Appendix A
Specifications

Introduction

The instrument specifications presented here are applicable within the conditions listed in the Environmental chapter.

The specifications state total instrument accuracy following calibration, including:

- A/D errors
- Linearization conformity
- Initial calibration errors
- Isothermality errors
- Relay thermal emf's
- Reference junction conformity
- Temperature coefficients
- Humidity errors

Sensor inaccuracies are not included in the accuracy figures.

Accuracies at Ambient Temperatures Other than Specified

To determine typical accuracies at temperatures intermediate to those listed in the specification tables, linearly interpolate between the applicable 0°C to 60°C and 18°C to 28°C accuracy specifications.

Response Times

Refer to Typical Scanning Rate and Maximum Autoranging Time later in this Appendix.

DC Voltage Measurements

Resolution

See Table A-1

Table A-1. DC Voltage Measurements - Resolution

Range	Resolution	
	Slow	Fast
90 mV*	1 µV	10 µV
300 mV	10 µV	0.1 mV
3V	0.1 mV	1 mV
30V	1 mV	10 mV
300V	10 mV	0.1 V
900 mV**	10 µV	0.1 mV

* Not used in Autoranging

*** Computer interface only (see FUNC command).

Accuracy

See Table A-2.

Table A-2. DC Voltage Measurements - Accuracy

RANGE	ACCURACY ±(%±V)				
	18°C TO 28°C			0°C TO 60°C	
	90 DAYS SLOW	1 YEAR SLOW	1 YEAR FAST	1 YEAR SLOW	1 YEAR FAST
90 mV*	.019% + 6 µV	.024% + 6 µV	.044% + 20 µV	.068% + 6 µV	.088% + 20 µV
300 mV	.018% + 20 µV	.023% + 20 µV	.040% + 0.2 mV	.067% + 20 µV	.084% + 0.2 mV
3V	.019% + 0.2 mV	.024% + 0.2 mV	.041% + 2 mV	.065% + 0.2 mV	.082% + 2 mV
30V	.019% + 2 mV	.024% + 2 mV	.041% + 20 mV	.086% + 2 mV	.103% + 20 mV
150/300V	.019% + 20 mV	.024% + 20 mV	.041% + 0.2 V	.087% + 20 mV	.104% + 0.2 V
900 mV* **	.016% + 20 µV	.021% + 20 µV	.037% + 0.3 mV	.064% + 20 µV	.096% + 0.3 mV

* Not used in Autoranging.

** Computer interface only (see FUNC command).

Input Impedance

100 MΩ minimum in parallel with 150 pF maximum for all ranges 3V and below 10 MΩ in parallel with 100 pF maximum for the 30V and 300V ranges

Normal Mode Rejection

53 dB minimum at 60 Hz ±0.1%, slow rate

47 dB minimum at 50 Hz ±0.1%, slow rate

Common Mode Rejection

120 dB minimum at dc, 1 kΩ imbalance, slow rate
120 dB minimum at 50 or 60 Hz ±0.1%, 1 kΩ imbalance, slow rate

Maximum Input

300V dc or ac rms on any range for channels 0,1, and 11
150V dc or ac rms for channels 2 to 10 and 12 to 20
Voltage ratings between channels must not be exceeded.

Cross-Talk Rejection

Refer to Appendix B.

AC Voltage Inputs (True rms AC Voltage, AC-Coupled Inputs)

Resolution

See Table A-3.

Table A-3. AC Voltage Measurements - Resolution

Range	Resolution		Minimum Input for Rated Accuracy
	Slow	Fast	
300 mV	10 µV	100 µV	20 mV
3V	100 µV	1 mV	200 mV
30V	1 mV	10 mV	2V
150/300V	10 mV	100 mV	20V

Accuracy

See Table A-4.

