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## Section 1

# Introduction & Specifications

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### 1-1. INTRODUCTION

1-2. The Model 8300A is a versatile digital voltmeter with five full decades of digits plus a sixth digit for 20% overrange. Its mainframe will accept options in any sequence for expansion from a bench DVM into a bench or systems multimeter.

1-3. The Model 8300A uses the Fluke developed Recirculating Remainder\* A-to-D conversion system which determines the most significant digit by a very accurate direct comparison process, stores a sample of the remaining input voltage, and serially determines the value of succeeding digits from this sample. This process requires only one decade of BCD counter and one decade of precision resistive ladder network for five complete decades of conversion. Multiple use of components results in low parts count, and low power consumption, thus ensuring high reliability. Complete isolation of digital data outputs is yet another outstanding characteristic of this Fluke developed technique.1-4.

1-4. The basic instrument offers three ranges of dc voltage measuring capability including autorange, auto-polarity, and switchable active filtering. In addition, the 8300A-10 configuration offers five ranges of dc volts, and

the 8300A-02 version offers both five ranges of DC volts and five ranges of ohms measurements.

1-5. The Model 8300A's sample rate can be manually varied from the front panel or it can be remotely controlled (optional). Full guarding is accomplished by box-in-a-box construction and use of a FLUKE custom-designed isolating power transformer. Guarding is not compromised when the isolated Data Output and Remote Control units are added. Calibration is accomplished through the guard via labelled ports.

### 1-6. ANALOG OPTIONS

1-7. All optional functions may be installed in the field. The analog options are fully within the guard, their installation automatically enables the appropriate function light of the display. Options may be field installed. AC volts features a 50Hz to 20kHz midband with excellent accuracy to 30Hz and 100kHz. Mv function extends the dc capability of the 8300A to 100mV at full range with 1 $\mu$ V of resolution. The ohms function includes 5 resistance ranges, using a modified four-terminal configuration on the two lowest. DC External Reference can be used for true four-terminal ratio or for systems measurements related to a master reference. AC External Reference is available for AC/AC ratio measurement applications.

## 1-8. DIGITAL OPTIONS

1-9. Data Output is completely isolated from the analog input and is available in a 8-4-2-1 BCD logic level format. Data is transferred serially via guarded toroids from the Model 8300A to the Data Output unit. Single decade code conversion and serial-character, parallel-bit acquisition are unique capabilities in addition to standard full parallel output.

1-10. Remote Control is fully isolated from analog input and may be fully isolated from the Data Output unit but is normally used in conjunction with it. Control is exerted by logic levels or contact closures. Isolation from analog circuitry is accomplished through the use of light-emitting diodes and photo-transistors.

## 1-11. ELECTRICAL SPECIFICATIONS

### DC VOLTS

RANGES . . . . .  $\pm 10V$ ,  $\pm 100V$  and  $\pm 1000V$ . 20% overrange capability (1100V maximum)

POLARITY . . . . . Automatic, instantaneous selection and display.

RANGE SELECTION . . . . . Manual and autorange standard (Remote optional)

RESOLUTION . . . . . 0.001% of range (1  $\mu V$  on 0.1V range)

#### ACCURACY:

24 hours,  $23^{\circ}C \pm 1^{\circ}C$  . . . . .  $\pm(0.005\%$  of input + 0.001% of range)  
 30 days,  $20^{\circ}C$  to  $30^{\circ}C$  . . . . .  $\pm(0.008\%$  of input + 0.002% of range)  
 90 days,  $20^{\circ}C$  to  $30^{\circ}C$  . . . . .  $\pm(0.01\%$  of input + 0.002% of range)  
 6 months,  $20^{\circ}C$  to  $30^{\circ}C$  . . . . .  $\pm(0.01\%$  of input + 0.004% of range)  
 1 year,  $20^{\circ}C$  to  $30^{\circ}C$  . . . . .  $\pm(0.015\%$  of input + 0.005% of range)

#### TEMPERATURE COEFFICIENT:

$0^{\circ}C$  to  $20^{\circ}C$ ,  $30^{\circ}C$  to  $50^{\circ}C$  . . . . .  $\pm(0.0007\%$  of input + 0.0003% of range/ $^{\circ}C$

INPUT RESISTANCE . . . . . 10V: 10,000 megohms minimum, 100V & 1000V: 10 megohms

FILTER . . . . . Switch selected 3 pole active filter standard (remote control optional.)

RESPONSE TIME . . . . . To within 0.01% of step function change including polarity change.  
 25 ms maximum unfiltered. (No settling time required for input applied coincident with read command. Time given is digitizing time only.)

500 ms maximum filtered.

NOTE: Filter settling time unaffected by source impedance.

REJECTION:	DC	AC	NOTE
Normal Mode (Filtered)	—	> 60 db, above 50 Hz	150% of Range sum of Input Peak AC Normal Mode Voltage plus DC/Voltage
Common Mode (Unfiltered) 1 K $\Omega$ unbalance in either lead 100 $\Omega$ unbalance in either lead	> 140 db > 160 db	> 100 db, 60 Hz and above > 120 db, 60 Hz and above	
Common Mode (Filtered) 1 K $\Omega$ unbalance in either lead	> 140 db	> 140 db, 60 Hz and above	1000V DC or peak AC maximum common mode voltage.

**ADDITIONAL SPECIFICATIONS BASIC DC UNIT** 1100V DC or RMS (1500V peak AC) overload with no damage (any range).  
 Input capacitance < 100 pf.  
 Input offset current less than 50 pa on any range.

**DC MILLIVOLTS** (USING MV OPTION 8300A-10 OR MV/OHMS OPTION 8300A-02)

RANGES . . . . .  $\pm 100$  mv and  $\pm 1000$  mv. 20% overrange capability  
(Up to 1100V overload with no damage)

POLARITY . . . . . Automatic, instantaneous selection and display.

RANGE SELECTION . . . . . Manual and autorange standard (Remote optional)

RESOLUTION . . . . . 0.001% of range  
(1 uv on 100 mv range)

## ACCURACY

Using millivolts zero control

	1000MV RANGE	100MV RANGE
24 hrs, $\pm 1^\circ\text{C}$	$\pm(0.005\%$ of input + 0.001% of range)	$\pm(0.005\%$ of input + 0.004% of range)
90 days and 6 mos $20^\circ\text{C}-30^\circ\text{C}$	$\pm(0.01\%$ of input + 0.002% of range)	$\pm 0.01\%$ of input + 0.005% of range)
1 year $20^\circ\text{C}-30^\circ\text{C}$	$\pm(0.015\%$ of input + 0.002% of range)	$\pm(0.015\%$ of input + 0.005% of range)

ZERO STABILITY (After 30 minute warmup) Better than 8 uv for 90 days. (Front panel millivolt zero control provided to compensate for external thermal EMF's etc.)

## TEMPERATURE COEFFICIENT:

$0^\circ\text{C}$  to  $20^\circ\text{C}$ ,  $30^\circ\text{C}$ , to  $50^\circ\text{C}$  . . . . . 1000 mv range  $\pm(0.0007\%$  of input + 0.0003% of range)/ $^\circ\text{C}$   
100 mv range  $\pm(0.0007\%$  of input + 0.0005% of range)/ $^\circ\text{C}$

INPUT RESISTANCE . . . . . 100 mv: 100 megohms min. 1000 mv: 1000 megohms min.

RESPONSE TIME: . . . . . (Including polarity change, to within 0.01% of step function change)

1000 mv Range . . . . . 1 second maximum.

100 mv Range . . . . . 3 seconds maximum.

NOTE: Response time figures applicable for source resistance up to 50 K $\Omega$

## REJECTION

	DC	INTERFERENCE FREQUENCY	
		50 Hz	60 Hz
Normal Mode	—	> 55 db	> 60 db, 60 Hz and above
Common Mode 1 K $\Omega$ unbalance in either lead		> 140 db, DC to 60 Hz	

MAXIMUM INPUT VOLTAGE . . . . . 1100 VDC or RMS (1500V peak AC) overload with no damage (any range)

**AC VOLTS** (USING AC OPTION 8300A-01)

RANGES: . . . . . 1V, 10V, 100V and 1000V  
20% overrange capability (1100V RMS maximum) \*\*

RANGE SELECTION . . . . . Manual and autorange standard (Remote Optional)

RESOLUTION . . . . . 0.001% of range (10 uv on 1V range)

## ACCURACY:

 $20^\circ\text{C}$  to  $30^\circ\text{C}$ 

FREQUENCY RANGE	INPUT VOLTAGE		
	.001V – 500V		500 – 1100V
50 Hz - 20 kHz	$\pm(0.1\%$ of input	+0.005% of range) * +0.02% of range) 30 days +0.03% of range) 90 days +0.035% of range) 6 months	$\pm 0.15\%$ of input
20 kHz - 50 kHz	$\pm(0.2\%$ of input	+0.005% of range) * ** +0.02% of range) 30 days +0.03% of range) 90 days +0.035% of range) 6 months	$\pm 0.2\%$ of input **
30 - 50 Hz and 50 kHz - 100 kHz	$\pm(0.5\%$ of input	+0.005% of range) * ** +0.02% of range) 30 days +0.03% of range) 90 days +0.035% of range) 6 months	$\pm 0.5\%$ of input **

" $\pm 0.005\%$  of range" accuracy can be obtained at any time during a six month period via front panel AC zero.  $\pm 0.005\%$  accuracy is typically maintained for 24 hours following zero adjustment. 30 day, 90 day and 6 mos intervals start after the last use of the AC zero.

\*\* Input Volt-Hertz product should not exceed  $2 \times 10^7$ .

## TEMPERATURE COEFFICIENT

0°C to 20°C, 30°C to 50°C .....  $\pm(0.002\% \text{ of input} + 0.001\% \text{ of range})/^{\circ}\text{C}$ .

## INPUT IMPEDANCE

(All Ranges) ..... 1 megohm shunted by  $< 100 \text{ pf}$ .

## RESPONSE TIME:

(To within 0.1% of step function change) ..... 500 ms maximum.

## MAXIMUM INPUT VOLTAGE..... 1100V RMS

(Up to  $\pm 1100\text{V}$  superimposed DC is allowed if the peak voltage does not exceed 1500V).

## REJECTION:

Common Mode (DC to 60 Hz) .....  $100\Omega$  unbalance in either lead.  $> 120 \text{ db}$

Maximum Common Mode Voltage..... 1000V DC or peak AC.

**OHMS** (USING MV/OHMS OPTION 8300A-02)

RANGES .....  $1\text{K}\Omega$ ,  $10\text{K}\Omega$ ,  $100\text{K}\Omega$ ,  $1000\text{K}\Omega$ ,  $10\text{M}\Omega$ , 20% overrange capability all ranges.

RANGE SELECTION ..... Manual and autorange  $1\text{K}\Omega$  through  $1000\text{K}\Omega$  ranges.  $10\text{M}\Omega$  range selected manually. (Remote selection optional all ranges).

RESOLUTION ..... 0.001% of range  
(10 milliohms on 1 K range)

## ACCURACY:

	1K – 1000K	10M
90 days, 20°C to 30°C	$\pm(0.01\% \text{ of input} + 0.002\% \text{ of range})$	$\pm(0.05\% \text{ of input} + 0.002\% \text{ of range})$
6 months, 20°C to 30°C	$\pm(0.01\% \text{ of input} + 0.004\% \text{ of range})$	$\pm(0.05\% \text{ of input} + 0.004\% \text{ of range})$
1 year, 20°C to 30°C	$\pm(0.015\% \text{ of input} + 0.005\% \text{ of range})$	$\pm(0.06\% \text{ of input} + 0.005\% \text{ of range})$

## TEMPERATURE COEFFICIENT:

0°C to 20°C, 30°C to 50°C .....  $\text{K}\Omega$  Ranges  
 $\pm(0.0007\% \text{ of input} + 0.0003\% \text{ of range})/^{\circ}\text{C}$   
 $10\text{M}\Omega$  Range  
 $\pm(0.003\% \text{ of input} + 0.0003\% \text{ of range})/^{\circ}\text{C}$

## MEASUREMENT CURRENT:

(And Mode)

Range ( $\text{K}\Omega$ )	1	10	100	1000	10 $\text{M}\Omega$
Current (ua)	1.1 ma	110	100	10	1
Mode	4 terminal		2 terminal		

NOTE: Power dissipated in unknown resistor is only 1.2 milliwatts at  $1\text{K}\Omega$

## RESPONSE TIME:

(To within 0.01% of step function change)

RANGE	UNFILTERED	FILTERED
$1\text{K}\Omega$ $10\text{K}\Omega$	1 sec.	1.5 sec
$100\text{K}\Omega$ $1000\text{K}\Omega$	15 ms*	
$10\text{M}\Omega$	50 ms*	

\* Includes 25 ms digitizing time - No settling time required on 100K & 1000K ranges for input applied coincident with read command.

MAXIMUM INPUT VOLTAGE ..... 30V RMS opens protective fuse.

**4-WIRE RATIO** (USING ISOLATED REFERENCE OPTION 8300A-05)

## RANGES:

MODE	RATIO RANGE $\left(\frac{A}{B}\right)$	READING	V INPUT (A)	V REF. (B)
DC/DC	$0 \pm 1.0$ $0 \pm 10$ $0 \pm 100$	$0 \pm 10.0000$ $0 \pm 100.000$ $0 \pm 1000.00$	$0 \pm 10\text{V}$ $0 \pm 100\text{V}$ $0 \pm 1000\text{V}$	+2V to +10.5V Standard
MV/DC	$0 \pm 0.01$ $0 \pm 0.1$	$0 \pm 100.000$ $0 \pm 1000.00$	$0 \pm 100 \text{ mv}$ $0 \pm 1000 \text{ mv}$	
NOTE: DC External Reference may also be used for AC measurements.				

20% overranging, autorange and autopolarity operation apply to V input for all modes above as applicable.

ACCURACY :  
90 days  
20°C-30°C

RATIO RANGE	
0 ± 0.1, 0 ± 1, 0 ± 10, 0 ± 100	±(0.01% of input + 0.002% X 10V/E <sub>ref</sub> of range)
0 ± 0.01	±(0.01% of input + 0.005% X 10V/E <sub>ref</sub> of range)*

NOTE! 24 hr, 6 mos & 1 year accuracy same as basic DC & MV specifications except multiply "% of range" by 10V/E<sub>ref</sub>.

\* Using MV zero

#### EXTERNAL REFERENCE INPUT SPECIFICATIONS:

Input Impedance . . . . . 1 megohm.  
Response Time . . . . . To within 0.01% of step function change (2 seconds)

NORMAL MODE REJECTION: . . . . . > 30 db at 60 Hz.

ISOLATION: . . . . . Difference between "V<sub>INPUT</sub> +" and DC EXT. REF. "COMMON" may be ±13V peak on 10V and MV Ranges.  
(Input & reference commons)

#### AC/AC RATIO

AC/AC Ratio measurements may be made with the 8300A equipped with the following options:\*

8300A-01 AC CONVERTER  
8300A-05 DC EXTERNAL REFERENCE  
8300A-06 REAR INPUT  
8300A-08 AC REFERENCE CONVERTER

RATIO RANGES:	AC REF. RANGE (B)	AC:AC RATIO RANGES (A:B)
	1V (0.2 to 1.05V)	1:1 to 1000:1
	10V (2.0 to 10.5V)	0.1:1 to 100:1
	100V (20 to 105V)	0.01:1 to 10:1

- (A) Ranges & range selection same as AC Option 8300A-01  
(B) Range selected manually using internal switch.

#### ACCURACY OF RATIO

(Input and reference need not be at same frequency)

20°C to 30°C; 50 Hz - 20 kHz

Input (A) and Ref. (B) on same range . . . . . ±0.05% of input ±0.005%  $\left(\frac{\text{REF. RANGE}}{\text{V REF.}}\right)$  of range.\*\*

±0.05% of input ±0.02%  $\left(\frac{\text{REF. RANGE}}{\text{V REF.}}\right)$  of range -90 days

All other ratio and frequency ranges . . . . . ±0.2% of input ±0.005%  $\left(\frac{\text{REF. RANGE}}{\text{V REF.}}\right)$  of range.\*\*

±0.2% of input ±0.04%  $\left(\frac{\text{REF. RANGE}}{\text{V REF.}}\right)$  of range -90 days

Accuracy Specifications from 30 Hz to 50 Hz and from 20 kHz to 100 kHz equal 2 times those listed under 8300A-01 AC Converter with "% of Range" specifications multiplied by  $\left(\frac{\text{REF. RANGE}}{\text{V REF.}}\right)$

#### TEMPERATURE COEFFICIENT OF RATIO:

0°C to 20°C, 30°C to 55°C . . . . . 2 times that listed for the 8300A-01 AC Converter.

INPUT IMPEDANCE (All Ranges) . . . . . 1 megohm shunted by 100 pf.

#### RESPONSE TIME: (To within 0.1% of specifications)

AC EXT. REF. . . . . 2 sec. max.

\* The 8300A-02 MV/OHMS converter is not compatible with the AC-AC ratio configuration. This option may be substituted for 8300A-08 in the field to allow normal MV/OHMS measurements.

\*\*Using front panel zero controls periodically (typically 8 to 24 hours after 30 minute warmup) 90 day specifications apply if front panel zero is not used.

#### DATA OUTPUT UNIT (USING OPTION 8300A-03)

OUTPUTS	LINES	LOGIC LEVELS	
		0 to +0.5V	+5V
FUNCTION: DCV, MV, ACV, K $\Omega$ , M $\Omega$ Filter, Ext. Ref.	7	Function inactive.	Function called.
RANGE (Coded): 1 = 00 10 = 01 100 = 10 1000 = 11	2	Logic 0	Logic 1
POLARITY:	1	Negative	Positive
6 DIGITS (Including "Overrange "1") Binary-Coded Decimal 8-4-2-1	21	Logic 0	Logic 1
DATA READY (Print) COMMAND	1	Data Ready	Data
OVERLOAD FLAG	1	No Overload	Overload
+5V REF & RETURN (TO POWER RCU)	2	-----	-----

**DATA OUTPUT UNIT** (USING OPTION 8300A-03)

INPUTS	LINES	LOGIC LEVELS	
		0 to +0.5V (or short)	+5V (or open)
EXT. TRIGGER (Read Command)	1		+5V pulse > 1 usec
SAMPLE DELAY (Internally programmed timeout delays sample until the Analog functions specified settling time has elapsed.)	1	No Delay (FAST)	Settling delay enabled (NORMAL)
INHIBITS (Address Lines for Serial Acquisition)	10	Inhibit	Normal
NOTE: 8 additional output lines and 4 input lines provided for code conversion of output data -- contact factory. Output is series 930 DTL with 6K collector resistors.			

OUTPUT FORMAT . . . . .	Complete parallel and addressable for parallel bit-serial character in multiples of 4 bits.
BLANKING . . . . .	All outputs are high during conversion and programmed time outs. Outputs enabled at time "Data Ready" flag appears.
POWER . . . . .	+5V DC available as output to power remote control unit if desired.
ISOLATION . . . . .	All CMRR specifications apply with DOU installed. 1000 VDC or peak AC may be applied between DOU common and input "LO".

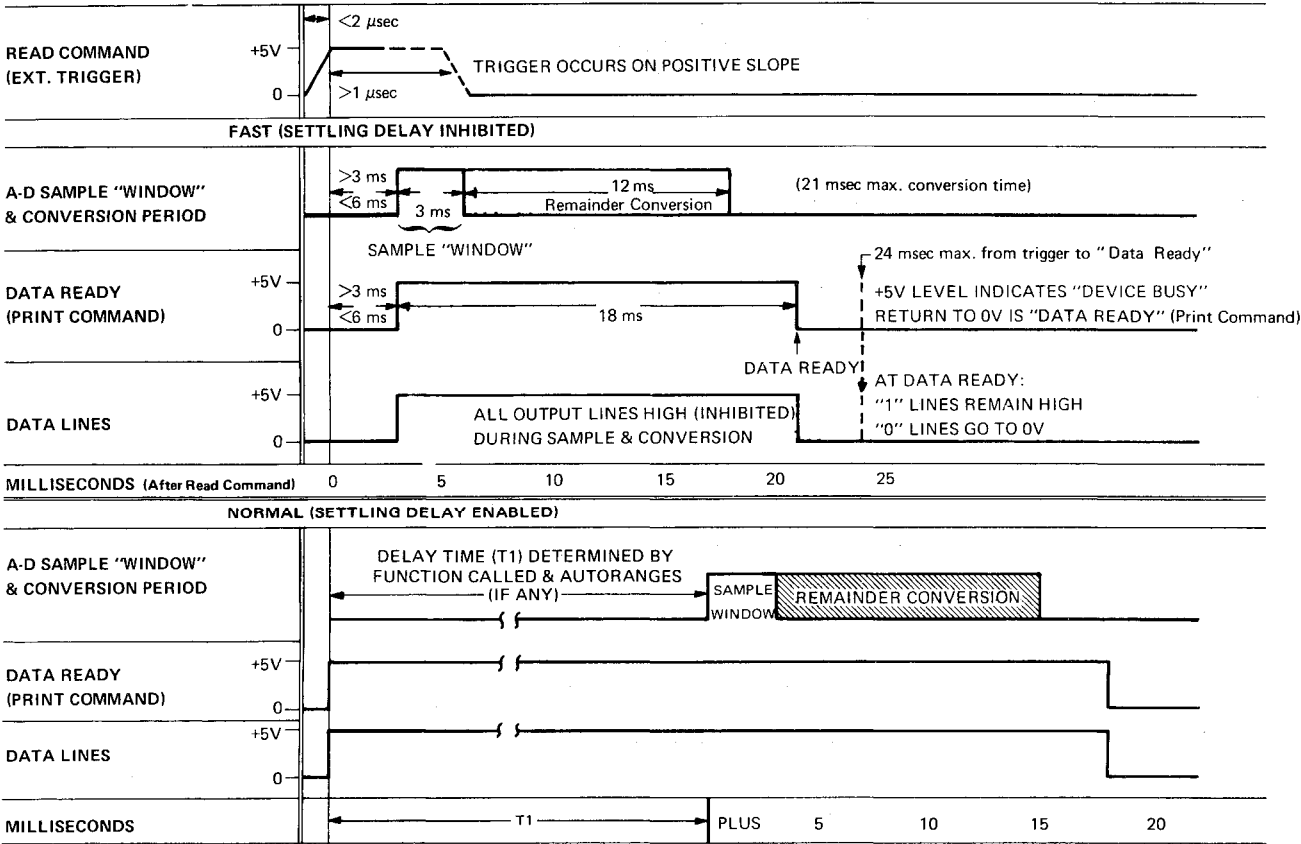
**REMOTE CONTROL** (USING REMOTE CONTROL OPTION 8300A-04)

INPUTS	LINES	LOGIC LEVELS	
Function: DCV, MV, ACV, K $\Omega$ , M $\Omega$ Filtered, External Reference	7	0 to +0.5V (or contact closure)	+5V (or open)
		Function Called	Function inactive
Range: 1, 10, 100, 1000 uncoded	4	Range Called	All lines open Autorange

Input is series 930 DTL

INTERLOCKS . . . . .	Interlocks are provided to disallow multiple function or range calls for incompatible combinations.
POWER . . . . .	+5V power available from Data Output Unit (May be externally powered, 5V DC at 150 ma required.)
ISOLATION . . . . .	All CMRR specifications apply with RCU installed. 1000 VDC or peak AC may be applied between RCU common and input "LO".

**DATA OUTPUT TIMING DIAGRAMS**



## 1-12. GENERAL SPECIFICATIONS

DISPLAY . . . . .	Function/polarity display block plus six digit in-line neon readout.
DIGITIZING TIME . . . . .	25 ms maximum.
SAMPLE RATE . . . . .	Front panel variable from 10 readings/sec to 1 reading/3 sec + "EXT" (External Control) position. 40 reading/sec under external control through the Data Output Unit.
MAXIMUM INPUTS:	
"HI" to "LO" . . . . .	See individual function specifications.
"LO" to "GUARD" . . . . .	100V
"GUARD" to "GROUND" . . . . .	1000V DC or peak AC.
TEMPERATURE RANGE . . . . .	Operating   0°C to 50°C Storage     -40°C to +75°C
HUMIDITY RANGE . . . . .	Operating <80% relative humidity; 0°C to 25°C <70% relative humidity; 25°C to 50°C
ALTITUDE . . . . .	Operating   10,000 Feet. (3.048 Km) Non Operating 50,000 Feet (15.24 Km)
SHOCK & VIBRATION . . . . .	Meets requirements of MIL-T-21200G and MIL-E-16400F.
POWER . . . . .	115/230V, $\pm 10\%$ , 50-440 Hz line, 20 watts with all options.
WARMUP TIME . . . . .	30 minutes to meet all specifications.
WEIGHT . . . . .	15 lbs basic (6.81 Kg) 19 lbs with all options (8.63 Kg)
SIZE . . . . .	3.5" high by 17.5" wide by 15" deep (see outline drawing.) (88.9 mm H X 444.5 mm W X 381 mm D)

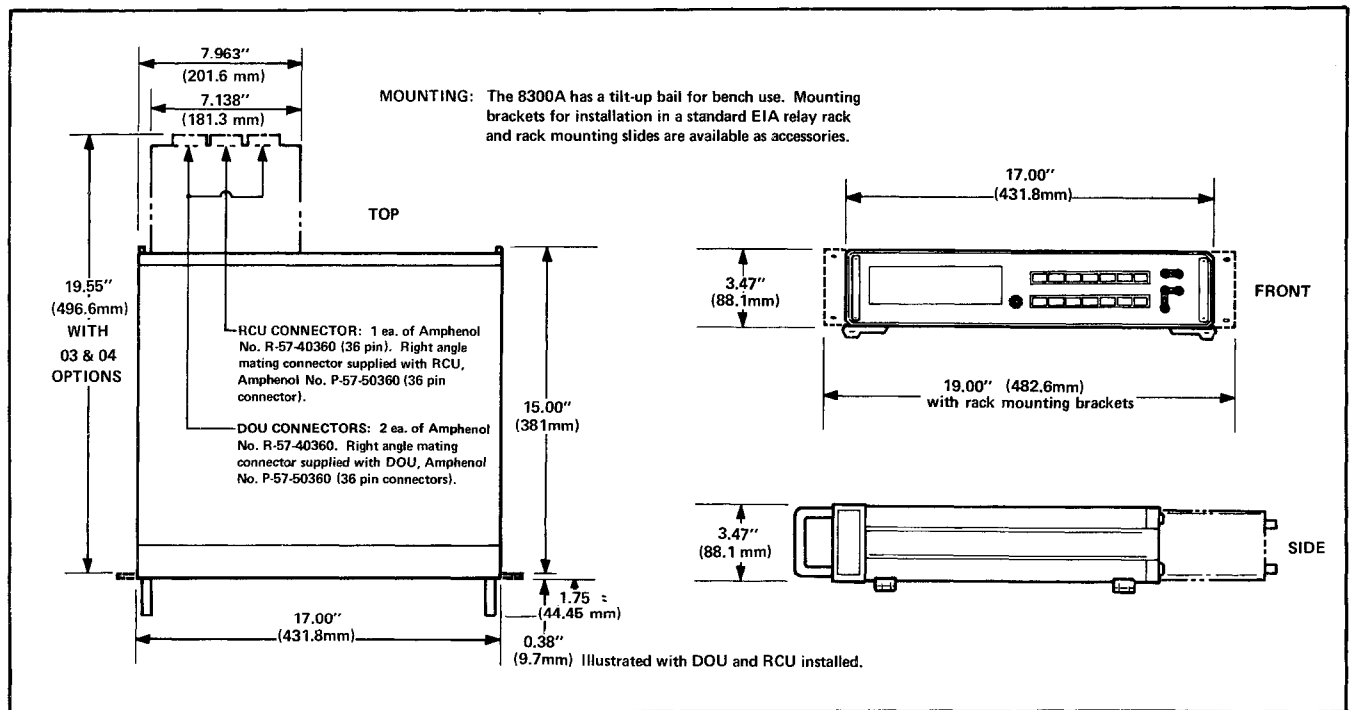


Figure 1-1. OUTLINE DRAWING

