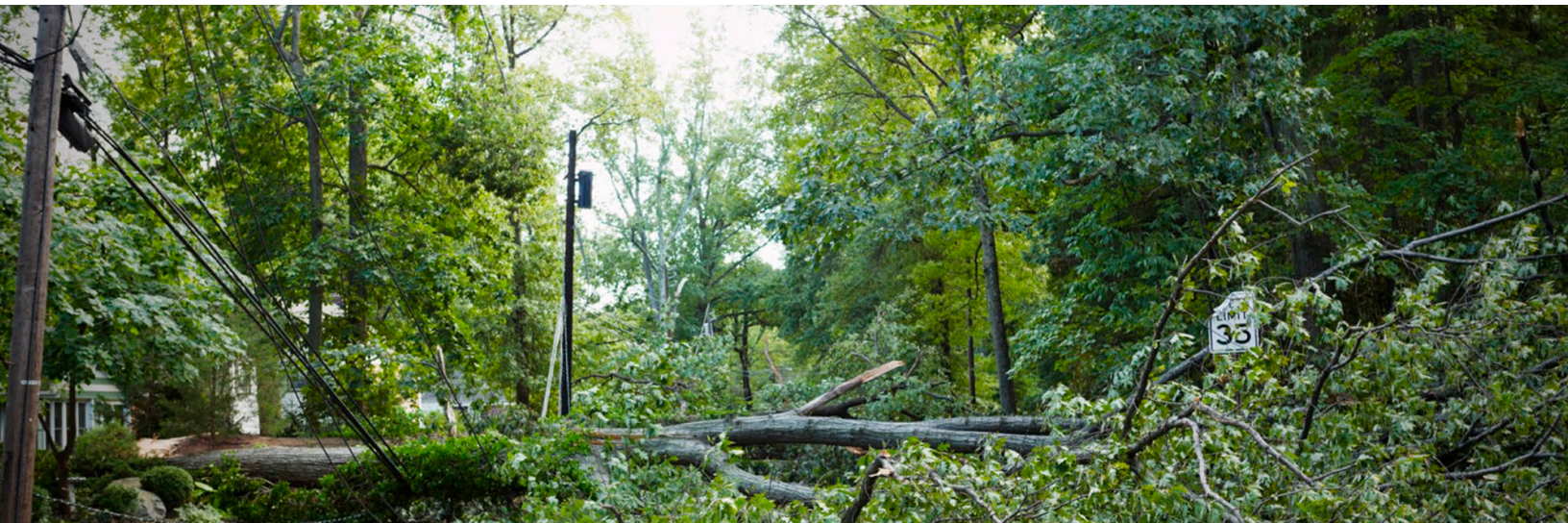


# Arc Sense™ Technology (AST)

## High-Impedance Fault Detection



### Securely detect and clear more high-impedance faults with AST

- Improve employee and public safety, and reduce the risk of fire and electrocution from a downed live conductor.
- Improve security while providing sensitive and dependable high-impedance fault (HIF) detection.
- Minimize the number of customers affected by an HIF.
- Apply AST using SEL protective relays and recloser controls on distribution systems.





## HIF Detection

AST from SEL is an innovative solution that detects HIFs on distribution systems. Detecting HIFs has challenged utilities and researchers for years. SEL-patented AST detects electrical arcing, allowing the technology to identify more HIFs than conventional ground overcurrent protection elements. Using AST results in enhanced protection system security and fewer false trips.



### Common Causes and Dangers of HIFs

An HIF, such as one caused by a downed live conductor, draws low fault current, and although it's unlikely to cause thermal damage to electrical distribution equipment, an HIF poses a significant danger to humans (utility employees and the public), livestock, and property. Downed live conductors can electrocute people and animals that come into contact with them, or they can initiate fires that cause significant property damage. Such faults are difficult to detect and may exist in the distribution system for an extended period, increasing their risk. AST helps detect and clear these distribution system faults while maintaining protection security.

