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1270

VXIBus Frequency Response Analyzer

OPERATING MANUAL

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a Roxboro Group company

1270

VXIBUS FREQUENCY RESPONSE ANALYZER

OPERATING MANUAL

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Solartron pursues a policy of continuous development and product improvement.
The specification in this document may therefore be changed without notice.

GENERAL SAFETY PRECAUTIONS

The equipment described in this manual has been designed in accordance with IEC publication 348 (Class 1) Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. To avoid injury to an operator or service technician the safety precautions given below, and throughout the manual, must be strictly adhered to, whenever the equipment is operated, serviced or repaired. For specific safety details, please refer to the relevant sections within the manual.

The equipment is designed solely for electronic measurement and should be used for no other purpose. Solartron Instruments accept no responsibility for accidents or damage resulting from any failure to comply with these precautions.

GROUNDING

To minimize the hazard of electrical shock it is essential that the equipment is connected to a protective ground whenever the power supply, measurement or control circuits are connected, even if the equipment is switched off. The protective ground for ac and dc supplies is connected separately.

AC GROUND is connected via the ac supply cord. The cord must be plugged into an ac line outlet with a protective ground contact. When an extension lead is used, this must also contain a ground conductor. Always connect the ac supply cord to the supply outlet before connecting the control and signal cables; and, conversely, always disconnect control and signal cables before disconnecting the ac supply cord. The ac ground connection must have a continuous current rating of 6A.

DC GROUND is connected via a ground stud on the equipment power supply unit (PSU). The dc ground connection must have a continuous current rating of 35A.

Where both protective grounds are used it must be ensured that these grounds are, and will remain, at the same potential.

AC SUPPLY VOLTAGE

Never operate the equipment from a line voltage or frequency in excess of that specified. Otherwise, the insulation of internal components may break down and cause excessive leakage currents.

FUSES

Before switching on the equipment check that the fuses accessible from the exterior of the equipment are of the correct rating. The rating of the ac line fuse must be in accordance with the voltage of the ac supply.

Should any fuse continually blow, do not insert a fuse of a higher rating. Switch the equipment off, clearly label it "unserviceable" and inform a service technician.

EXPLOSIVE ATMOSPHERES

NEVER OPERATE the equipment, or any sensors connected to the equipment, in a potentially explosive atmosphere. It is NOT intrinsically safe and could possibly cause an explosion.

Continued overleaf.

SAFETY PRECAUTIONS (continued from previous page)

SAFETY SYMBOLS

For the guidance and protection of the user, the following safety symbols appear on the equipment:

SYMBOL	MEANING
	Refer to operating manual for detailed instructions of use.
	Hazardous voltages.
	Protective conductor terminal. This must be connected to ground before operating the equipment.

NOTES, CAUTIONS AND WARNINGS

For the guidance and protection of the user, Notes, Cautions and Warnings appear throughout the manual. The significance of these is as follows:

NOTES	highlight important information for the reader's special attention.
CAUTIONS	guide the reader in avoiding damage to the equipment.
WARNINGS	guide the reader in avoiding a hazard that could cause injury or death.

AVOID UNSAFE EQUIPMENT

The equipment may be unsafe if any of the following statements apply:

- Equipment shows visible damage.
- Equipment has failed to perform an intended operation.
- Equipment has been subjected to prolonged storage under unfavorable conditions.
- Equipment has been subjected to severe physical stress.

If in any doubt as to the serviceability of the equipment, don't use it. Get it properly checked out by a qualified service technician.

LIVE CONDUCTORS

When the equipment is connected to its measurement inputs or supply, the opening of covers or removal of parts could expose live conductors. The equipment must be disconnected from all power and signal sources before it is opened for any adjustment, replacement, maintenance or repair. Adjustments, maintenance or repair, must be done only by qualified personnel, who should refer to the Maintenance Manual.

EQUIPMENT MODIFICATION

To avoid introducing safety hazards, never install non-standard parts in the equipment, or make any unauthorized modification. To maintain safety, always return the equipment to Solartron Instruments for service and repair.

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1 INTRODUCTION

The 1270B is a frequency response analyzer that is compatible with the VXIbus System Specification.

The instrument is a "C" size double-height VXI module that acts as a single-message based servant device, implementing word-serial protocol. Furthermore, the 1270B allows communication with a GPIB controller, via a '488-VXIbus Interface Device'.

Gain and phase are measured on one or two channels, via a single multiplexed analyzer, from 1mHz to 20kHz and from 1μV to 300V, with basic accuracy of 0.05dB and 0.5° below 500Hz. The instrument may be synchronized to an external system excitation or may stimulate the system with a sine, square or triangular wave, at single or swept frequencies, from an internal generator. A carrier frequency input may be used to modulate the generator output and to demodulate the analyzer inputs.

The 1270B conforms with VXIbus Specification, Revision 1.3. For systems that conform with the VXIbus Specification, Revision 1.2, the 1270B may easily be converted for use as a 1270 with a switch setting. Should the system subsequently be converted to conform with the VXIbus Specification, Revision 1.3, then an equally simple operation converts the instrument back to a 1270B. The operational differences between the 1270B and the 1270 are shown in Appendix A.

2 HOW TO USE THIS MANUAL

Chapter 1 contains a brief introduction, plus notes on safety when using the instrument.

Chapter 2 gives instructions and hints on operating and using the 1270B. There is also a detailed diagram of the front panel. It shows how to take measurements and gives advice on selecting values for parameters. There is also a brief introduction to the theory of the correlation technique used by the 1270B.

Chapter 3 includes the VXIbus implementation details, such as register information and word serial protocols, plus information on the data output formats and an acceptance check.

Chapter 4 is an encyclopedia of the commands available for the 1270B. Each section contains the command syntax, default state, mnemonic, description and related commands. In some cases, notes containing further helpful information are also included.

Chapter 5 gives a full explanation of the errors that may be generated when using the 1270B.

Chapter 6 contains the specifications for the instrument.

3 SAFETY

The 1270B has been supplied in a safe condition. This user manual contains information and warnings which must be followed to ensure safe operation and to keep the equipment in a safe condition.

See overleaf the general safety precautions.

3.1 GENERAL SAFETY PRECAUTIONS

The 1270B FRA receives low voltage power supplies from the VXIbus rack. However, the rack itself is connected to a high voltage ac source which powers the dc supply modules. To ensure your safety, and the correct operation of the 1270B, the following precautions should be taken.

1. Before switching on, ensure that the rack power lead is connected to the ac supply in accordance with the color code, i.e. brown=live, blue=neutral, green/yellow=ground (Europe).

2. Ensure that the rack power voltage selector is set in accordance with the local line voltage.

3. Ensure that the rack power plug is connected only to a power outlet which has a protective ground contact. This applies equally if an extension lead is used: the lead must contain a ground conductor capable of conducting at least 25A.

4. For grounding, the power plug must be inserted before connections are made to measuring and control circuits. The power plug or external ground (as appropriate) must remain connected until all measuring and control circuits have been disconnected.

5. Any interruption of the ground connection, outside or within the rack, is prohibited.

6. When the 1270B is powered up the opening of covers or removal of parts could expose high voltages. The 1270B should be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair. Adjustments, maintenance or repair of the instrument when it is powered should not be attempted. Consult a Solartron regional service center if repairs are necessary.

7. Ensure that fuses of the correct rating and of the specified type are fitted to the rack supplies. Makeshift fuses, or short-circuiting of fuse holders, is prohibited.

8. Whenever it is likely that the safety of the Instrument has been impaired, it should be switched off and not used again until repaired. Safety could be impaired if the 1270B:

   a. shows visible damage,
   b. fails to perform intended measurements,
   c. has been subjected to prolonged storage under unfavourable conditions,
   d. has been subjected to severe transport stress.

9. Take care when measuring high voltages. The 1270B FRA may have voltages up to 350Vdc and 500V peak ac applied to its front panel inputs via the inner part of the BNC connector leads. The BNC outers provide the "LO" terminal differential input connection. These should not be driven with voltages in excess of 30V.

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1 INTRODUCTION

This chapter contains helpful information on the use of the 1270B. There are four sections:

Section 2 deals with the process of getting the 1270B to operate and covers such topics as initializing, self-testing, handling error signals and reading the status of the instrument. Not covered in this section are general topics related to the VXIbus protocol: these are adequately dealt with in the VXIbus specification, Revision 1.3. However, for information on the VXIbus that is specific to the 1270B, see Chapter 3, "System Integration".

Section 3 points out the salient features of the 1270B front panel and explains the significance of the LED indicators.

Section 4 tells you how to take measurements, and gives a step-by-step approach to such topics as:

- the choice of suitable measurement parameters,
- starting and stopping measurements,
- the manipulation of measurement data, and
- the use of the synchronizer.

Finally, **Section 5** gives a brief introduction to the theory of the correlation technique used by 1270B.

Note: 1270B commands are shown in the form "AB P", where AB is the command code (always upper-case) followed, in most cases, by a parameter value, P. It is not essential to insert a space character between a command and its parameter, but this has been done in this chapter for the sake of clarity.

P can take four different forms:

F	= floating-point number;
I	= one- or two- digit integer;
I,J	= two one- or two- digit integers;
D	= four digit integer.

Further details of these formats are given at the start of Chapter 4, which also contains details of all 1270B commands.

2 OPERATING THE 1270B

2.1 INTRODUCTION

To operate the 1270B, you need to know how to send commands to it, and how to perform operations such as:

- performing internal tests to verify the integrity of the system,
- initialization,
- stopping an undesired operation before it has completed,
- getting information about what the instrument is doing, and
- error handling.

These operations are covered in Sections 2.2 through 2.6, below.

2.2 COMMUNICATING WITH THE 1270B

All communication with the 1270B is done via the VXIbus: this may be under the control of a Controller card in Slot 0. To program the Controller successfully, it is essential to have a thorough understanding of the VXI bus, which is described fully in "VXI bus System Specification Rev. 1.3". Details of how the VXIbus system interface has been implemented on the 1270B are given in Chapter 3, "System Integration". The rest of this section explains, generally, how the 1270B communicates with the Controller.

At the highest level, the 1270B is controlled by *messages* sent from the Controller. These messages consist of a string of characters, that are written sequentially (i.e. serially) to the Data Low Register (see Chapter 3). Messages are transmitted to the 1270B using the Word Serial Protocol, and the commands implemented for this by the 1270B are listed in Chapter 3. A detailed description of the Word Serial Protocol can be found in the VXI Specifications and need not concern us here.

We can, therefore, regard 1270B as a device which accepts simple character strings, such as "WF 1", or "RE". These strings are known as *commands*. Details of the syntax for each of these are given in Chapter 4.

Some 1270B commands request information, e.g. *status*, to be returned to the Controller. In this case, having received and interpreted the message that requests the information, the 1270B places a sequence of characters into the Data Low Register one at a time, and the Controller reads each in turn.

It is often necessary for the 1270B to indicate to the Controller that a particular *event* has occurred. For example, that a measurement has completed, an error has arisen, or that 1270B is ready to transmit the data or information that the Controller has requested The 1270B can be commanded to *interrupt* when specific circumstances occur. These circumstances are defined by the content of the Status Byte and the Service Request Enable Register, as detailed in Chapter 3. When an interrupt occurs, the Controller establishes the cause then *services* the interrupt. In other words, the Controller executes a program to satisfy the requirements of the interrupting device. If it is not desirable for the 1270B to generate interrupts the Controller can poll the 1270B to see whether it is ready, or not, to transmit data. Interrupts, however, free the Controller from the overhead required to poll the 1270B.

2.3 INITIALIZE, RESET AND BREAK

Two commands in the *self-test* group provide the means for completely restarting the 1270B.

TT 1 *initializes* the 1270B: the generator is stopped; all measurement parameters are returned to their default settings; the timer is set to zero; and the history file is erased. This command is useful when you don't know what state the 1270B is in; it provides a quick way of "wiping the slate clean".

TT 2, which *resets* the 1270B, does exactly the same as the TT 1 command, *except that the history file is not cleared.* This means that you can start setting up the 1270B again, without destroying previously filed data. The TT 2 command is useful when the 1270B is being used with automated test equipment (ATE): it avoids the need to send lots of messages to return the instrument to a known state. It is also useful in error-handling routines.

A command related to the above is **Break** [BK]. This halts the current operation, but has no effect on the generator, measurement parameters , the timer or the history file. It does, however, switch off *sweep,* if it is on. Break can be very useful when a very long operation has been started by mistake, and you don't want to waste several hours waiting for it to complete.

2.4 SELF TEST

Before making an important measurement, it is reassuring to know that the instrument is functioning correctly. A series of commands is available for just this purpose.

TT 3 *(check)* triggers the 1270B into doing a simple check that indicates whether or not the instrument is functioning correctly.

TT 4 *(test)* does the same as TT 3 ***and*** tests the analyzers. Normally, TT 4 should be used in preference to TT 3.

To read the result of a TT 3 or TT 4 command the 1270B must be sent the query command **'?TS 0'**. A "0" result indicates a successful test, whereas a value other than "0" indicates a failure. The cause of failure may be ascertained with the commands ?TS1 through ?TS6. (See Chapter 4) If a failure occurs there is no point in continuing until the 1270B is repaired: contact your local Solartron service center.

Finally, a *self-test* command may be used to ensure accurate measurements. **TT 0** *(drift correct)* checks the analog input circuits of the 1270B and nullifies any offsets that may affect the measurement. This operation is actioned at the next measurement. The 1270B automatically performs drift correction every minute or once per integration time, whichever is the longer: therefore, it is not necessary to issue a TT 0 command before every measurement.

2.5 INTERROGATING THE 1270B

To interrogate the control state of a 1270B you may use query commands or the status page. In general, query commands are to be preferred, since they return only the parameter value required. However, some status values can not be accessed with a query command, in which case the status page must be used.

2.5.1 Query Commands

Almost every command that sets a parameter in 1270B can also be used as a query command, simply by sending the command prefixed with a question-mark. For example, ?AM returns the generator amplitude value. Most VXIbus systems have little use for this facility, since the parameter value sent to the 1270B is probably stored in the database of the Controller. However, the facility can prove useful in certain circumstances.

The following commands may not be used with a query. If they are, an error message is given.

RG, SG	Run, Stop Generator.
SI, RE	Single, Recycle Measurement.
SA	Stop Analyzer.
ST	Status.
BK	Break.
TT	Self-test.
CE	Clear Last Error.
DO	Repeat Last Result.
FO	File Output.
UF	Output Record.
FC	File Clear.

Special query commands are available for values which relate to the operating state of the instrument, but are not set by the user. These commands are:

?AR i	Analyzer range for last measurement; i=1 or 2, to denote analyzer channel
?ER	Last error
?FP 0	Number of results stored in history file
?FP 1	File pointer position, in history file.
?FS	History file size: fixed number greater than 500 (the actual number depends on the software version).
?NR	Number of readings taken.
?SF 0-6	Synchronizer frequency.
?SN	Synchronizer state: off, idle, wait, locked, fault.
?TS 0-6	Result of a self test command (TT 3 or TT 4).
?VN	Software version

Each of the above commands is fully defined in Chapter 4. Note that ?AR returns the analyzer range setting for the *last* measurement: this is useful for querying the range selected when *range auto* is in operation. ?AR should not be confused with ?RA (see Chapter 4) which returns the *current* analyzer range setting ("0" for *range auto* or "1" through "5" for a fixed range).

2.5.2 Status Page

The 1270B contains a database, known as the *status page*, which relates to the present control setup and operation. Provided that the output has been switched on with the OP 2,1 command, the status page may be output with the ST command. The format of the status page is shown in Fig 2.1.

1270 FRA	aaaaa	TIME	00:00:00
GENERATOR	bbbbb	CARRIER	gggg
ANALYZERS	ccccc	RANGE	hh (/hh)
SWEEP	ddddd		
SYNC	eeeee	INPUT F	66666
MIN F	00000	MAX F	77777
FILE SIZE	11111	LAST ERRORS	12 34 56
UPPER LIMIT	22222		
LOWER LIMIT	33333		
FILE READINGS	44444	FILED	88888
SOFTWARE	f f f f f		
STATUS BYTE	55555		

Fig 2.1 *1270B status page.*

The information that may represented by the above parameters is as follows:

aaaaa	*ready, busy,*
bbbbb	*run, kill, freeze, kill-ext, freeze-ext,*
ccccc	*stop, run, idle, delay, wait,*
ddddd	*stop, idle, run,*
eeeee	*off, idle, wait, locked, fault 1, fault 2, fault 3,*
00000	0 to 2.0000E + 04 (*minimum frequency detected by the synchronizer*)
11111	number greater than 500 (*actual value depends of the software issue*)
22222	upper limit of last menu parameter entered,
33333	lower limit of last menu parameter entered,
44444	0 to 9999,
f f f f f	six characters representing the software product, status and issue,
55555	eight binary digits denoting the status byte,
00:00	elapsed time in hours (0 to 99) and minutes from the last power on, reset, or initialize.
ggggg	*off, low, on, high,*
hh*	*auto, 30mV, 300mV, 3V, 30V, 300V,*
66666	0 to 2.0000E + 04 (*present synchronizer input frequency*)
77777	0 to 2.0000E + 04 (*maximum frequency detected by the synchronizer*)
12 34 56	error code (see Chapter 5)
88888	file size.

*hh/hh if the display output has been set to CH1/CH2 with an SO 201 command.

For the status page to be examined, the VXIbus Controller must be programmed to select and examine the line (or lines) required.

The status page can be used to take an overall "snapshot" of the 1270B control state at any time, but individual status values can usually be interrogated with the query commands (described in Section 2.5.1 above). However, some values on the status page are not accessible with query commands. These are:

1270 FRA	
GENERATOR	
CARRIER	
ANALYZERS	
SWEEP	
UPPER LIMIT	
LOWER LIMIT	
STATUS BYTE	(The status byte can, however, be read with a VXIbus "Read STB" command.)

