Colby Instruments

HPDL-100A Programmable Delay Line

Operating and Programming Manual

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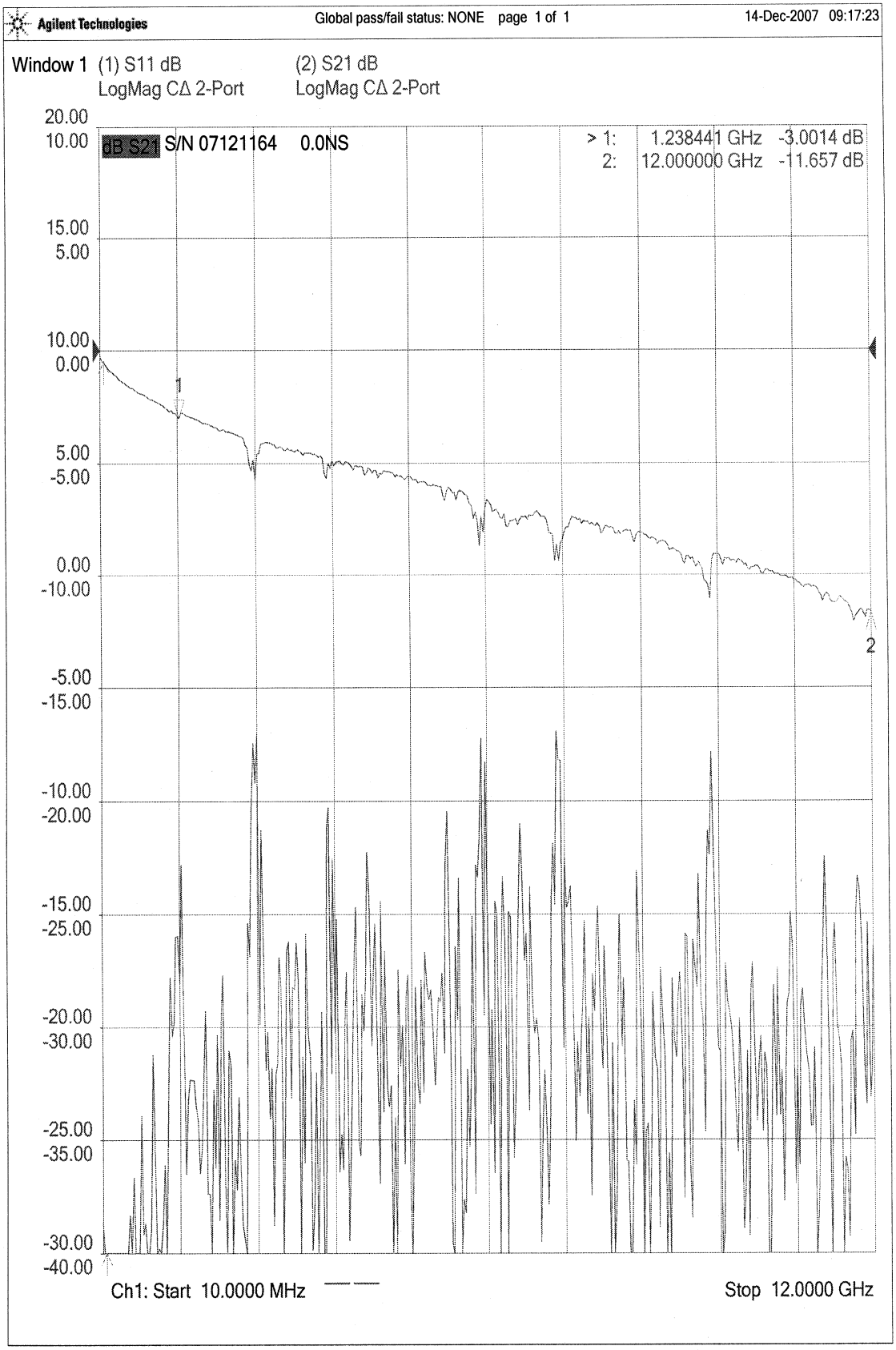
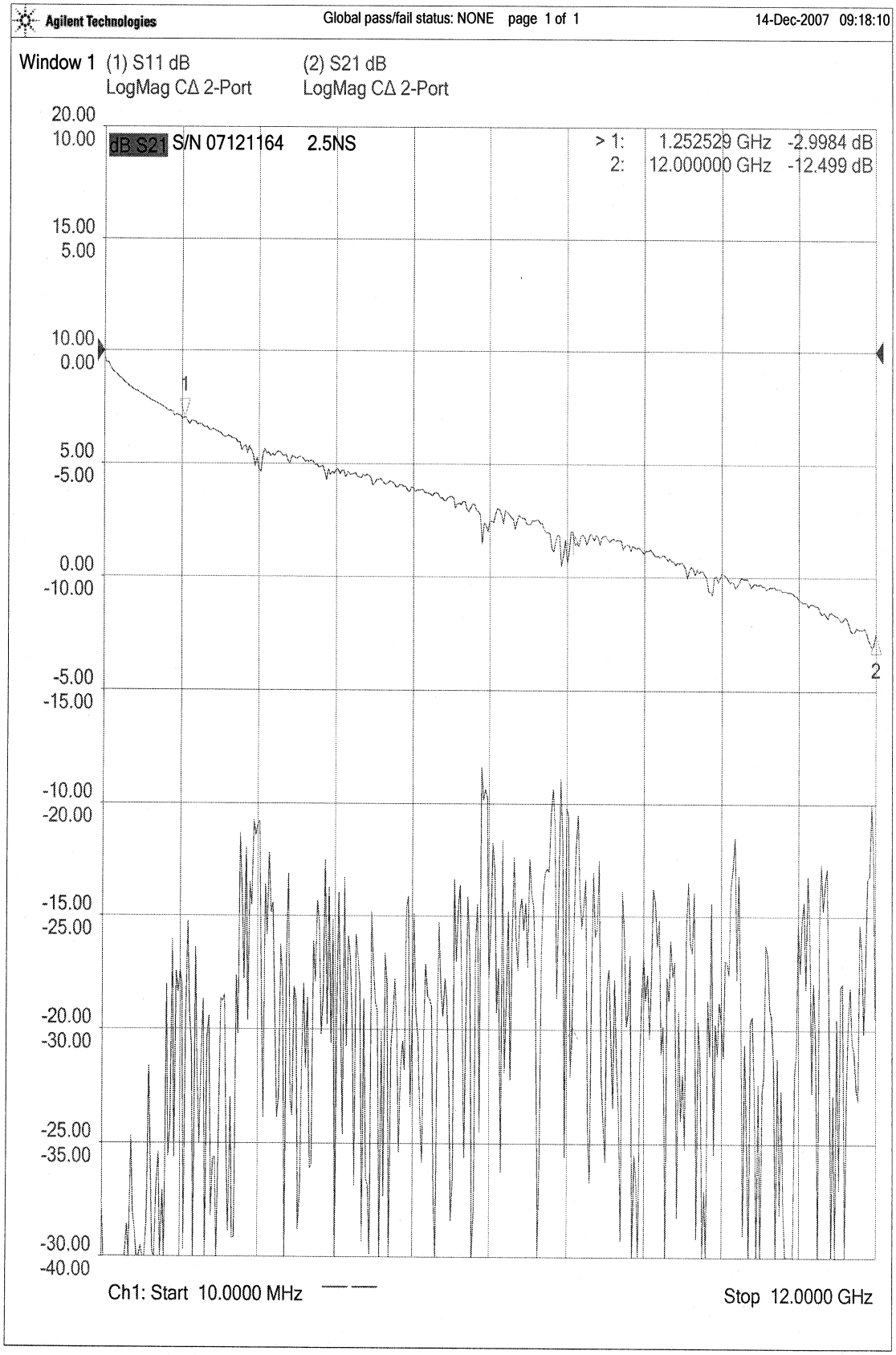
Electrical Specifications of HPDL-100A-20.47NS

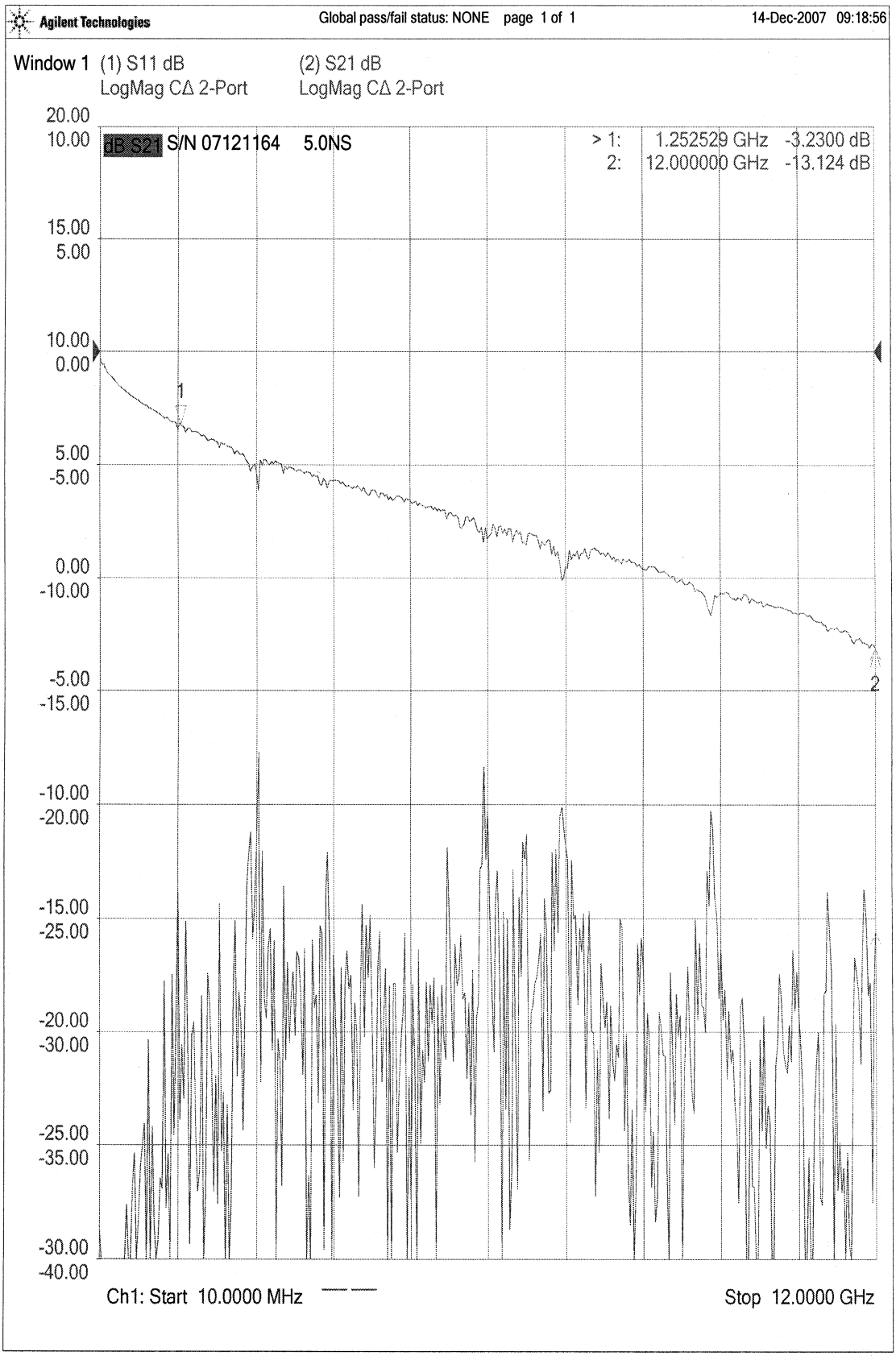
MODEL #	**HPDL-100A-20.47NS**
SERIAL #	**07121164**
Maximum Delay	**20.47 ns**
Minimum Resolution	**10.0 ps**
Software Version	**1.53**
Input Frequency Range	DC to 12.5 GHz
Delay Settling Time	50 ms
Absolute Accuracy (typ.)	0.1% +/- 2 ps per binary step
Power Handling Capability	10 W CW, 50W peak
Recommended Service Interval	500,000 Operations
AC Supply	85 to 240 VAC, 50-60 Hz
Operating Temperature	10 to 30 deg. C
Physical Dimensions	32.75 cm (12 7/8")x 13.4 cm (5 ¼") x 34 cm (13 3/8")
Weight	7.3 kg (16 lbs)

