FLUKE®

709/709H/710

Precision Loop Calibrator

Calibration Manual

May 2013 Rev. 1, 12/18

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.

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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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11/99

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Introduction

⚠⚠Warning

To prevent possible electrical shock, fire, or personal injury, read all safety information before you use the Product.

The Fluke 709, 709H, and 710 Precision Loop Calibrator (the Product or the Calibrator) can be used for installation, calibration, and troubleshooting of field transmitters, valves, and other control system components at process plants. Primary functions are source and measure mA signals in the 0 mA to 24 mA range. The Product can measure 0 V to 30 V and produce 24 V dc loop power.

The 709H includes HART communication functionality and supports a select set of HART universal and common-practice commands. The Product can be used as a loop calibrator or basic function communicator.

The 710 has all the functions of the 709H plus test functions for HART smart control valves.

This manual explains how to verify the Product functions and how to adjust Product Calibration. For usage information, see the *709/709H/710 Users Manual*.

Note

All figures in this manual show the 709H.

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: +81-3-6714-3114
- Singapore: +65-6799-5566
- China: +86-400-921-0835
- Brazil: +55-11-3530-8901
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's website at 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

For complete information about how to safely use this Product, read the *709/709H/710 Safety Information* included with the Product or located on the Fluke website.

Specifications

Ranges	
mA	0 mA to 24 mA
Volts	0 V dc to 30 V dc
Resolution	
mA Ranges	1 µA
Voltage Range	1 mV
Accuracy	0.01 % ±2 LSD all ranges (@23 °C ±5 °C)
Stability	20 ppm of F.S. /°C from -10 °C to 18 °C and 28 °C to 55 °C
Operating Temp Range	-10 °C to 50 °C (14 °F to 122 °F)
Storage Temp Range	-20 °C to 60 °C (-4.0 °F to 140 °F)
Altitude	3000 meters
Ingress Protection Rating	IEC 60529: IP40
Humidity Range	10 % to 95 % non-condensing
Display	128 x 64 pixels, LCD Graphic with backlight, 8.6 mm high digits
Power	Six IEC LR03 batteries
Battery Life (Alkaline Batteries)	≥40 hours continuous use (measure mode)
Loop Compliance Voltage	24 V dc @ 20 mA
Loop Drive Capability	1200 Ω without HART resistor, 950 Ω with HART resistor
Electromagnetic Environment	IEC 61326-1 (portable equipment)
Dimensions (LxWxD)	152 x 93 x 44 mm, (6.0 x 3.7 x 1.7 in)
Weight	0.3 kg (9.5 oz)

Safety.....IEC 61010-1: Pollution Degree 2

Electromagnetic Compatibility (EMC)

International .....IEC 61326-1: Portable Electromagnetic Environment IEC 61326-2-2

CISPR 11: Group 1, Class A

Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.

Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object.

Korea (KCC).....Class A Equipment (Industrial Broadcasting & Communication Equipment)

Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.

USA (FCC).....47 CFR 15 subpart B. This product is considered an exempt device per clause 15.103.

Maintenance

⚠⚠Warning

For safe operation and maintenance of the Product:

- **Repair the Product before use if the battery leaks.**
- **Be sure that the battery polarity is correct to prevent battery leakage.**
- **Remove the input signals before you clean the Product.**
- **Use only specified replacement parts.**
- **Have an approved technician repair the Product.**

Clean the Product

Clean the Product and pressure modules with a soft cloth dampened with water or water and mild soap.

⚠Caution

To prevent possible damage to the Product:

- **Do not use solvents or abrasive cleansers.**
- **Do not allow water into the case.**

Fuse

The Product is protected from overcurrent condition by an internal self-resetting fuse. The fuse will automatically reset within a few seconds. The fuse cannot be repaired manually.

Battery Replacement

Replace the batteries when the battery indicator is shown on the display.

To replace the batteries:

1. Turn the Product over so the display is face down.
2. Lift bail to access the battery door. See Figure 1.
3. With a flat-head screwdriver, remove the battery door screws.
4. Remove the batteries.
5. Replace the old batteries. Note the correct polarity as the new batteries are installed.
6. Attach the battery door.
7. Replace and tighten the two battery door screws.