Note also that the query command ?ER returns the last error value only, whereas the status page contains the last *three* error values.

The remaining information on the status page may be accessed with query commands, as follows:

TIME	?TM 0, ?TM 1, ?TM 2
RANGE	?AR 1, ?AR 2
SYNC	?SN
INPUT F	?SF 0
MAX F	?SF 1
MIN F	?SF 2
FILE SIZE	?FS
FILE READINGS	?NR
FILED	?FP 0
SOFTWARE	?VN
ERRORS	?ER

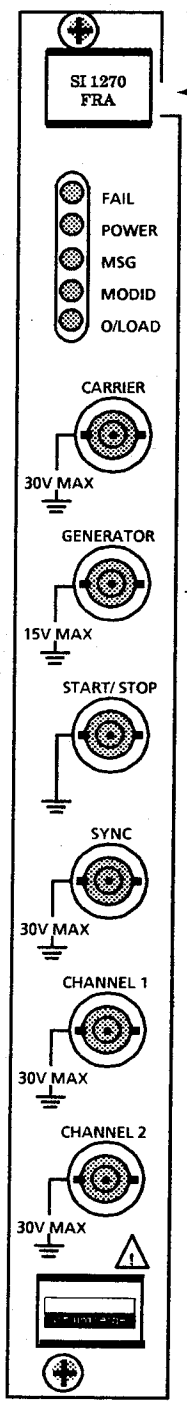
2.6 ERRORS

1270B specific errors are reported by means of the Status Byte Register and the Service Request Enable Register. If an error occurs, due, for example, to an incorrect command, a measurement problem or a malfunction, then the *error* bit in the Status Byte Register is set. If the error bit in the Service request Enable Register is set also, then an interrupt is generated. The Controller can then read the error message during the interrupt service routine, using the ?ER command. Error messages that may possibly occur are listed in Chapter 5. In addition, the Controller may read the Status Byte Register at any time, using the "Read STB" command.

The system programmer must provide routines to handle these situations. Normally, a message to the user to prompt some corrective action is appropriate, but it may also be necessary to: (a) log the error into a file, (b) try sending the command again, or (c) alter the parameter being sent. The response to the error is entirely dependent on the system being implemented.

1270B offers some commands to help the programmer. The query command ?ER returns the values of the last error: if there hasn't been an error since the last *reset* or *initialize* or CE command, "00" is returned. The CE command clears all the current errors, which can be helpful when debugging programs.

3 FRONT PANEL FEATURES



Two extractor handles, one at the top and one at the bottom of the front panel, facilitate removal of the module from the rack. Simply undo the top and bottom retaining screws and push the handles apart: this eases the rear panel connectors from the backplane and allows the module to be withdrawn easily.

FAIL	Normally unlit; lights briefly at power on. Should the controller have a RESET button, the FAIL indicator will also light briefly when this button is pressed.
POWER	Lit when power is on.
MSG	Normally unlit; flashes as messages pass between the Controller and the instrument.
MODID	Normally unlit; lights when the controller asserts the MODID line that corresponds to the 1270B slot.
O/LOAD	Normally unlit; lights briefly at power on; remains lit whilst an analogue overload is present on CH1 input, CH2 input or CARRIER input.

Note: If the input channels are set to autorange the O/LOAD light may flash. This does not indicate a malfunction and doesn't invalidate the results.

The GENERATOR connector is the only output from the 1270B. All other connectors are inputs to the instrument.

4 TAKING MEASUREMENTS

The process of obtaining frequency response analysis results can be divided into the following tasks:

1. Connecting to the system under test (SUT).
2. Setting up the generator to stimulate the SUT appropriately.
3. Setting up the analyzer to measure the resultant response of the SUT.
4. Starting and stopping the generator and analyzers.
5. Manipulating the results.
6. Using the synchronizer in place of the generator.

Each of these tasks is considered in turn in Sections 4.1 through 4.6. Finally, Section 4.7 describes the use of vernier commands to adjust control parameters, and the time command.

4.1 GENERATOR AND ANALYZER CONNECTIONS

The equivalent circuit for the generator output of the 1270B is shown in Fig 2.2. This can be used to calculate the effect of an applied load on the output. (Note that the effect of loading on the measurement results is largely eliminated if you use one analyzer channel to measure the input of the SUT and the other to measure the output. This is explained below, with reference to Fig 2.4.) For mechanical systems, a suitable amplifier and shaker are needed to translate the electrical output of the generator into mechanical motion.

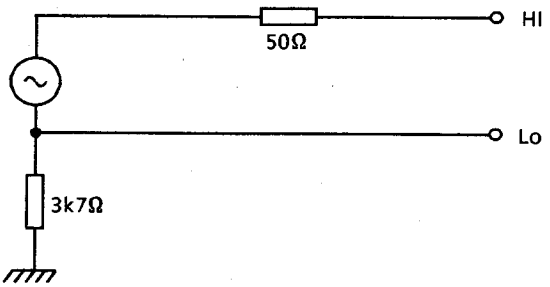


Fig 2.2 *Equivalent circuit of the generator output.*

The input circuit of the analyzers is differential, i.e. neither terminal is connected directly to ground. This enables signals which are offset from ground by up to 30V to be analyzed accurately. The equivalent circuit for the analyzer inputs is shown in Fig 2.3.

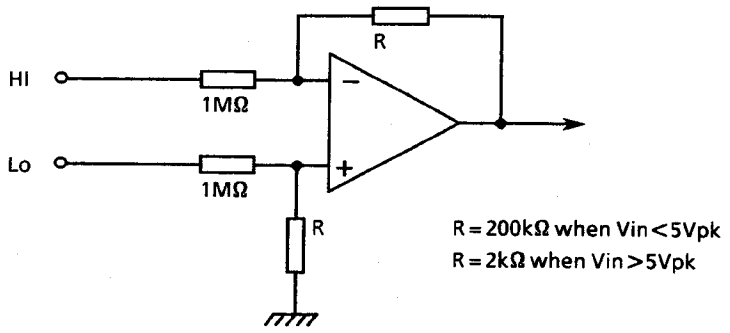


Fig 2.3 *Equivalent circuit of the analyzer input.*

It is possible to measure the frequency response of the SUT simply by measuring the output. However, a more accurate method is to use the CH2/CH1 facility, as shown in Fig 2.4. This removes any errors that might be introduced, (a) by the lead resistances, or (b) by the dynamics of an amplifier/shaker system, etc.

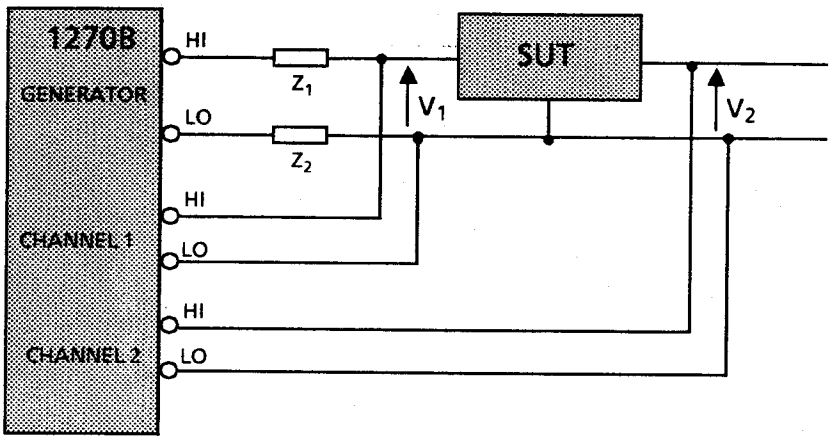


Fig 2.4 *Eliminating errors caused by lead impedances, Z_1, Z_2.*

It is also possible to measure the transfer function of part of the SUT, as shown in Fig 2.5.

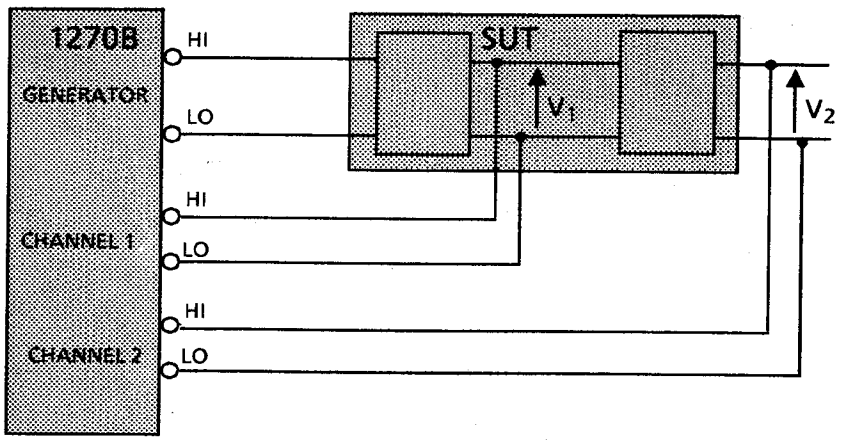


Fig 2.5 *Measuring the Transfer Function of part of the SUT*

4.2 SETTING UP THE GENERATOR

The generator, contained in the 1270B, provides a stimulus for the SUT. At the GENERATOR output a very stable and accurate waveform is provided, with frequencies from 1mHz (one cycle every 17 minutes) to 20kHz. For experiments where the SUT cannot be stimulated by the generator – for example, when analyzing a rotating machine with respect to its shaft frequency – the synchronizer is used in place of the generator: see Section 4.6.

There are several parameters to be defined for the generator output:

- waveform,
- frequency,
- amplitude,
- dc bias (if any),
- modulation (if any),
- stop mode.

Each of these parameters is described in turn, in Sections 4.2.1 through 4.2.6, below.

4.2.1 Generator Waveform

There are three choices for the output waveform: a sinewave [WV 0] is the most usual choice, and is the default setting. However, the other two waveforms can be useful when you need a high-performance function generator. The triangular output [WV 2] can provide a slow ramp output, useful for linearity measurements, and the squarewave [WV 1] can provide an accurate timing reference.

Although there is little point in doing so, square or triangular outputs may also be used for frequency response measurements. This is because the inherent harmonic rejection of the correlation technique used by 1270B rejects all but the fundamental frequency. However, since the correlation technique assumes that the input signal is sinusoidal, absolute amplitude measurements will need correction. This can be avoided by using relative measurements (CH2/CH1).

4.2.2 Generator Frequency and Sweep

The generator frequency can be set to one fixed value using the FR *F* command. The digital technique used by the 1270B generates a discrete set of frequencies, which means that the actual output frequency may not be exactly that requested. Table 2.1 shows the resolution across the frequency range.

Table 2.1 Frequency Resolution

Frequency Range	Resolution	Worst Case Accuracy
1.0mHz to 399.9mHz	0.1mHz	10%
400mHz to 3.999Hz	1mHz	0.25%
4.00Hz to 39.99Hz	10mHz	0.25%
40.0Hz to 399.9Hz	100mHz	0.25%
400Hz to 20kHz	1Hz	0.25%

In most cases, the frequency response over a range of frequencies is required and, for this, the sweep commands are used. Setting up the sweep is quite straightforward: you must decide on the maximum and minimum frequencies required (set by the MA F and MI *F* commands, respectively) the number of steps in that range (set by the GS *D* command) and the direction of the sweep (set by the SE *I* comand). The 1270B then calculates the frequency values for each step, so that they are equally spaced on a logarithmic scale. This means that the ratio between successive frequencies is the (N-1)th root of $F_{max} \div F_{min}$.

For instance, if F_{min} is 100Hz and F_{max} is 10kHz, and the number of steps is 100, the successive frequencies are in the ratio

$$\sqrt[99]{\frac{10000}{100}}, \text{ ie., } 1.0476,$$

so that the first measurement frequency sequence is: 100Hz, 104.76Hz, 109.74Hz, 114.97Hz.....

At first glance it might seem a good idea to have lots of steps in the sweep, for maximum resolution, but the more steps you have, the longer the analysis will take to complete. The number of steps is therefore a compromise between measurement resolution and the time available for measurement. The actual time taken depends on the frequency range chosen and the integration time set.

The total time for a complete sweep of *N* steps is approximately:

$$N \times \{\textit{measurement delay} + \textit{integration time}\},$$

where the measurement delay (which allows the SUT to settle to a steady-state after each change of frequency) is 100ms, and the integration time is set by the IS F command. For a CH2/CH1 measurement the integration time is doubled.

This calculation is approximate because the sweep time is affected by other factors, typically software delays, and the drift correction delays which take place every minute.

Once the sweep parameters have been set the analysis can be started, using either the 'SI' (Single) or 'RE' (Recycle) commands. Note that 'BK' (*break*) will stop the sweep and set the SE parameter back to 0, i.e. the sweep is disabled.

4.2.3 Generator Amplitude

The generator amplitude depends on the application, but it is a good idea to begin with a small amplitude, and increase it gradually until a satisfactory measurement is obtained. This will ensure that no damage is done to the SUT or other equipment. (And may also safeguard the user, in extreme cases!) The ideal amplitude is where the SUT (but not the rest of the system) is almost driven into non-linear operation: this gives the best noise rejection.

Amplitude is set by the AM *F* command, where *F* is the rms value (*not* the peak value) of the amplitude and can be up to 10.23V (5.11V for triangular waveform) with a resolution of 0.01V. The peak value is calculated by multiplying the rms value by the following crest factors:

$\sqrt{2}$ ($\approx$1.414)	for the sinusoidal output,
$\sqrt{3}$, ($\approx$1.732)	for the triangular output,
1.000	for the square wave output.

4.2.4 Generator Bias

Some SUTs may require the input waveform to be shifted with a dc bias, as shown in Fig 2.6. This may be necessary, for instance, to nullify offsets in the SUT. The BI *F* command sets up the bias, to a maximum of ±10.22V, with a resolution of 0.02V. Note, though, that the generator amplitude (peak value)+bias+modulation must not exceed ±15V, otherwise an error message will be given.

4.2.5 Generator Modulation

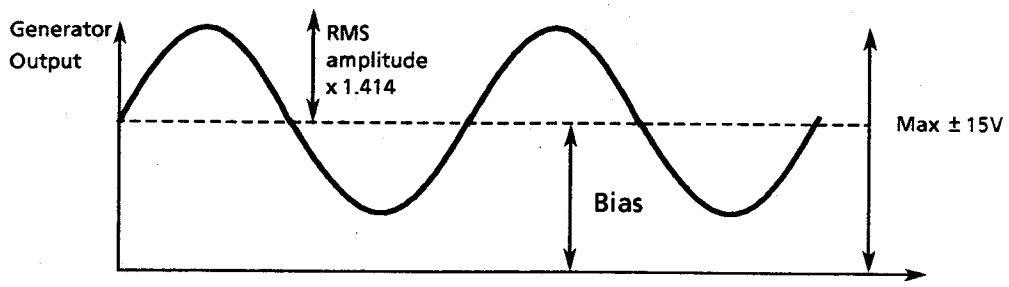


Fig 2.6 *Generator Bias and Amplitude*

1270B provides modulation/demodulation facilities for SUTs that require amplitude modulated carrier signals, such as avionic control systems. It has an input socket for the carrier signal, amplitude $250V_{rms}$ maximum, frequency range 48Hz to 10kHz. This signal is used as a reference signal which is modulated by the generator waveform and output to the system under test. The carrier signal is also used for demodulating the input signals. Modulation and demodulation can be selected independently. The amount of modulation is set by the BI *F* (*bias*) command. The depth of modulation is set by the ratio of the bias command and the AM *F* (*amplitude*) command. The minimum carrier input signal is 6V; below this an error message will be given.

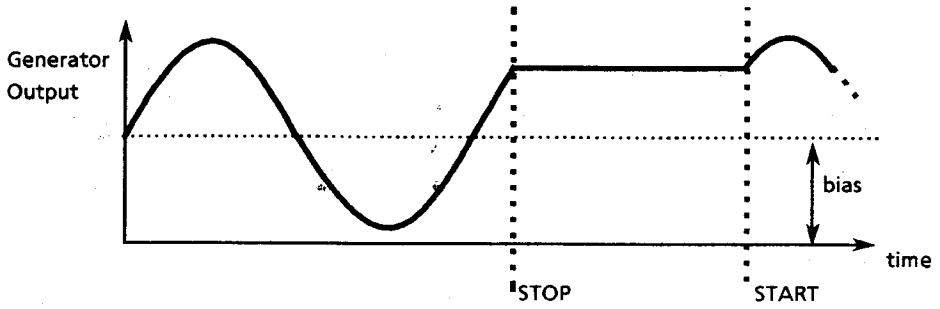
To achieve full specified accuracy the ratio of the carrier frequency to the measurement frequencies should be an integer, particularly for carrier frequencies less than 400Hz. If this is not possible, when using sweep for instance, use a longer integration time.

The modulation is switched on and off by the MO *I* command: MO 1 switches it on, MO 0 turns it off.

