Substation Ground Grid: Copper Theft Monitoring Systems

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CRESATECH

CuTS®

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April 6, 2016
PEG Conference
Monroe, LA

The problems caused by network metal theft

Metal theft from power delivery grounding networks creates multiple high-impact issues as well as both direct and indirect costs:

Safety
- Technicians,
- Police and first responders

Operations
- Direct costs of repairing damage and replacing infrastructure
- Additional engineering time and operations costs
- Service Outages

Indirect Costs
- Penalties and compensation
- Mobile generator deployment
- Public and regulatory pressure for fast resolution of issues

Substation copper theft

Theft from substations is mostly of grounding copper,
and is seen as an easy to harvest, low risk target

- First target is cable from ground grid
- Removal leaves much of site plant ungrounded
- Often majority of such connections are removed during a raid
- Perpetrator knowledge can be high
- Less organized thieves often get injured or worse
- Ground grid also damaged or partially removed

Safety issues resulting from substation theft

These images are from a 161 kV capacitor bank from which the grounds had been stolen. When the Transmission System Operator energized the ungrounded bank, the structure, including the anchor bolts, became energized. The path to ground was through the foundation

Safety issues resulting from substation theft

These images were taken of a single phase voltage regulator stand where the regulator neutral and stand grounds were stolen. The stand became energized at line potential and was energized when it was discovered. Voltage/current was seeking ground through the foundation. This was a potentially lethal event.

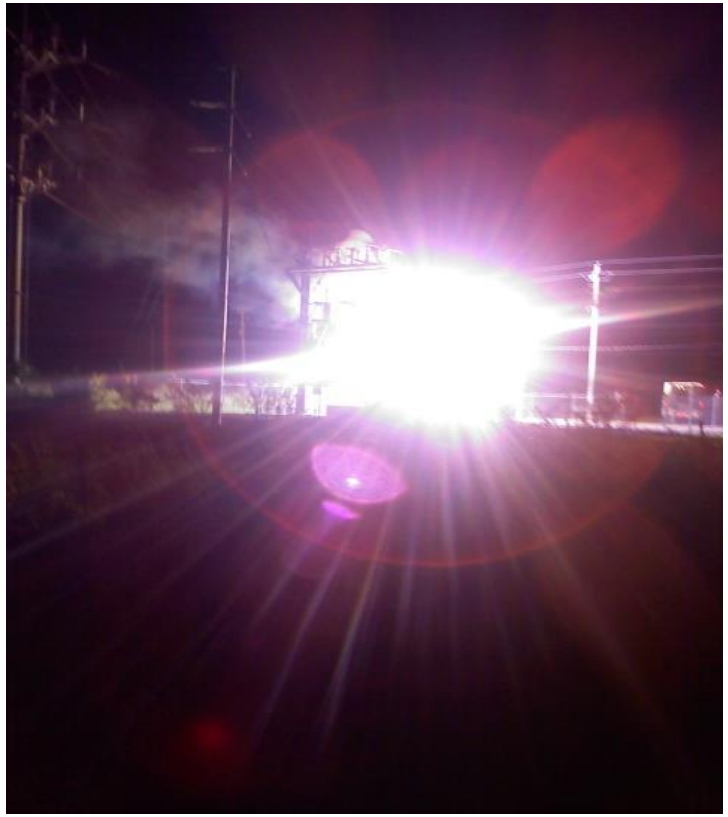
Safety issues resulting from substation theft

‘These photos were from a substation we found where the neutral and tank grounds were stolen from a 3750kva, 34 / 12 kv transformer. We discovered and replaced the grounds not knowing the damage that had occurred under the tank’.

Safety issues resulting from substation theft

‘When the transformer was removed, it was obvious that the current path was attempting to return to the source. The concrete foundation as well as the sub structure of the transformer showed significant damage’.

Safety issues resulting from substation theft



Significant and potentially more risky issues for customers occur at the delivery end of the network

This fault occurred when the neutral and grounds were stolen from a single phase voltage regulator.

