Automated Frequency Response of a Linear System Using Agilent VEE

By: A.C. Neve
I.T.I.S. "E. Fermi"
Lecce, Italy

Equipment:

- Agilent 3478A Digital Multimeter or Agilent 34401A DMM
- Agilent 8116A Function Generator or Agilent 33120A Function/Arb Generator
- GP-IB card for P.C. (Agilent 82335B)
- Agilent VEE Software

Procedure:

1) GPIB (IEEE488) interface

GBIB (IEEE488) is a standard interface widely used in technical and scientific environments to exchange information between computers and instruments and to develop Automatic Test Equipment (A.T.E.) systems that perform iterative measurements.

This interface allows a bus connection up to 15 devices. The total cable length should be held to 15m to obtain a maximum transfer rate of 1 Mby/sec and the average inter-device cable should be no more than 1m with a resistive termination.

The data exchange is parallel asynchronous type with bilateral handshake mode on three wires.

Data are coded in 7 bits ASCII code and the block length can vary from 1 to 20 bytes.

There are three types of devices connectable to this interface:
Controller: able to initialize, manage and control the system. Only one controller is active at a time

Listener: a device capable of receiving data when addressed

Talker: a device capable of transmitting data when addressed

Each GPIB device has a specific address. This address is used by controller to activate the transfer process of command or data with the same device. A device address is set by a group of seven dip-switches usually located on rear panel of the device. The first five dip-switches define the interface work address and can be from 0 to 30. The remaining 2 dip-switches define the operating mode.

The flexibility and extendibility of this interface allow us to design systems with varying dimensions and performance:

The minimum system can be implemented with only two instruments, the first one configured as listen-only and the second configured as talk-only. In this case the operations are controlled by a local control panel of the instrument to run the internal communication firmware. This operating mode is typically used in the oscilloscope with hard-copy function to send display data to a printer or plotter. In more complex systems a Personal Computer (PC) is used with a dedicated software to manage the different operations. The most important advantage of this interface is the possibility to connect products from different companies that differ greatly in terms of performance, operating rate and functionality.

The GPIB (IEEE488) interface has 16 bus signal lines that are grouped into three sets:

8 bi-directional data lines	3 handshake lines	5 general interface management lines
DIO 1…8	DAV- Data Valid	IFC- Interface Clear
	NRFD- Not ready for Data	ATN- Attention
	NDAC-Not Data Accepted	SRQ- Service Request
		REN- Remote Enable
		EOI- End Or Identify

Fig. 1 shows an application system based on this interface.

