THE AUTOCAL 1081/2

FROM THE WORLDS FINEST RANGE OF DIGITAL MULTIMETERS

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Datron's versatile AUTOCAL range of high quality, precision multimeters includes instruments to satisfy the complete spectrum of measurement requirements from the general purpose capability of the 1065 to the Standards Laboratory precision of the 1081. Each instrument in the AUTOCAL range has been designed to achieve optimum performance in its class and standard features include, among others, instant 'SPEC' read-out of limits of uncertainty; specially designed high brightness displays with floating points for ease of reading; full computing functions; hinged, plug in PCBs and complete electronic calibration from its own front panel.

The 1081 is the ultimate in electrical measurement performance. Designed for Standard Laboratories and specialist applications, the 7½ digit 1081 instrument is a truly 'no compromise' design.

The 1081 offers the most comprehensive measurement capability of any DMM to date. The instrument can be supplied to meet the customer's individual requirements simply as a basic DC voltmeter or, with any combination of the following options:

- ★ True RMS AC Voltage
- ★ Resistance
- ★ Comprehensive Ratio and Rear Input
- ★ IEEE-488 Digital Interface
- ★ Analog Output
- ★ PRT Temperature Probe

With key features of high precision, stability and exceptional low noise performance, the AUTOCAL 1081 fully justifies its position as the 'best' in the AUTOCAL DMM range.

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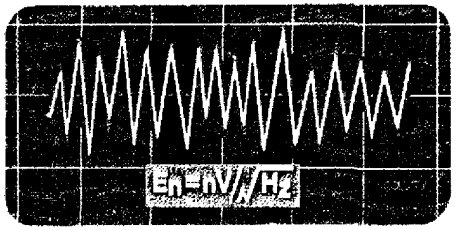
Accuracy and Linearity

The 1081's super-high accuracy and stability specifications are based on the prime element of the internal reference circuitry. Using computer selected and certified zener diodes from an automated system specially developed by Datron, each reference circuit includes four diodes for 'statistical enhancement' giving the 1081 a 7½ digit short term stability performance of ±0.25ppm reading.

The 1081 achieves the exceptional linearity of ±0.5ppm on a scale length ±9,999,999 using an enhanced version of the Datron multi-slope analog to digital converter.



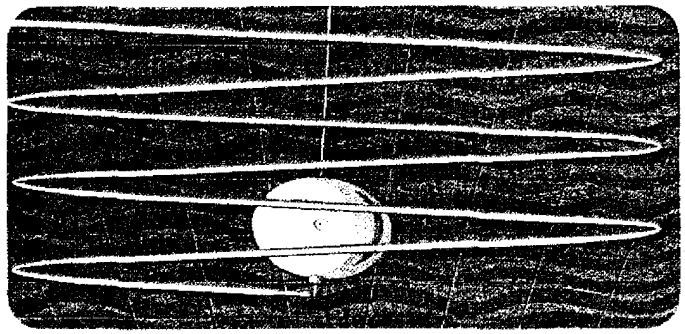
Stability and Low Noise

The input amplifier design provides outstanding short and long term zero performance enabling realistic measurement down to 10nV resolution and, for the first time on any DMM, a guaranteed noise specification.

The preamp stage takes advantage of the low input current and super low noise characteristics of a matched FET input pair. This, together with the secondary stage, a monolithic chopper stabilised amplifier, achieves unsurpassed performance of low noise, input zero and temperature coefficient.

Unequalled AC Performance

For over a decade Datron has led the world in precision AC measurement. The unsurpassed accuracy and extended bandwidth of the 1081 ensures the continuation of this position of excellence.



The true RMS converter, which uses Datron's 'Log feedback' technique, is not waveshape dependent, accommodates high crest factor signals and operates over a dynamic input of 1% to 200% range. The all solid-state converter uses precision logarithmic amplifiers to achieve this high performance.

It suffers none of the problems of slow speed, limited dynamic range and low frequency restrictions associated with its thermal counterpart.

Improvements in stability and accuracy in the 1081 have been made possible using the latest precision bulk metal film resistors and glass dielectric capacitors in all critical gain defining networks. These have also enabled a high 'flatness' factor over the main frequencies of interest to be achieved, needing only three specification bands to cover the range, with selection of the 'Spec' readout facility always displaying the correct limits of uncertainty.

