

**AC CIRCUIT BREAKER TEST SET
OPERATOR'S MANUAL
Version 1.3**

MODEL HC-12C (240/480V)

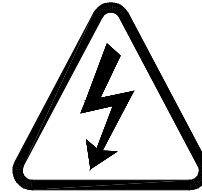
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GENERAL SAFETY PRECAUTIONS



CAUTION



HIGH VOLTAGE

This equipment is capable of providing POTENTIALLY LETHAL VOLTAGES! Improper operation or test practices may result in injury or death to the operator or surrounding personnel.

The operation of High Voltage test equipment should only be performed by personnel familiar with HIGH VOLTAGE testing and safety procedures. The operator of this equipment must be aware of all hazards associated with High Voltage testing. The operator is responsible for himself and others in close proximity of the testing area.

Some General Safety Practices for working with High Voltage Test Equipment have been listed below for your reference.

- Get familiar with your instrument before performing an actual test
- Know your work area, check that all circuits are de-energized and locked out.
- Never work alone; always work with another qualified worker.
- Mark off entire work area with barriers and warning tape.
- Make all personnel aware of your testing activities.
- Be aware of dangerous conditions that may arise from energizing a test specimen.
- Never modify test equipment, modifications to equipment could introduce an unknown hazard or hinder a designed-in safety feature.
- DO NOT operate damaged equipment. Remove power, and do not use the equipment until safe operation can be verified by service-trained personnel.

Phenix Technologies, Inc. assumes no liability for unsafe or improper use of test equipment.

SPECIFICATIONS

Input: 240 / 480 VAC, 60 Hz, 80 / 40 AAC
400 V, 50 Hz, 40 AAC

(Note: The above current levels are based on the 30 minute duty cycle. To estimate the current draw on the facility power at different duty cycles, multiply the above currents by the ratio of the output currents. Ex.: An HC-75C will draw approximately 7.5 times the above current at the 1 second duty cycle.)

Output:

| OUTPUT CURRENT SPECIFICATIONS (PARALLEL CONNECTION) | | | | |
|--|--------------------------------|---------------------------------|----------------------------------|------------|
| DUTY CYCLE | 1 Second ON / 2 Minutes OFF | 1 Minute ON / 10 Minutes OFF | 30 Minute ON / 30 Minutes OFF | Continuous |
| HC-12C | 12,000 A | 2,500 A | 1,700 A | 1,200 A |
| HC-20C | 20,000 A | 4,500 A | 3,000 A | 2,000 A |
| HC-40C | 40,000 A | 9,000 A | 6,000 A | 4,000 A |
| HC-75C | 75,000 A | 15,000 A | 10,000 A | 7,500 A |

**Note: The HC-C Controller will impose a shutdown and a 5-minute off time if one of the above limits is exceeded.*

| OUTPUT CURRENT SPECIFICATIONS (SERIES CONNECTION) | | | | |
|--|--------------------------------|---------------------------------|----------------------------------|------------|
| DUTY CYCLE | 1 Second ON / 2 Minutes OFF | 1 Minute ON / 10 Minutes OFF | 30 Minute ON / 30 Minutes OFF | Continuous |
| HC-12C | 6,000 A | 1,250 A | 850 A | 600 A |
| HC-20C | 10,000 A | 2,250 A | 1,500 A | 1,000 A |
| HC-40C | 20,000 A | 4,500 A | 3,000 A | 2,000 A |
| HC-75C | 37,500 A | 7,500 A | 5,000 A | 3,750 A |

**Note: The HC-C Controller will impose a shutdown and a 5-minute off time if one of the above limits is exceeded.*

| OUTPUT VOLTAGE SPECIFICATIONS (OPEN CIRCUIT) | | | | | |
|---|---------------|-----------------|---------------|-----------------|-------------------|
| Connection / Frequency | Series / 60Hz | Parallel / 60Hz | Series / 50Hz | Parallel / 50Hz | Number of Taps |
| HC-12C | 15 V | 7.5 V | 12.5 V | 6.25 V | 3 |
| HC-20C | 20 V | 10 V | 16.6V | 8.3 V | 4 |
| HC-40C | 24 V | 12 V | 20 V | 10 V | 6 |
| HC-75C | 32 V | 16 V | 26.6 V | 13.3 V | 8 |

SPECIFICATIONS

Instrumentation:

Currentmeter: Resolution: 0.1% of Full Scale
Ranges: 100/1000/10,000/100,000 Amps
Accuracy: 0.8% rdg + 0.3% range
 $\pm 5\%$ of Full Scale 0.02 – 0.10 Seconds

Timer: Resolution: 0.002 Seconds
0.120 Cycles
Ranges: 0 - 999.999 Seconds
0 - 99,999.990 Cycles

Test durations of less than 10 cycles
Timer Accuracy: ± 0.004 Seconds
 ± 0.250 Cycles

Test durations of greater than 10 cycles
Timer Accuracy: ± 0.010 Seconds
 ± 0.600 Cycles

INTRODUCTION

Phenix Technologies' High Current Test Sets represent a new era of electrical testing technology. This design is based on time-proven concepts and the power offered by an embedded 32-bit microcomputer.

High reliability SCR's have been combined with a phase angle firing system to deliver precisely repeatable current pulses with minimal distortion.

The output is continuously variable over the entire range by means of tap selection and vernier adjustment. Utilizing a motorized vernier and programmable tap selector, the test set has both auto-jog and current-hold capabilities. These features can be controlled from the HC Controller User Interface Panel, or from a Laptop computer plugged into the HC Controller's serial port.

The test set incorporates a standard measurement and control interface that is operated with special cards installed in an embedded computer system, under software control. The combination of automated hardware and a highly intelligent monitor/controller provides an extremely versatile test instrument capable of exceptional accuracy. This combination also allows for the manual control or remote computer control of the High Current Test Set.

SAFETY

Several safeguards have been built into the Phenix Technologies high current test set, however, these safeguards are only effective if safe work practices are also used. The test set and these procedures have been designed for use by knowledgeable electrical workers who have been properly trained in its use.

Please note the following:

1. The test set must be grounded before input power is connected.
2. All power must be disconnected before the test set is ungrounded.
3. The tests described here are to be used only on DE-ENERGIZED and isolated circuit breakers.
4. High currents are generated during the tests and extreme caution must be used. Follow all safety procedures.
5. See section 5 for Installation Instructions.

INSTALLATION INSTRUCTIONS

1. Position the test set in the desired position. For 2-cabinet units, place the regulator cabinet on top of the transformer cabinet.

The following procedure is only required for 2-cabinet units (HC-12C and HC-20C):

- 1a. Connect the interconnect ground cable from the regulator cabinet to the transformer cabinet.
- 1b. Connect the four interconnect power leads from the regulator cabinet to the transformer cabinet, connecting B1 to B1, B2 to B2, ...
- 1c. Connect the control interconnect cable from CON208 on the regulator cabinet to CON209 on the transformer cabinet.

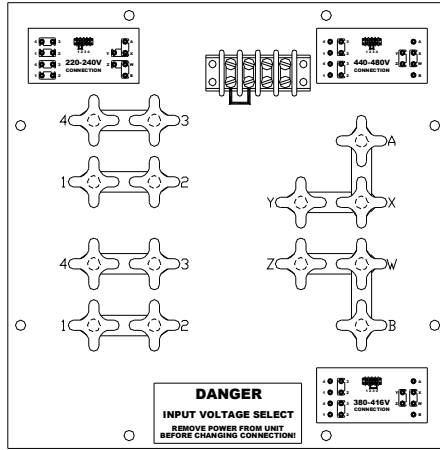
The following procedure is only required for models HC-12C, HC-20C and HC-40C:

- 1d. Check the input power jumper configuration in both the Regulator and Transformer cabinet. It is *VERY* important that these are set correctly. See the tag on the inside panel of the unit and the following page.
2. Connect a #4 AWG ground cable from a good electrical ground to CON201 (green Cam-Lock connector). An additional ground stud is provided on the transformer cabinet for an optional connection of an external ground cable.
3. Position the HC Controller (on top of the cabinet works well) and connect the computer interconnect cable. Take special care not to pinch or damage the interconnect cable. Next, plug the HC Controller into the provided ground fault outlet and position all wires and cables behind the controller to prevent catching or snagging during movement.
4. Ensure that the main input circuit breaker (CB201), control power switch (SW201) and vernier circuit breaker (CB202) are all in the OFF position.
5. Connect the input power cables to CON202 and CON203 (black Cam-Lock connectors), and then to the facility power. See the Specifications section for input ratings. Generally, cable sized thermally for the current listed in the specifications (30 minute duty) is sufficient.
6. Perform the Power On Procedure as described on page 6-1.

