Datron—Innovation for Systems and Calibration

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The Datron Range and Autocal

The choice of Datron precision DMMs and Calibrators is extensive, with instruments to suit a broad range of different applications—from bench and system use in a production environment to the exacting measurements performed in Standards and Calibration Laboratories. Each instrument offered by Datron provides not only the excellent performance associated with a technological leader, but also the high quality of a well established international supplier.

One of the strongest themes which links all of the instruments is that of automated calibration, where innovation in its application can lead to both improved accuracies and ease of support. Techniques of automated calibration can be applied to instrumentation at different levels, but they all have the common objectives of reducing calibration downtime, and improving the reliability, repeatability, and accuracy of the process. In addition, because calibration may be carried out with the instrument in-situ—even in its A.T.E. rack if necessary—some of these benefits extend to the systems in which such instruments are used. These include reduced system downtime, lower spares and logistics costs, higher accuracy and increased confidence in the overall system measurement.

Datron is a pioneer in the field of automated calibration, and leads the market in three different but related areas: AUTOCAL, SELFCAL and PORTOCAL.

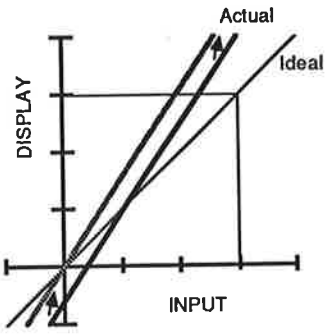
Autocal

Before the development of Autocal, calibration of precision DMMs was undoubtedly one of the biggest headaches for the user. Calibration involved the removal of the DMM's covers, which in itself upset the thermal balance within the instrument, and then manually adjusting up to 30 or 40 trimmers—each one tending to interact with the others. This meant that the whole calibration procedure was a long and complex process, requiring experienced and skilled personnel.

Taking advantage of a microprocessor's ability to make calculations and control analog circuitry, Datron was the first DMM manufacturer to develop complete, electronic covers-on calibration, Autocal. This technique has proved to be so successful that variations are employed by the vast majority of precision and systems DMMs available today.

Calculated Corrections. There are many techniques which can be used for Autocal, but the simplest form is achieved through the calculation capability of the microprocessor.

Consider an uncalibrated DMM, suffering from both zero and gain errors on a particular range. These would normally have been adjusted manually in older designs of instruments. However, providing the magnitude of these errors can be measured by the DMM, the microprocessor is capable of compensating for them mathematically.

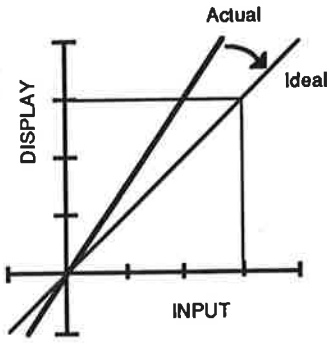


Digital Zero Correction—removes zero errors without mechanical adjustment.

For example, if zero input is applied to the DMM (e.g. a short circuit is connected across the terminals) and yet the DMM display shows an offset error, the press of a key or the sending of an IEEE-488 command is all that is needed to tell the microprocessor to take a measurement of the offset error, store its value in memory, and subtract it from all subsequent readings.

Similarly, if a known nominal full range signal is applied to the DMM's terminals and the DMM's display indicates an incorrect value (due to gain error), another key press or bus command means the microprocessor can compute the size of the gain error (providing it has been told the value of the external source through a keyboard or the bus) and use it to compensate for all readings in the future.

In this way, the zero and gain errors for each range of each function can be stored in non-volatile memory and automatically recalled to correct all readings.



Digital Gain Correction—removes gain errors without mechanical adjustment.

Although first implemented on DMMs, the technique has also been successfully applied to sources such as calibrators. Measured errors are again used to determine correction factors, but in this case the factors are used by the microprocessor to modify the digitally programmed divider settings which control the calibrator's output.

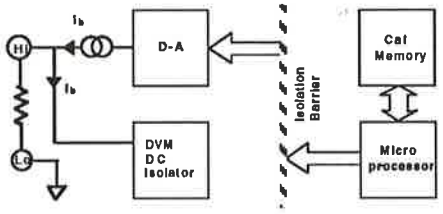
Standardize. This is another form of a simple correction which relies on the fact that zener reference drift on a DMM or calibrator appears as a gain error on all ranges of all functions. Therefore by calibrating a single range against a known external standard and then applying the same gain correction factor to all ranges, the zener drift gain error on all ranges will be removed (assuming that it was the dominant contributor to error on the single range that was calibrated).

This facility has several applications but the most obvious is well illustrated by considering the situation where the value of the volt for a Standards Laboratory may have changed for some reason. Recently calibrated instruments can be realigned to the new value of the Laboratory volt with a single key stroke, rather than having to recalibrate every single range. Therefore, when the anticipated change in the National Standards maintained volt due to international agreement on the determination of the value of 2e/h occurs, re-calibration of Datron DMMs and calibrators will be a comparatively simple task.

Source Dependent Errors. The numeric approach to correcting analog errors cannot cope with source dependent errors such as input bias current in DMMs or frequency response in both measurement and sourcing instruments. Datron's DMMs correct for such errors

by using a digital to analog converter to provide a method of converting digitally stored values to analog corrections.

Input Bias Current Corrections. With many designs of DMMs, a small input bias current flows from the input terminals of the DMM through whatever source impedance is connected. Although very small (typically 50pA), the input bias current can create an error voltage which is seen by the DMM. Obviously the size of the error depends on the source impedance.



Any errors caused by the DC Isolator's Input Bias Current can be removed through microprocessor control of an internal current source via a Digital to Analog converter.

To eliminate this effect, a high resistance is placed across the DMM terminals at calibration and the DMM measures the voltage drop caused by the bias current. The microprocessor then uses a digital to analog converter (D-A) to control a current source to provide an equal and opposite current to the bias current, so nulling its effect. The correction value stored in the calibration memory is that setting of the D-A which causes just enough compensation current to flow in order to remove the effects of the bias current.

In a similar way, other forms of source dependent errors such as those due to AC frequency response, can also be compensated for.

AC Frequency Response. The AC high frequency response of a DMM is normally set by adjusting the values of capacitors which form part of the gain-defining R-C attenuator networks of the input amplifier. To mimic this adjustment digitally would require a large number of point calibrations at numerous frequencies of each range. Instead, the instrument's microprocessor notes any high frequency errors at a single high frequency point on each range and supplies a calculated correction factor to the D-A converter which converts it to a suitable varicap drive voltage. The varicap is therefore adjusted to compensate the attenuator and give a significantly flatter frequency response. Although the calibration is carried out at one high frequency, it effectively flattens the AC attenuator response, and the correction is applied for all specified frequencies.

Calibrator AC Frequency Response. AC frequency response can also be improved using Autocal techniques in precision voltage sources such as ACV calibrators.

One of the key components that affects the performance of an AC Calibrator is the sense amplifier. Its function is to detect the output voltage via the sense terminals (or internal local sense connection) and therefore it performs the prime measurement for the calibrator RMS output control loop.

The input impedance of the sense amplifier is kept high so that errors due to lead resistance are virtually negligible. However, the main difficulty in the design is keeping the frequency response flat to within a few ppm. Careful guarding techniques around the input chains and very smooth open-loop phase response in the amplifier are used to keep all response poles and zeros well above 1 MHz. Nevertheless, the performance above 100kHz tends to fall off quite sharply.

The microprocessor can make great improvements to this situation because the error well below the poles is predictable and approximates to a square law. This means that a single pole software correction, derived from a single high frequency calibration point, can be used to give excellent compensation for what is really a multiple pole characteristic.

Spot Frequency Calibration. Over and above the normal zero, Lf gain, and Hf compensation corrections already described, microprocessor techniques can be used to enhance instrument accuracies still further. For example, ranges on instruments can be spot calibrated at specific frequencies, which removes the frequency flatness uncertainty at or around that particular frequency. This technique can be applied to both calibrators and DMMs, though the DMM also needs to be able to detect the frequency of the signal it is measuring so that it knows when it is valid to apply the spot frequency corrections.

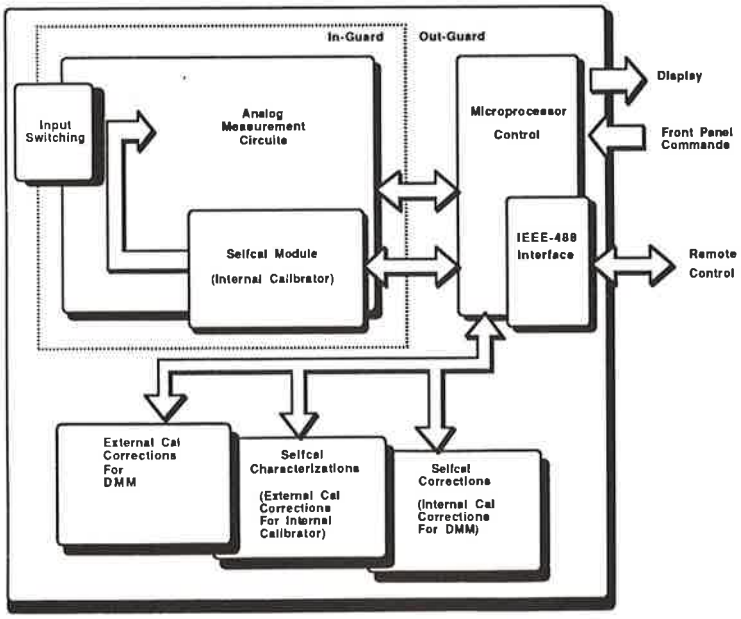
Autocal Benefits. It can be seen, therefore, that many different approaches can be used to give the microprocessor control over the calibration of an instrument. This simplifies the calibration process, saving time and avoiding human errors. At the same time, the ability to leave the instrument's covers on during calibration provides higher accuracies (because thermal balances and capacitance effects remain unchanged), and makes it possible to calibrate an instrument in its A.T.E. rack. This kind of in-situ calibration can lead to further benefits in terms of reducing system downtime and support costs.

Selfcal

As the pioneer of Autocal, Datron has taken advantage of its technological leadership in this area and has taken the concept one stage further—with Selfcal.

Whereas Autocal is an electronic technique for calibrating equipment against *external* calibration standards, Selfcal—as embodied in Datron's model 1281 DMM—is a technique for calibration against traceable *internal* standards. Selfcal has all the benefits of Autocal plus one additional factor: the calibrator is actually inside the instrument—so you do not need an external source.

Embedded within the 1281's normal measurement circuits is an accurate internal calibrator composed of highly stable zener diodes, reference resistors, and a precision transformer



The Model 1281 contains separate calibration memories for the DMM and its internal calibrator. When the DMM calibrates itself against the internal calibrator, another set of calibration corrections are derived and stored.

multiplier. During a Selfcal, the inherently stable turns ratio of the transformer multiplier is used to derive different levels of very high accuracy calibration signals from the 1281's zener references, which are then routed via an internal signal bus to all of the instrument's various functions. Over 150 different calibration measurements are used by the microprocessor to compute and store corrections for the effects of time and temperature drift in the 1281's circuits, significantly enhancing its long term performance and temperature coefficient specifications.

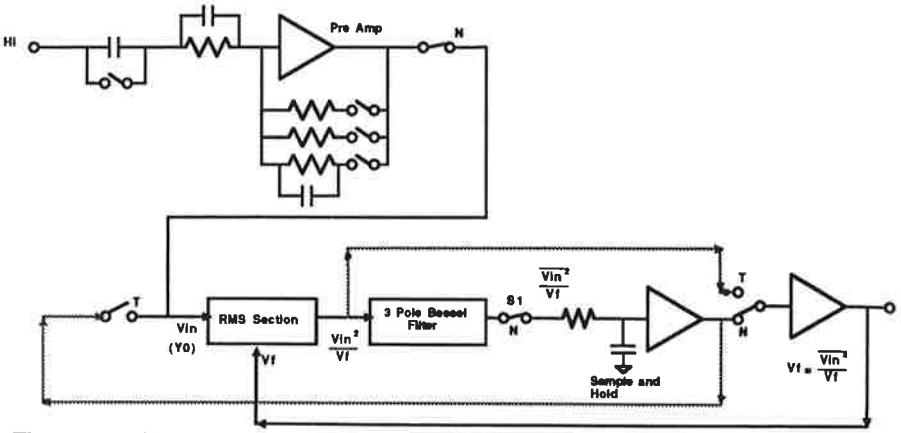
The result is a 2:1 improvement in temperature coefficient and a 35% improvement in performance over the identical instrument when used without Selfcal. This means the instrument is capable of maintaining its standards lab performance over longer periods of time before returning to the Calibration Laboratory. In addition, the ability to calibrate itself, in-situ in an A.T.E. rack, gives the 1281 the ability to perform very well in relatively hostile production environments.

Traceability. Apart from having a compact internal calibrator which is highly stable, a Selfcal instrument must provide a means to ensure that its internal calibrator can be calibrated traceably, so that all subsequent internal calibrations are also traceable.

Taking a DMM as an example, periodically it will be electronically calibrated against traceable external standards, when any differences in the DMM's readings compared to the value of the external calibration sources can be used to derive calibration constants which are stored by the instrument in non-volatile memory.

At the same time as the DMM is being externally calibrated, the internal calibrator can also be traceably calibrated by comparing the readings taken by the DMM on any particular range against external standards with those made using its internal Selfcal sources. In effect the DMM is used as a transfer device to calibrate the internal calibrator against the external standards, with the characterization factors being stored in the DMM's non-volatile memory alongside the instrument's normal external calibration corrections. (This is a form of Autocal for the internal calibrator.)

At a later date, when the DMM's user decides to Selfcal the instrument, a single key press will cause another set of internal measurements to be made but using only the internal calibrator to calibrate the DMM's circuits. The new set of readings are compared against the corresponding characterized values, and any differences between the two are recognized as errors which can be compensated for by the microprocessor in all subsequent measurements. A third set of calibration constants—



The gain of the RMS section can be calibrated at the time the DMM is actually making its measurements using an internal AC-DC transfer technique.

the Selfcal corrections—are stored alongside the original external calibration constants and the internal calibrator characterization factors. (In other words, Selfcal is an internal form of Autocal.)

Two factors ensure that the process of internal calibration is totally traceable to National Standards and also highly repeatable; firstly, the internal calibrator is itself traceably calibrated against external standards, and secondly, the internal calibration process uses the identical circuit configurations, switching paths and signal timings that were originally used to derive the internal calibrator's characterizations. This avoids the introduction of errors due to settling, frequency, and thermal effects.

Real Time Selfcal. Some techniques for Selfcal can be run in real time, while the instrument is actually making measurements. For example, the Model 1281 DMM uses an internal technique to remove gain errors in its electronic RMS section at the time of taking a reading.

Consider the circuit with all switches set to "normal" mode (N). When an AC signal (Y0) is passed through the RMS converter, a DC equivalent value (Y1) is produced. For an ideal RMS converter Y0=Y1, but assuming the RMS converter has a gain other than unity, then GY0=Y1, where G is the true gain of the converter. This gain factor G may drift with time and temperature, and the purpose of the AC-DC transfer technique is to remove these effects. This is achieved by setting all switches to "transfer" mode (T) and opening switch S1. The DC signal Y1 is sampled and held, and then fed back through the RMS converter to obtain another value, Y2. In this case, GY1=Y2 and as Y1 and Y2 may be measured to high accuracy, an accurate value for G can be determined. This can then be used to give a value for Y0, corrected for the RMS converter gain.

Portocal

This is the name given to Datron's series of automated DMM calibration systems. The word is short for "Portable Calibration," and is appropriate because these systems are compact and rugged enough to be wheeled around a factory installation to calibrate equipment in-situ (e.g. an Autocal DMM located in an A.T.E. rack).

All of Datron's Autocal and Selfcal instruments can be remotely controlled and calibrated via the IEEE-488 interface, which means that apart from being ideal for general systems applications, these instruments can also either form part of a computer controlled calibration system, or indeed be totally automatically calibrated by such a system.

Closed Loop Calibration. A typical DMM calibration system would comprise a multifunction calibrator (such as the Datron Model 4707), an instrument controller and a printer. Under software control, the calibrator generates traceable sources which are applied to a DMM under test. Readings can be taken from the DMM, and, if the DMM also has an Autocal facility, then the system controller can even command it to electronically adjust itself against the calibrator.

Such systems are quite capable of fully calibrating (i.e. adjusting) a multifunction precision DMM in under twenty minutes. At the same time, the results can be compared against pre-defined limits and displayed on a monitor, stored to disk, or printed out in the form of a calibration certificate. Automation is not only applicable to DMMs that are controlled and calibrated via the IEEE-488 interface. For instruments that require any form of manual intervention, the computer prompts the operator whenever intervention is required.

Datron provides comprehensive menu driven software to help users to develop automated calibration procedures for all kinds of DMMs. In addition, the system controller also manages the calibration data that is generated from using the system. This means that past results and comments can be retrieved very quickly, and presented in a high quality format—important facilities for the management of any calibration laboratory. Such systems, based on one of the 4700 series of calibrators, can provide a very compact, accurate and yet cost-

effective integrated solution for DMM calibration and data management.

The sequence of events during a typical calibration give an example of the facilities available: The DMM to be calibrated is brought to the system and a bar code reader is wiped across the DMM's bar code label. The system controller reads the label and recognizes it as an instrument that is known to the system. The instrument files are accessed to recall all of the data relevant to that DMM such as location, user, and asset number, along with the recommended cal procedure and certificate printout formats. A quick glance at the screen to confirm that the data is correct and then the user can connect the DMM up to the controller's IEEE-488 interface and to the calibrator's analog lead set. At the press of a key, the controller will automatically search and find the DMM on the bus (the calibrator is on a separate bus to avoid address conflicts with the DMM under test, and also to aid diagnostics in case of bus problems). The computer then self-checks the calibrator and ensures it is still within its valid calibration period before carrying out the pre-defined calibration sequence, storing results in a results library and displaying the readings as they are taken, alongside pre-defined high and low limits and pass/fail indication.

