HEWLETT PACKARD

OPERATING AND PROGRAMMING MANUAL

8175A
Option 002

This manual applies directly to all 8175A's which have option 002 installed.

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HERRENBERGER STR. 130, D-7030 BOEBLINGEN
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HEWLETT PACKARD

CERTIFICATION

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WARRANTY

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HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

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Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GENERAL – This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

OPERATION – BEFORE APPLYING POWER comply with the installation section. Additionally, the following shall be observed:

Do not remove instrument covers when operating.

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers and devices connected to it should be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

SAFETY SYMBOLS

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal

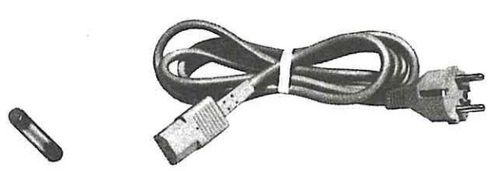
WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

8175A



FUSE

POWER CORD

Figure 1-1. 8175A Option 002 and Minimum Supplied Accessories

NOTE: Refer to the last paragraph of the Introduction to this manual for more details concerning accessories.

CHAPTER 1
GENERAL INFORMATION

Introduction

This Operating and Programming Manual contains only the additional* information required to install, operate and test option 002 - the Dual Arbitrary Waveform Generator - of the Hewlett-Packard Model 8175A. (Service related information is located in the corresponding sections of the complete manual set).

*NOTE: Regarding operation of the 8175A, irrespective of which options are installed, many operational procedures are common to both the standard (Parallel and Serial D.G.) and option 002 configurations. The procedures concerned are defined in chapter 3, section 3A of this manual and explained in the standard 8175A Op. and Prog. manual. In some cases, such procedures etc. are also explained in this manual. This is usually the case where only a few lines of test are required. It minimises the need for repeated cross referencing to the standard Op. and Prog. manual.

Use of abreviation "Arb."
Throughout this manual the abreviation "Arb." is often used to refer to the Arbitrary Waveform Generator configuration.

Figure 1-1 shows the mainframe 8175A option 002 and minimum accessories as supplied with any 8175A. (Note that externally an 8175A with option 002 installed is identical to a standard 8175A.) Apart from the power cord and fuse, any other accessories supplied will depend on the particular options ordered with the instrument. Details of these, together with illustrations of all available accessories are included in the standard 8175A Op. and Prog. manual.

MANUAL CONTENTS

The contents of this manual are as follows:

Chapter 1 covers instrument identification, description, options, accessories, specifications and other basic information.

Chapter 2 provides installation instructions for the 8175A and its accessories. It also includes information about initial inspection and damage claims, preparation for use, packaging, storage and shipment.

Chapter 3 is sub-divided into several sections, the purpose of the chapter is to familiarize you with operation of the 8175A Arb. Manual operation of the 8175A Arbitrary Waveform Generator is explained with the aid of a "Getting Started" section which includes worked examples. "Getting Started" is designed to help you learn the basics of Arb. operation as quickly as possible. Comprehensive descriptions of all Arb. related Main Displays, their menus, edit capabilities and how to use them are included. The additional HP-IB commands related to the Arb. are listed. (Remote (or programmable) operation of the 8175A is described in the standard 8175A O and P manual).

Chapter 4 details performance testing of **only** the Arb. option of the 8175A, not the complete 8175A. (Performance tests for the standard 8175A are given in the standard Op. and Prog. manual).

SPECIFICATIONS

Instrument specifications for the Arb. option are listed in Table 1-2. These specifications are the performance standards or limits against which the instrument, when in Arb. configuration, is tested.

SAFETY CONSIDERATIONS

The Model 8175A is a Safety Class 1 instrument (instrument with an exposed metal chassis that is directly connected to earth via the power supply cable).

Before operation, the instrument and manual, including the red safety page, should be reviewed for safety markings and instructions. These must then be followed to ensure safe operation and to maintain the instrument in a safe condition.

INSTRUMENTS COVERED BY THE MANUAL

Attached to the rear of the instrument is a serial number plate (Figure 1-3). The first four digits of the serial number only change when there is a significant change to the instrument. The last five digits are assigned to instruments sequentially. The contents of this manual apply directly to the instrument serial number quoted on the title page (or to all instruments if stated).
For instruments with higher serial numbers, refer to the Manual Change sheets supplied with this manual. In addition to change information, the Manual Change sheets may contain information for correcting any errors in the manual.

Figure 1-3. Serial Number Plate

To keep this manual as up-to-date and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Change supplement. The supplement for this manual is identified by a print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

DESCRIPTION

The Arbitrary Waveform Generator is an option for the 8175A. It enhances the standard instrument's features by providing:

Programmable arbitrary waveforms output as:
2 independent but synchronous analog signals with:

10 bit amplitude resolution and
a sample update rate of up to 50 MHz

Programmable peak to peak output voltages
and separately programmable offset voltages

Simultaneous analog and digital signals
either 1 analog arbitrary plus 14 independent digital signals or,
2 analog arbitrary plus their 10 bit equivalents

OPTIONS

The Arbitrary Waveform Generator is itself an option (option 002) of the 8175A. Refer to the standard 8175A O and P manual for details of other options available for the 8175A.

ACCESSORIES SUPPLIED

Apart from the minimum accessories of power cord and fuse, any other accessories supplied will depend on the particular options ordered with the instrument. Details of these, together with illustrations of all available accessories are included in the standard 8175A O and P manual. Referring to Figure 1-1 of this manual the accessories are:

Fuses (one fitted and one supplied):

4A fuse (F 4A, 250 V) for 230V operation 2110-0055

8A fuse (F 8A, 125 V) for 115V operation 2110-0036

Power Cable (see Figure 2-2)

ACCESSORIES AVAILABLE

Refer to the standard 8175A O and P manual.

RECOMMENDED TEST EQUIPMENT

Table 1-1 lists the equipment required to maintain option 002 of the 8175A. Alternative equipment may be substituted provided that it meets or exceeds the critical specifications listed in the table.

Table 1-1. Recommended Test Equipment for option 002

INSTRUMENT	REQUIRED CHARACTERISTICS	RECOMMENDED MODELS	USE*
Oscilloscope	275 MHz Bandwidth	HP 1725A/1722B	P,A,T
Probe	1:1 36 pF	HP 10021A	P,A,T
DVM	0.1 V Range, >10 MΩ	HP 3456A/3455A	P,A,T
Counter	50 MHz START/STOP T. Int. A to B	HP 5335A/5345A	P,A,T
Time Marker	2 ns		P
Controller	HP 200 Series Basic Compatible HP-IB Interface	HP 9816/9836	P,A

* P=Performance Test A=Adjust T=Troubleshooting

OPTION 002, DUAL ARBITRARY WAVEFORM GENERATOR

Option can be retrofitted at HP service office.

NUMBER OF OUTPUTS (Output A and Output B on front panel, can be separately disabled): 2

NUMBER OF BITS: 10

NUMBER OF DATA POINTS:
Horizontal: 1024 points
Vertical: 1000 points with additional 24 points override, 800 points for 16 V P-P Output Voltage Range, 640 points for 32 V P-P Output Voltage Range.

DIFFERENTIAL NON-LINEARITY: ≦1 LSB (monotonic)

OUTPUT IMPEDANCE: 50 Ohm ±5%

OUTPUT LEVELS

Level Window defines the maximum output signal range for the sum of Offset and P-P Output Voltage.

Load Impedance: 50 Ohm

Level Window	P-P Output Voltage Range	P-P Output Voltage Res.	Offset Range	Offset Res.
±0.8 V	0.2 V	0.2 mV	±0.8 V	0.5 mV
±0.8 V	0.5 V	0.5 mV	±0.8 V	0.5 mV
±0.8 V	1 V	1 mV	±0.8 V	1 mV
± 8 V	2 V	2 mV	± 8 V	5 mV
± 8 V	5 V	5 mV	± 8 V	5 mV
± 8 V	10 V	10 mV	± 8 V	10 mV
± 8 V	16 V	20 mV	± 8 V	20 mV

Load Impedance ≧50 kOhm

Level Window	P-P Output Voltage Range	P-P Output Voltage Res.	Offset Range	Offset Res.
±1.6 V	0.5 V	0.5 mV	±1.6 V	0.5 mV
±1.6 V	1 V	1 mV	±1.6 V	1 mV
±1.6 V	2 V	2 mV	±1.6 V	2 mV
± 16 V	5 V	5 mV	± 16 V	5 mV
± 16 V	10 V	10 mV	± 16 V	10 mV
± 16 V	20 V	20 mV	± 16 V	20 mV
± 16 V	32 V	50 mV	± 16 V	50 mV

Accuracy (Output A and Output B):

Amplitude Accuracy: ±4% ±4 LSB 1)

Offset Accuracy:
±1% of programmed value
±4% of (programmed High Level of P-P Output Voltage + programmed Low Level of P-P Output Voltage) ÷ 2 2)

plus:

into 50 Ohm
± 10 mV for 0.2 V to 1 V P-P Output Voltage Range
or ± 25 mV for 2 V to 5 V P-P Output Voltage Range
or ± 50 mV for 10 V to 16 V P-P Output Voltage Range

into ≧50 kOhm
± 20 mV for 0.5 V to 2 V P-P Output Voltage Range
or ± 50 mV for 5 V to 10 V P-P Output Voltage Range
or ±100 mV for 20 V to 32 V P-P Output Voltage Range

1) Amplitude is programmed High Level - programmed Low Level.

2) If programmed High and Low Level of P-P Output Voltage are identical in magnitude but opposite in sign, this error will be zero.

TIMING (for Output A and B)

The maximum sample update rate is 50 MHz.
The Data Point Duration is 20 ns to 9.99 s (for more information see "TIMING in PARALLEL mode." specs. in 8175A manual.)

TRIGGER OUTPUT CHARACTERISTICS

NUMBER OF TRIGGER OUTPUT CHANNELS: 2
(Trigger Output A on front panel, Trigger Output B on rear panel, can be commonly disabled)

TRIGGER OUTPUT IMPEDANCE: 50 Ohm ±5%

TRIGGER OUTPUT LEVELS:

	Load Impedance 50 Ohm	Load Impedance ≧50 kOhm
TTL Low Level:	≦ 0.3 V	≦0.2 V
TTL High Level:	≧ 2.4 V	≧4.8 V
ECL Low Level:	≦-1.6 V	
ECL High Level:	≧-0.9 V	

Trigger Pulse Width: The trigger can be set for each individual data point to High Level or Low Level. The trigger width depends on the programmed Data Point Duration.

Supplementary Specifications (these describe typical non-warranted performance).

OPTION 002, DUAL ARBITRARY WAVEFORM GENERATOR

REPEATABILITY: Factor 4 better than accuracy.

WAVEFORM CHARACTERISTICS
(Output A and Output B, at maximum P-P Output Voltage for all ranges into 50 Ohm)

Sinewave from 20 Hz ... 500 kHz, characterized by 100 Datapoints:

Harmonic signals: (98 harmonics taken into account)
from 20 Hz to 50 kHz: ≦-51 dBc
from >50kHz to 500 kHz: ≦-46 dBc

Amplitude flatness: ±3% [±0.26 dB]
(reference is 1 kHz at 2 V P-P Output Voltage)

Triangle at 1 kHz, characterized by 1000 datapoints:

Integral nonlinearity between 10% and 90% of P-P Output Voltage (data point at steady state): ≦10 LSB

Pulse Performance:

Rise/Fall Time (10% to 90% of P-P Output Voltage): <16 ns
Settling Time
(from 10% of P-P Output Voltage to ±5% of final value): ≦20 ns

DELAYS

Trigger A to Channel A: <20 ns
Trigger B to Channel B: <20 ns
Channel A to Channel B: < 5 ns

Digital outputs to channel A and B: <15 ns

RESPONSE TIMES
(Refer to 8175A supplementary specs, TRISTATE ON/OFF function does not apply to OUTPUTs A and B and TRIG OUTPUTs.)

CHAPTER 2
INSTALLATION

WARNING

The instrument weighs 17.5 kg (38.8 lbs). Care must be exercised when lifting to avoid personal injury.

INTRODUCTION

This section provides installation instructions for the 8175A option 002 and its accessories. It also includes information about initial inspection and damage claims, preparation for use, packaging, storage and shipment.

INITIAL INSPECTION

Inspect the shipping container for damage. If the container or cushioning is damaged, it should be kept until the contents of the shipment have been checked for completeness, and the instrument has been verified mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1 plus any accessories that were ordered with the instrument. Procedures for checking the electrical operation are given in Chapter 4. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Hewlett Packard Office. Keep the shipping materials for carriers inspection. The HP office will arrange for repair or replacement without waiting for settlement.

PREPARATION FOR USE

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, connectors etc.).

Power Requirements

The instrument requires a power source of 115/230 V rms (+10% -22%) at a frequency of 48 - 66 Hz single phase. The maximum power consumption is 630 VA.

Line Voltage Selection

CAUTION

BEFORE SWITCHING ON THE INSTRUMENT, make sure that it is set to the local line voltage.

Figure 2-1 provides information for line voltage and fuse selection:

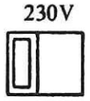
VOLTAGE:	230 V	115V	230V	115V
FUSE:	4 A	8 A		

Figure 2-1 Switch settings for Line Voltages

Power Cable

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate a.c. power receptacle, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends upon the country of destination. Refer to Figure 2-2 to identify the types available and their Option numbers.

WARNING

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on.

a) If this instrument is to be energized via an autotransformer for voltage reduction, ensure that the common terminal is connected to the grounded pole of the power source.

b) The power cable plug shall only be inserted into a socket outlet provided with a protective ground contact. **The protective action must not be negated by the use of an extension cord without a protective conductor.**

c) Before switching on the instrument, the protective ground terminal of the instrument must be connected to the protective conductor of the power cable. This is verified by checking that the resistance between the instrument chassis and the front panel and the ground pin of the power cable is zero Ohms.

The following work should be done by a qualified electrician and all local electrical codes must be strictly observed.
If the plug on the cable does not fit the power outlet, or the cable is to be attached to a terminal block, cut the cable at the plug end and re-wire it. The color coding used in the cable will depend on the cable supplied (see Figure 2-2).

If a new plug is to be connected, it should meet local safety requirements and include the following features:

Adequate load-carrying capacity (see table of specifications in Section 1).

Ground connection.

Cable clamp.

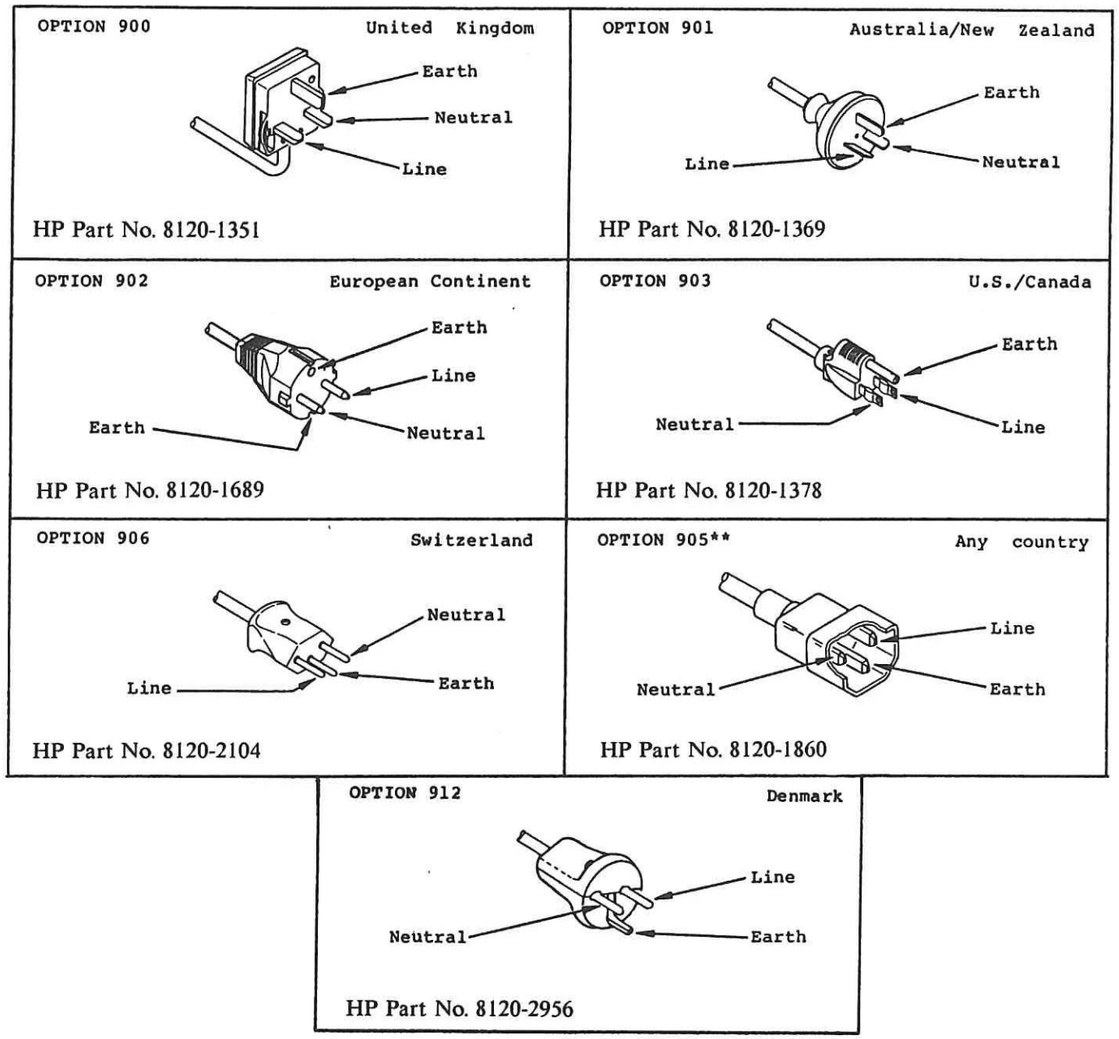


Figure 2-2. Mains Plug Contact Configuration for HP Option Numbers

* In the U.S.A. a 230 volt mains might not include a neutral connector. In this case it is a recommended that the blue connector of the standard power cord be connected to the terminal normally used for the neutral (line 1).

** Plug option 905 is frequently used for interconnecting system components and peripherals.

HP-IB Connector

The rear panel HP-IB connector (Fig 2-3), is compatible with the connector on Cable Assemblies 10833A, B, C and D. If a cable is to be locally manufactured, use connector male, HP part number 1251-0293.

HP-IB Logic Levels

The 8175A HP-IB lines use standard TTL logic, the levels being as follows:

True = Low = digital ground or 0V dc to 0.4V dc,

False = High = open or 2.5V dc to 5V dc.

All HP-IB lines have LOW assertion states. High states are held at 3.0V d.c. by pull-ups within the instrument. When a line functions as an input, approximately 3.2mA of current is required to pull it low through a closure to digital ground. When a line functions as an output, it will sink up to 48mA in the low state and approximately 0.6mA in the high state.

CAUTION

NOTE: Isolation, the HP-IB line screens are not isolated from ground.

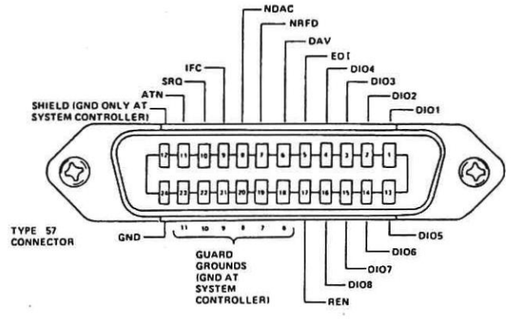


Figure 2-3. HB-IB Connector

Operating Environment

The operating temperature limits are 0 degrees C to + 55 degrees C. The specifications also apply over this range.

RACK MOUNTING

Refer to the standard 8175A O and P manual.

CLAIMS FOR DAMAGE

If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Hewlett-Packard Sales/ Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

Storage and Shipment

The instrument can be stored or shipped at temperatures between minus 40 deg C and plus 65 deg C. The instrument should be protected from temperature extremes which may cause condensation within it.

If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required. The original shipping carton and packing material may be re-usable. However the Hewlett-Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packing is no longer available or re-usable. General instructions for re-packing are as follows:

1. Wrap instrument in heavy paper or plastic.

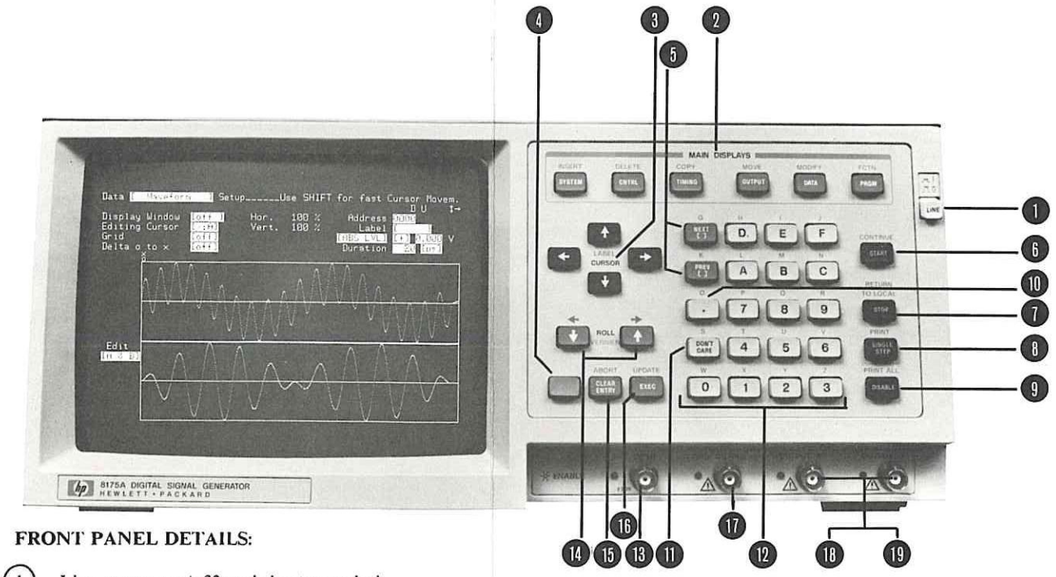
2. Use strong shipping container. A double wall carton made of 350-pound test material is adequate.

3. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside container. Protect control panel with cardboard.

4. Seal shipping container securely.

5. Mark shipping container **FRAGILE** to encourage careful handling.

6. In any correspondence, refer to instrument by model number and serial number.



FRONT PANEL DETAILS:

(1) Line power on/off push button switch.

(2) **MAIN DISPLAYS**. Six keys which enable selection of the 8175A "Pages". Each Page comprises one or more sub-pages or "**menus**". In Arb. configuration the details are as follows: **SYSTEM** comprises three menus, these enable the instrument configuration to be set, status of peripherals to be input, and control of internal and external storage operations. **CNTRL** comprises four menus for setting: clock, input trigger, flag conditions and simulation of trigger functions. **TIMING** has no significance for Arb outputs (see standard O and P manual). **OUTPUT** enables the Arb. output ranges and conditions (and the high level of TTL/CMOS PODS) to be set. It also provides enable/disable control for all output PODS. **DATA** comprises four menus which enable data to be set up and displayed. The data can be set up and/or displayed in an alpha-numeric base (pattern) or as a waveform. **PRGM** comprises two menus which enable pattern sequencing to be defined.

All six **MAIN DISPLAYS** keys have secondary functions. These are the blue "**EDIT**" functions above the keys. They are accessed via the (blue) SHIFT KEY. Refer to section 3E in this manual for detailed information.

(3) **CURSOR.** These keys enable the flashing cursor to be moved from field to field in the menus. The (blue) SHIFT and CURSOR ← or → keys, allow fast movement of the cursor into the next inverse video field. SHIFT + CURSOR ↑ or ↓ enables interchange of LABELS (DATA Page menus).

(4) Blue key. This key activates the blue SHIFT function assigned to each keyboard key. A momentary press activates the SHIFT function for the next keystroke. The SHIFT function will continue as long as the blue key is pressed.

(5) **NEXT** [] and **PREV** [] keys. These enable any setting/value/condition within brackets [], to be changed.

(6) **START**, starts data cycling from the program segment defined on the **PRGM** Page menus.
CONTINUE, continues data cycling (after a STOP) from the STOP address (see item 7)

(7) **STOP**, stops data cycling at the address currently being output. The corresponding output level(s) will then be held at the outputs. **RETURN TO LOCAL**, returns the 8175A from HP-IB control to local.

(8) **SINGLE STEP,** lets you step one address (or program segment) at a time, through a program. **PRINT**, enables the current display content to be printed on an HP-IB printer. A print can be stopped via **STOP** key.

(9) **DISABLE**, disables <u>all</u> outputs including Arb. ones and their triggers. **PRINT ALL**, enables a whole page e.g., the whole pattern setup of the Data Page to be printed.

(10) . (decimal point) for normal numeric entry purposes and, (detailed on CNTRL Page - **[Input]** Trig. Word Ass. menu) special function.

FRONT PANEL DETAILS continued

(11) **DON'T CARE.** In a text field enters a space in lieu of a character or, (CNTRL Page **[Input]** Trig. Word Ass. pattern setting menu) an "X" in lieu of a 1 or 0.

(12) Alphanumeric keyboard for data and text entry.

(13) BNC Connector for external Start/Stop control

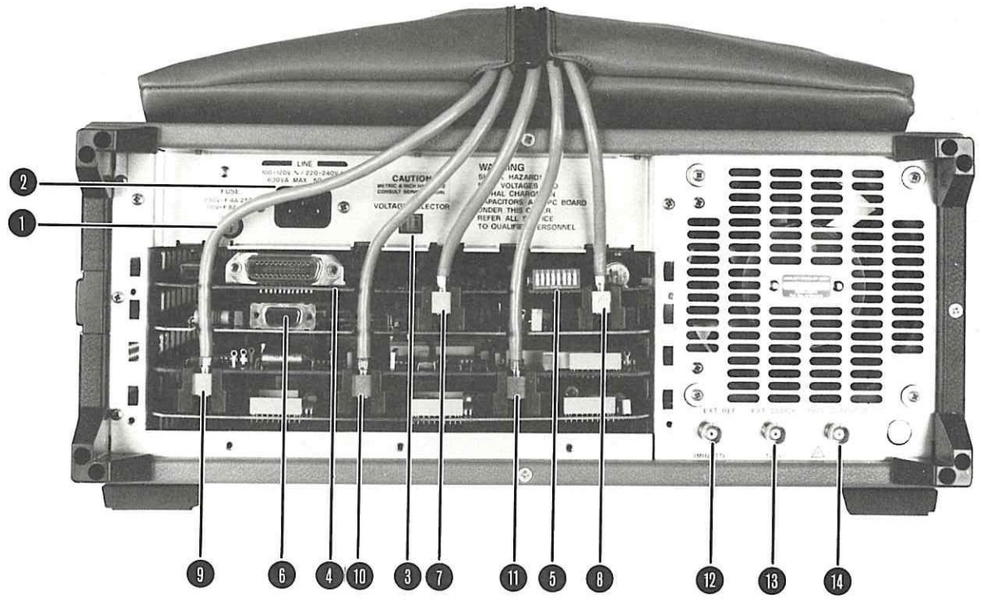
(14) **ROLL** keys, enable data, waveform and module displays to be moved: left, right, up or down depending on the display. They also provide a vernier increment/decrement function for certain numeric settings. Arrows in the upper right hand corner of the display indicate which ROLL keys are currently operational.

(15) **CLEAR ENTRY**, sets a default (Standard Setting) value in the field. **ABORT** enables Edit functions to be cancelled (if EXEC not yet pressed) and also enables a Calculator RUN to be aborted.

(16) **EXEC** executes functions and clock calibration. **UPDATE** enables new settings/data/conditions etc. to be delivered to the outputs.

(17) BNC connector for Arb. OUTPUT A trigger signal.

(18)(19) BNC connectors for Arb. output signals.



REAR PANEL CONNECTORS (Note: rear cover plate removed in this view)

(1) Fuse 4A/230V or 8A/115V.

(2) Power line voltage receptacle.

(3) Line voltage selector sliding switch, to be set to local line voltage.

(4) HP-IB interface connector.

(5) Switch for setting HP-IB address and mode.

(6) Connector for interfacing a second 8175A (for master-slave operation).

(7) Connector for Trigger POD.

(8) Connector for Flag output POD.

(9) Connector for Output POD 0.

(10) Connector for Output POD 1.

(11) Connector for Output POD 2.

(12) BNC connector for an external reference clock signal (1 MHz TTL).

(13) BNC connector for inputting an external System clock signal.

(14) BNC connector for Arb. OUTPUT B trigger signal.

 Figure 3-1. 8175A (with option 002 installed) Controls, Connectors and Display

CHAPTER 3
OPERATING

3A
Introduction

The operating and programming information in this manual applies **only** to the 8175A Arbitrary Waveform Generator (option 002). Operation in the other two configurations and for option 001 of the 8175A, is explained in the standard 8175A Operating and Programming manual.

NOTE: In this manual the abbreviation "Arb." is often used to refer to the Arbitrary Waveform Generator.

NEVER USED AN 8175A BEFORE? START HERE

If this is the first time that you have used an 8175A (irrespective of which options are fitted), do not proceed any further before reading at least Chapter 3, sections 3A and 3B of the standard 8175A Operating and Programming Manual. Check out also section 3E of the same manual, it explains the various Edit capabilities of the 8175A and how to use them. Most of them also apply to the Arb. configuration. Once you have mastered the basics of standard 8175A operation, the Arb. will present no difficulties.

Note that depending on whether you have specified Option D04 (delete standard pod configuration) for your 8175A, it is possible that you only intend using it as an Arbitrary Waveform Generator. However, many operating points and features apply to all three configurations and as such are not separately described in this manual. Therefore whatever the case, you should still start by learning the basics as described in the standard 8175A Operating and Programming manual.

USED AN 8175A BEFORE? START HERE

If you have used an 8175A before, you will be able to quickly learn the additional operating principles related to Arb. use. Most of the standard 8175A's operating principles also apply to the Arb. configuration. In the same way as for the standard 8175A, you can start using the Arb. without understanding all aspects of all menus. It is sufficient to understand the basics.

OPERATING INFORMATION OVERVIEW

The operating information is presented under the following headings:

- 3A. Introduction
- 3B. Getting started
- 3C. More about using the Calculator
- 3D. Disc Storage/Recall of Calculator Modules
- 3E. The Menu Map
- 3F. The Edit Capabilities and How to use Them
- 3G. Master Slave
- 3H. Programming Information

3A-1
SPECIAL OPERATING POINTS

DO NOT apply power to an 8175A until you have read (and, as necessary, confirmed) the following points.

CAUTION

a) Read safety summary at front of this manual

b) To avoid instrument damage, ensure that the voltage selector switch is set correctly for the local line voltage. If it is necessary to change the setting at any time, the instrument must be switched off and the power cable disconnected.

TO AVOID POSSIBLE DUT DAMAGE!
The Arb. output levels are: 16V pp into 50 Ohm and 32 V pp into open, therefore **ensure** that you set the correct output load value (setting on the Output Page, Level... menu).

⚠
MAXIMUM ALLOWABLE VOLTAGES AT INPUTS AND OUTPUTS:

OUTPUT A, B and TRIG OUTPUTS
Do not apply an external voltage or electrostatic discharge (ESD) to any output marked with an ⚠.

EXT REF: Maximum allowable input voltage: +/-20 V

EXT INPUT: Maximum allowable input voltage: +/-20 V

Refer to the Specifications (Table 1-2) in the standard 8175A Operating and Programming manual for the maximum allowable external voltages which can be applied to POD inputs and outputs.

3A-2
CONTROLS, CONNECTORS AND DISPLAY

A brief explanation of the function of the 8175A controls, connectors and display is given in Figure 3-1. Take time to read through it before continuing with the following paragraphs. Refer to it later as necessary.

PODS - IDENTIFICATION AND CONNECTION/DISCONNECTION

NOTE: This is only of significance if your 8175A includes the standard pod set and, in connection with your digital output requirements, you need to connect/disconnect particular PODs.

If you need to connect/disconnect or change any of the PODs, take special note of the rear view of the 8175A. The connection points of all PODs can easily be identified from the connector cover plate and/or by referring to Figure 3-1 (Rear Panel Connectors). Note that the two types of Data and/or Flag output PODs (TTL/CMOS and ECL) and the Trigger POD, have identifying legends on their bodies. Self adhesive labels are supplied with the output PODs, these enable you to label them as appropriate.

Connection/disconnection of PODs:
First, switch **off** the 8175A.
Unscrew the securing screws identified on the cover plate and remove the plate.
Carefully unplug/plug in (as appropriate) the required POD connectors.
Install the cover plate back in position, taking care to route the POD cables through their corresponding grommets in the plate. Secure the plate firmly with its screws.

3B
Getting Started

INTRODUCTION

Since you are now reading this section it is assumed that you have read section 3A, and know the basic principles of operating a standard 8175A. If however you have skipped 3A and do not know the basics, then please go back and learn them! It will not take very long and will really help you to quickly learn how to use the Arb.

With almost any instrument or system, the best way to learn how to use it is to start practicing as soon as possible. This applies especially to the Arb. option of the 8175A since, in many cases more than one method of setting the same value is possible. Also, the quickest way to understand the significance and use of some of the waveform setting up procedures (especially those related to the Data [Waveform] Setup) is by trying them out.

Having read this, please don't now rush off and "blindly" try to work out everything yourself and refer back to the manual only as a last resort when you get into difficulties. If you take the time to first work through the examples included here, it could save you a lot of time later on!

NOTE: In the following pages the abbreviation "Arb." is used to refer to the Arbitrary Waveform Generator.

The contents of section 3B are listed under the following headings:

3B-1 Power Up and Initial Conditions
3B-2 Setting up Arbitrary Waveforms - The Different Methods
3B-3 Setting up Waveforms - What are the Steps?
3B-4 Some Basic Points and Terminology Explained
3B-5 How to set up Waveforms - Using the Calculator
3B-6 How to set up Waveforms - by Interpolation
3B-7 How to set up Waveforms - by Graphical Editing
3B-8 How to set up Waveforms - by Numeric Entry

Once you have mastered the basics, the reference section (identified by the blue registers) will provide any additional information concerning menu explanations and editing etc.

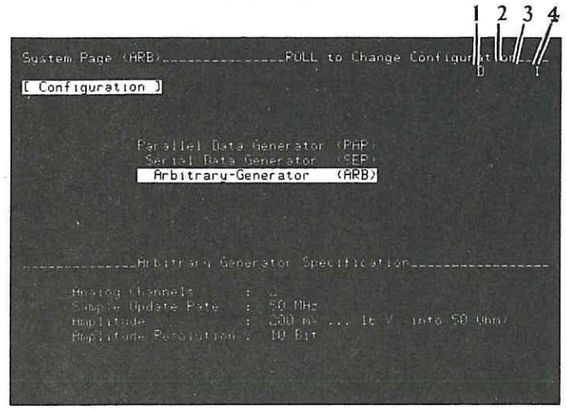
"Hands on" use of the Arb. via worked examples is not started until section 3B-5. Although the sections are structured as "self contained" learning modules, it is recommended that you work through them in the order shown above.

3B-1
POWER-UP AND INITIAL CONDITIONS

Have you read the points in section 3A-1? Ok, then press the **LINE** switch. Do not press any other front panel keys. You will hear the cooling fans start up and the LEDs adjacent to the front panel BNC connectors will illuminate. During power-up, an automatic self test routine is performed. The message: **"Self Test Running"** will appear on the screen and remain until the test is completed. If any failure is detected, it will result in an appropriate error message being displayed on the screen. These messages (together with the procedure to follow) are listed in Appendix A-1 of the standard Op. and Prog. manual. On completion of the power-up sequence, the LEDs will go off (this is in fact their "outputs disabled" status) and the System Page **[Configuration]** menu will be displayed. This is illustrated in Figure 3B-1. The message **"Power-Up Complete"** will be briefly displayed on the top line.

Initial Configuration

The configuration at power up is always the same as when last switched off (provided no boards have been removed in between!). The position of the bright bar (inverse video) in the center of the display area indicates the current configuration. It is also shown in (), adjacent to every Page name, at the top left hand side of the display. The 8175A automatically recalls the complete parameter and data set, which was current at switch off, whenever power is re-enabled. All outputs (PODs and Arb.) are automatically disabled at power up.



STATUS INDICATORS Explanation:

1. "**D**" here means all POD* outputs are disabled (see standard manual sect. 3B-5, point 7).
2. A "**U**" here means an update is necessary (see standard manual, sect. 3B-5, point 6).
3. A [ ] in this location means the 8175A is active (e.g. after START, see standard manual, sect. 3B-5, point 8).
4. Arrows displayed here mean that **ROLL** (or VERNIER if appropriate) action, via the keys indicated is possible.

*Arb. outputs "off" status is indicated by their front panel LEDs being off.

Figure 3B-1. Example of Power up Display and Status Indicators (manual operation) Explanation.

Select **Arbitrary-Configuration** (if not already active) and note the shortform specifications shown in the lower part of the display area. Note, depending on what data was previously set up in the 8175A, it is possible that when Arb. configuration is selected, a warning message relating to Data Limitation or Offset Modified will be displayed. Do not worry! Explanations are given in section 3B-4, but at present do not concern yourself with the reasons. Simply recall the Standard Settings as explained in section 3B-5, select Arb. configuration and continue from here.

3B-2 SETTING UP ARBITRARY WAVEFORMS - THE DIFFERENT METHODS

The Arb. provides four basic methods of setting up and/or editing waveforms. These are as follows:

METHOD	APPLICABLE PAGE/MENU
(1) **NUMERIC ENTRY** of voltage level/base code and duration values.	Data [Pattern/level] Setup menu.
(2) **GRAPHICAL ENTRY** of data point levels and durations.	Data [Waveform] Setup menu.
(3) **INTERPOLATION** of user set Characteristic Points. (Interpol. capability accessed via FCTN key).	Data [Waveform] Setup menu.
(4) **CALCULATOR** Set up and run the mathematical expression which represents the required waveform.	Data [Calculator] Page.

Although in theory any of these methods can be used to set up a waveform, in practice the "best" or most practical method to use will depend on the type and complexity of the waveform concerned. Modification of an existing waveform can often be done much quicker via a different method than that used to set up the original. Once you have learned the basics of Arb. operation, you will be able to decide for yourself which is the best method to use.

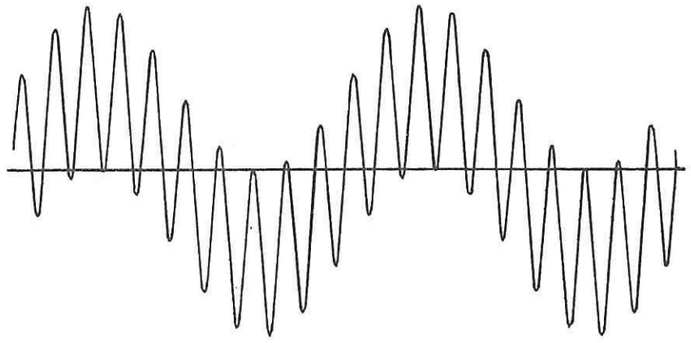
At this point however it is worth noting that method (3), which is based on Interpolation and (4) based on the Arb's Calculator, will usually be the fastest and most practical for setting up waveforms from scratch unless only step functions are required. For such cases (1) is often the quickest method. Generally (1) and (2) are more suitable for editing existing waveforms. If you need to set up a waveform which includes a mixture of simple and complex trigonometrical (Sine, Cosine etc.) and step functions etc., then a combination of methods will often be the fastest solution.

Which Method should I use?

To help you decide which is the best method to use, here are a few guidelines:

For **Simple and complex waveforms**, based on standard functions for which the mathematical expression(s) is already known or can easily be defined (including sine, cosine, tan based waveforms etc.), use the:

Data **[Calculator]** Page

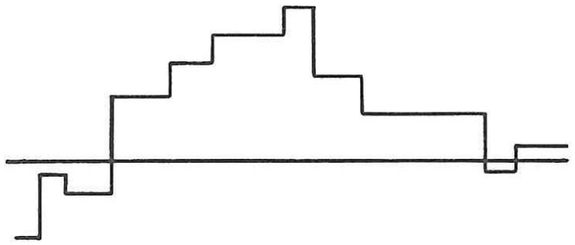


Standard Function Based Waveforms*

If you know (or can easily derive) the mathematical expression(s) for the waveform, the Calculator is a very good and quick method to use. In principle it involves entering the algorithm(s) for the waveform directly via hard and softkeys into the 8175A, setting the Parameter conditions and running the resulting "program".

