

# MRL TC100

## Trip circuit supervision



## T: Technical specifications

### T-1: Inputs

2 digital inputs considered for trip contact & C.B. ( 52a N.O.)  
Nominal voltage: 110 Vdc  
Voltage range: 80 – 180 Vdc

Aux. power supply Nominal: 110Vdc Range: 60 – 180Vdc

Power consumption: Max 2W

### T-2: Outputs

- 2 relay contacts fixed for TCS alarm & power safe
- 2 optional contacts for user request i.e. for C.B. open & close

Contact specification: 12A 250Vac /12A 30Vdc/ 0.3A 125Vdc/0.4A 110Vdc

### T-3: User interfaces

- Rear RS485 with Modbus protocol
- Front USB port for settings & events extraction directly from PC
- Safety front LED (Green blink)
- Trip circuit status monitoring LED (3 color, green=OK, red=not OK, yellow=Acceptable fail)
- Graphic dot matrix LED display for monitoring time, date, & trip circuit status

### T-4: Settings

- Time & date, Christian or Solar (Get data only from PC if selected)
- Delay time for perfect operation (d1)
- Max allowable delay time for circuit breaker operation (d2)
- Modbus address & name
- Modbus baud rate

### T-5: Features

- Event recording with time tag & detailed information of trip steps (Up to 200 events)
- 1 mSec time tag accuracy for events
- PC software, via USB or based on Modbus protocol via RS485 for settings &

- events
- Ability to network several relays via RS485 Modbus & receive related events
  - Ability to synchronize relays with station server time, via RS485
  - Two delay steps d1 & d2
    - d1: 10 to 1000 mSec definable on relay by setting (uncritical as time out)
    - d2: d1 to 5000 mSec definable on relay by setting(critical delay as breaker failure)
  - Breaker "DC power out of range" detection and alarm

## T-6: Technical specifications according to standard

### T-6.1 Mechanical specifications

#### Design

Modular FMA Full draw-out Case – 2U

#### Mounting

Rack or flush mounting.

#### Connections

Rear (Green Phoenix pluggable connectors)

### T-6.2 Environmental conditions

#### Ambient Temperature Range

Per IEC 60255-6: 1988

Operating temperature range:

Continuous Withstand: –20 to +55°C

Storage Temperature Range: –20 to +70°C

Tested as per IEC 60068-2-1:2007:

–20°C storage (16 hours), –20°C operation (16 hours)

IEC 60068-2-2-2007:

+70°C storage (16 hours), +55°C operation (16 hours)

#### Ambient Humidity Range

Humidity:

Per IEC 60068-2-78: 2001:

Per IEC 60068-2-30: 2005:

#### Solar radiation

Avoid exposure of the front panel to direct solar radiation.

**Insulation**

Rated insulation: 300

PER IEC 60255-5: 2000, Insulation resistance > 100MΩ at 500Vdc

**High Voltage (Dielectric) Withstand**

Per IEC 60255-5: 2000, 2 kV rms AC, 1 minute:

Between all case terminals connected together, and the case earth, and between all terminals of independent circuits (RS232 ports excepted).

2.0kVrms for one minute between all terminals and case earth

2.0kVrms for one minute between all terminals of independent circuits, including contact circuits

1.5kVrms for one minute across dedicated normally open contacts of output relays.

1.5kVrms AC for 1 minute, across open contacts and across open contacts of changeover output relays.

**Impulse Voltage Withstand Test**

Per IEC 60255-5: 2000

The product will withstand without damage impulses of 1.2 / 50 μs, peak value: 5 kV, 0.5J across:

Each independent circuit and the case with the terminals of each independent circuit connected together.

Independent circuits with the terminals of each independent circuit connected together.

Terminals of the same circuit except normally open metallic contacts

**ELECTROMAGNETIC COMPATIBILITY (EMC)****DC Supply Interruption**

Per IEC60255-11:1979:

The product will withstand a 20ms interruption in the auxiliary voltage in its quiescent condition

**AC Ripple on DC Supply**

Per IEC60255-11:1979:

The product will operate with 12% AC ripple on the DC auxiliary supply without any additional measurement errors

**Disturbances on AC Supply**

Per IEC61000-4-11:1994:

The products satisfies the requirements of EN61000 - 4 - 11 for voltage dips and short interruptions.

