

APPLICATION NOTE #107

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1. Introduction

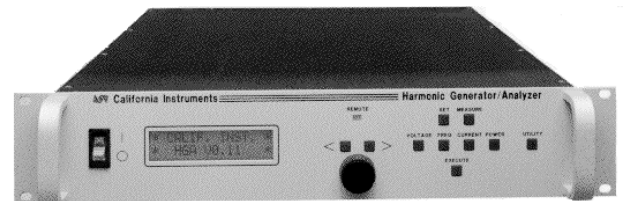
The Harmonics Generation and Analysis (HGA) controller, used with a variety of AC power sources, is capable of interfacing to a computer over either the IEEE-488 bus (GPIB) or an RS232C serial interface. While the IEEE-488 bus is well defined and generally poses few problems, use of the RS232C interface is not always straightforward. This is due largely to the lack of standards for RS232C interface cables and protocols. This application note addresses the most common obstacles encountered in getting the HGA to operate over the RS232C serial interface. An IBM compatible PC will be used as the computer due to its widespread usage.

2. Selecting a suitable COM port

Most PC's are equipped with one or two serial ports or COM ports. While the PC can have a total of four COM ports, only two can be used simultaneously. due to the limited number of interrupts available for serial communications. In the PC hardware standard, interrupts 3 (IRQ3) and 4 (IRQ4) are assigned to these serial ports. Thus, only two out of four COM ports can be active at the same time.

When determining the suitability of a PC to control the HGA via the RS232C interface, determine if any free COM port is available. Many PC's have a mouse that is connected to COM1. Since the mouse is often needed to run Windows 3.1™, COM1 will be unavailable. If a modem is installed in the PC, it also occupies a COM port. To free up such a COM port, the modem will have to be disabled or removed. An easy way to find out how many COM ports are available is to run the MSD.EXE program that ships with Windows 3.1™. This DOS program is located in the "WINDOWS" directory and should be run from DOS, not Windows 3.1™. This diagnostics program will

Using the HGA Controller over the RS232C Interface



show you how many serial ports are in your PC and what interrupts are assigned to them.

Typically, IRQ4 is assigned to COM1 and COM3 while IRQ3 is assigned to COM2 and COM4. If you have more than two COM ports, make sure COM1 and COM3 or COM2 and COM4 are never used at the same time. For example, if you have a Modem on COM2 and connect the HGA to COM4, make sure the modem is never used while operating the HGA. If you have a mouse on COM1, never use COM3 even when available, since it will always conflict with the mouse.

3. Serial cable

Once the COM port is selected, use the RS232C cable supplied with the HGA to connect the HGA to the PC. Note the orientation of the cable which is marked on the cable itself. The end marked HGA should be connected to the HGA, the end marked PC should be connected to the PC. Do not reverse this orientation as the communications will not work.

If your PC has a 25 pin D-connector, you will need a 25 to 9 pin adapter since the supplied HGA serial cable is a 9 pin to 9 pin cable. 25 pin D connectors are commonly found on older PC's and COM2 ports. Make sure you obtain the correct 9 to 25 pin adapter. It should convert the 25 pin male

connector to a 9 pin male connector at the back of the PC. Do not use your own 9 to 25 pin cable as it is most likely incorrectly wired.

The HGA uses hardware handshaking which requires the correct hardware connections to be made between the HGA serial port and the PC COM port.

If you are unable to locate the cable that was originally supplied with the HGA, or need a longer cable, one will have to be manufactured according to the diagrams shown below. Diagrams for 9 to 25 and 9 to 9 pin cables are shown here.

Signal	PC DB-25 Female	HGA DB-9 Female
RxD	2	2
TxD	3	3
DTR	5	4
RTS	6 and 8	7
GND	7	5
CTS	20	8

Table 1: PC to HGA serial cable pinout for 25 pin PC COM ports. Do not use this pinout to construct a 9 to 25 pin adapter.

Signal	PC DB-9 Female	HGA DB-9 Female
RxD	3	2
TxD	2	3
DTR	8	4
RTS	6 and 1	7
GND	5	5
CTS	4	8

Table 2: PC to HGA serial cable pinout for 9 pin PC COM ports

4. Setting HGA serial parameters

The HGA serial interface can be configured for different communication settings using the front panel UTILITY key. These settings are stored in non volatile memory when the HGA is turned off and recalled automatically on power up.

