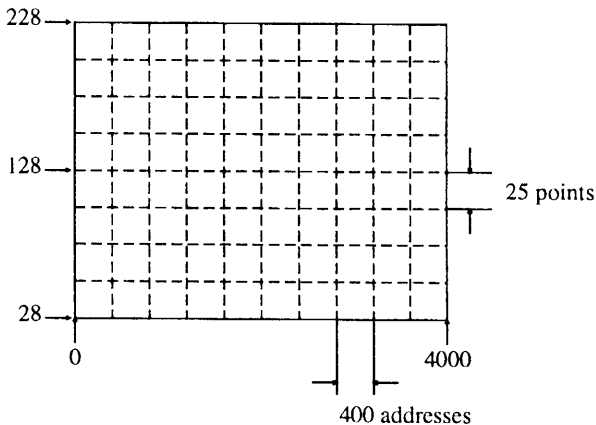


Figure 4-1. Waveform Resolution

(4) Abbreviations of Commands

As a general rule, Headers and Arguments may be abbreviated into three-character symbols.

Examples: "ATRIGGER" → "ATR"
 "CHANNEL1" → "CH1"

The abbreviated forms of Headers and Arguments are shown in the enclosed parentheses in the Command Tables described later.

4.4 Command Tables

This section provides the command tables for controlling COR5500U series oscilloscope. Each table introduces the function and format of each command. Programming examples are also introduced later in this section. The rules of the command tables are described below:

(1) Setting the Oscilloscope

- To reset Single Trigger Mode:

ATRIGGER (ATR)	MODE RESET (MOD RES)	Resets the Single Trigger Mode in the Storage Mode.
-------------------	-------------------------	--

ATRIGGER + SPACE + MODE RESET

"ATRIGGER MODE RESET"

Abbreviation: "ATR MOD RES"

In response to this command, the IF02-COR will return "OK" or "ERROR."

(2) Reading back of panel setting or measured data

- To read back the deflection factor of CH1:

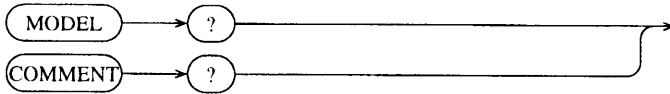
CHANNEL 1 (CH1)	VOLT? (VOL?)	Returns the CH1 deflection factor.
--------------------	-----------------	------------------------------------

CH1 + SPACE + VOL?

"CH1 VOL?"

In response to this command, the IF02-COR will return data or "ERROR."

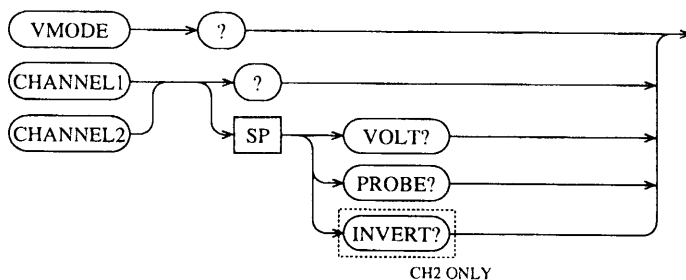
4.4.1 System Commands



Header	Argument	Function
MODEL?		Returns the model name. [COR5502U, COR5501U, COR5561U, COR5541U, or COR5521U]
COMMENT? (COM?)		Returns the contents of the current comment text. If the Comment function is turned off, you will get IRG FUNC ERR.

NOTE : For delta (Δ), degree ($^{\circ}$) and micro (μ), non-standard ASCII characters used in the comments, ASCII codes 7CH (;), 60H (') and 5EH (^) will be returned instead of those graphic characters.

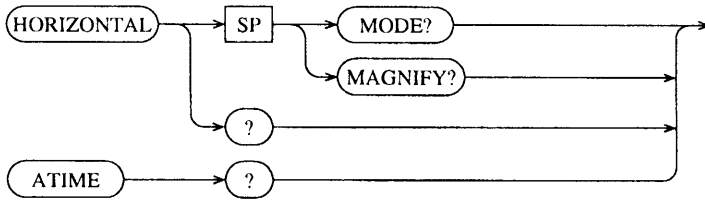
4.4.2 Vertical Axis Commands



Header	Argument	Function
VMODE?		Returns the setting of VERT MODE. [CH1, CH2, ADD, or DUAL]
CHANNEL1 (CH1)	VOLT? (VOL?) PROBE? (PRO?)	Returns the CH1 deflection factor. COR5502U, COR5501U, COR5561U: [5V through 1MV] COR5541U, COR5521U: [10V through 2MV] Returns the CH1 probe scale factor. [X1, X10]
CHANNEL1? (CH1?)		[VOLT (UNCAL)] [PROBE] * See the Note.
CHANNEL2 (CH2)	VOLT? PROBE? INVERT? (INV?)	Returns the CH2 deflection factor. Returns the CH2 probe scale factor. Returns the CH2 polarity. [ON or OFF]
CHANNEL2? (CH2?)		[VOLT (UNCAL)] [PROBE] [INVERT] * See the Note.

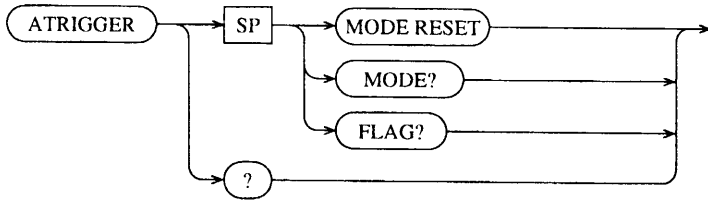
NOTE : Returns [OFF] if the channel is not selected.

