



# Contents

<u>General Safety</u> .....	3
<u>Safety Around Lasers</u> .....	3
<u>Safety Around Electricity</u> .....	4
<u>Safety Notification</u> .....	5
<u>System Specifications</u> .....	6
<u>Handling Precautions</u> .....	7
<u>Chapter 1 - System Overview</u> .....	8
<u>Introduction</u> .....	8
<u>E-BERT Measurement System features</u> .....	8
<u>Physical features</u> .....	9
<u>System</u> .....	9
<u>Generator</u> .....	9
<u>Analyzer</u> .....	10
<u>PC interface</u> .....	10
<u>Chapter 2 - System Installation</u> .....	11
<u>Introduction</u> .....	11
<u>Hardware installation</u> .....	11
<u>Software Installation</u> .....	12
<u>Installing USB to RS232 Driver</u> .....	12
<u>Installing the Run-Time Engine and the E-BERT GUI</u> .....	17
<u>Running the E-BERT GUI</u> .....	19
<u>Chapter 3 - E-BERT Graphical User Interface (GUI)</u> .....	20
<u>Introduction</u> .....	20
<u>Running the E-BERT GUI</u> .....	20
<u>Components of the E-BERT Measurement System GUI</u> .....	20
<u>Chapter 4 - E-BERT Labview Driver Programming Guide</u> .....	20
<u>Compliance and Certification</u> .....	31
<u>Software License Agreement</u> .....	32
<u>Customer Service and Contact Information</u> .....	34

# General Safety

## Intended Audience

This document is intended for trained personnel in either telecommunications or networking environments who have a solid understanding of safety procedures around electricity and lasers.

**WARNING: ONLY TRAINED AND QUALIFIED PERSONNEL ARE ALLOWED TO OPERATE THIS EQUIPMENT.**

## Safety on Lasers

### Disconnected Optical Fiber Cable

Observe the following in the event that an optical cable is disconnected from an energized chassis:

- Do not examine, look directly at or stare into disconnected fiber optical cable ends.
- A disconnected or open fiber port is the most likely way to become exposed to laser radiation from this product. Do not leave fiber optic cable ports open if not in use (See Table A6 in the Appendix for the power levels emitted from an open transceiver transmit port).
- The E-BERT Measurement System uses Class 1 laser transceivers that emit invisible radiation. Never stare into open ports and do not view connectors or fibers with an eye loupe or other collecting optics.
- Arrange for a trained service person to de-energize the equipment and repair or replace the optical fiber or cable.

### Laser Radiation Sources Specific to E-BERT

E-BERT systems may contain lasers that emit invisible radiation. Never stare into open fiber optic cable ports. Cap all unused fiber ports.

The Laser Class 1 pluggable optical transceivers are the only source of laser radiation from the E-BERT system.

## **Safety on Electricity**

Do not perform any action that creates a potential hazard to personnel or makes the equipment unsafe. Observe the following guidelines when working with any electrical equipment:

- Carefully examine the entire work area for possible hazards such as wet floors, ungrounded power extension cables, and missing safety grounds before beginning work
- Disconnect the power cords from the equipment whenever possible. Make sure that power cord is readily identifiable and easily reached
- Disconnect all external cables before installing or removing
- Failure to ensure adequate grounding can cause product damage and can make the product dangerous
- Never install equipment that appears damaged.
- Never position the equipment where it is difficult to operate the disconnecting device (appliance coupler).
- Use of this equipment in a manner not specified by the manufacture may impair built-in safety protection mechanisms provided by the equipment.
- The E-BERT System should be used in accordance with local and national electrical codes.
- The power plug must be connected to a properly wired earth ground outlet receptacle. An improperly wired power outlet could place hazardous voltages on accessible metal parts of the chassis.

The E-BERT Measurement System has electrical and optical ports. Follow appropriate electrostatic discharge and optical eye safety precautions when using the Measurement System.

### **ELECTRICAL CLASS I EQUIPMENT**

**THIS EQUIPMENT MUST BE EARTHED.** Power plug must be connected to a properly wired earth ground outlet. An improperly wired socket outlet could induce hazardous voltages on accessible metal parts. Use the power cord supplied with the equipment.

### **ELECTRICAL - AC MAIN CIRCUIT OVERLOADING**

When installing product, consideration must be given to the accumulative nameplate rating when connecting the equipment to the AC supply wiring.

### **ELECTRICAL – AUTOMATIC PRIMARY INPUT VOLTAGE ADJUSTMENT**

This product will automatically adjust to any voltage between the ranges shown on the datasheet.

## Safety Notification

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### WARNING

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1. Always refer to this manual when working near environment which the alert mark show on the left. If operation is performed without heeding the advice in this operation manual, there is a risk of personal injury. In addition, the performance of this equipment may be reduced. Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangerous.



2. When supplying the power to this equipment, please make sure the 3-pin power cable to 3-pin grounded power outlet is well connected. If a grounded power outlet is not available, before supplying power to the equipment, use a conversion adapter and ground the green wire, or connect the frame ground on rear panel of this equipment to ground. If power is supplied without grounding the equipment, there is risk of receiving a severe or fatal electric shock.



3. This equipment cannot be repaired by user. **DO NOT** attempt to open the cabinet or disassemble internal parts without authorization. Only Phytrex well trained service people or staff who get the authorization could service this equipment. In addition, there is a risk of damage to precision parts inside the equipment.

### CAUTIONS

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1. Before changing the fuse, **ALWAYS** remove the power cord from the power outlet and replace the fuses. Always use new fuses of the same type and rating specified on the fuse marking on the rear panel of cabinet.
  2. Keep the power supply and cooling fan free of dust.
    - Clean the power inlet regularly. If dust accumulates around the power pin, there is a risk of fire.
    - Keep the cooling fan clean and the ventilation holes are not obstructed. If the ventilation is obstructed, the cabinet may over heat.
-

## System Specifications

The E-BERT Measurement System is intended for indoor controlled environment use only.

<b>Environmental</b>	
Acoustic Noise	60 dBA maximum
Temperature	Operating: 5 °C to 40 °C Storage: 0 °C to 70 °C
Relative Humidity	Operating, non-condensing 5 to 85% continuous Storage, non-condensing: 5 to 95%
<b>Electrical</b>	
Electrical Rating	100 to 240 VAC, 1.4A, 50/60 Hz
Mains voltage fluctuations	±10%
Transient	Transient Overvoltage Category II
<b>Physical</b>	
Dimensions	(L)475mm X (W)350mm X (H)160mm
Net Weight	< 6.5 Kgw

## Handling Precautions

1. The E-BERT Measurement System is intended for operation at an ambient temperature of 25 degrees Centigrade.
2. Adequate airflow should be provided to the Measurement System to maintain the required ambient thermal conditions.
3. Ensure that the Measurement System power supply and all equipment used with it have properly earthed ac power supplies.
4. Standard precautions against electrostatic discharge (ESD) must be followed while handling the Measurement System. Terminate unused electrical output ports with 50 ohm connected to ground.
5. **The optical input power to the Measurement System should not exceed the maximum value in Table A.1 to avoid permanent damage to the optical receiver.**
6. The Measurement System must be operated in a dust-free environment. Keep unused ports capped. Particular care must be taken to ensure that the optical connectors are kept clean. It is recommended that the connector surfaces and exposed parts be cleaned periodically with lint-free wipes (Texwipes® or Kimwipe®) and talcum-free swabs soaked in optical-grade isopropyl alcohol, and then blown dry with inert dusting gas (Tech Spray® Duster 1671). Do not use freon-based cleaners.
7. Follow ESD precautions when removing or inserting pluggable optics modules. Although the modules can be removed or installed when the unit is powered up, it is recommended that the System be powered down for changing optical modules.
8. Use the DB-9/USB adapter cable provided with the System to connect the serial interface to the standard USB COM port of a desktop or laptop PC.

