

**FLUKE®**

# **1750**

Power Recorder

## Calibration Manual

November 2007

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# 1750 Power Recorder

## Introduction

### Warning

**To avoid electric shock or personal injury, do not perform the calibration verification tests or calibration procedures described in this manual unless you are qualified to do so. The information provided in this manual is for the use of qualified personnel only.**

The *1750 Calibration Manual* provides the following information:

- Precautions and safety information
- Specifications
- Basic maintenance
- Calibration procedures
- Verification procedures
- Replaceable parts and accessories

For complete operating instructions and calibration software, refer to the *1750 Users Manual CD*.

## Contacting Fluke

To contact Fluke, call:

1-888-993-5853 in USA  
1-800-363-5853 in Canada  
+31-402-675-200 in Europe  
+81-3-3434-0181 in Japan  
+65-738-5655 in Singapore  
+1-425-446-5500 from anywhere in the world

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

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

To contact Technical Support:

[fpqsupport@fluke.com](mailto:fpqsupport@fluke.com)

or 888-257-9897 (US only)

## **Safety Information**

The 1750 Power Recorder (hereafter referred to as the Recorder) complies with EN 61010-1 600 V CAT IV, 1000 V CAT III overvoltage rating. See Specifications for a full agency compliance list.

### **Warning**







**To avoid electrical shock, personal injury, or fire:**

- **Review the entire manual before using the Recorder and its accessories and observe all warnings and cautions.**
- **Do not perform the calibration verification tests or calibration procedures described in this manual unless you are qualified to do so.**
- **Avoid working alone.**
- **Do not operate the Recorder around explosive gas or vapor.**
- **Use only insulated current probes, test leads, and adapters as supplied with the Recorder, or indicated as suitable for the Recorder.**
- **Before use, inspect the Recorder, voltage probes, current probes, leads, and accessories for mechanical damage, and replace when damaged. Look for cracks or missing plastic. Pay special attention to the insulation surrounding the connectors.**
- **Remove all probes, test leads, and accessories that are not in use.**
- **Make sure the Recorder is properly connected through the power cord to protective earth ground.**
- **Do not apply input voltages above the rating of the Recorder as shown on the input panel.**
- **Do not apply voltages in excess of the marked ratings of the voltage probes and current probes.**
- **Use caution if exposed metal BNC or banana plug connectors are used for calibration. Avoid applying voltage to the shell of the BNC during calibration.**
- **Do not insert metal objects into connectors.**
- **Never open the Recorder's enclosure, dangerous voltages are present. There are no user-replaceable parts in the Recorder. Refer servicing of internal parts to qualified service personnel.**
- **Use the Recorder only as specified in this manual, or the protection provided by the Recorder may be impaired.**

## Symbols

Symbols used in this manual and on the Recorder are listed in Table 1.

**Table 1. Symbols**

	Hazardous voltage. Risk of electrical shock.		Risk of danger. Important information. See manual.
	Conforms to requirements of European Union and European Free Trade Association (EFTA).		Do not dispose of this product as unsorted municipal waste. Go to Fluke's web site for recycling information.
	<i>Canadian Standards Association.</i> [ <b>Note:</b> Canadian and US. ]		Protective conductor terminal.
<b>CAT III</b>	<b>CAT III</b> 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>	<b>CAT IV</b> equipment is designed to protect against transients from the primary supply level, such as an electricity meter or an overhead or underground utility service.

## Specifications for the System: Recorder and Power Analyze Software

### General Specifications

#### Power Quality Measurement Standards

**Conformance**..... IEC 61999-1-4 Class 1, IEC 61000-4-30 Class A or B depending on measurement function, IEEE519, IEEE1159, IEEE1459

**Clock/Calendar**..... Leap years, 24-hour clock

**Real-time Clock Accuracy**..... Not more than  $\pm 1$  s/day

**Internal Memory Capacity for Data** ..... At least 1 GB

**Maximum Recording Period** ..... At least 31 days

**Measurement Time Control** ..... Automatic

**Maximum Number of Events** ..... Limited only by the size of the internal memory.

**Power Requirements** ..... 100 to 240 V rms  $\pm 10\%$ , 47-63 Hz, 40 W

#### Operating Time During Interruptions

(internal UPS operation) ..... 5 minutes per interruption, 60 minutes total operating time without recharging

**Dimensions** ..... 215 x 310 x 35 mm (8.5 x 12.2 x 3.5 inch)

**Mass (Weight)** ..... 6.3 kg (14 lbs)

### Input Specifications

**Measurement Types** ..... One Phase Plus Neutral, One Phase IT No Neutral, One Phase Split Phase, Three Phase Wye, Three Phase Delta, Three Phase IT, Three Phase High Leg, Three Phase Open Leg, 2 Element Delta, 2 1/2 Element Wye

**Input Channels**..... Voltage: 5 channels, AC/DC  
Current: 5 channels

**Voltage Channels**..... Input resistance: 2 M $\Omega$   
Input capacitance: <20 pF

**Current Channels**..... 1 M $\Omega$ . Self-identifying probes  
Types available: current clamps, Flexi-CTs

**Measuring Method** ..... Simultaneous digital sampling of voltage and current. Digital PLL synchronized sampling, internal frequency reference used during voltage drops.

## Synchronization and Sampling

PLL-Synchronization Source .....	The PLL synchronizes to the A-N voltage for wye power types, and to the A-B voltage for delta power types. All listed power types can be characterized as either wye or delta.
PLL Lock Range .....	42.5 to 69 Hz
Sampling Frequency .....	Voltage and current: 256 samples/cycle Inter-harmonics per IEC61000-4-7: 2560 samples / 10 cycles (50 Hz), 3072 samples/12 cycles (60 Hz) Transient Voltage: 5 MHz
A/D Resolution .....	Voltage and current: 24 bits Transient voltage: 14 bits

## Voltage and Current Measurements

Voltage Measurement Range .....	AC voltage: 1000 V rms $\pm$ 10 % Overrange DC voltage: $\pm$ 1000 V + 10 % Overrange
Voltage Crest Factor .....	3 or less
Voltage Input Impedance .....	2 M $\Omega$
Current Measurement Range .....	Depends on current probe used
Current Crest Factor .....	4 or less
Current Input Characteristics .....	2 V rms = full scale, 1 M $\Omega$ Input Impedance for ferro CTs, low impedance for Flexi-CTs

## Voltage and Current Measurement Accuracy

### RMS Voltage

Measurement Type .....	True rms calculated continuously: every cycle, every 1/2 cycle, and every 10 or 12 cycles at 50 or 60 Hz respectively, as required by IEC 61000-4-30.
Measurement Uncertainty .....	AC: $\pm$ 0.2 % reading $\pm$ 0.1 % full scale above 50 V rms DC: $\pm$ 0.5 % reading $\pm$ 0.2 % full scale above 50 V dc If the ac component of a dc signal is below 40 V rms, the dc uncertainty specification may have an offset.

