

DISTRELAYITR Modeling in PowerWorld Simulator



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for more info:

angel@powerworld.com

217-384-6330 ext. 21



PowerWorld
Corporation

DISTRELAYITR Model

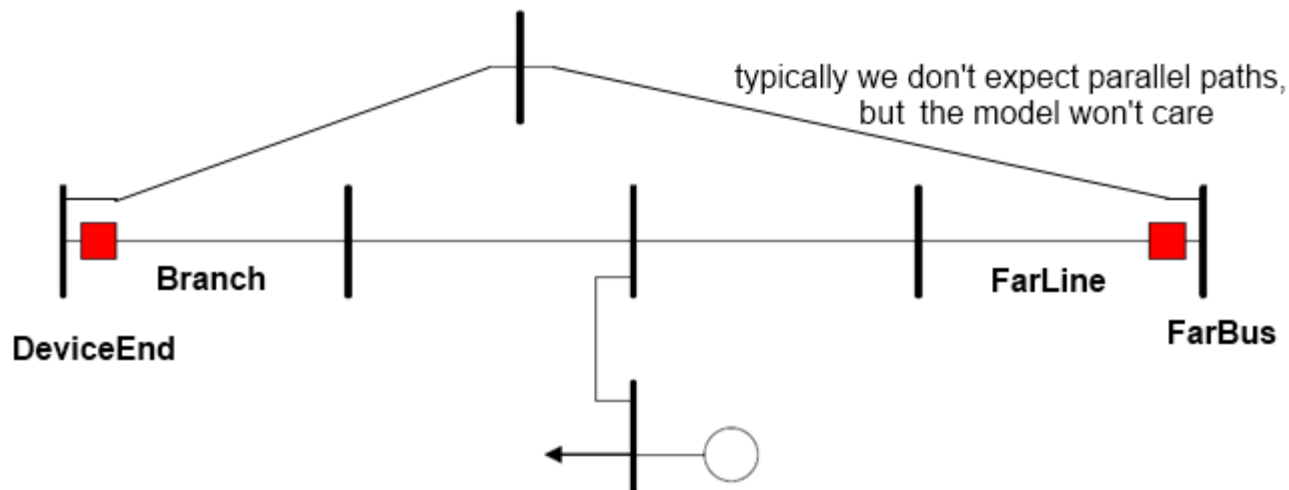


- **DISTRELAYITR** will have the following functionalities to simplify and increase functionality of the distance relay model
 - Zone Definition / Description / Direction
 - Blinder Definition
 - Transfer Trip Scheme functionality and individual reclosing times
 - User Defined Logic schemes

Device Specification



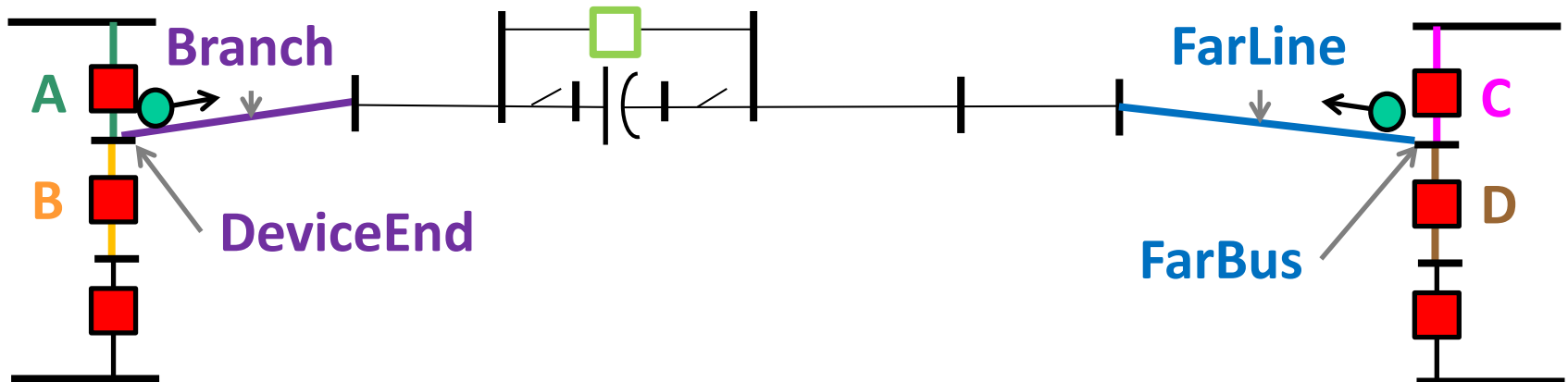
- **DistRelayITR** is assigned to a particular end of a particular **Branch** (line or transformer)
- **DeviceEnd** corresponds to the bus where the relay is located at.
- **FarBus** corresponds to the end of series of branches that this impedance relay is looking toward.
- **FarLine** is end of series branch and is the branch where a second relay may be placed and used in the different Transfer Trip schemes.
 - If no **FarLine** defined then **FarLine** will be the branch to which the relay is assigned and **FarBus** will be the terminal opposite of **DeviceEnd**



