1. **GENERAL DATA & INFORMATION**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Panel No.** | **=** |  | **CT Ratio HV** |  |
| **Panel Name** |  |  | **CT Ratio LV** |  |
| **Manufacturer** |  | **Transf. MVA** |  |
| **Serial No** |  | **Transf. HV** |  |
| **Order No.** |  | **Transf. LV** |  |
| **Frequency Fn** | 60 HZ | **DC. Aux. Voltage** | 125 VDC |

1. **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. | ❑ Yes | ❑ N/A |
| 2 | Verify connections and ferrules as per approved drawings | ❑ Yes | ❑ N/A |
| 3 | Check tightness of all the connections. | ❑ Yes | ❑ N/A |
| 4 | Check Apparatus List | ❑ Yes | ❑ N/A |
| 5 | Check relay version and switching elements on printed circuit board | ❑ Yes | ❑ N/A |

1. **ELECTRICAL TESTS**

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

* 1. **FUNCTION TEST**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Description** | **Remarks** | |
| 1 | Date & Time - Set clock to local time.  - Time maintained when Aux. Supply removed. | ❑ Yes | ❑ N/A |
| 2 | Alarm (yellow) LED – to check make Test Mode enable under Commissioning Test menu. | ❑ Yes | ❑ N/A |
| 3 | Out of service (yellow) LED – to check make Test Mode enable under Commissioning Test menu. | ❑ Yes | ❑ N/A |
| 4 | Trip (red) LED – apply any fault to produce any trip condition | ❑ Yes | ❑ N/A |
| 5 | 8 + 10 function key programmable LEDs – apply Test LEDs under Commissioning test menu. | ❑ Yes | ❑ N/A |
| 6 | Output Relays Checked | ❑ Yes | ❑ N/A |
| 7 | Test switch / plug checked for correct function. | ❑ Yes | ❑ N/A |

* 1. **OPERATING DC SUPPLY CURRENT**

|  |  |  |  |
| --- | --- | --- | --- |
| DC voltage  (V) | DC current w/o fault (mA) | DC current with fault (mA) | Max. calculated watt (W) |
| 125 |  |  |  |

Limit: DC burden 15/20 VA. (Refer to the reference technical manual).

* 1. **WATCH DOG CHECK**

SUPPLY OFF

TERMINALS (CLOSED) - (J11, J12) :

TERMINALS (OPEN) - (J13, J14) :

SUPPLY ON

TERMINALS (CLOSED) - (J13, J14) :

TERMINALS (OPEN) - (J11, J12) :

* 1. **TIME AND DATE CHECK**

To check time & date go to main menu on the display for **MiCOM P643** 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: \_\_\_\_\_\_\_\_\_\_\_\_

* 1. **SECONDARY INJECTION TESTS**

1. **INPUT OPTO-ISOLATORS CHECKS (With Relay Energized):**

Note: Go to Commissioning Test, Test mode (test mode), then go to system data column to check the status of the binary inputs.

|  |  |  |  |
| --- | --- | --- | --- |
| **OPTO INPUT NO.** | **TEST METHOD**  **(Energize only one at a time with 125V DC Station Battery voltage)** | **RESULT**  **Display 0 to 1** | **REMARKS** |
| OPTO 1 | ENERGIZE TB NO. D2-D1 | 1 | SPARE |
| OPTO 2 | ENERGIZE TB NO. D4-D3 | 1 | SPARE |
| OPTO 3 | ENERGIZE TB NO. D6- D5 | 1 | SPARE |
| OPTO 4 | ENERGIZE TB NO. D8-D7 | 1 | **TRAFO VT MCB TRIP** |
| OPTO 5 | ENERGIZE TB NO. D10-D9 | 1 | **LV CBF INITIATION** |
| OPTO 6 | ENERGIZE TB NO. D12-D11 | 1 | SPARE |
| OPTO 7 | ENERGIZE TB NO. D14-D13 | 1 | SPARE |
| OPTO 8 | ENERGIZE TB NO. D16-D15 | 1 | SPARE |
| OPTO 9 | ENERGIZE TB NO. F2-F1 | 1 | **87T2 PROTN IN** |
| OPTO 10 | ENERGIZE TB NO. F4-F3 | 1 | **87T2 PROTN OUT** |
| OPTO 11 | ENERGIZE TB NO. F6-F5 | 1 | **RESET DC SUP FAIL** |
| OPTO 12 | ENERGIZE TB NO. F8-F7 | 1 | **IND DC SUP FAIL** |
| OPTO 13 | ENERGIZE TB NO. F10-F9 | 1 | **AC SUPPLY FAIL** |
| OPTO 14 | ENERGIZE TB NO. F12-F11 | 1 | SPARE |
| OPTO 15 | ENERGIZE TB NO. F14-F13 | 1 | SPARE |
| OPTO 16 | ENERGIZE TB NO. F16-F15 | 1 | SPARE |

