S&C IntelliRupter® PulseCloser
Outdoor Distribution 15.5 kV and 27 kV
S&C’s IntelliRupter PulseCloser is a breakthrough in overhead distribution system protection. This unitized package of fault-interrupting and control components can operate as a standalone fault interrupter or, with appropriate options, can be integrated into a SCADA system and/or an S&C IntelliTEAM II® Automatic Restoration System.

IntelliRupter features S&C’s revolutionary PulseClosing™ Technology—a unique means for verifying that the line is clear of faults before initiating a close operation. Pulseclosing is superior to conventional reclosing. It greatly reduces stress on system components, as well as voltage sags experienced by customers upstream of the fault.

IntelliRupter offers outstanding protection for 60-Hz systems through 27 kV, and 50-Hz systems through 24 kV. It provides full live-switching performance under all ice conditions . . . circuit making, circuit breaking, and pulse-closing are accomplished within the interrupters; there are no external moving parts.

IntelliRupter is factory-assembled on a stainless-steel base and includes:

- **Three-pole vacuum interrupters** rated 630 amperes continuous, 12,500 amperes interrupting. A rating of 800 amperes continuous applies with a 2 ft./sec. wind, similar to conductor ratings.

- **Unique magnetic latching actuators** that provide three-phase tripping and lockout of the interrupters. Interrupters can also be manually tripped by means of a manual lever, operable from the ground with an extendostick.

- **Sensors for three-phase monitoring of line current, and three-phase monitoring of line voltage** on both sides of each interrupter.

- **One or two integral power modules**, which derive the necessary energy directly from the distribution line.

- **Open/close indicator** for each phase.

- **External power supply connector**. Permits pre-installation uploading and downloading of configuration settings, plus radio programming and battery charging, as applicable, indoors in your service center or lab.

- **Manually actuated open/close/ready lever**, operable from the ground with an extendostick.

- **Manually actuated hot-line tag lever**, also operable from the ground with an extendostick, to enable or disable a hot line tag or disable an electronically set hot-line tag.

- **Control group**, featuring a hookstick-removable protection and control module and communication module mounted in the base. It’s easily configured from the safety and security of your vehicle parked near the base of the pole, using a secure WiFi communication link to a laptop computer.

- **Unique multi-function status indicator** which shows that the control group is operating normally. Blink rate changes if WiFi connection is made, control power is lost, or position of the open/close/ ready operating lever is changed. **Separate hot line tag indicator** shows a “set” tag.

- **Integrated Global Positioning System**. Provides 1-ns accurate time-stamping of events to speed post-event analysis, as well as IntelliRupter location data for entry in your graphical information system.

- **Provisions for three surge arresters** on each side of IntelliRupter. Joslyn Zforce Type ZHP (Heavy Duty) polymer-housed metal-oxide surge arresters can be optionally factory-installed and wired.

- **Single-point lifting means**, for convenient rigging and hoisting of IntelliRupter during installation.

IntelliRupter is available in the upright-crossarm mounting configuration, with or without integral, hookstick-operated disconnect for visible air-gap isolation of switched-open circuits. The disconnect is interlocked with the interrupters to ensure the pole-units are open prior to opening or closing the disconnect; a status point for remote monitoring of disconnect position is included. Interrupters may be operated with the disconnect in the open position.

**Easy Up—Easy On**

IntelliRupter is **totally** self-contained. All components go up in one easy, single-point lift. See Figure 1.

The embedded current and voltage sensors eliminate the cost, clutter, and complexity of separately mounted sensors. And since IntelliRupter is directly powered from the line, external transformers are unnecessary too.
Figure 1. All components are factory-assembled and go up in one easy, single-point lift. Top: Non-Disconnect Style IntelliRupter PulseCloser. Bottom: Disconnect Style IntelliRupter PulseCloser.
Fault Testing With a PULSE . . . Instead of a BANG!

Conventional reclosers stress the circuit with fault current every time they reclose into a fault. But after IntelliRupter interrupts a fault, it pulsecloses to intelligently test for fault current before closing. The oscillograms in Figure 2 show the remarkable difference in current versus time during fault testing with a conventional recloser and IntelliRupter.

The relative let-through energy, in $I^2t$, of a pulseclosing operation is typically less than 2% of a conventional reclosing operation, as shown in Figure 3.
Innovative Technology is the Key

After clearing a fault, a conventional recloser simply recloses the interrupters to test for continued presence of the fault. If the fault is still there, the interrupters are tripped again. Then, after a time delay, the interrupters are reclosed. *With each reclosing operation, even the fastest recloser feeds a significant amount of energy into the fault, resulting in system-damaging stress and voltage sags.*

Figure 4 shows how a conventional recloser operates in response to a permanent single-phase-to-ground fault. The uncontrolled closing often results in asymmetric fault current, significantly increasing peak energy into the fault.

