HP 4062C/PC Semiconductor Parametric Test System
HP 4062UX Semiconductor Process Control System

Programming Reference

HEWLETT
PACKARD

HP Part No. 04062-90331
Printed in Japan February 1995

Edition 2
E0295

Product Warranty

This Hewlett-Packard system product is warranted against defects in material and workmanship for a period of one year from date of installation. During the warranty period, HP will, at its option, either repair or replace products which prove to be defective.

Warranty service of this product will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other cases, products must be returned to a service facility designated by HP.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modifications or misuse, operation outside of the environment specifications for the products, or improper site preparation or maintenance.

No other warranty is expressed or implied. Hewlett-Packard specifically disclaims the implied warranties or merchantability and fitness for a particular purpose.

Exclusive Remedies

The remedies provided herein are buyer's sole and exclusive remedies. Hewlett-Packard shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Assistance

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

Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. HP further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology (NIST), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page change only when a new edition is published. No information is incorporated into a reprinting unless it appears as a prior update; the edition does not change when an update is incorporated.

The software revision code printed before the date indicates the version level of the software product at the time the manual or update was issued. Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one to one correspondence between product updates and manual updates.

Edition 1	Rev. C.05.60 and X.05.60, January 1990
Update 1	Rev. C.06.00 and X.06.00, May 1991
Update 2	Rev. C.06.20, X.06.20, and P.06.20, November 1991
Edition 2	Rev. C.06.30, X.06.30, and P.06.30, February 1995

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 may impair the protections provided by the equipment. In addition, it violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for customer's failure to comply with these requirements.

Note HP 4062C/UX complies with INSTALLATION CATEGORY II and POLLUTION DEGREE 2 defined in IEC 1010-1.
HP 4062C/UX is INDOOR USE product.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The power terminal and the power cable must meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

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.

KEEP AWAY FROM LIVE CIRCUITS

Operation personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for services and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

Warning **Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.**

Safety Symbols

The general definitions of safety symbols used on equipment or in manuals are listed below.

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

OR

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).

Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

OR

Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current.

Direct current.

ON (Supply).

OFF (Supply).

STANDBY (Supply).

Warning The warning sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

Caution The caution sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

Note The note sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

Preface

Purpose

This manual contains the information about subprograms that are provided for both HP 4062C and HP 4062UX system.

Audience

This manual is intended for programmers who develop test programs with the HP 4062C/UX system.

Contents

This manual provides the information on all the subprograms that is used in the user-written test programs.

Contents

Figures

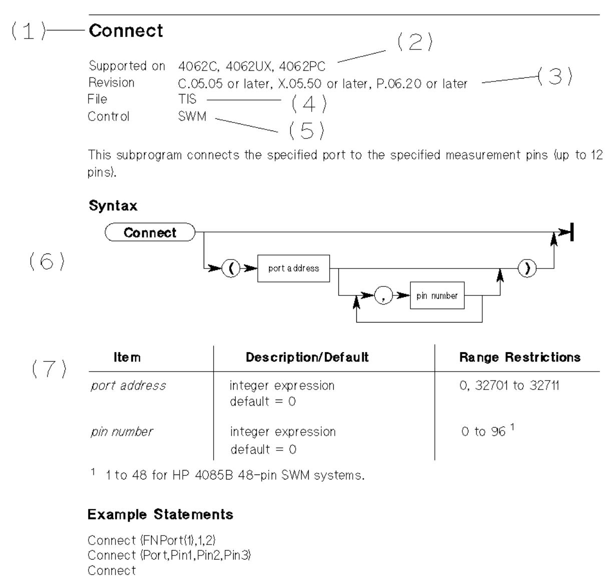
Tables

1

Programming Reference

Introduction

This manual contains an alphabetical listing of subprograms contained in the system software of the HP 4062C/UX that can be called in user-written programs. Each entry defines the subprogram name, shows the syntax of the calling context, gives several examples, and explains relevant descriptions, as shown below.



(1) Subprogram name.

(2) Name abbreviations for the supported product.

(3) Supported revision for the subprogram.

(4) Name of file that contains this subprogram.

(5) Device controlled by this subprogram. Note that the device indicated here is the primary device. Other devices, however, may be affected also.

(6) Syntax diagram of the calling context for the subprogram.

(7) Explanation of parameters.

Syntax Diagram Explanation

Subprogram calling context is represented pictorially. All characters enclosed by a rounded envelope must be entered exactly as shown. Words enclosed by a rectangular box are names of items used in the calling context.

A description of each item is given either in the table following the drawing or another drawing. Optional items usually have default values. The table or text following the drawing specifies the default value used when an optional item is not included in a calling context.

Calling context elements are connected by lines. Each line can be followed in only one direction, as indicated by the arrow at the end of the line. Any calling context that can be generated by following the lines in the proper direction is syntactically correct. An element is optional if there is a path around it.

The omission of CALL when invoking a subprogram is left to the discretion of the programmer. However, the following three instances require the CALL statement when invoking a subprogram:

- If the subprogram is called from the keyboard
- If the subprogram is called after the THEN keyword in an IF statement
- In an ON *event* CALL statement

Assumptions on the Reference Pages

To simplify the subprogram descriptions, the following information is assumed.

Dimensioning an Array

The first element number of an array is assumed to be 1 in this manual. Therefore, the size of array is the same as the last array number. To declare the dimension of an array in a user-written program, use the following statements:

```
10  OPTION BASE 1
20  DIM Voltage(50)
30   . . . .
```

or

```
10  REAL Current(1:30)
20   . . . .
```

Abbreviations

Throughout this manual, the following abbreviations are used to identify subsystems and instruments of the HP 4062C/UX:

SMS: **S**witching **M**atrix **S**ubsystem: consist of the SWC(s) and SWM

SWC: HP 4084B **SW**itching Matrix **C**ontroller

SWM: HP 4085B or HP 4089A **SW**itching **M**atrix

DCS: **DC** Measuremnet **S**ubsystem: HP 4142B Modular DC Source/Monitor

CMS: **C**apacitance **M**easurement **S**ubsystem

CMU: **C**apacitance **M**easurement **U**nit: HP 4280A 1 MHz C Meter/C-V Plotter

CMU84: **C**apacitance **M**easurement **U**nit: HP 4284A 20 Hz–1 MHz Precision LCR Meter

SMU: **S**ource **M**onitor **U**nit: HP 41420A (1 A/200 V) and HP 41421B (100 mA/100 V)

VS/VMU: **V**oltage **S**ource/**V**oltage **M**onitor **U**nit: HP 41424A

AFU: **A**nalog **F**eedback **U**nit: HP 41425A

GNDU: **G**rou**ND** **U**nit

TIS: **T**est **I**nstruction **S**et

CSUB: **C**ompiled **SUB**program

Subprogram Listings

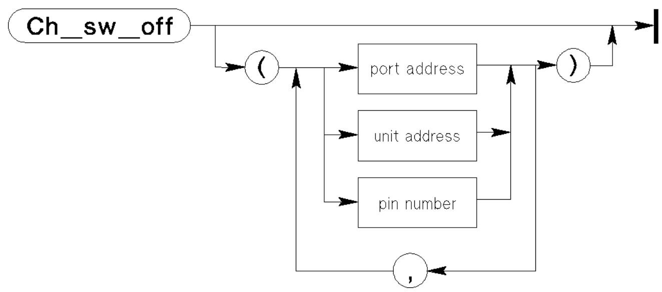
The following pages provide descriptions for all TIS, PARA, XYGRAPH, WAFER, VFP, TIS_UTIL, DVR4284, and prober driver subprogram files (EGX, EGY, and TSK) included in your HP 4062C/UX system software. The subprograms are arranged in alphabetical order.

Ch_sw_off

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the output switch of the specified DCS output unit(s) to off (disables output).

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (SMU) 32705, 32706, 32708, 32709, 32721 to 32732 [1]
unit address	integer expression	32621 to 32628 (HP 41421B SMU) 32629 to 32632 (HP 41420A SMU) 32633, 32635, 32637 · · · 32663 (for HP 41424A (VS/VMU) VSs) [2]
pin number	integer expression	1 to 96 [3]

1 The 32721 to 32732 port addresses are available only when your SWM is equipped with a port expander and when the system instruments are connected to the proper SWM ports.
2 The VMs of the VS/VMU do not have output switches.
3 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

Example Statements

```
Ch_sw_off(32621, 32622)
Ch_sw_off(32629)
Ch_sw_off(FNUnitsmu(1), FNUnitsmu(2))
Ch_sw_off(FNUnitsmu(2))
Ch_sw_off(FNVs(1))
Ch_sw_off
```

Description

This subprogram sets the output switch of the specified DCS output unit(s) to off, and sets the mask flag of the output unit. Either *port address*, *unit address*, or *pin number* can be used to specify the output unit(s). Up to 8 output units can be specified. Mask flags are cleared by the Ch_sw_on subprogram only. If no parameters are specified, this subprogram disconnects all output switches and sets the mask flag of each output unit.

This subprogram cannot be used if an output unit is set to the High Voltage state (more than 42 V). If no parameters are specified, however, all output switches are set to off even if one or more output units are set to the High Voltage state.

When this subprogram executes, the specified output unit(s) are set as follows:

	SMU	**VS**
output switch	OFF	OFF
output mode	voltage	—
output voltage	0 V (20 V range)	0 V (20 V range)
compliance/limiter	100 μA compliance (100 μA range)	100 mA limiter
SMU filter	ON	—

The following TIS subprograms also control the output switch of the DCS output units, as described in the table below:

Subprogram	**Description**
Init_system	Sets all output switches to off and clears all mask flags.
Force_v, Force_i, Set_iv, Set_piv, Set_pbias, Measure_p, Set_sync, Set_asearch, Set_bsearch, Set_lsearch	Sets all output switches to on (ignores mask flag setting).

See Also

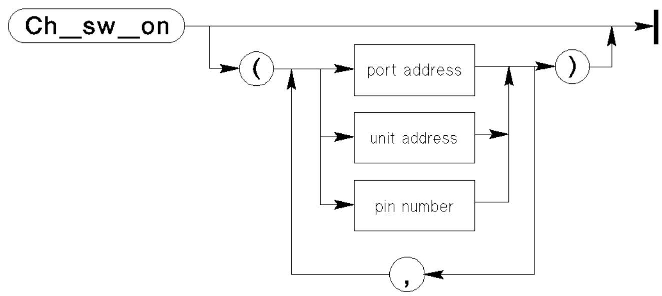
Ch_sw_on

Ch_sw_on

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the output switch of the specified DCS output unit(s) to on (enables output).

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (SMU) 32705, 32706, 32708, 32709, 32721 to 32732 [1]
unit address	integer expression	32621 to 32628 (HP 41421B SMU) 32629 to 32632 (HP 41420A SMU) 32633, 32635, 32637 · · · 32663 (for HP 41424A (VS/VMU) VSs) [2]
pin number	integer expression	1 to 96 [3]

1 The 32721 to 32732 port addresses are available only when your SWM is equipped with a port expander and when the system instruments are connected to the proper SWM ports.
2 The VMs of the VS/VMU do not have output switches.
3 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

Example Statements

```
Ch_sw_on(32621, 32622)
Ch_sw_on(32629)
Ch_sw_on(FNUnitsmu(1), FNUnitsmu(2))
Ch_sw_on(FNUnitsmu(2))
Ch_sw_on(FNVs(1))
Ch_sw_on
```

Description

This subprogram sets the output switch of the specified DCS output unit(s) to on, and clears the mask flag of the output unit. Either *port address*, *unit address*, or *pin number* can be used to specify the output unit(s). Up to 8 output units can be specified. Mask flags are set by the Ch_sw_off subprogram only. If no parameters are specified, this subprogram connects all output switches and clears the mask flag of each output unit.

This subprogram cannot be used if an output unit is set to the High Voltage state (more than 42 V). If no parameters are specified, however, all output switches are set to on even if one or more output units are set to the High Voltage state.

When this subprogram executes, the specified output units are set as follows:

	SMU	VS
output switch	OFF	OFF
output mode	voltage	—
output voltage	0 V (20 V range)	0 V (20 V range)
compliance/limiter	100 μA compliance (100 μA range)	100 mA limiter
SMU filter	ON	—

The following TIS subprograms also control the output switch of the DCS output units as described below:

Subprogram	Description
Init_system	Sets all output switches to off and clears all mask flags.
Force_v, Force_i, Set_iv, Set_piv, Set_pbias, Measure_p, Set_sync, Set_asearch, Set_bsearch, Set_lsearch	Sets all output switches to on (ignores mask flag setting).

See Also

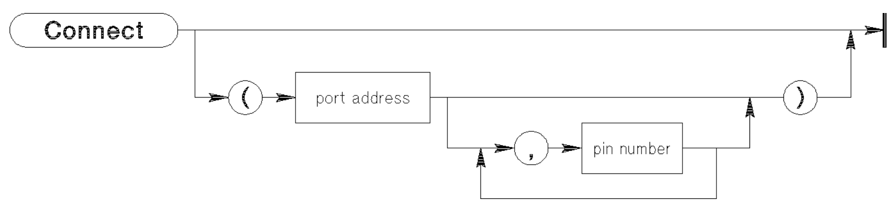
Ch_sw_off

Connect

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	SWM

This subprogram connects the specified port to the specified measurement pins (up to 12 pins).

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression default = 0	0, 32701 to 32711, 32721 to 32732 [1]
pin number	integer expression default = 0	0 to 96 [2]

[1] The 32721 to 32732 port addresses are available only when your SWM is equipped with a port expander and when the system instruments are connected to the proper SWM ports.
[2] 0 to 48 for HP 4085B 48-pin SWM systems.

Example Statements

```
Connect (FNPort(1),1,2)
Connect (Port,Pin1,Pin2,Pin3)
Connect
```

Description

No more than one port can be connected to a measurement pin. Thus, if the same *pin number* appears in two or more Connect subprograms that specify different ports, only the port specified in the most recent Connect subprogram is connected to the measurement pin. Conversely, a port can be connected to up to twelve measurement pins with one Connect subprogram, without having to clear previous SWM settings. Thus, a single port can be connected to all measurement pins with additional Connect subprograms.

If the *port address* in a Connect subprogram is 0, all measurement pins specified in the subprogram are disconnected. If the first specified *pin number* is 0, the specified port is disconnected from all measurement pins. If the Connect subprogram contains no parameters, or if both parameters are 0, all measurement pins are disconnected from all ports.

Statements	Line Number	Connected Pins	
`10 Init_system`	10	–	–
`20 Connect(FNPort(1),1,2,3)`	20	1, 2, 3	–
`30 Connect(FNPort(2),3,4)`	30	1, 2	3, 4
`40 Connect(0,1)`	40	2	3, 4
`50 Connect(FNPort(2),5)`	50	2	3, 4, 5
`60 Connect(FNPort(2),0)`	60	2	–
`70 Connect`	70	–	–

If the device connected to the specified port is ACTIVE when the Connect subprogram executes, other related devices are set to Zero Output. Refer to the following table:

Port	Port Number	Description
SMU1 SMU2 SMU3 SMU4	1 2 3 4	Only the specified SMU is set to Zero Output status if it is ACTIVE when the Connect subprogram executes. The status of other ports, ACTIVE or not, is not affected.
AUX1 AUX2	5 6	If the VS cable is connected to these ports, all ACTIVE VSs and SMUs connected to the SWM are set to Zero Output.
GNDU GSMU	7 10, −1	All ACTIVE SMUs and VSs are set to Zero Output.
AUX3(CMH) AUX4(CML) GCMU	8 9 11, −8, −9	If the VS cable is connected to these ports, all ACTIVE VSs and SMUs connected to the SWM are set to Zero Output. If CMH and CML cables are connected to these ports, the internal dc bias source of the CMU is set to Zero Output.

If a device is set to Zero Output status by the Connect subprogram and is still connected to measurement pins, it can be returned to its previous setting with the Force_i, Force_v, or Execute subprogram.

If your system is equipped with an HP 4089A SWM, the Switching Matrix Subsystem consists of one HP 4089A SWM and two HP 4084B SWCs. One SWC controls measurement pins 1 to 48 (block 1), and the other SWC controls measurement pins 49 to 96 (block 2).

All pin-port interconnections are controlled by the input relays for each block. Input relays are automatically controlled by the Connect TIS subprogram, which connects the specified pin(s) and port(s). Refer to the HP 4089A SWM Diagram discussion in chapter 2 of the *System Information* Manual for more information.

An operational example for controlling input relays and pin-port interconnections is as follows:

Statements	Connected Ports of Input relays		Connected Pins	
	Block 1	Block 2	Port (1)	Port(2)
`10 Init_system`	—	—	—	—
`20 Connect(FNPort(1),1)`	1	—	1	—
`30 Connect(FNPort(1),5,50,55)`	1	1	1,5,50,55	—
`40 Connect(FNPort(1),0)`	1	—	—	—
`50 Connect(FNPort(1),70)`	—	1	70	—
`60 Connect(FNPort(2),10,20,80,90)`	2	1,2	70	10,20,80,90
`70 Connect(FNPort(1),10)`	1,2	1,2	10,70	20,80,90
`80 Connect(0,90)`	1,2	1,2	10,70	20,80
`90 Connect(0,20,80)`	1,2	1	10,70	—
`100 Connect`	—	—	—	—

Note

If you connect a measurement port to measurement pins in both blocks 1 and 2, guard capacitance increases more than usual, resulting in the following:

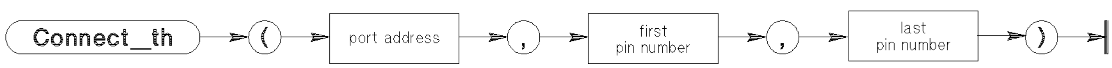
- For capacitance measurements, the accuracy of the measurement results is not guaranteed. Capacitance measurement error correction is valid only when the CML or CMH ports of the CMS are connected to two measurement pins in either block 1 or block 2.
- For SMU measurements, SMU oscillation may occur.

Connect_th

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control SWM

This program connects the specified port to a range of measurement pins.

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression	32701 to 32711, 32721 to 32732 [1]
first pin number	integer expression less than the last pin number	1 to 96 [2]
last pin number	integer expression greater than the first pin number	1 to 96 [2]

1 The 32721 to 32732 port addresses are available only when your SWM is equipped with a port expander and when the system instruments are connected to the proper SWM ports.
2 1 to 48 for HP 4085B 48-pin SWM systems.

Example Statements

```
Connect_th(FNGnd,3,10)
Connect_th(Port,From_pin,To_pin)
```

Description

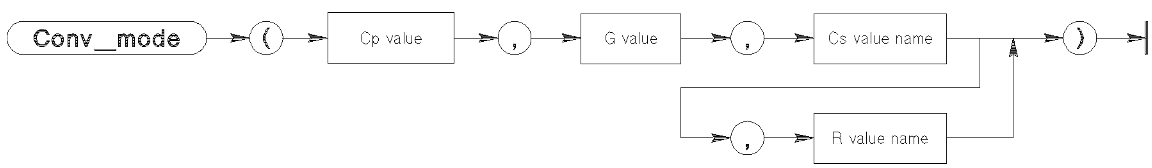
The Connect_th subprogram is functionally identical to the Connect subprogram. Refer to the Semantics of the Connect subprogram for further details.

Conv_mode

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS_UTIL
Control —

This utility subprogram converts the capacitance and conductance measurement values obtained by Measure_cmu to the capacitance and resistance values of a series equivalent circuit, and returns the values.

Syntax



Item	Description/Default	Range Restrictions
C_p *value*	numeric expression: [F]	larger than 0
G value	numeric expression: [S]	larger than 0
Cs value name	numeric variable name	any valid name
R value name	numeric variable name	any valid name

Example Statements

```
Measure_cmu(Cap,G)
Conv_mode(Cap,G,Cs,R)
```

Description

The Measure_cmu subprogram measures the capacitance Cp and conductance Gp of a parallel equivalent circuit. This utility subprogram converts these measurement values to the capacitance Cs and resistance Rs of a series equivalent circuit. The capacitance Cs and resistance Rs of a series circuit are calculated by the following formulas:

$$C_s = (1 + D^2)C_p$$

$$R_s = \frac{D^2}{1 + D^2} \times \frac{1}{G}$$

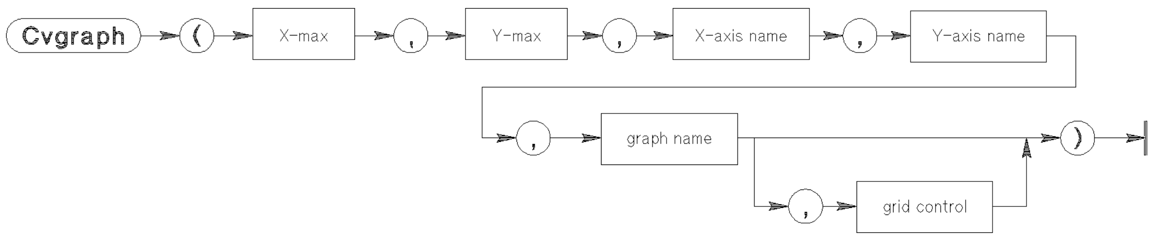
where d = $\frac{\mathrm{g}}{\omega \mathrm{C_p}}$, $\omega = 2\pi$f, f: measurement frequency (1 MHz).

Cvgraph

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File XYGRAPH
Control —

This subprogram clears the CRT of all graphics and optimizes the specified X-max and Y-max values. Next, it draws a Y-axis between 0 and the optimized Y-axis value, and draws an X-axis between the negative and positive equivalents of the X-max value.

Syntax



Item	Description/Default	Range Restrictions
X-max	numeric expression	—
Y-max	numeric expression	—
X-axis name	string expression	—
Y-axis name	string expression	—
graph name	string expression	—
grid control	integer expression default=0	0: no grid lines 1: grid lines

Example Statements

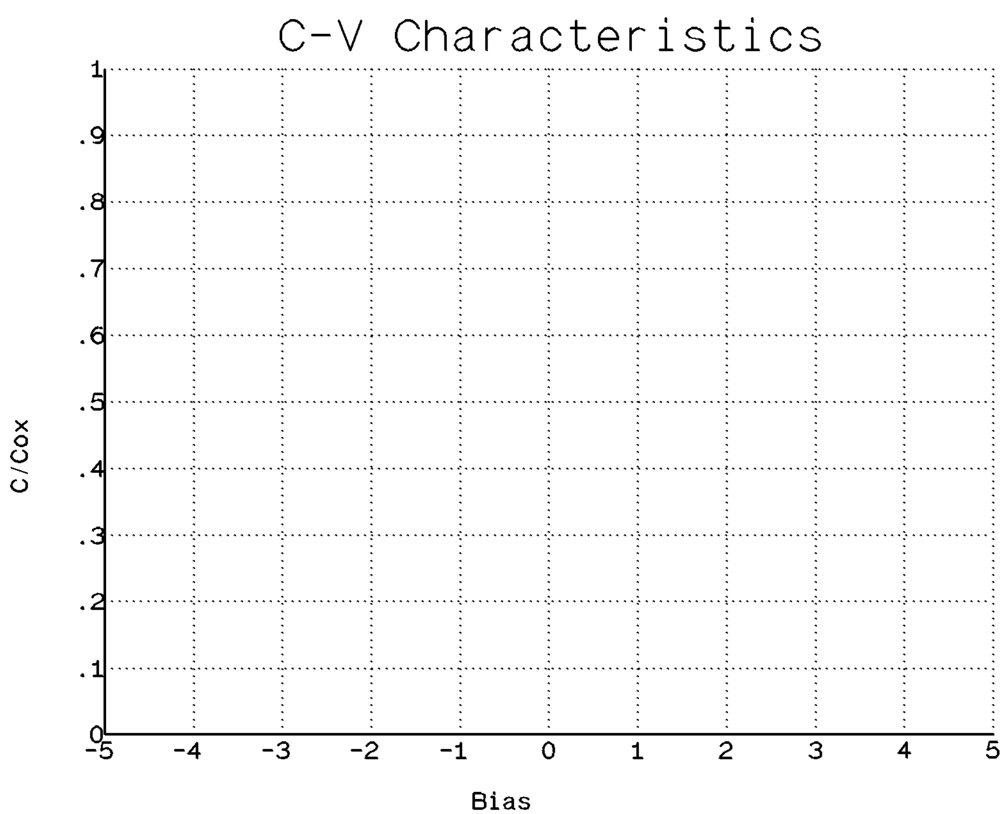
```
Cvgraph(-5,1,"Bias","C/Cox","C-V Characteristics",1)
Cvgraph(Xmax,Ymax,Xname$,Graph_name$,Gridding)
```

Description

This subprogram executes a BASIC language GINIT statement and plots a graph in accordance with the specified parameters. For example, executing the first example statement will result in the graph shown below. The Cvgraph subprogram also sets certain graphics-related variables by executing a subroutine similar to the one shown here.

```
DEG
VIEWPORT RATIO*12,PATIO*17,95
WINDOW -Xmaxaxis,Xmaxaxis,0,Ymaxaxis
CLIP ON
CSIZE 0
LDIR 0
LORG 8
LINE TYPE 1
MOVE -Xmaxaxis,0
```

Xmaxaxis: Maximum value of the X-axis
Ymaxaxis: Maximum value of the Y-axis

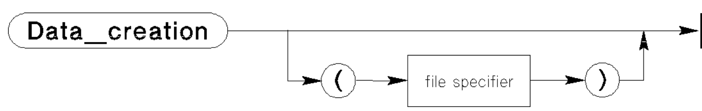


Data_creation

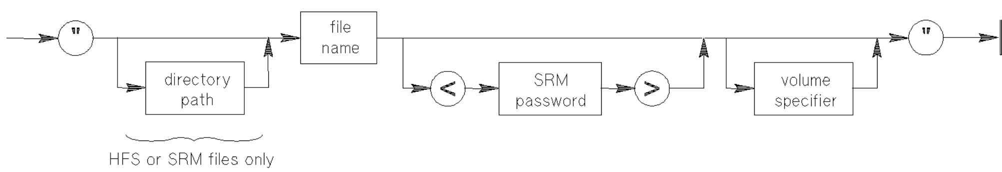
Supported on 4062UX
Revision X.05.50 or later
File TIS
Control —

This subprogram creates an offline data simulation file.

Syntax



Literal form of file specifier:



Item	Description/Default	Range Restrictions
file specifier	string expression	(see drawing)
directory path	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)
file name	literal	depends on the format of the volume (see Glossary in the *BASIC Language Reference*)
SRM password	literal; first 16 nonblank characters are significant	> not allowed
volume specifier	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)

Example Statements

```
Data_creation("DUM_VTH")
Data_creation
```

Description

This subprogram starts and stops the automatic creation of an offline data simulation file.

Online mode operation

If you specified a *file specifier*, this subprogram automatically creates an offline data simulation file and stores the measurement data of the TIS program into the file. If this subprogram executes without a *file specifier* specified, automatic file creation stops.

Offline mode operation

Constant data simulation mode: If you specify a *file specifier*, this subprogram automatically creates an offline data simulation file and stores the simulated constant values of the TIS program into the file. If this subprogram executes without a *file specifier* specified, automatic file creation stops.

File data simulation mode: If you specified a *file specifier*, this subprogram resets to the constant data simulation mode, automatically creates an offline data simulation file. The simulated constant values of the TIS program are stored in the file. If this subprogram executes without a *file specifier* specified, automatic file creation stops.

File creation and data storing stops if this subprogram executes without a *file specifier* specified and if a TIS error occurs. Also, file creation stops if the Off_line_data subprogram executes while in the offline mode.

See Also

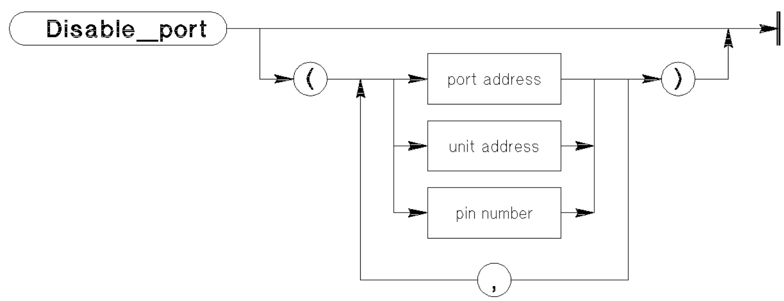
Off_line_data

Disable_port

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS, CMU, CMU84 (CMU84 is supported only by Rev. C.05.60 or later, and X.05.60 or later.)

This subprogram sets the specified ports, measurement pins, or units to Zero Output status.

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression default = all ports	0, 32701 to 32706, 32708 to 32710 [1], 32721 to 32732 [2]
unit address	integer expression	0, 32621 to 32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663, 32671, 32676 [3]
pin number	integer expression	0, 1 to 96 [4]

[1] Only ports connected to the SWM can be specified. 32710 is available only when an SMU is connected to the SMU1 port.

[2] The 32721 to 32732 port addresses are available only when your SWM is equipped with a port expander and when the system instruments are connected to the proper SWM ports.

[3] This unit address is available for CMU84 only.

[4] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

Example Statements

```
Disable_port(FNPort(1),FNPort(2))
Disable_port(Drain,Source,Gate)
Disable_port(FNUnitsmu(1),FNVs(1))
Disable_port
```

Description

Either *port addresses* or *pin numbers* can be used to specify units that are connected to pins or ports, and are to be disabled. The *unit address* can be used to specify units that are not connected to the SWM, and are to be disabled.

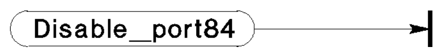
Up to 8 parameters can be specified. If no *port addresses*, *unit addresses*, or *pin numbers* are specified or if 0 is specified, all ports and units are set to Zero Output when this subprogram executes. If the *unit address* of a nonexistent unit is specified, an error occurs.

Disable_port84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284
Control	CMU84

This subprogram sets the ports of the CMU84 to Zero output status.

Syntax



Example Statement

```
Disable_port84
```

Description

This subprogram sets the dc bias voltage to 0 V. When the pin-port connections are changed, the dc bias voltage between the CMH and CML ports must be 0 V. See the Force_v84 reference page for more information about using this subprogram.

This subprogram is equivalent to the Disable_port(FNCmu84(1)) statement.

See Also

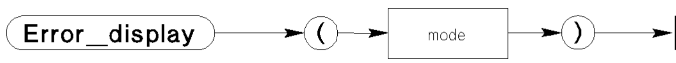
Force_v84
Disable_port

Error_display

Supported on 4062C, 4062UX, 4062PC
Revision C.05.60 or later, X.05.50 or later, P.06.20 or later
File TIS
Control —

This subprogram enables and disables the displaying of TIS error messages when executing the TIS CSUBs.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
mode	integer expression default = 1	−32768 to 32767	0: disabled 1: enabled

Description

If an error is detected during TIS subprogram execution, a TIS error number and an error message is displayed on the display line. This error number and message display can be suppressed by using this subprogram. Calling this subprogram with *mode* set to 0 suppresses the TIS error display; setting *mode* to nonzero enables the TIS error display.

If the TIS error display is disabled by this subprogram, BASIC errors caused by TIS errors are still displayed. BASIC errors, however, can be trapped in a program by using the ON ERROR statement.

Error display is enabled when a program is loaded and when TIS is linked.

See Also

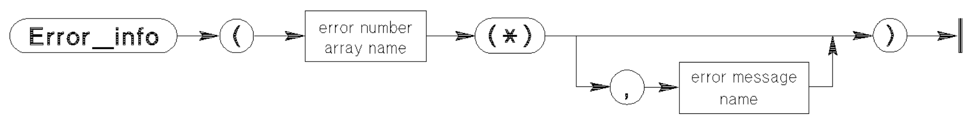
Error_info

Error_info

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This subprogram returns a TIS error number and an error message string.

Syntax



Item	Description/Default	Range Restrictions
error number array name	integer array name array(1): TIS error number array(2): DCS error number (if array(1)=40) CMU84 error number (if array(1)=85) [1]	any valid name (size=2)
error message name	string variable name	any valid string name (size=100)

[1] CMU84 is supported only by Rev. C.06.00 or later and X.06.00 or later.

Example statements

```
Error_info(Error_number(*))
Error_info(Error_number(*), Error_msg$)
```

Description

This subprogram examines the completion status of the most recently executed TIS subprogram and returns the error numbers and error message string to *error number array* and *error message name*, respectively. The first array value represents the TIS error number, and the second array value represents the DCS error number if the TIS error number is 40. If the previous TIS subprogram executed with *no* errors, both error numbers are set to 0 and the error message string is a null string.

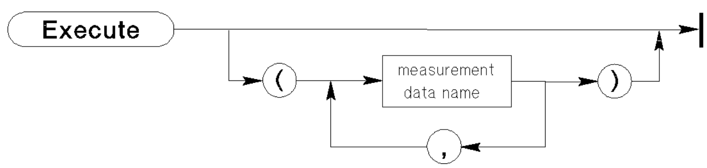
If the specified *error message name* is not large enough to store the entire error message, the error message is truncated.

Execute

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS, CMU, SWM

This subprogram executes all program lines in a Prepare ... Execute construct. It can also be used to re-establish the original settings of once ACTIVE devices that are set to Zero Output status by the Connect or Connect_th subprograms.

Syntax



Item	Description/Default	Range Restrictions
measurement data name	numeric variable name	any valid name

Description

If the program lines in a Prepare ... Execute construct include any measurement subprograms, the Execute subprogram must specify as many *measurement data names* as measurements made in the construct. Measurement results are assigned to these measurement data names, not to the dummy names specified in the various measurement subprograms. The order in which the *measurement data names* are specified corresponds to the order of the measurement subprograms in the Prepare ... Execute construct. More information can be found in the discussion of the Prepare ... Execute construct.

Another function of the Execute subprogram is to re-establish or recall the original settings of devices (SMUs, VSs, or the internal dc bias source of the CMU) that were ACTIVE but are set to Zero Output status by a Connect or Connect_th subprogram. This is possible only if the port connected to the device is still connected to a measurement pin.

Note Execute is *not* supported in the offline mode for HP 4062UX. Calling Execute in the offline mode results in an error.

See Also

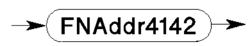
Prepare ... Execute

FNAddr4142

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	—

This function returns the DCS device selector, which consists of an interface select code and a primary address.

Syntax



Example Statement

```
Dcs_addr=FNAddr4142
ASSIGN @Dcs TO FNAddr4142
```

Description

This function gets the device selector of the DCS. The device selector consists of an interface select code and a primary address. For the default system configuration, this function returns 2723.

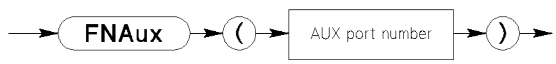
If the DCS is not configured, turned off, or if the system is in the offline mode (HP 4062UX only), this function returns a 0.

FNAux

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control —

This function returns the address of a specified AUX (auxiliary) port of the SWM.

Syntax



Item	Description/Default	Range Restrictions
AUX port number	integer expression	1, 2, 3, 4, 11 to 13[1], 21 to 23[1], 31 to 33[1], 41 to 43[1]

1 These AUX port numbers are used for the AUX ports of the port expander.

Example Statements

```
Vs1=FNAux(1)
Aux_port=FNAux(N)
```

Description

Port addresses, AUX port numbers, and AUX port names are as follows:

Port Name	AUX Port	Port Address	Port Name	AUX Port	Port Address
AUX1	1	32705	AUX3 (CMH)	3	32708
AUX11[1]	11	32721	AUX31[1] (CMH)	31	32727
AUX12[1]	12	32722	AUX32[1]	32	32728
AUX13[1]	13	32723	AUX33[1] (SMU)	33	32729
AUX2	2	32706	AUX4 (CML)	4	32709
AUX21[1]	21	32724	AUX41[1] (CML)	41	32730
AUX22[1]	22	32725	AUX42[1]	42	32731
AUX23[1]	23	32726	AUX43[1] (SMU)	43	32732

1 These AUX ports are available for the port expander of the SWM.

See Also

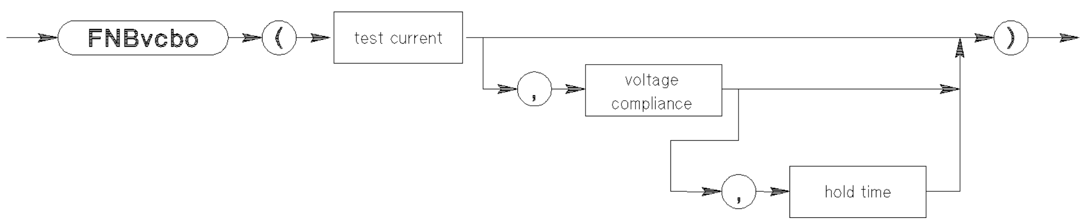
FNPort

FNBvcbo

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function measures the collector-base breakdown voltage of a bipolar transistor and returns the measurement result to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
test current	numeric expression: [A]	−0.1 to 0.1
voltage compliance	numeric expression: [V] default = 20	−100 to 100 [1]
hold time	numeric expression: [s] default = 0.4	—[2]

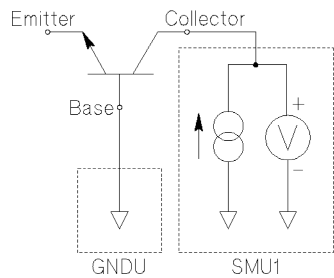
1 Actual range restrictions for *voltage compliance* depend on the specified *test current*. Refer to the Force_i subprogram for details.
2 Refer to WAIT in the *BASIC Language Reference* Manual.

Example Statements

```
Vcbo=FNBvcbo(1.E-5)
Vcbo=FNBvcbo(Ic,Vlimit, Hold_time)
```

Description

This function connects SMU1 and GNDU to the measurement pins specified in the Set_tr subprogram. The resulting measurement circuit is shown below.



SMU1 outputs the specified *test current*, waits the specified *hold time*, and measures the collector-base voltage of the transistor. This measurement value is the breakdown voltage of the test device, and is returned to the user-specified variable.

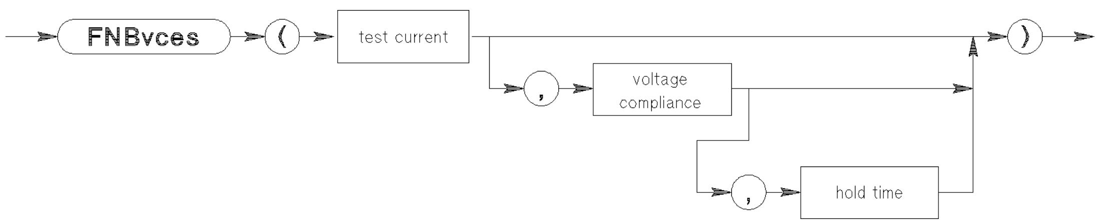
A hold time is required to allow the current source to fully charge the output capacitance of the SMU and to allow the transistor to complete minority carrier generation. Immediately after the measurement, SMU1 is set to Zero Output, and both the SMU1 and GNDU ports are disconnected from the measurement pins.

FNBvces

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File PARA
Control DCS, SWM

This function measures the collector-emitter breakdown voltage of a bipolar transistor with the base and substrate both connected to the emitter. The function then returns the measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
test current	numeric expression: [A]	−0.1 to 0.1
voltage compliance	numeric expression: [V] default = 20	−100 to 100 [1]
hold time	numeric expression: [s] default = 0.4	—[2]

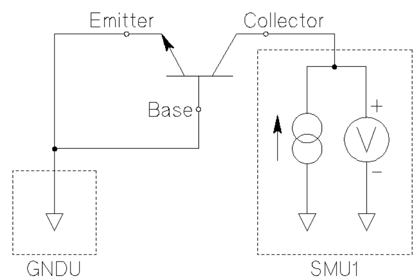
1 Actual range restrictions for *voltage compliance* depend on the specified *test current*. Refer to the Force_i subprogram for details.
2 Refer to WAIT in the *BASIC Language Reference* Manual.

Example Statements

```
Vces=FNBvces(1.E-3)
Vces=FNBvces(Ic,Vlimit, Hold_time)
```

Description

This function connects SMU1 and GNDU to the measurement pins specified in the Set_tr subprogram. The resulting measurement circuit is shown below.



SMU1 outputs the specified *test current*, waits the specified *hold time*, and measures the collector voltage of the transistor. This measurement value is the test voltage of the test device, and is returned to the user-specified variable.

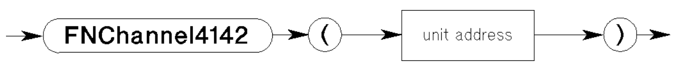
A hold time is required to allow the current source to fully charge the SMU output capacitance and to allow the transistor to complete minority carrier generation. Immediately after the measurement, SMU1 is set to Zero Output, and both the SMU1 and GNDU ports are disconnected from the measurement pins.

FNChannel4142

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	—

This function returns the DCS channel number of a specified unit address.

Syntax



Item	Description/Default	Range Restrictions
unit address	integer expression	32621 to 32664

Example Statement

```
No_smu3=FNChannel4142(FNUnitsmu(3))
No_smu3=FNChannel4142(FNUnit4142(FNSmu(3)))
No_vm2=FNChannel4142(FNVm(2))
No_vs1=FNChannel4142(32633)
OUTPUT @Dcs;"DV";FNChannel4142(FNUnitsmu(1)),0,1
```

Description

This function is useful for storing the DCS control commands in program memory. When you use a program that sends the DCS control command using the OUTPUT statement, the channel number of the DCS is used to specify the units under control (SMU, VS, or VM). You do not need to know where the units are installed in the DCS to use this function.

For more information on the channel number, see the HP 4142B *Operation Manual*.

See Also

FNUnit4142

FNCmh

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the CMH port address of the SWM and is functionally identical to FNPort(8).

Syntax

Example Statement

```
Cmh=FNCmh
```

Description

This function cannot be used if the CMH is not connected to the AUX3(CMH) port.

See Also

FNCml
FNCmu
FNPort

FNCml

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the CML port address of the SWM and is functionally identical to FNPort(9).

Syntax

Example Statement

```
Cml=FNCml
```

Description

This function cannot be used if the CML is not connected to the AUX4(CML) port. If your SWM has a port expander, the AUX4 (CMH) port address is identical to the AUX41 port address.

See Also

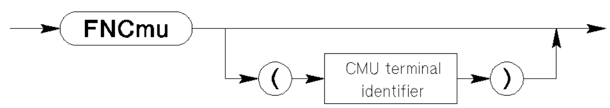
FNCmh
FNCmu
FNPort

FNCmu

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control —

This function returns the CMH or CML terminal address of the CMU.

Syntax



Item	Description/Default	Range Restrictions
CMU terminal identifier	integer expression default = 1	1, 2

Example Statement

```
Cmu=FNCmu(1)
```

Description

The unit address corresponds to the *CMU terminal identifier* as follows:

CMU Terminal	CMU Terminal Identifier	Unit Address
CMH terminal	1	32671
CML terminal	2	32672

See Also

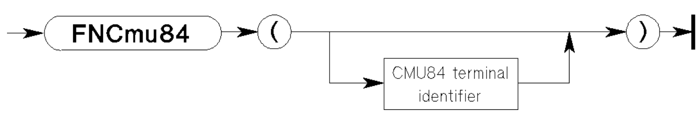
FNCmh
FNCml
FNPort

FNCmu84

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	—

This function returns the CMH84 or CML84 terminal address of the CMU84.

Syntax



Item	Description/Default	Range Restrictions
CMU84 terminal identifier	integer expression default = 1	1, 2

Example Statement

```
Cmu84=FNCmu84(1)
```

Description

The unit address corresponds to the *CMU84 terminal identifier* as follows:

CMU84 Terminal	CMU84 Terminal Identifier	Unit Address
CMH84 terminal	1	32676
CML84 terminal	2	32677

See Also

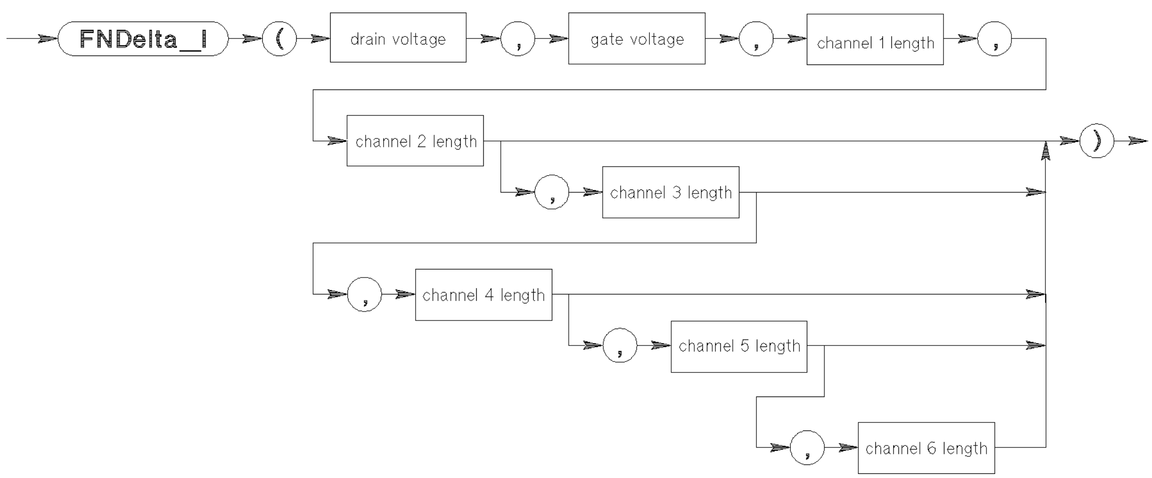
FNCmh
FNCml
FNCmu
FNPort

FNDelta_I

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File PARA
Control DCS, SWM

This function measures the drain currents of up to six FETs, each having a different channel length, and calculates lateral diffusion ΔL. The function then returns the calculated ΔL value to a user-specified variable. The returned value units are μm.

Syntax



Item	Description/Default	Range Restrictions
drain voltage	numeric expression: [V]	−100 to 100 [1]
gate voltage	numeric expression: [V]	−100 to 100
channel 1 length	numeric expression: [μm]	—[2]
channel 2 length	numeric expression: [μm]	—[2]
channel 3 length	numeric expression: [μm]	—[2]
channel 4 length	numeric expression: [μm]	—[2]
channel 5 length	numeric expression: [μm]	—[2]
channel 6 length	numeric expression: [μm]	—[2]

[1] The maximum measurable drain current is equal to the current compliance of the SMU driving the drain. Refer to the Force_v subprogram for details.

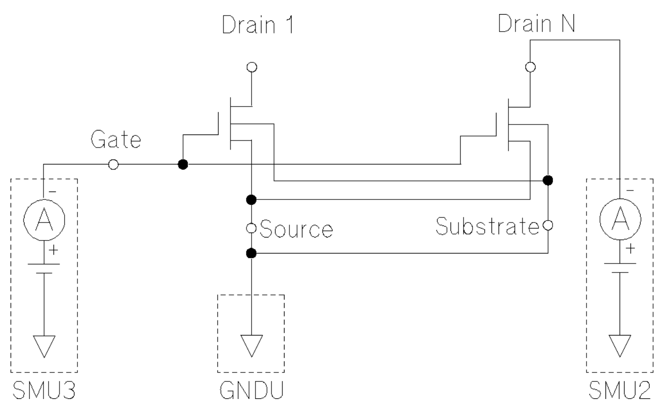
[2] The order in which the *channel n lengths* are specified must correspond to the order of the drain pin numbers in the Setmultitr subprogram.

Example Statements

```
Delta_l=FNDelta_l(5,1,5,3,2)
Delta_l=FNDelta_l(Vds,Vgs,D1_length,D2_length,D3_length,D4_length)
```

Description

The specified *gate voltage* must be higher than the threshold voltage of the transistor. Measurement is performed on all FETs whose drain pins are specified in the Setmultitr subprogram. The measurement circuit is shown below.



If an abnormal condition occurs during the measurement, the measurement is aborted and −9999999.99999 is returned. The function calculates lateral diffusion ΔL from the following using the least squared method:

$$\Delta L = \frac{1}{2}\left(L - \frac{W}{Ids}\right)$$

where L is channel length, W is channel width, and Ids is the drain current measurement value. Immediately after the measurement, the SMUs are set to Zero Output, and both SMU ports and the GNDU port are disconnected from the measurement pins.

See Also

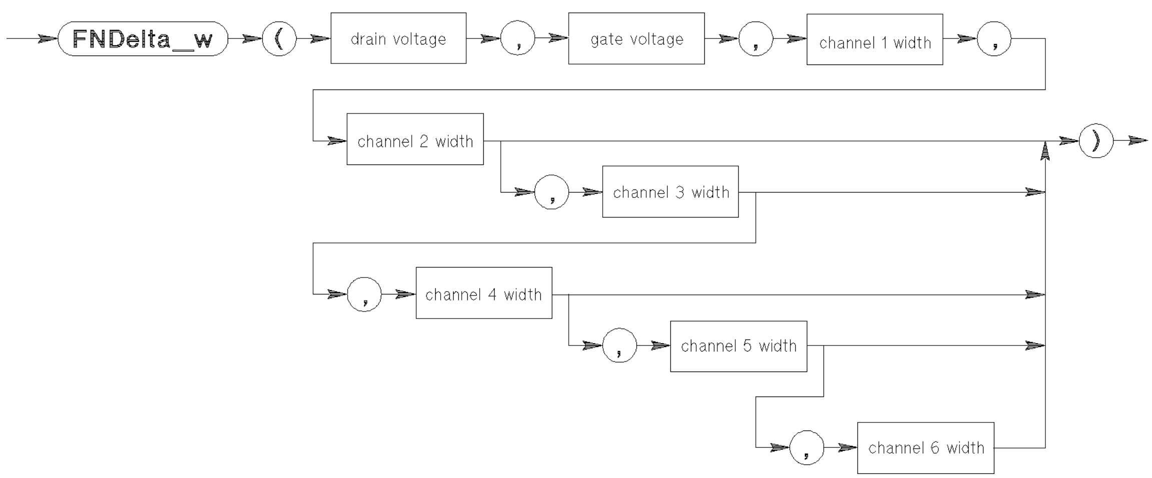
FNDelta_w

FNDelta_w

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function measures the drain currents of up to six FETs, each having a different channel width, and calculates oxide encroachment ΔW. The function then returns the calculated ΔW value to a user-specified variable. The returned value units are μm.

Syntax



Item	Description/Default	Range Restrictions
drain voltage	numeric expression: [V]	−100 to 100 [1]
gate voltage	numeric expression: [V]	−100 to 100
channel 1 width	numeric expression: [μm]	—[2]
channel 2 width	numeric expression: [μm]	—[2]
channel 3 width	numeric expression: [μm]	—[2]
channel 4 width	numeric expression: [μm]	—[2]
channel 5 width	numeric expression: [μm]	—[2]
channel 6 width	numeric expression: [μm]	—[2]

[1] The maximum measurable drain current is equal to the current compliance of the SMU driving the drain. Refer to the Force_v subprogram for details.

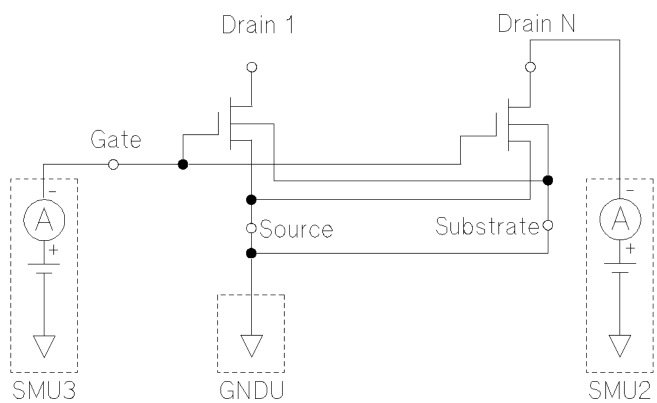
[2] The order in which the *channel n widths* are specified must correspond to the order of the drain pin numbers in the Setmultitr subprogram.

Example Statements

```
Delta_w=FNDelta_w(5,1,5,3,2)
Delta_w=FNDelta_w(Vds,Vgs,D1_width,D2_width,D3_width,D4_width)
```

Description

The specified *gate voltage* must be higher than the threshold voltage of the transistor. Measurement is performed on all FETs whose drain pins are specified in the Setmultitr subprogram. The measurement circuit is shown below.



If an abnormal condition occurs during the measurement, the measurement is aborted and −9999999.99999 is returned. The function calculates oxide encroachment ΔW from the following equation using the least squared method:

$$\Delta W = \frac{W - L \times Ids}{2}$$

where L is channel length, W is channel width, and Ids is drain current measurement value. Immediately after the measurement, the SMUs are set to Zero Output, and both SMU ports and the GNDU port are disconnected from the measurement pins.

See Also

FNDelta_l

FNGcmu

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the GCMU port (Guard terminal of CMS) address of the SWM and is functionally identical to FNPort(11).

Syntax

Example Statement

```
Cmug=FNGcmu
```

Note

This function cannot be used if the CMH and CML are not connected to the AUX3 (CMH) and AUX4 (CML) ports, respectively.

See Also

FNPort

FNGnd

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the GNDU port address of the SWM and is functionally identical to FNPort(7).

Syntax

Example Statement

```
Gnd=FNGnd
```

See Also

FNPort

FNGsmu

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the GSMU port (guard of SMU1) address of the SWM and is functionally identical to FNPort(10).

Syntax

Example Statement

```
Smu1g=FNGsmu
```

See Also

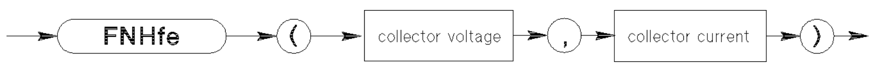
FNPort

FNHfe

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function measures the forward current transfer ratio h_{FE} of bipolar transistors. It does this by varying the base current until a specified collector current is reached, and h_{FE} is calculated as the ratio of collector current to base current.

Syntax



Item	Description/Default	Range Restrictions
collector voltage	numeric expression: [V]	−100 to 100
collector current	numeric expression: [A]	−0.095 to 0.095 [1]

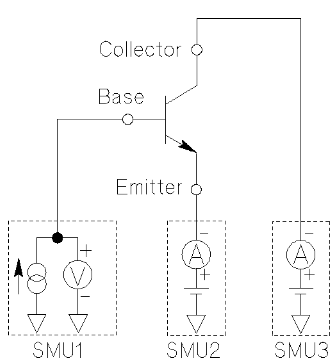
[1] Actual range restrictions for *collector current* depend on the specified *collector voltage*. Refer to the Force_v subprogram for details.

Example Statements

```
Hfe=FNHfe(5,1.E-2)
Hfe=FNHfe(Vce,Ic)
```

Description

SMU1, SMU2, and SMU3 are connected to the measurement pins specified in the Set_tr subprogram, resulting in the measurement circuit shown below.



The polarity of the specified *collector voltage* must be positive for NPN transistors and negative for PNP transistors.

Depending on the polarity of the specified *collector current*, SMU1 will either source or sink base current. Base current is increased until collector current, which is monitored by SMU3, reaches the specified level. If the specified *collector current* cannot be reached or if SMU3 detects an abnormal condition, −9999999.99999 is returned to the user-specified variable as the h_{FE} value.

Immediately after the measurement, the SMUs are set to Zero Output, and the SMU1, SMU2, and SMU3 ports are disconnected from the measurement pins.

See Also

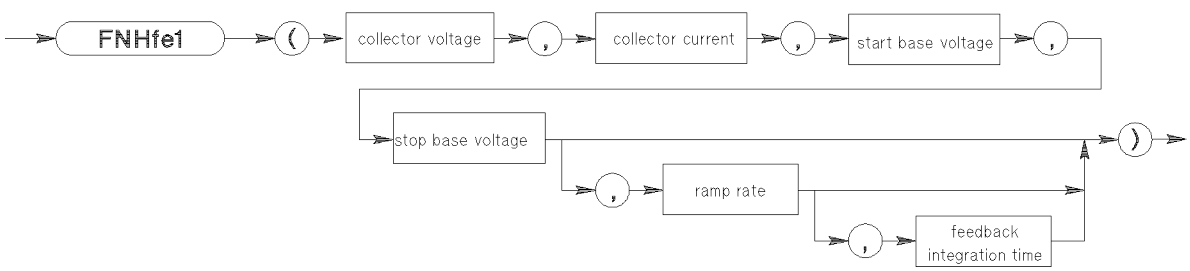
FNHfe1

FNHfe1

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function measures the forward current transfer ratio h_{FE} of bipolar transistors using the Analog Feedback Unit (AFU). It does this by varying base voltage until a specified collector current is reached, and h_{FE} is calculated as the ratio of collector current to base current.

Syntax



Item	Description/Default	Range Restrictions
collector voltage	numeric expression: [V]	−200 to 200 [1]
collector current	numeric expression: [A]	−0.869 to 0.869 [1]
start base voltage	numeric expression: [V]	−200 to 200 [2]
stop base voltage	numeric expression: [V]	−200 to 200 [2]
ramp rate	numeric expression: [V/s] default = 500	0.5 to 100000 [2]
feedback integration time	numeric expression: [s] default = 0.005	5E−6 to 0.45 [2]

[1] If an HP 41420A SMU is connected to the SMU2 port, *collector voltage* and *collector current* can be set up to ±200 V and ±0.869 A, respectively. For the HP 41421B SMU, up to ±100 V and ±0.0869 A can be set.

[2] These parameters must satisfy the conditions in Set_asearch. Refer to the Set_asearch subprogram. The parameter correspond as follows:

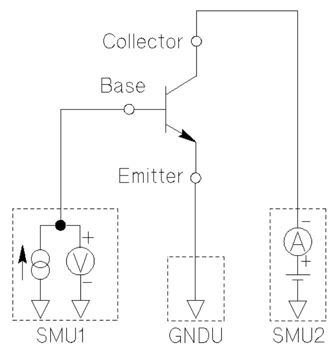
FNHfe1 parameters	Set_asearch parameters
start base voltage	*start value*
stop base voltage	*stop value*
ramp rate	*ramp rate*
feedback integration time	*feedback integration time*

Example Statements

```
Hfe=FNHfe1(6,1E-2,0,0.6)
Hfe=FNHfe1(Vce,Ic,Vbmin,Vbmax,Ramp,Integ)
```

Description

SMU1, SMU2, and GNDU are connected to the measurement pins specified in the Set_tr subprogram, resulting in the measurement circuit shown below.



Note that the SMU1 is set to the current source mode in the figure, but it is actually set to the voltage source.

The polarity of the specified *collector voltage* must be positive for NPN transistors, and negative for PNP transistors. Base voltage is varied until collector current, which is monitored by SMU2, reaches the specified level. If the specified *collector current* cannot be reached or if SMU2 detects an abnormal condition, −9999999.99999 is returned to the user-specified variable as the h_{FE} value.

Immediately after the measurement, both SMUs are set to Zero Output, and the SMU1, SMU2, and GNDU ports are disconnected from the measurement pins.

This subprogram uses the Set_asearch subprogram, and sets the *hold time*, *delay time*, and *base current compliance* value parameters of Set_asearch as follows:

Hold time:	5 ms
delay time:	5 ms
base current compliance:	$\frac{\text{collector current}}{h_{FE}} \times 1.15\,(h_{FE} = 50)$

The optimum values of these parameters depend on the characteristics of the test device and the measurement range. If necessary, you can modify these parameter values in the FNHfe1 subprogram.

See Also

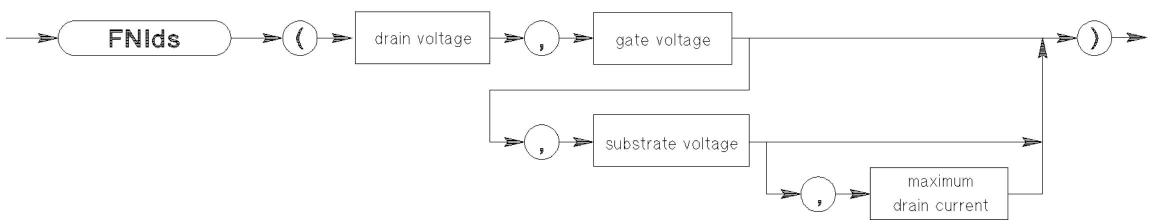
FNHfe

FNIds

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File PARA
Control DCS, SWM

This function measures the drain current for a specified drain voltage and gate voltage, and returns the measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
drain voltage	numeric expression: [V]	−100 to 100
gate voltage	numeric expression: [V]	−100 to 100
substrate voltage	numeric expression: [V] default = 0	−100 to 100
maximum drain current	numeric expression: [A] default = 1E−6	−0.1 to 0.1 [1]

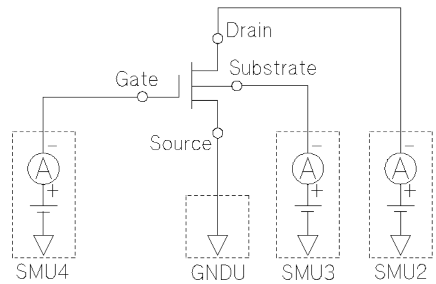
[1] Actual range restrictions for *maximum drain current* depend on the specified *drain voltage*. Refer to the Force_v subprogram for details.

Example Statements

```
Idss=FNIds(6,0)
Ids=FNIds(Vds,Vgs,Vsub,Id_limit)
```

Description

SMU2, SMU3, SMU4, and GNDU are connected to the measurement pins specified in the Set_tr subprogram, resulting in the measurement circuit shown below.



The *maximum drain current* parameter specifies the current compliance for SMU2. If SMU2 detects an abnormal condition, −9999999.99999 is returned to the user-specified variable.

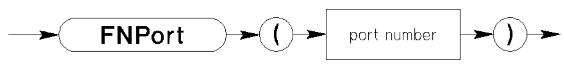
Immediately after the measurement, all SMUs are set to Zero Output, and the SMU2, SMU3, SMU4, and GNDU ports are disconnected from the measurement pins.

FNPort

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the address of the specified SWM port. Port addresses are used to designate ports in TIS subprograms.

Syntax



Item	Description/Default	Range Restrictions
port number	integer expression	−1 to 11, −8, −9

Example Statements

```
Smu1=FNPort(1)
Port=FNPort(N)
```

Description

Port number 0 is an imaginary port to which nothing is connected. FNPort(0) returns 0. Port numbers, port addresses, and port names are as follows:

Port Name	Description	Port Number	Port Address
SMU1	SMU1 (for low current measurement)	1	32701
SMU2	SMU2	2	32702
SMU3	SMU3	3	32703
SMU4	SMU4	4	32704
AUX1	VS or VM [1]	5	32705
AUX2	VS or VM [1]	6	32706
AUX3 (CMH)	CMS High Port, VS or VM [1]	8	32708
AUX4 (CML)	CMS Low Port, VS or VM [1]	9	32709
GNDU	DC Ground Unit	7	32707
GSMU	Guard of SMU1	10, −1	32710
GCMU	CMS Guard Terminal	11, −8, −9	32711

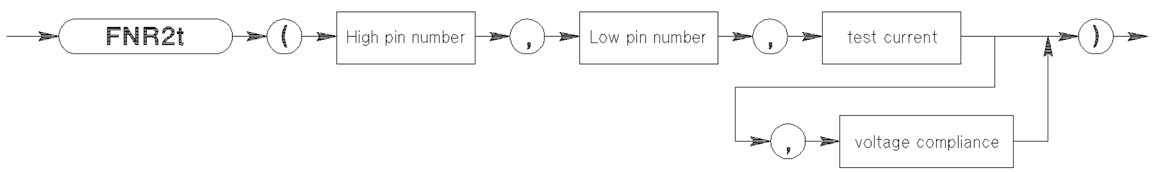
[1] The units or terminals physically connected to the AUX1 through AUX4 ports are displayed during the START program under AUXILIARY PORT CONFIGURATION.

FNR2t

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function performs a two-terminal resistance measurement using two SMUs, and returns the measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
High pin number	integer expression	1 to 96 [1]
Low pin number	integer expression	1 to 96 [1]
test current	numeric expression: [A]	−0.1 to −1E−9, 1E−9 to 0.1
voltage compliance	numeric expression: [V] default = 20	−100 to 100 [2]

[1] 1 to 48 for HP 4085B 48-pin SWM systems.

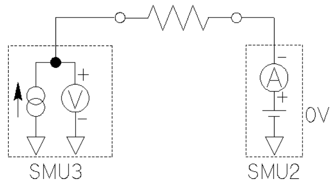
[2] Actual range restrictions for *voltage compliance* depend on the specified *test current*. Refer to the Force_i subprogram for details.

Example Statements

```
R=FNR2t(1,5,1.E-6)
Resistance=FNR2t(High,Low,Itest,Vlimit)
```

Description

SMU3 forces current through an unknown resistance and measures the resulting voltage drop while SMU2 measures the current forced by SMU3. Refer to the equivalent measurement circuit shown below.



The function calculates the unknown resistance from standard Ohm's Law relationships using the voltage measurement value of SMU3 and the current measurement value of SMU2.

A hold time is incorporated to allow the capacitance of the measurement circuit (SMU output capacitance and capacitance of the device being measured) to fully charge before measurement data is taken. The length of this hold time is inversely proportional to the specified *test current*. If the specified *test current* is too low (lower than 1 nA), −9999999.99999 will be returned. Conversely, if the *test current* is set at its upper limit (±100 mA), SMU2 may reach current compliance, making it impossible to obtain valid measurement results.

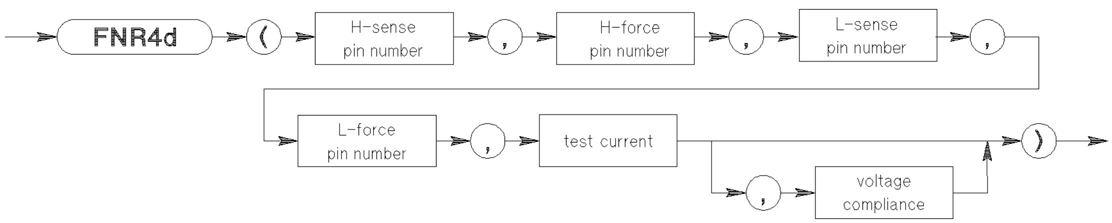
Immediately after the measurement, both SMUs are set to Zero Output and both SMU ports are disconnected from the measurement pins.

FNR4d

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File PARA
Control DCS, SWM

This function performs a four-wire (Kelvin connection) resistance measurement using two SMUs and two VMs, and returns the measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
H-sense pin number	integer expression	1 to 96 [1, 2]
H-force pin number	integer expression	1 to 96 [1]
L-sense pin number	integer expression	1 to 96 [1, 2]
L-force pin number	integer expression	1 to 96 [1]
test current	numeric expression: [A]	−0.1 to −1E−6, 0.1 to 1E−6
voltage compliance	numeric expression: [V] default = 20	−100 to 100 [3]

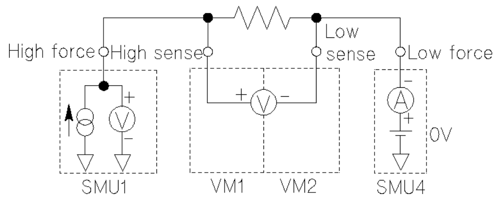
1 1 to 48 for HP 4085B 48-pin SWM systems.
2 VM1 and VM2 must be connected to AUX1 port and AUX2 port, respectively.
3 Actual range restrictions for *voltage compliance* depend on the specified *test current*. Refer to the Force_i subprogram for details.

Example Statements

```
R=FNR4d(1,2,5,6,1.E-3)
Resistance=FNR4d(H_sense,H_force,L_sense,L_force,Itest,Vcomp)
```

Description

The High-sense and High-force pins, and the Low-sense and Low-force pins must be connected to each other as close to the unknown resistance as possible. Refer to the equivalent measurement circuit shown below.



The function performs two measurements, then calculates the unknown resistance as follows:

1. Each port, except the SMU1 port, is connected to the measurement pins (as shown in the figure). The SMU4 outputs 0 V, and VM1 and VM2 measure the offset voltage (Vofs) between the high and low DUT terminals using the VM differential voltage measurement function.
2. The SMU1 port is connected to the high DUT terminal (as shown in the figure). The SMU1 outputs *test current*. Then, VM1 and VM2 measure the voltage (Vdiff) between the high and low DUT terminals. The unknown resistance is calculated as follows:

$$Rx = -\frac{Vdiff - Vofs}{SMU4\ current}$$

This four-wire resistance measurement can obtain 10 times the resolution of a two-wire resistance measurement when the voltage between the high and low DUT terminals is less than 0.2 V. The offset error caused by the thermo-electromotive force is canceled by the offset measurement.

If the specified *test current* is too low (lower than $\pm 1\ \mu$A), if the SMU1 reaches voltage compliance, or if the port status condition is abnormal, -9999999.99999 is returned. Also, if the voltage between the high and low DUT terminals is larger than 2 V, -9999999.99999 is returned. Conversely, if the *test current* is set to its upper limit ($\pm$100 mA), SMU4 may reach current compliance, making it impossible to obtain valid measurement results.

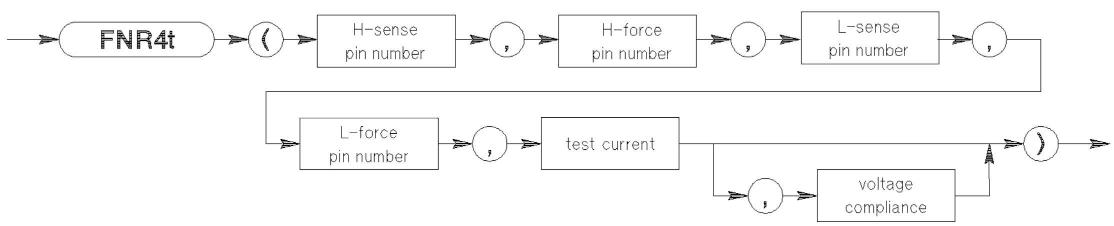
Immediately after the measurement, VS1 and VS2 are set to the grounded measurement mode, all SMUs are set to Zero Output, and all SMU ports are disconnected from the measurement pins.

FNR4t

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function performs a four-wire (Kelvin connection) resistance measurement using four SMUs, and returns the measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
H-sense pin number	integer expression	1 to 96 [1]
H-force pin number	integer expression	1 to 96 [1]
L-sense pin number	integer expression	1 to 96 [1]
L-force pin number	integer expression	1 to 96 [1]
test current	numeric expression: [A]	−0.1 to −1E−6, 0.1 to 1E−6
voltage compliance	numeric expression: [V] default = 20	−100 to 100 [2]

[1] 1 to 48 for HP 4085B 48-pin SWM systems.

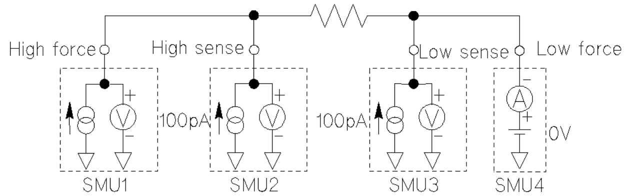
[2] Actual range restrictions for *voltage compliance* depend on the specified *test current*. Refer to the Force_i subprogram for details.

Example Statements

```
R=FNR4t(1,2,5,6,1.E-3)
Resistance=FNR4t(H_sense,H_force,L_sense,L_force,Itest,Vlimit)
```

Description

The High-sense and High-force pins, and the Low-sense and Low-force pins must be connected to each other as close to the unknown resistance as possible. Refer to the equivalent measurement circuit shown below.



The unknown resistance is calculated as follows:

$$Rx = \frac{SMU3\ voltage - SMU2\ voltage}{SMU4\ current}$$

A hold time is incorporated to allow the capacitance of the measurement circuit (SMU output capacitance and capacitance of the device being measured) to fully charge before measurement data is taken. The length of this hold time is inversely proportional to the specified *test current*. If the specified *test current* is too low (lower than $\pm 1\ \mu$A), -9999999.99999 is returned. Conversely, if the *test current* is set to its upper limit (± 100 mA), SMU4 may reach current compliance, making it impossible to obtain valid measurement results.

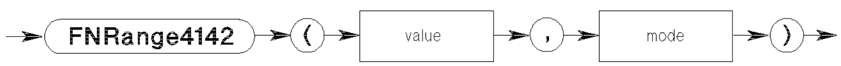
Immediately after the measurement, all SMUs are set to Zero Output and all SMU ports are disconnected from the measurement pins.

FNRange4142

Supported on 4062C, 4062UX, 4062PC
Revision C.06.00 or later, X.06.00 or later, P.06.20 or later
File PGMLIB
Control —

This function returns the DCS range code of a specified value.

Syntax



Item	Description/Default	Range Restrictions
value	numeric expression [V]: if voltage range [A]: if current range	 −200 to 200 −1 to 1
mode	integer expression	1: voltage range 2: current range

Example Statement

```
Vrange1=FNRange(Volt1,1)
OUTPUT @Dcs;"DV",3,FNRange(5,1),5
```

Description

This function converts a voltage/current range value to a range code, which stores the DCS control commands in the DCS program memory using the OUTPUT statement.

The relationship between the specified voltage/current value and the range code is shown in the following table:

Mode	Specified Value	Code
Voltage Range	$0 \leq value \leq 2$ V	11
	2 V $< value \leq 20$ V	12
	20 V $< value \leq 40$ V	13
	40 V $< value \leq 100$ V	14
	100 V $< value \leq 200$ V	15
Current Range	$0 \leq value \leq 1$ nA	11
	1 nA $< value \leq 10$ nA	12
	10 nA $< value \leq 100$ nA	13
	100 nA $< value \leq 1$ μA	14
	1 μA $< value \leq 10$ μA	15
	10 μA $< value \leq 100$ μA	16
	100 μA $< value \leq 1$ mA	17
	1 mA $< value \leq 10$ mA	18
	10 mA $< value \leq 100$ mA	19
	100 mA $< value \leq 1$ A	20

If you use VMs that are set to the differential measurement mode, a voltage range code of 10 ($0 \leq value \leq 0.2$ V) is also available. Please note that you cannot use current range code 11 for pulsed spot, pulsed sweep, or sweep with pulsed bias measurements.

If you specify an undefined value, this function returns a -1.

See Also

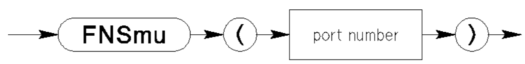
FNChannel4142
FNUnit4142

FNSmu

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the address of a specified SMU port of the SWM.

Syntax



Item	Description/Default	Range Restrictions
port number	integer expression	1 to 6, −1, 29[1], 32[1]

1 Ports 29 and 32 are available when a port expander is installed in the SWM.

Example Statement

```
Smu_port=FNSmu(N)
```

Description

This function is identical to FNPort. Refer to the FNPort function for details.

The following table shows the relationship between the SMU port name and port number.

SMU Port Name	Port Number	SMU Port Name	Port Number
GSMU[1]	−1	AUX1	5
SMU1	1	AUX2	6
SMU2	2	AUX33[2]	29
SMU3	3	AUX43[2]	32
SMU4	4		

1 GSMU port is the guard port of the SMU1 port.

2 These ports are available only when the port expander is installed on the SWM.

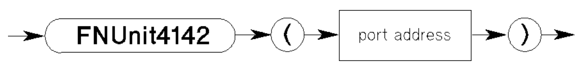
If invalid value is specified as the *port number*, 32000 is returned.

FNUnit4142

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	—

This function returns a unit address converted from a port address of the DCS.

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression	32701 to 32711, 32721 to 32732[1]

1 The 32721 to 32732 range is available when a port expander is installed in the SWM.

Example Statement

```
Unit=FNUnit4142(Port)
OUTPUT @Dcs;"DV",FNChannel4142(FNUnit4142(FNSmu(3))),12,5
```

Description

This function converts a port address to the unit address where the DCS control commands are stored. Use the OUTPUT statement to store the DCS control commands into the unit address in program memory.

The relationship between the specified port address and the unit address depends on the system configuration.

If an invalid value is specified as a *port address*, or if the specified port is not connected to the DCS terminal, a 0 is returned.

See Also

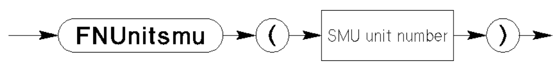
FNChannel4142

FNUnitsmu

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the unit address of the specified SMU. Unit addresses are used to designate SMUs in TIS programs.

Syntax



Item	Description/Default	Range Restrictions
SMU unit number [1]	integer expression	1 to 8

[1] The *SMU unit number* specifies the SMU. For example, *SMU unit number* = 2 specifies the second SMU from the left.

Example Statement

```
Smu=FNUnitsmu(3)
```

Description

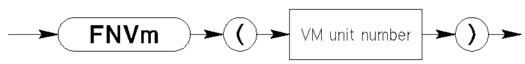
The *SMU unit number* specifies the SMU (HP 41420A or HP 41421B) by the installed SMU order from the left. If the specified unit is an HP 41421B, this function returns a unit address that is in the range from 32621 to 32628. If the specified unit is an HP 41420A, this function returns a unit address that is in the range from 32629 to 32632.

FNVm

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control —

This function returns the unit address of the specified VM. Unit addresses are used to designate VMs in TIS programs.

