

# 320 Series True-rms Clamp Meters

Fluke rugged. Fluke precise. Fluke reliable.

The Fluke 323, 324 and 325 Clamp Meters are designed to perform in the toughest environments and provide noise-free, reliable results users can trust to confidently diagnose problems. True-rms measurements and optimized ergonomics make the 320 Series Clamp Meters the best general troubleshooting tools for commercial and residential electricians.

**New**



## Technical Data

### Measurement capability

- 400 A ac current measurement (ac and dc current; 325 only)
- 600 V ac and dc voltage measurement
- True-rms ac voltage and current for accurate measurements on non-linear signals
- Resistance measurement to up to 40 k $\Omega$  with continuity detection
- Temperature and capacitance measurement (324 and 325 only)
- Frequency measurement (325 only)

### Features

- Slim, ergonomic design
- Large, easy to read backlight display (324 and 325 only)
- CAT IV 300 V/CAT III 600 V safety rating
- Hold button
- Two-year warranty
- Soft carrying case

## Specifications

|                            |                   | <b>323</b>                                                                  | <b>324</b>                                                                         | <b>325</b>                                                                  |
|----------------------------|-------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <b>AC current</b>          | Range             | 400.0 A                                                                     | 40.00 A/400.0 A                                                                    | 40.00 A/400.0 A                                                             |
|                            | Accuracy          | 2 % ± 5 digits<br>(45 Hz to 65 Hz)<br>2.5 % ± 5 digits<br>(65 Hz to 400 Hz) | 1.5 % ± 5 digits<br>(45 Hz to 400 Hz)<br>Note: Add 2 %<br>for position sensitivity | 2 % ± 5 digits<br>(45 Hz to 65 Hz)<br>2.5 % ± 5 digits<br>(65 Hz to 400 Hz) |
| <b>DC current</b>          | Range             | —                                                                           | —                                                                                  | 40.00 A/400.0 A                                                             |
|                            | Accuracy          | —                                                                           | —                                                                                  | 2 % ± 5 digits                                                              |
| <b>AC voltage</b>          | Range             | 600.0 V                                                                     | 600.0 V                                                                            | 600.0 V                                                                     |
|                            | Accuracy          | 1.5 % ± 5 digits                                                            | 1.5 % ± 5 digits                                                                   | 1.5 % ± 5 digits                                                            |
| <b>DC voltage</b>          | Range             | 600.0 V                                                                     | 600.0 V                                                                            | 600.0 V                                                                     |
|                            | Accuracy          | 1.0 % ± 5 digits                                                            | 1.0 % ± 5 digits                                                                   | 1.0 % ± 5 digits                                                            |
| <b>Resistance</b>          | Range             | 400.0 Ω/4000 Ω                                                              | 400.0 Ω/4000 Ω                                                                     | 400.0 Ω/4000 Ω/40.00 kΩ                                                     |
|                            | Accuracy          | 1 % ± 5 digits                                                              | 1 % ± 5 digits                                                                     | 1 % ± 5 digits                                                              |
| <b>Continuity</b>          |                   | ≤ 70 Ω                                                                      | ≤ 30 Ω                                                                             | ≤ 30 Ω                                                                      |
| <b>Capacitance</b>         |                   | —                                                                           | 100.0 μF to 1000 μF                                                                | 100.0 μF to 1000 μF                                                         |
| <b>Frequency</b>           |                   | —                                                                           | —                                                                                  | 5.0 Hz to 500.0 Hz                                                          |
| <b>AC response</b>         |                   | True-rms                                                                    | True-rms                                                                           | True-rms                                                                    |
| <b>Backlight</b>           |                   | —                                                                           | Yes                                                                                | Yes                                                                         |
| <b>Data hold</b>           |                   | Yes                                                                         | Yes                                                                                | Yes                                                                         |
| <b>Contact temperature</b> |                   | —                                                                           | -10.0 °C to 400.0 °C<br>(14.0 °F to 752.0 °F)                                      | -10.0 °C to 400.0 °C<br>(14.0 °F to 752.0 °F)                               |
| <b>Min/Max</b>             |                   | —                                                                           | —                                                                                  | Yes                                                                         |
| <b>Size</b>                | H x W x D (mm)    | 207 x 75 x 34                                                               | 207 x 75 x 34                                                                      | 207 x 75 x 34                                                               |
|                            | Max wire diameter | 30 mm (600 MCM)                                                             | 30 mm (600 MCM)                                                                    | 30 mm (600 MCM)                                                             |
|                            | Weight            | 265 g                                                                       | 208 g                                                                              | 283 g                                                                       |
| <b>Category rating</b>     |                   | CAT III 600 V<br>CAT IV 300 V                                               | CAT III 600 V<br>CAT IV 300 V                                                      | CAT III 600 V<br>CAT IV 300 V                                               |
| <b>Warranty</b>            |                   | Two-year                                                                    | Two-year                                                                           | Two-year                                                                    |

### Ordering information

**323** True-rms Clamp Meter

**324** True-rms Clamp Meter

**325** True-rms Clamp Meter

### Included with all models

Clamp meter, test leads, soft case,  
and users manual.

**Fluke.** *Keeping your world  
up and running.®*

**Fluke Corporation**  
PO Box 9090, Everett, WA 98206 U.S.A.

**Fluke Europe B.V.**  
PO Box 1186, 5602 BD  
Eindhoven, The Netherlands

**For more information call:**  
In the U.S.A. (800) 443-5853 or  
Fax (425) 446-5116  
In Europe/M-East/Africa +31 (0) 40 2675 200 or  
Fax +31 (0) 40 2675 222  
In Canada (800)-36-FLUKE or  
Fax (905) 890-6866  
From other countries +1 (425) 446-5500 or  
Fax +1 (425) 446-5116  
Web access: <http://www.fluke.com>

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# Four Things to Consider When Buying a Clamp Meter

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## 1 Choose a clamp that gives accurate and repeatable results

*Does your clamp report the true-rms reading?*

*Is the problem with your motor or your clamp?*

**Make sure your clamp meter is working for you, not against you.**

Imagine that you have spent the whole day troubleshooting a problem with a motor only to discover that the problem wasn't really the motor, but the clamp you were using to measure it. You stake your reputation on your ability to get the job done, be sure your clamp meter is working for you not against you.

First, make sure your clamp meter reports the true-rms reading. Otherwise noise from everything including a variable frequency drive to compact fluorescent bulbs can result in a less accurate reading.

## 2 Make sure the clamp meter works where you do

*Have you ever dropped your clamp?*

*Do you use your clamp outside?*

*Ever used your clamp to pry apart wires?*

**If so, make sure your clamp can work where and how you do.**

Making accurate and repeatable results in a laboratory is a good start. But you don't always work in a clean and controlled environment. Before making a purchase, check whether the clamp is specified to work in the environment you do.

Be sure you don't buy a clamp specified for indoor use only or with a minimum operating range warmer than 15 °F if you think you might need to make measurements outside. If the clamp isn't designed for the outdoors the measurements you get might not be accurate.

Finally be sure the clamp you are using is rugged enough to continue to give reliable results after years of prying wires apart, drops from ladders and bouncing around the back of your truck.

## 3 Don't compromise on safety

*Does the clamp have the correct rating for the work you are doing?*

*Can you use the meter easily when wearing personal protective equipment?*

**If the answer is no, you could be in danger.**

Your test and measurement tools are a critical barrier between you and danger. They are quite literally an extension of your body into a very dangerous environment. First things first, be sure you choose a clamp meter with an appropriate category rating for the work you are doing.

Second, choose a brand with a reputation for providing safe and reliable test equipment. Anyone can buy a clamp meter and put their brand on it. Only a few manufacturers design, build and test their own equipment to exceed international safety standards.

Finally, your clamp meter is part of a safety system that includes personal protective equipment (PPE). In addition to having the right PPE, be sure that you can easily operate your test and measurement equipment with that gear in place.

## 4 When choosing features, pick quality over quantity

*Not using all the features on your clamp meter?*

**If so, you could be wasting money and functionality.**

These days you can get almost anything built into a clamp meter (tape measure anyone?). The more gadgets that are built into a clamp meter, the harder it becomes to use and the worse it performs. Instead of trying to get the most features possible, choose a meter that has the measurement functions you need to get the job done, without any of fluff that doesn't make sense. Plus, you don't end up paying for features irrelevant to the job at hand.

## Fluke 323

The best option for general, grab-and-go troubleshooting needs.

### Measurement capability:

- 400 A ac current measurement
- 600 V ac and dc voltage measurement
- True-rms ac voltage and current for accurate measurements on non-linear signals
- Resistance measurement up to 4000  $\Omega$  with continuity detection

### Features:

- Slim, ergonomic design
- CAT IV 300V/CAT III 600 V safety rating
- Hold button
- Two-year warranty
- Soft carrying case



| Technical specifications |                             |                                                                       |
|--------------------------|-----------------------------|-----------------------------------------------------------------------|
| AC current               | Range                       | Accuracy                                                              |
|                          | 400.0 A                     | 2 % ± 5 digits (45 Hz to 65 Hz)<br>2.5 % ± 5 digits (65 Hz to 400 Hz) |
| AC voltage               | Range                       | Accuracy                                                              |
|                          | 600.0 V                     | 1.5 % ± 5 digits                                                      |
| DC voltage               | Range                       | Accuracy                                                              |
|                          | 600.0 V                     | 1.0 % ± 5 digits                                                      |
| Resistance               | Range                       | Accuracy                                                              |
|                          | 400.0 Ω                     | 1.0 % ± 5 digits                                                      |
|                          | 4000 Ω                      |                                                                       |
| Continuity               | ≤ 70 Ω                      |                                                                       |
| Data hold                | Yes                         |                                                                       |
| Category rating          | CAT III 600 V, CAT IV 300 V |                                                                       |

## Fluke 324

General electrical measurements with temperature and capacitance capabilities.

### Measurement capability:

- 400 A ac current measurement
- 600 V ac and dc voltage measurement
- True-rms ac voltage and current for accurate measurements on non-linear signals
- Resistance measurement up to 4000  $\Omega$  with continuity detection
- Temperature and capacitance measurement

### Features:

- Slim, ergonomic design
- Backlight display
- CAT IV 300V/CAT III 600 V safety rating
- Hold button
- Two-year warranty
- Soft carrying case



| Technical specifications |                                            |                                                                              |
|--------------------------|--------------------------------------------|------------------------------------------------------------------------------|
| AC current               | Range                                      | Accuracy                                                                     |
|                          | 40.00 A                                    | 1.5 % ± 5 digits (45 Hz to 400 Hz)<br>Note: Add 2 % for position sensitivity |
|                          | 400.0 A                                    |                                                                              |
| AC voltage               | Range                                      | Accuracy                                                                     |
|                          | 600.0 V                                    | 1.5 % ± 5 digits                                                             |
| DC voltage               | Range                                      | Accuracy                                                                     |
|                          | 600.0 V                                    | 1.0 % ± 5 digits                                                             |
| Resistance               | Range                                      | Accuracy                                                                     |
|                          | 400.0 Ω                                    | 1.0 % ± 5 digits                                                             |
|                          | 4000 Ω                                     |                                                                              |
| Continuity               | ≤ 30 Ω                                     |                                                                              |
| Capacitance              | 100.0 μF to 1000 μF                        |                                                                              |
| Backlight                | Yes                                        |                                                                              |
| Data hold                | Yes                                        |                                                                              |
| Contact temperature      | -10.0 °C to 400.0 °C (14.0 °F to 752.0 °F) |                                                                              |
| Category rating          | CAT III 600 V, CAT IV 300 V                |                                                                              |

## Fluke 325

Big ac/dc features in a small form factor.