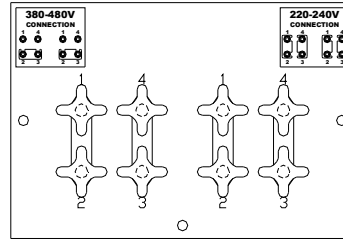
INSTALLATION INSTRUCTIONS

HC-12C, HC-20C, and HC40C INPUT POWER JUMPER CONFIGURATIONS:

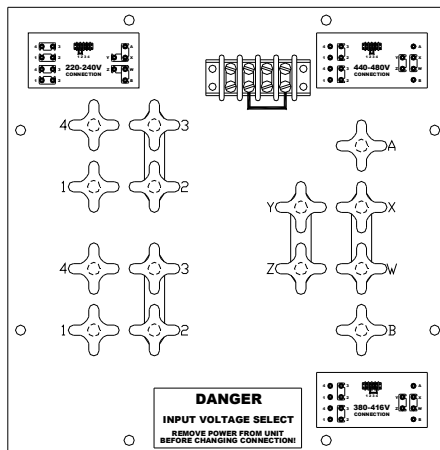
REGULATOR (TOP) CABINET 220-240V CONNECTION



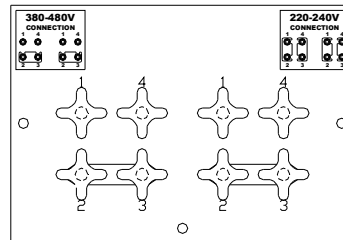
TRANSFORMER (BTM) CABINET 220-240V CONNECTION



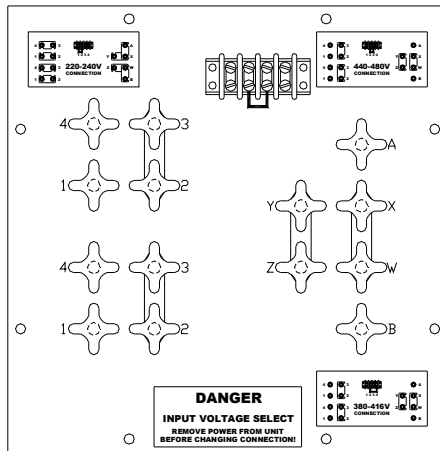
REGULATOR (TOP) CABINET 380-416V CONNECTION



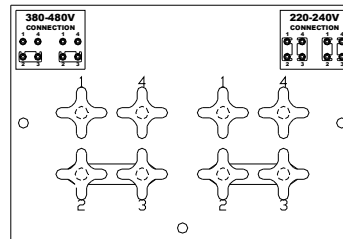
TRANSFORMER (BTM) CABINET 380-480V CONNECTION



REGULATOR (TOP) CABINET 440-480V CONNECTION



TRANSFORMER (BTM) CABINET 380-480V CONNECTION



POWER ON PROCEDURE

1. Ensure proper connection of the test set and its components as described in the Installation Instructions, Section 5.
2. Ensure that CB201, CB202 and the CONTROL POWER switch (SW201) are in their OFF positions.
3. Energize the facility power distribution breaker. (Input Power lamp should illuminate.)
4. Turn the control power ON (SW201). The Control Power lamp should illuminate and the HC Controller will automatically start the HC Operating Software.
5. Follow the outlined test procedure(s) in Section 9.

WARNING: To ensure safe operation, breaker CB201 should be opened prior to any connections being made to the output stabs on the test set. CB201 may then be closed after the connections are complete.

POWER OFF PROCEDURE

1. Ensure that the output is OFF.
2. Switch CB201 (main input circuit breaker) OFF.
3. Switch CB202 (vernier circuit breaker) OFF.
4. Switch the control power OFF (SW201).
5. De-energize the facility power distribution breaker.
6. Disconnect the test set as required.

WARNING: Connecting or disconnecting the controller with power applied may damage test set and/or controller.

POWER SECTION DESCRIPTION

Fuses and Circuit Breakers

The single phase input power enters the regulator through CON202 and CON203 and is immediately connected to CB201. Circuit breaker CB201 protects the main power section and is equipped with an under-voltage release coil. The under-voltage release coil is wired so that if an interlock opens, the main circuit breaker will open and disable the power section.

Circuit breaker CB202 protects the output of the variable transformer, T202A/B, and the input to transformer Primary #1 of the main transformer T301.

Fuses F201 and F202 provide control power transformer protection. Fuse F203 protects the 120 V control circuits and F204 protects the vernier motor controller.

Interlock Circuit

The interlock circuit is a safety mechanism that prevents the high power section from operating under unsafe conditions. The following conditions must exist to close the interlock:

1. Control power must be on.
2. The computer controller must be on, out of reset, and running the HC software. If the controller is displaying INTERLOCK or OVERTEMP, the interlock will not close.
3. CB202 must be in the ON position.
4. The Emergency Off mushroom switch must not be pressed. (Ensure that it is pulled out.)

After the interlock circuit is closed, the panel INTLK light will go out and allow the main circuit breaker CB201 to be reset.

Triggering

An SCR Trigger board, PCB201, turns the high current output ON when signaled by the HC Controller. The trigger board receives its command from the HC Controller via an I/O interface PC board, PCB202. The HC Controller precisely controls the phase angle and duration of the output waveform.

POWER SECTION DESCRIPTION

Taps and Variable Transformer

To achieve a variable output from minimum to maximum, a system of taps and a motorized variable transformer are employed. The tap selects the coarse range of the output and the variable transformer controls the output from the 'top' of the previous tap to the maximum of the selected tap. The HC Controller controls all of the taps and the motorized variable transformer. This method makes possible the current hold and auto-jog functions.

A potentiometer is accessible on the front panel for varying the speed of the motorized variable transformer.

All transformers and regulators are equipped with several thermocouples and a thermistor to monitor and protect against an over-temperature condition. The output of the thermistor is fed back to the computer controller in order to constantly monitor the temperature. In addition to these safeguards, the SCR heatsink is forced-air cooled to provide lower operating temperature and a longer service life.

Metering

There is a precision current transformer employed in the high current section to measure the output current. This transformer is placed directly around the output bus.

Output Stabs

The stabs are designed to be versatile and facilitate connection to a large variety of circuit breakers. They are nickel plated for greater conductivity and a long service life.

The output stabs can be configured for parallel or series connection:

Parallel output connection is achieved by using the supplied stabs to short H1 to H2 for one output connection and L1 to L2 for the other output connection.

Series connection is achieved by shorting L1 to H2 and connecting the breaker to H1 and L2. A series connection link is available as an option.

Continuity

Located near the output stabs are the continuity binding posts. These posts can be connected to an unused pole of the breaker or an auxiliary contact. This allows the use of the Normally Closed or Normally Open test modes by the test set.

If the continuity connections cannot be used (i.e. a single-phase breaker), the set must be operated in the Current Latch mode.

CAUTION:

DO NOT CONNECT CONTINUITY TERMINALS TO ENERGIZED SOURCE.

DAMAGE TO CONTROLLER WILL OCCUR!

POWER SECTION DESCRIPTION

The following is a brief description of the various parts of the HC test set.

| | | |
|----|--|---|
| 1 | HC Controller | Performs all monitoring and control functions for the HC Test Set. |
| 2 | Input Power Indicator, LMP201 | Indicates that Input Power is applied to the test set. |
| 3 | Control Power Switch, SW201 | Applies 120-Volt AC Power to all of the controls in the test set. |
| 4 | Fuse, F201,202 | Provides overload protection for the primary side of the control power transformer T201. |
| 5 | Fuse, F203 | Provides overload protection for the secondary side of the control power transformer T201. |
| 6 | Fuse, F204 | Provides overload protection for the vernier motor controller. |
| 7 | Variable Transformer Circuit Breaker, CB202 | Provides overcurrent protection for the variable transformer output brushes. This circuit breaker must be energized for INTLK to be cleared. |
| 8 | Main Circuit Breaker, CB201 | Applies Input Power to the transformers and relays. An under-voltage safety release is tied to the interlock circuit for safety purposes. If the interlock light is lit on the front panel, then the main circuit breaker cannot be turned on. If, during the operation of the test set, the interlock opens, the main circuit breaker will trip. |
| 9 | Emergency Off Button, SW202 | De-energizes the output and the main circuit breaker. Control power will remain energized. Also part of the interlock circuit. |
| 10 | Control Power Indicator, LMP203 | Indicates internal 120-Volts AC power has been energized. |
| 11 | Output On Indicator, LMP202 | Indicates that the output of the HC test set is energized. |
| 12 | Interlock Open Indicator, LMP204 | Indicates that the safety interlock is not reset. The main breaker cannot be turned on when this indicator is illuminated. |
| 13 | Chassis Ground Terminal | Connect to the facility ground with the Ground Cable (see #15) |
| 14 | Main Input Power Cables | Connect appropriate power to the test set. |
| 15 | Ground Cable | Connect between the Chassis Ground Terminal and the facility ground. |
| 16 | Output Stabs | Connection to the circuit breaker under test. |
| 17 | Continuity Binding Post | For use in contact mode, i.e. Normally Closed or Normally Open. |
| 18 | Regulator Speed Control | Controls the vernier speed. |

HC CONTROLLER DESCRIPTION

The HC Controller consists of a PC-104 stack 32-bit computer with a special solid-state memory storage capability, an industry standard Analog-to-Digital Conversion (ADC) board, and a custom printed circuit board utilizing a Complex Programmable Logic Device (CPLD) used for interfacing. The HC Controller User Interface Panel consists of twenty LED's for status signaling, seventeen keys for input and control, a four line by twenty-character LED backlit Liquid Crystal Display (LCD), a parallel printer output port, a serial communications port, and a single outlet for plugging in a laptop computer. Software is stored in a solid-state Disk-On-Chip device located on the 32-bit computer board. This feature will allow for very simple modifications and upgrades in the future.

