



GIRL,

FAULT

INTERRUPTED

whoami



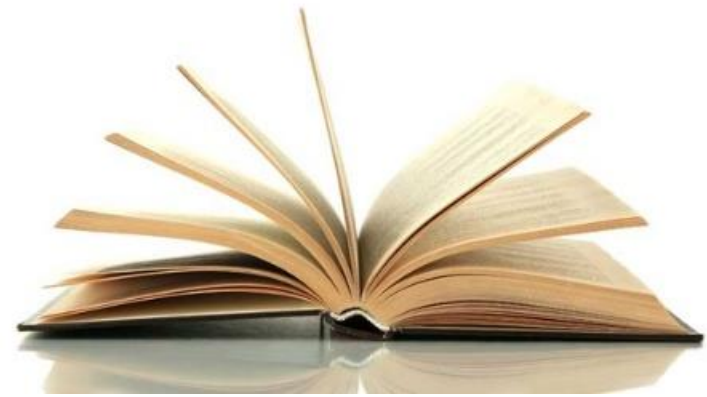
Maggie Jauregui
@magsjauregui







**TECNOLÓGICO
DE MONTERREY®**





DISCLAIMERS



Ideas/research
my own...

IMPORTANT
MESSAGE
TO
CONSUMERS



THIS MESSAGE ABOUT
GROUND FAULT CIRCUIT INTERRUPTERS
CAN SAVE A LIFE

Please read reverse side.

(3294A) Printed in China

⚠ ATTENTION

The GFCI Trip Test must occur to allow proper spa function. Within 24 hours of startup, the spa will trip the GFCI to test it. Be sure to notify and train the customer to reset the GFCI once it has been tripped. After passing the GFCI Trip Test, subsequent GFCI trips will indicate a ground fault or other unsafe condition requiring the power to the spa to be shut off.

The installer can cause the GFCI Trip Test to occur sooner by initiating it with a button sequence. *Note: The Temp button can be any button which controls the water temperature (Up, Down, Warm, Cool, Temp, Thermometer icon, etc).* Press "Temp", then "Jets 1", then "Light." Press the "Temp" button repeatedly until gFC is displayed. Press "Jets 1" to select it.

Press the "Temp" button until Gt.n is displayed. Press "Jets 1" to initiate the GFCI Trip Test. The GFCI should trip within several seconds and the spa should shut down. If it does not, shut down the power and manually verify that a GFCI breaker is installed and that the circuit and spa are wired correctly. Verify the function of the GFCI with its own test button. Restore power to the spa and repeat the GFCI Trip Test.

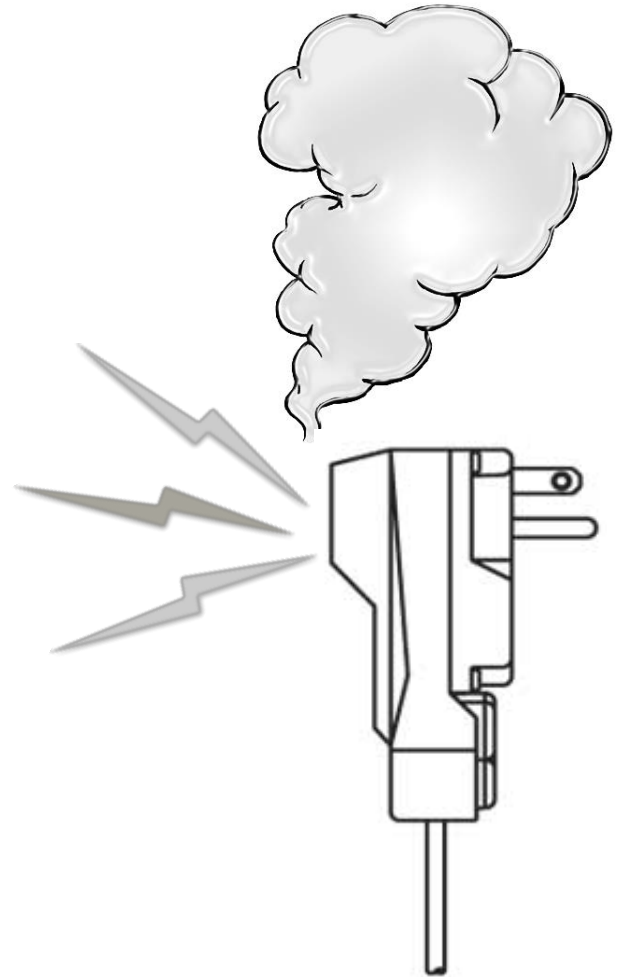
Once the GFCI is tripped by the test, reset the GFCI and the spa will operate normally from that point. You can verify a successful test by navigating to the gFC Item as described above, pressing "Jets 1" and then pressing the "Temp" button until you see gS.P, a code that signifies GFCI Status - Passed.

The system will exit this menu in 30 seconds if no buttons are pressed.

⚠ Warning: The GFCI Trip Test does NOT take the place of training the customer to locate, test and reset the GFCI on a regular basis to verify its function.

This label may be removed after the GFCI Trip Test has been successfully completed.

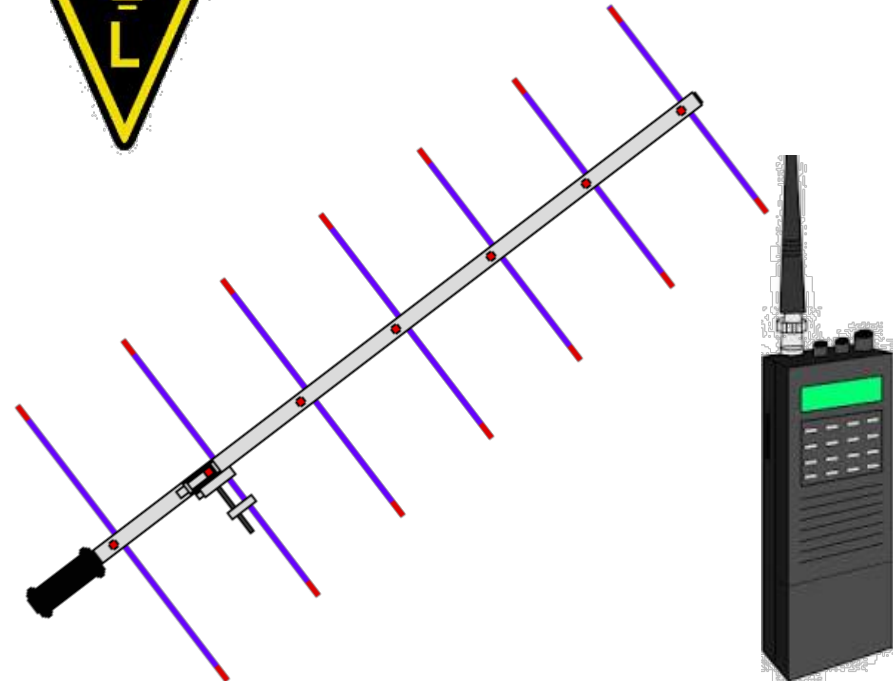
Story time!



