N2102B PXIT Pattern Generator Module

User's Guide

Agilent Technologies

Notice

Manual Part Number

N2102-90002

Edition

January 2008
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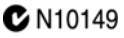

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Contents

Introduction

The N2102B PXIT Pattern Generator Module is a double-slot PXI instrument capable of generating a number of low-jitter patterns at rates up to 10.3125Gb/s, using an externally supplied clock. The ideal clock input can be supplied by the N2099A Synthesizer. ActiveX drivers provide a convenient software interface that allows you to manually operate the module. The N2102B provides the following features:

- PRBS generation
- User-selectable data patterns
- Differential NRZ data generation
- SMA trigger output
- SMA clock input and output
- Variable modulation voltage
- Wide range of supported data rates and patterns

The accompanying software includes a Windows application described in "Using the N2102B Control Panel Application" on page 12 and an ActiveX control wrapper for the DLL, providing the same functions. For programming information, refer to "Programming" on page 17.

Data Bit Rates

The available data bit rate is from 622 Mb/s to 10.3125 Gb/s.

Output Voltage

The actual output range is from 250 mV to 1V single-ended. If you set the output signal amplitude to a value below the minimum value in this range, the output signal will be automatically set to 250 mV. If you set the output signal amplitude to a value above the maximum value of the operating range, the output amplitude will be automatically set to 1.0V.

NOTE

The N2101A operating range is 250 mV to 1.6V.

Clock Input

The frequency value of the clock input is equivalent to the value of the rate. For example, a 1 Gb/s clock input would need to be 1 GHz.

Clock and Pattern Outputs

The module has a clock output that includes a divided clock output and a pattern output. You can select from up to 9 different internal pattern types or define your own pattern. The pattern length can be a PRBS at 2^n-1, where n is equal to 7, 9, 11, 15, 23, or 31. Pattern lengths of K28.5, K28.7, CRPAT are also available.

- When the selection is "clock / 128," the trigger signal is periodic at 1/128 of the bit rate.
- When the pattern trigger selection is "pattern," a short trigger pulse occurs synchronously with the start of the pattern although not necessarily at the start of each occurrence of the pattern.

NOTE

You can configure the pattern trigger so that the trigger pulse changes state at each repetition of the transmit pattern, or at a specified multiple of 128 bits of the transmit signal.

General Safety Considerations

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

CAUTION The N2102B is shipped in materials which prevent damage from electrostatic discharge. The module should only be removed from the packaging in an anti-static area ensuring that correct anti-static precautions are taken, refer to "Electrostatic Discharge Information" on page 6.

WARNING **Install the plug-in module according to the enclosure protection provided and placing filler panels in empty slots. This instrument does not protect against the ingress of water. This instrument protects against finger access to hazardous parts within the enclosure.**

WARNING **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

WARNING **No operator serviceable parts inside. Refer servicing to qualified service personnel. To prevent electrical shock do not remove covers.**

WARNING **Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

WARNING **This product is NOT tested for use in medical or clinical applications.**

Electrostatic Discharge Information

CAUTION

Electrical channel input circuits and the trigger input circuit can be damaged by electrostatic discharge (ESD). Therefore, avoid applying static discharges to the front-panel input connectors. Prior to connecting any coaxial cable to the connectors, momentarily short the center and outer conductors of the cable together. Avoid touching the front-panel input connectors without first touching the frame of the instrument. Be sure that the instrument is properly earth-grounded to prevent buildup of static charge. Wear a wrist-strap or heel-strap.

Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe work station. The following figure shows an example of a static-safe work station using two types of ESD protection:

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

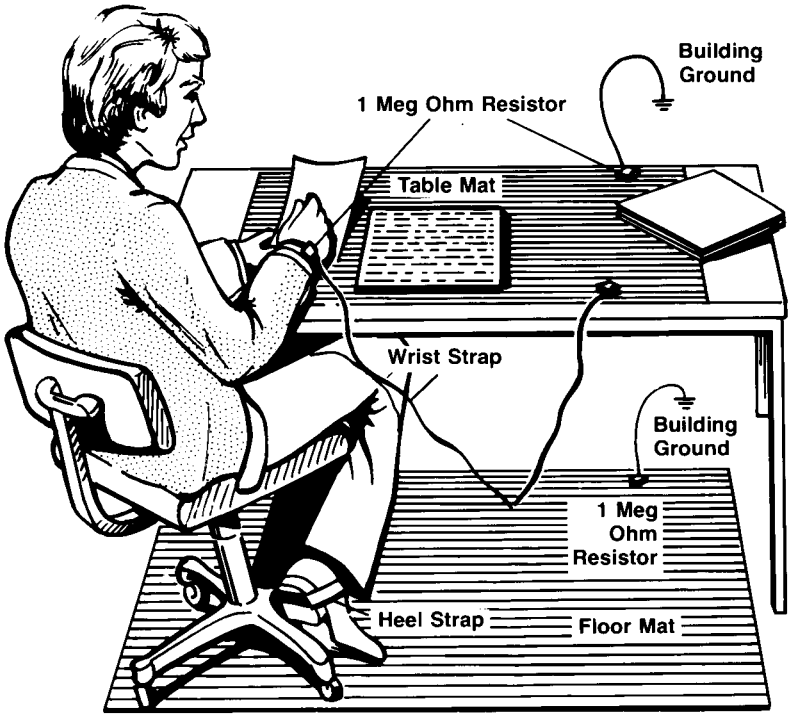


Figure 1. Static-safe Work Station

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground.

