THE APPLICATION
OF TECHNOLOGY

KEHUI

XC-2100E TRAVELLING WAVE FAULT LOCATION SYSTEM

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The word Kehui, literally means the Application of Technology in the Chinese language. This phrase perfectly defines the company's commitment to technological innovation, which it achieves whilst striving for the highest levels of quality.

The company was founded in 1991, utilising the best of Asian and European expertise to develop its range of cable and transmission line fault locators, as well as equipment for the automation of electrical distribution systems and its range of switched reluctance motors.

XC-2100E Travelling Wave Fault Location System

Introduction

Transmission systems are at the heart of the power network and their availability is essential to the reliability of the system. When a fault does occur, it can be difficult to locate, particularly on long remote lines.

XC-2100E uses travelling wave technology to provide an accurate fault distance measurement and is independent of line length and other factors which affect the fault location accuracy of traditional impedance measurement methods.

In addition to overhead lines, the system is suitable for underground and submarine cables, plus hybrid systems combining overhead lines and cables.

Benefits of the XC-2100E

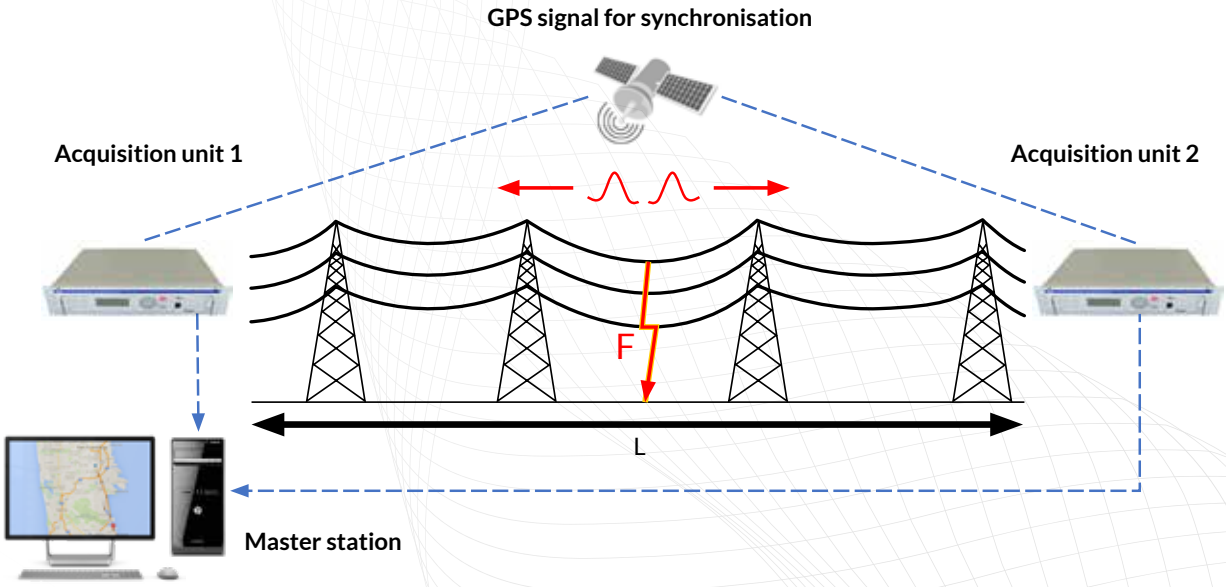
- Accurate fault location to one power span (±150m)
- Fault location conveniently superimposed on to Google Maps ™ or an off-line map
- Suitable for:
  - AC overhead lines
  - underground and submarine cables
  - hybrid overhead and underground lines
  - HVDC lines
  - lines with T-branches
- Can be retrofitted to substations without disturbing existing wiring
- Each unit can monitor up to 8 lines
- Monitoring of lightning events and circuit breaker operation

Travelling Waves for fault location

The distance to the fault can be determined by measuring the time taken by the travelling wave to travel from the fault to the busbars in the substations. This is achieved by connecting an XC-100E travelling wave data acquisition unit to either the existing line CT secondary winding, using a small interposing CT, or by direct connection to the protection CTs. Alternatively, the current can be taken from a CT around the earth connection of a capacitor-voltage transformer or, on an HVDC system, the harmonic suppression filter. Where the application requires, a connection to a voltage transformer is also available. In all cases, the travelling wave will pass through the instrument transformer, where it can be recorded by the XC-100E unit.