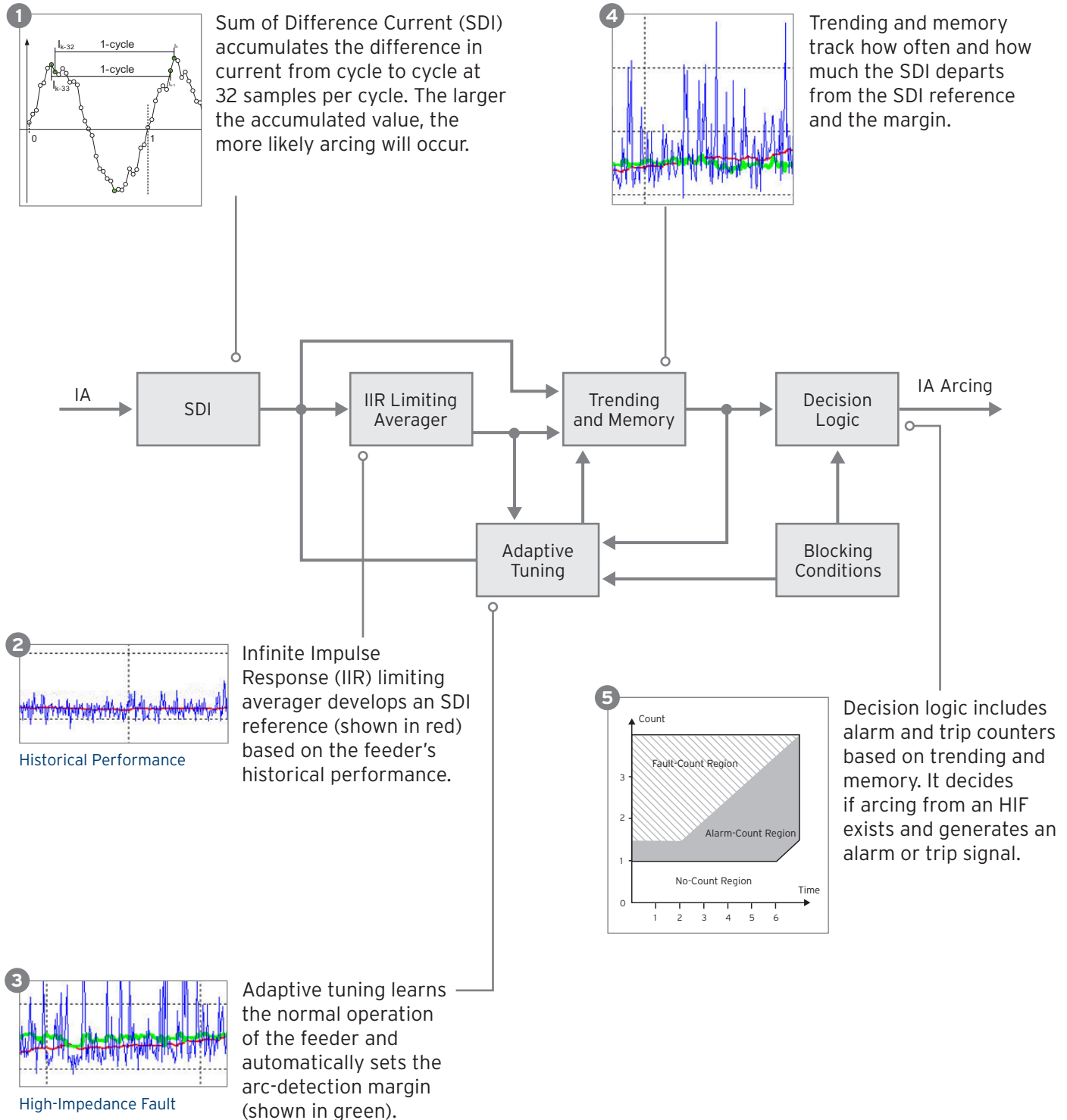


# Understanding HIF Detection

To ensure sensitive, dependable, and secure HIF detection, AST algorithms measure odd-harmonic content and interharmonic content. AST maximizes sensitivity and security by adapting the AST algorithms to minimize

the ambient characteristics of the distribution feeder, including two-way automatic communications system (TWACS) power line communications schemes.