**1 MHz Burst High Frequency Disturbance Test**

Per IEC 60255-22-1: 2008, Class III,

Common-mode test voltage: 2.5 kV,

Differential test voltage: 1.0 kV,

Test duration: 2 s, Source impedance: 200  $\Omega$

**Electrical Fast Transient or Burst Requirements**

Per IEC 60255-22-4: 2002

The product complies with all classes up to and including Class A 4kV without any mal-operations or additional measurement errors.

Fast transient disturbances on terminal block, communications (common mode only)	2kV, 5ns rise time, 50ns decay time, 5kHz repetition time, 15ms burst, repeated every 300ms for 1min in each polarity, with a 50 $\Omega$ source impedance.
Fast transient disturbances on power supply, I/O signal, data and control lines (common mode only)	4kV, 5ns rise time, 50ns decay time, 2.5kHz repetition time, 15ms burst, repeated every 300ms for 1min in each polarity, with a 50 $\Omega$ source impedance.

Per IEC 61000-4-4: 2004.

The product complies with all classes up to and including Level 4 4kV without any mal-operations or additional measurement errors:

Fast transient disturbances on power supply (common mode only)	2kV, 5ns rise time, 50ns decay time, 5kHz repetition time, 15ms burst, repeated every 300ms for 1min in each polarity, with a 50 $\Omega$ source impedance.
Fast transient disturbances on I/O signal, data and control lines (common mode only)	2kV, 5ns rise time, 50ns decay time, 5kHz repetition time, 15ms burst, repeated every 300ms for 1min in each polarity, with a 50 $\Omega$ source impedance.

**Immunity to Electrostatic Discharge**

Per IEC 60255-22-2: 1997 & IEC61000-4-2:2001

The product will withstand application of all discharge levels up to the following without Mal - operation:

15 kV discharge in air to user interface, display, and exposed metalwork.

8 kV discharge in air to all communication ports.

8 kV point contact discharge to any part of the front of the product.

**Conducted Emissions**

Per EN 55022: 1998:

0.15 – 0.5MHz, 79dB $\mu$ V (quasi peak) 66dB $\mu$ V (average)

0.5 – 30MHz, 73dB $\mu$ V (quasi peak) 60dB $\mu$ V ( average ).

**Radiated Emissions**

Per EN 55022: 1998:

30 - 230MHz, 40dB $\mu$ V/m at 10m measurement distance

230 – 1GHz, 47dB $\mu$ V/m at 10m measurement distance.

**Immunity to Radiated Electromagnetic Energy**

Per IEC 60255-22-3: 2000, Class III & IEC61000-4-3:2002

Test field strength, frequency band 80 to 1000 MHz:

10 V/m, test using AM: 1 kHz / 80%, at 80 to 1GHz,

30 V/m, test using AM: 1 kHz / 80%, at 80 to 900MHz and 1.4GHz to 2.0GHz

**Conducted Immunity**

Per IEC 60255-22-6: 2001

10 V/m, test using AM: 1 kHz / 80%, at 0.15 to 80MHz,

**Surge Immunity**

Per IEC 60255-22-5: 2002

Class IV: 4kV common mode 12 $\Omega$  source impedance, 2kV differential mode 2 $\Omega$  source impedance – power supply

Class IV: 4kV common mode 42 $\Omega$  source impedance, 2kV differential mode 42 $\Omega$  source impedance – Opto inputs, relays, CT, VT

Class IV - 4kV common mode 2 $\Omega$  source impedance applied to cable screen – terminal block communications

**Power Frequency Magnetic Field Immunity**

Per IEC 61000-4-8:2001, class V: 100A/m quiescent condition, 1000A/m short duration (1-3s)

**Pulse Magnetic Field Immunity**

Per IEC 61000-4-9:2001, class V: 1000A/m pulse (5 positive, 5 negative)

