FLUKE®

345

Power Quality Clamp Meter

Calibration Manual

PN 3095315
October 2007

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Power Quality Clamp Meter

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.

This manual provides the complete verification and adjustment procedure for the 345 Power Quality Clamp Meter (referred to in this manual as the Clamp Meter). The Clamp Meter allows closed-case calibration using reference sources. It measures the reference signals, calculates the correction factors, and stores them in memory. The instrument should be calibrated after repair, or if it fails a performance test.

The *345 Calibration Manual* provides the following information:

- Precautions and safety information
- Specifications
- Basic maintnenance
- Calibration verification procedure
- Replaceable parts and accessories

For complete operating instructions, refer to the *345 Users Manual.*

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

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

Safety Information

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 test instrument.

The design and manufacture of the device conforms to the latest state of technology and the safety standards specified in IEC 61010-1/ 2nd edition. If used improperly, there is a risk of damage to persons and property.

⚠⚠Warning

To avoid possible electric shock or personal injury, follow these guidelines:

- **Use the Clamp Meter only as specified in this manual or the protection provided by the Clamp Meter might be impaired.**
- **Use caution when working with voltages above 33 V acrms, 46.7 V ac peak, or 70 V dc. These voltages pose a shock hazard.**
- **When using probes, keep your fingers behind the finger guards.**
- **Replace the batteries as soon as the low battery indicator (▭) appears to avoid false readings that can lead to electric shock and injury.**
- **Adhere to local and national safety codes. Individual protective equipment must be used to prevent shock and arc blast injury where hazardous live conductors are exposed.**
- **Do not hold the Clamp Meter anywhere beyond the tactile barrier, see Figure 1.**
- **Before use, inspect the Clamp Meter, voltage probes, test leads, and accessories for mechanical damage, and replace if damaged. Look for cracks or missing plastic. Pay special attention to the insulation surrounding the connectors.**
- **Avoid working alone when working with live circuits.**
- **Use only insulated test leads and adapters as supplied with the Clamp Meter, or indicated as suitable for the Clamp Meter.**

- **Always connect the Battery Charger/Power Adapter first to the ac outlet before connecting it to the Clamp Meter.**
- **Remove all probes, test leads and accessories not in use.**
- **Do not operate the Clamp Meter around explosive gas or vapor.**
- **Do not exceed Clamp Meter input voltage or current ratings.**
- **Do not use exposed metal BNC or banana plug connectors or insert metal objects into connectors.**

⚠Caution

To avoid damage to the Clamp Meter:

- **Do not open the Clamp Meter for cleaning. Do not use solvents to clean it, and do not immerse it in liquid.**
- **Only trained personnel should perform maintenance work. Any such work undertaken by unauthorized personnel may damage the Clamp Meter and will invalidate the warranty.**

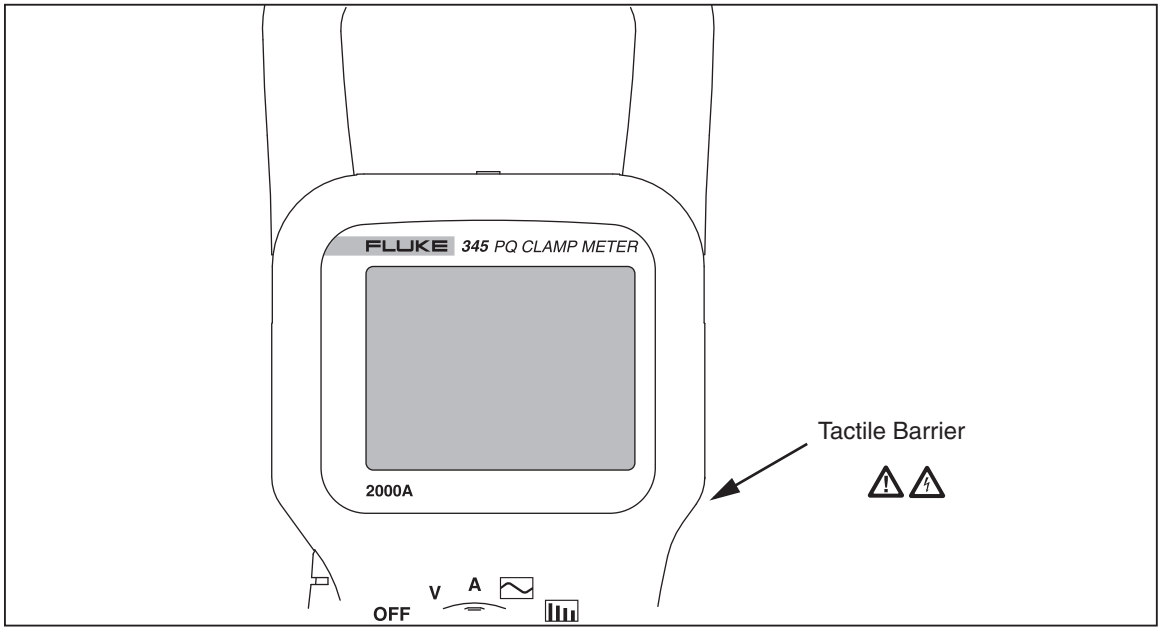

Figure 1. Tactile Barrier

Symbols

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

Table 1. Symbols

⚠	Hazardous voltage. Risk of electrical shock.	⚠	Risk of danger. Important information. See manual.
	Application to or removal from hazardous, live conductors is permitted.		Battery
	Low batteries		Batteries fully charged
	Battery Eliminator is connected.		Do not dispose of this product as unsorted municipal waste. Contact Fluke or a qualified recycler for disposal.
⏚	Earth ground		Canadian Standards Association.
⧈	Double insulated	N10140	Conforms to relevant Australian standards.
CAT III	Equipment designed to protect against transients in equipment in fixed-equipment installations, such as televisions, personal computers, protable tools, and other household appliances.	**CAT IV**	Equipment designed to protect against transients from the primary supply level, such as an electricity meter or an overhead or underground utility service.
CE	Conforms to requirements of European Union and European Free Trade Association (EFTA).		

