# Entellisys 5.0
# Low Voltage Switchgear
# Test Kit User Manual


imagination at work

# DEH-503

## Warnings, Cautions, and Notes as used in this publication

### Warnings

**WARNING!** Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

Warning notices are also used for situations in which inattention or lack of equipment knowledge could cause either personal injury or damage to equipment.

### Cautions

CAUTION: Caution notices are used for situations in which equipment might be damaged if care is not taken.

### Notes

NOTE: Notes call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described in here that are not present in all hardware and software systems. GE Consumer & Industrial assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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Second Revision

## How to contact us

Please have your Entellisys System Summary # and Sub # ready when calling. This information can be found on the Entellisys HMI on the **System Health** screen by clicking the **Job Info** button.

Post Sales Service
GE Switchgear
510 East Agency Road
West Burlington, IA 52655

Phone (toll free): 1-888-437-3765

Additional information:
www.entellisys.com/support

# Contents

# 1 Quick start guide

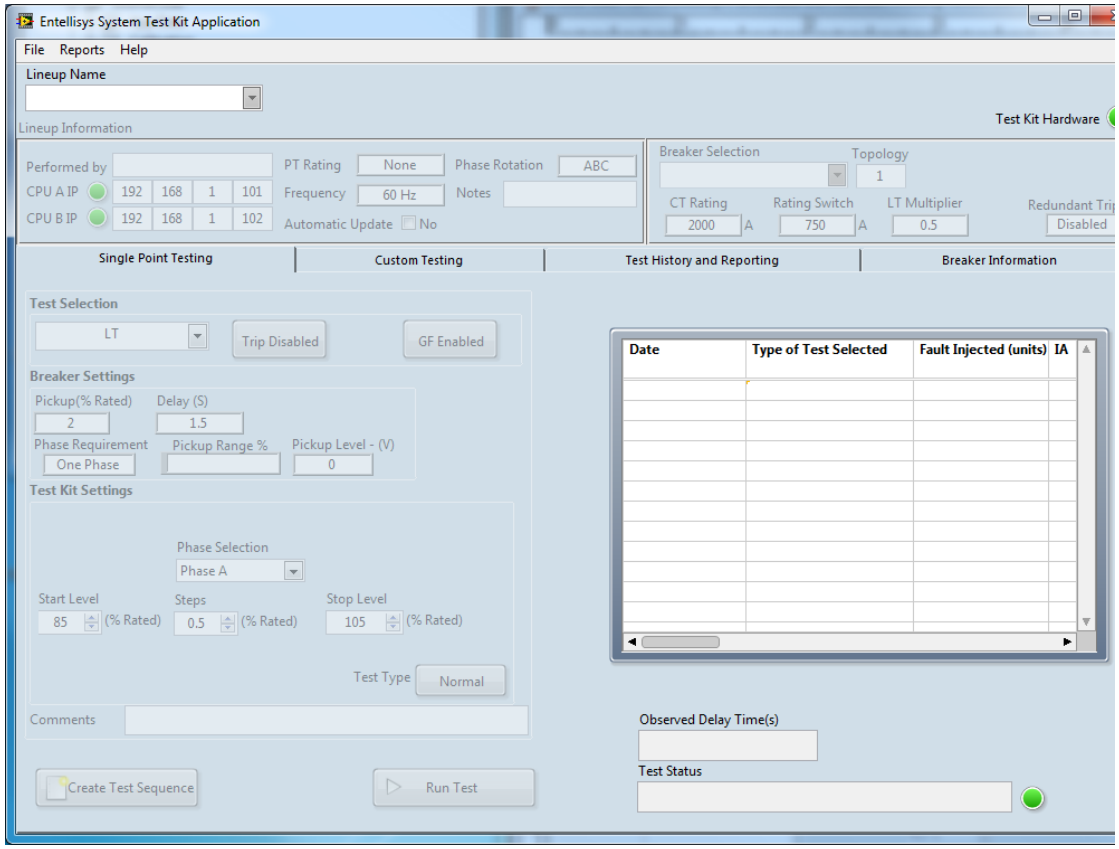
To quickly get to testing a breaker, this guide will require a current Entellisys archive to determine breaker configuration and relay settings.

## 1.1 Installing the application

Included in the test kit there is a USB thumb drive with the test kit application. Insert the thumb drive in the designated laptop and install.

After the installer has completed installing both the Test Kit application and the National Instruments runtime engine, run the application.

**Figure 1-1** Start Up screen

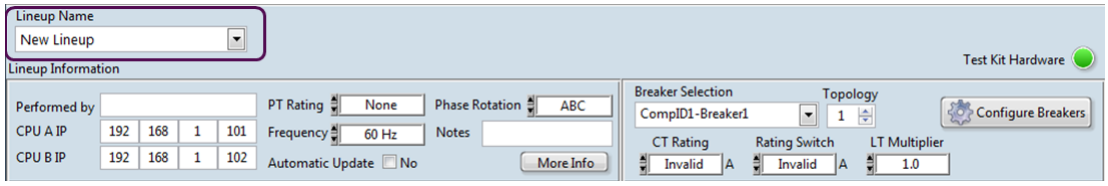


# 1.2 Running the application for the first time

To begin testing with the Customer Test Kit:

- On the test kit, connect the AC power supply and plug the USB cable to the PC or laptop running the test kit application.
- Start the test kit application. The test kit application will check for connectivity to the test kit. It will prompt the user if test kit is not detected and will check continuously until it is found.
- Once the application is open, create a new lineup by typing the lineup name in the ***Lineup Name*** text box. The line up and breaker controls will then be enabled.

**Figure 1-2** Configuring a new lineup




# 1.3 Import settings from the Entellisys archive

On the Entellisys HMI, sign in as an administrator and insert a thumb drive into the Entellisys HMI and navigate to the ***Backup \ Restore Archive*** tab and deselect the ***Log Files*** and click ***Ok***. (For more information on the taking an archive, see the Entellisys user manual).

**Figure 1-3** Taking an archive on the Entellisys HMI.

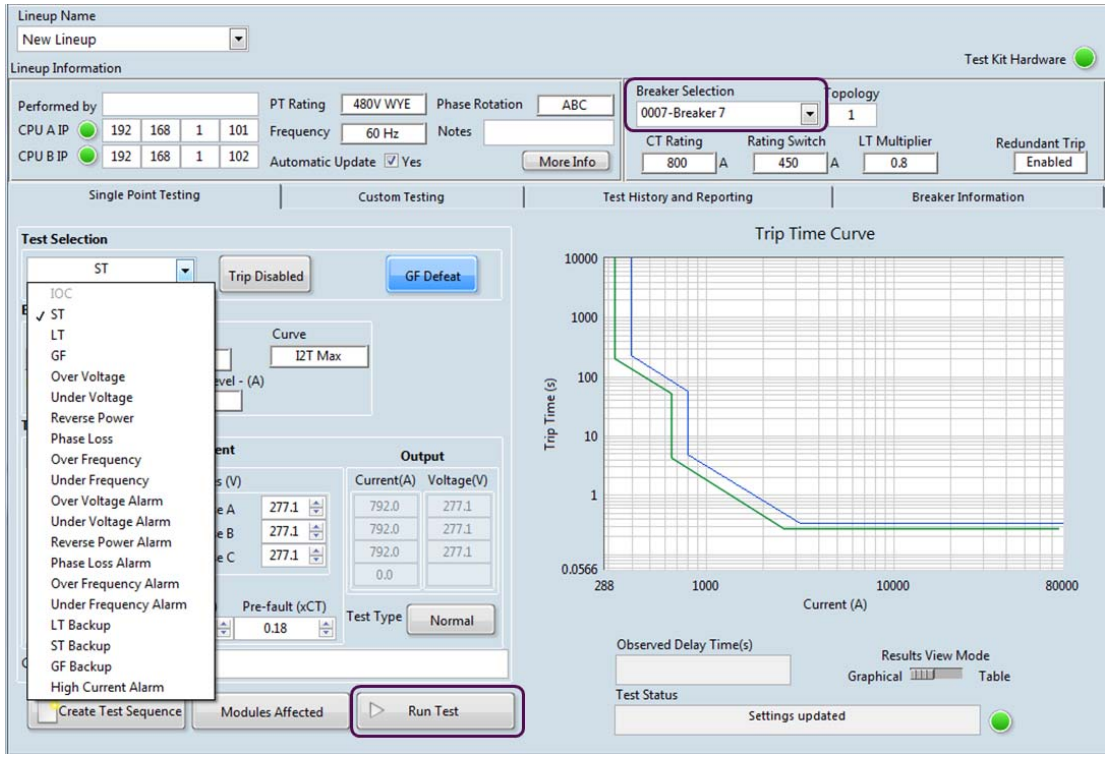

In the test kit application, select ***Import Settings from Archive*** from the ***File*** menu and navigate to the archive directory taken from the HMI previously.