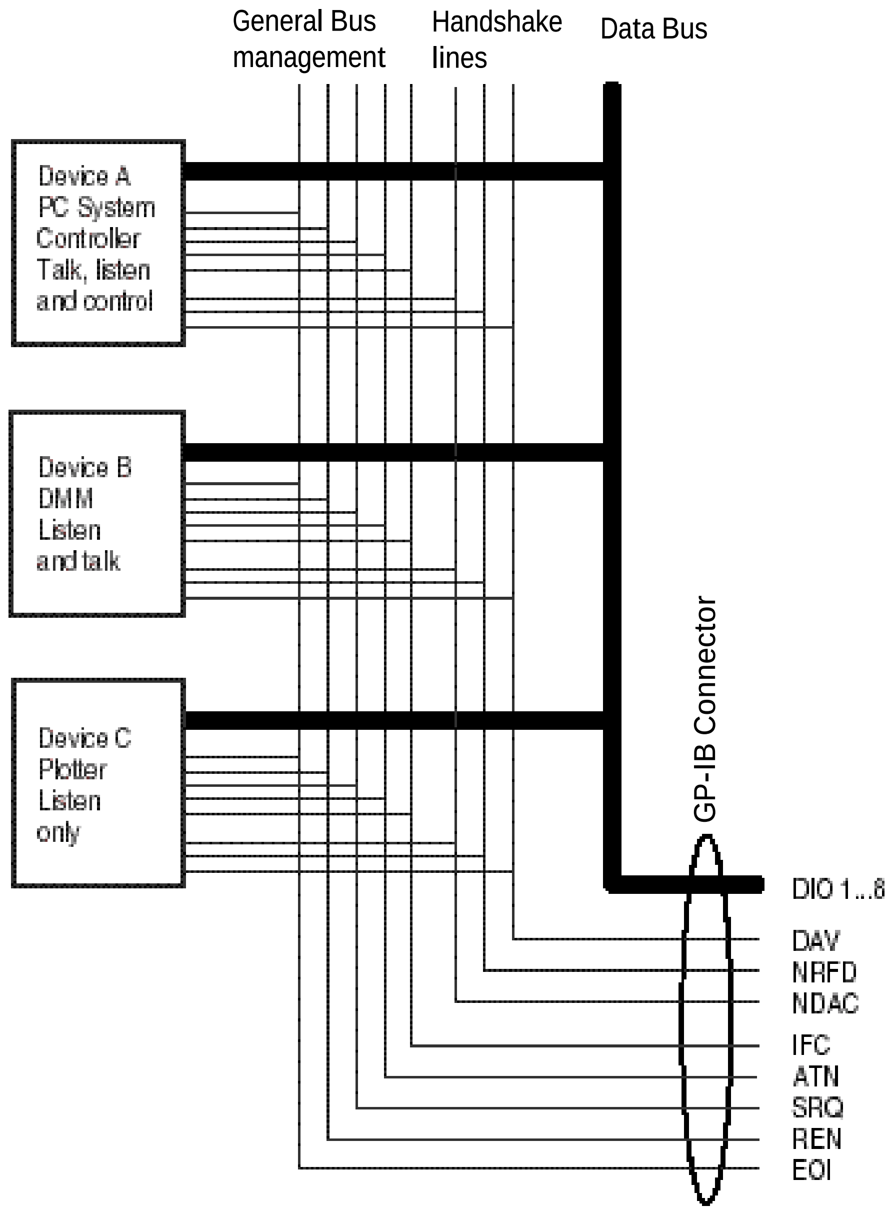

Fig. 1 - Typical system based on GPIB (IEEE488) and signal interface

There are two types of interface commands:

uniline commands - these commands are created by means of the five general interface management lines

multi-lines commands - these commands are created from the controller in ASCII code and exchange by means of the eight bus lines with ATN line activated.

There are five type of multi-lines commands:

- addressed commands
- universal commands
- non addressed commands
- secondary commands
- dedicated commands

The interface signals are low-true TTL logic so that any signal voltage greater than +2V is defined as logic false and any signal voltage less than 0.8V is defined as logic true. Signal drivers must be open collector logic and the use of tri-state 48 mA buffer drivers is recommended. Every line must be terminated with a resistance of 3 K ohm to power supply and 6.2 K ohm to ground.

The GP-IB (IEEE488) connector is a 24 pin connector with male and female receptacles wired in parallel to allow daisy chaining. Six pins are used as dedicated ground to the more critical signals (ATN, SRQ, IFC, NDAC, NRFD and EOI). There are two other common pins dedicated to common signal ground and common shield.

2) Agilent-82335B interface card

This product allows any IBM compatible PC to make use of an GP-IB (IEEE488) interface to manage devices.

The installation is very easy: insert the card in a free ISA slot. Setting the card switches as suggested in the reference manual, install the software drivers and utility for DOS-WINDOWS environment and I/O library.

Make sure that EMM386 (Expander Memory Manager) address space does not overlap with address card, otherwise use the exclude option in EMM386 config.sys line command, per the manual information.

This card accommodates programs written in C, Pascal, Basic, FORTRAN and Visual Basic languages.

The maximum I/O transfer rate is 355 KB/sec.

After this simple installation, the card will operate immediately.