Datron engineers have concentrated on substantial improvements to the low frequency and DC performance of the AC converter. For example, a switchable 3 pole Bessel active filter extends LF capability to 0.1 Hz bringing a new capability to the Standards Laboratory. This, together with a new pre-amp design including high performance, low noise DC coupled AC circuitry throughout, makes the 1081 unequalled in AC measurement.

Resistance Plus

To complete the 1081's high performance across all functions, no compromises have been made with the Resistance measurement facility.

Based on a new floating precision current source design using a commutating reference supply for isolation, the basic circuit provides a range of switchable precision currents to drive the resistance to be measured. The circuit configuration permits a TRUE 4 wire sense measurement to be made with up to 100 ohms in ANY lead having no effect.

Noise when measuring high resistances is a familiar problem, but on the 1081 the scaling of the current source on the megohm ranges has been optimized to reduce this effect.

In addition, a special high precision 100 ohm range with a 1mA source is provided for platinum resistance thermometer measurements.

High Resolution

'Hi-Res' extends the performance of the 1081 on all measurement functions to

produce 7½ digits on DCV and Resistance and 6½ digits on ACV.

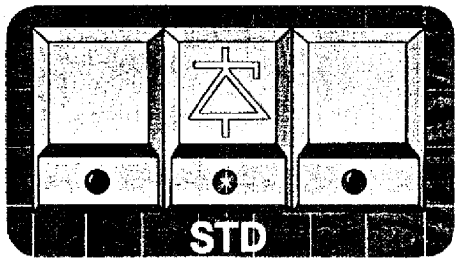
The technique employed involves switching additional circuitry into the analog to digital converter to produce a finer determination of the null detector zero cross-over, thus producing a GENUINE increase in resolution as opposed to simple averaging.

However, when an application requires averaging, selection of 'Hi-Res' and 'keyboard' programming makes two averaging modes available. The first is 'continuous' where all subsequent readings are taken into account and the second is 'block' where the user can select any number up to 19,999 readings to be averaged.

Autocal

This high confidence calibration technique is vital to achieving the outstanding accuracy of the 1081.

The ability to fully calibrate from the front panel with covers on, avoiding the need for additional stabilization time, enables the potential of full AUTOCAL,

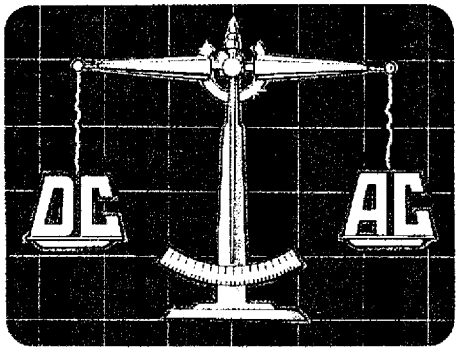


a Datron innovation, to be realized.

For ultimate precision, the numeric keyboard can be used to enable direct calibration to non-cardinal point sources such as standard cells, thus eliminating the uncertainties of additional transfer equipment. Furthermore, to provide the user with a full understanding of the 1081 specifications, the traceable uncertainty of equipment used to calibrate the 1081, maintained at Calibration Centers around the world is shown in the 1081 specification.

In the 1081, AUTOCAL has been extended to include a new standardize operation. This 'STD' enables the user, with one keystroke, to simultaneously re-standardize all ranges and functions by correcting for any change in the 1081 internal reference circuitry or the Standards Laboratory prime reference.

AUTOCAL is fast, simple and complete. The keyswitch protection ensures no unauthorized use and, for the 1081, no other method of calibration would be appropriate.



Stable Transfers

Ratio measurement in the 1081 is a powerful and versatile feature.

Inputs up to 350volts pk are accepted via two isolated and floating channels to provide readings of SIG, REF, SIG-REF difference, SIG/REF ratio or percentage deviation. Coupled with 'Auto' ranging, high accuracy ratio measurements of widely differing inputs can be made automatically.

Great care has been taken to closely match both signal channels, virtually eliminating errors in the input switching circuitry. Each channel is independently guarded with provision for remote guard connections to minimize errors back to the signal source.