# Chapter 1 - System Overview

## Introduction

The E-BERT Measurement System is an easy-to-use bit-error-ratio measurement system suited for research, development, and manufacturing environments. The Measurement System is a very compact unit that incorporates electrical and optical interfaces to a pattern generator and bit error analyzer. It comes with an intuitive graphical user interface (GUI) and a comprehensive single screen display.

The E-BERT Measurement System has been designed to operate with few user-settable parameters and with minimal training. The System has a built-in clock recovery mechanism that is typically not available in an integrated form in commercial bit-error-rate testers. The System also has an intelligent data pattern synchronization feature that automatically initiates pattern synchronization when the data rate is changed or the Analyzer signal is interrupted.

The Measurement System records the results of bit-error-rate measurements in a spreadsheet format for analysis and archiving. No programming knowledge is required to enable the recording feature.

## E-BERT Measurement System features

The Measurement System is a versatile unit possessing a wide variety of features summarized below:

1. Bit-Error-Ratio (BER) measurement for NRZ PRBS  $2^7-1$ ,  $2^{23}-1$ ,  $2^{31}-1$ , FC CJTPAT, FC CRPAT, FC CSPAT, K28.5, K28.7, D21.5 and User Edit patterns 64 bits
2. Click "Data Rate" pop-up menu shows multi-rate operation covering SONET OC-3/12/48, OC-48 with Forward Error Correction (FEC), Gigabit Ethernet (1.25 Gb/s), Fibre Channel (1.0625 Gb/s, 2.125 Gb/s, 4.25Gb/s), Infiniband (2.5Gb/s, 5 Gb/s) rates
3. Dual Differential 100  $\Omega$  SMA electrical interface to double the testing throughput
4. Pluggable optical interfaces compliant to Multi-Source Agreement (MSA) standards
5. Built-in clock recovery provides half-rate clock output and data alignment eliminates the need for additional external modules and user-initiated data alignment
6. Accumulated error count and error ratio statistics
7. Graphical display of BER and Error Count
8. User-settable BER measurement duration (gating time)
9. User programming library for sequential control
10. Measurement result export option

## Physical features



Figure 1:E-BERT Measurement System

The physical features of the E-BERT Measurement System are shown in Figure. 1.

## System

The chassis provides DC power and cooling for the Measurement System. The chassis has LEDs that indicate the status of the electrical power supply and the fan.

## Generator

The generator produces PRBS  $2^7-1$ ,  $2^{23}-1$ ,  $2^{31}-1$ , FC CJTPAT, FC CRPAT, FC CSPAT, K28.5, K28.7, D21.5 and User edit 40/64 bits patterns NRZ data signal that can be output to the electrical, or optical through the coaxial cables on the front panel. The generator also outputs the half data rate clock and a lower speed trigger signal to facilitate observing the data signal using a sampling oscilloscope or communication analyzer. The generator has LEDs indicating the power status of the system.

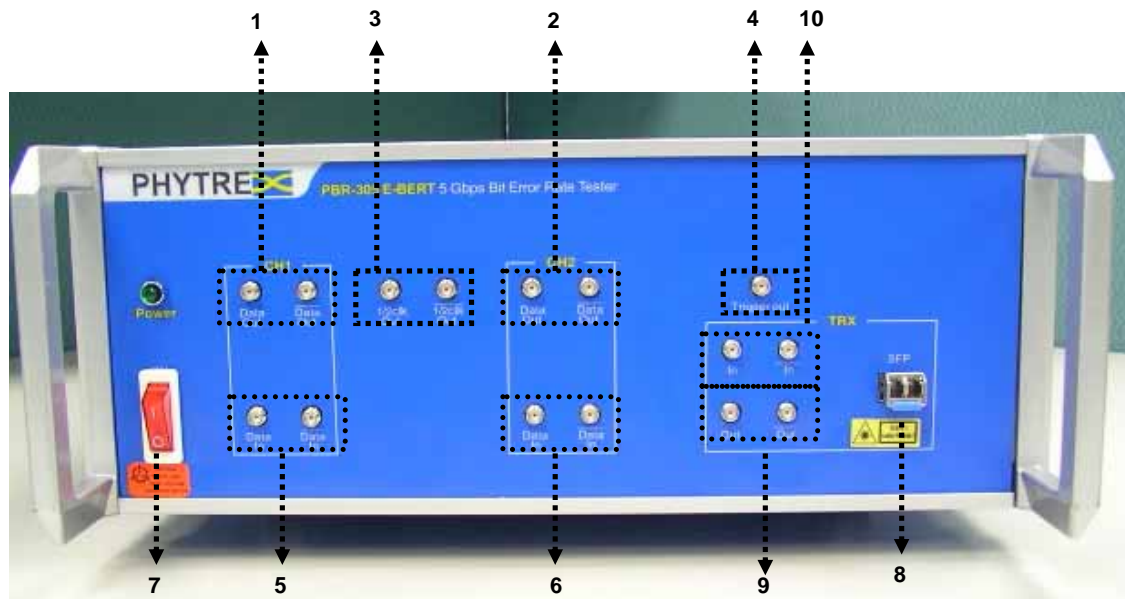


Figure 2: Front Panel Overview

No.	Description	Note	No.	Description	Note
1	Channel 1 Data Output	Differential	6	Channel 2 Data Input	Differential
2	Channel 2 Data Output	Differential	7	Power Switch	
3	Clock Output	Half Rate	8	Optical SFP Module	Pluggable
4	Trigger Output	Reference Clk	9	Data Output	Differential
5	Channel 1 Data Input	Differential	10	Data Input	Differential

Table 1 Front Panel Description

## Analyzer

The electrical or optical signal to be tested for bit errors is provided to the Measurement System via the 50Ω SMA connector or through the coaxial cable from LC single-mode/multi-mode optical fiber connector on the front panel . Unlike most commercial bit-error-rate testers, the analyzer does not require externally clock signals .

## PC interface

An RS-232 compatible serial communication interface is provided through an USB connector jack on the front panel. Use the special DB-9/USB cable provided with the System to connect the unit to the desktop or laptop PC. There is no hardware flow control provided on the Measurement System's serial interface. The RS-232 port settings are shown in Chapter 2. No other special serial port settings (such as FIFO buffer sizes) are required on the computer (PC) running the E-BERT GUI.

## Chapter 2 - System Installation

### Introduction

This chapter provides information necessary for the proper installation of the E-BERT Measurement System.