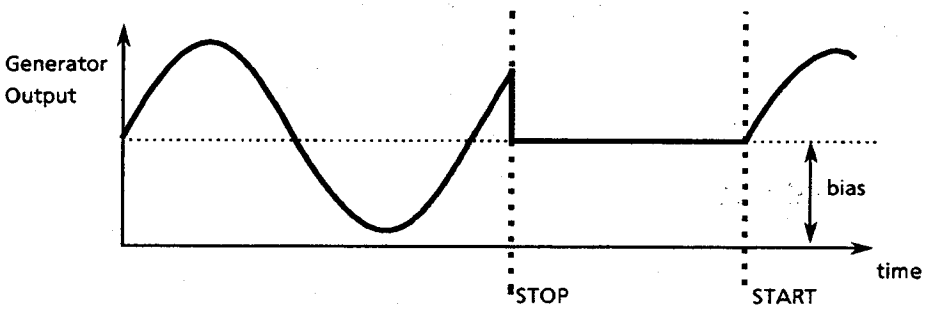
4.2.6 Generator Stop Mode

Even in the best run test setup, things may sometimes take an unexpected turn. Therefore, to avoid possible injury to people, or damage to equipment, ***it must be ensured that the generator can be stopped quickly and safely.*** One aspect of this is selecting the correct mode of stopping the generator, at any point in the cycle. There are two options: *freeze* and *kill.*

"Freeze" (SM 0) is the default mode, which, when the SG (*stop generator*) command is given, holds the generator output at its existing level. The alternative, "kill" (SM 1) reduces the generator amplitude to zero immediately SG is sent, although any bias set is still present. The difference between the two modes is illustrated in Fig 2.7.



[**freeze**] *Stops the Generator at the existing output level.*



[**kill**] *Sets the Generator to zero (Note: Bias will not be removed).*

Fig 2.7 *The effect of the two stop mode selections.*

The correct choice of Stop mode depends on the safety conditions relevant to the SUT. A heavy piece of machinery whose position depends on the input amplitude, for instance, may react too dramatically to the sudden change in input if ***kill*** is used. On the other hand, a system exhibiting positive feedback may not be favourably affected by stopping in *freeze* mode.

Note that the generator continues to run from its current value when an RG (*run generator*) RE (*recycle*) or SI (*single*) command is given.

4.3 ANALYZER

1270B has two independent channels, multiplexed into one analyzer. The analyzer correlates the input signal with the generator signal. This enables it to calculate the magnitude and phase of the input signals at each measurement frequency with great accuracy and removes the effects of noise and harmonics due to distortion within the SUT. Further details of this are described in Section 5 in this chapter.

The parameters to be set before analysis can begin are:

- integration time,
- input range,
- demodulation (if any).

Each these parameters is decribed in Sections 4.3.1 through 4.3.3. Starting and stopping an analysis are described in Section 4.4.

4.3.1 Integration Time

A feature of the correlation method is that the rejection of signals not at the fundamental frequency is increased if the correlation is extended over several cycles of the fundamental. This is shown in Fig 2.8. Even after just one cycle, the rejection is good, particularly at the harmonics of the measurement frequency.

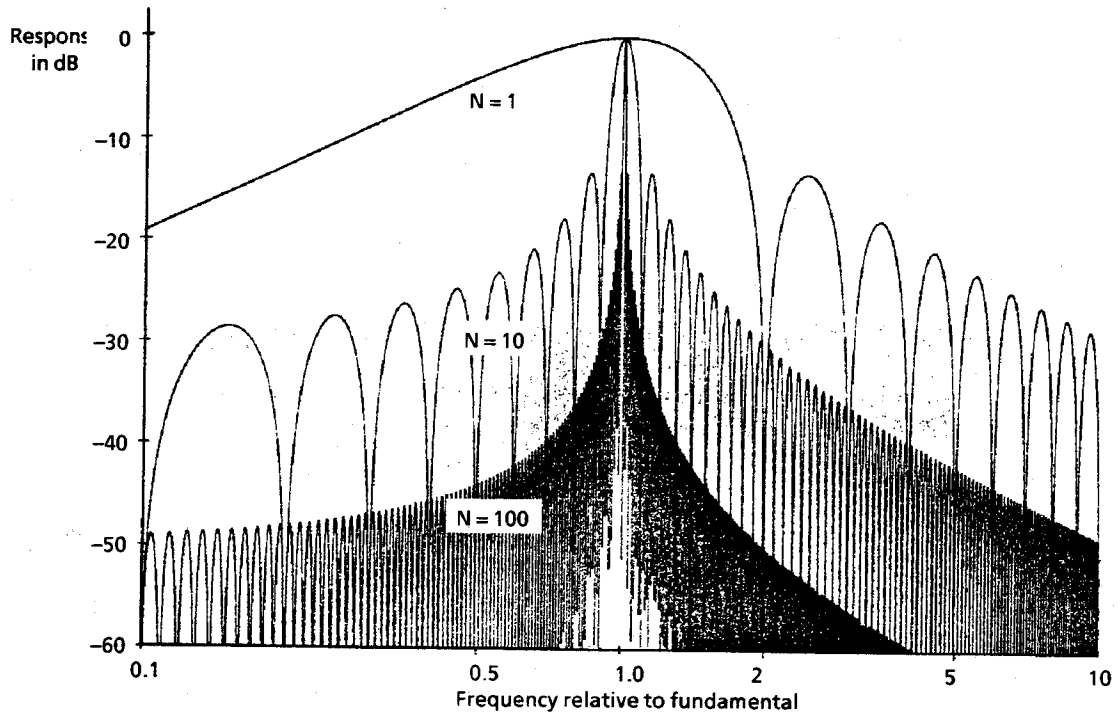


Fig 2.8 *Harmonic rejection curves for N cycles of integration.*

The IS *F* (*integration time*) command sets the number of cycles over which the correlation is to be performed. This time is defined in seconds, from 0.1s to 100000s, and is rounded to the nearest number of complete measurement frequency cycles. The minimum integration time is 0 1s or 1 measurement frequency cycle, whichever is the longer; this is also the default setting.

There is an obvious trade-off between maximising the noise rejection, by using the longest possible integration time, and the overall time required for the analysis. One way of optimising this is to set up the SUT and take repeated measurements at a single frequency, using *recycle*. After a few measurements, note the amount of deviation, or "scatter", between the readings. Then increase the integration time and repeat the process. The integration time is about right when a further increase gives no further reduction in scatter.

4.3.2 Analyzer Input Range

The command RA 1,0 (*range analyzer*) sets channel 1 to autorange, and RA 2,0 does the same for channel 2. Autorange is normally the best choice, as the 1270B adjusts itself to the optimum level for the input signal. It does this at each measurement frequency, which is particularly valuable during sweeps. Here, the analyzer can range up when it encounters a resonance, which avoids a bad measurement through overload, and range down at anti-resonances, which increases the signal-to-noise ratio. The effect is to enhance the dynamic range of the overall result.

Then why bother to use fixed ranges? Essentially, to save time. When autoranging, 1270B may have to make several measurements to select the correct range, and this will take time, especially at very low frequencies. Fixed ranging avoids this problem, at the possible expense of accuracy. Fixed ranges can be set by the command RA *I,J*, where *I* defines the channel, and *J* the range required.

The query command ?AR 1 returns the range used by channel 1 for the last measurement. ?RA 1 returns the current range set for channel 1. ?AR 1 can be used when on autorange to find out which range is actually set.

4.3.3 Demodulation

Demodulation can be selected for either analyzer input channel, independently of whether or not the generator output is modulated. The command used is DE *I,J*, where *I* is the selected channel and *J* selects demodulation off ("0") or on ("1").

4.4 STARTING AND STOPPING MEASUREMENTS

Once all the relevant parameters have been set, as described above, the measurement can begin. SI (*single*) starts the generator if it is stopped, and makes a single measurement. SI starts a measurement only if the analyzers are not busy, so that a rapid succession of SI commands does not result in a series of results unless the measurements complete before the next SI is given.

RE (*recycle*) also starts the generator if it is stopped, and the analyzers then make repeated measurements. These continue until an SI (*single*) SA (*stop analyzer*) or SG (*stop generator*) command is given. If sweep is enabled, the measurements are at successive values of generator frequency, and will stop once the maximum frequency has been reached.

Both SI and RE take effect immediately, i.e. the analyzers do not wait until the output reaches the 0° point of the cycle. SA stops the analyzer, and does not complete the measurement or produce a result.

To restart measurements after they have been stopped, use RE or SI. If sweep is on, and was stopped before reaching the end, measurements will continue from where they were stopped. To restart at the minimum frequency, you must re-set one of the sweep parameters: MI, MA, GS or SE.

4.4.1 Stopping the Generator

Once started, the generator continues to run, so the system designer must give proper consideration to the need to stop the generator quickly should a potentially dangerous situation arise. With the 1270B there are two very easy ways of doing this: (a) giving an SG (*stop generator*) command and (b) using the START/STOP input. The generator may also be stopped with the SQ *I* (*stop quadrant*) command, but this command should not be used for emergencies because it does not stop the generator immediately. (For very low frequencies it may take several minutes to reach the appropriate quadrant.) Two other commands that are acceptable for emergency stops are the *reset* and *initialize* commands, although, with these, the 1270B control parameters must be re-defined afterwards.

The SG command stops the generator in the mode set by the SM *I* command, (see Section 3.2.6). The generator remains stopped until either RG (*run generator*) is given, when no measurements will be made, or when SI or RE are sent to begin measurements.

The generator can also be stopped by applying a TTL logic "0" to the START/STOP input on the front panel. (A closed switch connected across the socket will admirably emulate this condition). This can be used to provide an additional safety mechanism, utilising a limit-switch, for instance. The Generator output will continue as soon as the input is released.

The SQ *I* (*stop quadrant*) command holds the Generator at one of four points in its cycle, depending on the value of *I*. Once the command has been given, the cycle continues until the specified point is reached, and the output is then held at that level. Fig 2.9 shows the effect of different values of *I* for this command. This feature is useful when setting up an experiment, to check for maximum excursions, etc, or when using the triangular output as a ramp signal.

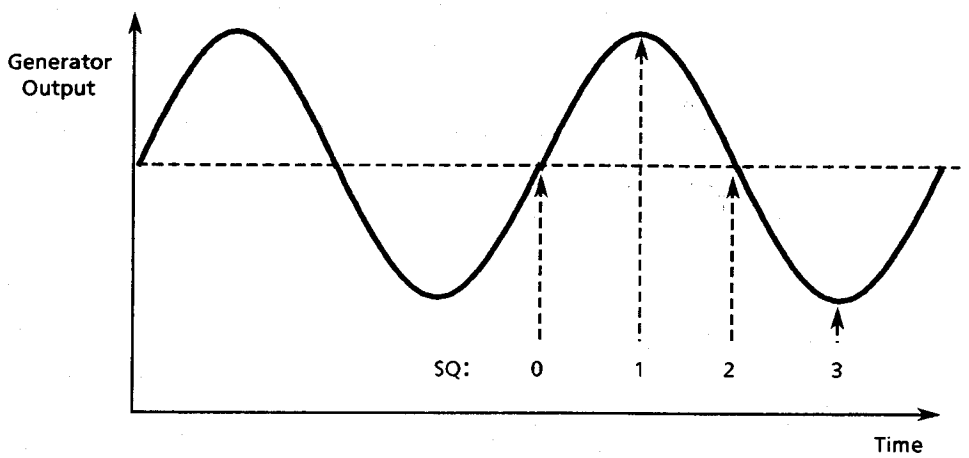


Fig 2.9 *Stopping points for SQ command*

4.5 MANIPULATING RESULTS

All results are automatically stored in the *history file*, but you can also output results as they are made. In most applications, it is better to store results in the history file and output them in one go, since this will reduce the overhead on the VXI bus. The next two sections describe how to set up the result format, and how to use the history file.

4.5.1 Results Setup

The following selections must be made to define how the results will be output:

- source,
- type of coordinates, Cartesian or polar,
- terminator and separator,
- scaling factors.

The SO D (*source*) command can specify either channel or the transfer function CH2/CH1. This last setting is selected by default and is the normal one to use.

The results are vectors, denoted in polar coordinates as having both magnitude, r, and phase, θ. This information can also be expressed in cartesian form, $a+jb$, where a and b are the real and imaginary parts respectively. The relationship between these two coordinate systems is shown in Fig 2.10.

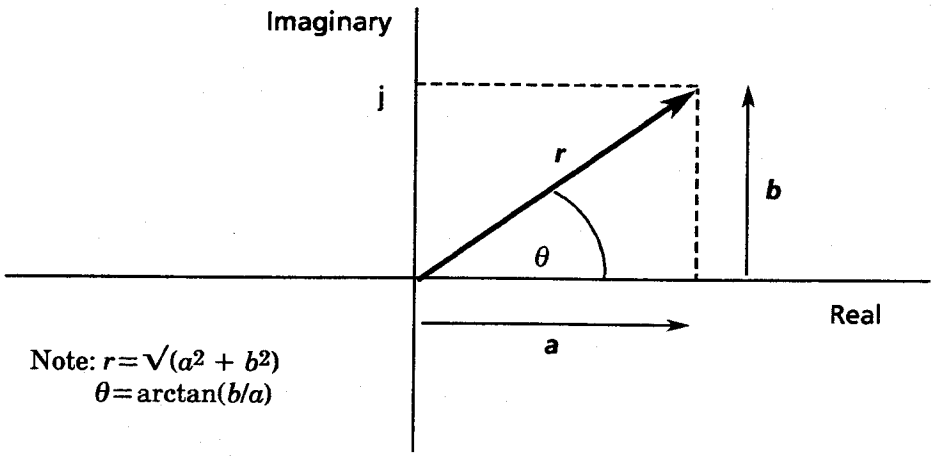


Fig 2.10 *Relationship between Cartesian and polar coordinates.*

Results can be expressed in both these forms, and also in r(db),θ format, known as log polar. This is the same as the r,θ format, but with the magnitude, r, converted to decibels, and referenced to 1 volt for single channel measurements.

The coordinate system for output is selected using the CO *I* command, where *I*="0" for $a+jb$, "1" for r,θ, and "2" for r(db),θ. The results are stored in the history file as $a+jb$, and converted during output. Therefore, it is possible to output the same results in all three formats, one after the other, simply by changing the co-ordinate system.

With the 1270B you are able to define the field separator and terminator character(s) in the result. These characters are selected with the OS *I* (*output separator*) and OT *I* (*output terminator*) commands. The default characters are <,> for the separator and <CR> <LF> for the terminator Sometimes, it is desirable to scale the output; where, for example, the results are to be normalised to a reference measurement, or where a known, fixed error has been introduced into the experiment. Although the results can be processed externally, the 1270B will do it for you. Scaling is defined by selecting scale factors for r and θ, which has the effect of dividing the magnitude of each result by the r factor, and subtracting the θ factor from the phase measurement.

Any one of four scaling factors may be selected with the FN *I* (*fractional*) command:

I=0 results scaled by a factor of unity, i.e. there is no scaling,
I=1 results scaled by a user-defined scaling factor (see below),
I=2 results scaled by the *magnitud and phase* of the most recent result, i.e. the one taken before the FN 2 command is given,
I=3 results are scaled by the *magnitude* of the most recent result, i.e. only the r coordinate (of the polar coordinates r,θ) is used.

User-defined scale factors are entered with the RF *F* command for the *r factor*, and the TF *F* command for the *θ factor* (in degrees). These factors are initially set to 1 and 0° respectively, which effectively disables scaling.

4.5.2 Results Output

Measurement results can be output to the VXIbus Controller as they are made, although this is not essential, since they are also stored in the history file, automatically. If the command OP 2,0 is sent, no results are output: this is the default ouput state. Query comands are not affected by the results output setting, but status and results are.

The commands OP 2,1 and OP 2,2 output results in ASCII and binary format, respectively. These commands, which also control the format of the history file output, are explained in more detail in Chapter 3, Section 2. The last result alone can be output by issuing the DO command, assuming the output is on.

4.5.3 History File

The History File automatically records measurement results. Although not essential in a VXI-based system (the Controller could store each result as it is made) it can be used to reduce bus activity, by storing the results and outputting them in one go.

Results are stored sequentially in the history file, and each result is allocated a record number. Over 500 results can be stored. The exact number can be found using the ?FS (*file size query*) command. When this number is exceeded, the earliest results are overwritten by the latest. This isn't usually a problem, however, because few applications require so many results. The number of readings taken can be found by issuing a ?NR command: if this number is greater than the file size some earlier results will have been lost. The counter is reset whenever the history file is cleared, or the 1270B is initialized.

A *file pointer* indicates the next record to be filled. The current file pointer value can be queried using the ?FP 1 command. The ?FP 0 command tells you the number of readings currently in the history file The file pointer is reset to "0" whenever a sweep is started, when the command FC (*file clear*) is given, or when the 1270B is initialized. By querying the file pointer before and after a set of readings are taken, the relevant record numbers can be identified.
There are two ways in which to access the history file. The whole file, beginning at record 0, may be output by using the command FO. Alternatively, each record may be output individually by using the command UF *n*, where *n* is the record number.

The format of the history file output is set using the command OP 2,1 for ASCII or OP 2,2 for binary. The separator and terminator are set with the commands OS *I* and OT *I*, respectively.

From the above, a normal sequence of events to store and output results could be:

1. Set up the generator and analyzers.
2. Send an FC command to clear the history file. (Not necessary for sweep.)
3. Stop the results output to the VXIbus by sending OP 2,0.
4. Start measurements, using RE or SI.
5. Stop measurement, using SA or SI. (This is done automatically for sweep.)
6. Set the output format to ASCII or binary, using OP 2,1 or OP 2,2.
7. Read the history file, using FO.

4.6 SYNCHRONIZER

4.6.1 Introduction

Some devices in a system under test cannot be stimulated by the 1270B Generator. We therefore have to use the SUT itself to provide a frequency reference. An example of this is analysis of a turbine, where the rotating shaft, which is effectively the stimulus for the system, must be used (see Fig 2.11). However, the 1270B analyzers must be linked to the stimulation frequency in some way, and this link is achieved by the Synchronizer. The synchronizer monitors a suitable steady signal (measurement frequency) in the SUT and from this derives a suitable reference for the analyzers.