4.4.3 Horizontal Axis Commands



Header	Argument	Function
HORIZONTAL (HOR)	MODE? (MOD?)	Returns the setting of HORIZ MODE. [A or XY]
	MAGNIFY? (MAG?)	Returns the magnification factor. COR5502U, COR5501U, COR5561U: [X1, X5, X10, or X50] COR5541U, COR5521U: [X1, X10, or X20]
HORIZONTAL? (HOR?)		[MODE], [MAG]
ATIME? (ATI?)		Returns the timebase setting. COR5502U, COR5501U: [5S through 20NS (UNCAL)] COR5561U: [5S through 50NS (UNCAL)] COR5541U: [5S through 0.1US (UNCAL)] COR5521U: [5S through 0.2US (UNCAL)]

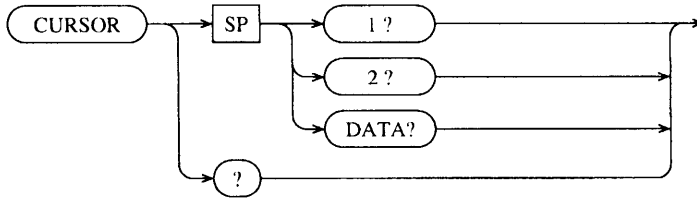
4.4.4 Trigger Commands



Header	Argument	Function
ATRIGGER (ATR)	MODERESET (MOD RES)	Resets the Single Trigger Mode in the Storage Mode. (Note 1)
	MODE? (MOD?)	Returns the Trigger Mode setting. [AUTO, NORM, or SINGLE]
	FLAG? (FLA?)	Becomes ON when the Single Trigger Mode is effected and data is acquired. [ON or OFF] (Note 2)
ATTRIGGER? (ATR?)		It works similarly to "ATRIGGER MODE?"

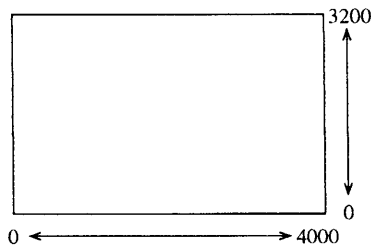
- NOTE** :
1. If you reset the Single Trigger in the Auto or Normal Trigger Mode, a readout message IRG FUNC ERR will appear on the screen.
 2. The "ATRIGGER FLAG?" is effective only when in the single sweep operation in the storage mode.

4.4.5 Cursor Commands

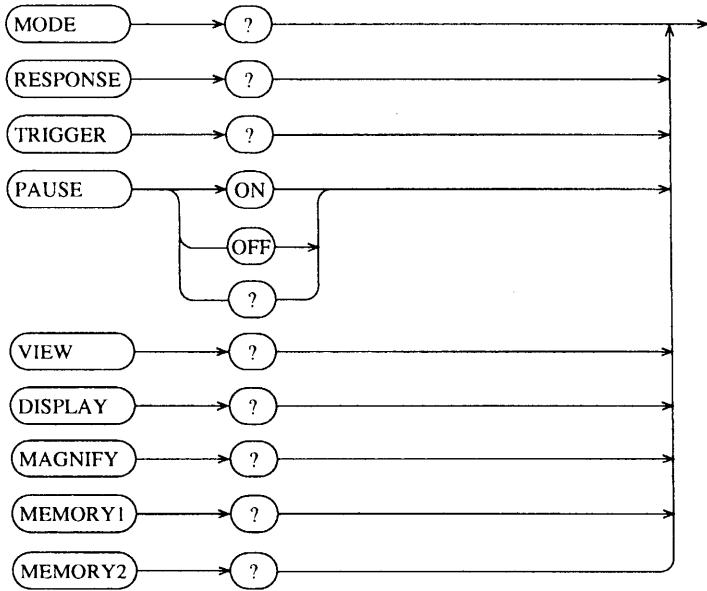


Header	Argument	Function
CURSOR (CUR)	1?	Returns the position of Cursor 1 (C1). [0-4000] (*See the Note.)
	2?	Returns the position of Cursor 2 (C2).
	DATA? (DAT?)	Returns the data measured with the Cursors.
CURSOR? (CUR?)		[OFF, VOLT, TIME, PERTIME, VDIV, TDIV], [1] [2] [DATA]

NOTE : The relationships between the CRT screen position data and the cursor positions are as illustrated here. (400 points/DIV)



