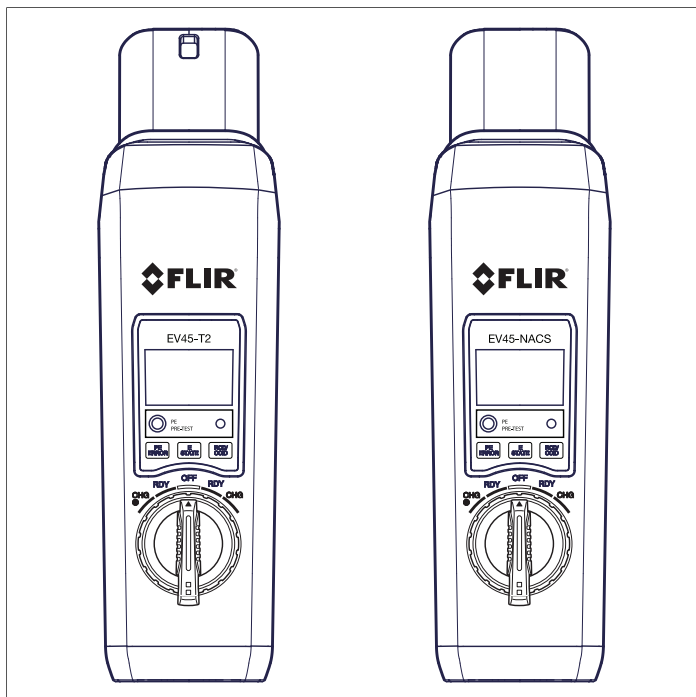




USER MANUAL

EV Charger Test Adapter

MODELS EV45-NACS and EV45-T2





USER MANUAL

EV Charger Test Adapter

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1 Introduction

Thank you for your purchase of the FLIR EV45 Series Charger Test Adapter. This document provides instructions for both the EV45–NACS (North America version) and the EV45–T2.

The EV45 series is rated CAT II 300 V and is compliant with IEC 61851–1 (EV Safety). As explained below, the EV45 series can be used for a variety of tests on level 1 or level 2 electric vehicle **AC charging stations**.

The charging station under test sees the EV45 as an electric vehicle, for all intents and purposes.

1.1 EV45–NACS Product Overview

The FLIR EV45–NACS is designed to test NACS charging stations and AC wall outlets in North American commercial and residential installations. It is equipped with a built-in NACS plug and is compatible with SAE J1772 Type 1 stations. A NACS to Type 1 converter is included.

1.2 EV45–T2 Product Overview

The FLIR EV45–T2 is designed to test level 1 or level 2 EV charging stations and AC wall outlets in commercial and residential installations outside the US. It is equipped with a built-in IEC 62196–2 Type 2 plug for Type 2 charging stations and is compatible with SAE J1772 Type 1 charging stations. A Type 2 to Type 1 converter is included.

1.3 EV Charger Tests and Applications

- Check the Protective Earth (PE) grounding circuit.
- Measure the maximum charge current.
- Simulate a Control Pilot (CP) error.
- Test the current interrupter circuit (CCID and RCD).
- Measure AC line voltage and frequency with the optional FLIR DM286.
- Test cable insulation using the optional FLIR IM75–2 insulation tester.
- Share readings with mobile devices using the FLIR DM286 Bluetooth® METERLiNK® technology.

1.4 Glossary of Terms

EVSE	Electric Vehicle Supply Equipment (charging station)
Control Pilot (CP)	A pulse width modulated (PWM) signal that allows communication between the EV and charging station. The CP informs the EV of the maximum current that can supplied by the charger.
Proximity Pilot (PP)	Electrical signal that informs the charging station that the plug is connected to the EV inlet. Also known as 'plug present', it prevents the EV from moving while connected to the charging station.
Protective Earth (PE)	A safety feature, commonly known as 'grounding', that protects against electrical shock by diverting excess electrical current away from the user.
CCID	Charge Current Interrupting Device. A safety feature, similar to ground fault circuit interrupter (GFCI), protecting the user from electrical shock.
RCD	Residual Current Device. Removes power to a circuit when a current imbalance is detected, protecting the user from electrical shock.
Level 1	North America only. Slowest AC EV charging system that uses a standard wall outlet to access AC power. A 'mobile charge cable', typically supplied with an EV, is required to connect the EV45 to a wall outlet.
Level 2	Faster, and more powerful (240 V) EV charging system which requires special equipment. Most common form of charging.
NACS	North American Charging Standard for AC and DC charging connectors.
Type 1 charger plug	Five (5) pin plug configuration that employs a latch which prevents the plug from being dislodged from the charger.
Type 2 charger plug	Seven (7) pin plug configuration that uses a locking pin (instead of a latch) which prevents the plug from being dislodged from the charger.
Ventilation	In some regions, indoor chargers require ventilation (fan, for example). Check with the charger manufacturer.

