FLUKE®

1652C/1653B/1654B

Electrical Installation Tester

Calibration Manual

March 2011

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Introduction

The Fluke 1652C, 1653B, and 1654B are battery powered electrical installation testers (the Tester). This manual applies to all three models. All figures show the 1653B.

In this manual, you will find the following topics:

- Safety Information
- General and Electrical Measurement Specifications
- Equipment Requirements
- Basic Maintenance
- Performance Tests
- Accuracy Tests
- Accessories and Replaceable Parts

For complete instructions on how to use the Tester, refer to the *1652C/1653B/1654B Users Manual*.

How to Contact Fluke

To contact Fluke, call one of the telephone numbers that follow:

- Technical Support USA: 1-800-99-FLUKE (1-800-993-5853)
- 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: +65-738-5655
- 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.

Precautions and Safety Information

If this product is used in a manner not specified by the manufacturer, the protection provided by the Tester may be impaired.

Read the *Safety Information* page before servicing the Tester.

In this manual, a **Warning** identifies conditions and actions that pose hazard(s) to the user. A **Caution** identifies conditions and actions that may damage the Tester or the test instruments.

Symbols used on the Tester and in this manual are explained in Table 1.

Table 1. Symbols

Symbol	Description	Symbol	Description
	Fuse		Hazardous voltage. Risk of electrical shock.
	Double Insulated.		Earth Ground
	Risk of Danger. Important information. See Manual.	CE	Conforms to relevant European standard.
	Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.		Battery or battery compartment. Low battery when shown on display
CAT III	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.		
CAT IV	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.		
>550 V	Do not use in distribution systems with voltages higher than 550 V.		

⚠⚠ Safety Information

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

- **Use the product only as specified, or the protection supplied by the product can be compromised.**
- **Do not use the product around explosive gas, vapor or in damp or wet environments.**
- **Do not use test leads if they are damaged. Examine the test leads for damaged insulation, exposed metal, or if the wear indicator shows. Check test lead continuity.**
- **Use only current probes, test leads, and adapters supplied with the product.**
- **Measure a known voltage first to make sure that the product operates correctly.**
- **Do not use and disable the product if it is damaged.**
- **Have an approved technician repair the product.**
- **Do not apply more than the rated voltage between the terminals or between each terminal and earth ground.**
- **Remove all probes, test leads, and accessories before the battery door is opened.**
- **Do not operate the product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Use caution when working with voltages above 30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Use only specified replacement fuses.**
- **Use the correct terminals, function, and range for measurements.**
- **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.**
- **Replace the batteries when the low battery indicator shows to prevent incorrect measurements.**
- **Use only specified replacement parts.**
- **Do not use the tester in distribution systems with voltages higher than 550 V.**
- **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.**

Specifications

General Specifications

Specification	Characteristic
Size	10 cm (L) x 25 cm (W) x 12.5 cm (H)
Weight (with batteries)	1.3 kg
Battery size, quantity	Type AA, 6 ea.
Battery type	Alkaline supplied. Usable with 1.2 V NiCd or NiMH batteries (not supplied)
Battery life (typical)	200 hours idling
Fuse	T3.15 A, 500 V, 1.5 kA 6.3 x 32 mm (PN 2030852)
Operating Temperature	-10 °C to 40 °C
Storage Temperature	-10 °C to 60 °C indefinitely (to -40 °C for 100 hrs)
Relative Humidity	80 % 10 to 35 °C; 70 % 35 to 40 °C
Operating Altitude	0 to 2000 meters
Shock, Vibration	Vibration to Class 3 per Mil-Prf-28800F 1 meter drop test, six sides, oak floor
Sealing	IP 40
EMC	Complies with EN61326-1: 2006
Safety	Complies with EN61010-1 Ed 2.0 (2001-02), UL61010, ANSI/ISA –s82.02.01 2000 and CAN/CSA c22.2 No.1010 2nd edition Overvoltage Category: 500 V/CAT III 300 V/CAT IV Complies with EN/IEC 61010-031:2002+A1:2008 Measurement Category III is for measurements performed in the building installation. Examples are distribution panels, circuit breakers, wiring and cabling. Category IV equipment is designed to protect against transients from the primary supply level, such as an electrical meter or an overhead or underground utility service. Performance EN61557-1, EN61557-2, EN61557-3, EN61557-4, EN61557-5, EN61557-6, EN61557-7 Second edition. EN61557-10 First edition.
Pollution Degree	2
Maximum voltage between any terminal and earth ground	500 V
Surge Protection	6 kV peak per EN 61010-1 Ed. 2.0 (2001-02)

Category Ratings and Usage

Part/Accessory	Printed CAT Rating	CAT II 250 V	CAT III 500 V	CAT IV 300 V
165XB Electrical Installation Tester	CAT III 500 V CAT IV 300 V	√ √	√ √	√ √
Country-Specific Mains Cord	CAT II 250 V	√		
Multifunction Probe (red)	CAT III 1000 V	√	√	√
Test Lead (red/green/blue)	CAT III 1000 V	√	√	√
Test Probe (red/green/blue)	CAT III 1000 V	√	√	√
Alligator Clip (red/green/blue)	CAT III 1000 V	√	√	√
UK Test Leads and Probes: Non-fused (red/green/blue) Fused (red/green/blue)	 CAT III 1000 V CAT III 600 V	 √ √	 √ √	 √ √

Electrical Measurement Specifications

The accuracy specification is defined as ±(% reading +digit counts) at 23 °C ±5 °C, ≤80 % RH. Between -10 °C and 18 °C and between 28 °C and 40 °C, accuracy specifications may degrade by 0,1 x (accuracy specification) per °C. The following tables can be used for the determination of maximum or minimum display values considering maximum instrument operating uncertainty per EN61557-1, 5.2.4.

Insulation Resistance (R_{ISO})

50 V		100 V		250 V		500 V		1000 V	
Limit Value	Maximum Display Value	Limit Value	Maximum Display Value	Limit Value	Maximum Display Value	Limit Value	Maximum Display Value	Limit Value	Maximum Display Value
1	1.12	1	1.12	1	1.3	1	1.3	1	1.3
2	2.22	2	2.22	2	2.4	2	2.4	2	2.4
3	3.32	3	3.32	3	3.5	3	3.5	3	3.5
4	4.42	4	4.42	4	4.6	4	4.6	4	4.6
5	5.52	5	5.52	5	5.7	5	5.7	5	5.7
6	6.62	6	6.62	6	6.8	6	6.8	6	6.8
7	7.72	7	7.72	7	7.9	7	7.9	7	7.9
8	8.82	8	8.82	8	9.0	8	9.0	8	9.0
9	9.92	9	9.92	9	10.1	9	10.1	9	10.1
10	11.02	10	11.02	10	11.2	10	11.2	10	11.2
20	22.02	20	22.02	20	22.2	20	22.2	20	22.2
30	33.02	30	33.2	30	33.2	30	33.2	30	33.2
40	44.02	40	44.2	40	44.2	40	44.2	40	44.2
50	55.02	50	55.2	50	55.2	50	55.2	50	55.2
		60	66.2	60	66.2	60	66.2	60	66.2
		70	77.2	70	77.2	70	77.2	70	77.2
		80	88.2	80	88.2	80	88.2	80	88.2
		90	99.2	90	99.2	90	99.2	90	99.2
		100	110.2	100	110.2	100	110.2	100	110.2
				200	220.2	200	220.2	200	220.2
						300	347	300	345
						400	462	400	460
						500	577	500	575
								600	690
								700	805
								800	920
								900	1035
								1000	1150

Continuity (R_{LO})

Limit Value	Maximum Display Value	Limit Value	Maximum Display Value
0.2	0.16	3	2.68
0.3	0.25	4	3.58
0.4	0.34	5	4.48
0.5	0.43	6	5.38
0.6	0.52	7	6.28
0.7	0.61	8	7.18
0.8	0.7	9	8.08
0.9	0.79	10	8.98
1	0.88	20	17.98
2	1.78	30	26.8

Loop Tests (Z_l)

Loop Z_l Hi Current		Loop Z_l No Trip		Loop Z_l		Loop R_E	
Limit Value	Maximum Display Value	Limit Value	Maximum Display Value	Limit Value	Maximum Display Value	Limit Value	Maximum Display Value
0.20	0.14	-	-	3	2.53	3	2.72
0.30	0.23	-	-	4	3.38	4	3.62
0.40	0.32	0.40	0.28	5	4.23	5	4.52
0.50	0.41	0.50	0.37	6	5.08	6	5.42
0.60	0.50	0.60	0.45	7	5.93	7	6.32
0.70	0.59	0.70	0.54	8	6.78	8	7.22
0.80	0.68	0.80	0.62	9	7.63	9	8.12
0.90	0.77	0.90	0.71	10	8.48	10	9.02
1.00	0.86	1.00	0.79	20	16.98	20	18.02
1.10	0.95	1.10	0.88	30	25.3	30	27.2
1.20	1.04	1.20	0.96	40	33.8	40	36.2
1.30	1.13	1.30	1.05	50	42.3	50	45.2
1.40	1.22	1.40	1.13	60	50.8	60	54.2
1.50	1.31	1.50	1.22	70	59.3	70	63.2
1.60	1.40	1.60	1.30	80	67.8	80	72.2
1.70	1.49	1.70	1.39	90	76.3	90	81.2
1.80	1.58	1.80	1.47	100	84.8	100	90.2
1.90	1.67	1.90	1.56	200	169.8	200	180.2
2.00	1.76	2.00	1.64	300	253	300	272
-	-	-	-	400	338	400	362
-	-	-	-	500	423	500	452
-	-	-	-	600	508	600	542
-	-	-	-	700	593	700	632
-	-	-	-	800	678	800	722
-	-	-	-	900	763	900	812
-	-	-	-	1000	848	1000	902

