



# Automated Local Loop Test System

Comprehensive Local Loop Testing for  
Voice, Data, Fax and Internet Services



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## Two-way Testing of Copper, Wireless, and Hybrid-Fiber Coax Local Loops

A whole new concept in Local Loop Testing. The 923LTS Hand-held unit works in conjunction with the Sage Instruments 356E Plus Central Office Responder to form the fastest and most comprehensive Local Loop Test System in the industry. A single technician can profile a Local Loop in less than 1 minute (additional time required for a 2-way Impulse Noise Test).

Using the 23-Tone testing concept as defined in IEEE Standard 743-1995, the system quickly profiles the transmission characteristics of the local loop. Measurements are compared to a user-defined template and the technician receives a PASS or FAIL indication at the subscriber's site.

In addition, the system allows you to enter the circuit number, work order number and the technician's identification.

The Callback option measures ringing voltage, verifies that the switch translations have been programmed for the correct telephone number and confirms that the station under test is capable of receiving a call.

The unit has a programmable phone list for storing frequently called test numbers and also features an optional built-in Butt Set.

The unit is capable of storing the last 10 tests. All data is time/date stamped and stored for easy retrieval. An RS-232 port is provided for printing.

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## Comprehensive Measurements

The 923LTS is designed to be connected to the customer network interface (CUST-NI) and automatically performs or measures the following:

- Loop Voltage
- Loop Current
- Call Setup Time
- Verifies Number Translation (requires callback option)
- Ringing Voltage (requires callback option)
- Dial Tone Delay
- 23-Tone to Measurements:
  - Attenuation Distortion @ 23 Frequencies
  - 2-Wire Group Delay @ 22 Frequencies
  - Signal-to-Noise Ratio
  - Signal-to-Total Distortion
  - 2nd & 3rd Order Intermodulation Distortion

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## Comprehensive Measurements, Continued

3-Tone Slope  
C-Message Noise (Psophometric Noise - *International*)  
C-Notch Noise (P-Notch Noise - *International*)  
Noise-to-Ground  
Absolute Delay  
2-Wire Echo Return Loss (ERL, SRH, SRL)  
Hits:  
    3-Level Impulse Noise, Timed  
    Phase Hits  
    Gain Hits  
    Dropouts  
Jitter:  
    Phase Jitter (hi and low)  
    Amplitude Jitter (hi and low)

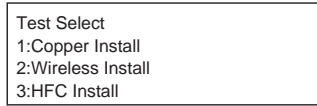
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Quick, Easy-to-Use, and Comprehensive. PASS/FAIL indications take the mystery out of interpreting results.



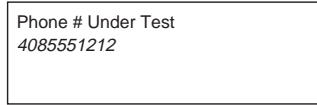
Main Menu  
1:<Test>  
2:Setup  
3:View Results

From the Main Menu, Select 1: <Test>



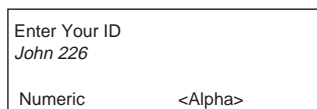
Test Select  
1:Copper Install  
2:Wireless Install  
3:HFC Install

The unit advances to the Test Select Menu. In this menu, select the test you wish to perform, such as 1: <Copper Install>. This will tell the 356E *Plus* to use the test suite and measurement template associated with this type of service.



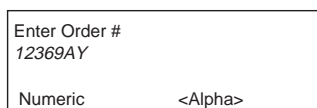
Phone # Under Test  
4085551212

The unit will automatically advances to the Phone # Under Test screen. Here you enter the number for the circuit that you are testing. Press NEXT to advance to the next entry screen.



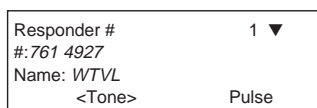
Enter Your ID  
John 226  
Numeric                   <Alpha>

Enter your Name or Company Identification and press NEXT.



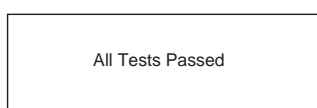
Enter Order #  
12369AY  
Numeric                   <Alpha>

Enter the Work or Service Order Number and press NEXT.



Responder #                   1 ▼  
#:761 4927  
Name: WTVL  
          <Tone>                   Pulse

Manually enter a Responder Test Number or select one from the phone list. Press NEXT and the number will be dialed.



All Tests Passed

The 923LTS will automatically make 2-way tests on the selected circuit. The 923LTS will display All Tests PASSED or FAILED. At this point, press NEXT to view the individual results or start another test.

