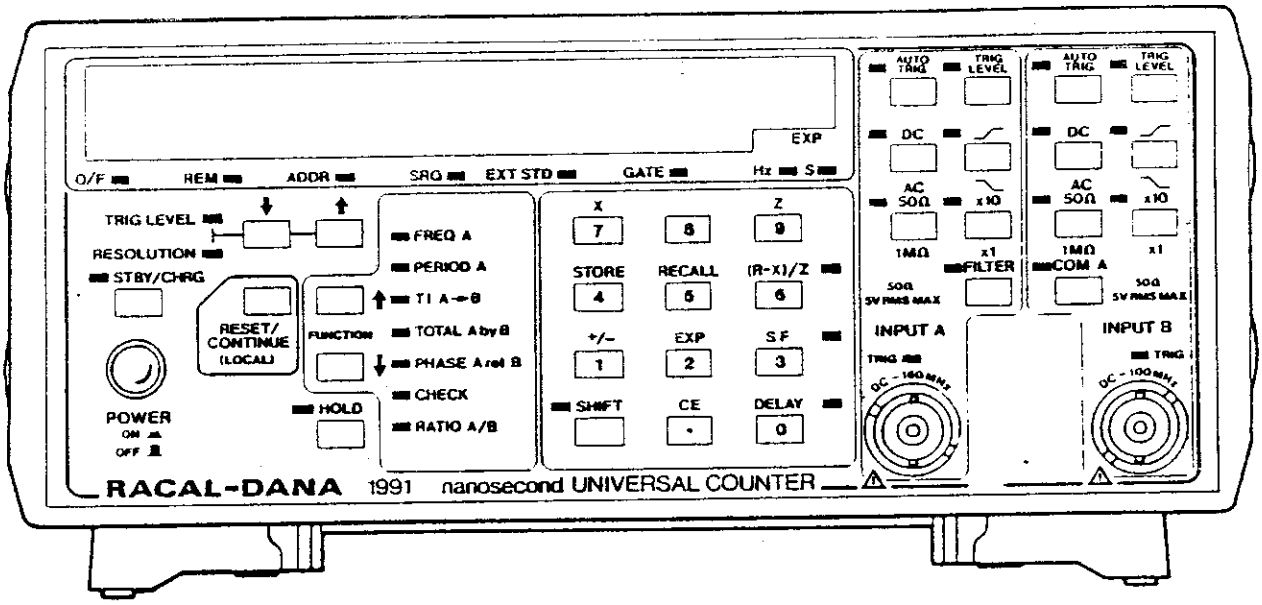

Figure 1.1 - Model 1991 Universal Timer/Counter

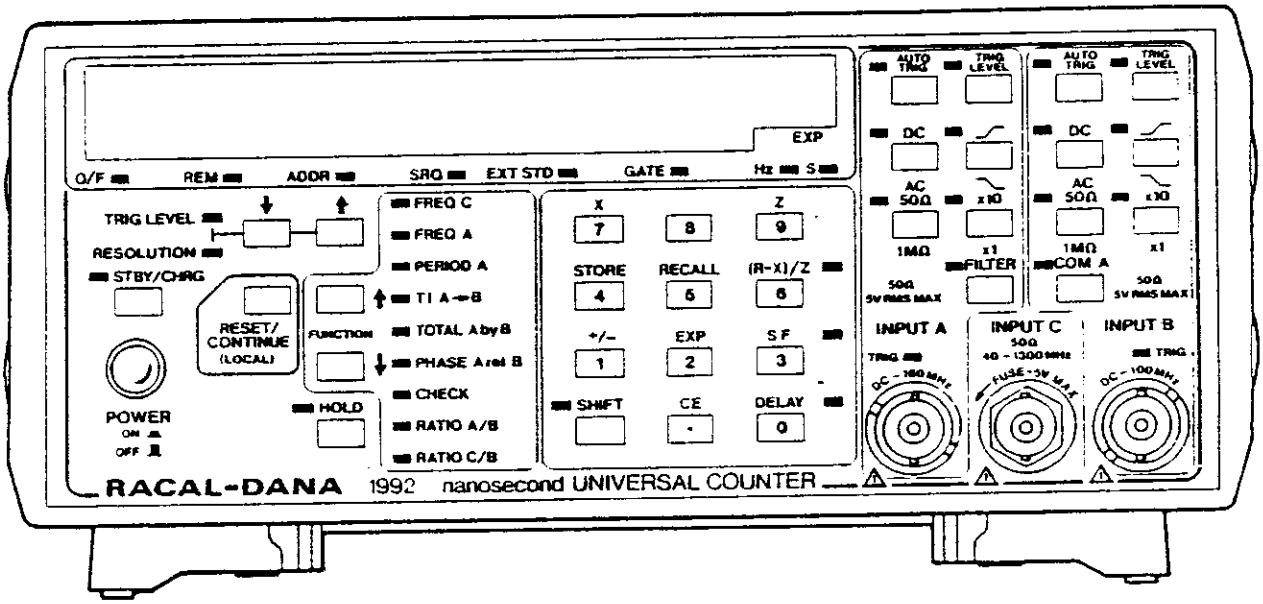

Figure 1.2 - Model 1992 Universal Timer/Counter

Table 1.1 - 1991/1992 Specifications (Cont'd)

Trigger Level Range:	
Manual:	
x1 attenuation:	± 5.1V in 20 mV steps
x10 attenuation:	± 51V in 200 mV steps
Automatic:	± 51V
Trigger Level Accuracy:	
Manual and Automatic:	
x1 attenuation:	± 30 mV ±1% of trigger level reading
x10 attenuation:	± 300 mV ±1% of trigger level reading
Auto Trigger:	
Frequency Range:	DC and 50 Hz to 100 MHz (Typically 160 MHz)
Min. Amplitude (AC):	Typically 150 mV p-p*
x10 attenuator	Automatically selected if input signal exceeds ± 5.1V or 5.1V p-p*
Trigger Level Outputs: (Rear Panel)	
Range:	± 5.1V
Accuracy (Relative to true trigger level)	
x1 attenuation:	± 1% V output ±10 mV
x10 attenuation:	± 1% V output ± 100 mV
Impedance:	10 kohm nominal

MODEL 1992: Specification for input characteristics is identical to that for the 1991 except for the following addition:

Input C

Frequency Range:	40 MHz to 1.3 GHz
Sensitivity:	
Sine Wave:	<15 mV rms, 40 MHz to 1 GHz <75 mV rms to 1.3 GHz
Dynamic Range:	15 mV rms to 5V rms to 1 GHz 75 mV rms to 5V rms to 1.3 GHz