Delay Specifications

Relay #	Delay Value
1	10 ps
2	20 ps
3	40 ps
4	80 ps
5	160 ps
6	320 ps
7	640 ps
8	1280 ps
9	2560 ps
10	5120 ps
11	10240 ps


Agilent Technologies
Global pass/fail status: NONE page 1 of 1
14-Dec-2007 09:17:23
Window 1 (1) S11 dB
LogMag CΔ 2-Port
(2) S21 dB
LogMag CΔ 2-Port
dB S21 S/N 07121164 0.0NS
> 1: 1.238441 GHz -3.0014 dB
2: 12.000000 GHz -11.657 dB
20.00
10.00
15.00
5.00
10.00
0.00
5.00
-5.00
0.00
-10.00
-5.00
-15.00
-10.00
-20.00
-15.00
-25.00
-20.00
-30.00
-25.00
-35.00
-30.00
-40.00
1
2
Ch1: Start 10.0000 MHz
Stop 12.0000 GHz


Window 1 (1) S11 dB LogMag CΔ 2-Port
(2) S21 dB LogMag CΔ 2-Port
dB S21 S/N 07121164 2.5NS
> 1: 1.252529 GHz -2.9984 dB
2: 12.000000 GHz -12.499 dB
20.00
10.00
15.00
5.00
10.00
0.00
5.00
-5.00
0.00
-10.00
-5.00
-15.00
-10.00
-20.00
-15.00
-25.00
-20.00
-30.00
-25.00
-35.00
-30.00
-40.00
1
2
Ch1: Start 10.0000 MHz
Stop 12.0000 GHz


Agilent Technologies
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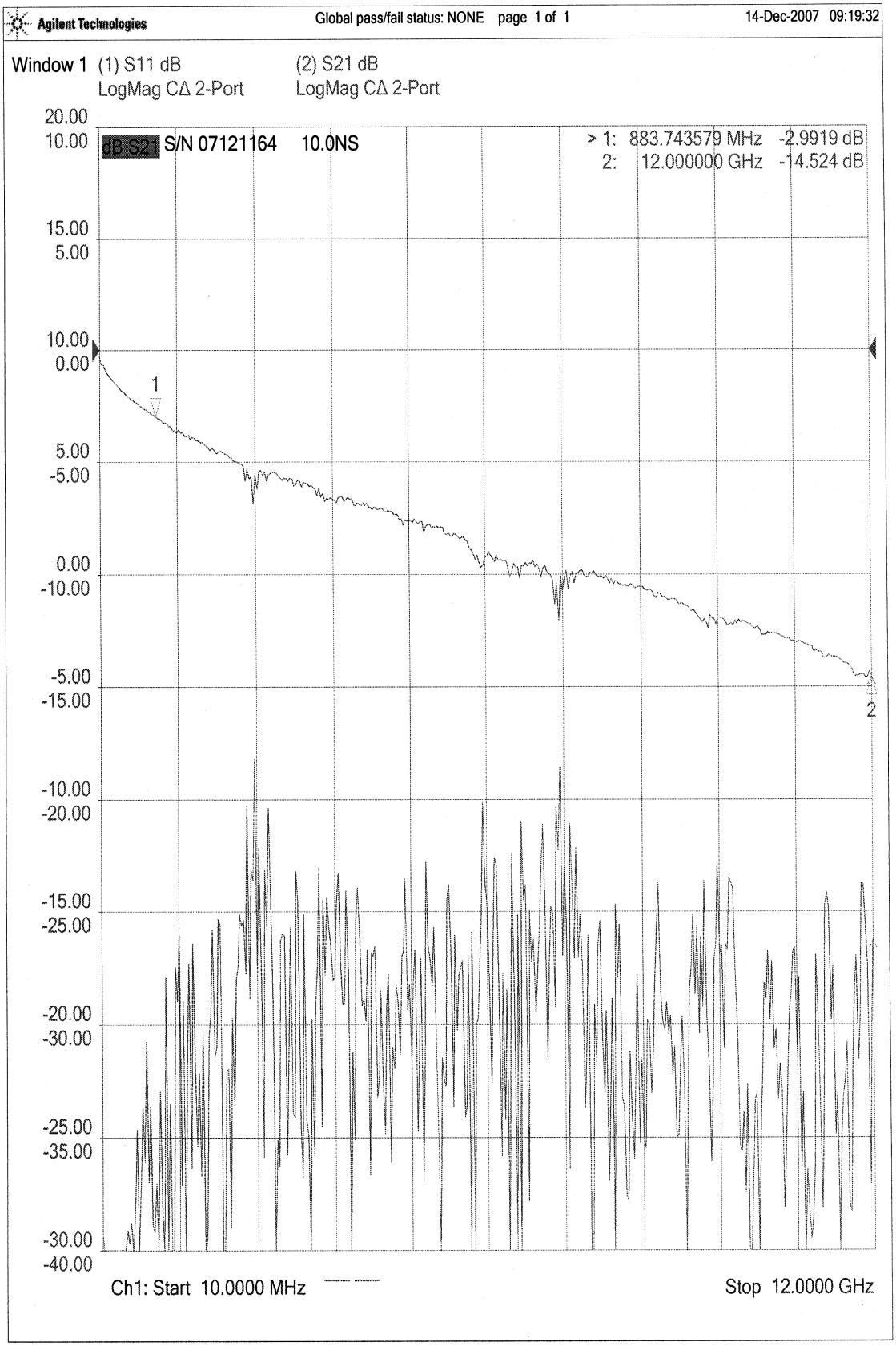
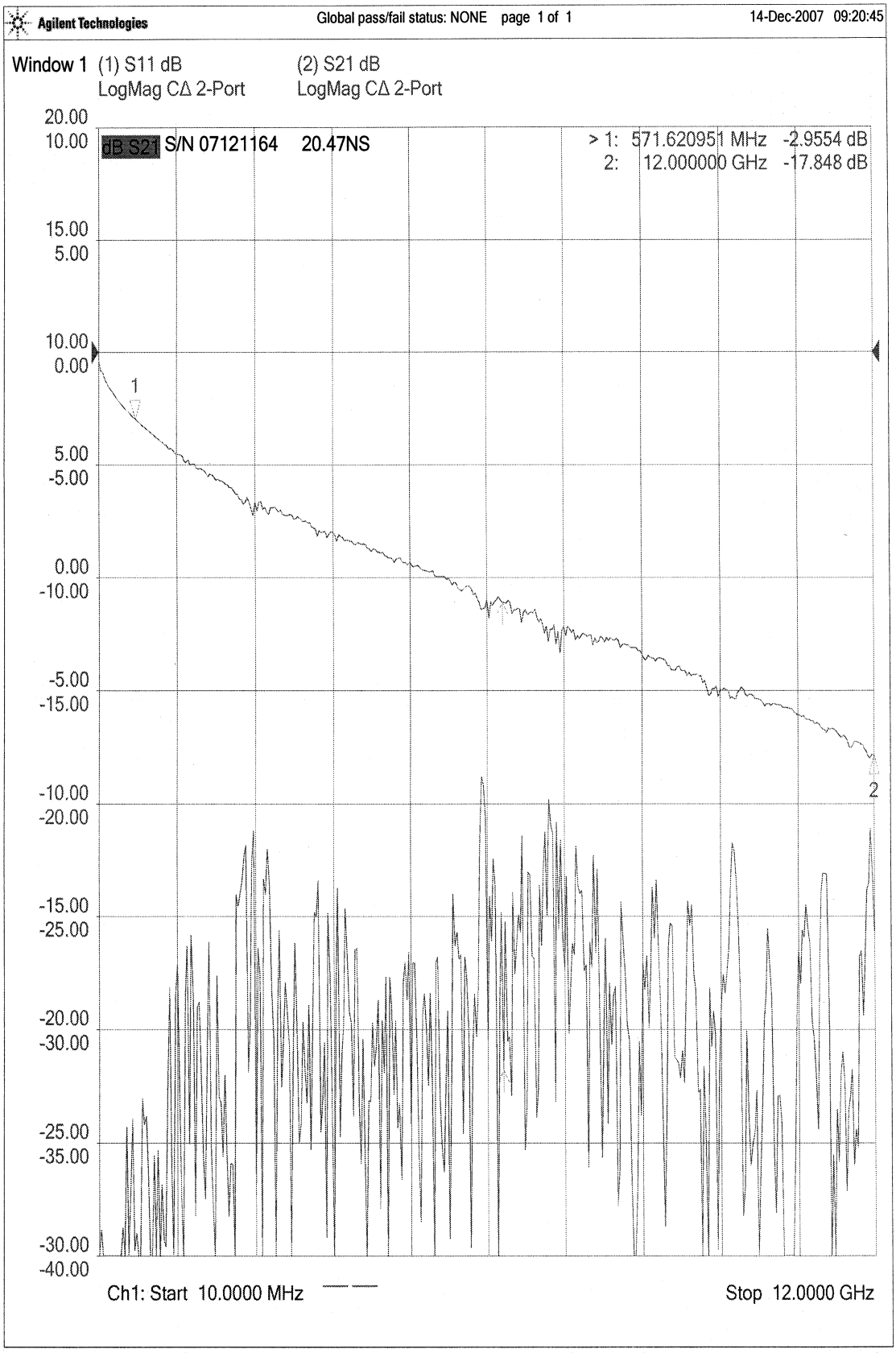
14-Dec-2007 09:18:56
Window 1 (1) S11 dB LogMag CΔ 2-Port
(2) S21 dB LogMag CΔ 2-Port
dB S21 S/N 07121164 5.0NS
> 1: 1.252529 GHz -3.2300 dB
2: 12.000000 GHz -13.124 dB
20.00
10.00
15.00
5.00
10.00
0.00
5.00
-5.00
0.00
-10.00
-5.00
-15.00
-10.00
-20.00
-15.00
-25.00
-20.00
-30.00
-25.00
-35.00
-30.00
-40.00
Ch1: Start 10.0000 MHz
Stop 12.0000 GHz


Agilent Technologies
Global pass/fail status: NONE page 1 of 1
14-Dec-2007 09:19:32
Window 1 (1) S11 dB LogMag CΔ 2-Port
(2) S21 dB LogMag CΔ 2-Port
dB S21 S/N 07121164 10.0NS
> 1: 883.743579 MHz -2.9919 dB
2: 12.000000 GHz -14.524 dB
20.00
10.00
15.00
5.00
10.00
0.00
5.00
-5.00
0.00
-10.00
-5.00
-15.00
-10.00
-20.00
-15.00
-25.00
-20.00
-30.00
-25.00
-35.00
-30.00
-40.00
1
2
Ch1: Start 10.0000 MHz
Stop 12.0000 GHz


Agilent Technologies
Global pass/fail status: NONE page 1 of 1
14-Dec-2007 09:20:45
Window 1 (1) S11 dB
LogMag CΔ 2-Port
(2) S21 dB
LogMag CΔ 2-Port
dB S21 S/N 07121164 20.47NS
> 1: 571.620951 MHz -2.9554 dB
2: 12.000000 GHz -17.848 dB
20.00
10.00
15.00
5.00
10.00
0.00
5.00
-5.00
0.00
-10.00
-5.00
-15.00
-10.00
-20.00
-15.00
-25.00
-20.00
-30.00
-25.00
-35.00
-30.00
-40.00
1
2
Ch1: Start 10.0000 MHz
Stop 12.0000 GHz

1.0 Description of the HPDL-100A Programmable Delay Line Instrument

1.0.1 Introduction

The **HPDL-100A** Programmable Delay Line Instrument Series offers a range of programmable delay beginning from 0 delay (DC) to a maximum of 10.23 ns (model HPDL-100A-10.23ns) or to 20.47 ns (model HPDL-100A-20.47ns).