WARNING

These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.

Connector Care

Advances in measurement capabilities make connectors and connection techniques more important than ever. Observing simple precautions can ensure accurate and reliable measurements.

Handling and storage
- Keep connectors clean
- Extend sleeve or connector nut
- Use plastic endcaps during storage
- Do not touch mating plane surfaces
- Do not set connectors contact-end down

Visual inspection
- Inspect all connectors carefully before every connection
- Look for metal particles, scratches, and dents
- Do not use damaged connectors

Cleaning
- Clean with compressed air first
- Clean the connector threads
- Do not use abrasives
- Do not get liquid onto the plastic support beads

Making connections
- Use a connector saver
- Align connectors carefully
- Make preliminary connection lightly
- To tighten, turn connector nut only
- Do not apply bending force to connection
- Do not over tighten preliminary connection
- Do not twist or screw in connectors
- Use a torque wrench, and do not tighten past the "break" point of the torque wrench

3.5 mm and SMA Connectors

Precision 3.5 mm microwave connectors are compatible with an SMA connector within its specification. Due to the variable quality of the SMA connector, mating with an SMA can sometimes cause severe damage to the 3.5 mm connector. You can use SMA connectors if special care is taken when mating the connectors, and all connectors are undamaged and clean. Before each use, check the mechanical dimensions of all connectors with a connector gauge to make sure that the center conductors are positioned correctly.

CAUTION A male SMA connector pin that is too long can smash or break the delicate fingers on the precision 3.5 mm female connector.

CAUTION Some precision 3.5 mm female connector fingers are very tight and can pull the center pin of their mates out past specifications when the connectors are disconnected. If such a male pin is inserted into a female connector, it can cause considerable damage by pushing the female center conductor back too far. Be aware of this possibility and check all connectors before mating them again.

Returning the N2102B to Agilent Technologies

The instructions in this section show you how to properly package the instrument for returning to an Agilent Technologies service office. If the instrument is still under warranty or is covered by an Agilent maintenance contract, it will be repaired under the terms of the warranty or contract. If the instrument is no longer under warranty or is not covered by an Agilent maintenance plan, Agilent will notify you of the cost of the repair after examining the unit.

When an instrument is returned to an Agilent service office for servicing, it must be adequately packaged and have a complete description of the failure symptoms attached.

When describing the failure, please be as specific as possible about the nature of the problem. Include copies of any instrument failure settings, data related to instrument failure, and error messages along with the instrument being returned.

Please notify the service office before returning your instrument for service. Any special arrangements for the instrument can be discussed at this time. This will help the Agilent service office repair and return your instrument as quickly as possible.

Call Center

For technical assistance, contact your local Agilent Call Center. In the Americas, call 1 (800) 829-4444. In other regions, visit http://www.agilent.com/find/assist. Before returning an instrument for service, you must first contact your local Agilent Call Center.

Preparing the product for shipping

1. Write a complete reason for returning the product and attach it to the instrument. Include any specific performance details related to the problem.
2. Pack the product. Use original packaging or comparable. Original materials are available through any Agilent office. Or, follow these recommendations:
   - Insert the product in an anti-static bag.
   - Use a double-walled, corrugated cardboard carton of 159 kg (350 lb) test strength. The carton must allow approximately 7 cm (3 inches) on all sides of the kit for packing material and be strong enough to accommodate the weight of the kit.
   - Surround the kit with approximately 7 cm (3 inches) of packing material, to protect the kit and prevent it from moving in the carton. If packing foam is not available, the best alternative is S.D-240 Air Cap™ from Sealed Air Corporation (Commerce, California 90001). Air Cap looks like a plastic sheet filled with air bubbles. Use the pink (antistatic) Air Cap™ to reduce static electricity. Wrapping the kit several times in this material will protect the kit and prevent it from moving in the carton.
3. Seal the carton with strong nylon adhesive tape.
4. Mark the carton "FRAGILE, HANDLE WITH CARE."
5. Retain copies of all shipping papers.

Installation

You can control the PXI chassis using either the embedded PXI controller or an external PC using a PCI - cPCI/PXI remote bridge (such as the NI MXI-4 product). If an external PC is used, the PC must meet the following specifications:

- Windows 2000 or XP operating system
- 1 GB RAM
- Pentium, 133 MHz or greater
- NI-VISA

NOTE If you are using an external PC, you must follow the installation steps in the sequence described for the PC BIOS to locate the instruments in the PXI chassis.

Step 1. Inspect the Shipment

1. Inspect the shipping container and kit for damage. Keep the shipping container and cushioning material until you have inspected the contents of the shipment for completeness and have checked the kit mechanically and electrically.
2. Locate the shipping list. Verify that you have received all of the items listed.

   To contact Agilent Technologies for technical assistance, contact your local Agilent Call Center. In the Americas, call 1 (800) 829-4444. In other regions, visit http://www.agilent.com/find/assist. Before returning an instrument for service, you must first contact your local Agilent Call Center.
3. Verify that the following environmental conditions exist before proceeding with the installation procedure.

WARNING **Ensure that the PXI chassis is connected to the specified power source using the correct power cord (noting country of use).**

WARNING **Ensure that the PXI chassis provides adequate earth grounding.**

WARNING **Ensure that the air supply to the chassis is working correctly. The N2102B requires an optimal air flow within the chassis. It is recommended to regularly change air filters on PXI Chassis.**

Step 2. Install the Instrument Driver Software

NOTE This procedure assumes that NI-VISA has already been installed.