At the end of the run, the results can be reviewed on the screen and printed out in the format of a user defined calibration certificate. Afterwards, the instrument inventory can be interrogated for information such as which other DMMs are due for calibration that day. Alternatively, the results library may contain previous results for the instrument which may be recalled and examined so as to determine how results vary from period to period.

As can be seen, Portocal is a higher level extension of the Autocal concept. It provides all the benefits of speed, accuracy, and repeatability associated with Autocal but in addition offers even more as it is a fully integrated calibration control and data management system.

Innovation

Being innovative with automated calibration techniques has allowed Datron to provide all kinds of measurement and support advantages for users of their instruments. Furthermore, these benefits are not just confined to the calibration laboratory, finding very real use in systems and other factory applications.

PRECISION DIGITAL MULTIMETERS

Model	Ranges	Resolution (Digits)	Accuracy (1 Year, 23°±5°C ±(ppmR+ppm FS))	Digital Interface	Other Features
1281	DCV: 100 mV to 1kV ACV: 100 mV to 1kV Ω: 10Ω to 1GΩ DCI: 100μA to 1A ACI: 100μA to 1A	DCV: 10 nV, 8½ ACV: 10 nV, 6½ Ω: 1μΩ, 8½ DCI: 100pA, 6½ ACI: 1 nA, 5½	DCV: 3 + 0.1 ACV: 60 + 5 Ω: 6 + 0.3 DCI: 25 + 2 ACI: 200 + 100	IEEE-488.2	Ratio/Rear Input Spot Frequency ACV Low Current Ohms Frequency SELFCAL/AUTOCAL Math/Limits/Max-Min/Spec Readout
1081	DCV: 100 mV to 1kV ACV: 100 mV to 1kV Ω: 10Ω to 10MΩ °C: −100 to +200	DCV: 10 nV, 7½ ACV: 100 nV, 6½ Ω: 1μΩ, 7½ °C: 1m°C, 5½	DCV: 14 + 1.5 ACV: 300 + 50 Ω: 20 + 2 °C: ±0.1°C	IEEE-488	Ratio/Rear Input AUTOCAL Math/Limits/Max-Min/Spec Readout Temperature
1071	DCV: 100 mV to 1kV ACV: 100 mV to 1kV Ω: 10Ω to 10MΩ DCI: 100μA to 1A ACI: 100μA to 1A	DCV: 10 nV, 7½ ACV: 1μV, 5½ Ω: 1μΩ, 7½ DCI: 1 nA, 5½ ACI: 1 nA, 5½	DCV: 20 + 2 ACV: 600 + 100 Ω: 30 + 3 DCI: 150 + 20 ACI: 0.3% + 0.05%	IEEE-488	Ratio/Rear Input AUTOCAL Math/Limits/Max-Min/Spec Readout
1061A	DCV: 100 mV to 1kV ACV: 100 mV to 1kV Ω: 10Ω to 10MΩ DCI: 100μA to 1A ACI: 100μA to 1A	DCV: 100 nV, 6½ ACV: 100 nV, 6½ Ω: 10μΩ, 6½ DCI: 1 nA, 5½ ACI: 1 nA, 5½	DCV: 30 + 4 ACV: 300 + 50 Ω: 45 + 4 DCI: 150 + 20 ACI: 0.3% + 0.05%	IEEE-488	Ratio/Rear Input AUTOCAL Math/Limits/Max-Min/dB/Spec Readout
1062MT	DCV: 100 mV to 1kV ACV: 100 mV to 1kV Ω: 10Ω to 10MΩ DCI: 100μA to 1A ACI: 100μA to 1A	DCV: 10 nV, 6½ ACV: 1μV, 5½ Ω: 10μΩ, 6½ DCI: 1 nA, 5½ ACI: 1 nA, 5½	DCV: 30 + 4 ACV: 600 + 100 Ω: 45 + 4 DCI: 150 + 20 ACI: 0.3% + 0.05%	MATE IEEE-488	Rear Input AUTOCAL Math/Limits/Max-Min/Spec Readout
1062MT-5	DCV: 100 mV to 1kV ACV: 100 mV to 1kV Ω: 10Ω to 10MΩ	DCV: 100 nV, 6½ ACV: 1μV, 5½ Ω: 10μΩ, 6½	DCV: 60 + 4 ACV: 1000 + 250 Ω: 60 + 4	MATE IEEE-488	Rear Input AUTOCAL Math/Limits/Max-Min/Spec Readout
1065A	DCV: 100 mV to 1kV ACV: 1V to 1kV Ω: 100Ω to 10MΩ	DCV: 100 nV, 6½ ACV: 10μV, 5½ Ω: 100μΩ, 6½	DCV: 60 + 4 ACV: 1000 + 250 Ω: 60 + 4	IEEE-488	Rear Input AUTOCAL Math/Limits/Max-Min/Spec Readout
1065	DCV: 100 mV to 1kV ACV: 1V to 1kV Ω: 100Ω to 10MΩ	DCV: 1μV, 5½ ACV: 10μV, 5½ Ω: 1mΩ, 5½	DCV: 60 + 5 ACV: 1000 + 250 Ω: 60 + 5	IEEE-488	Rear Input AUTOCAL Math/Limits/Max-Min/Spec Readout

PRECISION DIGITAL MULTIMETERS

MODEL 1281

Selfcal Digital Multimeter

- **The World's Finest 8½ Digit DMM**
- **1 Year DCV Specifications to ±3.1 ppm**
- **1 Year ACV Specifications to ±65 ppm**
- **Selfcal Internal Calibration**
- **Simultaneous Display of Frequency and RMS ACV**

State of the Art Accuracy

A glance at the specifications opposite will confirm that the 8½ digit 1281 Selfcal Digital Multimeter is, without exception, the best DMM in the world. Designed with Standards and Calibration laboratories in mind, the 1281 provides the ultimate in electrical measurement, outperforming all rivals in accuracy, functional capability, and ease of use.

Selfcal

The impressive specifications of the 1281, achieved through a blend of innovation, experience and new component technology, are further enhanced by "Selfcal"—Datron's unique method of accurate internal calibration.

Embedded within the 1281's normal measurement circuits is a compact and accurate internal calibrator based on an inherently stable precision transformer multiplier. This is used to derive different levels of very high accuracy calibration signals from the 1281's zener references, which are then routed to the various measurement circuits in order to calibrate them. Over 150 calibration measurements are used by the microprocessor to compute and store corrections for the effects of time and temperature drift in the 1281's circuits, significantly enhancing its long term performance and temperature coefficient specifications.

Applications

Long term accuracy and wide functional capability make the 1281 an obvious choice as a lab standard for the smaller calibration facility, while its short term stability and ease of calibration without removal of covers also makes it ideal for the short term transfer work appropriate to a Standards environment. In addition to its stability, the 1281's rugged construction and extensive selftesting capability (which can be carried out to very high precision due to the 1281's internal calibrator) are characteristics that lend it to audit applications, where laboratories can compare measurements knowing that the transfer instrument can check itself to a high degree of accuracy after transportation, and is highly stable over the period the measurements are taken.

Calibration Systems

Apart from enhancing accuracies, the 1281's ability to internally calibrate itself gives it a low effective temperature coefficient, which when combined with comprehensive control over the IEEE-488 interface makes the instrument an ideal component either for a mobile calibration system, or for integration in a high accuracy A.T.E. The low temperature coefficient means that the 1281 can deliver highly accurate measurements outside of a controlled calibration environment.

Versatile

In addition to its basic measurement capability, the 1281 incorporates many features to enhance the usefulness of its fundamental performance. These include frequency measurements which can be displayed simultaneously with the signal's True RMS value, low-current

resistance modes which are of particular interest to users of resistance thermometers, comprehensive autoranging ratio (including difference and deviation measurements), rolling and block averaging, linear math computations, dB's and automatic readout of the uncertainty of measurements.

SPECIFICATIONS

DC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 10 nV, 8½ digits.
Total Uncertainty: (1 Year, 23° ±5°C, ±(ppmR+ppmFS)).

100mV Range:	6 + 0.5
1V Range:	3 + 0.2
10V Range:	3 + 0.1
100V Range:	6 + 0.2
1000V Range:	6 + 0.2

CMRR: (1kΩ unbalance) >140dB at DC, >(80dB+NMRR) at 1Hz-60Hz.
NMRR: 60 dB at 50/60 Hz ±0.09% (Filter out), 110 dB at 50/60 Hz (Filter in).
Input Impedance: >10,000MΩ from 100 mV to 10V ranges, 10MΩ ±0.1% on 100V and 1000V ranges.
Input Protection: Withstands 1kV RMS on any range.
Input Current: <50pA.
Settling Time: (To 10ppm step size) <50 ms (Filter out), <1s (Filter in).
Read Rate: 1/6s at 8½ digits, 150/s at 4½ digits.

True RMS AC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 100 nV, 6½ digits.
Total Uncertainty: (1 Year, 23° ±5°C, Signal >1%FS, ±(ppmR+ppmFS)).

100 mV Range:

40 Hz-10 kHz	100+20
10-30 kHz	300+40
30-100 kHz	700+100

1V to 100V Ranges:

40-100 Hz	80+10
100 Hz-2 kHz	60+10
2-10 kHz	80+10
10-30 kHz	200+20
30-100 kHz	500+100
100-300 kHz	0.3%+0.1%
300 kHz-1 MHz	1%+1%

1000V Range:

40 Hz-10 kHz	80+10
10-30 kHz	200+20
30-100 kHz	500+100

Lf Accuracy: (DC coupled. Add to main accuracy specs).

DC	±(50ppmR+20ppmFS+20μV)
1Hz-10Hz	±(20ppmR+50ppmFS)
10-40 Hz	±(20ppmR)

CMRR: (1kΩ unbalance) >90 dB at DC-60 Hz.
Input Impedance: >1MΩ shunted by 150pF.
Input Protection: Withstands 1kV RMS on any range.
Crest factor: 5:1 at Full Range.
Max Volt-Hertz: 3 x 10^7.
Settling Time: (To 100 ppm step size) <500 ms (100Hz), <1.25s (40 Hz), <5s (10 Hz), <50s (1 Hz).
Read Rate: 1/s at 6½ digits.

Spot Frequency AC Voltage:

Total Uncertainty: (1 Year, 23° ±5°C, Signal >1%FS, ±(ppmR+ppmFS), Valid within ±10% of calibrated RMS value and Spot Frequency).

100 mV Range:

40 Hz-10 kHz	100+10
10-30 kHz	150+25
30-100 kHz	500+100

1V to 100V Ranges:

40 Hz-10 kHz	60+5
10-30 kHz	150+15
30-100 kHz	400+50
100-300 kHz	0.2%+0.05%
300 kHz-1 MHz	0.5%+0.3%

1000V Range:

40 Hz-10 kHz	60+5
10-30 kHz	150+15
30-100 kHz	400+50

Resistance

Ranges: 10Ω to 1GΩ in decades.
FS: 2 x Full Range, 100% Overrange.
Resolution: 1μΩ, 8½ digits (Except 100MΩ and 1GΩ ranges).
Total Uncertainty: (1 Year, 23° ±5°C, ±(ppmR+ppmFS)).

10Ω Range:	12+1
100Ω to 10kΩ Range:	8+0.3
100kΩ Range:	6+0.2
1MΩ Range:	10+0.7
10MΩ Range:	20+4
100MΩ Range:	200+45
1GΩ Range:	0.2%+450

Open Circuit Voltage: <20V.
Lead Resistance: Up to 100Ω.
Current Through Unknown:

10Ω and 100Ω	10 mA
1kΩ	1 mA
10kΩ and 100kΩ	100μA
1MΩ	10μA
10MΩ	1μA
100MΩ	100nA
1GΩ	10nA

Input Protection: Withstands 250V RMS on any range.
Settling Time: Up to 100kΩ generally the same as DCV.
Read Rate: 1/6s at 8½ digits, 150/s at 4½ digits

Low Current Resistance

Total Uncertainty: (1 Year, 23° ±5°C, ±(ppmR+ppmFS)).

10Ω to 1kΩ Ranges:	12+1
10kΩ Range:	15+1
100kΩ Range:	70+3
1MΩ Range:	400+10

Open Circuit Voltage: <0.2V.
Current Through Unknown:

10Ω	10 mA
100Ω	1 mA
1kΩ	100μA
10kΩ	10μA
100kΩ	1μΩ
1MΩ	100 nA

DC Current

Ranges: 100μA to 1A in decades.
FS: 2 x Full Range. 100% Overrange.
Resolution: 100pA, 6½ digits.
Total Uncertainty: (1 Year, 23° ±5°C, ±(ppmR+ppmFS)).

100μA to 10mA Ranges:	25+2
100 mA Range:	50+5
1A Range:	150+10

AC Current

Ranges: 100μA to 1A in decades.
FS: 2 x Full Range. 100% Overrange.
Resolution: 1 nA, 5½ digits.
Total Uncertainty: (1 Year, 23° ±5°C, ±(%R+%FS)).

100μA to 100mA Range:

40 Hz-5 kHz	200+100

1A Range:

10 Hz-1 kHz	500+200
1-5 kHz	0.15%+0.04%

Frequency

Resolution: 4½ or 6½ digits.
Total Uncertainty: (1 Year, 13°-33°C).
±10ppmR+2 digits (6½ digits, 10 Hz-1 MHz).
±2 digits (4½ digits, 200 Hz-1 MHz).
Sample Interval:

Fast Gate	50 ms (4½ digits).
Normal Gate	1s (6½ digits)

Ratio Accuracy

±(net signal accuracy+net reference accuracy).

GENERAL

Calibration: Selfcal internal calibration. Autocal external cal from front panel or via IEEE-488 interface
Remote Programming: IEEE-488.
Environmental:
Operating temp: 0° to +50°C.
Storage temp: −40° to +70°C.
Dimensions: 88 mm (3.5 in.) high, 427 mm (16.8 in.) wide, 487 mm (19.2 in.) deep.
Weight: 13.5 kg (30 lb).
Power: 100-130V or 200-260V, 47Hz-63Hz, 37VA.

OPTIONS

10: True RMS AC Converter
20: 2-Wire and 4-Wire Resistance Converter
30: Current Converter. (Only available with Option 20)
70: Isolated Analog Output
80: 115V 60Hz Line Operation
81: 115V 50Hz Line Operation
90: Rack Mounting Kit

ACCESSORIES

1501: DMM Lead Kit

FACTORY/FOB

Indianapolis, IN
Norwich, England

Autocal Digital Multimeter

- **7½ Digit Resolution**
- **90 Day DCV Specifications to ±9ppm**
- **Comprehensive Ratio**
- **Autocal and Temperature Measurement**
- **IEEE-488 Programmable**

Designed for Standards Laboratories and specialist applications, the 7½ digit 1081 offers the most comprehensive measurement capability of the entire AUTOCAL range of DMMs.

High Performance

The 1081's key features are high precision, stability and low noise performance. Its wide functional capability includes 90 day DCV from 10 nV to 1000V with total uncertainty specifications to ±9ppm, True RMS ACV from 100 nV to 1000V over frequencies ranging from 0.1 Hz to 1 MHz to ±250ppm, and Resistance from 1μΩ to 20MΩ to ±11ppm.

Ratio

Ratio measurement is a particularly versatile and powerful feature of the 1081. Inputs of up to 350 volts peak are accepted via two isolated and floating channels to provide readings of ratio, difference, and percentage deviation. Coupled with autoranging, highly accurate ratio measurements of widely differing inputs can be made automatically. Apart from DC/DC, AC/AC and Ω/Ω comparisons, ratio can be used very effectively to compare AC sources to known DC values—a rapid technique for AC-DC transfer.

Temperature

Using a Datron supplied Platinum Resistance Thermometer, the 1081 can also make temperature measurements from −100°C to +200°C to 90 day accuracies of ±0.06°C. A special 100Ω range with 1mA energization current is used to keep thermometer self-heating effects to a minimum and to provide a measurement displayed in °C.

Autocal

As with all Datron DMMs, the 1081 incorporates AUTOCAL—a rapid covers-on calibration technique activated either from the front panel or via the IEEE-488 interface.

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.

In the 1081, AUTOCAL has been extended to include a standardize operation. This 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.

Calibration Systems

In addition to its impressive measurement features, the 1081 has a comprehensive IEEE-488 interface capability and excellent series mode and common mode rejection, making the instrument ideal for calibration systems or precision A.T.E. applications.

Computation

The 1081 is supplied with math functions which include offset and scaling for simple linear calculations, Max, Min, and Max-Min stores for capturing the largest excursions of a signal over a period of time, and Hi and Lo limits for checking signals against predetermined tolerances.

In addition, the 1081 has Datron's patented spec readout capability, where the entire accuracy specifications are stored in the instrument's memory. This permits the worst case uncertainty for any particular measurement to be recalled at the press of a key.

SPECIFICATIONS

DC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 10 nV, 7½ digits.
Total Uncertainty: (90 Day, 23° ±1°C, ±(ppmR+ppmFS)).
100 mV Range: 13+2.
1V Range: 8+1.5.
10V Range: 8+1.
100V Range: 13+1.5.
1000V Range: 13+1.5.
Temperature Coefficient: (13° 18°C and 28° 33°C, ±ppmR/°C).
100 mV Range: 1.5.
1V and 10V Ranges: 1.0.
100V and 1000V Ranges: 1.5.
CMRR: (1kΩ unbalance) >140 dB at DC, >(80 dB+NMRR) at 1 Hz-60 Hz.
NMRR: 66 dB at 50/60 Hz ±0.15% (Filter out), 120 dB at 50/60 Hz (Filter in).
Input Impedance: >10,000MΩ from 100 mV to 10V ranges, 10MΩ ±0.1% on 100V and 1000V ranges.
Input Protection: Withstands 1kV RMS on any range.
Input Current: <50pA.
Settling Time: (To 10ppm step size) <50 ms (Filter out), <1 s (Filter in).
Read Rate: 2 s.