What to Trip



- **Trip1, Trip2, Trip3, Trip4, Trip5 (Also a bus with each)**
 - List of up to 5 separate branches are specified.
 - List a terminal bus with each branch too.
 - If specified only that end of the line will be opened.
 - If unspecified, we'll just open both ends of the branch
- **NumDirect:** defines which are considered a direct trip
- **Example:**
 - A = Trip1; B = Trip2; C = Trip3; D = Trip4
 - Number of Direct = 2
 - This means that A and B are opened for a “Direct Trip” and C and D are opened for a “Transfer Trip”



Zone Shapes



- There are 4 zones. Each zone is described by 8 parameters
- Shape Definitions (6 parameters)
 - **Zone Shape**: integer 0, 1, 2, or 3
 - 0 = circle, lens, or tomato
 - 1 = rectangle
 - 2 = reactance distance
 - 3 = impedance distance
 - **Angle** : Angle
 - **Wt**: Total Width (Primary Ohms)
 - **Rr**: Reverse Reach (Primary Ohms)
 - **InternalAngle** : (Degrees: used with Shape = 0)
 - **Rb** (Primary Ohms: Only used with Shape = 1)
 - **ZoneDir**: Zone Direction (Forward = 0; Reverse = 1)
 - **Oper** (Logic operator):
 - 0: AND
 - 1: OR
 - 2: NOT
 - < 0: Do not use Zones greater than current Zone
- **Time**: seconds the apparent impedance must remain in zone for the zone to return TRUE
- **Ithres**: A current threshold in single line current specified in amps.

Logic Operators



- There are 3 Logic Operators.
- For the case $\text{Oper} < 0$ then means the following:
 - Oper1:
 - 0: Zone 1 AND Zone 2 Shape
 - 1: Zone 1 OR Zone 2 Shape
 - < 0 : Do not use Zone 2, Zone 3 and Zone 4
 - Oper2
 - 0: Zone 1/2 (OPER1) AND Zone 3 Shape
 - 1: Zone 1/2 (OPER1) OR Zone 3 Shape
 - < 0 : Do not use Zone 3 and Zone 4
 - Oper3
 - 0: Zone 1/2/3 (OPER2) AND Zone 4 Shape
 - 1: Zone 1/2/3 (OPER2) OR Zone 4 Shape
 - < 0 : Do not use Zone 4