Table A-4. AC Voltage Measurements - Accuracy

Range	Frequency	1 Year Accuracy ±(% ± V)			
		18°C to 28°C		0°C to 60°C	
		Slow	Fast	Slow	Fast
300 mV	20 Hz - 50 Hz	1.43% + 0.25 mV	1.43% + 0.4 mV	1.54% + 0.25 mV	1.54% + 0.4 mV
	50 Hz - 100 Hz	0.30% + 0.25 mV	0.30% + 0.4 mV	0.41% + 0.25 mV	0.41% + 0.4 mV
	100 Hz - 10 kHz	0.16% + 0.25 mV	0.16% + 0.4 mV	0.27% + 0.25 mV	0.27% + 0.4 mV
	10 kHz - 20 kHz	0.37% + 0.25 mV	0.37% + 0.4 mV	0.68% + 0.25 mV	0.68% + 0.4 mV
	20 kHz - 50 kHz	1.9% + 0.30 mV	1.9% + 0.5 mV	3.0% + 0.30 mV	3.0% + 0.5 mV
	50 kHz - 100 kHz	5.0% + 0.50 mV	5.0% + 1.0 mV	7.0% + 0.50 mV	7.0% + 1.0 mV
3V	20 Hz - 50 Hz	1.42% + 2.5 mV	1.42% + 4 mV	1.53% + 2.5 mV	1.53% + 4 mV
	50 Hz - 100 Hz	0.29% + 2.5 mV	0.29% + 4 mV	0.40% + 2.5 mV	0.40% + 4 mV
	100 Hz - 10 kHz	0.13% + 2.5 mV	0.13% + 4 mV	0.24% + 2.5 mV	0.24% + 4 mV
	10 kHz - 20 kHz	0.22% + 2.5 mV	0.22% + 4 mV	0.35% + 2.5 mV	0.35% + 4 mV
	20 kHz - 50 kHz	0.6% + 3.0 mV	0.6% + 5 mV	0.9% + 3.0 mV	0.9% + 5 mV
	50 kHz - 100 kHz	1.0% + 5.0 mV	1.0% + 10 mV	1.4% + 5.0 mV	1.4% + 10 mV
30V	20 Hz - 50 Hz	1.43% + 25 mV	1.43% + 40 mV	1.58% + 25 mV	1.58% + 40 mV
	50 Hz - 100 Hz	0.29% + 25 mV	0.29% + 40 mV	0.45% + 25 mV	0.45% + 40 mV
	100 Hz - 10 kHz	0.15% + 25 mV	0.15% + 40 mV	0.30% + 25 mV	0.30% + 40 mV
	10 kHz - 20 kHz	0.22% + 25 mV	0.22% + 40 mV	0.40% + 25 mV	0.40% + 40 mV
	20 kHz - 50 kHz	0.9% + 30 mV	0.9% + 50 mV	1.1% + 30 mV	1.1% + 50 mV
	50 kHz - 100 kHz	2.0% + 50 mV	2.0% + 100 mV	2.2% + 50 mV	2.2% + 100 mV
300V	20 Hz - 50 Hz	1.42% + 0.25V	1.42% + 0.4V	1.57% + 0.25V	1.57% + 0.4V
	50 Hz - 100 Hz	0.29% + 0.25V	0.29% + 0.4V	0.44% + 0.25V	0.44% + 0.4V
	100 Hz - 10 kHz	0.14% + 0.25V	0.14% + 0.4V	0.29% + 0.25V	0.29% + 0.4V
	10 kHz - 20 kHz	0.22% + 0.25V	0.22% + 0.4V	0.38% + 0.25V	0.38% + 0.4V
	20 kHz - 50 kHz	0.9% + 0.30V	0.9% + 0.5V	1.0% + 0.30V	1.0% + 0.5V
	50 kHz - 100 kHz	2.5% + 0.50V	2.5% + 1.0V	2.6% + 0.50V	2.6% + 1.0V

Temperature Measurements (Thermocouples)

Accuracy

See Table A-5.

Table A-5. Temperature Measurements - Accuracy (Thermocouples) (IPTS-68)