|  |  |  |  |
| --- | --- | --- | --- |
| **OPTO INPUT NO.** | **TEST METHOD**  **(Energize only one at a time with 125V DC Station Battery voltage)** | **RESULT**  **Display 0 to 1** | **REMARKS** |
| OPTO 17 | ENERGIZE TB NO. B2-B1 | 1 | **IN/OUT DC FAIL** |
| OPTO 18 | ENERGIZE TB NO. B4-B3 | 1 | **94T2 OPTD** |

|  |  |  |  |
| --- | --- | --- | --- |
| OPTO 19 | ENERGIZE TB NO. B6- B5 | 1 | **86T2 OPTD** |
| OPTO 20 | ENERGIZE TB NO. B8-B7 | 1 | SPARE |
| OPTO 21 | ENERGIZE TB NO. B10-B9 | 1 | SPARE |
| OPTO 22 | ENERGIZE TB NO. B12-B11 | 1 | SPARE |
| OPTO 23 | ENERGIZE TB NO. B14-B13 | 1 | SPARE |
| OPTO 24 | ENERGIZE TB NO. B16-B15 | 1 | SPARE |

1. **OUTPUT RELAYS CHECKS (With Relay Energized):**

Note: Go to Commissioning Test, Test mode (blocked), Test Pattern mode and select each relay to be tested and Apply Contact Test, after test; apply remove test to de-energize the relay.

|  |  |  |  |
| --- | --- | --- | --- |
| **OUTPUT RELAY No.** | **TEST METHOD**  **(Energize only one relay at a time by**  **‘Contact Test in ‘Apply Test Mode’)** | **RESULT**  **Contact Checked** | **REMARKS** |
| RL1 | CONTACT OPERATED H1-H2 (N/O) |  | SPARE |
| RL2 | CONTACT OPERATED H3-H4 (N/O) |  | SPARE |
| RL3 | CONTACT OPERATED H5-H6 (N/O) |  | SPARE |
| RL4 | CONTACT OPERATED H7-H8 (N/O) |  | SPARE |
| RL5 | CONTACT OPERATED H9- H10 (N/O) |  | SPARE |
| RL6 | CONTACT OPERATED H11-H12 (N/O) |  | SPARE |
| RL7 | CONTACT OPERATED H13-H14-H15 (C/O) |  | SPARE |
| RL8 | CONTACT OPERATED H16-H17-H18 (C/O) |  | SPARE |
| RL9 | CONTACT OPERATED G1-G2 (N/O) |  | 87T2 |
| RL10 | CONTACT OPERATED G3-G4 (N/O) |  | 64NP |
| RL11 | CONTACT OPERATED G5-G6 (N/O) |  | 64NS |
| RL12 | CONTACT OPERATED G7-G8 (N/O) |  | 50/51P |
| RL13 | CONTACT OPERATED G9-G10 (N/O) |  | 50/50NP |
| RL14 | CONTACT OPERATED G11-G12 (N/O) |  | 51/51NS |
| RL15 | CONTACT OPERATED G13-G14-G15 (C/O) |  | 51/51NS |
| RL16 | CONTACT OPERATED G16-G17-G18 (C/O) |  | SPARE |

\* After output relay test; select test mode to be disable.