***NOTE:** The Calculator module to produce the type of waveform shown here (Line Ripple) is given in section 3C of this manual.

For **Step functions** use any method



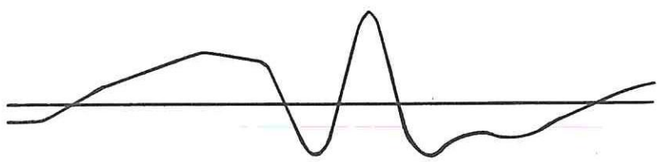
Step Functions

The [Pattern/Level] Setup menu enables levels and variable durations of step functions to be set up very quickly. However, the [Waveform] Setup menu (either normal or Interpolation) offers the advantage that you can see* the waveform "taking shape" on the display. The [Calculator] can also be used, but since a separate algorithm has to be keyed in for each and every level/duration combination, it is not recommended.

*You will not see the differences between variable durations on the [Waveform] menu. Reasons etc. are explained in section 3B-7.

For **Extremely complex waveforms** which are not easily mathematically definable, graphical construction is usually the best solution, therefore use the:

Data **[Waveform]** Setup.



Non-specific Complex Waveform

For such waveforms, which would maybe require hundreds of algorithms to represent them mathematically, the quickest solution is often to "draw" the waveform directly on the screen by means of the Graphic editing capabilities. This can be done with or without the aid of the Interpolation feature. Remember also that there may be specific parts of the waveform (step functions etc.) which can be done by one of the other methods.

3B-3
SETTING UP A WAVEFORM - WHAT ARE THE STEPS

Irrespective of which method you decide to use, there are some basic steps involved in setting up and outputting an arbitrary waveform. These, together with the Pages/menus concerned are as follows:

STEPS IN SETTING UP AN ARBITRARY WAVEFORM:

1.	Select Arb. configuration.		**SYSTEM** **[Configuration]**
2.	Decide on best method(s) for setting up the waveform.		**DATA** **[Calculator]** **[Waveform]** Setup **[Pattern/Level]** Setup
3.	For the required Arb. outputs set:	Output impedance Amplitude Range Offset value Output Mode	**OUTPUT** **Level [ARB A]/[ARB B]**
4.	Set up waveform by method decided in (2).		

HOW TO OUTPUT A WAVEFORM:

		PAGE/[menu] TO ACCESS
5.	Set up a program module.	**PRGM** **[Module]**
6.	Set the required cycling mode.	**CNTRL** **[Clock]**
7.	Set the required outputs to "enabled".	**OUTPUT** **Level [ARB A]/[ARB B]**
8.	Do an "Update".	**SHIFT + UPDATE**
9.	Press "START".	

From this you will see that setting up a waveform involves only the first four steps. To output it, the steps (5 to 9) are in principle the same as for the Parallel and Serial configurations of the 8175A. Therefore, at present you need concentrate only on steps 1 to 4.

Now take a few minutes to check out the Pages/menus referred to above.

IF YOU WANT TO START "HANDS ON" RIGHT NOW

Before reading any further, it is worth mentioning that section 3B-4 which follows, is in effect a glossary of various points and terminology related to Arb. operation. As such, as well as providing a good general overview of Arb. related points, it will also serve as a useful reference source. It is recommended that you read through it before actually starting to operate the Arb., but this is not essential. If you are already quite familiar with the standard 8175A and have had no problem understanding any of the Arb. menu terms etc. encountered so far then, proceed directly to 3B-5.

If however you are unsure as to the meaning of some of the menu settings you have already seen or, simply want an overview of the A to D principles etc. as applied to the 8175A Arb., then continue with 3B-4.

3B-4
SOME BASIC POINTS AND TERMINOLOGY EXPLAINED

The following explanations are designed to clarify some of the basic points and terminology associated with 8175A Arb. use. It is intended only as an overview and should be sufficient to answer any questions you will have while working through the Getting Started explanations. The information is presented under the following headings:

First, some General Points about the Arb.
Some Menu Settings Explained
Points related to Config. changes (ARB to PAR/SER etc.)
Points related to Outputting

FIRST, SOME GENERAL POINTS ABOUT THE ARB

What are the differences between Serial/Parallel and Arb. configurations?
In the 8175A's data generator modes, at each address a data pattern (or stream of bits for Serial D.G.) can be set for subsequent outputting. For each pattern, although a different duration value can be set, amplitude is a fixed (user set) value. The big difference with the Arb. is that it enables, at each address instead of a data pattern, an amplitude level to be set. For the 8175A Arb. each amplitude level is based on the analog equivalent of a 10 bit binary word. The words are derived from the data which you set in the 10 channels allocated to each Arb. output (see paragraph after next). Since a 10 bit word is used, 10 bit amplitude resolution is achieved. The duration value at each address can be either fixed or variable. By assigning appropriate level and, if required, duration values over the required time interval, an arbitrary waveform can be systematically built up.

The Calculator - What is it?
In case you are unsure as to what the Calculator is (it is fully explained later in sections 3B-5 and 3C of this manual) here is a short explanation:
The Calculator is a special capability of the Arb. which basically enables you to write and run "programs" to set up waveforms. You do not need a separate technical computer since everything can be done directly via the 8175A's keyboard. A comprehensive selection of standard statements and mathematical functions is available directly via softkeys (instead of every character having to be typed) therefore, "programs" can be very quickly written.

NOTE: In Arb. configuration, recall of Standard Settings will result in any existing Calculator modules being **destroyed!** This is not the case in Par. and Ser. configurations.

Which data channels are allocated to each Arb. output?
As mentioned previously, for each Arb. output 10 normal data channels are used. To identify which these are, simply access the Data **[Format]** Allocation menu. Asterisks (*) identify the channels concerned including those allocated to the trigger (TRG) channels. Just in case you are wondering what channels 1 and 3 of POD 0 are used for, they are reserved for Characteristic Point (CP) information. This is related to the Interpolation capability of the Arb. and is discussed elsewhere in this manual. Note that, unlike in Parallel configuration, all the Data Formats are all fixed. If **[fixed]** Duration is selected, then you set the value here. If **[variable]** selected, then the value(s) have to be set on one of the other Data Page menus. For either type of duration the default value is 0.02 μs.

How do I input the level values?
This depends on the particular method you wish to use to set up the waveform. As described in 3B-2, there are four basic methods of setting up waveforms. Numeric, graphic and interpolation methods enable individual level values to be input in voltage terms (the Calculator method differs completely from the others and will not be considered here). Depending on the menu concerned, level values can also be input in their equivalent "code" form. These include decimal, binary etc. Only one method allows all possibilities. This is numeric entry via the Data **[Pattern/Level]** Setup menu.

Access the menu and note the details. Each individual level value can be input (and displayed) either as the required voltage or in one of several base codes. Currently the Amplitude values at each Address are displayed in voltage terms. Note also that the Amplitude Ranges cannot be changed on this menu (see next paragraph). The required base code is user set in the field below the data column header --- ARB A --- etc.). The code can at any time be changed. In the following paragraph a display example is included which illustrates how the binary (BIN) base code relates to actual voltage values.

SOME MENU SETTINGS EXPLAINED

Amplitude Ranges and Resolution

Press the OUTPUT key and display the "Level **[ARB A]** into **[50 Ohm]** menu". This is where settings including the Amplitude Range for Arb. A are made. Regarding the resolution of each Ampl. Range note the following:

For the current range of **[200 mV]**, a 10 bit amplitude resolution means that:

the resolution is 200 mV)/1024 (since 2 to power 10 = 1024).

However, instead of having a resolution of 1/1024 (which is not very practical), a factor of 1/1000 is used for all except two ranges* . In addition, for all (except the same two) an additional override of 24 steps of the resolution value is provided. This therefore extends the usable range to 1024 (0 to 1023) discrete values.

* The resolution/step count figures for the different ranges are as follows:

Range	Resolution/Steps	Available Step Window
200 mV - 10 V, 20 V,	1/1000, 1023 steps	0 to 1023
16 V	1/800, 800 steps	112 to 912
32 V	1/640, 640 steps	192 to 832

To illustrate these points, consider the 200 mV range, it allows 1023 incremental steps of 0.2 mV.
This therefore provides an actual usable range of 1023 x 0.2 mV = 204.6 mV.
(Note that 1024 actual values are available, corresponding to: binary 0000000000 (the smallest) and 1023 steps up to: 1111111111 (the largest)). In binary equivalent terms, the max/mid and lowest values will therefore equate to:

Maximum value (Upper Limit) of +102.2 mV equates to:	1111111111 (dec. 1023 steps)
Mid range value of 0.0 V equates to:	1000000000 (dec. 512 steps)
Minimum value (Lower Limit) of -102.4 mV equates to:	0000000000 (dec. 0 steps)

From this you can also see that one more step is available in the negative direction (512) than the positive (511) one. For the 16 and 32 V ranges, an equal number of steps (400 or 320 respectively) apply in each direction. In any range, an attempt to set a value which exceeds the allowable step count (and hence the binary data limit) in either direction, will result in: "**ERROR Data out of Limit**" being displayed.

NOTE: Output load setting can influence range availability. For example, the 20 and 32 V ranges are available only if the output load is set to **[open]**. However, the 200 mV and 16 V ranges are available only if **[50 Ohm]** output load is set. Full details are given in the OUTPUT Page description in the Quick Reference section.

The following display example will help to clarify some of the points concerning Range/Resolution. At each Address the level values for both Arb. outputs are identical but displayed in two different forms. Note how the step resolution of 0.2 mV is represented in binary terms by one bit.

ARB A: Amplitude Range: [200 mV] Upper Limit: + 102.2 mV
Lower Limit: - 102.4 mV

Address	Name	--- ARB A -- [ABS. LEVEL]	--- ARB B -- [BIN]	--TRG-- A	B	-Duration-
0506		- 1.0 mV	0111111011	0	0	2.00 µs
0507		- 0.8 mV	0111111100	0	0	2.00 µs
0508		- 0.6 mV	0111111101	0	0	2.00 µs
0509		- 0.4 mV	0111111110	0	0	2.00 µs
0510		- 0.2 mV	0111111111	0	0	2.00 µs
0511		[+] 000.0 mV	1000000000	0	0	2.00 µs
0512		+ 0.2 mV	1000000001	0	0	2.00 µs
0513		+ 0.4 mV	1000000010	0	0	2.00 µs
0514		+ 0.6 mV	1000000011	0	0	2.00 µs
0515		+ 0.8 mV	1000000100	0	0	2.00 µs
0516		+ 1.0 mV	1000000101	0	0	2.00 µs

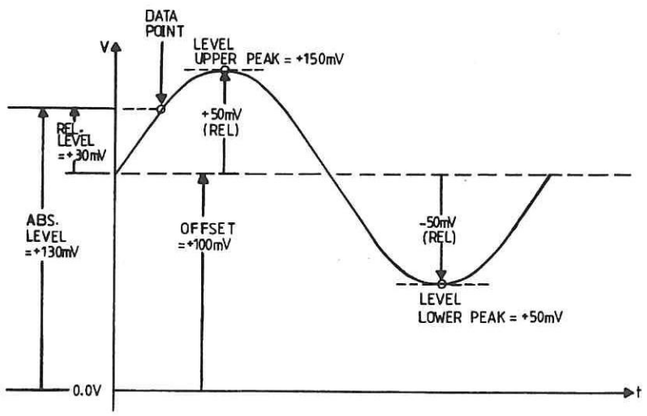
Different Representation of Identical Values

LEVEL and Peak Values Explained
In case you have difficulty understanding the "Level" and "Peak" terms, the following explanations will help. Refer also to the included figure. The sinewave shown is 100 mV P to P, with +100 mV offset applied. Note the difference between the "REL" and "ABS" levels of the example Data Point.

[REL. LEVEL] (Data **[Pattern/Level]** Setup menu)
The displayed value is the output level referenced (or relative) to the applied offset.

[ABS. LEVEL] (Data **[Pattern/Level]** Setup menu)
The displayed value is the actual output level (i.e. Relative Level plus offset).

Level Upper and Lower Peaks (Output Page menu)
Level Upper and Lower Peaks are the max/min values (including offset) currently set. Note that the peak values are also influenced by the Output Mode. Refer to the Output Page menu description: Output Mode, for more information.



Some Level Terms Explained

Upper and Lower Limits (Data **[Pattern/Level]** Setup menu)
For both limits the values depend basically on the current Amplitude Range. In addition, Offset may or may not be included in the displayed value. This is explained as follows:

When **[REL. LEVEL]** data format is active, then U and L (Upper and Lower) Limits show the maximum/minimum values **without offset** which can be set within the currently active Amplitude Range.

When **[ABS. LEVEL]** data format is active, then U and L Limits show the maximum/minimum values **including offset**, which can be set within the currently active Amplitude Range.

NOTE: When level values are displayed (or set up) in an alpha-numeric codes the displayed value is based on the [REL. LEVEL] equivalent.

POINTS RELATED TO CONFIG. CHANGES (ARB--> PAR--> SER--> ,.)

Outputs - Arb. Automatic Disabling
The Arb. outputs are automatically disabled whenever the Generator configuration is changed. This can be done in several ways including: via the System Page **[Configuration]** menu, recall of internally or externally stored "complete" instrument settings to the ACTUAL (display) settings, HP-IB command etc. Remember that when **[internal]** storage is used, settings are automatically returned to the ACTUAL (display) settings. Therefore "recall" of any **internally** stored settings will result in the Arb. outputs being disabled. For **[external]** storage the destination can be set to hardware (output stage).

Outputs PODs - Automatic Disabling
Whenever the 8175A configuration is changed to Arb. from either Parallel D.G. or Serial D.G., the PODs will be automatically disabled.

Displayed Message: WARNING Data Limitation .....
If when you select Arb. configuration such a warning is displayed relating to ARB A, ARB B or Both, it simply means that data has been set up when the 8175A was configured as a Parallel or Serial D.G. which exceeds the allowable limits of the current Amplitude Range(s) for the corresponding Arb. channels. It will disappear when the corresponding data or Amplitude Range is set to an allowable value.

Displayed Message: WARNING .....Offset Modified
If when you select Arb. configuration such a warning is displayed relating to ARB A, ARB B or Both, it is based on a similar reason to the previous one. This is as follows: In any Amplitude Range, allowable Offset Limits are limited by the current Upper and Lower Level Peaks of the waveform. In normal Arb. use any attempt to set an illegal (out of limits etc.) Level or Offset value would be auto-detected and prevented. Also, an "**ERROR .... out of Limit**" message relating to **Data** or **Offset** would be displayed.
However, in Parallel/Serial configurations, data within the "Arb. channel groups" can obviously be changed. After such changes, if Arb. configuration is then reselected, it is possible that the new data, when combined with the existing Offset value, will be "out of limits". In such cases, the offset concerned will be reduced to zero. To illustrate this, consider the following example:

A waveform is set up in Arb. configuration for ARB A using the 200 mV Amplitude Range. Level Upper and Lower Peaks for the waveform are:
+/-40 mV (or BIN:1011001000 and 0111111000) respectively.
For these Peak values the Offset Limit will be +/-760 mV (since the allowable Level Window = +/-0.8 V. If the Offset is now set to +760 mV the level Window is "filled". This means that in Arb. configuration, an attempt to set a level value > +40 mV will not be allowed. However, if you now switch to Parallel or Serial configuration and change the data bits in those channels "belonging" to ARB A to say:
BIN:1111111111
this would equate in Arb. configuration to +102.2 mV. Therefore, on switching back to Arb. configuration, an error will be detected. It will be automatically corrected by changing the Offset to zero.

POINTS RELATED TO OUTPUTTING

VERY IMPORTANT: Output Load Setting
Before setting up (and definitely before outputting) an Arb. signal always ensure that the load setting of the 8175A (either "open" or "50 Ohm") is correctly set. It not only affects which Amplitude Ranges are available/operative but, **more important**, could result in the output voltage being up to twice the programmed value if incorrectly set! More about this is explained in the Output Page menu description.

Outputs - POD and Arb. Global Disable
A global disable of all outputs (Pod, Flag and Arb.) can be done via the **DISABLE** key on the 8175A front panel. A "D" will then be displayed in the top right hand corner of the screen. However, note that unless a global disable has been done, a "D" can also indicate that just the Output Pods are disabled (if previously done via the Output Page).

Arb. Outputs - Enabled Status Indication
The Arb. outputs, including TRIG OUTPUT for Arb. A, which are available at the 8175A front panel are provided with LEDs. These, when "on" indicate that the corresponding output is active (enabled). Note that Arb. outputs and triggers can be enabled only via the Output Page (ARB) ARB A/ARB B menus.

3B-5
HOW TO SET UP WAVEFORMS - USING THE CALCULATOR

As mentioned in section 3B-2, there are two methods by which waveforms can be set up very quickly. These are the Calculator and Interpolation methods. We will start with the Calculator. While this section explains all the basics about the Calculator, subjects such as module syntax limitations/restrictions etc. are explained in section 3C. It also explains the meanings of less obvious softkeys etc., and includes some more worked examples.

What is the Calculator and What can it do?

The Calculator is a special capability of the Arb. that enables you to write and run "programs" to set up complex mathematically definable waveforms. Instead of having to do this via a technical computer, you can do it directly via the 8175A keyboard. A comprehensive selection of standard statements and mathematical functions is available directly via softkeys (instead of every character having to be typed), so "programs" can be very quickly written.

The following example will teach you all the basics of Calculator use. This includes Editing (setting up the function), setting the Parameters and, finally Running the module. This is the process that does the actual calculation and transfers the new amplitude and timing values to memory and hence to the Pattern and Waveform Setups. The example will show to set up and run a simple sinusoidal waveform.

RECALLING STANDARD SETTINGS ETC.
Before setting up any waveform data via the 8175A Arb. it is best to do a "Recall Standard Settings" sequence. This then ensures that you will begin with all data set to zero (binary, not 0 V) and parameter values and conditions at their default conditions. Do this as follows:

NOTE: In Arb. configuration whenever the Standard Settings are recalled any existing Calculator modules are **destroyed!** (This is not the case in Par. and Ser. configurations.) Therefore to clear the Calculator module memory as well, Arb. configuration must first be selected before doing the recall.

Press **SYSTEM** to select the System Page.

Press **NEXT[]** until the **[Configuration]** menu is displayed.

Press **CURSOR ↓** or **ROLL** keys to select **Arbitrary-Generator** configuration.

Press **NEXT[]** until the **[Storage]** menu is displayed.
If necessary, **CURSOR →** and **NEXT[]** to select **[internal]**.

CURSOR ↓ and **NEXT[]** until **[recall]** Standard Settings.

Press **EXEC**. The message "Transfer in Process" will be displayed, followed by the original one (**Press EXEC...**) when the transfer is completed.

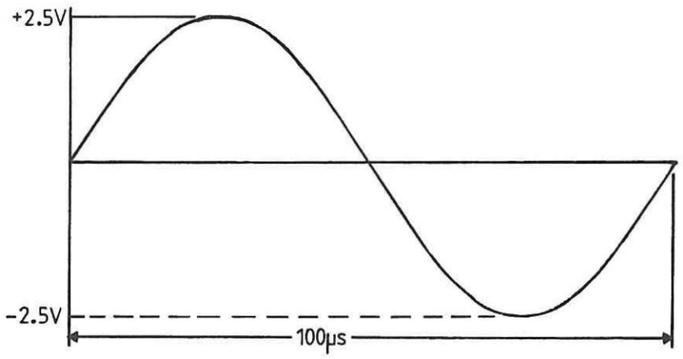
Reselect **Arbitrary-Generator** configuration.

NOTE: ERROR MESSAGES
It is quite likely that when practicing with the Calculator you will accidentally attempt an illegal (non-allowed) action. Do not worry! An error message or warning will be displayed to tell that something is wrong. In most cases the messages are self-explanatory, however they are all explained at the end of section 3C.

Example 1: Using the Calculator

This example will explain the basics of Calculator use by showing how to set up a simple sinusoidal waveform. Although a complex waveform could have been used, setting up this one is very easy but will still teach you all the basics of Calculator use. Section 3C includes the Calculator functions for some more complex waveforms. The following procedure for a sine wave can, with a little modification, be easily adapted for complex arbitrary waveforms. The actual procedural steps (keyboard operations etc.) are numbered for easy identification. Since this is the first example in the manual, fairly detailed explanations of procedural steps etc. are included. The examples in section 3C do not include so much explanation.

The sine wave is to be as follows:
Frequency 10 kHz Amplitude 5 V peak to peak
To be output from OUTPUT A into a 50 Ohm load.



Waveform for Example 1

DERIVING THE MATHEMATICAL FUNCTION:

As already mentioned, using the Calculator involves setting up the mathematical expression(s)* that represents the waveform. In practice the first step would be to derive this for the waveform. For our example it is done as follows:

***NOTE:** Complex waveforms may comprise one or more mathematical functions.

A sinusoidal waveform can be expressed as:

$$y = \sin(wt) = \sin(2.Pi.f.t) = \sin(2.Pi.f.Tx)$$

where Tx is the instantaneous time. A frequency of 10 kHz means that the period is 100 µs.

Within any amplitude range, waveform accuracy depends on the combination of max./min. level values and the number of data points (discrete level values) used. We will use 1000 data points for one cycle which means that 1000 steps (sequential Address/level values) must be calculated. (1024 steps are available but 1000 is an easier number to work with!)

So, for our waveform, since the period is 100 µs and we want 1000 steps, the timing window (the duration that the waveform will be calculated for) must be set to 100 µs and each incremental step of Tx must therefore be 0.1 µs.
Therefore Tx will have values of: 0, 0.1, 0.2, 0.3.....99.9 µs.

Calculator functions are always set up as one or more modules each of which consists of a Header and an Algorithmic part. For our example these will be as follows:

The Header defines the required time window of: **FOR** 100 µs
and the (incremental) step duration of: **STEP** 0.1 µs

The number of steps is the time window **FOR**.. divided by the step duration **STEP**.
The Algorithmic part is the mathematical expression for the waveform. For our example the complete module to be input is:

HEADER: FOR 100 US STEP 0.1 US
ALGORITHM: (SIN(2*PI*10000*Tx))

A Header can begin with a label if wished to identify where the module begins in the overall pattern setup. Up to 50 labels are settable, each of which can consist of up to five alphanumeric characters. The first character must be must be an alpha type.

PRE-SETTINGS:

As previously mentioned, whichever method you use to set up a waveform, there are certain initial settings which have to be made before data can be calculated and set. Although you can input a module irrespective of these, it cannot be Run (since this causes the data to be calculated and set) without eg., Amplitude Max. and Min Levels being set. For the example the following pre-settings need to be made. Although they could be set immediately prior to the Run command, if you set them now it will save you some steps later. (The exact reasons are explained in section 3C but you do not need to know them at present).

DURATION
Access the Data [Format] Allocation menu and set the Duration to [variable].

AMPLITUDE RANGE
Press the **OUTPUT** key. On the Level **[ARB A]** into **[50 Ohm]** menu, position the cursor in the Amplitude Range field (press **CURSOR** ↑) and set the range to 5V. Note how the Level Upper and Lower Peak and Offset Limit values change to reflect the new Amplitude Range.

HOW TO ACCESS THE CALCULATOR

Press the **DATA** followed by the **NEXT[]** keys until the Data **[Calculator]** Page is displayed.

Note the initial details of the menu. The Status of the menu reads: "Awaiting Command". As soon as you press one of the three softkeys, the status will change to reflect the activity concerned or awaited. As you work through the example note how the status report changes. "Step Algorithm of the Waveform" are just headings for the working area of the display.

By the way, from now on until you want to exit from the Calculator, your 8175A is softkey driven. You cannot exit from the Calculator by simply pressing a corresponding **MAIN DISPLAY** key!

HOW TO EXIT FROM THE CALCULATOR

To exit from the Calculator once you are in any soft-key level is a little different from exiting from other menus. Note the following points:

Exiting is done via the **NEXT[]/PREV[]** keys. It is possible only when the flashing cursor lies in the inverse video **[Calculator]** field in the top right hand corner of the screen.
To display this field, you must first exit from the currently active softkey layer.

You **cannot** exit if an error condition exists, therefore in such cases either:
make whatever corrections are necessary, or
Abort (via a Calculator softkey), this will leave the module in its original pre-edited state) or
Delete the module.
When any of these three conditions has been satisfied, then you can exit.

To continue, the initial layer of three softkeys give access to the three "actions" involved in using the Calculator. These, in their logical sequence are:

Editing
Parameter setting
Running the module.

Briefly, the meaning of these is:

Edit This enables you to edit a module. Note that even initially setting up a module is still considered to be an "editing" action. The **Edit** key lets you access several further layers of softkeys covering all module editing/setting-up requirements.

Param This gives access to the "Parameter Setup menu". You set all parameters (Amplitude Levels etc.) related to running the module here.

Run This starts the calculating process. The resulting amplitude and timing values will be transferred to the Data **[Pattern/Level]** Setup.

CALCULATING - THE ACTUAL STEPS INVOLVED

The first step is to edit (set up) the module. This involves simply typing it in which is simple enough but, before starting, take special note of the blanks (spaces), parentheses () and the multiplying symbols (*) required in the Header and algorithm.

HEADER: FOR 100 US STEP 0.1 US
ALGORITHM: (SIN(2*PI*10000*Tx))

Blanks (these are only applicable to the Header) between numeric values and their units e.g., 100 and US, are not essential but may be included for clarity. In all other cases they are essential. If you happen to forget one, as soon as you attempt to "**End_edit**" a message will be displayed to remind you.

1. Press **Edit**. All softkeys related to module creation and/or editing are available via **Insert**. Note how the normal "flashing" cursor has disappeared. Press **Insert**. There are now six layers of module softkeys available via the **Etc.** softkey. Before continuing, check them out and note how related functions and statements are grouped together on the same layers.

Typing in the Module:

The Header

2. Type in the Header text via the appropriate soft and alpha-numeric keys. Remember to enter "FOR" and "STEP" via softkeys. As you enter each character etc. the cursor will auto-advance one space. For Blanks use the front panel "**DON'T CARE**" key.

If you enter an incorrect character or statement, move the cursor (via the **CURSOR** → or ← key) back to the position, enter the correct character and use **Delete** to delete the false one. (You can also do the delete first and then make the correction if you wish.)
The **Recover** softkey enables you to recover the last deleted character or statement etc. if you deleted the wrong thing.

After entering the last "S" of the Header line, press **Cr/lf** and a new blank line will be displayed*.

***NOTE: Use CR/lf to initiate new lines!**
Do not fill a line with blanks to complete it and initiate a new one! Although it will result in a new line being produced, since each blank is treated as a character, internal storage allocated for Calculator modules will be unnecessarily used up! Section 3C explains how much memory is allocated for the Calculator.

The Algorithm

3. Type in the Algorithm using the same procedure as for the Header.

Compilation and/or Error Detection

4. Press **End_edit**. The module will be compiled. (Note how the Status briefly changes to indicate this. If a syntax error is discovered, an appropriate error message will be displayed. In addition, its location within the module will be indicated by the cursor.
   If no error exists and the display details are as shown in the figure below, procede to step (5).

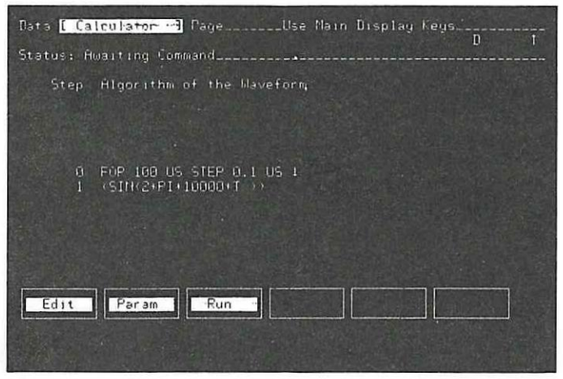


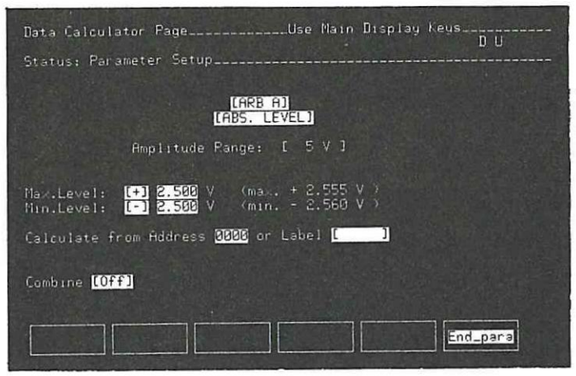
Figure 3B-2. Display Details after **End_edit**

(The error messages are generally self-explanatory, but are in any case, listed together with explanations at the end of section 3C.)

The Calculator Status will change to "Inserting". Make the necessary correction(s) and press **End_ins** followed by **End_edit**. If you have made more than one mistake then another error message will be displayed and **End_edit** will not be allowed. Only when all errors have been corrected will it be allowed.

Parameter setting:

5. Press **Param**. The first setting field defines which Arb. output (and hence which data channels) the function is to be calculated for. Since we want it in Arb. A, leave it as the default setting. The Amplitude Range of 5 V as previously set will be displayed. Now set the required Max. and Min. Levels to + and -2.500 V respectively. These will then be the amplitude values which will be assigned to the maximum and minimum data values calculated from the module. Note that the maximum values which could be set within the 5 V range are +2.555 and -2.560 V respectively. The "Calculate from Address" will be the default value of 0000. This will be the address from where the calculated data (patterns) will start. The menu details should be as shown below.



Running the Module:

6. Press **End_para**.

7. Press **Run**. This starts the calculating process. The Status will indicate the current phase of calculation. Until calculation is completed, the following message will be displayed:

RUNNING To Stop Press Abort

On completion of Run, the new level and duration values will be assigned to the addresses. In the same way as for Edit, if an error is detected an appropriate message will be displayed. Refer to the end of section 3C for explanations.

8. Access the Data **[Waveform]** Setup menu (remember to use **NEXT[]/PREV[]** to exit) the Calculator. The menu details will be as shown in Figure 3B-3.

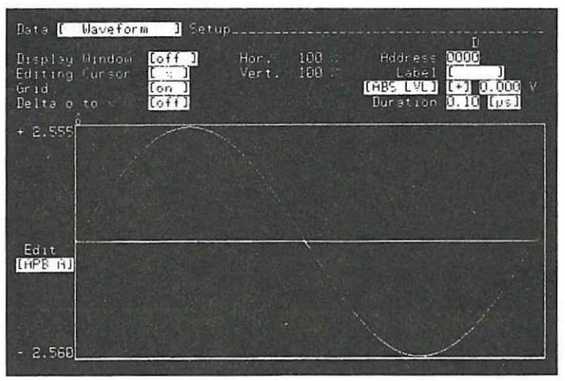


Figure 3B-3. [Waveform] Setup menu Details

Outputting the Waveform:
To output the waveform (from OUTPUT A front panel connector) the following additional steps are necessary:

		PAGE/[menu] etc.
9.	Set a Program Module to run from 0 to 999*.	**PRGM** **[Module]**
10.	Set the cycling mode to [Auto Cycle].	**CNTRL** **[Clock]**
11.	Set the ARB A Output to "enabled".	**OUTPUT** **Level [ARB A]**
12.	Do an "Update".	**SHIFT + EXEC**
13.	Press "START".	

*The last value calculated for the waveform is at Address 999.

SOME FURTHER PRACTICE

As you can see, using the Calculator is actually quite easy. If you want to practice a bit more (before creating your own modules) then edit the existing module as described in the following paragraphs and note the changes which occur on the displayed waveform. Some more module examples together with the resulting waveform displays are given in section 3C.

Editing the Frequency:

First, press **Edit** and then **Insert**.
Change the frequency to 100 kHz, leave all other values unchanged.
Press **End_ins** and **End_edit**.
Press **Run**. 10 complete cycles will now be produced in the time window. This is because the time window, given by the **FOR** time of 100 µs, equates to 10 periods of the new frequency.

Editing the STEP value:

Now change the frequency back to 10 kHz and the **STEP** value to 0.2 µs.
This means that within the unchanged time window of 100 µs, only 500 new steps will be calculated.

Press **RUN**. The "new" module will overwrite the first 500 addresses of the previous one. Therefore, a composite waveform comprising one cycle of 10 kHz at the first 500 addresses, followed by 5 cycles of the original 100 kHz waveform at the next 500 addresses will be the result.

Explanation of why Different Duration Values Not Always Obvious
Note that the total duration of the new waveform from Address 0000 to 1000 is 150 µs (100 + 50). From the 8175A waveform display it may not at first be obvious because different duration values between data points cannot be graphically displayed. Therefore, irrespective of duration values, identical numbers of data points always occupy the same length of display. In other words, 50 data points each of duration 0.1 µs will occupy exactly the same display length as 50 of duration 1.0 µs.

So for this example although the first 100 kHz cycle extends over 500 data points and is 100 µs long, the second **half**, of five 100 kHz cycles is only 50µs long but, because it also extends over 500 data points, it occupies the same display length. If viewed on an oscilloscope, the second part (the five 100 kHz cycles) would be "compressed" to its correct length relative to the first part of 50%.

How to Measure Waveform Durations:
You can measure the duration of the previously edited waveform (and therebye learn how to use another Arb. menu feature) with the "Delta o to x" feature of the **[Waveform]** Setup menu. This enables the duration between the addresses where the **o** and **x** graphical editing cursors are currently positioned to be measured. It is done as follows:

On the Data **[Waveform]** Set, move the cursor into the "**Delta o to x**" field and press **NEXT[]** to activate it for **<-->** measurements. Check that the Editing Cursor is still the **x** one and that the **o** cursor is still at Address 0000.
Move the cursor into the Address field and set a value of 1000.
The **x** Editing cursor will move along the graphics display area to address 1000 and the time duration between it and the **o** cursor will be displayed. Section 3B-7 includes more information about using this feature.

What next?

While setting up the module, maybe you noticed some softkeys and/or menu settings whose meanings you did not understand. Do not worry, they are all explained together with limitations/restrictions etc. in Section 3C. Depending on whether you now want to learn more about the Calculator, or first want to check out the graphical capabilities of the Arb., either move on to section 3C or 3B-6 respectively.

3B-6
HOW TO SET UP WAVEFORMS - BY INTERPOLATION

Interpolation is actually one of the graphic methods of setting up a waveform. Therefore this section begins by explaining a few general points related to graphical editing.

Whereas, on the **[Pattern/Level]** Setup menu, the pattern parameters at each address are displayed in numeric form, on the **[Waveform]** menu graphical representation is used. A numeric setting/display field is also provided. Basically, the **[Waveform]** Setup menu enables either existing waveforms (including trigger data) to be displayed and/or edited, or new ones to be set up.

Waveforms can be graphically set up and/or edited either by:
- "drawing" directly on the display via the graphic editing features or,
- setting, then interpolating between, specified characteristic points or,
- entering level and duration values in the corresponding data entry/setting fields.

A combination of any of these methods can also be used.

NOTE:
The following general points apply to the [Waveform] menu:

Graphical editing (including Interpolation) is not allowed if the Display Window is active.
When graphical editing is possible, a waveform selection field with the header "Edit" will be displayed.

Level values can be set up and/or edited either numerically or graphically.
Duration values can only be numerically set up and/or edited.
Variable Duration values are not graphically displayable.
Trigger points can only be graphically set up and/or edited.

A "zoom" type feature for the graphical display is provided by the Display Window. This enables a section instead of the complete waveform to be displayed, therefore providing a "magnification" factor. You can therefore "zoom" in on a specific part of a waveform to edit it.

INTERPOLATION - WHEN AND HOW TO USE IT

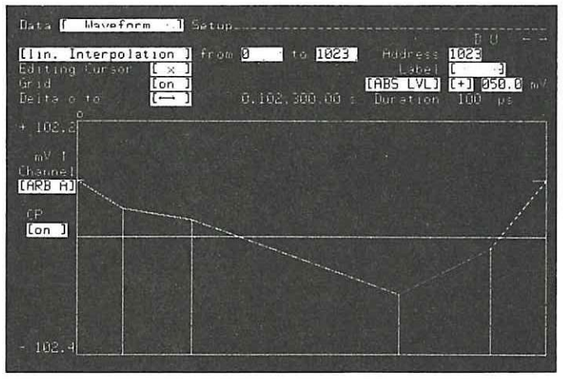
Theoretically, the simplest way of setting up a waveform on the [Waveform] Setup menu is to select appropriate addresses, and then assign specific level/pattern values to them. This can be done either via the numeric setting fields or on the graphical display area. In either case, it is very laborious and time consuming. However, in some cases it is the only possibility. If you only want to edit an existing waveform then it is often a practical method. If it is possible, a much simpler and quicker method is to interpolate the waveform.

This section concentrates initially on how to set up a waveform by using the Arb's Interpolation capability. It is followed by some basic aspects of editing. The next section (3B-7) will show you how to use the other editing features.

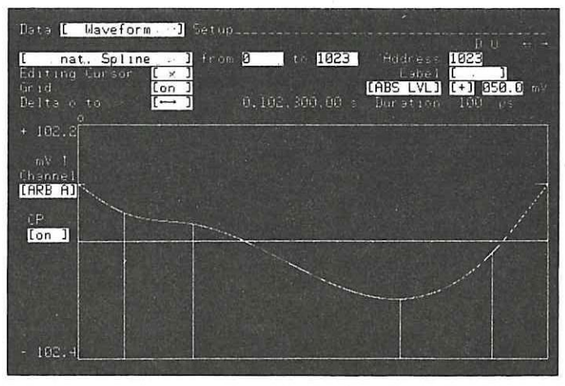
Waveforms which are very complicated to describe mathematically can often be easily created by using the Interpolation capability. (Simple waveforms e.g., sine, triangular, sawtooth etc. can also be produced by interpolation, if wished). The procedure involves first setting the characteristics points (CPs) of the waveform and then interpolating between them. In case you do not know what CPs are, the easiest way to explain them is graphically. The figures relating to the next paragraph do this.
The Interpolation capability is accessible only when the Data **[Waveform]** Setup menu is displayed. All features of the menu are described in the appropriate Menu Map section.

Linear Interpolation, Natural and Periodic Splines
The interpolation can be either **Linear**, **Natural Spline** or **Periodic Spline**. In the same way as for CPs, the meaning of each of these can best be explained graphically. Therefore, refer to the following figures. They show how, from the same set of CPs, three different waveforms can be interpolated. The CPs are identified by the vertical lines projecting down from beneath the waveforms. They are in effect address/level co-ordinates. For the waveforms illustrated, a total of six CPs are used, four of these can be clearly identified and the other two are at Addresses 0 and 1023.

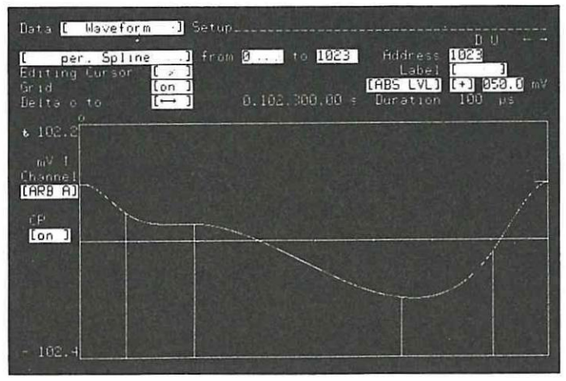
A special point about Periodic Splines is that they have the same slope at start and finish of the chosen time interval. This is of special significance when waveforms are to be output in Auto Cycle mode and a smooth transition from the end of one cycle to the start of the next is required. To achieve the same slopes, the level values at the start and finish CPs must be identical.



Linear Interpolation



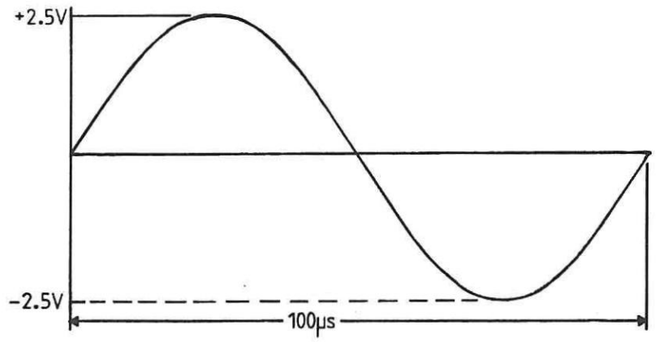
Natural Spline Interpolation



Periodic Spline Interpolation

Example 2. Using the Interpolation Capability:

To enable you to compare this method of setting waveforms with the Calculator, and also to keep the example simple, the same waveform as for Example (1) will be set up as ARB B, it is shown below.