### RMS Current

Measurement Type .....	True rms calculated continuously: every cycle, every 1/2 cycle, and every 10 or 12 cycles at 50 or 60 Hz respectively, as required by standards
Measurement Uncertainty .....	$\pm$ (0.1 % full scale + 0.5 % reading + current sensor accuracy, valid for 5 % to 100 % of current sensor range)
Current Accuracy .....	Ferromagnetic Clamps $\pm$ (0.1 % full scale + 0.2 % reading + current sensor accuracy), valid for 5 % to 100 % of current sensor range Flexible Current Probes $\pm$ (0.1 % full scale + 0.5 % reading + current sensor accuracy), valid for 5 % to 100 % of current sensor range

## Transient Voltage (Impulse)

Measurement Type .....	Waveshape sampling, not peak detect
Full Scale .....	8000 V pk
Sample Resolution .....	200 nS
Measurement Uncertainty .....	$\pm$ 5 % reading $\pm$ 20 V (test parameters: 1000 V dc, 1000 V rms, 100 kHz)

## Dip (Sag) and Swell Measurements

### Voltage Swell (rms swell)

Measurement Type .....	True rms (one cycle calculation by overlapping each half cycle) (voltage between lines is measured for 3P3W lines and phase voltage is measured for 3P4W lines)
Displayed Data .....	Amplitude and duration of swell

Measurement Accuracy .....	Same as rms voltage
<b>Voltage Dip (RMS sag)</b>	
Measurement Type .....	True rms (one cycle calculation by overlapping each half cycle) (voltage between lines is measured for 3P3W lines and phase voltage is measured for 3P4W lines)
Displayed Data .....	Amplitude and duration of dip or interruption
Measurement Accuracy .....	Same as rms voltage
<b>Voltage Dropout (Interruption)</b>	
Measurement Type .....	Same as Voltage Dip

## **Power and PF Measurement**

### **Power**

Measurement Method .....	Calculated per IEEE1459 for best performance when distortions exist
Measurement Type .....	True rms calculated continuously: every cycle, and every 10 or 12 cycles at 50 or 60 Hz respectively, as required by standards
Measurement Accuracy .....	$\pm 0.2\%$ reading $\pm 0.1\%$ full scale + current sensor accuracy

### **Frequency**

Measurement Range .....	42.5 to 69 Hz
Measurement Source .....	Same as PLL synchronization source
Measurement Accuracy .....	$\pm 10$ mHz (10 to 110 % of range, with sine wave)

### **Reactive Power**

Accuracy .....	$\pm 0.2\%$ reading $\pm 0.1\%$ full scale + current sensor accuracy
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### **Power Factor**

Measurement Range .....	-1.000 (leading) to 0.000 to +1.000 (lagging)
Measurement Accuracy .....	$\pm 1$ digit from the calculation of each measured value ( $\pm 3$ digits for total)

### **Displacement Power Factor**

Measurement Method .....	Calculated from the phase difference between voltage fundamental and current fundamental
Measurement Range .....	- 1.000 (leading) to 0.000 to + 1.000 (lagging)
Measurement Accuracy .....	$\pm 0.5\%$ reading $\pm 2\%$ full scale $\pm 1$ digit

### **Voltage Unbalance and Phase Sequence**

Measurement Method .....	Positive sequence voltage divided by negative sequence voltage, per IEC 61000-4-30
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### **Harmonic Voltage and Current**

Analysis Window .....	rectangular
Analysis Order .....	1st to 50th order
Measurement Accuracy .....	Voltage / Current: 1st to 20th orders: $\pm 0.5\%$ reading $\pm 0.2\%$ full scale 21st to 50th orders: $\pm 1\%$ reading $\pm 0.3\%$ full scale (current sensor accuracy must be included for current and power)
Measurement Method .....	IEC 61000-4-7

### **Inter-harmonic Voltage and Current (Intermediate Harmonics)**

Analysis Window .....	rectangular
Analysis Orders .....	0.5 to 49.5th order
Measurement Method .....	IEC 61000-4-7

## **External Interface Specifications**

### **LAN Interface**

Connector .....	RJ-45
Speed and Type .....	10/100 Base-T, auto MDIX
Communications Protocol .....	TCP/IP over Ethernet
<b>Wireless Controller Interface</b>	
Connection .....	wireless (2.4 GHz radio)
Speed .....	up to 700 kbit/second
Communications Protocol .....	Bluetooth SPP

## Environmental and Safety Specifications

Operating Environment.....	indoors or in covered area outdoors, up to 2000 m altitude
Storage Temperature and Humidity.....	-20 °C to 50 °C, 80 % rh max, non-condensing
Operating Temperature and Humidity .....	0 °C to 40 °C, 80 % rh max, non-condensing
Maximum Rated Working Voltage	
<b>Voltage Terminals</b> .....	1100 V rms
Voltage Durability .....	5550 V rms ac for 1 minute, between voltage input terminals, voltage input terminals and current probes, and voltage input terminals and case (50/60 Hz, 1 mA sense current)
Enclosure Protection.....	IP30 (per EN 60529)
<b>Standards Conformance</b>	
EMC .....	EN 61326-1:2000 Class A EN 61000-3-2:1995+A1:1998+A2:1998 EN 61000-3-3:1995
Safety.....	EN 61010-1:2 <sup>nd</sup> Edition Voltage input unit: Contamination Level 2 Measurement Category 1000 V CAT III, 600 V CAT IV (transient: 8 kV)

## Cleaning and Maintenance

### Caution

**To avoid damage to the Recorder, do not apply abrasives or solvents to the housing.**

The Recorder contains no user serviceable parts. Contact an authorized Fluke service center for repair. See Contacting Fluke.

Periodically wipe the case with a damp cloth and mild detergent.

## Required Equipment

For a list of required equipment for the verification tests and calibration adjustment, see Tables 2 and 3.

