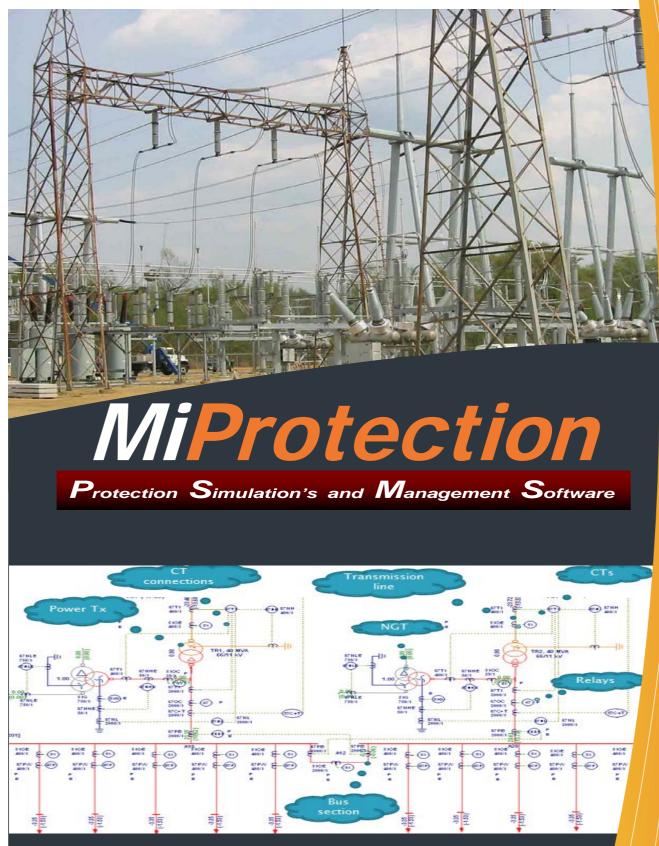


An Indian Product of International repute



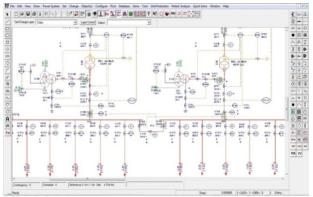
**Power Research & Development Consultants Pvt. Ltd.** # 5,11<sup>th</sup> CROSS 2nd STAGE WEST OF CHORD ROAD BANGALORE INDIA PIN: 560086 Tel: +91-80-4245 5555, 2319 2209, Fax: +91-80-23192210, e-mail: prdc@vsnl.com, www.prdcinfotech.com



# Power System Protection & Simulation Software Package

# INTRODUCTION

MiProtection is highly interactive, user-friendly windows based Power system protection analysis package. It includes a set of modules for performing a wide range of power system protection studies including both equipment protection and system protection and other system studies. MiProtection features include a top notch Windows GUI.



#### PROTECTION SYSTEM MODELLING

- Standard power system components and relay symbols.
- Association of relays to power system elements.
- Switching status for all relay elements from the screen.
- Highlighting of relay operational sequence after the analysis.
- Display of sequence operation of relays with respect to tripping time.
- Display of fault on the SLD with standard notation after fault creation.
- Disturbance analysis with single click on mapping of disturbance files with corresponding relay.

#### RELAY DATABASE UTILITY

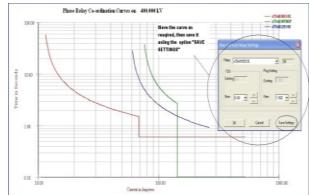
- Enhanced database creation including detailed modeling of all relay elements with standard libraries.
- Splitting of database into two groups element information and library information - avoids repetitive entry of power system elements having same parameters.
- Studies at your fingertips once relay database is created accurately; protection study can be conducted.
- Toggling facility database to network editor, data base to graph to facilitate easier navigation.