The test kit application will configure the breaker names and relay settings. These settings can be changed if desired. The available default protection tests are also enabled in the ***"Test Selection"*** pulldown.

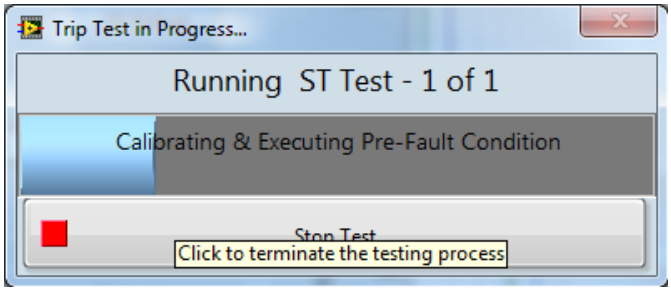
# 1.4 Select and run a test

Select the desired breaker from the ***Breaker Selection*** pulldown and select the desired test from the ***Test Selection*** *pulldown.*

**Figure 1-4** Selecting a test in the test selection pulldown




Check current levels and click ***Run Test*.**



# 2 Introduction

The Entellisys™ System Test Kit is a portable test instrument designed for field testing of the Entellisys Low Voltage Switchgear System. The test kit is controlled by an application loaded on the user's laptop.

The test kit will produce sinusoidal current and voltage waveforms which are injected into the Entellisys Messenger through the front test port.

The overview of features:

- Compatible with all Entellisys versions*
- Simulates power line characteristics for a single circuit breaker in the Entellisys Low Voltage System
- Verifies the function/operation of the protection system
  - Overcurrent Protection Tests – Long Time, Short Time, Instantaneous and Ground Fault Protection Tests
  - Single Point Relay Protection Tests (Overvoltage, Undervoltage, Over Frequency, Under Frequency, Power Reversal and Phase Loss, High Current Test)
- Verifies the calibration of the trip time current curve
- Verifies the operation of the circuit breaker actuation in "Trip mode"
- Performs tests without trips in "No Trip mode"
- Ground Fault Defeat function provides temporary suspension of all Ground Fault protection in the breaker
- Automatically retrieves system configuration for increased productivity
- Displays a summary of all protection configurations
- Saves test results to be reviewed later
- Windows Interface for ease of use
- Operation from 120 Vac

The test kit will interface with the system through the EntelliGuard™ Messenger located above each circuit breaker. The interface consists of 7 analog and several digital channels representing actual power line characteristics. The signals are injected directly into the Messenger A/D converters. This tests the entire Entellisys System, excluding the CTs, the CT interface (burden resistors) inside the Messenger, and the PTs.

*Entellisys 3.0 systems must use an archive to import settings.

**Figure 2-1** System Test Kit photograph


CAUTION: Tests conducted with the System Test Kit must be performed with the circuit breaker de-energized and racked-out to the test position. The test inputs will supersede the normal current and voltage inputs which disables normal protection, preventing response to fault conditions.

**Figure 2-2** HMI screen showing circuit breaker in Test Mode

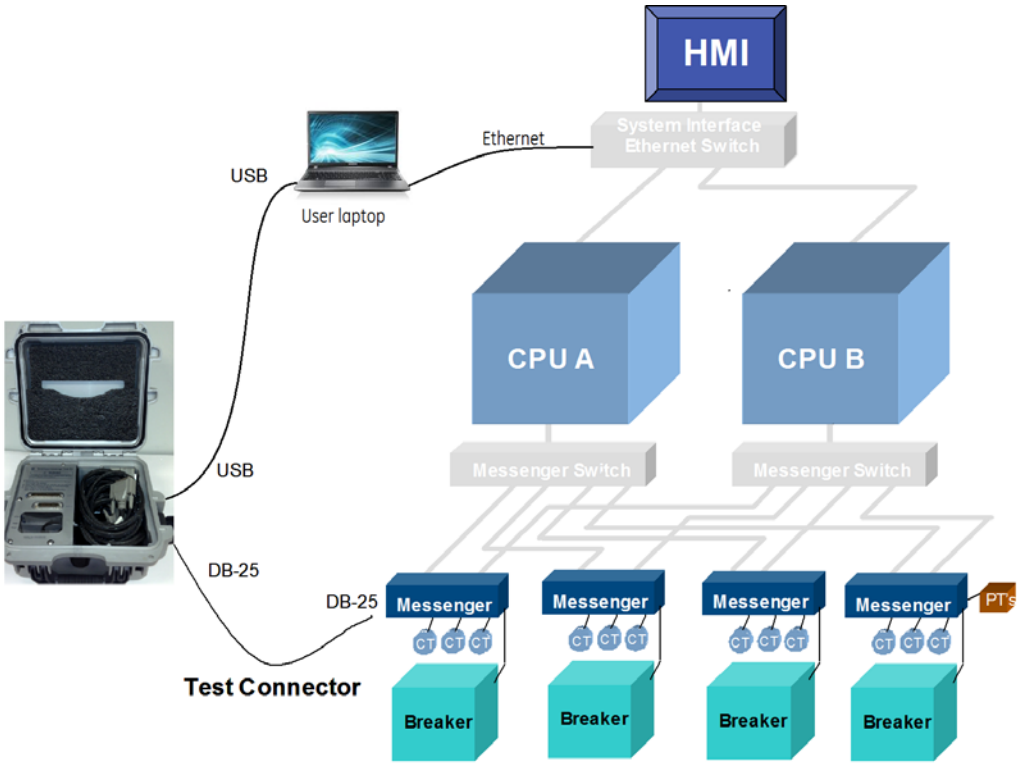

The HMI will indicate that the unit is in Test Mode. It will also record the analog test signals and trip responses in the waveform capture (viewable in the HMI event log).

# 2.1 Test architecture

The System Test Kit injects synchronized analog sinusoidal waveforms for each current and voltage phase to perform its tests. When in test mode, the Messenger will switch out the CT and PT inputs for the test signals before the A/D converters.

All Single Point voltage and current alarming and protection relays can be tested using low voltage injection from the System Test Kit.

**Figure 2-3** Entellisys system architecture with System Test Kit




The Test Kit requires its application to be loaded on a Windows laptop. The Entellisys test kit application will control the test kit to inject specific currents and voltages into the messenger via the DB-25 Messenger cable.

Messenger trip output is timed and reported back to the user interface.

The Test Kit application can obtain the system settings from either an Ethernet connection or from an archive.

# 2.2 System Requirements

## 2.2.1 Test Kit software requirements

**Table 2-1** Minimum system requirements

| Spec | Minimum requirements |
|---|---|
| Processor | Pentium III/Celeron 1GHz or equivalent |
| RAM | 1GB (32-bit) / 2GB (64-bit) |
| Screen resolution | 1024x768 |
| Operating system | Windows 8/7/Vista (32-bit and 64-bit)<br>Windows XP SP3 (32-bit)<br>Windows Server 2003 R2 (32-bit)<br>Windows Server 2008 R2 (64-bit) |
| Additional Software | Microsoft Excel 2010 (for reporting) |

## 2.2.2 Test kit hardware specification

All the digital signals given from the test kit and accepted from the test kit are active low TTL signals.

**Table 2-2** Actual System Test Kit output accuracy

| Sl.No | Parameter | Accuracy |
|---|---|---|
| 1. | Voltage | ±0.05% |
| 2. | Frequency | ±0.05 Hz |
| 3. | Phase angle | ±0.1 deg |
| 4. | Time Stamping | ±0.5 ms |

Accuracy for protection testing is based on the Entellisys System Accuracy.

**Table 2-3** System accuracy with the test kit

| Sl.No | Protection | Accuracy |
|---|---|---|
| 1. | Current Protection 1X | ±6.5% |
| 2. | Relay Protection | ±6.5% |
| 3. | Ground Fault 0.2X | ±2% |

## 2.2.3 Calibration

The calibration on the NI 9264 analog output card on the test kit should be verified once per year. The complete calibration procedure can be found NI.com\calibration.