**Table 2. Required Equipment**

Equipment	Required Characteristics	Recommended Model
Calibrator	AC Voltage Range: 0 - 1000 V ac Accuracy: $\pm 0.03$ % Frequency Range: 50 - 10000 Hz DC Voltage Range: 0 - 1000 V dc Accuracy: $\pm 0.03$ %	Fluke 5520A Multi-Product Calibrator or equivalent
Multimeter with 4-wire Ohms	Ohms Range: 100 K $\Omega$ Accuracy: $\pm 0.011$ %	Fluke 8846A Precision Multimeter or equivalent
Personal Computer (PC) (Windows XP)	1750 Cal Wizard and Fluke Power Analyze software installed	

The cables listed in Table 3 are necessary for verification and calibration adjustment. To assemble the cables, see cable assembly figures in the Test Cables section.

**Table 3. Required Cables**

Cable	Required Characteristics	Notes
Ethernet cable	CAT 5 with RJ-45 connectors	Supplied with the Recorder
Voltage calibration cable with BNC-banana adapter	Double banana to safety banana and spade lug	See Figure 5
Four jumper cables, safety-banana type		
Current calibration cable	Shielded cable with double banana to CT pins in Redel connector with 100 A CT ID resistor	See Figure 6
Rogowski resistor measurement cable	Safety banana to Redel	See Figure 4
Rogowski calibration cable	Shielded cable with double banana to Rogowski pins in Redel connector with 100 A Rogowski ID resistor	See Figure 3
Ground calibration cable	Lug to banana	See Figure 2
Fluke recommends the use of Pomona brand cables and banana plugs when building these cables.		

## Verification Tests

### Warning

To avoid electrical shock, personal injury, or fire:

- Do not perform the calibration procedures or calibration verification tests described in this manual unless you are qualified to do so.
- Repairs or servicing should be performed only by qualified personnel.

The following tests are used to verify the functions of the Recorder. If the Recorder fails any of the verification tests, calibration or repair may be needed. For service, see Contacting Fluke.

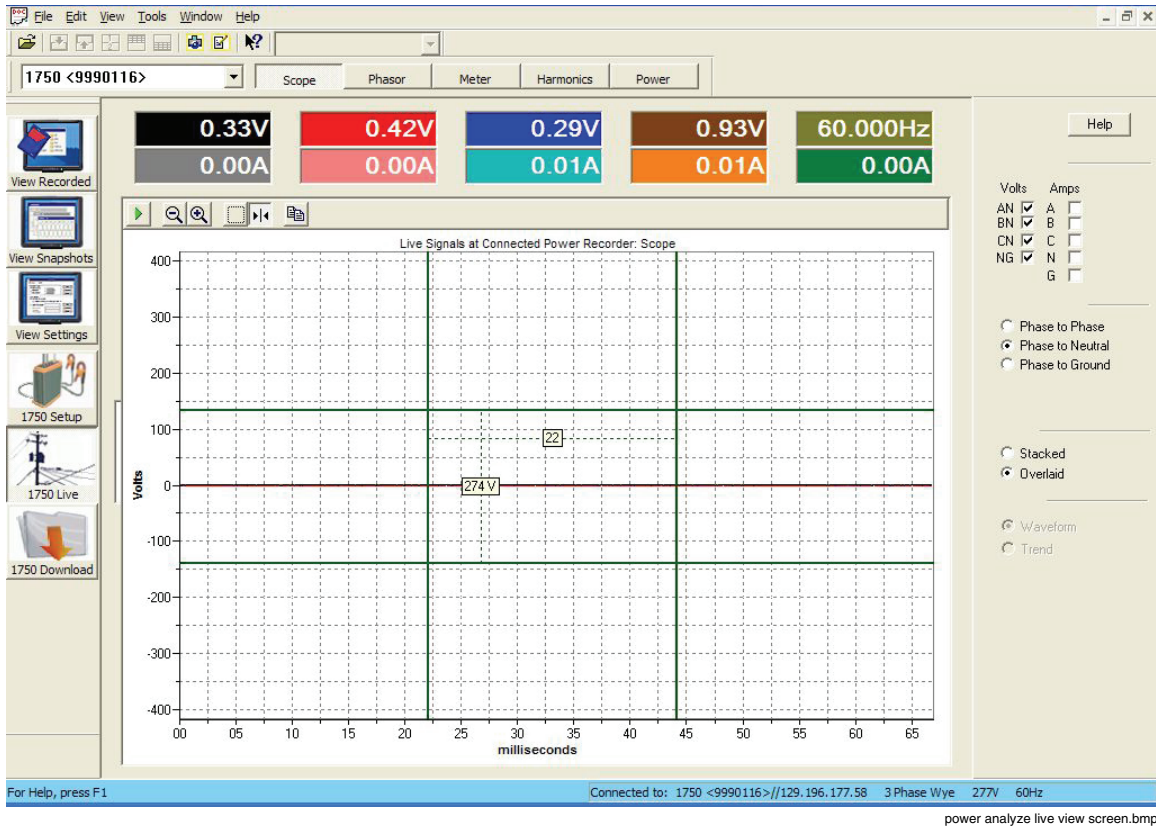
### Note

*Power Analyze can be set to display the channels as L1, L2, and L3 instead of A, B, and C. The channels on the Recorder could also be labeled A, B, and C, or L1, L2, and L3, depending on which decal was applied to the Recorder front panel. For this manual A, B, and C are used.*

### AC Voltage Accuracy Verification

1. Connect an Ethernet cable to the Recorder.
2. Apply power to the Recorder. During power up, indicators near all jacks should flash.
3. Launch Power Analyze software on a personal computer (PC).
4. Select the Recorder to be tested in the drop down box next to the **Scope** button.
5. Select **1750 Live**, then **Scope**.
6. Check all the voltage display check boxes to the right of the scope display. Make sure the correct items are checked.





**Figure 1. Power View Software Live View**

7. Connect the calibrator **NORMAL HI** to inputs **A, B, C**, and  $\perp$  of the Recorder.
8. Connect the **NORMAL LO** to input **N** and the protective conductor terminal  $\oplus$  of the Recorder.
9. Apply the voltages from Table 4 and list the Recorder readings for channels **AN, BN, CN**, and **NG** in the appropriate areas. Sine waves will be displayed for **AN, BN** and **CN**, all at the same amplitude and phase shift. **NG** will be inverted.