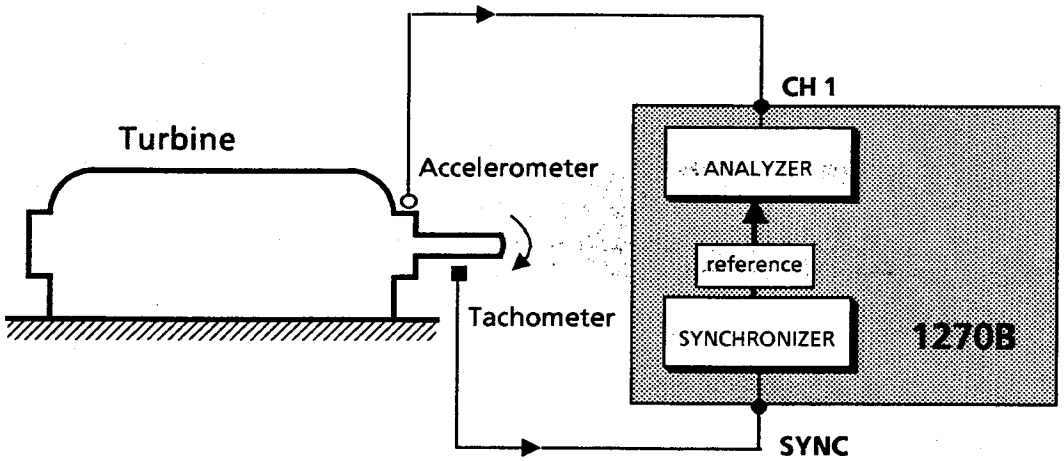


Fig 2.11 *Example of synchronizing. The reference frequency for the vibration analysis is derived from the rotating shaft.*

4.6.2 The Synchronizing Signal

The synchronizing signal can be any periodic signal up to 350Vpk (250Vrms) [see spec] . The 1270B uses the positive going edges of the signal to determine the phase and frequency references.

The normal trigger point is the positive zero-crossing of the signal between Hi and Lo inputs: the outer part of the BNC connector is Lo and the inner part Hi. Triggering on the negative edge of a waveform is effected simply by interchanging Hi and Lo connections. To trigger at a voltage other than zero, bias the Lo terminal (or Hi terminal for negative edges) to the required trigger voltage with respect to ground, and then apply the trigger signal between Hi (or Lo) and earth. Fig 2.12 illustrates the arrangement with a TTL synchronizer signal.

Note: The maximum Lo to ground voltage is 30 Volts.

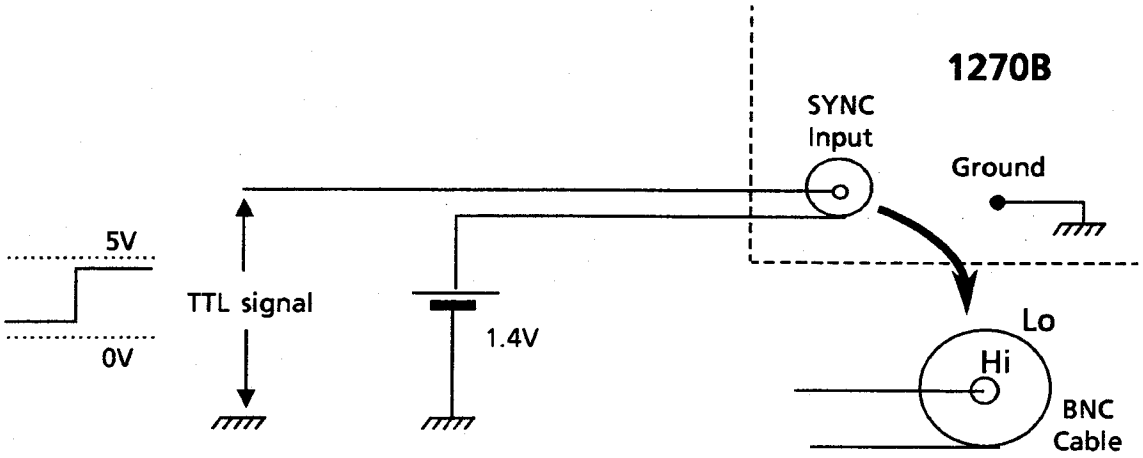


Fig 2.12 *Adjusting the SYNC trigger level to suit a TTL signal*

4.6.3 Operation

The command SY 1 switches the analyzer reference signal from the generator to the synchronizer. The 1270B measures the period of the synchronizing signal, adjusts the frequency of the internal reference accordingly and then corrects the phase of the reference until it is synchronized with the external signal. (The generator output is also adjusted, although it may not be in use.) In the worst case, the synchronizer takes the longer of 6 cycles or 500ms to synchronize with a steady signal. The accuracy of frequency measurements is limited by the normal frequency resolution at low frequencies, and by the period resolution at high frequencies. If the external signal changes, the internal signal will change with it, thus ensuring that the measurements remain accurately correlated with the stimulus signal.

Allow the synchronizer to attain synchronism before commanding a measurement. If a measurement is commanded before the synchronizer is ready, "ERROR 94" will be generated. "ERROR 94" is also associated with a synchronizer fault.

To examine the state of the synchronizer, including any fault information, use the Status Page (see Section 2.5.2) or the query command ?SN. The 1270B responds to this command with a number from 0 to 6, corresponding to the following states. The Status Page entry against "SYNC" describes the state:

0=off	the synchronizer is off.
1=idle	the synchronizer is on but has not yet detected the first two level changes in the synchronizing signal.
2=wait	the synchronizer is waiting for a stable signal.
3=locked	the synchronizer has achieved satisfactory synchronism. Measurements can be taken.

Continued on next page.

4=fault 1	Frequency overflow. Input frequency > 20 kHz.
5=fault 2	Time overflow. Input frequency < 1 mHz.
6=fault 3	Signal unstable. If the input frequency varies by more than 10% noisy analyzer results are possible.

If the Analyzers are running, faults 1 or 2 will cause the measurement to stop. Any attempt to run the analyzers while SYNC status is 'idle' or 'wait' will fail and give ERROR 94.

In addition, the query command SF? *I* will give the following data:

I=0 Synchronizer input frequency.
I=1 Maximum frequency reached by Synchronizer input*.
I=2 Minimum frequency reached by Synchronizer input*.
I=3 Frequency of the input when the first measurement was taken.
I=4 Frequency of the input when the last measurement was taken.
I=5 Average frequency for the measurement

*This value is reset when 1270B is initialised or reset, and when the synchronizer is switched on by the SY 1 command.

4.7 OTHER COMMANDS

4.7.1 Vernier

The vernier commands provide a way of altering the generator amplitude, bias or frequency in increments. This facilitates fine-tuning and can be used, for example, when searching for a resonance.

The VA I command selects which parameter is to be altered: VA 0 disables the vernier, whilst VA 1, VA 2 and VA 3 provide for changes in the frequency, amplitude, and bias, respectively.

Once a parameter is selected, the UP *I* and DN *I* commands give an instant change; except when a measurement is in progress, when the change does not occur until the measurement is complete. If recycling, the adjustment occurs between successive measurements. Parameter *I* in the UP *I* and DN *I* commands can take any value from 1 to 4: 1 gives a fine change, and 4 a coarse change. The magnitude of the change depends on the present value of the parameter. For the UP *I* command this is shown in Table 2.2, whilst for the DN *I* command it is shown in Table 2.3.

Table 2.2 Increment Values for UP I Command

I	Adjustment	Frequency <1Hz	Frequency ≥1Hz	Amplitude or |Bias| <1V	Amplitude or |Bias| ≥1V
1	Very Fine	+0.0001Hz	×1.00001	+0.0001V	×1.00001
2	Fine	+0.001Hz	×1.0002	+0.001V	×1.0002
3	Coarse	+0.01Hz	×1.005	+0.01V	×1.005
4	Very Coarse	+0.1Hz	×1.1	+0.1V	×1.1

Table 2.3 Increment Values for DN I Command

I	Adjustment	Frequency <1Hz	Frequency ≥1Hz	Amplitude or |Bias| <1V	Amplitude or |Bias| ≥1V
1	Very Fine	-0.0001Hz	×0.99999	-0.0001V	×0.99999
2	Fine	-0.001Hz	×0.9998	-0.001V	×0.9998
3	Coarse	-0.01Hz	×0.99502	-0.01V	×0.99502
4	Very Coarse	-0.1Hz	×0.90909	-0.1V	×0.90909

4.7.2 Time

The 1270B has an internal timer that can be set and read. However, the timer is reset by the initialize and reset commands and is not maintained if the power fails: therefore, the timer is not recommended for use as a real-time clock —except for applications where you can be certain that none of the foregoing conditions will arise.

The timer is set by the command TM I,J, where I represents hours, and can be in the range 0 to 99, and J represents minutes, in the range 0 to 59. The time is read by separate query commands for hours, minutes and seconds by ?TM 0, ?TM 1 and ?TM 2, respectively.

5 FREQUENCY RESPONSE ANALYSIS

5.1 INTRODUCTION

This section describes the basic theory of frequency response analysis, as applied in the 1270B.

Fig 2.13 shows the basic analysis system. The GENERATOR stimulates the system under test (SUT) with a sinewave of known frequency and amplitude. The ANALYZER measures the input and the output of the SUT through CHANNEL 1 and CHANNEL 2, and uses a correlation method to compute the transfer function.

The gain and phase measurements obtained through CHANNEL 1 and CHANNEL 2 are both made with reference to the GENERATOR output. Therefore, an accurate transfer function for the SUT can be obtained by measuring each channel individually and calculating the quotient (*output÷input*). Alternatively, if you select the CH2/CH1 analyzer mode, the 1270B will compute the transfer function for you.

The correlation method used by the 1270B multiplies and integrates the input and output of the SUT over a whole number of cycles. This reduces or eliminates noise and harmonic waveforms caused by non-linearities in the system under test. Greater accuracy is obtained as the integration time, i.e. the number of integration cycles, is increased.

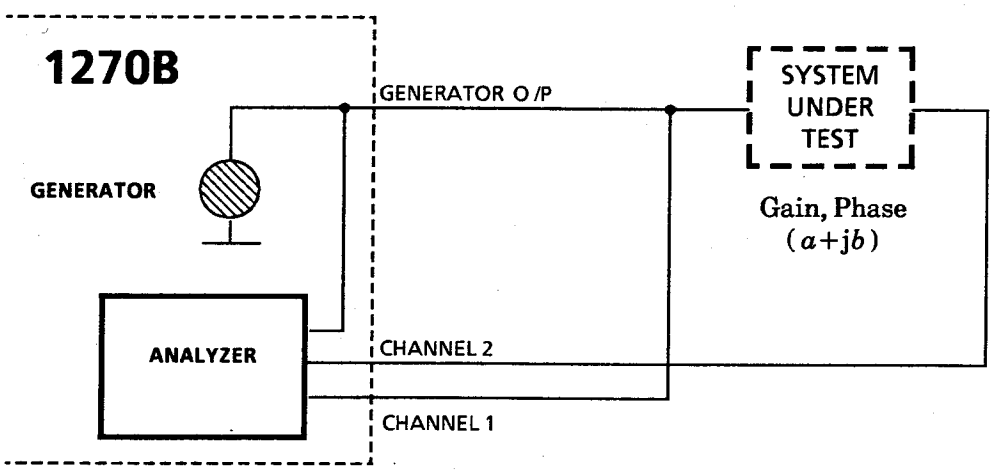


Fig 2.13 *Basic schematic of the 1270B frequency response analyzer.*

The *single sine* technique outlined above gives a precise measurement of gain and phase between any two points in a dynamic system — mechanical, electronic and electrochemical. This precision makes single sine analysis an excellent tool for assessing the performance and characteristics of complex systems. Some advantages of single sine analysis are listed below:

- The physics of sinusoidal response is well understood and can be expressed simply in mathematical terms. Therefore, experimental data can be directly related to mathematical models.
- Gain and phase parameters are easily related to physical features. Therefore, system performance can be optimised with minimum trial and error.
- Unwanted signal components are filtered out; thus the results remain accurate and repeatable, even in the presence of noise and other disturbances.

- The correlation that is part of the single sine process enables both linear and non-linear systems to be analyzed accurately and efficiently.

- Excitation at a single frequency, in effect, allows the gain of the analyzer input amplifiers to be adjusted for each frequency, thus providing a large dynamic range for gain measurement. The large dynamic range of the analysis system, combined with the high frequency resolution of the generator, allows measurements to be made on filters having sharp cut-offs and high attenuation characteristics for out-of-band signals.

5.2 BASIC FRA SYSTEM THEORY

The system under test is stimulated by the sinsusoidal waveform $Asin\omega t$. Refering to Fig 2.14, the output of the system, V_{in}, is applied to two multipliers, along with two stimulus waveforms $sin\omega t$ and $cos\omega t$. The resultant of these, i.e. $V_{in}sin\omega t$ and $V_{in}cos\omega t$, are then integrated to produce the real and imaginary parts of the system's response, $(a+jb)$.

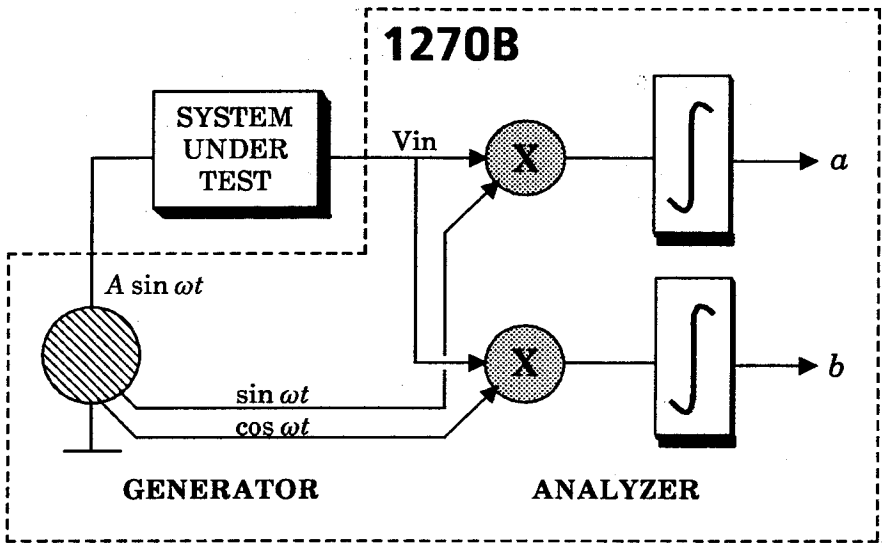


Fig 2.14 *1270B Theoretical Representation*

$$V_{in} = r\,Asin(\omega t+\theta) \qquad \ldots ①$$

where,
r=gain of the system under test, θ=phase angle of the system under test,
A=generator output amplitude, ω=angular velocity ($2\pi f$) of the generator output,
t =elapsed time.

The frequency response of the system under test can also be expressed in rectangular form as $a+jb$, where

$$r = \sqrt{(a^2+b^2)}\,, \qquad \theta = arctan(b/a)$$

or

$$a = r\cos\theta\,, \qquad b = r\sin\theta$$

To simplify equation ①, normalise all equations to the generator output, i.e.. let A=1

$$V_{in} = r\sin(\omega t+\theta)$$

$$\therefore\ V_{in} = r\sin\omega t\,.\,\cos\theta + r\cos\omega t\,.\,\sin\theta \qquad \ldots . ②$$

But $\cos\theta = a/r$ *and* $\sin\theta = b/r$

Therefore equation ② becomes,

$$V_{in} = r \sin\omega t \,.\, a/r + r\cos\omega t \,.\, b/r$$

$$\therefore \quad V_{in} = a \sin\omega t + b \cos\omega t \qquad \ldots . ③$$

If equation ③ is multiplied by $sin\omega t$, then

$$V_{in} sin\omega t = a\, sin\omega t.sin\omega t + b\, cos\omega t.sin\omega t$$

Therefore

$$V_{in}\, sin\omega t = \frac{a}{2} cos(\omega t - \omega t) - \frac{a}{2} cos(\omega t + \omega t) + \frac{b}{2} sin(\omega t + \omega t) - \frac{b}{2} sin(\omega t - \omega t)$$

$$V_{in}\, sin\omega t = \frac{a}{2} - \frac{a}{2} cos2\omega t + \frac{b}{2} sin2\omega t$$

Integrating $V_{in}sin\omega t$ over one cycle gives

$$\oint_0^{2\pi/\omega} (V_{in} sin\omega t)dt = \left[\frac{a}{2} t - \frac{a}{2}\frac{1}{2\omega} sin2\omega t - \frac{b}{2}\frac{1}{2\omega} cos2\omega t \right]_0^{2\pi/\omega}$$

$$= \left[\frac{a}{2} t + harmonics \right]_0^{2\pi/\omega}$$

$$= a\frac{\pi}{\omega}$$

$$= constant\ x\ a$$

In the same way it can be shown that

$$\oint_0^{2\pi/\omega} (V_{in} cos\omega t)dt = constant\ x\ b$$

Thus the cartesian values (a,b) of the frequency response at the analysis frequency (ω) can be derived.

Chapter 3
System Integration

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Table

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1 VXIBUS IMPLEMENTATION

The 1270B is a single slot, Message-Based Device and conforms with the VXIbus System Specification Revision 1.3.

This section details the way in which the VXIbus system interface has been implemented on 1270B. For easy reference with the VXIbus system specification, the sub-sections include the specification section number, in brackets, in the title.

The 1270B is a VMEbus slave, with no master capability. It has interrupt capability, and implements Release On Acknowledge (ROAK). Event and response interrupters are implemented. A16 addressing, D16 data transfer and D16 interrupt status /ID transfer are also implemented, along with Dynamic Configuration capabilities. The following protocols are supported:

- Trigger command,
- VXIbus Instrument,
- Programmable Interrupter Capability (This is user selectable. See Section 1.2.1.)
- Event Generation,
- Response Generation,

Manufacturer ID : 4084, Model Code : 1270.