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*What could be easier?*

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# 356E Plus Central Office Unit



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## Central Office Responder

The 356E *Plus* is a stand-alone responder designed to be rack mounted in the Central Office. The unit is connected to a 2-wire or 4-wire analog test number appearance in the central office. The 356E *Plus* automatically emulates a 105, 105E, 107 or 23-Tone responder as required.

Working in conjunction with the 923LTS Hand-held Unit, the 356E *Plus* will emulate a 23-Tone responder. In this mode, it is sensitive to the same impairments that affect high speed modem traffic. To minimize any communications problems, a very robust protocol is used to communicate back and forth between the 923LTS and the 356E *Plus*. This protocol is used to pass status and commands and to transport test results from one unit to another. The 356E *Plus* is also capable of downloading new test templates to the 923LTS. The unit has an RS-232 port for local printing or remote access.

The 356E *Plus* is the "brain" behind the Sage Instruments Automated Local Loop Test System. It stores all the test templates and determines which tests should be initiated. It then compares all test results to the individual templates. It generates a Pass/Fail indication and sends it to the 923LTS. The 356E *Plus* has a real-time clock that time-date stamps all results.

It stores over 100 individual records, including the circuit number, order number, technician's ID number and all individual test measurements.

Each time a test suite is completed, the 356E *Plus* passes the results of the tests to the 923LTS. The 923LTS maintains in its memory results of the last 10 test suites run.

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## A Wide Range of Applications

In addition to working with the 923LTS in the Sage Automated Local Loop Test System, the 356E *Plus* can be used in a variety of other applications.

The 356E *Plus* can be used in conjunction with the 923LTS, the Sage Instruments 930A Communications Test Set, or the 950RTS Remote Test System to address a wide variety of applications in the Central Office, PABX and private network environments. Uses include: provisioning, quality assurance and preventative maintenance of voice, data, fax and special services.

The 356E *Plus* can be placed at Internet ISPs to conduct special studies on Internet modem performance.

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## Test System Controller (TSC)

This TSC software package resides on a Personal Computer and allows the user to remotely communicate with the 356E *Plus*. The user may download circuit performance templates, update software revisions, and extract stored data from the 356E *Plus*. Separate templates may be stored for Copper, Wireless, HFC, or any type of loop required. Individual templates may also be developed for installation tests, maintenance tests and special studies.

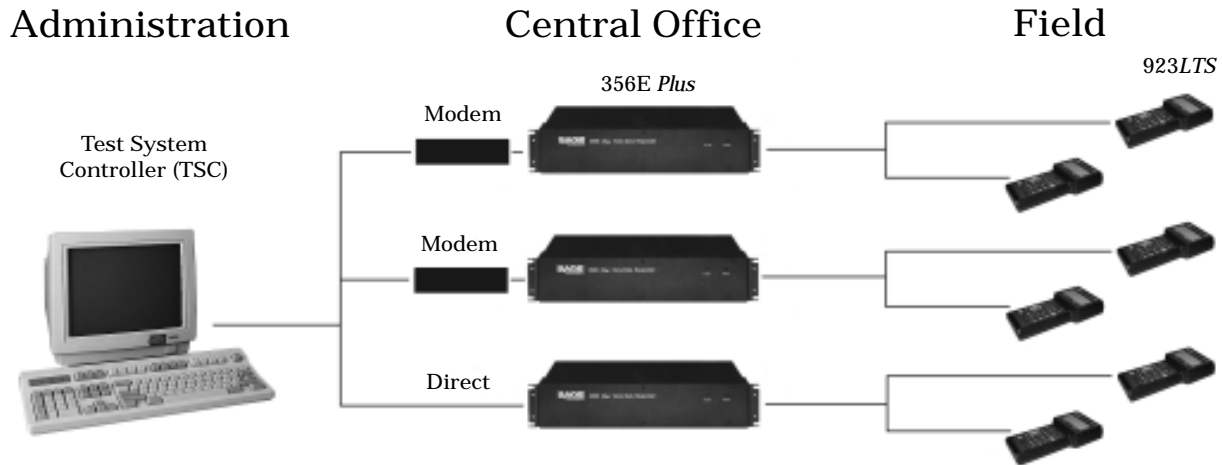
Stored data can be formatted for reporting, or printed for review.

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## TSC Software Utilities

The *Test File Definition Editor* allows the user to create test templates and test limit files for individual service testing.

The *Test File Viewer* utility allows review of extracted test results and generation of printed reports.



The 923LTS, 356E Plus and TSC form an exciting new concept in Local Loop Testing. If you are "lean and mean," concerned about "productivity" and demand "cost effective solutions" CHECK IT OUT!