# ANALYSIS

- Modeling of phase and earth over-current relays with NI, VI, RI, EI & DT characteristics.
- Modeling of phase to phase and phase to earth loop characteristics of distance relays.
- Over current Relay Coordination (ORCD) and Distance Relay Coordination (DRCD) modules can be used for verifying the validity of existing settings of over-current and distance relays. Also, these modules can be used to generate new settings for over-current and distance relays respectively.

- Visualisation and co-ordination of over-current relays using the graph plotter facility.
- Modeling of unit protection schemes such as differential protection for transformers, lines/cables and busbar and restricted earth fault protection and verification of settings.

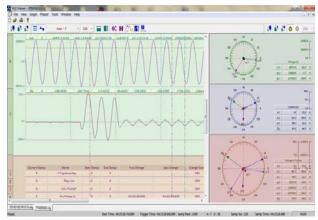
#### **GRAPH PLOT**



Also, these modules can be used to generate new settings for over-current and distance relays respectively.

- Visualisation and co-ordination of over-current relays using the graph plotter facility.
- Modeling of unit protection schemes such as differential protection for transformers, lines/cables and busbar and restricted earth fault protection and verification of settings.
- Log and semi log view for relay coordination and setting graphs.
- Horizontal and vertical movement of relay curves as per the predefined steps.
- Pick drag and drop facility for relay curves.
- Changing the base voltage of the plotted graphs.
   Coordination of relays from graph itself to the desired value.

# COMTRADE VIEWER



- Used for viewing the COMTRADE files of the Disturbance Recorder (DR) data received.
- Facilitates to view vector diagrams of voltages and currents of the DR data.
- ♣ Selected interval view of a particular file.
- Selected disturbance view of a particular relay.
- Harmonics present in disturbance record can be viewed in tabular form.



#### INTRODUCTION

Relay Co-ordination can be conducted for relays of all make and with user defined characteristics for over current and distance relays. Various simulation options are available. Provides new relay settings for improved performance and compute zone settings for Distance Relays.

#### FEATURE HIGHLIGHTS

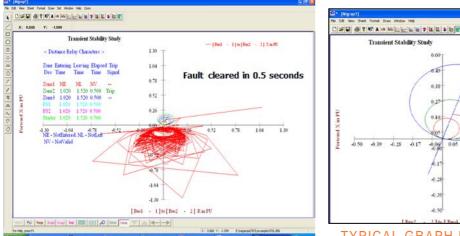
- Radial and Mesh Networks
- Automatic/Interactive/Manual Primary-back-up relay pairs generation
- ♣ Save and retrieval of selected relay pairs
- Embedded fault calculation
- 4 Phase and earth relay co-ordination
- Optimum setting for motor relays
- Hot and cold curves considered / Extensive database of relays
- Extensive fuse data / Easy adding of new relay to library
- Graphical co-ordination Pick, drag and drop relay curves
- Verification of existing relay settings
- Fault simulation and relay trip sequence
- Text and graphical output / Thermal curves for each equipment
- 4 Optional voltage input from load flow or flat start
- Overload factor; unbalance factor and discrimination time for each relay
- Inbuilt discrimination time calculator

#### OVER CURRENT CO-ORDINATION

- Phase relay coordination
- # Earth relay coordination / Standby earth fault
- Partial busbar protection simulation / Fuse coordination
- Instantaneous setting for relays
- 4 Directional and non directional feature for relays
- Pre-loaded standard relay curves
- Normalized curve and fault line feature
- View existing and newly computed relay settings simultaneously
- Partial analysis for selected relays / Quick solve

#### DISTANCE RELAY CO-ORDINATION

- Phase relay coordination
- 4 Automatic computation of zone setting
- Standard relay characteristics (example: mho, circular, etc.,)
- View existing and newly computed relay settings simultaneously
- Impedance seen by the relay for faults
- Quick solve



 Over Current Relay Data
 Paid bit 8

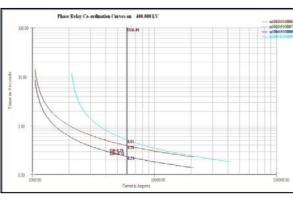
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# OVER CURRENT RELAY DATA

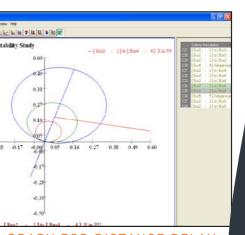


# FAULT LINE

#### Distance Relay Data



#### DISTANCE RELAY DATA



TYPICAL GRAPH FOR DISTANCE RELAY



# **Equipment Protection**

#### INTRODUCTION

A unit protection system involves the measurement of fault currents (and possibly voltages) at each end of the zone, and the transmission of information between the equipment at zone boundaries. Protection schemes such as differential protection (for transformers, lines, busbar etc) and distance protection (for lines) are employed to achieve equipment protection. The following types of protection schemes are available in MiProtection.

- 4 Transformer differential
- Restricted earth fault
- \rm Line pilot
- Bus bar differential
  Line/cable differential
- Line/cable differentia
- Distance protect

# TRANSFORMER DIFFERENTIAL

transformer differential А protection compares the flowing the current to transformer with the current leaving the transformer. Power transformers introd often not only a change magnitudes of voltages currents but also a change phase angle. These effects m be considered in obtaining correct analysis of fault conditi by the differential protection.

- Choice of relay library based on the manufacturer
- User defined bias slope setting
- Provision to enter CT details for 2 winding and 3 winding transformers
- Provision to enter existing relay settings
- Program computed transformer differential settings

# **RESTRICTED EARTH FAULT**

Relay Number Relay Type	403		Name FEYROLLE te Code F7N	
Relay Setting Ty	pe 17 Voltage	RaiedCurent in Bating 1	Angeles Fatrg 2	<u>F</u>
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Voltage Setting	p Continu	ious if Unitem (	Discritte 44 In Bi	- Charle
		our * Uniform *	Decrete * in Bu	
C % C Vota		Nax	Sho	

Restricted earth fault (REF) relay is a unit protection intended for one winding of a transformer (neutral winding) the input of which is from a neutral bushing CT and in some applications, balanced by the output of three line CTs in the Y-winding directly connected to neutral. This provides accurate sensing of zero-sequence leakage for a

fault within its zone of -

protection, i.e., on the windings.

- REF relay in MiProtection has:
- Choice of relay library based on the manufacturer.
- User choice of current or voltage setting
- Provision to enter normal and sensitive current setting range details.
- User choice of voltage setting details in % or volts.
- Program computed stabilizing resistance value.
- Program computed current/voltage settings.

#### LINE PILOT

Pilot relaying is an adaptation of the principles of differential relaying for the protection of transmission-line sections. For faults occurring within the protected feeder it is desirable to trip the circuit breakers at each end to isolate the fault. A pair of pilot wire is used to transmit information between the two relays so that each may be able to compare the current flowing at its respective end with current at the other end

Line	Pilot Relay		
Roley Number 1993	Name and Inc. 1500 PW		
Eleven funde	(13.221 - 13.22 <u>-</u>	Kentreg Satur	e des
New Action Party and Ac		Time ()	- 14
Loop Resistance C Moscored IF Computed Long Re-	untarios (c) area	Computed Settle	
Notice Transforme	er Fault Current (A)	Tate	- +
Currer Transferrer Primary 400 A Second	ndars 1 A. R	res Port Volt (ac	0
CT Peotone 1 over Lea	Resistance 1	m	
8 1 E N 1	Time Constant 20	- Ka (0	8 🔳
franct			
6 Thilling C Dites	Eurori Number		- 2
	CT Location	C fee	C.Te
To CI			
R Thatline C Ofen	Element Number		
	ET Looken	Citizen 18	Cital I

- User defined Line Pilot relay characteristics
- Choice of pilot wire voltage (either 5 or 15 kV)
- Choice of loop resistance between measured and computed
- Provision to input isolation transformer data
- Provision to input CT data
   Padding resistance as a computed output

