742A Series

RESISTANCE STANDARDS

Instruction Manual
WARRANTY

John Fluke Mfg. Co., Inc. (Fluke) warrants this instrument to be free from defects in material and workmanship under normal use and service for a period of 1 year from date of shipment. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke instruments. It is not warranted to be error free. This warranty extends only to the original purchaser and shall not apply to fuses, computer media, batteries or any instrument which, in Fluke's sole opinion, has been subject to misuse, alteration, abuse or abnormal conditions of operation or handling.

Fluke's obligation under this warranty is limited to repair or replacement of an instrument which is returned to an authorized service center within the warranty period and is determined, upon examination by Fluke, to be defective. If Fluke determines that the defect or malfunction has been caused by misuse, alteration, abuse, or abnormal conditions of operation or handling, Fluke will repair the instrument and bill the purchaser for the reasonable cost of repair. If the instrument is not covered by this warranty, Fluke will, if requested by purchaser, submit an estimate of the repair costs before work is started.

To obtain repair service under this warranty purchaser must forward the instrument, (transportation prepaid) and a description of the malfunction to the nearest Fluke Service Center. The instrument shall be repaired at the Service Center or at the factory, at Fluke's option, and returned to purchaser, transportation prepaid. FLUKE ASSUMES NO RISK FOR IN-TRANSIT DAMAGE.

THE FOREGOING WARRANTY IS PURCHASER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

CLAIMS

Immediately upon arrival, purchaser shall check the packing container against the enclosed packing list and shall, within thirty (30) days of arrival, give Fluke notice of shortages or any nonconformity with the terms of the order. If purchaser fails to give notice, the delivery shall be deemed to conform with the terms of the order.

The purchaser assumes all risk of loss or damage to instruments upon delivery by Fluke to the carrier. If an instrument is damaged in transit, PURCHASER MUST FILE ALL CLAIMS FOR DAMAGE WITH THE CARRIER to obtain compensation. Upon request by purchaser, Fluke will submit an estimate of the cost to repair shipment damage.

Fluke will be happy to answer all questions to enhance the use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WA 98206,
INTRODUCTION

The 742A Series are small, light, rugged resistance standards. The standards require no temperature-controlled air or oil bath. The 742A Series are well suited for use as the following:

- Working standards
- Portable transfer standards
- Calibration support for the Fluke 5700A Calibrator

Stability and temperature coefficients of the 742A Series make them ideal for easy transport to and operation in any working environment within the range of 18 to 28°C. The standards come with six-month and one-year uncertainty specifications. Depending on the accuracy required, a 742A can be recertified at intervals based on either specification.

Each 742A comes with a Report of Calibration and a rear panel label showing the measured value. The rear panel also has a Fluke Primary Standards Lab calibration label, labels that show temperature coefficient alpha and beta centered on 23°C, and the standard’s serial number.

NOTE

Refer to “How Temperature Correction Factors are Calculated,” further on in this manual for definitions of alpha and beta.
SPECIFICATIONS

Table 1 lists specifications for the available 742A Series Resistance Standards.

Table 1. 742A Series Resistance Standard Specifications

<table>
<thead>
<tr>
<th>MODEL</th>
<th>NOMINAL RESISTANCE AT 23°C</th>
<th>TIME STABILITY</th>
<th>CALIBRATION UNCERTAINTY</th>
<th>MAXIMUM DEVIATION FROM THE 23°C VALUE (18 TO 28°C)</th>
<th>MAXIMUM CURRENT (VOLTAGE)</th>
<th>POWER COEFFICIENT +1 PPM WHEN CURRENT EXCEEDS THE FOLLOWING</th>
</tr>
</thead>
<tbody>
<tr>
<td>742A-1</td>
<td>1Ω</td>
<td>±5.0 ppm</td>
<td>±1.0 ppm</td>
<td>3.0 ppm</td>
<td>500 mA (500 mV)</td>
<td>200 mA</td>
</tr>
<tr>
<td>742A-10k</td>
<td>10 kΩ</td>
<td>±2.5 ppm</td>
<td>±1.0 ppm</td>
<td>1.5 ppm</td>
<td>3 mA (30V)</td>
<td>0.6 mA</td>
</tr>
</tbody>
</table>

GENERAL SPECIFICATIONS:

Accuracy: The initial resistance is trimmed to ±2 ppm of nominal. The measured value is printed on the rear panel.

Operating Temperature Range: 23 ± 5°C

Storage Temperature Range: 0 to 40°C

Report of Calibration: The report of calibration includes a table of resistance values in 0.5° increments from 18 to 28°C.

Size: 8.64 cm H x 10.54 cm W x 12.70 cm L (including binding posts)
(3.4 in H x 4.15 in W x 5.0 in L (including binding posts))
Binding posts; 2.54 cm (1.0 in)

Weight: 0.91 kg (2.0 lbs)
DESIGN AND CONSTRUCTION NOTES

The 742A Series are constructed of arrays of Fluke wirewound precision hermetically-sealed resistors. No adjustable resistors of any kind are used.

Each 742A is built with a temperature coefficient near zero at 23°C. To further reduce errors caused by temperature changes, the binding posts are constructed of low-thermal emf material.

FEATURES

Figure 1 shows a front panel view. Figure 2 shows a rear panel view. Table 2 describes binding post functions. Table 3 describes the rear panel labels.

