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1.2 SPECIFICATIONS

SIGNAL CHANNEL

(1) INPUT SENSITIVITY

±50 mV to ±10 V in 1-2-5 sequence for ±10 V output. Relative attenuator accuracy is better than ±0.5%.

(2) INPUT COUPLING

AC, DC, or GRD.

(3) INPUT IMPEDANCE

100 kilohms or 50 ohms, switch selectable, separate input jacks provided.

COUPLING	100 kΩ INPUT	50Ω INPUT
DC ------ 100 kΩ paralleled by 50 pF AC ------- 1 μF in series with 100 kΩ. GRD. ---- 1 μF in series with 10 MΩ.		dc coupled 50 ohms (±2%) regardless of position of Coupling switch.*

(4) MAXIMUM INPUT VOLTAGE

50 ohm input --- 10 V rms, 20 V peak.
100 kΩ input --- 200 V peak.

(5) PREFILTER BANDWIDTH (-3 dB)

(a) Type Filter - Single-section, low-pass filter providing a -6 dB/octave rolloff.

(b) Bandwidth - dc to 3 kHz through 30 MHz in 1-3-10 sequence. Bandwidth accuracy is ±10%.

(c) OFF bandwidth - dc to 50 MHz (typical). **

(6) INPUT OFFSET

±100% or ±1000% of full scale. Calibrated to ±2% accuracy.

(7) NOISE

Internally generated noise is a function of aperture time, duty factor, and time constant. Typically, the output noise is less than 0.03% rms of full scale.

*Although the input resistance is 50 ohms direct, the internally processed signal will be "AC", "DC" or "GROUND" coupled, according to Coupling switch position.

**Step Function Response --- ±3% Pulse flatness. Rise time is typically 8 ns (10% to 90%) with Prefilter switch set to OFF.

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(8) DC DRIFT

Typically 0.03% of full scale per degree Celsius. Twenty-four hour drift at constant ambient temperature is less than 0.2% of full scale after a two-hour warm-up.

(9) GAIN STABILITY

±0.5% of full scale per week, maximum.

(10) LINEARITY

Less than ±0.25% of full-scale error for signals within the full scale range. Linearity is degraded to ±0.5% for aperture times shorter than 50 ns. For signals exceeding full scale, the linearity is degraded ±2% of maximum input up to 10 times full scale in the normal resolution mode and three times full scale in the high resolution mode.

(11) OUTPUTS (relative to full-scale input)

(a) Panel Meter - ±1% linear, center zero. The scales on the meter correspond to the selected sensitivity.

(b) ±10 V dc at 1000 ohms. Two of these outputs are provided, one normal and the other inverted.

(c) ±1 mA for low impedance recorders.

(d) Preamplifier output: ±0.5 V at 300 ohms*. With 50 ohm load, output is nominally ±70 mV.

SAMPLE-HOLD CHARACTERISTICS

(1) APERTURE TIME (Gate Width)

(a) High Resolution Mode - Continuously variable from 10 ns to 5.5 μs in three ranges. Accuracy is ±10% of range.

(b) Normal Resolution Mode - Continuously variable from 0.5 μs to 0.55 s. Accuracy is ±10% of range.

(2) AVERAGING TIME CONSTANTS

(a) High Resolution Mode - 3 ns to 1000 μs in 1-3-10 sequence. Time constant may be effectively increased to at least one second by using the Stretch Time switch and Normal Resolution time constant.

(b) Normal Resolution Mode - 0.1 ms to 100 s in 1-3-10 sequence. Also 0.01 ms. Provision for determining time constant with external capacitor.

*±1 V at 600 Ω in early units.

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(3) HOLDING TIME (Memory Drift)

The holding time is a function of the setting of the Time Constant, Aperture Time Mode, and Retention controls. The drift is typically linear with time and it can be expressed as a percentage of full-scale output change per second.

(a) Normal Resolution Mode

$$\text{Memory Drift (typical)} = \frac{5 \text{ ppm of full scale per second}}{\text{Time Constant}}$$

or, tabularized:

Time Constant	Memory Drift (typical) % of full scale per 100 seconds
.01 ms	5
.1 ms	5
.3 ms	2
1 ms	0.5
3 ms	0.2
10 ms	0.1
30 ms	0.05
100 ms	0.01
.3 s	0.01
1 s	0.01
3 s	0.01
10 s	0.01
30 s	0.01
100 s	0.01

(b) High Resolution Mode - Memory drift is reduced to the drift characteristics of the previously specified normal resolution Time Constant settings providing the Retention control is optimally adjusted. This relationship is shown in the following table.