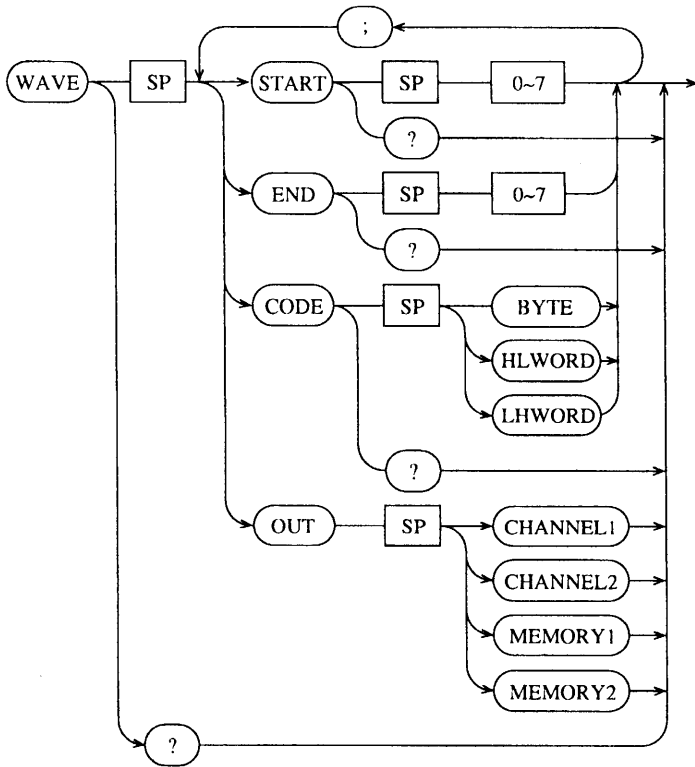
4.4.6 Storage Commands



Header	Argument	Function
MODE? (MOD?)		Returns operation mode. [REAL or STORAGE]
RESPONSE? (RES?)		Returns the Interpolation status. [LINEAR or CURVE]
TRIGGER? (TRI?)		Returns the Trigger Point. It is available only when in the Pause Off state. [0, 1, 5, or 9]
PAUSE (PAU)	ON OFF	Sets to the PAUSE state. (See the Note.) Release from the PAUSE state. (See the Note.)
PAUSE? (PAU?)		Returns the Pause status. [ON or OFF]
VIEW? (VIE?)		Returns the View Time status. [ON or OFF]
DISPLAY? (DIS?)		Returns the display mode. [NORMAL, ROLL, REPEAT, or INTERPOLATION] COR5502U, COR5501U and COR5561U only: [REPEAT]
MAGNIFY? (MAG?)		Returns the Magnification point. It is available only when in Pause On state. [0, 1, 5, 9]
MEMORY1? (MEM1?)		Returns ON/OFF of MEMORY1 waveform display. When ON, returns [VOLT] and [TIME] also.
MEMORY2? (MEM2?)		Returns ON/OFF of MEMORY2 waveform display. When ON, returns [VOLT] and [TIME] also.

NOTE : The PAUSE ON/OFF commands are available with ROM Version 1.20 and later Versions only.
With Version 1.10, they result in errors.

4.4.7 Waveform Commands



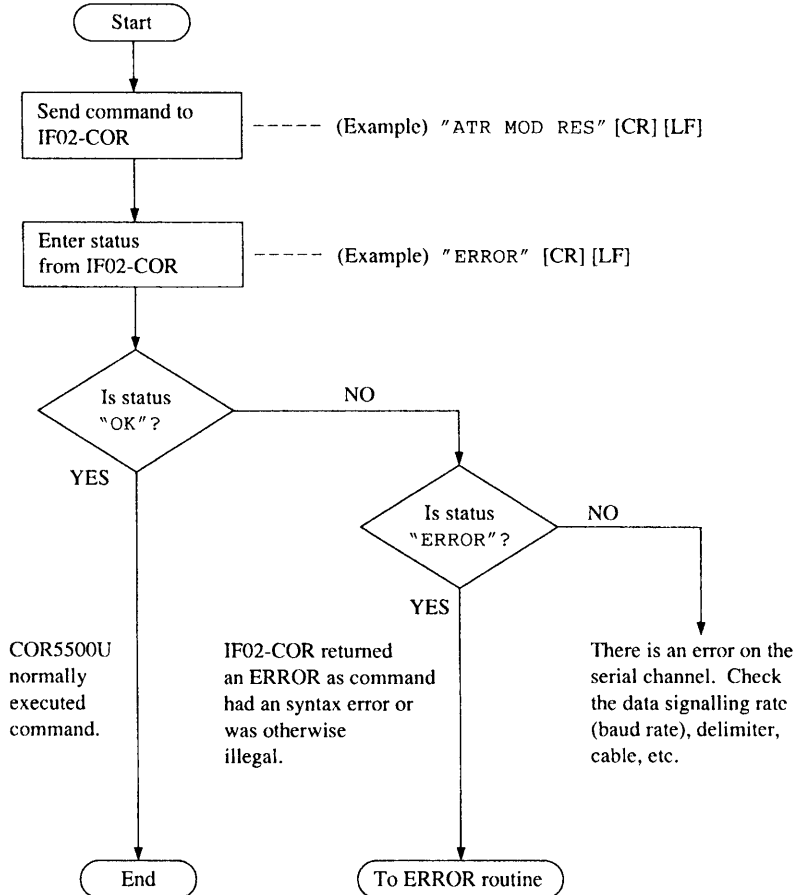
Header	Argument	Argument	Function	
WAVE (WAV)	START (STA)	0 to 7	Specifies the Start Block of waveform transfer. (default = 0)	
	START? (STA?)		Returns the current Start Block. [0 to 7]	
	END	0 to 7	Specifies the End Block of waveform transfer. (default = 7)	
	END?		Returns the current End Block. [0 to 7]	
	CODE (COD)	BYTE (BYT)		Specifies the waveform transfer format to BYTE. (default)
		HLWORD (HLW)		Specifies the waveform transfer format to HLWORD.
		LHWORD (LHW)		Specifies the waveform transfer format to LHWORD.
CODE? (COD?)		Returns the current format of waveform transfer. [BYTE, HLWORD, or LHWORD]		
OUT	CHANNEL1 (CH1)		Reads the CH1 waveform data.	
	CHANNEL2 (CH2)		Reads the CH2 waveform data.	
	MEMORY1 (MEM1)		Reads the MEM1 waveform data.	
	MEMORY2 (MEM2)		Reads the MEM2 waveform data.	
WAVE? (WAV?)			Returns [START] [END] [CODE].	

NOTE : In the Roll Mode operation, waveform transfers might not work correctly. Make sure to press PAUSE switch to freeze the acquisition before transfer in the Roll Mode.

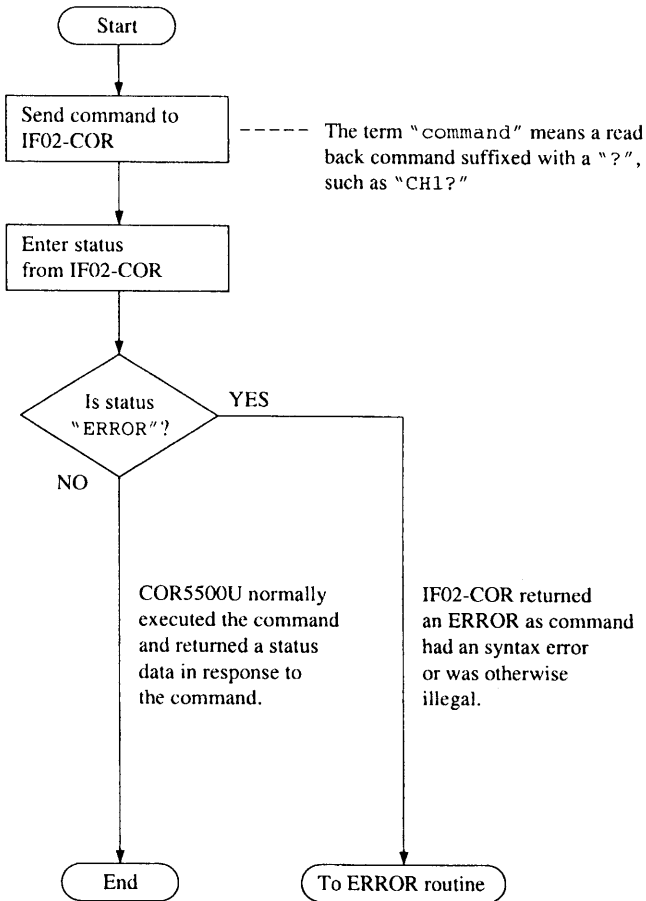
4.5 Basic Protocols for Communication Programs