The main alphanumeric display of the HC Controller indicates the following:

- Output Current
- Number of seconds or cycles
- Measured voltage
- Temperature of transformer
- Tap selection
- Vernier position
- Test mode

The LED indicators will signal the following:

- Output On/Off
- Breaker Open/Closed
- Continuity On/Off
- N.O./N.C./Current Latch contacts
- Parallel/Series connection
- 100A / 1kA / 10kA / 100kA current range
- Input/Output/External voltage sense
- Cycles/Seconds timer

HC CONTROLLER DESCRIPTION

A menu of commands is accessible by pressing the key for the command. The controls and commands keys are as follows:

| | FUNCTION | ALTERNATE | DESCRIPTION | INDICATOR |
|----|--------------------|----------------|---|-----------|
| 1 | CONNECT MODE | (none defined) | Toggles between Parallel and Series connections | LED |
| 2 | CONTACTS | (none defined) | Selects contact type: N.O. / N.C. / CURRENT LATCH | LED |
| 3 | CURRENT RANGE | (none defined) | Selects current range: 100/1k/10k/100k Amps | LED |
| 4 | JOG | (none defined) | Briefly turns on the output and then turns it off | BOTH |
| 5 | MENU | (none defined) | Displays the menu selections on the LCD | LCD |
| 6 | PRINT | PRINT | Prints the current results in memory to the printer | LCD |
| 7 | RESET | RESET | Clears system and stops the output | BOTH |
| 8 | START | ACCEPT | Starts the output OR Accept the request/data | BOTH |
| 9 | STOP | CANCEL | Stops the output OR Declines the request/data | BOTH |
| 10 | TAP DOWN | SCROLL DOWN | Selects the next lower Tap OR Scrolls down | LCD |
| 11 | TAP UP | SCROLL UP | Selects the next higher Tap OR Scrolls up | LCD |
| 12 | TEST MODE | (none defined) | Toggles through the various test modes | LCD |
| 13 | TIMER | (none defined) | Toggles the timer between Seconds and Cycles | BOTH |
| 14 | SAVE TEST | (none defined) | Transfer data through the RS-232 port to the Laptop | LAPTOP |
| 15 | VERNIER DOWN | ADJUST DOWN | Moves vernier down OR adjust field down | LCD |
| 16 | VERNIER UP | ADJUST UP | Moves vernier up OR adjust field up | LCD |
| 17 | VOLTS AC SELECT | (none defined) | Selects Input, Output, or External voltage source (OPTION) | BOTH |

* Note: Alternate Key Functions are only active in the Menu Mode.

MENU MAP

| | |
|-------------|--|
| Max Amps | MENU ► LIMITS ► MAX AMPS |
| Max Seconds | MENU ► LIMITS ► MAX DURATION ► MAX SECONDS |
| Max Cycles | MENU ► LIMITS ► MAX DURATION ► MAX CYCLES |
| On Cycles | MENU ► JOG / HOLD ► ON CYCLES |
| Off Seconds | MENU ► JOG / HOLD ► OFF SECONDS |
| Hold Amps | MENU ► JOG / HOLD ► HOLD AMPS |
| Phase Angle | MENU ► SYSTEM ► PHASE ANGLE |
| Hardware | MENU ► SYSTEM ► HARDWARE |

MENU SCREEN NAVIGATION INSTRUCTIONS:

- The current menu selection is bracketed by > X123 <.
- To select a different item in a menu, press the TAP UP (SCROLL) or the TAP DOWN (SCROLL) keys. The next line will then be selected.
- To adjust a numerical value, press VERNIER UP / DOWN (ADJUST) keys for fine adjustment or the TAP UP / DOWN (SCROLL) keys for coarse adjustment (if available).
- To select a menu choice, press the START (ACCEPT) key.
- To exit the menu screen without making any changes, press the STOP (CANCEL) key.

HC CONTROLLER DESCRIPTION

LED's

At power up the, the test set will be placed into a safe mode of operation. The following LED's will be illuminated:

Output Off
 Breaker Open
 Continuity Off
 N. C.
 Parallel
 100 A
 Input
 Seconds

MAIN OPERATING SCREEN

LCD

| | | | | |
|-----------|-------|---------|-----|-------|
| 0 . 0 | A | 0 . 0 | 0 0 | S e c |
| | | | 7 5 | C |
| T a p : | 1 | V e r : | 0 | % |
| M o d e : | N o r | m a l | | |

1. Output Currentmeter: Displays the current to the device under test.
2. Timer: Displays the trip time in Seconds or the number of Cycles elapsed in the test. This can be toggled between the two states by pressing the TIMER key.
3. Voltmeter: Displays the selected voltage. The voltage is selected by pressing the VOLTS AC SELECT key. This will cycle through the Input, Output, and an External voltage sense.
4. Temperature Meter: Displays the primary winding temperature of the high current transformer, T301. This temperature must be less than 75°C for the unit to operate.
5. Tap Display: Displays the current Tap selection. This can be adjusted by pressing the TAP UP or TAP DOWN keys.
6. Vernier Position Indicator: Displays the position of the variable transformer wiper arm as a percent of maximum. The output voltage range of the variable transformer varies from minimum to maximum for each tap resulting in a continuously variable total output voltage. This can be adjusted by pressing the VERNIER UP or VERNIER DOWN keys.
7. Circuit Breaker Test Mode: Displays the type of test being performed: Normal, Jog to Hold, Jog to Trip, Current Hold, and Memory. Select the test mode by pressing the TEST MODE key.

HC CONTROLLER DESCRIPTION

MENU SCREENS

Main Menu

```

* *   M a i n   M e n u   * *
> L i m i t s           <
  J o g   /   H o l d
  S y s t e m

```

- This screen is reached by pressing the MENU key.
- See the menu screen navigation instructions at the beginning of this section.

Limits Screen

```

* * *   L i m i t s   * * *
> M a x   A m p s           <
  M a x   D u r a t i o n

```

- This screen is reached by selecting MENU ► LIMITS.
- See the menu screen navigation instructions at the beginning of this section.

Max Amps Screen

```

M a x   A m p s :   # # # # #

```

- This screen is reached by selecting MENU ► LIMITS ► MAX AMPS.
- See the menu screen navigation instructions at the beginning of this section.
- Fine adjust in increments of 50, Coarse adjust in increments of 1,000.
- Min Value = 1,000
- Max Value is dependent on the model of HC Test set.
This value is equal to the current specified at the 1 second duty of the specific model. (See Specifications)

HC CONTROLLER DESCRIPTION

MENU SCREENS

Max Duration Screen

```

* *   D u r a t i o n   * *
> M A x   S e c o n d s   <
M A x   C y c l e s

```

- This screen is reached by selecting MENU ► LIMITS ► MAX DURATION.
- See the menu screen navigation instructions at the beginning of this section.

Max Seconds Screen

```

M a x   S E c o n d s :   O f f

```

- This screen is reached by selecting MENU ► LIMITS ► MAX DURATION ► MAX SECONDS.
- See the menu screen navigation instructions at the beginning of this section.
- Fine adjust in increments of 1, Coarse adjust not available
- Min Value = 0 Max Value = 360

Max Cycles Screen

```

M a x   C Y c l e s :   O f f

```

- This screen is reached by selecting MENU ► LIMITS ► MAX DURATION ► MAX CYCLES.
- See the menu screen navigation instructions at the beginning of this section.
- Fine adjust in increments of 1, Coarse adjust not available
- Min Value = 0 Max Value = 21,600

HC CONTROLLER DESCRIPTION

MENU SCREENS

Jog / Hold Screen

```

* *   J o g   /   H o l d   * *
> O n   C y c l e s   <
O f f   S e c o n d s
H o l d   A m p s

```

- This screen is reached by selecting MENU ► JOG / HOLD.
- See the menu screen navigation instructions at the beginning of this section.

On Cycles Screen

```

O n   C y C l e s :   5

```

- This screen is reached by selecting MENU ► JOG / HOLD ► ON CYCLES.
- See the menu screen navigation instructions at the beginning of this section.
- Fine adjust in increments of 1, Coarse adjust not available
- Min Value = 3 Max Value = 60

Off Seconds Screen

```

O f f   S E c o n d s :   2

```

- This screen is reached by selecting MENU ► JOG / HOLD ► OFF SECONDS.
- See the menu screen navigation instructions at the beginning of this section.
- Fine adjust in increments of 1, Coarse adjust not available
- Min Value = 1 Max Value = 60

Hold Amps Screen

```

H o l d   A m p s :   # # # #

```

- This screen is reached by selecting MENU ► JOG / HOLD ► HOLD AMPS.
- See the menu screen navigation instructions at the beginning of this section.
- Fine adjust in increments of 50, Coarse adjust in increments of 1,000.
- Min Value = 50
- Max Value is dependent on the model of HC Test set. This value is equal to the current specified at the 1 second duty of the specific model. (See Specifications)

HC CONTROLLER DESCRIPTION

MENU SCREENS

System Screen

```

* * *   S y s t e m   * * *
> P h a s e   A n g l e   <
  H a r d w a r e

```

- This screen is reached by selecting MENU ► SYSTEM.
- See the menu screen navigation instructions at the beginning of this section.

Phase Angle Screen

```

P h a s e :   9 0

```

- This screen is reached by selecting MENU ► SYSTEM ► PHASE ANGLE.
- Fine adjust in increments of 1, Coarse adjust not available
- Min Value = 1 Max Value = 300

Hardware Screen

```

E n t e r   P a s s w o r d
< R e s e t   t o   C a n c e l >

```

- This screen is reached by selecting MENU ► SYSTEM ► HARDWARE.
- A Password is required to enter this menu area. Contact Phenix Technologies for access to this area.
- Press the RESET key to exit this screen without making any changes.

VOLTMETER

The voltmeter provides convenient panel display of input voltage, output voltage, or an external voltage connected to the binding posts near the output panel. The value displayed is TRUE RMS VOLTS AC.

To use, select the desired sensing mode (INPUT, OUTPUT, or EXTERNAL) by pressing the VOLTS AC SELECT key. The metering system is auto ranging.

TESTING PROCEDURE

WARNING: *To insure safe operation, breaker CB201 should be opened prior to any connections being made to the output stabs on the test set. CB201 may then be closed after the connections are complete.*

FACTORY SETTINGS

The following chart shows the factory settings. These are provided as a reference, as many of these will change with each test set-up.

| | | |
|-----------------|-------------|-------|
| LIMITS MENU | MAX AMPS | 12000 |
| | MAX SECONDS | OFF |
| | MAX CYCLES | OFF |
| JOG / HOLD MENU | ON CYCLES | 5 |
| | OFF SECONDS | 1 |
| | HOLD AMPS | 50 |
| SYSTEM MENU | PHASE ANGLE | 90 |

GENERAL SETTINGS

The following settings are the general limit settings of the high current test set. The limits set here are used as absolute limits that over-ride all other test settings, and therefore should be set high enough (or OFF) not to interfere with individual test settings or requirements.

