

Description:	RED670 CABLE DIFFERENTIAL	
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Contractor:	Contract no.:	Substation No :

1. GENERAL DATA & INFORMATION

Panel No.		CT Ratio	800/1A
Relay Name		I _N	1A
Manufacturer	ABB	VT Ratio	33kV/110V
Serial No		V _N	110 V
Order No.	1MRK004810-DC	Draw. & Sh. No.:	
Software Version	1.2.3	Conn. Diag. No.	
Frequency F _n	60 Hz	DC. Aux. Voltage	125 V _{DC}

2. MECHANICAL CHECKS AND VISUAL INSPECTION

As per TCS -P-105 Rev -1, Item no 4.1& 4.12.1.1

ITEM	DESCRIPTION	REMARKS	
1	Inspect for any physical damage or defects.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
2	Verify connections and ferrules as per approved drawings	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
3	Check tightness of all the connections.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
4	Check Apparatus List	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
5	Check relay version and switching elements on printed circuit board	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A

3. ELECTRICAL TESTS

As per TCS -P-105 Rev -1, Item no 4.2& 4.12.1.2

3.1. FUNCTION TEST

ITEM	DESCRIPTION	REMARKS	
1	Human Machine Interface (HMI) Checked.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
2	Case Earthing checked.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
3	LED's Function Checked.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
4	Trip Contacts Checked.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
5	Reset Function Checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
6	Group active Functions Checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
7	Binary inputs checked.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
8	Output Relays Checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
9	Event Display on HMI Screen Checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
10	Test switch / plug checked for correct function.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
11	Watchdog contacts checked	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A
12	Current shorting facility.	<input type="checkbox"/> Yes	<input type="checkbox"/> N/A

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3.2. OPERATING DC SUPPLY CURRENT

DC voltage (V)	DC current w/o fault (mA)	DC current with fault (mA)	Max. calculated watt (W)

Limit: DC burden 50 watts. (Refer to the reference technical manual page 391).

3.3. WATCH DOG CHECK

SUPPLY OFF

TERMINALS (CLOSED) - (X11:2, X11:3) :

TERMINALS (OPEN) - (X11:1, X11:3) :

SUPPLY ON

TERMINALS (CLOSED) - (X11:1, X11:3) :

TERMINALS (OPEN) - (X11:2, X11:3) :

3.4. TIME AND DATE CHECK

To check time & date go to main menu on the display for RED670 then open system time and adjust time & date.

To test keeping time and date setting this, remove the auxiliary supply from the relay for approximately 30 seconds, then restoring the auxiliary supply, the time and date setting should not be lost.

Result: _____

3.5. SETTING ADOPTED

Refer enclosed setting printout

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3.6. SECONDARY INJECTION TESTS

DIFFERENTIAL PROTECTION

10. MEASUREMENTS :

- For Angle Measurement; Set Measurement Ref is IR.
- Inject three phase current with different values and angles.
- For Neutral Current (N) Inject 3 Phase Current with same magnitude and same phase angles.

$$\text{So, } I_N = I_R + I_B + I_Y = 0.5 (0^\circ) + 1.0 (240^\circ) + 1.5 (120^\circ) = 0.866 (150^\circ)$$

Phase	Applied Current		Display secondary		%Error	
	Magnitude	Angle	Magnitude	Angle	Magnitude	Angle
R	0.5	0.0				
Y	1.0	240.0				
B	1.50	120.0				
N	--	--				

MEASUREMENTS (LOCAL / REMOTE)

Phase	Applied CURRENT		Display Primary		LDCM Value	
	Magnitude	Angle	Magnitude	Angle	Magnitude	Angle
R	1.0	0.0				
Y	1.0	240.0				
B	1.0	120.0				

Limits: Amplitude Accuracy; $\pm 0.5 \% I_r$

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11. PICK UP & DROP OFF TEST FOR DIFFERENTIAL CURRENT (ID) :

Use fiber optic communication between ch1& ch2 then test of differential protection element;

Also, **charge current** should be not active in the setting.