### Measurement capability:

- 400 A ac and dc current measurement
- 600 V ac and dc voltage measurement
- True-rms ac voltage and current for accurate measurements on non-linear signals
- Resistance measurement up to 40 k $\Omega$  with continuity detection
- Temperature and capacitance measurement
- Frequency measurement
- Min/Max functionality

### Features:

- Slim, ergonomic design
- Backlight display
- CAT IV 300V/CAT III 600 V safety rating
- Hold button
- Two-year warranty
- Soft carrying case



| Technical specifications |                                            |                                                                       |
|--------------------------|--------------------------------------------|-----------------------------------------------------------------------|
| AC current               | Range                                      | Accuracy                                                              |
|                          | 40.00 A                                    | 2 % ± 5 digits (45 Hz to 65 Hz)<br>2.5 % ± 5 digits (65 Hz to 400 Hz) |
|                          | 400.0 A                                    |                                                                       |
| AC voltage               | Range                                      | Accuracy                                                              |
|                          | 600.0 V                                    | 1.5 % ± 5 digits                                                      |
| DC voltage               | Range                                      | Accuracy                                                              |
|                          | 600.0 V                                    | 1.0 % ± 5 digits                                                      |
| Resistance               | Range                                      | Accuracy                                                              |
|                          | 400.0 Ω                                    | 1.0 % ± 5 digits                                                      |
|                          | 4000 Ω                                     |                                                                       |
|                          | 40.00 kΩ                                   |                                                                       |
| Continuity               | ≤ 30 Ω                                     |                                                                       |
| Capacitance              | 100.0 μF to 1000 μF                        |                                                                       |
| Frequency                | 5.0 Hz to 500.0 Hz                         |                                                                       |
| Backlight                | Yes                                        |                                                                       |
| Data hold                | Yes                                        |                                                                       |
| Contact temperature      | -10.0 °C to 400.0 °C (14.0 °F to 752.0 °F) |                                                                       |
| Min/Max                  | Yes                                        |                                                                       |
| Category rating          | CAT III 600 V, CAT IV 300 V                |                                                                       |

# GO TO WORK WITH THE BEST.

## Fluke 320 Series True-rms Clamp Meters



**FLUKE®**

# 323/324/325

Clamp Meter

**Users Manual**

PN 4045153

May 2012

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Specifications are subject to change without notice.

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## **LIMITED WARRANTY AND LIMITATION OF LIABILITY**

This Fluke product will be free from defects in material and workmanship for two years from the date of purchase. This warranty does not cover fuses, disposable batteries, or damage from accident, neglect, misuse, alteration, contamination, or abnormal conditions of operation or handling. Resellers are not authorized to extend any other warranty on Fluke's behalf. To obtain service during the warranty period, contact your nearest Fluke authorized service center to obtain return authorization information, then send the product to that Service Center with a description of the problem.

THIS WARRANTY IS YOUR ONLY REMEDY. NO OTHER WARRANTIES, SUCH AS FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSED OR IMPLIED. FLUKE IS NOT LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, ARISING FROM ANY CAUSE OR THEORY. Since some states or countries do not allow the exclusion or limitation of an implied warranty or of incidental or consequential damages, this limitation of liability may not apply to you.

Fluke Corporation  
P.O. Box 9090  
Everett, WA 98206-9090  
U.S.A.

Fluke Europe B.V.  
P.O. Box 1186  
5602 BD Eindhoven  
The Netherlands

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## ***Introduction***

The Fluke 323/324/325 Clamp Meters (the Product) measure ac and dc voltage, ac current, resistance, and continuity. The 324 and 325 can also measure capacitance and contact temperature. The 325 can also measure dc current and frequency. Note that the 325 is shown in all of the illustrations. For temperature measurement, you must use the included K-Type Thermocouple.



**Read "Safety Information" before you use the Product.**

## ***How to Contact Fluke***

To contact Fluke, call one of the following telephone numbers:

- Technical Support USA: 1-800-44-FLUKE (1-800-443-5853)
- Calibration/Repair USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-675-200

- Japan: +81-3-3434-0181
- Singapore: +65-6799-5566
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's website at [www.fluke.com](http://www.fluke.com).

To register your product, visit <http://register.fluke.com>.

To see, print, or download the latest manual supplement, visit  
<http://us.fluke.com/user/support/manuals>.

## ***Safety Information***

A **Warning** identifies conditions and procedures that are dangerous to the user. A

**Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

Table 1 tells you about symbols used on the Product and in this manual.

### **Warning**

**To prevent personal injury, use the Product only as specified, or the protection supplied by the Product can be compromised.**

**To prevent possible electrical shock, fire, or personal injury:**

- **Use only correct measurement category (CAT), voltage, and amperage rated probes, test leads, and adapters for the measurement.**
- **Do not touch voltages > 30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Carefully read all instructions.**
- **Hold the Product behind the tactile barrier. See The Clamp Meter, item ①.**
- **Do not exceed the Measurement Category (CAT) rating of the lowest rated individual component of a Product, probe, or accessory.**
- **Do not measure current while the test leads are in the input jacks.**
- **Do not use the Product around explosive gas, vapor, or in damp or wet environments.**
- **Limit operation to the specified measurement category, voltage, or amperage ratings.**
- **Do not work alone.**
- **Do not apply more than the rated voltage, between the terminals or between each terminal and earth ground.**

- **Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame-resistant clothes) to prevent shock and arc blast injury where hazardous live conductors are exposed.**
- **Replace the batteries when the low battery indicator shows to prevent incorrect measurements.**
- **The battery door must be closed and locked before you operate the Product.**
- **Measure a known voltage first to make sure that the Product operates correctly.**
- **Remove all probes, test leads, and accessories that are not necessary for the measurement.**
- **Only use probes, test leads, and accessories that have the same measurement category and voltage rating as the Product.**
- **Keep fingers behind the finger guards on the probes.**

- **Connect the common test lead before the live test lead and remove the live test lead before the common test lead.**
- **Remove all probes, test leads, and accessories before the battery door is opened.**
- **Do not use and disable the Product if it is damaged.**
- **Do not use the Product if it operates incorrectly.**
- **Do not use test leads if they are damaged. Examine the test leads for damaged insulation, exposed metal. Check test lead continuity.**
- **Before each use, examine the Product. Look for cracks or missing pieces of the clamp housing. Also look for loose or weakened components. Carefully examine the insulation around the jaws. See The Clamp Meter, item ②.**
- **Examine the case before you use the Product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.**
- **Read all safety Information before you use the Product.**

- **Remove batteries to prevent battery leakage and damage to the Product if it is not used for an extended period.**
- **Remove batteries to prevent battery leakage and damage to the Product if is to be stored above its operating temperature.**

** Caution**

**To avoid possible damage to the Product or to equipment under test, use a thermocouple rated for the temperatures to be measured. The Product is rated for -10.0 °C to +400.0 °C and 14 °F to 752 °F. The included type-K thermocouple is rated to 260 °C.**

**Table 1. Symbols**

| Symbol                                                                            | Meaning                                            | Symbol                                                                            | Meaning                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ~                                                                                 | AC (Alternating Current)                           |  | Earth ground                                                                                                                                                                                                        |
| ≡                                                                                 | DC (Direct Current)                                |  | Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.                                                                                                        |
| ⎓                                                                                 | AC and DC Current                                  | CE                                                                                | Conforms to European Union directives.                                                                                                                                                                              |
|  | Risk of Danger. Important information. See Manual. |  | Double insulated                                                                                                                                                                                                    |
|  | Hazardous voltage. Risk of electric shock.         |  | This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements. |
|  | Conforms to relevant Australian standards.         |  | German certifying body.                                                                                                                                                                                             |

**Table 1. Symbols (cont.)**

| <b>Symbol</b>                                                                     | <b>Meaning</b>                                                                                                                                                                                                      | <b>Symbol</b>                                                                     | <b>Meaning</b>                                                                                                                                                        |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Battery                                                                                                                                                                                                             |  | Application around and removal from HAZARDOUS LIVE conductors is permitted.                                                                                           |
| <b>CAT III</b>                                                                    | CAT III equipment is designed to protect against transients in equipment in fixed equipment installations, such as distribution panels, feeders and short branch circuits, and lighting systems in large buildings. | <b>CAT IV</b>                                                                     | CAT IV equipment is designed to protect against transients from the primary supply level, such as an electricity meter or an overhead or underground utility service. |

*Note*

*The Measurement Category (CAT) and voltage rating of combinations of test probes, test probe accessories, current clamp accessories, and the Product is the LOWEST rating of individual components.*

## ***How to Clean the Product***

Regularly wipe the case with a damp cloth and weak detergent.



### **Caution**

**To prevent damage to the Product, do not use abrasives or solvents to clean the Product case.**

To clean the Product Jaw:

1. Examine the jaw mating surface to make sure it is clean. If there is unwanted material (including rust), jaw closure will not be correct and there will be measurement errors.
2. Open the jaws and clean the clamp metal ends with a lightly oiled cloth.

## **Specifications**

### **Electrical Specifications**

#### **AC Current (Jaw)**

Range

|               |                  |
|---------------|------------------|
| 323.....      | 400.0 A          |
| 324, 325..... | (40.00, 400.0) A |

Resolution

|               |               |
|---------------|---------------|
| 323.....      | 0.1 A         |
| 324, 325..... | (0.01, 0.1) A |

|                |                                    |
|----------------|------------------------------------|
| Accuracy ..... | 2.0 % $\pm$ 5 digits (45 – 65 Hz)  |
|                | 2.5 % $\pm$ 5 digits (65 – 400 Hz) |

#### **DC Current with Jaw (325)**

|                  |                      |
|------------------|----------------------|
| Range.....       | (40.00, 400.0) A     |
| Resolution ..... | (0.01, 0.1) A        |
| Accuracy .....   | 2.0 % $\pm$ 5 digits |

#### **AC Voltage**

|                              |                      |
|------------------------------|----------------------|
| Range.....                   | 600.0 V              |
| Resolution .....             | 0.1 V                |
| Accuracy (45 – 400 Hz) ..... | 1.5 % $\pm$ 5 digits |

**DC Voltage**

|                  |                    |
|------------------|--------------------|
| Range .....      | 600.0 V            |
| Resolution ..... | 0.1 V              |
| Accuracy .....   | 1 % $\pm$ 5 digits |

**Resistance**

|                   |                               |
|-------------------|-------------------------------|
| Range             |                               |
| 323, 324.....     | (400.0, 4000) $\Omega$        |
| 325.....          | (400.0, 4000, 40000) $\Omega$ |
| Resolution .....  | (0.1, 1, 10) $\Omega$         |
| Accuracy .....    | 1 % $\pm$ 5 digits            |
| Continuity Beeper |                               |
| 323 .....         | $\leq 70 \Omega$              |
| 324/325 .....     | $\leq 30 \Omega$              |

**Capacitance (324, 325)**

|                  |                       |
|------------------|-----------------------|
| Range .....      | (100.0, 1000) $\mu$ F |
| Resolution ..... | (0.1, 1) $\mu$ F      |
| Accuracy .....   | 1 % $\pm$ 4 digits    |

**Frequency (325)**

|             |                 |
|-------------|-----------------|
| Range ..... | 5.0 to 500.0 Hz |
|-------------|-----------------|

|                     |                            |
|---------------------|----------------------------|
| Resolution .....    | 0.1 Hz                     |
| Accuracy .....      | 0.5 % $\pm$ 4 digits       |
| Trigger Level ..... | 5 to 10 Hz, $\geq$ 10 A    |
|                     | 10 to 100 Hz, $\geq$ 5 A   |
|                     | 100 to 500 Hz, $\geq$ 10 A |

**Contact Temperature (324, 325)**

|                  |                      |
|------------------|----------------------|
| Range.....       | -10.0 °C to 400.0 °C |
| Resolution ..... | 0.1 °C               |
| Accuracy .....   | 1 % $\pm$ 8 digits   |

Note: Temperature uncertainty (accuracy) does not include error of the thermocouple probe.

**Mechanical Specifications**

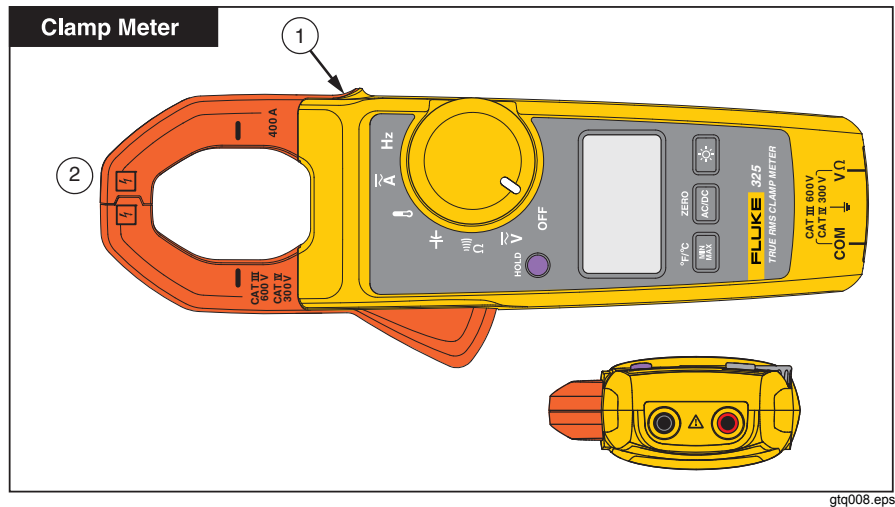
|                        |                    |
|------------------------|--------------------|
| Size (L x W x H) ..... | (207 x 75 x 34) mm |
| Weight                 |                    |
| 323.....               | 265 g              |
| 324.....               | 208 g              |
| 325.....               | 283 g              |

