3321 and 3322 LCZ Meters

Two cost-effective LCZ meters: both easy to use, 4½ digits, DC bias capability, and built-in IEEE-488 interface.

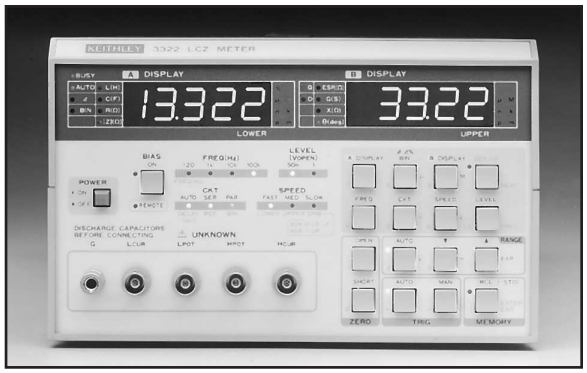
MODEL 3321:

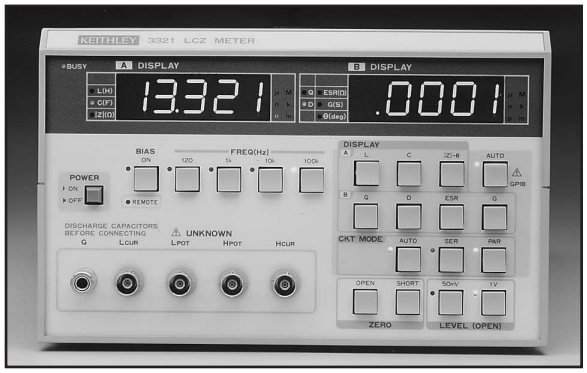
- **0.1% accuracy.**
- **Low cost.**
- **Automatic function and circuit selection: just connect the DUT and read.**
- **Four test frequencies to 100kHz.**

MODEL 3322:

- **0.1% accuracy.**
- **Low cost.**
- **Automatic function and equivalent circuit selection.**
- **Binning and deviation capability.**
- **Eleven frequencies in 1, 2, 5 steps to 100kHz.**
- **Front panel setup memory.**

These instruments are for precision component or circuit testing in R&D labs, component test labs, inspection, qualification and reliability labs, and on the production line. Both are very easy to use, cost effective, and provide accurate measurements of L, C, or |Z| and θ along with D, Q, G, or ESR. The Model 3322 also directly reads R and X, and has a % deviation and binning function.





High Precision

Both models have 4½-digit resolution, and 0.1% basic accuracy. D and Q resolution is 0.0001, and θ resolution is 0.01°. These instruments provide top-of-the-line lab accuracy combined with low cost and easy operation.

Automatic Settings

Both instruments have automatic selection of function and equivalent circuits. In the AUTO mode, no knowledge of any controls is required; operation is literally as simple as connecting the DUT and reading the L,C, or |Z| and θ of the DUT. Any time additional information is desired, easily understood front panel controls may be used. Additionally, the Model 3322 has battery backed-up memory to store ten front panel control settings.

Selectable Test Frequency and Voltage

The Model 3322 has 11 test frequencies up to 100kHz. The Model 3321 has test frequencies of 120Hz, 1kHz, 10kHz and 100kHz. Both units have selectable 1V or 50mV AC test voltages, permitting components to be tested at small signal levels or with minimum noise.

Built-In DC Bias

A 2V bias source is built in for electrolytic capacitor and semiconductor test. Externally supplied voltages up to 35V may also be used.

% Deviation and Binning

The Model 3322 also has the capability to read % deviation from a preset value, and identify which of up to 20 preset "bins" into which the measured value of a DUT falls.

Measurement Speed

The Model 3322 has a selection of FAST (to 64ms per measurement), MED or SLOW reading rates. Manual trigger, with a delay time of 0 to 199.9s, may also be used. The Model 3321 automatically selects MED (150ms) or SLOW rates. Both have built-in IEEE-488 interfaces for computer control and data collection.

See pages A-40 and A-42 for specifications.

ACCESSORIES AVAILABLE

TEST FIXTURE	
3323A	Test Fixture
3327	Chip Component Test Fixture
TEST LEADS	
3324	4-Terminal Alligator Clip Test Leads
3325	Kelvin Clip Test Leads
3326	Chip Component Test Leads
CABLES	
7051-2	BNC Interconnect Cable, 0.6m (2 ft)
7051-5:	BNC Interconnect Cable, 1.5m (5 ft)
RACK MOUNT KITS	
3900-1	Single Fixed Rack Mount Kit
3900-2	Dual Fixed Rack Mount Kit

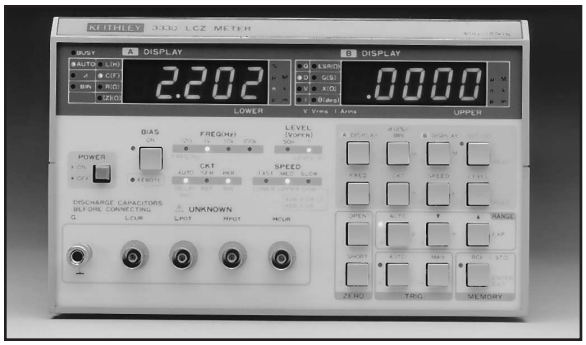
See page A-231 for descriptions of all accessories.