Pick Up Value = I_{dmin} A

Phase	Setting I_{dmin} (A)	Injected Current I bias (A)	Measured Pick Up Value (A)	Measured Drop Out Value (A)
R	0.2	0.2		
	0.6	0.6		
Y	0.2	0.2		
	0.6	0.6		
B	0.2	0.2		
	0.6	0.6		
R-Y	0.4	0.4		
Y-B	0.4	0.4		
B-R	0.4	0.4		
R-Y-B	0.4	0.4		

Limits: Pick up & Drop Out $\pm 2\%$ of I_r According to the Catalogue for Technical Data -
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12. OPERATING TIME TEST FOR DIFFERENTIAL CURRENT (ID)

Set: DT Mode Idmin = 0.4Ibase, AddDelay = on, ImaxDelay > 4 A

PHASE	Inject current (A)	Delay Time (ms)	Operating Time (ms)
R	4	Zero (Inst)	
	4	100	
Y	4	Zero (Inst)	
	4	100	
B	4	Zero (Inst)	
	4	100	
R-Y	4	Zero (Inst)	
Y-B	4	Zero (Inst)	
B-R	4	Zero (Inst)	
R-Y-B	4	Zero (Inst)	

Accuracy: Instantaneous Operation: 25 ms typically at 0 to 10*Id

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13. PICK UP & DROP OFF TEST & OPERATING TIME FOR DIFFERENTIAL CURRENT ALARM

PHASE	SETTING IdAlarm (A)	Injected Current A	Measured Pick Up Value (A)	Measured Drop Out Value (A)
R	0.2	0.2		
	0.6	0.6		
Y	0.2	0.2		
	0.6	0.6		
B	0.2	0.2		
	0.6	0.6		
R-Y	0.4	0.4		
Y-B	0.4	0.4		
B-R	0.4	0.4		
R-Y-B	0.4	0.4		

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14. DELAY TIME FOR DIFFERENTIAL CURRENT ALARM

Set IdAlarm = 0.2 IB

PHASE	Delay (sec)	Operating time in sec
R	zero	
	100	
	200	
Y	zero	
	100	
	200	
B	zero	
	100	
	200	
R-Y	zero	
	100	
	200	
Y-B	zero	
	100	
	200	
B-R	zero	
	100	
	200	
R-Y-B	zero	
	100	
	200	

15. BIAS CHARACTERISTIC TESTING

Use fiber optic communication between ch1&ch2 then test differential protection element; also charging current should be active.as shown figure.

A current is injected into the R phase, which is used as the bias current, and another current is injected into the Y phase, which is used as differential current.

Inject a bias current of 1A in the R phase. The relay will trip and any contacts associated with the R phase will operate.

Slowly increase the current in the Y phase until phase Y trips. Record the phase Y current magnitude and check that it corresponds to the following equation;