Specifications

Electrical Data

All accuracies specified at 23 °C ± 1 °C

Temperature coefficient of current ≤ ±0.15 % of rdg per °C

Temperature coefficient of voltage ≤ ±0.15 % of rdg per °C

Current Measurement (DC, DC RMS, AC RMS)

Measuring range ..... 0 – 2000 A dc, 1400 ac rms

Autorange facility ..... 40 A / 400 A / 2000 A

Resolution ..... 10 mA in 40 A range
100 mA in 400 A range
1 A in 2000 A range

Accuracy

RMS and DC

I > 10 A ..... ± 1.5 % rdg ± 5 digits

I < 10 A ..... ± 0.2 A

AVE

I > 10 A ..... ± 3 % rdg ± 5 digits

I < 10 A ..... ± 0.5 A

Pk

I > 10 A ..... ± 5 % rdg ± 5 digits

I < 10 A ..... ± 0.5 A

AHr

I > 10 AHr ..... ± 2 % rdg ± 5 digits

I < 10 AHr ..... ± 0.5 AHr

CF (Crest Factor)

1.1 ≤ CF < 3 ..... ± 3 % rdg ± 5 digits

3 ≤ CF < 5 ..... ± 5 % rdg ± 5 digits
Resolution 0.01

RPL (Ripple)
2 % ≤ RPL< 100 % ..... ± 3 % rdg ± 5 digits
100 % ≤ RPL< 600 % ..... ± 5 % rdg ± 5 digits
Resolution ..... 0.1 %

I_{DC} > 5 A, I_{AC} > 2 A

All measurements DC and 15 Hz to 1 kHz.

Maximum overload 10,000 A or rms x frequency < 400,000.

Amps rms is a true rms measurement (ac + dc)

Harmonics

THD (Total Harmonic Distortion)
1 % ≤ THD 1 % to 100 %: ..... ± 3 % rdg ± 5 digits
100 % to 600 %: ..... ± 5 % rdg ± 5 digits
Resolution ..... 0.1 %

DF (Distortion Factor)
1 % ≤ DF < 100 % ..... ± 3 % rdg ± 5 digits
Resolution ..... 0.1 %
H02 ≤ I_{harm} < H13 ..... ± 5 % rdg ± 2 digits
H13 ≤ I_{harm} ≤ H30 ..... ± 10 % rdg ± 2 digits

All measurements up to 30th harmonic (40th harmonic for 15 Hz to 22 Hz)

Frequency range of fundamental F_0 15 Hz to 22 Hz and 45 Hz to 65 Hz

I_{acrms} > 10 A

Voltage Measurement (DC, DCRMS, ACRMS)

Measuring range ..... 0 – 825 V dc or ac rms
Autorange facility ..... 4V / 40V / 400V / 750V
Resolution ..... 1 mV in 4 V range
10 mV in 40 V range
100 mV in 400 V range
1 V in 750 V range

Accuracy

RMS and DC
V > 1 V ..... ± 1 % rdg ± 5 digits
V < 1 V ..... ± 0.02 V

AV
V > 1 V ..... ± 3 % rdg ± 5 digits
V < 1 V ..... ± 0.03 V

Pk
V > 1 V ..... ± 5 % rdg ± 5 digits
V < 1 V ..... ± 0.03 V

CF (Crest Factor)
1.1 ≤ CF < 3 ..... ± 3 % rdg ± 5 digits
3 ≤ CF < 5 ..... ± 5 % rdg ± 5 digits
Resolution 0.01

RPL (Ripple)
2 % ≤ RPL< 100 % ..... ± 3 % rdg ± 5 digits
100 % ≤ RPL< 600 % ..... ± 5 % rdg ± 5 digits
Resolution ..... 0.1 %

V_{DC} > 0.5 V, V_{AC} > 0.2 V

All measurements DC and 15 Hz to 1 kHz.

Maximum overload 825 V rms

Volts rms is a true rms measurement (ac + dc)

Harmonics

THD (Total Harmonic Distortion)

1 % ≤ THD < 100 % ..... ± 3 % rdg ± 5 digits

100 % ≤ THD < 600 % ..... ± 5 % rdg ± 5 digits

Resolution ..... 0.1 %

DF (Distortion Factor)

1 % ≤ DF < 100 % ..... ± 3 % rdg ± 5 digits

Resolution ..... 0.1 %

$H02 \leq V_{harm} < H13$ ..... ± 5 % rdg ± 2 digits

$H13 \leq V_{harm} \leq H30$ ..... ± 10 % rdg ± 2 digits

All measurements up to 30th harmonic (40th harmonic for 15 Hz to 22 Hz)

Frequency range of fundamental F_0 15 Hz to 22 Hz and 45 Hz to 65 Hz

$V_{acrms} > 1V$

Watts Measurement (Single and 3 Phase) (DC, DC RMS, AC RMS)

Measuring range ..... 0 – 1650 kW dc or 1200 kW ac

Autoranging facility ..... 4 kW, 40 kW, 400 kW, 1650 kW

Resolution ..... 1 W in 4 kW
10 W in 40 kW
100 W in 400 kW
1 kW in 1650 kW

Accuracy ..... 2.5 % rdg ± 5 digits
W1Ø < 2 kW ± 0.08 kW
W3Ø < 4 kW ± 0.25 kW

VA Measurement (Single and 3 Phase) (DC, DC RMS, AC RMS)

Measuring range ..... 0 to 1650 kVA dc or 1200 kVA ac

Autorange facility ..... 4 kVA, 40 kVA, 400 kVA, 1650 kVA

Resolution ..... 1 VA in 4 kVA
10 VA in 40 kVA
100 VA in 400 kVA
1 kVA in 1650 kVA

Accuracy

VA > 2 kVA ..... 2.5 % rdg ± 5 digits

VA < 2 kVA ..... ± 0.08 kVA

VAR Measurement (Single and 3 Phase)

Measuring range ..... 0 – 1200 kVAR

Autorange facility ..... 4 kVAR, 40 kVAR, 400 kVAR, 1200 kVAR

Resolution ..... 1 VAR in 4 kVAR range
10 VAR in 40 kVAR range
100 VAR in 400 kVAR range
1 kVAR in 1200 kVAR range