- Select MENU ► LIMITS ► MAXIMUM AMPS. Set the maximum current allowed on the output of the test set. Factory setting / maximum setting is based on the 1 second rating of the specific model. This may be set to a lower value, if required, to limit the current that can be applied to a breaker during JOG to TRIP testing in case the breaker does not open at the expected value.
- Select MENU ► LIMITS ► MAXIMUM SECONDS. Set the maximum amount of time the output can be energized. If set to Off, MAXIMUM SECONDS protection will be disabled.
- Select MENU ► LIMITS ► MAXIMUM CYCLES. Set the maximum number of cycles for which the output can be energized. If set to Off, MAXIMUM CYCLES protection will be disabled.

CONNECTION NOTE

If using cables to connect the circuit breaker under test to the output stabs, twisting of the high current output and return cables together will reduce the impedance of the loop, which will increase the output capability of the set-up. Twisting the cables will also help to reduce noise on the current measurement.

SAVING RESULTS

After a test is performed and while test results are still displayed, press the SAVE RESULTS key. A laptop running the WinHC PC software package (see section 12) must be connected via the HC Controller's serial port.

TESTING PROCEDURE

BASIC OPERATION

The following basic steps should be followed to test a circuit breaker after the POWER ON procedure in Section 6:

1. Ensure that the test set's main circuit breaker, CB201, is open.
2. Connect the breaker under test to the output of the test set. Ensure the output is configured correctly (either Parallel or Series connection) and the HC Controller's Connection setting (indicated by LED's on the HC Controller's User Interface panel) matches the configuration. Also see *CONNECTION NOTE* on page 9-1.
3. If required, select the voltmeter sensing mode (INPUT, OUTPUT, or EXTERNAL) by pressing the VOLTS AC SELECT key. The metering system is auto ranging.
4. Switch CB202 ON (if previously opened), then switch CB201 ON.
5. Ensure that Tap 1 is selected and the Vernier is at approximately 1%. Alternately, the Vernier and Tap may be set closer to their final positions, if known, to limit the time to reach a specific current level.
6. Press CONTACT to select the method of breaker trip sense. Select either Normally Open (N.O.), Normally Closed (N.C.), or Current Latch (CURRENT LATCH) Contacts Mode. The selected mode is indicated by one of three LED's next to the Contacts button on the HC Controller's User Interface Panel. If using N.C. or N.O. sense, connect the continuity sense leads to an unused set of contacts on the breaker under test. *The N.O. and N.C. modes offer more reliable trip timing than Current Latch, and should be used whenever possible (i.e. multi-phase breakers).*
7. Press the CURRENT RANGE key to select the current range. For best resolution, select the lowest appropriate range for the expected current. *The test set will auto-range up if the output current exceeds the selected range and Range Error will be displayed on the LCD. If this occurs, the test should be performed again to obtain a correct current measurement.*
8. Press TEST MODE to select the desired mode of operation. The currently selected test mode will be displayed on the bottom line of the LCD. The available test modes are as follows:
 - NORMAL MODE In this mode, the test technician controls all of the functions.
 - MEMORY MODE This mode retains the test results after the output is manually turned off (without the breaker tripping) to allow saving of the test results. It is used for tests that do not cause the breaker to trip, for example, performing a minimum pickup test, where the output is slowly increased until the minimum pickup indicator illuminates.
 - JOG to TRIP This mode is used for determining the instantaneous trip point of the circuit breaker under test.
 - JOG to HOLD This mode is used to reach a desired breaker holding current with minimal breaker stress.
 - CURRENT HOLD This mode is used to maintain a preset current value for a long period of time.
9. Press MENU to access the Menu Screen and to input the test parameters. See the specific procedures for the different Test Modes on the next few pages.

TESTING PROCEDURE

NORMAL MODE

After performing the steps under *BASIC OPERATION*, follow the steps below to operate in Normal Mode.

1. The menu settings that affect operation during NORMAL mode depend upon whether the START key or JOG key is to be pressed to initiate the output.

START: Only the MAX AMPS, MAX DURATION and MAX CYCLES settings under the LIMITS menu effect the output level and duration. See GENERAL SETTINGS at the beginning of this section.

JOG: In addition to the general settings, the JOG / HOLD - ON CYCLES determine the output duration.

Select MENU ► JOG / HOLD ► ON CYCLES. Enter the number of cycles that the output will be energized. This should be long enough to get a good reading, but short enough to avoid overheating. Phenix Technologies recommends a value of 5 cycles.
2. Ensure that the status indicator LED's indicate that the Breaker is CLOSED.
3. Press either the START key or JOG key to initiate the test.
 - A. If the START key is pressed, the output will stay ON until either the operator presses STOP, the circuit breaker trips, or the MAX DURATION or MAX CYCLES is reached. Use the Vernier and Tap controls to reach the desired output.
 - B. If the JOG key is pressed, the output will pulse ON for the ON CYCLES time. The current-meter will read the value of the current pulse, and the timer will read the duration in seconds or cycles, as selected on the HC Controller's User Interface panel. Use the Vernier and Tap controls to reach the desired output. Pressing JOG again will initiate the output and record new data. The currentmeter and timer may be reset by pressing the RESET key.
4. Optional - Save Results – See page 9-1. Data is only displayed if the circuit breaker trips (START key was pressed.) or if the JOG key was pressed.

MEMORY MODE

Similar to NORMAL Mode operation, except the data is retained when the output is turned off manually. Press Reset to clear the data.

TESTING PROCEDURE

JOG to TRIP MODE

After performing the steps under *BASIC OPERATION*, follow the steps below to perform the Jog to Trip function.

1. Select MENU ► JOG / HOLD ► ON CYCLES. Enter the number of cycles that the output will be energized. This should be long enough to get a good reading and at least twice the expected instantaneous trip time, but short enough to avoid overheating. Phenix Technologies recommends a value of 5 cycles. Be sure to press START (Accept) to record the setting.
2. Select MENU ► JOG / HOLD ► OFF SECONDS. Enter the time period that the regulator will increase its output with the output of the test set de-energized. The OFF Seconds should be long enough to move the Vernier a reasonable amount, such as 1 to 2 seconds, but not so long that the current increment is too coarse. The setting of the Regulator Speed Control also must be adjusted in conjunction with the OFF SECONDS to prevent too much / too little travel during the OFF time. Be sure to press START (Accept) to record the setting.
3. Select MENU ► LIMITS ► MAXIMUM AMPS. Set the maximum current allowed on the output of the test set. Factory setting / maximum setting is based on the 1 second rating of the specific model. If desired, the MAXIMUM AMPS may be set to a lower value to limit the current if the breaker does not trip at the expected value. Typically set at 20% higher than the expected trip current. Be sure to press START (Accept) to record the setting.
4. Return to the Main Operating screen by pressing the STOP (CANCEL) key several times (from the LIMITS or JOG/HOLD menu screen).
5. Ensure that the status indicator LED's indicate that the Breaker is CLOSED.
6. Press the START key to begin the test.
7. The test set will automatically increase the current until the breaker trips. Press the STOP key to stop the test at any time.
8. Optional - Save Results – See page 9-1.

TESTING PROCEDURE

JOG to HOLD MODE

After performing the steps under *BASIC OPERATION*, follow the steps below to perform the Jog to Hold function.

1. Select MENU ► JOG / HOLD ► HOLD AMPS. Enter the desired output current set-point. This is the current that the test set will 'jog' to. Be sure to press START (Accept) to record the setting.
2. Select MENU ► JOG / HOLD ► ON CYCLES. Enter the number of cycles that the output will be energized. This should be long enough to get a good reading, but short enough to avoid overheating. Phenix Technologies recommends a value of 5 cycles. Be sure to press START (Accept) to record the setting.
3. Select MENU ► JOG / HOLD ► OFF SECONDS. Enter the time period that the regulator will increase its output with the output of the test set de-energized. The OFF Seconds should be long enough to move the Vernier a reasonable amount, such as 1 to 2 seconds, but not so long that the current increment is too coarse. The setting of the Regulator Speed Control also must be adjusted in conjunction with the OFF SECONDS to prevent too much / too little travel during the OFF time. Be sure to press START (Accept) to record the setting.
4. Return to the Main Operating screen by pressing the STOP (CANCEL) key several times (from the LIMITS or JOG/HOLD menu screen).
5. Ensure that the status indicator LED's indicate that the Breaker is CLOSED.
6. Press the START key to begin the test.

Note: If the regulator speed is set too high, the test set may overshoot the set-point and will be constantly adjusting the variable transformer to try to obtain the set-point current. If this occurs, use the speed control knob on front panel to decrease the regulator speed until the variable transformer movement is acceptable.

If the desired current is obtained at a low Tap and Vernier position, it may be impossible to hold the set value accurately. Better results can be obtained by adding impedance (such as longer cables), to raise the Tap and Vernier settings.

7. The test set will automatically increase the current up to the HOLD AMPS setting. The output turns off when the HOLD AMPS setting is reached. Press the STOP key to stop the test at any time.

To continue with a long time test, perform the following:

8. Select either the CURRENT HOLD mode or the NORMAL mode by pressing the TEST MODE key.
 - CURRENT HOLD mode will constantly adjust to hold the specified current. (Recommended)
 - NORMAL mode will not adjust the output, and the effects of heating and input line fluctuations will affect the output current. The operator must make any adjustments required to maintain current at the HOLD AMPS set-point.
9. Press the START key to energize the output. Press the STOP key to stop the test at any time.
10. The test set will hold the current until the breaker trips or the operator interrupts the test.
11. Optional - Save Results – See page 9-1.

TESTING PROCEDURE

CURRENT HOLD MODE

After performing the steps under *BASIC OPERATION*, follow the steps below to perform the Current Hold function. Although this continuous mode of operation is possible, the recommended method for reaching a HOLD current is to use the JOG to HOLD function.