Input Impedance:	50 ohms nominal AC-coupled
VSWR:	≤2:1 at 1 GHz
Maximum Input:	7V rms (fuse-protected) Fuse located in BNC connector
Damage Level:	2.5W

*See Definitions

Table 1.1 - 1991/1992 Specifications (Cont'd)

MEASUREMENT MODES	
Frequency A	
Range:	DC to 160 MHz
Digits Displayed:	3 to 9 digits plus overflow
LSD Displayed (Hz):	$F \times 10^{-D}$ (D = No. of digits, F = Frequency rounded up to next decade)*
Resolution* (Hz):	± LSD† ± (Trig. Error* x Frequency) /Gate Time
Accuracy* (Hz):	± Resolution ± (Timebase Error x Frequency)
Frequency C (Model 1992 only)	
Range:	40 MHz to 1.3 GHz
LSD*:	As for Frequency A
Resolution* and Accuracy*:	As for Frequency A
Time Interval	
Range:	
Separate Mode:	0 to 8×10^5s Typically -2 ns to $+8 \times 10^5$s
Common Mode:	5 ns to 8×10^5s
Input:	
Common:	Input A START and STOP
Separate:	Input A START Input B STOP
Trigger Slopes:	+ve or -ve Selectable START and STOP
LSD Displayed:	1 ns min
Resolution* (sec):	± LSD ± 1 ns ± Trig Error*
Accuracy* (sec):	± Resolution ± (Timebase Error x T1) ± Trigger Level Timing Error* ± 2 ns**

*See Definitions
†2LSD for 6-9 digits displayed
**A differential delay which may be reduced by numerical offset or external compensation.