1.5 About the Proximity Pilot and Control Pilot Signals

The Proximity Pilot (PP) and Control Pilot (CP) signals (on the charging plug) allow electric vehicles and chargers to communicate.

The **Proximity Pilot** informs the charger that a vehicle is, or is not, connected.

For Type 1 connectors, the PP detects the EV connection and whether the connection latch is secured.

For Type 2 connectors, the PP detects both the EV connection and the current handling capability of the cabling (note that a locking pin is used instead of a latch in Type 2 connectors).

The **Control Pilot** signal informs the vehicle of the charger’s maximum rated current. The control pilot also provides EVSE (electric vehicle supply equipment) states, indicated on the right side of the display (see Figure 3.6); these states are defined below.

STATE	DESCRIPTION
A	Connection to charger not detected.
B	Connection detected, not charging.
C	Actively charging.
D	Actively charging (ventilated charger).
E	Error detected.

2 Safety

A Warning identifies conditions and procedures that are dangerous to the user. A Caution identifies conditions and procedures that can cause damage to the product or the equipment under test.

	WARNING
To prevent the risk of electric shock and personal injury: • Read and understand all safety instructions before using this device. • Connect this device to charging stations only as indicated in this user manual. • Operate this device only at the specified measurement category, voltage, and current ratings. • Do not modify the device, otherwise the protection provided by the device may be ineffective. • Do not use the device if it behaves abnormally or has obvious physical damage. • Do not use any cable assemblies if they appear damaged. Examine cables for exposed insulation or metal. • Use care when working with voltages > 30 V AC RMS, 42 V AC peak, or 60 V DC. • Comply with all local and national safety regulations. • Remove power from the device before cleaning. • Do not use the device near explosive gases, vapor, or in damp or wet environments.	
	This symbol adjacent to another symbol, terminal or operating device indicates that the operator must refer to an explanation in the operating instructions to avoid personal injury or damage to the meter.
	This symbol adjacent to one or more terminals identifies them as being associated with ranges that may, in normal use, be subjected to hazardous voltages.
	Double insulation.
	Earth ground.

3 Product Description

3.1 Meter Front

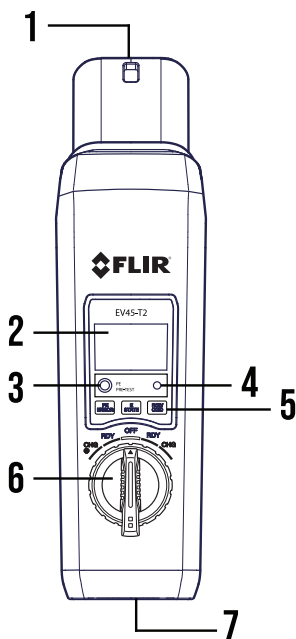


Figure 3.1 Meter front. See descriptions below.

1. Plug protective cap, see Section 3.6 below.
2. Color display, see Section 3.8 below.
3. PE PRE-TEST pad, see Section 3.3, below.
4. LED status indicator. Green for pass and red for fault.
5. Control buttons, see Section 3.3, below.
6. Rotary switch, see Section 3.2, below.
7. External meter connection terminals, see Section 3.7, below.

3.2 Rotary Switch

OFF	Select this position to switch OFF the adapter.
RDY	Standby (ready) state. Turn to the RDY position on the left if ventilation is required (typically required for indoor chargers), otherwise turn the switch to the RDY position on the right.
CHG 	Select this switch position to begin testing when the charging system is ventilated.
CHG	Select this switch position to begin testing when the charging system is not ventilated.

3.3 Control Buttons

Caution: The table below provides a brief explanation of each button. For safety, please read the sections, referenced below, before initiating any of the tests.

PE PRE-TEST	Contact pad used for the protective earth (PE) pre-test. See Section 5.3.
PE ERROR	Button for simulating a Protective Earth error. See Section 5.4.
E STATE	Button for simulating an error condition where the Control Pilot signal is shorted to ground. See Section 5.5.
RCD / CCID	Button for testing the charger's circuit interrupt protection. See Section 5.6. Note: Performing this test will trip the circuit breaker supplying power to the charging station.

3.4 LED Indicator

The LED indicator to the right of the PE PRE-TEST button glows green when a test passes and red when a test fails. See Figure 3.1.

