BIUT- 820

TS2 Bus Interface Unit Tester

User's Manual
Revision 1.0

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1. <u>Explanation of Symbols, Terms, and Abbreviations</u>

Graphical Symbols

The following symbols are used on the BIUT-820 enclosure and in this manual. Anytime one of these symbols is encountered the user should be aware of the condition described here next to each symbol.

Caution. Risk of danger. Read the Users Manual before operating the BIUT-820

Terms and Abbreviations

The following is a list of terms and abbreviations used throughout the text of this manual along with the definition.

<u>Term or Abbreviation</u>	<u>Definition</u>
BIU	Bus Interface Unit
CU	Traffic signal cabinet controller unit.
DR	Detector Rack
mA	milliamperes (thousandths of an amp)
ms	milliseconds (thousandths of a second)
NEMA	National Electrical Manufacturers Association
PC	Personal computer
SDLC	Synchronous Data Link Control. This is the digital communications link between a BIU and controller.
Tester	The ATSI BIUT-820 TS2 Bus Interface Unit Tester
TF	Terminals and Facilities
TS2	A published standard which defines how the BIU should function.

Term or Abbreviation	Definition
VDC	Volts DC
Vrms	Volts RMS (root-mean-squared)

2. <u>Safety Information</u>

IMPORTANT SAFETY INFORMATION !

READ BEFORE ATTEMPTING TO USE THE BIUT-820 !

The BIUT-820 (Tester) should only be used by qualified and authorized traffic signal technicians or engineers who are familiar with generally accepted electrical safety practices as well as local and national safety codes. To avoid possible electric shock, burns, or fire, read all information contained in this manual before attempting to use the Tester.

• Do not use the Tester around explosive gas, vapor, or dust.

• Do not use the Tester in a wet environment.

• Do not attempt to open any part of the Tester enclosure.

• Do not put hands , or any object besides a NEMA TS2 BIU , into the BIU slot.

• Do not attempt to test devices that have been subject to lightning strikes or other severe electrical stress.

• Only test BIU devices that are designed according to the NEMA TS2 standard.

• If you are not sure if a device is designed according to the NEMA TS2 standard, consult the device manufacturer.

• Only use the power cord provided with the Tester.

• The Tester should only be powered from 120V AC / 60Hz.

3. <u>Introduction</u>

The BIUT-820 TS2 Bus Interface Unit Tester will run a series of tests on BIU devices that comply with *NEMA Standards Publication TS2-2003 v2.06.*

The BIU is a key component in a modern NEMA TS2 signal cabinet. It is responsible for converting all the inputs and outputs that need to be controlled and monitored by the controller into a digital data stream. The data is transmitted to and received from the controller over a Synchronous Data Link Control (SDLC) connection.

The only link between the BIU and the controller unit is the SDLC connection. This makes testing individual BIUs extremely difficult outside of a fully functional TS2 cabinet. Even then, only limited testing is possible because built-in TS2 controller diagnostic capabilities are extremely limited. This situation has created the need for a comprehensive standalone BIU Tester.

The BIUT-820 is housed in an industry standard 19" rack mount type enclosure with a 3U height. A rugged carrying case is also available as an option.

4. <u>BIUT-820 Software Installation</u>

4.1. Computer Requirements

Windows XP (minimum)

At least one available USB port.

Adobe Acrobat Reader must be installed. (This can be downloaded for free at www.adobe.com).

4.2. BIUT-820 Interface Software Installation

Installation of the software is a simple process. However it may require an administrative access to the computer.

The BIUT-820 comes with a software CD which can be used to install the software. If the CD is not available, the software can be downloaded from the Internet. To download the software visit our website: www.atsi-tester.com.

<u>To install the software from a CD</u> , insert the CD into drive of the computer. A start-up screen should open automatically. In the start-up screen click the "BIUT-820" button, then follow the instructions in the software installation wizard.

<u>To install the software that was downloaded from our website</u> , double-click the downloaded executable file to run the installation. Follow the instructions in the software installation wizard.

> **Note:** Do not forget to install the ATSI Tester USB device driver for BIUT-820.

4.3. BIUT-820 USB Driver Installation

To communicate with the BIUT-820 an *ATSI Tester USB driver* needs to be installed. The same driver is used with several ATSI products and is included on the software installation CD. The latest version of the driver can also be downloaded from our website: www.atsi-tester.com. The driver installation package is also copied to the computer during the software installation.

<u>To install the USB device driver from a CD</u> , insert the CD into the drive of the computer. A start-up screen should open automatically. In the start-up screen click "ATSI Tester USB Driver" button, then follow the instructions in the device driver installation wizard.