Table 1.1 - 1991/1992 Specifications (Cont'd)

Time Delay	
Available on Time Interval and Totalize	
Range:	200 µs to 800 ms nominal
Step Size:	25 µs nominal
Accuracy:	± 0.1% Rdg. ± 50 µs
Period A	
Range:	6.25 ns to 1.7×10^3s
Digits Displayed:	3 to 9 digits plus overflow
LSD Displayed (sec):	$P \times 10^{-D}$ (D = No. of digits, P = Period rounded up to next decade)*
Resolution* (sec):	± LSD† ± (Trig. Error* x Period) /Gate Time
Accuracy* (sec):	± Resolution ± (Timebase Error x Period)
Ratio A/B	
Specified for higher frequency applied to Input A	
Range:	DC to 100 MHz on both inputs
LSD Displayed: (for 6-9 digits selected)	$\left(\frac{10}{\text{Freq. B} \times \text{Gate Time}}\right)$, rounded to nearest decade*
Resolution*:	± LSD ± (Trig. Error B*/Gate Time) x Ratio
Accuracy*:	± Resolution
Ratio C/B (Model 1992 only)	
Specified for higher frequency applied to Input C	
Range:	Input C 40 MHz to 1.3 GHz Input B DC to 100 MHz

*See Definitions
† 2LSD for 6-9 digits displayed

Table 1.1 – 1991/1992 Specifications (Cont'd)

LSD Displayed: **(for 6–9 digits selected)**	$\left(\frac{640}{\text{Freq. B x Gate Time}}\right)$, rounded to nearest decade*
Resolution* and Accuracy*:	As for Ratio A/B
Totalize A by B	
Accumulative or single totalize	
Input:	Input A
Range:	10^{12}–1 (Max. 9 most significant digits displayed)
Maximum Rate:	10^{8} events/s
Minimum Pulse Width:	5 ns min. at trigger points
Accuracy:	± 1 count
Start/Stop:	Electrical (Input B) or Manual
Phase (A rel. to B)	
Range:	0.1° to 360°
LSD Displayed:	0.1° to 1 MHz 1.0° to 10 MHz 10° to 100 MHz
Resolution* (degrees):	± LSD ± (TI Resolution/Period A) x 360°
Accuracy* (degrees):	± LSD ± (TI Accuracy/Period A) x 360°
Amplitude Measurement	
Peak*	
Frequency Range:	50 Hz to 20 MHz
Amplitude Range:	160 mV p–p to 51V p–p
Resolution:	
x1 attenuation:	20 mV
x10 attenuation:	200 mV
Accuracy:	
x1 attenuation:	± 50 mV ± 6%V p–p (Typically ± 40 mV ± 2%V p–p)
x10 attenuation:	± 500 mV ± 10%V p–p (Typically ± 400 mV ± 3%V p–p)

*See Definitions

Table 1.1 - 1991/1992 Specifications (Cont'd)

DC (<15 mV p-p AC)	
Amplitude Range:	± 51V
Resolution:	
x1 attenuation:	20 mV
x10 attenuation:	200 mV
Accuracy:	
x1 attenuation:	± 40 mV ± 1% Rdg.
x10 attenuation:	± 400 mV ± 1% Rdg.
Math	
Available on all measurements except Phase and Check	
Function:	(Result - X)/Z
Entry Range:	$\pm 1 \times 10^{-10}$ to $\pm 1 \times 10^{10}$ to 9 significant figures
EXTERNAL ARMING	
A comprehensive external arming capability to determine the START and/or STOP point of a measurement. Available on all measurement functions except phase.	
Input Signal: (via Rear Panel)	TTL compatible (min. pulse width 200 ns)
Slope:	+ve or -ve independently selectable on START or STOP arm
Impedance:	1 kohm nominal
GENERAL SPECIFICATIONS	
Frequency Standard Output:	
Frequency:	10 MHz
Amplitude:	>600 mV p-p into 50 ohms
Impedance:	250 ohms nominal
External Standard Input:	
Frequency:	10 MHz
Signal Amplitude:	Min. 100 mV rms
(Sine Wave)	Max. 10V rms
Impedance:	1 kohm nominal at 1V p-p 500 ohms nominal at 10V p-p