Syntax



Item	Description/Default	Range Restrictions
VM unit number	integer expression	1 to 16

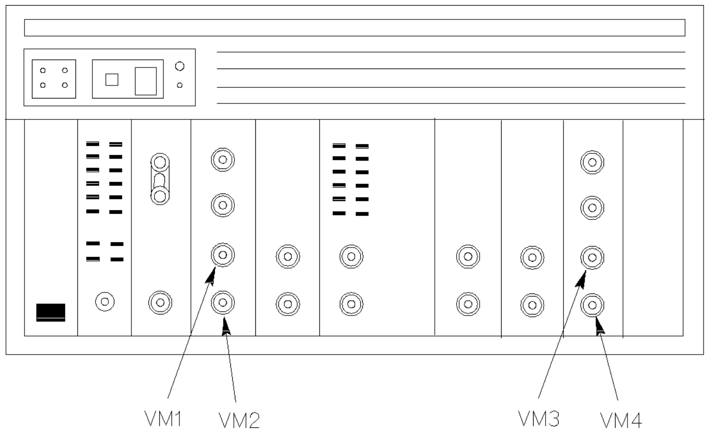
Example Statement

```
Vm=FNVm(2)
```

Description

The *VM unit number* specifies the VM (HP 41424A). This number corresponds to the installed VM position from the left as shown in the example on next page. The unit addresses and corresponding *VM unit numbers* are as follows:

VM Unit Number	Unit Address	VM Unit Number	Unit Address
1	32634	9	32650
2	32636	10	32652
3	32638	11	32654
4	32640	12	32656
5	32642	13	32658
6	32644	14	32660
7	32646	15	32662
8	32648	16	32664

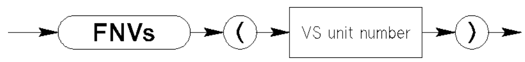

VM1
VM2
VM3
VM4

FNVs

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	—

This function returns the unit address of the specified VS. Unit addresses designate VSs in TIS programs.

Syntax



Item	Description/Default	Range Restrictions
VS unit number	integer expression	1 to 16

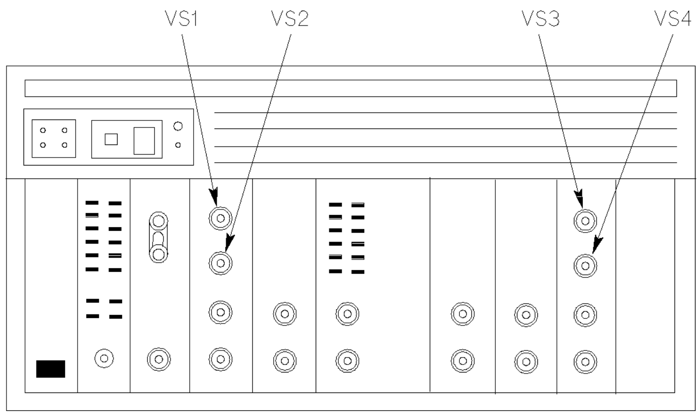
Example Statement

```
Vs=FNVs(2)
```

Description

The *VS unit number* specifies the VS (HP 41424A). This number corresponds to the installed VS position from the left as shown in the example on the next page. The unit addresses and corresponding *VS unit numbers* are as follows:

VS Unit Number	Unit Address	VS Unit Number	Unit Address
1	32633	9	32649
2	32635	10	32651
3	32637	11	32653
4	32639	12	32655
5	32641	13	32657
6	32643	14	32659
7	32645	15	32661
8	32647	16	32663

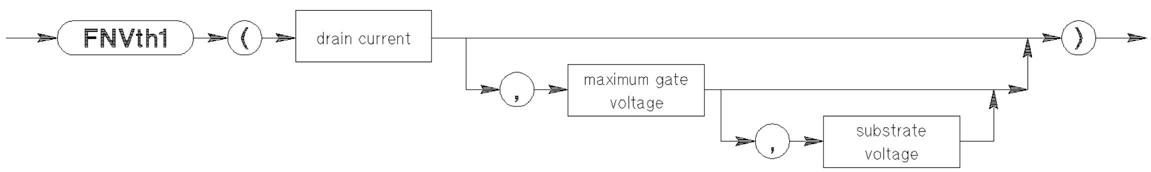

VS1
VS2
VS3
VS4

FNVth1

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function measures the gate-source threshold voltage of an enhancement-type FET when a specified drain current is forced. The function then returns the measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
drain current	numeric expression: [A]	−0.1 to 0.1
maximum gate voltage	numeric expression: [V] default = 20	−100 to 100 [1]
substrate voltage	numeric expression: [V] default = 0	−100 to 100

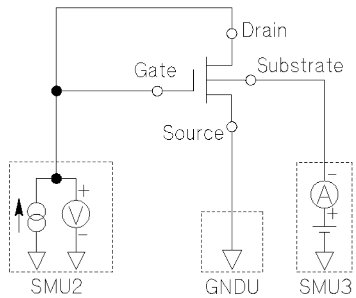
[1] Actual range restrictions for *maximum gate voltage* depend on the specified *drain current*. Refer to the Force_i subprogram for details.

Example Statements

```
Vth=FNVth1(1.E-5)
Vth=FNVth1(Id,Vgs_limit,Vsub)
```

Description

The SMU2, SMU3, and GNDU ports are connected to the measurement pins specified in the Set_tr subprogram. The resulting measurement circuit is shown below.



A hold time is incorporated to allow the SMU capacitance to fully charge before measurement data is taken. The voltage measured by SMU2 is returned to the user-specified variable as the threshold voltage. If SMU2 detects an abnormal condition, −9999999.99999 is returned.

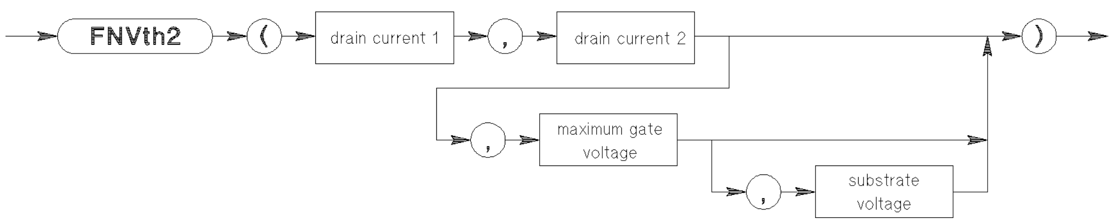
Immediately after the measurement, both SMUs are set to Zero Output, and the SMU2, SMU3, and GNDU ports are disconnected from the measurement pins.

FNVth2

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function is identical to the FNVth1 function, except that the gate-source voltage is measured at two different drain current settings and the threshold voltage is calculated from the Vgs–Ids characteristics using linear extrapolation. The function returns the calculated value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
drain current 1	numeric expression: [A]	−0.1 to 0.1
drain current 2	numeric expression: [A]	−0.1 to 0.1
maximum gate voltage	numeric expression: [V] default = 20	−100 to 100 [1]
substrate voltage	numeric expression: [V] default = 0	−100 to 100

[1] Actual range restrictions for *maximum gate voltage* depend on the specified *drain current*. Refer to the Force_i subprogram for details.

Example Statements

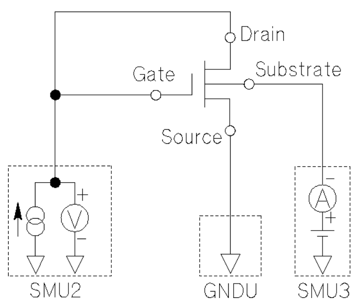
```
FNVth2(1.E-6,1.E-4)
Vth=FNVth2(Id1,Id2,Vgs_limit,Vsub)
```

Description

The gate voltage of the transistor is measured twice: once when *drain current 1* is being forced and again when *drain current 2* is being forced. The threshold voltage is then calculated from the following equation using the specified drain currents and the measured gate voltages:

$$Vth = \frac{\left(\sqrt{\frac{Ids_2}{Ids_1}} \times Vgs_1\right) - Vgs_2}{\sqrt{\frac{Ids_2}{Ide_1}} - 1}$$

where Ids1 and Ids2 are *drain current 1* and *drain current 2* respectively; Vgs1 and Vgs2 are measured gate voltages. Refer to FNVth1 for additional information on this function, such as hold time, post-measurement states of the SMUs, etc. The equivalent measurement circuit is shown below.

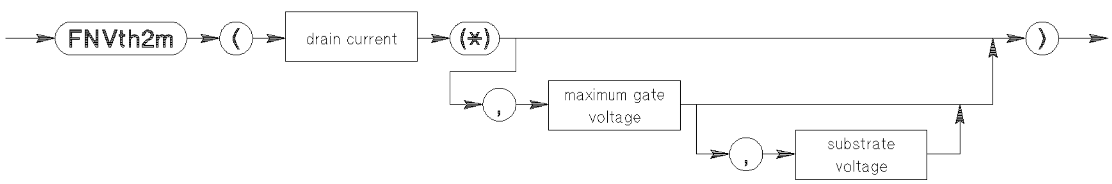


FNVth2m

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function is identical to the FNVth1 function, except that the gate-source voltage is measured at multiple specified drain current settings and the threshold voltage is calculated from the Vgs–Ids characteristics using the least squared method. The function returns the calculated value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
drain current [1]	numeric array name	any valid name
maximum gate voltage	numeric expression: [V] default = 20	−100 to 100 [2]
substrate voltage	numeric expression: [V] default = 0	−100 to 100

1 The maximum number of array elements is 50. The array elements are drain current values, and the units are ampere A.

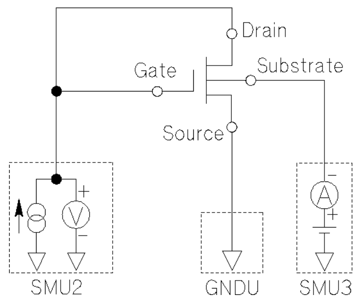
2 Actual range restrictions for *maximum gate voltage* depend on the specified *drain current* values. Refer to the Force_i subprogram for details.

Example Statements

```
REAL Ids(1:10)
     :
Ids(1)=1E-3
Ids(2)=2E-3
     :
Vth=FNVth2m(Ids(*),Vgs_limit,Vsub)
```

Description

The SMUs and GNDU are connected to the measurement pins specified in the Set_tr subprogram, resulting in the measurement circuit shown below.



The gate voltage of the transistor is measured for each drain current specified in the array. The threshold voltage (Vth) is then calculated from the following equation using the specified drain currents (Idsi) and the measured gate voltages (Vgsi):

$$Vth = \frac{\sum (Vgs_i)^2 \times \sum \sqrt{Ids_i} - \sum Vgs_i \times \sum \left(\sqrt{Ids_i} \times Vgs_i\right)}{\sum Vgs_i \times \sum \sqrt{Ids_i} - n \sum \left(\sqrt{Ids_i} - Vgs_i\right)}$$

where n is the total number of array elements; and i corresponds to the array element from element 1 to element n.

$$Ids_i \geq 0 : \sqrt{Ids_i} = \sqrt{|Ids_i|}$$
$$Ids_i < 0 : \sqrt{Ids_i} = -\sqrt{|Ids_i|}$$

The calculated value is returned to the user-specified variable as the threshold voltage. You can set a negative or positive polarity for the *drain current*. The polarity of the returned threshold voltage value (Vth) is the same polarity as the *drain current* and the gate voltage.

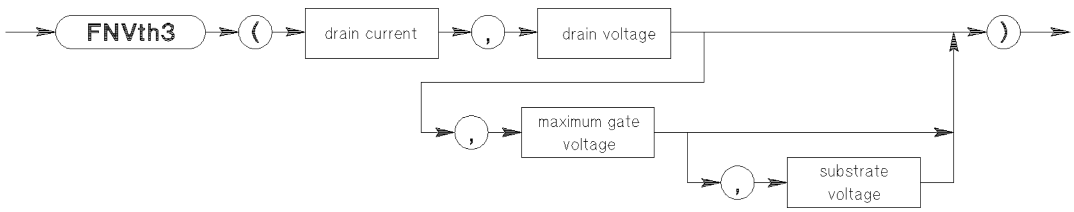
If SMU2 detects an abnormal condition, −9999999.99999 is returned. Immediately after the measurement, both SMUs are set to Zero Output, and the SMU2, SMU3, and GNDU ports are disconnected from the measurement pins.

FNVth3

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File PARA
Control DCS, SWM

This function measures the gate-source threshold voltage of an FET by varying an applied gate voltage until a specified drain current flows, then returns the gate voltage measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
drain current	numeric expression: [A]	−0.1 to 0.1 [1]
drain voltage	numeric expression: [V]	−100 to 100
maximum gate voltage	numeric expression: [V] default = 20	−100 to 100
substrate voltage	numeric expression: [V] default = 0	−100 to 100

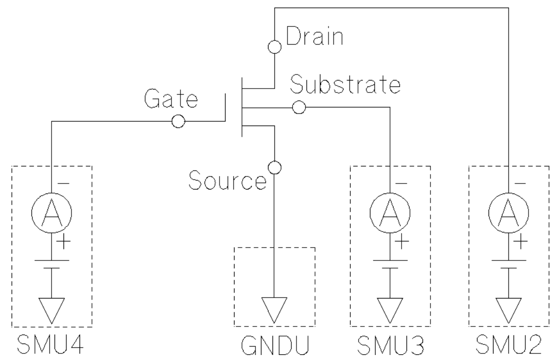
[1] The *drain current* setting must be less than I compliance setting of the SMU.

Example Statements

```
Vth=FNVth3(1.E-5,6)
Vth=FNVth3(Id,Vds,Vgs_limit,Vsub)
```

Description

The SMU2, SMU3, SMU4, and GNDU ports connect to the measurement pins specified in the Set_tr subprogram, resulting in the following measurement circuit:



SMU4 varies the gate voltage until the drain current, which is monitored by SMU4, reaches the specified value. The gate voltage required to obtain the specified drain current is returned to the user-specified variable.

If SMU2 detects an abnormal condition or if the threshold voltage exceeds the specified *maximum gate voltage*, FNVth3 returns −9999999.99999.

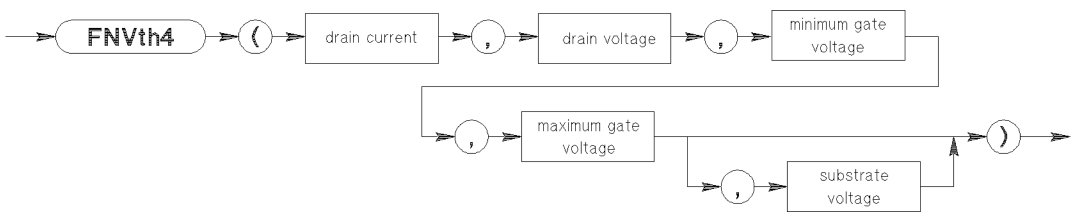
Immediately after the measurement, all SMUs are set Zero Output, and the ports used in the measurement are disconnected from the measurement pins.

FNVth4

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function measures the gate-source threshold voltage of a FET using the binary search method.

Syntax



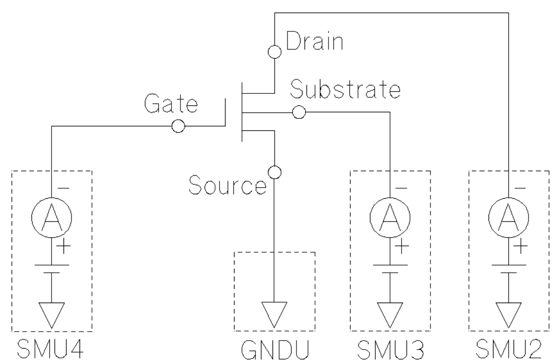
Item	Description/Default	Range Restrictions
drain current	numeric expression: [A]	−0.1 to 0.1
drain voltage	numeric expression: [V]	−100 to 100
minimum gate voltage	numeric expression: [V]	−100 to 100
maximum gate voltage	numeric expression: [V] default = 20	−100 to 100
substrate voltage	numeric expression: [V] default = 0	−100 to 100

Example Statements

```
Vth=FNVth4(1.E-7,5,.5,5)
Vth=FNVth4(Ids,Vds,Vgmin,Vgmax,Vsub)
```

Description

The SMU2, SMU3, SMU4, and GNDU ports connect to the measurement pins specified in the Set_tr subprogram, resulting in the following measurement circuit:



SMU4 varies the gate voltage using a binary search method until the drain current, monitored by SMU2, reaches the specified value ±1%. The gate voltage measurement value required to obtain the specified drain current is returned to the user-specified variable.

If SMU2 detects an abnormal condition, or if the threshold voltage is not between *minimum gate voltage* and *maximum gate voltage*, this function returns −9999999.99999.

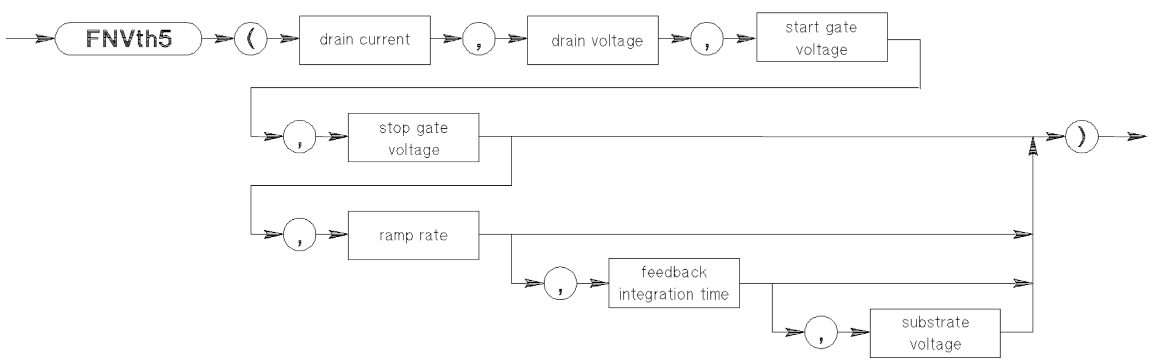
Immediately after the measurement, all SMUs are set to Zero Output, and the ports used in the measurement are disconnected from the measurement pins.

FNVth5

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	DCS, SWM

This function measures the gate-source threshold voltage of a FET by using an analog search to vary the applied gate voltage until a specified drain current flows. The function then returns the gate voltage measurement value to a user-specified variable.

Syntax



Item	Description/Default	Range Restrictions
drain current	numeric expression: [A]	—[1]
drain voltage	numeric expression: [V]	—[2]
start gate voltage	numeric expression: [V]	−100 to 100 [3]
stop gate voltage	numeric expression: [V]	−100 to 100 [3]
ramp rate	numeric expression: [V/s] default = 500	0.5 to 100000 [3]
feedback integration time	numeric expression: [s] default = 0.005	5E−6 to 0.45 [3]
substrate voltage	numeric expression: [V] default = 0	−100 to 100

1 ±0.869A for HP 41420A SMU (SMU2 port). ±0.0869A for other SMUs.
2 ±200V for HP 41420A SMU (SMU2 port). ±100V for other SMUs.
3 These parameters must satisfy the conditions in the Set_asearch. Refer to the Set_asearch subprogram. The parameters correspond as follows:

FNVth5 parameters	Set_asearch parameters
start gate voltage	*start value*
stop gate voltage	*stop value*
ramp rate	*ramp rate*

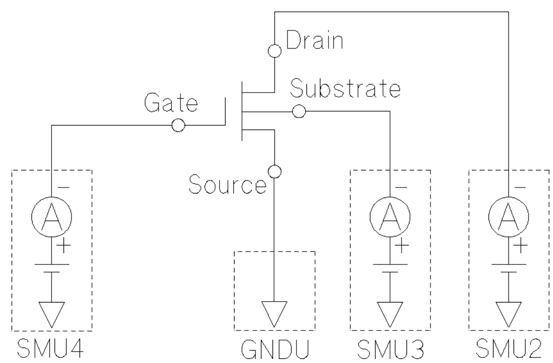
feedback integration time	*feedback integration time*

Example Statement

```
Vth=FNVth5(Id,Vds,Vgmin,Vgmax,Ramp,Integ,Vsub)
```

Description

The SMU2, SMU3, SMU4, and GNDU ports are connected to the measurement pins specified in the Set_tr subprogram, resulting in the following measurement circuit.



SMU4 varies the gate voltage using an analog search method until the drain current, which is monitored by SMU2, reaches the specified value. The gate voltage measurement value required to obtain the specified drain current is returned to a user-specified variable.

If SMU2 detects an abnormal condition, or if the threshold voltage is not between *start gate voltage* and *stop gate voltage*, FNVth5 returns −9999999.99999.

Immediately after the measurement, all SMUs are set to Zero Output, and the measurement ports used are disconnected from the measurement pins.

FNVth5 uses the Set_asearch subprogram. The *hold time* and *delay time* of Set_asearch, and the *current compliance* of the SMU connected to the gate of the test device are set as follows:

hold time: 5 ms

delay time: 5 ms

gate SMU's *current compliance* : 100 μA

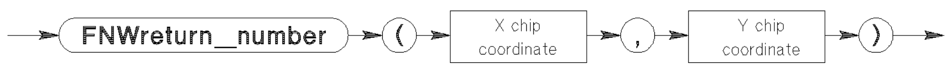
Optimize these parameters, which are dependent on the measurement range and characteristics of your test device, by modifying FNVth5 accordingly.

FNWreturn_number

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File WAFER
Control —

This function returns the chip number corresponding to the X- and Y-chip coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-chip coordinate	integer expression	value set by PPG
Y-chip coordinate	integer expression	value set by PPG

Example Statements

```
No=FNWreturn_number(1,2)
Chip_number=FNWreturn_number(X,Y)
```

Description

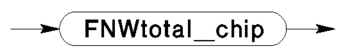
This function returns the chip number corresponding to the X- and Y-coordinates from the probing pattern data created by PPG. The Wget subprogram must appear in a measurement program before this function can execute.

FNWtotal_chip

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	—

This function returns the number of chips per wafer registered by PPG.

Syntax



Example Statement

```
N=FNWtotal_chip
```

Description

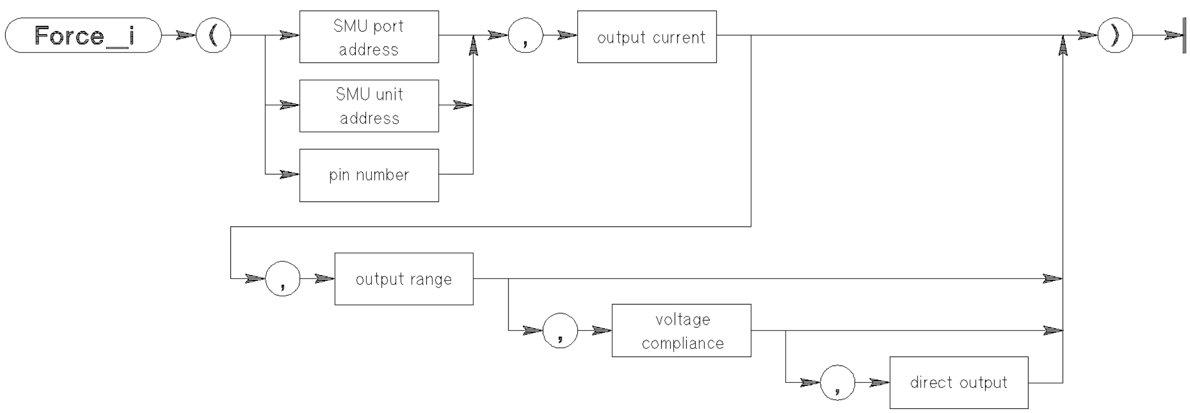
This function returns total number of chips from the probing pattern data created by PPG. The Wget subprogram must appear first in a measurement program before this function can execute.

Force_i

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram sets the output current of the specified SMU.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
SMU port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
SMU unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
output current	numeric expression: [A]	−1 to 1 [3]	
output range	numeric expression: [A] default = 0 (Auto range)	−1 to 1 [3]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
voltage compliance	numeric expression: [V] default = last valid setting or 20 [5] if SMU is set to VS mode.	−200 to 200 [4]	
direct output	integer expression default = 0	−32768 to 32767	0, 1

[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

[3] For details on range for *output current* and *output range*, refer to Description.
[4] Range restrictions for *voltage compliance* depend on the specified *output current*. Refer to Description for details.
[5] If *output current* is larger than 100 mA, default value is set to 2 V.

Example Statements

```
Force_i(FNSmu(1),1.E-6)
Force_i(FNUnitsmu(2),2.E-3)
Force_i(Trbase,Ib,0,2)
Force_i(Port,Current,Range,Compliance,Direct_out)
```

Description

port address, *unit address*, and *pin number*

Either the SMU *port address*, *unit address*, or the *pin number* of any pin connected to the SMU port can be used to specify the SMU.

output current, *output range*, and *voltage compliance*

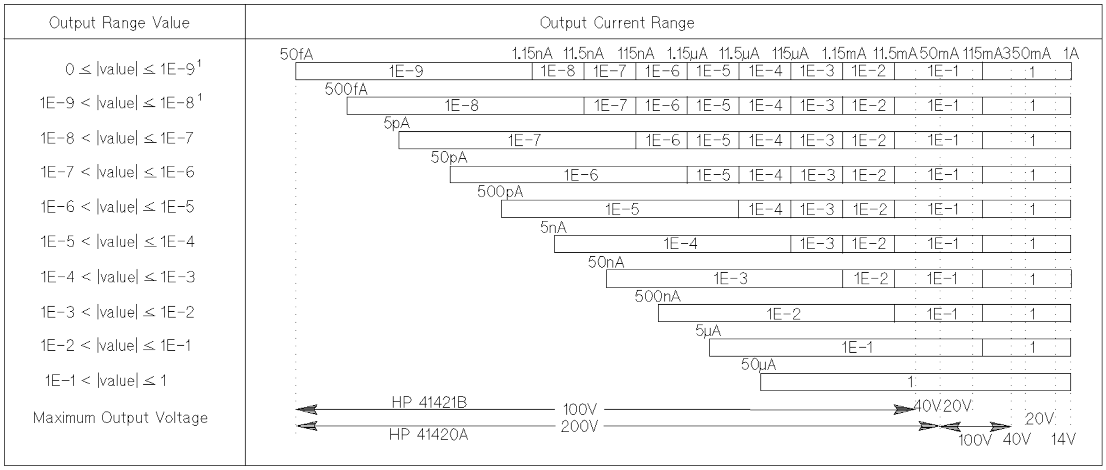
The actual range restrictions of *output current*, *output range*, and *voltage compliance* depend on the SMU and SMU port used.

The *output range* parameter sets the current range of the SMU. If you specify 0 or no range, the SMU is set to Auto-ranging mode. If you specify a range, however, the SMU is set to Limited Auto-ranging mode. Refer to chapter 2 in the *System Information Manual* for a description of Limited Auto-ranging.

The ranging mode must be considered when you use Force_i in, for example, a FOR ... NEXT loop, in which the specified *output current* changes with each iteration.

Output current resolution and the range you can set for *voltage compliance* (maximum output voltage) depend on the specified *output current*. If the specified *output current* is high, the maximum allowable voltage compliance and output current resolution drop accordingly.

Setting the *output range* to a low value improves output current resolution but may increase settling time because of additional ranging time and wait time. Refer to the following table for the relationships between output current, range, and voltage compliance.



[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

The maximum output voltage of an SMU operating as a current source (I source (IS) mode) is set by the specified *voltage compliance*. *Voltage compliance* should not be set too high, because the SMU may output a pulse when changing range.

direct output

The *direct output* parameter is a conditional ON/OFF specifier for SMUs when an SMU is specified by the *SMU port address* or *pin number* parameter. If any value other than 0 is specified for this parameter, the SMU outputs the specified current, regardless of the pin-port connections of the SWM. If the *direct output* parameter is omitted or is set to 0, however, current output depends on whether an SMU port is connected to a measurement pin. If the port is connected to at least one measurement pin, the SMU outputs the specified current when the program executes the Force_i subprogram. If the port is not connected to a measurement pin, the SMU does not output the specified current until the port is connected to a measurement pin and an Execute, Force_v, or another Force_i subprogram executes.

When an SMU not connected to SWM is specified using *SMU unit address*, it is not necessary to specify the *direct output* parameter.

In the following example, SMU1 outputs 1 μA to measurement pin 1 when the program executes line 130.

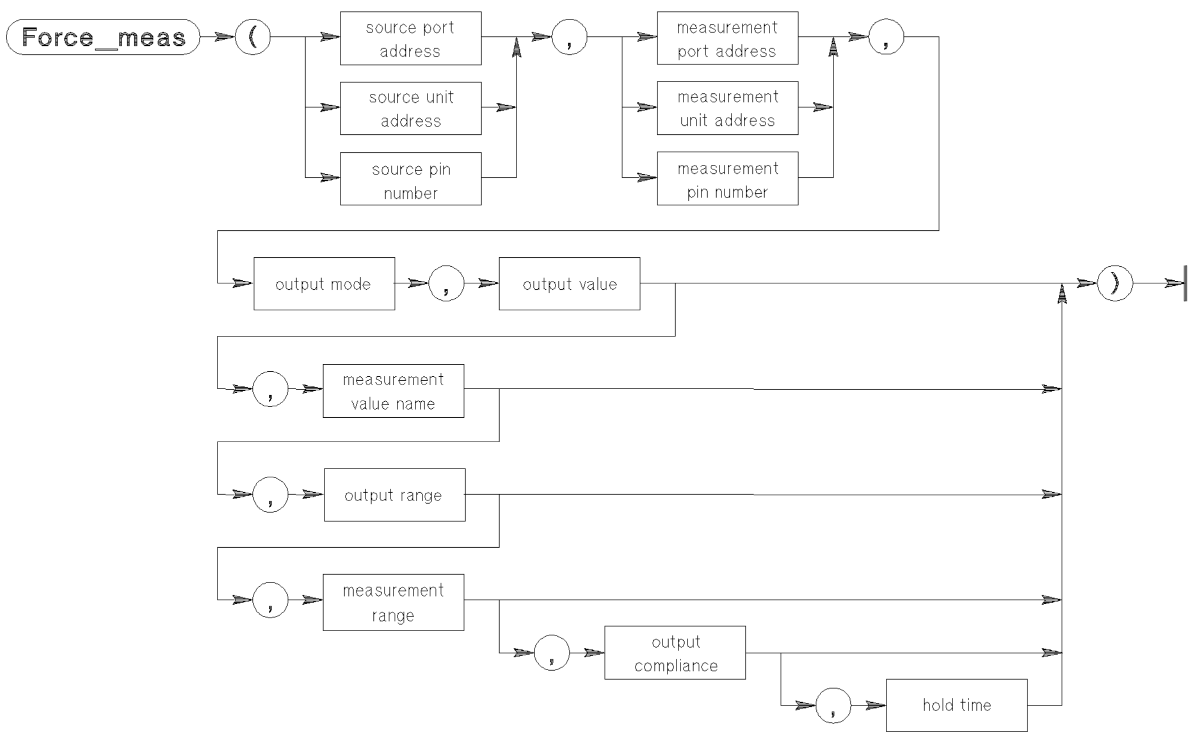
```
100      Connect
110      Force_i(FNPort(1),1.E-6)
120      Connect(FNPort(1),1)
130      Execute
```

Force_meas

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the output current or voltage of the specified SMU or VS, measures the dc current or voltage using the specified SMU or VM, and returns the measurement value.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
source port address	integer expression	32701 to 32709, 32721 to 32732 [1]	
source unit address	integer expression	32621 to 32633 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	

Item	Description/Default	Range Restrictions	Recommended Range
source pin number	integer expression	1 to 96 [2]	
measurement port address	integer expression	32701 to 32709	
measurement unit address	integer expression	32621 to 32664	
measurement pin number	integer expression	1 to 96 [2]	
output mode	numeric expression	1: voltage 2: current	
output value	numeric expression		
	When using SMU in VS mode: [V]	−200 to 200 [3]	
	When using VS: [V]	−40 to 40	
	When using SMU in IS mode: [A]	−1 to 1 [4]	
measurement value name	numeric variable name	any valid name	
output range	numeric expression default = 0		
	When using SMU in VS mode: [V]	−200 to 200 [3]	0, 2, 20, 40, 100, 200
	When using VS: [V]	−40 to 40	0, 20, 40
	When using SMU in IS mode: [A]	−1 to 1	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
measurement range	numeric expression default = last valid setting		
	When using SMU in VS mode: [A]	−1 to 1	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
	When using VM: [V]	−40 to 40	0, 2, 20, 40
	When using VS, or an SMU in IS mode	—[5]	

Item	Description/Default	Range Restrictions	Recommended Range
output compliance	numeric expression		
	IF the SMU is in VS mode: [A] default = last valid setting or 1E−4 if the SMU is in IS mode.	−1 to 1 [3]	−1 to −1E−12 1E−12 to 1
	If VS is used	— [5]	
	If the SMU is in IS mode: [V] default = last valid setting or 20 [6] if the SMU is in VS mode.	−200 to 200 [4]	
hold time	numeric expression: [s] default = 0	0 to 99.9999 resolution: 0.0001	

1 These port addresses are used for the ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.
3 Maximum output voltage and actual range restrictions for *current compliance* depend on the specified voltage range, and SMU and SMU port used.
4 Maximum output current and actual range restrictions for *voltage compliance* depend on the specified test current, and SMU and SMU port used.
5 This is a dummy parameter.
6 If the *output value* is larger than 100 mA, default value is set to 2 V.

Example Statements

```
Force_meas(FNSmu(1),FNSmu(2),1,5,Data)
Force_meas(FNUnitsmu(1),FNUnitsmu(3),2,1.5E-4,Value,1E-3,0)
Force_meas(Gate,Drain,Mode,Vg,Id,F_range,M_range,F_comp,Delay)
```

Description

When using an SMU other than the source port or source unit as a measurement port or measurement unit, the SMU must be already set to the measurement mode required to perform the desired measurement (IS mode for voltage measurements, VS mode for current measurements). You can establish this setting by using Force_i or Force_v.

The maximum output value, resolution, and output compliance depend on the specified *output range*. Refer to the Force_v or Force_i subprograms.

Measurement range is the same as for Measure_v or Measure_i. Refer to the Measure_v or Measure_i subprograms.

Hold time is the time between V or I forcing and when a measurement is made.

If you include Force_meas in a Prepare ... Execute construct, Force_meas is equal to a pair of Force and Measure subprograms; *hold time* is ignored.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* variable. The type of value returned depends on the simulation mode: constant data or file data simulation mode.

Constant Data Simulation mode:

Returned values are determined by the *measurement range* value as follows:

For current measurements:

Unit	Meas.Range	Returned Value	Polarity
SMU	$= 0$	I compliance	Same as SMU *output value*
	$\neq 0$	Range Value	
VS	any	20 mA	Same as VS *output value*

For voltage measurements:

Unit	Meas.Range	Returned Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
VM	$= 0$	2.0 V	Always positive
	$\neq 0$	Range Value	Same as *measurement range*

If you do not set a *measurement range* for the SMUs, this subprogram uses the last valid range setting as the *measurement range* value.

File Data Simulation mode:

This subprogram reads <meas> from the data simulation file and returns this value. The data simulation file format is as follows:

```
Force_meas  <meas>
```

Force_v

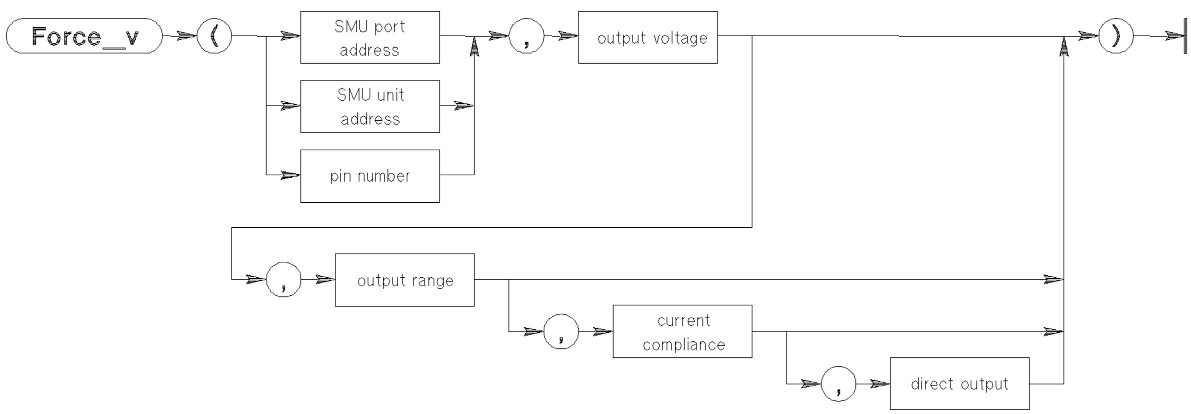
Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS, CMU, CMU84 (CMU84 is supported only by Rev. C.05.60 or later and X.05.60 or later.)

This subprogram sets the output voltage for a specified SMU or VS of the DCS, and sets the internal dc bias source of the CMU.

For DCS Measurements:

Syntax

For SMUs:

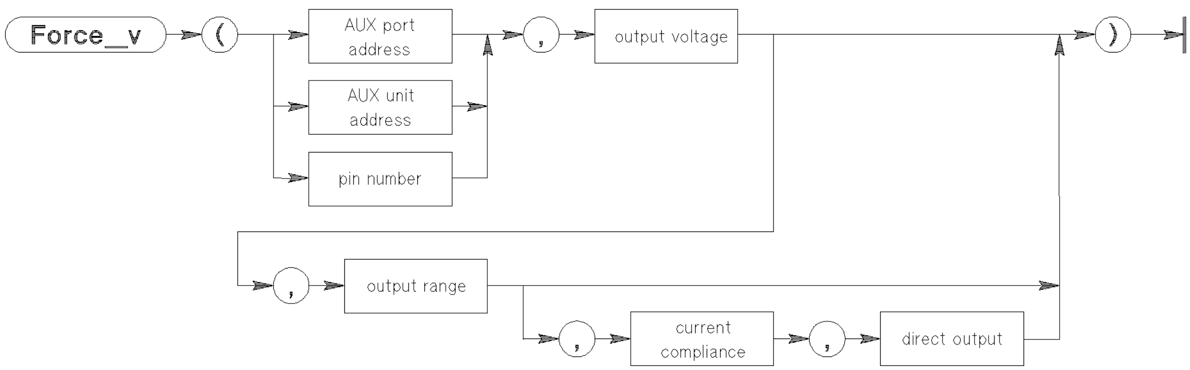


Item	Description/Default	Range Restrictions	Recommended Range
SMU port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
SMU unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
output voltage	numeric expression: [V]	−200 to 200 [3]	
output range	numeric expression: [V] default = 0	−200 to 200 [3]	0, 2, 20, 40, 100, 200

Item	Description/Default	Range Restrictions	Recommended Range
current compliance	numeric expression: [A] default = last valid setting or 1E−4 if the SMU is in IS mode.	−1 to 1 [3]	−1 to −1E−12, 1E−12 to 1
direct output	integer expression default = 0	−32768 to 32767	0, 1

[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.
[3] Maximum output voltage and the actual range restrictions for *current compliance* depend on the specified voltage range. Refer to Description for details.

For VSs:



Item	Description/Default	Range Restrictions	Recommended Range
AUX port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
AUX unit address	integer expression	32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	
pin number	integer expression	1 to 96 [2]	
output voltage	numeric expression: [V]	−40 to 40	

Item	Description/Default	Range Restrictions	Recommended Range
output range	numeric expression	−40 to 40	0, 20, 40
current compliance	numeric expression	—[3]	
direct output	integer expression default = 0	−32768 to 32767 [4]	0, 1

[1] 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VS port.

[3] This is a dummy parameter.

[4] If the specified AUX port is not connected to a VS at system START, 0 must be specified in the *direct output* parameter.

Example Statements

```
Force_v(FNSmu(1),10)
Force_v(Drain,Vds,0,1.E-3)
Force_v(FNVs(1),5,20)
Force_v(Port,Voltage,Range,Compliance,Direct_out)
```

Description

Port address, *unit address*, and *pin number*

Either the *port address*, the *unit address*, or the *pin number* of any measurement pin connected to the port can be used to specify the SMU or VS.

Output voltage, *output range*, and *current compliance*

The actual range restrictions of the *output voltage*, *output range*, and *current compliance* parameters of the SMU depend on the SMU and SMU port used.

The voltage range of the SMU is set by the *output range* parameter. The maximum output voltage, voltage resolution, and the range of current compliance (maximum output current) depend on the specified voltage range. VSs do not have a current compliance setting.

Unit	Output Range Value	Output Voltage Range	Maximum Output Current: HP 41420A	Maximum Output Current: HP 41421B
HP 41420A HP 41421B	0	Depends on the previous setting [1]		
	$0 \le \lvert value \rvert \le 2$	100 uV – 2 V (2)	1 A	100 mA
	$2 < \lvert value \rvert \le 20$	1 mV – 20 V (20)	1 A (≤ 14 V) 700 mA (> 14 V)	100 mA
	$20 < \lvert value \rvert \le 40$	2 mV – 40 V (40)	350 mA	50 mA
	$40 < \lvert value \rvert \le 100$	5 mV – 100 V (100)	125 mA	20 mA
HP 41420A	$100 < \lvert value \rvert \le 200$	10 mV – 200 V (200)	50 mA	
VS (HP 41424A)	0	Depends on the previous setting		
	$0 < \lvert value \rvert \le 20$	1 mV – 20 V (20)	100 mA	
	$20 < \lvert value \rvert \le 40$	2 mV – 40 V (40)	20 mA	

[1] If the previous setting of the SMU was IS mode, the optimum voltage range is automatically selected for the specified output voltage. However, if the SMU is already set to VS mode, the voltage range does not change, regardless of the specified output voltage, and if the specified output voltage is outside the limits of the range, TIS ERROR 56 is reported.

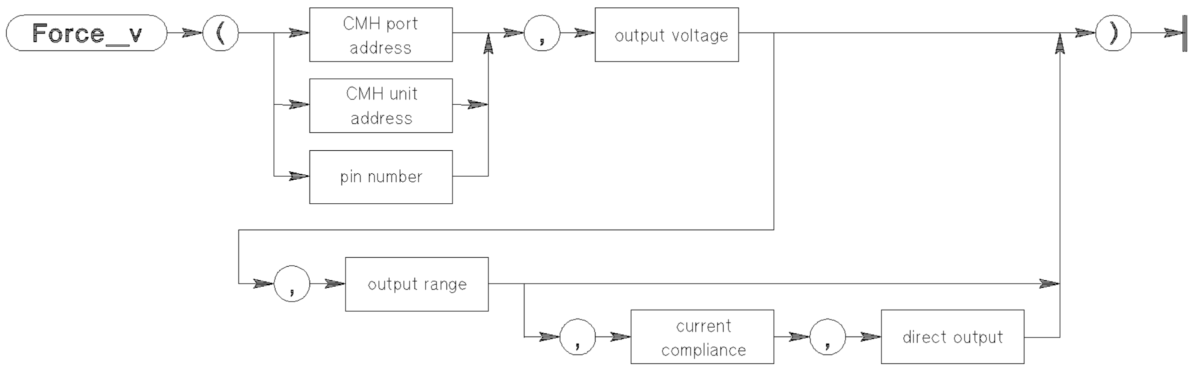
If Force_v is used in a FOR ... NEXT loop, the *output range* should be kept constant at each iteration of the loop. The reason for this is that each time a range change occurs, the SMU is briefly set to Zero Output, causing the device under test to exhibit unexpected characteristics.

Direct output

Refer to the Force_i subprogram Description for more details on the *direct output* parameter.

For CMU Measurements:

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
CMH port address	integer expression	32708 [1]	
CMH unit address	integer expression	32671	
pin number	integer expression	1 to 96 [2]	
output voltage	numeric expression: [V]	−100 to 100 [3]	
output range	numeric expression: [V] default = previously set range	−100 to 100 [3]	0, 1, 10, 100
current compliance	numeric expression	— [4]	
direct output	integer expression default = 0	−32768 to 32767	0, 1

1 Must be the CMH and CML terminals of the CMU connected to AUX3 (CMH) and AUX4 (CML) ports, respectively.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the CMH port.

3 Actual *output voltage* range restrictions depend on the specified bias range.

4 This is a dummy parameter.

Example Statements

```
Force_v(FNCmh,5)
Force_v(Gate,Bias,0)
Force_v(Cmh_port,Voltage,Range)
```

Description

CMH port address, *CMH unit address*, and *pin number*

Either the *CMH port address*, the *CMH unit address*, or the *pin number* of any pin connected to the CMH port can be used to specify the CMH.

The *output range* sets the range of the CMU internal dc bias source. It also determines the maximum output voltage and output resolution. Refer to the following table:

Output Range Value	DC Bias Range	Max. Output Voltage	Max. Resolution	Max. Output Current
$0 < \lvert \text{value} \rvert \leq 1.999$	1 V	±1.999 V	1 mV	±5 mA
$1.999 < \lvert \text{value} \rvert \leq 19.999$	10 V	±19.99 V	10 mV	±5 mA
$19.99 < \lvert \text{value} \rvert \leq 100$	100 V	±100.0 V	100 mV	±5 mA
0	last valid range setting			

If the Force_v subprogram is used in a FOR ... NEXT loop to sweep the output of the CMU internal dc bias source, the *output range* should be kept constant at each iteration of the loop. The reason for this is that each time a range change occurs, the internal dc bias source is briefly set to Zero Output, causing the device under test to exhibit unexpected characteristics.

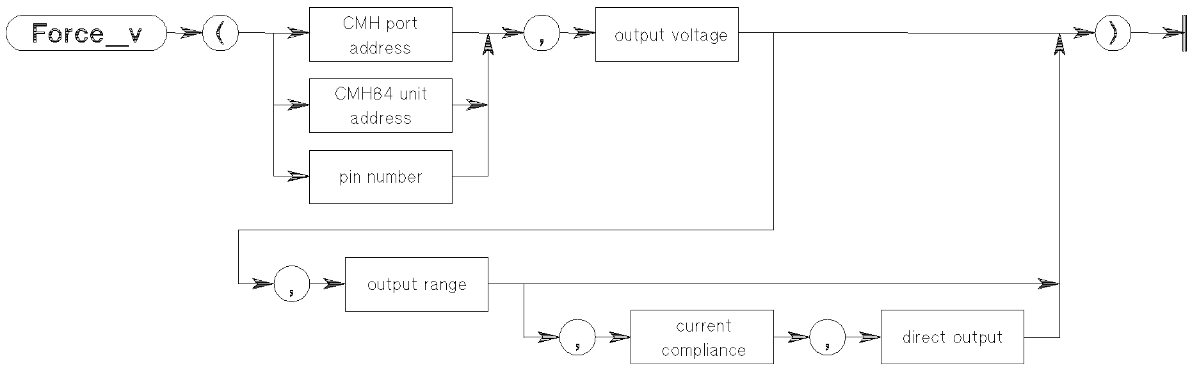
If the output current exceeds approximately 5 mA, the V OUTPUT indicator on the CMU blinks and the internal dc bias source is not able to output the specified voltage.

Direct output

Refer to the Force_i subprogram Description for more details on the *direct output* parameter.

For CMU84 Measurements:

Syntax



Item	Description/Default	Range Restrictions
CMH port address	integer expression	32708, 32727, 32728[1]
CMH84 unit address	integer expression	32676
pin number	integer expression	1 to 96[2]
output voltage	numeric expression: [V]	−40 to 40[3]
output range	numeric expression	—[4]
current compliance	numeric expression	—[4]
direct output	integer expression default = 0	−32768 to 32767 0: false ≠0: true

1 Must be the CMH84 and CML84 terminals of the CMU84 and connected to the AUX3 (CMH) and AUX4 (CML) ports, respectively. If the SWM is equipped with a port expander, the CMH84 and CML84 terminals must be connected to the AUX31 and AUX41 or AUX32 and AUX42, respectively.

2 For HP 4085B 48-pin SWM systems: 1 to 48. Must be the number of a measurement pin connected to the CMH port.

3 If the CMU84 is not equipped with a power amplifier (Option 321/531), the voltages available are 0 V, 1.5 V, and 2.0 V.

4 This is a dummy parameter.

Example Statements

```
Force_v(FNCmh,5)
Force_v(Gate,Bias)
Force_v(FNCmu84(1),Voltage)
```

Description

Either the *CMH port address*, the *CMH84 unit address*, or the *pin number* of any pin connected to the CMH port can be used to specify the CMH.

Output voltage defines the dc bias voltage.

If Option 321/531 (HP 4284A Option 001) is *not* installed, the dc bias voltage can be set to 0 V, 1.5 V, or 2.0 V, as shown in the following table:

Output voltage **Value**	**Actual Dc Bias Voltage**
$0 \leq \mid \text{value} \mid < 1.5$	0 V
$1.5 \leq \mid \text{value} \mid < 2.0$	$\pm$1.5 V
$\mid \text{value} \mid = 2.0$	$\pm$2.0 V
$2.0 < \mid \text{value} \mid$	error

If Option 321/531 (HP 4284A Option 001) is installed, the allowable dc bias voltage is 0 through $\pm$ 40.0 V, as shown in the following table:

Output voltage **Value**	**Actual Dc Bias Voltage**	**Resolution**
$0 \leq \mid \text{value} \mid \leq 4.000$	value	1 mV
$4.000 < \mid \text{value} \mid \leq 8.000$	value	2 mV
$8.000 < \mid \text{value} \mid \leq 20.000$	value	5 mV
$20.000 < \mid \text{value} \mid \leq 40.00$	value	10 mV
$40.00 < \mid \text{value} \mid < 40.01$	$\pm$ 40.00 V	—
$40.01 \leq \mid \text{value} \mid$	error	—

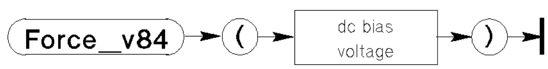
Refer to the Force_i subprogram Description for more details on the *direct output* parameter.

Force_v84

Supported on 4062C, 4062UX, 4062PC
Revision C.05.60 or later, X.05.61 or later, P.06.20 or later
File DVR4284
Control CMU84

This subprogram sets the internal dc bias source of the CMU84.

Syntax



Item	Description/Default	Range Restrictions
dc bias voltage	numeric expression: [V]	0, 1.5, or 2.0 (standard) 0 to ± 40.0 (option 321/531)

Example Statement

```
Force_v84(2)
Force_v84(-15)
Force_v84(Bias_voltage)
```

Description

The `Force_v84` (*dc bias voltage*) statement is equivalent to the `Force_v(FNCmu84(1),` *output voltage*) statement.

dc bias voltage

This parameter defines the dc bias voltage.

If Option 321/531 (HP 4284A Option 001) is *not* installed, the dc bias voltage can be set to 0 V, 1.5 V, or 2.0 V, as shown in the following table:

Output voltage **Value**	**Actual Dc Bias Voltage**
$0 \leq \mid \text{value} \mid < 1.5$	0 V
$1.5 \leq \mid \text{value} \mid < 2.0$	±1.5 V
$\mid \text{value} \mid = 2.0$	±2.0 V
$2.0 < \mid \text{value} \mid$	error

If option 321/531 (HP 4284A option 001) is installed, the allowable dc bias voltage is 0 through ± 40.0 V, as shown in the following table:

Dc Bias Voltage Value	Actual Dc Bias Voltage	Resolution
$\lvert$ value $\rvert \le 4.000$	value	1 mV
$4.000 < \lvert$ value $\rvert \le 8.000$	value	2 mV
$8.000 < \lvert$ value $\rvert \le 20.000$	value	5 mV
$20.000 < \lvert$ value $\rvert \le 40.00$	value	10 mV
$40.00 < \lvert$ value $\rvert < 40.01$	$\pm$ 40.00 V	—
$40.01 \le \lvert$ value $\rvert$	error	—

Programming Annotations (only for Rev. C.05.70 or before, and X.05.61 or before)

This subprogram does not confirm the pin-port connections in SWM during dc bias output. The zero dc bias voltage must be output when the pin-port connections are changed. The Disable_port84 subprogram outputs 0 V as the dc bias voltage. The following is an example using Forc_v84:

```
 . . . . . . .
Connect(Cmh,10)
Connect(Cml,12)
Force_v84(Bias_v)              output dc bias voltage
Measure_cmu84(Capacitance)
PRINT Bias_v,Capacitance
Disable_port84                 O V output
Connect                        disconnect pin-port
Connect(Cmh,14)
Connect(Cml,16)
Force_v84(Bias_v)
Measure_cmu84(Capacitance)
PRINT Bias_v,Capacitance
 . . . . . . .
```

See Also

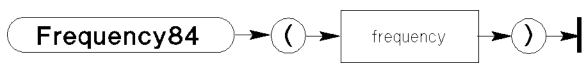
Disable_port84

Frequency84

Supported on 4062C, 4062UX, 4062PC
Revision C.05.60 or later, X.05.61 or later, P.06.20 or later
File DVR4284
Control CMU84

This subprogram sets the measurement frequency of the CMU84.

Syntax



Item	Description/Default	Range Restrictions
frequency	numeric expression: [Hz]	1E3, 1E4, 1E5, and 1E6

Example Statement

```
Frequency84(1000)
Frequency84(Freq1)
```

Description

The `Frequency84(`*frequency*`)` statement is equivalent to the `Set_freq(FNCmu84(1),`*frequency*`)` statement.

frequency

The measurement frequency can be set to 1 kHz, 10 kHz, 100 kHz, or 1 MHz with this parameter.

Note

Frequencies between 20 Hz through 1 MHz are available for *frequency* parameter and the measurement is executed without an error message. However, Hewlett-Packard guarantees the accuracy of measurement data taken with only the following frequencies: 1 kHz, 10 kHz, 100 kHz, and 1 MHz.

Init_system

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS, DVR84
Control	DCS, CMU, CMU84, SWM

This subprogram initializes the system.

Syntax

Description

Execute Init_system before executing any other TIS subprogram. Init_system clears all previous settings and sets the main functions of the systems (excluding the wafer prober) as follows:

Subsystem	Item	Settings
SWM	Measurement Pins	Disconnected
DCS	SMU	VS Mode, 20 V Range, 0 V Output, 100 μA Current Compliance, Filter ON
	VM	20 V Range, Grounded Measurement mode
	VS	0 V Output, 20 V Range
	Integration Time	SHORT
	Auto Calibration	ON
	Output Switch	OFF
CMU	C·G Range	Auto Range
	Test Signal Level	30 mVrms
	Integration Time	MEDIUM
	Bias Source	0 V Output, INTERNAL DC BIAS, V Output Lamp ON (enable)
CMU84	Integraion Time	MEDIUM
	Measurement Range	AUTO
	Test Signal Level	30 mVrms
	DC Bias Source	0 V Output
	Frequency	1 MHz

Init_system also clears the following variables and TIS procedures:

- The program segment of a Prepare ... Execute construct.
- The measurement parameters set by Set_iv, Set_cv, Set_ct, Set_pbias, Set_piv, Set_asearch, Set_bsearch, Set_lsearch, Set_sync, Set_cmu84, Set_cv84, and Frequency84.
- The probing sequence loaded by Wget.

- The index values set by Pscale.
- The probing wafer chip coordinates.

The initial control settings of the SWM, DCS, CMU, and CMU84 can be found in chapter 5 of the *System Information Manual* .

Note

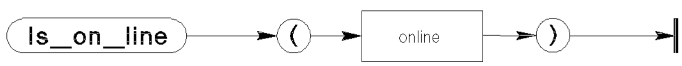
If your software revision is before C.06.00/X.06.00/P.06.20, and if your system is equipped with the CMU84, you must link TIS and DVR4284 when executing Init_system statement.

Is_on_line

Supported on	4062UX
Revision	X.05.50 or later
File	TIS
Control	—

This subprogram returns online test session status.

Syntax



Item	Description/Default	Range Restrictions
online	integer variable name	any valid name

Example Statements

```
Is_on_line(On_line_flag)
```

Description

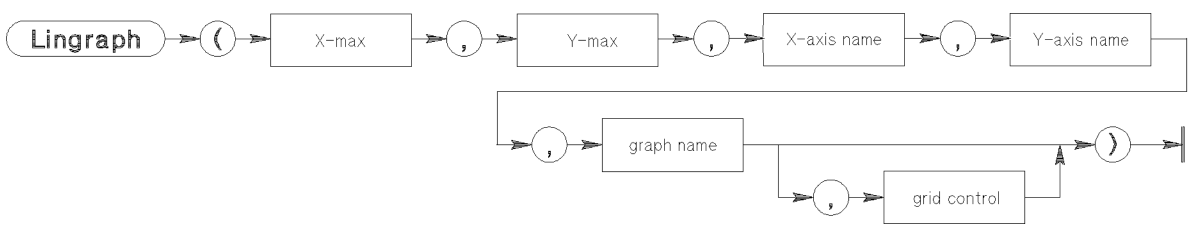
When running a test session, this subprogram returns the online mode status to *online*: 1 if in the online mode; 0 if not in the online mode.

Lingraph

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File XYGRAPH
Control —

This subprogram clears the CRT of all graphics, optimizes the specified X-max and Y-max values, and draws an X-axis and Y-axis from 0 to the optimized maximum values.

Syntax



Item	Description/Default	Range Restrictions
X-max	numeric expression	—
Y-max	numeric expression	—
X-axis name	string expression	—
Y-axis name	string expression	—
graph name	string expression	—
grid control	integer expression default = 0	0: no grid lines 1: grid lines

Example Statements

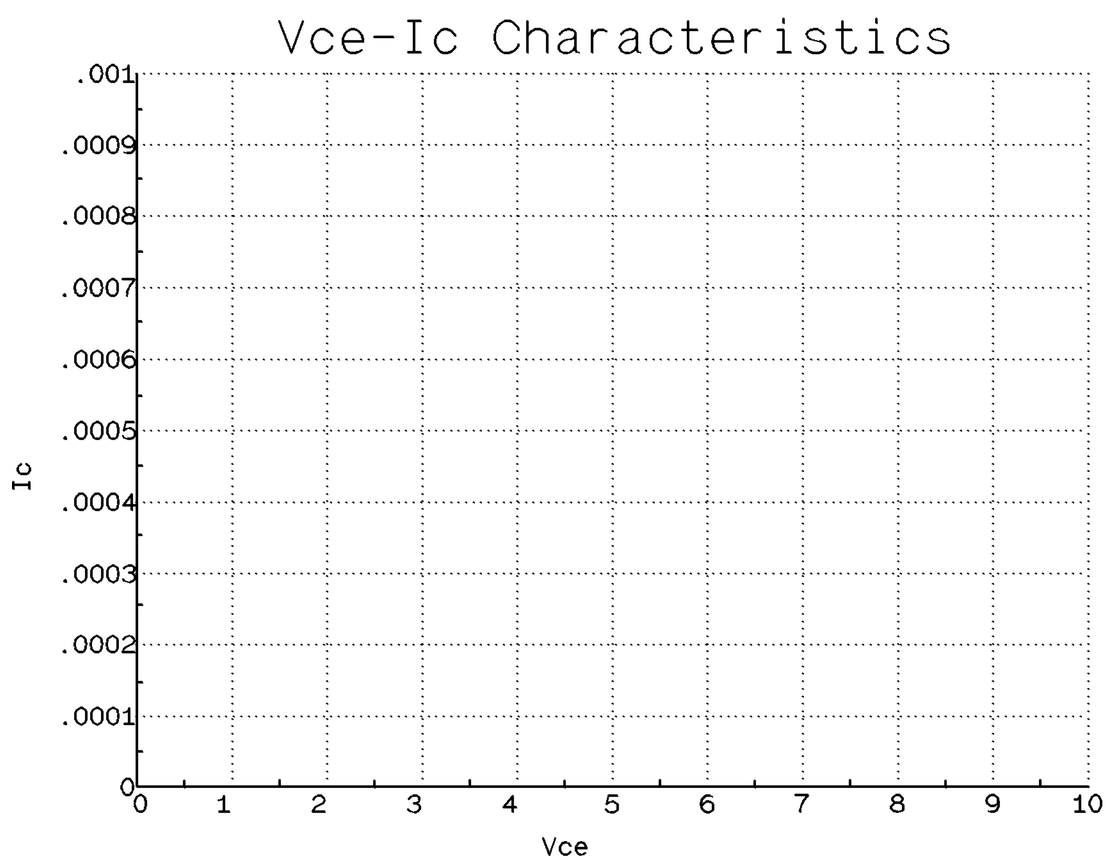
```
Lingraph(10,1.E-3,"Vce","Ic","Vce-Ic Characteristics",1)
Lingraph(Xmax,Ymax,Xname$,Yname$,Graph_name$,Gridding)
```

Description

This subprogram executes a BASIC language GINIT and plots a graph in accordance with the specified parameters. For example, executing the first example statement results in the graph shown below. The Lingraph subprogram also sets certain graphics-related variables by executing a subroutine similar to the one shown here.

```
DEG
VIEWPORT RATIO*12,RATIO*95,17,95
WINDOW 0,Xmaxaxis,0,Ymaxaxis
CLIP ON
CSIZE 3
LDIR 0
LORG 8
LINE TYPE 1
MOVE 0,0
```

Xmaxaxis: Maximum value of the X-axis
Ymaxaxis: Maximum value of the Y-axis

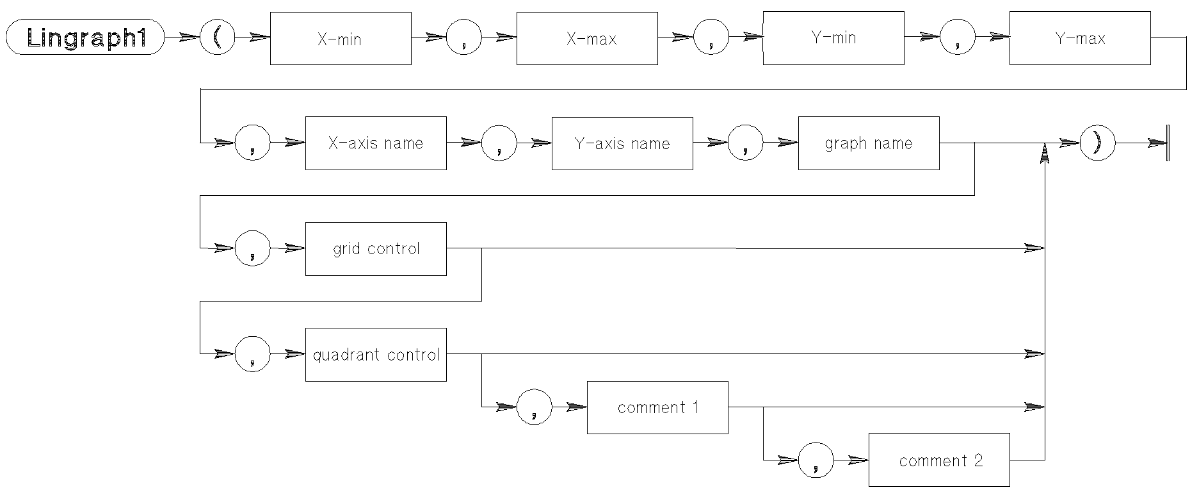


Lingraph1

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	XYGRAPH
Control	—

This subprogram optimizes the specified X-max, X-min, Y-max, and Y-min values, and draws an X-axis and Y-axis from the optimized minimum values to the optimized maximum values.

Syntax



Item	Description/Default	Range Restrictions
X-min	numeric expression	—[1]
X-max	numeric expression	—[1]
Y-min	numeric expression	—[1]
Y-max	numeric expression	—[1]
X-axis name	string expression	30 characters max.[2]
Y-axis name	string expression	30 characters max.[2]
graph name	string expression	35 characters max.
grid control	integer expression default = 0	0: no grid lines 1: broken lines 2: solid lines

Item	Description/Default	Range Restrictions
quadrant control	integer expression default = 0 (full screen)	0 to 4
comment1	string expression	20 characters max.
comment2	string expression	20 characters max.

[1] *X-min* and *Y-min* values can be set larger than *X-max* and *Y-max* values, respectively. The *X-min* value is always assigned to the leftmost point of the X-axis, and the *Y-min* value is always assigned to the lowest point of the Y-axis.

[2] If the *quadrant control* parameter is set to 1 through 4, the *X-axis name* and *Y-axis name* should not exceed 20 characters. If the name includes more than 20 characters, it may overlap with other areas.

Example Statements

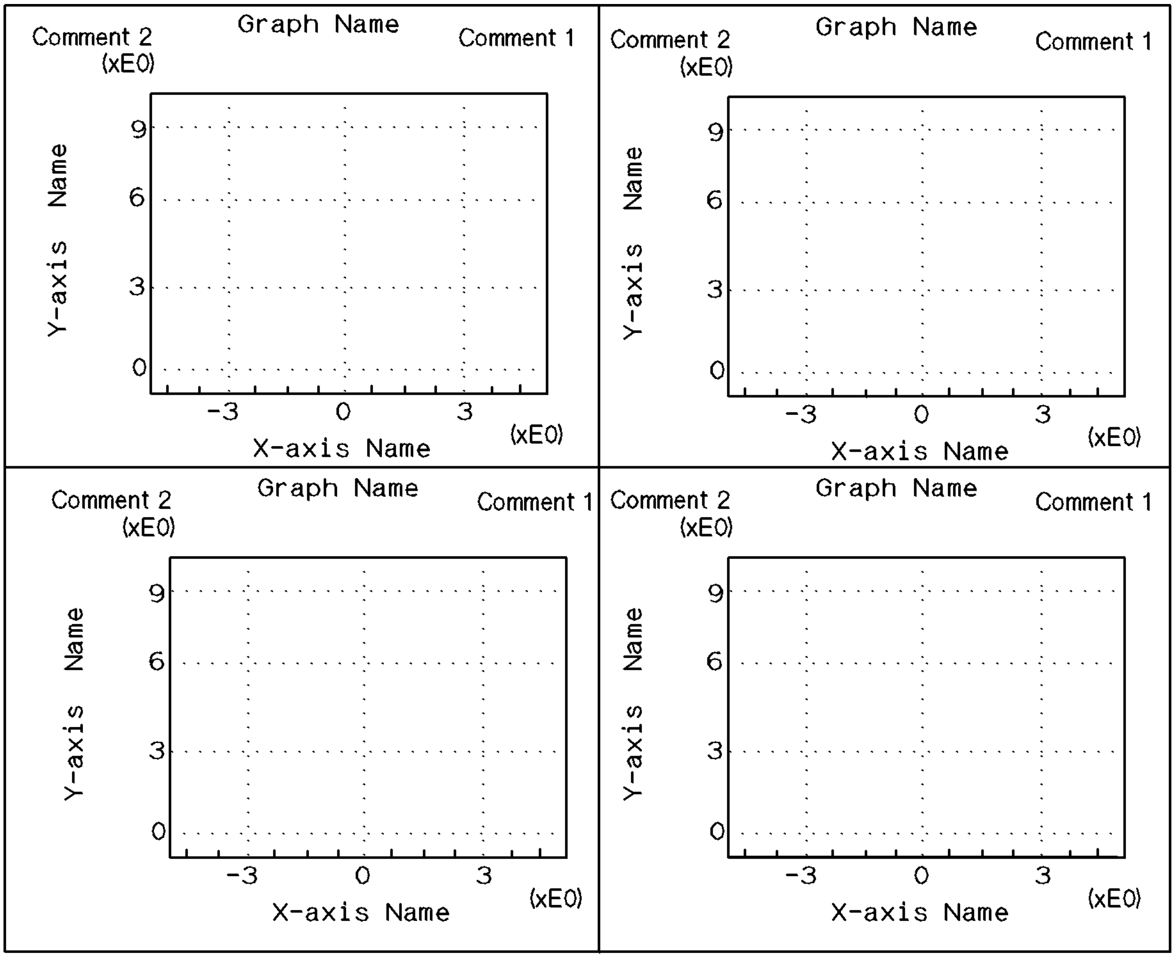
```
Lingraph1(-5,5,-1E-3,1E-3,"Vce","Ic","Vce-Ic Characteristics")
Lingraph1(Xmin,Xmax,Ymin,Ymax,Xname$,Yname$,Title$,Grid,Quadrant,Right_ti
tle$,Left_title$)
```

Description

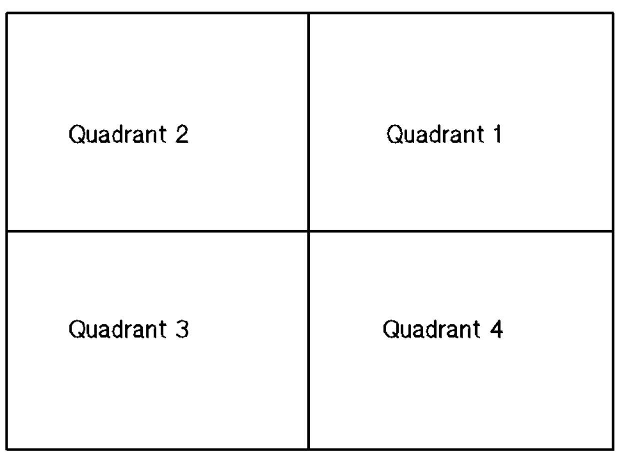
This subprogram plots a graph in accordance with the specified parameters. An example graph is shown on next page. To move the pen to any X-Y coordinate, execute a BASIC MOVE X,Y command.

Quadrant control

The *quadrant control* parameter specifies the plotted position of the graph scale. If you set *quadrant control* to 0, a graph scale is plotted full screen. If you set *quadrant control* to 1 through 4, a graph scale is plotted in the quadrant specified, as shown on the next page.


Comment 2
Graph Name
Comment 1
(xE0)
Y-axis Name
9
6
3
0
-3
0
3
X-axis Name
(xE0)

CRT Display

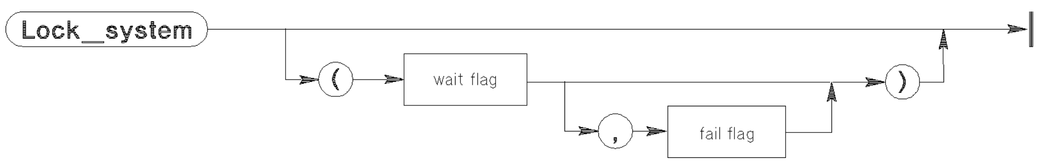

Quadrant 2
Quadrant 1
Quadrant 3
Quadrant 4

Lock_system

Supported on	4062UX
Revision	X.05.50 or later
File	TIS
Control	—

This subprogram explicitly locks the system instruments specified in a calling process to that process.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
wait flag	integer expression default = 0	−32768 to 32767	0, 1
fail flag	integer variable name	any valid name	

Example Statements

```
Lock_system
Lock_system(0,Fail)
```

Description

If the system instruments are explicitly or implicitly locked to another process and you specify a *wait flag* value other than 0, this process waits for the other process to release the system instruments.

If you specify a *wait flag* value of 0 and do not specify a *fail flag* name, or if you do not specify a *wait flag* value, an error occurs if system instruments are explicitly locked to another process.

If system instruments are locked to another process implicitly, Lock_system waits until the other process releases the instruments, regardless of the *wait flag* setting.

If you specify a *fail flag* name, a −1 is returned if explicit locking is unsuccessful (instruments locked to another process); and a 0 is returned if locking was successful.

Explicit locking cannot be nested. This subprogram is ignored if system instruments are already locked to the calling process.

In Offline Mode (HP 4062UX Only)

Lock_system is ignored in offline mode execution.

See Also

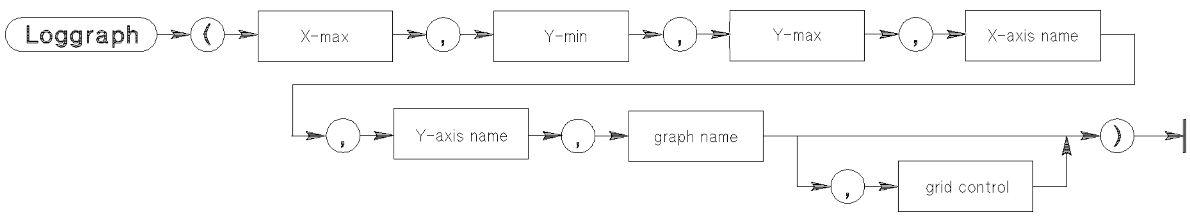
Unlock_system

Loggraph

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	XYGRAPH
Control	—

This subprogram clears the CRT of all graphics, and optimizes the specified X-max, Y-min, and Y-max values. It draws an X-axis from 0 to the optimized X-max value and a Y-axis from the optimized Y-min value to the optimized Y-max value.

Syntax



Item	Description/Default	Range Restrictions
X-max	numeric expression	—
Y-min	numeric expression	—
Y-max	numeric expression	must be same polarity as Y-min, and |Y-min| < |Y-max|
X-axis name	string expression	—
Y-axis name	string expression	—
graph name	string expression	—
grid control	integer expression default = 0	0: no grid lines 1: grid lines

Example Statements

```
Loggraph(5,1.E-12,1.E-6,"Vgs","Id","Vgs-Id Characteristics",1)
Loggraph(Xmax,Ymin,Ymax,Xname$,Yname$,Graph_name$,Gridding)
```

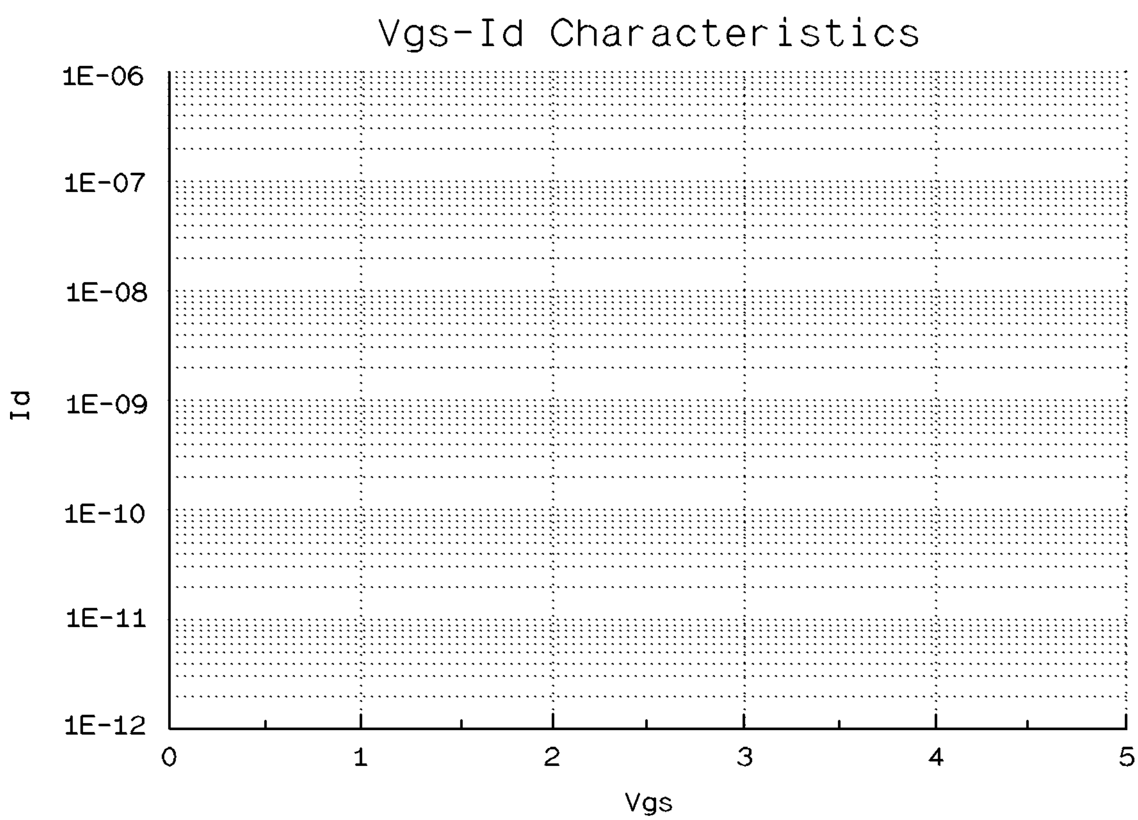
Description

This subprogram executes a BASIC language GINIT and plots a graph in accordance with the specified parameters. For example, executing the first example statement results in the graph shown below. The Loggraph subprogram also sets certain graphics-related variables by executing a subroutine similar to the one shown here.

```
DEG
VIEWPORT RATIO*12,RATIO*95,17,95
WINDOW 0,Xmaxaxis,Yminaxis,Ymaxaxis
CLIP ON
CSIZE 3
LDIR 0
LORG 8
LINE TYPE 1
MOVE 0,Yminaxis
```

Xmaxaxis: Maximum value of the X-axis
Ymaxaxis: Maximum value of the Y-axis
Yminaxis: Minimum value of the Y-axis

To move the pen to any X-Y coordinate, execute MOVE X, LGT(Y).

