

MP Corrosion Innovation of the Year Awards Nomination Form for 2021

2021 Award Nomination

Title of Innovation: Touchscreen Bidirectional GPS Current Interrupter

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Summary Description:

GPS synchronized current interrupters have been available for some time now but there was still room for improving the field friendliness, safety and operator convenience. Older LCD screens and keypads were replaced with a touchscreen user interface. Relays were changed to a new bidirectional model that is not polarity or orientation sensitive, increasing the ease of correct installation. The firmware now allows for a UTC offset to be programmed so that the CI-TS can be operated in local time. The CI-TS can be programmed to begin the interruption cycle with either the ON or the OFF portion of the cycle so that the equipment can be seamlessly merged with any other manufacturer/brand of survey equipment. Error checking was incorporated into the firmware to ensure accurate performance in the field once deployed. Long life Lithium Ion batteries are now utilized to increase stand alone run time in the field.



Full Description

(Please provide complete answers to the questions below. Graphs, charts, and photos can be inserted to support the answers.)

1. What is the innovation?

- Re-invention of the GPS synchronized current interrupter for use in pipeline integrity surveys to cycle the CP current ON & OFF for a variety of amperages. The new CI-TS's are self-contained instruments with internal storage for all cables and components. The CI-TS has been upgraded to use bidirectional relays eliminating polarity or orientation sensitivity. Firmware upgrades were made to allow programming in local time with a UTC offset and to start the interruption cycle with either the ON or the OFF portion of the cycle allowing the equipment to be seamlessly merged with other brands of pipeline integrity survey instruments. Lithium Ion batteries allow for longer standalone run time in the field. Additionally, the CI-TS can be powered directly off the transformer rectifier taps to allow for use of extended durations where no local AC outlet is available.
- Features
 - Portable GPS synchronized current interrupter
 - Touch screen user interface
 - Polarity and orientation independent
 - Programmable local time GPS offset
 - Battery conserving sleep mode
 - Start with OFF or ON
 - 5 programmable time schedules
 - Interruption cycle
 - Start and stop times
 - Start and stop dates
 - Holds CP power ON or OFF when not interrupting
 - SuperCon® output terminals
 - Storage compartment for cables and accessories

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- Specifications
 - Capacity: Up to rated Amps, 150VDC, 100VAC RMS
 - Switching: Bidirectional electronic relays
 - Case: IP67 / NEMA 4X plastic case with O-ring seal and locking hasp
 - Battery: 11.1V 9 Ahr Lithium Ion
 - User Interface: 4.3" color LCD capacitive touch screen
 - External Power: Accepts 12-30V AC/DC external power to supplement battery life
 - GPS synchronized, with magnet mount antenna for easy placement with view of the sky
 - Cycle time 1 second to 360 seconds
 - Off time: 0- to 9999mSec (synchronized to the beginning of the minute, 0 seconds)
 - Non GPS synchronized operation also possible

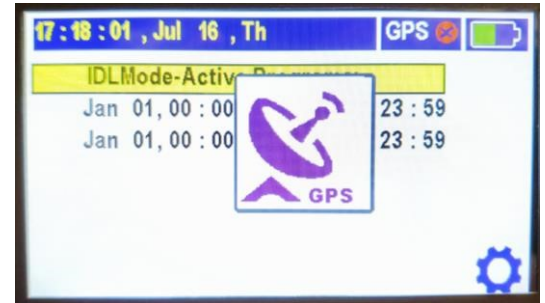


Figure 2 - Waiting for GPS lock

2. How does the innovation work?

- The instrument utilizes the GPS signal for timing. This is then compared to the operator defined programs allowing the CI-TS to operate independently for long periods of time in the field. This GPS connection is maintained to prevent drift over time and remain synchronized with other current interrupters and data loggers.
- A touchscreen provides a graphic user interface. This allows for easy navigation regardless of language.
- To increase the longevity in the field, the CI-TS can be powered in 3 ways:
 - Internal Lithium Ion battery, will operate for approximately 5 days
 - AC mains power 110V – 240V, 50-60 Hz, usable worldwide
 - External voltage of 12-30 V AC or DC. Sources include a large car battery, solar panels, or the rectifier taps
- The internal relay configuration is a custom design that can switch the current regardless of direction.
 - The interrupter can be inserted into either output of the rectifier without having to consider polarity. Reducing possible errors in installation and damage to the equipment.
 - This allows the user to interrupt DC or AC current, or bonds where the current direction is unknown.

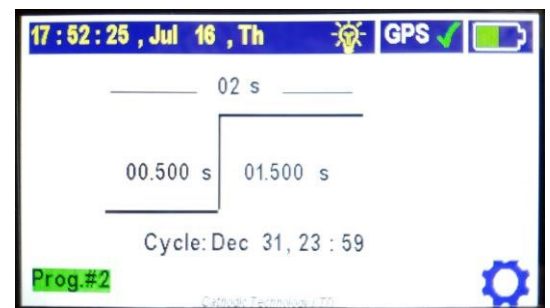


Figure 1 - Operation Screen

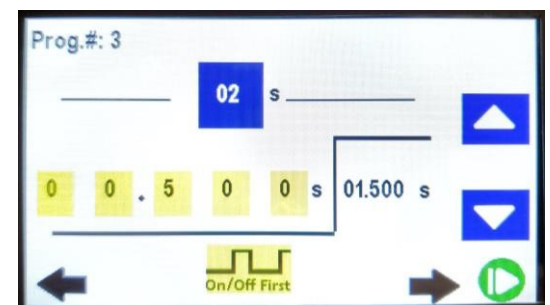


Figure 3 - Set the cycle times

3. Describe the corrosion problem or technological gap that sparked the development of the innovation. How does the innovation improve upon existing methods/technologies to address this corrosion problem or provide a new solution to bridge the technology gap?