**Recommended calibration device**: use a multiranging 6 1/2 digit DMM with an accuracy of 40 ppm.

**Creating a breakout cable:** Modify a Female DB37 pin cable to provide accessibility to pins 1 - 7 and 21.

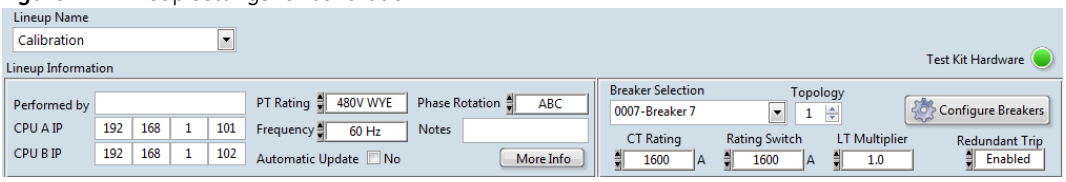
**Table 2-4** NI 9264 Verification Test Limits

| Test Point | Test Kit Setting | Pin # on DB37 connector | Peak Output (V) | 1-Year Limits Lower | Sensor type |
|---|---|---|---|---|---|
| Current: Phase A | 1.6xCT | 1 | +-9.14V | +-0.01V | |
| Current: Phase B | 1.6xCT | 2 | +-9.14V | +-0.01V | |
| Current: Phase C | 1.6xCT | 3 | +-9.14V | +-0.01V | |
| Current: Neutral | 1.6xCT | 4 | +-9.14V | +-0.01V | |
| Voltage Phase A | 480V | 5 | +-8.66V | +-.01V | 480 Wye |
| Voltage Phase B | 480V | 6 | +-8.66V | +-.01V | 480 Wye |
| Voltage Phase C | 480V | 7 | +-8.66V | +-.01V | 480 Wye |
| Analog Ground | -- | 21 | -- | -- | -- |

### Calibration Procedure:

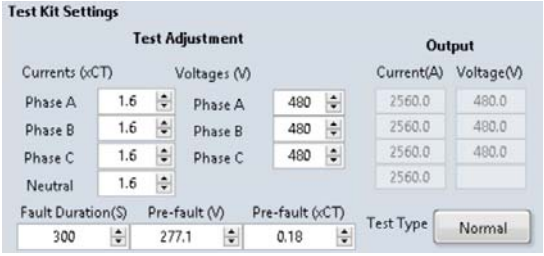
**Step 1:** Create a new lineup named “Calibration” and set the breaker CT Size, rating, LT Setting and PT Rating to 1600, 1600, 1.0 and 480 Wye.

**Figure 2-4** Lineup settings for calibration




**Step 2:** Set the test settings to match **Figure 2-5**. Set the “Fault Duration” to 300 seconds.

**Figure 2-5** Test settings for calibration




**Step 3:** Run the test and measure the min and max voltages on the pins listed in Table 2-4 relative to the analog ground. Verify they meet the calibration standards.

**Adjustment**: If the device measures outside the desired specifications shown in Table 2-4, the analog output card must be factory calibrated by National Instruments.

## 2.2.4 Replacement parts

Contact GE Post Sales Service for replacement parts:

Phone (toll free): 1-888-437-3765

Additional information:
www.entellisys.com/support

**Table 2-5** Replacement part numbers

| Description | GE Part Number |
|---|---|
| Entellisys System Test Kit | ETSTESTKIT03 |
| Custom Messenger Test Cable | ETSMSGRCABLE |
| 4 Slot Compact DAQ Chassis | ETSK03CHASSIS |
| 8-Channel, 100 ns, TTL Digital Input/Output Module | ETSK038IOCARD |
| ±10V, 25 kS/s per Ch 16-Bit, Analog Output Module, DSUB | ETSK03ACARD |

# 3 System Test Kit

## 3.1 Importing System Settings

The Entellisys test kit requires specific details about the lineup, it's sensors, number of breakers, relays that are enabled, the settings of each of the relays and other settings so that the test kit can determine the default values to test each of the relays as well as the correct pass / fail criteria.

This data provides the operator valid selections when selecting tests, and provides the proper output levels for the "Pre-Defined" Tests.

The test kit software provides three different methods to enter the lineup configuration.

- Directly from the CPU
- Imported from an Entellisys archive
- Manually configured

**Entellisys Version Compatibility**

The Customer test kit can connect to and read settings from Entellisys 4.0 systems and later. Entellisys 3.0 settings must be imported through an archive. (See section 3.1.2)

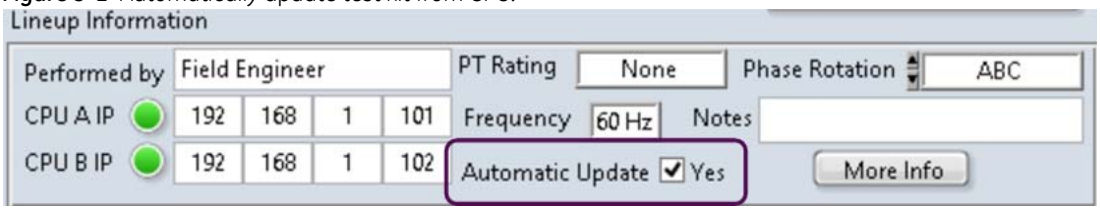
### 3.1.1 Directly from the CPU

The Entellisys settings can be downloaded by the test kit via Ethernet TCP/IP. There are two modes: Automatically update, yes or no.

**Automatic Update** will continuously monitor the Entellisys system and will automatically update any of the ratings or protection settings if changed by the user at Entellisys HMI or rating/LT pickup settings changed at the Messenger.

**Discover CPU IP addresses from HMI**: On the Entellisys HMI, go to **Main Menu, User Settings, HMI Preferences).**

**Figure 3-1** Automatically update test kit from CPU.




Enter the CPU IP addresses for each CPU. If the test kit can communicate to the CPUs, the status light will indicate green.

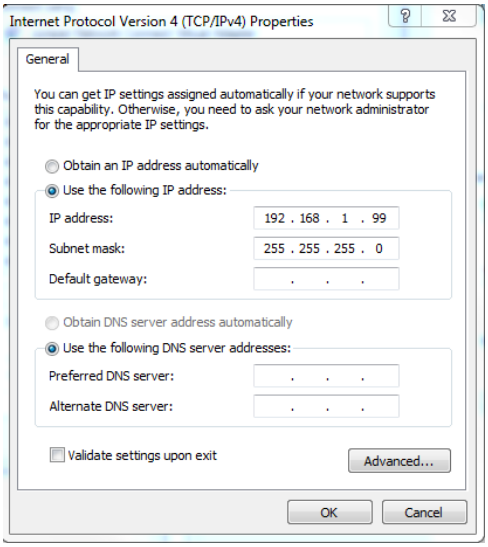
**Modbus TCP/IP network connectivity**:

Each Entellisys LV switchgear is equipped with a customer interface firewall device. Most laptops will be connected to the customer interface VPN via a Ethernet cable.

Entellisys LV switchgear is shipped from the factory with static CPU Ethernet IP addresses to **192.168.1.101 and 102**. The CPUs IP addresses may have been changed during commissioning to adhere to an existing addressing scheme.

Before connecting the Customer Test Kit application to the Entellisys LV switchgear, the PC running the Customer Test Kit software must be manually configured to a unique IP address on the same subnet as the CPUs. To configure connectivity to an Entellisys system:

1. Go to the Entellisys HMI and determine the CPU IP addresses (***Main Menu / User Settings / HMI preferences***)
2. Connect the Customer Test Kit PC to the VPN switch, open the control panel and navigate to the Networking area. Select the correct network adapter and modify the ***TCP/IPv4*** properties.
3. Check the "***Use the following IP address***:" check box and update the IP address field making sure the three left most numbers are identical to the Entellisys CPUs. The right most number must be unique.

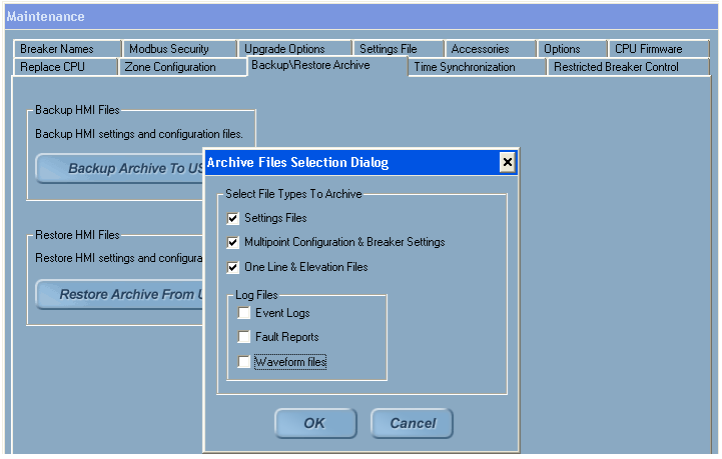


## 3.1.2 Import settings from an Entellisys archive

If there are issues connecting to the CPUs directly, an archive can be used to import the equipment configuration and settings.