Current Site Security Layers

Existing site security and deterrents fall into the following categories:

- **Those that prevent the thieves getting onto the site**
  Fences, locks, visible alarm systems

- **Detecting the thieves while on sites**
  CCTV, movement and sound sensors

- **Catching the thieves after the event**
  Smart water, dye ‘bombs’, printed cable sheathing

None of these methods detects the actual theft and ultimately the severe safety and operational risks of substation copper theft.

CuTS® Design Criteria agreed with Industry Sponsors

- Quick communication of removal event
- Difficult to circumvent
- Not to affect the integrity of the grounding systems
- Not susceptible to false alarms
- Suitable for installation in varying locations and environments
- Easy to install with no service down-time
- Easily integrate with existing site telemetry communications where present - SCADA
- Low Asset cost

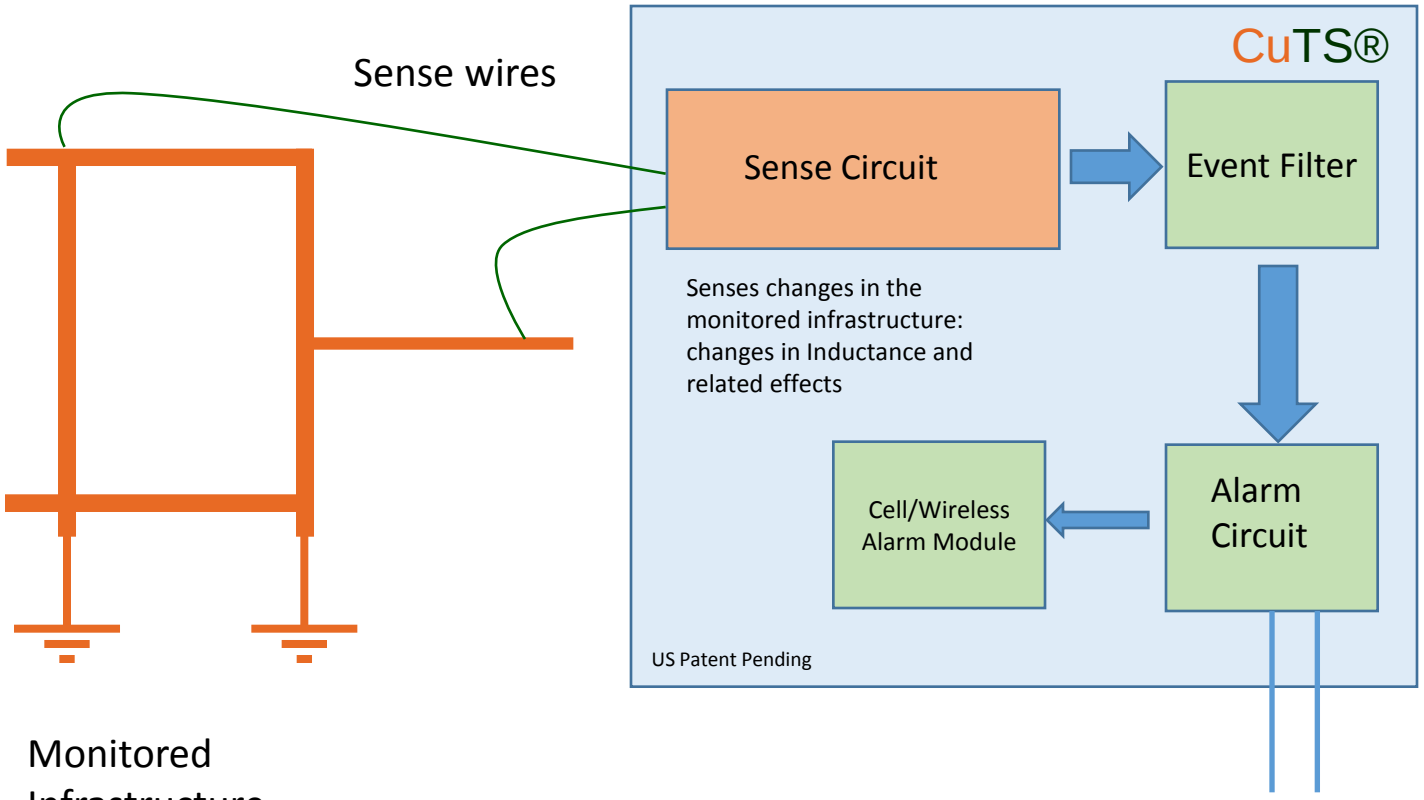
CuTS® Benefits Derived

- **Enhanced site safety** protects staff, first responders and the public from electrocution