Thermocouple		Accuracy (±°C)*				
		18°C to 28°C			0°C TO 60°C	
Type	Temperature (C°)	90 Days Slow	1 Year Slow	1 Year Fast	1 Year Slow	1 Year Fast
J	-100 to -30	0.42	0.43	0.90	0.54	1.08
	-30 to 150	0.37	0.38	0.80	0.57	1.01
	150 to 760	0.44	0.48	0.93	0.88	1.37
K	-100 to -25	0.51	0.52	1.12	0.64	1.30
	-25 to 120	0.43	0.44	0.94	0.62	1.15
	120 to 1000	0.81	0.87	1.57	1.47	2.22
	1000 to 1372	1.05	1.15	2.03	2.01	2.95
N	-100 to -25	0.61	0.62	1.42	0.73	1.60
	-25 to 120	0.53	0.54	1.21	0.68	1.39
	120 to 410	0.50	0.52	1.11	0.74	1.31
	410 to 1300	1.00	1.08	1.82	1.75	2.53
E	-100 to -25	0.43	0.44	0.89	0.56	1.08
	-25 to 350	0.38	0.41	0.77	0.64	1.02
	350 to 650	0.41	0.45	0.84	0.82	1.24
	650 to 1000	0.67	0.73	1.22	1.28	1.81
T	-150 to 0	0.69	0.71	1.51	0.83	1.72
	0 to 120	0.45	0.46	0.95	0.59	1.13
	120 to 400	0.41	0.43	0.82	0.66	1.06
R	250 to 400	0.89	0.91	2.53	1.07	2.71
	400 to 1000	0.93	0.98	2.35	1.37	2.67
	1000 to 1767	1.39	1.48	2.98	2.26	3.78
S	250 to 1000	1.02	1.07	2.69	1.49	2.96
	1000 to 1400	1.23	1.29	2.75	1.87	3.34
	1400 to 1767	1.56	1.65	3.38	2.48	4.24
B	600 to 1200	1.22	1.23	3.64	1.38	3.81
	1200 to 1550	1.18	1.23	2.61	1.64	3.03
	1550 to 1820	1.42	1.48	2.95	2.02	3.49
C	0 to 150	0.73	0.75	1.92	0.87	2.10
	150 to 650	0.70	0.74	1.66	1.09	2.04
	650 to 1000	0.90	0.96	2.01	1.49	2.58
	1000 to 1800	1.74	1.86	3.48	3.00	4.66
	1800 to 2316	2.81	3.03	5.56	5.00	7.60

*Sensor inaccuracies are not included

Table A-6. Temperature Measurements - Accuracy (Thermocouples) (ITS-90)

Thermocouple		Accuracy (±°C)*				
		18°C to 28°C			0°C to 60°C	
Type (°C)	Temperature (°C)	90 Days Slow	1 Year Slow	1 Year Fast	1 Year Slow	1 Year Fast
J	-100 to -30	0.42	0.43	0.91	0.55	1.08
	-30 to 150	0.37	0.39	0.80	0.57	1.02
	150 to 760	0.44	0.48	0.94	0.88	1.38
K	-100 to -25	0.52	0.53	1.13	0.65	1.31
	-25 to 120	0.43	0.44	0.93	0.62	1.16
	120 to 1000	0.61	0.68	1.38	1.28	2.03
	1000 to 1372	0.89	0.98	1.87	1.85	2.79
N	-100 to -25	0.62	0.63	1.44	0.75	1.61
	-25 to 120	0.53	0.55	1.22	0.67	1.39
	120 to 410	0.47	0.49	1.08	0.69	1.28
	410 to 1300	0.70	0.78	1.52	1.45	2.23
E	-100 to -25	0.44	0.46	0.91	0.57	1.09
	-25 to 350	0.38	0.39	0.77	0.61	0.98
	350 to 650	0.39	0.43	0.82	0.80	1.23
	650 to 1000	0.50	0.56	1.05	1.11	1.63
T	-150 to 0	0.68	0.69	1.50	0.82	1.71
	0 to 120	0.45	0.46	0.95	0.59	1.13
	120 to 400	0.36	0.39	0.78	0.61	1.02
R	250 to 400	0.83	0.85	2.47	1.02	2.66
	400 to 1000	0.79	0.81	2.30	1.15	2.53
	1000 to 1767	0.96	1.05	2.59	1.85	3.42
S	250 to 1000	0.88	0.89	2.60	1.26	2.80
	1000 to 1400	0.83	0.89	2.34	1.47	2.94
	1400 to 1767	1.07	1.17	2.96	2.03	3.84
B	600 to 1200	1.11	1.12	3.53	1.27	3.69
	1200 to 1550	0.74	0.77	2.25	1.18	2.57
	1550 to 1820	0.82	0.89	2.35	1.43	2.90
C	0 to 150	0.72	0.73	1.90	0.86	2.08
	150 to 650	0.62	0.64	1.62	0.99	1.94
	650 to 1000	0.70	0.76	1.81	1.29	2.38
	1000 to 1800	1.12	1.25	2.86	2.38	4.04
	1800 to 2316	1.86	2.08	4.61	4.06	6.66

* Sensor inaccuracies are not included.

