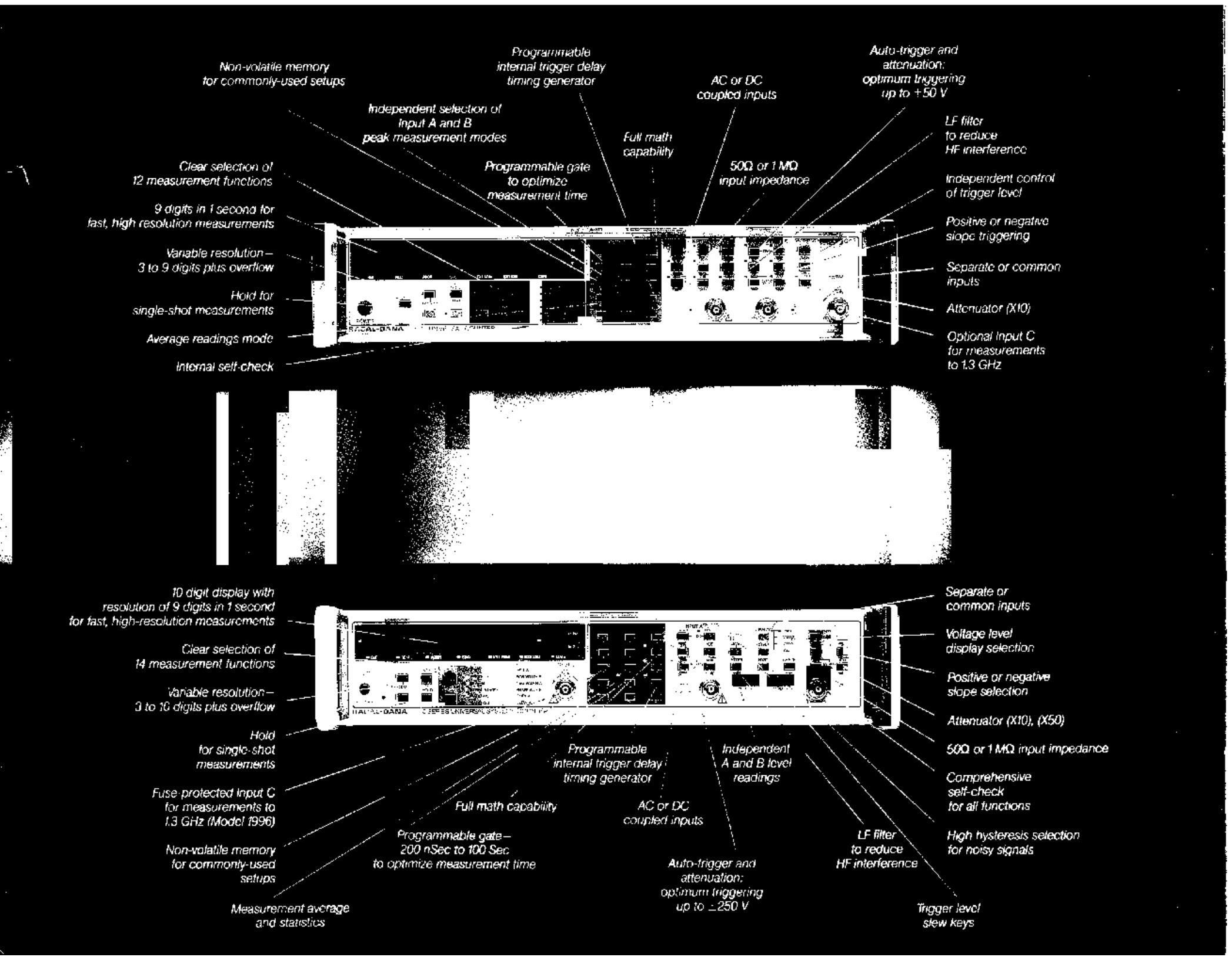
Non-volatile memory for commonly-used setups
Programmable internal trigger delay timing generator
AC or DC coupled inputs
Auto-trigger and attenuation: optimum triggering up to +50 V
Independent selection of input A and B peak measurement modes
Full math capability
LF filter to reduce HF interference
Clear selection of 12 measurement functions
Programmable gate to optimize measurement time
50Ω or 1 MΩ input impedance
Independent control of trigger level
9 digits in 1 second for fast, high resolution measurements
Positive or negative slope triggering
Variable resolution— 3 to 9 digits plus overflow
Separate or common inputs
Hold for single-shot measurements
Attenuator (X10)
Average readings mode
Optional Input C for measurements to 1.3 GHz
Internal self-check
10 digit display with resolution of 9 digits in 1 second for fast, high-resolution measurements
Separate or common inputs
Clear selection of 14 measurement functions
Voltage level display selection
Variable resolution— 3 to 10 digits plus overflow
Positive or negative slope selection
Attenuator (X10), (X50)
Hold for single-shot measurements
50Ω or 1 MΩ input impedance
Programmable internal trigger delay timing generator
Independent A and B level readings
Comprehensive self-check for all functions
Fuse-protected Input C for measurements to 1.3 GHz (Model 1996)
Full math capability
AC or DC coupled inputs
High hysteresis selection for noisy signals
Programmable gate— 200 nSec to 100 Sec to optimize measurement time
LF filter to reduce HF interference
Non-volatile memory for commonly-used setups
Auto-trigger and attenuation: optimum triggering up to ±250 V
Measurement average and statistics
Trigger level slew keys

