DC Ground Detection

THE EVOLUTION OF A RESISTIVE JUMPER

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Disclaimer:

The purpose of this presentation is to encourage consideration into the nature of DC circuits. The content of this presentation is not meant to suggest any particular methodology.

*If you leave this class with a broader understanding of DC circuits and / or grounds, then the presentation will have performed its function.*
How the creation of a home-made tool led to a better understanding of DC circuits and DC grounds.
MY BACKGROUND:

- Navy Nuclear Electrician 83 – 89.
- IBEW Wireman LMSC (Sunnyvale, Ca.) 89 – 92.
- Metering Electrician City of Palo Alto 92 – 01.
- Meterman Portland General Electric 01 – 06.
- Meter/Relay Technician Portland General Electric 06 – present.
- Apprentice Instructor 93 – present.
- Lectured at NW Meter School approximately 12 years.
ORIGINS OF THE RESISTIVE JUMPER

MANUALLY ASSERTING INPUTS

POSITIVE TO NEGATIVE SHORT

FUSE BLOWN.
DAMAGE TO SCREW.
DAMAGE TO JUMPER.

FUSES ONLY LIMIT TIME OF FAULT.
WHY NOT LIMIT CURRENT?
LIMITING FAULT CURRENT

\[ E^2 / R = 130V^2 / 1200\Omega \approx 14 \text{ WATTS} \]

\[ E / R = 130V / 1200\Omega \approx 0.11 \text{ AMPS} \]

*DIRECT POSITIVE TO NEGATIVE SHORT RESULTS IN A .11 AMP 14 WATT INSTANTANEOUS EVENT*
CONDUCTOR IDENTIFICATION
CIRCUIT IDENTIFICATION
YELLOW-LINE OF A LOCKOUT CIRCUIT

DE-ENERGIZED!
VERIFYING INPUT CIRCUITS

MORE TO FOLLOW ON INPUTS...

\[ \text{VDC MODE} = 123.4 \text{ VDC} \]

\[ \mu \text{AMPS MODE} = 12.42 \mu \text{A} \]

\[ 123.4 \text{ VDC} / 12.42 \mu \text{A} = 10 \text{M}\Omega \]

\[ \text{INPUT OHMS} = 10,000,000 / 64 \approx 150 \text{ K}\Omega \]
VERIFYING INPUT CIRCUITS (CONTINUED)
VERIFYING INPUT CIRCUITS  (CONTINUED)
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## VERIFYING INPUT CIRCUITS (CONTINUED)

<table>
<thead>
<tr>
<th>RELAY</th>
<th>APPLIED VOLTAGE</th>
<th>CURRENT THRU INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>751A</td>
<td>20V DC</td>
<td>.1 µA</td>
</tr>
<tr>
<td></td>
<td>40V</td>
<td>.13 µA</td>
</tr>
<tr>
<td></td>
<td>60V</td>
<td>.15 µA</td>
</tr>
<tr>
<td></td>
<td>70V</td>
<td>.17 µA</td>
</tr>
<tr>
<td></td>
<td>74V</td>
<td>.19 µA</td>
</tr>
<tr>
<td></td>
<td>76V</td>
<td>9.2 µA</td>
</tr>
<tr>
<td></td>
<td>78V</td>
<td>85 µA</td>
</tr>
<tr>
<td></td>
<td>80V</td>
<td>170 µA</td>
</tr>
<tr>
<td></td>
<td>84V</td>
<td>340 µA</td>
</tr>
</tbody>
</table>

Asserted = 87 V @ 500 µA (.5 MA)

| 551   | 20V DC         | 596 µA             |
|       | 40V            | 1227 µA (1.2 MA)   |

Asserts ~39 VDC
GROUND LOCATION

DISCLAIMER:

THIS METHOD OF GROUND LOCATION COULD, IN THEORY, CAUSE A TRIP.
NORMAL DC VOLTAGES
IN A 125 VDC SUBSTATION
OLD-STYLE GROUND INDICATOR LIGHTS

NORMAL CONDITION

\[ P^2 / R = 11 \text{ WATTS} \]
\[ 130V^2 / R = 11 \text{ WATTS} \]
\[ 130V^2 / 11W = R = 3500\Omega \]

HARD POSITIVE GROUND
OLD-STYLE (CONTINUED)
OLD-STYLE (CONTINUED)

RESISTANCE GROUND

BLOWN BULB
TABOR SUBSTATION
TABOR SUBSTATION (CONTINUED)
TABOR SUBSTATION (CONTINUED)

BULB IN (+) ONLY

\[ G \approx 74 \text{ VDC} \]  \[ G \approx 60 \text{ VDC} \]

\( \approx 1500\Omega \)  \( \approx 1200\Omega \)

NO BULBS IN

\[ G \approx 128 \text{ VDC} \]  \[ G \approx 6 \text{ VDC} \]

\( \approx 1200\Omega \)  \( \approx 1200\Omega \)

BOTH BULBS

\[ G \approx 90 \text{ VDC} \]  \[ G \approx 44 \text{ VDC} \]

\( \approx 1500\Omega \)  \( \approx 1200\Omega \)
TABOR SUBSTATION (CONTINUED)
TRIPPING HAZARD
TRIPPING HAZARD
ARNETT DC SCOUT
DOBLE 6150 TEST SET & FLUKE 1750 POWER RECORDER
DOBLE 6150 TEST SET & FLUKE 1750 POWER RECORDER
MORE TO COME...

AUTHORIZED UP TO 10 VAC @ 180HZ

10 VOLTS / .002 AMPS = 5000Ω