**Damped Oscillatory Magnetic Field**

Per IEC 61000-4-10:2001, class V: 100A/m @100kHz / 1MHz 2 second burst duration

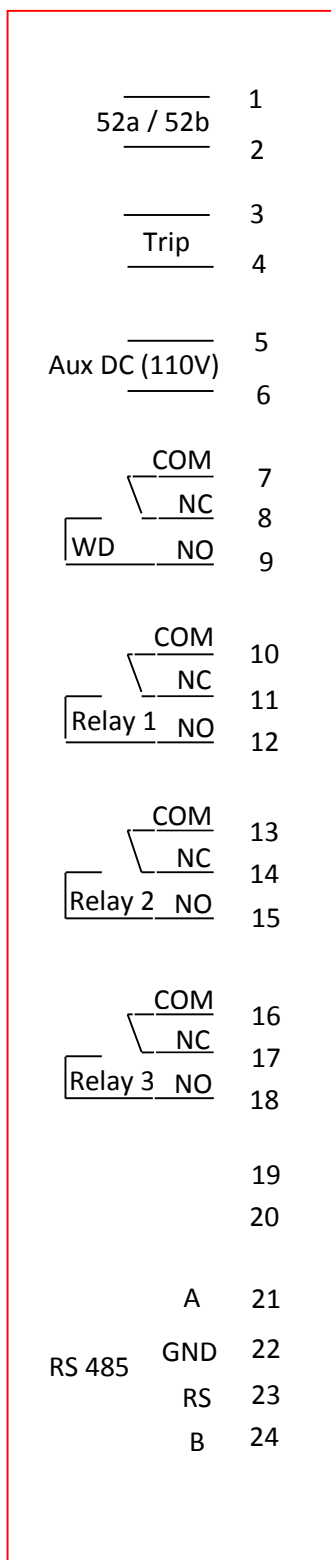
**Oscillatory Waves Immunity**

Per IEC 61000-4-12:2001:

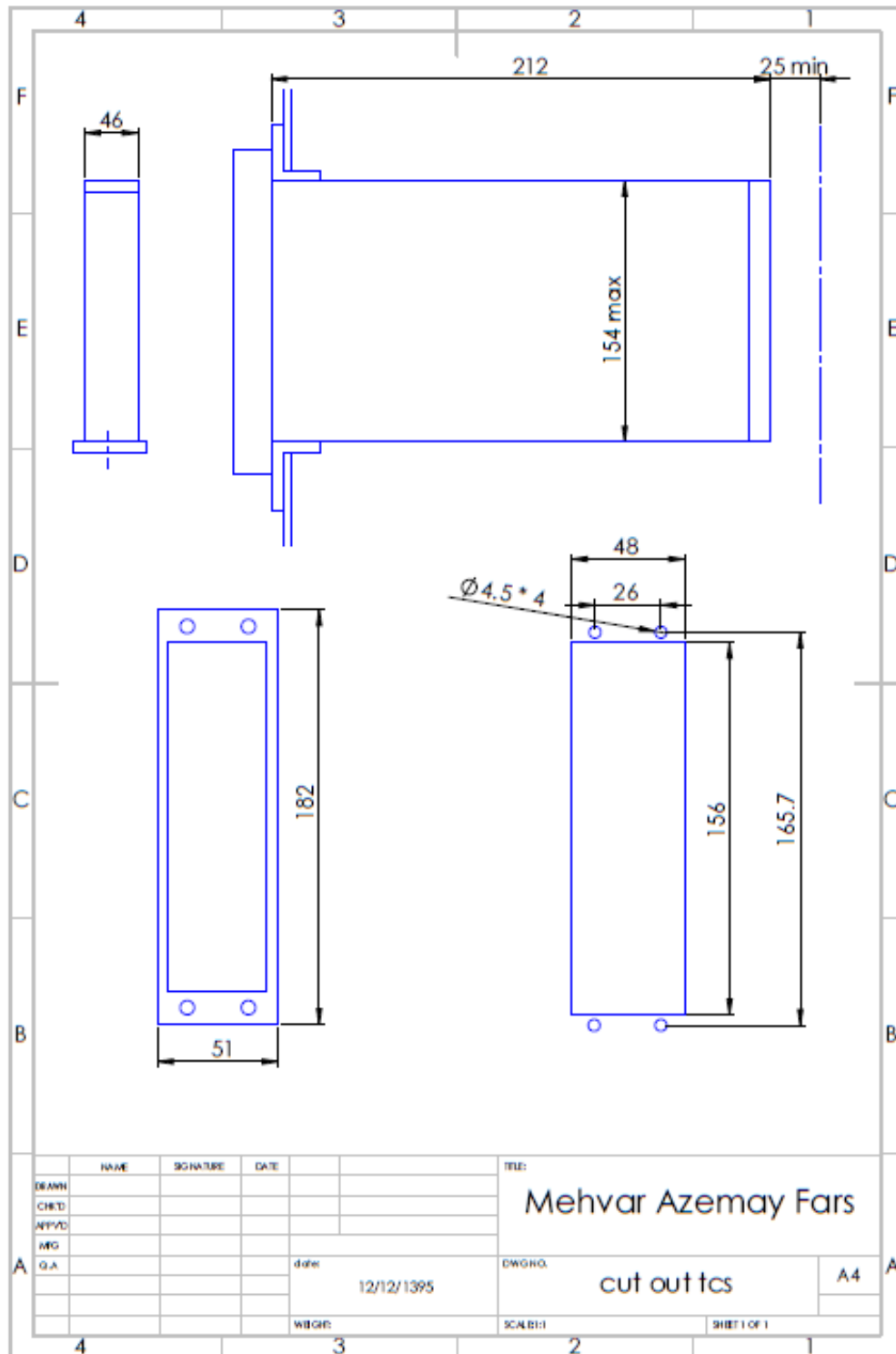
2.5kV peak between independent circuits and case earth

