Telephone Repair
252-1578 ext. 300
serial # 3700087

1900A
Multifunction Counter

Instruction Manual

P/N 384875
January 1976
Rev. 1 2/77

FLUKE®

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way"* prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC, will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

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Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 1900A is a 5 Hz to 80 MHz multiple-function counter capable of making frequency, period, period averaging and totalize measurements. In the frequency mode, resolution is manually selectable at 0.1 Hz, 1.0 Hz, 10 Hz and 100 Hz. In the period averaging mode, the number of periods averaged is manually-selectable at 10^0, 10^1, 10^2 and 10^3 periods. Automatic selection of resolution and number of periods averaged (autoranging) is also provided to automatically select the optimum range for a particular input signal. However, the 100 Hz resolution and 10^3 periods must be manually selected.

1-3. The measurement display is six digits, light-emitting-diode-type (LED) with leading-zero suppression and automatic decimal point positioning. Annunciators are provided to indicate measurement units (kHz, MHz, milliseconds and microseconds) and also overflow when the capacity of the display is exceeded. All displayed information is also available, in parallel BCD format, at a rear-panel connector when the unit is equipped with an optional Data Output Unit (DOU).

1-4. The Model 1900A is equipped with a selectable 1 MHz low-pass filter for use in electrically noisy environments, and a selectable 10:1 attenuator for use with high-level inputs. A self-check mode of operation is provided to verify overall performance of the unit. Power requirements are 100, 115 or 230 volts at 50 to 400 Hz for the line-powered version. An optional battery-powered version, Model 1900A–01, provides for use away from ac power lines and is equipped with rechargeable nickel-cadmium batteries. The battery-powered version also operates from the ac lines, but only at the power line frequency and voltage specified on the bottom of the instrument.

1-5. SPECIFICATIONS

1-6. The pertinent specifications for the Model 1900A are listed in the following Table 1-1.

Table 1-1. MODEL 1900A SPECIFICATIONS

OPERATING RANGES

Frequency:
5 Hz to 80 MHz

Period:
5 Hz to 1 MHz single and multiple period averages

Totalize:
1 count to 999999 counts

INPUT CHARACTERISTICS

Sensitivity:
25 mV, typically 15 mV rms sine wave, 5 Hz to 80 MHz
Frequency and totalize: 200 mV P-P pulse amplitude with minimum pulse width of 20 nsec. Duty cycle > 10%.
Period: 200 mV P-P pulse amplitude with minimum pulse width of 200 nsec. Duty cycle > 10%.

Impedance:
1 MΩ shunted by less than 30 pf for signal levels < 500 mV decreasing to approx. 220K shunted by less than 40 pf for levels greater than 500 mV.

Filter:
1 MHz (3dB point) lowpass

Attenuator:
Decreases sensitivity by 10

Overload:
250V rms 5 Hz to 1 kHz decreasing to 20V at 80 MHz

RESOLUTION

Frequency:
Four manually selected gate times of:
10ms (100 Hz resolution)
100ms (10 Hz resolution)
1s (1 Hz resolution)
10s (0.1 Hz resolution)

Autorange position will automatically seek to fill all 6 digits but will not select a gate time greater than 1 second (1 Hz resolution)

Period:
Manual selection of single period through 10^3 periods averaged ratios:
10^0 single period (100 ns resolution)
10^1 periods averaged (10 ns resolution)
10^2 periods averaged (1 ns resolution)
10^3 periods averaged (100 ps resolution)

Autorange position will automatically seek to fill all 6 digits. Autoranging will not select a period average of greater than 10^2 averages.

Totalizing:
Accumulates up to 999999 counts, then activates overflow indicator.

TIME BASE CHARACTERISTICS

Frequency: 10 MHz

Stability:
Aging Rate: $< \pm 5 \times 10^{-7}$ month
Short Term: $< \pm 5 \times 10^{-8}$ over 1 second
Temperature: $< \pm 5 \times 10^{-6}$ 0°C to 50°C
$< \pm 2 \times 10^{-6}$ (typical) 20°C to 30°C

Line Variation:
$< \pm 1 \times 10^{-7}$ for ±10% variation in line voltage

GENERAL

Display:
6 digit LED, leading zero suppression
Time between successive measurements is 200 ms plus measurement time

Annunciation:
MHz, kHz, msec, μs overflow

Automatic Features:
AUTORANGE:
In both frequency and period modes, autoranging includes a unique 20% hysteresis in its switching thresholds, to eliminate redundant up range/down range commands. This allows measurements to be made on signals containing large amounts of FM and PM.
Hysteresis memory can be reset by depressing the reset button.
AUTORESET:
A new measurement sequence is started every time a front panel button is activated.

Operating Temp: 0°C to +50°C (0°C to +40°C for -01 Battery option if operated from line.

Storage Temp: –40°C to +60°C

Power Requirements:
115/230 VAC ±10% - 100 VAC available - 50, 60, 400 Hz - 6.5 watts line model - 8.5 watts battery model

Fuses:
1/4A AC-line version-½ A slo-blo battery version

DIMENSIONS

Width:	8.55 inches	217.2 mm
Height:	2.52 inches	64.0 mm
Depth:	10.65 inches	270.5 mm
Weight:	2.75 lbs	1.2 Kg

DATA OUTPUT OPTION

8-4-2-1 BCD output from each digit, plus encoded decimal point and units annunciation information. All outputs CMOS/Low Power TTL compatible, high true. Print command is provided.