3) Agilent-VEE

Agilent-VEE (Visual Engineering Environment) is a program that allows data processing with very high mathematical and statistical operators, data presentation, system simulation and instruments measurement control.

The applications are developed by an iconic programming language by inserting in the working area various function blocks and connecting them with software wires. This programming method is more efficient and rapid than the classic textual programming language. To execute the program, you must click on the RUN button.

It is possible to define any variables, their type and range, execute mathematical and statistical process, present the results in different mode, define the calculus flow, manage data files and communication with external I/O.

This feature allows us to develop and debug any application software in a short time and without effort.

Very interesting is the possibility to manage measurement instruments by means of this interface. After installation in the PC, the card is ready to be used by Agilent-VEE program as well as the devices connected to the interface. This operating mode is feasible if the instrument driver is available.

Agilent-VEE has a library with a large number of drivers for measurement instruments engineered by various well-known producers (digital multi-meters, oscilloscopes, function generators, counters, spectrum analyzers). The instrument management begins by placing the control panel of the specific instrument in the work area and setting the functions in manual mode or programmed mode by means of the other function blocks.

If the driver is non available in the library it is possible to design it by means of a software utility named "Driver Writer Tool"(DWT). The driver design is very simple if the Learning mode is used. In this mode just refer to the user manual of the instrument to know the various ASCII function codes.

After the driver development it is necessary to compile it and save in the instrument library.

4) A.T.E. system design to measure frequency response of linear system

Often it is necessary to measure the frequency response of linear circuits with R-L-C-components or amplifiers.

This measurement is implemented by the use of one sinewave generator and two digital multi-meters with frequency range operation greater than the frequency range of the linear two-port under test.

The measurement is executed as follows: set the voltage level output of the sinewave generator to a value compatible with the input sensitivity of the amplifer, measure the input and output voltages and put them into a three column table (Freq., Vin, Vout). Increment the sinewave generator frequency and repeat the two voltage measurements. This iterative process is repeated to a maximum frequency response of the two-port device.

After the measurement it is necessary to execute the Vout/Vin ratio for all frequency table values and transform them into dB levels.

At the end, it is necessary to draw the transfer function on an appropriate sheet.

All these operations are certainly long and tedious!

But Agilent-VEE allows the quick develop of an automatic system measurement using a PC, the three instruments and the GP-IB (IEEE488) card.

Fig. 2 shows the block diagram of the measurement bench.

The application development in Agilent-VEE environment is very simple. Fig. 3 shows the Agilent-VEE flow diagram.

The instruments used in this experiment are the following:

Agilent-8116A Pulse/Function Generator	**Agilent-3478A** Digital Multimeter
Functions: sine, triangle, ramp, square, pulse, DC Frequency: 1mHz to 50 MHz	Mode: VDC, VAC, AAC, ADC, 2 or 4 wires ohm Digits: 3 1/2, 4 1/2, 5 1/2
Mode: Normal, FM, AM, PWM, VCO	Accuracy: ±0.003% VDC, ±0.5% VAC
Duty Cycle: 10% to 90%	Resolution at 5 1/2 digits: 100 nV DC, 1 µV AC
Amplitude: 10mVpp to 16.0 Vpp	Frequency range: 300 kHz