1.1 DEVICE ADDRESSING (C.2.1.1.1)

The registers of the 1270B use A16 address space and have a 16-bit word length (D16). A unique logical address is assigned to the instrument by the settings of two hexadecimal switches, accessed at the rear of the 1270B. (Fig 3.1) On each switch an arrowed slot permits adjustment with a small screwdriver: the arrowhead points to the setting selected.

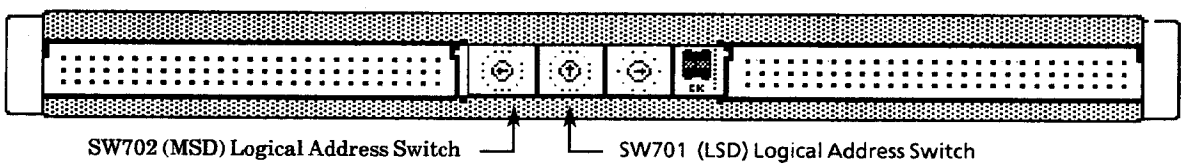


Fig 3.1 *Location of the VXI module logical address switches at the rear of the instrument.*

The LSD switch (SW701) selects the least significant digit of the address and the MSD switch (SW702) selects the most significant digit: this combination provides for any address in the range 0 through 255. The settings "MSD = 8" and "LSD = 0", for example, give a logical address of 80_{16} (= 128). Note that "0" is reserved for the VXI commander. For Dynamic Configuration, the switches must be set to 255.

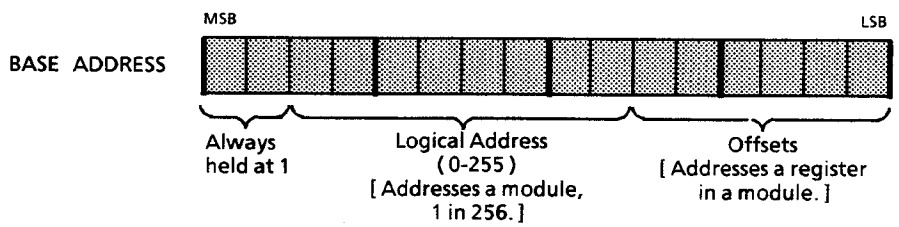


Fig 3.2 *Address relationships.*

The logical address determines the actual addresses that must be used to access the instrument registers, which are the *configuration* and *communication* registers described in Section 1.4. Fig 3.2 above shows the relationship between the base address, the logical address and the register addresses.

1.2 PRIORITY INTERRUPTS (C.2.1.3)

The 1270B has Interrupter capability, which is indicated to the resource manager by a "1" in bit 12 of the protocol register. A priority interrupt is requested on one of seven lines, IRQ1* through IRQ7*. The line to be used by the 1270B is selected with the 10-position INT LEVEL switch (Fig 3.3), accessed at the rear of the instrument.

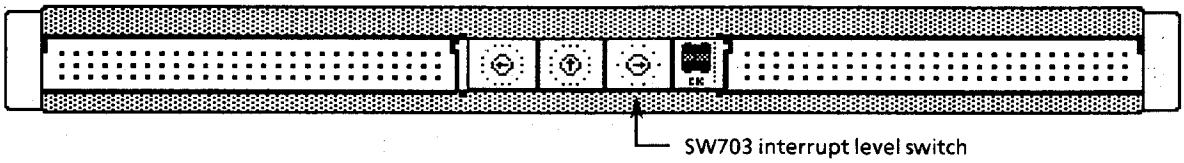


Fig 3.3 *Location of the 1270B INT LEVEL switch [at rear of instrument].*

The INT LEVEL switch has an arrowed slot that permits adjustment with a small screwdriver: the arrowhead points to the selected setting. The interrupt functions thus made available are:

settings 1 through 7	select IRQ lines 1 through 7, respectively,
settings 0 and 8	disable priority interrupts, newline or heading,
setting 9	enables the programmable interrupter capability (Section 1.2.1).

1.2.1 Programmable Interrupter Capability

The programmable interrupter capability is user selectable. To enable this capability, set switch SW703 on the rear panel of the 1270B to position 9 (see above). In all other positions of SW703 the programmable interrupter capability is inhibited.

The controller is able to check the availability of the programmable interrupter capability by sending a "Read Protocol" command. Bit #6 (PI*) in the response is set to "0" when the facility is available, or to "1" when it is not.

1.3 1270B TO 1270 CONVERSION

The 1270B conforms with VXIbus Specification, Revision 1.3. For systems that conform with the VXIbus Specification, Revision 1.2, the 1270B may easily be converted for use as a 1270 with a switch setting. Should the system subsequently be converted to conform with the VXIbus Specification, Revision 1.3, then an equally simple operation converts the instrument back to a 1270B. The operational differences between the 1270B and the 1270 are shown in Appendix A.

The conversion switch, shown below, is set to the "up" position for 1270B operation and to the "down" position for 1270 operation.

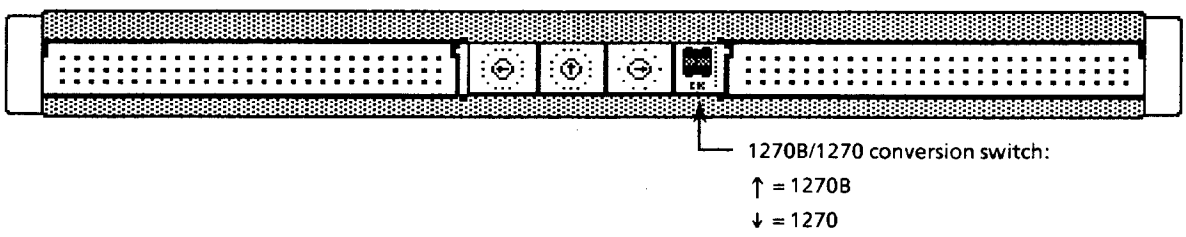
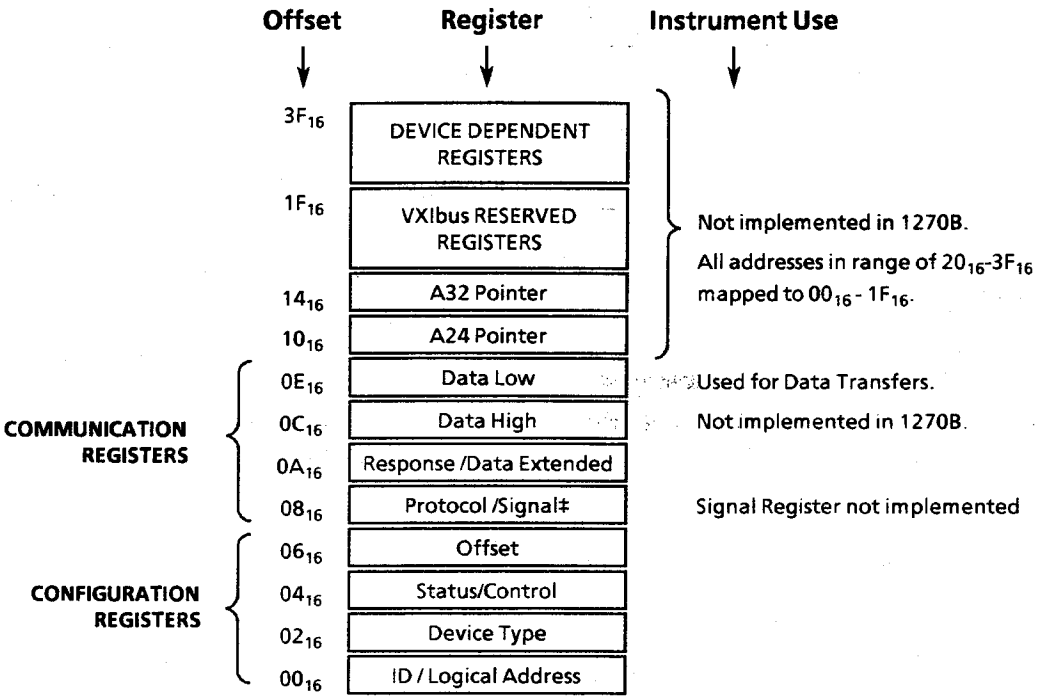


Fig 3.4 *Location of the 1270B/1270 conversion switch [at rear of instrument].*

The operational differences between the 1270B and the 1270 are shown in Appendix A.

1.4 VXIBUS REGISTERS (C.2.1.1.2) & (C.2.4.3.1)

The registers through which the 1270B is operated from the VXIbus are shown in Fig 3.5 below.



‡Signal Register not implemented, indicated to the Resource Manager by a "1" in bit 14 of the Protocol Register.

Fig 3.5 *VXIbus register map of the 1270B.*

Note: VXIbus register bits that are suffixed with an asterisk use negative logic. This is a convention of the VXIbus specification.

The 1270B does not implement any registers in the range of 10_{16} through $3F_{16}$. Address offsets 20_{16} through $3F_{16}$ map onto 00_{16} through $1F_{16}$. Where registers are shown as "Not implemented in 1270B" writing to them has no effect and reading them will return $FFFF_{16}$.

Logical Address Register (Write Only)

Bits	Definition	Value Written	Interpretation
15- 8 7- 0	Undefined. Logical Address.	Don't care Logical Address	Contains logical address when Dynamic Configuration is used.

ID Register (Read Only)

Bits	Definition	Contents	Interpretation
15-14	Device class.	10_2	Message-based device.
13-12	Address Space.	11_2	A16 only.
11- 0	Manufacturer Identity.	4084_{10}	Schlumberger Instruments ID No.

Device Type Register (Read Only)

Bits	Definition	Contents	Interpretation
15-0	Model Code.	1270_{10}	The FRA type number.

Status Register (Read Only)

Bits	Definition	Contents	Interpretation
15	Device Dependent.	always 1	
14	MODID*	†	
13- 4	Device Dependent.	always 1	
3	Ready	†	
2	Passed.	†	
1- 0	Device Dependent.	always 1	

† These bits are set/reset under the conditions defined in the VXI Specification Rev 1.3

Control Register (Write Only)

Bits	Definition	Value Written	Interpretation
15	A24/A32 Enable.	Don't care	
14-2	Device Dependent.	Don't care	
1	Sysfail Inhibit.	†	
0	Reset.	†	

† These bits are set/reset under the conditions defined in the VXI Specification Rev 1.3

Offset Register (Read Only)

Bits	Definition	Contents	Interpretation
15- 8	Undefined.	FF_{16}	
7- 0	Number of Devices.	01_{16}	Indicates the 1270B is a single device.

Protocol Register (Read Only)

Bits	Definition	Contents	Interpretation
15	CMDR*	1	Instrument has servant capability only.
14	Signal Register*	1	No signal register.
13	Master*	1	No VME master capability.
12	Interrupter.	1	Instrument has interrupter capability.
11	FHS*	1	No fast handshake mode.
10	Shared Memory*	1	No shared memory protocol.
9- 4	Reserved.	1	Reserved for future definition.
3- 0	Device Dependent.	always 1	

Signal Register (Write Only)

Bits	Definition	Value Written	Interpretation
15-0	Not Implemented.	Don't care	

Response Register (Read Only)

Bits	Definition	Contents	Interpretation
15	0	0	
14	RESERVED	1	Reserved for future VXI definition.
13	DOR	†	DOR bit implemented.
12	DIR	†	DIR bit implemented.
11	Err*	†	Err* bit implemented.
10	Read Ready.	†	
9	Write Ready.	†	
8	FHS Active*	1	No Fast Handshake capability.
7	Locked*	†	
6- 0	Device Dependent.	always 1	

† These bits are set/reset under the conditions defined in the VXI Specification Rev 1.3.

Data Extended Register (Write Only)

Bits	Definition	Value Written	Interpretation
15-0	Not implemented.	Don't care	

Data Low Register (Read / Write)

Bits	Definition	Data	Interpretation
15-0		†	

† These bits are set/reset under the conditions defined in the VXI Specification Rev 1.3.

1.5 WORD SERIAL PROTOCOL COMMANDS (E.1)

The word serial protocol commands that are implemented in the 1270B are listed in Table 3.1. Further details and word formats may be found in the VXIbus Specifications, Revision 1.3.

Table 3.1 Word Serial Protocol Commands Implemented in1270B

Protocol/Commands	Comments
VXIbus Instrument (I)	
Abort Normal Operation	Implemented as defined in VXIbus spec, rev. 1.3.
Begin Normal Operation	Implemented as defined in VXIbus spec, rev. 1.3.
End Normal Operation	Implemented as defined in VXIbus spec, rev. 1.3.
Byte Available *Byte Request*	Implemented as defined in VXIbus spec, rev. 1.3, Byte Transfer Protocol.
Clear	On receiving a clear command the 1270B: • clears its input buffer (set DIR) • clears its output queue (clear DOR, if appropriate) • becomes ready to process new commands.
Clear Lock *Set Lock*	Implemented as defined in VXIbus spec, rev. 1.3, but no action is taken as 1270B has no source of local control.
Identify Commander	This command is accepted, but the information is not used because the 1270B has no VMEbus master capability. The 1270B uses interrupts rather than signals to communicate with its bus master.
Read Protocol	Protocols supported are VXIbus instruments, programmable interrupter and event, response generation and trigger command.
Read Protocol Error	1270B detects all word serial protocol errors. (See Section 1.7 in this chapter.)
Read STB	The status byte of the 1270B is defined in Chapter 4.
Trigger Command (TRG)	
Trigger	Generates an SI command.
Programmable Interrupter (PI)	
Assign Interrupter Line *Read Interrupter Line* *Read Interrupters*	Implemented as defined in VXIbus spec, rev. 1.3, when enabled by switch on 1270B rear panel (See Section 1.2 in this chapter).
Event Generation (EG) and Response Generation (RG)	
Asynchronous Mode Control *Control Event* *Control Response*	Implemented as defined in VXIbus spec, rev. 1.3.

1.6 WORD SERIAL PROTOCOL EVENTS (E.4)

Events are sent using interrupts, not signals. The *request true* and *request false* events are generated by changes in the internal state of 1270B, depending on the value of the Service Request Enable Register that are set with the "SV" command.

1.7 ERROR HANDLING (C.3.3.4)

The 1270B detects all word serial protocol errors:

- Unsupported Command,
- Multiple Query,
- DIR Violation,
- DOR Violation,
- Write Ready Violation,
- Read Ready Violation.

1.8 STATUS REPORTING REGISTERS

It is often necessary for the 1270B to signal to the VXIbus commander that a particular event has occurred; for example, that a measurement has completed or an error occurred. The 1270B does this using *interrupts*, and it can be commanded to interrupt when specific circumstances occur. The required circumstances are defined by the contents of two registers:

- the Status Byte Register,
- the Service Request Enable Register.

The inter-relationship of these registers is shown schematically in Fig 3.6.

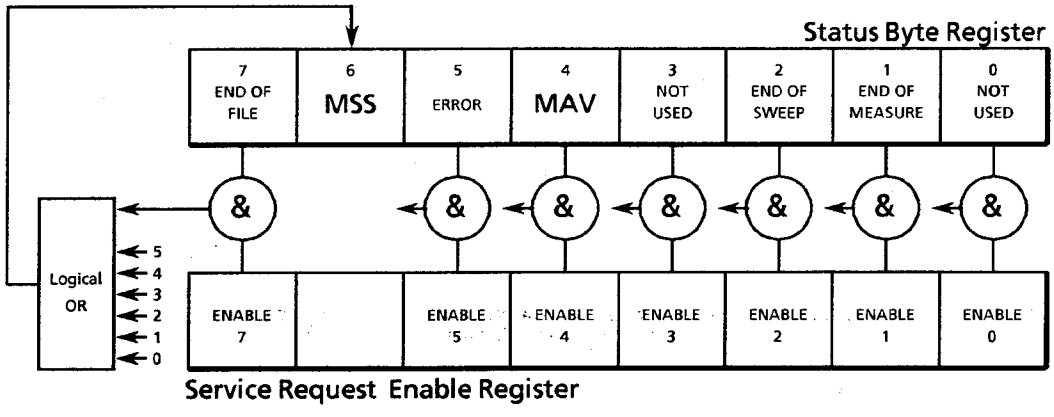


Fig 3.6 *Status reporting registers.*

The Status Byte register stores the 1270B specific events such as "end of sweep", and two standard events (MSS and MAV) that are defined by IEEE 488. Interrupts from the Status Byte register are enabled, or disabled, by the bit states of the Service Request Enable Register, which acts as an interrupt "mask"

The Status Byte Register can be read with the VXIbus word serial command "Read STB". Whenever an event is true the corresponding bit is set to "1" (e.g. bit 3 is set to "1" at the end of a sweep) otherwise the bit is set to "0". Bits 1 through 4, and 7, continuously follow status changes, e.g. if the 1270B is measuring in the RECYCLE mode then bit 1 is set to "1" as each measurement is completed and reset to "0" as a new measurement starts.

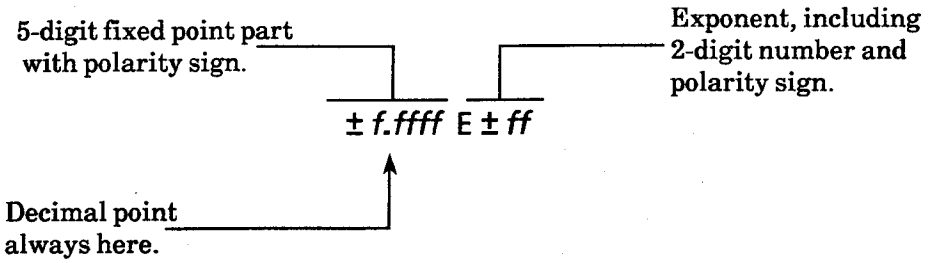
The information contained in the status byte is summarised in Table 3.2.