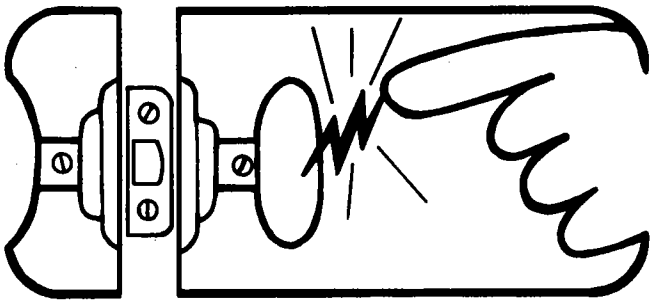
BATTERY

NICAD rechargeable - discharge time 5 hours - charge time 14 hours @ ≤ 30°C ambient with unit inoperative.

static awareness

A Message From

John Fluke Mfg. Co., Inc.

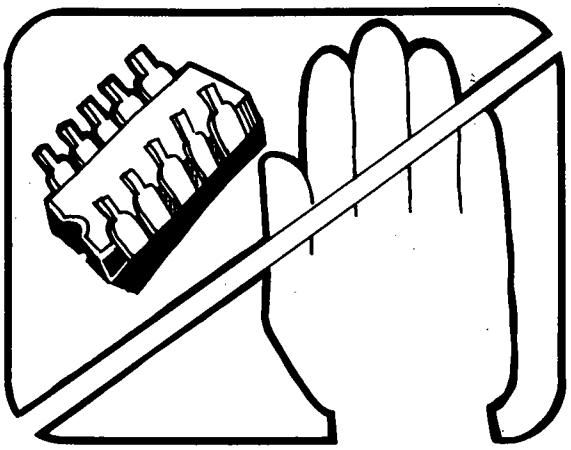


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

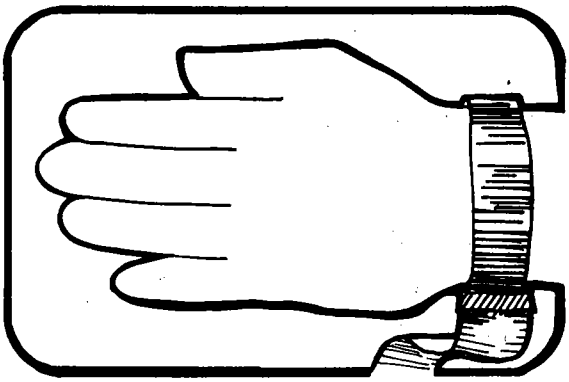
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

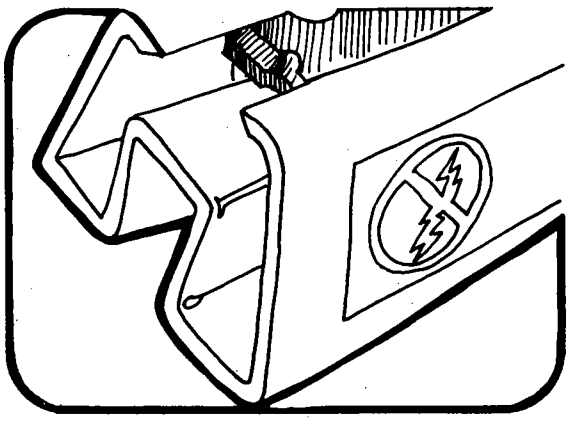
The following practices should be followed to minimize damage to S.S. devices.



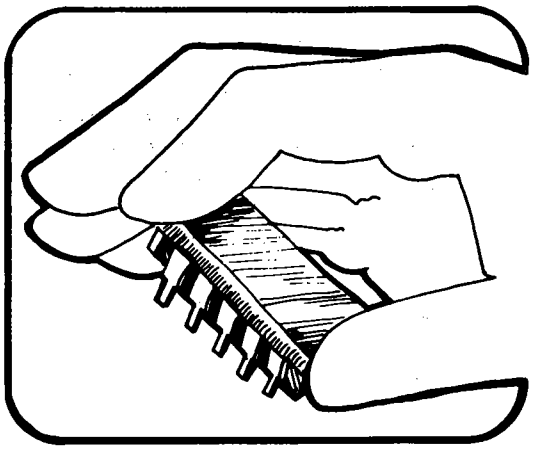
1. MINIMIZE HANDLING



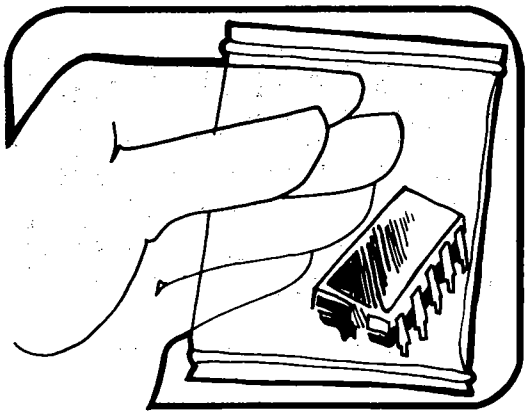
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



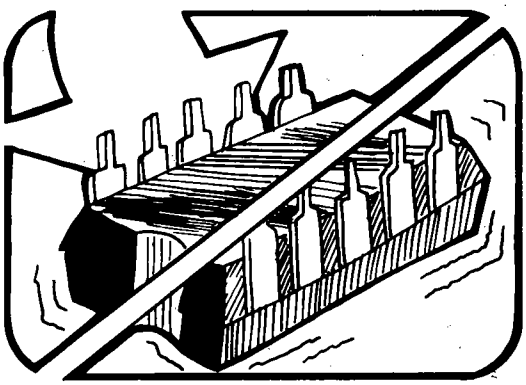
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



