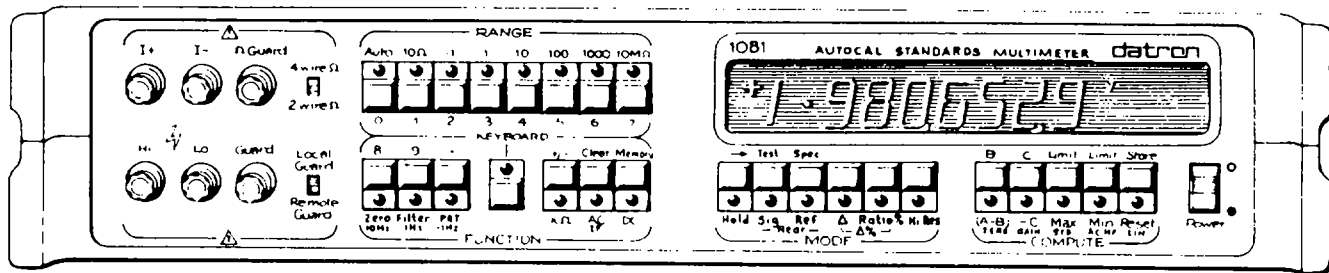


SECTION 1 THE 1081 AUTOCAL STANDARDS MULTIMETER



The Datron 1081 6½/7½ digit AUTOCAL STANDARDS microprocessor-controlled digital Multimeter (DMM) is a high precision measuring instrument. It features exceptionally high stability and systems capability. The instrument provides full measurement capability, computation facilities, self check routines and calibration memory.

Standard and optional measurement facilities

The instrument is offered in two versions, either complete with all options or as a basic DC voltage instrument to which individual options can be added to provide further measurements:

- Resistance (including temperature)
- True RMS AC voltage
- DC coupled true RMS AC voltage
- Ratio %, Δ, Δ%

The full range of options is as follows:

- Option 10: True RMS AC Converter
- Option 20: 4-Wire Resistance Converter
- Option 40: Selectable Rear/Reference Input
- Option 50: IEEE 488-1978 Standard Digital Interface
- Option 52: Remote Trigger
- Option 70: Analog Output
- Option 80: 115V 60Hz Line Operation
- Option 81: 115V 50Hz Line Operation
- Option 82: 115V 400Hz Line Operation
- Option 90: Rack Mounting Kit

Calibration

The AUTOCAL instruments have been designed to make the removal of the covers for calibration unnecessary, as full calibration of all ranges and functions can be carried out from the front panel.

The procedure for calibrating the instrument is contained in the Calibration and Servicing Handbook.

Accidental or unauthorised use of the calibration routine is prevented by a key operated switch on the instrument rear panel.

Message read-out

The measurement display doubles as a message display, providing a clear read-out of 14 different messages. Full details of the meanings of these displays can be found in sections 2 and 3.

Self test

Pressing the '→' then 'Test' key starts a self test procedure, during which a sequential routine:

- checks, in turn, all the display segments, characters and legends
- verifies the correct functioning of individual measuring circuits
- checks the non-volatile calibration memory

On completion of the test, the instrument returns to the last selected function and range to provide rapid return to measurement. In the event of the self test failing, an error message is displayed.

Computing

The range and function selection keys double as a keyboard for the input of data so that measurements can be compared with previously recorded data or manually input data for display of:

- measurement offset
- percentage deviation
- maximum and minimum value storage
- the exceeding of limits (upper and lower)

Full details of these facilities are given in section 3.

Systems use

The AUTOCAL 1081 instrument can form part of a system by means of the IEEE 488 standard digital interface option. The details for the connections of the instrument to the system and programming details for the controlling machine can be found in section 4.