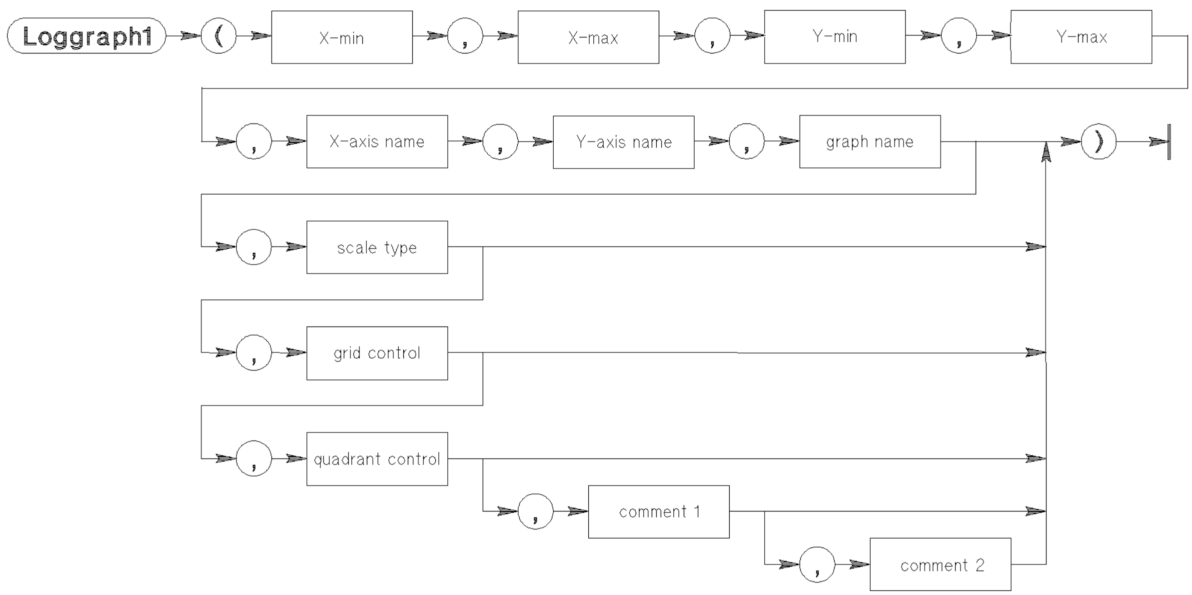


Loggraph1

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	XYGRAPH
Control	—

This subprogram optimizes the specified X-min, X-max, Y-min, and Y-max values, and draws an X-axis from the optimized X-min to the optimized X-max value and a Y-axis from the optimized Y-min value to the optimized Y-max value.

Syntax



Item	Description/Default	Range Restrictions
X-min	numeric expression	—[1]
X-max	numeric expression	must be same polarity as *X-min* if log. scale. [1]
Y-min	numeric expression	—[1]
Y-max	numeric expression	must be same polarity as *Y-min* if log. scale. [1]

Item	Description/Default	Range Restrictions
X-axis name	string expression	30 characters max. [2]
Y-axis name	string expression	30 characters max. [2]
graph name	string expression	35 characters max.
scale type	integer expression default = 1	1: X-lin. Y-log. 2: X-log. Y-lin. 3: X-log. Y-log.
grid control	integer expression default = 0	0: no grid line 1: broken line 2: solid line
quadrant control	integer expression default = 0 (full screen)	0 to 4
comment1	string expression	20 characters max.
comment2	string expression	20 characters max.

[1] *X-min* and *Y-min* values can be set larger than *X-max* and *Y-max* values, respectively. The *X-min* value is always assigned to the left most point of the X-axis, and the *Y-min* value is always assigned lowest point of the Y-axis.

[2] If the *quadrant control* parameter is set to 1 through 4, the *X-axis name* and *Y-axis name* should not exceed 20 characters. If the name includes more than 20 characters, it may overlap with other areas.

Example Statements

```
Loggraph1(-5,5,1E-12,1E-3,"Vce","Ic","Vce-Ic Characteristics")
Loggraph1(Xmin,Xmax,Ymin,Ymax,Xname$,Yname$,Graph_name$,Graph_mode,
Gridding,Quadrant,Right_title$,Left_title$)
```

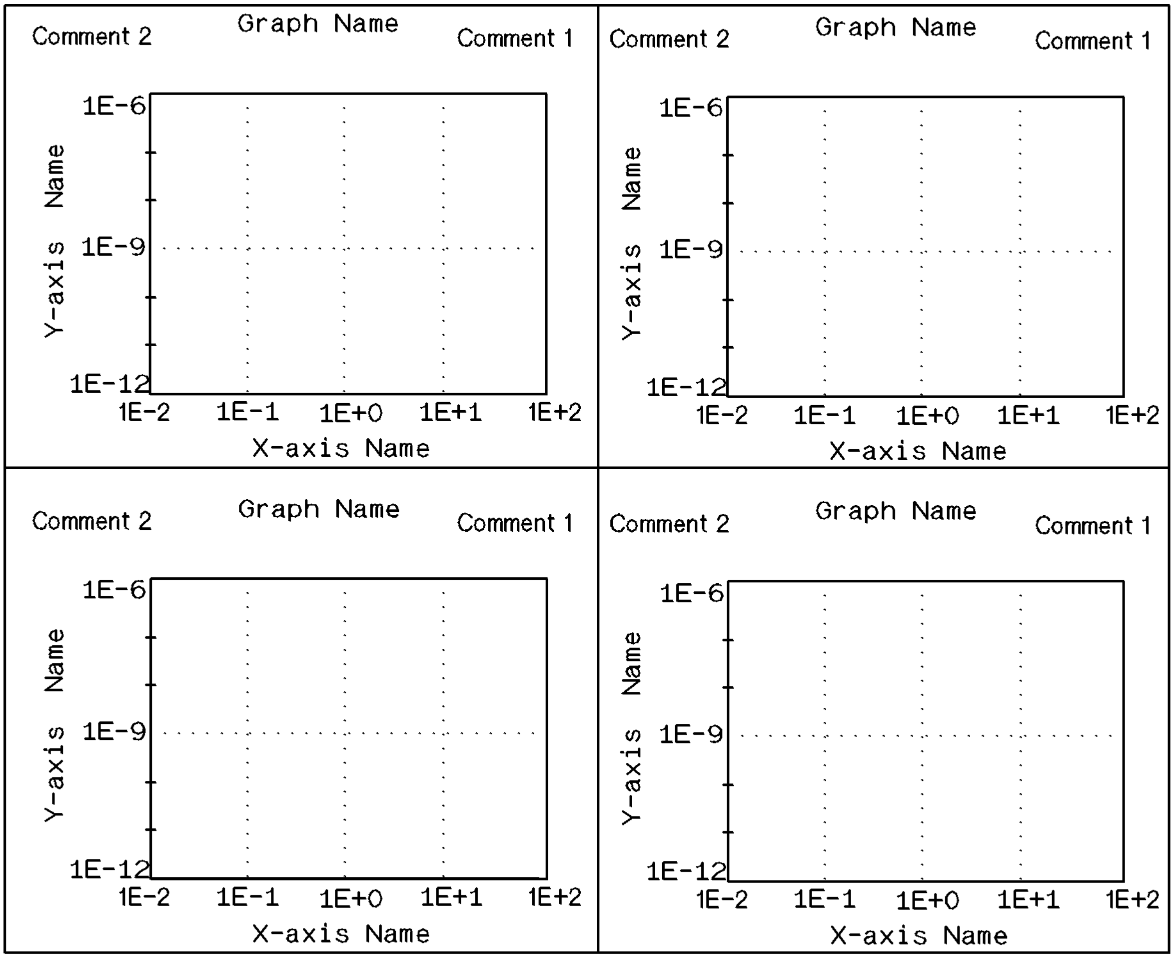
Description

This subprogram plots a graph in accordance with the specified parameters. An example graph is shown on the next page. To move the pen to any X-Y coordinate, execute a BASIC MOVE command as follow.

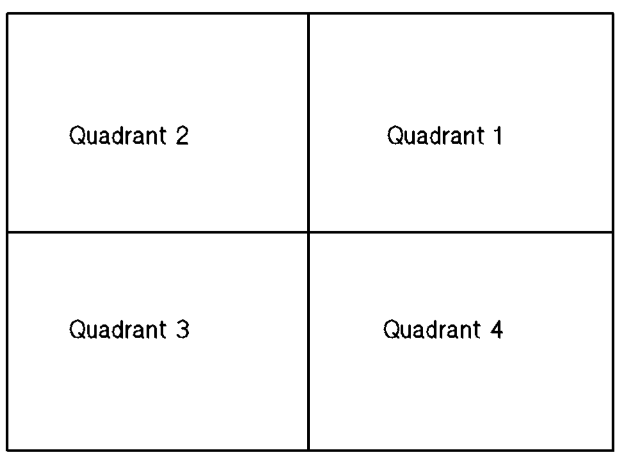
`MOVE X,LGT(Y)`	*X-lin Y-log graph*
`MOVE LGT(X),Y`	*X-log Y-lin graph*
`MOVE LGT(X),LGT(Y)`	*X-log Y-log graph*

quadrant control

The *quadrant control* parameter specifies the plotted position of the graph scale. If you set *quadrant control* to 0, a graph scale is plotted full screen. If you set *quadrant control* to 1 through 4, a graph scale is plotted in the quadrant specified, as shown on the next page.


Comment 2
Graph Name
Comment 1
1E-6
1E-9
1E-12
Y-axis Name
1E-2
1E-1
1E+0
1E+1
1E+2
X-axis Name

CRT Display


Quadrant 2
Quadrant 1
Quadrant 3
Quadrant 4

Long_cal

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets all SMUs, VSs, VMs, and the AFU to their initial status. It also initiates the automatic calibration function of the DCS, which measures and compensates for the dc offset voltages of the SMUs, VSs, VMs, AFU, A/D and D/A converter.

Syntax

Example Statements

```
Long_cal
```

Description

The SMUs and VSs of the DCS are set to their initial states, and calibration takes approximately 21 seconds for a standard system configuration.

You should perform Long_cal after your system has fully warmed up to correct for offsets caused by temperature drifts.

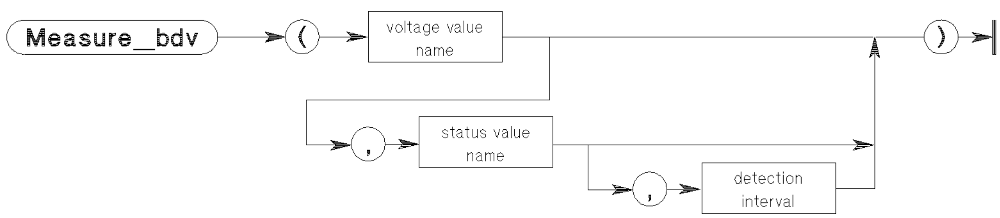
For best measurement results, perform Short_cal every 30 minutes or when the ambient temperature changes more than 3°C (6°F). Calibration is performed at about 30 minute intervals if all DCS (HP 4142B) units are in a disabled state for longer than 30 minutes.

Measure_bdv

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram triggers quasi-pulsed measurements to measure breakdown voltage, then returns the measured value.

Syntax



Item	Description/Default	Range Restrictions
voltage value name	numeric variable name	any valid name
status value name	integer variable name	any valid name
detection interval	integer expression default = 0	0: SHORT 1: LONG

Example Statements

```
Measure_bdv(Vbreakdown)
Measure_bdv(Bdv,Stat)
Measure_bdv(Breakdown,St,1)
```

Description

This subprogram triggers the quasi-pulsed measurement to measure breakdown voltage. The conditions of the quasi-pulsed measurements are determined by the Set_bdv statement. The measured value and its measurement status are returned to the *voltage value name* and *status value name*, respectively.

The following table shows the measurement status for the quasi-pulsed measurements of breakdown voltage:

Status Code	Condition
0	The quasi-pulsed measurement ended normally.
1	Another unit reached compliance.
2	Breakdown voltage measurement failed because current did not reach *breakdown current*.
3	This unit is oscillating.
4	Measurement overflow while monitoring output voltage or measuring breakdown voltage.
6	The quasi-pulsed measurement did not reach *breakdown current* within timeout.
7	The monitored slew rate of the output voltage is too small.

Detection interval defines the monitoring duration of the output voltage. When the *detection interval* is set to LONG, the results of monitoring the SHORT mode 10 times are used to decide when the output current reaches the *breakdown current* value.

When the *detection interval* is set to SHORT, a slew rate of less than 1000 V/s (= 1 V/ms) causes an error (status = 7). When the *detection interval* is set to LONG, a slew rate of less than 100 V/s (= 0.1 V/ms) causes an error (status = 7).

The timeout for the quasi-pulsed measurement is set to 3 seconds for SHORT mode and 12 seconds for LONG mode.

For more information on the quasi-pulsed measurements, see the *HP 4142B Operation Manual*.

Programming Example

The following program executes the quasi-pulsed measurement to measure the breakdown voltage. If the slew rate is too small, the detection interval is set to LONG and the measurement is executed again.

```
100  INTEGER St
110  REAL Bdv
120  !
130  Connect(FNSmu(2),24)
140  Connect(FNGnd,32)
150  Set_bdv(FNSmu(2),40,0,35,1.E-6)
160  Measure_bdv(Bdv,St)
170  IF St>=5 THEN CALL Measure_bdv(Bdv,St,1)
180  PRINT "Breakdown Voltage: ";Bdv;" (V)"
190  Connect
200  END
```

See Also

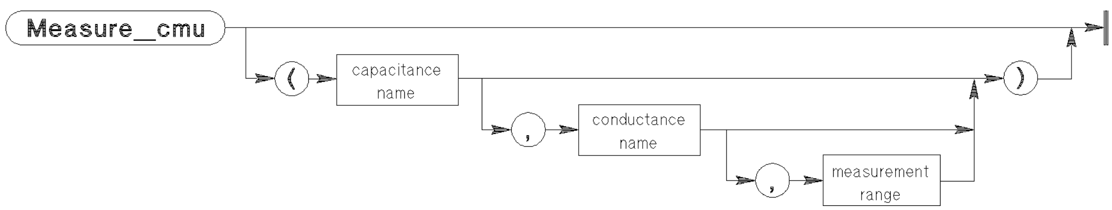
Set_bdv

Measure_cmu

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	CMU

This subprogram measures capacitance and conductance, and returns error corrected values.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
capacitance name	numeric variable name	any valid name	
conductance name	numeric variable name	any valid name	
measurement range	numeric expression default = last valid setting	−1E−2 to 1E−2	0, 1E−11, 1E−10, 1E−9, 1E−4, 1E−3, 1E−2

Example Statements

```
Measure_cmu(Cap,G)
Measure_cmu(C_data,G_data,Range)
```

Description

This subprogram returns the error-corrected measurement results to the specified *capacitance name* and *conductance name*. Measure_cmu provides automatic correction for the residuals of the signal cables that connect the CMU to the SWM, and the residuals of the pin boards. Measurement values include the residual impedance that exists between the SWM and the device under test. The *measurement range* parameter sets the C·G range of the CMU. Refer to the following table.

Measurement Range Value	C Range (Maximum) [1]	G Range (Maximum) [1]
$0 < \vert \text{value} \vert \leq 1\text{E}{-11}$ $1\text{E}{-9} < \vert \text{value} \vert \leq 1\text{E}{-4}$	10 pF (19.00 pF)	100 μS (120.0 μS)
$1\text{E}{-11} < \vert \text{value} \vert \leq 1\text{E}{-10}$ $1\text{E}{-4} < \vert \text{value} \vert \leq 1\text{E}{-3}$	100 pF (190.0 pF)	1 mS (1.200 mS)
$1\text{E}{-10} < \vert \text{value} \vert \leq 1\text{E}{-9}$ $1\text{E}{-3} < \vert \text{value} \vert \leq 1\text{E}{-2}$	1000 pF (1900 pF)	10 mS (12.00 mS)
0	Auto range [2]	

[1] Maximum value that can be displayed on the front panel of the CMU.
[2] The optimum C·G Range for the capacitance measurement value is automatically selected.

The measurement resolution of each range depends on the integration time setting. Refer to the Set_cmu subprogram. If a measurement overflow occurs, 9.99999E+9 is returned to the *capacitance name*, and 9.9999E+9 is returned to the *conductance name*.

When Measure_cmu is called in a Prepare ... Execute construct, the variable parameters (*capacitance name* and *conductance name*) are regarded as dummy parameters. Measurement values are returned to the variables specified in the Execute subprogram.

If the existing C·G range is correct and if only the capacitance value is required, the Measure_cmu subprogram requires no parameters. Refer to the Description of the Prepare ... Execute construct for further details.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *capacitance* and *conductance name* variables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

Returned values are determined by the *measurement range* value as follows:

Measurement Range Value	Capacitance	Conductance
0	10 pF	100 μS
$0 < \vert \text{value} \vert \leq 1\text{E}{-11}$	Range value	100 μS
$1\text{E}{-11} < \vert \text{value} \vert \leq 1\text{E}{-10}$	Range value	1 mS
$1\text{E}{-10} < \vert \text{value} \vert$	Range value	10 mS

If you do not set a *measurement range*, this subprogram uses the last valid range setting as the *measurement range* value.

File Data Simulation mode:

This subprogram reads <c_meas> and <g_meas> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Measure_cmu  <c_meas>  <g_meas>
```

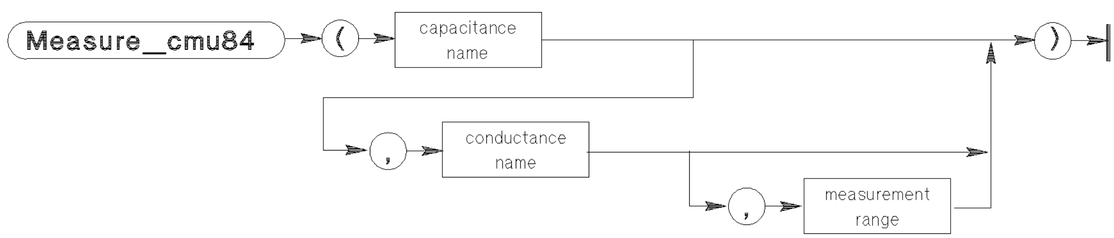
You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Measure_cmu84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284 (for Rev. C.05.60, C.05.70 or X.05.61), TIS (for Rev. C.06.00 or later, X.06.00 or later, P.06.20 or later)
Control	CMU84

This subprogram uses the CMU84 to measure capacitance and conductance, and returns error corrected values.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
capacitance name	numeric variable name	any valid name	
conductance name	numeric variable name	any valid name	
measurement range	numeric expression: [F] default = 0 (AUTO ranging)	real value	

Example Statement

```
Measure_cmu84(Capacitance)
Measure_cmu84(C,G)
Measure_cmu84(C,G,5.E-9)
Measure_cmu84(C,G,Crange)
```

Description

This subprogram performs the capacitance measurement with the CMU84 set to Cp-G mode and returns the error compensated capacitance and conductance values to the *capacitance name* and *conductance name* variables, respectively. If the CMU84 is not set to the Cp-G mode, this subprogram returns incorrect data.

measurement range

This parameter sets the capacitance measurement range (C range) of the CMU84. The conductance measurement range (G range) is automatically set to *measurement range* $\times$ 1.0$\times 10^7$. If this is omitted or if zero is specified as the parameter value, the CMU84 adopts the AUTO ranging mode. If a certain value other than zero is specified, the following rule applies for the measurement range of the CMU84.

You can specify a capacitance range as this parameter, but the CMU84 performs the impedance measurement according to the impedance range. The relationship between the capacitance and impedance range is shown in the following equation:

$$impedance\ range = \frac{1}{2\pi f|measurement\ range|}$$

Where, f is the measurement frequency.

The specified measurement and impedance ranges are shown below:

	measurement frequencies			
$\mid$ *measurement range* $\mid$ **restrictions [F]**	1 kHz	10 kHz	100 kHz	1 MHz
$0 \leq \mid$ value $\mid \leq$ 1.592E−12	100 kΩ	100 kΩ	100 kΩ	100 kΩ
1.592E−12 $< \mid$ value $\mid \leq$ 5.305E−12	100 kΩ	100 kΩ	100 kΩ	30 kΩ
5.305E−12 $< \mid$ value $\mid \leq$ 1.592E−11	100 kΩ	100 kΩ	100 kΩ	10 kΩ
1.592E−11 $< \mid$ value $\mid \leq$ 5.305E−11	100 kΩ	100 kΩ	30 kΩ	3 kΩ
5.305E−11 $< \mid$ value $\mid \leq$ 1.592E−10	100 kΩ	100 kΩ	10 kΩ	1 kΩ
1.592E−10 $< \mid$ value $\mid \leq$ 5.305E−10	100 kΩ	30 kΩ	3 kΩ	300 Ω
5.305E−10 $< \mid$ value $\mid \leq$ 1.592E−9	100 kΩ	10 kΩ	1 kΩ	100 Ω
1.592E−9 $< \mid$ value $\mid \leq$ 5.305E−9	30 kΩ	30 kΩ	300 Ω	100 Ω
5.305E−9 $< \mid$ value $\mid \leq$ 1.592E−8	10 kΩ	1 kΩ	100 Ω	100 Ω
1.592E−8 $< \mid$ value $\mid \leq$ 5.305E−8	3 kΩ	300 Ω	100 Ω	10 Ω
5.305E−8 $< \mid$ value $\mid \leq$ 1.592E−7	1 kΩ	100 Ω	100 Ω	10 Ω
1.592E−7 $< \mid$ value $\mid \leq$ 5.305E−7	300 Ω	100 Ω	10 Ω	1 Ω
5.305E−7 $< \mid$ value $\mid \leq$ 1.592E−6	100 Ω	100 Ω	10 Ω	1 Ω
1.592E−6 $< \mid$ value $\mid \leq$ 1.592E−5	100 Ω	10 Ω	1 Ω	1 Ω
1.592E−5 $< \mid$ value $\mid \leq$ 1.592E−4	10 Ω	1 Ω	1 Ω	1 Ω
1.592E−4 $< \mid$ value $\mid$	1 Ω	1 Ω	1 Ω	1 Ω

Refer to the *HP 4284A Precision LCR Meter Operation Manual* for more information on the impedance range.

In Offline Mode (HP 4062UX Only)

In offline mode execution, this subprogram returns dummy data. Refer to the following table.

measurement range	dummy capacitance value	dummy conductance value
AUTO	previous C range value default = 10 pF	previous G range value default = 100 μS
other than AUTO	C range value	G range value

See Also

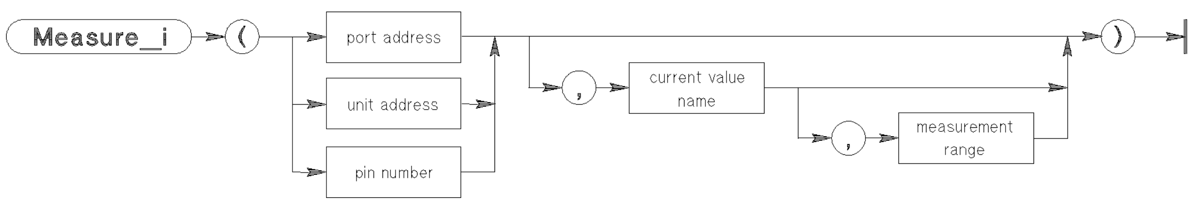
Set_cmu84
Frequency84
Force_v84

Measure_i

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram measures dc current using a specified SMU or VS and returns the measurement value in amperes.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32709 [1], 32721 to 32732 [2]	
unit address	integer expression	32621 to 32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	
pin number	integer expression	1 to 96 [3]	
current value name	name of a numeric variable	any valid name	
measurement range	numeric expression [A]		
	When using SMU in VS mode. Default = last valid setting	−1 to 1 [4]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
	When using VS.	[5]	

[1] The port specified by a port address of 32705, 32706, 32708, or 32709 must be connected to a VS.
[2] These port addresses are used for the AUX port of the port expander.
[3] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the SMU or VS that will perform the measurement.
[4] Actual range restrictions for *measurement range* depend on the SMU and SMU port used. Refer to Description for details.
[5] This is a dummy parameter.

Example Statements

```
Measure_i(FNPort(1),Ids)
Measure_i(Drain,Ids,0)
Measure_i(Port,I_data,Range)
```

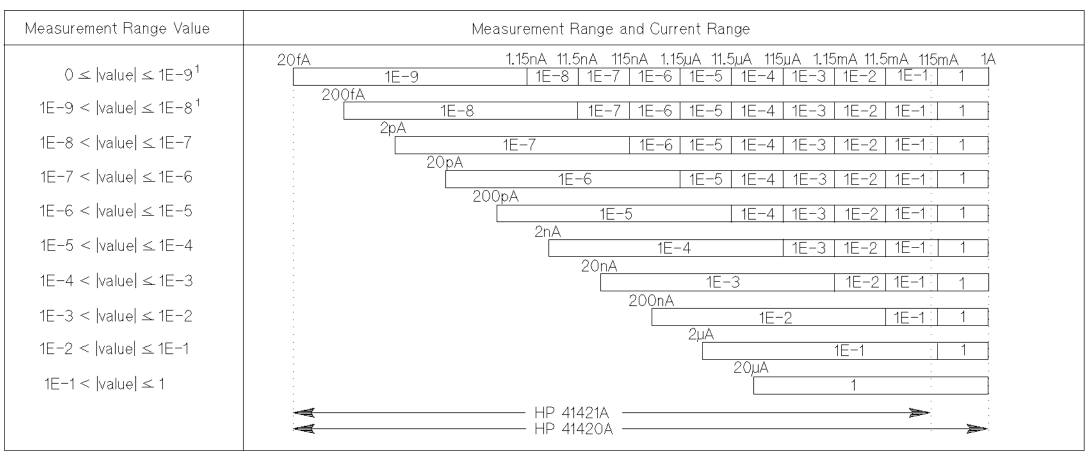
Description

Either the *port address* , the *unit address* , or the *pin number* of any measurement pin connected to the SMU or VS port can be used to specify the SMU or VS, respectively. When using an SMU, the SMU specified must be set to the VS mode. The current range of the SMU is set by the *measurement range* , and the measurement value is returned to the *current value name* .

When measuring current using the DCS (not via the SWM), the allowable current range is the same as the range for the SMU used (HP 41420A or HP 41421B). Measurement resolution is 6 digits on all ranges.

The current range of the VS depends on its voltage range. For the 20 V range, the 100 mA range is used; for the 40 V range, the 20 mA range is used.

If you specify 0 for the *measurement range* of the SMU, it is set to the Auto-ranging mode. If you specify a range, however, the SMU is set to the Limited Auto-ranging mode. Refer to chapter 2 in the *System Information Manual* for a description of Limited Auto-ranging.



[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

Setting the *measurement range* of SMU to a low value improves measurement resolution but may increase measurement time because of additional ranging and wait times.

When Measure_i is called in a Prepare ... Execute construct, the variable parameter (*current value name*) is regarded as a dummy parameter. The measurement value is returned to the variable specified in the Execute subprogram. If the existing current range is correct, only the *port address* or *pin number* parameter is required. Refer to the Description for Prepare ... Execute for further details.

Measure_i

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *current value name* variable. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

Returned values are determined by the *measurement range* value as follows:

Unit	Meas.Range	Returned Value	Polarity
SMU	0	I compliance	Same as SMU *output value*
	$\neq 0$	Range Value	
VS	any	20 mA	Same as VS *output value*

If you do not set a *measurement range* for SMUs, this subprogram uses the last valid range setting as the *measurement range* value.

File Data Simulation mode:

This subprogram reads <meas> from the data simulation file and returns this value. The data simulation file format is as follows:

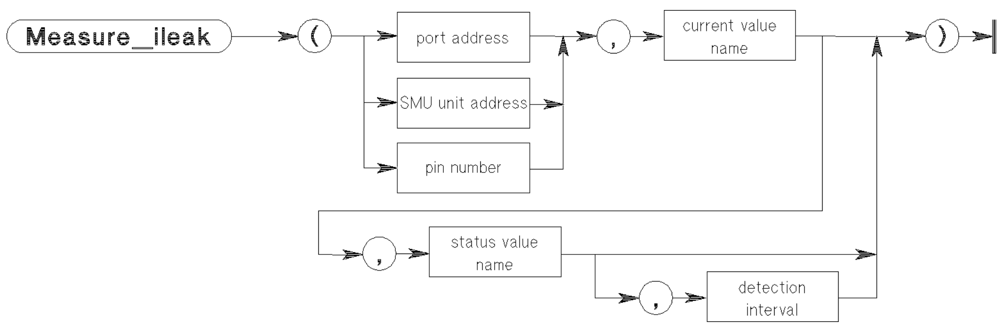
```
Measure_i     <meas>
```

Measure_ileak

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram triggers the quasi-pulsed measurement to measure leakage current, then returns the measured value.

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression	32701 to 32704, 32729[1], 32732[1]
SMU unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU)
pin number	integer expression	1 to 96[2]
current value name	numeric variable name	any valid name
status value name	integer variable name	any valid name
detection interval	integer expression default = 0	0: SHORT 1: LONG

1 These port addresses are used for the AUX ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

Example Statements

```
Measure_ileak(FNSmu(1),Current)
Measure_ileak(32622,Ileak,Stat)
Measure_ileak(Port,Leakage,St,1)
```

Description

This subprogram triggers the quasi-pulsed measurement to measure leakage current. The conditions of the quasi-pulsed measurements are determined by the Set_ileak statement. The measured value and its measurement status are returned to the *current value name* and *status value name*, respectively.

Port address, *SMU unit address*, or *pin number* can be used to specify the measurement port.

The following table shows the measurement status for the quasi-pulsed measurements of leakage current:

Status Code	Condition
0	The quasi-pulsed measurement ended normally.
1	Another unit reached compliance.
2	This unit reached compliance.
3	This unit is oscillating.
4	Measurement overflow while monitoring the output voltage or measuring the leakage current.
6	The quasi-pulsed measurement did not reach *output voltage* within the timeout.
7	The monitored slew rate of the output voltage is too small.

Detection interval defines the monitoring duration of the output voltage. When the *detection interval* is set to LONG, the results of monitoring the SHORT mode 10 times are used to decide when the output voltage reaches the *output voltage* value.

When the *detection interval* is set to SHORT, a slew rate of less than 1000 V/s (= 1 V/ms) causes an error (status = 7). When the *detection interval* is set to LONG, a slew rate of less than 100 V/s (= 0.1 V/ms) causes an error (status = 7).

The time out is set to 3 seconds for SHORT mode and 12 seconds for LONG mode.

For more information on the quasi-pulsed measurements, see the *HP 4142B Operation Manual*.

Programming Example

The following program executes the quasi-pulsed measurement to measure the leakage current. If the slew rate is too small, the detection interval is set to LONG and the measurement is executed again.

```
100  INTEGER St
110  REAL Ileak
120  !
130  Connect(FNSmu(2),24)
140  Connect(FNGnd,32)
150  Set_ileak(FNSmu(2),40,35,1.E-6,0)
160  Measure_ileak(FNSmu(1),Ileak,St)
170  IF St>=5 THEN CALL Measure_ileak(FNSmu(1),Ileak,St,1)
180  PRINT "Leakage Current: ";Ileak;" (A)"
190  Connect
200  END
```

See Also

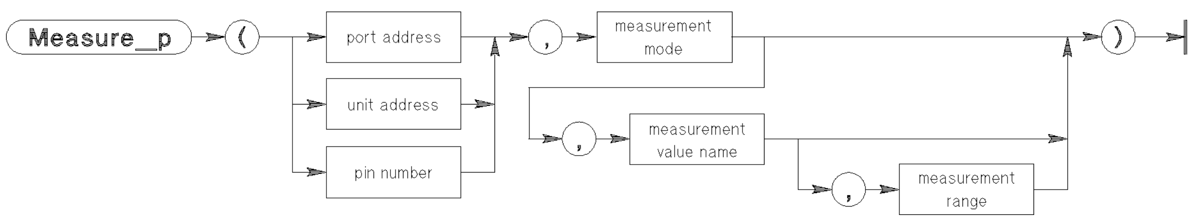
Set_ileak

Measure_p

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram performs pulsed spot measurements in accordance with the conditions established by the Set_pbias subprogram, and returns the measurement values.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32706, 32708, 32709, 32721 to 32732 [1]	
unit address	integer expression	32621 to 32632, 32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
pin number	integer expression	1 to 96 [2]	
measurement mode	integer expression	1 (voltage measurement) 2 (current measurement)	
measurement value name	name of a numeric variable	any valid name	

Item	Description/Default	Range Restrictions	Recommended Range
measurement range	numeric expression		
	For SMU voltage measurements:	[3]	
	For SMU current measurements: [A] default = last valid setting	−1 to 1 [4]	1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
	For VM voltage measurements: [V]	−40 to 40	2, 20, 40

[1] 32721 to 32732 are used for the AUX ports of the port expander.
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the SMU or VS that performs the measurement.
[3] This is a dummy parameter. The voltage range of the SMU depends on the voltage compliance value.
[4] Actual range restrictions for *measurement range* depend on the SMU and SMU port used. If zero is specified for current range, the current range is set to the range that can measure current compliance with the highest resolution.

Example Statements

```
Measure_p(FNPort(2),1,Vmeas)
Measure_p(Drain,Mode,Id,Range)
```

Description

Either the *port address* , the *unit address* , or the *pin number* of any measurement pin connected to the SMU or VM port can be used to specify the SMU or VM. The specified unit must be set to desired mode (IS mode for voltage measurements; VS mode for current measurements).

The current range of an SMU and the voltage range of a VM are determined by the *measurement range* . The voltage range of an SMU is determined by Set_pbias or Force_i voltage compliance. When performing pulsed measurements, differential voltage measurements cannot be performed.

Measurement Mode = 2 (current measurements):

Measurement Range Value	Measurement Range and Current Range
1E−9 < |value| ≤ 1E−8 [1]	1E−8 (200fA – 11.5nA)
1E−8 < |value| ≤ 1E−7	1E−7 (2pA – 115nA)
1E−7 < |value| ≤ 1E−6	1E−6 (20pA – 1.15μA)
1E−6 < |value| ≤ 1E−5	1E−5 (200pA – 11.5μA)
1E−5 < |value| ≤ 1E−4	1E−4 (2nA – 115μA)
1E−4 < |value| ≤ 1E−3	1E−3 (20nA – 1.15mA)
1E−3 < |value| ≤ 1E−2	1E−2 (200nA – 11.5mA)
1E−2 < |value| ≤ 1E−1	1E−1 (2μA – 115mA)
1E−1 < |value| ≤ 1	1 (20μA – 100mA – 1A)
	HP 41421B: 200fA – 115mA
	HP 41420A: 200fA – 1A

[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

Measurement Mode = 1 (voltage measurements):

Unit	Voltage Compliance Setting	Measurement Range
HP 41420A HP 41421B	0 ≤ |value| ≤ 2	2 (40 uV – 2 V)
	2 < |value| ≤ 20	20 (400 uV – 20 V)
	20 < |value| ≤ 40	40 (800 uV – 40 V)
	40 < |value| ≤ 100	100 (2 mV – 100 V)
HP 41420A	100 < |value| ≤ 200	200 (4 mV – 200 V)
VM (HP 41424A)	**Measurement Range Value**	
	0	40 (800 uV – 40 V)
	0 < |value| ≤ 2	2 (40 uV – 2 V)
	2 < |value| ≤ 20	20 (400 uV – 20 V)
	20 < |value| ≤ 40	40 (800 uV – 40 V)

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* variable. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

Returned values are determined by the *measurement range* value as follows:

For current measurements:

Unit	Meas.Range	Returned Value	Polarity
SMU	$= 0$	I compliance	Same as SMU *output value*
	$\neq 0$	Range Value	
VS	any	20 mA	Same as VS *output value*

For voltage measurements:

Unit	Meas.Range	Returned Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
VM	$= 0$	2.0 V	Always positive
	$\neq 0$	Range Value	Same as *measurement range*

If you do not set a *measurement range* for SMUs, this subprogram uses the last valid range setting as the *measurement range* value.

File Data Simulation mode:

This subprogram reads <meas> from the data simulation file and returns this value. The data simulation file format is as follows:

```
Measure_p     <meas>
```

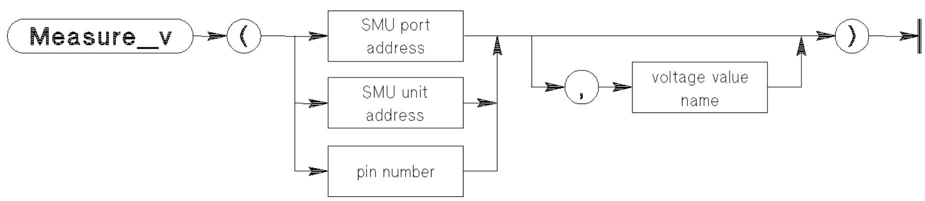
Measure_v

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

The subprogram measures dc voltage using the specified SMU or VM and returns the measurement value in volts (V).

Syntax

For SMUs:

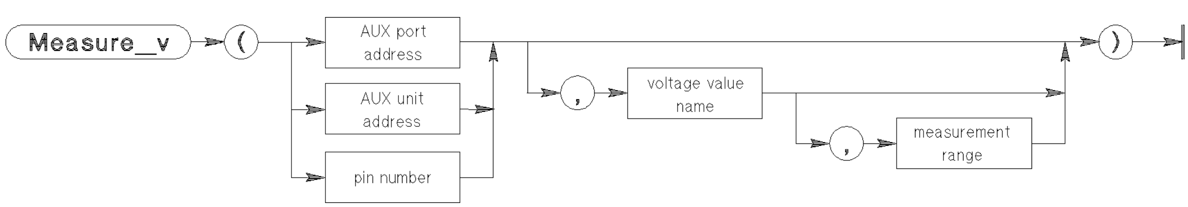


Item	Description/Default	Range Restrictions	Recommended Range
SMU port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
SMU unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
voltage value name	numeric variable name	any valid name	

[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.

[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the SMU that performs the measurement.

For VMs:



Item	Description/Default	Range Restrictions	Recommended Range
AUX port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
AUX unit address	integer expression	32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
pin number	integer expression	1 to 96 [2]	
voltage value name	numeric variable name	Any valid name	
measurement range	numeric expression [V]	-40 to 40	
	If VM is operating in grounded measurement mode [3] default = last valid setting		0, 2, 20, 40
	If VM is operating in differential measurement mode [3] default = 0 (Auto range)		0, 0.2, 2

[1] 32721 to 32728, 32730, and 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VM port.

[3] VM measurement mode is specified by the Set_vm subprogram.

Example Statements

```
Measure_v(FNSmu(1),Vbe)
Measure_v(Trbase,Vbe)
Measure_v(Port,V_data,Range)
```

Description

Either the *port address* , the *unit address* , or *pin number* of any measurement pin connected to the port can be used to specify the SMU or VM. The specified SMU must be set to IS mode. The measurement value is returned to the *voltage value name* .

The voltage range of the SMU is set by the *voltage compliance* parameter specified in the Force_i subprogram. The voltage range of the VM is set by the *measurement range* . The 0.2 V range is available only when a VM is set to the differential voltage measurement mode by the Set_vm subprogram.

VM Voltage Ranges for Grounded Measurement Mode and SMU Voltage Range

Unit	Voltage Compliance Setting	Measurement Range
HP 41420A HP 41421B	$0 \le \lvert value \rvert \le 2$	40 uV — 2 — 2 V
	$2 < \lvert value \rvert \le 20$	400 uV — 20 — 20 V
	$20 < \lvert value \rvert \le 40$	800 uV — 40 — 40 V
	$40 < \lvert value \rvert \le 100$	2 mV — 100 — 100 V
HP 41420A	$100 < \lvert value \rvert \le 200$	4 mV — 200 — 200 V
VM (HP 41424A)	Measurement Range Value 0	40 uV — 2 — 2 V — 20 — 20 V — 40 — 40 V
	$0 < \lvert value \rvert \le 2$	40 uV — 2 — 2 V
	$2 < \lvert value \rvert \le 20$	400 uV — 20 — 20 V
	$20 < \lvert value \rvert \le 40$	800 uV — 40 — 40 V

VM Voltage Ranges for Differential Measurement Mode

Unit	Measurement Range Value	Measurement Range and Current Range	Maximum Voltage (VM terminal–Circuit Common)
VM (HP 41424A)	0	4 uV — 0.2 V — 2 V	Max. 40 V
	$0 < \lvert value \rvert \le 0.2$	4 uV — 0.2 V	
	$0.2.< \lvert value \rvert \le 2$	40 uV — 2 V	

When Measure_v is called in a Prepare ... Execute construct, the variable parameter *voltage value name* is regarded as a dummy parameter. The measurement value is returned to the variable parameter of the Execute subprogram. If the existing voltage range of the VM is correct, only the *port address* or *pin number* parameter is required. Refer to the Description for Prepare ... Execute for further details.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *voltage value name* variable. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

Returned values are determined by the *measurement range* value as follows:

Unit	Meas.Range	Returned Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
	= 0	2.0 V	Always positive
VM	≠ 0	Range Value	Same as *measurement range*

If you do not set a *measurement range* for SMUs, this subprogram uses the last valid range setting as the *measurement range* value.

File Data Simulation mode:

This subprogram reads <meas> from the data simulation file and returns this value. The data simulation file format is as follows:

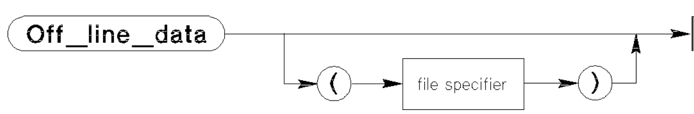
```
Measure_v     <meas>
```

Off_line_data

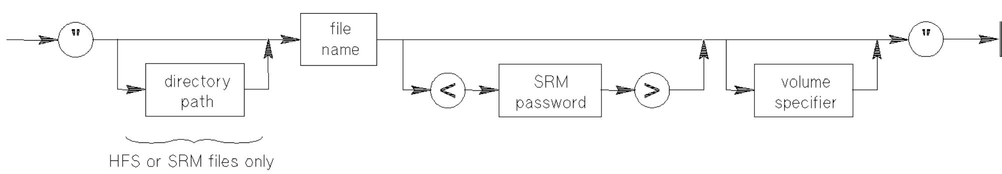
Supported on 4062UX
Revision X.05.50 or later
File TIS
Control —

This subprogram sets the offline data simulation mode.

Syntax



literal form of file specifier:



Item	Description/Default	Range Restrictions
file specifier	string expression	(see drawing)
directory path	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)
file name	literal	depends on the format of the volume (see Glossary in the *BASIC Language Reference*)
SRM password	literal; first 16 nonblank characters are significant	> not allowed
volume specifier	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)

Example Statements

```
Off_line_data("DUM_VTH")
Off_line_data
```

Description

Calling this subprogram with a *file specifier* changes the execution mode to the file data simulation mode. In this mode, TIS measurement programs return the measurement data contained in the specified *file specifier* as measurement results. Only an existing *file specifier* is valid: specifying a nonexistent *file specifier* results in a TIS error. The HP-UX command pipe stream is not applicable for offline data simulation files.

The file data simulation mode terminates if you load a program or link TIS subprograms.

If you do not specify a *file specifier*, the mode is reset to the constant data simulation mode.

If an error is detected while reading a data simulation file, an error is reported and the file data simulation mode is reset to the constant data simulation mode.

In the online mode, this subprogram is ignored.

See Also

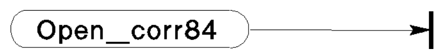
Data_creation

Open_corr84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284 (for Rev. C.05.60, C.05.70 or X.05.61), TIS (for Rev. C.06.00 or later, X.06.00 or later, P.06.20 or later)
Control	CMU84

This subprogram performs the OPEN correction of the CMU84.

Syntax



Example Statement

```
Open_corr84
CALL Open_corr84
```

Description

This subprogram triggers the OPEN compensation function in the CMU84, and compensation data is stored in the internal non-volatile memory of the CMU84. Refer to the "Residual Error Compensation" in the *System Operation* for more information about the CMU84 error compensation theory.

See Also

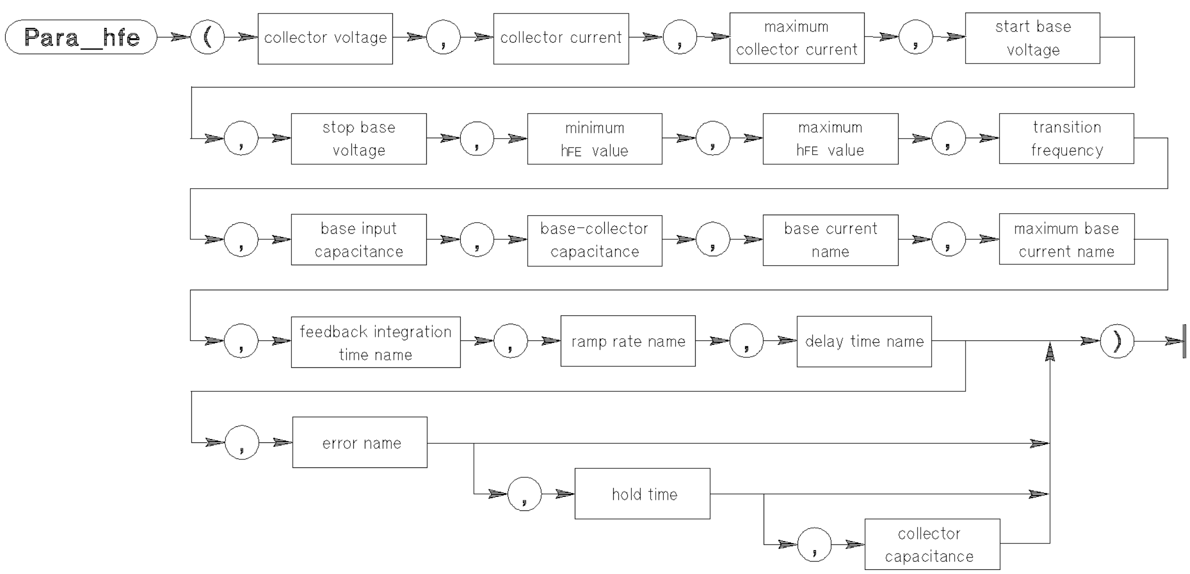
Short_corr84

Para_hfe

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS_UTIL
Control	—

This utility subprogram calculates, from the specified measurement conditions, the optimum parameters (*feedback integration time*, *ramp rate*, *delay time*, and *maximum base current*) for an analog search forward current transfer ratio h_{FE} measurement.

Syntax



Item	Description/Default	Range Restrictions
collector voltage	numeric expression: [V] (*sense SMU bias value*)	−200 to 200
collector current	numeric expression: [A] (*target value*)	−1 to 1
maximum collector current	numeric expression: [A] (*sense SMU compliance*)	−1 to 1
start base voltage	numeric expression: [V] (*start value*)	−200 to 200
stop base voltage	numeric expression: [V] (*stop value*)	−200 to 200
minimum h_{FE} value	numeric expression	> 1

Item	Description/Default	Range Restrictions
maximum h_{FE} value	numeric expression	> 1
transition frequency	numeric expression: [Hz]	> 0
base input capacitance	numeric expression: [F]	0 to 1E−9
base-collector capacitance	numeric expression: [F]	0 to 1E−9
base current name	numeric variable name	any valid name
maximum base current name	numeric variable name (*search SMU compliance*)	any valid name
feedback integration time name	numeric variable name (*feedback integration time*)	any valid name
ramp rate name	numeric variable name (*ramp rate*)	any valid name
delay time name	numeric variable name (*delay time*)	any valid name
error name	integer variable name	any valid name
hold time	numeric variable name: [s]	any valid name
collector capacitance	numeric expression	0 to 2.E−8

Example Statements

```
220  Para_hfe(Vc,Ic,Ic_max,Start,Stop,Hfe_min,Hfe_max,Ft,Cin,Cbc,Ib,Ib_max,
Integ,Ramp,D_time)
230  Set_asearch(FNSmu(1),FNSmu(2),S_mode,M_mode,Start,Stop,Vc,Ic,Ramp,Ib_m
ax,Ic_max,H_time,D_time,Integ)
240  Search(Ib,Status,Ic)
250  Hfe=Ic/Ib
```

Description

When performing an analog search forward current transfer ratio h_{FE} measurement, execute Para_hfe first to obtain the optimized parameters for the Set_asearch subprogram, as shown in the example statements.

This subprogram ignores the stray capacitance in the SWM. Add the value of the stray capacitance to the *base input capacitance (Cin)*, *base-collector capacitance (Cbc)*, or *collector capacitance (Cc)*. The following tables list the typical data of stray capacitance for each SWM.

Value of the Stray Capacitance for 48-Pin SWM (Units: pF)

		Collector Port			
		SMU1	SMU2	SMU3	SMU4
	SMU1	—	Cin:40 Cc:70 Cbc:2	Cin:40 Cc:70 Cbc:2	Cin:40 Cc:70 Cbc:2
Base	SMU2	Cin:70 Cc:40 Cbc:1	—	Cin:70 Cc:70 Cbc:11	Cin:70 Cc:70 Cbc:7
Port	SMU3	Cin:70 Cc:40 Cbc:1	Cin:70 Cc:70 Cbc:11	—	Cin:70 Cc:70 Cbc:7
	SMU4	Cin:70 Cc:40 Cbc:1	Cin:70 Cc:70 Cbc:8	Cin:70 Cc:70 Cbc:9	—

Value of the Stray Capacitance for 96-Pin SWM (Units: pF)

		Collector Port			
		SMU1	SMU2	SMU3	SMU4
	SMU1	—	Cin:25 Cc:80 Cbc:4	Cin:25 Cc:80 Cbc:2	Cin:25 Cc:80 Cbc:2
Base	SMU2	Cin:80 Cc:25 Cbc:1	—	Cin:80 Cc:80 Cbc:14	Cin:80 Cc:80 Cbc:6
Port	SMU3	Cin:80 Cc:25 Cbc:1	Cin:80 Cc:80 Cbc:15	—	Cin:80 Cc:80 Cbc:10
	SMU4	Cin:80 Cc:25 Cbc:1	Cin:80 Cc:80 Cbc:7	Cin:80 Cc:80 Cbc:10	—

If you do not specify the optional *error name* parameter, an error message is displayed on the CRT and execution aborts due to the error message. If you specify an *error name*, the error code is returned to the specified *error name*, and execution continues. Error code meanings are listed as follows:

0: No error

10: | *collector voltage* | > 200 is not allowed.

11: Unsuitable *collector current* (too small or too large).

12: *collector voltage* and *collector current* must be the same polarity.

13: | *maximum collector current* | < 1.15 × | *collector current* | or
| *maximum collector current* | > 1 is not allowed.

14: *maximum collector current* and *collector current* must be the same polarity.

15: | *start base voltage* | > 200 is not allowed.

16: | *stop base voltage* | > 200 is not allowed.

17: (*stop base voltage* − *start base voltage*) and *collector voltage* must be the same polarity.

19: *minimum* h_{FE} < 1 or *maximum* h_{FE} < 1 is not allowed.

20: *maximum* h_{FE} ≤ *minimum* h_{FE} is not allowed.

21: *transition frequency* ≤ 0 is not allowed.

22: *base input capacitance* must be 0 to 2.E−8.

23: *base-collector capacitance* must be 0 to 2.E−8.

24: *collector capacitance* must be 0 to 2.E−8.

30: | *start base voltage* − *stop base voltage* | is too small.

31: | *start base voltage* − *stop base voltage* | > 200 is not allowed.

See Also

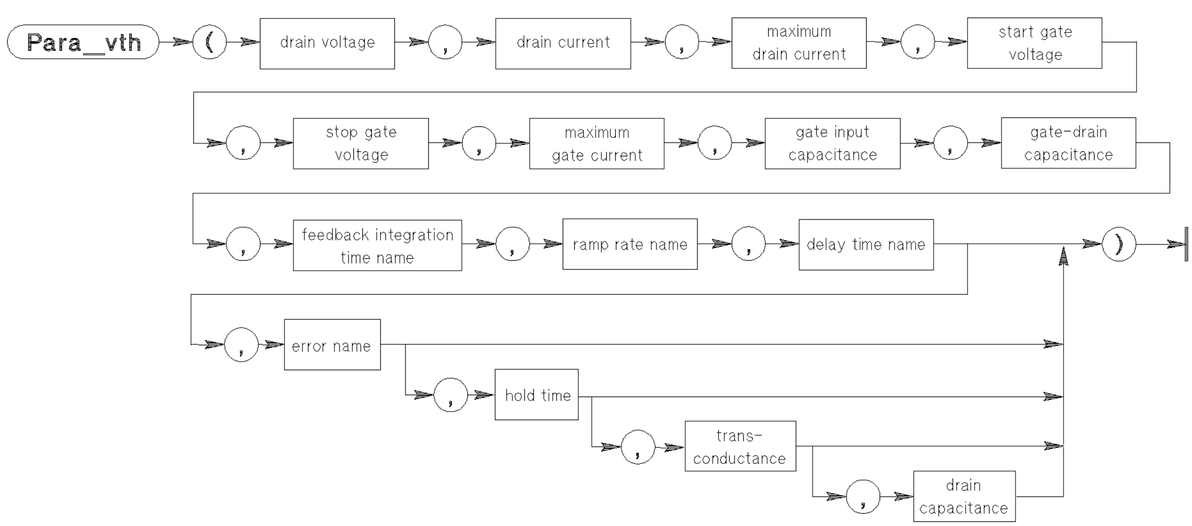
Set_asearch

Para_vth

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS_UTIL
Control —

This utility subprogram calculates, from the specified measurement conditions, the optimum parameters (*feedback integration time*, *ramp rate*, and *delay time*) for an analog search threshold voltage measurement.

Syntax



Item	Description/Default	Range Restrictions
drain voltage	numeric expression: [V] (*sense SMU bias value*)	−200 to 200
drain current	numeric expression: [A] (*target value*)	−1 to 1
maximum drain current	numeric expression: [A] (*sense SMU compliance*)	−1 to 1
start gate voltage	numeric expression: [V] (*start value*)	−200 to 200
stop gate voltage	numeric expression: [V] (*stop value*)	−200 to 200
maximum gate current	numeric expression: [A] (*search SMU compliance*)	−1 to 1
gate input capacitance	numeric expression: [F]	0 to 1E−9

Item	Description/Default	Range Restrictions
gate-drain capacitance	numeric expression: [F]	0 to 1E−9
feedback integration time name	numeric variable name (*feedback integration time*)	any valid name
ramp rate name	numeric variable name (*ramp rate*)	any valid name
delay time name	numeric variable name (*delay time*)	any valid name
error name	integer variable name	any valid name
hold time	numeric variable name: [s]	any valid name
transconductance	numeric expression: [S]	lager than 0
drain capacitance	numeric expression: [F]	0 to 2.E−8

Example Statements

```
250  Para_vth(Vd,Id,Id_max,Start,Stop,Ig_max,Cin,Cgd,Integ,Ramp,D_time,Err)
260  Set_asearch(FNSmu(1),FNSmu(2),Mode,3,Start,Stop,Vd,Id,Ramp,Ig_max,Id_m
ax,H_time,D_time,Integ)
270  Search(Vth,Status,Id)
```

Description

When performing an analog search threshold voltage measurement, execute this utility subprogram first to obtain the optimized parameters for the Set_asearch subprogram, as shown in the example statements.

This subprogram ignores the stray capacitance in the SWM. Add the value of the stray capacitance to the *gate input capacitance (Cin)*, *gate-drain capacitance (Cgd)*, or *drain capacitance (Cd)*. The following tables list the typical data of stray capacitance for each SWM.

Value of the Stray Capacitance for 48-Pin SWM (Units: pF)

		Drain Port			
		SMU1	SMU2	SMU3	SMU4
	SMU1	—	Cin:40 Cd:70 Cgd:2	Cin:40 Cd:70 Cgd:2	Cin:40 Cd:70 Cgd:2
Gate	SMU2	Cin:70 Cd:40 Cgd:1	—	Cin:70 Cd:70 Cgd:11	Cin:70 Cd:70 Cgd:7
Port	SMU3	Cin:70 Cd:40 Cgd:1	Cin:70 Cd:70 Cgd:11	—	Cin:70 Cd:70 Cgd:7
	SMU4	Cin:70 Cd:40 Cgd:1	Cin:70 Cd:70 Cgd:8	Cin:70 Cd:70 Cgd:9	—

Value of the Stray Capacitance for 96-Pin SWM (Units: pF)

		Drain Port			
		SMU1	SMU2	SMU3	SMU4
	SMU1	—	Cin:25 Cd:80 Cgd:4	Cin:25 Cd:80 Cgd:2	Cin:25 Cd:80 Cgd:2
Gate	SMU2	Cin:80 Cd:25 Cgd:1	—	Cin:80 Cd:80 Cgd:14	Cin:80 Cd:80 Cgd:6
Port	SMU3	Cin:80 Cd:25 Cgd:1	Cin:80 Cd:80 Cgd:15	—	Cin:80 Cd:80 Cgd:10
	SMU4	Cin:80 Cd:25 Cgd:1	Cin:80 Cd:80 Cgd:7	Cin:80 Cd:80 Cgd:10	—

If you do not specify the optional *error name* parameter, an error message is displayed on the CRT and execution is aborted if an error occurs. If you specify an *error name*, the error code is returned to the specified *error name*, and execution continues. Error code meanings are listed as follows:

0: No error

10: | *drain voltage* | > 200 is not allowed.

11: Unsuitable *drain current* (too small or too large).

12: *drain voltage* and *drain current* must be same polarity.

13: | *maximum drain current* | < 1.15 × | *drain current* | or
| *maximum drain current* | > 1 is not allowed.

14: *maximum drain current* and *drain current* must be same polarity.

15: | *start gate voltage* | > 200 is not allowed.

16: | *stop gate voltage* | > 200 is not allowed.

17: (*stop gate voltage* − *start gate voltage*) and *drain voltage* must be same polarity.

19: Unsuitable *maximum gate current* (too small or too large).

20: *gate input capacitance* must be 0 to 2.E−8.

21: *gate-drain capacitance* must be 0 to 2.E−8.

22: *drain capacitance* must be 0 to 2.E−8.

30: | *start gate voltage* − *stop gate voltage* | is too small.

31: | *start gate voltage* − *stop gate voltage* | > 200 is not allowed.

See Also

Set_asearch

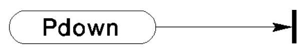
Pdown

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram lowers the chuck of the wafer prober.

Syntax



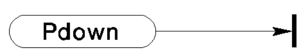
Description

This subprogram can execute only when the Electroglas 1034X is set to Auto. If you include Pdown in a program that also contains PCL subprograms, raise the wafer chuck before any PCL subprograms execute, especially if the PCL subprograms are nested in a loop.

For Electroglas 2001X: file EGY

This subprogram lowers the chuck of the wafer prober.

Syntax



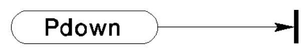
Description

This subprogram can execute only when the Electroglas 2001X is set to Remote. If you include Pdown in a program that also contains PCL subprograms, raise the wafer chuck before any PCL subprograms execute, especially if the PCL subprograms are nested in a loop.

For TSK A-PM Probers: file TSK

This subprogram lowers the chuck of the wafer prober.

Syntax



Description

This subprogram can execute only when your TSK prober is set to Remote. If you include Pdown in a program that also contains PCL subprograms, raise the chuck before any PCL subprograms execute, especially if the PCL subprograms are nested in a loop.

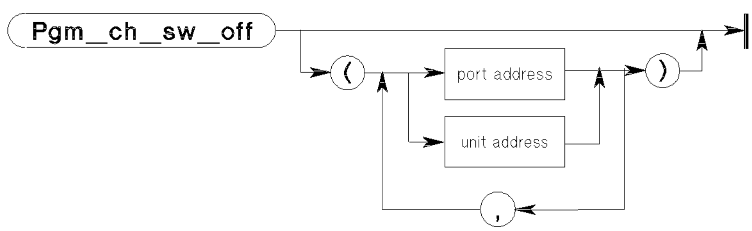
Executing Pdown releases the processor of the prober from a halt condition if a halt condition exists.

Pgm_ch_sw_off

Supported on 4062C, 4062UX, 4062PC
Revision C.06.00 or later, X.06.00 or later, P.06.20 or later
File PGMLIB
Control DCS

This subprogram stores into the DCS program memory the commands that set the output switches of specified unit(s) to off. You can specify up to 8 ports/units.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41421B 200 V/1 A SMU) 32633, 32635, 32637, · · · · · 32661, 32663 (for HP 41424A (VS/VMU) VS)

1 The 32721 to 32732 range is available when a port expander is installed in the SWM.

Example Statements

```
Pgm_ch_sw_off(32621,32622)
Pgm_ch_sw_off(FNSmu(3),FNSmu(4),FNAux(1),FNAux(2))
Pgm_ch_sw_off
```

Description

This subprogram stores into program memory the DCS control commands that are equivalent to those of Ch_sw_off. The Pgm_ch_sw_off actually sends the "CL · · ·" command to the DCS.

Up to 8 ports/units can be specified as parameters. When this subprogram is called with no parameters, all output switches in the DCS are set to off.

See the Ch_sw_off reference page for details.

See Also

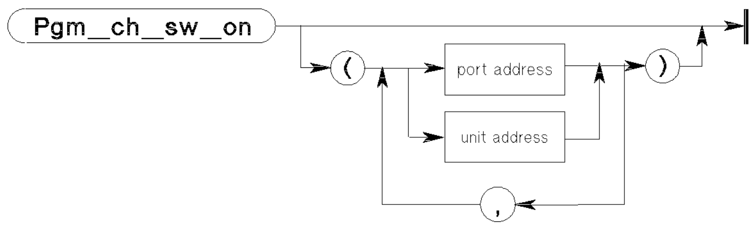
Ch_sw_off
Pgm_ch_sw_on

Pgm_ch_sw_on

Supported on 4062C, 4062UX, 4062PC
Revision C.06.00 or later, X.06.00 or later, P.06.20 or later
File PGMLIB
Control DCS

This subprogram stores into the DCS program memory the commands that set the output switches of specified unit(s) to on. You can specify up to 8 ports/units.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41421B 200 V/1 A SMU) 32633, 32635, 32637, · · · · · 32661, 32663 (for HP 41424A (VS/VMU) VS)

1 The 32721 to 32732 range is available when a port expander is installed in the SWM.

Example Statements

```
Pgm_ch_sw_on(32621,32622)
Pgm_ch_sw_on(FNSmu(3),FNSmu(4),FNAux(1),FNAux(2))
Pgm_ch_sw_on
```

Description

This subprogram stores into program memory the DCS control commands equivalent to Ch_sw_on. Pgm_ch_sw_on actually sends the "CN · · ·" command to the DCS.

Up to 8 ports/units can be specified as parameters. When this subprogram is called with no parameters, all output switches in the DCS are set to on.

See the Ch_sw_on reference page for details.

See Also

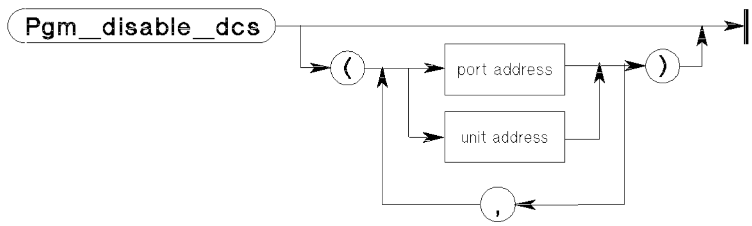
Ch_sw_on
Pgm_ch_sw_off

Pgm_disable_dcs

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into DCS program memory the commands that set specified units to the zero output status. You can specify up to 8 ports/units.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41421B 200 V/1 A SMU) 32633, 32635, 32637, · · · · · 32661, 32663 (for HP 41424A (VS/VMU) VS)

1 The 32721 to 32732 range is available when a port expander is installed in the SWM.

Example Statements

```
Pgm_disable_dcs(32623,32622)
Pgm_disable_dcs(FNSmu(1),FNSmu(2),FNAux(1),FNAux(2))
Pgm_disable_dcs
```

Description

This subprogram stores into program memory the DCS control commands that are equivalent to the commands for Disable_port. Disable_port sets specified units to zero output status for the DCS. Pgm_disable_dcs actually sends the "DZ · · ·" command to the DCS.

Up to 8 ports/units can be specified as parameters. When this subprogram is called with no parameter, all the units are programmed to be set to the Zero Output status in the DCS.

Use this subprogram before the end of your DCS subprogram. If the forced value is not set to zero after the DCS program is executed, wet switching at the relays may occur and the pin board relays may be damaged.

See the Disable_port reference page for details.

See Also

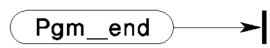
Disable_port

Pgm_end

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram is part of the Pgm_start ... Pgm_end context. It terminates the program that stores the DCS control commands in the program memory.

Syntax



Example Statements

```
Pgm_end
```

Description

This subprogram ends the procedure that stores the DCS control commands in the program memory. The procedure is started with the Pgm_start statement. This subprogram actually sends the “END” command to the DCS.

See Also

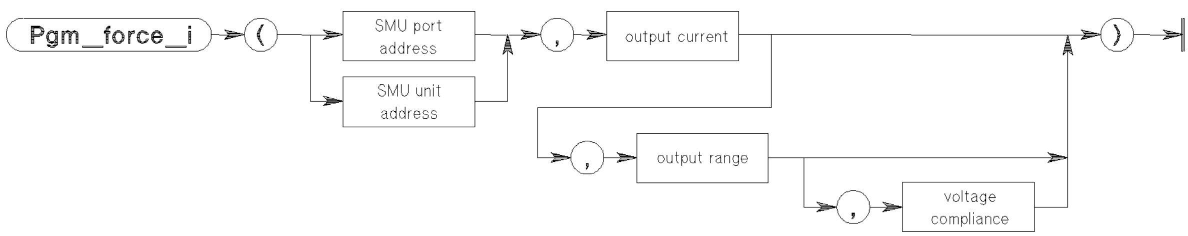
Pgm_start

Pgm_force_i

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into DCS program memory the commands that force a specified current.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32729, 32732 (for AUX33 and AUX34 ports of port expander)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU)
output current	numeric expression: [A]	−1 to 1 (for 200 V/1 A SMU) −0.1 to 0.1 (for 100 V/100 mA SMU)
output range	numeric expression: [A] default = 0 (auto ranging)	−1 to 1[2]
voltage compliance	numeric expression: [V] default: see “Description”	−200 to 200[3]

1 Ports 32729 and 32732 are available when a port expander is installed in the SWM.

2 The *output range* depends on the *output current*. For details, see the “Description” of the Force_i reference page.

3 Range restrictions for *voltage compliance* depend on the specified *output current*. Refer to the “Description” of the Force_i reference page.

Example Statements

```
Pgm_force_i(FNSmu(1),1.E-6)
Pgm_force_i(FNUnitsmu(3),5.E-3,0)
Pgm_force_i(32702,1.E-1,1,5)
```

Description

This subprogram stores into the program memory the DCS control commands that set the output current to a specified SMU. This subprogram actually sends the "DI · · · " command to the DCS.

The parameters of this subprogram are the same as those of the Force_i subprogram. See the Force_i reference page for details.

The default setting for the *voltage compliance* parameter depends on the last valid setting when the stored program is executed. If the last mode of the specified SMU is current source mode, the last valid setting for the voltage compliance is used. Note that the *voltage compliance* cannot be omitted if the last mode of the specified SMU is voltage source mode.

See Also

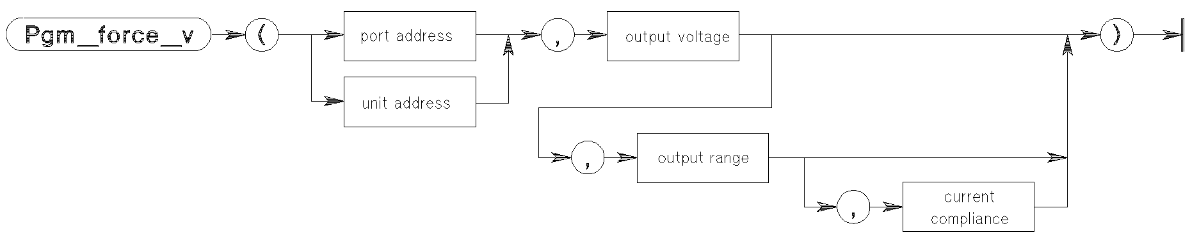
Force_i

Pgm_force_v

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into the DCS program memory the commands that force a specified voltage.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU) 32633, 32635, 32637, · · · · · 32661, 32663 (for HP 41424A (VS/VMU) VS)
output voltage	numeric expression: [V]	−200 to 200 (for 200 V/1 A SMU) −100 to 100 (for 100 V/100 mA SMU) −40 to 40 (for VS)
output range	numeric expression: [V] default = 0 (auto ranging)	−200 to 200[2]
current compliance	numeric expression: [A] default: see "Description"	−1 to 1[3] (for SMU) —[4]

1 Ports 32721 to 32732 are available when a port expander is installed in the SWM.

2 The *output range* is depends on the *output voltage*. For details, see the "Description" of the Force_v reference page.

3 Range restrictions for *current compliance* depend on the specified *output current*. Refer to the "Description" of the Force_i reference page.

4 This is dummy parameter for VS. The current limiter depends on the output range and is set automatically.

Example Statements

```
Pgm_force_v(FNSmu(1),4)
Pgm_force_v(FNUnitsmu(2),15,0)
Pgm_force_v(FNAux(1),32,40)
Pgm_force_v(32703,5,0,0.02)
```

Description

This subprogram stores into program memory the DCS control commands that set the output voltage to a specified SMU or VS. This subprogram actually sends the "DV · · · " command to the DCS.

The parameters of this subprogram are the same as those of the Force_v subprogram. See the Force_v reference page for details.

The default setting for the *current compliance* parameter depends on the last valid setting when the stored program is executed. If the last mode of the specified SMU is voltage source mode, the last valid setting for the current compliance is used. Note that the *current compliance* cannot be omitted if the last mode of the specified SMU is current source mode.

See Also

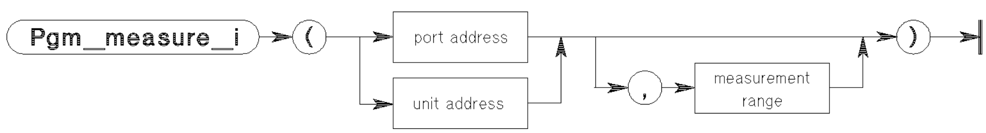
Force_v

Pgm_measure_i

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into the DCS program memory the commands that execute the current measurement of a specified SMU or VS.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU) 32633, 32635, 32637, · · · · · 32661, 32663 (for HP 41424A (VS/VMU) VS)
measurement range	numeric expression: [A] default = 0 (auto ranging)	−1 to 1

1 Ports 32721 to 32732 are available when a port expander is installed in the SWM.

Example Statements

```
Pgm_measure_i(FNPort(1))
Pgm_measure_i(FNUnitsmu(3),0.1)
Pgm_measure_i(FNAux(1))
Pgm_measure_i(32703,0)
```

Description

This subprogram stores into program memory the DCS control commands that measure current at a specified SMU or VS. This subprogram actually sends the "TI · · · " command to the DCS.

The parameters of this subprogram are not the same as those of the Measure_i subprogram. This subprogram stores the commands to execute the current measurement. To get the measured data and status from the DCS, use the Readout_dcs statement.

See the Measure_i reference page for details.

See Also

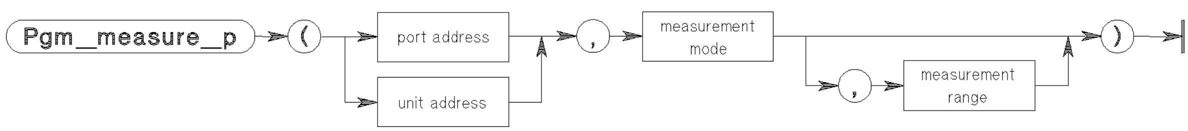
Measure_i
Readout_dcs

Pgm_measure_p

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into the DCS program memory the commands that execute the pulsed spot measurement of a specified SMU or VS.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU) 32634, 32636, 32638, · · · · · 32662, 32664 (for HP 41424A (VS/VMU) VM)
measurement mode	integer expression	1: voltage measurement 2: current measurement
measurement range	For voltage measurement numeric expression: [V] default = 0 (auto ranging)	—[2] (for SMU) −40 to 40[3] (for VM)
	For current measurement numeric expression: [A] default = 0 (auto ranging)	−1 to 1

1 Ports 32721 to 32732 are available when a port expander is installed in the SWM.

2 This parameter is ignored for SMUs. The measurement range for the current source of the SMUs is determined by the voltage compliance setting.

3 For grounded measurement mode, 0 V (auto ranging), 2 V, 20 V, and 40 V ranges are available. For differential measurement mode, 0 V (auto ranging), 0.2 V, and 2 V ranges are available.

Example Statements

```
Pgm_measure_p(FNPort(1),Voltage)
Pgm_measure_p(FNUnitsmu(3),2)
Pgm_measure_p(FNAux(1),2,0.01)
Pgm_measure_p(32701,1)
```

Description

This subprogram stores into program memory the DCS control commands that execute a pulsed spot measurement and measure current or voltage at a specified SMU or VM. This subprogram actually sends the "MM3", "FL0", and "XE" commands to the DCS. The "RI · · · " or "RV · · · " command is also sent.

The parameters of this subprogram are not the same as those of the Measure_p subprogram. This subprogram does not allow you to specify a variable name in which the measured value is returned. The variable name is specified in the Readout_dcs statement.

See the Measure_p reference page for details.

See Also

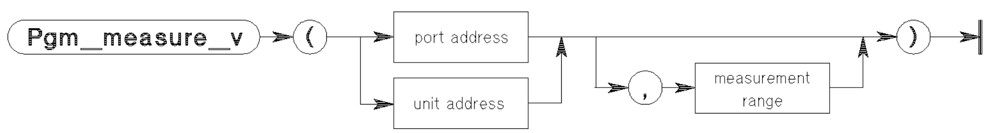
Measure_p
Readout_dcs

Pgm_measure_v

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into the DCS program memory the commands that execute the voltage measurement of a specified SMU or VM.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU) 32634, 32636, 32638, · · · · · 32662, 32664 (for HP 41424A (VS/VMU) VM)
measurement range	numeric expression: [A] default = 0 (auto ranging)	—[2] (for SMUs) −40 to 40[3] (for VMs)

1 Ports 32721 to 32732 are available when a port expander is installed in the SWM.

2 This parameter is ignored for SMUs. The measurement range for the current source of the SMU is determined by the voltage compliance setting.

3 For grounded measurement mode, 0 V (auto ranging), 2 V, 20 V, and 40 V ranges are available. For differential measurement mode, 0 V (auto ranging), 0.2 V, and 2 V ranges are available.

Example Statements

```
Pgm_measure_v(FNPort(1))
Pgm_measure_v(FNUnitsmu(3))
Pgm_measure_v(FNAux(2),40)
Pgm_measure_v(32703,0)
```

Description

This subprogram stores into program memory the DCS control commands that measure voltage at a specified SMU or VM. This subprogram actually sends the "TV · · · " command to the DCS.

The parameters of this subprogram are not the same as those of the Measure_v subprogram. This subprogram does not allow you to specify a variable name in which the measured value is returned. The variable name is specified in the Readout_dcs statement.

The *measurement range* is ignored for SMUs because the measurement range is determined by the voltage compliance setting for the current source of the SMUs. If the specified unit is a VM and if the *measurement range* is omitted, the VM uses auto ranging.

See the Measure_v reference page for details.

See Also

Measure_v
Readout_dcs

Pgm_search

Supported on 4062C, 4062UX, 4062PC
Revision C.06.00 or later, X.06.00 or later, P.06.20 or later
File PGMLIB
Control DCS

This subprogram stores into DCS program memory the commands that execute the search measurement.

Syntax

Example Statements

```
Pgm_search
```

Description

This subprogram stores into program memory the DCS control commands that trigger the analog search measurement. This subprogram actually sends the "MM6" and "XE" commands to the DCS.

The analog search conditions are established using the Pgm_set_asearch subprogram.

The searched value is returned to the variable specified in the Readout_dcs statement. For details, see the Readout_dcs reference page.

See Also

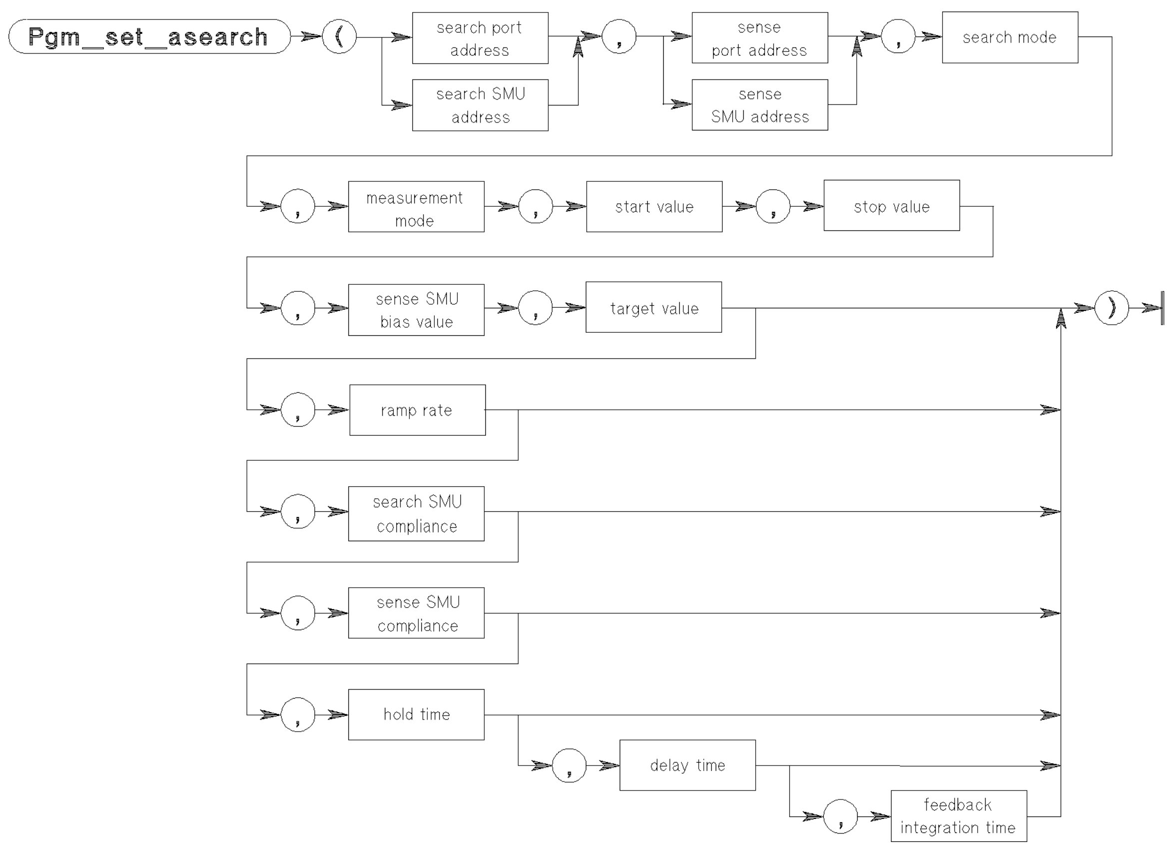
Pgm_set_asearch
Readout_dcs

Pgm_set_asearch

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into the DCS program memory the commands that set parameters for analog search measurements.

Syntax



Item	Description/Defaults	Range Restrictions
search port address	integer expression	32701 to 32704 (for SMU) 32729, 32732 (for port expander port)[1]
search SMU address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU)
sense port address	integer expression	32701 to 32704 (for SMU) 32729, 32732 (for port expander port)[1]
sense SMU address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU)
search mode	integer expression	1: negative feedback 2: positive feedback 3: positive ramp 4: negative ramp
measurement mode	integer expression	−4 to 4
start value	numeric expression: [V]	−200 to 200
stop value	numeric expression: [V]	−200 to 200
sense SMU bias value	numeric expression If sense SMU is in VS mode: [V] If sense SMU is in IS mode: [A]	 −200 to 200 −1 to 1
target value	numeric expression If sense SMU is in VS mode: [A] If sense SMU is in IS mode: [V]	 −1 to 1 −200 to 200
ramp rate	numeric expression: [V/s] default = 500	0.5 to 100000
search SMU compliance	numeric expression: [A]	−1 to 1
sense SMU compliance	numeric expression If sense SMU is in VS mode: [V] If sense SMU is in IS mode: [A]	 −1 to 1 −200 to 200
hold time	numeric expression: [s] default = 0	0 to 65.535 (resolution: 0.001)
delay time	numeric expression: [s] default = 0	0 to 65.535 (resolution: 0.001)
feedback integration time	numeric expression: [s] default = 5E−3	5E−7 to 0.45

1 Ports 32729 and 32732 are available when a port expander is installed in the SWM.

Example Statements