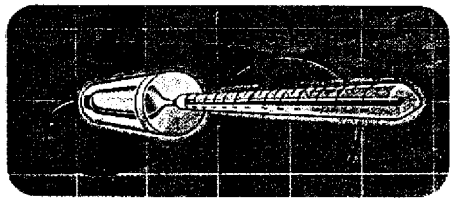
ACV/DCV transfer performance is a key feature of the 1081. With the true RMS AC Converter DC coupled, identical circuitry throughout is used for both inputs and, without limitations on input dynamic range the 1081 AC/DC transfer stablity of ±30ppm for 24 hours offers many advantages over alternative methods.

Furthermore, using the LF response of the AC converter means that traceable AC/DC transfers down to 0.1 Hz are achievable – an area of Standards Laboratory measurements not previously possible.

Temperature

Using a Datron supplied Platinum Resistance Thermometer Probe, the 1081 can be usefully extended to make accurate temperature measurements from −100° C to +200° C.

In the Standards Laboratory the stainless steel probe is particularly suited to measuring oil-bath temperature, which with the 5½ digit display provides a resolution of 1m° C.



Internal linearization correction is optimized by entering the actual traceable probe resistance at 0° C and +100° C using the numeric 'keyboard',and the AUTOCAL facility. This conforms to IPTS-68 standards using a 5th order polynomial.

Other P.R.T. probes can be used with the special 1mA Resistance range provided.

Calibration Systems

With the IEEE-488 standard interface, Datron's 1081 brings Standards Room measurements under bus control for the first time. For a specialist and high performance instrument, the 1081 is appropriately fitted with an impressive range of bus facilities making it the ideal instrument for calibration systems.

Support

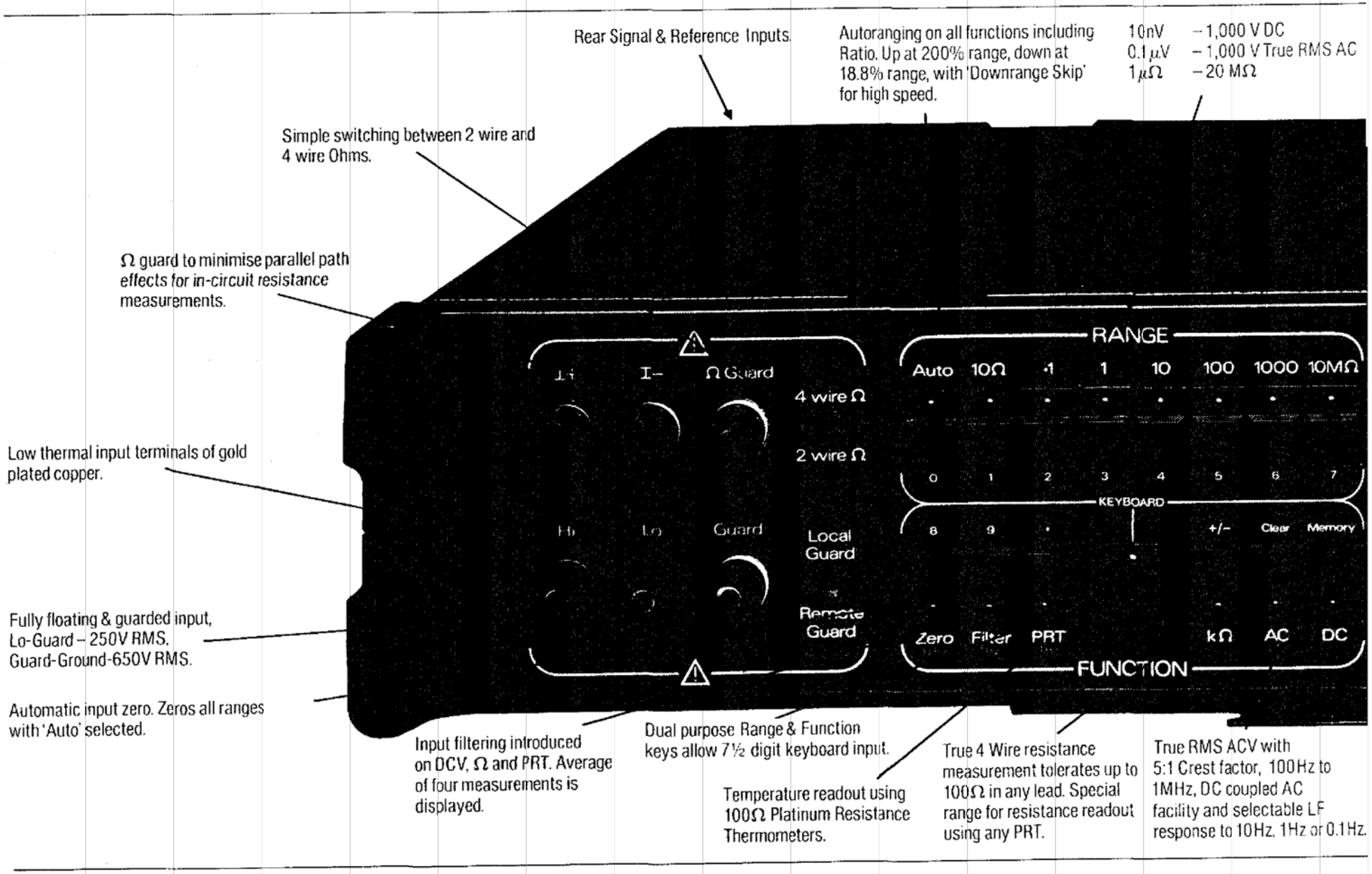
As a diagnostic self-check, a test routine can be selected to sequentially check all main function circuitry including the vital calibration memory. At any stage, an error code identifies failure to plug-in module level.

