



Sage Instruments

935AT

Test Options Guide

Last Updated 20 February 2001



Table of Contents

- 935AT Applications 3
 - Transmission 3
 - Signaling and Supervision 3
 - Trunks 3
 - Digits 3
 - Emulation 3
 - PCM 3
 - Voice Quality 4
 - User Interface 4
- 935AT Purchased Options 5
 - 935AT-100 Fax/Modem TMS Package 5
 - Peak-to-Average Ratio 5
 - 3-Level Impulse Noise 5
 - Phase/Amplitude Jitter and Hits 5
 - Envelope Delay Distortion 5
 - 4-Tone Intermodulation Distortion 5
 - Absolute Delay 5
 - 23 Tones 6
 - 935AT-110 Voice Circuit Test Package 6
 - Remote Office Test Line, Interrogator, Responder 6
 - 935AT-200 BER Test Package 7
 - DS-1 and DS-0 (56/64 Kb) Bit Error Rate Testing (BERT) and Fractional DS-1 BERT 7
 - DS-1 BERT (Standard Feature) 7
 - DS-0 (56/64 Kb) BERT (Standard Feature) 7
 - Dual Direction Fractional T-1/DDS 7
 - Fractional T-1 Testing 7
 - DDS Testing 8
 - 935AT-210 SS7 Call Trace and Error Analysis 8
 - 935AT-320 Digital Rear Panel Access 8
 - 935AT-330 Ring Generator/True REN-3 Load 8
 - 935AT-340 Wideband TMS 9
 - 935AT-347 Remote Audio Monitor 9
 - 935AT-348 -48V DC Office Battery Power Supply 9
 - 935AT-436 Extended Warranty 9
 - 935AT-541 PSQM 9
 - 935AT-555 Echo Sounder 9
 - 935AT-575 Packet Voice Impairment Test (PVIT) 10
 - 935AT-9400-2400 930Win 10
 - Contacting Sage Instruments 10



935AT Applications

The 935AT Communications Test Set combines the functions of a voiceband transmission measurement set (TMS) and wideband TMS, signaling emulator and analyzer, T-1 test set, and voice quality analyzer in a portable package.

This test set, while general purpose in nature, is particularly useful for DEMARC and Central Office testing, as well as PBX and Circuit Switch and Packet Switch installation testing. It is capable of performing all in-band transmission and signaling tests required at these locations, including those for Feature Groups A - D (Equal Access). The 935AT can simulate or monitor both ends of a typical North American circuit.

Transmission

The following list shows the standard features and capabilities of the 935AT transmission testing.

- level and frequency
- noise (C-message, C-notch, and 3-KHz flat weighted)
- signal-to-noise ratio
- peak-to-average ratio (P/AR)
- 3-level impulse noise
- phase and amplitude jitter and hits
- envelope delay distortion (EDD)
- 4-tone intermodulation distortion (IMD)
- frequency sweep
- return loss (2- and 4-wire)
- establish (hold) talk conditions

Signaling and Supervision

The following list shows the standard 935AT signaling and supervision simulation capabilities.

Trunks

- loop start (2- and 4-wire or SX; normal and reverse battery)
- ground start (2- and 4-wire; normal and reverse battery)
- E&M signaling Types I through V
- T-1 interface with D4 SF, ESF, and SLC-96 framing

Digits

The 935AT can send and receive and analyze strings of DP, MF, and DTMF digits up to a length of 72 digits. The digits can be analyzed for % break, dial speed, inter-digit time, amplitude of low and high tones, frequency of low and high tones, timing, and spurious tones.

Emulation

The 935AT can send, receive, and monitor sequences of signaling events composed of digit records, supervision events (wink, off hook, delay dial), and call progress (monitor only). This feature allows the 935AT to monitor or emulate either end of a typical North American circuit for troubleshooting or qualification.

PCM

The following list shows the PCM capabilities of the standard 935AT.

- simultaneously monitor both directions of transmission on digital facilities
- perform true drop and insert tests



The 935AT can be connected to a T-1 carrier and perform the same measurements on PCM trunks as it does on metallic trunks.

