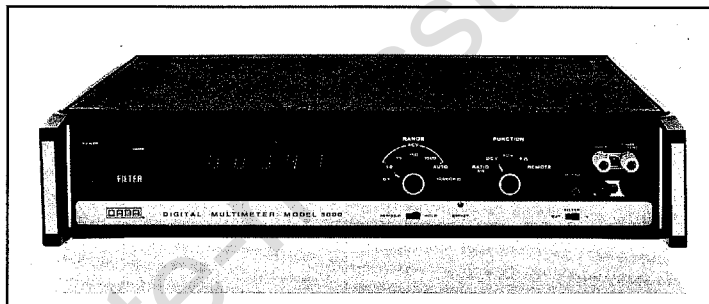


The Model 5000+ Digital Voltmeter.



DANA®

Others measure by us.

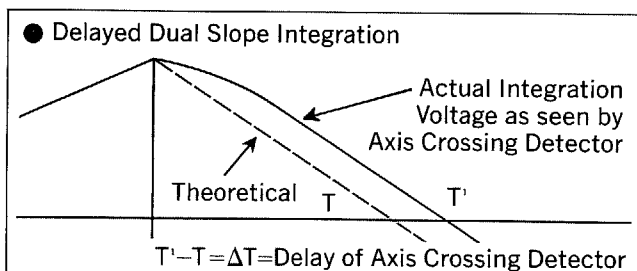


The Model 5000+ Digital Voltmeter. We've reduced the price to the lowest in our history. But we haven't lowered our standards one bit.

Technical Innovations.

Our first decade of operation began with a major technical breakthrough in the data amplifier field. The years since have seen further significant technical contributions. In the Model 5000+ Digital Voltmeter, we have implemented two important technical developments.

Delayed Dual Slope Integration. This is a technique used in the Model 5000+ to reduce noise and increase linearity, making possible the 100% overrange (unique for a five-digit voltmeter in the industry today), the reduction of bouncing digits, and the reduction of cost.

