**Note**:

* The approved updated final settings should be applied and printed out from the relay by using the software of the relay.
* The approved final setting and the printout final setting should be attached with this test format.
* The print out final setting should be signed by SEC AND Contractor.
* The following test format contains minimum required tests and some of settings are mentioned as an example and not as limitation.
1. **GENERAL DATA & INFORMATION**

|  |  |  |  |
| --- | --- | --- | --- |
| **Panel No.**  |  | **CT Ratio of HV Side**  |  |
| **Relay Type**  | TR DIFF + REF | **CT Ratio of LV Side** |  |
| **Manufacturer** |  | **Draw. & Sh No.**  |  |
| **Serial No** |  | **Dc. Auxiliary. Voltage**  | 125VDC |
| **Order - No.** | 1MRK004816-DC | **Frequency Fn**  | 60 Hz |
| **Software Version** | 1.2.3 | **Opto-Coupler Supply:** | 125 V |

1. **MECHANICAL CHECKS AND VISUAL INSPECTION**

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

|  |  |  |
| --- | --- | --- |
| item | Description | Remarks |
|  | Inspect for any physical damage or defects. | ❑ Yes | ❑ N/A |
|  | Verify connections and ferrules as per approved drawings | ❑ Yes | ❑ N/A |
|  | Check tightness of all the connections. | ❑ Yes | ❑ N/A |
|  | Check Apparatus List | ❑ Yes | ❑ N/A |
|  | 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 |
|  | Human Machine Interface (HMI) Checked. | ❑Yes  | ❑N/A  |
|  | Case Earthing checked. | ❑Yes  | ❑N/A  |
|  | LED’s Function Checked. | ❑Yes  | ❑N/A  |
|  | Trip Contacts Checked. | ❑Yes  | ❑N/A  |
|  | Reset Function Checked | ❑Yes  | ❑N/A  |
|  | Group active Functions Checked | ❑Yes  | ❑N/A  |
|  | Binary inputs checked. | ❑Yes  | ❑N/A  |
|  | Output Relays Checked | ❑Yes  | ❑N/A  |
|  | Event Display on HMI Screen Checked | ❑Yes  | ❑N/A  |
|  | Test switch / plug checked for correct function. | ❑Yes  | ❑N/A  |
|  | Watchdog contacts checked | ❑Yes  | ❑N/A  |
|  | 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) |
| 125 |  |  |  |

 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) - (X11:2, X11:1) :

SUPPLY ON

 TERMINALS (CLOSED) - (X11:1, X11:2) :

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

* 1. **TIME AND DATE CHECK:-**

To check time &date go to main menu on the display for RET670 then system time and adjust time &date.

To test this, remove the auxiliary supply from the relay for approximately 30 seconds, then restoring the auxiliary supply, the time and date should be correct.

Result: \_\_\_\_\_\_\_\_\_\_\_\_

* 1. **SETTING ADOPTED:**

Transformer Data: (All Values as an example)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Winding 1 ( HV ) | Winding 2 ( LV ) | Winding 3 (Tertiary.) |
| Connection Type | Y0 | y0 | d1 |
| Capacity ( MVA ) | 100 | 100 |  |
| Rated Voltage ( KV ) | 132 | 33 |  |
| Rated Current ( A ) | 437 | 1750 |  |

CT Data:

|  |  |  |  |
| --- | --- | --- | --- |
|  | CT 1 ( HV ) | CT 2 ( LV ) | CT 3 (Tertiary.) |
| Connection Type | Y | y |  |
| Primary Current ( A ) | 800 | 2000 |  |
| Secondary Current (A ) | 1 | 1 |  |

Calculated Amplitude Matching Factor (K):

KX = CTX / Rated Current of Ref. Wdg

Where Ref. Wdg is First Wdg with Y connection. If no Y connection then HV side selected automatically

KHV = 1.830

KLV = 1.143

KTerit. =

General Differential Equation:



Where

1. is Differential Current

2. is Differential Current Contribution from W1 side

3. is Differential Current Contribution from W2 side

4. is Differential Current Contribution from W3 side

A, B, C is a coefficients depended on vector group; refer to Manual to get exact value.