3.5 Meter Back

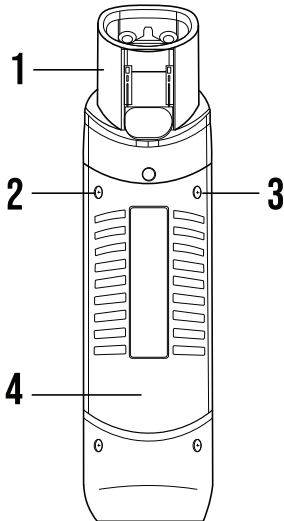


Figure 3.2 Meter back. See descriptions below.

1. Plug end (protective cap not pictured).
2. First battery compartment screw.
3. Second battery compartment screw.
4. Battery compartment cover.

3.6 Meter Top

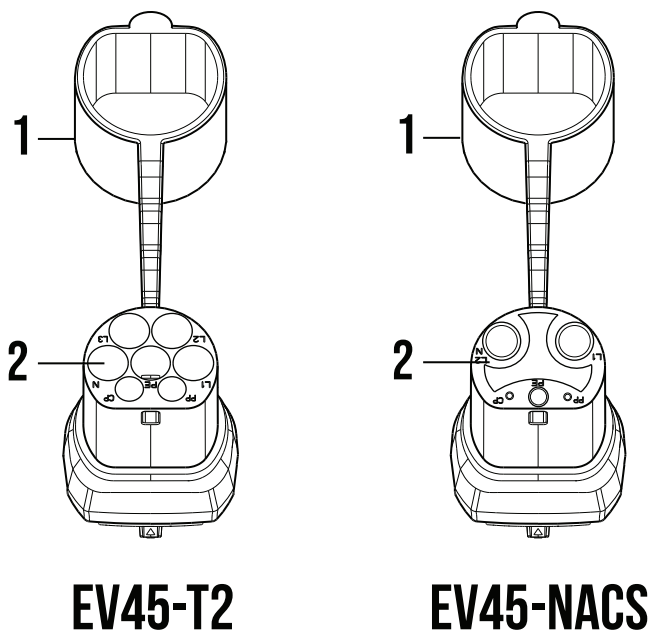


Figure 3.3 Meter top.

1. Protective cap.
2. Connect this end directly to the charging station or to the supplied converter.

3.7 Meter Bottom

3.7.1 Meter Bottom (EV45–T2)

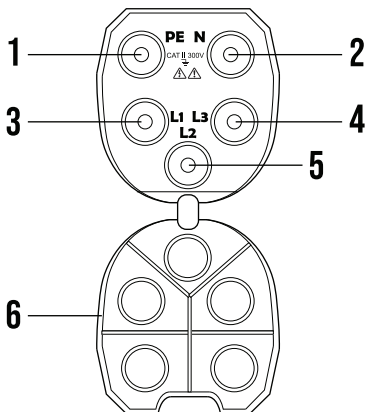


Figure 3.4 EV45–T2 bottom. Connect to a digital multimeter, or other tester, for single or three phase systems. See descriptions below.

1. PE (protective earth) terminal.
2. N (neutral) terminal.
3. Line 1 (L1) phase terminal.
4. Line 2 (L2) phase terminal.
5. Line 3 (L3) phase terminal.
6. Compartment cover flap.

3.7.2 Meter Bottom (EV45–NACS)

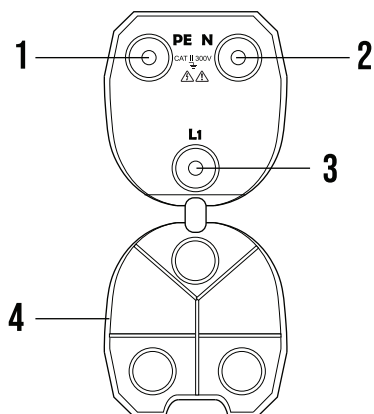


Figure 3.5 EV45–NACS bottom. Connect to a digital multimeter, or other tester. See descriptions below.

1. PE (protective earth) terminal.
2. N (neutral) / Line 2 (L2) terminal.
3. Line 1 (L1) phase terminal.
4. Compartment cover flap.

3.8 Display

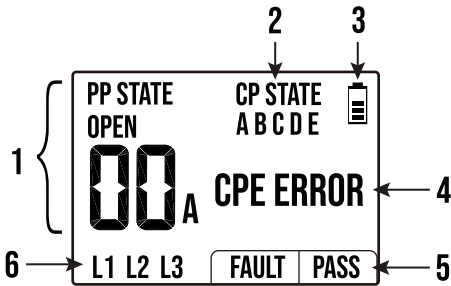


Figure 3.6 Display overview. See descriptions below.