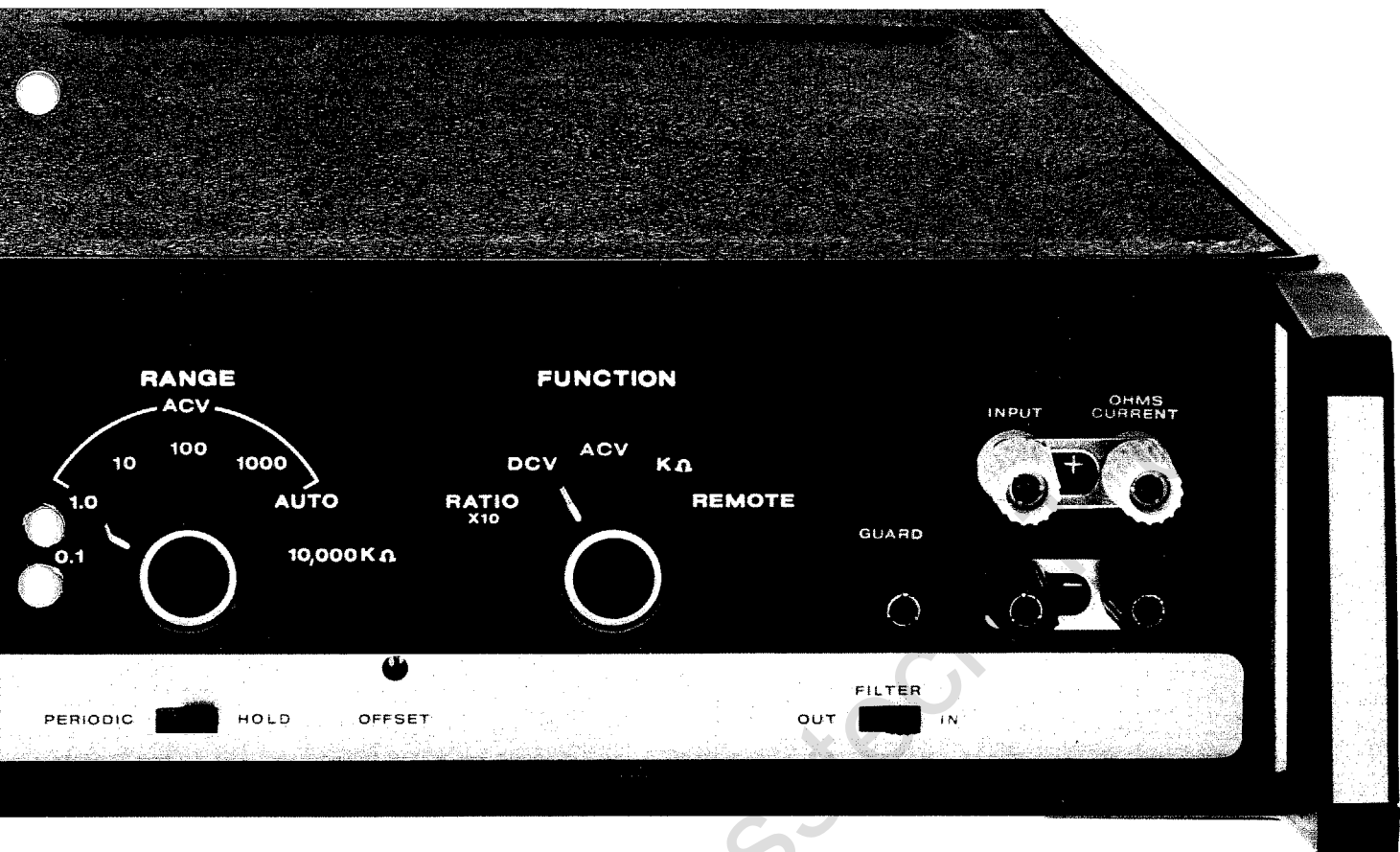


Briefly, the Model 5000+ lowers noise by reducing the bandwidth of the axis crossing detector with a filter. This quiets the axis crossing detector, allowing lower integrator voltage swings to obtain the necessary dynamic range. This in turn permits the use of a low-cost IC amplifier in the design.

However, this filtering does delay the actual integration signal as seen by the detector by ΔT as shown above. The digitizer is preset with sufficient digits to compensate for this delay. This compensation also improves linearity because the axis crossing detector has more time to settle to final filter delay.

Internal Autozero Without Kickback. The diagram opposite shows schematically sources of offset voltage in a digital voltmeter. The 5000+ uses an FET switching scheme in which Phase One grounds the digitizer input and puts the input offset voltage on C-Hold, a storage capacitor.

Phase Two, switches open, simply takes the measurement with C-Hold acting as an offset compensating battery. The isolator with patented input for low drift and high stability eliminates kickback current from the autozero.



Low Price, High Standards.

The Model 5000+ is the lowest-priced five-digit voltmeter Dana has ever produced. Yet the instrument reflects a high standard of design and performance. It was built by men responsible for voltmeters selling for many times the price of the 5000+, and it benefits from their standards of excellence.

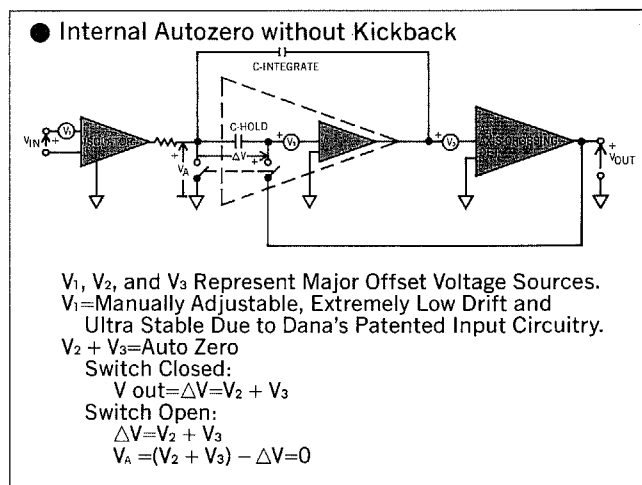
Reliability.

To ensure the utmost in reliability, Dana has used silicon solid state circuitry exclusively in the 5000+.

All integrated circuits are tested prior to installation, and every voltmeter shipped from the factory is exposed to a 120-hour run-in at 50°C, a 2.5 G vibration test, and a 168-hour run-in at elevated temperature. These extensive quality control procedures isolate and help ensure the correction of infant component failures before the instrument reaches the customer.