ORDERING INFORMATION

3321	LCZ Meter with operating manual, power cable and fuses
3321/23	LCZ Meter with 3323A Test Fixture, operating manual, power cable and fuses
3322	LCZ Meter with operating manual, power cable and fuses
3322/23	LCZ Meter with 3323A Test Fixture, operating manual, power cable and fuses

These products are available with an **Extended Warranty.** See section C for complete ordering information.

3330 LCZ Meter



The Model 3330 is a full-featured, 4½-digit LCZ meter, designed for characterizing a wide variety of passive and active components and material samples. It's well-suited for use in both bench-top applications and in automated test systems. For example, when used as a bench unit, the Model 3330 features an AUTO mode that quickly determines the type of component being tested, then automatically configures its displays to show the corresponding major and minor parameters of interest, for faster component characterization. For system applications that require high speed testing, the Model 3330 offers a standard IEEE-488 interface and a handler interface for uncomplicated system control and fastest throughput.

- **0.1% basic accuracy**
- **4½-digit resolution**
- **Choice of 201 frequencies from 40Hz to 100kHz**
- **Finely adjustable test signal levels from 10mV to 1.100V**
- **Determines L, C, R, |Z|, Q, D, ESR, G, X, θ, V or I in as little as 64ms**
- **Sorting/binning options include % deviation, handler interface and beeper feature**
- **Programmable via GPIB interface or front panel controls**
- **Accepts bipolar bias voltage up to ±35V.**

ORDERING INFORMATION

3330 LCZ Meter (201 test frequencies and handler interface) with operating manual, power cable and fuses

This product is available with an **Extended Warranty.** See section C for complete ordering information.

The Model 3330 offers a broad test frequency range, with a choice of 201 frequencies from 40Hz to 100kHz, which makes it easy to match the test frequency to the actual in-circuit frequency. The lower end of the Model 3330's frequency range simplifies testing capacitors and inductors at the power line frequency, a valuable capability when characterizing components for power supplies. There's also a wide test signal amplitude range from 10mV to 1.100V. Lower amplitude test signals and the ability to accept bipolar external DC bias are useful when performing C-V tests on semiconductors and characterizing active devices, while the higher end of the range is valuable in passive component testing. The desired test signal level can be adjusted by as little as 1mV, so it's easy to match test signal amplitude to in-circuit amplitude.

When characterizing devices with extremely low impedances, a built-in voltage/current monitor makes it easy to confirm the exact magnitude of the voltage applied to the DUT or the magnitude of the measured current, without the need for a DMM.

High Accuracy

The Model 3330 has been designed to simplify obtaining accurate, high-resolution parameter readings quickly. In addition to its 0.1% basic accuracy, the meter provides 0.0001 resolution on dissipation and quality factor, and 0.01° resolution on phase. Even when combined with switching hardware to speed testing of multiple devices, the Model 3330 demonstrates minimal accuracy degradation.

A number of other built-in features also help ensure reading accuracy. For example, the Model 3330 automatically self-calibrates on power-up. A built-in zero correction feature allows the user to cancel offsets caused by leads and test fixtures. A battery-backed memory allows users to store up to ten frequently-used front panel settings, which reduces configuration time as well as the chance of set-up errors.

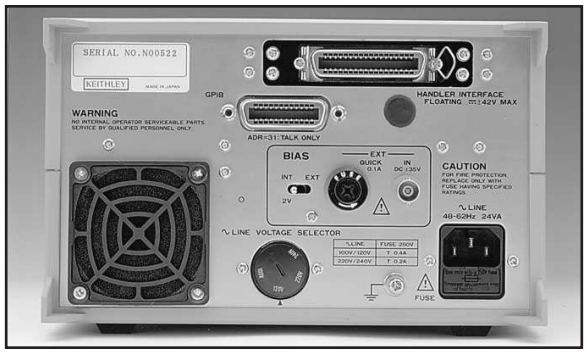
Automatic Mode

The Model 3330's AUTO mode simplifies component evaluation. The meter analyzes the component, then automatically selects the appropriate component parameters to be displayed. The meter "powers-up" in the AUTO mode, so even infrequent or inexperienced operators can begin characterizing components in seconds—the user simply turns on the instrument, inserts the component into the test fixture, and reads the component parameters from the displays.

GPIB and Handler Interfaces

All measurement functions are programmable via the GPIB interface to automate incoming component inspection operations, or they may be controlled using the front panel buttons. An output handler interface allows the Model 3330 to control a component handler directly without the need for a separate PC controller. When used in conjunction with the Model 3330's binning capabilities, the handler interface allows the meter to control sorting components into the appropriate bins automatically.

See pages A-41 and A-42 for specifications.