Accessories

The instrument is supplied with the following accessories:

Description	Part Number
Power cable	920012
Hexagon key 2mm A/F	630101
Hexagon key 2.5mm A/F	630109
Set of calibration keys	700068
User's Handbook	850042
Calibration and Servicing Handbook	850048
Power fuse (230V)	920024
or Power fuse (115V)	920084

In addition, the following accessories are available for use with the 1081 instrument:

Description	Part Number
HVP high voltage probe	400335
RMK rack mounting kit (option 90)	440063
1501 de luxe lead kit	440070
PRT 100: Platinum resistance thermometer probe (100Ω)	630161

Additional documentation

The Calibration and Servicing Handbook contains information required to adjust and service the DMM. It contains detailed description of the circuits, trouble shooting diagrams, calibration procedures, parts lists and circuit diagrams.

SECTION 6 SPECIFICATIONS

General

POWER SUPPLY

Voltage	: 105-127 or 205-255 Volts
Line Frequency	: 50Hz $\pm$ 2%, 60Hz $\pm$ 2%, or 400Hz $\pm$ 2%
Consumption	: Approximately 20 Watts
Fuses	: 160mA or 500mA anti-surge (depends on voltage)

CLIMATIC CONDITIONS

Operating Temperature	: 0°C to + 50°C (except where specified)
Storage Temperature ^[1]	: 40°C to + 70°C
Maximum Relative Humidity	: 75% @ 40°C
Warm-up Time	: Two hours to meet all specifications

MECHANICAL

Dimensions	: Height = 89mm (3.5ins) Width = 455mm (17.9ins) Depth = 420mm (16.5ins)
Weight	: 10 kg (22lbs)

OPERATING INDICATIONS

Scale length	: 7 1/2 digits maximum, i.e. 19,999,999
Overload indication	: Error 0L displayed : Symbols lit on display and illuminated keys

AUTORANGE

Range Up	: 200% of nominal range
Range Down	: 18.8% of nominal range

DIGITAL ERROR

Computation	: +1 digit (assumes no error in stored value)
Spec read out	: < 1% of displayed SPEC

SAFETY

The 1081 has been designed to meet BSI 4743, IEC 348, and UL 1244 specifications.

Read rate	: with full scale input 2 second
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MAXIMUM INPUTS

See Tables 2.1 and 2.2 on page 2.1

ANALOG OUTPUT (0 to +2 Volts)

1 Volt output for full range signal input	
Accuracy	: $\pm$ 1% of Reading +2mV
Output Resistance	: Approximately 200 Ω

[1] Excessive temperature stress may affect calibration stability.

DC Voltage

Stability and Accuracy

RANGES	STABILITY 2 ± (ppm Reading + ppm FS) 4		ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (ppm Reading + ppm FS) 4 : 8 23°C ± 1°C			ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (ppm Reading + ppm FS) 4 : 8 23°C ± 5°C		
	1 Minute	24 Hours	24 Hours	90 Days	1 Year	24 Hours	90 Days	1 Year
100.0000(0)mV	0.25 + 0.25µV	2.0 + 1.50	3 + 2.0	8 + 2.0	11 + 2.0	8 + 2.0	11 + 2.0	14 + 2.5
1.000000(0)V	0.25 + 0.5µV	1.5 + 0.25	2 + 1.0	5 + 1.5	8 + 1.5	5 + 1.5	8 + 1.5	11 + 1.5
10.00000(0)V	0.25 + 2.5µV	1.5 + 0.25	2 + 0.5	5 + 1.0	8 + 1.0	5 + 1.0	8 + 1.0	11 + 1.5
100.0000(0)V	0.25 + 50µV	2.0 + 0.25	3 + 1.0	8 + 1.5	11 + 1.5	8 + 1.5	11 + 1.5	14 + 1.5
1000.000(0)V	0.25 + 250µV	2.0 + 0.25	3 + 1.0	8 + 1.5	11 + 1.5	8 + 1.5	11 + 1.5	14 + 1.5

NOTES:

() – Hi Res selected gives 7 ½ digits on DCV and Resistance; 6 ½ digits on ACV.

[1] – signals < 2 × 10⁷ Volt-Hertz > 1% FS; DC coupled below 100Hz.