### Hardware installation

The Measurement System package has the following items:

- E-BERT Measurement System in a chassis
- DC to 18GHz Broadband Terminator
- DB-9 to USB cable for Serial interface
- AC power cable (grounded)
- Software installation disk
- E-BERT Measurement System User Manual

The E-BERT Measurement System's power supply can be connected to any AC outlet with a rating of 100-240 VAC / 50-60 Hz. It draws a maximum of 1.4A. Use of conditioned AC power is recommended.

- ◆ Place the System on a tabletop or similar flat surface. It is recommended that the air in the vicinity of the System be relatively free of dust and heavy particulates. Excessive dust can damage fan and other internal components, and cause overheating.
- ◆ Use the AC power cable included with the System to connect the unit to the AC power outlet. To avoid the chance of electric shock, attach the power cord to the E-BERT chassis before inserting the plug into the AC power outlet. Turn the AC power on . The front panel LEDs should glow steadily.
- ◆ Connect the terminator on unused channel.
- ◆ Connect the USB connector of the serial interface cable to the desktop or laptop PC to launch the E-BERT GUI (Graphical User Interface) will be run. Connect the DB9 connector of the cable to the E-BERT rear panel.

## Software Installation

The E-BERT Measurement System GUI is a LabVIEW application operating on Microsoft Windows NT and Windows XP operating systems. The E-BERT GUI needs LabVIEW 7.1 Run-Time Engine to be installed on the PC connected to the E-BERT System. The executable versions of the application and the Run-Time Engine are provided with the System on a storage disk

## Installing USB to RS232 Cable Driver



Figure 3: USB to RS232 Driver installation Wizard

1. Power on your computer and make sure that the USB port is enabled and working properly.
2. During installation, please don't link USB-Serial cable with your computer.
3. Double click 'setup.exe', then it will start install
4. After installation, click 'OK'
5. Plug in the USB-Serial cable into the USB port and run the **Found New Hardware Wizard** to assist you in setting up the new device. Click **Next** to continue. (Figure 3)



Figure 4: Run “**Found New Hardware Wizard**”

6. Click Next to continue. Select the “ **Search for a suitable driver for my device(recommend)** “



Figure 5: Search New device for new device

7. Windows will detect the driver and Click Next to continue installation.



Figure 6: Detect the New device and install the driver from dedicate folder

8. Click Finish to continue and let Windows copy the needed files to your hard disk.



Figure 7: Complete the Driver installation

9. You can to check the Device Manager and see the Prolific USB to Serial Com. Port)

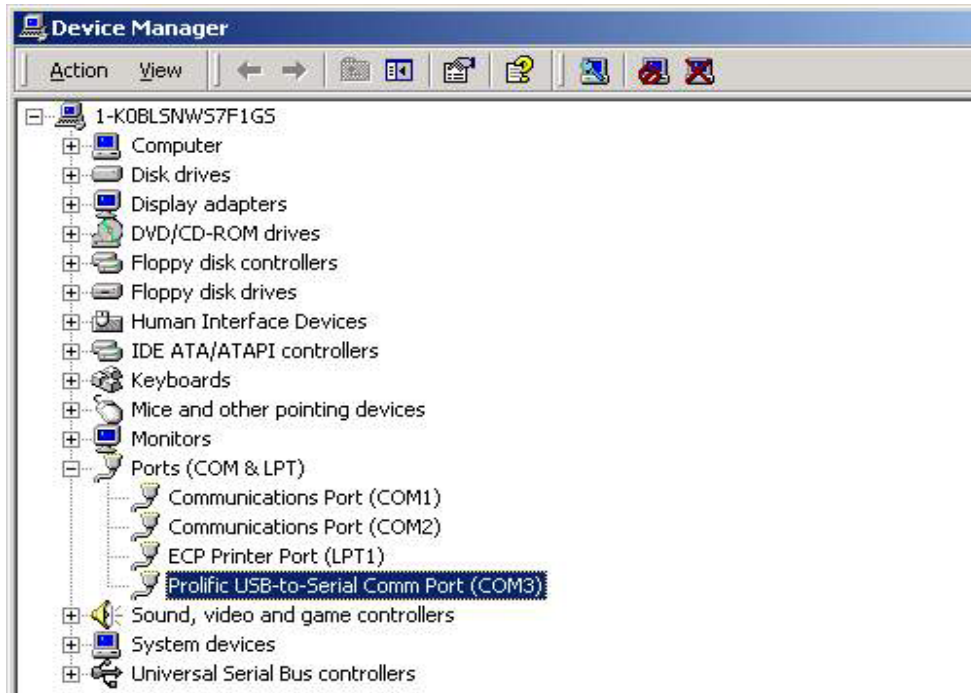


Figure 8: Device manager

### Changes COM Port

(1) Please click on the **Device Manager\ Devices by connection \ ports (COM & LPT)**. (Figure 9)

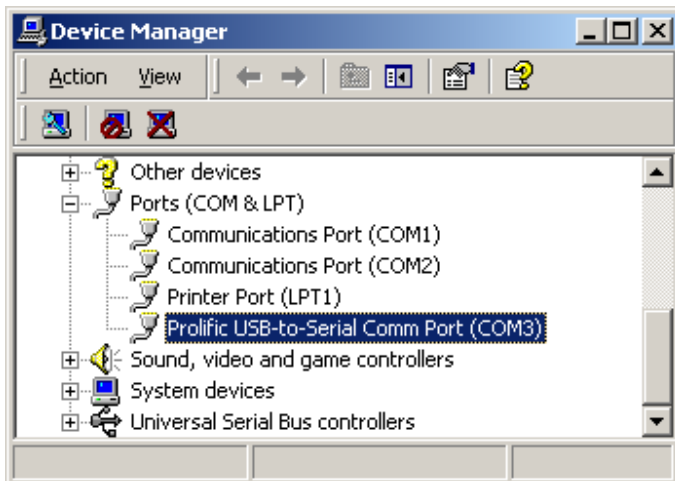


Figure 9: Select Port (COM& LPT)

(2) Doubly click on **“Prolific USB-to- serial Comm port(COM3)”** .And it could go to **‘ properties’**. (Figure 10)