1. Proximity Pilot (PP) indicates the charger current (OPEN indicates open circuit).
2. Control Pilot (CP) charger state A (disconnected), B (connected, not charging), C (charging), D (charging with ventilation), E (error).
3. Battery status.
4. Description of selected test.
5. Test result.
6. Active phase(s).

3.9 Converter

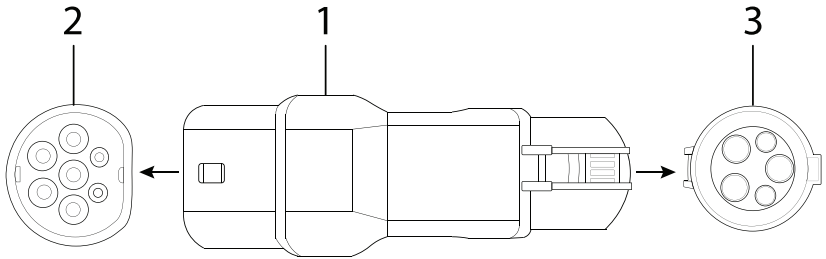


Figure 3.7 Type 2 to Type 1 Converter. Supplied with the EV45–T2. See descriptions below.

1. Converter body.
2. Type 2 end connects to the EV45.
3. Type 1 end connects to the charging station.

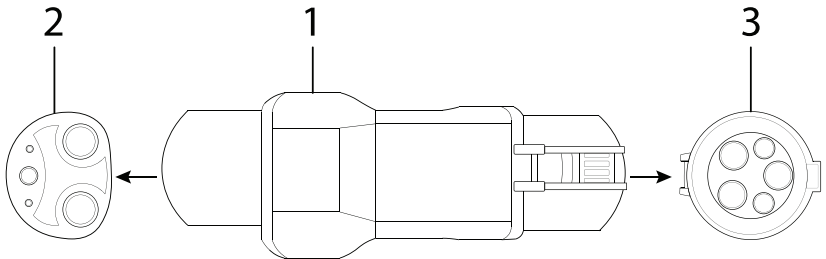


Figure 3.8 NACS to Type 1 Converter. Supplied with the EV45–NACS. See descriptions below.

1. Converter body.
2. NACS end connects to the EV45.
3. Type 1 end connects to the charging station.

4 Battery Power

The EV45 is powered by four (4) AA alkaline batteries, housed in the rear compartment. The compartment is secured by two screws at the top of the compartment. See Section 8, *Maintenance*, for battery replacement instructions.

To switch ON the EV45, turn the rotary switch to the **RDY** (ready) position on the left, if the charger is ventilated. Turn the rotary switch to the **RDY** position on the right for unventilated systems. The display will illuminate if fresh batteries are installed and the device is functioning properly.

5 Operation

5.1 Preparation for Testing a Commercial Charger

When testing a commercial charging station, you'll need an account with a mobile charging application to activate the charger.

Typically the charger will have a printed QR code that you scan with a mobile device through the application. Examples of these apps include AmpUp®, PlugShare®, and ChargePoint®. See the App Store® (iOS®) or Google Play™ (Android™) for available applications.

NOTE

When working with a Tesla™ charging system, **please set your Tesla One® App access control setting to the 'All Vehicles' option** before testing with the EV45. Otherwise, the charging system will not communicate with the EV45.

5.2 Connect the EV45 to the Charger

As shown in Figure 5.1, below, plug the EV45 directly into the charger socket or connect the EV45 to the plug on the charger's connecting cable. To match plugs, use the supplied Converter.

See Sections 3 for diagrams of the plugs and supplied converter. Connecting directly to an AC wall outlet requires a mobile connecting cable, typically supplied with the EV.

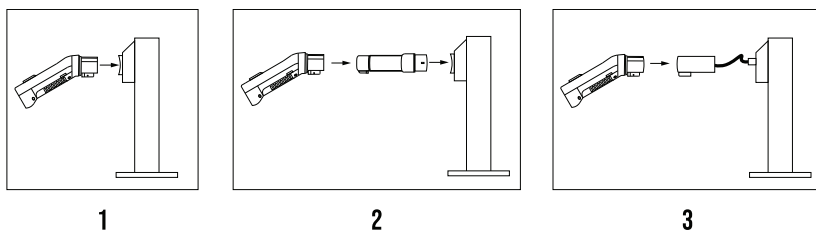


Figure 5.1 Connect the EV45 directly to the charging station socket (1), connect the EV45 to the supplied converter, and then to the charging station socket (2), or connect the EV45 (or Converter) to the charging station's cable socket (3).