But after IntelliRupter clears a fault, it tests for continued presence of the fault using S&C’s advanced magnetic actuator design—coupled with unique PulseClosing Technology—to intelligently close at a precise point on the voltage wave.

Figure 5 shows how IntelliRupter operates in response to a permanent single-phase-to-ground fault, with a typical current pulse of just 5 milliseconds. *With IntelliRupter, your system only experiences overcurrent stress from the initial fault—not from every reclosing operation.* Component life is extended, eliminating costly replacement. Pulseclosing dramatically reduces through-faults too . . . a leading cause of premature aging of substation transformers. And power quality is improved since pulseclosing doesn’t disturb source-side customers with irritating voltage sags and blinks.

**Fully Compatible with IntelliTEAM II® Automatic Restoration System**

When IntelliRupter is furnished with an appropriate control group, it can be readily integrated into a new or existing S&C IntelliTEAM II® Automatic Restoration System. No modifications to your S&C 5800 Series Automatic Switch Controls or UtiliNet® WanGate Radio System are needed.

After IntelliRupter has isolated a fault, IntelliTEAM II makes full use of alternate sources to restore unfaulted line segments without overloading any part of the system. IntelliTEAM II minimizes the number of customers experiencing an extended power interruption, tremendously improving your System Average Interruption Duration Index. IntelliTEAM II can handle multiple contingencies too.
Loop Restoration Applications
IntelliRupter can enhance the performance of loop restoration schemes using conventional reclosers, by eliminating the need to subject the alternate circuit in the loop to a fault when closing the tie. Just replace the recloser in the tie position with an IntelliRupter to take advantage of PulseClosing Technology.

Even greater benefits can be achieved in loop schemes where all protective points use IntelliRupter. Its fast interrupters and accurate sensing and control enable significant reductions in protection margins. With the negligible effect pulseclosing has on source-side customers, the system can be segmented as needed without sacrificing protection.

And with IntelliRupter protecting the loop, customers won't experience voltage sags on their good circuit during testing of a faulted circuit! Complaints and costly claims will be greatly reduced.

Radial Circuit Protection Applications
IntelliRupter enhances reliability on radial circuits by overcoming the limits of conventional coordination methods. Series-connected IntelliRupters can be configured so that after one unit opens to isolate a fault, those downstream, with the same settings, also open.

When power returns, each IntelliRupter—starting at the source—pulsecloses, in turn, to verify that its line segment is unfaulted . . . then closes to restore service. It will never close into a fault. Cold-load inrush is mitigated because only one line segment is energized with each closing. No communication system is required to take advantage of this enhanced coordination and inrush mitigation.

A New Concept in Controls
IntelliRupter is available with a variety of control groups. Each features easy configuration and operation—and examination of waveforms and events—using secure wireless communication to a nearby laptop computer.

The control group includes a base-mounted, hookstick-removable protection and control module and communication module. See Figure 6. This flexible, low-maintenance arrangement offers excellent immunity to surges and noise induced by normal power line events such as faults and lightning strikes, and minimizes pole clutter. IntelliRupters are powered from the distribution line, through integral power module(s).

The protection and control module provides point-on-wave closing to minimize asymmetric fault current and inrush current. It features a complete set of protection and control functions including:

- Simultaneous independent directional phase, ground, and negative-sequence time-overcurrent, instantaneous-overcurrent, and definite-time elements,
- Directional blocking of overcurrent elements,
- Over/under voltage elements,
- Over/under frequency elements,
- Phase unbalance detection,
- Synchronization check, and
- Cold-load pickup modifier.

Comprehensive diagnostics are included too.

A sophisticated 20-channel Global Positioning System chip set provides 1-ms accurate time-stamping of events to speed post-event analysis, as well as IntelliRupter location data to help you maintain your graphical information system.

Select the control group that meets the needs of your distribution system:

- **Standard Control Group** is ideal for standalone (non-communicating) applications. It can also provide wide-area network capability for SCADA applications when equipped with a user-specified radio. The radio permits configuration, operation, interrogation, and software maintenance of IntelliRupter from any location having access to the communication system, using IntelliLINK® Remote Setup Software. No batteries are required for standalone operation but ac line voltage must be available on the side of IntelliRupter with the integral power module.

- **Standard Control Group with Battery Backup** is identical to the Standard Control Group but
additionally includes batteries that support operation for up to four hours after loss of ac line voltage on both sides of IntelliRupter, permitting full communication and extended dead-line switching.