* 1. **SECONDARY INJECTION TESTS: (ALL VALUES AS AN EXAMPLE)**
		1. **MEASUREMENTS (HV side):**

|  |
| --- |
| TRM P40 - 9I+3U |
| Channel | DUTY | CTR | Injected Values | Measured Values | REMARKS |
| Primary | Sec |
| CH 1-I | W1 CT IL1 |  |  |  |  |  |
| CH 2-I | W1 CT IL2 |  |  |  |  |
| CH 3-I | W1 CT IL3 |  |  |  |  |
|  |
| CH 4-I | W1 CT IN |  |  |  |  |  |
| CH 5-I | W2 CT IN |  |  |  |  |  |
| CH 6-I | W2 CT IL1 |  |  |  |  |  |
| CH 7-I | W2 CT IL2 |  |  |  |  |
| CH 8-I | W2 CT IL3 |  |  |  |  |
| CH 9-I | Spare |  |  |  |  |  |
|  |
| CH 10-U | W1 VT Ph-R |  |  |  |  |  |
| CH 11-U | W1 VT PhY |  |  |  |  |
| CH 12-U | W1 VT Ph-B |  |  |  |  |
|  |  |  |  |  |  |  |

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):**

* This is single phase injection test.
* Disable SOTF facility.
* Disable any Negative Sequence facility.
* Disable zero Sequence removing facility.

Apply equation at page 3 the Diff. Eq. for single phase injection, 2 winding will be:

IDLx = A. KHV. Iw1Lx + B. (U2/U1). KLV. Iw2L

Where x represents the concerted phase

HV Winding

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Id min.Set Value | Calculated value (A) | Measured Value( A ) | Drop OutPick UpRatio | Operating Time @ 2XI pick up (ms) |
|
| Pick up | Drop out |
| R | 0.1 |  |  |  |  |  |
| 0.3 |  |  |  |  |  |
| 0.5 |  |  |  |  |  |
| Y | 0.1 |  |  |  |  |  |
| 0.3 |  |  |  |  |  |
| 0.5 |  |  |  |  |  |
| B | 0.1 |  |  |  |  |  |
| 0.3 |  |  |  |  |  |
| 0.5 |  |  |  |  |  |

LV Winding

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Id min.Set Value | Calculated value ( A ) | Measured Value( A ) | Drop OutPickupRatio | Operating Time @ 2XI pickup (ms) |
|
| Pick up | Drop out |
| R | 0.1 |  |  |  |  |  |
| 0.3 |  |  |  |  |  |
| 0.5 |  |  |  |  |  |
| Y | 0.1 |  |  |  |  |  |
| 0.3 |  |  |  |  |  |
| 0.5 |  |  |  |  |  |
| B | 0.1 |  |  |  |  |  |
| 0.3 |  |  |  |  |  |
| 0.5 |  |  |  |  |  |

Limits: Pick up & Drop Out ±2% of Ir for I < Ir or ±2% of I for I > Ir, Reset Ratio > 95%,

Timing tolerance Typically 25 ms for 2 Id, and 12 ms for 5 Id for unrestrained function ,

According to the Catalogue for Technical Data Page: 143

* + 1. **PICK-UP & DROP-OFF TEST FOR UNRESTRAINED DIFFERENTIAL CURRENT (ID):**

H.V Winding

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Value | Calculated value ( A ) | Measured Value( A ) | Drop OutPickupRatio | Operating Time @ 5XI pickup (ms) |
|
| Pick up | Drop out |
| R | 2.00 |  |  |  |  |  |
| 3.00 |  |  |  |  |  |
| 5.00 |  |  |  |  |  |
| Y | 2.00 |  |  |  |  |  |
| 3.00 |  |  |  |  |  |
| 5.00 |  |  |  |  |  |
| B | 2.00 |  |  |  |  |  |
| 3.00 |  |  |  |  |  |
| 5.00 |  |  |  |  |  |