1. **LED CHECKS**

|  |  |  |  |
| --- | --- | --- | --- |
| **LED’S** | **FUNCTION** | **RESULT**  **Checked** | **REMARKS** |
| LED 1 | I DIFF OPTD |  | - |
| LED 2 | REF OPTD HV |  | - |
| LED 3 | REF OPTD LV |  | - |
| LED 4 | O/C OPTD HV |  | - |
| LED 5 | O/C OPTD LV |  | - |
| LED 6 | E/F OPTD HV |  | - |
| LED 7 | E/F OPTD LV |  | - |
| LED 8 | PROT. OUT |  | - |
| F.key LED 1 | 2ND HARMONICS |  | - |
| F.key LED 2 | 5TH HARMONICS |  | - |
| F.key LED 3 | R-PHASE OPTD |  | - |
| F.key LED 4 | Y-PHASE OPTD |  | - |
| F.key LED 5 | B-PHASE OPTD |  | - |
| F.key LED 6 | HIGH SET OPTD |  | - |
| F.key LED 7 | CBF LV OPTD |  | - |
| F.key LED 8 | NEUTRAL ALARM |  | - |
| F.key LED 9 | STANDBY EF |  | - |
| F.key LED 10 | RESET LED |  | - |

* 1. **CURRENT INPUTS CHECK:**
     1. **HIGH SIDE:**

I **diff**= I1\*CT matching factor + I2\*CT matching factor

I rest =0.5\* ( I1\*CT matching factor + I2\*CT matching factor)

Transformer Rated Current I**n** = MVA/ {√3 \* (KVN-HVS)}

KVN - HVS = 132KV

CT Ratio = 800/1 A Transf. I**n** = 437 A

Calculated 1ph I diff= I1\*CT matching factor + I2\*CT matching factor / 1.5

Calculated 1ph I rest= 0.5 (I1\*CT matching factor + I2\*CT matching factor) / 1.5

HV CT matching factor-1.830, LV CT matching factor-1.143

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase** | **Injected Current (A)** | **Measuring From Relay** | | | | **Calculated Values** | |
| **IPrim. (A)** | **Isec (A)** | **I diff** | **I rest** | **I diff** | **I rest** |
| L1 |  |  |  |  |  |  |  |
| L2 |  |  |  |  |  |  |  |
| L3 |  |  |  |  |  |  |  |

* + 1. **LOW SIDE:**

I **diff**= I1\*CT matching factor + I2\*CT matching factor

I rest =0.5\* ( I1\*CT matching factor + I2\*CT matching factor)

Transf. I**n** =MVA/ {√3 \* (kVn-LVS)}

KVn - LVS =33 kV

CT Ratio= 2000/1 A, Transf. I**n** = 1750 A

Calculated 1ph I diff= I1\*CT matching factor + I2\*CT matching factor / 1.5

Calculated 1ph I rest= 0.5 (I1\*CT matching factor + I2\*CT matching factor) / 1.5

HV CT matching factor-1.830, LV CT matching factor-1.143

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase** | **Injected Current (A)** | **Measuring From Relay** | | | | **Calculated Values** | |
| **I Prim. (A)** | **ISec(A)** | **I diff.** | **I rest** | **I diff** | **I rest** |
| L1 |  |  |  |  |  |  |  |
| L2 |  |  |  |  |  |  |  |
| L3 |  |  |  |  |  |  |  |

* 1. **VOLTAGE INPUT CHECK:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Phase injected | voltage injected (volt) | Voltage read on relay display (kV) | | | | | |
| Relay 1 | RN | YN | BN | RY | YB | BR |
| L1-E | 66.39 |  |  |  |  |  |  |
| L2-E | 66.39 |  |  |  |  |  |  |
| L3-E | 66.39 |  |  |  |  |  |  |
| L1-L2-L3 | 76.42 |  |  |  |  |  |  |

