Appendix

GP_HPSA.EXE

HP Spectrum Analyzers Driver

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Overview

The GP_HPSA.EXE driver is compatible with HP859x series analyzers that speak HP-IB as well as analyzers that speak SCPI interface language such as the HP E Series analyzers. This driver is also compatible with IEEE-488 as well as RS232 hardware interfaces. It is often used to measure several signals during a single drive test.

> **Note:** If your analyzer requires IEEE-488 hardware interface you must connect the appropriate hardware such as NI-488-USB-A between the laptop and the analyzer and you must install drivers in the laptop. Driver installation instructions are included in the Field Test 6 installation in the file: C:\STI6\Manuals\Drivers\NI488USB.PDF.

HP analyzers with an RS232 interface use a cable with special wiring that is documented in the HP manual and, for some analyzers, here in the Analyzer Serial Cable section. Correct wiring of these cables is important for successful communication with the analyzer through the serial connection.

There are two measurement strategies used by this driver that may be used to make measurements on a spectrum of one or more signals. The measurement strategy is set by the 'Measurement Type, Peak or Sweep' parameter in the <name>.REC file. They are described in the following two sections.

Peak Search Measurements

Peak Search Measurements set the analyzer so a desired spectrum of signals are displayed on the screen. To average the effects of Raleigh patterns several sweeps may be averaged.

The analyzer cursor is then stepped from left to right, to the detectable peaks, reading the frequency and amplitude of each detected peak. Frequency readings at these peaks are used to assign the amplitude readings to channels as listed by the Frequency List section of the `.REC` file within a tolerance defined by the 'Bucket Width' parameter.

Fields in the measurement database are assigned on a channel basis, one field for each entry in the Frequency List. When the frequency of a peak falls in a frequency bucket that is centered at a frequency defined in the Frequency List it is assigned to the corresponding field in the measurement database. Peak measurements are ignored if they fall outside any of the frequency buckets.

If more than one peak is detected in a bucket the highest is recorded in the measurement database.

If no peak is detected in the bucket a null value is recorded which indicates no measurement was made. (Null is signified by the value of -3.21x10^38 in the measurement database.)

Peaks will not be detected if the noise level is higher than the signal level or if a near by signal is large relative to the measured signal and the skirt of the analyzer IF filter buries the signal peak.

Sweep Measurements

The Sweep Measurements screen setup is the same as the Peak Search. However, instead of searching for signal peaks, the entire analyzer sweep is loaded into the computer. The driver then selects the maximum (peak) value on the screen in the region defined by the channel center frequency, within a tolerance defined by the 'Bucket Width' parameter.

This measurement strategy always results in a measurement for every displayed frequency in the frequency list. However, when the signal is very low the recorded amplitude will be a noise level and when a nearby signal is very strong the recorded level will be a value on the skirt of the nearby signal.

To summarize, when a signal is not easily measurable due to the limitations of the noise level or the adjacent channel rejection of the analyzer the Peak Search method will ignore the measurement while the Sweep method will record a result. Thus the two measurement strategies yield slightly different results.

Analyzer Languages

HP 859x analyzers are programmed with a simple command language we are calling HP-IB, that is unique to the HP product line. In an effort to standardize on a product independent programming language HP has adopted the SCPI language for their new E series of analyzers.

The STI, GP_HPSA.EXE driver is compatible with both programming languages. This driver will replace the STI, HP8500_32.EXE with additional functionality of peak search as well as sweep measurement strategies and is compatible with both RS232 and IEEE-488 hardware interfaces.

