supply. The plug-in boards plug into the mainframe and are between the mainframe and the bottom cover. The plug-in boards are the DAC board, channel A Signal Conditioning board, the channel B Signal Conditioning board, the Reference Multiplier, and the Computer III board. (Instruments designed to meet the special requirements of a customer may have three boards in place of the Computer III board.)

1.4 ELECTRICAL DESCRIPTION.

1.4.1 The Model 9000, shown in simplified form in figure 1.3, consists of the following functional blocks: Signal Conditioning circuitry that scales, generates a squared wave output from the input signal, and selects the points on the incoming signal that determine the characteristics of the squared wave output; a stable and accurate 100 MHz reference frequency; an adjustable timebase that allows the signal applied to it to be divided by 1, 10, or some multiple of 10; gate logic that converts a signal input into a corresponding time period; a gate (controlled by the gate logic) that regulates the flow of pulses to the accumulator; an accumulator that counts a signal applied to it and stores the binary value of the count; a microcomputer that controls the operation of the counter, performs any programmed arithmetic operations, and routes the data in the accumulator to the display; the display that provides in visual form the numeric value of the binary data stored in the accumulator as well as the status of the timebase, signal conditioners and other instrument operations.

1.4.2 The instrument performs the various measurement functions by routing the input signal and internal signals, according to the function and timebase division selected, between the various functional blocks. Mathematical operations are performed by routing the data from the accumulator to the microcomputer. All computations then take place within the microcomputer and the results routed to the display.

1.5 MISCELLANEOUS.

1.5.1 Items Furnished.

1.5.1.1 Items provided with the Series 9000 includes:

a. Power Cable.

b. Operators Manual.

1.5.2 Required Tools & Test Equipment.

1.5.2.1 Tools required for maintenance are listed in paragraph 5.7.1.1.

1.5.2.2 Equipment required for calibration is shown in table 5.1.

1.6 SPECIFICATIONS.

1.6.1 The specifications are shown in table 1.2.

Table 1.2 - Specifications

GENERAL	
Calculating Capability:	ADD or SUBTRACT a constant from the measurement; MULTIPLY and DIVIDE the measurement by a constant reciprocal of a measurement.
Memory Capability:	The constant operates on successive measurements until either the measurement mode is changed or the constant/ operation is changed, or the unit is reinitialized.
Constant Range:	±999.999999 EXP ±99
Automatic Ranging:	Channels A and B voltage ranges are automatically selected as a function of the input signals' voltage levels.
Manual Ranging:	Channels A and B voltage ranges are selected as a function of the trigger level resolution.
Automatic Trigger Level:	The counter measures the maximum and minimum peak of the input signal, calculates the arithmetic mean, and automatically sets the trigger level at the mean. Standard on both channels A and B. For inputs ≥ 400 Hz, ≥ 50 mV RMS.
Internal Reference Oscillator:	
Aging Rate:	$<3\times10^{-7}$ per month
Temperature Stability:	$<5\times10^{-6}$, 0°C to +50°C
Voltage Stability:	$<1\times10^{-7}$ with 10% line voltage variation
Internal Reference Output:	10 MHz square wave, buffered, TTL compatible

Table 1.2 - Specifications continued

GENERAL continued	
External Reference Input:	1, 5, or 10 MHz; 1V RMS into 1 Kohm. Counter automatically locks to external reference; if present, front panel indicator lights.
Marker Output:	Negative-going pulse, 14 volt amplitude, rear BNC, duration equal to channel A trigger point to channel B trigger point.
Display:	
Numeric:	Eleven, 11 mm (.43 inch) yellow LEDs. Leading and following zeros suppressed.
Status Indicators:	LED lamps show status of counter controls: Function, Measurement Time, System Control, External Reference, Input voltage range, Slope, Coupling, Separate/Common, and Test. LED lamps show numeric readout dimensional units, overflow, condition, and channel C input status.
Trigger Level:	Two, 3-digit 2.8 mm (.11 inch) red LEDs.
Sample Rate:	Periodic or hold, switch selectable. In periodic mode, rest time between readings is approximately 300 msec.
Input/Output Connectors:	BNC
Operating Temperature:	0°C to +50°C
Storage Temperatures:	−20°C to +70°C at 75% RH
Operating Humidity:	< 75% RH from +25°C to +40°C <50% RH from +40°C to +50°C
Dimensions: (HxWxD)	3-15/32 x 16-3/4 x 18 inches
Weight:	Net 19 lbs. (8.6 Kg) Shipping 25 lbs. (11.4 Kg)
Power Requirement:	100/120/220/240V RMS, +5%, −10%, 50-60 Hz 125 Watts, maximum