<u>To install the USB device driver package that was downloaded</u> from our

website, double-click the downloaded executable file to run the installation. Follow the instructions in the device driver installation wizard.

To install the USB device driver from the package copied during software installation , open My Computer and navigate to the directory where the BIUT-820 Interface software was installed. In that directory, open the folder caller "driver" and run dpinst.exe and follow the instructions.

5. <u>Running Tests</u>

Plug in the Tester :

Before running a test make sure the Tester is plugged into a standard 120V AC / 60Hz outlet using the power cable that is provided.

Put the BIU in the slot :

Slide the BIU into the yellow slot on the Tester. Make sure that the BIU printed circuit card edges are lined up with the card guides.

Be sure to push the BIU all the way in until the connector is fully engaged. The faceplate of the BIU should be flush with the front of the Tester when the connector is fully engaged.

Connect the SDLC cable :

Once the BIU is installed in the yellow slot, connect the provided SDLC cable from the SDLC port on the front of the Tester to the SDLC port on the front of the BIU.

Start the tests :

The preferred method of controlling the Tester is to use the BIUT-820 computer interface software. This will allow the user to enter information about the BIU that is being tested and also allow the test reports to be saved. The software will also record specific information about each failure that may be detected.

For situations where simple "good" or "bad" functional testing of a BIU is all that is required, the tests may be started without using the computer interface software.

Details for both methods are given in the following sections.

5.1. Testing a BIU without using a computer

For simple "good" or "bad" testing of a BIU, it is not necessary to use the computer software. The tests can be started by using the push buttons and display located on the front of the Tester.

1. Turn the Tester power switch to the ON position.

2. After a power-up sequence, the Tester display will show the main menu.

3. Push the NEXT button to move the cursor (->) and select one of the two testing options. RUN SELECTED TESTS will allow you to choose which test to run.

RUN ALL TESTS will run all of the tests that are available.

```
            ->RUN SELECTED TESTS
              RUN ALL TESTS
              SETUP
              INFO

              RUN SELECTED TESTS
            ->RUN ALL TESTS
              SETUP
              INFO
```

4. When the cursor is pointing to the desired option, push the ENTER button to begin the tests. If RUN ALL TESTS was chosen, the tests will begin automatically. If RUN SELECTED TESTS was chosen, push the NEXT button until the desired test is shown, then press ENTER to begin the test.

   If you would like to return to the main menu without running a test, keep pushing the NEXT button until you see :

```
            ->RETURN TO MAIN MENU
```

 Then press the ENTER key.

5.2. Testing a BIU using the computer interface software

The preferred method of testing is to use the BIUT-820 computer interface software to control the Tester. The software will allow you to enter more complete information about the BIU that is being tested and save the test reports. You will also be able to view more detailed information about each test failure that may occur.

To start a test using the software :

1. Connect a USB cable from the computer to the USB port on the front of the Tester. **Note :** Before you can go any further, the USB driver must be installed. Refer to the USB Driver Installation section of this manual.

2. Turn the tester power switch to the ON position.

3. Start the BIUT-820 software.

4. From the BIUT-820 software click on the *Test Setup* tab and fill in the data. All information is optional except for the BIU Serial Number.

5. Click on the *Run Tests* tab and select the tests that you would like to run.

6. Select *One Lap* or *Multiple Laps*. A lap is defined as one time through all of the selected tests.

7. Click the *Start* button when you are ready to begin testing.

8. You will be prompted to verify that the information you have entered is correct. If you click yes, the testing will continue. If you click no, the testing will not continue and you may re-enter any information that is not correct and then press the Start button again when you are ready to begin testing.

> **Note:** If you hover your mouse pointer over any of the objects in the BIUT-820 software, a help hint will appear in the status bar at the bottom of the window.

6. Test Descriptions

All of the BIUT-820 tests are based on *NEMA Standards Publication TS2-2003 v2.06.* It is the intent of ATSI to test the requirements of the aforementioned standard according to the most generally accepted interpretation. It is recommended that the user run all available tests. However, the operation of some BIUs may deviate from the standard in a known and repeatable fashion due to the design of the hardware or firmware. Furthermore, an individual jurisdiction (state, city, county) may have specific requirements or practices that are routinely followed which deviate from the standard or ignore certain parts. In such cases, the user has the option to disable the testing of certain BIU functions. <u>ATSI has no authority to enforce compliance with any part of the standard. It is the responsibility of the user to determine what tests are appropriate for their local requirements.</u>

6.1. Power Tests

Power-up Initialization Test

Test description :
The BIU address pins are set to TF BIU 1 and the BIU is powered-up with 24 VDC. The state of the output pins is checked and then Type 10 frames are sent.