Table 1.1 - 1991/1992 Specifications (Cont'd)

Gate Time: **(Frequency, Period, and Ratio modes)**	Automatically determined by resolution selected (Range 1 ms - 10s)* Resolution Selected: / Gate Time: (seconds) 9 + overflow / 10 9 / 1 8 / 0.1 7 / 0.01 6,5,4,3 / 0.001
Single Cycle: **(Hold)**	Enables a single measurement to be initiated and held
Display:	9-digit, high brightness, 14 mm LED display in engineering format with exponent digit
Power Requirements:	
Voltage:	90-110 103-127 193-237 207-253 VAC
Frequency:	45-450 Hz
Rating:	35 VA max.
Environmental Requirements:	
Temperature, Storage:	-40°C to +75°C at 75%RH
Temperature, Operating:	0°C to +50°C
Relative Humidity:	95% to 30°C 75% to 40°C 45% to 50°C
Altitude, Storage:	12,000 meters
Altitude, Operating:	3,050 meters
Vibration:	2 g
Shock:	30 g
Safety:	Designed to meet the requirements of IEC 348 and follow the guidelines of UL1244
Weight:	Net 3.63 kg (8 lb) Shipping 5.5 kg (11 lb)
Dimensions, Instrument:	331 x 212 x 88 mm (13.03 x 8.35 x 3.46 in)

*See Definitions

OPTIONS

List of Options and Accessories

01*	Rear Panel Inputs	11-1709 (Model 1991)
01*	Rear Panel Inputs	11-1732 (Model 1992)
04T**	Temperature Controlled Crystal Oscillator	11-1713
04A**	Oven Oscillator	11-1710
04E**	High Stability Oven Oscillator	404386
07†	Battery Pack	11-1625
10	Reference Frequency Multiplier	11-1645
55†	GPIB Interface	404574
60	Handles	11-1730
60A	Rack Mounting Kit (Fixed, Single)	11-1648
60B	Rack Mounting Kit (Fixed, Double)	11-1649
61	Carrying Case	15-0773
61M	Protectomuff Case	15-0736
65	Chassis Slides (incl. Rack Mounts)	11-1716
	Thru-line Connector	11-0167
	Telescopic Antenna	23-9020
	High Impedance Probe	23-9104
	1.3 GHz Fuse (Pkt. 5)	11-1718

*Installing Option 01 may affect certain specification parameters

**Only one frequency standard may be installed at any one time. The standard reference will be supplied unless Option 04T, 04A, or 04E is specified

† The battery pack and GPIB options cannot both be installed at the same time

Option 01 Rear Panel Inputs

A rear-panel input, factory-fitted option, is available for ATE applications. Inputs A and B are in parallel with those on the front panel while Input C (Model 1992 only) is fitted in place of the front panel input.

Option 04T Temperature Controlled Crystal Oscillator

Frequency:	10MHz
Aging Rate:	$\leq 3 \times 10^{-7}$/month $\leq 1 \times 10^{-6}$ in the first year
Temperature Stability:	$\leq 1 \times 10^{-6}$ over the range 0°to +40°C (Operable to +50°C)
Adjustment:	Via rear panel

Option 04A Ovened Oscillator

Frequency:	10MHz
Aging Rate:	$\leq 3 \times 10^{-9}$/day averaged over 10 days after 3 months continuous operation
Temperature Stability:	$\leq 3 \times 10^{-9}$/°C averaged over range 0° to + 45° C (operable to +50° C)
Warm Up:	Typically $\pm 1 \times 10^{-7}$ within 6 minutes
Adjustment:	Via rear panel