RCD/FI Tests ($_{\Delta}T$, $I_{\Delta}N$)

RCD/FI Time		RCD/FI Current	
Limit Value	**Maximum Display Value**	**Limit Value**	**Maximum Display Value**
20	18.1	0.5	0.43
30	27.1	0.6	0.52
40	36.1	0.7	0.61
50	45.1	0.8	0.7
60	54.1	0.9	0.79
70	63.1	1	0.88
80	72.1	2	1.78
90	81.1	3	2.68
100	90.1	4	3.58
200	180.1	5	4.48
300	271	6	5.38
400	361	7	6.28
500	451	8	7.18
600	541	9	8.08
700	631	10	8.98
800	721	20	17.98
900	811	30	26.8
1000	901	40	35.8
2000	1801	50	44.8
		60	53.8
		70	62.8
		80	71.8
		90	80.8
		100	89.8
		200	179.8
		300	268
		400	358
		500	448

Earth Tests (R_E)

Limit Value	Maximum Display Value	Limit Value	Maximum Display Value
10	8.8	200	179.8
20	17.8	300	268.0
30	26.8	400	358.0
40	35.8	500	448.0
50	44.8	600	538.0
60	53.8	700	628.0
70	62.8	800	718.0
80	71.8	900	808.0
90	80.8	1000	898.0
100	89.8	2000	1798.0

AC Voltage Measurement (V)

Range	Resolution	Accuracy 50 Hz – 60 Hz	Input Impedance	Overload Protection
500 V	0.1 V	0.8 % + 3	3.3 MΩ	660 V rms

Continuity Testing (R_{LO})

Range (Autoranging)	Resolution	Open Circuit Voltage	Accuracy
20 Ω	0.01 Ω	>4 V	±(1.5 % + 3 digits)
200 Ω	0.1 Ω	>4 V	±(1.5 % + 3 digits)
2000 Ω	1 Ω	>4 V	±(1.5 % + 3 digits)
Note The number of possible continuity tests with a fresh set of batteries is 3000.			

Range R_{LO}	Test Current
7.5 Ω	210 mA
35 Ω	100 mA
240 Ω	20 mA
2000 Ω	2 mA

Test Probe Zeroing	Press the (ZERO) to zero the test probe. Can subtract up to 2 Ω of lead resistance. Error message for >2 Ω.
Live Circuit Detection	Inhibits test if terminal voltage >10 V ac detected prior to initiation of test.

Insulation Resistance Measurement (R_{ISO})

Test Voltages		Accuracy of Test Voltage (at rated test current)
Model 1652C	**Model 1653B Model 1654B**	
250-500-1000 V	50-100-250-500-1000 V	+10 %, -0 %

Test Voltage	Insulation Resistance Range	Resolution	Test Current	Accuracy
50 V	10 kΩ to 50 MΩ	0.01 MΩ	1 mA @ 50 kΩ	±(3 % + 3 digits)
100 V	100 kΩ to 20 MΩ	0.01 MΩ	1 mA @ 100 kΩ	±(3 % + 3 digits)
	20 MΩ to 100 MΩ	0.1 MΩ		±(3 % + 3 digits)
250 V	10 kΩ to 20 MΩ	0.01 MΩ	1 mA @ 250 kΩ	±(1.5 % + 3 digits)
	20 MΩ to 200 MΩ	0.1 MΩ		±(1.5 % + 3 digits)
500 V	10 kΩ to 20 MΩ	0.01 MΩ	1 mA @ 500 kΩ	±(1.5 % + 3 digits)
	20 MΩ to 200 MΩ	0.1 MΩ		±(1.5 % + 3 digits)
	200 MΩ to 500 MΩ	1 MΩ		±10 %
1000 V	100 kΩ to 200 MΩ	0.1 MΩ	1 mA @ 1 MΩ	±(1.5 % + 3 digits)
	200 MΩ to 1000 MΩ	1 MΩ		±10 %

Note
The number of possible insulation tests with a fresh set of batteries is 2000.

Auto Discharge	Discharge time constant <0.5 second for C = 1 µF or less.
Live Circuit Detection	Inhibits test if terminal voltage >30 V prior to initiation of test.
Maximum Capacitive Load	Operable with up the 5 µF load.

No Trip and Hi Current Modes RCD/FI

Mains Input Voltage Range	100 - 500 V ac (50/60 Hz)
Input Connection (soft key selection)	Loop Impedance: phase to earth
	Line impedance: phase to neutral
Limit on Consecutive Tests	Automatic shutdown when internal components are too hot. There is also a thermal shutdown for RCD tests.
Maximum Test Current @ 400 V	20 A sinusoidal for 10 ms
Maximum Test Current @ 230 V	12 A sinusoidal for 10 ms

Range	Resolution	Accuracy[1]
10 Ω	0.001 Ω	Hi Current mΩ mode: ±(2 % + 15 digits)
20 Ω	0.01 Ω	No Trip mode: ±(3 % + 6 digits)
		Hi Current mode: ±(2 % + 4 digits)
200 Ω	0.1 Ω	No Trip mode: ±(3 %)
		Hi Current mode: ±(2 %)
2000 Ω	1 Ω	±6 %[2]

Notes
[1] Valid for resistance of neutral circuit <20 Ω and up to a system phase angle of 30 °. Test leads must be zeroed before testing.
[2] Valid for mains voltage >200 V.

Prospective Earth Fault Current Test (PSC/I_K)

Computation	Prospective Earth Fault Current (PEFC/I_K) or Prospective Short Circuit Current (PSC/I_K) determined by dividing measured mains voltage by measured loop (L-PE) resistance or line (L-N) resistance, respectively.	
Range	0 to 10 kA or 0 to 50 kA (See Power-On Options earlier in this manual)	
Resolution and Units	Resolution	Units
	I_K <1000 A	1 A
	I_K >1000 A	0.1 kA
Accuracy	Determined by accuracy of loop resistance and mains voltage measurements.	

RCD Testing

RCD Types Tested

RCD Type[6]		Model 1652C	Model 1653B	Model 1654B
AC[1]	G[2]	√	√	√
AC	S[3]	√	√	√
A[4]	G	√	√	√
A	S	√	√	√
B[5]	G			√
B	S			√

Notes
[1] AC – Responds to ac
[2] G – General, no delay
[3] S – Time delay
[4] A – Responds to pulsed signal
[5] B – Responds to smooth dc
[6] RCD test inhibited for V >265 ac
RCD tests permitted only if the selected current, multiplied by earthing resistance, is <50 V.

Test Signals

RCD Type	Test Signal Description
AC (sinusoidal)	The waveform is a sinewave starting at zero crossing, polarity determined by phase selection (0 ° phase starts with low to high zero crossing, 180 ° phase starts with high to low zero crossing). The magnitude of the test current is $I_\Delta n$ x Multiplier for all tests.
A (half wave)	The waveform is a half wave rectified sinewave starting at zero, polarity determined by phase selection (0 ° phase starts with low to high zero crossing, 180 ° phase starts with high to low zero crossing). The magnitude of the test current is 2.0 x $I_\Delta n$ (rms) x Multiplier for all tests for $I_\Delta n$ = 0.01A. The magnitude of the test current is 1.4 x $I_\Delta n$ (rms) x Multiplier for all tests for all other $I_\Delta n$ ratings.
B (DC)	This is a smooth DC current according to EN61557-6 Annex A

Tripping Speed Test ($_{\Delta}T$)

Test Function	RCD Current Selection						
	10 mA	30 mA	100 mA[1]	300 mA[1]	500 mA[1]	1000 mA[2]	var[3]
x ½, 1	√	√	√	√	√	√	√
x 5	√	√	√				
Ramp	√	√	√	√	√	√	√
Auto	√	√	√				

Notes
Mains voltage 100 V – 265 V ac, 50/60 Hz
[1] Type B RCDs require mains voltage range of 195 V – 265 V.
[2] Type AC RCDs only.
[3] Type A RCDs are limited to 700 mA, not available for Type B RCDs.

Current Multiplier	*RCD Type	Measurement Range		Trip Time Accuracy
		Europe	UK	
x ½	G	310 ms	2000 ms	±(1 % Reading + 1 ms)
x ½	S	510 ms	2000 ms	±(1 % Reading + 1 ms)
x 1	G	310 ms	310 ms	±(1 % Reading + 1 ms)
x 1	S	510 ms	510 ms	±(1 % Reading + 1 ms)
x 5	G	50 ms	50 ms	±(1 % Reading + 1 ms)
x 5	S	160 ms	160 ms	±(1 % Reading + 1 ms)

Notes
*G – General, no delay
*S – Time delay

Maximum Trip Time

The RCD ✓ symbol switches on when testing the RCD trip time if the trip time meets the following conditions:

RCD	$I_{\Delta N}$	Trip Time Limits
AC G, A, B	x 1	Less than 300 ms
AC, G - S type, A - S type, B - type	x 1	Between 130 ms and 500 ms
AC G, A, B	x 5	Less than 40 ms
AC, G - S type, A - S type, B - type	x 5	Between 50 ms and 150 ms

RCD/FI-Tripping Current Measurement/Ramp Test ($I_{\Delta N}$)

Current Range	Step Size	Dwell Time		Measurement Accuracy
		Type G	Type S	
30 % to 110 % of RCD rated current[1]	10 % of $I_{\Delta N}$[2]	300 ms/step	500 ms/step	±5 %

Notes
[1] 30 % to 150 % for Type A $I_{\Delta N}$ >10 mA
30 % to 210 % for Type A $I_{\Delta N}$ = 10 mA
20 % to 210 % for Type B
Specified trip current ranges (EN 61008-1):
50 % to 100 % for Type AC
35 % to 140 % for Type A (>10 mA)
35 % to 200 % for Type A (≤10 mA)
50 % to 200 % for Type B
[2] 5% for Type B

Earth Resistance Test (R_E)

Models 1653B and 1654B Only. This product is intended to be used to measure installations in process plants, industrial installations, and residential applications.