ACCESSORIES AVAILABLE

TEST FIXTURE

3323A	Test Fixture
3327	Chip Component Test Fixture

TEST LEADS

3324	4-Terminal Alligator Clip Test Leads
3325	Kelvin Clip Test Leads
3326	Chip Component Test Leads

CABLES

7051-2	BNC Interconnect Cable, 0.6m (2 ft)
7051-5:	BNC Interconnect Cable, 1.5m (5 ft)

RACK MOUNT KITS

3900-1	Single Fixed Rack Mount Kit
3900-2	Dual Fixed Rack Mount Kit

See page A-231 for descriptions of all accessories.

QUESTIONS?

1-800-552-1115 (U.S. only)

Call toll free for technical assistance, product support or ordering information.

3321 and 3322 LCZ Meters

Specifications on this page are for Models 3321 and 3322 LCZ Meters only.

Accuracy of IMPEDANCE |Z| AND ANGLE θ (Tables 1, 2 and 3)

FOR 0.2Ω ≤ |Z| ≤ 20 MΩ:

TABLE 1: |Z|, Ω LEVEL = 1V rms, SPEED = MED or SLOW for 3322

3321 Frequency, [Hz]	120		1k		10k			100k
3322 Frequency, [Hz]	100 120	200 500	1k	2k 5k	10k	20k	50k	100k
10M ≤ |Z| < 20M	3.0% 1.5°	2.0 % 1.0°	1.0% 0.8°	2.0% 1.5°	3.5% 2.0°	4.0% 3.0°	14.0% 8.0°	20.0% 12.0°
5M ≤ |Z| < 10M	1.5% 0.9°	1.0% 0.6°	0.5% 0.4°	1.0% 0.6°	1.8% 1.1°	2.0% 1.3°	7.0% 4.0°	10.0% 6.0°
2M ≤ |Z| < 5M	0.75% 0.45°	0.5% 0.3°	0.3% 0.2°	0.5% 0.3°	0.9% 0.6°	1.0% 0.6°	3.5% 2.0°	5.0% 3.0°
1M ≤ |Z| < 2M	0.36% 0.22°	0.3% 0.15°	0.2% 0.1°	0.3% 0.15°	0.4% 0.2°	0.5% 0.3°	1.6% 1.0°	3.0% 2.0°
200k ≤ |Z| < 1M	0.25% 0.15°	0.2% 0.12°	0.15% 0.09°	0.2% 0.12°	0.27% 0.16°	0.35% 0.2°	1.0% 0.6°	2.0% 1.2°
20k ≤ |Z| < 200k	0.15% 0.10°	0.12% 0.06°	0.1% 0.04°	0.18% 0.08°	0.25% 0.15°	0.3% 0.2°	0.6% 0.4°	1.2% 0.8°
2k ≤ |Z| < 20k	0.14% 0.09°	0.12% 0.05°	0.1% 0.03°	0.12% 0.06°	0.15% 0.08°	0.2% 0.12°	0.4% 0.3°	0.8% 0.6°
10 ≤ |Z| < 2k	0.13% 0.08°	0.11% 0.05°	0.1% 0.03°	0.11% 0.08°	0.13% 0.1°	0.17% 0.15°	0.4% 0.25°	0.7% 0.5°
2 ≤ |Z| < 10	0.25% 0.15°	0.2% 0.1°	0.15% 0.07°	0.2% 0.12°	0.32% 0.2°	0.5% 0.3°	0.8% 0.4°	1.5% 0.8°
1 ≤ |Z| < 2	0.35% 0.22°	0.3% 0.2°	0.2% 0.12°	0.25% 0.15°	0.5% 0.3°	0.7% 0.4°	1.0% 0.6°	2.0% 1.2°
0.5 ≤ |Z| < 1	0.7% 0.45°	0.6% 0.4°	0.4% 0.25°	0.5% 0.3°	0.8% 0.5°	1.2% 0.7°	1.7% 1.0°	3.3% 2.0°
0.2 ≤ |Z| < 0.5	1.4% 0.9°	1.1% 0.7°	0.8% 0.5°	1.1% 0.7°	1.25% 0.8°	1.8% 1.1°	2.7% 1.6°	5.5% 3.0°

