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Warnings

These safety warning are provided to ensure the safety of personnel and proper operation of the tester.

- The tester must not be operated beyond its specified operating range.
- Safety is the responsibility of the operator.

Receiving your Shipment

Upon receiving your shipment, be sure that the contents are consistent with the packing list. Notify your distributor or factory of any missing items. If the equipment appears to be damaged, file a claim immediately with the carrier and notify your the factory at once, giving a detailed description of any damage. Save the damaged packing container to substantiate your claim.

Packaging

The HILT 9000 Inductive Loop Tester is shipped with a hard carrying case, one set of test leads with clips, two 9V batteries (installed), and a user manual. Depending on whether you purchased the HILT 9000 only or the complete Loop Test Kit, you may have additional items included.

General Description

The HILT-9000 is designed to measure characteristics of an inductive loop at different frequencies; measure working parameters of the loop system; as well as simulate the detector by measuring the change of inductance. The measurement modes can be easily switched by pressing corresponding buttons on the keypad.

The following tests can be run to verify the condition of the loop:

- R, L, and Q of the loop
- Operating parameters of the loop system: operating mode, frequency (f_{OP}), and peak-to-peak voltage (V_{PP})
- Change of inductance of the loop ($\Delta L/L$)

Where,

Q = quality factor (dimensionless)

L = inductance (μH)

R_{DC} = DC resistance (Ω)

f_{OP} = operating frequency (KHz)

V_{PP} = peak-to-peak voltage (V)

The tester offers a user-selectable frequency at which Q and L are measured. At power-up, the frequency is pre-set to 50KHz and can be easily changed from 20KHz to 80KHz range using the keypad.

An inductance change ($\Delta L/L$) can be measured to assess the real life behavior of the loop. In this mode the tester displays the current value of the inductance change and the maximum observed change which can be reset by pressing a button on the keypad.

When the loop is connected to a detector, the tester can measure the oscillating frequency and peak-to-peak voltage of the signal. In addition, the tester detects the operating mode and indicates if it is a continuous (single channel) or scanning (for most multi-channel detectors).

The tester has a 16 by 2-character LCD for presenting the measured values to the user. The control keypad has 7 command buttons and one Power On/Off button. The tester requires two standard 9V alkaline batteries. To extend the life of the batteries, the tester shuts off automatically after 30 seconds of non-use.

Overview of HILT 9000 Controls

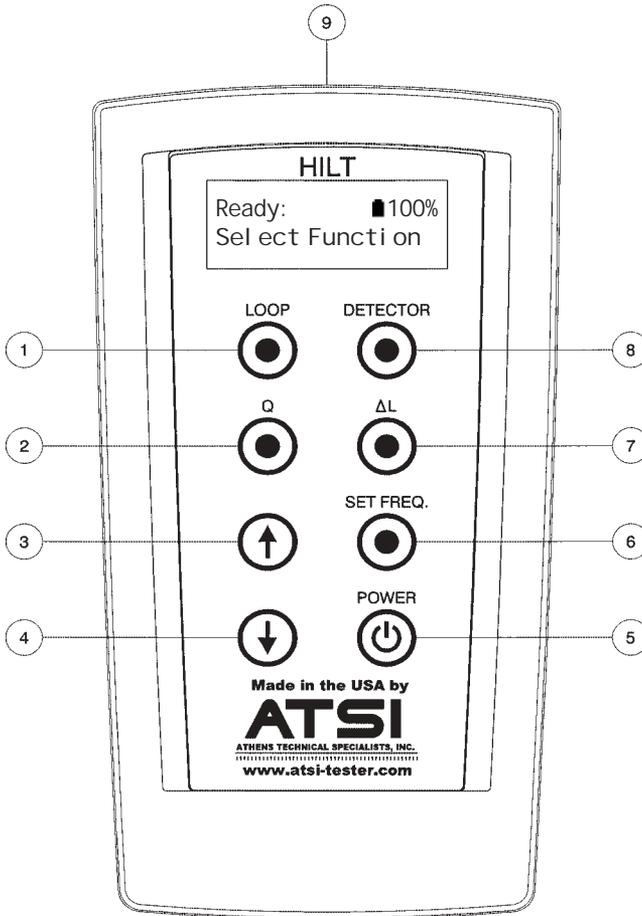


Figure 1

1. **LOOP:** Measures R_{DC} , L, and Q. If $Q > 15$, use Q push-button to obtain actual value.
2. **Q:** Measures high Q values (when Q is > 15).
3. Used in SET FREQ mode to increase frequency by 1KHz.
4. Used in SET FREQ mode to decrease frequency by 1KHz.
5. **POWER:** Turns unit On/Off.
6. **SET FREQ:** Selects operating frequency to measure L & Q.
7. **ΔL:** Measures change of inductance.
8. **DETECTOR:** Measures operating parameters of the loop system: V_{P-P} , Oscillating frequency, and mode.
9. **Input:** Color coded input connectors.