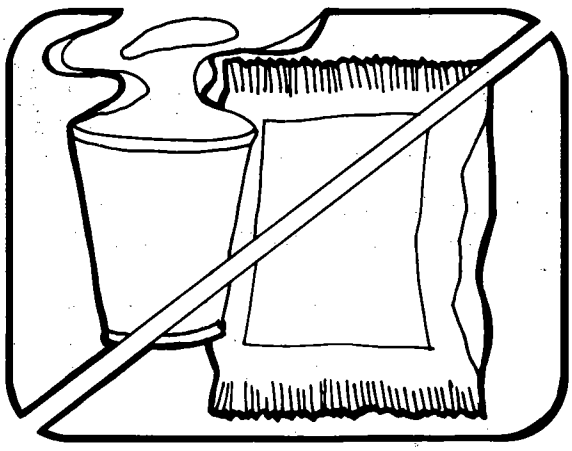
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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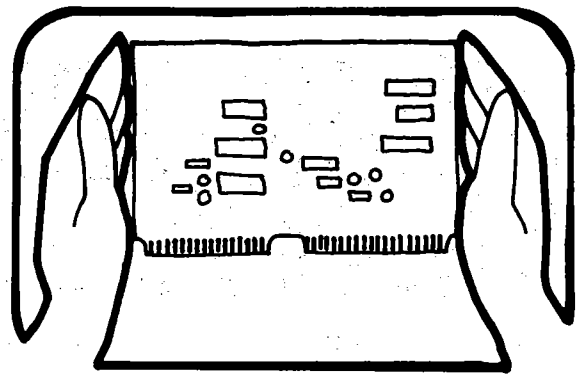
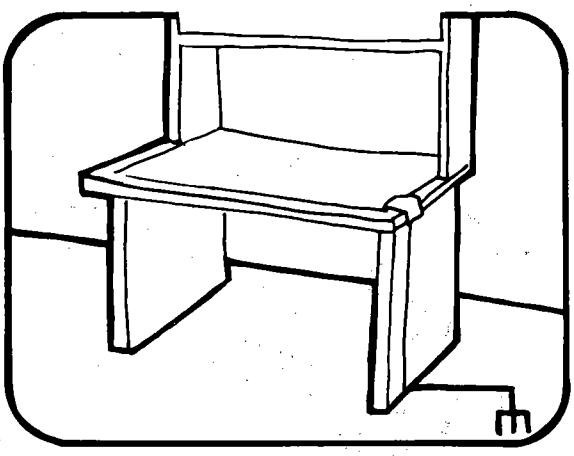
® Dow Chemical



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet 30"x60"x60 Mil P/N RC-AS-1200 $20.00	Wrist Strap P/N TL6-60 $7.00

J0089B-07U7810/SE EN Litho in U.S.A.

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains operating information for the Model 1900A. The contents of this section should be read before operating the counter. Should any difficulties arise during operation of this instrument, please contact your nearest John Fluke Sales Representative, or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. A list of Sales Representatives is located at the rear of this manual.

2-3. SHIPPING INFORMATION

2-4. The Model 1900A is packaged and shipped in a protective container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included in the shipping carton.

2-5. If reshipment of the equipment is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co. Please reference the equipment model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The Models 1900A and 1900A–01 are supplied with one of three ac input power configurations. These consist of 100Vac, 115Vac and 230Vac; at 50 to 400 Hz. Before connecting to the ac line power, insure that the instrument is in the proper configuration for your power lines. A decal on the underside of the instrument indicates the ac line voltage and frequency required.

CAUTION

The battery-powered version must be operated at the line frequency stamped on the bottom-panel decal.

2-8. RACK INSTALLATION

2-9. The Model 1900A may be mounted in a standard 19-inch rack when supplied with the appropriate rack mounting kit. Rack mounting kits are available to allow left, right or center mounting. Instructions for installing units in the rack mount are supplied with the rack mounting kit. The center rack mounting kit is Model No. M00-200-612. The offset rack mounting kit is Model No. M00-200-611.

2-10. OPERATING FEATURES

2-11. The location and function of all controls, connectors, and indicators are shown in Figure 2-1. Operating features and instructions for accessories are discussed in Section 6.