1. Log onto the PC with administrator privileges, so that you can install the software.
2. Go to the Agilent website: www.agilent.com/find/pxit.

3 Click on the **Technical Support** link and then the **Drivers** link.

4 Download the latest version of the following driver:

```
Agilent N2102B PPG Driver
```

5 Once the download is complete, run the N2102B installation file.

   a During the installation, you will enter the user name and organization.

   b Select the **all users** option to ensure the software is available to all users of the PC. Click **Next**.

6 When the installation process is finished, click **Finish**. The N2102B control software is now installed.

7 To ensure that the PC BIOS will be able to locate the instruments in the PXI chassis, follow this step according to the controller that you are using:

- If you are using an external PC and remote bridge, switch off the power to the PXI chassis and PC.
- If you are using an embedded controller, switch off the power to the PXI chassis and PC and remove all N2102B modules from the chassis.

NOTE As part of the installation, the N2102B User's Guide is made available on the Windows **Start** menu.

Step 3. Install the N2102B

1 With the PC and chassis powered off, install the N2102B module in an available slot in a PXI chassis.

2 Power on the PXI chassis and wait for the power up sequence to complete.

3 Turn on the PC.

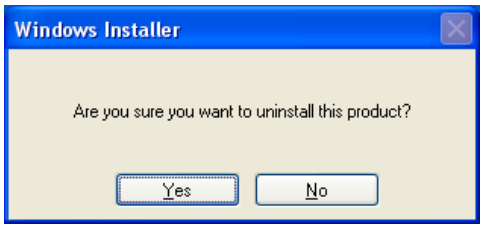
If the software is correctly installed, you will see an indication that new hardware is detected and that the system is attempting to locate the associated software driver. When this process is complete, a notification appears indicating that the hardware is ready for use.

If needed, you can use Windows Device Manager to determine if the instruments have been correctly identified by the BIOS. There should be an NI-VISA PXI Devices entry with your N2102B instrument.

NOTE The N2102B User's Guide is provided as a PDF file. To locate and view the user's guide, go to the Windows Start menu and select **All Programs > Agilent > N2102B > Documents > User's Guide**.

Removing the Software Installation

Also available within the Windows Start/ALL Programs/Agilent/N2102B/ directory is the uninstall option. Select this to remove the software. The following screen appears:



Click **Yes** to continue with the uninstall. This will complete the removal of the software.

Upgrading the Instrument Firmware (N2101A Only)

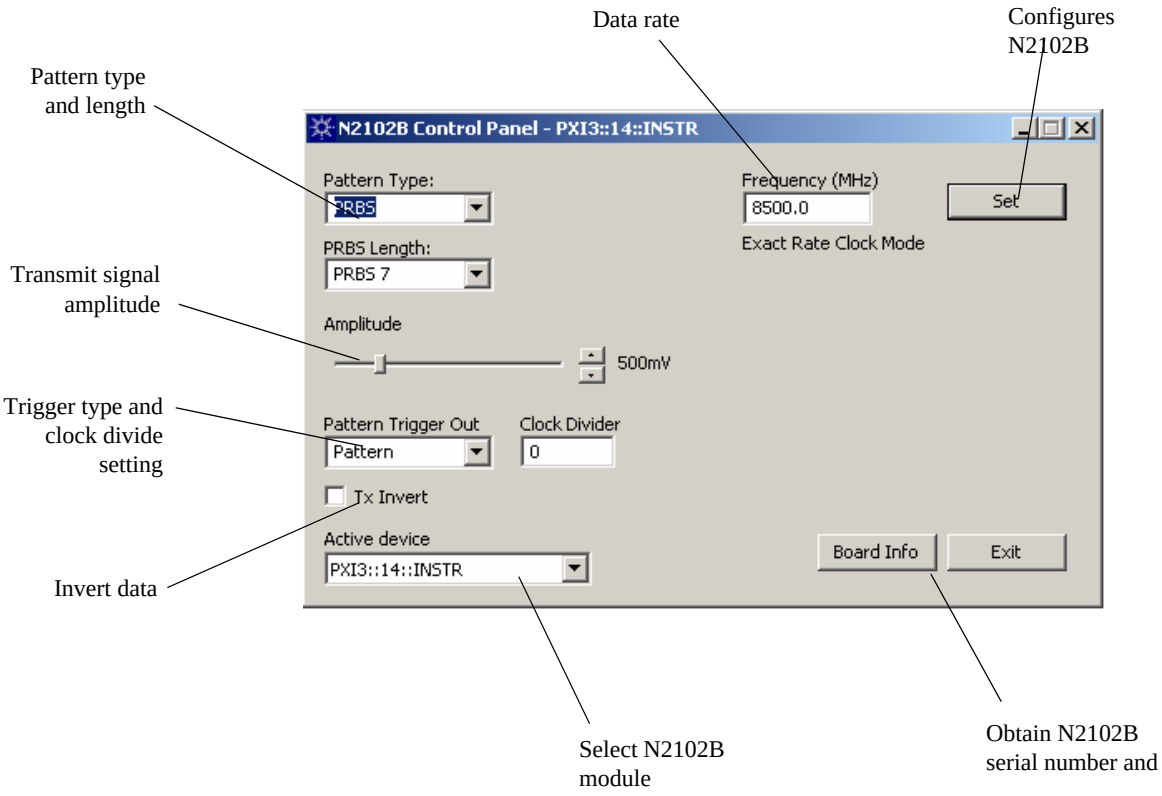
To update the firmware, perform the following steps:

1. Close any open Control Panels.
2. On the Windows **Start** menu, click **All Programs > Agilent > N2102A > N2102A FPGA Loader**.
3. Press the appropriate buttons to connect to a given module, and note the current module Serial Number, API, and Firmware Versions.
4. Select the new firmware and FPGA files located in the installation directory (typically C:\Program Files\Agilent\N2101A\fw), and click **start**.