5.3 Protective Earth (PE) PRE-TEST

The EV45 must pass the PE PRE-TEST before further testing can be performed. This safety feature checks for dangerous voltages on the protective earth conductor of an EV charging system.

- 1. Connect the EV45 to the charging station, and activate the charger, as explained above.
- 2. Turn the rotary switch to the **RDY** position on the left, if the charger is ventilated, or to the right if the charger is unventilated. The **PE** icon will flash on the display.

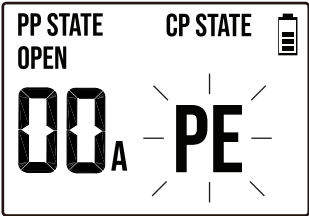


Figure 5.2 Protective Earth (PE) pre-test pending.

- 3. Wait 3 seconds from the previous step, and place your fingertip on the PE PRE-TEST pad.
- 4. If the test passes (< 50 V detected), the LED will glow green and **PASS** will flash three times in green on the display (**PE** will stop flashing).
- 5. If the test fails (> 50 V detected), the LED indicator will glow red and **FAULT** will flash three times in red on the display. Switch OFF the EV45 and disconnect it from the charger if the test fails. The charging station must be repaired, to correct the grounding issue, before it can be used safely.

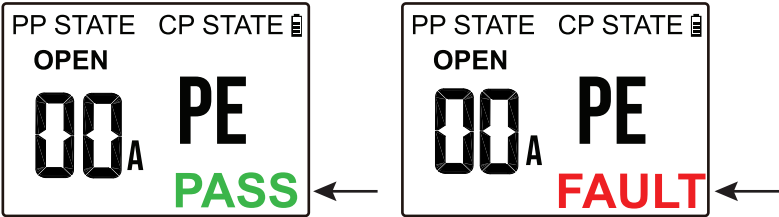


Figure 5.3 Pass (left) and Fault (right) display screens.

-
6. Three seconds after the test passes, the display will show the maximum current capability of the connected charger, the phase line(s) detected, and the Control Pilot state, as shown in Figure 5.4, below. For this step, the state should be **B**, which indicates that the charger is connected but not charging. If the CP state does not switch to **B** after 10 seconds, the display will return to the **FAULT** condition.

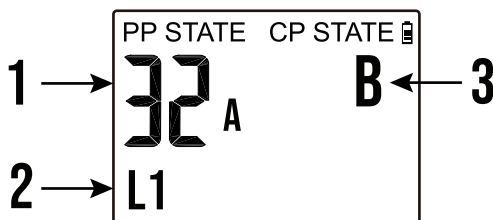


Figure 5.4 Control Pilot (CP) and Proximity Pilot (PP) signals indicate maximum current capability of a connected charger (1), phase line(s) detected (2), and state (3).

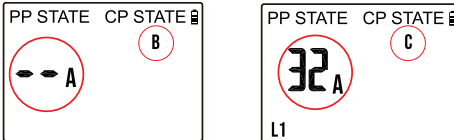
NOTE: If you perform a PE PRE-TEST with the EV45 disconnected from the charger, the test will pass, but the Control Pilot will show **E** for error, instead of **B**.

5.4 TEST 1: PE ERROR SIMULATION

This test simulates an opened Protective Earth (PE) conductor in the charging station. To run this test, you must first pass the PE PRE-TEST, as described in Section 5.3.

NOTE

Do not move the switch to the **CHG** position before the maximum charger current is indicated, otherwise the display will show dashes (— A), as shown in the image on left, below. In this case, return the switch to the **RDY** position until the maximum current is displayed (as shown in the image on right, below), and then move the switch to the **CHG** position.



1. Ensure that the maximum charger is displayed and then set the rotary switch to the **CHG** position. The Control Pilot (CP) state should indicate **C** (charging, without ventilation) or **D** (charging, with ventilation).
2. Press the **PE ERROR** button for two seconds to run the test.
3. If the test passes, the CP state indicator will switch to **E**, the **PASS** alert will appear in green, the Proximity Pilot (PP) indicator will show **OPEN**, and the LED indicator will glow green.
4. If the test fails, the CP state will show **C** or **D**, the **FAULT** alert will appear in red, and the LED will glow red. A fault indicates an interruption of the PE conductor.
5. If the test fails, switch OFF the EV45 and disconnect it from the charger. The charging station must be repaired before it can be safely used.

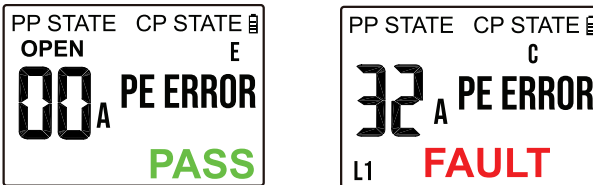


Figure 5.5 PASS and FAULT display examples for PE ERROR test.