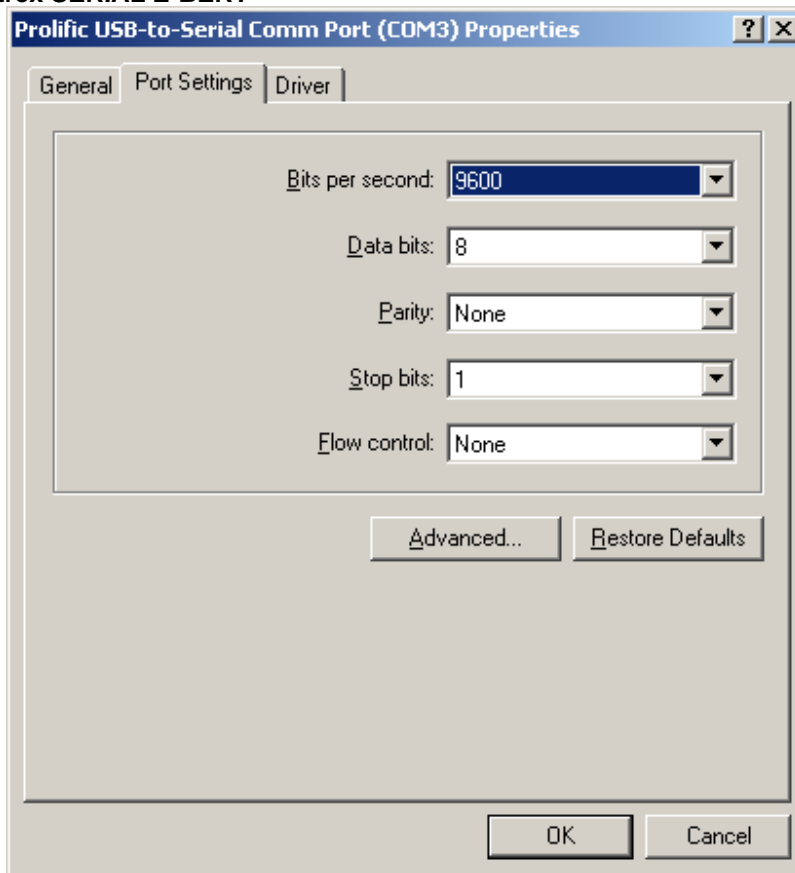


Figure 10: COM Port Setting

(3) Please choose "Port Settings", and then click on "Advanced". Please kindly choose the needed com, and click on "ok". (Figure 11)

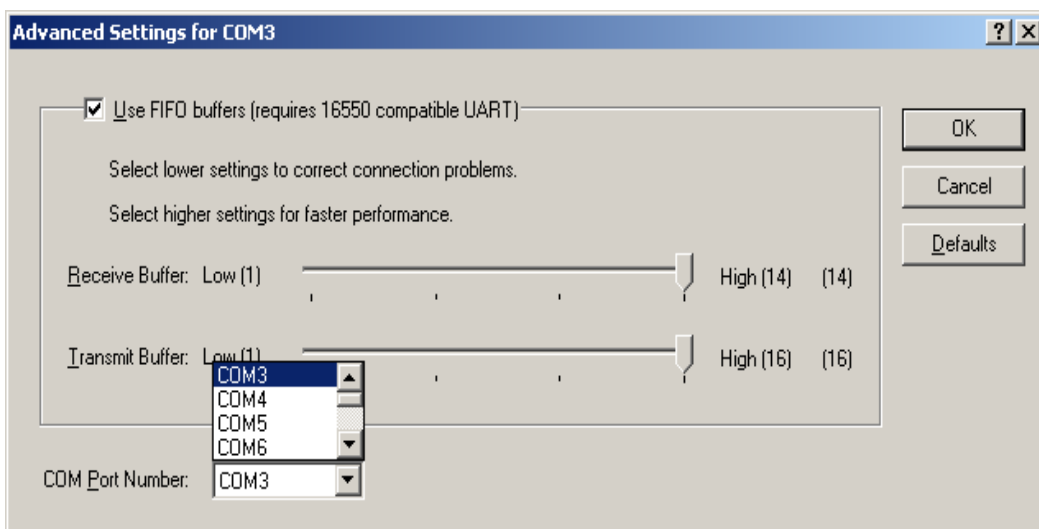


Figure 11: COM Port Setting (2)

**Notice:** If the E-BERT could not link with the new port, and run smoothly when changed the port, please kindly unload E-BERT, and re-install it.

**When Changing the port, the peripheral equipment could not shift to the new port, and run smoothly. Under this situation, please kindly unload the equipment and install again.**

### **Installing the Run-Time Engine and the E-BERT GUI**

To install the Run-Time Engine and the E-BERT GUI on the PC connected to the E-BERT Measurement System, place the Software installation disk in the CD drive. Double-click the 'SETUP' file. The installer will automatically prompt the user for options and install the software.