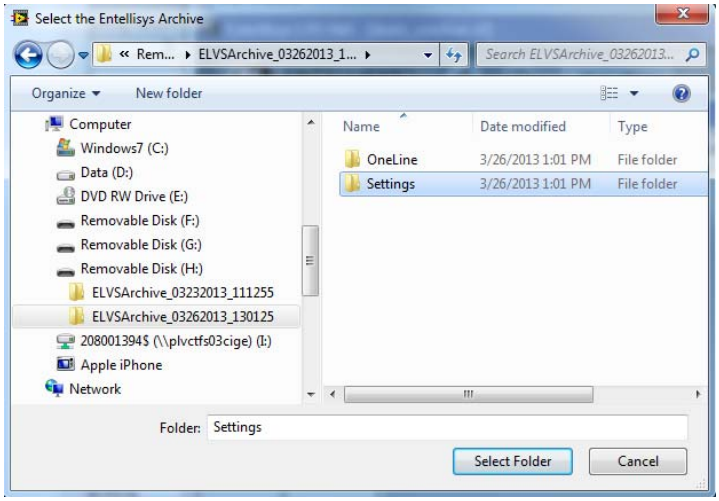
On the Entellisys HMI create an archive from the **Backup\Restore Archive** tab.

**Figure 3-2** Taking an archive from the Entellisys HMI




Once archive is complete, insert the USB into the PC running the test kit software and choose the “Import Settings from Archive” from the “File” menu. Select the archive directory and click **Select Folder**

**Figure 3-3** Importing an Entellisys archive




Enter a new name for the imported lineup and click Ok.

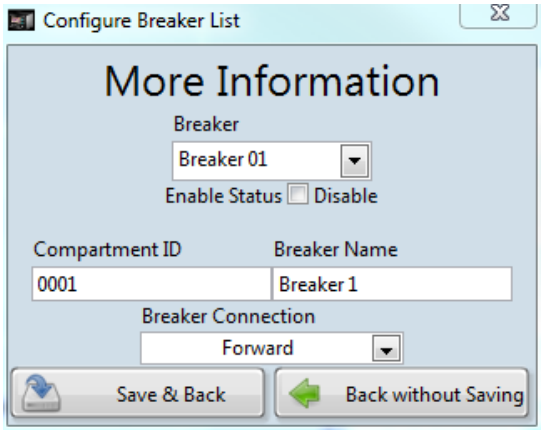
## 3.1.3 Manually configuring a lineup

Finally, if network connectivity or Entellisys archive is unavailable, then the system can be configured manually. To configure a lineup manually, settings and rating must be manually configured for each breaker.

NOTE: Any errors in the breaker or relay settings could result in apparent test failures.

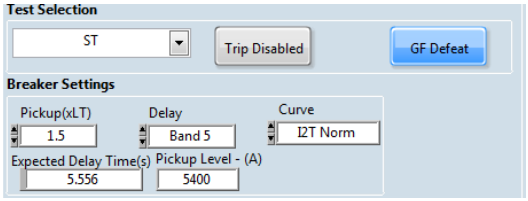
1. Create a new lineup and fill in the **Lineup Information**.
2. Click on "Configure Breakers" and enable each breaker in the system and set the Compartment name and Breaker name. Leave power connection as Forward. When completed, click "Save and Back."

**Figure 3-4** Manually configuring breakers




3. Manually set Pickup, delay and type for each overcurrent function or relay to be tested.

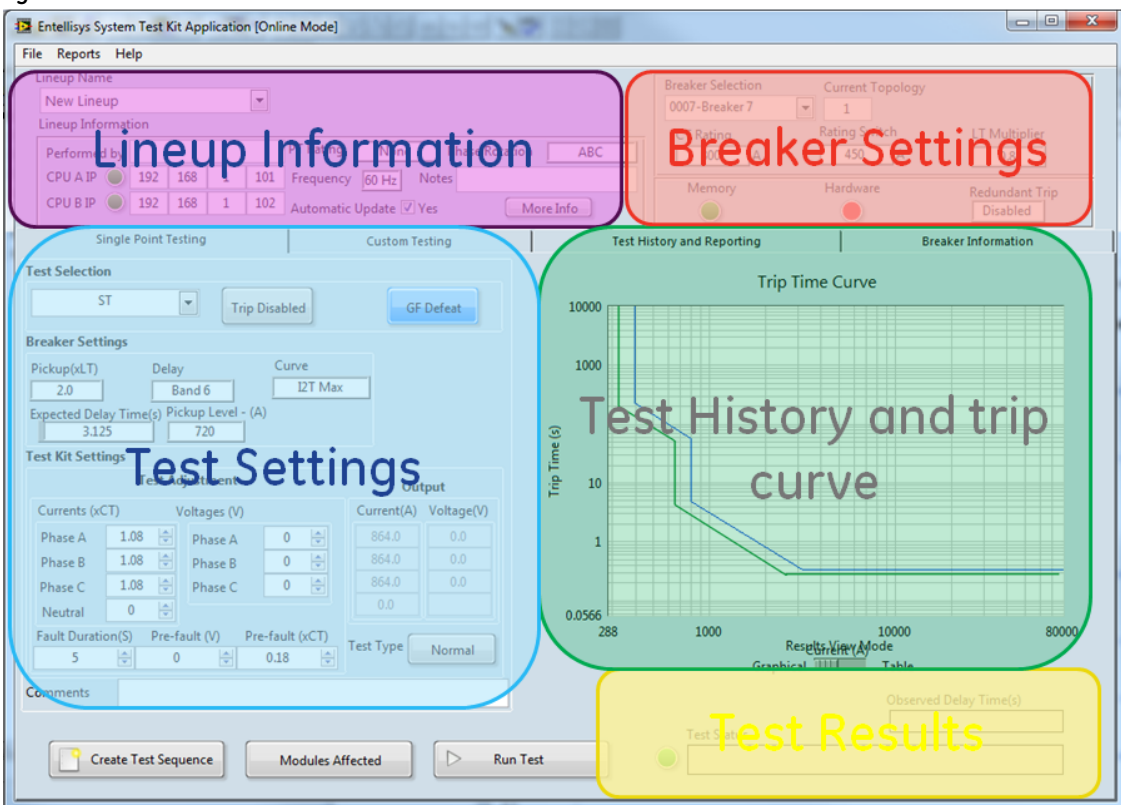
**Figure 3-5** Manually set trip settings in test kit



# 3.2 User Interface

The user interface is organized so all the information is available to the user. Also, the user has the ability to change any of the parameters during the testing process.

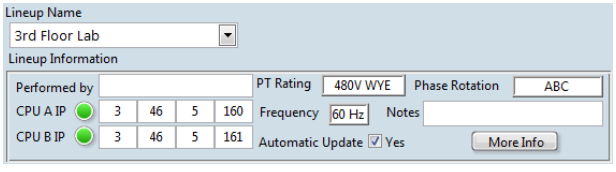
**Figure 3-6** The mainscreen overview




## 3.2.1 Lineup Information

The Customer Test Kit allows for creation of unique line ups. Each lineup, will consist of it's own set of breakers and site configuration. The lineup information control group stores all information related to the Entellisys lineup as a whole.

**Figure 3-7** Lineup Information




### 3.2.1.1 Controls

**Lineup Name**: Select from any number of previously configured lineups. Type in text to create a new lineup.

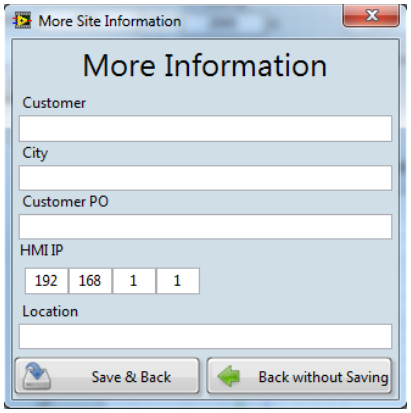
**CPUA and CPUB IP address controls**: Enter the IP address of the Entellisys CPUs

**PT Rating, Frequency and Phase rotation controls**: Global Entellisys settings that affect which tests are enabled, the output frequency and phase relationships of the output signals of the test kit.

**Performed by and Notes fields**: Optional fields. Enter the test engineer's name and any misc information.

**More Info**: Provides fields to add additional site specific information

**Figure 3-8** More information dialog

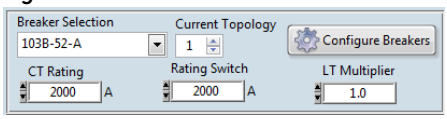



## 3.2.2 Breaker Settings

The breaker settings control group gives all breaker related information. Select the breaker of interest in the pulldown and the ***Test Settings*** will be populated.

In the offline mode, the user can also configure breakers manually.