Communication between the computer and the COR5500U + IF02-COR is done by sending commands from the computer and then waiting for a status message or an "OK" or "ERROR" message. The communication procedures are shown in the following flowcharts, which you may refer to when you are writing programs on the computer side.

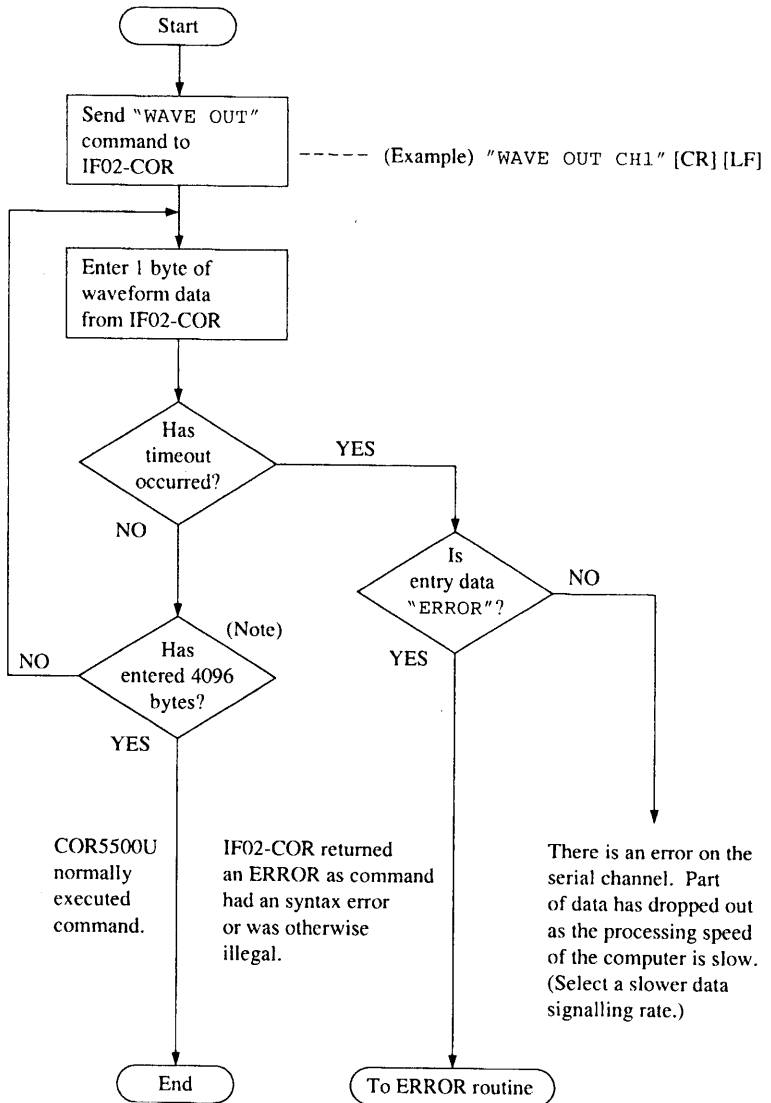
(1) Panel Setting



(2) Reading Back the Panel Setting

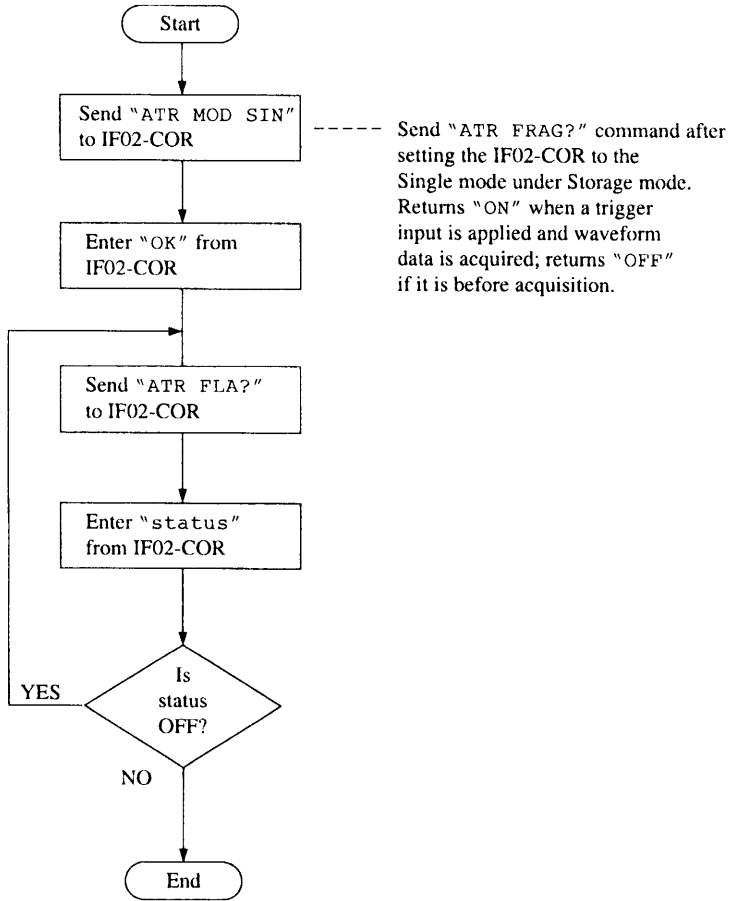


(3) Reading Back the Waveform Data



NOTE : Adjust the total number of data bytes in conformity with the number specified by the WAVE START and END commands.