Function Controls

POWER



Power

Press the **POWER** push-button to turn the tester on and off. The tester performs an initial self-test to verify that the internal circuit is working. After the self-test is complete, the tester shows the current battery level and the message: **Ready: Select Function**. If the battery is low, a message **Replace Battery** will be displayed.

Press and hold the **POWER** push-button during power-up to display the serial number of the unit and the version of the firmware as show in Figure 2. Release the push-button to return to normal operation.

The unit can be turned off at any time by pressing the **POWER** button. The tester shuts off automatically after 30 seconds of non-use.

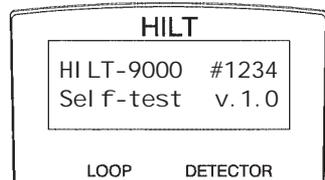


Figure 2

LOOP



Loop

⚠ ATTENTION ⚠

- Disconnect the detector from the loop before running this test.
- DO NOT switch to a different test while the measurements are being generated for the current test. Only after the results of the current test are displayed can a different test be performed.

Connect the test leads to the loop. Press the **LOOP** push-button to begin the test. After the measurement is complete, the tester displays the results as shown in Figure 3 on the next page. Note that the frequency at which L and Q were measured is also displayed.

The **LOOP** test can measure a maximum Q of 15. If Q is greater than 15 the tester displays **$Q > 15$** . To measure the actual value, press the **Q** button on the keypad to run a separate Q test.

The default frequency at which the LOOP and Q tests run is 50 KHz. It can be changed to any value within the range from 20 KHz to 80 KHz with 1 KHz increment.

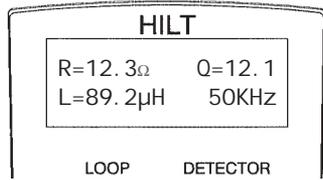


Figure 3



Quality (Q)

⚠ ATTENTION ⚠

- Disconnect the detector from the loop before running this test.
- DO NOT switch to a different test while the measurements are being generated for the current test. Only after the results of the current test are displayed can a different test be performed.

Connect the test leads to the loop. This test requires several seconds to run during which the tester will measure Q at some arbitrary frequency and calculate Q for a user-selected frequency. If a user-selected frequency is not entered prior to pressing **Q**, the default 50KHz setting will be used. Refer to the **Set Frequency** section on page 7 for full instructions to enter a different frequency.

Both Q results will be presented on the display as shown in Figure 4. The calculated value is shown on the second line and indicated with an *.

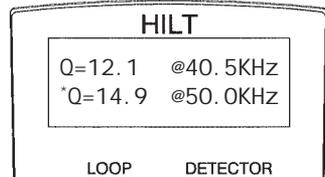


Figure 4

SET FREQ.



Set Frequency

When the tester is powered, the test frequency is automatically set to 50 KHz. The frequency can be changed to any value between 20 KHz and 80 KHz with 1 KHz resolution. To set a different frequency press the **SET FREQ** push-button to view the frequency adjustment display as show in Figure 5. Use the \uparrow or \downarrow push-button to increase or decrease the frequency by 1KHz. Pressing and holding \uparrow or \downarrow button will automatically increase/ decrease the value.

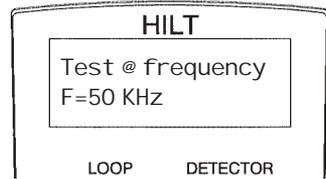


Figure 5



Change of Inductance



- Disconnect the detector from the loop before running this test.
- Prior to measuring the operating parameters of the loop system, press the **DETECTOR** push-button and verify the tester displays the “No Signal” message. Once this message is received the detector can be reconnected to the loop.

In this mode, the tester simulates a detector by measuring a relative change of the inductance and displaying the results.

Connect the test leads to the loop and press ΔL button on the keypad. The display will appear as shown in Figure 6. The top line indicates the current change of the inductance and the bottom line indicates the maximum recorded change of inductance. To reset the maximum value press the ΔL button.

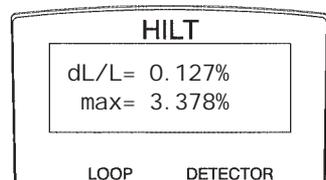


Figure 6

If there is bad connection, the tester displays a message as shown in Figure 7. Make sure that the test leads are properly connected. If the leads are connected to the loop and the message is still present, it means that Q of the loop is too low to generate the oscillation or the inductance is out of range. This can be verified by performing the LOOP test.