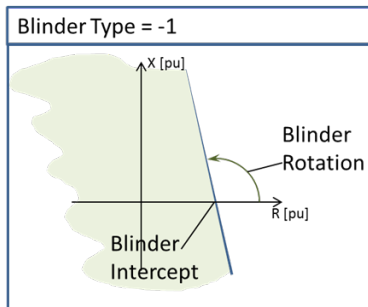
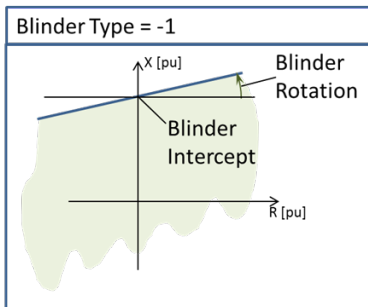
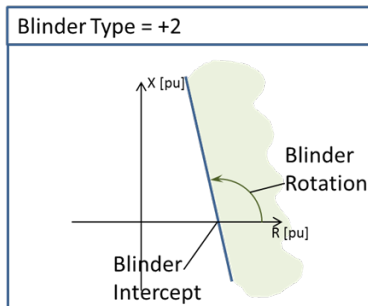
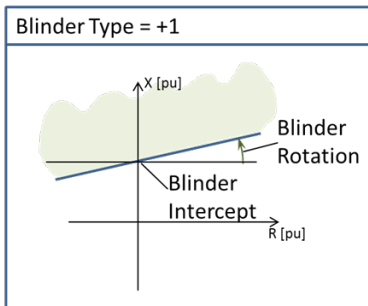
Individual Transfer Reclose Times



- The DISTRELAYITR also have individual transfer recloses
- TransferReclose1 to 5 times (in cycles) for each of the End Trips defined in the Transfer Trips.

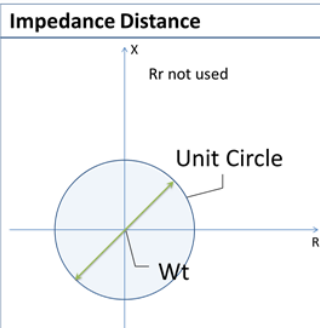
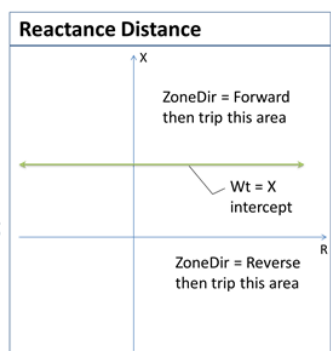
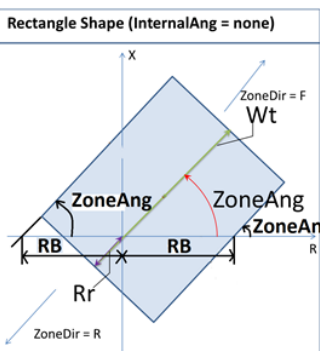
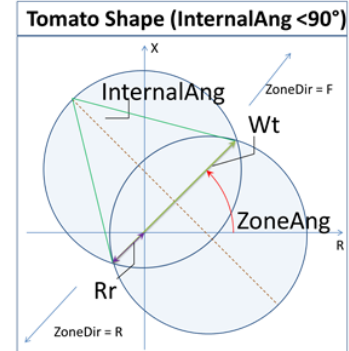
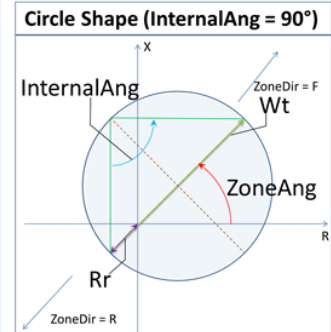
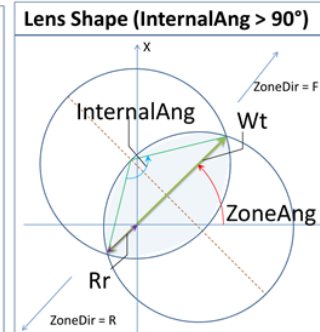
DISTRELAYITR Zone Shapes

- 4 separate blinders are available and act to block all zones.