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

[3] – Datron Instruments traceability to National Standards.

[4] – FS = 2 × Full Range.

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

[6] – Add 0.01% per 100V above 500V.

[7] – At full range ± 2%.

[8] – Figures assume prior Input Zero.

CALIBRATION UNCERTAINTY $\pm$ ppm [3]	TEMPERATURE COEFFICIENT $\pm$ ppm Reading per $^{\circ}\text{C}$ 13 $^{\circ}\text{C}$ – 18 $^{\circ}\text{C}$ 28 $^{\circ}\text{C}$ – 33 $^{\circ}\text{C}$	NOISE Filter (Hi-Res) selected and after 'Zero' Peak over 1 min. $\pm$ ppm Reading	INPUT IMPEDANCE
5	1.5	0.15 + 0.2 μV	1 to 10V ranges, ($< 20\text{V}$): > 10,000M Ω
3	1.0	0.15 + 0.3 μV	
3	1.0	0.15 + 2.0 μV	
5	1.5	0.15 + 30 μV	100 Ω to 1000V ranges: 10M $\Omega \pm 0.1\%$
5	1.5	0.15 + 200 μV	

Other Specifications

Type:	Multi-slope A-D Converter.
Read Rate:	2 Readings per second.
Full Scale Count:	1,999,999(9) on all ranges except 1000V.
Normal Mode Rejection Ratio	
Filter Out:	66dB at 50/60Hz $\pm 0.15\%$.
Filter In:	120dB at 50Hz increasing at 18dB per octave.
Common Mode Rejection Ratio (1k Ω Source Unbalance)	
DC:	> 140dB.
1Hz – 60Hz:	80dB plus Normal Mode Rejection.
Settling Time: (to within 10ppm of step size)	
Filter Out:	< 50ms.
Filter In:	< 1s (< 3s in LOCAL operation).
Input Current:	< 50pA drifting at < 1pA per $^{\circ}\text{C}$.
Input Protection:	Withstands 1000V RMS on any range.
Zero Temperature Coefficient:	1/10 of 'FS' part of 90-day specification, per $^{\circ}\text{C}$.
Zero Stability:	(± 0.2 digits $\pm 0.1\mu\text{V}$) per month).
Ratio Accuracy [5]:	$\pm$ net signal accuracy $\pm$ net reference accuracy.

AC Voltage

True RMS 1

Stability and Accuracy

RANGE			STABILITY 2 ± (ppm Reading + ppm FS) 4		ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (% Reading + % FS) 4 23°C ± 1°C		
Resolution	Frequencies	Ranges	1 Minute	24 Hours	24 Hours	90 Days	1 Year
100.000(0)mV	10Hz-2kHz	100mV	10 + 5.0	40 + 15	0.02 + 0.007	0.025 + 0.007	0.03 + 0.007
1.00000(0)V		1V-100V	10 + 2.5	30 + 8	0.01 + 0.005	0.015 + 0.005	0.02 + 0.005
10.0000(0)V		1kV	20 + 2.5	50 + 8	0.02 + 0.007	0.025 + 0.007	0.03 + 0.007
100.000(0)V	2kHz-20kHz	100mV	10 + 5.0	60 + 20	0.04 + 0.012	0.060 + 0.012	0.08 + 0.012
1000.00(0)V		1V-100V	10 + 2.5	50 + 12	0.02 + 0.010	0.030 + 0.010	0.04 + 0.010
		1kV 6	20 + 2.5	70 + 12	0.04 + 0.012	0.060 + 0.012	0.08 + 0.012
	20kHz-100kHz	100mV	10 + 5.0	70 + 30	0.08 + 0.022	0.120 + 0.022	0.16 + 0.022
		1V-100V	10 + 2.5	60 + 25	0.04 + 0.020	0.070 + 0.020	0.10 + 0.020
		1kV 6	20 + 2.5	80 + 25	0.08 + 0.022	0.120 + 0.022	0.16 + 0.022