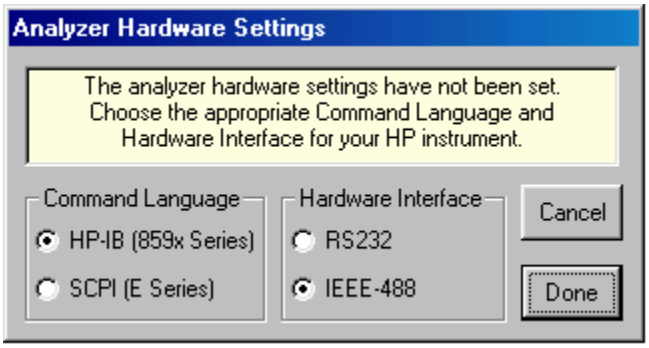
This flexibility is obtained by making all hardware and language specific analyzer commands and software settings available in an .INI file and project related commands and settings in a <name>.REC file. This will allow adjustments of commands to accommodate future changes in the command language.

Commands and settings that are language and hardware specific to a particular analyzer are set in the C:\STI Projects\GP_HPSA.INI file. These commands are described in the section GP_HPSA.INI section below. These files are fully described in later sections of this appendix.

Note: Most settings in the .INI and .REC files are preset to default values the first time the driver is started. These default values can then be edited by the user.

Flow of Driver Operation

The flow diagram at the end of this section shows the measurement process of the GP_HPSA driver. The sections of the <name>.REC file that control spectrum analyzer initial commands and acquisition commands are described in the following section. Commands are different for HP859x analyzers and SCPI language compatible analyzers. Sample commands for each language are contained in included <name>.REC files.



When the driver is started for the first time, or if a communication error has occurred recently, an Analyzer Hardware Settings window appears. The Analyzer Hardware Settings window allows for selection of the Command Language (HP-IB or SCPI) and Hardware Interface (RS232 or IEEE-488). These settings are required before the driver can successfully communicate with the instrument.

Communication with the analyzer is tested by sending a reset command followed by a request for the analyzer ID. When successful the analyzer model name is displayed in the driver window.

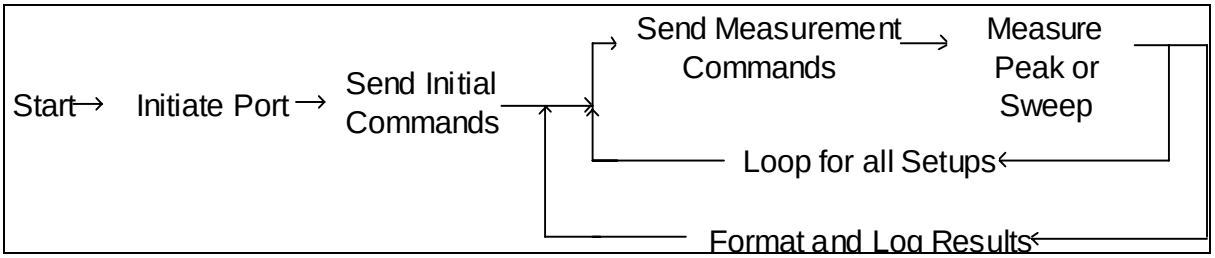
If the port hardware is RS232 baud rates from 4800 to 57600 are tested on all available com ports. After the analyzer has been detected by receipt of the analyzer ID, the port number and baud rate are saved in the GP_HPSA.INI file. This port and baud rate is the starting point for future communication with the analyzer.

If the port hardware is IEEE-488 the address of the IEEE-488 interface must be set to 0 and the address of the analyzer must match the value of 'IEEE-488 Instrument Address=' set in the <name>.REC file. The default value for IEEE-488 Instrument Address=18.

Error messages are displayed if communication with the analyzer is unsuccessful. In this case, check the hardware and software interface to the analyzer. Also check the analyzer for an indication of a communication error. If an error is indicated on the analyzer it may be necessary to increase the Timeout parameters in the GP_HPSA.INI file or edit commands being sent to the analyzer. See the GP_HPSA.INI section for details.

Next, the commands listed in the `[Initial Commands]` section are sent to the analyzer to set it up for testing. The test loop is then entered. Commands in the first `[Measurement Commands 1] section` are sent and Peak Search or Sweep measurements are made for this setup. This is repeated for each [Measurement Commands n] section in the <name>.REC file.