   A progress bar appears as the module is updated.
5. Once complete, shut down the host PC and cycle the power on the PXI chassis.
6. After restarting the PC, connect to the N2101A and obtain Module Configuration, to confirm the software uploaded properly.

Using the N2102B Control Panel Application

This section describes how to start and configure the Control Panel. You can manage all aspects of the N2102B through the Control Panel application.



Control Panel Features

To start the control panel

1 Click the Windows **Start** menu.

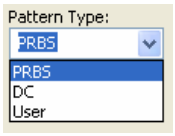
2 Click **All Programs > Agilent > N2102B**.

3 Click **N2102B Control Panel**.

Refer to the following paragraphs to learn the choices you have for configuring the N2102B Control Panel.

Pattern Type

Click on the Pattern Type drop down box to choose the appropriate pattern type. Also see "To use your own patterns" on page 15.



- If PRBS is selected as the pattern, you must select which length of PRBS is required.
- If a DC pattern is selected, you must choose between: K28.5, K28.7, or CRPAT.
- If the User Pattern option is selected, you must click the browse button to select the appropriate file. A user pattern requires a file with the following format:
  - Text (txt) file.
  - The first line must contain the length of the pattern in HEX.
  - The next line contains the pattern in a 16-bit HEX format or multiples of.
  - If the pattern is less than 16 bits, then it gets padded to the right with 0's.
  - User comments can be entered on any line once the line begins with //.

The following is an example of a user pattern file:

```
// This creates a K28.7 signal - 5 1's and 5 0's.
A
// The A is the length in Hex.
// So we are saying its length here is 10 bits.
F800
       // The above is the pattern in a 16Bit Hex value
       // To get this you start with 1111100000  and
    //   then pad 000000 to the right giving 1111100000000000 and then
     //  convert to HEX
```

The N2102B has the capability of storing a pattern that is 2^{17} or 131,072 bits in length. However, there are a number of requirements needed in order to achieve this maximum pattern length. The pattern is stored within a 64 x 2048 array. The FPGA processes the data 64 bits at a time. The following table shows the relationship between the possible maximum user pattern length based on even length patterns that are divisible by 64, or 32, or 16, and so forth.

Table 1. Pattern Length

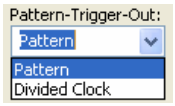
Pattern Length Divisor	Maximum Length
64	131072
32	65536
16	32768
8	16384
4	8192
2	4096
Odd number	2047

Amplitude

You can set the amplitude by moving the slider or clicking the increment or decrement buttons.

Pattern Trigger Out

The Pattern Trigger Out SMA connector on the front panel of the N2102B can be set to one of the following selections :



- Pattern

  This selection makes a short pulse at the start of the pattern, although not necessarily at the start of each occurrence of the pattern.

- Divided Clock

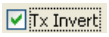
  This selection allows you to use the pattern trigger output as a clock divided down signal. If this is selected then you must also enter a value into the clock divide option.

  The clock divide = Data rate Out * (n+1) * 128 for n= 0,1,2…64,000

  Entering a zero will give a clock divide out signal of 128.

TX Invert

Checking this box inverts the output.



Active Device

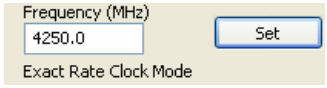
This drop down box allows you to select between various N2102B Pattern Generators within the system.

Board Info

Selecting this button returns the serial number of the pattern generator and the software revision numbers.

Set Frequency

You must enter the frequency in MHz of the required rate within this input box. When you click the Set button, the N2102B sets its appropriate internal configuration for this rate. If the rate is set between 2.5 and 3.3 Gb/s, a message appears, stating that the input clock rate must be doubled. For example, if the required rate is 2.7 Gb/s, you must supply a clock rate at twice this value (5.4 Gb/s).



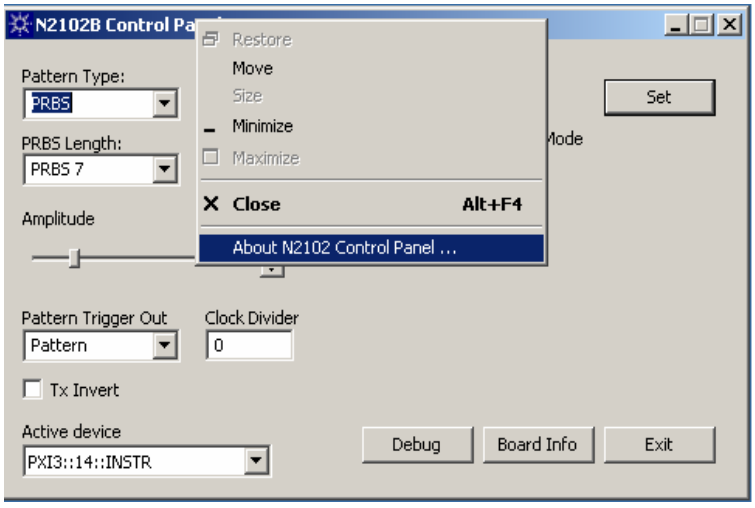
NOTE The N2101A/B BERTs have the same clock-rate restrictions as the N2102A/B.