Table 3.2 Status Byte Information

Bit No.	Title	Function
0	–	Not used.
1	End of Measure	Set to "1" at the end of a measurement, and to "0" when a new measurement starts.
2	End of Sweep	Set to "1" at the end of asweep, and to "0" when a new sweep starts.
3	–	Not used.
4	MAV	Message available: set t0 "1" when data is available in the *output queue*; otherwise, set to "0".
5	Error	Set to "1" whenever a 1270B error or warning is detected; otherwise, set to "0".
6	MSS	Master summary status: set to "1" whenever an event in the status byte register is true and enabled; otherwise, set to "0".
7	End of File	Set to "1" when: a. the n^{th} reading is read in to file, where n is the file size, or b. the final reading, whatever number this may be, is read from the file; otherwise, set to "0".

2 DATA OUTPUT [BINARY OR ASCII]

In ASCII output mode the 1270B automatically allocates to each number in the reading a constant field width of 11 characters, containing a 5-digit fixed point part and a 2-digit exponent. For example, the frequency field is of the form:



A complete reading takes the form:

$$\pm f.fffffE \pm ff<,> \pm a.aaaaE \pm aa<,> \pm b.bbbbE \pm bb<,> e<cr>$$

where f = frequency
a = a , r , r (dB)
b = b , θ
e = error code

"e" represents a 1-digit Error Code: 0=okay, 1=overload. In this example, the Output Separator character is shown as a comma, and the Output Terminator is CR (Carriage Return).

3 DUMP OUTPUT

This mode provides the fastest means of outputting data from the 1270B. Each reading is compressed into 12 bytes of binary information.

The format is:

$$aaaabbbbffff$$

which represents 3 × 4-byte floating point numbers, where:

$aaaa$ = in phase data
$bbbb$ = quadrature data
$ffff$ = frequency

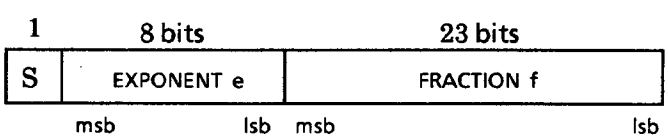
The floating point format used is described in the following section.

No separators or terminators are sent, as there is no way they can be distinguished from binary data.

The output rate is approximately 1 byte per millisecond, but the data is compressed into only 12 bytes compared with up to 40 bytes for ASCII. Also, in this mode, the internal computation time of the 1270B is less.

3.1 FLOATING POINT FORMAT

The floating point format conforms to the ANSI/ IEEE Standard 754. It consists of a 4-byte (32 bit) floating point number, as shown below:



S = Sign bit
msb = most significant bit
lsb = least significant bit

The value of the number is $(-1)^s 2^{e-127}(1.f)$ provided that $0<e<255$

Note:

1. A zero sign bit indicates a positive number: a 1 sign bit indicates a negative number.
2. If e=0 and f=0,the value of the floating point number is zero.
3. If e=255 and f=0, the value of the floating point number is $\pm\infty$

4 ACCEPTANCE CHECK

The acceptance check verifies that the instrument is functioning correctly. This may be used as a "goods inwards" check, or as a "confidence" check after the instrument has been repaired.

The equipment required for the acceptance check is as follows :

- VXI card frame
- Digital Multimeter, Schlumberger 7060G, 7151 or 7150plus or equivalent
  d.c. volts 0.01%
  a.c. volts 0.05%
- Oscillator, sine / square, 400Hz ± 1%, 5V rms
- 50ohm BNC short-circuit or terminator.
- Timer/Counter, 0.2Hz - 20kHz, 0.001%
- Oscilloscope

Convention
The commands to be sent to the 1270B are given in brackets :- [ ]

4.1 SELF TEST

Set the address and interrupt switches (accessible at the rear of the 1270B) as required to work in your system. See Sections 1.1 and 1.2 for further details.

4.1.1 The Front Panel LEDs

As the VXI chassis is powered-up, check that the front panel LEDs operate as follows:

FAIL	Normally unlit; lights briefly at power ON, or whenever the VXI SYSRESET* line is asserted.
POWER	Lit when power is ON.
MSG	Normally unlit, but flashes as messages pass between the controller and the card under test.
MODID	Normally unlit; lights briefly at power ON, if SW701 and SW702 are set to FF.
O/LOAD	Normally unlit; lights briefly at power ON, and when analyzers up-range automatically.

4.1.2 Circuit Self Test

Command:

SELF TEST		[TT 4]
	Query result	[?TS0]

The reply should be "00" indicating a "PASS". Any other reply indicates a faulty unit.

4.2 GENERATOR CHECK

1 Set up the following:

INITIALISE			[TT 1]
GENERATOR	Amplitude	10V	[AM 10]
	Waveform	square	[WV 1]
	Stop Mode	0°	[SM 1]
	Run Generator		[RG]

2 As shown in Fig 3.7, connect the Generator output to the CH1 and CH2 inputs, the DVM, the oscilloscope, and the timer / counter.

Program each of the following frequencies and check that the frequency counter gives the correct reading, within the limits stated. (At the lower frequencies measure period instead of frequency. Then calculate the frequency by taking the reciprocal value. This gives a more accurate result.)

Frequency	**Limits**			
200 mHz	4.9995s	to	5.0005s	[FR 0.2]
2 Hz	499.95ms	to	500.05ms	[FR 2]
20 Hz	19.998Hz	to	20.002Hz	[FR 20]
200 Hz	199.98Hz	to	200.02Hz	[FR 200]
2 kHz	1.9998kHz	to	2.0002kHz	[FR 2E3]
20 kHz	19.998kHz	to	20.002kHz	[FR 2E4]

3 Command:

GENERATOR	Waveform	Sine	[WV0]

Monitor the generator output on an oscilloscope, checking that the waveform is a sinewave.

4 Still using the oscilloscope, connect a short circuit (or BNC terminator) across the START / STOP input and check that the Generator output stops.

Release the STOP / START input, i.e. remove short circuit, and check that the generator output re-starts.

5 Set the generator frequency to 300Hz [FR 300]. With the DVM set to measure a.c. volts, monitor the following Generator output with the DVM and check that the readings are within the limits stated. Record the results as indicated, for use in Section 4.3.

Amplitude	**Limits**				**Record as**
10 V	9.89V	to	10.11 V	[AM 10]	"a"
3 V	2.96V	to	3.04 V	[AM 3]	"b"
1.0 V	0.98V	to	1.02 V	[AM 1]	
0.3 V	0.287V	to	0.313 V	[AM 0.3]	"c"
0.03 V	19.7V	to	40.3 mV	[AM 0.03]	"d"

6 Set the DVM to measure d.c. volts .

Program a Generator Amplitude of 0V [AM 0] and bias voltages as follows, and for each voltage check that the DVM reading is within the limits stated:

Bias	Limits			
10V	9.88V	to	10.12V	[BI 10]
5V	4.93V	to	5.07V	[BI 5]
1V	0.970V	to	1.030V	[BI 1]
0V	–0.020V	to	0.020V	[BI 0]
–1V	–0.970V	to	–1.030V	[BI -1]
–5V	–4.93V	to	–5.07V	[BI -5]
–10V	–9.88V	to	–10.12V	[BI-10]

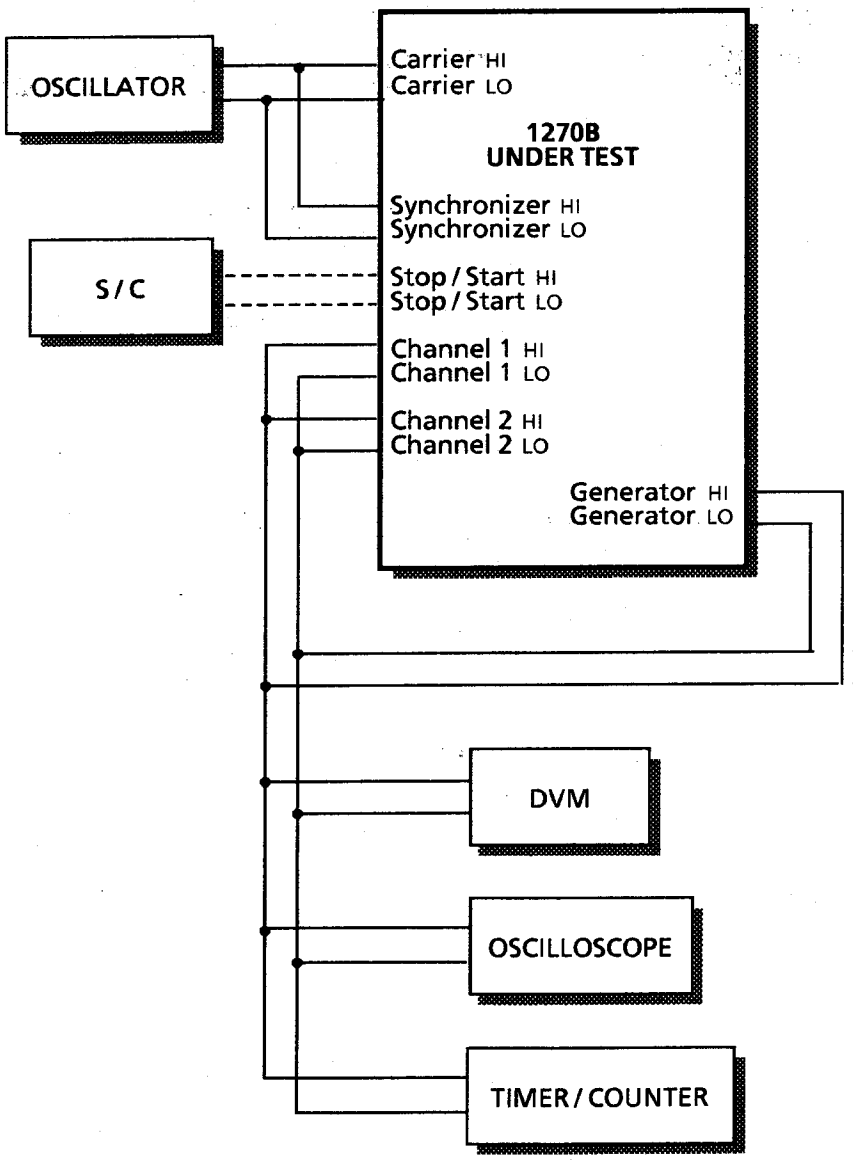


Fig 3.7 *Acceptance test connections.*

4.3 ANALYZER CHECK

1 Set up the following:

INITIALISE			[TT 1]
GENERATOR	Frequency	300Hz	[FR 300]
ANALYZER	Integration time	1sec	[IS 1]
	Range	300V	[RA 1,5]
			[RA 2,5]
SOURCE		CH1	[SO 0100]
RECYCLE			[RE]

2 As shown in Fig 3.7, connect the Generator output to the Channel 1 and 2 inputs. Do the tests below. Values "a" to "d" come from the generator tests in Section 4.2.

Range	**Input**	**Reading**		**Commands**		
		Magnitude	*Phase*			
300V	10V	a ±0.5V	±0.50°	[AM 10]	[RA 1,5]	[RA 2,5]
30V	10V	a ±0.050V	±0.50°	[AM 10]	[RA 1,4]	[RA 2,4]
3V	3V	b ±0.0150V	±0.50°	[AM 3]	[RA 1,3]	[RA 2,3]
300mV	300mV	c ±1.50mV	±0.50°	[AM 0.3]	[RA 1,2]	[RA 2,2]
30mV	30mV	d ±0.150mV	±0.50°	[AM 0.03]	[RA 1,1]	[RA 2,1]

Repeat the tests above for Channel 2 [SO 0200].

Then using the same set up except :

SOURCE	CH2/CH1	[SO 0201]
CO-ORDINATES	r (dB), theta	[CO 2]

Repeat the test as below :

Range	**Input**	**Reading**		**Commands**		
		Magnitude	*Phase*			
300V	10V	±0.9dB	±0.50°	[AM 10]	[RA 1,5]	[RA 2,5]
30V	10V	±0.05dB	±0.50°	[AM 10]	[RA 1,4]	[RA 2,4]
3V	3V	±0.05dB	±0.50°	[AM 3]	[RA 1,3]	[RA 2,3]
300mV	300mV	±0.05dB	±0.50°	[AM 0.3]	[RA 1,2]	[RA 2,2]
30mV	30mV	±0.05dB	±0.50°	[AM 0.03]	[RA 1,1]	[RA 2,1]

4.4 MODULATOR CHECK

1 As shown in Fig 3.7, connect the output of the sine / square oscillator to the 1270B carrier input. Set the oscillator to apply a 400Hz, 5V sine wave to the 1270B carrier input. On the 1270B, set up the following:

GENERATOR	Frequency	20Hz	[FR 20]
	Amplitude	1V	[AM 1]
	Modulator	on	[MO 1]
ANALYZER	Integration time	1 sec	[IS 1]
	Demodulator 1	on	[DE 1,1]
SOURCE		CH1	[SO 0100]
RECYCLE			[RE]

2 Check that carrier status indicates ON by commanding [ST]. Check for a 400Hz carrier modulated by 20Hz at the generator output, using the oscilloscope.

3 Connect the generator output to both the Channel 1 Input and the DVM (set to a.c. volts). Check that the analyzer reading is 1V±15mV and that the DVM agrees to within 5mV.

4.5 SYNCHRONIZER CHECK

1 Set up the following:

INITIALISE			[TT 1]
GENERATOR	Amplitude	2V	[AM 2]
	Synchronizer	on	[SY 1]
ANALYZER	Integration time	0.5 sec	[IS 0.5]
RECYCLE			[RE]

2 The command [?SN] is used to check the status of the synchronizer. The expected response "01" indicates "idle".

3 Set up the sine/square oscillator to give a 400Hz, 5V square wave. This signal must swing beyond the limits ±1V.

As shown in Fig 3.7, connect the oscillator output to the synchronizer input and to the timer / counter. Measure the oscillator frequency with the timer / counter and record this value as "f".

4 Connect the timer / counter input to the 1270B generator output and measure the frequency. Check that the value is "f" ± 0.56Hz.

5 Command a single measurement [SI]. Using the [?SF 0] command, check that the synchronizer frequency lies in the range "f" ± 0.56Hz.

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Commands

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1 INTRODUCTION

Each command code consists of a simple ASCII-character string, often qualified by an argument (also in ASCII).
The majority of codes are qualified by a numerical argument. In the following lists:

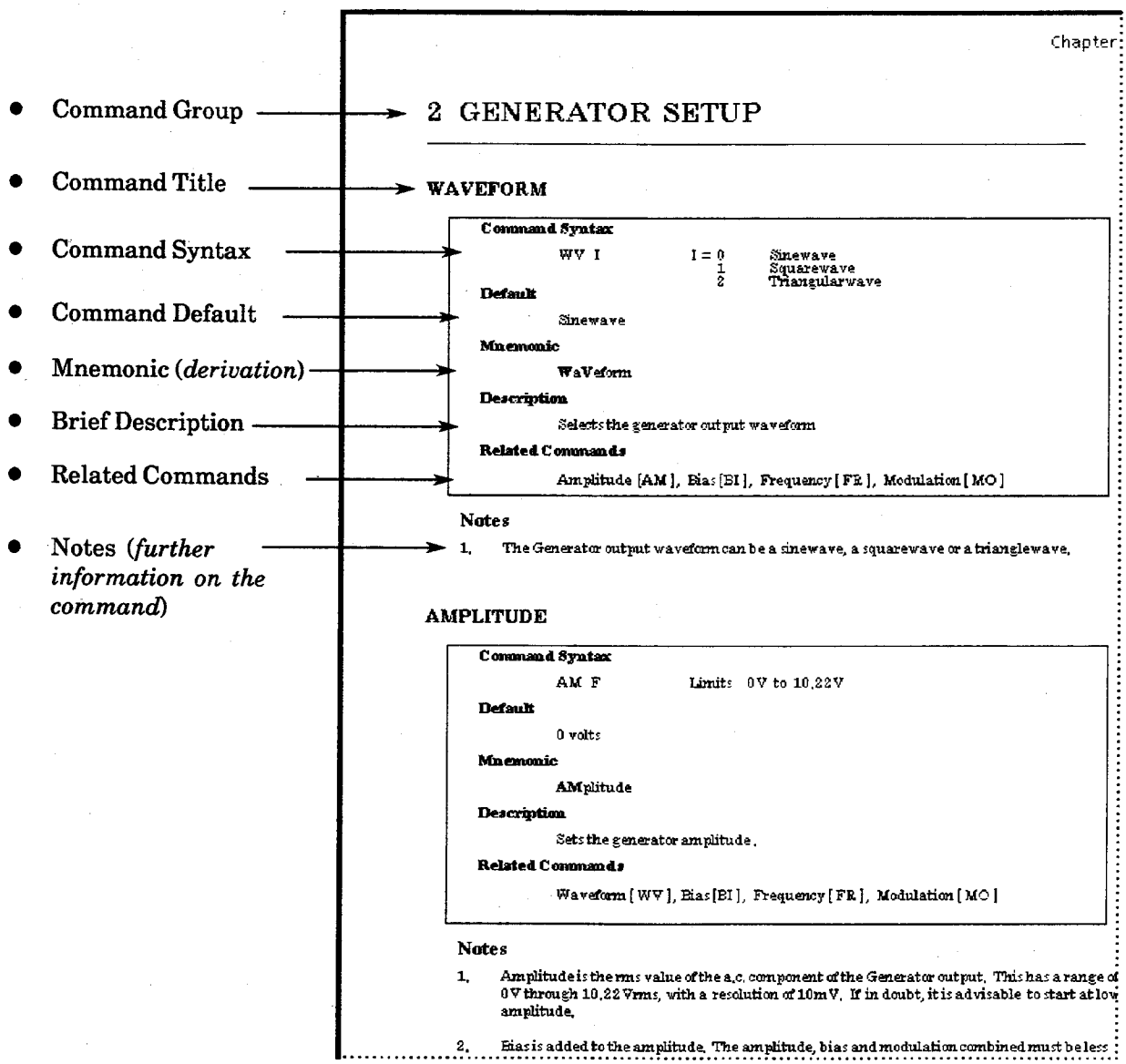
F is a floating point number ±*n.nnnn* E ±*xx* (Note ±*n.nn* will be accepted)
I is an integer of up to 2 digits
I, J is two integers of up to 2 digits each, separated by a comma
D is an integer of up to 4 digits

Default values are stated for all commands and all commands must be entered in upper case.
Most commands can be queried simply by typing a (?) in front of the command e.g. ?FR

The command terminators are carriage return (cr), line feed (lf), END and semi-colon (;).