L.V Winding

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase | Set Value | Calculated value ( A ) | Measured Value( A ) | Drop OutPickupRatio | Operating Time @ 5XI pickup (ms) |
|
| Pick up | Drop out |
| R | 2.00 |  |  |  |  |  |
| 3.00 |  |  |  |  |  |
| 5.00 |  |  |  |  |  |
| Y | 2.00 |  |  |  |  |  |
| 3.00 |  |  |  |  |  |
| 5.00 |  |  |  |  |  |
| B | 2.00 |  |  |  |  |  |
| 3.00 |  |  |  |  |  |
| 5.00 |  |  |  |  |  |

* + 1. **BIAS CHARACTERISTIC TESTING**



Inject H.V and L.V phase with equal current on each, and angle 0 for H.V and 180 for L.V, then decrease L.V Phase until trip, while leave H.V with fixed current which will be the bias current, and record values and check that corresponds to following equation.

1. **Section 1 *(All Values as an example)***

Where bias current is between:

0 ≤ Ibias ≤ Endsection1

Idmin = 0.3 ,

Set End section1 = 1.25

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Slope section1 | I bias(A) | IH.V(A) | Expected IL.V (A) | Id calculated | Measured IL.V (A) | Errors % |
| R | Y | B | R | Y | B |
| Idmin | 0.3 |  |  | 0.3 |  |  |  |  |  |  |
| 0.4 |  |  | 0.3 |  |  |  |  |  |  |
| 1.00 |  |  | 0.3 |  |  |  |  |  |  |

Limits; ± 2 %Ir According to the Technical Reference Catalogue – Page24

1. SLOPE Section 2 *(All Values as an example)*

When bias current is between:

Endsection1 ≤ Ibias ≤ Endsection2

Trip Id = (Idmin + slope section2/100 \*(Ibias - End section1) A

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 Idmin = 0.3

End section1 = 1.25

End section2 =3.0

Slope section 2 = 40%

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IbiasA | *IH.V = Ibias / kHV* A | Expected *IL.V = (Ibias – Id) / kLV* (A) | Id calculated | Measured IL.V (A) | Errors % |
| R | Y | B | R | Y | B |
| 1.25 |  |  | 0.300 |  |  |  |  |  |  |
| 1.50 |  |  | 0.400 |  |  |  |  |  |  |
| 1.75 |  |  | 0.500 |  |  |  |  |  |  |
| 2.00 |  |  | 0.600 |  |  |  |  |  |  |
| 2.25 |  |  | 0.700 |  |  |  |  |  |  |
| 2.50 |  |  | 0.800 |  |  |  |  |  |  |

Limits; ± 2 %Ir According to the Technical Reference Catalogue – Page24

1. SLOPE Secton3 *(*All Values as an example*)*

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

When bias current is more than:

Ibias ≥ End section2

Trip Id = (Idmin + slope section2/100\*(End section2 - End section1)) +

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

Set End section1 = 1.25

 End section2 =3.0

 Slope section1 = 40%

 Slope section2 = 80%

 Idmin = 0.3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| I biasA | IH.V = Ibias / kHV A | Expected *IL.V = (Ibias – Id) / kLV* (A) | Id calculated | Measured IL.V (A) | Errors % |
| R | Y | B | R | Y | B |
| 3.0 |  |  | 1.000 |  |  |  |  |  |  |
| 3.5 |  |  | 1.400 |  |  |  |  |  |  |
| 4.0 |  |  | 1.800 |  |  |  |  |  |  |
| 4.5 |  |  | 2.200 |  |  |  |  |  |  |

Limits; ± 2 %Ir According to the Technical Reference Catalogue – Page24

* + 1. **Test of 2nd Harmonics *(*All Values as an example*)***

Idmin = 0.3 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. **CROSS BLOCK TEST**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Winding | IR | IY | IB | Cross Block on | Cross Block Off |
| HV | I > pickup with 2nd harmonic | I > pickup without 2nd harmonic |  |  |  |
|  | I > pickup with 2nd harmonic | I > pickup without 2nd harmonic |  |  |
| I > pickup without 2nd harmonic | I > pickup with 2nd harmonic |  |  |  |
| l.V | I > pickup with 2nd harmonic | I > pickup without 2nd harmonic |  |  |  |
|  | I > pickup with 2nd harmonic | I > pickup without 2nd harmonic |  |  |
| I > pickup without 2nd harmonic | I > pickup with 2nd harmonic |  |  |  |