To check or adjust the serial interface settings of the HGA proceed as follows:

1. Press the UTILITY key
2. Turn the knob until the word 'RS232' appears in the LCD display

3. Press the > (right arrow) key to select the parameter to be changed :

Available Parameters	Recommended Setting
Baud Rate	9600
Parity Bit	None
Bits	8D1S
Handshake	HW

4. To change any of these parameters, press the > (right arrow) key while the desired parameter is displayed on the LCD. Then use the rotary knob to change.
5. When all parameters are set as desired, press the EXECUTE knob to acknowledge and save your new settings.

The settings shown in the table are chosen to work correctly with the HGA GUI windows program supplied with the HGA. If the distance between the PC and the HGA is great and you experience communication problems, you may have to lower the baud rate to 2400 or even 1200. In most instances however, this should not be necessary.

5. Checking communication

To perform a simple check of the RS232C interface setup, a terminal program can be used. For this application note we will use the Windows Terminal program which can be found in the Accessories group in Windows 3.1™. Similar terminal programs like Procomm™ or QModem™ could be used for the same purpose. You can also use the HGA GUI program supplied with the HGA as it requires the same RS232C cable and connection parameters to be set.

Start Windows Terminal by clicking on the Ter-

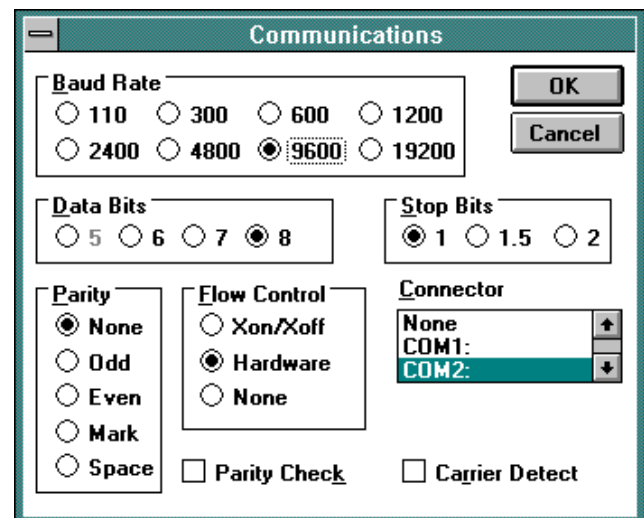


Figure 1: Recommended Terminal communication settings

terminal Icon in the accessories group. From the Terminal Window, select the Settings menu. Select the Communications entry. This will result in the dialog box shown here. Make sure you select all the settings shown in the picture below. This example uses COM2. If the HGA is connected to a different serial port, select the correct one.

Click on OK to close the Communications Settings dialog box. You are now ready to communicate to the HGA. Sending commands requires that you send a terminator after each string. The terminator used by the HGA is linefeed or 0x0A. You can enter this from the keyboard by holding down the CTRL key and pressing the letter 'J'. If you send a query command which causes data to be sent from the HGA to the PC, you must also send an acknowledge character after the terminator. This is done by sending 0x04 or holding down the CTRL key and pressing the letter 'D'.

Thus, to check for the presence of the HGA, type the following in the terminal window:

***IDN?^J^D** (^J is Ctrl-J, ^D is Ctrl-D)

The response should be :

California Instruments, HGA, 70805, V1.02

Note that pressing the Enter Key at the end of the command does not generate a linefeed to the HGA but only a CR. That is why the Ctrl-J is needed. You can change the Terminal settings to convert the CR to a CRLF from the Settings|Terminal Preferences menu if you want. The Ctrl-D is still required to get the response from a query command. Any com-

mand that contains a question mark (?) is a query command.

Note also that the command you entered is not echoed on the terminal screen as the HGA does not echo commands and the local echo feature of the Terminal program is default off. You can turn it on by selecting the Terminal Preferences from the Settings menu and clicking on Local Echo. Now anything you type will appear on the screen as you type it in.

From the Terminal program you can send any command to the HGA. Refer to the Instruction manual for a listing and syntax of all available commands.

6. Simple QBASIC program

For those that do not have Windows 3.1™ or prefer to operate under DOS, Table 3 shows a listing of a simple basic program written in QBASIC that can be used to communicate with the HGA. QBASIC is supplied with DOS 5.0 and up.

This program will enter a loop asking the user to enter a command at the prompt. The command entered will be sent to the HGA. If the command involves a query, the response from the HGA will be shown. After each command is issued, the program performs a check of the Event Status Register to determine if an error has occurred. The four relevant bits of the ESR register are masked off and decoded. The relevant information needed to decode this register can be found in the HGA instruction manual under *ESR. The program terminates when the user enters 'quit' instead of a HGA command.