Range	Resolution	Accuracy
200 Ω	0.1 Ω	±(2 % + 5 digits)
2000 Ω	1 Ω	±(3.5 % + 10 digits)

Range: $R_E + R_{PROBE}$[1]	Test Current
2200 Ω	3.5 mA
16000 Ω	500 µA
52000 Ω	150 µA
Note [1] Without external voltages	

Frequency	Output Voltage
128 Hz	25 V

Live Circuit Detection	Inhibits test if terminal voltage >10 V ac is detected prior to start of test.

Phase Sequence Indication

Icon	icon Phase Sequence indicator is active.
Display of Phase Sequence	Displays “1-2-3” in digital display field for correct sequence. Displays “3-2-1” for incorrect phase. Dashes in place of a number indicate a valid determination could not be made.
Mains Input Voltage Range (phase-to-phase)	100 to 500 V

Mains Wiring Test

Icons (, ,) indicate if L-PE or L-N terminals are reversed. Instrument operation is inhibited and an error code is generated if the input voltage is not between 100 V and 500 V. The UK Loop and RCD tests are inhibited if the L-PE or the L-N terminals are reversed.

Operating Ranges and Uncertainties per EN 61557

Function	Display Range	EN 61557 Measurement Range Operating Uncertainty	Nominal Values
V EN 61557-1	0.0 V ac – 500 V ac	50 V ac – 500 V ac ±(2% + 2 dgt)	U_N = 230/400 V ac f = 50/60 Hz
R_{LO} EN 61557-4	0.00 Ω - 2000 Ω	0.2 Ω - 2000 Ω ±(10 % + 2 dgt)	4.0 V dc <U_Q <24 V dc R_{LO} ≤2.00 Ω I_N ≥200 mA
R_{ISO} EN 61557-2	0.00 MΩ - 1000 MΩ	1 MΩ - 200 MΩ ±(10 % + 2 dgt) 200 MΩ - 1000 MΩ ±(15 % + 2 dgt)	U_N = 50 / 100 / 250 / 500 / 1000 V dc I_N = 1.0 mA
Z_I EN 61557-3	Z_I (No Trip) 0.00 Ω - 2000 Ω	0.4 Ω - 2000 Ω ±(15 % + 6 dgt)	U_N = 230/400 V ac f = 50/60 Hz I_K = 0 A – 10.0 kA
	Z_I (Hi Current) 0.00 Ω - 2000 Ω	0.2 Ω - 200 Ω ±(10 % + 4 dgt)	
	Z_I (Hi Current, Hi Res) 0 mΩ - 9999 mΩ	100 mΩ - 9999 mΩ ±(8 % + 20 dgt)	
	R_E 0.00 Ω - 2000 Ω	10 Ω - 1000 Ω ±(10 % + 2 dgt)	
$_{\Delta}T$, $I_{\Delta N}$ EN 61557-6	$_{\Delta}T$ 0.0 ms – 2000 ms	25 ms – 2000 ms ±(10 % + 1 dgt)	$_{\Delta}T$ = 10 / 30 / 100 / 300 / 500 / 1000 / VAR mA
	$I_{\Delta N}$ 3 mA – 550 mA (VAR 3 mA – 700 mA)	3 mA – 550 mA ±(10 % + 1 dgt)	$I_{\Delta N}$ = 10 / 30 / 100 / 300 / 500 / VAR mA
R_E EN 61557-5	0.0 Ω - 2000 Ω	10 Ω - 2000 Ω ±(10 % + 2 dgt)	f = 128 Hz
Phase EN 61557-7			1 : 2 : 3

Operating Uncertainties per EN 61557

The Operating Uncertainty shows the maximum possible uncertainty when all influence factors E1-E10 are counted.

	Volts	R_{Lo} EN 61557-4	R_{ISO} EN 61557-2	Z_I EN 61557-3	Δ^T EN 61557-6	$I_{\Delta N}$ EN 61557-6	R_E EN 61557-5
Intrinsic Uncertainty A	0.80 %	1.50 %	10.00 %	6.00 %	1.00 %	5.00 %	3.50 %

Influence Quantity	Volts	R_{Lo} EN 61557-4	R_{ISO} EN 61557-2	Z_I EN 61557-3	Δ^T EN 61557-6	$I_{\Delta N}$ EN 61557-6	R_E EN 61557-5
E1 - Position	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
E2 - Supply Voltage	0.50 %	3.00 %	3.00 %	3.00 %	3.00 %	2.75 %	2.25 %
E3 - Temperature	0.50 %	3.00 %	3.00 %	3.00 %	3.00 %	2.25 %	2.75 %
E4 - Series Interferences Voltage	-	-	-	-	-	-	1.50 %
E5 - Resistance of the probes and auxiliary earth electrodes	-	-	-	-	-	-	4.00 %
E6.2 - System phase angle	-	-	-	1.00 %	-	-	-
E7 - System frequency	0.50 %	-	-	2.50 %	-	-	0.00 %
E8 - System voltage	-	-	-	2.50 %	2.50 %	2.50 %	0.00 %
E9 - Harmonics	-	-	-	2.00 %	-	-	-
E10 - D.C. Quantity	-	-	-	2.50 %	-	-	-

Equipment Requirements

The Tester's recommended calibration cycle is one year. Table 2 lists the calibration equipment required for the Tester. If the recommended models are unavailable, you can substitute equipment with equivalent specifications.

⚠ Warning

For safe operation and maintenance of the product, have an approved technician repair the product.

Table 2. Equipment Requirements

Equipment	Description	Recommended Model
Multifunction Electrical Tester Calibrator	AC Voltage Range: 0 to 500 V ac Accuracy: ±0.215 % Frequency Range: 50 Hz Insulation Resistance: 10 kΩ to 900 MΩ Accuracy: 10 kΩ to 200 MΩ = ±0.413 % 200 MΩ to 900 MΩ = 2.5 % Low Resistance: 2 Ω to 1800 Ω Accuracy: ±0.416 % Loop Resistance: 100 mΩ to 1.8 kΩ Accuracy: 100 mΩ = ±5 % 1.8 Ω = ±1 % 18 Ω to 180 Ω = ±0.5 % 500 Ω to 1800 Ω = ±1.5 % RCD Trip Current Measurement Range: 10 to 1000 mA Accuracy: 0.5 x 1 and 1 x 1 mode = ±2.5 % 1.4 x 1 and 2 x 1 mode = ±2.5 % 5 x 1 mode = ±2.5% Trip time Measurement Range: 30.0 to 500.0 ms Accuracy: ±1.2 %	Fluke 5320A Calibrator
Decade Resistor Box	Resistance: 18 Ω, 180 Ω, 1800 Ω Accuracy: 0.75 % or better Power: 0.5 W minimum	GenRad 1433
PC	PC with Windows 98 or newer	---
IR adapter Cable	---	Fluke P/N 1590638
IR Cable adapter holder	FLK-1653-2014-OSP, 2043365, IR Adapter	Fluke P/N 3270172
Zero Adapter	Fluke-165XB-8001, Zero Adapter	Fluke P/N 3301338

Basic Maintenance

This section contains information about the basic maintenance of the Tester.

⚠⚠ Warning

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

- **Remove the input signals before you clean the product.**
- **Remove all probes, test leads, and accessories before the case is opened.**
- **Use only specified replacement parts.**

How to Clean the Tester

⚠⚠ Warning

To prevent electrical shock or damage to the Tester, never allow water inside the case.

⚠ Caution

To prevent damage to the housing, never apply abrasives or solvents to the Tester.

Periodically wipe the case with a damp cloth and mild detergent. Dirt or moisture in the input jacks can affect readings.

To clean the input jacks:

1. Turn the Tester off and remove all test leads.
2. Shake out any dirt that may be in the input jacks.
3. Soak a new swab with alcohol. Work the swab around each input jack.

How to Test and Replace the Batteries

The Tester continuously monitors Battery voltage. If the voltage falls below 6.0 V (1.0 V/cell), the low battery icon (+▬) appears on the display, indicating that there is minimal battery life left. The low battery icon continues to appear on the display until you replace the batteries.

⚠⚠ Warning

Replace the batteries when the low battery indicator shows to prevent incorrect measurements.

Replace the batteries with six AA batteries. Alkaline batteries are supplied with the Tester but you can also use 1.2 V NiCd or NiMH batteries. You can also check the battery charge so that you can replace them before they discharge.

To test the batteries:

1. Turn the rotary switch to the V position.
2. Press F3 to initiate the battery test. The Voltage function display clears and is replaced by the measured battery voltage in the secondary display for 2 seconds, the Voltage function display then returns.

To replace the batteries (refer to Figure 1):

1. Press ⏻ to turn off the Tester.
2. Remove the test leads from the input jacks.
3. Remove the battery door by using a standard-blade screwdriver to turn the battery

door screws (3) one-quarter turn counterclockwise.

4. Press the release latch and slide the battery holder out of the Tester.
5. Replace the batteries and the battery door.

Note

All stored data will be lost if the batteries are not replaced within approximately one minute (1653B and 1654B only).

6. Secure the door by turning the screws one-quarter turn clockwise.

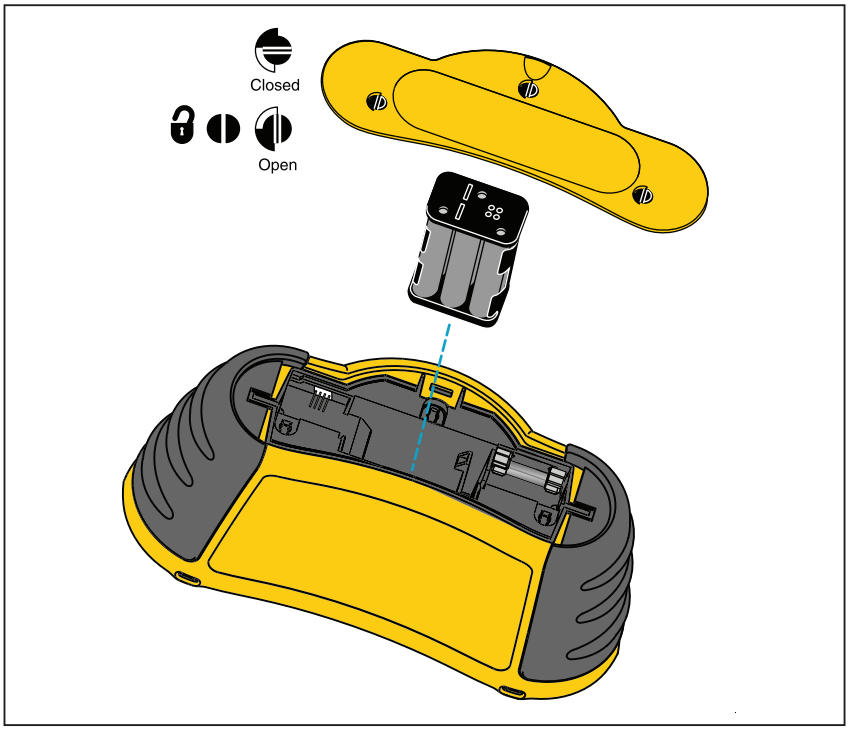

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Figure 1. Battery Replacement

How to Test and Replace the Fuse

The Tester performs a fuse test each time it turns on. If leads are plugged into the L and PE input jacks, the fuse test is skipped. If a blown fuse is detected, testing is disabled, FUSE appears on the primary display, and the Tester issues a warning beep.

You can also perform a manual check of the fuse.

To check the fuse manually:

1. Turn the rotary switch to either R_{ISO} or R_{LO}.
2. Short the leads.
3. Press and hold TEST.

If the fuse is bad, FUSE will appear on the display to indicate the Tester is damaged and needs repair. Contact Fluke Service for repair (see *How to Contact Fluke*).

Performance Tests

The performance tests that follow will ensure that the Tester, or Unit Under Test (UUT), is in proper operating condition and will check the accuracy of each Tester function against its specifications. To perform the tests you will need a Fluke 5320A/VLC Calibrator or equipment meeting the minimum specification given in Table 2. Before you begin the accuracy tests, allow the Tester to stabilize to room temperature. Depending on temperature gradient, this could take up to several hours.

If the Tester fails any of these tests, it needs calibration adjustment or repair.

Backlight Test

To test that the backlight circuit works, do the steps that follow:

1. Turn the Tester on using ⏻.
2. To turn on the backlight, press ☼ once.
3. Press the ☼ button a second time to turn it off.

LCD Test

To test all LCD segments and the display's contrast quality:

1. To turn the UUT off, press ⏻.
2. While holding down F1, power the Tester back on.
3. Continue to hold F1 down after releasing ⏻.
4. Compare the display segments to Figure 2 for the 1652C and 1653B. Compare the display segments to Figure 3 for the 1654B. Check for any missing segments or poor contrast areas.

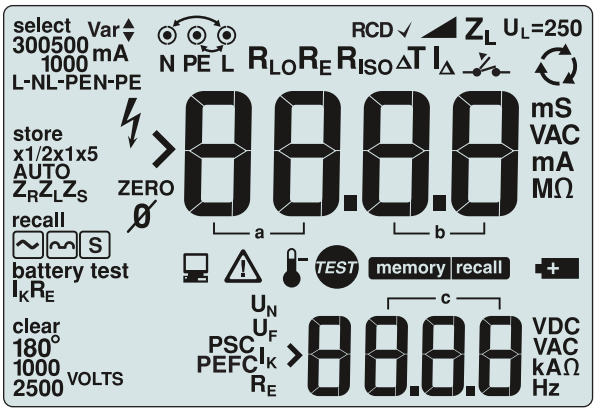

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Figure 2. 1652C and 1653B LCD Tests

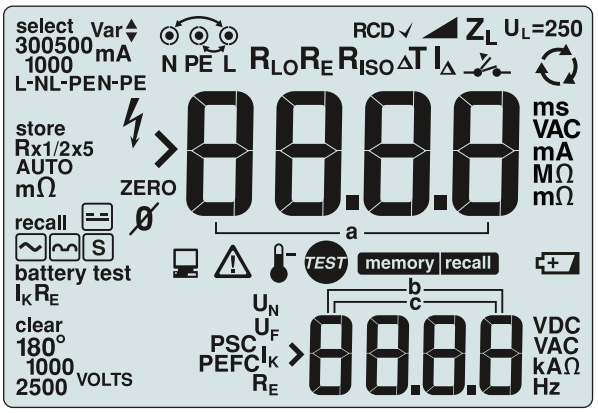

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Figure 3. 1654B LCD Tests

Input Jack Sensing Test

This test determines if the input jack detect-circuits are operating correctly:

1. Install test leads into the L and PE UUT input jacks.
2. Set the rotary switch for Loop Z_I and use (F1) to select L-PE.
3. Remove the test lead from the PE jack and note that **LEAD** appears on the display.
4. Reinsert the test lead into the PE jack and note that **LEAD** extinguishes.
5. Repeat steps 3 and 4 for the L jack.

IR Port Verification

Note

You can do this verification procedure with Windows®98 or later. If you are successfully using MET/CAL for reading data over the UUT IR port, it is unnecessary to do this verification test.

To verify the UUT IR port:

1. Connect the Infrared Serial Cable to a COM port on the PC and the UUT IR port adapter.
2. Press (ⓘ).
3. Set the rotary switch to any function.
4. On the PC, go to **Start**, **Programs**, **Accessories**, and open **HyperTerminal**.
5. Setup the following:

   Name: 165XB IR Port Test

   Connect using: Com 1

   Bits per second: 9600

   Data bits: 8

   Parity: None

   Stop bits: 1

   Flow control: None
6. Enter the identification command **<ID>** followed by <**Enter**>.

7. The Tester should return the response:

   FLUKE 165XB, VX.XX/X.XX, XXXXXXX
   (indicates the model, software version, and unit serial number)

Note

If the PC indicates that the Tester is not connected, ensure that the COM port is correct and that the IR Serial Cable is properly connected and aligned to the UUT IR window.

Touch Pad Sense Test

⚠⚠ Warning

To avoid exposure to dangerous voltage, this test must be done correctly. Do not perform this test unless you are qualified to do so.

The UUT Touch Pad measures the potential between the operator and the UUT PE input jack. If the potential exceeds the 100 V, the ⚠ (Warning) symbol illuminates. Perform the following test to verify that the Touch Pad circuit is working properly (refer to Figure 3):

1. Connect the PE input jack of the Tester to the HI terminal of the 5320A V, HIΩ, mA~ Output.
2. Connect the 5320A LO terminal to a test lead with test probe attached at the opposite end.
3. Set the 5320A output for 100 V, 50 Hz. Leave the 5320A in Standby mode.
4. Touch the test lead's probe tip to the UUT Touch Pad, as shown in Figure 3.
5. Set the 5320A to operate and note that the ⚠ symbol illuminates on the Tester's front panel.
6. Set the 5320A to standby and remove the test leads and probe from the Tester and calibrator.

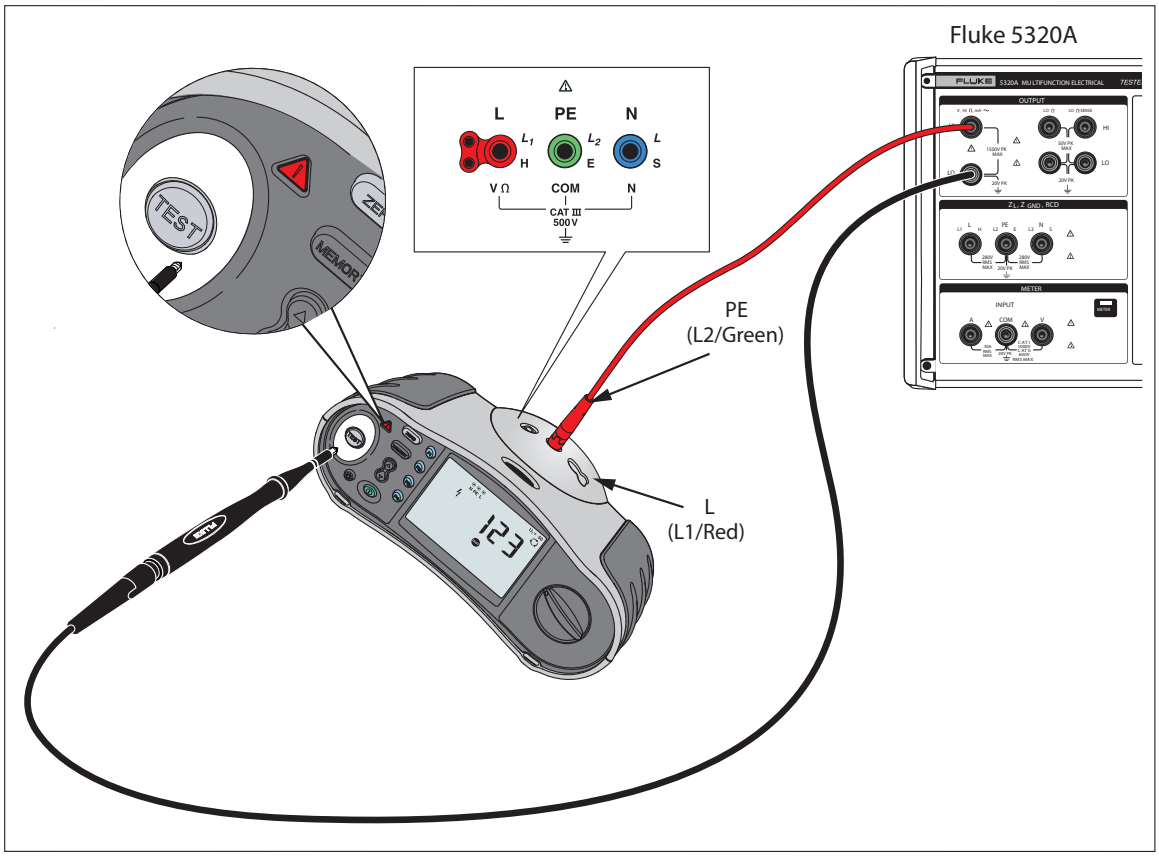

Figure 4. Touch Pad Sense Test

Memory Mode Test (1653B and 1654B Only)