When measurements for all setups have been completed, the measurement results are formatted and sent to the main Field Test 6 program for display and logging. This process repeats continuously until stopped by clicking the Stop control on the Receiver Window.



<name>.REC FILE STRUCTURE:

A <name>.REC file is an ASCII, Windows .INI type of file that controls the measurement functions of the GP_HPSA.EXE driver and spectrum analyzer. This file has at least five sections. The name of each of the sections is critical to successful parsing of the .REC file, so they must be retained exactly.

[Compatibility]

The compatibility section lists the driver program name in the line (driver=GP_HPSA.EXE) with which this specific .REC file is compatible. Also included in this section is a line showing the software version with which this file is compatible.

Note: The entries in this section should not be changed.

[Global Settings]

The global setup section contains settings for the driver program in the form of parameters as described below.

BucketWidth = 10000	Bucket width accounts for frequency error in the source as well as frequency measurement error in the analyzer. It is not the same as the width of the channel, although it may be set equal to the channel spacing. It is used by the driver program to set the tolerance of acceptable frequencies that a frequency reading will fit into (match) for a particular channel frequency. Bucket width is centered at the frequencies in the frequency list.
Signal Display Top = 0	Sets the value of signal amplitude at the top of the STI-9400 Signals display.
Signal Display Bottom = -100	Sets the value of signal amplitude at the bottom of the STI-9400 Signals display.
Measurement Type, Peak or Sweep = Peak	Sets the type of measurement strategy to be used. The options are Peak or Sweep.
IEEE-488 Instrument Address = 18	This option is shown if the hardware interface is IEEE-488. The default value for the instrument address is 18. **Note:** This is not the address of the IEEE-

	488 computer interface hardware which must be set to 0.
Sweep Average Time Out = 10000	Sets the time to wait for the commands in [Measurement Commands n] sections to execute and the VAVG sweeps to be completed. Wait or error generation is dependent upon the Wait For Sweep Average parameter.
Wait For Sweep Average = False	Set to False for newer analyzers which will only continue execution after the Take Sweep command is completed, i.e. VAVG sweeps are completed. In this case a communication error is generated if Sweep Average Time Out seconds is exceeded before completion of the Take Sweep command. Set to True for older analyzers, such as the HP8560A, so further commands are held off for Sweep Average Time Out seconds to allow VAVG sweeps to be completed before more measurement commands are sent.

[Initial Commands]

The [Initial Commands] section contains a list of instrument commands sent to the analyzer to set it up to make the desired measurements. These commands are sent once prior to starting the measurement process. Refer to your specific spectrum analyzer's HP Programming Guide for details on instrument commands. The format for these command lines is:

<line number>=<instrument command> '<comment>

and are sent to the instrument in line number order.

[Measurement Commands n]

The Measurement Commands section(s) contain a list of instrument commands that are sent to the analyzer the during each measurement cycle. This command list should be minimized to reduce measurement cycle time. Commands, such as setting the start and stop frequencies, are necessary here. The format for these command lines is:

<line number>=<instrument command> '<comment>

and are sent to the instrument in order of line number.

The GP_HPSA.EXE driver can sequence through as many as 32 [Measurement Commands n] sections to set different frequency bands or displays, reading signal amplitudes from each display.

The file, GP_HPSA AB-Cell.REC is an example in which the A system cellular control channels are set up in the first Measurement Commands section and the B system control channels are set up in the second Measurement Commands section.

[Freq List]

Each line in the [Freq List] section must have the following format.

<line number> = <channel name>, <channel frequency in MHz>

Each frequency in the frequency list has a corresponding field in the measurement database in which measured amplitude is recorded. One line is required for each item in the frequency list. Line numbers must be in order.

Channel names are used by the Field Test 6 program to label the X axis of the Signals Display, to name the fields in the measurement database and to name files when generating analysis results, so they must satisfy Windows file naming restrictions.

The Frequency and BucketWidth parameters are used by GP_HPSA.EXE to assign amplitude readings to appropriate frequency channels.