TABLE 2: |Z|, Ω LEVEL = 50mV rms, SPEED = MED or SLOW for 3322

3321 Frequency, [Hz]	120		1k		10k			100k
3322 Frequency, [Hz]	100 120	200 500	1k	2k 5k	10k	20k	50k	100k
10M ≤ |Z| < 20M	7.0% 4.0°	4.5% 2.5°	3.5% 2.0°	6.0% 3.5°	8.5% 5.0°	17.0% 10.0°		
5M ≤ |Z| < 10M	3.5% 2.0°	2.2% 1.3°	1.7% 1.0°	2.7% 1.6°	3.5% 2.0°	7.0% 4.0°		
2M ≤ |Z| < 5M	2.0% 1.2°	1.2% 0.8°	0.9% 0.6°	1.2% 0.8°	1.6% 1.0°	3.5% 2.0°		
1M ≤ |Z| < 2M	1.0% 0.6°	0.6% 0.35°	0.4% 0.25°	0.6% 0.35°	0.8% 0.5°	1.6% 0.9°	12.0% 7.0°	14.0% 8.0°
200k ≤ |Z| < 1M	0.5% 0.3°	0.4% 0.25°	0.3% 0.18°	0.35% 0.20°	0.4% 0.25°	0.7% 0.4°	6.0% 3.6°	7.0% 4.0°
20k ≤ |Z| < 200k	0.3% 0.18°	0.2% 0.12°	0.16% 0.08°	0.24% 0.14°	0.32% 0.18°	0.40% 0.23°	1.8% 1.0°	3.0% 1.5°
2k ≤ |Z| < 20k	0.25% 0.15°	0.18% 0.09°	0.16% 0.06°	0.2% 0.12°	0.24% 0.14°	0.35% 0.20°	1.4% 0.8°	2.0% 1.2°
10 ≤ |Z| < 2k	0.20% 0.12°	0.18% 0.09°	0.15% 0.06°	0.20% 0.12°	0.23% 0.13°	0.32% 0.18°	1.2% 0.7°	1.6% 1.0°
2 ≤ |Z| < 10	0.5% 0.3°	0.35% 0.20°	0.25% 0.14°	0.35% 0.20°	0.5% 0.3°	0.7% 0.4°	3.4% 2.0°	4.0% 2.3°
1 ≤ |Z| < 2	1.0% 0.6°	0.6% 0.4°	0.5% 0.3°	0.6% 0.4°	0.8% 0.5°	1.1% 0.7°	6.0% 3.6°	8.0% 5.0°
0.5 ≤ |Z| < 1	1.8% 1.1°	1.2% 0.7°	1.0% 0.6°	1.2% 0.7°	1.5% 0.9°	1.8% 1.1°	10.0% 6.0°	14.0% 8.5°
0.2 ≤ |Z| < 0.5	3.7% 2.2°	2.6% 1.5°	2.0% 1.2°	2.6% 1.5°	2.9% 1.7°	3.4% 2.0°	21.5% 13.0°	28.0% 16.0°

|Z| Accuracy: ± % of reading shown on upper line.
q Accuracy: ± degrees shown on bottom line.
When 3322 speed = fast, accuracy is 2 times amount shown.

FOR |Z| > 20 MΩ, OR |Z| < 0.2Ω:

TABLE 3: |Z|, Ω or |Y|, S Level = 1V rms, Speed = MED or SLOW for 3322

3321 Frequency, [Hz]	120		1k		10k			100k
3322 Frequency, [Hz]	100 120	200 500	1k	2k 5k	10k	20k	50k	100k
0 ≤ |Y| ≤ 50nS	1.8nS	1.2nS	0.6nS	1.2nS	2.1nS	2.4nS	7.5nS	12nS
0 ≤ |Z| < 0.2	1.7% +0.2m	1.5% +0.2m	1.0% +0.2m	1.3% +0.2m	1.4% +0.3m	2.0% +0.6m	3.0% +1.5m	6.0% +3m

FOR |Z| > 20 MΩ:

|Z| Accuracy: Specified by the ± deviation (S) of admittance shown in Table 3.

θ **Accuracy:** (θ Accuracy for 10MΩ ≤ |Z| < 20M in Table 1) × (|Z|/20MΩ).

FOR |Z| < 0.2 Ω:

|Z| Accuracy: ± (% reading + R) shown in Table 3.

θ **Accuracy:** (θ Accuracy for 0.2Ω ≤ |Z| < 0.5 in Table 1) × F (0.2Ω/|Z|).

When 3322 speed = FAST, accuracy is 2 times amount shown.

NOTES:

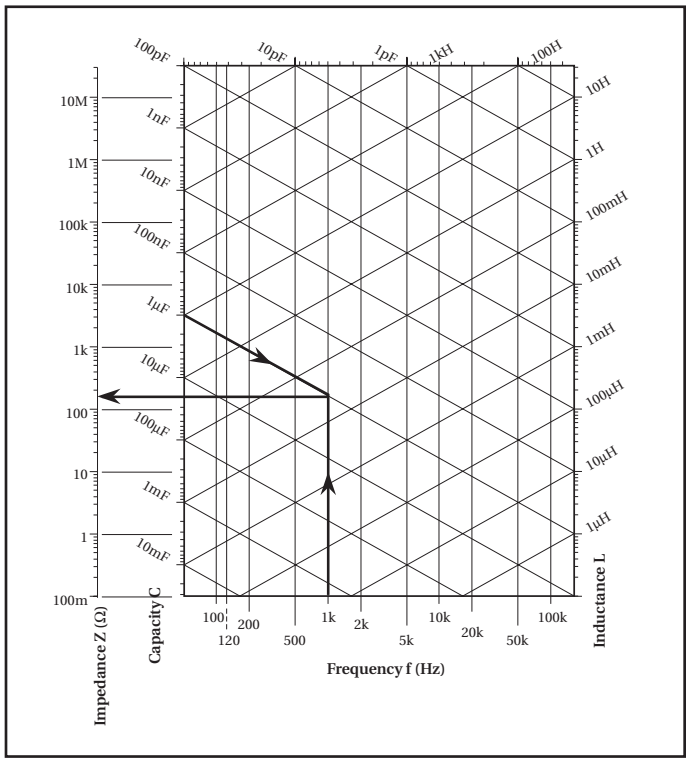
[1] When measurement is made at twice line frequency, the measured value may deviate beyond the accuracy range due to interaction with line frequency.