Use the following test to verify the proper function of the UUT Memory Mode:

1. Turn the rotary switch to V.
2. Connect the PE and L input jacks of the Tester to the 5320A V, HIΩ, mA~ Output terminals as shown in Figure 4.
3. Set the 5320A for the Volts function and apply 25 V, 50 Hz to the Tester.
4. Press UUT (MEMORY) to enter Memory Mode.
5. Use (F1) and the ⇕ to set the data identity.
6. Press (F2) to save the data.

To recall the saved data:

7. Press (MEMORY) to re-enter Memory Mode.
8. Use (F1) and ⇕ to set the data identity.
9. Press (F3) twice to recall the data. The recalled data should match the saved value.

Accuracy Tests

Volt and Insulation Functions

To verify the accuracy of the UUT volt and insulation functions:

1. Turn the UUT rotary switch to VOLTS V position.
2. Press (F1) until L-PE appears in the upper left corner of the display.
3. Connect the L and PE input jacks of the UUT to the 5320A V, HIΩ, mA~ Output terminals as shown in Figure 5.
4. Apply the Input Level for steps 1 through 3 of Table 3.
5. Compare the UUT display reading with the Display Reading Limits in Table 3.
6. Set the 5320A to [STBY].
7. Set the UUT rotary switch to INSULATION $R_{ISO.}$
8. Press (F4) on the UUT to set to the requested range.
9. Repeat steps 4 and 5 for each step of the Insulation function.
10. Use the UUT (TEST) to start each measurement.

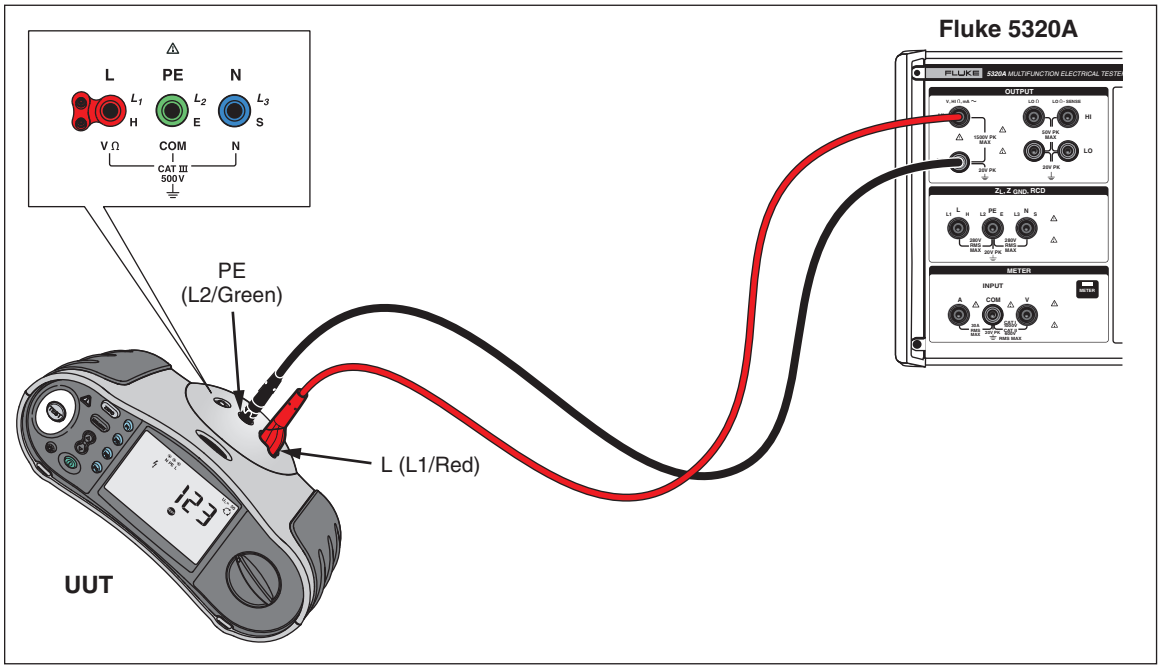

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Figure 5. Volts and Insulation Accuracy Tests

Table 3. Volt and Insulation Accuracy Tests

Step	Function	Range	Input Level	Frequency or Model	UUT Display Reading	
					Lower Limit	Upper Limit
1	Volts, AC	500 V	25 V	50 Hz	24.5	25.5
2			250 V	50 Hz	247.7	252.3
3			475 V	50 Hz	470.9	479.1
Set 5320A to Standby						
4	Insulation	50 V	34 V dc		Displays 34 V with ϟ & Tester gives garbled beep when (TEST) is pushed	
5		50 V	2.5 MΩ		2.40	2.61
6		50 V	45 MΩ		43.62	46.38
7		100 V	100 kΩ	**1653B and 1654B Only**	0.07	0.13
8		100 V	1 MΩ		0.94	1.06
9		100 V	18 MΩ		17.43	18.57
10		100 V	22 MΩ		21.0	23.0
11		100 V	90 MΩ		87.0	93.0
12		250 V	40 kΩ		0.01	0.07
13		250 V	1 MΩ		0.95	1.05
14		250 V	18 MΩ		17.70	18.30
15		250 V	22 MΩ		21.4	22.6
16		250 V	180 MΩ		177.0	183.0
17		500 V	100 kΩ		0.07	0.13
18		500 V	2 MΩ		1.94	2.06
19		500 V	18 MΩ		17.70	18.30
20		500 V	22 MΩ	**All**	21.4	22.6
21		500 V	180 MΩ		177.0	183.0
22		500 V	220 MΩ		198	242
23		500 V	450 MΩ		405	495
24		1000 V	1 MΩ		0.7	1.3
25		1000 V	180 MΩ		177.0	183.0
26		1000 V	220 MΩ		198	242
27		1000 V	900 MΩ		810	990

Continuity Function

To verify accuracy of the UUT continuity function:

1. Turn the UUT rotary switch to CONTINUITY R_{LO}.
2. Connect a shorting bar directly to the UUT PE and L input jacks.
3. Press and hold the UUT (ZERO) until the Tester displays a reading and the ZERO ∅ annunciator.
4. Compare the UUT display reading with the Display Reading Limits for step 1 of Table 4.
5. Connect the measurement test leads to the UUT L and PE input jacks in a 4-wire configuration as shown in Figure 6.
6. Connect the UUT test leads to the 5320A LOΩ Output terminals as shown in Figure 6.
7. Apply the 5320A Output values for the remaining steps in Table 4, and press the UUT (TEST).
8. Compare each UUT display reading with the Display Limits in Table 4.

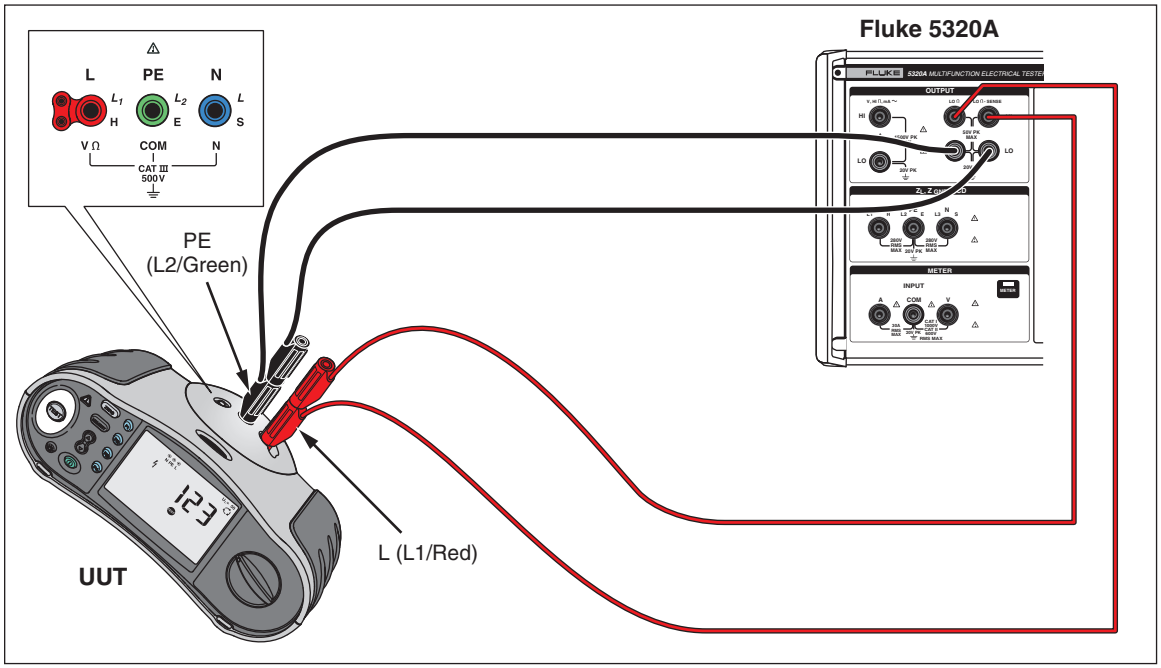

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Figure 6. Continuity Tests (4-Wire Connection)

Table 4. Continuity Accuracy Tests

Step	Function	Range	5320A Output	Display Reading	
				Lower Limit	Upper Limit
1	Continuity	20	0 Ω Shorting Bar	0.00	0.03
2		20	2 Ω	1.94	2.06
3		20	18 Ω	17.70	18.30
4		200	22 Ω	21.4	22.6
5		200	180 Ω	177.0	183.0
6		2000	220 Ω	214	226
7		2000	1800 Ω	1770	1830

LOOP Z_I NO TRIP, L-PE

To verify the UUT LOOP Z_I NO TRIP, L-PE accuracy, complete the following procedure.