(4) Entry of Trigger Flag when in Single Mode (for Storage Mode only)



4.6 Programming Examples

The programming examples introduced here are those with an IBM personal computer. There are written in Microsoft QuickBASIC 4.

①

```

' *****
' PANEL READBACK
' *****KIKUSUI*****
'
  OPEN "COM1:2400, N, 8, 1" FOR RANDOM AS #1
  CLS

  FOR LP% = 1 TO 9
    READ p$, CMND$
    DAT$ = SPACE$(20)
    PRINT #1, CMND$
    INPUT #1, DAT$
    IF LEFT$(DAT$, 5) = "ERROR" THEN DAT$= ""
    PRINT p$ + DAT$
  NEXT
END

DATA "Real/Storage mode...", "MODE?"
DATA "Channell volt/div...", "CH1 VOLT?"
DATA "Channel2 volt/div...", "CH2 VOLT?"
DATA "Horizontal Mode...", "HORIZONTAL?"
DATA "Time/div...", "ATIME?"
DATA "Trigger Mode...", "ATRIGGER MODE?"
DATA "Display Mode...", "DISPLAY?"
DATA "Trigger Point...", "TRIGGER?"
DATA "Cursor data...", "CURSOR DATA?"

```

This program reads back the panel settings from the oscilloscope.
(2400 BPS, STOP BITS = 1, DELIMITER = CR)

FUNCTIONS OF DEVICE

②

```

' *****
' RECEIVING WAVEFORM
' *****KIKUSUI*****
'
  DIM SHARED WAV$
  OPEN "COM1:2400, N, 8, 1" FOR RANDOM AS #1 LEN = 4096
  CALL wavread
  CALL dispout
END

SUB dispout
  SCREEN 2
  WINDOW (0, 0) - (4096, 255)
  y0% = 255 - ASC(MID$(WAV$, 1, 1))
  PRINT y0%
  FOR x% = 1 TO 4095
    y% = 255 - ASC(MID$(WAV$, x% + 1, 1))
    LINE (x%, y%)-(x% - 1, y0%), 1
    y0% = y%
  NEXT x%
  PRINT "Press any key to text mode."
  WHILE INKEY$ = "": WEND
  SCREEN 0
END SUB

SUB wavread
  PRINT #1, "WAVE START 0;END 7": INPUT #1, OK$
  PRINT #1, "WAVE CODE BYTE": INPUT #1, OK$
  PRINT #1, "WAVE OUT CH1"
  WAV$ = INPUT$(4096, #1)
END SUB

```

The program displays on the computer screen the waveform data being displayed on CH1 of the oscilloscope.

Set the oscilloscope to the Storage mode and select CH1 for the VERT Mode.

If the oscilloscope is operating in the ROLL mode, data may not be successfully transferred. If it is in the ROLL mode, press the PAUSE key to pause it and then start transferring the data.

(2400 BPS, STOP BITS = 1, DELIMITER = CR)

Chapter 5. PLOTOUT

In the Storage Mode, you can copy a screen data of the oscilloscope directly—without any RS-232C controller—onto an RS-232C plotter which accepts HP-GL commands. The plotout data includes scale factors, cursor data, and comments, as well as the waveform data.

NOTE : The starting position of the plotted out waveform will be at the left end of the graticule irrespective of the horizontal positioning on the oscilloscope.

The following readout message will not appear:

- Pause message
- View Time message (↵)
- Cursor function mode
- Storage Menu
- Various error messages

5.1 Setup

Before you execute plotout, prepare a setup as follows:

- (1) Turn off the oscilloscope.
- (2) Set the data signalling rate (baud rate) of the IF02-COR to the same with that of the plotter. (See Section 3.3 “Setting of switches.”)
- (3) Connect the plotter to the RS-232C connector of the IF02-COR with the RS-232C cable. Be sure to securely fix the cable ends with the screws.
- (4) Turn on the oscilloscope and the plotter.

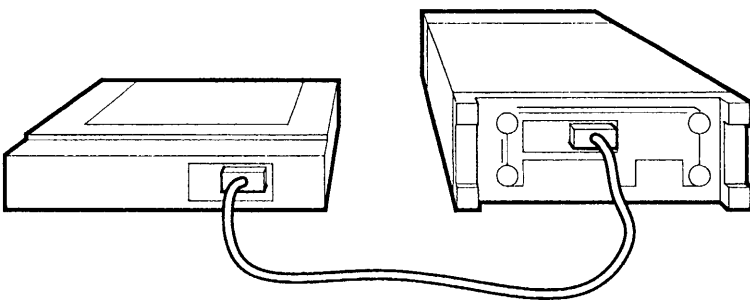


Figure 5-1. Connecting an RS-232C Cable

5.2 Operation Method

As you press the PLOT switch in the Storage Mode, the waveform acquisition will be interrupted and the plotout operation will start. After the plotting out is over, the oscilloscope resumes the state which existed before the plotout.

5.2.1 Plotout Procedure

To execute plotout, proceed as follows:

- (1) Invoke the Storage Menu by the MENU switch, and move down the marker (▲) to the PLOT position.
- (2) Select a printing size and location by the STATUS switch. The printing sizes and locations are denoted by symbols S1 through S4, and N. Each output is illustrated below:

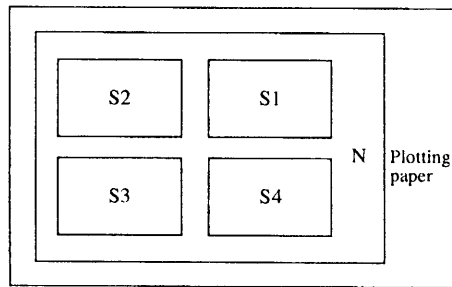


Figure 5-2. Printing Sizes and Locations

- (3) Press the PLOT switch, then plotout will start and a readout message PLOT OUT will appear on the oscilloscope screen. When the plotout is over, a message PLOT END will appear.

