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INSTRUMENTS

THE 1271 SELFCAL DIGITAL MULTIMETER

THE MODEL 1271 SELFCAL PRECISION SYSTEMS DMM

A PREMIUM DMM FOR THE SYSTEM SPECIALIST
'Designed by engineers for engineers . . .'

FUNCTIONAL CAPABILITY, HIGH ACCURACY & VALUE
'. . . unrivalled combinations of performance and price.'

1000/SEC USABLE $5\frac{1}{2}$ DIGIT READINGS
'. . . consistent with stable and noise-free data.'

IEEE-488.2 COMPATIBLE
'. . . speed up system implementation.'

TRACEABLE 'AUTOCAL' & 'SELFCAL'
'. . . conform to well established principles . . .'

OUTSTANDING DIAGNOSTICS
'. . . most exhaustive test program ever. . .'

1271 SELFCAL DIGITAL MULTIMETER

2 WIRE AND 4 WIRE OHMS

OHMS GUARD TO MINIMIZE PARALLEL PATH EFFECTS FOR IN-CIRCUIT RESISTANCE MEASUREMENTS

ANALOG OUTPUT FOR XY PLOTTERS AND CHART RECORDERS

READING RESOLUTION FROM $8\frac{1}{2}$ DIGITS TO $5\frac{1}{2}$ DIGITS

199,999,999 FLOATING POINT HIGH BRIGHTNESS VACUUM FLUORESCENT DISPLAY, WITH FULL FUNCTION ANNUNCIATION

TWO REAR INPUTS

FULLY PROGRAMMABLE IEEE-488.2 INTERFACE

INSTANTANEOUS DISPLAY OF INSTRUMENT STATUS

CONFIGURE EACH FUNCTION FOR RESOLUTION, FILTER, AND SPEED

AUTORANGING ON ALL FUNCTIONS INCLUDING RATIO. UP AT 200% RANGE, DOWN AT 18.8% RANGE

40 CHARACTER DOT MATRIX MENU DISPLAY

SELECT FROM MENU USING SOFT KEYS

DUAL PURPOSE KEYS ALLOW KEYBOARD ENTRY

SELFCAL ENHANCED ACCURACIES

FULL FRONT PANEL CALIBRATION WITH AUTOCAL

RETRACTABLE LOW THERMAL INPUT TERMINALS OF GOLD PLATED COPPER

FULLY FLOATING & GUARDED INPUT, LO GUARD - 250V RMS GUARD-GROUND - 650V RMS

INHIBITS INTERNAL TRIGGERS, ENABLES IEEE-488.2, REAR OR FRONT PANEL TRIGGERS

FRONT PANEL SINGLE SHOT TRIGGER

FRONT PANEL GENERATION OF SRQ's

CALIBRATION TRIGGER

AUTOMATIC INPUT ZERO ZEROS ALL RANGES WITH 'AUTO' SELECTED

DCV, 10nV-1100V

TRUE RMS ACV, 100nV-1100V, WITH 1Hz-1MHz AND DC COUPLED AC FACILITY

RESISTANCE, 1μΩ-2GΩ, WITH TRUE 4 WIRE MODE, LOW CURRENT MODE AND AUTOMATIC ELIMINATION OF ZERO OFFSETS

DCI, 100pA-2A TRUE RMS ACI 1nA-2A, 10Hz-5kHz

CHOICE OF THREE INDEPENDENT INPUTS, RATIO, DIFFERENCE AND DEVIATION

MONITOR PROVIDES SPECIFICATION READOUT, MAX/MIN, PEAK-PEAK, LIMITS, AND SIMULTANEOUS FREQUENCY AND RMS ACV DISPLAYS

SELFTEST DIAGNOSTICS WITH COMPREHENSIVE DISPLAY OF ERROR CODES

COMPUTATION CAPABILITY FOR OFFSETS, SCALING, dBs AND AVERAGING

The Datron 1271 is a Premium Digital Multimeter designed for the system specialist. It has a performance optimized for military and aerospace test applications and is a significant addition to the Datron SELFCAL range of DMMs.

With DCV and IEEE-488 bus control fitted as standard, the model 1271 also offers individual Ohms, Ratio, DCI & ACI options and two versions of ACV to produce unrivalled combinations of performance and price.