Serviceability and Maintainability.

In a few minutes, the entire instrument can be disassembled and each circuit board removed for easy servicing. Calibration has been greatly facilitated by printing an abbreviated procedure on the instrument.



Features of the Basic DC Instrument

5 DC Ranges—1 μ V Resolution. Five standard DC ranges offer measurement capability from 1 μ V through 1000V. In addition, this DC capability is provided in one mode of operation, and is completely autoranging.

Complete Autoranging. The 5000+ offers autoranging in all functions (DC, AC, Ohms, and DC/DC Ratio), thus eliminating the need to select ranges manually. Kilohms through megohms ranging is completely automatic. Manual range switching is also available.

Internal Autozero Without Kick-Back Current. A combination of Dana's patented Low Drift Isolator and internal closed loop autozeroing circuitry provides the unique and sensible capabilities of a highly stable electrical zero, with no kick-back current. This absence of kick-back current to the source permits the instrument to measure capacitive sources such as filter outputs.

10¹⁰ Ohm Input Resistance. Accuracy is further enhanced by an electrometer type input resistance on lower ranges, which permits measurement of megohm sources with less than 0.01% loading error. This high input impedance, which does not change during any part of the reading cycle, enables the 5000+ to maintain high accuracy, regardless of source resistance.

100% Overrange. The 5000+ provides 100% overranging on all ranges not limited by overload protection. This feature is not available on any other five-digit voltmeter. It is especially useful when high resolution is required of such common voltages as ± 15 V, ± 18 V, and ± 20 V.

Large LED Display with Leading Zero Blanking. Reading is made much easier by an oversized LED display. Also, all but one non-significant zero left of the decimal point is blanked to reduce confusion. The display may be easily removed from a plug-in board for convenient servicing.

Function Annunciators. An annunciator system is incorporated in the display, which indicates the function selected (AC, DC, Kilohm, Ratio), filter and overload. The function annunciators are blanked for those options which are not installed.

Cam Interlocks. Mechanical Cam interlocks physically prevent the selection of an improper range and function combination, thus reducing a potential source of confusion and error.

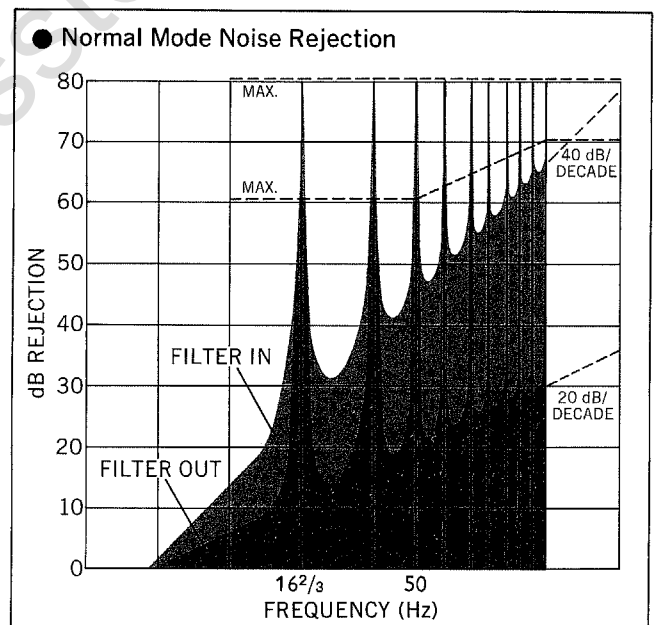
Switchable Filter—30 mSec Response Time. The 5000+ uses the stable, reliable delayed dual slope integrating technique, which provides inherent noise rejection at multiples of $16^{2/3}$ Hz (54 dB maximum at line frequency-filter out). A front panel selectable broadband filter is incorporated as part of the standard instrument, providing additional noise rejection over the complete band. DC settling time (filter out) is only 30 mSec. More detail is illustrated in the normal mode rejection curves.

1000 Volt Overload Protection in All DC and AC Ranges. Better than 1000 volts DC and 1000 V RMS can be applied to all DC and AC ranges without damage. On Ratio, the reference input will withstand 300 V DC. These limits are designed to protect the machine under all reasonable—and most unreasonable—hook-up situations.