- dual-direction test capability

The 935AT can sit in series with an in-service T-1 facility between two offices. The 935AT can drop out one of the incoming 24 channels and insert a test into the outgoing channel without taking the other 23 channels carrying traffic out-of-service.

- compare T-1 clocks in both directions to measure wander or drifting clocks
- monitor or perform out-of-service testing when terminating a T-1 span
- accommodate D1D, D2, and D3/D4 channel numbering sequences
- access standard D4 superframe format, extended superframe format, and SLC-96® trunks
- send robbed-bit and CCIS signaling, as well as AMI or B8ZS line codes
- internal/external (loop timed) clock source operation
- send remote (yellow) alarm and blue alarm signals
- normal loop supervision or user-definable supervision states
- detect and count
 - bipolar violations
 - frame slips
 - bit slips
 - frame errors
 - CRC errors (ESF mode)
 - frame loss (red alarm)
 - loss of PCM or >15 consecutive zeroes
 - remote alarm (yellow alarm)
 - blue alarm
- simultaneous real-time display of A and B signaling bits on all 24 channels
- manual manipulation of A and B signaling bits on a selected channel
- measure DSX voltage
- error history in 15 minute blocks for up to 24 hours
- single error injection of BPVs, frame errors, or CRC errors (ESF)
- simulates the tri-state signaling on ground start foreign exchange trunks being carried on PCM trunks
- customer service unit (CSU) interface, allowing a low-level direct connection from the 935AT to a T-1 span without an intermediate office repeater or CSU unit
- high stability clock source for Extended Superframe (ESF) operation.

Voice Quality

- Perceptual Speech Quality Measurement (PSQM) provides PSQM and MOS scores, round trip delay, and audio level
- Echo Sounder measures up to 4 echoes and correlating delays
- Packet Voice Impairment Test (PVIT) measures voice frame loss, voice frame slips (jitter resizing), voice clippings, and noise hits
- ITU Standard 0.22, Automated Test Measurement Equipment (ATME) verifies echo cancellers and qualifies digital transmission facilities
- Bellcore CB106, 105 testline (Type 56) measures voice band impairments

User Interface

- RS-232 control
- store and recall up to 999 tests
- remote control via a display terminal or computer
- interface connection for an 80-column serial printer



The Purchase Options enhance the feature set of the 935AT and greatly extend its testing capabilities. Listed below are some of the major extended test functions that can be performed only if the appropriate options are purchased:

Each of the options described in the following sections is designated software only (SO), software and hardware (S/H), or hardware only (HO). Software-only options can be installed in the field. Software-and-hardware and hardware-only options might need to be installed at the factory. Contact Sage Instruments to determine whether a unit needs to be returned to the factory for a particular option.

935AT Purchased Options

935AT-100 Fax/Modem TIMS Package

Peak-to-Average Ratio

The 935AT can send and measure the P/AR waveform over a 0–120 P/AR unit range. The P/AR test is a measure of the channel dispersion (amplitude and phase distortion over time) due to transmission impairments. The P/AR waveform is a complex signal consisting of 16 non-harmonically related tones with a spectrum which approximates modem type data signals on VF trunks.

The P/AR test provides a quick method of gauging the deterioration of a channel, if any, without having to resort to the very expensive and time consuming tests such as attenuation distortion, envelope delay distortion, 4-tone intermodulation distortion, or phase jitter.

It is important to note that P/AR is only valid as an end-to-end measurement. Test sets are required at both ends of the circuit. The 935AT is fully compatible with existing P/AR test sets.

3-Level Impulse Noise

The 935AT can measure 3-level impulse noise, which is described in AT&T and IEEE published standards and specifications for measurements on voice band data circuits. The default settings in the 935AT take note of the fact that impulse noise is usually measured with the holding tone present by allowing users to select the C-message filter instead of the default C-Notch filter. This parameter, while not a tariff parameter, is extremely important on circuits carrying voice band data.

The low threshold level setting range is 30–106 dBmC. Users can set the measurement spread between the low, medium, and high thresholds in 2, 4, 6, or 8 dB steps. Users can also adjust the time duration of the measurement from 1 to 99 minutes or continuously. The standard duration is 15 minutes. Users can vary the number of measurements per second from the standard value of 7 up to 99 measurements per second.