![Image of a 742A resistance standard instrument](image)

**Figure 1. Typical Front Panel View**

<table>
<thead>
<tr>
<th>742A BINDING POST</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURRENT HI</td>
<td>Input for the current source from an ohmmeter</td>
</tr>
<tr>
<td>CURRENT LO</td>
<td>Input for the current source from an ohmmeter</td>
</tr>
<tr>
<td>SENSE HI</td>
<td>Measurement point for a four-wire ohmmeter</td>
</tr>
<tr>
<td>SENSE LO</td>
<td>Measurement point for a four-wire ohmmeter</td>
</tr>
<tr>
<td>CHASSIS GROUND</td>
<td>Connected to the case for shielding</td>
</tr>
</tbody>
</table>
Figure 2. Typical Rear Panel View

Table 3. Contents of the Rear Panel Labels

<table>
<thead>
<tr>
<th>REF NO.</th>
<th>LABEL INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measured value label. Shows the measured value at 23 ± 0.6°C; the same as on the Report of Calibration.</td>
</tr>
<tr>
<td>2</td>
<td>Temperature coefficient label. Shows alpha and beta centered on 23°C. Refer to &quot;How Temperature Correction Factors are Calculated,&quot; further on in this manual for definitions of alpha and beta, and the formula to predict exact resistance at different temperatures.</td>
</tr>
<tr>
<td>3</td>
<td>Fluke Primary Standards Lab Calibration Label documents traceability to the U.S. National Bureau of Standards.</td>
</tr>
<tr>
<td>4</td>
<td>Serial number label. Shows the standard's serial number. This number and the full model number (i.e., 742A-1) positively identify a particular unit.</td>
</tr>
</tbody>
</table>
OPERATING NOTES

This part of the manual explains operational and environmental considerations for the 742A Series. Follow these guidelines when operating or storing the resistance standard. Precautions for handling are under “Care and Maintenance.”

Connecting to the 742A Series

CAUTION

Do not apply voltages above the maximum voltage printed on the front panel. Excessive voltage can cause a permanent shift in resistance value or damage.

The specifications for models with CURRENT and SENSE binding posts require four-wire connections to the standard. Use these binding posts as described in Table 2.

For the case to act as a shield, the CHASSIS GROUND binding post must be connected to earth ground or instrument guard at some point in a calibration system. Normally when two or more instruments with guards are connected together, the use of a single common grounding point avoids ground loops. If applicable, ground the 742A CHASSIS GROUND binding post to that common grounding point.

Figure 3 shows a typical connection to a four-wire ohmmeter. Figure 4 shows the connection used to calibrate the 1Ω internal resistance standard in the 5700A.

Cable Recommendations

For optimum results, use two sets of the Fluke 5440A-7004 Low Thermal Test Leads, which are designed to reduce errors caused by thermal emfs.

![Diagram of connections](image-url)
Operating Temperature Range

You can use the 742A Series in ambient temperatures between 18 and 28° C. To predict the deviation from nominal at temperatures other than 23° C, use the temperature characterization table provided with each unit. The table shows the calculated value and the deviation from nominal at temperatures between 18 and 28° C in half-degree increments. An example of this table is included as Table 4.

How Temperature Correction Factors are Calculated

A label on the rear panel shows temperature coefficient factors alpha and beta centered on 23° C. (See Figure 2 for the label location.) The values of alpha and beta are individualized for each 742A. Alpha and beta are established by measurement in the Fluke Primary Standards Lab 18° C, 23° C, and 28° C. The temperature characterization table is generated from these three measurements and the following formula:

\[ R_t = R_{23} \left[ 1 + \alpha (t - 23) + \beta (t - 23)^2 \right] \]

Where,  
- \( R_t \) = Resistance at \( t^\circ C \)
- \( R_{23} \) = Resistance at 23°C
- \( \alpha \) = Slope of the curve (ppm/°C) at 23°C
- \( \beta \) = Rate of change of slope of the curve (ppm/°C^2)

\( \alpha \) and \( \beta \) are constants which do not change appreciably over time and hence need to be determined only once.

In the case of the example 742A-1 used in this manual, \( \alpha \) and \( \beta \) are calculated as follows:

\[ \alpha = \frac{(R_{28} - R_{18})}{\Delta t} = \frac{-0.9 \times 10^{-6}}{10} = -0.9 \times 10^{-7} \]

\[ \frac{(R_{28} + R_{18})}{2} - R_{23} \]

\[ \frac{(\Delta t)}{2} \]

\[ \beta = \frac{(R_{28} + R_{18})}{2} - R_{23} \]

\[ \frac{(\Delta t)}{2} \]

Where,  
- \( R_{28} \) = Resistance at 28°C
- \( R_{18} \) = Resistance at 18°C
- \( R_{23} \) = Resistance at 23°C
- \( \Delta t = (28 - 18) = 10 \)
<table>
<thead>
<tr>
<th>Temp (Celsius)</th>
<th>Resistance (OHMS)</th>
<th>Dev from nominal (in ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.0</td>
<td>1.00000006</td>
<td>0.6</td>
</tr>
<tr>
<td>18.5</td>
<td>1.00000007</td>
<td>0.7</td>
</tr>
<tr>
<td>19.0</td>
<td>1.00000008</td>
<td>0.8</td>
</tr>
<tr>
<td>19.5</td>
<td>1.00000009</td>
<td>0.9</td>
</tr>
<tr>
<td>20.0</td>
<td>1.00000010</td>
<td>1.0</td>
</tr>
<tr>
<td>20.5</td>
<td>1.00000010</td>
<td>1.0</td>
</tr>
<tr>
<td>21.0</td>
<td>1.00000010</td>
<td>1.0</td>
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<tr>
<td>21.5</td>
<td>1.00000011</td>
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<td>1.00000009</td>
<td>0.9</td>
</tr>
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<td>1.00000009</td>
<td>0.9</td>
</tr>
<tr>
<td>24.5</td>
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<td>0.8</td>
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<td>1.00000007</td>
<td>0.7</td>
</tr>
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<td>1.00000006</td>
<td>0.6</td>
</tr>
<tr>
<td>26.0</td>
<td>1.00000004</td>
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<td>26.5</td>
<td>1.00000003</td>
<td>0.3</td>
</tr>
<tr>
<td>27.0</td>
<td>1.00000001</td>
<td>0.1</td>
</tr>
<tr>
<td>27.5</td>
<td>0.9999999</td>
<td>-0.1</td>
</tr>
<tr>
<td>28.0</td>
<td>0.9999997</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