Table 1.1 - 1991/1992 Specifications (Cont'd)

Option 04E High- Stability Ovened Oscillator	
Frequency:	10MHz
Aging Rate:	$\leq 5 \times 10^{-10}$/day at shipment averaged over 10 days
Temperature Stability:	$\leq 7 \times 10^{-9}$ over the range 0°C to 50°C
Line Voltage Stability:	$\leq 5 \times 10^{-10}$ two minutes after a 10% line voltage change
Adjustment	Via rear panel
Option 07 Rechargeable Battery Pack and External DC Operation	
Battery Type:	Sealed lead-acid cells
Battery Life:	Typically 4 hours at 25°C (10 hrs on standby)
Battery Condition:	Display indicates battery low
External DC:	11-16V via socket on rear panel (-ve ground, not isolated)
Option 10 Reference Frequency Multiplier	
Input Frequency:	1,2,5 or 10 MHz ($\pm 1 \times 10^{-5}$)
Input Amplitude and Impedance:	As for external standard input
Option 55 GPIB Interface	Designed to comply with IEEE-STD-488 (1978) and to conform with the guidelines of IEEE-STD-728 (1982).
Control Capability:	All functions and controls are programmable except power on/off and standby charge
Output:	Engineering format (11 digits and exponent)
IEEE-STD-488 Subsets:	SH1,AH1,T5,TE0,L4,LE0,SR1,RL1,PP0,DC1, DT1,C0,E2
Handshake Time:	250µs to 1ms/character dependent on message content
Read Rate:	Typically 20/s dependent upon measurement function

SUPPLIED ACCESSORIES

Power Cord
Instruction Manual
Spare Fuse
Spare 1.3 GHz Fuse (Model 1992 only)

DEFINITIONS

LSD (Least Significant Digit)
In Frequency and Period modes, display automatically upranges at 1.1 x decade and downranges at 1.05 x decade, except on Input C for input frequency >1 GHz

Accuracy and Resolution is expressed as an RMS value

Trigger Error RMS

$$\text{Trigger Error (seconds)} = \sqrt{\frac{(e_{i1}^2 + e_{n1}^2)}{S1^2} + \frac{(e_{i2}^2 + e_{n2}^2)}{S2^2}}$$

where e_i = input amplifier RMS noise (typically 150 µV RMS in 160 MHz bandwidth)
e_n = input signal RMS noise in 160 MHz bandwidth
S = Slew rate at trigger point V/s
Suffix 1 denotes START edge
Suffix 2 denotes STOP edge
In Frequency A, Period A, Frequency B, and Period B modes, triggering is always on positive-going edge

Trigger Level Timing Error

$$\text{Trigger Level Timing Error (seconds)} = 0.035\left(\frac{1}{S1} - \frac{1}{S2}\right)$$

$$\text{typically} = 0.018\left(\frac{1}{S1} - \frac{1}{S2}\right)$$

S1 = Slew rate on START edge V/s
S2 = Slew rate on STOP edge V/s

Gate Time

The nominal gate time indicated is set by the resolution selected in Frequency, Period, Ratio, and Check modes. It is the value which is used in the calculation of LSD and Resolution. The true gate time will be extended from this value by up to:

(a). One period of the input signal(s) on Frequency B, Period B, and Ratio A/B

(b). Two periods of the input signal on Frequency A and Period A

(c). One period of input signal B on Ratio C/B (Model 1992 only)

Peak and Peak-to-Peak Amplitudes

Peak is defined as being the highest or lowest point at which the signal width is 5 ns. Similarly, Peak-to-Peak is the difference between the highest and lowest points at which the signal width is 5 ns.

