



Technical Report

Interoperability validation of AFCI's/GFCI's and intentional radiators in panelboards

At the request of NEMA a project was opened by UL at UL LLC Melville, NY to conduct ground fault and arc fault performance tests according to the NEMA prescribed and developed limited test program

The project intent was to test if wireless communicating electric submeters and current sensors installed in the same panelboard influence the safety performance of electronic circuitry of the AFCI and GFCI type Circuit Breakers. The tests intended to create conditions for two potential malfunctions:

- Nuisance tripping
- "Blinding", where the electromagnetic field created by the intentional radiator (antenna) negatively affects the detection of the fault the electronic circuitry intends to detect, leakage to ground for GFCIs, arching for AFCIs.

The following technical report is entirely based on the UL Close out Letter 4789739784 dated 9/19/2022.

The results indicate there were no adverse effects noted.

UL was in receipt of 5 manufacturers of UL Listed Molded Case Circuit Breaker protective type devices with corresponding UL Listed panel boards. During testing, UL was supported by two intentional radiator manufacturer's representatives who installed the transmitters and were responsible to enable transmitting signals during the respective arc and ground fault performance testing. Additionally, the respective panelboard protective device manufacturer was also present to install the protective device in the panel board. UL conducted the prescribed testing and recorded test results which included photos of test setup for reference.

The performance testing referenced in this report were conducted according to the following Standard(s):

1. UL 1699 - Arc-Fault Circuit-Interrupters, Edition 3, Revision Date 02/09/2022.
2. UL 943 - Ground Fault Circuit Interrupters, Edition 5, Revision Date 02/23/2018.

The testing was conducted over 5 days from 6/13/22 to 6/17/22 at UL Melville, NY. All Testing under this project No. 4789739784 Verification Services have been completed.

Five circuit breaker protective device/panel board manufacturers will be referred to as circuit breaker manufacturer A through E and the two intentional radiator manufactures will be referenced as Y and Z.

Test session #	Intentional Radiator Mfr.	Test	Panelboard Size	AFCI/GFCI Type	Observations	Comments
Manufacturer A						
1.	Y	<ul style="list-style-type: none"> AFCI Operation inhibition tests 	<ul style="list-style-type: none"> Small panel 	<ul style="list-style-type: none"> Single-phase, Single Pole AFCI 	Test results meet requirement per UL 1699 Section 42.2	EMI Filter and Line Impedance test not conducted due to time constraints
2.	Z	<ul style="list-style-type: none"> 6mA Ground Fault Test 500 Ohm Ground Fault Test Resistance to False Tripping Test 	<ul style="list-style-type: none"> Medium panel 	<ul style="list-style-type: none"> Single-phase, Single Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
3.	Z	<ul style="list-style-type: none"> 6mA Ground Fault Test 500 Ohm Ground Fault Test Resistance to False Tripping Test 	<ul style="list-style-type: none"> Medium panel 	<ul style="list-style-type: none"> Single-phase, 2-Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
Manufacturer B						
4.	Z	<ul style="list-style-type: none"> Carbonized path arc interruption test Carbonized path arc clearing time test Point contact arc test Unwanted tripping tests 	<ul style="list-style-type: none"> Medium panel 	<ul style="list-style-type: none"> Single-phase, Single Pole AFCI 	Test results meet requirement per UL 1699 Section 40.3, 40.4, 40.4, 40.5, and 41.	
5.	Y	<ul style="list-style-type: none"> 6mA Ground Fault Test 500 Ohm Ground Fault Test Resistance to False Tripping Test 	<ul style="list-style-type: none"> Small panel 	<ul style="list-style-type: none"> Single-phase, Single Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
6.	Y	<ul style="list-style-type: none"> 6mA Ground Fault Test 500 Ohm Ground Fault Test Resistance to False Tripping Test 	<ul style="list-style-type: none"> Small panel 	<ul style="list-style-type: none"> Single-phase, 2-Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
7.	Y	<ul style="list-style-type: none"> 6mA Ground Fault Test 500 Ohm Ground Fault Test Resistance to False Tripping Test 	<ul style="list-style-type: none"> Small panel 	<ul style="list-style-type: none"> Single-phase, Single-Pole Dual Function AF/GF 	Test results meet requirement per UL 943 Section 6.7	

Manufacturer C						
8.	Y	<ul style="list-style-type: none"> • Carbonized path arc interruption test • Carbonized path arc clearing time test • Point contact arc test • Unwanted tripping tests 	<ul style="list-style-type: none"> • Medium panel 	<ul style="list-style-type: none"> • Single-phase, Single Pole AFCI 	Test results meet requirement per UL 1699 Section 40.3, 40.4, 40.4, 40.5, and 41.	
9.	Z	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Small panel 	<ul style="list-style-type: none"> • Single-phase, Single Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
10.	Z	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Small panel 	<ul style="list-style-type: none"> • Single-phase, 2-Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
11.	Z	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Small panel 	<ul style="list-style-type: none"> • Single-phase, Single-Pole Dual Function AF/GF 	Test results meet requirement per UL 943 Section 6.7	
Manufacturer D						
12.	Z	<ul style="list-style-type: none"> • AFCI Operation inhibition tests 	<ul style="list-style-type: none"> • Medium panel 	<ul style="list-style-type: none"> • Single-phase, Single Pole AFCI 	Test results meet requirement per UL 1699 Section 42.2	EMI Filter and Line Impedance test not conducted due to time constraints
13.	Y	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Small panel 	<ul style="list-style-type: none"> • Single-phase, Single Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
14.	Y	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Small panel 	<ul style="list-style-type: none"> • Single-phase, 2-Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	

Manufacturer E						
15.	Z	<ul style="list-style-type: none"> • Carbonized path arc interruption test • Carbonized path arc clearing time test • Point contact arc test • Unwanted tripping tests 	<ul style="list-style-type: none"> • Small panel 	<ul style="list-style-type: none"> • Single-phase, Single Pole AFCI 	Test results meet requirement per UL 1699 Section 40.3, 40.4, 40.4, 40.5, and 41.	
16.	Y	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Medium panel 	<ul style="list-style-type: none"> • Single-phase, Single Pole GFCI 	Test results meet requirement per UL 943 Section 6.7	
17.	Y	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Medium panel 	<ul style="list-style-type: none"> • Single-phase, 2-Pole 	Test results meet requirement per UL 943 Section 6.7	
18.	Y	<ul style="list-style-type: none"> • 6mA Ground Fault Test • 500 Ohm Ground Fault Test • Resistance to False Tripping Test 	<ul style="list-style-type: none"> • Medium panel 	<ul style="list-style-type: none"> • Single-phase, Single-Pole Dual Function AF/GF 	Test results meet requirement per UL 943 Section 6.7	