Trapped Charge Example for Cable Energization

Written for PSCAD v4.5 and V4.6.

This example shows how to perform a simple trapped charge study during high voltage cable energization (Figure 1).

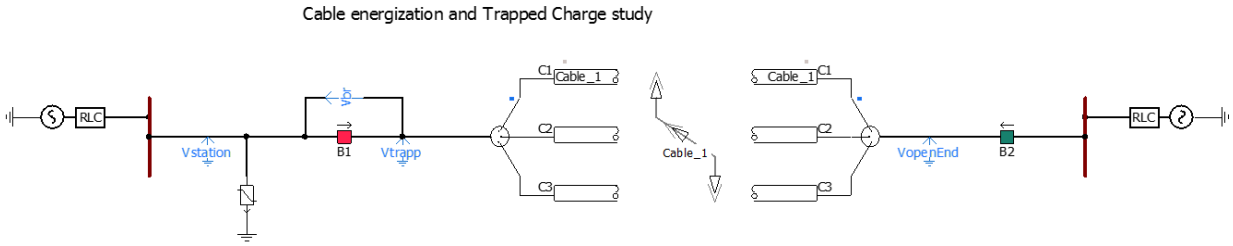

Figure 1: Overall power system for trapped charge study during cable energization

Figure 2 shows the Timed Breaker Logic. The breaker B1 is close initially to energize the cable and then opens at 0.2s to intrupt the current. It reenergized the cable at a time equal to "Bt".

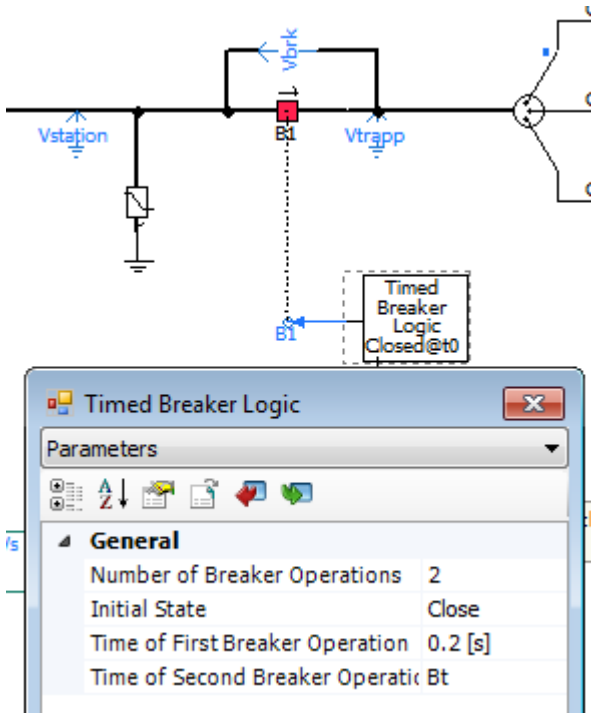

Figure 2: Breaker B1 and the measured signals

The multiple run feature of PSCAD is used to change the closing time (Bt) in this study to see the worst case senario.

In this way, PSCAD will run a number of simulations (97 in this example), with a slightly different closing time (Bt) for the breaker at each run (Figure 3). The trapped voltage (Vtrapp), the breaker voltage (Vbrk) and the voltage at the station (Vstation), and the surge arrester energy (Energy) are measured during a simulation run and saved in a file named "Results.out".

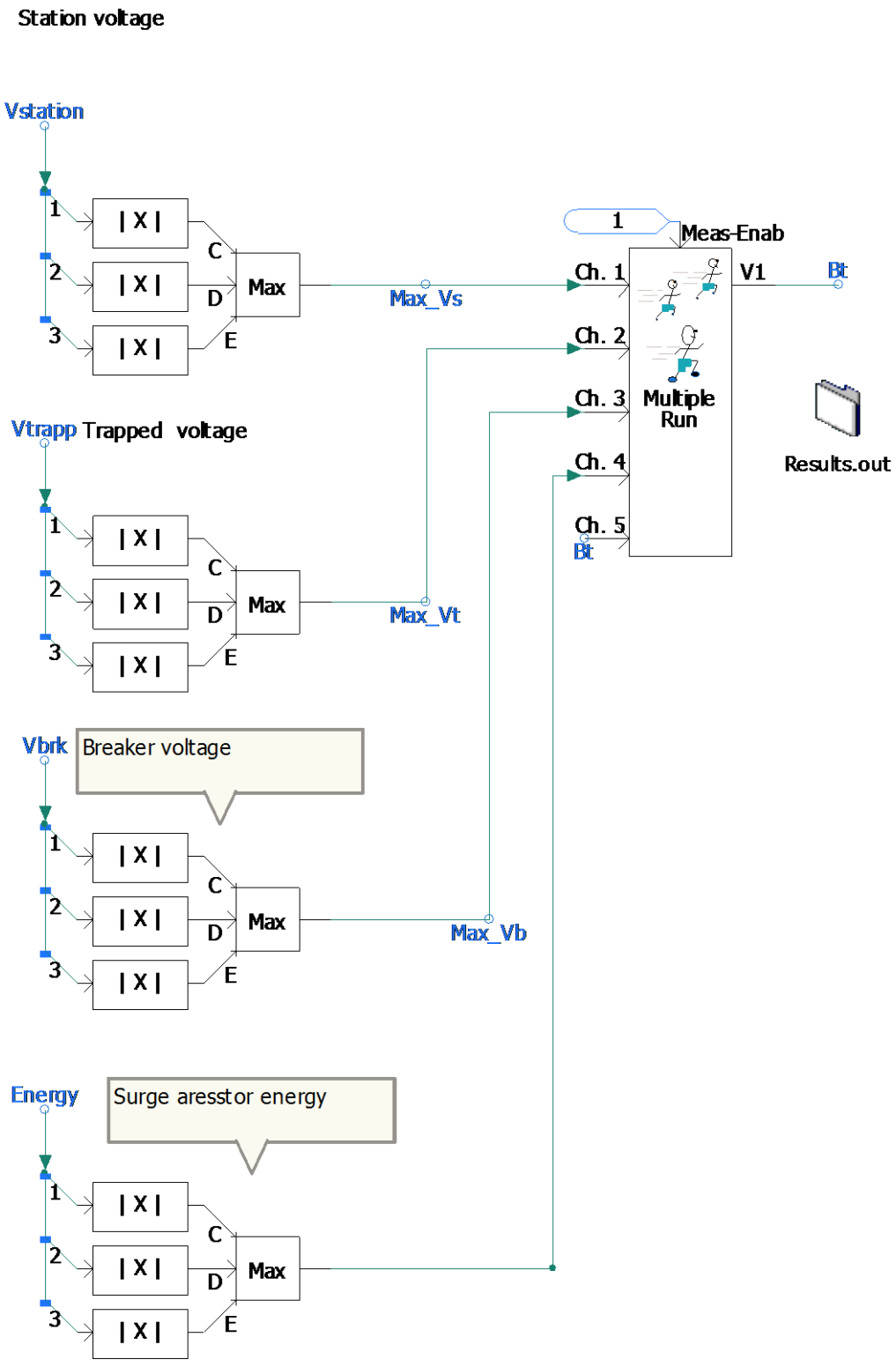

Figure 3: The Trapped voltage, the breaker voltage, the station voltage, and the energy of the surge arrester are measured during a simulation run and saved in a file named "Results.out"

The criteria to select the optimum run is based on the maximum value of the surge aresstor energy (fourth input chanel shown in Figure 4). There can be othere criteria for the optimum run depending on what is the purpose of the study.

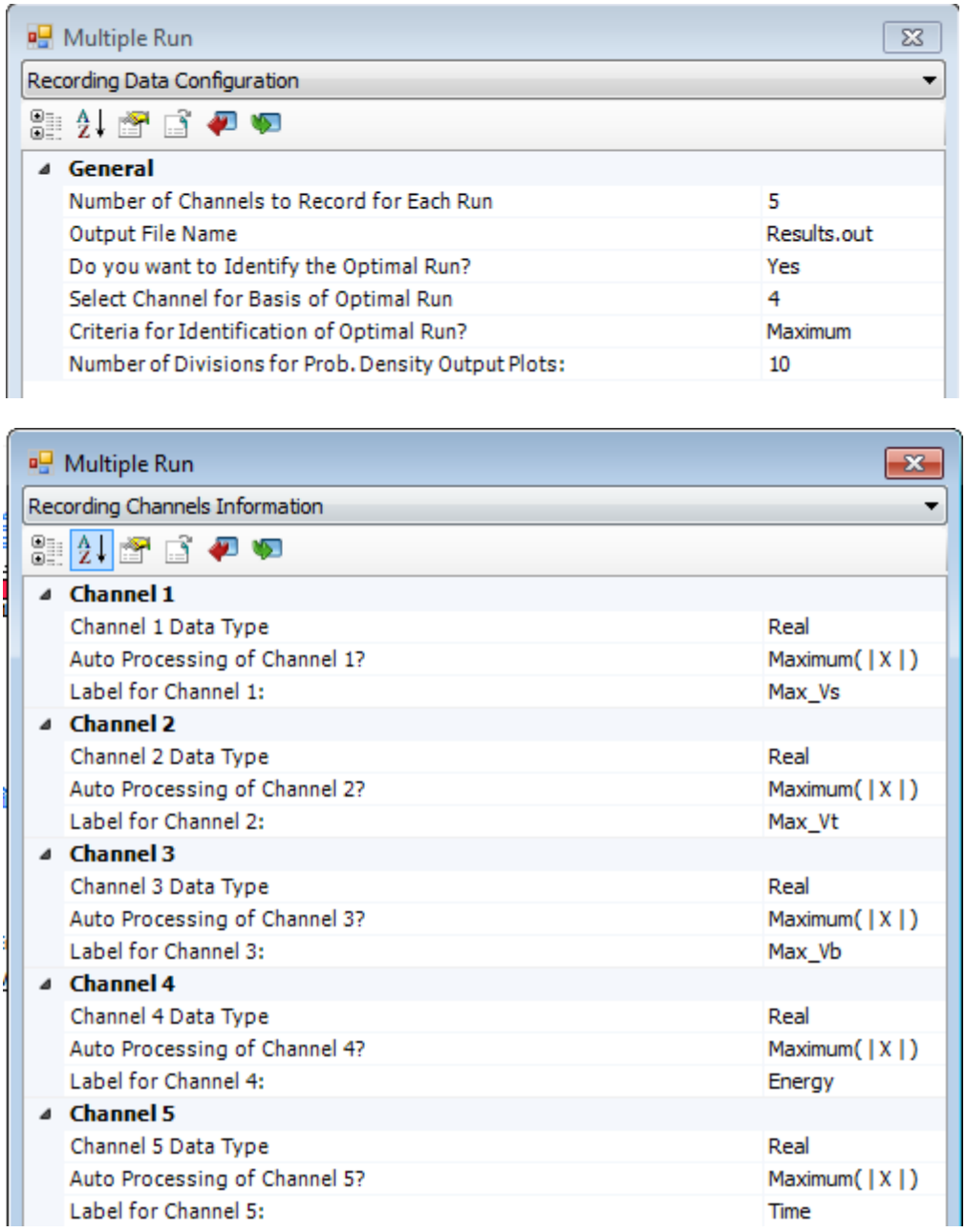

Figure 4: The multiple run settings for the recording chanels; results are available at the file named "Results.out"

Once the simulation is completed, the results are available in the Results.out file.

In the output file, we can find that the maximum energy and voltage occur at Run# 97 and Bt = 0.2164s (Figure 5).

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The optimum occurred for run #     78 and has been repeated for the last run below:
  Run #            Var # 1          Max_Vs          Max_Vt          Max_Vb          Energy            Time
    97       0.2164000000     397.0885368     397.1265571     398.9488877     745.2044930     0.2164000000
```

Figure 5: Simulation results are available at the output file named "Results.out"

The snapshot feature can be used to save simulation time. Once the simulation reaches a steady-state condition before switching actions, a snapshot can get from the simulation to start the simulation from that point rather than from the beginning. In this way, simulation time can be saved, and results can be obtained in a shorter simulation time.

The steps for snapshot are:

1. Disable the Multiple-run Component (Figure 6).

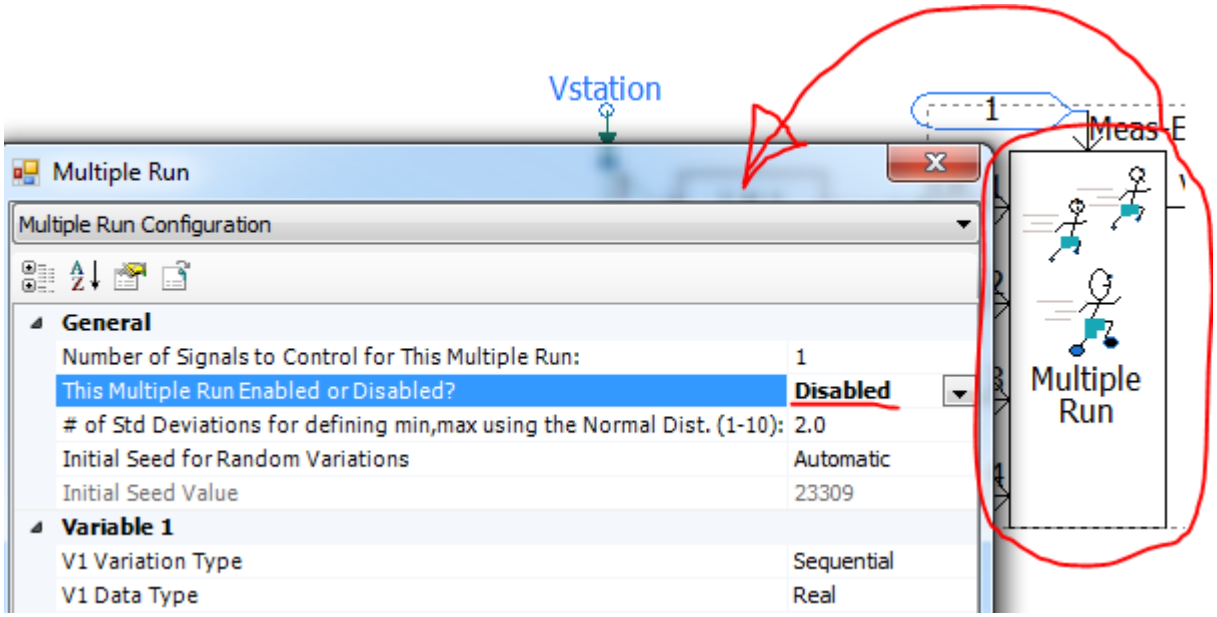

Figure 6: Disabling the Multiple-run Component

2. Set a snapshot at 0.18 sec (Project Settings of the case) (Figure 7).

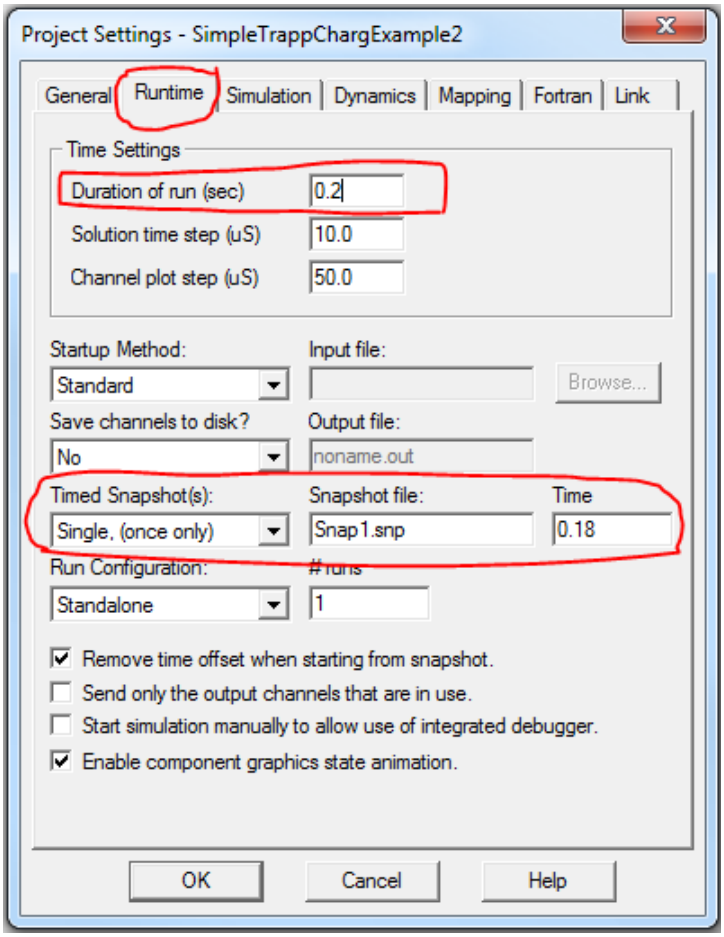

Figure 7: Setting snapshot

3. Run the case to make the snapshot file named "Snap1.snp".

4. Enable the Multiple-run Component (Figure 8).

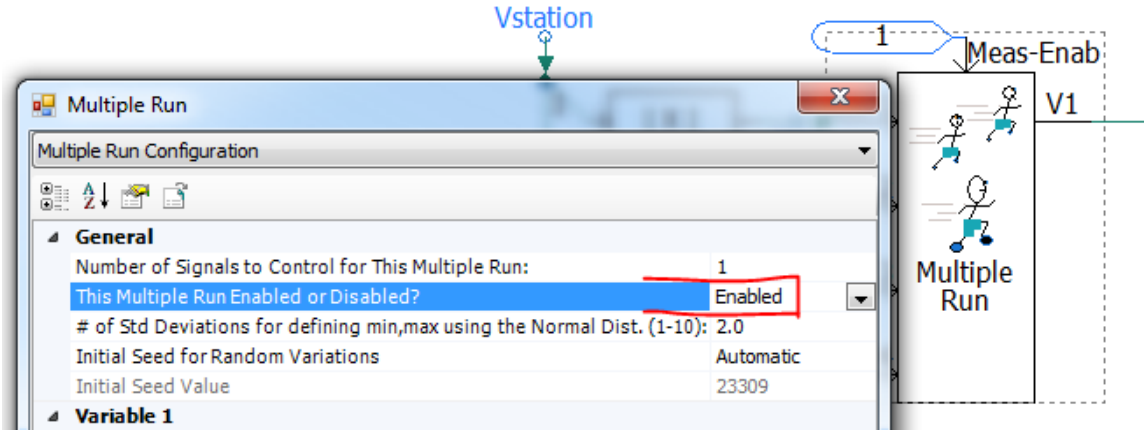

Figure 8: Enabling the Multi-run Component

5. Set the case startup from the snapshot, and change the simulation time to 0.4 sec (in the Project Settings of the case) (Figure 9).

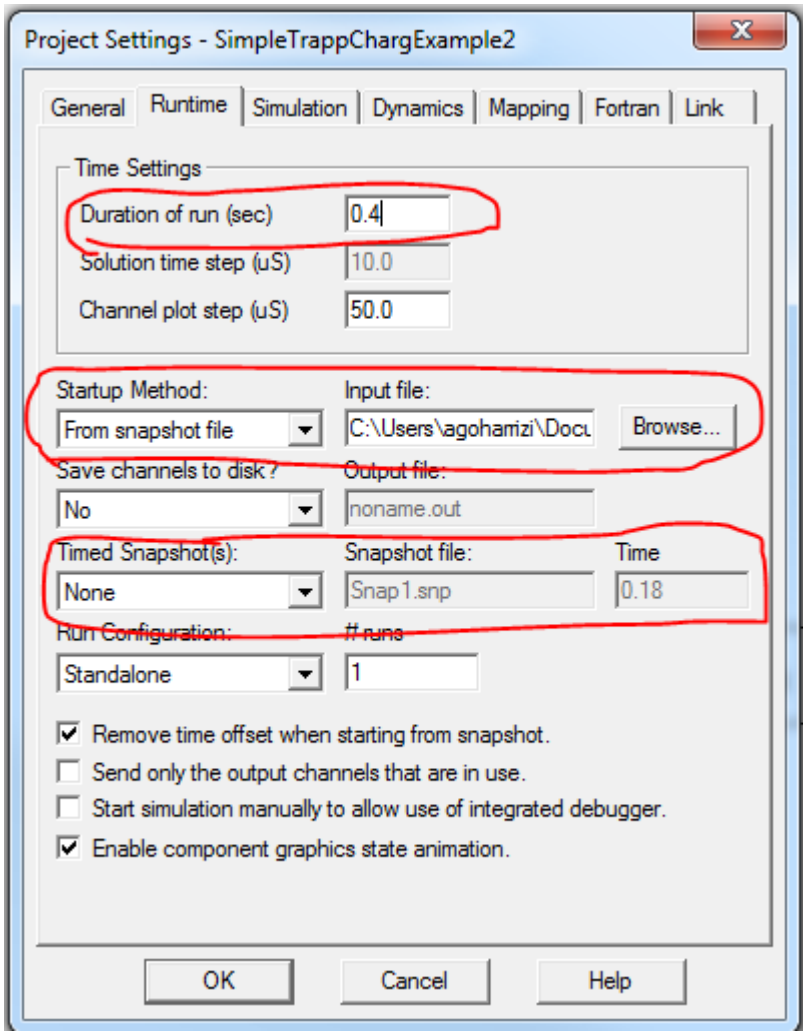

Figure 9: Setting the simulation start-up from the snapshot