**Figure 3-9** Breaker Selection




### 3.2.2.1 Controls

**Breaker Selection:** Select the breaker to be tested.

**Current Topology:** For Entellisys 4.5 and later, each single point relay can have different settings depending on the topology. Generally speaking, the source and tie breakers are considered "topology breakers" and are assigned a topology for each possible state combination. Entellisys provides individual settings for each topology. Therefore, the topology should be known when determining the correct pickup and delay settings.

When ***Automatic Update*** is enabled, the topology will be automatically updated from the CPU. In **manual mode**, the current topology can be viewed in the overcurrent overview screen in the Entellisys HMI. (**Main menu / User Settings / Overcurrent Protection**)

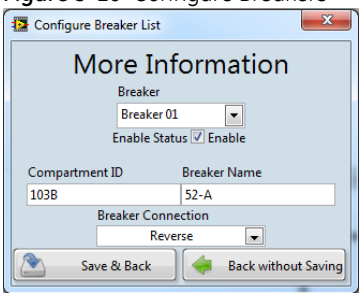
**CT Rating:** The rating of the current sensors installed in the breaker cubical. Refer to table on switchgear front view drawing or from the HMI Overcurrent Protection screen.

**Rating Switch and LT Multiplier:** The rating switch and LT Multiplier will reflect the position of the rating switch and LT Settings knob located on the front of the Messenger.

**Configure Breakers button** will be displayed if the system is off-line from the CPUs, each breaker of interest must be added to the test kit configuration manually. Select the breaker, check the "Enable Status" checkbox and update the desired breaker name fields.

Click "**Save & Back**" to return to the main screen.

**Figure 3-10** Configure Breakers




### 3.2.2.2 Manually configuring breakers

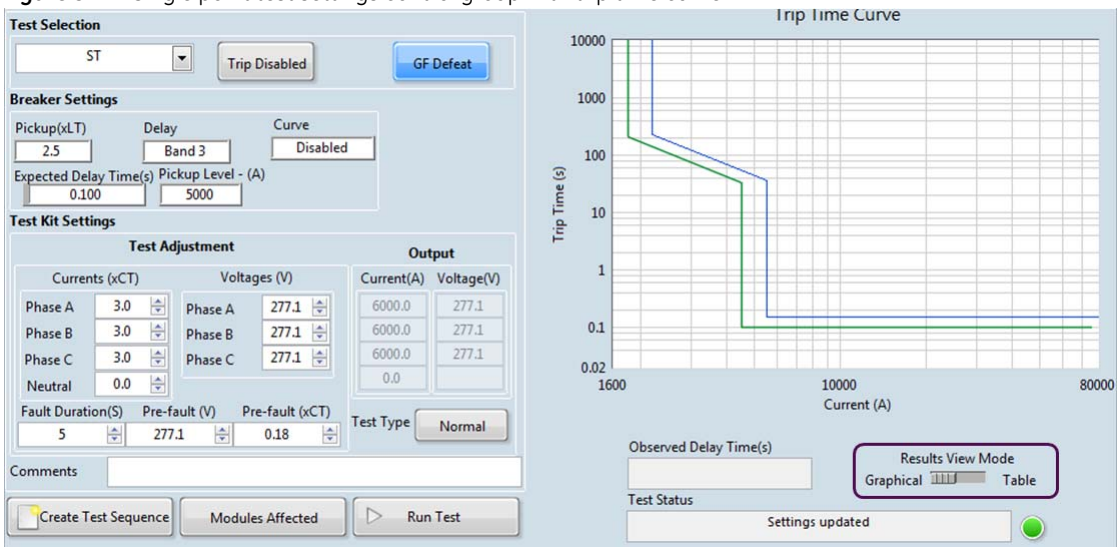
When off-line from the CPUs, breakers can be named manually. ***CT Rating, Rating Switch, and LT Multiplier*** can all freely be changed. Once a breaker is configured, the Test Settings will become active.

**Note**: Manual settings will be overwritten when an archive is imported or the test kit software is communicating to the CPU.

# 3.3 Single point testing tab

The Customer Test kit application will pre-populate the “Breaker Settings” parameters relevant to the selected test. The current and voltage output settings are pre-set to values that are 10% above the pickup threshold. The settings are adjustable by the user for any test.

**Figure 3-11** Single point test settings control group with trip time curve




For overcurrent relays, the associated trip time curve is drawn.

**Results View Mode:** The test results can also be shown in table form.

## 3.3.1 Breaker Settings

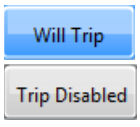
The relevant breaker settings are displayed for each test and can be changed when the Customer Test Kit is off-line from the Entellisys CPUs.

If off-line, care must be taken to ensure that the pickup, delay and curve settings match the breaker under test to successfully execute a test.

**Expected Delay Time and Pickup Level**

The Customer Test Kit software will automatically compute the expected trip time for the circuit breaker under test depending on Protection elements and update **Expected Delay Time** and the **Trip Time Curve** on the right.

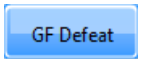
**Trip Disabled Button** specifies whether or not the test will physically trip the circuit breaker.



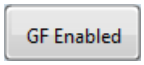

Circuit Breaker will Trip

– Circuit Breaker will not Trip

**GF Defeat button** allows users to temporarily Defeat Ground Fault during the test, or to Resume/Run Ground Fault as normal during the test. Ground Fault must be defeated for single phase tests—otherwise a trip on Ground Fault will occur.



– GF will be temporarily defeated during the test period.



– GF will Resume/Run as Normal.

**Note**: After the test has concluded, Ground Fault will resume automatically. This feature is enabled only when Ground Fault is enabled on the selected circuit breaker.

## 3.3.2 Test Kit Settings

The software will update the test kit settings according to test and relay settings selected in **Test Selection** and in **Breaker Settings.**

Each test sequence there is a “pre-Fault” time period, then a “Fault”

Test Adjustment

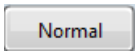
**Currents (xCT)** Fault currents are given in xCT. Range: 0-28x.

**Voltages (V)** Fault voltages are given in Volts. Range: 0 - 1.9 x PT rating for Delta PTs and 1.9xPhase voltages on WYE PTs.

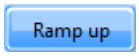
**Fault Duration (S)** Number of seconds the fault current will be injected into the Messenger.

**Pre-Fault (V)** & **Pre-Fault (xCT)** Voltage & current levels for the pre-fault portion of the test. Should be below the pickup threshold of any active protection relay.

**Test Type**: Select between Normal or ramp-up



– Normal single point test



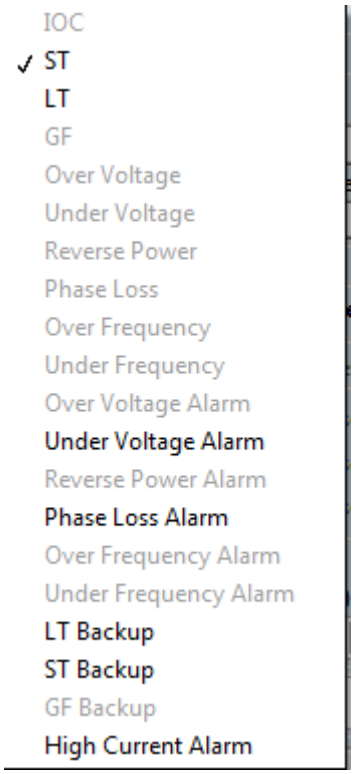
– Ramp-up test

## 3.3.3 Test Selections

The Test kit software will detect which relays are available to be tested for the selected breaker. The available relays will be enabled in the **Test Selection** pulldown.

### 3.3.3.1 Overcurrent Tests (IOC/ST/LT/GF)

The overcurrent tests verify the overcurrent protection functions for a circuit breaker in the system. The test can be performed as either a trip or no trip test.




**Instantaneous Overcurrent (IOC) Protection**

Verifies the instantaneous overcurrent protection function for a circuit breaker in the system. The test can be performed as either a trip or no trip test. To test IOC, the test kit provides an input current that exceeds the programmed IOC threshold. The result of the test is a trip time with an accuracy of 10% of the expected trip time.

**Short Time (ST) Overcurrent Protection**

Verifies the short time overcurrent protection function for a circuit breaker in the system. The test can be performed as either a trip or no trip test. To test ST, the test kit injects a sum-of-squares current value for any phase above the ST pickup setting. The result of the test is a trip time with an accuracy of 10% of the expected trip time.

**Long Time (LT) Overcurrent Protection**

Verifies the long time overcurrent protection function for a circuit breaker in the system. It can be performed as either a trip or no trip test. To test LT, the test kit injects a sum-of-squares current value for any phase above the LT pickup setting. The result of the test is a trip time with an accuracy of 10% of the expected trip time.