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, do not touch the L or N input jacks while performing the following tests. These input jacks have line voltage on them during the test.

⚠ Caution

To prevent Decade Resistor Damage, the following tests must be performed in the LOOP Z_I NO TRIP function only. Setting the 165XB function switch to LOOP Z HI CURRENT function will result in damage to the Decade Resistor Box when you press (TEST).

Perform a LOOP Zero as follows:

1. Set the UUT rotary switch to **LOOP Z_I NO TRIP** function.
2. Using (F1), set the UUT for L-PE test.
3. Using a shorting block, short the UUT L-PE-N input jacks together at the UUT.
4. Press and hold (ZERO).
5. Read the UUT display. The display should read from 0.00 to 0.06 Ω.
6. Disconnect the shorting bar and connect test leads to the UUT L-PE-N input jacks.
7. Short the far end of the test leads together with a Zero Adapter (Fluke P/N 3301338) See Figure 8.
8. Press and hold (ZERO) for approximately three seconds until the UUT ZERO ∅ annunciator appears.

Complete the steps in Table 5 as follows:

1. Connect the test leads to the UUT, Decade R Box, and 5320A, as shown in Figure 7.
2. Set the Decade R value for 18 Ω.
3. Set the UUT rotary switch to **LOOP Z_I NO TRIP** function.
4. Using the UUT (F1) select L-PE.
5. On the 5320A select [Z_L].
6. Using the 5320A Mode softkey, select Loop.
7. Using the 5320A Setup softkey, select Loop Impedance and then select Loop imp. correction and COMP.
8. Using the 5320A cursor keys or keypad, set the 5320A Nominal R Value for 25 mΩ (approximate).
9. Record the 5320A Displayed OUTPUT impedance value for Step 1 of Table 5.
10. Using the UUT Accuracy Spec. and the Recorded 5320A Displayed Output impedance value + Decade R Value, calculate the Upper and Lower UUT display limits for Step 1 with the formula that follows:

    (18 + Recorded 5320A Displayed OUTPUT Z Value) ± {[(18 + Recorded 5320A Displayed OUTPUT Z Value) x 3%] + 0.06}
11. Set the Decade R value for the next step value.
12. Put the 5320A in OPER and wait to settle.
13. Press and release (TEST) and note the UUT display reading.
14. Compare the UUT display reading to the Upper and Lower limits in Table 5.
15. Repeat steps 10 thru 13, above, for the remaining steps of Table 5.
16. Set the 5320A [STBY] and disconnect the Decade R Box from the UUT and 5320A.

Table 5. LOOP Z_I NO TRIP Accuracy Tests

Step	UUT Function	UUT (F1) Setting	Decade R Box Setting	5320A Residual Impedance Correction Type	Recorded 5320A Displayed OUTPUT Z Value	UUT Accuracy Spec. ±(% + dig)	UUT Res.	UUT Display Limits	
								Lower	Upper
1	LOOP Z_I NO TRIP	L-PE	18 Ω	COMP		±(3 % +6)	0.01		
2			180 Ω		N/A	±3 %	0.1	174.6	185.4
3			1800 Ω		N/A	±6 %	1	1692	1908

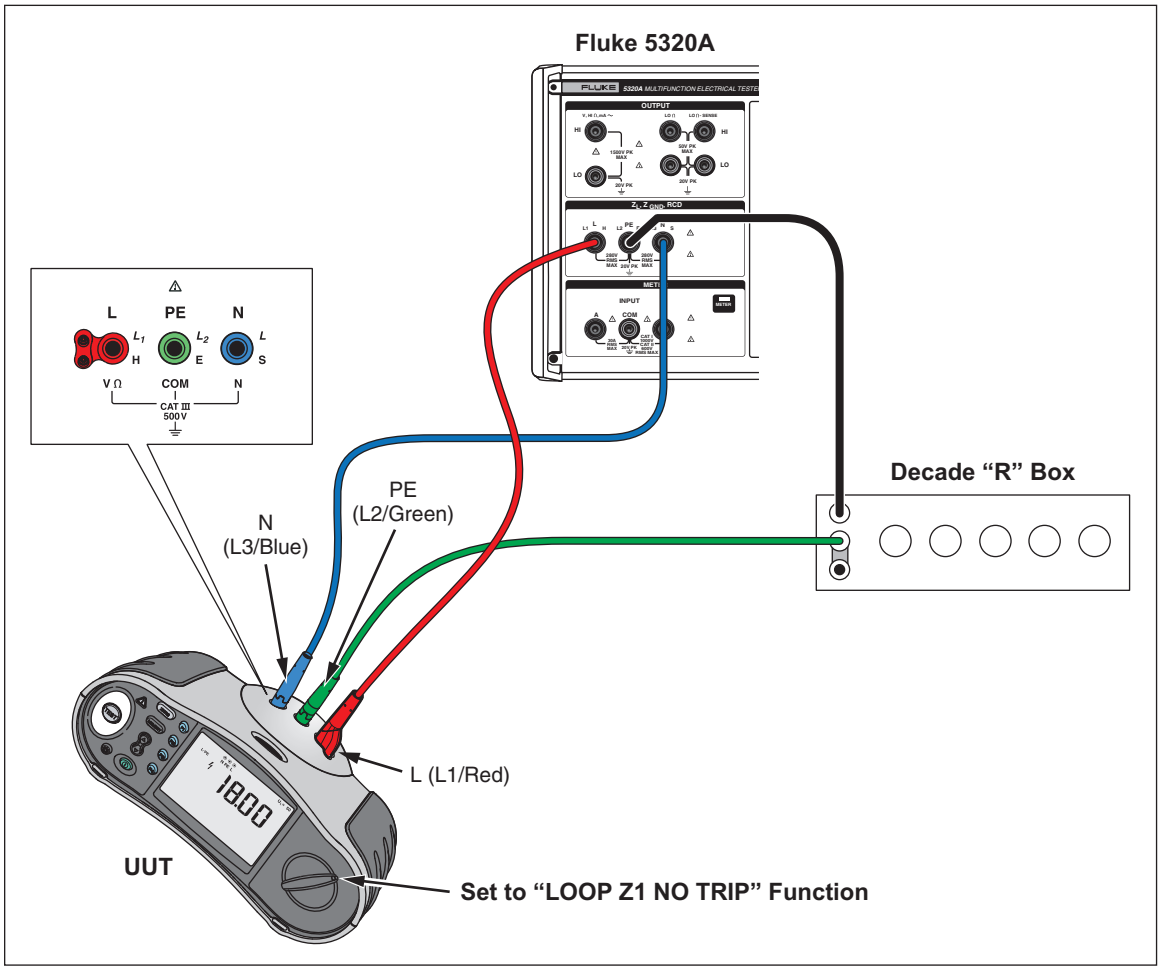

Figure 7. LOOP Z_l NO TRIP Test

Loop Z_l Hi Current

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, do not touch the L or N input jacks while performing the following tests. These input jacks have line voltage on them during the test.

⚠ Caution

Before performing the following test, remove the Decade R Box used in Figure 7. Failure to do so will result in damage to the decade resistors. Setting the function switch to the LOOP Z HI CURRENT function, or selecting L-N test with (F1), will result in damage to the Decade Resistor Box when (TEST) is performed.

Perform a LOOP Zero as follows:

1. Set the UUT rotary switch to LOOP Z_l HI CURRENT function.
2. Using a shorting block, short the UUT L-PE-N input jacks together at the UUT.
3. Press and hold (ZERO).
4. Read the UUT display. The display should read from 0.00 to 0.04 Ω.

5. Disconnect the shorting bar and connect test leads to the UUT L-PE-N input jacks.
6. Short the far end of the test leads together with a Zero Adapter (Fluke P/N 3301338) See Figure 8.
7. Press and hold (ZERO) for approximately three seconds until the UUT ZERO ∅ annunciator appears.

Perform the steps in Table 6 as follows:

1. Connect the test leads to the UUT and 5320A as shown in Figure 9.
2. Set the UUT rotary switch to LOOP Z_I HI CURRENT function.
3. Use (F1) to set L-PE (L-N).
4. On the 5320A, select Z_I.
5. Using the 5320A Mode softkey select Line (Loop).
6. Using the 5320A Setup softkey, select Line Impedance (Loop Impedance) and then select Line (Loop) imp. correction and COMP.
7. Using the 5320A cursor keys or keypad, set the 5320A Nominal R Value (approximate) for the value from Table 6.
8. Record the 5320A Displayed OUTPUT impedance value.
9. Using the UUT accuracy spec. and the recorded 5320A Displayed Output impedance value, calculate the Upper and Lower UUT display limits for Table 6 with the formula that follows:

   (Recorded 5320A Displayed OUTPUT Z Value) ± {[(Recorded 5320A Displayed OUTPUT Z Value) x %] + Counts}
10. Put the 5320A in **OPER** and wait to settle.
11. Press and release (TEST) and note the UUT display reading.
12. Compare the UUT display reading to the calculated UUT Display Limits in Table 6.