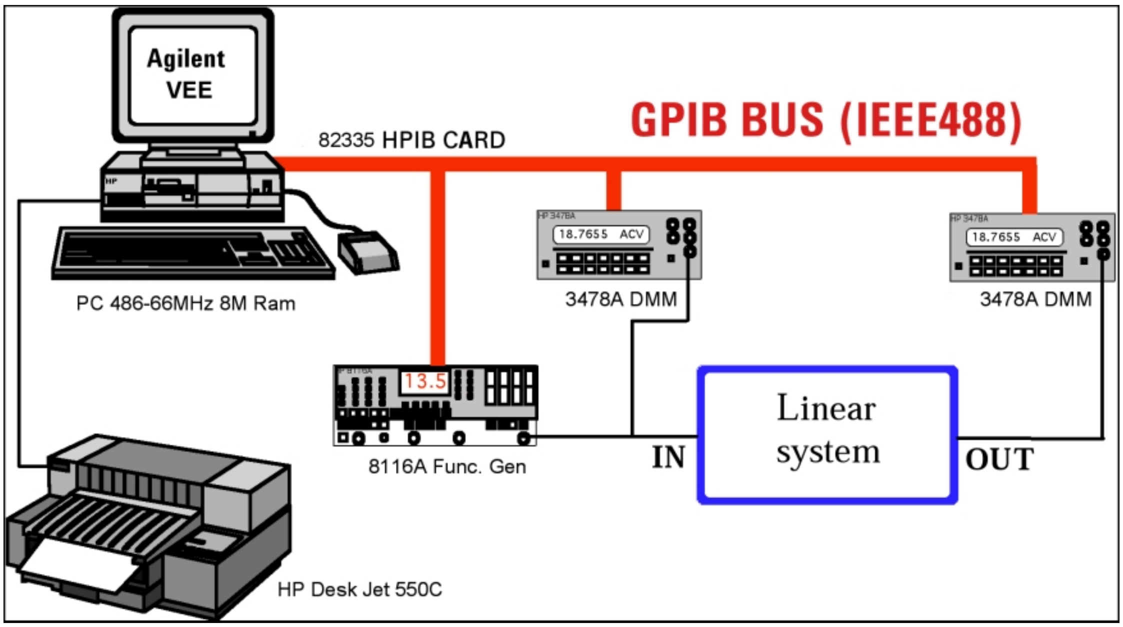

Fig. 2 - Block diagram of the measurement bench

The Agilent-VEE flow diagram:

The <Vin Set> block defines the level output voltage of the sinewave generator during the global measurement process. The output of this block is connected to control the input voltage generator.

The <Freq. Range> block is a flow control block. It defines the frequency range measurement and the increment step frequency. The output of this block is connected to control input frequency generator.

The <Frequency>, <Vin> and <Vout> blocks are alphanumeric displays that show, in real time, the values of the frequency generator, input and output voltage.

The <Vout/Vin> and <dB> blocks are Formula blocks. The first calculates the Vout/Vin ratio and the second transforms this ratio in dB level.

The <Transfer Function> block is an X vs. Y Plot. It has two inputs: the first one applies the frequency value and the second one applies the relative dB transfer function level.

If the multimeter resolution is set to 5 1/2 digits, the measurement time is about one minute. Less time is necessary if the multimeter resolution is set to 4 1/2 or 3 1/2 digits.

