Core partner

LPQI-VES is co-financed by

Education and Culture

Leonardo da Vinci

LPQI is part of

Leonardo ENERGY

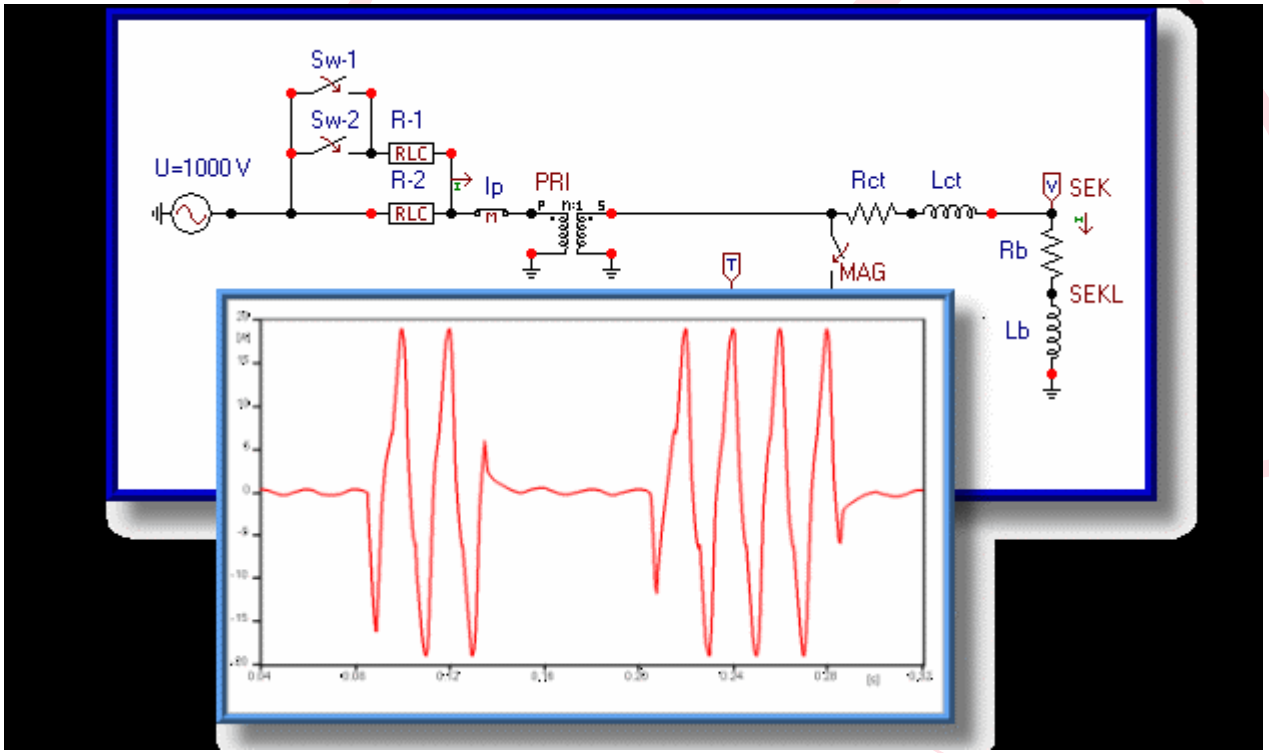
KOMPUTEROWE METODY OBLICZANIA PRZEPIĘĆ I STANÓW NIEUSTALONYCH

Jarosław Wiater
Wydział Elektryczny
Politechnika Białostocka
jaroslawwiater@vela.bp.bialystok.pl

Szkolenie LPQIVES
Białystok
2-3 grudnia 2005

LEONARDO POWER QUALITY INITIATIVE

Alternative Transients Program



http://www.emtp.org

EMTP

- ***Symetryczne i niesymetryczne zakłócenia w układach elektrycznych (przepięcia łączeniowe, atmosferyczne, zwarcia, stany nieustalone)***

- ***Modelowanie rozbudowanego systemu elektroenergetycznego***

- ***...***

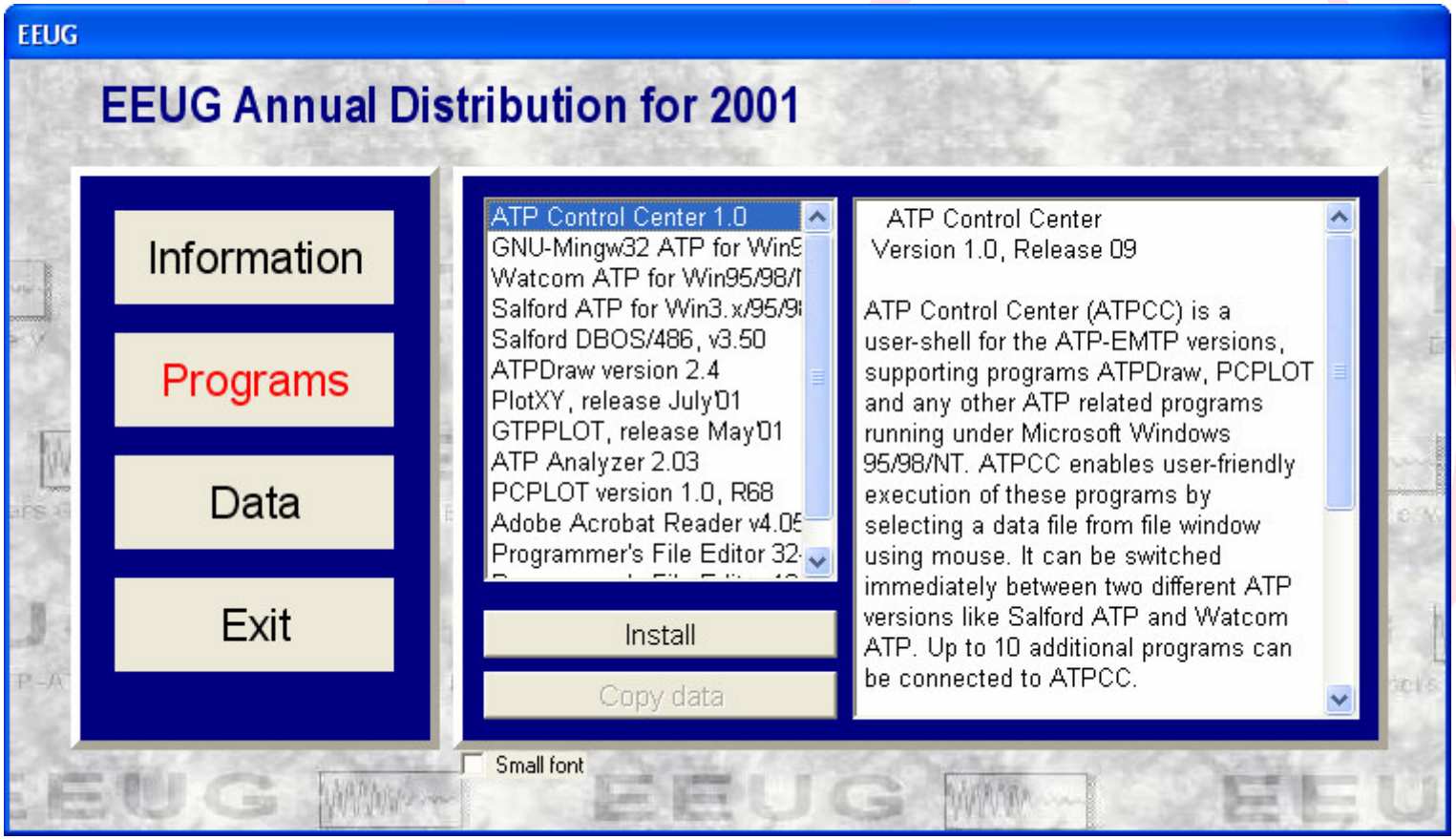
- ***Tworzenie własnych modeli***

POLSKIE CENTRUM PROMOCJI MIEDZI S.A.

EMTP

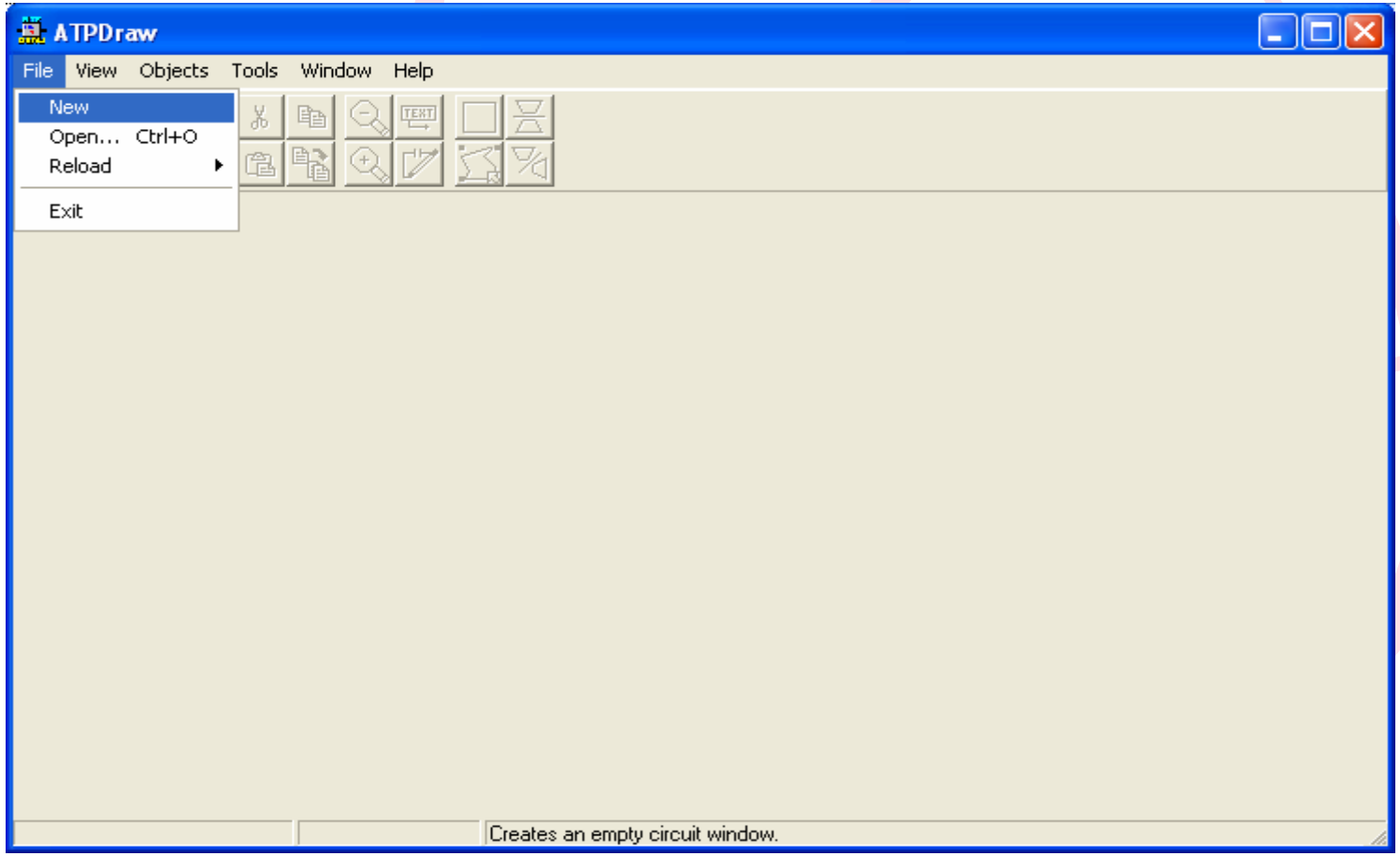
- ATPDraw Graphical Preprocessor to ATP
- ATP Control Center
- PlotXY Plotting program
- Watcom ATP for Windows


EMTP

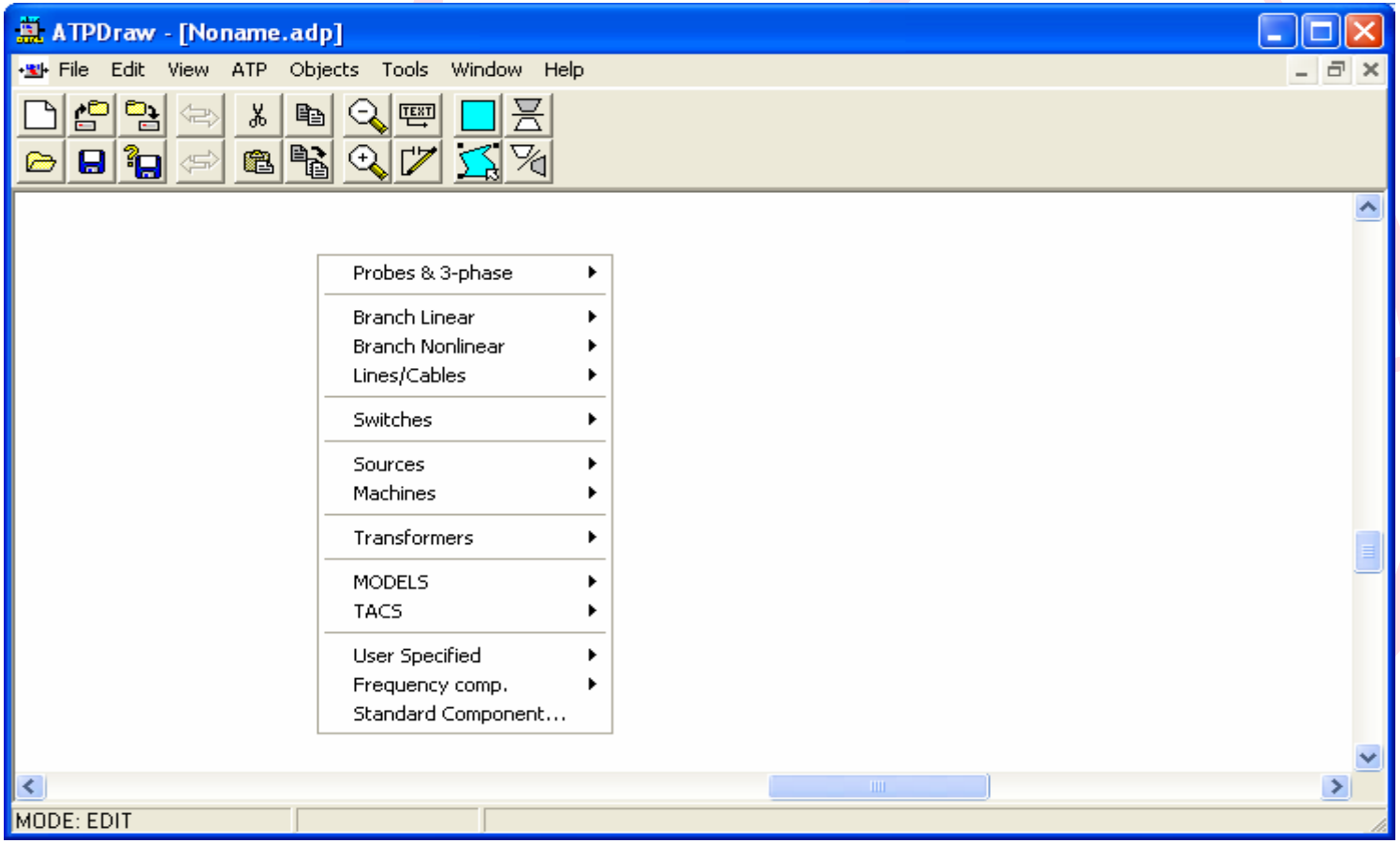


POLSKIE CENTRUM PROMOCJI MIEDZI S.A.

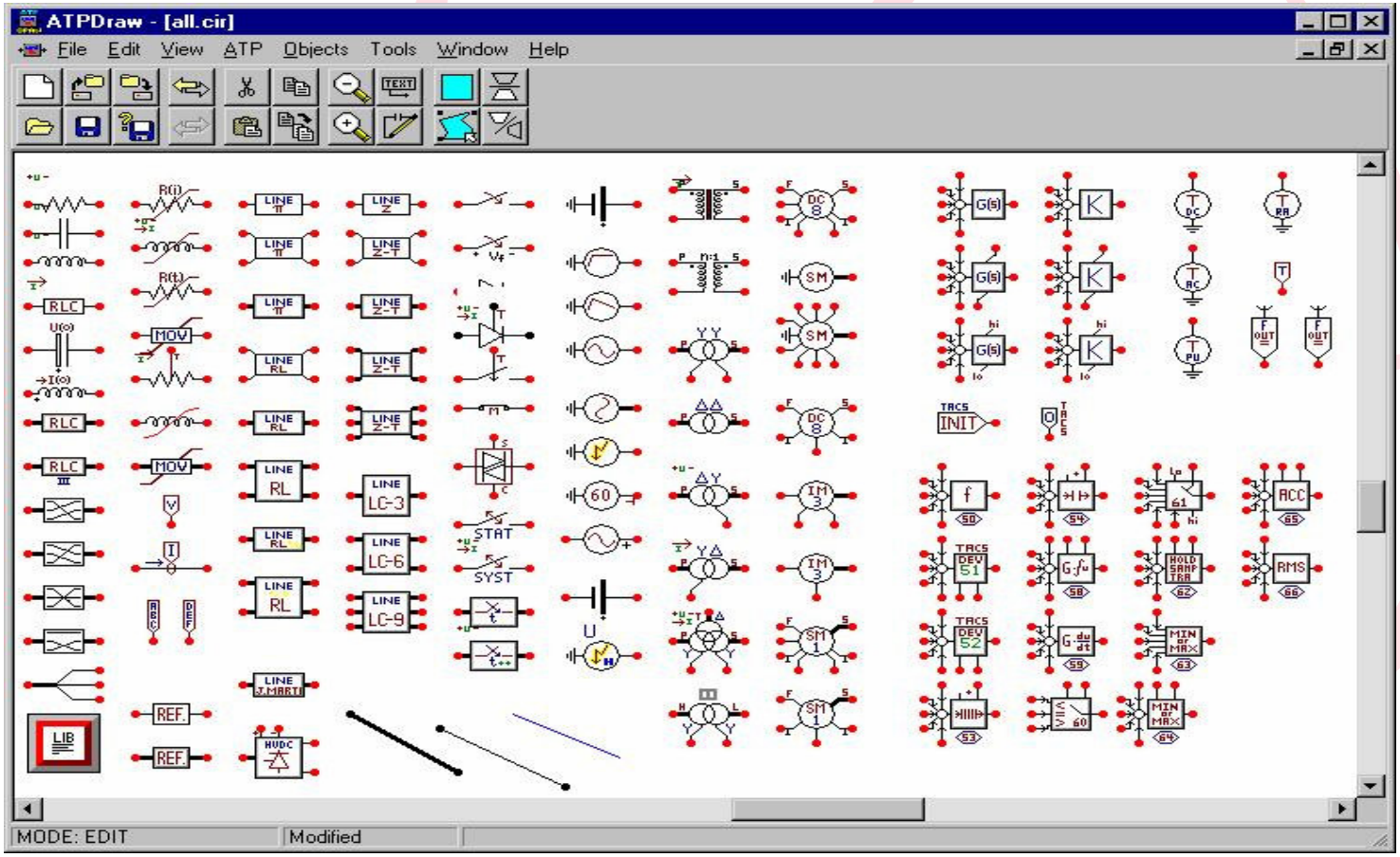
ATP Draw


ATPDraw
File
View
Objects
Tools
Window
Help
New
Open... Ctrl+O
Reload
Exit
Creates an empty circuit window.

ATP Draw

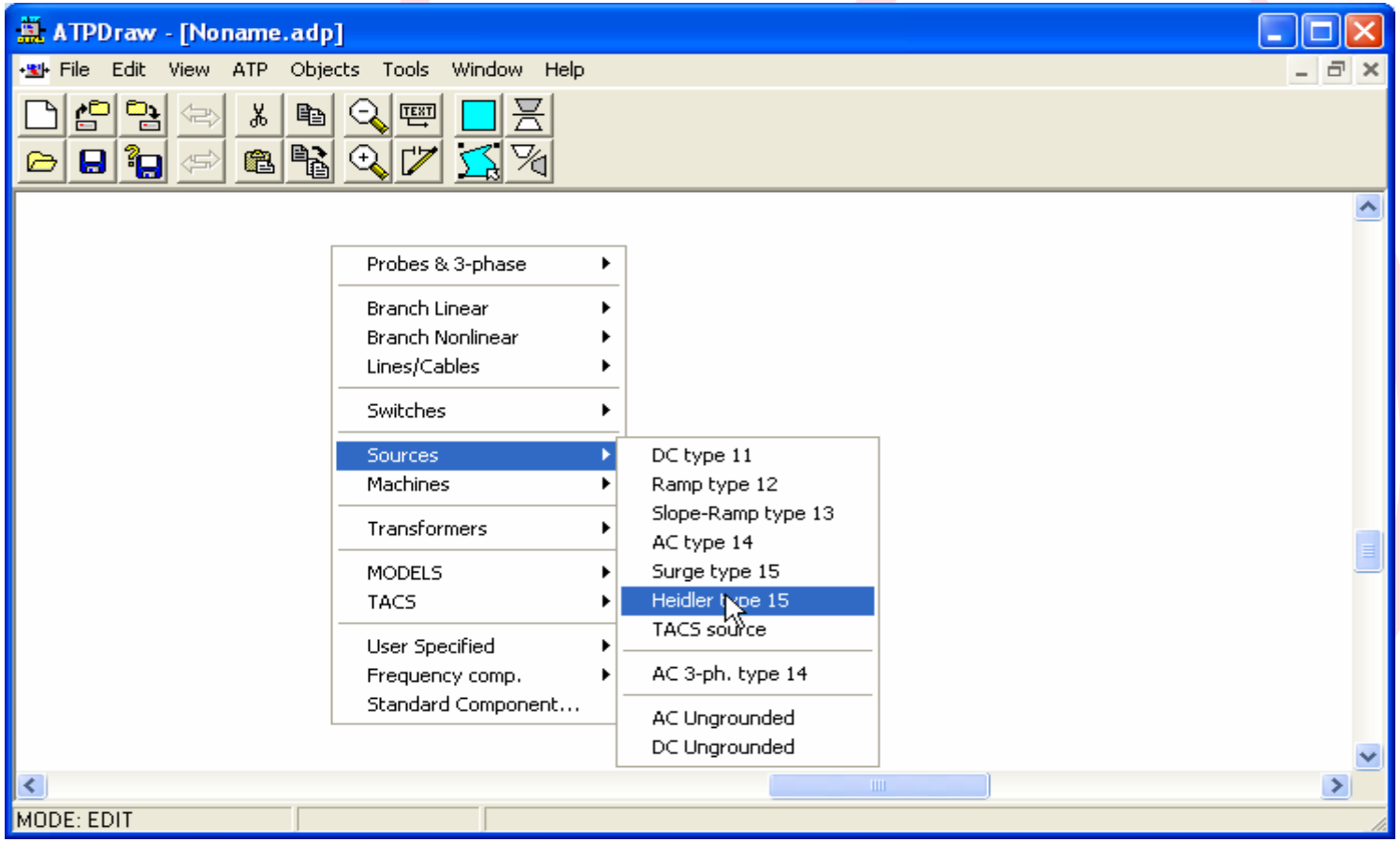

ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
Probes & 3-phase
Branch Linear
Branch Nonlinear
Lines/Cables
Switches
Sources
Machines
Transformers
MODELS
TACS
User Specified
Frequency comp.
Standard Component...
MODE: EDIT

ATP Draw

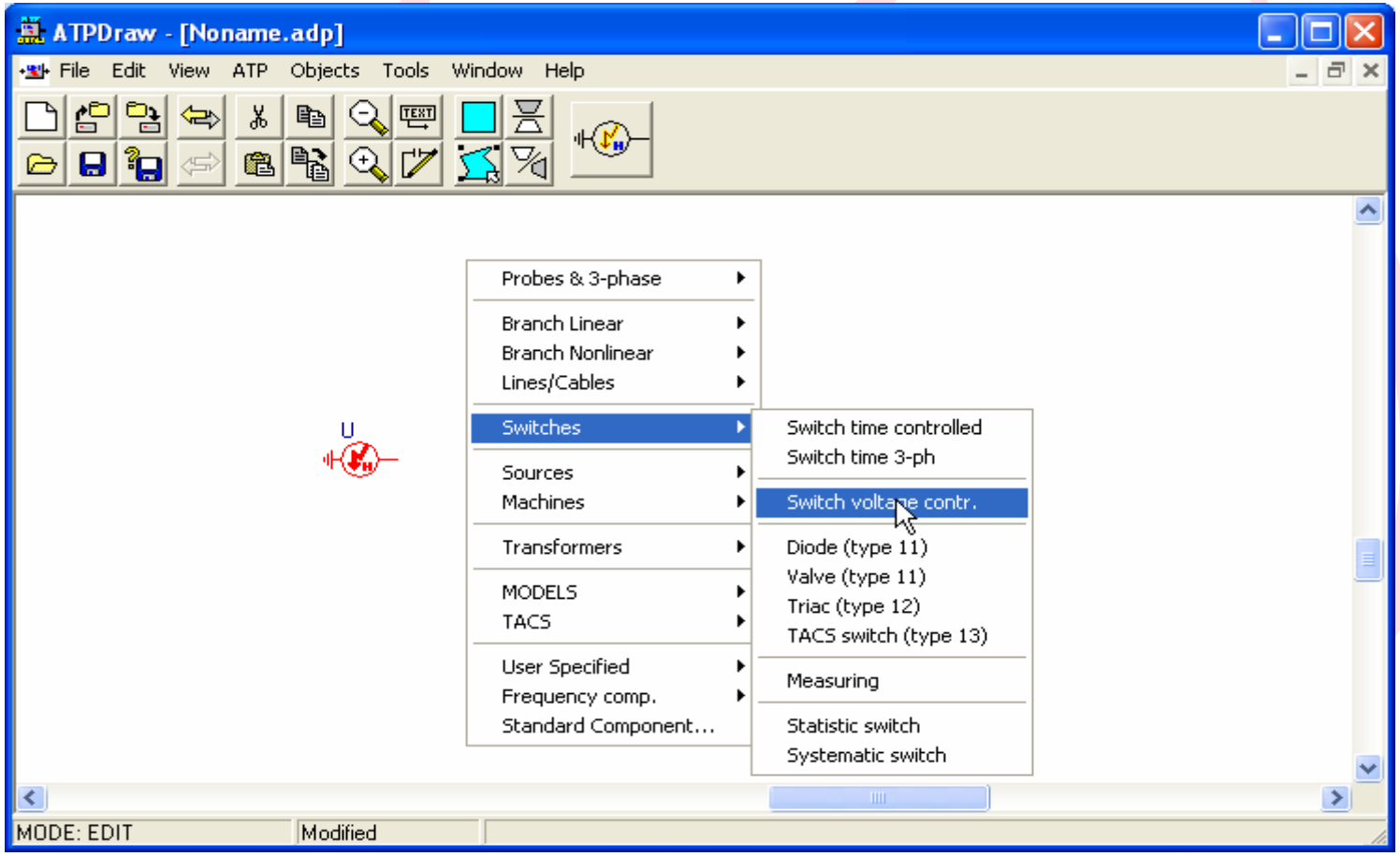


POLSKIE CENTRUM PROMOCJI MIEDZI S.A.

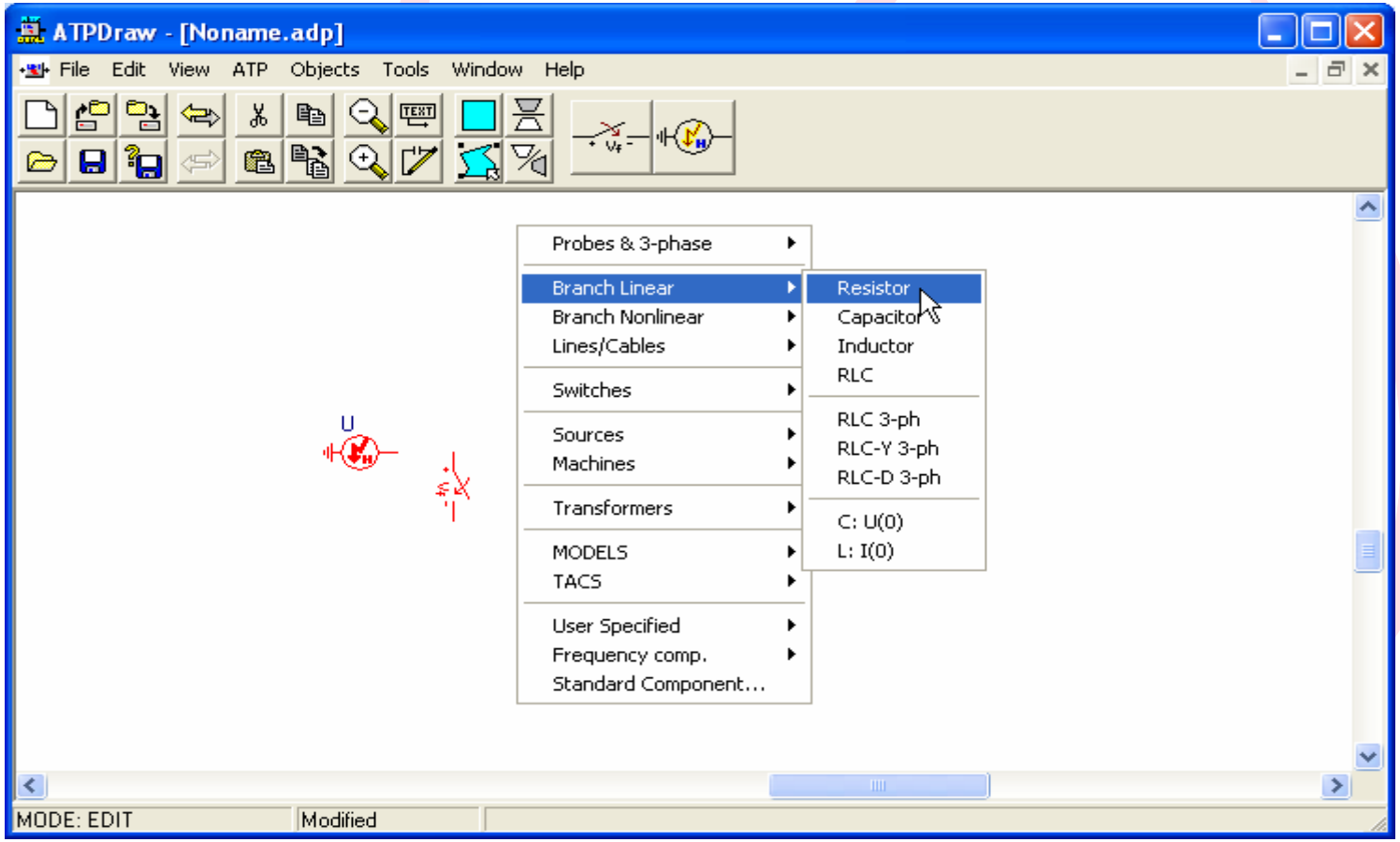
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
Probes & 3-phase
Branch Linear
Branch Nonlinear
Lines/Cables
Switches
Sources
Machines
Transformers
MODELS
TACS
User Specified
Frequency comp.
Standard Component...
DC type 11
Ramp type 12
Slope-Ramp type 13
AC type 14
Surge type 15
Heidler type 15
TACS source
AC 3-ph. type 14
AC Ungrounded
DC Ungrounded
MODE: EDIT

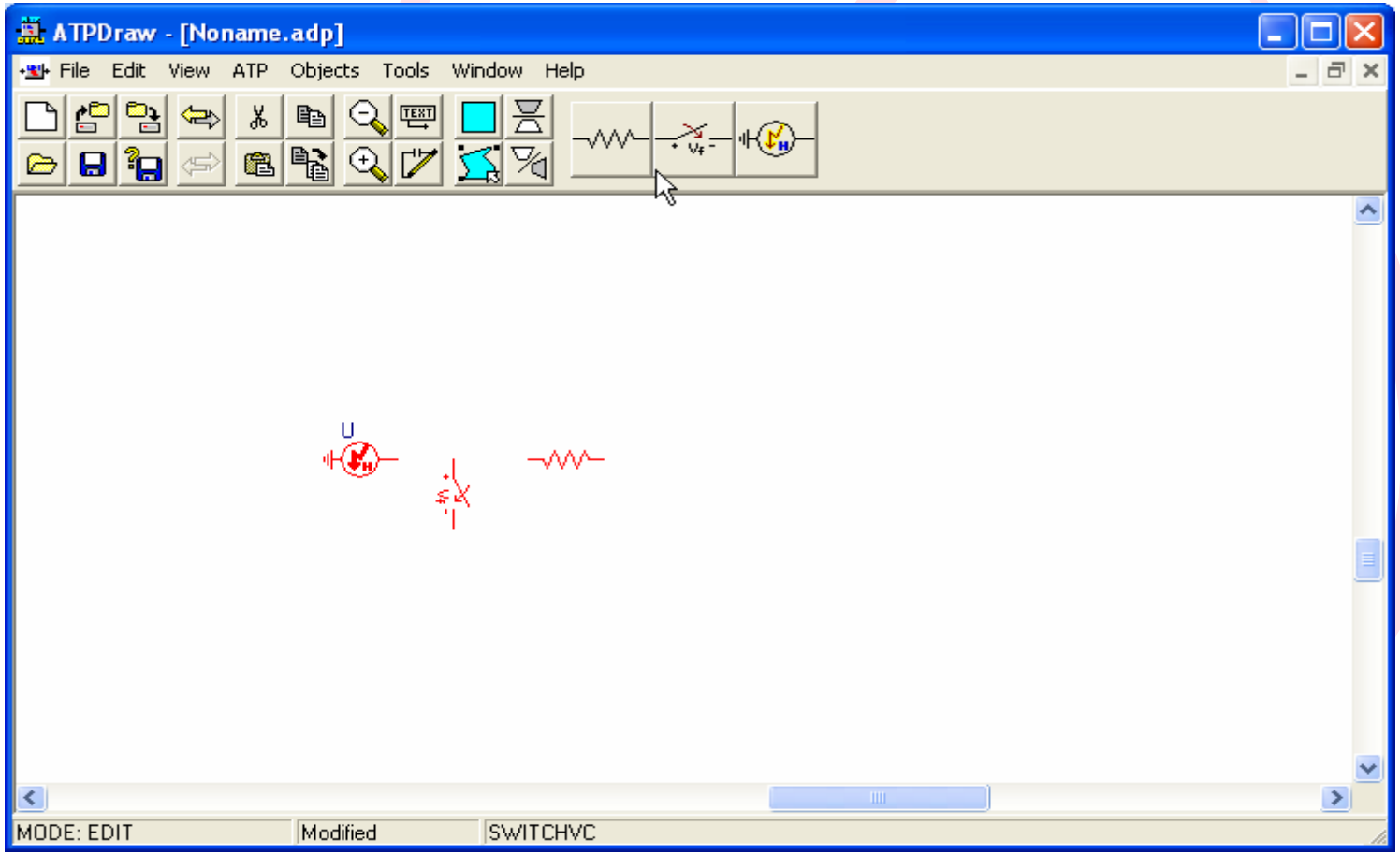
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
Probes & 3-phase
Branch Linear
Branch Nonlinear
Lines/Cables
Switches
Sources
Machines
Transformers
MODELS
TACS
User Specified
Frequency comp.
Standard Component...
Switch time controlled
Switch time 3-ph
Switch voltage contr.
Diode (type 11)
Valve (type 11)
Triac (type 12)
TACS switch (type 13)
Measuring
Statistic switch
Systematic switch
U
MODE: EDIT
Modified

ATP Draw

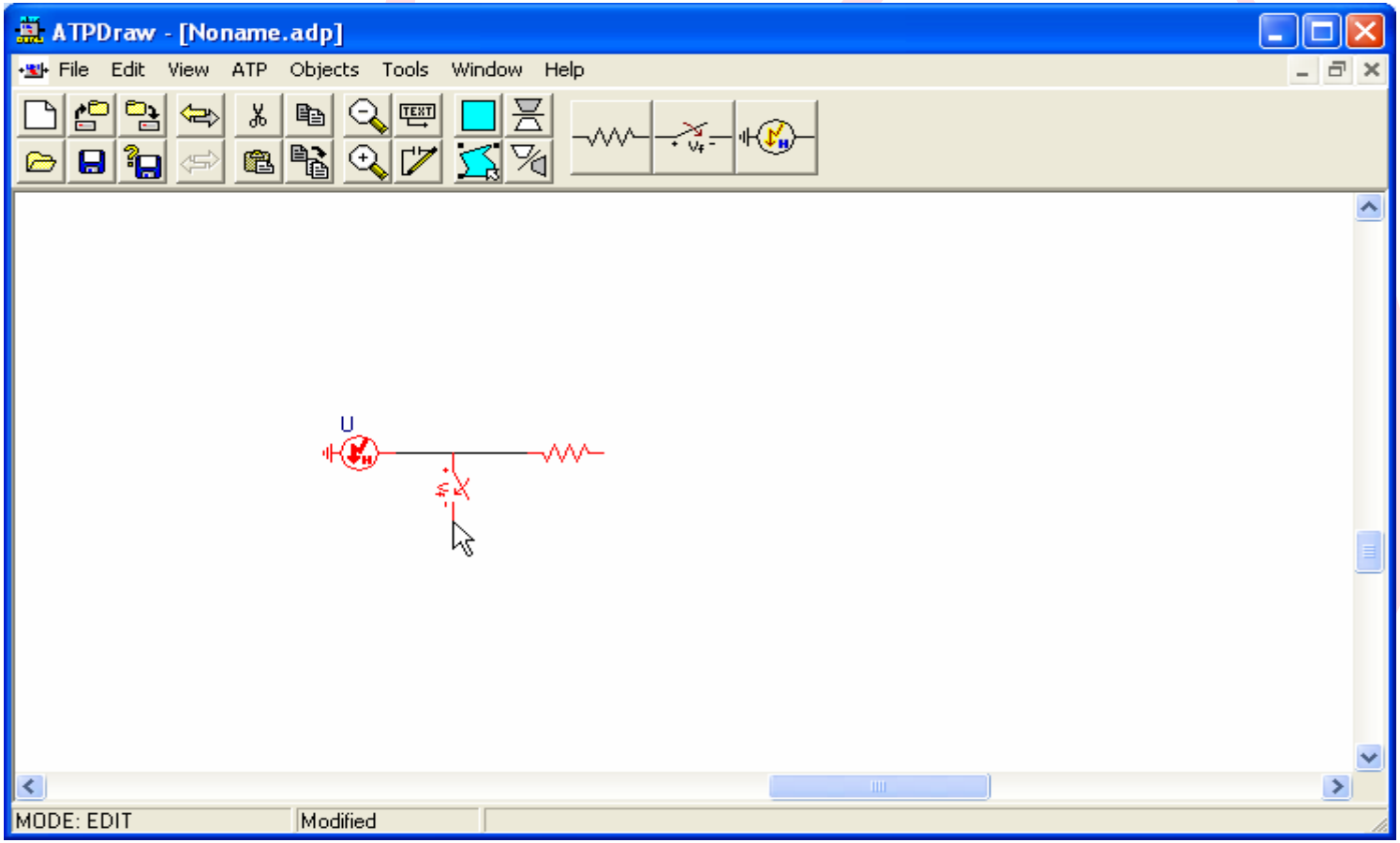

ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
Probes & 3-phase
Branch Linear
Branch Nonlinear
Lines/Cables
Switches
Sources
Machines
Transformers
MODELS
TACS
User Specified
Frequency comp.
Standard Component...
Resistor
Capacitor
Inductor
RLC
RLC 3-ph
RLC-Y 3-ph
RLC-D 3-ph
C: U(0)
L: I(0)
U
MODE: EDIT
Modified

ATP Draw

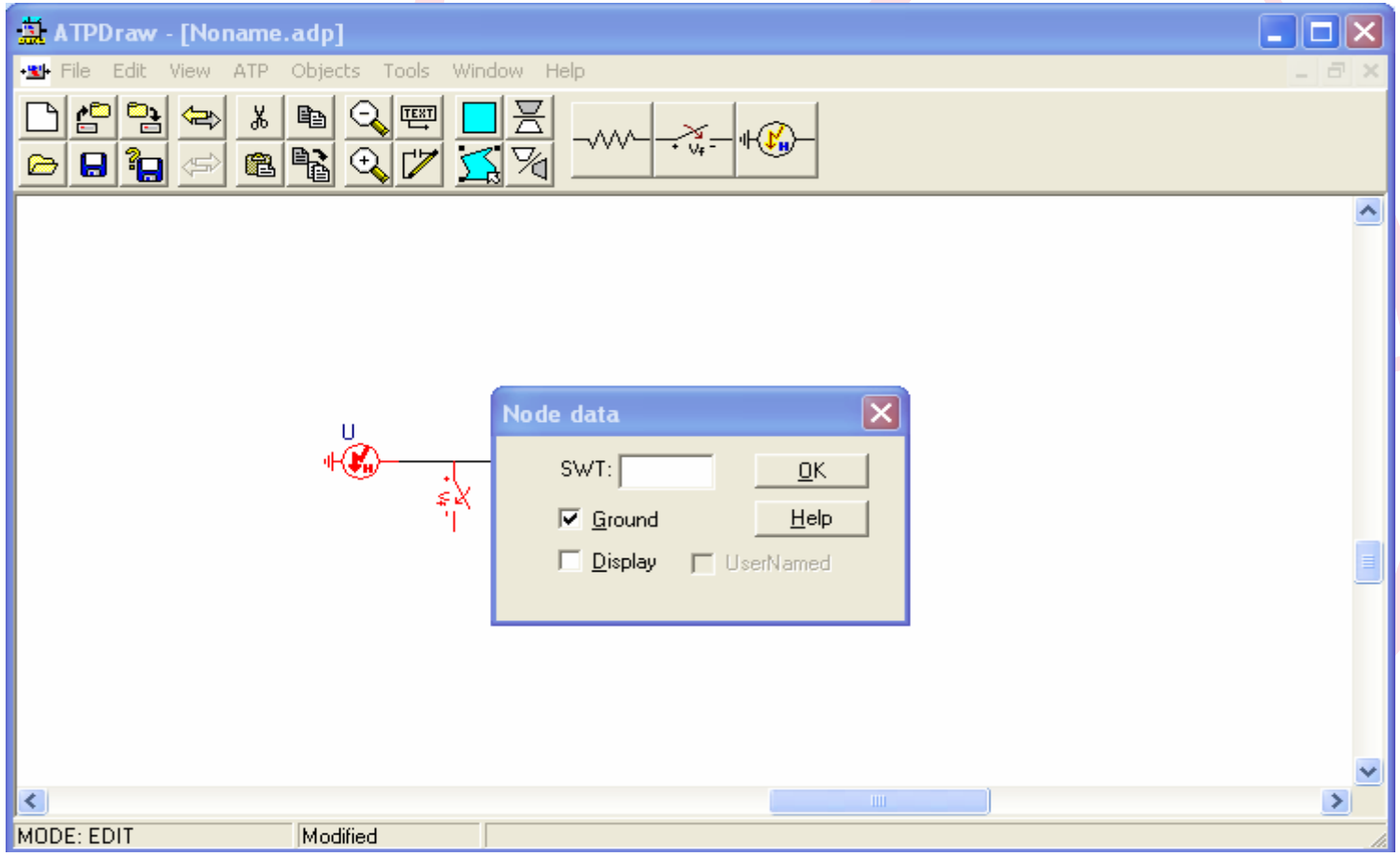


POLSKIE CENTRUM PROMOCJI MIEDZI S.A.

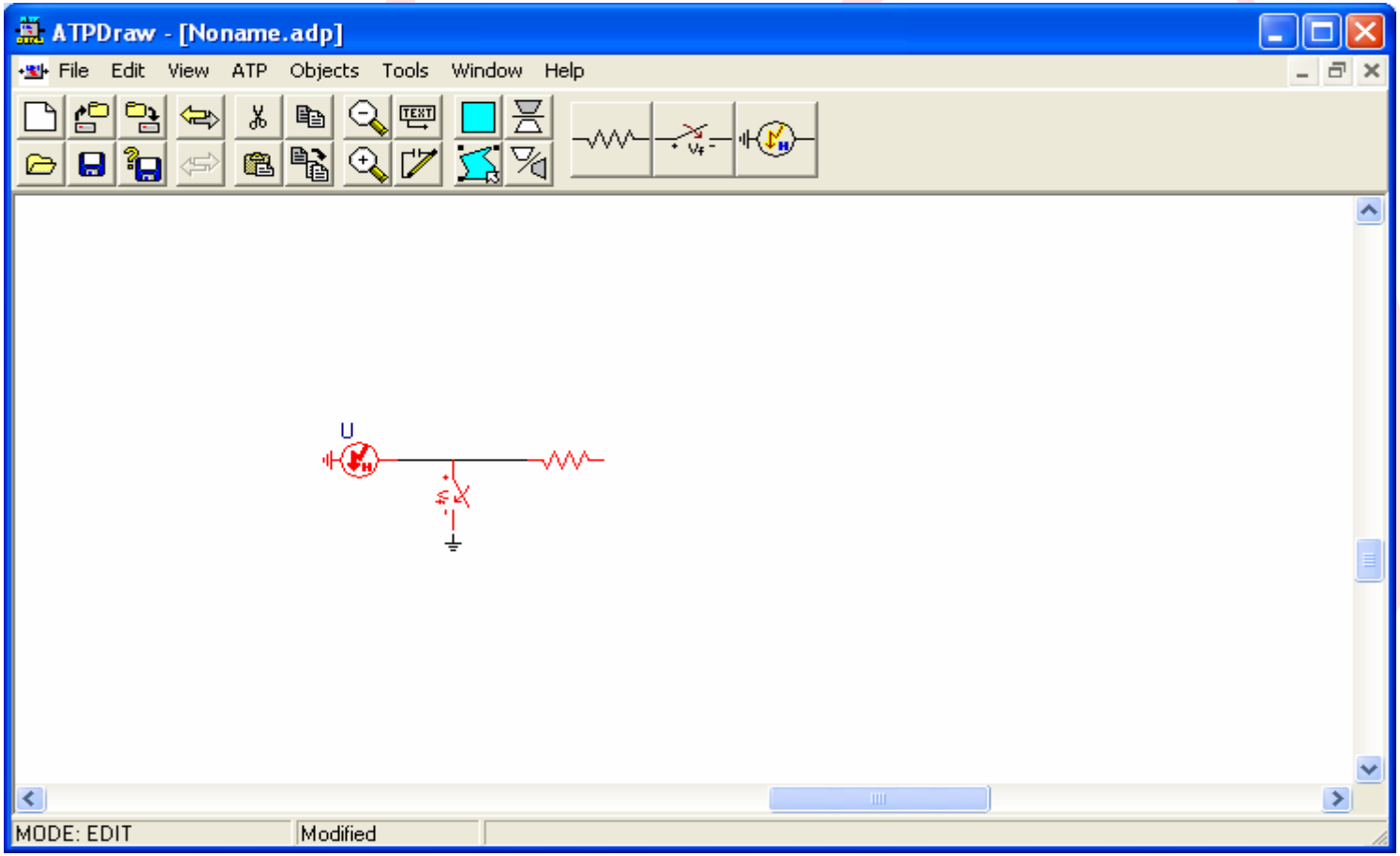
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
TEXT
U
MODE: EDIT
Modified

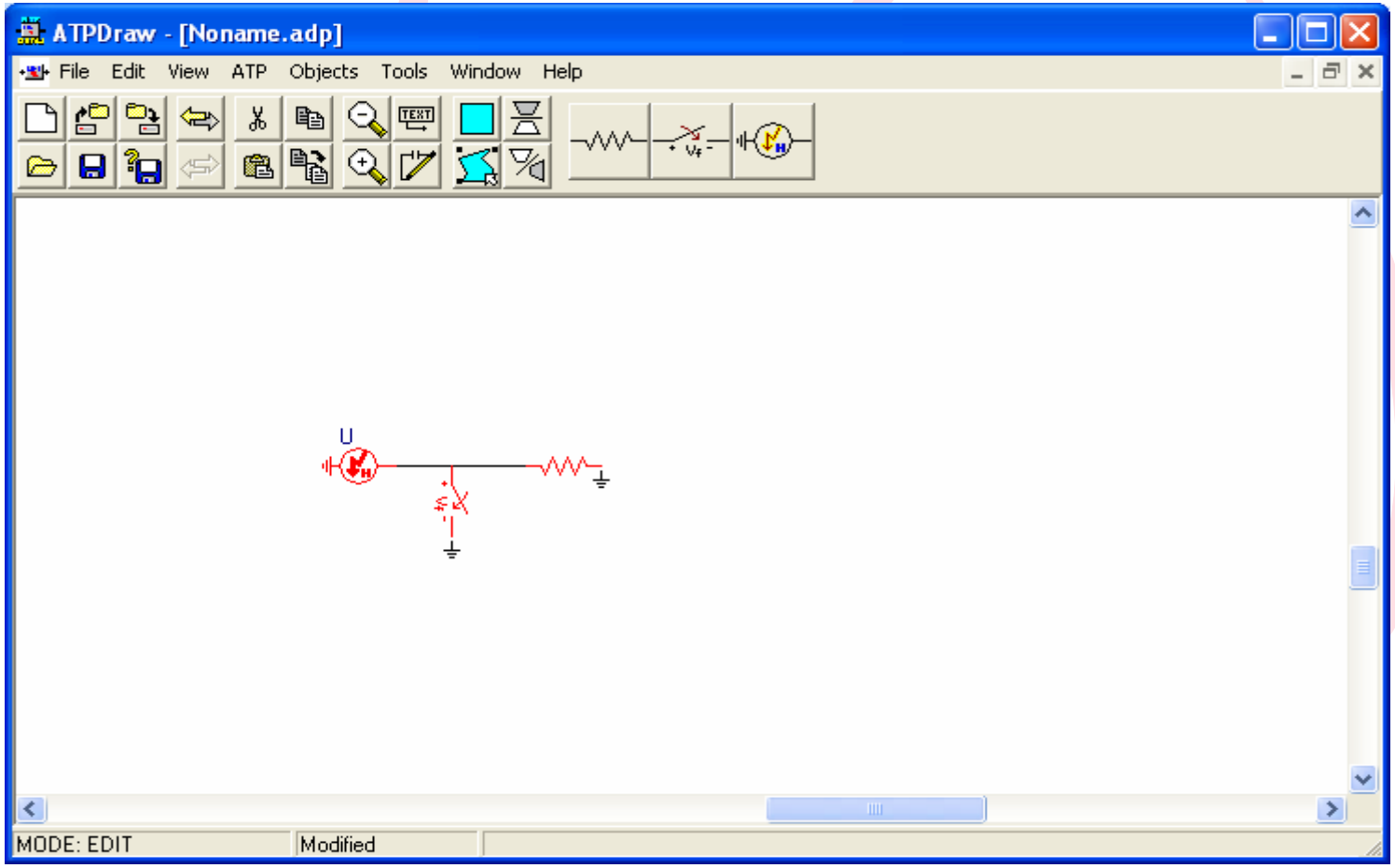
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
TEXT
U
Node data
SWT:
OK
Ground
Help
Display
UserNamed
MODE: EDIT
Modified

ATP Draw

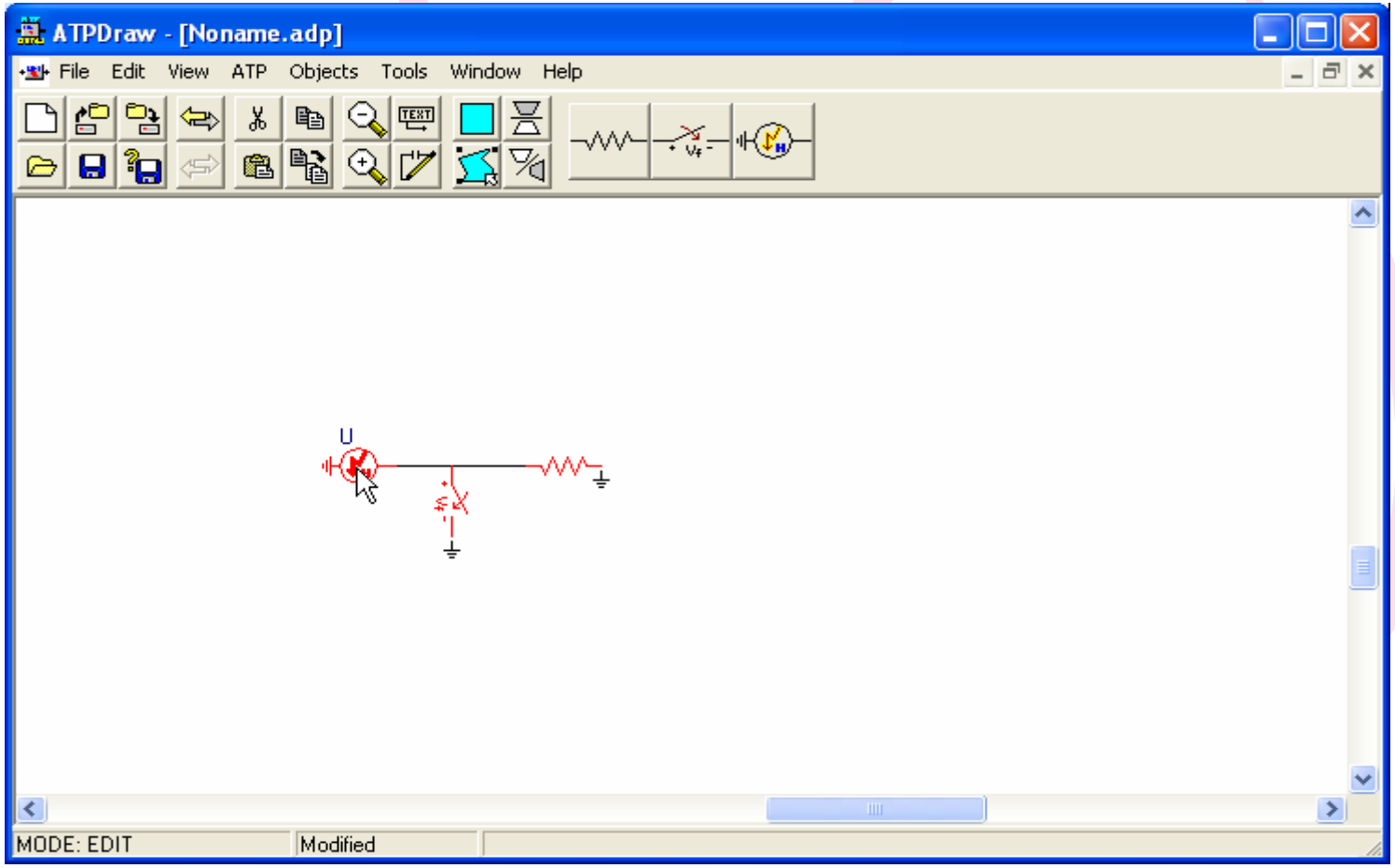

ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
U
MODE: EDIT
Modified

ATP Draw



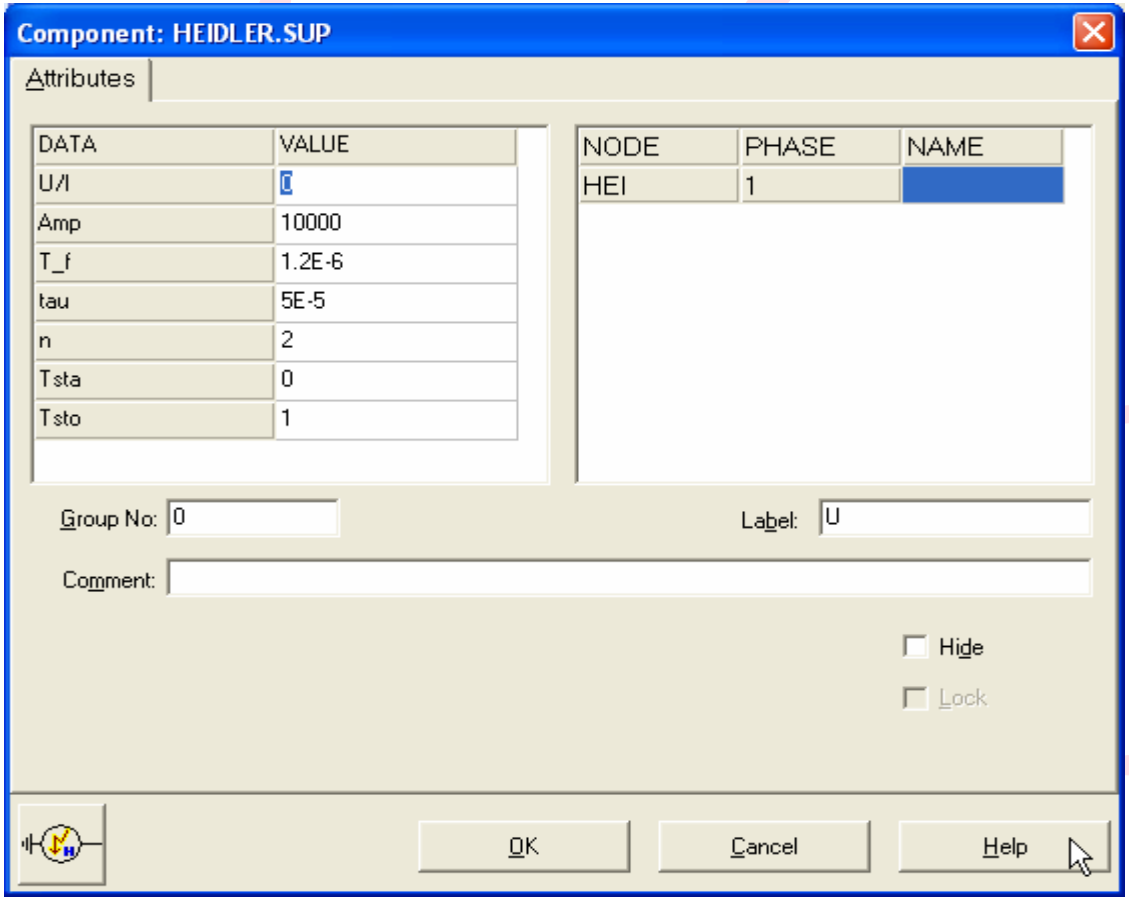
POLSKIE CENTRUM PROMOCJI MIEDZI S.A.

ATP Draw

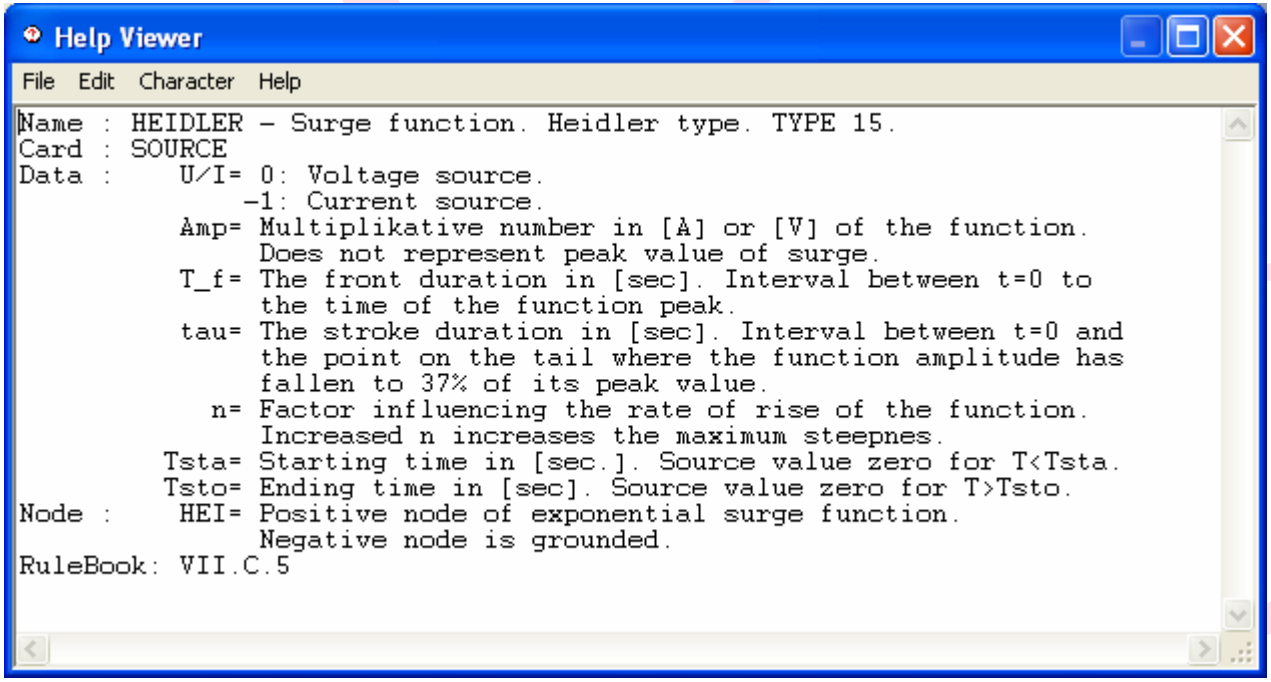


POLSKIE CENTRUM PROMOCJI MIEDZI S.A.

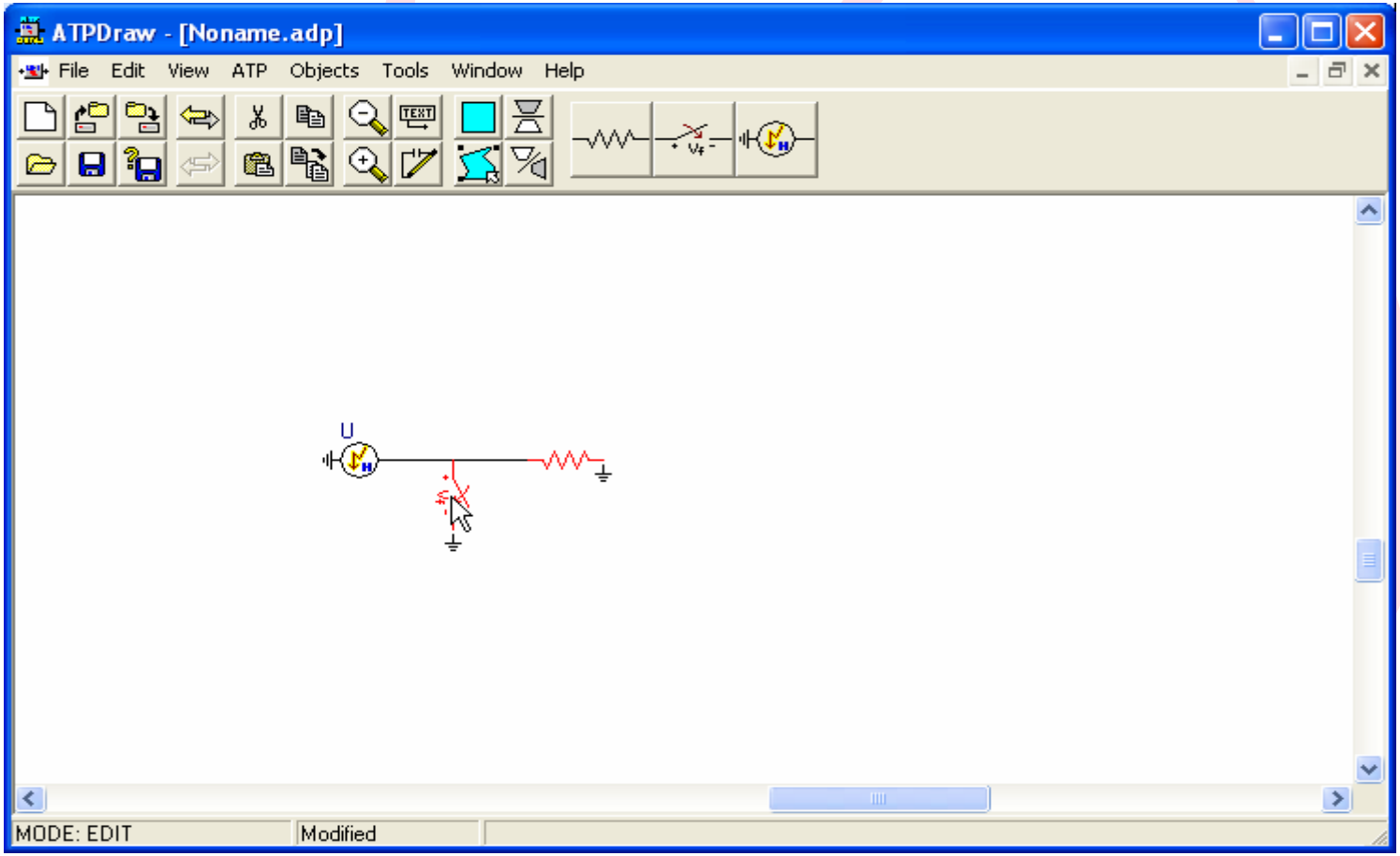
ATP Draw


Component: HEIDLER.SUP
Attributes
DATA
VALUE
U/I
0
Amp
10000
T_f
1.2E-6
tau
5E-5
n
2
Tsta
0
Tsto
1
NODE
PHASE
NAME
HEI
1
Group No: 0
Label: U
Comment:
Hide
Lock
OK
Cancel
Help

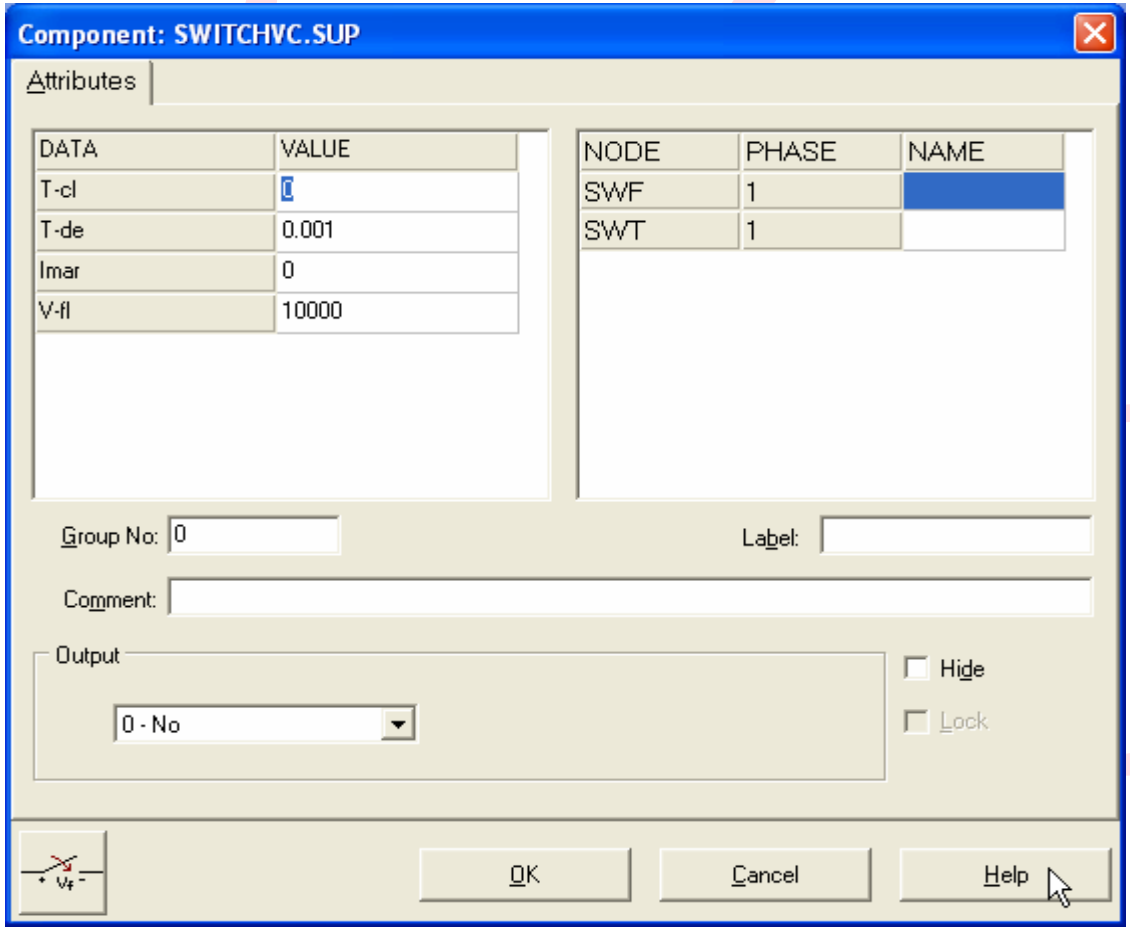
ATP Draw


Help Viewer
File Edit Character Help
Name : HEIDLER - Surge function. Heidler type. TYPE 15.
Card : SOURCE
Data : U/I= 0: Voltage source.
-1: Current source.
Amp= Multiplikative number in [A] or [V] of the function.
Does not represent peak value of surge.
T_f= The front duration in [sec]. Interval between t=0 to
the time of the function peak.
tau= The stroke duration in [sec]. Interval between t=0 and
the point on the tail where the function amplitude has
fallen to 37% of its peak value.
n= Factor influencing the rate of rise of the function.
Increased n increases the maximum steepnes.
Tsta= Starting time in [sec.]. Source value zero for T<Tsta.
Tsto= Ending time in [sec]. Source value zero for T>Tsto.
Node : HEI= Positive node of exponential surge function.
Negative node is grounded.
RuleBook: VII.C.5

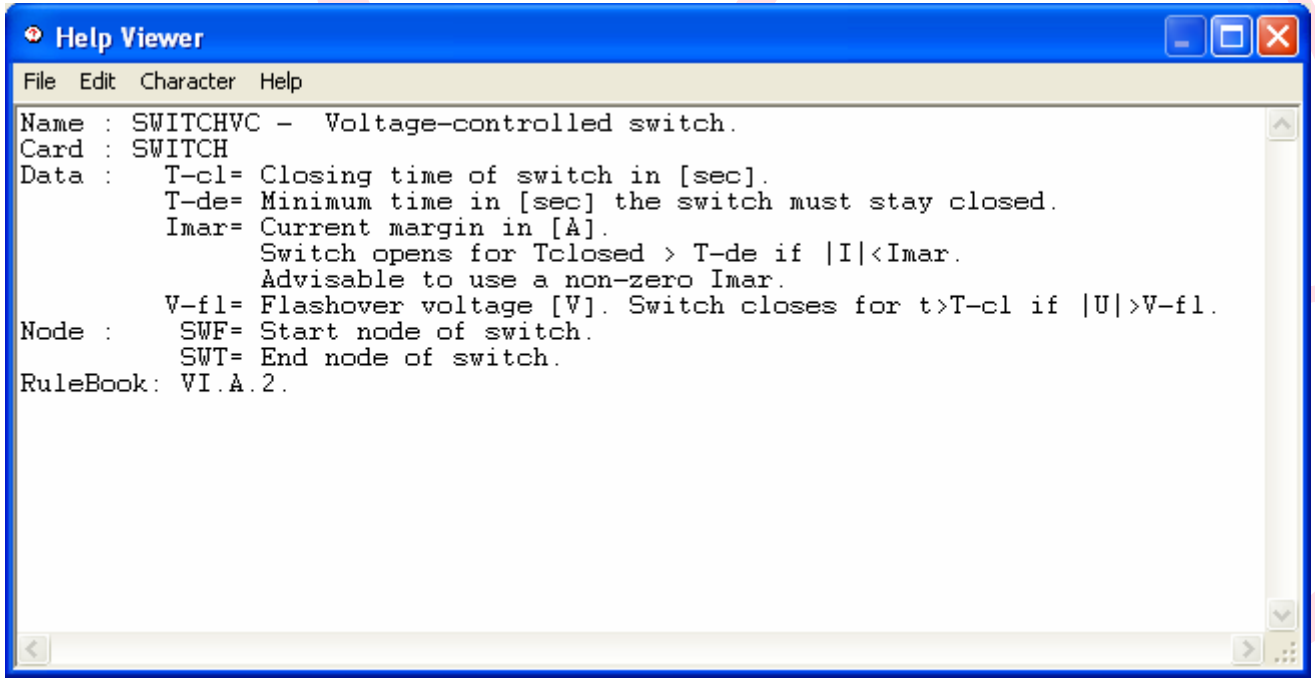
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
U
MODE: EDIT
Modified

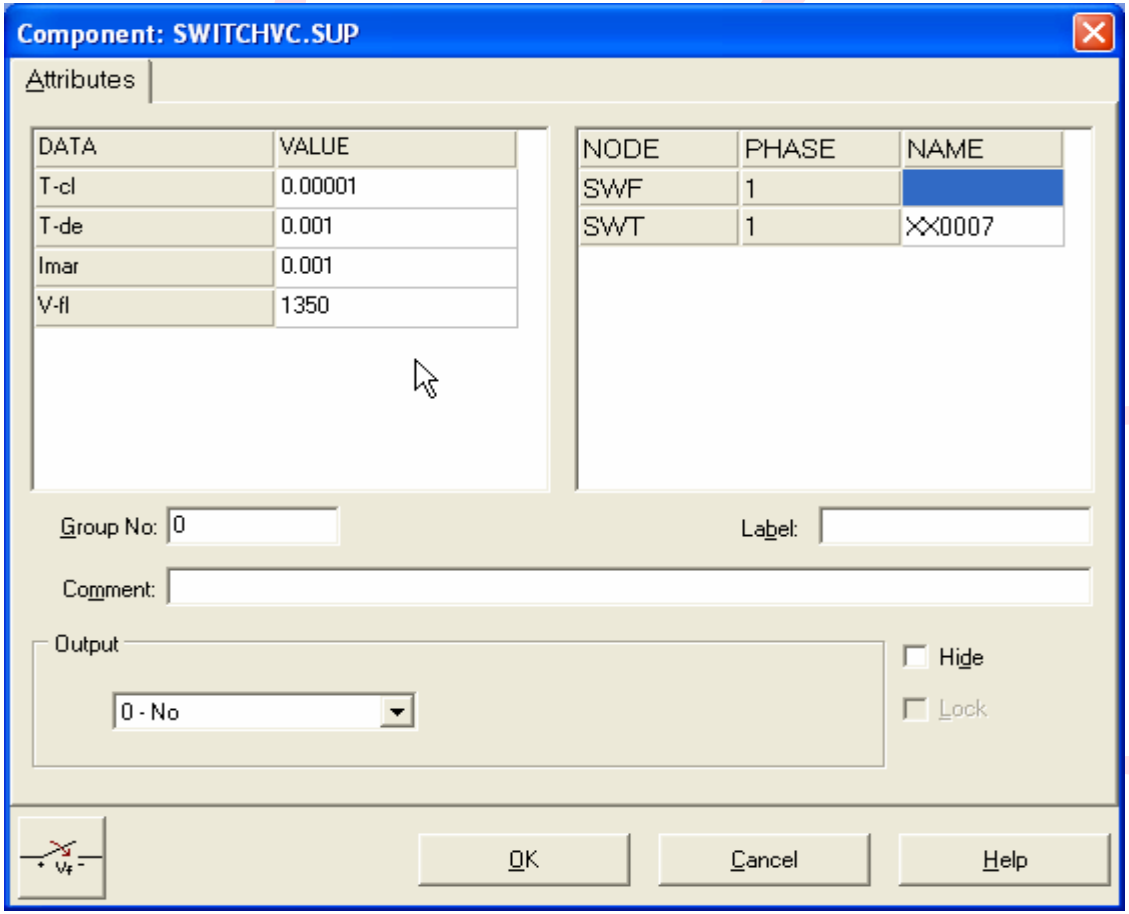
ATP Draw


Component: SWITCHVC.SUP
Attributes
DATA
VALUE
T-cl
0
T-de
0.001
Imar
0
V-fl
10000
NODE
PHASE
NAME
SWF
1
SWT
1
Group No:
0
Label:
Comment:
Output
0 - No
Hide
Lock
OK
Cancel
Help

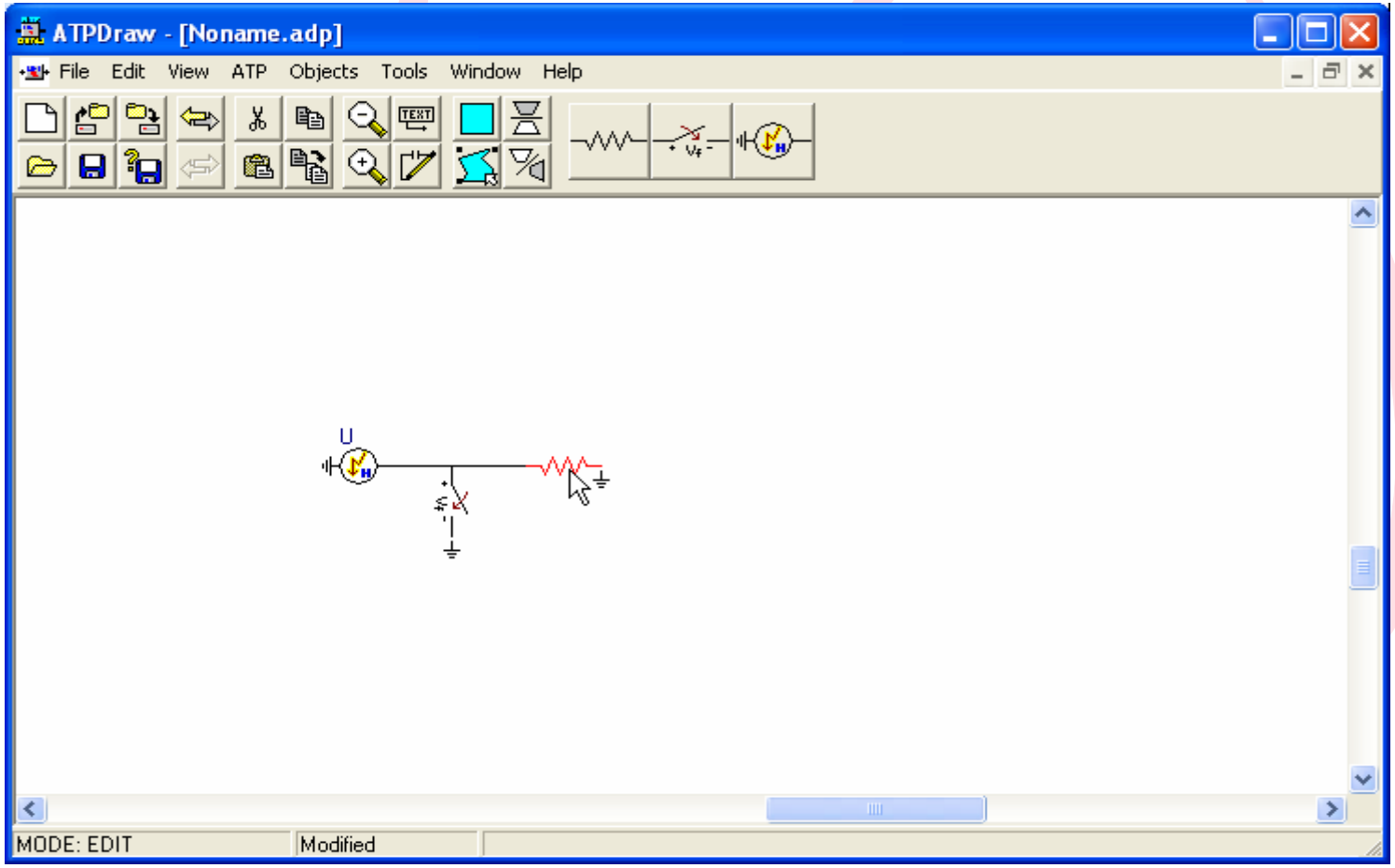
ATP Draw


Help Viewer
File Edit Character Help
Name : SWITCHVC - Voltage-controlled switch.
Card : SWITCH
Data : T-cl= Closing time of switch in [sec].
T-de= Minimum time in [sec] the switch must stay closed.
Imar= Current margin in [A].
Switch opens for Tclosed > T-de if |I|<Imar.
Advisable to use a non-zero Imar.
V-fl= Flashover voltage [V]. Switch closes for t>T-cl if |U|>V-fl.
Node : SWF= Start node of switch.
SWT= End node of switch.
RuleBook: VI.A.2.

ATP Draw

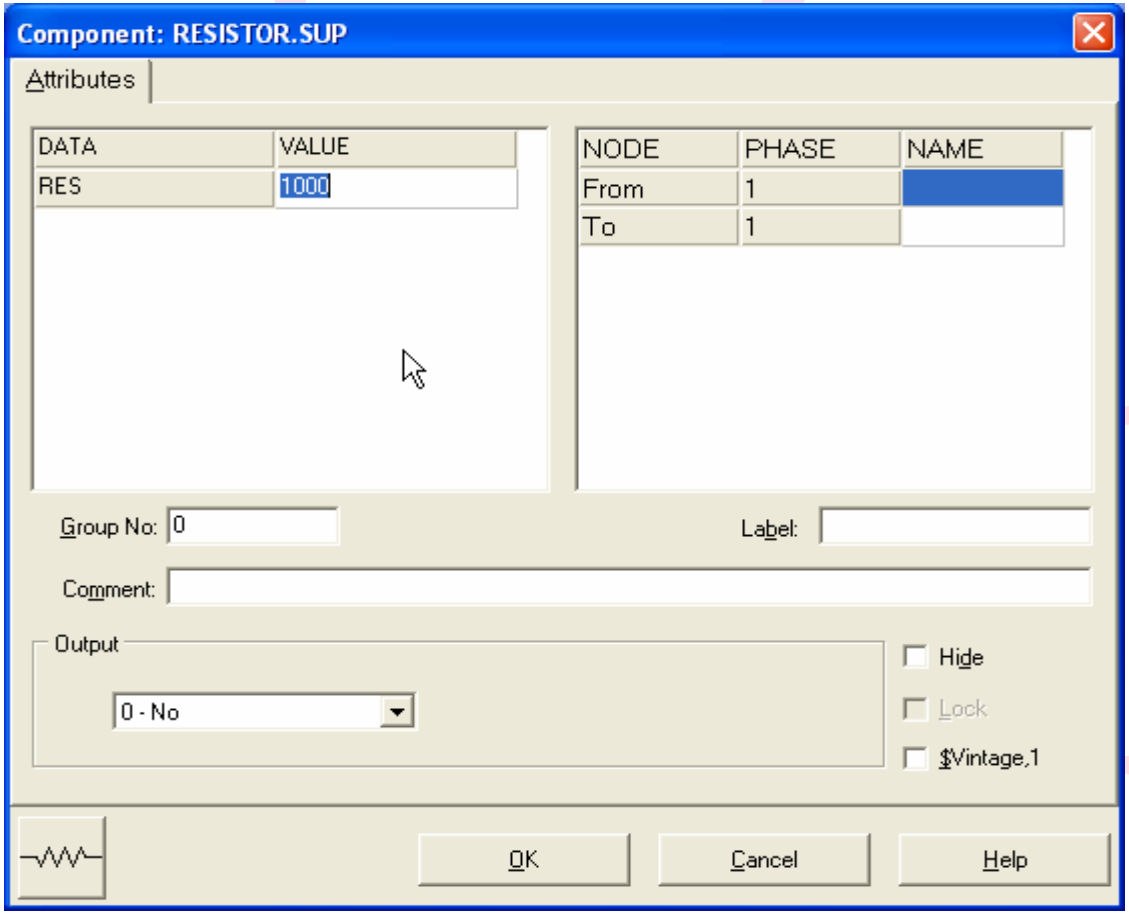

Component: SWITCHVC.SUP
Attributes
DATA
VALUE
T-cl
0.00001
T-de
0.001
Imar
0.001
V-fl
1350
NODE
PHASE
NAME
SWF
1
SWT
1
XX0007
Group No:
0
Label:
Comment:
Output
0 - No
Hide
Lock
OK
Cancel
Help

ATP Draw

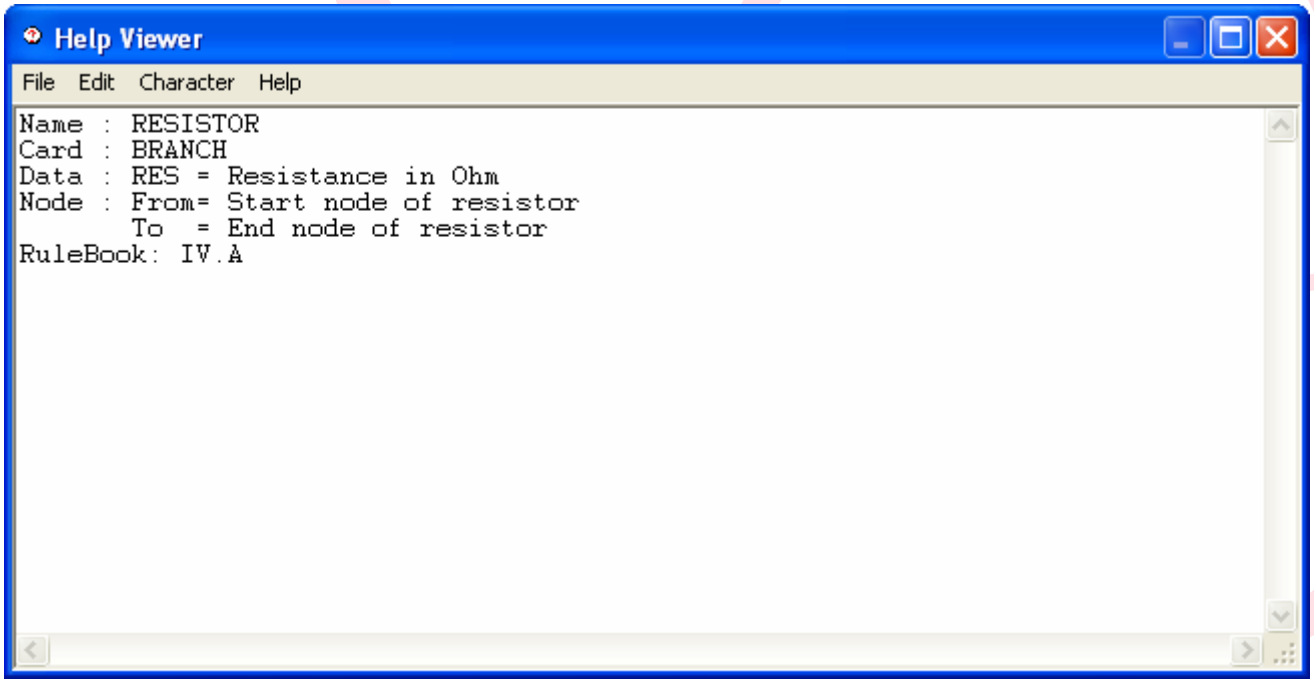


POLSKIE CENTRUM PROMOCJI MIEDZI S.A.

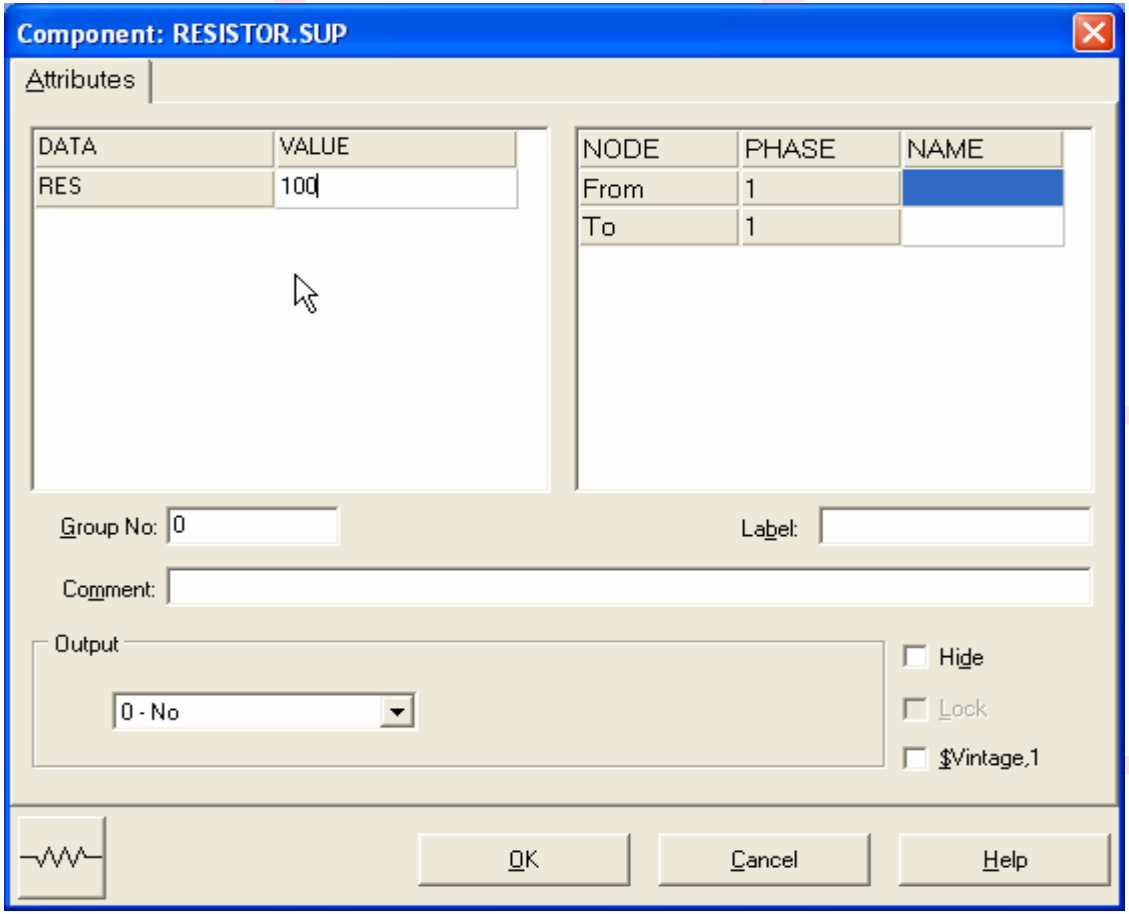
ATP Draw


Component: RESISTOR.SUP
Attributes
DATA
VALUE
RES
1000
NODE
PHASE
NAME
From
1
To
1
Group No:
0
Label:
Comment:
Output
0 - No
Hide
Lock
$Vintage,1
OK
Cancel
Help

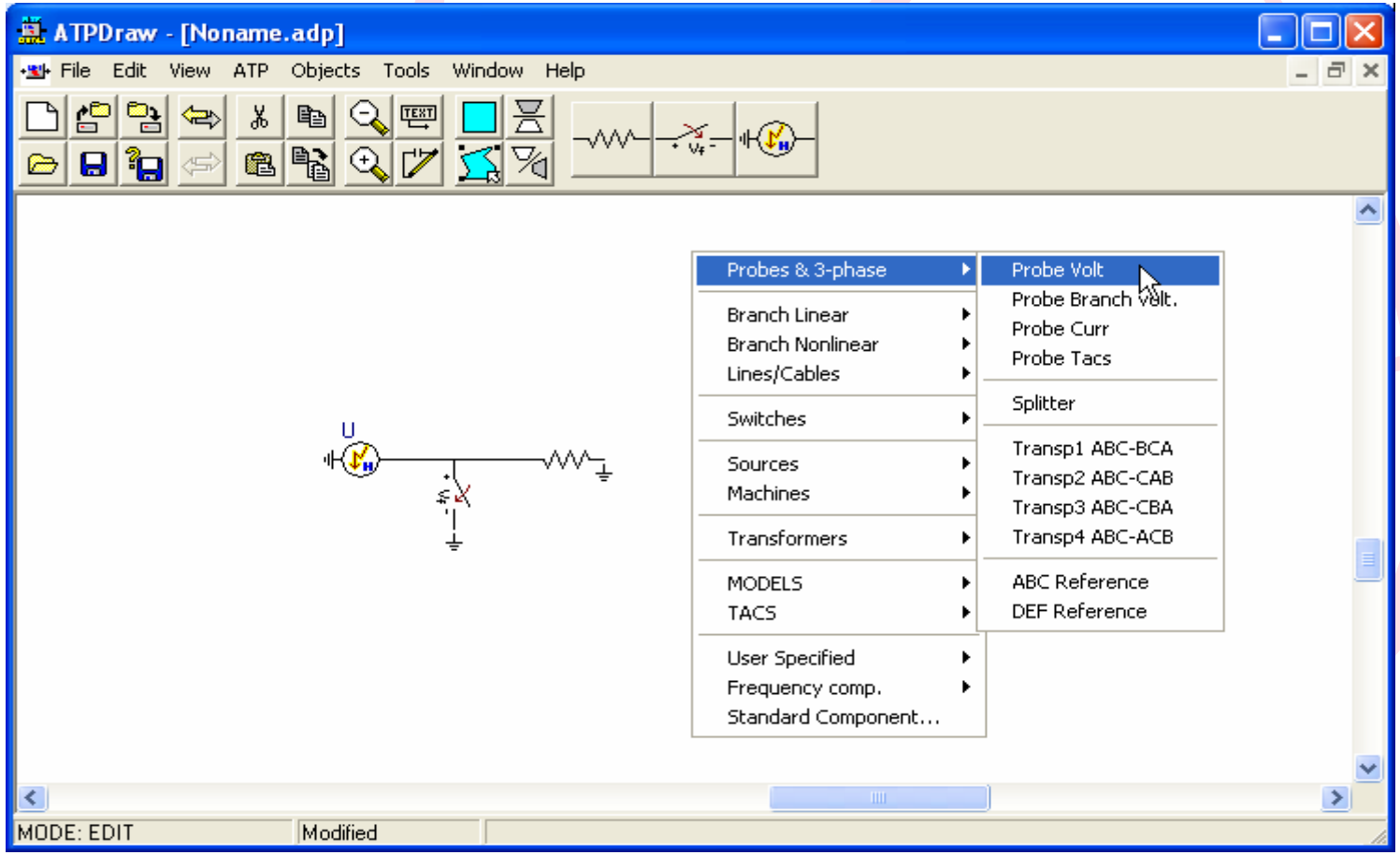
ATP Draw


Help Viewer
File Edit Character Help
Name : RESISTOR
Card : BRANCH
Data : RES = Resistance in Ohm
Node : From= Start node of resistor
To = End node of resistor
RuleBook: IV.A

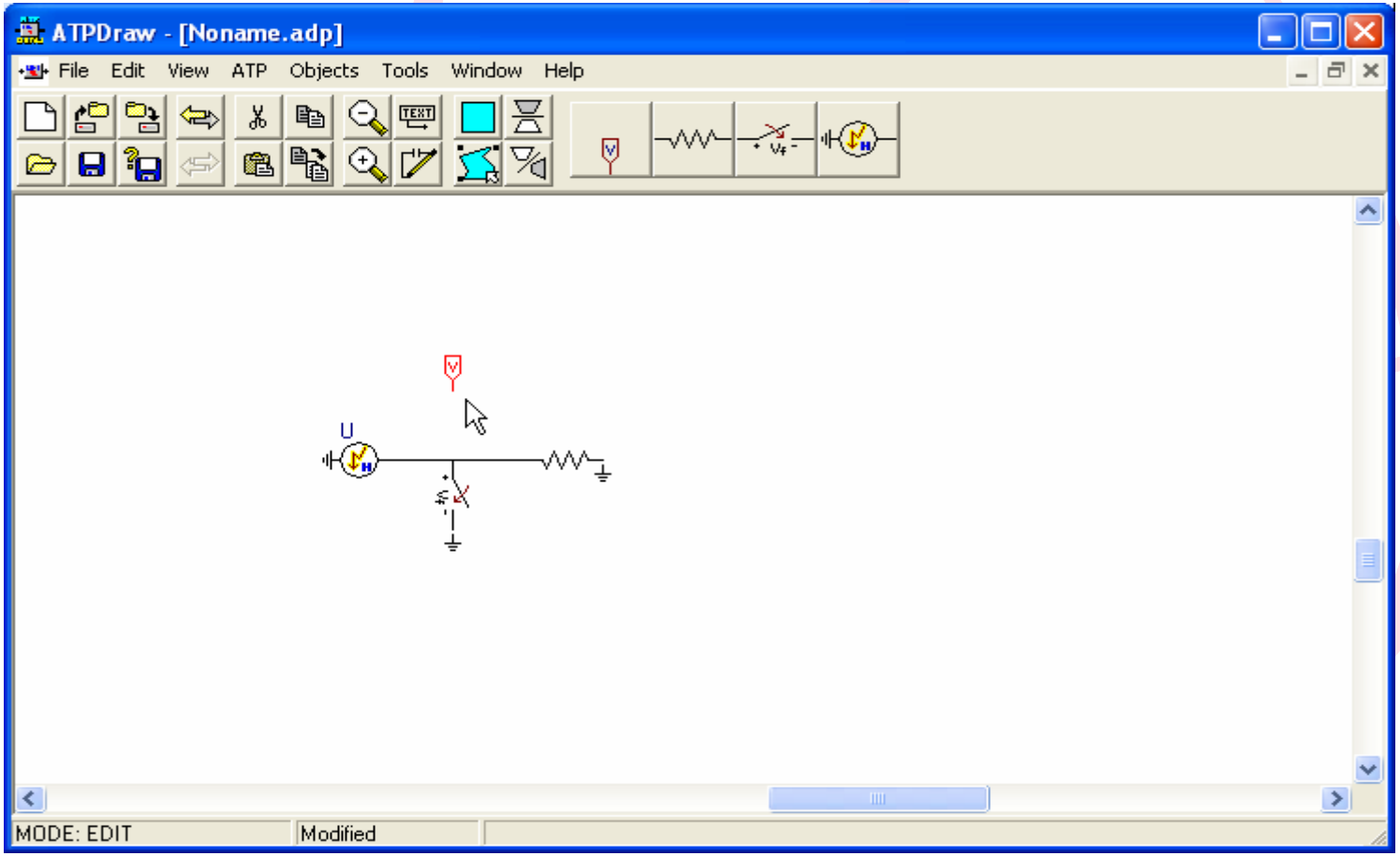
ATP Draw


Component: RESISTOR.SUP
Attributes
DATA
VALUE
RES
100
NODE
PHASE
NAME
From
1
To
1
Group No:
0
Label:
Comment:
Output
0 - No
Hide
Lock
$Vintage,1
OK
Cancel
Help

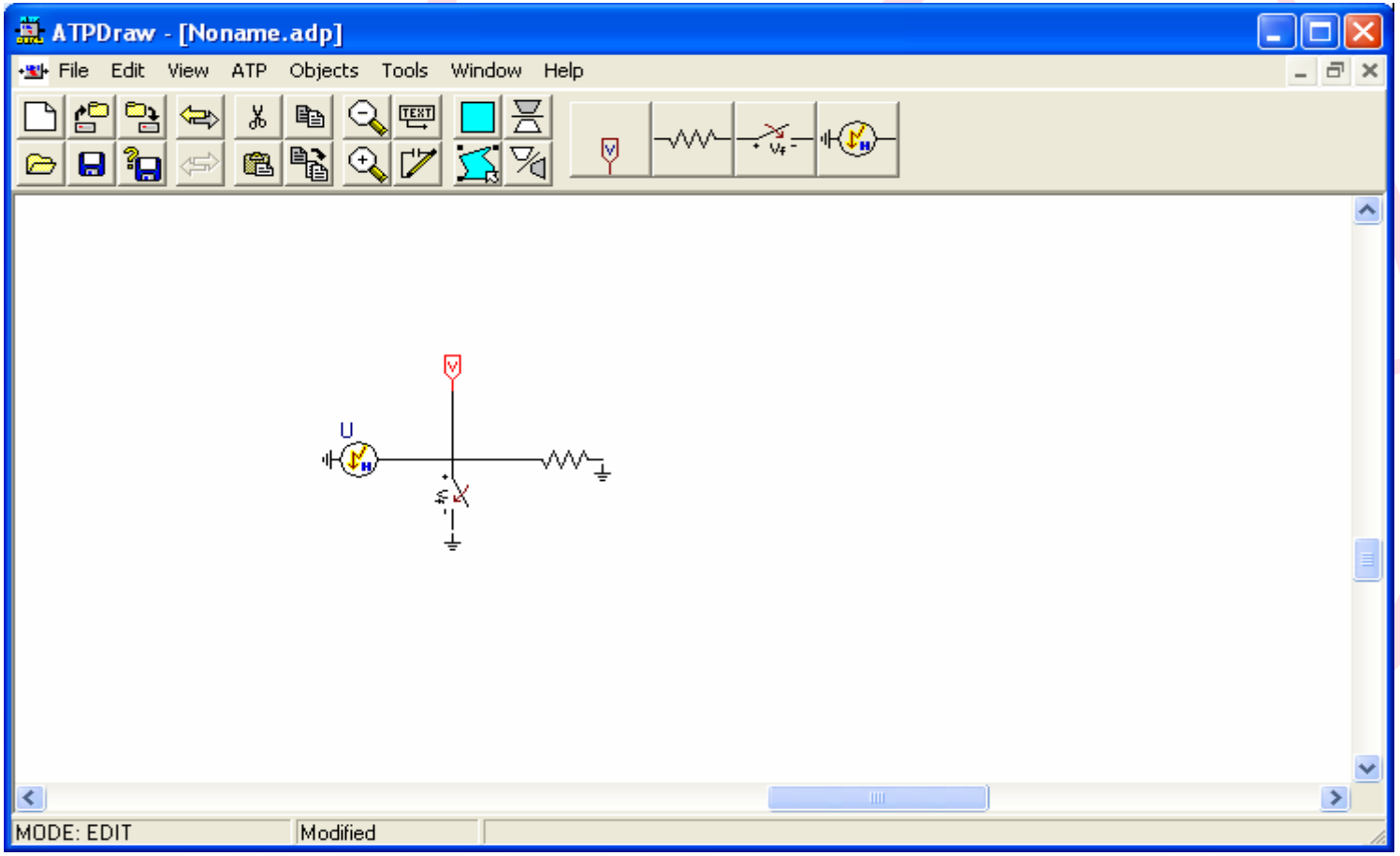
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
Probes & 3-phase
Branch Linear
Branch Nonlinear
Lines/Cables
Switches
Sources
Machines
Transformers
MODELS
TACS
User Specified
Frequency comp.
Standard Component...
Probe Volt
Probe Branch Volt.
Probe Curr
Probe Tacs
Splitter
Transp1 ABC-BCA
Transp2 ABC-CAB
Transp3 ABC-CBA
Transp4 ABC-ACB
ABC Reference
DEF Reference
U
MODE: EDIT
Modified

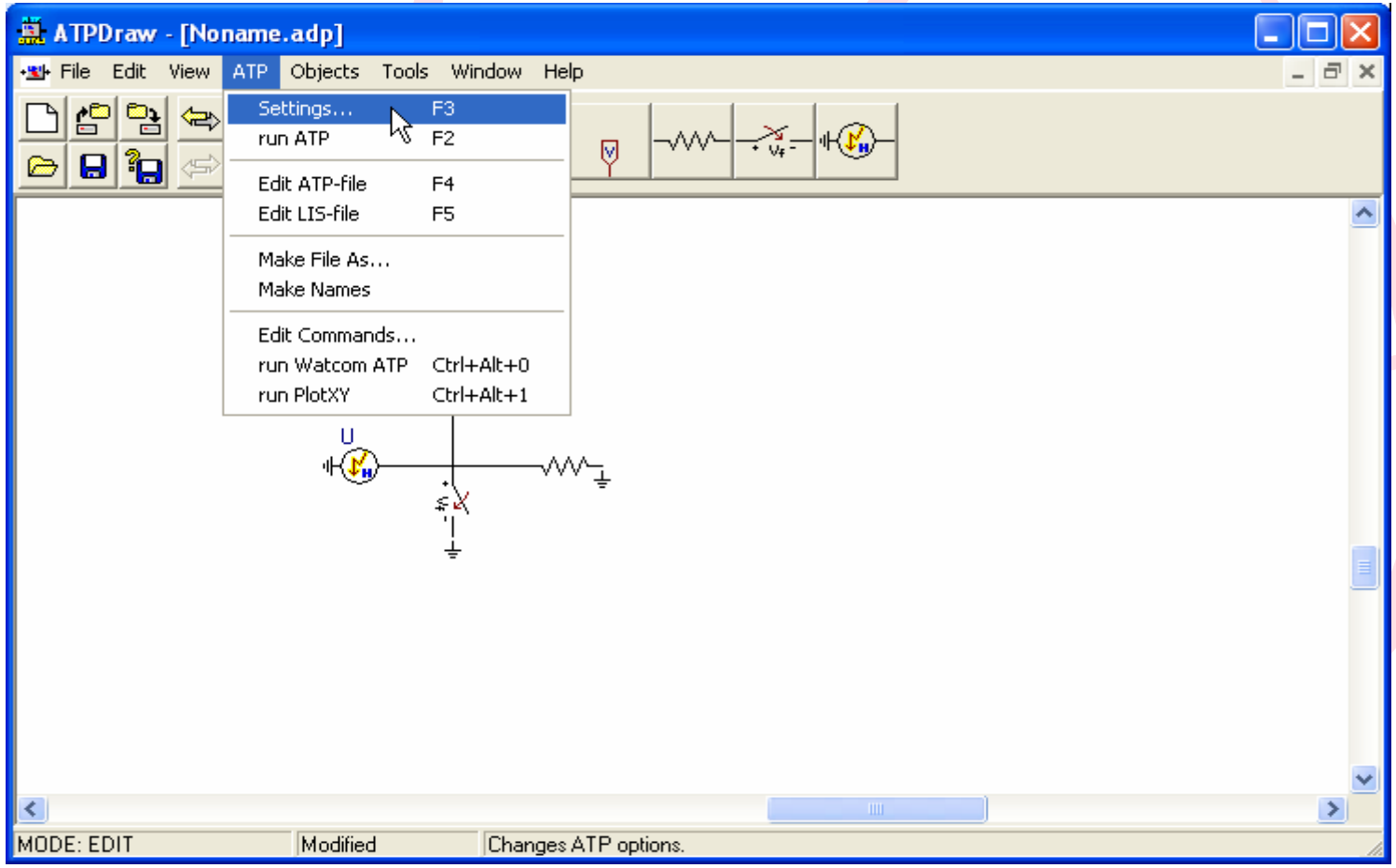
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
U
MODE: EDIT
Modified

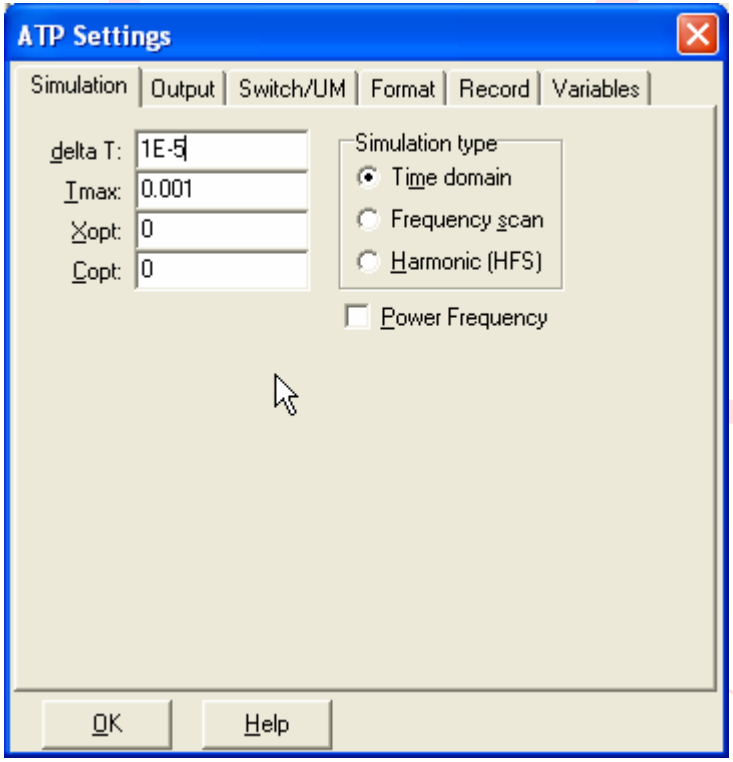
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
TEXT
U
MODE: EDIT
Modified

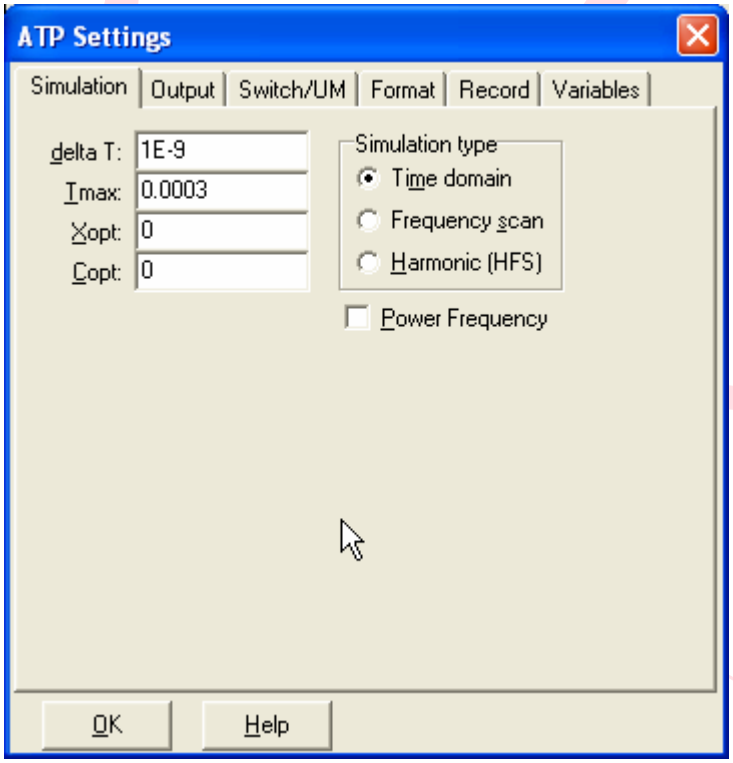
ATP Draw


ATPDraw - [Noname.adp]
File Edit View ATP Objects Tools Window Help
Settings... F3
run ATP F2
Edit ATP-file F4
Edit LIS-file F5
Make File As...
Make Names
Edit Commands...
run Watcom ATP Ctrl+Alt+0
run PlotXY Ctrl+Alt+1
U
MODE: EDIT
Modified
Changes ATP options.

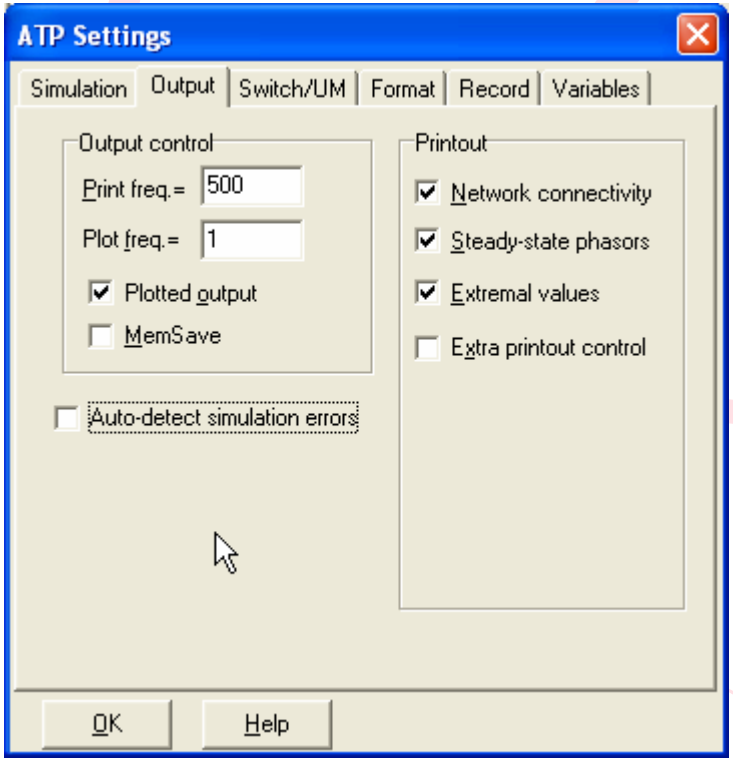
ATP Draw


ATP Settings
Simulation
Output
Switch/UM
Format
Record
Variables
delta T:
1E-5
Tmax:
0.001
Xopt:
0
Copt:
0
Simulation type
Time domain
Frequency scan
Harmonic (HFS)
Power Frequency
OK
Help

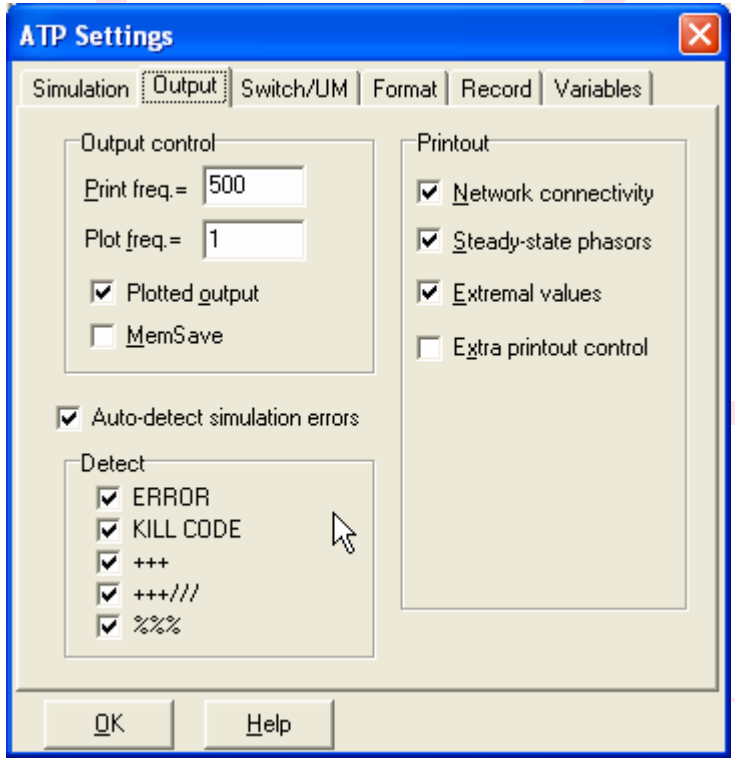
ATP Draw


ATP Settings
Simulation
Output
Switch/UM
Format
Record
Variables
delta T:
1E-9
Tmax:
0.0003
Xopt:
0
Copt:
0
Simulation type
Time domain
Frequency scan
Harmonic (HFS)
Power Frequency
OK
Help

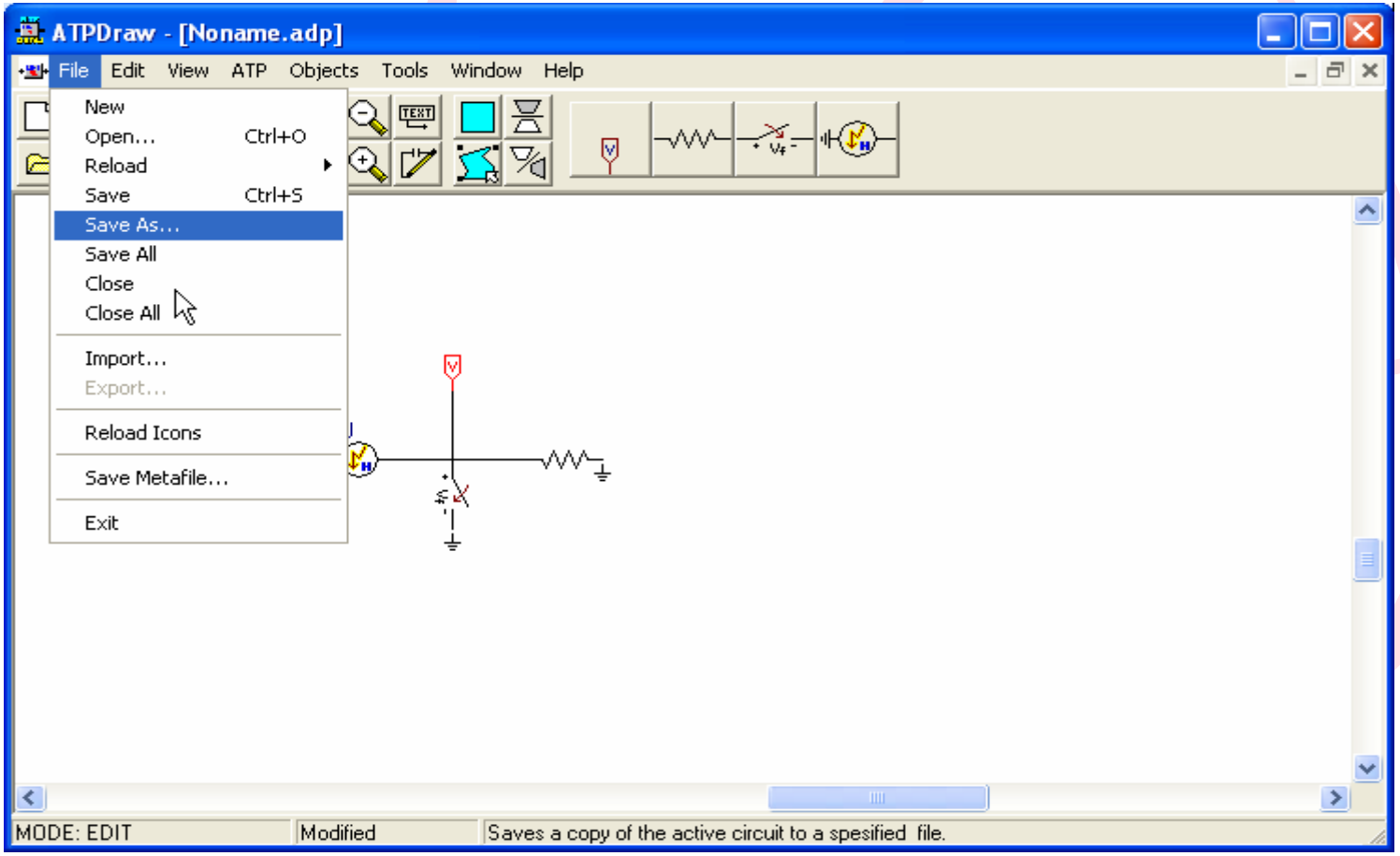
ATP Draw


ATP Settings
Simulation
Output
Switch/UM
Format
Record
Variables
Output control
Print freq.= 500
Plot freq.= 1
Plotted output
MemSave
Auto-detect simulation errors
Printout
Network connectivity
Steady-state phasors
Extremal values
Extra printout control
OK
Help

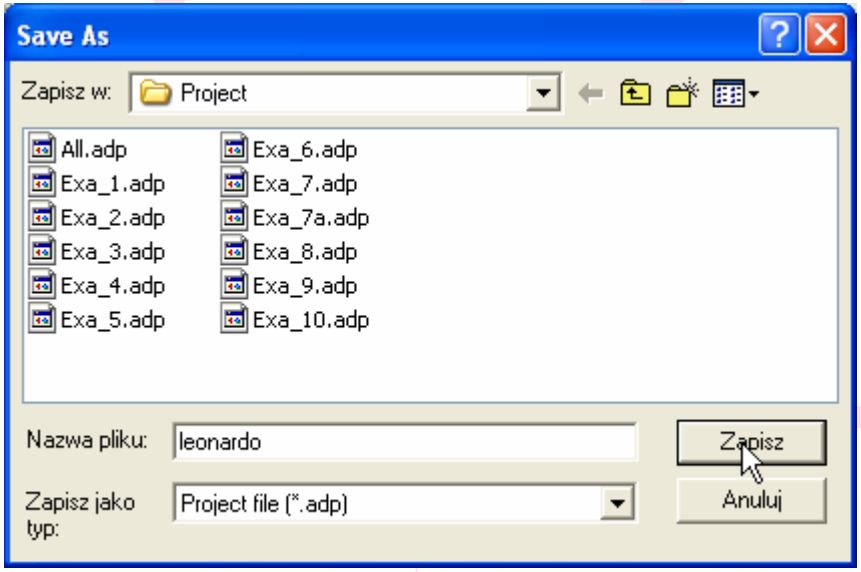
ATP Draw


ATP Settings
Simulation
Output
Switch/UM
Format
Record
Variables
Output control
Print freq.= 500
Plot freq.= 1
Plotted output
MemSave
Printout
Network connectivity
Steady-state phasors
Extremal values
Extra printout control
Auto-detect simulation errors
Detect
ERROR
KILL CODE
+++
+++///
%%%
OK
Help

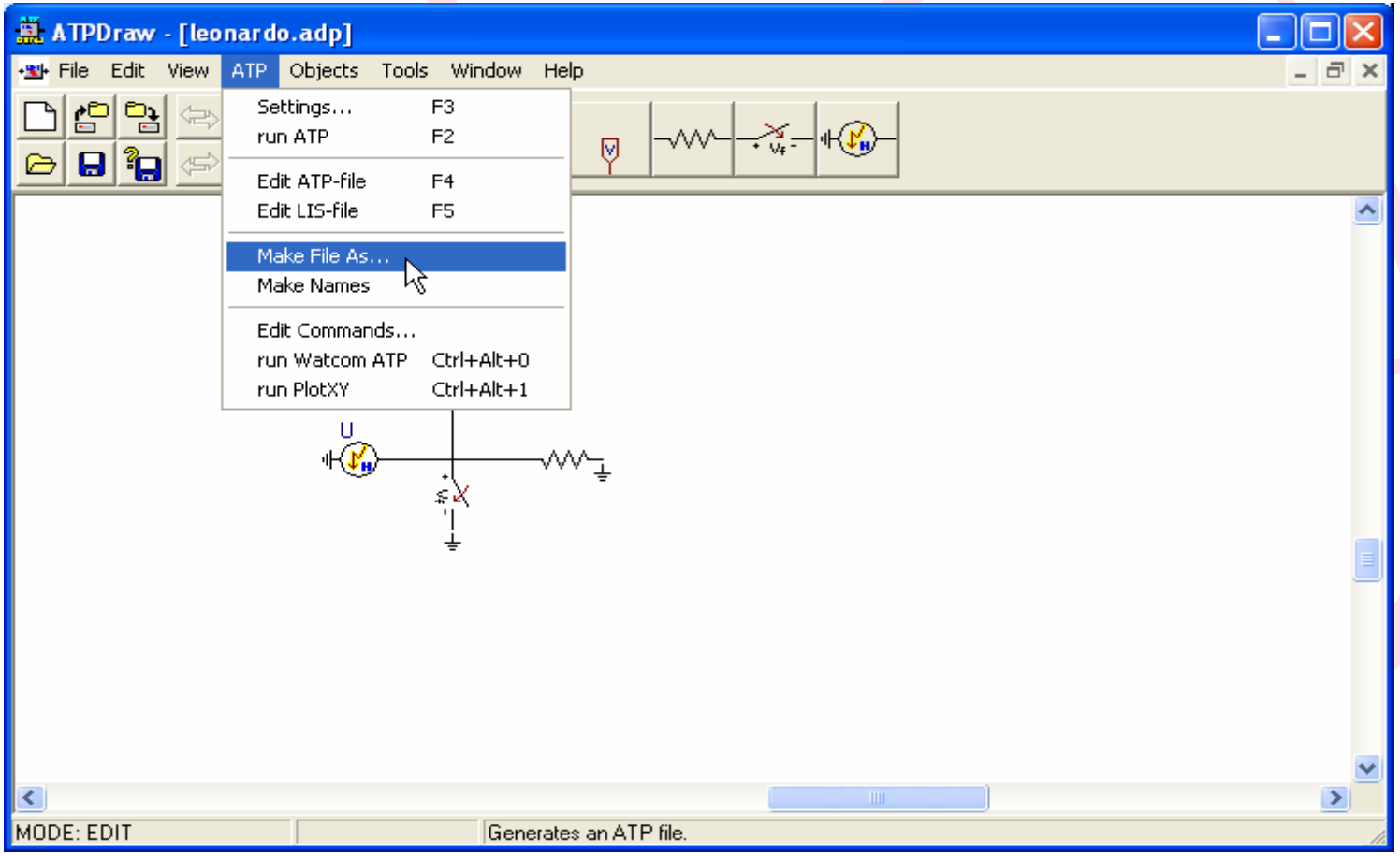
ATP Draw


ATPDraw - [Noname.adp]
File
Edit
View
ATP
Objects
Tools
Window
Help
New
Open... Ctrl+O
Reload
Save Ctrl+S
Save As...
Save All
Close
Close All
Import...
Export...
Reload Icons
Save Metafile...
Exit
MODE: EDIT
Modified
Saves a copy of the active circuit to a spesified file.

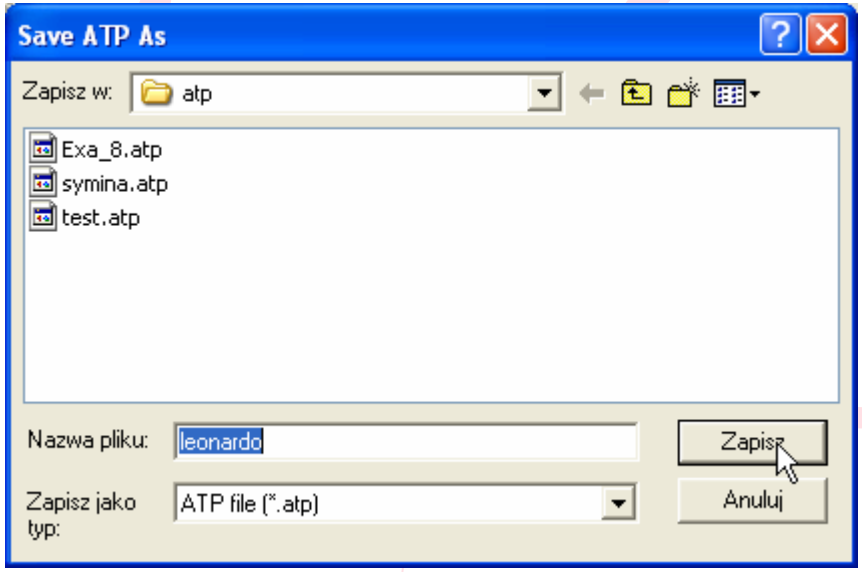
ATP Draw


Save As
Zapisz w:
Project
All.adp
Exa_1.adp
Exa_2.adp
Exa_3.adp
Exa_4.adp
Exa_5.adp
Exa_6.adp
Exa_7.adp
Exa_7a.adp
Exa_8.adp
Exa_9.adp
Exa_10.adp
Nazwa pliku:
leonardo
Zapisz
Zapisz jako typ:
Project file (*.adp)
Anuluj

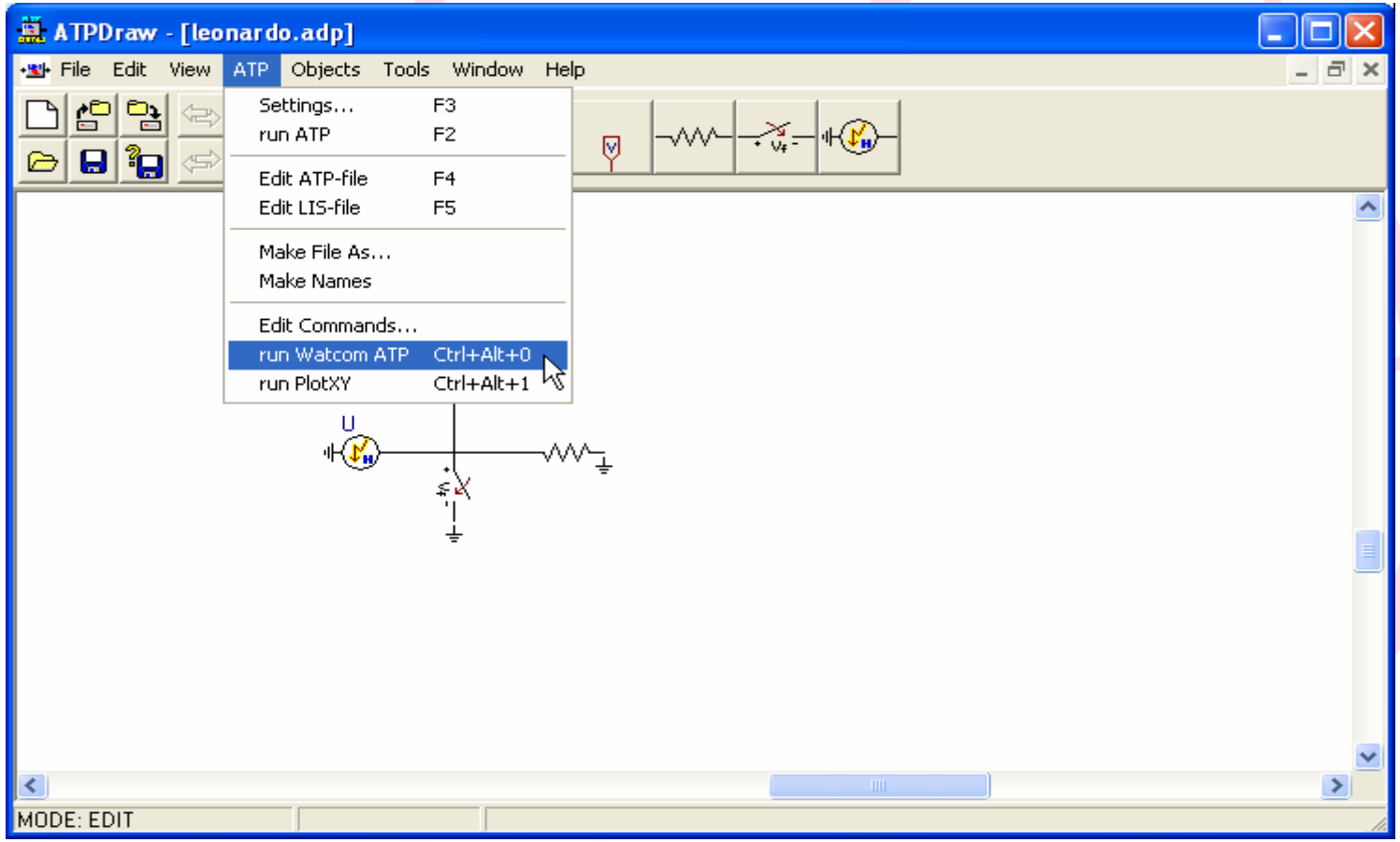
ATP Draw



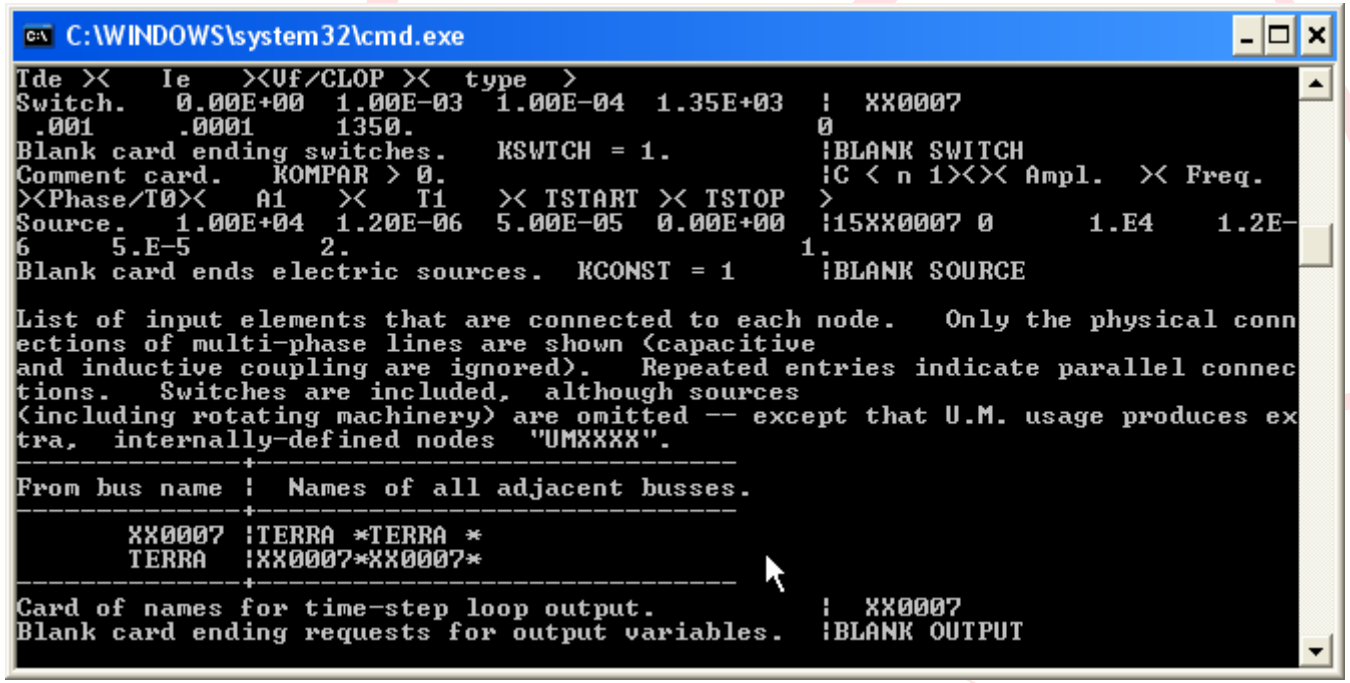
ATP Draw


Save ATP As
Zapisz w:
atp
Exa_8.atp
symina.atp
test.atp
Nazwa pliku:
leonardo
Zapisz
Zapisz jako typ:
ATP file (*.atp)
Anuluj

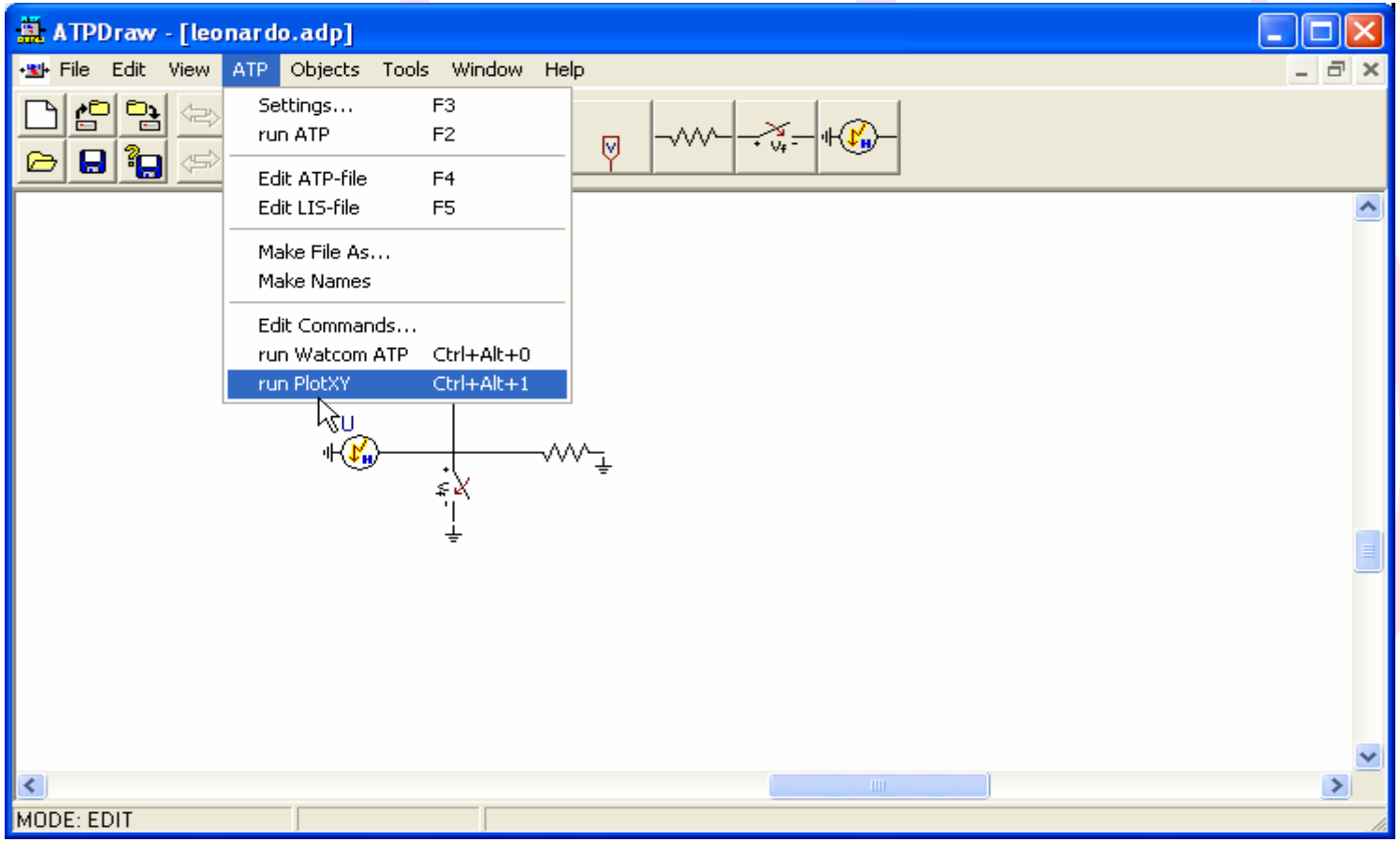
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
Settings... F3
run ATP F2
Edit ATP-file F4
Edit LIS-file F5
Make File As...
Make Names
Edit Commands...
run Watcom ATP Ctrl+Alt+0
run PlotXY Ctrl+Alt+1
U
MODE: EDIT

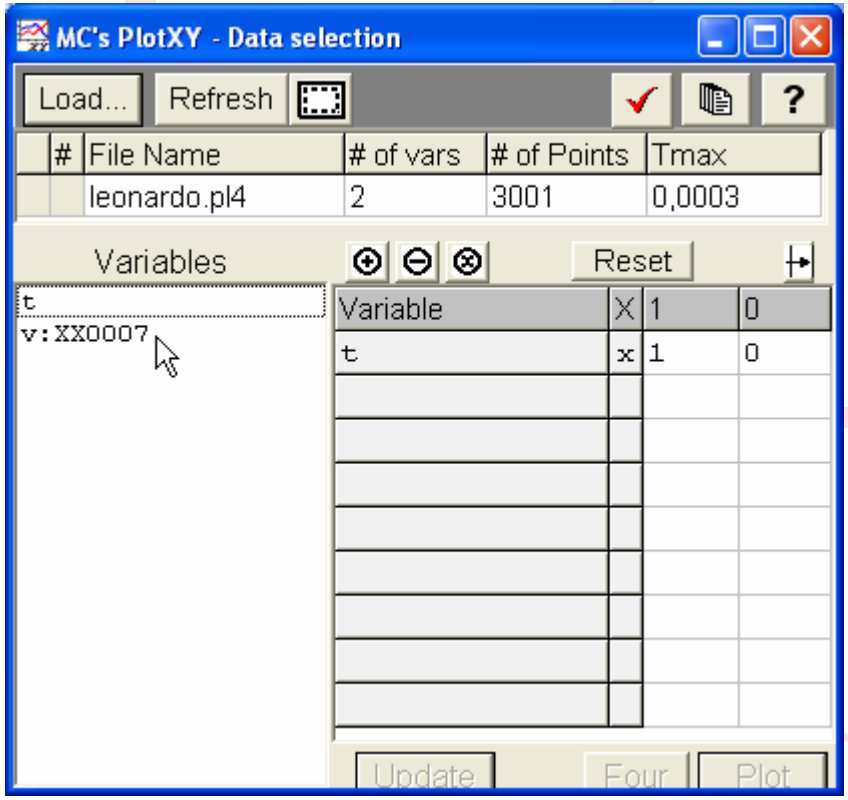
ATP Draw


C:\WINDOWS\system32\cmd.exe
Tde >< Ie ><Vf/CLOP >< type >
Switch. 0.00E+00 1.00E-03 1.00E-04 1.35E+03 ¦ XX0007
.001 .0001 1350. 0
Blank card ending switches. KSWTCH = 1. ¦BLANK SWITCH
Comment card. KOMPAR > 0. ¦C < n 1><>< Ampl. >< Freq.
><Phase/T0>< A1 >< T1 >< TSTART >< TSTOP >
Source. 1.00E+04 1.20E-06 5.00E-05 0.00E+00 ¦15XX0007 0 1.E4 1.2E-
6 5.E-5 2. 1.
Blank card ends electric sources. KCONST = 1 ¦BLANK SOURCE
List of input elements that are connected to each node. Only the physical conn
ections of multi-phase lines are shown (capacitive
and inductive coupling are ignored). Repeated entries indicate parallel connec
tions. Switches are included, although sources
(including rotating machinery) are omitted -- except that U.M. usage produces ex
tra, internally-defined nodes "UMXXXX".
From bus name ¦ Names of all adjacent busses.
XX0007 ¦TERRA *TERRA *
TERRA ¦XX0007*XX0007*
Card of names for time-step loop output. ¦ XX0007
Blank card ending requests for output variables. ¦BLANK OUTPUT

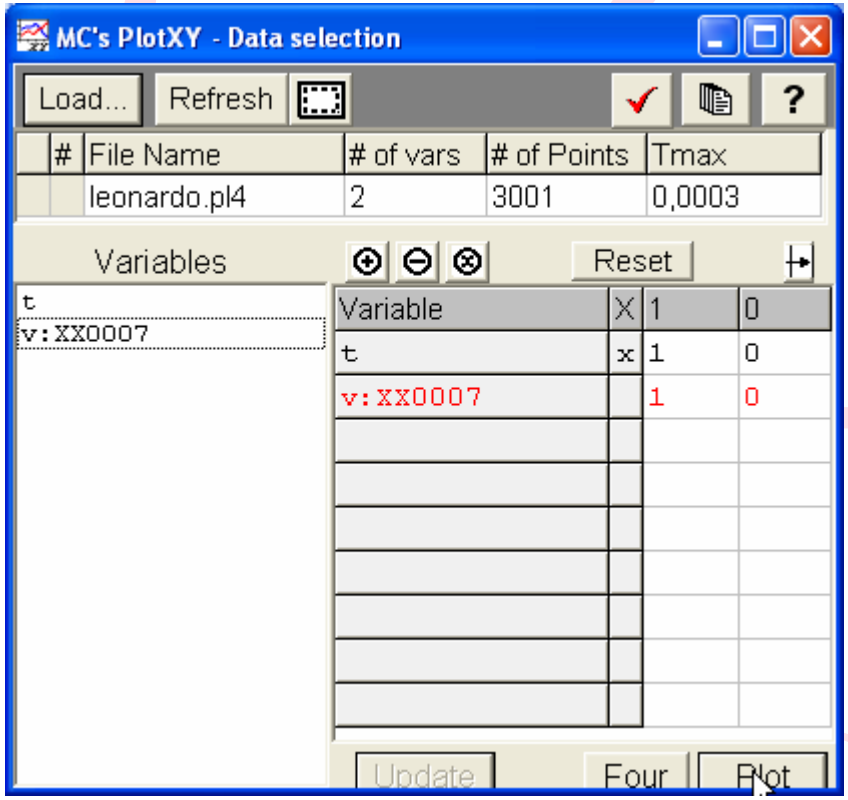
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
Settings... F3
run ATP F2
Edit ATP-file F4
Edit LIS-file F5
Make File As...
Make Names
Edit Commands...
run Watcom ATP Ctrl+Alt+0
run PlotXY Ctrl+Alt+1
U
MODE: EDIT

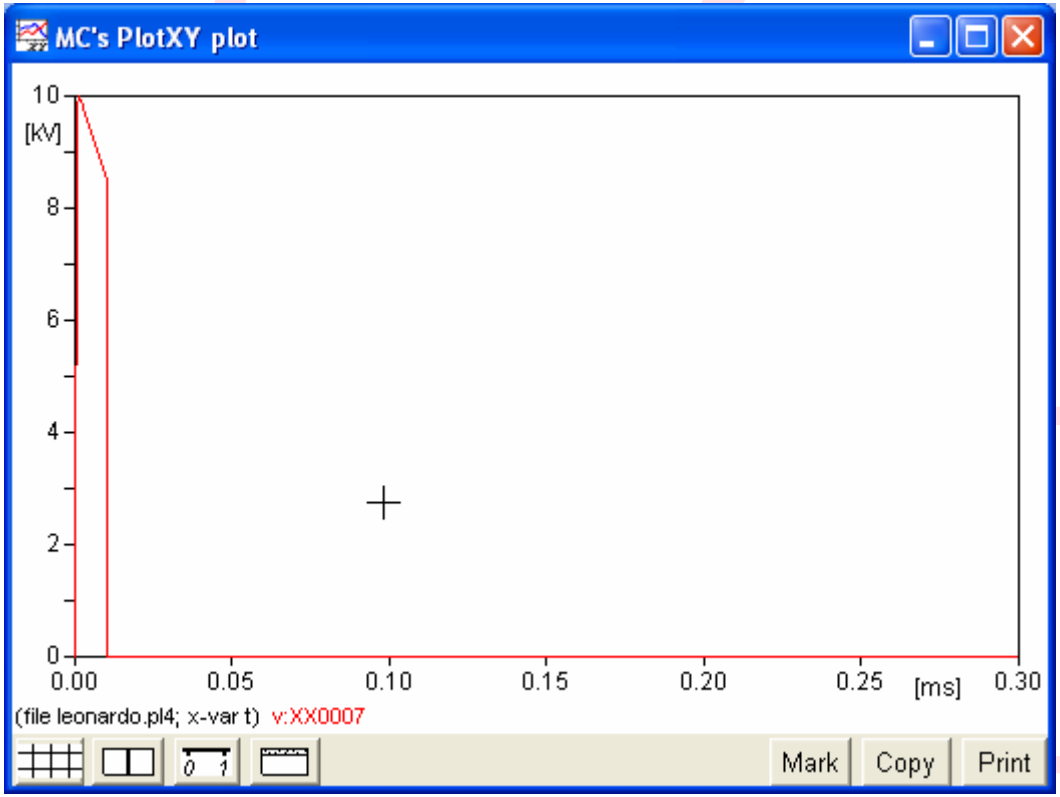
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 2 3001 0,0003
Variables
Reset
t
v:XX0007
Variable X 1 0
t x 1 0
Update
Four
Plot

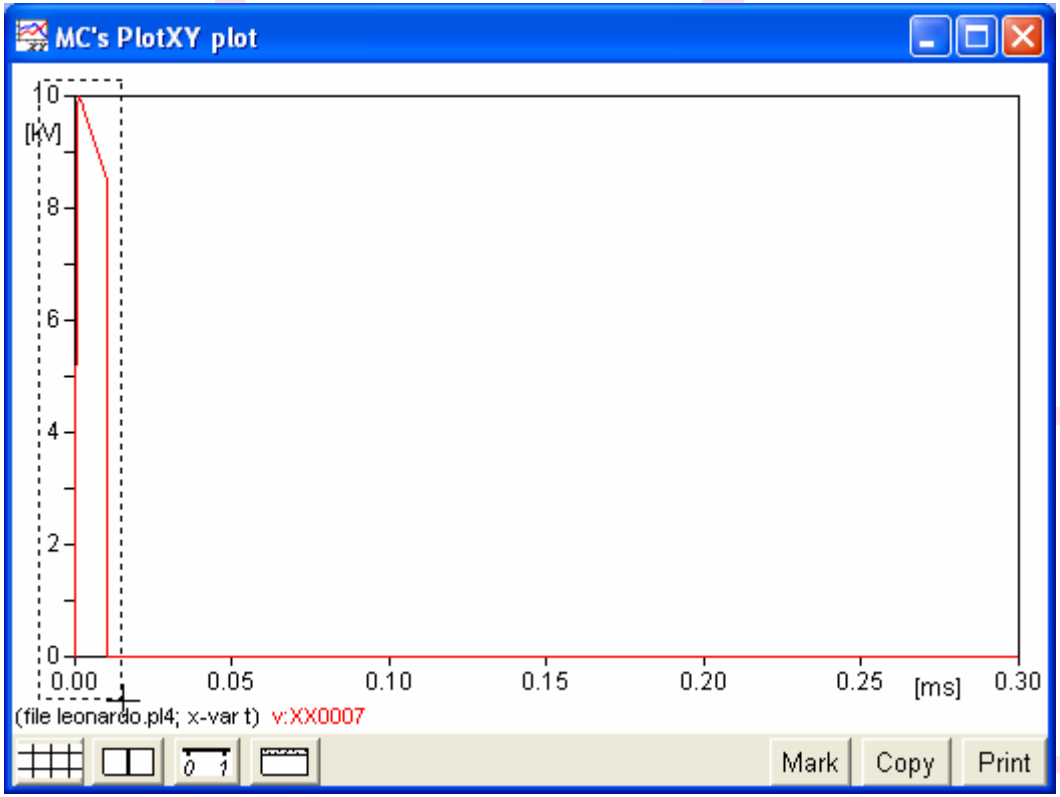
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 2 3001 0,0003
Variables
Reset
t
v:XX0007
Variable X 1 0
t x 1 0
v:XX0007 1 0
Update
Four
Plot

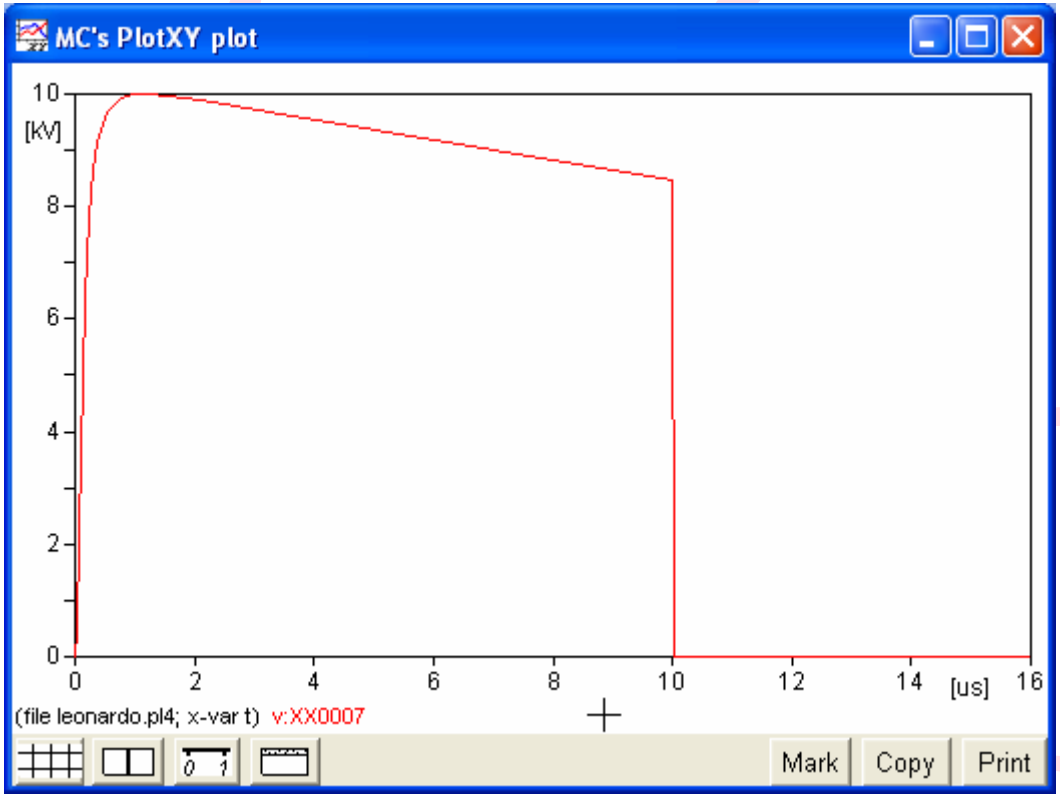
ATP Draw


MC's PlotXY plot
10
[kV]
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file leonardo.pl4; x-var t) v:XX0007
Mark
Copy
Print

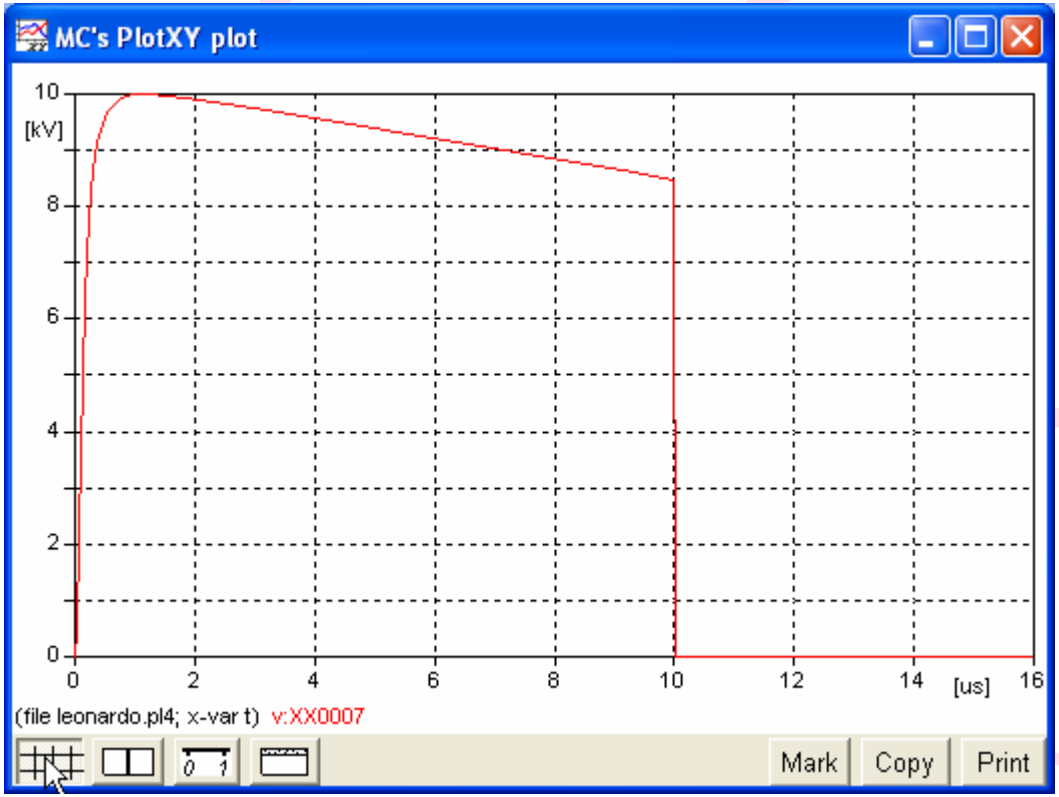
ATP Draw


MC's PlotXY plot
10
[kV]
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file leonardo.pl4; x-var t) v:XX0007
Mark
Copy
Print

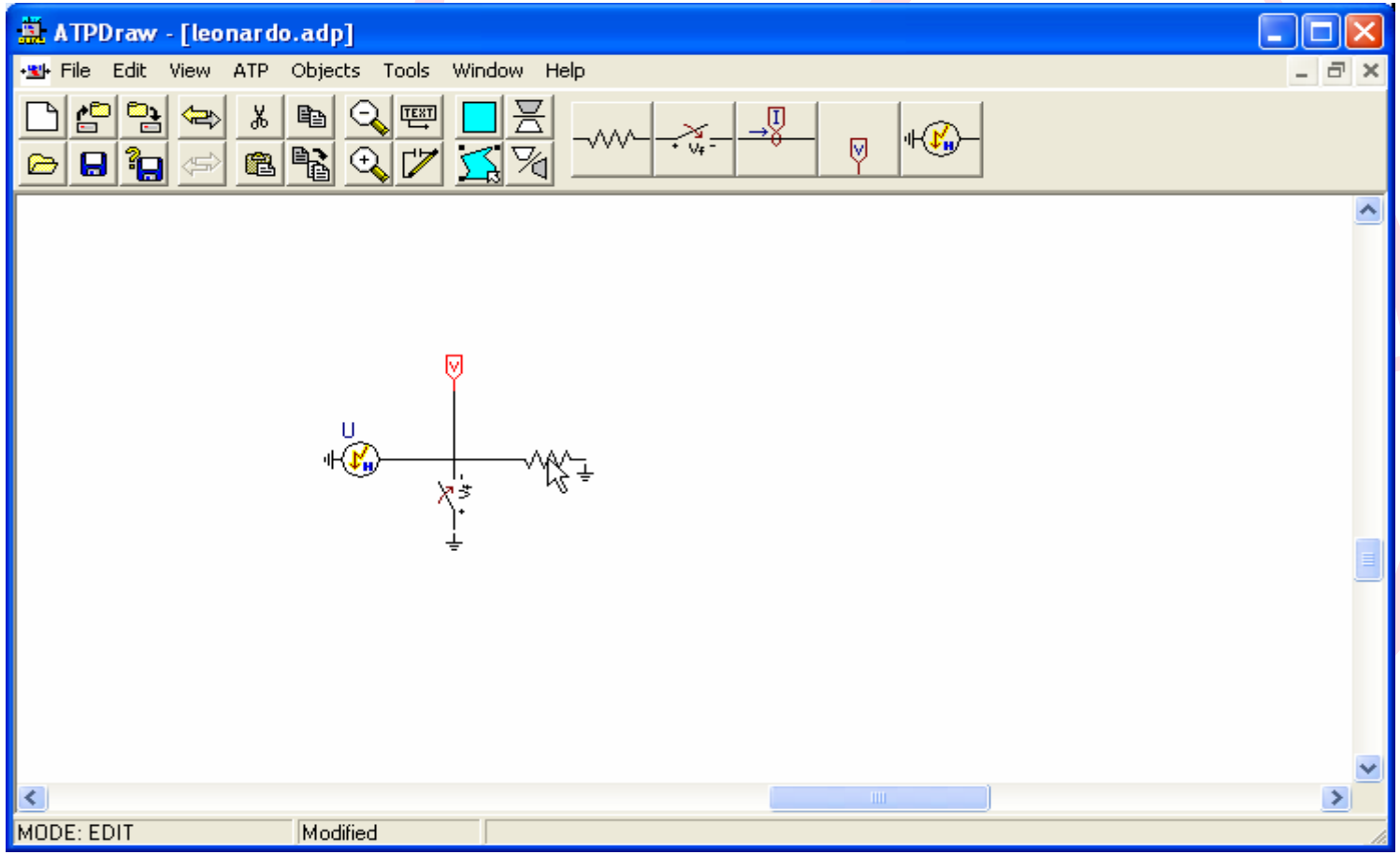
ATP Draw


MC's PlotXY plot
10
[kV]
8
6
4
2
0
0
2
4
6
8
10
12
14
[us]
16
(file leonardo.pl4; x-var t) v:XX0007
Mark
Copy
Print

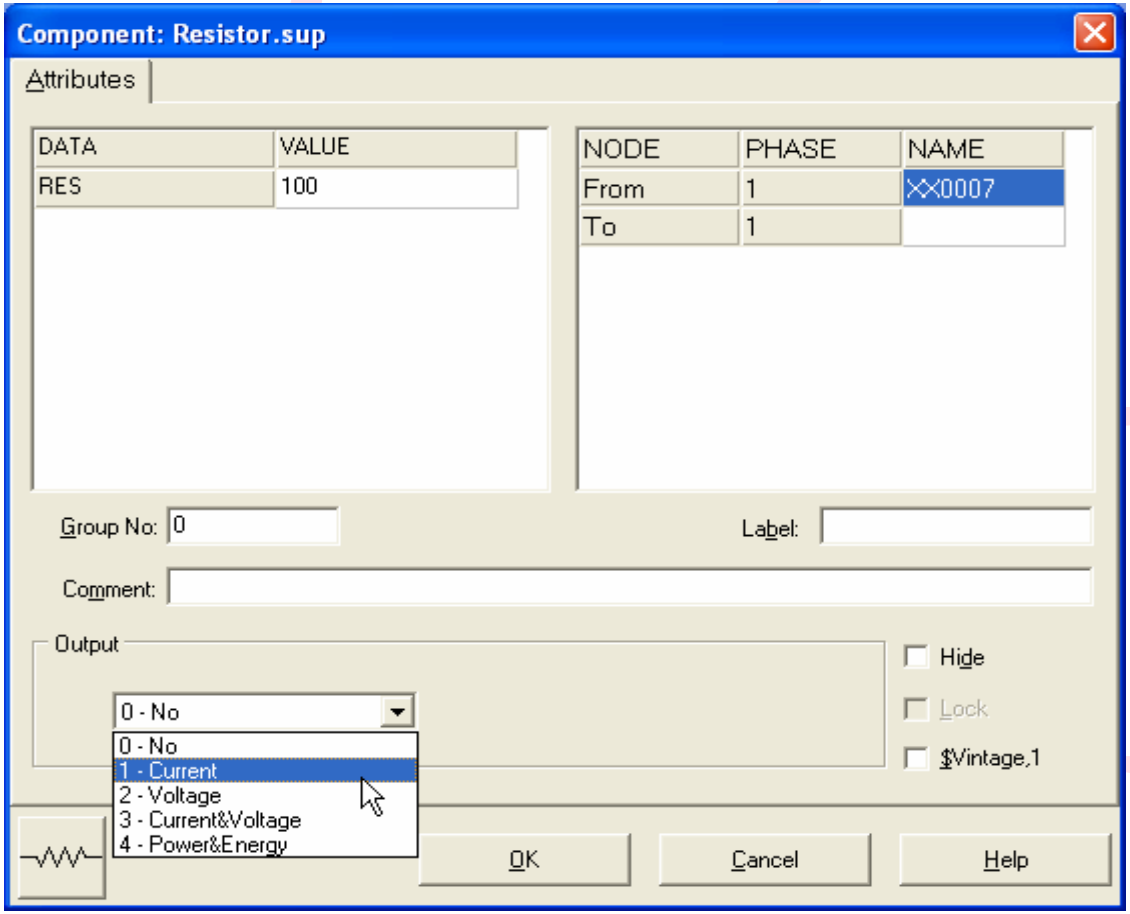
ATP Draw


MC's PlotXY plot
10
[kV]
8
6
4
2
0
0
2
4
6
8
10
12
14
[us]
16
(file leonardo.pl4; x-var t) v:XX0007
Mark
Copy
Print

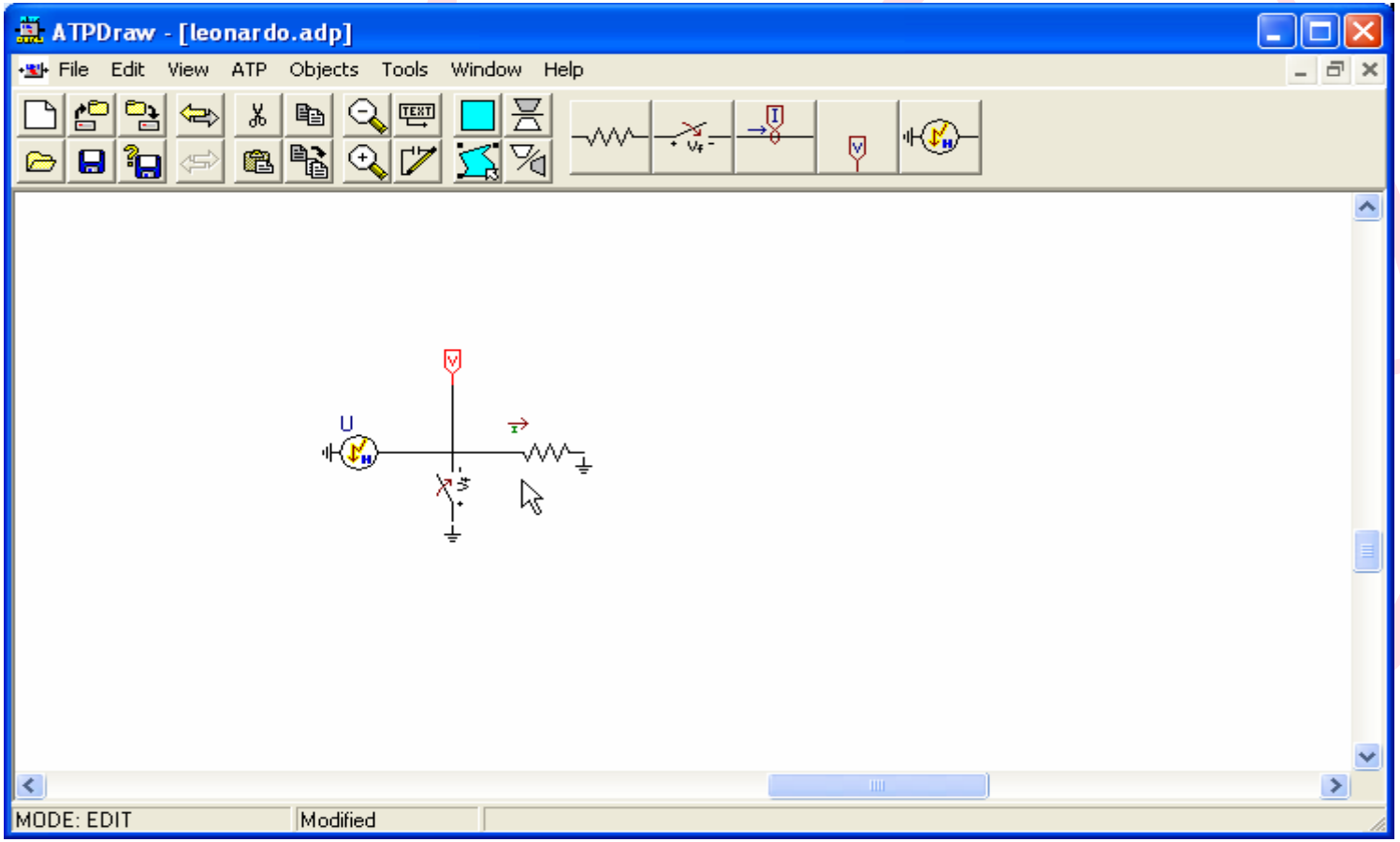
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
U
MODE: EDIT
Modified

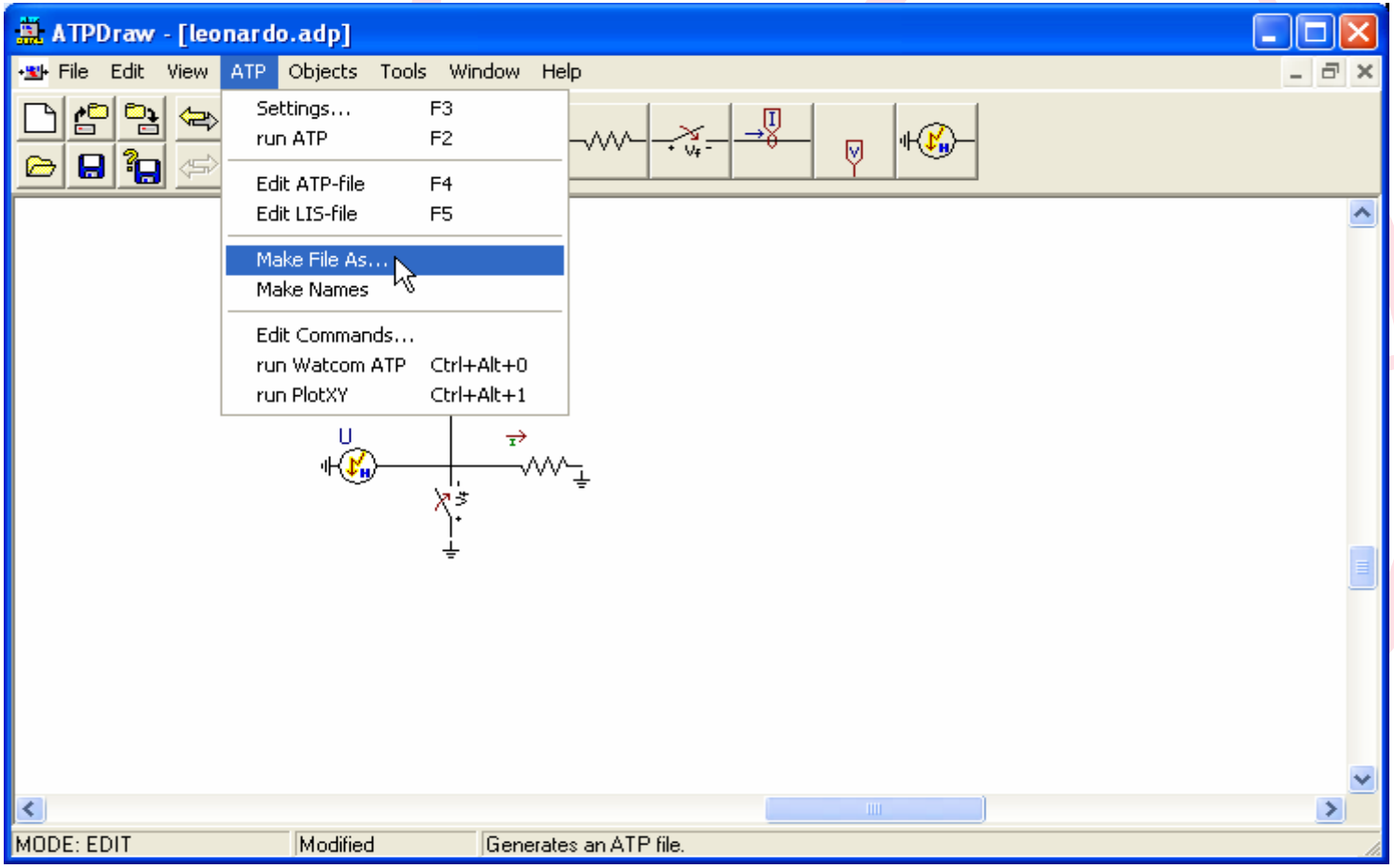
ATP Draw


Component: Resistor.sup
Attributes
DATA
VALUE
RES
100
NODE
PHASE
NAME
From
1
XX0007
To
1
Group No:
0
Label:
Comment:
Output
0 - No
0 - No
1 - Current
2 - Voltage
3 - Current&Voltage
4 - Power&Energy
Hide
Lock
$Vintage,1
OK
Cancel
Help

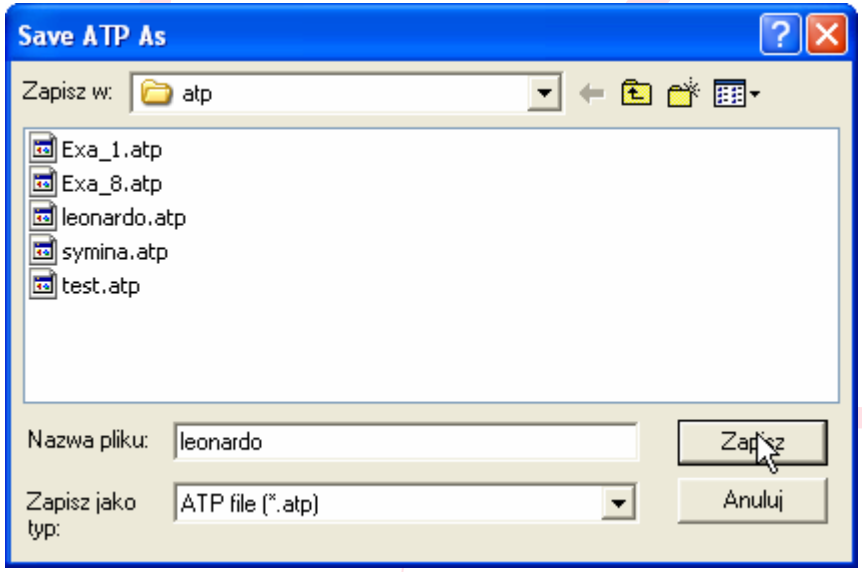
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
TEXT
U
MODE: EDIT
Modified

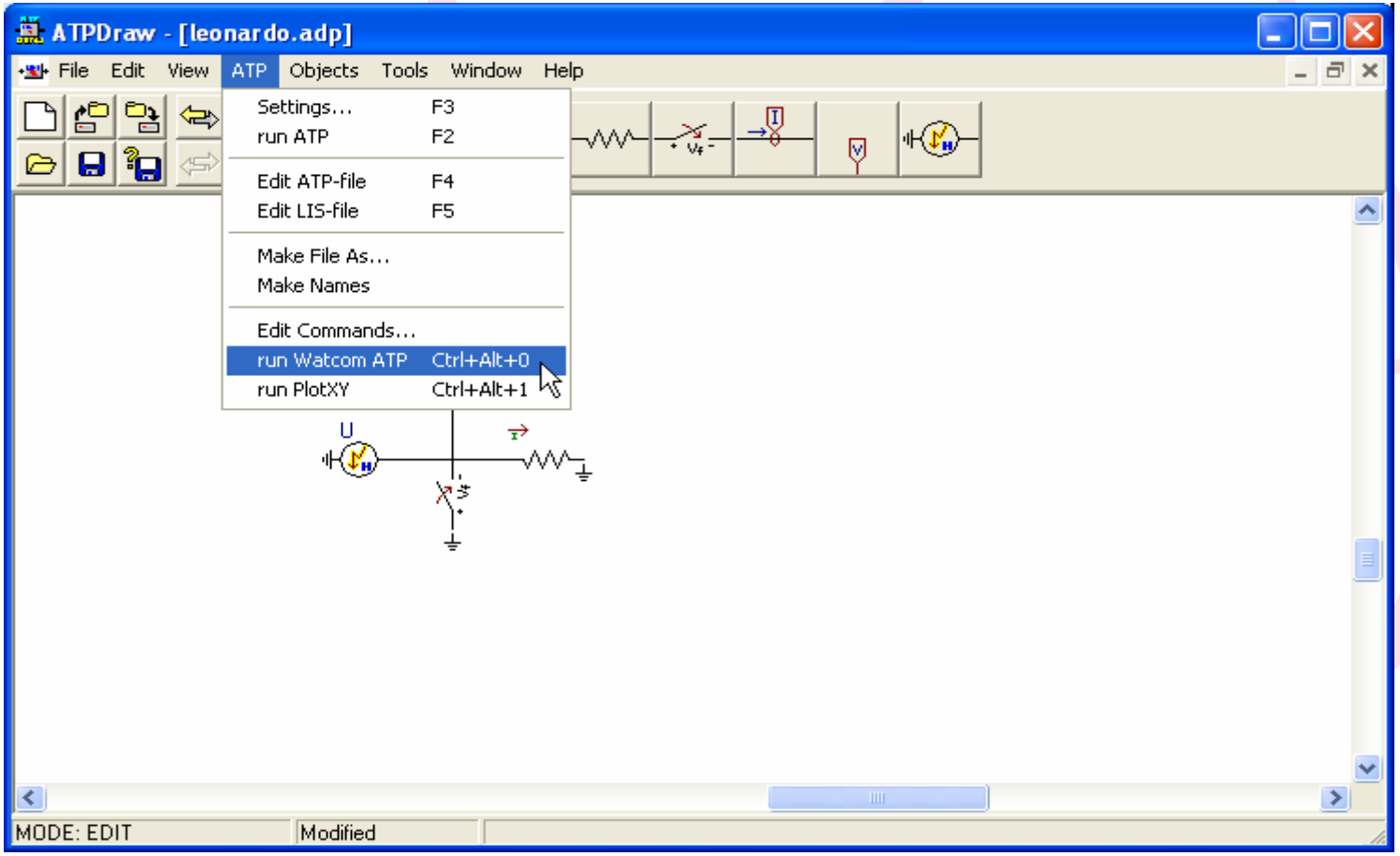
ATP Draw



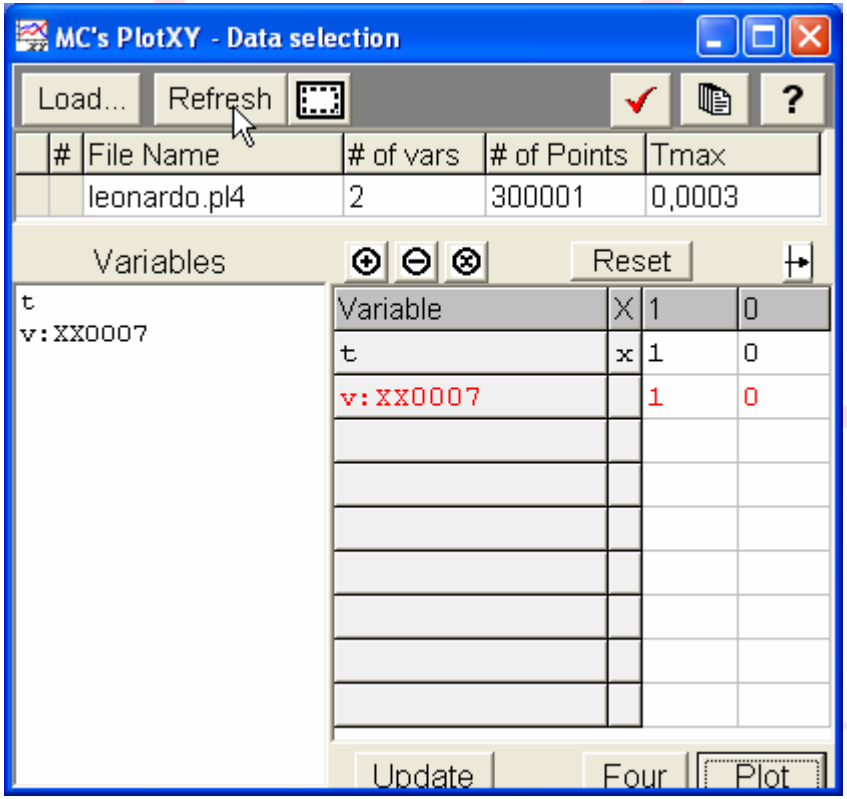
ATP Draw


Save ATP As
Zapisz w:
atp
Exa_1.atp
Exa_8.atp
leonardo.atp
symina.atp
test.atp
Nazwa pliku:
leonardo
Zapisz
Zapisz jako typ:
ATP file (*.atp)
Anuluj

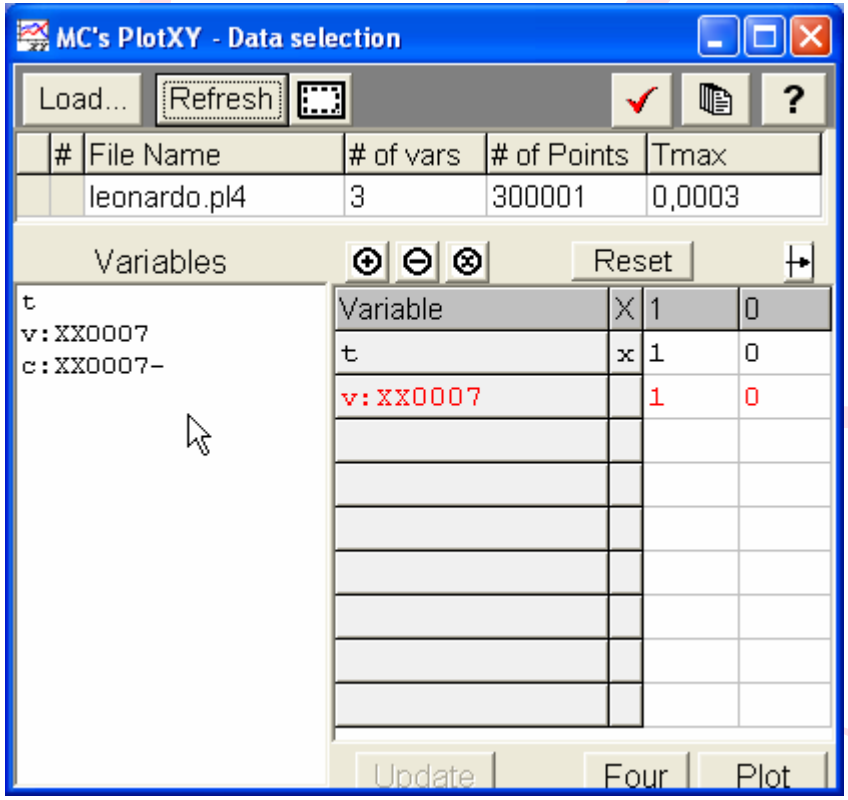
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
Settings... F3
run ATP F2
Edit ATP-file F4
Edit LIS-file F5
Make File As...
Make Names
Edit Commands...
run Watcom ATP Ctrl+Alt+0
run PlotXY Ctrl+Alt+1
U
MODE: EDIT
Modified

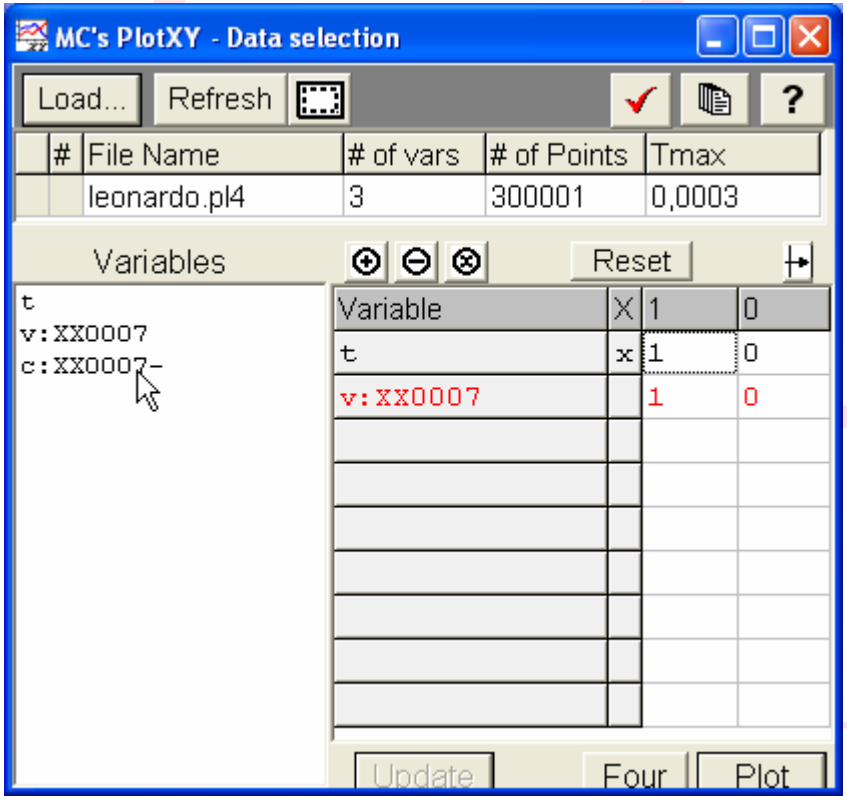
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 2 300001 0,0003
Variables
Reset
t
v:XX0007
Variable X 1 0
t x 1 0
v:XX0007 1 0
Update
Four
Plot

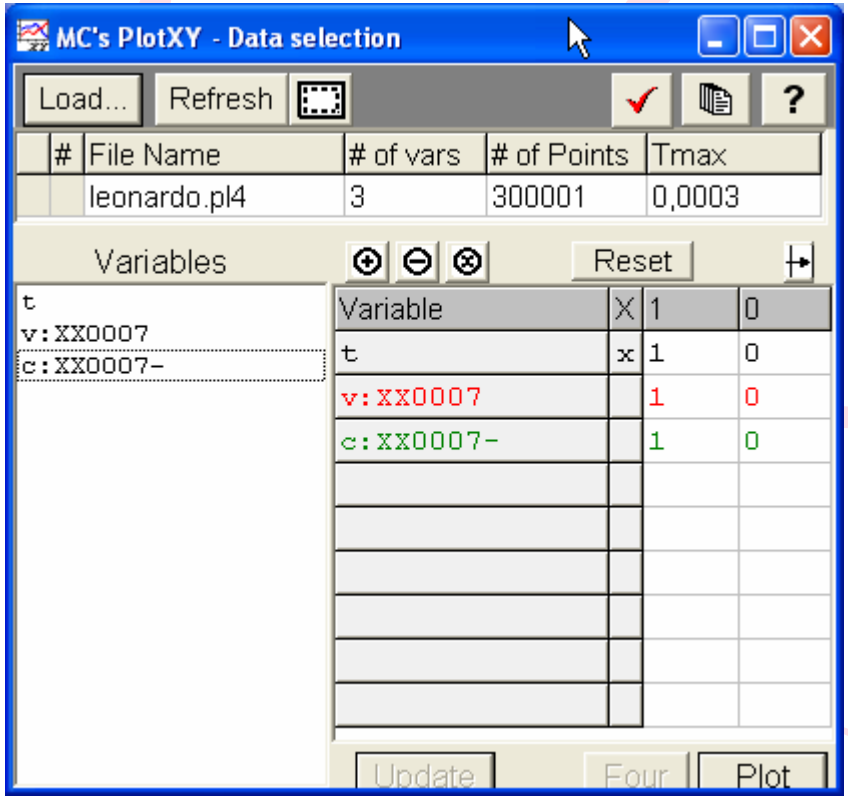
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
v:XX0007 1 0
Update
Four
Plot

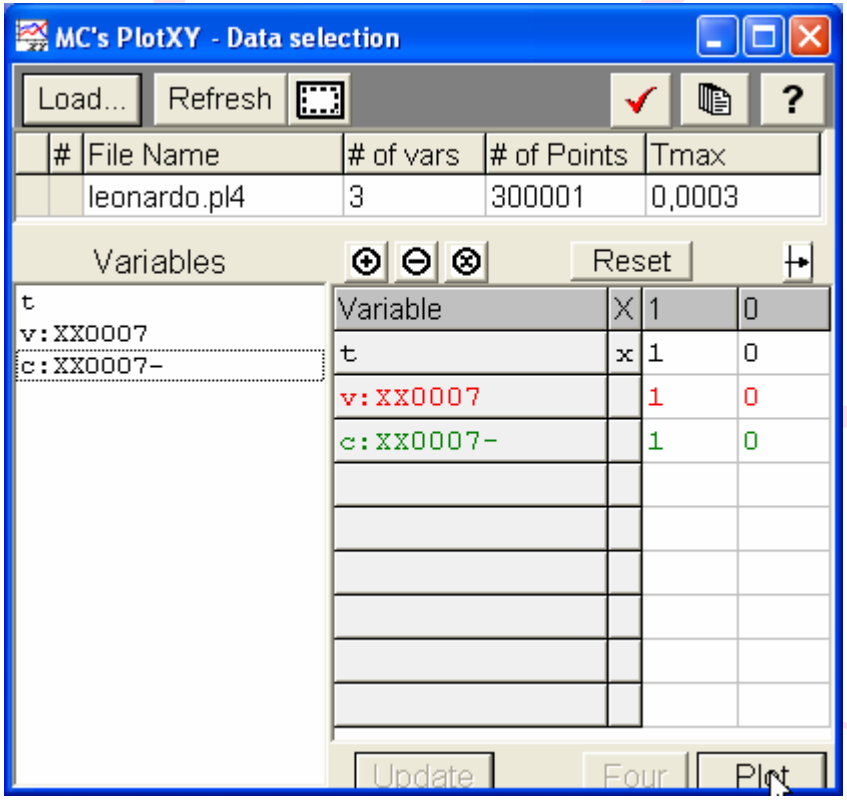
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
v:XX0007 1 0
Update
Four
Plot

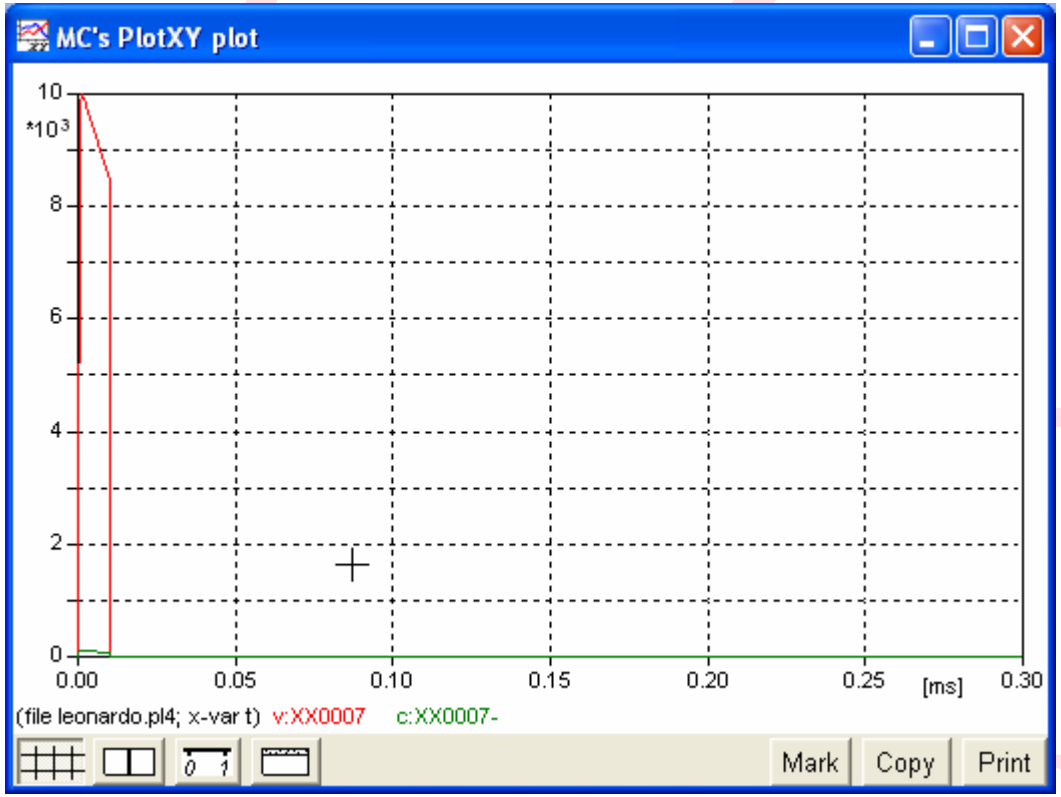
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
v:XX0007 1 0
c:XX0007- 1 0
Update
Four
Plot

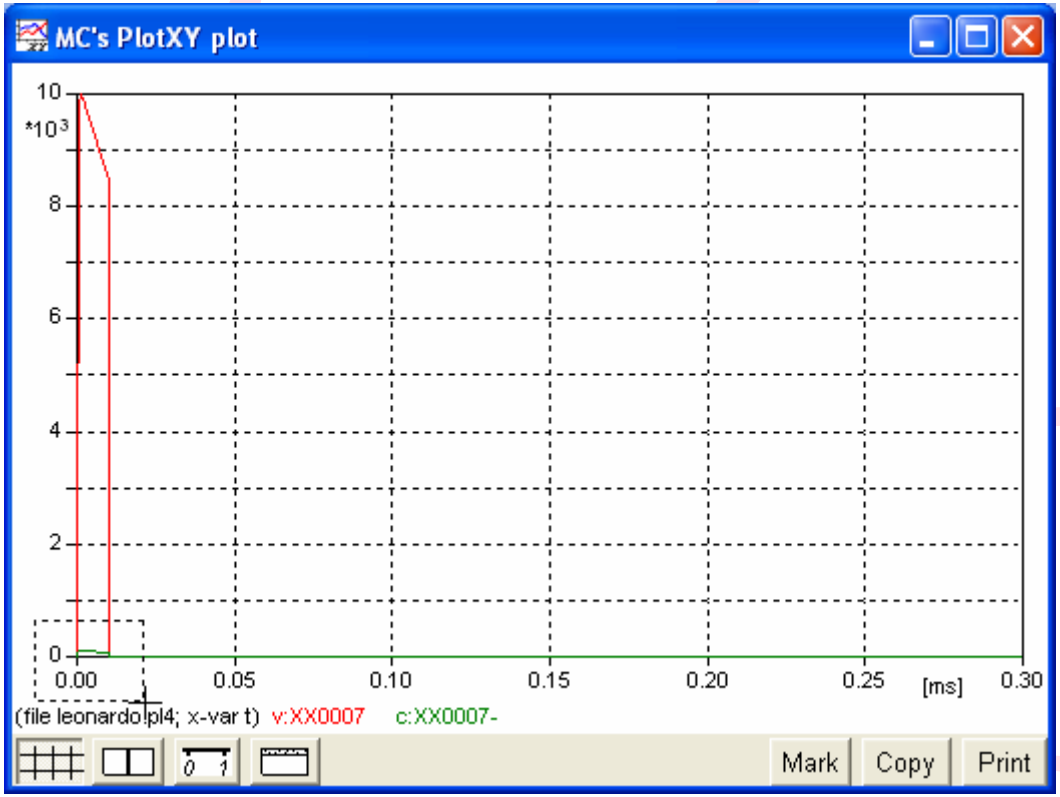
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
v:XX0007 1 0
c:XX0007- 1 0
Update
Four
Plot

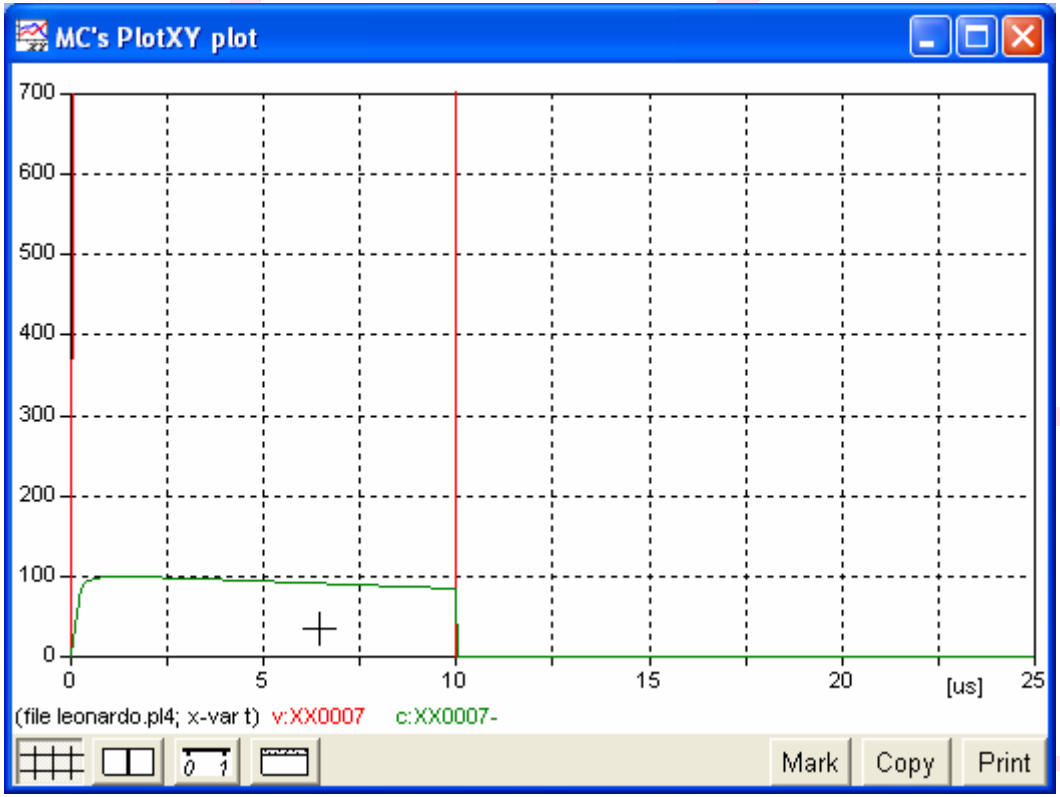
ATP Draw


MC's PlotXY plot
10
*10^3
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file leonardo.pl4; x-var t) v:XX0007 c:XX0007-
Mark
Copy
Print

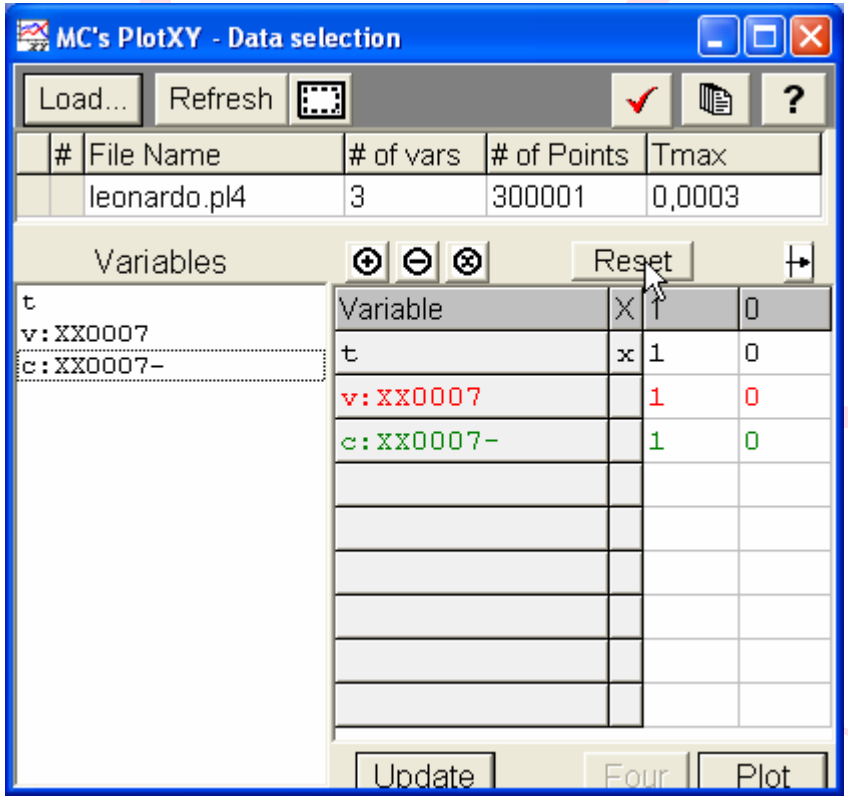
ATP Draw


MC's PlotXY plot
10
*10³
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file leonardo.pl4; x-var t) v:XX0007 c:XX0007-
Mark
Copy
Print

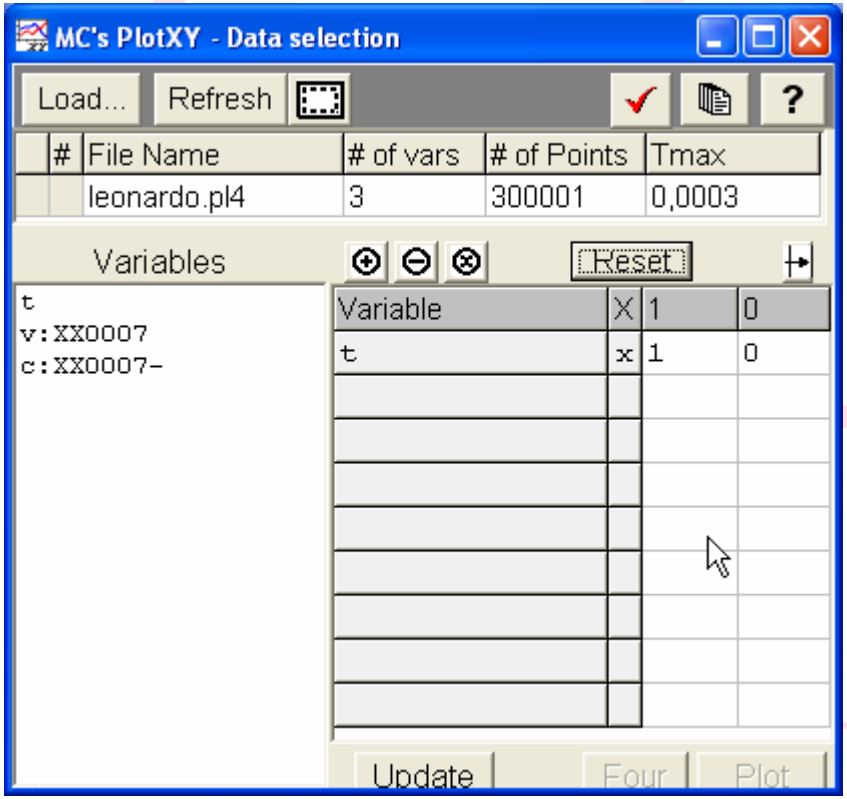
ATP Draw


MC's PlotXY plot
700
600
500
400
300
200
100
0
0
5
10
15
20
[us]
25
(file leonardo.pl4; x-var t) v:XX0007 c:XX0007-
Mark
Copy
Print

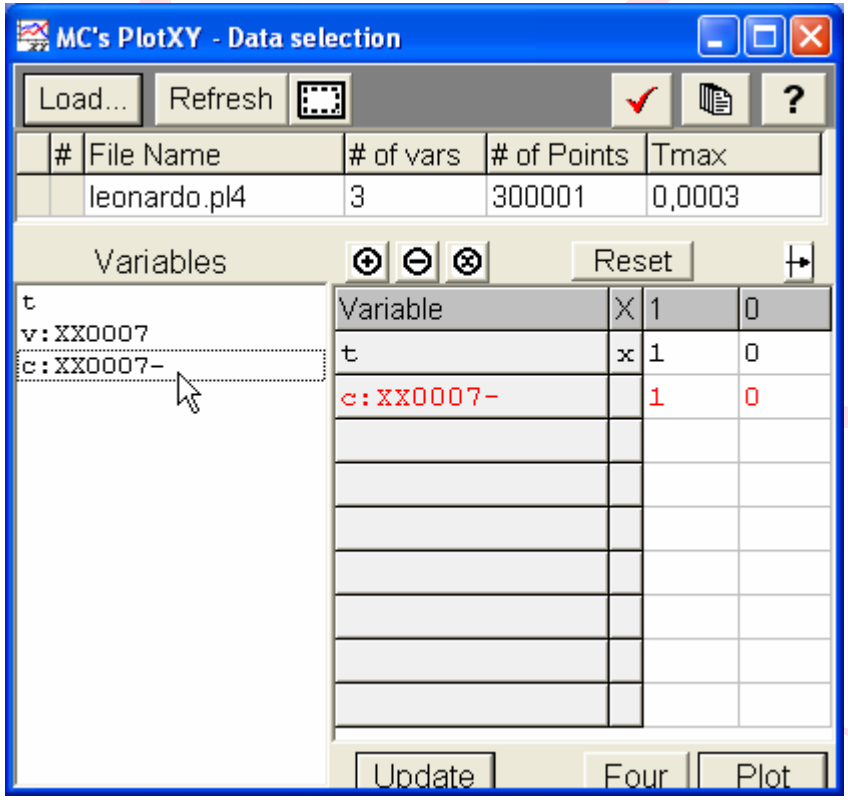
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
v:XX0007 1 0
c:XX0007- 1 0
Update
Four
Plot

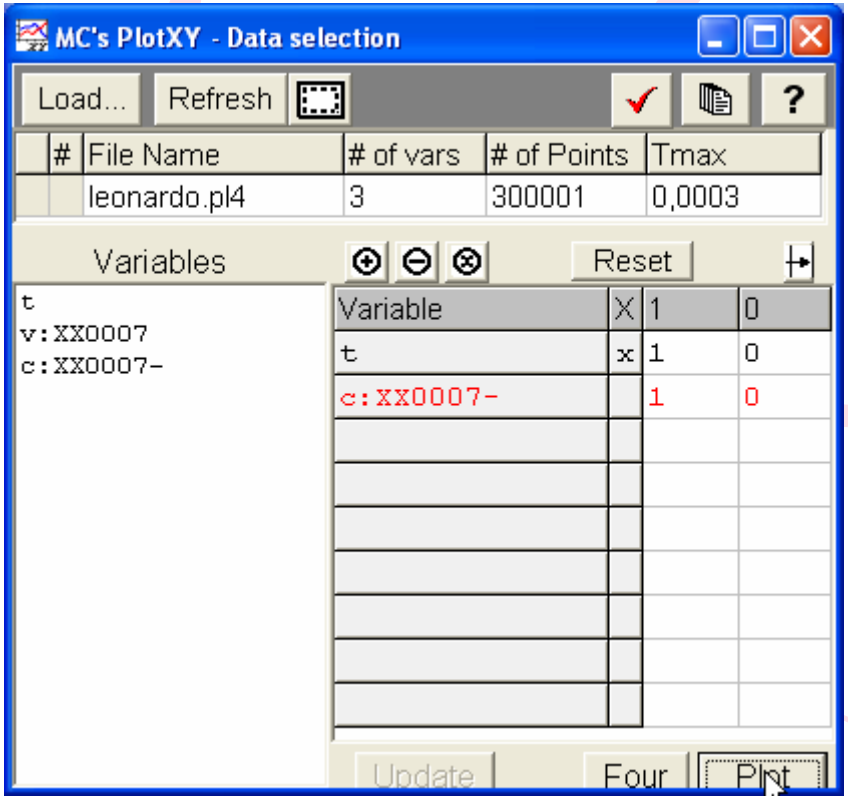
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
Update
Four
Plot

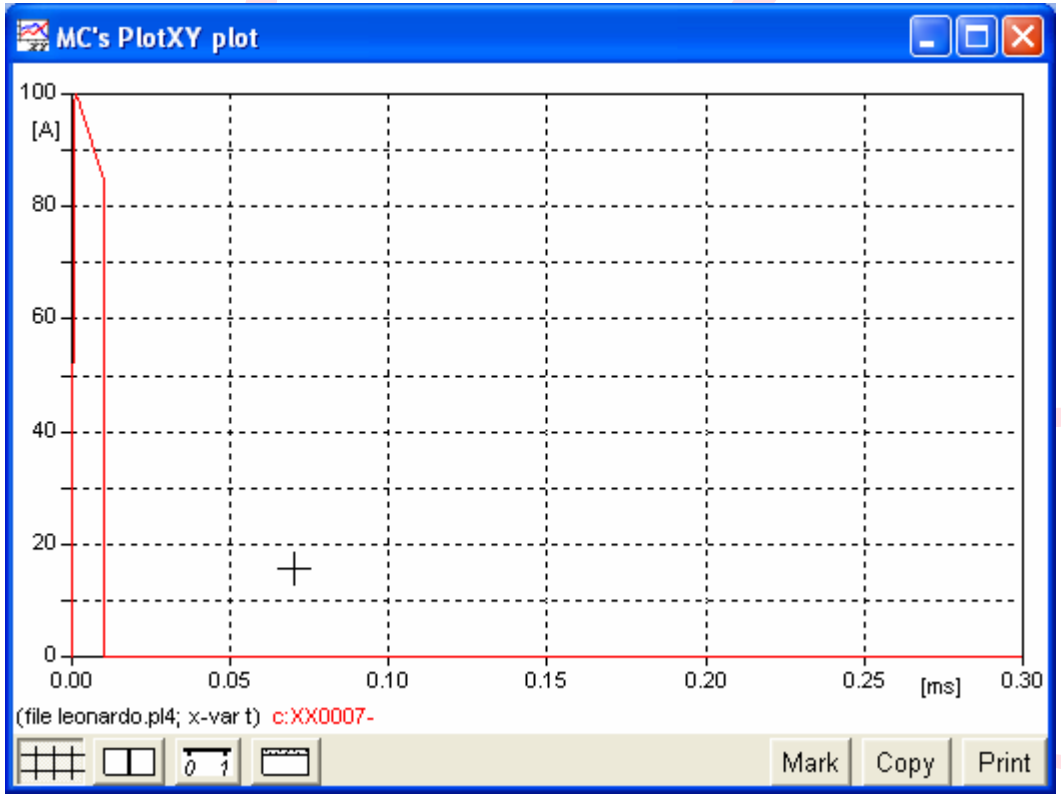
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
c:XX0007- 1 0
Update
Four
Plot

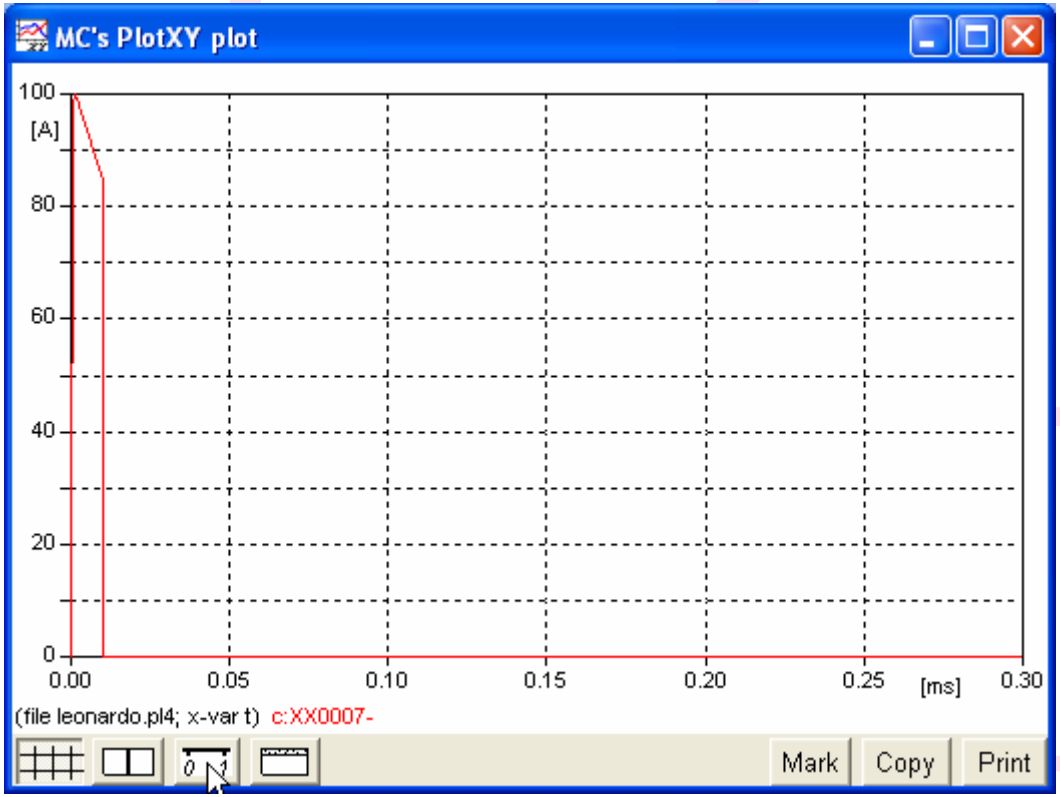
ATP Draw


MC's PlotXY - Data selection
Load...
Refresh
File Name # of vars # of Points Tmax
leonardo.pl4 3 300001 0,0003
Variables
Reset
t
v:XX0007
c:XX0007-
Variable X 1 0
t x 1 0
c:XX0007- 1 0
Update
Four
Plot

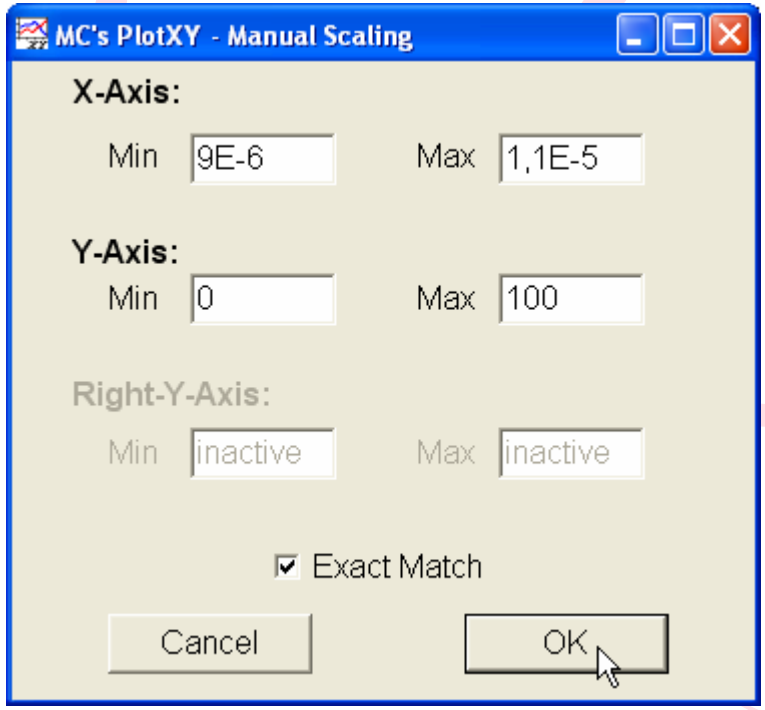
ATP Draw


MC's PlotXY plot
100
[A]
80
60
40
20
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file leonardo.pl4; x-var t) c:XX0007-
Mark
Copy
Print

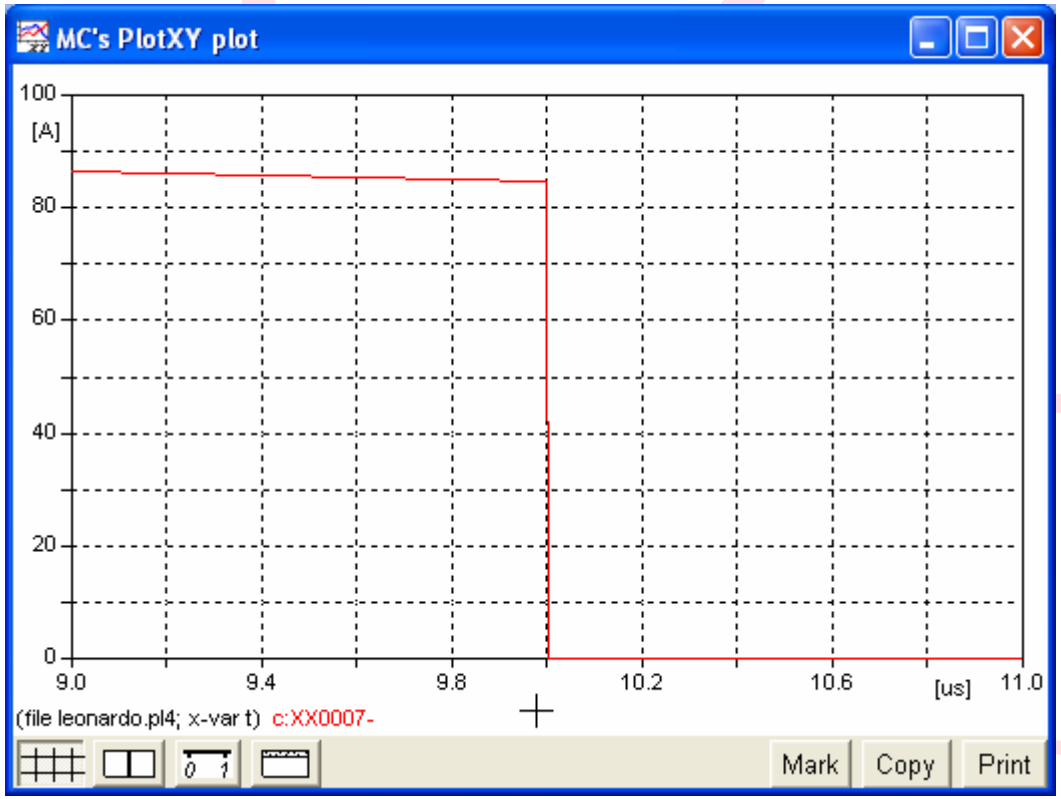
ATP Draw


MC's PlotXY plot
100
[A]
80
60
40
20
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file leonardo.pl4; x-var t) c:XX0007-
Mark
Copy
Print

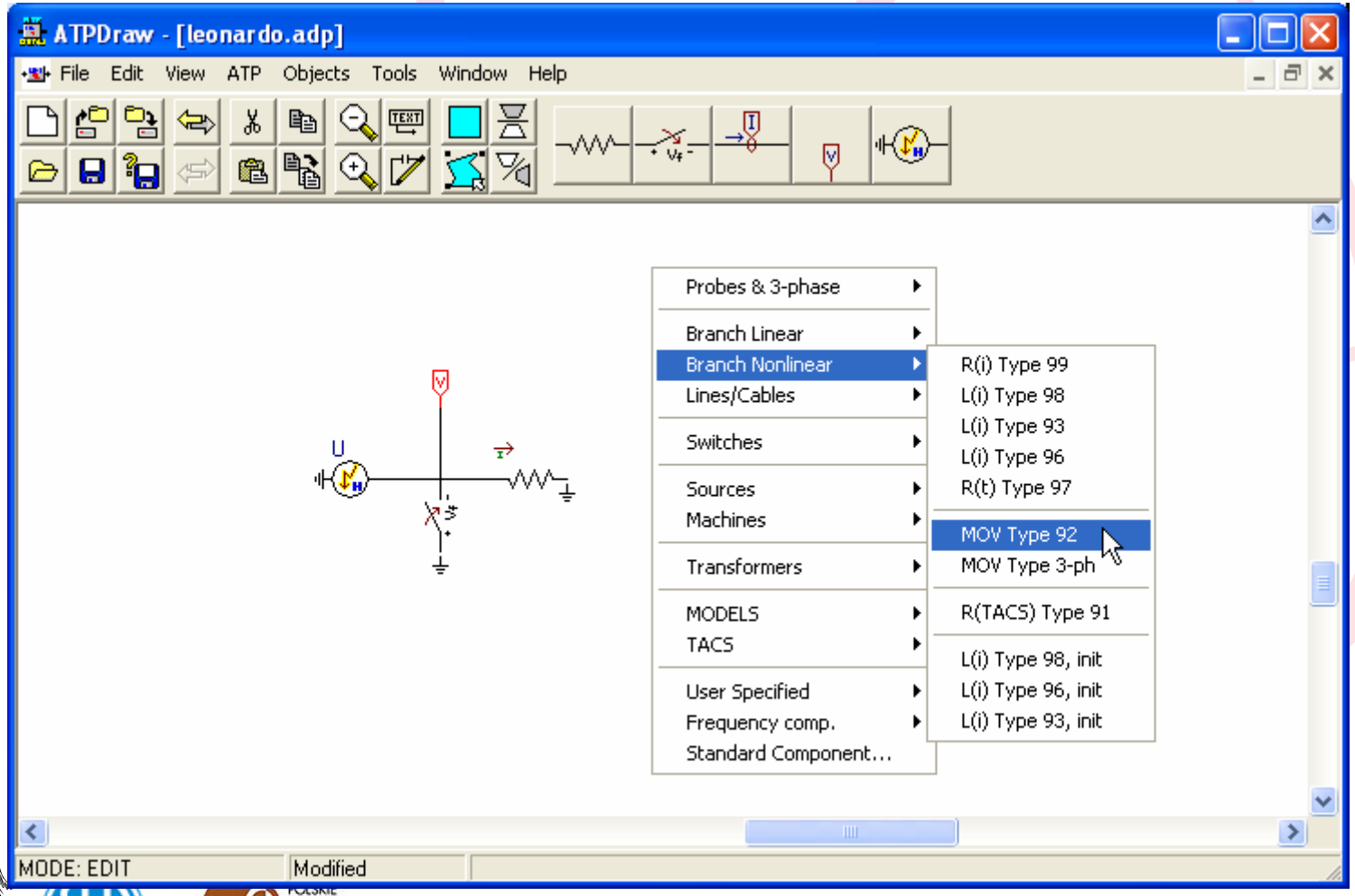
ATP Draw


MC's PlotXY - Manual Scaling
X-Axis:
Min
9E-6
Max
1,1E-5
Y-Axis:
Min
0
Max
100
Right-Y-Axis:
Min
inactive
Max
inactive
Exact Match
Cancel
OK

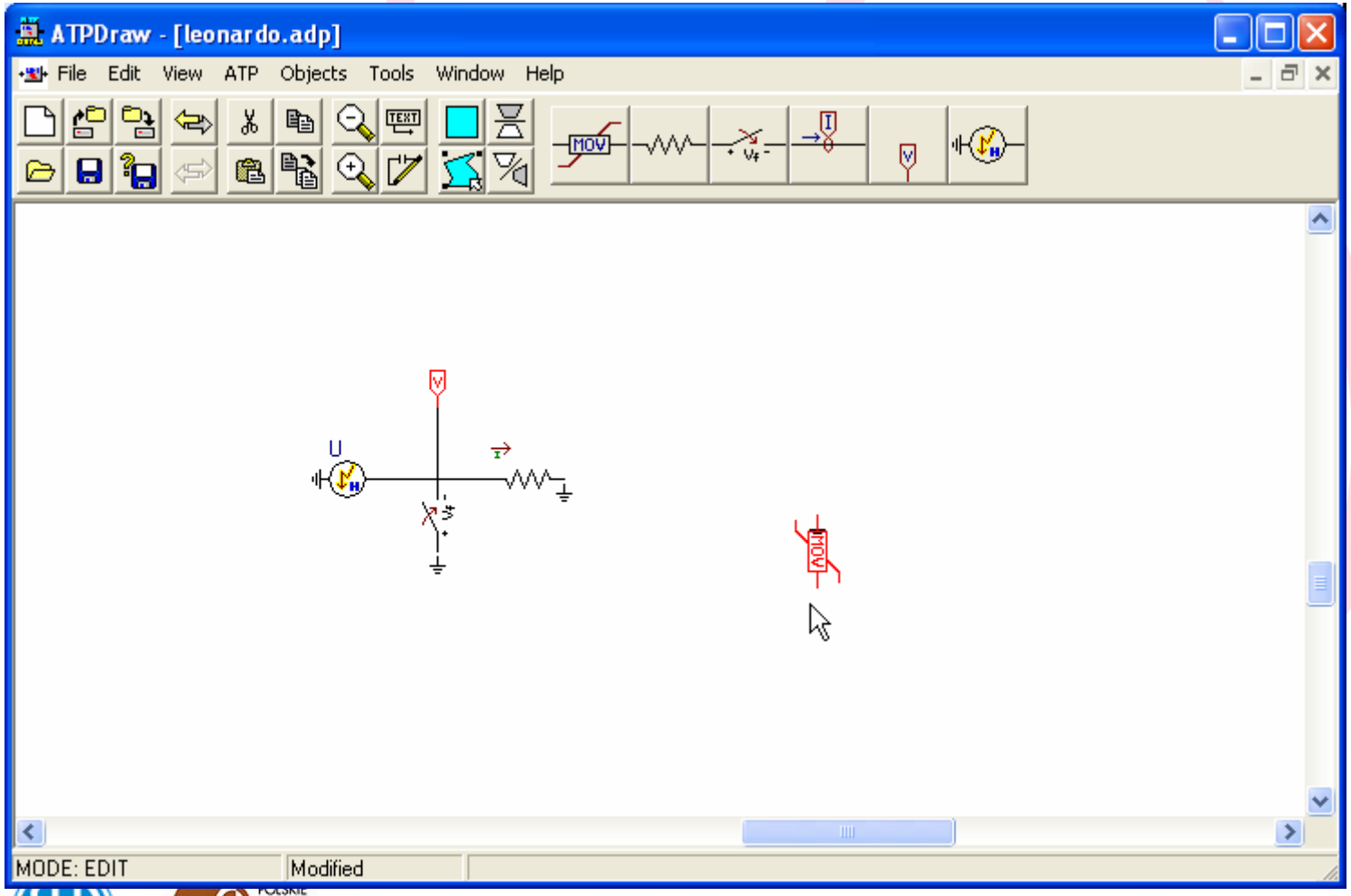
ATP Draw


MC's PlotXY plot
100
[A]
80
60
40
20
0
9.0
9.4
9.8
10.2
10.6
[us]
11.0
(file leonardo.pl4; x-var t) c:XX0007-
Mark
Copy
Print

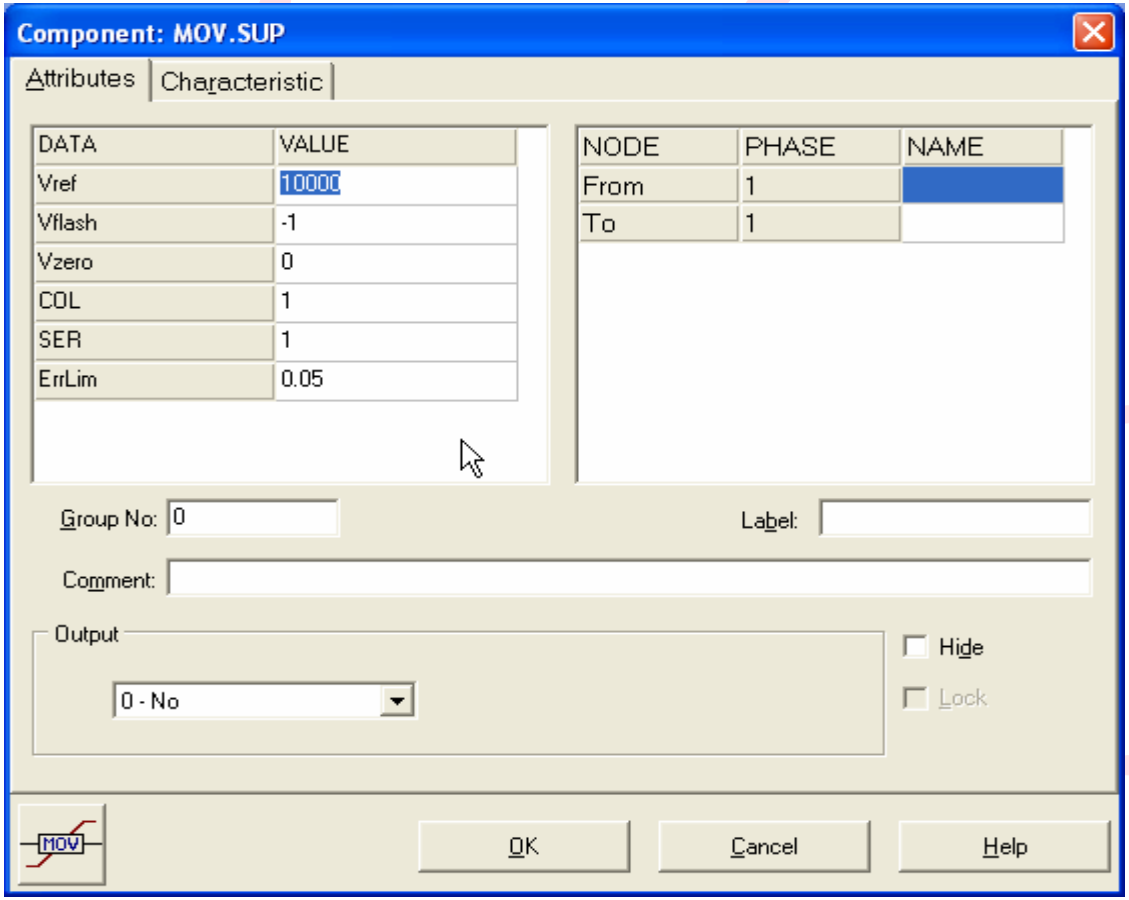
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
Probes & 3-phase
Branch Linear
Branch Nonlinear
Lines/Cables
Switches
Sources
Machines
Transformers
MODELS
TACS
User Specified
Frequency comp.
Standard Component...
R(i) Type 99
L(i) Type 98
L(i) Type 93
L(i) Type 96
R(t) Type 97
MOV Type 92
MOV Type 3-ph
R(TACS) Type 91
L(i) Type 98, init
L(i) Type 96, init
L(i) Type 93, init
MODE: EDIT
Modified

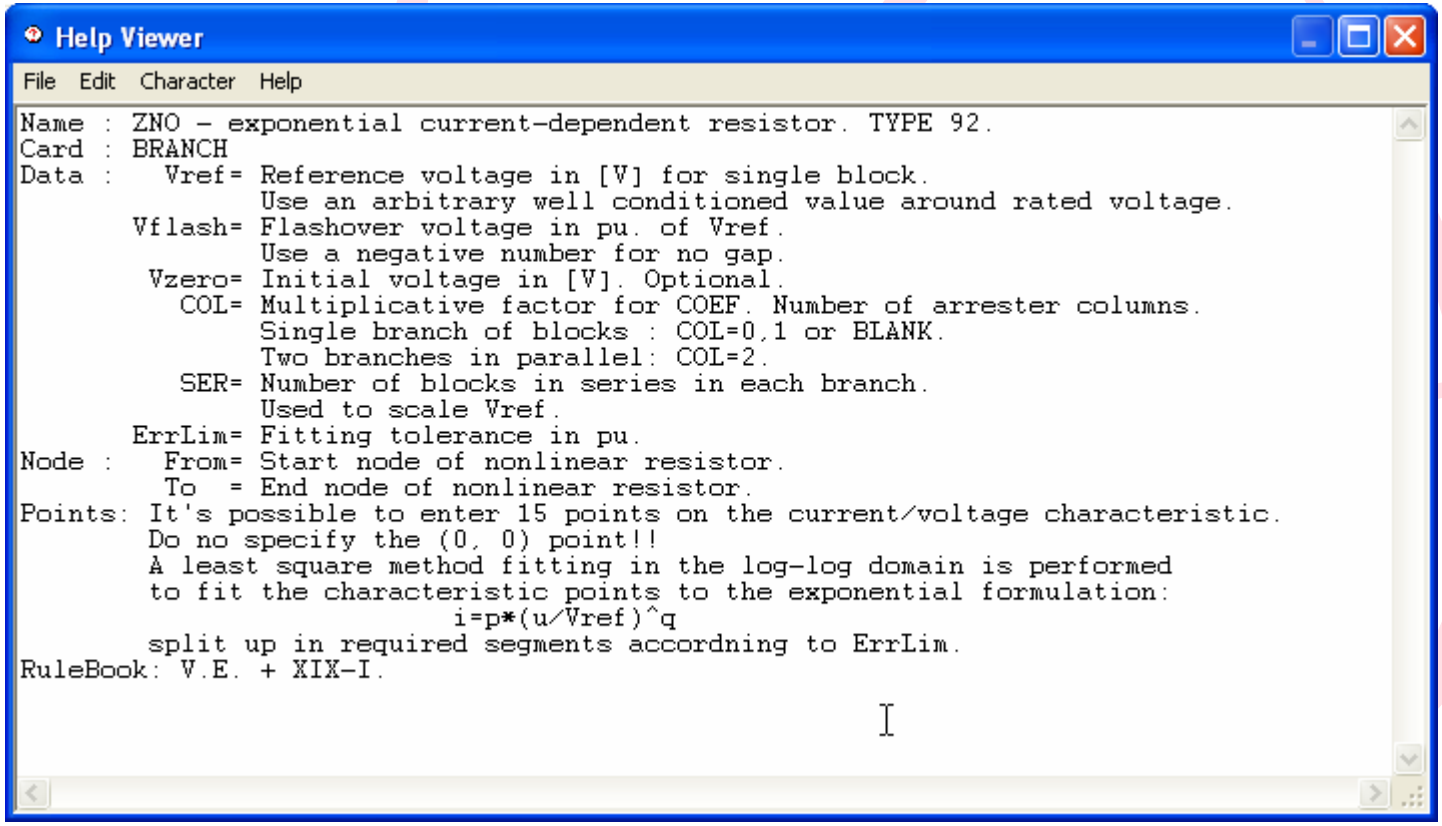
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
MOV
U
MODE: EDIT
Modified

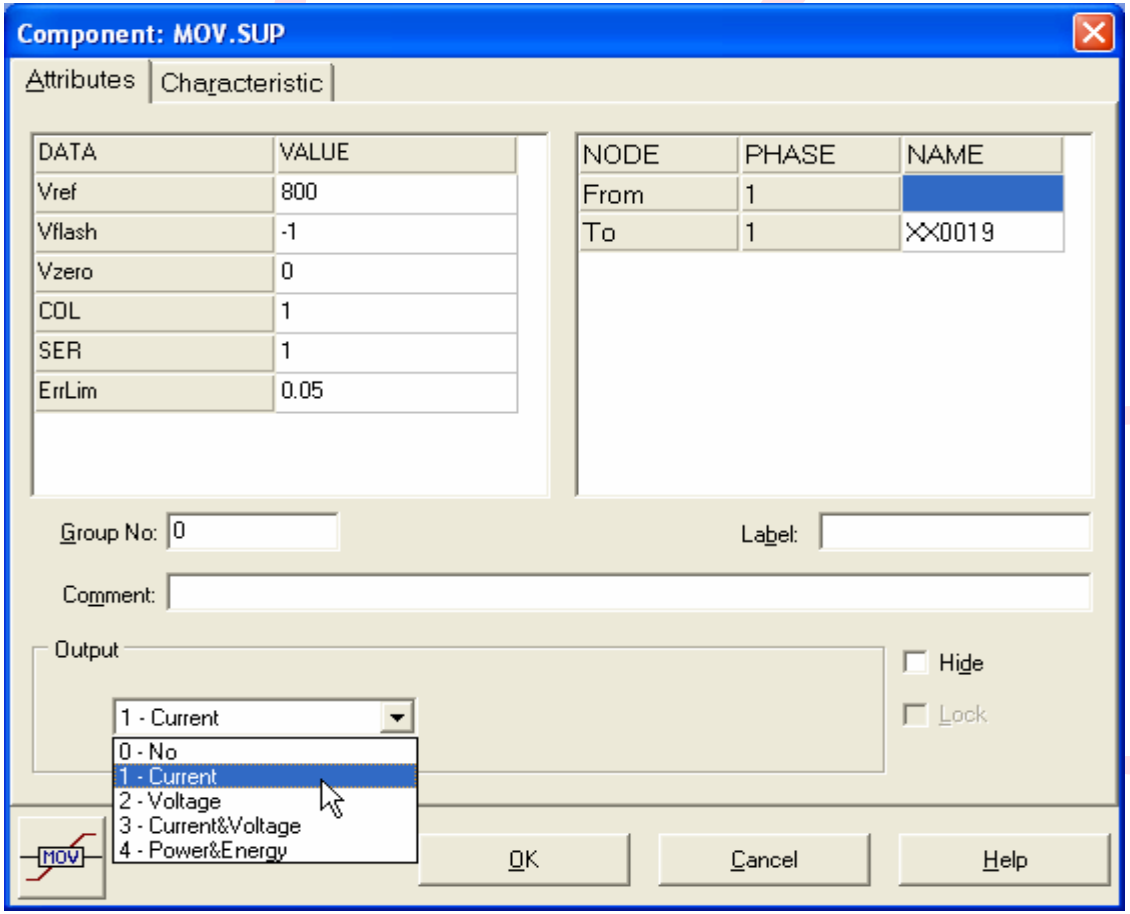
ATP Draw


Component: MOV.SUP
Attributes
Characteristic
DATA
VALUE
Vref
10000
Vflash
-1
Vzero
0
COL
1
SER
1
ErrLim
0.05
NODE
PHASE
NAME
From
1
To
1
Group No:
0
Label:
Comment:
Output
0 - No
Hide
Lock
MOV
OK
Cancel
Help

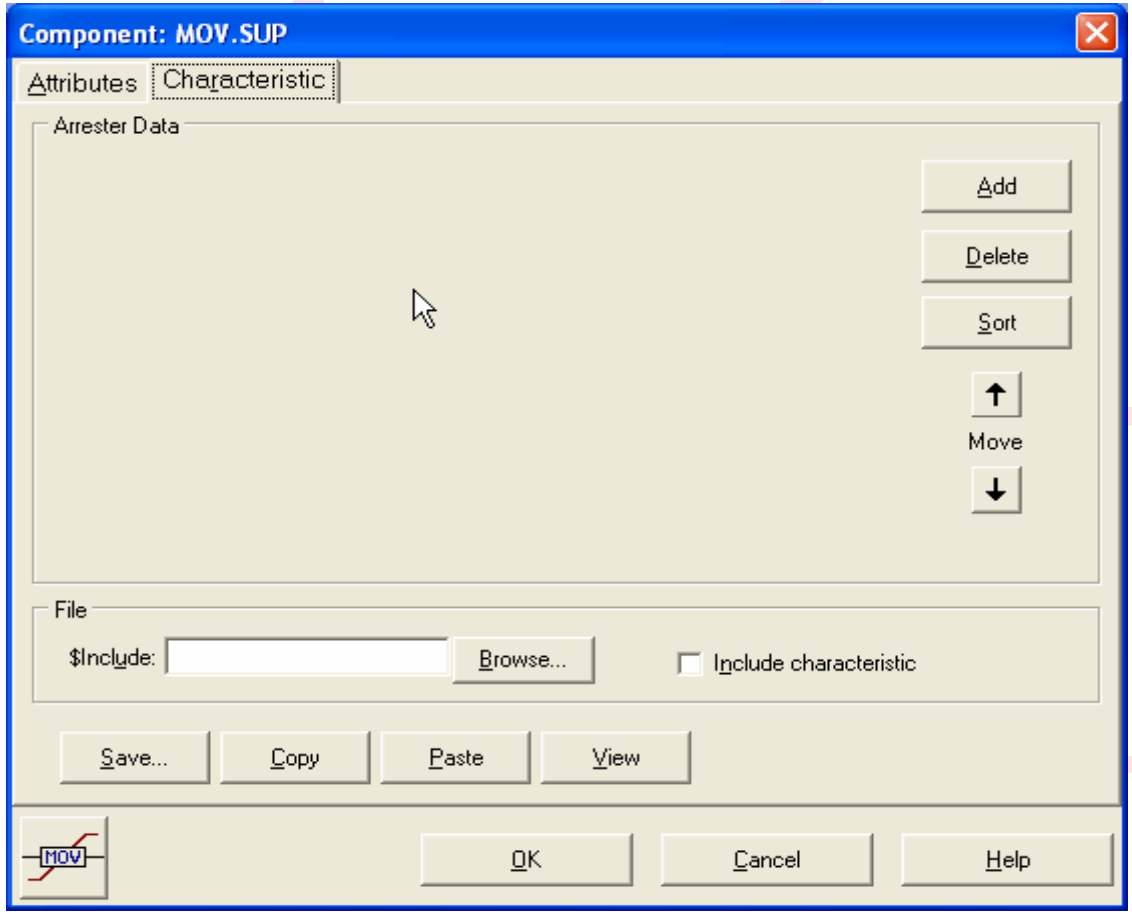
ATP Draw


Help Viewer
File Edit Character Help
Name : ZNO - exponential current-dependent resistor. TYPE 92.
Card : BRANCH
Data : Vref= Reference voltage in [V] for single block.
Use an arbitrary well conditioned value around rated voltage.
Vflash= Flashover voltage in pu. of Vref.
Use a negative number for no gap.
Vzero= Initial voltage in [V]. Optional.
COL= Multiplicative factor for COEF. Number of arrester columns.
Single branch of blocks : COL=0,1 or BLANK.
Two branches in parallel: COL=2.
SER= Number of blocks in series in each branch.
Used to scale Vref.
ErrLim= Fitting tolerance in pu.
Node : From= Start node of nonlinear resistor.
To = End node of nonlinear resistor.
Points: It's possible to enter 15 points on the current/voltage characteristic.
Do no specify the (0, 0) point!!
A least square method fitting in the log-log domain is performed
to fit the characteristic points to the exponential formulation:
i=p*(u/Vref)^q
split up in required segments accordning to ErrLim.
RuleBook: V.E. + XIX-I.

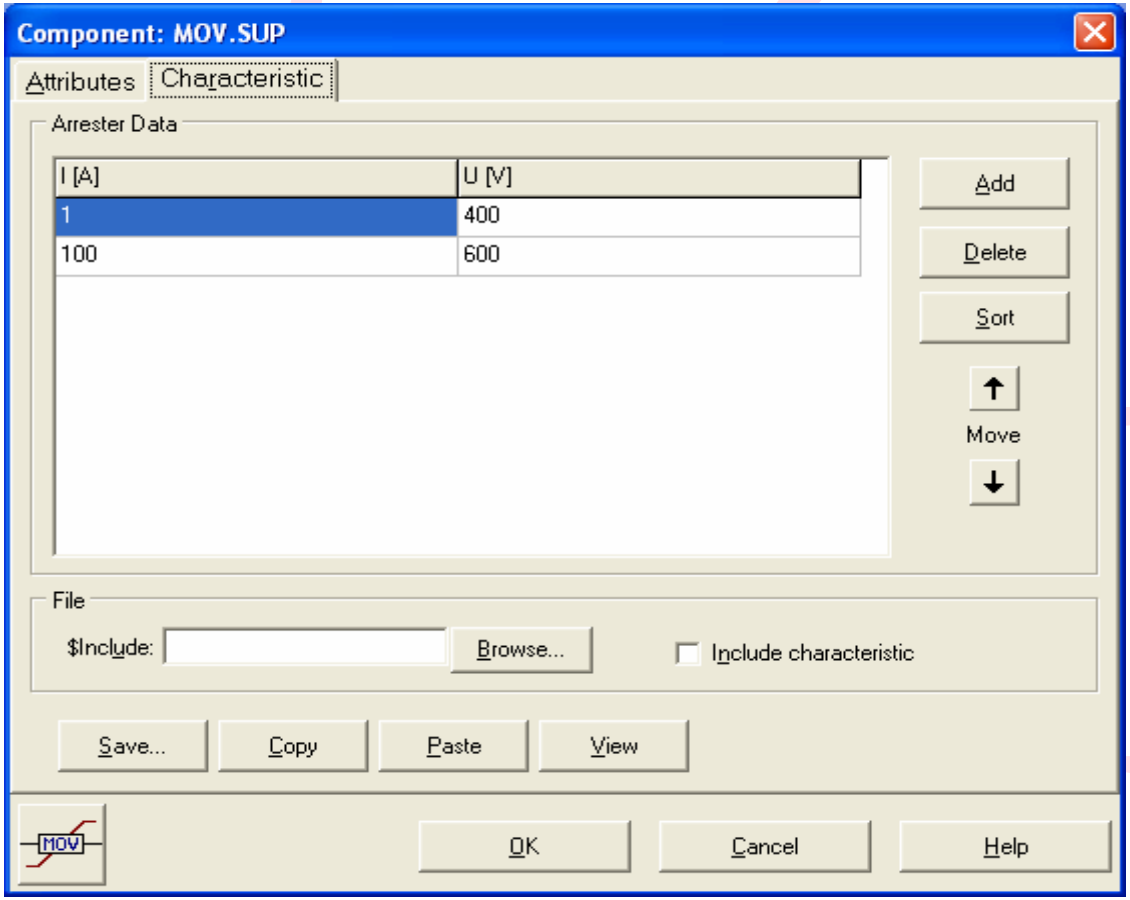
ATP Draw


Component: MOV.SUP
Attributes
Characteristic
DATA
VALUE
Vref
800
Vflash
-1
Vzero
0
COL
1
SER
1
ErrLim
0.05
NODE
PHASE
NAME
From
1
To
1
XX0019
Group No:
0
Label:
Comment:
Output
1 - Current
0 - No
1 - Current
2 - Voltage
3 - Current&Voltage
4 - Power&Energy
Hide
Lock
MOV
OK
Cancel
Help

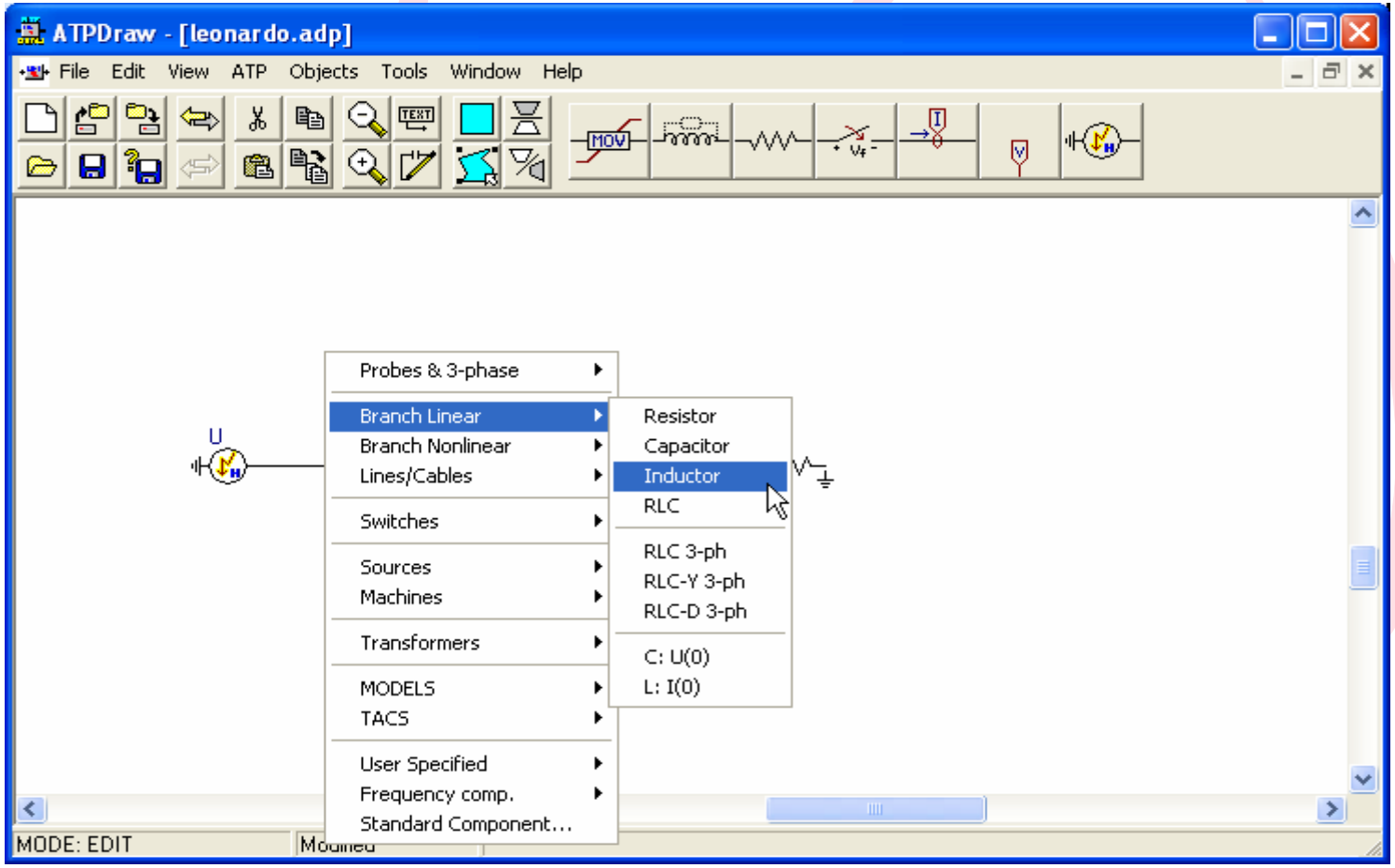
ATP Draw


Component: MOV.SUP
Attributes
Characteristic
Arrester Data
Add
Delete
Sort
Move
File
$Include:
Browse...
Include characteristic
Save...
Copy
Paste
View
MOV
OK
Cancel
Help

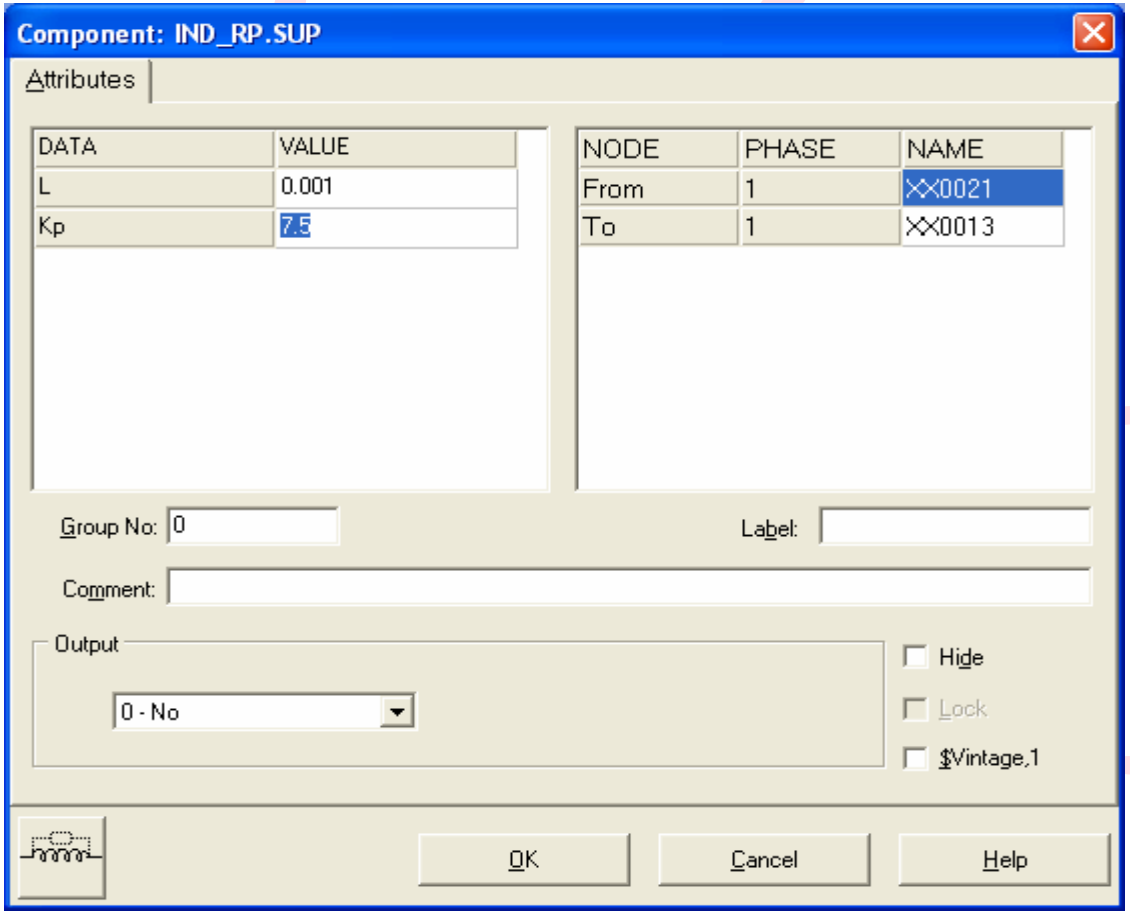
ATP Draw


Component: MOV.SUP
Attributes
Characteristic
Arrester Data
I [A]
U [V]
1
400
100
600
Add
Delete
Sort
Move
File
$Include:
Browse...
Include characteristic
Save...
Copy
Paste
View
MOV
OK
Cancel
Help