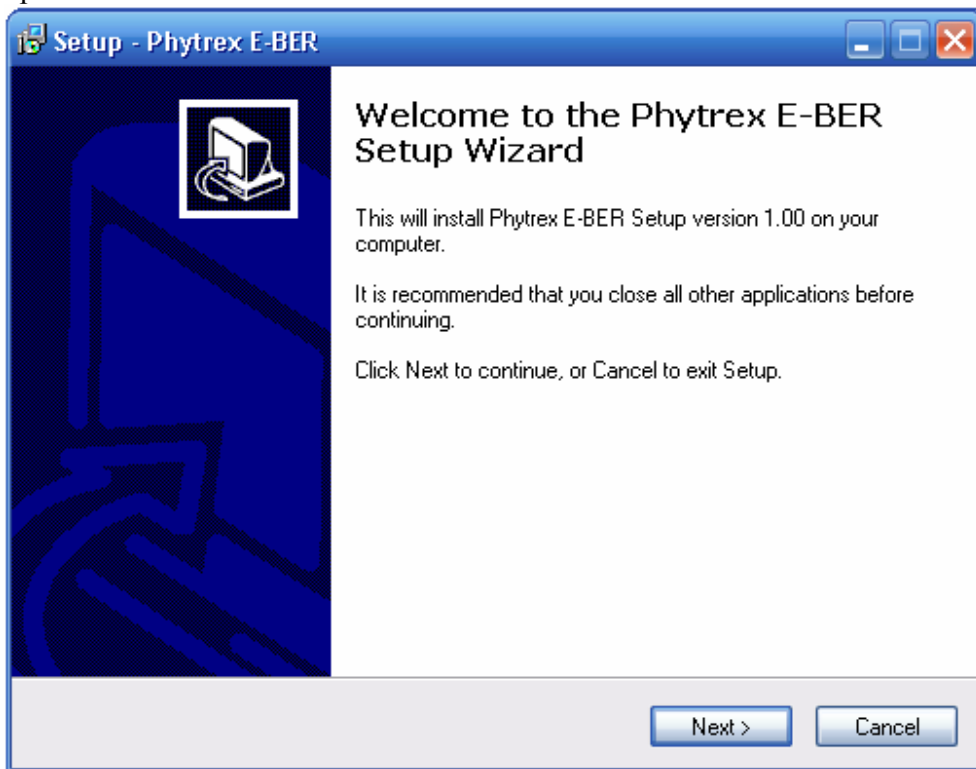


Figure 12 Installing the E-BERT GUI

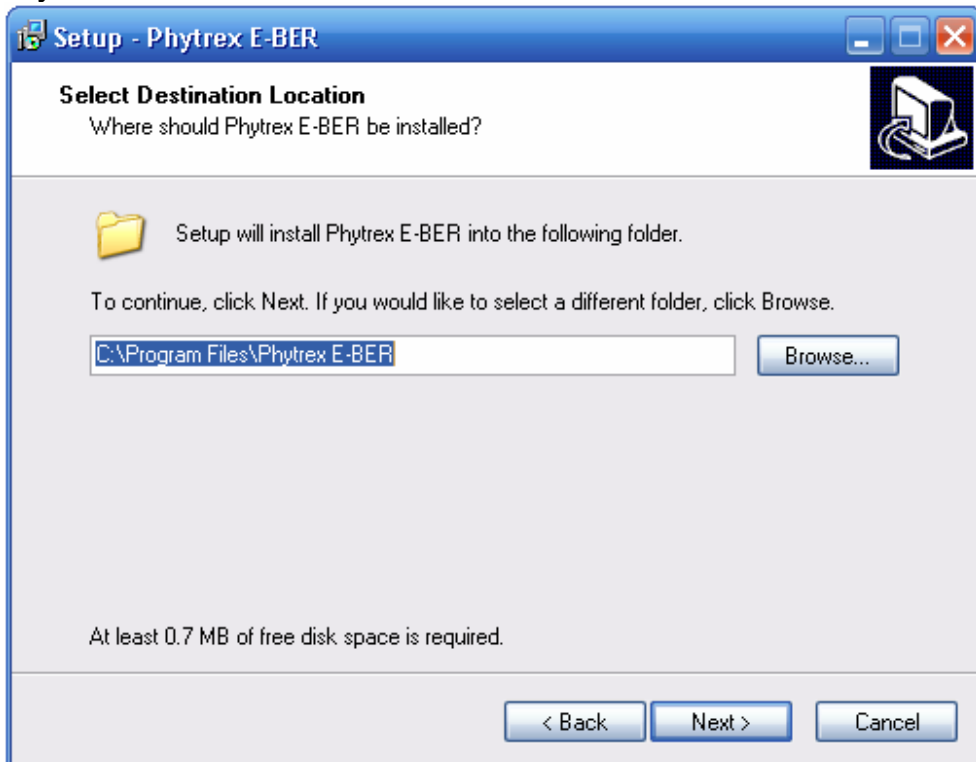


Figure 13: Installing the E-BERT GUI (2)

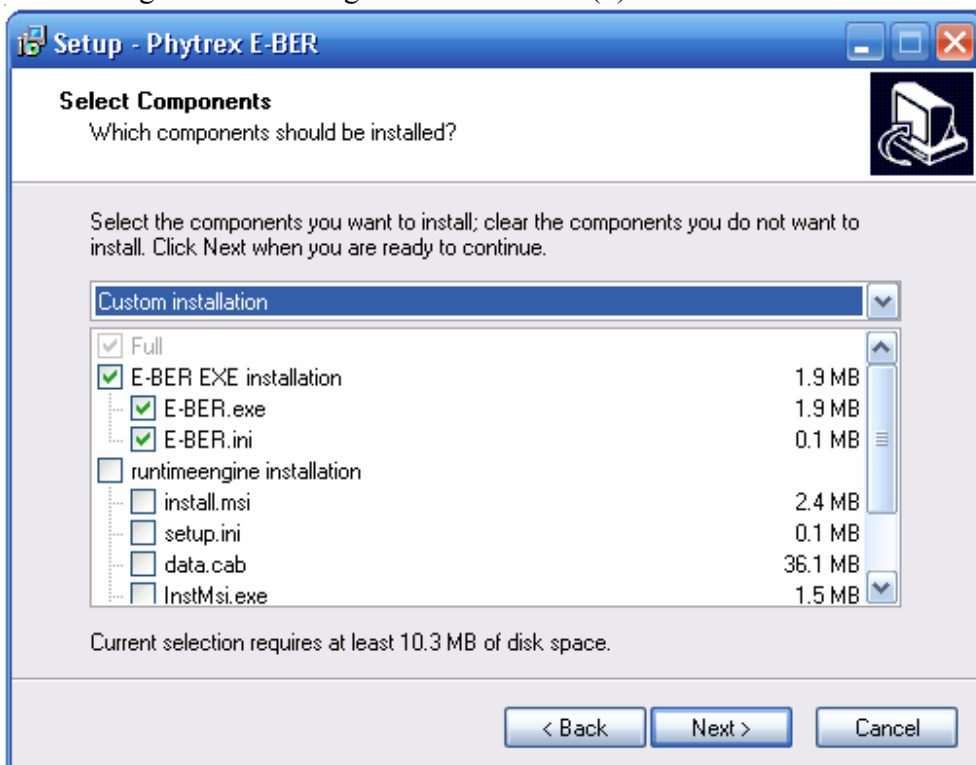


Figure 14: Select Installation Options

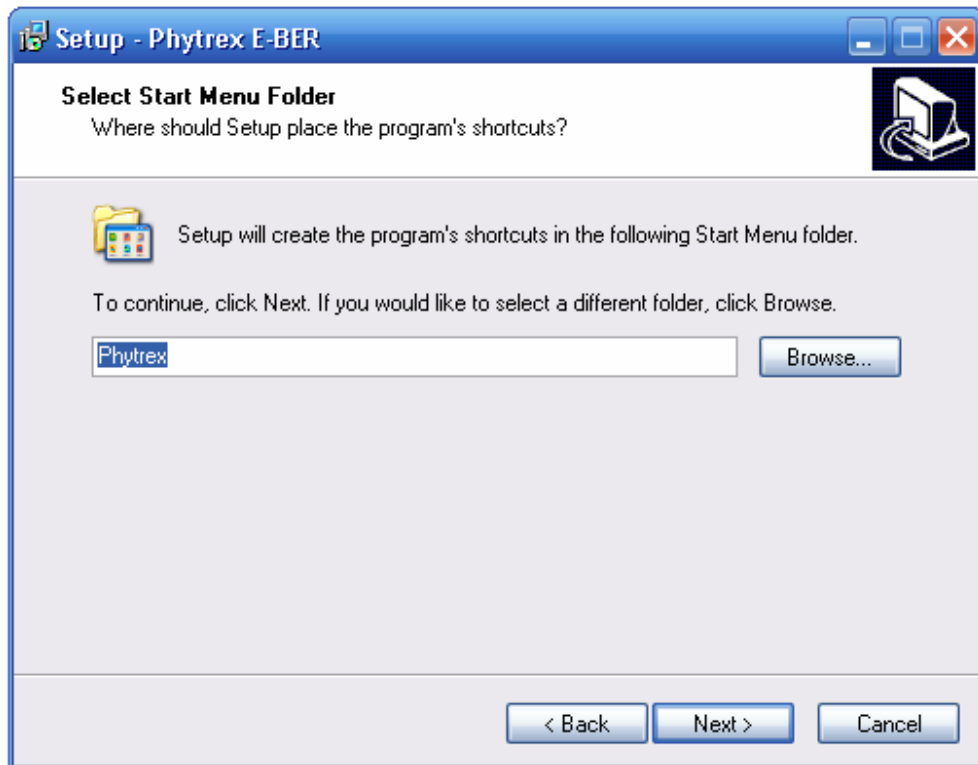


Figure 15: Generate the shortcuts icon in specified menu folder

## Running the E-BERT GUI

Launch the E-BERT Graphical User Interface by double-clicking on the E-BERT GUI icon. Click the arrow at the top left hand corner of the screen to operate the E-BERT Measurement System.

<sup>1</sup> Windows NT and Windows XP are trademarks of Microsoft Corp. LabVIEW is a trademark of National Instruments Corporation.





