Fault

g
fault5
10ms|1|0

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1   Available versions

This device can be 1-phase or 3-phase.

1.1 When changing phases
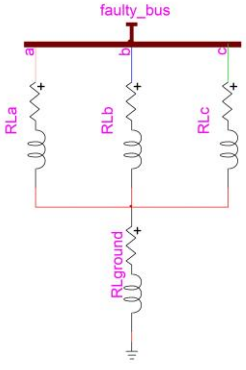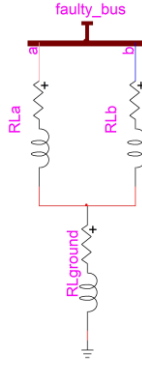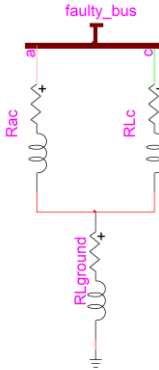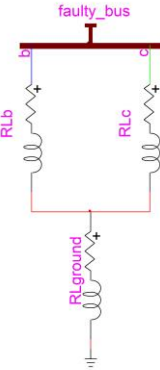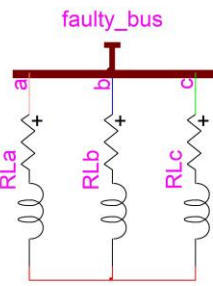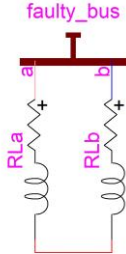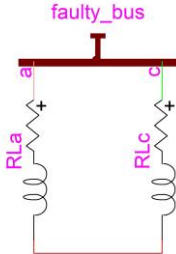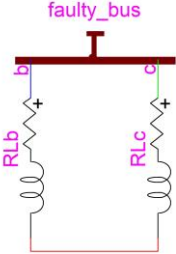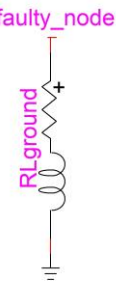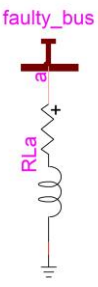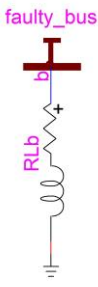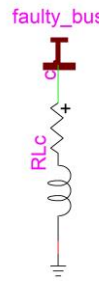
It is allowed to switch from 1-phase to 3-phase or from 3-phase to 1-phase. The user must verify data and scope requests according to requirements after changing the number of phases.

2   Description

This device allows to model a fault.
1. For its single phase version, it is equivalent to an ideal switch in series with a resistance to ground.
2. For the 3-phase version, this device is equivalent to a 3-phase ideal switch that creates fault conditions according to selected configurations. The possible configuration are listed in the table below.

Table 1: types of faults

3-phase-to-ground	Phase A-to-Phase B-to-ground	Phase A-to-Phase C-to-ground	Phase B-to-Phase C-to-ground
3-phase ungrounded	Phase A-to-Phase B	Phase A-to-Phase C	Phase B-to-Phase C
Single-phase	Phase A-to-ground	Phase B-to-ground	Phase C-to-ground

This device has random data capability. It is also possible to simulate fault arc current interruption and reignition.

3 Parameters and rules

3.1 Data tab

❑ **Type of fault**
- o For the 3-phase version only.
- o Select one of the fault types listed in Table 1 using the available chekboxes.

❑ **Fault Impedance**
- o Fault resistance and inductance values.
- o Ra, Rb, and Rc are used to specify the resistance values in each phase for the 3-phase version.