[2] Formulas for accuracy at any specific impedance level are given in the Instruction Manual. Tables 1, 2, and 3 indicate the worst accuracy in the stated impedance range.

Magnitude and Phase Accuracy Example

To find the accuracy of a 1µF capacitance measurement at 1kHz, follow the 1µF diagonal line down until it intersects with the vertical 1kHz line. Read the magnitude of the impedance (about 160Ω). Then locate the row corresponding to this impedance in Table 1 or 2 (10 ≤ |Z| < 2k). Read the |Z| accuracy as 0.1% and the phase accuracy as 0.03° in the 1kHz column of Table 1.

CONVERSION DIAGRAM FROM LC TO |Z|



3330 LCZ Meter

Specifications on this page are for Model 3330 LCZ Meter only.

IMPEDANCE MAGNITUDE ACCURACY (%) and PHASE ACCURACY (°) (Tables 1, 2, 3 and 4)

TABLE 1: Test Level= 0.9-1.1Vrms, Speed = Med or Slow

	Frequency (Hz)								
|Z| (Ω)	40 to 90	100 to 130	160 to 900	1k	1.1k to 5.0k	5.1k to 10k	11k to 20k	21k to 50k	51k to 100k
10M ≤ |Z| < 20M	4.5% 2.25°	3.0% 1.5°	2.0% 1.0°	1.0% 0.80°	2.0% 1.5°	3.5% 2.0°	4.0% 3.0°	14% 8.0°	20% 12°
5M ≤ |Z| < 10M	2.2% 1.3°	1.5% 0.90°	1.0% 0.60°	0.5% 0.40°	1.0% 0.60°	1.8% 1.1°	2.0% 1.3°	7.0% 4.0°	10% 6.0°
2M ≤ |Z| < 5M	1.10% 0.68°	0.75% 0.45°	0.5% 0.30°	0.3% 0.20°	0.5% 0.30°	0.9% 0.60°	1.0% 0.60°	3.5% 2.0°	5.0% 3.0°
1M ≤ |Z| < 2M	0.54% 0.33°	0.36% 0.22°	0.30% 0.15°	0.20% 0.10°	0.30% 0.15°	0.40% 0.20°	0.50% 0.30°	1.6% 1.0°	3.0% 2.0°
200k ≤ |Z| < 1M	0.37% 0.22°	0.25% 0.15°	0.20% 0.12°	0.15% 0.09°	0.20% 0.12°	0.27% 0.16°	0.35% 0.20°	1.0% 0.60°	2.0% 1.2°
20k ≤ |Z| < 200k	0.22% 0.15°	0.15% 0.10°	0.12% 0.06°	0.10% 0.04°	0.18% 0.08°	0.25% 0.15°	0.30% 0.20°	0.60% 0.40°	1.2% 0.8°
2k ≤ |Z| < 20k	0.21% 0.13°	0.14% 0.09°	0.12% 0.05°	0.10% 0.03°	0.12% 0.06°	0.15% 0.08°	0.20% 0.12°	0.40% 0.30°	0.80% 0.60°
10 ≤ |Z| < 2k	0.20% 0.12°	0.13% 0.08°	0.11% 0.05°	0.10% 0.03°	0.11% 0.08°	0.13% 0.10°	0.17% 0.15°	0.40% 0.25°	0.70% 0.50°
2 ≤ |Z| < 10	0.37% 0.22°	0.25% 0.15°	0.20% 0.10°	0.15% 0.07°	0.20% 0.12°	0.32% 0.20°	0.50% 0.30°	0.80% 0.40°	1.5% 0.80°
1 ≤ |Z| < 2	0.52% 0.33°	0.35% 0.22°	0.30% 0.20°	0.20% 0.12°	0.25% 0.15°	0.50% 0.30°	0.70% 0.40°	1.0% 0.60°	2.0% 1.2°
0.5 ≤ |Z| < 1	1.0% 0.68°	0.70% 0.45°	0.60% 0.40°	0.40% 0.25°	0.50% 0.30°	0.80% 0.50°	1.2% 0.70°	1.7% 1.0°	3.3% 2.0°
0.2 ≤ |Z| < 0.5	2.1% 1.3°	1.4% 0.90°	1.1% 0.70°	0.80% 0.50°	1.1% 0.70°	1.2% 0.80°	1.8% 1.1°	2.7% 1.6°	5.5% 3.0°

For 5°–18°C or 28°–40°C, multiply the |Z| accuracy by 1.4 and the phase accuracy by 1.8.
When measurement speed is FAST, multiply the accuracies by 2.0.
For test levels other than 0.9–1.1V rms or 50mV rms, see Instruction Manual.

