

SECTION VII

SPECIFICATIONS

This section contains general information regarding the installation and operation of the Sage Instruments **930A** Communications Test Set.

The **930A** specifications are listed in Section 7-1. These specifications are the performance standards or limits against which the instrument is tested. Options for the instrument have separate specifications which are provided on supplementary specification sheets or within the sections of this manual describing the specific option.

7-1 DESCRIPTION

The **930A** combines the functions of a Transmission Impairment Measurement Set (TIMS); a Return Loss Measurement Set; Dial Pulse, Touchtone® (DTMF) and Multi-Frequency (MF) Sender and Talk Battery supply into one lightweight package. Hardware and software options allow the user to greatly increase the capabilities of the **930A**.

7-2 STANDARD FEATURES

7-2.1 Level/Frequency

TRANSMITTER

Frequency Range:	50 Hz to 5.0 kHz (0.131)
Resolution:	1 Hz
Accuracy:	±1.0 Hz
Output Steps:	1 Hz, 10 Hz, 100 Hz, or 1000 Hz steps
Frequency Sweep:	Single or Continuous with selectable bounds, level and step size.
Level Range:	-60 dBm to +12 dBm
Resolution:	0.1 dB
Accuracy:	±0.1 dB @ 1020 Hz (0 to -19 dBm) ±0.2 dB at all other frequencies.
Flatness:	±0.2 dB (200 Hz to 5 kHz referenced to level at 1 kHz)
Distortion:	-70 dB @ 1020 Hz, 0 dBm

RECEIVER

Frequency Range:	50 Hz to 5.0 kHz
Resolution:	1 Hz
Accuracy:	±1.0 Hz
Level Range:	-50 dBm to +12 dBm
Resolution:	0.1 dB
Accuracy:	±0.1 dB @ 1020 Hz (0 to -19 dBm), ±0.2 dB @ 200 Hz to 5 kHz
Detector:	RMS or Average

7-2.2 Noise Measurements

Input:	Balanced or Noise-to-Ground
Weighting Filters:	C-MSG, C-NOTCH, 3 kHz Flat
Notch Filter:	1010 Hz (995 Hz to 1025 Hz Notch); >60 dB Notch depth
Range:	10 dBm to 100 dBm (Balanced) 50 dBm to 130 dBm (Noise-to-Ground)
Resolution:	1.0 dB
Accuracy:	±0.5 dB
SIGNAL-TO-NOISE	
Level Range:	-50 dBm to +10 dBm
Noise Range:	10 dBm to 90 dBm
S/N Range:	10 dB to 70 dB
Accuracy:	±0.5 dB
Resolution:	1.0 dB

7-2.3 Return Loss

Modes:	ERL, SRL-Low, SRL-High or Sinewave (OSCillator mode)
Transmitted Signal:	Meets the specifications of Bell Publication 41009 (page 13, Tables D, E and F,) and IEEE Standard 743-1984

ECHO CANCELLER DISABLE TONE

Frequency:	2100 Hz, ±1 Hz
Phase Reversals:	450 ms, ±5 ms; 180°, ±5°
Level:	-12 dBm0, ±1 dB

2-WIRE RETURN LOSS

Transmitter Level:	-10 dBm0
Receiver Range:	0 dB to 40 dB
Resolution:	1.0 dB
Accuracy:	±0.5 dB
Internal Hybrid Impedance:	600 or 900 Ohms ± 0.1% in series with 2.16 uF ± 1%

4-WIRE RETURN LOSS

Impedance:	150, 600, 900, or 1200 Ohms
Transhybrid Loss Compensation:	-30 dB to +30 dB
Transmitter Level:	-10 dBm0—in Oscillator mode the level is 0 dBm relative to the TLP
Receiver Range:	-10 dB to 50 dB
Resolution:	1.0 dB
Accuracy:	±0.5 dB