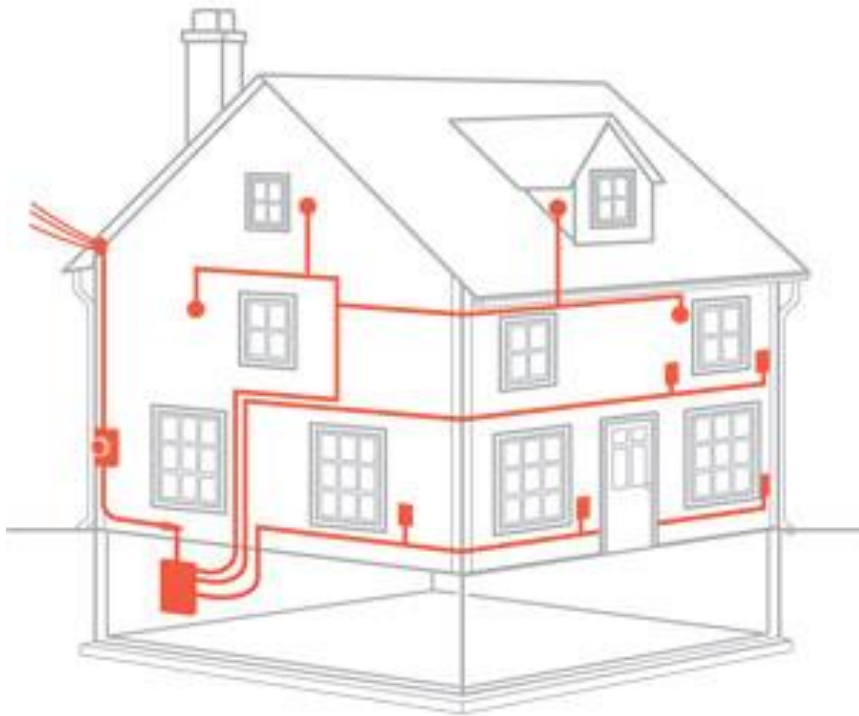
Supply Acquisition



ARRL
The national association for
AMATEUR RADIO



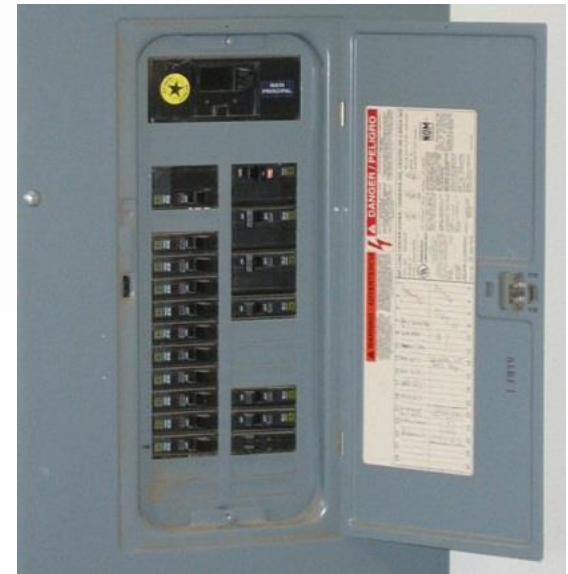
Circuit Interrupts around the house



GFCI



AFCI



≠ Purposes

GFCI: Intends to prevent Electric Shock



AFCI: Intends to prevent fires



Code Requirements



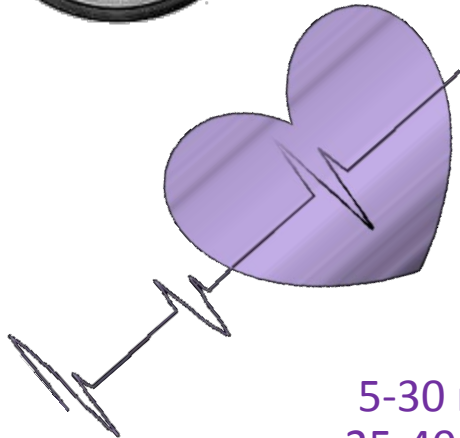
GFCI's

- Bathrooms/Indoor wet locations
- Garages/storage areas/non habitable areas/unfinished basements
- Outdoors/Compartments accessible from outside the unit/Rooftops/ Pools/Hot tubs
- Crawl spaces at or below grade level
- Kitchen [dish washer, Refrigerator]
- Laundry Areas

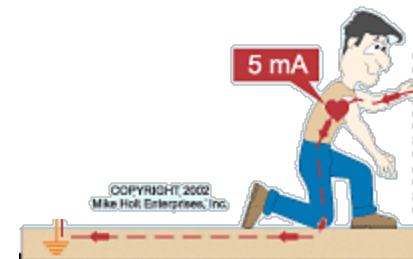
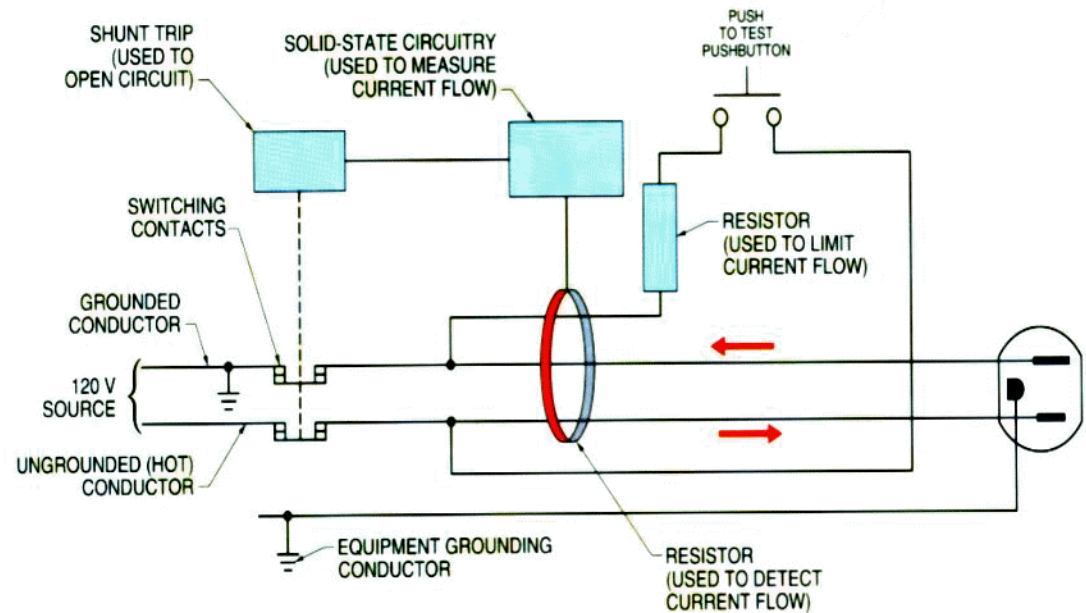
AFCI's

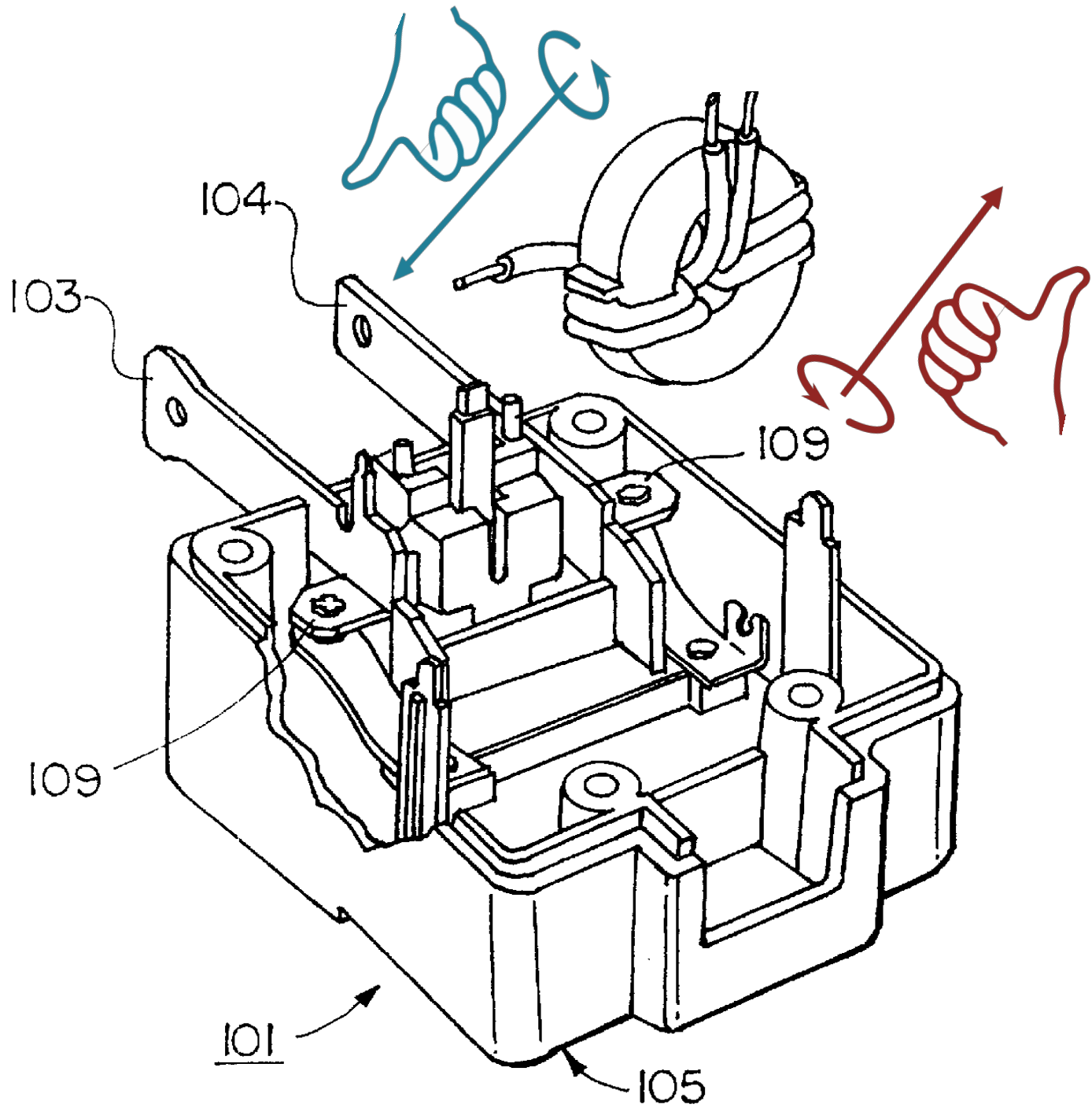
- Kitchens
- Family Rooms
- Dining Rooms
- Living Rooms
- Parlors
- Libraries
- Dens
- Bed rooms
- Sun rooms
- Recreation Rooms
- Closets/Hallways
- Laundry Areas
- Or similar rooms