- **Detect theft activity as it happens** minimizing exposure to associated safety and service risks
- **Reduced risk of consequential damage** across distribution network through to the delivery points
- **Maximize service continuity and customer service**. Provider can replace or repair site damage at earliest opportunity
- **Return on investment.** Calculated using a risk-based model to be between two and five years, depending on site and risks included in model.

How CuTS® Works

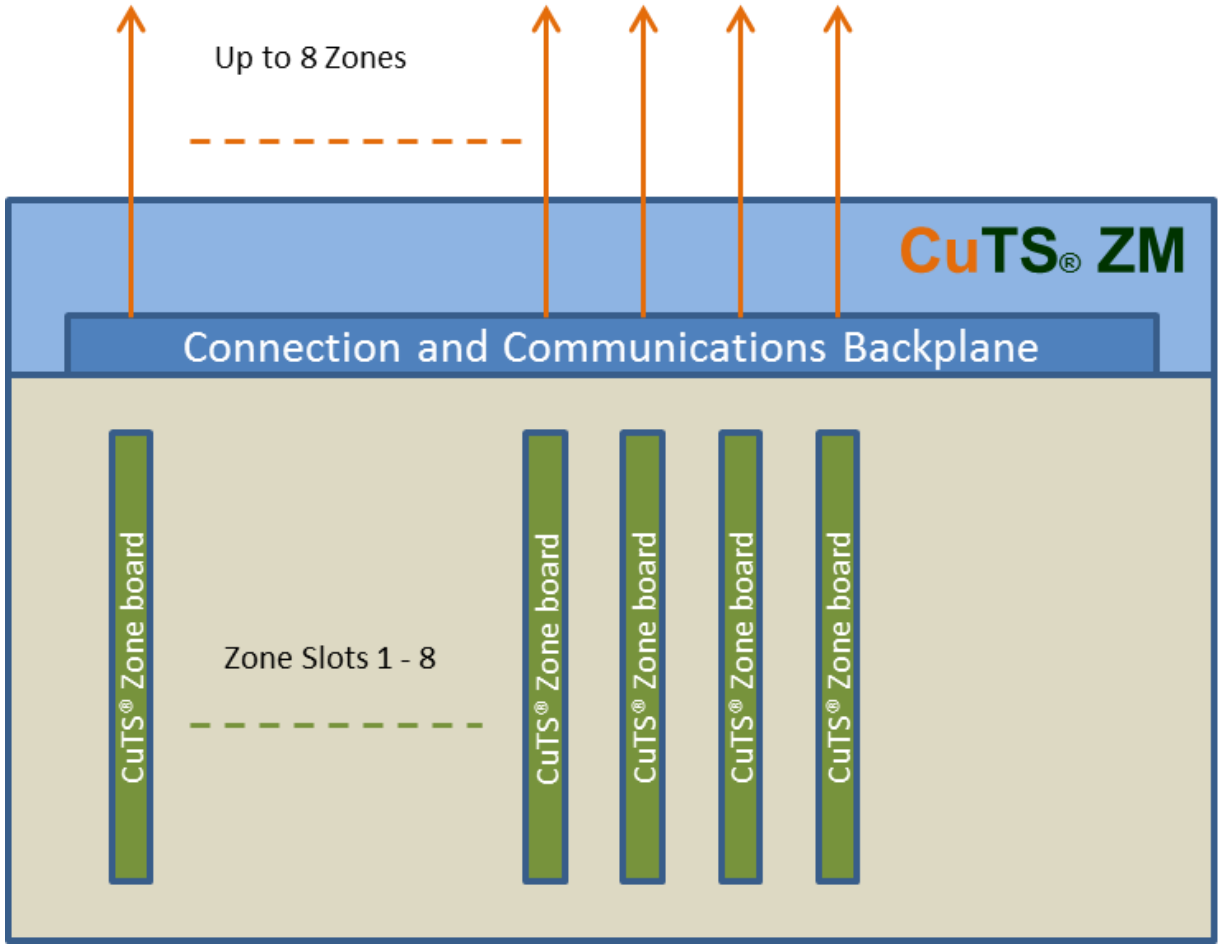
- CuTS® monitors metallic infrastructure for change due to cutting, removal, damage or degradation
- CuTS® system looks for changes in the monitored infrastructure inductance characteristics
- The monitored infrastructure is coupled into a sensing circuit via sense wire inputs which detects minor changes (down to below 0.02µH)
- When change occurs beyond the adjustable thresholds, the unit alarm is activated
- Filter thresholds include extent of change detected and duration of change- this copes with site faults and other events