True RMS AC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 100 nV, 6½ digits.
Total Uncertainty: (90 Day, 23° ±1°C, Signal >1%FS, DC coupled below 100 Hz, ±(%R+%FS)).
100mV and 1000V Ranges:
10 Hz to 2 kHz: 0.035+0.007.
2 kHz to 20 kHz: 0.07+0.012.
20 kHz to 100 kHz: 0.14+0.022.
Add 0.01% per 100V above 500V.
1V to 100V Ranges:
10 Hz to 2 kHz: 0.02+0.005.
2 kHz to 20 kHz: 0.035+0.01.
20 kHz to 100 kHz: 0.08+0.02.
Lf Accuracy: (Add to main accuracy specifications)
DC: ±(0.01%R+0.0015%FS+10μV).
0.1 Hz: As DC coupled ±0.05%FS.
1 Hz: As DC coupled ±0.01%FS.
Hf Accuracy: (1V and 10V ranges)
100 kHz to 1 MHz: ±(2%R+1%FS).
Temperature Coefficient: (13° 18°C and 28° 33°C, ±ppmR/°C).
10 Hz to 2 kHz: 15.
2 kHz to 20 kHz: 25.
20 kHz to 100 kHz: 100.
CMRR: (1kΩ unbalance) >90 dB at DC −60 Hz.
Input Impedance: >1MΩ shunted by 150 pF.
Input Protection: Withstand 1kV RMS on any range.
Crest factor: 5:1 at full range.
Max Volt-Hertz: 2 x 10^7
Settling Time: (To 0.1% step size) <500 ms (100 Hz), <2.5s (10 Hz), <15s (1 Hz), <150s (0.1 Hz).
Read Rate: 2s.

Resistance

Ranges: 10Ω to 10MΩ in decades.
FS: 2 x Full Range, 100% Overrange.
Resolution: 1μΩ, 7½ digits.
Total Uncertainty: (90 Day, 23° ±1°C, ±(ppmR+ppmFS)).
10Ω Range: 12+3.
100Ω Range: 10+1.5.
1kΩ Range: 10+1.5.
10kΩ Range: 10+1.5.
100kΩ Range: 16+1.5.
1MΩ Range: 30+1.5.
10MΩ Range: 50+1.5.
Temperature Coefficient: (13° to 18°C and 28° to 33°C, ±ppmR/°C).
10Ω: 1.5.
100Ω: 1.0.
1kΩ: 1.0.
10kΩ: 1.0.
100kΩ: 1.0.
1MΩ: 2.0.
10MΩ: 2.5.
Open Circuit Voltage: <20V.
Lead Resistance: Up to 100Ω.
Current Through Unknown
10Ω: 10mA.
100Ω: 10 mA (1 mA-PRT).
1kΩ: 1 mA.
10kΩ: 100μA.
100kΩ: 10μA.
1MΩ: 5μA.
10MΩ: 500 nA.
Input Protection: Withstands 250V RMS on any range.
Settling Time: Up to 10kΩ generally the same as DCV.
Read Rate: 2s.

Temperature Accuracy

Total Uncertainty: (90 Day, 23° ±5°C, ±°C).
−100° to −55°C: 0.25.
−55° to 0°C: 0.1.
0° to +100°C: 0.06.
+100° to +200°C: 0.1.

Ratio Accuracy

±(net signal accuracy+net reference accuracy).

GENERAL

Calibration: Autocal from front panel or via IEEE interface.
Remote Programming: IEEE-488.
Environmental:
Operating Temp: 0° to +50°C.
Storage Temp: −40° to +70°C.
Dimensions: 88 mm (3.5 in.) high, 455 mm (17.9 in.) wide, 420 mm (16.5 in.) deep.
Weight: 10 kg (22 lb) net.
Power: 105-127V or 205-255V, 50 Hz, 60 Hz, or 400 Hz. 20 Watts approx.

CONFIGURATIONS

Model 1081: 7½ Digit AUTOCAL Standards Digital Multimeter (includes DCV, 5 Year Warranty).

OPTIONS

10: True RMS AC Converter.
20: 2-wire and 4-wire Resistance Converter.
40: Comprehensive Ratio and Rear Input.
50: IEEE-488 (1978) Standard Digital Interface.
52: Remote Trigger. (Included in Option 50.)
70: Analog Output.
80: 115V 60 Hz Line Operation.
81: 115V 50 Hz Line Operation.
82: 115V 400 Hz Line Operation.
90: Rack Mounting Kit.

ACCESSORIES

PRT 100: Platinum Resistance Thermometer Probe (100Ω). (Needs Option 40.)
1501: DMM Lead Kit.

FACTORY/FOB

Indianapolis, IN
Norwich, England

Autocal Digital Multimeter

- **7½ Digit Resolution**
- **90 Day DCV Specifications to ±18ppm**
- **ACV, Ω, DCI, ACI Options**
- **Autocal**
- **Comprehensive Ratio**

The well established 1071 has been designed to be at the upper end of the AUTOCAL range of digital multimeters. With its key features of high accuracy and resolution, the 7½ digit 1071 is intended principally for calibration laboratory and precision system applications.

Versatile

The basic DCV instrument, with 90 day specifications to ±18ppm, can be expanded to include a large number of measurement options. These include ACV, Resistance, and both DC and AC Current. In addition, a particularly useful Ratio option can be installed which permits highly accurate automatic ratio measurements of widely differing inputs.

Programmable

With the addition of the IEEE-488 interface, the 1071 becomes a powerful systems instrument. Ideally suited for calibration systems, it is also a cost effective solution in precision ATE and data logging systems.

Self Test

Support of the 1071 is made easy through the use of AUTOCAL covers-on calibration and extensive diagnostic self test routines. Calibration is rapid and may be controlled either from the front panel keys or via the IEEE-488 interface. In addition, the self test checks all the display segments sequentially, along with the individual measurement circuits and the non-volatile calibration memory. At any stage of a self test, an error code indicates a failure to individual module level.

Averaging

The averaging facility provided as standard on the 1071 can be used to extend the performance on all measurement functions. On DCV and Resistance, for example, the selection of "Av" extends the scale length to 7½ digits on all ranges to produce a 0.05ppm FS resolution. Additionally, "Av" can smooth a noisy input signal characteristic to produce a stable reading, which is particularly useful when using LF ACV or ACI.

Two modes of "Av" are selectable: firstly, "continuous," where all subsequent readings are taken into account, and secondly, "block," where the user can select any number of readings up to 19,999 to be averaged.

Spec Readout

The complete accuracy specifications for the 1071 have been pre-programmed into its memory, so that selection of the "Spec" key will compute and display the precise limits of uncertainty for a measured value, saving both time and effort.

Computation

Compute facilities are installed as standard, including a numerical keyboard and memories which can be manipulated in a variety of ways to enhance the measurement performance of the 1071. Two of the memories are used to continuously monitor maximum and minimum readings while others can store readings, keyboard values or alarm limits, which can be applied to measured data before display.

PRECISION DIGITAL MULTIMETERS

MODEL 1071

VOLTAGE

DC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 10nV, 7½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR +ppmFS)).
100 mV Range: 20+2.5.
1V Range: 15+1.5.
10V Range: 15+1.5.
100V Range: 20+1.5.
1000V Range: 20+1.5.
Temperature Coefficient: (13° to 18°C and 28° to 33°C). 1/10th 90 Day Accuracy/°C ±0.3μV/°C.
CMRR: (1kΩ unbalance) >140dB at DC, >(80 dB+NMRR) at 1 Hz-60 Hz.
NMRR: 66 dB at 50/60 Hz ±0.15% (Filter out), 120dB at 50/60 Hz (Filter in).
Input Impedance: >10,000MΩ from 100 mV to 10V ranges, 10MΩ ±0.1% on 100V and 1000V ranges.
Input Protection: Withstands 1kV RMS on any range.
Input Current: <50pA.
Settling Time: (To 10ppm step size) <50 ms (Filter out), <1s (Filter in).
Read Rate: 2/s.

True RMS AC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 1μV, 5½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, Signal >0.25%FS, ±(%R+%FS)).
100mV & 1000V Ranges
DC+45 Hz-5 kHz: 0.08+0.02.
DC+5 kHz-100 kHz: 0.2+0.05.
1V to 100V Ranges
DC+45 Hz-5 kHz: 0.04+0.01.
DC+5 kHz-100 kHz: 0.1+0.025.
Hf Accuracy: (1V and 10V ranges, typical).
DC+100 kHz-1 MHz: ±(2%R+1%FS).
Temperature Coefficient: (13° to 18°C and 28° to 33°C). 1/10th 90 Day Accuracy/°C.
CMRR: (1kΩ unbalance) >90 dB at DC-60 Hz.
Input Impedance: >1MΩ shunted by 150pF.
Input Protection: Withstands 1kV RMS on any range.
Crest factor: 7:1 at Full Range.
Max Volt-Hertz: 2 x 10^7.
Settling Time: (To 0.1%ppm step size) <500 ms (Filter in), <150 ms (Filter out).
Read Rate: 2/s.

RESISTANCE & CURRENT

Resistance

Ranges: 10Ω to 10MΩ in decades.
FS: 2 x Full Range, 100% Overrange.
Resolution: 1μΩ, 7½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR+ppmFS)).
10Ω Range: 30+4.
100Ω Range: 20+2.
1kΩ Range: 20+2.
10kΩ Range: 20+2.
100kΩ Range: 30+2.
1MΩ Range: 80+2.
10MΩ Range: 240+2.
Temperature Coefficient: (13° to 18°C and 28° to 33°C). 1/10th 90 Day Accuracy/°C ±100μΩ/°C.
Open Circuit Voltage: <10V.
Lead Resistance: Up to 100Ω.
Current Through Unknown
10Ω: 10 mA.
100Ω: 10 mA.
1kΩ: 1 mA.
10kΩ: 100μA.
100kΩ: 10μA.
1MΩ: 1μA.
10MΩ: 100 nA.
Input Protection: Withstands 250V RMS on any range.
Settling Time: Up to 10kΩ generally the same as DCV.
Read Rate: 2/s.

DC Current

Ranges: 100μA to 1A in decades.
FS: 2 x Full Range. 100% Overrange.
Resolution: 1 nA, 5½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR+ppmFS)).
100μA to 100mA Ranges: 100+20.
1A Range: 200+20.
Temperature Coefficient: (13° to 18°C and 28° to 33°C). 1/10th 90 Day Accuracy/°C.
Shunt Resistance
100μA: 1kΩ.
1 mA: 100Ω.
10 mA: 10Ω.
100 mA: 1Ω.
1A: 100mΩ.
Settling Time: (To 10ppm of step size) <50 ms (Filter out), <1s (Filter in).
Read Rate: 2/s.

AC Current

Ranges: 100μA to 1A in decades.
FS: 2 x Full Range. 100% Overrange.
Resolution: 1 nA, 5½ digits.
Total Uncertainty: (90 Day, 23° to ±5°C, ±(%R+%FS)).
100μA to 1A Ranges:
DC+45 Hz-5 kHz: 0.2+0.05.
Temperature Coefficient: (13° to 18°C and 28° to 33°C). 1/10th 90 Day Accuracy/°C.
Shunt Resistance
100μA: 1kΩ.
1 mA: 100Ω.
10 mA: 10Ω.
100 mA: 1Ω.
1A: 100mΩ.
Settling Time: (To 0.1% of step size) <150 ms (Filter out), <500 ms (Filter in).
Read Rate: 2/s.

Ratio Accuracy: ±(net signal accuracy+net reference accuracy).

GENERAL

Calibration: Autocal from front panel or via IEEE-488 interface.
Remote Programming: IEEE-488.
Environmental
Operating Temp: 0° to +50°C.
Storage Temp: −40° to +70°C.
Dimensions: 88 mm (3.5 in.) high, 455 mm (17.9 in.) wide, 420 mm (16.5 in.) deep.
Weight: 10 kg (22 lb).
Power: 105-127V or 205-255V, 50 Hz, 60 Hz, or 400 Hz. 20 Watts approx.

CONFIGURATIONS

Model 1071: 7½ Digit AUTOCAL Digital Multimeter (includes DCV, 5 Year Warranty).

OPTIONS

10: True RMS AC Converter
20: 2-wire and 4-wire Resistance Converter
30: Current Converter
40: Comprehensive Ratio and Rear Input
41: Selectable Rear Input (Included in Option 40)
50: IEEE-488 (1978) Standard Digital Interface
52: Remote Trigger (Included in Option 50)
70: Analog Output
80: 115V 60 Hz Line Operation
81: 115V 50 Hz Line Operation
82: 115V 400 Hz Line Operation
90: Rack Mounting Kit

ACCESSORIES

1501: DMM Lead Kit

FACTORY/FOB

Indianapolis, IN
Norwich, England

PRECISION DIGITAL MULTIMETERS

MODEL 1061A

Autocal Digital Multimeter

- **6½ Digit Resolution**
- **90 Day DCV Specifications to ±28ppm**
- **High Accuracy ACV Option**
- **IEEE-488 Programmable**
- **200 Readings/sec**

The 1061A is an accurate 6½ digit DMM which is optimized for systems applications, and also satisfies a wide range of bench and professional requirements.

Optional Configuration

Maximum flexibility is assured by offering the 1061A as a DC voltmeter to which options may be added, giving it multifunctional capability specific to the user's requirements. Optional measurement functions include True RMS ACV, High accuracy True RMS ACV, Resistance, DC and True RMS AC Current, and Ratio.

In the ratio mode the DMM takes sequential readings of each channel before displaying the ratio in percent. Each channel can handle 4-wire inputs on resistance and up to 350 Volts peak on voltage measurements. Used with Auto ranging, ratios of any function can be read automatically using the highest to lowest range on either channel. This facility is particularly useful for measurements such as circuit gain, and the 1061A's math capability means that the result can also be displayed directly in dB's.

Systems Capability

The 1061A can be configured with an IEEE-488 interface, turning it into a DMM capable of meeting the most demanding systems applications. With complete control from the bus, and a wide selection of SRQ and trigger modes, the 1061A can readily adapt to a wide variety of systems configurations. For more exacting ATE applications, the 1061A provides an impressive selection of specialist features including Ohms Guard for in-circuit resistance measurements, and excellent common mode and series mode rejection. These ensure that the 1061A maintains a high degree of measurement integrity under the most adverse conditions.

For users wishing to interface the 1061A into parallel BCD systems, a BCD Digital Interface can be fitted to a 5½ digit version of the instrument known as the 1061. Full range and function programming is provided together with control of the DMM's triggering, while readings are output as BCD data together with full instrument status. With this interface fitted, the 1061 can achieve 30 readings per second with 5½ digits resolution or up to 100 readings per second in 4½ digit Superfast mode. In applications requiring more than one instrument on a common data bus, the BCD interface can be tri-stated to disconnect it from the system.

High Reliability

In systems use the 1061A's high reliability and fast AUTOCAL features eliminate expensive downtime for repair and recalibration. In addition, an extensive diagnostic self-check routine can be run on command to sequentially test all displays, measurement circuits, and the non-volatile calibration memory.

Computation

The 1061A is supplied with math functions which include offset and scaling for simple linear calculations, Max, Min, and Max-Min stores for capturing the largest excursions of a signal over a period of time, and Hi and Lo limits for checking signals against pre-determined tolerances. A dB feature is also provided covering a dynamic range of ±200 dB to a resolution of 0.0001 dB.

DC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1 kV range).
Resolution: 100 nV, 6½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR+ppmFS)).
100 mV Range: 30+8.
1V & 10V Ranges: 20+4.
100V Range: 30+4.
1000V Range: 30+4.
CMRR: (1kΩ unbalance) >140 dB at DC, >(80 dB+NMRR) at 1 Hz–60 Hz.
NMRR: 66 dB at 50/60 Hz (Filter out), 100 dB at 50/60 Hz (Filter in).
Input Impedance: >10,000MΩ from 100 mV to 10V ranges, 10MΩ ±0.1% on 100V and 1000V ranges.
Input Protection: Withstands 1kV RMS on any range.
Input Current: <50pA.
Settling Time: (To 10ppm step size) <5 ms (Filter out), <350 ms (Filter in).
Read Rate: 1.5/s at 6½ digits, 200/s in Superfast mode, 4 digits.

True RMS AC Voltage.

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 1μV, 5½ digits.
Total Uncertainty: (90 Day, 23° ±5° C, Signal >0.25%FS, ±(%R+%FS)).

100 mV and 1000V Ranges

DC+45 Hz-5 kHz: 0.08+0.02.
DC+5 kHz-100 kHz: 0.2+0.05.

1V to 100V Ranges

DC+45 Hz-5 kHz: 0.04+0.01.
DC+5 kHz-100 kHz: 0.1+0.025.
Hf Accuracy: (1V and 10V ranges, typical). DC+100 kHz-1 MHz: ±(2%R+1%FS).
CMRR: (1kΩ unbalance) >90 dB at DC –60 Hz.
Input Impedance: >1MΩ shunted by 150pF.
Input Protection: Withstands 1kV RMS on any range.
Crest factor: 7:1 at Full Range.
Max Volt-Hertz: 2 x 10^7.
Settling Time: (To 0.1% step size) <500 ms (Filter in), <150 ms (Filter out).
Read Rate: 3/s.

High Performance True RMS ACV

Resolution: 100 nV, 6½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, Signal >1%FS, ±(%R+%FS).

100 mV and 1000V Ranges

45 Hz-2 kHz: 0.04+0.007.
2 kHz-30 kHz: 0.08+0.015.
30 kHz-100 kHz: 0.2+0.022.
Add 0.01% per 100V above 500V.

1V to 100V Ranges

45 Hz-2 kHz: 0.025+0.005.
2 kHz-30 kHz: 0.05+0.01.
30 kHz-100 kHz: 0.1+0.02.
DC Coupled: For DC add ±(0.1%R+15ppm FS +10μV) to main specs.
Hf Accuracy: (1V and 10V ranges) 100 kHz-1 MHz ±(2%R+1%FS).
Ranges, FS, CMRR, Input Impedance, Input Protection, Max Volt-Hertz: All as Option 10.
Crest Factor: 5:1 at Full Range.
Settling Time: (To 0.1% step size) <200 ms (Filter out), <1.25 ms (Filter in).

