6 8593E Specifications and Characteristics

This chapter contains specifications and characteristics for the 8593E Spectrum Analyzer.

The specifications and characteristics in this chapter are listed separately. The specifications are described first and are followed by the characteristics.

General	General specifications.
Frequency	Frequency-related specifications and characteristics.
Amplitude	Amplitude-related specifications and characteristics.
Cable TV	Cable TV measurement specifications and characteristics.
Option	Option-related specifications and characteristics.
Physical	Input, output and physical characteristics.

The distinction between specifications and characteristics is described as follows.

- Specifications describe warranted performance over the temperature range 0 °C to +50 °C (unless otherwise noted). The spectrum analyzer will meet its specifications after 2 hours of storage at a constant temperature within the operating temperature range, 30 minutes after the spectrum analyzer is turned on, and after the CAL frequency and CAL amplitude routines have been run.
- Characteristics provide useful, but non-warranted information about the functions and performance of the spectrum analyzer. Characteristics are specifically identified.
- Typical Performance, where listed, is not warranted, but indicates performance that most units will exhibit.
- Nominal Value indicates the expected, but not warranted, value of the parameter.

0 °C to +50 °C with Option 015 or Option 016 operating/carrying case.

General Specifications

All specifications apply over 0 °C to +55 °C unless equipped with Option 015 or 016. The analyzer will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 30 minutes after the analyzer is turned on and after CAL FREQ, CAL AMPTD and CAL YTF have been run.

Temperature Range	
Operating	0 °C to +55 °C*
Storage	–40 °C to +75 °C
* 0 °C to +50 °C with Option 015 or Option 016 operating and carrying case.	

EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.

Audible Noise	<37.5 dBA pressure and <5.0 Bels power (ISODP7779)

Power Requirements	
ON (LINE 1)	90 to 132 V rms, 47 to 440 Hz
	195 to 250 V rms, 47 to 66 Hz
	Power consumption <500 VA; <180 W
Standby (LINE 0)	Power consumption <7 W

Environmental Specifications	Type tested to the environmental specifications of Mil-T-28800 class 5

Frequency Specifications

Frequency Range		9 kHz to 22.0 GHz
	(Options 026 or 027)	9 kHz to 26.5 GHz
Band	**LO Harmonic (N)**	
0	1—	9 kHz to 2.9 GHz
1	1—	2.75 GHz to 6.5 GHz
2	2—	6.0 GHz to 12.8 GHz
3	3—	12.4 GHz to 19.4 GHz
4	4—	19.1 GHz to 22.0 GHz
(Options 026 or 027)		
4	4—	19.1 GHz to 26.5 GHz

Frequency Reference	
Aging	$\pm 2 \times 10^{-6}$/year
Settability	$\pm 0.5 \times 10^{-6}$
Temperature Stability	$\pm 5 \times 10^{-6}$

Precision Frequency Reference *(Option 004)*	
Aging	$\pm 1 \times 10^{-7}$/year
Settability	$\pm 2.2 \times 10^{-8}$
Temperature Stability	$\pm 1 \times 10^{-8}$

Frequency Readout Accuracy	
(Start, Stop, Center, Marker)	±(frequency readout × frequency reference error* + span accuracy + 1% of span + 20% of RBW + 100 Hz × N††)‡

* frequency reference error = (aging rate × period of time since adjustment + initial achievable accuracy + temperature stability). See “Frequency Characteristics.”

†† N = LO harmonic. See “Frequency Range.”

‡ See “Drift” under “Stability” in Frequency Characteristics.

Marker Count Accuracy†	
Frequency Span ≤10 MHz × N††	±(marker frequency × frequency reference error* + counter resolution + 100 Hz × N††)
Frequency Span >10 MHz × N††	±(marker frequency × frequency reference error* + counter resolution + 1 kHz × N††)
Counter Resolution	
Frequency Span ≤ 10 MHz × N††	Selectable from 10 Hz to 100 kHz
Frequency Span > 10 MHz × N††	Selectable from 100 Hz to 100 kHz

* frequency reference error = (aging rate × period of time since adjustment + initial achievable accuracy and temperature stability). See “Frequency Characteristics.”

† Marker level to displayed noise level > 25 dB, RBW/Span ≥ 0.01. Span ≤ 300 MHz. Reduce SPAN annotation is displayed when RBW/Span < 0.01.

†† N = LO harmonic. See “Frequency Range.”

Frequency Span	
Range	0 Hz (zero span), (10 kHz × N††) to 19.25 GHz**
(Option 130)	0 Hz (zero span), (1 kHz × N††) to 19.25 GHz**
Resolution	Four digits or 20 Hz × N††, whichever is greater.
Accuracy (single band spans)	
Span ≤10 MHz × N††	±2% of span§
Span >10 MHz × N††	±3% of span

** Maximum span is 23.25 GHz for Option 026 or 027.

†† N = LO harmonic. See “Frequency Range.”

§ *(Option 130)* For spans < 10 kHz × N††, add an additional 10 Hz × N†† resolution error.

Frequency Sweep Time	
Range	
	20 ms to 100 s
(Option 101)	20 µs to 100 s for span 0 Hz
Accuracy	
20 ms to 100 s	±3%
20 µs to <20 ms *(Option 101)*	±2%
Sweep Trigger	Free Run, Single, Line, Video, External

Resolution Bandwidth	
Range	1 kHz to 3 MHz, 8 selectable resolution (3 dB) bandwidths in 1-3-10 sequence. 9 kHz and 120 kHz (6 dB) EMI bandwidths.
(Option 130)	Adds 30, 100 and 300 Hz (3 dB) bandwidths and 200 Hz (6 dB) EMI bandwidth.
Accuracy	
3 dB bandwidths	±20%

Stability	
Noise Sidebands	(1 kHz RBW, 30 Hz VBW and sample detector)
>10 kHz offset from CW signal	≤–90 dBc/Hz + 20 Log N[††]
>20 kHz offset from CW signal	≤–100 dBc/Hz + 20 Log N[††]
>30 kHz offset from CW signal	≤–105 dBc/Hz + 20 Log N[††]
Residual FM	
1 kHz RBW, 1 kHz VBW	≤(250 × N[††]) Hz pk-pk in 100 ms
30 Hz RBW, 30 Hz VBW *(Option 130)*	≤(30 × N[††]) Hz pk-pk in 300 ms
System-Related Sidebands	
>30 kHz offset from CW signal	≤–65 dBc + 20 Log N[††]

[††] N = LO harmonic. See “Frequency Range.”

Calibrator Output Frequency	300 MHz ±(freq. ref. error* × 300 MHz)
* frequency reference error = (aging rate × period of time since adjustment + initial achievable accuracy + temperature stability). See “Frequency Characteristics.”	