1. Select MENU ► JOG / HOLD ► HOLD AMPS. Enter the desired output current set-point. This is the current that the test set will continuously increase to. Be sure to press START (Accept) to record the setting.
2. Return to the Main Operating screen by pressing the STOP (CANCEL) key several times (from the JOG/HOLD menu screen).
5. Ensure that the status indicator LED's indicate that the Breaker is CLOSED.
6. Press the START key to begin the test.

Note: If the regulator speed is set too high, the test set may overshoot the set-point and will be constantly adjusting the variable transformer to try to obtain the set-point current. If this occurs, use the speed control knob on front panel to decrease the regulator speed until the variable transformer movement is acceptable.

If the desired current is obtained at a low Tap and Vernier position, it may be impossible to hold the set value accurately. Better results can be obtained by adding impedance (such as longer cables), to raise the Tap and Vernier settings.

7. The test set will automatically increase the current up to the HOLD AMPS setting and remain ON until either the operator presses STOP, the circuit breaker trips, or the MAX DURATION or MAX CYCLES is reached. Press the STOP key to stop the test at any time.

TROUBLESHOOTING

If the unit is suspected to be malfunctioning, refer to the following guide for testing the unit and isolating the problem. Some minor repairs can be made in the field. Otherwise, call the factory for assistance.

NOTE: SOME TROUBLESHOOTING PROCEDURES REQUIRE OPENING THE TEST SET, WHICH HAS POTENTIALLY LETHAL VOLTAGES ON EXPOSED CONDUCTORS. ONLY FULLY EXPERIENCED TECHNICIANS SHOULD ATTEMPT TO PERFORM THESE PROCEDURES. IF YOU HAVE ANY DOUBTS, CONTACT THE FACTORY FOR ASSISTANCE.

1. **Insufficient Output**

When the unit does not seem to yield sufficient current through a breaker, the problem could be one of the following:

- a. Insufficient power supply.
- b. Loose connection in unit.
- c. Incorrect controller range or output tap configuration setting.
- d. Poor connections or excessive contact resistance at the breaker. Check cable or stab connections.

2. **Cannot Energize Main Circuit Breaker**

- a. Main breaker can only be energized when the interlock is clear. Check the status on the controller.
- b. Remove power and inspect the under voltage release mechanism for the main breaker.

3. **No Output Current When Initiated**

- a. Check to see that main circuit breaker is on.
- b. Verify that the breaker is reset and not in the trip position.
- c. Verify continuity of the breaker contacts.
- d. Check LED indicator on SCR trigger board. It should light when initiated.
- e. Check voltage out of SCR's when initiated.

SERVICE AND MAINTENANCE

Periodic Maintenance

The following maintenance should be performed about once a year, unless otherwise indicated below, to ensure that the test set maintains proper output and operation. Units that are used and transported often should have shorter maintenance intervals.

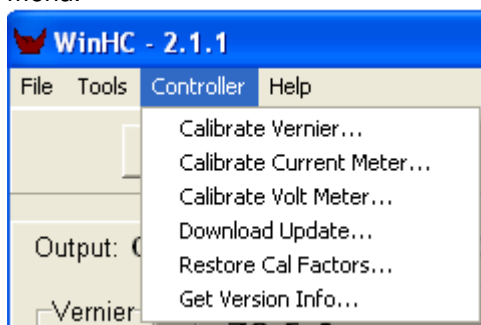
1. Disconnect the unit from the input supply.
2. Open all panels on the unit. Using a vacuum cleaner, remove any dust and debris from the interior of the unit, including wiring and components. Use caution when cleaning printed circuit boards and small components.
3. Tighten all connections, especially those on transformers, contactors, and input and output connectors. Special attention should be given to tightening all connections in the high current section every six months or less. If the unit is transported often, this procedure should be performed more often.
4. Remove the front cover on the main circuit breaker and clean the main contacts. Replace the contacts if they are beyond repair.
5. Inspect the variable transformer brushes for wear. Replace if they appear worn.
6. Perform basic operational tests to determine proper operation.

Calibration of Circuit Breaker Test Sets Models HC-12C through HC-75C

Calibration of this series of HC's must be performed with the laptop computer. The following items will be required to perform the calibration.

1. A laboratory "benchtop" multimeter
 - a. AC Voltage 0 – 480 with an overall accuracy of 0.3% or better.
 - b. AC Current from the output of your laboratory grade CT's with trigger/memory and overall accuracy of 0.3% or better.
2. Laboratory grade CT's capable of calibrating the 100, 1000, 10000 & 100000 amp ranges with an overall accuracy of 0.3% or better.
3. A variable voltage source 0 – 480 VAC to inject into your voltage metering circuit.

Start software from the laptop. Calibration will be explained in the order they appear in the drop down menu.

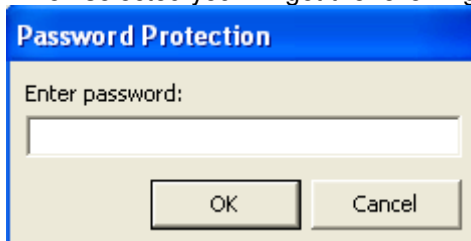


Calibrate Vernier:

This is a self calibrating function, when selected the variac will automatically run from limit to limit to adjust the systems 0% & 100% position sensors

Calibrate Current Meter:

When selected you will get the following screen. Enter password 8118.



After password is entered you will see the following screen.

Calibrate Current Meter

Calibration Procedure

1. Select the current Range.
2. Energize output and adjust current to 80% of full scale.
3. Enter the actual measured current and click Update.
4. Repeat for each current range.

Actual Current:

Cal Factors

| | |
|---------|--------------------------------------|
| 100 A: | <input type="text" value="0.01093"/> |
| 1K A: | <input type="text" value="0.05690"/> |
| 10K A: | <input type="text" value="0.52447"/> |
| 100K A: | <input type="text" value="5.27486"/> |

When this screen, is displayed the Cal Factors will be blank. Press Retreive to view them. Before adjustment you should document these numbers for record keeping.

Connect the standard CT with cables rated for the current you need to apply as if running a breaker.

NOTE: Make sure the top two plates and the bottom two plates are shorted. (Parallel Mode)

Use your Stabs or copper bars for this connection.

Raise the current to approximately 80% of range. Enter the value from your standard in the Actual Current field and press update. The Cal Factor will automatically update.

NOTE: For the higher ranges it is not necessary to be on to update. If you "jog" your current and capture your standard value you can enter it and update between "jogs".

Repeat for other ranges.

NOTE: For the 100 kA range your standard will most likely be a much smaller value than your range. In this case you should calibrate near 100% of your standard's value. The standard should be at least 20% of range.

Calibrate Volt Meter:

The voltmeter calibration functions the same as the current meter calibration.

Calibrate Volt Meter

Calibration Procedure

- Select the voltage range.

Range

 - Range 1 (480 V)
 - Range 2 (358 V)
 - Range 3 (213 V)
 - Range 4 (114 V)
- Select External voltage input.
- Inject calibration voltage.
- Enter the actual measured voltage and click Update.

Actual Voltage:
- Repeat for each voltage range.

Cal Factors

R1:

R2:

R3:

R4:

When this screen is displayed the Cal Factors will be blank. Press Retrieve to view them. Before adjustment you should document these numbers for record keeping.

For this calibration you will inject voltages into the banana jacks over the output panel. **(NOT CONTINUITY BINDING POSTS)**

Raise the voltage source to approximately 80% of range. Enter the value from your standard in the Actual Voltage field and press update. The Cal Factor will automatically update.

Repeat for other ranges.

Restore Cal Factors:

It is recommended that documentation of the cal factors be maintained, in the event that the cal factors become corrupt or if inadvertently changed and need to be restored. This can be done by going to the Restore Cal Factors drop down.

Cal Factors

| Current Meter | | Voltage Meter | |
|---------------|----------------------|---------------|----------------------|
| Max Amps | Calibration | Range | Calibration |
| 100: | <input type="text"/> | R1: | <input type="text"/> |
| 1K: | <input type="text"/> | R2: | <input type="text"/> |
| 10K: | <input type="text"/> | R3: | <input type="text"/> |
| 100K: | <input type="text"/> | R4: | <input type="text"/> |

*

*You can enter any or all values at the same time.

WinHC PC Software

About WinHC

Welcome to WinHC, circuit breaker test system software developed by Phenix Technologies to interface with Phenix Technologies high current test sets. WinHC provides advanced database and report generation capabilities, enabling you to save your circuit breaker test results in a database for future recall and report generation. WinHC also gives you complete remote control capability, allowing you to perform all tests from your computer.

Installation

WinHC is a MS-Windows application designed for use on the Windows 95/98/NT/2000/ME/XP operating systems. Before you install WinHC, make sure that you have a computer system capable of running the software effectively. The WinHC computer system requirements are shown below.