Waveform to be set as Example 2

Interpolation is an edit capability which applies only to the Data **[Waveform]** Setup menu. It is accessed via the SHIFT + PRGM keys. Once accessed, the Characteristic Points (CPs) can be set and/or removed by one of the following basic methods:

by setting values numerically and then using the INSERT/DELETE keys, or
by setting values graphically and then using the 1/0 keys.
A combination of the two methods can also be used.

In almost all cases the numerical method is the quickest way of setting up CPs. This example explains how it is done. Graphical setting of CPs is explained at the end of the example under "Some Further Practice".

PRE-SETTINGS:

DURATION
Access the Data **[Format]** Allocation menu and set the Duration to **[fixed]** and 100 µs.

AMPLITUDE RANGE
Press the **OUTPUT** key.
On the Level **[ARB B]** into **[50 Ohm]** menu, position the cursor in the Amplitude Range field and set the range to 5V. Note how the Level Upper and Lower Peak and Offset Limit values change to reflect the new Amplitude Range.

Access the Data **[Pattern/Level]** Setup menu and set all level values to 0.000 mV. This is done easily via the edit function "**MODIFY**". When you access **MODIFY**, simply use the default level values (+000.0 mV). The reason for setting all levels at 0.000 mV is only that it makes the graphics cursor movements for the example easier to follow! You will understand why when you start to use the Data **[Waveform]** Setup menu. Continue as follows:

Access the **Data [Waveform] Setup** menu and note the details. Two types of cursors are provided: text and graphics. At present only the normal (text) one will be obvious. Two graphics cursors are available, only one of them can be active at any time. Disregard the Display Window, and Delta o to x setting fields at present.

HOW TO ACCESS THE INTERPOLATION CAPABILITY

Press the **SHIFT** (blue) and **PRGM** keys. Note the new menu details. The Interpolation capability is now active, the default interpolation is linear (lin.). Some new fields will have appeared and the Edit one is replaced by two new ones. One of these is the Channel one. Since the waveform is to be set up as ARB A, change it via the **NEXT[]** key.

HOW TO EXIT FROM INTERPOLATION

Exiting from Interpolation can be done either by pressing ABORT, or any MAIN DISPLAY key (including DATA).

INTERPOLATING - THE STEPS INVOLVED

1 After accessing Interpolation, change the setting of the first field (currently displaying **[lin. Interpolation]** by pressing **PREV[]** until **[remove CPs]** is displayed. Set the "**from**" and "**to**" fields to 0 and 1023 respectively. Press **EXEC***.

***NOTE: [remove CPs]** is included here only to ensure that you start with a "clean" CP status. You do not have to do it each time Interpolation is to be done. More about why it may be necessary is explained under the explanation of **[remove CPs]**, in the Data [Waveform] Setup menu description (blue registers).

2. Move the cursor back into the first field and press **NEXT[]** until **[nat. Spline]** is displayed. (Periodic could also be used for this example but it makes no difference.)

To produce one complete cycle of the sinewave, only four characteristic points (CPs) need to be set. The address and level values for them are as shown in the following figure.

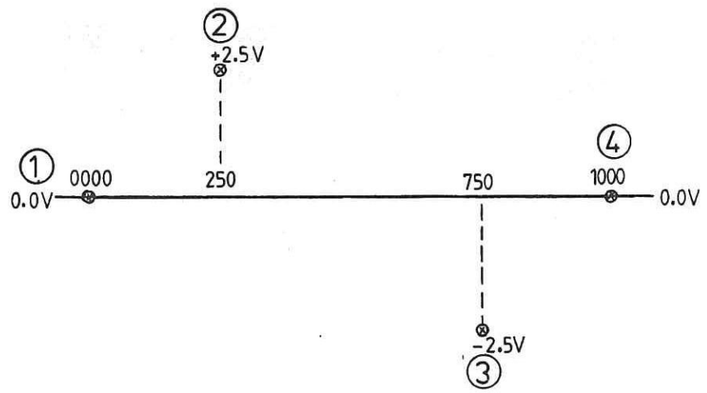


Figure 3B-4. Characteristic Points (CPs) to be set.

Setting the CPs:
For each CP, first an Address then its corresponding Level ([ABS LVL]) value must be set. Each level value must then be defined as a CP. CPs can be set and defined graphically but, as previously stated, for this example we will do it numerically. The CPs will therefore be defined via the **SHIFT** and **SYSTEM** i.e., **INSERT** keys. (The **DELETE** key enables individual CPs. to be removed.)
For the numerical method, the actual setting field in which the cursor lies when **INSERT/DELETE** is done is unimportant, as long as it is one of the upper right hand "parameter values" group eg., Address, Label etc.

3. The first CP is to be Address 0000 and 0.000 V level, so set the values (they may already exist) and do an **INSERT** (press **SHIFT + SYSTEM**).

4. Set the other CPs in the same way. Their Address/Level values are:

250	750	1000
+ 2.500 V	- 2.500 V	0.000 V

Note that as you set the different Address values, the currently active cursor (the "x" one) will step-move across the graphical display area. The actual graphics cursor part - the cross (+) - will move to each CP co-ordinate as you set them. Note also, because you previously set all levels to 0.0 V, as the various addresses are accessed, the cursor always starts from the 0.0 V level. Since this runs through the middle of the graphics display area, it is therefore easier to track the cursor movements compared to if all levels had been set to -102.4 mV.

5. Now that you have set all CPs , to interpolate between them you need to set the required "from" and "to" addresses. Set these to 0 and 1000 respectively. (Note that in practice you could have set these directly after doing the **[remove CPs])**

6. Press **EXEC.** The message **"WAIT Interpolation in Execution"** will be briefly displayed, then the waveform will appear. If you have done everything correctly it will be as shown in **Figure 3B-5.** If your result looks different or an error message is displayed, then try again!

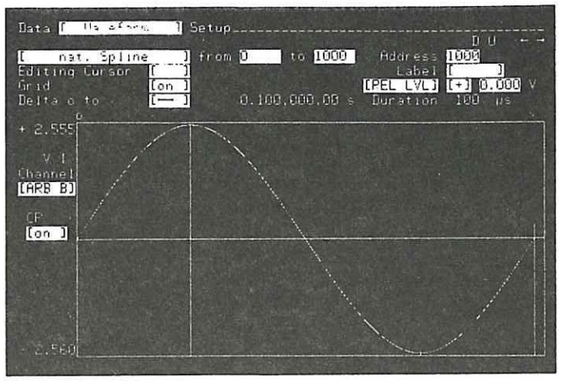


Figure 3B-5. Sinewave from Natural Spline Interpolation

SOME FURTHER PRACTICE

The next few paragraphs explain how to do some basic graphical editing and also how to set up CPs graphically.

Linear Interpolation
First, leave all settings exactly as they were on completion of the previous example, now do a **[linear Interpolation]**. This shows you how simple it is to construct triangular waveforms etc.

Editing of CPs, and using Fast Search
This exercise involves changing the level values of the existing CPs at Addresses 250 and 500 to +2.0 V and -2.0 V respectively. You will see how to use the "fast CP search" feature to access them. This is a special capability which applies only in Interpolation mode. Briefly it is as follows: In Interpolation mode, the horizontal **ROLL** ← and → keys (**SHIFT ROLL** ↑ or ↓) enable the Edit Cursor to be stepped from CP to CP. A "fast CP search" can be done with the text cursor positioned anywhere on the menu.

1. Move the (text) cursor into the value part of the level setting field (you will see the reason in a moment).

2. Press **SHIFT** and **ROLL** ↑, this does a "fast CP search" which you can stop when the graphics cursor gets to Address 250

3. The text cursor is already positioned in the level field so just change the value to +2.0 V. (Note that since a CP is already defined at the address, it does not need to be redefined)

4. **SHIFT ROLL** ↑ to Address 750 and change the level to -2.0 V.

5. Press **EXEC** to do a linear Interpolation. A new triangular waveform with P-P voltage of 4.0 V will be created. As you will now understand, this is a very quick way of editing CPs.

Combining two types of Interpolation
Leave all settings as they are and do a **[nat Spline]** Interpolation.
Change the Interpolation to **[lin. Interpolation]**.
Set the "from" and "to" field address values to 250 and 750 respectively.
Press **EXEC**.

Editing/Setting CPs graphically
It is worth noting, that due to certain graphical display area limitations (explained in 3B-7), graphical editing/setting of CPs is often far slower than the numerical method. However, since it can be done, here is a simple example. The exercise is to set a CP at Address 306 with level value of +1.85 V.

Procedure:

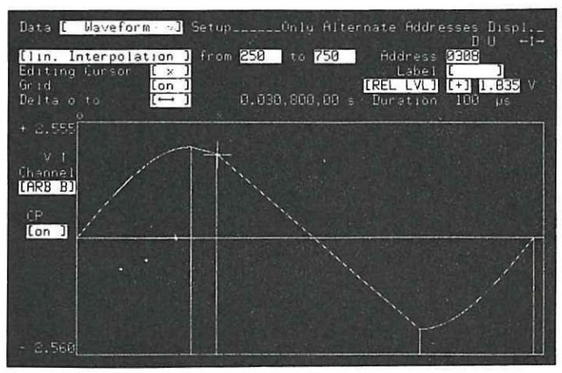
1. Move the cursor into the CP **[on]** field.

2. To save time, first do a "fast CP search" to move the cursor to Address 250, then use the **SHIFT CURSOR →** and normal **CURSOR ←** and **→** keys to get to 306.

3. Set the level value by pressing the **ROLL ↑** and **↓** keys as appropriate until a value of +1.85 V is displayed in the level field.

4. Do not move the cursor, now define the level as a CP by pressing the front panel **1** key. (CPs are graphically deleted by positioning the cursor and then pressing the **0** key.) If you now press the **CURSOR ←** or **→** key, note how the cursor returns to the waveform.

5. Press **EXEC** to do a linear Interpolation. The figure below shows the resulting waveform if all editing previously described is done. The cursor has been moved to Address 308.



NOTE: CURSOR Fast and Slow Movement
As you have just seen, "fast moving" the cursor steps it 20 addresses at a time, normal movement steps 2 addresses. So how can each and every address be accessed? Similarly, for level setting, what if a level setting of say 1.86 V had been required? For both problems there are solutions but even so, you probably now understand why numeric setting of CPs is far easier! As for the message "Only Alternate Addresses Displ." , its significance and answers to the other two questions are given in section 3B-7.

Switching off the Grid and CP markers

If you wish to delete the Grid markings do it as follows:
Move the (text) cursor into the Grid **[on]** field and press **NEXT[]**, the Grid will then be switched **[off]**.

The CP indicators can also be switched off if you wish, as follows:
Move the cursor into the field directly beneath the CP header.
Change the setting to **[off]**.

Note that even when CPs are not indicated, new ones can still be set and existing ones edited exactly as before.

3B-7
HOW TO SET UP WAVEFORMS - BY GRAPHICAL EDITING

First, What does Editing mean?

Strictly speaking, whenever you set a new level and/or duration value you are in effect "editing" an existing value. Therefore, any values assigned via the **[Waveform]** menu, must also "edit" an existing waveform. Any waveform, irrespective of how originally set up, can later be edited on the **[Waveform]** menu. As you have just seen (from the previous example), setting values numerically is very easy. Pure graphical editing, done via cursor movement commands etc, is also straightforward.

Rather than just explaining how to change a few values etc. (which could be done very quickly), this section explains how to use the graphical editing capabilities of the **[Waveform]** Setup menu. It also explains how to set up trigger points. The waveform derived from Example 2 in section 3B-6, is used to illustrate certain points in the following paragraphs. Therefore it will help to have it available. More detailed explanations of the various settings and capabilities are given in the Menu map.

BASIC PRINCIPLES OF GRAPHICAL EDITING

Level values can be edited "numerically" by positioning the text cursor in the appropriate setting field and then entering the new value via the front panel keys. Graphical editing enables the same result to be achieved by "redrawing" the waveform as required. Basically this involves simply positioning the active graphics (Editing) Cursor via the **CURSOR** ← → keys at the data point to be edited, and then "shifting" the point up or down to the new level via the **ROLL** ↑ ↓ keys. Trigger points can be graphically set via the 0 and 1 keys. They can only be set/deleted when the trigger channel concerned is displayed.

The most important point to note is that, for any type of graphical editing to be possible, the text cursor **must** be positioned in the Edit field.

The **CURSOR** ← and → keys enable horizontal movement of the graphics cursor. This enables addresses to be accessed. The cursor can be moved at "normal speed" or, when **SHIFT** is used, fast.
The **ROLL** ↑ and ↓ keys enable vertical movement of the graphics cursor. Since data points are then shifted, their levels will be edited (changed in value). Vertical cursor movement can also be at "normal speed" or, when **SHIFT** is used, fast.

As you have probably already seen, it is not always possible (in 100% Display Window) to graphically access each address, or to precisely edit levels as required. The reasons and solutions are provided in the next paragraphs.

A Display Window feature is available which enables certain limitations of the graphical display area (discussed later) to be overcome. It basically enables a specific section, instead of the complete waveform to be displayed over the complete display area. Therefore, very precise editing can be done. It can also be considered as providing a "zoom" capability.

GRAPHICAL DISPLAY AREA LIMITATIONS AND RESTRICTIONS

"Alternate Addresses Displayed", What does this mean?
You have probably already seen this message, here is the explanation. When a 100% Display Window (default) is being used, only half of the available addresses can be currently accessed via the Editing Cursor. The message is in effect just a reminder of this fact. The reasons behind this limitation are as follows.

The graphics display area is 512 pixels wide, therefore in 100% Horizontal Display Window, only 512 addresses can be defined on the screen. For the full address count of 1024 to be accommodated, an address pair has to be accommodated in each pixel column. An address pair is eg. 0001 and 0002. Therefore, each single step of the Editing Cursor actually "covers" two addresses.

The addresses which can currently (in 100% Window) be accessed by the Editing Cursor are determined as follows: If the address currently displayed in the numeric setting field is an "**odd**" one (ie., ending with 1, 3, 5,.etc.) then only **odd** addresses can be accessed. If an "**even**" address (ie., one ending with 0, 2, 4,..etc.) is displayed then only even ones can be accessed. Therefore one way to enable each and every address to be accessed, is to change the Address field content from odd to even or vice-versa as necessary. This is obviously not a very practical solution! There is actually a much better way which involves using the Display Window feature. This is explained later.

How can I Graphically Access all Addresses?
You cannot display all 1024 addresses simultaneously, therefore it is not possible to have immediate access to each and every address. But, from doing the previous examples you know that a complete waveform can be displayed. This is in fact often the main reason for using a 100% Display Window. Graphical editing of a waveform normally requires that a number of odd and even addresses be accessed sequentially. The easiest way to do this is to display only 50% (or 25%) of the waveform on the complete display area at any time. Then you can access each of 512 addresses. The Display Window feature enables this to be done. Its operation is explained later. You can either select the part of the waveform to be displayed, or simply scroll it horizontally via the cursor.

What about Level Values?
In the vertical direction (level setting one), only 256 pixels are available. Depending on the current Display Window, Amplitude Range (and hence resolution/step count) each pixel may therefore have to represent up to 4 level values.

An example of this for the 200 mV Amplitude Range and 100% Vertical Display Window:
At Address 0010, level values: 0.0, 0.2, 0.4, and 0.6 mV are all represented by one pixel.

Graphical editing of level values therefore has obvious limitations. Note, however, although in 100% Window, only alternate addresses are shown, depending on their values, each individual level can in fact be displayed. They will appear one above the other according to their respective values. As an example, for the waveform of Example 2, the following address pair have the levels shown:

80	0.925 V
81	0.94 V

When they are numerically accessed, the cursor will remain fixed horizontally as you access each address but will move vertically to each level.

The easiest way to understand this is to first graphically step the cursor to an address pair (eg., 80/81). Now **numerically** access each individual address of the pair and note how the cursor moves to each level value.

In the same way as for Addresses, the Display Window feature enables this limitation to be overcome. Its operation is explained later. You can either select a specific part of the waveform to be displayed, or simply scroll it horizontally via the cursor.

SPECIAL POINTS TO NOTE

Graphical editing is not possible if the Display Window is active.
When graphical editing is possible, a waveform selection field with the header "Edit" will be displayed.
One or more waveforms plus their trigger patterns can be simultaneously displayed/edited.

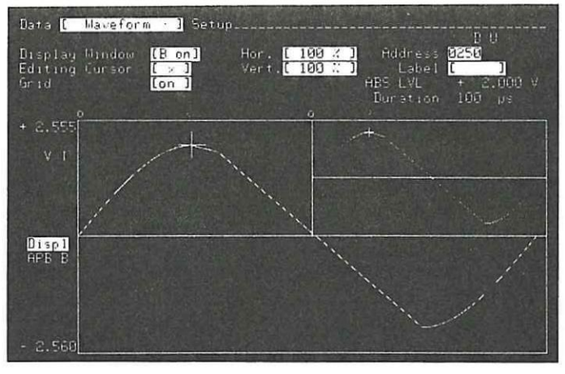
Level values can be set up and/or edited either numerically or graphically.
Duration values can only be numerically set up and/or edited.
Variable Duration values are not graphically displayable.
Trigger points can be graphically but not numerically set up and/or edited on the [Waveform] menu.

HOW TO ACTUALLY USE THE GRAPHICAL EDITING FEATURES

When reading through the following paragraphs, try out the various settings etc. referred to. As mentioned earlier, the waveform from Example 2 is used here to illustrate certain edit features. If you still have it then refer to it whilst reading the following paragraphs.

Display Window and Hor./Vert.
This enables a specific section of either the A or B Arb. waveforms to be displayed. Whatever percentage values are set apply to both Arb. waveforms. Waveforms and trigger points **cannot** be edited when Display Window is on.

Set Display Window to: **[B on]** via the NEXT[] key.
If you still have the waveform from Example 2, it will now be displayed. The details will be as shown in the following figure.



Display Window On

Note the menu details. In the top right hand side of the graphics display area, a 1/4 scale version of the waveform is displayed. Assume that you want to graphically edit some levels near the top of the positive half cycle. Also, you want to access addresses sequentially e.g., 230, 231, 232 etc.

Move the cursor into the **Hor.** field and press NEXT[] to set 50%.
Move the cursor in the Vert. field and set 25%.

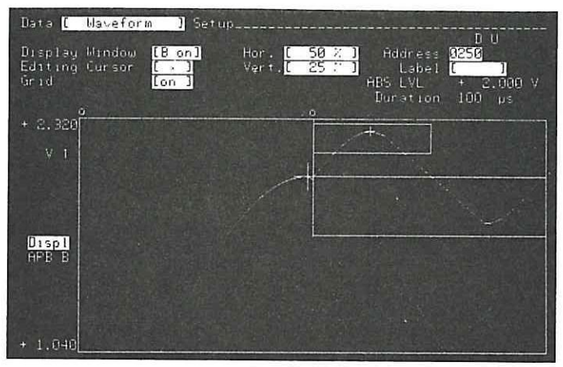
You have now defined the size of the window to be used. However in practice the part of the waveform that you wish to edit might not currently be within the window. This means that if you switched back to Edit mode, it could take quite a time to position the Editing Cursor (E. Cursor) at the required data points. In the Display Window mode, the window can be quickly positioned with respect to the waveform. This can be done in several ways including: by setting an Address, calling up a Label, interchanging the active Editing Cursors or, by scrolling via the **ROLL** ↑ ↓ → ← keys.

Set the Address to 0250 (if not already set). The window will move (assuming that Edit cursor was not previously positioned at 0250).

How to Position the Window - by Scrolling:
Move the (text) cursor into the Displ field. Now just practice scrolling by pressing the **ROLL** ↑ ↓ → ← keys and note the different way in which the window moves. By noting the changes in the 1/4 display area, you will see how vertical scrolling is possible only as long as the active E. Cursor remains within the chosen Display Window. The E. Cursor stays at its original address for vertical scrolling. Horizontal scrolling however enables the window, together with the E. Cursor, to be moved within the complete address range. Therefore the displayed address will change.

Remember that for editing purposes, you can access any data point of the waveform. The window only defines "how much" of the waveform can be displayed at any time.

By scrolling the window you should be able to produce a display similar to the one below. The window does not have to be in exactly the same vertical position as shown. The main thing is that you understand how to scroll it!



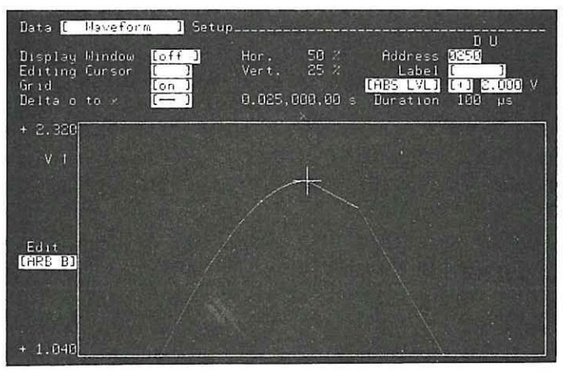
Result of Scrolling the Window

HOW TO EDIT

You cannot do any editing in Display Window mode, you first need to switch it off.

CURSOR to Display Window and set it to **[off]**. Then go to the Edit field and select **[ARB B]**.

For the various steps done, the display should now look like that shown next.



Window Size Defined and Display Window **Off**

The waveform can only be edited with the active Editing Cursor. Here are some details about what this means and also a few more points to note.

Editing Cursor
Two Editing Cursors (E. Cursors) are user selectable, an "x" and "o" one. At any particular time only one of them can be set as the active one. The active cursor always appears as a large + on the graphics display area. The inactive one is represented by a small +. The default active Editing Cursor is the "x" one.

The values displayed in the Address, Label, Level and Duration fields relate directly to the data point currently addressed by the active E. Cursor. This also means that, whenever the displayed Address or Label is changed, the active E. Cursor will "fast move" along the waveform to its new position. The active E. Cursor cannot be moved outside the current Display Window.

The **CURSOR** and **ROLL** ↑ ↓ → ← keys enable the active E. Cursor to be positioned at any point on the graphics display area. Note that for Display Window of <100% (Hor. or Vert.), when the cursor reaches the limit of its travel the window will be scrolled. Try this by moving the E. Cursor to the far right of the display area.

Label
This field has two functions, either:
(a) Labels (previously entered on the **[Pattern/Level]** Setup menu) corresponding to particular addresses will be displayed when the corresponding address is displayed.
(b) Labels can be accessed (via the **NEXT[]/PREV** keys) and therefore the corresponding addresses will be displayed.

Duration
The type of duration cannot be changed on this menu (see Data **[Format]** Allocation menu). If duration is set to variable, then each value can be set as required. Note that, if the clock source is external the units will be expressed in Cycles.

Explanation of why Different Duration Values are Not Always Obvious
On the 8175A [Waveform] Setup display, different duration values between data points cannot be graphically displayed. Therefore, irrespective of duration values, identical numbers of data points always occupy the same horizontal length of display. In other words, 50 data points each of duration 0.1 μs will occupy exactly the same display length as 50 of duration 1.0 μs.

Delta o to x
This enables either the duration or level difference between two points on a waveform to be displayed. The points are identified by the position of the two Editing Cursors. Horizontal or vertical measurement is selected via the **NEXT[]/PREV[]** keys. In Display Window mode it is disabled. Whenever more than one arbitrary waveform is displayed, only duration differences can be displayed.

How to Measure Waveform Durations or Level Differences:
Move the cursor into the "**Delta o to x**" field and press **NEXT[]** to select the measurement mode required (horizontal or vertical).
Then position the active and inactive Editing Cursors at the addresses concerned. The time or level difference as appropriate will then be displayed.

3B-8
HOW TO SET UP WAVEFORMS - BY NUMERIC ENTRY

What is Numeric Entry?

The term "numeric entry" as used here, refers to setting up levels, trigger data and duration on the Data **[Pattern/Level]** Setup menu. As you already know, numeric setting fields are also available on the **[Waveform]** Setup menu, but they are not considered here. Numeric entry is very simple, but there are some points to note, they are described in the following paragraphs.

WHEN SHOULD IT BE USED?

In principle it can be used for almost any type of waveforms, however in general, it is not practical to set up a complete, complex waveform on the **[Pattern/Level]** Setup menu. Exceptions to this are step and staircase functions etc. Such waveforms, whether they are just part, or a complete waveform, can be very quickly set up. Spikes etc. can also be quickly set. The menu is provided with a powerful set of edit capabilities. These are described in section 3F and enable such actions as: copying, moving and exchanging segments of level/trigger data, within and between Arb. channels**. These capabilities mean that waveforms can often be set up very quickly. It is therefore recommended that you familiarize yourself with the editing capabilities, before getting too involved with numeric entry.

The **[Pattern/Level]** Setup menu is fully described in the corresponding Menu Map section (3E-2). Refer to it for specific information concerning the various setting fields etc.

THE PRINCIPLES OF NUMERIC ENTRY

The principles of numeric entry are described below. Please do not immediately be deterred by the large number of steps shown! In practice, it is very unlikely that all of them will be required. The sequence is in no way mandatory, you can change it as you wish according to the situation. This will become obvious with practice.

1. If the current Amplitude Range, Offset, Duration type, Used Format Allocation and level entry codes are as required, then go straight to step 6. If any of these settings need to be changed, then proceed as follows:

2. Set the required Amplitude Range and Offset as applicable (both on the Output Page menu).

3. Set the Duration type (**[fixed]** or **[variable]**) on the Data **[Format]** Allocation menu. Note that if Duration is to be fixed, you can also set type and value after setting the level/trigger values. If Duration type is to be variable, by setting it now you can save unnecessary work after.

4. If necessary, display just those Arb./trigger channels required*. Do this by selecting the appropriate Used Format Allocation.

5. Set the level entry code, this is done via the setting field directly under the ARB A and ARB B headers. Each Arb. can be set to a different entry code. Whatever the code(s) set, they will be assigned to the current Used Format Allocation and recalled whenever the same Format is assigned.

6. Select the Address required in the inverse video field. This can be done either via the **ROLL** ↑ or ↓ keys or, by simply moving the cursor into the Address field and changing the current address to the required one.

7. Move the cursor to the level, TRG and/or Duration settings and change the values as required.

NOTES

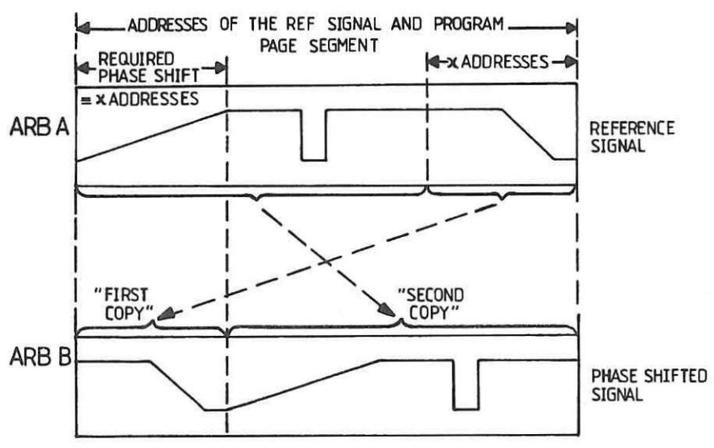
***Displaying Specific Channels**
While there is nothing against displaying all Arb. and trigger channels, remember that you can select specific ones to be displayed via the Used Format Allocation field. This point is also of significance when using the edit capabilities, since they apply only to those Arb. and trigger channels currently displayed.

****Production of Phase shifted signals**
This can be done very easily via the **COPY**: **[ARB A > ARB B]** (or vice versa) edit functions. The principle is illustrated in the figure below and is basically as follows (it assumes that the Duration is set to **[fixed]**!):

1. Set up the signal in one Arb. channel as a reference eg, ARB A and note the addresses used. These will be the limits for phase shifting and for the Segment to be set on the Program Page. Note also the number of addresses which equate to the required phase shift (x Addresses).

2. Now copy the signal into the other Arb. channel, note that this will involve copying the signal in two separate copy actions!

The minimum resolution of the phase shift will be 360°/number of addresses used. Eg., if 1000 addresses are used the minimimum resolution will be 360°/1000 = 0.36°.



Production of Phase Shifted Signals

CURSOR Fast/Slow Movements
When it is in the Address or level/trigger setting fields, the cursor can be "fast moved" between fields via the **SHIFT** plus **CURSOR** → ← keys.

3C
More about the Calculator

This section explains additional points about using the Calculator, and provides general information. It is assumed that you have already worked through section 3B-5 and know the basics of using the Calculator. The information is presented under the following headings:

3C-1 Some General Points Explained
3C-2 Module Syntax
3C-3 Softkey Explanations
3C-4 Restrictions and Limitations to be Observed
3C-5 Some more Worked Examples
3C-6 Error and Warning Messages Explained

Note that the worked examples included here are shown as the module and the resulting waveform. Apart from an example involving the Conmbine feature, detailed step by step procedures etc. as given in section 3B-5 are not included. These examples are designed to show you some more of the Calculator's possibilities. They will also give you some more general practice in using the Calculator so do try them!.

3C-1
SOME GENERAL POINTS EXPLAINED

How much Memory is Available for the Calculator Modules?
750 bytes are reserved in the 8175A memory for Calculator use. Each ASCII character (including spaces) requires one byte. Keywords such as: For, Step etc., and functions e.g., Sin, Cos etc. also require only one byte each. Note that each line of a Calculator module can be up to 50 characters long. Therefore, always use Cr/lf to end a line and initiate a new one. Spaces will just waste memory space.

Duration - Why variable is recommended
When using the Calculator, ensure that the Duration (Data [Format] Allocation) menu is set to [variable]. If not done, it is almost certain that problems will arise when attempting to output the function. The reason is that, irrespective of the Duration type, the Calculator will assume that the "STEP value" (given in the header of each module) is the required duration (i.e. the time that each amplitude level is to be active). If Duration is set to [variable], the chosen STEP value will be assigned at each address. However, if Duration is set to [fixed], the actual fixed values will be used instead of the calculated ones.

Frequency/Time Window Relationship
Note that if the Time Window value is less than the period of the waveform, an incomplete waveform (less than one cycle) will be produced. Eg, a 50 Hz sine wave requires a Time Window of 20 ms or more.

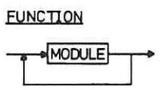
Step Resolution
Do not set a Step duration which is outside the 8175A's timing (20 ns to 9.99 s) and/or resolution (10 ns) capabilities.

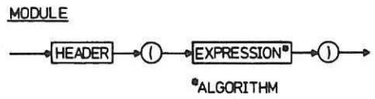
Graphical Display of Durations
If your waveform requires that several modules, each with different time windows and step values etc. be calculated, the resulting graphical display will usually be different from that seen on an oscilloscope. The reason is simply that although different duration values can be set (and will be numerically displayed), the differences cannot be displayed graphically. This means for example, that if at Address 100 duration = 0.1 ms and at Address 101 duration = 10 ms, the corresponding data points will be equidistant from one another. Therefore the 100:1 duration difference will not be graphically obvious.

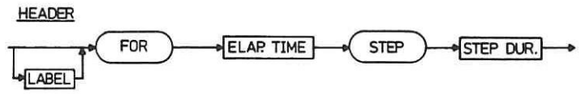
Combine - what does it mean?
This is a feature of the Calculator which enables an existing waveform to be combined with another "Calculator derived" one. It is accessed via the Combine field of the Calculator Parameter Setup menu. It is useful in cases where for example, a waveform which is very difficult to describe mathematically and has therefore been set up graphically, needs to have noise added to it. The noise waveform can be set via the Calculator and then combined (add, subtract, multiply or divide are possible) with the original waveform. The signals can be combined in a ratio of between +/- 60dB. An example illustrating the use of Combine is included in 3C-5 of this section.

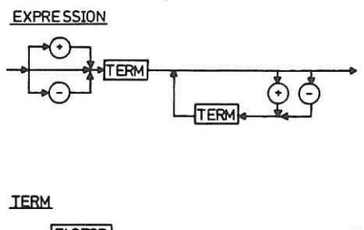
3C-2
MODULE SYNTAX

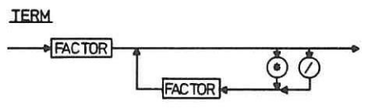
Module statement syntax is similar to that required by normal computer program statements. It is shown by the followng syntax diagrams. All items enclosed by a rounded envelope are available directly via the corresponding softkeys. Words enclosed by a rectangular box are names of items used in the statement. Refer to 3C-3 for softkey explanations.

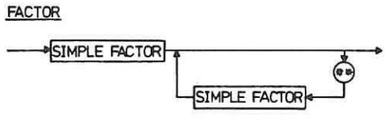


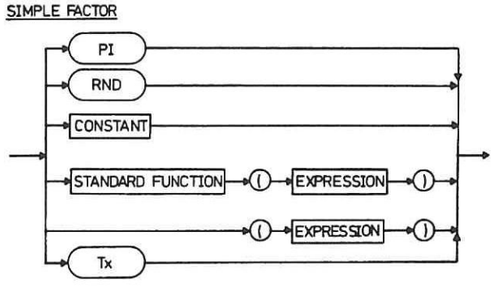


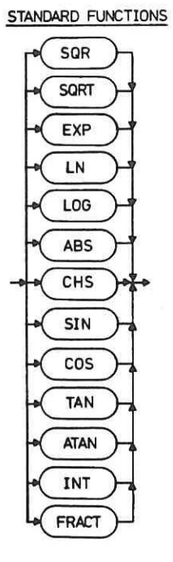






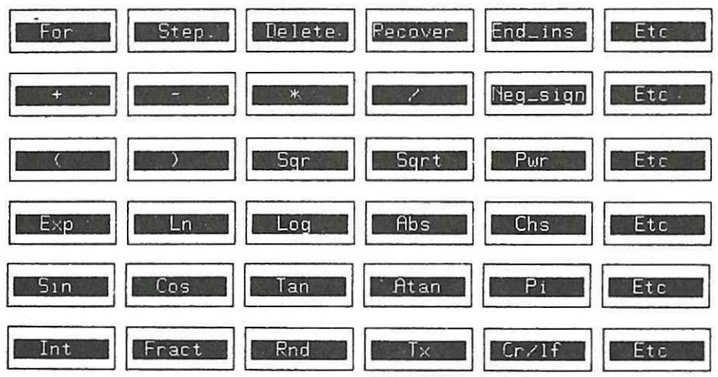






3C-3
SOFTKEY EXPLANATIONS

The Edit softkeys which are available via **Insert** are distributed over six layers as shown below. Each successive layer is accessed via the **Etc** softkey of the current layer. The layer hierarchy is as shown.



Some softkeys have already been explained in section 3B-5 of Getting Started. The others are either self explanatory or explained below. Simple examples are included in some cases to illustrate how to use them.

SOFT KEY		MEANING
Neg sign	-	Assigns a negative (-) sign.
Sqr	**SQR**	Square function. Eg: SQR(3) = $3^2 = 9$
Sqrt	**SQRT**	Square root function. Eg: SQRT(9) = $\sqrt{9} = 3$
Pwr	**	Raise to power function (Y^X) Eg: 10**4 = 10^4 = 10000, 10**(-3) = 10^{-3} = 0.001 (Note: 10000 could also be expressed as: 1E4 where E4 = 10^4)
Exp	**EXP**	e^x (e to power x). Eg: EXP(2) = e^2
Ln	**LN**	Natural logs (base e).
Log	**LOG**	Normal logs (base 10).
Abs	**ABS**	Modulus of value. Eg: ABS(+5) = 5, ABS(-7) = 7
Chs	**CHS**	Change sign from + to - or vice-versa.
Atan	**ATAN**	Arc tan. Eg: ATAN(1) = 45°
Int	**INT**	Integer part of a number. Eg: INT(10.93) = 10
Fract	**FRACT**	Fractional part of a number. Eg: FRACT(10.93) = 0.93
Rnd	**RND**	Random function (see examples later in this section).

3C-4
RESTRICTIONS AND LIMITATIONS TO BE OBSERVED

For certain expressions/functions restrictions and/or limitations exist. These are as stated below.

Function/expression	Restriction/Limitation
+	None
-	None
*	None
/	None
Sqrt	None
Abs	None
Chs	None
Atan	None
Int	None
Fract	None
Rnd	None
Ln	value > 0
Log	value > 0
Exp	-43.5 < exponent < 43.5
Pwr	$A^X = e^{X*}$ Ln A A > 0 (see Ln) -43.5 < x * Ln A < 43.5 (see Exp)
Sin	-32768 * Pi < argument < 32767 * Pi
Cos	-32768 * Pi < argument < 32768 * Pi
Tan	-32768 * Pi < argument < 32768 * Pi

3C-5
SOME MORE WORKED EXAMPLES

The following examples show some more aspects of using the Calculator. It is assumed that by now you know the basics, therefore apart from in Example 4, no step by step instructions are given. The examples are as follows:

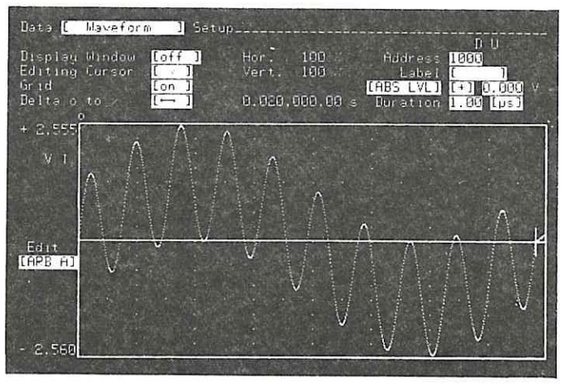
Example 1. Line Ripple A
Example 2. Line Ripple B
Example 3. Amplitude Modulation
Example 4. Sine wave with Noise - Use of Combine

NOTE: For all these examples, the following settings apply throughout. All other settings are default ones unless otherwise stated.

Amplitude Range: 5 V
Max./Min. Levels: +/- 2.5 V

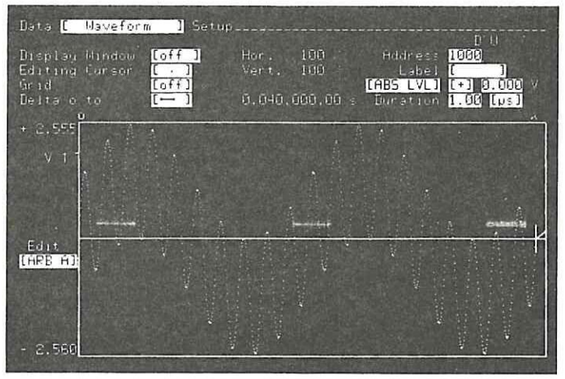
Example 1: Line Ripple A
The first half of the algorithm defines a 50 Hz sine wave, the second defines a 500 Hz one. The two are added together.

```
    0  FOR 20MS STEP 20US ↓
>   1  ((SIN(2*PI*50*Tx))+(SIN(2*PI*500*Tx)))
```



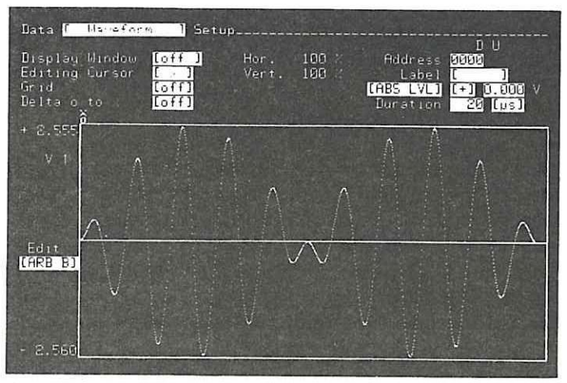
Example 2: Line Ripple B
This has the same algorithm as Example 1, but the time window and step duration values have been doubled to enable two complete cycles to be produced.

```
>    0  FOR 40MS STEP 40US ↓
     1  ((SIN(2*PI*50*Tx))+(SIN(2*PI*500*Tx)))
```



Example 3: Amplitude Modulation
If you look closely at the module required for this example, it is actually identical to the one for Example 1 except that the two sine functions are multiplied.

```
>    0  FOR 20MS STEP 20US ↓
     1  ((SIN(2*PI*50*Tx))*(SIN(2*PI*500*Tx)))
```



Example 4. Sine wave with Noise - Use of Combine
This example shows the basics of using the Combine feature. The requirement is to produce a "noisy" sine wave, the noise will be derived via the Random Function feature (Rnd) and the two functions will be combined in the ratio: sine:noise = 10:1.