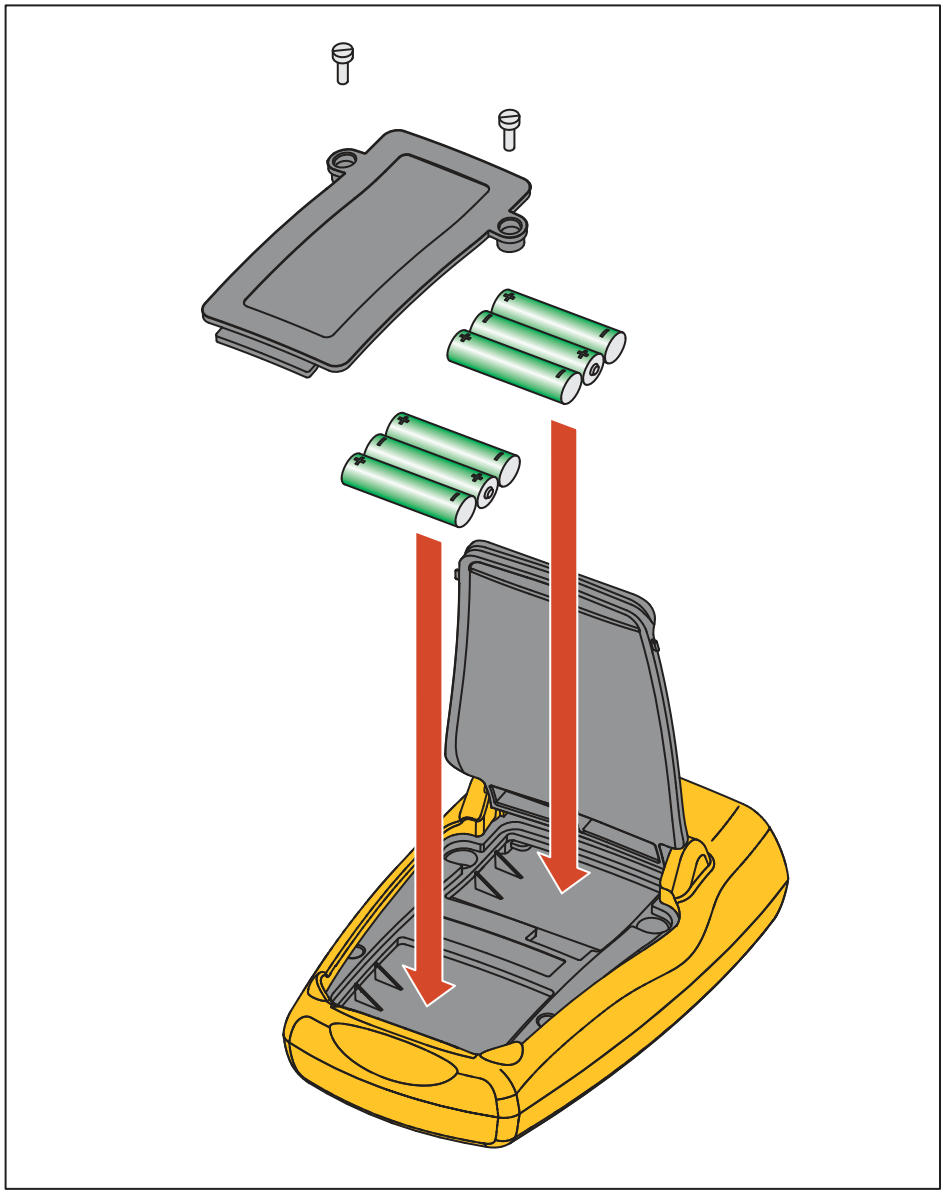

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Figure 1. Battery Replacement

Required Test Equipment

Table 1 is a list of the required equipment for the performance verification tests and calibration adjustment.

Table 1. Required Equipment for Verification and Calibration

Equipment	Recommended Model	Minimum Specification
DC Calibrator	Fluke 5522A Multi-Product Calibrator	DC Voltage: 0 V to 30 V Accuracy: ±0.002 % +0.5 mV DC Current 0 mA to 24 mA Accuracy: ±0.002 % +0.5 µA
Digital Multimeter	Fluke 8508A	DC Current: 0 mA to 26 mA Accuracy: ±0.002 % +0.5 µA
HART Temperature Transmitter	Rosemount 644	-
Flexible Test Leads	Fluke TL24	-
Double Banana Jack Cable	-	-

Performance Verification Tests

⚠⚠Warning

To prevent possible electrical shock, fire, or personal injury, do not perform the performance test or verification test procedures unless the Product is fully assembled.

The performance tests verify the complete operation of the Product and measure the accuracy of each function against Product specifications. If the Product fails a part of the test, calibration adjustment or repair is necessary. See “Calibration Adjustment Procedure”.