Note: When editing the .REC file, the semicolon (;) can be used as the first character for a comment line. Field Test 6 programs ignore lines with a semicolon as the leading character.

Blank lines are also ignored.

GP_HPSA AB-CELL.REC Example

This sample .REC file contains the HP859x commands. It measures A and B cellular control channels. Two setups are used, one for A and another for B channels. This file may be edited to make measurements in other frequency band(s).

```
;Measures A and B Cell Control Channels

[Compatibility]
File Version=4
Driver=GP_HPSA.EXE

[Global Settings]
IEEE-488 Instrument Address=18  'Address of the analyzer.
Sweep Average Time Out=10000  'Time, in milliseconds, to wait
for the analyzer to execute commands in [Measurement Commands
n] section and complete sweep averaging.
Wait For Sweep Average=False  'Set to TRUE for older analyzers
to require a hold off for Sweep Average Time Out seconds while
sweep averaging is completed.  FALSE for newer analyzers which
continue only after the TS command completes the required
averages.  FALSE generates an error if Sweep Average Time Out
is exceeded.
Measurement Type, Peak or Sweep=Sweep
Bucket Width=20000            'In Hertz

Sweep Average Time Out=10000  'Time in milliseconds, to wait
for Sweep Averaging to take place.  This depends upon the
setting for VAVG in the [Initial Commands] section.

[Initial Commands]
1=RB 10KHZ      'RESOLUTION BANDWIDTH
2=VB 10KHZ      'VIDEO BANDWIDTH
3=AT 0DB        'ATTENUATOR SETTING
4=RL -40DB      'REFERENCE LEVEL
5=TH -130DB     'THRESHHOLD LEVEL
6=MKPX 5DB      'MINIMUM PEAK TO DETECT
7=TDF P         'OUTPUT ASCII FORMAT
8=MKREAD FRQ    'READ FREQUENCY
9=VAVG 20       'NUMBER OF SWEEPS TO AVERAGE

[Measurement Commands 1]
1=FA 879.37MHZ           'START FREQUENCY
2=FB 880.00MHZ           'STOP FREQUENCY

[Measurement Commands 2]
1=FA 880.00MHZ           'START FREQUENCY
2=FB 880.64MHZ           'STOP FREQUENCY
```

```
[Freq List]
1=ch 313,879.390
2=ch 314,879.420,
3=ch 315,879.450,
---
---
40=ch 352,880.560
41=ch 353,880.590
42=ch 354,880.620
```

GP_HPSA.INI File

When the receiver driver is started for the first time the GP_HPSA.INI file is initialized with spectrum analyzer hardware and language settings selected in the Analyzer Hardware Settings window.

```
[Hardware Settings]
Instrument Language, HP-IB or SCPI=HP-IB   'Reflects the
selection made in the Analyzer Hardware Settings window,
Command Language box.
Hardware Interface, IEEE-488 or RS232=IEE-488  'Reflects
the selection made in the Analyzer Hardware Settings
window, Hardware Interface box.
IEEE-488 Device Address=0  'Must be set to the address of
the IEEE-488 device in the laptop. Default value is 0.
```

The [HP-IB Internal Commands] or [SCPI Internal Commands] sections set software commands that are used internally in the GP_HPSA driver. In most cases the setting name is an adequate description of the use for the setting. Comments have been added below where necessary for clarity.