**Ground Fault (GF) Protection**

Verifies Ground Fault protection function for a circuit breaker in the system. The test can be performed as either a trip or no trip test.

In a three-wire system, the test kit will provide three phase currents with vector sum greater than the pickup threshold.

In a four-wire, WYE-system, the test kit will provide three phase currents and a neutral with vector sum greater than the pickup threshold.

In either case, the result is a trip time with an accuracy of 10% of the expected trip time.

### 3.3.3.2 Voltage and frequency relays

The Relay Protection Test screen allows the user to perform various tests for Relay protection functionality based on the options enabled in the system. Possible tests are as follows:

- Over Frequency Test
- Under Frequency Test
- Overvoltage Test
- Undervoltage Test
- Phase Loss
- Power Reversal
- High Current Alarm

**Over Frequency**

Sets the frequency above the set point for the specified time delay.

**Under Frequency**

Sets the frequency below the set point for the specified time delay.

**Overvoltage**

Injects a phase voltage greater than the set point for the specified time delay. There are three options:

- One phase is above the pickup threshold
- Two phases are above the pickup threshold
- Three phases are above the pickup threshold

**Undervoltage**

Injects a phase voltage less than the set point for the specified time delay. There are three options:

- One phase is below the pickup threshold
- Two phases are below the pickup threshold
- Three phases are below the pickup threshold

**Phase Loss**

Injects a negative-phase-sequence voltage greater or less than the nominal 1X value of the system voltage.

**Power Reversal**

Injects waveforms that have the direction of the power reversed and the magnitude of the power greater than the set point for the specified time delay.

**High Current Alarm**

Injects waveforms that have currents greater than the programmed threshold for a time greater than the programmed delay to generate high current alarm.

### 3.3.3.3 Messenger Backup Tests (LT / ST / GF)

The Entellisys architecture provides redundant overcurrent protection through Messenger backup. LT/ST/GF overcurrent relays are running on both CPUs and locally at each Messenger. However, the Messenger's trip signal is typically generated by the CPUs as it is running with smaller delay settings and therefore the Test Kit's trip signal originates from the CPU.

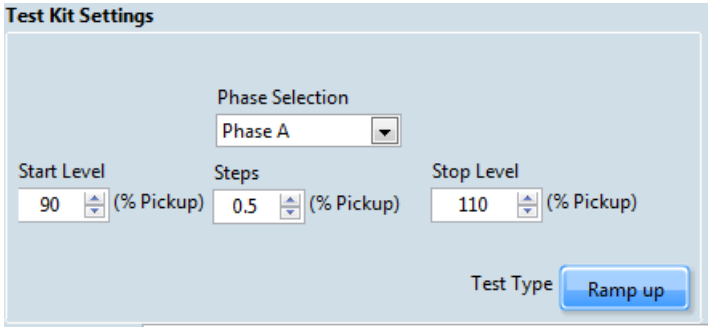
To test the overcurrent relays running locally on the Messenger, the **Messenger Backup Tests** output fault currents until the CPU detects a trip generated from the Messenger.

The backup tests test the Messenger's local LT/ST and GF test settings. The settings are pre-configured and require connectivity to the CPU.

### 3.3.3.4 Ramp up Test

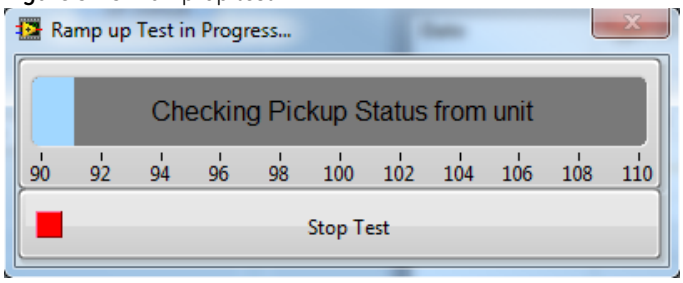
Each of the tests have a ramp-up function. The ramp-up test will begin at an adjustable start level and will test at each current level until the trip signal is detected.

**Figure 3-12** Ramp-up Test controls




Adjust the start, step and stop parameters. Click the **Run Test** button. The Test application will run through each of the tests until a trip signal is detected.

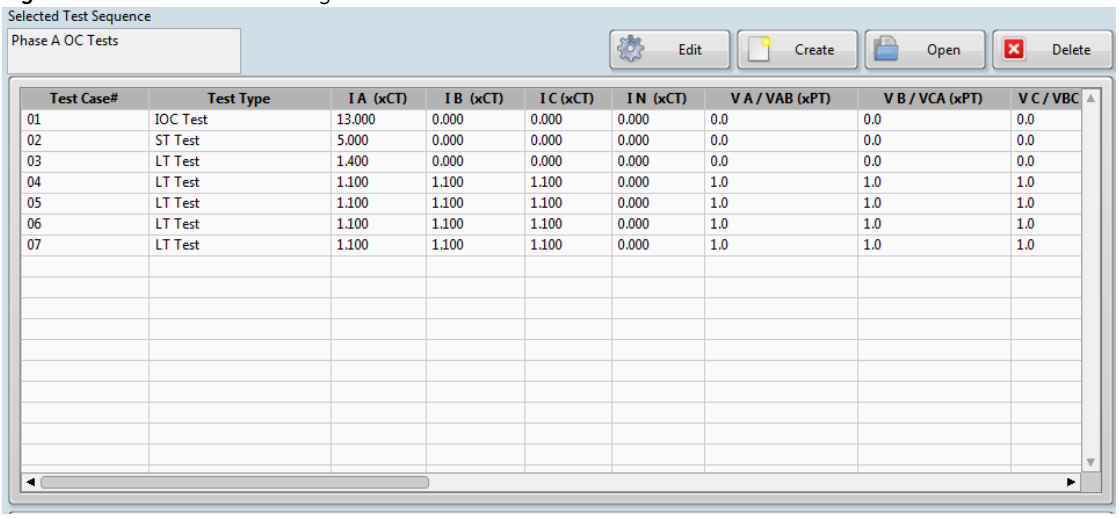
**Figure 3-13** Ramp-up test



# 3.4 Custom Testing tab

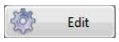
The customer test kit provides the capability to create test scripts. The user can store and recall test sequences comprised of custom settings or multiple tests.

**Figure 3-14** The Custom Testing Interface

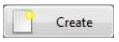



| Test Case# | Test Type | I A (xCT) | I B (xCT) | I C (xCT) | I N (xCT) | V A / VAB (xPT) | V B / VCA (xPT) | V C / VBC |
|---|---|---|---|---|---|---|---|---|
| 01 | IOC Test | 13.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 |
| 02 | ST Test | 5.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 |
| 03 | LT Test | 1.400 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 |
| 04 | LT Test | 1.100 | 1.100 | 1.100 | 0.000 | 1.0 | 1.0 | 1.0 |
| 05 | LT Test | 1.100 | 1.100 | 1.100 | 0.000 | 1.0 | 1.0 | 1.0 |
| 06 | LT Test | 1.100 | 1.100 | 1.100 | 0.000 | 1.0 | 1.0 | 1.0 |
| 07 | LT Test | 1.100 | 1.100 | 1.100 | 0.000 | 1.0 | 1.0 | 1.0 |

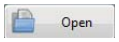
### Controls



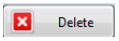

Edit current test - can also double click on any of the records.




Create new custom test script.




Open an existing test sequence




Delete an existing test sequence.

CAUTION: The test entries can be rearranged by highlighting and dragging. They can also be copied by pressing the CTL key while moving.

### Running a test sequence

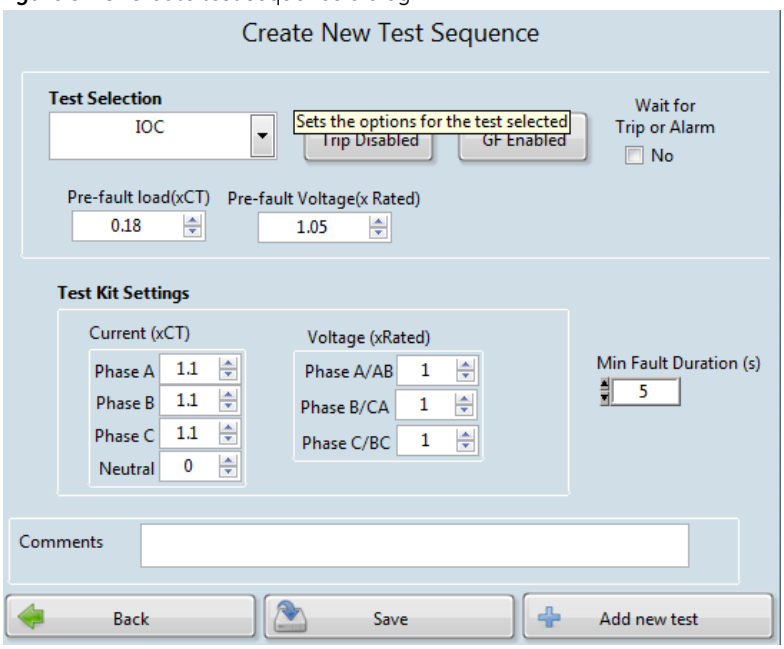
To run a test sequence, click the **Open** button to open a saved test sequence. Click **Run Tests** to run all the tests OR highlight one or more of the tests to run a subset.