Resistance

Ranges: 10Ω to 10MΩ in decades.
FS: 2 x Full Range, 100% Overrange.
Resolution: 10μΩ, 6½ digits.
Total Uncertainty: (90 Day, 23° ±5° C, ±(ppmR+ppmFS)).
10Ω Range: 40+8.
100Ω to 10kΩ Range: 30+4.
100kΩ Range: 40+4.
1MΩ Range: 100+4.
10MΩ Range: 300+4.
Open Circuit Voltage: <10V.
Lead Resistance: Up to 100Ω.
Current Through Unknown:

10Ω	10mA
100Ω	10mA
1kΩ	1mA
10kΩ	100μA
100kΩ	10μA
1MΩ	1μA
10MΩ	100nA

Input Protection: Withstands 250V RMS on any range.
Settling Time: Up to 10kΩ generally the same as DCV.
Read Rate: 1.5/s at 6½ digits, 200/s in Superfast mode, 4 digits.

DC Current

Ranges: 100μA to 1A in decades.
FS: 2 x Full Range. 100% Overrange.
Resolution: 1nA, 5½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR+ppmFS)).
100μA to 100mA Ranges: 100+20.
1A Range: 200+20.
Shunt Resistance:

100μA	1kΩ
1 mA	100Ω
10 mA	10Ω
100 mA	1Ω
1A	100mΩ

Settling Time: (To 10ppm of step size) <5 ms (Filter out), <350 ms (Filter in).
Read Rate: 35/s.

AC Current

Ranges: 100μA to 1A in decades.
FS: 2 x Full Range. 100% Overrange.
Resolution: 1nA, 5½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(%R+%FS)).
100μA to 1A Ranges:
DC+45 Hz-5 kHz 0.2+0.05
Shunt Resistance:

100μA	1kΩ
1 mA	100Ω
10 mA	10Ω
100 mA	1Ω
1A	100mΩ

Settling Time: (To 0.1% of step size) <150 ms (Filter out), <500 ms (Filter in).
Read Rate: 3/s.

Ratio Accuracy

±(net signal accuracy+net reference accuracy).

GENERAL

Calibration: Autocal from front panel or via the IEEE-488 interface.
Remote Programming:
IEEE-488
BCD (1061 Only)
Environmental:
Operating Temp: 0° to +50°C.
Storage Temp: –40° to +70°C.
Dimensions: 88 mm (3.5 in.) high, 455 mm (17.9 in.) wide, 420 mm (16.5 in.) deep.
Weight: 10 kg (22 lb.).
Power: 105-127V or 205-255V, 50 Hz, 60 Hz, or 400 Hz. 20 Watts approx.

CONFIGURATIONS

Model 1061A: 6½ Digit AUTOCAL Digital Multimeter (includes DCV, 5 Year Warranty).
Model 1061: 5½ Digit AUTOCAL Digital Multimeter (includes DCV, 5 Year Warranty).

OPTIONS

10: True RMS AC Converter
12: High Performance True RMS AC Converter
20: 2-wire and 4-wire Resistance Converter
30: Current Converter (Not available with Option 12)
40: Comprehensive Ratio and Rear Input
41: Selectable Rear Input (Included with Option 40)
50: IEEE-488 (1978) Standard Digital Interface
51: BCD Digital Interface (1061 only. Not available with Option 50)
52: Remote Trigger (Included in Option 50)
70: Analog Output
80: 115V 60 Hz Line Operation
81: 115V 50 Hz Line Operation
82: 115V 400 Hz Line Operation
90: Rack Mounting Kit

ACCESSORIES

1501: DMM Lead Kit

FACTORY/FOB

Indianapolis, IN
Norwich, England

PRECISION DIGITAL MULTIMETERS

MODEL 1062MT

MATE Digital Multimeters

- **6½ Digit Resolution**
- **IEEE-488 and MATE Compatible**
- **DCV, ACV, and Resistance Functions**
- **DCI and ACI Option**
- **Autocal**

The AUTOCAL 1062MT and 1062MT-5 are accurate 5½/6½ digit DMMs, specifically designed for MATE (Modular Automated Test Equipment) systems applications. Under the United States Air Force MATE System Control Interface Standard, these DMMs are each classified as Sensor Modules, type DMM, with single measurement channels. CIIL (Control Interface Intermediate Language) is used as the normal programming language, although native IEEE-488 commands may be used when required.

Multifunction Capability

Both instruments provide high accuracy measurement functions of DCV, ACV and Resistance, and are virtually identical in operation and appearance. The 1062MT, however, is more accurate than the 1062MT-5, and has the optional facility to measure current.

System Measurement Integrity

The performance of the 1062MT and the 1062MT-5 has been optimized to meet the most demanding systems applications, using both the IEEE-488 and the MATE interfaces. For example, specialist features such as Ohms Guard can be used to overcome the effects of systems lead capacitance to maintain fast settling time for resistance measurements, while extensive guard and ground plane shielding and selectable input filtering maintain a high degree of measurement integrity under the most adverse conditions.

AUTOCAL=Low Life Cycle Cost

The long term goal of MATE philosophy is to reduce the Life Cycle Cost of A.T.E. Improvements in downtime and reliability resulting from AUTOCAL are significant steps towards meeting this objective. AUTOCAL enables the 1062MT and the 1062MT-5 to be quickly and accurately calibrated without removal of covers or the need to make any mechanical adjustments. Front panel keystrokes or IEEE-488 interface commands are used to establish and store digital calibration constants. The entire process can be completed without even removing the DMM from its A.T.E. rack which not only removes the need to dismantle an A.T.E. in order to send equipment away for calibration, but also removes the requirement to temporarily replace that equipment with spares to avoid unacceptably long A.T.E. downtimes. Furthermore, eliminating the transportation or movement of equipment in order to get it calibrated inevitably increases its reliability.

In addition to all of these benefits, rugged programmable calibrators, such as the Datron 4700 series, may be used to completely automate the calibration of the 1062MT and the 1062MT-5, thereby reducing calibration downtime even further.

The high reliability of the 1062MT and 1062MT-5, coupled with the AUTOCAL capability, truly represent a means to not only reduce A.T.E. downtime, but also to cut the spares and logistics costs associated with repair and calibration.

SPECIFICATIONS

1062MT DC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 100nV, 6½ digits.
Total Uncertainty: (180 Day, 23° ± 5°C, ±(ppmR+ppmFS)).
100mV Range: 35+8.
1V and 10V Ranges: 25+4.
100V and 1000V Ranges: 35+4.
CMRR: (1kΩ unbalance) >140 dB at DC, >(80 dB + NMRR) at 1-60 Hz.
NMRR: 66 dB at 50/60 Hz (Filter out), 100 dB at 50/60 Hz (Filter in).
Input Impedance: >10,000MΩ from 100 mV to 10V ranges, 10MΩ ± 0.1% on 100V and 1000V ranges.
Input Protection: Withstands 1kV RMS on any range.
Input Current: <50 pA.
Settling Time: (To 10 ppm step size) <5 ms (Filter out), <350 ms (Filter in).
Read Rate: 1.5s at 6½ digits, 100s at 4½ digits.

1062MT True RMS AC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 1μV, 5½ digits.
Total Uncertainty: (180 Day, 23° ± 5°C, Signals >0.25% FS, ±(%R + %FS)).
100mV and 1000V Ranges:
DC+45 Hz- 5kHz: 0.1+0.02.
DC+5 kHz-100 kHz: 0.25+0.05.
1V to 100V Ranges:
DC+45 Hz-5 kHz: 0.05+0.01.
DC+5 kHz-100 kHz: 0.12+0.025.
Hf Accuracy: (1V and 10V ranges, typical).
DC+100 kHz-1 MHz: ±(2%R + 1% FS).
CMRR: (1kΩ unbalance) >90 dB at DC '60 Hz.
Input Impedance: >1MΩ shunted by 150 pF.
Input Protection: Withstands 1kV RMS on any range.
Crest factor: 7:1 at full range.
Max Volt-Hertz: 2 x 10^7.
Settling Time: (To 0.1% step size) <150 ms (Filter out), <500 ms (Filter in).
Read Rate: 3s.

1062MT Resistance

Ranges: 10Ω to 10MΩ in decades.
FS: 2 x full range, 100% overrange.
Resolution: 10μΩ, 6½ digits.
Total Uncertainty: (180 Day, 23° ± 5°C, ±(ppmR+ppmFS)).
10Ω Range: 50+8.
100Ω to 10kΩ Ranges: 40+4.
100kΩ Range: 50+4.
1MΩ Range: 150+4.
10MΩ Range: 400+4.
Open Circuit Voltage: <10V.
Lead Resistance: Up to 100Ω.
Current Through Unknown:
10Ω and 100Ω: 10 mA.
1kΩ: 1 mA.
10kΩ: 100μA.
100kΩ: 10μA.
1MΩ: 1μA.
10MΩ: 100 nA.
Input Protection: Withstands 250V RMS on any range.
Settling Time: Up to 10kΩ generally the same as DCV.
Read Rate: As DCV.

1062MT DC Current

Ranges: 100μA to 1A in decades.
FS: 2 x full range. 100% overrange.
Resolution: 1 nA, 5½ digits.
Total Uncertainty: (180 Day, 23° ± 5°C, ±(ppmR + ppmFS)).
100μA to 100 mA Ranges: 130 + 20.
1A Range: 250 + 20.
Shunt Resistance:
100μA: 1kΩ.
1 mA: 100Ω.
10 mA: 10Ω.
100 mA: 1Ω.
1A: 100MΩ.
Settling Time: (To 10 ppm of step size) <5 ms (Filter out), <350 ms (Filter in).
Read Rate: 35s.

1062MT AC Current

Ranges: 100μA to 1A in decades.
FS: 2 x full range. 100% overrange.
Resolution: 1 nA, 5½ digits.
Total Uncertainty: (180 Day, 23° ± 5°C, ±(%R+%FS)).
100μA to 1A Ranges:
DC+45 Hz-5 kHz: 0.25+0.05.
Shunt Resistance:
100μA: 1kΩ.
1 mA: 100Ω.
10 mA; 10Ω.
100 mA: 1Ω.
1A: 100mΩ.
Settling Time: (To 0.1% of step size)<150 ms (Filter out), <500 ms (Filter in).
Read Rate: 3s.

1062MT-5 DC Voltage

Total Uncertainty: (180 Day 23° ± 5°C, ±(ppmR+ppmFS)).
100 mV Range: 70+16.
1V and 10V Ranges: 50+4.
100V and 1000V Ranges: 85+4.
Other Specs: As 1062MT.

1062MT-5 AC Voltage

Total Uncertainty: (180 Day, 23° ± 5°C, Signals >0.25% FS, ±(%R.%FS)).
100mV and 1000V Ranges:
DC + 45 Hz-100 kHz: 0.08+0.025.
1V to 100V Ranges:
DC + 45 Hz-100 kHz: 0.5+0.1.
Hf Accuracy: (1V and 10V ranges, typical).
DC + 100 kHz-1 MHz: ±(7%R+1%FS).
Other Specs: As 1062MT.

1062MT-5 Resistance

Total Uncertainty: (180 Day, 23° ± 5°C, ±(ppmR.ppmFS)).
10Ω and 100Ω Ranges: 70+16.
1kΩ and 10kΩ Ranges: 50+4.
100kΩ Range: 60+4.
1MΩ Range: 200+4.
10MΩ Range: 500+4.
Other Specs: As 1062MT.

GENERAL

Calibration: Autocal from front panel or via the IEEE-488 interface
Remote Programming:
MATE
IEEE-488
Environmental:
Operating Temp: 0° to +50°C.
Storage Temp: −40° to +70°C.
Dimensions: 88 mm (3.5 in.) high; 455 mm (17.9 in.) wide; 420 mm (16.5 in.) deep.
Weight: 10 kg (22 lb.) net.
Power: 105-127V or 205-255V, 50 Hz, 60 Hz, or 400 Hz. 20 Watts approx.

CONFIGURATIONS

Models 1062MT and 1062MT-5: 6½ Digit AUTOCAL Digital Multimeter (includes DCV, ACV, Resistance, Rear Input, IEEE-488, MATE, 1 Year Warranty).

OPTIONS

30: Current Converter. (For 1062MT only).
80: 115V 60 Hz Line Operation.
81: 115V 50 Hz Line Operation.
82: 115V 400 Hz Line Operation.
90: Rack Mounting Kit.

ACCESSORIES

1501: DMM Lead Kit.

FACTORY/FOB

Indianapolis, IN
Norwich, England

PRECISION DIGITAL MULTIMETERS

MODEL 1065A

Autocal Digital Multimeter

- **6½ Digit Resolution**
- **DCV, ACV and Resistance Functions**
- **90 Day DCV Specifications to ±48 ppm**
- **Autocal**
- **IEEE-488 Programmable**

The 1065A is a general purpose 6½ digit DMM designed to offer the facilities required in most systems and bench applications. With ACV, DCV and Resistance measurement capabilities installed as standard, the 1065A possesses many of the features from the higher performance models in the AUTOCAL range, including full autocalibration, selectable front or rear input terminals, maximum and minimum readings, and a powerful IEEE-488 bus capability.

Performance

On DCV five ranges, 100 mV to 1kV, cover the vast majority of applications in either bench or systems work. Basic 24 hour stability is ±15 ppm, with long term accuracy of better than ±60 ppm per year. 100% overrange (1,999,999) is provided throughout.

True RMS ACV measurement is a Datron specialty, and the electronic "log feedback" circuitry used accepts a wide range of inputs up to 1 MHz and also provides accuracies to ±0.04% in the 1065A.

Resistance ranges from 100Ω to 10MΩ provide accuracies to ±60 ppm over 1 year, and offer lead resistance rejection of 80 dB with up to 10Ω lead resistance on any range.

Programmable

All front panel controls are IEEE-488 programmable and additional features only available on the bus include superfast read rate up to 200 readings per second, and programmable Hi and Lo limits. Even AUTOCAL is controllable via the bus, enabling in-situ calibration to eliminate any errors that may be present at various system analog interfaces.

In addition, measurement integrity in systems is assured through the use of a 3 pole active filter before the input pre-amplifier, together with a line-locked, multi-slope, integrating analog to digital converter, giving over 100 dB of normal mode rejection.

Spec Readout

The complete accuracy specification of the instrument has been pre-programmed into its memory so that selection of the "spec" key will display the precise limits of uncertainty for any measured value. The spec readout facility—available on all Datron AUTOCAL instruments—means that the optimum range for any particular measurement can be readily determined.

Reliable

The whole instrument is designed to withstand hostile environments and a high level of user misuse. Input protection for example permits 1000V RMS on any DCV or ACV range, while resistance ranges are protected up to 250V RMS.

Support

The cost to support and maintain the 1065A is kept very low through the instrument's proven high reliability and fast AUTOCAL features, which eliminate expensive downtime for repair and recalibration. In addition, an extensive diagnostic self check routine can be run on command to sequentially test all displays, measurement circuits and the non-volatile calibration memory.

SPECIFICATIONS

1065A DC Voltage

Ranges: 100 mV to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 100 nV, 6½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR+ppmFS)).

100 mV Range:	60+16
1V Range:	40+4
10V Range:	40+4
100V Range:	70+4
1000V Range:	70+4

Temperature Coefficient: (13°-18°C and 28° -33°C). 1/10th 90 Day Accuracy/° C ±0.3μV/°C.
CMRR: (1kΩ unbalance) >140 dB at DC, >(80 dB+NMRR) at 1-60 Hz.
NMRR: 66 dB at 50/60 Hz±0.15% (Filter out), 120 dB at 50/60 Hz (Filter in).
Input Impedance: >10,000MΩ from 100 mV to 10V ranges, 10MΩ ±0.1% on 100V and 1000V ranges.
Input Protection: Withstands 1kV RMS on any range.
Input Current: <50pA.
Settling Time: (To 10 ppm step size) <5ms (Filter out), <350 ms (Filter in).
Read Rate: 1.5/s at 6½ digits, 200/s in Super-fast mode, 4 digits.

1065A & 1065 True RMS AC Voltage

Ranges: 1V to 1000V in decades.
FS: 2 x Full Range. 100% Overrange. (Except 1kV range).
Resolution: 10μV, 5½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, Signals >1%FS, ±(%R+%FS)).
1V to 1000V Ranges:

DC+45 Hz-30 kHz	0.06+0.025
DC+30-100 kHz	0.4+0.1
DC+100 kHz-1 MHz	6+1

Lf Accuracy: (Filter in) Add 2%R at 10 Hz. For DC multiply accuracy by 1.5.
Temperature Coefficient: (13°-18° C and 28°-33°C). 1/10th 90 Day Accuracy/°C.
CMRR: (1kΩ unbalance) >90 dB at DC-60 Hz.
Input Impedance: >1MΩ shunted by 150pF.
Input Protection: Withstands 1kV RMS on any range.
Crest factor: 5:1 at Full Range.
Max Volt-Hertz: 2 x 10^7.
Settling Time: (To 0.1% step size) <500 ms (Filter in), <150 ms (Filter out).
Read Rate: 3/s.

1065A Resistance

Ranges: 100Ω to 10MΩ in decades.
FS: 2 x Full Range, 100% Overrange.
Resolution: 100μΩ, 6½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR+ppmFS)).