### Phytrex SERIAL E-BERT

The E-BERT GUI contains the following user-configurable parameters (refer to Figure 16)

#### User-Interface -Generator parameters

**PPG On/Off:** Set the generator output enable/ disable. The default is “On”.

**Detect Mode:** Set Ch1 or Ch2 to be the generator and detector

The default is Ch1

**Data rate:** The Data Rate pull-down menu list sets the data rate. Select the desired data rate from the list provided. The following data rates are supported:

- OC-3/12/48/48+FEC (155.52 Mb/s, 622.08Mb/s, 2.488Gb/s, 2.67Gb/s)
- Fibre Channel (1.0625 Gb/s, 2.125 Gb/s, 4.25Gb/s)
- Gigabit Ethernet (1.25Gb/s)
- Infini-band /PCI-E Gen.I or II(2.5Gb/s, 5.0Gb/s)

Data rates can be changed at any time during operation. Allow 1-2 seconds for a rate change to take effect. The default is 2.5 Gb/s.

**Generator Pattern:** This pull-down list allows selection of one of the following data patterns: PRBS  $2^7-1$ ,  $2^{23}-1$ ,  $2^{31}-1$ , FC CJTPAT, FC CRPAT,FC CSPAT, K28.5, K28.7, D21.5 and 64/40 bits User Edit patterns.

The default is PRBS  $2^7-1$

**Exit Program:** To stop and quite the E-BERT GUI when pressing the bottom.

**Output interface:** The Generator signal can be output as an electrical signal or as an optical signal which is connected to optical area through the coaxial cable. The electrical interface is set to the default.

### User interface- Analyzer parameters

**Data rate selection:** The pull-down menu allows selection of one of the following data rates: OC-3/12/48/48+FEC, Fibre Channel (1.0625 Gb/s, 2.125 Gb/s, 4.25Gb/s), Gigabit Ethernet(1.25Gb/s), and Infiniband or PCI-Express (2.5Gb/s and 5.0Gb/s). The data rate can be changed at any time during operation. Allow 1-2 seconds for a rate change to take effect. The System may indicate a high bit error rate or lack of pattern synchronization during the data rate change. *The Analyzer data rate can **not** be set to be a rate different from that of the Generator.*

**Checker Pattern:** This pull-down list allows selection of one of the following data patterns: NRZ PRBS  $2^7-1$ ,  $2^{23}-1$ ,  $2^{31}-1$ , FC CJTPAT, FC CRPAT, FC CSPAT, K28.5, K28.7, D21.5 and 64/40 bits User Edit patterns. *The Analyzer data pattern can be set to be a pattern different from that of the Generator.*

**Sync. Criteria:** Sync. Success or Sync Loss state judgment is performed by Sync. Criteria value. In the sync success state, when the error ratio less than the Sync. Criteria value, if the error ratio exceed the criteria, the sync loss state is judged. In the sync loss state, pattern synchronization is not established and measurements cannot be made. However, when the error ratio is smaller than the Sync. Criteria value, pattern synchronization is established As Sync. Criteria is either of  $1E-3$  to  $1E-10$  can be selected.

**BER Threshold:** The pass/ fail criteria judgment is achieved through this level setting. Under the fail condition is judged if the bit error ratio is exceed the BER Threshold.

BERT Threshold range can be set from  $1E+0$  to  $1E-15$

**Input interface:** Allows the choice of the signal at the electrical or the optical interface for bit-error-rate (BER) measurements. The default is the electrical interface.

**Measuring Time:** This window allows the user to indicate the time over which the BER is to be accumulated. The default value is one. The measuring time can be changed at any time during operation.

**File:** Clicking this button pops up a dialog window including the **save/load** system configuration and prompts the user to enter the name of a file under specified directory. Use a .txt extension to make the file readable by Microsoft Notepad. **Save to database** is completion of each measuring time, error count and error ratio results are appended to database the file and it was readable through Microsoft Access. If an existing filename is used, results will be appended to the end of that file. The file has 8 columns, viz., date, time, gating time (seconds), gating time BER, gating time errors, gating time. Opening the file while the E-BERT Measurement System GUI is recording data could stop GUI operation or corrupt data. To use the file while the GUI is running, copy the file into another name or directory. If the measuring time is set to its default value of 1, the GUI will not prompt for a file name or record data.



Figure 17: E-BERT GUI (2)

PBR 305 E-BERT has an intelligent pattern synchronization algorithm and, typically, does not require the user to use this button. The Measurement System may display a high error rate for 1 or 2 seconds when this button is clicked.

**Measuring Mode:** Setting testing mode into “Single” or “Repeat”

The measurement modes are defined below.

(1) REPEAT mode

Unit measurement is repeated continuously during the set gating time.

(2) SINGLE mode

Unit measurement is performed once during the set gating time.

**Start/Stop:** When pressing the “Start”, it clears the previous testing result and begin the new testing event with respective gating time, error count, and BER, until pressing the “Stop”

**Free run mode:** The BER measuring will not stop until release into normal mode

**Error Insert ON/OFF:** This red LED on the GUI will display when pressing the bottom

### Measurement indicators and graphs

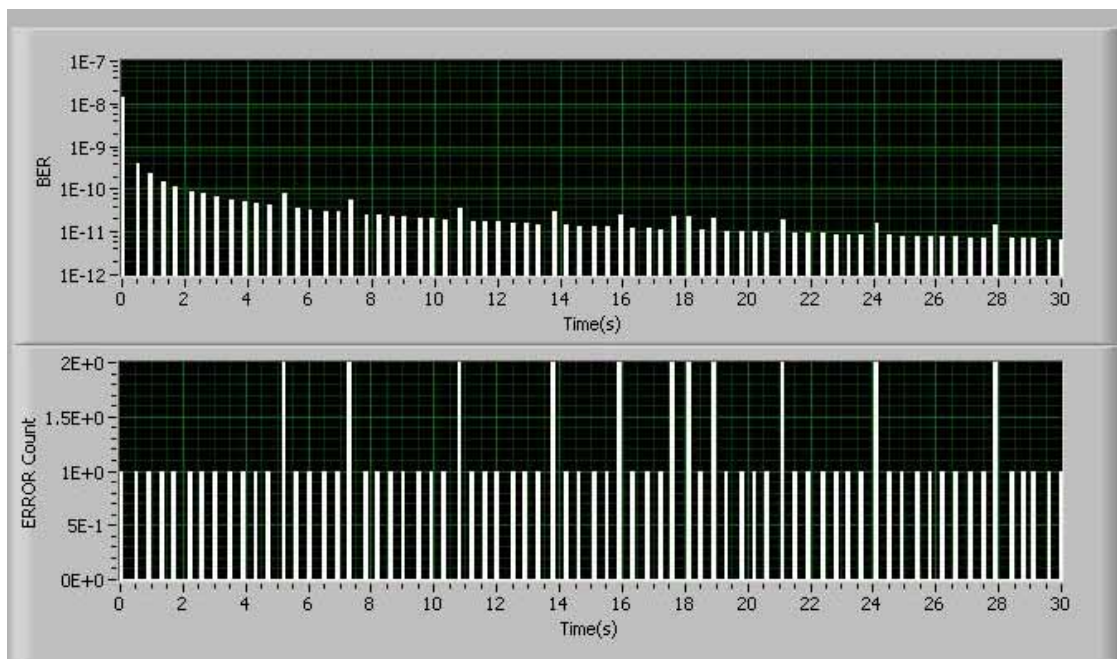


Figure 18: Graphical indicator about Error count/Ratio versus time

**Time:** Indicates the time that has elapsed within the current gating interval.

**Error Count:** Indicates the number of bit errors in the previously elapsed second. This display is refreshed every half second.