Comb Generator Frequency	100 MHz fundamental frequency
Accuracy	±0.007% of comb tooth frequency

Amplitude Specifications

Amplitude specifications do not apply for Analog+ mode and negative peak detector mode except as noted in “Amplitude Characteristics.”

Amplitude Range	–114 dBm to +30 dBm
(Option 130)	–129 dBm to +30 dBm

Maximum Safe Input Level	
Average Continuous Power	+30 dBm (1 W, 7.1 V rms), input attenuation ≥10 dB.
Peak Pulse Power	+50 dBm (100 W) for <10 µs pulse width and <1% duty cycle, input attenuation ≥30 dB.
dc	0 Vdc

Gain Compression‡	
>10 MHz	≤0.5 dB (total power at input mixer* –10 dBm)

* Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB).

‡ (Option 130) If RBW ≤ 300 Hz, this applies only if signal separation ≥ 4 kHz and signal amplitudes ≤ Reference Level + 10 dB.

Displayed Average Noise Level	(Input terminated, 0 dB attenuation, 30 Hz VBW, sample detector)	
	1 kHz RBW	**30 Hz RBW** *(Option 130)*
400 kHz to 2.9 GHz	≤–112 dBm	≤–127 dBm
2.75 GHz to 6.5 GHz	≤–114 dBm	≤–129 dBm
6.0 GHz to 12.8 GHz	≤–102 dBm	≤–117 dBm
12.4 GHz to 19.4 GHz	≤–98 dBm	≤–113 dBm
19.1 GHz to 22 GHz	≤–92 dBm	≤–107 dBm
19.1 GHz to 26.5 GHz *(Options 026 and 027)*	≤–87 dBm	≤–102 dBm

Spurious Responses	
Second Harmonic Distortion	
10 MHz to 2.9 GHz	<–70 dBc for –40 dBm tone at input mixer.*
> 2.75 GHz	<–100 dBc for –10 dBm tone at input mixer* (or below displayed average noise level).
Third Order Intermodulation Distortion	
>10 MHz	<–70 dBc for two –30 dBm tones at input mixer* and >50 kHz separation.
Other Input Related Spurious	
9 kHz to 18 GHz	<–65 dBc at ≥30 kHz offset, for –20 dBm tone at input mixer ≤18 GHz.
18 GHz to 22 GHz	<–60 dBc at ≥30 kHz, for –20 dBm tone at input mixer ≤22 GHz.
* Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB).	

Residual Responses	(Input terminated and 0 dB attenuation)
150 kHz to 2.9 GHz (Band 0)	<–90 dBm
2.75 GHz to 6.5 GHz (Band 1)	<–90 dBm

Display Range	
Log Scale	0 to –70 dB from reference level is calibrated; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps; eight divisions displayed.
Linear Scale	eight divisions
Scale Units	dBm, dBmV, dBµV, mV, mW, nV, nW, pW, µV, µW, V, and W

Marker Readout Resolution	0.05 dB for log scale 0.05% of reference level for linear scale
Fast Sweep Times for Zero Span	
20 µs to 20 ms *(Option 101 or 301)*	
Frequency ≤ 1 GHz	0.7% of reference level for linear scale
Frequency > 1 GHz	1.0% of reference level for linear scale

Reference Level	
Range	
Log Scale	Minimum amplitude to maximum amplitude**
Linear Scale	–99 dBm to maximum amplitude**
Resolution	
Log Scale	±0.01 dB
Linear Scale	±0.12% of reference level
Accuracy	(referenced to –20 dBm reference level, 10 dB input attenuation, at a single frequency, in a fixed RBW)
0 dBm to –59.9 dBm	±(0.3 dB + 0.01 × dB from –20 dBm)
–60 dBm and below	
1 kHz to 3 MHz RBW	±(0.6 dB + 0.01 × dB from –20 dBm)
30 Hz to 300 Hz RBW *(Option 130)*	±(0.7 dB + 0.01 × dB from –20 dBm)
** See “Amplitude Range.”	

Frequency Response	(10 dB input attenuation)	
Preselector peaked in band > 0	**Absolute**§	**Relative Flatness**†
9 kHz to 2.9 GHz	±1.5 dB	±1.0 dB
2.75 GHz to 6.5 GHz	±2.0 dB	±1.5 dB
6.0 GHz to 12.8 GHz	±2.5 dB	±2.0 dB
12.4 GHz to 19.4 GHz	±3.0 dB	±2.0 dB
19.1 GHz to 22 GHz	±3.0 dB	±2.0 dB
19.1 GHz to 26.5 GHz *(Options 026 and 027)*	±5.0 dB	±2.0 dB

† Referenced to midpoint between highest and lowest frequency response deviations.

§ Referenced to 300 MHz CAL OUT.

Calibrator Output	
Amplitude	–20 dBm ±0.4 dB

Absolute Amplitude Calibration Uncertainty⌗	±0.15 dB
⌗ Uncertainty in the measured absolute amplitude of the CAL OUT signal at the reference settings after CAL FREQ and CAL AMPTD self-calibration. Absolute amplitude reference settings are: Reference Level –20 dBm; Input Attenuation 10 dB; Center Frequency 300 MHz; Res BW 3 kHz; Video BW 300 Hz; Scale Linear; Span 50 kHz; Sweep Time Coupled, Top Graticule (reference level), Corrections ON.	

Input Attenuator	
Range	0 to 70 dB, in 10 dB steps

Resolution Bandwidth Switching Uncertainty	(At reference level, referenced to 3 kHz RBW)
3 kHz to 3 MHz RBW	±0.4 dB
1 kHz RBW	±0.5 dB
30 Hz to 300 Hz *(Option 130)*	±0.6 dB

Linear to Log Switching	±0.25 dB at reference level

Display Scale Fidelity	
Log Maximum Cumulative	
0 to –70 dB from Reference Level	
3 kHz to 3 MHz RBW	± (0.3 dB + 0.01 × dB from reference level)
RBW ≤ 1 kHz	± (0.4 dB + 0.01 × dB from reference level)
Log Incremental Accuracy	
0 to –60 dB from Reference Level	±0.4 dB/4 dB
Linear Accuracy	±3% of reference level

Cable TV Measurement Specifications

These specifications describe warranted performance of the spectrum analyzer and the 85721A cable TV measurements personality.