High accuracy is provided across all functions, and with scale lengths from $5\frac{1}{2}$ to $8\frac{1}{2}$ digits and resolutions of 1 part in 200 million, a useful range of read-rates is achieved.

With systems use firmly in mind, the 1271 incorporates a variety of dedicated facilities. Maths processing, reading storage and limit testing are available on all functions. Included on Ohms are active guard, low source current and true ohms, to maintain accuracy in difficult measurement applications.

Remote control using the IEEE-488 interface conforms to the latest IEEE-488.2 specification, offering increased software standardization and therefore faster system implementation.

Serviceability has received careful attention in the 1271, resulting in the most exhaustive test program ever in a systems instrument of this type. More than 250 individual points are checked to provide the operational confidence necessary to meet National Quality Standards.

The high accuracy claims of the 1271 are supported by two independent re-calibration techniques, AUTOCAL and SELFCAL, both offering guaranteed traceability to provide the highest possible calibration confidence.

Overall the 1271 is an outstanding DMM, it is packed with features but straightforward and practical in use. Designed by engineers for engineers and with a performance unequalled in the premium systems sector.

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ANALOG EXPERTISE

Datron's wealth of specialist experience has resulted in excellent analog performance in the 1271.

On DCV, inputs from 10nV to 1kV are processed by a pre-amplifier optimised for low noise but with a wide bandwidth for fast response. An input impedance of > 10GΩ is maintained for inputs to 20V and a super low temperature coefficient of < 0.1μV/°C eliminates the requirement for intermediate and time-consuming zeroing cycles. Long-term stability of 8ppm/year surpasses even the most demanding systems requirements.

For RMS ACV measurements only a truly analog technique reliably covers the divergent needs of a typical system.

Using Datron's acclaimed 'log feedback' technique, further refinements have been introduced to offer two alternatives - one with the highest accuracy attainable, the other speed of operation. Inputs up to 1kV RMS can be measured from 1Hz to 1MHz, with direct readout of frequency also available.

Ohms measurements have received equal attention in the 1271. Accepting inputs from 1μΩ to 2GΩ, the circuit is truly four-wire and uses an innovative 'flying capacitance' technique to produce a genuine fully floating current source.

To complete the multifunction capability, a set of internal precision current shunts enables measurements in five ranges of DCI up to 2A, and ACI in the frequency range 10Hz-5kHz.

Line related EMI degrades performance on all functions, and to combat this, the critical timing waveforms of the 1271 digitizer precisely synchronize with the frequency of the incoming power line. The effect of this 'line-locking' is to present a deep and narrow 60dB continuously tracking rejection notch which is independent of the input amplifier response time and supports high data rates.

In cases of excessive wideband input noise, on DCV and Ohms where unstable readings could occur, a selectable 2 pole active filter can be introduced to provide a further 40dB above 50Hz.

Similar errors result from undesirable common mode signals present at most system interfaces. By careful design, rejection levels of > 140 dB on DCV and > 90dB on ACV attenuate these effects to preserve measurement integrity.

FUNCTIONAL CAPABILITY

Recognizing that systems applications are among the most functionally demanding and environmentally unfavourable, the 1271 has been designed with a diverse and impressive range of facilities.

On ratio measurements, both independently zeroed and separately guarded inputs have DC/DC, AC/DC, AC/AC and Ω/Ω capability, with reference inputs up to 250V RMS and outputs expressed as a ratio, difference or deviation.

Maximum and minimum reading memories are continuously updated, from which peak to peak outputs are derived - useful in noise measurement applications. For further statistical work a diversity of digital filtering selections provide block, continuous, rolling or timed average, and other maths routines can be set up for linear rescaling and readings in dB. Further memories accept user defined limit levels, from which alarm signals output via the IEEE-488 bus and directly on a separate rear panel connector.

Both the high accuracy and high speed ACV options can be DC coupled for non-symmetrical inputs, and also measure frequency in the range 1Hz to 1MHz.

Resistance measurements can be seriously affected by offsets, noise and thermals always present at the analog interfaces of a system.

However, in the 1271, the fully-floating four-wire Ohms circuit can operate with 100Ω in any or all leads with negligible effect. For ATE in-circuit work, an ingenious and unique ohms guarding design minimizes the effects of parallel paths, yielding only the resistance value of interest. This same circuit also masks out parallel and stray capacitances to produce a remarkable increase in system speed especially when measuring high values.