Horizontal Magnification

If the oscilloscope is in the Paused State, you can plot out a waveform magnified with the TIME/DIV knob. However, the waveform magnified with the MAG switch is not available. If you attempt a plotout when the MAG switch is set to other than $\times 1$, the attempt will be unsuccessful and you will see the following message:

CHANGE HORIZ MAG to X1

If you alter the MAG switch to other than $\times 1$ position when a plotout is running, the following message will appear to notify you that the waveform on the paper differs from the waveform on the oscilloscope screen:

PANEL SETUP differ with READOUT

Output for Multi-pen Plotter

If you have a multi-pen plotter, you can get a color copy of the plotout. Each pen is used properly as follows:

- PEN 1: Graticule and Readout
- PEN 2: CH1 and CH2 waveforms
- PEN 3: MEM1 and MEM2 waveforms
- PEN 4: Cursors

5.2.2 Aborting the Plotout

To abort the plotout, press the PLOT switch again. The plotout will be aborted and a readout message PLOT ABORT will appear on the screen. If you press the PLOT switch once more, the plotout will start all over again.

NOTE : The plotter might not stop immediately as you press the PLOT switch nevertheless the PLOT ABORT message appears on the screen. This is because a certain amount of data has been already sent onto the buffer memory of the plotter.

5.2.3 Display Center

The vertical positioning of waveform on the paper might not exactly conform with that of waveform on the oscilloscope screen. The cause of this is the terrestrial magnetism. Generally, oscilloscopes and other instruments which employ cathode-ray tubes are affected by disturbances from the terrestrial magnetism. The degree of disturbances depends on the location of the oscilloscope. To compensate for the disturbances by the terrestrial magnetism, the COR5500U series oscilloscope employs a Trace Rotation.

However, the waveform on the paper is not affected by any terrestrial magnetism. It is immutable even if the oscilloscope is placed at any location because only the digital data of waveform are used for plotout. Thus, the relationships between the waveform on the oscilloscope screen and that on the paper will vary with the location of the oscilloscope. The Display Center function is useful to compensate this difference.

Procedure for Display Center Adjustment

To adjust the Display Center, proceed as follows:

- (1) Select the single trace operation (CH1) and the Auto Trigger Mode. Next, set the Input Coupling of CH1 to GND.
- (2) Invoke the Storage Menu by the MENU switch and move down the marker (◀) to the PLOT position.
- (3) Select the CTR by the STATUS switch.
- (4) Align the baseline trace to the center of the CRT graticule by the CH1 POSITION knob.
- (5) Press the PLOT switch. Then, the vertical position of CH1 trace will be defined as the Display Center. The defined Display Center is not destroyed even if the oscilloscope is turned off.

NOTE : If the waveform you want to plot out is already acquired, store it onto the Saving Memory first, and then adjust the Display Center.

5.2.4 Messages

When you use plotout functions, you will see various messages on the oscilloscope screen. This section describes what these messages mean.

(1) **INVALID**


This message will appear for about two seconds when you attempt a plotout operation without IF02-COR.

(2) **PLOT OUT**

This message will appear while the plotout operation is running. When the plotout is over, this message will be replaced by the PLOT END message.


(3) **PLOT END**

This message will appear when the plotout operation is over. The message will remain displayed until you operate one of the following switches:

CH1 VOLTS/DIV, CH2 VOLTS/DIV, TIME/DIV, MENU, STATUS, TRIG PT (MAG PT), LOAD, SAVE (PLOT), PAUSE, CMNT/CUR, MODE, or CURSOR ().


(4) **PLOT ABORT**

This message will appear when you have pressed again the PLOT switch while the plotout operation is running. The message will remain displayed until you operate one of the following switches:

CH1 VOLTS/DIV, CH2 VOLTS/DIV, TIME/DIV, MENU, STATUS, TRIG PT (MAG PT), LOAD, SAVE (PLOT), PAUSE, CMNT/CUR, MODE, or CURSOR ().

(5) **PLOT ERROR**

This message will appear to indicate that the plotout operation is unsuccessful due to some errors. The message will remain displayed until you operate one of the following switches:

CH1 VOLTS/DIV, CH2 VOLTS/DIV, TIME/DIV, MENU, STATUS, TRIG PT (MAG PT), LOAD, SAVE (PLOT), PAUSE, CMNT/CUR, MODE, or CURSOR ().

(6) **CAUTION**

This message will appear, together with the message of (8) or (9), to notify you that there is a mistake for plotout operation.

(7) **CHANGE HORIZ MAG to $\times 1$**

This message will appear if you attempt a plotout operation when the horizontal MAG switch is placed at other than $\times 1$. Then, the plotout operation will not start. As you turn the MAG switch to the $\times 1$ position, the message will disappear. To resume the plotout operation, place the MAG switch at $\times 1$ position and press the PLOT switch again.

(8) **PANEL SETUP differ with READOUT**

This message will appear when you turn the horizontal MAG switch to other than $\times 1$ while a plotout is running. A waveform data magnified by the MAG switch cannot be plotted out anyhow. However, even if you have seen this message, the plotout operation will continue at the $\times 1$ magnification factor. This message will disappear as you turn the MAG switch to the $\times 1$ position.