The whole instrument is designed to meet Datron's rigorous quality standards. Each unit is subjected to an extended period of 'burn-in' before shipment.

To back our confidence in the 1081 as the best DMM in the world, each instrument carries the now familiar Datron comprehensive five year warranty and free annual calibration.

1082

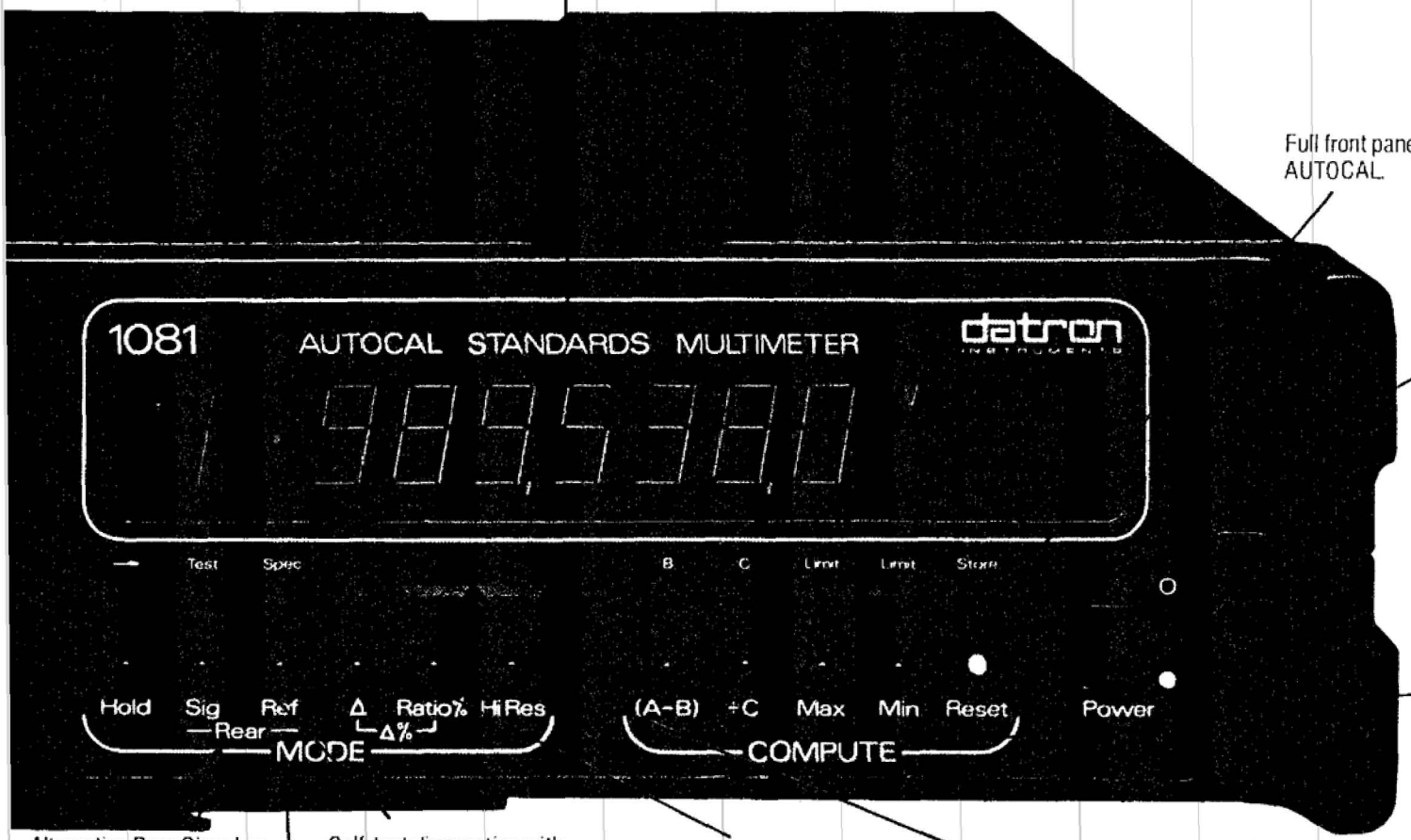
For maximum economy, the 1082 is also available with the full performance of the 1081 in a fixed configuration which includes DCV, true RMS ACV, Resistance, & IEEE-488 interface as standard with one year warranty.