Parameter Meanings:

ZoneAng	=	Zone Angle / Maximum Torque Angle
ZoneDir	=	Zone Direction (F = Forward) (R = Reverse)
InternalAng	=	Internal Angle (defines shape) > 90° - lens shape = 90° - circle shape < 90° - tomato shape
Wt	=	Width total Impedance Ω
Rr	=	Reverse reach impedance positive # would move shape in the reverse direction negative # would move shape in the forward direction
Rb	=	Resistive blinder location measured along horizontal axis (for quadrilateral shape only).



Transfer Trip Scheme



- **TransferType:** Integer Parameter specifying hard-coded logic on transfer trip.
- All relays will operate for Zone 1 logic
- For transfer trip to work, you MUST have one DISTRELAYITR assigned to the from bus and a second DISTRELAYITR assigned the other side
- Tripping logic then operates on the two relay's zones



Transfer Trip Scheme



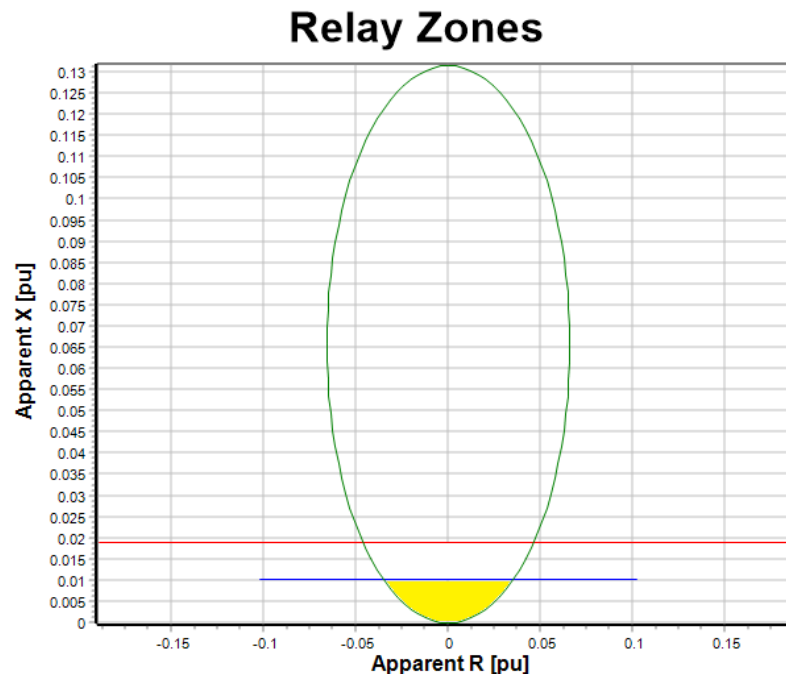
- Trip Logic for DistRelayITR_A
 - 0 = Use Zones 1 to 4 for protection
 - 1 = DUTT: ZA1
 - 2 = POTT: ZA2 and ZB2
 - 3 = PUTT: ZA2 and ZB1
 - 4 = DCB: ZA1 and [ZA2 and (not ZB3)]
 - 5 = Use Logic Operators (Use Oper1 to Oper3)



Example when Trip Logic = 5



- The user specifies what the logic is going to be based on the Oper1 to Oper3 parameter
- Let's say we want to trigger an opening when impedance is inside the Yellow Zone:



Example when Trip Logic = 5

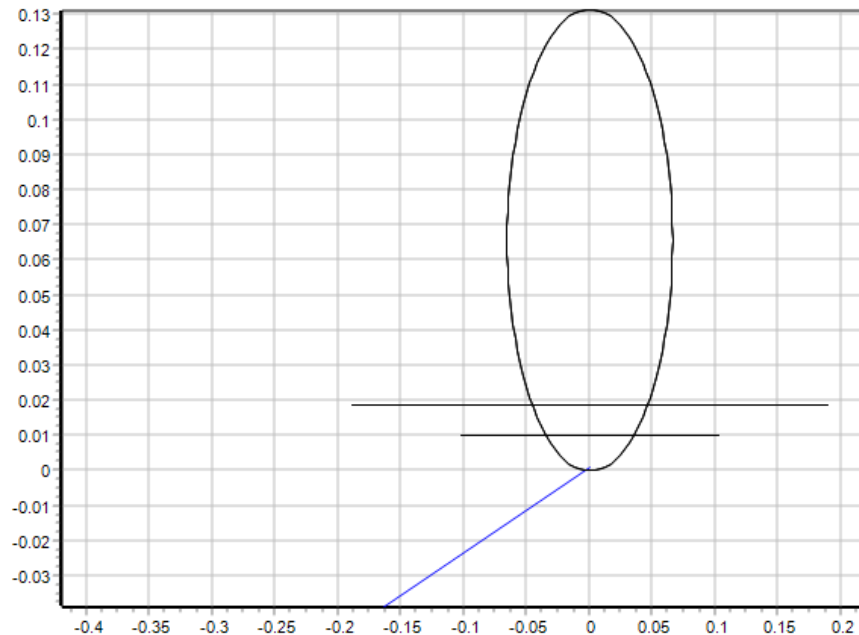


- The Relay Zone 1 and Zone 2 are Reactance Impedance Relays with a Reverse Zone Direction (ZoneDir1/2 = 1)
- Zone 3 Relay is a Mho Circle impedance in the Forward Direction (ZoneDir3 = 0)
- The Logic is: Zone 1 AND Zone 2 AND Zone 3 then
 - Oper1 = 0 (Zone 1 AND Zone 2 Shape)
 - Oper2 = 0 (Zone 1/2 (OPER1) AND Zone 3 Shape)
 - Oper3 = -1 (Do not use Zone 4)
 - PLEASE NOTE:
 - NOTE: Oper3 is negative because we want to tell the simulation that do not use the Zone 4.
 - If the User only wants to use Zone 1 and Zone 2 in the logic then Oper 2 and Oper 3 need to be set to -1.
 - If the user set all Oper1 to Oper3 to -1, it will only check if the impedance is inside Zone 1.

Example when Trip Logic = 5



- In this example the Relay will operate only when the impedance reaches inside the specified zone during the simulation:



DISTRELAYITR Input Data



Line Relay Model

Insert Delete Show Block Diagram Show Relay Zones

Type Active - DISTRELAYITR ID=1 ☒ Active Set to Defaults

Device ID 1 ☒ Device is at From End of Line (otherwise at To End)

Parameters

Far Bus	Bus [REDACTED]	Choose...	Notrip	0	DirectTrip	5.0000	Wt2	2.5000	InternalAng4	0.00000
Far Line	Branch [REDACTED]	Choose...	Shape1	2	DirectReclose	0.00000	Rr2	0.00000	Rb4	0.00000
End Trip 1	Bus [REDACTED]	Choose...	Shape2	2	TransferTrip	5.5000	InternalAng2	0.00000	T4	0.00000
Trip Line 1	Branch [REDACTED]	Choose...	Shape3	0	TransferReclose1	0.00000	Rb2	0.00000	IThres4	0.00000
End Trip 2	Bus [REDACTED]	Choose...	Shape4	0	TransferReclose2	0.00000	T2	0.4167	BlindType0	0.00000
Trip Line 2	Branch [REDACTED]	Choose...	TransferType	5	TransferReclose3	0.00000	IThres2	-1.0000	BlindInt0	0.00000
End Trip 3	none	Choose...	UseLoadEncroach	0	TransferReclose4	0.00000	Angle3	90.0000	BlindRot0	0.00000
Trip Line 3	none	Choose...	NumDirect	1	TransferReclose5	0.00000	Wt3	17.4000	BlindType1	0.00000
End Trip 4	none	Choose...	RecloseWithFault	1	Angle1	0.00000	Rr3	0.00000	BlindInt1	0.00000
Trip Line 4	none	Choose...	ZoneDir1	1	Wt1	1.3500	InternalAng3	90.0000	BlindRot1	0.00000
End Trip 5	none	Choose...	ZoneDir2	1	Rr1	0.00000	Rb3	0.00000	BlindType2	0.00000
Trip Line 5	none	Choose...	ZoneDir3	0	InternalAng1	0.00000	T3	0.08330	BlindInt2	0.00000
			ZoneDir4	0	Rb1	0.00000	IThres3	-1.0000	BlindRot2	0.00000
			Oper1	0	T1	0.08333	Angle4	0.00000	BlindType3	0.00000
			Oper2	0	IThres1	-1.0000	Wt4	0.00000	BlindInt3	0.00000
			Oper3	-1	Angle2	0.00000	Rr4	0.00000	BlindRot3	0.00000