Input Configuration	75 Ω BNC Female

Channel Selection	Analyzer tunes to specified channels based upon selected tune configuration.
Tune Configuration	Standard, Off-the Air, HRC, IRC (T and FM channels also in channel mode)
Channel Range	1 to 158 and 201 to 300 (channel mode) 1 to 158 (system mode)
Channel Frequencies	Defined by Code of Federal Regulations, Title 47, Telecommunications, Parts 73.603, 76.605, 76.612
Frequency Range	5 to 1002 MHz (channel mode) 54 to 896 MHz (system mode)
Amplitude Range	–15 to +70 dBmV for S/N > 30 dB

Visual-Carrier Frequency	Visual-carrier frequency is counted

Frequency Reference* (Standard)	
Resolution	1 kHz
Accuracy	±(7.5 x 10^{-6} × carrier frequency + 110 Hz)
@55.25 MHz (Ch. 2)	±524 Hz
@325.25 MHz (Ch. 41)	±2.55 kHz
@643.25 MHz (Ch. 94)	±4.93 kHz
* Will not meet FCC frequency accuracy requirements.	

Precision Frequency Reference (*Option 004*)	
Resolution	100 Hz
Accuracy	±(1.2 x 10^{-7} × carrier frequency + 110 Hz)
@55.25 MHz (Ch. 2)	±117 Hz
@325.25 MHz (Ch. 41)	±149 Hz
@643.25 MHz (Ch. 94)	±187 Hz

Visual-to-Aural Carrier Frequency Difference	Frequency difference between visual and aural carriers is counted.
Difference Range	4.1 to 4.9 MHz
Resolution	100 Hz
Accuracy	±221 Hz for precision frequency ref (std) ±254 Hz for Option 704 frequency ref

Visual-Carrier Level	The peak amplitude of the visual carrier is measured to an absolute standard traceable to the National Institute of Standards and Technology.
Amplitude Range	–15 to +70 dBmV
Resolution	0.1 dB
Absolute Accuracy	±2.0 dB for S/N > 30 dB
Relative Accuracy	±1.0 dB relative to adjacent channels in frequency
	±1.5 dB relative to all other channels

Visual-to-Aural Carrier Level Difference	The difference between peak amplitudes of the visual and aural carrier is measured.
Difference Range	0 to 25 dB
Resolution	0.1 dB
Accuracy	±0.75 dB for S/N > 30 dB

Hum/Low-Frequency Disturbance	Power-line frequency and low-frequency disturbance measured on modulated and/or unmodulated carriers. May not be valid for scrambled channels.
AM Range	0.5 to 10%
Resolution	0.1%
Accuracy	±0.4% for hum ≤3% ±0.7% for hum ≤5% ±1.3% for hum ≤10%

Visual Carrier-to-Noise Ratio (C/N)*	The C/N is calculated from the visual-carrier peak level and the minimum noise level, normalized to 4 MHz noise bandwidth.
Optimum Input Range	See the graphs in the characteristics section of this chapter.
Maximum C/N Range	Input level dependent - See graphs
C/N Resolution	0.1 dB
C/N Accuracy	Input level and measured C/N dependent ±1.0 to ±3.5 dB over optimum input range
* A preamplifier and preselector filter may be required to achieve specifications.	

CSO and CTB Distortion †	Manual composite second order (CSO) and composite triple beat (CTB) distortions are measured relative to the visual carrier peak and require momentary disabling of the carrier. Automatic measurements are made in the channel above the channel selected and assumes that it is unused. If the analyzer has Option 107, a non-interfering CSO measurement can be made.
Optimum Input Range	See the graphs in the characteristics section of this chapter.
Maximum CSO/CTB Range	Input level dependent - see graphs. 66 to 73 dB over optimum input range
Manual CSO/CTB Resolution	0.1 dB
System CSO/CTB Resolution	1 dB
CSO/CTB Accuracy	Input level and measured CSO/CTB dependent - See graphs ±1.5 dB to ±4.0 dB over optimum input range
† A preamplifier and preselector filter may be required to achieve specifications.	

System Frequency Response (flatness)

System amplitude variations are measured relative to a reference trace stored during the setup.

Frequency Response Setup	
Fast Sweep Time	2 s (default) for no scrambling
Slow Sweep Time	8 s (default) for fixed-amplitude scrambling
Reference-trace Storage	50 traces that include analyzer states

Frequency Response Test	
Range	1.0 dB/Div to 20 dB/Div (2 dB default)
Resolution	0.05 dB
Trace-flatness Accuracy	±0.1 dB per dB deviation from a flat line and ±0.75 dB maximum cumulative error
Trace-position Accuracy	0.0 dB for equal temperature at test locations and ±0.4 dB maximum for different ambient temperatures

Option Specifications

Tracking Generator Specifications (Option 010)

All specifications apply over 0 °C to +55 °C.* The spectrum-analyzer/tracking-generator combination will meet its specifications after 2 hours of storage at a constant temperature within the operating temperature range, 30 minutes after the spectrum-analyzer/tracking-generator is turned on and after CAL FREQ, CAL AMPTD, CAL TRK GEN, and TRACKING PEAK have been run.

* 0 °C to +50 °C with Option 015 or Option 016 operating and carrying case.

NOTE: There are two models of the tracking generator. One has a frequency range of 300 kHz to 2.9 GHz, typically analyzers with a serial prefix of 3431A and below. The newer tracking generator has a range of 9 kHz to 2.9 GHz, typically serial prefix of 3440A or higher. Check the front panel for the tracking generator output frequency range of the installed generator.

Warm-Up	30 minutes

Output Frequency	
Range*	9 kHz to 2.9 GHz 300 kHz to 2.9 GHz
* Refer to the “Note” in the description above.	

Output Power Level	
Range	–1 dBm to –66 dBm
Resolution	0.1 dB
Absolute Amplitude Accuracy (at 25 °C ±10 °C)	
(–20 dBm at 300 MHz)	±0.75 dB
Vernier‡	
Range	9 dB
Accuracy (at 25 °C ±10 °C)	
(–20 dBm at 300 MHz, 16 dB attenuation)	
Incremental	±0.20 dB/dB
Cumulative	±0.50 dB total
Output Attenuator	
Range	0 to 56 dB in 8 dB steps
‡ See the Output Accuracy table in “Option Characteristics.”	

