# A GUIDE TO DIGITAL FAULT RECORDING EVENT ANALYSIS

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## Abstract

Proper interpretation of fault and disturbance data is critical for the reliability and continuous operation of the power system. A correct interpretation gives you valuable insight into the conditions and performance of various power system protective equipment. Analyzing records is not an intuitive process and requires system protection knowledge and experience. Having an understanding of the fundamental guidelines for the event analysis process is imperative for new power engineers to properly evaluate faults. As senior power engineers retire, knowledge of how to decipher fault records could be lost with them. This paper addresses aspects of power system fault analysis and provides the new event analyst with a basic foundation of the requirements and steps to analyze and interpret fault disturbances.

## Introduction

The power system, a matrix composed of hundreds and thousands of electrical elements, is so massive that it can cover inter-continental territories and sometimes different countries. This colossal living matrix has to be properly synchronized, operated, and coordinated where power generation must equal power consumption. If sporadic interruptions are experienced inside of it, they must be isolated, investigated, and repaired until the cause of interruption has been resolved. Its advantage in size has it downsides since a failure in a small part of its structure can crumple the whole system. Fortunately, there are event analysts who investigate system failures and behavior of power system events, allowing them to continuously oversee proper and improper operation of the system. As a result, new discoveries are found on how to improve the design and proficiency of the power system. Being a good event analyst takes system protection knowledge, practice, and years of experience; good analysts are hard to replace. So how do we follow in their footsteps and train new people to have a great start? It is the purpose of this paper to provide a simple guide that will give the new event analyst a solid beginning to an exciting and rewarding career.

It is important to understand the meaning of fault analysis and recoding, and this guide offers the newcomer some practical explanations and applications. Digital fault recorders (DFRs) and microprocessor-based relays offer recording capabilities in the form of waveforms and sequences of events. However, these two differ in the sampling rate processing power, type of record they can capture, lengths of records, and the ability to record wide system response. Depending on the utility philosophy, one type of equipment might be preferred to the other. The important factor is to know the characteristics that both pieces of equipment offer and determine which one offers the best information for event analysis.

Sequence of event information is crucial for event analysis. It is widely known that a 52a contact operation can determine the status of a breaker operation. However, having trip surge coils can offer specific “trip coil energization time”, allowing analysts to determine whether or not a breaker is interrupting the current at an adequate time. Similar techniques can be applied to check transfer trip signals and operating times.

The basic concepts of symmetrical components and their respective sequences can be applied to decipher types of faults. In addition, phasor diagrams for current and voltages can greatly aid in the visualization of distinguishing fault behavior. This guide exhibits real time fault events where the concepts of phasor diagrams and symmetrical components are applied to decipher faults.

The analysis of power system events can be as exciting as it can be laborious. It can also be time-consuming since faults might happen in different parts of the system and may involve different utilities. Unique software features can definitely improve the analysis and investigation of system events.

## Purpose of Fault Recording

Fault records are one of the most important pieces of evidence that event analysts can have during system event investigations. They can provide the reasons for premature equipment failure, supply waveforms and status of equipment behavior during an event, and give necessary information to perform post-fault event analysis. Proper use and interpretation