Accuracy

VAR > 4 kVAR ..... ± 2.5 % rdg ± 5 digits

VAR < 4 kVAR ..... ± 0.25 kVAR

Power Factor range ..... 0.3 < PF < 0.99

Power Factor (Single and 3 Phase)

Power Factor

Measuring range ..... 0.3 cap … 1.0 … 0.3 ind
(72.5° capacitive ... 0° ... 72.5° inductive)

Resolution 0.001

Accuracy ..... ± 3 °

Frequency range 15 Hz to 1 kHz

Displacement Power Factor

Measuring range ..... 0.3 cap … 1.0 … 0.3 ind
(72.5 ° capacitive ... 0° ... 72.5 ° inductive)

Resolution 0.001

Accuracy ..... ± 3 °

Frequency ranges ..... 15 Hz to 22 Hz and 45 Hz to 65 Hz

Kilowatt Hour (kWHr)

Measuring range ..... 40,000 kWHr

Autorange facility ..... 4 kWHr, 40 kWHr, 400 kWHr, 4,000 kWHr, 40,000 kWHr

Resolution ..... 1 WHr in 4 kWHr range
10 WHr in 40 kWHr range
100 WHr in 400 kWHr range
1 kWHr in 4,000 kWHr range
10 kWHr in 40,000 kWHr range

Accuracy

kWHr > 2 kWHr ..... ± 3 % ± 5 digits

kWHr < 2 kWHr ..... ± 0.08 kWHr

All Watts /VA /VAR /PF measurements

Frequency range ..... DC and 15 Hz to 1 kHz

Current range ..... 10 A to 1400 A rms

Voltage range ..... 1 V to 825 V rms

Maximum input ..... 825 V rms / 1400 A rms

Maximum overload ..... 825 V rms / 10,000 A All measurements DC and 15 Hz to 1 kHz.
Maximum overload 10,000 A or rms x frequency < 400,000.

Frequency Measurement (From Current or Voltage sources)

Measuring range ..... 15 Hz to 1 kHz

Resolution ..... 0.1 Hz

Accuracy

15 to 22 Hz ..... ± 0.5 % rdg

40 to 70 Hz ..... ± 0.5 % rdg

15 to 1000 Hz ..... ± 1 % rdg

Current Range ..... 10 A to 1400 A rms

Voltage Range ..... 1 V to 825 V rms

Scope Function

Current measurement

Ranges ..... 10 A/20 A/40 A/100 A/200 A/400 A/1000 A/2000 A

Resolution ..... 1 A in 40 A range
10 A in 400 A range
50 A in 2000 A range

Accuracy ..... ± 3 % rdg ± 1 pixel

Maximum overload ..... 10,000 A

Voltage measurement

Ranges ..... 4 V/10 V/20 V/40 V/100 V/200 V/400 V/1000 V

Resolution ..... 100 mV in 4 V range
1 V in 40 V range
10 V in 400 V range
31.25 V in 1000 V range

Accuracy ..... ± 2 % rdg ± 1 pixel

Maximum overload ..... 1000 V rms

Frequency range ..... DC and 15 Hz to 600 Hz

Time base ..... 2.5 ms, 5 ms, 10 ms, 25 ms, 50 ms/div

Refresh rate ..... 0.5 seconds

Sampling rate ..... 15.625 kHz

Inrush Current Function

Ranges ..... 40, 400 and 2000 A

Resolution ..... 10 mA in 40 A range
100 mA in 400 A range
1 A in 2000 A range

Accuracy

I > 10 A ..... ± 5 % rdg ± 1 pixel

I < 10 A ..... ± 0.5 A

All measurements DC and 15 Hz to 1 kHz

Maximum overload ..... 10,000 A or rms x frequency < 400,000.
Amps rms is a true rms measurement (AC + DC)
Capture time ..... 1, 3, 10, 30, 100 and 300 s
Sampling rate..... 15.625 kHz

Digital Output

USB Interface to a PC
Power Log software for download, analysis and reporting
345 Upgrade Utility for installing a new firmware version

Logging Memory

Logging Areas..... Three areas that can be used individually or combined into one large area.
Averaging periods..... 1 s, 2 s, 5 s, 10 s, 30 s, 1 min, 5 min, 10 min, 15 min, and custom

Logging Times:

Volts and Current Mode		
Average Time	**Logging Time (1 area)**	**Logging Time (3 areas)**
1 s	1 h 49 m	5 h 12 m
2 s	3 h 38 m	10 h 24 m
5 s	9 h 06 m	1 d 2 h 00 m
10 s	18 h 12 m	2 d 04 h 00 m
30 s	2 d 06 h 36 m	6 d 12 h 01 m
1 min	4 d 13 h 12 m	13 d 00 h 03 m
5 min	22 d 18 h 00 m	65 d 00 h 15 m
10 min	45 d 12 h 00 m	130 d 00 h 30 m
15 min	68 d 06 h 00 m	195 d 00 h 45 m

V & A Harmonics Mode		
Average Time	**Logging Time (1 area)**	**Logging Time (3 areas)**
1 s	0 h 34 m	1 h 38 m
2 s	1 h 08 m	3 h 16 m
5 s	2 h 52 m	08 h 11 m
10 s	5 h 44 m	16 h 23 m
30 s	17 h 13 m	2 d 01 h 11 m
1 min	1 d 10 h 26 m	4 d 02 h 23m
5 min	7 d 04 h 10 m	20 d 11 h 25m
10 min	14 d 08 h 20 m	81 d 0 h 50m
15 min	21 d 12 h 30 m	121 d 13 h 15m

Single and Three Phase Power Mode		
Average Time	**Logging Time (1 area)**	**Logging Time (3 areas)**
1 s	1 h 40 m	4 h 47 m
2 s	3 h 21 m	9 h 34 m
5 s	8 h 22 m	23 h 57 m
10 s	16 h 45 m	1 d 23 h 54 m
30 s	2 d 02 h 17 m	5 d 23 h 42 m
1 min	4 d 04 h 35 m	11 d 23 h 25 m
5 min	20 d 22 h 55 m	59 d 21 h 05 m
10 min	41 d 21 h 50 m	119 d 18 h 10 m
15 min	62 d 20 h 45 m	179 d 15 h 15 m

General Data

Display

Color transmissive LCD 320 x 240 pixels (70 mm diagonal) with 2 level backlight.