## 3.4.1 Creating a test sequence

From the "**Custom Testing"** tab, click the **Create** or **Edit button.** The custom testing dialog will appear as shown in Figure 3-15 with default values.

Alternatively, after selecting one of the default tests in the **Single Point Testing** tab, click on the **Create Test Sequence** button on the same tab and the test sequence will appear with values configured in the **Test Kit Settings.**

**Figure 3-15** Create test sequence dialog




The test sequence dialog will appear first. Configure the first test. Select the test from the **Test Selection** pulldown and then configure:

- **Pre-fault Voltage**: Given in xPT Rating
- **Test Kit Currents**: Given in xCT
- **Test Kit Voltages**: Given in xPT Rating
- **Min Fault Duration**: Time the fault current will be injected into the Messenger.
- **Wait for Trip or Alarm:** Indicates to the Customer Test Kit application that must wait for trip or alarm events from the Entellisys CPU before continuing.

**Add new test:** Add a new test to the current test sequence.

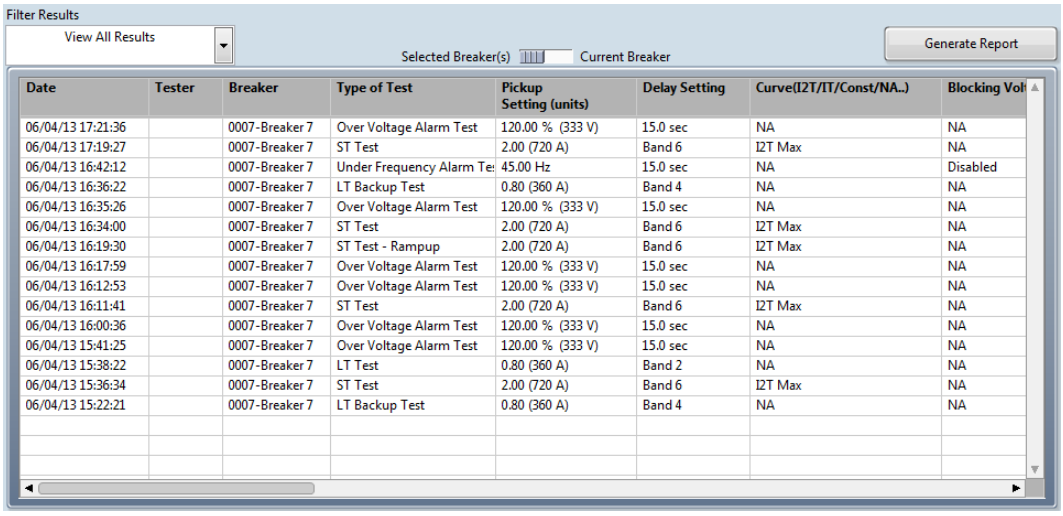
**Save:** Save the test sequence.

**Back:** Exit to the main user interface.

# 3.5 Test History and Reporting tab

The Customer Test Kit software will retain the entire test history for each breaker installed in each lineup. The **Generate Report** button will generate an Excel report and requires Microsoft Excel 2010 or later.

**Figure 3-16** The test history tab




| Date | Tester | Breaker | Type of Test | Pickup Setting (units) | Delay Setting | Curve(I2T/IT/Const/NA..) | Blocking Vol |
|---|---|---|---|---|---|---|---|
| 06/04/13 17:21:36 | | 0007-Breaker 7 | Over Voltage Alarm Test | 120.00 % (333 V) | 15.0 sec | NA | NA |
| 06/04/13 17:19:27 | | 0007-Breaker 7 | ST Test | 2.00 (720 A) | Band 6 | I2T Max | NA |
| 06/04/13 16:42:12 | | 0007-Breaker 7 | Under Frequency Alarm Te | 45.00 Hz | 15.0 sec | NA | Disabled |
| 06/04/13 16:36:22 | | 0007-Breaker 7 | LT Backup Test | 0.80 (360 A) | Band 4 | NA | NA |
| 06/04/13 16:35:26 | | 0007-Breaker 7 | Over Voltage Alarm Test | 120.00 % (333 V) | 15.0 sec | NA | NA |
| 06/04/13 16:34:00 | | 0007-Breaker 7 | ST Test | 2.00 (720 A) | Band 6 | I2T Max | NA |
| 06/04/13 16:19:30 | | 0007-Breaker 7 | ST Test - Rampup | 2.00 (720 A) | Band 6 | I2T Max | NA |
| 06/04/13 16:17:59 | | 0007-Breaker 7 | Over Voltage Alarm Test | 120.00 % (333 V) | 15.0 sec | NA | NA |
| 06/04/13 16:12:53 | | 0007-Breaker 7 | Over Voltage Alarm Test | 120.00 % (333 V) | 15.0 sec | NA | NA |
| 06/04/13 16:11:41 | | 0007-Breaker 7 | ST Test | 2.00 (720 A) | Band 6 | I2T Max | NA |
| 06/04/13 16:00:36 | | 0007-Breaker 7 | Over Voltage Alarm Test | 120.00 % (333 V) | 15.0 sec | NA | NA |
| 06/04/13 15:41:25 | | 0007-Breaker 7 | Over Voltage Alarm Test | 120.00 % (333 V) | 15.0 sec | NA | NA |
| 06/04/13 15:38:22 | | 0007-Breaker 7 | LT Test | 0.80 (360 A) | Band 2 | NA | NA |
| 06/04/13 15:36:34 | | 0007-Breaker 7 | ST Test | 2.00 (720 A) | Band 6 | I2T Max | NA |
| 06/04/13 15:22:21 | | 0007-Breaker 7 | LT Backup Test | 0.80 (360 A) | Band 4 | NA | NA |

Clicking on Generate report, a popup dialog will ask for the selected breaker or all breakers.

**Selected Breaker:** Will open an Excel worksheet and create a tab for the selected breaker breaker.

**All Breakers:** Will open an Excel worksheet and create a tab for each breaker installed and an additional tab for the complete test history.

The breaker report includes the breaker details such as CT Rating and settings for each of the configured relays. The report will also give the latest test data for each of the overcurrent relays.

When the report is run, the Customer Test Kit Application updates the report with the observed trip time and the timestamp of when the test was performed. The application will search the test history and use the last test that matches the test type and test current

**Figure 3-17** Example Test Report

## *Test Report*

| | | | | | |
|---|---|---|---|---|---|
| Date: | Wed, Jun 05, 2013 | Customer | | City | |
| Time: | 8:53 AM | Site | Test Config | Customer PO | |

Peformed by:
Notes:

**Equipment Data:**

| | | | |
|---|---|---|---|
| Breaker Name: | Breaker 7 | Cubicle Number: | 7 |
| Substation: | | Manufacturer: | GE |
| Type: | EG | Serial Number: | |
| Cat: | | Voltage Rating: | 480V WYE |
| Control Voltage Rating: | 120V AC | Phases: | 3 |
| Messenger Cat #: | | Messenger Serial #: | MF0A11000086 |

**Trip Device Data/Settings:**

| | | | |
|---|---|---|---|
| **Topology** | 1 | | |
| Frame Size: | 800 A | Sensor Size: | 800 A |
| Rating Switch Setting: | 450 A | Current Switch Setting: | 0.8 |
| Long Time Delay: | Band 2 | Instantaneous Setting: | NA |
| Short Time Setting: | 2 | Short Time Delay: | Band 6 / I2T Max |
| Ground Fault Setting: | 0.24 | Ground Fault Delay: | Band 3 / I2T ON |
| Under Voltage Pickup | 50.00% | Under Voltage Delay | 30.0 Sec / Const Curve |
| Over Voltage Pickup | 120.00% | Over Voltage Delay | 30.0 Sec |
| Phase Loss Pickup | 8.00% | Phase Loss Delay | 30.0 Sec |
| Reverse Power Pickup | 990 KW | Reverse Power Delay | 30.0 Sec |
| Over Frequency Pickup | 50.0 Hz | Over Frequency Delay | 30.0 Sec |
| Under Frequency Pickup | 45.0 Hz | Under Frequency Delay | 30.0 Sec |
| Under Voltage Alarm Pickup | 50.00% | Under Voltage Alarm Delay | 15.0 Sec / Const Curve |
| Over Voltage Alarm Pickup | 120.00% | Over Voltage Alarm Delay | 15.0 Sec |
| Phase Loss Alarm Pickup | 8.00% | Phase Loss Alarm Delay | 15.0 Sec |
| Reverse Power Alarm Pickup | 990 KW | Reverse Power Alarm Delay | 15.0 Sec |
| Over Frequency Alarm Pickup | 50.0 Hz | Over Frequency Alarm Delay | 15.0 Sec |
| Under Frequency Alarm Pickup | 45.0 Hz | Under Frequency Alarm Delay | 15.0 Sec |
| High Current Alarm Pickup | 200% | High Current Alarm Delay | 15 Sec |

