

The given failure rates refer to more than one article.  
For the valid articles please refer to the article list.

Device category 2 - electrical article with relay

Prediction done by: pyff02

|    |            |                     | based on | Environmental condition            | MTTF in h   | MTTF in a | failure rate in FIT (λ basis) |
|----|------------|---------------------|----------|------------------------------------|-------------|-----------|-------------------------------|
| at | 25 °C with | 21,00 % duty cycle  | SN 29500 | GB, GC - Ground Benign, Controlled | 26542276,82 | 3029,94   | 37,675743                     |
| at | 40 °C with | 34,25 % duty cycle  | SN 29500 | GB, GC - Ground Benign, Controlled | 16044174,88 | 1831,53   | 62,327917                     |
| at | 40 °C with | 100,00 % duty cycle | SN 29500 | GB, GC - Ground Benign, Controlled | 7588792,13  | 866,3     | 131,773276                    |
| at | 60 °C with | 100,00 % duty cycle | SN 29500 | GB, GC - Ground Benign, Controlled | 4025390,44  | 459,52    | 248,423107                    |
| at | °C with    | % duty cycle        |          |                                    | -           | -         |                               |
| at | °C with    | % duty cycle        |          |                                    | -           | -         |                               |

**MTTF values and failure rates - relay contact -, details according to SN 29500-7**

| ambient temperature in °C | type of load | type of voltage | voltage in V | current in A | operating cycles per h | failure criteria | failure rate in FIT (λ contact) | MTTF in h   | MTTF in a |
|---------------------------|--------------|-----------------|--------------|--------------|------------------------|------------------|---------------------------------|-------------|-----------|
| 40                        | resistive    | DC              | >0,5         | <0,1         | 360                    | normal           | 360                             | 2777777,78  | 317,1     |
| 40                        | resistive    | AC              | >13          | >0,1         | 360                    | normal           | 36                              | 27777777,78 | 3170,98   |
| 40                        | resistive    | DC              | >13          | >0,1         | 360                    | normal           | 180                             | 5555555,56  | 634,2     |
| 40                        | inductive    | AC              | >13          | >0,1         | 360                    | normal           | 360                             | 2777777,78  | 317,1     |
| 40                        | inductive    | DC              | >13          | >0,1         | 360                    | normal           | 900                             | 1111111,11  | 126,84    |
|                           |              |                 |              |              |                        |                  |                                 | -           | -         |
|                           |              |                 |              |              |                        |                  |                                 | -           | -         |
|                           |              |                 |              |              |                        |                  |                                 | -           | -         |
|                           |              |                 |              |              |                        |                  |                                 | -           | -         |
|                           |              |                 |              |              |                        |                  |                                 | -           | -         |

**Notes for device category 2 (electrical article with relay)**

- failure rates (  $\lambda$  ) respectively MTTF values (rounded)
- One changeover contact counts as two contact
- One double contact counts as one contact
- Optional spark-extinguished contacts behave like contacts on ohm resistive load at the same current load
- Standardized load characteristic diagrams are shown in diagramm

The failure rate respectively the MTTF value of the relay can be calculated with the following formula  
**Only used contacts have to be considered!**

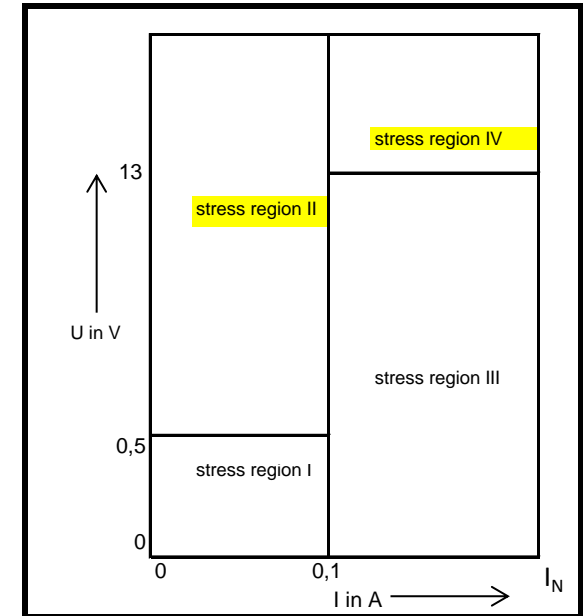
Calculation of total failure rate,  $\lambda$  device (FIT)

$$\lambda_{device} = \lambda_{basis} + \sum \lambda_{contact}$$

Calculation of total MTTF value, MTTF device (h)