```
Pgm_set_asearch(FNSmu(2),FNSmu(1),1,1,0,10,2,3E-5)
Pgm_set_asearch(32621,32622,2,2,0,10,3,0.001,100,1.E-5,1.E-2,0.1,0.1.0.1)
```

Description

This subprogram stores into program memory the DCS control commands that set the parameters for the analog search measurements. This subprogram actually sends the "ASV · · · ", "AIV · · · " or "AVI · · · ", and "AT · · · " commands to the DCS.

If the *search SMU compliance* or *sense SMU compliance* is omitted, the SMU compliance parameter is not stored in the program memory. For details, refer to the HP 4142B *HP-IB Command Reference Manual*.

See the Set_asearch reference page for details.

See Also

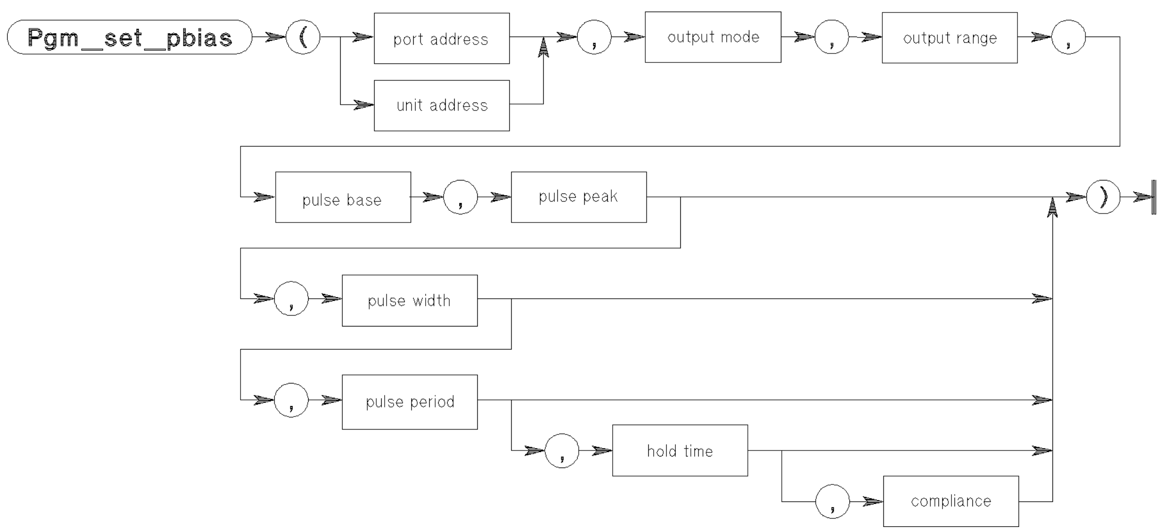
Set_asearch
Pgm_search
Readout_dcs

Pgm_set_pbias

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into the DCS program memory the commands that set the parameters for the pulsed spot measurements at a specified unit.

Syntax



Item	Description/Defaults	Range Restrictions
port address	integer expression	32701 to 32704 (for SMU port) 32705, 32706, 32708, 32709 (for AUX port) 32721 to 32732 (for port expander port)[1]
unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41421B 200 V/1 A SMU) 32633, 32635, 32637, · · · · · 32661, 32663 (for HP 41424A (VS/VMU) VS)
output mode	integer expression	1: pulsed voltage output 2: pulsed current output
output range	numeric expression If pulsed voltage is forced: [V] If pulsed current is forced: [A]	 −200 to 200 −1 to 1

1 Ports 32721 to 32732 are available when a port expander is installed in the SWM.

Item	Description/Defaults	Range Restrictions
pulse base	numeric expression If pulsed voltage is forced: [V] If pulsed current is forced: [A]	 −200 to 200 −1 to 1
pulse peak	numeric expression If pulsed voltage is forced: [V] If pulsed current is forced: [A]	 −200 to 200 −1 to 1
pulse width	numeric expression: [s] default = 0.005	0.001 to 0.05 (resolution: 1E−4)
pulse period	numeric expression: [s] default = 0.2	0, 0.01 to 0.5 (resolution: 1E−4)
hold time	numeric expression: [s] default = 0	0, 655.35 (resolution: 0.01)
compliance	numeric expression If pulsed voltage is forced: [A] If pulsed current is forced: [V]	 −1 to 1 −200 to 200

Example Statements

```
Pgm_set_pbias(32623,2,1E-3,0,5E-4,)
Pgm_set_pbias(FNSmu(2),1,40,20,30,1E-3,2E-2,0.1,1E-3)
Pgm_set_pbias(Addr,Mode,Range,Base,Peak,Width,Period,Hold,Comp)
```

Description

This subprogram stores into program memory the DCS control commands that set the parameters for the pulsed spot measurements. This subprogram actually sends "PV · · · " to the DCS for the pulsed voltage forcing, and sends "PI · · · " for the pulsed current forcing. "PT · · · " is sent to set the pulse width, pulse period, and hold time.

See the Set_pbias reference page for details.

See Also

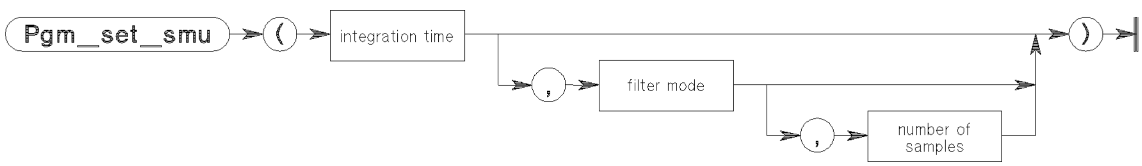
Set_pbias
Pgm_measure_p

Pgm_set_smu

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into the DCS program memory the commands that set the measurement integration time and the filter mode for the SMUs, VSs, and VMs.

Syntax



Item	Description/Defaults	Range Restrictions
integration time	integer expression	0: MANUAL 1: SHORT 2: MEDIUM 3: LONG
filter mode	integer expression default = 1 (filter on)	0: filter OFF 1: filter ON
number of samples	integer expression default = 1	1 to 1023[1]

1 This parameter is ignored when the *integration time* parameter is set to 1, 2, or 3.

Example Statements

```
Pgm_set_smu(2)
Pgm_set_smu(Integ_time,Filter)
Pgm_set_smu(Manual,Filter,Integ)
```

Description

This subprogram stores into program memory the DCS control commands that set the integration time and filter mode for the SMUs, VSs, and VMs of the DCS. This subprogram actually sends "AV · · · " and "FL · · · " to the DCS. When the *filter mode* parameter is omitted, "FL1" is sent to the DCS.

See the Set_smu reference page for details.

See Also

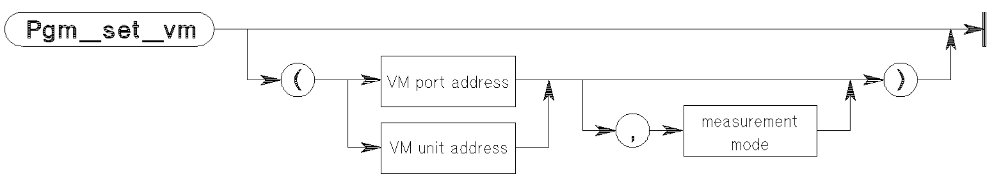
Set_smu

Pgm_set_vm

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	PGMLIB
Control	DCS

This subprogram stores into DCS program memory the commands that set the voltage measurement mode of a specified VM to either grounded measurement mode or differential measurement mode.

Syntax



Item	Description/Defaults	Range Restrictions
VM port address[1]	integer expression	32705, 32706, 32708, 32709 (for AUX port) 32721 to 32728, 32730, 32731 (for port expander)[2]
VM unit address[1]	integer expression	32634, 32636, 32638, · · · · · 32662, 32664 (for HP 41424A (VS/VMU) VS)
measurement mode	integer expression default = 0 (grounded meas.)	0: grounded measurement 1: differential measurement

1 If the VM unit is not specified, all VMs installed in the DCS are set to grounded measurement mode.

2 Ports 32721 to 32728, 32730, and 32731 are available when a port expander is installed in the SWM.

Example Statements

```
Pgm_set_vm
Pgm_set_vm(FNVm(1),1)
Pgm_set_vm(32634,0)
```

Description

This subprogram stores into program memory the DCS control commands that set the voltage measurement mode of the specified VM. The voltage measu rement mode of the VM is either grounded measurement mode or differential measurement mode. This subprogram actually sends "VM · · · " to the DCS.

If this subprogram is called with no parameters, the subprogram stores DCS control commands that set all the VMs to the grounded measurement mode.

See the Set_vm reference page for details.

See Also

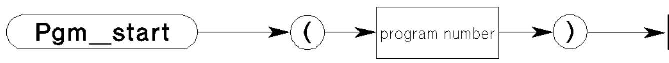
Set_vm

Pgm_start

Supported on 4062C, 4062UX, 4062PC
Revision C.06.00 or later, X.06.00 or later, P.06.20 or later
File PGMLIB
Control DCS

This subprogram is part of the Pgm_start ... Pgm_end context. It starts a program that has control commands stores in DCS program memory. The program is specified by a program number.

Syntax



Item	Description/Defaults	Range Restrictions
program number	integer expression	0[1], 1 to 99

1 See "Description."

Example Statements

```
Pgm_start(1)
```

Description

This subprogram starts the procedure that stores the DCS control commands with a specified program number. This subprogram actually sends the "ST · · · " command to the DCS.

The program numbers available range from 1 to 99. If 0 is specified as the *program number*, the DCS control commands sent between the Pgm_start and Pgm_end context are not stored in the program memory, but are immediately executed.

For example, the following program lines store DCS control commands that force 10 V and measure current at the SMU1:

```
  .   .   .   .   .   .   .   .
320  Pgm_start(1)
330   Pgm_force_v(FNSmu(1),10)
340   Pgm_measure_i(FNSmu(1))
350  Pgm_end
  .   .   .   .   .   .   .   .
```

To execute the DCS control commands stored in the program memory, use Run_dcs_program. To read the measured data, use Readout_dcs or Readsweep_dcs.

See Also

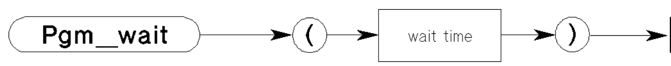
Pgm_end
Run_dcs_program
Readout_dcs
Readsweep_dcs

Pgm_wait

Supported on 4062C, 4062UX, 4062PC
Revision C.06.00 or later, X.06.00 or later, P.06.20 or later
File PGMLIB
Control DCS

This subprogram stores into program memory the DCS control commands that pause for a specified time.

Syntax



Item	Description/Defaults	Range Restrictions
wait time	numeric expression: [s]	0 to 99.9999 (resolution: 0.0001)

Example Statements

```
Pgm_wait(0.01)
```

Description

This subprogram stores into program memory the DCS control commands that pause for a specified *wait time*. This subprogram actually sends the "PA · · · " command to the DCS.

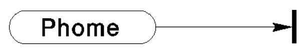
Phome

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram moves the X-Y positioner to the home position and sets the Electroglas 1034X to Manual mode.

Syntax



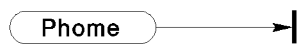
Description

This subprogram can execute only when the Electroglas 1034X is set to Auto. When Phome executes, the wafer chuck lowers, the X-Y positioner (if not presently at the home position) moves to the home position, and the prober is set to the Manual mode. The operator can then perform any manual operations that may be required, such as the loading or unloading of wafers.

For Electroglas 2001X: file EGY

This subprogram moves the X-Y stage of the prober to the wafer loading station, unloads the present wafer, loads the next wafer, aligns the wafer, and probes the first probing chip position. Actual operation depends on the LOAD, PROFILE, and ALIGN switch settings of the prober. This subprogram requires modification if your Electroglas 2001X is *not* equipped with a profiler.

Syntax



Description

If the AUTO LOAD option of your prober is set to DISABLE, Phome instructs the prober to move the X-Y stage to the wafer loading station, at which time you can perform any required manual operations.

If LOAD, PROFILE, and ALIGN switch settings of your prober are set to ENABLE, Phome instructs the prober to move the X-Y stage to the wafer loading station, unload the present wafer, load the next wafer in the wafer stack (if the stack is not empty), profile and align the wafer, and move to the first probe position.

While performing Phome operations, the prober is set to Local (released from Remote) until alignment is completed. The prober must be in the Remote mode, however, before any prober control subprograms can execute.

Use the Prober_status subprogram to determine whether the prober has returned to the Remote mode. If the wafer stack is empty when Phome executes, the current wafer is unloaded and a TIS ERROR 41 occurs.

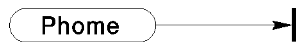
If your Electroglas 2001X is *not* equipped with the AUTO LOAD, PROFILE, and/or AUTO ALIGN options or if either of these options is disabled, delete the corresponding program lines from your prober control subprograms as follows:

Delete · · ·	**If** · · ·
`OUTPUT Paddress;"LO"` `Wait_ready`	AUTO LOAD is not specified or is disabled.
`OUTPUT Paddress;"PZ"` `Wait_ready`	PROFILE is not specified or is disabled.
`OUTPUT Paddress;"AA"`	AUTO ALIGN is not specified or is disabled.

For TSK A-PM Probers: file TSK

This subprogram moves the X-Y stage of the prober to the wafer loading station, unloads the present wafer, loads the next wafer, and aligns the chuck at the initial probing position. Actual operation depends on the UNLOAD switch setting of the prober.

Syntax



Description

If the UNLOAD switch of your prober is set to MANUAL, Phome instructs the prober to move the X-Y stage to the wafer loading station. At this time you can perform any required manual operation. Also, the processor of the prober is released from its halt state and the prober is set to Local mode.

If the UNLOAD switch of your prober is set to AUTO, Phome instructs the prober to move the X-Y stage to the wafer loading station, unload the present wafer, load the next wafer in the wafer stack (if the stack is not empty), and align the X-Y stage at the initial probe position.

While performing Phome operations, the prober is set to Local (released from Remote) until alignment is completed. The prober must be in the Remote mode, however, before any prober controlled subprograms can execute.

Use the Prober_status subprogram to determine whether the prober has returned to the Remote mode. If the wafer stack is empty when Phome executes, the present wafer unloads, the *last wafer* flag (see Prober_status) is be set to true, and your prober waits for further instructions.

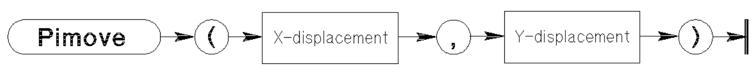
Pimove

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram instructs the wafer prober to execute the relative movement of the X-Y positioner. The X-Y positioner moves the number of specified X- and Y-displacement units (established by Pscale) relative to the present X- and Y-coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-displacement	numeric expression Units: X-index set by Pscale	—
Y-displacement	numeric expression Units: Y-index set by Pscale	—

Example Statements

```
Pimove(0,1)
Pimove(Delta_x,Delta_y)
```

Description

This subprogram can execute only when the Electroglas 1034X is set to Auto. When Pimove executes, the X-Y positioner of the prober moves in a direction opposite that of the specified X- and Y-displacements.

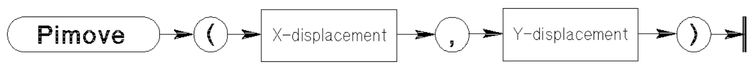
For example, if both displacement values are positive, the X-Y positioner moves toward the lower-left so that a position in the upper-right is aligned for probing. The chuck automatically lowers before the X-Y positioner moves.

If you use Pimove in a program in conjunction with any PCL subprograms, the X-Y positioner must be returned to its previous position before a PCL subprogram can execute.

For Electroglas 2001X: file EGY

This subprogram instructs the wafer prober to execute a relative movement of the X-Y stage. The X-Y stage moves the number of specified X- and Y-displacement units (established by Pscale) relative to the present X- and Y-coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-displacement	numeric expression rounded to the nearest integer Units: X-index set by Pscale	—
Y-displacement	numeric expression rounded to the nearest integer Units: Y-index set by Pscale	—

Example Statements

```
Pimove(0,1)
Pimove(Delta_x,Delta_y)
```

Description

This subprogram can execute only when the Electroglas 2001X is set to Remote. When Pimove executes, the X-Y stage of the prober moves in a direction opposite to that of the specified X- and Y-displacements.

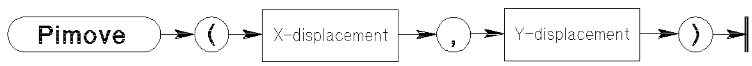
For example, if both displacement values are positive, the X-Y stage moves toward the lower-left so that a position in the upper-right is aligned for probing. The chuck automatically lowers before the X-Y stage moves.

If you use Pimove in a program in conjunction with any PCL subprograms, the X-Y stage must be returned to its previous position before a PCL subprogram can execute. You must set the system index using Pscale before Pimove can execute.

For TSK A-PM Probers: file TSK

This subprogram instructs the wafer prober to execute a relative movement of the X-Y stage. The X-Y stage moves the number of specified X- and Y-displacement units (established by Pscale) relative to the present X- and Y-coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-displacement	numeric expression Units: X-index set by Pscale	—
Y-displacement	numeric expression Units: Y-index set by Pscale	—

Example Statements

```
Pimove(0,1)
Pimove(Delta_x,Delta_y)
```

Description

This subprogram can execute only when your TSK prober is set to Remote. When Pimove executes, the X-Y stage of the prober moves in a direction opposite to that of the specified X- and Y-displacements.

For example, if both displacement values are positive, the X-Y stage moves to the lower-left so that a position in the upper-right is aligned for probing. The chuck automatically lowers before the X-Y stage moves. After the X-Y stage is moved, the processor of the prober is halted.

If you use Pimove in a program in conjunction with any PCL subprograms, the X-Y stage must be returned to its previous position before a PCL subprogram can execute.

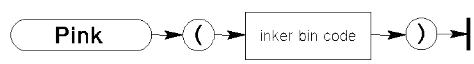
Pink

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGY, TSK
Control	Electroglas 2001X, TSK A-PM Probers

For Electroglas 2001X: file EGY

This subprogram triggers the specified inker of the wafer prober.

Syntax



Item	Description/Default	Range Restrictions
inker bin code	inker number integer	0 to 15

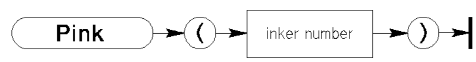
Description

Pink can execute only when your Electroglas 2001X is set to Remote. The *inker bin code* parameter specifies the inker to be triggered.

For TSK A-PM Probers: file TSK

This subprogram triggers the specified inker of the wafer prober.

Syntax



Item	Description/Default	Range Restrictions
inker number	inker number integer	1 to 4

Description

Pink can execute only when your prober is set to Remote. The *inker number* parameter specifies the inker to be triggered. The Pink subprogram also releases the processor of the prober from its halt state.

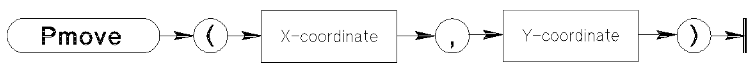
Pmove

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram instructs the wafer prober to execute an absolute movement of the X-Y positioner. The X-Y positioner moves to the specified X- and Y-coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate	numeric expression Units: X-index set by Pscale	—
Y-coordinate	numeric expression Units: Y-index set by Pscale	—

Example Statements

```
Pmove(5,3)
Pmove(X,Y)
```

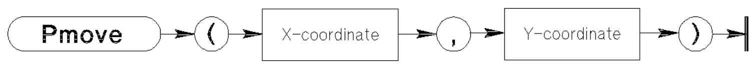
Description

This subprogram can execute only when the Electroglas 1034X is set to Auto. When Pmove executes, the X-Y positioner moves toward the lower left, if the specified X- and Y-coordinate values are larger than those of the present position. The chuck lowers automatically before the X-Y positioner moves. Pmove cannot be used in conjunction with any PCL subprograms.

For Electroglas 2001X: file EGY

This subprogram instructs the wafer prober to execute an absolute movement of the X-Y stage. The X-Y stage moves to the specified X- and Y-coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate	numeric expression rounded to the nearest integer Units: X-index set by Pscale	—
Y-coordinate	numeric expression rounded to the nearest integer Units: Y-index set by Pscale	—

Example Statements

```
Pmove(5,3)
Pmove(X,Y)
```

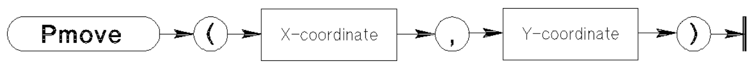
Description

This subprogram can execute only when the Electroglas 2001X is set to Remote. When Pmove executes, the X-Y stage moves toward the lower left, if the specified X- and Y-coordinate values are larger than those of the present position. The chuck lowers automatically before the X-Y stage moves. Pmove cannot be used in conjunction with any PCL subprograms.

For TSK A-PM Probers: file TSK

This subprogram instructs the wafer prober to execute an absolute movement of the X-Y stage. The X-Y stage moves to the specified X- and Y-coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate	numeric expression Units: X-index set by Pscale	—
Y-coordinate	numeric expression Units: Y-index set by Pscale	—

Example Statements

```
Pmove(5,3)
Pmove(X,Y)
```

Description

Pmove can execute only when your TSK prober is set to Remote. When Pmove executes, the X-Y stage moves toward the lower left, if the specified X- and Y-coordinate values are larger than those of the present position. The chuck lowers automatically before the X-Y stage moves.

Pmove cannot be used in conjunction with any PCL subprograms.

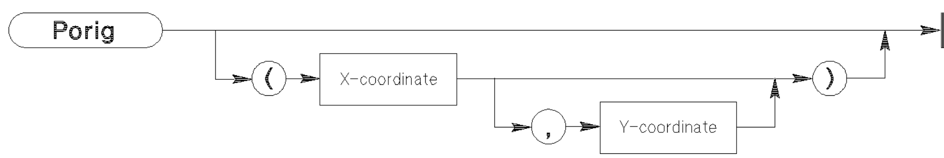
Porig

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram assigns the specified X- and Y-coordinate values to the present position of the X-Y positioner.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate	numeric expression Units: X-index set by Pscale default = 0	—
Y-coordinate	numeric expression Units: Y-index set by Pscale default = 0	—

Example Statements

```
Porig
Porig(Xpos,Ypos)
```

Description

This subprogram must execute before any Pmove or Pimove subprograms.

The present position of the X-Y positioner is defined as the specified X- and Y-coordinates, and the specified X- and Y-coordinate values are stored as TIS internal variables.

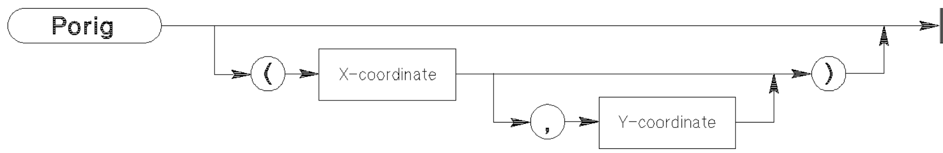
If Porig (0,0) executes when the X-Y positioner is at (10,5), the TIS internal variables is set to (0,0) at (10,5), and the value displayed on the prober is 0,0.

Porig cannot be used with Wstart_number or Wstart_xy PCL subprograms.

For Electroglas 2001X: file EGY

This subprogram assigns the specified X- and Y-coordinate values to the present position of the X-Y stage.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate	numeric expression rounded to the nearest integer Units: X-index set by Pscale default = 0	—
Y-coordinate	numeric expression rounded to the nearest integer Units: Y-index set by Pscale default = 0	—

Example Statements

```
Porig
Porig(Xpos,Ypos)
```

Description

This subprogram must execute before any Pmove or Pimove subprograms.

The present position of the X-Y stage is defined as the specified X- and Y-coordinates, and the specified X- and Y-coordinate values are stored as TIS internal variables.

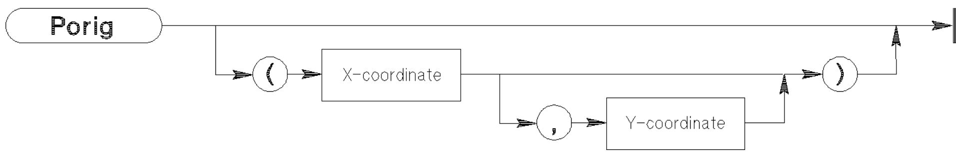
If Porig (0,0) executes when the X-Y stage is at (10,5), the TIS internal variables are set to (0,0) at (10,5), and the value displayed on the prober is 0,0.

Porig cannot be used with Wstart_number or Wstart_ xy PCL subprograms.

For TSK A-PM Probers: file TSK

This subprogram assigns the specified X- and Y-coordinate values to the current position of the X-Y stage.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate	numeric expression Units: X-index set by Pscale default = 0	—
Y-coordinate	numeric expression Units: Y-index set by Pscale default = 0	—

Example Statements

```
Porig
Porig(Xpos,Ypos)
```

Description

The Porig subprogram can only be used when your prober is set to Remote, and Porig must execute before any Pmove or Pimove subprograms.

The present position of the X-Y stage is defined as the specified X- and Y-coordinates, and the specified X- and Y-coordinate values are stored as TIS internal variables.

If Porig (0,0) executes when the X-Y stage is at (10,5), the TIS internal variables are set to (0,0) at (10,5), and the value displayed on the prober is 0,0.

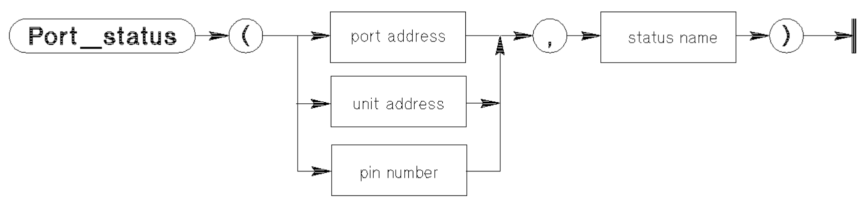
Porig cannot be used with Wstart_number or Wstart_ xy PCL subprograms.

Port_status

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS, CMU, CMU84 (CMU84 is supported only by Rev. C.05.60 or later, X.05.60 or later, and P.06.20 or later)

This subprogram returns the status of the specified port when a measurement is done.

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression	32701 to 32711, 32721 to 32732 [1]
unit address	integer expression	32621 to 32665, 32671, 32672, 32676 [2], 32677 [2]
pin number	integer expression	1 to 96 [3]
status name	integer variable name	any valid name

[1] 32721 to 32732 are used for the AUX ports of the port expander.
[2] These unit addresses are used for CMU84 only.
[3] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

Example Statements

```
Port_status(FNSmu(1),Smu_status)
Port_status(Port,Condition)
```

Description

Either *pin number*, *unit address*, or *port address* can be used to specify a port or ports whose status is to be returned. The value returned to the *status name* is a 1-digit integer, as listed in the following table.

Port_status

Unit Name	Returned Value: Condition
SMU, VS, VM	0: Normal 1: Another unit has reached compliance or current limit. 2: This unit has reached compliance or current limit. 3: This unit is oscillating. 4: Measurement overflow.
GNDU	0: Normal
CMU	0: Normal 6: Measurement value exceeds the set range.
CMU84	0: Normal 1: Analog bridge is unbalanced. 2: A/D converter is not working. 3: Signal source is overloaded. 4: ALC[1] is unable to regurated.

1 ALC is an acronym of Automatic Level Control.

The relationship between port name, port number, and unit name is shown in the following table.

Port Name	Port No.	Unit Name
SMU1	1	SMU1
GSMU	10, −1	
SMU2	2	SMU2
SMU3	3	SMU3
SMU4	4	SMU4
AUX1[1]	5	VS, VM
AUX2[1]	6	
AUX3[1]	8	
AUX4[1]	9	
GNDU	7	GNDU
AUX3(CMH)[1]	8	CMU, CMU84
AUX4(CML)[1]	9	
GCMU[1]	11, −8, −9	

Port Name	Port No.	Unit Name
AUX11[2,1]	21	VS, VM
AUX12[2,1]	22	
AUX13[2,1]	23	
AUX21[2,1]	24	
AUX22[2,1]	25	
AUX23[2,1]	26	
AUX31[2,1]	27	
AUX32[2,1]	28	
AUX41[2,1]	30	
AUX42[2,1]	31	
AUX31(CMH)[2,1]	27	CMU, CMU84
AUX41(CML)[2,1]	30	
AUX33[2]	29	SMU
AUX43[2]	32	SMU

1 These ports report the status of the unit actually connected to the SWM port.

2 These ports are available if a port expander is equipped with the SWM.

The following table shows the relation between unit address and unit.

Unit Address	Unit
32621 to 32628	HP 41421B (SMU 100 V/100 mA)
32629 to 32632	HP 41420A (SMU 200 V/1 A)
31633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	HP 41424A (VS)
31634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	HP 41424A (VM)
32671	CMU (CMH)
32672	CMU (CML)
32676	CMU84 (CMH84)
32677	CMU84 (CML84)

The returned status of any unused port is always 0 (Normal). If two or more conditions occur during a measurement, the priority of the returned numerical code is the following order:

$$3 > 4 > 2 > 1$$

For instance, if an SMU reaches compliance and is oscillating at the same time, a '3' (oscillating) is returned to the *status name*. This *status name* remains unchanged until the next measurement.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *status name* variable in the offline mode. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns 0 to *status name* for all measurements.

File Data Simulation mode:

This subprogram reads <status> from the data simulation file and returns the value. The data simulation file format is as follows:

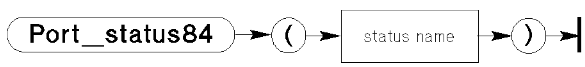
```
Port_status   <status>
```

Port_status84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284
Control	CMU84

This subprogram returns the latest measurement status of CMU84 when a measurement is done.

Syntax



Item	Description/Default	Range Restrictions
status name	integer variable name	any valid name

Example Statement

```
Port_status84(Stat)
```

Description

The meanings of the returned value in *status name* is as follows:

Returned Value	Status
0	Normal measurement data.
1	Analog bridge is unbalanced.
2	A/D converter is not working.
3	Signal source is overloaded.
4	ALC[1] is unable to regulate.

[1] ALC is an acronym of Automatic Level Control.

The `Port_status84(`*status*`)` statement is equivalent to the `Port_status(FNCmu84(1),`*status*`)` statement.

In Offline Mode (HP 4062UX Only)

In offline mode execution, this subprogram returns 0 to the *status name*.

See Also

Measure_cmu84

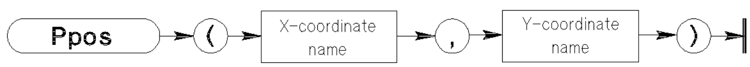
Ppos

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram returns the X- and Y-coordinates of the chip currently being probed, and stores the coordinates in the corresponding TIS variables.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate name	numeric variable name	any valid name
Y-coordinate name	numeric variable name	any valid name

Example Statement

```
Ppos(Xpos,Ypos)
```

Description

The X- and Y-coordinates returned by Ppos indicate the position of the chip currently being probed. These coordinates are also stored in the corresponding TIS variable and are updated whenever the X-Y positioner is moved by a Pimove or Pmove subprogram.

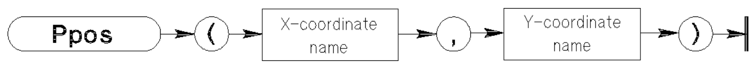
The returned coordinates may differ from those of the actual position if either of the following conditions exist:

- If the Electroglas 1034X is set to Manual mode and the joystick is used to move the X-Y positioner during the program.
- If the X- or Y-coordinate specified in the Pimove or Pmove subprogram causes the X-Y positioner to move beyond the allowable range.

For Electroglas 2001X: file EGY

This subprogram returns the X- and Y-coordinates of the chip currently being probed, and stores the coordinates in the corresponding TIS variables.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate name	numeric variable name	any valid name
Y-coordinate name	numeric variable name	any valid name

Example Statement

```
Ppos(Xpos,Ypos)
```

Description

The X- and Y-coordinates returned by Ppos indicate the position of the chip currently being probed. These coordinates are also stored in a TIS variable and are updated whenever the X-Y stage is moved by a Pimove subprogram.

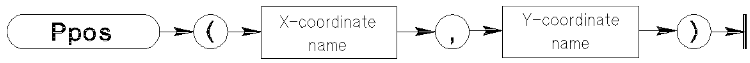
The returned coordinates may differ from those of the actual position if either of the following conditions exist:

- If the Electroglas 2001X is set to Local mode and the joystick is used to move the X-Y stage during the program.
- If the X- or Y-coordinate specified in the Pimove subprogram causes the X-Y stage to move beyond the allowable range.

For TSK A-PM Probers: file TSK

This subprogram returns the X- and Y-coordinates of the chip presently being probed, and stores the coordinates in corresponding TIS variables.

Syntax



Item	Description/Default	Range Restrictions
X-coordinate name	numeric variable name	any valid name
Y-coordinate name	numeric variable name	any valid name

Example Statement

```
Ppos(Xpos,Ypos)
```

Description

The X- and Y-coordinates returned by Ppos indicate the position of the chip currently being probed. These coordinates are also stored in a TIS variable and are updated whenever the X-Y stage is moved by a Pimove subprogram.

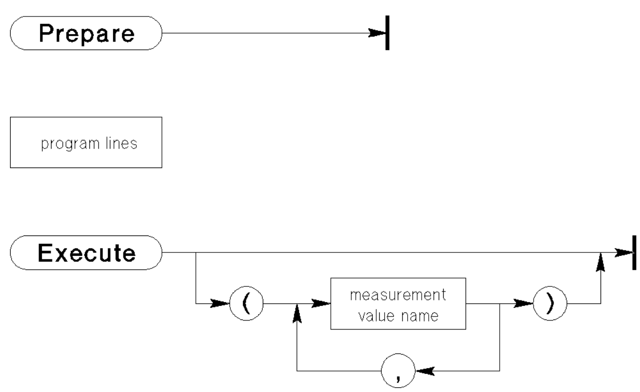
The returned coordinates may differ from those of the actual position if the joystick is used to move the X-Y stage during the program.

Prepare ... Execute

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS, CMU, SWM

This subprogram defines and executes all program lines in a Prepare ... Execute construct.

Syntax



Item	Description/Default	Range Restrictions
program lines	Refer to description	—
measurement value name	numeric variable name	any valid name

Description

The *program lines* in a Prepare ... Execute construct may include all BASIC language and TIS statements, except for the Init_system statement. All statements are performed in the order in which they appear in the program, except for the following TIS subprograms.

Connect
Connect_th
Force_i
Force_v
Force_meas
Measure_cmu
Measure_i
Measure_v

These statements, except for Force_meas, are executed simultaneously in the order shown above when the Execute program line is reached in a Prepare ... Execute construct. SWM ports for Force and Measure subprograms previous to the Connect subprogram cannot be specified by a pin number.

Force_meas is equal to a pair of Force and Measure statements, so hold time is ignored.

The entire program segment is stored in the system until an Init_system or Execute subprogram is called.

Measurement values are not returned to the variables in the Measure statement, but are instead returned to the variables specified in the Execute statement. Measurement values are returned in the same order in which the Measure statements appear. See sample 2.

Programming Example

Sample 1:

```
100   Prepare
110      Short_cal
120      Force_v(FNPort(1),5)
130      Measure_i(FNPort(1),I1)
140      Set_smu(2)
150      Connect(FNPort(1),1)
160      Connect(FNGnd,2)
170   Execute(I1)
```

Line 110 and 140 are performed first, followed by the Connect, Force, and Measure statements, all of which execute simultaneously at line 170.

Sample 2:

```
100   Prepare
110      Force_v(Drain,5)
120      Force_v(Gate,0)
130      Measure_i(Drain)
140      Measure_cmu(Cap,G)
150   Execute(Id,Cap,G)
```

You can omit the Measure_i and Measure_v variable parameters. You can also omit Measure_cmu's variable parameters unless a conductance measurement is necessary.

In Offline Mode (HP 4062UX Only)

Note

This subprogram is *not* supported in the offline mode and causes an error if used.

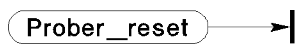
Prober_reset

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGY, TSK
Control	Electroglas 2001X, TSK A-PM Probers

For Electroglas 2001X: file EGY

This subprogram sets the Electroglas 2001X to Local mode (releases the Electroglas 2001X from Remote).

Syntax



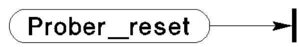
Description

Press the PAUSE key on the console of the Electroglas 2001X to recover from a prober error.

For TSK A-PM Probers: file TSK

This subprogram sets your TSK prober to the Local mode (releases the prober from Remote).

Syntax



Description

Execute Prober_reset as the first step in recovering from a prober-related error. When your prober is set to Local, manual operations from the control panel of the prober are possible.

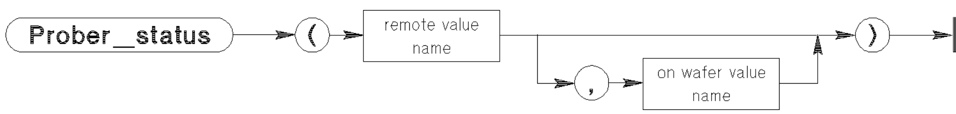
Prober_status

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram returns up to two integer values to indicate the status of the wafer prober.

Syntax



Item	Description/Default	Range Restrictions
remote value name	integer variable name	any valid name
on wafer value name	integer variable name	any valid name

Example Statements

```
Prober_status(Auto)
Prober_status(Auto,Onwafer)
```

Description

The values returned are either 1 or 0. When a condition is true, 1 is returned; otherwise 0 is returned.

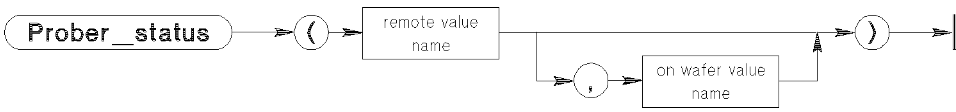
Variable Name	Returned Value	Description
remote value name	1	The Electroglas 1034X is set to Auto mode (controlled by the HP 4062C/UX).
	0	The Electroglas 1034X is set to Manual mode (controlled from the subpanel).
on wafer value name	1	On the wafer
	0	Not on the wafer (the wafer edge has been detected).

This subprogram can execute when the Electroglas 1034X is ON LINE.

For Electroglas 2001X: file EGY

This subprogram returns up to two integer values that indicate the status of the wafer prober.

Syntax



Item	Description/Default	Range Restrictions
remote value name	integer variable name	any valid name
on wafer value name	integer variable name	any valid name

Example Statements

```
Prober_status(Rmt)
Prober_status(Rmt,Onwafer)
```

Description

The values returned are either 1 or 0. When a condition is true, 1 is returned; otherwise 0 is returned.

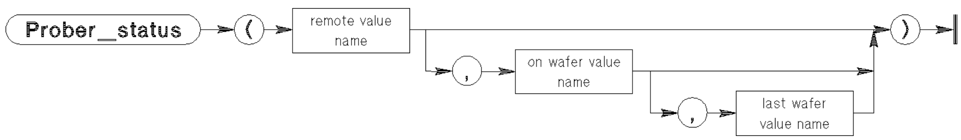
Variable Name	Returned Value	Description
remote value name	1	The Electroglas 2001X is set to Auto mode (controlled by the HP 4062C/UX).
	0	The Electroglas 2001X is set to Manual mode (controlled from the subpanel).
on wafer value name	1	On the wafer
	0	Not on the wafer (the wafer edge has been detected).

This subprogram can execute when the Electroglas 2001X is ON LINE.

For TSK A-PM Probers: file TSK

This subprogram returns from one to three integer values to indicate the status of the wafer prober.

Syntax



Item	Description/Default	Range Restrictions
remote value name	integer variable name	any valid name
on wafer value name	integer variable name	any valid name
last wafer value name	integer variable name	any valid name

Example Statement

```
Prober_status(Rmt,Onwafer)
Prober_status(Remote_p,Onwafer,Last_wafer)
```

Description

The values returned are either 1 or 0. When a condition is true, 1 is returned; otherwise 0 is returned.

Variable Name	Returned Value	Description
remote value name	1	The A-PM-6000A can be controlled by the HP 4062C/UX using TIS subprograms (REMOTE mode).
	0	The A-PM-6000A can be controlled from the subpanel.
on wafer value name	1	On the wafer
	0	Not on the wafer (the wafer edge is detected).
last wafer value name	1	The last wafer is unloaded.
	0	There are wafers to be loaded.

The *onwafer value* may change as a result of a Pmove, Pimove, or Pup initiated X-Y stage movement. The *last wafer value* is 0 as long as wafers remain in the wafer stack, and is set to 1 after the last wafer is unloaded from the chuck following a Phome subprogram. The *last wafer value* is always 0 if your TSK prober is *not* equipped with an automatic wafer loader.

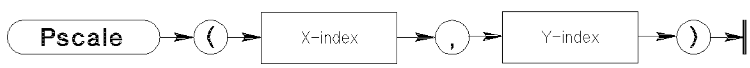
Pscale

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram sets the system index for the X- and Y-coordinates specified in the Pmove and Porig subprograms, and the system index for the X- and Y-displacements specified in the Pimove subprogram.

Syntax



Item	Description/Default	Range Restrictions
X-index	numeric expression: [μm]	—
Y-index	numeric expression: [μm]	—

Example Statements

```
Pscale(3000,3000)
Pscale(Xindex,Yindex)
```

Description

The system index must be set by Pscale before a Pimove, Pmove, or Porig subprogram can execute. Normally, the system index needs to be set only after the wafer prober is first turned on.

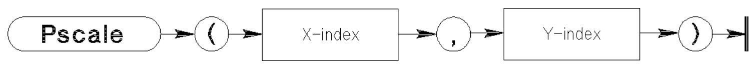
All programmed movements of the X-Y positioner are in the index units set by Pscale; joystick initiated movements, however, are in the index units set from the subpanel of the prober.

Pscale cannot be used in conjunction with Wstart_number or Wstart_xy PCL subprograms.

For Electroglas 2001X: file EGY

This subprogram sets the system index for the X- and Y-coordinates specified in the Pmove and Porig subprograms, and the system index for the X- and Y-displacements specified in the Pimove subprogram.

Syntax



Item	Description/Default	Range Restrictions
X-index	numeric expression: [μm]	—
Y-index	numeric expression: [μm]	—

Example Statements

```
Pscale(3000,3000)
Pscale(Xindex,Yindex)
```

Description

The system index must be set by Pscale before a Pimove, Pmove, or Porig subprogram can execute. Normally, the system index needs to be set only after the wafer prober is first turned on.

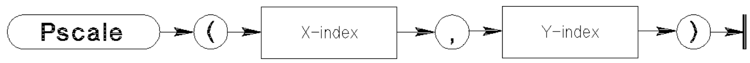
All programmed movements of the X-Y stage are in the index units set by Pscale; joystick initiated movements, however, are in the index units set from the operator console of the prober.

Pscale cannot be used in conjunction with Wstart_number or Wstart_xy PCL subprograms.

For TSK A-PM Probers: file TSK

This subprogram sets the system index for the X- and Y-coordinates specified in the Pmove and Porig subprograms, and the system index for the X- and Y-displacements specified in the Pimove subprogram.

Syntax



Item	Description/Default	Range Restrictions
X-index	numeric expression: [μm]	—
Y-index	numeric expression: [μm]	—

Example Statements

```
Pscale(3000,3000)
Pscale(Xindex,Yindex)
```

Description

The system index must be set by Pscale before a Pimove, Pmove, or Porig subprogram can execute. Normally, the system index needs to be set only after the wafer prober is first turned on.

All programmed movements of the X-Y stage are in the index units set by Pscale; joystick initiated movements, however, are in the index units set from the operator console of the prober.

Pscale cannot be used in conjunction with any PCL subprograms.

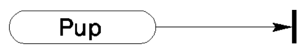
Pup

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	EGX, EGY, TSK
Control	Electroglas 1034X, Electroglas 2001X, TSK A-PM Probers

For Electroglas 1034X: file EGX

This subprogram raises the chuck of the wafer prober.

Syntax



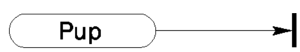
Description

This subprogram can execute only when the Electroglas 1034X is set to Auto mode.

For Electroglas 2001X: file EGY

This subprogram raises the chuck of the wafer prober.

Syntax



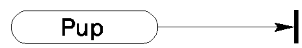
Description

This subprogram can execute only when the Electroglas 2001X is set to Remote mode.

For TSK A-PM Probers: file TSK

This subprogram raises the chuck of the wafer prober.

Syntax



Description

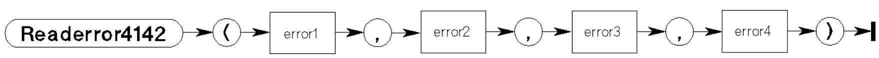
This subprogram can execute only when your TSK prober is set to Remote. After raising the chuck, this subprogram halts the prober processor.

Readerror4142

Supported on 4062C, 4062UX, 4062PC
Revision C.06.00 or later, X.06.00 or later, P.06.20 or later
File PGMLIB
Control DCS

This subprogram gets the error codes that occur between the Pgm_start ... Pgm_end context.

Syntax



Item	Description/Defaults	Range Restrictions
error1 to *error4*	integer variable name	any valid name

Example Statements

```
Readerror4142(Err1,Err2,Err3,Err4)
```

Description

Use this subprogram to get error codes that occur during the DCS control commands downloading. This subprogram actually sends the "ERR?" command to the DCS and gets the four error codes from the error register of the DCS. Note that four integer variables must be specified as parameters.

This subprogram is used when you debug the DCS control commands stored in the program memory. The DCS translates the received control commands to the internal codes. The command syntax and its parameter contents are checked during the translation. If some errors are detected during the translation, the error codes are stored in the error register of the DCS.

The DCS can hold up to four error codes in the error register and this subprogram can retrieve the errors. If two errors are detected, the two error codes are returned to *error1* and *error2*, and a 0 is returned to both *error3* and *error4*. If no errors are detected, 0s are returned to *error1* through *error4*.

For details on the error codes, see the HP 4142B *HP-IB Command Reference Manual*.

An example using this subprogram follows:

```
  .   .   .   .   .   .   .   .
120  INTEGER Err1, Err2, Err3, Err4, St
  .   .   .   .   .   .   .   .
330  Pgm_start(3)
  .   .   .   .   .   .   .   .
370   Pgm_force_v(FNSmu(1),5,0,0.02)
380   St=SPOLL(FNAddr4142)
390   IF BINAND(St,32) THEN Error_rep
400  Pgm_end
  .   .   .   .   .   .   .   .
  .   .   .   .   .   .   .   .
500 Error_rep:!
510  Pgm_end
520  Readerror4142(Err1,Err2,Err3,Err4)
530  IF Err1 THEN
540    PRINT "Errors are detected."
550    PRINT "    Error 1: ";Err1
560    PRINT "    Error 2: ";Err2
570    PRINT "    Error 3: ";Err3
580    PRINT "    Error 4: ";Err4
590  END IF
600  END
```

Note The Readerror4142 statement must be executed outside of the Pgm_start ... Pgm_end context; otherwise, an error will occur.

See Also

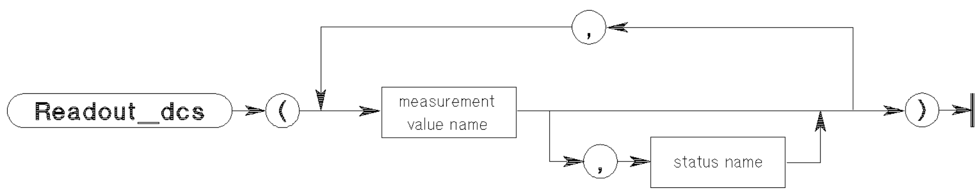
Error_info

Readout_dcs

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram requests that the DCS transfers measured data from spot measurements, pulsed spot measurements, or analog search measurements, then returns the measured data to specified variables. Up to eight sets of measured data can be transferred.

Syntax



Item	Description/Defaults	Range Restrictions
measurement value name	numeric variable name	any valid name
status name	integer variable name	any valid name

Example Statements

```
Readout_dcs(Imeas,Stat)
Readout_dcs(Vmeas)
Readout_dcs(Data1,St1,Data2,St2,Data3,St3,Data4,St4)
```

Description

This subprogram transfers measured data from the DCS after a program stored in the DCS program memory is executed. This subprogram is used for spot, pulsed spot, and analog search measurements. This subprogram cannot be used between the Pgm_start ... Pgm_end context because the transfer mode is different.

Other than the Pgm_start ... Pgm_end context, the transfer mode is set to the binary mode to reduce the transfer time. For more information on the binary format, see the HP 4142B *Operation Manual*.

The *measurement value name* and *status name* are one pair of data and up to eight pairs of data can be specified. The following example shows a program that gets one pair of data:

```
  .    .    .    .    .    .    .    .
280  Pgm_start(3)                Store the control commands into program memory.
  .    .    .    .    .    .    .    .
310   Pgm_force_v(FNSmu(3),10)
320   Pgm_measure_i(FNSmu(3))
330   Pgm_disable_dcs(FNSmu(3))
340  Pgm_end
  .    .    .    .    .    .    .    .
  .    .    .    .    .    .    .    .
530  Run_dcs_program(3)          Trigger the program stored in program memory.
540  Readout_dcs(Imeas,Stat)     Get the measured data from the DCS.
  .    .    .    .    .    .    .    .
```

In the above example, the second parameter `Stat` of the Readout_dcs statement (line 540) can be omitted.

As another example, if you execute a multichannel spot measurement using the "MM · · · " command, the following statements are available:

```
  .    .    .    .    .    .    .    .
310  Pgm_start(2)                           Store the control commands in program
                                            memory.
  .    .    .    .    .    .    .    .
380   OUTPUT @Dcs;"MM1,1,3,4,5"
390   OUTPUT @Dcs;"EX"
400   OUTPUT @Dcs;"DZ"
410  Pgm_end
  .    .    .    .    .    .    .    .
  .    .    .    .    .    .    .    .
640  Run_dcs_program(2)                     Trigger the program stored in program
                                            memory.
650  Readout_dcs(I1,S1,I2,S2,I3,S3,I4,S4)   Get the measured data from the DCS.
  .    .    .    .    .    .    .    .
```

The returned data is in the same order as the channel numbers of the "MM · · · " command.

The status codes, which may be returned to the *status* variable, are shown in the following table:

Status	**Description of Condition**
0	The measurement completed normally.
1	The measurement reached compliance/limit at another unit.
2	The measurement reached compliance/limit at this unit.
3	This unit is oscillating.
4	A measured data overflow is detected.
6[1]	The target value is not reached during a search (between search start value and search stop value).
7[1]	The measurement is made before the feedback search is complete.

1 This status is used only for analog search measurements.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* and *status name*. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant data simulation mode:

0.1 is always returned to the *measurement value name* and 0 is always returned to the *status name*.

File data simulation mode:

This subprogram reads <meas> and <stat> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Readout_dcs    <meas> <stat>  ·  ·  ·  ·  ·  <meas> <stat>
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file. Note that the data entries in the file data simulation file must correspond to the parameters of the calling statements.

See Also

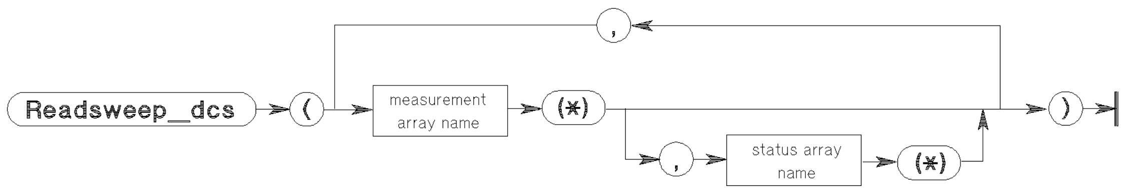
Readsweep_dcs
Run_dcs_program

Readsweep_dcs

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram requests that the DCS transfers measured data from sweep measurements. The measured data is returned to specified arrays. Up to nine pairs of data arrays can be specified.

Syntax



Item	Description/Defaults	Range Restrictions
measurement array name	numeric array name	any valid name
status array name	integer array name	any valid name

Example Statements

```
Readsweep_dcs(Imeas(*),Stat(*))
Readsweep_dcs(Vmeas(*))
Readsweep_dcs(Data1(*),St1(*),Data2(*),St2(*),Data3(*),St3(*))
```

Description

This subprogram is used to transfer the measured data from the DCS after the program stored in the DCS program memory is executed. The subprogram is used for sweep measurements and cannot be used between the Pgm_start ... Pgm_end context because the transfer mode is different.

Note

The Pgm_*xxxxx* subprograms that set sweep parameters are not supported. To set the sweep parameters, you must send the DCS control commands u sing an OUTPUT statement.

Other than the Pgm_start ... Pgm_end context, the transfer mode is set to the binary mode (FMT3) to reduce the transfer time. For more information on the binary format, see the HP 4142B *Operation Manual*.

The *measurement array name* and *status array name* are one pair of data. Up to nine pairs of data can be specified. The following example shows a program that gets one pair of data:

```
  .   .   .   .   .   .   .   .
280  Pgm_start(1)                       Store the control commands into program
                                        memory.
  .   .   .   .   .   .   .   .
320   OUTPUT @Dcs;"WI3,1,0,0,3E-2,31,4"
330   OUTPUT @Dcs;"MM2,3"
340   OUTPUT @Dcs;"FTM3,0"
350   OUTPUT @Dcs;"XE"
360   OUTPUT @Dcs;"DZ3"
370  Pgm_end
  .   .   .   .   .   .   .   .
  .   .   .   .   .   .   .   .
480  Run_dcs_program(1)                 Trigger the program stored in program mem-
                                        ory.
490  Readsweep_dcs(Vf(*),Vf_st(*))       Get the measured data from the DCS.
  .   .   .   .   .   .   .   .
```

In the above example, the second array name `Vf_st` of the Readout_dcs statement (line 490) can be omitted.

The status codes, which may be returned to the *status array name*, are shown in the following table:

Status	**Description of Condition**
0	The measurement completed normally.
1	The measurement reached compliance/limit at another unit.
2	The measurement reached compliance/limit at this unit.
3	This unit is oscillating.
4	A measured data overflow is detected.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement array name* and *status array name*. The type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant data simulation mode:

0.1 is always returned to the elements of the *measurement array name* and 0 is always returned to the elements of the *status array name*.

File data simulation mode:

This subprogram reads <meas*n*> and <stat*n*> from the data simulation file and returns the values. The data simulation file format follows:

```
Readout_dcs
[
<meas1> <stat1> <meas2> <stat2> · · · <meas9> <stat9>    element 1
<meas1> <stat1> <meas2> <stat2> · · · <meas9> <stat9>    element 2
  .   .   .   .   .   .   .   .   .   .   .   .
<meas1> <stat1> <meas2> <stat2> · · · <meas9> <stat9>    element n
]
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file. Note that the data entries in the file data simulation file must correspond to the parameters of the calling statements.

See Also

Readout_dcs
Run_dcs_program

Rsweep_iv

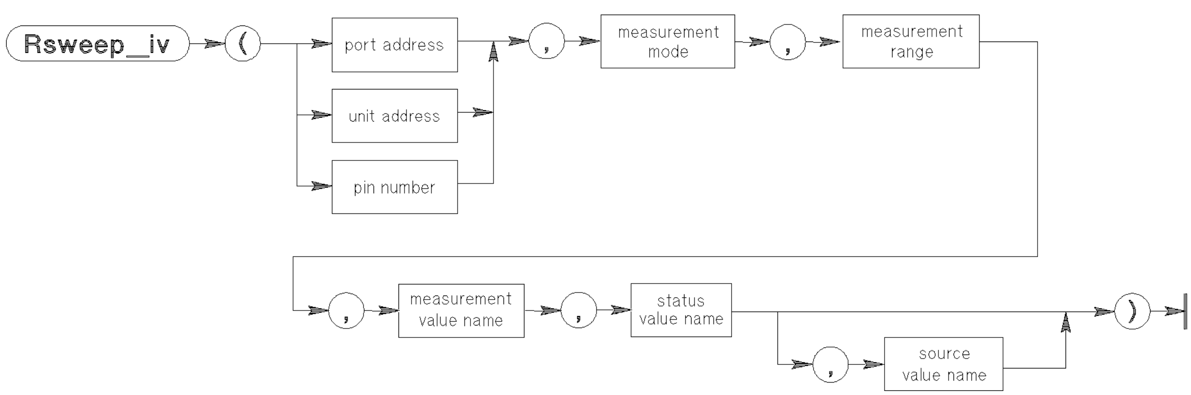
Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram performs real-time staircase sweep, synchronous staircase sweep, pulsed sweep, and staircase sweep with pulsed bias measurements. Synchronous staircase sweep measurements are described later.

For Staircase Sweep, Pulsed Sweep, and Staircase Sweep with Pulsed Bias Measurements:

Syntax

For SMUs:

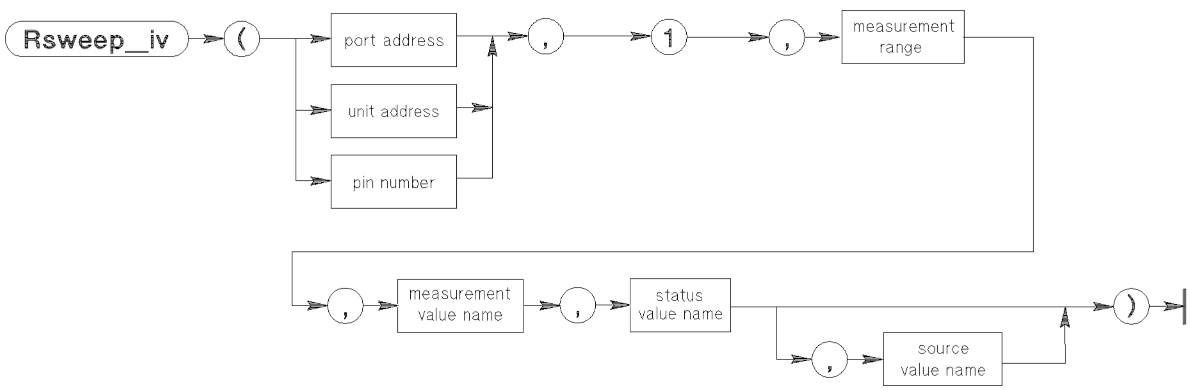


Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
measurement mode	integer expression	1: V measurement 2: I measurement	
measurement range [3]	numeric expression: [A]	−1 to 1 [4]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
measurement value name	numeric variable name	any valid name	

Item	Description/Default	Range Restrictions	Recommended Range
status value name	integer variable name	any valid name	
source value name	numeric variable name	any valid name	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.
3 If the measurement mode is 1 (V measurement),this is a dummy parameter because the V measurement range is defined by the set V compliance.
4 Actual range restrictions depend on the SMU or SMU port used.

For VMs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
pin number	integer expression	1 to 96 [2]	
measurement range	numeric expression: [V]		
	grounded measurements	−40 to 40	0, 2, 20, 40
	differential measurements	−2 to 2	0, 0.2, 2

Item	Description/Default	Range Restrictions	Recommended Range
measurement value name	numeric variable name	any valid name	
status value name	integer variable name	any valid name	
source value name	numeric variable name	any valid name	

[1] 32721 to 32732, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VM port.

Example Statements

```
Rsweep_iv(FNPort(1),1,0,Vmeas,Stat,Source)
Rsweep_iv(FNPort(3),2,0,Imeas,Stat)
Rsweep_iv(FNVm(1),1,0,Vmeas,Stat,Source)
```

Description

Rsweep_iv performs staircase sweep, pulsed sweep, and staircase sweep with pulsed bias measurements in accordance with the measurement parameters established in the following subprograms:

Measurement	Subprogram Name
Staircase sweep measurements	Set_iv
Pulsed sweep measurements	Set_piv
Staircase sweep with pulsed bias measurements	Set_iv, Set_pbias

Rsweep_iv returns measurement data as each sweep measurement finishes, so that the measurement results are plotted on the CRT for each measurement performed. When including Rsweep_iv in a measurement program, you must include Rsweep_iv within a FOR ... NEXT loop. Use the Rsweep_stop subprogram to abort a sweep measurement. Refer to the programming examples.

Port address, *unit address*, and *pin number*

Either *port address*, *unit address*, or *pin number* can be used to specify the measurement port for Rsweep_iv .

Measurement and *status values*

Rsweep_iv obtains DCS data during a measurement and returns the measurement and status values. Status values are returned as single-digit integer values and are defined as follows:

Status Value	Conditon
0	Normal measurement end
1	Another unit has reached compliance
2	This unit has reached compliance
3	This unit is oscillating
4	A/D converter saturated
5	Sweep aborted by stop mode = 2

If the *stop mode* = 2 of the Set_iv or Set_piv subprogram, Rsweep_iv measurements are aborted when the measurement SMU(s) reach compliance. If this occurs before a measurement loop ends, Rsweep_iv returns 9999999.99999.

If a measurement loop exceeds the number of sweep points, −9999999.99999 is returned when the sweep ends.

In Offline Mode (HP 4062UX Only)

In offline mode, this subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *source value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0. Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurement\ value = \frac{measurement\ value}{number\ of\ steps - 1} \times (n-1)$$

Where: *Number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	= 0	I compliance	Same as SMU *output value*
	≠ 0	Range value	
VS	any	20 mA	Same as VS *output value*

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
	$= 0$	2.0 V	Always positive
VM	$\neq 0$	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, and <source> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Rsweep_iv
[
<meas> <status> <source>
<meas> <status> <source>
  .   .   .   .   .   .   .
<meas> <status> <source>
]
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Programming Examples

1. Real-Time Sweep Measurement

```
100 Swp_mode=1
110 Meas_mode=2
120  · · · · · ·
130 Force_v(FNPort(1),Vout1,Range1)
140 Force_v(FNPort(2),Vout2,Range2)
150  · · · · · ·
160 Lingraph1(······)
170 Set_piv(FNPort(3),Swp_mode,Range3,Vstart,Vstop,Point,Ht,Dt,I_comp)
180 !
190 FOR I=1 TO Point
200   Rsweep_iv(FNPort(1),Meas_mode,Range,Imeas,St,Vswp)
210   DRAW Vswp,Imeas
220   IF St<>0 THEN
230     Rsweep_stop
240     I=Point
250   END IF
260 NEXT I
270  · · · · · ·
```

2. Change the Average Time

```
100 Swp_mode=1
110 Meas_mode=2
120  · · · · · ·
130 Force_v(FNPort(1),Vout1,Range1)
140 Force_v(FNPort(2),Vout2,Range2)
150  · · · · · ·
```

```
160 Lingraph1(......)
170 Set_iv(FNPort(3),Swp_mode,Range3,Istart,Istop,Point,Ht,Dt,V_comp)
180 !
190 FOR I=1 TO Point
200   ON KEY 1 LABEL "SHORT" GOSUB Short
210   ON KEY 2 LABEL "MED" GOSUB Med
220   ON KEY 3 LABEL "LONG" GOSUB Long
230   Rsweep_iv(FNPort(4),Meas_mode,Range,Imeas,St,Vswp)
240   DRAW Vswp,Imeas
250 NEXT I
260  . . . . . .
270 !
280 STOP
290 !
300 Short:!
310 Set_smu(1)
320 RETURN
330 Med:!
340 Set_smu(2)
350 RETURN
360 Long:!
370 Set_smu(3)
380 RETURN
390 !
400 END
```

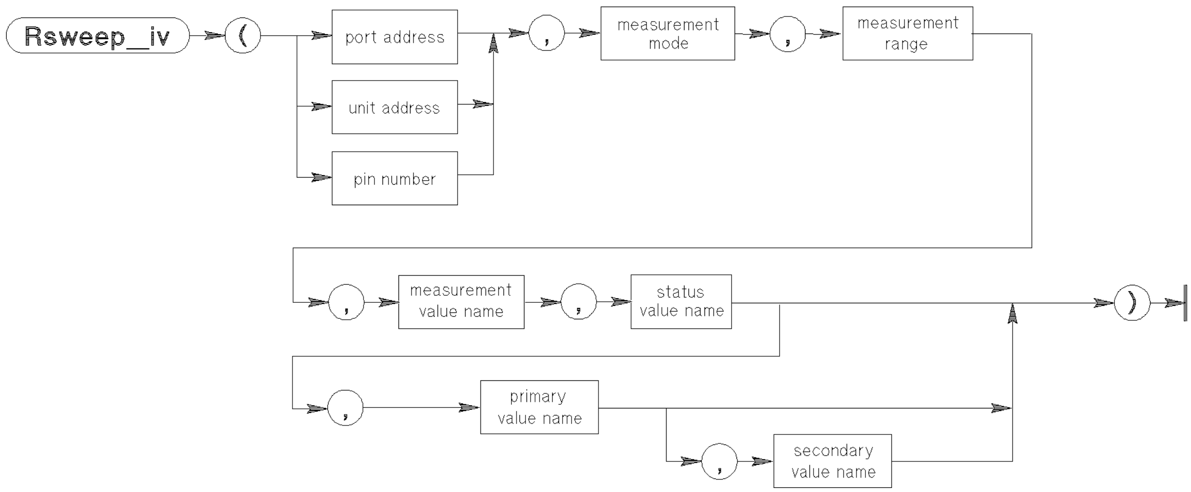
See Also

Set_iv
Set_piv
Set_pbias
Sweep_iv
Sweep_piv
Rsweep_stop

For Synchronous Staircase Sweep Measurements:

Syntax

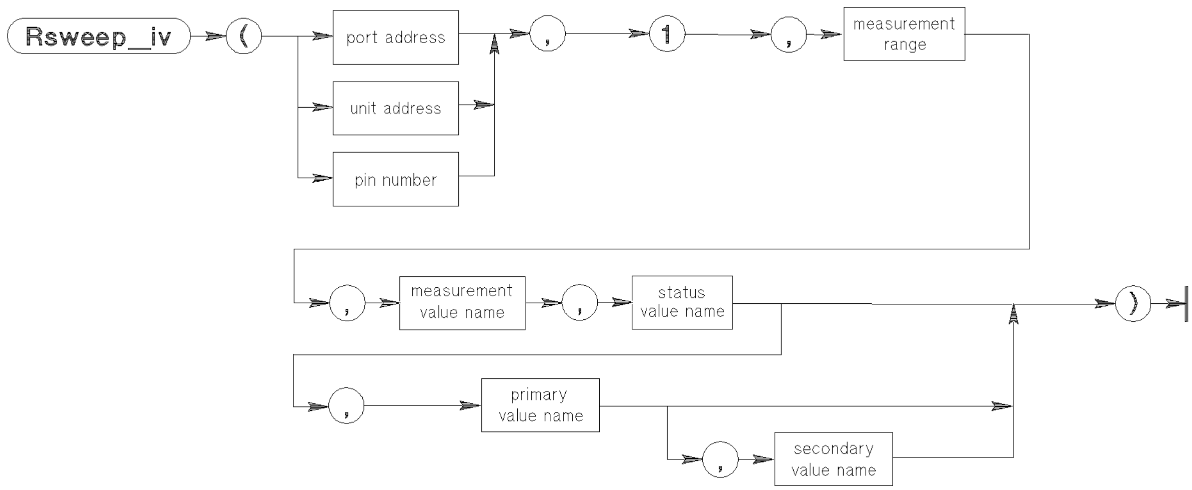
For SMUs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
measurement mode	integer expression	1: V measurement 2: I measurement	
measurement range [3]	numeric expression: [A]	−1 to 1 [4]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
measurement value name	numeric variable name	any valid name	
status value name	integer variable name	any valid name	
primary value name	numeric variable name	any valid name	
secondary value name	numeric variable name	any valid name	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.
3 If the measurement mode is 1 (voltage measurement), this is a dummy parameter because the V measurement range is defined by the set voltage compliance.
4 Actual range restrictions depend on the SMU or SMU port used.

For VMs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
pin number	integer expression	1 to 96 [2]	
measurement range	numeric expression: [V]		
	grounded measurements	−40 to 40	0, 2, 20, 40
	differential measurements	−2 to 2	0, 0.2, 2
measurement value name	numeric variable name	any valid name	
status value name	integer variable name	any valid name	
primary value name	numeric variable name	any valid name	
secondary value name	numeric variable name	any valid name	

1 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VM port.

Example Statements

```
Rsweep_iv(FNPort(1),1,0,Vmeas,Stat,Prmswp,Secswp)
Rsweep_iv(FNPort(3),2,0,Imeas,Stat,Prmswp,Secswp)
```

Description

Rsweep_iv performs synchronous staircase sweep measurements in accordance with the measurement parameters established in the Set_iv and Set_sync subprograms.

Rsweep_iv returns measurement data as each sweep measurement completes and measurement results are plotted on the CRT for each measurement performed. When including Rsweep_iv in a measurement program, you must include Rsweep_iv within a FOR ... NEXT loop. Use the Rsweep_stop subprogram to abort a sweep measurement. Refer to the programming examples.

Port address, *unit address*, and *pin number*

Either *port address*, *unit address*, or *pin number* can be used to specify the measurement ports of Rsweep_iv.

Measurement value and *status value*

Rsweep_iv obtains DCS data during a measurement and returns measurement and status values. Status values are returned as single-digit integer values and are defined as follows:

Status Value	Condition
0	Normal measurement end
1	Another unit has reached compliance
2	This unit has reached compliance
3	This unit is oscillating
4	A/D converter saturated
5	Sweep aborted by stop mode = 2

If the *stop mode* = 2 of the Set_iv or Set_piv subprogram, Rsweep_iv measurements are aborted when the measurement SMU(s) reach compliance. If this occurs before a measurement loop ends, Rsweep_iv returns 9999999.99999.

If a measurement loop exceeds the number of sweep points, −9999999.99999 will be returned when the sweep ends.

Primary and *secondary values*

Rsweep_iv also obtains and returns primary (sweep port) and secondary (synchronous sweep port) values during a synchronous staircase sweep measurement. The DCS returns primary sweep values; secondary sweep values are calculated by Rsweep_iv and are stored in the *secondary value name*. The secondary sweep value calculation method is the same as that performed by the DCS, as follows:

V sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$Vn = Vstart + \frac{Vstop - Vstart}{N - 1}(n - 1)$
	double sweep	N + 1 to 2N	$Vn = Vstop - \frac{Vstop - Vstart}{N - 1}(n - N - 1)$
logarithmic sweep	single sweep	1 to N	$Vn = Vstart \times EXP\left(\frac{\log_e\left(\frac{Vstop}{Vstart}\right)}{N - 1}(n - 1)\right)$
	double sweep	N + 1 to 2N	$Vn = Vstop \times EXP\left(\frac{\log_e\left(\frac{Vstart}{Vstop}\right)}{N - 1}(n - N - 1)\right)$

n: the n-th measurement point
N: number of steps determined in Set_iv subprogram

I sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$In = Istart + \frac{Istop - Istart}{N - 1}(n - 1)$
	double sweep	N + 1 to 2N	$In = Istop - \frac{Istop - Istart}{N - 1}(n - N - 1)$
logarithmic sweep	single sweep	1 to N	$In = Istart \times EXP\left(\frac{\log_e\left(\frac{Istop}{Istart}\right)}{N - 1}(n - 1)\right)$
	double sweep	N + 1 to 2N	$In = Istop \times EXP\left(\frac{\log_e\left(\frac{Istart}{Istop}\right)}{N - 1}(n - N - 1)\right)$

n: the n-th measurement point
N: number of steps determined in Set_iv subprogram

In Offline Mode (HP 4062UX Only)

In offline mode, this subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *primary value name* and *secondary value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0. Note that power compliance is not applicable in the offline mode. If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurement\ value = \frac{measurement\ value}{number\ of\ steps - 1} \times (n - 1)$$

Where: *number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	= 0	I compliance	Same as SMU *output value*
	≠ 0	Range value	
VS	any	20 mA	Same as VS *output value*

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
	= 0	2.0 V	Always positive
VM	≠ 0	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, <source1>, and <source2> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Rsweep_iv
[
<meas> <status> <source1> <source2>
<meas> <status> <source1> <source2>
  .   .   .   .   .   .   .
<meas> <status> <source1>  <source2>
]
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Programming Examples

1. Real-Time Sweep Measurement

```
100 Swp_mode=1
110 Meas_mode=2
120  · · · · · ·
130 Force_v(FNPort(1),Vout1,Range1)
140  · · · · · ·
150 Lingraph1(······)
160 Set_iv(FNPort(2),Swp_mode,Range2,Istart,Istop,Point,Ht,Dt,V_comp1)
170 Set_sync(FNPort(3),0,Ioffset,Ratio,V_comp2)
180 !
190 FOR I=1 TO Point
200   Rsweep_iv(FNPort(1),Meas_mode,Range,Imeas,St,Vswp1,Vswp2)
210   DRAW Vswp2,Imeas
220   IF St0 THEN
230     Rsweep_stop
240     I=Point
250   ENDIF
260 NEXT I
270  · · · · · ·
```

See Also

Set_iv
Set_sync
Sweep_iv
Rsweep_stop

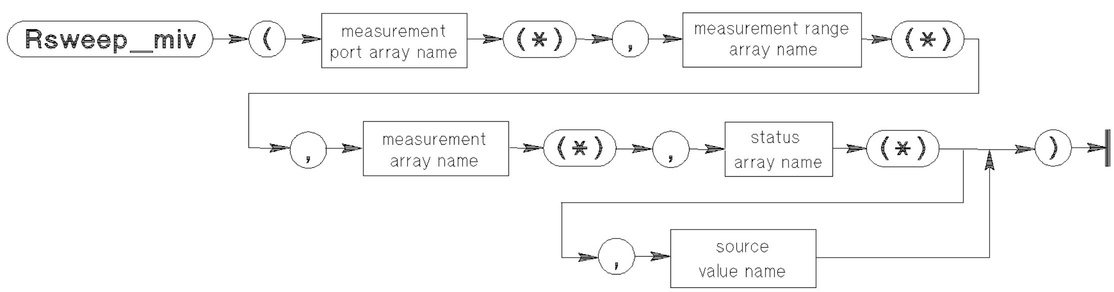
Rsweep_miv

Supported on 4062C, 4062UX, 4062PC
Revision C.05.60 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram performs real-time multichannel staircase sweep, synchronous staircase sweep, pulsed sweep, and staircase sweep with pulsed bias measurements. Multichannel synchronous staircase sweep measurements are described later.

For Staircase Sweep, Pulsed Sweep, and Staircase sweep with Pulsed Bias Measurements:

Syntax



Item	Description/Default	Range Restrictions
measurement port array name	integer array name	any valid name
measurement range array name	numeric array name	any valid name
measurement array name	numeric array name	any valid name
status array name	numeric array name	any valid name
source value name	numeric variable name	any valid name

Example Statement

```
Rsweep_miv(Port(*),Range(*),Measval(*),St(*),Source)
```

Description

Rsweep_miv performs multichannel staircase sweep, pulsed sweep, and staircase sweep with pulsed bias measurements in accordance with the measurement parameters established in the following subprograms:

Measurement	Subprogram Name
Staircase sweep measurements	Set_iv
Pulsed sweep measurements	Set_piv
Staircase sweep with pulsed bias measurements	Set_iv, Set_pbias

Rsweep_miv returns measurement data as each sweep measurement completes and the measurement results are plotted on the CRT for each measurement performed. When including Rsweep_miv in a measurement program, you must include Rsweep_miv within a FOR ... NEXT loop. Use the Rsweep_stop subprogram to abort a sweep measurement. Refer to the programming examples.