Perform the following tests using the Entellisys Test Kit.

| | Test Settings | | Test Current | | Expected | Measured Delay Time | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pick-up | Delay | % CT | Amps | Delay Time | A | B | C | Ti |
| Long Time | 360.0 A | Band 2 | 81 | 648.0 A | | | | | |
| Short Time | 720.0 A | Band 6 / I2T Max | 99 | 792.0 A | | | | | |
| Instantaneous | NA | NA | NA | NA | | | | | |
| Ground Fault | 192.0 A | Band 3 / I2T ON | 26 | 211.2 A | | | | | |

| | Test Current | Expected Delay Time | Measured Delay Time |
|---|---|---|---|
| Long Time Backup | 612.0 A | 311.4187(239.6367-395.6574) | Test Stopped by operator |
| Short Time Backup | 3888.0 A | 0.4000(0.3840-0.4160) | Backup Trip Not Observed |
| Ground Fault Backup | | | |

| | Test Settings | | Test Value | Expected Delay Time | Measured Delay Time |
|---|---|---|---|---|---|
| | Pick-up | Delay | | | |
| Under Voltage | 50.00% | 0.0 Sec / Const Curv | | | |
| Over voltage | 120.00% | 30.0 Sec | | | |
| Phase Loss | 8.00% | 30.0 Sec | | | |
| Reverse Power | 990 KW | 30.0 Sec | | | |
| Under frequency | 45.0 Hz | 30.0 Sec | | | |
| Over frequency | 50.0 Hz | 30.0 Sec | | | |

| | Test Settings | | Test Value | Expected Delay Time | Measured Delay Time |
|---|---|---|---|---|---|
| | Pick-up | Delay | | | |
| Under Voltage Alarm | 50.00% | 5.0 Sec / Const Curv | | | |
| Over voltage Alarm | 120.00% | 15.0 Sec | 365.8 V | 15.0000(14.9000-15.1000) | Test Completed No Alarm Observed |
| Phase Loss Alarm | 8.00% | 15.0 Sec | | | |
| Reverse Power Alarm | 990 KW | 15.0 Sec | | | |
| Under frequency Alarm | 45.0 Hz | 15.0 Sec | 42.8 Hz | 15.0000(14.9000-15.1000) | Test Completed No Alarm Observed |
| Over frequency Alarm | 50.0 Hz | 15.0 Sec | | | |
| High Current Alarm | 200.00% | 15 Sec | | | |

# 3.6 System Information tab

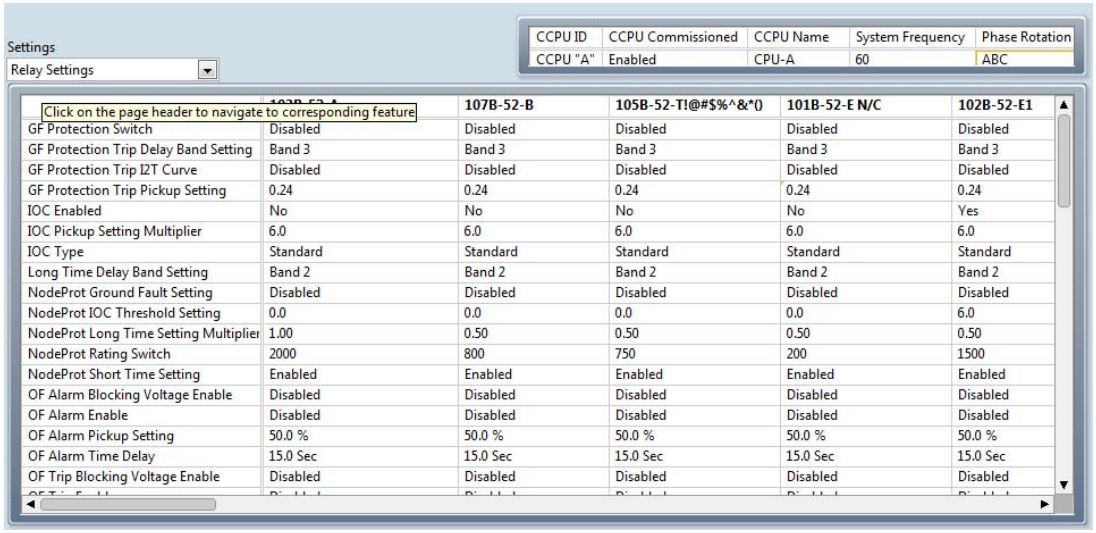
System wide information is available under the **System Information tab** arranged in sections that are selectable from the **Settings** pulldown.

**Messenger Information**: Includes Messenger serial number, MAC address, firmware version, and sensor ratings.

**Relay Settings**: Relay parameters for all single point relays.

**All Settings**: Messenger Information and Relay Information combined

**Figure 3-18** Messenger information



# A Definition of terms

The terms listed and defined are displayed in the Test Kit and are used throughout this guide.

**Table A-1** Definition of terms

| Term | Definition |
|---|---|
| ATT | Automatic Trip Time Test. |
| CT | Current Transformer—a sensor that measures current. There are normally 3 CTs, one for each phase, and an optional neutral CT. |
| CT Compensation | The system is designed to compensate for particular characteristics of the CTs used in the Entellisys System in order to improve accuracy. If a user is testing the system through secondary injection (input into the CT inputs of the EntelliGuard Messenger), then the unique compensation algorithm must be disabled or test results will be incorrect. |
| CT Rating | Rating of connected Current Transformer for that circuit breaker. |
| DAQ | Data Acquisition |
| Fault/Fault Level | The period of time and/or the voltage/current condition during a fault. |
| Flux Shifter | One of two means to actuate the circuit breaker. The flux shifter is used to open (and lockout) the circuit breaker when the CPU or EntelliGuard Messenger issues a trip signal. |
| Frame Rating | Frame Size or Rating of the Circuit Breaker. |
| GF | Ground Fault overcurrent protection function |
| GF Defeat | Some tests like single phase tests, will trigger GF trips unintentionally. Therefore, it may be desirable to disable or defeat GF temporarily during these tests. |
| HC | High Current Alarm protection function |
| HMI | Human Machine Interface |
| IOC | Instantaneous overcurrent protection function |
| LT | Long Time overcurrent protection function |
| Manual Breaker Injection | User must manually setup the circuit breaker configuration and power line characteristics to be injected into the system. Might be desired for a quick test. |
| NAN | Not a number—error message that gets displayed. |
| No Trip Test | A test that does not cause the circuit breaker to trip |
| OF | Over frequency relay protection function |
| OV | Overvoltage relay protection function |

**Table A-1** Definition of terms

| Term | Definition |
|---|---|
| Phase or Phase Angle | Phase angle rotation that can be set from test kit. Range of Phase angle is –360° to +360°. |
| PL | Phase Loss relay protection function |
| Post-Fault / Post-Fault Level | The period of time or the voltage/current condition following a fault. |
| PR | Power Reversal relay protection function |
| Pre-Fault / Pre-Fault Level | The period of time and/or the voltage/current condition preceding a fault. |
| PT Rating | Rating of Potential Transformer of the circuit breaker. |
| Rating Switch | Rating switch value of the circuit breaker. |
| RMS | Root Mean Square—calculation used to measure voltage or current. |
| Secondary Injection | Current (and voltage) injection into the system through the CT (and PT) connections of the EntelliGuard Messenger. |
| Shunt Trip | One of two means to actuate the circuit breaker. Shunt trip is used to open the circuit breaker when users manually open the circuit breaker from the HMI. |
| ST | Short Time overcurrent protection function |
| Trip Test | A test that causes the circuit breaker to trip |
| Trip Time Curve | Trip time curve of the connected circuit breaker for different protection schemes. |
| UF | Under frequency relay protection function |
| USB | Universal Serial Bus |
| UV | Undervoltage relay protection function |