Exit

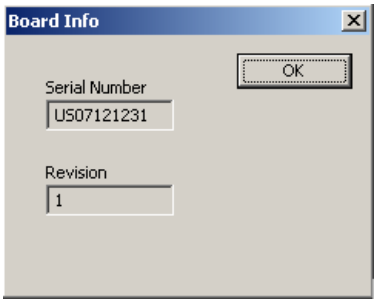
The Exit button allows you to close the Control Panel window.

About N2102B Panel

To obtain further information about the Pattern Generator, right-click the top of the Control Panel window title bar.



Then select **About N2102B Control Panel….** A panel displays showing the Panel Version number, DLL version number, and Hardware (FPGA) version number. You can also click **Board Info** and view the following panel.



To use your own patterns

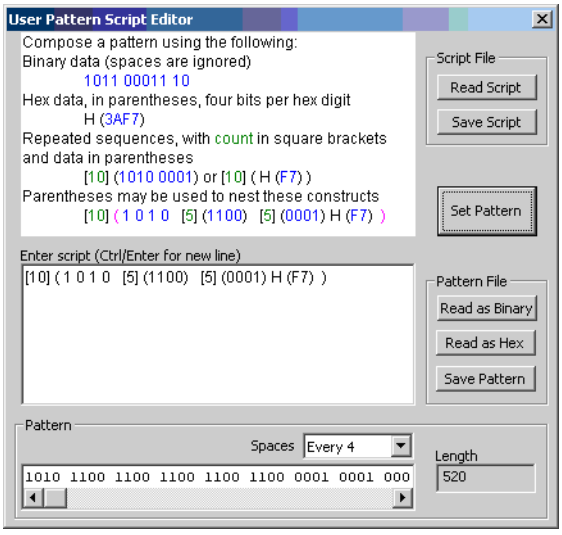
You can use your own user-defined patterns with the N2102B. The control panel application includes a user pattern editor that allows you to save and import text pattern-files to and from the N2102B.

1 Open the Configuration dialog box

Select **User** from the **Pattern Type** list. The N2102B immediately begins generating and synchronizing to any specified pattern.

2 Click **Browse** to locate and load a file that contains a user pattern. The user pattern could also be in hexadecimal format.

3 Click **Edit** to view the User Pattern Script Editor shown below. The editor uses an abbreviated script syntax, which is explained in the editor. In the User Pattern Editor, you can also save a pattern by clicking the Save Pattern button.



4 Enter the syntax for the bit pattern in the Script field.

5 Click **Set Pattern** to verify the syntax and display the resulting pattern of bits in the Pattern field.

User-defined pattern lengths must meet the following criteria:

- Integers from 1 to 2048
- Even numbers up to 4,096
- Multiples of 4 up to 8,192
- Multiples of 8 up to 16,384
- Multiples of 16 up to 32,764
- Multiples of 32 up to 65,536
- Multiples of 64 up to 131,072 (or 2^{17})

Programming

The API is provided in the form of a Windows based DLL and an Active-X control. These allow control of the N2102B. The API allows the host application to:

- Create and delete communication channels to the N2102B.
- Receive notification for status change.
- Configure the N2102B.

A Dynamic Link Library (DLL) provides an API for developing custom applications. An ActiveX Control wrapper for the DLL is also provided which extends programmability to any ActiveX container application or COM compliant programming environment. This includes Visual C++, Visual Basic, C#, LabView and many other environments.

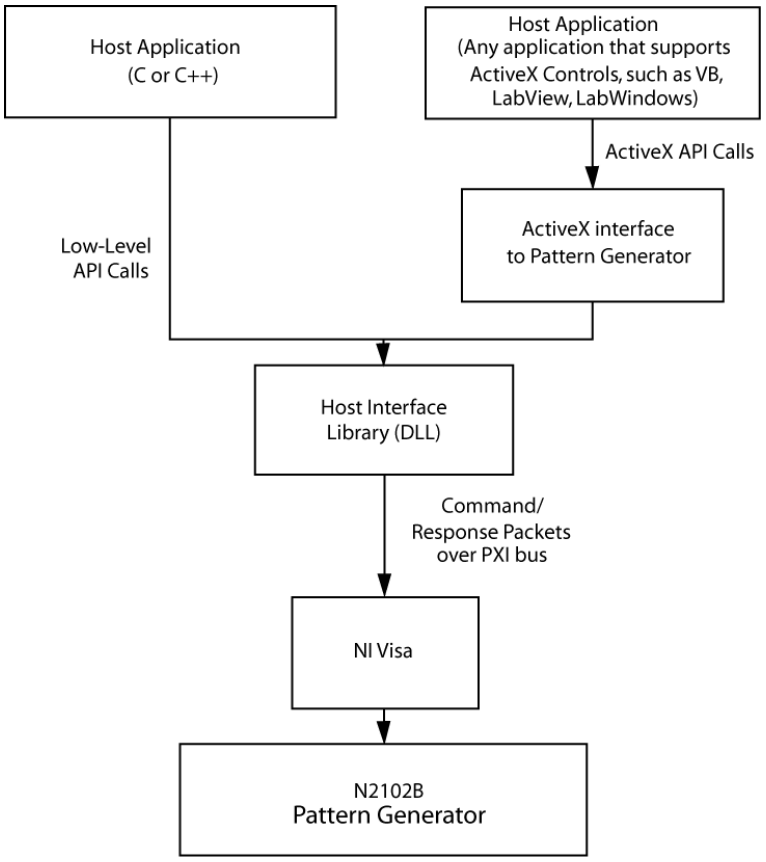


Figure 2. Host Library Overview

To program the N2102B

1 Obtain the N2102B VISA handle.

All calls to the N2102B API take a VISA handle that identifies the module to be accessed by the function call. This handle can be obtained by either of the following methods:

- Using the VISA API
- Calling the function PXIT337GetInstHandle
  - The first parameter to this function call is a pointer to the location where the VISA handle will be stored.
  - The second parameter is used to enumerate the N2102B modules present in the system.