1.0kV peak across terminals of the same circuit

## T-8: Terminals & connection guide (Single phase)



### T-9: Dimensions & panel cut out

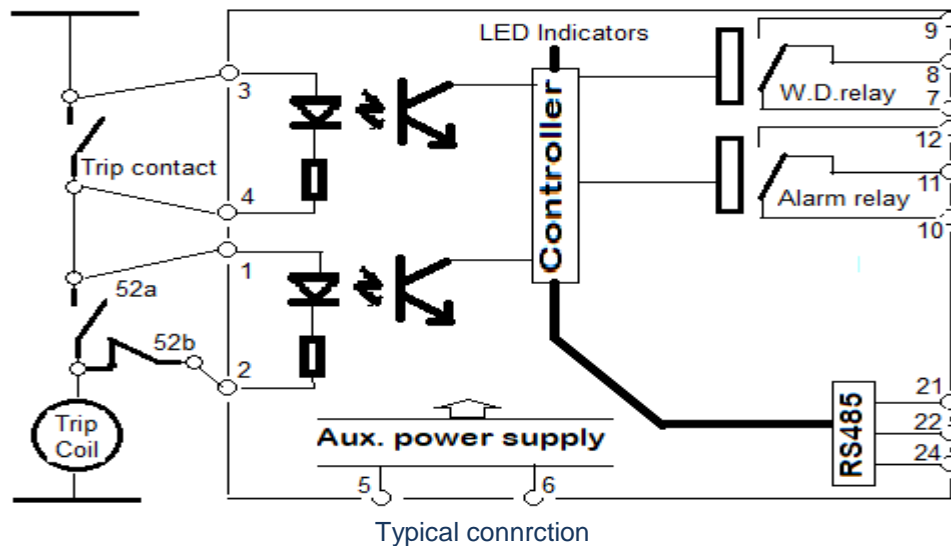




## A: Application & operation principles

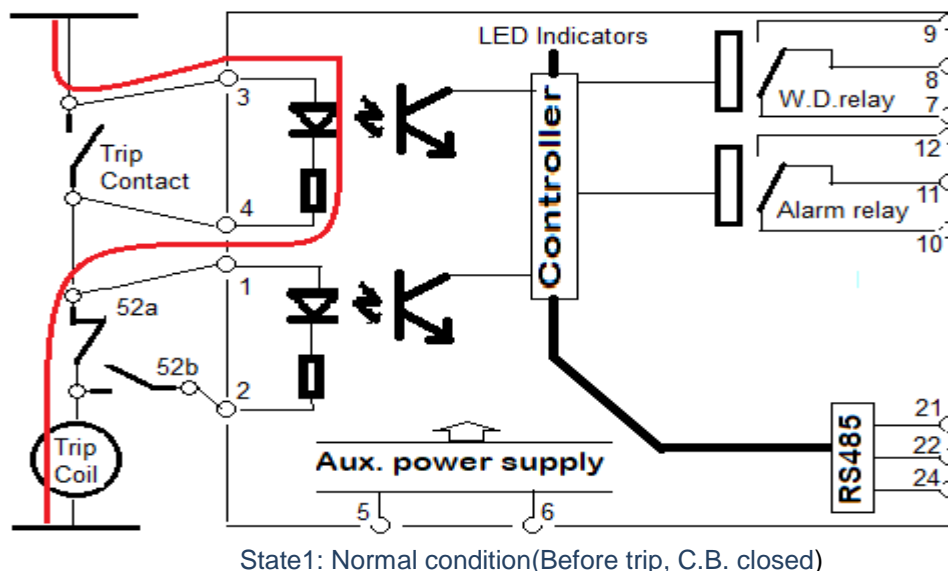
The MRL TC100 relay is used to monitor and report the situation of circuit breaker trip circuit and also the operation of circuit breaker.