DISTRELAYITR Input Data



PARAMETER	TYPE	DESCRIPTION
Nf	Check	Device is at From End of Line
Far Bus		This relay will only trip the end of the branch specified by the Device Location. The Far Bus specifies the other end of a series of branches that this impedance relay is looking toward. This parameter has no functional purpose in the stability run. It is only provided so that various GUI features which show the percentage reach of the relay can automatically sum up the series of impedances.
Far Line		The branch at the end of a series of branches that the relay is looking toward.
End Trip 1		The end bus of Trip 1 Branch
Trip Line 1		Transmission branch that will be tripped if the relay operates (direct trip) In the From Bus, To Bus, Ckt format
End Trip 2		The end bus of Trip 2 Branch
Trip Line 2		Additional transmission branch that will be tripped if the relay operates In the From Bus, To Bus, Ckt format
End Trip 3		The end bus of Trip 3 Branch
Trip Line 3		Additional transmission branch that will be tripped if the relay operates In the From Bus, To Bus, Ckt format
End Trip 4		The end bus of Trip 4 Branch
Trip Line 4		Additional transmission branch that will be tripped if the relay operates In the From Bus, To Bus, Ckt format
End Trip 5		The end bus of Trip 5 Branch
Trip Line 5		Additional transmission branch that will be tripped if the relay operates In the From Bus, To Bus, Ckt format
No Trip	INTEGER	0 means to monitor and Trip; 1 means it will only monitor
Shape1	INTEGER	Zone 1 Shape Specification: 0 means circle, lens, tomato; 1 means rectangle ; 2 means Reactance Distance; 3 means Impedance Distance
Shape2	INTEGER	Zone 2 Shape Specification: 0 means circle, lens, tomato; 1 means rectangle ; 2 means Reactance Distance; 3 means Impedance Distance
Shape3	INTEGER	Zone 3 Shape Specification: 0 means circle, lens, tomato; 1 means rectangle ; 2 means Reactance Distance; 3 means Impedance Distance
Shape4	INTEGER	Zone 4 Shape Specification: 0 means circle, lens, tomato; 1 means rectangle ; 2 means Reactance Distance; 3 means Impedance Distance

DISTRELAYITR Input Data



PARAMETER	TYPE	DESCRIPTION
Transfer Type	INTEGER	Transfer Trip Type: 0 means none; 1 Direct Underreaching Transfer Trip (DUTT); 2 Permissive Overreaching Transfer Trip (POTT); 3 Permissive Underreaching Transfer Trip (PUTT); 4 Directional Comparison Blocking (DCB) 5 Use Logic Operators (Use Oper 1 to Oper3)
Use Load Encroach	INTEGER	Use Load Encroachment: 0 means NO; 1 means USE. Note: In order to be work a model RELODEN needs to exist or be added to the branch.
Num Direct	INTEGER	Number of direct trips before the transfer branches trip
RecloseWithFault	INTEGER	1 means reclose even when fault is not cleared 0 means DO NOT reclose if fault is not cleared
ZoneDir1	INTEGER	0 = Forward 1 = Reverse
ZoneDir2	INTEGER	0 = Forward 1 = Reverse
ZoneDir3	INTEGER	0 = Forward 1 = Reverse
ZoneDir4	INTEGER	0 = Forward 1 = Reverse
Oper1	INTEGER	0 = Zone 1 AND Zone 2 Shape 1 = Zone 1 OR Zone 2 Shape < 0 = Do not use Zone 2, Zone 3 and Zone 4
Oper2	INTEGER	0 = Zone 1/2 (OPER1) AND Zone 3 Shape 1 = Zone 1/2 (OPER1) OR Zone 3 Shape < 0 = Do not use Zone 3 and Zone 4
Oper3	INTEGER	0 = Zone 1/2/3 (OPER2) AND Zone 4 Shape 1 = Zone 1/2/3 (OPER2) OR Zone 4 Shape < 0 = Do not use Zone 4

