SFL-3000 and F/L Server

Travelling Wave Fault Locator System

Accurately calculates fault locations throughout transmission lines

Key Features

- Locates faults with high accuracy
- Reliable fault detection triggers
- Easy to operate

Benefits

- Downtime reduction
- Operation/maintenance cost reduction
- Improve customer satisfaction

SFL-3000 is developed based on SFL-2000 technology and compatible with existing SFL-2000.
Highly precise triggers can detect a transmission line fault, and provide its location with an accuracy of +/- 200m.
Web server service allows uses to access fault location data without requiring additional software installation.

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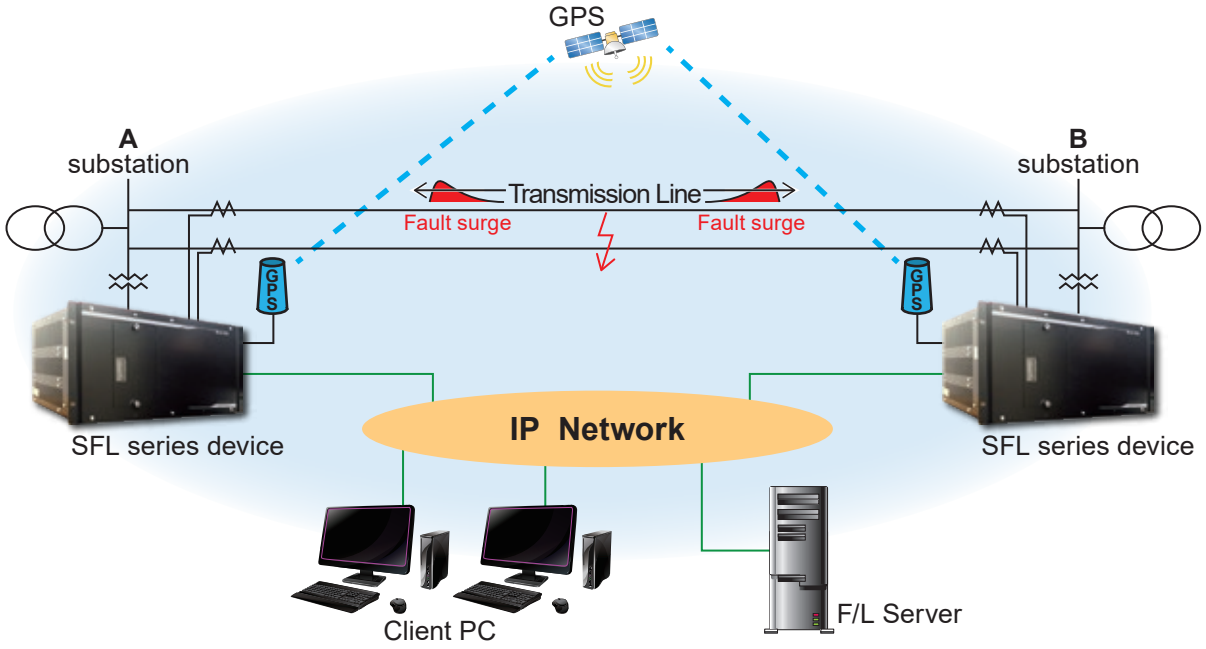
■Description

- ●The product consists of a travelling wave type Fault Locator (SFL-3000), installed in terminals of High Voltage transmission lines, and a Fault Locator Server (F/L Server).
- ●Monitoring and recording with high-speed sampling of 10MHz and a low-speed sampling of 12.8kHz(or 15.36kHz)
- ●Detects transmission line faults and records the waveforms.
- ●The F/L Server receives waveforms from SFL-3000 (or SFL-2000) and calculates the fault location with high accuracy, based on the time difference between the arrival of the fault detection travelling wave at substations.
- ●An E-mail is automatically sent to the registered address to notify the occurrence of a fault.
- ●A web browser can be used to connect to the F/L server to display fault identification results.
- ●The SFL-3000 can be accessed using a web browser.