When using Combine, the original waveform is termed the "Actual". For this example it will therefore be the sine wave. The function to be combined is termed the: "Function". However, as you will later see from the Combine related setting fields, the ratio of "Actual" to "Function" can be interchanged as wished.

Procedure:

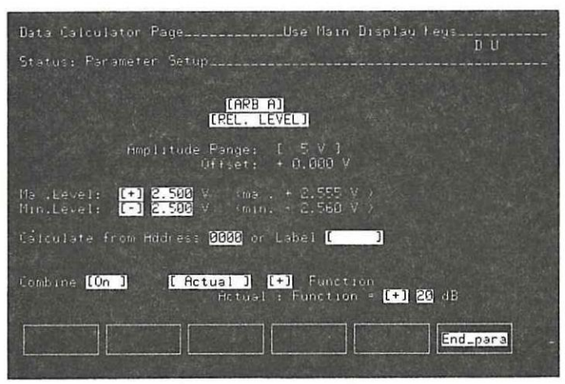
1. First, set up and run the sine wave. The module required is shown below.

```
      0  FOR 20MS STEP 20US ↓
>     1  (SIN(2*PI*50*Tx))
```

2. Set up (but do not yet run) the noise function, it is given by the following module. Note that the original sine wave module must be deleted (you can actually use it as the basis of this one).

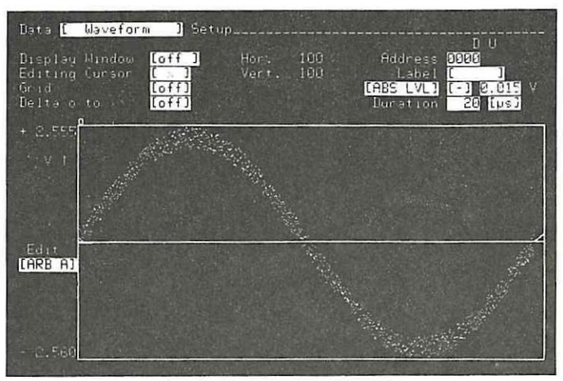
```
      0  FOR 20MS STEP 20US ↓
>     1  (RND)
```

3. Press **Param**, set Combine to **[On]** and Actual : Function = **[+] 20 dB**
(This means a combine ratio of 10:1) The menu settings should now be as follows. An important point to note in connection with Combine, is that the Level settings on this menu will apply to the final resulting combined waveform. Their significance for the noise function is in effect only temporary.



Parameter Setup Menu for Example 4

4. Press **End_para**, then **Run**. If you have done everything correctly, the resulting waveform will be as shown.



Combined Sine and Noise Waveform

Some more Practice with Combine

The best way to understand what you can do with Combine, is to checkout the four combining methods with various dB loadings applied. Here is one suggested way to do it. Try out your own way instead if you wish.

This method involves combining existing ramps with a sine wave. By first just overlaying the two waveforms, and then successively combining them as A + F with different dB loadings, you will see the different results.

The first step is, (MODIFY) durations **[variable]** over the complete address range to 1 µs.
Set up a ramp (use Interpolation!) between say -100 and +100 mV and addresses 0 to 128.
Now copy it (hint, use COPY Address edit function) to produce 8 identical ramps over the complete address range (you can do this with just three COPY Address actions!). Confirm by checking out the **[Waveform]** menu that you have 8 ramps.
Set up a 20 kHz sine wave (period 50 µs) one complete cycle over 50 steps of 1 µs.

Now try out the various Combine possibilities. Just overlay the sine wave (Combine off) on the first ramp to begin with. Then do some combined functions on the other ramps, this will make it easier to understand the different results. For the same reason, "do each" Combine at the same relative address on each ramp.

3C-6
ERROR AND WARNING MESSAGES EXPLAINED

If, when using the Calculator you attempt an illegal (non-allowed) action or have not completed the previous setting correctly, an error message will generally be displayed. Note that "illegal" can also mean that you have attempted a setting etc. which is in conflict with another existing one. Apart from displaying any error or warning messages, the current status will always be displayed. The following list details all Calculator related messages in alphabetical order and grouped according to their type.

1. General Messages
2. Edit
3. Param
4. Run
5. Status

1. General Messages

These messages are not related to any specific edit type action etc.

USE MAIN DISPLAY KEYS — Displayed when the Calculator Page is accessed and disappears temporarily when the Calculator is in Run mode or an error is detected.

ERROR Command ignored — Displayed if an illegal action attempted (eg., pressing a currently inactive or inappropriate key).

ERROR Fix Problem First — Displayed if an error has been detected and the user tries to leave the current field without correcting it.

ERROR Numeric entry required — Displayed if only a numeric key entry is allowed and another type was pressed.

ERROR Use [NEXT][PREV] Keys — Displayed if the cursor is in a field requiring a **PREV[]/NEXT[]** entry and some other key is pressed.

WARNING Check Parameter — Displayed on accessing the Calculator if current Max./Min. Levels on Parameter Setup are identical. This can mean that no values have yet been set, or that the levels have been auto-set to zero due to a conflict setting on another menu eg., a new Amplitude Range. Refer also to the Run related message: "**ERROR** Check Parameter".

2. Edit related messages

All the following messages are related to either the **Insert**, **Delete**, **Abort** or **End_edit** functions as indicated.

Insert

ERROR No more INSERT's allowed — Displayed if the function memory is full and the user attempts to insert another statement.

ERROR Nothing to Delete — Displayed if Delete pressed and there is nothing to delete.

ERROR Nothing to Recover — Displayed if Recover pressed and there is nothing to recover.

Delete

ERROR Nothing to Delete — Displayed if Delete pressed and there is nothing to delete.

ERROR Nothing to Recover — Displayed if Recover is pressed and there is nothing to recover.

Abort

There are no error messages related to the **Abort** function.

End edit

In all the following cases, compilation (initiated by End_edit) will be aborted if an error is detected. The statement causing the error will be highlighted in inverse video.

ERROR Arithmetic overflow — Displayed if an arithmetic overflow occurs.

ERROR Arithmetic underflow — Displayed if an arithmetic underflow ocurs.

ERROR Argument out of range — Displayed if an argument is out of range. E.g., Sqrt (-1)

ERROR Blank missing — Displayed if key words (statements) and timing values are not separated by blanks.

ERROR Clock Source must be unique — Displayed if the clock sources for elapsed timing and duration are different.

ERROR Duplicate Label — Displayed if the edited function includes at least two identical labels.

ERROR Exponent Expected — Displayed if an Exponent is expected.

ERROR Elapsed Timing Expected — Displayed if Elapsed Timing is expected but no value exists.

ERROR Function too complex — Displayed if it is not possible to compile the complete function because there is an internal memory overflow.

ERROR For Statement Expected — Displayed if a For statement is expected but is missing or if algorithm is incorrectly closed.

ERROR Illegal Character — Displayed if an algorithm includes an illegal character.

ERROR Illegal Unit — Displayed if the unit is not allowed.

ERROR Leading point — Displayed if a timing value starts with a point instead of a digit.

ERROR Left Parenthesis Expected — Displayed if a left parenthesis is expected but is missing.

ERROR Max. Data Labels Used — Displayed if the edited function includes more than 50 labels.

ERROR Only 7 Digits Allowed — Displayed if the mantissa of a numerical value consists of more than 7 digits.

ERROR Only 2 Digits Allowed	Displayed if the exponent of a numeric value consists of more than 2 digits.
ERROR Only 1 Point Allowed	Displayed if the mantissa of a numerical value consists of more than 1 point.
ERROR Part of Function missing	Displayed if the Header of a function is incomplete.
ERROR Right Parenthesis Expected	Displayed if a right parenthesis is expected but is missing.
ERROR Step Statement expected	Displayed if a Step statement is expected but is missing.
ERROR Step Duration Expected	Displayed if the Step Duration is expected but is missing.
ERROR Simple Factor Expected	Displayed if a simple factor is expected.
ERROR Steps > 1024	Displayed if the number of steps determined by the Calculator is greater than 1024.
ERROR Timing Conflict	Displayed if the step count derived from the two timing values is not an integer.
ERROR Unit expected	Displayed if a Timing Unit is expected but a statement or non-unit type character follows.
ERROR Zero divide	Displayed if a zero divide occurs.
WARNING Steps > 1024	Displayed if, sum of current "from Address" value (Param. setup), plus the number of steps calculated exceeds 1024. This will be only a warning because the start address can be changed before pressing RUN.

One of the following messages can occur if the resolution of the Step Duration is incorrect. They are all self explanatory.

ERROR Value is too low
ERROR Value is too large
ERROR Resolution 10 ns
ERROR Resolution 100 us
ERROR Resolution 10 ms
ERROR Resolution 1 cycle
ERROR Resolution 0.1 kcycle
ERROR Resolution 10 kcycle

3. Parameter related messages

ERROR Fix Problem First	Displayed if an error condition exists and End_para is pressed.
ERROR Value out of Range	Self explanatory.
WARNING Missing Label	Displayed if label selection for address attempted and no labels exist.

4. Run related messages

In all the following cases RUN will be aborted if an error is detected.

ERROR Arithmetic overflow	Displayed if an arithmetic overflow occurs.
ERROR Arithmetic underflow	Displayed if an arithmetic underflow occurs.
ERROR Argument out of Range	Displayed if a function includes a wrong argument. E.g., the square root of -1.
ERROR Check Parameter	Displayed if "RUN" is pressed and there is a conflict caused by offset, levels and/or load. Another cause could be if no difference exists between the Max. and Min. Levels.
ERROR Dynamic missing	Displayed if Combine On is selected and, either original pattern or values calculated from the functions are constant. In this case weighting is impossible.
ERROR Memory Exceeds	Displayed if the address where the first calculated pattern is to be stored plus the number of steps defined in the function is greater than 1024.
ERROR No Function available	Displayed if RUN pressed and no function is available.
ERROR Stack overflow	Displayed if it is not possible to calculate the whole function because there is an internal user stack overflow.
ERROR Timing Conflict	Displayed only when RUN with Combine is executed. It means that durations of the old patterns and the calculated ones differ.
ERROR Zero divide	Displayed if division by zero is attempted.
RUNNING To Stop press ABORT	Displayed while calculating. The message remains until RUN completed or an error detected.
WARNING Durations Modified	Displayed if, as a result of calculation, any duration values have been changed. This is because the new (calculated) durations will apply to both Arb. channels.
WARNING Set Durations Variable	Displayed if Duration setting (Data **[Format]** Allocation menu) is **[fixed]**. Calculated durations will not be possible until Duration is changed to **[variable]**.

5. Status messages

The following messages indicate the current Calculator status:

Awaiting Command	Displayed when Calculator initially accessed or Edit, Param or Run completed.
Editing	Displayed when Edit mode is active.
Inserting	Displayed when Insert mode is active.
Deleting	Displayed when Delete mode is active.
Compiling pass 1 of 2 **Compiling pass 2 of 2**	Displayed when End_edit pressed and hence the compiler is started.
Parameter Setup	Displayed when Parameter Setup Page accessed.
Calculating Pass* x of n	Displayed when RUN pressed.

NOTES

Run related messages:
"**ERROR** Arithmetic overflow/underflow" - if either of these messages is displayed, the cause will probably be an "internal calculation sequence" error. To correct it, even though the algorithm concerned is almost certainly ok, you will need to change the order of its argument parameters.

Status related
*On the Status line the Pass status is displayed as a two digit running value. The first digit (running one) is the current status and the second is the total number of passes to be completed.

3D
How to Store and Recall Calculator Modules

This section explains how to store/load Calculator Modules (waveform functions) to/from micro disc via an HP 9121S/D or 9122S/D Flexible Disc Drive. Connection and use of such disc drives is fully explained in the standard 8175A Operating and Programming Manual. Therefore, this section only provides the information specifically related to storing/loading Calculator Modules. Note that Calculator Modules can also be stored by an external controller, the HP-IB commands involved are listed in the Programming section of this manual.

The information is presented under the following headings. If you already know the basics of how to connect up and use a disc drive, and have a (LIF) formatted disc installed, then go straight to 3D-3.

3D-1 Storage Basics
3D-2 Connecting The Disc Drive
Setting the 8175A as the Controller
Inputting the Disc Drive Address to the 8175A
3D-3 Using the Disc Drive
How to format a Disc
3D-4 How To Store A Calculator Function
3D-5 How To Load (recall) a Calculator Function
3D-6 Notes on Error Messages

3D-1
STORAGE BASICS

Although the 8175A's internal storage (LOC1 and/or LOC2) can be used in the normal manner for Arb. waveforms etc., including those produced via a Calculator module (function), actual Calculator functions cannot be stored in either of the user specifiable internal locations. They are of course auto-stored, like all other settings, whenever the 8175A is switched off. They can also be stored on an external disc in the same way as any other settings etc. The main difference is that they cannot be stored in the same file as other settings.

NOTE: File Type "all"
Calculator functions are stored using a different internal routine from settings and data etc. They are stored as a specific file type and cannot be combined with other files. In other words, even when the File Type on the storage menu is set to "all", the current Calculator function will not be stored as part of the set. Therefore, whenever you wish to store a Calculator function, remember that it must be done as a specific "Store" action.

The main difference concerning storage/loading of Calculator functions is that they can only be stored from, and/or loaded to, the actual (current) 8175A settings. (Other types of settings can be stored/loaded from/to current or internal storage locations.) Automatically, whenever Calculator functions are stored or loaded the location is defined as "ACT" (actual). Therefore only the file name and type (plus description if wished) need to be given when storing a new file. Loading is even simpler since it requires only the name.

3D-2
CONNECTING THE DISC DRIVE

1. Connect a power cord to the disc drive but do **not** switch on.

2. Connect an HP-IB cable from the signal generator HP-IB output to the disc drive HP-IB connector.

3. Set the HP-IB address switches on the rear panel of the disc drive to the desired operating address. More than one disc drive may be connected to the HP-IB, however, each must have a unique address assignment. Note, if you also want to control a printer at the same time, ensure that it has its own addresses (do not set to Listen Always/Only or you will print out everything that appears on the bus!)

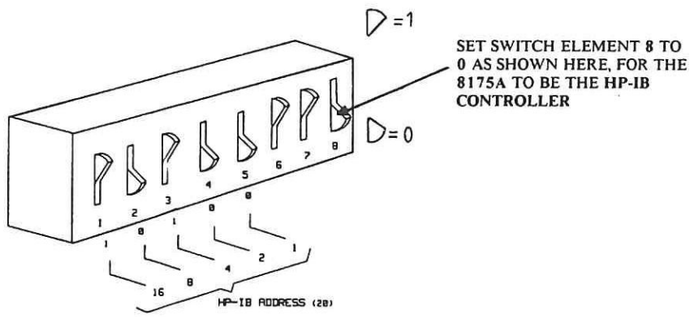
4. Apply power to the disc drive. When power is applied the disc drive will go through an initialization sequence which causes the indicator lamps to momentarily light.

5. Install one or two (as appropriate) flexible discs into the disc drive by pressing the disc all the way into the disc drive unit.

SETTING THE 8175A AS THE HP-IB CONTROLLER

To be able to control the disc drive from the 8175A, the 8175A must be set as the HP-IB controller. Do this as follows:

On the (rear panel mounted) HP-IB System switch set switch element 8 to 0. Refer to the figure below. The 8175A checks the status of this switch only during the power on sequence, so you may need to switch the 8175A off and on again.



HP-IB Switch Settings

Check via the **[Peripherals]** menu of the System Page that the following status is displayed:
System Controller: 8175A is controller

INPUTTING THE DISC DRIVE ADDRESS TO THE 8175A

You have to manually input the disc drive address and the identifying number of the specific disc unit to be used to the 8175A. Do this as follows:

Access the System Page **[Peripherals]** menu, set the Address and Unit values in their respective fields. Note that if either of the dual type disc drives (D) is used, the 8175A can be addressed to only one of the disc units at a time.

3D-3
USING THE DISC DRIVE

This section is intended **only** as a quick "Getting Started" explanation of how to use the disc drive. It describes the basic steps necessary to get you started. Detailed descriptions of the **[Storage] [external]** menu and how to Load, Store, Find, Delete and Format, are given in the standard 8175A Op. and Prog. manual.
Once you have completed all steps of "Connecting the Disc Drive", the procedure for storing Calculator functions is as follows:

Access the SYSTEM Page **[Storage]** menu and select **[external]** via the **NEXT[]/PREV[]** keys. The 8175A will search for the disc and then display the **[Storage] [external]** menu.

HOW TO FORMAT A DISC

If you are starting with a new disc (or a previously used but not LIF formatted one), it must first be formatted to LIF format. Do this as follows:

Position the cursor in the Operation field and select **[Format disc]**.
Press **EXEC** and move the cursor into the new setting field which will be displayed.
Input a "Y" to confirm. The disc will then be formatted.
Once formatted, the details adjacent to "LIF volume" (top left of menu) will change to "L8175A". (This simply indicates that the 8175A formatted the disc.) You can now store a file on the disc. This is described in the next paragraph.

3D-4
HOW TO STORE A CALCULATOR FUNCTION

If the disc has not already been formatted (LIF format), refer to the previous sub-section, otherwise proceed as follows:

On the **[Storage] [external]** menu make the following settings:

set **Operation** to **Store**
set **File Name** (any name, 1 to 10 characters long (no blanks!), first must be alpha.)
set **File Type** **calc**
set **Description** (optional, up to 26 characters)

Then, to store the function:

Press **EXEC**, the 8175A will first check the disc, then store the function. When storage is completed, the file information will be displayed under the appropriate File directory headings. If the message "No LIF directory" is displayed, then reformat the disc. (It means either, in the case of a new disc that it was not correctly formatted or, for a used disc, that it was previously formatted in some other non-LIF format).

3D-5
HOW TO LOAD A CALCULATOR FUNCTION

1. Access the **[Storage] [external]** menu. The directory of the files will be displayed. If more files exist than can be displayed, the ROLL keys enable all available ones to be checked out.

2. Move the cursor into the Operation field and press the **NEXT[]/PREV[]** keys until **[Load]** is displayed. Enter the file name in the field and press **EXEC**. This accesses the file on the disc. Then press **EXEC** again to actually load the file into the 8175A. Note that, for "calc" files no "to destination" can be user set. It is automatically set as "ACT".

3D-6
NOTES ON ERROR MESSAGES

Generally the meaning of any error messages/warnings which are displayed during Disc Drive operation, will be obvious. However there are two different messages relating to whether the disc drive is actually correctly connected or not. These are as follows:

ERROR no disc drive present
This means that either the disc drive is not properly connected or, it is not connected at all but, some other instrument is connected to the 8175A via the HP-IB eg., a printer.

ERROR operation time out
This means that neither the disc drive nor any other instrument is connected to the HP-IB.

3E
The Menu Map

INTRODUCTION

This section describes only those menus which relate specifically to Arb. configuration. This means menus which either do not exist in the standard 8175A or, for Arb. configuration, differ significantly from the standard 8175A ones. This includes the menus of the **OUTPUT** and **DATA** Pages. Note the following points concerning the other menus (which are all described in the standard O and P manual):

The **TIMING** page menus are disabled whenever Arb. configuration is selected and the **SYSTEM**, **CNTRL**, and **PRGM** menus are configuration independent. This means that Irrespective of whether Parallel Data, Serial Data or Arbitrary Generator configuration is selected, they are used in the same way.

OVERVIEW OF MENUS DESCRIBED HERE

Brief details of the menus described in this manual are as follows:

OUTPUT Page, Level **[ARB A]/[ARB B]** into **[50 Ohm]/[open]** menus. These are "new" and relate purely to Arb. operation.

DATA Page, **[Format]** Allocation menu. Minor differences.

DATA Page, **[Pattern/Level]** Setup menu. Although this has several points in common with the Data **[Pattern]** Setup Page of the standard 8175A, it is treated as a new menu and therefore completely explained.

DATA Page, **[Waveform]** Setup menu. This menu, although similar in some respects to the corresponding standard (Parallel D.G.) one, includes a host of additional features and capabilities related to curve setting/editing/display. An example of this is the Interpolation capability.

DATA Page, **[Calculator]** menu. This is a totally "new" menu with a completely different operating concept from any other. Therefore only brief menu settings explanations etc. are included here since it is fully documented in sections 3B and 3C of this manual.

INTRODUCTION TO USING THE ARB.MENUS

Whichever configuration is selected, the menus of the 8175A are all accessed via the six **MAIN DISPLAYS** keys on the front panel. Each key accesses the corresponding Page, each Page comprises one or more menus. Once you have learned which menus "belong" to each Page, operation of the 8175A is very easy.

Unless otherwise mentioned, all figures showing menu contents are the **Standard Settings** or "default" conditions. (Note that normally, whenever any Page is accessed, the first menu displayed will be the last one displayed on the previous access.)

When working with the Data Page menus, section 3F of this manual which covers the Edit capabilities is of special significance.

3E-1
OUTPUT (Output Page) Menu

This section describes the Arb. related **OUTPUT** (Output Page) menus and how to use them. The default menu (**[POD]** Output Levels) has no significance in connection with Arb. use unless you need to generate analog and digital signals simultaneously, and/or need flag outputs. In such cases, refer to the appropriate Menu Map sections in the standard O and P manual.

The other two menus are identical to each other in terms of use and setting fields etc. and therefore only one of them is described. It is the one for Arb. OUTPUT A. Regarding the menu layout, note how it is divided into five distinct sections each for a particular type of setting etc. Four of these contain setting fields and the fifth is a pure display field (Level Upper Peak...). A figure illustrating several different settings is included at the end of the menu description. It will help to clarify the meaning of many of the terms used.

IMPORTANT NOTE: Output Load Setting
Ensure that the output load setting on this menu matches the actual output load, if not damage to the DUT may occur! Refer to the "Level..into" *explanation below.*

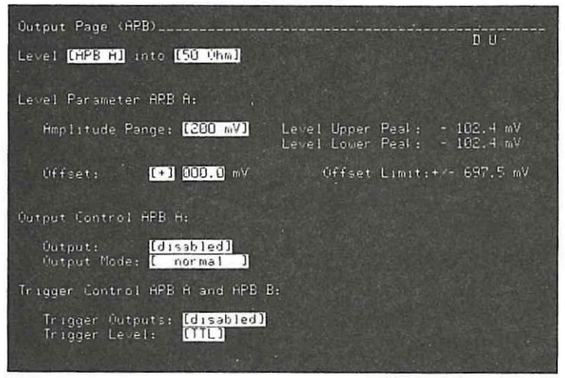
THE MENUS AND HOW TO USE THEM

DISPLAY CONTROL FIELDS	SETTINGS EXPLANATION
Level....into	The first field, currently displaying **[ARB A]**, determines the particular* Arb. output whose various settings are to be changed/displayed. *Trigger Control settings (at bottom of menu) apply to both Arb. outputs. The second field enables one of two output loads - 50 Ohm or open - to be defined. Open means a load resistance > 50 kOhm. The Arb. output signal level is adjusted to match whichever load is selected so *ensure that you set the load correctly!* To explain the possible consequences: If the menu setting is "into **[50 Ohm]**" but the actual load is say > 50 kOhm, it is possible that the voltage across the load could be double the expected value! Amplitude Range availability (see next paragraph) is dependent on the load setting.
Level Parameter ARB A:	The fields in this section enable output voltage range and applied offset to be set. Refer to Table 3E-1 towards the end of the menu description for specific values.
Amplitude Range:	Each Amplitude Range provides a range of voltage values for level setting. The maximum difference waveform level values for any range cannot exceed the Range value*. Upper and Lower Limits within any Range (without offset) equate to +/-50% of the Range value. Eg., 200 mV enables nominal* level values of between -100 and +100 mv to be set.

*For all except the 16 and 32 V Ranges an over-ride of 24 resolution steps is provided. Therefore, the actual Range values are extended.

For each Range there is a corresponding Level Window, output level plus offset level must "fit" into the Window*.

As an example, the Level Window for the 200 mV Range is +/-800 mV. For each output load seven different Amplitude Ranges are available. Not all ranges are available for each output load. See Table 3E-1.



Output Page (ARB) menu

ERROR and **WARNING** conditions explanation

* An Amplitude Range change to a higher range may result in an "**ERROR** Offset out of Limit" and/or "**WARNING** Data Limitation ...." type message being displayed. This simply means that the new level and/or offset values (derived from the previous "step equivalent" values of the previous ones) are outside the Level Window. An example of when the warning would occur is as follows:

Assume that in the 10 V Amp. Range, Peak Levels of +/-5.00 V (equivalent to 0012 and 1012 steps) currently exist. Then the 16 V Range is selected. Since the allowable step window is now only 112 to 912, an error condition will be detected and "clipping" of the waveform will occur. Refer to Table 3E-1 for more details.

In a similar way, if the "old" Offset value exceeds the new Limit, "**ERROR** Offset out of Limit." will be displayed.

Level Upper Peak:
Level Lower Peak:

These are the maximum (Upper)/minimum (Lower) signal output levels including offset, which are currently set. Because currently <u>all</u> output levels are identical (-102.4 mV), both Peak Levels are also identical.

Offset: This field is for setting the required offset voltage. It must be within the "Offset Limit" applicable to the current Amplitude Range.
Eg., this is currently: +/-697.5 mV.
Values can be set numerically or via the VERNIER keys. For each Amplitude Range a corresponding offset range also applies. Since the sum of output + offset levels combined must fit within the Level Window, output and offset are interdependent. This means that changing one of them can affect the other.
Therefore current max/min level values determine the Offset Limits. Refer to the figure at the end of the menu description to, clarify this if necessary.

Offset Limit: This is the max/min value of offset which can currently be set in the Offset field. It is dependent on both the Level Window of the Amplitude Range and the current max/min level values set.

Output Control ARB A: These setting fields enable the Arb. output to be enabled/disabled and mode to be selected. Note that if the front panel **DISABLE** key is pressed then Arb. outputs (including Triggers) can only be re-enabled via this menu.

Output: When **[enabled]** the Arb. A signal will be available at the front panel BNC connector and its LED will illuminate.

Output Mode: When set to **[complement]** the Arb. output signal will be inverted to produce a "mirror" image. The displayed Level Upper and Lower Peak values may change depending on their values. Note that the fact that a signal can be "complemented" is also a limiting factor for output levels as soon as applied offset exceeds a certain value. (Refer to figure at end of this menu description to clarify both these points.)

Trigger Control ARB A and ARB B:
Settings made in these fields are common to both ARB A and B outputs. Refer also to the Output Control ARB A explanation.

Trigger Outputs: Common enable/disable control.
Trigger Level: Either TTL or ECL fixed high levels can be selected.

Table 3E-1. Amplitude Range/Offset/Level Window Details

The resolution/step count figures for the different ranges are as follows:

Range	Resolution, Steps	Available Step Window
0.2 V -> 10 V, 20 V,	1/1000, 1023 steps	0 to 1023
16 V	1/800, 800 steps	112 to 912
32 V	1/640, 640 steps	192 to 832

Load impedance: 50 Ohm

Amplitude Range	Step Resolution	Level Window	Offset Range	Offset Resolution
0.2 V	0.2 mV	+/- 0.8 V	+/- 0.8 V	0.5 mV
0.5 V	0.5 mV	+/- 0.8 V	+/- 0.8 V	0.5 mV
1 V	1 mV	+/- 0.8 V	+/- 0.8 V	1 mV
2 V	2 mV	+/- 8 V	+/- 8 V	5 mV
5 V	5 mV	+/- 8 V	+/- 8 V	5 mV
10 V	10 mV	+/- 8 V	+/- 8 V	10 mV
16 V	20 mV	+/- 8 V	+/- 8 V	20 mV

Load impedance >= 50 kOhm

Amplitude Range	Step Resolution	Level Window	Offset Range	Offset Resolution
0.5 V	0.5 mV	+/- 1.6 V	+/- 1.6 V	0.5 mV
1 V	1 mV	+/- 1.6 V	+/- 1.6 V	1 mV
2 V	2 mV	+/- 1.6 V	+/- 1.6 V	2 mV
5 V	5 mV	+/- 16 V	+/- 16 V	5 mV
10 V	10 mV	+/- 16 V	+/- 16 V	10 mV
20 V	20 mV	+/- 16 V	+/- 16 V	20 mV
32 V	50 mV	+/- 16 V	+/- 16 V	50 mV

EXPLANATION OF SOME TERMS ETC.

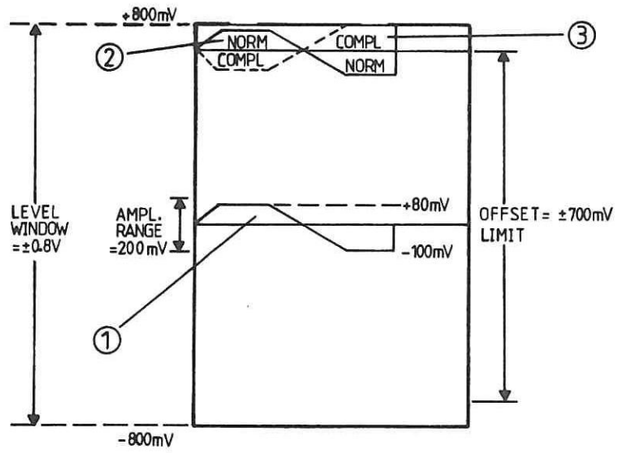


Figure 3E-1. Example to Illustrate some Terminology

1 Shows a waveform set up in Arb. output A, it has a current maximum level (Level Upper Peak) of +80.0 mV and Level L.P. of -100 mV. It is set up in the Amplitude Range **[200 mV]** which has a Level Window of +/-0.8 V. The offset is currently 0.0 mV and limited to +/-700 mV due to the Level Window and Level L.P. values. The waveform could actually be shifted to any position (within the offset limits) within the Level Window. The corresponding Output Page (ARB) menu settings for the stated conditions will be as follows:

Amplitude Range:	**[200 mV]**	Level Upper Peak: +80.0 mV Level Lower Peak: -100.0 mV
Offset:	**[+] 000.0 mV**	Offset Limit: +/-700.0 mV
Output Mode:	**[normal]**	

2 Shows same waveform but now with an offset of +700.0 mV applied. Note how the menu displayed Level Peak values have changed.

Amplitude Range:	**[200 mV]**	Level Upper Peak: +780.0 mV Level Lower Peak: +600.0 mV
Offset:	**[+] 700.0 mV**	Offset Limit: +/-700.0 mV
Output Mode:	**[normal]**	

3 Shows same conditions as for (2) except that the Output Mode is now set to **[complement]**. Note how the Level Peak values have changed again. This also shows how although the "normal" waveform of (2) was within the window, a negative value exceeding -100 mV is not possible since when "complemented" it would be outside the Level Window.

Amplitude Range:	**[200 mV]**	Level Upper Peak: +800.0 mV Level Lower Peak: +620.0 mV
Offset:	**[+] 700.0 mV**	Offset Limit: +/-700.0 mV
Output Mode:	**[complement]**	

3E-2
DATA (Data Page) Menus

This section describes the DATA (Data Page) menus and how to use them. The four menus enable you to set up, edit and display signal levels, duration and trigger data. The **[Pattern]** and **[Waveform]** menus are for setting up and displaying level data etc. The **[Calculator]** menu (actually classified as a Page) enables waveforms to be set up in terms of their equivalent mathematical functions. The **[Format]** menu enables the Duration type to be selected and values (if **[fixed]** type) to be set. Since data formats are fixed in Arb. configuration, they are only "displayed" settings on this menu.

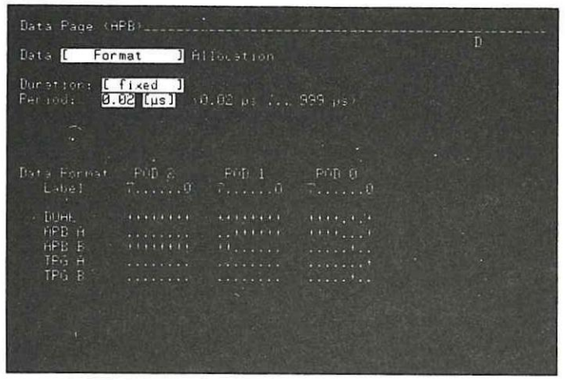
The Calculator menu is described in sections 3B-5 and 3C of this menu, therefore it is only briefly referred to here.

A powerful set of editing capabilities is provided for the Data Page **[Pattern/Level]** Setup menu. Section 3F explains them and their use. For the **[Waveform]** Setup menu an interpolation edit capability is provided. It is fully described in section 3B-6, therefore only some additional points to note are included here.

THE MENUS AND HOW TO USE THEM

Data [Format] Allocation menu

DISPLAY CONTROL FIELDS	SETTINGS EXPLANATION
Duration:	Duration is the time that any signal/trigger level will remain at the output. Either **[fixed]** or **[variable]** can be set. **[fixed]** means that each discrete signal/trigger level will be active for a fixed (identical) time. Therefore a constant rate as set in the "Period" field will apply. **[variable]** means that each signal level can have a different duration value. When **[variable]** is set, the Period entry field is deleted from the display. Signal level duration values must then be input on either the **[Pattern]** or **[Waveform]** menus. Note that whenever Duration is changed from **[fixed]** to **[variable]** or vice-versa, the values will always revert to their last variable or fixed setting as appropriate.
Period:	The Period setting field is available only if Duration has been defined as **[fixed]**. The type of setting which can be made here depends upon the System Clock source. (System Clock is set on the Control Page **[Clock]** menu.) If the **internal** clock source is used, Period is input as a numeric value plus a units setting. An example of this is: **0.02 [us]**, which is the default value.



Data **[Format]** Allocation menu

When an **external** clock source is used, the Period (duration) is expressed as:
m x the period of the clock,
where m = the numeric value x 1 , k, or M. It is expressed in cycles **[Cyc]**. The default (fixed timing mode) is: **1[Cyc]**. This means that the signal level duration will equal the clock signal period.
Example for System Clock **[external..]**:
If external clock frequency is 10 Mhz (period = 0.1 us) and you want a duration of 2 us, the Period setting must be:
20 [Cyc], (20 x 0.1 us)

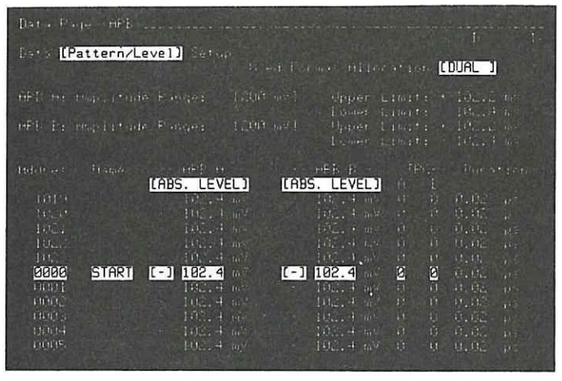
Data Format Label — POD 2 etc. 7.....0

These are only display fields, none of the settings can be changed. It shows which channels are allocated to each Arb. and trigger. Channels 1 and 3 of Pod 0 are reserved for Characteristic Point (CP) information. For more information, refer to the **[Waveform]** Setup menu, Interpolation related settings explanation.

Data [Pattern/Level] Setup menu

On this menu, discrete signal levels and trigger data can be set up and edited. If the duration is **[variable]**, duration values can also be set. Data Formats, as shown on the **[Format]** Allocation menu, can be assigned here. They determine which Arb. signal and/or trigger data will be displayed. Data can be set up and displayed in voltage terms or equivalent code form. The possible codes are: binary, octal, hexadecimal or decimal.

DISPLAY CONTROL FIELDS	SETTINGS EXPLANATION
Used Format Allocation:	This field indicates the assigned Data Format Label. Any of the formats, available from the **[Format Allocation]** menu can be used. The formats can be stepped through, in the order shown on the **[Format]** menu, by pressing the **NEXT[]/PREV[]** keys. For each Format, level entry/display base can be set to voltage or code terms. These code(s) will be recalled as part of the format. Any edit action (section 3F) will apply only to the Arb./trigger channels currently displayed.



Data **[Pattern/Level]** Setup menu

ARB A:Amplitude Range:	This shows the Amplitude Range selected (on the Output Page, see Table 3E-1), if offset also set, it may also be displayed depending on the whether **REL** or **ABS LEVEL** used (see below).
Upper and Lower Limits	For both limits the values depend basically on the current Amplitude Range. In addition, offset may or may not be included in the displayed value. This is explained as follows: When **[REL. LEVEL]** data format is active, then U and L (Upper and Lower) Limits show the maximum/minimum values **without offset** which can be set within the currently active Amplitude Range. Any applied offset will be separately displayed. When **[ABS. LEVEL]** data format is active, then U and L Limits show the maximum/minimum values **including offset**, which can be set within the currently active Amplitude Range.

[ABS. LEVEL] [ABS. LEVEL]

These fields are for assigning the level entry (and display) base/code for the two Arb. channels. It can be set (via the **NEXT[]/PREV[]** keys) to either: **ABS. LEVEL, REL. LEVEL, BIN, OCT,DEC** or **HEX**. Whenever a Format is assigned, the codes as assigned previously will be recalled. Note that, the selected code determines which alphanumeric keys will be active for data entry. Note also the next paragraph.

[REL. LEVEL]
The displayed value is the output level referenced (or relative) to the applied offset.

[ABS. LEVEL]
The displayed value is the actual output level (i.e. Relative Level plus offset).

NOTE: When level values are displayed (or set up) in an alphnumeric code, the displayed value is based on the [REL. LEVEL] equivalent.

Address:

Up to 1024 discrete ARB A, ARB B (and their related TRG) level values can be assigned. Each such group is assigned to a specific address. There are two methods of accessing an address, they are:
1) Either, **ROLL** the display up or down until the required address lies in the inverse video field.
or,
2) (usually the quickest method) move the cursor into the address field, then change the current value to the required one.

Name:

The field under this heading is for assigning and/or displaying a name or label. Up to 50 can be assigned. Names/Labels can be from 1 to 5 alphanumeric characters long, the first character must be alphabetic. Note (particularly for single character names) that the position of characters within the field is significant. The Name **A....** is not the same as **....A**.
Labels are of particular help, in enabling existing level/trigger data blocks to be easily accessed after INSERTion or DELETion of new ones. This is because a label remains assigned to its pattern even though the pattern has a new address. This is of special significance for the PRGM Page and data cycling.

Level setting fields:

For each Arb. signal (as indicated by the corresponding **ARB A** and **ARB B** display headers), a level entry/display field is displayed (inverse video). To edit a level, access the required Address, move the cursor to the required position and set the new value via the alphanumeric keys.
Comprehensive data editing capabilities are provided. These enable level and/or trigger data to be moved, copied exchanged etc. By using these, levels can often be very quickly set up. Section 3F explains all of them.

TRG: For each Arb. signal, a trigger channel entry/display field is provided. Trigger data can be set up in the corresponding channels via the 0 and 1 keys.

Duration: At each Address, the duration applies to the corresponding Arb. A, B and trigger values. In **[fixed]** duration mode, the duration value cannot be changed on this menu. It is for reference purposes only. In **[variable]** mode, the duration of each level group can be set here. For either duration mode, if the System Clock is externally sourced, duration values will be expressed in "Cyc" (cycles). Refer to the [Format] Allocation menu - Duration explanation, for more information.

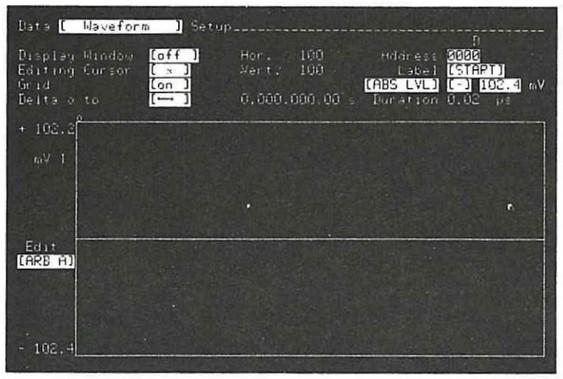
Data [Waveform] Setup menu

This menu provides an alternative method of setting up, editing and displaying waveforms. In addition to normal graphical editing capabilities, it also has an interpolation capability. The use of this is fully described in section 3B-6 of this manual, so it is not repeated here. However some points of interest relating to the capability are included at the end of the menu description. The use of all the other graphical editing capabilities which are described in the following pages, is explained in section 3B-7 of this manual. Refer to section 3F for information about using **INSERT** and **DELETE** on this menu.