**BER:** Displays the BER (graphical) up to the last elapsed second within the current



### **Phytrex SERIAL E-BERT**

gating interval. The graphical display plots the gating time BER versus time in half second unit. The scrollbar allows viewing the BER over 24 hours. Drag and hold the scroll button along the scroll bar at the desired location. Once the scroll button is released, the graph scrolls forward automatically to display the latest BER result.

#### **Note:**

Error Ratio: ( Number of Error bit under the specified measuring time) / (Number of total accumulate bits over the measuring period)

Error Count: Number of error bits under the specified measuring period.



**Phytrex SERIAL E-BERT**

Vendor	Transceiver Model	Nominal Wavelength (nm)	Min. Output Power (dBm)	Nominal Output Power (dBm)	Max. Output Power (dBm)
Agilent	HFBR-5701L&LP	850	-9.5	-6.5	0
Agilent	HFBR-5710L&LP	850	-9.5	-6.5	0
Agilent	HFCT-5701L&LP	1310	-9.5	-6.2	-3
Agilent	HFTC-5710L &L	1310	-9.5	-6.2	-3
Finisar	FTRJ1321P1xTL	1310	-9.5	-6.2	-3
Finisar	FTRJ1421P1xCL	1310	-5	-2.5	0
Finisar	FTRJ8519P1xN	850	-9	-6.2	-3.5
Stratos	SPLC_20_7D_X_BX	1310	-10	-6.5	-3
Stratos	SPLC_20_7D_3L_XX	1470 – 1610 <sup>1</sup>	-2	+0.5	+3
Stratos	SPLC_20_C_1_B	850	-10	-6.0	-2
Stratos	SPLC_20_4_1_B	850	-9.5	-5.8	-2
Stratos	SPLC_20_4_X_XX	1310	-9.5	-6.2	-3
Stratos	SPLC_20_8_1_B	850	-9.5	-5.8	-2
Stratos	SPLC_20_4D_2M_B	1310	-9.5	-6.2	-3
Stratos	SPLC_20_8D_2M_B	1310	-8	-5.5	-3
Stratos	SPLC_20_4D_3_B	1550	-2	+1.0	+4

Table A.: E-BERT optical transceiver options indicating the maximum laser radiation power levels from an open transceiver transmit port.

Note: Substituting transceivers other than specified above is considered a modification to the product. Modifications made to certified products generally require the product to be re-certified with the modifications. Certification requirements can be found in the legislation and regulations defining Laser Safety, Product Safety, and EMC requirements. See the Compliance and Certification Section below for the certifications and requirements related to E-BERT.

## Chapter 4 – Labview Driver Programming Guide

### Introduction

This chapter describes the functionality of the PBR-305 Labview Driver. The main intention of the software is provided to support for the control of the E-BER to make the test and measurement programs.

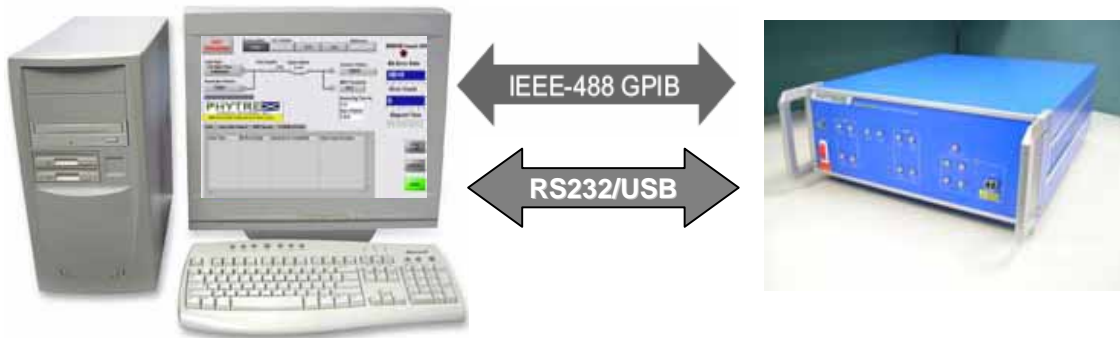


Figure 19: Remote access and custom application development with E-BERT VISA Driver for Labview

### Installation

Installation the Labview driver must be under NI Labview 7.0 environment.

Step 1. Select E-BERT Labview Diver.exe to start installation



Step 2. Installation result in under the following folder Function panel >>All Functions>>User Libraries>>E-BER (Figure 19)

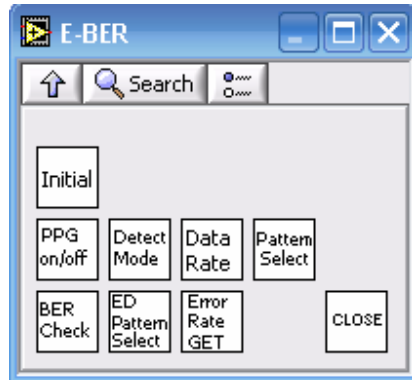


Figure 20: E-BERT Driver folder

### Command Summary

<b>Initial</b>	Set	Initialize the E-BERT and set input COM Port and build the link to E-BERT
<b>PPG on/off</b>	Set	Set PPG output On/Off
<b>Detect Mode</b>	Set	Set the output channel
<b>Data Rate</b>	Set	Set Data Rate
<b>Pattern Select</b>	Set	Set data generator pattern (not include User Edit Pattern)
<b>BER Check</b>	Set	Set error checker Start or Stop
<b>ED Pattern Select</b>	Set	Set your error check Pattern (not include User Edit Pattern)
<b>Error Rate GET</b>	Get	Read your Error Rate or Error Count
<b>Sync Loss</b>	Get	Detect Sync. Loss
<b>CLOSE</b>	Set	Close the link between Computer and E-BERT

**LabVIEW example**

**PPG turn on/off**

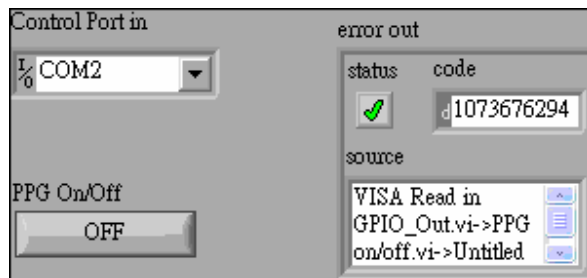
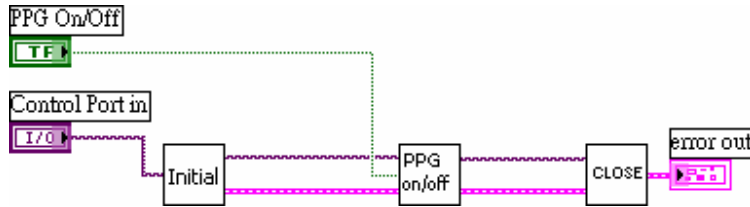