* 1. **TEST DONE W/O ZERO SEQUENCE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase Fault** | **High Side (132kV)** | | | | **Low Side (33kV)** | | | |
| **Calculated P/U** | **Actual P/U** | **DROP OFF** | **Trip Time at 2I**  **trip (ms)** | **Calculated P/U** | **Actual P/U** | **DROP OFF** | **Trip Time at 2I**  **trip (ms)** |
| **L1-N** |  |  |  |  |  |  |  |  |
| **L2-N** |  |  |  |  |  |  |  |  |
| **L3-N** |  |  |  |  |  |  |  |  |
| **L1-L2-L3** |  |  |  |  |  |  |  |  |

\* Pick-up: formula ±5%

\* Drop-off: 95% of formula ±5% (see technical manual P64×\_112 page no: 40)

* 1. **DIFFERENTIAL PICKUP TEST.**

**Settings:**

|  |  |  |
| --- | --- | --- |
| IS1 | 0.4 | PU |
| K1 | 30 | % |
| Is2 | 4 | PU |
| K2 | 80 | % |
| tDIFF | 0.0 | Sec |
| IS-HS1 | 8 | PU |
| IS-HS2 | 12 | PU |

HV Calculated pickup - Is1\*HV Full load current

LV Calculated pickup - Is1\*LV Full load current

* 1. **HIGH SET CHECK:**

IS-HS1=8 PU = 8 x I rated/CTR

HIGH SIDE: 8\*437/800 LOW SIDE: 8\*1750/2000

* + 1. **ZERO SEQUENCE FILTER FUNCTION DISABLED IN SYSTEM CONFIGURATION.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase fault** | **High Side (132kv)** | | | | **Low Side (33kV)** | | | |
| **Calculated P/U** | **Actual P/U** | **DROP OFF** | **Trip Time at 2I**  **trip (ms)** | **Calculated P/U** | **Actual P/U** | **DROP OFF** | **Trip Time at 2I**  **trip (ms)** |
| **L1-N** |  |  |  |  |  |  |  |  |
| **L2-N** |  |  |  |  |  |  |  |  |
| **L3-N** |  |  |  |  |  |  |  |  |
| **L1-L2-L3** |  |  |  |  |  |  |  |  |

IS-HS2 =12 PU = 12 I rated/CTR

**IS-HS2=12 PU**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase fault** | **High Side (132kv)** | | | | **Low Side (33kV)** | | | | |
| **Calculated P/U** | **Actual P/U** | **DROP OFF** | **Trip Time at 15A**  **trip (ms)** | **Calculated P/U** | **Actual P/U** | **DROP OFF** | **Trip Time at 15A**  **trip (ms)** |
| **L1-N** |  |  |  |  |  |  |  |  |
| **L2-N** |  |  |  |  |  |  |  |  |
| **L3-N** |  |  |  |  |  |  |  |  |
| **L1-L2-L3** |  |  |  |  |  |  |  |  |

\* Pick-up: formula ±5%

\* Drop-off: 95% of formula ±5% (see technical manual P64×\_112 page no: 40)

* 1. **BIAS CHARACTERISTIC CHECK:**
     1. **LOWER SLOPE TEST:**

- IS1: Basic Diff Current Setting.

- K1: Lower Percentage Bias Setting.