With resolution precision to 10 picoseconds per step and wideband signal frequency input from DC to 12.5 GHz, the HPDL-100A is the finest value priced custom programmable delay line instrument available in the marketplace.

The HPDL-100A Series offers electrical delay through use of microwave relays and low-loss precision-cut semi-rigid coaxial cables inserted into the signal path. The step size resolution is fixed at 10.0 ps. All signal input and output connections are easily accessible at the front panel and are terminated with Female SMA (50 ohm impedance) connectors.

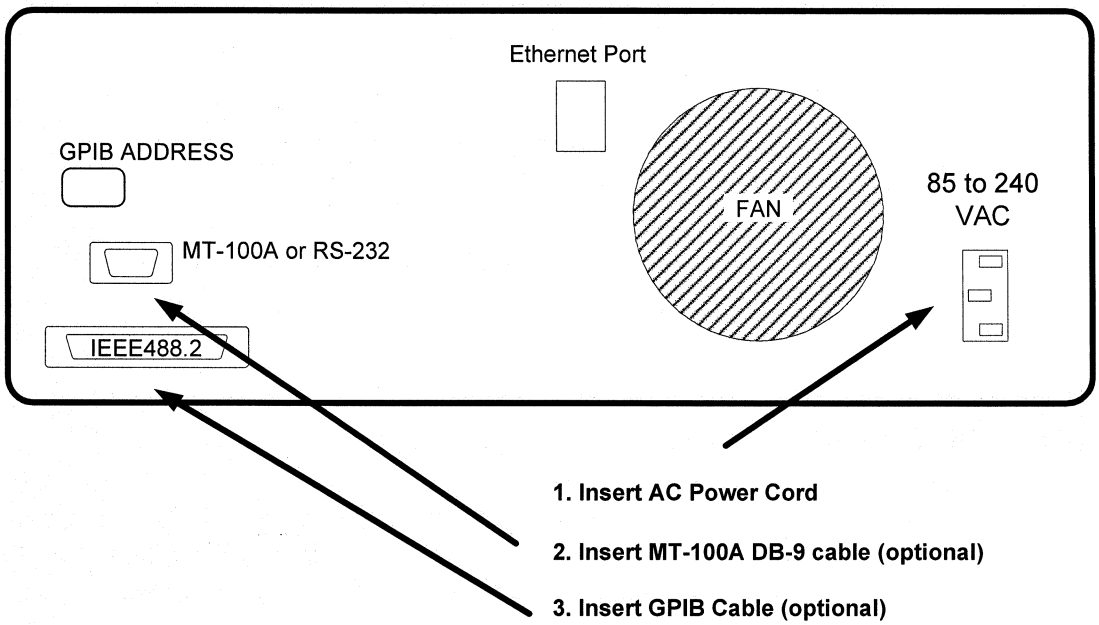
HPDL-100A Series Instruments are programmable and can be locally controlled through a MT-100A Microterminal (LCD display and numeric keypad) or remotely through GPIB (IEEE 488.2), Ethernet TCP/IP, and RS-232 Serial interfaces.

2.0 Getting Started

2.0.1 Using the HPDL-100A for the First Time

After unpacking the instrument, carefully inspect it for any shipping damage. Remove all standard accessories from the shipping carton.

HPDL-100A BACKPANEL



The HPDL-100A accepts AC line input voltage from 85VAC to 240VAC.

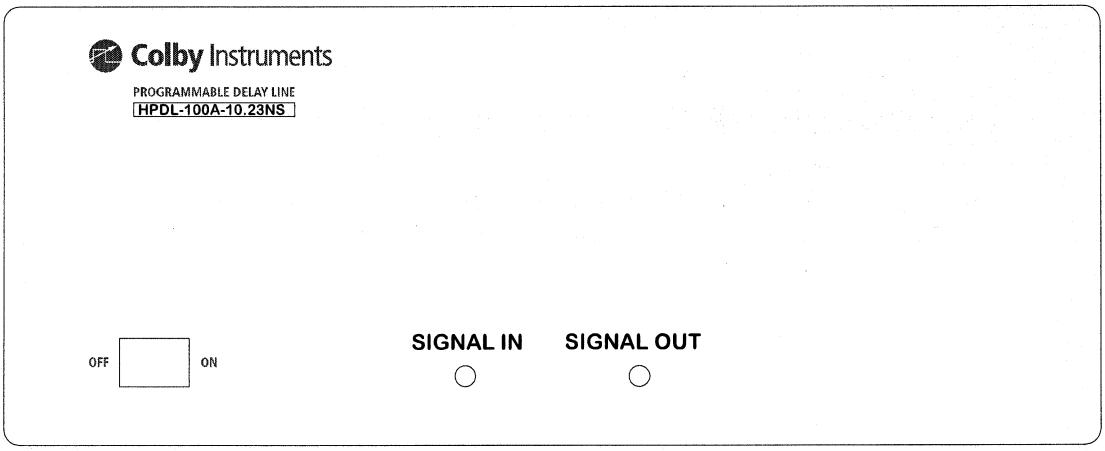
Connecting to the HPDL-100A:

1. Plug in the HPDL-100A to a power source by inserting the AC power cord into the 85 to 240 VAC power entry module located on the backpanel.

Note: Models delivered to customers in North America include a power cord. Customers outside of North America must supply their own power cords. The power entry module uses a standard IEC connector.

2. If you have the optional MT-100A Microterminal, connect the mated cable to the HPDL-100A and to the MT-100A Microterminal.

3. If you have a GPIB (IEEE488.2) interface cable, connect the cable into the IEEE488.2 connector.



Model HPDL-100A FRONT PANEL

4. Push the flat rocker switch on the front panel to turn on the HPDL-100A System Unit.

2.0.2 Self-Test After Power Up

Both the MT-100A Microterminal and the HPDL-100A System Unit each use an embedded microprocessor to perform all necessary tasks. After you power up the HPDL-100A System Unit, both microprocessors will initiate a self-test.

2.0.3 Self-Test without MT-100A Microterminal connected

The HPDL-100A will perform an internal self-test and check the settings of each relay by power cycling all relays to OFF, ON, and then OFF. The delay is reset to its zero delay (0.0 ns) position and the unit is ready to accept commands.

The HPDL-100A is now ready to accept commands from any of the attached interfaces (GPIB(IEEE488.2), Ethernet TCP/IP, or RS-232).

2.0.4 Self-Test with MT-100A Microterminal connected

The following sequence is displayed on the MT-100A Microterminal LCD:

1.
```
  MT-100A V1.0
COLBYINSTRUMENTS
```

2.
```
HPDL100A-10.23NS
..INITIALIZING..
```

3.
```
 10.23 NS RANGE
    10 PS STEP
```

See also Section 4.1.1 The MT-100A Microterminal at a glance.

The HPDL-100A will now check the settings of each relay by power cycling all relays to OFF, ON, and then OFF. The delay is reset to its zero delay (0 ns) position and the unit is ready to accept commands.

The MT-100A Microterminal LCD screen will display as shown below:

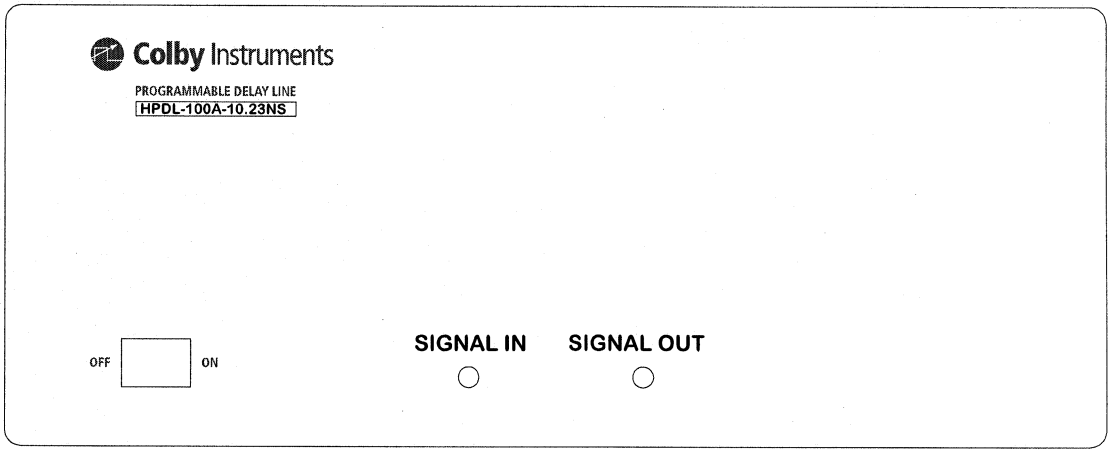
```
   0.0000ns |H| 0
```

The HPDL-100A is now ready to accept commands from the MT-100A Microterminal or via any of the attached interfaces (GPIB(IEEE488.2), Ethernet TCP/IP, or RS-232).

3.0 Using the Front Panel Connections

3.0.1 Overview of the Front Panel Connections

The Custom Programmable Delay Line Instrument (HPDL-100A) instrument has two connectors located on the front panel, SIGNAL IN, and SIGNAL OUT. Both are terminated with SMA FEMALE connectors.



Model HPDL-100A Front Panel

4.0 Setting Delay Values

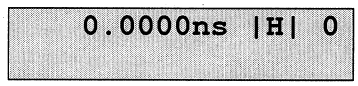
There are two general methods to set delay values:

- Locally via the MT-100A Microterminal (numeric keypad entry)
- Remotely via the GPIB (IEEE488.2) Interface, the Ethernet TCP/IP Port interface, or via the Serial Port RS-232 interface.