*There's nothing like it anywhere in the industry.*

# Automated Local Loop Test System



## Standard Features and Options

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### 356E Plus Central Office Unit

Basic Unit  
Includes Operator's Manual

For Information on  
Pricing and Availability  
Consult Your Local Distributor

Options  
Callback  
Additional Operator's Manual

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### Test System Controller (TSC)

TSC Software Package  
Windows-based software used to  
download circuit, performance  
templates and update application  
software, and extract stored data  
from the 356E *Plus*.

For Information on  
Pricing and Availability  
Consult Your Local Distributor

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### 923LTS Hand-held Field Test Unit

Basic Unit  
Includes Operator's Manual,  
AC Adapter, RJ-48 to RJ-11  
Test Cord and Grounding Cable.

For Information on  
Pricing and Availability  
Consult Your Local Distributor

Options

- Built-in Butt Set
- Callback  
(Verifies Switch Translations and Measures  
Ringing Voltage. Callback is also required in the 356E *Plus*.)
- Hits and Jitter Measurements  
(Impulse Noise, Phase/Amplitude Jitter,  
Phase/Gain Hits, and Dropouts)
- Soft Pack Carrying Case
- Test Cord, RJ-48 to Alligator Clips  
Cable, RS-232
- Additional RJ-48 to RJ-11 Test Cord
- Additional Grounding Cable
- Additional Operator's Manual

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## 923LTS Hand-held Field Test Unit Line Interface Specifications

Input: Holding:	2-Wire Loop ≥ 20 ma 42.5 to 105 VDC open circuit voltage with line resistance of ≤1700Ω. Compatible with constant current source
DC Blocking: Balance:	150 VDC >90 dB, 50 to 120 Hz, decreasing 6 dB/Octave above 120 Hz
Termination:	600 or 900Ω or complex impedance; return loss ≥30 dB from 200 to 4000 Hz, ≥15 dB from 20 to 5000 Hz
Listen and Talk:	Built-in speaker (standard) Talk capabilities (optional)
Return Loss Termination:	600Ω or 900Ω (1%) in series with 2.16 μ (3%) or custom termination
AC Bridging Impedance:	> 20,000Ω, 50 to 5000 Hz
AC Impedance to Ground:	> 20,000Ω, tip or ring to ground
Signaling: Dial Pulse:	10 PPS, accuracy ± 2 PPS, 60% break, accuracy ±2%, 700 msec. interdigit timing
DTMF:	
Frequency:	±0.5% of Bell standard frequencies
Level:	-7.0 dBm0 per tone, accuracy ±0.5 dB
Timing:	50 msec. On/Off, accuracy 0.5 msec.

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## 923LTS AC and DC Measurements

DC Measurements:	
Range:	+99 VDC to -99 VDC (with overrange indication)
Voltage Resolution:	0.1 VDC
Voltage Accuracy:	±2% of reading, ±0.3 VDC
DC Measurement Modes	Tip-to-Ring Tip-to-Ground Ring-to-Ground
Tip-to-Ring Current:	
Range:	±125 mA
Resolution:	1 mA DC
Accuracy:	±2% of reading, ±1 mA DC
AC Measurements:	
Voltage Range:	0 to 150 V rms
Voltage Resolution:	1 V rms
Voltage Accuracy:	±2% of reading, ±0.5 V rms
Frequency Range:	20 to 120 Hz
Frequency Resolution:	1 Hz
Frequency Accuracy:	±1 Hz
Ringing:	
Ring Detect:	40 V rms ±8 V
Termination:	(1 REN) resistor in series with capacitor; impedance = 8000Ω @ 20 Hz, 1.5 watts; impedance ≥ 7000Ω @ 70 Hz
Isolation:	
Tip and ring and station ground are isolated from data interface connector, charging connector, and case by more than 500 Volts.	

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## 923LTS/356E Plus Send/Receive Performance Specifications

Send:	
Frequency Range:	50 to 5000 Hz
Resolution:	1 Hz
Accuracy:	±0.5 Hz
Level Range:	+10 to -40 dBm
Resolution:	0.1 dB
Level Accuracy:	
1000 Hz:	±0.1 dBm, 0 to -19 dBm
50 to 5000 Hz:	±0.2 dBm, +10 to -40 dBm
Distortion:	
1 kHz	70 dB, 0 dBm
200 to 3700 Hz:	≤65 dB, 0 to -16 dBm
100 to 5000 Hz:	≤50 dB, +10 to -40 dBm
Receive:	
Frequency Range:	20 to 5000 Hz
Resolution:	1 Hz
Accuracy:	±1 Hz
Level Range:	+10 to -50 dBm
Resolution:	0.1 dB
Level Accuracy (terminated):	
1000 to 1020 Hz:	±0.1 dB, 0 to -19 dBm
200 to 5000 Hz:	±0.2 dB, +10 to -50 dBm
20 to 200 Hz:	±0.5 dB, +10 to -50 dBm
Noise:	
Level Range:	+10 to +100 dBmC
Resolution:	1 dB
Level Accuracy:	1 dB
Filters:	C-Message, C-Notch, 3 kHz Flat
Noise-to-Ground:	
Level Range:	+40 to +130 dBmC
Resolution:	1 dB
Level Accuracy:	1 dB
Filters:	C-Message, C-Notch, 3 kHz Flat