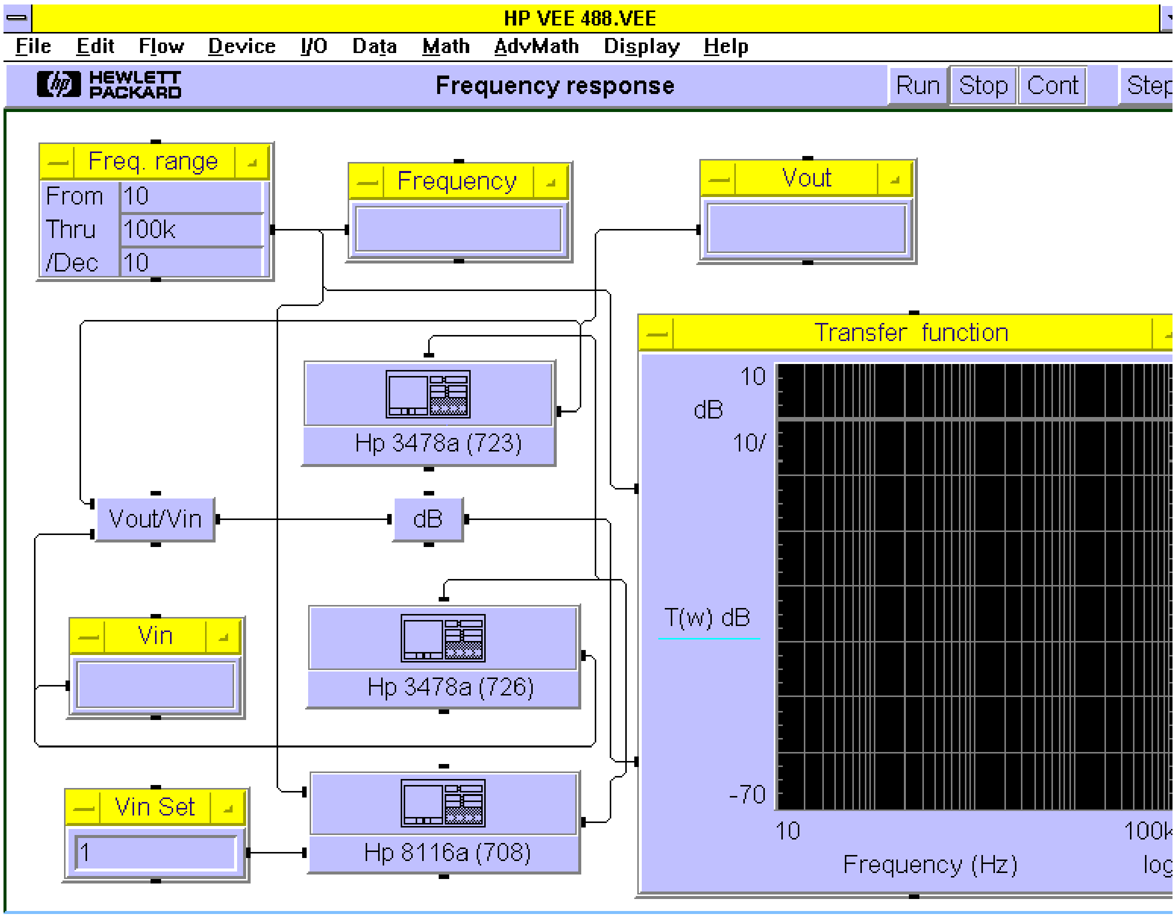

Fig. 3 – HP/Agilent-VEE flow diagram to measure transfer function.

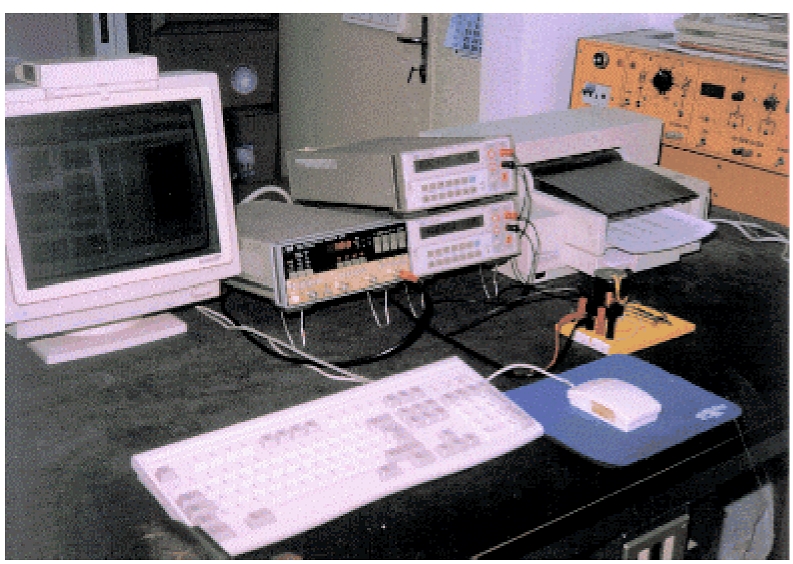

Fig. 4 - Measurement bench with the instruments used.