Rear Signal & Reference Inputs.
Autoranging on all functions including Ratio. Up at 200% range, down at 18.8% range, with 'Downrange Skip' for high speed.
10nV – 1,000 V DC
0.1 μV – 1,000 V True RMS AC
1 μΩ – 20 MΩ
Simple switching between 2 wire and 4 wire Ohms.
Ω guard to minimise parallel path effects for in-circuit resistance measurements.
Low thermal input terminals of gold plated copper.
Fully floating & guarded input, Lo-Guard – 250V RMS, Guard-Ground-650V RMS.
Automatic input zero. Zeros all ranges with 'Auto' selected.
Input filtering introduced on DCV, Ω and PRT. Average of four measurements is displayed.
Dual purpose Range & Function keys allow 7½ digit keyboard input.
Temperature readout using 100Ω Platinum Resistance Thermometers.
True 4 Wire resistance measurement tolerates up to 100Ω in any lead. Special range for resistance readout using any PRT.
True RMS ACV with 5:1 Crest factor, 100Hz to 1MHz, DC coupled AC facility and selectable LF response to 10Hz, 1Hz or 0.1Hz.
I+
I–
Ω Guard
4 wire Ω
2 wire Ω
Hi
Lo
Guard
Local Guard
Remote Guard
RANGE
Auto
10Ω
·1
1
10
100
1000
10MΩ
0
1
2
3
4
5
6
7
KEYBOARD
8
9
·
+/–
Clear
Memory
Zero
Filter
PRT
kΩ
AC
DC
FUNCTION

THE AUTOCAL 1081/2

Analog Output for XY plotters and chart recorders.

19,999,999 floating point high brightness plasma display, with full function annunciation.



Full front panel calibration with AUTOCAL.

Max/Min and Limits.

Computation capability for offsets, scaling or other repetitive calculations.

Alternative Rear Signal or Reference inputs.

Self-test diagnostics with displayed error codes.

Display of Sig/Ref Ratio, Sig-Ref Difference or Percentage Deviation. With 'Autorange', wide range of inputs accepted.

Instant read-out of limits of uncertainty taking account of function, range, reading, full scale and frequency. Period since calibration set on rear panel.

High resolution extends scale length to 7½ digits on DCV, Ω and to 6½ digits on ACV. Continuous or Block average included.