Ground Fault Circuit Interrupt GFCI



5-30 mA
25-40 ms





Solenoid

U.S. Patent

Aug. 24, 1999

Sheet 3 of 8

5,943,199

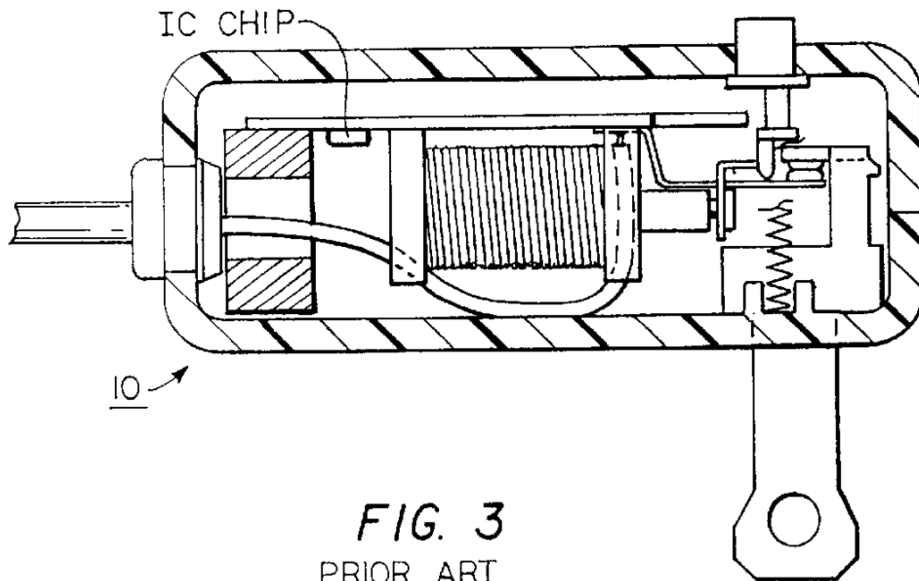


FIG. 3
PRIOR ART

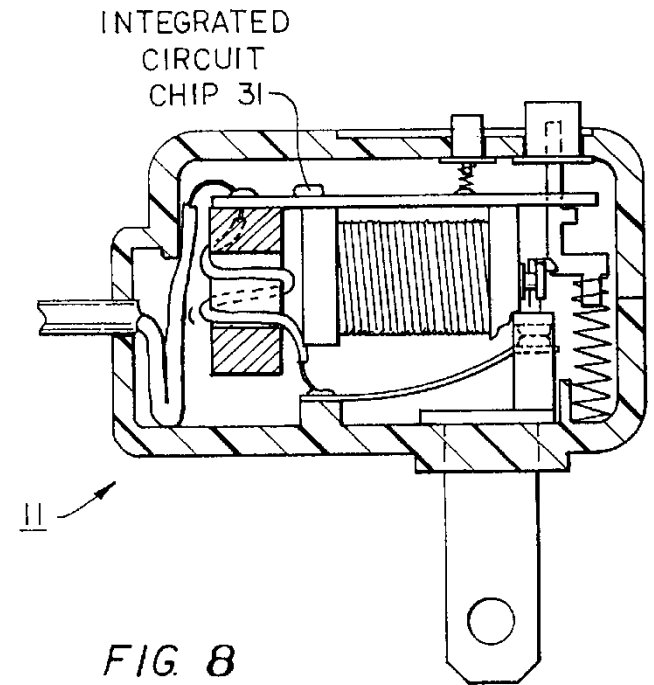
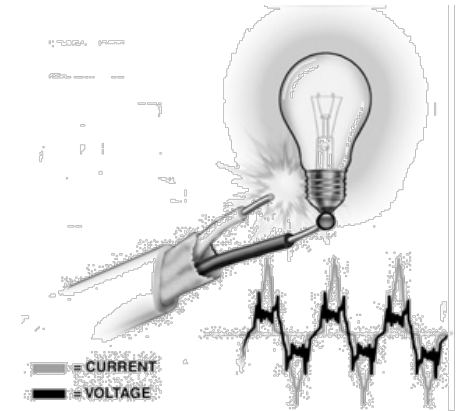
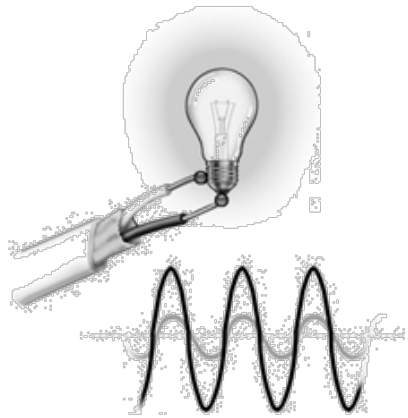


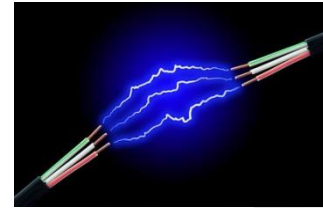
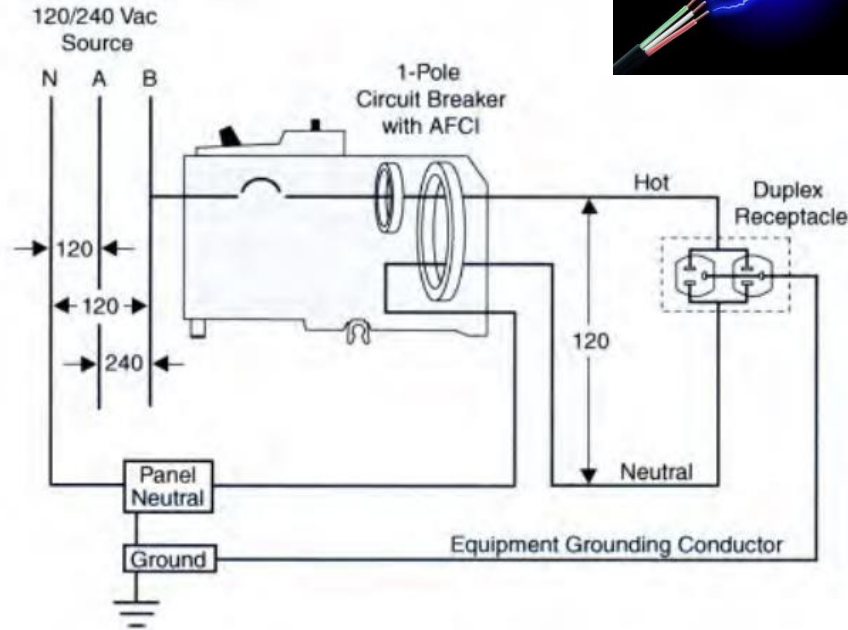
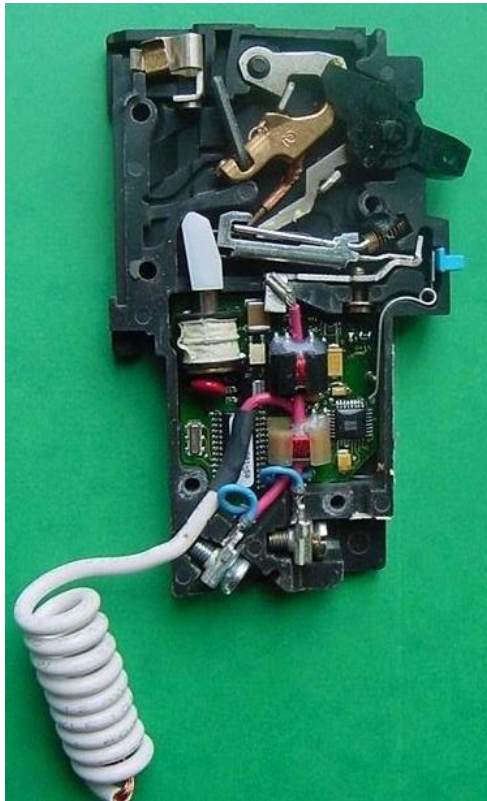
FIG. 8