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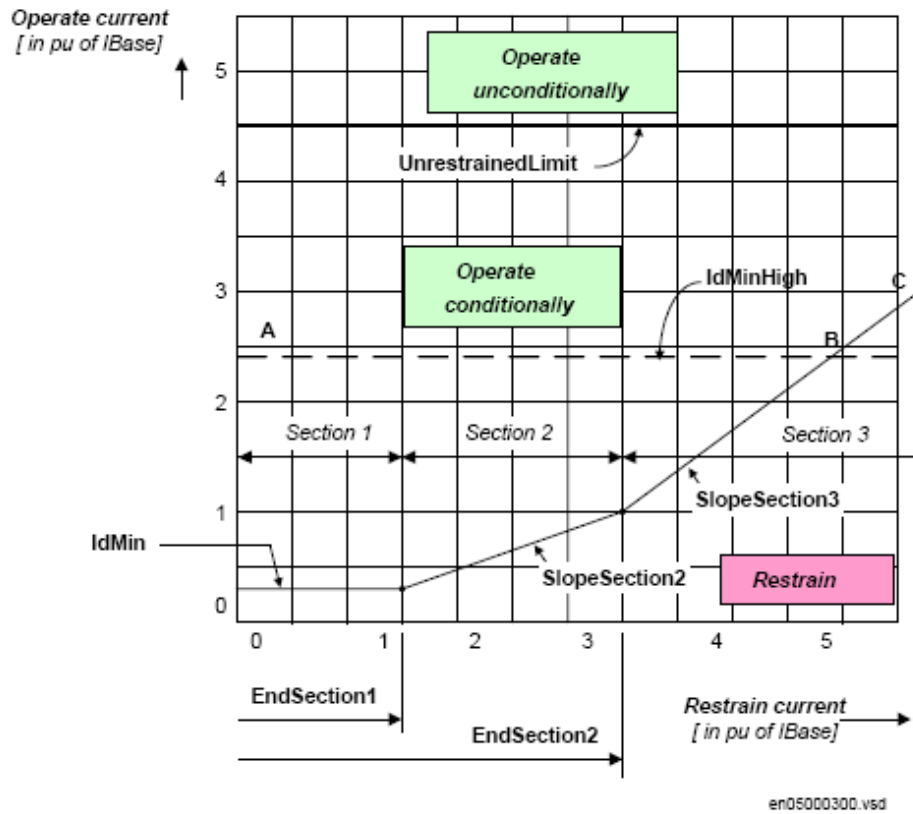
SECTION 1

When bias current is between:

$$0 \leq I_{bias} \leq \text{Endsection1} * I_{Base}$$

$$\text{Trip} = I_{dminOp} * I_{base}$$

$$\text{Set End section1} = 1.25 * I_{Base}$$



where:

$$\text{slope} = \frac{\Delta I_{operate}}{\Delta I_{restrain}} \cdot 100\%$$

and where the restrained characteristic is defined by the settings:

1. IdMin
2. EndSection1
3. EndSection2
4. SlopeSection2
5. SlopeSection3

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Slope section 1	I _{dmin set}	I bias (A)	Id calculated (Trip)	Id Measured			Errors %		
				R	Y	B	R	Y	B
IdminOp	0.2	0.20	0.20						
	0.4	0.4	0.4						
	0.6	0.6	0.60						

Limits; $\pm 2 \% I_r$

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SLOPE SECTION 2

When bias current is between:

$$\text{Endsection1} * I_{\text{base}} \leq I_{\text{bias}} \leq \text{Endsection2} * I_{\text{base}}$$

$$\text{Trip} = (I_{\text{dminOp}} * I_{\text{base}} + \text{slope section2} / 100 * (I_{\text{bias}} - \text{End section1} * I_{\text{base}}))$$

Where; I_{dmin} ; The Basic Diff Current Setting.

To check more than one point at the same slope, Change the bias current value and the equation above can be used, and also for other differential settings " Different slopes, Is1 ".

Apply the above procedure for each phase.

$$\text{Set End section1} = 1.25 * I_{\text{Base}}$$

$$\text{End section2} = 3.0 * I_{\text{Base}}$$

Slope section 2	I _{dmin set}	I bias A	Id calculated (Trip)	Id Measured			Errors %		
				R	Y	B	R	Y	B
30 %	0.2	1.5	0.275						
	0.4	2.0	0.625						
	0.6	3.0	1.125						
50 %	0.2	1.5	0.325						
	0.4	2.0	0.775						
	0.6	3.0	1.475						

Limits; $\pm 2 \% I_r$

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SLOPE SECTION3

Repeat the test and check the result with the following equation;