This is done by using two inputs of relay, one connected in parallel with trip contact ( pins 3 , 4 ), and the other , connected in parallel with breaker aux. contacts 52a & 52b, as shown in the following figure.

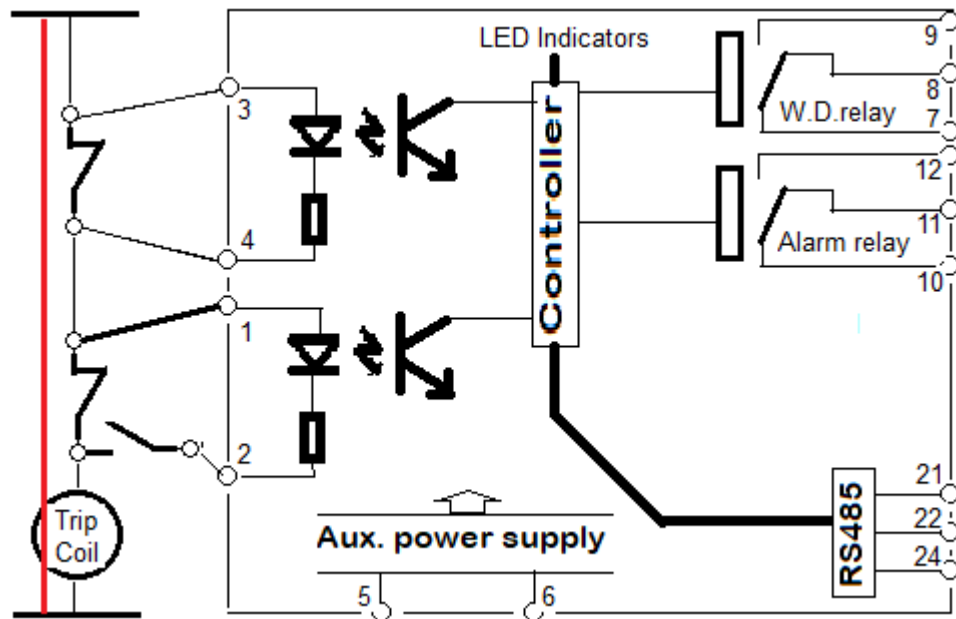


Depending on the situations of input contacts, there are the condition states of trip circuit and C.B. :

**State1:** in this state, trip contact is not operated and circuit breaker is closed, trip circuit connections are OK and a small current will flow through input of terminal 3 , 4 (input trip = 1 , input 52a = 0) (No fault, trip circuit OK).



**State2:** This state declares that trip contact of protection relay is operated, but C.B. has not operated to open yet, and should operate during a defined time. This state should not prolong for a long time, otherwise shows a problem in C.B. operation or trip circuit( such as disconnection ).



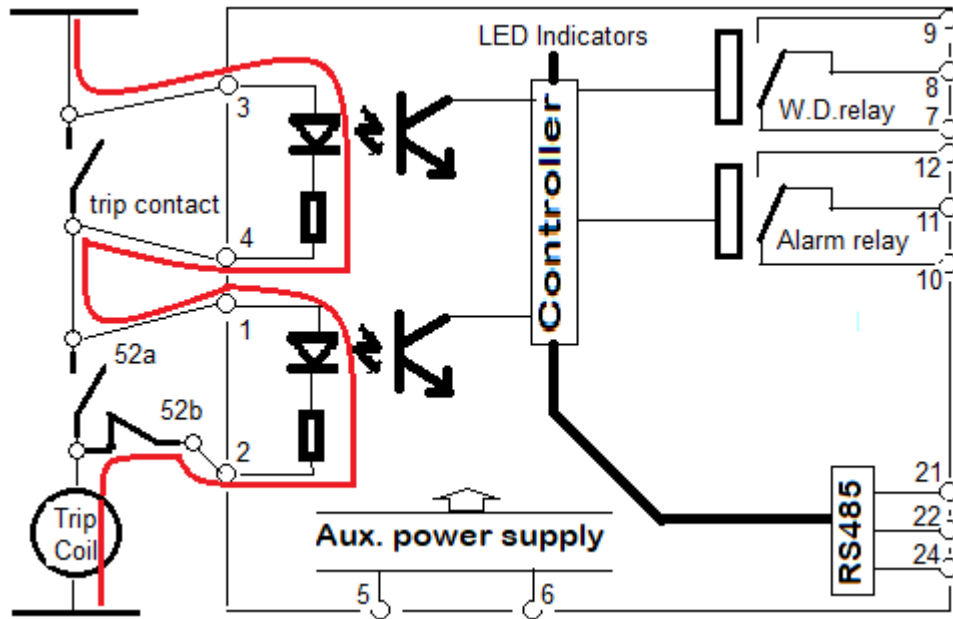
State 2,3,4: Trip condition, before operation of C.B. or trip circuit disconnection or DC power loss