Time Constant	Memory Drift (maximum) % of full scale per second	
	Retention off	Retention optimal
3 ns	300	0.05
10 ns	300	0.05
30 ns	300	0.05
100 ns	30	0.05
300 ns	30	0.05
1 µs	1	0.05
3 µs	1	0.05
10 µs	1	0.05
30 µs	0.1	0.05
100 µs	0.1	0.05
300 µs	0.05	0.05
1000 µs	0.05	0.05

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TIMING AND CONTROL

(1) TRIGGER MODES

(a) External - The timing and delay sequence is initiated by an externally derived waveform greater than 0.3 V and less than 5 V and having a rise time of 10 ns or slower. The maximum trigger repetition rate is 250 kHz.

(b) Recurrent - Unit triggers automatically and repetitively at approximately the reciprocal time base.

(2) DELAY RANGE

The delay between triggering and aperture opening is continuously adjustable from 5% to 100% of the Time Base Period. The delay is set by means of a ten turn calibrated dial and has a relative accuracy of ±0.5% of the Time Base. Provision is made for remotely adjusting the delay by applying an externally derived 0-to-10 volt positive dc signal. The jitter is either 1 ns rms or 0.05% rms of the Time Base, whichever is greater.

(3) TIME BASE

(a) Internal - 2.0 µs to 20 s in 1-2-5 sequence. Accuracy is ±5%. Linearity is typically ±1% from 10% to 95% of the Time Base.

(b) External - Provision is made for applying an externally derived zero to plus ten volt ramp. The external Time Base may be as fast as 10 V/µs for a delay accuracy of 2% or better.

(4) DELAYED TRIGGER OUTPUT

A pedestal is provided with an amplitude of one volt minimum into fifty ohms and a risetime of 25 ns or faster. The leading edge of the pedestal can begin anywhere between 5% and 100% of the Time Base. The trailing edge is simultaneous with the end of the Time Base. The pedestal may be manually positioned at a fixed percentage of the Time Base range or may be automatically scanned in synchronization with the aperture delay. Automatic scanning of Delayed Trigger output not available in early units.

(5) AUTOMATIC SCAN

(a) Scan Mode - The aperture delay is automatically scanned over any incremental portion of the Time Base Period. Full-scale scan periods range from one minute to 1000 minutes in 1-2-5 sequence. Scan period accuracy is ±15%.

(b) Scan Hold - Automatic scan may be stopped at any point and held.

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(c) External Scan/Delay - An externally derived zero to +10 V signal will provide aperture delay over the range of the Time Base. The input impedance is nominally 5000 ohms.

GENERAL

(1) POWER REQUIREMENTS

105 to 130 Vac or 210 to 260 Vac, 50-60 Hz, 50 volt-amperes maximum.

(2) OUTPUT POWER

The following voltages are available at the rear-panel interface connector, allowing external accessories or external equipment to be powered by the Model 160.

Pin	Voltage	Accuracy and Regulation	Maximum Available Current
B	+24.0 V	±10 mV	50 mA
C	-24.0 V	±20 mV	50 mA
E	+12.0 V	±20 mV	50 mA
F	-12.0 V	±20 mV	50 mA
D	+ 4.7 V	±250 mV	50 mA
A	0 V	Power Ground Reference	
J	- 200 V*	±20 V	0.5 mA

(3) SIZE

(a) 19 inches wide, 7 inches high, and 15 inches deep.

(b) Unit is supplied with nineteen inch relay rack mounting fixtures.

(c) Weight - 43 lbs.

(4) OPTIONS (consult the factory for more specific information)

(a) Analog Storage Accessory, Model 161.

(b) Preamplifier, Model 115.

(c) Pre-Sampler.

ANALOG STORAGE MODULE SPECIFICATIONS

The Model 161 Analog Storage Accessory improves the memory drift charac-

*-200 V not provided in early units.

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teristics of the Model 160 Boxcar Integrator when making low duty factor examinations of signals having a low repetition rate.

(1) MEMORY DRIFT

±0.05% of full scale per 100 seconds. Memory drift is independent of time constant.

(2) TRIGGER INPUT RATE

100 Hz maximum. Instrument "ignores" faster input triggers when Analog Storage is active (Memory switch to ON). However, with faster trigger rates, there is no need to use the Analog Storage capability.

(3) DUTY FACTOR LIMIT

Duty factor limit is a function of the integration time constant as explained in subsection 3.4G, page III-19.

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