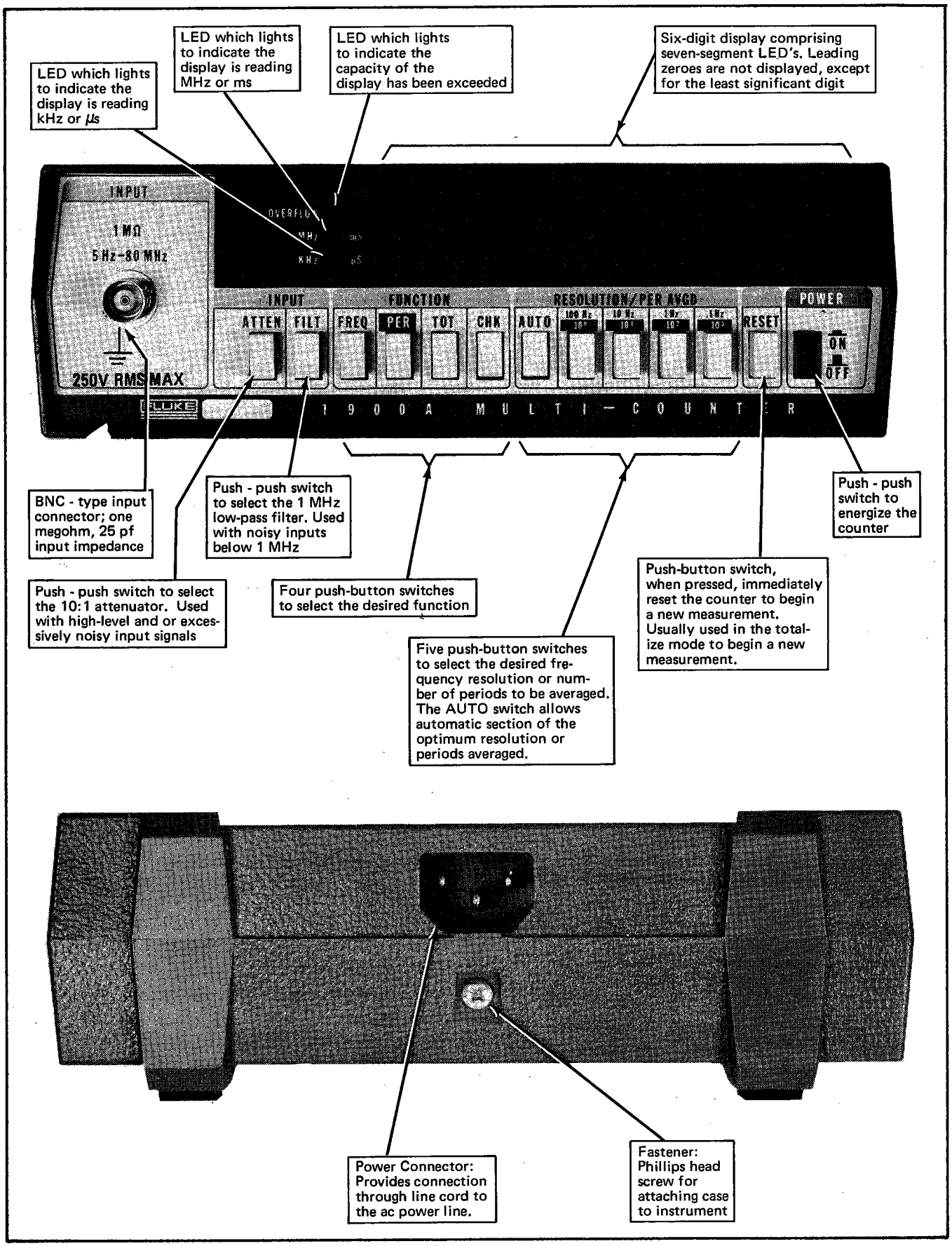


Figure 2-1. CONTROLS, CONNECTORS AND INDICATORS

2-12. OPERATING NOTES

2-13. Input Connection

2-14. Signals to be measured by the Model 1900A are applied to the front-panel BNC connector. Connection of all input signals should be by means of coaxial-type cable fitted with a mating BNC connector. Input impedance is one megohm shunted by < 30 pf. Input sensitivity is 25 millivolts rms. The input impedance derates to approximately 220K shunted by less than 40 pf for input levels greater than 500 mV.

WARNING

The outside contact of the BNC connector is tied directly to earth ground through the power plug. DO NOT connect the active lead of input signals to the outside contact. Irrepairable damage to the 1900A may result. To measure power line frequencies, use an isolation transformer.

2-15. Overload Protection

2-16. The Model 1900A will accept inputs as high as 250 volts rms at frequencies below 1 kHz without damage. Overload capability decreases linearly from 250 volts rms at 1 kHz to 20 volts rms at 80 MHz input, as illustrated in Figure 2-2.

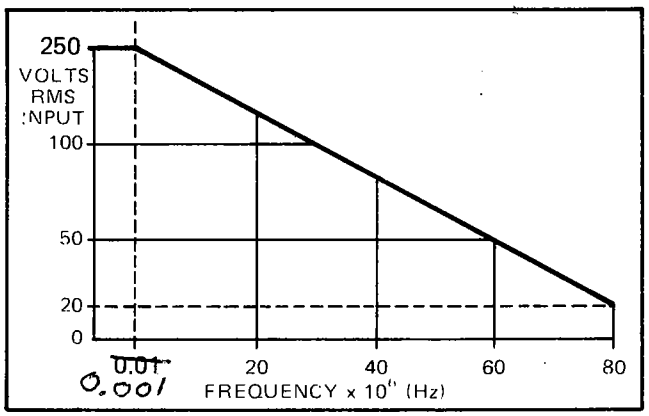


Figure 2-2. INPUT OVERLOAD PROTECTION LEVELS

2-17. FREQUENCY MEASUREMENTS

2-18. Perform frequency measurements as follows:

a. Press the POWER switch to the ON position.

b. Press the FREQ switch to select the frequency mode of operation.

c. Select the desired resolution, or the autorange mode by pressing the AUTO switch. If the input signal is completely unknown, the autorange mode will select the optimum range.

NOTE

In the autorange mode, automatic selection is made between the lower three resolutions. The 0.1 Hz resolution can only be manually selected (by means of the .1 Hz RESOLUTION switch).

d. Connect the input signal to the front-panel BNC connector. In the case of input waveform jitter or noise, spiked waveforms, or ripple on TTL waveforms, the reading obtained may be incorrect or unsteady due to false triggering of the schmitt trigger in the input section. If the signal level is greater than 150mV, depressing the ATTEN switch will decrease the triggering sensitivity of the input section by a factor of ten and reduce errors.

e. If the input signal is below 1 MHz, high-frequency noise can be eliminated by pressing the FILT switch.

f. Read the frequency on the display, and observe the unit of measurement indication (kHz or MHz) to the left of the display.