- Id Calculated = I diff> K1 \* Ibias

|  |  |  |
| --- | --- | --- |
| IS1 | 0.4 | A |
| K1 | 30 | % |
| Is2 | 4 | A |
| K2 | 80 | % |
| tDIFF | 0.0 | Sec |
| IS-HS1 | 8 | A |
| IS-HS2 | 12 | A |



|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| PHASE | APPLIED CURRENT(A) HV SIDE | APPLIED CURRENT(A) LV SIDE | CALCULATED VALUE | | MEASURED VALUE | | SLOPE IN % |
| I DIFF | I BIAS | I DIFF | I BIAS |
| R | 1.5 |  |  |  |  |  |  |
| 2.0 |  |  |  |  |  |
| Y | 1.5 |  |  |  |  |  |  |
| 2.0 |  |  |  |  |  |
| B | 1.5 |  |  |  |  |  |  |
| 2.0 |  |  |  |  |  |

K1-30% Is1-0.4

\* Pick-up: formula ±5%

\* Drop-off: 95% of formula ±5% (see technical manual P64×\_112 page no: 40)

**ID----I DIFF IB----IBIASE SLOPE = (ID2-ID1)/ (IB2-IB1)**

B- Upper Slope Test:

- IS2: Basic Diff Current Threshold Setting.

- K2: High Percentage Bias Setting.

- Id Calculated = I diff> K1 \* Is2 + K2 ( Ibias – Is2 )

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| PHASE | APPLIED CURRENT (A) HV SIDE | APPLIED CURRENT (A) LV SIDE | CALCULATED VALUE | | MEASURED VALUE | | SLOPE IN % |
| I DIFF | I BIAS | I DIFF | I BIAS |
| R |  |  |  |  |  |  |  |
|  |  |  |  |  |  |
| Y |  |  |  |  |  |  |  |
|  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |
|  |  |  |  |  |  |

Differential Setting (Is1=0.4 , Is2=2 , K1= 30%, K2=60%). K1-30%

\* Pick-up: formula ±5%

\* Drop-off: 95% of formula ±5% (see technical manual P64×\_112 page no: 40)

* 1. **HARMONICS CHECK** 
     1. **2ND HARMONIC RESTRAIN CHECK:**

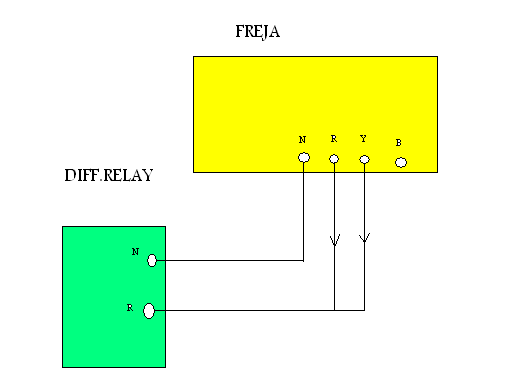
**Pass criteria**:

Measured second harmonic threshold for blocking of differential element should be +/-10% of set value.

**TEST PROCEDURE: -**

1. From general mode page (7/7) change the frequency setting from (All Equal) to (Free Frequency).
2. From page (7/7) select the frequency of phase (R) as fundamental (60 HZ) and Phase (Y) as 2nd harmonics (120 HZ).
3. From page (1/7) select the current injection value according to the setting of the differential relay operating current we can select phase (R) as (1A) and angle (0) and phase (Y) (1A) Current and angle (0) 3-After that click START the relay will pick up then slowly reduce the current in phase (Y) Until relay trip depend on relay setting.
4. If the ratio of (IY/IR) mean (I (2fn)/I (1fn > Setting (in our case setting is 15%)
5. Relay will BLOCK.

**CONNECTION: -**

****

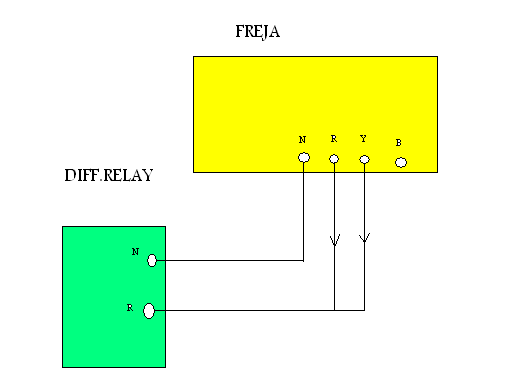
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Winding** | **Current Injected**  **In phase** | **Harmonic**  **Setting** | **Normal current (A)** | **Observed 2nd Harmonics** | |
| **Blocking Expected** | **Blocking Measured** |
| **HV** | **AN** | 15% | 1 | 0.150 |  |
| **BN** | 15% | 1 | 0.150 |  |
| **CN** | 15% | 1 | 0.150 |  |
| **LV** | **AN** | 15% | 1 | 0.150 |  |
| **BN** | 15% | 1 | 0.150 |  |
| **CN** | 15% | 1 | 0.150 |  |