Arc Fault



Circuit Interrupt

AFCI



GFI Demos 😊

Magic Smoke - Closed

<https://www.youtube.com/watch?v=wdIDoE3rV9M>

Internal Spark

<https://www.youtube.com/watch?v=E-fKU9MvDjg>

Close range Outlet trip

https://www.youtube.com/watch?v=21UeF_cHRxU

Close range Outlet trip

<https://www.youtube.com/watch?v=7yw-DV2URE0>

GFCI Outlet Trip through RF

<https://www.youtube.com/watch?v=lpzHTYNK52Y>

Across Walls

<https://www.youtube.com/watch?v=30t50Hs0pZM>

“Remote”

<https://www.youtube.com/watch?v=fKxL1MMLe0I>

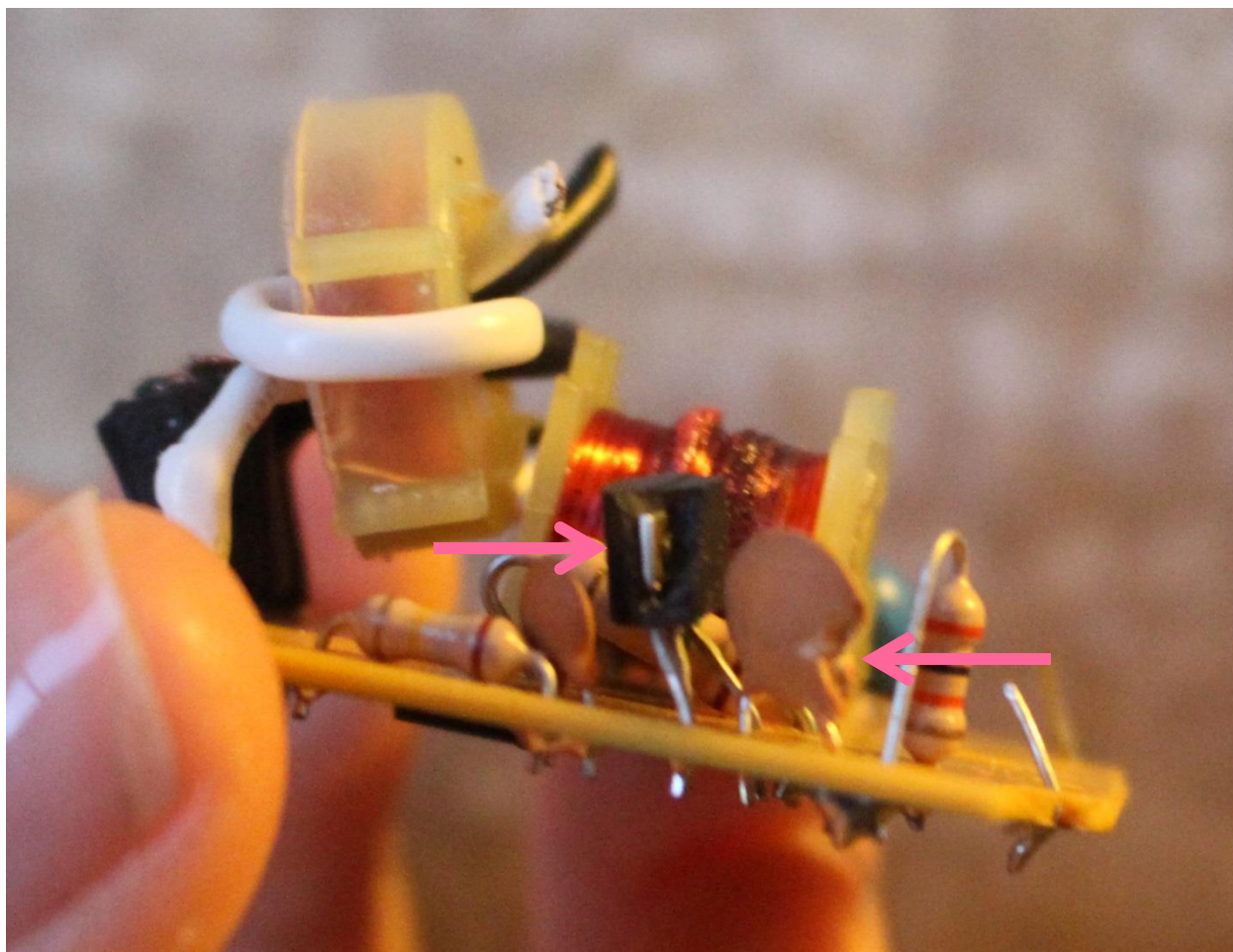
Magic smoke

<https://www.youtube.com/watch?v=Nt6HiCsAKhw>

Flaming flying components 😊

<https://www.youtube.com/watch?v=S16zuJACdds>

Result



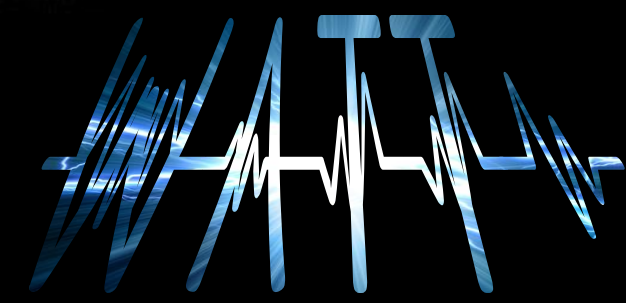
Fried GFCI

<https://www.youtube.com/watch?v=dnIJeakOugc>



Turn Down

For



AFCI Breakers vs. HAM Radio

<https://www.youtube.com/watch?v=JsILD0Fce1s>

0:22 & 5:47

AFCI Breakers vs. HAM Radio

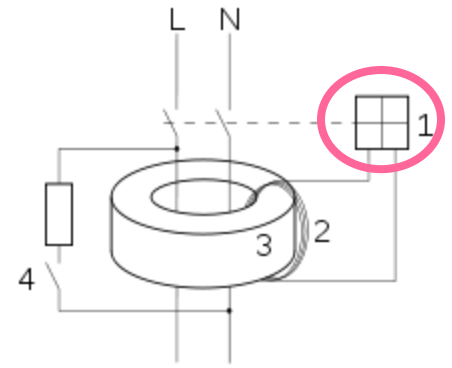
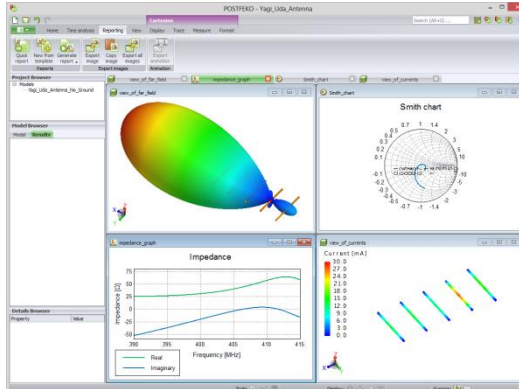
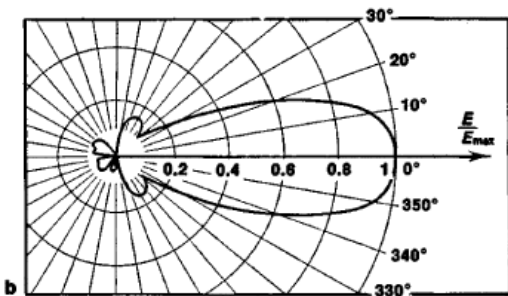
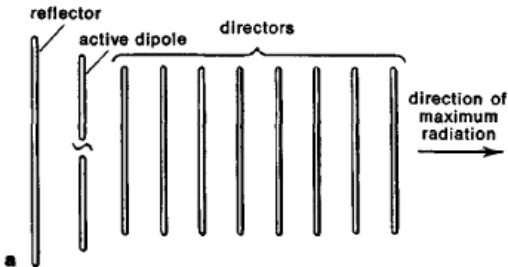
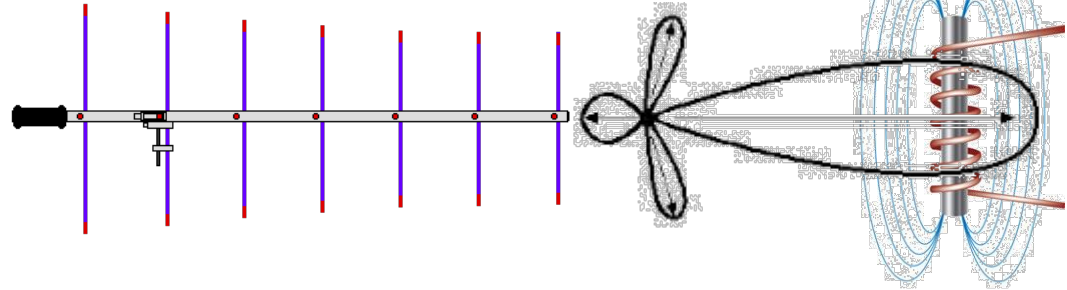
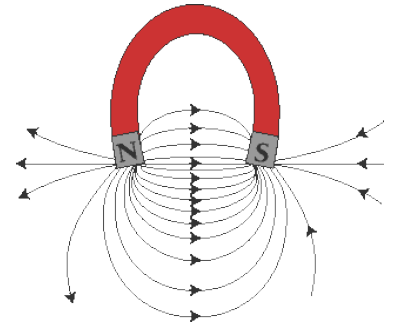
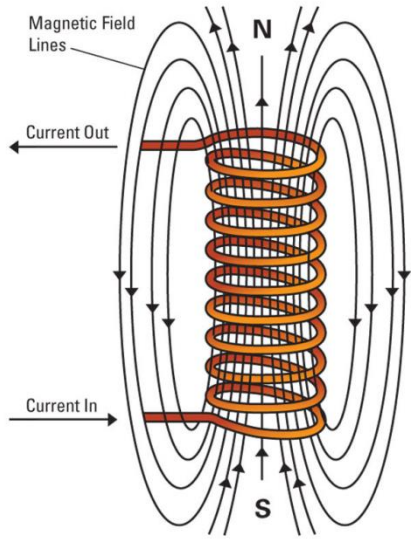


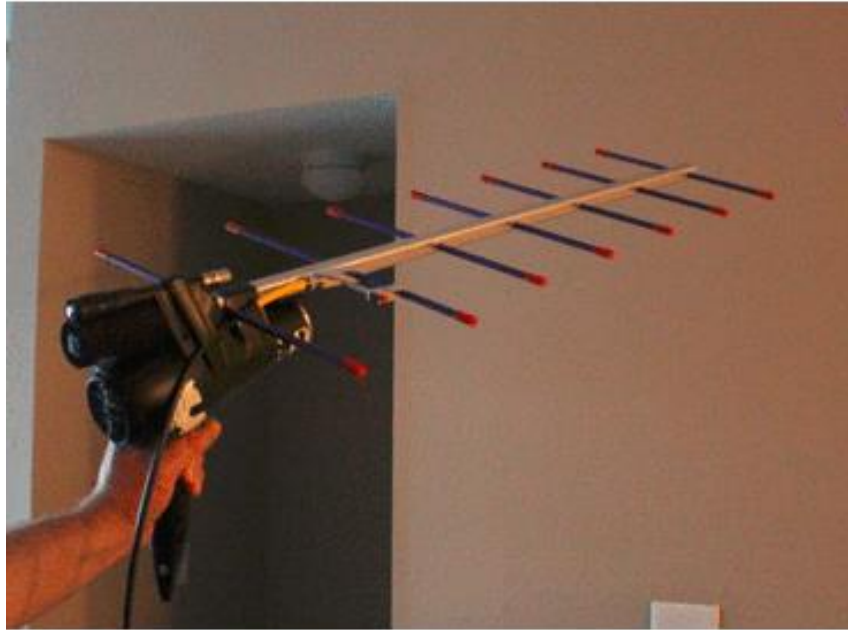
The screenshot shows the ARRL website interface. At the top left is the ARRL logo, a diamond shape containing a stylized antenna and the letters 'A', 'R', 'R', 'L'. To its right is the text 'ARRL The national association for AMATEUR RADIO®'. On the top right, there is a 'Site Login' section with fields for 'Username' and a password, and buttons for 'Login', 'Forgot Password?', and 