*Note*

*If the voltage goes over scale, right click on the voltage scale on the left margin of the graphical display, then click on the **Zoom to Fit** box to resize.*

**Table 4. AC Voltage Accuracy Verification**

Applied	AN Reading	BN Reading	CN Reading	NG Reading	Limits
60 Vrms @ Local Hz					$\pm 1.12$ V
240 Vrms @ Local Hz					$\pm 1.48$ V
600 Vrms @ Local Hz					$\pm 2.20$ V

10. Verify that **A, B, C**, and  $\perp$  LEDs are on. **N** should be off.
11. Set the calibrator to **STBY**.
12. Verify that **A, B, C**, and  $\perp$  LEDs are off.

### Neutral Voltage Verification

1. Connect **NORMAL LO** to **A, B, C,  $\perp$** , and  $\oplus$ .
2. Connect the calibrator **NORMAL HI** to **N** on the Recorder.
3. Apply the voltages from Table 5, listing the Recorder readings for the appropriate model.

Table 5. Neutral (AC) Voltage Accuracy Check

Applied	NG Reading	Limits
60 V @ Local Hz		$\pm 1.12$ V
100 V @ Local Hz		$\pm 1.20$ V

4. Verify that the **N** LED is on.
5. Set the calibrator to **STBY**, verify that the LED for **N** turns off.
6. Disconnect the test leads from the Recorder.

### Rogowski Current Verification

1. Verify the resistor in the Rogowski calibration cable is within 0.1 % of 100 k $\Omega$ .
2. Connect the calibrator **NORMAL HI** to **Voltage A, B, and C** on the Recorder.
3. Connect the calibrator **NORMAL LO** to **N** and **Voltage  $\perp$**  on the Recorder.
4. Connect the calibrator **AUX HI** and **LO** to current input **A** using the Rogowski calibration cable. See Figure 3.
5. Set the calibrator output to 120.0 V @ 55 Hz on the **NORMAL** output and the values from Table 6 the **AUX** output.
6. Press the **WAVE MENUS** softkey and ensure the phase angle is -90 °.
7. Press the **HARMONIC MENU** softkey; ensure the **HARMONIC** selection is set to 1 and the **FUNDMTL** selection is set to **aux**.
8. Press **OPR**.
9. Set the calibrator to voltages from Table 6 and list the Recorder readings for channel **A**.
10. Move cable to next channel and repeat step 9 for channels **B, C, N**, and  $\perp$ .

**Table 6. Rogowski Current Accuracy Check**

Applied Voltage	Expected Current	Expected Reading	A Reading	B Reading	C Reading	N Reading	G Reading	Limits
0.649 V	6.49 $\mu$ A	20 A						$\pm 20.00$ A
1.6225 V	6.225 $\mu$ A	50 A						$\pm 0.50$ A
3.245 V	32.45 $\mu$ A	100 A						$\pm 0.00$ A

**CT Current Verification**

1. Connect the calibrator **NORMAL HI** to Voltage **A**, **B**, and **C** on the Recorder.
2. Connect the calibrator **NORMAL LO** to Voltage **N** and  $\perp$  on the Recorder.
3. Connect the calibrator **AUX HI** and **LO** to current input **A** using the current test cable. See Figure 6. The current test calibration cable connects the voltage to all current sense inputs and indicates that a 100 A current transformer is attached.
4. Set the calibrator output to 120.0 V @ 50 or 60 Hz on the **NORMAL** output and the values from Table 7 on the **AUX** output.
5. Press the **WAVE MENUS** softkey and ensure the phase angle is 0.0  $^{\circ}$ .
6. Press the **HARMONIC MENU** softkey; ensure the **HARMONIC** selection is set to 1 and the **FUNDMTL** selection is set to **aux**.
7. Press **OPR**.
8. Set the calibrator to voltages from Table 7 and list the Recorder readings for that channel.

**Table 7. CT Current Accuracy Check**

Applied Voltage	Expected Reading	A Reading	B Reading	C Reading	N Reading	G Reading	Limits
0.4 V	20 A						$\pm 02.0$ A
1.0 V	50 A						$\pm 03.5$ A
2.0 V	100 A						$\pm 06.0$ A

9. Verify that the current LED is on.
10. Move cable to next channel and repeat steps 8 and 9 for channels **B**, **C**, **N**, and  $\perp$ .
11. Set the calibrator to **STBY**. Verify that the current LEDs turn off.

### Watt Verification

1. Use the same connections as the CT current verification and apply 440 V and local line frequency out of the **NORMAL** output and 1.9 V on the **AUX** output.
2. Click on the power button in Power Analyze. The **A**, **B** and **C** should be  $41.8 \text{ kW} \pm 0.3 \text{ kW}$ .
3. On the calibrator press the blue button for **Phase** and **Ref Menu**.
4. Press the blue button for **AUX Phase NRM**.
5. Enter 90 with the numerical keypad and press **Enter**. The power should be  $0 \pm 0.1 \text{ kW}$ .

### Impulse Verification

#### Initialize the UUT

#### Warning

The impulse verification steps instruct the user to apply working voltages in excess of 700 V, so extreme caution must be applied. To avoid electrical shock or personal injury, **DO NOT** use connectors having exposed metal.

1. Power down the UUT until Power LED turns off, approximately five minutes.
2. Power up the UUT and wait for start up, and connect with Power Analyze.
3. Select **Tools>Erase 1750 Memory** to empty the UUT data.

#### Normalize Thresholds

4. Connect the calibrator **NORMAL LO** to the UUT  $\oplus$  terminal.
5. Connect the voltage test cable to the calibrator **NORMAL HI** jack, leaving the safety-connector end free.
6. Set the calibrator to 750 V 10 kHz.
7. Press **OPR** on the calibrator.
8. Connect the voltage test cable to UUT voltage input  $\perp$  for approximately 15 seconds, and then disconnect.

#### Apply Stepped Verification Voltages to Voltage Inputs A, B, C, N, and $\perp$

9. Set the calibrator to 800 V 10 kHz.
10. Connect the voltage test cable to UUT voltage input **A** for approximately 15 seconds, and then disconnect.
11. Set the calibrator to 850 V 10 kHz.
12. Connect the voltage test cable to UUT voltage input **B** for approximately 15 seconds, and then disconnect.
13. Set the calibrator to 900 V 10 kHz.
14. Connect the voltage test cable to UUT voltage input **C** for approximately 15 seconds, and then disconnect.
15. Set the calibrator to 950 V 10 kHz.
16. Connect the voltage test cable to UUT voltage input **N** for approximately 15 seconds, then disconnect.