	Model 1994	Models 1995/1996
Rise/Fall Time		
Range	20 nSec to 20 mSec	5 nSec to 25 mSec
	Other parameters as Time Interval	
Pulse Width	5 nSec to 20 mSec	5 nSec to 33 mSec
	Other parameters as Time Interval	
Duty Cycle		
Range	—	0.01% to 99.99%
		Other parameters may be derived from T.I. specifications
Slew Rate		
Range	—	10 V/Sec to 2×10^9 V/Sec
		Other parameters may be derived from T.I. and read peak amplitude specifications
Read Peak Amplitude		
Frequency Range	DC, 50 Hz to 20 MHz	DC, 30 Hz to 25 MHz
Amplitude Range	150 mV to 51 V	150 mV to 250 V
Resolution (x1)	20 mV	10 mV
Accuracy (x1)	±50 mV ±6% $V_{pk\text{-}pk}$ (Sine wave) ±40 mV ±1% rdg (DC)	±20 mV ±5% $V_{pk\text{-}pk}$ (Sine wave) ±10 mV ±2% $V_{pk\ pk}$ (pulse)
Display	Main display. Selectable: A & B; (−) peak, (+) peak and mean (trigger level)	Individual 3 digit displays for A & B. Selectable: (−) peak, (+) peak, peak-to-peak or mean (trigger level)
Math	$\frac{(\text{Reading-X})\ Y}{Z}$	$\frac{(\text{Reading-X})\ Y}{Z}$
Statistics		
Sample size	100	2 to 9999
Average	Yes	Yes
Standard Deviation	—	Yes
Highest Value	—	via Special Function
Lowest Value	—	via Special Function

General

General Purpose Interface Bus Full programming, IEEE-STD-488 (1978) of all signal conditioning, function and data entry controls

Data Output		
Normal	20 rdgs/Sec	150 rdgs/Sec
High Speed Mode	150 unprocessed rdgs/Sec	—
Gate Time		
Range	1 mSec to 100 Sec	Single period of input signal or 200 nSec to 100 Sec
Resolution	1 mSec or 3 digits	0.1 μSec or 3 digits
External Arming	Independently selectable, positive, or negative on start and finish of measurement	
Input	External arm input	Selectable input A, B or D
Characteristics		
Sensitivity	500 mV pk-pk	300 mV pk-pk §
Threshold	±4 V (adjustable)	Zero crossing or TTL compatible §
Minimum Time	200 nSec	50 nSec