■System Configuration



■ Technical Specifications (SFL-3000 and F/L Server)

Properties		Specification
Locating accuracy		±200m (best ±48m)
Applicable systems (Neutral grounding method)		Solid (directly) grounding system, Resistance grounding system (Please consult Kinkei System for application within a non-grounding system or a direct current (HVDC) transmission system.)
Applicable transmission lines		Overhead line (OH), Underground cable (UG), combined OH&UG
Maximum length of transmission lines		600km
Maximum number of transmission lines		100 lines (* extendable)
Maximum number of stored location results		10,000 items (* extendable)
Maximum number of terminals per transmission line		4 terminals per line (the main line with 2 terminals and 2 branch lines with 1 terminal each)
Fault detection methods	Surge trigger	10MHz high speed sampling (current, voltage)
	DFR trigger (deviation)	12.80kHz/15.36kHz low speed sampling (current, voltage)
	DFR trigger (variation)	
	Digital Input trigger	110 -220 Vdc, ON/OFF
Properties of a fault location results		Fault occurrence time / Line name Fault phase / Location result (Distance from the substation [km])
Backup fault locating methods		Current division ratio method / Impedance method

Highly accurate 10MHz (1 sample = 100ns) fault locating

- Locating accuracy : ±200m(best ±48m)
- Time Synchronization accuracy : 160ns(GPS)
- Sampling frequency : 10MHz(1sample = 100ns)

Fault Location Examples:

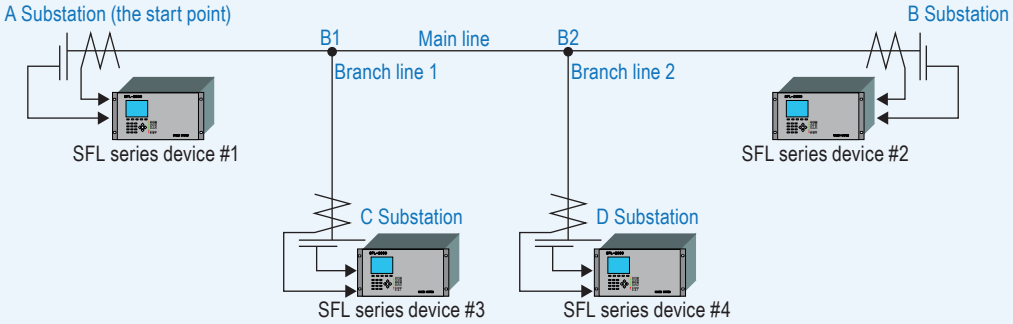
Voltage Level	Line Length	Actual Distance to Fault	F/L Calculation Result	Difference
500[kV]	229.95km	110.7km	110.54km	160m
220[kV]	267.39km	19.53km	19.57km	40m
115[kV]	71.54km	37.75km	37.71km	40m
70[kV]	11.8km	4.05km	4.24km	190m

Reliable Fault Detection

- Four types of triggers are available to detect transmission line fault certainly.
  - (1)Surge trigger: 10MHz high speed sampling
    - Triggered when current (or voltage) variation exceeds set values.
  - (2)DFR trigger (deviation): 12.80kHz/15.36kHz low speed sampling
    - Triggered when voltage RMS is lower than the threshold level.
    - Triggered when current RMS is larger than the threshold level.
  - (3)DFR trigger (variation): 12.80kHz/15.36kHz low speed sampling
    - Triggered when current (or voltage) variation exceeds the set values.
  - (4)Digital Input Trigger
    - Protection relay tripping or Circuit Breaker status.
- Voltage elements are used for fault location
  - Not only current elements but also voltage elements are used for fault location.
- Backup Fault Location functions
  - Current division ratio method or Inpedance method are available.

Able to manage up to 4 terminals per transmission line

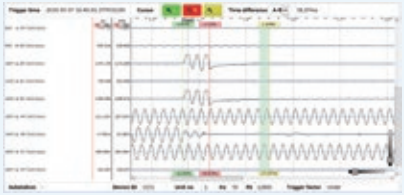
One (1) main line with two (2) terminals and two (2) branch lines with one (1) terminal each.



Easy to operate human machine interface

Both F/L server and SFL-3000 are equipped web server.
Connection to the F/L server and the SFL-3000 can be made through a web browser.