The performance verification tests check the accuracy of each Product function against its specifications. If the Product fails any of these tests, calibration adjustment or repair is necessary.

DC Current Source Mode

To verify the performance of the dc current source function:

1. Turn on the Product. The Product shows 4.000 mA on the display.

   If the display does not show 4.000 mA:

   a. Push MENU EXIT.

   b. Select **mA Source** with the rotary knob.

   - Push the rotary knob. If 4.000 mA is flashing, go to step 2.
   - If the display shows 0.000 mA:

     i. Push MENU EXIT.

     ii. Turn the rotary knob to select **Calibrator Setup Menu** and push to select.

     iii. Select any other necessary parameters and then push the rotary knob.

     iv. Select **mA Span** and push to select.

     v. Select **4 to 20 mA** and push to select.

     The Product shows 4.000 mA on the display.

2. Connect the Product:

   a. Connect the Product + terminal to the Digital Multimeter (DMM) I input.

   b. Connect the COM terminal to the DMM LO input. See Figure 2.

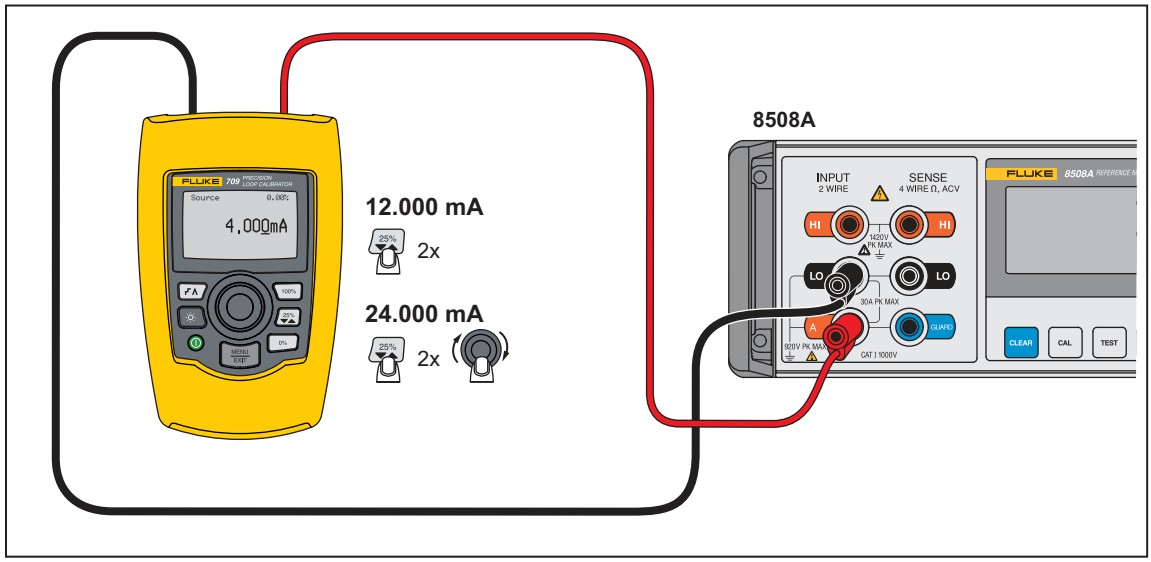

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Figure 2. DC Current Source Mode

3. Make sure that the Product shows SOURCE in the upper-left corner.
4. Set the DMM to measure dc current.
5. See Table 2 to verify the readings on the DMM for the subsequent tests. (No adjustment is necessary for Test 1.)
6. Test 2: Push 25% twice to select 12.000 mA. Verify the readings.
7. Test 3: Push 25% twice to select 20.000 mA. Push and rotate the knob until 24.000 mA is shown. Verify the readings.

Table 2. DC Current Source, Current Measure, Voltage Measure Mode Tests

Test Number	Product Output	Mode	8508A DMM Minimum	8508A DMM Maximum
1	4.000 mA	mA Source	3.9976 mA	4.0024 mA
2	12.000 mA	mA Source	11.9968 mA	12.0032 mA
3	24.000 mA	mA Source	23.9956 mA	24.0044 mA
Test Number	**5522A Calibrator Output**	**Mode**	**Product Minimum**	**Product Maximum**
4	4.000 mA	mA Measure	3.998 mA	4.002 mA
5	12.000 mA	mA Measure	11.997 mA	12.003 mA
6	24.000 mA	mA Measure	23.996 mA	24.004 mA
Test Number	**5522A Calibrator Output**	**Mode**	**Product Minimum**	**Product Maximum**
7	0.000 V	Volt Measure	-0.002 V	0.002 V
8	14.000 V	Volt Measure	13.997 V	14.003 V
9	28.000 V	Volt Measure	27.995 V	28.005 V