100Ω Range:	60+16
1kΩ Range:	40+4
10kΩ Range:	40+4
100kΩ Range:	50+4
1MΩ Range:	150+4
10MΩ Range:	400+4

Temperature Coefficient: (13°-18°C and 28° -33°C). 1/10th 90 Day Accuracy/° C ±600μΩ/°C.
Open Circuit Voltage: <10V.
Lead Resistance: Up to 10Ω.
Current Through Unknown:

100Ω	1 mA
1kΩ	1 mA
10kΩ	100μA
100kΩ	10μA
1MΩ	1μA
10MΩ	100 nA

Input Protection: Withstands 250V RMS on any range.
Settling Time: Up to 10kΩ generally the same as DCV.
Read Rate: 1.5/s at 6½ digits, 200/s in Super-fast mode, 4 digits.

1065A DC Voltage

Resolution: 1μV, 5½ digits.
Total Uncertainty: (90 Day, 23° C±5° C, ±(ppmR+ppmFS))

100 mV Range:	60+20
1V Range:	40+5
10V Range:	40+5
100V Range:	70+5
1000V Range:	70+5

Other Specs: As 1065A.

1065 Resistance

Resolution: 1mΩ, 5½ digits.
Total Uncertainty: (90 Day, 23° ±5°C, ±(ppmR+ppmFS)).

100Ω Range:	60+20
1kΩ Range:	40+5
10kΩ Range:	40+5
100kΩ Range:	50+5
1MΩ Range:	150+5
10MΩ Range:	400+5

GENERAL

Calibration: Autocal from front panel or via IEEE-488 interface.
Remote Programming: IEEE-488.
Environmental:
Operating temp: 0° to +50°C.
Storage temp: −40° to +70°C.
Dimensions: 88 mm (3.5 in.) high; 455 mm (17.9 in.) wide; 420 mm (16.5 in.) deep.
Weight: 10 kg (22 lb).
Power: 105-127V or 205-255V, 50 Hz, 60 Hz, or 400 Hz. 20 Watts approx.

CONFIGURATIONS

Model 1065A: 6½ Digit AUTOCAL Digital Multimeter (Includes DCV, ACV, Resistance, IEEE-488, Rear Input, 5 Year Warranty).
Model 1065A/60: 6½ Digit AUTOCAL Digital Multimeter (Includes DCV, IEEE-488, Rear Input, 5 Year Warranty).
Model 1065: 5½ Digit AUTOCAL Digital Multimeter (Includes DCV, ACV, Resistance, IEEE-488, Rear Input, 1 Year Warranty).
Model 1065/60: 5½ Digit AUTOCAL Digital Multimeter (Includes DCV, IEEE-488, Rear Input, 1 Year Warranty).

OPTIONS

80: 115V 60Hz Line Operation
81: 115V 50 Hz Line Operation
82: 115V 400Hz Line Operation
90: Rack Mounting Kit

ACCESSORIES

1501: DMM Lead Kit

FACTORY/FOB

Indianapolis, IN
Norwich, England

Calibrators

The Datron Instruments Autocal family of calibrators and automated calibration systems leads the world in innovative calibration technology, providing an unparalleled choice of functional capability and performance. Together with Datron's calibration software, controllers and accessories, the Autocal range offers a selection of high quality instruments and systems with a variety of different specifications and costs. From this range, the optimum solutions can be found to most Digital Multimeter (DMM) calibration, DC to Low Frequency Standards, and high-accuracy system-source applications.

Datron calibrator performances vary from the Standards Laboratory accuracy of a multifunction calibrator capable of calibrating today's highly accurate 7½ and 8½ digit DMMs, to one similar in appearance and functionality, but with a performance and price which is ideally suited for handheld and 3½ and 4½ digit DMM calibration requirements. Functionally, the number of options within the complete calibrator range is virtually limitless, varying from dedicated DCV-only or ACV-only units, suitable for standards laboratory or systems use, to calibrators which are fully multifunctional: single instruments with all the flexibility of functions and the breadth of range in both amplitude and frequency to fulfill the ever more stringent demands of the modern calibration facility. Practical and straightforward to use on the bench, all Datron Autocal calibrators are fully programmable via the IEEE-488 interface, making them perfect sources for automated calibration systems. In addition, the wide temperature tolerance of these instruments extends their usefulness to many A.T.E. or systems applications outside the calibration laboratory, on the production floor or in the factory test bay. Datron Calibration Software is available to enhance these features, offering a range of fully integrated, menu driven, automated multimeter calibration systems either for use in traditional calibration environments, or for more demanding mobile calibration roles.

BENCHTOP CALIBRATION SYSTEMS

Software	Calibrator	Controller	Printer[1]	Analog Leads	IEEE Leads
4101B	4707, 4700 or 4705	IBM-XT or HP Vectra (4103A) or Compaq (4103B)	4104	PLK-2	2
4101B	4707, 4700 or 4705 with 4600 amplifier	IBM-XT or HP Vectra (4103A) or Compaq (4103B)	4104	PLK-2 440151 440154	2
4101B	4000/A and 4200/A	IBM-XT or HP Vectra (4103A) or Compaq (4103B)	4104	PLK-1	3

Note: [1]Includes printer interface cable.

PROGRAMMABLE CALIBRATORS SELECTION GUIDE

Model No.	Basic Functions	Optional Functions	Display Resolution	Ranges	Basic Total Accuracy (90 day, ±1°C) (±ppmR±ppmFS)	Frequency Span	Comments
4707	DCV & ACV to 200V, IEEE-488	1000V ranges, DCI, ACI & Ω	7½/6½	DCV: 100μV-1000V ACV: 1 mV-1000V DCI: 100μA-1A ACI: 100μA-1A Ω: 10Ω-100MΩ	3.5 + 0.25 90 + 10 29 + 5 320 + 50 7	10 Hz-1 MHz 10 Hz-5 kHz	For calibration of up to 8½ digit DMMs 4101B compatible 4600 compatible
4700	DCV & ACV to 200V, IEEE-488	1000V ranges, DCI, ACI & Ω	7½/6½	DCV: 100μV-1000V ACV: 1 mV-1000V DCI: 100μA-1A ACI: 100μA-1A Ω: 10Ω-100MΩ	8.5 + 0.5 220 + 20 72 + 7 475 + 80 15	10 Hz-1 MHz 10 Hz-5 kHz	For calibration of up to 6½ digit DMMs 4101B compatible 4600 compatible
4705	DCV, ACV DCI, ACI Ω, IEEE-488	None	6½/5½	DCV: 100μV-1000V ACV: 1 mV-1000V DCI: 100μA-1A ACI: 100μA-1A Ω: 10Ω-100MΩ	20 + 1 350 + 50 82 + 15 475 + 80 15	10 Hz-1 MHz 10 Hz-5 kHz	For calibration of up to 5½ digit DMMs 4101B compatible 4600 compatible
4600	DCI, ACI	None	—	DCI: 0-11A ACI: 90 mA-11A	80 + 25 330 + 55	10 Hz-5 kHz	For high current
4000	DCV, IEEE-488	DCI, Ω	7½/6½	DCV: 100μV-1000V DCI: 100μA-1A Ω: 1Ω-10MΩ	4.5 + 0.5 29 + 5 7		For calibration of up to 8½ digit DMMs 4101B compatible
4000A	DCV, IEEE-488	DCI, Ω	7½/6½	DCV: 100μV-1000V DCI: 100μA-1A Ω: 1Ω-10MΩ	3.5 + 0.25 29 + 5 7		For calibration of up to 8½ digit DMMs 4101B compatible
4200A	DCV to 200V, IEEE-488	1000V range, ACI	6½	ACV: 1 mV-1000V ACI: 100μA-1A	85 + 10 300 + 50	10 Hz-1 MHz 10 Hz-5 kHz	For calibration of high accuracy AC DMMs 4101B compatible

Multifunction Standard

- **DCV, ACV, DCI, ACI and Ω Functions**
- **True 1kV AC Performance from a Single Unit**
- **Configurable to Meet Individual Requirements**
- **IEEE-488, Autocal, 4101B and 4600 Compatible**
- **Calibrates DMMs of up to 8½ Digit Scale Length**

The model 4707 Autocal Multifunction Standard offers the very best in programmable multifunction performance. Capable of calibrating—BY ITSELF—the latest generation of high performance systems and standards DMMs, it represents the most practical and cost-effective solution to today's high accuracy calibration requirements.

DC Voltage
With outputs available from 10 nV to 1100V, and total 90 day, ±1°C uncertainties to 4 ppm, the DC Voltage function offers performance unrivalled by any other instrument. This performance extends to high linearity and low noise, essential when calibrating 7½ and 8½ digit DMMs, while the fast settling times inherent in the signal generation techniques employed make the instrument ideal for automated applications.

AC Voltage
The AC Voltage function also offers unmatched performance and functional capability, offering total 90 day, ±1°C uncertainties to 100 ppm and 65 mA of current drive on the optional 1000V range. In practice this means that the high voltage-high frequency test requirements of today's DMMs may be met by one single, compact unit.

The internal AC-DC transfer is accomplished by a fully electronic technique, which offers faster settling times than traditional thermal techniques. These settling times are also independent of signal level, a most desirable feature in automated applications.

Resistance and Current
Fully floating, high accuracy DC and AC currents are generated using a voltage to current converter which incorporates specially developed low loss shunts and is driven from either the DCV or ACV sections of the calibrator. For applications that require higher currents, such as the calibration of handheld multimeters, the model 4600 Transconductance Amplifier extends the current function to 11A. Resistance outputs are derived from eight fixed value, hermetically sealed standard resistors, each being 4-wire or 2-wire connected to the output terminals, using ultra high isolation relay switches.

Flexibility and Ease of Use
The IEEE-488 interface is fitted as standard, enabling the 4707 to form the heart of a compact and highly accurate calibration or test system, while its rugged construction and insensitivity to temperature variations make it ideal for applications outside of the traditional calibration environment. It is compatible with the Datron 4101B Multimeter Calibration software package, a combination which forms an automated calibration system capable of calibrating anything from simple handheld multimeters up to the most sophisticated Standards DMMs.

Calibration
The Model 4707 employs Autocal, the electronic adjustment technique whereby all calibration adjustments are made through the

use of digital corrections stored in non-volatile memory. The instrument is calibrated by applying the standard and following a simple sequence of front panel keystrokes or IEEE-488 bus commands. Moreover, the signal generation circuit configuration employed during calibration is the same as that used during normal operation, ensuring fast, traceable, repeatable calibration.

SPECIFICATIONS

DC Voltage

Ranges: 100μV to 1000V in decades.
Full scale: 2 x range except 1000V range, where max output≈1100V.
Resolution: 1 digit in 19,999,999 or 10 nV, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output ±μV).
100μV to 100 mV Ranges: 8±1.4.
1V Range: 5±0.8.
10V Range: 3.5±5.
100V Range: 5±100.
1000V Range (Option 17): 6±500.
Sensing: Selectable remote/local sensing on 1V to 1000V ranges.
Guarding: Selectable remote/local guarding.
Settling Time: <1 s to 10 ppm of step size.
Output Impedance/Max Output Current:
100μV to 100 mV Ranges: 100Ω.
1V to 1000V Ranges: 25 mA max.

AC Voltage

Ranges: 1 mV to 1000V in decades.
Full Scale: 2 x range except 1000V range, where max output=1100V.
Resolution: 1 digit in 1,999,999 or 100 nV, whichever is greater.
Frequency: Ranges: 100Hz to 1MHz in decade steps. Resolution: 1% of range. Accuracy <±100ppm.
Sensing: Selectable remote/local sensing on 1V to 1000V ranges.
Guarding: Selectable remote/local guarding.
Maximum Capacitive load: 1000 pF on 1V to 100V ranges, 300 pF on 1000V range.
Total Uncertainty: 90 day, 23°±1°C (±ppm Output±μV).

1 mV Range
170±6: (10-31 Hz).
140±6: (32-330 Hz).
130±6: (300 Hz-10 kHz).
280±6: (10-33 kHz).
800±6: (30-100 kHz).
0.14%±11: (100-330 kHz).
0.24%±23: (330k-1 MHz).

10 mV Range
170±7: (10-31 Hz).
140±6: (32-330 Hz).
130±6: (300 Hz-10 kHz).
280±6: (10-33 kHz).
800±6: (30-100 kHz).
0.14%±13: (100-330 kHz).
0.24%±41: (330k-1 MHz).

100 mV Range
170±12: (10-31 Hz).
140±10: (32-330 Hz).
130±10: (300 Hz-10 kHz).
280±10: (10-33 kHz).
800±10: (30-100 kHz).
0.14%±31: (100-330 kHz).
0.24%±221: (330k-1 MHz).

1V Range
140±40: (10-31 Hz).
100±20: (32-330 Hz).
90±20: (300 Hz-33 kHz).
170±40: (30-100 kHz).
500±200: (100-330 kHz).
0.23%±800: (330k-1 MHz).

10V Range
140±400: (10-31 Hz).
100±200: (32-330 Hz).
90±200: (300 Hz-33 kHz).
170±400: (30-100 kHz).
500±2 mV: (100-330 kHz).
0.23%±8 mV: (330k-1 MHz).

100V Range
140±4 mV: (10-31 Hz).
100±2 mV: (32-330 Hz).
90±2 mV: (300 Hz-10 kHz).
100±2 mV: (10-33 kHz).
200±4 mV: (30-100 kHz).

1000V Range (Option 17)
150±50 mV: (45-330 Hz).
130±50 mV: (300 Hz-10 kHz).
200±50 mV: (10-33 kHz).
Settling Times: To 100 ppm of step size: <10 s (10-32 Hz), <3 s (33-330 Hz), <1 s (>330 Hz).

DC Current (Op 27)

Ranges: 100μA to 1A in decades.
Full scale: 2 x range.
Resolution: 1 digit in 1,999,999 or 100 pA, whichever is greater.
Total Uncertainty: 90 day, 23°±1°C (±ppm Output ± nA).
100μA Range: 59±2.
1 mA Range: 29±10.
10 mA Range: 29±100.
100 mA Range: 29±1μA.
1A Range: 71±20μA.
10A Range (Requires Model 4600): 85 ±500μA.
Guarding: Selectable remote/local guarding.

AC Current

Ranges: 100μA to 1A in decades.
Full Scale: 2 x range.
Resolution: 1 digit in 1,999,999 or 100 pA, whichever is greater.
Total Uncertainty: 90 day, 23°±1°C (±ppm Output±nA).

100μA Range
600±10: (10-1 kHz).
1050±16: (1k-5 kHz).

1mA Range
320±100: (10-1 kHz).
450±100: (1k-5 kHz).

10 mA Range
320±1μA: (10-1 kHz).
450±1μA: (1k-5 kHz).

100 mA Range
320±10μA: (10-1 kHz).
450±10μA: (1k-5 kHz).

1A Range
500±100μA: (10-1 kHz).
750±160μA: (1k-5 kHz).

10A Range (Requires Model 4600):
450±1.5 mA (10-1 kHz).
1060±1.6 mA (1k-5 kHz).
Guarding: Selectable remote/local guarding.

Resistance (Op 27)

Ranges: 10Ω to 100MΩ in decades. (Ranges are nominal, actual calibrated values are displayed).
Connections: Selectable 2 or 4-wire, remote/local guard.
Display Resolution: 1 digit in 19,999,999.
Total Uncertainty: 90 day, 23°±1°C (±ppm Output).
10Ω: ±20.
100Ω & 1kΩ: ±8.
10kΩ: ±7.
100kΩ: ±13.
1MΩ: ±27.
10MΩ: ±42.
100MΩ: ±230.

GENERAL

Calibration: Autocal from front panel or via the IEEE-488 interface.
Environmental:
Operating Temp: 0° to +50°C.
Storage Temp: −40° to +70°C.
Dimensions: 178 mm (7 in.) high; 455 mm (17.9 in.) wide; 563 mm (22.2 in.) deep.
Weight: 36 kg (80 lb.) net.
Power: 100/120/220/240 Vac ±10%, 50 Hz or 60 Hz. Consumption 370 VA standby, 660 VA full power.

OPTIONS

17: 1000V Ranges, DCV and ACV.
27: DCI, ACI and Ω.
42: Alternative Rear Output.
80: 115V 60 Hz Line Operation.
81: 115V 50 Hz Line Operation.
90: Rack Mounting Kit.

FACTORY/FOB

Indianapolis, IN
Norwich, England

Multifunction Calibrator

- **DCV, ACV, DCI, ACI and Ω Functions**
- **True 1kV AC Performance from a Single Unit**
- **Configurable to Meet Individual Requirements**
- **IEEE-488, Autocal, 4101B and 4600 Compatible**
- **Calibrates DMMs of up to 6½ Digit Scale Length**

Some 90% or more of the typical calibration facility DMM workload consists of a range of instruments, varying in performance and capabilities, from simple handheld multimeters to the latest generation of mid-performance 5½ and 6½ digit systems DMMs. For these instruments, the model 4700 offers the most cost-effective calibration solution available, offering the necessary performance at an economic price.

DC and AC Voltage

The standard instrument will source DC voltages from 10nV to 200V with total 90 day, ±1°C uncertainties to 9 ppm, which provides a sufficient margin of accuracy over the latest generation of mid-performance half and full rack systems DMMs. With AC voltages from 90μV to 200V to within 240 ppm, the 4700 is capable of calibrating all but the most accurate AC-measuring meters. The output capability of both functions may be extended to 1100V by the high voltage option. This is installed inside the unit and is capable of sourcing, from one single, compact unit, the high voltage-high frequency test points required by today's systems DMMs.

Resistance and Current

Fully floating, high accuracy DC and AC currents are generated using a voltage to current converter which incorporates specially developed low loss shunts and is driven from either the DCV or ACV sections of the calibrator. For applications that require higher currents, such as the calibration of handheld multimeters, the model 4600 Transconductance Amplifier extends the current functions to 11A. Resistance outputs are derived from eight fixed value, hermetically sealed standard resistors, each being 4-wire or 2-wire connected to the output terminals, using ultra high isolation relay switches.