Using the DMMs True Ohms facility, an intermediate 'voltage only' measurement detects and eliminates the effects of thermals in the resistance circuit.

In sensitive applications the resistance to be measured can alter due to self-heating by the DMM's source current. The 1271's 'Lo Current' selection scales down the source current to mimimize this effect. This is particularly useful when using the 1271 with platinum resistance thermometer (PRT) sensors for temperature readout. As a further benefit of 'Lo Current' operation, the voltage developed across the resistance under test does not exceed semiconductor junction thresholds, enabling in-circuit testing on complex assemblies.

"... a diverse and impressive range of facilities."

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BUS CONTROL

The 1271 remote control interface conforms to the latest IEEE-488.2 specification. This is compatible with the IEEE-488 (1978) version, but now introduces specific message handling protocols, common commands and standard status reporting formats.

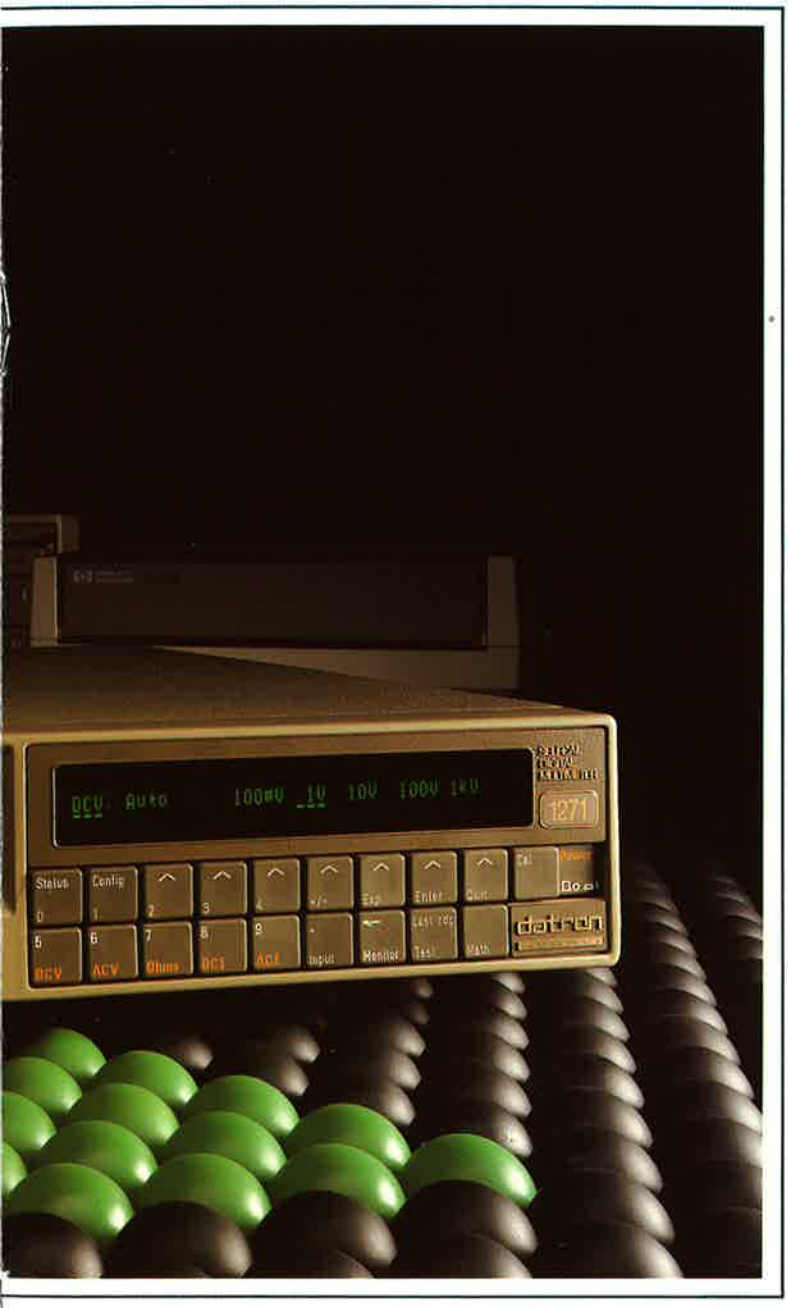
The new standard ensures that the DMM only responds to messages presented strictly in the correct format. This eliminates the illogical states and potential 'lock-ups' possible with some designs.