**SEL's patented AST uses the process outlined below for HIF detection.**



# SEL Products Equipped With AST

Apply the integrated AST solution using the SEL devices listed below, to improve HIF detection.



## SEL-451 Protection, Automation, and Bay Control System

The SEL-451 is a complete standalone protection, automation, and control system. The SEL-451 has speed, power, HIF detection, and the flexibility to combine complete substation bay control with high-speed breaker protection in one economical system.



## SEL-751 Feeder Protection Relay

The SEL-751 is ideal for directional overcurrent, fault location, and HIF detection applications. Flexible I/O options, easy mounting, and fast settings make the SEL-751 the right solution for industrial and utility feeder protection.



## SEL-651R Advanced Recloser Control

Apply the easy-to-use SEL-651R for Automatic Network Reconfiguration, three-phase and single-phase tripping, and all your distribution automation needs. The SEL-651R is compatible with most manufacturers' reclosers and includes HIF detection, directional power, and directional overcurrent elements for advanced applications.



## SEL-651RA Recloser Control

Apply the SEL-651RA Recloser Control for Automatic Network Reconfiguration, three-phase tripping, and all your traditional 14-pin recloser control needs. The SEL-651RA includes HIF detection, directional power, and directional overcurrent elements for added protection.

# Easy to Set and Test

Setting your AST device to detect HIFs is easy. Simply enable the feature to start monitoring HIFs and downed live conductor events. Available Relay Word bits allow additional reporting and trip actions. The test mode eliminates adaptive tuning, making it easy to test the system before, during, or after commissioning.

**High Impedance Fault Detection**

EHIF Enable High Impedance Fault Detection  
Y Select: Y, N, T

MPHDUR HIF Multi Phase Event Duration Window (seconds)  
OFF Range = 30 to 600, OFF

HIFMODE HIF Detection Sensitivity (SELogic)  
0

HIFER HIF Event Report Ext. Trigger (SELogic)  
0

HIFITUNE Begin 24-Hour Initial HIF Tuning (SELogic)  
0

Enable: Yes, No, Test

Optional: Longest time observed between interharmonic activity

Optional: Increased sensitivity

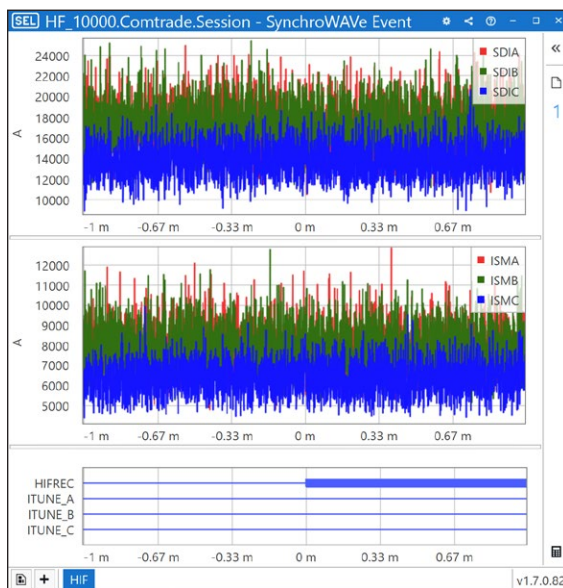
Optional: External event report trigger

Optional: Restart the initial tuning process

SEL-751 HIF detection settings

# Comprehensive Diagnostic Tools

Quickly evaluate downed live conductor events and HIFs with oscillographic and digital elements recorded at 30 samples per second. The RMS current, SDI element, statistical element, and digital quantities are all available. AST files in COMTRADE format can be displayed using a COMTRADE file viewer, such as SEL-5601-2 SYNCHROWAVE<sup>®</sup> Event Software.



Analyze relay event data.