Minimum System Requirements:

- Intel Pentium 450 Mhz compatible computer
- 64 MB of system RAM
- 10 MB available hard disk space
- Microsoft Windows 98/NT/2000/ME/XP

Additional Hardware Requirements:

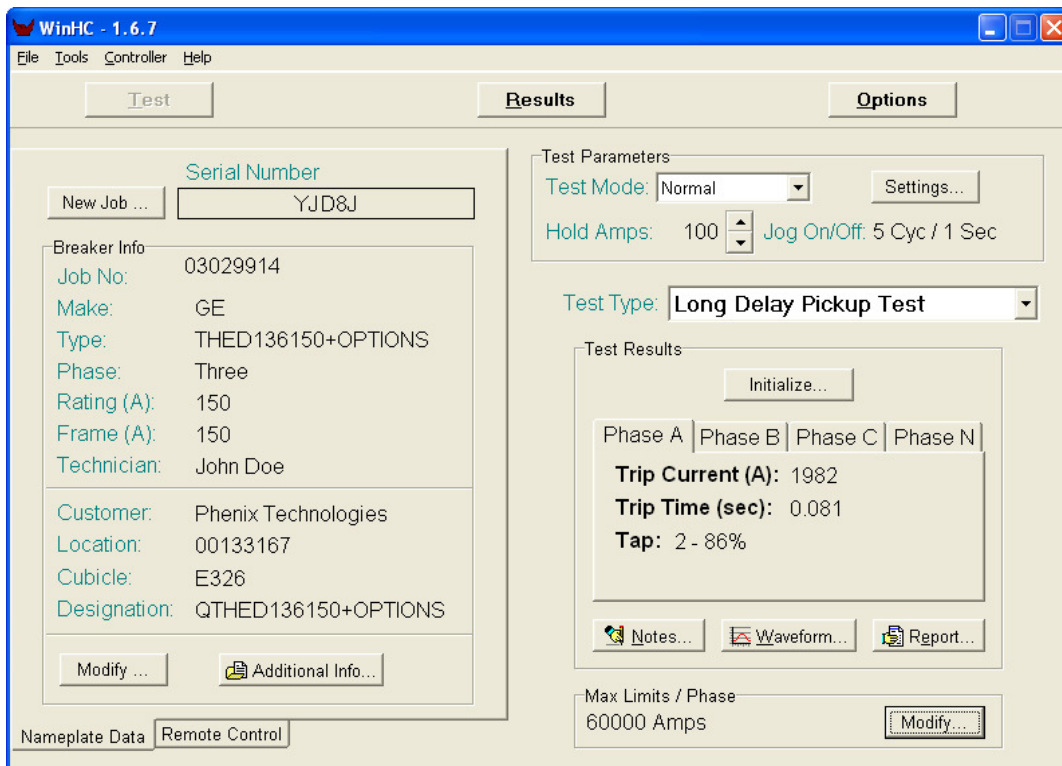
The computer must have one serial port available.

To Install WinHC:

1. Insert **Disk 1** into the floppy disk drive.
2. Click Start, then choose Run.
3. Type 'a:setup' and click *Ok*. NOTE: 'a:' is the floppy disk drive specification. It may be 'b:' on your system.
4. Follow the installation instructions as they appear on the screen. You may install WinHC in the default directory 'C:\Program Files\HC', or enter a different drive/directory.
5. When the installation is complete, double-click on the "Circuit Breaker Test System" icon to launch the software.

WinHC PC Software (Continued)

Using WinHC



WinHC main screen

Navigating WinHC is made easy by the navigation buttons. These buttons are always accessible and located on the heading bar of every screen. These buttons provide access to the major areas of WinHC: **Test**, **Results**, and **Options**.

Test: The starting point for all circuit breaker tests. Shows the nameplate data, test parameters and test results.

Results: Shows a list of your test history. From here you can generate test reports and view your history of tests.

Options: Contains your system configuration and customization.

Remote Control

The remote control screen allows you to completely control the individual functions of the high current test set: adjusting the vernier, selecting a output tap and current range, turning on the output, etc. All control functions available on the controller may be accessed remotely via this screen. Remote control is accomplished via a RS-232 cable connected to a serial port on your computer. WinHC defaults to serial port 1, but may be reconfigured to a different serial port in the options screen.

Vernier Control: The position of the vernier determines the level of the output voltage and current of the WinHC. Click the up/down arrows to change the position of the vernier, or enter a vernier position and click *Go...*

WinHC PC Software (Continued)

Tap: Selects the output tap. Higher taps produce a higher output voltage and therefore higher current.

Curr Range: Selects the range on the current meter. Note: The current meter will auto-range upward when the current level exceeds the current range.

Start/Stop: Initiates and halts a test.

Jog: Pulses the output on, just long enough to collect an accurate RMS current reading, which is then displayed in the current meter window.

Reset: Aborts a test and resets the test results.

Meters: Displays the RMS output current, the trip timing and the transformer temperature.

Save: Downloads and saves in the database the results of the latest breaker test, including the waveform.

Time: Selects the time base of the trip timer results, either seconds or cycles.

Test Mode: Selects the test mode of operation: Normal, Jog-To-Hold, Jog-To-Trip, Current Hold, Memory.

Connection: The output connection mode, the default is Parallel for maximum output current.

Test Parameters

This window displays the current test parameters. Click the *Settings...* buttons to modify these parameters. Each test type title has a set of test parameters associated with it. When you select a different test type the test parameters, last used with that test type, will be recalled.

Max Limits

This window displays the present max duration and max current limits (if any exist). Click *Modify...* to change these parameters.

Initialize...

The traditional method to position the output level is to use the Jog-To-Hold function. The Initialize function performs the exact same function as Jog-To-Hold but does it faster and more efficiently. Initialize is an automatic process, you do not need to pre-configure the controller. The test mode, current range, etc. will all be controlled automatically.

Initialize works as follows: beginning near the bottom of tap 1, sample output pulses will be made at various points of each tap as the software determines the required tap and vernier position for the desired current. You **MUST NOT** enter a desired test current that is at or above the level where the breaker under test will trip. If the breaker trips during initialization, then the process will be aborted.

WinHC PC Software (Continued)



Performing a Circuit Breaker Test

The following is the step-by-step procedure for using WinHC to test a circuit breaker, save the results in the database and generate a test report.

1. On the main screen, click *New Job...* Enter the Serial Number of the unit you are about to test then click *Ok*, or use the pull-down menu to select a recently tested serial number.

NOTE: If a previous test result already exists for this circuit breaker, you will be given the option of creating a new test result, or of adding new results to the most recent test.

2. The Nameplate Data Screen will appear. Enter the nameplate data for the circuit breaker you wish to test then click OK.

The Nameplate data screen is where you enter the circuit breaker nameplate, job, and location information. This data will appear on the test report. The serial number is the only required field.

Job No: Your internal job tracking number.

Make: The manufacturer of the circuit breaker. Select from the pull-down menu, or type it in.

Type: The type of the circuit breaker. Select from the pull-down menu, or type it in.

Rating (A): The continuous current rating of the circuit breaker.

Frame (A): The frame current rating of the circuit breaker.

Phase: Single or three-phase circuit breaker.

Technician: The name of the test technician.

Additional Info...: Click to open the additional information screen. This is optional nameplate and test data that may appear on the test report.

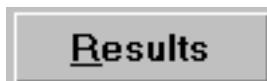
Use Tab to move through the fields or click the desired field to activate. Click OK when you're done.

3. The required test data has now been entered and you are ready to perform the circuit breaker test. Select the appropriate test type title for the test that you wish to perform. Select the phase of the circuit breaker that you wish to test.

Use the Remote Control screen or the push buttons on the controller itself, to perform the circuit breaker test. When the test is complete click (or push) **Save** to download the test results. The results will automatically be saved in the database. Click **Waveform...** to view the waveform of the output current.

WinHC PC Software (Continued)

4. Repeat step 3 for each phase and test level that you wish to test.
5. Click **Notes...** to add any test notes.
6. Click **Report...** to generate a test report.



Generating Reports

The WinHC software keeps a history of all circuit breaker and tests that have been performed. Here's the procedure for creating test reports of previous tests.

1. On the main screen, click the Results button. The Results screen will appear.
2. Select the order in which you want the results to appear by clicking a *Sort By...* item. This selection also determines which field is used by search.
3. Browse the results menu to find the test result you wish to print. The most recent test will already be highlighted. Or, to search for a specific result, click the search field and enter the search value.
NOTE: The search will be performed on the field selected by *Sort By...*
4. Click *Test Report...* to generate a report. You will be given the option of pre-viewing the report on screen or sending it directly to the printer.

WinHC PC Software (Continued)

Options

General Options

Use these options to configure your test report and other generic options. Access these options by clicking the *Options* button on the main screen, then click the *General* tab.

The screenshot shows the 'Setup' dialog box with the 'General' tab selected. The 'Company' field contains 'Phenix Technologies'. The 'Header 1' field contains 'Industrial Drive', 'Header 2' contains 'Accident, MD. 21520', and 'Header 3' contains '(301) 746-8118'. The 'Logo File Name (.BMP)' field is empty. The 'Data Path' field contains 'C:\Program Files\HC\DATA'. The 'Report Options' section has five checkboxes: 'Print Address in Header' (checked), 'Print Test Notes' (checked), 'Print Sign Off' (checked), 'Print Resistance Measurements' (checked), and 'Print User Defined Fields (Group 1)' (unchecked). The 'Print User Defined Fields (Group 2)' checkbox is also unchecked. The 'Serial Port' dropdown menu is set to 'COM1'. At the bottom, there are 'OK' and 'Cancel' buttons.

The General Options screen

Company, Header1, Header2, Header3: These fields determine what text will appear at the top of reports.

Report Options: These settings determine what “extras” will appear on test reports.

Serial Port: The serial port of your computer that you wish to use to communicate with the HC controller.

Data Path: This setting determines where the WinHC data files are located. For instance, you can change this setting to move your WinHC data to a network server. You are responsible for moving the data files, if you change this setting without moving the files, WinHC will create empty data files in the new location.

WinHC PC Software (Continued)

Labels

The screenshot shows the 'Setup' dialog box with the 'Labels' tab selected. The 'Nameplate Fields' section contains four input fields: 'Serial Number', 'Cubicle', 'Location', and 'Designation'. The 'Resistance Measurements' section contains three input fields: '1: Insulation Resistance (MegOhms)', '2: Contact Resistance (MicroOhms)', and '3:'. The 'User Group 1' and 'User Group 2' sections each contain eight input fields labeled 'User 1' through 'User 8'. The 'OK' and 'Cancel' buttons are located at the bottom of the dialog.

The Labels options screen

The labels options screen contains the field labels for the optional circuit breaker nameplate fields. You may change any of these to suit your particular needs. These labels appear on the circuit breaker nameplate screen, under *Additional Info...*, and on test reports.