2-19. PERIOD MEASUREMENTS

2-20. Perform period measurements as follows:

a. Press the POWER switch to the ON position.

b. Press the PER switch to select the period mode of operation

c. Select the desired number of periods to be averaged, or the autorange mode by pressing the AUTO switch. If the input signal is completely unknown, the autorange mode will select the optimum number of periods to average.

NOTE

In the autorange mode, automatic selection is made between 10^0, 10^1 and 10^2 periods to be averaged. The 10^3 (1000) periods averaged can only be manually selected (by means of the 10^3 PER AVGD switch).

d. Connect the input signal to the front-panel BNC connector. In the case of input waveform jitter or noise, spiked waveforms, or ripple on TTL waveforms, the reading obtained may be incorrect or unsteady due to false triggering of the schmitt trigger in the input section. If the signal level is greater than 150mV, depressing the ATTEN switch will decrease the triggering sensitivity of the input section by a factor of ten and reduce errors.

e. If the input signal is below 1 MHz, high-frequency noise can be eliminated by pressing the FILT switch.

f. Read the period time on the display, and observe the unit of measurement indication (ms or μs) to the left of the display.

2-21. TOTALIZE MEASUREMENTS

2-22. Perform totalize measurements as follows:

a. Press the POWER switch to the ON position.

b. Press the TOT switch to select the totalize mode of operation, and the RESET switch to initialize the counter.

c. Connect the input signal to the front-panel BNC connector. In the case of input waveform jitter or noise, spiked waveforms, or ripple on TTL waveforms, the reading obtained may be incorrect or unsteady due to false triggering of the schmitt trigger in the input section. If the signal level is greater than 150mV, depressing the ATTEN switch will decrease the triggering sensitivity of the input section by a factor of ten and reduce errors.

d. If the input signal is below 1 MHz, high-frequency noise can be eliminated by pressing the FILT switch.

e. Read the accumulated total on the display.

2-23. SELF-CHECK MODE

2-24. The self-check mode provides a means of verifying proper overall operation of counter, excluding input section, time base accuracy, and time base dividers used in the period mode.

a. Press the POWER switch to the ON position.

b. Press the CHK switch to select the self-check mode.

c. Press the 100 Hz RESOLUTION switch; the display should read 1.0000 MHz, with the leading zero blanked (X1.0000).

d. Press the 10 Hz RESOLUTION switch; the display should read 1000.00 kHz.

e. Press the 1 Hz RESOLUTION switch; the display should read ~~00.0000~~ 000,000 kHz, and light the OVFL annunciator.

f. Press the AUTO switch; the display should read 1000.00 kHz, as in step d.

Section 3
Theory of Operation

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. This section of the manual is divided into two parts. Overall Functional Description gives an overview of the circuit functions and how they are used in each mode. Circuit Description details the operation of each circuitry section. Simplified block diagrams are referred to by figure number. Complete schematic diagrams are located in section 8. Table 3-1 is a list of definitions for the mnemonics used in the schematic diagrams and text.

Table 3-1. MNEMONIC DEFINITIONS

BCD	Binary Coded Decimal
BL	Blank or Blanking
CLK	Clock
DP	Decimal Point
DS	Decimal Signal
FF	Flip-Flop
ICR	Iteration Counter Reset
KL	Annunciator Signal (MHz - mSec)
LSD	Least Significant Digit
ML	Annunciator Signal MHz - mSec)
MSD	Most Significant Digit
MSDM	MSD Memory
MUP	Memory Update
OV, OVFL	Overflow
RMAX	Reset to Maximum Count
RNG	Range
TOT	Total or Totalize

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. Introduction

3-5. Seven basic sections compose the circuitry of the 1900A multicounter: an input section, main gate, decade counters/display memory/ display multiplexer, display, time base, range control logic, and program control logic. The input section conditions the signal with regard to amplitude and waveshape. The main gate controls the application of the signal to be counted to the decade counters. A signal is counted by the decade counters, stored in the display memory, and multiplexed to the display on a common data bus.

3-6. The time base section provides two frequencies which compose the time base against which other signals are compared. Range control divides the time base (or the input signal in the period mode) to control the main gate. Decimal information is derived from range control. Program control consists of a sequencer and autorange logic. Understanding the sequencer logic, which controls the timing of events, is very important to understanding the functioning of the instrument. An outline of the sequence of events is given in the explanation of the frequency mode.

3-7. Frequency Mode

3-8. In the frequency mode the signal from the input section is applied to the first decade counter. Refer to figure 3-1. The duration of the count is derived from the time base. The sequence of events, as ordered by the pro-