ORDERING INFORMATION

1991 160 MHz Universal Counter
1992 1300 MHz Universal Counter

1.4 SAFETY

1.4.1 The 1991/1992 incorporates a protective ground terminal and is designed to meet international safety requirements. Refer to the Safety Page "FOR YOUR SAFETY" immediately preceding the Table of Contents. Follow all **NOTES**, **CAUTIONS**, and **WARNINGS** to ensure personal safety and prevent damage to the instrument.

1.5 PRODUCT SUPPORT

1.5.1 Racal-Dana supports the 1991/1992 with Product Engineering, Service, and Parts Departments. A complete listing of service centers and field representatives is provided on the last two pages of the manual.

1.6 GENERAL DESCRIPTION

1.6.1 The 1991/1992 is a universal timer/counter designed for system or bench use. Basic measurement functions (described briefly in Subsection 1.6.2) include Frequency, Period, Time Interval, Totalize, Phase, and Ratio.

1.6.2 Measurement Functions

1.6.2.1 Frequency A Function

1.6.2.1.1 Frequency A function is used to measure the frequency of the signal applied to the Channel A input. A resolution of nine digits is available with a one-second gate time.

1.6.2.2 Frequency B Function

1.6.2.2.1 Special Function 21 (see Subsection 3.8 "Special Functions"), permits Frequency B measurements. Frequency B function is used to measure the frequency of the signal applied to the Channel B input. A resolution of nine digits is available with a one-second gate time.

1.6.2.3 Frequency C Function (Model 1992 only)

1.6.2.3.1 Frequency C function is used to measure the frequency of the signal applied to the Channel C input. A resolution of nine digits is available with a one-second gate time.

1.6.2.4 Period A Function (See Note below)

1.6.2.4.1 Period A function is used to measure the period of the waveform applied to the Channel A input. A number of periods, depending upon the resolution (and, therefore, the gate time) selected, are measured and the average value is displayed.

1.6.2.5 Time Interval A→B Function (See Note below)

1.6.2.5.1 Time Interval function is used to perform single-shot measurements of the time interval between:

a. An event occurring at the Channell A input and a later event at the Channel B input (using separate input channels)

b. Two events occurring at the Channel A input (using a common input channel)

1.6.2.5.2 The arming of the stop circuit can be delayed for a specific time set by the operator. This feature prevents the measurement interval being stopped prematurely by spurious pulses, such as those caused by relay contact bounce.

1.6.2.6 Total A Function (See Note below)

1.6.2.6.1 Total A function permits events occurring at the Channel A input to be totalized. The counting interval can be controlled by:

a. Electrical start and stop signals applied to the Channel B input (Total A by B)

b. Successive operations of a front-panel key (Manual Totalize)

1.6.2.6.2 Delayed arming of the stop circuit to prevent spurious triggering is available in the Total A by B measurement mode. The Manual Totalize mode provides the capability for totalizing cumulatively over a number of periods.

1.6.2.7 Phase A rel B Function (See Note below)

1.6.2.7.1 Phase A rel B function is used to measure the phase difference between the waveform applied to the Channel A input and that applied to the Channel B input. The phase difference is displayed in degrees, and indicates the phase lead at the Channel A input. The signals for phase measurement must be continuous and have the same frequency.

1.6.2.8 Ratio A/B Function

1.6.2.8.1 Ratio A/B function is used to measure the ratio of the frequency applied to the Channel A input to that applied to the Channel B input.

1.6.2.9 Ratio C/B Function (Model 1992 only)

1.6.2.9.1 Ratio C/B function is used to measure the ratio of the frequency applied to the Channel C input to that applied to the Channel B input.

NOTE:

Special Function 21 (see Subsection 3.8 "Special Functions") permits Period B, Time Interval B →A, Total B by A, and Phase B rel A. For these functions, note the following:

a. Period B is specified down to 10 ns

b. Total B by A operates for one complete cycle of the Channel A signal. The stop circuit delay is available on Channel A

1.6.3 Check Function

1.6.3.1 With the Check function selected, a number of functional tests of the instrument's circuits can be made without the use of additional test equipment. Although these tests do not check the instrument's performance to published specifications, they can be used to verify that the equipment is operating correctly following receipt or transportation to a new location. A brief, preliminary functional check procedure is given in Subsection 2.6.