$$MTTF_{device} = \frac{10^9 h}{\lambda_{device}}$$

Diagram



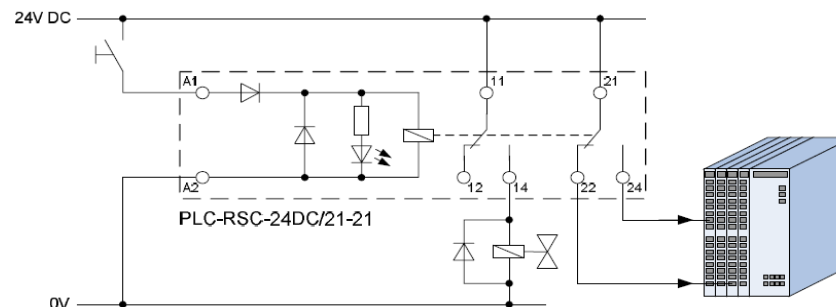
## Example of a MTTF calculation for an electronic article with relay (e.g. relay modul)

### 1. Product

Relay module with 2 changeover contacts: PLC-RSC-24DC/21-21 (Art.-No. 2967060)



### 2. Application setup



### 3. Information about contact load

Load 1 at contact 1 (only NC of the changeover contact is used):  
Solenoid valve 24VDC / 1 A, wired up with freewheeling diode

Load 2 at contact 2 (change over contact is used):  
Electronical control input, 24VDC / 10mA (resistive load)

### 4. Result lists of the failure rates $\lambda$

(relevant values for this example are highlighted in grey)

$\lambda$  basic Failure rate for the electronic share (LED, freewheeling diode, polarity protection etc.) and e.g. the connections of the relay modul

$\lambda$  contact Failure rate for one single contact of the relay module for different typical contact loads

#### Failure rate $\lambda$ basic

|    |    |         |        |              |          |          |                         |                                    |           |             |           |         |  |      |
|----|----|---------|--------|--------------|----------|----------|-------------------------|------------------------------------|-----------|-------------|-----------|---------|--|------|
| at | 40 | °C with | 100,00 | % duty cycle | based on | SN 29500 | Environmental condition | GB, GC - Ground Benign, Controlled | MTTF in h | 23310023,31 | MTTF in a | 2660,96 | failure rate in FIT ( $\lambda$ basis) | 42,9 |
|----|----|---------|--------|--------------|----------|----------|-------------------------|------------------------------------|-----------|-------------|-----------|---------|--|------|

#### Failure rate $\lambda$ contact

| ambient temperature in °C | type of load | type of voltage | voltage in V | current in A | operating cycles per h | failure criteria | failure rate in FIT ( $\lambda$ contact) | MTTF in h  | MTTF in a |
|---------------------------|--------------|-----------------|--------------|--------------|------------------------|------------------|--|------------|-----------|
| 40                        | resistive    | DC              | >0,5         | <0,1         | 360                    | normal           | 360                                      | 2777777,78 | 317,1     |
| 40                        | resistive    | AC              | >13          | >0,1         | 360                    | normal           | 36                                       | 2777777,78 | 3170,98   |
| 40                        | resistive    | DC              | >13          | >0,1         | 360                    | normal           | 180 (1)                                  | 5555555,56 | 634,2     |
| 40                        | inductive    | AC              | >13          | >0,1         | 360                    | normal           | 360                                      | 2777777,78 | 317,1     |
| 40                        | inductive    | DC              | >13          | >0,1         | 360                    | normal           | 900                                      | 1111111,11 | 126,84    |

(1) A freewheeling diode at load 1 represent an ideal contact protection circuit at an inductive DC load and the inductive share of the load. -> Select value for resistive load!

### 5. Calculation of the MTTF for the whole relay modul

$\lambda$  device =  $\lambda$  basic +  $\sum \lambda$  contact -> in this example: ->  $\lambda$  device =  $\lambda$  basic +  $\lambda$  contact 1 +  $\lambda$  contact 2

Entry of the values from the result lists

$$\lambda_{device} = 42,9 \text{ FIT} + 180 \text{ FIT} + (2^{(2)} \times 360 \text{ FIT}) = 942,9 \text{ FIT}$$

(2) 2 x table value, because a changeover contact is considered as two contacts

$$MTTF_{device} = \frac{10^9 \text{ h}}{\lambda_{device}} = \frac{10^9 \text{ h}}{942,9} = 1060558 \text{ h} = 121 \text{ years}$$