How CuTS® Works

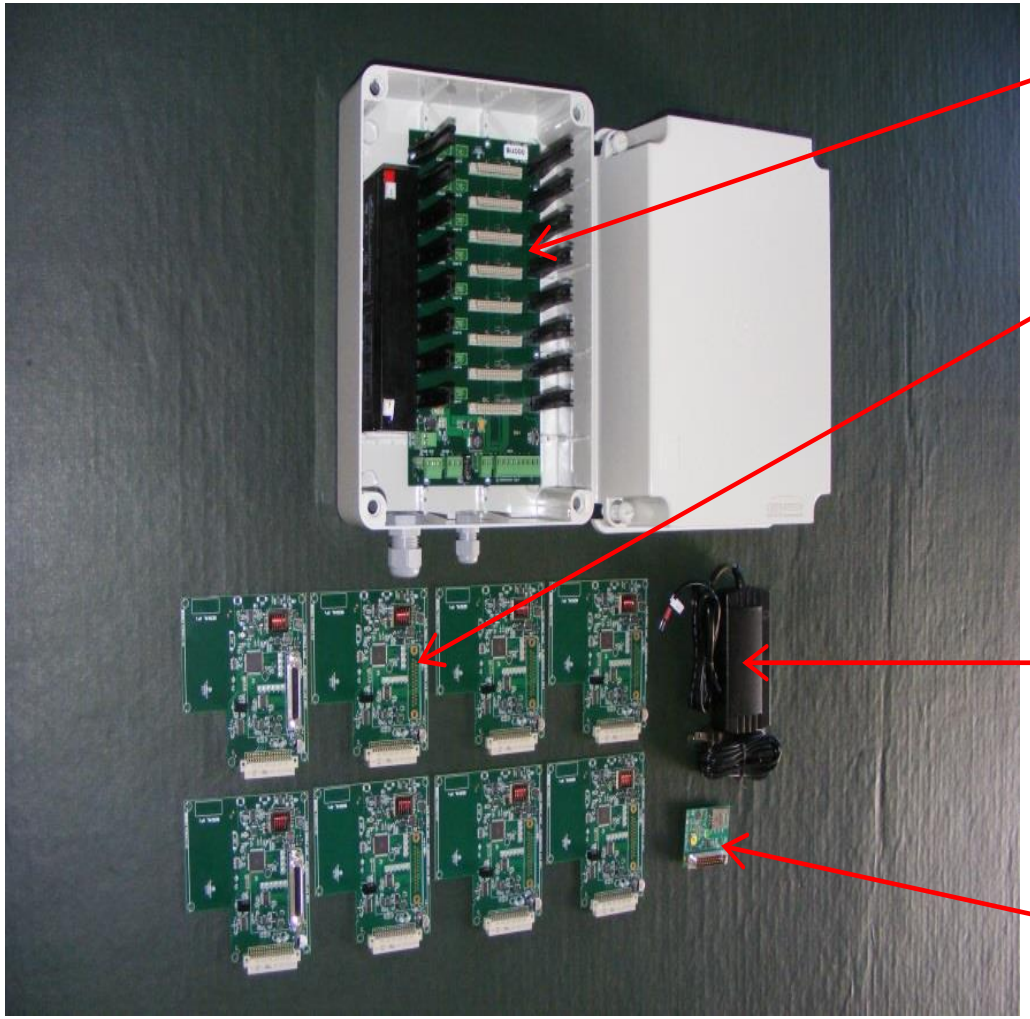


CuTS® is equipped with cellular modem, and can also provide a simple make/break pair for connection to SCADA.

