The TWS Traveling Wave Fault Locator

The most precise overhead line fault locator available

Reduces line outage costs and patrol times

A better solution. The Telefault TWS is a traveling wave fault locator for overhead lines. It can operate simultaneously in the following modes; Type D (double-ended) and/or Type E (breaker initiated).

In the Type D mode the fault location is determined using the transients generated by the fault itself. In the Type E mode faults are located using the transients generated by the re-closure of the circuit breaker onto the faulty line after the initial trip. The TWS is unaffected by fault resistance and provides a consistent level of accuracy many times better than conventional 'impedance' type fault locators. Phase to ground faults, phase to phase faults and broken conductor faults, including those clear of ground where no fault current flows, can all be located with the TWS.

The TWS can be used on high voltage AC lines of any length, including those containing sections of cable, parallel circuits, tapped loads and series capacitors. It can also be used on HVDC lines.

The Telefault TWS Traveling Wave Fault Locator:

- Features traveling wave based fault location
- Allows simple and non-intrusive installation
- Provides a consistent level of accuracy
- Can monitor up to eight circuits
- Offers flexible communications
- Includes high performance software
- Can be customized to suit your needs

Combining high performance with unrivaled accuracy

QUALITROL Hathaway

COST EFFECTIVE

Traveling wave based fault location

- The theory of determining fault location by the use of traveling waves was reported as early as 1931. It recognized that a fault generates a high frequency *traveling wave* pulse on the faulted line.
- Detection of this pulse and echo of the pulse, with appropriate timing accuracy, allows determination of the distance to the fault.
- The advent of inexpensive GPS receivers and a novel means of detecting and recording the high frequency impulse generated by a fault has now made traveling wave fault location practical and cost effective.

EASY TO SET UP

Simple and non-intrusive installation

- In order to determine the distance to a fault, the TWS monitors the *current* transient instead of the voltage transient used by previous systems.
- This makes installation very easy and avoids the need for special PTs.
- The transient signals recorded by the TWS are taken from existing CT secondaries via split-core inductive couplers for maximum ease of installation.
- The TWS is triggered when any of the input signals exceed a pre-defined threshold level which can be set independently for each 'Line Module'.

HIGHLY ACCURATE

A consistent level of accuracy

- Transient data is acquired via the Line Modules which have three analog channels (one for each phase). Each channel has 32kbytes of memory.
- The resolution of the analog to digital conversion is 8 bits and the sample rate is set to 1.25MHz to give a location accuracy of ±500 feet (±150 meters) regardless of line length.

EXPANDABLE

Monitors up to eight circuits

- The standard version of the TWS can accommodate up to eight Line Modules so eight circuits may be monitored simultaneously.
- A Global Positioning System (GPS) based time receiver is included to allow the TWS to operate in a double-ended (Type D) mode.

FLEXIBLE

Offers flexible communications

- When the TWS is triggered, the transient data is processed and the distance to the fault is calculated and displayed via *TWSBase™2000* software. The original data is stored on a local hard disk.
- An internal modem and Ethernet port are installed as standard to allow the TWS to connect to a remote PC for configuration and data retrieval.
- Contact outputs are provided for remote alarm and local indication of equipment operation or failure.

POWERFUL

Provides high performance software

- Communications software is included which allows complete remote operation of the TWS via modem or Ethernet, including fully automatic reporting of the calculated distance to fault and transmission of the recorded data.
- *TWSBase™2000*, a Windows based software package, is provided so the recorded data can be displayed graphically for detailed inspection, manipulation and measurement.

ADAPTABLE

Customize to suit your needs

- Interface to SCADA systems via *TWSBase™2000*
- Time synchronisation outputs, including IRIG-B.