* + 1. **5TH HARMONIC RESTRAINT CHECK: -**

**TEST PROCEDURE: -**

1. From general mode page (7/7) change the frequency setting from (All Equal) to (Free Frequency).
2. From page (7/7) select the frequency of phase (R) as fundamental (60 HZ) and Phase (Y) as 5th harmonics (300 HZ).
3. From page (1/7) select the current injection value according to the setting of the differential relay operating current we can select phase (R) as (1A) and angle (0) and phase (Y) (1A) Current and angle (0) 3-After that click START the relay will pick up then slowly reduce the current in phase (Y) Until relay trip depend on relay setting.
4. If the ratio of (IY/IR) mean (I (5fn)/I (1fn > Setting (in our case setting is 25%)
5. Relay will BLOCK.

**CONNECTION: -**

****

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Winding** | **Current Injected**  **In phase** | **Harmonic**  **Setting** | **Normal current (A)** | **Observed 5th Harmonics** | |
| **Blocking Expected** | **Blocking Measured** |
| **HV** | **AN** | 25% | 1 | 0.250 |  |
| **BN** | 25% | 1 | 0.250 |  |
| **CN** | 25% | 1 | 0.250 |  |
| **LV** | **AN** | 25% | 1 | 0.250 |  |
| **BN** | 25% | 1 | 0.250 |  |
| **CN** | 25% | 1 | 0.250 |  |

* 1. **HV over current and earth fault:**
     1. **OVER CURRENT PICK UP / RESET RESULT:** In=0.77 In CURVE:NI

|  |  |  |  |
| --- | --- | --- | --- |
| **PHASE** | **PICK UP**  **SETTING** | **MEASURED**  **PICK UP(A)** | **MEASURED**  **DROP OFF (A)** |
| **PHASE – R** | 0.77 |  |  |
| **PHASE –Y** | 0.77 |  |  |
| **PHASE - B** | 0.77 |  |  |

###### Note: pick up error =±5% Drop off Level = >95% of pick up

* + 1. **OVER CURRENT CHARACTERISTIC**:

Normal inverse Is =1.2In Tm : 0.3

T = (0.14\*Tm) / ( (I/I s) ^ 0.02 – 1 )) sec.

|  |  |  |
| --- | --- | --- |
| **PHASE** | **2 \* Is** | |
| EXP sec | ACT sec. |
| **PHASE-R** |  |  |
| **PHASE-Y** |  |  |
| **PHASE-B** |  |  |

* + 1. **EARTH FAULT PICK UP / RESET RESULT:** In=0.13In CURVE:NI

|  |  |  |  |
| --- | --- | --- | --- |
| **PHASE** | **PICK UP**  **SETTING** | **MEASURED**  **PICK UP(A)** | **MEASURED**  **DROP OFF (A)** |
| **PHASE – R** | 0.13 |  |  |

###### Note: pick up error =±5% Drop off Level = >95% of pick up

* + 1. **EARTH FAULT CHARACTERISTIC**:

Normal inverse Is =0.2In Tm : 0.3

T = (0.14\*Tm) / ( (I/I s) ^ 0.02 – 1 )) sec.

|  |  |  |
| --- | --- | --- |
| **PHASE** | **2 \* Is** | |
| EXP sec | ACT sec. |
| PHASE-R |  |  |