INPUT CHARACTERISTICS	
Channel A and B Frequency Range:	
DC Coupled:	0 to 100 MHz
AC Coupled:	20 Hz to 100 MHz
Coupling:	DC or AC, switch selectable
Sensitivity Sinewave:	25 mV RMS to 1 MHz 50 mV RMS to 50 MHz 100 mV RMS to 100 MHz
Pulse:	150 mV P-P; 8 nsec minimum width
Input Impedance:	1 Mohm shunted by less than 25 pF.
Maximum Input: (without damage)	250V RMS or 300V peak on all ranges. On 1V range, degrade by 20 dB/decade above 1 MHz to 2.5V RMS at 100 MHz.
Voltage Ranges:	1, 10, 100; Keyboard selectable or automatically selected.
Trigger Level:	Digitally adjustable (keyboard entry) from +318.75% to −320% of voltage range. Digital levels displayed on front panel and analog levels (DAC outputs) available on rear panel.
Input Trigger Level Accuracy:	±5% of range ±0.1% range per °C
Output Trigger Level Accuracy:	±2% of range of actual trigger point
Channel C (Model 9035 only) Frequency Range:	100 MHz to 512 MHz
Sensitivity Sinewave:	15 mV RMS
Input Impedance:	50 Ohms nominal
Maximum Operating Input:	1V RMS
Maximum Input: (without damage)	5V RMS (fuse protected)
Automatic Gain Control:	40 dB without adjustment
Prescale Factor:	10

Table 1.2 - Specifications continued

TIME INTERVAL MEASUREMENT	
Range:	10 nsec to 10^9 seconds
Resolution:	10 nseconds
Accuracy:	±1 count ± reference error ± trigger error*
Input:	
Separate Mode:	Channel A start and Channel B stop
Common Mode:	Channel A start and stop
Home State:	
Resolution:	10 nsec
Reciprocal Mode (1/X):	Displays $\frac{1}{\text{Time Interval}}$
Display:	nsec, μsec, msec, sec, ksec, or Msec
*trigger error $\frac{\leq 0.0025\ \mu\text{sec}}{\text{Signal Slope (in V/}\mu\text{sec)}}$	

TIME INTERVAL AVERAGE	
Range:	100 psec to 1 sec
Accuracy:	$\pm\text{reference error} \pm 2\text{ nsec} \pm \frac{(\text{trigger error}^* + 10\text{ nsec})}{\sqrt{\text{Number of Intervals Averaged}}}$
Intervals Averaged:	10 to 10^9, selectable in decade steps
Dead Time:	Minimum time between stop and start: 50 nsec
Input:	
Separate Mode:	Channel A start and Channel B stop
Common Mode:	Channel A start and stop
Home State:	
No. Intervals Averaged:	'10'
Resolution:	1 nsec
Reciprocal Mode (1/X):	Displays $\frac{1}{\text{Time Interval Average}}$
Display:	psec, nsec, μsec, msec, or sec
*trigger error $\frac{\leq 0.0025\ \mu\text{sec}}{\text{Signal slope (in V/}\mu\text{sec)}}$	

PERIOD MEASUREMENT	
Range:	10 nsec to 10^9
Resolution:	10 nsec
Accuracy:	±1 count ± reference error ± trigger error*
Input:	Channel A
Home State:	
Resolution:	10 nsec
Reciprocal Mode (1/X):	Displays Frequency, 1 Hz to 100 MHz
Display:	nsec, μsec, msec, sec, ksec, or Msec
*trigger error $\frac{\leq 0.3}{(S/N)\ f_A}$	
where S/N equals signal to noise ratio in volts and f_A equals input frequency	

PERIOD AVERAGE	
Range:	10 nsec to 1 sec
Accuracy:	$\pm\text{reference error} \pm 1\text{ count} \pm \frac{\text{trigger error}^*}{\text{Number of Periods Averaged}}$
Intervals Averaged:	1 to 10^8, selectable in decade steps
Input:	Channel A
Home State:	
No. Intervals Averaged:	'10'
Resolution:	1 nsec
Reciprocal Mode (1/X):	Displays frequency, 1 Hz to 100 MHz
Display:	nsec, μsec, msec, or sec
*trigger error $\frac{\leq 0.3}{S/N\ f_A}$	
where S/N equals signal to noise ratio in volts and f_A equals input frequency	