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1081/2 Specifications

To provide the user with a full understanding, the main specifications of the 1081/2 are shown under the following headings:

Stability is the repeatability of a set output for exactly the same conditions.

Accuracy relative to calibration standards includes all the effects of stability, temperature coefficient, noise and linearity under worst case line and load conditions.

Calibration uncertainty shows the traceability of Datron's calibration of the 1081/82. After re-calibration the traceability of the users standards should be substituted.

Absolute accuracy is expressed by a summation of 'accuracy relative to calibration standards' plus 'calibration uncertainty'.

					STABILITY [2] ± (ppm reading + ppm FS) [4]		ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (ppm reading + ppm FS) [4] 23°C ± 1°C		
	RANGES	OVERRANGE	Ranges		1 min	24 Hours	24 Hours	90 Days	1 Year
DC VOLTAGE	100.0000 (0) mV 1.000000 (0) V 10.00000 (0) V 100.0000 (0) V 1000.000 (0) V	100% on all ranges except 1000V, i.e. 1,999,999 (9) Full Scale	100mV 1V 10V 100V 1000V		0.25 + 0.25μV 0.25 + 0.5μV 0.25 + 2.5μV 0.25 + 50μV 0.25 + 250μV	2 + 1.5 1.5 + 0.25 1.5 + 0.25 2 + 0.25 2 + 0.25	3 + 2 2 + 1 2 + 0.5 3 + 1 3 + 1	8 + 2 5 + 1.5 5 + 1 8 + 1.5 8 + 1.5	11 + 2 8 + 1.5 8 + 1 11 + 1.5 11 + 1.5
AC VOLTAGE True RMS [1]	100.000 (0) mV 1.00000 (0) V 10.0000 (0) V 100.000 (0) V 1000.00 (0) V	100% on all ranges except 1000V, i.e. 199,999 (9) Full Scale	10Hz-2kHz	100mV 1V-100V 1kV	10 + 5 10 + 2.5 20 + 2.5	40 + 15 30 + 8 50 + 8	0.02% + 0.007% 0.01% + 0.005% 0.02% + 0.007%	0.025% + 0.007% 0.015% + 0.005% 0.025% + 0.007%	0.03% + 0.007% 0.02% + 0.005% 0.03% + 0.007%
			2kHz-20kHz [6]	100mV 1V-100V 1kV	10 + 5 10 + 2.5 20 + 2.5	60 + 20 50 + 12 70 + 12	0.04% + 0.012% 0.02% + 0.01% 0.04% + 0.012%	0.06% + 0.012% 0.03% + 0.01% 0.06% + 0.012%	0.08% + 0.012% 0.04% + 0.01% 0.08% + 0.012%
			20kHz-100kHz [6]	100mV 1V-100V 1kV	10 + 5 10 + 2.5 20 + 2.5	70 + 30 60 + 25 80 + 25	0.08% + 0.022% 0.04% + 0.02% 0.08% + 0.022%	0.12% + 0.022% 0.07% + 0.02% 0.12% + 0.022%	0.16% + 0.022% 0.1% + 0.02% 0.16% + 0.022%
RESISTANCE	10.00000 (0) Ω 100.0000 (0) Ω 1.000000 (0) kΩ 10.00000 (0) kΩ 100.0000 (0) kΩ 1.000000 (0) MΩ	100% on all ranges, i.e 1,999,999 (9) Full Scale.	10Ω 100Ω 1kΩ 10kΩ 100kΩ 1000kΩ 10MΩ		0.5 + 50μΩ 0.5 + 60μΩ 0.5 + 600μΩ 0.5 + 6mΩ 0.5 + 60mΩ 1 + 500mΩ 5 + 5Ω	2.5 + 2.5 2 + 0.5 2 + 0.5 2 + 0.5 2.5 + 0.5 4 + 0.5 6 + 0.5	4 + 3 3 + 1 3 + 1 3 + 1 4 + 1 7 + 1 10 + 1	7 + 3 5 + 1.5 5 + 1.5 5 + 1.5 6 + 1.5 15 + 1.5 30 + 1.5	12 + 3 10 + 1.5 10 + 1.5 10 + 1.5 11 + 1.5 25 + 1.5 50 + 1.5