**Environmental Specifications**

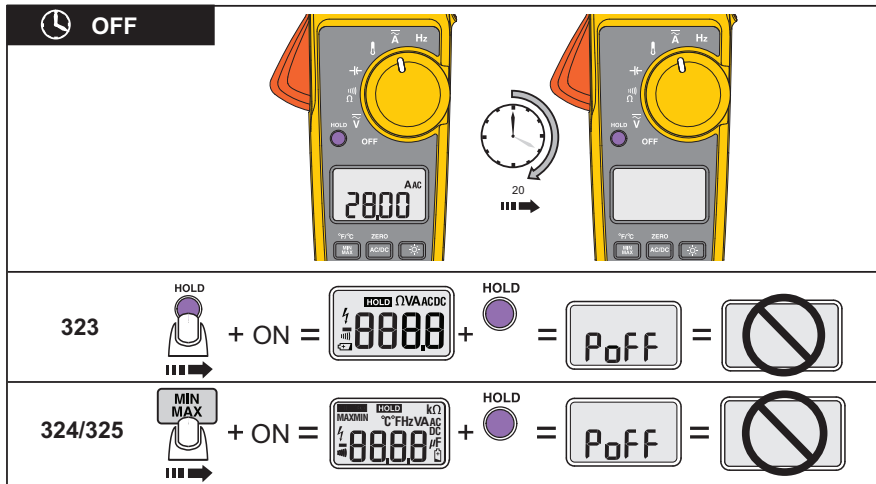
|                            |                  |
|----------------------------|------------------|
| Operating Temperature..... | -10 °C to +50 °C |
| Storage Temp .....         | -30 °C to +60 °C |

|                               |                                                                                                                                                                                                                                                                                          |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operating Humidity .....      | Non Condensing ( $\leq 10^{\circ}\text{C}$ )<br>$\leq 90\%$ RH (at $10^{\circ}\text{C}$ to $30^{\circ}\text{C}$ )<br>$\leq 75\%$ RH (at $30^{\circ}\text{C}$ to $40^{\circ}\text{C}$ )<br>$\leq 45\%$ RH (at $40^{\circ}\text{C}$ to $50^{\circ}\text{C}$ )<br>(Without Condensation)    |
| Operating Altitude .....      | 2000 meters                                                                                                                                                                                                                                                                              |
| Storage Altitude .....        | 12,000 meters                                                                                                                                                                                                                                                                            |
| EMI, EMC.....                 | Meets all applicable requirements in EN/IEC 61326-1                                                                                                                                                                                                                                      |
| Temperature Coefficients..... | Add 0.1 x specified accuracy for each degree C<br>above $28^{\circ}\text{C}$ or below $18^{\circ}\text{C}$                                                                                                                                                                               |
| Over Voltage Category .....   | CAT IV 300 V, CAT III 600 V                                                                                                                                                                                                                                                              |
| Safety Compliance.....        | EN/IEC 61010-1, Pollution Degree 2<br>EN/IEC 61010-2-032<br>EN/IEC 61010-031:2002/A1:2008<br>CE                                                                                                                                                                                          |
| Agency Approvals .....        | SP <sup>®</sup> C <sub>US</sub> Complies with CAN/CSA-C22.2 No. 61010-1,<br>2nd edition, including Amendment 1.,   |
| IP Rating .....               | IP 30 Per IEC 60529:2001; Non-operating                                                                                                                                                                                                                                                  |
| Batteries.....                | 2 AAA, NEDA 24A, IEC LR03                                                                                                                                                                                                                                                                |

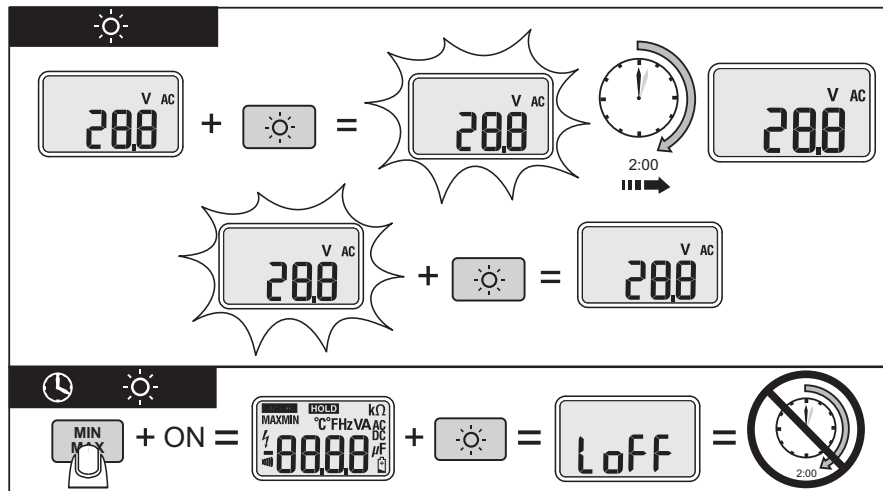
## The Meter



gtq008.eps

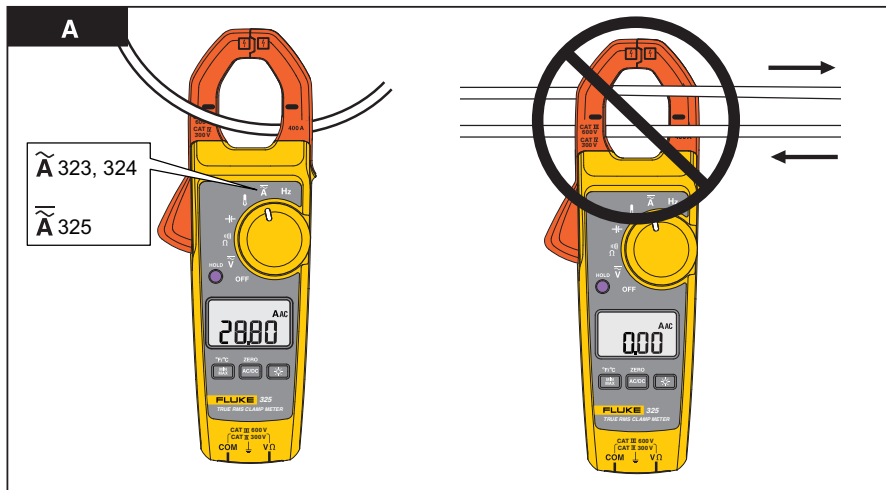


gtq001.eps

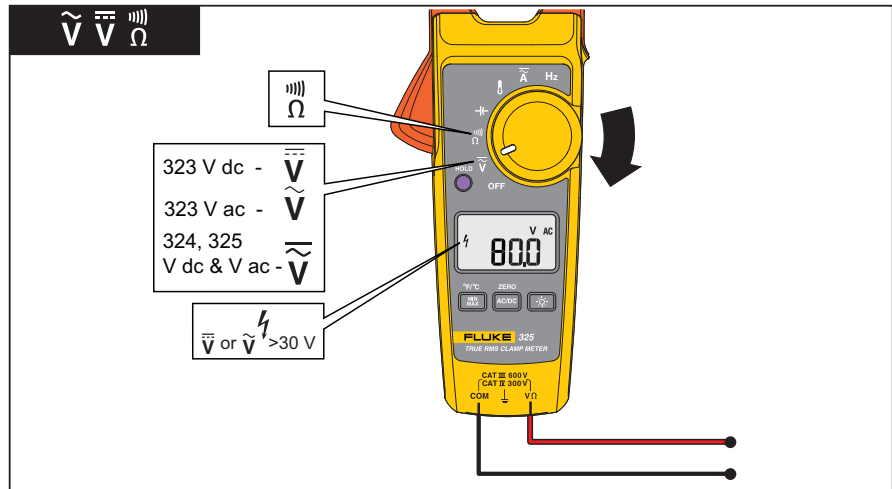


gtq002.eps

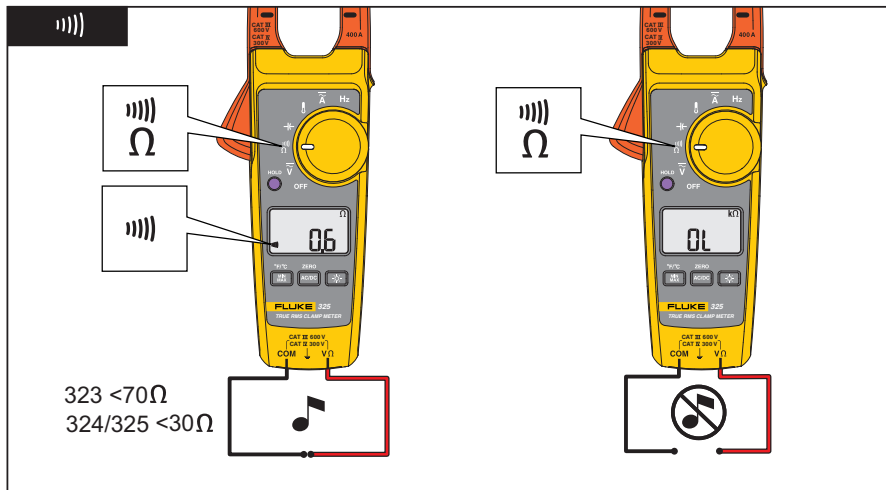
## Clamp Meter The Meter



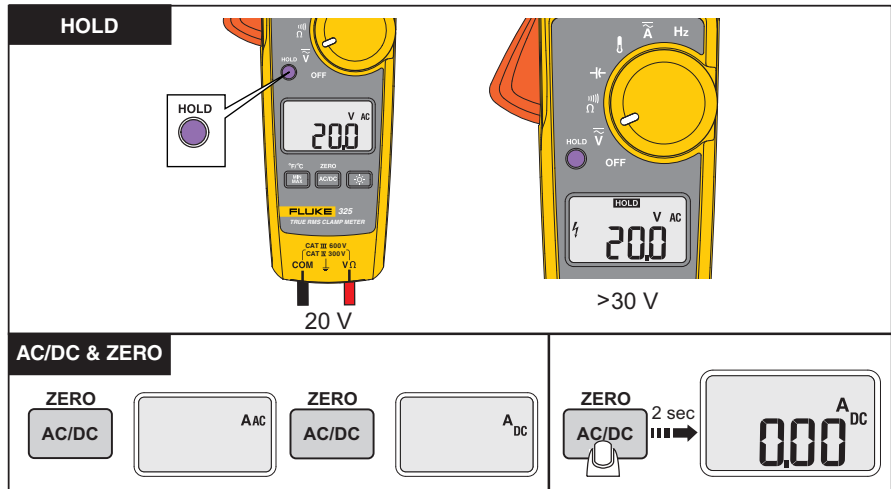
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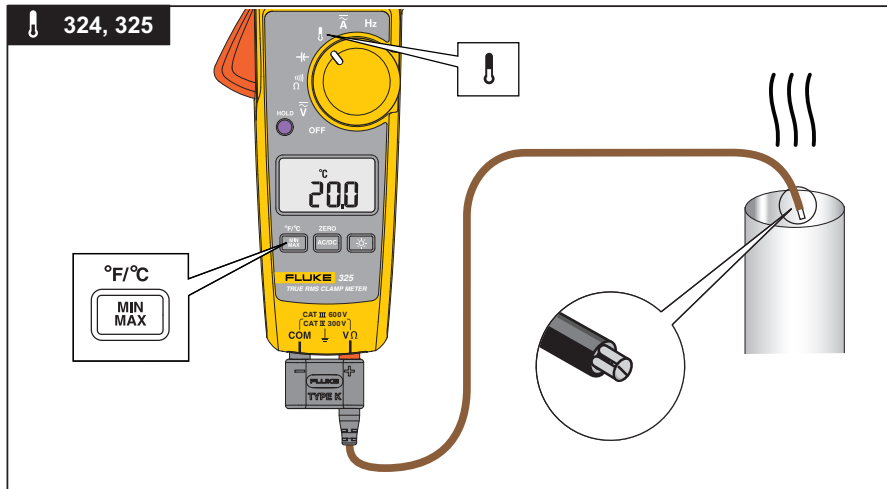
gtq004.eps



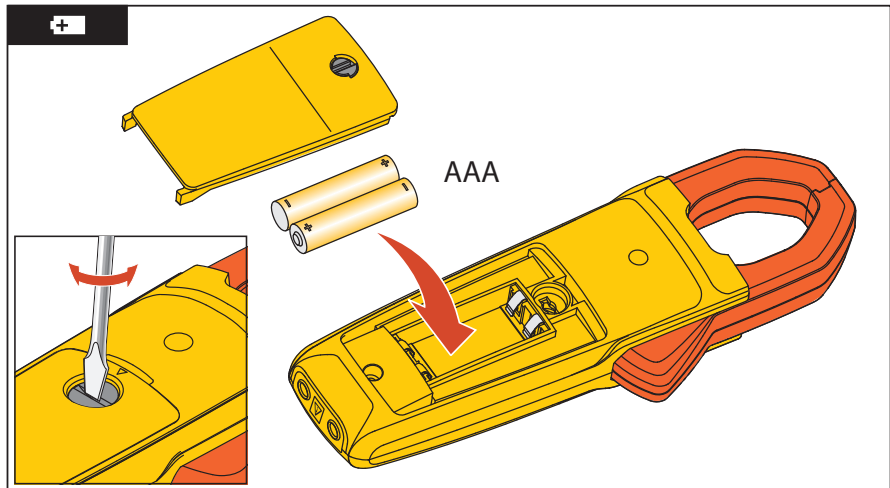
gtq005.eps



gtq006.eps



gtq009.eps



# Fluke 424D, 419D and 414D Laser Distance Meters

## Technical Data

**Professional-grade distance measuring tools that are fast, easy to use, and fit in your pocket.**

The Fluke laser distance meters use the most advanced distance measuring technology. These meters are fast, accurate, durable, and easy to use—just point and shoot. Their simple design and easy one-button operation means you spend less time measuring while increasing the reliability of the answers that you need.