Input Impedance

100 MΩ minimum in parallel with 150 pF maximum

Common Mode and Normal Mode Rejection

See the specifications for dc voltage measurements.

Cross-Talk Rejection

Refer to Appendix B.

Open Thermocouple Detect

Small ac signal injection and detection scheme before each measurement detects greater than 1 to 4 kΩ as open. Performed on each channel unless defeated by computer command

Temperature Measurements (RTDs)

Accuracy

See Table A-7, A-8 and A-9.

Table A-7. Temperature Measurements - Accuracy (RTDs) (IEC751 Amendment 2) (ITS-90)

RTD Temperature (°C)	4-Wire Accuracy* (±°C)						
	Resolution		18°C to 28°C			0°C to 60°C	
	Slow	Fast	90 Day Slow	1 Year Slow	1 Year Fast	1 Year Slow	1 Year Fast
-200.00	0.02	0.1	0.05	0.05	0.47	0.06	0.48
0.00	0.02	0.1	0.08	0.09	0.55	0.13	0.59
100.00	0.02	0.1	0.10	0.10	0.58	0.17	0.64
300.00	0.02	0.1	0.13	0.14	0.65	0.24	0.75
600.00	0.02	0.1	0.19	0.20	0.76	0.36	0.92
* Sensor inaccuracies are not included							

Table A-8. Temperature Measurements - Accuracy (RTDs) (IEC751 Amendment 1) (ITS-90)

RTD Temperature (°C)	4-Wire Accuracy* (±°C)						
	Resolution		18°C to 28°C			0°C to 60°C	
	Slow	Fast	90 Day Slow	1 Year Slow	1 Year Fast	1 Year Slow	1 Year Fast
-200.00	0.02	0.1	0.11	0.11	0.53	0.12	0.54
0.00	0.02	0.1	0.09	0.09	0.55	0.13	0.59
100.00	0.02	0.1	0.11	0.11	0.59	0.18	0.65
300.00	0.02	0.1	0.19	0.20	0.70	0.30	0.81
600.00	0.02	0.1	0.44	0.45	1.01	0.61	1.17
* Sensor inaccuracies are not included							

Table A-9. Temperature Measurements - Accuracy (RTDs) (IEC751) (IPTS-68)

RTD Temperature (°C)	4-Wire Accuracy* (±°C)						
	Resolution		18°C to 28°C			0°C to 60°C	
	Slow	Fast	90 Day Slow	1 Year Slow	1 Year Fast	1 Year Slow	1 Year Fast
-200.00	0.02	0.1	0.11	0.11	0.53	0.12	0.54
0.00	0.02	0.1	0.09	0.09	0.55	0.13	0.59
100.00	0.02	0.1	0.12	0.12	0.60	0.18	0.66
300.00	0.02	0.1	0.23	0.24	0.74	0.34	0.84
600.00	0.02	0.1	0.56	0.56	1.13	0.73	1.29
* Sensor inaccuracies are not included							

RTD Type

DIN/IEC 751, 100Ω Platinum (385)

2-wire Accuracy

For 2-wire sensors with R0 = 100Ω: degrade accuracy by 5.0°C per lead-ohm, plus degrade accuracy an additional 11°C for channels 1 to 20 and 0.05°C for channel 0.

Maximum Current Through Sensor

1 mA

Typical Full Scale Voltage

0.22 V

Maximum Open Circuit Voltage

3.2 V

Maximum Sensor Temperature

600°C nominal

Cross-Talk Rejection

Refer to Appendix B.

AC Voltage Measurements

AC voltage measurements are true rms and use ac-coupled inputs.

Resolution

See Table A-10.

Table A-10. AC Voltage Measurements - Resolution

Range	Resolution		Minimum Input for Rated Accuracy
	Slow	Fast	
300 mV	10 µV	100 µV	20 mV
3V	100 µV	1 mV	200 mV
30V	1 mV	10 mV	2V
150/300V	10 mV	100 mV	20V

Accuracy

See Table A-11.