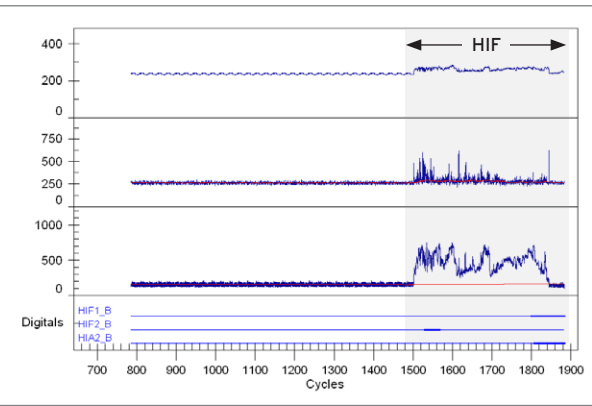
Compare measurements.

Time-align event records.

Perform calculations.

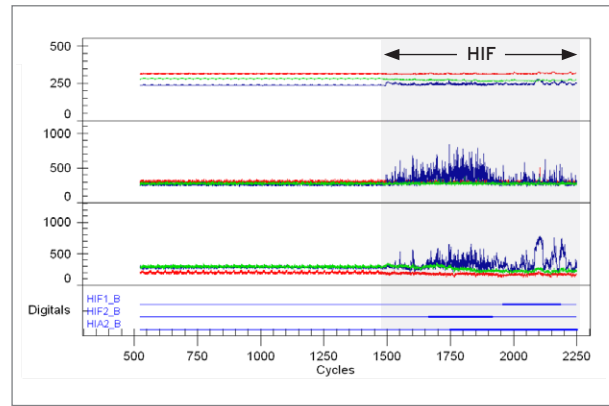
# Detection and Security

Many factors influence the amount of electrical arcing produced by an HIF or a downed live conductor. These factors include surface type, mineral content, moisture, thickness of material, distance to system ground, and others.

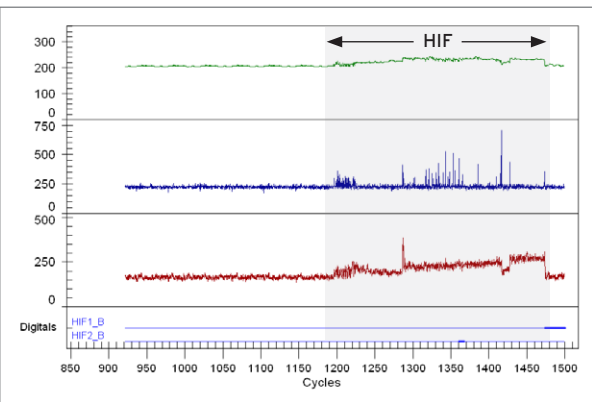


HIF detection on a dry-earth surface.

In many cases, security is the most important aspect of a protective relaying system. High security means there will not be any false trips. AST is designed to improve security compared to existing systems while still providing the best possible sensitive and dependable HIF detection.



HIF detection on wet sand.