- For many years, Cathodic Technology had been producing Current Interrupters, as have many other companies around the world. Each model had their own strengths and weaknesses. We gathered feedback from our customers and created a project to re-design our Current Interrupter to address the needs of our customers and take advantage of technological innovations.
- Many people are now used to using touchscreens as a user interface for various electronic devices. This also offers an advantage in that graphics can be used and understood regardless of language, instead of character displays where language is limited, typically to English.

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- Error checking is built into the firmware to ensure that there is no conflict between programs.
- Understanding current polarity and orientation for correct operation by the user has been problematic in the past. This innovative design uses a bi-directional relay that reduces installation error and increases installation placement options.
- The CI-TS has extensive heat sinking to prevent temperature cut-outs and overheating. This also improves operator safety.
- This new design is ROHS compliant and avoids the use of toxins like lead or mercury that were present in older models.
- There are additional options in the program to improve the user experience:
 - Program in local time
 - Cycle starts with OFF or ON so that it can seamlessly integrate with other brands
 - CI-TS will hold CP ON or OFF when not interrupting
 - ON with normal CP operation
 - OFF with increased CP for DCVG surveys requiring high IR drop, preventing over-polarization of the pipe

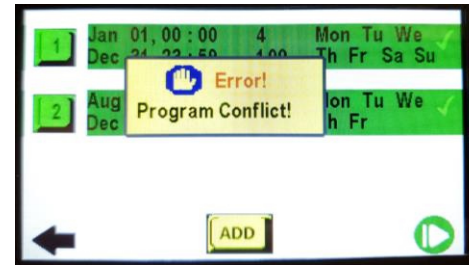


Figure 4 - Error checking



Figure 5 - Set GPS offset for local time

4. Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.

- There were 2 aspects of this project that were tested independently, then combined and tested prior to entering production.
 - The touchscreen control was developed and tested incrementally internally by Cathodic Technology and externally by our trusted partners. Feedback was incorporated to improve the user interface. The control circuitry was also tested for synchronization and run for days to simulate field use.
 - The choice of touchscreen was changed from resistive to capacitive for better user response, as the capacitive screen responded to touch much faster.
 - The relay assemblies were designed separately and tested in a variety of ways to simulate the potential use in the field.
 - Isolation testing was performed to ensure that the operator is protected from contact with the CP voltage and current. The relays are also isolated from the controls to protect from power surges.
 - In an enclosed heat chamber at 50 C / 122 F to simulate desert conditions – compared the temperature rise with other relay designs.

Relay	Temp at 30 min	Temp at 90 min
Old relay	63.6 C / 146 F	86.4 C / 188 F
New design	66.6 C / 152 F	102.6 C / 217 F

- At 55 amps, or 110% of rated current, in the open with an air temperature of 22 C / 72 F the temperature rise was 26 C / 46 F above ambient temperature

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- At 200% of rated current the temperature rise was 56 C / 101 F above ambient temperature of 22 C / 72 F. It performed without failure of any components and continued to interrupt for hours.



Figure 6 - Temperature at 110% of rated current



Figure 7 - Temperature at 200% of rated current

- The goal was to evaluate the functionality of the relays, prevent failure, and user safety by ensuring that the generated heat would be safe to handle. The results of the testing exceeded our expectations.

5. How can the innovation be incorporated into existing corrosion prevention and control activities and how does it benefit the industry/industries it serves (i.e., does it provide a cost and/or time savings; improve an inspection, testing, or data collection process; help to extend the service life of assets or corrosion-control systems, etc.)?

- The new CI-TS is easier to program and install, reducing potential errors in the field.
- The CI-TS has been extensively tested to ensure the operator's safety.
- The CI-TS can be powered directly from TR taps for extended field use when no local AC outlet is available, increasing the flexibility of operation. As before, it can also be powered by its internal battery, AC mains or an external battery.
- Cables, GPS antenna and other accessories are stored directly in the rugged case, making the CI-TS very portable and reducing the possibility of misplaced components being lost and the CI-TS unable to function.

6. Is the innovation commercially available? If yes, how long has it been utilized? If not, what is the next step in making the innovation commercially available? What are the challenges, if any, that may affect further development or use of this innovation and how could they be overcome?

- The CI-TS is now in production in 4 sizes (25, 50, 100 and 200 Amp) and in use around the world. It was successfully launched and welcomed by the industry in the summer of 2020 despite upheaval from COVID-19.
- The CI-TS's are competitively priced and expected to last for years, providing an excellent return on investment.
- The next step in development is to repackage it into a smaller unit suitable for deployment at anodes.
- Another potential application is as a stand-alone controller permanently installed into a rectifier. This will work with any type of relay and can be incorporated at the factory or as a later installation. Permanent installation improves the user safety as the installation is only done once by a qualified technician and future use does not require the handling of high current/voltage by the field technician.

7. Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.

- No