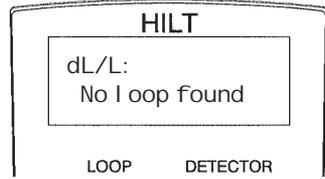


Figure 7

In this mode, the the tester will shut off automatically after 45 seconds if no buttons are pressed.

DETECTOR



Detector

⚠ ATTENTION ⚠

- Verify the Loop is connected to detection system before running this test.
- Disconnect the detector from the loop before running a **LOOP**, **Q**, or **ΔL** test.

The purpose of this test is to measure the operating parameters of the working loop while it is connected to the detector.

Connect the test leads to the loop and press the **DETECTOR** push-button. During this test the measurements are constantly updated displaying the type of the operating mode, peak-to-peak voltage, and the operating frequency as show in Figure 8. If the signal is not present or signal is weak, the tester displays "No Signal" message as show in Figure 9.

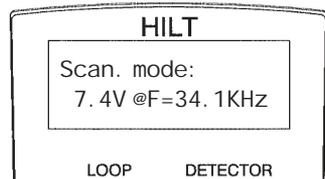


Figure 8

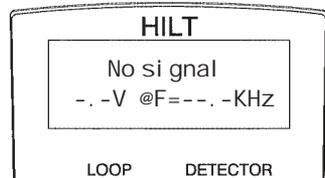


Figure 9

In this mode, the the tester will shut off automatically after 45 seconds if no buttons are pressed.

Function Controls Summary

BUTTON	DESCRIPTION	COMMENTS
LOOP	Used to measure L, Q, and R_{DC} of the loop. Q is measured up to 15. If $Q > 15$, use Q button to obtain the actual value of Q	The loop must be disconnected from the system to run this test
Q	Used to measure high Q values (when Q is >15)	The loop must be disconnected from the system to run this test
ΔL	Used to measure change of inductance	The loop must be disconnected from the system to run this test
DETECTOR	Used to measure operating parameters of the loop system: V_{p-p} , Oscillating Frequency, and Mode	The loop must be connected from the system to run this test
SET FREQ.	Used to select operating frequency to measure L and Q	
↑ and ↓	Used in SET FREQ mode to increase and decrease frequency in 1KHz steps.	
POWER	Used to turn the unit on and off.	The tester can be turned off at any time during or after a test

Overview of Traffic Loop Detection Systems

The inductive loop represents the most commonly used method to detect vehicles. The inductive loop is simply a coil of wires embedded into the pavement and can be characterized by several parameters, L (inductance), Q (quality factor), R (active resistance, measured using AC signal), and R_{DC} (DC resistance). These parameters are affected by the type of pavement, number of turns in the loop, type of wire, length and type of the lead-in cable, shape and dimension of the loop, and presence of any objects near the loop.

A detector is connected to the loop and is used to measure the AC characteristics of the loop and change of those. A part of the circuitry in the detector and the loop creates an oscillating circuit. The oscillating frequency of this circuit depends on the parameters of the loop and the parameters of the detector. When a vehicle or other metallic mass is located above the loop almost all of the characteristics (except DC resistance R_{DC}) are altered. This change causes the oscillating frequency to drift which in turn is detected by the detector.

Unfortunately, the deterioration of the loop begins virtually from the moment of installation. There appear to be two basic mechanisms for loop degradation, mechanical and chemical. Under daily and seasonal temperature variations, the pavement is constantly flexing. To this may be added the pounding of heavy vehicles, particularly at the approaches to signalized intersections where loops are often located. These mechanical factors cause flexure of the wires comprising the loop, especially at the juncture between pavement and berm, leading initially to fine cracks in the insulation, and perhaps ultimately to actual breakage of the wires. After insulation failure occurs (fine cracks or breakage), there is a path for water intrusion. While water itself is a poor conductor, its conductivity is greatly increased by the highly ionic de-icing salts which saturate the berm and all cracks and fissures of the pavement. Aside from the ground leakage which results, these highly active solutions can actually erode the copper conductors by displacement, aided by electrolysis of even the small potentials of the wire to ground. Lead-in wires are also vulnerable, especially on long pulls through conduit, because of the high probability of minor insulation failures due to chafing and stretching during installation.

To guarantee a reliable oscillation in the loop system the quality factor (Q) of the loop with the lead-in wires should be above some value, determined by the amplifiers inside the detector. Deterioration of the loop and lead-in wires reduces Q and eventually prevents the system from oscillating even with a known good detector.

Battery replacement



NEVER OPEN THE BATTERY COMPARTMENT
WHILE THE HILT-9000 POWER IS ON.