17. Set the calibrator to 1000 V 10 kHz.
18. Connect the voltage test cable to UUT voltage input  $\perp$  for approximately 15 seconds, then disconnect. Note, this signal is designated **G** in Power Analyze.
19. Press **STBY** on the calibrator.
20. Set the calibrator to 0 V 0 Hz.

**To Use Power Analyze to Verify the Amplitude Accuracy of Recorded Impulse Events**

21. Wait two minutes for the UUT to compile event information.
22. Click on **1750 Download**, and then **Save**.
23. Click on **View Recorded**, and then **Events**.
24. On the right side, verify that all four **Volts** selections are checked and all five **Amps** selections are unchecked in **Phase Selection**, and **Phase to Neutral** is selected in **Voltage Reference**.
25. Click on **Event Detector**.
26. Select **all channels the same** and set both **AN** and the **NG** thresholds to 50 %.
27. Click **Done**.
28. Click on **View > Table View > Top Table View**. This changes the Event Summary data at the top of the screen from graph-view to table-view.
29. Click on **View > Screen View > Top Full Screen**. This provides a full screen view of the Event Summary table.
30. The following steps concern the two right-hand columns in the Event Summary table, the Absolute and Triggered Phase columns.
31. Starting from Event 1, scroll down the table through the NG Triggered Phase data until the AN Triggered Phase data is reached. This group of NG Triggered Phase data is from the Normalize Thresholds section of this check. It is not used for verification.
32. Scroll down through the AN Triggered Phase data until the BN Triggered Phase data is reached. Record the sixth-to-last AN Triggered Phase Absolute value in Table 8.
33. Scroll down through the BN Triggered Phase data until CN is reached.
34. Record the sixth-to-last BN Triggered Phase Absolute value in Table 8.
35. Scroll down through the CN Triggered Phase data until N-triggered data is reached. Because voltage events on N cause triggers on **AN**, **BN**, **CN**, and **NG**, (resulting in any one of these labels) this can be most easily distinguished by the change in the Absolute values from the CN Triggered Phase data. Record the sixth-to-last CN Triggered Phase Absolute value in Table 8.
36. Scroll down through the N-triggered data until G-triggered data is reached. As with the previous step this can be most easily distinguished by the change in the Absolute values from the Triggered Phase data.
37. Record the sixth-to-last N-triggered Phase Absolute value in Table 8.
38. Scroll to the bottom of the Event Table until the end of the G-triggered data is reached. These will all show up as NG for Triggered Phase.
39. Record the sixth-to-last N-triggered Phase Absolute value in Table 8.

Table 8. Impulse Verification Inputs

Applied Voltage [Vrms]	Expected Reading [Vpk]	Channel	Measured Magnitude [Vpk]	Limits [Vpk]
800	1131	AN (A)		± 77
850	1202	BN (B)		± 80
900	1273	CN (C)		± 84
950	1344	NG (N)		± 87
1000	1414	NG (G)		± 91

## Calibration

### Required Equipment

The required equipment and cables for calibrating the Recorder are listed in Tables 2 and 3.

### Warning

To avoid electrical shock, personal injury, or fire:

- Do not perform the calibration procedures or calibration verification tests described in this manual unless you are qualified to do so.
- Repairs or servicing should be performed only by qualified personnel.

### Calibration Adjustment

The Recorder features closed-case calibration adjustment using known reference sources. During calibration, the Recorder measures the applied reference source, calculates correction factors, and stores the correction factors in nonvolatile memory.

Perform calibration adjustment if the Recorder fails any performance test in the verification procedure.

#### Note

*Calibration should be performed under ambient temperature conditions between 20 °C and 30 °C.*

Calibration consists of four parts: I-Wave, I-Rogowski, V-Wave, and V-Impulse. Each part calibrates one measurement system in the Recorder. For each part, the calibration values are checked to be sure the Recorder is working correctly and calibration results are valid. All of the calibration steps for each of the four measurement systems must be completed before the calibration values can be written to the Recorder's nonvolatile memory.

I-Wave, I-Rogowski, and V-Wave channels are calibrated using 55 Hz sine wave signals to minimize 50 Hz or 60 Hz power line interference with the calibration measurements.

V-Impulse channels are calibrated using dc voltages, averaging calibration measurements to suppress power line interference.

Calibration is controlled by 1750 Cal Wizard Software (Cal Wizard), which communicates with the Recorder over Ethernet. Cal Wizard steps through the calibration

procedure, with instructions for making cable connections, setting the correct sources, and finalizing the calibration.

The following steps detail the calibration adjustment procedure:

1. Connect the Recorder and the PC to the network with an Ethernet cable. This can either be by direct connection or via a hub on an Ethernet network.
2. Connect ac power to the Recorder. Make sure the Recorder, calibrator, and PC running Cal Wizard software are all properly connected to safety ground.
3. Allow the calibrator and Recorder to warm up (30 minutes for the Recorder). If necessary, run Ohms-Cal or Zero-Cal on the calibrator.
4. Reset the calibrator. Confirm the following calibrator state: 0 V, Standby (OPR LED off), EARTH Off (LED off), and EXGRD Off (LED off).
5. Start Cal Wizard.
6. With Cal Wizard, select the Recorder to be calibrated, and then click **Connect**.

*Note*

*If the Recorder is password protected, the correct password must be supplied to continue.*

7. Click **Next**.
8. Follow the on-screen instructions to perform each of the four calibration types. If any of these procedures report a failure, the Recorder must be returned for inspection and service. See Contacting Fluke.
9. If all calibrations are successful, click **Apply** to store the correction values in the Recorder memory. This will take up to a minute to complete.
10. Click **Finish**. The Recorder will shut down and restart using the new calibration values. This may take several minutes.

This concludes Recorder calibration.

Test Cables

The following figures detail the assembly of cables used for calibrating the Recorder.