Familiar 7400 Series Logic. Ease of service, low cost, backup, highest reliability and quick circuit familiarity are all facilitated by the use of 7400 Series TTL and a standard, commercially available MOS logic chip. All IC's are in sockets or on plug-in assemblies.

High Resolution Calibration. All critical calibration adjustments are quality multi-turn potentiometers for maximum resolution and stability. All adjustments are convenient and are protected from being accidentally disturbed.

Plug-In Accessories. Accessory functions, such as AC, Ohms, and Ratio, are plug-in modules and may be installed in the field. In instruments with systems capability, the systems interface may also be installed in the field.



Optional Accessories.

AC Volts:

Broadband AC—30 Hz to 250 kHz. Dana's plug-in Model 34 AC Converter covers both low-frequency and high-frequency measurement requirements in four full-scale ranges from 1V through 1000V, RMS with 10 μ V resolution. Typical accuracy is 0.1% with 600 milliseconds settling time.

Ohms:

Six Kilohm Ranges—1 Milliohm Resolution. A plug-in Model 54 Ohms Converter is available for expanding instrument capability to cover six full-scale ranges of ohms, from 100 ohms to 10 megohms (with 100% overranging, from 200 ohms to 20 megohms). Its 1 milliohm resolution greatly expands the applicability to low ohms measurements.

4-Wire Ratiometric® Ohms Measurements. Four-wire ohms configuration allows small resistance values to be precisely measured. This configuration eliminates most errors caused by lead resistance. The Ratiometric® scheme eliminates reading errors caused by reference drift.

Low Test Voltages and Currents. The maximum test voltage applied across the unknown resistance is 5 Volts DC for a full-scale 10 megohm reading. Worst case test current is 1 milliampere.

250 Volts DC or RMS AC Protection in All Ranges.

DC/DC Ratio:

4-Wire—4-Quadrant—Autopolarity. Dana's 4-wire, 4-quadrant polarity scheme (Option 64) is unique in the industry. It permits the measurement of ratios between bipolar signals and bipolar references with autoranging and autopolarity. Five ranges of DC/DC ratio are available (Option 64), with isolation between signal and reference commons. This virtually eliminates ground loop errors and greatly increases applicability as a ratiometer. Highly accurate ratio measurements, such as mV to volt ratios common to strain gauge work, transfer functions, voltage dividers and DC amplifier gains, are greatly facilitated.

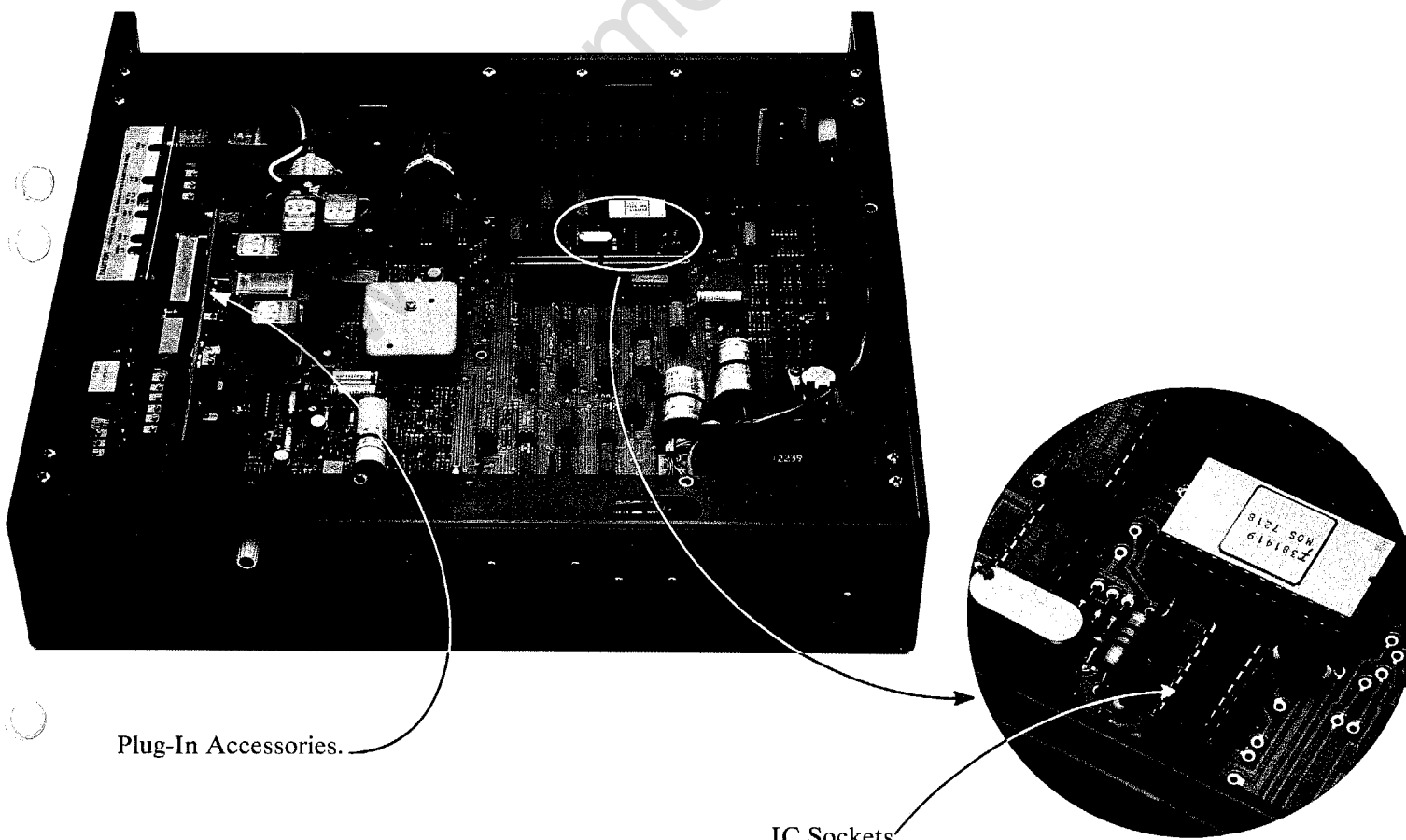
100-Volt Reference. A special option. If necessary, the 5000+ can be modified to accept an external 100-volt reference, in addition to the 10-volt reference.

300-Volt DC Reference Protection. The reference input circuit will withstand 300 VDC or RMS AC overload. The input signal is protected to 1000 VDC.

AC/DC—Ohms/DC Ratio: This capability is available with the system programming option.

General:

Parallel Front/Rear Input. This option permits use in a wide variety of applications in which input requirements might vary. Rear input is especially useful in applications where the instrument is rack-mounted.



Plug-In Accessories.

IC Sockets.

Systems Interface:

Data Output and Programming are available as Option 94.

Isolated, Buffered and Stored TTL BCD Output. The 5000-03 can be easily interfaced to digital recording equipment, computers, or other devices operating with digital inputs. The TTL isolated BCD output provides full isolation from signal sources and recording devices. TTL compatible outputs of range, functions, and polarity are provided, using solid-state techniques. Reed relays have been eliminated from the isolation circuitry, greatly increasing speed and reliability. In addition, the outputs are buffered from the digitizer to prevent system malfunctions from doing major damage to the instrument. Also, memory has been provided to hold the previous reading while a new reading is being made.

Isolated and Buffered Programming with Memory. All ranges, functions, and filter positions are completely programmable in the 5000-03. All command input lines are isolated, and buffered through solid state optical couplers, permitting interfacing with both grounded and ungrounded equipment, while still maintaining high common mode noise rejection. Memory is provided so previous commands may be stored until the program is updated.

Accurate Built-In System Time-Outs. The 5000-03 has special circuitry included which provides print command delays (automatic time-outs). The user may select a direct command, in which case a print command is issued immediately. A delayed command is issued with an appropriate time-out, according to the instrument's function, introduced before the digitizing cycle.

Range Programming and Data Output Codes

Range	Range R ₁	Range R ₂	Range R ₄	Range R ₆
Auto Range*	0	0	0	0
.1 KΩ, .1V	1	1	0	0
1 KΩ, 1V	0	0	1	0
10 KΩ, 10V	1	0	1	0
100 KΩ, 100V	0	1	1	0
1 MΩ, 1000V	1	1	1	0
10 MΩ	0	0	0	1
*Programming Only				

System Applications – Interface Data.

Output Levels. T² logic levels (approximately 2.4V true; .4V false). Higher voltage outputs available on special request.

Read Commands. Ground to read.

BCD Data. 1-2-4-8 positive true (negative true available on special request).

Data Transfer Time. 5 milliseconds.

Programming Set-Up Time. 5 milliseconds.

Print Commands. 5 milliseconds pulse at end of reading. Modes of operation and timing are as follows:

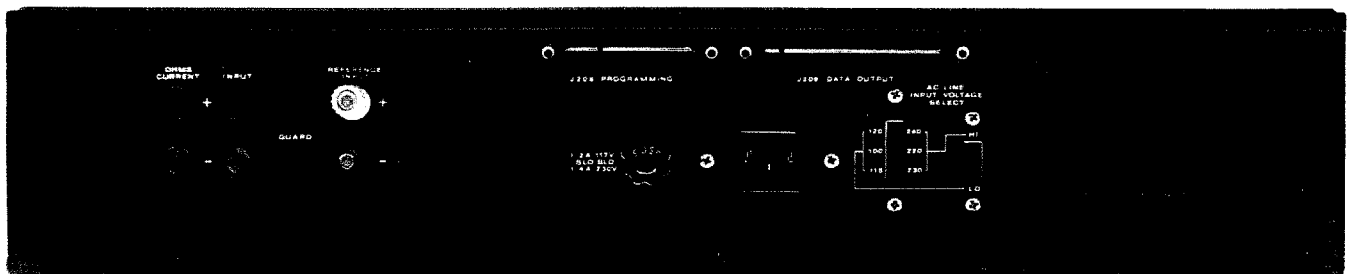
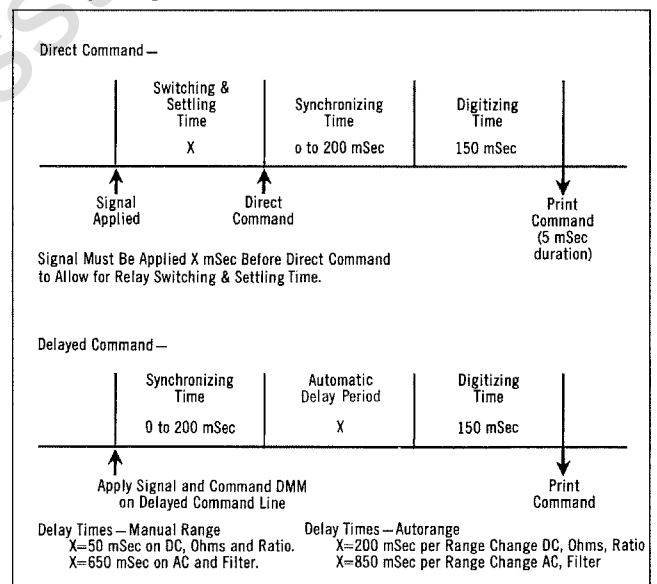
Periodic – Print command occurs every 200 milliseconds; print command is skipped during autoranging.

Hold – One print command per read command except if autorange occurs, then print command is skipped and range is stepped up or down. Print command timing for the two read command are:

A. Direct Command – One print command after each reading (shown in timing diagram).

B. Delayed Command – One print command after each reading (shown in timing diagram).

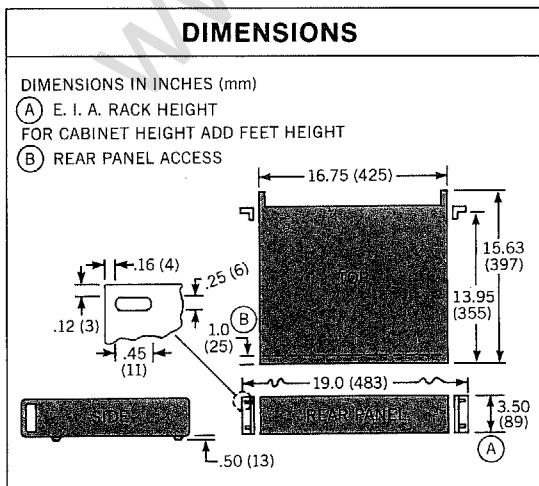
Timing Diagram



Model 5000-03 rear panel.

PROGRAMMING CONNECTOR J-208		
Bottom Side	Top Side	
1-B	1-A	
2-B	2-A	
3-B	3-A	
4-B	4-A	
5-B	5-A	
6-B	6-A	
7-B Filter	7-A	
8-B Ratio	8-A AC	
9-B Data Inhibit	9-A K Ω	
10-B Delayed Command	10-A Hold	
11-B Range R _a	Range Programming	11-A
12-B Range R ₁		12-A
13-B Range R ₂		13-A + 5 Volts
14-B Range R ₄		14-A Digital Common
15-B Program Storage	15-A Direct Command	
Connector - Viking - 2V 15 / 1JN5 Dana P/N 403714		

DATA OUTPUT CONNECTOR J-209		
Bottom Side	Top Side	
1-B Digital Common	1-A AC	
2-B Kohms	2-A Ratio	
3-B +5 Volts	3-A	
4-B	4-A	
5-B Filter	5-A	
6-B 10 K ₁	10 K's Decade	6-A
7-B 10 K ₄		7-A Data Inhibit
8-B 100 K ₁		8-A Direct Command
9-B 10 K _a		9-A - Polarity } Polarity
10-B 10 K ₂	10-A + Polarity } Lines	
11-B	11-A Print	
12-B 1K ₄	1 K's Decade	12-A OL(100 K ₂)
13-B 1K ₁		13-A External Supply Voltage
14-B 1K _a	100's Decade	14-A R _a
15-B 1K ₂		15-A R ₁
16-B 100 ₄		16-A R ₄
17-B 100 ₁	1's Decade	17-A R ₂
18-B 100 _a		18-A 1 ₂
19-B 100 ₂	10's Decade	19-A 1 _a
20-B 10 ₄		20-A 1 ₄
21-B 10 ₁		21-A 1 ₁
22-B 10 _a	22-A 10 ₂	
Connector - Viking - 2VH22 / 1JNS Dana P/N 403715		



Dana Series 5000+ Specifications

DC VOLTAGE	
Full Range Display:	$\pm 1.00000, \pm 1.00000, \pm 10.0000, \pm 100.000, \pm 1000.00$
Overrange:	100% on all ranges, ± 1000 volts maximum input
Resolution:	1 microvolt
Accuracy:	24 hours, 23°C, $\pm 1^\circ\text{C}$ 100 mV range $\pm(0.005\%$ of reading $+0.005\%$ of range) 1V-1000V range $\pm(0.005\%$ of reading $+0.001\%$ of range) 6 months, 23°C, $\pm 5^\circ\text{C}$ 100 mV range $\pm(0.01\%$ of reading $+0.005\%$ of range) 1V-1000V range $\pm(0.01\%$ of reading $+0.002\%$ of range)
Temperature Coefficient:	0 to 50°C 100 mV range $\pm(0.002\%$ of reading $+0.002\%$ of range) $^\circ\text{C}$ 1V-1000V range $\pm(0.001\%$ of reading $+0.0003\%$ of range) $^\circ\text{C}$
Input Resistance:	100 mV range 1,000 megohms 1 V range 10,000 megohms minimum 10, 100 and 1000V ranges 10 megohms
Normal Mode Noise Rejection:	Filter in At or near line frequency 80 dB (10,000 to 1) Filter out At or near line frequency 54 dB (500 to 1)
Common Mode Noise Rejection:	Up to 100 Ω in either lead: DC and at line frequency 140 dB minimum
Settling Time to 0.01% of Full Scale Step Input:	Filter in 600 mSec maximum Filter out 30 mSec maximum

WIDEBAND AC VOLTAGE (With addition of Model 34 AC Converter)	
Full Range Display:	1.00000, 10.0000, 100.000, 1000.00 V RMS
Overrange:	100% on all ranges; Maximum Voltage Rating: 1000 volts to 10 kHz, decreasing linearly to 100V RMS at 100 kHz. Maximum input voltage x frequency should be less than 2×10^7 Volt-Hz.
Resolution:	10 microvolts
Accuracy:	6 months, 25°C, $\pm 5^\circ\text{C}$ 30 Hz to 50 Hz $\pm(0.20\%$ of reading $+0.02\%$ of range) 50 Hz to 30 kHz $\pm(0.10\%$ of reading $+0.02\%$ of range) 30 kHz to 100 kHz $\pm(0.15\%$ of reading $+0.02\%$ of range) 100 kHz to 250 kHz - 1, 10, 100 ranges $\pm(1\%$ of reading $+0.10\%$ of range)
Input Resistance:	1 megohm
Shunt Capacitance:	100 PF front, 200 PF front/rear
Common Mode Noise Rejection:	Up to 100 ohms in either lead At line frequency 80 dB
Settling Time to 0.1% of Full Scale Step Input:	600 mSec maximum

Dana Series 5000+ Specifications

DC/DC 4-WIRE RATIO – 4-QUADRANT (With addition of Option 64)		
Full Range Display:	±.100000:1, ±1.00000:1, ±10.0000:1, ±100.000:1, and ±1000.00:1 (Readout is Ratio x 10)	
Overrange:	100% on all ranges, ±1000 volts maximum input	
Accuracy:	6 months, 25°C, +5°C .010000:1 range ±[0.02% R + 0.005% (10V/ref.) F.S.] .100000:1 to 100.000:1 ±[0.01% R + 0.002% (10V/ref.) F.S.]	
Voltage Range:	Input Sig 0 to ±1000V	Reference Sig (Denominator) ±2 to ±11V
	300 volts DC or RMS AC overload protection	
Input Resistance:	.01:1 range .1:1 range 1:1 range 10:1 and 100:1 ranges	1,000 megohms: 10,000 megohms: 10 megohms: 10 megohms:
	1 megohm 1 megohm 1 megohm 1 megohm	
Normal Mode Noise Rejection, Common Mode Noise Rejection, and Settling Time:	Same as DC specifications	

RESISTANCE (4-WIRE OHMS) (With addition of Model 54 Ohms Converter)		
Full Range Display:	.100000, 1.00000, 10.0000, 100.000, 1000.00, and 10000.0 kilohms	
Overrange:	100% on all ranges Fault Voltage: All Ranges: 250V	
Resolution:	1 milliohm	
Accuracy:	6 months, 25°C, ±5°C .1 kilohm range ±(0.02% of reading + 0.005% of range) 1, 10, 100 kilohm ranges ±(0.01% of reading + 0.002% of range) 1000 kilohm range ±(0.02% of reading + 0.002% of range) 10,000 kilohm range ±(0.03% of reading + 0.002% of range)	
Settling Time to 0.01% of Full Scale Step Input:	Filter in Filter out	600 mSec 30 mSec
Current Through Unknown:	Kilohm Range	Current
	.1	1.02 milliampere
	1	1.25 milliampere
	10	125 microamperes
	100	50 microamperes
	1000	5 microamperes
	10,000	0.5 microampere

GENERAL	
Ranging:	Automatic or manual
Digitizing Technique:	Dual Slope Integrator
Integration Time:	60 mSec
Digitizing Time:	220 mSec maximum
Maximum Common Mode Voltage:	500 volts peak
Maximum Power Requirements:	Optional: 100, 115, 120, 220, 230, 240 V RMS ±10%; 50 to 400 Hz, 40 watts
Operating Temperature:	0 to 50°C
Warm Up:	2 hours to full stability.
Dimensions: Model 5330	17x3½x14 inches or 43.2x8.9x35.6 cm.
Weight (Approx.):	17 pounds net, 20 pounds shipping
Guarantee:	12 months, faulty workmanship or component failure

(All specifications are subject to change at manufacturer's discretion.)

HOW TO ORDER INSTRUMENTS AND ACCESSORIES.

To order the 5000+ Digital Voltmeter, provide a complete model number, indicating both the basic instrument and all options and accessories that are to be included. The total cost is the sum of the individual items ordered.

Refer to Dana's Master Price List when ordering options and accessories separately.

Basic Instrument

Model 5000+ Digital Voltmeter
Model 5000-03, with Systems Acceptability

Optional Functions and Programming

Model 34 Averaging AC Converter
Model 54 4-Wire Ohms
Model 64 4-Wire 4-Quadrant Ratio
Model 94 Remote Programming and Data Output
Rear Input—1

Miscellaneous Accessories

Input Cable, Part Number 402190
Rack Mounting Flanges, Part Number 403402
Extender Card, Kit, Part Number 403701
Current Shunts, Model Number 651

DANA'S REPRESENTATIVE IN YOUR AREA:



Dana Laboratories, Inc.,