DC Current Measurement Mode

To verify the performance of the dc current measurement function:

1. Push MENU EXIT.
2. Turn the rotary knob to select **mA Measure**.
3. Push the rotary knob.

   The Product shows **MEASURE**.
4. Disconnect all connections to the Product.
5. Connect the product:
   a. Connect a test lead from the red AUX terminal of the DC Calibrator (Calibrator) to the DMM I input.
   b. Connect a test lead from the black AUX terminal of the Calibrator to the COM terminal on the Product.
   c. Connect a test lead from the DMM LO input to the Product + terminal. See Figure 3.

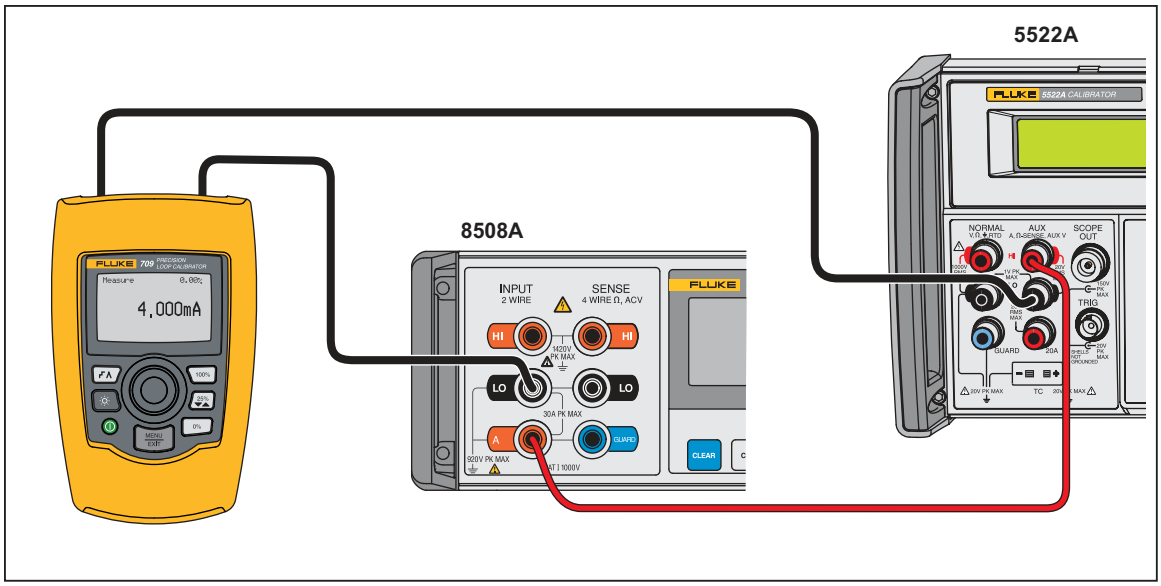

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Figure 3. DC Current Measurement Verification Connections

6. Adjust the Calibrator to output the value of test 4 in Table 2 as measured by the DMM, adjust the Calibrator if necessary to cause the DMM to show the necessary value. Then verify the display readings on the Product.
7. Repeat for tests 5 and 6. The reading on the Product display should be within the minimum and maximum values shown in Table 2.
8. Disconnect the test leads from the Calibrator, DMM, and the Product terminals.

DC Voltage Measurement Mode

To verify the performance of the dc voltage measurement function:

1. Push MENU EXIT.
2. Turn the rotary knob to select **Volts Measure**.

   The Product display shows **Measure** with **V** next to the measurement.
3. Connect the test leads from the output NORMAL terminals of the Calibrator to the input terminals on the Product (black to COM and red to [+]). See Figure 4.

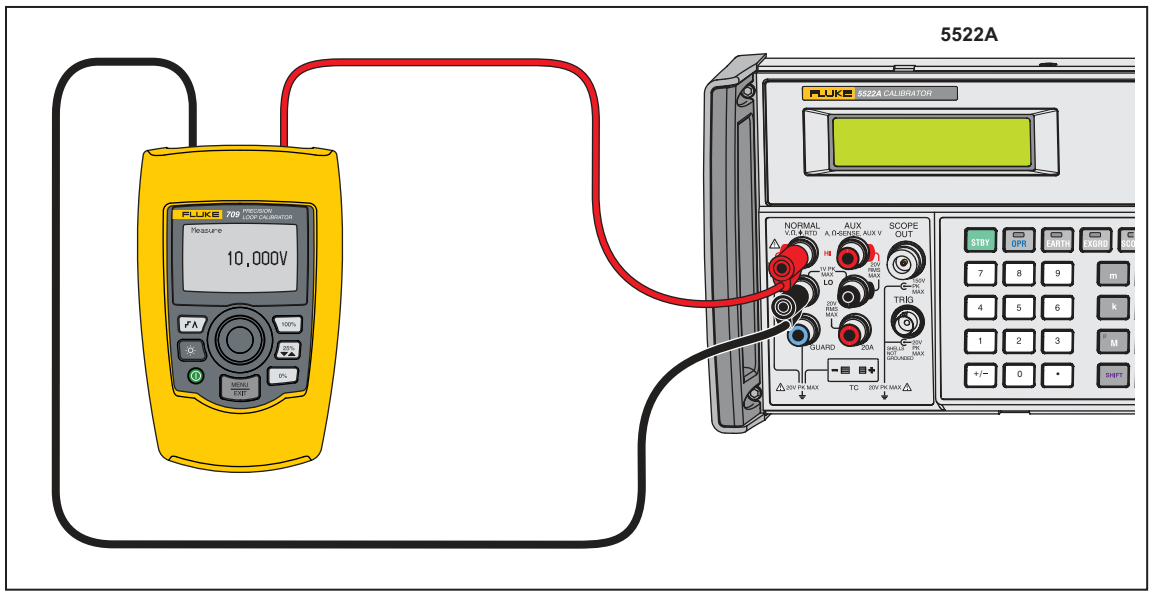

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Figure 4. DC Voltage Measurement Verification Connections

4. Set the Calibrator to the voltage in test 7 in Table 2 and verify the display reading on the Product.
5. Repeat for tests 8 and 9. The reading on the display should be within the minimum and maximum values shown in Table 2.
6. Set the Calibrator output to 0 V and set the output to STANDBY.
7. Turn the Product off and disconnect it from the Calibrator.

   If the Product failed any of these tests, calibration adjustment or repair is necessary.

   The performance verification tests for the 709 are now complete. For the 709H see the next section.

Hart Transmitter (709H/710 Only)

1. Push MENU EXIT on the Product.
2. Turn the knob to select **mA Measure with 24 V**.
3. Connect the red jack to the **+ HART** connection on a transmitter. Connect the black jack to the **– HART** connection on a transmitter. See Figure 5.

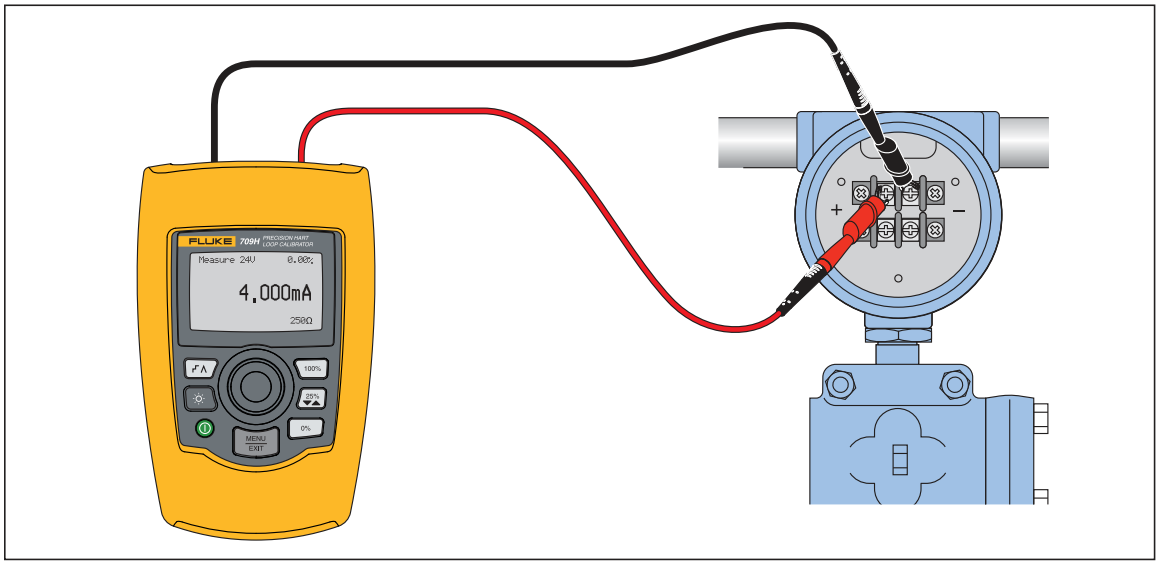

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Figure 5. HART Transmitter Connections