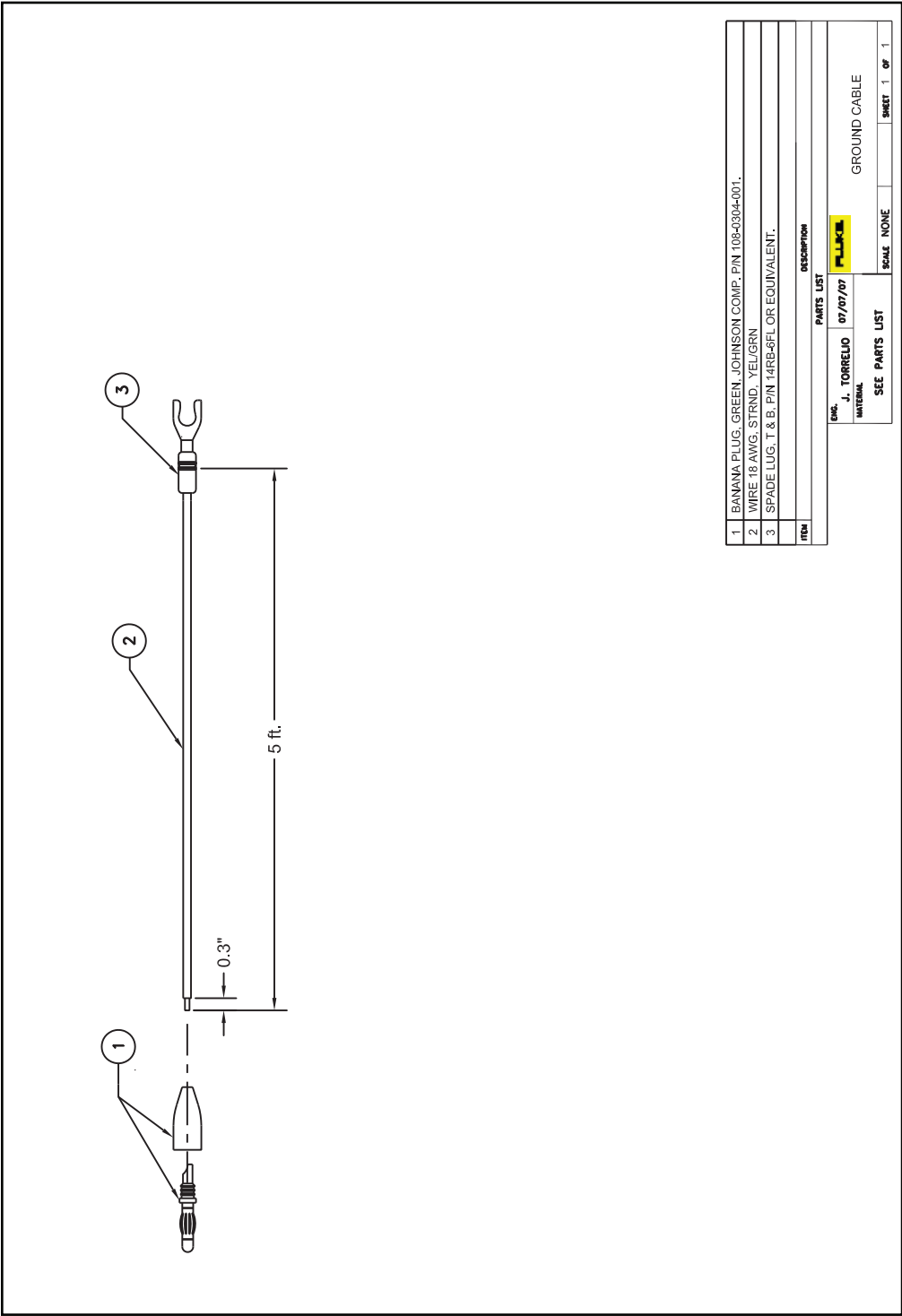


Figure 2. Ground Calibration Cable

fdo02.eps



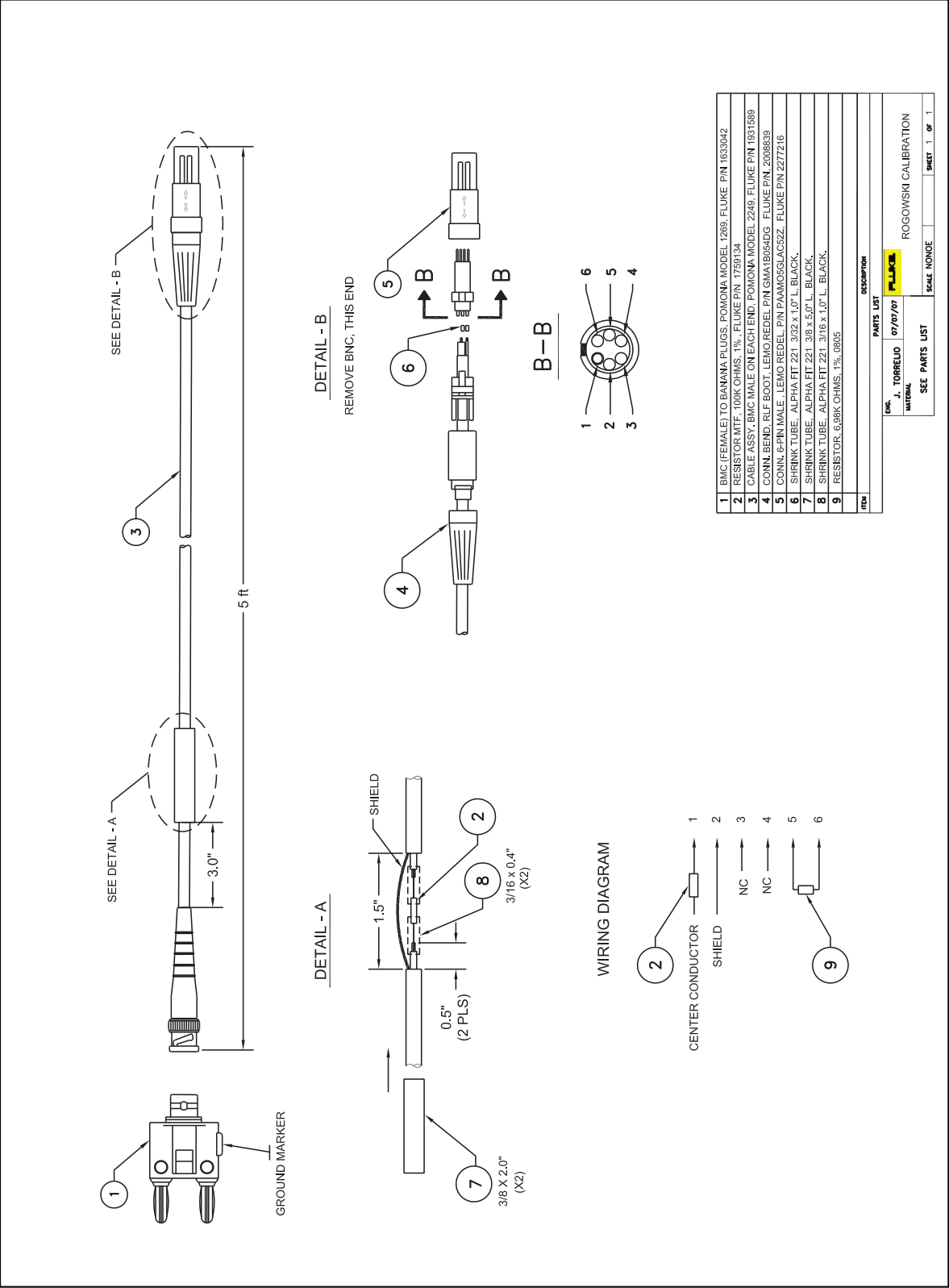


Figure 3. Rogowski Calibration Cable