Examples of plotted out waveforms

(By EPSON HI-80 with HP-GL Emulation Set)

PLOT S1~S4

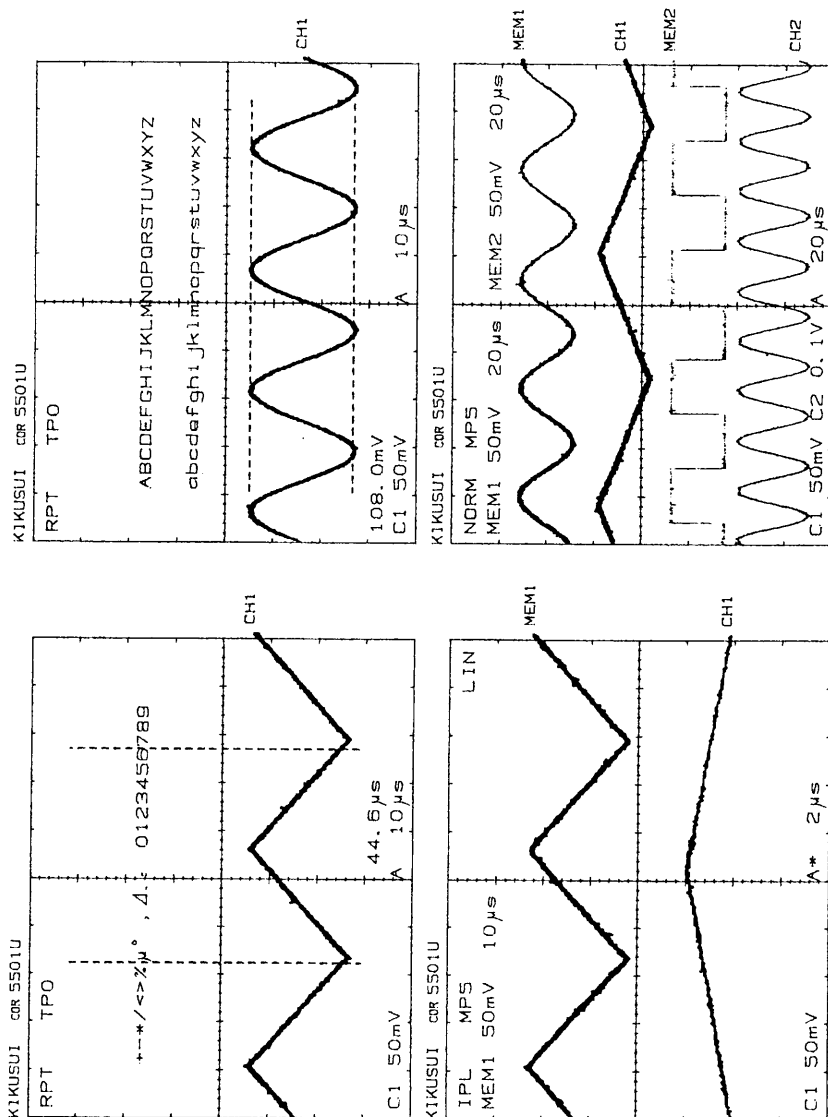


Figure 5-3. Plotted Waveforms (Example 1)

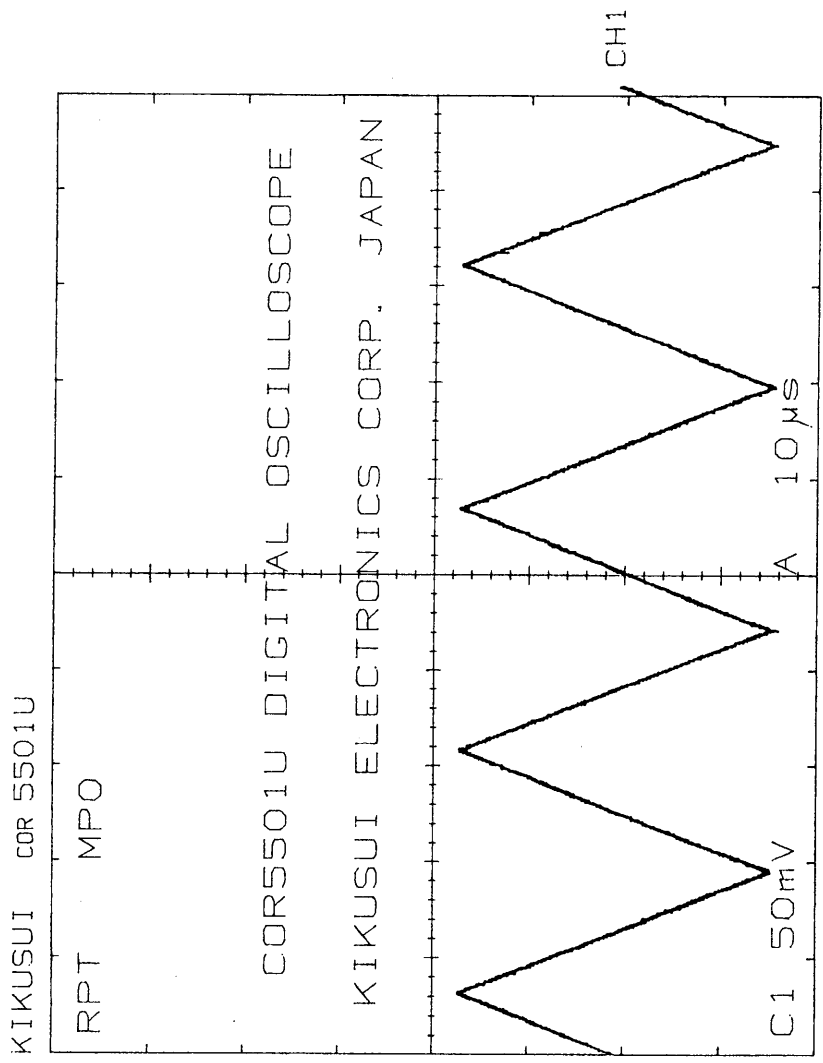


Figure 5-4. Plotted Waveforms (Example 2)

Chapter 6. TROUBLESHOOTING

6.1 No Communication at all

If the IF02-COR does not operate at all in response to commands, check the following:

- Do the data signalling rates (baud rates) of the devices conform?