CuTS® ZM Sub-Station Applications



CuTS® ZM Sub-Station Applications



CuTS® unit

Zone Cards

AC Power Adapter
(suitable for location)

Modem and SIM Card

CuTS® ZM Sub-Station Applications

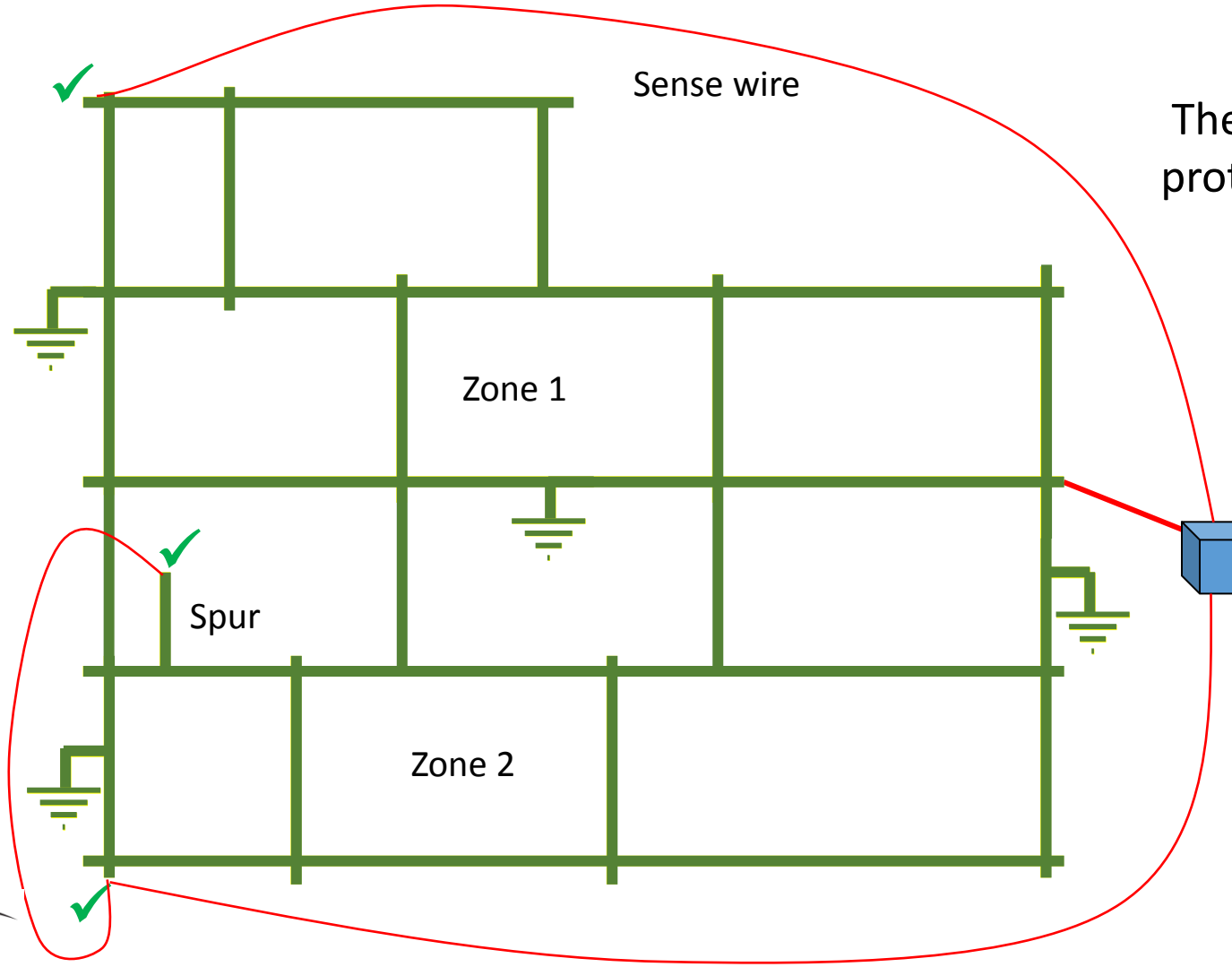
- CuTS® system is powered by an AC wall adaptor for 12V DC (12V DC battery feed can be used)

- Alarm by modem or make/break alarm output through SCADA or similar on-board modem is not utilised for alarm connection.