Response required to pass :
The BIU outputs must be set to the 24 VDC level at power-up and the BIU must be fully functional within 1000 ms (TS2-2003 v2.06, Section 8.5.1).

Supply Current Test

Test description :
The BIU is powered up with 26 VDC, all the inputs are set to the active state and the supply current is measured.

Response required to pass :
Measured DC supply current must be less than 200 mA (TS2-2003 v2.06, Section 8.5).

700 ms Power Loss Test

Test Description :
The BIU address pins are set to TF BIU 1 and the BIU is powered-up

with 24 VDC. Type 10 command frames are sent to set the BIU outputs to a specific pattern. The state of the outputs is verified. The 24 VDC power is set to 0 VDC for less than 700 ms and then restored. The state of the outputs is checked.

Response required to pass :
The state of the output pins must be the same as before the power was set to 0 VDC (TS2-2003 v2.06, Section 8.5.1)

1500 ms Power Loss Test

Test description :
The BIU address pins are set to TF BIU 1 and the BIU is powered-up with 24 VDC. Type 10 command frames are sent to set the BIU outputs to a specific pattern. The state of the outputs is verified. The 24 VDC power is set to 0 VDC for 1500 ms and then restored. The state of the output pins is checked.

Response required to pass :
The BIU outputs must be set to the 24 VDC level (TS2-2003 v2.06, Section 8.5.1).

Comm Cease Test

Test description :
The BIU address pins are set to TF BIU 1 and the BIU is powered-up with 24 VDC. Type 10 command frames are sent and the proper BIU response is verified. The 24 VDC power is then set to 0 VDC. After a 9 ms delay a Type 10 command frame is sent and the response is checked. The BIU is then powered-up with 24 VDC. After a delay of 200ms, Type 10 command frames are sent and the proper BIU response is verified.

Response required to pass :
There must be no response from the BIU after the 9 ms delay (comm cease) . There must be a valid response from the BIU after the 200ms delay (comm restore) (TS2-2003 v2.06, Section 8.5.1).

6.2. SDLC Protocol Tests

CRC Test

Test description :
The BIU address pins are set to TF BIU 1 and the BIU is powered-up

with 24 VDC. Type 10 command frames are sent and the proper response is verified. Next a Type 10 command frame is sent with a one bit error in the CRC bytes.

Response required to pass :
There must be no response from the BIU to the Type 10 command frame with a one bit CRC error (TS2-2003 v2.06, Section 3.3.1.4.2.4).

Correct Address Response Test

Test description :
The BIU address pins are set to TF BIU 1* and the BIU is powered-up with 24 VDC. Valid command frames addressed to each of the TF BIUs are sent.

Response required to pass :
The BIU must only respond to command frames with addresses that match the address pins (TS2-2003 v2.06, Section 3.3.1.3).

* The test is repeated when the BIU address is set to all of the other valid TF and DR addresses.

6.3. Input / Output Tests

Input 1 - 8 Recognition Test

Test description :
The BIU address pins are set to TF BIU 1* and the BIU is powered-up with 24 VDC. Each BIU input is set to the active state while all others are set to the inactive state. Command frames are sent and the response is verified.

Response required to pass :
The proper bits must be set in the BIU response frame to indicate that the BIU is reading the inputs correctly (TS2-2003 v2.06, Section 3.3.5.1.3 and 8.8.5).

* The test is repeated when the BIU address is set to all of the other valid TF addresses

Opto Input 1- 4 Recognition Test

Test description :
The BIU address pins are set to TF BIU 1* and the BIU is powered-up

with 24 VDC. An 8.5 Vrms sine wave is applied to each opto input one at a time. Command frames are sent and the response is verified.

Response required to pass :
The proper bits must be set in the BIU response frame to indicate that the BIU is reading the opto inputs correctly (TS2-2003 v2.06, Section 8.8.5 and 8.8.5.2).

* The test is repeated when the BIU address is set to all of the other valid
  TF addresses

I/O 14 - 24 Recognition Test

Test Description :
The BIU address pins are set to TF BIU 1 and the BIU is powered-up with 24 VDC. BIU I/O pins 14 - 24 are set to the active state one at a time. Command frames are sent and the response is verified.

Response required to pass :
I/O pins 14 - 24 must be recognized as inputs to TF BIU 1. The proper bits must be set in the response frame to indicate that the BIU is reading the inputs correctly (TS2-2003 v2.06, Section 3.3.5.1.3 and 8.8.5 and 5.3.1.4.2).