The compact and handy Fluke laser distance meters were designed for indoor and limited outdoor applications. All three models are simple to operate, with the Fluke durability and quality you expect. And, with specific function buttons, different tasks can be completed quickly and easily.

The extra bright laser is clearly visible so you can always see your targeting point even if the target object is in a hard-to-reach spot, or a long distance away. These units have a large LCD screen and buttons positioned for one-handed measurements.

### Features and benefits

#### All meters offer:

- Reduction of estimation errors, saving both time and money
- The most advanced laser technology for distance measurement
- Instant measurement with one-button operation
- Easy targeting with bright laser
- Quick calculation of area (square footage) and volume
- Easy addition and subtraction of measurements
- Minimum/maximum function
- Improved battery life from automatic shut-off feature
- Pythagoras calculation for determining distance indirectly from two other measurements
- Pouch with Fluke logo
- Three-year warranty



Fluke 414D, 419D and 424D Laser Distance Meters.

#### The 424D and 419D additionally offers:

- Improved visibility with backlit screen
- Ability to measure up to 80 m (260 ft) for 419D, 100 m (330 ft) for 424D
- Tripod mode allows you to mount to a tripod for measuring long distances
- Stake out function
- Enhanced Pythagoras calculation for determining distance indirectly from three other measurements
- Audible keypad feedback
- Storage of the last twenty measurements for quick recall of distance
- Strong environmental protection with IP54 (water spray and dust proof) sealing

#### The 424D additionally offers:

- Inclination sensor for taking measurements in hard to reach areas
- Compass provides a "heading" for distance measurement
- Automated endpiece correction: when measuring from an edge or corner, a built-in sensor detects the position of this bracket and automatically changes the reference point

## General specifications

|                                                  | 414D                                                                                                                                       | 419D                                                                       | 424D                                                 |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------|
| Distance measurement                             |                                                                                                                                            |                                                                            |                                                      |
| Typical measuring tolerance <sup>[1]</sup>       | ± 2.0 mm <sup>[3]</sup>                                                                                                                    | ± 1.0 mm <sup>[3]</sup>                                                    |                                                      |
| Maximum measuring tolerance <sup>[2]</sup>       | ± 3.0 mm <sup>[3]</sup>                                                                                                                    | ± 2.0 mm <sup>[3]</sup>                                                    |                                                      |
| Range at Leica target plate GZM26                | 50 m/165 ft                                                                                                                                | 80 m/260 ft                                                                | 100 m/330 ft                                         |
| Typical range <sup>[1]</sup>                     | 40 m/130 ft                                                                                                                                | 80 m/260 ft                                                                | 80 m/260 ft                                          |
| Range at unfavorable condition <sup>[4]</sup>    | 35 m/115 ft                                                                                                                                | 60 m/195 ft                                                                | 60 m/195 ft                                          |
| Smallest unit displayed                          | 1 mm /1/16 in                                                                                                                              | 1 mm /1/32 in                                                              |                                                      |
| Power Range Technology™                          | no                                                                                                                                         | yes                                                                        | yes                                                  |
| Ø laser point at distances                       | 6/30/60 mm (10/50/100 m)<br>0.23/1.18/2.36 in (32.8/164/330)                                                                               | 6/30/60 mm (10/50/100 m)<br>0.23/1.18/2.36 in (32.8/164/330)               |                                                      |
| Tilt measurement                                 |                                                                                                                                            |                                                                            |                                                      |
| Measuring tolerance to laser beam <sup>[5]</sup> | no                                                                                                                                         | no                                                                         | ± 0.2°                                               |
| Measuring tolerance to housing <sup>[5]</sup>    | no                                                                                                                                         | no                                                                         | ± 0.2°                                               |
| Range                                            | no                                                                                                                                         | no                                                                         | 360°                                                 |
| General                                          |                                                                                                                                            |                                                                            |                                                      |
| Laser class                                      | II                                                                                                                                         |                                                                            |                                                      |
| Laser type                                       | 635 nm, <1 mW                                                                                                                              |                                                                            |                                                      |
| Protection class                                 | IP40                                                                                                                                       | IP54                                                                       |                                                      |
| Automatic laser off                              | After 90 seconds                                                                                                                           |                                                                            |                                                      |
| Automatic power off                              | After 180 seconds                                                                                                                          |                                                                            |                                                      |
| Battery life (2 x AAA) 1.5 V NEDA 24A/IEC LR03   | up to 3,000 measurements                                                                                                                   | up to 5,000 measurements                                                   |                                                      |
| Size (HxWxD)                                     | 116 mm x 53 mm x 33 mm<br>(4.56 in x 2.08 in x 1.29 in)                                                                                    | 127 mm x 56 mm x 33 mm<br>(5 in x 2.20 in x 1.29 in)                       | 127 mm x 56 mm x 33 mm<br>(5 in x 2.20 in x 1.29 in) |
| Weight (with batteries)                          | 113 g (3.98 oz)                                                                                                                            | 153 g (5.39 oz)                                                            | 158 g (5.57 oz)                                      |
| Temperature range:<br>Storage<br>Operation       | -25 °C to +70°C (-13 °F to +158 °F)<br>0 °C to +40 °C (32 °F to +104 °F)                                                                   | -25 °C to +70°C (-13 °F to +158 °F)<br>-10 °C to +50 °C (14 °F to +122 °F) |                                                      |
| Calibration cycle                                | Not applicable                                                                                                                             | Not applicable                                                             | tilt and compass                                     |
| Maximum altitude                                 | 3000 m                                                                                                                                     | 3000 m                                                                     | 3000 m                                               |
| Maximum relative humidity                        | 85 % at 20 °F to 120 °F<br>(-7 °C to 50 °C)                                                                                                | 85 % at 20 °F to 120 °F<br>(-7 °C to 50 °C)                                | 85 % at 20 °F to 120 °F<br>(-7 °C to 50 °C)          |
| Safety                                           | CAN/CSA-C22.2 No. 61010-1-04, UL Std. No. 61010-1 (2nd Edition), ISA-82.02.01,<br>IEC Standard No. 61010-1:2001, EN60825-1:2007 (Class II) |                                                                            |                                                      |
| EMC                                              | 61326-1:2006                                                                                                                               |                                                                            |                                                      |

[1] Applies for 100 % target reflectivity (white painted wall), low background illumination, 25 °C (13 °F).

[2] Applies for 10 % to 500 % target reflectivity, high background illumination, -10 °C to +50 °C (14 °F to +122 °F).

[3] Tolerances apply from 0.05 m to 10 m (0.001 ft to 32.8 ft) with a confidence level of 95 %. The maximum tolerance may deteriorate to 0.1 mm/m (0.003 in/ft) between 10 m to 30 m (32.8 ft to 98.4 ft) and to 0.15 mm/m (0.005 in/ft) for distances above 30 m (98.4 ft).

[4] Applies for 100 % target reflectivity, background illumination between 10'000 lux and 30'000 lux.

[5] After user calibration. Additional angle related deviation of ± 0.01° per degree up to ± 45° in each quadrant. Applies at room temperature. For the whole operating temperature range the maximum deviation increases by ± 0.1°.

## Ordering information

Fluke 424D Laser Distance Meter  
Fluke 419D Laser Distance Meter  
Fluke 414D Laser Distance Meter

All models include: Laser distance meter, two AAA batteries, users manual on CD, quick reference guide, vinyl carrying pouch, and three-year warranty

## Why use a distance meter?

**Instant measurements up to 100 meters/330 feet.** Just point, click, done.

**Measure with greater accuracy.** Up to ± 1 mm. No scales to interpret or misread.

**Do the work of two.** Instead of holding the tape, your helper can do other jobs.

**Speed up the job.** Easily measure hard-to-access areas, like high ceilings, without climbing a ladder.

**Keep it on the level.** New inclination sensor on the Fluke 424D helps with leveling, height tracking, and measuring around obstacles.

**Reduce estimating errors—let the meters do the math.** Find area and volume. Easily add and subtract distances. Use Pythagoras calculations for height.

**Trust Fluke tools.** Rugged and reliable, dust- and splash-proof, you can work indoors and out with confidence, because they're Fluke tools.

For more information visit [www.fluke.com/distance](http://www.fluke.com/distance)

**Fluke. Keeping your world up and running.®**

### Fluke Corporation

PO Box 9090, Everett, WA USA 98206

### Fluke Europe B.V.

PO Box 1186, 5602 BD  
Eindhoven, The Netherlands

### For more information call:

In the U.S.A. (800) 443-5853 or  
Fax (425) 446-5116

In Europe/M-East/Africa (31 40) 2 675 200 or  
Fax (31 40) 2 675 222

In Canada (800)-36-FLUKE or

Fax (905) 890-6866

From other countries +1 (425) 446-5500 or

Fax +1 (425) 446-5116

Web access: <http://www.fluke.com>

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# 414D/419D/424D

Laser Distance Meter

## Users Manual

June 2012

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## **LIMITED WARRANTY AND LIMITATION OF LIABILITY**

Each Fluke product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is three years and begins on the date of shipment. Parts, product repairs, and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke authorized reseller, and does not apply to fuses, disposable batteries, or to any product which, in Fluke's opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Fluke warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke does not warrant that software will be error free or operate without interruption.

Fluke authorized resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Fluke. Warranty support is available only if product is purchased through a Fluke authorized sales outlet or Buyer has paid the applicable international price. Fluke reserves the right to invoice Buyer for importation costs of repair/replacement parts when product purchased in one country is submitted for repair in another country.

Fluke's warranty obligation is limited, at Fluke's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Fluke authorized service center within the warranty period.

To obtain warranty service, contact your nearest Fluke authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB Destination). Fluke assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Fluke determines that failure was caused by neglect, misuse, contamination, alteration, accident, or abnormal condition of operation or handling, including overvoltage failures caused by use outside the product's specified rating, or normal wear and tear of mechanical components, Fluke will provide an estimate of repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

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Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

Fluke Corporation  
P.O. Box 9090  
Everett, WA 98206-9090  
U.S.A.

Fluke Europe B.V.  
P.O. Box 1186  
5602 BD Eindhoven  
The Netherlands

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# ***Laser Distance Meter***

## ***Introduction***

The Fluke 414D/419D/424D Laser Distance Meters (Meter or Product) are professional-grade laser distance meters. Use these Meters to quickly and accurately get the distance to a target, the area, and the volume measurements.

This Meter is better than an ultrasonic device because it uses laser light waves and measures their reflection. The Meter includes:

- Most advanced technology for distance measurements
- More accurate measurement
- Longer measurement distance – *model dependent*

This manual identifies when a feature is model-dependent. If not identified, all models include the feature.

## ***How to Contact Fluke***

To contact Fluke, call one of the following telephone numbers:

- Technical Support USA: 1-800-44-FLUKE (1-800-443-5853)
- Calibration/Repair USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-675-200
- Japan: +81-3-3434-0181
- Singapore: +65-6799-5566
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's website at [www.fluke.com](http://www.fluke.com).

To register your product, visit <http://register.fluke.com>.

To view, print, or download the latest manual supplement, visit <http://us.fluke.com/usen/support/manuals>.

## Safety Information

A **Warning** identifies hazardous conditions and procedures that are dangerous to the user. A **Caution** identifies the conditions and procedures that can cause damage to the Product or cause permanent loss of data.

### Warning

To prevent eye damage and personal injury, do not look into the laser. Do not point the laser directly at persons or animals or indirectly off reflective surfaces.

### Warning

To prevent personal injury:

- Read all safety information before you use the Product.
- Carefully read all instructions.
- Use the Product only as specified, or the protection supplied by the Product can be compromised.
- Replace the batteries when the low battery indicator shows to prevent incorrect measurements.
- Do not use the Product around explosive gas.
- Do not use the Product if it operates incorrectly.
- Do not use and disable the Product if it is damaged.