Phase/Amplitude Jitter and Hits

The 935AT can measure phase and amplitude jitter simultaneously, as well as count phase hits, gain hits, and dropouts in conjunction with the impulse noise counters. This option can be used on metallic trunks or on PCM channels on a T-1 span. This measurement is different than timing jitter measurements on a T-1.

The range of measurement is 0° to 25° peak-to-peak phase jitter, and 0% to 25% peak amplitude jitter. Up to 999 phase hits can be counted, and the threshold is adjustable from 5° to 45°. Up to 999 gain hits can be counted, and the threshold is adjustable from 2 dB to 10 dB. Dropouts use a fixed threshold of 12 dB relative to the level of the holding tone. The received holding tone level is measured at the start of testing; if the level drops more than 12 dB below the reference level, a dropout is declared.

Envelope Delay Distortion

The 935AT can measure the envelope delay distortion on metallic or PCM trunks. The measurement range is up to 12000 μ s, ± 10 μ s, with a resolution of 1 μ s. SEND mode is equivalent to other test sets in MASTER mode, and REPEAT mode is equivalent to other sets in SLAVE mode.

4-Tone Intermodulation Distortion

The 935AT can measure the second and third order harmonic distortion products using the 4-tone method. The 935AT automatically adjusts itself for the signal-to-noise ratio, and requires no manual calculations to obtain the test results.

Absolute Delay



The 935AT can measure roundtrip absolute delay on a 4-wire metallic or PCM circuit with loopback. The measurement is in ms with a range from 0 to 1.2 seconds and an accuracy of ± 1 ms.

23 Tones

The 935AT can make a variety of transmission impairment measurements across the full channel spectrum in a short period of time. The test signal consists of 23 equally spaced, phase coherent tones ranging from 203 Hz to 3228 Hz. The phase relationships of the tones create a signal that simulates the probability density of high speed modems such as V.29, V.32, and V.34. A single burst of 23 tones that lasts only three seconds can yield multiple measurements.

- attenuation distortion at 23 frequencies
- envelope delay distortion at 22 frequencies
- signal-to-total distortion ratio (S/TD)
- second and third order intermodulation distortion

In addition, the 23-tone test has capabilities not available with traditional techniques:

- Two-wire EDD is measured immediately without a repeater set or a return path.
- The 23-tone S/TD measurement uses a complex signal that stresses the channel much better than a single tone, and intermodulation products are included in the reading.
- ADPCM detection: the complexity of the 23-tone signal causes channels that use signal compression to exhibit a characteristically low S/TD ratio.

935AT-110 Voice Circuit Test Package

Remote Office Test Line, Interrogator, Responder

The 935AT can emulate a Type 105 test line, a manual remote office test line (ROTL)/near-end responder, or a ROTL interrogator. The 935AT provides a test capability similar to that provided by the CAROT system for automated routing of trunks in manual or remote control applications. The 935AT performs the following tests in this mode.

- 1004-Hz loss
- noise
- noise with tone
- gain/slope tones
- ERL
- SRL-LO
- SRL-HI

Users can perform two-way end-to-end testing without requiring technicians at both ends of the circuit under test. Instead, a 935AT or a Type 105 responder is needed at the far-end.

If the 935AT also has Option 935AT-100, Fax/Modem TIMS Package, then the 935AT can extend the 105 testing to the voice band data tests (P/AR, impulse noise, EDD, phase/amplitude jitter and hits).

When acting as a ROTL/near-end responder, the 935AT can work with another 935AT (equipped with the appropriate options) acting as a far-end responder or a Sage Instruments 356E Far-End Responder, and perform the following tests, in addition to those mentioned above.

- attenuation distortion
- signal-to-noise ratio
- 3-KHz flat noise
- 4-tone intermodulation distortion
- phase/amplitude jitter (20–300 Hz)
- phase/amplitude jitter (4–300 Hz)
- 3-level impulse noise and hits

The 935AT can also act as a ROTL interrogator when used with the standard CAROT system.

When acting as an ATME director, users can perform automated two-way end-to-end tests for echo cancellers, loss, noise, noise with tone, gain/slope, and bert using a 935AT or a ITU Type 0.22 ATME responder at the far-end.