Table 1.2 - Specifications continued

FREQUENCY MEASUREMENT TO 100 MHz	
Frequency Range:	
DC Coupled:	0 to 100 MHz
AC Coupled:	20 Hz to 100 MHz
Accuracy:	
Standard Mode:	±1 count ± reference error
Computing Mode:	$\frac{1}{\text{Accuracy of Period Meas'mt}}$
Input:	Channel A
Measurement:	
Standard Mode:	1 μsec to 10 sec, selectable in decade steps
Home State:	
Measurement Time:	.1 sec
Frequency Resolution:	10 Hz
Reciprocal Mode (1/X):	Displays Period, 10 nsec to 10^6 sec
Display:	9 digits; mHz, Hz, kHz, or MHz
Self Test: (10^{-1} sec timebase):	10.00000 MHz

FREQUENCY MEASUREMENT TO 512 MHz (Model 9035 Only)	
Frequency Range:	100 MHz to 512 MHz
Accuracy:	±1 count ± reference error
Input:	Channel C
Measurement Time:	1 μsec to 10 sec, selectable in decade steps
Home State:	
Measurement Time:	.1 sec
Frequency Resolution:	100 Hz
Reciprocal Mode (1/X):	Displays Period, 2 nsec to .1 μsec
Display:	9 digits, MHz

FREQUENCY RATIO MEASUREMENTS	
Frequency Range:	
Channel A:	0 to 100 MHz
Channel B:	0 to 100 MHz
Ratio:	10^{-8} to 10^8
Multiplier:	f_B scaled by 1 to 10^9, selectable in decade steps
Accuracy:	±1 count of f_A ± trigger error* of f_B
Home State:	
Multiplier:	10
Reciprocal Mode (1/X):	Displays multiplier $f_B \div f_A$,
Display:	$f_A \div$ multiplier f_B, dimensionless
*trigger error $\frac{\leq 0.0025\ \mu\text{sec}}{\text{Signal slope (in V/}\mu\text{sec)}}$	

TOTALIZE MEASUREMENT	
Frequency Range:	0 to 100 MHz
Count Range:	0 to 10^9
Accuracy:	±1 count per gate

SCALING	
Frequency Range:	0 to 100 MHz
Scaling Range:	
≤10 MHz:	1 to 10^9, selectable in decade steps
> 10 MHz:	10 to 10^9, selectable in decade steps
Input:	Channel C

Table 1.2 - Specifications continued

PULSE PARAMETER MEASUREMENTS (Option 11)	
Initiation of the required measurement by a single key entry activates the microprocessor to measure the pulse amplitude, calculate and set the required start/stop trigger level settings, and initiate the counter to take the time interval measurement. The start and stop trigger level values are displayed on the front panel and are available to the system output.	
Rise Time:	
Start Point:	10% of pulse amplitude, positive slope
Stop Point:	90% of pulse amplitude, positive slope
Fall Time:	
Start Point:	90% of pulse amplitude, negative slope
Stop Point:	10% of pulse amplitude, negative slope
Pulse Width:	
Start Point:	50% of pulse amplitude, positive slope
Stop Point:	50% of pulse amplitude, positive slope
Range:	
Single Measurement:	10 nsec to 10^9 sec
Multiple Intervals Measurement:	100 psec to 1 sec
Intervals Averaged:	1 to 10^9, selectable in decade steps
Time Measurement Accuracy:	
Single Measurement:	$\pm$1 count $\pm$ reference error $\pm$ trigger error*
Multiple Intervals Measurement:	$\pm$reference error $\pm$ 2 nsec $\pm$ $\frac{\text{(trigger error* + 10 nsec)}}{\sqrt{\text{Number of Intervals Averaged}}}$
Trigger Level Setting Accuracy:	$\pm$5% of voltage range
Input:	Channel A
Minimum Pulse Height:	0.3V
Display:	nsec, μsec, msec, sec, ksec, or Msec
*Trigger error $\frac{\leq 0.0025\ \mu\text{sec}}{\text{Signal slope (in V/}\mu\text{sec)}}$	

INTERNAL REFERENCE OSCILLATOR OPTIONS	
Option 22	
Aging Rate:	$<1\times10^{-9}$ per day
Temperature Stability:	$<5\times10^{-9}$, 0°C to +50°C
Voltage Stability:	$<2\times10^{-9}$ with 10% line voltage variation
Option 24	
Aging Rate:	$<5\times10^{-10}$ per day
Temperature Stability:	$<5\times10^{-9}$, 0°C to +50°C
Voltage Stability:	$<2\times10^{-9}$ with 10% line voltage variation
Warmup*:	72 hours

*Time to reach aging specification after 24 hours off.