Power Supply

Battery type 1.5 V Alkaline AA MN 1500 or IEC LR6 x 6

Battery life typically:

>10 hours (backlight on full)

>12 hours (backlight reduced)

Battery Eliminator BE345

Input ..... 110V / 230V, 50/60 Hz

Output ..... 15 V dc, 300 mA

Environmental (FOR INDOOR USE ONLY)

Reference conditions. All accuracies stated at 23 °C ± 1 °C

Operating temperature..... 0°C to 50°C (32°F to 122°F)

Temperature coeff. of current ..... ≤ ±0.15 % of rdg per °C

Temperature coeff. of voltage ..... ≤ ±0.15 % of rdg per °C

Maximum relative humidity ..... 80 % for temperatures up to 31 °C (87 °F) decreasing linearly to 50 % relative humidity at 40 °C (104 °F)

Maximum operating altitude ..... 2000 m

Electrical Safety

Safety IEC 61010-1 600 V CAT IV, 1000V CAT III (maximum input phase-phase 825V rms) double or reinforced insulation, pollution degree 2

Protection IP 40; EN 60529

Maximum working voltage in CAT IV areas:

Current measurement: ..... 600 V ac rms or dc between conductor & ground

Voltage measurement..... 600 V ac rms or dc between either input terminal and ground, or 825 V between energized phase voltages (delta power config.)

Maximum working voltage in CAT III areas .... 825V ac rms or dc between either input terminal and ground

EMC

Emission IEC/EN 61326-1:1997 class B

Immunity IEC/EN 61326-1:1997

Mechanical

Dimensions

Length 300 mm (12 inches)

Width 98 mm (3.75 inches)

Depth 52 mm (2 inches)

Weight incliding batteries..... 820 g / 1.8 lbs.

Jaw opening..... 60 mm

Jaw capacity ..... 58 mm diameter

Battery Charger/Power Adapter

Note

To accommodate connection to various line power sockets, the BE345 Universal Battery Eliminator is equipped with a male plug that must be connected to a line plug adapter appropriate for local use.

Since the Charger is isolated, you can use line plug adapters with or without a protective ground terminal. The 230 V rating of the BE345 is not for use in North America. A line plug adapter complying with the applicable country-specific requirements may be provided to alter the blade configuration.

The Clamp Meter can be used with an included ac power adapter.

⚠⚠Warning

To avoid possible electric shock or personal injury, follow these guidelines:

- **To supply ac power, only use the BE345 Universal Battery Eliminator.**
- **Before use, check that the selected voltage range indicated on the BE345 matches the local line power voltage and frequency (refer to Figure 2). If necessary, set the slider switch of the BE345 to the correct voltage.**
- **For the BE345, use only ac line plug adapters or ac line cords that comply with local safety regulations.**

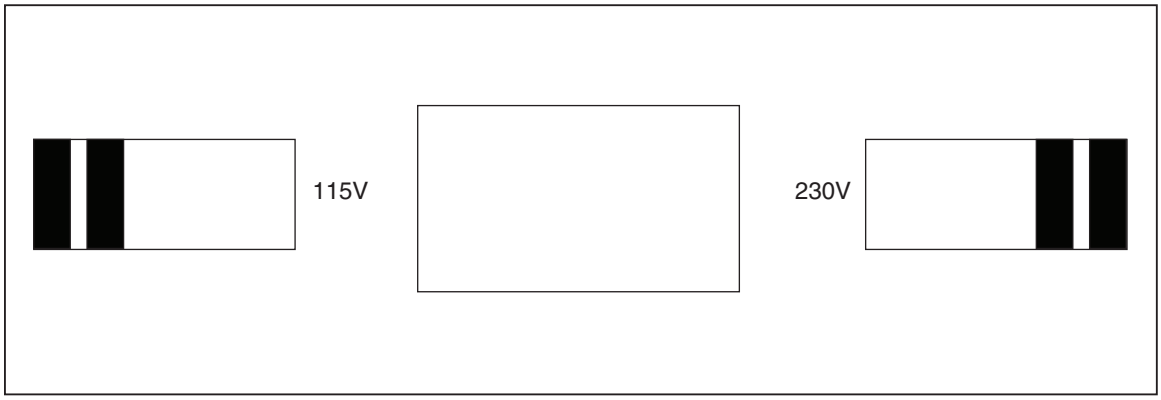

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Figure 2. Slider Switch for Line Power Voltage (115 V and 230 V)

Cleaning and Maintenance

⚠Caution

To avoid damage to the Clamp Meter, do not apply solvents to the case.

The Clamp Meter 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. Do not use abrasives or solvents.

Change the batteries when  appears.

To change the batteries, see Figure 3:

1. Remove all inputs from the Clamp Meter and the clamp from stimuli.
2. Turn the Clamp Meter off.
3. Turn the Clamp Meter over and use a flat-head screwdriver to remove the two battery door screws.
4. Replace the six batteries with new AA LR6 batteries.
5. Reattach the battery door and tighten the screws.

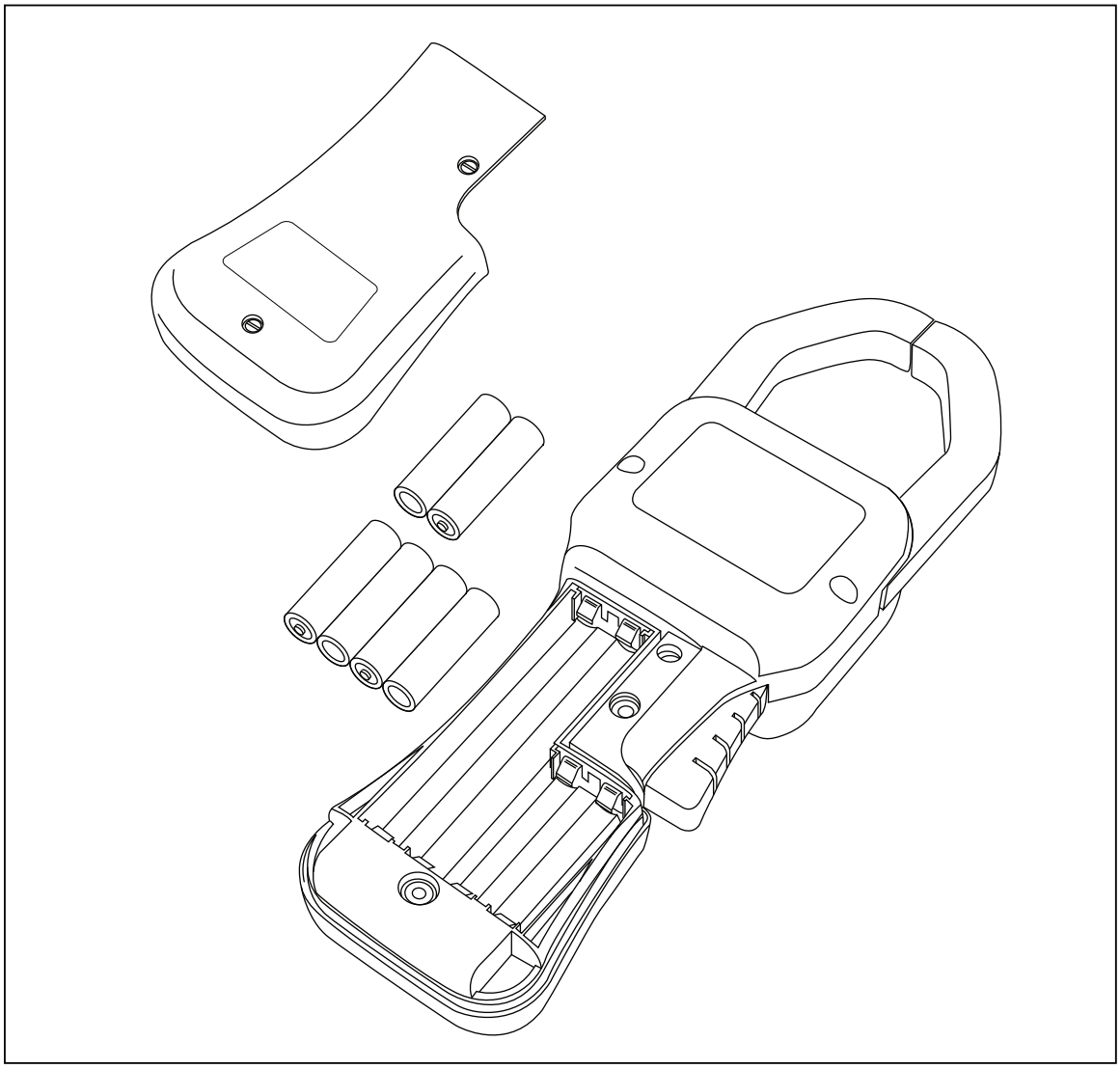

Figure 3. Changing the Batteries

Verification Tests

The following tests verify the functions of the Clamp Meter. If any of the verification tests fail, repair is necessary. For service, see *Contacting Fluke*.

Battery and Battery Eliminator Check

With six new AA batteries installed, the battery symbol next to the date on the display should show indicate full batteries.

1. Connect the BE345 Battery Eliminator. The battery symbol on the display changes to a plug symbol .
2. Disconnect the Battery Eliminator. The should change back to .

Rotary Switch Check

To check the rotary switch:

1. Move the switch from the **OFF** position and wait for the power-up screen to clear.
2. Move Rotary Switch through each position. Check that each position accesses the correct mode.

Date/Time Check

To check the date and time:

1. Observe the date and time at top of the display. If necessary, change date and time using the instrument's main menu.
2. Access the main menu by pressing ESC MENU after power up.
3. Use ▼ZERO to move to **Instrument Setup** then press ENTER SAVE.
4. Use ▼ZERO to move to **Date & Time**.
5. Press ENTER SAVE.
6. Use ▶ and ◀ to adjust each field.
7. Use ▼ZERO to move to the next field. From this menu, year, month, day, hour, minute, and time format preferences can be edited.
8. Press ENTER SAVE. Date and time are saved and appear on the display.

Display Contrast Check

To check the display contrast:

1. Press ESC MENU.
2. Use ▼ZERO to move to **Instrument Setup**.
3. Press ENTER SAVE.
4. Use ▼ZERO to move to **Display Contrast**.
5. Press ENTER SAVE.
6. Use ▼ZERO to darken the screen contrast and ▲☼ to lighten it.
7. Choose the desired contrast by pressing ENTER SAVE.

Beeper Check

To check the beeper:

1. Press ESC MENU.
2. Use ▼ZERO to move to **Instrument Setup**.
3. Press ENTER SAVE.
4. Use ▼ZERO to move to **Beeper Volume.**
5. Use ▶ and ◀ to select **LOW**, **HIGH**, or **OFF**.
6. When selecting, listen to the volume for each choice and make the desired selection.
7. When complete, press ENTER SAVE to save the selection.

Key Pad Check

To check the keypad, press each key and verify that each functions as expected.

Save and Clear Screenshots

To save screenshots:

1. Move the rotary switch to **V**.
2. Press ENTER SAVE to save the screen.
3. Press ENTER SAVE again to exit.
4. Repeat step 3 to save the screen twice.
5. Press ESC MENU. **View/Delete Screens** is selected.
6. Press ENTER SAVE. The saved screens appear in the list.
7. Press ENTER SAVE to view the last screen saved.

To clear the screenshots:

1. Press ◀ to delete all screen shots
2. Press ▶ to delete one at a time.

Language Set

The default language for the Clamp Meter is English. To change the language:

1. Press ESC MENU.
2. Use ▼ZERO to move to **Language…**.
3. Press ENTER SAVE.
4. Use ▼ZERO and ▲☼ to select desired language.
5. Press ENTER SAVE to save the choice.