TABLE 2: Test Level = 50mVrms, Speed = Med or Slow

	Frequency (Hz)								
|Z| (Ω)	40 to 90	100 to 130	160 to 900	1k	1.1k to 5.0k	5.1k to 10k	11k to 20k	21k to 50k	51k to 100k
10M ≤ |Z| < 20M	10.5% 6.0°	7.0% 4.0°	4.5% 2.5°	3.5% 2.0°	6.0% 3.5°	8.5% 5.0°	17% 10.0°	100% 60°	120% 70°
5M ≤ |Z| < 10M	5.25% 3.0°	3.5% 2.0°	2.2% 1.3°	1.7% 1.0°	2.7% 1.6°	3.5% 2.0°	7.0% 4.0°	50% 30°	60% 35°
2M ≤ |Z| < 5M	3.0% 1.8°	2.0% 1.2°	1.2% 0.80°	0.90% 0.60°	1.2% 0.8°	1.6% 1.0°	3.5% 2.0°	25% 15°	30% 18°
1M ≤ |Z| < 2M	1.5% 0.90°	1.0% 0.60°	0.60% 0.35°	0.40% 0.25°	0.60% 0.35°	0.80% 0.50°	1.6% 0.90°	12% 7.0°	14% 8.0°
200k ≤ |Z| < 1M	0.75% 0.45°	0.50% 0.30°	0.40% 0.25°	0.30% 0.18°	0.35% 0.20°	0.40% 0.25°	0.70% 0.40°	6.0% 3.6°	7.0% 4.0°
20k ≤ |Z| < 200k	0.45% 0.27°	0.30% 0.18°	0.20% 0.12°	0.16% 0.08°	0.24% 0.14°	0.32% 0.18°	0.40% 0.23°	1.8% 1.0°	3.0% 1.5°
2k ≤ |Z| < 20k	0.37% 0.23°	0.25% 0.15°	0.18% 0.09°	0.16% 0.06°	0.20% 0.12°	0.24% 0.14°	0.35% 0.20°	1.4% 0.80°	2.0% 1.2°
10 ≤ |Z| < 2k	0.30% 0.18°	0.20% 0.12°	0.18% 0.09°	0.15% 0.06°	0.20% 0.12°	0.23% 0.13°	0.32% 0.18°	1.2% 0.70°	1.6% 1.0°
2 ≤ |Z| < 10	0.75% 0.45°	0.50% 0.30°	0.35% 0.20°	0.25% 0.14°	0.35% 0.20°	0.50% 0.30°	0.70% 0.40°	3.4% 2.0°	4.0% 2.3°
1 ≤ |Z| < 2	1.5% 0.9°	1.0% 0.60°	0.60% 0.40°	0.50% 0.30°	0.60% 0.40°	0.80% 0.50°	1.1% 0.70°	6.0% 3.6°	8.0% 5.0°
0.5 ≤ |Z| < 1	2.7% 1.65°	1.8% 1.1°	1.2% 0.70°	1.0% 0.60°	1.2% 0.70°	1.5% 0.90°	1.8% 1.1°	10% 6.0°	14% 8.5°
0.2 ≤ |Z| < 0.5	5.55% 3.3°	3.7% 2.2°	2.6% 1.5°	2.0% 1.2°	2.6% 1.5°	2.9% 1.7°	3.4% 2.0°	21% 13°	28% 16°

Accuracy is not guaranteed in the following ranges: |Z| > 20MΩ, |Z| < 0.2Ω.
For 5°–18°C or 28°–40°C, multiply the |Z| by 2.0 and the phase accuracy by 2.0.
When measurement speed is FAST, multiply the accuracies by 2.0.
For test levels other than 0.9–1.1V rms or 50mV rms, see Instruction Manual.

FOR |Z| > 20 MΩ, OR |Z| < 0.2Ω:

TABLE 3: |Z|, Ω or |Y|, S Level = 1V rms, Speed = MED or SLOW for 3322

Frequency, [Hz]	100 120	200 500	1k	2k 5k	10k	20k	50k	100k
0≤|Y|≤50nS	1.8nS	1.2nS	0.6nS	1.2nS	2.1nS	2.4nS	7.5nS	12nS
0≤|Z|<0.2	1.7% +0.2mΩ	1.5% +0.2mΩ	1.0% +0.2mΩ	1.3% +0.2mΩ	1.4% +0.3mΩ	2.0% +0.6mΩ	3.0% +1.5mΩ	6.0% +3mΩ

FOR |Z| > 20 MΩ:

|Z| Accuracy: Specified by the ± deviation (S) of admittance shown in Table 3.

θ **Accuracy:** (θ Accuracy for 10MΩ ≤ |Z| < 20M in Table 1) × (|Z|/20MΩ).

FOR |Z| < 0.2 Ω:

|Z| Accuracy: ± (% reading + R) shown in Table 3.

θ **Accuracy:** (θ Accuracy for 0.2Ω ≤ |Z| < 0.5 in Table 1) × F (0.2Ω/|Z|).

When 3330 speed = FAST, accuracy is 2 times amount shown.