Flexibility and Ease of Use

A major design objective of the 4700 was to make it simple and straightforward to operate. Rapid rolling up/down keys are used for fast and easy setting of amplitude and frequency. The selected output is displayed at all times on a high brightness display, while the patented spec. readout feature eliminates the need to make complex and tedious calculations of the accuracy of the applied signal. Deviation controls—Error and Offset—enable the output of the calibrator to differ from that indicated on the display, useful for checking the linearity and calibration of measuring instruments.

The 4700 is not limited to applications inside the calibration laboratory. Its rugged construction and insensitivity to temperature variations (specifications are available for 23°C±10°C operation) mean that the instrument is equally suited to applications outside of the traditional calibration environment. As an accurate test source or stimulus, the 4700 provides a very cost effective solution to meet the growing requirements in A.T.E.s for improved test accuracy and confidence. For example, the basic 4700—without any options—can be installed as an integral source within an ATE rack to provide accurate, stable, programmable DC and AC voltages up to 200V.

In addition, the instrument is compatible with the Datron 4101B Multimeter Calibration software package. Together, the 4700 (optionally configured with the model 4600) and 4101B can form the basis of a compact, rugged and highly versatile automated calibration system capable of calibrating any multimeter from simple handhelds up to 5½ and 6½ digit systems DMMs.

VOLTAGE

DC Voltage

Ranges: 100μV to 1000V in decades.
Full scale: 2 x range except 1000V range, where max output=1100V.
Resolution: 1 digit in 19,999,999 or 10nV, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output ±μV).
100μV to 100 mV Ranges: 15±1.8.
1V Range: 12±1.6.
10V Range: 8.5±10.
100V Range: 13±200.
1000V Range (Option 10): 16±1 mV.
Sensing: Selectable remote/local sensing on 1V to 1000V ranges.
Guarding: Selectable remote/local guarding.
Settling Time: <1s to 10ppm of step size.
Output Impedance/Max output current:
100μV to 100 mV ranges: 100Ω.
1V to 1000V range: 25 mA max.

AC Voltage

Ranges: 1 mV to 1000V in decades.
Full scale: 2 x range except 1000V range, where max output=1100V.
Resolution: 1 digit in 1,999,999 or 100nV, whichever is greater.
Frequency: Ranges: 100Hz to 1MHz in decade steps. Resolution: 1% of range. Accuracy <±100ppm.
Sensing: Selectable remote/local sensing on 1V to 1000V ranges.
Guarding: Selectable remote/local guarding.
Maximum Capacitive Load: 1000pF on 1V to 100V ranges, 300pF on 1000V range.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output ±μV).
1mV Range
10 to 31 Hz: 330±22.
32 Hz to 33 kHz: 430±20.
30 to 100 kHz: 0.11%±21.
100 to 330 kHz: 0.27%±32.
300k to 1 MHz: 0.7%±46.
10mV Range
10 to 31 Hz: 330±23.
32 Hz to 33 kHz: 430±21.
30 to 100 kHz: 0.11%±22.
100 to 330 kHz: 0.27%±36.
300k to 1 MHz: 0.7%±82.
100mV Range
10 to 31 Hz: 330±34.
32 Hz to 33 kHz: 430±28.
30 to 100 kHz: 0.11%±33.
100 to 330 kHz: 0.27%±72.
300k to 1 MHz: 0.7%±442.
1V Range
10 to 31 Hz: 330±80.
32 Hz to 33 kHz: 220±40.
30 to 100 kHz: 340±60.
100 to 330 kHz: 850±400.
300k to 1 MHz: 0.48%±2mV.
10V Range
10 to 31 Hz: 330±800.
32 Hz to 33 kHz: 220±400.
30 to 100 kHz: 340±600.
100 to 330 kHz: 850±4 mV.
300k to 1 MHz: 0.48%±20mV.
100V Range
10 to 31 Hz: 330±8 mV.
32 Hz to 33 kHz: 230±4 mV.
30 to 100 kHz: 420±8 mV.
1000V Range (Option 10)
45 to 330 Hz: 370±100 mV.
300 Hz to 10 kHz: 290±100 mV.
10 to 33 kHz: 430±100 mV.
Settling times: To 100ppm of step size.
10 to 32 Hz: <10s.
33 to 330 Hz: <3s.
>330 Hz: <1s.

DC Current (Option 20)

Ranges: 100μA to 1A in decades.
Full scale: 2 x range.
Resolution: 1 digit in 1,999,999 or 100pA, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output±nA).
100μA Range: 84±2.
1 mA Range: 72±14.
10 mA Range: 72±140.
100 mA Range: 72±1.4μA.
1A Range: 176±30μA.
10A Range: (Requires Model 4600). 85±500μA.
Guarding: Selectable remote/local guarding.

AC Current (Option 20)

Ranges: 100μA to 1A in decades.
Full scale: 2 x range.
Resolution: 1 digit in 1,999,999 or 100pA, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output±nA).
100μA Range
10 to 1 kHz: 800±16.
1k to 5 kHz: 1450±20.
1 mA Range
10 to 1 kHz: 475±160.
1k to 5 kHz: 605±160.
10 mA Range
10 to 1 kHz: 475±1.6μA.
1k to 5 kHz: 605±1.6μA.
100 mA Range
10 to 1 kHz: 475±16μA.
1k to 5 kHz: 605±16μA.
1A Range
10 to 1 kHz: 690±160μA.
1k to 5 kHz: 990±200μA.
10A Range: (Requires Model 4600).
10 to 1 kHz: 530 ± 2 mA.
1k to 5 kHz: 1100 ± 2 mA.
Guarding: Selectable remote/local guarding.

Resistance (Option 20)

Ranges: 10Ω to 100MΩ in decades (Ranges are nominal, actual calibrated values are displayed).
Connections: Selectable 2 or 4-wire, remote/local guard.
Display resolution: 1 digit in 19,999,999.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output).
10Ω: ±45.
100Ω and 1kΩ: ±16.
10kΩ: ±15.
100kΩ: ±24.
1MΩ: ±57.
10MΩ: ±112.
100MΩ: ±300.

GENERAL

Calibration: Autocal from front panel or via the IEEE-488 interface.

Environmental
Operating Temp: 0° to +50°C.
Storage Temp: −40° to +70°C.

Dimensions: 178 mm (7 in.) high, 455 mm (17.9 in.) wide, 563 mm (22.2 in.) deep.

Weight: 36 kg (80 lb).
Power: 100/120/220/240 Vac ±10%, 50 Hz or 60 Hz. Consumption 370 VA standby, 660 VA full power.

OPTIONS

10: 1000V Ranges for DCV and ACV
20: DCI, ACI and Ω
42: Alternative Rear Output
80: 115V 60 Hz Line Operation
81: 115V 50 Hz Line Operation
90: Rack Mounting Kit

FACTORY/FOB

Indianapolis, IN
Norwich, England

Multifunction Calibrator

- **DCV, ACV, DCI, ACI and Ω Functions as Standard**
- **ACV Output from 10 Hz to 100 kHz**
- **True 1kV AC Performance from a Single Unit**
- **IEEE-488, Autocal, 4101B and 4600 Compatible**
- **Calibrates DMMs of up to 5½ Digit Scale Length**

The model 4705 is a low cost, fully multifunction, programmable calibrator which has all functions fitted as standard. It is designed to calibrate DMMs of up to 5½ digit scale length without the addition of external performance enhancement techniques, such as the use of a standards DMM to monitor the output.

An IEEE-488 interface is fitted as standard, so the unit can readily be integrated into a cost effective automated calibration system. Furthermore, its rugged construction makes it ideal for applications outside of the calibration laboratory, while its insensitivity to temperature variations ensures that a minimal loss of accuracy is experienced when the unit is installed in an A.T.E. rack.

DC and AC Voltage

The 4705 is capable of sourcing continuously variable DC voltages from 100 nV to 1100V with 90 day, ±1°C total uncertainties to 21 ppm, and so has a comfortable margin of calibration accuracy over those 5½ digit DMMs and below that constitute 80% of the typical calibration laboratory DMM workload. The outputs are truly bipolar, which removes the need for an operator to change test lead connections when a change of polarity is required.

AC voltages are available from 90μV to 1100V, at frequencies continuously variable between 10 Hz and 100 kHz, with total 90 day, ±1°C uncertainties to 400 ppm. The solid state 1000V range drive circuitry is installed inside the unit, and is able to drive a capacitive load of 300pF. This means that all of the high voltage-high frequency test points required by today's 4½ to 5½ digit bench and lower performance systems instruments may be sourced by one single, compact unit.

Resistance and Current

The 4705 will source continuously variable DC and AC currents to 2A, with total 90 day, ±1°C uncertainties to 100 ppm and 555 ppm respectively. For applications that require higher currents, such as calibration of handheld multimeters, the model 4600 Transconductance Amplifier extends the current function to 11A. The resistance function makes resistances between 10Ω and 100MΩ available, in both 2 and 4-wire configurations, with 90 day, ±1°C total uncertainties to 15 ppm.

Flexibility and Ease of Use

A major design objective of the 4705 was to make it simple and straightforward to operate. Rapid rolling up/down keys are used for fast and easy setting of amplitude and frequency. The selected output is displayed at all times on a high brightness display, while the patented spec. readout feature eliminates the need to make complex and tedious calculations of the accuracy of the applied signal. Deviation controls—Error and Offset—enable the output of the calibrator to differ from that indicated on the display, useful for checking the linearity and calibration of measuring instruments.

In addition, the instrument is compatible with the Datron 4101B Multimeter Calibration software package. Together, the 4705 (optionally configured with the model 4600) and 4101B can form the basis of a compact, rugged, cost-effective and highly versatile automated calibration system capable of calibrating any multimeter from simple handhelds up to 5½ digit systems DMMs.

SPECIFICATIONS

DC Voltage

Ranges: 100μV to 1000V in decades.
Full scale: 2 x range except 1000V range, where max output=1100V.
Resolution: 1 digit in 1,999,999 or 100nV, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output ±μV).

100μV to 100mV Ranges:	24±2
1V Range:	21±2
10V Range:	20±20
100V Range:	22±200
1000V Range:	25±2mV

Sensing: Selectable remote/local sensing on 1V to 1000V ranges.
Guarding: Selectable remote/local guarding.
Settling Time: <1s to 10 ppm of step size.
Output Impedance/Max output current: 100μV to 100mV ranges: 100Ω.
1V to 1000V ranges: 25 mA max.

AC Voltage

Ranges: 1mV to 1000V in decades.
Full scale: 2 x range except 1000V range, where max output=1100V.
Resolution: 1 digit in 199,999 or 1μV, whichever is greater.
Frequency: Ranges: 100 Hz to 1 MHz in decade steps. Resolution: 1% of range. Accuracy <±100 ppm.
Sensing: Selectable remote/local sensing on 1V to 1000V ranges.
Guarding: Selectable remote/local guarding.
Maximum Capacitive load: 1000pF on 1V to 100V ranges, 300pF on 1000V range.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output±μV).

1mV Range:	
380±22	(10-31 Hz)
480±20	(32 Hz-33 kHz)
0.13%±21	(30-100 kHz)
10mV Range:	
380±23	(10-31 Hz)
480±21	(32 Hz-33 kHz)
0.13%±22	(30-100 kHz)
100mV Range:	
380±34	(10-31 Hz)
480±32	(32 Hz-33 kHz)
0.13%±37	(30-100 kHz)
1V Range:	
430±120	(10-31 Hz)
350±100	(32 Hz-33 kHz)
440±160	(30-100 kHz)
10V Range:	
430±1.2 mV	(10-31 Hz)
350±1 mV	(32 Hz-33 kHz)
440±1.6 mV	(30-100 kHz)
100V Range:	
430±12 mV	(10-31 Hz)
360±10 mV	(32 Hz-33 kHz)
470±16 mV	(30-100 kHz)
1000V Range:	
470±120 mV	(45-330 Hz)
390±100 mV	(300 Hz-10 kHz)
480±160 mV	(10-33 kHz)

Settling times: to 100 ppm of step size: <10s (10-32 Hz), <3s (33-330 Hz), <1s (>330 Hz).

DC Current

Ranges: 100μA to 1A in decades.
Full scale: 2 x range.
Resolution: 1 digit in 199,999 or 1nA, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output±nA).

100μA Range:	84±3
1mA Range:	82±30
10mA Range:	82±300
100mA Range:	82±3μA
1A Range:	191±40μA
10A Range (Requires Model 4600):	95±520μA

Guarding: Selectable remote/local guarding.

AC Current

Ranges: 100μA to 1A in decades.
Full scale: 2 x range.
Resolution: 1 digit in 199,999 or 1nA, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output±nA).

100μA Range:	
800±16	(10-1 kHz)
1450±20	(1k-5 kHz)
1mA Range:	
475±160	(10-1 kHz)
605±160	(1k-5 kHz)
10mA Range:	
475±1.6μA	(10-1 kHz)
605±1.6μA	(1k-5 kHz)
100mA Range:	
475±16μA	(10-1 kHz)
605±16μA	(1k-5 kHz)
1A Range:	
690±160μA	(10-1 kHz)
990±200μA	(1k-5 kHz)
10A Range: (Requires Model 4600)	
630±2.3mA	(10-1 kHz)
1230±2.4mA	(1k-5 kHz)

Guarding: Selectable remote/local guarding.

Resistance

Ranges: 10Ω to 100MΩ in decades (Ranges are nominal, actual calibrated values are displayed).
Connections: Selectable 2 or 4-wire, remote/local guard.
Display resolution: 1 digit in 1,999,999.
Total Uncertainty: 90 day, 23° ±1°C (±ppm Output).

10Ω	±55
100Ω & 1kΩ	±16
10kΩ	±15
100kΩ	±24
1MΩ	±62
10MΩ	±162
100MΩ	±325

GENERAL

Calibration: Autocal from front panel or via the IEEE-488 interface
Environmental:
Operating temp: 0° to +50°C.
Storage temp: −40° to +70°C.
Dimensions: 178 mm (7 in.) high; 455 mm (17.9 in.) wide; 563 mm (22.2 in.) deep.
Weight: 36 kg (80 lb).
Power: 100/120/220/240 Vac±10%, 50 Hz or 60 Hz. Consumption 370VA standby, 660VA full power.

CONFIGURATION

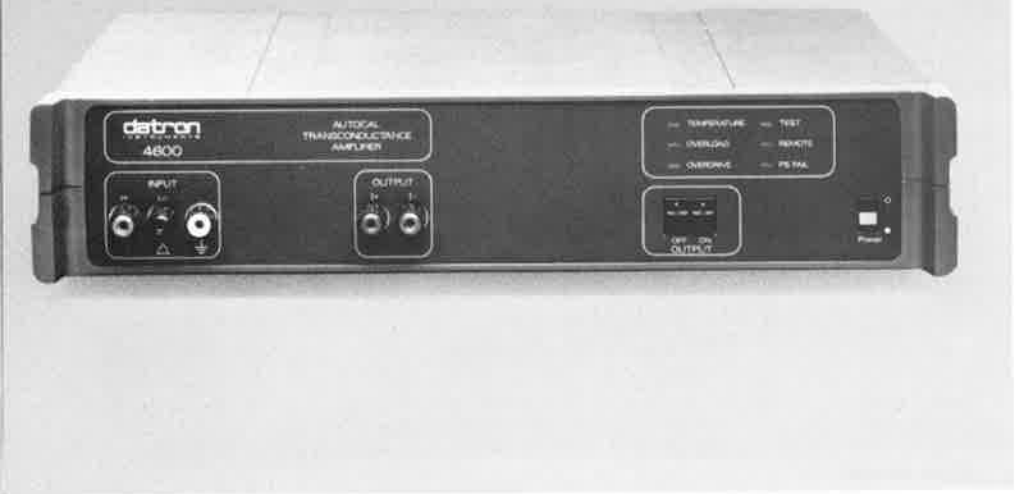
Model 4705: DCV, ACV, DCI, ACI and Ω functions IEEE-488 interface.

OPTIONS

42: Alternative Rear Output
80: 115V 60 Hz Line Operation
81: 115V 50 Hz Line Operation
90: Rack Mounting Kit

FACTORY/FOB

Indianapolis, IN
Norwich, England



Transconductance Amplifier

- **Extends Calibrator Current to 11A DC & AC**
- **Programmable From 4707, 4700 & 4705**
- **Rugged & Compact**

A significant proportion of lower performance bench and handheld DMMs are capable of measuring currents of up to 10A or more. In the interests of traceability and operator safety, these instruments require calibration at these higher current levels. The model 4600 Transconductance Amplifier is an attractive, compact solution, extending the current sourcing capabilities of the Datron range of Multifunction Calibrators and Standards to 11A DC or rms AC. It is designed for, but not limited to, operation in conjunction with a model 4707, 4700 or 4705 multifunction unit forming a combination that offers a unique level of performance and functionality.

Solo Mode

Working on the principle of converting a voltage input to a current output, with a transfer characteristic of 1 Amp DC or AC output for 1V DC or AC input, it may be coupled to any convenient voltage source. With total 90 day, ±1°C accuracies to ±125 ppm (DC currents from 0 to 11A) and ±430 ppm (AC currents from 0.9 to 11A at frequencies from 10 Hz to 5 kHz), a sufficient margin of calibration accuracy is assured over the performance of bench and handheld DMMs.

Slave Mode

When used in conjunction with a compatible model 4707, 4700 or 4705, two cables connect the Transconductance Amplifier to the Calibrator. The first cable is fully shielded and carries the analog voltage from the rear panel of the Calibrator to the rear panel of the Amplifier. A digital cable carries control signals between the two rear panels enabling the Calibrator to automatically determine the presence of the Amplifier, and control it. The 10A range of the Calibrator is then enabled, and the user is able to program the required current output from the front panel or IEEE-488 interface of the Calibrator.

Calibration

For use in the solo mode, where the Calibrator has no control over the amplifier, there are a series of easily accessible trimpots that allow periodic re-calibration of the model 4600 circuitry. The slave mode, however, eliminates the need for any mechanical adjustments during the re-calibration process, as it utilizes the Autocal technique employed in the Calibrator. At calibration, the Calibrator is informed of the voltage output required for a given output current at the terminals of the model 4600 and the Calibrator, in effect, stores the transconductance characteristics of the Amplifier. During normal operation, the Calibrator calculates the voltage required for the requested current output and automatically makes the necessary corrections.