    For example, a second parameter of 0 returns the VISA handle of the first N2102B detected. Incrementing this parameter in subsequent calls returns the VISA handle of other detected N2102B modules.

Example

```
#include <stdlib.h>
#include <windows.h>
#include <pxit337.h>

main ()
{
 ViSession instHandle; VISA handle for the PATTERN GENERATOR.
 PXIT337GetInstHandle(&instHandle, 0);
      if (instHandle != NULL)
    {
         PXIT337Reset(instHandle);Reset the N2102B
    }
 }
```

2 Open the device using the following API call:

```
BOOL PXIT337OpenDevice (char *pszDevice,ViSession *inst,int *pDevID);
```

3 Set the signal amplitude in 5 mV increments from 250 mV up to 1V using the following API call:

```
int PXIT337SetTxAmplitude(ViSession inst, unsigned long amplitude);
```

4 Set the bit rate. You must also provide a clock input into the N2102B at the required bit rate. Use the following API call:

```
int PXIT337SetFrequency (ViSession inst, float fFrequency);
```

5 Set the pattern trigger.

The clock trigger output cannot be reconfigured, but the pattern trigger output can be programmed to toggle at either of the following events:

- Start of the transmit pattern
- Secified multiple of 128 bits of the transmit output

Use the following API calls:

```
int PXIT337SetPatternTrigger(ViSession inst, PGPatternTrigger patternTriggerCfg);
void    PXIT337SetClockDivide (int viSession,ULONG ClockDivide);
```

DLL API Reference

This section documents the functions that are included in the DLL. Table 2 specifies bits 16 to 31 of the methods return values. You should mask off the lowest 16 bits of the return values before comparing to one of the major error codes described in this table. Bits 16-31 of the error codes may contain information about the cause of the error.

Table 2. Function Return Codes

Mnemonic	Value	Description
SUCCESS	0x00000000	Operation completed successfully.
UNEXPECTED_ERROR	0x00010000	Unexpected error. Contact support with a description of how this error occurred.
MEASURE_IN_PROGRESS_ ERROR	0x00020000	The requested operation cannot be completed because there is a measurement currently running. Try calling the StopCurrentMeasure() method before retrying.
UNKNOWN_DEVICE	0x00030000	The instrument handle used is not recognized as a valid handle. Make sure there is at least one PATTERN GENERATOR present in the system, that the PXI chassis is powered up, and that the PC has been rebooted after the chassis was powered up.
INVALID_PARAMETER	0x00040000	One of the parameters passed to the method is invalid or is not supported by the revision of hardware present in the system.
BOARD_REGISTER_ERROR	0x00050000	Cannot access the N2102B board registers. Power cycle the system. Contact support if the problem persists.
BOARD_DEVICE_ERROR	0x00060000	Cannot access one of the devices present on the board. The usual cause of this error is when one of the I2C devices present on the board is not responding. Bits 0-7 contain the bus address and bits 8-15 contain the bus number of the device causing the error.

PXIT337GetInstHandle

Obtains a VISA handle identifying a N2102B detected in the system. This handle is stored in the location passed as parameter. The content of this location is set to NULL if no N2102B was detected for the specified index.

Function Prototype int PXIT337GetInstHandle(ViSession *instHandle, int index);

***InstHandle** Pointer to the location where the VISA handle of the first N2102B detected in the system will be stored.

Index Index of N2102B for which a VISA handle is requested. This index starts at 0 and can be incremented after each call to PXIT337GetInstHandle to enumerate all the N2102Bs present in the system.

PXIT337Reset

Resets the N2102B hardware. The traffic generator is configured to a known "sensible" state that can be retrieved by calls to PXIT337GetTxConfig.

Function Prototype int PXIT337Reset(ViSession inst);

Inst VISA handle of the N2102B to be reset.

PXIT337GetHardwareVersion

Reads the PATTERN GENERATOR hardware version number.

Function Prototype int PXIT337GetHardwareVersion(ViSession inst, Pattern GeneratorVersion *versionNb);

Inst VISA handle of the N2102B from which to read the hardware version.

***VersionNb** Pointer to a Pattern GeneratorVersion variable into which the function will write the hardware version number.

PXIT337GetSoftwareVersion

Reads the PATTERN GENERATOR software version number.

Function Prototype void PXIT337GetSoftwareVersion(PGVersion *versionNb);

***VersionNb** Pointer to a PGVersion variable into which the function will write the software version number.

PXIT337GetTxConfig

Retrieves the current configuration of the transmit part of the PATTERN GENERATOR.

Function Prototype int PXIT337GetTxConfig(ViSession inst, PGTxConfig *txConfig);

Inst VISA handle of the N2102B from which to read the configuration.

***TxConfig** Pointer to an instance of PGTxConfig. Points to the location where the transmit configuration will be stored.

PXIT337ConfigureTx

Configures the PATTERN GENERATOR transmit block.