Table A-11. AC Voltage Measurements - Accuracy

Range	Frequency	1 Year Accuracy ±(% ± V)			
		18°C to 28°C		0°C to 60°C	
		Slow	Fast	Slow	Fast
300 mV	20 Hz - 50 Hz	1.43% + 0.25 mV	1.43% + 0.4 mV	1.54% + 0.25 mV	1.54% + 0.4 mV
	50 Hz - 100 Hz	0.30% + 0.25 mV	0.30% + 0.4 mV	0.41% + 0.25 mV	0.41% + 0.4 mV
	100 Hz - 10 kHz	0.16% + 0.25 mV	0.16% + 0.4 mV	0.27% + 0.25 mV	0.27% + 0.4 mV
	10 kHz - 20 kHz	0.37% + 0.25 mV	0.37% + 0.4 mV	0.68% + 0.25 mV	0.68% + 0.4 mV
	20 kHz - 50 kHz	1.9% + 0.30 mV	1.9% + 0.5 mV	3.0% + 0.30 mV	3.0% + 0.5 mV
	50 kHz - 100 kHz	5.0% + 0.50 mV	5.0% + 1.0 mV	7.0% + 0.50 mV	7.0% + 1.0 mV
3V	20 Hz - 50 Hz	1.42% + 2.5 mV	1.42% + 4 mV	1.53% + 2.5 mV	1.53% + 4 mV
	50 Hz - 100 Hz	0.29% + 2.5 mV	0.29% + 4 mV	0.40% + 2.5 mV	0.40% + 4 mV
	100 Hz - 10 kHz	0.13% + 2.5 mV	0.13% + 4 mV	0.24% + 2.5 mV	0.24% + 4 mV
	10 kHz - 20 kHz	0.22% + 2.5 mV	0.22% + 4 mV	0.35% + 2.5 mV	0.35% + 4 mV
	20 kHz - 50 kHz	0.6% + 3.0 mV	0.6% + 5 mV	0.9% + 3.0 mV	0.9% + 5 mV
	50 kHz - 100 kHz	1.0% + 5.0 mV	1.0% + 10 mV	1.4% + 5.0 mV	1.4% + 10 mV
30V	20 Hz - 50 Hz	1.43% + 25 mV	1.43% + 40 mV	1.58% + 25 mV	1.58% + 40 mV
	50 Hz - 100 Hz	0.29% + 25 mV	0.29% + 40 mV	0.45% + 25 mV	0.45% + 40 mV
	100 Hz - 10 kHz	0.15% + 25 mV	0.15% + 40 mV	0.30% + 25 mV	0.30% + 40 mV
	10 kHz - 20 kHz	0.22% + 25 mV	0.22% + 40 mV	0.40% + 25 mV	0.40% + 40 mV
	20 kHz - 50 kHz	0.9% + 30 mV	0.9% + 50 mV	1.1% + 30 mV	1.1% + 50 mV
	50 kHz - 100 kHz	2.0% + 50 mV	2.0% + 100 mV	2.2% + 50 mV	2.2% + 100 mV
300V	20 Hz - 50 Hz	1.42% + 0.25V	1.42% + 0.4V	1.57% + 0.25V	1.57% + 0.4V
	50 Hz - 100 Hz	0.29% + 0.25V	0.29% + 0.4V	0.44% + 0.25V	0.44% + 0.4V
	100 Hz - 10 kHz	0.14% + 0.25V	0.14% + 0.4V	0.29% + 0.25V	0.29% + 0.4V
	10 kHz - 20 kHz	0.22% + 0.25V	0.22% + 0.4V	0.38% + 0.25V	0.38% + 0.4V
	20 kHz - 50 kHz	0.9% + 0.30V	0.9% + 0.5V	1.0% + 0.30V	1.0% + 0.5V
	50 kHz - 100 kHz	2.5% + 0.50V	2.5% + 1.0V	2.6% + 0.50V	2.6% + 1.0V

Maximum Voltage Input VS. Frequency Input

See Table A-12.

Table A-12. AC Voltage Measurements

Frequency	Maximum Input at Upper Frequency
20 Hz - 50 Hz	300V rms
50 Hz - 100 Hz	300V rms
100 Hz - 10kHz	200V rms
10 kHz - 20 kHz	100V rms
20 kHz - 50 kHz	40V rms
50 kHz - 100 kHz	20V rms

Input Impedance

1 MΩ in parallel with 100 pF maximum Maximum

Maximum Crest Factor

3.0
2.0 for rated accuracy

Crest Factor Error

Non-sinusoidal input signals with crest factors between 2 and 3 and pulse widths 100 μs and longer add 0.2% to the accuracy specifications.