NOTE

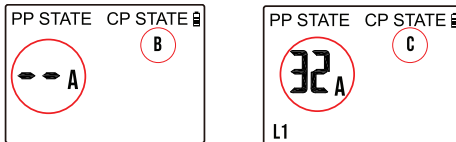
After each test, switch OFF the EV45, disconnect it from the charger and perform the PRE-TEST again before proceeding to the next test.

5.5 TEST 2: E-STATE ERROR SIMULATION

This test simulates a charging station Control Pilot (CP) error, interrupting the charging process. To run this test, you must first pass the PE PRE-TEST, as described in Section 5.3.

NOTE

Do not move the switch to the **CHG** position before the maximum charger current is indicated, otherwise the display will show dashes (— A), as shown in the image on left, below. In this case, return the switch to the **RDY** position until the maximum current is displayed (as shown in the image on right, below), and then move the switch to the **CHG** position.



1. Set the rotary switch to the **CHG** position on left (for chargers with ventilation) or to the right position (for chargers without ventilation). The display shows the Control Pilot state **C** (no ventilation) or **D** (ventilated).
2. Press the **E STATE** button for two seconds to run the test.
3. If the test passes, the CP state will switch to **E**, the **PASS** alert will appear in green, the PP (Proximity Pilot) state will indicate **OPEN**, and the LED will glow green.
4. If the test fails, the CP state will switch to **C** or **D**. the **FAULT** alert will appear in red, the PP state will remain unchanged, and the LED will glow red.
5. If the test fails, switch OFF the EV45 and disconnect it from the charger. The charging station must be repaired before it can be safely used.

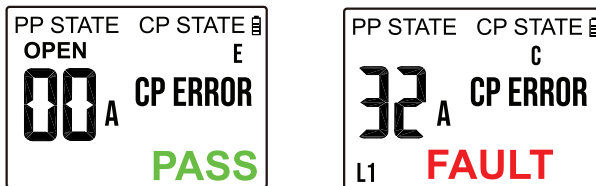


Figure 5.6 PASS and FAULT display examples for the E-STATE test.

NOTE

After each test, switch OFF the EV45, disconnect it from the charger and perform the PRE-TEST again before proceeding to the next test.

5.6 TEST 3: RCD/CCID CHECK

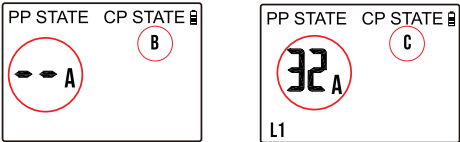
CAUTION

This test will intentionally trip the circuit breaker in the charging station. Do not perform this test without permission, or if you cannot reset the breaker after the test. To run this test, you must first pass the PE PRE-TEST, as described in Section 5.3.

This test checks the residual current detection (RCD) or the charge current interrupt detection (CCID) circuit (depending on region). These circuits are similar to GFCI circuits, where the breaker that controls power to the charger is switched OFF.

NOTE

Do not move the switch to the **CHG** position before the maximum charger current is indicated, otherwise the display will show dashes (— A), as shown in the image on left, below. In this case, return the switch to the **RDY** position until the maximum current is displayed (as shown in the image on right, below), and then move the switch to the **CHG** position.



1. When the CP state indicates **C** or **D**, press the **RCD / CCID** button for two seconds, to run the test.
2. The test passes if the circuit breaker is tripped in one second. The CP state will indicate **E**, the LED will glow green, and the **PASS** alert will appear.
3. The test fails if the circuit breaker does not trip after three seconds. The CP state will indicate **C** or **D**, the LED will glow red, and the **FAULT** alert will appear.

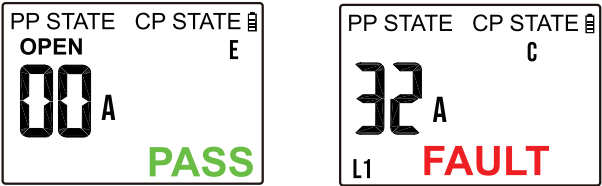


Figure 5.7 PASS and FAULT display examples for the RCD/CCID test.

NOTE

After each test, switch OFF the EV45, disconnect it from the charger and perform the PRE-TEST again before performing another test.

6 Using an External Multimeter

An external digital multimeter (DMM) can be used to indicate a charger's voltage and frequency. First connect the EV45 to the charging station, as instructed earlier, and then connect the DMM to the EV45. The DM286 is shown in Figure 6.1 and 6.2 for illustrative purposes.