Calibration Adjustment

Required Equipment

The equipment listed in Table 2 is necessary to perform calibration adjustments. If the listed equipment is not available, substitute equipment items of equal specification.

Table 2. Required Equipment

Description	Model Number	Specifications
Calibrator	Fluke Model 9100 Universal Calibration System with power functionality, or Fluke 5520 or equivalent	0.4 to 600 V >0.25 % accuracy 4 to 1000 A >0.25 % accuracy (with 50 turn coil) Phase accuracy 0.75 %
Coil	Fluke 9100-200 10/50 turn coil, or Fluke 5500 coil	See Calibrator
Test leads and the BE345 Universal Battery Eliminator are also required.		

Entering Calibration Mode

To enter calibration mode:

1. With the Clamp Meter power OFF, simultaneously press ◄, ►, ▼ZERO, and ▲☼.
2. Turn rotary switch to any position except **OFF**.

   The last calibration date and firmware version are displayed at the bottom left of the startup screen, see Figure 4.

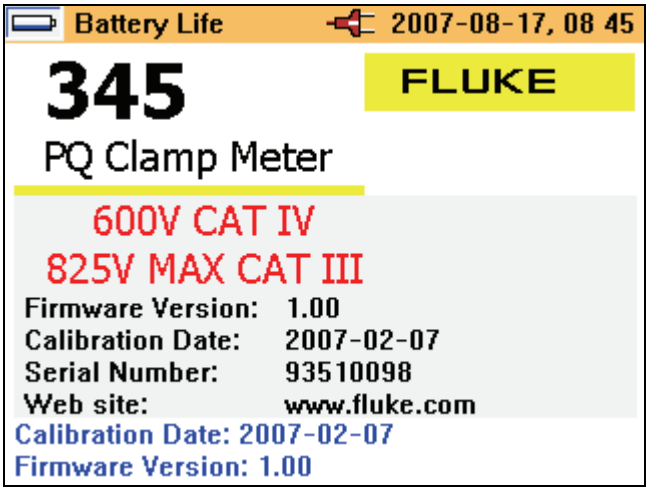

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Figure 4. Startup Screen Noting Calibration Date and Firmware

Once the screen in Figure 4 appears:

1. Press ESC MENU twice.
2. Press ENTER SAVE twice.

   The calibration mode screen appears, see Figure 5.

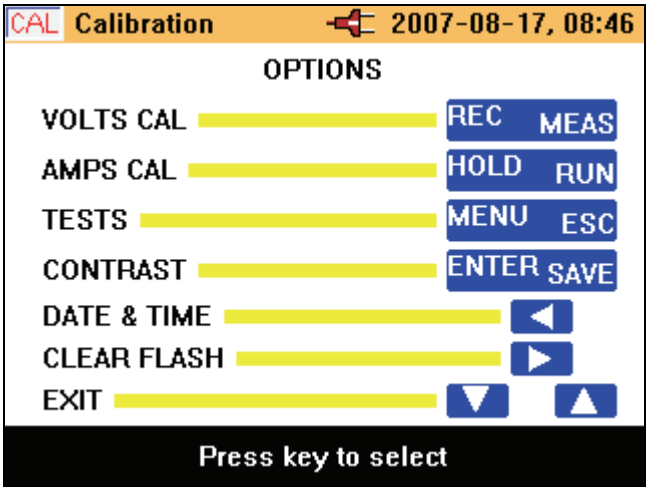

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Figure 5. Calibration Mode Screen

Use the procedure in the next section to adjust the Clamp Meter.

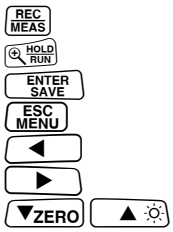
Calibration Adjustment Procedure

Note

Before calibration, ensure that the instrument clamp is degaussed up to a minimum of 1000 A.

The calibration mode steps are listed in Table 3. Make sure the date and time are set to the current date and time. VOLTS CAL and AMPS CAL are independent, calibration constants are saved at the end of each section.

Table 3. Calibration Mode

State	Key	Action	Comments
First Calibration Screen		Screen for S6: VOLTS CAL – REC AMPS CAL – HOLD CONTRAST – SAVE SELF-TEST – MENU DATE & TIME – left arrow CLEAR FLASH – right arrow EXIT – down arrow, up arrow EXIT to normal operation.	
V1	REC MEAS	"Apply 0V" "Press <RUN> when ready" Next State: V2	Connect Calibrator Hi to 345 V Connect Calibrator Lo to 345 COM
V2	HOLD RUN	Screen for V2: "VOLTS OFFSETS" "V to ASIC V" – hex value "V to ASIC A" – hex value "V SCF" – hex value "A SCF" – hex value On completion: "Press <RUN> when ready" Next State: V3	
V3	HOLD RUN	"VOLTS COMMON MODE" "APPLY 10V AC 400Hz between V and COM connected together and 0V" "Press <RUN> when ready" Next State: V4	Connection instruction on the unit is incorrect. Do not open the battery door. Maintain the 0 V from previous step, press <RUN>.

State	Key	Action	Comments
V4	HOLD RUN	Screen for V4: “VOLTS COMMON MODE” “V CM” – hex value On completion: “Press <RUN> when ready” Next State: V5	
V5	HOLD RUN	Screen for V5: “VOLTS 4V CAL” “APPLY 4V DC” “Press <RUN> when ready” Next State: V6	
V6	HOLD RUN	Screen for V6: “VOLTS 4V CAL” “V to ASIC V” – Cal value “V to ASIC A” – Cal value “V SCF” Cal Value – hex value “A SCF” Cal value- hex value On completion: “Press <RUN> when ready” Next State: V7	
V7	HOLD RUN	Screen for V7: “VOLTS 40V CAL” “APPLY 40V DC” “Press <RUN> when ready” Next State: V8	
V8	HOLD RUN	Screen for V8: “VOLTS 40V CAL” “V to ASIC V” – Cal value “V to ASIC A” – Cal value On completion: “Press <RUN> when ready” Next State: V9	
V9	HOLD RUN	Screen for V9: “VOLTS 400V CAL” “APPLY 400V DC” “Press <RUN> when ready” Next State: V10	