If this state is continued for time longer than defined time **d2** ( Max. allowed time for breaker to operate to open ), this means a problem in C.B. operation, or a disconnection in C.B. trip coil circuit, or loss of breaker DC supply. So this state for times longer than **d2**, means fault.

**State4,5,7,8:** In this case, circuit breaker and trip contact of protection relay are open. This may be caused by the following reasons:

- Circuit breaker is operated in time, because of trip signal(state7).
- C.B. operated at time  $> d1$  &  $< d2$ , not critical fault (state5).
- C.B. operation timeout, operate time  $> d2$ , critical fault (state4)
- C.B. is opened manually( state8)

A small current is flowing through both inputs of relay in this case. The situation of contacts and inputs of relay are shown in the following figure.



States 4,5,7,8: After operation of circuit breaker to open

### A-1: Breaker DC voltage check

The DC supply of the trip coil is also supervised, to ensure you that the breker is connected to a supply with a suitable value. If it is not in the suitable range, it is detected as the trip circuit fail. This option can be disabled or enabled by user.

For this purpose, the TCS relay should be supplied from a similar source as breaker.

If the supply voltage is out of bellow defined range, the TCS relay will give the "DC supply low" or "DC supply high" alarm.

DC supply low:      Going to alarm state:  $69 \pm 1$  V  
                               Return back to safe state:  $75 \pm 1$  V

DC supply high:      Going to alarm state:  $147 \pm 1$  V  
                               Return back to safe state:  $141 \pm 1$  V

## D: description

### D-1: Defined messages in relay (pc log text)

- Back to Normal State
- trip Signal or trip circuit fail
- CB close at timeout1 due to TC/CB fail
- TC Fail or CB not Operate in time; CB close at timeout2
- TC Fail or CB not Operate in time; CB open after timeout2,
- TC is ok CB open by trip after timeout1
- Reset by Key
- CB Operate in Time after trip signal
- CB open Without Trip
- TC/CB fail is acknowledged; CB close
- TC/CB fail is acknowledged; CB open

### Defined messages (display text in "show record")

- Back to  
Normal  
State
- trip  
signal or  
TC fail
- CB close  
or TC fail  
timeout1
-

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TC/CB fail  
CB close  
timeout2

- TC/CB fail  
CB open  
timeout2

- TC OK  
CB open  
timeout1

- TC/CB OK  
CB Open

- CB open  
without  
trip

- TC/CB fail  
CB close  
timeout2-A

- CB fail  
CB open  
timeout2-A

- DC voltage  
is LOW

- DC voltage  
is HIGH

- DC Voltage  
return to  
range

## Defined messages (display text in "supervision mode")

- CB close  
or TC fail  
timeout1  
VDC LOW / VDC HIGH
  
- TC/CB fail  
CB close  
timeout2  
VDC LOW / VDC HIGH
  
- TC/CB fail  
CB open  
timeout2  
VDC LOW / VDC HIGH
  
- TC OK  
CB open  
timeout1  
VDC LOW / VDC HIGH
  
- TC/CB OK  
CB Open  
VDC LOW / VDC HIGH
  
- CB open  
without  
trip  
VDC LOW / VDC HIGH
  
- TC/CB fail  
CB close  
timeout2-A  
VDC LOW / VDC HIGH
  
- CB fail  
CB open  
VDC LOW / VDC HIGH

## D-2: Sample of event recording

No	Event Message	Date	Time	ms
001	, trip Signal or trip circuit fail	,97/05/02,	10:45:06,	121
002	, CB close at timeout1 due to TC/CB fail	,97/05/02,	10:45:06,	222
003	, TC Fail or CB not Operate in time ; CB close at timeout2	,97/05/02,	10:45:08,	360
004	, TC/CB fail is acknowledged ; CB open	,97/05/02,	10:45:22,	868
005	, Back To Normal State	,97/05/02,	10:45:23,	005