#### **BUS BAR DIFFERENTIAL**

Busbar protection is primarily concerned with speedy isolation of busbar faults in less time than could be achieved by back-up line protection, with the twin objective of maintaining system stability and limitation of consequential damage

RelayNuster 555	Reis Nat	e k210121171	10	
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Peiblance : atr	h Lead Pesiblance	du	Cass [1	2.6101
Fault Current in Angenes	Variable Flerenter	in chrus	Residence	e sheri
Haines 1100	Fasidance	6300	Ottental	22
Nranue 1000	Feitand	12116	Stabilizerg D	isul 🕅
LoadCurrent in Angents Manimum	Audau CT R	nin Falut	abety Factor	
Computed Settings				
Pellup Current  1	Date Factor Elde	aikeal (c	Diterents Cur	at F
Tee D1	Step Factor (cf	ect (F	Differential di	F

- Provision to enter relay details like max, min and step values of current in %.
- Provision to enter relay details like max, min and step values of alarm in %.
- Provision to enter relay details like max, min and step values of time in seconds.
- Variable resistor values: enter minimum, maximum and step values
- Provision to input pick up characteristics data for minimum, maximum and step details for over current setting in %, stabilizing factor (selective), stabilizing factor (check zone) and Time in ms.
- Provision to view computed and existing stabilizing resistance simultaneously

#### LINE/CABLE DIFFERENTIAL

The line cable differential function offers phasesegregated true current differential protection for transmission, sub-transmission and distribution networks. The function compares the currents enterina and leaving the protected overhead line or cable.

to

influence of second harmonic

Provision

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Line/Cable Differential Relay

User defined values for minimum, maximum and step values in % for differential set, switch on, high set and 2nd harmonic restraint.

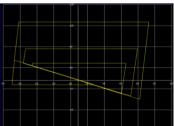
the

Provision to view computed and existing settings simultaneously

#### LINE/CABLE DIFFERENTIAL

include

MiProtection offers а graphical tool. MiPContour, using which distance relay characteristics can be created. User can create characteristics library as per the relay settings by using this tool. Various types of characteristics



followed in distance relays of different makes can be drawn and used for analysis.

MiPContour has the following features:

- Concept of layer for defining zones of operation.
- Facility to enter co-ordinates.
- Ability to draw shapes such as rectangle, square, circle, polygon and poly arc.
- + Option to create separate library for phase and earth.
- Option to enter the characteristics on primary or secondary side of CT/CVT.



#### INTRODUCTION

In an Industrial Plant, during normal system operation the inplant generators operate in synchronism with the grid. The power flow balance is maintained by either importing or exporting power to the grid. However, during severe system disturbance, the frequency and / or the voltage of the grid might violate the safe operating limits of the in-plant generators and load, thereby resulting in plant black out due to tripping initiated by generator protection. Further, loss of grid lines will result in either frequency or voltage related issues, depending on pre disturbance condition.

In order to avoid black out of the plant's sensitive loads and generators, grid islanding scheme needs to be developed, which can sense such severe grid disturbance and isolate the sensitive section from the non-sensitive one. Also in order to maintain the load generation balance, frequency dependent load shedding and generator tripping scheme (if necessary) needs to be developed.

A similar analogy can be drawn to a utility network too.

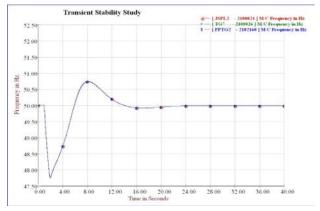
#### FREQUENCY RELAY

 
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 Image: Ima Frequency Relay Data

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Load (I)	Load II	Load [J]	Two Winding Generator (G)	Transformer (T)		Listian	n.:		-
			Load (I)						

In a power system, during pre-disturbance condition if the net sensitive load is greater than the net sensitive generation, the resulting frequency, post islanding will drop below the nominal value (50/60 Hz) and the vice-versa. In order to prevent the frequency to fall below a certain value, load shedding needs to be undertaken. This is done based on the quantum of power mismatch and the priority of loads to be shed.