1.6.4 Input Signal Channels

1.6.4.1 Inputs A and B are fully independent. However, provision is made for connection of the signal at the Channel A input into both channels. This is effected by selecting the COM(mon) A mode. When COM A is selected, Channel B's input socket is isolated from Channel B's circuitry.

1.6.4.2 Inputs A and B are provided with independent controls to permit the following selections:

a. AC or DC input coupling

b. 1MΩ or 50Ω input impedance

c. x1 or x10 input attenuation

d. Positive or negative-slope trigger

e. Manually or automatically-set input trigger level

1.6.4.2.1 The manually-set trigger level is entered as an internal store.

1.6.4.2.2 The auto-trigger level is derived by measuring the positive and negative peaks of the input signal. If the peak-to-peak value exceeds 5.1V or if either peak is outside the range ± 5.1V, the x10 attenuator is automatically switched in. The trigger level is then set to the arithmetic mean of the measured value.

1.6.4.2.3 When operating in the auto-trigger mode, with the x10 attenuator in circuit, the attenuator will be switched out if the peak-to-peak value is less than 4.6V and both peak values are within the range ± 4.6V.

1.6.4.2.4 The trigger levels in use are available at pins mounted on the rear panel of the instrument. The voltage range is ± 5.1V regardless of whether the attenuator is switched in or not, so the voltage should be multiplied by 10 when the x10 attenuator is selected.

1.6.4.3 Input C is available on the Model 1992 only. It has a nominal input impedance of 50Ω and is AC-coupled. Protection against excessive signal levels is provided by a fuse mounted in the input socket.

1.6.5 Low-Pass Filter

1.6.5.1 An internal low-pass filter can be introduced to reduce the bandwidth of Channel A to 50 kHz (nominal).

1.6.6 Math Function

1.6.6.1 When the math function is active, the displayed value is:

$$\frac{\text{Measurement Result} - X}{Z}$$

where X and Z are values entered into stores within the instrument by the operator. X is set to 0 and Z to 1 when the instrument is first switched on. By suitable choice of values for X and Z, ratio, offset (null), and percentage-difference displays can be obtained.

1.6.7 Special Functions

1.6.7.1 A number of special functions are available to the operator. These provide test procedures and operating facilities in addition to those available by operation of the front-panel controls. See Subsection 3.8 of this manual for further details.

1.6.8 Error Indication

1.6.8.1 When operating the 1991/1992, certain errors will result in displayed error codes. See Subsection 3.9 of this manual for further details.

1.6.9 External Arming

1.6.9.1 External arming of the start and stop circuits for the measurement interval can be carried out by means of signals connected to a rear-panel mounted socket. Any combination of internal and external arming can be selected by using the appropriate special function. For further details, refer to Subsections 3.8 and 3.11 along with Table 3.12 in this manual.

1.6.10 Display Format

1.6.10.1 The display uses an engineering format, with a nine-digit mantissa and one exponent digit. Overflow of the most significant digits can be used to increase the display resolution.

1.6.11 Hold Feature

1.6.11.1 The hold feature allows readings to be held indefinitely. A new measurement cycle is initiated using the RESET key.

1.6.12 Resolution and Gate Time

1.6.12.1 The counting interval (gate time) in the Total A by B mode is controlled by the time interval between the start and stop signals at the Channel B input. In the Manual Totalize mode, the gate time is determined by successive operations of the HOLD key. In the Frequency A, Frequency C, Period A, Ratio A/B, and Ratio C/B modes, the gate time is determined by the selected display resolution. In Phase mode, the gate time is fixed and the display resolution is determined by the input signal frequency. Details of the relationship between gate time and resolution for each measurement mode are provided in Subsection 3.6 of this manual.

1.6.13 External Frequency Standard Input

1.6.13.1 The 1991/1992 may be operated using an external frequency standard. The instrument will operate from the external standard whenever the signal at the EXT STD INPUT socket is of sufficient amplitude. The instrument will automatically revert to internal standard operation if the input from the external standard is removed.