* 1. **lV over current and earth fault:**
     1. **OVER CURRENT PICK UP / RESET RESULT:** In= 1.23 In CURVE:NI

|  |  |  |  |
| --- | --- | --- | --- |
| **PHASE** | **PICK UP**  **SETTING** | **MEASURED**  **PICK UP(A)** | **MEASURED**  **DROP OFF (A)** |
| **PHASE – R** | 1.23 |  |  |
| **PHASE –Y** | 1.23 |  |  |
| **PHASE - B** | 1.23 |  |  |

###### Note: pick up error =±5% Drop off Level = >95% of pick up

* + 1. **OVER CURRENT CHARACTERISTIC:**

Normal inverse Is =1.0In Tm : 0.3

T = (0.14\*Tm) / ( (I/I s) ^ 0.02 – 1 )) sec.

|  |  |  |
| --- | --- | --- |
| **PHASE** | **2 \* Is** | |
| EXP sec | ACT sec. |
| PHASE-R |  |  |
| **PHASE-Y** |  |  |
| **PHASE-B** |  |  |

* + 1. **EARTH FAULT PICK UP / RESET RESULT:** In=0.2In CURVE:NI

|  |  |  |  |
| --- | --- | --- | --- |
| **PHASE** | **PICK UP**  **SETTING** | **MEASURED**  **PICK UP(A)** | **MEASURED**  **DROP OFF (A)** |
| **PHASE – R** | 0.2 |  |  |

###### Note: pick up error =±5% Drop off Level = >95% of pick up

* + 1. **EARTH FAULT CHARACTERISTIC:**

Normal inverse Is =0.1In Tm : 0.3

T = (0.14\*Tm) / ( (I/I s) ^ 0.02 – 1 )) sec.

|  |  |  |
| --- | --- | --- |
| **PHASE** | **2 \* Is** | |
| EXP sec | ACT sec. |
| PHASE- E/F |  |  |

* 1. **STANDBY EARTH FAULT**:

PICK UP TEST: Is =0.15In Tm : 0.1

|  |  |  |  |
| --- | --- | --- | --- |
| **PHASE** | **PICK UP**  **SETTING** | **MEASURED**  **PICK UP(A)** | **MEASURED**  **DROP OFF (A)** |
| **PHASE – R** | 0.15 |  |  |

###### Note: pick up error =±5% Drop off Level = >95% of pick up

120 × Tp

Long Inverse t (s) = ---------------------------

(I/I p)^ 1 - 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PHASE** | **2 \* Is** | | **5 \* Is** | | **10 \* Is** | |
| EXP sec | ACT sec. | EXP sec. | ACT sec. | EXP sec | ACT sec |
| PHASE-E/F |  |  |  |  |  |  |

* 1. **LV NUTRAL CUREENT ALARM:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SET  CURRENT (A) | SET TIME (s) | PICK UP CURRENT (A) | DROP OFF (A) | OPTD TIME (s) |
| 0.100 | 5 sec |  |  |  |

###### Note: pick up error =±5% Drop off Level = >95% of pick up

* 1. **RESTRICTED EARTH FAULT PROTECTION (REF):**
     1. **HV SIDE**

**REF Pickup Test.**

Settings:

|  |  |  |
| --- | --- | --- |
| IS1 | 0.1 | A |
| K1 | 0 | % |
| Is2 | 0.9 | A |
| K2 | 150 | % |
| tDIFF | 0.0 | Sec |

\* Limits: Pick up 10 %.

|  |  |  |  |
| --- | --- | --- | --- |
| **set value (A)** | **Actual P/U (A)** | **DROP OFF (A)** | **Trip Time at**  **2I trip (ms)** |
| **0.1** |  |  |  |

* + 1. **BIAS CHARACTERISTIC CHECK:**

A- Lower Slope Test:

- IS1: Basic Diff Current Setting.

- K1: Lower Percentage Bias Setting.