'Register'. Further right is a 'Website Search' section with a 'Keyword' field and a 'Search' button. Below the header is a navigation menu with buttons for 'Home', 'On The Air', 'Licensing, Education & Training', 'Membership', 'Regulatory & Advocacy', 'Public Service', 'Technology', 'Get Involved', and 'ARRL Store'. The main content area is titled 'News' and features a sidebar on the left with links to 'ARRL Audio News', 'Features and Columns', 'ARRL Periodicals Archive Search', 'QST', 'QEX', 'NCJ', 'ARRL Letter', and 'News Tips'. The main article is titled 'ARRL Helps Manufacturer to Resolve Arc Fault Circuit Interrupter RFI Problems' and is dated '11/19/2013'. The article text discusses the ARRL Lab's work with a manufacturer to resolve complaints that Amateur Radio RF was causing certain AFCI breaker models to trip unnecessarily. It explains that AFCIs are safety devices designed to detect potentially hazardous arc faults that result from often unseen damage or poor connections in wiring and in extension cords and cord sets. A quote from Mike Gruber, W1MG, the ARRL Lab's EMC specialist, notes that the issue has been a topic of online ham radio discussions as well as on homeowner sites; it seems that stray RF is not the only thing that can cause a "nuisance trip" of an AFCI. Gruber pointed out that the National Electrical Code (NEC) already requires AFCIs in some household circuits, but not all US jurisdictions have adopted the requirement.

<http://www.arrl.org/news/arrl-helps-manufacturer-to-resolve-arc-fault-circuit-interrupter-rfi-problems>

So what's going on?

Electromagnetism







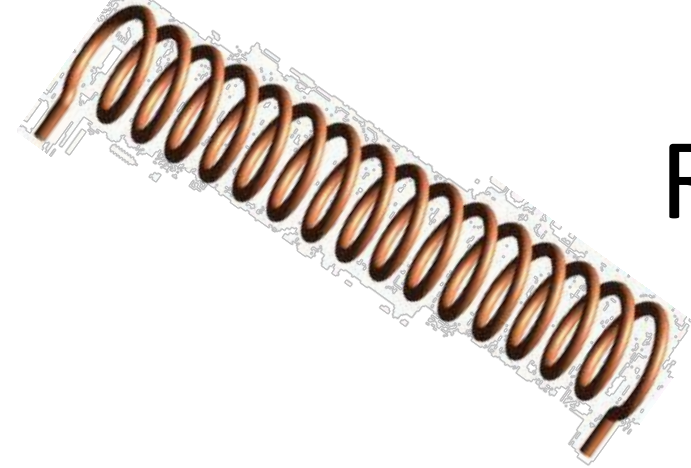
It MHz...