State	Key	Action	Comments
V10	HOLD RUN	Screen for V10: "VOLTS 400V CAL" "V to ASIC V" – Cal value "V to ASIC A" – Cal value On completion: "Press <RUN> when ready" Next State: V11	
V11	HOLD RUN	Screen for V11: "SAVING VOLTS CAL" On completion: "Press <RUN> when ready" Next State: S6	
A1	HOLD	Screen for A1: "HALL OFFSETS" "Apply 0A" "Press <RUN> when ready" Next State: A2	
A2	HOLD RUN	Screen for A2: "HALL OFFSETS" "A to ASIC A, 40A" – hex value "TOP HALL" – hex value "BOTTOM HALL" – hex value On completion: "Press <RUN> when ready" Next State: A3	
A3	HOLD RUN	Screen for A3: "SENSITIVITY TEST" "APPLY 40A DC" "TO TOP OF JAWS" "Press <RUN> when ready" Next State: A4	The arrow at the top of the case shows the current flow direction.
A4	HOLD RUN	Screen for A4: "SENSITIVITY TEST" "TOP HALL" – ASIC reading – hex "BOTTOM HALL" – ASIC reading - hex On completion: "Press <RUN> when ready" Next State: A5	

State	Key	Action	Comments
A5	HOLD RUN	Screen for A5: “SENSITIVITY TEST” “APPLY 40A DC” “TO BOTTOM OF JAWS” “Press <RUN> when ready” Next State: A6	
A6	HOLD RUN	Screen for A6: “SENSITIVITY TEST” “TOP HALL” – ASIC reading – hex “BOTTOM HALL” – ASIC reading – hex “Gain Adjustment” – ASIC reading - hex On completion: “Press <RUN> when ready” Next State: A7	“Gain Adjustment” – ASIC reading
A7	HOLD RUN	Screen for A7: “AMPS BALANCE” “APPLY 40A 60Hz “TO TOP OF JAWS” “Press <RUN> when ready” Next State: A8	
A8	HOLD RUN	Screen for A8: “AMPS BALANCE” “BALANCE” – hex value On completion: “APPLY 40A 60Hz “TO BOTTOM OF JAWS” “Press <RUN> when ready” Next State: A9	

A9	HOLD RUN	Screen for A9:
		“AMPS BALANCE”
		“BALANCE” – hex value
		On completion:
		if Count < 7:
		“APPLY 40A 60Hz
		“TO TOP OF JAWS”
		“Press <RUN> when ready”
		Next State: A8
		if Count = 7:
		“DONE <RUN>”
		Next State: A10	

State	Key	Action	Comments
A10	HOLD RUN	Screen for A10: "AMPS ZEROING" "APPLY 0A" "Press <RUN> when ready" Next State: A11	
A11	HOLD RUN	Screen for A11: "AMPS ZEROING" "A to ASIC A, 40A" – hex value On completion: "Press <RUN> when ready" Next State: A12	
A12	HOLD RUN	Screen for A12: "AMPS GAIN" "APPLY 40A DC" "Press <RUN> when ready" Next State: A13	
A13	HOLD RUN	Screen for A13: "AMPS GAIN" "GAIN POT" – hex value "Press <RUN> when ready" Next State: A14	
A14	HOLD RUN	Screen for A14: "AMPS OFFSETS" "APPLY 0A" "Press <RUN> when ready" Next State: A15	
A15	HOLD RUN	Screen for A15: "AMPS OFFSETS" "A to ASIC A, 40A" – hex value "A to ASIC V, 40A" – hex value "A to ASIC A, 400A" – hex value "A to ASIC V, 400A" – hex value "A to ASIC A, 2000A" – hex value "A to ASIC V, 2000A" – hex value "V to A difference – hex value On completion: "Press <RUN> when ready" Next State: A16	

State	Key	Action	Comments
A16		Screen for A16: “AMPS 40A CAL” “APPLY 40A DC” “Press <RUN> when ready” Next State: A17	
A17		Screen for A17: “AMPS 40A CAL” “A to ASIC V” – Cal value “A to ASIC A” – Cal value “Press <RUN> when ready” Next State: A18	
A18		Screen for A18: “AMPS 400A CAL” “APPLY 400A DC” “Press <RUN> when ready” Next State: A19	
A19		Screen for A19: “AMPS 400A CAL” “A to ASIC V” – Cal value “A to ASIC A” – Cal value “Press <RUN> when ready” Next State: A20	
A20		Screen for A20: “AMPS 2000A CAL” “APPLY 1000A DC” “Press <RUN> when ready” Next State: A21	
A21		Screen for A21: “AMPS 2000A CAL” “A to ASIC V” – Cal value “A to ASIC A” – Cal value “Press <RUN> when ready” Next State: A22	
A22		Screen for A22: “SAVING AMPS CAL” On completion: “Press <RUN> when ready” Next State: S6	

State	Key	Action	Comments
C1	ENTER SAVE	Screen for C1: Screen showing colours and writing. Right arrow to increase, left arrow to decrease, contrast. Up arrow to toggle backlight. "Press <RUN> when ready" to save. Next State: S6	
T1 Self Test	ESC MENU	Screen for T1: Symbols of the 8 keys. "Press RUN twice for next test" Next State: T2	As each key is pressed, and indication appears on the screen. Since the RUN key is also checked, it must be pressed for a second time.
T2	HOLD RUN	Screen for T2: "EEPROM TEST" "Press <RUN> when ready" On completion: "PASS" or "FAIL". "Press <RUN> in Screen tests" Next State: T3	Simple, not exhaustive, tests only. After each test is run, a PASS/FAIL message is displayed.
T3	HOLD RUN	Black screen. Next State: T4	Tests that all pixels can be turned off. Press <RUN> as each screen appears to go to the next test.
T4	HOLD RUN	Red screen. Next State: T5	
T5	HOLD RUN	Green screen. Next State: T6	
T6	HOLD RUN	Blue screen. Next State: S6	
D1	◀	Screen for D1: date & time as in menu. Next State: S6	
F1	▶	Screen for X1: "SAVED SCREENS AND LOGGING SESSIONS CLEARED" "Press <RUN> when ready" Next State: First Calibration Screen	

Calibration is now complete.