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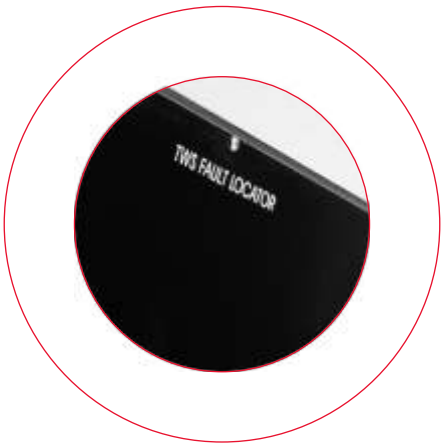
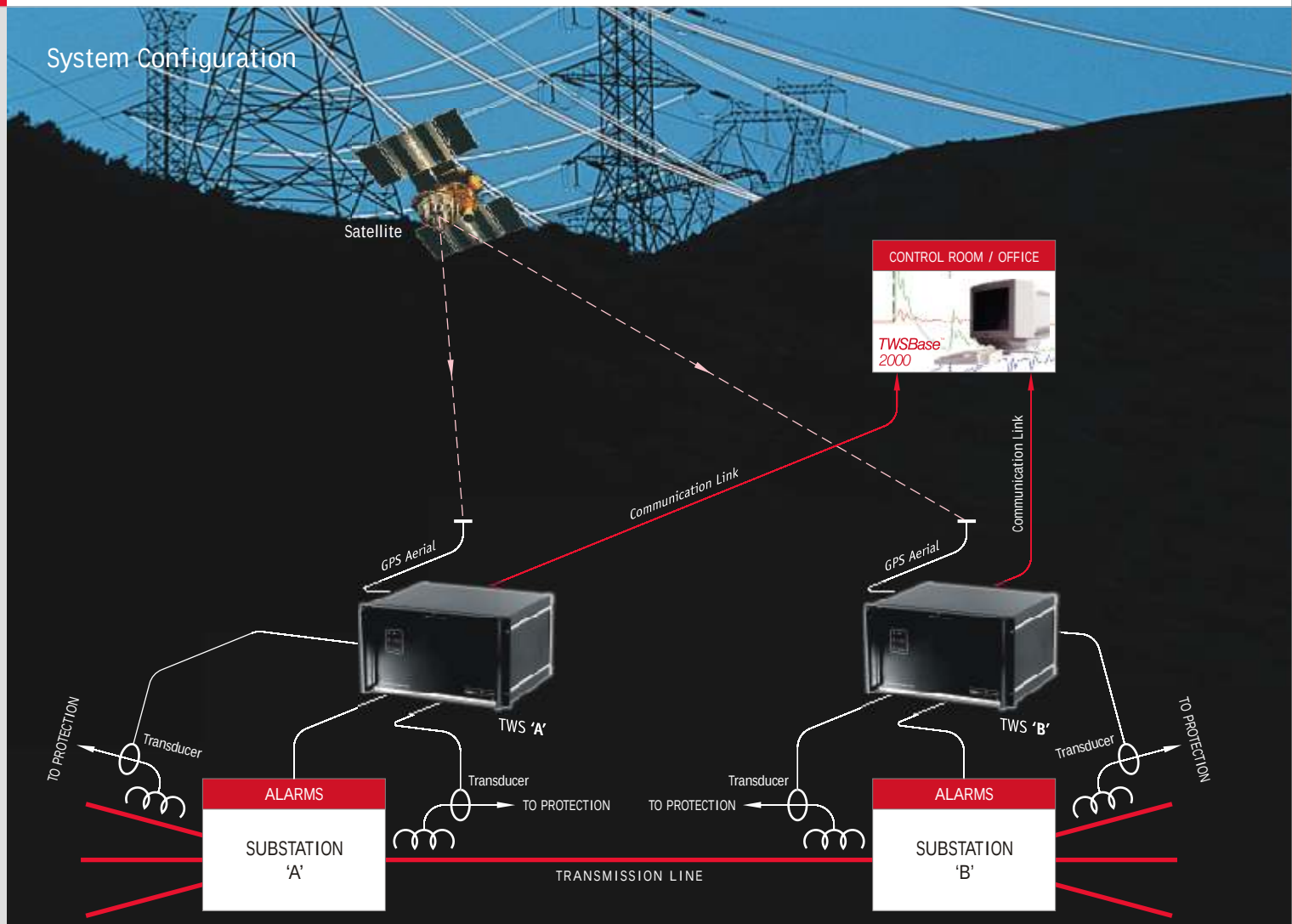
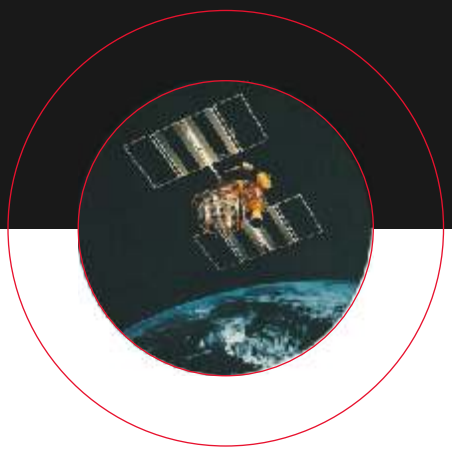
a consistent level of accuracy
many times better than conventional
'impedance' based fault locators....
a better solution!