Figure 21: PPG turn on/off

**Channel Selection**

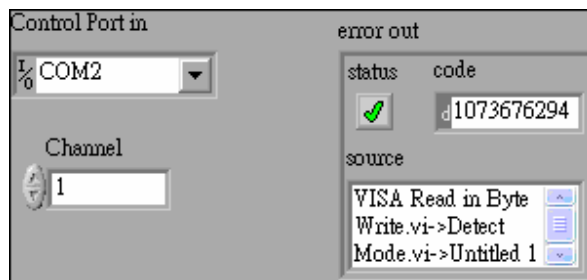
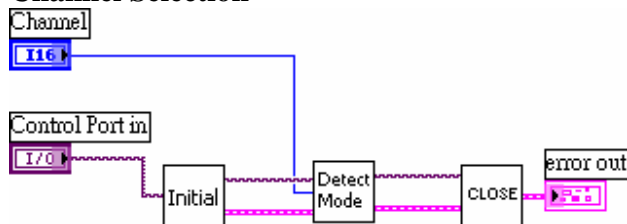


Figure 22: Channel Select

**PHYTREX**  
 Innovative Transmission Tech  
**Phytrex SERIAL E-BERT**  
**Set Data Rate**

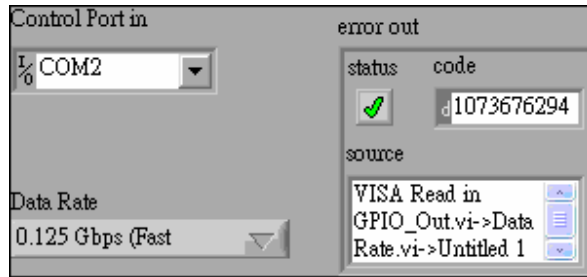
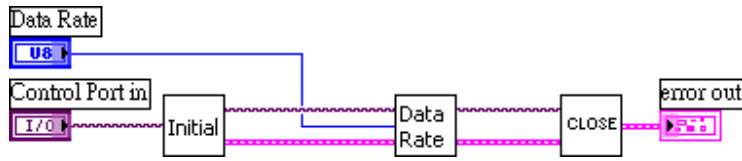


Figure 23: Data Rate Select

**Set Pattern**

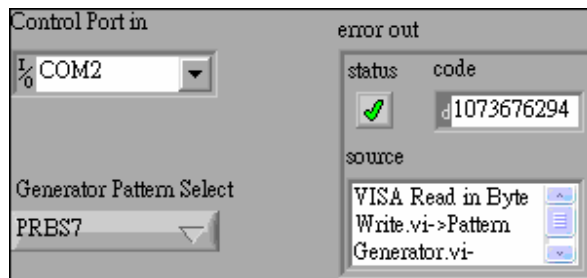
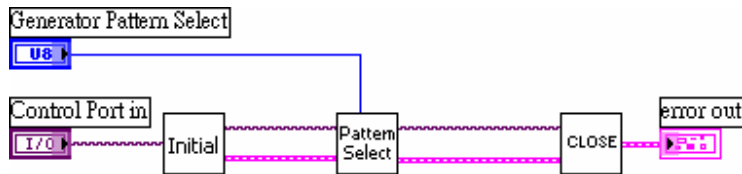


Figure 24: Pattern Select

**Get Error Rate/Count**

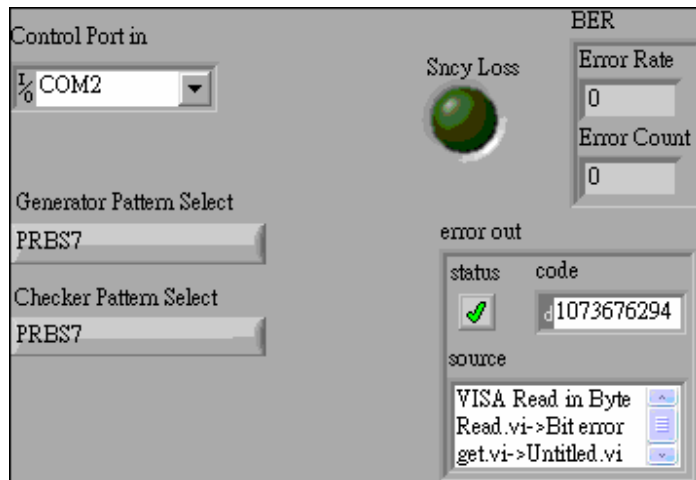
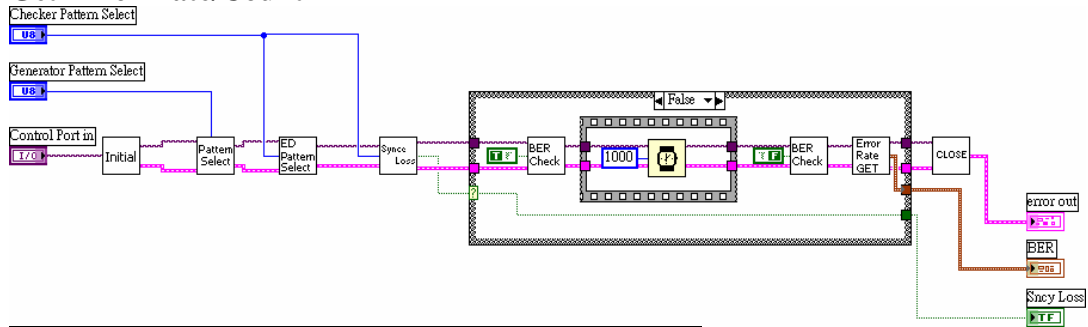


Figure 25: Get Error Rate/Count



Phytrex SERIAL E-BERT

## Compliance and Certification

### FCC Part 15 Compliance

This product has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's own expense.

### UL/IEC Safety

This product is UL and cUL Listed to the requirements of Standard UL/IEC 61010-1 Second Edition, "Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements".

### FDA/IEC Laser Safety

The E-BERT is classified by the manufacturer as a Class 1 Laser product under the requirements set by FDA/CDRH 21 CFR 1040.10 and IEC 60825-2.

### CE Mark

This product has been tested for compliance with the applicable Harmonized Standards under the European Commission EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC including amendments to both Directives.

### Modification of a certified product.

The modification of a laser product, previously certified under Sec. 1010.2, by any person engaged in the business of manufacturing, assembling, or modifying laser products shall be construed as manufacturing under the act if the modification affects any aspect of the product's performance or intended function(s) for which this section and Sec. 1040.11 have an applicable requirement. The manufacturer who performs such modification shall re-certify and re-identify the product in accordance with the provisions of Title 21 Sections 1010.2. and 1010.3.

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**Contact Information:**

**Taiwan**

Tel: 886-3-5169331

Phytrex Technology Corp.

3F-10 81, Shuli Rd, Hsinchu , Taiwan, 300

**China,**

**Wuhan**

Phytrex Technology (Wuhan) Corp.

Tel: 86-27-87259852; Fax: 86-27-87810356

Email : [ellenye@phytrex.com](mailto:ellenye@phytrex.com)

Room 1701,Nan Fang Di Yuan Mansion,No.568,Wuluo Rd.,Wuhan, P.R.China

**ShenZhen**

Tel: 86-755-82965212; Fax: 86-755-82964378

Email :[ellenye@phytrex.com](mailto:ellenye@phytrex.com)