If an invalid syntax is used for a query, the program will hang waiting for a response from the HGA that never comes. If this occurs, press Ctrl-Break to terminate the program. Some common HGA commands can be found in Table 4.

7. Technical support

If you continue to have difficulties operating the HGA over the RS232C interface, call California Instruments at the number shown below. Our application support engineers will be happy to assist you. Please have information on your PC and COM settings available when you call.

***In the US, call 1 800 422-7693
International, call 619 279-8620***

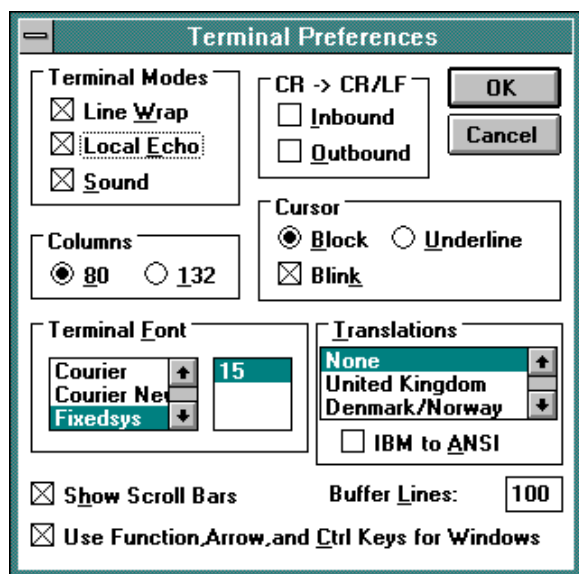


Figure 2: Local Echo option enabled

```

'California Instruments HGA RS232C Communication Demo Program
'(c) 1995 Copyright California Instruments, All Rights Reserved
'
'This program is for demonstration purposes only and is not to be
'used for any commercial application
'=====
=
'OPEN COM2. Replace with COM1, COM3 or COM4 for COM port used
'The input and output buffers are set to 2K each although
'this is not required for most HGA operations.
OPEN "COM2:9600,n,8,1,BIN,TB2048,RB2048" FOR RANDOM AS #1
CLS
PRINT "**** INTERACTIVE HGA MODE ****"
'Enter and endless loop to accept user entered commands
DO
    INPUT "Enter HGA Command ('quit' to exit)--> ", cmd$
    IF cmd$ <> "QUIT" AND cmd$ <> "quit" THEN
        PRINT #1, cmd$ + CHR$(10);
        IF INSTR(cmd$, "?") THEN
            PRINT #1, CHR$(4);
            LINE INPUT #1, response$
            PRINT response$
        END IF
        'Check for Errors after each command is issued
        PRINT #1, "**ESR?" + CHR$(10);
        PRINT #1, CHR$(4);
        LINE INPUT #1, esr$
        esr% = VAL(esr$) AND 60
        IF esr% AND 4 THEN
            PRINT "**** Query Error Reported by HGA ****"
        END IF
        IF esr% AND 8 THEN
            PRINT "**** Instrument Dependent Error Reported by HGA ****"
        END IF
        IF esr% AND 16 THEN
            PRINT "**** Command Execution Error Reported by HGA ****"
        END IF
        IF esr% AND 32 THEN
            PRINT "**** Command Syntax Error Reported by HGA ****"
        END IF
    END IF
LOOP UNTIL cmd$ = "QUIT" OR cmd$ = "quit"
'Close COM port on exit
CLOSE #1
END

```

Table 3: Sample QBASIC program source listing

HGA Command Summary

Common SCPI Commands:

*IDN? Get Instrument ID
 *CLS Clear Event Registers
 *ESR? Query Event Status
 *OPT? Query Installed Options
 *RST Reset to initial state
 *SAV Save HGA setup (1-4)
 *RCL Recall HGA setup (1-4)
 *STB? Query Status Byte
 *TST? Perform selftest (0=ok)

System Commands

SYST:ERR? Query error status
 SYST:LOC Goto Local
 SYST:REM Goto Remote

Output System

OUTP ON Close output relay
 OUTP OFF Open output relay

Source System

MODE ONE|THREE Select no of phases
 VRAN LOW|HIGH Select Voltage range
 COUP NONE|ALL Apply voltage programming to individual or all phases
 FREQ <Nrf> Set frequency to <Nrf> Hz
 VOLTn <Nrf> Set Voltage of phase n to <Nrf> Volt
 CURRn <Nrf> Set current limit of phase n to <Nrf> Amps

Table 4: HGA Commands

Contact California Instruments:



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() 677-9040

FAX : () 677-0940

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Procomm is a registered trademark of DataStorm Technologies Corp.

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