Test Number: XXXXX
Date: 04-Aug-88
Page 2 of 2
Figure 5 shows a graph of the value of the 742A-1 represented by the sample temperature characterization chart (Table 4). To illustrate use of the formula, calculations for resistance at 20°C and 26°C are shown. You can see that using the formula shown with alpha and beta you get the same value as in the characterization table.

![Graph of Resistance VS. Temperature for Sample 742A-1](image)

**Figure 5.** Graph of Resistance VS. Temperature for Sample 742A-1

\[
R_t = R_{23} \left[ 1 + \alpha (t - 23) + \beta (t - 23)^2 \right] \\
\text{At} = 20^\circ C, \\
R_{20} = 1.0000010 \left[ 1 + (-0.09 \times 10^{-6}) (-3) + (-0.034 \times 10^{-6}) (-3)^2 \right] \\
= 1.0000010 \left( 1.00000003 - 0.00000003 \right) \\
= 1.0000010 \left( 1.0000000 \right) \\
= 1.0000010 \Omega
\]

\[
R_t = R_{23} \left[ 1 + \alpha (t - 23) + \beta (t - 23)^2 \right] \\
\text{At} = 26^\circ C, \\
R_{26} = 1.0000010 \left[ 1 + (-0.09 \times 10^{-6}) (3) + (-0.034 \times 10^{-6}) (3)^2 \right] \\
= 1.0000010 \left( 1 - 0.00000003 - 0.00000003 \right) \\
= 1.0000010 \left( 1 - 0.0000006 \right) \\
= 1.0000004 \Omega
\]

**Storage Temperature Range**

To maintain accuracy within the specified limits, do not subject the 742A Series to temperatures below 0°C or above 40°C. If exposure to temperatures outside this range is unavoidable, you can minimize the adverse effects by doing the following:

- Keep the standards in the optional transit case (Option 742A-7002). The transit case is insulated and helps protect the standards during short-term temperature extremes.

- Keep exposure to temperature extremes brief.
CARE AND MAINTENANCE

The only maintenance procedure for the 742A Series is occasional cleaning. The following text gives cleaning instructions and precautions for handling.

Cleaning the 742A Series

To keep the 742A Series looking like new, clean the outer surfaces using a soft cloth slightly dampened with water or a non-abrasive mild cleaning solution that does not harm plastics.

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the resistance standard.

Precautions for Handling

The 742A Series are designed for mechanical stability, but do not abuse the standard with excessive shock. Avoid temperature extremes as mentioned under “Storage Temperature Range”. When you transport the standard, it is recommended that you use the Option 742A-7002 Transit Case for shock and temperature protection. The case holds two 742A Series Resistance Standards.

SERVICING INFORMATION

Because the 742A Series are certified and non-adjustable resistance standards, they are considered non-user repairable. If the unit is damaged, it must be returned to the factory for repair and recalibration.

RECERTIFICATION

For recertification, send the resistance standard to a Fluke technical center. For a nominal fee, Fluke will remeasure and recertify the value of your 742A based on comparison to standards traceable to the U.S. National Bureau of Standards. A new temperature characterization chart is provided on recertification. If you wish, you can record the changes at each recertification and use this data to more closely predict the performance of your 742A. A list of sales and service centers is located near the end of this manual.
## Sales and Service Centers