System Configuration



easy set up -
with simple and non-intrusive installation....
the perfect system!



Classification

Since the 1950s overhead line fault locators have been classified by their types or *modes*

- The Telefault TWS Traveling Wave Fault Locator combines type D mode with a new operating mode - Type E.
- Type D modes use the traveling wave transients created by *faults* whilst Type E use transients produced by *circuit breakers*.

Type D Mode

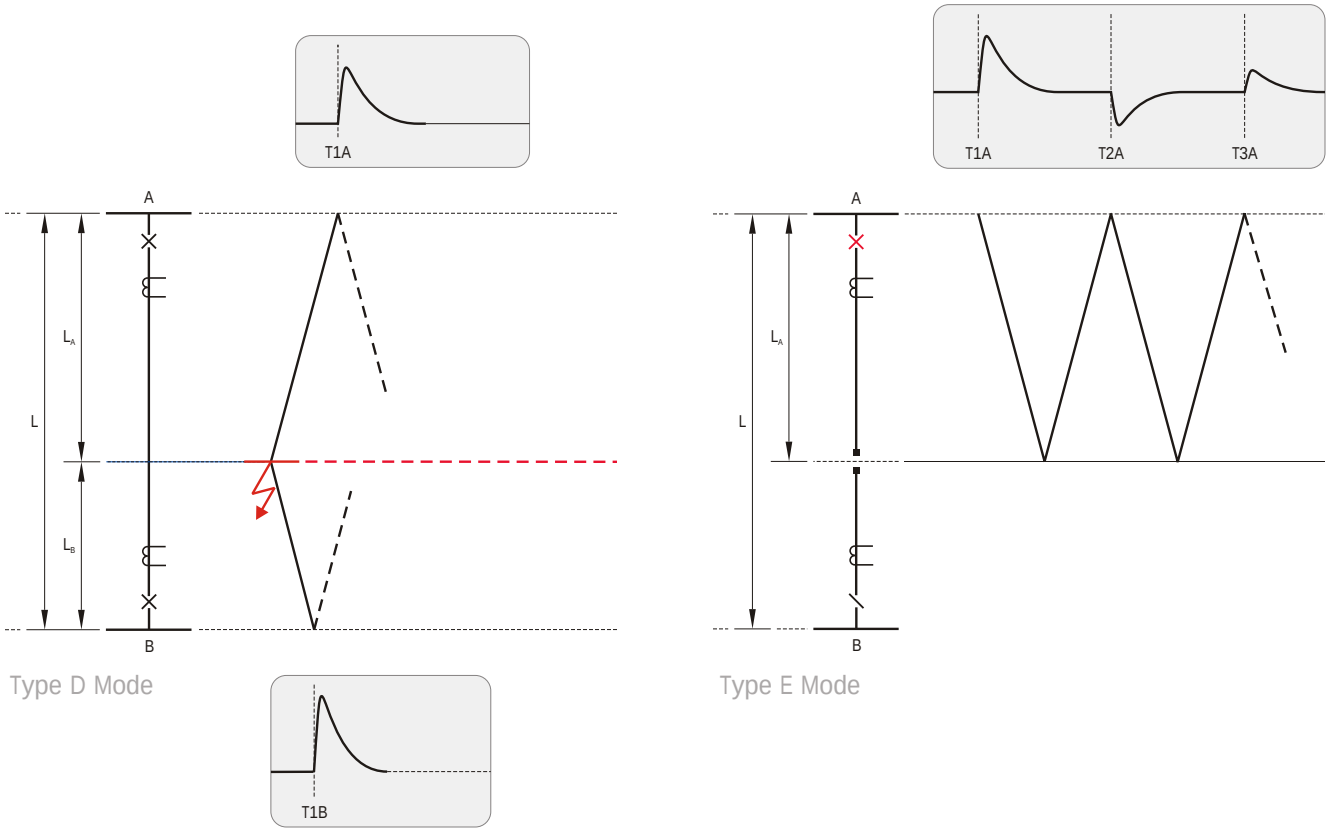
Type D mode of operation allows automatic calculation of the fault location.