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ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (ppm reading + ppm FS) [4]			CALIBRATION UNCERTAINTY ppm [3]	TEMPERATURE COEFFICIENT ± ppm Output/°C 13°C – 18°C 28°C – 33°C	SETTLING TIME	COMMON MODE REJECTION RATIO (1kΩ Source Unbalance)	INPUT IMPEDANCE	OTHER SPECIFICATIONS
23° C ± 5°C								
24 Hours	90 Days	1 Year						
8 + 2 5 + 1.5 5 + 1 8 + 1.5 8 + 1.5	11 + 2 8 + 1.5 8 + 1 11 + 1.5 11 + 1.5	14 + 2.5 11 + 1.5 11 + 1.5 14 + 1.5 14 + 1.5	5 3 3 5 5	1.5 1.0 1.0 1.5 1.5	To 10ppm step size Filter out: <50ms Filter in: <1s	>140dB at DC >80dB + normal mode at 1Hz – 60Hz	0.1 to 10V ranges (<20V): >10,000MΩ. 100V & 1000V ranges: 10MΩ ± 0.1%	Type: multi-slope A-D converter Ratio Accuracy [5]: ± net signal accuracy ± net reference accuracy Read Rate: 2/s Normal Mode Rejection: filter out: 66dB at 50/60Hz ± 0.15% filter in: 120dB at 50Hz increasing at 18dB/octave Input Current: <50pA drifting at <1pA/°C Input Protection: withstands 1000V RMS on any range Zero Stability: ± (0.2 digits ± 0.1μV)/month ± t.c.
0.025% + 0.007% 0.015% + 0.005% 0.025% + 0.007%	0.03% + 0.007% 0.02% + 0.005% 0.03% + 0.007%	0.04% + 0.007% 0.025% + 0.005% 0.04% + 0.007%	100 50 100	15 15 15	To 0.1% step size: 100Hz <500ms 10Hz <2.5s 1Hz <15s 0.1Hz <150s	>90dB at DC – 60Hz	1MΩ shunted by 150pF	Type: true RMS AC coupled measures AC component with up to 1000V DC bias on any range. By pressing AC and DC keys, DC coupled true RMS AC is obtained, i.e. $\sqrt{AC^2 + DC^2}$ Ratio Accuracy [5]: ± net signal accuracy ± net reference accuracy Read Rate: 2/s Crest Factor: 5:1 at full range Input Protection: withstands 1000V RMS on any range. Add to main accuracy specification for: DC signals 0.01% reading ± 0.0015% FS ± 10μV LF 0.1Hz as DC coupled ± 0.05% FS 1Hz as DC coupled ± 0.01% FS 10Hz as main specification HF 100kHz – 1MHz 2% reading ± 1% FS (1V & 10V range)
0.06% + 0.012% 0.03% + 0.01% 0.06% + 0.012%	0.09% + 0.012% 0.045% + 0.01% 0.09% + 0.012%	0.11% + 0.012% 0.055% + 0.01% 0.11% + 0.012%	100 50 100	25 25 25				
0.12% + 0.022% 0.06% + 0.02% 0.12% + 0.022%	0.18% + 0.022% 0.09% + 0.02% 0.18% + 0.022%	0.23% + 0.022% 0.14% + 0.02% 0.23% + 0.022%	200 100 200	100 100 100				
10 + 3 7 + 1.5 7 + 1.5 7 + 1.5 8 + 1.5 15 + 1.5 20 + 1.5	15 + 3.5 10 + 1.5 10 + 1.5 10 + 1.5 10 + 1.5 25 + 1.5 40 + 1.5	20 + 4 15 + 2 15 + 2 15 + 2 15 + 2 35 + 2 60 + 2	5 5 5 5 10 15 20	1.5 1.0 1.0 1.0 1.0 2.0 2.5	Up to 10kΩ range: generally the same as DCV but depends on external capacitances and guarding/shielding techniques used.			Type: true 4 wire with active guard (250Ω minimum) can be switched to 2 wire on front panel. Ratio Accuracy [5]: ± net signal accuracy ± net reference accuracy Input Protection: withstands 250V RMS on any range. Read Rate: 2/s Open Circuit Voltage: < 20V all ranges Lead Resistance: up to 100Ω Current through unknown: 10Ω: 10mA 100Ω: 10mA (1mA -PRT) 1kΩ: 1mA 10kΩ: 100μA 100kΩ: 10μA 1000kΩ: 5μA 10MΩ: 500nA

NOTES

( ) – Hi-Res selected gives 7½ digits on DCV & Resistance & 6½ digits on ACV.