Test done at I2/I1= 15%, I5/I1 = 25 %

### **NEGATIVE SEQUENCE TEST:**

**IminNegSeq test :**

INegSeq. =**1/3 { IR + a2 IY + a IB } , where a =** 

Irelay = Iinject \* K

And we at test inject single phase then :

Irelaynegseq = 1/3 Iinject \* K

|  |  |  |  |
| --- | --- | --- | --- |
| IMinNegSeq setting | IH.V ( > IMinNegSeq setting ) (A) | Expected IL..V  (A) | Measured IL..V  (A) |
| 0.04 | 0.11 | 0.100 |  |
| 0.08 | 0.22 | 0.201 |  |
| 0.09 | 0.24 | 0.226 |  |

**Negative sequence Relay Operating Angle (NegSeqROA ) test :**

Inject H.V & L.V > IMinNegSeq

Inject H.V with angle zero degree and change the L.V to get the operating zone.

|  |  |  |
| --- | --- | --- |
| NegSeqROA setting | Expected IL..V angle for operating zone (Deg)  | Measured IL..V angle for operating zone (Deg) |
| 30 | 330 – 30 |  |
| 40 | 320 – 40 |  |
| 80 | 280 – 80 |  |

**Sensitive negative sequence ( turn-to-turn fault ) test:**

This function based on Negative sequence discriminator . where if there is no start signal ( independent on existence or not for start signal ) and the fault is classified as internal fault and at same time for H.V and L.V sides the negative sequence current is greater than IminNegSeq .. then trip transformer

To test it , inject single phase from 2 winding in phase and increase them at same time until trip , ( must happen by ssneg only not restrain function ) .

Status \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. **HV REF:**

**PICK/UP AND DROP/OFF TEST**

Idiff = IN + 3I0

Ibias = the highest current at 3 Phases or Neutral

|  |  |  |  |
| --- | --- | --- | --- |
| **Inj. Curr. to** | **Setting value** | **P/Up (A)** | **D/Off (A)** |
| **IN** | **10% IB** |  |  |
| **IN** | **20% IB** |  |  |

 Limits : ± 2.0% of Ir at I £ Ir

 ± 2.0% of I at I > Ir Reset ratio > 95%

* + 1. **TIMING TEST:**

|  |  |  |  |
| --- | --- | --- | --- |
| Inj. Curr. to | Setting value | Inj current (A) | Meas time (ms) |
| IN | **10% IB** |  |  |

Limits : 20 ms typically at 0 to 10 x Id

**HV REF (REFPDIF) DIRECTIONALITY CHECK**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Phase** | **Id Min** | **Setting ROA** | **Injected Current** | **Meas. ROA** |
| **3I0** | **IN** |
| **3I0** | **0.1 x IB** | **600** | **0.1 A ∟00** | **0.1 A ∟00** |  |
| **IN** |  |

**Limits :** ± 2.0 degree

* + 1. **SLOPE TEST:**

As per technical reference manual page 147, 148:

End zone 1=125% IB

End zone 2=2.536 (calculated from the graph at our setting Idmin=10%).

First Slope =70%.

Second Slope=100%.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Injection** | **Current Injected** | **I diff** | **I bias** | **1st Slope** | **2nd Slope** | **Remarks** |
| **Slope1 IN** | **Slope1 3I0** | **Slope1 IN** | **Slope1 3I0** |
| **HV 3I0****&****HV IN** | **1.25 A** |  |  |  |  |  |  |  |  |
| **1.50 A** |  |  |  |  |  |  |  |  |
| **2.536 A** |  |  |  |  |  |  |  |  |
|  |  | **3.00 A** |  |  |  |  |  |  |
|  |  | **5.00 A** |  |  |  |  |  |  |