- By time tagging the arrival of the traveling waves at two time synchronized locations, one at either side of the fault, the fault can be located.
- The two fault locators do not necessarily have to be connected to the faulted line as the traveling waves will travel across a system through intermediate substations. The line circuit breakers of the faulted line must be closed for current transients to be produced.
- Inter-end communication, which does not have to be 'on-line', can be via any convenient channel. This includes PSTN, microwave, optical fibre or SCADA network.

Type E Mode

The Type E mode of operation is a single-ended mode which uses the transients created when a circuit breaker is closed onto a dead line.

- The substation busbar and line circuit breaker act as three separate impulse generators with 'firing times', output voltage amplitudes and polarities which vary between the phases due to the different 'points-on-wave' at which each pole *pre-strikes.*
- This mode is used to accurately determine the true length of line conductors.



Type D Mode

Type E Mode

TWS Operating Modes

Communications and Analysis Software

ANALYSIS

- *TWSBase™2000* is a software package running on Windows 9x, Me, NT, 2000 or Windows XP.
- It allows full remote interrogation of fault records, with automatic fault distance reporting on Type D systems.
- The software also allows the fault waveforms to be analyzed manually for distance measurement on Type A and Type E systems.

MANIPULATION

- *TWSBase™2000* allows waveform analysis of fault records which includes direct measurement of fault distance, filter characteristics, amplitude, expansion and comparison of previous fault data with new data.

COMMUNICATIONS

- Fully automatic interrogation via modem or Ethernet of all installed Telefault TWS units and remote configuration.