7-2.4 Supervision/Signaling

WINK TIMING

Resolution: 5 ms
 Accuracy: ± 5 ms
 Wink Fail Event: Fails for wink period > 600 ms
 Off-Hook Fail Event: Fails for Off-Hook period < 600 ms

E/M SUPERVISION

Types: I, II, III, IV, V
 Battery: -48 VDC current limited to 200 mA
 Threshold Voltages:

	<u>E Lead</u>	<u>M Lead</u>
On-hook	< -39 V	> -11 V
Off-hook	> -11 V	< -39 V

LOOP SUPERVISION

Types: 2- and 4-wire Loop Start, Ground Start, Loop Reverse Battery, and SX supervision.
 Battery: -48 VDC series limited to 120 mA

MF AND DTMF SUPERVISION

Frequency Accuracy: $\pm 0.1\%$ of ITU-T Standard Frequencies
 Adjustment Range: Tone Frequencies adjustable in 0.1% steps to $\pm 10\%$ of standard Bell frequencies for Margining Tests.
 Level: Automatically adjusted to -7 dBm0 per tone.
 Level Adjustment Range: Tone level adjustable in 0.1 dB steps from -60.0 dBm to +6.0 dBm
 Resolution: 0.1 dB
 Accuracy: ± 0.2 dB
 Timing: MF: 70 ms Tone On and Tone Off (KP is 100 ms Tone On)
 DTMF: 50 ms Tone On and Tone Off
 Timing Adjustment Range: Tone On and Tone Off times adjustable in 1 ms steps from 13 ms to 267 ms.
 Resolution: 1 ms.
 Accuracy: ± 1.0 ms.

7-2.5 Dial Pulse Sender

PPS

Range: 2 to 50 PPS (PCM), 2 to 35 PPS (metallic)
 Resolution: 0.1 PPS
 Accuracy: $\pm 1.0\%$ at 10 PPS

% BREAK

Range: 5 to 95%
 Resolution: 0.1%
 Accuracy: $\pm 1.0\%$ for 25% to 75% BRK at 10 PPS

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INTERDIGIT TIMING

Range:	40 to 990 ms.
Resolution:	10 ms.
Accuracy:	±5 ms.

7-3 GENERAL

Impedances:	150, 600, 900, 1200 Ohms and > 50 KOhms Bridging
Maximum DC Blocking:	160 VDC
Audio Bandwidth:	±3.0 dB 300 Hz to 3.0 kHz
Audio Volume:	Adjustable by front panel control

Longitudinal Balance:	90 dB at 60 Hz
Receiver Return Loss:	>30 dB 200 Hz to 5 kHz (600, 900, 1200 Ohms) >30 dB 800 Hz to 5 kHz (150 Ohms)

Display:	40 char. vacuum fluorescent plus 4 LED's for on/off-hook status
AC Power Supply:	115 VAC ± 10%, 60 Hz
Operating Temperature:	0° C to 50° C
Storage Temperature:	- 40° C to 70° C
Dimensions:	5.79" H. x 14.33" W. x 14.25" D
Weight:	16 to 18 lbs. depending upon options

7-4 PURCHASED OPTIONS

7-4.1 MF/DTMF/DP Receiver and Analyzer (Option 930A-01)

MF AND DTMF

Input Level Range:	-25 dBm to 0 dBm
Accuracy:	±0.2 dB
Resolution:	0.1 dB
Input Frequency Range:	±10% of AT&T standard frequencies for MF and DTMF tones
Accuracy:	±0.1%
Resolution:	1 Hz
Input Tone on/off Range:	35 ms. to 250 msecs. Tone on 35 msecs. to 250 msecs. Tone off
Accuracy:	±5 ms.
Resolution:	1 ms.

DIAL PULSE (DP)

PPS Range:	5 PPS to 30 PPS
Accuracy:	±2% @ 10 PPS
Resolution:	0.1 PPS

% Break:	10% to 90%
Accuracy:	±2% (25% to 75% break at 10 PPS)
Resolution:	1%
Interdigit Timing Range:	50 ms. to 990 ms.
Accuracy:	±5 ms.
Resolution:	1 ms.

7-4.2 SF Supervision (Option 930A-02) ---

SF Oscillator:	2604 Hz ± 1.0 Hz
Send Level:	-36 dBm0 on-hook, -13 dBm0 pulse
Receiver Sensitivity:	-42 dBm0

7-4.3 PEAK-TO-AVERAGE RATIO (P/AR) (OPTION 930A-06) ---

Transmit Level Range:	0 dBm to -40 dBm
Resolution:	0.1 dB
Receive Level Range:	-40 dBm to +12 dBm
Resolution:	0.1 dB
P/AR Measurement Range:	0 to 120 P/AR units
Resolution:	1 P/AR unit
Accuracy:	±1 P/AR unit

7-4.4 3-Level Impulse Noise (Option 930A-07) ---

Weighting Filter:	C-Notch
Threshold Range:	30 dBmC to 106 dBmC
Accuracy:	±1.0 dB
Threshold Spread:	2, 4, 6, or 8 dB steps
Timer:	1 min. to 99 mins. or continuous
Counter Capacity:	0 to 9999 for LO, MD and HI.
Measurements Range:	7 to 99 measurements per second

7-4.5 DS-1 PCM Drop/Insert Options (Options 930A-08E, 09E) ---

Format:	DS-1 AMI or B8ZS Line Code
DS-1 Input Frequency:	1.544 Mbps ±15 kbps
Jitter Tolerance:	Exceeds Bell Pub 43802 Requirements
Channel Numbering	
Sequence:	D1D, D2, D3/D4/D5
Signaling Mode:	NORM (Robbed Bit) or CCIS
Framing Format:	D4 Superframe, Extended Superframe or SLC-96
Selection:	Automatic or manual selection of frame format-D4/SF or ESF
Input Mode:	Terminated: 100 Ohms nominal Bridging: >1000 Ohms
Input Level:	200 mV to 6.0 V. base-to-peak

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Input Level Measurement:	200 mV to 6.0 V. ± 50 mV base-to-peak or -23 dBdsx to +3 dBdsx ± 1 dB								
DS-1 Output:	1.544 Mbps ± 40 bps (Stratum 4) in INTERNAL Clock mode. Output rate equal to input rate in LOOP-TIMED mode								
Frequency Skew:	Output frequency can be shifted by 100 bps in INTERNAL Clock mode to verify far-end loop-timed status								
Output Pulse Level:	3.0 V. nominal base-to-peak into 100 Ohms resistive load								
Output Imbalance:	Positive and Negative pulses are within 0.2 V. base-to-peak								
Channel Selection:	Any one of 24 selectable from keypad								
PCM Supervision Displays:	40 character vacuum fluorescent display shows A and B bit signaling states for all 24 channels (Option Menu #: 20) simultaneously. In ESF mode A, B, C and D bits are displayed. 4 LED's show status of on/off-hook supervision of selected time slot								
Operating Modes:	TERMINATE: selected channel is connected to channel generator and receiver. Other 23 channels send IDLE code (7F) MONITOR: monitor selected channel in one or both directions. All 24 channels pass through unchanged. Framing is regenerated. DROP&INSERT: dual-direction only. Selected channel dropped out for testing. Other 23 channels pass through unchanged. (Option 930A-09E)								
Pattern Simulation:	Idle Code (7F), Received PCM Optional patterns require Option 930A-22 Bit Error Rate testing								
Frame Loss Criteria:	Loss of frame occurs when 2 out of 4 Ft bits are in error for Superframe and SLC-96. Loss of frame for ESF occurs when 2 out of 4 FPS bits are in error								
Error Displays:	Detects and counts Frame Errors, Bipolar Violations, Frame Slips and CRC Errors (ESF Only).								
Alarms:	Sends Blue Alarm (All Ones) or Yellow Alarm (ALL Bit#2=0) on Superframe and sent on Facility data Link for ESF								
Alarm Displays:	Detects and displays Frame Loss, Carrier Loss, Excess 0's, Yellow and Blue Alarm.								
<i>PCM CHANNEL ENCODER</i>									
Analog Tone Generation:	20 Hz to 3904 Hz selectable in 1.0 Hz steps from keypad +3.0 dBm to -50.0 dBm in 0.1 dB steps selectable from keypad								
Frequency Response:	± 0.1 dB (20 Hz to 3904 Hz)								
Basic Accuracy:	<table><thead><tr><th><u>Accuracy</u></th><th><u>Level</u></th></tr></thead><tbody><tr><td>± 0.1 dB</td><td>+3.0 dBm0 to -30 dBm0</td></tr><tr><td>± 0.2 dB</td><td>-30 dBm0 to -40 dBm0</td></tr><tr><td>± 0.5 dB</td><td>-40 dBm0 to -50 dBm0</td></tr></tbody></table>	<u>Accuracy</u>	<u>Level</u>	± 0.1 dB	+3.0 dBm0 to -30 dBm0	± 0.2 dB	-30 dBm0 to -40 dBm0	± 0.5 dB	-40 dBm0 to -50 dBm0
<u>Accuracy</u>	<u>Level</u>								
± 0.1 dB	+3.0 dBm0 to -30 dBm0								
± 0.2 dB	-30 dBm0 to -40 dBm0								
± 0.5 dB	-40 dBm0 to -50 dBm0								
Supervision:	NORMAL (E&M), USER DEFINED states of A and B bits (C and D bits in ESF). FXO/FXS simulation (Option 930A-25)								
Signaling:	MF, DTMF aDP								

PCM CHANNEL DECODER

Recovered Analog Tones: 20 Hz to 3904 Hz \pm 1 Hz
 Recovered Level: +3.0 dBm to -40.0 dBm (Average and RMS)
 Basic Accuracy: \pm 0.1 dB with Digital Milliwatt

<u>Accuracy</u>	<u>Input Level</u>
\pm 0.1 dB	+3.0 dBm0 to -30 dBm0
\pm 0.2 dB	-30 dBm0 to -40 dBm0
\pm 0.5 dB	-40 dBm0 to -50 dBm0

Frequency Response: \pm 0.1 dB @ 204 Hz to 3904 Hz with 0 dBm applied.
 Supervision: On-hook and Off-hook supervision are user definable as any combination of A, C and B, D bits (i.e., 0, 1, or "don't care"). FXO/FXS supervision available with Option 930A-25

Signal to Total Distortion:

<u>Input</u>	<u>7 5/6 Signaling</u>	<u>CCIS</u>
0 to -30 dBm0	38 dB	40 dB
30 to -40 dBm0	36 dB	36 dB
-40 to -50 dBm0	32 dB	32 dB

Gain Tracking Error:

<u>Input</u>	<u>Max. Deviation</u>
+3.0 to -30 dBm0	\pm 0.1 dB
-30 to -40 dBm0	\pm 0.2 dB
-40 to -50 dBm0	\pm 0.5 dB

Intrinsic Noise: 10 dBmC (with Idle Code received)

7-4.6 Phase/Amplitude Jitter and Hits (Option 930A-18)

PHASE AND AMPLITUDE JITTER MEASUREMENTS

Received Holding Tone Level: +10 dBm to -40 dBm (Metallic)
 0.0 dBm to -40 dBm (PCM)
 Holding Tone Frequency Range: 990 Hz to 1030 Hz
 Phase Jitter Measurement: 0.0° to 30.0° peak-to-peak
 Accuracy: \pm 5%, \pm 0.2°
 Amplitude Jitter Measurement: 0.0% to 30.0% peak
 Accuracy: 4 Hz to 300 Hz, and 20 Hz to 300 Hz

TRANSIENTS (HITS) MEASUREMENTS*

Phase Hits: 5° to 50° peak in 10 steps
 Gain Hits: \pm 1 to \pm 10 dB in 1 dB steps
 Dropouts: Tone level drops below 12 dB \pm 1 dB
 Guard Interval: Per IEEE STD. 743-1984 Figs. 6 and 7
 Timer: Same as Impulse Noise
 Count Rate: Same as Impulse Noise
 Counter Capacity: Same as Impulse Noise

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Purchased Option 930A-18 requires that *Purchased Option 930A-07, Impulse Noise* be installed as well. The Impulse Noise counts are interlocked with the transient measurements in accordance with IEEE specifications.

7-4.7 Envelope Delay Distortion (Option 930A-19)

Modes:	SEND and REPEAT (Master and Slave)
Transmitter:	50% AM signal at modulation frequency of $83\frac{1}{3}$ Hz
Carrier Frequency:	304 Hz to 3504 Hz \pm 2 Hz
Carrier Level:	0.0 dBm to -40 dBm (Metallic), 0.0 dBm to -40 dBm (PCM)
Flatness:	\pm 0.2 dB (304 to 3504 Hz)
Receiver Input Level:	+10 dBm to -40 dBm (Metallic) 0.0 dBm to -40 dBm (PCM)
Distortion Measurement Range:	+9000, -3000 μ seconds
Accuracy:	\pm 10 μ s 604 Hz to 3504 Hz, \pm 30 μ s 304 Hz to 603 Hz

7-4.8 Intermodulation Distortion (Option 930A-20)

Transmitter Spectrum:	Four equal level tones (857, 863, 1372 and 1388 Hz)
Harmonic Distortion:	>35 dB below tone level
Transmitter Level Range:	0 dBm to -40 dBm RMS (Metallic) -6 dBm to -40 dBm RMS (PCM)
Accuracy:	\pm 1 dB
Receiver Input Level:	0 dBm to -40 dBm RMS (Metallic) -6 dBm to -40 dBm RMS (PCM)
Distortion Products:	2nd Order centered at 520 and 2240 Hz 3rd Order centered at 1900 Hz
Distortion Range:	10 dB to 70 dB below signal-2nd Order 10 dB to 70 dB below signal-3rd Order
Resolution:	1 dB
Accuracy:	\pm 1 dB
Signal-to-Noise Test:	Removes Low Tone pair and increases level of remaining tone pair by 3 dB.

7-4.9 Absolute Delay (Option 930A-21)

Modes	Send and Repeat
Transmitter	50% AM signal with a Modulation Frequency of $83\frac{1}{2}$ Hz
Frequency	1020 Hz Send, 1800/1850 Hz Repeat
Level	0.0 dBm to -40.0 dBm
Flatness	\pm 0.2 dB
Delay Range	0 to 1.2 sec
Accuracy	\pm 0.1 msec
Harmonic Distortion	>35dB below tone level

7-4.10 DS-0/DS-1 Bit Error Rate Testing (Option 930A-22)

DS-1 BERT SPECIFICATIONS

Input:	See Option 930A-08E/09E specifications
Output:	See Option 930A-08E/09E specifications
Framing:	Patterns may be framed (D4 or ESF) or unframed
Test Patterns:	Pseudo-random bit sequences (PRBS) of the following lengths may be sent and received: 29-1 (511) 211-1 (2047) 215-1 220-1 QRSS (220-1 with 14 zero suppression) 223-1
Stress Patterns:	3 in 24 bits (100010001000000000000000) 1 : 7 bits (10000000) 1 : 1 bits (1010) All 1's 55 OCTETS (440 bit pattern for Multiplexer Testing)
User-Defined Patterns:	User may input any bit sequence length from 1 to 24 bits (even numbers from 18 to 24). Pattern will continuously repeat
Loop-back Codes:	Send and Receive CSU loop codes: Loop-Up=10000 continuous for 8 seconds Loop-Down= 100 continuous Other Loop codes can be sent and received by editing the above patterns up to 8 bits.
Error Injection:	Inject single logic errors, bipolar violations, frame errors (D4 mode) or CRC errors (ESF mode)
PRBS Receiver Sync:	128 consecutive error-free bits must be received to achieve synchronization. BER of greater than 10 ⁻¹ for 320 milliseconds causes sync loss and resync attempt
Pattern Sync:	386 consecutive bits with less than 10 ⁻² error rate must be received to achieve pattern sync. BER of greater than 10 ⁻² for 2 milliseconds causes sync loss and resync attempt
Measurements:	Measures and displays: Bit (Logic) Errors, Bit Error Rate, Bit Slips, Bipolar Violations (BPV), Frame Errors, Frame Losses, Frame Slips, CRC Errors (ESF mode), Errored Seconds, % Errored Seconds, Error Free Seconds, % Error Free Seconds, Severely Errored Seconds, % Severely Errored Seconds, Failed Seconds, % Failed Seconds, Unavailable Seconds, % Unavailable Seconds, % Availability, No PCM, Test Length, Clock Time/Date, Elapsed Time.

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Test Length:	Timed or continuous
Timed Test Length:	15 minutes, 1 hour or 24 Hours
56 kbps Mode:	Selected when 930A is in Option 56. Least significant bit of channel under test is always set to 1. Selected when 930A is in Option 56 requires change to Clear Channel Signaling
Test Patterns:	Pseudo-random bit sequences (PRBS) of the following lengths may be sent and received: 29-1 (511) 211-1 (2047)
Stress Patterns:	1 : 7 bits (10000000) 1 : 1 bits (1010) All 1's
User-Defined Patterns:	User may input any bit sequence length from 1 to 8 bits. Pattern will continuously repeat.
Loop-Back Codes:	Send and Receive CSU/DSU/OCU loop codes in 56 kbps mode. LSB of selected channel byte is always set to 0. Cannot be used with switched 56 kbps channels using robbed bit signaling.
Error Counters:	All DS-1 errors (i.e., BPV errors, frame errors, CRC errors, Slips, etc.) are recorded for the entire DS-1. Bit Errors and Bit Error Rate are calculated on the received DS-0 channel selected. CCITT G.821 Error statistics are based on the bit errors of the selected DS-0 channel received.
Measurements:	Bit Errors, Bit Error Rate, No Sync, Error Free Seconds, % Error Free Seconds, Errored Seconds, % Errored Seconds, Severely Errored Seconds, % Severely Errored Seconds, Failed Seconds, % Failed Seconds, Available Seconds, % Available Seconds, Unavailable Seconds, % Unavailable Seconds and Elapsed Test Time
Error Injection:	Inject single bit errors

7-4.11 23 Tones (Option 930A-54)

Transmitter

Composite Level	-40 dBm to -6 dBm
Individual Tones	
Level	-13.6 dB below Composite Level
Flatness	±0.1 dB
Frequencies	203.125 to 3640.625 Hz in 156.25 Hz steps ±10 ppm
Phase	per IEEE 743 ±0.25°
Peak to RMS Ratio	8.79

Receiver

Range	-40 dBm to -6 dBm
Level	±0.2 dB
Attenuation	±0.2 dB
Envelope Delay Distortion	
Accuracy	± 10 secs
Range	10,000 secs
Frequencies	281.15 to 3562.5 Hz in 156.25 Hz steps
Signal-to-Noise	
	± 2 dB from 10 dB to 24 dB
	± 1 dB from 25 dB to 40 dB
	± 2 dB from 41 dB to 45 dB
Signal-to-Total Distortion	
	± 2 dB from 10 dB to 24 dB
	± 1 dB from 25 dB to 40 dB
	± 2 dB from 41 dB to 45 dB
Intermodulation Distortion (2nd and 3rd order)	
	± 2 dB from 20 dB to 29 dB
	± 1 dB from 30 dB to 46 dB
	± 2 dB from 47 dB to 55 dB
	± 3 dB from 56 dB to 60 dB