* 1. **LV REF:**
		1. **PICK/UP AND DROP/OFF TEST**

Idiff = IN + 3I0

Ibias = the highest current at 3 Phases or Neutral

|  |  |  |  |
| --- | --- | --- | --- |
| **Inj. Current to** | **Setting value** | **P/Up (A)** | **D/Off (A)** |
| **IN** | **10% IB** |  |  |
| **IN** | **20% IB** |  |  |

 Limits : ± 2.0% of Ir at I £ Ir

 ± 2.0% of I at I > Ir Reset ratio > 95%

* + 1. **TIMING TEST:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Inj. Curr. to | Setting value | Inj current (A) | Meas time (ms) | Remarks |
| IN | **10% IB** |  |  |  |

Limits : 20 ms typically at 0 to 10 x Id

* + 1. **LV REF (REFPDIF) DIRECTIONALITY CHECK:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Phase** | **Id Min** | **Setting ROA** | **Injected Current** | **Meas. ROA** |
| **3I0** | **IN** |
| **3I0** | **0.1 x IB** | **600** | **0.1 A ∟00** | **0.1 A ∟00** |  |
| **IN** |  |

 **Limits :** ± 2.0 degre

* + 1. **SLOPE TEST:**

As per technical reference manual page 147, 148:

End zone 1=1.25\*IB

End zone 2=2.536\*IB (calculated from the graph at our setting Idmin=10%).

First Slope =70%. Second Slope =100%.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Injection** | **Current Injected** | **I diff** | **I bias** | **1st Slope** | **2nd Slope** | **Remarks** |
| **Slope1 IN** | **Slope1 3I0** | **Slope1 IN** | **Slope1 3I0** |
| **HV 3I0****&****HV IN** | **1.25 A** |  |  |  |  |  |  |  |  |
| **1.50 A** |  |  |  |  |  |  |  |  |
| **2.536 A** |  |  |  |  |  |  |  |  |
|  |  | **3.00 A** |  |  |  |  |  |  |

* 1. **WINDING-1 OVERCURRENT & EARTH FAULT PROTECTION TEST**
		1. **PICK/UP AND DROP/OFF TEST**

|  |  |  |  |
| --- | --- | --- | --- |
| **Current****Setting****Amps** **I>** | **OC4TOC: 1** | **Current****Setting****Amps** **Io>** | **EF4TOC: 1 [IO>]** |
| **R** | **Y** | **B** | **N** |
| Pick Up | Drop Off | Pick Up | Drop Off | Pick Up | Drop Off | Pick Up | Drop Off |
| 1xIn = 1 |  |  |  |  |  |  | 0.1xIn = 0.1 |  |  |
| 1.5xIn = 1.5 |  |  |  |  |  |  | 0.3xIn = 0.3 |  |  |

 Limits : ± 1.0% of Ir at I £ Ir

 ± 1.0% of I at I > Ir Reset ratio > 95%

* + 1. **TIMING TEST**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FUNCTION** | **INJECT****CURRENT****AMPS** | **EXPECTED****TIME** **SEC** | **OPERATING TIME (SEC), TMS = 1.0** | **RANGE****SEC** |
| **R** | **Y** | **B** | **N** |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 10.03 |  |  |  |  | 10.52 – 9.519 |
| 10 x Isetting | 2.97 |  |  |  |  | 3.188 – 2.82 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 13.5 |  |  |  |  | 14.175 – 12.825 |
| 10 x Isetting | 1.5 |  |  |  |  | 1.57 – 1.42 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 26.67 |  |  |  |  | 28.00 – 25.336 |
| 10 x Isetting | 0.808 |  |  |  |  | 0.848 – 0.767 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 120 |  |  |  |  | 126 – 114  |
| 10 x Isetting | 13.333 |  |  |  |  | 13.999 – 12.666 |

Limits: IEC 60255-3, class 5 + 40 ms

* 1. **WINDING 2 OVERCURRENT& EARTH FAULT PROTECTION TEST**
		1. **PICK/UP AND DROP/OFF TEST**

|  |  |  |  |
| --- | --- | --- | --- |
| **Current****Setting****Amps** **I>** | **OC4TOC: 2** | **Current****Setting****Amps** **Io>** | **EF4TOC: 2 [IO>]** |
| **R** | **Y** | **B** | **N** |
| Pick Up | Drop Off | Pick Up | Drop Off | Pick Up | Drop Off | Pick Up | Drop Off |
| 1xIn = 1 |  |  |  |  |  |  | 0.1xIn = 0.1 |  |  |
| 1.5xIn = 1.5 |  |  |  |  |  |  | 0.3xIn = 0.3 |  |  |