During initial communication with the analyzer the Instrument Reset command is sent followed by a Request for ID command. Two additional commands, First Init Command and Second Init Command, may be sent but their default values are set to null. Successful receipt of an ID response is required to indicate that communication with the analyzer has been established. The name of the instrument, contained in the ID response, is then placed in the Receiver Window in the lower right corner of the Acquisition display.

```
[HP-IB Internal Commands]
Init Response Time Out=5000   'Time allowed for resetting
the analyzer and receiving the ID response.
Sweep Download Time Out=5000   'Time allowed for
receiving 401 screen data points from the analyzer.
Instrument Reset=IP
First Init Command=
Request ID Command=ID
ID Name Field Number=1  'The number of the field in the
ID response that contains the name of the analyzer.
ID Field Separator=44     'The ASCII value of the
character used to separate fields in the ID response.  44
represents a comma.
Required ID Content=!@#$%^&*()   'The ID response is
tested for existence of "HP" or "Hewlett" or "Agilent".
The Required ID field is an additional test string.  Its
```

```
default string must be set to garbage or a character
string that will only appear in a valid ID response.
Sweep Field Separator=44   'The ASCII value of the
character used to separate fields in the sweep data.  44
represents a comma.
Last Init Command=
Take Sweep Command=TS
Completion Request=DONE?
Set Marker Left=MKP 0
Set Marker Right=MKP 401
Marker Next Right=MKPK NR
Request Marker Frequency=MKF?
Request Marker Amplitude=MKA?
Download Sweep=TRA?
ASCII Command Terminator=59,13  'A comma delimited string
representing the ASCII values for a command termination.
59,13 represent semicolon, carriage return.
ASCII Input Message Terminator=13,10  'A comma delimited
string representing the ASCII values of a response
terminator.  13,10 represent carriage return, line feed.
```

The [Serial Port Settings] section is shown if the hardware interface is RS232. These settings are used to define the port search criteria and save the last set of successful communication settings. Notes describing the function of each setting are included in italics below.

```
[Serial Port Settings]
Forced Port Search=     'Normally not used but can be
used to specify a reduced port search.  If left blank all
system ports will be searched.
Baud Sequence=9600,19200,38400,57600  'Specifies the baud
rates that will be searched during first initialization.
Port=       'Filled with the last port with successful
communication with the receiver.  Is the starting port
for the next communication.
Baud=       'Filled with the last baud rate with
successful communication with the receiver.  Is the
starting baud rate for the next communication.
Settings=n,8,1  'Parity, Bits and Stop Bits setting for
the hardware.
Handshake=2       '2 indicates hardware handshaking which
is necessary for HP analyzers.
```

Note: Some (older) analyzers after receiving a garbled message due to an incorrect baud rate will take longer than 5 seconds to recover from the resulting error condition. In this case the value of the Init Response Timeout parameter should be increased to 10 seconds or more.

Analyzer Serial Cable

The serial cable for newer HP859x analyzers with HP Option 043 serial interface should be wired as a null modem with the following wiring connections. This diagram is also documented in the HP manual for your analyzer.

Computer DB9		Analyzer DB9	
Pin	Function	Pin	Function
1	DCD	7	RTS
2	Rx	3	Tx
3	Tx	2	Rx
4	DTR	6	DSR & 8 CTS
5	Gnd	5	Gnd
6	DSR & 8 CTS	4	DTR
7	RTS	1	DCD
9	NC	9	NC

The serial cable for the E Series analyzer is a laplink type of cable with the following wiring list. This diagram is also documented in the HP manual for your analyzer.

Computer DB9		Analyzer DB9	
Pin	Function	Pin	Function
1	DCD	1	DCD
2	Rx	3	Tx
3	Tx	2	Rx
4	DTR	6	DSR
5	GND	5	GND
6	DSR	4	DTR
7	RTS	8	CTS
8	CTS	7	RTX
9	Ring	9	Ring

The serial port on older HP 859x analyzers with HP Option 023 serial interface have a DB 25 serial connector. Use a DB 9 to DB 25 cable wired exactly as described in the HP manual for connecting the analyzer to a computer. Neither straight through or null modem wiring will work properly. The diagram below is for these analyzers.

Computer DB9		Analyzer DB25	
Pin	Function	Pin	Function
1	DCD	4	RTS
2	Rx	2	Tx
3	Tx	3	Rx
4	DTR	5&6	CTS/DSR Jumper
5	GND	7	GND
6	DSR	20	DTR 2 wires
7	RTS	8	DCD
8	CTS	20	DTR 2 wires
9	Ring		No Connection