1.1 COMMAND DESCRIPTION FORMAT

The command descriptions in this chapter have the following format :



2 GENERATOR SETUP

WAVEFORM

Command Syntax

WV I I = 0 Sinewave
1 Squarewave
2 Triangularwave

Default

Sinewave

Mnemonic

WaVeform

Description

Selects the generator output waveform

Related Commands

Amplitude [AM], Bias [BI], Frequency [FR], Modulation [MO]

Notes

1. The Generator output waveform can be a sinewave, a squarewave or a trianglewave.

AMPLITUDE

Command Syntax

AM F Limits 0V to 10.22V

Default

0 volts

Mnemonic

AMplitude

Description

Sets the generator amplitude.

Related Commands

Waveform [WV], Bias [BI], Frequency [FR], Modulation [MO]

Notes

1. Amplitude is the rms value of the a.c. component of the Generator output. This has a range of 0V through 10.22Vrms, with a resolution of 10mV. If in doubt, it is advisable to start at low amplitude.

2. Bias is added to the amplitude. The amplitude, bias and modulation combined must be less than 15V, otherwise Error 22 will occur.

3. For triangular waveforms the amplitude range is restricted to 0V through 5.11Vrms.

FREQUENCY

Command Syntax

FR F Limits 1E-3 to 2E4 Hz

Default

100 Hz

Mnemonic

FRequency

Description

Sets the Generator frequency .

Related Commands

Waveform [WV] , Amplitude [AM] , Bias [BI] , Modulation [MO] ,

Notes

1. The frequency range of the Generator output is 1mHz through 20kHz, with a maximum resolution of 1 in 4000. To step the frequency automatically use the SWEEP menu.

BIAS

Command Syntax

BI F Limits -10.22 to 10.22 V

Default

0 volts

Mnemonic

BIas

Description

Sets the dc bias applied to the Generator output.

Related Commands

Waveform [WV] , Amplitude [AM] , Frequency [FR] , Modulation [MO]

Notes

1. Bias is a steady d.c. offset of the Generator output in the range -10.22Vdc to +10.22Vdc, with a resolution of 20mV. This is useful for setting a quiescent operating point in the system under test, or for cancelling d.c. offsets in the system.

2. The peak output of the Generator, set by the combination of Amplitude [AM] , Bias [BI] and Modulation [MO] , cannot exceed ±15V.

MODULATION

Command Syntax

MO I I = 0 modulation off
1 modulation on

Default

Modulation off

Mnemonic

MOdulation

Description

Selects modulation on or off

Related Commands

Waveform [WV], Frequency [FR], Amplitude [AM], Bias [BI]

Notes

1. The Modulator enables measurements to be made on systems that require amplitude modulated carrier signals. To achieve the full specified accuracy when using the modulator, particularly for carrier frequencies less than 400Hz, the ratio between the carrier and input frequencies should be kept to integer values. If this cannot be achieved, longer integration times should be used. (Refer to Chapter 2. Section 3.)

STOP GENERATOR

Command Syntax

SG

Default

Generator output off

Mnemonic

Stop Generator

Description

Selects generator output off .

Related Commands

Stop Mode [SM], Stop Quadrant [SQ], Run Generator [RG]

Notes

1. The SG command stops the Generator. Depending on the selection made with the Generator STOP MODE command, the Generator waveform either remains at the level reached when the command was actioned or drops to the bias voltage.

2. **Because of its immediate action, the GEN STOP command can be used as a 'Panic Switch' to stop the measurement if things seem to be getting out of control!**

STOP MODE

Command Syntax

SM I I = 0 Generator output freeze
1 Generator output kill

Default

Generator output freeze

Mnemonic

Stop Mode

Description

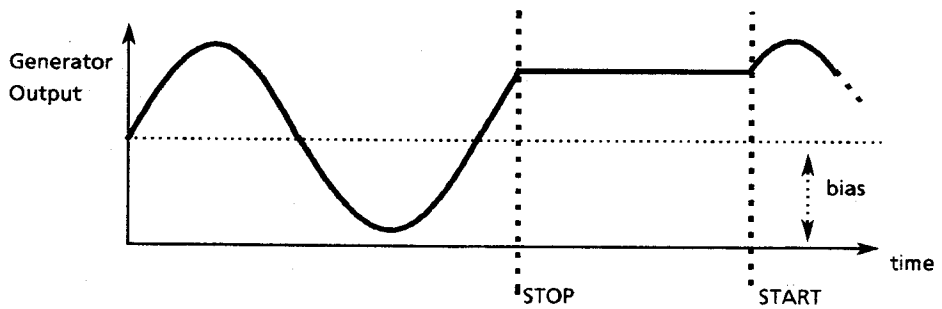
Selects the position in which the Generator stops.

Related Commands

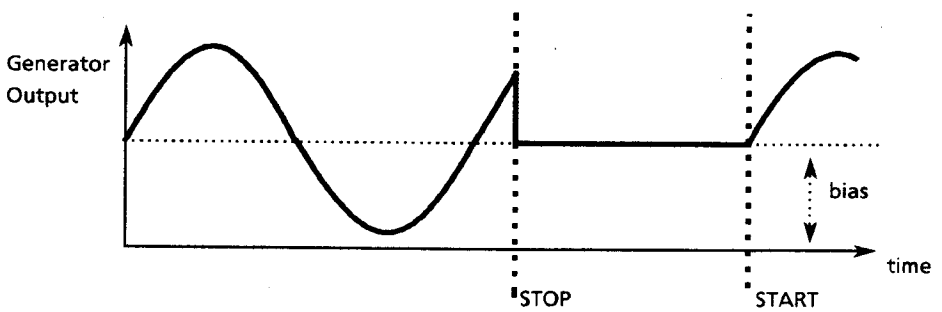
Stop Quadrant [SQ], Stop Generator [SG], Run Generator [RG]

Notes

1. The following diagrams show the action the Generator takes when the SM command is actioned.



[**freeze**] *Stops the Generator at the existing output level*



[**kill**] *Sets the Generator to zero (Note: Bias will not be removed)*

STOP QUADRANT

Command Syntax

SQ I

I = 0 Generator held @ 0
1 Generator held @ 90
2 Generator held @ 180
3 Generator held @ 270

Default

Generator held @ 0

Mnemonic

Stop Quadrant

Description

Selects the quadrant in which the Generator is held .

Related Commands

Stop Mode [SM] , Stop Generator [SG] , Run Generator [RG]

Notes

1. This command stops the Generator at the specified quadrant point. The Generator waveform then remains at that level.

RUN GENERATOR

Command Syntax

RG

Default

Generator output on

Mnemonic

Run Generator

Description

Selects Generator output on

Related Commands

Stop Mode [SM] , Stop Generator [SG] , Stop Quadrant [SQ]

Notes

1. The Generator is started automatically by "SI" and "RE".

3 ANALYZER

INTEGRATION TIME

Command Syntax

IS F Limits 0.1 to 1E5 secs

Default

0.1 secs

Mnemonic

Integration Seconds

Description

Integrates for IS seconds or 1 / FR which ever is the larger.

Related Commands

None

Notes

1. With ch2/ch1 there are two sequential integrations, one for each channel.

DEMODULATION

Command Syntax

DE I,J I = 1 Demod channel 1; 2 Demod channel 2 J = 0 Demod off; 1 Demod on

Default

Demod off

Mnemonic

DEmodulation

Description

Selects Demodulation on or off for channels 1 or 2

Related Commands

None

SINGLE

Command Syntax

SI

Default

Not Applicable

Mnemonic

SIngle

Description

Commands the Analyzer to take a single measurement

Related Commands

Recycle [RE], Stop Analyzer [SA]

Notes

1. SIngle is an instant action command that starts the Generator, if this is not running. There is a one second delay before starting measurement.

RECYCLE

Command Syntax

RE

Default

Not Applicable

Mnemonic

REcycle

Description

Commands the Analyzer to take a continuous series of measurements

Related Commands

Single [SI], Stop Analyzer [SA]

Notes

1. REcycle is an instant action command that starts the Generator, if this is not running. There is a one second delay before starting measurement.

STOP ANALYZER

Command Syntax

SA

Default

Not Applicable

Mnemonic

Stop Analyzer

Description

Stops the analyzer

Related Commands

Single [SI], Recycle [RE]

Notes

1. With this command the Generator left running.

RANGE ANALYZER

Command Syntax

RA I, J

I = 1	Channel 1	J = 0	Range auto
2	Channel 2	1	Range 30 mV
		2	Range 300 mV
		3	Range 3 V
		4	Range 30 V
		5	Range 300 V

Default

Auto

Mnemonic

Range Analyzer

Description

Selects Analyzer channel and range

Related Commands

Analyzer Range [?AR] & [?RA]

ANALYZER RANGE

Command Syntax

? AR I	I =	1	Channel 1
Reply		2	Channel 2

Default

Not Applicable

Mnemonic

Analyzer Range

Description

Returns the range on one of the two channels at the last measurement. The reply could be in the following ranges :

0	Range	auto
1	Range	30 mV
2	Range	300 mV
3	Range	3 V
4	Range	30 V
5	Range	300 V

Related Commands

Range Analyzer [RA] & [?RA]

4. SYNCHRONIZER

SYNCHRONIZER

Command Syntax

SY I

I = 0 Synchronizer off
1 Synchronizer on

Default

Synchronizer off

Mnemonic

SYnchronizer

Description

Establishes frequency and phase lock between internal generator and external excitations or signal source

Related Commands

Synchronizer Frequency [?SF I], Synchronizer Status [?SN]

SYNCHRONIZER FREQUENCY

Command Syntax

?SF I
Reply

I = 0 Input Frequency
1 Max Frequency
2 Min Frequency
3 Start Frequency
4 Stop Frequency
5 Average Frequency

Default

Not Applicable

Mnemonic

Synchronizer **F**requency

Description

Returns requested synchronizer frequency

Related Commands

Synchronizer [SY], Synchronizer Status [?SN]

SYNCHRONIZER STATUS

Command Syntax

?SN	Q =	0	Off
Reply Q		1	Idle
		2	Wait
		3	Locked
		4	Fault 1
		5	Fault 2
		6	Fault 3

Default

Not Applicable

Mnemonic

SyNchronizer Status

Description

Reports the Status of Synchronizer

Related Commands

Synchronizer [SY] , Synchronizer Frequency [SF I]

Notes

1. The synchronizer status reported may be any of the following:

0 (=Off)	Synchronizer is off.
1 (=Idle)	Synchronizer is on but has not yet detected the first two level changes in the synchronizing signal.
2 (=Wait)	Synchronizer is waiting for a stable signal.
3 (=Locked)	Synchronizer has achieved satisfactory synchronism. Measurements can be taken.
4 (=Fault 1)	Frequency overflow. Input frequency >20 kHz.
5 (=Fault 2)	Time overflow. Input frequency <1 mHz.
6 (=Fault 3)	Signal unstable. If the input frequency varies by more than 10%, noisy analyzer results are possible.

5. SWEEP

SWEEP

Command Syntax

SE I I = 0 Sweep off
1 Sweep up
2 Sweep down

Default

Sweep off

Mnemonic

SwEep

Description

Selects sweep options.

Related Commands

Minimum Sweep [MI], Maximum Sweep [MA], Log Sweep [GS]

Notes

1. The following sweep options may be selected:

[off]	No frequency sweep will occur.
[up]	The frequency is swept upwards according to the parameters entered in the rest of the sweep menu.
[down]	The frequency is swept downwards according to the parameters entered in the rest of the sweep menu.

MINIMUM SWEEP FREQUENCY

Command Syntax

MI F Limits = 1E-3 to 2E4 Hz

Default

100 Hz

Mnemonic

MInimum frequency

Description

Minimum value of frequency during sweep

Related Commands

Sweep [SE], Maximum Sweep [MA], Log Sweep [GS]

Notes

1. The minimum sweep frequency selectable is in the range 1mHz through 20kHz, with a maximum resolution of 1 in 4000.

MAXIMUM SWEEP FREQUENCY

Command Syntax

MA F Limits = 1E-3 to 2E4 Hz

Default

2E4 Hz

Mnemonic

MAximum frequency

Description

Maximum value of frequency during sweep.

Related Commands

Sweep [SE], Minimum Sweep [MI], Log Sweep [GS]

Notes

1. The maximum sweep frequency selectable is in the range 1mHz to 20kHz, with a maximum resolution of 1 in 4000.

LOGARITHMIC SWEEP

Command Syntax

GS D Limits = 2 to 9999 points / sweep

Default

100 points / sweep

Mnemonic

lo**G** Sweep

Description

Number of steps in the sweep, which is logarithmic

Related Commands

Sweep [SE], Minimum Sweep [MI], Maximum Sweep [MA]

Notes

1. The number of measurement points per sweep can be selected within the range 2 through 9999.

2. Step ratio = $(N-1)^{th}$ root of FR max / FR min, where N = steps/sweep.

6. VXI Commands

OUTPUT CONTROL

Command Syntax

OP 2,I

I = 0 Output off
1 Output in ASCII
2 Output in Binary

Default

Output off

Mnemonic

OutPut Control

Description

Selects output format

Related Commands

None

OUTPUT TERMINATOR

Command Syntax

OT I

I = 0 <CR><LF>
1 <CR><LF>
2 <CR>
3 <CR>

Default

<CR><LF>

Mnemonic

Output Terminator

Description

Defines the character which terminates each result

Related Commands

Output Separator [OS]

Notes

1. End always asserted with last byte of a result.

OUTPUT SEPARATOR

Command Syntax

OS I I = 0 Comma
1 Terminator

Default

Comma

Mnemonic

Output Separator

Description

Defines the character which separates the result into fields.

Related Commands

Output Terminator [OT]

SERVICE REQUEST ENABLE

Command Syntax

SV F Limits 0 to 255

Default

0

Mnemonic

SerVice Request Enable

Description

An integer defining which event or combinations of events will cause an interrupt.

Related Commands

None

Notes

1. The Status Byte contains the following data (for more information see Chapter 3, System Integration) :

128	64	32	16	8	4	2	1
END OF FILE	MSS	ERROR	MAV	NOT USED	END OF SWEEP	END OF MEASURE	NOT USED

7. RESULTS SELECTION AND SCALING

RESULT SOURCE

Command Syntax

SO D

D =	0100	Result source Channel 1
	0200	Result source Channel 2
	0201	Result source Ch 2 / Ch 1

Default

Result source Ch 2 / Ch 1

Mnemonic

result **SO**urce

Description

Specifies the output source as a single channel or a ratio of results from both channels

Related Commands

Result Co-ordinates [CO], Result Output [DO]

RESULT CO-ORDINATES

Command Syntax

CO I

I =	0	Results a , b
	1	Results r , Theta
	2	Results r (dB) , Theta

Default

Results r , Theta

Mnemonic

results **CO**-ordinates

Description

Selects co-ordinate convention for presentation of results

Related Commands

Result Source [SO], Result Output [DO]

RESULT OUTPUT

Command Syntax

DO

Default

Not Applicable

Mnemonic

Display Output

Description

Repeats last result

Related Commands

Result Source [SO] , Result Co-ordinates [CO]

RESULT SCALING : DIVIDE BY

Command Syntax

FN I

I = 0 Divide by unity (off)
1 Divide by r , Theta
2 Divide by last result
3 Divide by last magnitude

Default

Divide by unity

Mnemonic

FractioNal

Description

Selects result scaling

Related Commands

None

SCALE R

Command Syntax

RF F Limits -1E9 to 1E9

Default

1

Mnemonic

R Fractional

Description

Divides r by value entered

Related Commands

Scale Theta [TF]

SCALE THETA

Command Syntax

TF F Limits -180 to 180

Default

0 degrees

Mnemonic

Theta Fractional

Description

Theta is subtracted from the phase

Related Commands

Scale R [RF]

8. VERNIER

VARY

Command Syntax

VA I I = 0 Off
1 Vary Frequency
2 Vary Amplitude
3 Vary Bias

Default

0

Mnemonic

VAry

Description

Allows small changes to be made to selected parameter

Related Commands

Up [UP], Down [DN]

UP

Command Syntax

UP I I = 1 Very Fine +
2 Fine +
3 Coarse +
4 Very Coarse +

Default

Not Applicable

Mnemonic

UP

Description

Selects coarseness of upwards adjustment during Vernier operations

Related Commands

Vary Frequency [VA], Down [DN]

Notes

1. The change in response to an UP command is instant and is linear below unity, logarithmic after.

DOWN

Command Syntax

DN I I = 1 Very Fine -
2 Fine -
3 Coarse -
4 Very Coarse -

Default

Not Applicable

Mnemonic

DowN

Description

Selects coarseness of downwards adjustment during Vernier operations

Related Commands

Vary Frequency [VA], Up [UP]

Notes

1. The change in response to a DN command is instant and is linear below unity, logarithmic after.

9. BREAK, STATUS AND SELF TEST

BREAK

Command Syntax

BK

Default

Not Applicable

Mnemonic

BreaK

Description

Halts current operation. Returns 1270 to ready state. Menu setups unaffected. History unaffected. Synchronizer always turned off.