- Id Calculated = I diff> K1 \* Ibias ( here settings k1-0% so using below formula)

- Id Calculated = I diff> I1-I2

REF SLOPE SETTINGS:

IS1-0.1 PU, IS2- 1 PU, K1-0%, K2-150%, tREF- 0 SEC



* First change the settings in secondary value in measurement setup.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| PHASE | APPLIED CURRENT(A) HV SIDE | APPLIED  CURRENT (A) NEUTRAL SIDE | CALCULATED VALUE | | MEASURED VALUE | | SLOPE IN % |
| I DIFF | I BIAS | I DIFF | I BIAS |
| R | 0.5 |  |  |  |  |  |  |
| 0.8 |  |  |  |  |  |

K1-0% Is1-0.1

B- Upper Slope Test:

- IS2: Basic Diff Current Threshold Setting.

- K2: High Percentage Bias Setting.

- Id Calculated = I diff> K1 \* Is2 + K2 ( Ibias – Is2 )

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| PHASE | APPLIED CURRENT(A) HV SIDE | APPLIED  CURRENT (A) NEUTRAL SIDE | CALCULATED VALUE | | MEASURED VALUE | | SLOPE IN % |
| I DIFF | I BIAS | I DIFF | I BIAS |
| R | 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |

Differential Setting (Is1=0.1 , Is2=0.9 , K1= 0%, K2=150%).

* + 1. **LV SIDE**

**Restricted earth fault protection:**

**REF Pickup Test.**

Settings:

|  |  |  |
| --- | --- | --- |
| IS1 | 0.1 | A |
| K1 | 0 | % |
| Is2 | 0.9 | A |
| K2 | 150 | % |
| tDIFF | 0.0 | Sec |

\* Limits: Pick up 10 %.

\* Limits: Pick up 10 %.

|  |  |  |  |
| --- | --- | --- | --- |
| **set value (A)** | **Actual P/U (A)** | **DROP OFF (A)** | **Trip Time at**  **2I trip (ms)** |
| **0.1** |  |  |  |

* + 1. **BIAS CHARACTERISTIC CHECK:**

**A- Lower Slope Test:**

- IS1: Basic Diff Current Setting.

- K1: Lower Percentage Bias Setting.

- Id Calculated = I diff> K1 \* Ibias ( here settings k1-0% so using below formula)

- Id Calculated = I diff> I1-I2

* First change the settings in secondary value in measurement setup.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| PHASE | APPLIED CURRENT  (A)  HV SIDE | APPLIED  CURRENT (A) NEUTRAL SIDE | CALCULATED VALUE | | MEASURED VALUE | | SLOPE IN % |
| I DIFF | I BIAS | I DIFF | I BIAS |
| R | 0.5 |  |  |  |  |  |  |
| 0.8 |  |  |  |  |  |

K1-0% Is1-0.1

\* Pick-up: formula ±5%

\* Drop-off: 95% of formula ±5%

**B- Upper Slope Test:**

- IS2: Basic Diff Current Threshold Setting.

- K2: High Percentage Bias Setting.

- Id Calculated = I diff> K1 \* Is2 + K2 ( Ibias – Is2 )

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| PHASE | APPLIED CURRENT (A)  HV SIDE | APPLIED  CURRENT (A) NEUTRAL SIDE | CALCULATED VALUE | | MEASURED VALUE | | SLOPE IN % |
| I DIFF | I BIAS | I DIFF | I BIAS |
| R | 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |

Differential Setting (Is1=0.1 , Is2=0.9 , K1= 0%, K2=100%).

\* Pick-up: formula ±5%

\* Drop-off: 95% of formula ±5%

* 1. **CBF LV SIDE:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Phase** | **Current (A)** | | | **Stage 1** | |
| **Set** | **Pickup** | **Drop-off** | **Set** | **OPTD (ms)** |
| **R** | 10% In |  |  | 150 ms |  |
| **Y** |  |  |  |
| **B** |  |  |  |

**Limits:**

I > Pick-up: Setting ±5% or 20 mA

I > Drop-off: 100%of setting ±5% or 20 mA

Timers: ± 2% or 50 ms whichever is greater