Function Prototype int PXIT337ConfigureTx(ViSession inst, PGTxConfig *TxConfig);

Inst VISA handle of the N2102B to configure.

***TxConfig** Pointer to an instance of PGTxConfig. Points to the location containing the new transmit configuration to be applied.

PXIT337SetTxAmplitude

Specifies the amplitude of the pattern generator output. The amplitude is specified in milli-Volts.

Function Prototype int PXIT337SetTxAmplitude(ViSession inst, unsigned long amplitude);

Inst VISA handle of the N2102B to configure.

Amplitude Output signal amplitude specified in mV.

PXIT337SetPatternTrigger

Selects the configuration of the pattern trigger output.

- When the selection is "divided clock," the trigger output frequency is the bit rate divided by 128, which is the programmed divider plus 1.
- When the selection is "pattern," the trigger occurs at the start of the memory, which is at the start of the first occurrence in memory of the pattern.

In this configuration, the trigger output is toggled every time a PRBS or user pattern starts repeating itself.

Function Prototype int PXIT337SetPatternTrigger(ViSession inst,unsigned long pattern);

Inst VISA handle of the N2102B to configure.

Pattern Specifies the trigger pattern with which to configure the trigger output. Setting this parameter to 0 indicates that the pattern trigger output must toggle at the beginning of each repetition of the transmit pattern. The pattern trigger toggling rate is then dependant on the length of the PRBS or user pattern generated on the transmit output. Setting this parameter to a non-zero value indicates how many 64-bit blocks should be generated on the transmit output in between each toggling of the pattern trigger output. Valid values range from 1 up to 256.

PXIT337GetPatternTrigger

Retrieves the current configuration of the pattern trigger output.

Function Prototype int PXIT337GetPatternTrigger(ViSession inst, PGPatternTrigger *patternTriggerCfg);

Inst VISA handle of the N2102B to configure.

***PatternTriggerCfg** Pointer to a Pattern GeneratorPatternTrigger instance where the configuration of the pattern trigger output will be stored when this function returns.

PXIT337SetClockDivide

Sets the clock output configuration.

Function Prototype int PXIT337SetClockDivide(ViSession inst, unsigned long ClockDivide);

Inst VISA handle of the N2102B to configure.

ClockDivide Specifies the the new clock division ratio value when Pattern Trigger is set to 1 (divided clock output).

Allowed values:

0: Bit clock divided by 128

n: Bit clock divided by 128 * (n + 1)

PXIT337GetClockDivide

Retrieves the clock output configuration.

Function Prototype int PXIT337GetClockDivide(ViSession inst, unsigned long *PtrToClockDivide);

Inst VISA handle of the N2102B to configure.

***PtrToClockDivide** Specifies a pointer to the clock division ratio (see PXIT337GetClockDivide above).

Data Types and Structures

PGPattern This data structure is used to individually describe transmit patterns. All parameters to define transmit and receive patterns are included in this structure. This structure is typically used to specify the traffic generator and receiver configurations.

```
typedef struct
{
     PGPatternType     Type;
     Union
     {
     PGPrbsLength  PrbsLength;
     PGDcPattern   DcPattern;
     PGUserPattern UserPattern;
     };
} PGPattern;
```

PGPatternType This enumeration defines the three possible pattern types supported by the N2102B.

```
typedef enum
{
    PRBS,
    DC,
    User
} PGPatternType;
```

PGPrbsLength This enumeration defines the PRBS pattern lengths supported by the N2102B.

```
typedef enum
{
    PRBS_7,
    PRBS_9,
    PRBS_11,
    PRBS_15,
    PRBS_23,
    PRBS_31
} PGPrbsLength;
```

PGDcPattern This enumeration defines the DC patterns supported by the N2102B.

```
typedef enum
{
    K28dot5 = 0,
    K28dot7,
    CRPAT,
} PGDcPattern;
```

PGUserPattern This structure is used to define a user pattern by specifying the buffer in which the user pattern is stored and the bit length of that pattern.

```
typedef struct
{
    unsigned long * BitPattern;
    int BitSize;
} PGUserPattern;
```

PGTxConfig This data structure is used to fully describe the traffic generator configuration. This structure is typically used as a parameter to a PXIT337ConfigureTx function call to configure the traffic generator.

```
typedef struct
{
    PGBitRate         BitRate;
    PGPattern         Pattern;
    unsigned long       Amplitude;
    PGClockSource     ClockSource;
    bool                DataInvert;
} PGTxConfig;
```

ActiveX API Properties

TxPattern

Specifies the transmitter bit pattern.

Type long

Values 0: PRBS 7
1: PRBS 9
2: PRBS 11
3: PRBS 15
4: PRBS 23
5: PRBS 31
6: K28.5
7: K28.7
8: CRPAT
9: User Pattern. Set by a call to LoadUserPattern method.

TxAmplitude

Specifies the transmit signal amplitude in millivolts.

Type long

Values 50 to 1000

TxDataInvert

Specifies the transmiter data invert.

Type long

Values 0: Data not inverted
1: Data inverted

Pattern Trigger

Specifies the pattern trigger output divider.

Type long

Values 0: Pattern
1: Divide by 128.

Frequency

Specifies the frequency of the transmit clock.

Type float

Values A floating-point value greater than 0 and less than 12000 (N2102B) or 6000 (PX2000-337), that specifies the applied clock frequency in MHz.

ClockDivide

Specifies the clock division ratio when PatternTrigger is set to 1 (divided clock output).