fdo01.eps

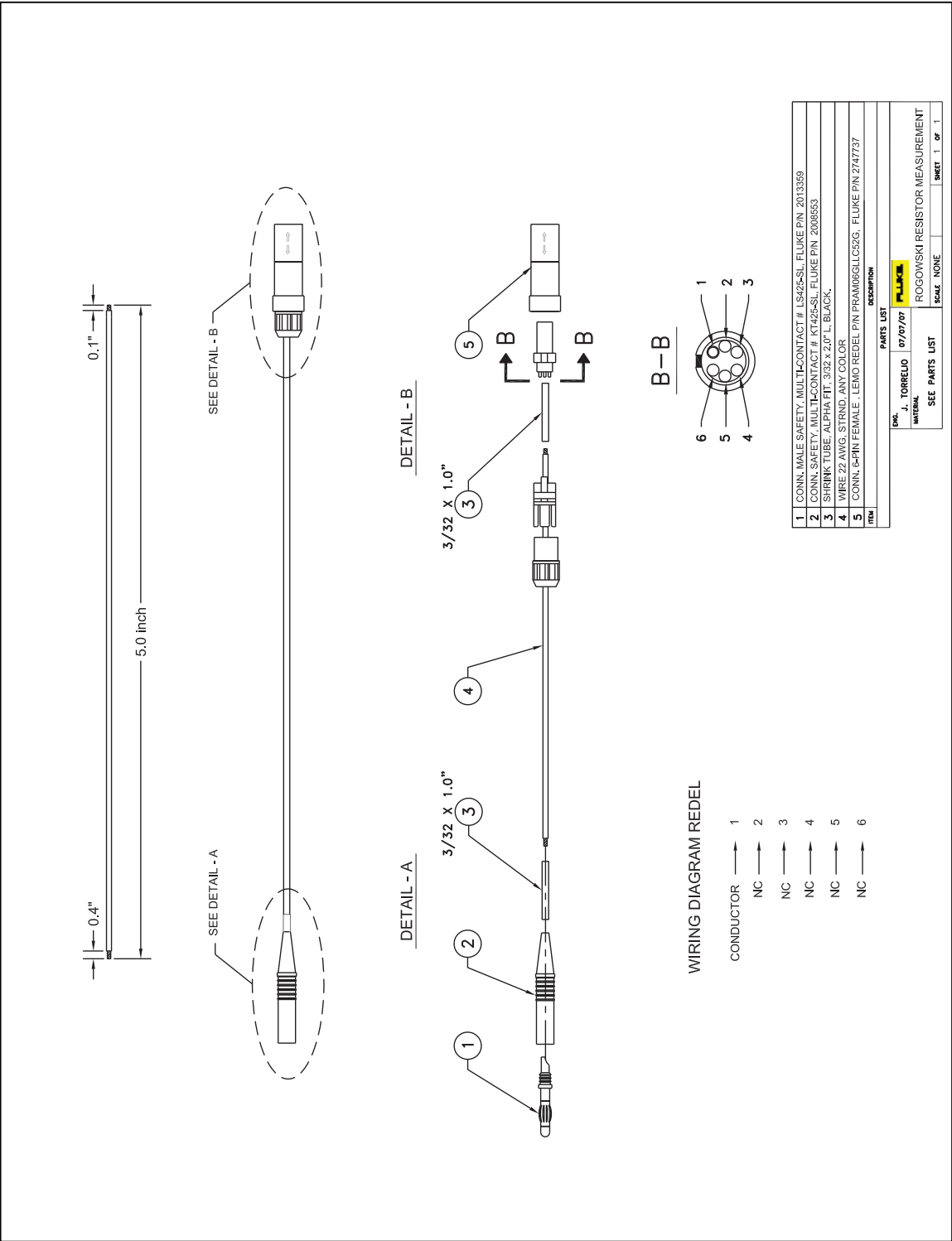


Figure 4. Rogowski Resistor Measurement Cable

fdo05.eps

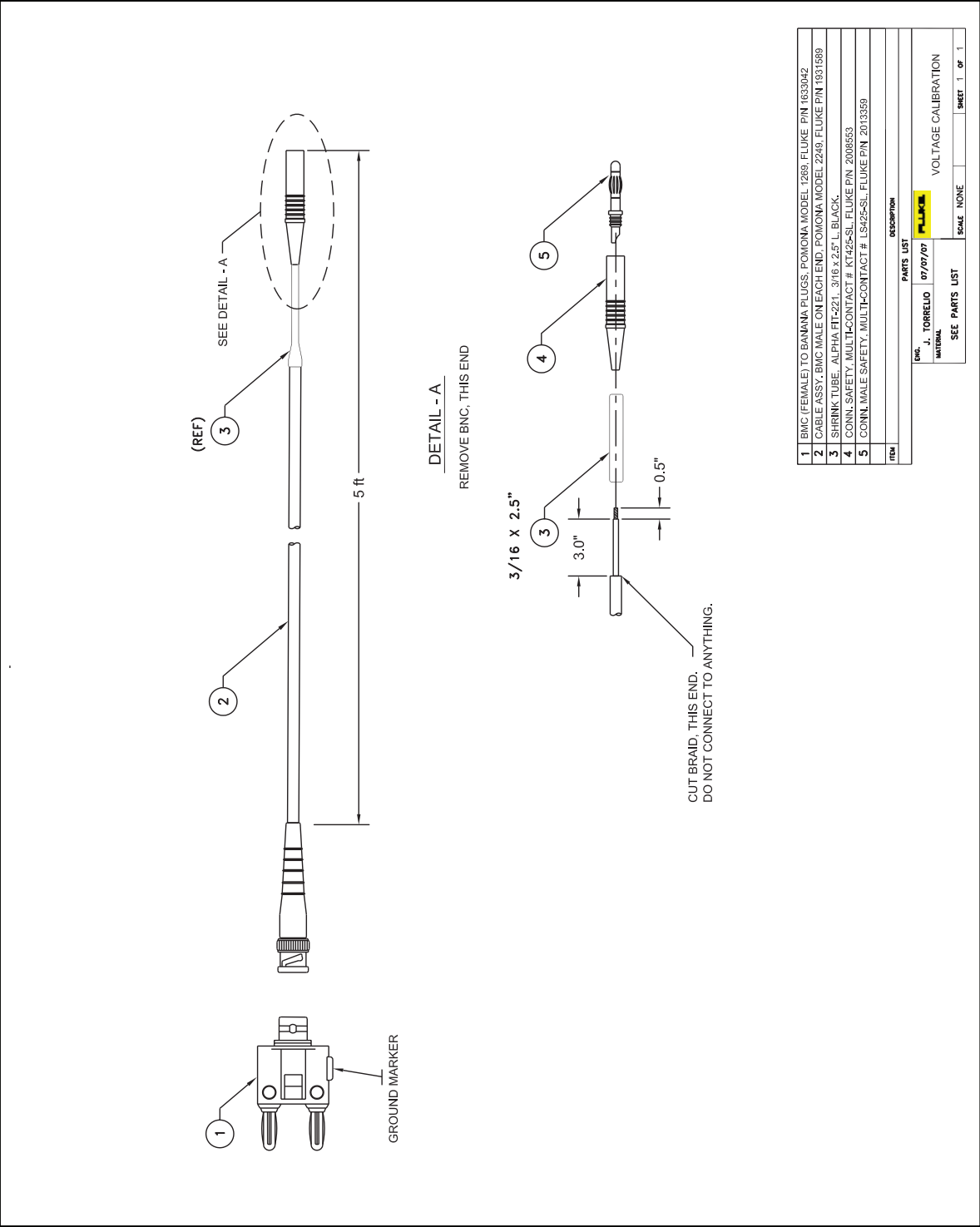