4. Push MENU EXIT on the Product.
5. Turn the knob to select **Hart Comm. Menu** and then push the rotary knob.
6. The display shows if the 250 Ω for HART is on or off. If the transmitter used does not have a built in 250 Ω Hart resistor, the 250 Ω resistor will need to be on. Turn the rotary knob to highlight the **250 Ω Resistor** then push the rotary knob to change states if necessary.
7. Turn the rotary knob to select **Hart 250 Ω Connect** and then push the rotary knob. If properly connected, it will start polling for HART devices. When one is found, push the rotary knob. If data acquisition succeeds, the HART resistor and loop supply are operating correctly.

   This concludes the performance verification tests.

Calibration Adjustment Procedure

The Product features electronic calibration. There are no mechanical adjustments and calibration adjustment is done with its case closed. The calibration adjustment is done with the keypad. Use the display to guide you through the calibration process.

Note

Make sure that the Product has new batteries before you start the calibration adjustment procedure. Calibration adjustment will not function properly if the low battery indicator is on.

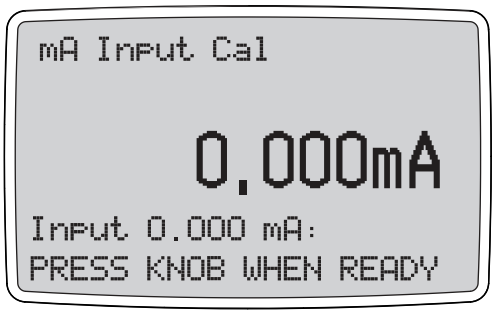
The calibration adjustment of the Product consists of three independently-calibrated ranges: mA source, mA measure, and voltage measure. To enter calibration mode, hold MENU EXIT and ☼ down as you turn on the Product. The first mode to be calibrated is mA measure.

Use the test equipment listed in Table **Error! Reference source not found.** for calibration. If the equipment listed in Table **Error! Reference source not found.** is not available, then equipment with the same or better specifications can be substituted.

mA Measure Mode

To calibrate the mA measure mode:

1. Use the double banana jack cable to attach the current output of the Calibrator to the jacks of the Product.
2. Hold MENU EXIT and ☼ down as you turn on the Product to enter calibration mode. The display should show:



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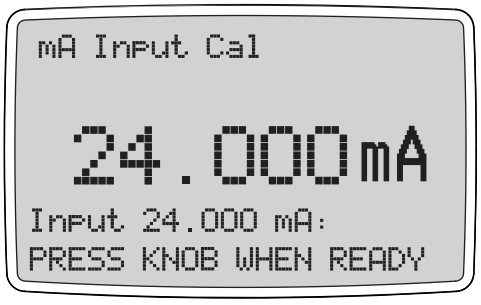
3. Output 0 mA from the Calibrator. After the output is stable, push the knob to continue. As the Product takes readings, the screen shows ------- . When the readings are complete, the screen should look as shown below.



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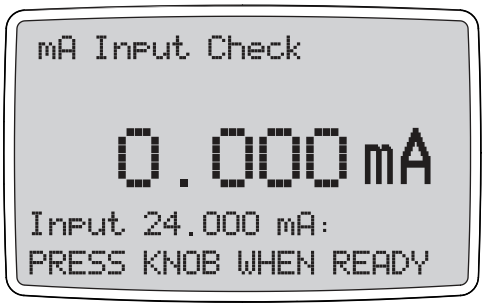
4. Output 24 mA from the Calibrator. After the output is stable, push the knob to continue. As the Product takes readings, the screen shows ------- . When the readings are complete, the unit goes to the check mode.



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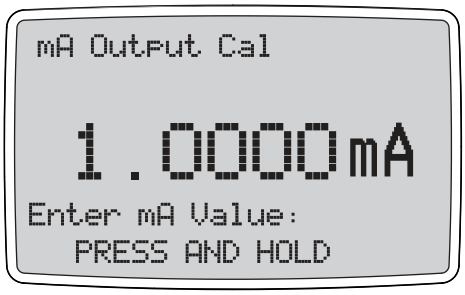
5. The Check mode shows what the measurement will be with the new calibration constants. Current can be sourced or not. No input is necessary. When finished with the check mode, push the knob to continue to the next calibration mode.

mA Source

To calibrate the mA Source mode:

1. Use the double banana jack cable to attach the current input of the DMM to the jacks of the Product.
2. Set the DMM to measure dc current.
3. After you have made your connections, the display should look as shown below.