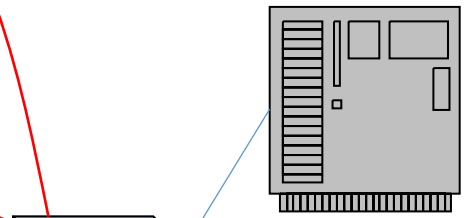
CuTS® Deployed In A Substation

- Multi-zone version
- Antenna to extend GSM coverage when required
- Customer requested armoured cables – connection methods follow customers' own policies
- Installations are intended to be carried out by our customers' own engineers, with training

Example Of CuTS® Installation



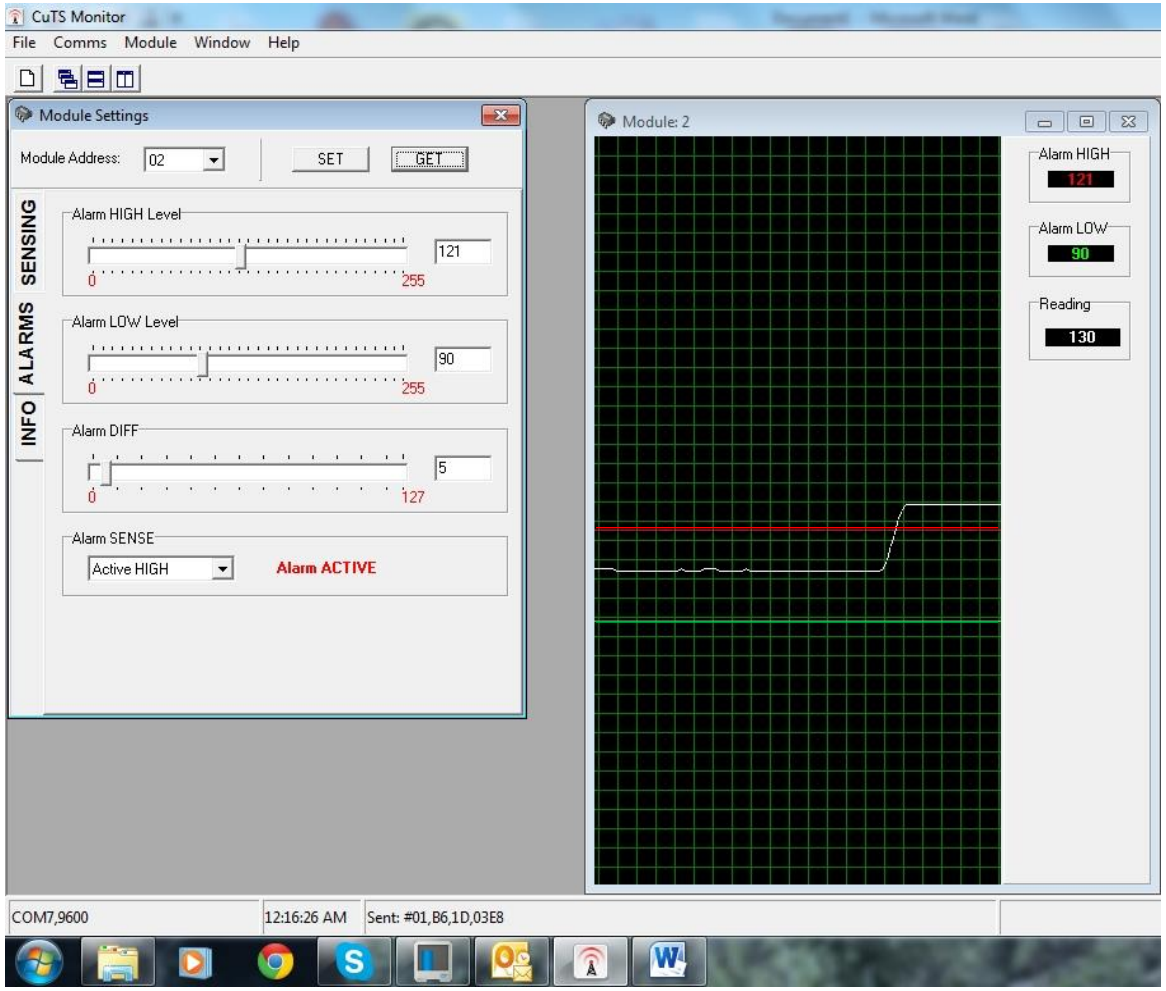
The first sense wire protects the top half of the grid.