Output Power Sweep	
Range	(–10 dBm to –1 dBm) – (Source Attenuator Setting)
Resolution	0.1 dB

Output Flatness	
(referenced to 300 MHz, –20 dBm)	
Frequency > 10 MHz	±2.0 dB
Frequency ≤ 10 MHz	±3.0 dB

Spurious Output (–1 dBm output)	
Harmonic Spurs from 9 kHz to 2.9 GHz	
TG Output 9 kHz to 20 kHz	≤–15 dBc
TG Output 20 kHz to 2.9 GHz	≤–25 dBc
Harmonic Spurs from 300 kHz to 2.9 GHz	
TG Output 300 kHz to 2.9 GHz	≤–25 dBc
Nonharmonic Spurs from 9 kHz to 2.9 GHz	
TG Output 9 kHz to 2.0 GHz	≤–27 dBc
TG Output 2.0 GHz to 2.9 GHz	≤–23 dBc
Nonharmonic Spurs from 300 kHz to 2.9 GHz	
TG Output 300 kHz to 2.0 GHz	≤–27 dBc
TG Output 2.0 GHz to 2.9 GHz	≤–23 dBc
LO Feedthrough	
LO Frequency 3.9217 to 6.8214 GHz	≤–16 dBm

Tracking Generator Feedthrough	
400 kHz to 2.9 MHz	<–112 dBm

Quasi-Peak Detector Specifications (Option 103)

The specifications for Quasi-Peak Detector (Option 103) have been based on the following:

- The spectrum analyzer displays the quasi-peak amplitude of pulsed radio frequency (RF) or continuous wave (CW) signals.
- Amplitude response conforms with Publication 16 of Comit\'e International Sp\'ecial des Perturbations Radio\'electriques (CISPR) Section 1, Clause 2.

The 200 Hz bandwidth is available only with Option 130. The 1 kHz resolution bandwidth may be used to approximate a quasi-peak measurement without Option 130. A quasi-peak measurement using the 1 kHz bandwidth will be greater than or equal to a quasi-peak measurement using a 200 Hz bandwidth.

Absolute amplitude accuracy is the sum of the pulse amplitude response relative to the reference, plus the reference pulse amplitude accuracy, plus the spectrum analyzer amplitude accuracy (calibrator output, reference level, frequency response, input attenuator, resolution bandwidth switching, linear display scale fidelity, and gain compression).

Relative Quasi-Peak Response to a CISPR Pulse (dB)	**Frequency Band**		
Pulse Repetition Frequency (Hz)	**120 kHz EMI BW 0.03 to 1 GHz**	**9 kHz EMI BW 0.15 to 30 MHz**	*(Option 130)* **200 Hz EMI BW 10 to 150 kHz**
1000	+8.0 ± 1.0	+4.5 ± 1.0	—
100	0 dB (reference)*	0 dB (reference)*	+4.0 ± 1.0
60	—	—	+3.0 ± 1.0
25	—	—	0 dB (reference)*
20	–9.0 ± 1.0	–6.5 ± 1.0	—
10	–14.0 ± 1.5	–10.0 ± 1.5	–4.0 ± 1.0
5	—	—	–7.5 ± 1.5
2	–26.0 ± 2.0	–20.5 ± 2.0	–13.0 ± 2.0
1	–28.5 ± 2.0	–22.5 ± 2.0	–17.0 ± 2.0
Isolated Pulse	–31.5 ± 2.0	–23.5 ± 2.0	–19.0 ± 2.0

* Reference pulse amplitude accuracy relative to a 66 dBµV CW signal is <1.5 dB. CISPR reference pulse: 0.044 µVs for 0.03 to 1 GHz, 0.316 µVs for 0.15 to 30 MHz, 13.5 ± 1.5 µVs for 10 to 150 kHz *(Option 130)*.

Time Gated Spectrum Analysis Specifications (Option 105 or Option 107)

GATE DELAY	
Range	1 µs to 65.535 ms
Resolution	1 µs
Accuracy	±(1 µs + (0.01% × GATE DELAY Readout))[†]
(From GATE TRIGGER INPUT to positive edge of GATE OUTPUT)	
GATE LENGTH	
Range	1 µs to 65.535 ms
Resolution	1 µs
Accuracy	±(0.2 µs +(0.01% × GATE LENGTH Readout))
(From positive edge to negative edge of GATE OUTPUT)	
Additional Amplitude Error[§]	
Log Scale	
< 2 µs	±0.8 dB
≥ 2 µs	±0.5 dB
Linear Scale	
< 2 µs	±1.0% of REFERENCE LEVEL
≥ 2 µs	±0.7% of REFERENCE LEVEL

[†] Up to 1 µs jitter due to 1 µs resolution of gate delay clock.

[§] With GATE ON enabled and triggered, CW Signal, Peak Detector Mode.

TV Receiver/Video Tester (Option 107)

(Option 107 required; appropriate TV line must be selected)

Non-interfering color	(requires FCC composite, NTC-7, or CCIR 17 and CCIR 330 test signal)
Differential Gain Accuracy	6% 50 averages (default)
Differential Phase Accuracy	4° 50 averages (default)
Chroma-luminance Delay Inequality Accuracy	±45 ns
Frequency Range	50 MHz to 850 MHz
Amplitude Range	+10 dBmV to +50 dBmV at coupler input (10 dB loss)
Coupler (part number 0955-0704)	Insertion loss: < 2 dB
	Coupled output: –10 dB ±0.5 dB

Non-Interfering Tests with Gate On*	
C/N and CSO	See graphs for accuracy
(quiet line must be selected)	
In-channel Frequency Response Accuracy	±0.5 dB within channel
* A preamplifier and preselector filter may be required to achieve specifications.	

Frequency Characteristics

These are not specifications. Characteristics provide useful but nonwarranted information about instrument performance.

Frequency Reference	
Initial Achievable Accuracy	$\pm 0.5 \times 10^{-6}$
Aging	$\pm 1.0 \times 10^{-7}$/day

Precision Frequency Reference *(Option 004)*	
Aging	5×10^{-10}/day, 7-day average after being powered on for 7 days.
Warm-Up	1×10^{-8} after 30 minutes on.
Initial Achievable Accuracy	$\pm 2.2 \times 10^{-8}$ after being powered on for 24 hours.

Stability	
Drift* (after warmup at stabilized temperature)	
Frequency Span ≤ ($10 \times N^{\dagger}$) MHz	≤($2 \times N^{\dagger\dagger}$) kHz/minute of sweep time*

* Because the analyzer is locked at the center frequency before each sweep, drift occurs only during the time of one sweep. For Line, Video, or External trigger, additional drift occurs while waiting for the appropriate trigger signal.

†† N = LO harmonic. See “Frequency Range.”

Resolution Bandwidth (–3 dB)	
Range	1 kHz to 3 MHz, selectable in 1, 3 and 10 increments, and 5 MHz. Resolution bandwidths may be selected manually, or coupled to frequency span.
(Option 130)	Adds 30 Hz, 100 Hz, and 300 Hz bandwidths.
Shape	Synchronously tuned four poles. Approximately Gaussian shape.
60 dB/3 dB Bandwidth Ratio	
Resolution Bandwidth	
100 kHz to 3 MHz	15:1
30 kHz	16:1
3 kHz to 10 kHz	15:1
1 kHz	16:1
60 dB/3 dB Bandwidth Ratio *(Option 130)*	
Resolution Bandwidth	
30 Hz to 300 Hz	10:1

Video Bandwidth (–3 dB)	
Range	30 Hz to 1 MHz, selectable in 1, 3, 10 increments, accuracy ±30% and 3 MHz. Video bandwidths may be selected manually, or coupled to resolution bandwidth and frequency span.
(Option 130)	Adds 1, 3, and 10 Hz bandwidths.
Shape	Post detection, single pole low-pass filter used to average displayed noise.
(Option 130)	Bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.