Measurement port and measurement range

Either *port address*, *unit address*s, or *pin number* can be used to specify the measurement port of Rsweep_miv. Measurement and sweep source ports must be already connected to the specified measurement units. Refer to the Measure_i and Measure_v subprograms for details on measurement range.

Measurement and status values

Rsweep_miv obtains DCS data during a measurement and returns measurement and status values to their corresponding arrays. Status values are returned as single-digit integer values and are defined as follows:

Status Value	Condition
0	Normal measurement end
1	Another unit has reached compliance
2	This unit has reached compliance
3	This unit is oscillating
4	A/D converter saturated
5	Sweep aborted by *stop mode* = 2

If the *stop mode* = 2 of the Set_iv or Set_piv subprogram, Rsweep_iv measurements are aborted when the measurement SMU(s) reach compliance. If this occurs before a measurement loop ends, Rsweep_iv returns 9999999.99999. If a measurement loop exceeds the number of sweep points, −9999999.99999 is returned when the sweep ends.

Array limitations

When specifying arrays, the *measurement port array* number (port number) must correspond to the *measurement range array* number, *measurement array* number, and *status array* number. *Measurement* and *status array* sizes must be equal to or larger than the available measurement ports. A zero (0) terminates a port list. Refer to the following example.

```
INTEGER PORT(1:6)
Port(1)=32701    Range(1)  Measval(1) Status(1)
Port(2)=32703    Range(2)  Measval(2) Status(2)
Port(3)=32702    Range(3)  Measval(3) Status(3)
Port(4)=0        Range(4)
Port(5)=32704    Range(5)
Port(6)=0        Range(6)
```

In this example, measurements are performed at ports 32701, 32702, and 32703 only (the three available measurement ports).

In Offline Mode (HP 4062UX Only)

In offline mode, this subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *source value name* valuable. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0. Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurement\ value = \frac{measurement\ value}{number\ of\ steps - 1} \times (n - 1)$$

Where *number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	= 0	I compliance	Same as SMU *output value*
	≠ 0	Range value	
VS	any	20 mA	Same as VS *output value*

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
	= 0	2.0 V	Always positive
VM	≠ 0	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, and <source> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Rsweep_miv
[
<meas1> <meas2> · · · <st1> <st2> · · · <source>
<meas1> <meas2> · · · <st1> <st2> · · · <source>
  .   .   .   .   .   .
<meas1> <meas2> · · · <st1> <st2> · · · <source>
]
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Programming Examples

```
100 INTEGER Port(5)
110 REAL Range(5),Mdata(3)
120 Swp_mode=1
130 !
140 Port(1)=FNPort(1)
150 Port(2)=FNPort(2)
160 Port(3)=FNVm(1)
170 Port(4)=0
180 Port(5)=FNPort(3)
190 !
200 Range(1)=1E-3
210 Range(2)=1E-6
220 Range(3)=2
230  · · · · · ·
240 Force_v(FNPort(3),Vout1,Range1)
250  · · · · · ·
260 Lingraph1(······)
270 Set_iv(FNPort(4),Swp_mode,Range4,Vstart,Vstop,Point,Ht,Dt,Icomp)
280 !
290 FOR I=1 TO Point
```

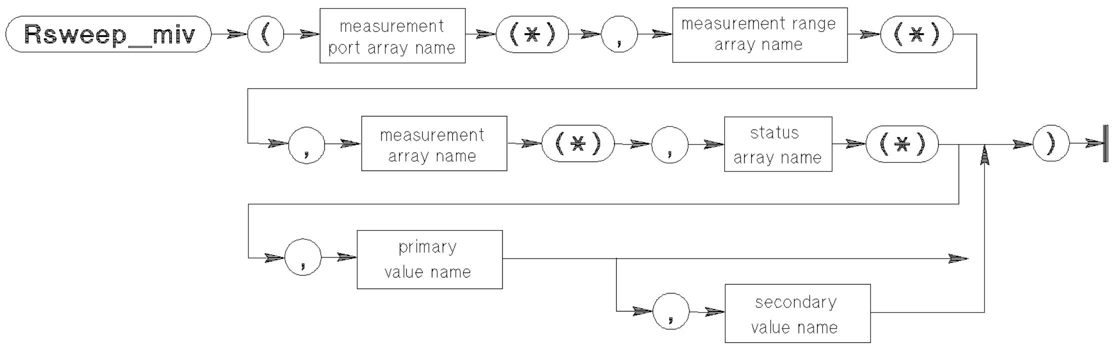
```
300   Rsweep_miv(Port(*),Range(*),Mdata(*),St(*), Swp)
310   DRAW Swp,Mdata(1)
320   DRAW Swp,Mdata(2)
330   DRAW Swp,Mdata(3)
340   IF St(1)0 OR St(2)0 THEN
350     Rsweep_stop
360     I=Point
370   ENDIF
380 NEXT I
390 · · · · · ·
```

See Also

Set_iv
Set_piv
Set_pbias
Rsweep_iv
Rsweep_stop

For Synchronous Staircase Sweep Measurements:

Syntax



Item	Description/Default	Range Restrictions
measurement port array name	integer array name	any valid name
measurement range array name	numeric array name	any valid name
measurement array name	numeric array name	any valid name
status array name	numeric array name	any valid name
primary value name	numeric valuable name	any valid name
secondary value name	numeric valuable name	any valid name

Example Statements

```
Rsweep_miv(Port(*),Range(*),Measval(*),St(*),Swp1,Swp2)
```

Description

Rsweep_miv performs multichannel synchronous staircase sweep measurements in accordance with the measurement parameters established in the Set_iv and Set_sync subprograms.

Rsweep_miv returns measurement data as each sweep measurement completes and the measurement results are plotted on the CRT for each measurement performed. When including Rsweep_miv in a measurement program, you must include Rsweep_miv within a FOR ... NEXT loop. Use the Rsweep_stop subprogram to abort a sweep measurement. Refer to the "Programming Examples."

Measurement port and measurement range

Either *port address, unit address*, or *pin number* can be used to specify the measurement port for Rsweep_miv. Measurement and sweep source ports must be connected to the specified measurement units. Refer to the Measure_i and Measure_v subprograms for details on measurement range.

Measurement and status values

Rsweep_miv obtains DCS data during a measurement and returns measurement and status values to their corresponding arrays. Status values are returned as single-digit integer values and are defined as follows:

Status Value	Condition
0	Normal measurement end
1	Another unit has reached compliance
2	This unit has reached compliance
3	This unit is oscillating
4	A/D converter saturated
5	Sweep aborted by *stop mode* = 2

If the *stop mode* = 2 for the Set_iv or Set_piv subprogram, Rsweep_iv measurements are aborted when the measurement SMU(s) reach compliance. If this occurs before a measurement loop ends, Rsweep_iv returns 9999999.99999. If a measurement loop exceeds the number of sweep points, −9999999.99999 is returned when the sweep ends.

Array limitations

When specifying arrays, the *measurement port array* number (port number) must correspond to the *measurement range array* number, *measurement array* number, and *status array* number. *Measurement* and *status array* sizes must be equal to or larger than the available measurement ports. A zero (0) terminates a port list. Refer to the following example.

```
INTEGER PORT(1:6)
Port(1)=32701    Range(1)   Measval(1) Status(1)
Port(2)=32703    Range(2)   Measval(2) Status(2)
Port(3)=32702    Range(3)   Measval(3) Status(3)
Port(4)=0        Range(4)
Port(5)=32704    Range(5)
Port(6)=0        Range(6)
```

In this example, measurements are performed at ports 32701, 32702, and 32703 only (the three available measurement ports).

Primary and secondary values

Rsweep_miv also obtains and returns primary and secondary values during a synchronous staircase sweep measurement. The DCS returns primary sweep values, and secondary sweep values are calculated by Rsweep_miv and are stored in the *secondary value name*. Secondary value calculation method is the same as that performed by the DCS, as follows:

V sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$Vn = Vstart + \frac{Vstop - Vstart}{N - 1}(n - 1)$
	double sweep	N + 1 to 2N	$Vn = Vstop - \frac{Vstop - Vstart}{N - 1}(n - N - 1)$
logarithmic sweep	single sweep	1 to N	$Vn = Vstart \times EXP\left(\frac{\log_e\left(\frac{Vstop}{Vstart}\right)}{N - 1}(n - 1)\right)$
	double sweep	N + 1 to 2N	$Vn = Vstop \times EXP\left(\frac{\log_e\left(\frac{Vstart}{Vstop}\right)}{N - 1}(n - N - 1)\right)$

n: the n−th measurement point
N: number of steps determined in Set_iv subprogram

I sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$In = Istart + \frac{Istop - Istart}{N - 1}(n - 1)$
	double sweep	N + 1 to 2N	$In = Istop - \frac{Istop - Istart}{N - 1}(n - N - 1)$
logarithmic sweep	single sweep	1 to N	$In = Istart \times EXP\left(\frac{\log_e\left(\frac{Istop}{Istart}\right)}{N - 1}(n - 1)\right)$
	double sweep	N + 1 to 2N	$In = Istop \times EXP\left(\frac{\log_e\left(\frac{Istart}{Istop}\right)}{N - 1}(n - N - 1)\right)$

n: the n−th measurement point
N: number of steps determined in Set_iv subprogram

Refer to the synchronous staircase sweep measurement description of the Sweep_iv subprogram for more details on these parameters.

In Offline Mode (HP 4062UX Only)

In offline mode, this subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *primary value name* and *secondary value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0. Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurement\ value = \frac{measurement\ value}{number\ of\ steps - 1} \times (n - 1)$$

Where *number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	$= 0$	I compliance	Same as SMU *output value*
	$\neq 0$	Range value	
VS	any	20 mA	Same as VS *output value*

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
VM	$= 0$	2.0 V	Always positive
	$\neq 0$	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, <source1>, and <source2> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Rsweep_miv
[
<meas1> <meas2> · · · <st1> <st2> · · · <source1> <source2>
<meas1> <meas2> · · · <st1> <st2> · · · <source1> <source2>
  .   .   .   .   .   .   .   .   .   .   .   .
<meas1> <meas2> · · · <st1> <st2> · · · <source1> <source2>
]
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Programming Examples

1. Synchronous Sweep Measurement

```
100 INTEGER Port(5)
110 REAL Range(2),Mdata(2)
120 Swp_mode=1
130 !
140 Port(1)=FNPort(1)
150 Port(2)=FNVm(1)
160 Port(3)=0
170 Port(4)=0
180 Port(5)=FNPort(3)
190 !
230 Range(1)=1E-3
240 Range(2)=2
250  · · · · · ·
260 Force_v(FNPort(3),Vout1,Range1)
270  · · · · · ·
```

```
280 Linegraph1(······)
290 Set_iv(FNPort(2),Swp_mode,Range4,Vstart,Vstop,Point,Ht,Dt,Icomp1)
300 Set_sync(FNPort(4),0,Voffset,Ratio,Icomp2)
310 FOR I=1 TO Point
320   Rsweep_miv(Port(*),Range(*),Mdata(*),St(*),Swp1,Swp2)
330    · · · · · ·
340   IF St(1)0 OR St(2)0 THEN
350     Rsweep_stop
360     I=Point
370   ENDIF
380 NEXT I
390  · · · · · ·
```

See Also

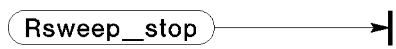
Set_iv
Set_sync
Sweep_miv
Rsweep_iv
Rsweep_stop

Rsweep_stop

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram stops real time sweep measurements.

Syntax



Example Statements

```
Rsweep_stop
```

Description

This subprogram is used in conjunction with the Rsweep_iv and Rsweep_miv subprograms to stop real time sweep measurements. After this subprogram executes, the sweep start value is set to the SMU(s) or VS(s), but sweep conditions are not changed at all and the output relay of the measurement unit is not disconnected.

See Also

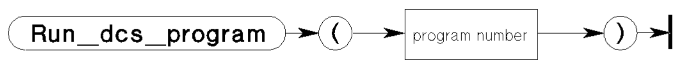
Rsweep_iv
Rsweep_miv

Run_dcs_program

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram triggers and executes specified DCS programs stored in the program memory.

Syntax



Item	Description/Defaults	Range Restrictions
program number	integer expression	1 to 99

Example Statements

```
Run_dcs_program(1)
Run_dcs_program(2,4,6,8)
```

Description

This subprogram triggers a program stored in the DCS program memory. By calling this subprogram once, up to eight programs can be executed.

Specify the program numbers that are specified by Pgm_start as the parameters of this subprogram. The same program number can be specified more than once.

The DCS programs are executed according to the order of the parameters.

The settings of SMUs, VSs, and VMs are altered when DCS programs are executed, and the settings kept in the TIS memory are different from the actual settings. After executing DCS programs in the program memory, you must use the following procedures to return to normal operation of the TIS:

- Init_system
- Disable_port
- Long_cal
- Short_cal

The above subprograms clear the settings in the TIS memory and reset the DCS.

In Offline Mode (HP 4062UX Only)

This subprogram performs nothing except parameter checking.

See Also

Readout_dcs
Readsweep_dcs

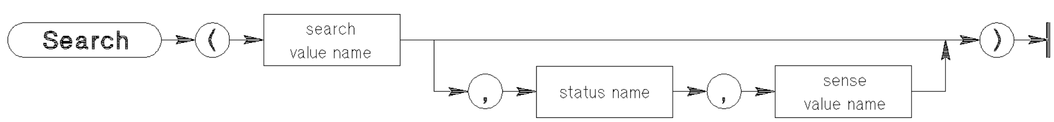
Search

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram performs search measurements in accordance with the conditions established by the Set_asearch, Set_bsearch, or Set_lsearch subprograms, and returns the resultant search value.

If you include a Set_sync subprogram between Set_bsearch or Set_lsearch and the Search subprogram, Search performs a search measurement using the synchronous search unit specified in Set_sync.

Syntax



Item	Description/Default	Range Restrictions
search value name	numeric variable name	any valid name
status name	integer variable name	any valid name
sense value name	numeric variable name	any valid name

Example Statements

```
Search(Vth,Status,Id)
Search(Vebo)
```

Description

This subprogram performs a search measurement and returns the search value to a user-specified variable. If a measurement does not execute normally or if the search value is not found, the value -9999999.99999[1] is returned. The Search subprogram returns a single-digit integer value translated from a binary number whose bits provide the following status codes:

Bit Number	bit2	bit1	bit0
Status Code	S2	S1	S0

Set_asearch:

S0 : Search value not found (between the *start* and *stop values*).

S1 : Abnormal data (for example, oscillating).

S2 : Parameter(s) incorrectly set for this search (search value not found).

Set_bsearch:

S0 : Search value not found (between the *min.* and *max. search values*).[1]

S1 : Abnormal data.

S2 : Monitor value is not within the defined error of target value.

Set_lsearch:

S0 : Search value not found (between the *start* and *stop values*).

S1 : Abnormal data

S2 : Abnormal compliance loop

[1] If the value −7777777.77777 is returned, change the *minimum search value* so the difference between the *minimum* and *maximum search values* is larger. If the value −8888888.88888 is returned, change the *maximum search value* so the difference between the *minimum* and *maximum search values* is larger.

A Force_i or Force_v statement cannot be used between the Search and Set_asearch, Set_bsearch, or Set_lsearch statements.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *search value, status*, and *sense value name* variables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

For Analog Feedback Measurements:

Search value is set to the average value of the *start value* and *stop value* in the Set_asearch subprogram. *Status* is always set to 0, which in the offline mode means that the search value is found. Sense value is set to the same value as *target value* in the Set_asearch subprogram.

For Binary Search Measurements:

Search value is set to the average value as *minimum control value* and *maximum control value* in the Set_bsearch subprogram. *Status* is always set to 0, which in the offline mode means that the search value was found. Sense value is set to the same value as *target value* in the Set_bsearch subprogram.

For Linear Search Measurements:

Search value is set to the average value of *start value* and *stop value* in the Set_lsearch subprogram. *Status* is always set to 0, which in the offline mode means that the search value is found. Sense value is set to the same value as *target value* in the Set_lsearch subprogram.

File Data Simulation mode:

This subprogram reads <search>, <status>, and <sense> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Search  <search>  <status>  <sense>
```

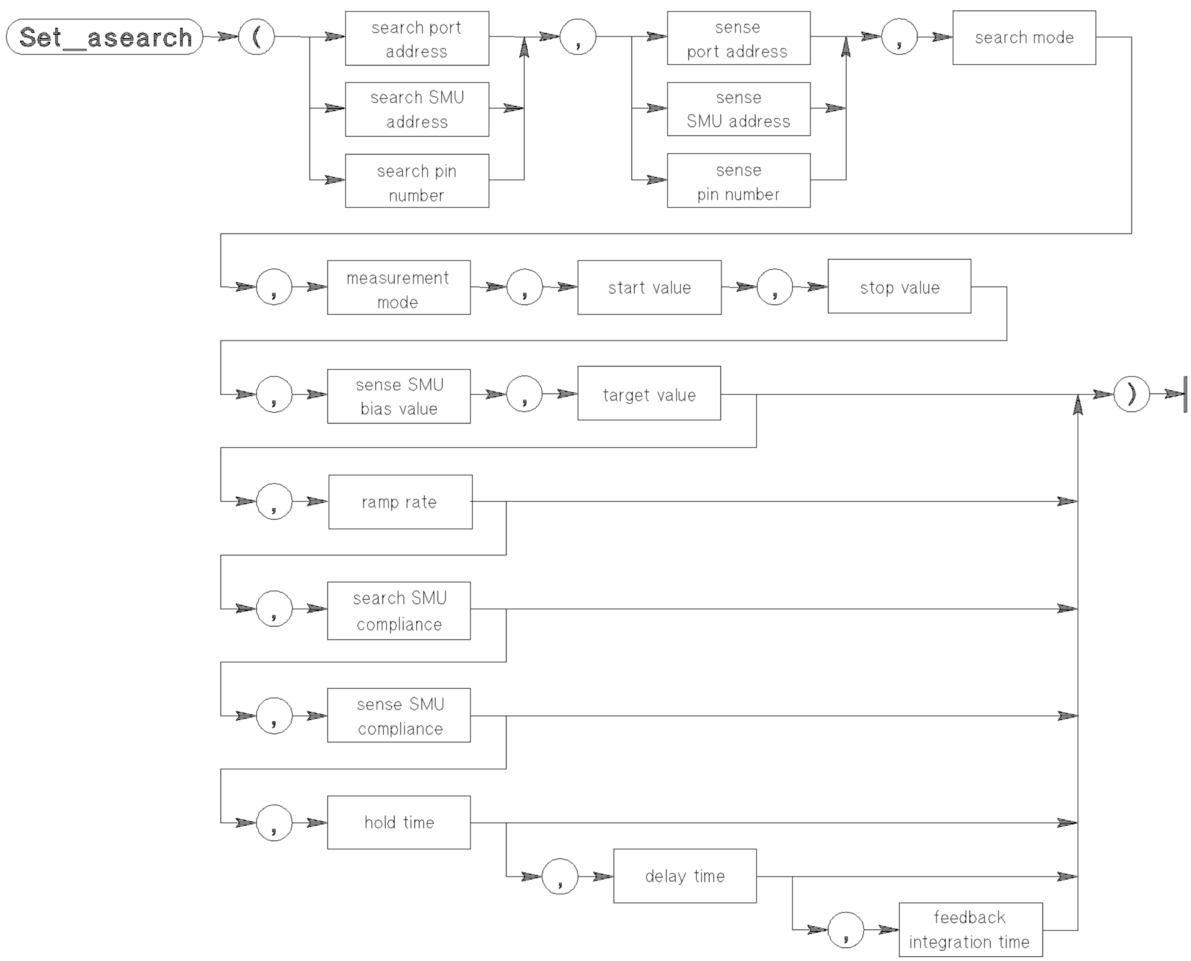
You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Set_asearch

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the parameters for analog search measurements.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
search port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
search SMU address	integer expression	32621 to 32632	
search pin number	integer expression	1 to 96 [2]	

Item	Description/Default	Range Restrictions	Recommended Range
sense port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
sense SMU address	integer expression	32621 to 32632	
sense pin number	integer expression	1 to 96 [2]	
search mode	integer expression	1 to 4	
measurement mode	integer expression	−4 to −1, 1 to 4	
start value	numeric expression [V]	−200 to 200 [3, 4]	
stop value	numeric expression [V]	−200 to 200 [3, 4]	
sense SMU bias value	numeric expression		
	If sense SMU is in VS mode: [V]	−200 to 200 [4]	
	If sense SMU is in IS mode: [A]	−1 to 1 [4]	
target value	numeric expression		< 90 % of *sense SMU compliance*
	If sense SMU is in VS mode: [A]	−1 to 1 [4]	
	If sense SMU is in IS mode: [V]	−200 to 200 [4]	
ramp rate	numeric expression: [V/s] default = 500	0.5 to 100000 [3]	
search SMU compliance	numeric expression: [A] If search SMU is in VS mode: default = last valid setting or 1E−4 if SMU is in IS mode.	−1 to 1 [4]	
sense SMU compliance	numeric expression		> 110 % of the *target value*
	If sense SMU is in VS mode: default = last valid setting or 1E−4 if SMU is in IS mode.	−1 to 1 [4]	
	If sense SMU is in IS mode: default = last valid setting or 20[5] if SMU is in VS mode.	−200 to 200 [4]	
hold time	numeric expression: [s] default = 0	0 to 65.535 resolution: 0.001	

Item	Description/Default	Range Restrictions	Recommended Range
delay time	numeric expression: [s] default = 0	0 to 65.535 resolution: 0.001	
feedback integration time	numeric expression: [s] default = 5E−3	5E−7 to 0.45 [6]	

[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a connected pin to the desired port.
[3] This range is supported for firmware revision 3.00 or later in the DCS. Otherwise, −20 to 20 is available.
[4] Actual range of these parameters depends on the SMU and SMU port used. Refer to description for details.
[5] If absolute *sense SMU bias value* is larger than 100 mA, default value is set to 2 V.
[6] This range is supported for firmware revision 3.00 or later in the DCS. Otherwise, 5E−6 to 0.45 is available.

Example Statements

```
Set_asearch(FNSmu(2),FNSmu(3),1,1,0,10,2,3E-5)
Set_asearch(FNSmu(1),FNSmu(3),Search_mode,Meas_mode,Vstart,Vstop,Vsense,
Target,Ramp,Comp_srch,Comp_sense,H_time,D_time,Integ_time)
```

Description

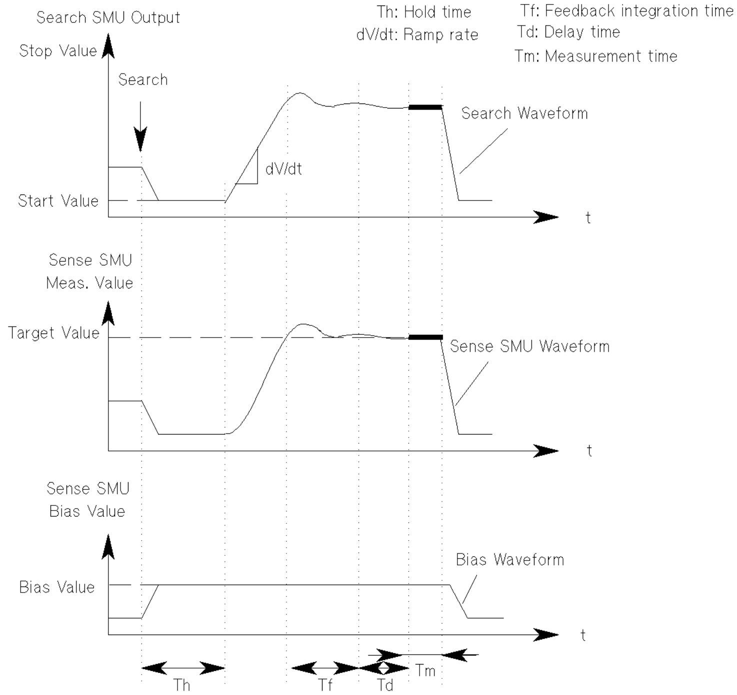
Set_asearch sets the parameters for analog search measurements. For details on analog search measurement operation, see "Analog Feedback Unit" in chapter 2 of the *System Information Manual* .

Either *port address*, *SMU address*, or *pin number* can be used to specify a desired SMU port.

Search modes 1 through 4 are explained briefly below:

search mode	Description
1	Performs a negative feedback analog search. Set this mode if an increase in search value causes an increase in sense value or if a decrease in search value causes a decrease in sense value.
2	Performs a positive feedback analog search. Set this mode if an increase in search value causes a decrease in sense value or if a decrease in search value causes an increase in sense value.
3	Performs a ramp analog search until the sense value is greater than the *target value*. Set this mode if an increase in search value causes an increase in sense value.
4	Performs a ramp analog search until the sense value is less than the *target value*. Set this mode if an increase in search value causes a decrease in sense value.

The follwing figure shows an example waveform for *search mode* = 1:



The *measurement mode* parameter determines the following conditions. If you want to measure the sense SMU value by the Search statement specified by the *sense value name*, ±3 or ±4 must be specified as the *measurement mode*.

measurement mode	**Sense SMU Mode**	**Returned Value for Search Statement**	
		search value	*sense value*
−4	voltage measurement	current value	voltage value
−3	voltage measurement	voltage value	voltage value
−2	voltage measurement	current value	—
−1	voltage measurement	voltage value	—
1	current measurement	voltage value	—
2	current measurement	current value	—
3	current measurement	voltage value	current value
4	current measurement	current value	current value

The *start value* can be less or greater than the *stop value*, but they cannot be equal. The output voltage range in the search SMU is automatically set to the range that can output the greater absolute *start* or *stop* value with the highest resolution, but these two parameters must satisfy the following conditions:

Output Voltage Range in Search SMU	*start* and *stop values* Conditions	
2 V	$0 < \mathrm{MAX}(\lvert start\rvert, \lvert stop\rvert) \leq 2$ V ,	$0.1 \text{ V} \leq \lvert start - stop \rvert \leq 2$ V
20 V	$2 \text{ V} \leq \mathrm{MAX}(\lvert start\rvert, \lvert stop\rvert) \leq 20$ V ,	$1 \text{ V} \leq \lvert start - stop \rvert \leq 20$ V
40 V [1]	$20 \text{ V} \leq \mathrm{MAX}(\lvert start\rvert, \lvert stop\rvert) \leq 40$ V ,	$2 \text{ V} \leq \lvert start - stop \rvert \leq 40$ V
100 V [1]	$40 \text{ V} \leq \mathrm{MAX}(\lvert start\rvert, \lvert stop\rvert) \leq 100$ V ,	$5 \text{ V} \leq \lvert start - stop \rvert \leq 100$ V
200 V [1]	$100 \text{ V} \leq \mathrm{MAX}(\lvert start\rvert, \lvert stop\rvert) \leq 200$ V ,	$10 \text{ V} \leq \lvert start - stop \rvert \leq 200$ V

[1] These ranges are supported for firmware revision 3.00 or later in the DCS (HP 4142B).

The allowable range for the *sense SMU bias value*, *target value*, *search SMU compliance*, and *sense SMU compliance* parameters depend on each SMU range and the allowable voltage or current of each SMU port. Refer to Specifications for details. Set the *target value* to less than 90% of the *sense SMU compliance* value.

Ramp rate and *feedback integration time* depend on the output voltage range in the search SMU as shown in the following table:

Output Voltage Range in Search SMU	Available Ramp Rate (R) [V/s]	Available Feedback Integration Time (t)
2 V	$0.5 \leq R \leq 5000$	$50\ \mu s \leq t \leq 450$ ms
20 V	$5.5 \leq R \leq 50000$	$5\ \mu s \leq t \leq 45$ ms
40 V [1]	$10 \leq R \leq 100000$	$2.5\ \mu s \leq t \leq 25$ ms
100 V [1]	$25 \leq R \leq 100000$	$1\ \mu s \leq t \leq 10$ ms
200 V [1]	$55 \leq R \leq 100000$	$0.5\ \mu s \leq t \leq 5$ ms

[1] These ranges are supported for firmware revision 3.00 or later in the DCS (HP 4142B).

Feedback integration time resolutions are shown in the following table:

Feedback Integration Time (t)	Setting Resolution
$0.5\ \mu s \leq t \leq 4.5\ \mu s$	$0.5\ \mu s$
$5\ \mu s \leq t \leq 45\ \mu s$	$5\ \mu s$
$50\ \mu s \leq t \leq 450\ \mu s$	$50\ \mu s$
$500\ \mu s \leq t \leq 4.5$ ms	$500\ \mu s$
$5 \text{ ms} \leq t \leq 45$ ms	5 ms
$50 \text{ ms} \leq t \leq 450$ ms	50 ms

Ramp rate resolutions (unit: V/s) are shown in the following table:

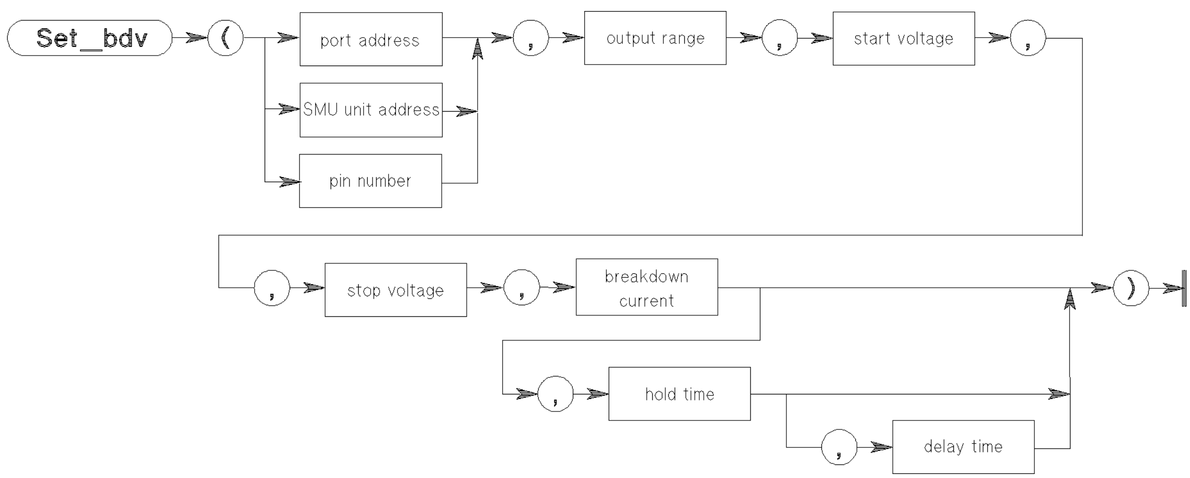
Ramp Rate (R)	**Voltage Range in Search SMU**				
	2 V range	20 V range	40 V range	100 V range	200 V range
0.5 V/s ≤ R ≤ 5 V/s	0.05	—	—	—	—
5.5 V/s ≤ R ≤ 10 V/s	0.5	0.5	—	—	—
10 V/s ≤ R ≤ 25 V/s	0.5	0.5	1	—	—
25 V/s ≤ R ≤ 50 V/s	0.5	0.5	1	2.5	—
55 V/s ≤ R ≤ 100 V/s	5	5	5	5	5
100 V/s ≤ R ≤ 250 V/s	5	5	10	5	5
250 V/s ≤ R ≤ 500 V/s	5	5	10	25	5
550 V/s ≤ R ≤ 1000 V/s	50	50	50	50	50
1000 V/s ≤ R ≤ 2500 V/s	50	50	100	50	50
2500 V/s ≤ R ≤ 5000 V/s	50	50	100	250	50
5500 V/s ≤ R ≤ 10000 V/s	—	500	500	500	500
10000 V/s ≤ R ≤ 25000 V/s	—	500	1000	500	500
25000 V/s ≤ R ≤ 50000 V/s	—	500	1000	2500	500
55000 V/s ≤ R ≤ 100000 V/s	—	—	5000	5000	5000

Set_bdv

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets quasi-pulsed measurement parameters for breakdown voltage measurements.

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression	32701 to 32704, 32729[1], 32732[1]
SMU unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU)
pin number	integer expression	1 to 96[2]
output range	numeric expression: [V]	−200 to 200[3]
start voltage	numeric expression: [V]	−200 to 200[3]
stop voltage	numeric expression: [V]	−200 to 200[3]
breakdown current	numeric expression: [A] If SMU is in VS mode: default = last valid setting If SMU is in IS mode: default = 1E−4	−1 to 1[3]

1 These port addresses are used for the AUX ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

3 Actual *output range*, *start voltage*, *stop voltage*, and *breakdown current* range restrictions depend on the SMU and SMU port used.

Item	Description/Default	Range Restrictions
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01
delay time	numeric expression: [s] default = 0	0 to 6.5535 resolution: 0.0001

Example Statements

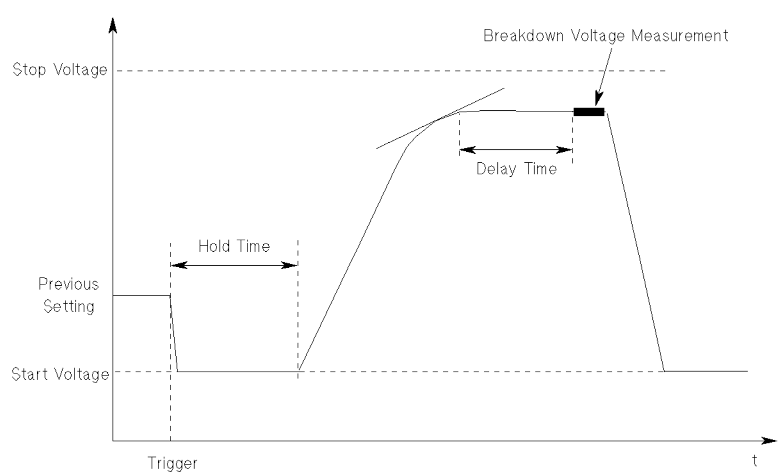
```
Set_bdv(FNSmu(2),0,0,50,1E-6)
Set_bdv(Pin12,100,30,80,1E-5,0.5,0.01)
Set_bdv(Port,Range,Vstart,Vstop,Ibdv,Hold,Delay)
```

Description

This subprogram sets the quasi-pulsed measurement conditions to measure breakdown voltage. To start quasi-pulsed measurements, the Measure_bdv s tatements are used.

A quasi-pulse is forced at a specified SMU and the forced voltage is monitored during a time interval. When the gradient of the voltage increase becomes less than half of the initial gradient of the voltage increase, the SMU current reaches *breakdown current* (current compliance), and the voltage value is measured at the SMU. After the measurement, the forced voltage is reset to *start voltage*. The slew rate of the quasi-pulse is determined by capacitance on the DUT, cables, test fixtures, and so on.

The quasi-pulsed wave form for a breakdown voltage measurement is shown in the following illustration. These measurements are useful when the breakdown voltage range of the DUT is designed very wide and when the breakdown voltage must be measured at a low breakdown current so that the DUT is not damaged.



Either *port address*, *SMU unit address*, or *pin number* can be used to specify the measurement port.

The breakdown voltage must be found within the *start voltage* and *stop voltage*. The *stop voltage* must not be the same value as the *start value*, and the difference between these two voltage values must be greater than or equal to 10 V.

Breakdown current is the current value when the breakdown voltage is measured. In fact, the *breakdown current* is the current compliance of the SMU and must be low enough not to damage the DUT.

Hold time takes a specified time before the output voltage starts from the *start voltage*. The default setting of this parameter is 0.

Delay time takes a specified time before the current value is measured at the SMU. The default setting of this parameter is 0.

For more information on the quasi-pulsed measurements, see the *HP 4142B Operation Manual*.

See Also

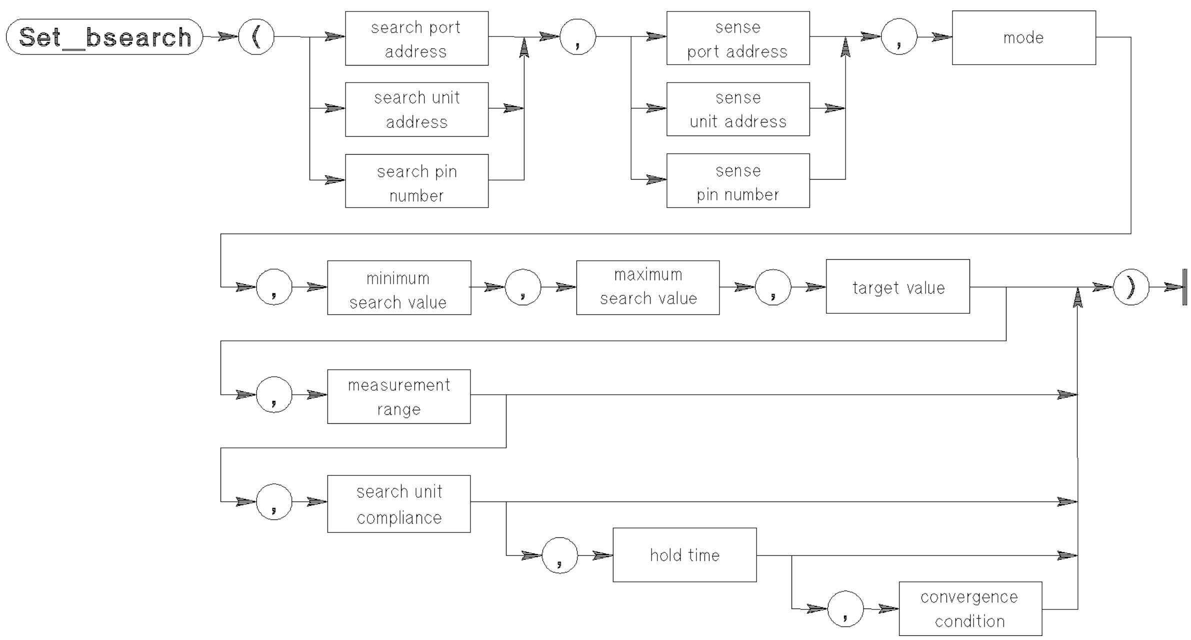
Measure_bdv

Set_bsearch

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram sets the parameters for binary search measurements.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
search port address	integer expression	32701 to 32706, 32708, 32709, 32721 to 32732 [1]	
search unit address	integer expression	32621 to 32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	
search pin number	integer expression	1 to 96 [2]	

Item	Description/Default	Range Restrictions	Recommended Range
sense port address	integer expression	32701 to 32706, 32708, 32709, 32721 to 32732 [1]	
sense unit address	integer expression	32621 to 32632, 32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
sense pin number	integer expression	1 to 96 [2]	
mode	integer expression	0 to 7	
minimum search value	numeric expression:		
	If search unit is SMU in VS mode: [V]	−200 to 200 [3]	
	If search unit is VS: [V]	−40 to 40	
	If search unit is SMU in IS mode: [A]	−1 to 1 [4]	
maximum search value	numeric expression		
	If search unit is SMU in VS mode: [V]	−200 to 200 [3]	
	If search unit is VS: [V]	−40 to 40	
	If search unit is SMU in IS mode: [A]	−1 to 1 [4]	
target value	numeric expression		
	If sense unit is SMU in VS mode: [A]	−1 to 1 [4]	
	If sense unit is VM: [V]	−40 to 40	
	If sense unit is SMU in IS mode: [V]	−200 to 200 [3]	

Item	Description/Default	Range Restrictions	Recommended Range
measurement range	numeric expression		
	If sense unit is SMU in VS mode: [A] default = 0	−1 to 1	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
	If sense unit is VM: [V] default = last valid setting	−40 to 40	0, 0.2, 2, 20, 40
	If sense unit is SMU in IS mode: [V]	any value [5]	
search unit compliance	numeric expression		
	If search unit is SMU in VS mode: [A], default = last valid setting or 1E−4 if SMU is in IS mode.	−1 to 1 [3]	−1 to −1E−12, 1E−12 to 1
	If search unit is VS:	any value [5]	
	If search unit is SMU in IS mode: [V] default = last valid setting, or 20[6] if SMU is in VS mode.	−200 to 200 [4]	
hold time	numeric expression: [s] default = 0	0 to 6.5535	
convergence condition	numeric expression		
	If convergence mode is accuracy: [%] default = 1	0 to 100 [7] resolution: 0.01	
	If convergence mode is number of times: default = 10	1 to 16	

1 32721 to 32732 are used for the AUX ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.
3 Maximum output voltage and actual range restrictions for current compliance depend on the specified voltage range.
4 Actual range restrictions for voltage compliance depend on the specified test current.
5 These are dummy parameters.
6 If the absolute *minimum search value* or *maximum search value* is larger than 100 mA, default is set to 2 V.
7 If the specified convergence accuracy is 0%, actual accuracy is set to 0.01%.

Example Statements

```
Set_bsearch(FNSmu(1),FNSmu(2),0,.5,2,1.E-7)
Set_bsearch(Gate,Drain,Mode,L_value,U_value,Target,Range,Comp,W_time)
```

Description

Set_bsearch divides the set of items to be searched into two equal parts, then determines which part contains the *target value*. This process repeats until the specified *convergence condition* is satisfied.

Either a *pin number* or *port address* can be used to specify a unit. The *mode* parameter determines the following conditions:

Mode	Search Port VS/IS Mode	Normal/Reset Mode	Convergence Mode
0	VS	Normal	Accuracy
1	IS	Normal	Accuracy
2	VS	Reset	Accuracy
3	IS	Reset	Accuracy
4	VS	Normal	Times
5	IS	Normal	Times
6	VS	Reset	Times
7	IS	Reset	Times

Normal and Reset Modes:

In the Normal mode, the output of the search unit increments or decrements directly to the next value. The Reset mode resets the output of the search unit to the start value, waits a delay time equal to the hold time, and increments or decrements to the next value.

Convergence mode:

If you select Accuracy mode, convergence is reached if the sense value is within the user defined error range. If the sense value does not converge, even if the output of the search unit is within its resolution, the binary search stops.

If you select Times mode, you must define how many iterations the binary search is to execute. The maximum number of iterations is 16.

The output range of the search port is set to either *maximum search value* or *minimum search value*, whichever is greater. Refer to Force_v or Force_i for output value, range, and compliance relationships.

The *measurement range* should be greater than the *target value*. If the *measurement range* is omitted or is less than the *target value*, the *measurement range* is set to the *target value*.

If you wish to set a compliance for the sense unit, execute a Force_v or Force_i subprogram to set the compliance of the sense unit before you execute a Set_bsearch.

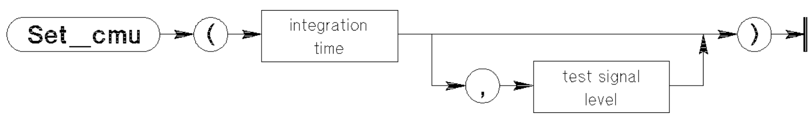
Hold time is the time between the output of the search unit and the measurement of the sense unit. If you select the Reset mode, the hold time is added to the delay time between iterations, and the output returns to the initial value between iterations.

Set_cmu

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	CMU

This subprogram sets the measurement integration time and test signal level of the CMU.

Syntax



Item	Description/Default	Range Restrictions
integration time	integer expression	1: SHORT 2: MEDIUM 3: LONG
test signal level	integer expression default = previously set value	1: 10 mVrms 2: 30 mVrms

Example Statements

```
Set_cmu(1,2)
Set_cmu(Integ_time,Sig_level)
```

Description

You can select measurement integration time of the CMU from the following 3 settings:

Integration Time	Description
1: SHORT	The integration time is set to 1 ms.
2: MEDIUM	The integration time is set to 10 ms.
3: LONG	The CMU averages the results of ten MEDIUM integration time measurements.

The test signal level of the CMU is set to 10 mVrms when you select 1, and 30 mVrms when you select 2 . Measurement resolutions for the set integration times are listed as follows:

Range	SHORT	MEDIUM	LONG
10 pF	10 pF	1 fF	
100 pF	0.1 pF	10 fF	
1000 pF	1 pF	0.1 pF	

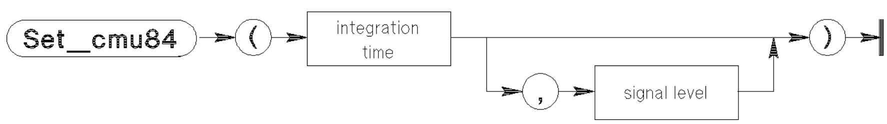
Integration time and test signal level are initially set to MEDIUM and 30 mVrms, respectively.

Set_cmu84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284 (for Rev. C.05.60, C.05.70 or X.05.61), TIS (for Rev. C.06.00 or later, X.06.00 or later, and P.06.20 or later)
Control	CMU84

This subprogram sets the measurement integration time and test signal level of the CMU84.

Syntax



Item	Description/Default	Range Restrictions
integration time	integer expression	1: SHORT 2: MEDIUM 3: LONG
test signal level	numeric expression: [V] default = last valid setting or 1.0	0 to 2.0 (standard) 0 to 20.0 (option 321/531)

Example Statement

```
Set_cmu84(3)
Set_cmu84(2,10)
Set_cmu84(Integ_time,Sig_level)
```

Description

integration time

The 1 to 3 parameters define the integration time; SHORT, MEDIUM, or LONG. The default integration time is MEDIUM. The following table shows typical measurement times.

	1 kHz	**10 kHz**	**100 kHz**	**1 MHz**
SHORT	40 ms	30 ms	30 ms	30 ms
MEDIUM	190 ms	180 ms	180 ms	180 ms
LONG	830 ms	820 ms	820 ms	820 ms

test signal level

This parameter defines the test signal voltage. When this parameter is omitted, the last signal level is available, and the signal level is set to 1.0 V after initialization. The test signal level consideration is as follows:

- Option 321/531 (HP 4284A option 001) *not* installed

Specified Signal level [V]	Actual Signal Level	Resolution
specification ≤ -0.005	error	—
$-0.005 <$ specification < 0.005	0.000 V	—
$0.005 \leq$ specification ≤ 0.200	specification	0.001 V
$0.200 <$ specification ≤ 2.00	specification	0.01 V
$2.00 <$ specification < 2.01	2.00 V	—
$2.01 \leq$ specification	error	—

- Option 321/531 (HP 4284A option 001) installed

Specified Signal level [V]	Actual Signal Level	Resolution
specification ≤ -0.005	error	—
$-0.005 <$ specification < 0.005	0.000 V	—
$0.005 \leq$ specification ≤ 0.200	specification	0.001 V
$0.200 <$ specification ≤ 2.00	specification	0.01 V
$2.00 <$ specification ≤ 20.0	specification	0.1 V
$20.0 <$ specification < 20.1	20.0 V	—
$20.1 \leq$ specification	error	—

See Also

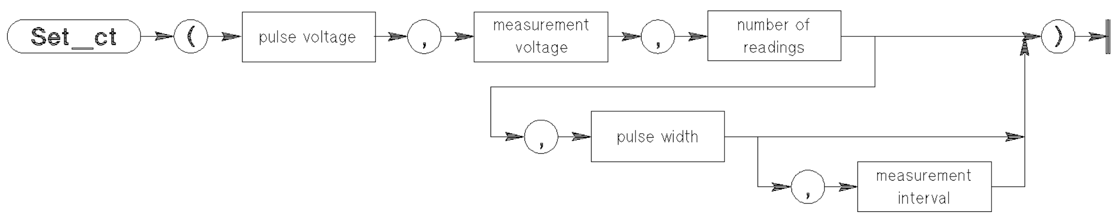
Measure_cmu84

Set_ct

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	CMU

This subprogram sets the sweep parameters for C·G-t measurements.

Syntax



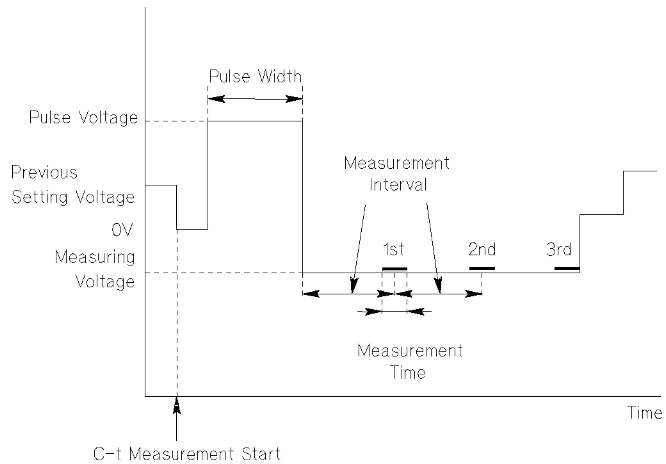
Item	Description/Default	Range Restrictions
pulse voltage	numeric expression: [V]	−100 to 100
measurement voltage	numeric expression: [V]	−100 to 100
number of readings	integer expression	2 to 1001
pulse width	numeric expression: [s] default = 0.01	0.01 to 32
measurement interval	numeric expression: [s] default = 0.06, 0.1	0.06 to 32

Example Statements

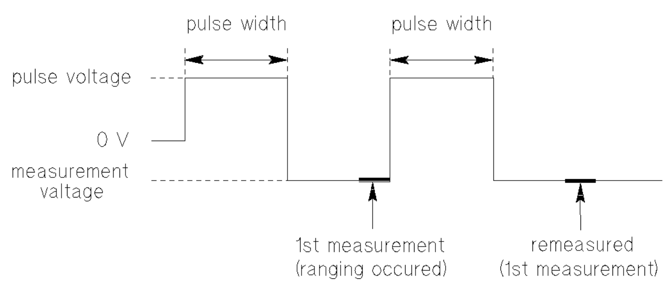
```
Set_ct(5,-5,100,60,.5)
Set_ct(Pulse_v,Meas_v,Num_of_meas,P_width,Interval)
```

Description

When Sweep_ct executes, *pulse voltage*, *measurement voltage*, *pulse width*, and *measurement interval* determine C·G-t measurement timing, as shown in the following illustration:



If the C-G range is set to Auto and the first measurement results in an overflow, the CMU automatically up-ranges and reapplies the pulse voltage.



The selected dc bias range depends on the *pulse voltage* or *measurement voltage* value, whichever is larger.

DC Bias Range	Maximum Output Voltage	Resolution
1 V	±1.999 V	1 mV
10 V	±19.99 V	10 mV
100 V	±100.0 V	100 mV

The measurement interval specified depends on the set integration time. If you select LONG, integration time automatically reverts to MEDIUM during a sweep. Pulse width and measurement interval resolution depend on their specified values, as shown in the following table.

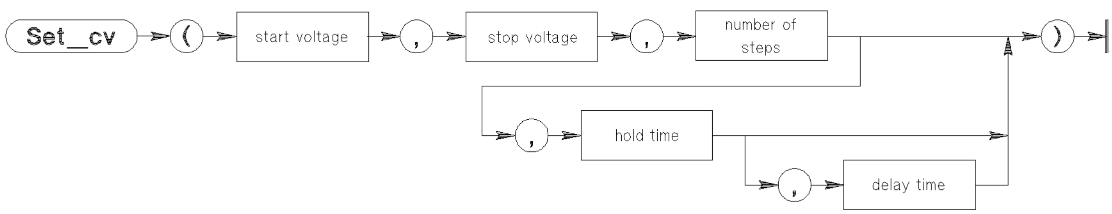
Item	Range	Resolution
		0.01 / 0.065 / 1 / 10 / 32
Measurement Interval (When integration time is SHORT)	0.06 s to 32 s	10 us / 500 us / 1 ms / 10 ms
Measurement Interval (When integration time is MEDIUM)	0.1 s to 32 s	500 us / 1 ms / 10 ms
Pulse Width	0.01 s to 32 s	10 us / 500 us / 1 ms / 10 ms

Set_cv

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control CMU

This subprogram sets the sweep parameters for C-G-V measurements.

Syntax



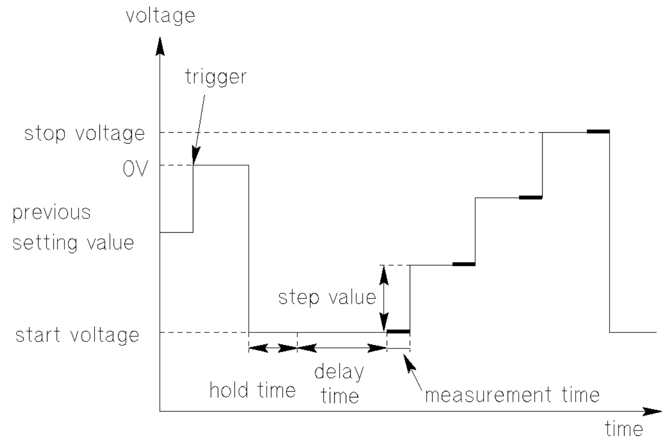
Item	Description/Default	Range Restrictions
start voltage	numeric expression: [V]	−100 to 100
stop voltage	numeric expression: [V]	−100 to 100
number of steps	integer expression	2 to 1001
hold time	numeric expression: [s] default = 0.003	0.003 to 650
delay time	numeric expression: [s] default = 0.003	0.003 to 650

Example Statements

```
Set_cv(-5,5,101,60,01)
Set_cv(Start_v,Stop_v,Steps,Hold,Delay)
```

Description

When Sweep_cv executes, *start voltage*, *stop voltage*, *hold time*, and *delay time* determine the sweep measurement conditions, as shown in the following illustration:



The selected dc bias range depends on the *start voltage* or *stop voltage* value, whichever is larger. The step voltage—(*stop voltage* − *start voltage*)/(*number of steps* − 1)—may be rounded off, depending on the resolution of the set bias range.

DC Bias Range	Maximum Output Voltage	Resolution
1 V	±1.999 V	1 mV
10 V	±19.99 V	10 mV
100 V	±100.0 V	100 mV

Because of this rounding-off, the actual *stop voltage* may be slightly different than the specified value, and the sweep measurement may finish before the number of measurements reach the specified number of steps.

Hold time and delay time resolutions depend on their specified value, as listed in the following table:

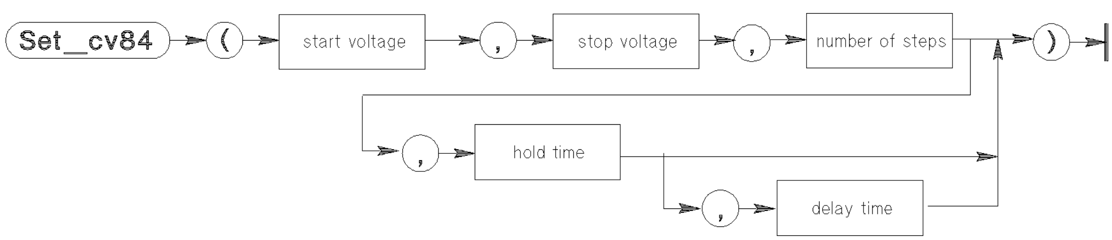
Hold Time or Delay Time [s]	Resolution
0.003 to 0.065	1 ms
0.07 to 99.99	10 ms
100.0 to 650.0	100 ms

Set_cv84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284 (for C.05.60, C.05.70 or X.05.61), TIS (for C.06.00 or later, X.06.00 or later, and P.06.20 or later)
Control	CMU84

This subprogram sets the sweep parameter for C·G-V measurements on the CMU84. Note that option 321/531 (HP 4284A option 001) must be installed in order to perform the C·G-V measurements on the CMU84.

Syntax



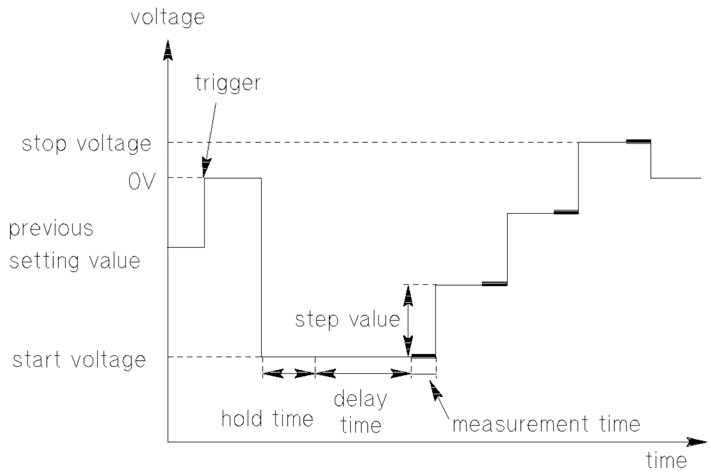
Item	Description/Default	Range Restrictions
start voltage	numeric expression: [V]	− 40.0 to 40.0
stop voltage	numeric expression: [V]	− 40.0 to 40.0
number of steps	integer expression	2 to 1001
hold time	numeric expression: [s] default = 0	0 to 60 : resolution = 1 ms 60 to 650 : resolution = depends on WAIT statement
delay time	numeric expression: [s] default = 0	0 to 60 : resolution = 1 ms 60 to 650 : resolution = depends on WAIT statement

Example Statement

```
Set_cv84(-5,5,11)
Set_cv84(10,-5,16,1,1E-1)
Set_cv84(Start_v,Stop_v,Number,Hold,Delay)
```

Description

The C·G-V measurement concept is shown in the following figure.



start voltage, *stop voltage*, and *number of steps*

The i-th output bias voltage is calculated from these three parameters by using the following equation:

$$ith\ output\ bias\ voltage = start\ voltage + \frac{stop\ voltage - start\ voltage}{number\ of\ steps - 1} \times (i-1)$$

$$i = 1, 2, \cdots\cdot, number\ of\ steps$$

The output bias voltage is rounded off in the same manner as Force_v84 subprograms. Refer to the Force_v84 subprogram.
If the *start voltage* value is the same as the *stop voltage* value, an error occurs.

See Also

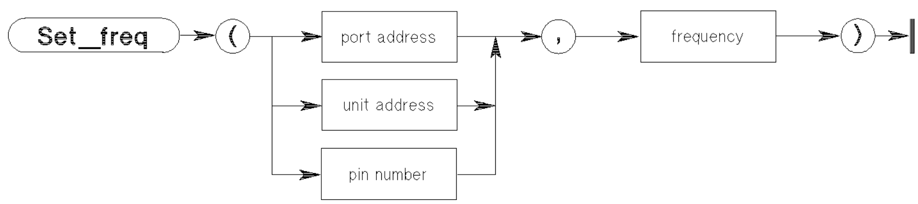
Sweep_cv84

Set_freq

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	CMU84

This subprogram sets the measurement frequency of a specified unit.

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression	32708[1]
unit address	integer expression	32671
pin number	integer expression	1 to 96[2]
frequency	numeric expression: [Hz]	1E+3, 1E+4, 1E+5, and 1E+6

1 Must be the CMH and CML terminals of a CMU84 connected to AUX3 (CMH) and AUX4 (CML) ports, respectively.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the CMH port.

Example Statement

```
Set_freq(FNCmh,1000)
Set_freq(32671,Freq1)
```

Description

Port address, *unit address*, and *pin number*

Either *port address*, *unit address*, or *pin number* can be used to specify the CMU84.

frequency

The measurement frequency can be set to 1 kHz, 10 kHz, 100 kHz, or 1 MHz with this parameter.

Note

Frequencies between 20 Hz through 1 MHz are available for *frequency* parameter and the measurement is executed without an error message. However, Hewlett-Packard guarantees the accuracy of measurement data taken with only the following frequencies: 1 kHz, 10 kHz, 100 kHz, and 1 MHz.

See Also

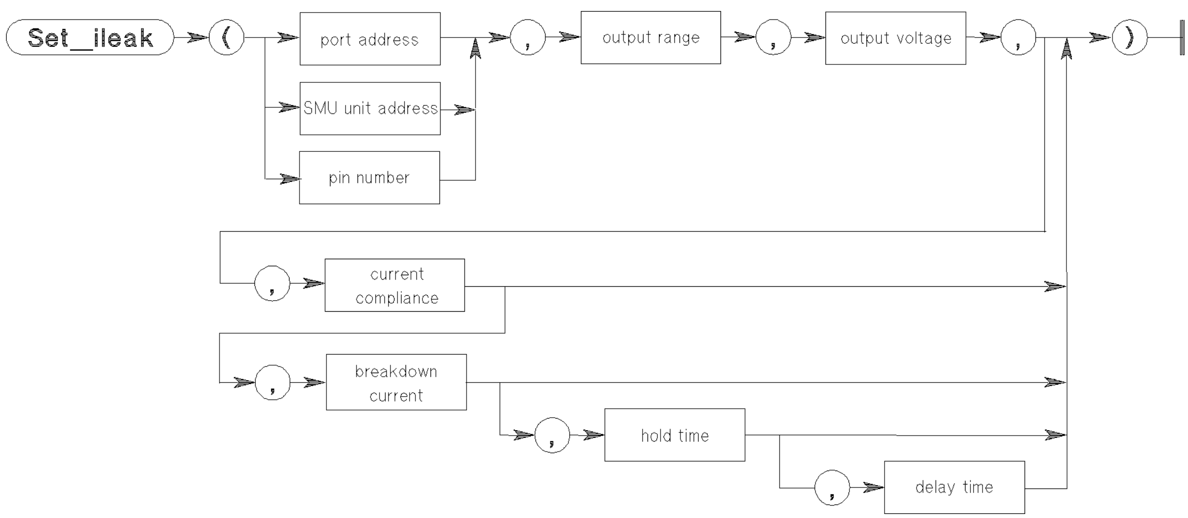
Frequency84

Set_ileak

Supported on	4062C, 4062UX, 4062PC
Revision	C.06.00 or later, X.06.00 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the quasi-pulsed measurement parameters for leakage current measurements.

Syntax



Set_ileak

Item	Description/Default	Range Restrictions
port address	integer expression	32701 to 32704, 32729[1], 32732[1]
SMU unit address	integer expression	32621 to 32628 (for HP 41421B 100 V/100 mA SMU) 32629 to 32632 (for HP 41420A 200 V/1 A SMU)
pin number	integer expression	1 to 96[2]
output range	numeric expression: [V]	−200 to 200[3]
output voltage	numeric expression: [V]	−200 to 200[3]
current compliance	numeric expression: [A]	−1 to 1[3]
	If SMU is in VS mode: default = last valid setting If SMU is in IS mode: default = 1E−4	

1 These port addresses are used for the AUX ports of the port expande r.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.

3 Actual *output range*, *output voltage*, *current compliance*, and *start voltage* range restrictions depend on the SMU and SMU port used.

Item	Description/Default	Range Restrictions
start voltage	numeric expression: [V] If SMU is in VS mode: default = last valid setting If SMU is in IS mode: default = 0	−200 to 200[1]
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01
delay time	numeric expression: [s] default = 0	0 to 6.5535 resolution: 0.0001

1 Actual *output range*, *output voltage*, *current compliance*, and *start voltage* range restrictions depend on the SMU and SMU port used.

Example Statements

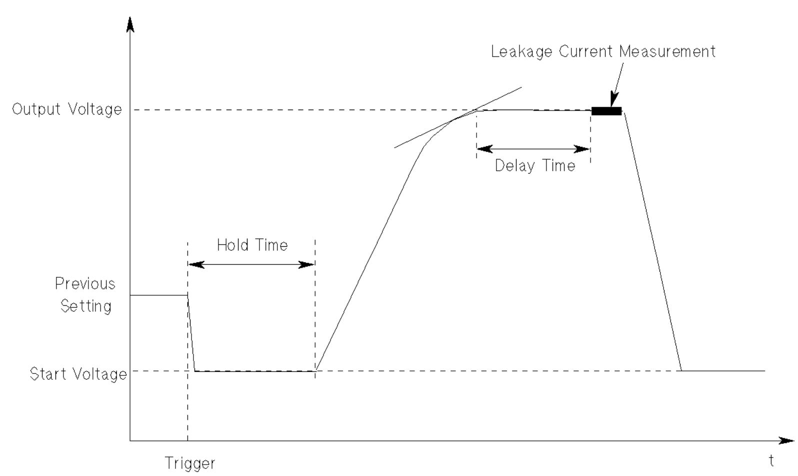
```
Set_ileak(FNSmu(2),0,35,100E-9,0)
Set_ileak(Pin12,100,60,1E-6,10,0.5,0.01)
Set_ileak(Port,Range,Volt,Icomp,Vstart,Hold,Delay)
```

Description

This subprogram sets the quasi-pulsed measurement conditions to measure leakage current. To start quasi-pulsed measurements, the Measure_ileak statements are used.

A quasi-pulse to the *output voltage* value is forced at a specified SMU and the forced voltage is monitored during a time interval. When the gradient of the voltage increase becomes less than half of the initial gradient of the voltage increase, the current value is measured at the SMU. After the measurement, the forced voltage is reset to the *start voltage*. The slew rate of the quasi-pulse is determined by capacitance on the DUT, cables, test fixtures, and so on.

The quasi-pulsed wave form for a leakage current measurement is shown in the following illustration. These measurements are useful when a high voltage is forced to a DUT and low leakage current is measured.



Port address, *SMU unit address*, or *pin number* can be used to specify the measurement port.

Output voltage, which corresponds to the *stop voltage* of the quasi-pulsed measurement, specifies the target voltage where the leakage current is measured.

Current compliance limits the current flow through the DUT. If this parameter is omitted, the previously set value is used if the SMU is a v oltage source. If this parameter is omitted and if the SMU is a current source, 100 μA is set.

Start voltage, which corresponds to the *start voltage* of the quasi-pulsed measurements, specifies the start voltage of the quasi-pulse. If this parameter is omitted, the previously set value is used when the SMU is a voltage source. If this parameter is omitted and if the SMU is a current source, 0 is set.

The *output voltage* must not be the same value as the *start value*, and the difference between these two voltages must be greater than or equal to 10 V.

Hold time takes a specified time before the output voltage starts from the *start voltage*. The default setting of this parameter is 0.

Delay time takes a specified time before the current value is measured at the SMU. The default setting of this parameter is 0.

For more information on quasi-pulsed measurements, see the *HP 4142B Operation Manual*.

See Also

Measure_ileak

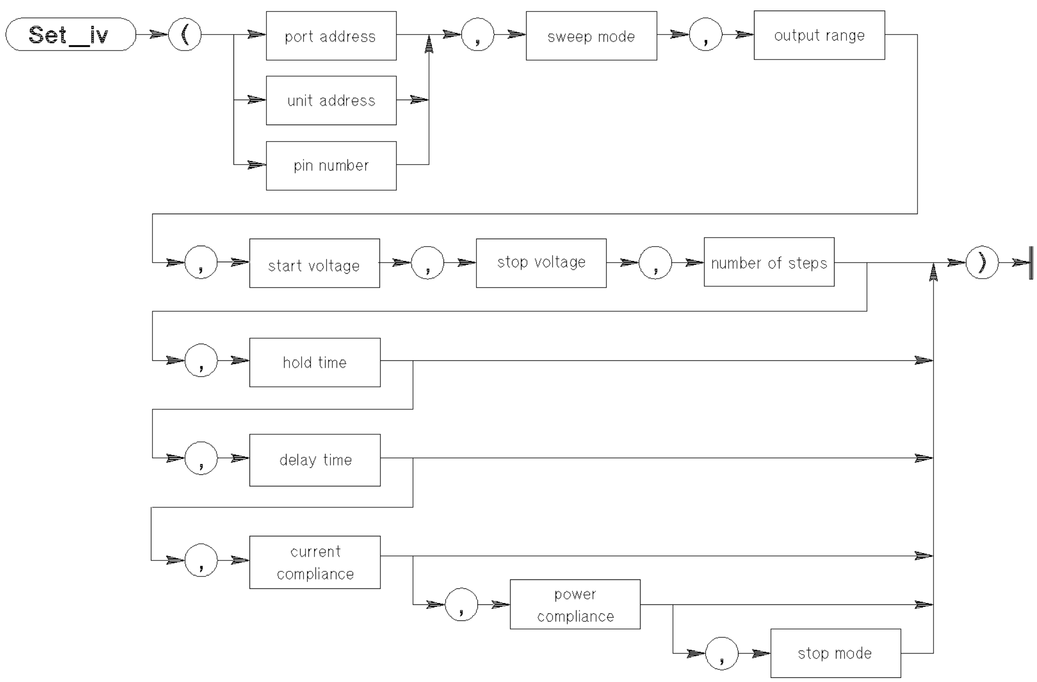
Set_iv

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the sweep parameters for I-V measurements.

Syntax

For SMU voltage sweep measurements:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	

Item	Description/Default	Range Restrictions	Recommended Range
sweep mode	integer expression	1: linear single sweep 3: linear double sweep −1: log single sweep −3: log double sweep	
output range	numeric expression: [V]	−200 to 200 [3]	0, 2, 20, 40, 100, 200
start voltage	numeric expression: [V]	−200 to 200 [3]	
stop voltage	numeric expression: [V]	−200 to 200 [3]	
number of steps	integer expression	2 to 1001	
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01	
delay time	numeric expression: [s] default = 0	0 to 65.535 resolution: 0.001	
current compliance	numeric expression: [A] If SMU is in VS mode: default = last valid setting or 1E−4 if the SMU is in IS mode.	−1 to 1 [3]	−1 to −1E−12, 1E−12 to 1
power compliance	numeric expression: [W]	0, 0.001 to 14 [4, 5] resolution: 0.001	
stop mode	integer expression default = 1	1, 2 [4]	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.

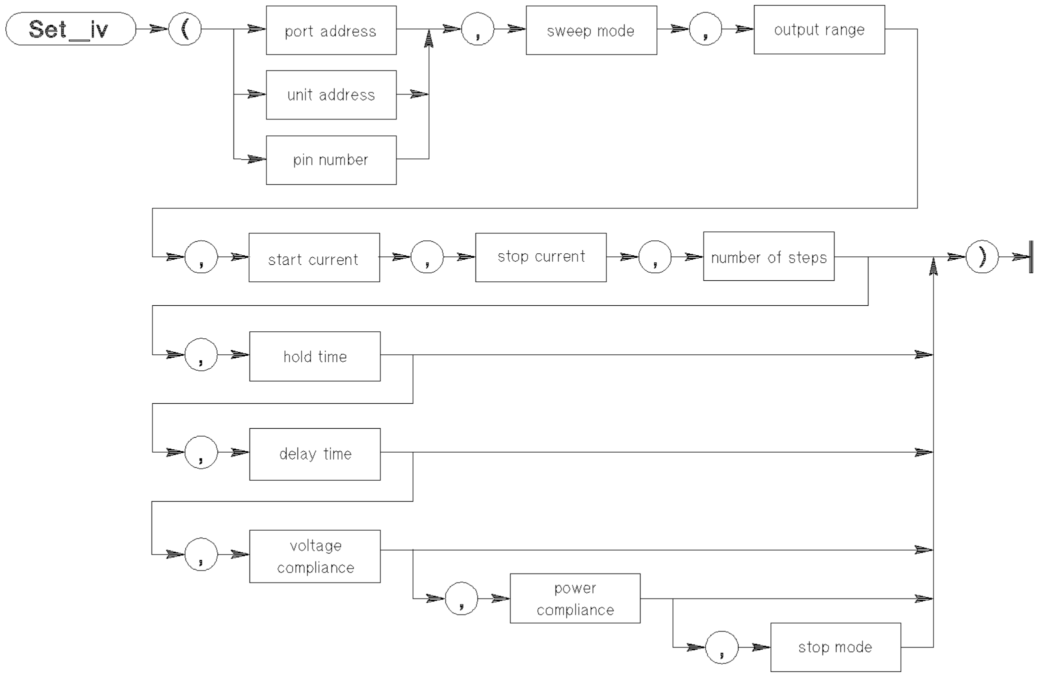
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.

3 Actual *output range*, *start voltage*, *stop voltage*, and *current compliance* range restrictions depend on the SMU and SMU port used. *Current compliance* depends on the set voltage range.

4 If you set *stop mode* to 2, set *power compliance* to 0.

5 You can set *power compliance* up to 14 W for the HP 41420A SMU connected to the SMU2 port only. For other SMUs, you can set *power compliance* up to 2 W.

For SMU current sweep measurements:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
sweep mode	integer expression	2: linear single sweep 4: linear double sweep −2: log single sweep −4: log double sweep	
output range	numeric expression: [A]	−1 to 1 [3]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
start current	numeric expression: [A]	−1 to 1 [3]	
stop current	numeric expression: [A]	−1 to 1 [3]	

Item	Description/Default	Range Restrictions	Recommended Range
number of steps	integer expression	2 to 1001	
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01	
delay time	numeric expression: [s] default = 0	0 to 65.535 resolution: 0.001	
voltage compliance	numeric expression: [V] If SMU is in IS mode: default = last valid setting or 20[4] if the SMU is in VS mode.	−200 to 200 [3]	
power compliance	numeric expression	0, 0.001 to 14 [5, 6] resolution: 0.001	
stop mode	integer expression default = 1	1, 2 [5]	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.

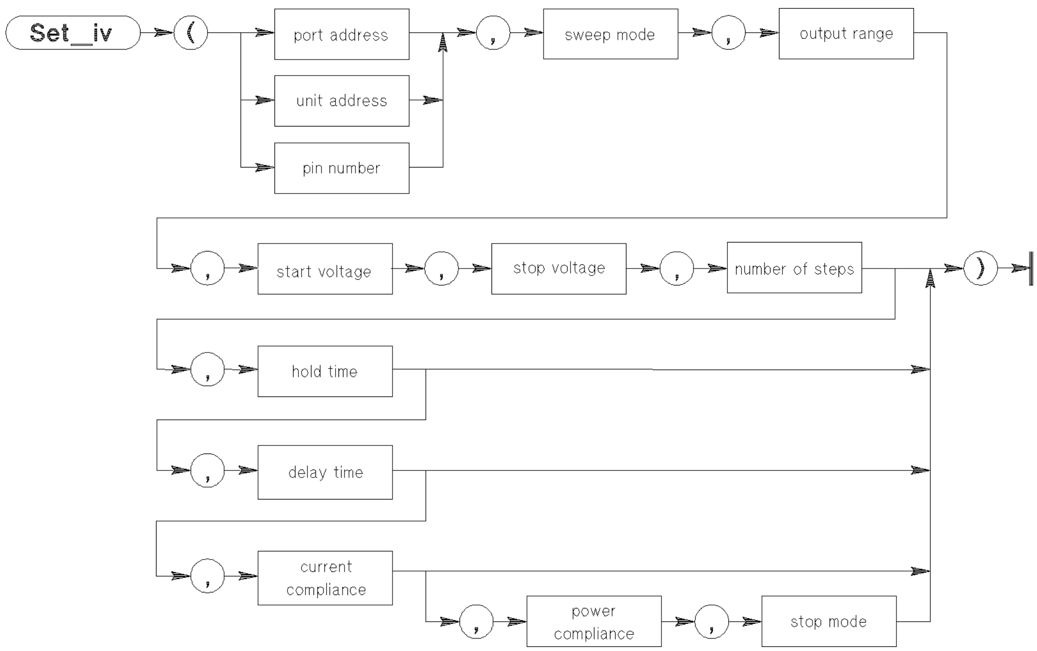
3 Actual *output range*, *start current*, *stop current*, and *voltage compliance* range restrictions depend on SMU and SMU port used. *Voltage compliance* depends on the selected *start current* and *stop current*.

4 If the absolute *start value* or *stop value* is larger than 100 mA, default value is set to 2 V.

5 If you set *stop mode* to 2, set *power compliance* to 0.

6 You can set *power compliance* up to 14 W for the HP 41420A SMU connected to SMU2 port only. For other SMUs, you can set *power compliance* up to 2 W.

For VS voltage sweep measurements:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32633, 32635, 32537, 32639, 32641, 32643, 32645, 32547, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	
pin number	integer expression	1 to 96 [2]	
sweep mode	integer expression	1: linear single sweep 3: linear double sweep −1: log single sweep −3: log double sweep	
output range	numeric expression	−40 to 40	0, 20, 40
start voltage	numeric expression: [V]	−40 to 40	
stop voltage	numeric expression: [V]	−40 to 40	

Item	Description/Default	Range Restrictions	Recommended Range
number of steps	integer expression	2 to 1001	
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01	
delay time	numeric expression: [s] default = 0	0 to 65.535 resolution: 0.001	
current compliance	numeric expression	[3]	
power compliance	numeric expression	[3]	
stop mode	integer expression default = 1	1, 2	

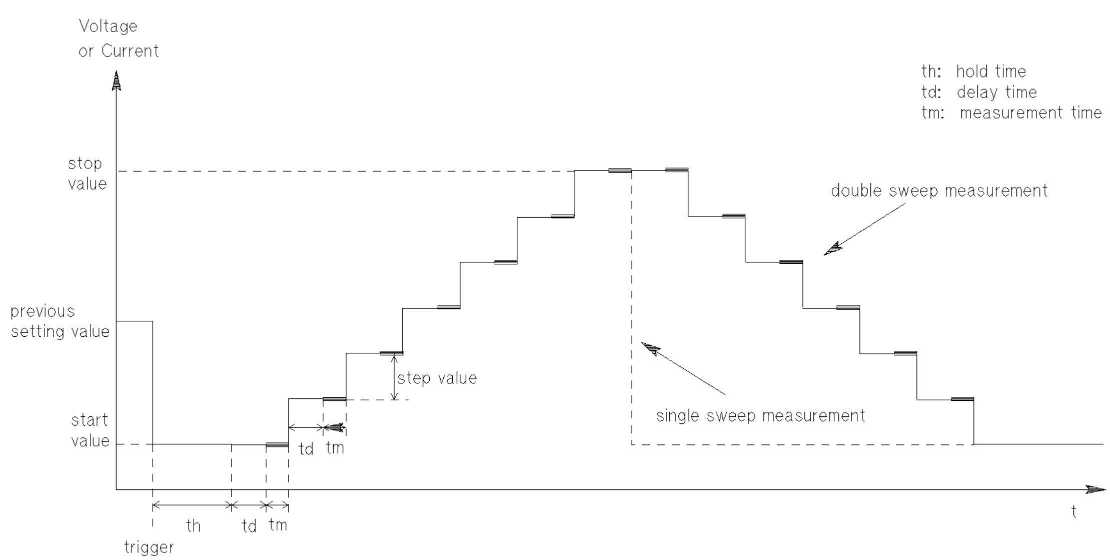
[1] 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VS port.
[3] These are dummy parameters.

Example Statements