Tests include:

- 1020Hz@0dBm
- 400Hz@0dBm
- 2800Hz@0dBm
- 1020Hz@-10dBm
- 400Hz@-10dBm
- 2800Hz@-10dBm
- Noise/CMS
- S/TD with -10dBm tone
- S/TD with -25dBm tone
- EC LEVEL
- Far to Near Noise
- Near to Far noise
- Bypass Loss
- BER test (in PCM only)

When acting as a PSQM director, users can perform automated two-way end-to-end voice quality tests for PSQM and MOS scores, round trip delay, and audio level using a 935AT at the far-end as a PSQM responder.

935AT-200 BER Test Package

DS-1 and DS-0 (56/64 Kb) Bit Error Rate Testing (BERT) and Fractional DS-1 BERT

DS-1 BERT (Standard Feature)

DS-1 BERT allows the 935AT to send patterns and detect bit or logic errors in addition to bipolar violations, frame errors, and CRC errors, which are already monitored. With this option the 935AT also has a dual BERT capability: a single 935AT can emulate two ordinary BERT sets.

The following patterns are available in Option Menu 46, DS-1 Bit Error Rate.

- QRSS
- 3 in 24
- 72 octect
- 2²³-1
- 2¹¹-1 (2047)
- user (3–24 bit)
- all ones
- 96 octect
- 2²⁰-1
- 2⁹-1 (511)
- 1:1 (alternating)
- 55 octet
- 120 octect
- 2¹⁵-1
- long
- 1:7
- 55 octect daly*

* 55 octect daly is a 55 octect pattern modified to not cause excess zeros when sent framed.

DS-0 (56/64 Kb) BERT (Standard Feature)

DS-0 BERT allows the 935AT to send patterns and detect logic errors within a single time slot of the DS-1 bit stream. Users can perform this test on a single channel without affecting other channels on the T-1. Switched 56Kb and 64Kb clear channel testing are both supported. Echo canceller disable tone is available, compliant with CCITT G.164/G.165. V.54 loopback is supported in switched 56Kb testing.

The following patterns are available in Option Menu 56, DS-0 Bit Error Rate.

- 2¹¹-1 (2047)
- long
- 72 octet
- 2⁹-1 (511)
- 1:7
- 96 octet
- user (3-8 bit)
- 55 octet
- 120 octet
- user (1–256 bytes)
- 55 octet daly*

* 55 octect daly is a 55 octect pattern modified to not cause excess zeros when sent framed.

Dual Direction Fractional T-1/DDS

Dual Direction Fractional T-1/DDS allows fractional T-1 and DDS testing from a T-1 access point.

Fractional T-1 Testing

Three modes of fractional T-1 testing are available: contiguous, noncontiguous, and true noncontiguous. Selected DS-0s can be tested at 56 or 64 Kbps.



- **Contiguous fractional T-1** testing allows channel selection on an N x 56 or N x 64 basis, where the channels are sequential (or non-sequential in increasing order) and carried on the same transmission facilities.
- **Noncontiguous fractional T-1** testing allows any combination of DS-0s to be specified for testing; the DS-0s must still be carried on the same transmission facilities. Remote loopbacks can be performed with V.54 loopback codes.
- **True noncontiguous Fractional T-1** testing allows any combination of DS-0s to be tested. The DS-0s can be carried on separate transmission facilities (i.e., have unequal network delays). This allows testing of facilities at the T-1 access point that are used with inverse multiplexers for resynchronization. With true noncontiguous testing, pattern synchronization and error indications are available on a per DS-0 basis.

The following patterns are available in Option Menu 55, DS-1 Fractional T-1 BERT.

Noncontiguous Fractional T-1

- $2^{15}-1$
- $2^{11}-1$ (2074)
- 2^9-1 (511)
- user (3–8 bit)
- long

True Noncontiguous Fractional T-1

- $2^{20}-1$
- $2^{14}-1$
- $2^{11}-1$ (2074)
- 2^9-1 (511)
- long

DDS Testing

DDS testing can be performed on DS0-A or DS0-B formatted signals at a T-1 access point. Data rates from 56K to 2400 bps are supported in DS0-A, and from 9600 to 2400 bps in DS0-B. Testing can be performed with standard PRBS patterns and the special DDS stress patterns. Both latching and alternating loopbacks are available in all modes. Multiport junction unit (MJU) control and testing are supported.