Typically, the XC-100E units are synchronised in time using a GPS satellite signal. The arrival time tags of fault generated travelling waves are recorded at both ends. The fault distance is determined by measuring the difference in the arrival times, based on a known value of propagation velocity and the length of the line.

Unlike impedance measurements, this is completely independent of factors such as the accuracy of the instrument transformers and the impedance of the Earth/Ground path, which usually needs to be estimated. Its precision compared to other fault location techniques make this the ideal tool to reduce outage times, particularly on long and inaccessible lines.



XC-2100E System

The XC-2100E system comprises the acquisition units XC-100E and the master station software XCF-2100E. In addition, there is an antenna (where required) and the signal transducers, normally clip-on CTs.

The hardware is mounted in a 2U high case, for mounting in a 19” rack. Its configuration can be changed by inserting different modules in to the rear of the unit. This allows the number of lines monitored to be varied by adding additional analogue input modules. The method of connection can also be changed with alternatives for indirect connection, using clip-on CTs, direct connection, in series with the line protection current inputs, or a voltage connection.

Variations in the number of digital inputs and the provision of digital outputs are also facilitated by adding modules.

The antenna can be equipped with different lengths of cable to ensure that it can be fitted with line-of-sight to GPS satellites, to ensure synchronisation is possible (n.b. this can also be achieved with a suitable IRIG-B source or similar).

XCF-2100E Software

The XCF-2100E is the heart of the system, it is installed on a Master Station PC in a Microsoft Windows© environment. XCF-2100E collects transient data retrieved from the XC-100E units installed in the substations, and automatically calculates the distance to the fault. It also allows the analysis of the recordings, saving the list of records and recorded waveforms.

A second software, called XCF-2100E WEB Information System (referred to as XCF-WEB), allows remote PCs to monitor the Master Station PC information, save data and print results.

In addition to fault location, the software also allows the analysis of circuit breaker operation and the classification of lightning activity in the vicinity of the monitored line. Both of these events produce travelling waves, which are detected by the system.

Waveform trace with automatic fault location

Google Map ™ images of the fault position

Specification:

XC-100E Data Acquisition Unit	
Channels	3–24 analogue inputs, configurable for application to 1–8 lines
Input type	– Current input with a clip-on CT – Current input from CT – Voltage input from VT/PT
AC Current input	– Nominal 5A/1A – Burden < 0.4VA (I_n = 5A) < 0.2VA (I_n = 1A) – Overload withstand: 400% I_n continuous or 4000% I_n for 1s.
AC Voltage input	– Nominal: 57V/63.5V/69V – Burden: < 0.4VA – Overload withstand: 200% U_n continuous or 250%U_n for 10s.
Digital Input	8 or 16 inputs for connection to external DC supply
Communications Port	– 2 RS232 Ports – 2 Ethernet ports
Communication protocols available	– DNP-3.0 – IEC 60870-5-101 – IEC 60870-5-104 – IEC 61850 (MMS) – IEC 61850 (GOOSE)
GPS time synchronisation	Internal GPS module with time accuracy: 100ns
Display	LCD display with 256 x 64 pixels; dimensions:132 x 39 mm
Memory Space	8 GB, 1000 records minimum
Power Supply	85 to 264V, 50/60 Hz AC and 90 to 260V DC Other ranges are available
Dimensions	483mm×323mm×88 mm (19”rack, 2U)
Weight	4–6kg (Depending on the configuration of modules)

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