Related Commands

None

STATUS

Command Syntax

ST

Default

Not Applicable

Mnemonic

STatus

Description

Outputs Status page

Related Commands

None

Notes

1. See Status Page description in Chapter 2.

SELF TEST

Command Syntax

TT I

I = 0 Drift Correct
1 Initialize
2 Reset
3 Check
4 Test

Default

Not Applicable

Mnemonic

self TesT

Description

Selects and actions type of self test to be performed

Related Commands

Self Test Result [?TS]

SELF TEST RESULT

Command Syntax

?TS 0
Reply Q

Q = 0 Pass
Q ≠ 0 Fail

If fail then ?TS 1 Ram Test Result
?TS 2 Rom Test Result
?TS 3 Timer Test Result
?TS 4 ---
?TS 5 Synchronizer Test Result
?TS 6 Analyzer Test Result

Default

Not Applicable

Mnemonic

self TeSt result

Description

Returns result of Self Test (reply 0 pass, 1 fail)

Related Commands

Self Test [TT]

10. TIME SETUP

TIME

Command Syntax

TM I,I I,I = 0-99 Hours setup
to 0-59 Minutes setup

Default

Not Applicable

Mnemonic

TiMe

Description

Sets up the time. Seconds automatically start at zero

Related Commands

None

TIME QUERY

Command Syntax

?TM I I = 0 Hours
Reply 1 Minutes
2 Seconds

Default

Not Applicable

Mnemonic

TIme

Description

Returns the time

Related Commands

None

11. HISTORY FILE

NUMBER OF READINGS

Command Syntax

?NR
Reply

Default

Not Applicable

Mnemonic

Number of Readings

Description

Returns the number of readings (0-9999)

Related Commands

File Population , File Pointer , File Size

FILE POPULATION

Command Syntax

?FP 0
Reply

Default

Not Applicable

Mnemonic

File Population

Description

Returns the number of readings in the file (0- file size)

Related Commands

Number of Readings , File Pointer , File Size

FILE POINTER

Command Syntax

?FP 1
Reply

Default

Not Applicable

Mnemonic

File Pointer

Description

Returns index number of entry currently being accessed in the file

Related Commands

Number of Readings , File Population , File Size

FILE SIZE

Command Syntax

?FS
Reply

Default

Not Applicable

Mnemonic

File Size

Description

Returns file size (>500). Constant for any issue but may vary between issues

Related Commands

Number of Readings , File Population , File Pointer

OUTPUT FILE

Command Syntax

FO

Default

Not Applicable

Mnemonic

File Output

Description

Outputs the contents of the history file

Related Commands

Output Record [UF]

OUTPUT RECORD

Command Syntax

UF n n = record number

Default

Not Applicable

Mnemonic

Not Applicable

Description

Outputs the contents of the record

Related Commands

Output File [FO]

CLEAR FILE

Command Syntax

FC

Default

Not Applicable

Mnemonic

File Clear

Description

Clears the history file , resets pointer and clears the number of readings

Related Commands

None

12. MISCELLANEOUS COMMANDS

LAST ERRORS

Command Syntax

?ER
Reply

Default

Not Applicable

Mnemonic

Last ERrors

Description

Returns last error message

Related Commands

Clear Last Error [CE]

CLEAR LAST ERRORS

Command Syntax

CE

Default

Not Applicable

Mnemonic

Clear last Errors

Description

Clears last errors

Related Commands

Last Error [?ER]

SOFTWARE VERSION

Command Syntax

?VN
Reply

Default

Not Applicable

Mnemonic

Software Version Number

Description

Six character string denoting Software part, Status and Issue

Related Commands

None

13 ALL COMMANDS (ALPHABETICAL ORDER)

CODE	GROUP	PARAMETER/SELECTION
AM	GENERATOR	AMPLITUDE
BI	GENERATOR	BIAS
BK	BREAK/TEST	BREAK
CE	MISCELLANEOUS	CLEAR LAST ERRORS
CO	RESULTS	CO-ORDINATES
DE	ANALYZER	DEMODULATOR
DN	VERNIER	DOWN
DO	RESULT	REPEAT LAST RESULT
FC	HISTORY FILE	CLEAR FILE
FN	SCALING	DIVIDE BY
FO	HISTORY FILE	OUTPUT FILE
FR	GENERATOR	FREQUENCY
GS	SWEEP	LOG INCREMENT (points/sweep)
IS	ANALYZER	INTEGRATION TIME
MA	SWEEP	MAXIMUM FREQUENCY
MI	SWEEP	MINIMUM FREQUENCY
MO	GENERATOR	MODULATOR
OP	VXI	OUTPUT CONTROL
OS	VXI	OUTPUT SEPARATOR
OT	VXI	OUTPUT TERMINATOR
RA	ANALYZER	RANGE
RE	ANALYZER	RECYCLE START
RF	SCALING	SCALE r
RG	GENERATOR	RESTART
SA	ANALYZER	STOP
SE	SWEEP	SWEEP ENABLE
SG	GENERATOR	STOP
SI	ANALYZER	SINGLE START
SM	GENERATOR	STOP MODE
SO	RESULTS	SOURCE
SQ	GENERATOR	STOP QUADRANT
ST	BREAK/TEST	STATUS
SV	VXI	SERVICE REQUEST ENABLE
SY	GENERATOR	SYNCHRONIZER
TF	SCALING	SCALE θ
TM	TIME SETUP	TIME
TT	BREAK/TEST	SELF TEST
UF	HISTORY FILE	OUTPUT RECORD
UP	VERNIER	UP
VA	VERNIER	VARY
WV	GENERATOR	WAVEFORM

ALL COMMANDS (ALPHABETICAL ORDER) (contd)

CODE	GROUP	PARAMETER/SELECTION
?AR	ANALYZER	LAST RANGE USED
?ER	MISCELLANEOUS	LAST ERROR
?FP	HISTORY FILE	FILE POP /POINTER
?FS	HISTORY FILE	FILE SIZE
?NR	HISTORY FILE	NUMBER OF READINGS
?SF	GENERATOR	SYNCHRONIZER FREQUENCY
?SN	GENERATOR	SYNCHRONIZER STATUS
?TM	TIME SETUP	TIME
?TS	BREAK/TEST	SELF TEST RESULT
?VN	MISCELLANEOUS	SOFTWARE VERSION

Chapter 5
Error Codes

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2	**Error Message Summary**	5.3
2.1	Command Structure	5.3
2.2	Combined Parameter Errors	5.3
2.3	Generator	5.3
2.4	History File	5.4
2.5	System	5.4
2.6	Measurement Validity	5.4
2.7	Synchronizer	5.4

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1 INTRODUCTION

Error and warning messages tell the user:

(a) why the instrument has stopped or failed to respond to a command,
(b) of an undesirable situation (e.g. overload),
(c) of an internal fault.

All errors regarding incorrect format / mismatch of the commands can be checked with Chapter 4 which gives a comprehensive overview of all commands available.

2 ERROR MESSAGE SUMMARY

2.1 GROUP 0 : COMMAND STRUCTURE

These errors indicate when the user has incorrectly entered or specified a command.

CODE	*Explanation*
01	Unknown Command.
02	Argument mismatch. The wrong type, or number of arguments was used.
03	Argument out of range.
04	Floating point format error. A floating point number was incorrectly entered e.g. 1.2.5E2 instead of 1.25E2.
05	Illegal request for value. Some parameter modes cannot be interrogated e.g. It is meaningless to send ?SG "What is the value of `Stop Generator' "

2.2 GROUP 2 : COMBINED PARAMETER

CODE	*Explanation*
22	The combination of AMPL, BIAS and MODULATION (if used) exceeds the maximum output voltage of 15V peak.
23	Sweep is not allowed when the synchronizer is switched on.
26	*WARNING*: The selected number of points/sweep, is greater than the available file size. The sweep is still allowed to run , but some results will not be filed.
27	FRMAX < FRMIN. If SWEEP ENABLE is on it will be switched off.

2.3 GROUP 3 : GENERATOR

CODE	*Explanation*
30	*WARNING*: Generator stopped.
31	Carrier low. Carrier input amplitude may be too small or the carrier input may not be connected.
32	Carrier overload. Common-mode or differential carrier input exceeds maximum allowed.

2.4 GROUP 4: HISTORY FILE + VERNIER

CODE	*Explanation*
43	An attempt to step Variable out of range or selection = off.
44	History file empty.
45	Illegal file access. It is illegal to display or list the History File whilst the Analyzer is running.
47	File pointer out of bounds. The user has attempted to read a History File entry that is outside the History File limits.

2.5 GROUP 7: SYSTEM

CODE	*Explanation*
70	Out of memory. No further memory is available for the operation attempted.
73	Calibration constants in error; 1 out of 3. Instrument is still operative, only needs re-cal if 3 out of 3 are corrupted.
74	Calibration constants in error; 3 out of 3. Re-calibration is required (cal constants are corrupted).
75	Commands not allowed if not in 'calibration mode'.
76	Offsets or multipliers out of range.

2.6 GROUP 8: MEASUREMENT VALIDITY

CODE	*Explanation*
81	Overload. Common-mode or differential analyzer input voltage exceeds maximum allowed.

2.7 GROUP 9: SYNCHRONIZER

CODE	*Explanation*
94	Synchronizer not ready or a synchronizer fault 1,2 or 3 has occurred. 'Fault', 1 Frequency overflow. Input frequency > 20 kHz. 2 Time overflow. Input frequency < 1 mHz. 3 Signal unstable. If the input frequency varies by more than 10% noisy analyzer results are possible.

Chapter 6
Specifications

Section *Page*

1270 Frequency Response Analyzer Specifications

1 Generator 6.3
2 Modulator / Demodulator 6.3
3 Analyzer 6.3
4 Synchronizer 6.4
5 Limit of Error 6.4
6 VME / VXI Interface 6.4

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1270B FREQUENCY RESPONSE ANALYZER

SPECIFICATIONS

1. GENERATOR

The generator provides a sine, square or triangular wave stimulus with programmable amplitude and frequency superimposed on a d.c. bias of programmable amplitude and polarity.

Waveform : sine,square, triangular.

Frequency

Range :	1mHz to 20 kHz
Accuracy (of reported frequency) :	0.01%
Maximum Resolution :	1 in 4000
Sweep Type :	Logarithmic , up or down
Points per sweep :	2 to 9999

Amplitude

Range :	10mV to 10.23V rms (5.11V rms for triangular output)
Resolution :	10mV
Error (driving open circuit) :	±1% ±10mV

Bias

Range :	±10.22V
Resolution :	20mV
Error (driving open circuit) :	±1% ±20mV

Maximum output , Hi to Lo (bias + ac) :	±15V
Distortion :	<2%
Maximum slew rate (square wave) :	2V/ µs
Output impedance (Hi to Lo) :	50Ω ± 10%
Output common mode range :	
maximum output , Lo to gnd :	±15V

External stop input : contact closure or TTL logic 0 kill or freeze
Connection : floating , single BNC
Maximum current : 300mA

Output is short-circuit proof

2. MODULATOR / DEMODULATOR

The generator can be programmed to have an amplitude modulated suppressed carrier output with the carrier input modulated by the generator frequency.
Additional, either, or both, analyzer inputs may be independently demodulated.

Input :	differential , single BNC
Impedance , Hi or Lo to gnd :	>1MΩ ±5%

Maximum input

Hi to ground :	±350V peak , 250V rms
Lo to ground :	±30V peak
Common mode rejection , up to 100 Hz :	>50dB
Carrier Frequency range :	48Hz to 10kHz

Phase Shift, carrier input to generator ouput

48Hz to 300Hz :	<3°
300Hz to 1kHz :	<1°
1kHz to 10kHz :	<(1° + ½°/kHz)

Additional analysis errror when demodulating mod freq = 0.05 carrier freq :	<1% , 1°
Analyzer quadrature rejection :	>26dB

3. ANALYZER

Two independent, autoranging input channels, with common analyzer.

Range	Sensitivity	Full Scale pk input	Common mode rejection
30mV	1µV	45mV	30V
300mV	10µV	500mV	30V
3V	100µV	5V	30V
30V	1mV	50V	30V
300V	10mV	500V	30V

Maximum resolution :	0.01dB, 0.01 deg
Maximum input	
Hi to ground :	±500V peak , 300V rms
Lo to ground :	±30V peak
Coupling :	dc
Connections :	differential , single BNC
Impedance Hi to Lo (grounded) :	1MΩ±2%
Capacitance Hi to Lo (grounded) :	<70pF
Common mode rejection , up to 100 Hz :	>60dB
DC rejection:	>50dB
Integration time :	0.1 to 10^5s
Cross Channel isolation :	
<1kHz ,1kΩ across inputs , Lo grounded :	>100dB
Dynamic Range :	>100dB

4. SYNCHRONIZER

The synchronizer enables the internal generator to be locked in frequency and phase to an external source of excitation.

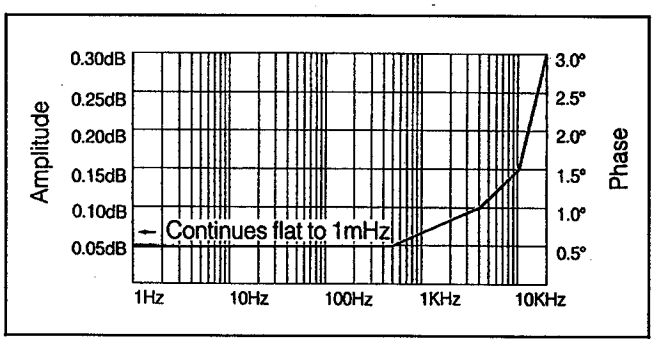
Connection :	differential , single BNC
Impedance Hi or Lo to ground :	>200kΩ,<100pF
Maximum input	
Hi to ground :	±350V peak , 250V rms
Lo to ground :	±30V peak
Trigger point :	positive zero crossing
Minimum signal to trigger (<1kHz) :	<-0.8 to >+0.1V
Maximum time to synchronize :	
<12Hz	6 cycles
>12Hz	500ms
Accuracy of period measurement :	±1μs

Additional analyzer error (stable trigger signal) , transfer function mode :

Gain :	1% + 0.2 % / kHz
Phase :	1° + 0.2° / kHz

5. LIMIT OF ERROR

Valid for 12 months	
Warm-up time :	30 mins
Temperature range :	10° C to 30° C
Input:	>10% full scale
Integration time:	> 200ms
Input :	CH2/CH1



History File	Capacity :	500 measurements
Scaling:	Scaling by previous measurement	
Division by vector :		a,jb or r,θ

6. VXI INTERFACE

The instrument is a message-based servant device implementing word-serial protocol. It is furthermore a 'VXIbus Instrument' which allows transparent communication with a GPIB controller via a '488-VXIbus Interface Device'.

Manufacturer ID No.	4084
Model code No.	1270
Device logical address	
Selection :	Dynamic or Static
Static :	2 rotary switches accessable from rear panel

Status LED : Fail, Power, Msg, Modid, O/Load

Interrupt facility configuration :
Manual via rotary switch accessable from rear panel

Programmable output : ASCII or binary

Environmental

Safety : In accordance with : IEC 348 class 1
VDE 0411 class 1
BS 4743 class 1

EMC : in accordance with : VXIbus specification

Vibration, including bump and drop :
DEF STD 66/31 Issue 01 cat3
MIL T 28800C Type 3 Class 5 Style F

Temperature :	Operating:	0 to 50°C
	Storage :	-40 to 70°C
	Specification Limits	10 to 30°C
Humidity :	Non-condensing:	95% at 40°C
Weight :		2.2kg
Power consumption :		+5V 1.0A max
		+24V 0.6A max
		-24V 0.3A max
Total power :		<30Watts

Appendix A
Differences Between the 1270 and the 1270B

Section		*Page*
1	**Introduction**	A.3
2	**Protocols Supported**	A.3
3	**VXIbus Registers**	A.3

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1 INTRODUCTION

A slide switch on the rear panel of the 1270B allows the instrument to be converted for use as a 1270. The 1270 conforms with Revision 1.2 of the VXIbus Specification, whereas the 1270B conforms with Revision 1.3. This appendix details the differences between the two types of instrument.

2 PROTOCOLS SUPPORTED

1270

- VXIbus Instrument
- Trigger Command

1270B

- VXIbus Instrument
- Trigger Command
- Response Generation
- Event Generation
- Programmable Interrupter (User selectable)

3 VXIBUS REGISTERS

3.1 Register Address Offsets

1270

Address offsets $10_{16} - 1F_{16}$, $20_{16} - 2F_{16}$ and $30_{16} - 3F_{16}$ all map onto $00_{16} - 0F_{16}$.

1270B

Address offsets $20_{16} - 3F_{16}$ map onto $00_{16} - 1F_{16}$.

3.2 Register Bit Functions

Except where stated below, and as defined in the relevant VXIbus specification, the bit functions of the VXIbus registers are the same for either instrument, 1270 or 1270B.

1270

Response Register, Bit 11, "Err*"

Not implemented

In all registers, bits are set/reset as defined in VXIbus Spec, Rev. 1.2.

1270B

Implemented. Errors handled are:

- unsupported command,
- multiple query,
- DIR violation,
- DOR violation,
- write ready violation,
- read ready violation.

In all registers, bits are set/reset as defined in VXIbus Spec, Rev. 1.3.

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