```
Set_iv(FNPort(1),-2,0,1,E-9,1.E-5,51)
Set_iv(Port,Sweep_mode,Range,Start_val,Stop_val,Steps,Hold,Delay,Limit)
```

Description

When Sweep_iv executes, *start value* (voltage or current), *stop value*, *hold time*, and *delay time* determine the sweep measurement conditions, as shown in the following illustration.



The start, stop, and step values are determined by the rules in the following table.

In the linear sweep mode (*sweep mode* = 1 to 4)

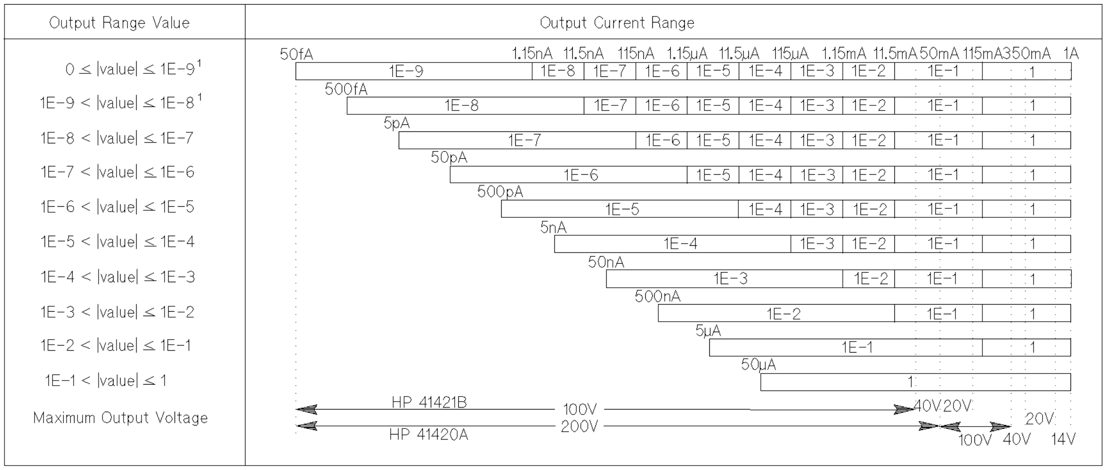
Item	Description
start value	resolution: depends on the set voltage or current range.
stop value [1]	stop value $=$ *start value* $+$ step value $\times$ (*number of steps* $-$ 1)
step value	step value $= \frac{stop\ value\ -\ start\ value}{number\ of\ steps\ -\ 1}$ resolution: depends on the set voltage or current range. maximum: *stop value* $-$ *start value*

In the log sweep mode (*sweep mode* = -1 to -4)

Item	Description
start value	resolution: depends on the set voltage or current range.
stop value [1]	stop value $=$ *start value* $\times 10^{\frac{\text{step ratio} \times (number\ of\ steps - 1)}{20}}$
step ratio	step ratio $= \frac{20 \times \log_{10} \frac{stop\ value}{start\ value}}{numbre\ of\ steps - 1}$ resolution: 0.02 dB/decade maximum: 20 dB/decade

[1] The actual stop value may be slightly different than the specified value. Refer to the Set_cv explanation for more details.

Either a *pin number*, *unit address*, or *port address* can be used to specify a port. A unit address can be used to specify a unit. In the *sweep mode*, a linear sweep or a logarithmic sweep is made depending on the polarity of the specified *sweep mode*. A single sweep is selected when the *sweep mode* is ± 1 or ± 2. A double sweep is selected when the *sweep mode* is ± 3 or ± 4. The current range is determined by the *output range* value, as shown in the following table.



[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E-8 (10 nA) because measurement value accuracy at ranges below the 1E-8 current range is guranteed only at the SMU1 port.

When the *sweep mode* is 2 or 4 (Linear), the current range during the sweep is set depending on the value of the *start current* or *stop current*, whichever is larger. If you set *output range* to 0 when the *sweep mode* is −2 or −4 (Log), the optimum current range is selected depending on the current value output during the sweep. If you set *output range* to a value other than 0, however, the current range covers a range lower than the specified range. Therefore, if the sweep covers more than four decades, set *output range* to 0.

The voltage range of an SMU set to the IS mode is determined by the voltage compliance. Also, a pulse that may reach voltage compliance can be output during the current range changing of an SMU, so do not set the voltage compliance to an unnecessarily large value.

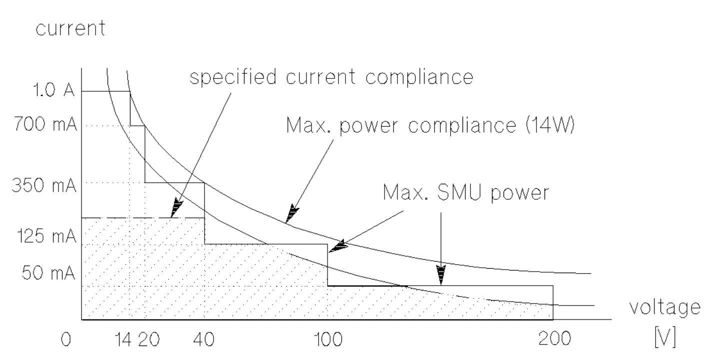
When the *sweep mode* is ±1 or ±3, the voltage range is set depending on the value of the *output range*. The maximum output voltage, voltage resolution, and current compliance range (maximum output current) depends on the set voltage range. (Current compliance cannot be set for VS.)

The ranges of start value and stop value depend on the unit. See the following table.

Unit	Output Range Value	Output Voltage Range	Maximum Output Current	
HP 41420A HP 41421B	0	The optimum range is selected depending on the value of the start voltage or stop voltage, whichever is larger.		
			HP 41420A	HP 41421B
	0 ≤ |value| ≤ 2	100 uV – 2 V (2)	1 A	100 mA
	2 < |value| ≤ 20	1m V – 20 V (20)	1 A (≤ 14 V) 7 00mA (> 14 V)	100 mA
	20 < |value| ≤ 40	2m V – 40 V (40)	350 mA	50 mA
	40 < |value| ≤ 100	5m V – 100 V (100)	125 mA	20 mA
HP 41420A	100 < |value| ≤ 200	10 mV – 200 V (200)	50 mA	
VS (HP 41424A)	0	The optimum range is selected depending on the value of the start voltage or stop voltage, whichever is larger.		
	0 < |value| ≤ 20	1 mV – 20 V (20)	100 mA	
	20 < |value| ≤ 40	2 mV – 40 V (40)	200 mA	

The ranges of current and voltage compliance depend on the output voltage or current range. Refer to Description for Force_v or Force_i for details. If you set *power compliance*, the compliance can be set up to the maximum value of the unit used, independent of the output voltage or current range.

Power compliance is the programmable output power limit of the SMU. Its function is to protect test devices against damage caused by excessive power. If *power compliance* is set, an SMU can output a voltage or current within the specified *power compliance* as shown in the following illustration.



Stop mode defines whether to continue or abort a voltage or current sweep if the output reaches the specified *voltage* or *current compliance* or current limit.

If you set *stop mode* to 1, voltage or current is swept to the last specified step, even if an SMU reaches *voltage* or *current compliance*.

If you set *stop mode* to 2, the voltage or current sweep aborts and returns dummy data (9999999.99999) if an SMU reaches *voltage* or *current compliance*.

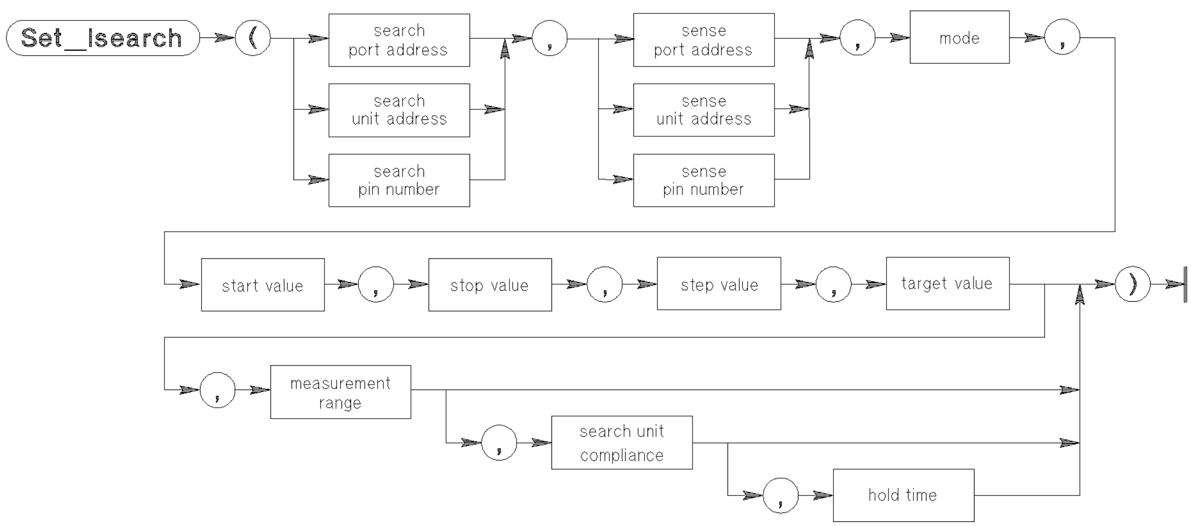
If you set *power compliance*, the sweep aborts and returns dummy data independent of the specified *stop mode* when an SMU reaches *power, voltage*, or *current compliance*.

Set_Isearch

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram sets the parameters for a linear search measurement.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
search port address	integer expression	32701 to 32706, 32708, 32709, 32721 to 32732 [1]	
search unit address	integer expression	32621 to 32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	
search pin number	integer expression	1 to 96 [2]	
sense port address	integer expression	32701 to 32706, 32708, 32709, 32721 to 32732 [1]	

Item	Description/Default	Range Restrictions	Recommended Range
sense unit address	integer expression	32621 to 32632, 32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
sense pin number	integer expression	1 to 96 [2]	
mode	integer expression	0 to 11	
start value	numeric expression		
	If search unit is SMU in VS mode: [V]	−200 to 200 [3]	
	If search unit is VS: [V]	−40 to 40	
	If search unit is SMU in IS mode: [A]	−1 to 1 [3]	
stop value	numeric expression		
	If search unit is SMU in VS mode: [V]	−200 to 200 [3]	
	If search unit is VS: [V]	−40 to 40	
	If search unit is SMU in IS mode: [A]	−1 to 1 [3]	
step value	numeric expression		
	If search unit is SMU in VS mode: [V]	0 to 200 [3]	
	If search unit is VS: [V]	0 to 40	
	If search unit is SMU in IS mode: [A]	0 to 1 [3]	

Item	Description/Default	Range Restrictions	Recommended Range
target value	numeric expression		
	If sense unit is SMU in VS mode: [A]	−1 to 1 [3]	
	If sense unit is VM: [V]	−40 to 40	
	If sense unit is SMU in IS mode: [V]	−200 to 200 [3]	
measurement range	numeric expression		
	If sense unit is SMU in VS mode: [A], default = target value	−1 to 1 [3]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
	If sense unit is VM: [V], default = target value	−40 to 40	0, 0.2, 2, 20 40
	If sense unit is SMU in IS mode: [V]	[4]	
search unit compliance	numeric expression		
	If search unit is SMU in VS mode: [A], default = last valid setting or 1E−4 if the SMU is in IS mode.	−1 to 1 [3]	
	If search unit is VS:	[4]	
	If search unit is SMU in IS mode: [V], default = last valid setting or 20[5] if the SMU is in VS mode.	−200 to 200 [3]	
hold time	numeric expression: [s] default = 0	0 to 6.5535	

1. 32721 to 32732 are used for the AUX ports of the port expander.
2. 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.
3. Actual *start value*, *stop value*, *step value*, *target value*, *measurement range*, and *search unit compliance* range restrictions depend on the SMU and the SMU port used.
4. These are dummy parameters.
5. If the absolute *start value* or *stop value* is larger than 100 mA, default value is set to 2 V.

Example Statements

```
Set_Isearch(FNSmu(1),FNSmu(2),0,0,10,.1,1.E-6,1.E-8,1.E-5,0)
Set_Isearch(Emitter,Emitter,Mode,Start,Stop,Step,Target)
```

Description

The *mode* parameter determines the following conditions.

Mode	Search Unit VS/IS Mode	Normal/Reset Mode	Stop Mode	Measurement/ Loop Status Mode
0	VS	Normal	> target	Measurement
1	IS	Normal	> target	Measurement
2	VS	Reset	> target	Measurement
3	IS	Reset	> target	Measurement
4	VS	Normal	< target	Measurement
5	IS	Normal	< target	Measurement
6	VS	Reset	< target	Measurement
7	IS	Reset	< target	Measurement
8	VS	Normal	> target	Loop status
9	IS	Normal	> target	Loop status
10	VS	Reset	> target	Loop status
11	IS	Reset	> target	Loop status

Note

Set the sense unit to VS mode if you set the *mode* parameter to 8 through 11.

Normal and Reset Modes:

In the Normal mode, the output of the search unit increments or decrements directly to the next value.

The Reset mode resets the output of the search unit to the start value, waits a delay time equal to the hold time, then increments or decrements to the next value.

Stop Mode:

Terminates a search when the sense value is greater than or less than the *target value*, as determined by the *mode* setting.

Measurement/Loop Status Mode:

The Measurement or Loop Status is determined by whether or not the sense value has reached the *target value*. The measurement status mode compares the measurement data with the target value and stops the measurement when the target value is greater than or equal to the measurement value. The loop status mode compares the target value with compliance and when the two values equal, the measurement stops.

The *start value* can be less or greater than the *stop value* but they cannot be equal. The *step value* must be positive. If the *start value* is less than the *stop value*, the *step value* is added to the *start value* at each iteration. If the *start value* is greater than the *stop value*, the *step value* is subtracted at each iteration.

The output range of the search unit is set to the greater absolute *start value* or *stop value*. Refer to Force_v or Force_i for output value, range, and compliance relationships.

The *measurement range* should be greater than the *target value*. If the *measurement range* is omitted or is less than the *target value*, the *measurement range* is set to the *target value*.

If you wish to set a compliance for the sense unit, execute a Force_v or Force_i subprogram to set the compliance of the sense unit before you execute a Set_lsearch.

The output of the sense unit is set to the *start value* after a feedback measurement executes.

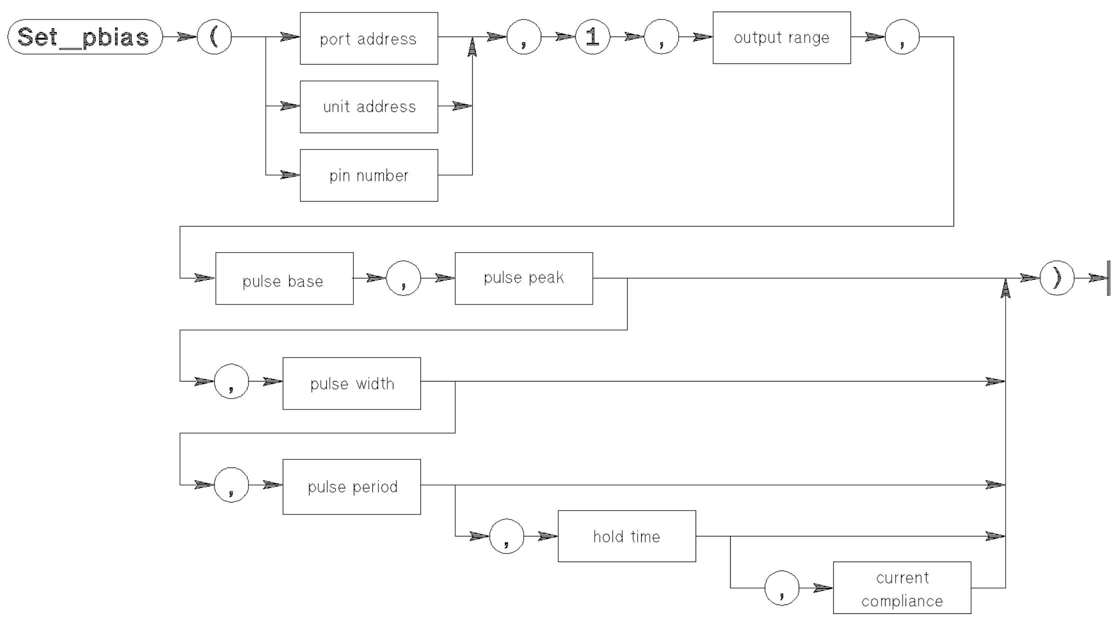
Set_pbias

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the parameters for a pulsed spot measurement or a sweep measurement with pulsed bias using Measure_p and Sweep_iv, respectively.

Syntax

When using an SMU as a voltage pulse source:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
output range	numeric expression: [V]	−200 to 200 [3]	0, 2, 20, 40, 100, 200
pulse base	numeric expression: [V]	−200 to 200 [3]	
pulse peak	numeric expression: [V]	−200 to 200 [3]	
pulse width	numeric expression: [s] default = 0.005	0.001 to 0.05 [4] resolution: 1E-4	

Set_pbias

Item	Description/Default	Range Restrictions	Recommended Range
pulse period	numeric expression: [s] default = 0.2	0, 0.01 to 0.5 [4, 5] resolution: 1E-4	
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01	
current compliance	numeric expression: [A] default = last setting valid or 1E-4 if the SMU is in IS mode	−1 to 1 [3]	−1 to −2E−9, 2E−9 to 1

[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.

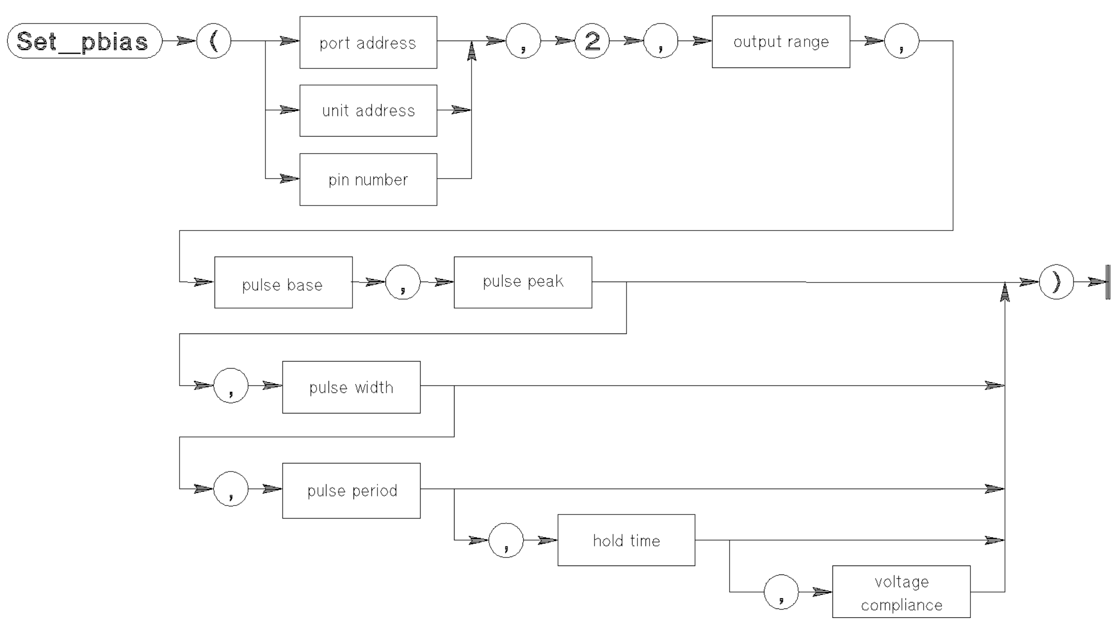
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.

[3] Actual range restriction of this value depends on the unit used. The values of *pulse base, pulse peak*, and *current compliance* depend on the specified voltage range.

[4] The *pulse width* must be less than 50% of the *pulse period*.

[5] If the *pulse period* is set to "0", the pulse period is not set.

When using an SMU as a current pulse source:

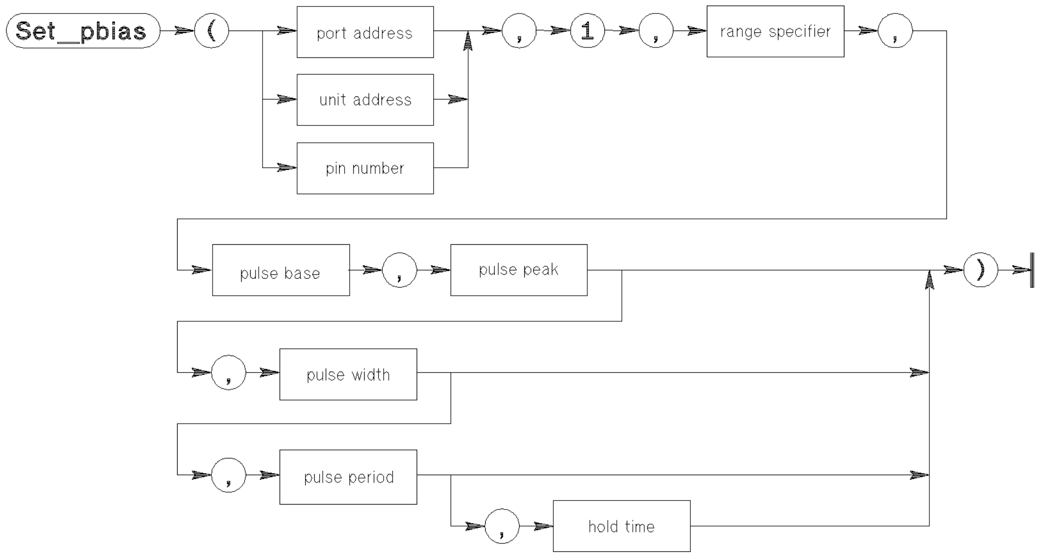


Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
output range	numeric expression: [A]	−1 to 1 [3]	0, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
pulse base	numeric expression: [A]	−1 to 1 [3, 4]	
pulse peak	numeric expression: [A]	−1 to 1 [3, 4]	
pulse width	numeric expression: [s] default = 0.005	0.001 to 0.05 [5] resolution: 1E−4	
pulse period	numeric expression: [s] default = 0.2	0, 0.01 to 0.5 [5, 6] resolution: 1E−4	
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01	
voltage compliance	numeric expression: [V] default = last setting valid or 20[7] if the SMU is in VS mode	−200 to 200 [3]	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.
3 Actual range restrictions of these values depend on the unit used. The values of *pulse base, pulse peak*, and *voltage compliance* depend on the specified current range.
4 *Pulse peak* must be the same polarity as the specified *pulse base*.
5 *Pulse width* must be less than 50 % of *pulse period*.
6 If *pulse period* is set to “0”, a pulse period is not set.
7 If *pulse base* or *pulse peak* is larger than ±100 mA, default value is set to 2 V

Set_pbias

When using a VS as a voltage pulse source:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	
pin number	integer expression	1 to 96 [2]	
output range	numeric expression: [V]	−40 to 40	0, 20, 40
pulse base	numeric expression: [V]	−40 to 40	
pulse peak	numeric expression: [V]	−40 to 40	
pulse width	numeric expression: [s] default = 0.005	0.001 to 0.05 [3] resolution: 1E−4	
pulse period	numeric expression: [s] default = 0.2	0, 0.01 to 0.5 [3, 4] resolution: 1E−4	
hold time	numeric expression: [s] defaults = 0	0 to 655.35 resolution: 0.01	

[1] 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VS port.

3 *Pulse width* must be less than 50% of *pulse period*.

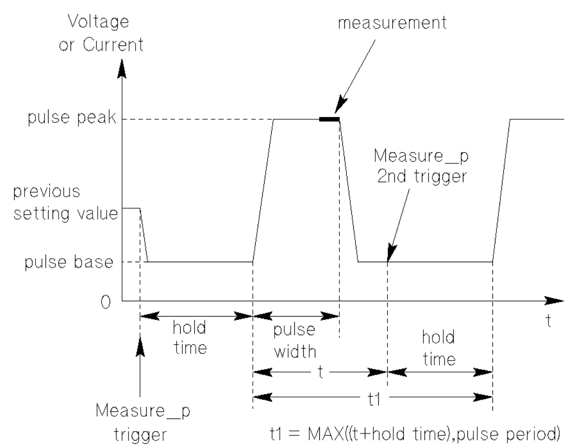
4 If *pulse period* is set to "0", a pulse period is not set.

Example Statements

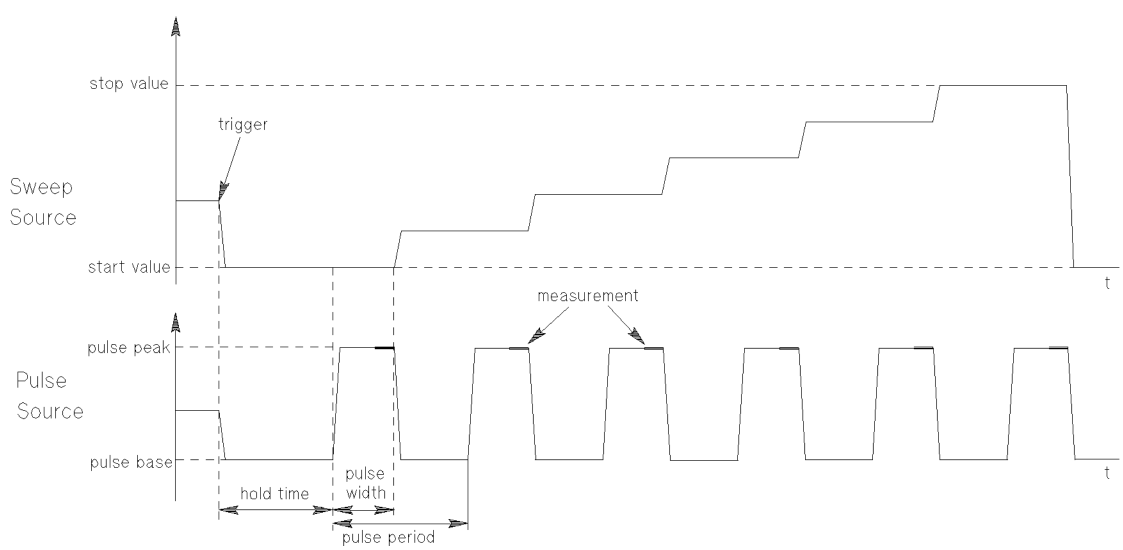
```
Set_pbias(FNSmu(2),1,40,20,30,1E-3,2E-2,0.1,1E-3)
Set_pbias(Address,Mode,Range,Base,Peak,Width,Period,Hold,Compliance)
```

Description

Pulse base, *pulse peak*, *pulse width*, *pulse period*, and *hold time* determine pulsed spot measurement and sweep measurement with pulsed bias conditions as shown in the following illustration:

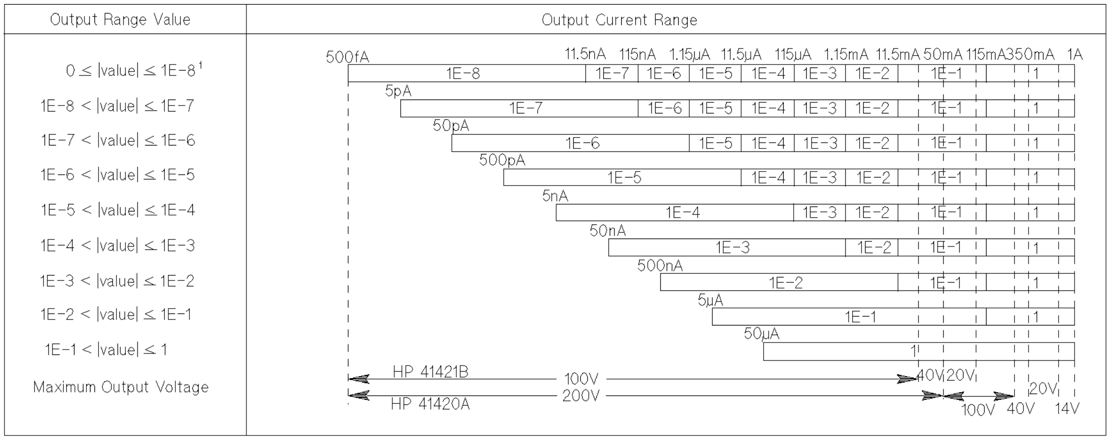


Pulsed Spot Measurements



Sweep with Pulsed Bias Measurements

The sweep source is synchronized with the pulsed bias and ignores the hold time and delay time settings of Set_iv. Either a *pin number*, *unit address*, or *port address* can be used to specify a port. The current range is determined by the *output range* value, as shown in the following table.



[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

If the specified voltage compliance is larger than 2 V, only current ranges greater than 100 μA can be set. If the specified current range can not output the *pulse base* or *pulse peak* value, the current range is set to the lowest range that can output the *pulse base* or *pulse peak* value.

The voltage range is determined by the *output range* value, as shown in the following table. The maximum output voltage, voltage resolution, and current compliance range (maximum output current) depend on the set voltage range. (Current compliance can not be set for VS.)

Unit	Output Range Value	Output Voltage Range	Maximum Output Current	
HP 41420A, HP 41421B	0	The optimum range is selected depending on the value of the start voltage or stop voltage, whichever is larger.		
			HP 41420A	HP 41421B
	0 ≤ $\lvert value\rvert$ ≤ 2	100 uV – 2 V (2)	1 A	100 mA
	2 < $\lvert value\rvert$ ≤ 20	1m V – 20 V (20)	1 A (≤ 14 V) 7 00mA (> 14 V)	100 mA
	20 < $\lvert value\rvert$ ≤ 40	2m V – 40 V (40)	350 mA	50 mA
	40 < $\lvert value\rvert$ ≤ 100	5m V – 100 V (100)	125 mA	20 mA
HP 41420A	100 < $\lvert value\rvert$ ≤ 200	10 mV – 200 V (200)	50 mA	
VS (HP 41424A)	0	The optimum range is selected depending on the value of the start voltage or stop voltage, whichever is larger.		
	0 < $\lvert value\rvert$ ≤ 20	1 mV – 20 V (20)	100 mA	
	20 < $\lvert value\rvert$ ≤ 40	2 mV – 40 V (40)	200 mA	

During a pulsed measurement, the DCS obtains a measurement result after each A/D conversion, and SMU filters are set to OFF, ignoring the settings of Set_smu.

For pulsed spot measurements, execute a Measure_p subprogram after you execute a Set_pbias subprogram.

For sweep measurements with pulsed bias, execute a Sweep_iv subprogram after you execute the Set_pbias and Set_iv subprograms. The sweep source must be set to the linear sweep mode, and you cannot set *power compliance*.

If the following subprograms are executed for the specified unit after Set_pbias executes, the Set_pbias settings are lost. Accordingly, these subprograms must be executed to perform other sweep measurements after you perform a sweep measurement with pulsed bias.

Disable_port
Init_system
Set_iv

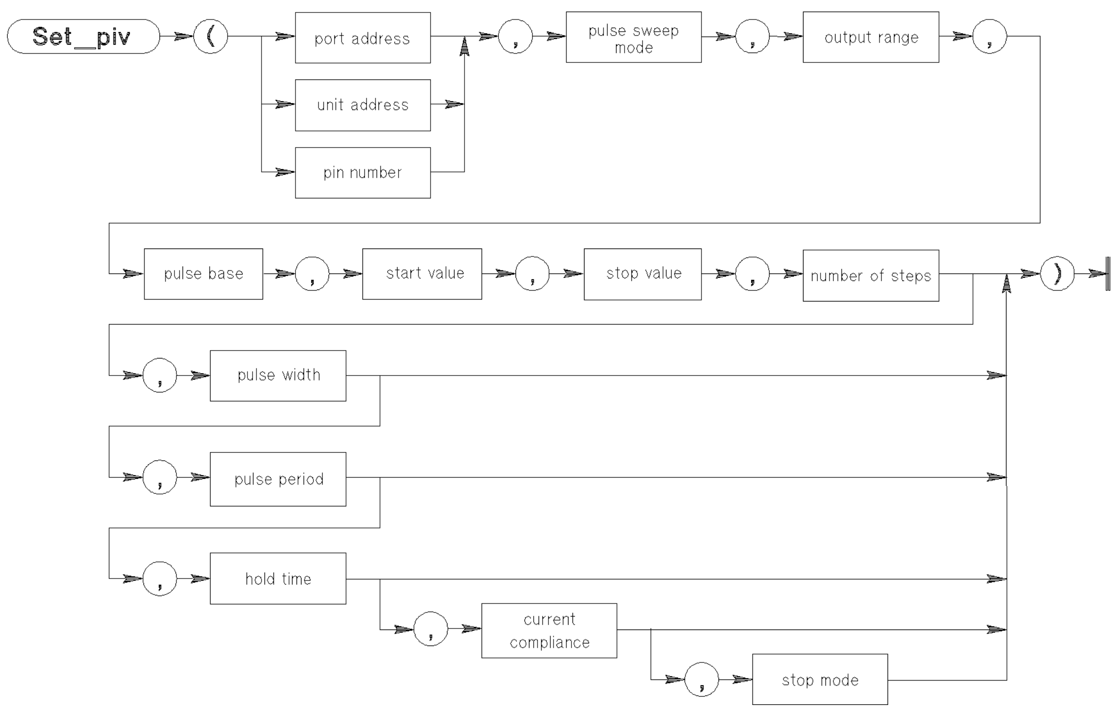
Set_piv

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram sets the parameters for SMU and VS pulsed sweep measurements. To execute pulsed sweep measurements, use the Sweep_iv subprogram.

Syntax

When using an SMU as a voltage pulse source:

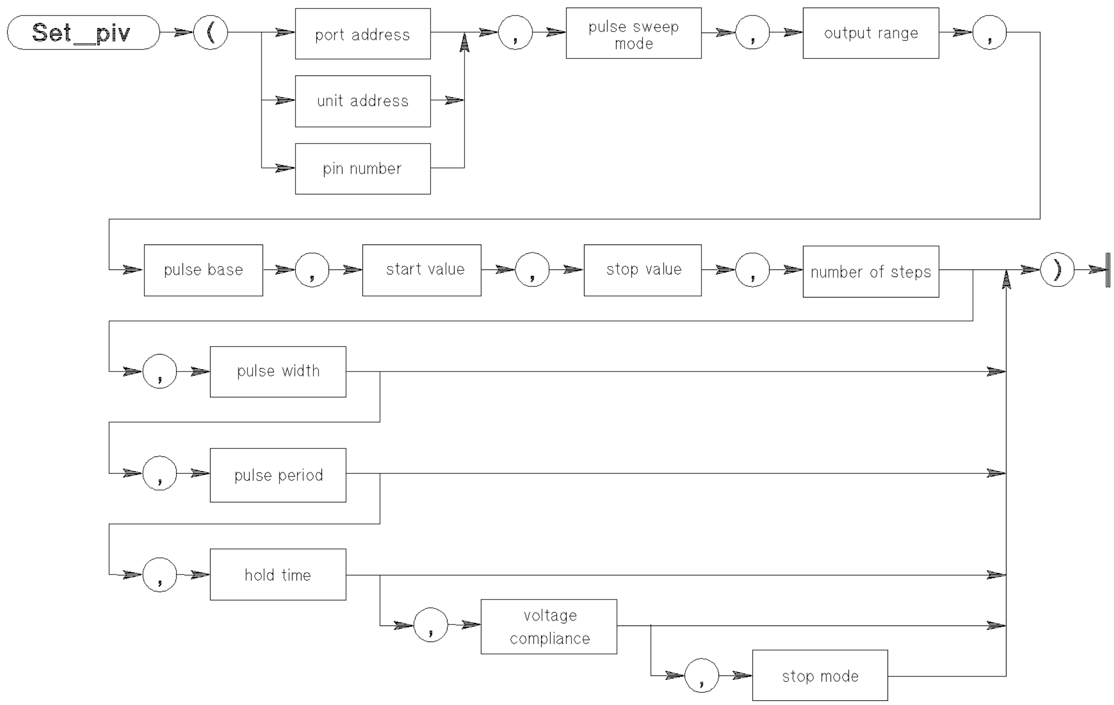


Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
pulse sweep mode	integer expression	1: single sweep mode 2: double sweep mode	

Item	Description/Default	Range Restrictions	Recommended Range
output range	numeric expression: [V]	−200 to 200 [3]	0, 2, 20, 40, 100, 200
pulse base	numeric expression: [V]	−200 to 200 [3]	
start value	numeric expression: [V]	−200 to 200 [3]	
stop value	numeric expression: [V]	−200 to 200 [3]	
number of steps	integer expression	2 to 1001	
pulse width	numeric expression: [s] defaults = 0.005	0.001 to 0.05 [4] resolution: 1E−4	
pulse period	numeric expression: [s] defaults = 0.2	0.01 to 0.5 [4] resolution: 1E−4	
hold time	numeric expression: [s] defaults = 0	0 to 655.35 resolution: 0.01	
current compliance	numeric expression: [A] default = last valid setting or 1E−4 if the SMU is in IS mode.	−1 to 1 [3]	−1 to −2E−9, 2E−9 to 1
stop mode	integer expression defaults = 1	1 or 2	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.
3 Actual range restrictions of these values depend on the unit used. The values of *pulse base, start value, stop value*, and *current compliance* depend on the specified voltage range.
4 *Pulse width* must be less than 50% of *pulse period*.

When using an SMU as a current pulse source:

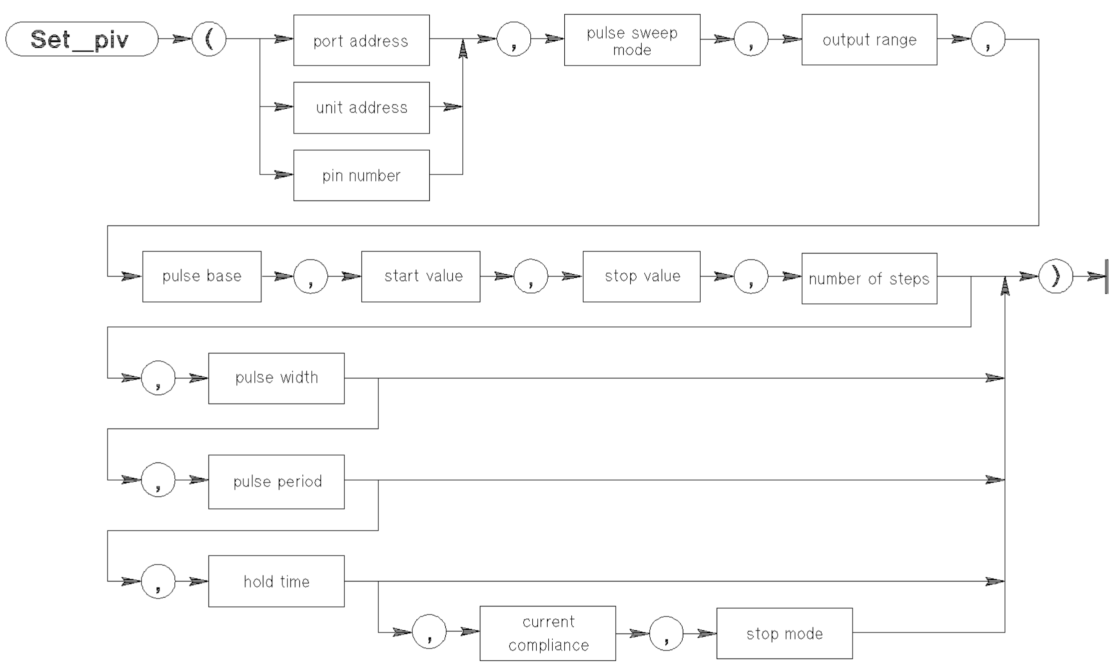


Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
pulse sweep mode	integer expression	2: single sweep mode 4: double sweep mode	
output range	numeric expression: [A]	−1 to 1 [3]	0, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
pulse base	numeric expression: [A]	−1 to 1 [3, 4]	
start value	numeric expression: [A]	−1 to 1 [3, 4]	
stop value	numeric expression: [A]	−1 to 1 [3, 4]	
number of steps	integer expression	2 to 1001	
pulse width	numeric expression: [s] defaults = 0.005	0.001 to 0.05 [5] resolution: 1E−4	

Item	Description/Default	Range Restrictions	Recommended Range
pulse period	numeric expression: [s] defaults = 0.2	0.01 to 0.5 [5] 1E−4	
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01	
voltage compliance	numeric expression: [V] default = last valid setting or 20 [6] if the SMU is in VS mode.	−200 to 200 [3]	
stop mode	integer expression default = 1	1 or 2	

[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.
[3] Actual range restrictions of these values depend on the unit used. The values of *pulse base, start value, stop value*, and *voltage compliance* depend on the specified current range.
[4] *Pulse peak* must be the same polarity as the specified *pulse base*.
[5] *Pulse width* must be less than 50% of *pulse period*.
[6] If *pulse base*, *start value*, or *stop value* is larger than ±100 mA, the default value is set to 2 V.

When using a VS as a voltage pulse source:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32645, 32657, 32659, 32661, 32663	
pin number	integer expression	1 to 96 [2]	
pulse sweep mode	integer expression	1: single sweep mode 3: double sweep mode	
output range	numeric expression: [V]	−40 to 40	0, 20, 40
pulse base	numeric expression: [V]	−40 to 40	
start value	numeric expression: [V]	−40 to 40	
stop value	numeric expression: [V]	−40 to 40	
number of steps	integer expression	2 to 1001	
pulse width	numeric expression: [s] default = 0.005	0.001 to 0.05 [3] resolution: 1E−4	
pulse period	numeric expression: [s] default = 0.2	0.01 to 0.5 [3] resolution: 1E−4	
hold time	numeric expression: [s] default = 0	0 to 655.35 resolution: 0.01	
current compliance	numeric expression:	[4]	
stop mode	integer expression default = 1	1 or 2	

1 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VS port.

3 *Pulse width* must be less than 50% of pulse period.

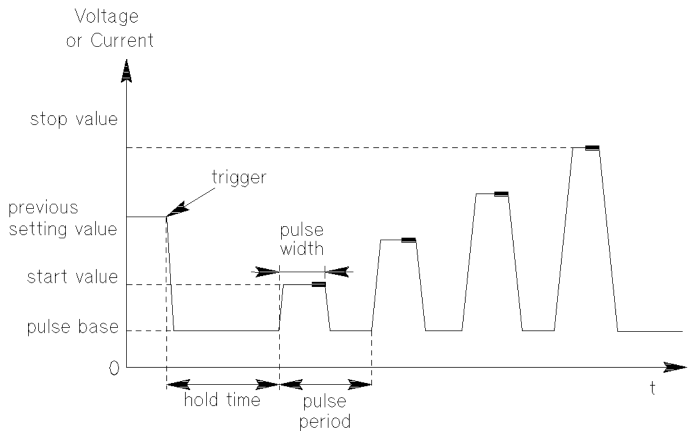
4 This is a dummy parameter.

Example Statements

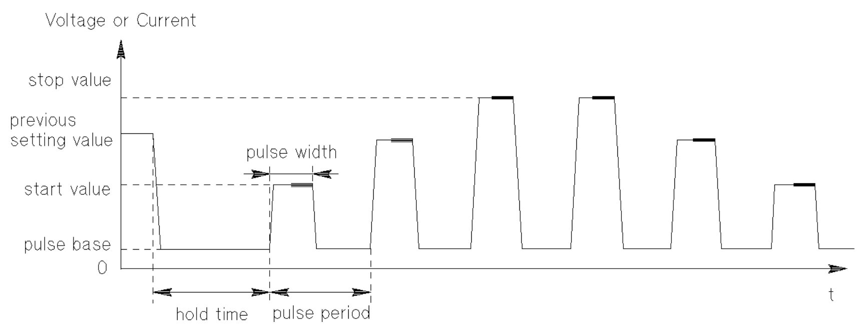
```
Set_piv(FNSmu(1),2,0,0,1E-4,1E-2,40)
Set_piv(FNSmu(2),Mode,Rng,Pbas,Pst,Pstp,Stp,Pwid,Period,Htime,Comp,Smode)
```

Description

When Sweep_piv executes, *pulse base*, *start value*, *stop value*, *pulse width*, *pulse period*, and *hold time* determine the pulsed sweep measurement conditions as shown in the following illustrations.



Single Pulsed Sweep (pulse sweep mode = 1 or 2)



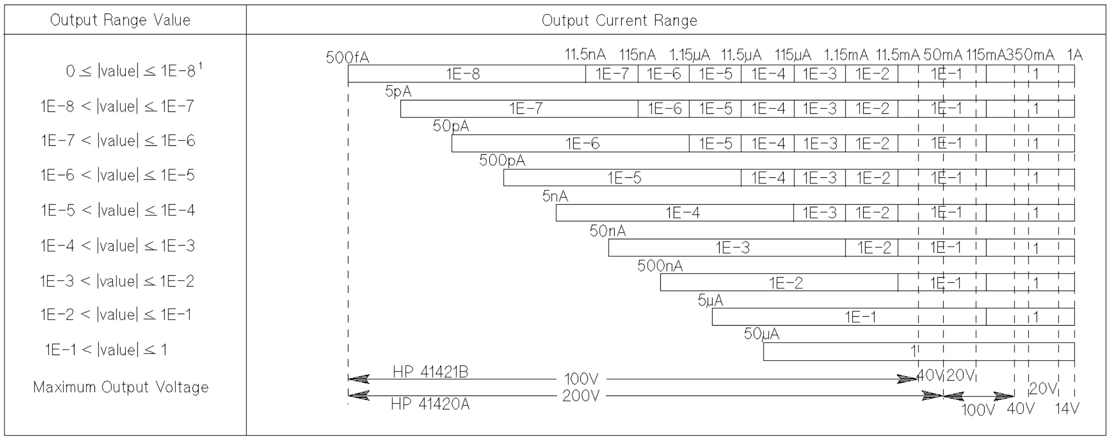
Double Pulsed Sweep (pulse sweep mode = 3 or 4)

Item	Description
start value	resolution: depends on the set voltage or current range
stop value [1]	stop value = *start value* + step value × (*number of steps* − 1)
step value	step value = $\frac{stop\ value\ -\ start\ value}{number\ of\ steps\ -\ 1}$

[1] The actual stop value may be slightly different than the specified value. Refer to the Set_cv explanation for more details.

Either a *pin number*, *unit address*, or *port address* can be used to specify a port. A single pulsed sweep is selected when the *pulse sweep mode* is 1 or 2. A double pulsed sweep is selected when the *pulse sweep mode* is 3 or 4.

The current range is determined by the *output range* value, as shown in the following table.



[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

If the *pulse sweep mode* is 2 or 4, the current range during a pulsed sweep is set depending on the value of the pulse base current, start current or stop current, whichever is largest. If the specified *voltage compliance* is larger than 2 V, only current ranges greater than 100 μA can be set.

The voltage range of an SMU set to the IS mode is determined by the *voltage compliance*. Also, a pulse may be output during an current range changing of an SMU that may reach voltage compliance, so do not set *voltage compliance* to an unnecessarily large value.

If the *pulse sweep mode* is 1 or 3, the voltage range is set depending on the value of the *output range*. The maximum output voltage, voltage resolution, and current compliance range (maximum output current) depends on the set voltage range. (Current compliance cannot be set for VS.)

The ranges of *start value* and *stop value*, depending on the unit used, are shown in the following table. The ranges of *current compliance* and *voltage compliance* depend on the output voltage or current range.

Unit	Output Range Value	Output Voltage Range	Maximum Output Current	
HP 41420A HP 41421B	0	The optimum range is selected depending on the value of the start voltage or stop voltage, whichever is larger.		
			HP 41420A	HP 41421B
	$0 \le \lvert value \rvert \le 2$	100 uV [2] 2 V	1 A	100 mA
	$2 < \lvert value \rvert \le 20$	1m V [20] 20 V	1 A ($\le$ 14 V) 700mA ($>$ 14 V)	100 mA
	$20 < \lvert value \rvert \le 40$	2m V [40] 40 V	350 mA	50 mA
	$40 < \lvert value \rvert \le 100$	5m V [100] 100 V	125 mA	20 mA
HP 41420A	$100 < \lvert value \rvert \le 200$	10 mV [200] 200 V	50 mA	
VS (HP 41424A)	0	The optimum range is selected depending on the value of the start voltage or stop voltage, whichever is larger.		
	$0 < \lvert value \rvert \le 20$	1 mV [20] 20 V	100 mA	
	$20 < \lvert value \rvert \le 40$	2 mV [40] 40 V	200 mA	

Stop mode defines whether to continue or abort a pulsed voltage or current sweep if the output reaches the specified *voltage* or *current compliance* or current limit.

If you set *stop mode* to 1, pulsed voltage or current is swept to the last specified step, even if an SMU reaches *voltage* or *current compliance*.

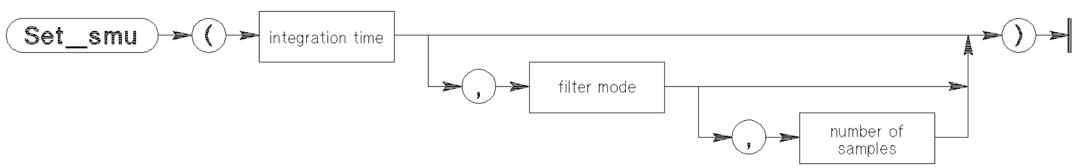
If you set *stop mode* to 2, the pulsed voltage or current sweep aborts and returns dummy data (9999999.99999) if an SMU reaches *voltage* or *current compliance*.

Set_smu

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the measurement integration time for the SMUs, VSs, and VMs of the DCS.

Syntax



Item	Description/Default	Range Restrictions
integration time	integer expression	0: MANUAL 1: SHORT 2: MEDIUM 3: LONG
filter mode	integer expression default = 1	0: Filter OFF 1: Filter ON
number of samples	integer expression default = 1	1 to 1023 [1]

[1] This parameter is ignored when the *integration time* parameter is set to 1 through 3.

Example Statements

```
Set_smu(2)
Set_smu(Integ_time,Filter_mode,Manual_mode)
```

Description

To reduce measurement errors caused by line frequency noise or any other environmental noise source, the DCS takes a number of measurement samples and averages them to obtain measurement data. The number of measurement samples taken during each measurement is determined by the set integration time. Refer to the following table.

Integration Time	Description
0 MANUAL	Measurement results are the average of the number of samples specified by the *number of samples* parameter.
1 SHORT	Measurement results are the average of the number of samples required to satisfy the specification of DCS. The number of samples depends on the voltage and current range. The maximum number of samples is 25.
2 MEDIUM	Measurement results are the average of 32 samples taken during 1 line frequency period.
3 LONG	Measurement results are the average of 512 samples taken during 16 line frequency periods.

The initial integration time setting is SHORT.

If a filter of an SMU is set to ON, the filter reduces overshoot voltage or current in the output of the SMU. If a filter of the SMU is set to OFF, the SMU may generate an overshoot voltage or current, but higher speed measurements can be performed.

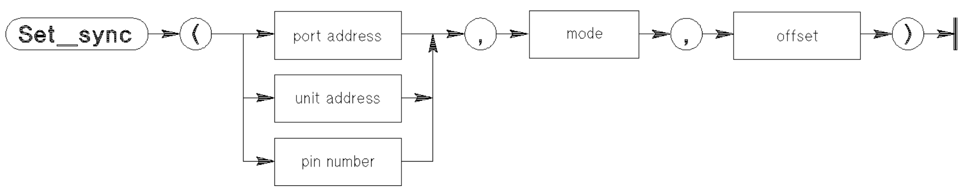
Set_sync

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later (for sweep), C.05.05 or later (for b/l search), X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram sets the synchronous port for performing synchronous search and synchronous staircase sweep measurements.

For synchronous search measurements:

Syntax



Item	Description/Default	Range Restrictions
port address	integer expression	32701 to 32706, 32708, 32709, 32721 to 32732 [1]
unit address	integer expression	32621 to 32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663
pin number	integer expression	1 to 96 [2]
mode	integer expression	0, 1
offset	numeric expression	
	If synchronous search port is SMU in VS mode: [V]	−400 to 400 [3]
	If synchronous search port is VS: [V]	−80 to 80 [3]
	If synchronous search port is SMU in IS mode: [A]	−2 to 2 [3]

1 32721 to 32732 are used for the AUX ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired port.
3 Depending on search range set by Set_bsearch or Set_lsearch.

Example Statements

```
Set_sync(FNSmu(1),0,-1)
Set_sync(Substrate,Mode,Offset)
```

Description

This subprogram, used in conjunction with Set_bsearch and Set_lsearch, sets the control parameters for the synchronous search port (SMU or VS).

The output mode of the synchronous search port is automatically set to the same output mode (VS or IS) as the search port of Set_bsearch or Set_lsearch subprogram.

Either the *port address, unit address*, or *pin number* of any measurement pin connected to the port can be used to specify the synchronous search port.

The *mode* and *offset* parameters set the output of the synchronous search port, as follows:

Mode = 0:

Synchronous search port output = *offset* + search port output

Mode = 1:

Synchronous search port output = *offset* − search port output

The output range of the synchronous search port is the same range as the search port. When the synchronous search port is a VS, the output range of the search port must be set to 20 V or 40 V.

The following conditions must be satisfied:

For Set_bsearch:

S = MAX(| *minimum search value* |, | *maximum search value* |) + | *offset* |

For Set_lsearch:

S = MAX(| *start value* |, | *stop value* |) + | *offset* |

In VS mode

S [V]	|Compliance| [mA]	
	HP 41420A	HP 41421B
$0 < \mid S \mid \leq 2$	< 1000	< 100
$2 < \mid S \mid \leq 20$	< 700	< 100
$20 < \mid S \mid \leq 40$	< 350	< 50
$40 < \mid S \mid \leq 100$	< 125	< 20
$100 < \mid S \mid \leq 200$	< 50	—

In IS mode

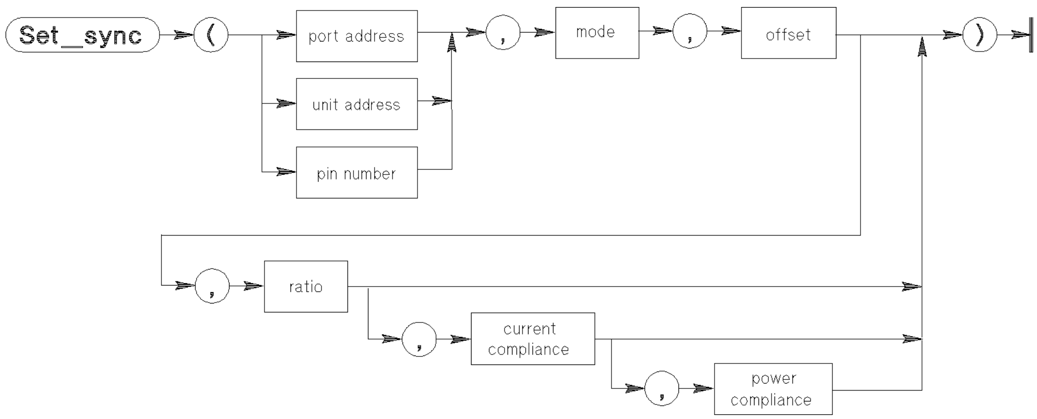
S [mA]	|Compliance| [V]	
	HP 41420A	HP 41421B
0 < | S | ≤ 20	< 200	< 100
20 < | S | ≤ 50	< 200	< 40
50 < | S | ≤ 100	< 100	< 20
100 < | S | ≤ 125	< 100	—
125 < | S | ≤ 350	< 40	—
350 < | S | ≤ 700	< 20	—
700 < | S | ≤ 1000	< 14	—

where compliance is the same as before this subprogram executed.

For Synchronous Staircase Sweep Measurements:

Syntax

For SMU voltage measurements:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
mode	integer expression	0, 1	
offset	numeric expression: [V]	−400 to 400 [3]	
ratio	numeric expression	0.01 to 10 resolution: 0.01	
current compliance	numeric expression: [A] default = last valid setting or 1E−4 if the SMU is in IS mode.	−1 to 1	−1 to −1E−12, 1E−12 to 1
power compliance	numeric expression: [W]	0.001 to 14 [4] resolution: 0.001	

[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.

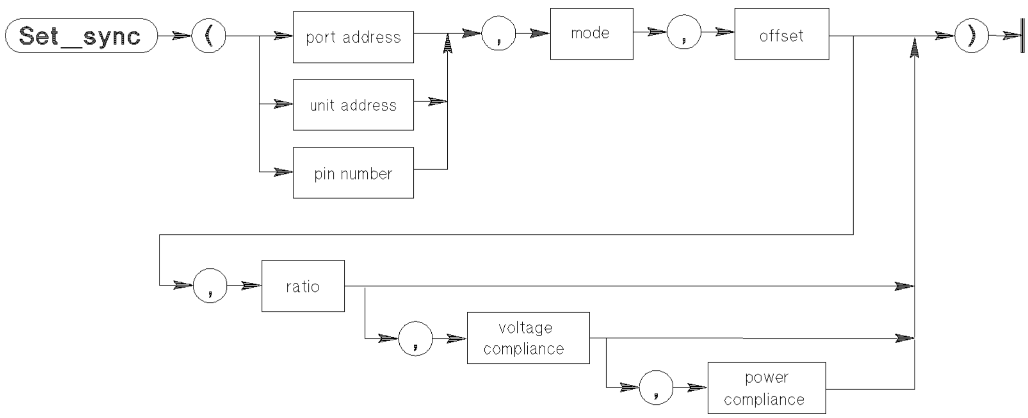
[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.

[3] Actual *offset* value restriction depends on the SMU and SMU port used.

[4] You can set *power compliance* up to 14 W for the HP 41420A SMU connected to SMU2 port only. For other SMUs, you can set *power compliance* up to 2 W.

Set_sync

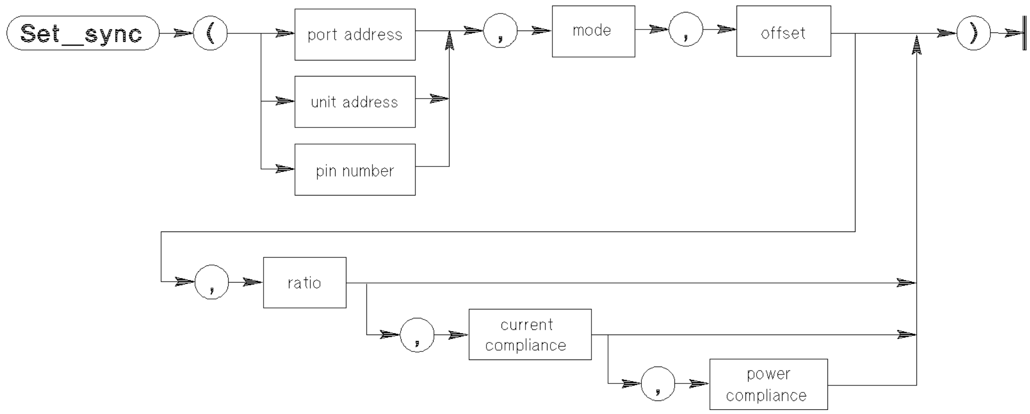
For SMU current measurements:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
mode	integer expression	0, 1	
offset	numeric expression: [A]	−2 to 2 [3]	
ratio	numeric expression	0.01 to 10 resolution: 0.01	
voltage compliance	numeric expression: [V] default = last valid setting or 20 if the SMU was in VS mode.	−200 to 200	
power compliance	numeric expression: [W]	0.001 to 14 [4] resolution: 0.001	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.
3 Actual *offset* value restriction depends on the SMU and SMU port used.
4 You can set *power compliance* up to 14 W for the HP 41420A SMU connected to SMU2 port only. For other SMUs, you can set *power compliance* up to 2 W.

For VS voltage measurements:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32633, 32635, 32637, 32639, 32641, 32643, 32645, 32647, 32649, 32651, 32653, 32655, 32657, 32659, 32661, 32663	
pin number	integer expression	1 to 96 [2]	
mode	integer expression	0, 1	
offset	numeric expression: [V]	−80 to 80	
ratio	numeric expression	0.01 to 10 resolution: 0.01	
current compliance	numeric expression: [A]	— [3]	
power compliance	numeric expression: [W]	— [4]	

1 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VS port.

3 This is a dummy parameter. If output range is 20 V, current is limited to 100 mA. If the output range is 40 V, current is limited to 20 mA.

4 This is a dummy parameter (cannot set *power compliance* for VSs).

Example Statements

```
Set_sync(FNSmu(1),mode,offset)
Set_sync(FNSmu(1),mode,offset,ratio,iv_compliance)
Set_sync(FNVs(1),1,1,1)
```

Description

This subprogram, used in conjunction with the Set_iv subprogram, sets the control parameters for the synchronous sweep port (SMU or VS).

The output mode of the synchronous sweep port is automatically set to the same output mode (VS or IS) and sweep type (linear or logarithmic) as the sweep port in the Set_iv subprogram. If the *sweep mode* of the Set_iv subprogram is set to perform a logarithmic sweep, the *offset* setting of this subprogram is ignored.

Note that you can only specify one port as the synchronous sweep port. This subprogram cannot be used for pulsed sweep or staircase sweep with pulsed bias measurements.

Port address, unit address, pin number

Either the *port address, unit address*, or *pin number* of any measurement pin connected to the synchronous sweep port in a Connect subprogram can be used to specify the synchronous sweep port.

Mode, offset, ratio

These parameters determine the start and stop values of the synchronous sweep port as follows:

Mode = 0:

Start2 = *offset* + *ratio* × Start1

Stop2 = *offset* + *ratio* × Stop1

Mode = 1:

Start2 = *offset* − *ratio* × Start1

Stop2 = *offset* − *ratio* × Stop1

Where: Start1 and Stop1 are the *start* and *stop* values of Set_iv, and Start2 and Stop2 are the calculated start and stop values of Set_sync.

The number of steps in Set_sync is the same as *number of steps* in Set_iv.

Compliance

The allowable *voltage* or *current compliance* you can specify for the synchronous sweep port is determined by the port range setting of synchronous sweep, which in turn is determined by the calculated Start2 and Stop2 values. The following tables list the compliance settings you can specify for each V and I range:

Allowable Compliance for Synchronous Voltage Output Port

Start2/Stop2 Value [V]	V Range	Allowable Compliance		
		HP 41420A	HP 41421B	HP 41424A(VS)
$0 \le \lvert start,stop \rvert \le 2$	2 V	±(1 pA to 1 A)	±(1 pA to 100 mA)	—
$0 \le \lvert start,stop \rvert \le 14$		±(1 pA to 1 A)	±(1 pA to 100 mA)	
$14 < \lvert start,stop \rvert \le 20$	20 V	±(1 pA to 700 mA)	±(1 pA to 100 mA)	100 mA
$0 \le \lvert start,stop \rvert \le 40$	40 V	±(1 pA to 350 mA)	±(1 pA to 50 mA)	20 mA
$0 \le \lvert start,stop \rvert \le 100$	100 V	±(1 pA to 125 mA)	±(1 pA to 20 mA)	—
$0 \le \lvert start,stop \rvert \le 200$	200 V	±(1 pA to 50 mA)	—	—

Allowable Compliance for Synchronous Current Output Port

Start2/Stop2 Value	I Range	Allowable Compliance	
		HP 41420A	HP 41421B
$0 \le \lvert start,stop \rvert \le 10$ mA	1 nA to 10 mA	0 to ±200 V	0 to ±100 V
$0 \le \lvert start,stop \rvert \le 20$ mA		0 to ±200 V	0 to ±100 V
20 mA $< \lvert start,stop \rvert \le 50$ mA	100 mA	0 to ±200 V	0 to ±40 V
50 mA $< \lvert start,stop \rvert \le 100$ mA		0 to ±200 V	0 to ±20 V
$0 \le \lvert start,stop \rvert \le 125$ mA [1]		0 to ±100 V	
125 mA $< \lvert start,stop \rvert \le 350$ mA		0 to ±40 V	
350 mA $< \lvert start,stop \rvert \le 700$ mA	1 A	0 to ±20 V	—
700 mA $< \lvert start,stop \rvert \le 1$ A		0 to ±14 V	

[1] If start or stop is greater than 100 mA, the 1 A range is selected. If both start and stop are less than or equal to 100 mA, the 100 mA range is selected.

Programming Examples

1. Voltage Sweep Measurement

```
100 Swp_mode=1
110  · · · ·
120 Force_v(FNPort(1),Vout,Range)
130  · · · ·
140 Set_iv(FNPort(2),Swp_mode,Range,Vstart,Vstop,Point,Ht,Dt,I_comp1)
150 Set_sync(FNPort(3),0,Voffset,Ratio,I_comp2)
160 Sweep_iv(FNPort(3),Imeas(*),Vswp1(*),Vswp2(*))
170  · · · ·
```

2. Current Sweep Measurement

```
100 Swp_mode=2
110  · · · ·
120 Force_v(FNPort(1),Vout,Range)
130  · · · ·
140 Set_iv(FNPort(2),Swp_mode,Range,Istart,Istop,Point,Ht,Dt,V_comp1)
150 Set_sync(FNPort(3),0,Ioffset,Ratio,V_comp2)
```

```
160 Sweep_iv(FNPort(3),Vmeas(*),Iswp1(*),Iswp2(*))
170  . . . .
```

See Also

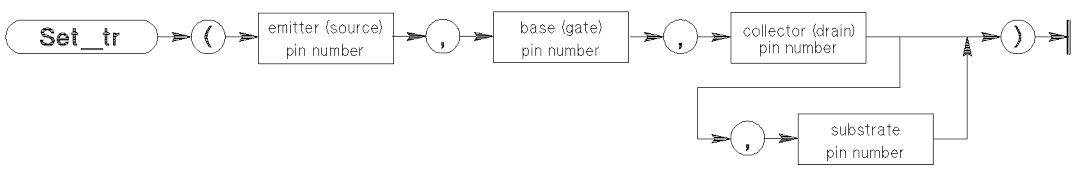
Set_iv
Sweep_iv

Set_tr

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	PARA
Control	—

This subprogram connects the specified measurement pins to a single transistor or FET, and passes these pin numbers to the following dc parameter (PARA) measurement subprograms: FNBvcbo, FNBvces, FNHfe, FNHfe1, FNIds, FNVth1, FNVth2, FNVth2m, FNVth3, FNVth4, and FNVth5.

Syntax



Item	Description/Default	Range Restrictions
emitter (source) pin number	integer expression	1 to 96 [1]
base (gate) pin number	integer expression	1 to 96 [1]
collector (drain) pin number	integer expression	1 to 96 [1]
substrate pin number	integer expression default = 0 (No connection)	0 to 96 [2]

[1] 1 to 48 for HP 4085B 48-pin SWM systems.
[2] 0 to 48 for HP 4085B 48-pin SWM systems.

Example Statements

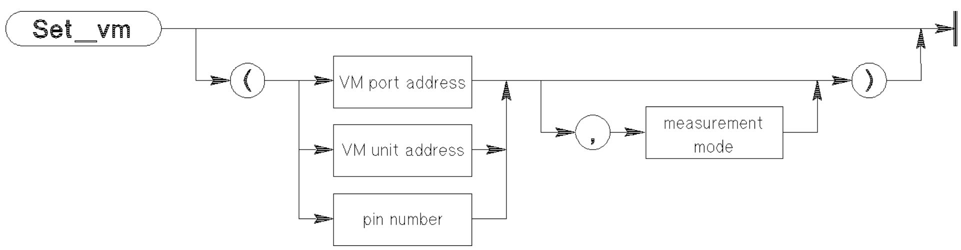
```
Set_tr(Emitter,Trbase,Collector,Substrate)
Set_tr(Source,Gate,Drain)
```

Set_vm

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram sets the voltage measurement mode of the specified VM to either grounded measurement mode or differential measurement mode.

Syntax



Item	Description/Default	Range Restrictions
VM port address [1]	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [2], 32730 [2], 32731 [2]
VM unit address [1]	integer expression	32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664
pin number [1]	integer expression	1 to 96 [3]
measurement mode [1]	integer expression default = 0	0: grounded measurement 1: differential measurement

[1] If no parameters are specified, all VMs installed in the DCS are set to grounded measurement mode.

[2] 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

[3] 1 to 48 for HP 4085B 48-pin SWM systems. Both VMs in the HP 41424A must be connected to the SWM, and one of the VMs must be connected to the specified pin.

Example Statements

```
Set_vm(FNVm(1),1)
Set_vm(Drain,Meas_mode)
Set_vm
```

Description

For VMs (HP 41424As), you can set either grounded voltage measurement mode or differential voltage measurement mode. For a grounded measurement, the voltage between the VM terminal and circuit common is measured. For a differential measurement, the voltage between the VM1 and VM2 terminals of the HP 41424A is measured. For a differential measurement, specify the *port address*, *unit address*, or *pin number* of either VM1 or VM2.

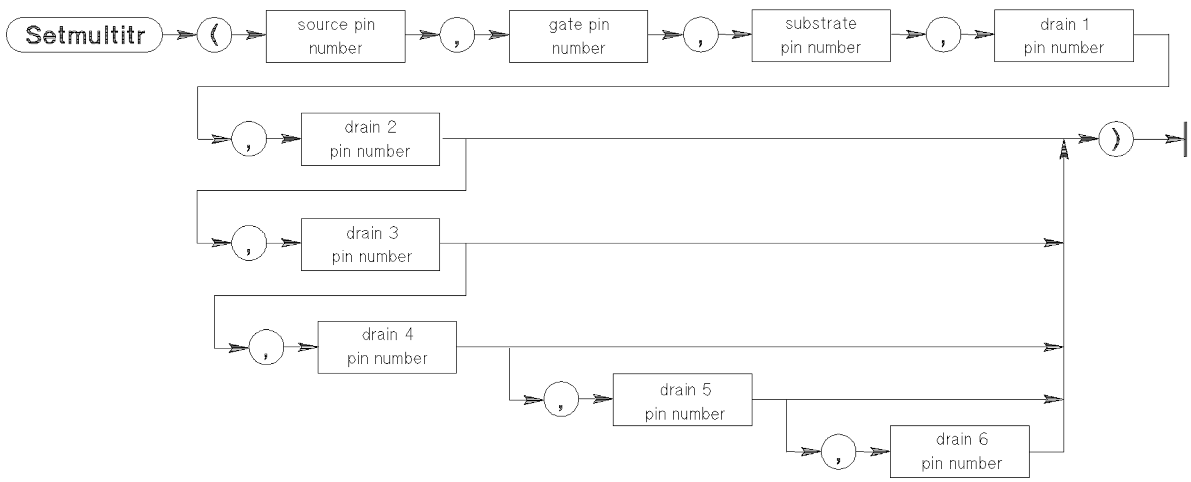
The voltage measurement ranges are determined by the Measure_v subprogram. If you do not use the Measure_v subprogram to set the voltage measurement ranges, the default is 20 V for grounded measurements and 2 V for differential measurements.

Setmultitr

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File PARA
Control —

This subprogram connects the specified measurement pins to a multiple FET, and passes these pin numbers to the lateral diffusion ΔL and oxide encroachment ΔW measurement functions (FNDelta_l, FNDelta_w).

Syntax



Item	Description/Default	Range Restrictions
source pin number	integer expression	1 to 96 [1]
gate pin number	integer expression	1 to 96 [1]
substrate pin number	integer expression	1 to 96 [1]
drain 1 pin number	integer expression	1 to 96 [1]
drain 2 pin number	integer expression	1 to 96 [1]
drain 3 pin number	integer expression	1 to 96 [1]
drain 4 pin number	integer expression	1 to 96 [1]
drain 5 pin number	integer expression	1 to 96 [1]
drain 6 pin number	integer expression	1 to 96 [1]

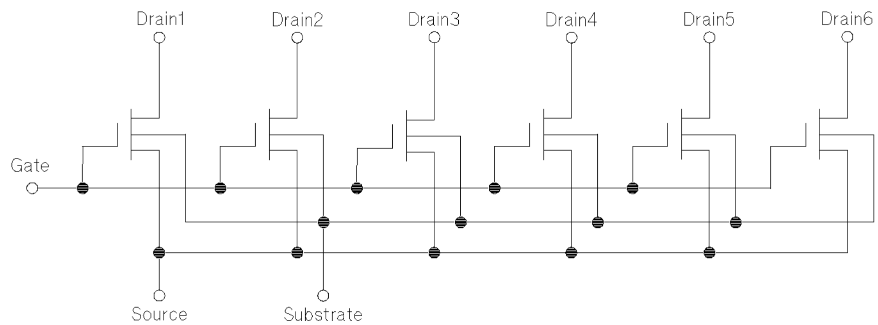
[1] 1 to 48 for HP 4085B 48-pin SWM systems.

Example Statement

```
Setmultitr(Source,Gate,Substrate,Drain1,Drain2,Drain3,Drain4)
```

Description

You can specify up to 6 drain pins as shown in the following figure.



See Also

FNDelta_l
FNDelta_w

Short_cal

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram sets the SMUs, VSs, VMs, and AFU to the initial status and initiates the automatic calibration function for DCS, which measures and compensates for the dc offset voltages of the SMUs, VSs, VMs, A/D converters, and D/A converters.

Syntax

Example Statement

```
Short_cal
```

Description

This subprogram is identical to the Long_cal subprogram. The SMUs and VSs of the DCS are set to their initial states, and calibration takes approximately 21 seconds for a standard system configuration.

You should perform Short_cal after your system has fully warmed up to correct for offsets caused by temperature drifts.

For best measurement results, perform Short_cal every 30 minutes or when the ambient temperature changes more than 3 °C (6 °F).

The system automatically performs calibration at about 30 minute intervals if all DCS (HP 4142B) units are in a disabled state for longer than 30 minutes.

See Also

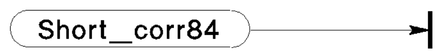
Init_system
Long_cal

Short_corr84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284 (for C.05.60, C.05.70 or X.05.61), TIS (for C.06.00 or later, X.06.00 or later, and P.06.20 or later)
Control	CMU84

This subprogram performs SHORT compensation on the CMU84.

Syntax



Example Statement

```
Short_corr84
CALL Short_corr84
```

Description

This subprogram triggers the SHORT compensation function in the CMU84, and compensation data is stored in the internal non-volatile memory of the CMU84. Refer to the "Residual Error Compensation" in the *System Operation* for more information about the error compensation theory for the CMU84.

See Also

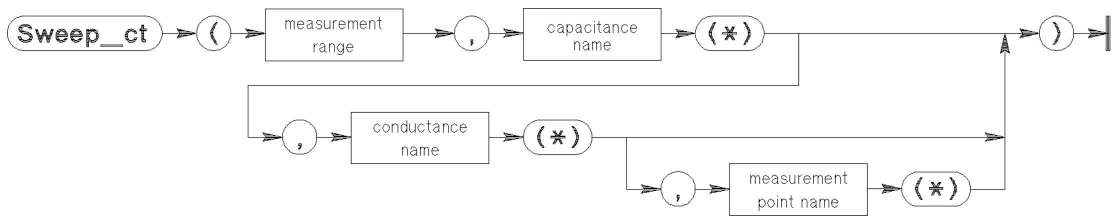
Open_corr84

Sweep_ct

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	CMU

This subprogram performs C·G-t measurements on the CMU in accordance with the conditions established by the Set_ct subprogram, and returns corrected values and measurement points.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
measurement range	numeric expression: [F] or [S] [1]	0 to 0.01	0, 1E−11, 1E−10, 1E−9, 1E−4, 1E−3, 1E−2
capacitance name	numeric array name: [F]	any valid name	
conductance name	numeric array name: [S]	any valid name	
measurement point name	numeric array name: [s]	any valid name	

[1] If 0 < |specified value| ≤ 1E−9, the unit is farad F, and if 1E−9 < |specified value| ≤ −2, the unit is siemens S.

Example Statements

```
Sweep_ct(0,Cap(*),G(*))
Sweep_ct(Range,C_data(*),G_data(*),Time_data(*))
```

Description

This subprogram returns capacitance and conductance measurement values and the times at which the measurements were made to the *capacitance name*, *conductance name*, and *measurement point name* arrays, respectively.

Sweep_ct compensates for the effects of the cables that interconnect the CMU, SWM, and pin boards. However, the measurement value includes the stray capacitance between the pin boards and test device. First, the stray capacitance must be measured without the test device connected, then you must subtract the stray capacitance value from the measured capacitance value.

The measurement resolution depends on the *integration time* set in the Set_cmu subprogram. Refer to the Set_cmu subprogram for details.

The size of the *capacitance name*, *conductance name*, and *measurement point name* arrays should be larger than the *number of readings* specified in the Set_ct subprogram, so that −9999999.99999 is returned to the remaining array elements. If smaller, the measurement values of the number equal to the array size are returned to the specified arrays, but the measurement values next to the (array size)-th measurement cannot be stored in the array, and are abandoned.

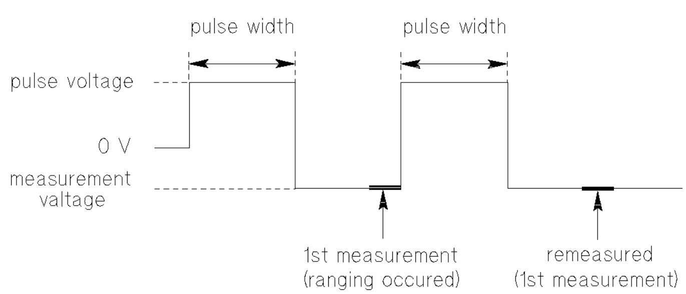
measurement range

The C·G measurement range is determined by the *measurement range* value as follows:

Measurement Range Value	C Range (Maximum [1])	G Range (Maximum [1])
$0 <$ value $\leq$ 1E−11 1E−9 $<$ value $\leq$ 1E−4	10 pF (19.00 pF)	100 μS (120 μS)
1E−11 $<$ value $\leq$ 1E−10 1E−4 $<$ value $\leq$ 1E− 3	100 pF (190.0 pF)	1 mS (1.2 mS)
1E−10 $<$ value $\leq$ 1E−9 1E−3 $<$ value $\leq$ 1E−2	1000 pF (1900 pF)	10 mS (12 mS)
0	Auto range	

[1] The maximum value displayed on the front panel of the HP 4280A.

If the *measurement range* is set to Auto range, and the first C·G-t measurement results in an overflow, the CMU automatically ranges up and reapplies the pulse voltage. However, for subsequent C·G–t measurements, the C·G range does not change, even if the measurement value exceeds the set range.



capacitance and *conductance name*

If overflow occurs during a measurement, twice the value of the set range is returned. For example, if a measurement is performed at the 1000 pF/10 mS range and overflow occurs, 2E−9 and 2E−2 is returned to *capacitance name* and *conductance name*, respectively.

measurement point name

The time after changing the measurement voltage to the n-th actual measurement is returned to the *measurement point name* array. The expected return data is as follows:

$$Array(i) = measurement\ interval \times i$$

$$i = 1, 2, \cdots, number\ of\ readings$$

Where the *interval time* and *number of readings* is set by Set_ct statement.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *capacitance name*, *conductance name*, and *measurement point name* arrays. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns a sequence of linear values to the *capacitance*, *conductance*, and *measurement point name* arrays. Linear values returned to the *measurement point name* array are determined by the *number of readings* and *measurement interval* parameters of the Set_ct subprogram. Linear values returned to the *capacitance* and *conductance name* arrays range from 0 to the value determined by the *measurement range* as described in the following table.

Measurement Range Value	Capacitance	Conductance
0	10 pF	100 μS
0 $<$ value $\leq$ 1E−11	range value	100 μS
1E−11 $<$ value $\leq$ 1E−10	range value	1 mS
1E−10 $<$ value	range value	10 mS

File Data Simulation mode:

This subprogram reads <c_meas>, <g_meas>, and <time> from the simulation file as the capacitance measurement, conductance measurement, and measurement point values, respectively. The data simulation file format is as follows:

```
Sweep_ct
[
<c_meas>  <g_meas>  <time>
<c_meas>  <g_meas>  <time>
  .   .   .   .   .
<c_meas>  <g_meas>  <time>
]
```

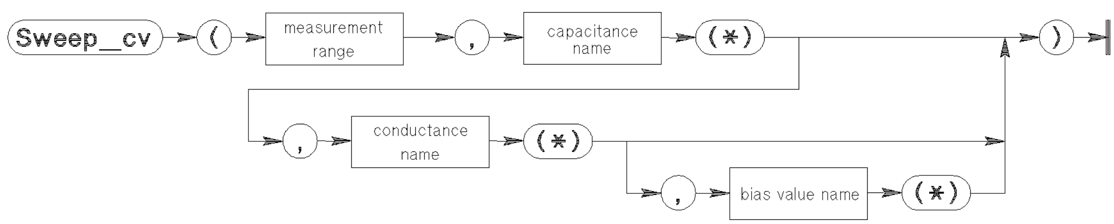
You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Sweep_cv

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	CMU

This subprogram performs C·G-V measurement on the CMU in accordance with the conditions established by the Set_cv subprogram, and returns error corrected values and bias values.

Syntax



Item	Description/Default	Range Restrictions	Recommended Range
measurement range	numeric expression: [F] or [S] [1]	0 to 0.01	0, 1E−11, 1E−10, 1E−9, 1E−4, 1E−3, 1E−2
capacitance name	numeric array name: [F]	any valid name	
conductance name	numeric array name: [S]	any valid name	
bias value name	numeric array name: [V]	any valid name	

[1] If $0 < |\text{specified value}| \leq 1E{-}9$, the unit is farad F, and if $1E{-}9 < |\text{specified value}| \leq -2$, the unit is siemens S.

Example Statements

```
Sweep_cv(0,Cap(*),G(*))
Sweep_cv(Range,C_data(*),G_data(*),Bias_data(*))
```

Description

This subprogram returns capacitance and conductance measurement values and the bias values at which the measurements are made to the *capacitance name*, *conductance name*, and *bias value name* arrays, respectively.

The C·G measurement range is determined by the *range specifier* value as follows:

Measurement Range Value	C Range (Maximum [1])	G Range (Maximum [1])
0 < value ≤ 1E−11 1E−9 < value ≤ 1E−4	10 pF (19.00 pF)	100 μS (120 μS)
1E−11 < value ≤ 1E−10 1E−4 < value ≤ 1E−3	100 pF (190.0 pF)	1 mS (1.2 mS)
1E−10 < value ≤ 1E−9 1E−3 < value ≤ 1E−2	1000 pF (1900 pF)	10 mS (12 mS)
0	Auto range	

[1] The maximum value displayed on the front panel of the HP 4280A.

The measurement resolution depends on the *integration time* set in the Set_cmu subprogram. Refer to the Set_cmu subprogram.

Sweep_cv compensates for the effects of the cables that interconnect the CMU, SWM, and pin boards. However, the measurement value includes the stray capacitance between the pin boards and test device. First, the stray capacitance must be measured without the test device connected, then you must subtract the stray capacitance value from the measured capacitance value.

If an overflow occurs during a measurement, twice the value of the set range is returned. For example, if a measurement is performed on the 1000 pF/10 mS range and overflow occurs, 2E−9 and 2E−2 is returned to the *capacitance name* and *conductance name*, respectively

The size of the *capacitance name, conductance name*, and *bias value name* arrays should be larger than the *number of steps* specified in the Set_cv subprogram, and −9999999.99999 is returned to the remaining array elements. If smaller, the measurement values of the number equal to the array size are returned to the specified arrays, but the measurement values next to the (array size)-th measurement cannot be stored in the array, and are abandoned.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *capacitance name*, *conductance name*, and *bias value name* arrays. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

> This subprogram returns a sequence of linear values to the *capacitance*, *conductance*, and *bias value name* arrays. Linear values returned to the *bias value name* array are determined by the *start voltage*, *stop voltage*, and *number of steps* parameters of the Set_cv subprogram. Linear values returned to the *capacitance* and *conductance name* arrays range from 0 to the value determined by the *measurement range* as described in the following table.

Measurement Range Value	Capacitance	Conductance
0	10 pF	100 μS
0 < value ≤ 1E−11	range value	100 μS
1E−11 < value ≤ 1E−10	range value	1 mS
1E−10 < value	range value	10 mS

File Data Simulation mode:

This subprogram reads <c_meas>, <g_meas>, and <source> from the simulation file as the capacitance measurement, conductance measurement, and measurement point values, respectively. The data simulation file format is as follows:

```
Sweep_cv
[
<c_meas>  <g_meas>  <source>
<c_meas>  <g_meas>  <source>
  .   .   .   .   .
<c_meas>  <g_meas>  <source>
]
```

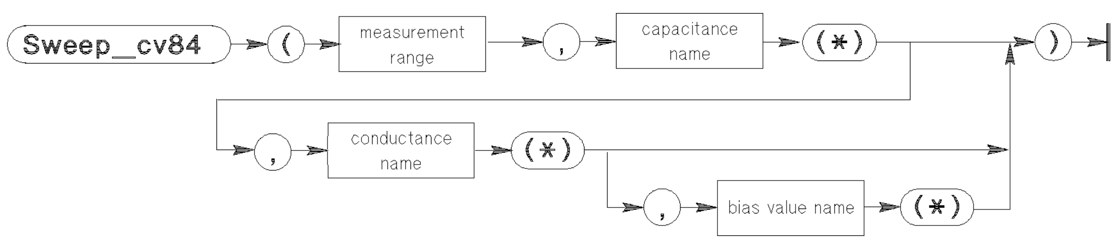
You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

Sweep_cv84

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.60 or later, X.05.61 or later, P.06.20 or later
File	DVR4284 (for C.05.60, C.05.70 or X.05.61), TIS (for C.06.00 or later, X.06.00 or later, and P.06.20 or later)
Control	CMU84

This subprogram performs the C·G-V measurement on the CMU84 in accordance with the conditions established by the Set_cv84 statement, and returns the error corrected and bias values.

Syntax



Item	Description/Default	Range Restrictions
measurement range	numeric expression: [F]	— [1]
capacitance name	numeric array name: [F]	any valid name
conductance name	numeric array name: [S]	any valid name
bias value name	numeric array name: [V]	any valid name

[1] See the description of the *measurement range* in the Measure_cmu84 subprogram for details.

Example Statement

```
Sweep_cv84(0,C_value(*))
Sweep_cv84(1.E-9,C_value(*),G_value(*))
Sweep_cv84(0,C_value(*),G_value(*),V_bias(*))
```

Description

The C·G-V measurement conditions are set by the Set_cv84 statement. The measurement resolution depends on the *integration time* set in the Set_cmu84 statement. Refer to the Set_cmu84 subprogram.

measurement range

Auto ranging mode occurs when the measurement range is set to zero. In Limited Auto ranging mode, you specify a measurement range and the specified measurement range is adopted during the sweep. See the Measure_cmu84 subprogram for details.

capacitance name

The compensated capacitance data is returned to this array. When the measurement status is abnormal, − 9999999.99999 is returned as the capacitance value.
The size of this array must be equal to or larger than the *number of steps* set in the Set_cv84 statement. If larger, the remaining elements of array are filled with −9999999.99999. If smaller, the sweep is terminated when all the elements are full.

conductance name

This parameter is optional. The compensated conductance data is returned to this array. When the measurement status is abnormal, − 9999999.99999 is returned as the capacitance value.
The size of this array must be the same as the size of the *capacitance name*.

bias value name

This parameter is optional. The step voltage is returned to this array as the bias voltage. The size of this array must be the same size as the *capacitance name*.

C·G-V measurement status

If the Port_status84 statement is performed after executing the Sweep_cv84 statement, the returned value reflects only the results of last sweep point.

In Offline Mode (HP 4062UX Only)

In offline mode execution, this subprogram returns the dummy data, which are a sequence of linear values. Linear values returned to the *bias value name* array are determined by the Set_cv statement. Linear values returned to the *capacitance* and *conductance name* arrays range from 0 to C and G range values determined by the *measurement range*. C range means the value of the *measurement range* and G range means the value of the *measurement range*$\times 10^7$.

See Also

Set_cv84

Sweep_iv

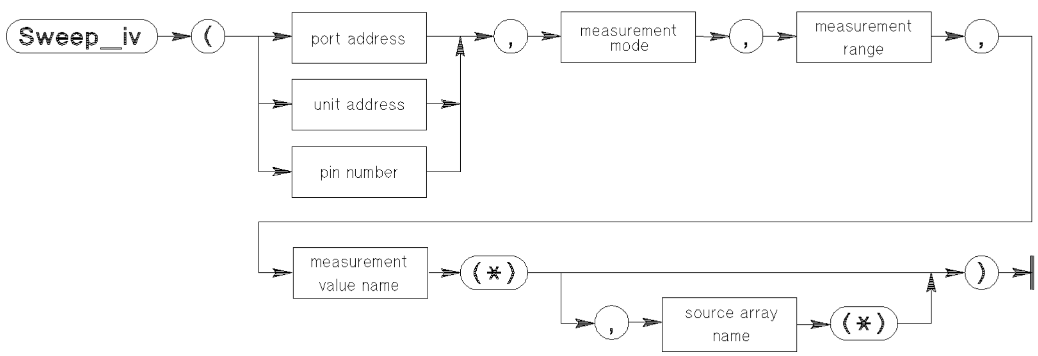
Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	TIS
Control	DCS

This subprogram performs staircase sweep, pulsed sweep, staircase sweep with pulsed bias, and synchronous staircase sweep measurements in accordance with parameters established in the Set_iv, Set_piv, Set_pbias and Set_iv, and Set_iv and Set_sync subprograms, respectively.

For Staircase Sweep Measurements:

Syntax

For SMUs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
measurement mode	integer expression	1: voltage measurement 2: current measurement	
measurement range [3]	numeric expression: [A]	−1 to 1 [4]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
measurement array name	numeric array name	any valid name	
source array name	numeric array name	any valid name	

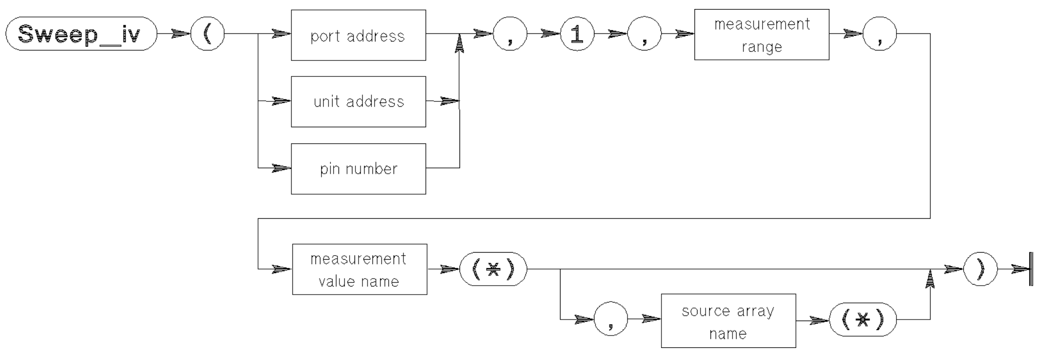
1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.

3 If the *measurement mode* is 1 (voltage measurement), SMUs ignore this parameter, and the voltage measurement range is set to the lowest range that includes *voltage compliance* of the measurement port SMU.

4 Actual range restriction depends on the SMU and SMU port.

For VMs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
pin number	integer expression	1 to 96 [2]	
measurement range	numeric expression: [V]		
	grounded measurements	−40 to 40	0, 2, 20, 40
	differential measurements	−2 to 2	0, 0.2, 2
measurement array name	numeric array name	any valid name	
source array name	numeric array name	any valid name	

1 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VM port.

Example Statements

```
Sweep_iv(FNPort(1),2,0,Ids(*),Vgs(*))
Sweep_iv(Port,Meas_mode,Range,Meas_data(*),Bias_data(*))
```

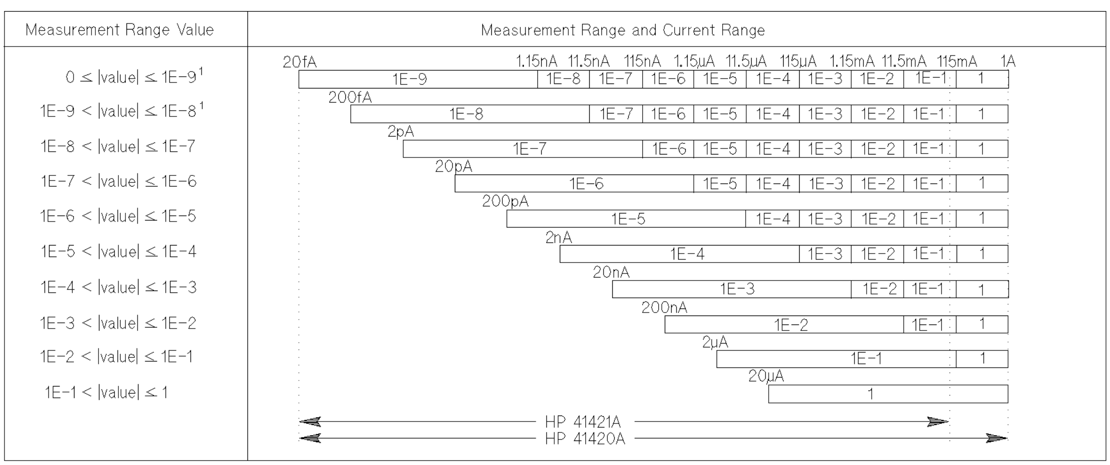
Description

The Sweep_iv subprogram triggers a staircase sweep measurement. The staircase sweep output is determined by the Set_iv subprogram. Measurements are made at the specified measurement port for each sweep step, and the measurement values and sweep source values are returned to the *measurement array* and *source array*, respectively.

Either *unit address*, *pin number*, or *port address* can be used to specify a port.

The size of the *measurement array* and the *source array* should be larger than the *number of steps* specified in the Set_iv subprogram, and −9999999.99999 is returned to the remaining array elements. If smaller, the measurement values of the number equal to the array size are returned to the specified arrays, but the measurement values next to the (array size)-th measurement cannot be stored in the array, and are abandoned. Also, if *stop mode* = 2 in the Set_iv program and the SMU reaches compliance, +9999999.99999 is returned for the remaining values of the *measurement array* and *source array*.

The current measurement range of the SMU is determined by the *measurement range* value. The measurement ranges for *measurement mode* = 2 (current measurement by an SMU) are shown in the following figure:



1 When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

For *measurement mode* = 2, if you specify *measurement range* = 0, Auto ranging is used, and the range changes up or down automatically to give the highest resolution. If you specify any other allowed *measurement range*, Limited Auto ranging is used. For Limited Auto ranging, the range changes between the specified range and all higher ranges automatically as required, but down ranging to ranges below the initially specified range cannot occur. By specifying a low *measurement range*, a high resolution current measurement can be achieved. If range changing occurs, the measurement speed decreases because of the SMU wait time and the time required for the range to change.

The voltage measurement range of a VM is determined by the *measurement range* value. The voltage measurement range of an SMU is automatically set to the lowest range that includes *V compliance*, set by the Set_iv or Force_i subprogram for the measurement port.

The measurement ranges for *measurement mode* = 1 (voltage measurement by an SMU or VM) are shown in the following figures:

VM Voltage Ranges for Grounded Measurement Mode and SMU Voltage Range

Unit	Voltage Compliance Setting	Measurement Range
HP 41420A HP 41421B	$0 \le \|value\| \le 2$	40 uV – 2 V: 2
	$2 < \|value\| \le 20$	400 uV – 20 V: 20
	$20 < \|value\| \le 40$	800 uV – 40 V: 40
	$40 < \|value\| \le 100$	2 mV – 100 V: 100
HP 41420A	$100 < \|value\| \le 200$	4 mV – 200 V: 200
VM (HP 41424A)	Measurement Range Value	
	0	40 uV – 2 V: 2; 2 V – 20 V: 20; 20 V – 40 V: 40
	$0 < \|value\| \le 2$	40 uV – 2 V: 2
	$2 < \|value\| \le 20$	400 uV – 20 V: 20
	$20 < \|value\| \le 40$	800 uV – 40 V: 40

VM Voltage Ranges for Differential Measurement Mode

Unit	Measurement Range Value	Measurement Range and Current Range	Maximum Voltage (VM terminal–Circuit Common)
VM (HP 41424A)	0	4 uV – 0.2 V – 2 V	Max. 40 V
	$0 < \|value\| \le 0.2$	4 uV – 0.2 V	
	$0.2 < \|value\| \le 2$	40 uV – 2 V	

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *primary value name* and *secondary value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0.

Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurementvalue = \frac{measurement\ value}{number\ of\ steps - 1} \times (n - 1)$$

Where *number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

Current Measurements

Unit	Meas. Range	Measurement Value	Polarity
	$= 0$	I compliance	
SMU	$\neq 0$	Range value	Same as SMU *output value*
VS	any	20 mA	Same as VS *output value*

Voltage Measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
	$= 0$	2.0 V	Always positive
VM	$\neq 0$	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, and <source> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Sweep_iv
[
<meas>  <status>  <source>
<meas>  <status>  <source>
  .   .   .   .   .
<meas>  <status>  <source>
]
```

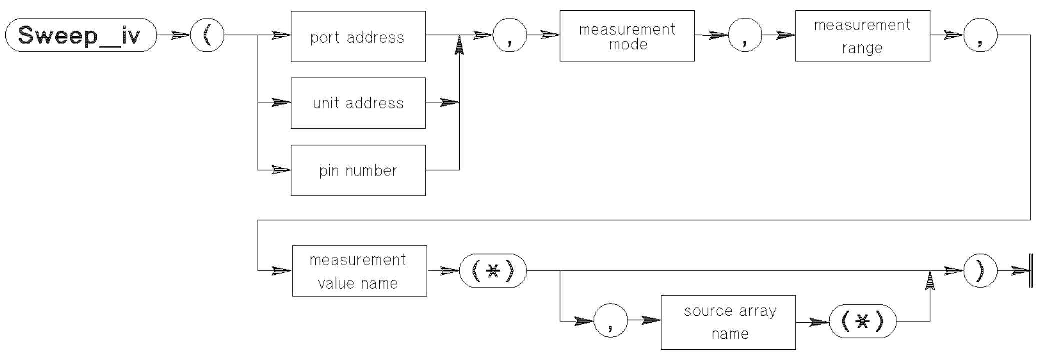
You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

For Pulsed Sweep Measurements:

The Sweep_iv subprogram triggers a pulsed sweep measurement or a staircase sweep with pulsed bias measurement with source output determined by the Set_piv program or by the Set_pbias and Set_iv subprograms. Measurements are made at the specified measurement port for each sweep step, and the measurement values and sweep source values are returned to the *measurement array* and *source array*, respectively.

Syntax

For SMUs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
measurement mode	integer expression	1: voltage measurement 2: current measurement	
measurement range [3]	numeric expression: [A]	−1 to 1 [4]	0, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
measurement array name	numeric array name	any valid name	
source array name	numeric array name	any valid name	

1 These port addresses are used for the AUX33 and AUX43 ports of the port expander.

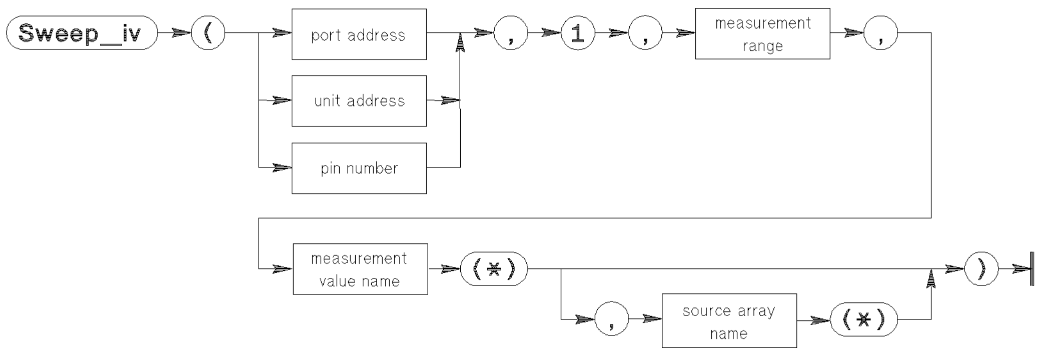
2 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.

3 If the *measurement mode* is 1, SMUs ignore this parameter, and the voltage measurement range is set to the lowest range that includes *voltage compliance* of the measurement port SMU.

4 Actual range restriction depends on the SMU and SMU port.

Sweep_iv

For VMs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
pin number	integer expression	1 to 96 [2]	
measurement range	numeric expression: [V]	−40 to 40	0, 2, 20, 40
measurement array name	numeric array name	any valid name	
source array name	numeric array name	any valid name	

[1] 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VM port.

Example Statements

```
Sweep_iv(FNPort(1),2,0,Ids(*),Vgs(*))
Sweep_iv(Port,Meas_mode,Range,Meas_data(*),Bias_data(*))
```

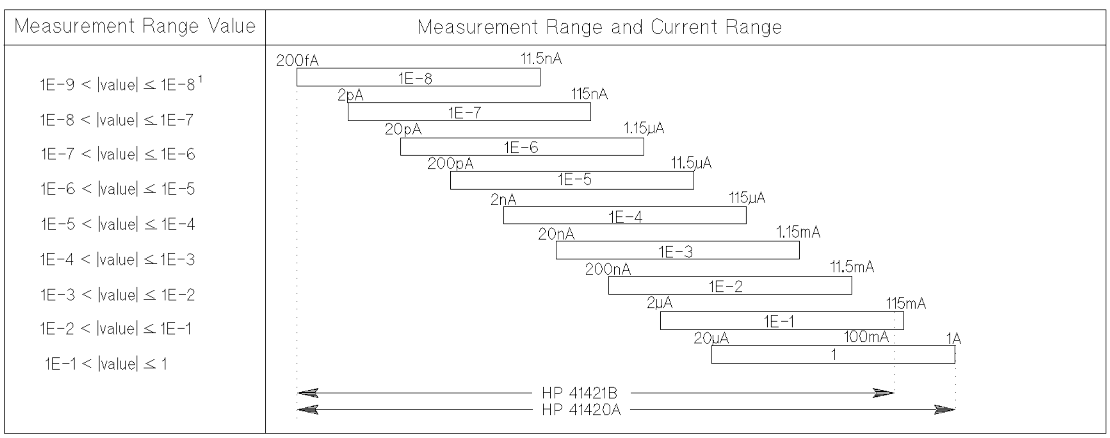
Description

For staircase sweep with pulsed bias measurements, a staircase sweep is output as determined by the Set_iv subprogram. For each sweep step, a pulse is output as determined by the Set_pbias subprogram, and the measurement is made at the specified measurement port.
For pulsed sweep measurements, a pulsed sweep is output as determined by the Set_piv subprogram, and measurements are made at the specified measurement port for each sweep step.

Either *unit address*, *pin number*, or *port address* can be used to specify a port.

The size of the *measurement array* and the *source array* should be larger than the *number of steps* specified in the Set_iv subprogram, and −9999999.99999 is returned to the remaining array elements. If smaller, the measurement values of the number equal to the array size are returned to the specified arrays. The measurement values next to the (array size)-th measurement cannot be stored in the array, and are abandoned. Also, if *stop mode* = 2 in the Set_iv or Set_piv subprogram and the SMU reaches compliance, −9999999.9999 is returned for the remaining values of the *measurement array* and *source array*.

The current measurement range of an SMU is determined by the *measurement range* value. The measurement ranges for *measurement mode* = 2 (I measurements) are shown in the following figure:



[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

The voltage measurement range of a VM is determined by the *measurement range* value. The voltage measurement range of an SMU is automatically set to the lowest range that includes *voltage compliance*, which is set by the Set_iv, Set_piv, Set_pbias, or Force_i subprogram for the measurement port.

The measurement ranges for *measurement mode* = 1 (voltage measurement—SMU or VM) are shown in the following figure:

<table>
<tr><th>Unit</th><th colspan="1">Voltage Compliance Setting</th><th>Measurement Range</th></tr>
<tr><td rowspan="4">HP 41420A
HP 41421B</td><td>0 ≤ |value| ≤ 2</td><td>40 uV – 2 V: 2</td></tr>
<tr><td>2 < |value| ≤ 20</td><td>400 uV – 20 V: 20</td></tr>
<tr><td>20 < |value| ≤ 40</td><td>800 uV – 40 V: 40</td></tr>
<tr><td>40 < |value| ≤ 100</td><td>2 mV – 100 V: 100</td></tr>
<tr><td>HP 41420A</td><td>100 < |value| ≤ 200</td><td>4 mV – 200 V: 200</td></tr>
<tr><td rowspan="5">VM
(HP 41424A)</td><td>Measurement Range Value
0</td><td>800 uV – 40 V: 40</td></tr>
<tr><td>0 < |value| ≤ 2</td><td>40 uV – 2 V: 2</td></tr>
<tr><td>2 < |value| ≤ 20</td><td>400 uV – 20 V: 20</td></tr>
<tr><td>20 < |value| ≤ 40</td><td>800 uV – 40 V: 40</td></tr>
</table>

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *primary value name* and *secondary value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values according to the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0.

Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurementvalue = \frac{measurement\ value}{number\ of\ steps - 1} \times (n-1)$$

Where: *Number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	= 0	I compliance	
	≠ 0	Range value	Same as SMU *output value*
VS	any	20 mA	Same as VS *output value*

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
	= 0	2.0 V	Always positive
VM	≠ 0	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, and <source> from the data simulation file and returns the values. The data simulation file format is as follows:

```
Sweep_iv
[
<meas>  <status>  <source>
<meas>  <status>  <source>
  .   .   .   .   .
<meas>  <status>  <source>
]
```

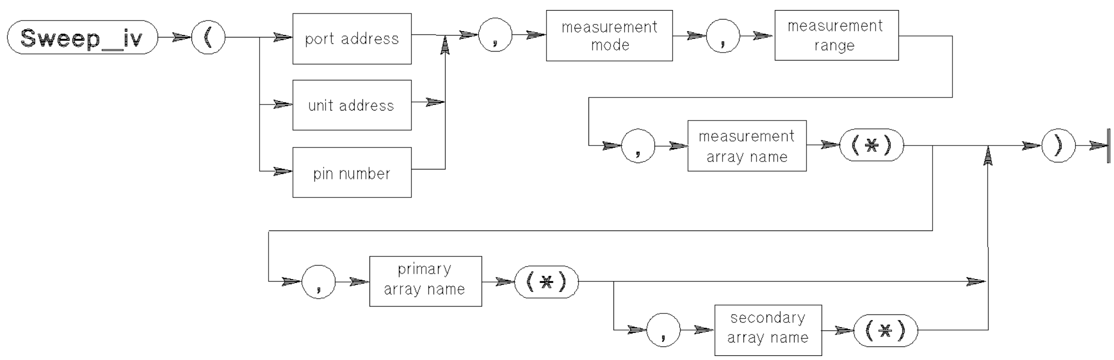
You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

For Synchronous Staircase Sweep Measurements:

Sweep_iv performs synchronous staircase sweep measurements using the sweep port specified in the Set_iv subprogram and the synchronous sweep port specified in the Set_sync subprogram. Measurements are made at the specified measurement port for each sweep step, and measurement, the sweep port of Set_iv, and the synchronous sweep port of Set_sync are returned to the *measurement*, *primary*, and *secondary array name* arrays, respectively.

Syntax

For SMUs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32701 to 32704, 32729 [1], 32732 [1]	
unit address	integer expression	32621 to 32632	
pin number	integer expression	1 to 96 [2]	
measurement mode	integer expression	1: voltage measurement 2: current measurement	
measurement range [3]	numeric expression: [A]	−1 to 1 [4]	0, 1E−9, 1E−8, 1E−7, 1E−6, 1E−5, 1E−4, 1E−3, 1E−2, 1E−1, 1
measurement array name	numeric array name	any valid name	
primary array name	numeric array name	any valid name	
secondary array name	numeric array name	any valid name	

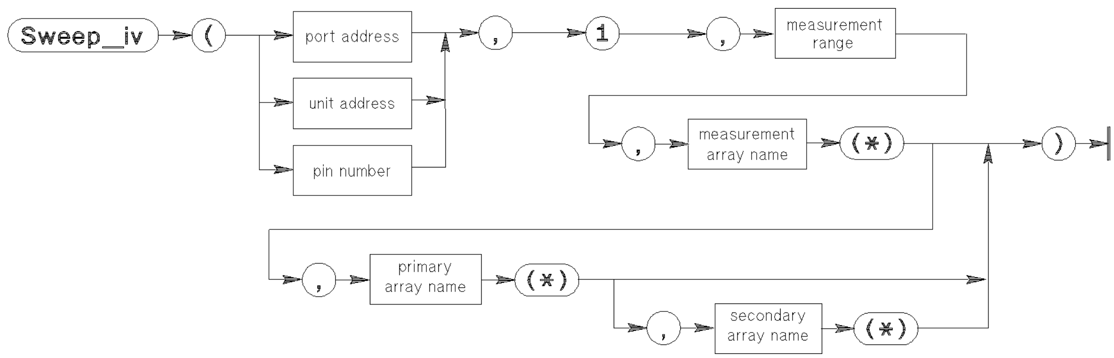
[1] These port addresses are used for the AUX33 and AUX43 ports of the port expander.

[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired SMU port.

[3] If *measurement mode* is 1 (voltage measurements), this is a dummy parameter because V measurement range is determined by the set voltage compliance.

[4] Actual range restrictions depend on the SMU or SMU port used.

For VMs:



Item	Description/Default	Range Restrictions	Recommended Range
port address	integer expression	32705, 32706, 32708, 32709, 32721 to 32728 [1], 32730 [1], 32731 [1]	
unit address	integer expression	32634, 32636, 32638, 32640, 32642, 32644, 32646, 32648, 32650, 32652, 32654, 32656, 32658, 32660, 32662, 32664	
pin number	integer expression	1 to 96 [2]	
measurement range	numeric expression: [V]		
	grounded measurement	−40 to 40	0, 2, 20, 40
	differential measurement	−2 to 2	0, 0.2, 2
measurement array name	numeric array name	any valid name	
primary array name	numeric array name	any valid name	
secondary array name	numeric array name	any valid name	

[1] 32721 to 32728, 32730, 32731 are used for the AUX11, AUX12, AUX13, AUX21, AUX22, AUX23, AUX31, AUX32, AUX41, and AUX42 ports of the port expander.

[2] 1 to 48 for HP 4085B 48-pin SWM systems. Must be the number of a measurement pin connected to the desired VM port.

Example Statements

```
Sweep_iv(FNPort(1),1,0,Mval(*),Pri_swp(*))
Sweep_iv(FNPort(3),2,0,Mval(*),Pri_swp(*),Sync_swp(*))
Sweep_iv(FNVm(1),1,0,Mval(*),Pri_swp(*),Sync_swp(*))
```

Description

Port address, unit address, pin number

Either *port address*, *unit address*, or *pin number* can be used to specify the measurement ports of Sweep_iv.

Measurement array name, primary array name, secondary array name

The size of the *measurement*, *primary*, and *secondary array name* arrays should be larger than the *number of steps* specified in the Set_iv subprogram, and −9999999.99999 is returned to the remaining array elements. If smaller, the measurement values of the number equal to the array size is returned to the specified arrays, but the measurement values next to the (array size)-th measurement cannot be stored in the array, and are abandoned. Also, if *stop mode* = 2 in the Set_iv subprogram and the SMU reaches compliance, −9999999.99999 are returned for the remaining values of the *measurement, primary*, and *secondary array name* arrays.

Maximum *measurement*, *primary*, and *secondary array name* array sizes are 2002. Note, however, that maximum number of measurement points are 1001 because the buffer size of each DCS unit is 1001. If you specify an array size greater than 2002, a TIS error occurs.

Primary and secondary values

Sweep_iv also obtains and returns primary (sweep port) and secondary (synchronous sweep port) values during a synchronous staircase sweep measurement. The DCS returns primary sweep values; secondary sweep values are calculated by Sweep_iv and are stored in the *secondary array name*. Secondary value calculation method is the same as that performed by the DCS, as follows:

V sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$Vn = Vstart + \frac{Vstop - Vstart}{N - 1}(n - 1)$
	double sweep	N + 1 to 2N	$Vn = Vstop - \frac{Vstop - Vstart}{N - 1}(n - N - 1)$
logarithmic sweep	single sweep	1 to N	$Vn = Vstart \times EXP\left(\frac{\log_e\left(\frac{Vstop}{Vstart}\right)}{N - 1}(n - 1)\right)$
	double sweep	N + 1 to 2N	$Vn = Vstop \times EXP\left(\frac{\log_e\left(\frac{Vstart}{Vstop}\right)}{N - 1}(n - N - 1)\right)$

n: the n-th measurement point
N: number of steps determined in Set_iv subprogram

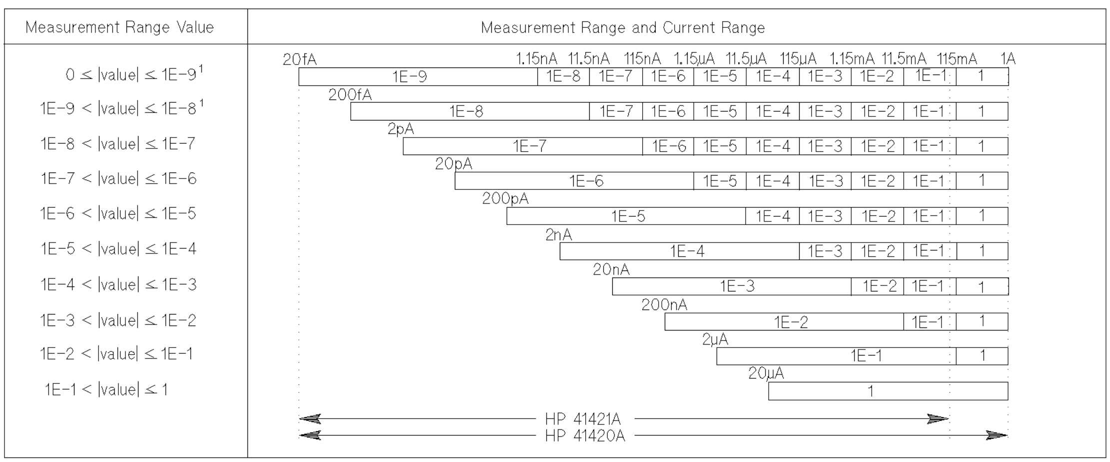
I sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$In = Istart + \frac{Istop - Istart}{N - 1}(n - 1)$
	double sweep	N + 1 to 2N	$In = Istop - \frac{Istop - Istart}{N - 1}(n - N - 1)$
logarithmic sweep	single sweep	1 to N	$In = Istart \times EXP\left(\frac{\log_e\left(\frac{Istop}{Istart}\right)}{N - 1}(n - 1)\right)$
	double sweep	N + 1 to 2N	$In = Istop \times EXP\left(\frac{\log_e\left(\frac{Istart}{Istop}\right)}{N - 1}(n - N - 1)\right)$

n: the n-th measurement point
N: number of steps determined in Set_iv subprogram

Measurement range

The current measurement range of an SMU is determined by the *measurement range* value. The measurement ranges for *measurement mode* = 2 (current measurements) are shown in the following figure:



[1] When using an SMU connected via the SMU1 port, you can specify a value less than 1E−8 (10 nA) because measurement value accuracy at ranges below the 1E−8 current range is guranteed only at the SMU1 port.

When *measurement mode* = 2 and *measurement range* = 0, Auto-ranging is used. Auto-ranging causes the measurement range to change automatically to a higher or lower range, if required, to provide the highest measurement resolution.

If you specify any other allowed *measurement range*, Limited Auto-ranging is used. Limited Auto-ranging causes the measurement range to change automatically to a higher range, if required, but range changing to a measurement range lower than the initially specified measurement range cannot occur.

By specifying a low *measurement range*, a high resolution current measurement can be achieved. If range changing occurs, the measurement speed decreases because of the wait time for the SMU and the time required for the range to change.

The voltage measurement range of a VM is determined by the *measurement range* value. The voltage measurement range of an SMU is automatically set to the lowest range that includes *V compliance*, which is set in the Set_iv, Set_sync, or Force_i subprogram for the measurement port. The measurement ranges for *measurement mode* = 1 (voltage measurements—SMU or VM) are shown in the following figure:

VM Voltage Ranges for Grounded Measurement Mode and SMU Voltage Range

Unit	Voltage Compliance Setting	Measurement Range
HP 41420A HP 41421B	0 ≤ |value| ≤ 2	40 uV – 2 V: 2
	2 < |value| ≤ 20	400 uV – 20 V: 20
	20 < |value| ≤ 40	800 uV – 40 V: 40
	40 < |value| ≤ 100	2 mV – 100 V: 100
HP 41420A	100 < |value| ≤ 200	4 mV – 200 V: 200
VM (HP 41424A)	Measurement Range Value	
	0	40 uV – 2 V: 2; 2 V – 20 V: 20; 20 V – 40 V: 40
	0 < |value| ≤ 2	40 uV – 2 V: 2
	2 < |value| ≤ 20	400 uV – 20 V: 20
	20 < |value| ≤ 40	800 uV – 40 V: 40

VM Voltage Ranges for Differential Measurement Mode

Unit	Measurement Range Value	Measurement Range and Current Range	Maximum Voltage (VM terminal-Circuit Common)
VM (HP 41424A)	0	4 uV – 0.2 V – 2 V	Max. 40 V
	0 < |value| ≤ 0.2	4 uV – 0.2 V	
	0.2.< |value| ≤ 2	40 uV – 2 V	

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *primary value name* and *secondary value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0.

Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurementvalue = \frac{measurement\ value}{number\ of\ steps - 1} \times (n - 1)$$

Where: *Number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	= 0	I compliance	Same as SMU *output value*
	≠ 0	Range value	
VS	any	20 mA	Same as VS *output value*

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
VM	= 0	2.0 V	Always positive
	≠ 0	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, <source1>, and <source2> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Sweep_iv
[
<meas>  <status>  <source1>  <source2>
<meas>  <status>  <source1>  <source2>
  .   .   .   .   .
<meas>  <status>  <source1>  <source2>
]
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

See Also

Set_iv
Set_sync

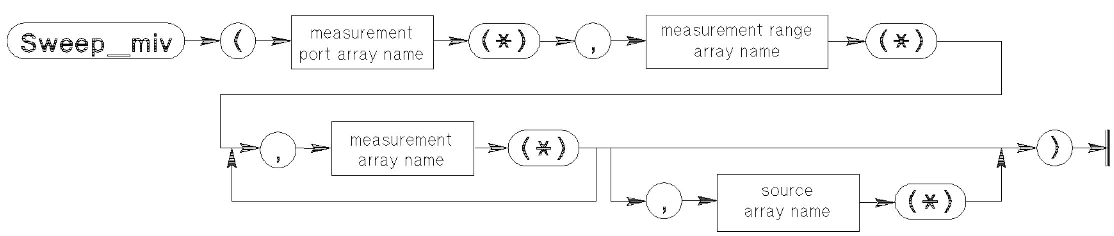
Sweep_miv

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File TIS
Control DCS

This subprogram performs multichannel staircase sweep and multichannel synchronous staircase sweep measurements using up to eight ports at a time, as specified in the *measurement port array*. Note that this subprogram cannot be used for pulsed sweep or staircase sweep with pulsed bias measurements.

For Multichannel Staircase Sweep Measurements:

Syntax



Item	Description/Default	Range Restrictions
measurement port array name [1]	integer array name	any valid name
measurement range array name [1]	numeric array name	any valid name
measurement array name [1]	numeric array name (up to 8 names)	any valid name
source array name [1]	numeric array name	any valid name

[1] Declare these parameters as one dimensional arrays as in the following example:

```
INTEGER Port(x)
DIM Range(x)
DIM Data_1(y)
DIM Data_2(y)
DIM Sweep(y)
```

Where x=number of measurement ports (1 to 8).
y=number of measurement values for each measurement port or number of source values for the source port.

If you specify x measurement ports, you must specify x measurement arrays. Also, y should be larger that the *number of steps* specified in the Set_iv program. If y is smaller, all the measurement and source values cannot be stored in the arrays.

Example Statement

```
Sweep_miv(Port(*),Range(*),Data_1(*),Data_2(*),Sweep(*))
```

Description

This subprogram performs multichannel staircase sweep measurements according to the measurement parameters set in the Set_iv subprogram. Measurements are made at the ports specified in the *measurement port array name* array of this subprogram. Measurement and sweep source values are returned to the *measurement array name* array(s) and *source array name* array, respectively.

Measurement port and measurement range

Before executing this subprogram, you must declare and assign the *measurement port* and *measurement range arrays*.

The *measurement port array* contains the *port address, unit address*, or *pin number* lists of the specified measurement ports. If you assign *port addresses, unit addresses*, or *pin numbers* to the *measurement port array*, the ports indicated by the *port addresses* and the measurement pins indicated by the *pin numbers* must be connected to the measurement units before this subprogram executes.

You can specify the same measurement port in the *measurement port array*. Note that the actual number of measurement ports is less than the number of specified measurement ports.

You must specify the measurement ports in ascending order in the *measurement port array*. That is, if you specify measurement ports as in the following example, measurements will execute at ports 1 and 3, but will *not* execute at ports 2 and 4.

```
INTEGER  Port(1:7)
Port(1) = FNPort(1)
Port(2) = FNPort(3)
Port(3) = FNPort(1)
Port(4) = 0
Port(5) = FNPort(4)
Port(6) = 0
Port(7) = FNPort(2)
```

The measurement mode used is the same as the previous measurement mode set for the measurement port.

Measurement and source arrays

The number of *measurement array name(s)* must equal the number of measurement ports listed in the *measurement port array*. Also, the *measurement array* size must be equal to the *source array* size. The maximum array size for both these arrays is 2002. For more information on these arrays, refer to the description of the Sweep_iv subprogram for staircase sweep measurements.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *primary value name* and *secondary value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0.

Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurement\ value = \frac{measurement\ value}{number\ of\ steps\ -1} \times (n-1)$$

Where *number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
	$= 0$	I compliance	
SMU	$\neq 0$	Range value	Same as SMU/VS *output value*
VS	any	20 mA	

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
	$= 0$	2.0 V	Always positive
VM	$\neq 0$	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, <source1>, and <source2> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Sweep_miv
[
<meas1>  <meas2> · · · <st1>  <st2> · · · <source1>  <source2>
<meas1>  <meas2> · · · <st1>  <st2> · · · <source1>  <source2>
  .   .   .   .   .   .   .
<meas1>  <meas2> · · · <st1>  <st2> · · · <source1>  <source2>
]
```

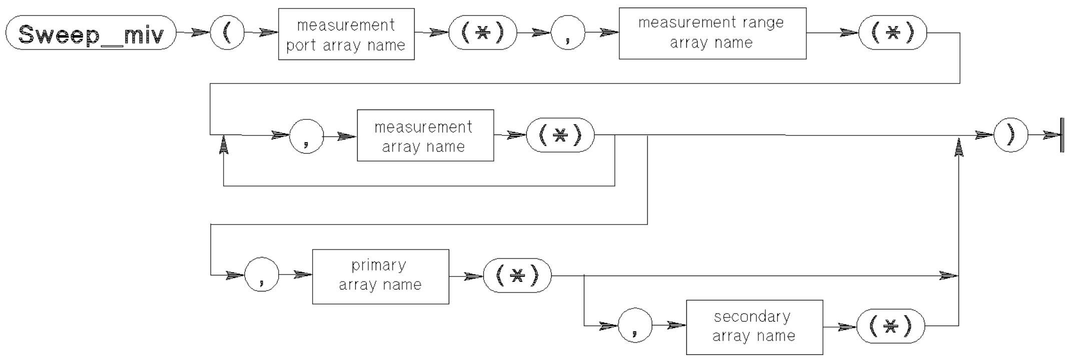
If you do not specify these values, the constant data simulation mode values are used. You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

See Also

Set_iv
Sweep_iv

For Multichannel Synchronous Staircase Sweep Measurements:

Syntax



Item	Description/Default	Range Restrictions
measurement port array name [1]	integer array name	any valid name
measurement range array name [1]	numeric array name	any valid name
measurement array name [1]	numeric array name (up to 8 names)	any valid name
primary array name [1]	numeric array name	any valid name
secondary array name [1]	numeric array name	any valid name

[1] Declare these parameters as one dimensional arrays as in the following example:

```
INTEGER Port(x)
DIM Range(x)
DIM Data_1(y)
DIM Data_2(y)
DIM Primary(y)
DIM Secondary(y)
```

Where x = number of measurement ports (1 to 8).
y = number of measurement values for each measurement port or number of source values for the source port.

If you specify x measurement ports, you must specify x measurement arrays. Also, y should be larger that the *number of steps* specified in the Set_iv program. If y is smaller, all the measurement and source values cannot be stored in the arrays.

Example Statement

```
Sweep_miv(Port(*),Range(*),Meas1(*),Meas2(*),Pri_swp(*))
Sweep_miv(Port(*),Range(*),Meas1(*),Meas2(*),Pri_swp(*),Sec_swp(*))
```

Description

This subprogram performs multichannel synchronous staircase sweep measurements in accordance with the measurement parameters established in the Set_iv and Set_sync subprograms. Measurements are made at the ports specified in the *measurement port array name* array of this subprogram. The measurement, primary sweep, and secondary sweep values are returned to the *measurement array name* array(s), *primary*, and *secondary array name* arrays, respectively.

Measurement port and measurement range

Before executing this subprogram, you must declare and assign the *measurement port* and *measurement range arrays*. The *measurement port array* contains the *port address, unit address*, or *pin number* lists of the specified measurement ports.

You can specify the same measurement port in the *measurement port array*. Note that the actual number of measurement ports is less than the number of specified measurement ports.

You must specify the measurement ports in ascending order in the *measurement port array*. That is, if you specify measurement ports as in the following example, measurements execute at ports 1 and 3, but *not* at ports 2 and 4.

```
INTEGER  Port(1:7)
Port(1) = FNPort(1)
Port(2) = FNPort(3)
Port(3) = FNPort(1)
Port(4) = 0
Port(5) = FNPort(4)
Port(6) = 0
Port(7) = FNPort(2)
```

The measurement mode used is the same as the previous measurement mode set for the measurement port.

Measurement, primary, and secondary arrays

The number of *measurement array name(s)* must equal the number of measurement ports listed in the *measurement port array*. Also, the *measurement array* size must be equal to the *primary* and *secondary array* sizes. The maximum array size for all arrays is 2002.

Primary and secondary values

Sweep_miv also obtains and returns primary and secondary values during a multichannel synchronous staircase sweep measurement. The DCS returns primary sweep values; secondary sweep values are calculated by Sweep_miv and are stored in the *secondary array name*. Secondary value calculation method is the same as that performed by the DCS, as follows:

V sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$Vn = Vstart + \frac{Vstop - Vstart}{N-1}(n-1)$
	double sweep	N + 1 to 2N	$Vn = Vstop - \frac{Vstop - Vstart}{N-1}(n-N-1)$
logarithmic sweep	single sweep	1 to N	$Vn = Vstart \times EXP\left(\frac{\log_e\left(\frac{Vstop}{Vstart}\right)}{N-1}(n-1)\right)$
	double sweep	N + 1 to 2N	$Vn = Vstop \times EXP\left(\frac{\log_e\left(\frac{Vstart}{Vstop}\right)}{N-1}(n-N-1)\right)$

n: the n-th measurement point
N: number of steps determined in Set_iv subprogram

I sweep:

sweep mode		range of n	equation
linear sweep	single sweep	1 to N	$In = Istart + \frac{Istop - Istart}{N-1}(n-1)$
	double sweep	N + 1 to 2N	$In = Istop - \frac{Istop - Istart}{N-1}(n-N-1)$
logarithmic sweep	single sweep	1 to N	$In = Istart \times EXP\left(\frac{\log_e\left(\frac{Istop}{Istart}\right)}{N-1}(n-1)\right)$
	double sweep	N + 1 to 2N	$In = Istop \times EXP\left(\frac{\log_e\left(\frac{Istart}{Istop}\right)}{N-1}(n-N-1)\right)$

n: the n-th measurement point
N: number of steps determined in Set_iv subprogram

For more information on these values, refer to the description of the Sweep_iv subprogram for synchronous staircase sweep measurements.

In Offline Mode (HP 4062UX Only)

This subprogram returns simulated measurement values to the *measurement value name* array, to the *status value name* array, and to the *primary value name* and *secondary value name* valuables. Type of value returned depends on the simulation mode used: constant data or file data simulation mode.

Constant Data Simulation mode:

This subprogram returns source, status, and calculated measurement values. Returned source values are a sequence of linear or logarithmic values in accordance with the *start* and *stop values* specified in the Set_iv or Set_piv subprogram. Status value is always set to 0.

Note that power compliance is not applicable in the offline mode: If *power compliance* is specified in the Set_iv or Set_piv subprogram, it is ignored.

Calculated measurement values are determined by the following equation:

$$nth\ measurement\ value = \frac{measurement\ value}{number\ of\ steps\ -1} \times (n-1)$$

Where *number of steps* is set by the Set_iv or Set_piv subprogram, and measurement value is determined as follows:

For current measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	$= 0$	I compliance	Same as SMU/VS *output value*
	$\neq 0$	Range value	
VS	any	20 mA	

For voltage measurements

Unit	Meas. Range	Measurement Value	Polarity
SMU	—	V compliance	Same as SMU *output value*
VM	$= 0$	2.0 V	Always positive
	$\neq 0$	Range value	Same as *measurement range*

File Data Simulation mode:

This subprogram reads <meas>, <status>, <source1>, and <source2> from the data simulation file and returns these values. The data simulation file format is as follows:

```
Sweep_miv
[
<meas1>  <meas2> · · · <st1>  <st2> · · · <source1>  <source2>
<meas1>  <meas2> · · · <st1>  <st2> · · · <source1>  <source2>
  .   .   .   .   .   .   .
<meas1>  <meas2> · · · <st1>  <st2> · · · <source1>  <source2>
]
```

You can use blank spaces, tabs, or commas to delimit values in a data simulation file.

See Also

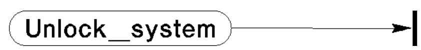
Set_iv
Sweep_iv

Unlock_system

Supported on 4062UX
Revision X.05.50 or later
File TIS
Control —

This subprogram unlocks explicitly locked system instruments.

Syntax



Example Statements

```
Unlock_system
```

Description

This subprogram unlocks the system instruments from the calling process. If the system instruments are not locked explicitly when this subprogram executes, this subprogram is simply ignored.

Explicitly locking cannot be nested.

Unlock_system is ignored in the offline mode.

See Also

Lock_system

Vfp_control

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	VFP
Control	DCS, CMU, SWM

This subprogram enables entry into the VFP control mode.

Syntax

Description

If this subprogram is executed in a user program, control is transferred from the user program to VFP control mode. If you press the (Stop) key, VFP control mode is disabled and user program execution continues from the program line following this subprogram. Refer to chapter 2, "VFP Operation," in the *System Operation Manual* , for complete details on VFP control mode operation.

Vfp_frame

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	VFP
Control	—

This subprogram clears the CRT and displays the VFP.

Syntax

Description

In a user program, the Vfp_frame subprogram must be executed before the VFP_monitor subprogram, as shown in the following example program:

```
100 Vfp_frame
110      .
120      .
130      .
140 Vfp_monitor
150      .
160      .
170      .
180 Vfp_monitor
190      .
200      .
```

The VFP display is the same for the VFP control and monitor modes, except for the softkeys and the C-offset portion of the capacitance measurement section of the display.

Vfp_monitor

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	VFP
Control	—

This subprogram refreshes the VFP display when in the VFP monitor mode.

Syntax

Description

As shown in the Vfp_frame example program, Vfp_monitor can be specified in a user program at any point where refreshing of the display is required.

Vfp_start

Supported on 4062C
Revision C.05.05 or later
File VFP
Control: VFP Timer Board

This subprogram controls the interrupt signals sent from VFP Timer Board.

Syntax

Description

After Vfp_start executes, the CRT is cleared, the VFP is displayed, and interrupt signals are sent from the VFP Timer Board every two seconds to refresh the VFP monitor display. The next time Vfp_start executes, the CRT is cleared and these interrupt signals are disabled. This subprogram is most commonly used as shown in the following programming example.

If this subprogram is executed on the HP 4062UX, nothing occurs.

Programming Example

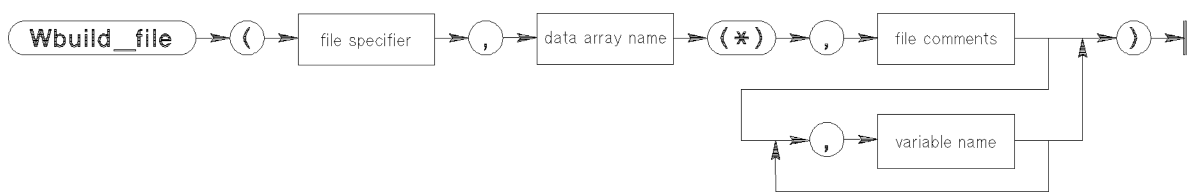
```
10  ON KEY 8 LABEL "VFP MONITOR",10 CALL Vfp_start
20  ON INTR 26,10 CALL Vfp_monitor
30   .  .  .  .
40   .  .  .  .
```

Wbuild_file

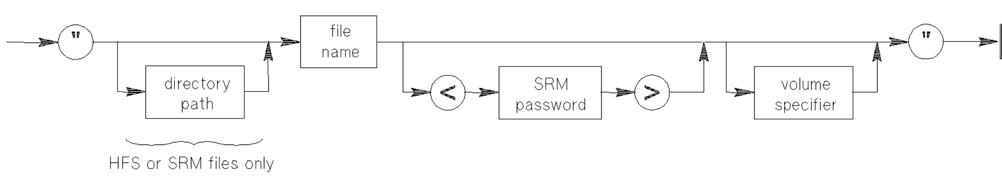
Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	Mass Storage

This subprogram generates and saves multiple parameter measurement data files that conform to the BSDM format (BDAT type). For Rev. C.06.20/X.06.20/P.06.20 or later, this subprogram generates and saves the files that conform also to the DOS data format (DOS or HP-UX type).

Syntax



Literal form of file specifier:



Item	Description/Default	Range Restrictions
file specifier	string expression	(see drawing)
data array name [1]	numeric array	any valid name
file comments	string expression	max. 80 characters
variable name [2]	string expression	max. 10 variables with max. 10 characters for each variable name
directory path	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)
file name	literal	depends on the format of the volume (see Glossary in the *BASIC Language Reference*)

Item	Description/Default	Range Restrictions
SRM password	literal; first 16 nonblank characters are significant	> not allowed
volume specifier	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)

[1] The *data array* must be a two dimensional array with lower boundary (1, 1). If OPTION BASE 1 is included in your program, this condition is automatically set up. If OPTION BASE 1 is not included in your program, you must set up *data array* so that this condition is met.

[2] These *variable names* correspond to rows in the *data array*.

Example Statements

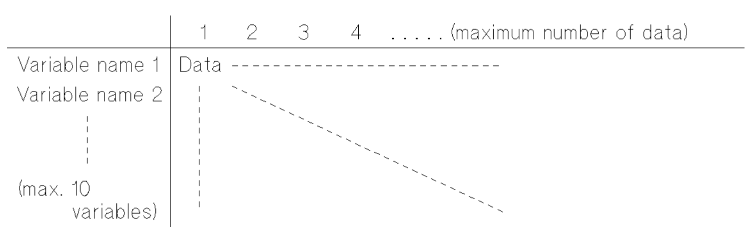
```
Wbuild_file("DATA_1",M_data(*),"MEASUREMENT DATA","Vth","hFE","Cox")
Wbuild_file(File$,all_data(*),Title$,Name_1$,Name_2$,Name_3$,Name_4$)
```

Description

This subprogram converts the *data array* that you set up to a BSDM format data (BDAT type) or a DOS data file, *file comments*, and *variable names* in the specified mass storage device. (DOS data file is supported only by C.06.20/X.06.20/P.06.20 or later.) Each row of *data array* is assigned to a *variable name* by Wbuild_file, so make sure that you set up the *data array* correctly.

This subprogram can be used by itself to create a data file. The *data array* used with this subprogram must be specified as follows:

data array name (number of *variable names*, maximum number of data per variable)



example: `DIM M_data(1:3,1:150)`

Because the maximum number of data items that are allowed by Wbuild_file is 1500, the following expression must be satisfied:

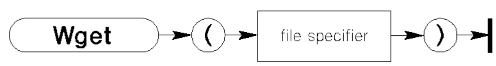
(number of *variable names*) $\times$ (maximum number of data per variable) $\leq$ 1500

Wget

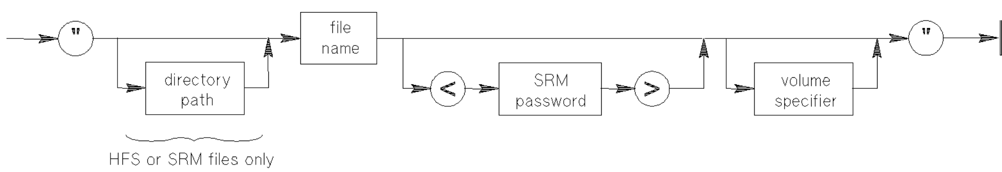
Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	Mass Storage

This subprogram retrieves probing data from a specified probing pattern data file.

Syntax



Literal form of the file specifier:



Item	Description/Default	Range Restrictions
file specifier	string expression	(see drawing)
directory path	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)
file name	literal	depends on the format of the volume (see Glossary in the *BASIC Language Reference*)
SRM password	literal; first 16 nonblank characters are significant	> not allowed
volume specifier	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)

Example Statements

```
Wget("PP_DATA")
Wget(File$)
```

Description

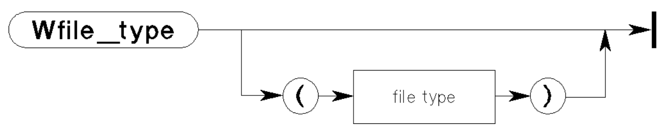
The file specified in this subprogram must be a probing pattern data file previously generated by PPG. This subprogram loads the probing data from the specified file to the COM blocks. Therefore, this subprogram must be executed in a measurement program before any other PCL subprograms can be executed.

Wfile_type

Supported on 4062C, 4062UX, 4062PC
Revision C.06.20 or later, X.06.20 or later, P.06.20 or later
File WAFER
Control —

This subprogram specifies the data file type: BASIC BDAT or DOS text file. The Wsave_data and Wbuild_file subprograms create data files according to this file type setting.

Syntax



Item	Description/Default	Range Restrictions
file type	string expression default = "BDAT"	"BDAT" or "DOS"

Example Statement

```
Wfile_type
Wfile_type("DOS")
```

Description

The Wfile_type subprogram specifies the data file type. When Wfile_type is executed with the parameter "DOS" specified, the data file type is set to DOS text file. When Wfile_type is executed without a parameter or with the parameter "BDAT" specified, the data file type is set to BDAT file formatted for the BSDM software.

The Wsave_data and Wbuild_file subprograms create data files determined by the data file type.

For more information on the DOS text file, see *System Operation*.

See Also

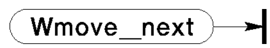
Wsave_data
Wbuild_file

Wmove_next

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	Wafer Prober

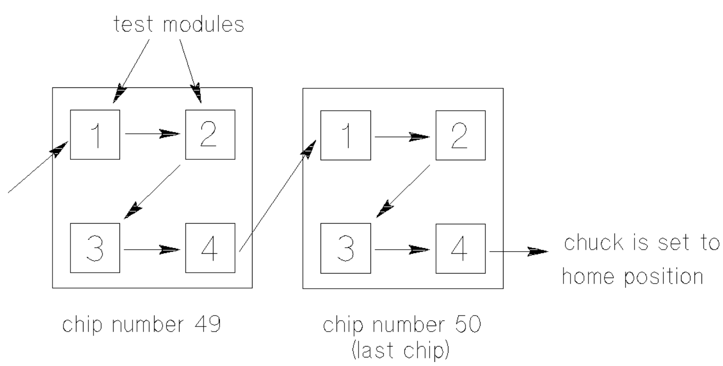
This subprogram moves the wafer prober chuck to the next test module in accordance with the set probing sequence.

Syntax



Description

When this subprogram executes, the wafer prober chuck is set to the next test module specified by the probing sequence established in the probing pattern data file. When the last test module on a wafer is probed, the wafer prober chuck moves to the home position (Phome subprogram is executed by this subprogram). For example, if the probing sequence shown in the following figure is specified, the wafer prober probes the next test module each time Wmove_next is executed.



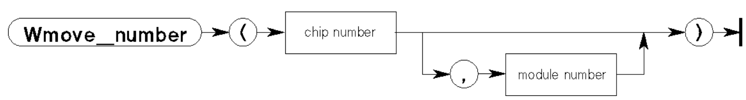
The Wget subprogram and the Wstart_xy or Wstart_number subprogram must be executed in a measurement program before Wmove_next can be executed.

Wmove_number

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	Wafer Prober

This subprogram moves the wafer prober chuck to the specified test module on the specified chip.

Syntax



Item	Description/Default	Range Restrictions
chip number	integer expression	value set by PPG
module number	integer expression default = minimum module number	value set by PPG

Example Statements

```
Wmove_number(3,1)
Wmove_number(Chip_number,Module_number)
```

Description

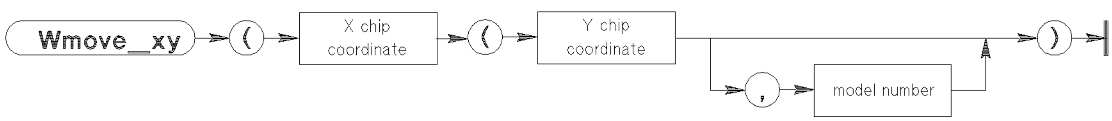
The Wget subprogram and the Wstart_xy or Wstart_number subprogram must be executed in a measurement program before Wmove_number can be executed.

Wmove_xy

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File WAFER
Control Wafer Prober

This subprogram moves the wafer prober chuck to the specified test module on the chip at the specified X-Y coordinates.

Syntax



Item	Description/Default	Range Restrictions
X-chip coordinate	integer expression	value set by PPG
Y-chip coordinate	integer expression	value set by PPG
module number	integer expression default = minimum module number	value set by PPG

Example Statements

```
Wmove_xy(2,2,1)
Wmove_xy(Chip_x,Chip_y,Module)
```

Description

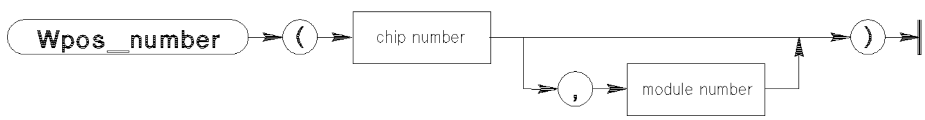
The Wget subprogram and the Wstart_xy or Wstart_number subprogram must be executed in a measurement program before Wmove_xy can be executed.

Wpos_number

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File WAFER
Control —

This subprogram returns the chip number and test module number of the present wafer prober chuck position.

Syntax



Item	Description/Default	Range Restrictions
chip number	integer variable name	any valid name
module number	integer variable name	any valid name

Example Statement

```
Wpos_number(Chip_number,Module_number)
```

Description

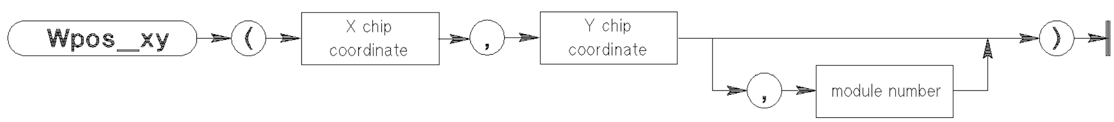
The Wget subprogram and the Wstart_xy or Wstart_number subprogram must be executed in a measurement program before Wpos_number can be executed.

Wpos_xy

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	—

This subprogram returns the X- and Y-chip coordinates and the test module number of the present wafer prober chuck position.

Syntax



Item	Description/Default	Range Restrictions
X-chip coordinate	integer variable name	any valid name
Y-chip coordinate	integer variable name	any valid name
module number	integer variable name	any valid name

Example Statement

```
Wpos_xy(Chip_x,Chip_y,Module)
```

Description

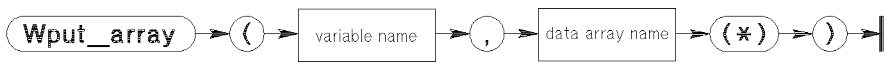
The Wget subprogram and the Wstart_xy or Wstart_number subprogram must be executed in a measurement program before Wpos_xy can be executed.

Wput_array

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File WAFER
Control —

This subprogram transfers a measurement *data array* to the COM blocks and assigns a *variable name* to the data array. COM block data arrays can be combined into a measurement data file by the Wsave_data subprogram.

Syntax



Item	Description/Default	Range Restrictions
variable name	string expression	max. 10 characters
data array name [1]	numeric array name	any valid name

[1] Must be a one dimensional array with lower boundary "1". If OPTION BASE 1 is included in your program, this condition is automatically set up. If OPTION BASE 1 is not included in your program, you must set up *data array* so that this condition is met.

Example Statements

```
Wput_array("hFE",Hfe(*))
Wput_array(Name$,Value(*))
```

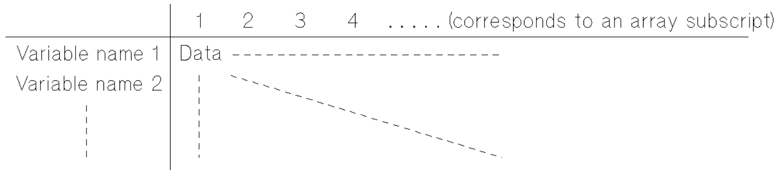
Description

The Wput_array subprogram transfers a user-specified one-dimensional measurement *data array* to the COM blocks of the system, where it is assigned a *variable name*.

When the Wsave_data subprogram executes, data arrays in the COM blocks are combined to create a measurement data file. Refer to the Wsave_data subprogram. A maximum of 50 variable names can be contained in a data file and the maximum allowed number of data in a data file is 1500:

(number of *variable names*) $\times$ (maximum array subscript) $\leq$ 1500

The data file created by the Wsave_data subprogram has the structure shown in the following figure:



Note

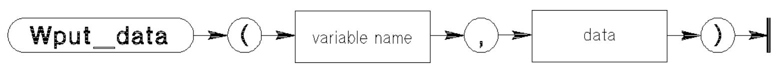
Wput_array and Wput_data cannot be used in the same measurement program.

Wput_data

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File WAFER
Control —

This subprogram transfers a *measurement value* to the COM blocks and assigns it to the specified *variable name*. COM block measurement values assigned to various variable names can be combined into a measurement data file by the Wsave_data subprogram.

Syntax



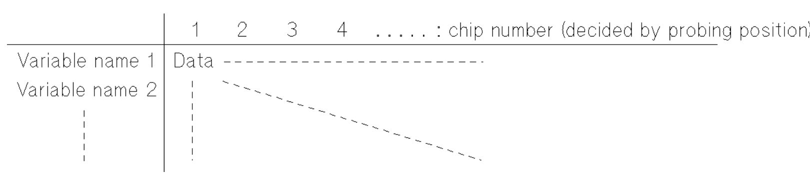
Item	Description/Default	Range Restrictions
variable name	string expression	max. 10 characters
measurement value	numeric expression	

Example Statements

```
Wput_data("Vth",Vth)
Wput_data(Name$,Value)
```

Description

The Wput_data subprogram transfers the *measurement value* to the COM blocks of the system where it is assigned to the specified *variable name* as shown in the following figure:



When this subprogram is used, it must be executed after each measurement. After using Wput_data subprograms to transfer all the desired measurement values to the desired variable names in the COM blocks, execute the Wsave_data subprogram to create a measurement data file from this data. Refer to Wsave_data. This method is ideal for creating measurement data files for wafer mapping, because the measurement values can easily be arranged by chip number order by using the chip number as the loop counter.

A maximum of 50 variable names can be contained in a data file and the maximum allowed number of data in a data file is 1500.

The Wget subprogram and the Wstart_xy or Wstart_number subprogram must be executed in a measurement program before Wput_data can be executed.

Note

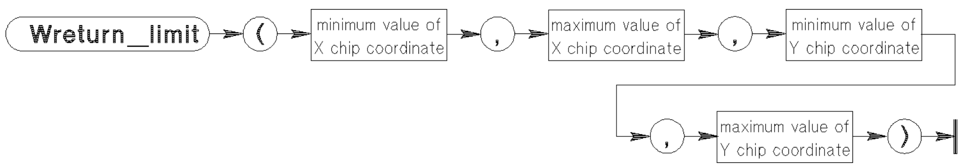
Wput_array and Wput_data cannot be used in the same measurement program.

Wreturn_limit

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	—

This subprogram returns the maximum and minimum values of the X- and Y-chip coordinates from the probing pattern data created by PPG.

Syntax



Item	Description/Default	Range Restrictions
minimum value of X chip coordinate	integer variable name	any valid name
maximum value of X chip coordinate	integer variable name	any valid name
minimum value of Y chip coordinate	integer variable name	any valid name
maximum value of Y chip coordinate	integer variable name	any valid name

Example Statement

```
Wreturn_limit(Xmin,Xmax,Ymin,Ymax)
```

Description

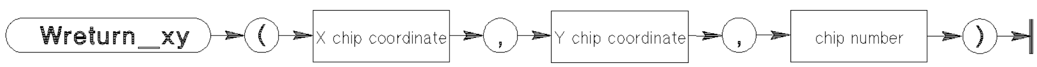
The Wget subprogram must be executed in a measurement program before this subprogram can be executed.

Wreturn_xy

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File WAFER
Control —

This subprogram returns the X- and Y-chip coordinates corresponding to the specified chip number.

Syntax



Item	Description/Default	Range Restrictions
X-chip coordinate	integer variable name	any valid name
Y-chip coordinate	integer variable name	any valid name
chip number	integer expression	value set by PPG

Example Statements

```
Wreturn_xy(X,Y,20)
Wreturn_xy(X_coord,Y_coord,Chip_number)
```

Description

This subprogram returns the X- and Y-coordinates corresponding to the specified chip number. The chip number must have been set up previously in the probing pattern data file created by PPG.

The Wget subprogram must be executed in a measurement program before this subprogram can be executed.

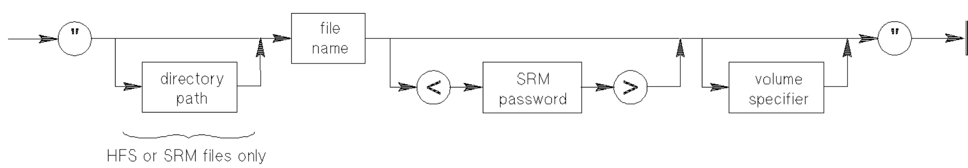
Wsave_data

Supported on 4062C, 4062UX, 4062PC
Revision C.05.05 or later, X.05.50 or later, P.06.20 or later
File WAFER
Control Mass Storage

This subprogram generates measurement data files in conjunction with the Wput_data or Wput_array subprograms.

Syntax

Literal form of the file specifier:



Item	Description/Default	Range Restrictions
file specifier	string expression	(see drawing)
file comments	string expression	max. 80 characters
directory path	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)
file name	literal	depends on the format of the volume (see Glossary in the *BASIC Language Reference*)
SRM password	literal; first 16 nonblank characters are significant	> not allowed
volume specifier	literal	(see MASS STORAGE IS in the *BASIC Language Reference*)

Example Statements

```
Wsave_data("DATA_W1","WAFER MEASUREMENT DATA")
Wsave_data(File$,Title$)
```

Description

Wsave_data creates a measurement data file in a specified mass storage device, and then transfers the data that was stored in the COM blocks by the Wput_data or Wput_array subprogram to this data file, along with any *file comments*. The data files created by this subprogram follow the same format as the BSDM system, and can be used to generate wafer maps and statistical graphs.

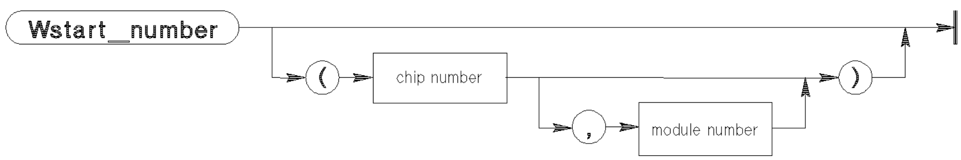
A DOS data file can also be created by this subprogram of Rev. C.06.20/X.06.20/P.06.20 or later, according to the file type setting of the Wfile_type subprogram, and can be used by any other database and data analysis software.

Wstart_number

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	—

This subprogram determines the wafer prober starting position.

Syntax



Item	Description/Default	Range Restrictions
chip number	integer expression default = 1	value set by PPG
module number	integer expression default = minimum module number	value set by PPG

Example Statements

```
Wstart_number(1,1)
Wstart_number(Chip,Module)
```

Description

The *chip number* and *module number* specified in this subprogram must agree with the actual position of the wafer prober before probing begins. For example, if chip 1, module 2 is specified in Wstart_number, the prober must be positioned at chip 1, module 2.

Wstart_number or Wstart_xy must be executed in a measurement program before any of the following subprograms can be executed:

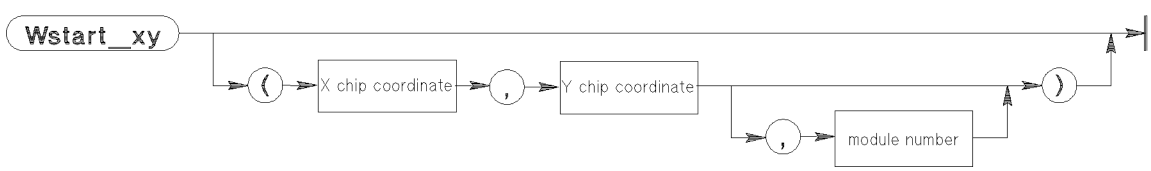
Wpos_number
Wpos_xy
Wmove_next
Wmove_number
Wmove_xy

Wstart_xy

Supported on	4062C, 4062UX, 4062PC
Revision	C.05.05 or later, X.05.50 or later, P.06.20 or later
File	WAFER
Control	—

This subprogram determines the wafer prober starting position.

Syntax



Item	Description/Default	Range Restrictions
X-chip coordinate	integer expression default = X-coordinate values of chip number 1	value set by PPG
Y-chip coordinate	integer expression default = Y-coordinate values of chip number 1	value set by PPG
module number	integer expression default = minimum module number	value set by PPG

Example Statements

```
Wstart_xy(2,2,1)
Wstart_xy(Chip_x,Chip_y,Module)
```

Description

The *X*- and *Y-chip coordinates* and *module number* specified in this subprogram must agree with the actual position of the water prober before probing begins, as in the Wstart_number subprogram.

Wstart_xy or Wstart_number must be executed in a measurement program before any of the following subprograms can be executed:

Wpos_number
Wpos_xy
Wmove_next
Wmove_number
Wmove_xy

A

Error Messages

Introduction

If your HP 4062C/UX detects a hardware failure or an illegal operation, an error message or error code, often both, appears on the system controller's display. Errors are divided into two basic categories: system controller-related and HP 4062C/UX-related, as explained here.

- System Controller Errors

  If a system controller error occurs, a BASIC or BASIC/UX language system error code is displayed, as in the following example:

  ```
  Error 7 in 1250  Undefined function or sub
  ```

  If a system controller hardware failure occurs, a SYSTEM ERROR message is displayed. Refer to the *BASIC* or *BASIC/UX Language Reference Manual* for details on system errors.

- HP 4062C/UX Errors

  If an HP 4062C/UX error occurs, an error message is displayed, as in the following example:

  ```
  TIS ERROR 20 Device not present.
  ERROR 449 IN 10
  ```

  Error message prefixes give the name of the program or subprogram in which the error occurred. In the example above, the error occurred in TIS. In some cases, only an error code is displayed.

This appendix lists all the HP 4062C/UX error messages and includes a partial listing of system controller error codes. For details on system controller error codes, refer to the *BASIC* or *BASIC/UX Language Reference Manual*.

Error Messages Listings

This appendix lists the following HP 4062C/UX system software file error messages:

START, TIS, DVR4284, PGMLIB, VFP, PPG, and DIAG.

Note

If an error occurs when using files other than those listed above, an error code is displayed. If an error occurs when using PARA, however, a TIS error message is displayed.

START Errors

This section lists errors related to your HP 4062C/UX's START program.

- `START ERROR 0 Not authorized to use the software.`
- `START ERROR 0 Not authorized to use the software (some HP-HIL devices locked).`
- `START ERROR 0 Not authorized to use the software. No CODEWORD file found.`

  The ID Module is not connected—or not connected properly—to your system controller, the CODEWORD file does not exist, or the codeword in the CODEWORD file is incorrect.

- `START ERROR 1 SWM/SWC failed power-on test.`
- `START ERROR 2 No pin boards installed in SWM.`
- `START ERROR 3 SWM down. SRQ asserted.`

  A hardware failure occurred during the SWC/SWM power-on self test. Check for one of the following possible causes:

  - A momentary power loss may have occurred.
  - The control cable interconnecting the SWM and SWC is disconnected, making poor contact, or defective.
  - The SWM control bus cable is disconnected, making poor contact, or defective.

  After checking the above, rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

- `START ERROR 4 SWM syntax error. SRQ asserted.`

  The SWC received an illegal program code. Rerun the START program.

- `START ERROR 5 SWM pin board malfunction. SRQ asserted.`

  Pin board failure occurred during the SWC/SWM power-on self test.

- `START ERROR 6 Switching matrix is open.`

  Enable the SWM by installing the Test Fixture Adapter on the SWM (closes the FIXTURE CLOSED DETECT switch) or by pressing and holding the SWM's WAFER PROBER SENSE switch, and rerun the START program.

- `START ERROR 7 This version of switching matrix controller not supported: HP 4084A REV.` *xx.xx*

  HP 4062C/UX supports only the HP 4084B (Rev. 2.0 or later) SWC.

- `START ERROR 10 DCS failed power-on test.`

  A hardware failure occurred during DCS self-test.

- `START ERROR 11 DCS syntax error. SRQ asserted. : Error` *xxx*

  The DCS received an illegal program code. Rerun the START program. The *xxx* above is the DCS's error code. Refer to the HP 4142B's *Operation Manual*, for details on DCS error codes.

- `START ERROR 12 DCS not interlocked. SRQ asserted.`

The interconnect cable assembly is disconnected, making poor contact, or defective. Check these possible causes and rerun the START program.

- `START ERROR 13 DCS shutdown. SRQ asserted.`

  DCS output is disabled because of a momentary power loss or because voltage or current in excess of an SMU's maximum current, voltage, or power was applied to an SMU. Rerun the START program.

- `START ERROR 14 DCS calibration error. SRQ asserted. : Error` *xxx* `in slot` *y*

  A hardware failure occurred during DCS calibration. The *xxx* above is the DCS's error code and *y* is the slot number of the failed module. For example, if the module in slot 1 is not functioning properly, the following error message is displayed.

  ```
  START ERROR 14 DCS calibration error.  SRQ asserted.  : Error 420 in slot 1
  ```

  If this error occurs, contact your system administrator or nearest HP Service Office. For emergency repair, replace or remove the module in the slot indicated and rerun the START program.

- `START ERROR 15 CMS syntax error. SRQ asserted.`
- `START ERROR 16 CMS illegally programmed. SRQ asserted.`
- `START ERROR 17 CMS triggered too fast. SRQ asserted.`

  Check your cabling configuration and BNC shorting cap connections, and rerun the START program.

- `START ERROR 18 CMS sweep/bias error. SRQ asserted.`

  The BNC shorting cap is not connected to the CMS's front panel REMOTE ON/OFF connector. Connect the BNC shorting cap and rerun the START program.

- `START ERROR 19 CMH terminal improperly connected.`
- `START ERROR 19 CMH84 terminal improperly connected.`
- `START ERROR 20 CMH cable connected to CML(AUX4) port on SWM.`
- `START ERROR 20 CMH terminal connected to CML (AUX`*xx*`) port on SWM.`
- `START ERROR 20 CMH84 terminal connected to CML (AUX`*xx*`) port on SWM.`
- `START ERROR 20 CMH terminal connected to AUX`*xx* `port on SWM.`
- `START ERROR 20 CMH84 terminal connected to AUX`*xx* `port on SWM.`
- `START ERROR 21 CML terminal improperly connected.`
- `START ERROR 21 CML84 terminal improperly connected.`
- `START ERROR 22 CML cable connected to CMH(AUX3) port on SWM.`
- `START ERROR 22 CML terminal connected to CMH (AUX`*xx*`) port on SWM.`
- `START ERROR 22 CML84 terminal connected to CMH (AUX`*xx*`) port on SWM.`
- `START ERROR 22 CML terminal connected to AUX`*xx* `port on SWM.`
- `START ERROR 22 CML84 terminal connected to AUX`*xx* `port on SWM.`

The CML or CMH cable is connected to the wrong terminal. Check for proper connection between the CMS and SWM, and rerun the START program.

- `START ERROR 23 CMS INT BIAS switch improperly set.`

  The CMS's INT BIAS switch is set to the ±42 V MAX position. Set the switch to ±100 V MAX and rerun the START program.

- `START ERROR 24 CMS cable impedance incorrect.`

  CMH or CML cable impedance is either too high or too low. Use the cables furnished with the system and rerun the START program.

- `START ERROR 25 CMU84 SRQ. Error code` *xxx*`. Check the cabling configuration and rerun the pcsstart program. * START ERROR 26 Relays for AUX`*yy* `of port expander cannot be controlled.`

  The Port Expander relays can not be controlled because one of the Port Expander relay control boards is either missing or incorrectly installed. The *yy* above refers to the AUX relays controlled. Check the installation and rerun the START program.

- `START ERROR 51 HVU/HCU NOT supported (remove HVU/HCU).`

  This error is reported with a full screen warning message whenever you attempt to install either an HVU or an HCU into the HP 4062UX system. Shared memory space, which is essential to TIS operation, is intentionally destroyed to avoid HVU/HCU operation during TIS programming.

- `START ERROR 90 SYSCONFIG file not found; on-line mode is not available.`

  Since SYSCONFIG does not exist in "/usr/pcs/etc" directory, you can perform only the off-line mode operation.

- `START ERROR 91 The instruments are being used in another session.`

  Another session already locks the instruments. You can perform only the off-line mode operation until the session is stopped or changed to off-line mode.

- `START ERROR 92 HP-IB timeout is detected at address` *xxx*`.`

  An expected interrupt did not occur within the specified limits. Check for one of the following possible causes:

  - The HP-IB cables interconnecting the system controller and instruments were *not* connected, making poor contact, or defective, when the START program executed.
  - Instruments were *not* On when the START program executed.
  - HP-IB Interface was *not* functioning properly.

  After checking the above, rerun the START program. If the same error code is displayed, exit from BASIC/UX and HP-UX, then reload HP-UX and BASIC/UX and rerun the START program.

- `START ERROR 100 DUMCONFIG file (`*xxx*`) not found.`
- `START ERROR 101 Non ASCII character '`*xxx*`' in DUMCONFIG file.`
- `START ERROR 102 Error in DUMCONFIG: File incompletely terminated.`
- `START ERROR 110 Error in DUMCONFIG: Invalid pin description:`
- `START ERROR 120 Error in DUMCONFIG: Invalid DCS configuration description:`

- START ERROR 121 Error in DUMCONFIG: Invalid slot number:
- START ERROR 122 Error in DUMCONFIG: HP 41420A can not be installed in DCS slot 1.
- START ERROR 123 Error in DUMCONFIG: HP 41420A requires slot X to be empty.
- START ERROR 124 Error in DUMCONFIG: Slot X is already occupied by an HP 41420A."
- START ERROR 125 Error in DUMCONFIG: Two or more units assigned in slot X.
- START ERROR 126 Error in DUMCONFIG: Unrecognized module *xxxx*.
- START ERROR 130 Error in DUMCONFIG: Invalid cabling description:
- START ERROR 131 Error in DUMCONFIG: Only Cmu(1) is attachable to CMH port:
- START ERROR 132 Error in DUMCONFIG: Only Cmu(2) is attachable to CML port:
- START ERROR 133 Error in DUMCONFIG: Invalid DCS/CMS unit address:
- START ERROR 134 Error in DUMCONFIG: Invalid SWM port address:
- START ERROR 135 Error in DUMCONFIG: Corresponding unit not installed:
- START ERROR 136 Error in DUMCONFIG: Multiple units are attached to SWM port X.
- START ERROR 137 Error in DUMCONFIG: SMU *xxx* has multiple cabling to SWM ports.
- START ERROR 138 Error in DUMCONFIG: VS *xxx* has multiple cabling to SWM ports.
- START ERROR 139 Error in DUMCONFIG: VM *xxx* has multiple cabling to SWM ports.
- START ERROR 140 Error in DUMCONFIG: Invalid CMS port connection:
- START ERROR 141 Error in DUMCONFIG: Invalid CMU84 port connection: *xxx*.
- START ERROR 142 Error in DUMCONFIG: CMU(*xxx*) has multiple cabling to SWM ports.
- START ERROR 143 Error in DUMCONFIG: CMU84(*xxx*) has multiple cabling to SWM ports.

  The description of DUMCONFIG is not proper. The *xxx* above refers to the unit number. The X refers to a slot or port number. Rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service O ffice.

- START ERROR 201 Illegal command parameter --- *xxx*.

  Rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

- START ERROR 202 Session *xxx*: Permission denied.

  The session that is specified by environment variable PCS_SESSION_ID does not allow accessing. Rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

- START ERROR 203 Session *xxx* busy.

  Another process is making measurements using TIS statements or locks the instruments.

- START ERROR 300 PCS_SESSION_ID not defined.
- START ERROR 301 Session ID *xxxx* too long.
- START ERROR 310 Group 'pcs' not registered.
- START ERROR 320 Non ASCII character '*xxx*' in SYSCONFIG file.

- START ERROR 321 Invalid SYSCONFIG entry.
- START ERROR 322 SYSCONFIG file contains no effective description.
- START ERROR 323 Error in SYSCONFIG: HP-IB select code must be identical.
- START ERROR 324 Error in SYSCONFIG: HP-IB address XXX not identical among components.
- START ERROR 325 Error in SYSCONFIG: Invalid HP-IB address *xxx*.
- START ERROR 326 Error in SYSCONFIG: Invalid select code *xxx*.
- START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as SWM.
- START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as SWC.
- START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as DCS.
- START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as CMS.
- START ERROR 330 Device file /dev/rmb/hpib*xx* not found.
- START ERROR 331 HP-IB interface card not on select code *xxx*.
- START ERROR 332 /dev/rmb/hpib*xx* is not an HP-IB device file.
- START ERROR 333 HP-IB device file /dev/rmb/hpib*xx* is not for select code *xx*.
- START ERROR 334 /dev/rmb/hpib*xx* is not a raw HP-IB device file.
- START ERROR 340 Test session is in bad state; No control terminal.
- START ERROR 341 Can not create session key file; directory /usr/pcs/sessions not found.
- START ERROR 350 Error on pcsstart invocation; *xxx*

  Check for one of the following possible causes:

  - The system software is not installed properly.
  - System files are destroyed.
  - Cluster node is not added properly.

  Contact your system administrator or nearest HP Service Office.
- START ERROR 400 Test session pcs_*xxx* is in bad state.
- START ERROR 401 Test session is in bad state; No shared memory.
- START ERROR 402 Test session is in bad state; No semaphore.
- START ERROR 403 Failed on pcsdaemon invocation. (for X.05.50 only)
- START ERROR 404 Invalid shared memory segment.
- START ERROR 405 Invalid shared memory segment.
- START ERROR 406 Invalid semaphore entity.
- START ERROR 407 Semaphore ID mismatched.
- START ERROR 408 Session ID inconsistent between key file and shared memory.
- START ERROR 409 Daemon process ID mismatched.

- START ERROR 410 Pcsstart co-exists; Shared memory found.
- START ERROR 410 START co-exists; Shared memory found.
- START ERROR 411 Pcsstart co-exists; Semaphore found.
- START ERROR 411 START co-exists; Semaphore found.
- START ERROR 412 Semaphore removed.
- START ERROR 413 The online_lock file seems to be snatched by other session.
- START ERROR 450 Fatal error in pcsstart command.

  Quit the BASIC/UX, log out, log in again, and restart the BASIC/UX. Then execute the START program. If the same error is detected, contact your system administrator or nearest HP Service office.

TIS Errors

This section lists errors related to your system's TIS software.

`ERROR 392`

An illegal value is specified in a TIS subprogram. For example, if you specify "200" in the "Disable_port" subprogram, this is illegal and must be changed. This error also occurs if the COM blocks established during START are lost and you execute a TIS Init_system subprogram. Rerun the START program.

`ERROR 499`

This error code is preceded by one of the following TIS errors:

- `TIS ERROR 1 Not authorized to use the software.`

  The ID Module is not connected—or not connected properly—to your system controller. Correct the connection and rerun the START program.

- `TIS ERROR 10 HP-IB time out error.`

  An expected interrupt did not occur within the specified limits or a system fatal error occurred. For example, an ON TIMEOUT statement is used abnormally in a measurement program. Initialize the system by executing the Init_system subprogram. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

- `TIS ERROR 11 HP-IB SRQ time out error.`

  An expected interrupt did not occur within the specified limits. The system's control settings were changed or your HP 4062C/UX is trying to execute an illegal program operation. For example, a Connect statement is executed with the SWM open. Initialize the system by executing the Init_system subprogram.

- `TIS ERROR 20 Device not present.`

  An instrument that was not present during START (displayed as Not Present) is specified, or the COM blocks are lost. Check the connection between the instruments and rerun the START program.

- `TIS ERROR 21 Invalid port or pin assigned.`

  A port or pin board is illegally specified. For example, a VS is specified in a Force_i statement; or an illegal pin, such as -5, is specified in a Force_v statement.

- `TIS ERROR 22 Improper number of pass parameters specified.`

  In the Sweep_miv subprogram's calling context, the number of measurement ports in the measurement port list is different than the number of measurement data arrays.

- `TIS ERROR 23 Improper size of pass parameters specified.`

  In the Sweep_miv subprogram's calling context, the size of the measurement data arrays is different than the number of sweep points.

- `TIS ERROR 24 Improper pass parameters' value specified.`

  Improper pass parameter value in a feedback measurement subprogram.

- `TIS ERROR 25 Between PREPARE ... EXECUTE, a port is measure-assigned twice.`

One port is assigned to perform two or more functions within one Prepare ... Execute construct. Rewrite the measurement commands and assign only one function to a port within each Prepare ... Execute construct. Initialize your system using the Init_system subprogram.

- `TIS ERROR 26 Do not execute TIS while using DCS program memory library.`

  After invoking a DCS program memory segment with the Run_dcs_program function, you called a regular TIS function. Only an Init_system, Long_cal, Short_cal, or Disable_port function is allowed to be executed after the execution of the DCS program memory segment.

- `TIS ERROR 30 SWM down. SRQ asserted.`

  The SWC or SWM is not functioning properly. Check your cabling configuration and rerun the START program.

- `TIS ERROR 31 SWM syntax error. SRQ asserted.`

  The SWC received an illegal program code. Initialize your system using the Init_system subprogram.

- `TIS ERROR 32 SWM open. SRQ asserted.`

  SWM output is disabled. This may occur if you're using a wafer prober and your SWM is not mounted properly on the prober; if the Test Fixture Adapter is mounted on SWM but its cover is not closed; or if there is nothing mounted on the SWM.

- `TIS ERROR 33 Specified pin board not present. SRQ asserted.`

  A pin board registered during START (pin number displayed) is specified, but cannot be accessed. Check for proper pin board configuration and installation. If you rearranged pin boards, make sure they are properly installed and that the control bus cable is connected.

- `TIS ERROR 34 Pin board not present.`

  A specified pin board is not installed in the SWM. Check for proper pin board configuration and rerun the START program.

- `TIS ERROR 35 (first pin number) >= (last pin number)`

  In the Connect_th subprogram's calling context, the first specified pin number is larger than the last specified pin number.

- `TIS ERROR 40 DCS reports the error code. Error code is` *xxxx*.

  The DCS received an illegal program code. Initialize your HP 4062C/UX using the Init_system subprogram. The *xxxx* is the DCS's error code.

- `TIS ERROR 41 DCS not interlocked. SRQ asserted.`

  The interconnect cable assembly is disconnected and an attempt was made to output voltage in excess of ±42 V. Connect the cable assembly.

- `TIS ERROR 44 VS output voltage incompatible with set voltage range.`

  A VS's specified output voltage exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

- `TIS ERROR 45 SMU compliance incompatible with set source or set range.`

- `TIS ERROR 45 Improper SMU current source, range, or compliance specified.`

The specified compliance value of an SMU is too large for the selected range or specified output value. Decrease the current compliance or the output value, or increase the voltage range setting.

- `TIS ERROR 46 Illegal sweep power-compliance specified.`

  In the Set_iv subprogram's calling context, the specified power compliance is larger than the SMU's maximum output power. Decrease the power compliance setting.

- `TIS ERROR 47 Start and stop value are not same polarity.`

  In the Set_iv subprogram's calling context, the start value and stop value for a current sweep measurement must be the same polarity.

- `TIS ERROR 49 Illegal SMU measurement function assigned.`

  During a sweep or pulsed measurement, an SMU is set to the wrong mode for the specified measurement. SMUs must be set to VS mode for current measurements, and IS mode for voltage measurements.

- `TIS ERROR 50 Target value incompatible with compliance value.`

  In the Set_asearch, Set_bsearch, or Set_lsearch subprograms' calling context in the measurement mode, the target value is larger than the sense unit's compliance value.

- `TIS ERROR 51 This port must be the same V/I mode as the control variable.`

  In the Set_sync subprogram's calling context, the search port's and synchronous search port's output modes (VS or IS) must be the same.

- `TIS ERROR 52 Improper search offset value specified.`

  MAX(|minimum control value| or |start value|) and MAX(|maximum control value| or |stop value|) + |offset| must be within the search unit's range.

- `TIS ERROR 53 Sense port must be different from search port.`

  In the Set_asearch subprogram's calling context, the search and sense ports are both specified (illegally) as the same port (unit).

- `TIS ERROR 54 Target value out of range.`

  The specified target value exceeds the sense unit's measurement range.

- `TIS ERROR 55 Illegal search v_range, time, and speed combination specified.`

  In the Set_asearch subprogram's calling context, the start value, stop value, ramp rate, and feedback integration time settings are incompatible.

- `TIS ERROR 56 SMU output voltage incompatible with set voltage range.`

  An SMU's specified output voltage exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

- `TIS ERROR 57 Analog Feedback Unit (AFU) not present.`

  The AFU is specified for use in a measurement, but is not registered during START, or the COM blocks are lost. Make sure your AFU is installed in the DCS and rerun the START program.

- `TIS ERROR 58 Pulse period incompatible with pulse width.`

The specified pulse width is greater than 50% of the specified pulse period. Decrease the pulse width or increase the pulse period.

- `TIS ERROR 59 Improper DCS sweep, search, and pulse settings.`

  In a sweep, search, or pulsed measurement, the measurement execution subprogram executed before you established the measurement conditions. For example, a Sweep_iv subprogram executed before its corresponding Set_iv subprogram executed.

- `TIS ERROR 60 Improper search values (start_value and stop_value) specified.`

  In the Set_asearch subprogram's calling context, start and stop values must satisfy the following conditions:

  |start value|≤2 and |stop value|≤2, then |start − stop value|≤2
  |start value|≤20 and |stop value|≤20, then |start − stop value|≤20

- `TIS ERROR 61 Base_value and peak_value are not same polarity.`

  In a pulsed current measurement, the specified pulse base and peak values must be of the same polarity.

- `TIS ERROR 62 Specified VM is still set to Differential Voltage Measurement mode.`

  In a pulsed measurement, a VM's differential voltage measurement mode cannot be used.

- `TIS ERROR 63 Sync range adjustment error.`

  The synchronous search port's range must be the same as the search port's range. Also, the synchronous search port cannot be set to a range equal to MAX(|maximum search value| or |stop value|) and MAX(|minimum search value| or |start value|) + |offset|.

- `TIS ERROR 64 Cannot specify zero (0) specified for sweep or bias&sweep.`

  In a pulsed sweep or sweep with pulsed bias measurement, you cannot set the pulse period to 0.

- `TIS ERROR 65 Improper pulse measurement pass parameter specified for Set_iv.`

  In the Set_iv subprogram's calling context, the specified compliance value is invalid or the logarithmic sweep mode is specified.

- `TIS ERROR 66 Improper pulse measurement range specified.`

  In a pulsed current measurement, the specified current range is too low for the voltage range set. If the voltage range is larger than 2 V, the current range must be ≥ 1E-4 A.

- `TIS ERROR 68 Set_sync and Set_iv cannot specify the same port.`

  The Set_sync and Set_iv subprograms cannot specify the same port.

- `TIS ERROR 69 Set_sync cannot be used with Set_piv or Set_pbias.`

  The secondary sweep parameter cannot be used with pulsed or pulsed bias sweep measurements.

- `TIS ERROR 70 Start or Stop value is out of minimum resolution.`

  Unsuitable start or stop values are set in the Set_iv subprogram, or unsuitable offset or ratio is set in the Set_sync subprogram.

- `TIS ERROR 71 VS cannot be used if the primary SMU is current source mode.`

When using a VS as a secondary sweep source, the VS and SMU must be the same source mode.

- `TIS ERROR 72 Set_sync cannot occur before Set_iv.`
- `TIS ERROR 72 Set_sync cannot be used before primary search or sweep setup.`

The primary sweep port must be set before the secondary sweep port is set.

- `TIS ERROR 73 The secondary sweep port is not set.`

The secondary sweep port must be set before the secondary sweep array name is specified.

- `TIS ERROR 74 In high voltage state, output relay can't be disconnected.`
- `TIS ERROR 75 In high voltage state, output relay can't be connected.`

DCS cannot disconnect or connect the output relay when the output voltage is more than 42 V.

- `TIS ERROR 76 Source SMU or VS unit is masked.`

The specified DCS's module is masked by Ch_sw_off statement. Unmask the module by running the START program or executing the Init_system, Long_cal, or Short_cal subprograms.

- `TIS ERROR 77 TIS cannot be used with this revision.`

Quasi-pulsed measurements are available for HP 4142B Rev. 4.0 or later.

- `TIS ERROR 80 CMS syntax error. SRQ asserted.`
- `TIS ERROR 81 CMS illegally programmed. SRQ asserted.`

The CMS received an illegal programming code. Initialize your HP 4062C/UX using the Init_system subprogram.

- `TIS ERROR 82 CMS triggered too fast. SRQ asserted.`

The CMS received a trigger signal while outputting measurement data from the previous measurement. Make sure that nothing is connected to the CMS's rear panel EXT TRIGGER terminal.

- `TIS ERROR 83 CMS sweep/bias error. SRQ asserted.`

The BNC shorting cap was removed from the CMS's front panel REMOTE ON/OFF connector. Connect the BNC shorting cap and initialize your HP 4062C/UX using the Init_system subprogram.

- `TIS ERROR 84 CMS output voltage incompatible with set voltage range.`

The CMS's specified output voltage exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

- `TIS ERROR 85 CMU84 reports an SRQ. Error code is` *xxxx*`.`

The CMU84 caused a service request. The *xxxx* is the error code of the CMU84. For the error code, see the *HP 4284A Operation Manual*.

- `TIS ERROR 86 CMU84 Option 001 is not present.`

In order to force arbitrary voltage by the HP 4284A (CMU84), the HP 4284A must be furnished with Option 001.

- TIS ERROR 94 `Voltage difference between start and stop is less than 10 V.`

  The conditions for Set_bdv or Set_ileak are not being met.

  For the Set_bdv function, the start and stop values must satisfy the following conditions:

  - Stop $\geq$ start + 10

  For the Set_ileak function, the start and stop values must satisfy the following conditions:

  - Start $\leq$ voltage − 10

- TIS ERROR 95 `Measure_bdv can not be used before Set_bdv.`

  You called the Measure_bdv function before setting up the measurement conditions with the Set_bdv function.

- TIS ERROR 96 `Measure_ileak can not be used before Set_ileak.`

  You called the Measure_ileak function before setting up the measurement conditions with the Set_ileak function.

- TIS ERROR 100 `This TIS subprogram is not supported by off-line mode.`

  A TIS subprogram that is not supported by off-line mode is used.

- TIS ERROR 101 `Specified file cannot be opened.`

  The file specified by the Off_line_data subprogram cannot be opened. One of the following may be the cause:

  - The file does not exist.
  - The directory pathname is incorrect.

- TIS ERROR 102 `Specified file cannot be opened.`

  The file specified by the Data_creation subprogram cannot be created. One of the following may be the cause:

  - A file with the same name already exists and is protected.
  - The directory pathname is incorrect.

- TIS ERROR 103 `Invalid file data is found.`

  While reading the data from the file, invalid data are found. Check for one of the following possible causes:

  - TIS subprogram name is not proper: The TIS subprogram that is executed in the program is different from the TIS subprogram that is declared in the file, a name that is not TIS subprogram name is detected, or not allowable characters are used.
  - Measurement data are not proper: data that are not number are detected or not allowable separators are used.
  - Data that is specified in option parameter does not exist in the file.
  - During reading the data, the end of file has come.

- TIS ERROR 200 `No test session; TIS is used before START program.`

  TIS subprograms are called before the START program is executed.

- TIS ERROR 201 `Permission denied to access this session.`

The session that is specified by environment variable PCS_SESSION_ID does not allow accessing. Rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

- `TIS ERROR 202 Session locked.`

  Another process in the same session locks the instruments.

- `TIS ERROR 203 Test session not ready; TIS in used after START failed.`

  TIS subprograms are called after the START program is failed.

- `TIS ERROR 204 Number of session processes exceeds the system limit.`

  More than 11 processes in one session call the TIS subprograms.

- `TIS ERROR 205 No valid HP-IB address; TIS is used after START failed.`

  TIS subprograms are called after the START program is failed.

- `TIS ERROR 220 PCS_SESSION_ID not defined.`
- `TIS ERROR 221 Session identifier too long.`
- `TIS ERROR 222 Failed to attach shared memory.`

  System software is not installed or customized properly. Contact your system administrator or nearest HP Service Office.

- `TIS ERROR 240 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 241 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 242 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 243 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 244 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 245 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 246 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 247 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 248 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 249 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 250 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 251 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 252 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 253 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 254 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 255 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 256 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 257 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 258 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 259 Fatal error ( errno =` *xxx* `)`

- `TIS ERROR 260 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 261 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 262 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 263 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 264 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 265 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 266 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 267 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 268 Fatal error ( errno =` *xxx* `)`
- `TIS ERROR 269 Fatal error ( errno =` *xxx* `)`

  A fatal system error occurred. The *xxx* above is the system call's error code. Contact your system administrator or nearest HP Service Office.

DVR4284 Errors

This section lists errors related to your system's DVR4284 subprograms. DVR4284 errors are only for Rev. C.05.05, C.05.10, C.05.60, C.05.70, X.05.50 and X.05.61.

- `DVR4284 ERROR 1 HP 4284A driver is not initialized yet.`

  The START program has not been run or the COM blocks are lost. Run the START program.

- `DVR4284 ERROR 2 HP 4284A caused an SRQ. Error code is` *zzzzz*.

  A hardware failure occurred. The *zzzzz* above is the CMU84's error code. Refer to the HP 4284A's *Operation Manual*.

- `DVR4284 ERROR 3 Improper Switching Matrix Model.`

  An unexpected error occurred. Contact your system administrator or nearest HP Service Office.

- `DVR4284 ERROR 4 HP 4284A is not present.`

  The CMU84 was not present during START (displayed as Not present) or the COM blocks are lost. Check the connection between the CMU84 and rerun the START program.

- `DVR4284 ERROR 5 Improper Switching Matrix connection.`

  Check your cabling configuration and rerun the START program.

- `DVR4284 ERROR 6 Option #001 is missing.`

  CMU84 is not installed Option 001 Power Amplifier/DC Bias. In this case,

  You can not use Set_cv84 and Sweep_cv84 subprograms.

  The test signal level is limited to 5 mV to 2 V.

  The internal dc bias is fixed to 0 V, 1.5 V, or 2 V.

- `DVR4284 ERROR 7 Improper Integration Time parameter.`

  In the Set_cmu84, the specified measurement integration time value is invalid.

- `DVR4284 ERROR 8 Improper Averaging Time parameter.`
- `DVR4284 ERROR 9 Improper Mode parameter.`

  An unexpected error occurred. Contact your system administrator or nearest HP Service Office.

- `DVR4284 ERROR 10 Improper Signal Level parameter.`

  In Set_cmu84, the specified test signal level value is invalid.

- `DVR4284 ERROR 11 Improper DC Bias parameter.`

  In Force_v84, the specified internal dc bias source value is invalid.

- `DVR4284 ERROR 12 Improper Measurement Function parameter.`

  An unexpected error occurred. Contact your system administrator or nearest HP Service Office.

- `DVR4284 ERROR 13 Improper Frequency parameter.`

In Frequency84, the specified measurement frequency value is invalid.

- `DVR4284 ERROR 14 Improper Hold/Delay Time parameter.`

  In Set_cv84, the specified hold time or delay time value for the C·G-v sweep measurements is invalid.

- `DVR4284 ERROR 15 Improper Sweep Step parameter.`

  In Set_cv84, the specified number of steps value for the C·G-V sweep measurement is invalid.

- `DVR4284 ERROR 16 Improper Sweep Bias parameter.`

  In Set_cv84, the specified start voltage or stop voltage value is invalid.

PGMLIB Errors

This section lists errors related to the DCS Program Memory Library (PGMLIB). You need to use the error handling facilities of the C Library and the HP 4062UX to see the PGMLIB error numbers and messages.

- `PGMLIB ERROR 1 Pgm_start is not declared.`

  DCS Program Library functions, such Pgm_force_v, are used before the Pgm_start function.

- `PGMLIB ERROR 2 Pgm_start is nested.`

  Pgm_start is called twice before the first Pgm_start is ended by a Pgm_end function.

- `PGMLIB ERROR 20 Device not present.`

  The DCS is not on line; that is, it is not recognized by the START program.

- `PGMLIB ERROR 21 Invalid port assigned.`

  An invalid port address or a unit address is specified to the function. Note that a SWM pin number is not accepted as the unit specifier for the PGMLIB functions.

- `PGMLIB ERROR 24 Improper pass parameter specified.`

  The parameter value passed is incompatible with the corresponding range restrictions.

- `PGMLIB ERROR 100 Error in Pcs_hpib_open.`
- `PGMLIB ERROR 101 Error in Pcs_hpib_output.`
- `PGMLIB ERROR 102 Error in Pcs_hpib_enter.`
- `PGMLIB ERROR 103 Error in Pcs_hpib_clear.`
- `PGMLIB ERROR 104 Error in Pcs_hpib_spoll.`

  The PGMLIB functions failed to operate on the HP-IB. Check the connection of the HP-IB.

VFP Errors

This section lists errors related to your HP 4062C/UX's VFP function.

- `WARNING 1 SWM open`

  SWM output is disabled. This may occur if you're using a wafer prober and your SWM is not mounted properly on the prober; if the Test Fixture Adapter is mounted on SWM but its cover is not closed; or if there is nothing mounted on the SWM.

- `WARNING 2 DCS shutdown`

  DCS output is disabled because of a momentary power loss or because voltage or current in excess of an SMU's maximum current or voltage is applied to an SMU. Initialize your HP 4062C/UX using the Init_system subprogram.

- `WARNING 3 DCS not interlocked`

  The interconnect cable assembly is disconnected and an attempt was made to output voltage in excess of ±42 V. Connect the cable assembly.

- `VFP ERROR 1 Improper cursor position`

  The cursor is not positioned correctly for the parameter being set, or you pressed the wrong key when changing a parameter. This error occurs under the following circumstances:

  - If you select the `[   ]` softkey when the cursor is *not* positioned in a `[   ]` field.
  - If you press a numeric key or the space bar when the cursor is positioned in a `[   ]` field.
  - If you select the `[   ]`, `EXECUTE ON / OFF`, or `MEAS / NOT MEAS` softkey when the cursor is positioned in the PIN CONNECTION area.
  - If you rotate the keyboard's rotary knob when output is enabled (EXEC mode) and the cursor is *not* positioned in an output value field.

  Note that you *cannot* change the cursor's position when the EXEC mode is enabled.

- `VFP ERROR 2 Illegal value`

  A value exceeding a parameter's specified limits was entered.

- `VFP ERROR 3 Not allowed while OFF status`

  While in the EXEC mode, an attempt was made to sweep the output of a source device (an SMU, a VS, or the CMS's internal dc bias source) that was set to Off. Set the source device to On by exiting from the EXEC mode and selecting the `EXECUTE ON / OFF` softkey.

- `VFP ERROR 4 Not allowed while ON status`

  An attempt was made to change the voltage range or compliance setting of a source device (an SMU or the CMS's internal dc bias source) that was set to On. Set the source device to Off by selecting the `EXECUTE ON / OFF` softkey before changing parameters.

- `VFP ERROR 5 Not allowed in EXEC mode`

  While in the EXEC mode, an attempt was made to change a control setting, or you pressed a key or selected a softkey other than the `EXECUTE ON / OFF` softkey.

- `VFP ERROR 6 Return (or Enter) key was not pressed`

A parameter is set or a control setting is changed, but not entered, because you did not press (Return) or (Enter).

- `VFP ERROR 7 DCS output voltage incompatible with set voltage range`

  An SMU's specified output voltage exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

- `VFP ERROR 8 SMU voltage compliance incompatible with set current value`

  The product of an SMU's compliance setting multiplied by the SMU's specified output value exceeds the SMU's maximum power. Decrease either the compliance setting or the specified output value.

- `VFP ERROR 9 SMU current compliance incompatible with set voltage value`

  An SMU's specified current compliance setting is too high for the selected voltage range. Decrease the current compliance setting or increase the voltage range setting.

- `VFP ERROR 10 CMS output voltage incompatible with set voltage range`

  The CMS's specified output voltage exceeds the selected dc bias range. Decrease the output voltage or increase the voltage range setting.

- `VFP ERROR 11 Illegal key`

  A key other than a VFP control key was pressed.

- `VFP ERROR 12 DCS not present`

  The DCS was not registered during START (displayed as Not Present) and an attempt was made to operate the DCS. Make sure the DCS is turned on and the HP-IB cable is connected. Rerun the START program.

- `VFP ERROR 13 CMS not present`

  The CMS was not registered during START (displayed as Not Present) and an attempt was made to operate the CMS. Make sure the CMS is turned on and the HP-IB cable is connected. Rerun the START program.

- `VFP ERROR 14 SWM not present`

  The SWM was not registered during START (displayed as Not Present) and an attempt was made to operate the SWM. Make sure the SWC is turned on and the HP-IB cable is connected. Rerun the START program.

- `VFP ERROR 15 Pin board not present`

  A pin board not registered during START (pin number not displayed) is specified. Check for proper pin board configuration and installation. If you rearranged pin boards, make sure they are properly installed and that the control bus cable is connected. Rerun the START program.

- `VFP ERROR 16 System is already locked, not allowed to enter Control mode.`

  The `Lock & Control` softkey is selected while another process locks the instruments.

PPG Errors

This section lists errors related to your HP 4062C/UX's PPG.

- `PPG ERROR 1 Printer timeout.`

  A printer is not connected, or the HP-IB address of the printer is not set to 1. Make sure a printer is connected and that its HP-IB address is 1.

- `PPG ERROR 6 File name is not specified.`

  The file name is not specified when you save the probing pattern data.

- `PPG ERROR 7 Duplicate file name. Overwrite or Abort ("O", "o": others) ?`

  The specified file name already exists in the directory when you save the probing pattern data.

- `PPG ERROR 8 Max. module number is too large.`

  The maximum module number exceeds the allowable limits because the specified module size is too small. Re-enter the appropriate module size.

- `PPG ERROR 11 Chip size > Wafer size`

  The specified chip size is too large for the specified wafer size. Re-enter the appropriate chip size.

- `PPG ERROR 12 Number of chips is too large ( MAX X=255 Y=255 )`

  The calculated number of chips exceeds the allowable limits (max. 255 for the X-coordinate; 255 for the Y-coordinate) because the specified chip size is too small. Re-enter the appropriate chip size.

- `PPG ERROR 13 Module size * Module number > Chip size`

  The module size multiplied by the module number exceeds the specified chip size. The specified module size is too large or the chip size is too small. Re-enter the appropriate module or chip size.

- `PPG ERROR 14 Module size > Chip size`

  The module size exceeds the specified chip size. The specified module size is too large or the chip size is too small. Re-enter the appropriate module or chip size.

- `PPG ERROR 15 Probing sequence number must be 1 to 6`

  The probing sequence number exceeds the allowable limits. The probing sequence number must be 1 through 6. Re-enter the appropriate probing sequence number.

- `PPG ERROR 16 Wafer size must be 0.1 to 99.99999 inches`

  The wafer size exceeds the allowable limits. The wafer size must be 0.1 through 99.99999 inches. Re-enter the appropriate wafer size.

- `PPG ERROR 17 Chip X-Y size must be 1 to 99999 microns.`

  The X- or Y- chip size exceeds the allowable limits. The X- and Y- chip size must be 1 through 99999 microns. Re-enter the appropriate chip size.

- `PPG ERROR 18 Module X-Y size must be 1 to 99999 microns.`

The X- or Y- module size exceeds the allowable limits. The X- and Y- module size must be 1 to 99999 microns. Re-enter the appropriate module size.

- `PPG ERROR 19 Number of X-Y modules must be 1 to 6.`

  The X- or Y- module number exceeds the allowable limits. The X- and Y- module number must be 1 through 6. Re-enter the appropriate module number.

- `PPG ERROR 21 Illegal input`

  An attempt was made to enter a value that exceeds the specified limits.

- `PPG ERROR 22 No modules have been selected`

  No modules are selected. You must select at least one module. To select modules individually, place the cursor at the desired module and select the `SELECT` softkey. To select all modules, select the `SELECT ALL` softkey.

- `PPG ERROR 26 Number of selected chips is too large. (MAX 32760)`

  The calculated number of chips exceeds the allowable limits (max. 32760) because the specified chip size is too small. Re-enter the appropriate chip size.

- `PPG ERROR 27 No chips have been selected`

  No chips are selected. You must select at least one chip. To select chips individually, place the cursor at the desired chip and select the `SELECT` softkey. To select all chips, select the `SELECT ALL` softkey.

- `PPG ERROR 28 X or Y (No.` *xxx*`) not set. Enter missing value, or delete (no.` *xxx*`).`

  The X- or Y- coordinate is not entered. The *xxx* above is the module number. Enter the appropriate coordinate or delete it.

- `PPG ERROR 31 Wget is not declared`

  The Wget subprogram is not included in your measurement program, or is placed out of sequence. The Wget subprogram must precede the Wstart_number or Wstart_xy subprogram.

- `PPG ERROR 32 Improper number of pass parameters specified`

  Only one coordinate (X- or Y-) is specified in the Wstart_xy subprogram. You must specify both X- and Y-coordinates.

- `PPG ERROR 33 Wstart_xy or Wstart_number is not declared`

  The Wstart_number or Wstart_xy subprogram is not included in your measurement program, or did not precede a Wmove_next, Wmove_number, or Wmove_xy subprogram.

- `PPG ERROR 34 Illegal chip coordinate`

  The X- and Y-chip coordinates specified in the Wmove_xy subprogram designate a non-existent chip.

- `PPG ERROR 35 CHIP not registered`

  A chip not registered during the WAFER configuration stage is specified in a Wmove_number or Wmove_xy subprogram. Execute PPG and register the chip, or delete all references to the chip in your Wmove_number or Wmove_xy subprogram.

- `PPG ERROR 36 MODULE not registered`

A module not registered during the CHIP configuration stage is specified in a Wmove_number or Wmove_xy subprogram. Execute PPG and register the chip, or delete all references to the chip in your Wmove_number or Wmove_xy subprogram.

- `PPG ERROR 41 Illegal VAR NAME ( no VAR NAME in DATA file )`

  A VAR NAME not listed in the data file is specified.

- `PPG ERROR 42 Illegal LIMIT value`

  One or all of the wafer map LIMIT values is specified out of sequence. For example, the uppermost LIMIT value must be $\geq$ the second LIMIT value; the second LIMIT value must be $\geq$ the third LIMIT value, and so on.

- `PPG ERROR 43 Illegal COORDINATE value`

  The X- or Y-axis of the wafer map is improperly scaled. For example, the X-axis minimum value is greater than the X-axis maximum value.

- `PPG ERROR 44 Illegal input ( MAX COLUMN=xx  ROW=yy )`

  The value specified for the X- or Y-axis of the wafer map exceeds the allowable limit (max. xx for the X- [COLUMN] axis, yy for the Y- [ROW] axis).

- `PPG ERROR 71 Illegal DATA file ( MIN Nv=3 )`

  The minimum number of variables (Nv) required for generation of a wafer map is not specified in the data file. At least three (3) variables must be specified (COLUMN, ROW, and measurement data).

- `PPG ERROR 72 Illegal DATA file ( Vn$(1)="COLUMN"  Vn$(2)="ROW" )`

  Illegal string variable is specified. VN$(1) must be “COLUMN” and VN$(2) must be “ROW.”

- `PPG ERROR 73 Illegal DATA NAME in SUB Wput_data or SUB Wput_array`

  Null data (” ”) is specified as the string variable (DATA NAME) in a SUB Wput_array or SUB Wput_data subprogram.

- `PPG ERROR 74 DATA NAME overflow`

  The number of characters specified in the data file name exceeds the allowable limit (max. 50 characters).

- `PPG ERROR 75 DATA number overflow`

  The number of data file variables multiplied by the number of chips exceeds the allowable limit (max. 1500).

- `PPG ERROR 78 Illegal File Type.`

  The file type specifier in the Wfile_type subprogram is not correct. Check the parameter of Wfile_type.

Note

BASIC/UX Language System errors occurring in PPG are displayed between two graphics arrows, as in the following example:

```
====> ERROR 53 IN 1950 Improper file name <====
```

For details on BASIC/UX errors, refer to the *BASIC* or *BASIC/UX Language Reference Manual*.

Diagnostics (DIAG) Errors

This section lists errors related to the HP 4062C/UX's DIAG software.

- `DIAG. ERROR 10 Switching Matrix not ready.`

  The SWC is not turned on, or the HP-IB cable is not connected (SWC displayed as Not Present during START). Stop the program, check the power and the HP-IB cable, and select the `RUN` softkey.

- `DIAG. ERROR 11` (Switching Matrix error)

  A relay failure is detected in the SWM. The displayed error message indicates the failure location. Make sure the Relay Test Adapter is installed securely on the SWM, and select the `RETRY` softkey.

  If the same error occurs at the same location, contact your nearest HP Service Office. If emergency repair is necessary, replace the defective pin board. See the *System Information* manual for details on replacing pin boards.

  If a DIAG. ERROR 11 followed by the message `A relay is stuck ...` is displayed, you may be able to repair the relay itself. See the *System Information* manual for details.

  Whenever a relay failure occurs, repair or remove the faulty pin board and rerun the relay test to check for additional failures.

- `DIAG. ERROR 12 Leakage in Switching Matrix.`

  Excessive leakage current is detected in the SWM, or in the cabling to the SWM. Contact your nearest HP Service Office.

- `DIAG. ERROR 13 Leakage in Switching Matrix.`

  Excessive leakage current is detected on a pin board. If a test fixture is mounted in the Test Fixture Adapter, remove the fixture and select the `RETRY` softkey. If the same error occurs, contact your nearest HP Service Office.

- `DIAG. ERROR 14 Some pin boards are not installed.`

  Pin boards required for DIAG program are not installed.

- `DIAG. ERROR 19 Block` *x* `Input Relay K`*yz* `test failed.`

  An Input Relay failure is detected in the SWM. The displayed error message indicates the failure location. Make sure the Relay Test Adapter is installed securely on the SWM, and select the `RETRY` softkey. If the same error occurs at the same location, contact your nearest HP Service Office.

- `DIAG. ERROR 20 DC Source/Monitor not ready.`

  The DCS is not turned on, its HP-IB cable is not connected (DCS displayed as Not Present during START), or a plug-in module required for a test's execution is not present or is not connected to the SWM. Stop the program, check these items, and select the `RUN` softkey.

- `DIAG. ERROR 21 DC Source/Monitor failed SELF TEST.`

  An SMU failure is detected during the DCS's self-test. Contact your nearest HP Service Office.

- `DIAG. ERROR 22 I-V measurement test failed.`

- `DIAG. ERROR 23 I-V measurement test failed.`
- `DIAG. ERROR 24 I-V measurement test failed.`
- `DIAG. ERROR 25 I-V measurement test failed.`

  An SMU failure is detected. If the relay test has not yet been performed, run the relay test, then retry the SMU test. If the same error occurs, contact your nearest HP Service Office. If emergency repair is necessary, replace the defective SMU plug-in module. See the *System Information* for details.

- `DIAG. ERROR 26 VS`*x* `and VS`*y* `are not connected.`
- `DIAG. ERROR 26 VS`*x* `is not connected.`

  Where x and y are integers from 1 to 16, and x is a lower integer than y. If the first error occurs, connect VSx to the AUX1 port, VSy to the AUX2 port, and perform the VS Test again. If the second error occurs, connect VSx to the AUX1 port, and perform the VS Test again.

- `DIAG. ERROR 27 Voltage output test failed.`

  A VS failure is detected. Contact your nearest HP Service Office.

- `DIAG. ERROR 28 VM`*x* `and VM`*y* `are not connected.`
- `DIAG. ERROR 28 VM`*x* `is not connected.`

  Where x and y are integers from 1 to 16, and x is a lower integer than y. If the first error occurs, connect VMx to the AUX1 port, VMy to the AUX2 port, and perform the VM Test again. If the second error occurs, connect VMx to the AUX1 port, and perform the VM Test again.

- `DIAG. ERROR 29 Voltage measurement test failed.`

  A VM failure is detected. Contact your nearest HP Service Office.

- `DIAG. ERROR 30 C Meter/C-V Plotter not ready.`

  The CMU is not turned on, its HP-IB cable is not connected (CMU displayed as Not Present during START), or it is not connected to the SWM. Stop the program, check the CMU's power, HP-IB cable, and SWM interconnection cables, and select the `RUN` softkey.

- `DIAG. ERROR 31 C Meter/C-V Plotter failed SELF TEST.`

  The CMU failed its self-test. Contact your nearest HP Service Office.

- `DIAG. ERROR 32 C-G measurement test failed.`

  A CMU or CMU84 measurement circuit failure is detected. Contact your nearest HP Service Office.

- `DIAG. ERROR 33 Stray capacitance too high.`

  Stray capacitance in the SWM or the CMH or CML cable exceeds 10 pF. Contact your nearest HP Service Office.

- `DIAG. ERROR 34 Bias output test failed.`

  A CMU and CMU84 internal dc bias source failure is detected. Contact your nearest HP Service Office.

- `DIAG. ERROR 35 Rear panel short-cap disconnected.`

A BNC shorting cap is not connected to the CMU's rear panel EXT. BIAS-SLOW connector.

- `DIAG. ERROR 36 Analog Feedback Unit test failed.`

  A failure is detected in the AFU of the DCS. If this error occurs when all SMUs are functioning normally, contact your nearest HP Service Office.

- `DIAG. ERROR 40` (CMU84 not ready)

  The CMU84 is not turned on, its HP-IB cable is not connected (CMU84 displayed as `Not present` during START), or it is not connected to the SWM. Stop the program, check the CMU84's power, HP-IB cable, and SWM interconnection cables, and select the `RUN` softkey.

- `DIAG. ERROR 45 Port Expander Relay K`*xx yyy* `side test failed.`

  DIAG program detected an malfunctioning Port Expander relay K*xx* (where *xx* is one of the relay number). The *yyy* in the above message should be replaced by either `force` or `guard`.

BASIC or BASIC/UX Language System Errors

This section lists several of the more common errors related to the BASIC or BASIC/UX language system. For more details, refer to the *BASIC* or *BASIC/UX Language Reference Manual*.

- `ERROR 5`

  Improper context terminator. You forgot to put an END statement in the program. Also applies to SUBEND and FNEND.

- `ERROR 7`

  Undefined function or subprogram. An attempt was made to call a SUB or user-defined function that is not in memory. Look out for program lines that assume an optional CALL.

- `ERROR 8`

  Improper parameter matching. A type mismatch between a pass parameter and a formal parameter of a subprogram. See *Programming Reference* for parameter types.

- `ERROR 9`

  Improper number of parameters. Passing either too few or too many parameters to a subprogram. Applies only to non-optional parameters. See *Programming Reference* for details on the number of parameters.

- `ERROR 53`

  Improper file name. File names are limited to 10 characters. Foreign characters are allowed, but punctuation is not.

- `ERROR 56`

  File name is undefined. The specified file name does not exist in the directory. Check your disk's contents using the CAT command.

- `ERROR 145`

  May not build COM at this time. An attempt was made to add or change COM while a program was running. For example, a program does a LOADSUB, and the COM in the new subprogram does not match the existing COM. Rerun the START program.

- `ERROR 392`

- `ERROR 499`

  See TIS Errors.

- `ERROR 902`

  Must delete entire context. An attempt was made to delete a SUB or DEF FN statement without deleting its entire context. Easiest way to delete is with DELSUB.

B

Subprogram Summary

Introduction

This appendix contains information on the subprograms supplied in the HP 4062C/UX system software. The subprograms are listed in the categories shown in Figure B-1. The subprograms supplied in the system software—TIS, DVR4284, PARA, XYGRAPH, WAFER, TIS_UTIL, VFP, PGMLIB, and prober drivers—are classified into two types in this section: the basic subprograms called the Test Instruction Set (TIS) and Libraries. (DVR4284 is supported only by before Rev. C.06.00 and X.06.00. PGMLIB is supported only by C.06.00 or later, X.06.00 or later, and P.06.20 or later.)

- Test Instruction Set (TIS)
  - Instrument Control and Measurement CSUBs[1] or subprograms
  - Port and Unit Address Functions[1]
  - Debug Environment Support CSUBs[1]
  - Process Control CSUBs[1] for HP-UX environment
  - Prober Drivers
- Libraries
  - TIS_UTIL Subprograms
  - PARA Subprograms
  - Prober Control Library (PCL) Subprograms[2]
  - File Creation Library (FCL) Subprograms[2]
  - XYGRAPH Subprograms
  - VFP Subprograms
  - PGMLIB Subprograms

[1] These CSUBs and subprograms are stored in the TIS file.
[2] These subprograms are stored in the WAFER file.

Figure B-1. Classification of System Subprograms

You can use Compiled Subprograms (CSUBs) and BASIC Subprograms the same way in the test programs.

The following sections summarize the supplied subprograms by categories.

Instrument Control and Measurement Subprograms

The main functions of these subprograms are to control DCS, CMS, and SWC/SWM.

Initialization

Init_system	Initializes your HP 4062C/UX system.

Controlling SWM

Connect	Connects a specified port to specified measurement pins.
Connect_th	Connects a specified port to a range of measurement pins.
Prepare ... Execute	Defines and executes all program lines in a Prepare ... Execute construct.

Controlling DCS

Long_cal	Performs the self-calibration in the DCS.
Short_cal	Performs the self-calibration in the DCS.
Disable_port	Sets the specified ports, units, or measurement pins to Zero Output status.
Port_status	Returns the status of the specified port.
Ch_sw_on	Sets the output switch of the specified DCS output units to on.
Ch_sw_off	Sets the output switch of the specified DCS output units to off.
Set_smu	Sets the measurement integration time and filter mode for SMUs, VSs, and VMs of the DCS.
Set_vm	Sets the voltage measurement mode of the specified VM to either grounded measurement or differential measurement.
Force_i	Sets the output current for the specified SMU.
Force_v	Sets the output voltage for the specified DCS output units.
Measure_v	Measures dc voltage using a specified SMU or VM and returns the measurement value.
Measure_i	Measures dc current using a specified SMU or VS and returns the measurement value.
Force_meas	Sets the output current or voltage of the specified SMU or VS, measures the current or voltage using the specified SMU or VM, and returns the measurement value.
Prepare ... Execute	Defines and executes all program lines in a Prepare ... Execute construct.
Set_pbias	Sets the parameters for a pulsed spot measurement or a sweep measurement with pulsed bias.
Measure_p	Performs a pulsed spot measurement and returns the measurement value.

Set_iv	Sets the sweep parameters for a staircase sweep measurement.
Set_piv	Sets the sweep parameters for a pulsed sweep measurement.
Set_sync	Sets a synchronous port and its parameters for a synchronous search measurement or a synchronous staircase sweep measurement.
Sweep_iv	Performs a staircase sweep, a pulsed sweep, a staircase sweep with pulsed bias, or a synchronous staircase sweep measurement.
Sweep_miv	Performs a multichannel staircase sweep or a multichannel synchronous staircase sweep measurement.
Rsweep_iv	Performs a staircase sweep, a pulsed sweep, a staircase sweep with pulsed bias, or a synchronous staircase sweep measurement in real time.
Rsweep_miv	Performs a multichannel staircase sweep or a multichannel synchronous staircase sweep measurement in real time.
Rsweep_stop	Ceases a real-time sweep measurement.
Set_bsearch	Sets parameters for a binary search measurement.
Set_lsearch	Sets parameters for a linear search measurement.
Set_asearch	Sets parameters for a analog search measurement.
Search	Performs a binary search, a linear search, or an analog search measurement.
Set_bdv	Sets quasi-pulsed measurement parameters for breakdown voltage measurements.
Measure_bdv	Triggers quasi-pulsed measurements to measure breakdown voltage, then returns the measured value.
Set_ileak	Sets the quasi-pulsed measurement parameters for leakage current measurements.
Measure_ileak	Triggers the quasi-pulsed measurement to measure leakage current, then returns the measured value.

Controlling CMU

Disable_port	Sets the specified ports, units, or measurement pins to Zero Output status.
Port_status	Returns the status of the specified port.
Set_cmu	Sets the measurement integration time and test signal level of the CMU.
Force_v	Sets the internal dc bias source of the CMU.
Measure_cmu	Measures capacitance and conductance using the CMU and returns the measurement value.
Prepare ... Execute	Defines and executes all program lines in a Prepare ... Execute construct.
Set_cv	Sets the sweep parameters for a C·G-V measurement.
Sweep_cv	Performs a C·G-V measurement on the CMU.

Set_ct	Sets the sweep parameters for a C·G-t measurement.
Sweep_ct	Performs a C·G-t measurement on the CMU.

Controlling CMU84

Open_corr84	Performs the OPEN correction of the CMU84.
Short_corr84	Performs the SHORT correction of the CMU84.
Disable_port	Sets the specified ports, units, or measurement pins to Zero Output status.
Disable_port84	Sets the ports of the CMU84 to Zero Output status.
Port_status	Returns the status of the specified port.
Port_status84	Returns the status of the CMU84 port.
Set_cmu84	Sets the measurement integration time and test signal level of the CMU84.
Set_freq	Sets the measurement frequency of the specified unit.
Frequency84	Sets the measurement frequency of the CMU84.
Force_v	Sets the internal dc bias source of the CMU84.
Force_v84	Sets the internal dc bias source of the CMU84.
Measure_cmu84	Measures capacitance and conductance using CMU84 and returns the measurement value.
Set_cv84	Sets the sweep parameters for a C·G-V measurement on the CMU84.
Sweep_cv84	Performs a C·G-V measurement on the CMU84.

Port and Unit Address Functions

These functions return address of a specified port or unit by number or name. This function makes it easier to identify the port or unit than specifying address of the port or unit.

Returning Port Address

FNPort	Returns the address of the specified SWM port.
FNSmu	Returns the address of the specified SMU port of the SWM.
FNGsmu	Returns the GSMU port (Guard terminal of SMU1) address of the SWM.
FNAux	Returns the address of the specified AUX (auxiliary) port of the SWM.
FNCmh	Returns the CMH port address of the SWM.
FNCml	Returns the CML port address of the SWM.
FNGcmu	Returns the GCMU port (Guard terminal of CMS) address of the SWM.
FNGnd	Returns the GNDU port address of the SWM.

Returning Unit Address

FNUnitsmu	Returns the unit address of the specified SMU.
FNVs	Returns the unit address of the specified VS.
FNVm	Returns the unit address of the specified VM.
FNCmu	Returns the CMH or CML terminal address of the CMU.
FNCmu84	Returns the CMH84 or CML84 terminal address of the CMU84.

Debug Environment Support CSUBs

These subprograms help you debug the measurement programs.

Controlling Offline Debugging (HP 4062UX only)

Off_line_data	Sets the offline data simulation mode.
Data_creation	Creates an offline data simulation file.
Is_on_line	Returns online test session status.

Error Handling

Error_display	Enables or disables the displaying of TIS error messages when executing the TIS CSUBs.
Error_info	Returns a TIS error number and an error message string.

Process Control CSUBs for HP-UX Environment (HP 4062UX only)

These subprograms let you access system instruments monopolistically within the HP-UX environment.

Controlling HP-UX Processes

Lock_system	Explicitly locks the system instruments specified in a calling process to that process.
Unlock_system	Unlocks explicitly locked system instruments.

Prober Drivers

These subprograms provide communication with the supported wafer probers.

Prober Drivers

Prober_reset	Sets your wafer prober to the Local mode.
Prober_status	Returns integer values that indicate the status of the wafer prober.
Pscale	Sets the system index for the X- and Y-coordinates specified in the Pmove and Porig subprograms, and the system index for the X- and Y-displacements specified in the Pimove subprogram.
Porig	Assigns the specified X- and Y-coordinate values to the present position of the X-Y stage.
Phome	Moves the X-Y stage to the home position.
Pup	Raises the chuck of the wafer prober.
Pdown	Lowers the chuck of the wafer prober.
Pmove	Instructs the wafer prober to execute an absolute movement of the X-Y stage.
Pimove	Instructs the wafer prober to execute a relative movement of the X-Y stage.
Ppos	Returns the X- and Y-coordinates of the chip currently being probed.
Pink	Triggers the specified inker of the wafer prober.

TIS_UTIL Subprograms

These subprograms are utilities for performing analog search and series equivalent circuit capacitance measurements.

Utility for Analog Search

Para_vth	Calculates, from the specified measurement conditions, the optimum parameters for an analog search threshold voltage measurement.
Para_hfe	Calculates, from the specified measurement conditions, the optimum parameters for an analog search forward current transfer ratio h_{FE} measurement.

Utility for Series Equivalent Circuit Capacitance Measurements

Conv_mode	Converts the capacitance and conductance measurement values obtained by Measure_cmu to the capacitance and resistance values of a series equivalent circuit, and returns the values.

PARA Subprograms

These subprograms are supplied to measure the device parameters. Most of these subprograms are a type of function. The purpose of a function is to return a single value.

Controlling SWM for PARA Functions

Set_tr	Connects the specified measurement pins to a single transistor or FET.
Set_multitr	Connects the specified measurement pins to a multiple FET.

Measuring Resistance with PARA Functions

FNR2t	Performs a two-terminal resistance measurement using two SMUs, and returns the measurement value.
FNR4t	Performs a four-wire (Kelvin connection) resistance measurement four SMUs, and returns the measurement value.
FNR4d	Performs a four-wire (Kelvin connection) resistance measurement two SMUs and two VMs, and returns the measurement value.

Measuring Transistor Parameters with PARA Functions

FNBvcbo	Measures the collector-base breakdown voltage of a bipolar transistor and returns the measurement value.
FNBvces	Measures the collector-emitter breakdown voltage of a bipolar transistor with the base and substrate both connected to the emitter, and returns the measurement value.
FNHfe	Measures the forward current transfer ratio h_{FE} of bipolar transistor, and returns the measurement value.
FNHfe1	Measures the forward current transfer ratio h_{FE} of bipolar transistor by the analog feedback measurement, and returns the measurement value.

Measuring MOSFET Parameters with PARA Functions

FNVth1	Measures the gate-source threshold voltage of an enhancement-type FET when a specified drain current is forced, and returns the result value.
FNVth2	Returns the gate-source threshold voltage of an enhancement-type FET when forcing two specified drain current and calculating it from the Vgs-Ids characteristics using the linear extrapolation.
FNVth2m	Returns the gate-source threshold voltage of an enhancement-type FET when forcing multiple specified drain current settings and calculating it from the Vgs-Ids characteristics using the least squared method.
FNVth3	Measures the gate-source threshold voltage of a FET by varying an applied gate voltage until a specified drain current flows, and returns the gate voltage measurement value.
FNVth4	Measures the gate-source threshold voltage of a FET using the binary search measurement.

FNVth5	Measures the gate-source threshold voltage of a FET using the analog search measurement.
FNIds	Measures the drain current for a specified drain voltage and gate voltage, and returns the measurement value.
FNDelta_l	Measures the drain currents of up to six FETs, each having a different channel length, calculates lateral diffusion ΔL, and returns the calculated value.
FNDelta_w	Measures the drain currents of up to six FETs, each having a different channel width, calculates lateral diffusion ΔW, and returns the calculated value.

Prober Control Subprograms

These subprograms are called Prober Control Library (PCL). These subprograms provide user control of the wafer prober.

Prober Control Library (PCL)

Wget	Retrieves probing data from a specified probing pattern data file.
FNWreturn_number	Returns the chip number corresponding to the X- and Y-chip coordinates.
FNWtotal_chip	Returns the number of chips per wafer registered by PPG.
Wreturn_limit	Returns the maximum and minimum values of the X- and Y-chip coordinates from the probing pattern data created by PPG.
Wstart_xy	Determines the wafer prober starting position.
Wstart_number	Determines the wafer prober starting position.
Wmove_next	Moves the wafer prober chuck to the next test module in accordance with the set probing sequence.
Wmove_xy	Moves the wafer prober chuck to the specified test module on the chip at the specified X-Y coordinates.
Wmove_number	Moves the wafer prober chuck to the specified test module on the specified chip.
Wpos_xy	Returns the X- and Y-chip coordinates and the test module number of the present wafer prober chuck position.
Wpos_number	Returns the chip number and the test module number of the present wafer prober chuck position.
Wreturn_xy	Returns the X- and Y-chip coordinates corresponding to the specified chip number.

File Control Subprograms

These subprograms are called File Control Library (FCL). These subprograms are used to create a BSDM data base.

File Control Library (FCL)

Wbuild_file	Generates and saves multiple parameter measurement data files that conform to the BSDM format.
Wfile_type	This subprogram specifies the data file type: BASIC BDAT or DOS text file. The Wsave_data and Wbuild_file subprograms create data files according to this file type setting.
Wput_data	Transfers a measurement value to the COM blocks and assigns it to the specified variable name.
Wput_array	Transfers a measurement data array to the COM blocks and assigns a variable name to the data array.
Wsave_data	Generates measurement data files in conjunction with the Wput_data or Wput_array subprograms.

XYGRAPH Subprograms

These subprograms are used to plot your measurement data.

Lingraph	Clears the CRT of all graphics, optimizes the specified X-max and Y-max values, and draws an X-axis and Y-axis from 0 to the optimized maximum values by linear scale.
Lingraph1	Optimizes the specified X-max, X-min, Y-max, and Y-min values, and draws an X-axis and Y-axis from the optimized minimum values to the optimized maximum values by linear scale.
Loggraph	Clears the CRT of all graphics, optimizes the specified X-max, Y-mim, and Y-max values. It draws an X-axis from 0 to the optimized X-max value and a Y-axis from the optimized Y-min value to the optimized Y-max value by log scale.
Loggraph1	Optimizes the specified X-max, X-min, Y-max, and Y-min values, and draws an X-axis from the optimized X-min to the optimized X-max value and a Y-axis from the optimized Y-min to the optimized Y-max value by log scale.
Cvgraph	Clears the CRT of all graphics, optimizes the specified X-max and Y-max values, and draws a Y-axis between 0 and the optimized Y-max value and an X-axis between the negative and positive equivalents of the X-max value.

VFP Subprograms

These subprograms enable you to use the virtual front panel (VFP) in your measurement programs.

Vfp_start	Controls the interrupt signals sent from VFP Timer Board. (HP 4062C only)
Vfp_control	Enables entry into the VFP control mode.
Vfp_frame	Clears the CRT and displays the VFP.
Vfp_monitor	Refreshes the VFP display when in the VFP monitor mode

PGMLIB Subprograms

These subprograms enable you to store the DCS control commands in the DCS program memeory. The measurement speed may be improved by this function.

Pgm_start	Is part of the Pgm_start ... Pgm_end context. It starts a program that has control commands stores in DCS program memory.
Pgm_end	Is part of the Pgm_start ... Pgm_end context. It terminates the program that stores the DCS control commands in the program memory.
Pgm_force_v	Stores into the DCS program memory the commands that force a specified voltage.
Pgm_force_i	Stores into DCS program memory the commands that force a specified current.
Pgm_measure_i	Stores into the DCS program memory the commands that execute the current measurement of a specified SMU or VS.
Pgm_measure_v	Stores into the DCS program memory the commands that execute the voltage measurement of a specified SMU or VM.
Pgm_set_asearch	Stores into the DCS program memory the commands that set parameters for analog search measurements.
Pgm_search	Stores into DCS program memory the commands that execute the search measurement.
Pgm_set_pbias	Stores into the DCS program memory the commands that set the parameters for the pulsed spot measurements at a specified unit.
Pgm_measure_p	Stores into the DCS program memory the commands that execute the pulsed spot measurement of a specified SMU or VS.

Pgm_set_smu	Stores into the DCS program memory the commands that set the measurement integration time and the filter mode for the SMUs, VSs, and VMs.
Pgm_set_vm	Stores into DCS program memory the commands that set the voltage measurement mode of a specified VM to either grounded measurement mode or differential measurement mode.
Pgm_ch_sw_on	Stores into the DCS program memory the commands that set the output switches of specified unit(s) to on.
Pgm_ch_sw_off	Stores into the DCS program memory the commands that set the output switches of specified unit(s) to off.
Pgm_disable_dcs	Stores into DCS program memory the commands that set specified units to the zero output status.
Pgm_wait	Stores into program memory the DCS control commands that pause for a specified time.
FNAddr4142	Returns the DCS device selector, which consists of an interface select code and a primary address.
FNUnit4142	Returns the address of a specified SMU port of the SWM.
FNChannel4142	Returns the DCS channel number of a specified unit address.
FNRange4142	Returns the DCS range code of a specified value.
Readerror4142	Gets the error codes that occur between the Pgm_start ... Pgm_end context.
Run_dcs_program[1]	Triggers triggers and executes specified DCS programs stored in the program memory.
Readout_dcs[1]	Requests that the DCS transfers measured data from spot measurements, pulsed spot measurements, or analog search measurements, then returns the measured data to specified variables.
Readsweep_dcs[1]	requests that the DCS transfers measured data from sweep measurements, then returns the measured data to specified arrays.

[1] These subprograms are of CSUB and are included in the TIS file.

C

History of Supported Subprograms

This reference manual documents the Test Instruction Set (TIS) and libraries provided for the HP 4062C/PC Semiconductor Parametric Test System or for the HP 4062UX Semiconductor Process Control System. The HP 4062 series has been enhanced several times. The following table shows the supported information for the TIS and libraries provided for the HP 4062C/UX/PC system. It is for those users who have more than one revision of the HP 4062C/UX/PC, or who are upgrading to the newest revision.

The first column is a list of TIS and libraries in alphabetical order. The remaining columns show revisions of HP 4062C/UX/PC with entries in a column indicating the included BASIC program file you must link. Note that "n.a." in any of the columns indicates that the subprogram was not available for that release.

Table C-1. Supported Subprogram Matrix

Subprogram Name	HP 4062C				HP 4062UX				HP 4062PC
	C.05.05/ C.05.10	C.05.60/ C.05.70	C.06.00	C.06.2*x*/ C.06.3*x*	X.05.50	X.05.61	X.06.00	X.06.2*x*/ X.06.3*x*	P.06.2*x*/ P.06.3*x*
Ch_sw_off	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Ch_sw_on	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Connect	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Connect_th	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Conv_mode	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL
Cvgraph	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH
Data_creation	n.a.	n.a.	n.a.	n.a.	TIS	TIS	TIS	TIS	n.a.
Disable_port	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Disable_port84[1]	n.a.	DVR4284	DVR4284	DVR4284	n.a.	DVR4284	DVR4284	DVR4284	DVR4284
Error_display	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Error_info	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Execute	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNAddr4142	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
FNAux	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNBvcbo	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA

1 The function of the Disable_port84 is included in the Disable_port for the revision C.06.00/X.06.00 or later.

Table C-1. Supported Subprogram Matrix (continued)

Subprogram Name	HP 4062C				HP 4062UX				HP 4062PC
	C.05.05/ C.05.10	C.05.60/ C.05.70	C.06.00	C.06.2x/ C.06.3x	X.05.50	X.05.61	X.06.00	X.06.2x/ X.06.3x	P.06.2x/ P.06.3x
FNBvces	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNChannel4142	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
FNCmh	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNCml	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNCmu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNCmu84	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
FNDelta_l	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNDelta_w	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNGcmu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNGnd	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNGsmu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNHfe	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNHfe1	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNIds	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNPort	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNR2t	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNR4d	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNR4t	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNRange4142	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
FNSmu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNUnit4142	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
FNUnitsmu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNVm	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNVs	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
FNVth1	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNVth2	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNVth2m	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA

Table C-1. Supported Subprogram Matrix (continued)

Subprogram Name	HP 4062C				HP 4062UX				HP 4062PC
	C.05.05/ C.05.10	C.05.60/ C.05.70	C.06.00	C.06.2x/ C.06.3x	X.05.50	X.05.61	X.06.00	X.06.2x/ X.06.3x	P.06.2x/ P.06.3x
FNVth3	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNVth4	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNVth5	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
FNWreturn_ number	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
FNWtotal_chip	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Force_i	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Force_meas	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Force_v	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Force_v84[1]	n.a.	DVR4284	DVR4284	DVR4284	n.a.	DVR4284	DVR4284	DVR4284	DVR4284
Frequency84[2]	n.a.	DVR4284	DVR4284	DVR4284	n.a.	DVR4284	DVR4284	DVR4284	DVR4284
Init_system	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Is_on_line	n.a.	n.a.	n.a.	n.a.	TIS	TIS	TIS	TIS	n.a.
Lingraph	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH
Lingraph1	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH
Lock_system	n.a.	n.a.	n.a.	n.a.	TIS	TIS	TIS	TIS	n.a.
Loggraph	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH
Loggraph1	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH	XYGRAPH
Long_cal	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Measure_bdv	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Measure_cmu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Measure_cmu84	n.a.	DVR4284	TIS	TIS	n.a.	DVR4284	TIS	TIS	TIS
Measure_i	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Measure_ileak	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Measure_p	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Measure_v	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Off_line_data	n.a.	n.a.	n.a.	n.a.	TIS	TIS	TIS	TIS	n.a.
Open_corr84	n.a.	DVR4284	TIS	TIS	n.a.	DVR4284	TIS	TIS	TIS
Para_hfe	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL
Para_vth	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL	TIS_UTIL

1 The function of the Force_v84 is included in the Force_v for the revision C.06.00/X.06.00 or later.

2 The function of the Frequency84 is included in the Set_freq for the revision C.06.00/X.06.00 or later.

Table C-1. Supported Subprogram Matrix (continued)

Subprogram Name	HP 4062C				HP 4062UX				HP 4062PC
	C.05.05/ C.05.10	C.05.60/ C.05.70	C.06.00	C.06.2x/ C.06.3x	X.05.50	X.05.61	X.06.00	X.06.2x/ X.06.3x	P.06.2x/ P.06.3x
Pdown	EGX, EGY, TSK	EGX, EGY, TSK	EGX, EGY, TSK	EGX, EGY, TSK	EGX, EGY, TSK	EGX, EGY, TSK	EGX, EGY, TSK	EGX, EGY, TSK	EGX, EGY, TSK
Pgm_ch_sw_off	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_ch_sw_on	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_disable_dcs	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_end	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_force_i	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_force_v	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_measure_i	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_measure_p	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_measure_v	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_search	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_set_asearch	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_set_pbias	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_set_smu	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_set_vm	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_start	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Pgm_wait	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Phome	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK
Pimove	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK
Pink	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK
Pmove	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EG Y, TSK
Porig	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK
Port_status	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Port_status84[1]	n.a.	DVR4284	DVR4284	DVR4284	n.a.	DVR4284	DVR4284	DVR4284	DVR4284

1 The function of the Port_status84 is included in the Port_status for the revision C.06.00/X.06.00 or later.

Table C-1. Supported Subprogram Matrix (continued)

Subprogram Name	HP 4062C				HP 4062UX				HP 4062PC
	C.05.05/ C.05.10	C.05.60/ C.05.70	C.06.00	C.06.2x/ C.06.3x	X.05.50	X.05.61	X.06.00	X.06.2x/ X.06.3x	P.06.2x/ P.06.3x
Ppos	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK
Prepare ... Execute	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Prober_reset	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK	EGY, TSK
Prober_status	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK
Pscale	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK
Pup	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK	EGX,EGY, TSK
Readerror4142	n.a.	n.a.	PGMLIB	PGMLIB	n.a.	n.a.	PGMLIB	PGMLIB	PGMLIB
Readout_dcs	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Readsweep_dcs	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Rsweep_iv	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Rsweep_miv	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Rsweep_stop	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Run_dcs_program	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Search	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_asearch	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_bdv	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Set_bsearch	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_cmu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_cmu84	n.a.	DVR4284	TIS	TIS	n.a.	DVR4284	TIS	TIS	TIS
Set_ct	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_cv	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_cv84	n.a.	DVR4284	TIS	TIS	n.a.	DVR4284	TIS	TIS	TIS
Set_freq	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Set_ileak	n.a.	n.a.	TIS	TIS	n.a.	n.a.	TIS	TIS	TIS
Set_iv	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_lsearch	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_pbias	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS

Table C-1. Supported Subprogram Matrix (continued)

Subprogram Name	HP 4062C				HP 4062UX				HP 4062PC
	C.05.05/ C.05.10	C.05.60/ C.05.70	C.06.00	C.06.2*x*/ C.06.3*x*	X.05.50	X.05.61	X.06.00	X.06.2*x*/ X.06.3*x*	P.06.2*x*/ P.06.3*x*
Set_piv	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_smu	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_sync (for sweep)	n.a.	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_sync (for b/l search)	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Set_tr	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
Set_vm	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Setmultitr	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA	PARA
Short_cal	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Short_corr84	n.a.	DVR4284	TIS	TIS	n.a.	DVR4284	TIS	TIS	TIS
Sweep_ct	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Sweep_cv	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Sweep_cv84	n.a.	DVR4284	TIS	TIS	n.a.	DVR4284	TIS	TIS	TIS
Sweep_iv	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Sweep_miv	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS	TIS
Unlock_system	n.a.	n.a.	n.a.	n.a.	TIS	TIS	TIS	TIS	n.a.
Vfp_control	VFP	VFP	VFP	VFP	VFP	VFP	VFP	VFP	VFP
Vfp_frame	VFP	VFP	VFP	VFP	VFP	VFP	VFP	VFP	VFP
Vfp_monitor	VFP	VFP	VFP	VFP	VFP	VFP	VFP	VFP	VFP
Vfp_start	VFP	VFP	VFP	VFP	n.a.	n.a.	n.a.	n.a.	n.a.
Wbulid_file	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wget	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wfile_type	n.a.	n.a.	n.a.	WAFER	n.a.	n.a.	n.a.	WAFER	WAFER
Wmove_next	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wmove_number	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wmove_xy	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER

Table C-1. Supported Subprogram Matrix (continued)

Subprogram Name	HP 4062C				HP 4062UX				HP 4062PC
	C.05.05/ C.05.10	C.05.60/ C.05.70	C.06.00	C.06.2x/ C.06.3x	X.05.50	X.05.61	X.06.00	X.06.2x/ X.06.3x	P.06.2x/ P.06.3x
Wpos_number	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wpos_xy	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wput_array	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wput_data	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wreturn_limit	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wreturn_xy	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wsave_data	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wstart_number	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER
Wstart_xy	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER	WAFER