Table 1 is a list of symbols used on the Product and in this manual.

**Table 1. Symbols**

| Symbol                                                                            | Description                                                                                                  |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
|  | Battery status.                                                                                              |
|  | Battery or battery compartment.                                                                              |
|  | Important information. See manual.                                                                           |
|  | Warning. Laser.                                                                                              |
|  | Conforms to relevant Australian standards.                                                                   |
|  | Conforms to requirements of European Union and European Free Trade Association.                              |
|  | Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information. |

### **Electromagnetic Compatibility (EMC)**

The term "electromagnetic compatibility" identifies that the Product operates smoothly in an environment where electromagnetic radiation and electrostatic discharges are present and does not cause electromagnetic interference to other equipment.

#### **⚠ Warning**

**The Product conforms to the most stringent requirements of the relevant standards and regulations. Yet, the possibility that it causes interference in other devices cannot be totally excluded.**

#### **⚠ Caution**

**Never repair the Product yourself. In case of damage, contact Fluke ([www.fluke.com](http://www.fluke.com)).**

### **FCC Statement (U.S.A Only)**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference with one or more of these measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### **⚠ Warning**

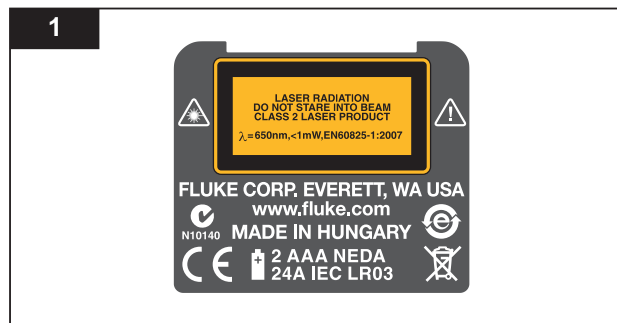
**Changes or modifications not expressly approved by Fluke for compliance could void the user's authority to operate the equipment.**

## **Laser Classification**

### **Integrated Distance Meter**

The Meter produces a visible laser beam from the front of the Meter. Figure 1 shows the warning that is on the back of the Meter.

It is a Class 2 laser product in accordance with IEC60825-1 : 2007 "Radiation safety of laser products."



gwo20.gif

## **Laser Class 2 Products**

Do not stare into the laser beam or direct it towards other people unnecessarily. Eye protection is normally afforded by aversion responses including the blink reflex.

### **Warning**

**Do not look directly into the beam with optical aids. Looking directly into the beam with optical aids (for example, binoculars and telescopes) can be hazardous.**

### **Caution**

**Looking into the laser beam may be hazardous to the eyes.**

Do not look into the laser beam. Make sure the laser is pointed above or below eye level, particularly with fixed installations in machines and similar setups.

## Features

Table 2 is a list of features for the Meter by model.

**Table 2. Model Feature Comparison**

| Feature                                                                                                                             | 414D | 419D | 424D | Feature                      | 414D | 419D | 424D |
|-------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------------------------------|------|------|------|
| Display Lines                                                                                                                       | 2    | 3    | 4    | Timer                        |      | •    | •    |
| Memory <sup>[1]</sup>                                                                                                               |      | 20   | 20   | Display/Keypad Illumination  |      | •    | •    |
| Add/Subtract                                                                                                                        | •    | •    | •    | Keypad Lock                  |      | •    | •    |
| Area                                                                                                                                | •    | •    | •    | Tripod Measurement           |      | •    | •    |
| Volume                                                                                                                              | •    | •    | •    | Compass                      |      |      | •    |
| Continuous Measurement                                                                                                              |      | •    | •    | Triangular Area              |      |      | •    |
| Pythagoras Calculations                                                                                                             | 1+2  | Full | Full | Smart Horizontal Mode (Tilt) |      |      | •    |
| Stake Out <sup>[2]</sup>                                                                                                            |      | •    | •    | Height Tracking              |      |      | •    |
| Multifunction Endpiece                                                                                                              |      | •    | •    | Room Corner Angle            |      |      | •    |
| Beeper                                                                                                                              |      | •    | •    | Handstrap                    | •    | •    | •    |
| <p>[1] 419D and 424D store a maximum of 20 complete display readouts.<br/>           [2] 419D uses 1 value. 424D uses 2 values.</p> |      |      |      |                              |      |      |      |

## Before You Start

This section has basic information about the batteries and measurement reference point. It also describes the Meter keypad and display.

### Batteries

Replace the batteries when  blinks in the display.

To install or replace the batteries:

1. Remove battery compartment lid. See Figure 2.
2. Attach the handstrap.
3. Install two AAA (LR03) batteries with the correct polarity.

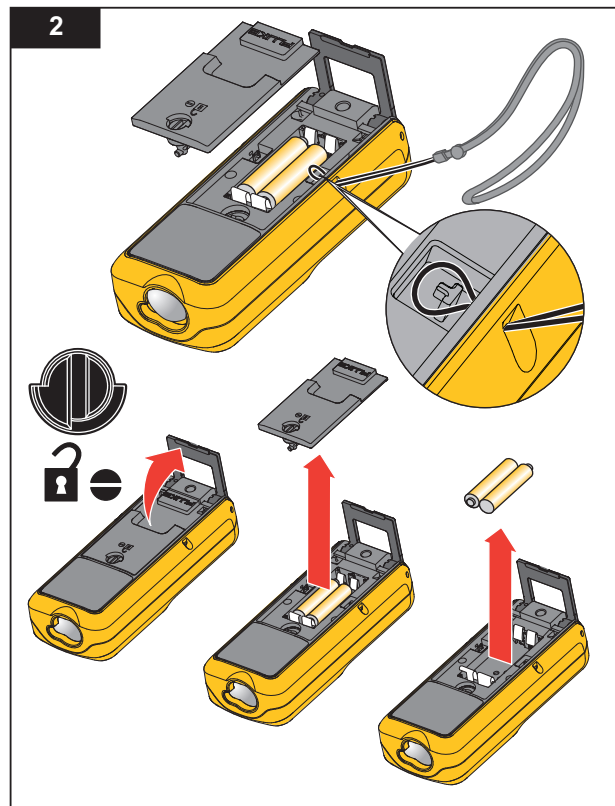
#### Note

*Do not use zinc-carbon batteries.*

4. Close the battery compartment.

#### ⚠ Caution

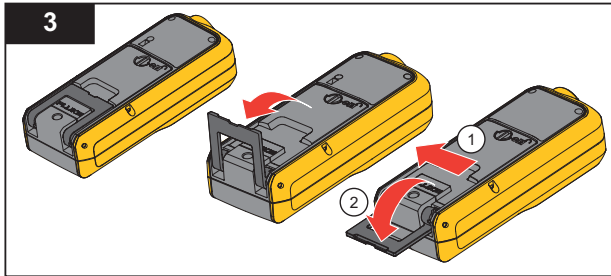
**To prevent corrosion, remove the batteries before a long period of nonuse.**



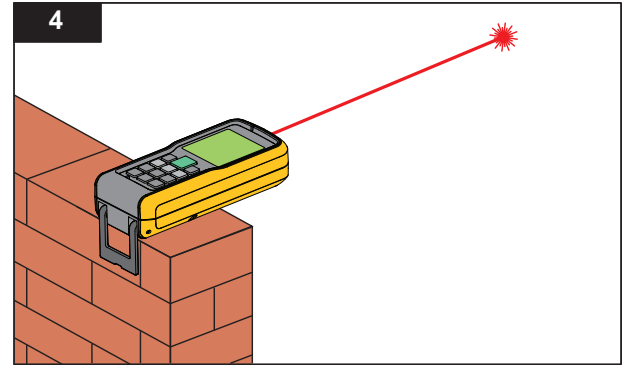
### **Multifunctional Endpiece**

The 419D and 424D Meters adapt to multiple measurement situations with the multifunctional endpiece, see Figure 3:

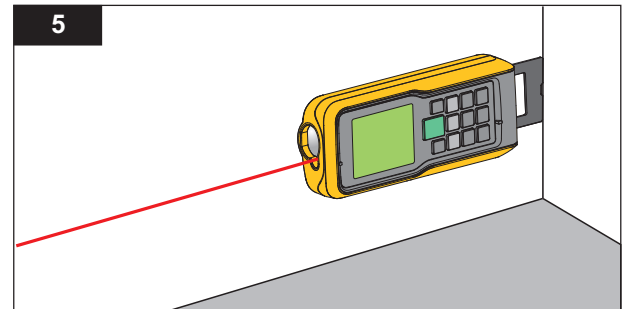
- For measurements from an edge, fold out the endpiece (90 °) until it locks into place. See Figure 4.
- For measurements from a corner, fold out the endpiece (90 °) until it locks into place. Push the endpiece lightly to the right side to fold it out fully. See Figures 3 and 5.
- A built-in sensor automatically senses the orientation of the endpiece and adjusts the zero point.



gwo02.eps



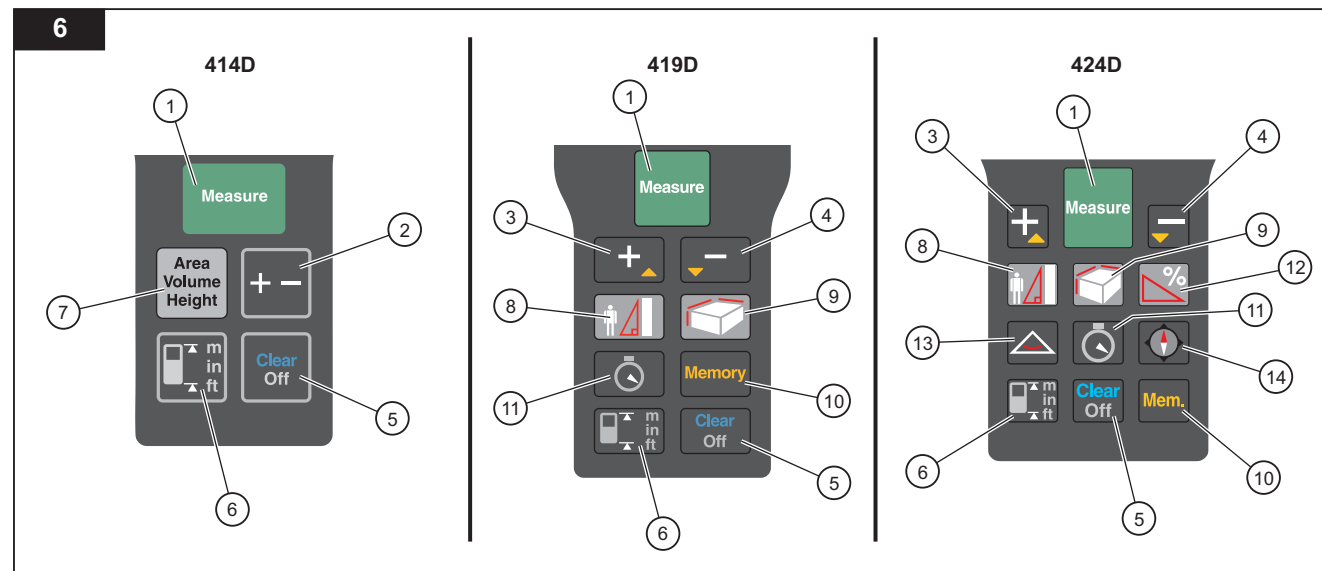
gwo03.eps



gwo04.eps

### Keypad

Figure 6 shows the location of each function button on the keypad.

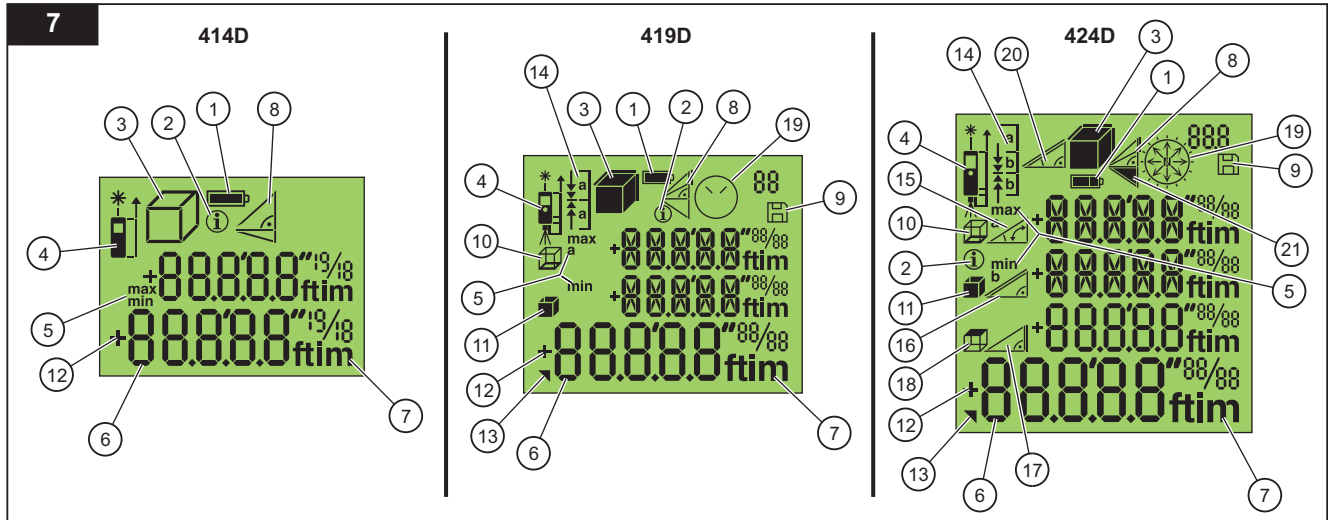


gwo05.eps

- |                         |                                                   |               |            |
|-------------------------|---------------------------------------------------|---------------|------------|
| ① Measure/Power On      | ⑤ Clear/Off                                       | ⑨ Area/Volume | ⑬ Triangle |
| ② Plus (+)/Minus (-)    | ⑥ Reference/Change Units                          | ⑩ Memory      | ⑭ Compass  |
| ③ Plus (+)/Scroll Up    | ⑦ Area/Volume/Indirect Measurement (Pythagoras)   | ⑪ Timer       |            |
| ④ Minus (-)/Scroll Down | ⑧ Indirect Measurement (Pythagoras and Stake Out) | ⑫ Tilt        |            |

## Display

Figure 7 shows the readout location on the display for each function.



gwo06.eps

- |                                       |                        |                                    |                             |
|---------------------------------------|------------------------|------------------------------------|-----------------------------|
| ① Battery Status                      | ⑦ Units of Measurement | ⑬ 2 <sup>nd</sup> Result Available | ⑲ Timer/Compass (424D only) |
| ② Info                                | ⑧ Pythagoras           | ⑭ Stake Out                        | ⑳ Leveling                  |
| ③ Area/Volume                         | ⑨ Memory               | ⑮ Tilt Angle                       | ㉑ Triangle Area             |
| ④ Measurement Reference               | ⑩ Circumference        | ⑯ Slope Distance                   |                             |
| ⑤ Min/Max Measurement (Tracking Mode) | ⑪ Wall Area            | ⑰ Indirect Height                  |                             |
| ⑥ Measurement Readout                 | ⑫ Addition/Subtraction | ⑱ Ceiling Area                     |                             |

## Button Functions

This section is about how to use the buttons and identifies when a function is model-dependent. When not identified, all models include the function.

### On/Off

Push  to turn on the Meter and laser. The display shows the battery symbol until you push a different button.

Push  for 2 seconds to turn off the meter.

#### Note

*The Meter turns off automatically if not used in 180 seconds.*

## Basics

### 414D

#### Measure Button

Push :

- 1x = Laser on
- 2x = Measure

In Pythagoras calculation mode:

- 2 seconds = Tracking (min/max measurement)

#### Function Buttons

Push :

- 1x = Area
- 2x = Volume
- 3x = Pythagoras 1
- 4x = Pythagoras 2

### 419D/424D

#### Measure Button

When off, push  for 2 seconds = Continuous Laser On

Push :

- 1x = Laser On
- 2x = Measure
- 2 seconds = Tracking (min/max measurement)

#### Function Buttons

Push :

- 1x = Pythagoras 1
- 2x = Pythagoras 2
- 3x = Pythagoras 3
- 4x = Stake Out (419D: 1 value / 424D: 2 values)

Push :

- 1x = Area
- 2x = Volume
- 2 seconds = 2<sup>nd</sup> Results

**424D Only**

Push :

- 1x = Smart Horizontal Mode
- 2x = Height Tracking
- 3x = Leveling

Push :

- 1x = Room Corner Angle (Triangular Area)
- 2 seconds = 2<sup>nd</sup> Results

**Units of Measurement**

Push and hold  (414D) or  (419D/424D) for 2 seconds to toggle between the units for distance measurements, see Table 3.

**Table 3. Units of Measurement**

| 414D  | 419D/424D  |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 0.000 m                                                                                  | 0.000 m                                                                                       |
| 0 00" 1/16*                                                                              | 0.000 <sup>0</sup> m                                                                          |
| 0 in 1/16                                                                                | 0.00 m                                                                                        |
| * Default                                                                                | 0.00 ft                                                                                       |
|                                                                                          | 0'00" 1/32*                                                                                   |
|                                                                                          | 0.000 in                                                                                      |
|                                                                                          | 0 in 1/32                                                                                     |

\* Default

**Timer (419D/424D)**

Fluke recommends that you use a time-delay for the most accurate measurements at long distances. This prevents Meter movement when you push .

To turn on the timer:

1. Push  1x to turn on the 5-second timer. This is the default time interval to release the laser for a measurement.
2. Push  to increase up to 60 seconds.
3. Push  to decrease the seconds.
4. Push  to begin the timer.

The seconds until measurement (for example, 59, 58, 57...) show as a countdown. The last 5 seconds count down with a beep. After the last beep, the Meter makes the measurement and the value shows on the display.

*Note*

*The timer is useful for all measurements.*

**Beeper (419D/424D)**

Push   at the same time for 2 seconds to turn on and turn off the beeper. The display shows the status as BEEP On or BEEP OFF.

**Backlight (419D/424D)**

Push   at the same time for 2 seconds to turn on and turn off the backlight. The display shows the status as ILLU On or ILLU OFF.

**Keypad Lock (419D/424D)**

To lock:

1. Push   at the same time to lock the keypad.

To unlock:

1. Push .
2. Push  within 2 seconds to unlock the keypad.

### **Compass (424D)**

The compass feature lets you know the view or direction as you make measurements. This is useful indoors to set the building plans in the correct direction. It is also useful to know the correct direction when you calculate the efficiency for a solar panel.

Tips:

- Make sure that the endpiece is folded in.
- When you use the compass feature, the Meter shows the calibration message. See Compass Calibration for more information.
- Compass arrows blink on the display if the Meter is tilted  $>20^\circ$  end to end or  $>10^\circ$  side to side.
- When you turn on the compass, the Meter shows the calibration message. See *Manual Calibration* for more information.

Push :

- 1x = Arrow points in north direction
- 2 seconds = Arrow points in direction of Laser beam and display shows the direction in degrees and an alpha symbol.

### **Caution**

**To prevent incorrect direction readouts, do not use near magnets and magnetic devices.**

### **Compass Calibration**

#### **Automatic Calibration**

The compass sensor continuously collects and saves new calibration values in 60-second intervals.

#### **Manual Calibration**

When you turn on the compass, the Meter shows the calibration message:

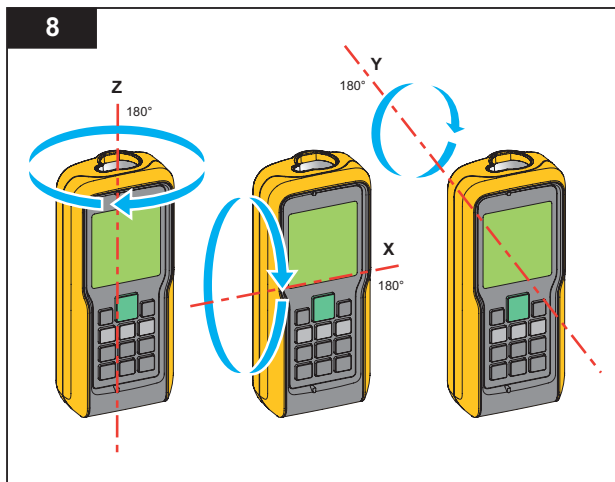
1. For no, push . The compass uses old data that can be inaccurate.
2. For yes, push .

To continue with the calibration:

3. Rotate the Meter  $180^\circ$  around the Z-axis. See Figure 8.
4. Rotate the Meter  $180^\circ$  around the X-axis.
5. Rotate the Meter  $180^\circ$  around the Y-axis.

The Meter counts from 1 to 12 during calibration. COMPA OK shows on the display when the calibration is complete.

8



gwo22.eps

### Magnetic Declination

The difference between the north geographic pole and the north magnetic pole is known as magnetic declination, or more plainly, declination. The angle of declination is different at different locations on the earth. The geographic and magnetic poles are aligned so declination is minimal. From some locations, the angle between the two poles can be fairly large.

Table 4 is a list of the current angles of declination by location. For other declination values, contact your local Geomagnetic Institute.

To set the Meter with the correct compensation for your location:

1. Push **Mem.** **+** at the same time.

The display shows **dDECLI** and the current setting. The default value is  $0^\circ$ .

2. Push **+** and **-** to change the value.
3. Push **Measure** to accept the new value.

**Table 4. Estimated Values of Magnetic Field**

| <b>Country</b> | <b>City</b>       | <b>Declination<br/>in Degrees<br/>(+E   -W)</b> | <b>Country</b> | <b>City</b> | <b>Declination<br/>in Degrees<br/>(+E   -W)</b> | <b>Country</b> | <b>City</b> | <b>Declination<br/>in Degrees<br/>(+E   -W)</b> |
|----------------|-------------------|-------------------------------------------------|----------------|-------------|-------------------------------------------------|----------------|-------------|-------------------------------------------------|
| Argentina      | Buenos Aires      | -7                                              | Greenland      | Godthab     | -29                                             | Spain          | Madrid      | -1                                              |
| Australia      | Darwin            | 3                                               | Iceland        | Reykjavik   | -15                                             | Switzerland    | Zurich      | 1                                               |
| Australia      | Perth             | -1                                              | Italy          | Rome        | 2                                               | Thailand       | Bangkok     | 0                                               |
| Australia      | Sidney            | 12                                              | India          | Mumbai      | 0                                               | Ukraine        | Donetsk     | 7                                               |
| Austria        | Vienna            | 3                                               | Japan          | Tokyo       | -7                                              | UAE            | Dubai       | 1                                               |
| Brazil         | Brasília          | -20                                             | Kenya          | Nairobi     | 0                                               | United Kingdom | London      | -1                                              |
| Brazil         | Rio de Janeiro    | -22                                             | Norway         | Oslo        | 2                                               | USA            | Anchorage   | 18                                              |
| Canada, BC     | Vancouver         | 17                                              | Panama         | Panama      | -3                                              | USA            | Dallas      | 3                                               |
| Chili          | Santiago de Chile | 2                                               | Russia         | Irkutsk     | -3                                              | USA            | Denver      | 8                                               |
| China          | Beijing           | -6                                              | Russia         | Moscow      | 10                                              | USA            | Honolulu    | 9                                               |
| Egypt          | Cairo             | 3                                               | Russia         | Omsk        | 11                                              | USA            | Los Angeles | 12                                              |
| France         | Paris             | 0                                               | Senegal        | Dakar       | -8                                              | USA            | Miami       | -6                                              |
| Germany        | Berlin            | 2                                               | Singapore      | Singapore   | 0                                               | USA            | New York    | -13                                             |
| Greece         | Athens            | 3                                               | South Africa   | Cape Town   | -24                                             | Venezuela      | Caracas     | -11                                             |

**Clear**

Push  :

- 1x = Clear last value
- 2x = Clear all
- 2 seconds = Turn off Meter

**Measurements with a Tripod**

Measurements with the 419D and 424D that use a tripod must have the tripod reference set. When set,  shows on the display.

**Reference Point**

The display shows the reference point for a measurement. The default reference point is from the end of the Meter. If the beeper is on, the Meter beeps as you change the reference point. See Figure 9 for more information.

**414D**

Push  1x to change the reference point between the front and the end of the Meter. The display shows  or .

**419D/424D**

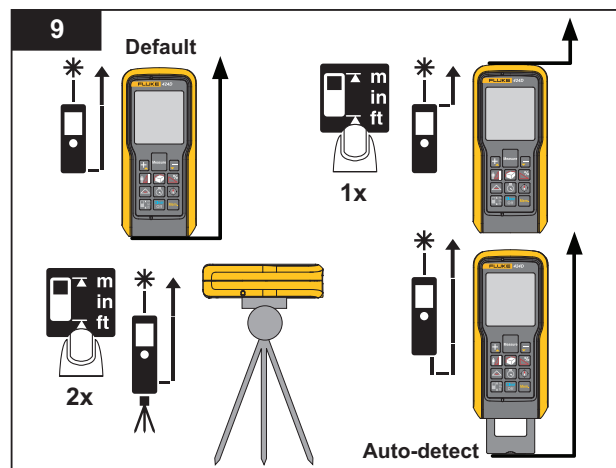
The Meter automatically adjusts the reference point when you use the endpiece and  shows on the display.