SPECIFICATIONS

DC Current

Total Uncertainty Relative to Voltage Source: 90 day, 23°±1°C, ±80 ppm output ±500μA.

Temperature Coefficient (23°±10°C): 7 ppm/°C.

Input Impedance: 300kΩ.

Compliance: >2V.

AC Current

Total Uncertainty Relative to Voltage Source: 90 day, 23°±1°C, ±(330 ppm output +1.1 mA) 10 Hz-1 kHz. ±(0.1% output + 1.4 mA) 1-5 kHz.

Temperature Coefficient (23°±10°C): 10 ppm/°C.

Distortion:
0.2% (10 Hz-1 kHz).
0.5% (1-5 kHz).

Input Impedance: 300kΩ in parallel with 100 pF.

Compliance: >2Vrms.

GENERAL

Compatibility: Slave Mode compatible with all 4700 series multifunction calibrators equipped with firmware of issue 5.0 and above.

Isolation: 100V pk I-to-Chassis.

Output Protection: Fully protected against open circuit outputs.

Input Protection: 1.1kV DC or rms AC (10 sec), 240V DC or rms AC (continuous).

Calibration: Trimpots (Solo mode), Autocal from front panel or IEEE-488 interface of calibrator (Slave mode).

Environmental:
Operating temp: 0° to +50°C.
Storage temp: −40° to +70°C.

Dimensions: 89 mm (3.5 in.) high; 455 mm (17.9 in.) wide; 420 mm (16.5 in.) deep.

Weight: 10 kg (22 lb).

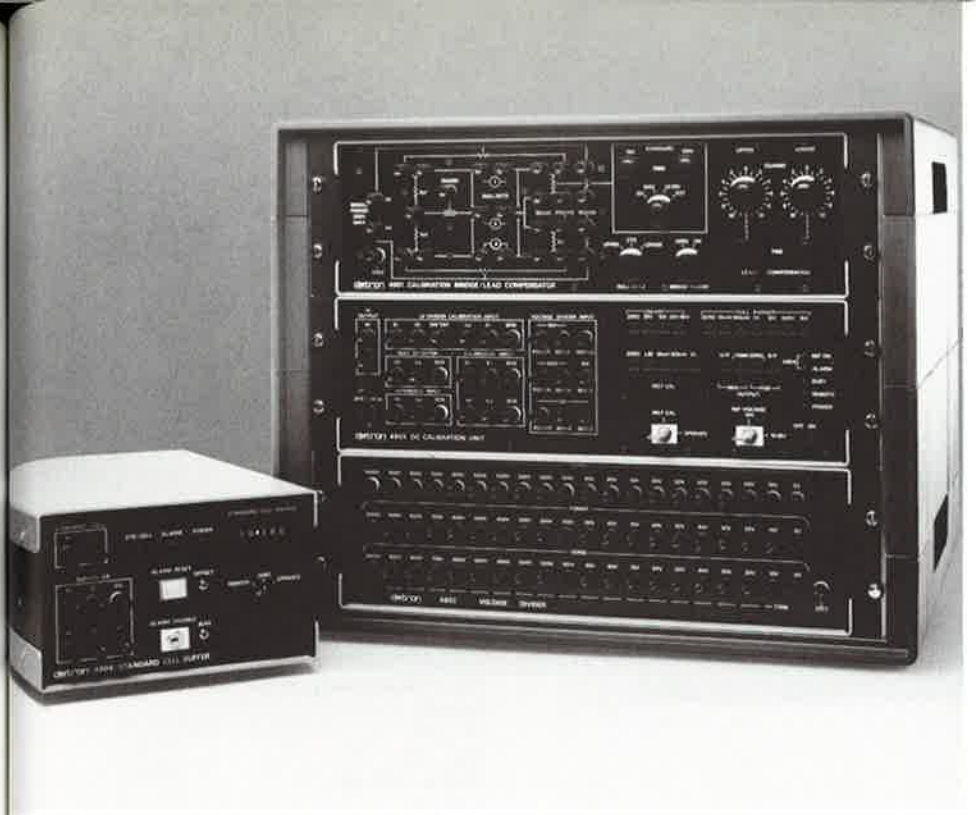
Power: 100/120/220/240 Vac ±10%. 50 or 60 Hz. Consumption 200W.

OPTIONS & ACCESSORIES

80: 115V 60 Hz Line Operation.
81: 115V 50 Hz Line Operation.
90: Rack Mounting Kit.
440151: Slave Mode Lead Kit.
440154: Current Output Lead Kit.

FACTORY/FOB

Indianapolis, IN
Norwich, England



DC Standards

- **4901 Bridge and Lead Compensator**
- **4902S Reference Divider**
- **4903 DC Calibration Unit**
- **4904 Standard Cell Buffer**

4902S Reference Divider and 4901 Calibration Bridge

The design and construction of the 4902S Divider and its companion Calibration Bridge (4901) significantly reduces or eliminates the sources of error in traditional divider designs, and is fully capable of providing 10:1 and 100:1 ratio accuracies, with a 100V or 1000V input, to within 0.2 ppm.

The 4902S is a true 4 wire, 5 terminal resistive divider. Each tapping is fully guarded by a companion guard chain, eliminating leakage errors. The guard shield for each tapping is accessible to the user on the front panel, so that effective guard connections can be made to the source of the measured signal. Each resistor element has a maximum of 10V applied across it, so that voltage coefficients, self and mutual heating effects are negligible and ensuring rapid settling times.

The 4901 Calibration Bridge and Lead Compensator is used to calibrate each section of divider to the very highest precision, using ratio techniques approved by National Standards authorities. Calibration of the individual elements of the 4902S at the voltage used during normal operation takes self heating, power and voltage coefficients into account, enabling the unit's ±0.2 ppm ratio accuracy.

SPECIFICATIONS (4902S)

Ratio Accuracy: 24 hours, ±1°C, assuming calibration with model 4901 Calibration Bridge: ±0.2 ppm (1000:10 and 100:10).
Temperature Coefficient: <±0.5 ppm/C.
Environmental: As 4904.
Dimensions: 132 mm (5.25 in.) high; 433 mm (17 in.) wide; 327 mm (12.9 in.) deep.
Weight: 5 kg (11 lb).

SPECIFICATIONS (4901)

Environmental: As 4904.
Dimensions: Same as 4902S.
Weight: Same as 4902S.

4904 Standard Cell Buffer

This device allows the user to take the accuracy of his sensitive Weston Standard Cells out of the standards laboratory, even onto the production floor, while providing protection against accidental damage by inexperienced operators. It is a low noise, low drift, unity gain amplifier with a 4-wire remote sense output stage so that it may drive Kelvin-Varley type dividers. During operation, it performs a comprehensive sequence of self tests to ensure that all of the internal circuitry is functioning correctly. On detection of an error condition it immediately disconnects the Standard Cell and audible and visual alarms notify the user of this fact.

SPECIFICATIONS (4904)

Input Voltage Range: 1 to 10 Standard Cell outputs (1.0V to 10.2V).
Offset Voltage: <0.1μV.
Noise: 0.3μV pk-pk.
Input Current: <5pA.
Output Current: 15 mA.
Output Resistance: <0.1mΩ.
Environmental:
Operating temp: 0° to +30°C.
Storage temp: −40° to +70°C.
Relative Humidity: <75% (0°-30°C).
Dimensions: 132 mm (5.25 in.) high; 222 mm (8.75 in.) wide; 327 mm (12.9 in.) deep.
Weight: 5 kg (11 lb).
Power: 100/120/220/240 Vac ±10%, 50 Hz or 60 Hz. Consumption 8VA.

4903 DC Calibration Unit

This unit is designed for, but not limited to, the calibration of the DCV functions of Datron calibrators. Primarily a switching matrix and precision low voltage divider, it is specifically designed for use with the 4902/S Reference Divider. It provides a convenient method of referencing DC voltages at levels between 10 mV and 1kV to prime standards without the time consuming and error-prone requirement of constantly changing lead connections.

SPECIFICATIONS (4903)

Output Voltage Accuracy: Relative to standards, within 24 hours of calibration using 4901 Calibration Bridge, ±1°C and use of 4902S Divider.

10mV	±0.4μV
100 mV	±4.3 ppm
1V	±0.7 ppm
10V	±0.1 ppm
100V	±0.7 ppm
1000V	±0.3 ppm

Environmental: As 4904.
Dimensions: Same as 4902S.
Weight: 7 kg (16 lb).
Power: 100/120/220/240V ±10%, 50 Hz or 60 Hz. Consumption 8VA.

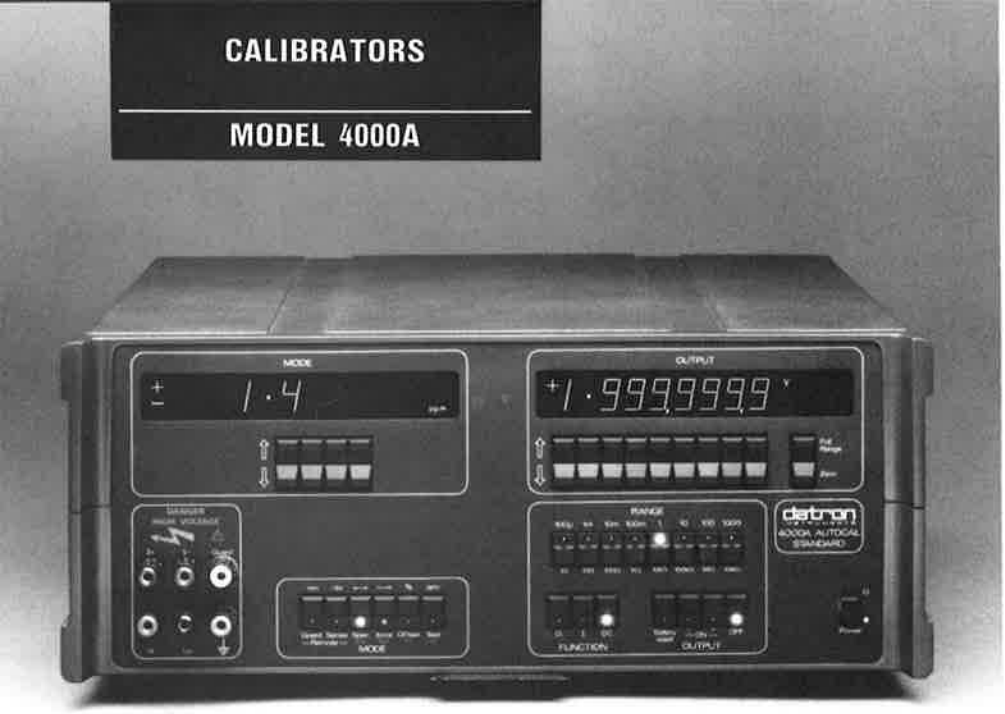
OPTIONS

90: Rack Mounting Kit. Specify model being mounted.
30: System Lead Kit for 4902S
10: System Lead Kit for 4903
20: System Cabinet (9U) for 4903

FACTORY/FOB

Indianapolis, IN
Norwich, England

MODEL 4000A



Autocal DC Standard

- **DCV, DCI and Ω Functions**
- **IEEE-488, Autocal, 4101B Compatible**
- **Calibrates up to 8½ Digit DMMs**

The 4000 Autocal Standard is a DC voltage, DC current and resistance calibrator specially designed for transportable accuracy, speed of operation and ease of use, both in the standards laboratory and in the production environment. 4000A includes all of the 4000's features, but extends the performance still further, achieving levels of stability and accuracy in hostile environments previously only available in temperature controlled laboratories.

In their most basic format, these calibrators offer very high accuracy DC voltage outputs up to 1100V, controllable from the front panel and via the integral IEEE-488 interface. Addition of the combined DC current and resistance option extends the functionality of these instruments still further, offering DC current to 2A and Resistances between 1Ω and 10MΩ.

Ease of Use

The 4000/A calibrators are "user friendly." Output setting, for example, is fast and easy using rapid rolling up/down keys. Two extra dedicated keys are provided for fast selection of full range and zero. The selected output is shown at all times on a 7½ digit high brightness display, while the deviation controls, "Error" and "Offset" allow the output of the calibrator to differ from that indicated on the main output display. This is particularly useful when checking the linearity of measuring instruments.

SPECIFICATIONS

DC Voltage (4000A)

Ranges: 100μV to 1000V in decades.
Full Scale: 2X range, except 1000V range, where max output=1100V.
Resolution: 1 digit in 19,999,999 or 10nV, whichever is greater.
Total Uncertainty: 90 day, 23° ±1° C, (±ppm Output ±μV).
100μV to 100mV Ranges: 8±1.4.
1V Range: 5±0.8.
10V Range: 3.5±5.
100V Range: 5±100.
1000V Range: 6±500.

DC Voltage (4000): As 4000A, except:
Total Uncertainty: 90 day, 23° ±1°C, (±ppm Output ±μV).
100μV to 100mV Ranges: 10±1.5.
1V Range: 6±2.
10V Range: 4.5±10.
100V Range: 6±200.
1000V Range: 8±3mV.

DC Current (4000 and 4000A, Op 20)

Ranges: 100μA to 1A in decades.
Full Scale: 2X range.
Resolution: 1 digit in 1,999,999 or 100pA, whichever is greater.
Total Uncertainty: 90 day, 23° ±1°C, (±ppm Output ±nA).
100μA Range: 29±1.
1mA Range: 29±10.
10mA Range: 29±100.
100mA Range: 29±1μA.
1A Range: 71±20μA.

Resistance (4000 and 4000A, Op 20)

Ranges: 1Ω to 10MΩ in decades. (Ranges are nominal, actual calibrated values are displayed.)
Display Resolution: 1 digit in 19,999,999.
Total Uncertainty: 90 day, 23°±1°C (±ppm Output).
1Ω: ±30.
10Ω: ±20.
100Ω & 1kΩ: ±8.
10kΩ: ±7.
100kΩ: ±13.
1MΩ: ±27.
10MΩ: ±42.

GENERAL

Calibration: Autocal from front panel or via the IEEE-488 interface.
Environmental:
Operating Temp: 0° to +50°C.
Storage Temp: −40° to +70°C.
Dimensions: 178 mm (7 in.) high; 455 mm (17.9 in.) wide; 563 mm (22.2 in.) deep.
Weight: 30 kg (66 lb.) net.
Power: 100/120/220/240 Vac ±10%, 50 or 60 Hz. Consumption <300 VA.

OPTIONS

20: DCI and Ω Functions.
42: Alternative Rear Output.
80: 115V 60 Hz Line Operation.
81: 115V 50 Hz Line Operation.
90: Rack Mount Kit.

FACTORY/FOB

Indianapolis, IN
Norwich, England

Autocal AC Standard

- **ACV and ACI Functions**
- **ACV Outputs from 10 Hz to 1 MHz**
- **IEEE-488, Autocal, 4101B Compatible**
- **Calibrates High Accuracy AC DMMs**

The model 4200A is the ultimate prime AC source for any standards or calibration laboratory, achieving levels of accuracy and stability in hostile environments previously only attainable in temperature controlled laboratories. It features 90 day, ±1°C total uncertainties of ±100 ppm, and output levels from 90μV to 1100V at frequencies between 10 Hz and 1 MHz. The output drive stages are solid state, providing a compact and highly reliable method of sourcing the high voltage-high frequency test points required by many of today's DMMs.

SPECIFICATIONS

AC Voltage

Ranges: 1 mV to 1000V in decades.
Full scale: 2 x range except 1000V range, where max output=1100V.
Resolution: 1 digit in 1,999,999 or 100nV, whichever is greater.
Frequency: Ranges: 100 Hz to 1 MHz in decade steps. Resolution: 1% of range. Accuracy <±100 ppm.
Sensing: Selectable remote/local sensing on 1V to 1000V ranges.
Guarding: Selectable remote/local guarding.
Maximum Capacitive load: 1000 pF on 1V to 100V ranges, 300 pF on 1000V range.
Total Uncertainty: 90 day, 23° ±5°C (±ppm Output ±ppm Full Scale).

1mV to 100 mV Ranges:	
170±30+6μV	(10-31 Hz)
140±20+6μV	(32-330 Hz)
130+20±6μV	(300-10 kHz)
280+20±6μV	(10-33 kHz)
800+20±6μV	(30-100 kHz)
0.14%+0.01%±11μV	(100-330 kHz)
0.24%±0.1%+21μV	(300k-1 MHz)
1V and 10V Ranges:	
140±20	(10-31 Hz)
100±10	(32-330 Hz)
90±10	(300 Hz-33 kHz)
170±20	(30-100 kHz)
500±100	(100-330 kHz)
0.23%±0.04%	(300k-1 MHz)
100V Range:	
140±20	(10-31 Hz)
100±10	(32-330 Hz)
90±10	(300-10 kHz)
100±10	(10k-33 kHz)
200±20	(30-100 kHz)
650±100	(100-200 kHz)
1000V Range: (Option 10).	
150±25	(45-330 Hz)
130±25	(300 Hz-10 kHz)
200±25	(10-33 kHz)
900±50	(30-100 kHz, up to 750V only)

Settling Times: to 100 ppm of step size: <10s (10-31 Hz), <3s (32-330 Hz), <1s (>330 Hz).

AC Current (Option 30)

Ranges: 100μA to 1A in decades.
Full scale: 2 x range.
Resolution: 1 digit in 1,999,999 or 100 pA, whichever is greater.
Total Uncertainty: 90 day, 23° ± 5°C (±ppm Output±nA).

100μA Range:	
600±10	(10-1 kHz)
1050±16	(1k-5 kHz)
1 mA Range:	
320±100	(10-1 kHz)
450±100	(1k-5 kHz)
10 mA Range:	
320±1μA	(10-1 kHz)
450±1μA	(1k-5 kHz)
100mA Range:	
320±10μA	(10-1 kHz)
450±10μA	(1k-5 kHz)
1A Range:	
500±100μA	(10-1 kHz)
750±160μA	(1k-5 kHz)

Guarding: Selectable remote/local guarding.