Figure 5. Voltage Calibration Cable

fdo03.eps

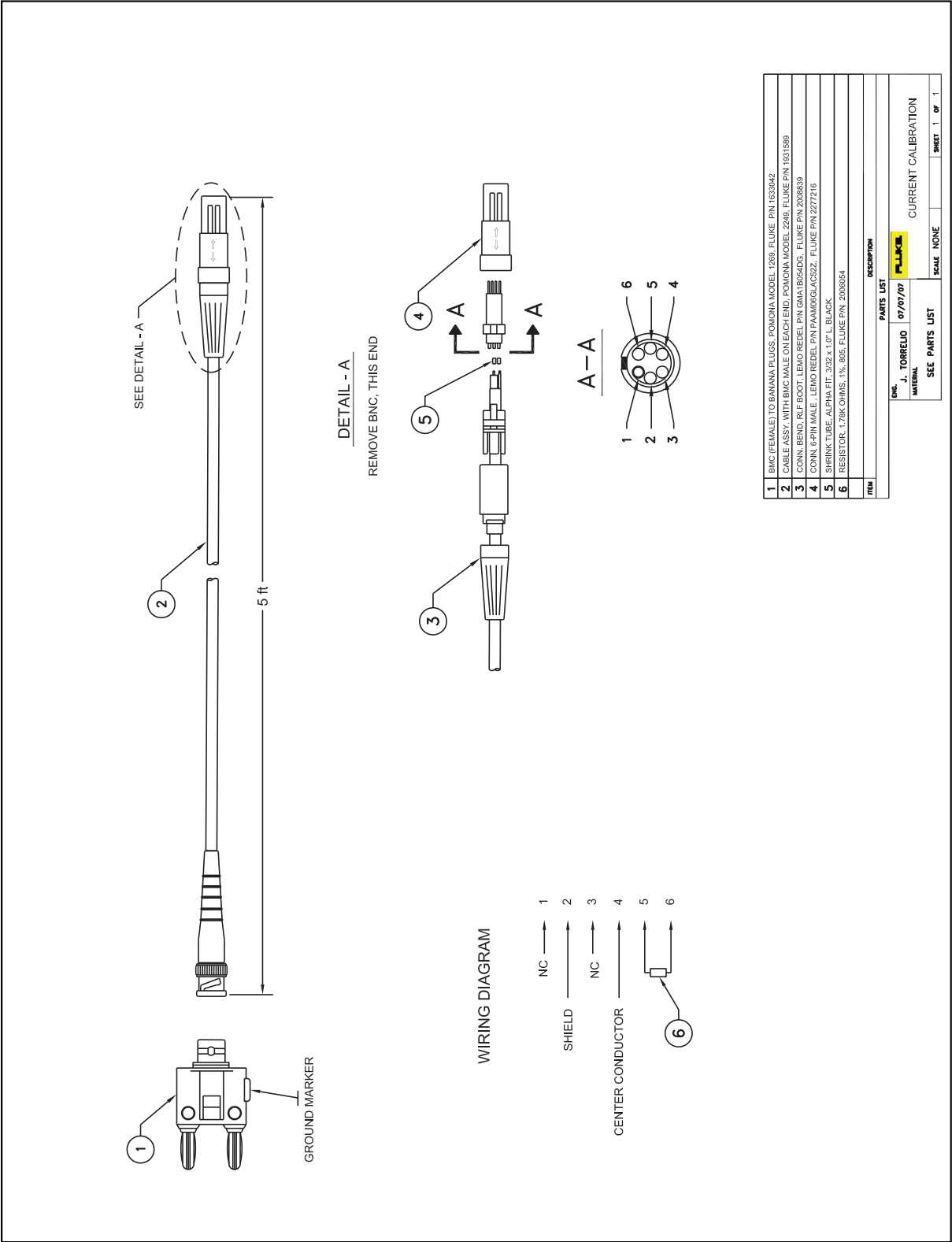


Figure 6. Current Calibration Cable

fdo04.eps