Common commands are defined by the standard for basic operation. A full set of other commands, specific to the 1271, are provided to retain full flexibility of control. These, compatible in format with the mandatory commands, are also in abbreviated plain English and readily comprehensible to engineer and programmer alike.

Standard status reporting is conducted in a logical manner, using a first level register to provide a summary report from which subsidiary registers can be interrogated for the detailed status of the DMM. This efficient approach to reporting ensures that the controller always has appropriate data and can therefore better control the programmed task.

Debugging is a necessary activity in any program development and in the 1271 this is simplified by using front panel keys to initiate a trigger and service request and also return the DMM to local control. In addition, extensive built-in syntax checking alerts the application programmer to errors in the control program.

"... all selections have been 'fine-tuned' to maximise throughput."



This new level of IEEE-488.2 standardization offers the user a welcome opportunity to acquire and use systems experience that applies not only to the 1271, but to other instruments which conform. Equally, once developed, programs can be transferred to and from other systems to speed up overall system implementation.

Only under remote control can the speed of the 1271 be fully realized. With 64K bytes of memory fitted as standard, $5\frac{1}{2}$ digit fully formatted readings at 1000/second can be data-stored for subsequent output via the interface. For continuous bus operation, speeds of 150 readings/second are achievable.

In the 1271 all selections have been 'fine-tuned' to maximise throughput consistent with stable and noise-free data. For any combination of function or range a comprehensive table of internal default delays ensures full analog settling before digitisation.

Front and rear inputs are fully programmable, and in addition to the IEEE-488, a separate rear connector outputs TTL level signals for synchronizing scanning systems and direct limit alarm detection.

For dedicated military systems applications an alternative MATE (CIIL) option is available.

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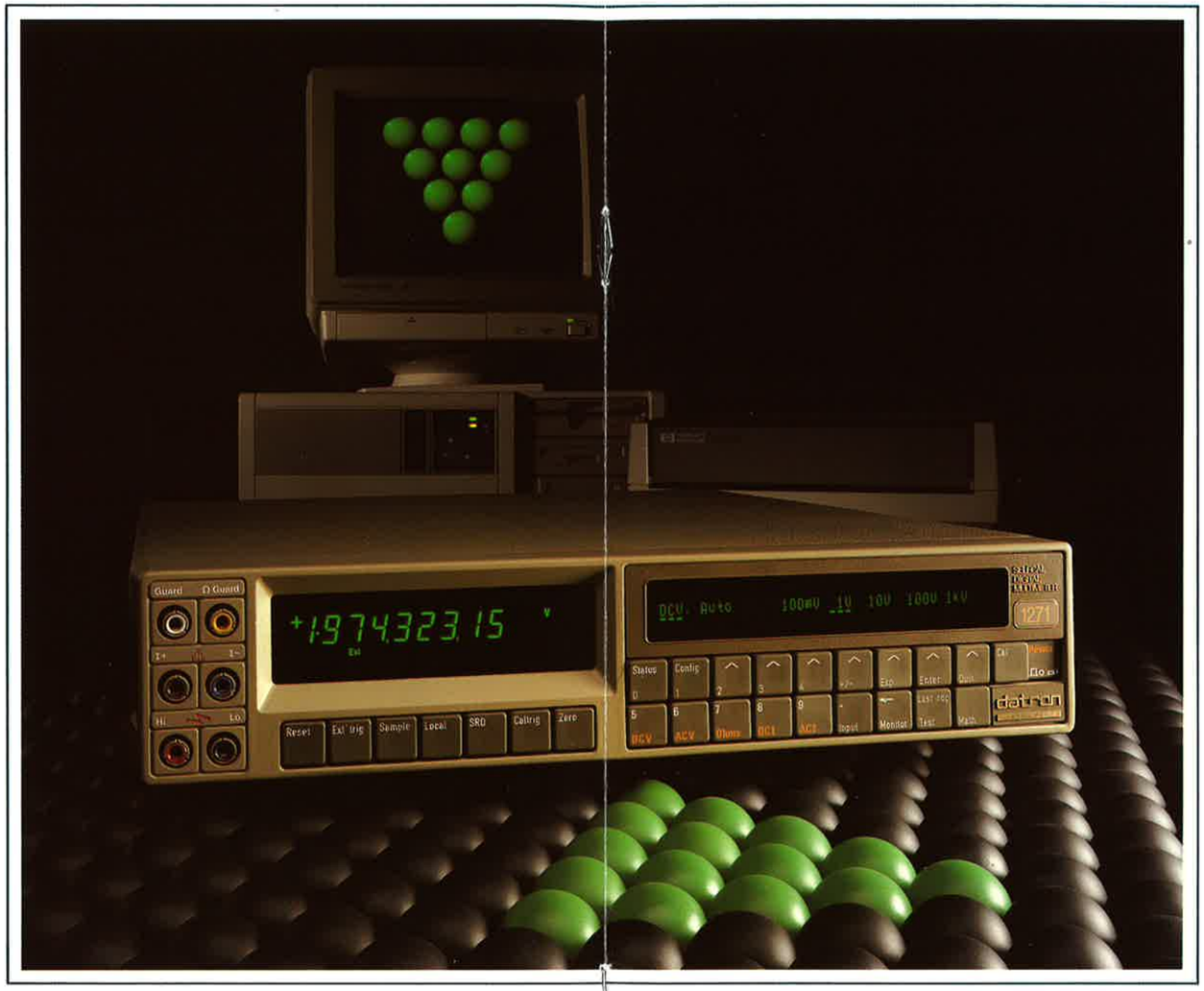

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Only under remote control can the speed of the 1271 be fully realized. With 64K bytes of memory fitted as standard, 5½ digit fully formatted readings at 1000/second can be data-stored for subsequent output via the interface. For continuous bus operation, speeds of 150 readings/second are achievable.

In the 1271 all selections have been 'fine-tuned' to maximise throughput consistent with stable and noise-free data. For any combination of function or range a comprehensive table of internal default delays ensures full analog settling before digitisation.

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FUNCTION	RANGE	FREQUENCY (Hz)	ACCURACY RELATIVE TO CALIBRATION STANDARDS [2] ±(ppmR + ppmFS) [3]		CALIBRATION UNCERTAINTY (ppm)	TEMPERATURE COEFFICIENT (ppm/°C) [4]
			24 Hour 23°C± 1°C	1 Year [4]		
DC VOLTAGE	100.00000mV		3 + 1	10 + 1	4.5	0.3
	1.00000000V		2 + 0.5	8 + 0.5	3.5	0.25
	10.0000000V		2 + 0.25	7 + 0.25	2.5	0.25
	100.000000V		3 + 0.5	8 + 0.5	4.5	0.4
	1000.00000V		3 + 1	10 + 1	4.5	0.4
AC VOLTAGE	100.0000mV	40-2k	150 + 70	250 + 70	40	5
		2k-20k	300 + 120	400 + 120	170	10
High Speed		20k-100k	800 + 220	0.16% + 0.022%	450	50
10Hz-1MHz	1.000000V to 100.0000V	40-20k	100 + 50	200 + 50	30	10
		20k-100k	400 + 200	0.1% + 0.02%	70	50
[5]		100k-300k	0.5% + 0.5%	1% + 1%	200	50
		300k-1M	1.5% + 1%	2% + 2%	500	50
	1000.000V [7]	40-2k	150 + 70	250 + 70	100	10
		2k-20k	300 + 120	400 + 120	100	10
		20k-100k	800 + 220	0.16% + 0.022%	200	50
AC VOLTAGE	100.0000mV	40-10k	60 + 20	100 + 20	40	5
		10k-30k	250 + 30	300 + 40	170	10
High Accuracy		30k-100k	400 + 100	700 + 100	450	50
1Hz-1MHz	1.000000V to 100.0000V	40-100	50 + 10	80 + 10	30	5
		100-2k	30 + 10	60 + 10	30	5
[5] [6]		2k-10k	50 + 10	80 + 10	30	5
		10k-30k	100 + 20	200 + 20	30	10
		30k-100k	250 + 100	500 + 100	70	50
		100k-300k	0.15% + 0.1%	0.3% + 0.1%	200	50
		300k-1M	1% + 0.5%	1% + 1%	500	50
	1000.000V [7]	40-10k	50 + 10	80 + 10	100	10
		10k-30k	100 + 20	200 + 20	100	10
		30k-100k	250 + 100	500 + 100	200	50
RESISTANCE	10.000000Ω	10mA	6 + 2	18 + 2	4.5	2
	100.000000Ω	10mA	3 + 0.5	10 + 0.5	4.5	1
	1.00000000kΩ	1mA	3 + 0.5	10 + 0.5	4.5	1
	10.0000000kΩ	100µA	3 + 0.5	10 + 0.5	4.5	1
	100.000000kΩ	100µA	3 + 0.5	10 + 0.5	8	1
	1.00000000MΩ	10µA	6 + 1	15 + 1	12	1
	10.0000000MΩ	1µA	12 + 5	30 + 5	15	4
	100.0000MΩ	100nA	50 + 50	400 + 50	100	40
	1.000000GΩ	10nA	500 + 500	0.3% + 500	1000	300
DC CURRENT	100.0000µA		20 + 2	50 + 2	20	8
	1.000000mA		20 + 2	50 + 2	20	8
	10.00000mA		20 + 2	50 + 2	20	8
	100.0000mA		30 + 5	100 + 5	20	8
	1.000000A		100 + 10	150 + 10	50	10
AC CURRENT	100.000µA	10-5k	150 + 50	200 + 100	200	15
	1.00000mA	10-5k	150 + 50	200 + 100	130	15
[5]	10.0000mA	10-5k	150 + 50	200 + 100	130	15
	100.000mA	10-5k	150 + 50	200 + 100	130	15
	1.00000A	10-1k	400 + 100	500 + 200	130	15
		1k-5k	0.1% + 0.03%	0.15% + 0.04%	130	15