DISPLAY CONTROL FIELDS — **SETTINGS EXPLANATION**

Display Window

This enables a specific section of either the Arb. A or B waveforms to be displayed. Waveforms and trigger points **cannot** be edited when Display Window is on. It is enabled via the **NEXT[]/ PREV[]** keys. When enabled, the complete graphics display area is displayed in reduced (1/4 of main area) form as an overlay in the top right hand corner of the graphical display area. Within this rectangular area, a window of the complete waveform can be defined. It can be defined in size and position as described in the following:



Data **[Waveform]** Setup menu

Hor. and Vert.

These setting fields appear as soon as Display Window is enabled. They enable frame size of the window to be defined. The window dimensions are expressed as percentages of the horizontal (Address) and vertical (level) axes. The window can be positioned either by setting an Address, calling up a Label, interchanging the active Editing Cursors or, via the **ROLL** ↑ ↓ → ← keys. For this last method which is done as follows, the (text) cursor must be positioned in the **Displ** field.

Positioning the Window by Scrolling:
Scrolling (or moving the window horizontally and/or vertically) is possible as long as the active Editing Cursor remains within the chosen Display Window. It is done via the **ROLL** ↑ ↓ and **SHIFT** keys as appropriate.

Horizontal Scrolling
The active Editing Cursor always remains stationary with respect to the main graphics display area. Therefore, as the window is horizontally scrolled and the waveform "moves" left or right, the Address where the Editing Cursor lies will change. The inactive cursor stays "fixed" at its last Address and therefore moves with the waveform. This means that during scrolling, it may disappear from the window.

Vertical Scrolling
In vertical scrolling both Editing Cursors remain at their current Addresses. Since, by definition the active Editing Cursor must remain within the Display Window, vertical scrolling is limited by the window vertical dimension.

Editing Cursor

Two Editing Cursors (E. Cursors) are user selectable, an "x" and "o". At any particular time only one of them can be set as the active one. The active E. Cursor is used to graphically edit a waveform (Its other use for quickly locating CPs during Interpolation will not be discussed here).
The active cursor is shown as a large + on the graphics display area. The inactive one is represented by a small +. The default active Editing Cursor is the x one. Whenever both waveforms are simultaneously displayed, the x cursor is automatically assigned to ARB A and the o one to ARB B.

The values displayed in the Address, Label, Level and Duration fields relate directly to the current position of the active E. Cursor. This also means that, whenever the displayed Address or Label is changed, the active E. Cursor will "fast move" along the waveform to its new position. The active E. Cursor cannot be moved outside the current Display Window.

The **CURSOR** ← → and **ROLL** ↑ ↓ keys, with or without SHIFT (for fast move), enable the active E. Cursor to be positioned at any point on the graphics display area*. Note that for Display Window of <100% (Hor. or Vert.), when the cursor reaches the limit of its travel the window will be scrolled.
* The **CLEAR ENTRY** key enables the E. Cursor to be "fast positioned" at 0.0 V ([REL LVL])/(DEC 512) at any Address.

Grid

This is a lattice of horizontal and vertical dividing lines on the graphics display area. It is useful for identifying specific parts of a waveform when editing etc. It can be switched off if not required.

Delta o to x

This enables either the duration or level difference between two points on a waveform to displayed. The points are identified by the position of the two Editing Cursors. Horizontal or vertical measurement is selected via the **NEXT[]/PREV[]** keys. In Display Window mode it is disabled. Whenever more than one arbitrary waveform is displayed, only duration differences can be displayed.

Edit

When this field is displayed, waveform and/or trigger point editing is allowed. Select the particular waveform/trigger combination required via the **NEXT[]/PREV[]** keys.

Address

This displays the particular address where the currently active Editing Cursor is positioned. It therefore follows, that whenever the address value is changed (eg. via the numeric keys), the Editing Cursor will also change its position.

Label

This field has two functions, either:
(a) Labels (previously entered on the **[Pattern/Level]** Setup menu) corresponding to particular addresses will be displayed when the corresponding address is displayed.
(b) Lables can be accessed and therefore the corresponding addresses will be displayed.

[ABS LVL]

Levels can be input/displayed either in voltage or decimal units. In both cases the limiting values depend on the Amplitude Range (set on Output Page, refer also to Table 3E-1). Note that changing from "**ABS LVL**" to "**REL LVL**" and vice-versa, can cause the position of the horizontal marker line on the graphics display to alter.

Horizontal Marker Line on Graphics Display
For **[ABS LVL]** it identifies the zero volt level. For **[REL LVL]** the line identifies the applied offset voltage. In both cases, whether or not the line can actually be seen on the graphics display area at any time, depends on the applied offset, the Display Window and its current position. For **[DEC]** level base, the line is deleted.

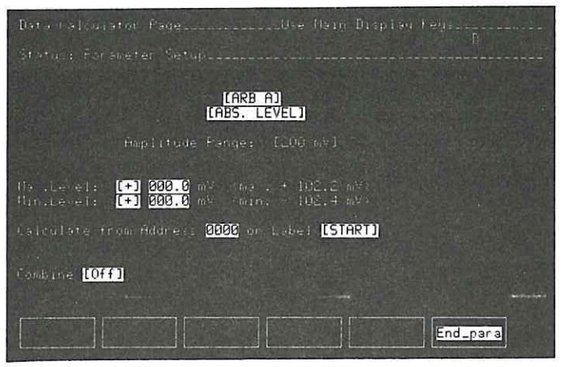
Duration

The type of duration cannot be changed on this menu (see Data **[Format]** Allocation menu). If duration is **[fixed]**, then the value cannot be changed. If **[variable]**, then values can be set. Note that if the clock source is external, the units will be expressed in Cycles.

Different Duration Values are Not Always Obvious
Irrespective of duration values, identical numbers of data points always occupy the same length of display. In other words, 50 data points each of duration 0.1 μs will occupy exactly the same display length as 50 of duration 1.0 μs.

Data [Calculator] Page

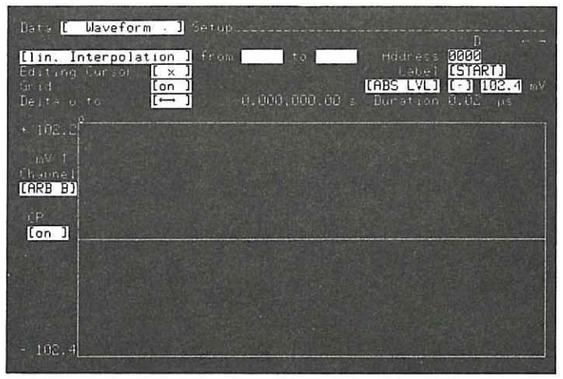
Although this is termed a Page, it is in effect one of the Data Page menus. The capabilities, menu settings etc. and their use are fully described in sections 3B-5 and 3C of this manual. Refer to those sections for more information. There is only one actual "menu" available: Parameter. It is shown below.



Data Calculator Page, Parameter "menu"

SOME POINTS RELATED TO INTERPOLATION

The Interpolation capability is accessed via the SHIFT and FCTN keys. The menu details when it is accessed are as shown below.



Data [**Waveform**] Setup menu - Interpolation Accessed.

The setting fields and their use etc. are described in sections 3B-6. The following points concerning "CPs" should be noted.

[remove CPs] - Why is it neccessary?
When a waveform is to be created by interpolation, CPs have to be defined at particular addresses. The **[remove CPs]** function enables prevously set CPs to be deleted. Even if you have not previously allocated any CPs, some may exist! This is explained as follows.
For each Arb. output one channel is reserved for CP data. These channels are 1 and 3 of POD 0 for ARB A and ARB B respectively. At each address where a CP is defined, a "1" is automatically set in the appropriate channel. You do not need to concern yourself with this process. In fact, in Arb. configuration you cannot access the channels. However, in Parallel config. they can be accessed and will quite possibly be used. Therefore "CPs" may exist even though not directly set.

If such "CPs" do exist, you may get a surprise later when using the Interpolation capability of **[Waveform]** menu! (particularly when CP set to **[on]**, reason will be obvious from previous explanation.) It is therefore recommended that before starting to set CPs, you first use **[remove CPs]** to ensure that only the ones you want are used.

Note that if not required for CPs, you can obviously access and use the two channels (Parallel config.) for say, trigger signals if you wish.

3F
The Edit Capabilities and How to use Them

GENERAL INFORMATION

This section explains only those edit capabilities which relate directly to the Arb. configuration of the 8175A.

The 8175A Arb. is provided with a powerful set of editing functions (capabilities) . Many of them are used in the same way as the corresponding standard 8175A ones. They are accessed via the blue SHIFT and MAIN DISPLAY keys. Most of the Arb. edit functions relate only to the [Pattern/level] Setup menu of the Data Page. However an interpolation edit function is provided for the [Waveform] Setup menu. A special point to note, is that edit initiated changes can be made while the 8175A is running, without affecting the signals currently being output. The changes are only transferred to the Arb. outputs once an **UPDATE** command has been given.

The interpolation edit function, is explained in section 3B of this manual and is therefore only briefly described here.

3F-1
OVERVIEW

By using the edit capabilities, the following can be achieved:
Single level (in voltage or code form) and duration values, can be inserted, or deleted. Segments of signals can be moved, copied or stored within each Arb. channel or between channels. The same applies for interchanging between channels. Segments of Level and duration values can also be modified. The interpolation function enables waveforms to be created by first setting Characteristic Points and then interpolating between them.

The main* functions available are:

INSERT DELETE COPY MOVE MODIFY SPLINE (FCTN)

*From the Data edit functions "COPY and MOVE", further sub-functions are available. Some of these (which enable copy/exchange between the two Arb. channels) are available only if both Arb. channels are displayed. The sub-functions are accessed via the **NEXT[]/PREV[]** keys and are as follows:

COPY	**MOVE**
↓	↓
COPY Address	MOVE Address
STORE	ARB A <> ARB B
ARB A > ARB B	
ARB B > ARB A	

COPY, MOVE and MODIFY apply only to the Data [Pattern] Setup menu. Access to them is cursor position independent. This means that they can be accessed (and implemented) with the cursor in any position within the menu. For all of them, unlike INSERT and DELETE, entry fields are provided below the pattern display. These fields, which appear immediately after selection of the particular edit mode, are for entry of the appropriate address/level values etc.

3F-2
BASIC PRINCIPLES OF EDITING

General

There are some basic points which you should note relating to use of the functions, these are as follows:

1. Any edit function result will apply **only** to those Arb. data and trigger channels displayed by the currently used Format Allocation.

2. All except, **INSERT** and **DELETE**, provide one or more fields for address, data and/or value entry.

3. **INSERT** and **DELETE** are initiated as soon as their corresponding keys are pressed (no "**EXEC**" is necessary).

4. **INSERT** and **DELETE**, can be accessed only when the cursor is positioned within a suitable field or display area. These are described later in the corresponding explanation.

5. All editing functions, except **INSERT** and **DELETE**, require that the **EXEC** key be pressed (after data and/or address entry etc.) to initiate the change(s).

6. For all editing functions, the change(s) will only become available for outputting after an **UPDATE** is done. The letter: "U" will be displayed on the 8175A screen to remind you to do this.

How to Cancel an Edit Function

The Edit functions COPY, MOVE, MODIFY and SPLINE can be cancelled (even if some, or all of the fields have been filled) in four different ways. Note that not all possibilities apply to all menus. The four methods are described below. In each case, after cancelling, the current menu status will be retained.
Edit functions can be cancelled by:

pressing Abort (SHIFT + CLEAR ENTRY)
pressing any **MAIN DISPLAY** key
changing the displayed Format
changing the data entry code (HEX BIN etc)

The following pages provide explanations of how to use all the Arb. related Edit functions. For all except INSERT and DELETE "Before and After" display examples are used to simplify the explanations.

3F-3
INSERT/DELETE

These functions can be used, on the [Waveform] and [Pattern/Level] Setup menus. As the names suggest, they provide an "insert or delete" capability. What can be inserted or deleted on any menu and, how to do it, is described in the following paragraphs. Note however the following points:

INSERT and **DELETE**, can be accessed only when the cursor is positioned within a suitable field or display area. These are menu dependent and are as follows:

[Pattern] menu - anywhere in the (inverse video) required Address/data row .
[Waveform] menu - only in the Edit field.

Note the following point, it has a special significance for the Program Page: Use of either function will result in existing data pattern/Address or Label relationships being changed. Therefore, you must ensure that any Program Segments which include such Addresses or Labels are changed as necessary.

The use and effect of INSERT and DELETE on the two menus is as follows:

Data [Pattern/Level] Setup menu.

INSERT and DELETE enable either new lines of level and trigger data or, just trigger data, to be inserted/deleted. In either case, simply position the cursor in the appropriate Address row and press the required key. The inserted line will be a copy of the line where the insert was done.

Remember that INSERT and DELETE will apply only to those Arb. level and trigger channels as currently displayed (according to the Used Format Allocation). This means that you can for example insert just trigger data if required.

Data [Waveform] Setup menu

On this menu, INSERT and DELETE enable level and trigger data to be inserted and deleted. The cursor must first be positioned in the Edit field. In the same way as for the [Pattern/Level] Setup menu, only those Arb. and trigger channels currently displayed will be affected.

3F-4
COPY

COPY comprises the four edit sub-functions: [COPY Address], [STORE], [ARB A > ARB B] and [ARB B > ARB A]. They apply only to the Data [Pattern/Level] menu. Access to them is cursor position independent. This means that they can be accessed (and implemented) with the cursor in any position within the menu.

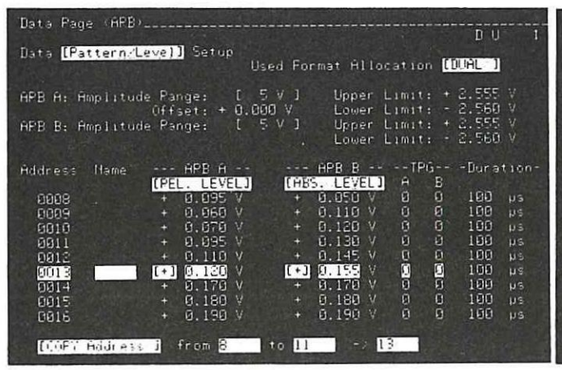
Note that for all these edit functions:

> COPY performs a pattern copy, therefore when the [ARB A > ARB B] etc, functions are used, only the "step value" of patterns will be copied. Levels from different Amplitude Ranges will be converted to the corresponding value in the destination range.
>
> **EXEC** must be pressed, once the fields have been filled, to initiate the edit changes.
> In addition, **UPDATE** must be pressed to transfer the new conditions to the outputs.

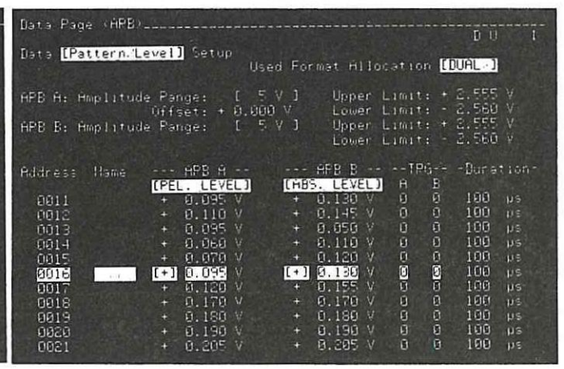
COPY: [COPY Address]
This edit function enables blocks of level and/or trigger data defined by "**from**" and "**to**" addresses, to be copied to a position defined by a destination "->" address. Note the following points regarding the use of COPY Address:

1. The data block to be copied will be defined by the addresses set in the "**from**" and "**to**" fields. Addresses can be defined by either the actual location number or a label.
2. The destination address (or label) will be set in the "->" field. It must be outside the data block defining addresses.
3. Data at and after the destination address will not be overwritten. It will be "shifted forward" when COPY is **EXEC**uted. Note also (4):
4. If the destination address is before the "**from**" one, the block of source data will also be "shifted forward" when COPY is **EXEC**uted.
5. Duration values will be copied along with the data.
6. Labels will not be copied.

Example: COPY Address
This example shows how to copy a data block, defined by addresses 8 and 11, to destination address 13.



COPY Address: Before **EXEC**



After **EXEC**

COPY: [STORE]
This edit function enables blocks of level and/or trigger data, defined by "**from**" and "**to**" addresses, to be copied to a position defined by a destination "**->**" address. It is similar in many respects to the [COPY Address] function, but existing data will be overwritten. Note the following points regarding the use of STORE:

1. The data block to be copied (STORED) will be defined by the addresses set in the "**from**" and "**to**" fields. Addresses can be defined by either the actual location number or a label.

2. The destination address (or label) will be set in the "->" field. It must be outside the block defining addresses.

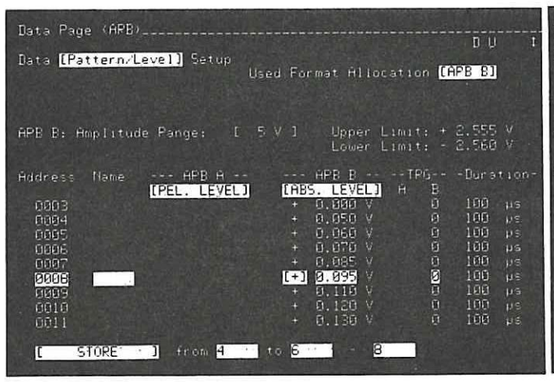
3. Data at, and after the destination address will be overwritten.

4. If the destination address is < the start (from) one, it will also be over written. Also, note that even in this case the block of source data will not be "shifted forward".

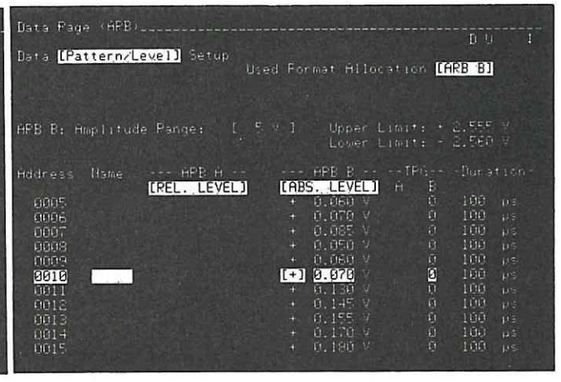
5. Duration values will be copied along with the data.

6. Labels will not be copied.

Example: STORE
This example shows how to STORE a data block defined by the addresses 4 and 6 The destination address is defined as 8. Note how after EXEC, the original data at addresses 0008 to 0010, is overwritten by the source data.



STORE: Before **EXEC**

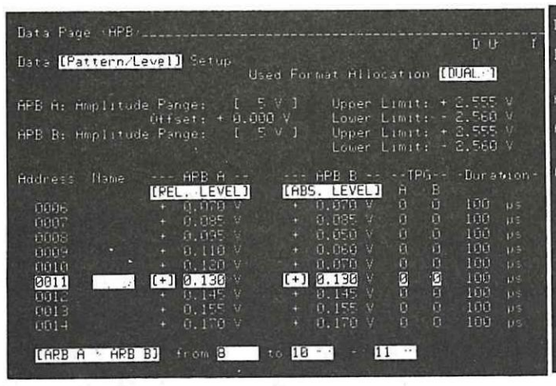


After EXEC

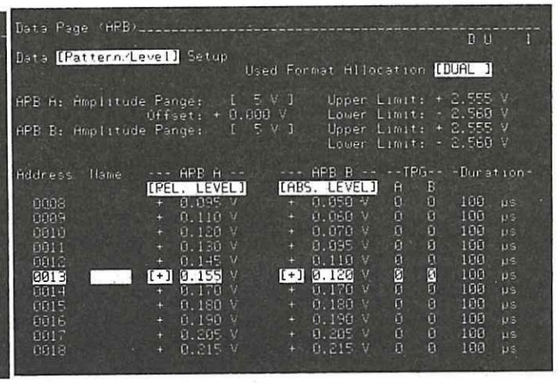
COPY: [ARB A > ARB B]
This edit function enables segments (data blocks) of source data to be copied from one Arb. channel to another. The segment can extend over the compete memory depth. Note the following points:

1. The function can be accessed only if both Arb. channel groups are displayed.
2. The NEXT[]/PREV[] keys enable the Arb. channels for the copy to be interchanged.
3. The data block to be copied will be defined by the addresses set in the "**from**" and "**to**" fields. Addresses can be defined by either the actual location number or a label.
4. The destination address (or label) will be set in the "->" field. It must be outside the block defining addresses.
5. Data at and after the destination address will be overwritten.

Example: ARB A > ARB B
This example shows how to copy a segment from Arb. A to Arb. B. The segment is defined by addresses 8 and 10, the destination address in Arb. B is 11.



ARB A > ARB B:Before EXEC



After EXEC

3F-5
MOVE

MOVE comprises the two edit sub-functions: [MOVE Address] and [ARB A <> ARB B]. They apply only to the Data [Pattern/Level] Setup menu. Access to them is cursor position independent. This means that they can be accessed (and implemented) with the cursor in any position within the menu.

Note that for both these edit functions:

MOVE performs a pattern move, therefore when the [ARB A <> ARB B] function is used, only the "step value" of patterns will be copied. Levels from different Amplitude Ranges will be converted to the corresponding value in the destination range.

EXEC must be pressed, once the fields have been filled, to initiate the edit changes.
In addition, **UPDATE** must be pressed to transfer the new conditions to the outputs.

MOVE: [MOVE Address]
This edit function enables a data segment to be moved from its current location within an Arb. channel to a new one within the same one. Locations "vacated" when the block is moved will be filled as the other patterns move back or forwards as appropriate. Note the following points regarding the use of MOVE Address:

1. The segment to be moved will be defined by the addresses set in the "**from**" and "**to**" fields. Addresses can be defined by either the actual location number or a label.

2. The destination address (or label) will be set in the "->" field. It must lie outside the data block defining addresses.

3. The function will not result in any data being destroyed. If the destination address > the "**to**" one, the following applies:
   All data from address "to"+1, up to the last new line to be occupied by the block, will "move" back to occupy the "empty addresses".
   If the destination address is < the "**from**" one, then it (destination address) plus all addresses up to "**from**-1" will move forward to occupy the vacated ones.

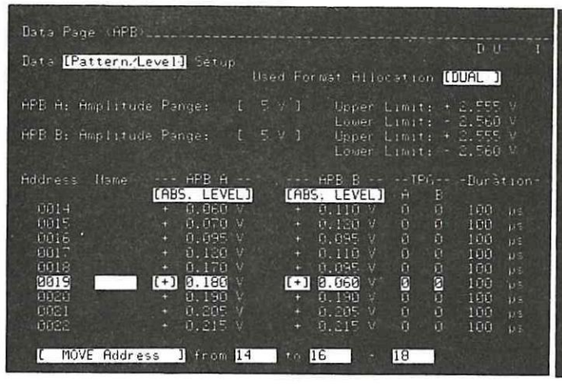
4. Duration values will be moved along with the data.

MOVE: [ARB A <> ARB B]
This edit function enables segments of data to be exchanged between Arb. channels. The channels can extend over the compete memory depth. Note the following points:

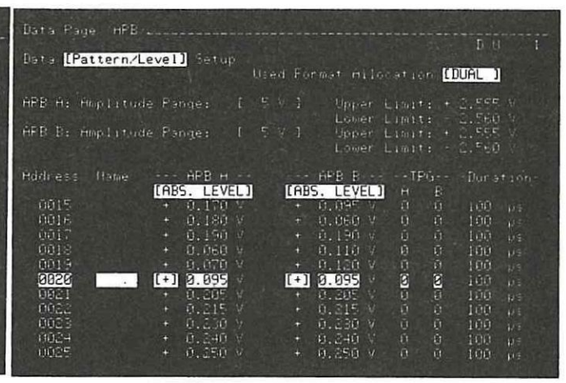
1. The function can be accessed only if both Arb. channels are displayed.

2. The segment to be exchanged will be identified by the "from" and "to" address settings.

Example: Move Address
This example illustrates the effect of moving the segment defined by addresses 14 and 16 to destination address 18. Note how, after **EXEC**, the original data from addresses 0017 to 0020 has shifted back to occupy the vacated locations.

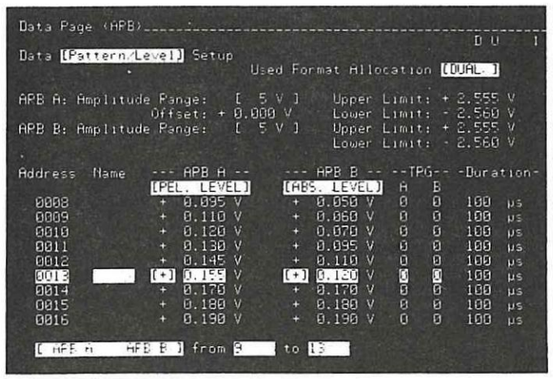


MOVE Address: Before **EXEC**

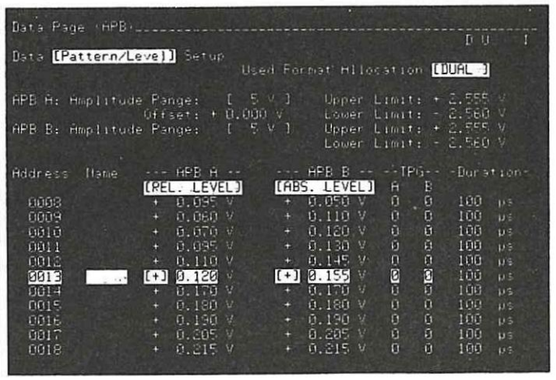


After **EXEC**

Example: ARB A<> ARB B
This example shows the effect of exchanging Arb. channel data between addresses 9 and 13.



ARB A <> ARB B:Before **EXEC**



After **EXEC**

3F-6
MODIFY

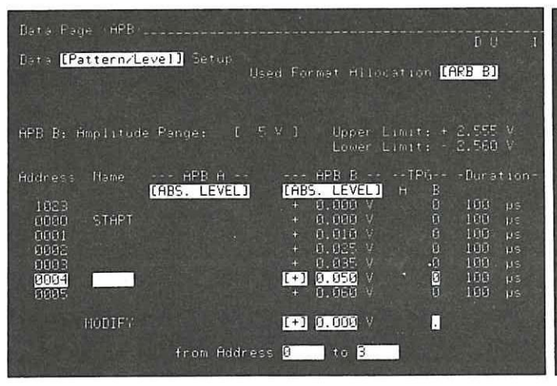
Modify enables segments of level (with or without duration) data to be set as required. The Arb. channel group(s) which can be modified depend on the current "Used Format Allocation". Duration can only be modified if set to [variable]. Note the following points:

1. Trigger and duration values can be left unmodified if wished. This is done by leaving their respective setting fields blank (they will contain dots).

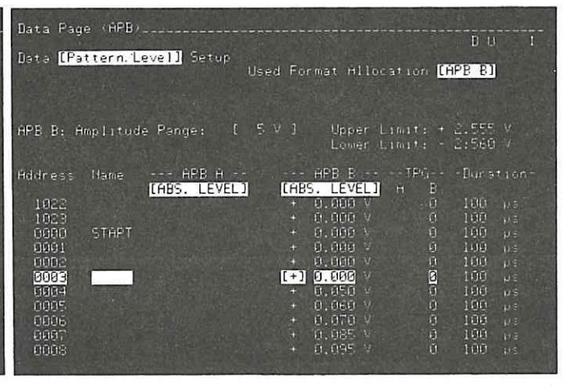
2. Trigger values are set via the **0 and 1** keys.

3. If they are to be modified, duration values must first be set to the default value (0.02 μs) via the **NEXT[]/PREV[]** keys. Then numeric values can be set. Use the **NEXT[]/PREV[]** keys to set the units.

Example: MODIFY
This example illustrates the effect of modifying level data of Arb. A between addresses 0 and 3. The levels are to be modified to 0.000 V, trigger data is to be left unchanged. Note that no duration modifying field is available, this is because duration is currently set to [fixed].



MODIFY: Before **EXEC**



After **EXEC**

3F-7
SPLINE

This function is accessed via the FCTN key. It applies only to the [Waveform] Setup menu and provides an interpolation capability. It is significantly different from the other edit capabilities in use and is described in detail in section 3B of this manual. It includes worked examples etc. Therefore refer to that section for more information.

3G
Parallel: Master Slave operation

In the same way as for the standard 8175A, two Arb. configured instruments be operated in a "Master-Slave" mode. This then doubles the available Arb. channels to 4. Synchronization is achieved by using the HP 15430 cable to interconnect the instruments. There are certain preconditions and restrictions to be observed when operating two 8175A's in parallel irrespective of the configuration. These are described in the following paragraphs.

NOTE: It is recommended that both instruments are switched off whenever interconnecting, disconnecting them and/or setting the HP-IB switch conditions etc.

3G-1
GENERAL PRECONDITIONS AND ASSIGNMENT OF MASTER/SLAVE

First, one 8175A must be designated as the "Master" and the other as the "Slave". This is done by setting switch element 7 of the HP-IB System switch to 1 (Master) or 0 (Slave) as required. On both instruments, switch element 6 must be set to 0 i.e., normal self test. For HP-IB operation, each 8175A must have a unique HP-IB address set. Interconnect the two instruments via the HP 15430A cable. The instruments will only take their Master and Slave status when the switch status is read in at power-up. Then, the one designated as "Slave" will include the word (Slave) at the top of each menu, adjacent to the configuration indicator.

NOTE: If the interconnecting cable is disconnected at only one end, correct operation of the still connected instrument cannot be guaranteed. (Reflections back up the cable may occur.) Therefore, if not needed for parallel operation, **disconnect it completely**

3G-2
RESTRICTIONS ON SETTINGS AND FUNCTIONS

General Restrictions

On each instrument, for true parallel operation, almost all settings (except for data, Flag outputs and Clock related ones), on corresponding Master/Slave menus, should be the same. However, it is possible that for a particular application, you will need to set certain settings differently. Details of those which can differ, their significance and general restrictions are as follows:

In parallel operation, the Master 8175A behaves almost exactly as if in single instrument configuration. The only restrictions for the Master, concern Single Step operation. These, together with related Slave restrictions are as follows:

Address Single Step is possible for the Master but not recommended since, for the Slave 8175A it is inhibited.
Program Single Step is possible for both under certain limitations, these are:

In Single Cycle mode, Program Single Step control is disabled from the Slave. It is allowed from the Master which, will automatically control the Slave.

In Auto Cycle mode, it is disabled from the Slave and not recommended from the Master since the Slave is not synchronously controllable.

All other restrictions apply only to the Slave 8175A. START, STOP. CONTINUE etc are all controllable only from the Master. Details of the Slave restrictions are as follows:

Slave 8175A Restrictions

CNTRL Page - [Clock] menu

Mode: **Auto** or **Single Cycle** are selectable but not **sychron** or **asychron**. These are only Master settable.

Trigger POD:
It will be disabled for trigger functions but still operative for Flag outputs. External input is disabled.

START and/or STOP:
Controllable only from Master, therefore no Trigger control possible.

Trigger POD [asychronous]
This is only significant for Flag outputting.

Trigger POD Threshold TTL:
As above

Valid Trigger Word Duration: [20 ns]
As above

System Clock: [internal]:
The System Clock is always derived from the Master. Both external clock sources are disabled. Clock calibration cannot be done from the Slave.

Clock: All functions are available.

CNTRL Page - [Flag] Assignment menu

All Flag capabilities are available.

PRGM Page - [trigger Event] Assignment menu

Address and Program Single-Step from:
This is disabled for the Slave

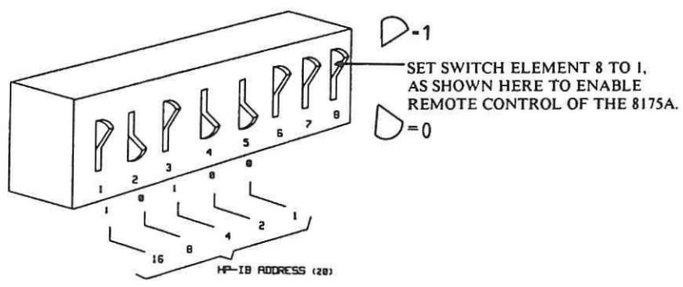
3H
Programming Information

3H-1
GENERAL INFORMATION

The same principles apply for remote control of an Arb. configured 8175A as for the other two configurations. Basic programming information and examples etc. are given in the standard 8175A Op. and Progr. manual. This section provides only the additional HP-IB commands applicable to the Arb. configuration.

NOTE: Setting the 8175A to be Remotely Controlled
Whenever the 8175A is to be remotely controlled over the HP-IB, it must be set to be **"HP-IB CONTROLLED"**. Once this is done, HP-IB control can only be achieved via an external controller (technical computer). If you do accidently have both the 8175A and an external controller simultaneously configured as the HP-IB controller strange things will happen! You will probably have to switch of the 8175A then set the switch (as mentioned in next paragraph) correctly etc.

For the 8175A to be **"HP-IB CONTROLLED"**, element 8 of the switch on the instrument rear panel must be set to 1. The lower part of the switch element must be pressed in flush with the main switch body. Refer to the figure below.



Switch setting for HP-IB Control of the 8175A

3H-2
LIST OF ARB. HP-IB COMMANDS

The following list details only those additional (to standard 8175A) HP-IB commands applicable to the Arb. configuration of the 8175A. Most of the additional commands are Output and Data Page based.

Arb. related Commands of the SYSTEM Page

Description/Requirement	COMMAND DETAILS: mnem	data	Unit	Comments ref.
Arbitrary Waveform Generator config.	GEN	2	-	

IMPORTANT NOTE: Internal Storage Capabilities
If the PRE command (Preset to Standard Settings) is sent when the 8175A is configured as an Arb., any Calculator modules will be deleted! In either of the other two configurations, Calculator modules will not be deleted by sending the PRE command.

Arb. related Commands of the OUTPUT Page

Description/Requirement	COMMAND DETAILS: mnem	data	Unit	Comments ref.
Output Page POD menu	OM	0	-	
ARB channel A menu	OM	1	-	
ARB channel B menu	OM	2	-	
Output Load of Arb. channel	LOAD	CHN, 0/1	-	C1
Amplitude Range of Arb. channel	AMPL	CHN, range		C2
Offset of Arb. channel	OFS	CHN, +/-NR	mV, V	C3
Disable/Enable Arb. channel	CHNM	CHN, 0/1	-	C4
Normal/Complement Mode selection	CHNM	CHN, 0/1	-	C5
Disable both Trigger channels	TRGA	0	-	
Enable both Trigger channels	TRGA	1	-	
Trigger Level TTL	TRGL	0	-	
Trigger Level ECL	TRGL	1	-	

Comments:

General: For C1 to C5, CHN means Arb. channel. O = Arb. A, 1 = Arb. B.

C1: Load value (N): O = 50 Ohm, 1 = high resist (open).

C2: **Amplitude Range:**

Load = 50 Ohm: Ranges:	0 : 200	mV
	1 : 500	mV
	2 : 1	V
	3 : 2	V
	4 : 5	V
	5 : 10	V
	6 : 16	V
Load = open: Range:	0 : 500	mV
	1 : 1	V
	2 : 2	V
	3 : 5	V
	4 : 10	V
	5 : 20	V
	6 : 32	V

C3: Level value consists of sign, value and unit. No sign will mean positive assigned. Value must be within range selected. If hardware unable to resolve value, then last digit will be rounded to enable resolving. Units can be, mV or V.

C4: Disable = 0, Enable = 1.

C5: Normal = 0, Complement = 1.

Arb. related Commands of the DATA Page

Description/Requirement	COMMAND DETAILS: mnem	data	Unit	Comments ref.
Data Page **Format** Allocation menu	DM	0	-	
Data Page **Pattern** Setup menu	DM	1	-	
Data Page **Waveform** Setup menu	DM	2	-	
Used Format Allocation	CFM	"name"	-	C1
Pattern/Level Data	CHAD	CHN, base, label, values, trigger		C2

Comments:

Calculator:
The calculator cannot be remotely activated or controlled. If the calculator is active and an HP-IB command is sent, the effect depends on the Calculator status.

Status: Calculating
The calculation will be continued until completed and then Data Page menu 0 ([Format] Allocation) will be accessed.

VERY IMPORTANT POINT:
Status: Editing:
The Calculator module(s) will be destroyed!
Then the Data Page menu 0 ([Format] Allocation) will be accessed.

For any other Status:
Data Page menu 0 ([Format] Allocation) will be accessed.

C1: CHN = Arb. channel, 0 = Arb. A, 1 = Arb. B.

Name:

(DUAL) : both Arbs. and both triggers
(ARB A) : Arb. A and trigger A
(ARB B) : Arb. B and trigger B
(TRG A) : trigger A
(TRG B) : trigger B

C2: **Base:**

0 : abs. level
1 : rel. level
2 : binary (10 sig. digits)
3 : octal (4 sig. digits)
4 : decimal (4 sig. digits)
5 : hex (3 sig. digits)

For base = 0/1:
Value consists of sign, value and unit. No sign will mean positive assigned. The value must be within range actually selected. If, the hardware unable to resolve value, the last siginificant digit will be rounded. Unit can be mV and V.

For base = 2/3/4/5:
See comments in brackets given for base types above.

QUERY MESSAGES

These commands are a subset of "HP Common Instrument Capabilities"

Description/Requirement	COMMAND DETAILS: mnem	data	Unit	Comments ref.
Returns Level Upper Peak Arb. A	UPA?	-	-	C1
Returns Level Lower Peak Arb. A	LPA?	-	-	C1
Returns Level Upper Peak Arb. B	UPB?	-	-	C1
Returns Level Lower Peak Arb. B	LPB?	-	-	C1
Returns Level Upper Limit Arb. A	ULA?	-	-	C2
Returns Level Lower Limit Arb. A	LLA?	-	-	C2
Returns Level Upper Limit Arb. B	ULB?	-	-	C2
Returns Level Lower Limit Arb. B	LLB?	-	-	C2
Returns Offset Limit Arb. A	OLA?	-	-	C3
Returns Offset Limit Arb. B	OLB?	-	-	C3

Comments:

C1: Format returned to controller is of form: "+/-xx.xxxxV"

C2: The format returned to the controller depends on the base actually selected:

Base:

0 : abs. level
1 : rel. level
2 : binary (10 sig. digits)
3 : octal (4 sig. digits)
4 : decimal (4 sig. digits)
5 : hex (3 sig. digits)

Base = 0/1
Value consists of sign, value and unit. No sign means positive one. Units is V.

Base = 2:
xxxxxxxxxxB

Base = 3:
xxxx0

Base = 4:
xxxxD

Base = 5:
xxxH

C3: The format returned to the controller will be as follows: "+/-xx.xxxxV".

LEARN STRING COMMANDS

Description/Requirement	COMMAND DETAILS: mnem	data	Unit	Comments ref.
Return Calculator module to Controller	CLC?	0	-	C1
Accept Calculator module from Controller	CLC	0	-	C1

Comments:

A point to be noted when using any learn string commands is that, 10240 bytes are allocated for internal storage of complete hardware and software data and settings etc. A total of 795 bytes are separately allocated for the Calculator. For both cases, an additional 4 bytes are required for string identification and length etc.

C1 Note that Calculator modules can only be returned to/accepted from the "actual" location (0).

CHAPTER 4

PERFORMANCE TEST

FOR OPTION 002

4-1 INTRODUCTION

4-2 The test procedures given here are for testing the electrical performance of only option 002 (Dual Arbitrary Waveform Generator) of the HP 8175A using the instrument specifications of Table 1-2 as performance standards. Test procedures for the standard 8175A are given in the standard Operating and Programming manual. Access to the interior of the instrument is not necessary for any of the following tests.

4-3 EQUIPMENT REQUIRED

4-4 Equipment necessary for performance testing is listed in Table 1-1, Recommended Test Equipment. Alternative test equipment may be substituted for recommended models, provided that it satisfies the critical specification given in the table.

4-5 TEST RECORD

4-6 A tabulated Test Record listing all of the tested specifications and their acceptable limits is provided at the end of the procedures. Test results recorded at incoming inspection will provide a reference for periodic calibration, troubleshooting and after-repair testing.

4-7 PERFORMANCE TEST

4-8 During any performance test, all shields and connecting hardware must be in place. All tests are designed to verify the published specifications. It is recommended that tests be performed in the sequence given, and that all data be recorded on the test record provided at the end of the test procedures.

4-9 Each test is arranged in the order that its specification appears in Table 1-2. Note that the instrument should be given a 30 minute warm-up period before the commencement of any of the following test.

