

Order Number

Serial Number

## PRODUCT/TEST MANUAL

**2C135K14**

### **DEFINITE TIME SENSITIVE EARTH FAULT RELAY WITH HARMONIC SUPPRESSION**

| <b>Issue Level</b> | <b>Date</b> | <b>Summary of changes</b> |
|--------------------|-------------|---------------------------|
| E                  | 10/12/1997  | Initial issue.            |
|                    |             |                           |
|                    |             |                           |
|                    |             |                           |
|                    |             |                           |

Due to RMS continuous product improvement policy this information is subject to change without notice.

| <b>Document updated</b> | <b>Checked</b> | <b>Registered</b> | <b>.pdf file created</b> | <b>.pdf uploaded to web site</b> |
|-------------------------|----------------|-------------------|--------------------------|----------------------------------|
|                         |                |                   |                          |                                  |

## 1. BROAD DESCRIPTION OF RELAY

The 2C135K14 is a high speed definite time sensitive earth fault relay with harmonic suppression. Current and time settings are made on DIL switches on the dial of the unit and bistable magnetic disc flag also mounted on the dial indicate when delayed output relay operation has occurred.

## 2. SPECIFICATIONS

|   |  |
|---|--|
| DC Auxiliary Supply   | 110 VDC nom.                                     |
| DC Auxiliary Supply Tolerance                                 | 85% to 110% of nom                               |
| Supply Burden (independent of range)                          | 55mA   |
| AC Current Sensing Range                                      | .5-15.5% of 1A (.5 - 155 mA, 5mA steps)          |
| Setting Accuracy (Vx & Temp at nominal)                       | ±5% of setting                                   |
| Temp Dependence of Ipickup (over Temp range 20-50 deg C)      | <±1.5mA per deg C                                |
| Vx Dependence of Ipickup (over Vsupply range 85%-110% of nom) | <±2% of setting                                  |
| Max operate time @ 1.1 x setting                              | <80ms  |
| Max resetting time from 1.1 x setting                         | <80ms  |
| Harmonic Rejection  | Greater than 20 x setting for frequencies >100Hz |
| AC Continuous Rating  | 10A  |
| AC Short Time Rating  | 200A for 3sec                                    |
| AC Burden   | Less than 1VA at 5A                              |
| Resetting ratio (at 20 deg C)                                 | Greater than 90%                                 |
| Instantaneous output  | <80 mS operate time                              |
| Timer Range   | 0-31.875s, .125s steps                           |
| Timer Accuracy (Vx & Temp at nominal)                         | ±5% of setting                                   |
| Temp Dependence of Timer (over Temp range 0-50 deg C)         | <30ms  |
| Vx Dependence of Timer (over Vsupply range 85%-110% of nom)   | <±2% of setting                                  |
| Max resetting time  | <50ms  |
| Overall Ambient Temperature Range                             | -5 to 55 deg C                                   |
| Operation Indicator (Timed output)                            | Magnetic Disc                                    |

### Output Relay Contact Ratings

#### Continuous Current

250 Volt AC at 10 Amp  
125 Volt DC at 10 Amp

#### Allowable Contact Power

1650 VA AC resistive and 300W DC resistive  
1100 VA AC inductive and 225 W DC inductive

## 2. SPECIFICATIONS (Cont)

### Rated Load

| Voltage  | Resistive Load | Inductive Load |
|----------|----------------|----------------|
| 110 V AC | 10 A           | 7.5 A          |
| 220 V AC | 7.5 A          | 5 A            |
| 30 V DC  | 10 A           | 7.5 A          |

Operation Indicators

Hand resettable magnetic disc  
(permanent memory).

Insulation Withstand

In accordance with AS2481-1981  
(Clause 5-4), 2KV 50Hz between  
output and input. In Accordance  
with AS2481-1981 (Clause 5-4),  
1.2/50 5KV.

Noise Immunity

The 2C135 relay has been  
designed to withstand the high  
frequency interference test detailed  
in AS2481-1981 (Clause 5-5).