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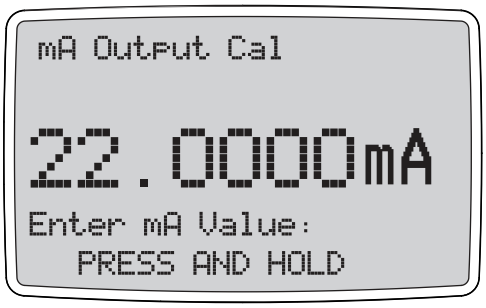
4. Turn the knob on the Product to adjust the display until it shows the same as the DMM. After the output has become stable, push and hold the knob to continue. The screen should look as shown below.



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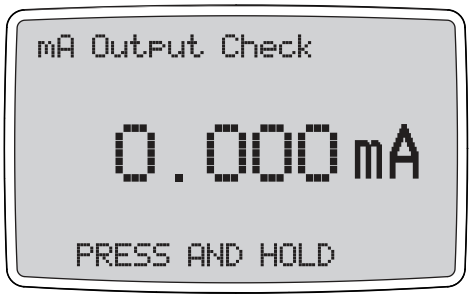
5. Turn the knob on the Product to adjust the display until it shows the same as the DMM. After the output has become stable, push and hold the knob to continue. When the readings are complete, the Product will go to the check mode.



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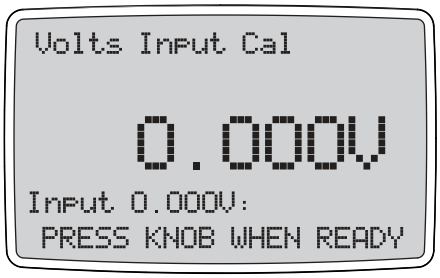
6. When you are done with the check mode, push the knob to continue to the next calibration point.

Voltage Measure

To calibrate the Voltage Measure mode:

1. Use the double banana jack cable to attach the current output of the Calibrator to the voltage jacks of the Product.
2. After you have made the connections, if you are in voltage measure calibration mode, the display should look as shown below.



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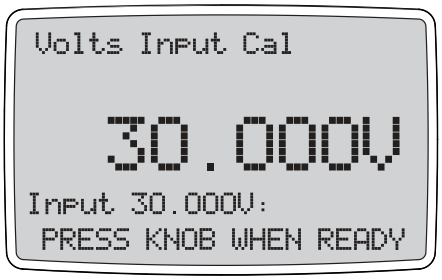
3. Output 0 V from the Calibrator. After the output has become stable, push the knob to continue. As the unit takes readings, the screen shows ------- .
4. Output 30 V from the Calibrator. After the output has become stable, push the knob to continue. As the Product takes readings, the screen shows ------- . When the readings are complete, the Product exits calibration mode and goes to volts mode.



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The calibration adjust procedure is complete and the Product changes to normal operation.

User-Replaceable Parts

User-replaceable parts are listed in Table 3 and shown in Figure 6. For more information about these items and their prices, contact a Fluke representative. See the *Contact Fluke* section.

Table 3. User-Replaceable Parts

Item Number	Description	Fluke Part Number
①	709 Case Assembly (includes case top and bottom with labels, battery door, end plate with jacks)	4341550
①	709H/710* Case Assembly (includes case top and bottom with labels, Lemo, battery door, end plate with jacks) *710 Case requires additional labels, 4991114 and 4996903	4341561
Not Shown	Fluke-710, Battery Door Label (use with 709H case)	4991114
Not Shown	Fluke-710, Display Lens Label (use with 709H case)	4996903
②	Fluke-709-2005, Knob	4282155
③	Fluke-709-2006, Holster, Fluke-709	4241437
③	Fluke-709H-2006, Holster, Fluke-709H/Fluke-710	4241443
④	Fluke-709-2007, Bail, Fluke709/709H/Fluke-710	4241455
Not Shown	Gasket, Black, Fluke 709 Remote	4440367
Not Shown	Fluke-709-8003, Keypad, Fluke-709/709H/Fluke-710	4252551
Not Shown	TL75-4201, Test Leads	855742
Not Shown	AC280 Suregrip Hook Clip (black)	2063165
Not Shown	AC280 Suregrip Hook Clip (red)	1613782
Not Shown	TP220 Test Probes (red)	2047206
Not Shown	TP220 Test Probes (black)	2063129
Not Shown	Alligator Clip Set, Extended Tooth	3765923
Not Shown	Stackable Lead Set	3669716
Not Shown	USB to 5-Pin Cable, 6-ft	4401616
Not Shown	710 ValveTrack Software-available as a free download at www.fluke.com.	
Not Shown	709H/TRACK Datalogging Software & Cable	4281225
Not Shown	Softcase	2643273
Not Shown	Screw, Pan, Phillips, Thread Forming, #3 Head	642931