[1] – Signals < 2 x 10^7 volt. Hz > 1% FS, DC coupled below 100Hz.

[2] – For same conditions with Hi-Res selected between 18° C – 28° C.

[3] – Datron Instruments traceability to National Standards.

[4] – FS = 2 x range.

[5] – At same amplitude, frequency etc. errors tend to zero.

[6] – Add 0.01% per 100V above 500V.

[7] – At full range ± 2%.

6½ digits AC VOLTAGE TRANSFER SPECIFICATIONS		TRANSFER STABILITY (± % reading) [2][7]			ACV/DCV TRANSFER ACCURACY (±% add to Transfer Stability)
		AC/DC		AC/AC	
		24 Hours (23°C ± 1°C)	90 Days (23°C ± 5°C)	24 Hours (23°C ± 1°C)	
10Hz–2kHz	100mV 1V–100V 1kV	0.005 0.003 0.005	0.01 0.005 0.01	0.004 0.003 0.005	0.02 0.01 0.02
2kHz–20kHz	100mV 1V–100V 1kV	0.01 0.005 0.01	0.04 0.015 0.04	0.006 0.005 0.007	0.06 0.03 0.06 [6]

TEMPERATURE (IPTS-68)

RANGE	ABSOLUTE ACCURACY (± °C)		
°C Display (5½ digits)	24 Hours (23°C ± 1°C)	90 Days (23°C ± 5°C)	1 Year (23°C ± 5°C)
−100 to −55	0.2	0.25	0.3
−55 to 0	0.04	0.1	0.15
0 to +100	0.02	0.06	0.1
+100 to + 200	0.04	0.1	0.15
At 0°C & 100°C	0.01	0.05	0.08
Ω Display (6½/7½ digits)	ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (ppm reading + ppm FS)		
100Ω (1mA)	3 ± 3	10 ± 3.5	15 ± 4

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GENERAL

POWER SUPPLY	105 – 127 volts or 205 – 255 volts 50Hz, 60Hz or 400Hz
POWER CONSUMPTION	20 watts approx.
OPERATING TEMP.	0°C to 50°C
STORAGE TEMP.	−40°C to + 70°C
DIMENSIONS (HxWxD)	89mm (3.5") x 455mm (17.9") x 420mm (16.5")
WEIGHT	10kg (22lbs)
SAFETY	Designed to UL 1244, IEC348 & BS 4743
WARRANTY	5 YEARS 1081 1 YEAR 1082

ORDERING INFORMATION

		PRICE $
1082:	6½/7½ Digit AUTOCAL Multimeter with DCV, ACV, Resistance, IEEE-488	6995
Option 40:	Comprehensive Ratio and Rear Input	595
Option 70:	Analog Output	150
Option 90:	Rack Mounting Kit	50
Accessory		
PRT 100:	Platinum Resistance Thermometer Probe (100Ω)	485
1081:	6½/7½ Digit AUTOCAL Standards DC Digital Multimeter	5750
Option 10:	True RMS AC Converter	1545
Option 20:	4-Wire Resistance Converter	875
Option 40:	Comprehensive Ratio and Rear Input	595
Option 50:	IEEE 488-1978 Standard Digital Interface	595
Option 52:	Remote Trigger (included in Option 50)	150
Option 70:	Analog Output	150
Option 80:	115V 60Hz Line Operation	n/c
Option 81:	115V 50Hz Line Operation	n/c
Option 82:	115V 400Hz Line Operation	n/c
Option 90:	Rack Mounting Kit	50
Accessories		
PRT 100:	Platinum Resistance Thermometer Probe (100Ω)	485
CSI:	Current Shunt Set	375
HVP:	High Voltage Probe	375
1501:	Deluxe Lead Kit	100