Table 6. Loop Z_I Hi Current Accuracy Tests

Step	UUT Function	UUT (F1) Setting	5320A Nominal R Value	5320A Residual Impedance Correction Type	Recorded 5320A Displayed Output Z Value	UUT Accuracy Spec. ±(% + dig)	UUT Res.	Calculated UUT Display Limits	
								Lower	Upper
1	Loop Zi Hi Current	L-PE	0.1 Ω	Comp		± (2% + 4)	0.01 Ω		
2			1.8 Ω						
3			18 Ω						
4			50 Ω			±2%	0.1 Ω		
5			180 Ω						
6			500 Ω			±6%	1 Ω		
7			1800 Ω						
8		L-N	0.1 Ω			±(2% + 4)	0.01 Ω		
9			1.8 Ω						
10			18 Ω						
11			50 Ω			±2 %	0.1 Ω		
12			180 Ω						
13			500 Ω			±6 %	1 Ω		
14			1800 Ω						

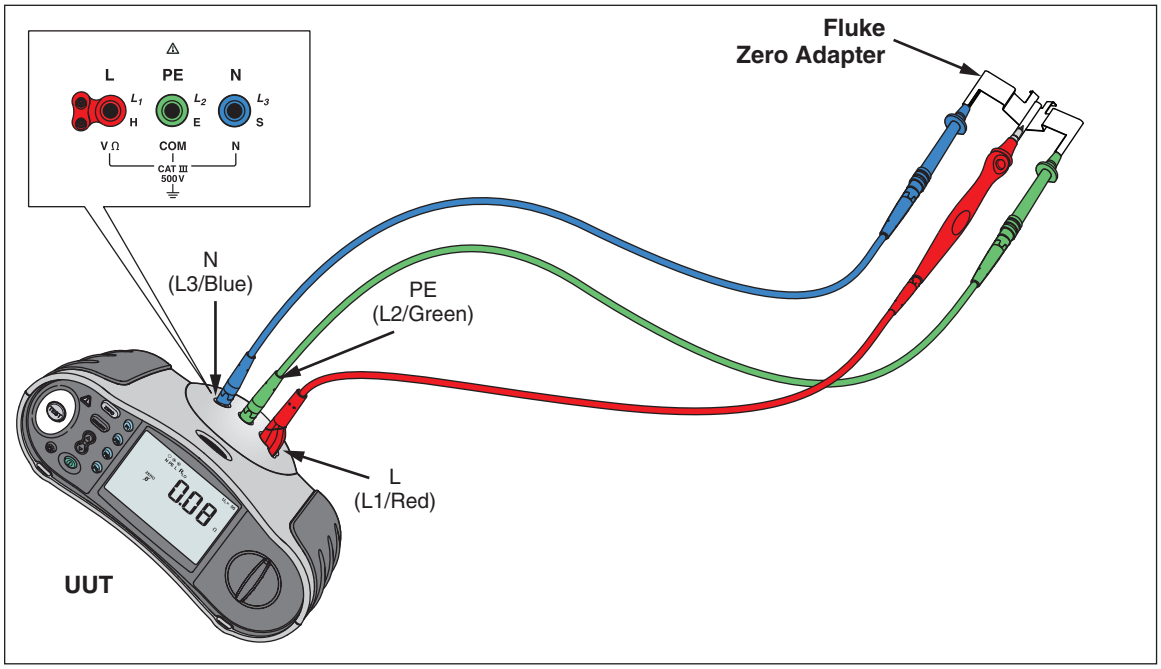

Figure 8. Loop Zero Tests

RCD Trip Current

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, do not touch the L or N input jacks while performing the following tests. These input jacks have line voltage on them during the test.

To test the RCD trip current accuracy, perform the following procedure for each step in Table 7.

1. Connect the UUT's L, PE and N to the 5320A as shown in Figure 9.
2. Turn the UUT rotary switch to the ΔT function.
3. On the UUT, set (F1), (F2), and (F3) to the values shown in Table 7.
4. ON the 5320A, press [RCD] and using the MODE key and Cursor key, select Trip Current.
5. Press the 5320A softkey to select Trip I. Using the cursor keys, modify the Trip I to the same value as the UUT RCD nominal trip current ((F1) setting).
6. Put the 5320A in OPER and wait to settle.
7. Press (TEST).
8. Compare the measured RCD trip current (or Maximum value Parameter) on the 5320A display to the Current Accuracy limits in Table 7.

   If the 5320A did not trip, press the Clear softkey on the 5320A to clear the maximum value.

Table 7. RCD Trip Current Accuracy Tests

Step	UUT Function	UUT Settings				Spec	Current Accuracy	
		F1	F2	F3	F4		Lo Limit	Hi Limit
1	ΔT	10 mA	x1/2	AC	0°	-10 % + 0	4.50	5.00
2		10 mA	x1/2	A	0°	-10 % + 0	3.15	3.50
3		10 mA	x5	AC	0°	+10 % - 0	50.0	55.0
4		30 mA	x1	AC	0°	+10 % - 0	30.0	33.0
5		30 mA	x1	AC	180°	+10 % - 0	30.0	33.0
6		30 mA	x1	A	0°	+10 % - 0	42.4	46.7
7		30 mA	x1/2	AC	0°	-10 % + 0	13.5	15.0
8[1]		30 mA	x1	B	0°	+10 % - 0	60	66
9[1]		30 mA	x1	B	180°	+10 % - 0	60	66
10[1]		300 mA	x1	B	0°	+10 % - 0	600	660
11		1000 mA	x1	AC	0°	+10 % - 0	1000	1100
[1] Steps 8-10 = 1654B only.								

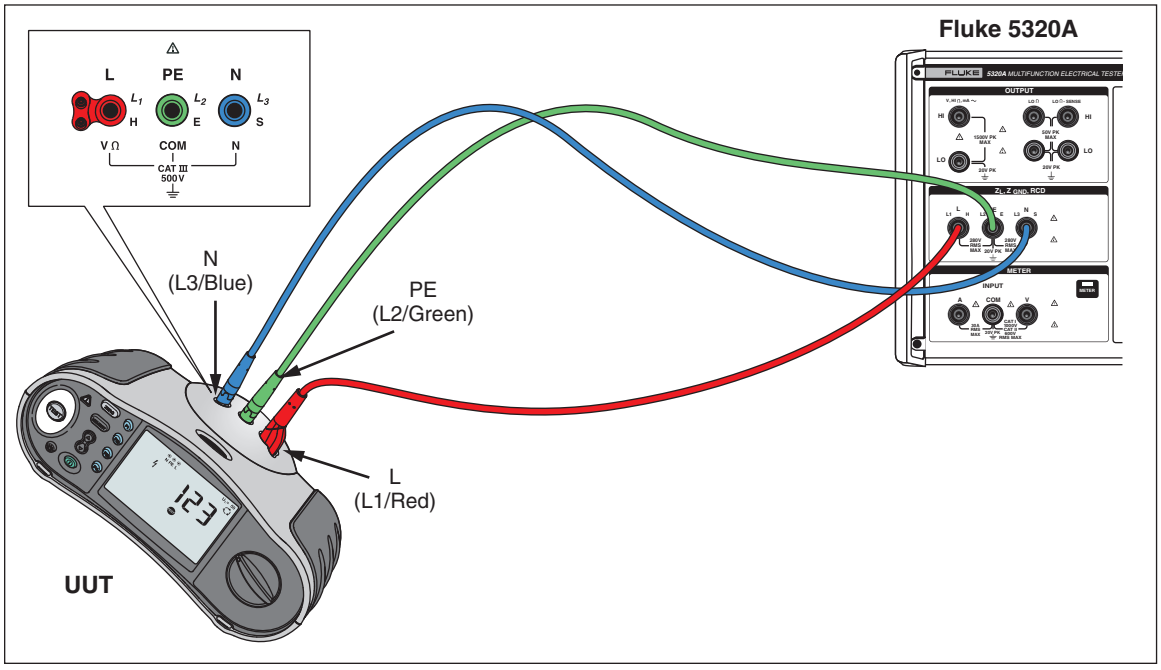

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Figure 9. Loop Z_l Hi Current Line Impedance and RCD Tests

RCD Trip Time

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, do not touch the L or N input jacks while performing the following tests. These input jacks have line voltage on them during the test.

To test the RCD Trip Time Accuracy, perform the following procedure for each step in Table 8.

1. Connect the UUT's L, PE, and N to the 5320A as shown in Figure 9.
2. Turn the UUT on and set the rotary switch to the ΔT function.
3. On the UUT, set (F1), (F2), (F3) to the values shown in Table 8.
4. On the 5320A, press [RCD] and use the MODE softkey and Cursor keys to select Trip Time.
5. Press the 5320A softkeys to select Trip I and I Mult.
6. Using the cursor keys, modify the Trip I and I Mult. to the same value as the UUT (F1) and (F2) setting.
7. Put the 5320A in [OPER] and wait to settle.
8. Press the UUT (TEST).
9. Compare the UUT measured trip time to the Accuracy limits in Table 8.