NOTES

[1] 100% overrange on all ranges (except 1kV DC & AC).

[2] Specifications for max resolution in each function, normal read mode.

[3] FS = 2 × Full Range.

[4] Valid for 30 days after Selfcal, ±1°C Selfcal Temperature, and within ±15°C (DCV & ACV) or ±5°C (other functions) of Autocal Temperature. Assumes Autocal at 23°C±5°C.

[5] Valid for signals > 1% FS, max. Volt.Hertz 3 × 10^7.

[6] Assumes Transfer mode selected.

[7] >300V, add ±0.0024(R-300)²ppmR.

OTHER SPECIFICATIONS

DCV	
Type	Multi-slope, multi-cycle A-D converter
CMRR (1kΩ unbalance):	140dB at DC
	>80dB + NMRR at 1-60Hz
NMRR: filter out	60dB at line frequency
[1] filter in	add to above 40dB at 50Hz + 12dB/octave
Protection: all ranges	1kV RMS
Input Impedance:	
0.1V to 10v ranges	>10,000MΩ
100V & 1000V ranges	10MΩ±0.1%
Max Input Current:	50pA
Ratio Accuracy:	±(Net ChA Accuracy + Net ChB Accuracy)
Settling Time:	
to 10ppm step size	
filter out	<500µs
filter in	<500ms
ACV	
Type:	True RMS, AC coupled measures AC component with up to 1000V DC bias on any range. DC coupled gives $\sqrt{(AC^2+DC^2)}$
CMRR (1kΩ unbalance):	<90dB at DC-60Hz
Crest Factor:	5:1 at Full Range (10:1 at 25% of range)
Protection: all ranges	1kV RMS
Input Impedance	1MΩ in parallel with 150pF
LF Accuracy:	
(DC Coupled)	
DC	Add ±(50ppmR+20ppmFS+20µV)
1Hz-10Hz	Add ±(20ppmR+50ppmFS)
10Hz-40Hz	Add ±20ppmR
Ratio Accuracy:	±(Net ChA Accuracy + Net ChB Accuracy)
Settling Time:	
to 100ppm step size	
1kHz	<30ms (option 10 only)
360Hz	<100ms (option 10 only)
100Hz	<500ms (option 12 only)
40Hz	<1s
10Hz	<5s
1Hz	<50s (option 12 only)
Frequency Accuracy:	
(1 year, 13°C-33°C, typical)	±(10ppmR+0.5ppmFS+1 digit)
Frequency Resolution:	Selectable, $4\frac{1}{2}$ digits or $6\frac{1}{2}$ digits
Sample Interval:	
Fast Gate	50ms ($4\frac{1}{2}$ digits, 200Hz-1MHz)
Normal Gate	1s ($6\frac{1}{2}$ digits, 10Hz-1MHz)
Frequency Range:	10Hz-1MHz, from 5% of range to limits set by Max Volt × Hertz.
RESISTANCE	
Type	True 4 wire with Ohms guard. 2 wire selectable.
Max Lead Resistance:	100Ω in any or all leads.
Protection: all ranges	250V RMS
Ratio Accuracy:	±(Net ChA Accuracy + Net ChB Accuracy)
Settling Time:	Up to 100kΩ range generally the same as DCV, but depends on external connections
DCI	
Type:	Multi-slope, multi-cycle A-D converter.
Protection:	<2A internally clamped, >2A rear panel fuse
Ratio Accuracy:	±(Net ChA Accuracy + Net ChB Accuracy)
Settling Time:	As DCV
ACI	
Type:	True RMS AC coupled. DC coupled gives $\sqrt{(AC^2+DC^2)}$.
Crest Factor:	3:1 at Full Range
Protection:	<2A internally clamped, >2A rear panel fuse
Ratio Accuracy:	±(Net ChA Accuracy + Net ChB Accuracy)
Settling Time:	As ACV