FFT Bandwidth Factors	FLATTOP	HANNING	UNIFORM
Noise Equivalent Bandwidth†	3.63×	1.5×	1×
3 dB Bandwidth†	3.60×	1.48×	1×
Sidelobe Height	<–90 dB	–32 dB	–13 dB
Amplitude Uncertainty	0.10 dB	1.42 dB	3.92 dB
Shape Factor (60 dB BW/3 dB BW)	2.6	9.1	>300

† Multiply entry by one-divided-by-sweep time.

Amplitude Characteristics

These are not specifications. Characteristics provide useful but nonwarranted information about instrument performance.

Log Scale Switching Uncertainty	Negligible error

Demod Tune Listen	Internal speaker, rear panel earphone jack and front-panel volume control. Adjustable squelch control mutes the audio signal to the speaker/earphone jack based on the level of the demodulated signal above 22 kHz. An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel.

Input Attenuation Uncertainty* Attenuator Setting	**9 kHz to 12.4 GHz**	**12.4 to 19 GHz**	**19 to 22 GHz**
0 dB	±0.75 dB	±1.0 dB	±1.0 dB
10 dB	Reference	Reference	Reference
20 dB	±0.75 dB	±0.75 dB	±1.0 dB
30 dB	±0.75 dB	±1.0 dB	±1.25 dB
40 dB	±0.75 dB	±1.25 dB	±2.0 dB
50 dB	±1.0 dB	±1.5 dB	±2.5 dB
60 dB	±1.5 dB	±2.0 dB	±3.0 dB
70 dB	±2.0 dB	±2.5 dB	±3.5 dB

* Referenced to 10 dB input attenuator setting. See the “Specifications” table under “Frequency Response.”

Input Attenuator 10 dB Step Uncertainty	(Attenuator setting 10 to 70 dB)
Center Frequency	
9 kHz to 19 GHz	±1.0 dB/10 dB
19 GHz to 22 GHz	±1.5 dB/10 dB

Input Attenuator Repeatability	±0.05 dB

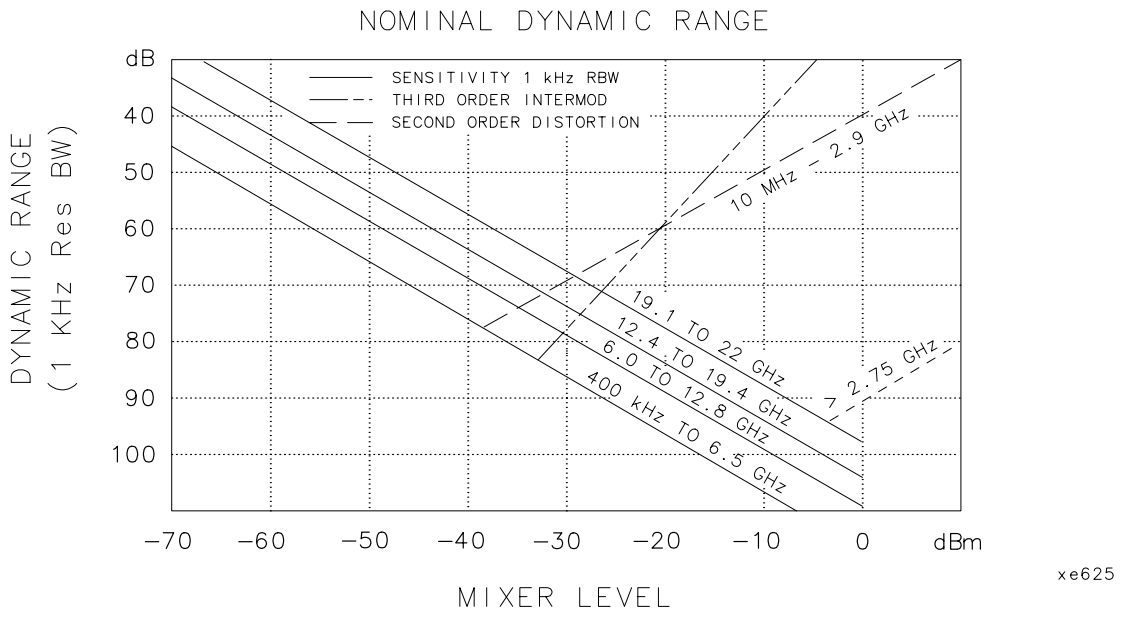
RF Input SWR	
10 dB attenuation	
Frequency	
300 MHz	1.15:1
10 dB to 70 dB attenuation	
Band	
9 kHz to 2.9 GHz	1.3:1
2.75 GHz to 6.5 GHz	1.5:1
6.0 GHz to 12.8 GHz	1.6:1
12.4 GHz to 19.4 GHz	2.0:1
19.1 GHz to 22.0 GHz	3.0:1

Unpeaked Frequency Response	(10 dB input attenuation)	
Without Preselector Peaking, Span ≤ 50 MHz	**Absolute**[§]	**Relative Flatness**[†]
2.75 GHz to 6.5 GHz	±4.0 dB	±3.5 dB
6.0 GHz to 12.8 GHz	±4.5 dB	±4.0 dB
12.4 GHz to 19.4 GHz	±6.0 dB	±5.0 dB
19.1 GHz to 22 GHz	±6.0 dB	±5.0 dB