Case Type

FSB

## 3. TEST EQUIPMENT REQUIRED

DC Auxiliary Supply  
AC Variable Current & Frequency Supply  
Ammeter  
Frequency Counter  
Oscilloscope  
HV Test Equipment  
Electronic Counter (for measuring operate & release times)

## 4. ASSOCIATED DRAWINGS

159-135-014 Descriptive Manual  
159-135-114 Wiring Diagram  
660-277-204 Circuit Diagram PCB 2C135K14  
660-277-303 Loading Diagram PCB

## 5. HIGH VOLTAGE TESTING

- a) Apply 2KV RMS 50Hz between terminal Groups 1 and 2 in Table 1 for 1 minute.
- b) Apply three 5KV 1/50us pulses of each polarity between terminal Groups 1 and 2 in Table 1.

**TABLE 1**

| <b>GROUP 1</b>    | <b>GROUP 2</b>       |
|-------------------|----------------------|
| 7&8, 9&10, joined | 1&2, 6&5, 3&4 joined |
| 9&10, 5&6, joined | 7&8, 1&2, 3&4 joined |
| All terminals     | Earth                |

## 6. CALIBRATION & TEST PROCEDURE

- a) Connect 110V DC Auxiliary power supply to terminals 7 (+) and 8 (-).
- b) Connect variable frequency adjustable current supply via Pickup/Dropout time measuring equipment and Ammeter to the current input terminals (9 and 10). Use RL2-1 contact (terminals 1 and 2) to detect pickup of the 2C135.
- c) Check that 12V supply rail is within tolerance. (Measure between auxiliary supply negative and transformer shield can.)

| <b>MINIMUM</b> | <b>MAXIMUM</b> | <b>NOMINAL</b> | <b>ACTUAL</b>        | <b>UNITS</b> |
|----------------|----------------|----------------|----------------------|--------------|
| 11.5           | 12.6           | 12.0           | <input type="text"/> | V DC         |

- d) Check that 24V supply rail is within tolerance. (Measure between auxiliary supply negative and IC1 pin 4.)

| <b>MINIMUM</b> | <b>MAXIMUM</b> | <b>NOMINAL</b> | <b>ACTUAL</b>        | <b>UNITS</b> |
|----------------|----------------|----------------|----------------------|--------------|
| 23.0           | 25.2           | 24.0           | <input type="text"/> | V DC         |

- e) Connect oscilloscope 0V connection to +12V rail (shield can of input transformer is a convenient point) and monitor U1C-8 pin 8.
- f) With zero input current, set trimpot R6 to mid setting, SW2 to .5% Inom (5mA) and adjust R12 to give zero DC offset as observed on the oscilloscope.

| <b>ACTUAL</b>        |    |
|----------------------|----|
| <input type="text"/> | OK |

**6. CALIBRATION AND TEST PROCEDURE (Cont)**

- g) Set current setting switch to 2% setting (20mA) and apply 50Hz input current such that a 5V peak to peak signal is observed on the oscilloscope at U2C-8.
- h) Change input current frequency to 150Hz and adjust trimpot R20 for minimum signal amplitude on the CRO. Note that C11 may be padded if necessary.
- i) Temporarily short out diode D9, set input frequency to 50Hz and adjust input amplitude until square waves just appear at U1D-14.
- j) Connect CRO second channel to U4B-4 pin 4 (D13 anode) and adjust trimpot R42 so that U4B-4 pin 4 goes high 8ms after U1D-14 pin 8 goes low.

| MINIMUM | MAXIMUM | NOMINAL | ACTUAL               | UNITS |
|---------|---------|---------|----------------------|-------|
| 8.0     | 9.0     | 8.0     | <input type="text"/> | ms    |

- k) Remove temporary short circuit from across D9.
- l) Set timer switches to zero.
- m) Set current setting DIL to 2%. Adjust trimpot R6 until output relay just picks up at 20mA.
- n) Connect a dual beam storage oscilloscope with one probe to TP9 and the other to U4-11. Adjust R51 for 15mS from the time TP9 goes low and U4-11 goes high.

| ACTUAL               | UNITS |
|----------------------|-------|
| <input type="text"/> | ms    |

- o) Check the operation of the Instantaneous output after adjustment is complete. Record results ensuring time is less than 80 mS

|    |          | MAXIMUM | ACTUAL               | UNITS |
|----|----------|---------|----------------------|-------|
| PU | 93 V DC  | 80      | <input type="text"/> | mS    |
| DO | 121 V DC | 80      | <input type="text"/> | mS    |

**6. CALIBRATION AND TEST PROCEDURE (Cont)**

- p) Set current setting DIL switch to .5% and input current to zero. Check that U1C-8 pin 8 output offset voltage is zero and adjust R12 if necessary.