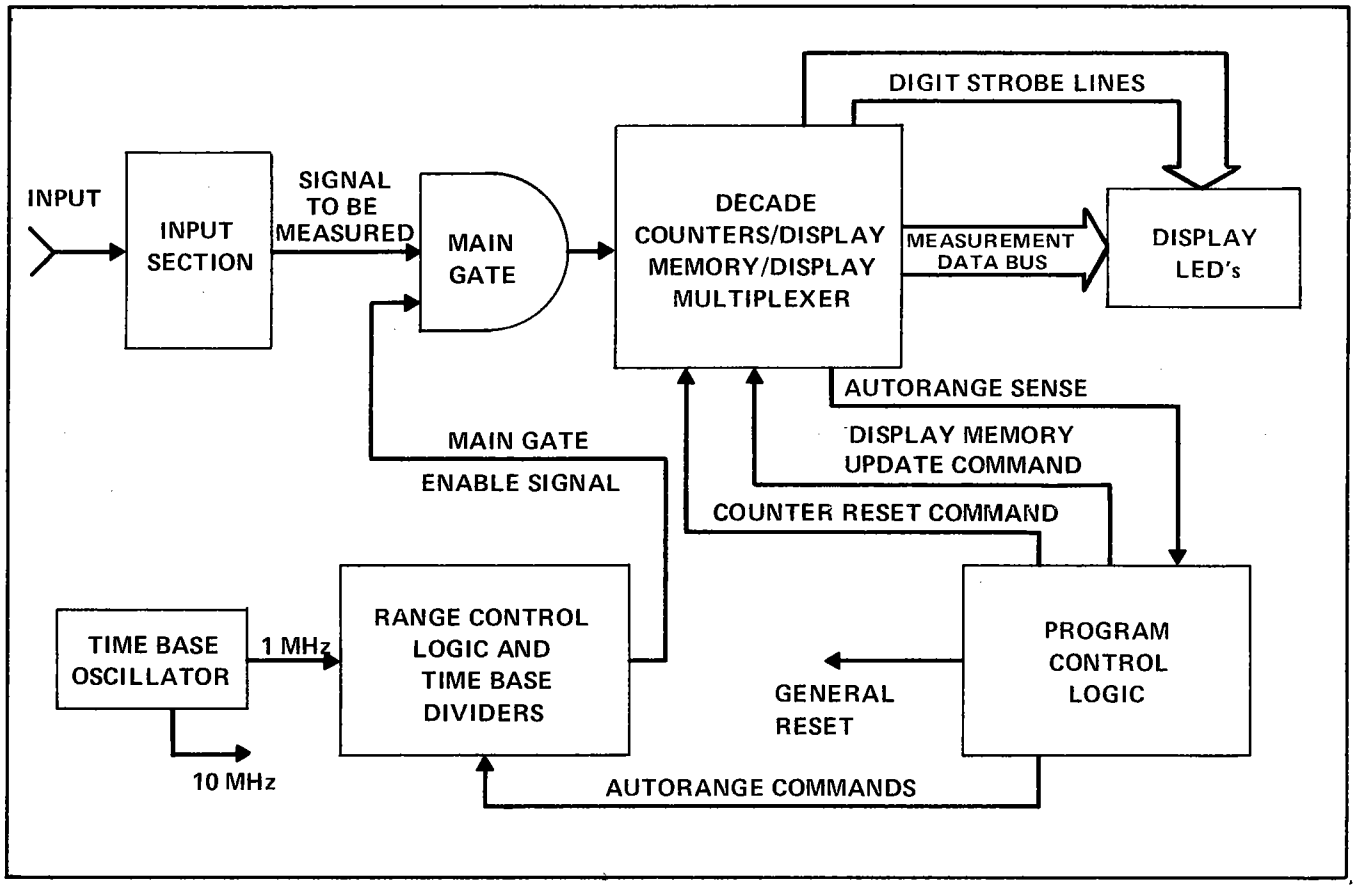


Figure 3-1. MODEL 1900A, SIMPLIFIED BLOCK DIAGRAM – FREQUENCY MODE

gram control section, begins with step 9. Refer to figure 3-2. Range logic is reset to the shortest gate time. A new measurement always begins with the shortest gate time. Any time a front panel switch is depressed, a new measurement is initiated by resetting the program control to step 9. The next event is general reset (GR), step 1. All the decade counters are set to 0 and the autorange logic is reset. Step 2 is skipped as only odd numbered steps are used to order events. At step 3 the time base dividers in the time base and the range control sections are enabled. The count is initiated by enabling the main gate to apply data to the first decade counter. The signal from the input section is applied to the clock input and toggles the counter. The output from the first counter is used to toggle the subsequent counters. At the end of the measurement period, the main gate is disabled and the count is held.

3-9. During step 5 the autorange logic decides whether or not the range is adequate for optimum resolution. If the most significant digit (MSD) is one or more, optimum resolution has been achieved. If the MSD is less than one, range control increases the gate time by a factor of ten. Manual selection of a range appears to the autorange logic as though the MSD is greater than one. Steps 7 and 9 are skipped and another count is taken in the new range. However, if in the previous measurement the MSD was equal to one, the second significant digit (2SD) must fall below 8 before a range change will be initiated This range hystersis prevents an unstable display if a measurement happens to vary a few cycles above or below MSD = 1. When a count is obtained with optimum resolution, the sequence may go on to step 7.

3-10. A memory update signal, MUP, occurs at step 7. The count obtained in step 5 is memorized for presentation to the display section. The display runs continuously. BCD digit information is strobed by the multiplexer from the memory on a data bus to the display. Six strobes are used, one for each digit. Each strobe enables one digit byte to be applied to the data bus and simultaneously enables the appropriate LED to light. MUP also enables the range logic conditions to be memorized by the decimal point logic. The decimal point logic decodes the range information and applies a pulse to the decimal bus during the correct strobe.

3-11. Range logic is reset to the shortest gate time during step 9. The measurement cycle is now complete and the instrument is ready to take a new measurement. Every new measurement starts with the shortest gate time.

3-12. Period Mode

3-13. The signal from the input section is applied to range control to derive the gate time in the period mode.