1.6.14 Standby Mode

1.6.14.1 When the instrument is switched to standby, the internal frequency standard continues to operate, but the measuring circuits are disabled.

1.6.15 Initialization

1.6.15.1 When the 1991/1992 is first switched on or when it is initialized via the GPIB interface, it is set to the following conditions:

Measurement Function:	Frequency A
Display Resolution:	8 digits
Continuous Measurement Mode:	Enabled
Channel A and B Inputs:	Manual trigger AC coupling Positive-slope trigger 1MΩ input impedance Filter disabled Common input disabled
Trigger Level	0.00V
Delay:	Disabled
Delay Store:	200 µs
Math Function:	Disabled
X Store:	0
Z Store:	1
Hold:	Disabled
Special Functions:	Functions 10, 20, 30, 40, 50, 60, and 70 enabled
SRQ Message:	Generated upon error detection

1.6.16 Options

1.6.16.1 **Frequency Standards (04X Options)**

1.6.16.1.1 Frequency standard Options 04-T, 04-E, and 04-A are available. The technical specifications are given in Table 1.1 of this section. The frequency standard can be changed, if required, by the customer; instructions are provided in Section 2.

1.6.16.2 **Reference Frequency Multiplier (Option 10)**

1.6.16.2.1 The reference frequency multiplier is an internally-mounted, phase-locked multiplier, which permits the use of external frequency standard signals of 1 MHz, 2 MHz, 5 MHz or 10 MHz. The multiplier can be installed by the customer; instructions are given in Section 2.

1.6.16.3 **GPIB Interface (Option 55)**

1.6.16.3.1 An internally mounted interface to the IEEE-488-GPIB is available. This permits remote control of all the instrument's functions except the power ON/OFF and standby switching. The interface can be installed by the customer; instructions are given in Section 2.

1.6.16.3.2 The GPIB interface cannot be installed in an instrument already provided with the battery pack option. An adapter, Racal-Dana Part Number 23-3254, to convert the connector to the IEC 625-1 standard is available as an optional accessory.

1.6.16.4 **Battery Pack (Option 07)**

1.6.16.4.1 Installing the internal battery pack option permits the counter to be used in locations where no suitable AC supply is available. This option also allows operation from an external DC supply.

1.6.16.4.2 The battery is trickle-charged whenever the instrument is operated from an AC supply. Charging at the full rate is carried out when the instrument is switched to the standby mode. A full charge requires approximately 14 hours.

1.6.16.4.3 The counter will operate continuously for approximately 4 hours from a fully-charged battery. It will switch off automatically when the battery approaches the discharged condition. The STBY/CHRG LED starts to flash approximately 15 minutes before this occurs. The battery life can be extended by using the Battery-Save feature.

1.6.16.4.4 The battery pack option can be installed by the customer. Instructions are given in Section 2. The battery pack option cannot be installed to an instrument already provided with the GPIB interface option.

1.6.16.5 Rack Mounting Kits

1.6.16.5.1 The following kits, permitting the instrument to be mounted in a standard 19-inch rack, are available:

a. Single instrument, fixed-mount kit (Option 60A)
(Racal-Dana Part Number 11-1648)
The mounted instrument occupies half the rack width and is two rack units (3.5 inches) in height. The instrument is mounted offset in the rack and may be at either side.

b. Double instrument, fixed-mount kit (Option 60B)
(Racal-Dana Part Number 11-1649)
The panel of the mounting kit occupies the full-rack width and is two rack units (3.5 inches) in height. Two instruments can be mounted side-by-side.

1.6.16.5.2 All rack-mounting kits can be installed by the customer. Instructions are given in Section 2.

1.6.16.6 Elapsed Time Indicator (Option ETI)

1.6.16.6.1 A non-mercuric elapsed time indicator can be factory installed inside the instrument as an option. The elapsed time can be read by removing the instrument's top cover.