If you purchased a kit (EV-KIT-1 or EV-KIT-2), it includes the FLIR DM286 DMM. The DM286 is also available separately, or another DMM will work in a similar way.

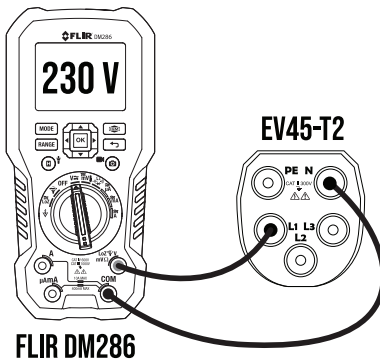


Figure 6.1 Connecting a DMM to an EV45–T2 to measure line voltage and frequency.

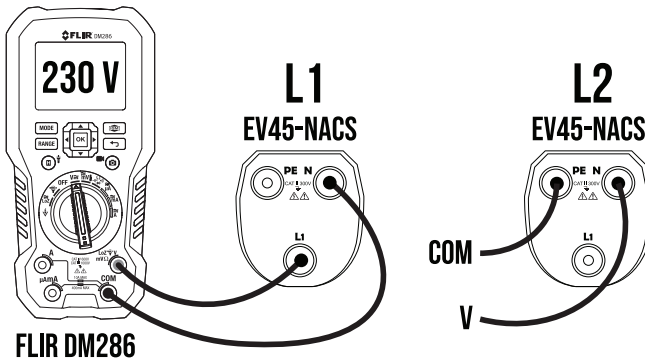


Figure 6.2 Connecting a DMM to an EV45–NACS to measure line voltage and frequency.

The EV45 must be in the **C** or **D** charging state (see Section 5.5). The terminals at the bottom of the EV45 (under the protective flap) accept standard test lead patch cables.

Connect the DMM to the EV45 as shown in Figure 6.1 or 6.2. See Section 3 for descriptions of the terminals.

Set the DMM function switch to measure line voltage and then read the measurement on the DMM display. Switch the DMM to the frequency mode to view the frequency (Hz) of the line voltage. Refer to the DMM user manual for complete instructions.

Note that the DM286 offers Bluetooth METERLiNK technology for sharing readings with mobile devices. See the dedicated DM286 user manual for complete instructions.

7

Using an External Insulation Tester

An external insulation resistance tester, such as the FLIR IM75–2, can be used to check the integrity of the charger’s cable insulation. First connect the EV45 to the charging station, as instructed earlier, and then connect the insulation tester to the EV45, as shown in Figure 7.1, below (the IM75–2 is shown for illustrative purposes).

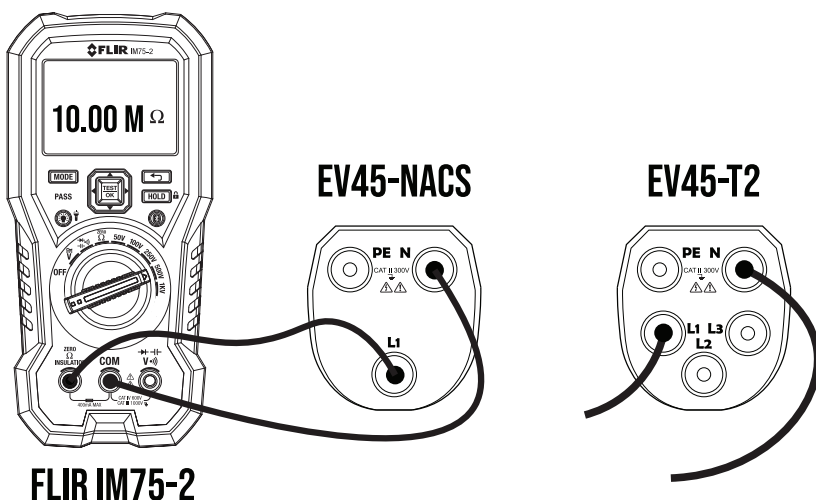


Figure 7.1 Testing insulation resistance of a charger’s wiring system using a FLIR IM75–2.

The EV45 must be in the **B** charging state for these tests. The terminals at the bottom of the EV45 (under the protective flap) accept standard test lead patch cables.

Connect the tester’s insulation resistance terminal to the EV45 **L1**, **L2**, or **L3** terminal and then connect the tester’s common (**COM**) terminal to the EV45 **N** (neutral) terminal.

Set the tester’s function switch to measure insulation resistance and read the results on the tester’s display. Refer to the tester’s user manual for complete instructions.