Common Mode Rejection

80 dB minimum at 50 or 60 Hz ± 0.1%, 1 kΩ imbalance, slow rate

Maximum AC Input

300V rms or 424V peak on channels 0, 1, and 11
150V rms or 212V peak on channels 2 to 10 and 12 to 20
Voltage ratings between channels must not be exceeded

2×10^6 Volt-Hertz product on any range, normal mode input

1×10^6 Volt-Hertz product on any range, common mode input

DC Component Error

SCAN and first MONitor measurements will be incorrect if the dc signal component exceeds 60 counts in slow rate or 10 counts in fast rate. To measure ac with a dc component present, MONitor the input and wait 5 seconds before recording the measurement.

Cross-Talk Rejection

Refer to Appendix B.

Resistance Measurements

Resolution

See Table A-13.

Table A-13. Resistance Measurements - Resolution.

Range	Resolution		Typical Full Scale Voltage	Maximum Current Through Unknown	Maximum Open Circuit Voltage
	Slow	Fast			
300Ω	10 mΩ	0.1Ω	0.22V	1 mA	3.2V
3 kΩ	0.1Ω	1Ω	0.25V	110 µA	1.5V
30 kΩ	1Ω	10 Ω	0.29V	13 µA	1.5V
300 kΩ	10 Ω	100 Ω	0.68V	3.2 µA	3.2V
3 MΩ	100 Ω	1 kΩ	2.25V	3.2 µA	3.2V
10 MΩ	1 kΩ	10 kΩ	2.72V	3.2 µA	3.2V

Accuracy

See Table A-14.

Table A-14. Resistance Measurements - Accuracy (Four-Wire)

Range	4-Wire Accuracy ±(%±Ω)				
	18°C to 28°C			0°C to 60°C	
	90 Days, Slow	1 Year, Slow	1 Year, Fast	1 Year, Slow	1 Year, Fast
300Ω	0.013% + 20 mΩ	0.014% + 20 mΩ	0.014% + 0.2Ω	0.031% + 20 mΩ	0.031% + 0.2Ω
3 kΩ	0.015% + 0.2Ω	0.016% + 0.2Ω	0.016% + 2Ω	0.039% + 0.2Ω	0.039% + 2Ω
30 kΩ	0.013% + 2Ω	0.014% + 2Ω	0.014% + 20Ω	0.039% + 2Ω	0.039% + 20Ω
300 kΩ	0.020% + 20Ω	0.021% + 20Ω	0.021% + 200Ω	0.050% + 20Ω	0.050% + 200Ω
3 MΩ	0.059% + 200Ω	0.063% + 200Ω	0.063% + 2 kΩ	0.231% + 200Ω	0.231% + 2 kΩ
10 MΩ	0.168% + 2 kΩ	0.169% + 2 kΩ	0.709% + 20 kΩ	0.573% + 2 kΩ	0.923% + 20 kΩ

2-Wire Accuracy

Add 4.0Ω to accuracy specifications for channels 1 to 20, and add 20 mΩ for channel 0. Lead wire resistances are not included.

300V dc or ac rms on all ranges

Cross-Talk Rejection

Refer to Appendix B.

Frequency Measurements

Resolution and Accuracy

See Table A-15.

Table A-15. Frequency Measurements-Resolution and Accuracy

Range	Resolution		Accuracy + (% ± Hz)	
	Slow	Fast	Slow	Fast
15 Hz - 900 Hz	0.01 Hz	0.1 Hz	0.05% + 0.02 Hz	0.05% + 0.2 Hz
9 kHz	0.1 Hz	1 Hz	0.05% + 0.1 Hz	0.05% + 1 Hz
90 kHz	1 Hz	10 Hz	0.05% + 1 Hz	0.05% + 10 Hz
900 kHz	10 Hz	100 Hz	0.05% + 10 Hz	0.05% + 100 Hz
1 MHz	100 Hz	1 kHz	0.05% + 100 Hz	0.05% + 1 kHz

Frequency Range

15 Hz to greater than 1 MHz

Input Sensitivity

See Table A-16.

Table A-16. Frequency Measurements - Input Sensitivity

Frequency	Level (sine wave)
15 Hz - 100 kHz	100 mV rms
100 kHz - 300 kHz	150 mV rms
300 kHz - 1 MHz -	2V rms
Above 1 MHz	Not specified

Maximum AC Input

300V rms or 424V peak on channels 0, 1, and 11
150V rms or 212V peak on channels 2 to 10 and 12 to 20
Voltage ratings between channels must not be exceeded

2×10^6 Volt-Hertz product on any range, normal mode input
1×10^6 Volt-Hertz product on any range, common mode input

Cross-Talk Rejection

Refer to Appendix B.