The baud rate setting methods differ among computers. Some computers are such that their hardware is not brought into effect until they are reset. Others are such that their hardware is cleared off if they are reset. Be certain that the baud rate of your computer is correctly set.

- Is the character format correct?

Check that the data bit size is eight bits and the data format is without the parity bit. (The data format is JIS 8-bit codes.)

- Is the cable a correct one?

The connector of IF02-COR is a DTE type. A different type of cable should be used depending on the type (DTE or DCE) of the connector of the counterpart device. Note that there are many look-alike cables on the market. Be certain that your cable is a correct one.

- Is it full duplex?

Set the computer to the full duplex.

- Is your program correct?

While the RS-232C is a popular computer interface, commands and invoke procedures differ depending on vendors. Programs also may differ depending on OS and languages. Be certain that your program is correct.

6.2 Error Message Appears

If the IF02-COR does not execute commands and an error message appears on the CRT, check the following:

- Are the commands in the program correct? (When message "SYNTAX ERR" appeared)

Check that the letters, spaces, "?" and other characters in the program are correct.

- Is the mode correct?
(When message "IRG FUNC ERR" appeared)

Check that the mode is correct. (For example, an error message will appear if a real mode command is given when a storage mode command should be given.) Also check that the selected value is within the valid range.

- Is not noise introduced through the cable?

Data can be disturbed by noise introduced through the cable if it is not shielded or is poorly shielded. To check the cable for this, test it at a location free of noise. The maximum allowable length of the RS-232C cable specified by the Standard is 15 meters.

- Is XON/XOFF set to OFF?

The IF02-COR does not involve the XON/XOFF handshake function. Set the function on the computer side to OFF.

- Does it read the returned data after sending a command?

Data must be entered each time a command is given. If your program is not structured like this, you will get an error.

6.3 Program Errors Occur When in Waveform Data Input/Output

If handshake is unsuccessful, such errors may occur when in waveform data input/output that the program becomes as if it were deadlocked and the only remedy is to reset it, that an error is displayed, or that the IF02-COR does not execute the subsequent commands at all. The most probable causes of these errors are as follows:

- The type of the cable is incorrect for connection between the IF02-COR and the computer(or the plotter), or you do not have correctly connected the cable.
- The transfer rates (BPS) is faster than can be coped with by the computer and an overrun error has occurred.

If the above is the case, reduce the amount of data sent at a time by separating it into blocks with "WAVE START . . ." and "WAVE END . . ." commands, or reduce the transfer rates (BPS). Correct the setting and program on the computer side as required, and then run the program again.

Chapter 7. SPECIFICATIONS

(1) Interface Standards

Based on EIA RS-232C

Item	Protocol Spec.
Sync. system	Asynchronous
Type of channel	Full duplex
Transfer rate	110, 150, 300, 600, 1200, or 2400 bps
Data format	Data bit size: 8 bits Parity bit: None Stop bit size: 1 bit or 2 bits
Handshake system	Hardware handshake with CTS line for TXD and with RTS line for RXD. (See Note.)

NOTE : Handshake by XON/XOFF is unavailable.

Item	Electrical Spec.
Input voltage range	-25V to +25V [Mark ("1"): -25 to 0.8V] [Space ("0"): 2.0 to 25V]
Output voltage	Approx. $\pm 9V$ (Min. $\pm 5V$)
Maximum output current	6mA (at output voltage $\pm 5V$)

Other items of electrical specifications complies with the RS-232C Standards.

SPECIFICATIONS

Item	Connector Spec.			
Type of Connector	D-SUB MINIATURE 25-pin receptacle			
Type of Connection	DTE connection			
Pin Assignment	Pin No.	Abbrev.	Use	I/O
	1	FG	Frame Ground	
	2	TXD	Transmitted Data	Output
	3	RXD	Received Data	Input
	4	RTS	Request to Send	Output
	5	CTS	Clear to Send	Input
	6	DSR	Data Set Ready	Input
	7	SG	Signal Ground	
	20	DTR	Data Terminal Ready	Output
	(All other pins are no connections.)			

(2) Ambient Conditions (installed on the oscilloscope)

To meet performance spec: 5 to 35°C (41 to 95°F)
Humidity 80% or less

Operable range: 0 to 40°C (32 to 104°F)
Humidity 85% or less

(3) Mechanical Specifications

Overall dimensions: 114.5 W × 27.5 H × 63.5 (65 max.) D mm
(4.51 × 1.08 × 2.50 in.)

Weight: Approx. 80 grams (0.176 lbs.)

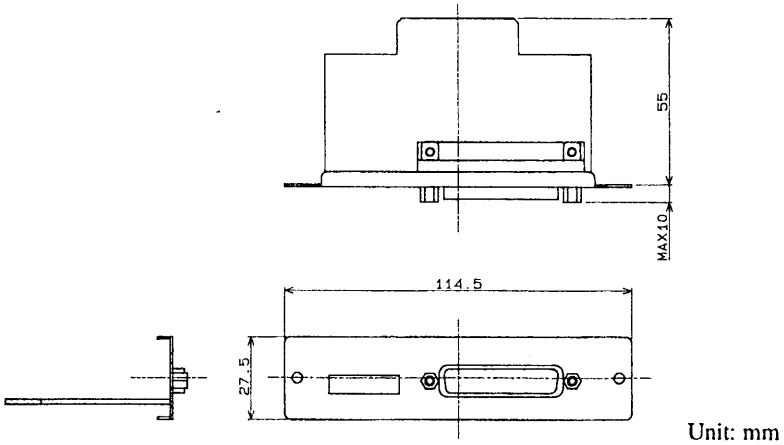


Figure 7-1. Overall Views and Dimensions of IF02-COR

(4) Accessories

Mounting screws 2

Operation manual 1 copy (Z1-000-252)

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KIKUSUI ELECTRONICS CORP.

1-1-3, Higashiyamata, Tsuzuki-ku, Yokohama, 224-0023, Japan

Tel : 045-593-7570 Fax : 045-593-7571