### U.S. SALES AREAS for all Fluke products

<table>
<thead>
<tr>
<th>State</th>
<th>City</th>
<th>Address</th>
<th>Phone</th>
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<tbody>
<tr>
<td>Alabama</td>
<td>Huntsville</td>
<td>4920 Corporate Drive, Suite J, Huntsville, AL 35805-6202</td>
<td>(205) 837-0581</td>
</tr>
<tr>
<td>Arizona</td>
<td>Tempe</td>
<td>2211 S. 48th Street, Suite B, Tempe, AZ 85282</td>
<td>(602) 438-8314</td>
</tr>
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<td></td>
<td>Tucson</td>
<td></td>
<td>(602) 790-9881</td>
</tr>
<tr>
<td>California</td>
<td>Burbank</td>
<td>2020 N. Lincoln Street, Burbank, CA 91504</td>
<td>(213) 849-7181</td>
</tr>
<tr>
<td></td>
<td>Northern</td>
<td>2300 Walsh Ave., Bldg. K, Santa Clara, CA 95051</td>
<td>(408) 727-0513</td>
</tr>
<tr>
<td></td>
<td>San Diego</td>
<td></td>
<td>(619) 292-7657</td>
</tr>
<tr>
<td></td>
<td>Southern</td>
<td>P.O. Box 19676, Irvine, CA 92137-9676</td>
<td>(949) 833-9000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irvine, CA 92614, Von Karman, Suite 100</td>
<td>(714) 863-9031</td>
</tr>
<tr>
<td>Colorado</td>
<td>Denver</td>
<td>14180 E. Evans Ave, Aurora, CO 80014</td>
<td>(303) 695-1000</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Hartford</td>
<td>Glen Lochen East, 41-C New London Turnpike, Glastonbury, CT 06033</td>
<td>(203) 659-3541</td>
</tr>
<tr>
<td>Florida</td>
<td>Clearwater</td>
<td></td>
<td>(813) 799-0087</td>
</tr>
<tr>
<td>Michigan</td>
<td>Detroit</td>
<td>33031 Schoolcraft, Livonia, MI 48150</td>
<td>(313) 522-9140</td>
</tr>
<tr>
<td>Missouri</td>
<td>St. Louis</td>
<td>11756 Borman Drive, Suite 160, St. Louis, MO 63146</td>
<td>(314) 993-3805</td>
</tr>
<tr>
<td>Missouri</td>
<td>Greensboro</td>
<td>1310 Beaman Place, Greensboro, NC 27408</td>
<td>(919) 273-1918</td>
</tr>
<tr>
<td>New Jersey</td>
<td>Paramus</td>
<td>P.O. Box 930, Paramus, NJ 07653-0930</td>
<td>(201) 262-9550</td>
</tr>
<tr>
<td>New Mexico</td>
<td>Albuquerque</td>
<td></td>
<td>(505) 881-3550</td>
</tr>
<tr>
<td>New York</td>
<td>Rochester</td>
<td>4515 Culver Road, Rochester, NY 14622</td>
<td>(716) 323-1400</td>
</tr>
<tr>
<td>Ohio</td>
<td>Cleveland</td>
<td>Plaza South Three, Suite 402, 7271 Engle Road, Middleburg Heights, OH 44130</td>
<td>(216) 234-4540</td>
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<tr>
<td>Oklahoma</td>
<td>Northeast</td>
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<td>(405) 236-2977</td>
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<td>Oregon</td>
<td>Portland</td>
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<td>(503) 227-2042</td>
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<tr>
<td>Pennsylvania</td>
<td>Malvern</td>
<td>200 Lindenwood Drive, Malvern, PA 19355</td>
<td>(215) 647-9550</td>
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<tr>
<td>Pennsylvania</td>
<td>Pittsburgh</td>
<td></td>
<td>(412) 261-5171</td>
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<tr>
<td>Texas</td>
<td>Austin</td>
<td></td>
<td>(512) 459-3344</td>
</tr>
<tr>
<td>Texas</td>
<td>Dallas</td>
<td>1801 Royal Lane, Suite 307, Dallas, TX 75229</td>
<td>(214) 669-0311</td>
</tr>
<tr>
<td>Texas</td>
<td>El Paso</td>
<td></td>
<td>(915) 533-3508</td>
</tr>
<tr>
<td>Houston</td>
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<td></td>
<td>(713) 240-5995</td>
</tr>
<tr>
<td>San Antonio</td>
<td></td>
<td></td>
<td>(210) 392-1313</td>
</tr>
<tr>
<td>Utah</td>
<td>Salt Lake City</td>
<td></td>
<td>(801) 268-9331</td>
</tr>
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<td>Washington</td>
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<td>(206) 881-6966</td>
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<tr>
<td>Washington</td>
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<td>(301) 776-1570</td>
</tr>
</tbody>
</table>
INTERNATIONAL SALES OFFICES

Algeria
Bureau de Liaison Philips
(For Philips products)
24 rue Bougainville
El Mouradla, Alger
Tel: (81) 647303
TLX: 62211

Antilles
Philips Antillana N.V.
(For Philips products)
Schottegatweg Oost 146
P.O. Box 929
Willemstad, Curacao
Tel: 599-9-619277
TLX: 1047

Argentina
Coisin S.A.
(For Philips products)
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1430 CAP FED
Buenos Aires, Argentina
Tel: (54) (1) 552-5246
TLX: (390) 22284

Philips Argentina S.A.
(For Philips products)
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Vedado, Cuba
1430 Buenos Aires
Tel: 54-1-541141/5411741
TLX: 21350/21243

Australia
Elmeanco Instruments Pty. Ltd.
(For Philips products)
P.O. Box 30
Concord, N.S.W.: 2137
Australia
Tel: (61) (2) 736-5988
TLX: (790) AA25887
FAX: (61) 2-733603

Elmeanco Instruments Pty. Ltd.
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P.O. Box 623
12 Maroon Road
Ringwood, Victoria 3134
Australia
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TLX: (790) AA30418
FAX: (61) 3-879-4310

Elmeanco Instruments Pty. Ltd.
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Salisbury, Qld Australia 4107
Tel: (61) (7) 875-1444
TLX: (790) AA44062

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P.O. Box 154
Prospect, South Australia 5092
Tel: (61) (8) 549-9000

Elmeanco Instruments Pty. Ltd.
(For Philips products)
32 Tredgdon Rd.
Victoria Park
Western Australia 6100
Tel: (61) 9-470-1855

Philips Scientific & Industrial Equipment Division
(For Philips products)
Centre Court 25-27 Paul Street
North Ryde
Sydney N.S.W. 2113
Tel: 88 89 222

Austria
Weiter Rekisch Elektronische
Gerate GmbH & Co.
(For Fluke products)
Vertrieb KG
Obchagasse 28
1220 Vienna, Austria
Tel: (43) (222) 253626
TLX: (847) 134759
FAX: (43) (222) 257275

Österreichische Philips Industrie GmbH
(For Philips products)
Geschäftsberich & E
Marktbereich Test-und Meßgerate
A-1101 Wien, Triester Strasse 64
Tel: (0222) 06010-1712 DW

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(For Fluke products)
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Manama, Bahrain
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FAX: (365) 245218

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Tel: 257249, (950) 642022

Philips Bangladesh Ltd.
(For Philips products)
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DHAKA
Tel: 414796
TLX: 65668