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## 923LTS/356E Plus Test Specifications

3-Tone Gain Slope:	
Frequency:	Programmable 50 to 5000 Hz
Level:	0 to -40 dBm
Loss:	+2.0 dB to -20.8 dBm
Accuracy:	±0.2 dB
C-Message Noise:	
Range:	10 dBmC to 90 dBmC
Accuracy:	±1 dB
C-Notch Noise:	
Frequency:	1020 Hz
Level:	0 to -40 dBm
Range:	20 dBmC to 70 dBmC
Accuracy:	±1 dB
Return Loss:	
Bands:	ERL, SRL High & Low
Level:	0 to -40 dBm
Range:	0 dB to +40.0 dB
Accuracy:	±1 dB
3kHz Flat Noise:	
Range:	20 dBm to 90 dBm
Accuracy:	±1 dB
Filter:	3 kHz Flat
Phase and Amplitude Jitter: (standard and low frequency)	
Frequency:	1020 Hz
Level:	0 to -40 dBm
Filters:	20-300 Hz or 4-300 Hz
Range:	0-20.0% amplitude, 0-20.0° phase
Accuracy:	±5% of reading, ±0.2

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## 923LTS/356E Plus Test Specifications, *Continued*

Impulse Noise/Hits:	
Frequency:	1020 Hz
Level:	0 to -40 dBm
Threshold:	50-90 dBmC
Spread:	1-9 dB ( $\pm 1$ dB)
Measurements per Second:	1-99
Phase Hit Threshold:	5-30° ( $\pm 10\%$ , $\pm 5^\circ$ )
Gain Hit Threshold:	1-8 dB ( $\pm 5$ dB)
Test Length:	1 to 99 minutes (each way)
Range:	0 to 999 impulses/hits
Accuracy:	$\pm 1$ impulse/hit
23-Tone Test	
Transmitter:	
Composite Level:	0 dBm to -40 dBm
Individual Tones:	
Level:	-13.6 dB below Composite Level
Flatness:	$\pm 0.1$ dB
Frequencies:	203.125 to 3640.625 Hz in 156.25 Hz steps $\pm 10$ ppm
Phase:	per IEEE 743 $\pm 0.25^\circ$
Peak to RMS Ratio:	8.79
Receiver:	
Range:	-40 dBm to -6 dBm
Level:	$\pm 0.2$ dB
Attenuation:	$\pm 0.2$ dB
Envelope Delay Distortion:	
Accuracy:	$\pm 10$ $\mu$ secs
Range:	10,000 $\mu$ secs
Frequencies:	281.15 to 3562.5 Hz in 156.25 Hz steps
Signal-to-Noise:	$\pm 2$ dB from 10 dB to 24 dB $\pm 1$ dB from 25 dB to 40 dB $\pm 2$ dB from 41 dB to 45 dB
Signal-to-Total Distortion:	$\pm 2$ dB from 10 dB to 24 dB $\pm 1$ dB from 25 dB to 40 dB $\pm 2$ dB from 41 dB to 45 dB
Intermodulation Distortion: (2nd and 3rd order)	$\pm 2$ dB from 20 dB to 29 dB $\pm 1$ dB from 30 dB to 46 dB $\pm 2$ dB from 47 dB to 55 dB $\pm 3$ dB from 56 dB to 60 dB

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## General

923LTS	
General:	
Weight:	Approximately 20 oz.
Size:	Approximately 4" Wide, 1.5" High X 9" Long
Temperature:	0 to 50° C, operating -20 to + 60° C, storage
Humidity:	85% Noncondensing
Serial Data Input/Output:	1200, 9600, 38,400 and 115,200 bps
Power:	120 VAC, 60 Hz or battery
356E Plus	
General:	
Weight:	7 lbs., 12 lbs. Shipping
Size:	3.5" High X 17" Wide X 10" Deep
Humidity:	85% Noncondensing
Temperature:	0-50° C
Power:	120 VAC, 60 Hz @ 0.2 Amp