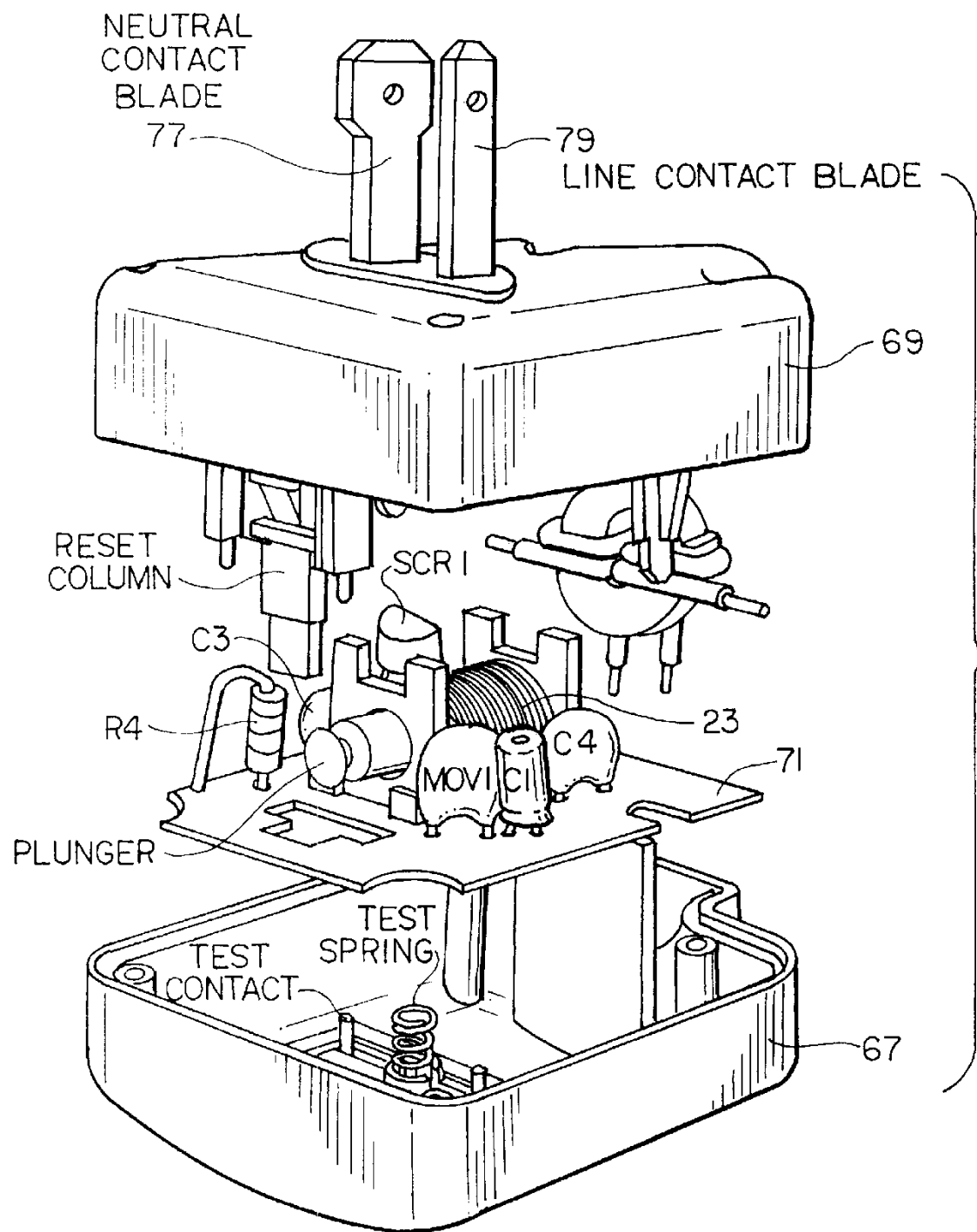
Resonance 🎵

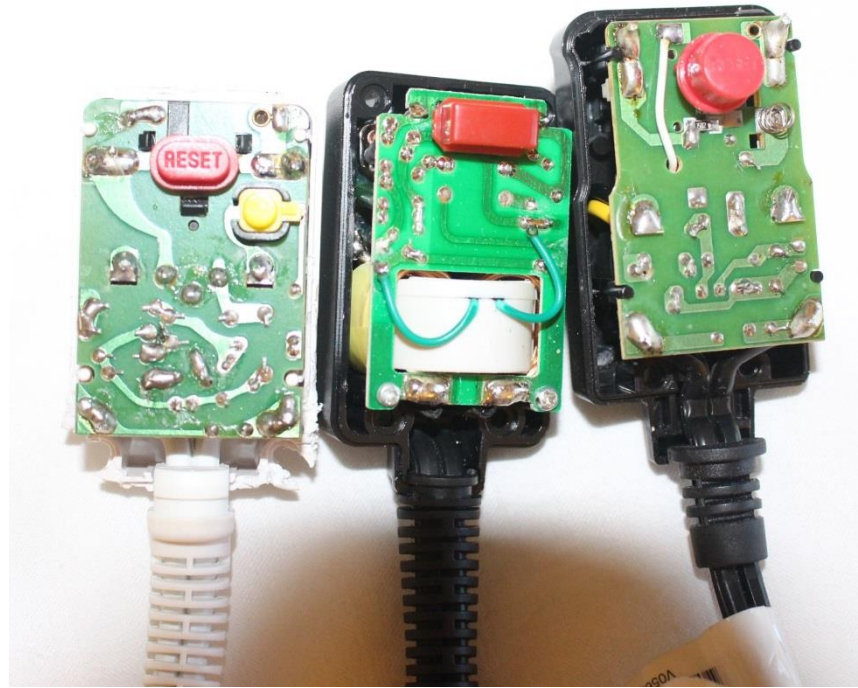
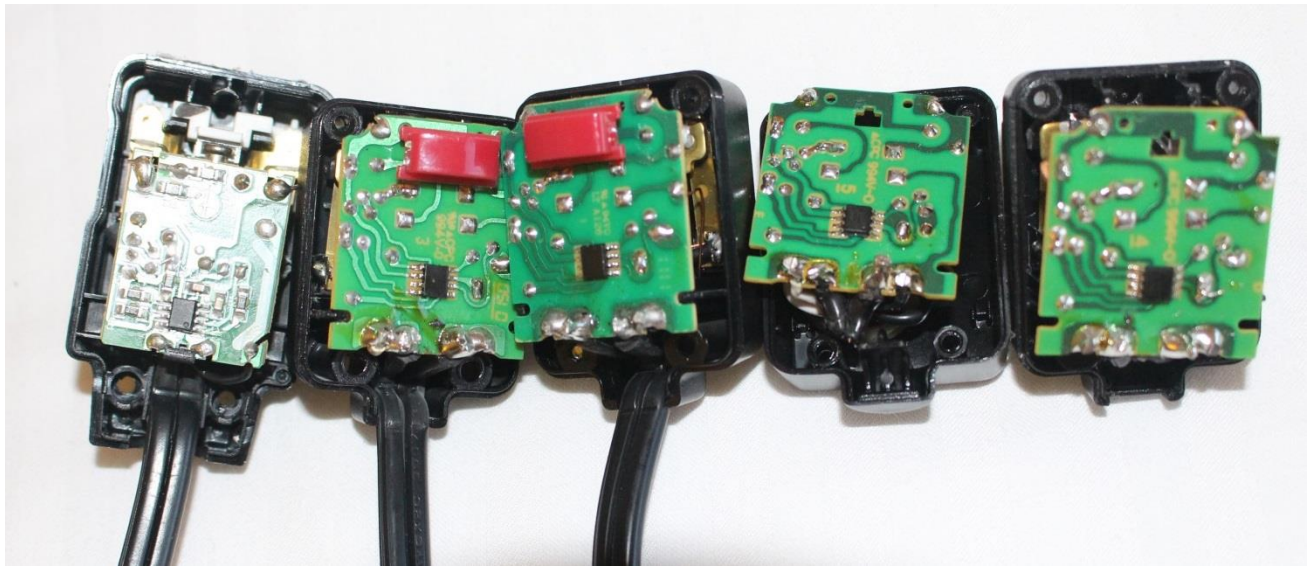
Defined by: Resistance, Inductance & Capacitance

A coil will resonate to its fundamental frequency
(or harmonics)