F/L result list screen



Waveform display screen

Displaying automatic fault location results

Fault location mapping

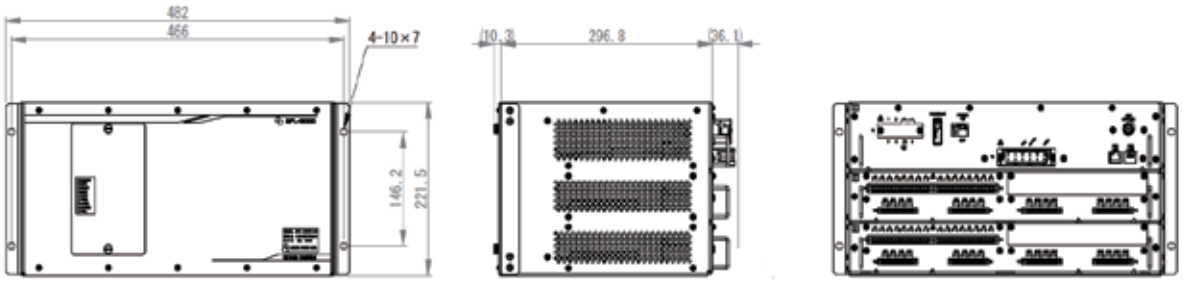
■ SFL-3000 Specifications

Item		Specification		
Sampling frequency	High speed sampling	10MHz	A/D resolution	14bits
	Low Speed sampling	12.80kHz@50Hz,15.36kHz@60Hz		16bits
Time synchronization accuracy		±200ns (GPS Receiver：±60ns)		
Input Elements Configuration		The number of channels per DSU		Max. DSUs
	Current + Digital	Current 16ch: 4 circuits of current ((3 phases + In) × 4) Digital 16contacts		Max 2 DSUs:8 circuit
	Current + Voltage + Digital	Current 8ch: 2 circuits of voltage ((3 phases + Vo) × 2) Voltage 8ch: 2 circuits of current ((3 phases + In) × 2) Digital 16 contacts		Max 2 DSUs: 4 circuit
Current element	1A rated	High speed:Ip-p=±2.896A	Burden	approx. 1mVA (at 5A)
	5A rated	High speed:Ip-p=±14.48A		
	Monitoring accuracy	FS±0.5%		
Voltage element	110V $\sqrt{3}$ rated	Vp-p=±231.78V(163.84V rms)	Burden	approx. 1mVA (at 5A)
	Monitoring accuracy	FS±0.5%		
Digital element	Rated	DC125V		
	ON/OFF level	ON ≧80Vdc, OFF≦30Vdc		
Alarm contact		Power supply failure, Device failure, GPS asynchronous		
Storage		8GB(SD card)		
HMI	LCD	256×64		
	Key input	8 key		
	LED	(×9)for status display		
	Web Server	Embedded web server		
Communication I/F		Ethernet LAN: RJ-45(10Base-T/100Base-TX) x 2 ports		
Communication protocol		TCP/IP,HTTP,HTTPS,IEC61850(GOOSE Publisher,File Transfer)		
Power supply	Input range	DC:110V-220V(-20%~30%:88V~286V) AC:100V-230V(-15%~15%:85V~265V)		
	Power consumption	Maximum 125W/300VA		
Environmental	Temperature	Operating:-10℃ to +55℃,Storage: -25℃ to +70℃		
	Humidity	0% to 95% RH(Non-condensing)		
Immunity		Conforms to IEC60255-26		
Mechanical(Vibration,Shock,Bump,Seismic)		Conforms to IEC60255-21		
Safety related electrical		Conforms to IEC60255-27		
External dimensions		482(W)×221.5(H)(EIA:5U)×296.8(D)mm		
Weight		Max 12kg		
Country of origin		Japan		

■ F/L Server & Client PC or F/L Application Specifications

	F/L Server	F/L Application (Single user only)
OS	Red Hat Enterprise Linux (64bit)	Windows 11 Pro
Memory	Minimum 16GB of RAM	Minimum 32GB of RAM
CPU	Minimum Xeon® 2GHz	Minimum Intel Corei7-11700 with 6 cores or equivalent
Storage	4TB or more for free space (RAID LEVEL 1)	C drive(OS): 500GB or more SSD and D drive(DATA): 4TB or more SSD
LAN I/F	RJ-45	RJ-45
Display	1920 × 1080 or more	1920 × 1080 or more
Web browser		Microsoft Edge(Chromium)
	Client PC	
Display	1920 × 1080 or more	
Web browser	Microsoft Edge(Chromium)	

■ SFL-3000 external view



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