Note:

1. The following tests start at 4-22 since the last test for the standard 8175A is 4-21.

2. For many of the following tests screen display figures of the 8175A are shown to illustrate the settings to be made. Ensure that in such cases, your 8175A settings are identical to these of the screen displays given.

4-22 OUTPUT AMPLITUDE AND OFFSET

Specifications:

Number of outputs: 2
(Output A and Output B on front panel, can be separately disabled)

Number of bits: 10

Number of data points:

Horizontal: 1024 points

Vertical: 1000 points with additional 24 points override except for:
800 points for 16 V P-P Output Voltage.
640 points for 32 V P-P Output Voltage.

Differential Non-Linearity: =< 1 LSB (monotonic)

Output Impedance: 50 Ohm +/- 5%

Output levels, see following tables for Output Voltage and Offset values.

P-P Output Voltage (Peak to Peak Output Voltage) is the output level with offset = 0. Level window defines the maximum output signal range for the sum of Offset and P-P Output Voltage.

Table 4-1.

Load Impedance: 50 Ohm

Level Window	P-P Output Voltage Range	P-P Output Voltage Res.	Offset Range	Offset Res.
+/- 0.8 V	0.2 V	0.2 mV	+/- 0.8 V	0.5 mV
+/- 0.8 V	0.5 V	0.5 mV	+/- 0.8 V	0.5 mV
+/- 0.8 V	1 V	1 mV	+/- 0.8 V	1 mV
+/- 8 V	2 V	2 mV	+/- 8 V	5 mV
+/- 8 V	5 V	5 mV	+/- 8 V	5 mV
+/- 8 V	10 V	10 mV	+/- 8 V	10 mV
+/- 8 V	16 V	20 mV	+/- 8 V	20 mV

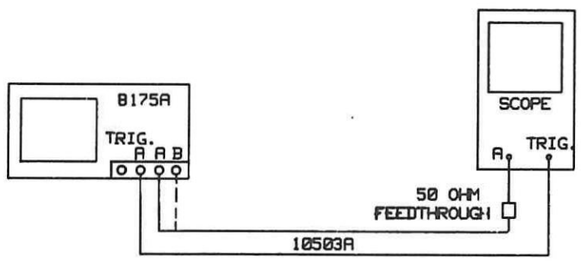
Load Impedance >= 50 kOhm

Level Window	P-P Output Voltage Range	P-P Output Voltage Res.	Offset Range	Offset Res.
+/- 1.6 V	0.5 V	0.5 mV	+/- 1.6 V	0.5 mV
+/- 1.6 V	1 V	1 mV	+/- 1.6 V	1 mV
+/- 1.6 V	2 V	2 mV	+/- 1.6 V	2 mV
+/- 16 V	5 V	5 mV	+/- 16 V	5 mV
+/- 16 V	10 V	10 mV	+/- 16 V	10 mV
+/- 16 V	20 V	20 mV	+/- 16 V	20 mV
+/- 16 V	32 V	50 mV	+/- 16 V	50 mV

Equipment: 8175A OPT 002, DVM, 10503A, 50 Ohm Feedthrough (+/- 1%), BNC-Banana

4-22A DATA POINTS

Test Setup:



Procedure:

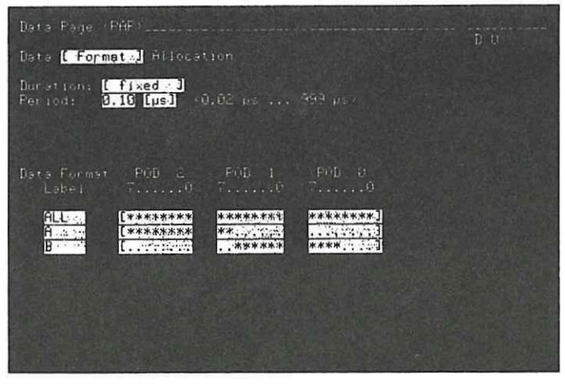
Note:

Where display details are given, ensure that all settings on your 8175A, are as shown.

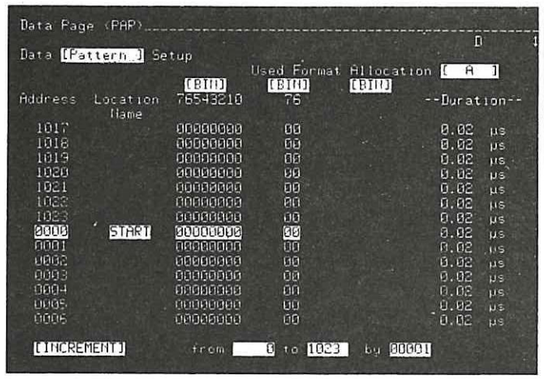
8175A: Recall Standard Settings

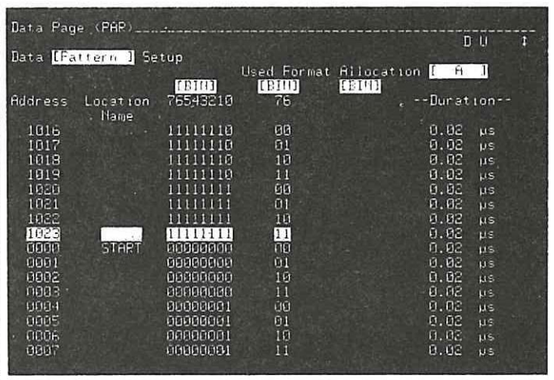
SYSTEM > NEXT = [Storage] > CURSOR↓ = [STORE] > NEXT = [recall] Standard Settings > EXEC

Set up configurations A and B (in Parallel Configuration) as shown below:



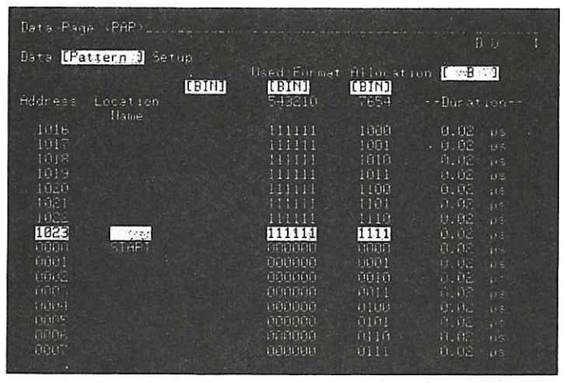
Set up data, using INCREMENT, as shown (blue > PRGM = Function).





A INCREMENT in steps of 1: Before EXEC After EXEC

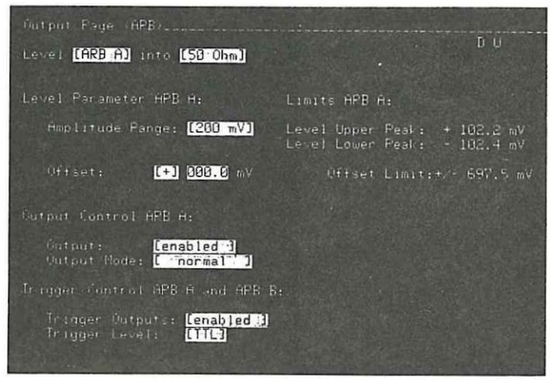
Repeat same procedure (setting up data) for Used Format Allocation [B] to produce following display:

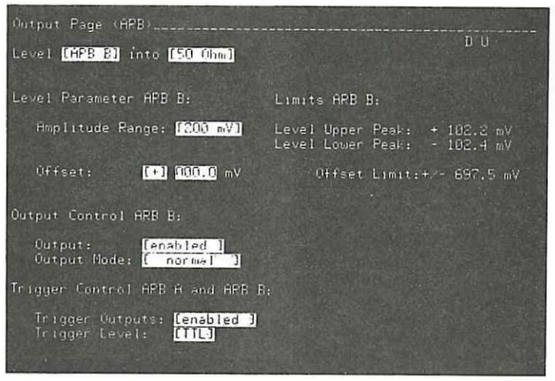


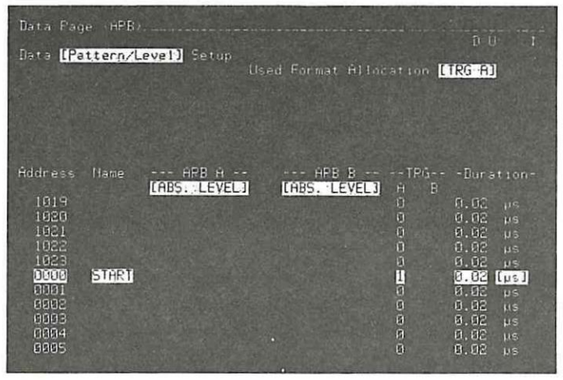
B INCREMENT in steps of 1: After EXEC

SYSTEM > CURSOR↓ = Arbitrary-Generator (ARB) >
CNTRL > CURSOR↓ = [Single Cycle] > NEXT = [Auto Cycle]

Set the following menus to read as shown:

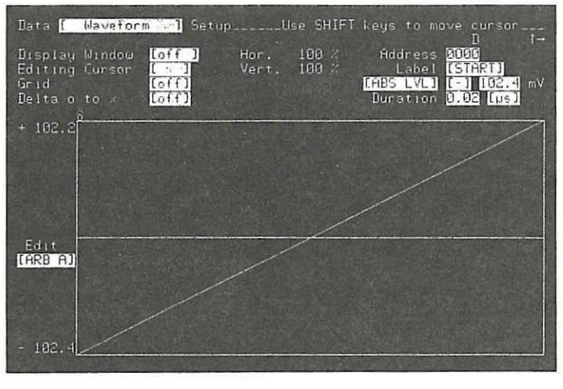






Trigger Setup

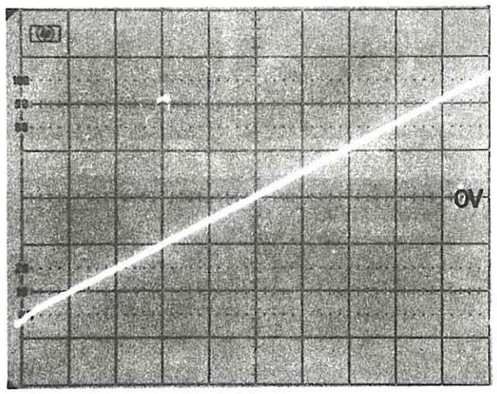
Press: blue > EXEC = UPDATE > START



Waveform Page after EXEC

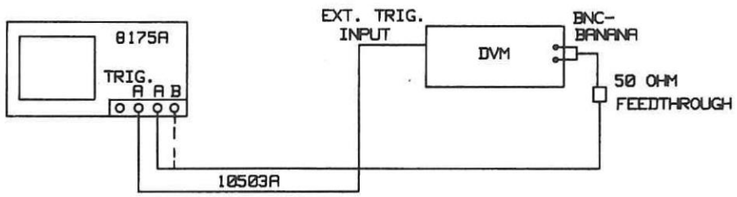
1. Measure with scope connected to Output A or B for a linearly increasing signal as shown below

   Trigger: Ext.
   Scope settings:
   Time/Div 10 us
   Volts/Div 0.05



4-22B AMPLITUDE/OFFSET

Test Setup



Procedure:

8175A:

On Data Page (ARB) Data [Format]Allocation change Period to 2[ms]

For addresses 0 to 511 and 512 to 1023, use MODIFY to set up the two level values as shown:

```
Data Page (ARB)                                                    D U   I
Data [Pattern,Level] Setup
                                   Used Format Allocation [DUAL ]

ARB A: Amplitude Range:   [200 mV]    Upper Limit: + 102.2 mV
                                      Lower Limit: - 102.4 mV
ARB B: Amplitude Range:   [200 mV]    Upper Limit: + 102.2 mV
                                      Lower Limit: - 102.4 mV

Address  Name    --- ARB A --      --- ARB B --    --TRG--  -Duration-
                 [ABS. LEVEL]      [ABS. LEVEL]    A   B
  0059           -  90.6 mV        -  90.6 mV      0   0    2.0  ms
  0060           -  90.4 mV        -  90.4 mV      0   0    2.0  ms
  0061           -  90.2 mV        -  90.2 mV      0   0    2.0  ms
  0062           -  90.0 mV        -  90.0 mV      0   0    2.0  ms
  0063           -  89.8 mV        -  89.8 mV      0   0    2.0  ms
  0064           [-] 089.6 mV      [-] 089.6 mV    0   0    2.0  ms
  0065           -  89.4 mV        -  89.4 mV      0   0    2.0  ms

       MODIFY    [+] 100.0 mV      [+] 100.0 mV    1   1

                 from Address    0 to 511
```

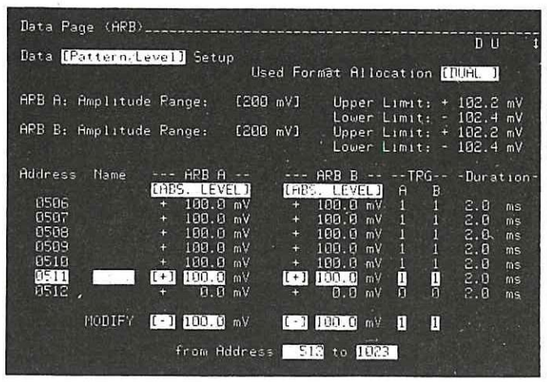
MODIFY before EXEC

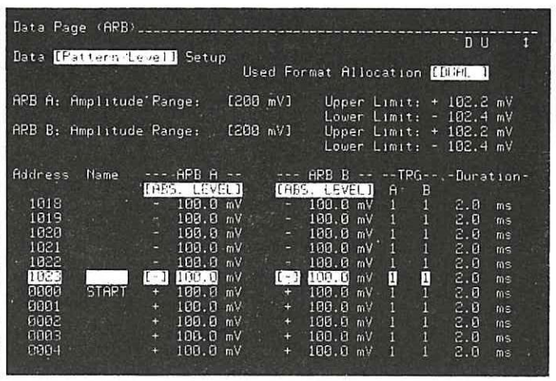
```
Data Page (ARB)                                                    D U   I
Data [Pattern,Level] Setup
                                   Used Format Allocation [DUAL ]

ARB A: Amplitude Range:   [200 mV]    Upper Limit: + 102.2 mV
                                      Lower Limit: - 102.4 mV
ARB B: Amplitude Range:   [200 mV]    Upper Limit: + 102.2 mV
                                      Lower Limit: - 102.4 mV

Address  Name    --- ARB A --      --- ARB B --    --TPG--  -Duration-
                 [ABS. LEVEL]      [ABS. LEVEL]    A   B
  0506           +  100.0 mV       +  100.0 mV     1   1    2.0  ms
  0507           +  100.0 mV       +  100.0 mV     1   1    2.0  ms
  0508           +  100.0 mV       +  100.0 mV     1   1    2.0  ms
  0509           +  100.0 mV       +  100.0 mV     1   1    2.0  ms
  0510           +  100.0 mV       +  100.0 mV     1   1    2.0  ms
  0511           [+] 100.0 mV      [+] 100.0 mV    1   1    2.0  ms
  0512           +    0.0 mV       +    0.0 mV     0   0    2.0  ms
  0513           +    0.2 mV       +    0.2 mV     0   0    2.0  ms
  0514           +    0.4 mV       +    0.4 mV     0   0    2.0  ms
  0515           +    0.6 mV       +    0.6 mV     0   0    2.0  ms
  0516           +    0.8 mV       +    0.8 mV     0   0    2.0  ms
```

After EXEC





MODIFY before EXEC After EXEC

At Addresses 0000 and 0512 only, change [TRG A] to 0.

UPDATE > START

On Output Pages [ARB A]/[ARB B] ensure that the Offset is set to 0.000V.

AMPLITUDE measurements:

Set DVM: VDC, Auto Range off, Trigger ext

1. With 8175A connected as shown in Test Setup, measure the output by summing the DVM readings as follows: e.g.

pos. measured value		neg. measured value	
(+) 100 mV	+	(-) 100 mV	= 200 mV

   On Output Page [ARB A]: change the Amplitude Ranges via NEXT[] key from 200 mV to 10V in normal/complement mode and measure the Amplitude values according to the following table:

   Table 4-2.

Amplitude Range	ABS LEVEL	Amplitude Low Limit	Amplitude High Limit
200 mV	+/- 100 mV	191.2 mV	208.8 mV
500 mV	+/- 250 mV	478 mV	522 mV
1 V	+/- 500 mV	956 mV	1.044 V
2 V	+/- 1 V	1.912 V	2.088 V
5 V	+/- 2.5 V	4.780 V	5.220 V
10 V	+/- 5 V	9.560 V	10.440 V

2. Disconnect the 50 Ohm Feedthrough and change on Output Page:

   Level [ARB A] into [open]

   Change Amplitude Ranges and measure the Amplitude values according to the following table:

   Table 4-3.

Amplitude Range	ABS LEVEL	Amplitude Low limit	Amplitude High limit
500 mV	+/- 250 mV	478 mV	522 mV
1 V	+/- 500 mV	956 mV	1044 mV
2 V	+/- 1 V	1.912 V	2.088 V
5 V	+/- 2.5 V	4.780 V	5.220 V
10 V	+/- 5 V	9.560 V	10.440 V
20 V	+/- 10 V	19.120 V	20.880 V

3. Repeat steps 1 and 2 for Output B.

4. In same way as for procedure at 4-22B, use MODIFY to set up the following level values:

   + 8V for Address 0 - 511
   - 8V for Address 512 - 1023

   On Output Page [ARB B], change the load to [50 Ohm] and the Amplitude Range to [16V].
   With 50 Ohm Feedthrough connected measure for

Ampl. Range	Abs. Level	Amplitude Low Limit	Amplitude High Limit
16V	+/- 8V	15.280V	16.720V

   Make the same load and Amplitude Range changes for [ARB A] and measure the Amplitude.

5. Change the load to: into [open].
   Amplitude Range to [32V].
   Use MODIFY on Data [Pattern/Level] Setup Page (as for step 4 previousley) to set the following levels:

   +16V for Address 0-511
   -16V for Address 512-1023

   Disconnect the 50 Ohm Feedthrough and measure the Amplitude:

Ampl. Range	Abs. Level	DVM Reading Low Limit	DVM Reading High Limit
32V	+/-16V	30.52V	33.48V

   Make the same load and Amplitude Range changes for [ARB B] and measure the Amplitude.

OFFSET measurements:

6. On Data [Pattern/Level] Setup Page, for both Output channels [DUAL] MODIFY the levels to 0.00V from Address 0-1023.

   Reconnect the 50 Ohm Feedthrough to Output A.

7. On Output Page (ARB):
   Change level [ARB A] into [50 Ohm].

   Change Amplitude Range to: [1V].

   Set Offset to +799 mV.
   DVM Reading +799 mV +/- 18 mV.

   Use Roll↑ as VERNIER to change the Offset to + 800 mV
   DVM Reading + 800 mV +/- 18 mV.

8. Change Amplitude Range to [500 mV] / [200 mV]
   DVM Reading + 800 mV +/- 18 mV
   Repeat for Amplitude Range = [200 mV]

   Change Offset to +799,5 mV
   DVM Reading +799,5 mV +/- 18 mV.

9. Repeat steps 7 and 8 for a neg. Offset (-800 mV).

10. Repeat steps 6 to 9 for OUTPUT B [ARB B].

11. Change Amplitude Range to: [2V] / [5V]
    Set Offset to - 7.995 V
    DVM Reading - 7.995 V +/- 105 mV
    Repeat for Amplitude Range = [5 V]

    With Roll↑ as VERNIER change the Offset to -8.00V
    DVM Reading - 8.000V +/- 105 mV.

12. Amplitude Range change to: [10V]
    DVM Reading - 8.00V +/- 130 mV

    Change Offset to -7.99V
    DVM Reading - 7.99V +/- 130 mV.

13. Change to Amplitude Range: [16V]
    DVM Reading - 8.00 V +/- 130 mV

    Change Offset to -7.98V
    DVM Reading -7.98V +/- 129.8 mV.

14. Repeat steps 11 to 13 for a pos. Offset (+8V).

15. Repeat steps 11 to 14 for OUTPUT A [ARB A].

16. Disconnect the 50 Ohm Feedthrough.
Change Level [ARB A] into [open].
Change Amplitude Range and Offset as shown in table below.

Measure against given Accuracy.

Table 4-4.

Ampl. Range	Offset	DVM Reading
500 mV	+/- 1.6 V	+/- 1.600 V +/- 36 mV
1 V	+/- 1.6 V	+/- 1.600 V +/- 36 mV
2 V	+/- 1.6 V	+/- 1.600 V +/- 36 mV
5 V	+/- 16 V	+/- 16.000 V +/- 210 mV
10 V	+/- 16 V	+/- 16.000 V +/- 210 mV
20 V	+/- 16 V	+/- 16.000 V +/- 260 mV
32 V	+/- 16 V	+/- 16.000 V +/- 260 mV

17. Repeat step 16 for OUTPUT B [ARB B].

4-23 OUTPUT TIMING

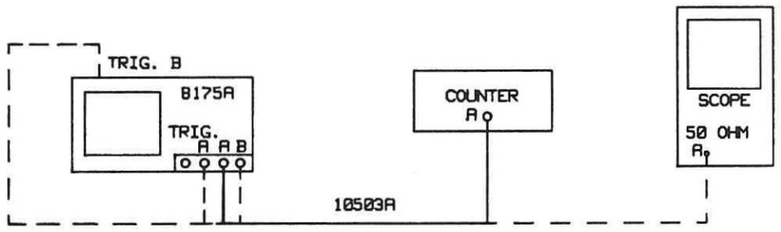
4-23A DATA POINT DURATION OUTPUT A/OUTPUT B WITH INTERNAL CLOCK

Specification:

Range	Resolution	Accuracy
20 ns - 9.99 us	10 ns	± 0.05% of prog. duration ± 2.5 ns (asynchron startable)
10 us - 999 us	1 us	
1 ms - 99.9 ms	100 us	
100 ms - 9.99 s	10 ms	± 0.5% of prog. duration ± 2.5 ns (synchr. startable, Clock Calibration)
		± 3% of prog. duration ± 2.5 ns (synchr. startable, no Clock calibration)

Equipment: 8175A Opt. 002, Counter, Time Mark Generator, Oscilloscope

Test Setup:



Procedure:

8175A: Recall Standard Settings

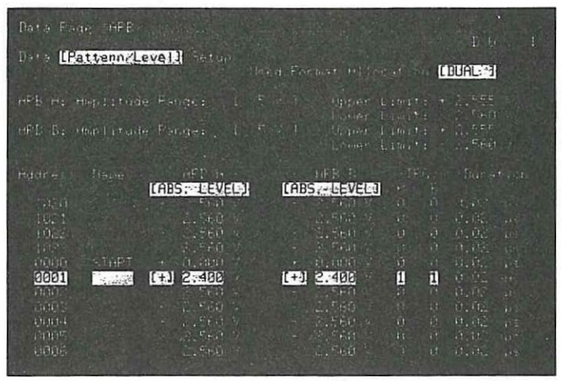
SYSTEM > NEXT = [Storage] > CURSOR↓ = [store] > NEXT = [recall] Standard Settings > EXEC

SYSTEM > NEXT = [Configuration] > CURSOR↓ = Arbitrary-Generator (ARB)

CNTRL = [Clock] > CURSOR↓ = Mode [Single Cycle] > NEXT = [Auto-Cycle]

On OUTPUT Page (ARB) level [ARB A] and [ARB B] Amplitude Range change to: [5V].

Change Outputs and Trigger Outputs to [enabled].



Data Page Set up

On Program Page (ARB) [Module] Assignment change the "to" Label or Address 1023 to 1.

`blue > EXEC = UPDATE > START`

Counter settings:

Trigger Level A and B 1.2V	Gate Mode Min
Time A --> B	Channel A⨍ and B\, Z=50 Ohm, COM A
Auto Trigger OFF	Statistics Mean

1. Using the time mark generator, check the oscilloscope time base accuracy in the 0.05 usec/Div x 10 Range. Note error and take timebase error into account.
   Connect Output A to oscilloscope and check for 20 ns.
   Connect Output A to the A input of counter.
   Program counter time offset so that 20.0 ns duration (+/- noted error) is displayed.
   E.G. OFFSET > (CHS) > x.x > EEX > CHS > 9 > ENTER.

2. Measure Data Point Duration of Output A and Output B in Mode:
   [Auto-Cycle] [asynchron] startable against Table 4-5.

   Set 8175A:
   Data Page (ARB)
   Data [Format] Allocation

   After each new Period Setting press `STOP > UPDATE > START`

   Table 4-5.

Period	Counter Reading low limit	high limit
0.10 us	97.455 ns	102.55 ns
1 us	997.0 ns	1.003 ns
9.00 us	8.9925us	9.0075 us
100 us	99.95 us	100.05 us
900 us	899.55 us	900.45 us
10 ms	9.995 ms	10.005 ms
1 s	999.5 ms	1.0005 s

3. Same test setup as before.
   Measure Data Point Duration in Mode:
   [Auto-Cycle] [synchron] startable. (See Table 4-6).
   Set 8175A:
   `CNTRL > CURSOR→ 2x > NEXT` = [Auto-Cycle] [synchron] startable > `DATA` = Period

Set 8175A:
CNTRL > CURSOR→ 2x > NEXT = [Auto-Cycle] [synchron] startable > DATA = Period

After each new Period Setting press STOP > UPDATE > START

Table 4-6.

Period	Counter Reading low limit	high limit
0.10 us	94.5 ns	105.50 ns
1 us	967.5 ns	1.0325 ns
9.00 us	8.9525ns	9.0475 us
100 us	97 us	103 us
900 us	895.5 us	904.5 us
10 ms	9.7 ms	10.3 us
1 s	970 ms	1.03 s

4. Same test setup as before.
Measure Data Point Duration in Mode:
[Auto-Cycle] [synchron] startable with [Clock Calibration). (See Table 4-7).
Set 8175A:
CNTRL = [Auto-Cycle] [synchron] startable >
DATA = Period > 0.1 (after the first Period setting) > STOP > UPDATE >
CNTRL > CURSOR→ > [Clock calibration] > EXEC > START

After each new Period Setting press STOP > UPDATE > START

Table 4-7.

Period	Counter Reading low limit	high limit
0.10 us	97.0 ns	103.0 ns
1 us	992.5 ns	1.0075us
9.00 us	8.7275us	9.2725us
100 us	99.5 us	100.5 us
900 us	873 us	927 us
10 ms	9.95 ms	10.05 ms
1 s	995 ms	1.005 s

5. Repeat steps 1 to 4 for OUTPUT B.

4-23B TRIGGER PULSE WIDTH WITH INTERNAL CLOCK

Specification:
Same as for Data Point Duration

Equipment:
Same as for Data Point Duration

Test setup:
Same as for Data Point Duration

Procedure:
Measure Trigger A and Trigger B in the same way as for steps 1 to 4 of Data Point Duration.

4-24 TRIGGER OUTPUT CHARACTERISTICS

Specifications:

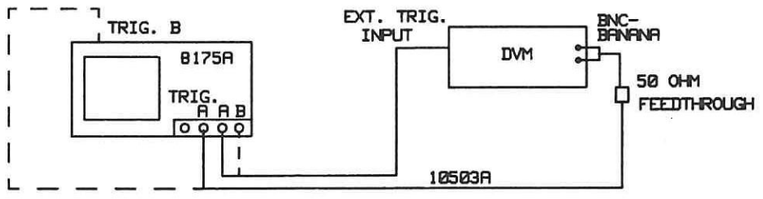
Number of Outputs: 2 (Trigger Output A at Front Panel and Trigger Output B at Rear Panel)

Trigger Output Levels:

TTL	Load impedance 50 Ohm	> = 50 KOhm
Low Level	< = 0.3V	< = 0.2V
High Level	> = 2.4V	> = 4.8V
ECL		
Low Level	< -1.6V	not specified
High Level	> -0.9V	

Equipment: 8175A Opt. 002, BNC Cable 10503A, 50 Ohm Feedthrough, Oscilloscope

Test Setup:



Procedure:

8175A: Recall Standard Settings

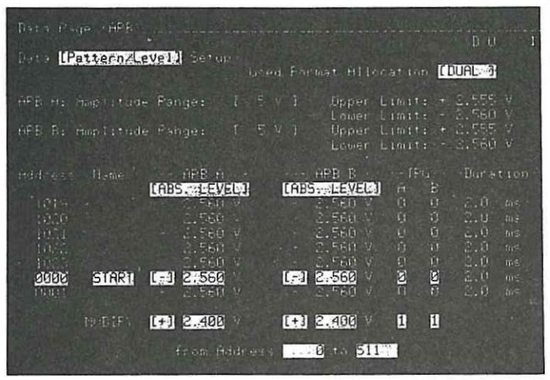
SYSTEM > NEXT = [Storage] > CURSOR↓ = [store] > NEXT = [recall] Standard Settings > EXEC

SYSTEM > NEXT = [Configuration] > CURSOR↓ = Arbitrary-Generator (ARB)

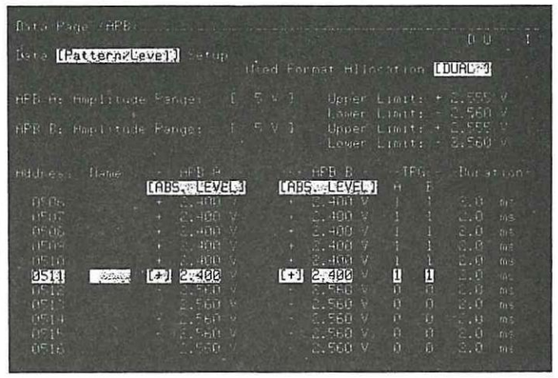
CNTRL = [Clock] > CURSOR↓ = Mode [Single Cycle] > NEXT = [Auto-Cycle]

On Data Page (ARB) Data [Format] Allocation change Period to: 2 [ms]

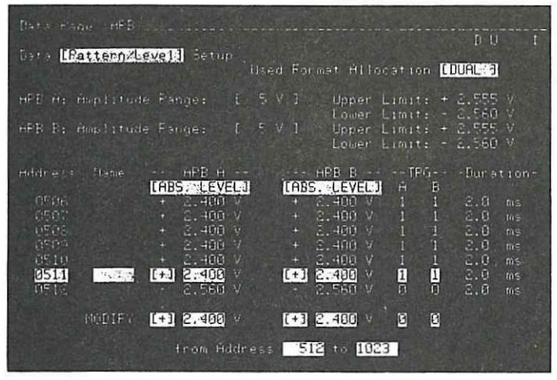
For Addresses 0 to 511 and 512 to 1023, use MODIFY as shown to set up the following two level values:



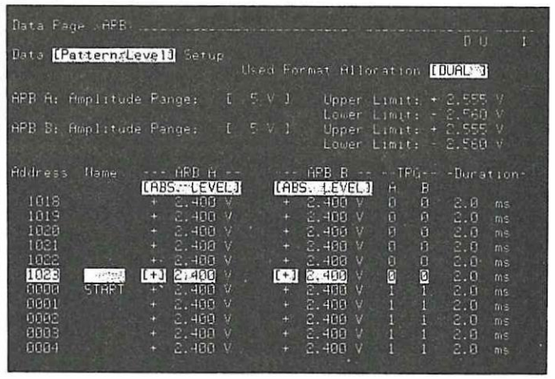
MODIFY before EXEC



After EXEC



MODIFY before EXEC



After EXEC

Change ARB A [ABS LEVEL] at Address 0000 and 0512 to 0.000V.

UPDATE > START

Using test setup:

1. Connect either the Trigger Output A or B to the DVM and measure the Trigger signal against the Table below.

   Trigger Level ECL

Low Level	< = -1.6V
High Level	> = -0.9V

   Trigger Level TTL

Low Level	< = 0.3V
High Level	> = 2.4V

2. Connect the trigger outputs without the 50 Ohm Feedthrough to the DVM and measure the signals.

   TTL

Low Level	< = 0.2V
High Level	> = 4.8V

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	Actual Reading corrected	High Limit
4-22	**OUTPUT AMPLITUDE AND OFFSET**				
4-22A	**DATA POINTS**				
	Output A		Y/N	Y/N	
	Output B		Y/N	Y/N	
4-22B	**AMPLITUDE NORM**				
Step 1	Amplitude into 50 Ohm OUTPUT A				
	200 mV	191.2 mV			208.8 mV
	500 mV	478 mV			522 mV
	1 V	956 mV			1.044 V
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
Step 3	OUTPUT B				
	200 mV	191.2 mV			208.8 mV
	500 mV	478 mV			522 mV
	1 V	956 mV			1.044 V
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
Step 2	Amplitude into open OUTPUT A				
	500 mV	478 mV			522 mV
	1 V	956 mV			1044 mV
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
	20 V	19.12			20.88 V
Step 3	OUTPUT B				
	500 mV	478 mV			522 mV
	1 V	956 mV			1044 mV
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
	20 V	19.12 V			20.88 V

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	corrected	High Limit
	AMPLITUDE COMPLEMENT				
Step 1	Amplitude into 50 Ohm OUTPUT A				
	200 mV	191,2 mV			208.8 mV
	500 mV	478 mV			522 mV
	1 V	956 mV			1.044 V
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
Step 3	OUTPUT B				
	200 mV	191.2 mV			208.8 mV
	500 mV	478 mV			522 mV
	1 V	956 mV			1.044 V
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
Step 2	Amplitude into open OUTPUT A				
	500 mV	478 mV			522 mV
	1 V	956 mV			1044 mV
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
	20 V	19.12 V			20.88 V
Step 3	OUTPUT B				
	500 mV	478 mV			522 mV
	1 V	956 mV			1044 mV
	2 V	1.912 V			2.088 V
	5 V	4.780 V			5.220 V
	10 V	9.560 V			10.44 V
	20 V	19.12 V			20.88 V

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	corrected	High Limit
	AMPLITUDE/NORM				
Step 4	Amplitude into 50 Ohm				
	OUTPUT A				
	16 V	15.28 V			16.72 V
	OUTPUT B				
	16 V	15.28 V			16.72 V
Step 5	Amplitude into open				
	OUTPUT A				
	32 V	30.52 V			33.48 V
	OUTPUT B				
	32 V	30.52 V			33.48 V
	AMPLITUDE/COMPLEMENT				
Step 4	Amplitude into 50 Ohm				
	OUTPUT A				
	16 V	15.28 V			16.72 V
	OUTPUT B				
	16 V	15.28 V			16.72 V
Step 5	Amplitude into open				
	OUTPUT A				
	32 V	30.52 V			33.48 V
	OUTPUT B				
	32 V	30.52 V			33.48 V

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	corrected	High Limit
4-22B	**OFFSET**				
Step 6	OUTPUT A into 50 Ohm				
Step 7	[1V] +799.0 mV	+781.0 mV			+817.0 mV
	+800.0 mV	+782.0 mV			+818.0 mV
Step 8	[500mV] +800.0 mV	+782.0 mV			+818.0 mV
	+799.5 mV	+781.5 mV			+817.5 mV
	[200mV] +799.5 mV	+781.5 mV			+817.5 mV
	+800.0 mV	+782.0 mV			+818.0 mV
Step 9	[200mV] -800.0 mV	+782.0 mV			-818.0 mV
	-799.5 mV	+781.5 mV			-817.5 mV
	[500mV] -799.5 mV	-781.5 mV			-817.5 mV
	-800.0 mV	-782.0 mV			-818.0 mV
	[1V] -800.0 mV	-782.0 mV			-818.0 mV
	-799.0 mV	-781.0 mV			-817.0 mV
Step 10	OUTPUT B into 50 Ohm				
Step 7	[1V] +799.0 mV	+781.0 mV			+817.0 mV
	+800.0 mV	+782.0 mV			+818.0 mV
Step 8	[500mV] +800.0 mV	+782.0 mV			+818.0 mV
	+799.5 mV	+781.5 mV			+817.5 mV
	[200mV] +799.5 mV	+781.5 mV			+817.5 mV
	+800.0 mV	+782.0 mV			+818.0 mV
Step 9	[200mV] -800.0 mV	+782.0 mV			-818.0 mV
	-799.5 mV	+781.5 mV			-817.5 mV
	[500mV] -799.5 mV	-781.5 mV			-817.5 mV
	-800.0 mV	-782.0 mV			-818.0 mV
	[1V] -800.0 mV	-782.0 mV			-818.0 mV
	-799.0 mV	-781.0 mV			-817.0 mV

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title		Low Limit	Actual Reading measured	corrected	High Limit
	OUTPUT B into 50 Ohm					
Step 11	[2V]	-7.995 V	-7.890 V			-8.100 V
		-8.000 V	-7.895 V			-8.105 V
	[5V]	-8.000 V	-7.895 V			-8.105 V
		-7.995 V	-7.890 V			-8.100 V
Step 12	[10V]	-8.00 V	-7.870 V			-8.130 V
		-7.99 V	-7.860 V			-8.120 V
Step 13	[16V]	-8.00 V	-7.870 V			-8.130 V
		-7.98 V	-7.850 V			-8.110 V
Step 14	[16V]	+7.98 V	+7.850 V			+8.110 V
		+8.00 V	+7.870 V			+8.130 V
	[10V]	+8.00 V	+7.870 V			+8.130 V
		+7.99 V	+7.860 V			+8.120 V
	[5V]	+7.995 V	+7.850 V			+8.100 V
		+8.000 V	+7.895 V			+8.105 V
	[2V]	+8.000 V	+7.895 V			+8.105 V
		+7.995 V	+7.850 V			+8.100 V

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title		Low Limit	Actual Reading measured	corrected	High Limit	
	OUTPUT A into 50 Ohm						
Step 11	[2V]	-7.995 V	-7.890 V			-8.100	V
		-8.000 V	-7.895 V			-8.105	V
	[5V]	-8.000 V	-7.895 V			-8.105	V
		-7.995 V	-7.890 V			-8.100	V
Step 12	[10V]	-8.00 V	-7.870 V			-8.130	V
		-7.99 V	-7.860 V			-8.120	V
Step 13	[16V]	-8.00 V	-7.870 V			-8.130	V
		-7.98 V	-7.850 V			-8.110	V
Step 14	[16V]	+7.98 V	+7.850 V			+8.110	V
		+8.00 V	+7.870 V			+8.130	V
	[10V]	+8.00 V	+7.870 V			+8.130	V
		+7.99 V	+7.860 V			+8.120	V
	[5V]	+7.995 V	+7.850 V			+8.100	V
		+8.000 V	+7.895 V			+8.105	V
	[2V]	+8.000 V	+7.895 V			+8.105	V
		+7.995 V	+7.850 V			+8.100	V

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	Actual Reading corrected	High Limit
Step 16	OUTPUT A into open				
	[500mV] +1.6 V	+1.564 V			+1.636 V
	-1.6 V	-1.564 V			-1.636 V
	[1V] -1.6 V	-1.564 V			-1.636 V
	+1.6 V	+1.564 V			+1.636 V
	[2V] +1.6 V	+1.564 V			+1.636 V
	-1.6 V	-1.564 V			-1.636 V
	[5V] -16 V	-15.790 V			-16.210 V
	+16 V	+15.790 V			+16.210 V
	[10V] +16 V	+15.790 V			+16.210 V
	-16 V	-15.790 V			-16.210 V
	[20V] -16 V	-15.740 V			-16.260 V
	+16 V	+15.740 V			+16.260 V
	[32V] +16 V	+15.740 V			+16.260 V
	-16 V	-15.740 V			-16.260 V
Step 17	OUTPUT B into open				
	[500mV] +1.6 V	+1.564 V			+1.636 V
	-1.6 V	-1.564 V			-1.636 V
	[1V] -1.6 V	-1.564 V			-1.636 V
	+1.6 V	+1.564 V			+1.636 V
	[2V] +1.6 V	+1.564 V			+1.636 V
	-1.6 V	-1.564 V			-1.636 V
	[5V] -16 V	-15.790 V			-16.210 V
	+16 V	+15.790 V			+16.210 V
	[10V] +16 V	+15.790 V			+16.210 V
	-16 V	-15.790 V			-16.210 V
	[20V] -16 V	-15.740 V			-16.260 V
	+16 V	+15.740 V			+16.260 V
	[32V] +16 V	+15.740 V			+16.260 V
	-16 V	-15.740 V			-16.260 V