4.1.0 Working with the MT-100A Microterminal

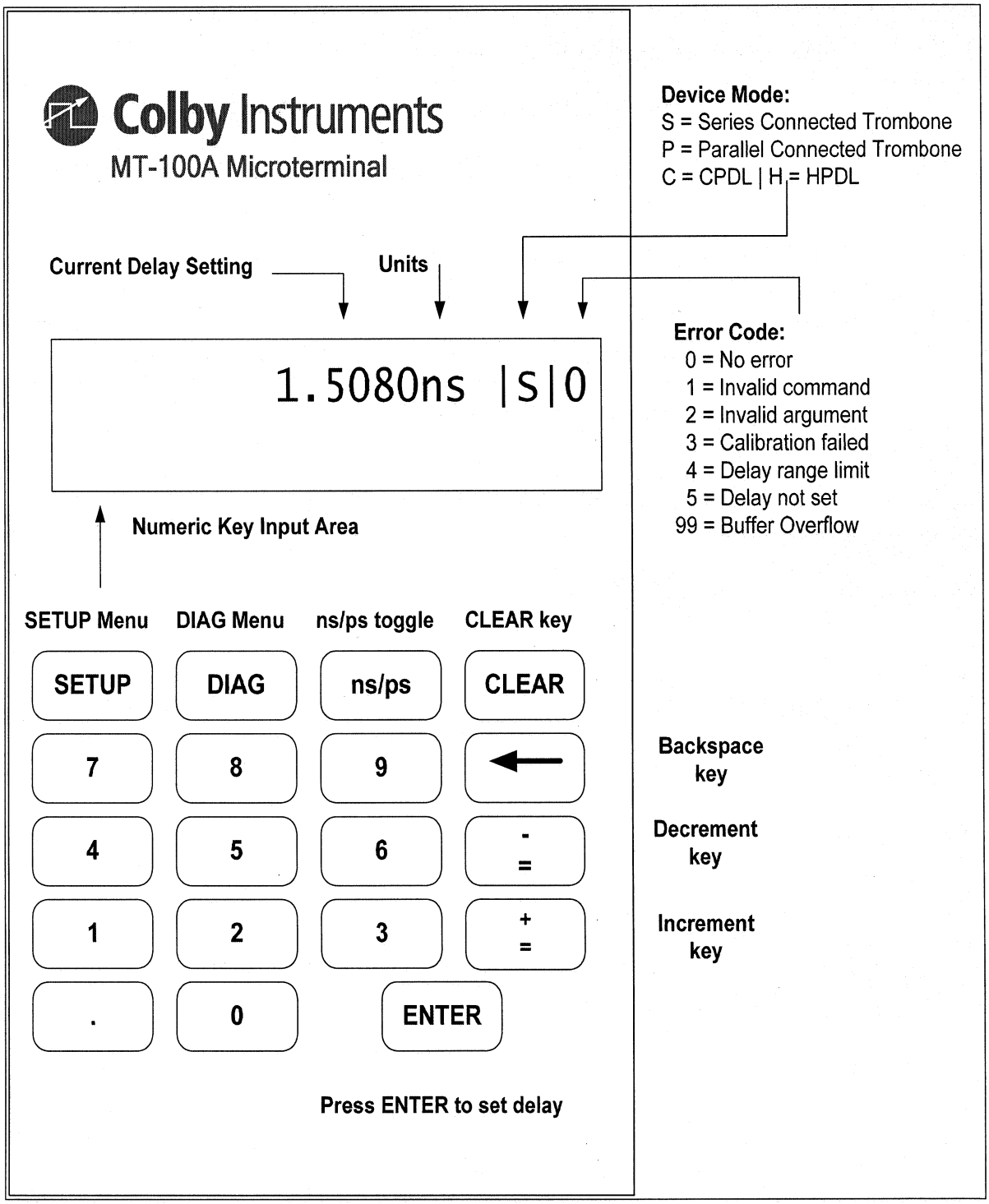
Make sure the HPDL-100A is powered off. Connect the MT-100A Microterminal to the instrument. After pressing the ON/OFF switch located on the front panel of the HPDL-100A unit, a short beep tone indicates that both the MT-100A and the HPDL-100A units have successfully powered up.

The HPDL-100A will then perform an initialization self-test and power cycle the relays. Upon successfully completing these tests, the MT-100A Microterminal unit will display:

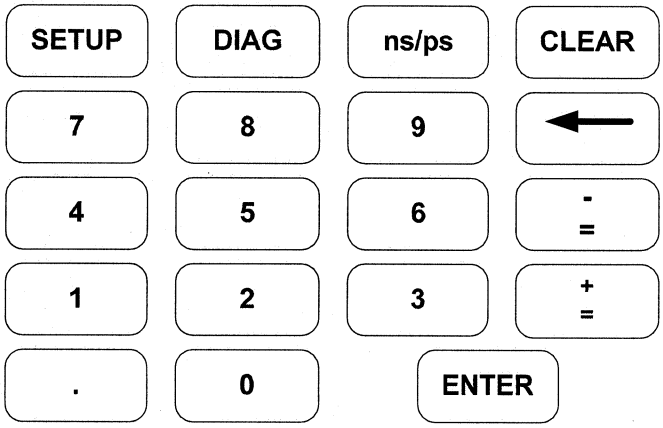


The HPDL-100A system unit is now ready to accept delay settings.

4.1.1 The MT-100A Microterminal at a glance



4.1.2 Working with the MT-100A Microterminal Keypad



SETUP

SETUP Menu. The SETUP Menu offers these options:
1. Display GPIB Address and Set/Display Network address
2. Set Series Connected or Parallel Connected Mode
3. Turn OFF/ON Terminal or MT-100A mode

See Section 4.2.0 The MT-100A Menu Keys - SETUP

DIAG

DIAG Menu. The DIAG Menu offers these options:
1. Turn ON/OFF any or all relays if installed
2. Perform Calibration and self-test
3. Reset the PDL-100A

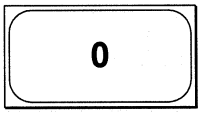
See Section 4.2.0 The MT-100A Menu Keys – DIAG

ns/ps

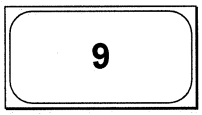
Toggles between display delay setting values in nanoseconds(ns) or picoseconds(ps) units.

CLEAR

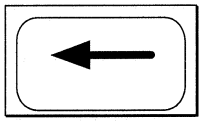
Clear the last entry and return to normal operating mode



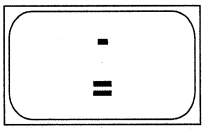
...

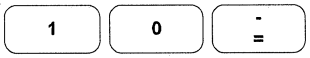


Numeric keypad to enter desired delay or set parameters

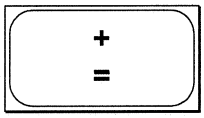


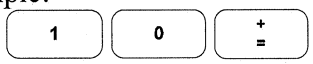
Backspace



Decrement current delay setting by a constant ***step size value*** (default is zero). Immediately pressing this key after entering a value will ***set*** the step size value.
Example:
Press 

to set a step size value of 10 ps and decrement the current delay by 10 ps.



Increment current delay setting by a constant ***step size value*** (default is zero). Immediately pressing this key after entering a value will ***set*** the step size value.
Example:
Press 

to set a step size value of 10 ps and increment the current delay by 10 ps.

Set Delay

4.2.0 Setting Delay with the MT-100A Microterminal

To Enter Desired Delay:

Enter a desired delay setting by using the numeric keypad and pressing ENTER to set the desired delay.

EXAMPLES:

1. Set delay to 2.50 nanoseconds:

```
  0.5000ns |H|0
```

Press **2.50** and **ENTER** *sets delay to 12.50 nanoseconds*

```
  2.5000ns |H|0
```

2. Toggle between nanoseconds (ns) or picoseconds (ps) units

```
  2.5000ns |H|0
```

Press **ns/ps** *toggles units between nanoseconds(ns) or picoseconds(ps.*

```
 2500.00ps |H|0
```