NOTE: [1] Not valid for $5\frac{1}{2}$ digits

FUNCTION		DIGITS	READ RATE (Readings/s)				ADDITIONAL ERRORS (ppmR+ppmFS)	
DCV			Normal		Fast		Normal	Fast
RESISTANCE [1]		8	1/10		1/6		0+0	0+0
DCI [2]		7	1/2		3		0+0	0+0
		6	10		50		0+0.5	0+3
		5	50		1000		0+5	0+30
ACV (Option 10)			1kHz	360Hz	40Hz	10Hz		
ACI		6	20	8	1	1/5	0+0	
		5	20	8	1	1/5	0+0	
ACV			100Hz	40Hz	10Hz	1Hz		
(Option 12) [3]	Transfer OFF	6	3	1	1/5	1/50	200+20	
ACI [4]		5	4	1	1/5	1/50	200+20	
	Transfer ON	6	1	1/2	1/5	1/50	0+0	
		5	2	1/2	1/5	1/50	0+5	

NOTES:
[1] Excluding True Ohms.
[2] Max DCI resolution is $6\frac{1}{2}$ digits.
[3] Assumes frequency monitor set to Fast Gate.
[4] Max ACI resolution is $5\frac{1}{2}$ digits. Read rate as for ACV. Transfer off. Additional error is 0+0.

GENERAL	
POWER SUPPLY	100-130V or 200-260V, 47-63Hz
POWER CONSUMPTION	37VA
OPERATING TEMPERATURE	0°C to +50°C
STORAGE TEMPERATURE	−40°C to +70°C
DIMENSIONS (H×W×D)	88mm (3.5") × 427mm (16.8") × 487mm (19.2")
WEIGHT	13.5kg (30lbs)
SAFETY	Designed to UL1244, IEC 348, BS4743
WARRANTY	1 Year

ORDERING INFORMATION

Model 1271:	$8\frac{1}{2}$ Digit Selfcal Digital Multimeter (Includes DCV, Rear Input and IEEE-488.2 Interface)
Option 10:	True RMS High Speed AC Converter
Option 12:	True RMS High Accuracy AC Converter
Option 20:	2 wire and 4 wire Resistance Converter
Option 30:	Current Converter (Only available with Option 20)
Option 40:	Comprehensive Ratio
Option 70:	Isolated Analog Output
Option 80:	115V, 60Hz Line Operation
Option 81:	115V, 50Hz Line Operation
Option 90:	Rack Mounting Kit
Model 1271MT	as 1271 mainframe with MATE(CIIL) Interface and including Options 12, 20, 30, 40 & 70

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A WAVETEK COMPANY

THE DATRON CALIBRATION AND MEASUREMENT RANGE

Datron Instruments leads the world in the design and manufacture of programmable calibrators, automated calibration systems and digital multimeters.
Complementing the Datron Instruments range, other divisions within the Group are also engaged in the production of some of the world's finest test instruments.
To assist you, data sheets are available with more detailed product information and full specifications. Contact us now and we will be pleased to send you the information you require.

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YOUR LOCAL AGENT/REPRESENTATIVE

1051/20K/AHP/1088