**ACTUAL**  
 OK

- q) Set current setting DIL to .5%. Connect pickup/dropout time measuring equipment to measure the time between application of 15 mA and subsequent closure of RL2-1 contact. Note that the pickup time of the instantaneous (range switch set to "all off") current sensing element plus output relay will be approximately 35ms. Record operate times at the following settings:

| SETTING | MINIMUM | MAXIMUM | NOMINAL | ACTUAL  | UNITS |
|---------|---------|---------|---------|---|-------|
| 0.125   | 0.15    | 0.17    | 0.16    | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 0.25    | 0.27    | 0.29    | 0.28    | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 0.5     | 0.50    | 0.56    | 0.53    | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 1.0     | 0.98    | 1.08    | 1.03    | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 2.0     | 1.93    | 2.13    | 2.03    | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 4.0     | 3.83    | 4.23    | 4.03    | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 8.0     | 7.63    | 8.43    | 8.03    | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 16.0    | 15.23   | 16.83   | 16.03   | <input style="width: 100%; height: 20px;" type="text"/> | s     |
| 31.875  | 30.30   | 33.40   | 31.91   | <input style="width: 100%; height: 20px;" type="text"/> | s     |

- r) Set timer to zero and record the following pickup and hysteresis currents at the indicated settings:

| SETTING    | MINIMUM | MAXIMUM | NOMINAL | ACTUAL  | UNITS |
|------------|---------|---------|---------|---|-------|
| 0.5% PU    | 4.4     | 5.6     | 5.0     | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| Hysteresis | .3      | .7      | .5      | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| 1.0% PU    | 9.3     | 10.7    | 10.0    | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| Hysteresis | .6      | 1.4     | 1.0     | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| 2.0% PU    | 19.0    | 21.0    | 20.0    | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| Hysteresis | 1.2     | 2.8     | 2.0     | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| 4.0% PU    | 38.4    | 41.6    | 40.0    | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| Hysteresis | 2.4     | 5.6     | 4.0     | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| 8.0% PU    | 77.2    | 82.8    | 80.0    | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| Hysteresis | 4.8     | 11.2    | 8.0     | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| 15.5% PU   | 150     | 160     | 155     | <input style="width: 100%; height: 20px;" type="text"/> | mA    |
| Hysteresis | 9.3     | 21.7    | 15.5    | <input style="width: 100%; height: 20px;" type="text"/> | mA    |

**6. CALIBRATION AND TEST PROCEDURE (Cont)**

- s) Reconnect auxiliary supply set to 93.5 V to enclosure terminal 7 (+ve) with terminal 8 common negative. Record pickup and hysteresis currents:

|            | MINIMUM | MAXIMUM | NOMINAL | ACTUAL               | UNITS |
|------------|---------|---------|---------|----------------------|-------|
| 2.0% PU    | 19.0    | 21.0    | 20.0    | <input type="text"/> | mA    |
| Hysteresis | 1.2     | 2.5     | 2.0     | <input type="text"/> | mA    |

- t) Repeat step q) above for an auxiliary supply of 121V:

|            | MINIMUM | MAXIMUM | NOMINAL | ACTUAL               | UNITS |
|------------|---------|---------|---------|----------------------|-------|
| 2.0% PU    | 19.0    | 21.0    | 20.0    | <input type="text"/> | mA    |
| Hysteresis | 1.2     | 2.5     | 2.0     | <input type="text"/> | mA    |

- u) Set input current to 22mA and record PU & DO times for an auxiliary supply of 110 volts

|    | MAXIMUM | ACTUAL               | UNITS |
|----|---------|----------------------|-------|
| PU | 80      | <input type="text"/> | mS    |
| DO | 80      | <input type="text"/> | mS    |

## 7. GENERAL & FUNCTIONAL

- a) Check that magnetic disc flag operates correctly when the output relay picks up.

OK

- b) Check that reset button resets the flag.

OK

- c) Check that the Instantaneous LED functions correctly

OK

- d) Check that the relay is electrically sound and mechanically robust as per Standard Inspection & Test Schedule 903-000-026.

PASS  OK

TESTED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

## 8. CONNECTION DIAGRAM