3. Set delay to 10000 picoseconds

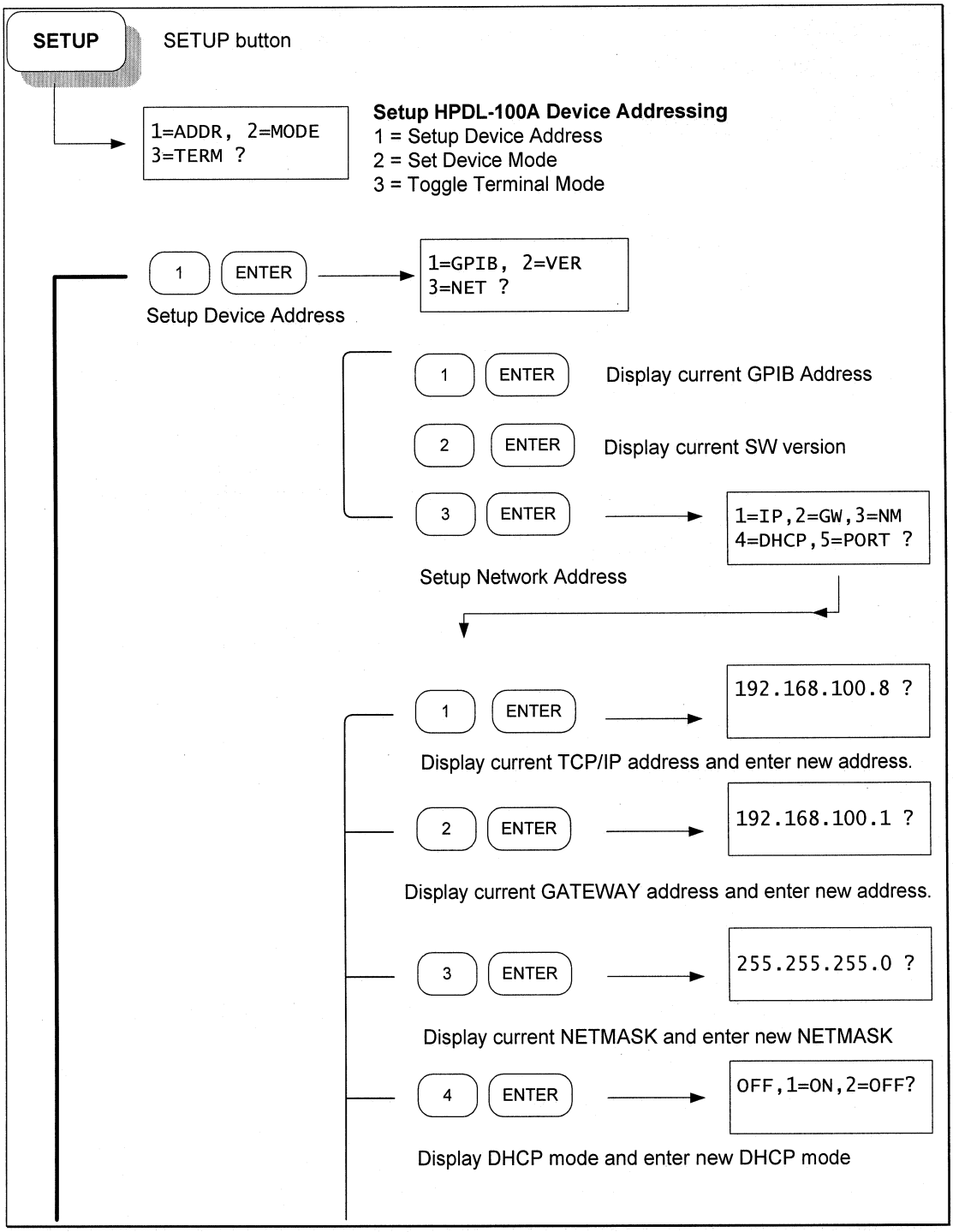
```
 12500.00ps |H|0
10000
```

Press **10000** and **ENTER** *sets delay to 10000 picoseconds*

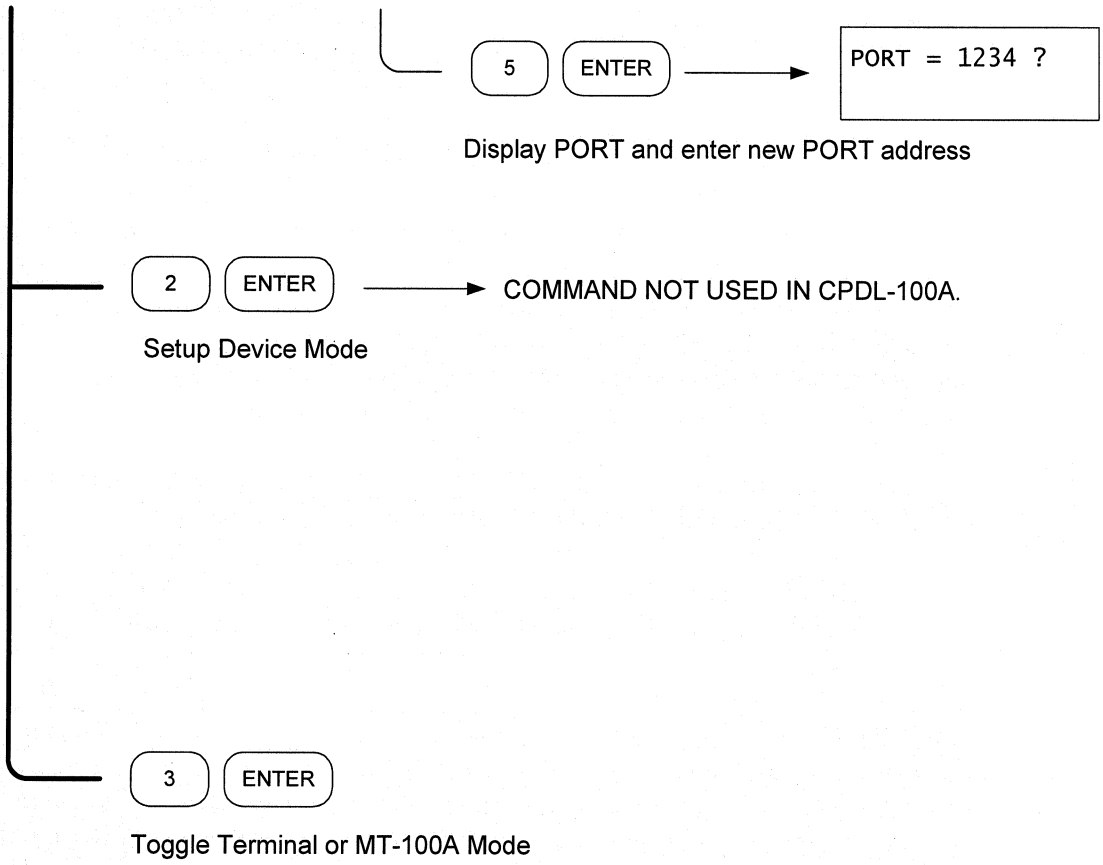
```
 10000.00ps |H|0
```

After pressing the ENTER key, the HPDL-100A will attempt to set the desired delay and return an error code of zero (0) if the delay was set. A BEEP tone will indicate an error (if any) and that the desired delay was not set.

4.3.0 The MT-100A Menu Keys - SETUP



4.3.1 The MT-100A Menu Keys - SETUP cont.



4.3.2 About the SETUP Menu options

The Setup Menu allows you to configure your HPDL-100A by specifying the GPIB instrument device address, the network device address, and to specify whether the RS-232 port is connected to the MT-100A Microterminal or to a PC.

4.3.3 SETUP Menu - GPIB Address

The current GPIB address is displayed. Valid GPIB addresses must be from 1 through 31 and are specified by setting the GPIB device address switches located on the instrument backpanel. ***See Section 7.0 Instrument Backpanel.***

4.3.4 SETUP Menu - Network Addresses

The current network address, gateway address, network mask, DHCP, and network port number can be displayed or specified. If no Ethernet cable is attached, the network IP address reported will be invalid, e.g. 0.0.0.0.

4.3.5 SETUP Menu - RS-232 Terminal Mode or MT-100A Mode

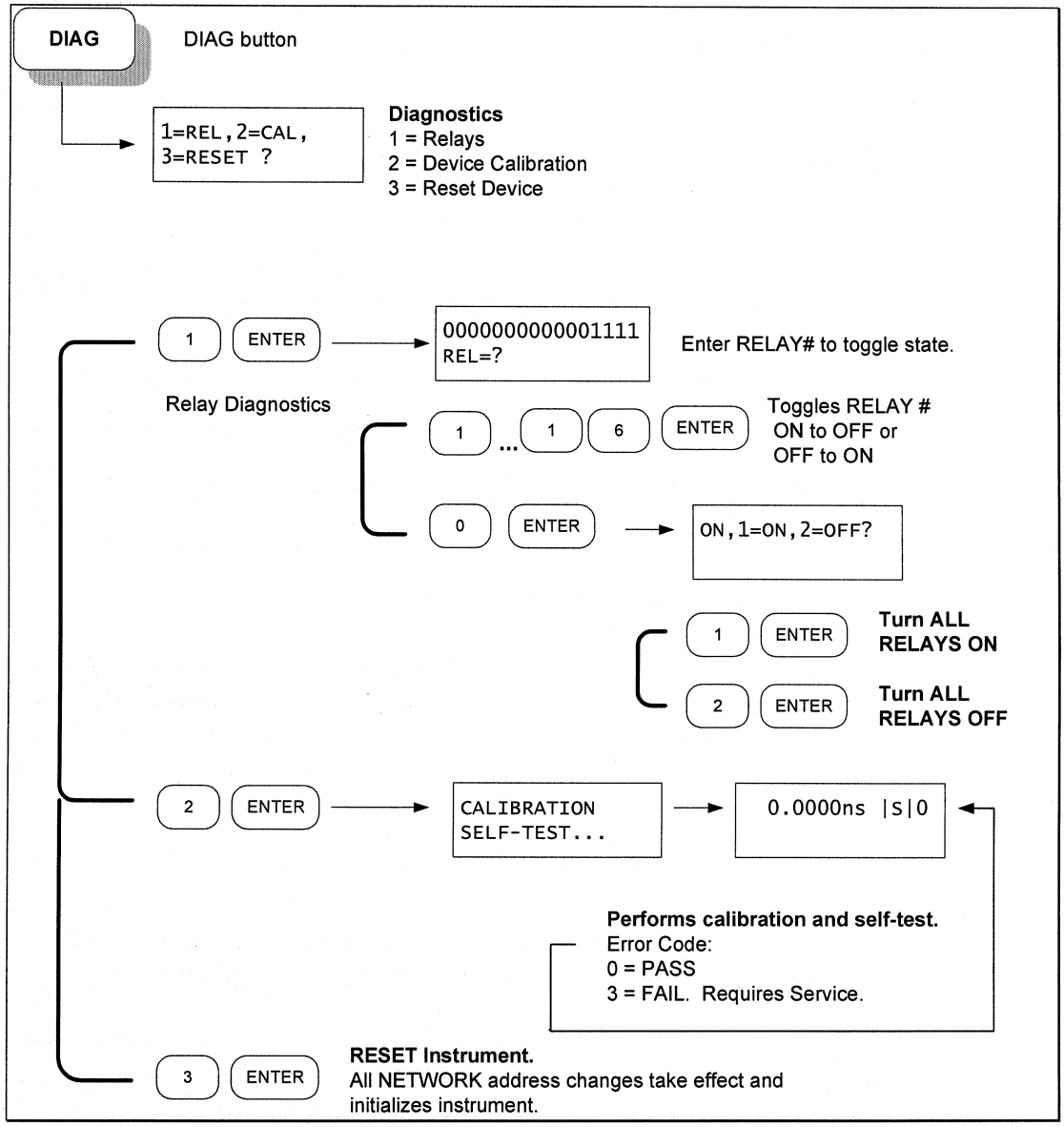
The HPDL-100A has one RS-232 port that can be connected to either a MT-100A Microterminal or to a PC. You must command the HPDL-100A to know which device you have attached else command prompts will not display correctly. The default mode is MT-100A Mode is ON (i.e. MT-100A Microterminal is connected the HPDL-100A). You can toggle between Command Terminal Mode (connected to PC) or MT-100A Mode by selecting this option.

You can also turn off or on Command Terminal Mode by sending the MODE TERM OFF command via GPIB, TCP/IP or RS-232 interface.

MODE TERM OFF	specify PC is connected to RS-232 port
MODE TERM ON	specify MT-100A is connected to RS-232 port

NOTE: To revert to factory default settings for all device addresses and parameters, set the GPIB address switches located on the backpanel to ZERO (all OFF) then power-cycle (turn OFF then ON) the HPDL-100A System Unit. Remember to set the GPIB address switches back to a valid address (1 to 31) after you configure your device settings.

4.4.0 The MT-100A Menu Keys - DIAG



4.4.1 About the DIAG Menu options

The DIAG Menu allows you to perform basic diagnostics on the microwave relays (if delay extensions are attached), perform a device calibration, or to reset the HPDL-100A instrument.

4.4.1.1 DIAG MENU - Relays

The current state of the microwave relays is displayed (0 = OFF, 1=ON) from leftmost (Relay #16) thru rightmost (Relay #01):

16----------1
```
0000000000000000
REL?
```

NOTE: See Specifications of HPDL-100A located in the front of this manual for your specific configuration of delay settings.

You can specify any one relay to toggle (if ON will turn it OFF or if OFF will trun it ON) by entering the relay number and pressing ENTER.

NOTE: Enter 0 to select ALL the relays to either the ON or OFF state.

4.4.1.2 DIAG MENU - Device Calibration

An internal self-test and calibration diagnostic will be performed. The electromechanical trombone will perform a self-test, all relays will cycle OFF, ON, and OFF. Delay will be reset to 0.00. If an error occurs during self-test or calibration, the instrument requires servicing or repair.

4.4.1.3 DIAG MENU - Resetting the HPDL-100A

The HPDL-100A will reset to a known initial POWER-ON state. If network addresses were changed or set, the new settings will take effect.

NOTE: To revert to factory default settings for all device addresses and parameters, set the GPIB address switches located on the backpanel to ZERO (all OFF) then power-cycle (turn OFF then ON) the HPDL-100A System Unit. Remember to set the GPIB address switches back to a valid address (1 to 31) after you configure your device settings.

4.5.0 Working Remotely Through the GPIB Interface

There are three different ways to connect remotely to the PDL-100A:

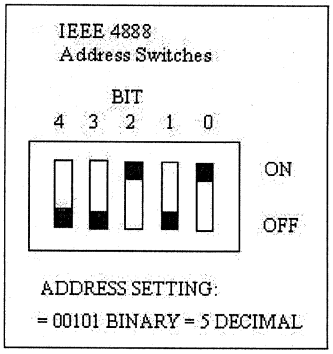
- GPIB (IEEE 488.2)
- Ethernet TCP/IP (Winsock)
- RS-232 Serial Port

4.5.1 Connecting remotely over GPIB (IEEE488.2)

Each instrument communicating using GPIB (IEEE488.2) protocol requires a unique hardware address in the range from 1 to 31.