The following patterns are available in Option Menu 58 DDS Bit Error Rate.

Switched 56K

- $2^{15}-1$
- $2^{11}-1$ (2074)
- 2^9-1 (511)
- user (3–8 bit)

64K/DS0-A/DS0-B

- $2^{23}-1$
- $2^{20}-1$
- $2^{15}-1$
- $2^{11}-1$ (2074)
- 2^9-1 (511)
- DDS stress 1
- DDS stress 2
- DDS stress 3
- DDS stress
- 4 DDS stress 5*

*DDS stress pattern 5 is a composite of patterns 1 through 4.

935AT-210 SS7 Call Trace and Error Analysis

This option allows non-intrusive error monitoring with direct T-1 access. The 935AT can monitor two 56 or 64 Kb SS7 links in both directions. This option allows you to determine link status, isolate transmission from protocol problems, trap and trace individual or multiple call segments, and determine line activity and percent line utilization. Powerful programs that are part of this option auto-configure the unit, automatically find the SS7 links, and allow the user to perform call trace functions.

935AT-320 Digital Rear Panel Access

This option provides wire-wrap terminals for PCM connection on rack mount (permanent) 935AT installations.

935AT-330 Ring Generator/True REN-3 Load

With this option the 935AT has a true sine wave ringing supply. Users can set the ringing frequency, ring voltage, and ring duration. This option also includes a three ringer equivalent load.



935AT-340 Wideband TMS

Wideband TMS extends the measurement ability of the 935AT from a range of 20 Hz to 5 kHz to a range of 20 Hz to 300 kHz. Wideband TMS provides additional noise filters for the 935AT including program, 15-KHz flat, 50 Kb, E-filter (IEEE standard for ISDN testing), and 3-level wideband impulse noise.

935AT-347 Remote Audio Monitor

This option allows users to monitor the test progress of a remote 935AT over a telephone line. In PCM mode, this option also allows a telephone conversation over the line under test from a remote site.

935AT-348 -48V DC Office Battery Power Supply

With this option the 935AT can be powered from the -48 V DC Central Office battery supply. This provides operation essentially from an uninterruptible power supply, but removes the capability for the 935AT to operate from 110 V AC. Therefore, this option is intended for 935AT units that are rack-mounted or otherwise permanently installed in systems, etc., and not for portable operation. The 935AT can be powered either from 110 V AC or -48 V DC, but not both in the same unit.

935AT-436 Extended Warranty

This option increases the warranty on 935AT parts and labor from 1 year to 3 years.

935AT-541 PSQM

With PSQM Director and Responder option, users can characterize voice quality (clarity and latency) by performing two-way end-to-end tests using a 935AT at the nearend (Director) and a 935AT at the far-end (responder). Tests include:

- PSQM Score
- MOS Score
- Round Trip Delay
- Audio Level

935AT-555 Echo Sounder

With Echo Sounder, users can continuously detect and isolate sources of echo. Measurements include:

- Up to Four Echo Amplitudes
- Round Trip Delay(s)



935AT-575 Packet Voice Impairment Test (PVIT)

With the Packet Voice Impairment Test (PVIT), users can continuously monitor for dynamic impairments in a voice over packet network. Measurements include:

- Voice Frame Loss
- Voice Frame Slips (Jitter re-sizing)
- Voice Clippings
- Noise Hits

935AT-9400-2400 930Win

With the 93X Remote Control Interface Software (Single user license), users can remotely control the 935AT over a direct serial or TCP/IP connection. Features include:

- Virtual 935AT Display
- Point & Click Mouse Control
- Script Generation Tool

Contacting Sage Instruments

For product and company information, technical support, or service, contact Sage via any method listed below. Customers located outside of the US may also contact their nearest Sage distributor for assistance.

Mail	Sage Instruments, Inc. 240 Airport Blvd. Freedom, CA 95019-2614
E-mail	sales@sageinst.com or support@sageinst.com
Phone	831-761-1000 M-F, 9 a.m. to 5 p.m., Pacific Time
Web	http://www.sageinst.com