When bias current is more than:

$$I_{bias} \geq \text{End section2} * I_{base}$$

$$\text{Trip} = I_{base} * (I_{dminOp} + \text{slope section2} / 100 * (\text{End section2} - \text{End section1})) + (\text{slope section3} / 100 * (I_{bias} - \text{End section2} * I_{base})) \quad A$$

$$\text{Set End section1} = 1.25 * I_{Base}$$

$$\text{End section2} = 3.0 * I_{Base}$$

$$\text{Slope section2} = 50\%$$

Slope section3	Id _{min set}	I injectedA	Id calculated (Trip)	Id Measured			Errors %		
				R	Y	B	R	Y	B
50%	0.2	4.0	1.575						
	0.4	5.0	2.275						
	0.6	6.0	2.975						
80 %	0.2	4.0	1.875						
	0.4	5.0	2.875						
	0.6	6.0	3.875						

Limits; $\pm 2 \% I_r$

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16. TEST OF 2ND HARMONICS

$$I_{dmin} = 0.25 I_b$$

Phase	I2 / I1 ratio %	I1 (F =60 Hz) (Pickup Value)	I2 (F = 120 Hz)	
			Expected Blocking	Measured
R	10	1.0	0.100	
Y	50	1.0	0.500	
B	100	1.0	1.00	

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17. TEST OF 5TH HARMONICS

Phase	I5 / I1 ratio %	I1 (F =60 Hz)	I5 (F = 300 Hz)	
			Expected Blocking	Measured
R	15	1.0	0.150	
Y	30	1.0	0.300	
B	50	1.0	0.500	

18. UNRESTRAINED CURRENT PICKUP TEST

Phase	Idunrest		
	Setting Value (of IB)	Pickup Value	Drop Off Value
R	5.0		
	8.0		
Y	5.0		
	8.0		
B	5.0		
	8.0		

19. UNRESTRAINED CURRENT TIME TEST

Phase	Idunrest		
	Setting Value (of IB)	Pickup Time (ms)	Error %
R	5.0		
	8.0		
Y	5.0		
	8.0		
B	5.0		
	8.0		

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20. ENHANCED DIFFERENTIAL (IDminhigh)

There are 2 condition during them the relay must decrease its sensitivity: during energized or at external fault, where at that conditions the slope chars. Use the value of IdminHigh instead of Idmin for just a time equal to tIdminHigh. After that slope chars. Back as usual using Idmin as basic setting

20.1. IDminhigh PICKUP & DROP OFF

Phase	IdMinHigh	
	Setting Value (of IB)	Pickup Value
R	5.0	
	8.0	
Y	5.0	
	8.0	
B	5.0	
	8.0	

20.2. IDminhigh TIME TEST

Phase	TIdminHigh	
	Setting Value (second)	Pickup Time seconds
R	5.0	
	8.0	
	10.0	
Y	5.0	
	8.0	
	10.0	
B	5.0	
	8.0	
	10.0	

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21. Trip indication test:

No.	Type of fault	Led Color	Check
01	GENERAL TRIP	Red	
02	R - PHASE TRIP	Red	
03	Y - PHASE TRIP	Red	
04	B - PHASE TRIP	Red	
05	DIFFERENTIAL TRIP	Red	
06	I/T RECEIVED	Red	
07	2 ND HARMONICS	Yellow	
08	5 TH HARMONICS	Yellow	
09	CH-1 COMM. FAIL	Yellow	
10	CH-2 COMM. FAIL	Yellow	
11	COMM. BLOCKED	Yellow	
12	C. SEND	Yellow	
13	C. RECIEVE	Yellow	
14	SPARE	Yellow	
15	SPARE	Yellow	

22. Disturbance recorder checked [].

23. Binary outputs and inputs checked [].

24. Test Equipments Used

Sl. No	Description	Make	Equipment Sl. No.	Calibration Date	Calibration Due Date
1.	FREJA 300	Programma	130267	19.04.2015	19.04.2016

Tested by: ENG.	Witnessed by: ENG.
Signature & Date:	Signature & Date: