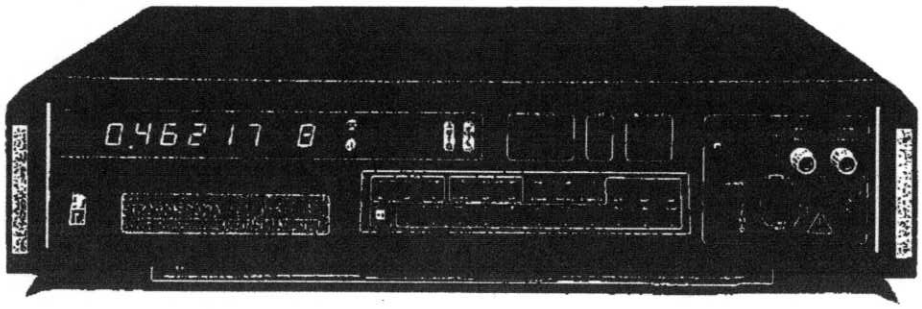
Amplitude Measurement System Series 6000



Introduction

We refer to the Series 6000 as an Amplitude Measurement System because it's so unique that descriptions such as Microprocessing DVM or Smart Digital Multimeter are no longer adequate.

In the 6000, we have combined highly stable analog technology with a microprocessor. The result is an instrument with features previously available only in expensive ATE systems.

The Series 6000 provides new measurement capabilities to both bench and systems users of amplitude measurement devices such as digital multimeters, A/D converters, high speed voltmeters, resistance bridges, AF voltmeters and peak-reading voltmeters.

It is specifically designed to meet these critical cost/performance considerations:

1. Reduced operator costs
2. Reduced calibration and maintenance expense
3. Reduced equipment downtime
4. Reduced engineering costs
5. Improved overall measurement accuracy and capability
6. Reduced equipment costs

Reduce your Operator Costs

Several unique features work together in the Series 6000 to allow faster testing, automatic testing and the use of less skilled operators.

Easy-to-Use Keyboard. An easy to use keyboard allows the Series 6000 to be set up and operated by even an inexperienced operator.

Results of Measurement Shown In High Level Units of Measure. Many voltage or resistance measurements are made only to be further calculated into high level units of measure such as temperature, strain, weight, gain, attenuation, deviation, etc. By combining features such as null, dB, mathematical scaling, and ratio; the Series 6000 will display the results of most measurements directly in the desired unit of measure. This eliminates the need for costly and time consuming operator calculations.

Internal Switching. The Series 6000 is provided with switchable (and programmable) front and rear inputs. This allows measurements from two different locations without requiring a skilled operator to move the input connections.

Automatic Recording Min/Max/Average. The Series 6000 may be operated unattended and, upon command, will display the minimum and maximum readings, the average of all readings (to 10,000 readings) and the number of readings taken. This eliminates the need for a full-time operator.

Built-in Memory. Not only will the Series 6000 remember the minimum and maximum for a series of readings, but it can be used to store up to 9 values for later recall. This reduces the need for logging of intermediate data.

Reduce Your Calibrations, Maintenance Costs and Equipment Downtime

The Series 6000 is built around a totally new concept of calibration and maintenance. No other digital multimeter can offer these combined features to reduce your equipment downtime and cut your maintenance and calibration expense. This concept can be summarized into four features.

Digital Calibration. You can calibrate the standard DC voltage and ohms functions of the Series 6000 automatically from the front panel without removing any covers. Digital correction factors are stored for these functions and ranges. You never have to worry about these correction factors because they are stored in EAROM and remain valid even when the power is off. They require no batteries that fail or potentiometers that change.

This exclusive feature reduces calibration time and expense to a minimum. Combined with guaranteed one year specification validity, this provides one of the lowest calibration costs possible.

ECM—Exchangeable Cal-Module. Applications in systems, production test, incoming inspection, QA, and R & D are far more efficient with an instrument that's

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GPIB Interface

Request Application Note 6000-5 for detailed description on program codes

Output Information: Numeric data, polarity and special flags

Input Information: Functions, ranges, microprocessing functions. Full control of all instrument capabilities

Compatibility: IEEE-STD-488-1978

Subsets: AH1, DC1, DT1, RL1, SH1, SR1, T5

Handshake Time

Address/Universal Commands: 75 μSec (15 μSec typical)

Programming Codes: 350 μSec per character

Data Output: 100 μSec per character (85 μSec per character HSD)

Annunciator (Front Panel): Remote/local, addressed to talk, addressed to listen, service request, bus address

Analog Signal Output

Description: Scaled and buffered DC output for driving a recorder etc.

Output Level: 0 to ±10 volts for zero to ±full scale

BCD Interface—Option 59

Compatibility: Similar to Racal-Dana Model 5900

Programming: DC V, AC V, Ohms, Filter. Remote /local, timeouts, trigger, range, ratio, superfast

Output: BCD data + range and function

Read Rate

Maximum continuous reading rates at 100% of ranges. All function and ranges except computing and ratio

Under System Control — Model 6001, 6002

Resolution / Condition	Option 03SH	No. Digits				
		4½	5½		6½	
Integration time		1.67 mSec	4.1 mSec	16.67 mSec	41 mSec	100 mSec
Internal Trigger	6000	55	55	25	3.0	3.0
External Trigger	34,000	50	40	20	3.0	3.0

Keyboard Control — All Models

Resolution / Condition	Option 03SH	No. Digits		
		4½	5½	6½
Internal Trigger	200	12	4	3.5
External Trigger	34,000	11	4	3.5

Ordering Information

Model 6000: 6½ Digit Digital Voltmeter

Model 6001: Amplitude Measurement System (DC V, Ohms, GPIB)

Model 6002: Amplitude Measurement System (DC V, AC V, Ohms, GPIB)

Options

03SH: High speed digitizer with sample and hold[1]

04: 50 Hz operation

71: 220/240 V operation

11: True rms AC reference (Model 6002)

14: High accuracy sinewave AC (Models 6000, 6001)

34: DC hardware ratio

41: 10 mV/1 ohm extended ranges

59: BCD interface[1]

60: Rack mount adapters

66: Chassis slides (including rack mounts)

1. Series 6000 will accept only one of these options simultaneously.

Accessories

980513: Extra Operator's Manual

980514: Maintenance Manual

400988: Calibration Test Assembly

454015: Spare Cal Module (for Model 6000)[3]

404172: Spare Cal Module (for Model 6001)[3]

404170: Spare Cal Module (for Model 6002)[3]

404044: 6000 Maintenance Kit

3. When ordering spare cal module, if option 11, 14 or 34 is in the original instrument, these options must be ordered with the spare cal module.

(High Speed Option 035H continued)

Input 2

Input: Wide bandwidth input on rear connector
Bandwidth: DC-1 MHz (3 dB), (8 V P-P)
Settling Time: 6 μSec to 0.5% of final value for 20 V step with 1 kilohm source impedance.
Input Range: ±20 V
Max Input: 100 V DC or Peak AC
Input Resistance: 100 kilohms
Accuracy: 24 hours 23°C ±1°C ±(0.05% reading ±0.15% range) 1 year 23°C ±5°C ±(0.35% reading +0.3% range)
Adjustable Delay: 2 μSec to 20 μSec (potentiometer adj.)
Programmable Read Rate
(Internal Trigger)
(Models 6001, 6002): From approximately 80 readings/second to 6000 readings/second in 255 steps
Aperture Time:
No Delay: 240 nSec ±50 nSec
Delayed: 240 nSec ±50 nSec + adjustable delay
Digitizing Time: 29 μSec

Math Ratio

Description: Implements formula R=X÷C
Where R = Ratio reading
X = Measured value
C = Stored constant

Accuracy: ±(Measurement accuracy + 1 digit)

Automatic Software Ratio

Description: Implements formula $R = V_1 \div V_2$
Where R = Ratio reading
V_1 = Signal voltage
V_2 = Reference voltage

Isolation: 1000 megohms between any signal terminal and any reference terminal
Signal Ranges: Standard functions and ranges
Reference Ranges: 1, 10, 100, 1000 V DC
1, 10, 100, 1000 V AC

Accuracy — DC/DC
Same Reference/Signal Range*:

$$\pm 0.001\% \text{ Input } \pm\left(0.001\% \text{ range } \frac{RR}{RI}\right)$$

Different Signal/Reference Range

$$\geq 1 \text{ V Range: } \pm 0.002\% \text{ Input } \pm\left(0.002\% \text{ FS } \frac{RR}{RI}\right)$$

$$100 \text{ mV Range: } \pm 0.007\% \text{ Input } \pm\left(0.1\% \text{ FS } \frac{RR}{RI}\right)$$

Accuracy — AC/AC
Same Reference/Signal Range

$$100 \text{ Hz} - 20 \text{ kHz: } \pm 0.06\% \text{ Input } \pm\left(0.05\% \text{ FS } \frac{RR}{RI}\right)$$

$$50 \text{ Hz} - 50 \text{ kHz: } \pm 0.1\% \text{ Input } \pm\left(0.1\% \text{ FS } \frac{RR}{RI}\right)$$

Accuracy — Mixed Functions: Signal function specification plus reference function specification with % of range multiplied by RR/RI.
*RR=Ref. Range
RI=Ref. Input

Computing Functions

High/Low Limit (HLL): Provides 7 memories which may be used for pass/fail or sorting operations
Min/Avg/Max (MAM): Accumulates minimum and maximum reading and average of up to 10,000 readings. Min, Max, or average can be recalled with or without clearing values.
Math Scaling: Implements the formula

$$X = \frac{(X - A)\,B}{C}$$

Where,
R = Reading
X = Measured value
A,B,C = Constants stored in math memories

dB: Displays dB, dBm, dBV, or dB of ratio

Hardware Ratio

DC Reference — Option 34
Readout: Signal Input ÷ Ref. Input. Ratios are displayed in scientific notation.
Signal Ranges: Same as Selected Function
Maximum Common Mode Voltage: ±15 V between reference input and −signal input
Accuracy: Selected function error x $\left(\frac{10\text{ V}}{\text{Ref}}\right)$

AC Reference — Option 11: (Model 6002)
Readout: Signal Input ÷ reference input. Ratios are displayed in scientific notation.
Reference Ranges: 1 V, 10 V, 100 V, 1000 V rms
Signal Ranges: Same as Selected Function
Maximum Signal Voltage: Same as Selected Function
Reference Voltage Range: 10% of range to 100% of range
Ratio Accuracy: ±(Accuracy of Function + Accuracy of true rms AC) multiplied by $\frac{\text{Reference Range}}{\text{Reference Input}}$

Frequency Range: 20 Hz to 10 kHz

General

Maximum Common Mode Voltage: 1000 V DC or peak AC guard to case, 250 V analog common to guard
Display: 6 full decades plus overrange digit and decimal point. All functions, ranges, and keyboard operations are annunciated
Overrange Indication: "OL" is displayed
Temperature Range
Operating: 0°C to +50°C
Storage: −40°C to +70°C
Cooling: Fan
Humidity: 75% RH, 0°C to +40°C;
50% RH, +40°C to +50°C;
Shock/Vibration: 0.025 inches double amplitude to 50 Hz for 15 minutes
Power Requirement: 100, 120, 220 or 240 V AC, selectable from rear panel. 60 Hz standard (50 Hz Option 04), 75 watts
Dimensions: 89 H x 425 W x 456 D mm
(3.5 H x 16.75 W x 18 D inches)
Weight: 11.4 kg (25 lb.)

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AC Voltage High Accuracy Sinewave—Option 14

(Models 6000, 6001 only)

Conversion Type: Averaged responding calibrated to rms of sinewave

Ranges: 1.00000, 10.0000, 100.000, 1000.00 V AC

Resolution: .001% of range.

Maximum Input Voltage: 1000 V rms or 1500 V peak, decreasing to 20 V rms at 1 MHz; 2 x 10^7V•Hz max. on any range.

Input Impedance: 1 megohm in series with 0.22 μF, shunted by less than 100 pF.

Settling Time
(To rated accuracy)

	"Filter" Out	"Filter" In
Zero to F.S.	200 mSec	600 mSec
F.S. to 10% F.S.	200 mSec	600 mSec

Temperature Coefficient[2] (% Input + No. Digits)/°C

Frequency	% Input	No. Digits
50 Hz-20 kHz (Filt.)	0.003%	0.5
20 kHz-100 kHz (Both)	0.005%	2
100 kHz-1 MHz (Both)	0.02%	10

2. With Auto-Cal after temperature change.

Accuracy (After Auto-Cal, sine wave input. For ≥250 V add 0.2% of input): ±(% input + No. of digits)

Frequency	24 Hours, 23°C±1°C		90 Days, 23°C±5°C		6 Months, 23°C±5°C	
	% Input	No. Digits	% Input	No. Digits	% Input	No. Digits
20 Hz-30 Hz (Filtered)	0.3%	2	0.31%	4	0.32%	5
30 Hz-50 Hz (Filtered)	0.2%	2	0.21%	4	0.22%	5
50 Hz-100 Hz (Filtered)	0.05%	2	0.06%	4	0.07%	5
100 Hz-5 kHz (Filtered)	0.03%	2	0.04%	4	0.05%	5
300 Hz-5 kHz (Unfiltered)	0.03%	2	0.04%	4	0.05%	5
5 kHz-50 kHz (Both)	0.04%	5	0.05%	7	0.06%	8
50 kHz-100 kHz (Both)	0.05%	10	0.06%	12	0.07%	13
100 kHz-300 kHz (Both)	0.6%	20	0.61%	22	0.62%	23
300 kHz-1 MHz (Both)	2.5%	70	2.5%	72	2.5%	73

Noise Rejection

Function	Normal (Series) Mode Rejection		Common Mode Rejection[1]	
	Filtered	Unfiltered	Filtered	Unfiltered
DC Volts	100 dB at 60 Hz	48 dB at multiples of 60 Hz[2]	140 dB, DC to 61 Hz 126 dB, 61 Hz to 100 kHz	140 dB at DC 120 dB at ≤61 Hz 174 dB at 60 Hz Harmonics
Ohms				
AC Volts	N/A	N/A	DC to 60 Hz	
			Range	CMR
			1 V	120 dB
			10 V	100 dB
			100 V	80 dB
			1000 V	60 dB

1. 100 ohms unbalance on either lead
2. 50 Hz with Option 04

High Speed Sample and Hold Digitizer—Option 03SH

Input 1

Range: May be used with any function and range, except Option 41

Input: Normal signal input terminals

Output: 12-bit binary parallel on all models, GPIB (IEEE-STD-488) on models 6001, 6002

Resolution: 0.1% of range

Accuracy: 1 year 23°C±5°C
±(0.57% reading +0.35% range) +function error

Settling Time: Same as function selected

Temperature Coefficient: ±(0.015% reading +0.01% range)/°C + function T.C.

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Resistance—Models 6001, 6002

Resolution: 0.001% F.S. in all ranges. 5½ digit mode

Overrange: 60% (120% on 1 ohm range Opt 41)

Ranges

Standard: 10.0000Ω, 100.000Ω, 1.00000 kΩ, 10.0000 kΩ, 100.000 kΩ, 1.000000 MΩ, 10.0000 MΩ, 100.000 MΩ

Option 41: 1.00000 Ω

Maximum Input Voltage: ±350 V peak on 1 ohm range. ±500 V peak on 10 ohm to 100 megohm ranges.

Ohms Guard: Allows in-circuit ohms measurements

Accuracy: (5½ digit mode; after Auto-Cal) ±(% Input + No. of Digits)

Range	24 Hours 23°C±1°C		90 Days 23°C±5°C		1 Year 23°C±5°C		Temperature Coefficient[2] 0°C to 50°C (±%Input ±No. Digits)/°C	
	% Input	No. Digits	% Input	No. Digits	% Input	No. Digits	% Input	No. Digits
1 ohm (Option 41)[1]	0.15%	50	0.02%	50	0.03%	50	0.002%	2
10 ohm[3,4]	0.003%	5	0.005%	5	0.006%	5	0.0008%	0.5
100 ohm—1 megohm[4]	0.002%	1	0.003%	1	0.004%	1	0.0007%	0.1
10 megohm	0.01%	1	0.03%	1	0.04%	1	0.003%	0.1
100 megohm	0.02%	1	0.03%	1	0.04%	1	0.005%	0.1

1. With source resistance ≤ 1 kilohm and input zeroed by pushing NULL with shorted input leads.
2. With Auto-Cal after temperature change.
3. After Null with shorted inputs.
4. If using ECM, add ±0.005% input to 10Ω, 100Ω and 1 kΩ ranges.

AC Voltage True rms—Model 6002

Ranges: 1.00000, 10.0000, 100.000, 1000.00 V rms

Resolution: 0.001% of range

Overrange: 60% except 1000 volt range

Maximum Input Voltage: 1000 V rms or 1500 V peak, decreasing to 50 V rms at 300 kHz. 1.5 x 10^7 V•Hz maximum any range.

Input Impedance: 1 megohm in series with 0.22 μF, shunted by less than 200 pF.

Crest Factor: 7:1 at full scale

Temperature Coefficient: ±(0.004% input +5 digits)/°C

Settling Time: (To within 0.1% of range).

	"Filter" Out	"Filter" In
Zero to F.S.	80 mSec	350 mSec
F.S. to 10% F.S.	100 mSec	400 mSec

Accuracy (After Auto-Cal, sinewave input. For ≥500 V add 0.1% of input): ±(% Input + No. of digits)

Frequency	24 Hours, 23°C±1°C		90 Days, 23°C±5°C		6 Months, 23°C ±5°C	
	% Input	No. Digits	% Input	No. Digits	% Input	No. Digits
20 Hz-30 Hz (Filtered)	0.5%	50	0.5%	60	0.52%	70
30 Hz-50 Hz (Filtered)	0.2%	50	0.2%	60	0.22%	70
50 Hz-100 Hz (Filtered)	0.1%	50	0.1%	60	0.12%	70
100 Hz-20 kHz (Filtered)	0.06%	50	0.07%	60	0.08%	70
200 Hz-20 kHz (Unfiltered)	0.06%	50	0.07%	60	0.08%	70
20 kHz-50 kHz (Both)	0.09%	100	0.1%	100	0.11%	110
50 kHz-100 kHz (Both)	0.38%	180	0.4%	200	0.42%	220
100 kHz-300 kHz (Both)* (10 V, 100 V, 1000 V ranges) (1 V range)	3% 5%	500 1000	3% 5%	500 1000	4% 6%	600 1100

* For voltages above 150 V AC, the filter should be in.

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Parallel BCD interface. This interface is designed for present users of parallel instruments. It provides a BCD interface which allows the Series 6000 to be added to your system with minimum hardware or software redesign.

Fully isolated operation. Both the GPIB and the BCD interfaces provide full isolation between the analog and digital circuitry.

Full annunciation. The Series 6000 provides full annunciation of all programmed conditions for easy software development. The readout display may be blanked while still maintaining annunciation of programmed conditions when your system is operating.

Automatic timeouts. When programmed, proper timeouts are automatically inserted to prevent first reading errors due to instrument settling times. The timeouts vary from a few milliseconds to 500 msec, depending on function, range and filter conditions.

Output is also inhibited during autorange to assure that only correct readings are available to your system.

Five integration times. A selection of five integration times from 1.66 mSec to 100 mSec, plus the 29 μSec High Speed Digitizer Option, gives you a read rate/resolution that will match your most demanding applications.

Six trigger modes. Six programmable trigger modes are available with the GPIB interface. The reading may be triggered internally, externally or by software command. And the High-Speed Digitizer (Option 03SH) may be triggered internally, externally with sample and hold, or externally with adjustable delay.

Auto-Test/Auto-Cal on command. The Auto-Test/Auto-Cal routine may be inhibited and performed only when commanded by your controller, or it may be performed any time you desire to ensure ultimate accuracy for your system.

Specifications

DC Voltage

Ranges
- **Standard:** ±100.000 mV, ±1.00000, ±10.0000, ±100.000, ±1000.00 V
- **Option 41:** ±10.0000 mV

Resolution: 0.001% range on 5½ digit mode

Overrange
- **100 mV to 100 V Ranges:** 60% (e.g. ±1.6000)
- **1000 V Range:** 1100 V DC, 1500 V peak AC
- **10 mV range:** 120% (i.e., 22 mV)

Maximum Input Voltage: 1100 V DC or 1500 V peak AC, all ranges except 10 mV range. 10 mV range = 350 V DC or 250 V rms

Input Impedance
- **100 mV, 1 V, 10 V ranges:** ≥10,000 megohm
- **100 V, 1 kV ranges:** 10 megohm
- **10 mV range:** 100 megohm minimum shunted by 4.8 kilohm in series with 1.5 μF.

Settling Time: (To within 0.01% with 10 kilohm source)
- **Filtered:** 450 mSec
- **Unfiltered:** 5 mSec
  - **100 V range:** 10 mSec
  - **10 mV range:** 850 mSec

Accuracy[3]: [5½ digit mode; after Auto-Cal] ±(% Input + No. Digits); T.C. = ±(ppm of input + No. Digits)/°C

Range	24 Hours 23°C ±1°C		90 Days 23°C ±5°C		1 Year 23°C ±5°C		Temperature Coefficient[2] 0°C to 50°C	
	% Input	No. Digits	% Input	No. Digits	% Input	No. Digits	PPM Input	No. Digits
10 V	—	1	0.001%	1	0.003%	1	1.5 ppm	0.05
1, 100, 1000 V	0.001%	1	0.002%	1	0.004%	1	3 ppm	0.1
100 mV	0.002%	5	0.003%	5	0.005%	5	4 ppm	0.5
10 mV (option 41)[1]	0.005%	5	0.008%	5	0.01%	5	20 ppm	0.5

1. With source resistance ≤ 1 kilohm and input zeroed by pushing Null with shorted input leads.
2. With Auto-Cal after temperature change.
3. After 2-hour warmup.

"on-the-job", and not "in-for-calibration." The exclusive Exchangeable Cal-Module allows complete on-site calibration of all standard functions and ranges. Simply replace the ECM with a recently calibrated one. This eliminates the need to send the entire unit away. Spare ECMs for use as exchange modules are available as an option.

Using the ECM, calibration downtime can be reduced to less than 3 minutes. The Exchangeable Cal-Module may be calibrated digitally in the calibration laboratory by inserting it into a Series 6000 Calibration Test Assembly or another Series 6000.

Non-Volatile Calibration. Since circuits that affect calibration traceability are contained inside the Exchangeable Cal-Module, other circuits may be repaired or replaced without invalidating the calibration certification. Most circuits are on plug-in assemblies and can be exchanged with minimal downtime.

Combining the ECM and the Non-Volatile Calibration concepts, the Series 6000 may never need to leave your system or bench.

Predictive Maintenance. Using the exclusive Auto-Test/Auto-Cal feature, the Series 6000 can actually predict many common types of failures before they affect the operation or accuracy of the measurement. The Auto-Test routine compares values within the Series 6000 to limits stored during manufacture in non-volatile read-only memory (ROM).

Each of these values is compared to two sets of limits. Limit set 1 contains the normal limits for each value. Limit set 2 contains the limits beyond which the Auto-Cal routine cannot correct. If the errors exceed the normal limits, a Predictive Maintenance code is displayed. This alerts the operator or system to a potential future failure. Should the error exceed the correctable limits, an error code is displayed continuously to alert the user to the need for immediate maintenance. The combination of the ECM, Non-Volatile Calibration, and Predictive Maintenance features means the Series 6000 will reduce downtime and maintenance expense to a minimum and allow you to schedule at your convenience.

Reduce Your Engineering Costs

For Your Bench Applications. Your engineering costs are reduced on bench applications by the elimination of many test fixtures and special setups normally required with the conventional digital multimeter.

For Your System Applications. An easy to use GPIB Interface (IEEE-STD-488, with all applicable subsets implemented) has been designed for speed and ease of programming. Drawing on three generations of GPIB design experience, Racal-Dana engineers have provided an instrument with unprecedented speed and versatility on the bus. When combined with the High Speed Digitizer Option, readings can be transferred on the bus at over 6000 readings per second.

Combine this interface with features such as the High Speed Digitizer, "7-bin" sorting, dB measurements, programmable front/rear inputs, Tri-function Ratio, etc., and you can reduce your system design time and cost significantly.

For customers using parallel systems, a BCD interface is available that enables you to update your system to include the Series 6000's exclusive calibration and maintenance concepts with minimum hardware or software redesign.

Improve Overall Measurement Accuracy and Capability

To provide better overall accuracies in the Series 6000, Racal-Dana looked outside the digital multimeter for sources of error. Features were added to the 6000 which allow you to reduce or eliminate errors external to the digital multimeter:

The Null feature allows external thermal voltages, lead resistance, or other offsets to be eliminated from the measurements, thereby improving overall accuracy.

The Software Ratio mode allows AC/AC ratios to be made using a single AC converter, thereby eliminating the effect of converter inaccuracy on many measurements.

These and other features such as switchable front and rear inputs, scaling, averaging, and selectable 4½ to 6½ digit resolution combine to make the Series 6000 the most comprehensive amplitude measurement system available.

Reduce Equipment Costs

In many applications, the Series 6000 can eliminate the need for expensive support equipment. For example, resistor sorting requires no external comparator box; the High Speed Digitizer Option eliminates the need for an A to D converter in systems; and the math and dB features may eliminate the need for a calculator or extensive computer software.

A New Standard for Bench Measurement

No other digital voltmeter gives you the on-the-bench performance and measurement capabilities of the Series 6000.

DC Volts

100 Nanovolt Resolution. Five DC ranges (0.1 V, 1 V, 10 V, 100 V, 1000 V) provide a resolution of 100 nV on the 0.1 V range.

0.001% Accuracy. The Series 6000 maintains 0.001% of full scale accuracy on its 10 V range for 24 hours, and ±(0.001% of reading + 0.001% of full scale) for 90 days over a 10°C temperature span.

Greater than 10,000 Megohm Input Resistance. A high input impedance increases accuracy with less than 0.001% loading error from up to a 100 kilohm source.

DC Millivolts (Option 41)

120% Overrange. The 10 mV/1 ohm Extended Range Option allows measurement of low level voltages from sources such as thermocouples, bridges and

detectors. The 120% overrange allows up to 22 mV to be measured with maximum resolution.

100 dB normal (series) mode rejection. Delayed dual slope integration combined with active input filtering assures a stable reading even with noise on the input signal. Multiple readings may also be averaged for an even greater integration of noise.

AC Volts

Broadband AC–20 Hz to 1 MHz. The Option 14 Averaging AC Converter has four AC ranges for making accurate measurements over a 20 Hz to 1 MHz frequency range. The AC Converter is located within the ECM and gives you AC/AC ratio capabilities. AC values may be displayed in dBm.

0.04% AC accuracy. The Averaging AC Converter maintains ±(0.04% of reading + 0.004% of full scale) accuracy for 90 days (±5°C) over a 100 Hz to 5 kHz frequency range.

True rms AC. The Model 6002 True rms Converter provides 0.1% typical accuracy over crest factors ranging from 7 to 22. The converter operates in either the AC mode or AC + DC mode.

Keyboard-controlled AC or DC coupling. The AC mode or AC + DC mode may be selected by keyboard control on the Model 6002. The GPIB interface also allows the coupling mode to be programmed remotely.

Two-speed measurement capability. The Series 6000 gives you the flexibility of two settling speeds for AC voltages. With the filter in, the input settles to within its rated accuracy in 400 mSec for the Model 6002 and in 600 mSec for the Option 14. With the filter out, the input settles to within its rated accuracy in 100 mSec for the Model 6002 and in 200 mSec for the Option 14.

Ohms

Nine ranges—1 ohm to 100 megohms. The 6001 and 6002 provide eight ranges of ohms. The Option 41 Extended Range gives you an additional range of 1 ohm full scale for measuring low resistance values.

Four-wire sensing. The 6001 and 6002 Ohms Converter provides four-wire sensing. Separate current and voltage leads eliminate errors caused by input lead resistance, and the use of Null feature lets you digitally correct lead resistance errors. A front panel switch converts the Series 6000 from two-wire to four-wire configuration.

0.003% ohms accuracy. The Models 6001 and 6002 maintain a ±(0.003% of readings + 0.001% of full scale) accuracy for 90 days (±5°C) on the 100 ohm to 1 megohm ranges.

Unique ohms guard. An ohms guard allows you to make certain in-circuit ohms measurements at full accuracy. This makes it possible to measure resistor networks (e.g., strain bridges) without disassembling individual resistors or calculating their values from a series of measurements. The ohms guard also prevents triboelectric errors in system applications where long input leads are utilized.

Microhm resolution. The Models 6001 and 6002 provide 10 μohm resolution when equipped with Option 41.

Tri-Function Ratio

24 different ratio configurations. The Tri-Function Ratio permits 24 different configurations, 10 reference ranges and 19 signal ranges. Capabilities equaled only by expensive computer-controlled ATE systems. And it also gives you three direct reading ratio function modes.

Computing Functions

Null. The null function is designed to permit rapid "zeroing" of the displayed value. When the null function is asserted, the display value is:

$$R = X - N$$

where: R = displayed value
X = measured value
N = value stored in null

The currently displayed value is stored as null function is asserted. Values other than the current reading may also be stored as null value.

Full math scaling

$$R = \frac{(X-A)B}{C}$$

Where R = displayed value
X = measured value
A = value stored in Memory A
B = value stored in Memory B
C = value stored in Memory C

This function may be used to convert the measured data into a variety of desired answers. For example:

Scale: $R = \frac{(X-A)}{C}$ Offset: $R = X-A$

Transducer Scaling: $R = \frac{[(X-N)-A]\,B}{C}$

Where N = value stored in null

% Deviation: $\% = \frac{(X-A)}{C} \times B$

Where A = C = 'norm'
B = 100

dB readings

The Series 6000 gives you a full 180 dB dynamic range.

Variable reference. On power-up, the Series 6000 automatically sets 0 dB = 1 mW into 600 ohms. Other impedance values may be entered directly from the keyboard or remotely for reference of 50 ohms, 75 ohms, etc.

Full function. dB indication may be displayed on all signal functions: DC Volts, AC Volts, and Ohms.

0.1 dB resolution. A 0.1 dB resolution is maintained over the entire 180 dB range.

Gain/Attenuation

AC or DC circuits. By combining the ratio and dB functions, decibels of gain or attenuation can be measured directly for either AC or DC circuits.

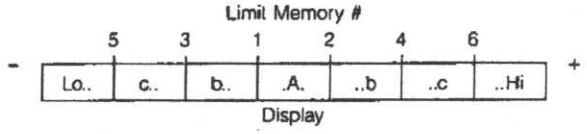
Gain/attenuaion vs. frequency. Scaling capabilities allow the frequency response of active or passive circuits to be measured directly in ±dB from the gain/attenuation at reference frequency.

Limit Testing (HLL)

The HLL function may be used for either go/no-go testing or for sorting operations. When combined with full-math function, limits may be stored in percent (i.e., −1% +1%).

Hi/low limits. The hi/low limit mode may be used for single or dual limit testing by storing values in either Limit Memory 1, Limit Memory 2, or both; and asserting the HLL function.

"7-bin" sorting. The HLL functions contain six memory locations (Limit Memories 1 through 6). Whenever values are stored in any memory locations other than Limit Memories 1 and 2, the HLL function is automatically converted to a "sorting bin" operation. The chart below shows the displayed indications when the HLL function is being used for sorting. The vertical lines represent the value stored in Limit Memories. The letters are displayed as shown for the measured values between each limit.



Any number of bins from 3 to 7 may be established by storing values in the appropriate Limit Memory.

Min/Avg/Max. The MAM function can be used for several measurements. It can continually update and store the minimum and maximum reading taken. And it can store the average of all readings and the total number of readings. Each of these values may be displayed when desired. Typical uses for the MAM function include storing and recalling + and − peak readings, digital averaging to achieve higher noise immunity, capturing average value of a signal with poor short-term stability, and power line monitoring.

Other Features

Switchable 3-pole active filter. The switchable 3-pole filter provides broadband noise rejection. Combined with the delayed dual slope integration which rejects the frequency noise, you get unequaled common and normal (series) mode noise rejection.

Three keyboard-controlled integration times. 1⅔ mSec, 16⅔ mSec and 100 mSec signal integration times are selectable from the keyboard (2 mSec, 20 mSec, 120 mSec for 50 Hz units). The selectable integration times allow the measurement speed to be optimized for the desired resolution and noise rejection.

Three keyboard-controlled resolution modes. You may set the Series 6000 for 4½, 5½, or 6½ digit display to eliminate unwanted digits when measuring imprecise signals.

High-speed autoranging. Most voltages will be measured with a maximum of two range changes, reducing the "wait time" when using autorange.

Up to 10 "scratch pad" memories. When the Full Function Math or HLL functions are not being used, the memory locations "A", "B", "C" and Limit Memories 1 through 6 may be used to store readings for recall and evaluation or recording.

Analog output. A scaled voltage output is available for driving a strip chart recorder or for use as a voltage source.

Switchable front and rear inputs. A useful feature for many applications where measurements are desired from two locations.

Externally triggered readings. A standard externally triggered reading feature is included for applications requiring precise timing of the integration period.

Fully guarded operation. The Series 6000 has full guarding on both the front and rear inputs.

Switchable input configuration. Front panel switches for two-wire ohms and low-to-guard operation eliminate time consuming and potentially dangerous shorting links from front panel inputs.

A New Standard for System Measurement

The Series 6000 is the result of our 10 years of experience as the leading systems digital voltmeter manufacturer. Along with all of its bench performance features, the Series 6000 gives you many state-of-the-art features designed exclusively for systems applications, at a price that's less than a traditional systems DVM.

Over 34,000 readings per second (Option 03SH). The Series 6000 serves as two separate and parallel analog-to-digital converters when equipped with the High-Speed Digitizer Option 03SH. The delayed dual slope converter provides high resolution and noise rejection, while a successive-approximation converter provides reading rates of over 34,000 readings per second with 3½ digit resolution (12-bit binary output). The sample and hold high-speed digitizer allows the Series 6000 to be used for applications requiring precise timing of measurement or extremely short sample times. The high speed digitizer also provides an adjustable delay circuit that delays the aperture point to compensate for system settling time, and a wide band-pass (1 MHz), fast settling (5 μSec) input.

Two independent digital outputs. Option 03SH provides12-bit parallel binary output. The GPIB (IEEE-STD-488) interface on Models 6001 and 6002 provides output of the high resolution data.

GPIB interface. This unique "3rd generation" IEEE interface is fully compatible with IEEE-STD-488. This interface lets you program all keyboard functions and controls. And it allows readings to be transferred over the bus at rates of over 6,000 readings per second when the unit is equipped with Option 03SH High Speed Digitizer. Implementation of the RL2 subset permits either full lockout of the keyboard or local operation while connected to the bus.