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N.V. Philips Professional Systems S.A.
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Rue des Deux Gares
Bruxelles 1070 Bruxelles
Tel: 2-525611

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FAX: (593) 223503 CDLAP BV

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(For Fluke products)
Al Amazonas 422, Alphaville
Barueri
CEP 06400, Sao Paulo, Brazil
Tel: (55) (11) 421-5477
TLX: (391) 11147143

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(For Philips products)
Av. Eng. Luct Carlos Borgini 3009
Caixa Postal 9681
04571 SAO PAULO S.P.
Tel: 55-11-2411611
TLX: (511) 42750

Bunei
Rank O’Connor’s, Sdn Bhd
(For Fluke products)
No. 8 Block D.
Sun Shophouse Complex
Mile 1 Jalan Tunong
Bdr Seri Begawan
Negara Brunei Darussalam
Tel: (673) (2) 231999 or 23557
TLX: (798) BU2265 RAHIL OC

Canada
Fluke Electronics Canada Inc.
400 Britannia Rd. East Unit #1
Mississauga, Ontario
L4X 1X3 Canada
Tel: (416) 690-7600
FAX: (416) 890-6866

Fluke Electronics Canada Inc.
1690 Woodward Drive
Suite 216
Ottawa, Ontaro
K2C 3R8 Canada
Tel: (613) 723-9453
FAX: (613) 723-9458

Fluke Electronics Canada Inc.
1255 Trans Canada Highway
Suite 130
Orval, Quebec
H9P 2Y4 Canada
Tel: (514) 685-0022
FAX: (514) 685-0039

Fluke Electronics Canada Inc.
101, 1144 - 29th Ave. E.N.E.
Calgary. Alberta
T2E 1P1 Canada
Tel: (403) 291-5215
FAX: (403) 291-5219

Chile
Intronica Chile Ltda.
(For Fluke products)
Casilla 16228
Santiago 9, Chile
Tel: (56) 2-2321866
TLX: (332) 346351

Philips Chilena S.A.
de Produz. Electr.
(For Philips products)
Avenda Santa Maria 0760
Casilla 2687
Santiago De Chile
Tel: 56-2-770038
TLX: 240293

China
Peoples Republic of Fluke International Corp.
(For Fluke products)
P.O. Box 2686
Everett, WA 98206 U.S.A.
Tel: (206) 356-5511
TLX: 185103 FLUKE UT
FAX: (206) 356-5516

Colombia
Sistemas E Instrumentacion, Ltda.
(For Philips products)
Carrera 13, No. 37-43, Of. 401
Ap Aereo 2983
Bogota DE, Colombia
Tel: (57) 232-5432
TLX: (396) 45-787

Industrias Philips de Colombia S.A.
(For Philips products)
Apartado Aereo 4282
Calle 13 No. 51-39
Bogota
Tel: 57-1-260500
TLX: 44714

Cyprus
Chris Radiovision Ltd.
(For Fluke products)
P.O. Box 1698
Nicosia, Cyprus
Tel: (357) (21) 661121
TLX: (826) 2395

Cyprus, Northern
Ucuk Burotek
(For Philips products)
2C & 20 Multlu Ziya Street
Leckosa, Northern Cyprus
Merces, 101, Turkey
Tel: (358) 367-2177
TLX: (821) 57267

Denmark
Tage Olsen A/S
(For Philips products)
Ballerup Byvej 222
2750 Ballerup
Denmark
Tel: (45) (2) 658111
TLX: (855) 532930
FAX: (45) 2-680 300

Philips A/S Test & Measurement
(For Philips products)
Prangs Boulevard 80
DK-3300 Kopenhagen S
Tel: (01) 579222
TLX: 31201

Ecuador
Proteco Coisan Cia., Ltda.
(For Philips products)
P.O. Box 222-A
Ave. 12 de Octubre 2285
y Ordiaria
Quito, Ecuador
Tel: (593) (2) 318294
TLX: (995) 22085

Philips Ecuador S.A.
(For Philips products)
Casilla 343
Pase 118 y Avenida Patria
Quito
Tel: 593-3-546100/546125
TLX: 2227 PHILPS ED

Proteco Coisan Cia., Ltda.
(For Philips products)
P.O. Box 9733
Ave. Principal No. 204 y Calle Segunda
Urbanizacion Miraflores
Quayyaky, Ecuador
Tel: (93) (1) 367151

Egypt and Sudan
Electronic Engineering Liaison Office
(For Fluke products)
P.O. Box 289/ Honeya
11361 Helopolis, Cairo
Egypt
Tel: (02) 2-695705
TLX: 9271 22152