NOTES:

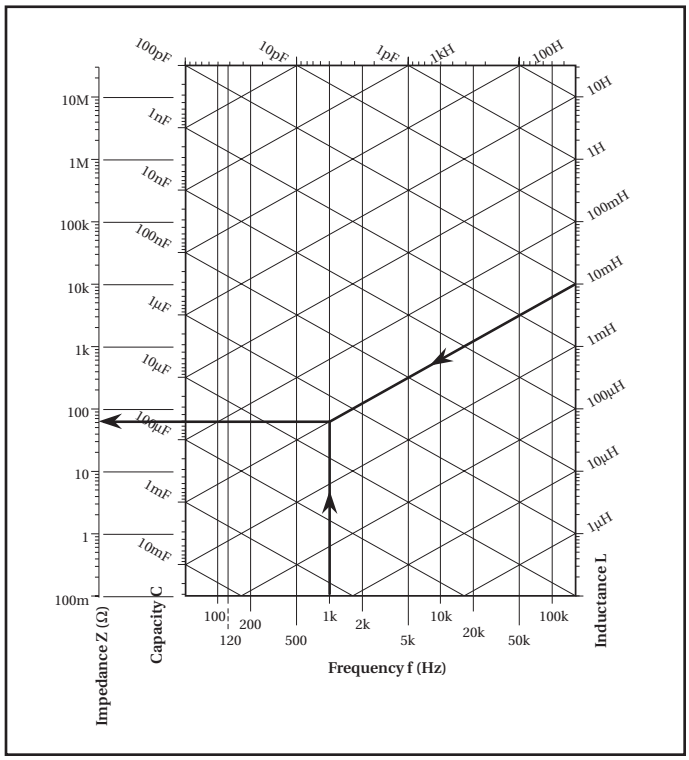
[1] When measurement is made at twice line frequency, the measured value may deviate beyond the accuracy range due to interaction with line frequency.

[2] Formulas for accuracy at any specific impedance level are given in the Instruction Manual. Tables 1, 2, and 3 indicate the worst accuracy in the stated impedance range.

Magnitude and Phase Accuracy Example

To find the accuracy of a 10mH inductance measurement at 1kHz, follow the 10mH diagonal line down until it intersects with the vertical 1kHz line. Read the magnitude of the impedance (about 63Ω). Then locate the row corresponding to this impedance in Table 1 or 2 (10 ≤ |Z| < 2k). Read the |Z| accuracy as 0.1% and the phase accuracy as 0.03° in the 1kHz column of Table 1.

CONVERSION DIAGRAM FROM LC TO |Z|



3321, 3322 and 3330 LCZ Meters

Specifications on this page are for Models 3321, 3322 and 3330 LCZ Meters.

ACCURACY (continued)

Accuracy of R, ESR and G:

In the case of Q < 0.1 (D>10), use the accuracy of |Z|:
|R| = |Z|, |ESR| = |Z|, |G| = 1/|Z|.

Accuracy of L, C and X:

In the case of Q >10 (D < 0.1) use the accuracy of |Z|:

$$L = \frac{|Z|}{2\pi f},\quad C = \frac{1}{2\pi f\,|Z|},\quad |X| = |Z|,$$

where f is test frequency in Hz.

Refer to the conversion diagram from LC to |Z|.

Accuracy of D and Q

In the case of D << 1 (Q >> 1), use the following equations:

Accuracy of D =
±(0.0175 × θ accuracy (deg))

Accuracy of Q =
±(0.0175×θ accuracy (deg)×Q^2)

ACCURACY OF V and I MONITORS (Model 3330 only): ±(2% + |Z| accuracy).

TRIGGER

TRIGGER MODES:

Models 3322 and 3330:
Automatic (repeat) and manual.

Model 3321: Automatic only.

TRIGGER DELAY TIME:
0 to 199.99s.

MEASUREMENT TERMINALS

4 terminals (BNC-R) + guard terminal.

FRONT PANEL SETUP MEMORY (Models 3322 and 3330)

NUMBER OF SETUPS: 10.

CONTENT OF MEMORY: All setting data other than bias on-off.

LIFE OF BATTERY: 3 years or longer after delivery.

GPIB

SETTING: Of the items settable via the front panel, all the parameters except address and delimitter of GPIB can be set. Also trigger, OPEN/SHORT compensation and memory operation can be performed.

READOUT: All the settable parameters, measurement data and status.

STANDARDS: Based on IEEE-488-1978 and IEEE-488A-1980.

CODE: ISO 7 bit code (ASCII code).

MEASURING PARAMETERS

MAIN PARAMETERS:

AUTO	Selects the main parameters, sub-parameters and equivalent circuits automatically.
L	Self-inductance (unit: H, Henry)
C	Electrostatic capacity (unit: F, Farad)
R	Resistance (unit: Ω, Ohm) (Models 3322 and 3330 only)
|Z|	Magnitude of impedance (unit: Ω, Ohm)

There are series and parallel measuring modes for each of L, C and R.

SUB-PARAMETERS:

Q	Quality factor (quality of circuit)
D	Dissipation factor (= tan δ = 1/Q)
ESR	Equivalent series resistance (unit: Ω)
G	Parallel conductance (unit: S, Siemens)
X	Series reactance (unit: Ω) (Models 3322 and 3330 only)
θ	Phase angle of impedance (unit: degree)
V, I	Monitored voltage and current (Model 3330 only) at DUT

DEVIATION DISPLAY (Models 3322 and 3330): Deviation and deviation of main parameter (not avail-able for sub-parameter). Possible measurement range of deviation is ±100% or more for Δ and ±199.99% for Δ%.