US AC works @ 60 Hz



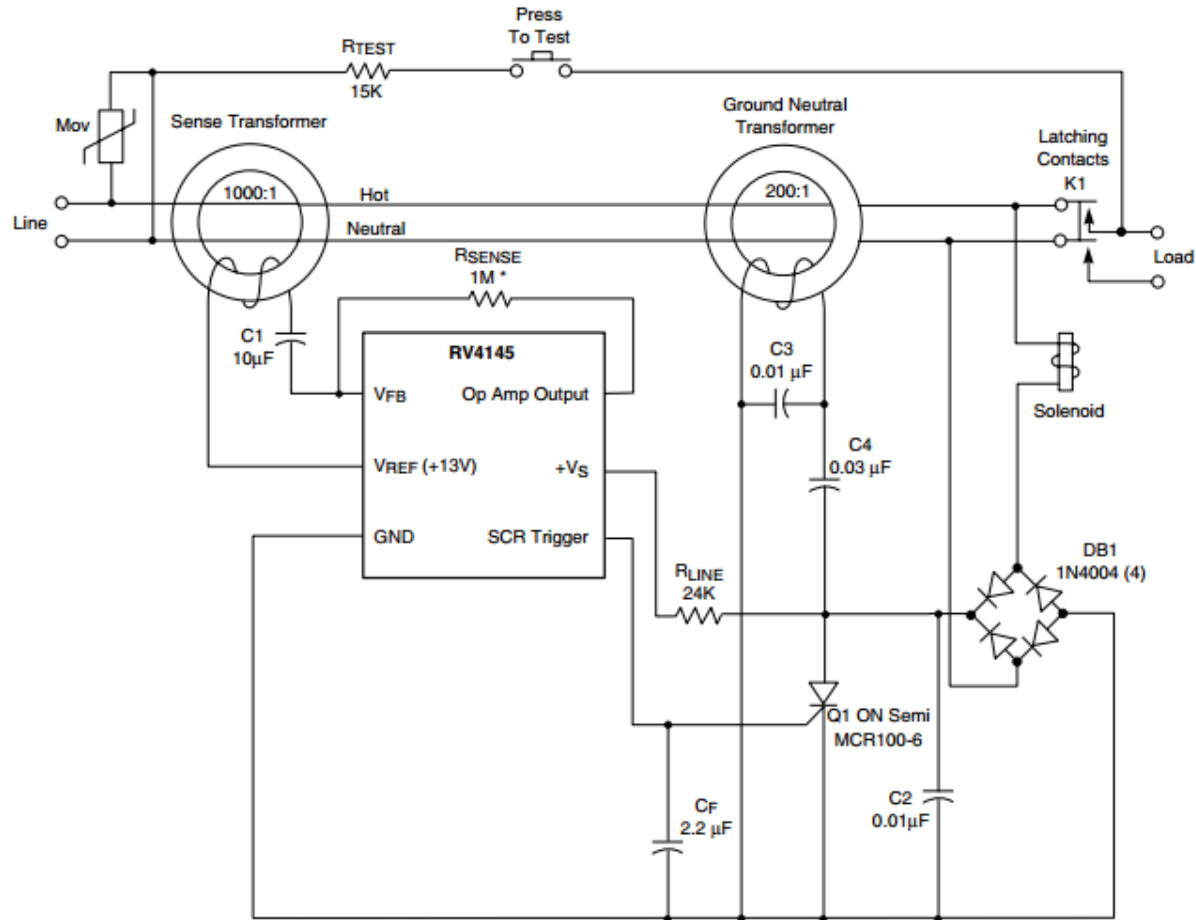




Low Power GFI

RV4145A

PRODUCT SPECIFICATION



65-4145A-03

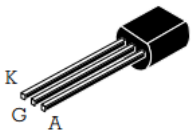
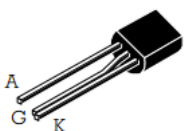
* Value depends on transformer characteristics.

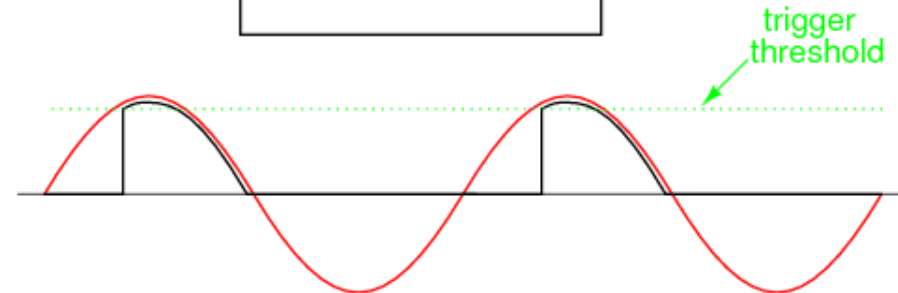
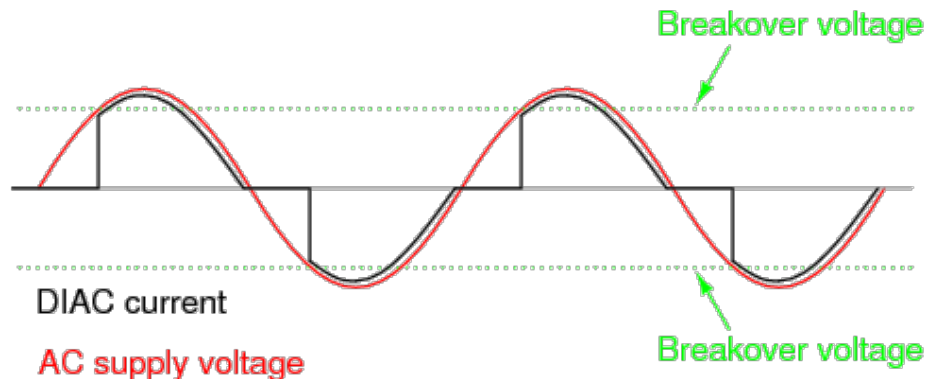
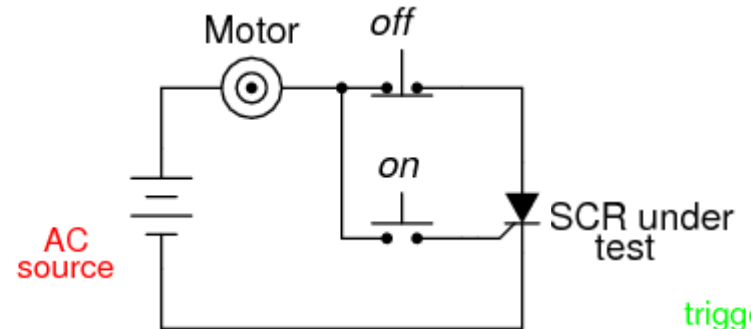
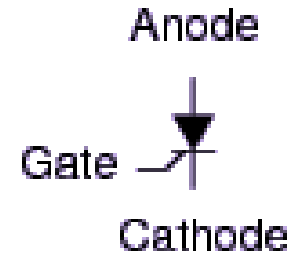
Figure 1. GFI Application Circuit (Three-Wire Outlet)

SCR's

Silicone Controlled Rectifiers

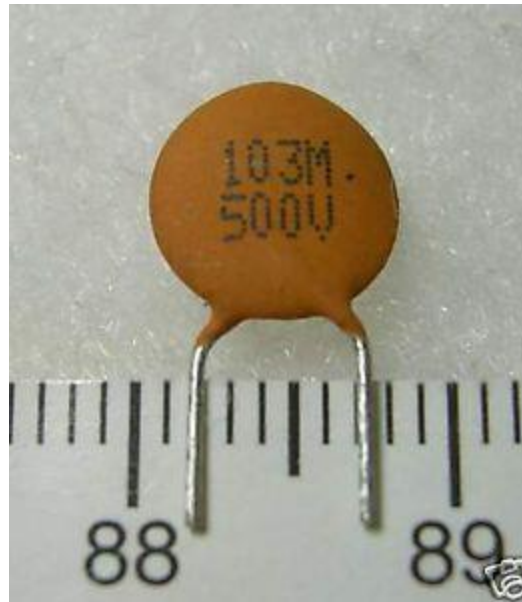
SENSITIVE GATE SCR

<p>TO92 (Plastic)</p>  <p>FS01...A</p>	<p>RD26 (Plastic)</p>  <p>FS01...B</p>	<p>On-State Current 0.8 Amp</p> <p>Gate Trigger Current < 200 μA</p> <p>Off-State Voltage 200 V \div 600 V</p>
<p>This series of Silicon Controlled Rectifiers uses a high performance PNP technology.</p> <p>This part is intended for general purpose applications where high gate sensitivity is required.</p>		