Philips Scientific & Industrial Equipment Division
(For Philips products)
Centre Court 25-27 Paul Street
North Ryde
Sydney N.S.W. 2113
Tel: 88 89 222
Sweden
Philips Foersaetning AB
Division Industri & elektronik
Test & Measurements
S-1 58 84 Stockholm
Tel: (08) 782 18 00
Switzerland
Traco Electronic AG
(For Philips products)
Janatschstrasse 1
8802 Zurich
Switzerland
Tel: (041) 201-0711, TLX: (845) 815570
Philips AG
(For Philips products)
Test und Messtechnik
Postfach
CH-8027 Zurich
Tel: (01) 4882390
Syria
Mobek (Electronics Division)
(For Philips products)
P.O. Box 4238
Damascus, Syria
Philips Moyen-Orient S.A.R.L.
(For Philips products)
Rue Fardoss 79
P.O. Box 2442
Damascus
Tel: 21605/21600
TLX: PHLY SYR 41120 SY
Taiwan
Schmied Electronics Corp.
(For Philips products)
5th Floor, Cathay Mm-Sheng
Commercial Building,
344 Min-Sheng East Road
Taipei 104, Taiwan R.O.C.
Tel: (886) 2-501-3438, TLX: (785) 11111
FAX: (886) 2-5029062
Philips Taiwan Ltd.
(For Philips products)
150, Turi Hua North Road
P.O. Box 22978
Taipei
Tel: 686-2-7120500
TLX: 21570 PHILPE
Tanzania
Philips (Tanzania) Ltd.
(For Philips products)
T.D.F.L. Building - 1st Floor
P.O. Box 20104
Osho/Upanga Rd.
Dar es Salaam
Tel: 20571/4
TLX: 4016
Thailand
Measutronicom Ltd.
(For Philips products)
2/02/63 Ramkhamhaeng Road
Bangkok 10240
Thailand
Tel: (66) (2) 374-2518, TLX: (788) 82799
Philips Electrical Co. of Thailand Ltd.
(For Philips products)
263, Silom Road
P.O. Box 961
Bangkok 10500
Tel: 68-2-233 6330,0
TLX: 87327 PHILTHM TH
Tunisia
Sekip S.A.R.L.
(For Philips products)
6, Rue de Sparte
Tunis - 1000 RP
Tunisia
Tel: (216) (1) 249090, TLX: (934) 13030
STIET
(For Philips products)
32bis rue Ben Ghdariem
Tunis
Tel: 348666, TLX: 14512
Turkey
Erikman Elektronik Aletler
(For Philips products)
Ticaret Anonim Sirketi
Necati Bey Cad 92/3
Karakoy, Istanbul, Turkey
Tel: (90) (1) 1441546, TLX: (821) 249399
FAX: (90) 1-1497037
Turk Philips Ticaret A.S.
(For Philips products)
Inonu Caddesi 78/80
P.K. 504
80074 Beyoglu-Istanbul
Tel: 90-1-1432610
TLX: 24192 PHTRTR
United Arab Emirates
Haris Al-Alag, Ltd.
(For Philips products)
P.O. Box 8141
Kamal Hamza Bldg.
Traffic Police Rd.
Dubai, U.A.E.
Tel: (971) 4-239325, TLX: (958) 481668
Philips Middle East
(For Philips products)
Dubai Intern. Trade Centre,
11th Floor
P.O. Box 9269
Dubai
Tel: 971-4-377000
TLX: 46350 PMOA EM
Al-Sanani Cen. Trad. Est.
(For Philips products)
P.O. Box 7187
Abu Dhabi, U.A.E.
Tel: (971) (2) 821370
TLX: (958) 22966
Uruguay
Cosain Uruguay S.A.
(For Philips products)
Libertad 2529
Casilla de Correo 1400
Montevideo, Uruguay
Tel: (598) (2) 786013, TLX: (398) UY23010
Industrias Philips del Uruguay S.A.
(For Philips products)
Av. Uruguay 1287
Casilla de Correo 294
Montevideo
Tel: 919000
TLX: PHILURUY UY 22296
Venezuela
Cosain C.A.
(For Philips products)
Galileo 9 C/alle 4, Edif Edinurbi
Apartado de Correos NA-70.136
Los Ruices
Caracas 1070-A, Venezuela
Tel: (58) 2-241-0309, TLX: (395) 21027
Indis. Venezolanas Philips, S.A.
(For Philips products)
Av. Francisco de Miranda,
Urb. La Caricota,
Edif. Centro Empresarial Parque del Este
Apartado 1167
Caracas 1010-A
Tel: 58-2-203-7111
TLX: 25267 IVPSA VC
Zaire
Philips Electronic S.A.R.L.
(For Philips products)
137, Boulevard du 30 juin
B.P. 16936
Kinshasa
Tel: 31693, TLX: 21078 KINSHASA
Zambia
Philips Electrical Zambia Ltd.
(For Philips products)
Mwembeshi Road
P.O. Box 1976
Lusaka
Tel: 218511/216701
TLX: ZA 41220
Zimbabwe
Philips Electrical (Pvt.) Ltd.
(For Philips products)
62 Mutare Road
P.O. Box 194
Harare
Tel: 47211/48031
TLX: 2238
For countries not listed above:
Philips Export B.V.
G.E. Export
Test & Measuring
Building HWV-3
P.O. Box 218
5600 MD Eindhoven
The Netherlands
Tel: +31 40 324984
TLX: 35000 phct nl
FAX: +31 40 3249898
TECHNICAL SERVICE CENTERS

U.S. Service Locators

California
Fluke Technical Center
2020 N. Lincoln Street
Burbank, CA 91504
(213) 849-4641

Fluke Technical Center
2330 Walsh Ave., Bldg. K
Santa Clara, CA 95051
(408) 727-8121

Colorado
Fluke Technical Center
14180 East Evans Ave.
Aurora, CO 80014
(303) 655-1000

Florida
Fluke Technical Center
940 N. Fern Creek Avenue
Orlando, FL 32803
(305) 896-4881

Illinois
Fluke Technical Center
1150 W. Euclid Ave.
Palatine, IL 60067
(312) 705-0500

Maryland
Fluke Technical Center
5640 Fallers Lane
Rockville, MD 20852
(301) 770-1576

New Jersey
Fluke Technical Center
West 75 Century Road
P.O. Box 920
Paramus, NJ 07653-3930
(201) 262-9550

Texas
Fluke Technical Center
1601 Royal Lane, Suite 307
Dallas, TX 75229
(214) 860-0311

Washington
Fluke Technical Center
6920 Seaay Blvd.
Everett, WA 98206
(206) 356-5460

International

Argentina
Coasin S.A.
(Fo Fluke products)
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 522-5248

Philips Argentina S.A.
(Fo Philips products)
Casilla Correo 3479
1000 Buenos Aires
Tel: 547-2411/51

Australia
Elmeasco Instruments Pty Ltd.
(Fo Fluke products)
P.O. Box 623
Ringwood, Vic 3134
Australia
Tel: 735-1222

Elmeasco Instruments Pty Ltd.
(Fo Fluke products)
P.O. Box 274
Salisbury, Queensland 4107
Australia
Tel: 675-1444

Philips Scientific & Industrial Equip. Div
(Fo Philips products)
Centrepoint 25-27 Paul St
North Ryde
Sydney N.S.W. 2113
Tel: 86 68 222

Austria
Walter Rekirsch Elektromsche Gerate GmbH & Co
(Fo Fluke products)
Vertrieb KG
Oberglacasse 28
1220 Vienna, Austria
Tel: 253028

Osterreichische Philips Industries GmbH
(Fo Philips products)
A.B.S.E. Industrie Elektronik
Triesenstraasse 64
A-1100 Wien
Tel: 645251

Algeria
Bureau de Liaison Philips
24 bis rue Bougainville
75116 Paris, France
Tel: 56 56 72

Antilles
Philips Antillana N.V.
(Fo Philips products)
P.O. Box 325
Willemstad, Curacoa
Tel: 414071/74

Bangladesh
Philips Bangla Desh Ltd.
(Fo Philips products)
P.O. Box 62
Ramna, Dhaka
Tel: 234230

Belgium
N.V. Philips & Mble Assoc.
Scientific & Industrial Div
70 Rue des Deux Gares
Brussels, Belgium
Tel: 2-525 6111

Brazil
Hi-Tek Electronica Ltda.
(Fo Fluke products)
Av. Amazonas 422
Alphaville, Barueri
CEP 06400 Sao Paulo, Brazil
Tel: 421-5477

Industrias Brasileiras
Philips Ltd.
Av. Eng. Luiz Carlos Berrani
3006-7 and CEP 04571
Sao Paulo S.P.
Tel: 241,1611

Canada
Fluke Electronics Canada Inc.
400 Britannia Rd
Unit #1
Mississauga, Ontario L4Z 1Y9
Tel: 416-890-7600

Fluke Electronics Canada Inc.
1205 Trans Canada Highway
Suite 130
Dorval, Quebec H9P 2V4
Tel: 514-685-0022

Fluke Electronics Canada Inc.
(Fo Fluke products)
101, 1144 29th Ave. N.E.
Calgary, Alberta T2E 1P7
(403) 291-5215

Chile
Intronica Chile Ltda.
(Fo Fluke products)
Casilla 16228
Sanlucar 9, Chile
Tel: 232-1886

Philips Chilena S.A.
(Fo Philips products)
Casilla Postal 2687
Santiago de Chile
Tel: 770038

China, Peoples Republic of
Instrumex - Fluke Service Center
(Fo Fluke products)
57 Xin Dong Da Jie
Xicheng - qu
P.O. Box 9085
Beijing
People's Republic of China
Tel: 65-7281

Colombia
Sistemas E Instrumentacion, Ltda
(Fo Fluke products)
Carrera 13, No. 37-43, Of. 401
Aa Aereo 2958
Bogota DE, Colombia
Tel: 232-4532

Denmark
Taga Olson A/S
(Fo Fluke products)
Ballerup, Byerg 222
2750 Ballerup
Denmark
Tel: 458111

Philips Elektronik Systeme A.
(Fo Philips products)
Afd Industri & Forsking
Philips Boulevard 80-82 B
DK-2800 Kopenhagen S
Tel: 572222

Ecuador
Ecualecos Co., Ltd.
(Fo Fluke products)
P.O. Box 226-A
Ave 12 de Octubre 2286 y
Doralana
Quito, Ecuador
Tel: 526750

Philips Ecuador S.A.
Casilla 343
Quito
Tel: 396100

Egypt and Sudan
Electronics Engineering
Liaison Office
(Fo Fluke products)
P.O. Box 2891 Hareya
11361 Helicopiers
Cairo, Egypt
Tel: 695705

Philips Egypt Branch
P.O. Box 1687
10 Abadel Rahman el Hater St
Dokki, Cairo
Tel: 499972

Ethiopia
Philips Ethiopia
Phy Ltd. Co.
(Fo Philips products)
Res Avee Aregay Avenue
P.O. Box 2565
Addis Ababa
Tel: 41360

Finland
Instrumentsm Elektronika
(Fo Fluke products)
P.O. Box 64, Viikinka 1
02631 ESPOO 63
Finland
Tel: 358-0-5281

Guy Philips AB
(Fo Philips products)
Kawokilla 5
P.O. Box 255
00101 Helsinki 10
Tel: 1-7121

France
IME Electronics S.A.
(Fo Fluke products)
606 Rue Fourny
P.O. Box 31
78530 BUC, France
Tel: 9568131

S A Philips Industriele Et Comerciale
Science et Industry
(Fo Philips products)
10 Rue de Paris
93002 Bobigny
Tel: 4930111
Norway
Morgenstierne & Co A/S
(For Philips products)
Konghillegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 356110

Norsk Akieselskap
Philips Dept
Industry and
Telecommunication
Sandvikveien 79
P.O. Box 1
Mangerud
Oslo 6
Tel: 2-68200

Pakistan
Philips International Operations
(For Philips products)
505 Muhammad Hause
U.I. Chundrigar Road
P.O. Box 6321
Karachi Pakistan
Tel: 221177/230052

Philips Electrical Industries
of Pakistan Ltd
(For Philips products)
M.A. Jinnah Road
P.O. Box 7101
Karachi 3, Pakistan
Tel: 72572/9

Paraguay
Philips del Paraguay S.A.
(For Philips products)
Av. Artigas 1457
Casilla Correo 605
Asuncion
Tel: 291924

Peru
Importaciones Y Representaciones
Electrónicas S.A.
(For Philips products)
Av. Franklin D. Roosevelt 165
Lima 1, Peru
Tel: 286650

Philips Peruana S.A.
(For Philips products)
Av. Alfonso Ugarte 1268
Apartado 1841
Lima
Tel: 32-6070

Philippines
Spark Radio and Electronics Corp.
(For Philips products)
Greenhills P.O. Box 610
San Juan Metro-Manila Zip. 5113
Philippines
Tel: 63-2-775192

Philips Industrial Development Inc.
(For Philips products)
2246 Pasong Tamo
Malakati, Metro Manila
Tel: 868951

Portugal
Decada Espacial
(For Fluke products)
Equipamentos de Eletronica e
Científicos, SARL
Av. Bombeiros Voluntários
Lot. 1026
Miraflores/Agaes
1495 Lisboa, Portugal
Tel: 2103420

Philips Portuguesa S.A.R.L
(For Fluke products)
Av. Eng. Duarte pacheco
Apartado 1331
Lisbon-1
Tel: (011) 683121

Singapore
Rank O’Connor’s Singapore
(For Philips products)
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 4737944

Philips Project Development
(S) Pte. Ltd.
(For Philips products)
Lorong 1
Toa Payoh
P.O. Box 340
Singapore 1331
Tel: 2538811

South Africa
Fluke S.A. Pty Ltd.
P.O. Box 39127
Bramley 2196
Republic of South Africa
Tel: 786-3647

South African Philips
(For Philips products)
P.O.B. 7703
2 Hemp Street
New Doornfontein, Johannesburg
2000
Tel: 786-3647

Spain
Equips Sistemas S.A. (ESSA)
(For Fluke products)
C/Aplacion Morales, 13B
Madrid 16, Spain
Tel: 4590150

Philips Iberica S.A.E
(For Philips products)
Dbt Aparatos de Medida
Manzana Villergas 2 Madrid 28027
Tel: 459-2900

Sweden
Svenska A.B. Philips
Div. Industrielektron
Avd. Malinsstation
11584 Stockholm
Tel: 792-1800

Switzerland
Traco Electronic AG
(For Philips products)
Filtatschstrasse 1
8022 Zurich
Switzerland
Tel: 2107111

Philips AG
(For Philips products)
S & S Equipment
Alimendesass 140
Postfach 670
CH-8027 Zurich; Switzerland
Tel: 488201

Syria
Philips Moyen-Orient S.A.
(For Philips products)
Rue Fardossi 79
B.P. 2442 Damascus
Tel 221650

Taiwan
Schmidt Electronics Corp.
(For Fluke products)
5th Floor, Cathay Min-Sheng
Commercial Building
344 Min-Sheng East Road
Taipei, Taiwan, R.O.C.
Tel: 5013458

Yung Kang Trading Co. Ltd.
(For Philips products)
11th Floor CTS Building
202 Kuang Fu South Road
P.O. Box 1467
Taipei
Tel: 752-7421

Tanzania
Philips (Tanzania) Ltd.
(For Philips products)
P.O. Box 20104
Dar es Salaam
Tel: 29571

Thailand
Measurtronix Ltd.
(For Fluke products)
2102/63 Pak Na Gao Rd.
Bangkok, 10240 Thailand
Tel: 3742516

Philips Electrical Company
of Thailand Ltd.
(For Philips products)
Electronic and Communication
Systems Dept.
283 Silom Road
P.O. Box 961
Bangkok 10
Tel: 233-6303/9

Tunisia
S.T.I.E.T.
(For Philips products)
32 bis
Rue Ben Ghedhatri
Tunis
Tel: 244268

Turkey
Erkan Elektronik Axler
(For Fluke products)
Ticaret Anonim Sirketi
Necatibey Cad 92/3
Karakoy, Istanbul. Turkey
Tel: 441546

Turk Philips Ticaret A.S.
(For Philips products)
Posta Kuleus 504
Beykozolu Istanbul
Tel: 14399/0

United Arab Emirates
Philips Middle East b.v.
(For Philips products)
Dubai 1 Trade Centre
Level 11
P.O. Box 6269
Dubai
Tel: 373000

Uruguay
Coasur Uruguay S.A.
(For Fluke products)
Casilla de Correo 1430
Libertad 2529
Montevideo, Uruguay
Tel: 789015

Industrias Philips del Uruguay
(For Philips products)
Avda Uruguay 1287
Casilla de Correo 294
Montevideo
Tel: 915641

Venezuela
Coaex C.A.
(For Fluke products)
Calle 9 Con Calle 4
Edif Edmiri
Apartado de Correo Nr. 70136
Los Nueces
Caracas 1070-A, Venezuela
Tel: 241-0309

Industrias Venezolanas
Philips S.A.
(For Philips products)
Av Puau los Nueces
Apartado Postal 1167
Caracas
Tel: 209-3811

Zaire
S.M.E. z.z.t.
(For Philips products)
B.P. 16963
Kinshasa
Tel: 31693

Zambia
Philips Electrónica Zambia Ltd
(For Philips products)
Mwembeshi Road
P.O. Box 31878
Lusaka
Tel: 218511

Zimbabwe
Philips Electric (Pvt) Ltd.
(For Philips products)
P.O. Box 904
62 Umfali Road
Beverley, Harare
Tel: 47211