NUMBER OF BINS (Models 3322 and 3330): 20 max.

MEASURING (DISPLAY) RANGE:

R, |Z|, ESR, X:	0.1 mΩ	to	19.999 MΩ
C:	0.001 pF	to	199.99 mF
L:	0.1 nH	to	19.999 kH
Q, D:	0.0001	to	19999
G:	0.001 µS	to	199.99 S
q:	–180.00 °	to	+179.99 °
(3330 only) V:	0.0 mV	to	1.999 V rms
(3330 only) I:	0.00 µA	to	19.99 mA rms

These ranges are dependent on the frequency, measuring range and phase angle of impedance.

MEASURING SIGNAL

FREQUENCY:
Model 3330:
Range: 40Hz–130Hz: 10Hz steps.
160, 200, 250Hz: 100Hz steps.
300Hz–9.9kHz: 100Hz steps.
10kHz–100kHz: 1kHz steps.

Model 3322: 100, 120, 200, 500, 1k, 2k, 5k, 10k, 20k, 50k, or 100k [Hz].

Model 3321: 120, 1k, 10k or 100k [Hz].

Accuracy: ±50 ppm (±0.005%).

SIGNAL LEVEL (Voltage with drive terminal H CUR open):
Models 3321 and 3322:
1V rms: ±3% at 1kHz, ± 4% at 100Hz to 20kHz
±5% at 50kHz and 100kHz
50mV rms: ±5% at 1kHz, ± 6% at 100Hz to 20kHz
±7% at 50kHz and 100kHz

Model 3330:
Range: 10mV rms–1.100V rms: 1mV steps.
Accuracy: ±(3% + 1mV) for 1kHz.
±(4% + 1mV) for 40Hz–20kHz.
±(5% + 1mV) for 21kHz–100kHz.

OUTPUT IMPEDANCE (all Models): 100Ω typical.

DC BIAS:	**3321 and 3322**	**3330**
Internal:	2V, ±5%	2V, ±5%
External:	0 to +35V	0 to ±35V

MEASURING RANGE

NUMBER OF RANGES: 6.

SELECTION: **Model 3322:** Automatic or manual.
Model 3321: Automatic.

MEASURING TIME (reference value, fixed range and auto trigger mode):

	Typical at 1kHz, 1kΩ	Maximum on any range, any frequency
FAST:	64 ms	80 ms
MED:	150 ms	245 ms
SLOW:	480 ms	600 ms

Model 3322: Selectable among above three measuring times.

Model 3321: Automatic switching (equivalent to MED or SLOW).

HANDLER INTERFACE (Model 3330)

CONNECTOR: 36-pin Centronix type (Cinch 57-30360).

OUTPUT SIGNALS:

BIN 0–11	Bin judgment signals
A_NG	Main parameter failure
B_NG	Sub-parameter failure
STROBE	Judgment completion pulse (pulse width ≥1.5ms)
BUSY	Measurement in progress flag

OUTPUT CHARACTERISTICS:
Type: TTL negative logic.
Maximum TTL Load: 10 standard TTL.
Maximum Output Current: 48mA sink, output voltage ≤1V).

INPUT SIGNALS:
TRIG: Measurement start trigger (pulse width ≥100µs).
LOCK: Panel operation prohibited.

INPUT CHARACTERISTICS:
Low Level Input Voltage: –1.5 to +0.8V.
High Level Input Voltage: +2.4V to 30V (TRIG), +3.5V to 30V (LOCK).
Low Level Input Current (approximate):
TRIG: –0.33mA.
LOCK: –3mA.

HANDLER INTERFACE GROUND: Isolated from chassis ground. Maximum voltage from chassis ±42VDC.

BEEPER (two functions, DIP switch selectable):
Beeper On/Off: Enables beeper function.
Beeper Mode:
1. Beep only for NO GO.
2. 4kHz beep for GO and 2kHz beep for NO GO.

NOTE: GO refers to comparator bins 1–19, and NO GO refers to comparator bin 0.

GENERAL

POWER REQUIREMENTS: AC line voltage: selectable to 100V, 120V, 220V, 240V ±10% (250V max.). 48 to 62Hz, approx. 21VA.

WARM-UP TIME: 30 minutes.

TEMPERATURE: 23°C ± 5°C.

HUMIDITY: ≤ 90% RH.

ZERO CORRECTION: Performed under above conditions.

CALIBRATION PERIOD: 12 months.

OPERATING ENVIRONMENT: 0° to 40°C, 10 to 90% RH (non-condensing).

STORAGE ENVIRONMENT: –10 to +50°C, 10 to 80% RH (non-condensing).

DIMENSIONS, WEIGHT: 216mm wide × 132.5mm high × 350mm deep (8½ in × 5¼ in × 13¾ in), excluding protrusions. Net weight 3.7kg (8.1 lb).

ACCESSORIES SUPPLIED: Operating manual, power cable, fuse (0.5A, 250V, normal acting type 5.2×20mm), fuse (0.1A, 250V, quick acting type 5.2×20mm).