8 Maintenance

8.1 Battery Replacement

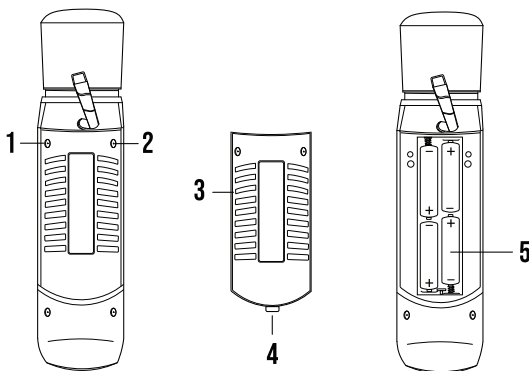


Figure 8.1 Battery replacement, see numbered descriptions below.

1. Remove the first battery compartment screw.
2. Remove the second battery compartment screw.
3. Lift off the compartment cover.
4. When replacing the battery compartment cover, insert this tab first.
5. Insert four (4) alkaline AA batteries, observing correct polarity. Replace the compartment cover before using the device.

8.2 Cleaning and Storage

Wipe the EV45 adapter and converter with a damp cloth when necessary. Do not use solvents or abrasives. Do not allow moisture into the connecting terminals or plugs.

Store the device in a protective pouch or case. Remove the batteries, and store separately, when storing the device for longer than 3 months.

9 Specifications

9.1 General Specifications

	EV45-T2	EV45-NACS
Display	FSTN type (high contrast, wide viewing angle)	
Connector (built-in)	IEC 62196-2 Type 2 socket	Connector for NACS Station
Converter accessory	IEC 62196-2 Type 2 to SAE J1772 Type 1	NACS to SAE J1772 Type 1
Category rating	CAT II 300 V	

9.2 Power System

Battery	4 x AA alkaline batteries
Battery life	100 hours (approx.) with alkaline batteries

9.3 Physical Data (Meter)

	EV45-T2	EV45-NACS
Weight	1.3 lbs. (600 g)	
Dimensions (L x W x H)	9.3 x 2.6 x 2.2 in. (237 x 65 x 56 mm)	
Included equipment	EV45-T2 EV Charger Test Adapter Converter (Type 2 to Type 1) Set of CAT. III 1000 V Test leads 4 x AA alkaline batteries Printed Quick Start Carrying pouch with shoulder strap	EV45-NACS EV Charger Test Adapter Converter (NACS to Type 1) Set of CAT. III 1000 V Test leads 4 x AA alkaline batteries Printed Quick Start Carrying pouch with shoulder strap

9.4 Environmental Data

Operating temperature and relative humidity	14 to 86°F (-10 to 30°C), <85% RH 86 to 104°F (30 to 40°C), <75% RH 104 to 122°F (40 to 50°C), <45% RH
Storage temperature and relative humidity	-4 to 140°F (-20 to 60°C), 0 to 80% RH (without batteries)
Operating altitude	6560 ft. (2000 m)
Pollution degree	2

9.5 Electrical Tests

	EV45-T2	EV45-NACS
Protective Earth (PE) pre-test	Passes when < 50 V AC/DC is detected	
Proximity Pilot (PP) states	OPEN or current measurement up to 63 A	
Control Pilot (CP) states	A (Disconnected) , B (Connected) , C (Charging), D (Charging w/ ventilation), E (Error)	
Voltage phase indication	Single or three phase (L1, L2, L3)	L1, L2
CP error (E state) simulation	Pass / Fault (CP signal short-circuited to PE)	
PE error simulation	Pass / Fault (interruption of PE conductor)	
RCD/CCID trip test	Pass / Fault (Test RCD/CCID activation, when tripped)	

9.6 Output Specifications

	EV45-T2	EV45-NACS
Measurement terminals L1, L2, L3, PE, N	Max. 250 V (Single Phase) / 430 V (3 phase), 50 / 60 Hz, CAT II 300 V, Max. 10 A	Max. 250 V, 50 / 60 Hz, CAT II 300 V, Max. 10 A

9.7 Safety Certifications and Standards

Certifications	ETL, CE
Safety standards	IEC 61010-1 CAT II-300 V
EMC standards	EN61326-1

9.8 Optional Meter Applications

FLIR DM286 Multimeter	CP State C / D for AC voltage and frequency measurements
FLIR IM75-2 Insulation Tester	CP State B for cable insulation test

10 Customer Support

Customer Support Telephone List	https://support.flir.com/contact
Repair, Calibration, and Technical Support	https://support.flir.com

11 Warranty

This product is protected by FLIR's Limited Three-Year Warranty. Visit www.flir.com/testwarranty to read the warranty document.



Website

<http://www.flir.com>

Customer support

<http://support.flir.com>

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