Calibration Verification Procedure

The following sections detail the input levels used to check the Clamp Meter's calibration. The specification is 100 % of the specified tolerance.

Notes

For regions with mains power at 50 Hz, inputs should be at 60 Hz. For regions with mains power at 60 Hz, inputs should be at 50 Hz. This avoids mains "beating" effect.

Ensure instrument is degaussed up to a minimum of 1000A.

Voltage Check

Mode: Volts

Input: dc & 60/50 Hz ac signal

Internal Accuracy: ± 1.0 % rdg ± 5 dgts for V > 1 V

± 0.02 V for V ≤ 1 V

Calibrator	Specification	
(Volts)	Min	Max
0.400	0.380	0.420
1.000	0.980	1.020
1.100	1.084	1.116
3.900	3.856	3.944
4.10	4.01	4.19
39.00	38.56	39.44
41.0	40.1	41.9
390.0	385.6	394.4
410	401	419
600	589	611

Amps Check

Mode: Amps

Input: dc & 60/50 Hz ac signal

Internal Accuracy: ± 1.5 % rdg ± 5 dgts for A > 10.0 A

± 0.2 A for A ≤ 10.0 A

Calibrator	Specification	
(Amps)	Min	Max
4.00	3.80	4.20
10.00	9.80	10.20
11.00	10.79	11.22
39.00	38.37	39.64
41.0	39.9	42.1
390.0	383.7	396.4
410	399	421
1000	980	1020

Harmonic Distortion

Harmonic distortion parameters are not checked because they use the same hardware paths as are used in measurement of amps and volts.

Frequency Check

Mode: Volts Frequency

Input: 2 V 60/50 Hz

Internal Accuracy: ± 0.5 % rdg 40 - 70 Hz

Power Check- Stage 1

Mode: Power

Input: 60/50Hz

Internal Accuracy: VA: ± 2.5% rdg ± 5 digits

W 1 phase < 2 kW + and - 0.08 kW

> 2 kW + and - 2.5 %rdg + and - 5 digits

W 3 phase < 4 kW + and - 0.25 kW

> 4 kW + and - 2.5 %rdg + and - 5 digits

VA 1 & 3 phase the same as single phase W (except SI unit is VA)

Calibrator			Specification (k)W		
Volts (V)	**Amps (A)**	**Phase Shift (°)**	**Min**	**Nom**	**Max**
19	100	0.00	1820	1900	1980
21	100	0.00	2043	2100	2158
39	100	0.00	3798	3900	4003
41	100	0.00	3.95	4.10	4.25
390	100	0.00	37.98	39.00	40.03
410	100	0.00	39.5	41.0	42.5
Calibrator			**Specification (k)VA**		
Volts (V)	**Amps (A)**	**Phase Shift (°)**	**Min**	**Nom**	**Max**
19	100	0.00	1848	1900	1943
21	100	0.00	2042	2100	2158
39	100	0.00	3797	3900	4003
41	100	0.00	3.95	4.10	4.25
390	100	0.00	38.00	39.00	40.00
410	100	0.00	39.5	41.0	42.5
Calibrator			**Specification PF**		
Volts (V)	**Amps (A)**	**Phase Shift (°)**	**Min**	**Nom**	**Max**
19	100	0.00	0.998	1.00	1.00
21	100	0.00	0.998	1.00	1.00
39	100	0.00	0.998	1.00	1.00
41	100	0.00	0.998	1.00	1.00
390	100	0.00	0.998	1.00	1.00
410	100	0.00	0.998	1.00	1.00

Power Check- Stage 2

Mode: Power

Input: 60/50 Hz

Internal Accuracy: VAR: > 4kVAR, ±2.5 % rdg ± 5 digits
< 4kVAR, ± 0.25 kVAR
PF: ± 3°

Calibrator			Specification (k)W		
Volts (V)	**Amps (A)**	**Phase Shift (°)**	**Min**	**Nom**	**Max**
19.87	100	73.00	501	581	661
21.96	100	-73.00	562	642	722
40.78	100	73.00	1.11	1.19	1.27
42.87	100	-73.00	1.17	1.25	1.33
407.82	100	73.00	11.13	11.92	12.27
428.73	100	-73.00	11.7	12.5	12.9
Calibrator			**Specification (k)VAR**		
Volts (V)	**Amps (A)**	**Phase Shift (°)**	**Min**	**Nom**	**Max**
19.87	100	73.00	1848	1900	1943
21.96	100	-73.00	2042	2100	2158
40.78	100	73.00	3.80	3.90	4.00
42.87	100	-73.00	3.85	4.10	4.35
407.82	100	73.00	38.75	39.00	39.25
428.73	100	-73.00	40.7	41.0	41.3
Calibrator			**Specification PF**		
Volts (V)	**Amps (A)**	**Phase Shift (°)**	**Min**	**Nom**	**Max**
19.87	100	73.00	0.242	0.292	0.342
21.96	100	-73.00	0.242	0.292	0.342
40.78	100	73.00	0.242	0.292	0.342
42.87	100	-73.00	0.242	0.292	0.342
407.82	100	73.00	0.242	0.292	0.342
428.73	100	-73.00	0.242	0.292	0.342

Customer-Replaceable Parts and Accessories

Table 4 lists customer-replaceable parts and standard accessories that ship with the Clamp Meter.

Table 4. Customer-Replaceable Parts and Accessories

Part or Item Number	Description
675501	Soft Case
AC285	SureGrip™ Alligator Clips
TL224	SureGrip™ Insulated Test Leads
TP74	Banana Jack Test Probes w/cap
2598222	Battery Cover Screws
2599515	Case Screws
2696398	Battery Cover
2696405	Back Label
BE345	Universal Battery Eliminator
2441372	International AC Power Connectors
2560401	*345 Users Manual* (English, French, Italian, German, Spanish, Portuguese, Simplified Chinese)