The battery indicator (in percentage format) on the LCD indicates when the batteries in the HILT-9000 require replacement. There are two 9V alkaline batteries in the HILT. Recommended replacement type is Alkaline (IEC 6LF22, 6LR61 or NEDA 1604A).

To replace the batteries, you will need to open the battery cover on the backside of the tester. Lay the tester face-down on a flat table, making sure that there is nothing underneath the tester that can accidentally turn the tester on. Remove the two Phillips head screws that secure the battery cover. The battery cover can then be removed and access to the batteries obtained. Installation is the reverse of this procedure.

All other types of services needed for the HILT-9000 should only be performed by an ATSI factory technician. Any attempt at servicing the tester yourself or by someone other than a ATSI technician will void the factory warranty. See the Warranty statement at the end of this manual for full details.

Commonly Asked Questions

*Q. Why do I have to disconnect the detector from the loop before running a **Loop**, **Q**, or **ΔL** test?*

A. During Loop, Q, and ΔL test, the tester is applying its own signal to the loop. The tester verifies there is no signal on the loop before running these tests. However, with a scanning detector connected to the loop, there are time intervals during which the loop does not have a signal applied. If the verification occurs during that time interval, the HILT will not “see” that there is another source of voltage connected to the loop and will begin the actual test. Presence of another voltage on the loop will result with incorrect measurements or potentially damage the tester.

*Q. When I run a **Q** test, why are there two results shown?*

A. The quality factor Q depends not only on the parameters of the loop but also the frequency of the measuring signal. During a Q test, the tester measures Q at a natural resonant frequency, which depends not only on the parameters of the loop but also those of the tester and it will not be the same as the user-selected frequency. The Q measurement for the natural resonant frequency is displayed on the first line. The Q for the user-selected frequency is calculated and is displayed on the second line.

Q. Is an adapter available to plug into the detector rack that will allow testing from the detector’s connection points?

A. Yes. Call your distributor or the factory for pricing and availability.

Repair and Calibration

To ensure that your instrument meets factory specifications, we recommend that it be returned to our factory at one-year intervals for calibration service. In addition to calibration of the test parameters, this service includes replacement of batteries and firmware updates. Please contact the factory for price and scheduling information on this service.

Request a Return Merchandise Form by phone or by fax from our Service Department (or complete the form on our website at www.atsi-tester.com), then return the tester along with the completed RM Form. Return the tester, postage or shipment pre-paid to:

ATSI
8157 US Route 50 • Athens, OH 45701
(740) 592-2874
(740) 594-2875 - Fax
service@atsi-tester.com

Caution: To protect yourself against in-transit loss, we recommend you insure your returned materials.

The HILT-9000 is sold with a one-year limited warranty to the original purchaser, as defined by the limited warranty on the inside back cover of this manual. No other warranties, expressed or implied, apply to the HILT-9000 or associated components.

After the first year, ATSI will continue to provide repairs to the tester on a parts-plus-labor basis. A phone call describing the problem may allow ATSI to make a nonbinding estimate of repair costs, but the surest approach is to send back the tester for a comprehensive evaluation and a binding repair estimate.

Technical and Sales Assistance

If you are experiencing any technical problems, or require any assistance with the proper operation or application of your tester, please call, fax, or e-mail our technical support staff:

ATSI

8157 US Route 50 • Athens, OH 45701

(740) 592-2984

(740) 594-2875 - Fax

service@atsi-tester.com

NOTES

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Limited Warranty

The HILT 9000 ("Product"), distributed by Athens Technical Specialists, Inc. (ATSI), is warranted to the original purchaser ("Purchaser") to be free of defects in materials and workmanship for a period of one year from the purchase date stated on the invoice. Within this period, in the event of a defect, malfunction, or other failure of the product while in the custody of the purchaser, ATSI will remedy the defect or cause of failure without charge to the Purchaser. Purchaser's sole remedy is restoration of product operation. ATSI accepts no liability for incidental or related expenses. Under no circumstances will ATSI's liability exceed the purchase price for items claimed to be defective.

This Limited Warranty does not extend to any Product that has been damaged or rendered defective (a) as a result of accident, misuse, or abuse; (b) by modification of the product; or (3) as a result of service by anyone other than ATSI.

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

**YOU CAN NOW REGISTER ONLINE AT:
www.atsi-tester.com**

Warranty Repair

What you must do to return the tester for Warranty Repair:

Request a Return Merchandise Form by phone or by fax from our Service Department (or complete the form on our website at www.atsi-tester.com), then return the tester along with the completed RM Form. Return the tester, postage or shipment pre-paid to:

ATSI
8157 US Route 50
Athens, OH 45701
(740) 592-2874
(740) 594-2875 - Fax
service@atsi-tester.com

Caution: To protect yourself against in-transit loss, we recommend you insure your returned materials.