- 4 User defined under frequency setting
- User defined over frequency setting
- User defined rate of change of frequency (df/dt)
- + Choice of tripping any element in the power system
- network based on the frequency relay setting
- Provision to define up to four tripping settings

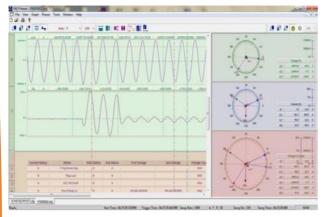
#### **VOLTAGE RELAY**

oltage Relay	Data								
Relay ID 🚺 Re	elay Name		Bus ID		•	Fetch	Relay		
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Voltage in p	u dv/dt E	)elay (sec)-		Elements		— % loac			
Setting 1 0.000000		.000000							
C Setting 2 0.000000		.000000					1		
C Setting 3 0.000000		.000000			_		1		
C Setting 4 0.000000		1.000000			-		-		
						J			
Element list Two Winding Transformer (T)	Elen	nent IDs				_			
Generator (G) Load (I)									
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		Network			Desc				
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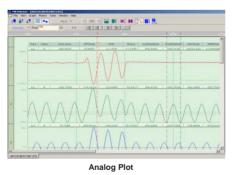
#### INTRODUCTION



Disturbance Records stored in numerical relays following a disturbance have proven to be very useful for power system engineers in the departments of operation, maintenance and protection. Normally, these disturbance records (DRs) are stored in COMTRADE format, a standard defined by IEEE for ease of data transfer between various disturbance recording sources and analytical tools. MiCtViewer is developed in order to view and analyse DRs in COMTRADE format.

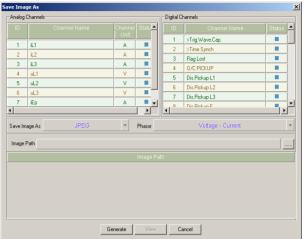
MiCtViewer allows the user to analyse the disturbance records in both numerical and graphical ways. The COMTRADE viewer reads the .cfg file and .dat file for the inputs and it displays the samples both in numerical as well as graphical format. The data display offers a highresolution graphical interface for displaying, analyzing and manipulating analog and digital channels of an oscillographic record or a periodic load file. Displayed channels can be marked, zoomed, numerically processed and summarized. Several features such as comparison of channels, merging of files, correction of time, resampling, harmonicsetc are also provided in this module. MiCtViewer also provides facility for user to filter the channels necessary for analysis. The data is displayed for both analog and digital channels. User has the option to select or deselect the particular channels. MiCtViewer can also generate report on the browsed COMTRADE file.

#### ANALOG & DIGITAL PLOT



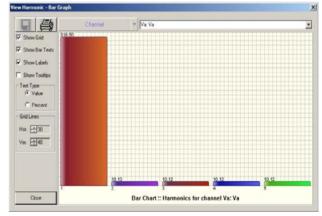
#### **Digital Plot**

#### GENERATE IMAGE - SAVE IMAGE AS



**Save Image As:** User can select the option to save the file into image format. The options available are .bmp and .jpeg. **Phasor:** The options to select in the phasor window are None, Voltage, Current, Voltage andCurrent and all. Depending on the selection type the images are generated.