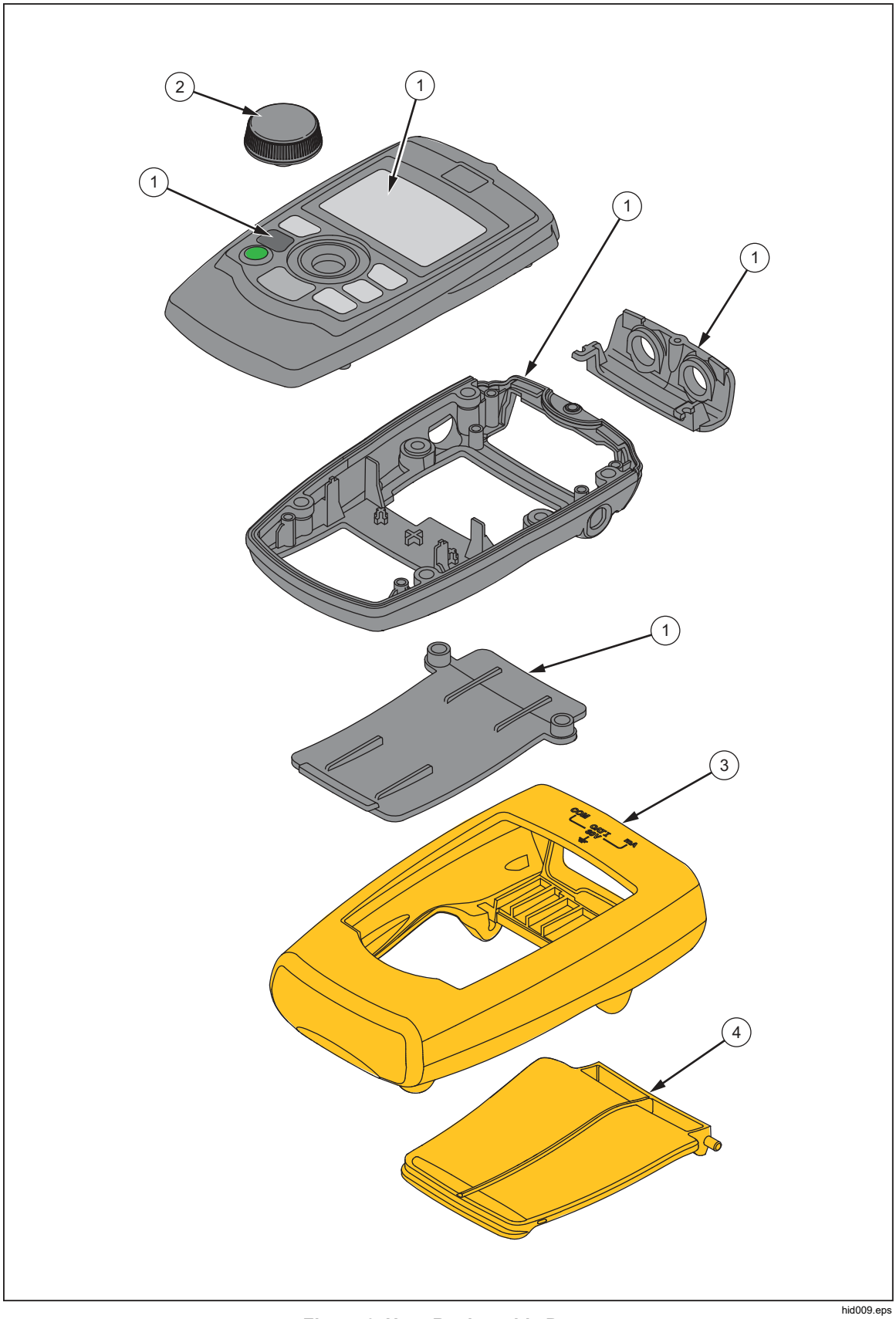

Figure 6. User-Replaceable Parts