AC Voltage Transfer

(6 1/2 digits)		TRANSFER STABILITY (± % Reading) 2, 7			ACV/DCV TRANSFER ACCURACY (± % add to Transfer Stability)
Frequencies	Ranges	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	0.005	0.010	0.004	0.02
	1V-100V	0.003	0.005	0.003	0.01
	1kV	0.005	0.010	0.005	0.02
2kHz-20kHz	100mV	0.010	0.040	0.006	0.06
	1V-100V	0.005	0.015	0.005	0.03
	1kV 6	0.010	0.040	0.007	0.06 6

NOTES:

- () - Hi Res selected gives 7 1/2 digits on DCV and Resistance; 6 1/2 digits on ACV.
- 1 - Signals < 2 × 10⁷ Volt Hertz > 1% FS; DC coupled below 100Hz.
- 2 - For same conditions with Hi Res selected between 18°C and 28°C.
- 3 - Datron Instruments traceability to National Standards.
- 4 - FS = 2 × Full Range.
- 5 - At same amplitude, frequency etc., errors tend to zero.
- 6 - Add 0.01% per 100V above 500V.
- 7 - At Full Range ± 2%.

ACCURACY RELATIVE TO CALIBRATION STANDARDS $\pm (\% \text{ Reading} + \% \text{ FS})$ 4! 23°C $\pm$ 5°C			CALIBRATION UNCERTAINTY $\pm$ ppm [3]	TEMPERATURE COEFFICIENT $\pm$ ppm Reading per °C 13°C-18°C 28°C-33°C	NOISE 1Hz LF filter and Hi Res selected. Peak over 1 Min. $\pm$ % Reading	INPUT IMPEDANCE
24 Hours	90 Days	1 Year				
0.025 + 0.007	0.030 + 0.007	0.040 + 0.007	100	15	0.001 $\pm$ 10 digits	1M Ω shunted by 150pF
0.015 + 0.005	0.020 + 0.005	0.025 + 0.005	50	15	0.001 $\pm$ 5 digits	
0.025 + 0.007	0.030 + 0.007	0.040 + 0.007	100	15	0.002 $\pm$ 5 digits	
0.060 + 0.012	0.090 + 0.012	0.110 + 0.012	100	25	0.001 $\pm$ 5 digits	
0.030 + 0.010	0.045 + 0.010	0.055 + 0.010	50	25	0.001 $\pm$ 5 digits	
0.060 + 0.012	0.090 + 0.012	0.110 + 0.012	100	25	0.002 $\pm$ 5 digits	
0.120 + 0.022	0.180 + 0.022	0.230 + 0.022	200	100	0.001 $\pm$ 5 digits	
0.080 + 0.020	0.090 + 0.020	0.140 + 0.020	100	100	0.001 $\pm$ 5 digits	
0.120 + 0.022	0.180 + 0.022	0.230 + 0.022	200	100	0.002 $\pm$ 5 digits	

Other Specifications

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 measured, i.e. $\sqrt{AC^2 + DC^2}$.

Read Rate: 2 Readings per second.

Full Scale Count: 199,999(9) on all ranges except 1000V.

Crest Factor: 5:1 at Full Range.

Common Mode Rejection Ratio: (1k Ω source unbalance)

DC-60Hz: >90dB.

Settling Time in Local Operation (to within 0.1% of step size)

100Hz: <500ms.

10Hz: <2.5s.

1Hz: <15s.

0.1Hz: <150s.

Input Protection: Withstands 1000V RMS on any range.

Ratio Accuracy .5 : $\pm$ net signal accuracy $\pm$ net reference accuracy.

Add to the main Accuracy Specifications for.

DC signals: 0.01% Reading $\pm$ 0.0015% FS $\pm$ 10 μ V.

LF 0.1Hz: As DC signals $\pm$ 0.05% FS.

LF 1Hz: As DC signals $\pm$ 0.01% FS.

LF 10Hz: As main Accuracy specification.