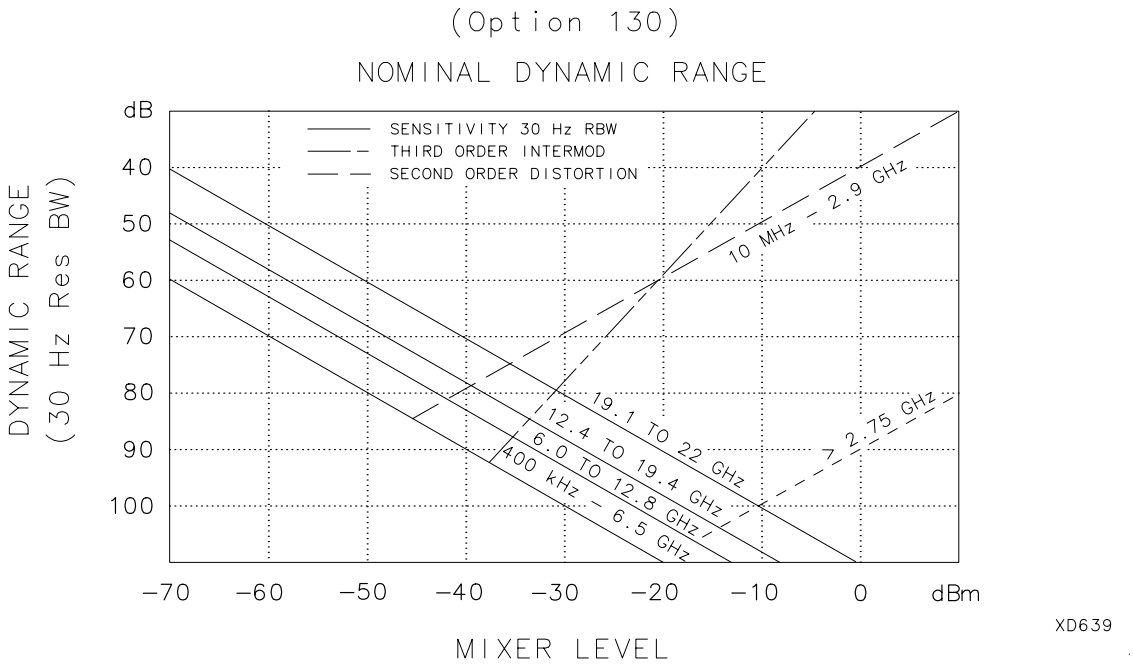
[†] Referenced to midpoint between highest and lowest frequency response deviations.

[§] Referenced to 300 MHz CAL OUT.

DYNAMIC RANGE



DYNAMIC RANGE



Immunity Testing	
Radiated Immunity	When tested at 3 V/m according to IEC 801-3/1984 the displayed average noise level will be within specifications over the full immunity test frequency range of 27 to 500 MHz except that at immunity test frequencies of 278.6 MHz ± selected resolution bandwidth and 321.4 MHz ± selected resolution bandwidth the displayed average noise level may be up to –45 dBm. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –70 dBm displayed on the screen.

Electrostatic Discharge	When an air discharge of up to 8 kV according to IEC 801-2/1991 occurs to the shells of the BNC connectors on the rear panel of the instrument spikes may be seen on the CRT display. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

Analog+ Mode and Negative Peak Detector Mode (Options 101 and 301)

These modes do not utilize the full set of internal amplitude corrections. Therefore, in these modes, some analyzer amplitude specifications are reduced to characteristics. Characteristics provide useful but nonwarranted information about instrument performance.

In these modes, the following analyzer specifications remain as specifications:

Amplitude Range	**Calibrator Output**
Maximum Safe Input Level	

In these modes, the following analyzer specifications are reduced to characteristics:

Gain Compression	**Reference Level**
Displayed Average Noise Level	**Resolution Bandwidth Switching**
Spurious Responses	**Linear to Log Switching**
Residual Responses	**Display Scale Fidelity**
Display Range	**Display Scale Fidelity for Narrow Bandwidths**

Finally, the following analyzer specifications:

Marker Readout Resolution	**Frequency Response**

are replaced by the characteristics which follow in this subsection.

Marker Readout Resolution	
(digitizing resolution)	
Log Scale	±0.31 dB
Linear Scale	
frequency ≤ 1 GHz	±0.59% of reference level
frequency > 1 GHz	±1.03% of reference level

Frequency Response in Analog+ Mode Preselector peaked in band > 0	(10 dB input attenuation, for spans ≤ 20 MHz)	
	Absolute[§]	**Relative Flatness**[†]
9 kHz to 2.9 GHz	±2.0 dB	±1.5 dB
2.75 GHz to 6.4 GHz	±2.5 dB	±2.0 dB
6.0 GHz to 12.8 GHz	±3.0 dB	±2.5 dB
12.4 GHz to 19.4 GHz	±3.5 dB	±2.5 dB
19.1 GHz to 22 GHz	±3.5 dB	±2.5 dB
19.1 GHz to 26.5 GHz *(Option 026 or 027)*	±5.5 dB	±2.5 dB

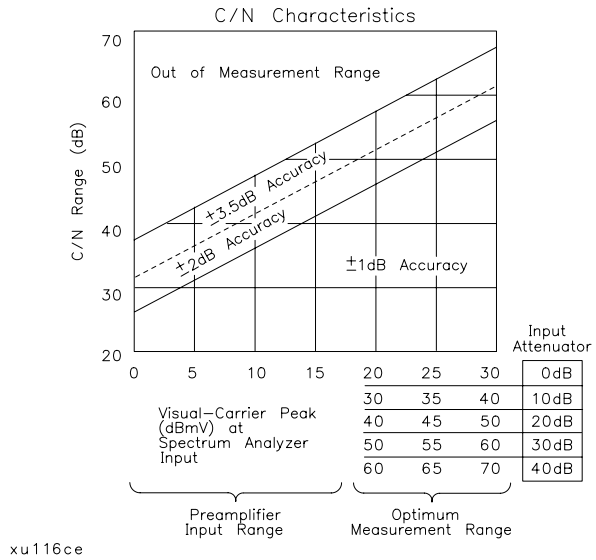
[†] Referenced to midpoint between highest and lowest frequency response deviations.

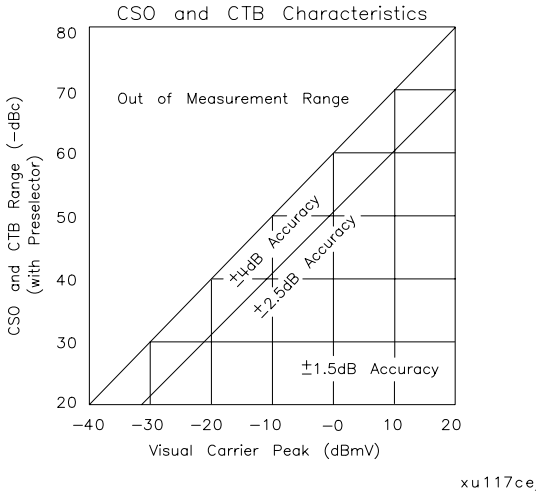
[§] Referenced to 300 MHz CAL OUT.