Typical Scanning Rate

See table below. The measurement conditions are: averaged rate over 20 scans; continuous scanning; alarm limits and Mx+B scanning set on all channels; logging data to internal memory; and RS-232 communications set at 9600 baud. Measurements were taken with short-circuit inputs on all channels, except frequency, which was taken with 5V at 15 Hz on all channels.

Table A-17. Typical Scanning Rate

FUNCTION	RANGE	CHANNELS					
		SLOW			FAST		
		1	10	20	1	10	20
VDC	300 mV	1.8	3.9	4.1	2.5	13.7	18.4
	3V	1.8	3.9	4.1	2.5	13.7	18.4
	30V	1.8	3.9	4.1	2.5	13.7	18.3
	150/300V	1.8	3.9	4.1	2.5	13.6	18.2
	AUTO	1.7	3.6	3.9	2.4	11.3	14.1
TEMPERATURE	J (TC)	1.0	3.3	3.8	2.1	12.2	16.6
	PT (RTD)	1.7	3.1	3.2	2.1	6.0	6.7
VAC	300 mV	1.1	1.5	1.6	1.3	2.5	2.6
	3V	1.1	1.5	1.6	1.3	2.5	2.6
	30V	1.1	1.5	1.6	1.3	2.5	2.6
	150/300V	1.1	1.5	1.6	1.3	2.5	2.6
	AUTO	1.1	1.5	1.5	1.3	2.4	2.5
OHMS	300Ω	1.7	3.1	3.2	2.1	6.0	6.7
	3 kΩ	1.7	3.1	3.2	2.1	6.0	6.7
	30 kΩ	1.7	3.1	3.2	2.1	6.0	6.7
	300 kΩ	1.2	1.8	1.8	1.7	4.0	4.4
	3 MΩ	1.2	1.6	1.7	1.7	3.9	4.2
	10 MΩ	1.1	1.6	1.6	1.7	3.8	4.0
	AUTO	1.7	3.1	3.2	2.1	6.0	6.7
FREQUENCY	ANY	0.5	0.6	0.6	0.6	0.7	0.7

Maximum Autoranging Time

See Table A-18 (shown in seconds per channel).

Totalizing Input

Input Voltage

30V maximum

4V minimum

2V peak minimum signal

Isolation

None

dc-coupled

Table A-18. Autoranging Rates

Function	Range Change			Slow	Fast
VDC	300 mV	---------->	150 V	0.25	0.19
	150V	---------->	300 mV	0.25	0.18
VAC	300 mV	---------->	150V	1.40	1.10
	150 mV	---------->	300 mV	1.40	1.10
Ohms	300 Ω	---------->	10.0 MΩ	1.70	0.75
	10.0 MΩ	---------->	300 Ω	1.50	0.60

Threshold

1.4V

Hysteresis

500 mV

Input Debouncing

None or 1.75 ms

Rate

0 to 5 kHz with debouncing off

Maximum Count

65,535

Digital Inputs

The specifications for the digital inputs are provided in the following paragraphs.

Input Voltage

30V maximum

-4V minimum

Isolation

none

dc-coupled

Threshold

1.4V

Hysteresis

500 mV

Trigger Inputs

Input Voltages

contact closure and TTL compatible
"high" =2.0V min, 7.0V max
"low" = -0.6V min, 0.8V max

Isolation

None
dc-coupled

Minimum Pulse Width

5 µs

Maximum Frequency

5 Hz

Specified Conditions

The instrument must be in the quiescent state, with no interval scans in process, no commands in the queue, no RS-232 activity, and no front panel activity if the latency and repeatability performance is to be achieved.

Maximum Latency

Latency is measured from the edge of the trigger input to the start of the first channel measurement for the Specified Conditions (above).

540 ms for fast rate, scanning DCV, ACV, ohms, and frequency only

610 ms for fast rate, scanning any thermocouple or 100 mV dc channels

500 ms for slow rate, scanning DCV, ACV, ohms, and frequency only

950 ms for slow rate, scanning any thermocouple or 100 mV dc channels

Repeatability

3 ms for the Specified Conditions (above)

Digital and Alarm Outputs

The specifications for the digital and alarm outputs are provided in the following paragraphs.