#### **VIEW HARMONICS**



	iom 1	To	40	Total Samples Samples/Cycle	1000		
Harmonic Peak Value	,						
							6
OVTIA		343707.814900	43.226228	25.374374	30.919083	31.072934	28.50618
			0.01 %	0.01 %	0.01 %	0.01 %	0.01 %
CVT 18		343650.442706	44.430714	21.965598	10.818927	9.284029	16.00170
		-	0.01 %	0.01 %	0.00 %	0.00 %	0.00%
CVT1C		343667.075120	7.594382	13.607904	21.340508	23.699913	12.85619
			0.00 %	0.00%	0.01 %	0.01 %	0.00 %
CT1A		232.897030	0.603804	0.616256	0.585948	0.635307	0.675431
			0.25 %	0.26 %	0.25 %	0.27 %	0.29 %
CT1B		223 189839	10.444566	10.454083	10.464324	10.484415	10 51 950
			4.68 %	4.68 %	4,70 %	4 70 %	471 %
CTIC		224.946854	9,858229	9.877696	9.521601	9.822758	9.827075
			4.38 %	4.39 %	4.41 %	4.37 %	4.37 %
1		1					i

- Computation of harmonics in the waveforms of analog channels.
- Harmonics upto the order of N/2 Hz (N -> Sampling frequency).
- Harmonics view in tabular form.
- Harmonics view in bar graphs.



#### REPORT

						HTML Report
File Informatic						PDF Report
Substation		Aranar_UDM1 Folder 4000CV	UDUMALPET LU	NE-1		
Device Mame		000096				DOC Report
File Name		TOPICOMTEDE FILENCO)	ATRADE FILES F	OR TESTINORCAL	CULATION FILESFROM	Dochopore
File Size()(B)		80				JPG Report
Prefault Time		07/08/2011 04:25:28:742599				ond Report
Trigger Time		07/08/2011 04:25:28 841999				TIEE Descub
Save Time		7/8/2011 11:17:52				TIFF Report
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		0.694				XLS Report
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End Time Sampling Freque	rcy (Hz)	1000				TXT Report
End Tine Sampling Freque Sampling Interval Line Frequency()	ncy (Hz) (0) (4)	1000 0 001000 50.000000				TXT Report
End Time Sampling Freque Sampling Interval Line Frequency() Summary of Ar	ncy (Hz) (0) (4)	1000 0 001000 50.000000 Bannels	Minison	(abas/mos)	Paritive Peak/Larri	
End Time	ncy (Hz) (() (2) waliog ()	1000 0 001000 50.000000	Minisom 3	(alue(mus)	Pecifive Peak(Inst) 3520 512	Negative Peak(East)
End Time Sampling Freque Sampling Interval Line Frequency() Summary of Ar Description	(Hz) (r) (z) Unit	1000 0 001000 50.000000 hannels Maximum Value (mus)		(alue(mus)		Negative Poak(Inst)
End Time Sampling Freque Sampling Interval Line Frequency O Summary of Au Description 1 (J.1)	icy (Hz) (i) (i) (ii) (iii)) (iii) (iii) (iii)) (iii) (iii)) (ii)) (ii)) (ii)) (ii)) (ii)) (ii)) (ii))) (ii)) (ii))) (ii))) (ii))) (ii))) (ii))) (ii))) (ii))) (ii))) (ii))) (ii))) (ii))) (ii))) (ii)))((ii)))((ii)))((ii)))((ii)))((ii)))((ii))((ii))((ii))((ii))	1000 0.001000 50.000000 Ibasine Is Maximum Value (mss) 2499.378	-4604 046	(akeetmas)	3520 512	Negative Poak(Inst) -6511.104
End Time Sampling Freque Sampling Interval Line Frequency O Summary of Ar Description 1 [J.1] 2 [J.2]	tey (Hz) (g) (g) (g) (g) (g) (g) (g) (g) (g) (g	1000 0.001000 50.000000 hannels Maximum Value (mss) 2489.778 172.652	-4604 046 -364 935		3520 512 244.224	Negative Poak(Isst) -6511104 -516.096
End Time Sampling Frequency Sampling Interval Line Prequency of Ar Description 1 (d.1) 2 (d.1) 2 (d.2) 3 (d.3)	icy (Hz) (g) (g) (g) (g) (g) (g) (g) (g) (g) (g	1000 0.001000 50.000000 hanne19 Maximum Value (mwr) 2449.778 172.692 351.902	-4604 046 -364 935 -521 336	5	3520 512 244 224 497 664	Negative Poak(Isst) -6511164 -516.096 -737.280
End Time Sampling Frequency Sampling Interval Line Prequency Bummary of Au Description 1 (L1) 2 (L2) 3 (L3) 4 (L1)	tan log D Unit A A A V	1000 0.001000 50.000000 Maanaels Maximum Valoe (msc) 0409.1708 172.692 351.902 216924.170	-4604 046 -364 935 -521 336 -236875 65	5	3520 512 244 224 497.664 335051 375	Negative Teak(Iast) +6511 104 -516 096 -737 280 -534002 764