	Model 1994	Models 1995/1996
Non Volatile Memory	10 complete measurement setups may be stored in non-volatile memory for subsequent recall. Stored setups include measurement function, input signal conditioning, keyboard functions, and constants.	
Gate Output	Rear panel BNC output. TTL compatible, corresponding to internal gate signal. (Gate output becomes discrete fault interrupt on MATE version of 1995/1996)	
Time Base		
Aging	$<2 \times 10^{-6}$ in first year	
Temperature Stability	$<\pm 1 \times 10^{-6}$ (0° to 50°C)	
Internal Standard Output		
Frequency	10 MHz	10 MHz
Level	600 mV pk-pk into 50 ohm	2 V pk-pk into 50 ohm
External Standard Input		
Frequency	10 MHz (See Option 41)	10, 5 or 1 MHz
Level	>500 mV rms <5 V rms	>100 mV rms <10 V rms
Power Requirements	100, 115, 220, 240 VAC ±10% 45-450 Hz 35 VA	100, 115, 220, 240 VAC ±10% 45-450 Hz 80 VA
Weight	8 kg (18 lb)	10 kg (22 lb)
Dimensions	89H x 427W x 345D mm (3.5H x 16.8W x 13.6D in.)	89H x 427W x 475D mm (3.5H x 16.8W x 18.7D in.)

Definitions

LSD: Least significant digit. (May be rounded to nearest whole decade.)

Trigger Error (rms)

$$\text{Trigger error} = \sqrt{\frac{(e_{ix}^2 + e_{nx}^2)}{S_x^2} + \frac{(e_{iy}^2 + e_{ny}^2)}{S_y^2}}$$

where e_i = input amplifier rms noise (typically 150 μV rms)
e_n = input signal rms noise in measurement bandwidth
S = Slew rate at trigger point V/Sec
Suffix x denotes START edge
Suffix y denotes STOP edge

Trigger Level Timing Error

$$\text{Trigger Level Timing Error (seconds)} = Z\left(\frac{1}{S_x} - \frac{1}{S_y}\right)$$

where Z = 0.035, typically 0.018 for Model 1994;
or where Z = 0.012, typically 0.006 for Models 1995/6.
S_x = Slew rate on START edge V/Sec
S_y = Slew rate on STOP edge V/Sec

Pulse Width: Measured at 50% of pulse amplitude

Rise/Fall Time: Measured between 10% and 90% of pulse amplitude

Slew Rate: Measured between 20% and 80% of pulse amplitude

Phase: Phase consists of 3 measurements: Ratio (to ensure A and B are at same frequency), Period, and Time Delay between two signals.

$$\text{Phase} = \frac{\text{Time Delay} \times 360°}{\text{Period}}$$

Specifications

Input Characteristics

	Model 1994	Models 1995/1996
Frequency Range		
Input A		
AC Coupled	10 Hz to 160 MHz	20 Hz to 200 MHz
DC Coupled	DC to 160 MHz	DC to 200 MHz
Input B		
AC Coupled	10 Hz to 100 MHz	20 Hz to 200 MHz
DC Coupled	DC to 100 MHz	DC to 200 MHz
Input C†		
AC Coupled	40 MHz to 1.3 GHz	40 MHz to 1.3 GHz
Sensitivity		
Inputs A & B		
Sine	25 mV, DC to 100 MHz 50 mV, 100 MHz to 160 MHz	25 mV, DC to 100 MHz 50 mV, 100 MHz to 200 MHz
Pulse	75 mV pk-pk @ 5 nSec	75 mV pk-pk @ 5 nSec
Input C†	10 mV, 40 MHz to 1.0 GHz 75 mV, 1.0 GHz to 1.3 GHz	
Trigger Level		
Range (x1)	±5.1 V in 20 mV steps	±5 V in 10 mV steps
(x10)	±51 V in 200 mV steps	±50 V in 100 mV steps
(x50)	–	±250 V in 1 V steps
Accuracy (x1)	±30 mV ±1% of trigger level reading	±10 mV ±1% of trigger level reading
Auto-trigger		
Frequency Range	DC, 50 Hz to 100 MHz	DC, 30 Hz to 200 MHz
Minimum Amplitude	50 mV rms sine wave, 150 mV pk-pk	
Attenuator	x1 or x10	x1, x10 or x50
Auto Attenuation	Selected with auto-trigger	
Trigger Slope	Positive or negative	
Impedance		
Separate	50 ohm or 1 megohm/45 pF	50 ohm or 1 megohm/40 pF
Common	50 ohm or 1 megohm/55 pF	50 ohm or 1 megohm/40 pF
Low Pass Filter	Input A, 50 kHz	Inputs A & B independently selectable, 100 kHz
Hysteresis	–	Reduces sensitivity (~ x4) for measurement of noisy signals.
Damage Level		
Inputs A & B (x1)		
50 ohm	5 Vrms	5 Vrms
1 megohm	DC-2 kHz: 260 V (DC + AC rms) 2 kHz-100 kHz: $(5 \times 10^5/f)$ Vrms 100 kHz-200 MHz: 5 Vrms	
Input C†	7 Vrms (fuse protected)	