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	corrected	High Limit
4-23A	**OUTPUT TIMING WITH INTERNAL CLOCK**				
	OUTPUT A				
Step 2	Auto-Cycle asynchron startable				
	Period				
	0.10 us	97.455 ns			102.55 ns
	1.00 us	997.0 ns			1.003 us
	9.00 us	8.9925 us			9.0075 us
	100 us	99.95 us			100.05 us
	900 us	899.55 us			900.45 us
	10.0 ms	9.995 ms			10.005 ms
	1 s	999.5 ms			1.0005 s
Step 3	Auto-cycle synchron startable				
	Period				
	0.10 us	94.5 ns			105.5 ns
	1 us	967.5 ns			1.0325 us
	9.00 us	8.9525 ns			9.0475 us
	100 us	97 us			103 us
	900 us	895.5 us			904.5 us
	10 ms	9.7 ms			10.3 ms
	1 s	970 ms			1.03 s
Step 4	Auto-Cycle synchron startable with Clock Calibration				
	Period				
	0.10 us	97.0 ns			103.0 us
	1 us	992.5 ns			1.0075 us
	9.00 us	8.7275 us			9.7275 us
	100 us	99.5 us			100.5 us
	900 us	873 us			927 us
	10 ms	9.95 ms			10.05 ms
	1 s	995 ms			1.005 s

PERFORMANCE TEST RECORD FOR OPTION 002

Hewlett Packard Model 8175A
Digital Signal Generator
Serial Number

Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	corrected	High Limit
Step 5	OUTPUT B				
Step 2	Auto-Cycle asynchron startable				
	Period				
	0.10 us	97.455 ns			102.55 ns
	1.00 us	997.0 ns			1.003 us
	9.00 us	8.9925 us			9.0075 us
	100 us	99.95 us			100.05 us
	900 us	899.55 us			900.45 us
	10.0 ms	9.995 ms			10.005 ms
	1 s	999.5 ms			1.0005 s
Step 3	Auto-cycle synchron startable				
	Period				
	0.10 us	94.5 ns			105.5 ns
	1 us	967.5 ns			1.0325 us
	9.00 us	8.9525 ns			9.0475 us
	100 us	97 us			103 us
	900 us	895.5 us			904.5 us
	10 ms	9.7 ms			10.3 ms
	1 s	970 ms			1.03 s
Step 4	Auto-Cycle synchron startable with Clock Calibration				
	Period				
	0.10 us	97.0 ns			103.0 us
	1 us	992.5 ns			1.0075 us
	9.00 us	8.7275 us			9.7275 us
	100 us	99.5 us			100.5 us
	900 us	873 us			927 us
	10 ms	9.95 ms			10.05 ms
	1 s	995 ms			1.005 s

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Test Performed By
Date
Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	Actual Reading corrected	High Limit
4-23B	**TRIGGER PULSE WIDTH WITH INTERNAL CLOCK**				
Step 2	TRIGGER A Auto-Cycle asynchron startable				
	Period				
	0.10 us	97.455 ns			102.55 ns
	1.00 us	997.0 ns			1.003 us
	9.00 us	8.9925 us			9.0075 us
	100 us	99.95 us			100.05 us
	900 us	899.55 us			900.45 us
	10.0 ms	9.995 ms			10.005 ms
	1 s	999.5 ms			1.0005 s
Step 3	Auto-Cycle synchron startable				
	Period				
	0.10 us	94.5 ns			105.5 ns
	1 us	967.5 ns			1.0325 us
	9.00 us	8.9525 ns			9.0475 us
	100 us	97 us			103 us
	900 us	895.5 us			904.5 us
	10 ms	9.7 ms			10.3 ms
	1 s	970 ms			1.03 s
Step 4	Auto-Cycle synchron startable with Clock Calibration				
	Period				
	0.10 us	97.0 ns			103.0 ns
	1 us	992.5 ns			1.0075 us
	9.00 us	8.7275 us			9.7275 us
	100 us	99.5 us			100.5 us
	900 us	873 us			927 us
	10 ms	9.95 ms			10.05 ms
	1 s	995 ms			1.005 s

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Reference Temperature

Test Number	Title	Low Limit	Actual Reading measured	corrected	High Limit
Step 5	TRIGGER B Auto-Cycle asynchron startable Period				
	0.10 us	97.455 ns			102.55 ns
	1.00 us	997.0 ns			1.003 us
	9.00 us	8.9925 us			9.0075 us
	100 us	99.95 us			100.05 us
	900 us	899.55 us			900.45 us
	10.0 ms	9.995 ms			10.005 ms
	1 s	999.5 ms			1.0005 s
Step 3	Auto-Cycle synchron startable Period				
	0.10 us	94.5 ns			105.5 ns
	1 us	967.5 ns			1.0325 us
	9.00 us	8.9525 ns			9.0475 us
	100 us	97 us			103 us
	900 us	895.5 us			904.5 us
	10 ms	9.7 ms			10.3 ms
	1 s	970 ms			1.03 s
Step 4	Auto-Cycle synchron startable with Clock Calibration Period				
	0.10 us	97.0 ns			103.0 ns
	1 us	992.5 ns			1.0075 us
	9.00 us	8.7275 us			9.7275 us
	100 us	99.5 us			100.5 us
	900 us	873 us			927 us
	10 ms	9.95 ms			10.05 ms
	1 s	995 ms			1.005 s

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Test Number	Title	Low Limit	Actual Reading measured	corrected	High Limit
4-24	**TRIGGER OUTPUT CHARACTERISTICS**				
Step 1	Trigger A into 50 Ohm				
	ECL				
	Low level <=-1.6V		Y/N	Y/N	
	High Level>=-0.9V		Y/N	Y/N	
	TTL				
	Low level <=0.3V		Y/N	Y/N	
	High levle>=2.4V		Y/N	Y/N	
Step 1	Trigger B into 50 Ohm				
	ECL				
	Low level <=-1.6V		Y/N	Y/N	
	High Level>=-0.9V		Y/N	Y/N	
	TTL				
	Low level <=0.3V		Y/N	Y/N	
	High levle>=2.4V		Y/N	Y/N	
Step 2	Trigger A into open				
	TTL				
	Low level <=0.2V		Y/N	Y/N	
	High level>=4.8V		Y/N	Y/N	
	Trigger B into open				
	TTL				
	Low level <=0.2V		Y/N	Y/N	
	High level>=4.8V		Y/N	Y/N	

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Arranged alphabetically by country

Product Line Sales/Support Key

Key Product Line

- **A** Analytical
- **CM** Components
- **C** Computer Systems
- **E** Electronic Instruments & Measurement Systems
- **M** Medical Products
- **P** Personal Computation Products
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ASIA

Hewlett-Packard Asia Ltd.
47/F, 26 Harbour Rd.,
Wanchai, **HONG KONG**
G.P.O. Box 863, Hong Kong
Tel: 5-8330833
Telex: 76793 HPA HX
Cable: HPASIAL TD

CANADA

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 069-8644

EASTERN EUROPE

Hewlett-Packard Ges.m.b.h.
Lieblgasse 1
P.O.Box 72
A-1222 **VIENNA,** Austria
Tel: (222) 2500-0
Telex: 1 3 4425 HEPA A

NORTHERN EUROPE

Hewlett-Packard S.A.
V. D. Hooplaan 241
P.O.Box 999
NL-118 LN 15 **AMSTELVEEN**
The Netherlands
Tel: 20 5479999
Telex: 18919 hpner

SOUTH EAST EUROPE

Hewlett-Packard S.A.
World Trade Center
110 Avenue Louis-Casai
1215 Cointrin, **GENEVA,** Switzerland
Tel: (022) 98 96 51
Telex: 27225 hpser
Mail Address:
P.O. Box
CH-1217 Meyrin 1
GENEVA
Switzerland

MIDDLE EAST AND CENTRAL AFRICA

Hewlett-Packard S.A.
Middle East/Central
Africa Sales H.Q.
7, rue du Bois-du-Lan
P.O. Box 364
CH-1217 Meyrin 1
GENEVA
Switzerland
Tel: (022) 83 12 12
Telex: 27835 hmea ch
Telefax: (022) 83 15 35

UNITED KINGDOM

Hewlett-Packard Ltd.
Nine Mile Ride
WOKINGHAM
Berkshire, RG113LL
Tel: 0344 773100
Telex: 848805/848814/848912

UNITED STATES OF AMERICA

Customer Information Center
(800) 752-0900
6:00 AM to 5 PM Pacific Time

EASTERN USA

Hewlett-Packard Co.
4 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 948-6370

MIDWESTERN USA

Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800

SOUTHERN USA

Hewlett-Packard Co.
2000 South Park Place
ATLANTA, GA 30339
Tel: (404) 955-1500

WESTERN USA

Hewlett-Packard Co.
5161 Lankershim Blvd.
NORTH HOLLYWOOD, CA 91601
Tel: (818) 505-5600

OTHER INTERNATIONAL AREAS

Hewlett-Packard Co.
Intercontinental Headquarters
3495 Deer Creek Road
PALO ALTO, CA 94304
Tel: (415) 857-1501
Telex: 034-8300
Cable: HEWPACK

ALGERIA

Hewlett-Packard Trading S.A.
Bureau de Liaison Alger
Villa des Lions
9, Hai Galloul
DZ-BORDJ EL BAHRI
Tel: 76 03 36
Telex: 63343 dlion dz

ANGOLA

Telectra Angola LDA
Empresa Técnica de Equipamentos
16 rue Cons. Julio de Vilhema
LUANDA
Tel: 35515,35516
Telex: 3134
E,P

ARGENTINA

Hewlett-Packard Argentina S.A.
Montaneses 2140/50
1428 **BUENOS AIRES**
Tel: 541-11-1441
Telex: 22796 HEW PAC-AR
A,C,E,P
Biotron S.A.C.I.M.e.I.
Av. Paso Colon 221, Piso 9
1399 **BUENOS AIRES**
Tel: 541-333-490,
541-322-587
Telex: 17595 BIONAR
M
Laboratorio Rodriguez
Corswant S.R.L.
Misiones, 1156 - 1876
Bernal, Oeste
BUENOS AIRES
Tel: 252-3958, 252-4991
A
Intermaco S.R.L.
Florida 537/71
Galeria Jardin - Local 28
1005 **BUENOS AIRES**
Tel: 393-4471/1928
Telex. 22796 HEW PAC-AR
P (Calculators)
Argentina Esanco S.R.L.
A/ASCO 2328
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Tel: 541-58-1981, 541-59-2767
Telex: 22796 HEW PAC-AR
A
All Computers S.A.
Montaneses 2140/50 5 Piso
1428 **BUENOS AIRES**
Tel: 781-4030/4039/783-4886
Telex: 18148 Ocme
P

AUSTRALIA

Adelaide, South Australia Office

Hewlett-Packard Australia Ltd.
153 Greenhill Road
PARKSIDE, S.A. 5063
Tel: 61-8-272-5911
Telex: 82536
Cable: HEWPARD Adelaide
A*,C,CM,E,P

Brisbane, Queensland Office

Hewlett-Packard Australia Ltd.
10 Payne Road
THE GAP, Queensland 4061
Tel: 61-7-300-4133
Telex: 42133
Cable: HEWPARD Brisbane
A,C,CM,E,M,P

Canberra, Australia Capital Territory Office

Hewlett-Packard Australia Ltd.
Thynne Street, Fern Hill Park
BRUCE, A.C.T. 2617
P.O. Box 257,
JAMISON, A.C.T. 2614
Tel: 61-62-80-4244
Telex: 62650
Cable: HEWPARD Canberra
C,CM,E,P

Melbourne, Victoria Office

Hewlett-Packard Australia Ltd.
31-41 Joseph Street
P.O. Box 221
BLACKBURN, Victoria 3130
Tel: 61-3-895-2895
Telex: 31-024
Cable: HEWPARD Melbourne
A,C,CM,E,M,P

Perth, Western Australia Office

Hewlett-Packard Australia Ltd.
Herdsman Business Park
CLAREMONT, W.A. 6010
Tel: 61-9-383-2188
Telex: 93859
Cable: HEWPARD Perth
C,CM,E,P

Sydney, New South Wales Office

Hewlett-Packard Australia Ltd.
17-23 Talavera Road
P.O. Box 308
NORTH RYDE, N.S.W. 2113
Tel: 61-2-888-4444
Telex: 21561
Cable: HEWPARD Sydney
A,C,CM,E,M,P

AUSTRIA

Hewlett-Packard Ges.m.b.h.
Verkaufsbuero Graz
Grottenhofstrasse 94
A-8052 **GRAZ**
Tel: 43-316-291-5660
Telex: 312375
C,E

Hewlett-Packard Ges.m.b.h.
Lieblgasse 1
P.O. Box 72
A-1222 **VIENNA**
Tel: 43-222-2500
Telex: 134425 HEPA A
A,C,CM,E,M,P

BAHRAIN

Green Salon
P.O. Box 557
MANAMA
Tel: 255503-250950
Telex: 84419
P

Wael Pharmacy
P.O. Box 648
MANAMA
Tel: 256123
Telex: 8550 WAEL BN
E,M
Zayani Computer Systems
218 Shaik Mubarak Building
Government Avenue
P.O. Box 5918
MANAMA
Tel: 276278
Telex: 9015 plans bn
P

BELGIUM

Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel. (02) 32-2-761-31-11
Telex: 23494 hewpac
A,C,CM,E,M,P

BERMUDA

Applied Computer Technologies
Atlantic House Building
P.O. Box HM 2091
Par-La-Ville Road
HAMILTON 5
Tel: 295-1616
Telex: 380 3589/ACT BA
P

BOLIVIA

Arrellano Ltda
Av. 20 de Octubre #2125
Casilla 1383
LA PAZ
Tel: 368541
M

BRAZIL

Hewlett-Packard do Brasil S.A.
Alameda Rio Negro, 750-I. AND.
ALPHAVILLE
06400 Barueri SP
Tel: (011) 421.1311
Telex: (011) 71351 HPBR BR
Cable: HEWPACK Sao Paulo
CM,E
Hewlett-Packard do Brasil S.A.
Praia de Botafago 228-A-614
6. AND.-CONJ. 601
Edificio Argentina - Ala A
22250 **RIO DE JANEIRO, RJ**
Tel: (02I) 552-6422
Telex: 21905 HPBR BR
Cable: HEWPACK Rio de Janeiro
E
Van Den Cientifica Ltda.
Rua Jose Bonifacio, 458
Todos os Santos
20771 **RIO DE JANEIRO, RJ**
Tel: (021) 593-8223
Telex: 33487 EGLB BR
A
ANAMED I.C.E.I. Ltda.
Rua Vergueiro, 360
04012 **SAO PAULO, SP**
Tel: (011) 572-1106
Telex: 24720 HPBR BR
M
Datatronix Electronica Ltda.
Av. Pacaembu 746-C11
SAO PAULO, SP
Tel: (118) 260111
CM

BRUNEI
Komputer Wisman Sdn Bhd
G6, Chandrawaseh Cmplx,
Jalan Tutong
P.O. Box 1297,
BANDAR SERI BEGAWAN
NEGARA BRUNI DARUSSALAM
Tel: 673-2-2000-70/26711
C,E,P

CAMEROON
Beriac
B. P. 23
DOUALA
Tel: 420153
Telex: 5351
C,P

CANADA
Alberta
Hewlett-Packard (Canada) Ltd.
3030 3rd Avenue N.E.
CALGARY, Alberta T2A 6T7
Tel: (403) 235-3100
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
11120-178th Street
EDMONTON, Alberta T5S 1P2
Tel: (403) 486-6666
A,C,CM,E,M,P

British Columbia
Hewlett-Packard (Canada) Ltd.
10691 Shellbridge Way
RICHMOND,
British Columbia V6X 2W8
Tel: (604) 270-2277
Telex: 610-922-5059
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
121 - 3350 Douglas Street
VICTORIA, British Columbia V8Z 3L1
Tel: (604) 381-6616
C

Manitoba
Hewlett-Packard (Canada) Ltd.
1825 Inkster Blvd.
WINNIPEG, Manitoba R2X 1R3
Tel: (204) 694-2777
A,C,CM,E,M,P*

New Brunswick
Hewlett-Packard (Canada) Ltd.
814 Main Street
MONCTON, New Brunswick E1C 1E6
Tel: (506) 855-2841
C

Nova Scotia
Hewlett-Packard (Canada) Ltd.
Suite 111
900 Windmill Road
DARTMOUTH, Nova Scotia B3B 1P7
Tel: (902) 469-7820
C,CM,E*,M,P*

Ontario
Hewlett-Packard (Canada) Ltd.
3325 N. Service Rd., Unit W03
BURLINGTON, Ontario L7N 3G2
Tel: (416) 335-8644
C,M*

Hewlett-Packard (Canada) Ltd.
552 Newbold Street
LONDON, Ontario N6E 2S5
Tel: (519) 686-9181
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 069-83644
A,C,CM,E,M,P

Hewlett-Packard (Canada) Ltd.
2670 Queensview Dr.
OTTAWA, Ontario K2B 8K1
Tel: (613) 820-6483
A,C,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
3790 Victoria Park Ave.
WILLOWDALE, Ontario M2H 3H7
Tel: (416) 499-2550
C,E

Quebec
Hewlett-Packard (Canada) Ltd.
17500 Trans Canada Highway
South Service Road
KIRKLAND, Quebec H9J 2X8
Tel: (514) 697-4232
Telex: 058-21521
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Hewlett-Packard (Canada) Ltd.
1150 rue Claire Fontaine
QUEBEC CITY, Quebec G1R 5G4
Tel: (418) 648-0726
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Hewlett-Packard (Canada) Ltd.
130 Robin Crescent
SASKATOON, Saskatchewan S7L 6M7
Tel: (306) 242-3702
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CHILE
ASC Ltda.
Austria 2041
SANTIAGO
Tel: 223-5946, 223-6148
Telex: 392-340192 ASC CK
C,P

Jorge Calcagni y Cia
Av. Italia 634 Santiago
Casilla 16475
SANTIAGO 9
Tel: 9-011-562-222-0222
Telex: 392440283 JCYCL CZ
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Metrolab S.A.
Monjitas 454 of. 206
SANTIAGO
Tel: 395752, 398296
Telex: 340866 METLAB CK
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Av. Rodrigo de Araya 1045
Casilla 256-V
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Tel: 225-5044
Telex: 340892 OLYMP
Cable: Olympiachile Santiagochile
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CHINA, People's Republic of
China Hewlett-Packard Co., Ltd.
47/F China Resources Bldg.
26 Harbour Road
HONG KONG
Tel: 5-8330833
Telex: 76793 HPA HX
Cable: HP ASIA LTD
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China Hewlett-Packard Co., Ltd.
P.O. Box 9610, Beijing
4th Floor, 2nd Watch Factory Main
Shuang Yu Shou, Bei San Huan Road
Hai Dian District
BEIJING
Tel: 33-1947 33-7426
Telex: 22601 CTSHP CN
Cable: 1920 Beijing
A,C,CM,E,M,P

China Hewlett-Packard Co., Ltd.
CHP Shanghai Branch
23/F Shanghai Union Building
100 Yan An Rd. East
SHANG-HAI
Tel: 265550
Telex: 33571 CHPSB CN
Cable: 3416 Shanghai
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Instrumentación
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Apartado Aereo 6287
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Telex: 44400 INST CO
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Nefromedicas Ltda.
Calle 123 No. 9B-31
Apartado Aereo 100-958
BOGOTA D.E., 10
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Telex: 43415 HEGAS CO
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Compumundo
Avenida 15 # 107-80
BOGOTA D.E.
Tel: 57-214-4458
Telex: 39645466 MARCO
P

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Calle 29 Norte No. 6A-40
Apartado Aereo 46
CALI
Tel: 9-011-57-3-621888
Telex: 39655650 CUJCL CO
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CONGO
Seric-Congo
B. P. 2105
BRAZZAVILLE
Tel: 815034
Telex: 5262

COSTA RICA
Cientifica Costarricense S.A.
Avenida 2, Calle 5
San Pedro de Montes de Oca
Apartado 10159
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Tel: 9-011-506-243-820
Telex: 3032367 GALGUR CR
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O. Fischel R. Y. Cia. S.A.
Apartados 434-10174
SAN JOSE
Tel: 23-72-44
Telex: 2379
Cable: OFIR
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Telerexa Ltd.
P.O. Box 1152
Valentine House
8 Stassandrou St.
NICOSIA
Tel: 45 628, 62 698
Telex: 5845 tlrx cy
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DENMARK
Hewlett-Packard A/S
Kongevejen 25
DK-3460 **BIRKEROD**
Tel: 45-02-81-6640
Telex: 37409 hpas dk
A,C,CM,E,M,P

Hewlett-Packard A/S
Rolighedsvej 32
DK-8240 **RISSKOV,** Aarhus
Tel: 45-06-17-6000
Telex: 37409 hpas dk
C,E

DOMINICAN REPUBLIC
Microprog S.A.
Juan Tomàs Mejía y Cotes No. 60
Arroyo Hondo
SANTO DOMINGO
Tel: 565-6268
Telex: 4510 ARENTA DR (RCA)
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ECUADOR
CYEDE Cia. Ltda.
Avenida Eloy Alfaro 1749
y Belgica
Casilla 6423 CCI
QUITO
Tel: 9-011-593-2-450975
Telex: 39322548 CYEDE ED
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Medtronics
Valladolid 524 Madrid
P.O. 9171, **QUITO**
Tel: 2-238-951
Telex: 2298 ECUAME ED
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Robles 625
Casilla 3590
QUITO
Tel: 545-250, 545-122
Telex: 2485 HOSPTL ED
Cable: HOSPITALAR-Quito
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Ecuador Overseas Agencies C.A.
Calle 9 de Octubre #818
P.O. Box 1296, Guayaquil
QUITO
Tel: 306022
Telex: 3361 PBCGYE ED
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EGYPT
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P.O. Box 259
ALEXANDRIA
Tel: 802908, 808020, 805302
Telex: 54333
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International Engineering Associates
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Agouza
CAIRO
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CAIRO
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Telex: 20503 SSC UN
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IPESA de El Salvador S.A.
29 Avenida Norte 1223
SAN SALVADOR
Tel: 9-011-503-266-858
Telex: 301 20539 IPESA SAL
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ETHIOPIA
Seric-Ethiopia
P.O. Box 2764
ADDIS ABABA
Tel: 185114
Telex: 21150
C,P

FINLAND
Hewlett-Packard Finland
Field Oy
Niittylanpolku IO
00620 **HELSINKI**
Tel: (90) 757-1011
Telex: 122022 Field SF
CM

Hewlett-Packard Oy
Piispankalliontie 17
02200 **ESPOO**
Tel: (90) 887-21
Telex: 121563 HEWPA SF
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FRANCE
Hewlett-Packard France
Z.I. Mercure B
Rue Berthelot
13763 Les Milles Cedex
AIX-EN-PROVENCE
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Telex: 410770F
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Tel: (98) 41-87-90
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Telex: 692315F
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Hewlett-Packard France
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5, avenue Raymond Chanas
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Tel: (76) 62-57-98
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Rue Fernand. Forest
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29239 **GOUESNOU**
Tel: (98) 41-87-90

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Batiment B4
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Bâtiment Ampère
Rue de la Commune de Paris
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Telex: 550105F
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Telex: 860602F
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Tel: (76) 90-38-40
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Bureau vert du Bois Briand
Cheman de la Garde
- CP 212 212
44085 **NANTES** Cedex
Tel: (40) 50-32-22
Telex: 711085F
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125, Rue du Faubourg Bannier
45000 **ORLÉANS**
Tel: 33-38-62-2031
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Hewlett-Packard France
Zone Industrielle de Courtaboeuf
Avenue des Tropiques
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Telex: 600048F
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Hewlett-Packard France
15, Avenue de L'Amiral-Bruix
75782 **PARIS** Cedex 16
Tel: 33-15-02-1220
Telex: 613663F
C,P*

Hewlett-Packard France
242 Ter, Ave J Mermoz
64000 **PAU**
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Telex: 550365F
C,E*

Hewlett-Packard France
6, Place Sainte Croix
86000 **POITIERS**
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Telex: 792335F
C, E*

Hewlett-Packard France
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Tel: 33-26-88-6919
C, P*

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Parc d'activités de la Poterie
Rue Louis Kerautel-Botmel
35000 **RENNES**
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A*,C,E,M,P*

Hewlett-Packard France
98 Avenue de Bretagne
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Tel: 33-35-63-5766
Telex: 770035F
C,E

Hewlett-Packard France
4, Rue Thomas-Mann
Boite Postale 56
67033 **STRASBOURG** Cedex
Tel: (88) 28-56-46
Telex: 890141F
C,E,M,P*

Hewlett-Packard France
Le Péripole III
3, Chemin du Pigeonnier de la Cépière
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Tel: 33-61-40-1112
Telex: 531639F
A,C,E,M,P*

Hewlett-Packard France
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Batiment B2
Route des Dolines
Parc d'activite de Valbonne
Sophia Antipolis
06560 **VALBONNE** (Nice)
Tel: (93) 65-39-40
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Hewlett-Packard France
9, Rue Baudin
26000 **VALENCE**
Tel: 33-75-42-7616
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57640 **VIGY** (Metz)
Tel: (8) 771 20 22
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Hewlett-Packard France
Parc d'activité des Prés
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59658 **VILLENEUVE D'ASCQ**
Tel: 33-20-91-4125
Telex: 160124F
C,E,M,P

Hewlett-Packard France
Parc d'activités Paris-Nord 11
Boite Postale 60020
95971 Roissy Charles de Gaulle
VILLEPINTE
Tel: (1) 48 63 80 80
Telex: 211032F
C,E,M,P*

GABON

Sho Gabon
P.O. Box 89
LIBREVILLE
Tel: 721 484
Telex: 5230

GERMAN FEDERAL REPUBLIC

Hewlett-Packard GmbH
Vertriebszentrum Mitte
Hewlett-Packard-Strasse
D-6380 **BAD HOMBURG**
Tel: (06172) 400-0
Telex: 410 844 hpbhg
A,C,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Keithstrasse 2-4
D-1000 **BERLIN** 30
Tel: (030) 21 99 04-0
Telex: 018 3405 hpbln d
A,C,E,M,P

Hewlett-Packard GmbH
Verbindungsstelle Bonn
Friedrich-Ebert-Allee 26
5300 **BONN**
Tel: (0228) 234001
Telex: 8869421

Hewlett-Packard GmbH
Vertriebszentrun Südwest
Schickardstrasse 2
D-7030 **BÖBLINGEN**
Postfach 1427
Tel: (07031) 645-0
Telex: 7265 743 hep
A,C,CM,E,M,P

Hewlett-Packard GmbH
Zeneralbereich Mktg
Herrenberger Strasse 130
D-7030 **BÖBLINGEN**
Tel: (07031) 14-0
Telex: 7265739 hep

Hewlett-Packard GmbH
Geschäftsstelle
Schleefstr. 28a
D-4600 **DORTMUND**-41
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Telex: 822858 hepdod
A,C,E

Hewlett-Packard gmbH
Reparaturzentrum Frankfurt
Berner Strasse 117
6000 **FRANKFURT/MAIN 60**
Tel: (069) 500001-0
Telex: 413249 hpffm

Hewlett-Packard GmbH
Vertriebszentrum Nord
Kapstadtring 5
D-2000 **HAMBURG** 60
Tel: 49-40-63-804-0
Telex: 021 63 032 hphh d
A,C,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Heidering 37-39
D-3000 **HANNOVER** 61
Tel: (0511) 5706-0
Telex: 092 3259 hphan
A,C,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Rosslauer Weg 2-4
D-6800 **MANNHEIM**
Tel: 49-0621-70-05-0
Telex: 0462105 hpmhm
A,C,E

Hewlett-Packard GmbH
Geschäftsstelle
Messerschmittstrasse 7
D-7910 **NEU ULM**
Tel: 49-0731-70-73-0
Telex: 0712816 HP ULM-D
A,C,E*

Hewlett-Packard GmbH
Geschäftsstelle
Emmericher Strasse 13
D-8500 **NÜRNBERG** 10
Tel: (0911) 5205-0
Telex: 0623 860 hpnbg
C,CM,E,M,P

Hewlett-Packard GmbH
Vertriebszentrum Ratingen
Berliner Strasse 111
D-4030 **RATINGEN** 4
Postfach 31 12
Tel: (02102) 494-0
Telex: 589 070 hprad
A,C,E,M,P

Hewlett-Packard GmbH
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Eschenstrasse 5
D-8028 **TAUFKIRCHEN**
Tel: 49-89-61-2070
Telex: 0524985 hpmch
A,C,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Ermlisallee
7517 **WALDBRONN** 2
Postfach 1251
Tel: (07243) 602-0
Telex: 782 838 hepk
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GREAT BRITAIN
See United Kingdom

GREECE

Hewlett-Packard A.E.
178, Kifissias Avenue
6th Floor
Halandri-**ATHENS**
Greece
Tel: 301116473 360, 301116726 090
Telex: 221 286 HPHLGR
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8, Omirou Street
ATHENS 133
Tel: 32 30 303, 32 37 371
Telex: 215962 RKAR GR
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Intelect Div.
209 Mesogion
11525 **ATHENS**
Tel: 6474481/2
Telex: 216286
P

Haril Company
38, Mihalakopoulou
ATHENS 612
Tel: 7236071
Telex: 218767
M*

Hellamco
P.O. Box 87528
18507 **PIRAEUS**
Tel: 4827049
Telex: 241441
A

GUATEMALA

IPESA DE GUATEMALA
Avenida Reforma 3-48, Zona 9
GUATEMALA CITY
Tel: 316627, 317853,66471/5
9-011-502-2-316627
Telex: 3055765 IPESA GU
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HONG KONG

Hewlett-Packard Hong Kong, Ltd.
G.P.O. Box 795
5th Floor, Sun Hung Kai Centre
30 Harbour Road, Wan Chai
HONG KONG
Tel: 852-5-832-3211
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Cable: HEWPACK HONG KONG
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CET Ltd.
10th Floor, Hua Asia Bldg.
64-66 Gloucester Road
HONG KONG
Tel: (5) 200922
Telex: 85148 CET HX
CM

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18th Floor, Great Eagle Centre
23 Harbour Road, Wanchai
HONG KONG
Tel: 5-8330222
Telex: 74766 SCHMC HX
A,M

ICELAND

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Hoefdabakka 9
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Maruthunkuzhi
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Tel: 65799, 65820
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115, Sarojini Devi Road
SECUNDERABAD 500 003
Tel: 310-184, 345-774
Telex: 031-2960
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INDONESIA

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Cable: BERSAL JAKARTA
P

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P.O.Box 2497/Jkt
Antara Bldg., 12th Floor
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SURABAYA
Tel: 67118
Telex: 31146 BERSAL SB
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Service Operation
Al Mansoor City 9B/3/7
BAGHDAD
Tel: 551-49-73
Telex: 212-455 HEPAIRAQ IK
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IRELAND

Hewlett-Packard Ireland Ltd.
Temple House, Temple Road
Blackrock, Co. **DUBLIN**
Tel: 88/333/99
Telex: 30439
C,E,P

Hewlett-Packard Ltd.
75 Belfast Rd, Carrickfergus
Belfast BT38 8PH
NORTHERN IRELAND
Tel: 09603-67333
Telex: 747626
M

ISRAEL

Eldan Electronic Instrument Ltd.
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JERUSALEM 91000
16, Ohaliav St.
JERUSALEM 94467
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Telex: 25231 AB/PAKRD IL
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Computation and Measurement Systems (CMS) Ltd.
11 Masad Street
67060
TEL-AVIV
Tel. 388 388
Telex: 33569 Motil IL
C,CM,E,P

ITALY

Hewlett-Packard Italiana S.p.A
Traversa 99C
Via Giulio Petroni, 19
I-70124 **BARI**
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Hewlett-Packard Italiana S.p.A.
Via Emilia, 51/C
I-40011 **BOLOGNA** Anzola Dell'Emilia
Tel: 39-051-731061
Telex: 511630
C,E,M

Hewlett-Packard Italiana S.p.A.
Via Principe Nicola 43G/C
I-95126 **CATANIA**
Tel: (095) 37-10-87
Telex: 970291
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Hewlett-Packard Italiana S.p.A.
Via G. di Vittorio 10
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Hewlett-Packard Italiana S.p.A.
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Tel: 39-10-541141
Telex: 215238

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
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Telex: 215238
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Tel: 02-92761

Hewlett-Packard Italiana S.p.A.
Via Nuova San Rocco a Capodimonte, 62/A
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Telex: 710698
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Tel: (081) 7611444
Telex: 710698

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Telex: 430315
A,C,E,M

Hewlett-Packard Italiana S.p.A.
Viale C. Pavese 340
I-00144 **ROMA EUR**
Tel: 39-65-48-31
Telex: 610514
A,C,E,M,P*

Hewlett-Packard Italiana S.p.A.
Via di Casellina 57/C
500518 **SCANDICCI-FIRENZE**
Tel: 39-55-753863
C,E,M

Hewlett-Packard Italiana S.p.A.
Corso Svizzera, 185
I-10144 **TORINO**
Tel: 39-11-74-4044
Telex: 221079
A*,C,E

IVORY COAST

S.I.T.E.L.
Societe Ivoirienne de Telecommunications
Bd. Giscard d'Estaing
Carrefour Marcory
Zone 4.A.
Boite postale 2580
ABIDJAN 01
Tel: 353600
Telex: 43175
E

S.I.T.I.
Immeuble "Le General"
Av. du General de Gaulle
01 BP 161
ABIDJAN 01
Tel: 321227
Telex: 22149
C,P

JAPAN

Yokogawa-Hewlett-Packard Ltd.
152-1, Onna
ATSUGI, Kanagawa, 243
Tel: (0462) 25-0031
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Bldg. 6F
3-1 Motochiba-Cho
CHIBA, 280
Tel: (0472) 25 7701
C,E

Yokogawa-Hewlett-Packard Ltd.
Yasuda-Seimei Hiroshima Bldg.
6-11, Hon-dori, Naka-ku
HIROSHIMA, 730
Tel: (082) 241-0611

Yokogawa-Hewlett-Packard Ltd.
Towa Building
2-2-3 Kaigan-dori, Chuo-ku
KOBE, 650
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi 82 Bldg.
3-4 Tsukuba
KUMAGAYA, Saitama 360
Tel: (0485) 24-6563
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Asahi Shinbun Daiichi Seimei Bldg.
4-7, Hanabata-cho
KUMAMOTO, 860
Tel: 96-354-7311
C,E

Yokogawa-Hewlett-Packard Ltd.
Shin-Kyoto Center Bldg.
614, Higashi-Shiokoji-cho
Karasuma-Nishiiru
KYOTO, 600
Tel: 075-343-0921
C,E

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Bldg.
1-4-73, Sanno-maru
MITO, Ibaraki 310
Tel: (0292) 25-7470
C,CM,E

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Kokubun Bldg.
7-8 Kokubun, 1 Chome, Sendai
MIYAGI, 980
Tel: (0222) 25-1011
C,E

Yokogawa-Hewlett-Packard Ltd.
Gohda Bldg. 2F
1-2-10 Gohda Okaya-Shi
Okaya-Shi
NAGANO, 394
Tel: (0266) 23 0851
C,E

Yokogawa-Hewlett-Packard Ltd.
Nagoya Kokusai Center Building
1-47-1, Nagono, Nakamura-ku
NAGOYA, AICHI 450
Tel: (052) 571-5171
C,CM,E,M

Yokogawa-Hewlett-Packard Ltd.
Sai-Kyo-Ren Building
1-2 Dote-cho
OOMIYA-SHI SAITAMA 330
Tel: (0486) 45-8031

SALES & SUPPORT OFFICES

Arranged alphabetically by country

JAPAN (Cont'd)

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg., 5-4-20 Nishi-Nakajima
4-20 Nishinakajima, 5 Chome,
Yodogawa-ku
OSAKA, 532
Tel: (06) 304-6021
Telex: YHPOSA 523-3624
C,CM,E,M,P*

Yokogawa-Hewlett-Packard Ltd.
1-27-15, Yabe
SAGAMIHARA Kanagawa, 229
Tel: 0427 59-1311

Yokogawa-Hewlett-Packard Ltd.
Hamamtsu Motoshiro-Cho Daichi
Seimei Bldg 219-21, Motoshiro-Cho
Hamamatsu-shi
SHIZUOKA, 430
Tel: (0534) 56 1771
C,E

Yokogawa-Hewlett-Packard Ltd.
Shinjuku Daiichi Seimei Bldg.
2-7-1, Nishi Shinjuku
Shinjuku-ku,**TOKYO** 163
Tel: 03-348-4611
C,E,M

Yokogawa Hewlett-Packard Ltd.
9-1, Takakura-cho
Hachioji-shi, **TOKYO,** 192
Tel: 81-426-42-1231
C,E

Yokogawa-Hewlett-Packard Ltd.
3-29-21 Takaido-Higashi, 3 Chome
Suginami-ku **TOKYO** 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
C,CM,E,P*

Yokogawa Hokushin Electric
Corporation
Shinjuku-NS Bldg. 10F
4-1 Nishi-Shinjuku 2-Chome
Shinjuku-ku
TOKYO, 163
Tel: (03) 349-1859
Telex: J27584
A

Yokogawa Hokushin Electric Corp.
9-32 Nakacho 2 Chome
Musashino-shi
TOKYO, 180
Tel: (0422) 54-1111
Telex: 02822-42' YEW MTK J
A

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei
Utsunomiya Odori Building
1-5 Odori, 2 Chome
UTSUNOMIYA, Tochigi 320
Tel: (0286) 33-1153
C,E

Yokogawa-Hewlett-Packard Ltd.
Yasuda Seimei Nishiguchi Bldg.
30-4 Tsuruya-cho, 3 Chome
Kanagawa-ku, **YOKOHAMA** 221
Tel: (045) 312-1252
C,CM,E

JORDAN

Scientific and Medical Supplies Co.
P.O. Box 1387
AMMAN
Tel: 24907, 39907
Telex: 21456 SABCO JO
C,E,M,P

KENYA

ADCOM Ltd., Inc., Kenya
P.O.Box 30070
NAIROBI
Tel: 331955
Telex: 22639
E,M

KOREA

Samsung Hewlett-Packard Co. Ltd.
Dongbang Yeoeuido Building
12-16th Floors
36-1 Yeoeuido-Dong
Youngdeungpo-Ku
SEOUL
Tel: 784-4666, 784-2666
Telex: 25166 SAMSAN K
C,CM,E,M,P

Young In Scientific Co., Ltd.
Youngwha Building
547 Shinsa Dong, Kangnam-Ku
SEOUL 135
Tel: 546-7771
Telex: K23457 GINSCO
A

Dongbang Healthcare
Products Co. Ltd.
Suite 301 Medical Supply Center
Bldg. 1-31 Dongsungdong
Jong Ro-gu, **SEOUL**
Tel: 764-1171, 741-1641
Telex: K25706 TKBKO
Cable: TKBEEPKO
M

KUWAIT

Al-Khaldiya Trading & Contracting
P.O. Box 830
SAFAT
Tel: 424910, 411726
Telex: 22481 AREEG KT
Cable: VISCOUNT
E,M,A

Gulf Computing Systems
P.O. Box 25125
SAFAT
Tel: 435969
Telex: 23648
P

Photo & Cine Equipment
P.O. Box 270
SAFAT
Tel: 2445111
Telex: 22247 MATIN KT
Cable: MATIN KUWAIT
P

W.J. Towell Computer Services
P.O. Box 5897
SAFAT
Tel: 2462640/1
Telex: 30336 TOWELL KT
C

LEBANON

Computer Information Systems S.A.L.
Chammas Building
P.O. Box 11-6274 Dora
BEIRUT
Tel: 89 40 73
Telex: 42309 chacis le
C,E,M,P

LIBERIA

Unichemicals Inc.
P.O. Box 4509
MONROVIA
Tel: 224282
Telex: 4509
E

LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,C,CM,E,M,P

MADAGASCAR

Technique et Precision
12, rue de Nice
P.O. Box 1227
101 **ANTANANARIVO**
Tel: 22090
Telex: 22255
P

MALAYSIA

Hewlett-Packard Sales (Malaysia)
Sdn. Bhd.
9th Floor
Chung Khiaw Bank Building
46, Jalan Raja Laut
50736 **KUALA LUMPUR, MALAYSIA**
Tel: 03-2986555
Telex: 31011 HPSM MA
A,C,E,M,P*

Protel Engineering
P.O.Box 1917
Lot 6624, Section 64
23/4 Pending Road
Kuching, **SARAWAK**
Tel: 36299
Telex: 70904 PROMAL MA
Cable: PROTELENG
A,E,M

MALTA

Philip Toledo Ltd.
Kirkirkara P.O. Box 11
Notabile Rd.
MRIEHEL
Tel: 447 47, 455 66, 4915 25
Telex: Media MW 649
E,M,P