 Limits : ± 1.0% of Ir at I £ Ir

 ± 1.0% of I at I > Ir

* + 1. **TIMING TEST**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FUNCTION** | **INJECT****CURRENT****AMPS** | **EXPECTED****TIME** **SEC** | **OPERATING TIME (SEC), TMS = 1.0** | **RANGE****SEC** |
| **R** | **Y** | **B** | **N** |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 10.03 |  |  |  |  | 10.52 – 9.519 |
| 10 x Isetting | 2.97 |  |  |  |  | 3.188 – 2.82 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 13.5 |  |  |  |  | 14.175 – 12.825 |
| 10 x Isetting | 1.5 |  |  |  |  | 1.57 – 1.42 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 26.67 |  |  |  |  | 28.00 – 25.336 |
| 10 x Isetting | 0.808 |  |  |  |  | 0.848 – 0.767 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 120 |  |  |  |  | 126 – 114  |
| 10 x Isetting | 13.333 |  |  |  |  | 13.999 – 12.666 |

Limits : IEC 60255-3, class 5 + 40 ms

* 1. **RESIDUAL OVER CURRENT (EF4PTOC:3) STEP 1 NEUTRAL ALARM**

* + 1. **PICK UP AND DROP-OFF TEST:**

|  |  |
| --- | --- |
| **Current****Setting****Amps** **Io>** | **EF4TOC: 3 [IO>]** |
| **N** |
| Pick Up | Drop Off |
| 0.03xIn = 0.03 |  |  |
| 0.05xIn = 0.05 |  |  |

* + 1. **TIMING TEST**

|  |  |  |
| --- | --- | --- |
| **INJECTED** **CURRENT****Amps** | **TIME SETTING****sec** | **OPERATING TIME** |
| **N** |
|  | 0.05 |  |
|  | 0.1 |  |

Limits: ± 0.5% of set time ± 10 ms

* 1. **RESIDUAL OVER CURRENT (EF4PTOC:3)**

**STEP 2 SENSITIVE EARTH FAULT**

* + 1. **PICK UP AND DROP-OFF TEST:**

|  |  |
| --- | --- |
| **Current****Setting****Amps** **Io>>** | **EF4TOC: 3 [IO>>]** |
| **N** |
| Pick Up | Drop Off |
| 0.05xIn = 0.05 |  |  |
| 0.1xIn = 0.1 |  |  |

 Limits: ± 1.0% of Ir at I £ Ir

 ± 1.0% of I at I > Ir

* + 1. **TIMING TEST**

Ion=1A, Is (Io>>) =0.3 x Ion =0.3A,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FUNCTION** | **INJECT****CURRENT****AMPS** | **EXPECTED****TIME** **SEC** | **OPERATING TIME (SEC),** **TMS = 1.0** | **RANGE****SEC** |
| **N** |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 10.03 |  | 10.52 – 9.519 |
| 10 x Isetting | 2.97 |  | 3.188 – 2.82 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 13.5 |  | 14.175 – 12.825 |
| 10 x Isetting | 1.5 |  | 1.57 – 1.42 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 26.67 |  | 28.00 – 25.336 |
| 10 x Isetting | 0.808 |  | 0.848 – 0.767 |
| **IEC NORMAL****INVERSE** | 2 x Isetting | 120 |  | 126 – 114  |
| 10 x Isetting | 13.333 |  | 13.999 – 12.666 |

Limits : IEC 60255-3, class 5 + 40 ms

**15 : BREAKER FAILURE (CCRBRF:2)**

**15.1: PICK UP TEST:**



 Limits : ± 1.0% of Ir at I £ Ir

 ± 1.0% of I at I > Ir

**15:2 TIMING TEST**



Limits : ± 0.5% of set time ± 10 ms