#### The summary of the report includes:

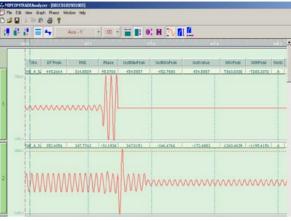
- File information
- Summary of analog channels
- 4 Digital channel data
- Digital channel sequence events
- # Images of analog, digital and phasor section
- Report Types: Multiple report types are available.

# FILE MERGE

igle/Multi	File Merging	& Time Dri	ift Correctio	n Dialog					
No of Files				Two Fil	э				
File 1	E:\\$DESKTOP	COMTRD^	1\HIDEDC~1	\Demo\0V	ERCU~1\00	10010671	2005.CF	G	Viev
File 2	E:\\$DESKTOP	P\COMTRD1	"1\HIDEDC"	\Demo\0\	/ERCU~1\0	02C01067	T1001.cf	g [	Vie
Output File	\\$DESKTOP\	COMTRD~1	HIDEDC~1\	emo\0VE	RCU~1\000	12232376	626427h.	• •••••	Vie
File 1 Info									
Total Sam	nple 18	00	Start Date	07/08/20	111 -	Trigger D	ate 07/	08/2011	4
Frequer	ncy 50.0	000	Start Time	4:25:21	AM 👘	Trigger T	ime 4:	25:22 AM	-
File 2 Info				, 					
Total Sam	nple 23	67	Start Date	05/10/20	109 -	Trigger D	ate 05/	10/2009	-
Frequer	ncy 50.0	000	Start Time	3:12:08	PM 👘	Trigger T	ime 3:	12:08 PM	-
Sample Nu	umber			, 					_
From Num				To N	umber 1800	1			_
Start Time	12:42:15 PM	Tri	gger Time 1	2:42:15 PM	F	requency		1000	
Select	File 1 🔺 Analog Channel	Sel	File 2 Analog Channel	Select		gita	elect		ita
IA		<b>–</b> L	NE_A_IL1		D1 M-CB F	IPH	G	ENERAL_	TF
📕 🛛 IB		🔳 Ju	NE_A_IL2		D2 M-CB Y	РН	🔳 🛛 Z	ONE1_TR	IP
□ IC			NE_A_IL3		D3 M-CB E			ONE1_ST	
IN IN			NE_A_IN		D5 M-2 DI			ONE2_TR	-
	·		NE_UL1 NE_UL2		D6 LINE IS			ONE2_ST. ONE3_TR	-
•	· ▼						1		► [

File merge tool allows users to modify existing COMTRADE files by removing unwanted channels, changing the sampling frequency and setting the start and end times. The result of this is a new COMTRADE file with filtered data which can be processed further for analysis.

# COMPARISON OF CHANNELS



The channels of interest can be selected and plotted for comparison. This can help the user to understand the type of disturbance and the various sequence of events occurred.

# COMPUTATIONAL TOOL

The calculation tool can be used for computation of basic electrical quantities such as active power, reactive power, impedance, rate of change of parameters etc from the voltage and current information. This feature allows the user to build the necessary functions and also plot.