DISTRELAYITR Input Data



PARAMETER	TYPE	DESCRIPTION
DirectTrip	FLOAT	Self trip time for relay + communications + breaker (in cycles)
DirectReclose	FLOAT	Self reclose (in cycles)
TransferTrip	FLOAT	Transfer trip time for relay + communications + breaker (in cycles)
TransferReclose1	FLOAT	Transfer reclose End Trip 1 (in cycles)
TransferReclose2	FLOAT	Transfer reclose End Trip 2 (in cycles)
TransferReclose3	FLOAT	Transfer reclose End Trip 3 (in cycles)
TransferReclose4	FLOAT	Transfer reclose End Trip 4 (in cycles)
TransferReclose5	FLOAT	Transfer reclose End Trip 5 (in cycles)

DISTRELAYITR Input Data



PARAMETER	TYPE	DESCRIPTION
Transfer Trip	FLOAT	Transfer trip time for relay + communications + breaker (in cycles)
TransferReclose1	FLOAT	Transfer reclose End Trip 1 (in cycles)
TransferReclose2	FLOAT	Transfer reclose End Trip 2 (in cycles)
TransferReclose3	FLOAT	Transfer reclose End Trip 3 (in cycles)
TransferReclose4	FLOAT	Transfer reclose End Trip 4 (in cycles)
TransferReclose5	FLOAT	Transfer reclose End Trip 5 (in cycles)
Angle1	FLOAT	Zone Angle for 1 st shape (in degrees)
Wt1	FLOAT	Width total Impedance (in Primary Ohms)
Rr1	FLOAT	Reverse reach impedance (in Primary Ohms) positive number would move shape in the reverse direction and a negative number would move shape in the forward direction
InternalAng1	FLOAT	Internal Angle (degrees) ; > 90° - lens shape, =90° - circle shape, <90° - tomato shape
Rb1	FLOAT	Resistive blinder location measured along the horizontal axis for quadrilateral shape only (in Primary Ohms)
T1	FLOAT	Zone 1 Pickup Time (in seconds)
IThres1	FLOAT	Fault Detector / Threshold Current (in Primary Amps) (if not used or available then -1)

Note: Same for Zones 2 to 4

DISTRELAYITR Input Data



PARAMETER	TYPE	DESCRIPTION
Blind type 0	FLOAT	First blinder type (+/-1 or +/-2)
Blind int 0	FLOAT	First blinder intercept (Primary Ohms)
Blind rot 0	FLOAT	First blinder rotation (degrees)
Blind type 1	FLOAT	Second blinder type (+/-1 or +/-2)
Blind int 1	FLOAT	Second blinder intercept (Primary Ohms)
Blind rot 1	FLOAT	Second blinder rotation (degrees)
Blind type 2	FLOAT	Third blinder type (+/-1 or +/-2)
Blind int 2	FLOAT	Third blinder intercept (Primary Ohms)
Blind rot 2	FLOAT	Third blinder rotation (degrees)
Blind type 3	FLOAT	Fourth blinder type (+/-1 or +/-2)
Blind int 3	FLOAT	Fourth blinder intercept (Primary Ohms)
Blind rot 3	FLOAT	Fourth blinder rotation (degrees)