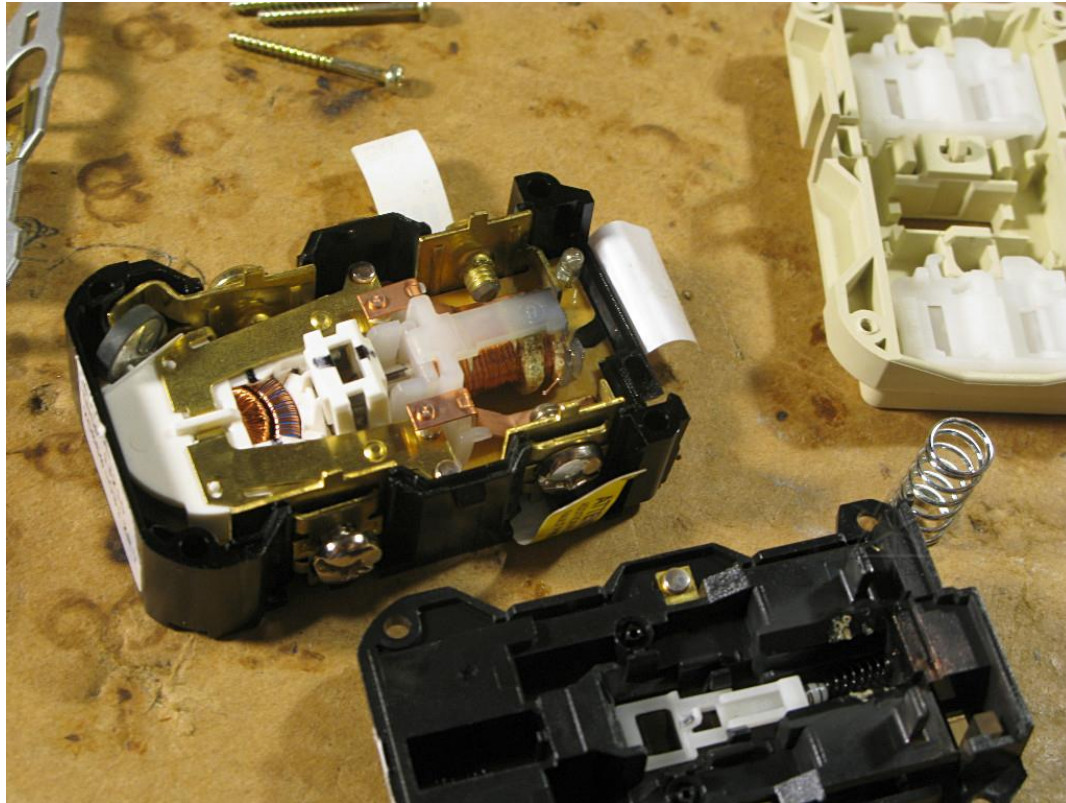


Ceramic Capacitor

- 0.01 μF
- Overheating, over current, short-circuit



GFI Power Outlets

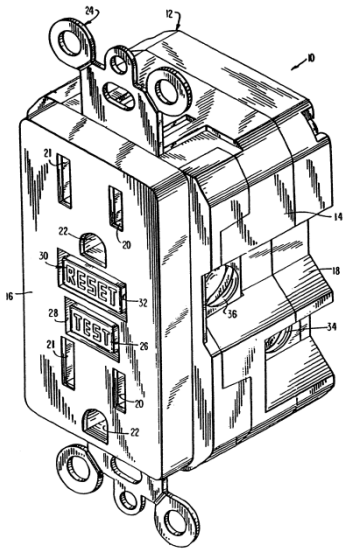


Patents

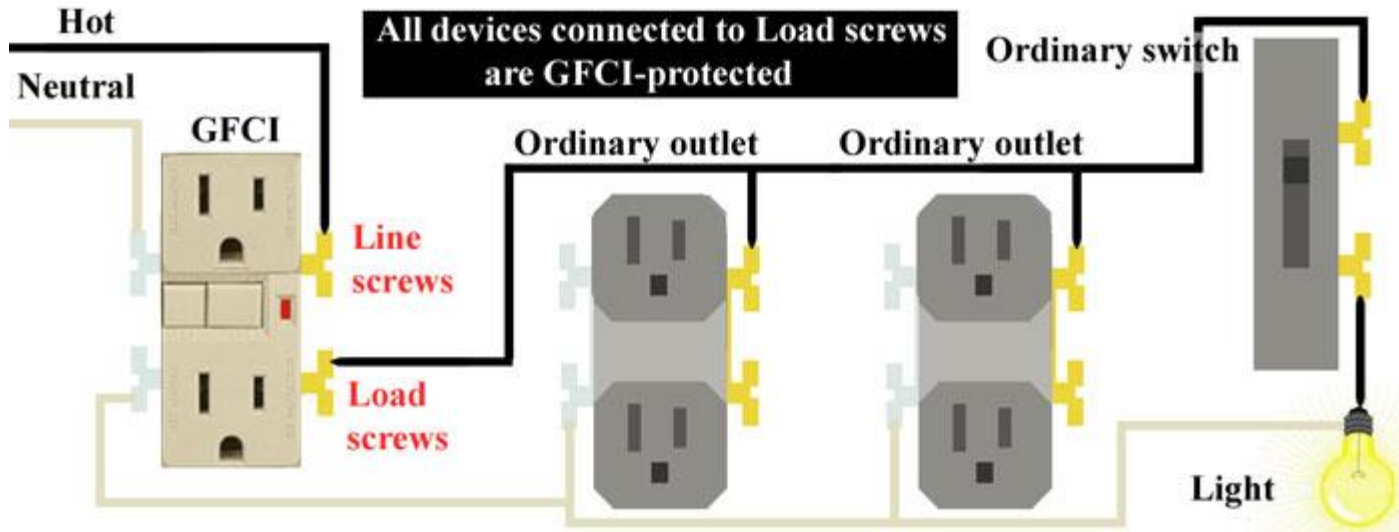
Impacted?	Count	Year	Brand	Country	Models
Y	12	1999	Tower Switches Limited	China	303 52
Y	2	2007	Luen Ming	China	LA5s, LA5D, LA5D-EMC, LA5S-EMC
Y	4	2008	Leviton	USA	B513-522
N	2	2013	Zhongshan Kaper Electrical Co.,LTD	China	XY421-DV5
N	1	2012	Wellong	China	P10D, P10S
N	1	2012	Luen Ming	China	LA2S, LA2D, LA3S, LA3D.

Certificate	Link
US5943199 A	https://www.google.com/patents/US5943199?dq=5943199&hl=en&sa=X&ei=S6rlU4PvEtLpoASNq4CYBQ&ved=0CBwQ6AEwAA
E256185	http://www.luenming.com.hk/index_topic.php?did=76074&didpath=/75489/76074
US7463124 B2	https://www.google.com/patents/US7463124?dq=7463124&hl=en&sa=X&ei=e7flU9-pM4X6oATjpoCwDw&ved=0CBwQ6AEwAA
UL E212530	http://yanyao1984.en.ec21.com/XY421-DV5--2830573_2948868.html
E130151	http://www.olilio.com/file/detail/AUHG2.E130151.html
E256185	http://www.olilio.com/file/detail/AUHG2.E256185.html





Other scenarios...



Relevance?

- RFI can be accidental or intentional
- RFI is wireless and fingerprint free
- Annoying DoS/Neighbor trolling
- Services/Devices that matter: Medical Equipment

Recent GFCI News ☹️

Electrocution causes death of 8 year old boy

July 28th, 2014 – Lake Conroe, Texas

He said investigators discovered the faulty wiring on the dock at the Piney Shores Resort near League Line Road where the boy sat before falling in the water feet first. The boy was only in the water about 15 seconds before his father pulled him from the lake and began CPR. The boy was later pronounced dead at Memorial Herman Hospital in Houston.

According to Nancy Mikeska, the Montgomery County Sheriff's Office requested the city inspect the dock as part of the investigation. Mikeska said the resort and the dock are in the city limits.

"Inspectors inspected the dock and made a determination that the wiring was not to city code and was dangerous and shut the power off to the dock," she said. "The GFIs appeared to malfunction and continued to run hot."

http://www.yourhoustonnews.com/courier/news/police-electrocution-may-have-caused-death-of--year-old/article_0c6c4b56-6c57-5796-9ccb-b25bb025f780.html

Suggested Solutions

- Test your GFCI's often
- Update to newer Circuit Breaker Patents
- Back ups:
 - Power Generators
 - Batteries
 - Manual Overrides
- Grounded FC encasing

LIVE Demos

Acknowledgements

- Carlos Abad
- Larry Averitt
- Michael Demeter
- Rafael Jauregui
- Habteab Yemane
- Michael Reams
- Chris Mitchell
- Laplinker ♡



Bloopers

<https://www.youtube.com/watch?v=3RvvFFfQZt8>

Thanks