Push  :

- 1x = Measure from front 
- 2x = Measure from tripod screw 
- 3x = Measure from end 

**Note**

*The tripod mode overrides other reference points. The Meter stays in the tripod mode until you change to a different reference point.*



gwo07.eps

## Measurements

The Meter measures the distance to a target, the area bounded by two distances, or the volume in three measurements. This manual identifies when a feature is model-dependent. When not identified, all models include the feature.

### Single Distance Measurement

To measure distance:

1. Push  to turn on the laser.
2. Push  again to make the distance measurement.

The measurement shows on the display.

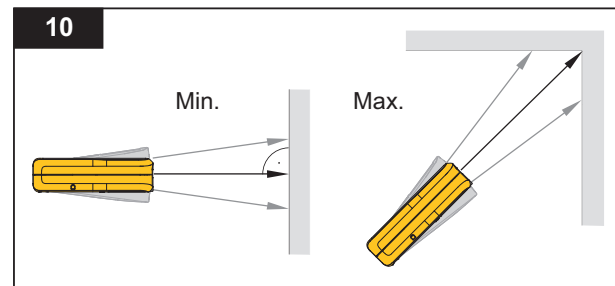
#### Note

*Measurement errors can occur if you point the laser at colorless liquids, glass, Styrofoam, semi-permeable surfaces, and high-gloss surfaces. The measurement time increases when you point the laser at dark surfaces.*

A target plate is useful for long distance measurements if the target reflectivity and illumination is a problem.

### Minimum/Maximum Tracking

The tracking function measures the room diagonal (maximum value) and the horizontal distance (minimum value) from a stable measurement point. It also can find the distance between objects. See Figure 10.



gwo08.eps

To measure:

1. Push and hold  for 2 seconds.  
→\* shows on the display to confirm that the Meter is in tracking mode.
2. Move the laser side to side, up and down on the target area (for example, into the corner of a room).
3. Push  to stop tracking mode.

The last measured value shows in the summary line.

#### Note

*419D/424D Only: The values for maximum and minimum distances show in the display. The last measured value shows in the summary line.*

### Addition/Subtraction

The Meter adds and subtracts a value to a single distance, area, and volume measurements.

#### 414D

To add or subtract:

Push :

- 1x = Add the next measurement
- 2x = Subtract the next measurement

#### 419D/424D

To add or subtract:

1. Push  to add the next measurement to the previous measurement.
2. Push  to subtract the next measurement from the previous measurement.
3. Do these steps again for each measurement.  
The total measurement result is always shown in the summary line with the value before in the second line.
4. Push  to cancel the last step.

### Area

To measure area:

#### 414D

1. Push  1x. The  symbol appears in the display.
2. Push  to make the first measurement (for example, length).
3. Push  again to make the second measurement (for example, width).

The result shows in the summary line.

#### 419D/424D

To measure area:

1. Push  1x. The  symbol shows in the display.
2. Push  to make the first measurement (for example, length).
3. Push  again to make the second measurement (for example, width).

The result shows in the summary line.

4. Push  and hold for 2 seconds to get the 2<sup>nd</sup> result as a circumference.

## **Volume**

### **414D**

To measure volume:

1. Push  2x. The  symbol shows in the display.
2. Push  to make the first length measurement (for example, length).
3. Push  again to make the second length measurement (for example, width).
4. Push  again to make the third length measurement (for example, depth).

The result displays in the summary line.

### **419D/424D**

To measure volume:

1. Push  2x. The  symbol appears in the display.
2. Push  to make the first measurement (for example, length).
3. Push  again to make the second measurement (for example, height).
4. Push  again to make the third length measurement (for example, depth).

The result shows in the summary line.

5. Push  x 2 seconds to show additional room information such as ceiling/floor area, surface area of the walls, circumference.

 Ceiling/floor area (424D)

 Wall area (419/424)

 Circumference (419D/424D)

**Tilt (424D only)****Note**

The inclinometer senses tilts at 360°. For tilt measurements, hold the Meter without a transverse tilt ( $\pm 10^\circ$ ).

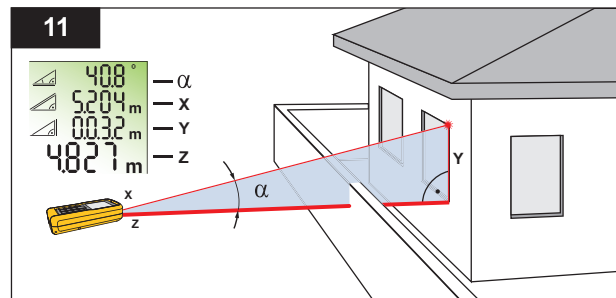
**Smart Horizontal Mode (424D only)**

The Smart Horizontal mode (indirect horizontal distance) function lets you find a horizontal distance when the line-of-sight is blocked by an object or obstacle. See Figure 11 for more information.

The tilt is continuously shown as  $^\circ$  or %. To change the units, push and hold **Mem** **%** at the same time for 2 seconds. The default unit is  $^\circ$ .

To measure:

1. Push **%** 1x = Smart Horizontal Mode.  shows in the display.
2. Point laser at target.
3. Push **Measure**. The display shows all results as  $\alpha$  (angle ) , x (diagonal distance ) , and y (vertical distance ) . The z (horizontal distance) shows in the summary line.
4. Push **%** to turn off Smart Horizontal Mode.



gwo09.eps

**Height Tracking (424D only)**

Height tracking shows continuously on the display as the Meter turns on a tripod. The tilt is continuously shown in the selected unit of measure as  $^\circ$  or %.

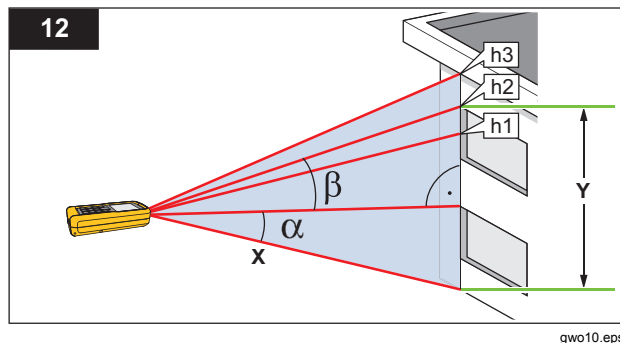
To measure:

1. Push **%** 2x = Height tracking.  shows in the display.
2. Point the laser at lower target.
3. Push **Measure**.  shows in the display with the distance and angle to the lower target.
4. Move the laser upwards to the top target. Height Tracking starts automatically. The display shows the angle to the actual target and the vertical distance from the lower target.

5. Push  at the top target. Height Tracking stops and the display shows the vertical distance between the two measured targets. See Figure 12 for more information.

**Note**

*The minimum/maximum tracking is very helpful for 90 ° angle measurements. See page 17 for more information.*



**Leveling**

The Leveling function continuously shows the angle of the Meter. From an angle of  $\pm 5^\circ$ , the Meter starts to beep. As it gets near  $\pm 1^\circ$ , the Meter beeps faster. At  $\pm 0.3^\circ$ , the Meter beeps constantly.

To level:

1. Push  3x = Leveling.  $\angle$  shows in the display.
2. Put the Meter on object to do a test for level.

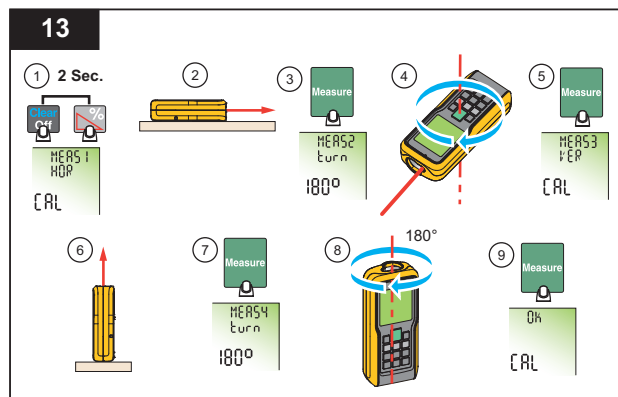
The angle continuously shows on the display as the object moves.

**Tilt Sensor Calibration**

To calibrate the tilt sensor:

1. Push **Clear On**  at the same time for 2 seconds.

The display shows **CAL** message and the instructions for the first measurement. See Figure 13.



gwo23.eps

4. Turn the Meter horizontally 180 ° on the same flat horizontal surface.

5. Push **Measure**.

The display shows the instructions for the subsequent measurement.

6. Put the Meter upright on a flat horizontal surface.

7. Push **Measure**.

The display shows the instructions for the subsequent measurement.

8. Turn the upright Meter 180 ° on the same flat surface.

9. Push **Measure**.

The display shows the calibration results as **OK CAL**.

2. Put the Meter on a flat horizontal surface.

3. Push **Measure**.

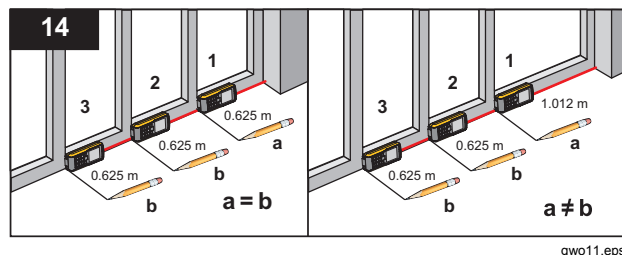
The display shows the instructions for the subsequent measurement.

### Stake Out Measurement (419D/424D)

A specific distance can be set in the Meter and used to mark off defined measured lengths. An example of this application is in the construction of wooden frames. See Figure 14 for more information.

#### Note

*For best results, it is recommended to use the end reference point for a stake out measurement. See page 16 for more information.*



### 419D (1 Value)

To find stake out distances with 1 value:

1. Push 4x. shows on the display.
2. Push and to increase and decrease the value that shows in the summary line.

#### Note

*Hold the buttons down to increase the rate of change for the values.*

3. Push to accept the value.

The display shows the stake out distance in the summary line between the stake out point and the Meter (rear reference).

4. Move the Meter slowly along the stake out line and the distance decreases on the display.

The arrows in the display indicate in which direction the Meter needs to be moved in order to achieve the defined distance.

#### Note

*If the beeper feature is on, the Meter starts to beep at a distance of 0.1 m (4 in) from the next stake out point. As the Meter moves near to the stake out point, the beep changes and the arrows do not show on the display.*

5. Push to stop the stake out function.

**424D (2 Values)**

You can enter two different distances (a and b) into the Meter and use them to mark off measured lengths, for example, in the construction of wooden frames.

To find stake out distances with 2 values:

1. Push  4x.  shows in the display.
2. Push  and  to increase and decrease the values that shows on the display.

The value (a), and the intermediate line that corresponds, blink on the display.

3. Push  and  to adjust the (a) value.

*Note*

*Hold the buttons down to increase the rate of change for the values.*

4. Push  to accept the (a) value.
5. Push  and  to adjust the (b) value.
6. Push  to accept the (b) value.

The display shows the stake out distance in the summary line between the stake out point (a and then b) and the Meter (rear reference).

7. Move the Meter slowly along the stake out line the displayed distance decreases.

The arrows in the display  indicate in which direction the Meter needs to be moved in order to achieve the defined distance (either a, or b).

*Note*

*If the beeper feature is on, the Meter starts to beep at a distance of 0.1 m (4 in) from the next stake out point. As the Meter moves near to the stake out point, the beep changes and the arrows do not show on the display.*

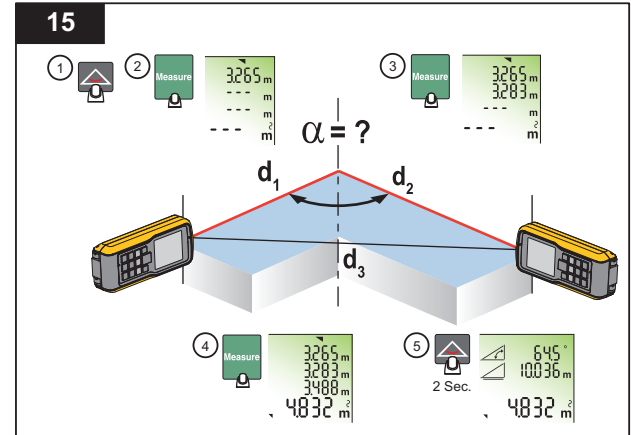
8. Push  to stop the stake out function.

### Corner Angle Measurement (424D only)

The Meter calculates the angles in a triangle with measurements from the three sides. As an example, use this function with a right-angle room corner. See Figure 15 for more information.

To make corner angle measurements:

1. Push  1x.  (room corner) shows in the display.
2. Put marks for the reference points to the right and left (d1/d2) of the angle for measurement.
3. Push  to make a measurement of the first side of the triangle (d1 or d2).
4. Push  to make a measurement of the second side of the triangle (d1 or d2).
5. Push  to make a measurement of the third side of the triangle (d3).
6. The result shows in the summary line as the room triangle area.



gwo12.eps

### Indirect Measurement

The Meter can calculate distances with Pythagoras' theorem. With this function, you can find a distance with two auxiliary measurements, such as building height or width measurements. It is helpful to use a tripod for a height measurement that uses two or three measurements.

#### Note

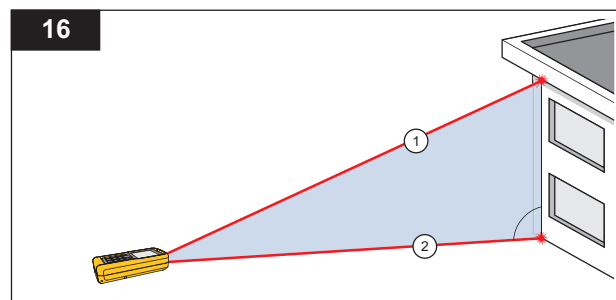
*Make sure that you use the correct sequence of measurement:*

- All target points must be in a horizontal or vertical plane.
- For the best results, turn the Meter about a set point. An example of this is with the endpiece fully open and the Meter on a wall.
- Make sure that the first measurement and the measurement distance are at  $90^\circ$  angles.
- The minimum/maximum tracking is very helpful for  $90^\circ$  angle measurements. See page 17 for more information.

### 414D

To find a vertical distance with two measurements (Pythagoras 1):

1. Push  3x.  shows on the display.
2. Point the laser at the first target (1). See Figure 16.
3. Push  for the first distance (diagonal) measurement.
4. Point the laser at the second target (2).



gwo13.eps

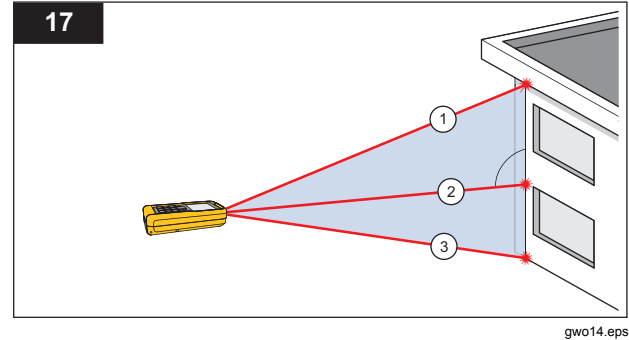
5. Make sure that the Meter is perpendicular to the wall.
6. Push  for the second distance measurement.

The Meter shows the height in the summary line. The distance of the second measurement shows in the secondary line.

To find a total distance with three measurements (Pythagoras 2):

1. Push  4x.  shows on the display.
2. Point the laser at the first target (1). See Figure 17.
3. Push  for the first distance (diagonal) measurement.
4. Point the laser at the second target (2).
5. Make sure that the Meter is perpendicular to the wall.
6. Push  for the second distance.
7. Point the laser at the third (3) target.
8. Push  for the third distance measurement.

The Meter shows the height in the summary line. The distance is the total vertical height from the first to last targets. The third measurement shows in the secondary line.



As an option, use the tracking mode on one or more targets. To use tracking mode:

1. Push and hold  for 2 seconds to start tracking mode.
2. Move the laser side to side and up and down on the ideal horizontal target point.
3. Push  to stop the tracking mode.

**419D/424D**

To find a distance with two measurements (Pythagoras 1):

1. Push  1x.  shows on the display.
2. Point the laser at the top point (1). See Figure 16.
3. Push .
4. Point the laser at the second target (2).
5. Make sure that the Meter is perpendicular to the wall.
6. Push  for the second distance measurement.

The Meter shows the height in the summary line. The distance of the second measurement shows in the secondary line.

To find a total distance with three measurements (Pythagoras 2):

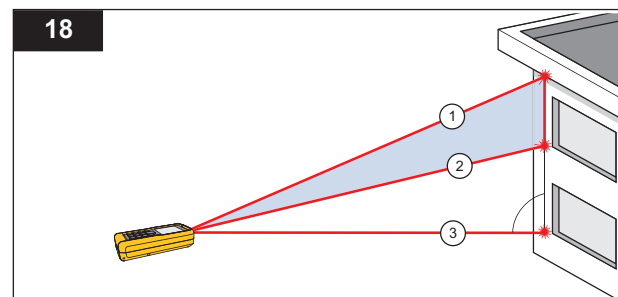
1. Push  2x.  shows on the display.
2. Point the laser at the first target. See Figure 17.
3. Push  for the first distance (diagonal) measurement.
4. Point the laser at the second target (2).
5. Make sure that the Meter is perpendicular to the wall.
6. Push  for the second distance.

7. Point the laser at the third (3) target.
8. Push  for the third distance measurement.

The Meter shows the result in the summary line. The measured distance to the subsequent measurement shows in the second line.

To find a partial distance, see Figure 18, with three measurements (Pythagoras 3):

1. Push  3x. The laser turns on and  shows on the display.
2. Point at the top target (1).



gwo15.eps

3. Push . The Meter stores this measurement value.
4. Point the laser at the second diagonal target (2).
5. Push  for the second distance measurement.

6. Make sure that the Meter is perpendicular to the wall.
7. Push  to trigger the bottom target (3) measurement.

The result is the partial vertical distance between target 1 and target 2. The third measurement shows in the secondary line.

As an option, use the tracking mode on one or more targets. To use tracking mode:

1. Push and hold  for 2 seconds to start tracking mode.
2. Move the laser side to side and up and down on the ideal horizontal target point.
3. Push  to stop the tracking mode.

### **Memory (419D/424D)**

You can recall a previous measurement from memory, for example, the height of a room. The Meter stores a maximum of 20 displays.

To recall:

1. Push  1x.
2. Push  and  to move through the stored displays.

 and the memory ID show on the display.

3. Push  for 2 seconds to use the value shown in the Summary line for further calculations.

To delete:

1. Push  and  at the same time.

The Meter deletes all the stored values in memory.

### **Maintenance**

Maintenance and calibration is not necessary for the Meter. To keep the Meter in good condition:

- Remove dirt with a moist, soft cloth.
- Do not put in water.
- Do not use aggressive detergents or solutions.

### **Disable the Meter**

If damaged, do not use and disable the Meter. To disable, remove the batteries. See page 6 for more information.

## Message codes

Table 5 is a list of all message codes that show on the display with **InFo** or **Error**.

**Table 5. Message Codes**

| Code         | Cause                                                 | Remedy                                                                                                                                   |
|--------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>156</b>   | Transverse tilt greater than 10 °                     | Hold the Meter without a transverse tilt.                                                                                                |
| <b>162</b>   | Calibration mistake                                   | Make sure that the device is on a horizontal and flat surface. Do the calibration procedure again. If the code continues, contact Fluke. |
| <b>204</b>   | Calculation error                                     | Do the measurement again.                                                                                                                |
| <b>252</b>   | Temperature too high                                  | Let the Meter cool down.                                                                                                                 |
| <b>253</b>   | Temperature too low                                   | Let the Meter warm up.                                                                                                                   |
| <b>255</b>   | Received signal too low,<br>measurement time too long | Change target surface (for example, white paper).                                                                                        |
| <b>256</b>   | Received signal too high                              | Change target surface (for example, white paper)                                                                                         |
| <b>257</b>   | Too much background light                             | Darken target surface.                                                                                                                   |
| <b>258</b>   | Measurement outside of<br>measurement range           | Correct the range.                                                                                                                       |
| <b>260</b>   | Laser beam interrupted                                | Do the measurement again.                                                                                                                |
| <b>Error</b> | Hardware error                                        | Turn on and turn off the device 2 to 3 times. If the symbol stays on the display, then your Meter is defective, contact Fluke.           |

## Specifications

|                                                    | 414D                                                                                              | 419D                                | 424D                               |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------|------------------------------------|
| Distance Measurement                               |                                                                                                   |                                     |                                    |
| Typical Measurement Tolerance <sup>[1]</sup>       | ± 2.0 mm (± 0.08 in) <sup>[3]</sup>                                                               | ± 1.0 mm (± 0.04 in) <sup>[3]</sup> |                                    |
| Maximum Measurement Tolerance <sup>[2]</sup>       | ± 3.0 mm (± 0.12 in) <sup>[3]</sup>                                                               | ± 2.0 mm (± 0.08 in) <sup>[3]</sup> |                                    |
| Range at target plate                              | 50 m / 165 ft                                                                                     | 80 m / 260 ft                       | 100 m / 330 ft                     |
| Typical Range <sup>[1]</sup>                       | 40 m / 130 ft                                                                                     | 80 m / 260 ft                       |                                    |
| Range at unfavorable condition <sup>[4]</sup>      | 35 m / 115 ft                                                                                     | 60 m / 200 ft                       |                                    |
| Smallest unit displayed                            | 1 mm / 1/16 in                                                                                    | 1 mm / 1/32 in                      |                                    |
| Ø laser point at distances                         | 6 mm @ 10 m / 30 mm @ 50 m / 60 mm @ 100 m<br>0.24 in @ 33 ft / 1.2 in @ 164 ft / 2.4 in @ 328 ft |                                     |                                    |
| Tilt measurement                                   |                                                                                                   |                                     |                                    |
| Measurement tolerance to laser beam <sup>[5]</sup> | no                                                                                                | no                                  | ± 0.2 °                            |
| Measurement tolerance to case <sup>[5]</sup>       | no                                                                                                | no                                  | ± 0.2 °                            |
| Range                                              | no                                                                                                | no                                  | 360 °                              |
| Compass accuracy                                   | no                                                                                                | no                                  | 8 points (± 22.5 °) <sup>[6]</sup> |

|                                                   | 414D                                                                            | 419D                                                                              | 424D             |
|---------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------|
| General                                           |                                                                                 |                                                                                   |                  |
| Laser class                                       | 2                                                                               |                                                                                   |                  |
| Laser type                                        | 635 nm, <1 mW                                                                   |                                                                                   |                  |
| Protection class                                  | IP40                                                                            | IP54                                                                              |                  |
| Automatic laser off                               | 90 seconds                                                                      |                                                                                   |                  |
| Automatic power off                               | 180 seconds                                                                     |                                                                                   |                  |
| Battery life (2 x AAA)<br>1.5 V NEDA 24A/IEC LR03 | up to 3,000 measurements                                                        | up to 5,000 measurements                                                          |                  |
| Dimensions (H x W x L)                            | 11.6 cm x 5.3 cm x 3.3 cm<br>(4.6 in x 2.1 in x 1.3 in)                         | 12.7 x 5.6 x 3.3 cm<br>(5.0 in x 2.2 in x 1.3 in)                                 |                  |
| Weight (with batteries)                           | 113 g (4 oz)                                                                    | 153 g (5 oz)                                                                      | 158 g (6 oz)     |
| Temperature range:<br>Storage<br><br>Operation    | -25 °C to +70 °C<br>(-13 °F to +158 °F)<br>0 °C to +40 °C<br>(32 °F to +104 °F) | -25 °C to +70 °C<br>(-13 °F to +158 °F)<br>-10 °C to +50 °C<br>(14 °F to +122 °F) |                  |
| Calibration cycle                                 | Not applicable                                                                  | Not applicable                                                                    | Tilt and Compass |
| Maximum altitude                                  | 3500 m                                                                          |                                                                                   |                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 414D                                                    | 419D | 424D |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------|------|
| Maximum relative humidity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 85 % at 20 °F to 120 °F (-7 °C to 50 °C)                |      |      |
| Safety                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | IEC/EN 61010-1:2001<br>IEC/EN 60825-1:2007 (Class 2)    |      |      |
| EMC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EN 55022:2010<br>EN 61000-4-3:2010<br>EN 61000-4-8:2010 |      |      |
| <div>[1] Applies for 100 % target reflectivity (white painted wall), low background illumination, 25 °C.</div> <div>[2] Applies for 10 to 500 % target reflectivity, high background illumination, -10 °C to +50 °C.</div> <div>[3] Tolerances apply from 0.05 m to 10 m with a confidence level of 95 %. The maximum tolerance may deteriorate to 0.15 mm/m between 10 m to 30 m and to 0.2 mm/m for distances above 30 m.</div> <div>[4] Applies for 100 % target reflectivity, background illumination ~ 30,000 lux.</div> <div>[5] After user calibration. Additional angle related deviation of ±0.01 ° per degree up to ±45 ° in each quadrant. Applies at room temperature. For the whole operating temperature range the maximum deviation increases by ±0.1 °.</div> <div>[6] After calibration. Do not use the compass for navigation.</div> |                                                         |      |      |