SCADA

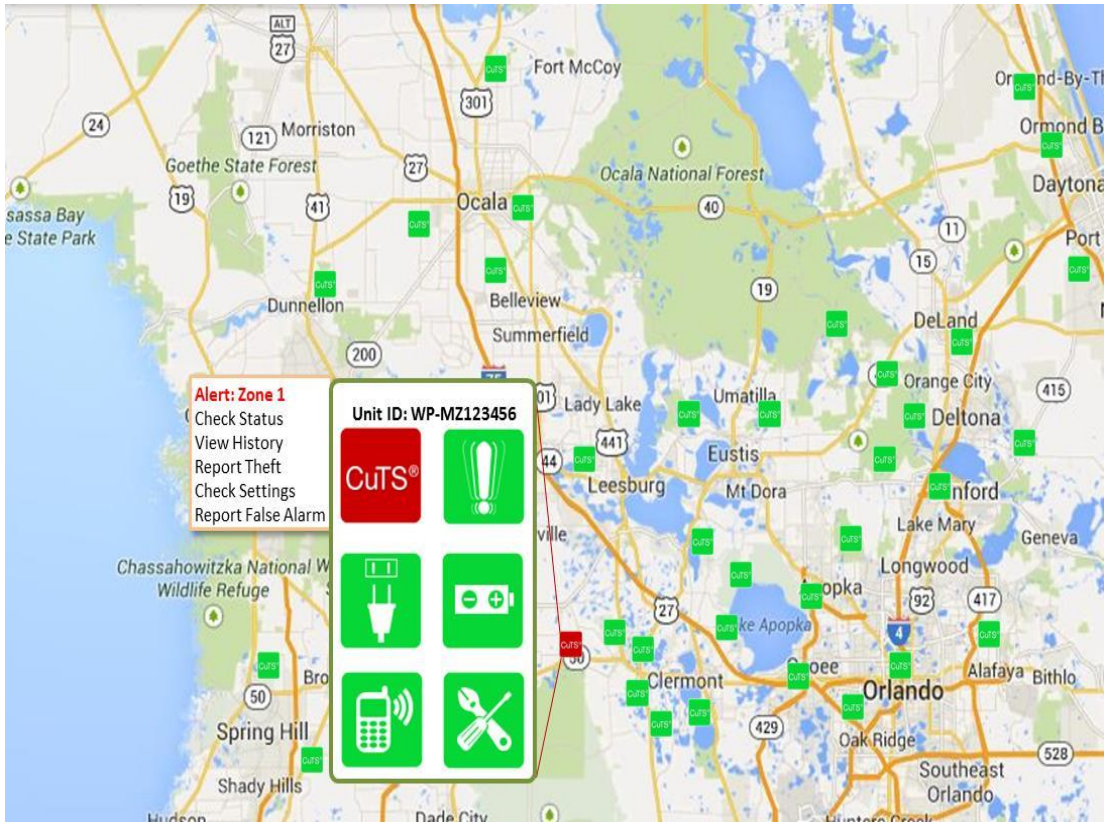
The second sense wire protects the bottom half of the grid.

CuTS® Set-Up And Monitoring



- Only required for configuration, not alarm monitoring
- Developed for Windows
- Remote wireless access
- High and Low alarm settings are independent for each board
  - High – red
  - Low – green
  - Signal - white
- Levels can be set manually or allowed to auto-tune

CuTS®: Service Portal



Customized Site Deployment and Alert Map From Service Portal to Track and Manage Activity. CuTS® Can Communicate With Other Technologies.

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