*MATE: Modular Automatic Test Equipment
CIIL: Control Intermediate Interface Language
†Model 1996 and 1994 with Option 41.
‡Systematic error which may be "nulled" out.
§Input D. For Inputs A & B, see main input characteristics specification.

Measurement Functions

	Model 1994	Models 1995/1996
Frequency A & B		
Range (A)	DC to 160 MHz	DC to 200 MHz
(B)	DC to 100 MHz	DC to 200 MHz
LSD		
DC to 100 MHz	(1 nSec/gate time) x frequency	
>100 MHz	(2 nSec/gate time) x frequency	
Resolution	±(LSD) ±(trigger error/gate time) x frequency	
Accuracy	±resolution ±(time base uncertainty) x frequency	
Frequency C†		
Range	40 MHz to 1.3 GHz Other parameters as Frequency A & B	
Period A		
Range	6.25 nSec to 1.7×10^3 Sec	5 nSec to 10^7 Sec
LSD		
>10 nSec	(1 nSec/gate time) x period	
<10 nSec	(2 nSec/gate time) x period	
Resolution	±(LSD) ±(trig error/gate time) x period	
Accuracy	±resolution ±(time base uncertainty) x period	
Time Interval A to B		
Range	−2 nSec to 8×10^5 Sec	−2 nSec to 10^7 Sec
LSD	1 nSec	1 nSec
Resolution	±(LSD) ±(1 nSec) ±(trigger error)	±(LSD) ±(trigger error)
Accuracy	±Resolution ±(time base uncertainty) x time interval ±trigger level timing error ±2 nSec‡	±Resolution ±(time base uncertainty) x time interval ± trigger level timing error ±1 nSec‡
Time Interval Delay (Time Interval and Totalize Measurements)		
Delay Range	200 μSec to 800 mSec	200 nSec to 100 Sec
Resolution	25 μSec (nominal)	0.1 μSec or 3 digits
Time Interval Average		
No. of Averages (N):	100	1 to 9999
LSD	1 nSec/ $\sqrt{N}$	(100 pSec for N>100)
Ratio A/B		
Range	DC to 100 MHz	DC to 200 MHz
LSD	$10/(F_B \times \text{gate time})$	$\text{Ratio}/(F_A \times \text{gate time})$
Ratio C/B†		
Range		
Input C	40 MHz to 1.3 GHz	40 MHz to 1.3 GHz
Input B	DC to 100 MHz	DC to 200 MHz
LSD	$640/(F_B \times \text{gate time})$	$\text{Ratio}/(F_C \times \text{gate time})$
Totalize A by B		
Range	0 to $(10^{16})-1$	0 to $(10^9)-1$
LSD	1 count	1 count
Phase A Relative B		
Range	0 to 360°	0 to 360°
LSD	0.1° DC to 1 MHz 1.0° 10 MHz to 10 MHz 10° 10 MHz to 100 MHz	Continuous monitoring of measurement provides optimum resolution based on Period and Time Interval resolution.