Table 8. RCD Trip Time Accuracy Tests

Step	UUT Function	5320A RCD Trip Time	UUT Settings			Spec	Trip Time Accuracy	
			(F1)	(F2)	(F3)		Lo Limit	Hi Limit
1	ΔT	30 ms	30 mA	x1	AC	1 % + 1	28.7	31.3
2		300 ms	30 mA	x1	AC	1 % + 1	296.0	304.0
3		500 ms	30 mA	x1	AC S	1 % + 1	494.0	506.0

Earth Resistance (1653B and 1654B Only)

To verify the UUT accuracy for measuring earth resistance, complete the following tests:

1. Turn the UUT to the R_E Earth function.
2. Connect the UUT to the 5320A LO Ω Output terminals as shown in Figure 10.
3. On the 5320A, press the LOΩ function.
4. Press the 5320A MODE softkey and then select "Resistance 4-Wire" using the cursor keys and Select softkey.
5. Using the 5320A numeric keypad, enter the resistance values in Table 9.
6. Put the 5320A in OPER.
7. Press the UUT TEST and compare the reading to the display limits in Table 9.

Table 9. Earth Resistance Test

Step	UUT Function	5320A Res. Value	Spec.	Display Reading	
				Lo Limit	Hi Limit
1	R_E Earth	2 Ω	2 % + 5	1.5	2.5
2		1800 Ω	3.5 % + 10	1737	1863

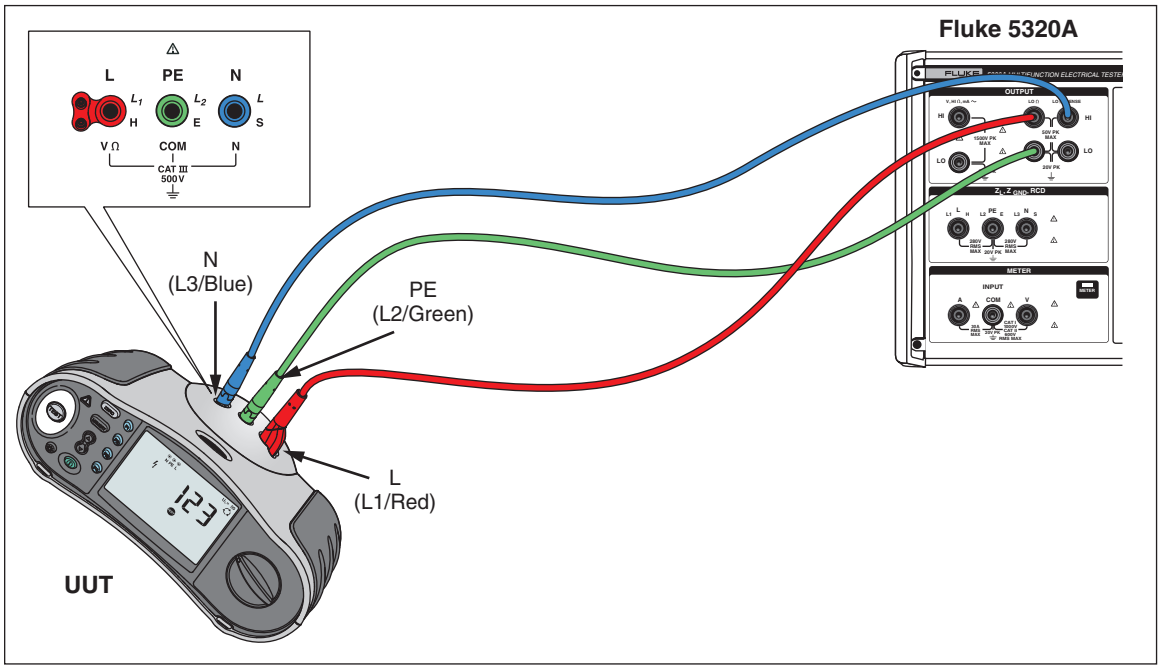

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Figure 10. Earth Resistance Tests

Accessories and Replaceable Parts

Accessories and user-replaceable parts are listed in Table 10 and shown in Figure 11. See *How to Contact Fluke* to order parts.

⚠⚠ Warning

For safe operation and maintenance of the product, use only specified replacement parts.

Table 10. Accessories and Replaceable Parts

Item	Description	Fluke PN	QTY
BT1- BT6	Battery, Primary, Alkaline,1.5V, 2.Ah, AA, Set of 3	2771610	6
⚠ F1-F2	Fuse, 3.15a, 500v, Slow, 6.35 x 32 mm	2030852	2
MP4	165xB-8001, Zero Adapter	3301338	1
MP26	Carrying Strap, Padded, 51.00 in - 63.00 in Adjustable,165x	2045406	1
MP30	165x-8008, Probe, Multifunctional	2000757	1
MP31	16xx- Leads, Tester Lead Set with Red, Green, and Blue Leads	3308124	1
MP31	16xx- Leads-01, Tester Lead Set with Green and Blue Leads	3308136	1
	Probe Cap, GS-38 Red	3306270	1
	Cable IRDA Optical to USB, 1.65 M	2166275	1
MP41	IR Adaptor For Mounting IR Cable to 165x	3270172	1
MP49	LC35 165x-8010, Mains Test Cord, Schuko	2061332	1
MP49	LC36 165x-8010-01, Mains Test Cord, Italian	2061344	1
MP49	LC37 165x-8010-02, Mains Test Cord, Swiss	2061359	1
MP49	LC38 165x-8010-03, Mains Test Cord, British	2061367	1
MP49	LC39 165x-8010-04, Mains Test Cord, Danish	2061371	1
MP49	LC40 165x-8010-05, Mains Test Cord, Australian	2061380	1
MP49	LC36 165x-8010-01, Mains Test Cord, Italian	2061344	1
MP49	LC40 165x-8010-05, Mains Test Cord, Australian	2061380	1
MP49	LC39 165x-8010-04, Mains Test Cord, Danish	2061371	1
	Adapter, 4 mm Banana Jack to 4 mm Dual Banana Plug, Insulated, Black	2131702	1
TM1	CD, User Manual 1654B/1653B/1652C	3798444	1
⚠ For safety, use exact replacement only.			

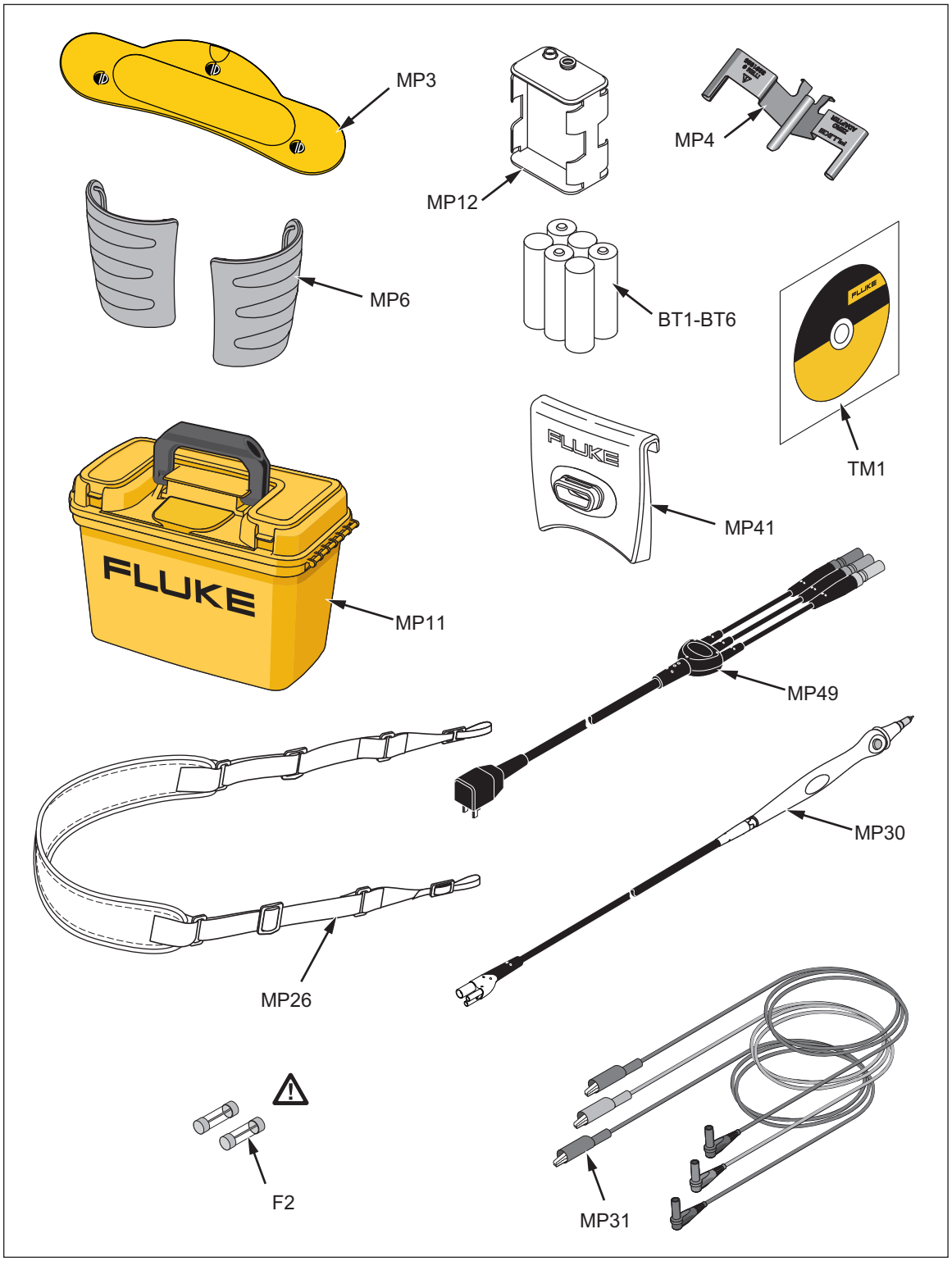

Figure 11. Accessories and Replaceable Parts