**IntelliTEAM II UtiliNet® Control Group and IntelliTEAM II SpeedNet™ Control Group**

include all the features of the Standard Control Group *plus* S&C’s IntelliTEAM II Automatic Restoration System, with peer-to-peer team communication provided by a UtiliNet Series 3000 IWR or S&C SpeedNet Radio. These controls further provide:

- Distributed intelligence, for automatic operating decisions. No central processing or SCADA is required, though fully supported.
- Automatic system restoration capability, using real-time data.
- Automatic selection of the protection group in response to system reconfiguration, for optimized protection.
- Sophisticated RTU functionality, including remote reporting of IntelliRupter status points and operations, as well as current, voltage, watts, and VARs.

With SpeedNet Radio, system operation checks, diagnostics, downloads of logs and oscillography data . . . even software upgrades . . . can be accomplished over the air—all but eliminating costly visits to each IntelliRupter after installation.

**Source-Transfer UtiliNet® Control Group and Source-Transfer SpeedNet™ Control Group**

Specifically intended for automatic source transfer using two IntelliRupters, with peer-to-peer communication. IntelliRupters assure a high degree of critical-load continuity by minimizing interruptions resulting from the loss of one source.

**Loop Restoration Control Group**

Adjacent feeders are tied together with a normally-open IntelliRupter that closes to an alternate source. Normally-closed IntelliRupters, installed between each source and the normally-open IntelliRupter, sectionalize to isolate the fault. Automatic sectionalization and subsequent restoration of the unfaulted line segments is achieved without communication equipment. PulseClosing is used to detect the presence of faults with minimal stress on distribution system components and without causing voltage sags.

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**Figure 6.** Control group includes protection and control module and communication module.
Easy Operation

The control group is easy to configure before installation. And it’s just as easy to configure after installation, from the security of your vehicle parked up to 150 feet away, as shown in Figure 7. Just establish the secure WiFi connection using your laptop computer and you’re ready to go.

The WiFi transceiver in the communication module provides encrypted wireless point-to-point communication to your PC operating under the IEEE 802.11b standard. Extensive security features prevent unauthorized access. You can open and close IntelliRupter, set hot-line tags, and change protection profiles using the simple operation screens. See Figure 8.

Detailed logs, oscillography data, and other operational information can be readily accessed and transferred over the wireless link. Software upgrades too. And if a wide-area network radio has been furnished—and it supports configuration through its serial port—is can be configured through the wireless link as well.

When set for remote operation, IntelliRupter can be operated through SCADA. If applicable, your dispatcher can test electrical operation of IntelliRupter as well as the entire SCADA control path, including communication.
If a PC isn’t available, IntelliRupter can be opened and closed and hot-line tags set using a hookstick, from the ground or a bucket truck, as shown in Figure 9.

Should module replacement ever be necessary, it’s easily performed as well, as shown in Figure 10.

There’s no need to reconfigure IntelliRupter... a memory module in the base remembers all the settings.
Integrated voltage sensors on both sides of IntelliRupter provide highly accurate sensing across entire temperature range. Integrated current sensors provide extremely flat response, from low-level load currents through fault current levels, ensuring reliable measurements critical for system analysis. Sensors are molded into interrupter housings for all-weather durability.

Integral power module fed from one side of IntelliRupter or, optionally, two integral power modules fed from a different phase on both sides to maximize availability of control power. Eliminates cost and complexity of separately mounted control power transformers.

Integrated disconnect on Disconnect Style models provides visible air gap isolation for dead-line work and facilitates operational testing. Mechanically interlocked with interrupters.

Optional factory-installed and wired surge arresters on both sides of IntelliRupter. Simplify installation.

Stainless-steel base provides outstanding corrosion-resistance, even in the harshest environments.

Integrated pole mounting bracket is designed for easy installation. Prevents IntelliRupter from tilting.

Integrated disconnect on Disconnect Style models provides visible air gap isolation for dead-line work and facilitates operational testing. Mechanically interlocked with interrupters.

Control group features hookstick-removable protection and control module and communication module. Multifunction status light indicates control group is operating normally. Hot-line tag light indicates "set" tag.

Figure 11. Disconnect Style IntelliRupter rated 15.5 kV maximum. Non-Disconnect Style is similar.

<table>
<thead>
<tr>
<th>Ratings</th>
<th>kV</th>
<th>Amperes, RMS</th>
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<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
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<td>11.43</td>
<td>15.5</td>
<td>110</td>
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<tr>
<td>18.81</td>
<td>27</td>
<td>125</td>
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★ 800 amperes with a minimum wind velocity of 2 ft/sec.
Interrupter open/closed indicator on each phase is large and reflective for easy viewing, day or night. It's attached directly to the operating rod—no complicated linkage to break.