I/O 16 - 20 Recognition Test

Test Description :
The BIU address pins are set to TF BIU 2 and the BIU is powered-up with 24 VDC. BIU I/O pins 16 - 20 are set to the active state one at a time. Command frames are sent and the response is verified.

Response required to pass :
I/O pins 16 - 20 must be recognized as inputs to TF BIU 2. The proper bits must be set in the response frame to indicate that the BIU is reading the inputs correctly (TS2-2003 v2.06, Section 3.3.5.1.3 and 8.8.5 and 5.3.1.4.2).

I/O 7 - 24 Recognition Test

Test Description :
The BIU address pins are set to TF BIU 3 and the BIU is powered-up with 24 VDC. BIU I/O pins 7 - 24 are set to the active state one at a time. Command frames are sent and the response is verified.

Response required to pass :
I/O pins 7 - 24 must be recognized as inputs to TF BIU 3. The proper bits must be set in the response frame to indicate that the BIU is reading the inputs correctly (TS2-2003 v2.06, Section 3.3.5.1.3 and 8.8.5 and 5.3.1.4.2).

I/O 10 - 14 Recognition Test

Test Description :
The BIU address pins are set to TF BIU 4 and the BIU is powered-up with 24 VDC. BIU I/O pins 10 - 14 are set to the active state one at a time. Command frames are sent and the response is verified.

Response required to pass :
I/O pins 10 - 14 must be recognized as inputs to TF BIU 4. The proper bits must be set in the response frame to indicate that the BIU is reading the inputs correctly (TS2-2003 v2.06, Section 3.3.5.1.3 and 8.8.5 and 5.3.1.4.2).

Load Switch Driver Test

Test description :
The BIU address pins are set to TF BIU 1* and the BIU is powered-up with 24 VDC. Command frames are sent to the BIU to set each load switch diver output one at at time.

Response required to pass :
The state of the BIU load switch pins is sampled. The pin must be in the active state when the correct bit is set in the command frame (TS2-2003 v2.06, Section 8.8.4 and 5.3.1.4.2).

* The test is repeated when the BIU address is set to TF BIU 2.

Constant Call Recognition Test

Test description :
The BIU address pins are set to DR BIU 1* and the BIU is powered-up with 24 VDC. Each of the detector channel inputs is set to the active state one at a time. Command frames are sent and the response is verified.

Response required to pass :
I/O pins 1 - 16 must be recognized as detector call inputs to DR BIU 1. The proper bits must be set in the response frame to indicate that the

BIU is reading a constant call correctly (TS2-2003 v2.06, Section 3.3.1.4.2.6).

7. <u>Summary of TS2-2003 v2.06 Standard</u>

In order to thoroughly understand the tests performed by the BIUT-820, it is important to be familiar with *NEMA Standards Publication TS2-2003 v2.06, Sections 3 and Sections 8*. The information given here is only a summary of some of the important terminology that is used in the test descriptions. It is highly recommended that the user obtain a copy of the complete standard.

7.1. General

The BIU is an important component in a TS2 signal control cabinet. It acts as the interface between Port 1 of the CU and the TF and Loop Detector Racks (DR). Its functions include controlling load switch outputs, detector resets, and communicating with inductive loop detectors.

The CU sends digital data frames to the BIU which tell it to do a certain task (e.g. turn on an output) or to respond with information (e.g. report the state of inputs). The data that the controller sends is referred to as a command frame. The response from a BIU is referred to as a response frame.

7.2. SDLC Communications

The transmission of data between the CU and BIU takes place by means of the SDLC protocol. The signal connections are shown below :

```
CU                            BIU
Tx Data (+) ------------- Rx Data (+)
Tx Data (-) ------------- Rx Data (-)
Tx Clock(+) ------------- Rx Clock(+)
Tx Clock(-) ------------- Rx Clock(-)
Rx Data (+) ------------- Tx Data (+)
Rx Data (-) ------------- Tx Data (-)
Rx Clock(+) ------------- Tx Clock(+)
Rx Clock(-) ------------- Tx Clock(-)
```

The data bits are transmitted on the Tx Data lines. Each bit is read at the receiving station on the rising edge of the Tx Clock signal. The data is transmitted at a rate of 153,600 bits per second.

7.3. Data Format

The data bits are arranged into 8 bit bytes and packaged into a format referred to as a frame. The CU sends command frames and the BIU responds with response frames. The general format of a frame is shown below :

```
Flag      Addr. Control   Information   CRC     Flag

01111110 8Bits 8bits    Variable length 16Bits 01111110
```

The frame always begins with an opening flag and ends with a closing flag. The second byte of the frame always contains the address of the BIU. A BIU should only respond to frames which have an address that matches the address set with the BIU address pins.