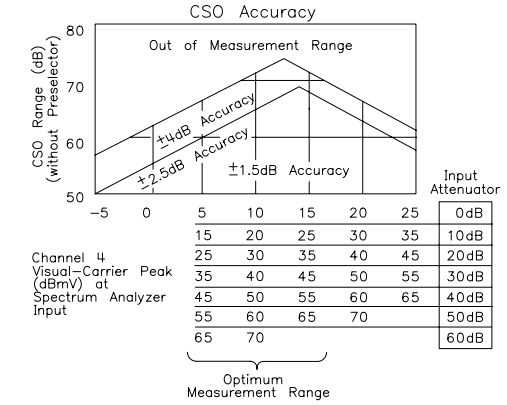
Cable TV Measurement Characteristics

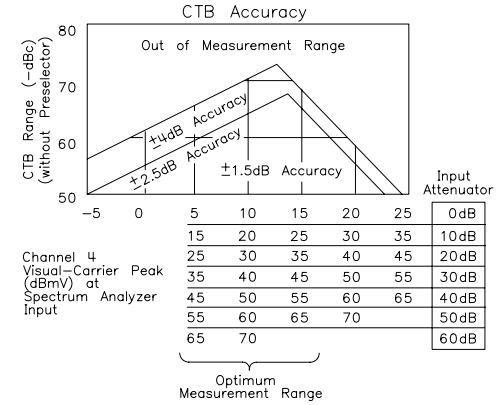
Depth of Modulation	Percent AM is measured from horizontal sync tip to maximum video level; measurement requires a white-reference VITS and may not be valid for scrambled channels.
AM Range	50 to 93%
Resolution	0.1%
Accuracy	±2.0% for C/N > 40 dB

FM Deviation	Peak reading of FM deviation
Range	±100 kHz
Resolution	100 Hz
Accuracy	±1.5 kHz









C/N, CSO, and CTB Measurements

The four graphs summarize the combined 8591C cable TV analyzer or 8590 E-Series spectrum analyzers, and 85721A characteristics for C/N, CSO, and CTB testing on cable TV systems with up to 99 channels and up to +9 dB amplitude tilt. C/N, CSO, and CTB measurement accuracies and ranges can be read from the relevant graphs. They depend upon the visual carrier peak level and the measurement reading. For C/N measurements with a preselector, there is no optimum range and the accuracy boundaries drop by the preselector's insertion loss (typically 2 dB).

Crossmodulation	Horizontal-line (15.7 kHz) related AM is measured on the unmodulated visual carrier.
Range	60 dB, usable to 65 dB
Resolution	0.1 dB
Accuracy	±2.0 dB for xmod. <40 dB, C/N >40 dB ±2.6 dB for xmod. <50 dB, C/N >40 dB ±4.6 dB for xmod. <60 dB, C/N >40 dB

Option Characteristics

Demod Tune Listen *(Option 102 or 103)*	Internal speaker, rear panel earphone jack and front-panel volume control. Adjustable squelch control mutes the audio signal to the speaker/earphone jack based on the level of the demodulated signal above 22 kHz. An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel.

TV Trigger *(Options 101 and 102)*	Triggers sweep of the analyzer after the sync pulse of a selected line of a TV video field.
Carrier Level for Trigger	Top 60% of linear display
Compatible Formats	NTSC, PAL, SECAM
Field Selection	Even, odd, non-interlaced
Trigger Polarity	Positive, negative
Line Selection	10 to 1021

Tracking Generator Characteristics (Option 010)

Tracking Drift (Usable in a 1 kHz RBW after 5-minute warmup)	1.5 kHz/5 minute

RF Power Off Residuals	
9 kHz to 2.9 GHz	<–120 dBm

Dynamic Range (difference between maximum power out and tracking generator feedthrough)	>111 dB

Output Attenuator Repeatability	
9 kHz to 300 MHz	±0.1 dB
300 kHz to 300 MHz	±0.1 dB
300 MHz to 2.0 GHz	±0.2 dB
2.0 GHz to 2.9 GHz	±0.3 dB

Output VSWR	
0 dB Attenuator	<3.0:1
8 dB Attenuator	<1.5:1

TRACKING GENERATOR OUTPUT ACCURACY, Option 010

(after CAL TRK GEN in auto-coupled mode, Frequency > 10 MHz, 25°C ± 10°C)

TG Output Power Level	**Attenuator Setting**	**Relative Accuracy (at 300 MHz referred to –20 dBm)**	**Absolute Accuracy (at 300 MHz)**	**Relative Accuracy (referred to –20 dBm)**	**Absolute Accuracy**
–1 to –10 dBm	0 dB	1.0 dB	1.75 dB	3.0 dB	3.75 dB
–10 to –18 dBm	8 dB	1.5 dB	2.25 dB	3.5 dB	4.25 dB
–20 dBm	16 dB	Reference	0.75 dB	2.0 dB	2.75 dB
–18 to –26 dBm	16 dB	1.0 dB	1.75 dB	3.0 dB	3.75 dB
–26 to –34 dBm	24 dB	1.5 dB	2.25 dB	3.5 dB	4.25 dB
–34 to –42 dBm	32 dB	1.6 dB	2.35 dB	3.6 dB	4.35 dB
–42 to –50 dBm	40 dB	1.8 dB	2.55 dB	3.8 dB	4.55 dB
–50 to –58 dBm	48 dB	2.0 dB	2.75 dB	4.0 dB	4.75 dB
–58 to –66 dBm	56 dB	2.1 dB	2.85 dB	4.1 dB	4.85 dB

Quasi-Peak Detector Characteristics (Option 103)

Quasi-Peak Measurement Range	
Displayed	70 dB
Total	115 dB

FM Demodulation (Option 102, 103, or 301)

Input Level	> (–60 dBm + attenuator setting)
Signal Level	0 to –30 dB below reference level
FM Offset	
Resolution	400 Hz nominal
FM Deviation (FM GAIN)	
Resolution	1 kHz nominal
Range	10 kHz to 1 MHz
Bandwidth	FM deviation/2
FM Linearity (for modulating frequency < bandwidth/100)	≤ 1% of FM deviation + 290 Hz

Physical Characteristics

Front-Panel Inputs and Outputs

INPUT 50Ω	
Connector	Type N female
Impedance	50 Ω nominal
INPUT 50Ω *(Option 026)*	
Connector	APC 3.5 male
Impedance	50 Ω nominal
INPUT 50Ω *(Option 027)*	
Connector	Type N female with adapter to SMA female
Impedance	50 Ω nominal

100 MHz COMB OUT	
Connector	SMA female
Output Level	+27 dBm
Frequency	100 MHz fundamental

RF OUT *(Option 010)*	
Connector	Type N female
Impedance	50 Ω nominal

PROBE POWER ‡	
Voltage/Current	+15 Vdc, ±7% at 150 mA max. –12.6 Vdc ±10% at 150 mA max.

‡ Total current drawn from the +15 Vdc on the PROBE POWER and the AUX INTERFACE cannot exceed 150 mA. Total current drawn from the –12.5 Vdc on the PROBE POWER and the –15 Vdc on the AUX INTERFACE cannot exceed 150 mA.