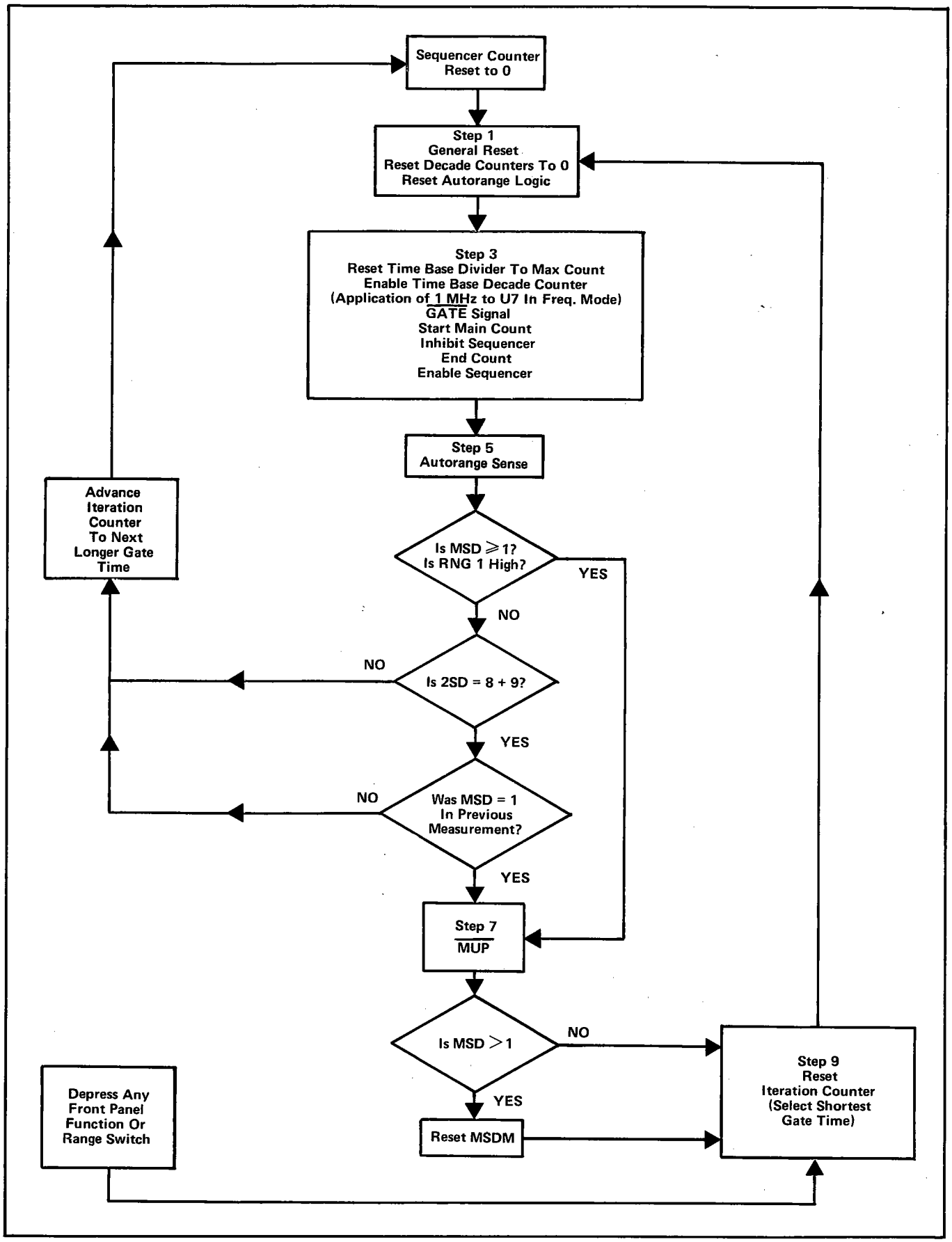


Figure 3-2. 1900A SEQUENCE FLOW CHART

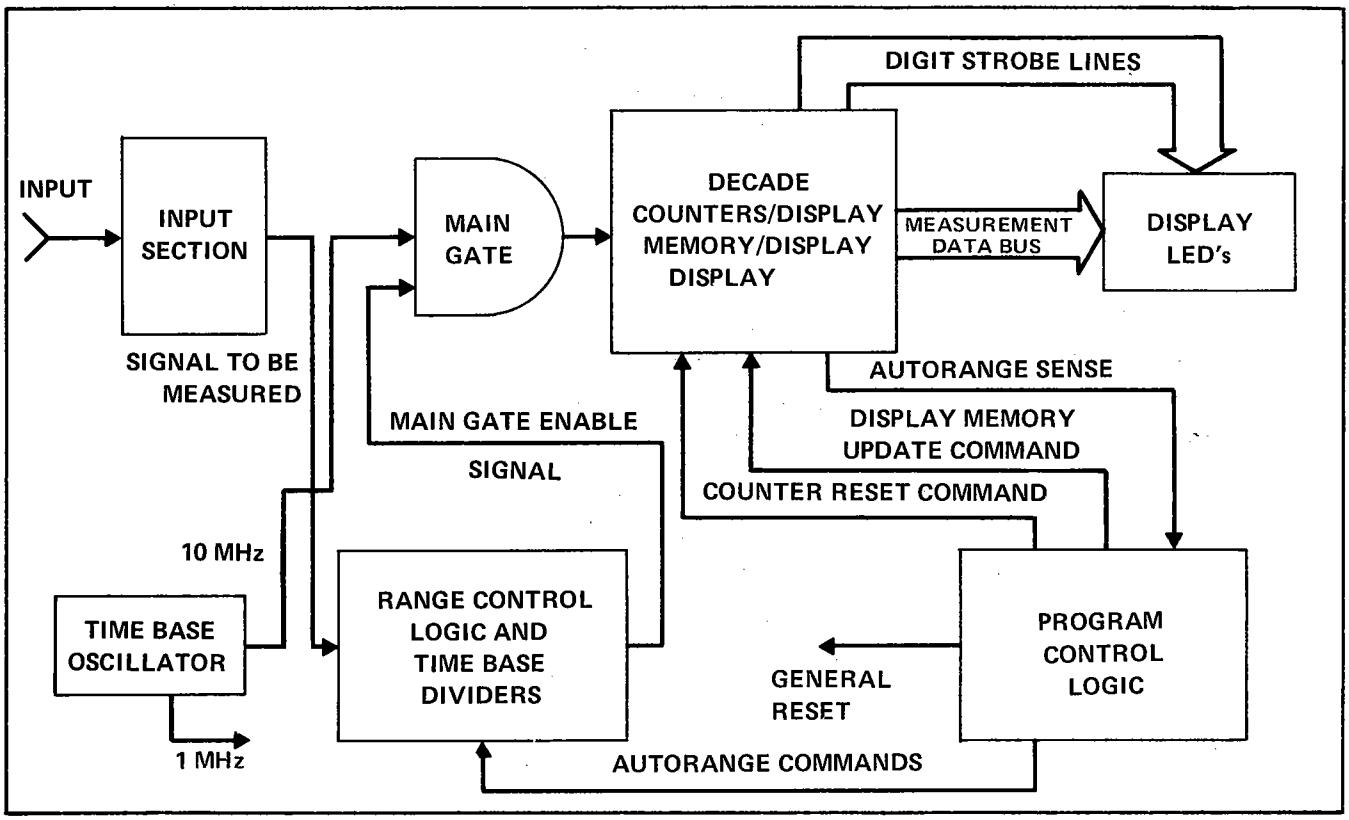


Figure 3-3. MODEL 1900A, SIMPLIFIED BLOCK DIAGRAM – PERIOD MODE

Refer to figure 3-3. Range control is programmed differently so that smaller division factors of ten are used in the period ranges. A 10MHz signal from the time base section is counted to determine how long the period is. The sequence of events is the same as in the frequency mode.

3-14. Totalize Mode

3-15. All range and program control functions are bypassed in the totalize mode. Refer to figure 3-4. The signal from the input section is applied to the first counter as in the frequency mode. However, the gate time is manually

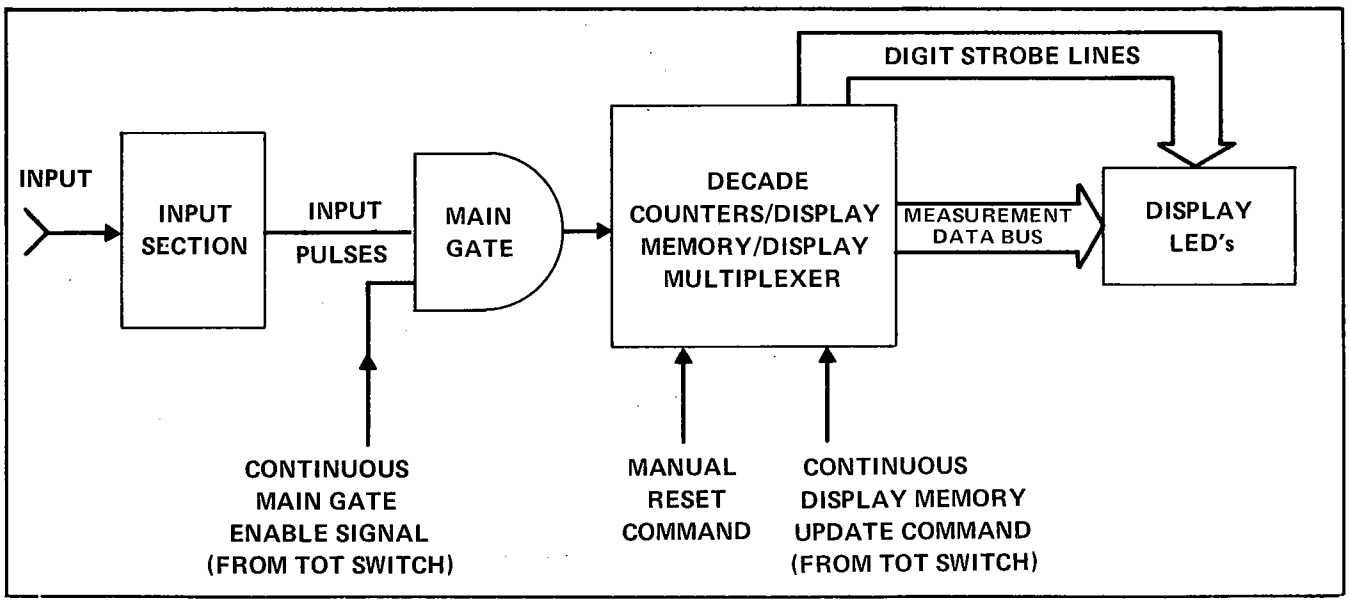


Figure 3-4. MODEL 1900A, SIMPLIFIED BLOCK DIAGRAM – TOTALIZE MODE