The third byte is a control character. It will always be 10000011 (83 hex).

The information field contains all of the frame data and the length will vary depending on the frame type.

The CRC bytes are used for error checking. These bytes contain a mathematically derived code that is calculated by the transmitting device from the bits that are set in the frame. The receiving device recalculates the code and compares it with what was received. If all of the bits were received correctly, the codes will match. If a BIU receives a frame with an incorrect CRC, it should not respond.

Below is a partial listing of command frames sent by the CU along with the BIU response. These frames are transmitted 10 times per second. For a complete listing refer to the NEMA Standard.

```
    TF Command Frames                TF Response Frames
Type           Function              Type    Function
----  ----------------------------  ---- ------------
 10   BIU 1 Outputs/Inputs Request   138 BIU 1 Inputs
 11   BIU 2 Outputs/Inputs Request   139 BIU 2 Inputs
 12   BIU 3 Outputs/Inputs Request   140 BIU 3 Inputs
 13   BIU 4 Outputs/Inputs Request   141 BIU 4 Inputs


    DR Command Frames            DR Response Frames
Type           Function          Type    Function
----  ----------------------    ---- ---------------
 20   BIU 1 Call Data Request    148 BIU 1 Call Data
 21   BIU 2 Call Data Request    149 BIU 2 Call Data
 22   BIU 3 Call Data Request    150 BIU 3 Call Data
 23   BIU 4 Call Data Request    151 BIU 4 Call Data
```

7.4. BIU Input / Output Signals

The BIU has 8 input pins, 15 output pins, and 24 I/O pins that may be operated as an input or an output. All of the input and output signals are nominally 24 VDC signals. They are active or "true" when in the low state. For example, to activate an input, it must be connected to logic ground. When not activated it will be pulled up to 24 VDC.   Likewise, when an output is active, it sinks to logic ground. When not active it will be pulled up to 24 VDC. Refer to the NEMA Standard for the maximum and minimum voltage thresholds required for proper operation of these signals.

The BIU inputs, outputs, and I/O pins are configured for different functions depending on the setting of the BIU address pins. Refer to the BIU signal assignment tables in the NEMA Standard for a complete listing.

7.5. BIU Opto Inputs

The BIU has 4 optically isolated inputs that are commonly used for pedestrian detectors. Typically a 12 VAC signal is connected between the input and opto common to activate the input.

8. Service and Calibration

The **BIUT-820 has no user serviceable parts**. Under no circumstances should the user attempt to open the enclosure. If the tester appears to be malfunctioning, contact ATSI to make arrangements for repair. See the *Limited Warranty and Liability* section of this manual for details.

ATSI strongly recommends that each Tester be calibrated yearly. A yearly calibration will verify that your Tester is operating within the original manufacturers specifications and provide you with a detailed calibration report for documentation. Please visit www.atsi-tester.com for the latest pricing of calibration services and extended maintenance plans.

9. <u>Limited Warranty and Liability</u>

The **BIUT-820 TS2 Bus Interface Unit Tester** (Product), distributed by Athens Technical Specialists, Inc. (ATSI), is warranted to the original purchaser (Purchaser) to be free of defects in materials and workmanship for a period of one year from the purchase date stated on the invoice. Within this period, in the event of a defect, malfunction, or other failure of the Product while in the custody of the Purchaser, ATSI will remedy the defect or cause of failure without charge to the Purchaser. The Purchaser's sole remedy is restoration of product operation. ATSI accepts no liability for incidental or related expenses. Under no circumstances will ATSI's liability exceed the purchase price for items claimed to be defective.

This Limited Warranty does not extend to any Product that has been damaged or rendered defective as a result of accident, misuse, abuse, modification of the product, or service by anyone other than ATSI.

EXCEPT AS EXPRESSLY SET FORTH IN THIS WARRANTY, ATSI MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICUALR PURPOSE OF THE PRODUCT AND ANY DEVICE TESTED BY THE PRODUCT. ATSI EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED IN THIS LIMITED WARRANTY. ANY IMPLIED WARRANTIES THAT MAY BE IMPOSED BY LAW ARE LIMITED TO THE TERMS OF THIS EXPRESS LIMITED WARRANTY.

Warranty Repair

To return the Product for repairs covered under the Limited Warranty :

Request a Return Merchandise Form by phone, fax, or email from the ATSI Service Department or complete the form at www.atsi-tester.com. Return the Product along with the completed form with prepaid postage to :

ATSI
8157 US Hwy 50
Athens, OH 45701

Phone: (740) 592 - 2874

Fax: (740) 594 - 2875

Email: service@atsi-tester.com

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