- o Rground is the fault resistance to ground (1-phase and 3-phase versions). When this option is not selected (checkbox "Fault to ground") in the 3-hase case, then Rground is given an infinite value.
- o La, Lb, and Lc are used to specify the inductance values in each phase for the 3-phase version.
- o Lground is the fault inductance to ground (1-phase and 3-phase versions). When this option is not selected (checkbox "Fault to ground") in the 3-hase case, then Lground value is zero.
- ❑ t_{close} — Time when the fault is applied. For the 3-phase version, the fault can be applied at different times on each phase. Any negative value means that the fault is applied in steady-state.
- ❑ t_{clear} — is the fault clearing time. For the 3-phase version, the fault can be cleared at different times on each phase. The fault will be cleared when $t \geq t_{clear}$ and its current falls below I_{margin} or when its current crosses zero when $I_{margin} = 0$. When $t_{close} \geq t_{clear}$ the fault will not be applied.
- ❑ I_{margin} — is the absolute current margin.
- ❑ **balanced** — when this option is checked, the fault switches on phases b and c are made equal (same timings) to phase a.
- ❑ **Simulate reignition**
  - o This option allows to simulate fault arc current interruption and reignition (see Figure 1). The fault current is interrupted when its absolute magnitude falls below I_{margin}. It is then reignited when the fault instantaneous voltage is larger than the Arc reignition voltage.
- ❑ **Arc voltage reignition**
  - o Fault instantaneous absolute voltage value above which arc reignition occurs.
  - o For a phase-to-ground fault, there is fault reignition when the phase-to-ground voltage exceeds this limit.
  - o For a phase-to-phase fault, there is fault reignition between phases if the phase-to-phase voltage reaches the sum of the two arc reignition voltages.
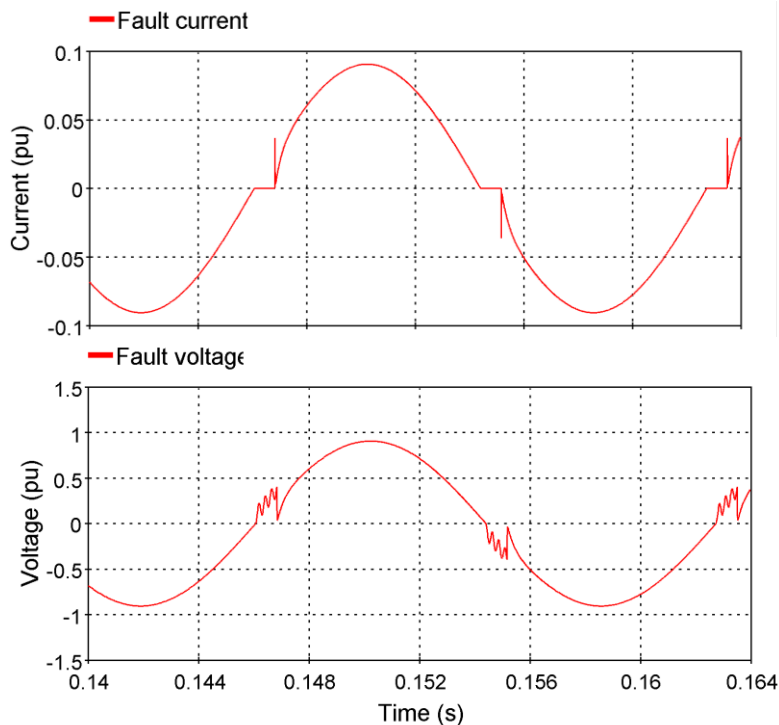

Figure 1: Arc reignition current and voltage. The voltage reignition is 0.4pu.

3.2 *Random tab*

This tab allows to enter data for statistical analysis. This option is similar to the Ideal switch model and the user can consult the Ideal switch model documentation.

If it is desired to refer (Reference switch name) to the fault switch, from another switch for the Dependency option, then the following rules are applicable.

For the 1-phase version, the reference should be given as:

FaultX/FAULT_SWITCH

where FaultX is an arbitrary fault device name and FAULT_SWITCH is the fixed internal fault switch name.

For the 3-phase version, the reference should be given as:

FaultX/Fault_Switcha or FaultX/Fault_Switchb or FaultX/Fault_Switchc

where FaultX is an arbitrary fault device name and Fault_Switcha is the fixed internal fault switch name with appropriate phase character.

3.3 *Scopes tab*

This section allows to select scopes for fault switches. The user can consult the documentation of the Ideal switch model.

It is noticed that the selection of voltage scope does not provide the voltage of fault switch, but the voltage at the bus or node being faulted.

3.4 *Observe tab*

Allows to specify observable variables that become available in a bundle. The voltage observable is the voltage at the bus or node being faulted

4 Rules

It is not allowed to delete or add pins.

If all resistances are set to zero, the fault is an ideal device. Placing several ideal devices in parallel is acceptable if they are not closed at the same time. When paralleled ideal devices are closed at the same time, mathematically impossible conditions will result and EMTP will try to solve such cases by inserting dummy resistances.

When switching between 1-phase and 3-phase versions:
1. EMTP will maintain appropriate data.
2. If there is a bundle pin and bundle used for accessing observables, EMTP will disconnect from the bundle and the user must reconnect manually.

5 Steady-state model and initial conditions

If the fault is applied in the steady-state solution ($t_{apply} < 0$), it is modeled as specified in Table 1. It is an open-circuit otherwise.

6 Frequency Scan model

Similar to the steady-state.

7 Time-domain model

The fault is modeled as specified in Table 1.