Lists

The screenshot shows the 'Setup' dialog box with the 'Lists' tab selected. The 'Lists' tab contains three empty list boxes: 'Manufacturer List', 'Breaker Type List', and 'Technician List'. The 'OK' and 'Cancel' buttons are located at the bottom of the dialog.

The Lists Options

Use these options to maintain standard circuit breaker type and circuit breaker manufacturer lists. Items in these lists will appear in pull-down menus, off of the circuit breaker type and make fields. You may edit these lists to match your specific needs.

WinHC PC Software (Continued)

Tests

The screenshot shows a dialog box titled "Setup" with a tabbed interface. The "Tests" tab is selected. Under the "Test Titles" section, there are ten text input fields arranged in two columns. The first column contains Test 1 through Test 5, and the second column contains Test 6 through Test 10. Test 1 is "Long Delay Pickup Test", Test 2 is "Long Delay Timing Test", Test 3 is "Short Delay Pickup Test", Test 4 is "Short Delay Timing Test", and Test 5 is "Instantaneous Pickup Test". Test 6 is "Ground Fault Pickup Test", Test 7 is "Ground Fault Timing Test", Test 8, Test 9, and Test 10 are empty. At the bottom of the dialog are "OK" and "Cancel" buttons.

| Test ID | Test Title |
|----------|---------------------------|
| Test 1: | Long Delay Pickup Test |
| Test 2: | Long Delay Timing Test |
| Test 3: | Short Delay Pickup Test |
| Test 4: | Short Delay Timing Test |
| Test 5: | Instantaneous Pickup Test |
| Test 6: | Ground Fault Pickup Test |
| Test 7: | Ground Fault Timing Test |
| Test 8: | |
| Test 9: | |
| Test 10: | |

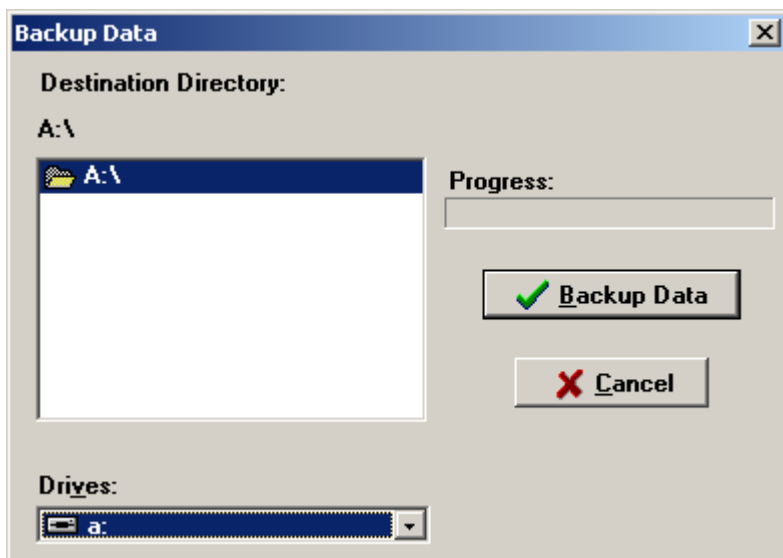
The Tests Options

Circuit breaker Test Titles: You may customize the test titles to match your individual testing procedures. Test Titles appear on the test screen and print on test reports.

WinHC PC Software (Continued)

Data Backup

WinHC data should be backed up on a regular basis. Hard disks do fail, you don't want to lose years of valuable data. We recommend that you maintain at least two separate floppy backup disks (floppy disks fail as well). WinHC has backup and restore functions that make this an easy task.

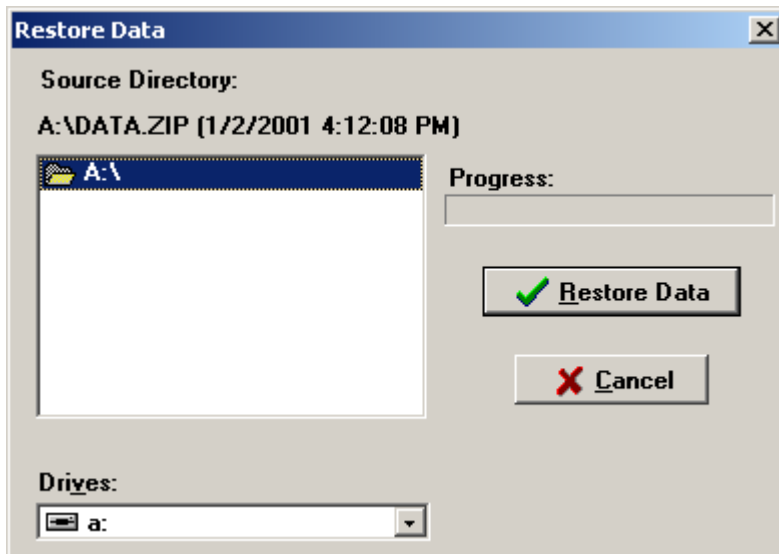


The Backup Data screen

The backup data screen allows you to easily select a drive/directory as a destination for your data backup. Access this screen by selecting Tools and then Backup Data.... Select the drive/directory and Click *Backup Data* to begin the backup.

WinHC PC Software (Continued)

Data Recovery



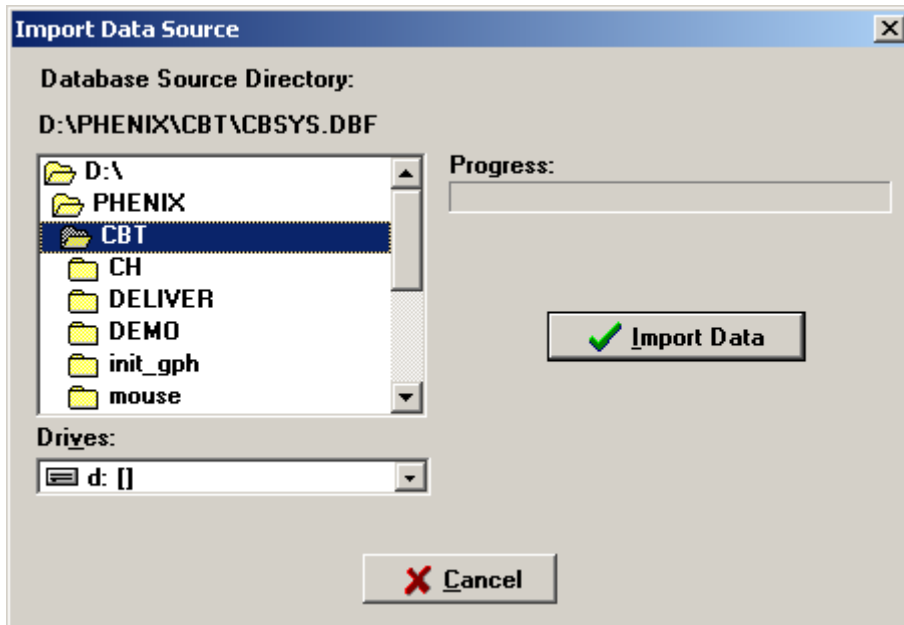
The Restore Data screen

Should something happen and you need to restore data from a backup, WinHC provides a similar function for restoring data. The restore data screen allows you to easily select a drive/directory as a source for your data recovery. Access this form by selecting *Tools* and then *Restore Data...* Select the drive/directory and Click *Restore Data* to begin the data recovery.

WinHC PC Software (Continued)

Import Data

The data import function will import data from the DOS circuit breaker test set software, into the new WinHC windows software.



The Data Import Screen

The data import procedure is as follows:

1. Select the drive and directory where the DOS data is located (this is the same directory as CBSYS.EXE). When the DOS data is detected, the path will show the file ...CBSYS.DBF.
2. Click *Import Data...* to import the data from DOS to Windows.

Repair Database Tables

Occasionally, a database table or index file may become corrupt and unusable. WinHC has a function that will rebuild all database files. If a database error occurs during software operation, this function should be executed. To repair the tables, select Tools and then *Repair Database Tables*.

RETURNED MATERIAL

If for any reason it should become necessary to return this equipment to the factory, the Service Department of Phenix Technologies, Inc. must be given the following information:

Name Plate Information

Model Number

Serial Number

Reason for Return

Cause of Defect

If Phenix Technologies, Inc. deems return of the part appropriate, it will then issue an "Authorization for Return".

If return is not deemed advisable, other inspection arrangements will be made.

NOTE: Material received at this plant without the proper authorization shall be held as "Customer's Property" with no service until such time as the proper steps have been taken.

Your cooperation is requested in order to ensure prompt service.

PARTS ORDERING INFORMATION

Replacement parts are available from Phenix Technologies, Inc.

Changes to Phenix Technologies' products are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest technical improvements developed in our Engineering Department. It is, therefore, important when ordering parts to include the serial number of the unit as well as the part number of the replacement part.

When your purchase order is received at our office, a representative of Phenix Technologies will contact you to confirm the current price of the part being ordered. If a part you order has been replaced with a new or improved part, an Applications Engineer will contact you concerning any change in part number.