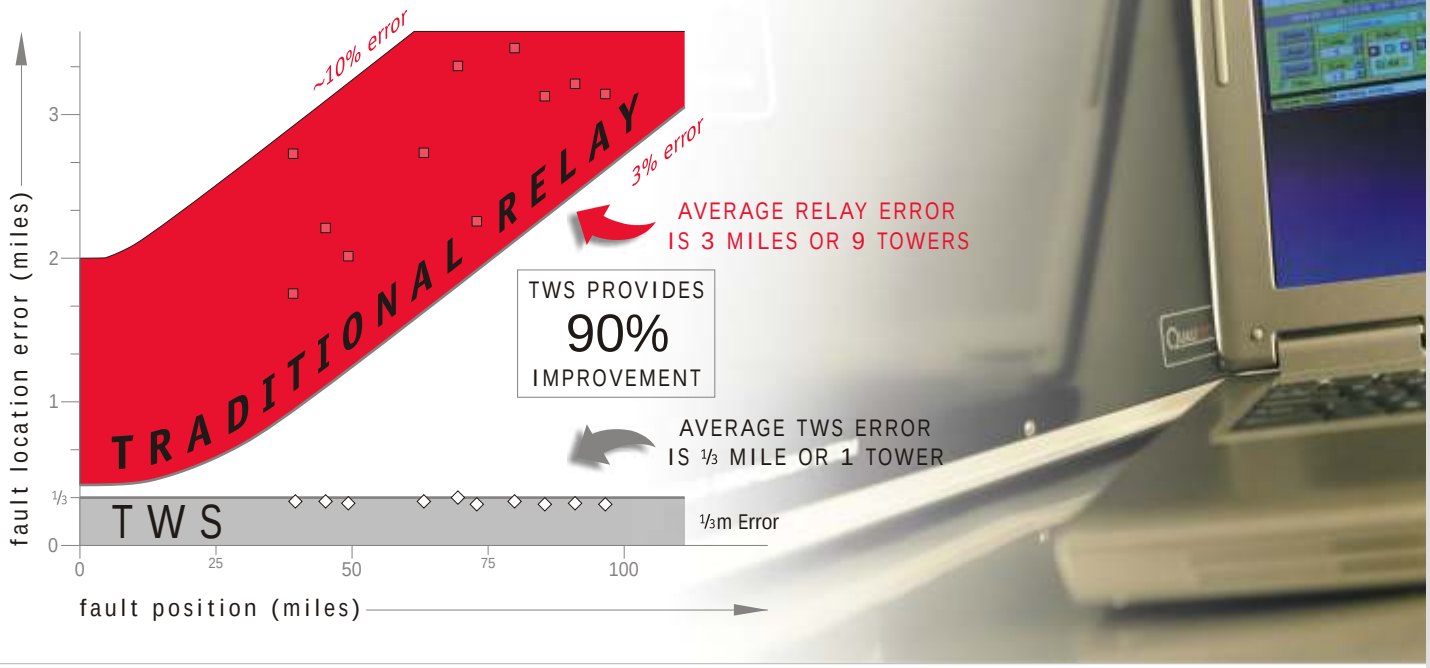
CONFIGURATION

- *TWSBase™2000* allows full configuration of the Telefault TWSs installed on the user power system, including substation name, circuit names and line length.
- The diagnostic file can also be interrogated remotely.

Power Supply	Voltage range:	■ 85 - 250Vac ■ 35 - 60Vdc ■ 90 - 240Vdc. To be specified at time of order.
	Power:	120W (maximum).
Front Panel	Indicators	LEDs indicate: ■ Power on ■ GPS locked ■ Watchdog
Performance	Analog triggering:	Preset over threshold triggering. ±25% of Full Scale Deflection (FSD). FSD of 0.2V for maximum gain setting.
	Non volatile storage:	Mass storage hard disk (maximum 500 records saved per Line Module).
	Time synchronization:	■ Internal real time clock ■ GPS (Global Positioning System) module.
Inputs	Analog AC inputs:	Via external interposing inductive couplers. Non-intrusive installation.
	Adjustments:	Digitally programmable gain (via configuration file).
Communication Ports	Serial port:	For use with external modem.
	Ethernet port:	For remote access, control and data retrieval.
Line Modules	Quantity:	1 supplied as standard. 8 maximum.
	Channels:	3 (one for each phase).
	Sampling rate:	1.25MHz.
	Resolution:	8 bits.
	Buffer:	2 x 16kbytes per channel.
GPS Module	Profile:	Internal GPS receiver. Programmable for local time and automatic daylight saving. Self contained module with on board battery backup of its parameters.
	Accuracy:	1µs (with GPS lock).
	Outputs:	One pulse per second (standard). Isolated serial port (standard). IRIG-B serial time code signal modulated and DC level standards (optional).
Communications and Alarm Module	Alarms:	Digital: All dry contacts, normally open. Contact rating: 125Vdc at 100W maximum (non reactive). Output alarms: ■ Power failure ■ System watchdog ■ GPS lost.
	Modem:	Internal or external. (standard internal).
	Standard internal modem:	ISA standard 56k modem.
Immunity	Dielectric strength:	Conforms to: ■ IEC 801-4 ■ IEC 255-5 ■ ANSI / IEEE C37.90.1, 1989.
Environmental	Operating temperature:	32 to 131ºF (0 to +55ºC).
	Storage temperature:	-40 to 158ºF (-40 to +70ºC).
	Relative humidity:	5% to 90% (non-condensing).
	Enclosure protection:	Rated at IP20 to BS/EN 60529.
Mechanical	Dimensions:	19" rack mountable chassis. ■ Width: 17.68" (448.8mm) ■ Depth: 15.21" (386mm) ■ Height: 6U - 10½" (266.7mm).
	Weight:	40lbs (18kg).

Fault Location Accuracy Comparison

Line Type	ACTUAL Fault Position	TWS Measurement	OTHER EQUIPMENT Measurement
Plain Feeder	23.3 miles	23.36 miles	16.1 miles (numerical distance relay)
Plain Feeder	0.93 miles	0.93 miles	0.43 miles (numerical distance relay)
HVDC	65.2 miles	64.9 miles	No other fault location means
Series Compensated Line	Number of faults over a period of time	Accuracy better than 980 feet (a tower span)	Error of 20 miles using pre-fault, post-fault voltage comparison technique. No impedance based method can be accurate



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