Figure 12. Interrupter open/closed indicator, one at each pole. Left: Red (closed) target. Right: Green (open) target. Reversed-color targets are optionally available.

Interrupter open/close/ready lever for manually opening and closing interrupters.

Pull the OPEN lever down to open the interrupters. Open position can be tagged if desired. Interrupters can be tripped during an outage; control power isn’t required. Open interrupters are mechanically prevented from closing.

Pull the CLOSE lever down once for the first closing profile. Pull the lever twice for the second closing profile. Control power must be available.

Hot-line tag lever for setting and releasing tags for energized line work.

A tag can be set locally using the lever or the secure WiFi communication link, or remotely using SCADA. Normally, a tag is removed the same way it was applied. However, the lever can be used to remove remotely set tags too. This approach meets NESC 442.E requirements, which allow local removal of a remotely set tag if local indication of the tag is provided... a hot-line tag indicator is furnished on the protection and control module.

Figure 13. Hot-line tag lever. Left: Manually applying hot-line tag. Right: Hot-line tag applied and tagged. Inset: physical tag applied.

Interrupter open/close/ready lever for


Figure 15. Disconnect open and close lever, can only be operated when the interrupters are open.
Optional Features

Figure 16. Wildlife protection. Reduces wildlife-related nuisance outages.

Figure 17. Joslyn Zforce Type ZHP (Heavy Duty) polymer-housed metal-oxide surge arresters, factory-installed and wired.

Figure 18. Bracket-mounted antenna. Extends four feet from the base; attaches at either end. Includes 900-MHz, 3-dBd-gain, omni-directional antenna, or 900-MHz, 9-dBd gain, directional Yagi antenna, plus cable and hardware. Also available: bracket only.

Other Options:

- International Crating. Features hardwood or certified heat-treated wood products.
Accessories

Figure 19. Module handle fitting. Attaches to hookstick with universal fitting. Permits field installation and removal of protection and control module and communication module. Includes prong for operating IntelliRupter levers.

Figure 20. Spare 12-Vdc, 8-ampere-hour battery pack for communication module.

Figure 21. Docking station. Powers protection and control module and communication module removed from the base, in your service center or lab. Permits pre-installation uploading and downloading of configuration settings, programming of radio, and charging of radio batteries, as applicable. For indoor use only.

Figure 22. Module handling handle. Permits installation and removal of protection and control module and communication module, in your service center or lab.

Figure 23. Power supply. Powers protection and control module and communication module installed in the base, in your service center or lab. Permits open, close, and pulseclose test operations, pre-installation uploading and downloading of configuration settings, programming of radio, and charging of radio batteries, as applicable. For indoor use only.

Other Accessories:
- SEL AutoRANGER™ Model AR8-OH Faulted Circuit Indicators, set of three.
IntelliRupter and IntelliTEAM II will completely change the way you think about designing distribution systems for reliability and optimum functionality. S&C’s Power Systems Services team of automation, system planning, and engineering experts have extensive experience helping electric utilities apply S&C’s automation tools. They can get you up to speed quickly—avoiding the time-consuming learning curve that might otherwise be required.

Working closely with S&C’s IntelliRupter/IntelliTEAM II designers, the Power Systems Services team has developed approaches for fully integrating distribution automation into even the most complex circuit configurations, ensuring your system works right ... the first time.

They’ll help you apply IntelliRupter and IntelliTEAM II to:
- Improve reliability
- Defer capital expenditures
- Reduce costs, and
- Manage aging assets.

Key considerations in the evaluation process include:
- Analysis of costs versus benefits
- Review of load levels and transfer capacity
- Determination of critical customer needs
- Determination of geographic concerns, and
- Determination of reliability impacts.

S&C can also provide critical engineering and field service expertise to ensure successful implementation of your distribution automation solution, including:

**Engineering Services**
- Coordination studies to evaluate protection settings
- End-to-end communication system design to make sure your system works right, today and in the future, and
- Testing on S&C’s IntelliTEAM II system simulator to ensure that the automation design performs as expected.
Field Services
- Communication surveys
- SCADA integration
- Commissioning, and
- Training.

Turnkey Installation Services
- Project management and
- Construction management.

And S&C can provide services to evaluate the performance of your IntelliRupters and IntelliTEAM II system after commissioning, including:
- System inspection and data collection
- Remote monitoring for “system health reports”
- System event evaluation
- System communication evaluation, and
- Post-installation benefit analysis.

No other supplier offers the latest in distribution automation technology—plus assistance in applying and implementing this technology—so you’ll realize the maximum return on your investment.

Contact your local S&C Sales Office today for more information.