Your order for replacement parts should be sent to:

Replacement Parts Department
Phenix Technologies, Inc.
75 Speicher Drive
Accident, Maryland 21520

RECOMMENDED SPARE PARTS HC-12C

In order to maintain your set in full operating condition with a minimum of down time, the following spare parts should be kept on hand to avoid unnecessary phone calls, expensive modes of shipment, delays in repairs, etc. Pricing is available upon request.

| Part Number | Description | Quantity |
|--------------------|-------------------------------|-----------------|
| 1603667 | Fuse, 5A, 500 V, FLQ-5 | 4 |
| 1603605 | Fuse, 250 V, 5A | 3 |
| 1603628 | Fuse, MDL-5 | 2 |
| 1423260 | Lamp, Neon, 125 VAC | 1 |
| 1420145 | Lamp, 28V, EAO | 6 |
| 1606100 | Movistor, 130V | 3 |
| 1793430 | IC, Hex Inverter, 74HCT14 | 1 |
| 1794115 | IC, Op. Amp, AD524 | 1 |
| 1793500 | IC, Darlington Array, ULN2803 | 3 |
| 1793400 | IC, Octal Bus Trans, 74HCT640 | 2 |

HC-12C PARTS LIST

| Qty | Phenix Part # | Item | Description |
|---|---------------|------------------------|---|
| CONTROLLER | | | |
| 1 | 1077170 | AC Input Cord | 18/3, 9'10" Right Angle Power Cord |
| 1 | 1152590 | AC Input Filter | Corcom, 6VM1 |
| 1 | 1001740 | Serial Interface Cable | DB-9 Male to Female, Straight Thru |
| 1 | 1001732 | HC Interface Cable | DB-37 Male to Male, Straight Thru |
| 1 | 1152145 | CON101 | DB-37 Panel Connector, Female |
| 1 | 1603628 | F101 | Fuse, MDL-5 |
| 2 | 1862950 | KEYPAD 101-102 | 1X4 DOUBLE WIDE MET KEYPADS |
| 3 | 1862955 | KEYPAD 103-105 | 1X3 MET KEYPADS |
| 1 | 1001230 | PCB101 | PCM-586 32-Bit Microcomputer |
| 1 | 1001205 | PCB102 | 16 Channel 16-Bit ADC Board |
| 1 | 31125010 | PCB103 | PC104 TO PCB 1155 Interface |
| 1 | 31125810 | PCB104 | HC Manual User Interface |
| 20 | 1420116 | PCB104: LED101-120 | Panel Mount LEDs (p/o 31125810 Assy.) |
| 1 | 1001223 | PCB105 | LCD Module and Key Scanner |
| 1 | 1001224 | PCB106 | 9 Pin – 9 Pin Jumper Box, F-F |
| 1 | 1590135 | PS101 | LPT62 Power Supply |
| 1 | 1159910 | RCP101 | Single Receptacle |
| 1 | 1862945 | SW101 | SPDT Momentary Pushbutton |
| 1 | 1154311 | TB101 | Terminal Block, 3-141 |
| 1 | 1001206 | U101 | 8MB Disk On a Chip |
| REGULATOR AND HIGH CURRENT SECTION | | | |
| 4 | 30120001 | B1-B4 Cable | 1 Cond. Power, 4AWG, 34", Tweco-Tweco |
| 2 | 1356214 | BP201,203 | Binding Post, Black |
| 2 | 1356215 | BP202,204 | Binding Post, Red |
| 1 | 1099120 | C201 | Capacitor, 76,000uF, 40VDC |
| 1 | 30000022 | CABLE 201 | Control Cable w / Circular Connectors |
| 1 | 30030007 | CABLE 202 | Internal Ribbon Cable, 40 Cond., 2Ft. |
| 1 | 1601173 | CB201 | Circuit Breaker, 2 Pole, 100A w / 24VDC UVR |
| 1 | 1600660 | CB202 | Circuit Breaker, 2 Pole, 25A w / Aux. Contacts, #S502-D25 |
| 1 | 1601506 | CB202 Aux. | Auxiliary Contacts, #S500-H11 |
| 1 | 1152145 | CON101 | DB-37 Panel Connector, Female |
| 1 | 1152903 | CON201 | Receptacle, Female, Green |
| 1 | 1152906 | CON201 | Plug, Green |
| 2 | 1152902 | CON202, CON203 | Receptacle |
| 2 | 1152910 | CON202, CON203 | Plug |
| 8 | 1153010 | CON204-207, 210-213 | Tweco, Panel |

HC-12C PARTS LIST

| Qty | Phenix Part # | Item | Description |
|---|---------------|---------------------------|---|
| REGULATOR AND HIGH CURRENT SECTION continued | | | |
| 21 | 1151174 | CON208 | Contact Pins, 24-20AWG, Female |
| 1 | 115011 | CON208 | Series 1 Circular Connector, REV, 28-37 |
| 1 | 1150170 | CON209 | Series 1 Circular Connector, STD, 28-37 |
| 20 | 1151170 | CON209 | Contact Pins, 24-20AWG, Male |
| 1 | 1506560 | CT201 | Coil for Current Meter |
| 6 | 1780025 | D201-206 | Diode, 1N4007 (1000V, 1.0A) |
| 2 | 1603667 | F201, F202 | Fuse, FLQ-5 |
| 2 | 1603921 | F201, F202 | HPL-B Fuse Holder |
| 2 | 1603605 | F203,204 | Fuse, 5A, 250V AGC-5 |
| 1 | 1603920 | F203 | Fuse Holder, 3AG Panel Mount |
| 1 | 1603910 | F204 | Fuseholder, 3AG |
| 1 | 2350125 | FAN201 | Fan, 4WT47 |
| 2 | 1705080 | K201, K202 | Contact, 3 Pole, 24V Coil, #AE40-30-11-81 |
| 4 | 1705058 | K203-K206 | Contact, 4 Pole, 24V Coil, #BC25-40-00-01 |
| 4 | 1705055 | K203-K206 | Aux. Contact Block, #CA5-01 |
| 6 | 1701361 | KS201- KS202, K211-214 | Relay, 24VDC Coil, #3RH1122-1JB40 |
| 1 | 41000004 | L201 | Current Limit Choke |
| 1 | 1423260 | LMP201 | Lamp, Neon, 125V |
| 1 | 1422150 | LMP202 | Lens, Red |
| 3 | 1420145 | LMP202- LMP204 | Lamp, 28V |
| 3 | 1423300 | LMP202- LMP204 | Socket |
| 1 | 1422151 | LMP203 | Lens, Green |
| 1 | 1422152 | LMP204 | Lens, Yellow |
| 1 | 1353048 | Meter Leads | Battery Clip, Red |
| 1 | 1353050 | Meter Leads | Battery Clip, Black |
| 1 | 1356213 | Meter Leads | Banana Plug, Red |
| 1 | 1356212 | Meter Leads | Banana Plug, Black |
| 1 | 1606150 | MOV201 | Movistor, V661DB40 |
| 1 | 1606100 | MOV202 | Movistor, V130LA10A |
| 6 | 1606108 | MOV203-208 | Movistor, V271DB40 |
| 1 | 1606140 | MOV213 | Movistor, V660PA100A |
| 1 | 2450220 | MOV213 | Movistor, Mounting |
| 40 Ft. | 1073340 | Output Lead | 4/0, 600V Cable (8 Pieces x 5 Ft. Long) |
| 16 | 1352136 | Output Lead | Lugs, BLU-025S2 |
| 1 | 31115600 | PCB201 | Trigger Board, PCB1156 |
| 1 | 31115520 | PCB202 | Input/Output Board, PCB1155B |
| 1 | 31125210 | PCB203 | RMS-to-DC Converter, PCB1252 |
| 1 | 1590293 | PS201 | Power Supply, 24VDC, 2.4A |
| 2 | 1714010 | R201, R202 | Resistor, 2W, 100K, 10% |
| 1 | 1761055 | R203 | Potentiometer, 5K, 3-Turn |

HC-12C PARTS LIST

| Qty | Phenix Part # | Item | Description |
|---|---------------|----------------|---------------------------------------|
| REGULATOR AND HIGH CURRENT SECTION continued | | | |
| 1 | 1769998 | R204 | Potentiometer, 5k |
| 1 | 1355315 | R204 | Knob, 1" |
| 1 | 1741030 | R205 | Resistor, 500Ω, 50W |
| 1 | 1159922 | RCP201 | Outlet, Duplex 120V, 15A, GFCI |
| 1 | 1808120 | SCR201, SCR202 | DSA162F120B AC Switch Assy |
| 1 | 1565226 | SCRC201 | KBMG-21D, SCR Motor Controller |
| 1 | 1863360 | SW201 | Switch, 600VAC, 15A DPST |
| 1 | 1860900 | SW202 | Switch, Mushroom |
| 1 | 1862905 | SW202A | Contact Block, NC |
| 2 | 1866005 | SW203, SW204 | Limit Switch, Roller, 20A |
| 1 | 3860025 | T201 | Transformer, Control Power, 500VA |
| 1 | 1894415 | T203 | Transformer, 115/40V CT, 1A |
| 1 | 1894438 | T204 | Transformer, 575/115 PT |
| 1 | 38602190 | T301 | Transformer, IA1-2190 |
| 1 | 1482925 | TH201 | Thermostat, 140°C |
| 1 | 1482915 | TH202 | Thermostat, 110°C |
| 1 | 1482940 | TH203 | Thermostat, 240°C |
| 1 | 1763000 | TH204 | Thermistor 5k ohm |
| 1 | 1482904 | TH205 | Thermal Switch, 90-100 Deg. F, #2E245 |
| 1 | 2960016 | DCOV | HC20 Dust Cover |

ELECTRICAL SCHEMATICS

HC Controller

| | <u>Drawing Number</u> | <u>Description</u> |
|----|-----------------------|--|
| 1. | 8314591 | HC-C Controller Electrical Schematic |
| 2. | 31125010 | PCB 1250A, PC104 to PCB 1155 Interface |
| 3. | 31125810 | PCB1258, HC-C Panel User Interface Schematic |

HC Regulator / Transformer Cabinet(s)

| | <u>Drawing Number</u> | <u>Description</u> |
|----|-----------------------|---------------------------------------|
| 1. | 9304540 | HC-12C Electrical Schematic |
| 2. | 31115520 | PCB 1155B, HC I/O Interface Schematic |
| 3. | 31115600 | PCB 1156, SCR Trigger Board |
| 4. | 31125210 | PCB 1252A, RMS-to-DC Converter |