Output Logic Levels

Logical "zero": 0.8V max for an Iout of -1.0 mA (1LSTTL load)
Logical "one": 3.8V min for an Iout of 0.05 mA (1LSTTL load)

For non-TTL loads: 1.8V max for an Iout or -20 mA
Logical "zero": 3.25 max for an Iout of -50 mA

Isolation

none

Real-Time Clock and Calendar

The specifications for the real-time clock and calendar are provided in the following paragraphs.

Accuracy

Within 1 minute per month for 0°C to 50°C range

Battery Life

>10 unpowered instrument years for 0°C to 28°C

>3 unpowered instrument years for 0°C to 50°C

>2 unpowered instrument years for 50°C to 70°C

Environmental Specifications

The environmental specifications are provided in the following paragraphs.

Warmup Time

1 hour to rated specifications

15 minutes when relative humidity is kept below the rated maximum minus 20% (e.g. below 70% for a 90% maximum rating).

Operating Temperature

0°C to 60°C

Storage Temperature

-40°C to +75°C

Instrument storage at temperature extremes may necessitate adding up to 0.008% to the dc and ac voltage accuracy specifications. Alternatively, any resulting shift can be compensated for by recalibrating the instrument.

Relative Humidity (Non-Condensing)

90% maximum for 0°C to 28°C
75% maximum for 28°C to 35°C
50% maximum for 35°C to 50°C
35% maximum for 50°C to 60°C
(Except 70% maximum for 0°C to 35°C, 0% maximum for 40°C to 50°C, and 20% maximum for 50°C to 60°C for the 300 kΩ, 3 MΩ, and 10 MΩ ranges.)

Altitude

Operating: 2,000 m maximum

Non-operating: 12,200m maximum

Vibration

0.7g at 15 Hz

1.3g at 25 Hz

3g at 55 Hz

Shock

30g half sine per Mil-T-28800

Bench handling per Mil-T-28800

General

The general specifications are provided in the following paragraphs.

Channel Capacity

21 Analog Inputs

4 Alarm Outputs

8 Digital I/O (inputs/outputs)

Measurement Speed

Slow rate: 4 readings/second nominal

Fast rate: 17 readings/second nominal

1.5 readings/second nominal for ACV and high-Ω inputs

For additional information, refer to Typical Scanning Rated and Maximum Autoranging Time.

Nonvolatile Memory Life

>10 unpowered instrument years for 0°C to 28°C

>3 unpowered instrument years for 0°C to 50°C

>2 unpowered instrument years for 50°C to 70°C

Stores: Real-time clock, set-up configuration, and measurement data.

Common Mode Voltage

300V dc or ac rms maximum from any analog input (channel) to earth provided that channel to channel maximum voltage ratings are observed.

Voltage Ratings

Channels 0,1, and 11 are rated at 300V dc or ac rms maximum from a channel terminal to earth and from a channel terminal to any other channel terminal.

Channels 2 to 10 and 12 to 20 are rated at 150V dc or ac rms maximum from a channel terminal to any other channel terminal within channels 2 to 10 and 12 to 20.

IEC Overvoltage Category II.

Size

9.3 cm high, 21.6 cm wide, 31.2 cm deep

Weight

Net, 2.95 kg

Shipping, 4.0 kg

Power

90V to 264V ac (no switching required), 50 and 60 Hz, 10 VA maximum

9V dc to 16V dc, 10W maximum

If both sources are applied simultaneously, ac is used if it exceeds approximately 8.3 times dc.

Automatic switchover occurs between ac and dc without interruption.

(At 120V ac the equivalent dc voltage is ~14.5V).

Standards

IEC 1010-1, ANSI/ISA S82.01-1994, CSA-C22.2 No.1010.1-92, and EN61010-1:1993.

Complies with EN 50081-1, EN 50082-1, Vfg. 243/1991 and FCC-15B at the Class B level, when shielded cables are used.

RS-232-C

Connector:	9 pin male (DB-9P)
Signals:	TX, RX, DTR, DSR, RTS, CTS, GND
Modem Control:	full duplex
Baud rates:	300, 600, 1200, 2400, 4800, 9600, 19200, 38400
Data format:	8 data bits, no parity bit, one stop bit, or 7 data bits, one parity bit (odd or even), one stop bit
Flow control:	CTS (Hardware) and XON/XOFF (Software)
Echo:	on/off