Rear-Panel Inputs and Outputs

10 MHz REF OUTPUT	
Connector	BNC female
Impedance	50 Ω nominal
Output Amplitude	>0 dBm

EXT REF IN	
Connector	BNC female Note: Analyzer noise sideband and spurious response performance may be affected by the quality of the external reference used.
Input Amplitude Range	–2 to +10 dBm
Frequency	10 MHz

AUX IF OUTPUT	
Frequency	21.4 MHz
Amplitude Range	–10 to –60 dBm
Impedance	50 Ω nominal

AUX VIDEO OUTPUT	
Connector	BNC female
Amplitude Range	0 to 1 V (uncorrected)

EARPHONE *(Option 102 or 103)*	
Connector	1/8 inch monaural jack

EXT ALC INPUT *(Option 010)*	
Input Impedance	>10 kΩ
Polarity	Use with negative detector

EXT KEYBOARD *(Option 041 or 043)*	Interface compatible with part number C1405B using adapter C1405-60015 and most IBM/AT non-auto switching keyboards.

EXT TRIG INPUT	
Connector	BNC female
Trigger Level	Positive edge initiates sweep in EXT TRIG mode (TTL).

GATE TRIGGER INPUT *(Option 105 or 107)*	
Connector	BNC female
Trigger Level	minimum pulse width >30 ns (TTL)
GATE OUTPUT *(Option 105 or 107)*	
Connector	BNC female
Output Level	High = gate on; Low = gate off (TTL)

LO OUTPUT *(Option 009 or 010)*	Note: LO output must be terminated in 50 Ω
Connector	SMA female
Impedance	50 Ω nominal
Frequency Range	3.0 to 6.8214 GHz
Output Level	+11 to +18 dBm

SWEEP + TUNE OUTPUT *(Option 009)*	
Connector	BNC female
Impedance (dc coupled)	2 kΩ
Range	0 to +10 V
Sweep + Tune Output	0.36 V/GHz of center frequency

HI-SWEEP IN/OUT	
Connector	BNC female
Output	High = sweep, Low = retrace (TTL)
Input	Open collector, low stops sweep.

MONITOR OUTPUT (Spectrum Analyzer Display)	
Connector	BNC female
Format	
SYNC NRM	Internal Monitor
SYNC NTSC	NTSC Compatible
	15.75 kHz horizontal rate
	60 Hz vertical rate
SYNC PAL	PAL Compatible
	15.625 kHz horizontal rate
	50 Hz vertical rate

REMOTE INTERFACE	
GPIB and Parallel *(Option 041)*	10833A, B, C or D and 25 pin subminiature D-shell, female for parallel
GPIB Codes	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28
RS-232 and Parallel *(Option 043)*	9 pin subminiature D-shell, male for RS-232 and 25 pin subminiature D-shell, female for parallel

SWEEP OUTPUT	
Connector	BNC female
Amplitude	0 to +10 V ramp

TV IN *(Option 107)*	
Connector	75 Ω BNC female
Impedance	75 Ω nominal

TV MON OUTPUT *(Option 107)*	
Connector	BNC female
Output	Baseband video output from TV Receiver

TV TRIG OUT *(Options 101 and 102)*	
Connector	BNC female
Amplitude	Negative edge corresponds to start of the selected TV line after sync pulse (TTL).

AUX INTERFACE

Connector Type: 9 Pin Subminiature "D"

Connector Pinout

Pin #	Function	Current	"Logic" Mode	"Serial Bit" Mode
1	Control A	—	TTL Output Hi/Lo	TTL Output Hi/Lo
2	Control B	—	TTL Output Hi/Lo	TTL Output Hi/Lo
3	Control C	—	TTL Output Hi/Lo	Strobe
4	Control D	—	TTL Output Hi/Lo	Serial Data
5	Control I	—	TTL Input Hi/Lo	TTL Input Hi/Lo
6	Gnd	—	Gnd	Gnd
7†	–15 Vdc ±7%	150 mA	—	—
8*	+5 Vdc ±5%	150 mA	—	—
9†	+15 Vdc ±5%	150 mA	—	—

* Exceeding the +5 V current limits may result in loss of factory correction constants.

† Total current drawn from the +15 Vdc on the PROBE POWER and the AUX INTERFACE cannot exceed 150 mA. Total current drawn from the –12.6 Vdc on the PROBE POWER and the –15 Vdc on the AUX INTERFACE cannot exceed 150 mA.

WEIGHT	
Net	
8593E	16.4 kg (36 lb)
Shipping	
8593E	19.1 kg (42 lb)

DIMENSIONS

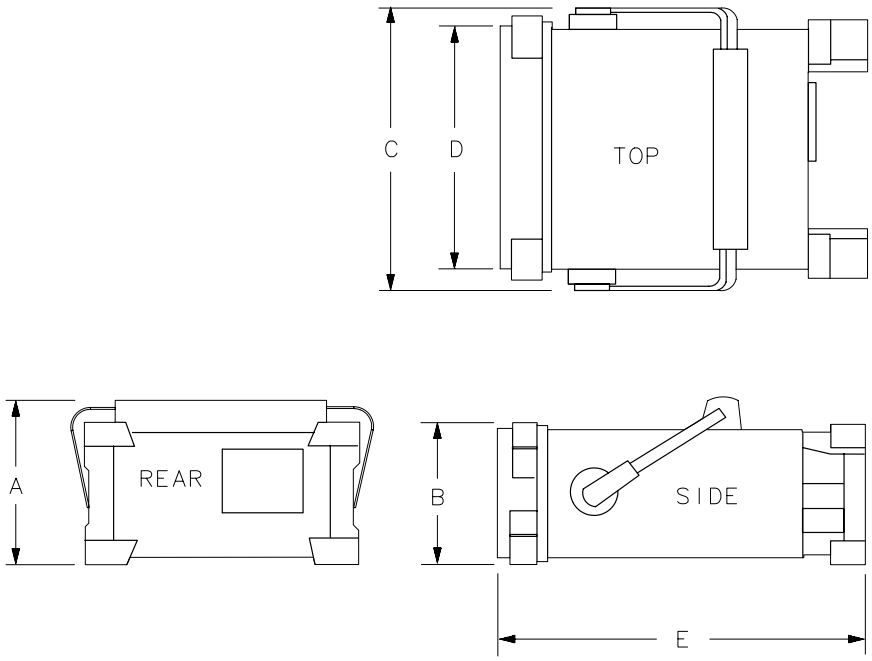
A 8 in (200 mm)

B 7.25 in (184 mm)

C 14.69 in (373 mm)

D 13.25 in (337 mm)

E 18.12 in (460.5 mm)



FORMAT100