		Digital Channel/Formula List	
	Color Select		
NST - iL2		Flag Lost	
NST - d(iL2)/dt		Dis.Pickup L1	
Magnitude - RMS - iL2			
Angle - RMS - iL2			
Magnitude - RMS - d(iL2)/dt			
Angle - RMS - d(iL2)/dt			
NST - uL3			
NST - d(uL3)/dt			
Magnitude - RMS - uL3			
Angle - RMS - uL3	E		
Magnitude - RMS - d(uL3)/dt			
Angle - RMS - d(uL3)/dt			
Build Formula >>		Build Formula >	>





**Post Mortem Analysis** 

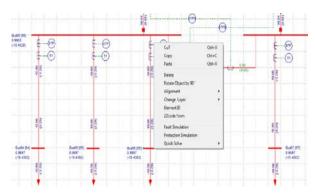
# COMTRADE FILE ANALYSIS

This tool has been provided so that operators may simulate previous faults and verify protection settings and system behavior. A list of all recorded waveforms reported by a recording device is maintained so that users may choose from the list and simulate the event of their choice. Operators may check different relay settings and protection schemes before applying them to the field in order to maintain protection system reliability and prevent mal-operation. This tool also provides an opportunity for post mortem analysis of faults and re-submission of reports on faults that have already passed.

	Station Name	PowerETA_MiPower_Simulation
-	Prefault Time	13/08/2012 16:50:31.000000
	Trigger Time	13/08/2012 16:50:31.000000
	Sampling Frequency[Hz]	2000
$\mathbf{Y}$	Fault Type	Y-G Fault
$\sim$	Fault Current (A)	1510.992899
$\sim$	Fault Voltage (kV)	211.824412
	Relay Pickup Time	16:50:31.234500
	Fault Clearing Time [s]	0.133500
6 ( )	Breaker Opening Time	16:50:31.368000
$\sim$	Auto Reclosure	Successfull/Temp. Fault
	A/R Dead Time (s)	0.020
Station 1: PowerETA_	MiPower_Simulation	
Y Phase		
Fault	Distance: 150.00 km	

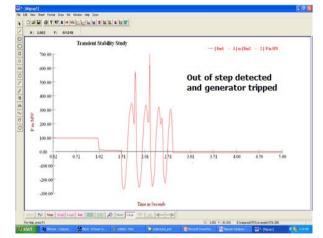
#### **PROTECTION SIMULATION**

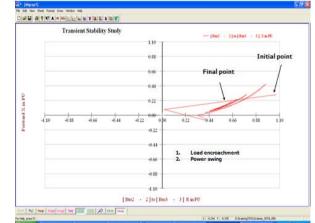
5019	xx5A03051 OE0	A		8 9	
CT-Ratio	400/1				
Curve-Char	3Sec		(STP)	E	
ElementType	Line		4 9	¢	
ElementID	49		(61)	E(**)	
Item	Existing		2		12349 2
Phase-PS	1000.000000		100		(93.97)
Phase-TMS	0.030000			MNT	
Phase-IS	0.000000				
<b>Flelay Trip Sequ</b>					
	Next > CPrevious	Last>>	3	TNOP	
	Next> < Previour		8		
cont	Next> < Previour		3 8		
PH Fault Curr Time	Next > CPreviour	-	8	24600 40 (00 00)	
PH Fault Curr Time	Next > < Previour		8	Bus00 (00) 24000 40 (6000)	



Protection simulation is a feature provided in MiProtection for observing the sequence of operation of relays when a fault is simulated in the system, after complete modeling of the system is carried out. Modeling of the system includes preparation of system Single Line Diagram (SLD) and database along with the relays. Protection simulation can then be performed by simulating faults at different buses (or lines, transformers) to analyze the sequence of operation of the relays which can give exact visualization of the primary and backup relays.

#### DYNAMIC STUDIES AND RELAY BEHAVIOUR





- Critical clearing time computation
- Voltage and frequency relay setting
- Power swing and out of step protection



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