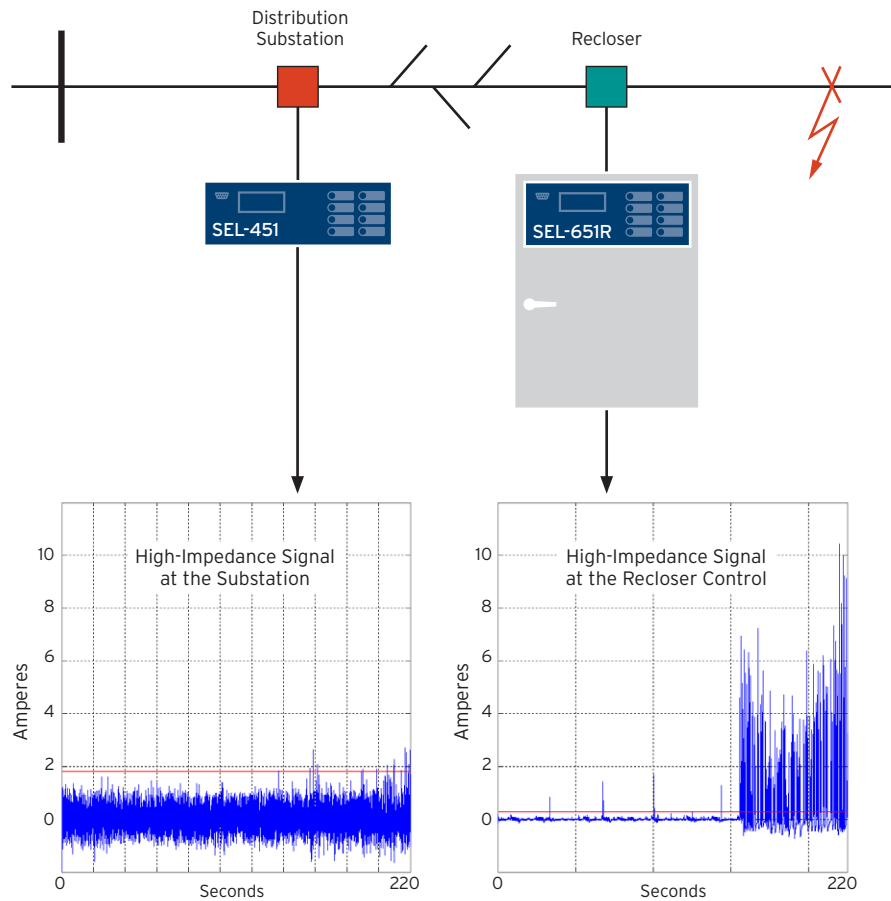


HIF detection on concrete.

Surface	Detection		
	Good	Better	Best
Earth	████████████████████	████████████████████	████████████████████
Tree	████████████████████	████████████████████	
Gravel	████████████████████	████████████████████	
Concrete	████████████████████	████████████████████	
Sand	████████████████████	████████████████████	

# AST System Coordination

When AST is present in multiple devices on a single feeder, the relay or recloser control closest to an HIF will detect the stronger signal and isolate the fault to coordinate with other relays or recloser controls on the system. This coordination isolates only the faulted segment of the feeder, rather than de-energizing the entire feeder, and minimizes the number of customers affected by an HIF.

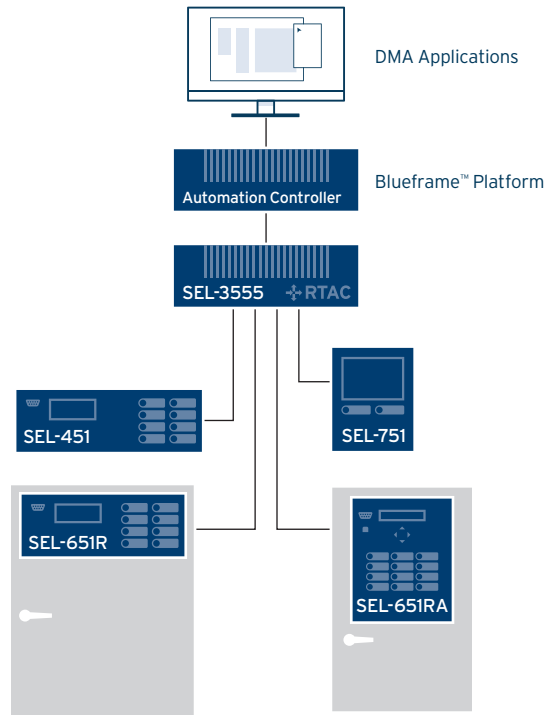


Device with AST that is closer to the fault detects a stronger HIF signal.

# Automatically Collect AST Event Records

Automatically transfer dedicated AST event record files to long-term storage to ensure you never miss an HIF event.

1. Select an HIF event record length of 2–40 seconds to record arcing throughout the event. Events include 60 seconds of pretrigger information.
2. Apply an SEL-3555 Real-Time Automation Controller (RTAC) to retrieve HIF event records automatically from connected SEL relays and recloser controls.
3. Use an SEL automation controller with the SEL Blueframe™ platform running the Data Management and Automation (DMA) application suite to automatically transfer and store HIF event record files obtained from the RTAC. Configure the RTAC to notify the DMA applications that new HIF event records are available for collection and to initiate the transfer.
4. Plot and evaluate HIF event records for proper operation and real-world performance.



## SCHWEITZER ENGINEERING LABORATORIES

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