1. **GENERAL DATA & INFORMATION**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Panel No.** |  |  | **CT Ratio** | 800/1A |
| **Relay Name** |  |  | **IN** | 1A |
| **Manufacturer** |  | **VT Ratio** | 33kV/110V |
| **Serial No** |  | **VN** | 110 V |
| **Order No.** | 1MRK004810-DC | **Draw. & Sh. No.:** |  |
| **Software Version** | 1.2.3 | **Conn. Diag. No.** |  |
| **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 | Human Machine Interface (HMI) Checked. | ❑ Yes | ❑ N/A |
| 2 | Case Earthing checked. | ❑ Yes | ❑ N/A |
| 3 | LED’s Function Checked. | ❑ Yes | ❑ N/A |
| 4 | Trip Contacts Checked. | ❑ Yes | ❑ N/A |
| 5 | Reset Function Checked | ❑ Yes | ❑ N/A |
| 6 | Group active Functions Checked | ❑ Yes | ❑ N/A |
| 7 | Binary inputs checked. | ❑ Yes | ❑ N/A |
| 8 | Output Relays Checked | ❑ Yes | ❑ N/A |
| 9 | Event Display on HMI Screen Checked | ❑ Yes | ❑ N/A |
| 10 | Test switch / plug checked for correct function. | ❑ Yes | ❑ N/A |
| 11 | Watchdog contacts checked | ❑ Yes | ❑ N/A |
| 12 | Current shorting facility. | ❑ 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) |
|  |  |  |  |

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

* 1. **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) :

* 1. **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: \_\_\_\_\_\_\_\_\_\_\_\_

* 1. **SETTING ADOPTED**

Refer enclosed setting printout

* 1. **SECONDARY INJECTION TESTS**

**DIFFERENTIAL PROTECTION**

1. **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.

So, IN = IR + IB + IY = 0.5 (0 O) + 1.0 (240 O) + 1.5 (120 O) = 0.866 (150 O)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **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; ± 0.5 % Ir

According to the Catalogue for Technical Data – Page: 32

1. **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 = Idmin A

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Phase** | **Setting**  **Idmin (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 ± 2% of Ir According to the Catalogue for Technical Data – Page: 24

1. **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

According to the Catalogue for Technical Data –Page: 24

1. **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 |  |  |

1. **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 |  |

1. **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;

**SECTION 1**

When bias current is between:

0 ≤ Ibias ≤ Endsection1\*IBase

Trip= IdminOp \*Ibase

Set End section1 = 1.25\*IBase



|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Slope section 1** | **Idmin 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; ± 2 %Ir

According to the Technical Reference Catalogue – Page24

**SLOPE SECTION 2**

When bias current is between:

Endsection1\*Ibase ≤ Ibias ≤ Endsection2\*IBase

Trip = (IdminOp \*Ibase+ slope section2/100 \*(Ibias - End section1\*Ibase )

Where; Idmin ; 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.

Set End section1 = 1.25\*IBase

End section2 = 3.0\*IBase

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Slope section 2** | **Idmin 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; ± 2 %Ir

According to the Technical Reference Catalogue – Page24

**SLOPE SECTION3**

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

When bias current is more than:

Ibias ≥ End section2\*Ibase

Trip = Ibase\*(IdminOp + slope section2/100\*(End section2 - End section1)) +

(slope section3/100 \* (Ibias- End section2\*Ibase) A

Set End section1 = 1.25\*IBase

End section2 = 3.0\*IBase

Slope section2 = 50%

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Slope section3** | **Idmin 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; ± 2 %Ir

According to the Technical Reference Catalogue – Page24

1. **TEST OF 2ND HARMONICS**

Idmin = 0.25 Ib

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 |  |

1. **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 |  |

1. **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 |  |  |

1. **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 |  |  |

1. **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

* 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 |  |

* 1. **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 |  |

1. **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 | **2ND HARMONICS** | Yellow |  |
| 08 | **5TH 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 |  |

1. Disturbance recorder checked [ ].
2. Binary outputs and inputs checked [ ].
3. TestEquipments Used

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