4.5.2 Setting the GPIB (IEEE488.2) Address

The HPDL-100A unit is shipped with the default GPIB address switch settings set to 5. You can modify the GPIB address for the Primary Trombone only with the switches located on the instrument backpanel. See ***Section 7.0 Instrument Backpanel*** for diagram and location of GPIB address switches. The switches are coded in a 5 bit binary fashion where the right-most switch represents bit 0 (the Least Significant Bit). A bit is ON when the switch is in the UP position.



ADDR		ADDR		ADDR		ADDR	
0	00000	8	01000	16	10000	24	11000
1	00001	9	01001	17	10001	25	11001
2	00010	10	01010	18	10010	26	11010
3	00011	11	01011	19	10011	27	11011
4	00100	12	01100	20	10100	28	11100
5	00101	13	01101	21	10101	29	11101
6	00110	14	01110	22	10110	30	11110
7	00110	15	01110	22	10110	31	11111

After setting the new GPIB address, you must reset the HPDL-100A either by powering the instrument OFF then ON or resetting the device through the Microterminal. ***See Section 4.4.4 DIAG Menu – Resetting the HPDL-100A.***

4.5.3 Setting the delay using GPIB(IEEE488.2) Commands

GPIB commands can be sent to the HPDL-100A by using one of many GPIB command Send and Receive programs available on the PC. This program should be included with the GPIB PC board.

4.5.4 Using National Instruments Measurement and Automation Explorer

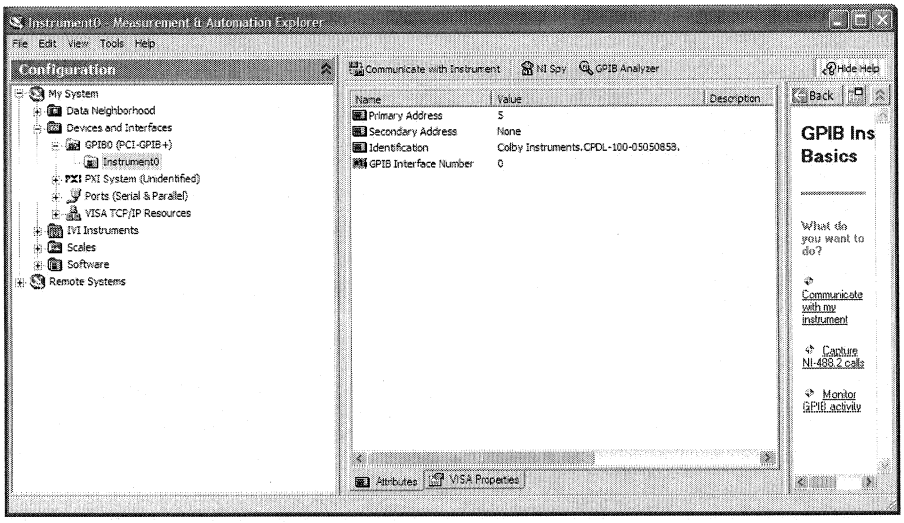
1. From Windows Desktop, double-click on the Measurement & Automation Explorer Icon.

2. In the Configuration Panel, click on Device and Interfaces under Devices

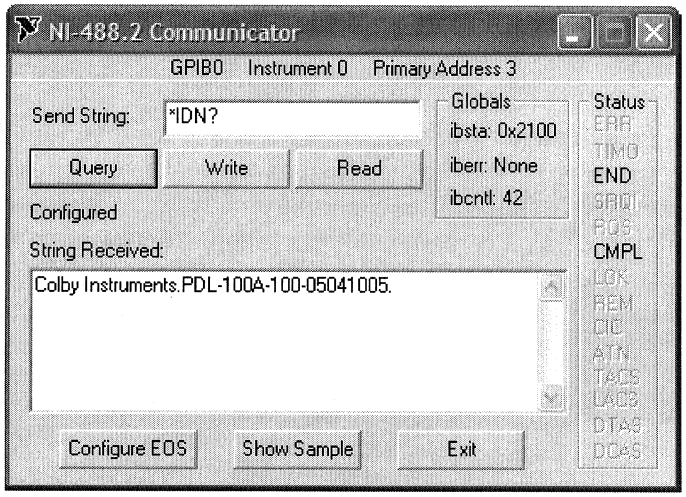
3. Click on your installed GPIB board e.g. GPIB0 (PCI-GPIB+) Folder

4. Click Scan For Instruments button

5. Double-click on Instrument0 (or corresponding instrument attached)



6. Click on Communicate with Instrument button



7. Click Query to send *IDN? to the HPDL-100A and view the response.

Now that NI-488.2 Communicator has started, you can enter commands and query the HPDL-100A unit from this application. See Chapter 5.0 Common Commands and Chapter 6.0 System Commands for specific commands supported.

4.6.0 Communicating with the HPDL-100A over Ethernet TCP/IP

TCP/IP Protocol using Winsock sends data packets to individual IP addresses over a unique and pre-specified port. The HPDL-100A supports fixed (static) and dynamic IP addresses and the Winsock interface. Network Addresses including IP address, Gateway IP, Netmask, DHCP, and Port Number can be specified or changed by sending commands to the HPDL-100A using the GPIB, TCP/IP, or RS-232 interfaces.

To change the network addresses using a command interface, ***see Section 5.0 Command Commands for NET, NET? and NETM? Commands.***

To change the network addresses using the MT-100A Microterminal, ***see Section 4.3.4 SETUP Menu – Network Addresses.***

4.6.1 Default Network Addresses

IP Address	192.168.100.8
Gateway Address	192.168.100.1
Netmask	255.255.0.0
DHCP	OFF
Port Number	1234

These are the default network addresses at time of manufacture and are stored internally in non-volatile storage. If you are unable to communicate with the HPDL-100A over Ethernet after changing a network address (no MT-100A Microterminal or GPIB communication available) and want to restore the default address settings, set the GPIB address switches to Zero (all OFF) and power-cycle (turn OFF then ON) the HPDL-100A System Unit. The default address will take effect.

4.6.1.1 Programming over the Ethernet TCP/IP

When programming the instrument over the Ethernet TCP/IP interface, characters are ***NOT*** echoed (sent from the HPDL-100A) back to the PC when sending the command string. For example, from your application program if you send the character string:

```
*IDN?<CR><LF>
```

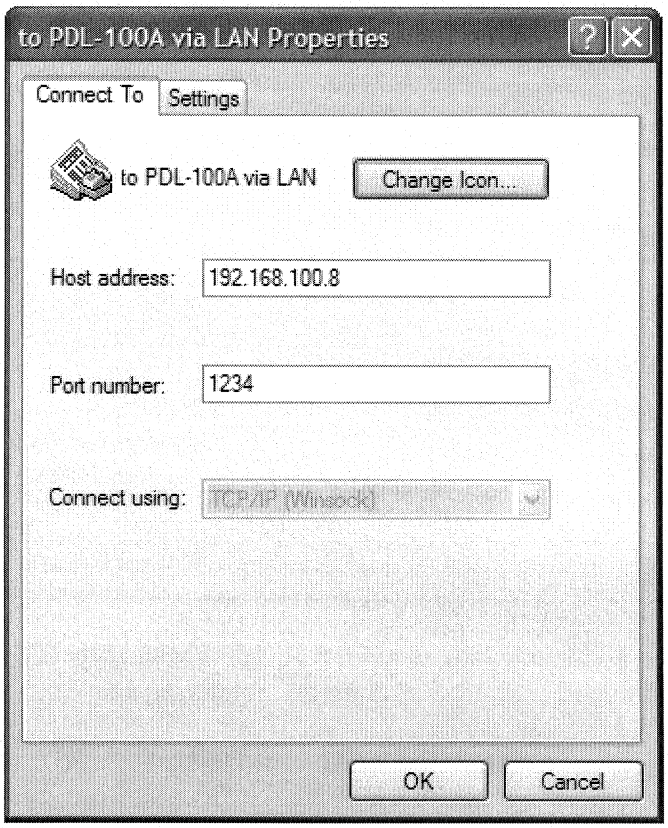
the HPDL-100A will respond with:

```
Colby Instruments,HPDL-100A-
10.23NS,06081020,V1.31<CR><LF>
```

4.6.2 Using HyperTerminal and Ethernet (TCP/IP)

1. From the Windows Desktop, start HyperTerminal on your PC.

2. Click on File and Properties



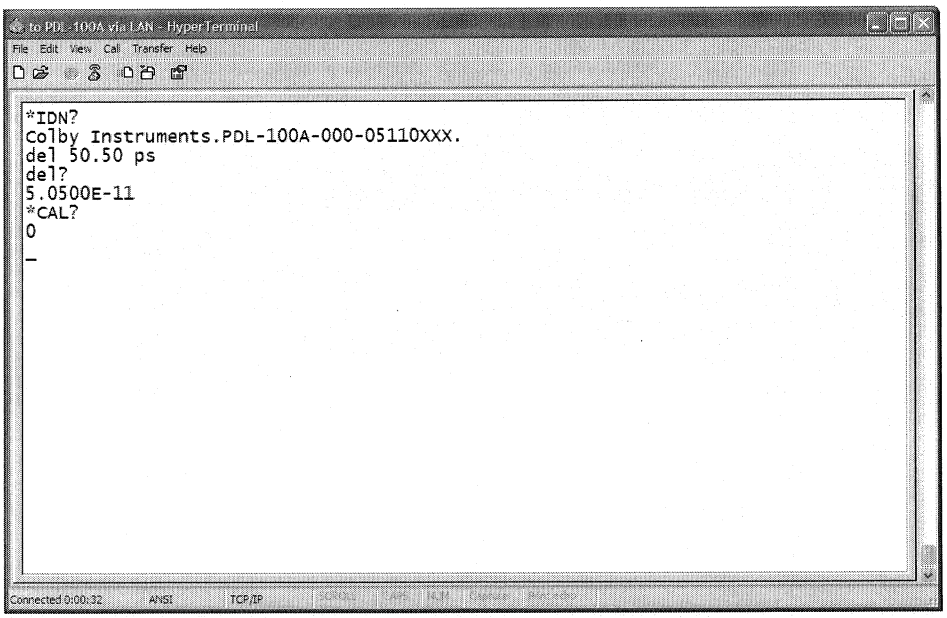
3. Select TCP/IP(Winsock) in Connect using: drop-down list box

4. Enter the Port Number that corresponds to the Port Number for the HPDL-100A.

5. Enter the Host address that corresponds to the Network IP address for the HPDL-100A.

6. Click on OK to continue.

7. Click on Call to initiate the Winsock Session with the HPDL-100A instrument.



Note: When communicating to the HPDL-100A with HyperTerminal and Winsock protocol, command prompts are not displayed.

Now that HyperTerminal has started and is configured correctly, you can enter commands and query the HPDL-100A unit from this application. See Chapter 5.0 Common Commands and Chapter 6.0 System Commands for specific commands supported.

4.7.0 Setting the delay over RS-232 Serial Port and PC

The RS-232 Serial Port is located on the backpanel of the HPDL-100A System Unit ***(see Section 7.0 Instrument Backpanel for diagram)*** and is used to connect to either the MT-100A Microterminal (with the supplied DB-9 MALE to FEMALE cable) or to a PC (with a NULL MODEM DB-9 FEMALE to MALE cable). Port speed is 9600 baud, 8 data bits, and 2 stop bits.

The HPDL-100A System Unit can operate (send command prompts and receive command data) in either Command Terminal Mode or in MT-100A Mode. You must specify the correct mode prior to attaching either the MT-100A Microterminal or the PC else command prompts will be displayed incorrectly. Default is MT-100A Mode with the Microterminal attached when the PDL-100A is first powered-on.

4.7.1 Attaching the MT-100A Microterminal to the RS-232 port

Ensure the MT-100A Mode is set by sending the command: MODE TERM ON to the HPDL-100A. This command can be sent via GPIB, TCP/IP, or via RS-232. If the MT-100A is already connected, you can set the MT-100A Mode ON by pressing: SETUP 3 ENTER on the MT-100A.

Note: if the MT-100A Mode is OFF, command prompts from the HPDL-100A will be displayed incorrectly.

Use the supplied DB-9 mated cable (supplied with MT-100A) to connect the MT-100A Microterminal to the PDL-100A System Unit. ***See Section 7.0 Instrument Backpanel for diagram.***

4.7.2 Attaching the PC to the RS-232 port

Ensure the MT-100A Mode is set by sending the command: MODE TERM OFF to the HPDL-100A. This command can be sent via GPIB, TCP/IP, or via RS-232. If the MT-100A is already connected, you can set the MT-100A Mode OFF by pressing: SETUP 3 ENTER on the MT-100A.

You must use a NULL MODEM cable when connecting the PC to the PDL-100A System Unit. The NULL MODEM cable should have a MALE DB-9 connector TO the HPDL-100A and a FEMALE DB-9

connector TO the PC. ***See Section 7.0 Instrument Backpanel for diagram.*** RS-232 Port speed is 9600 baud, 8 data bits, and 2 stop bits.

4.7.2.1 Programming over the RS-232 connection

When programming the instrument over the RS-232 Serial connection, characters are echoed (sent from the HPDL-100A) back to the PC when sending the command string. For example, from your application program if you send the character string:

```
*IDN?<CR><LF>
```

the HPDL-100A will respond with:

```
*IDN?<CR><LF>
Colby Instruments,HPDL-100A-
10.23NS,06081020,V1.31<CR><LF>
Command[      0.00ps |S|0]:
```

4.7.2.2 Error Checking

After every command sent to the instrument, you should check the Error Return code in the Command Prompt to ensure the command was executed correctly.

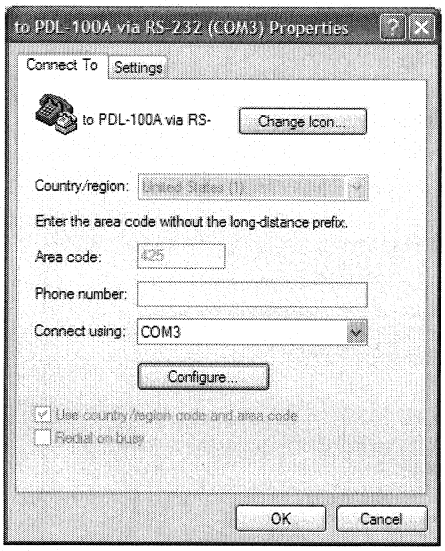
Error Code	Reason
0	No error
1	Invalid command
2	Invalid argument
3	Calibration failed
4	Delay range limit
5	Delay not set
*	Input Buffer Overflow (RS-232)

The Error Return code is a one character field that is the second to last character in the command prompt.

4.7.3 Using HyperTerminal and RS-232 connection

1. From Windows Desktop, click on the Windows Start button, click on All Programs, click on Accessories, click on Communications, and click on HyperTerminal to start the HyperTerminal application.

2. Click on File, and click on Properties:

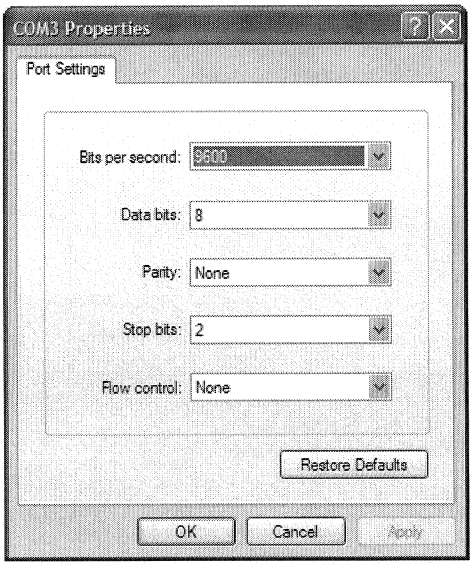


3. Click on the Settings Tab to set the Port Settings.

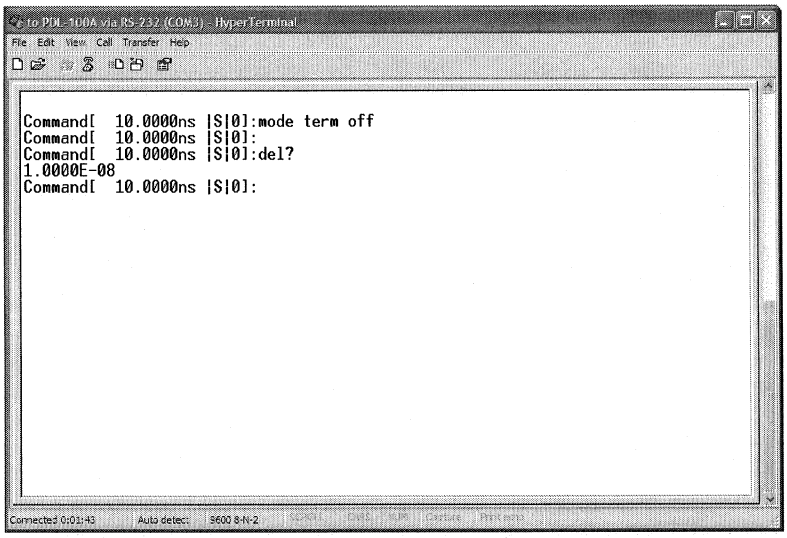
4. Select 9600 bits per second to connect to the HPDL-100A.

5. Select 2 Stop bits.

6. Select None for Flow Control



7. Press OK button to continue.



Now that HyperTerminal has started and is configured correctly, you can enter commands and query the HPDL-100A unit from this application. See Chapter 5.0 Common Commands and System Commands for specific commands supported.

5.0 Common Commands

The IEEE 488.2 standard defines a set of Common Commands. Instruments that adhere to this standard will all respond to these commands in the same manner.

The Common Commands are used to set and query instrument status and the status enable registers. They also include commands to reset the instrument and to inquire about the manufacturer.

5.1.0 Summary of Common Commands

***CLS**	Clears the Event Status Register (ESR)
***ESE mask**	Enable Event Status Register and Set Mask
***ESE?**	Query Event Status Register (ESR) Mask
***ESR?**	Query Event Status Register (ESR)
***IDN?**	Identification String (model and serial number)
***RST**	Reset Command
***TST?**	Test Relays and Returns Status
***OPC**	Set Operation Complete Bit

*CLS	Clear Status	COMMAND

The *CLS command clears the Standard Event Status Register (ESR) and resets any pending errors codes.

Command Syntax *CLS

Example *CLS

Returns None

Example

```
HP : OUTPUT 705;"*CLS"<NL>
NI:  CWGPIB.Write "*CLS"
```

*ESE Event Status Enable COMMAND

The *ESE command sets the Standard Event Status Enable Register bits. The ESR Register contains a mask value for the bits to be enabled in the Standard Event Status Register. A one in the ESR mask will enable the corresponding bit in the ESR to be reported, a zero will disable the bit. For example, a mask value of 255 will enable all bits while a mask value of 1 will enable only the OPC bit to be set.

Command Syntax

*ESE **mask_value**

Where **mask_value** is

Bit #	Value	Enables
7	128	PON – Power on (not used)
6	64	URQ – User Request (not used)
5	32	CME – Command Error
4	16	EXE – Execution Error
3	8	DDE – Device Dependent Error
2	4	QYE – Query Error
1	2	RQC – Request Control (not used)
0	1	OPC – Operation Complete

Example

```
*ESE 1
```

Returns

None

Programming Example

```
HP : OUTPUT 705;"*ESE 255"
NI : CWGPIB.Write "*ESE 1"  'enable OPC bit
```

*ESE? Event Status Enable Mask QUERY

The *ESE? query returns the ESE mask set for the ESR register.

Command Syntax

*ESE?

Example

*ESE?

Returns

<decimal integer><NL>

Example

```
HP : DIM ESE_MASK$(50)
     OUTPUT 705;"*ESE?"<NL>
     ENTER 705;ESE_MASK$
     PRINT(ESE_MASK$)
NI : DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "*ESE?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("ESR Mask is " & QUERY_RESPONSE)
```

*ESR? Operation Complete QUERY

The *ESR? Query returns the contents of the Standard Event Status Register (ESR). Reading this clears the Standard Event Status Register, as does the *CLS command.

NOTE: Use the *ESE command to set the mask value to determine which bits are reported in the ESR register.

Command Syntax

*ESR?

Example

*ESR?

Returns

<decimal integer><NL>

Example

```
HP : DIM ESR$(50)
     OUTPUT 705;"*ESR?"<NL>
     ENTER 705;ESR$
     PRINT(ESR$)
NI:  DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "*ESR?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("Response is " & QUERY_RESPONSE)
```

*IDN?	Identification	QUERY

This command queries the HPDL-100A for its identification string and returns:
Colby Instruments,HPDL-100A-10.23NS,06081005,V1.31.

Colby Instruments,	Denotes manufacturer
HPDL-100A-10.23NS, 6081005,	MODEL NAME-MODEL NUMBER-MAX DELAY, SERIAL NUMBER
V1.31	Software version.

Command Syntax

*IDN?

Example

*IDN?

Returns

<string> <NL>

Colby Instruments,HPDL-100A-10.23NS,06081005,V1.31.

Programming Example

```
HP : DIM ID$(50)
     OUTPUT 705;"*IDN?"<NL>
     ENTER 705;ID$
     PRINT(ID$)

NI : DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "*IDN?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("Response is " & QUERY_RESPONSE)
```

*RST	Reset	COMMAND

The *RST (Reset) command performs a device reset and sets the HPDL-100A to its initial POWER-ON state.
The following steps will be performed:

- Initialize Microterminal (if connected)
- Reset the delay line to zero delay, 0.00 ps
- All relays turned OFF (no delay)
- New Network IP addresses (if previously changed) take effect
- GPIB address switches (if changed) take effect

Command Syntax *RST

Example *RST

Returns None

Programming Example

```
HP : OUTPUT 705;"*RST"
NI : CWGPIB.Write "*RST"
```

*TST? Test Operation Query QUERY

The *TST? query initiates an internal self-test by setting all relays off, moving the electromechanical trombone to zero delay, and re-initializing all internal variables.

Command Syntax

*TST?

Example

*TST?

Returns

<decimal integer><NL>
0 = Internal self-test passed.
1 = Internal self-test failed.

Programming Example

```
HP : DIM TST$(50)
     OUTPUT 705;"*TST?"<NL>
     ENTER 705;TST$
     PRINT(TST$)
NI : DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "*TST?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("Response is " & QUERY_RESPONSE)
```

*OPC	Operation Complete	COMMAND

The *OPC command will cause the HPDL-100A to set the operation complete bit (bit 0) in the Standard Event Status Register (ESR) when all pending device operations have finished.

NOTE: The HPDL-100A blocks (i.e. does not return) until all operations are completed.

Command Syntax *OPC

Example *OPC

Returns None

Programming Example

```
HP : OUTPUT 705;"*OPC"
NI : CWGPIB.Write "*OPC"
```

6.0 System Commands

The following system commands are specific to the HPDL-100A instrument:

6.1.0 Summary of System Commands

DEC	Decrement Command
DEL arg [PS | NS]	Delay Command
DEL?	Delay Query
ERR?	Error Query
INC	Increment Command
NET IP | GW | NM | PORT | DHCP arg	Network IP Command
NET?	Network Query
NETM?	Network MAC ID Query
REL arg ON | OFF	Relay Command
STEP arg [PS | NS]	Step Command
STEP?	Step Query

DEC	DECREMENT	COMMAND

Decrement the delay setting by step size amount.

Command Syntax

DEC

Example

DEC

Returns

None

Programming Example

```
HP : OUTPUT 705;"DEC 100 ps"<NL>
NI : CWGPIB.Write "DEC"
```

DEL	Delay	COMMAND

The DEL command sets the delay of the unit. The desired delay must be within the total delay range of the device.

Delay can be specified in picosecond (ps) and nanosecond (ns) units or using scientific notation. The HPDL-100A will round DOWN to the nearest step size resolution if unable to provide exact delay as entered.

Command Syntax

DEL **arg [PS | NS]**

arg = desired delay value. For scientific notation, use <x.xxxxxE-yy> where (x..x) is a 4 digit mantissa and (yy) is a two digit exponent. E.g. 3.0000E-10 is 300.0 picoseconds.
PS = picoseconds
NS = nanoseconds

Note: Picoseconds is the units used if no units are specified in the command line.

Example

```
del 100.50 ps
DEL 123 NS
del 10.0e-11
```

Returns

None

Programming Example

```
HP : OUTPUT 705;"del 123 ps"<NL>
NI : CWGPIB.Write "DEL 123.50 PS"
```

DEL?	Delay	QUERY

The DEL? query command is used to return the current delay setting of the unit.

Command Syntax

DEL?

Example

DEL?

Returns

<x.xxxxxE-yy><NL>

(x..x) is a 4 digit mantissa and (yy) a two digit exponent.

For example, **3.0000E-10** is 300.00 picoseconds.

Programming Example

```
HP : OUTPUT 705;"DEL?"<NL>
     ENTER 705;Delay$
     PRINT (DELAY$)
NI:  DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "DEL?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("Delay is set at " & QUERY_RESPONSE)
```

ERR? ERROR QUERY

The ERR? query returns the last error number encountered.

Command Syntax

ERR?

Example

ERR?

Returns

<DECIMAL INTEGER><NL>

0 = No Error
1 = Invalid Command
2 = Invalid Argument
3 = Unit did not pass calibration
4 = Delay setting requested is beyond range of device.
5 = Delay not set
99 = Buffer overflow

Programming Example

```
HP : DIM Error$(100)
     OUTPUT 705;"ERR?"<NL>
     ENTER 705;Error$
     PRINT (ERROR$)
NI : DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "ERR?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("Last Error Code # " & QUERY_RESPONSE)
```

INC INCREMENT COMMAND

Increment the delay setting by step size amount.

Command Syntax

INC

Example

INC

Returns

None

Programming Example

```
HP : OUTPUT 705;"INC"<NL>
NI : CWGPIB.Write "INC"
```

NET NETWORK COMMAND

The NET command sets the network addresses and other network settings for the instrument. Addresses are stored in non-volatile memory.

Command Syntax

NET **[IP | GW | NM | PORT | DHCP] arg**

IP = XXX.YYY.ZZZ.AAA
Set IP address

GW = XXX.YYY.ZZZ.AAA
Set Gateway IP address

NM = XXX.YYY.ZZZ.AAA
Set Network Mask address

PORT = XXXX
Set Network Port #

DHCP = ON | OFF
Set DHCP to ON or OFF

NOTE: Network values are stored in non-volatile memory and do not take effect until the next power cycle or *RST command is performed.

Example

NET IP 192.168.100.10
NET NM 255.255.0.0
NET PORT 5678
NET DHCP OFF

Returns

None

Programming Example

```
HP : OUTPUT 705;"NET DHCP ON"<NL>
NI : CWGPIB.Write "NET IP 192.168.100.11"
```

NET?	NETWORK ADDRESS	QUERY

The NET? query retrieves the values for the ***currently set*** network addresses. Note: if no network cable is connected, the IP address returned is invalid (e.g. 0.0.0.0).

Command Syntax

NET?

Example

NET?

Returns

<ASCII TEXT><NL>

IP=192.168.100.8,NM=255.255.255.0,GW=192.168.100.1, PORT=1234,DHCP=OFF

Programming Example

```
HP : OUTPUT 705;"NET?"<NL>
     ENTER 705;NETWORK$
     PRINT (NETWORK$)
NI : DIM RESPONSE As Variant
     CWGPIB.Write "NET?"
     RESPONSE = CWGPIB.Read(250)
     MsgBox ("Network settings : " & RESPONSE)
```

NETM? NETWORK MAC_ID ADDRESS QUERY

The NETM? query returns the network MAC address.

Command Syntax

NETM?

Example

NETM?

Returns

<ASCII TEXT><NL>

MAC_ID=0090-C2C4-CDCE

Programming Example

```
HP : OUTPUT 705;"NETM?"<NL>
     ENTER 705;NETWORK$
     PRINT (NETWORK$)
NI : DIM RESPONSE As Variant
     CWGPIB.Write "NETM?"
     RESPONSE = CWGPIB.Read(250)
     MsgBox ("Network MAC ID: " & RESPONSE)
```

REL	RELAY	COMMAND

The REL command sets the relay #x to ON (delay) or OFF (no delay) state.

Command Syntax

REL **X ON** | ***OFF***

X = desired relay number 1 to 16. (0 sets ALL relays.)
ON = set relay X to ON
OFF = set relay X to OFF

NOTE: Relay numbering is from left to right. Relay # 16 (most delay) is on the left, while relay # 1 is on the right (least delay).

Example

REL 8 ON

Returns

None

Programming Example

```
HP : OUTPUT 705;"REL 1 ON"<NL>
NI : CWGPIB.Write "REL 1 OFF"
```

REL?	RELAY	QUERY

The REL? query asks for the status of all relays, 16 (far left) through 1 (far right).

Command Syntax

REL?

Example

REL?

Returns

<ASCII text><NL>

0001000000101011, X.YYYY ns

0 = Relay OFF
1 = Relay ON

X.YYYY ns = total delay

Programming Example

```
HP : OUTPUT 705;"REL?"<NL>
     ENTER 705;REL$
     PRINT (REL$)
NI:  DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "REL?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("Relay status is:" & QUERY_RESPONSE)
```

STEP	STEP COMMAND
	Sets the step size for the delay setting. Step size can be specified in picosecond (ps) and nanosecond (ns) units or using scientific notation. The HPDL-100A will round DOWN to the nearest step size resolution if unable to provide exact step size as entered.
Command Syntax	STEP ***arg*** **[ps | ns]** **arg** is the delay step size. For scientific notation, use <x.xxxxxE-yy> where (x..x) is a 4 digit mantissa and (yy) is a two digit exponent. E.g. 3.0000E-10 is 300.0 picoseconds. **ps** sets the delay in picoseconds **ns** sets the delay in nanoseconds
Example	STEP 100 PS STEP 1 NS Step 3.0e-11
Returns	None
Programming Example	`HP : OUTPUT 705;"STEP 100 ps"<NL>` `NI : CWGPIB.Write "STEP 123.50 PS"`

STEP?	STEP SIZE	QUERY

The STEP? query command is used return the current delay setting step size.

Command Syntax

STEP?

Example

STEP?

Returns

<x.xxxxxE-yy><NL>

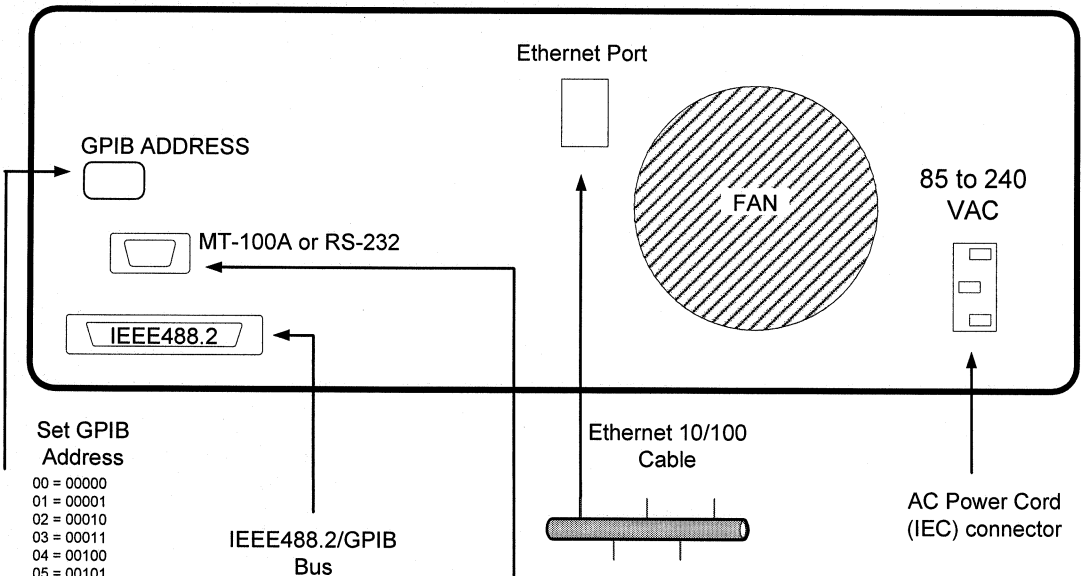
(x..x) is a 4 digit mantissa and (yy) a two digit exponent.

For example, **3.0000E-10** is 300.00 picoseconds.

Programming Example

```
HP : OUTPUT 705;"STEP?"<NL>
     ENTER 705;STEP$
     PRINT (STEP$)
NI:  DIM QUERY_RESPONSE As Variant
     CWGPIB.Write "STEP?"
     QUERY_RESPONSE = CWGPIB.Read(250)
     MsgBox ("Step size is: " & QUERY_RESPONSE)
```

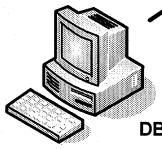
7.0 Instrument Backpanel



To PC with NULL MODEM DB9F-M cable

OR

To MT-100A Microterminal with supplied DB9M-F cable



DB-9 Pin Assignment

PIN 1 UNUSED
PIN 2 RXD (TO HPDL-100A)
PIN 3 TXD (FROM HPDL-100A)
PIN 4 UNUSED
PIN 5 GND
PIN 6 UNUSED
PIN 7 UNUSED
PIN 8 UNUSED
PIN 9 +5V (FOR MT-100A)*

*** = DO NOT USE WHEN CONNECTING WITH PC VIA NULL MODEM CABLE.**