MAURITIUS

Blanche Birger Co. Ltd.
18, Jules Koenig Street
PORT LOUIS
Tel: 20828
Telex: 4296
P

MEXICO

Hewlett-Packard de Mexico,
S.A. de C.V.
Rio Nio No. 4049 Desp. 12
Fracc. Cordoba
JUAREZ
Tel: 161-3-15-62
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Condominio Kadereyta
Circuito del Mezon No. 186 Desp. 6
COL. DEL PRADO - 76030 Qro.
Tel: 463-6-02-71
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Monti Morelos No. 299
Fraccionamiento Loma Bonita 45060
GUADALAJARA, Jalisco
Tel: 36-31-48-00
Telex: 0684 186 ECOME
P

Microcomputadoras
Hewlett-Packard, S.A.
Monti Pelvoux 115
LOS LOMAS, Mexico, D.F.
Tel: 520-9127
P

Microcomputadoras Hewlett-Packard,
S.A. de C.V.
Monte Pelvoux No. 115
Lomas de Chapultepec, 11000
MEXICO, D.F.
Tel: 520-9127
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Monte Pelvoux No. 111
Lomas de Chapultepec
11000 **MEXICO, D.F.**
Tel: 5-40-62-28, 72-66, 50-25
Telex: 17-74-507 HEWPACK MEX
A,C,CM,E,M,P

Hewlett-Packard De Mexico (Polanco)
Avenida Ejercito Nacional #579
2da y3er piso
Colonia Granada 11560
MEXICO D.F.
Tel: 254-4433
P

Hewlett-Packard de Mexico,
S.A. de C.V.
Czda. del Valle
409 Ote. 4th Piso
Colonia del Valle
Municipio de Garza
Garcia Nuevo Leon
66220 **MONTERREY,** Nuevo Leon
Tel: 83-78-42-40
Telex: 382410 HPMY
C

Infograficas y Sistemas
del Noreste, S.A.
Rio Orinoco #171 Oriente
Despacho 2001
Colonia Del Valle
MONTERREY
Tel: 559-4415, 575-3837
Telex: 483164
A,E

Hewlett-Packard de Mexico,
S.A. de C.V.
Blvd. Independencia No. 2000 Ote.
Col. Estrella
TORREON, COAH.
Tel: 171-18-21-99
P

MOROCCO

Etablissement Hubert Dolbeau & Fils
81 rue Karatchi
B.P. 11133
CASABLANCA
Tel: 3041-82, 3068-38
Telex: 23051, 22822
E

Gerep
2, rue Agadir
Boite Postale 156
CASABLANCA 01
Tel: 272093, 272095
Telex: 23 739
P

Sema-Maroc
Dept. Seric
6, rue Lapebie
CASABLANCA
Tel: 260980
Telex: 21641
C,P

NETHERLANDS

Hewlett-Packard Nederland B.V.
Startbaan 16
NL-1187 XR **AMSTELVEEN**
P.O. Box 667
NL-1180 AR **AMSTELVEEN**
Tel: (020) 547-6911
Telex: 13 216 HEPA NL
A,C,CM,E,M,P

Hewlett-Packard Nederland B.V.
Bongerd 2
P.O. Box 41
NL 2900AA **CAPELLE A/D IJSSEL**
Tel: 31-20-51-6444
Telex: 21261 HEPAC NL
C,E

Hewlett-Packard Nederland B.V.
Pastoor Petersstraat 134-136
P.O. Box 2342
NL 5600 CH **EINDHOVEN**
Tel: 31-40-32-6911
Telex: 51484 hepae nl
C,E,P

NEW ZEALAND

Hewlett-Packard (N.Z.) Ltd.
5 Owens Road
P.O. Box 26-189
Epsom, **AUCKLAND**
Tel: 64-9-687-159
Cable: HEWPAK Auckland
C,CM,E,P*

Hewlett-Packard (N.Z.) Ltd.
184-190 Willis Street
WELLINGTON
P.O. Box 9443
Courtenay Place, **WELLINGTON 3**
Tel: 64-4-887-199
Cable: HEWPACK Wellington
C,CM,E,P

Northrop Instruments & Systems Ltd.
369 Khyber Pass Road
P.O. Box 8602
AUCKLAND
Tel: 794-091
Telex: 60605
A,M

Northrop Instruments & Systems Ltd.
110 Mandeville St.
P.O. Box 8388
CHRISTCHURCH
Tel: 488-873
Telex: 4203
A,M

Northrop Instruments & Systems Ltd.
Sturdee House
85-87 Ghuznee Street
P.O. Box 2406
WELLINGTON
Tel: 850-091
Telex: NZ 3380
A,M

NIGERIA

Elmeco Nigeria Ltd.
45 Saka Tirubu St.
Victoria Island
LAGOS
Tel: 61-98-94
Telex: 20-117
E

NORTHERN IRELAND
See United Kingdom

NORWAY

Hewlett-Packard Norge A/S
Folke Bernadottes vei 50
P.O. Box 3558
N-5033 **FYLLINGSDALEN** (Bergen)
Tel: 0047/5/16 55 40
Telex: 76621 hpnas n
C,E,M

Hewlett-Packard Norge A/S
Osterndalen 16-18
P.O. Box 34
N-1345 **OESTERAAS**
Tel: 47-2-17-1180
Telex: 76621 hpnas n
A,C,CM,E,M,P

Hewlett-Packard Norge A/S
Boehmergt. 42
Box 2470
N-5037 **SOLHEIMSVIK**
Tel: 0047/5/29 00 90

OMAN

Khimjil Ramdas
P.O. Box 19
MUSCAT/SULTANATE OF OMAN
Tel: 795 901
Telex: 3489 BROKER MB MUSCAT
P

Suhail & Saud Bahwan
P.O.Box 169
MUSCAT/SULTANATE OF OMAN
Tel: 734 201-3
Telex: 5274 BAHWAN MB
E

Imtac LLC
P.O. Box 9196
MINA AL FAHAL/SULTANATE OF OMAN
Tel: 70-77-27, 70-77-23
Telex: 3865 Tawoos On
A,C,M

PAKISTAN

Mushko & Company Ltd.
House No. 16, Street No. 16
Sector F-6/3
ISLAMABAD
Tel: 824545
Telex: 54001 Muski Pk
Cable: FEMUS Islamabad
A,E,P*

Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
KARACHI 0302
Tel: 524131, 524132
Telex: 2894 MUSKO PK
Cable: COOPERATOR Karachi
A,E,P*

PANAMA

Electronico Balboa, S.A.
Calle Samuel Lewis, Ed. Alfa
Apartado 4929
PANAMA CITY
Tel: 9-011-507-636613
Telex: 368 3483 ELECTRON PG
CM,E,M,P

PERU

Cía Electro Médica S.A.
Los Flamencos 145, Ofc. 301/2
San Isidro
Casilla 1030
LIMA 1
Tel: 9-011-511-4-414325, 41-3705
Telex: 39425257 PE PB SIS
CM,E,M,P

SAMS S.A.
Arenida Republica de Panama 3534
San Isidro, **LIMA**
Tel: 9-011-511-4-229332/413984/413226
Telex: 39420450 PE LIBERTAD
A,C,P

PHILIPPINES

The Online Advanced Systems Corp.
2nd Floor, Electra House
115-117 Esteban Street
P.O. Box 1510
Legaspi Village, Makati
Metro **MANILA**
Tel: 815-38-10 (up to 16)
Telex: 63274 ONLINE PN
A,C,E,M,P

PORTUGAL

Mundinter Intercambio
Mundial de Comércio S.A.R.L.
Av. Antonio Augusto Aguiar 138
Apartado 2761
LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

Soquimica
Av. da Liberdade, 220-2
1298 **LISBOA** Codex
Tel: 56-21-82
Telex: 13316 SABASA
A

Telectra-Empresa Técnica de Equipmentos Eléctricos S.A.R.L.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
LISBON 1
Tel: (19) 68-60-72
Telex: 12598
CM,E

C.P.C.S.I.
Rua de Costa Cabral 575
4200 **PORTO**
Tel: 499174/495173
Telex: 26054
C,P

PUERTO RICO

Hewlett-Packard Puerto Rico
101 Muñoz Rivera Av
Esu. Calle Ochoa
HATO REY, Puerto Rico 00918
Tel: (809) 754-7800
A,C,CM,M,E,P

QATAR

Computer Arabia
P.O. Box 2750
DOHA
Tel: 428555
Telex: 4806 CHPARB
P

Nasser Trading & Contracting
P.O.Box 1563
DOHA
Tel: 422170
Telex: 4439 NASSER DH
M

SAUDI ARABIA

Modern Electronics Establishment
Hewlett-Packard Division
P.O. Box 281
Thuobah
AL-KHOBAR 31952
Tel: 895-1760, 895-1764
Telex: 671 106 HPMEEK SJ
Cable: ELECTA AL-KHOBAR
C,E,M

Modern Electronics Establishment
Hewlett-Packard Division
P.O. Box 1228
Redec Plaza, 6th Floor
JEDDAH
Tel: 644 96 28
Telex: 4027 12 FARNAS SJ
Cable: ELECTA JEDDAH
A,C,CM,E,M,P

Modern Electronics Establishment
Hewlett-Packard Division
P.O.Box 22015
RIYADH 11495
Tel: 491-97 15, 491-63 87
Telex: 202049 MEERYD SJ
C,E,M

Abdul Ghani El Ajou Corp.
P.O. Box 78
RIYADH
Tel: 40 41 717
Telex: 200 932 EL AJOU
P

SCOTLAND
See United Kingdom

SENEGAL

Societe Hussein Ayad & Cie.
76, Avenue Georges Pompidou
B.P. 305
DAKAR
Tel: 32339
Cable: AYAD-Dakar
E

Moneger Distribution S.A.
1, Rue Parent
B.P. 148
DAKAR
Tel: 215 671
Telex: 587
P

Systeme Service Conseil (SSC)
14, Avenue du Parachois
DAKAR ETOILE
Tel: 219976
Telex: 577
C,P

SINGAPORE

Hewlett-Packard Singapore (Sales) Pte. Ltd.
1150 Depot Road
SINGAPORE, 0410
Tel: 4731788
Telex: 34209 HPSGSO RS
Cable: HEWPACK, Singapore
A,C,E,M,P

Dynamar International Ltd.
Unit 05-11 Block 6
Kolam Ayer Industrial Estate
SINGAPORE 1334
Tel: 747-6188
Telex: 26283 RS
CM

SOUTH AFRICA

Hewlett-Packard So Africa (Pty.) Ltd.
P.O. Box 120
Howard Place, **CAPE PROVINCE**
7450 South Africa
Tel: 27 121153-7954
Telex: 57-20006
A,C,CM,E,M,P

Hewlett-Packard So Africa (Pty.) Ltd.
2nd Floor Juniper House
92 Overport Drive
DURBAN 4067
Tel: 27-31-28-4178
Telex: 6-22954
C

Hewlett-Packard So Africa (Pty.) Ltd.
Shop 6 Linton Arcade
511 Cape Road
Linton Grange
PORT ELIZABETH 6001
Tel: 27141130 1201
Telex: 24-2916
C

Hewlett-Packard So Africa (Pty.) Ltd.
Fountain Center
Kalkoen Str.
Monument Park Ext 2
PRETORIA 0105
Tel: (012) 45 5725
Telex: 32163
C,E

Hewlett-Packard So Africa (Pty.) Ltd.
Private Bag Wendywood
SANDTON 2144
Tel: 27-11-802-5111, 27-11-802-5125
Telex: 4-20877 SA
Cable: HEWPACK Johannesburg
A,C,CM,E,M,P

SPAIN

Hewlett-Packard Española, S.A.
Calle Entenza, 321
E.-BARCELONA 29
Tel: 3/322 24 51, 321 73 54
Telex: 52603 hpbee
A,C,E,M,P

Hewlett-Packard Española, S.A.
Calle San Vicente S/N
Edificio Albia II-7B
48001 **BILBAO**
Tel: 4/423 83 06
A,C,E,M

Hewlett-Packard Española, S.A.
Crta. N-VI, Km. 16, 400
Las Rozas
E-**MADRID**
Tel: (1) 637.00.11
Telex: 23515 HPE
C,M

Hewlett-Packard Española, S.A.
Avda. S. Francisco Javier, S/N
Planta 10. Edificio Sevilla 2
E-SEVILLA 5, SPAIN
Tel: 54/64 44 54
Telex: 72933
A,C,M,P

Hewlett-Packard Española, S.A.
Isabel La Catolica, 8
E-46004 **VALENCIA**
Tel: 34-6-361 1354
Telex: 63435
C,P

Hewlett-Packard Española, S.A.
Av. de Zugazarte, 8
Las Arenas-Guecho
E-48930 **VIZCAYA**
VIZCAYA
Tel: 34-423-83 06
Telex: 33032

SWEDEN

Hewlett-Packard Sverige AB
Östra Tullgatan 3
S-20011 **MALMÖ**
Box 6132
Tel: 46-40-702-70
Telex: (854) 17886 (via Spånga office)
C,P

Hewlett-Packard Sverige AB
Elementvagen 16
S-7022 7 **ÖREBRO**
Tel: 49-019-10-4820
Telex: (854) 17886 (via Spånga office)
C

Hewlett-Packard Sverige AB
Skalholtsgatan 9, Kista
P.O. Box 19
S-16393 **SPÅNGA**
Tel: (08) 750-2000
Telex: (854) 17886
Telefax: (08) 7527781
A,C,CM,E,M,P

Hewlett-Packard Sverige AB
Box 266
Topasgatan 1A
S-42123 **VÄSTRA-FRÖLUNDA**
(Gothenburg)
Tel: 46-031-89-1000
Telex: (854) 17886 (via Spånga office)
A,C,CM,E,M,P

SUDAN

Mediterranean Engineering & Trading Co. Ltd.
P.O. Box 1025
KHARTOUM
Tel: 41184
Telex: 24052
C,P

SWITZERLAND

Hewlett-Packard (Schweiz) AG
Clarastrasse 12
CH-4058 **BASEL**
Tel: 41-61-33-5920
A,C,E,P

Hewlett-Packard (Schweiz) AG
7, rue du Bois-du-Lan
Case postale 365-1366
CH-1217 **MEYRIN** 1
Tel: (0041) 22-83-11-11
Telex:27333 HPAG CH
A,C,CM,E,M,P

SALES & SUPPORT OFFICES

Arranged alphabetically by country

SWITZERLAND (Cont'd)

Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 **WIDEN**
Tel: 41-57-31-2111
Telex: 53933 hpag ch
Cable: HPAG CH
A,C,CM,E,M,P

Hewlett-Packard (Schweiz) AG
Schwamendingenstrasse 10
CH-8050 **ZURICH**
Tel: 41-1-315-8181
Telex: 823 537 HPAG CH
C,P

SYRIA

General Electronic Inc.
Nuri Basha Ahnaf Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33-24-87
Telex: 44-19-88
Cable: ELECTROBOR DAMASCUS
E

Middle East Electronics
P.O.Box 2308
Abu Rumaneh
DAMASCUS
Tel: 33 45 92
Telex: 411 771 Meesy
M

TAIWAN

Hewlett-Packard Taiwan Ltd.
THM Office
2, Huan Nan Road
CHUNG LI, Taoyuan
Tel: (034) 929-666
C

Hewlett-Packard Taiwan Ltd.
Kaohsiung Office
11/F, 456, Chung Hsiao 1st Road
KAOHSIUNG
Tel: (07) 2412318
C,E

Hewlett-Packard Taiwan Ltd.
8th Floor, Hewlett-Packard Building
337 Fu Hsing North Road
TAIPEI
Tel: (02) 712-0404
Telex: 24439 HEWPACK
Cable:HEWPACK Taipei
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Ing Lih Trading Co.
3rd Floor, No. 7, Sect. 2
Jen Ai Road
TAIPEI 100
Tel: (02) 394-8191
Telex: 22894 SANKWANG
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30 Patpong Ave., Suriwong
BANGKOK 5,
Tel: 235-5727, 234-0991/3
Telex: 84439 Simonco TH
Cable: UNIMESA Bangkok
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Bangkok Business Equipment Ltd.
5/5-6 Dejo Road
BANGKOK
Tel: 234-8670, 234-8671
Telex. 87699-BEQUIPT TH
Cable: BUSIQUIPT Bangkok
P

TOGO

Societe Africaine De Promotion
Immeuble Sageb
Rue d'Atakpame
P.O. Box 4150
LOME
Tel: 21-62-88
Telex: 5357
P

TRINIDAD & TOBAGO

Caribbean Telecoms Ltd.
Corner McAllister Street &
Eastern Main Road, Laventille
P.O. Box 732
PORT-OF-SPAIN
Tel: 624-4213
Telex: 22561 CARTEL WG
Cable: CARTEL, PORT OF SPAIN
CM,E,M,P

Computer and Controls Ltd.
P.O. Box 51
1 Taylor Street
PORT-OF-SPAIN
Tel: (809) 622-7719/622-7985
Telex: 38722798 COMCON WG
LOOGO AGENCY 1264
A,P

Feral Assoc.
8 Fitzgerald Lane
PORT-OF-SPAIN
Tel: 62-36864, 62-39255
Telex: 22432 FERALCO
Cable: FERALCO
M

TUNISIA

Tunisie Electronique S.A.R.L.
31 Avenue de la Liberte
TUNIS
Tel: 280-144
C,E,P

Tunisie Electronique S.A.R.L.
94, Av. Jugurtha, Mutuelleville
1002 **TUNIS-BELVEDERE**
Tel: 280144
Telex: 13238
C,E,P

Corema S.A.
1 ter. Av. de Carthage
TUNIS
Tel: 253-821
Telex: 12319 CABAM TN
M

TURKEY

E.M.A
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Yenisehir
ANKARA
Tel: 319175
Telex: 42321 KTX TR
Cable: EMATRADE ANKARA
M

Teknim Company Ltd.
Iran Caddesi No. 7
Karaklidere
ANKARA
Tel: 275800
Telex: 42155 TKNM TR
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Kurt & Kurt A.S.
Mithatpasa Caddesi No. 75
Kat 4 Kizilay
ANKARA
Tel: 318675/6/7/8
Telex: 42490 MESR TR
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Saniva Bilgisayar Sistemleri A.S.
Buyukdere Caddesi 103/6
Gayrettepe
ISTANBUL
Tel: 1673180
Telex: 26345 SANI TR
C,P

Best Inc.
Esentepe, Gazeteciler Sitesi
Keskin Kalem
Sokak 6/3, Gayrettepe
ISTANBUL
Tel: 172 1328, 173 3344
Telex: 42490
A

UNITED ARAB EMIRATES

Emitac Ltd.
P.O. Box 1641
SHARJAH
Tel: 591181
Telex: 68136 EMITAC EM
Cable: EMITAC SHARJAH
E,C,M,P,A

Emitac Ltd.
P.O. Box 2711
ABU DHABI
Tel: 820419-20
Cable: EMITACH ABUDHABI

Emitac Ltd.
P.O. Box 8391
DUBAI,
Tel: 377591

Emitac Ltd.
P.O. Box 473
RAS AL KHAIMAH
Tel: 28133, 21270

UNITED KINGDOM

ENGLAND

Hewlett-Packard Ltd.
Miller House
The Ring, **BRACKNELL**
Berks RG12 1XN
Tel: 44/344/424-898
Telex: 848733
E

Hewlett-Packard Ltd.
Elstree House. Elstree Way
BOREHAMWOOD, Herts WD6 1SG
Tel: 01 207 5000
Telex: 8952716
C,E

Hewlett-Packard Ltd.
Oakfield House, Oakfield Grove
Clifton **BRISTOL,** Avon BS8 2BN
Tel: 44-272-736 806
Telex: 444302
C,E,P

Hewlett-Packard Ltd.
9 Bridewell Place
LONDON EC4V 6BS
Tel: 44-01-583-6565
Telex: 298163
C,P

Hewlett-Packard Ltd.
Pontefract Road
NORMANTON, West Yorkshire WF6 1RN
Tel: 44/924/895 566
Telex: 557355
C,P

Hewlett-Packard Ltd.
The Quadrangle
106-118 Station Road
REDHILL, Surrey RH1 1PS
Tel: 44-737-686-55
Telex: 947234
C,E,P

Hewlett-Packard Ltd.
Avon House
435 Stratford Road
Shirley, **SOLIHULL,** West Midlands
B90 4BL
Tel: 44-21-745-8800
Telex: 339105
C,E,P

Hewlett-Packard Ltd.
Heathside Park Road
Cheadle Heath, Stockport
SK3 ORB, United Kingdom
Tel: 44-061-428-0828
Telex: 668068
A,C,E,M,P

Hewlett-Packard Ltd.
Harmon House
No. 1 George Street
UXBRIDGE, Middlesex UX8 1YH
Tel: 895 720 20
Telex: 893134/5
C,CM,E,M,P

Hewlett-Packard Ltd.
King Street Lane
Winnersh, **WOKINGHAM**
Berkshire RG11 5AR
Tel: 44/734/784774
Telex: 8471789
A,C,E,M,P

NORTHERN IRELAND

Hewlett-Packard (Ireland) Ltd.
Carrickfergus Industrial Centre
75 Belfast Road, Carrickfergus
CO. ANTRIM BT38 8PM
Tel: 09603 67333
C,E

Cardiac Services Company
95A Finaghy Road South
BELFAST, BT10 OBY
Tel: 0232-625566
Telex: 747626
M

SCOTLAND

Hewlett-Packard Ltd.
1/3 Springburn Place
College Milton North
EAST KILBRIDE, G74 5NU
Tel: 041-332-6232
Telex: 779615
C,E

Hewlett-Packard Ltd.
SOUTH QUEENSFERRY
West Lothian, EH30 9TG
Tel: 031 331 1188
Telex: 72682 HPSQFYG
C,CM,E,M,P

UNITED STATES

Hewlett-Packard Co.
Customer Information Center
Tel: (800) 752-0900
Hours: 6:00 AM to 5:00 PM
Pacific Time

Alabama

Hewlett-Packard Co.
2100 Riverchase Center
Building 100 - Suite 118
BIRMINGHAM, AL 35244
Tel: (205) 988-0547
A,C,M,P*

Hewlett-Packard Co.
420 Wynn Drive
HUNTSVILLE, AL 35805
Tel: (205) 830-2000
C,CM,E,M*

Alaska

Hewlett-Packard Co.
4000 Old Seward Highway
Suite 101
ANCHORAGE, AK 99503
Tel: (907) 563-8855
C,E

Arizona

Hewlett-Packard Co.
8080 Pointe Parkway West
PHOENIX, AZ 85044
Tel: (602) 273-8000
A,C,CM,E,M,P

Hewlett-Packard Co.
3400 East Britannia Dr.
Bldg. C, Suite 124
TUCSON, AZ 85706
Tel: (602) 573-7400
C,E,M**

California

Hewlett-Packard Co.
99 South Hill Dr.
BRISBANE, CA 94005
Tel: (415) 330-2500
C

Hewlett-Packard Co.
1907 North Gateway Blvd.
FRESNO, CA 93727
Tel: (209) 252-9652
C,M

Hewlett-Packard Co.
1421 S. Manhattan Av.
FULLERTON, CA 92631
Tel: (714) 999-6700
C,CM,E,M

Hewlett-Packard Co.
7408 Hollister Ave. #A
GOLETA, CA 93117
Tel: (805) 685-6100
C,E

Hewlett-Packard Co.
2525 Grand Avenue
LONG BEACH, CA 90815
Tel: (213) 498-1111
C

Hewlett-Packard Co.
5651 West Manchester Ave.
LOS ANGELES, CA 90045
Tel: (213) 337-8000

Hewlett-Packard Co.
3155 Porter Drive
PALO ALTO, CA 94304
Tel: (415) 857-8000
C,E

Hewlett-Packard Co.
5725 W. Las Positas Blvd.
PLEASANTON, CA 94566
Tel: (415) 460-0282
C

Hewlett-Packard Co.
4244 So. Market Court, Suite A
SACRAMENTO, CA 95834
Tel: (916) 929-7222
A*,C,E,M

Hewlett-Packard Co.
9606 Aero Drive
SAN DIEGO, CA 92123
Tel: (619) 279-3200
C,CM,E,M

Hewlett-Packard Co.
3003 Scott Boulevard
SANTA CLARA, CA 95054
Tel: (408) 988-7000
Telex: 910-338-0586
A,C,CM,E

Hewlett-Packard Co.
2150 W. Hillcrest Dr.
THOUSAND OAKS, CA 91320
(805) 373-7000
C,CM,E

Colorado

Hewlett-Packard Co.
2945 Center Green Court South
Suite A
BOULDER, CO 80301
Tel: (303) 499-6655
A,C,E

Hewlett-Packard Co.
24 Inverness Place, East
ENGLEWOOD, CO 80112
Tel: (303) 649-5000
A,C,CM,E,M

Connecticut

Hewlett-Packard Co.
500 Sylvan Av.
BRIDGEPORT, CT 06606
Tel: (203) 371-6454
C,E

Hewlett-Packard Co.
47 Barnes Industrial Road South
WALLINGFORD, CT 06492
Tel: (203) 265-7801
A,C,CM,E,M

Florida

Hewlett-Packard Co.
2901 N.W. 62nd Street
FORT LAUDERDALE, FL 33309
Tel: (305) 973-2600
C,E,M,P*

Hewlett-Packard Co.
6800 South Point Parkway
Suite 301
JACKSONVILLE, FL 32216
Tel: (904) 636-9955
C*,M**

Hewlett-Packard Co.
255 East Drive, Suite B
MELBOURNE, FL 32901
Tel: (305) 729-0704
CM,E

Hewlett-Packard Co.
6177 Lake Ellenor Drive
ORLANDO, FL 32809
Tel: (305) 859-2900
A,C,CM,E,P*

Hewlett-Packard Co.
4700 Bayou Blvd.
Building 5
PENSACOLA, FL 32503
Tel: (904) 476-8422
A,C,M

Hewlett-Packard Co.
5550 W. Idlewild, #150
TAMPA, FL 33614
Tel: (813) 884-3282
C,E,M,P

Georgia

Hewlett-Packard Co.
2015 South Park Place
ATLANTA, GA 30339
Tel: (404) 955-1500
Telex: 810-766-4890
A,C,CM,E,M,P*

Hewlett-Packard Co.
3607 Parkway Lane
Suite 300
NORCROSS, GA 30092
Tel: (404) 448-1894
C,E,P

Hawaii

Hewlett-Packard Co.
Pacific Tower
1001 Bishop St.
Suite 2400
HONOLULU, HI 96813
Tel: (808) 526-1555
A,C,E,M

Idaho

Hewlett-Packard Co.
11309 Chinden Blvd.
BOISE, ID 83714
Tel: (208) 323-2700
C

Illinois

Hewlett-Packard Co.
2205 E. Empire St.
P.O. Box 1607
BLOOMINGTON, IL 61702-1607
Tel: (309) 662-9411
A,C,E,M**

Hewlett-Packard Co.
525 W. Monroe, #1308
CHICAGO, IL 60606
Tel: (312) 930-0010
C

Hewlett-Packard Co.
1200 East Diehl Road
NAPERVILLE, IL 60566
Tel: (312) 357-8800
C

Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800
Telex: 910-687-1066
A,C,CM,E,M

Indiana

Hewlett-Packard Co.
11911 N. Meridian St.
CARMEL, IN 46032
Tel: (317) 844-4100
A,C,CM,E,M

Hewlett-Packard Co.
111 E. Ludwig Road
Suite 108
FT. WAYNE, IN 46825
Tel: (219) 482-4283
C,E

Iowa

Hewlett-Packard Co.
4070 22nd Av. SW
CEDAR RAPIDS, IA 52404
Tel: (319) 390-4250
C,E,M

Hewlett-Packard Co.
4201 Corporate Dr.
WEST DES MOINES, IA 50265
Tel: (515) 224-1435
A**,C,M**

Kansas

Hewlett-Packard Co.
North Rock Business Park
3450 N. Rock Rd.
Suite 300
WICHITA, KS 67226
Tel: (316) 684-8491
C,E

Kentucky

Hewlett-Packard Co.
305 N. Hurstbourne Lane,
Suite 100
LOUISVILLE, KY 40223
Tel: (502) 426-0100
A,C,M

Louisiana

Hewlett-Packard Co.
160 James Drive East
ST. ROSE, LA 70087
P.O. Box 1449
KENNER, LA 70063
Tel: (504) 467-4100
A,C,E,M,P

Maryland

Hewlett-Packard Co.
3701 Koppers Street
BALTIMORE, MD 21227
Tel: (301) 644-5800
Telex: 710-862-1943
A,C,CM,E,M

Hewlett-Packard Co.
2 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 948-6370
A,C,CM,E,M

Massachusetts

Hewlett-Packard Co.
1775 Minuteman Road
ANDOVER, MA 01810
Tel: (617) 682-1500
A,C,CM,E,M,P*

Hewlett-Packard Co.
29 Burlington Mall Rd
BURLINGTON, MA 01803-4514
Tel: (617) 270-7000
C,E

Michigan

Hewlett-Packard Co.
4326 Cascade Road S.E.
GRAND RAPIDS, MI 49506
Tel: (616) 957-1970
C,M

Hewlett-Packard Co.
39550 Orchard Hill Place Drive
NOVI, MI 48050
Tel: (313) 349-9200
A,C,E,M

Hewlett-Packard Co.
560 Kirts Rd.
Suite 101
TROY, MI 48084
Tel: (313) 362-5180
C

Minnesota

Hewlett-Packard Co.
2025 W. Larpenteur Ave.
ST. PAUL, MN 55113
Tel: (612) 644-1100
A,C,CM,E,M

Missouri

Hewlett-Packard Co.
1001 E. 101st Terrace Suite 120
KANSAS CITY, MO 64131-3368
Tel: (816) 941-0411
A,C,CM,E,M

Hewlett-Packard Co.
13001 Hollenberg Drive
BRIDGETON, MO 63044
Tel: (314) 344-5100
A,C,E,M

Nebraska

Hewlett-Packard
11626 Nicholas St.
OMAHA, NE 68154
Tel: (402) 493-0300
C,E,M

New Jersey

Hewlett-Packard Co.
120 W. Century Road
PARAMUS, NJ 07652
Tel: (201) 265-5000
A,C,CM,E,M

Hewlett-Packard Co.
20 New England Av. West
PISCATAWAY, NJ 08854
Tel: (201) 562-6100
A,C,CM,E

New Mexico

Hewlett-Packard Co.
7801 Jefferson N.E.
ALBUQUERQUE, NM 87109
Tel: (505) 823-6100
C,E,M

Hewlett-Packard Co.
1362-C Trinity Dr.
LOS ALAMOS, NM 87544
Tel: (505) 662-6700
C,E

New York

Hewlett-Packard Co.
5 Computer Drive South
ALBANY, NY 12205
Tel: (518) 458-1550
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Hewlett-Packard Co.
9600 Main Street
CLARENCE, NY 14031
Tel: (716) 759-8621
C,E,M

Hewlett-Packard Co.
200 Cross Keys Office Park
FAIRPORT, NY 14450
Tel: (716) 223-9950
A,C,CM,E,M

Hewlett-Packard Co.
7641 Henry Clay Blvd.
LIVERPOOL, NY 13088
Tel: (315) 451-1820
A,C,CM,E,M

Hewlett-Packard Co.
No. 1 Pennsylvania Plaza
55th Floor
34th Street & 7th Avenue
MANHATTAN NY 10119
Tel: (212) 971-0800
C,M*

Hewlett-Packard Co.
15 Myers Corner Rd.
Hollowbrook Park, Suite 2D
WAPPINGERS FALLS, NY 12590
Tel: (914) 298-9125
CM,E

Hewlett-Packard Co.
2975 Westchester Ave
PURCHASE, NY 10577
Tel: (914) 935-6300
C,CM,E

Hewlett-Packard Co.
3 Crossways Park West
WOODBURY, NY 11797
Tel: (516) 682-7800
A,C,CM,E,M

North Carolina

Hewlett-Packard Co.
305 Gregson Dr.
CARY, NC 27511
Tel: (919) 467-6600
C,CM,E,M,P*

Hewlett-Packard Co.
9401 Arrow Point Blvd
Suite 100
CHARLOTTE, NC 28217
Tel: (704) 527-8780
C*

Hewlett-Packard Co.
5605 Roanne Way
GREENSBORO, NC 27420
Tel: (919) 852-1800
A,C,CM,E,M,P*

Ohio

Hewlett-Packard Co.
2717 S. Arlington Road
AKRON, OH 44312
Tel: (216) 644-2270
C,E

Hewlett-Packard Co.
4501 Erskine Road
CINCINNATI, OH 45242
Tel: (513) 891-9870
C,M

Hewlett-Packard Co.
15885 Sprague Road
CLEVELAND, OH 44136
Tel: (216) 243-7300
A,C,CM,E,M

Hewlett-Packard Co.
9080 Springboro Pike
MIAMISBURG, OH 45342
Tel: (513) 433-2223
A,C,CM,E*,M

Hewlett-Packard Co.
One Maritime Plaza, 5th Floor
720 Water Street
TOLEDO, OH 43604
Tel: (419) 242-2200
C

Hewlett-Packard Co.
675 Brooksedge Blvd.
WESTERVILLE, OH 43081
Tel: (614) 891-3344
C,CM,E*

Oklahoma

Hewlett-Packard Co.
3525 N.W. 56th St.
Suite C-100
OKLAHOMA CITY, OK 73112
Tel: (405) 946-9490
C,E*,M

SALES & SUPPORT OFFICES

Arranged alphabetically by country

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UNITED STATES (Cont'd)

Hewlett-Packard Co
6655 South Lewis,
Suite 105
TULSA, OK 74136
Tel: (918) 481-6700
A**,C,E,M*,P*

Oregon

Hewlett-Packard Co
9255 S. W. Pioneer Court
WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,C,E*,M

Pennsylvania

Hewlett-Packard Co
Heatherwood Industrial Park
50 Dorchester Rd
Route 22
HARRISBURG, PA 17112-2799
Tel: (717) 657-5900
C

Hewlett-Packard Co.
111 Zeta Drive
PITTSBURGH, PA 15238
Tel: (412) 782-0400
A,C,E,M

Hewlett-Packard Co.
2750 Monroe Boulevard
VALLEY FORGE, PA 19482
Tel: (215) 666-9000
A,C,CM,E,M

South Carolina

Hewlett-Packard Co.
Brookside Park, Suite 122
1 Harbison Way
COLUMBIA, SC 29212
Tel: (803) 732-0400
C,M

Hewlett-Packard Co.
545 N. Pleasantburg Dr.
Suite 100
GREENVILLE, SC 29607
Tel: (803) 232-8002
C

Tennessee

Hewlett-Packard Co
One Energy Centr. Suite 200
Pellissippi Pkwy
KNOXVILLE, TN 37932
Tel: (615) 966-4747
A,C,E,M,P

Hewlett-Packard Co
3070 Directors Row
Directors Square
MEMPHIS, TN 38131
Tel: (901) 346-8370
A,C,E,M

Hewlett-Packard Co
44 Vantage Way,
Suite 160
NASHVILLE, TN 37228
Tel: (615) 255-1271
A,C,E,M,P

Texas

Hewlett-Packard Co
1826-P Kramer Lane
AUSTIN, TX 78758
Tel: (512) 835-6771
C,E,P*

Hewlett-Packard Co.
5700 Cromo Dr
EL PASO, TX 79912
Tel: (915) 833-4400
C,E*,M**

Hewlett-Packard Co.
3952 Sandshell Drive
FORT WORTH, TX 76137
Tel: (817) 232-9500
C

Hewlett-Packard Co
10535 Harwin Drive
HOUSTON, TX 77036
Tel: (713) 776-6400
A,C,E,M,P*

Hewlett-Packard Co.
3301 West Royal Lane
IRVING, TX 75063
Tel: (214) 869-3377
C,E

Hewlett-Packard Co.
109 E. Toronto, Suite 100
McALLEN, TX 78501
Tel: (512) 630-3030
C

Hewlett-Packard Co
930 E. Campbell Rd.
RICHARDSON, TX 75081
Tel: (214) 231-6101
A,C,CM,E,M,P*

Hewlett-Packard Co
1020 Central Parkway South
SAN ANTONIO, TX 78232
Tel: (512) 494-9336
A,C,E,M,P*

Utah

Hewlett-Packard Co
3530 W. 2100 South St
SALT LAKE CITY, UT 84119
Tel: (801) 974-1700
A,C,E,M

Virginia

Hewlett-Packard Co.
840 Greenbrier Circle
Suite 101
CHESAPEAKE, VA 23320
Tel: (804) 424-7105
C,E,M

Hewlett-Packard Co
4305 Cox Road
GLEN ALLEN, VA 23060
Tel: (804) 747-7750
A,C,E,M,P*

Hewlett-Packard Co
Tanglewood West Bldg
Suite 240
3959 Electric Road
ROANOKE, VA 24018
Tel: (703) 774-3444
C,E,P

Washington

Hewlett-Packard Co.
15815 S.E. 37th Street
BELLEVUE, WA 98006
Tel: (206) 643-4004
A,C,CM,E,M

Hewlett-Packard Co.
1225 Argonne Rd
SPOKANE, WA 99212
Tel: (509) 922-7000
C

West Virginia

Hewlett-Packard Co.
501 56th Street
CHARLESTON, WV 25304
Tel: (304) 925-0492
A,C,M

Wisconsin

Hewlett-Packard Co.
275 N. Corporate Dr.
BROOKFIELD, WI 53005
Tel: (414) 784-8800
A,C,E*,M

URUGUAY

Pablo Ferrando S.A.C. e I.
Avenida Italia 2877
Casilla de Correo 370
MONTEVIDEO
Tel: 59-82-802-586
Telex: 398802586
A,CM,E,M

Olympia de Uruguay S.A.
Maquines de Oficina
Avda. del Libertador 1997
Casilla de Correos 6644
MONTEVIDEO
Tel: 91-1809, 98-3807
Telex: 6342 OROU UY
P

VENEZUELA

Hewlett-Packard de Venezuela C.A.
3A Transversal Los Ruices Norte
Edificio Segre 2 & 3
Apartado 50933
CARACAS 1050
Tel: (582) 239-4133
Telex: 251046 HEWPACK
A,C,CM,E,M,P

Hewlett-Packard de Venezuela, C.A.
Centro Ciudad Comercial Tamanaco
Nivel C-2 (Nueva Etapa)
Local 53H05
Chuao, **CARACAS**
Tel: 928291
P

Albis Venezolana S.R.L.
Av. Las Marias, Ota. Alix,
El Pedregal
Apartado 81025
CARACAS 1080A
Tel: 747984, 742146
Telex: 24009 ALBIS VC
A

Tecnologica Medica del Caribe, C.A.
Multicentro Empresarial del Este
Ave. Libertador
Edif. Libertador
Nucleo "C" - Oficina 51-52
CARACAS
Tel: 339867/333780
M

Hewlett-Packard de Venezuela C.A.
Residencias Tia Betty Local 1
Avenida 3 y con Calle 75
MARACAIBO, Estado Zulia
Apartado 2646
Tel: 58-2-617-5669
Telex: 62464 HPMAR
C,E*

Hewlett-Packard de Venezuela C.A.
Urb. Lomas de Este
Torre Trebol – Piso 11
VALENCIA, Estado Carabobo
Apartado 3347
Tel: (5841) 222992
C,P

YUGOSLAVIA

Do Hermes
General Zdanova 4
YU-11000 **BEOGRAD**
Tel: (011) 342 641
Telex: 11433
A,C,E,M,P

Do Hermes
Celovsku 73
YU-61000 **LJUBLJANA**
Tel: (061) 553 170
Telex: 31583
A,C,E,M,P

Elektrotehna
Titova 51
YU-61000 **LJUBLJANA**
CM

Do Hermes
Kralja Tomislava 1
YU-71000 **SARAJEVO**
Tel: (071) 35 859
Telex: 41634
C**,P

ZAIRE

Computer & Industrial Engineering
25, Avenue de la Justice
B.P. 12797
KINSHASA, Gombe
Tel: 32063
Telex: 21552
C,P

ZAMBIA

R.J. Tilbury (Zambia) Ltd
P.O. Box 32792
LUSAKA
Tel: 215590
Telex: 40128
E

ZIMBABWE

Field Technical Sales (Private) Limited
45, Kelvin Road North
P.O. Box 3458
SALISBURY
Tel: 705 231
Telex: 4-122 RH
E,P

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