Type long

Values 0: Bit clock divided by 128.
n: Bit clock divided by 128 * (n + 1).

SerialNumber

Retrieves the pattern generator module's serial number. (Read only)

Type BSTR

Values NA

Revision

Retrieves the pattern generator module's module revision. (Read only)

Type long

Values NA

MaximumClockRate

The maximum value for the transmit or receive clock rate. (Read only)

Type float

Values NA

ActiveX API Methods

CloseDevice

void CloseDevice(void);

This method closes a previously open instance to a PPG. There are no parameters or return values associated with this method.

OpenDevice

CHAR OpenDevice(BSTR pszDevice);

This method is used to open an instance to a pattern generator. This method must be invoked prior to invoking any other PPG methods. Parameter BSTR pszDevice is the name of the device in NI Visa format. For example PXI3::12::INSTR. This method returns TRUE if the device was successfully opened, otherwise false.

InitUserPattern

Prototype void InitUserPattern(LONG bitLength);

Defines the user pattern length in bits that will be specified by subsequent calls to SetUserPatternData(). Parameter bitLength is the length in bits of the user pattern. This method does not return any value.

LoadUserPattern

void LoadUserPattern(VARIANT* pvPatternData,LONG ulBitCount);

Set the length and data for a user-specified pattern.

VARIANT* pvPatternData

Pointer to a VARIANT that contains the pattern data. The VARIANT must contain an array of LONGs and the binary data must be left-justified within the array. For example, a pattern of 40 bits would occupy the first word of the array and the leftmost eight bits of the second word; a pattern of 10 bits would occupy the leftmost ten bits of the first word only.

Parameter LONG ulBitCount is a LONG value that specifies the length, in bits, of the user pattern.

NOTE

Programming environments that cannot pass pattern data in a VARIANT can use the functions InitUserPattern, SetUserPatternData / SetUserPatternDataLong, and StartUserPattern to perform this function.

This method does not return any values.

SetUserPatternData, SetUserPatternDataLong

void SetUserPatternData(BYTE ucDataByte);

void SetUserPatternDataLong(LONG ulDataByte);

These calls transfer up to 8 bits of pattern data to the pattern generator.

Each call to one of these methods transfers a byte of data. Bytes must be transferred in order, and the transfer must begin with a call to InitUserPattern. After transferring the last byte, call StartUserPattern to begin pattern generator operation with the newly transferred pattern.

NOTE

SetUserPatternDataLong is provided to accommodate programming environments that cannot work with 8-bit data. SetUserPatternDataLong cannot transfer more than eight bits of data with each call.

Parameter BYTE ucDataByte (SetUserPatternData) is an 8-bit unsigned value that specifies a byte of the user pattern.

Parameter LONG ulDataByte (SetUserPatternDataLong) is a LONG value that specifies a byte of the user pattern.

This method does not return any value.

StartUserPattern

void StartUserPattern(void);

Causes the user pattern specified by previous calls to InitUserPattern() and SetUsetPatternData() to be generated in place of the currently generated pattern. This method does not return any value.

ActiveX Example

```
//
// Specify a 40 bits long repetitive pattern of 0xFF12345678
//
long bitLength = 40;
unsigned char pattern[5];
pattern[0] = 0xFF;
pattern[1] = 0x12;
pattern[2] = 0x34;
pattern[3] = 0x56;
pattern[4] = 0x78;
//
// Indicate the bit length of the new user pattern
//
InitUserPattern(bitLength);
//
// Load the user pattern
//
for (int idx = 0; idx < 5; idx++)
{
SetUserPatternData(pattern[idx]);
}
//
// Instruct to switch to the newly specified user pattern.
//
StartUserPattern();
```

Specifications

The distinction between specifications and characteristics is described as follows:

- Specifications describe warranted performance and apply after the instrument is turned on for one (1) hour.
- *Characteristics* provide useful information by giving functional, but nonwarranted, performance parameters. *Characteristics are printed in italics.*

This product complies with the Electrostatic Discharge immunity requirement in IEC/EN 61326 using performance criterion B. Degradation of some product specifications can occur during the instance of an electrostatic discharge. The product self-recovers and operates as specified after the discharge.

Table 3. Transmit (Tx) Specifications

Range of operation	622 Mb/s to 10.3125Gb/s
Output jitter	2.5 ps rms (Max *1.5 ps RMS (characteristic)*
Rise/Fall times (20-80%)	25 ps (Max) *22 ps (characteristic)*
Jitter	2.5 ps (Max) *1.5 ps (characteristic)*
Output voltage range (single-ended)	250 mV to 1 V
Accuracy of line rates	± 0.01%
Amplitude accuracy	± *10% (characteristic)*
Amplitude resolution	5 mV
Bit error insertion	Single and multiple bit bursts, continuous BER of 10^n (n= 3, 4, 5, 6, 7, 8, 9, 10)
Connector type	SMA

Table 4. Clock Specifications

Divided clock rate output	Bit clock rate divided by 128
Non-divided clock rate output range	622 MHz to 10.3125MHz
Pattern trigger	Triggers every 64th pattern for PRBS

Table 4. Clock Specifications

Pattern trigger / clock output voltage	*1 V pp (characteristic)*
External clock input voltage range	*500 mV to 1 V (characteristic)*
External clock input frequency range	622 MHz to 10.3125 GHz
Connector type	SMA

Table 5. Environmental Specifications

Use	Indoor
Power consumption	22 W (Max)
Dimensions	Two-slot PXI module (3U height)