GENERAL

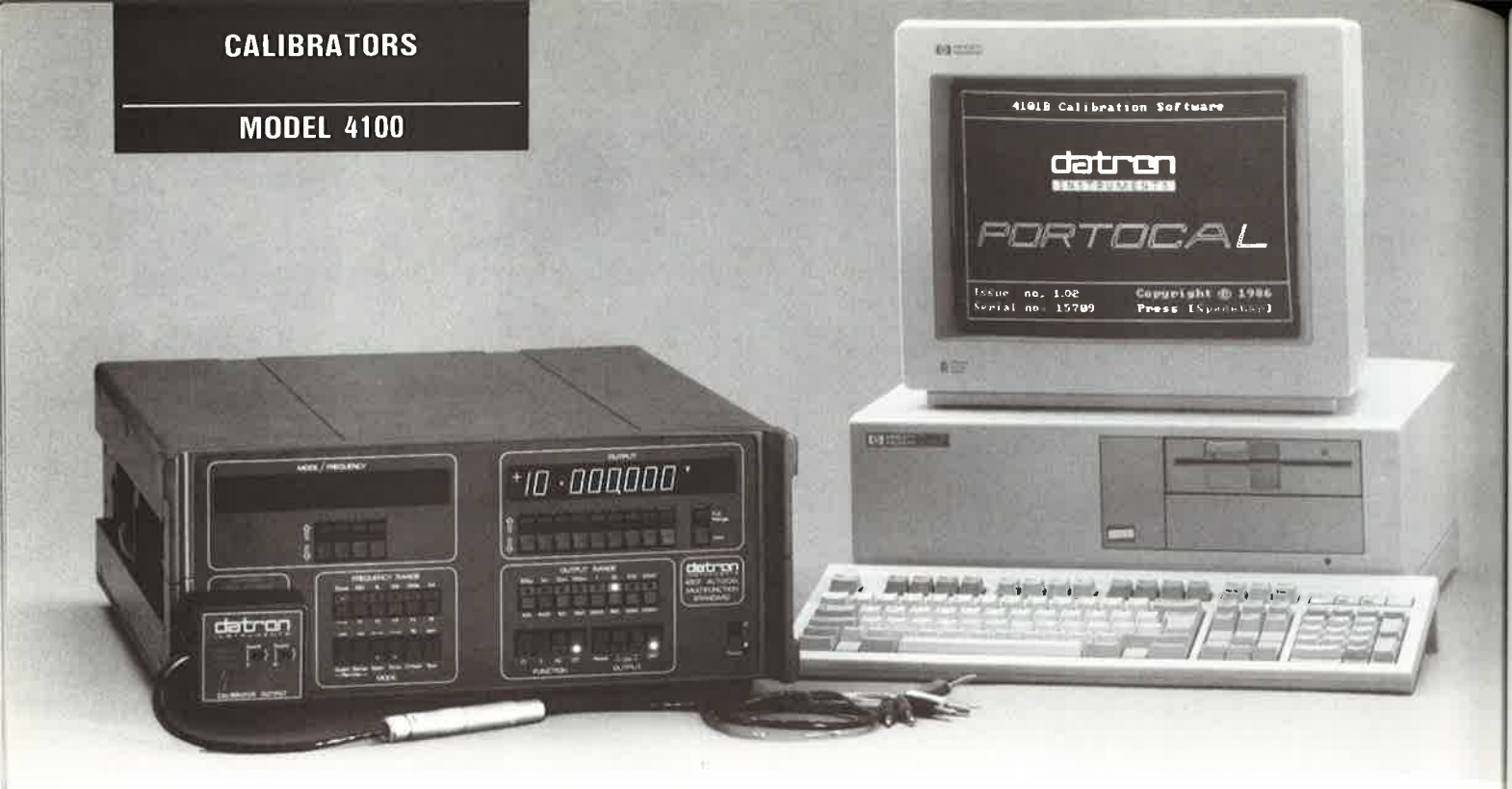
Calibration: Autocal from front panel or via the IEEE-488 interface.
Environmental:
Operating temp: 0° to +50°C.
Storage temp: −40° to +70°C.
Dimensions: 178 mm (7 in.) high; 455 mm (17.9 in.) wide; 563 mm (22.2 in.) deep.
Weight: 36 kg (80 lb).
Power: 100/120/220/240 Vac ±10%, 50 Hz or 60 Hz. Consumption 100VA standby, 450VA full power.

OPTIONS

10: 1000V Range
30: Current Function
42: Alternative Rear Output
80: 115V 60 Hz Line Operation
81: 115V 50 Hz Line Operation
90: Rack Mounting Kit

FACTORY/FOB

Indianapolis, IN
Norwich, England



Multimeter Calibration Systems

- **Calibrates Any Type of DMM or Analog Meter**
- **Comprehensive Menu Driven Structure, Easy to Use**
- **Runs on IBM PC-XT, HP Vectra, Compaq Portable**
- **Extensive Instrument Inventory Management Capabilities**
- **Compatible With All Datron Calibrators**

The 4100 PORTOCAL series of multimeter calibration systems offers a selection of high quality systems configured with Datron calibrators, calibration software and accessories. All 4100 systems are supplied with the 4101B Portocal Multimeter Calibration Software, a powerful and flexible package which is totally menu driven, and compatible with all Datron calibrators and IBM PC-XT, HP Vectra and Compaq Portable II controllers.

Users of this software have a tremendous choice of options in setting up automated calibration systems. The calibration hardware available ranges from the model 4707 (for calibration of standards and high performance system DMM's) to the more cost effective models 4700 or 4705 (for 6½ and 5½ digit calibration), and even the model 4600 Transconductance Amplifier for high current calibration. In addition, a range of accessories is also available which includes lead kits, bar code readers, tape drive units, cabinets and mobile calibration carts so that systems can be configured for many different requirements—from bench use in the calibration laboratory to far more demanding mobile calibration roles.

4101B Software

The Portocal software is a self-contained package resident in its own subdirectory on the hard disk, allowing the use of the controller for tasks other than calibration. It is designed to maximize the effectiveness of the Datron Autocal range of calibrator hardware and to guide the user in developing and controlling the calibration process, while providing, through the use of passwords, protection against unauthorized modification of any of the calibration procedures or historical data stored on the system.

Its use is not confined to IEEE-488 controllable DMMs, in fact all types of DMMs may be calibrated, from instruments that incorporate some method of electronic calibration (e.g. Autocal), to instruments that are controllable over the IEEE-488 interface but calibrated by operator intervention, and finally to instruments that are totally manually controlled and calibrated.

A dual port IEEE-488 interface is used so that the system calibrator is on a separate bus to the instrument under test. This means that should an instrument under test be faulty, Portocal is always able to reset the analog output of the system to a safe level and make error reporting and diagnosis easier. Secondly, this allows the software to execute an auto address search routine for the instrument-under-test, eliminating the need for any address settings to be modified. Thirdly, it enables an in-situ approach to the calibration of systems DMMs, as the address of the calibrator will not conflict with any instruments in the system containing the device under test.

Easy to Use

Ease of use is a prime feature of Portocal which, being menu-driven, does not require the user to be familiar with either instrument controllers

or their various languages. Furthermore, the software is specifically designed for the minimum of operator intervention in order to reduce possible human errors. For example, incorporating the calibration procedure library and the instrument and results database on a high capacity hard disk means that the operator has only to enter the instrument's serial number (either via the keyboard or the optional barcode reader) to completely set up the system for calibration of that instrument. The storage of all files required on the hard disk also eliminates the need for an operator to be constantly changing floppy disks.

Calibration Procedures

Generation of a calibration procedure for bus controlled instruments is swift and straightforward as detailed understanding of the operation and programming requirements of the IEEE-488 interface is not required. The user merely has to inform the 4101B software of which commands are required to select a given function, range, etc., and how the instrument should be triggered (information that is readily available from the instrument's operating manual) and the software is then able to control the instrument under test.

Programming the calibration of manually controlled instruments is even simpler. At each point that manual intervention is required, the user enters the relevant instruction text into an instruction menu, and the software then automatically handles all of the interaction with the operator and the calibrator.

Different manufacturers have different ways of expressing an instrument's performance, so there are many different ways that the user can specify the limits to which the unit is to be tested. Entry of these limits is simply a matter of entering the specifications as they are printed in the manufacturer's datasheet or operating manual, and Portocal will make all of the necessary calculations at run time.

Custom Certificates

Each organization has its own terminology, nomenclature and calibration certificate formats. Portocal allows the generation and storage of up to 20 customized calibration certificate designs, which are stored in a certificate library. Furthermore, the Universal Titles facility allows the user to modify the contents of fields displayed throughout the software. This allows the user to change, say, the prompt "Serial Number" to "Asset Number" in one single menu and have this change reflected throughout the software.

Instrument & Results Database

The use of a high capacity hard disk for the storage of all data and programs means that the details of all instruments calibrated by the system may be stored in the instrument inventory and calibration results database. Extensive database search facilities exist which allow, say, a search for all instruments that will require calibration next week. This facility is not limited to instruments that may be calibrated by the system, and therefore provides the basis for a computerized inventory management system. The user has access to the results in the library through an easy to use, menu driven sub-program, where results may be selected for recall, analyzed, printed, or "dumped" into an ASCII disk file or over the RS-232 serial interface for later examination by other commercial or even user-generated software.

System Management

The system management facilities available are comprehensive. They enable important functions such as backup of data to floppy disk or tape drive unit to be performed without leaving Portocal. Unwanted calibration results and instrument records may be deleted from the database, while the archive results facility allows important calibration results to be transferred from the results library to floppy disks in order to free up disk space. An abbreviated record for each result archived in this way is retained in the results library, so that these results are still accessible to the user. If recall of any of these archived results is required, the system will automatically prompt the user for the insertion of the correct archive disk.

SYSTEM ANALOG PERFORMANCE

To specify performance at the remote end of the analog lead assembly (either the 4102/4112 calibration carts or the PLK-1 and PLK-2 lead kits), add the following uncertainties to the specifications of the calibrator to be used in the system.

DC Voltage: No additions required.

AC Voltage:

1 mV to 100 mV Ranges:
Add 2%R+3%FS (100 kHz-1 MHz).

1V and 10V Ranges:
Add 0.3%R+0.1%FS (300 kHz-1 MHz).
Volts x Hertz product 2 x 10^7 Max.
No other additions required.

Resistance:
1MΩ Range: Add 10 ppm Output.
10MΩ Range: Add 100 ppm Output.
100MΩ Range: Add 1000 ppm Output.

DCI and ACI: No additions required.

MODEL 4101B SOFTWARE

Program Size: 1.5 MBytes.
Max Number of Calibration Procedures: 999.
Typical Procedure File Size: 10 kBytes.
Max Number of Certificate Designs: 20.
Typical Certificate File Size: 8 kBytes.
Capacity of Instrument Inventory: 32,000.
Typical Instrument File Size: 120 Bytes.
Disk Operating System: PC-DOS 3.0 or later, MS-DOS 3.1 or later.

CONTROLLER CONFIGURATIONS

These are the controller configurations that will support the 4101B software package

IBM PC-XT

System unit, including 256k Ram (minimum), 360kByte floppy drive, 20MByte hard drive and asyncronous communications adaptor.
Parallel Printer Adaptor
CGA Color Card
Color Monitor
Keyboard
IBM PC-DOS (3.0 or later)
IBM Basic
Ziatech ZT1488A and zSBX20 Interface Cards

Model 4103A

HP Vectra ES Model 22 (D1222A). Includes 45979D CPU, 1.2 MByte floppy (5.25 in.), 20 MByte winchester, EGA video card, serial and parallel ports.
14 In. Enhanced Monitor (35743 BU)
MSDOS 3.2 + PAM (45951 BU)
GW Basic (HP 45952A)
Ziatech ZT1488A and zSBX20 Interface Cards (Datron Part 440127)

Model 4103B

Compaq Portable II Model 3. Includes 640k RAM, 360 kByte (5.25 in.) floppy drive, 20 MByte winchester, CGA video card, serial and parallel ports, keyboard and integral monitor.
MS-DOS (3.1 or later).
Basic Interpreter
Ziatech ZT1488A and zSBX20 Interface Cards (Datron Part 440127).

Model 1404

Epson Printers: FX80 and FX800 Series.

MODEL 4102 CALIBRATION CART

Includes all power distribution and cabling.

OPTIONS & ACCESSORIES

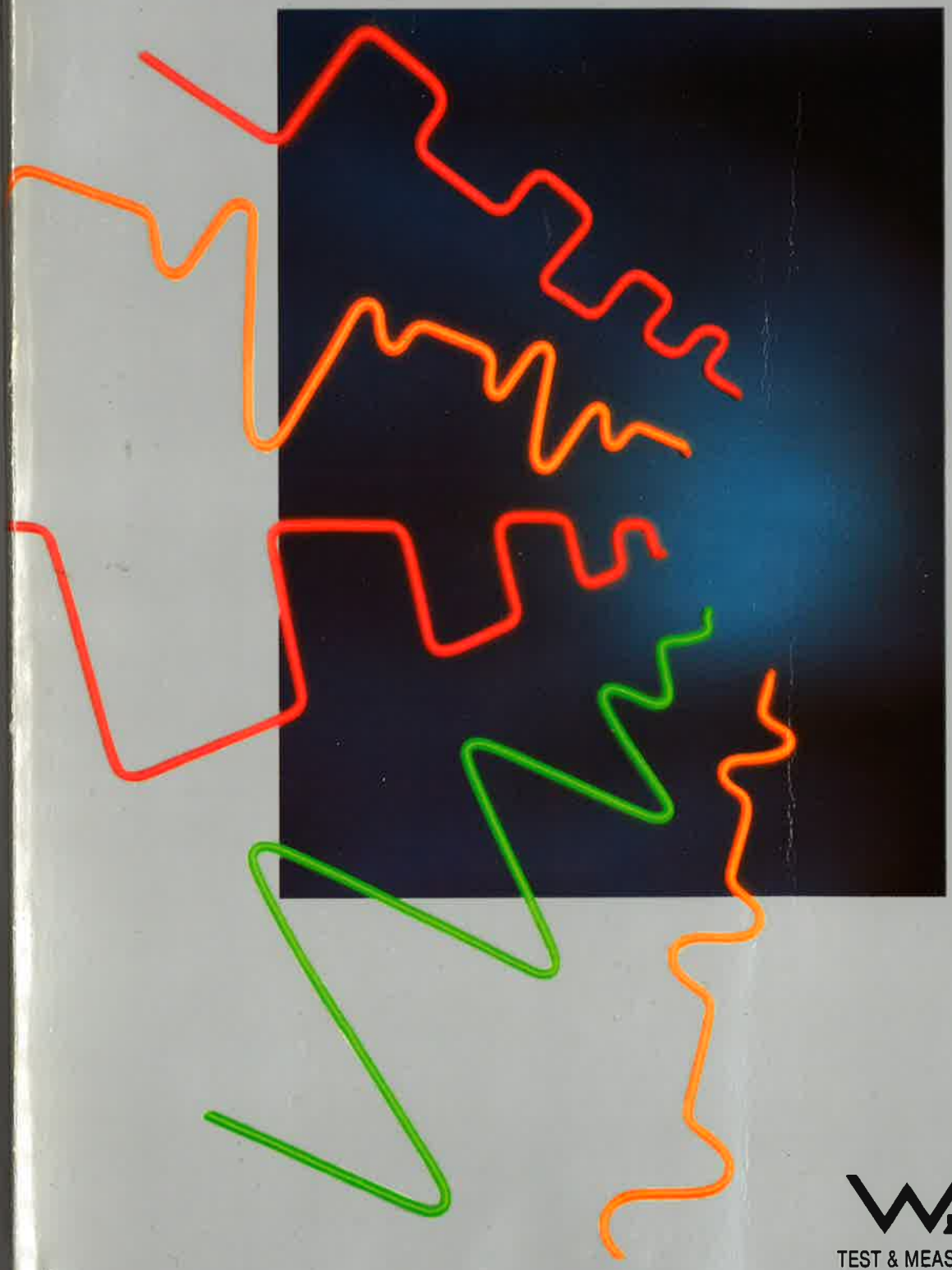
03: Barcode Reader
440127: Ziatech ZT1488A and zSBX20 Interfaces
PLK-1: Analog Benchtop Lead Kit. For 4000A, 4200A Configurations.
PLK-2: Analog Benchtop Lead Kit. For 4700 Series Configurations.
440154: 11A Current Lead Kit. For use in systems containing model 4600.
400277-0.5: 0.5m IEEE Cable
400277-1: 1m IEEE Cable
400277-2: 2m IEEE Cable

FACTORY/FOB

Indianapolis, IN
Norwich, England

25th ANNIVERSARY

INTERFAX SYSTEMS INC.
Suite 304, Discovery Park
3700 Gilmore Way, Burnaby, B.C.
(604) 430-1410 V5G 4M1



INSTRUMENTS ON A CARD

WAVETEST GPIB SOFTWARE

FUNCTION & ARBITRARY WAVEFORM GENERATORS

PULSE GENERATORS & WAVEFORM ANALYZERS

RF SIGNAL & SWEEP GENERATORS

MICROWAVE SIGNAL & SWEEP GENERATORS

MICROWAVE SCALAR ANALYZERS

MICROWAVE CW & PEAK POWER METERS

PRECISION DIGITAL MULTIMETERS

CALIBRATORS

DATA LOGGING SYSTEMS

SIGNAL PROCESSING FILTERS

SIGNAL SWITCHING SYSTEMS

CATV SIGNAL LEVEL METERS

CATV SYSTEM ANALYZERS

CATV SYSTEM SWEEP

RF COMPONENTS

WAVETEK

TEST & MEASUREMENT INSTRUMENTATION 1988-89