HF 100kHz-1MHz: 2% Reading $\pm$ 1% FS (1V and 10V ranges).

Resistance

Stability and Accuracy

RANGES	STABILITY [2] ± (ppm Reading + ppm FS) [4]		ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (ppm Reading + ppm FS) [4] 23°C ± 1°C			ACCURACY RELATIVE TO CALIBRATION STANDARDS ± (ppm Reading + ppm FS) [4] 23°C ± 5°C		
	1 Minute	24 Hours	24 Hours	90 Days	1 Year	24 Hours	90 Days	1 Year
10.00000(0)Ω	0.5 + 50μΩ	2.5 + 2.5	4 + 3	7 + 3.0	12 + 3.0	10 + 3.0	15 + 3.5	20 + 4
100.0000(0)Ω	0.5 + 60μΩ	2.0 + 0.5	3 + 1	5 + 1.5	10 + 1.5	7 + 1.5	10 + 1.5	15 + 2
1.000000(0)kΩ	0.5 + 600μΩ	2.0 + 0.5	3 + 1	5 + 1.5	10 + 1.5	7 + 1.5	10 + 1.5	15 + 2
10.00000(0)kΩ	0.5 + 6mΩ	2.0 + 0.5	3 + 1	5 + 1.5	10 + 1.5	7 + 1.5	10 + 1.5	15 + 2
100.0000(0)Ω	0.5 + 60mΩ	2.5 + 0.5	4 + 1	6 + 1.5	11 + 1.5	8 + 1.5	10 + 1.5	15 + 2
1000.000(0)kΩ	1.0 + 500mΩ	4.0 + 0.5	7 + 1	15 + 1.5	25 + 1.5	15 + 1.5	25 + 1.5	35 + 2
10.00000(0)MΩ	5.0 + 5Ω	6.0 + 0.5	10 + 1	30 + 1.5	50 + 1.5	20 + 1.5	40 + 1.5	60 + 2

NOTES:

[1] – Hi Res selected gives 7 ½ digits on DCV and Resistance; 6 ½ digits on ACV.

[1] – Signals $< 2 \times 10^7$ Volt-Hertz $> 1\%$ FS: DC coupled below 100Hz.

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

[3] – Datron Instruments traceability to National Standards.

[4] – FS = 2 × Full Range.

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

[6] – Add 0.01% per 100V above 500V.

[7] – At Full Range ± 2%.

CALIBRATION UNCERTAINTY $\pm$ ppm 3	TEMPERATURE COEFFICIENT $\pm$ ppm Reading per °C 13°C-18°C 28°C-33°C	NOISE Filter (Hi-Res) selected, and after 'Zero' Peak over 1 min. $\pm$ ppm Reading	MEASUREMENT CONSTANT- CURRENT VALUE (I + to I -)
5	1.5	0.25 + 30 $\mu\Omega$	10mA
5	1.0	0.25 + 50 $\mu\Omega$	10mA (1mA-PRT)
5	1.0	0.25 + 500 $\mu\Omega$	1mA
5	1.0	0.25 + 5m Ω	100 μ A
10	1.0	0.25 + 50m Ω	10 μ A
15	2.0	0.50 + 500m Ω	5 μ A
20	2.5	0.50 + 5 Ω	500nA

Other Specifications

Type:	True 4-wire can be switched to 2-wire from Front Panel.
	Active Guard allows in-circuit measurements (Refer to pages 2-7).
Read Rate:	2 Readings per second.
Full Scale Count:	1,999,999(9) on all ranges.
Settling Time:	Up to 10k Ω range; generally the same as DCV but depends on external capacitances and guarding/shielding techniques employed.
Open-circuit Voltage:	< 20V all ranges.
Lead Resistance:	Up to 100 Ω .
Input Protection:	Withstands 250V RMS on any range.
Ratio Accuracy 5 :	$\pm$ net signal accuracy $\pm$ net reference accuracy.

Temperature

Probe immersion using PRT 100 accessory 100mm

RANGE	ABSOLUTE ACCURACY ($\pm$ °C)			CALIBRATION UNCERTAINTY Included in 90 day and 1 year accuracy specifications ($\pm$ °C)
	23°C $\pm$ 1°C 24 Hours	23°C $\pm$ °C 90 Days	23°C $\pm$ 5°C 1 Year	
°C display (5 1/2 digits)				
100 to -55	0.20	0.25	0.30	
-55 to 0	0.04	0.10	0.15	0.002 at 0°C
0 to +100	0.02	0.06	0.10	0.01 at 100°C
+100 to +200	0.04	0.10	0.15	
At 0°C & +100°C	0.01	0.05	0.08	

Ω display (6 1/2 - 7 1/2 digits)	ACCURACY RELATIVE TO CALIBRATION STANDARDS $\pm$ (ppm reading + ppm FS)		
	3 + 3	10 + 3.5	15 + 4
100 Ω (1mA)			

Ratio

Normal Ratio Input Conditions: any input on any range

Accuracy:

$$\pm E_R \pm E_S \pm X \cdot \left(\left| \frac{\text{Ref. range}}{\text{Ref. reading}} \right| + \left| \frac{\text{Sig range}}{\text{Sig reading}} \right| \right)$$

Where E_R = Net error of reference
 E_S = Net error of signal
 settling factor X = 0.000 002 (DCV, k Ω)
 = 0.000 02 (ACV)

Time per reading (Full Scale input, Hi Res deselected):

FUNCTION	FILTER out	FILTER in
DCV: 100mV	5.6 s	47.5 s
1V-1kV	3.4 s	47.5 s
ACV	4.6 s	12 s (10Hz), 58 s (1Hz), 600 s (0.1Hz)
k Ω : 10 Ω	5.6 s	47.5 s
100 Ω -100k Ω	3.4 s	47.5 s
1M Ω	3.4 s	48 s
10M Ω	3.9 s	50 s

Transfer

Transfer Input Conditions:

same Function, Range & Polarity,
 Signal and Reference input amplitude both within $\pm 2\%$ of Full Range,
 'Hi Res' selected and after 'Zero' on both inputs,
 same Signal & Reference frequency on ACV (except ACV/DCV)

Accuracy:

DCV/DCV: as DC Voltage, Stability, 24 hr specification
 ACV/ACV: as AC Voltage, Transfer Stability, 24 hr specification
 ACV/DCV: shown on AC Voltage, Transfer Accuracy table
 k Ω /k Ω : as Resistance, Stability, 24 hr specification

Time per reading (Full Scale input, Hi Res selected):

as Ratio specification

Standard internal delays

Between the receipt of any trigger pulse and the commencement of a measurement cycle, an internal time delay is introduced.

This permits the application of the signal to the input terminals to be coincident with the trigger and ensures that the input circuitry has settled before the commencement of the reading cycle.

The standard internal delays differ for each range and function in order to ensure maximum read-rate and adequate settling. The delays are shown in the following table:

Function	Range	FILTER (ms)			
		OUT 100Hz	10Hz	IN 1Hz	0.1Hz
DCV	all	50	4s	1000	200s
ACV DC + ACV	all	1s		20s	
k Ω	10 Ω - 100k Ω	50	2500	1000	2500
	1M Ω	50		1200	
	10M Ω	310		2500	

Additional to all the delays shown above is 25ms when changing range between the 10V and 100V ranges and 100ms before the first reading following a function change.

'Spec' Readout Validity

DC Voltage & Resistance -- valid for all ranges

AC Voltage -- valid for all inputs except: - DC coupled signals <10Hz
- HF signals >100kHz

Temperature -- no readout for °C display
valid for Ω display

Ratio -- for normal Ratio, readout is $\pm E_R \pm E_S$
for Transfer, readout $\pm E_R$ for 24 hr accuracy
where E_R = Net error of reference
 E_S = Net error of signal