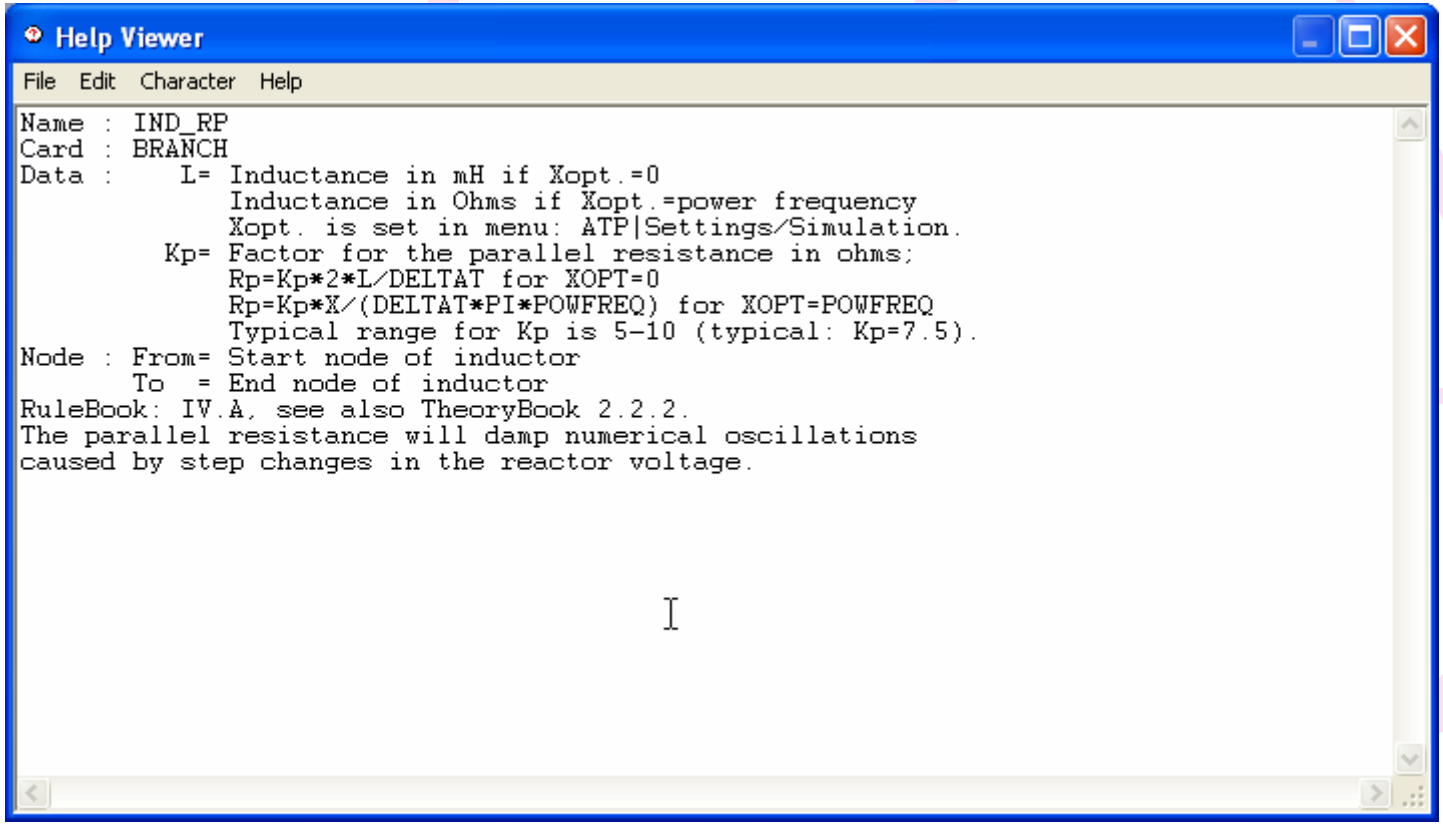
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
MOV
U
Probes & 3-phase
Branch Linear
Branch Nonlinear
Lines/Cables
Switches
Sources
Machines
Transformers
MODELS
TACS
User Specified
Frequency comp.
Standard Component...
Resistor
Capacitor
Inductor
RLC
RLC 3-ph
RLC-Y 3-ph
RLC-D 3-ph
C: U(0)
L: I(0)
MODE: EDIT

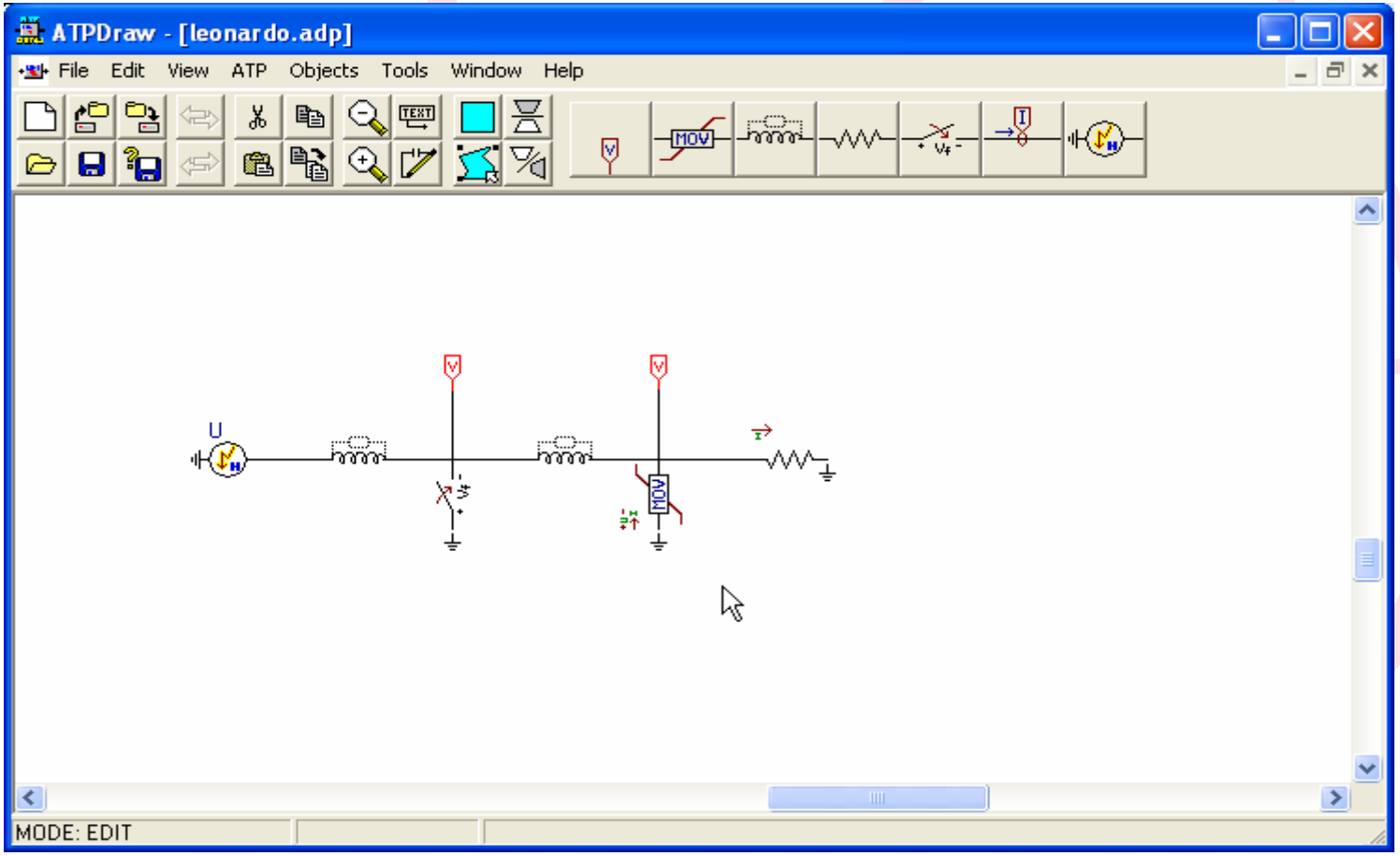
ATP Draw


Component: IND_RP.SUP
Attributes
DATA
VALUE
L
0.001
Kp
7.5
NODE
PHASE
NAME
From
1
XX0021
To
1
XX0013
Group No:
0
Label:
Comment:
Output
0 - No
Hide
Lock
$Vintage,1
OK
Cancel
Help

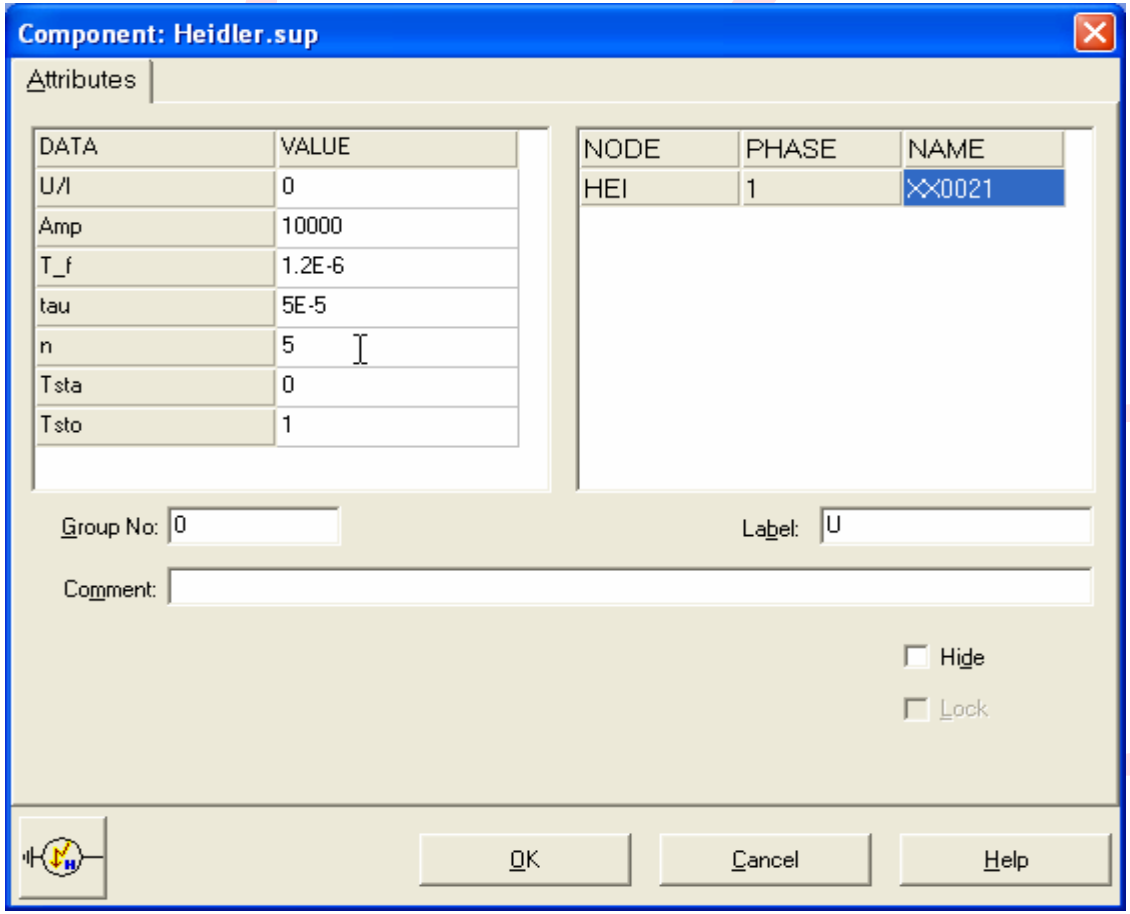
ATP Draw


Help Viewer
File Edit Character Help
Name : IND_RP
Card : BRANCH
Data : L= Inductance in mH if Xopt.=0
Inductance in Ohms if Xopt.=power frequency
Xopt. is set in menu: ATP|Settings/Simulation.
Kp= Factor for the parallel resistance in ohms;
Rp=Kp*2*L/DELTAT for XOPT=0
Rp=Kp*X/(DELTAT*PI*POWFREQ) for XOPT=POWFREQ
Typical range for Kp is 5-10 (typical: Kp=7.5).
Node : From= Start node of inductor
To = End node of inductor
RuleBook: IV.A, see also TheoryBook 2.2.2.
The parallel resistance will damp numerical oscillations
caused by step changes in the reactor voltage.

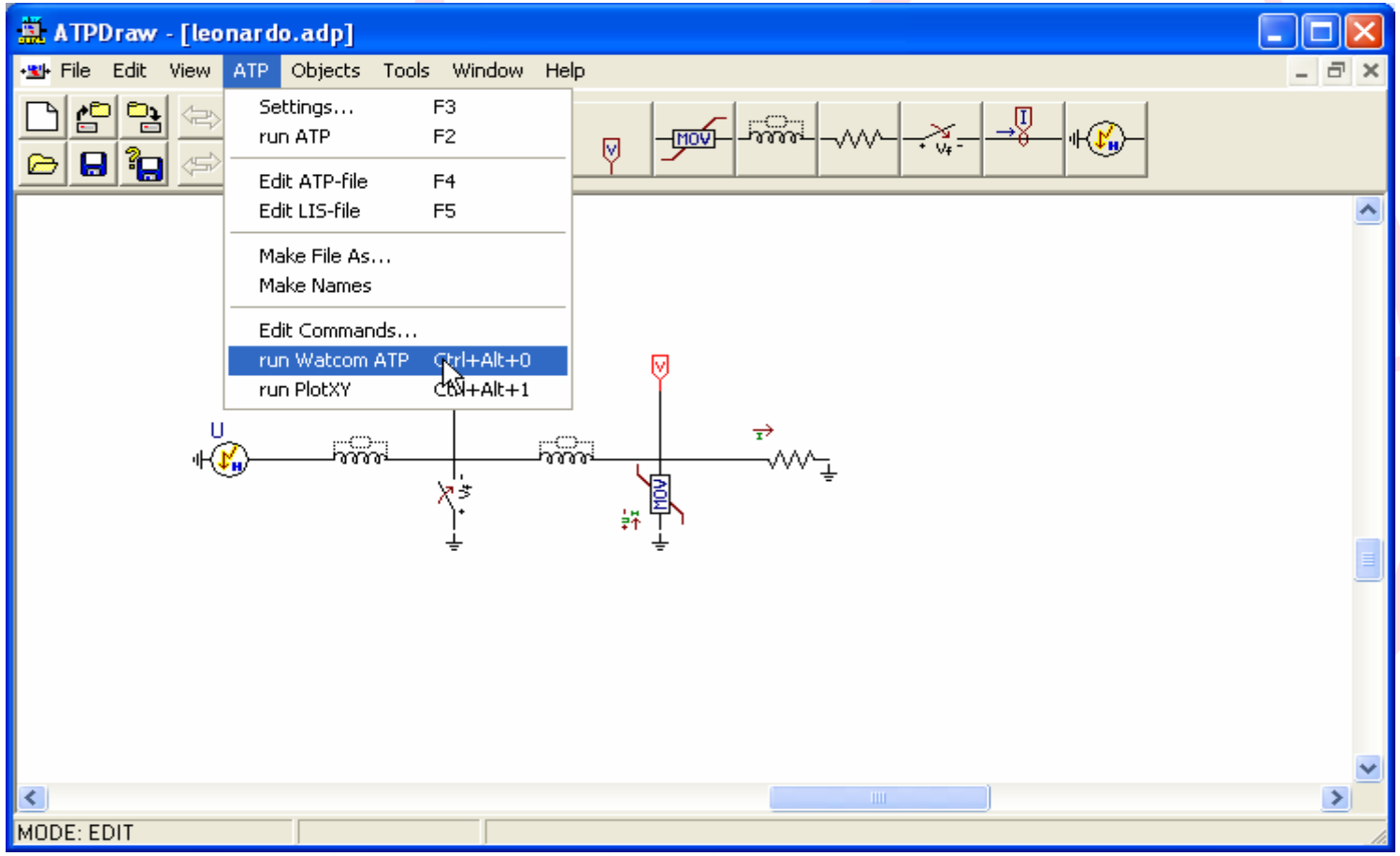
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
MOV
TEXT
U
MODE: EDIT

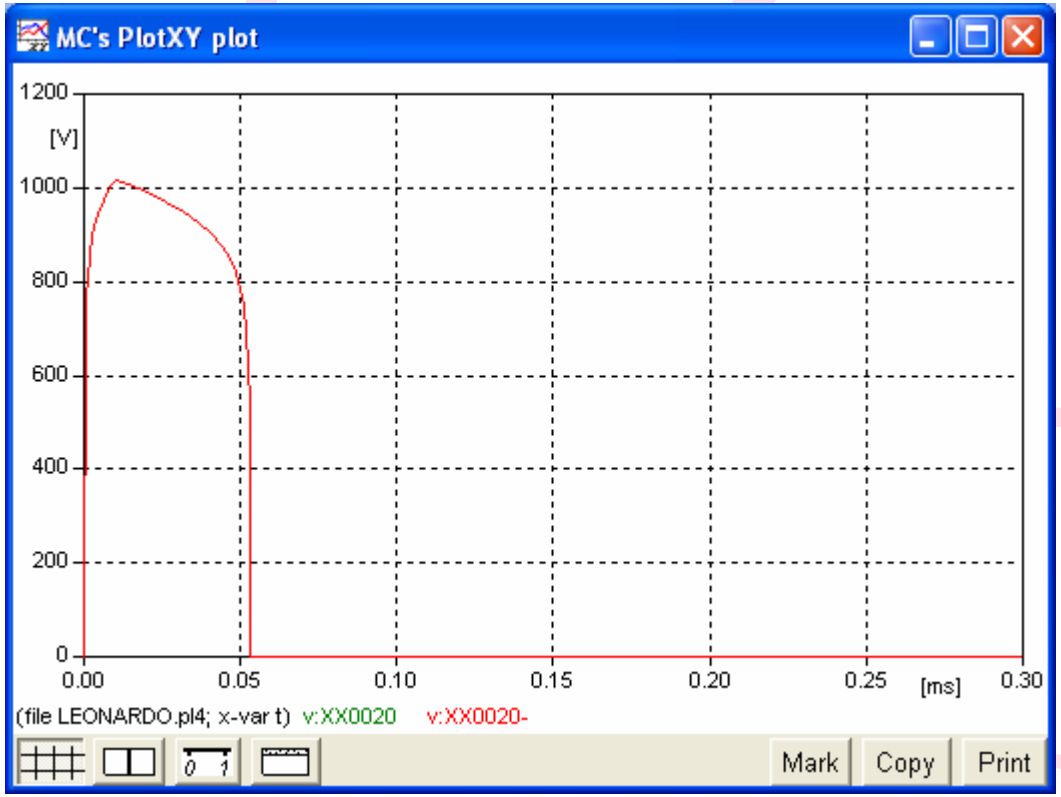
ATP Draw


Component: Heidler.sup
Attributes
DATA
VALUE
U/I
0
Amp
10000
T_f
1.2E-6
tau
5E-5
n
5
Tsta
0
Tsto
1
NODE
PHASE
NAME
HEI
1
XX0021
Group No:
0
Label:
U
Comment:
Hide
Lock
OK
Cancel
Help

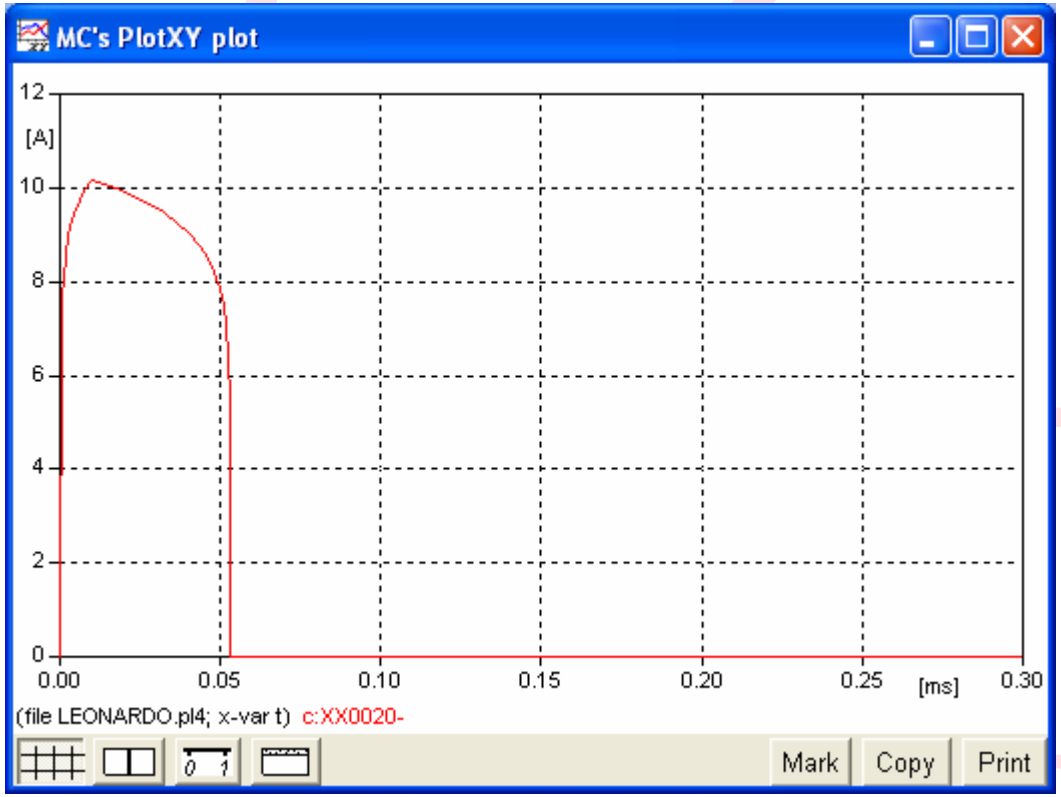
ATP Draw


ATPDraw - [leonardo.adp]
File Edit View ATP Objects Tools Window Help
Settings... F3
run ATP F2
Edit ATP-file F4
Edit LIS-file F5
Make File As...
Make Names
Edit Commands...
run Watcom ATP Ctrl+Alt+0
run PlotXY Ctrl+Alt+1
MOV
U
MODE: EDIT

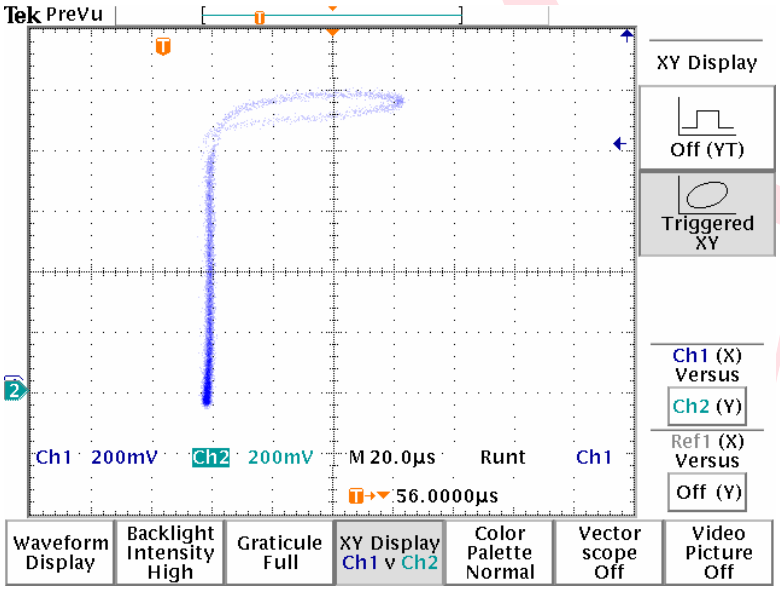
ATP Draw


MC's PlotXY plot
1200
[V]
1000
800
600
400
200
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file LEONARDO.pl4; x-var t) v:XX0020 v:XX0020-
Mark
Copy
Print

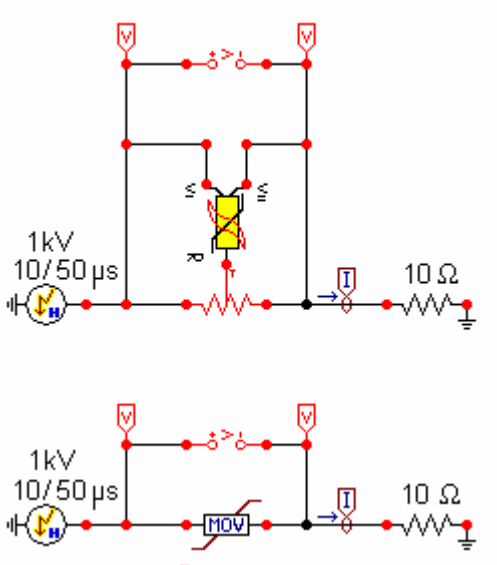
ATP Draw


MC's PlotXY plot
12
[A]
10
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
[ms]
0.30
(file LEONARDO.pl4; x-var t) c:XX0020-
Mark
Copy
Print

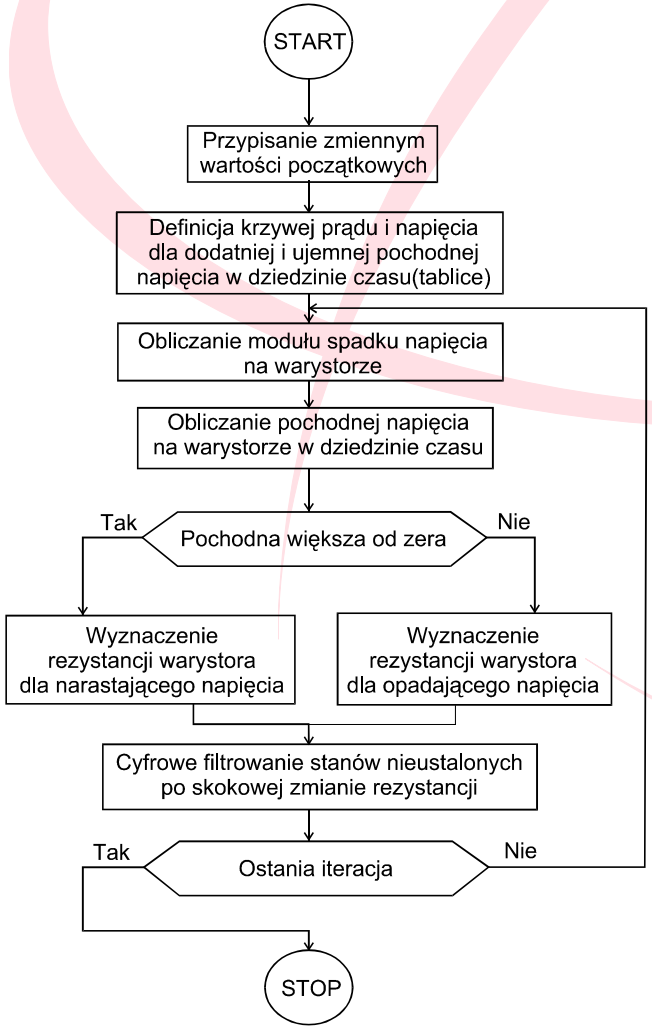
Models



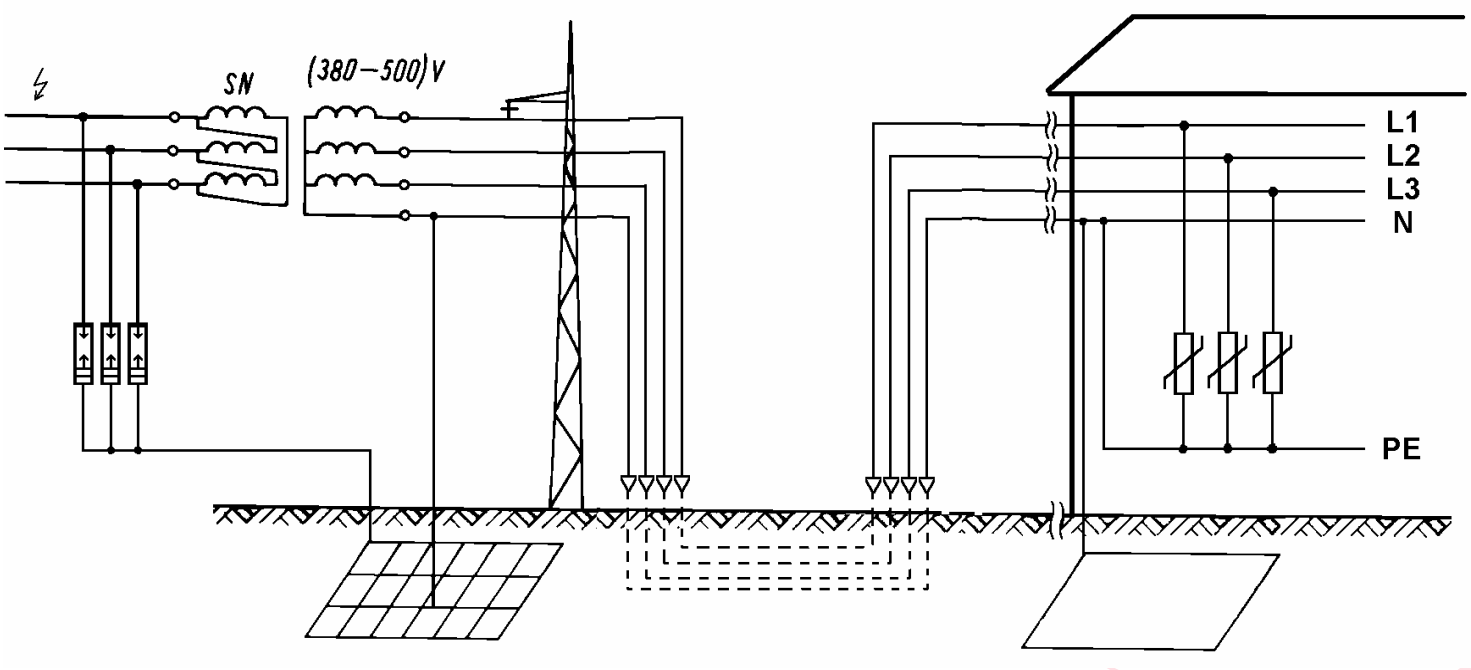
Rzeczywista charakterystyka przejściowa warystora nN



Models

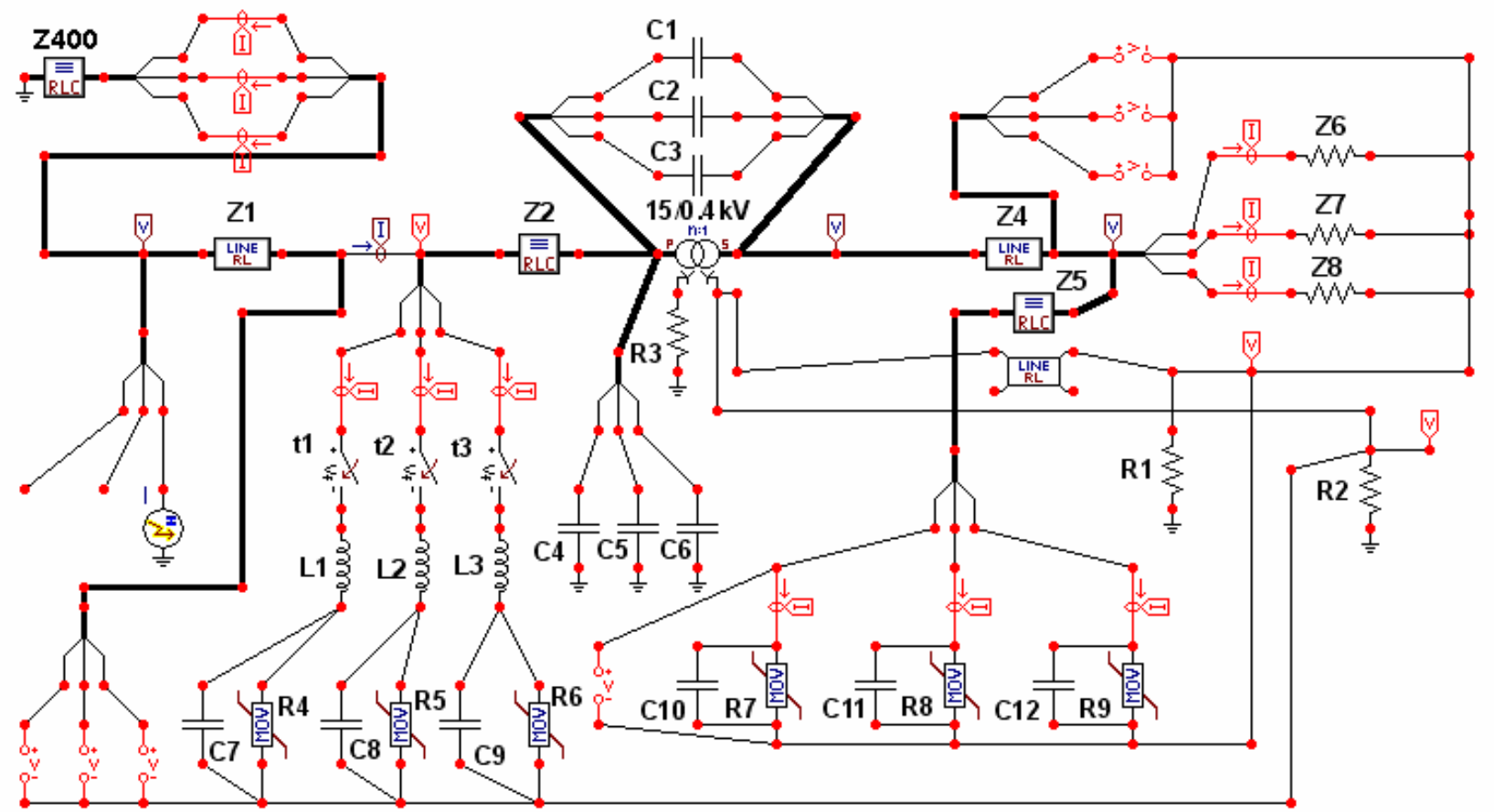


Algorytm warystora zaimplementowany do ATP/EMTP



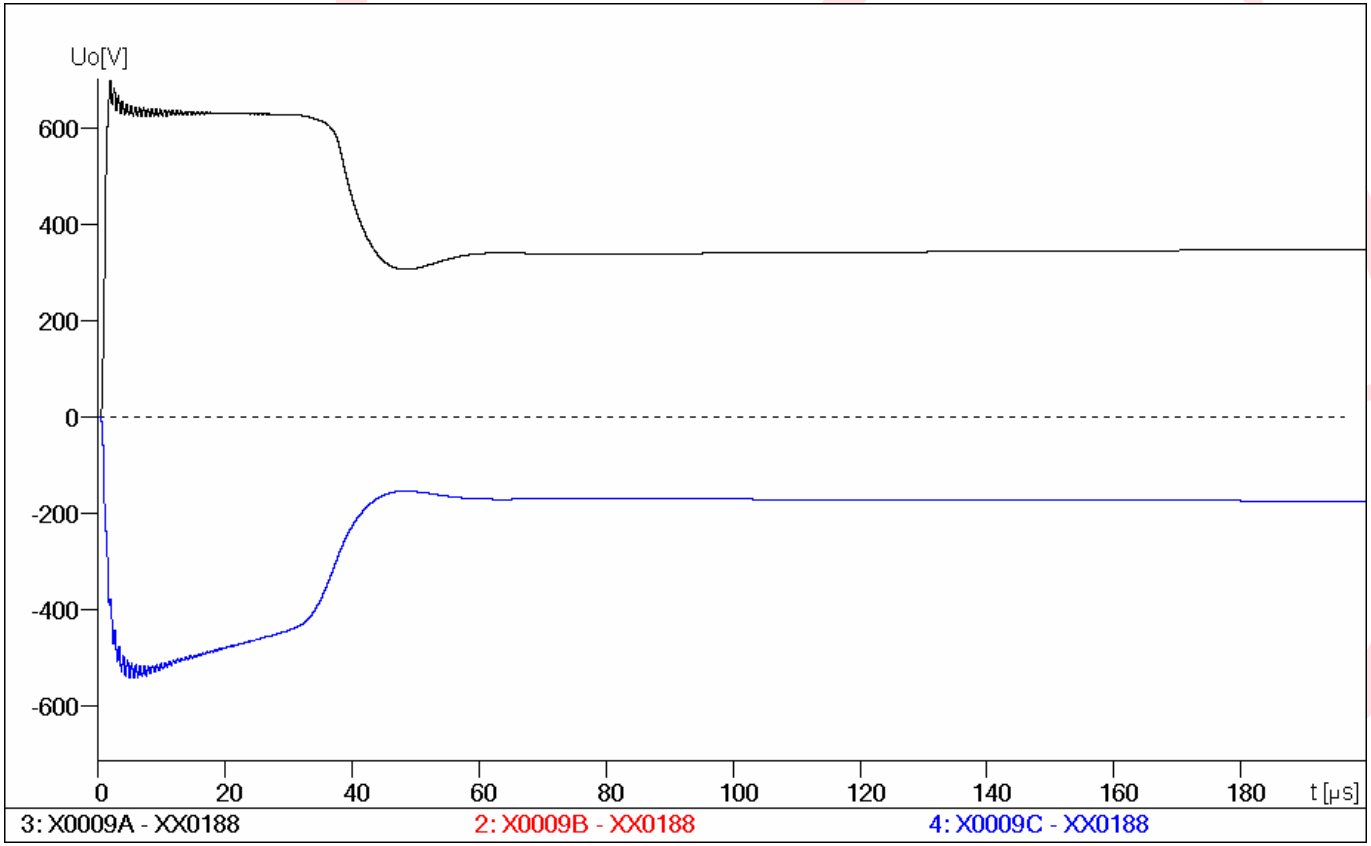
Stacja elektroenergetyczna SN/nN zasilająca linią napowietrzną obiekt budowlany

EMTP



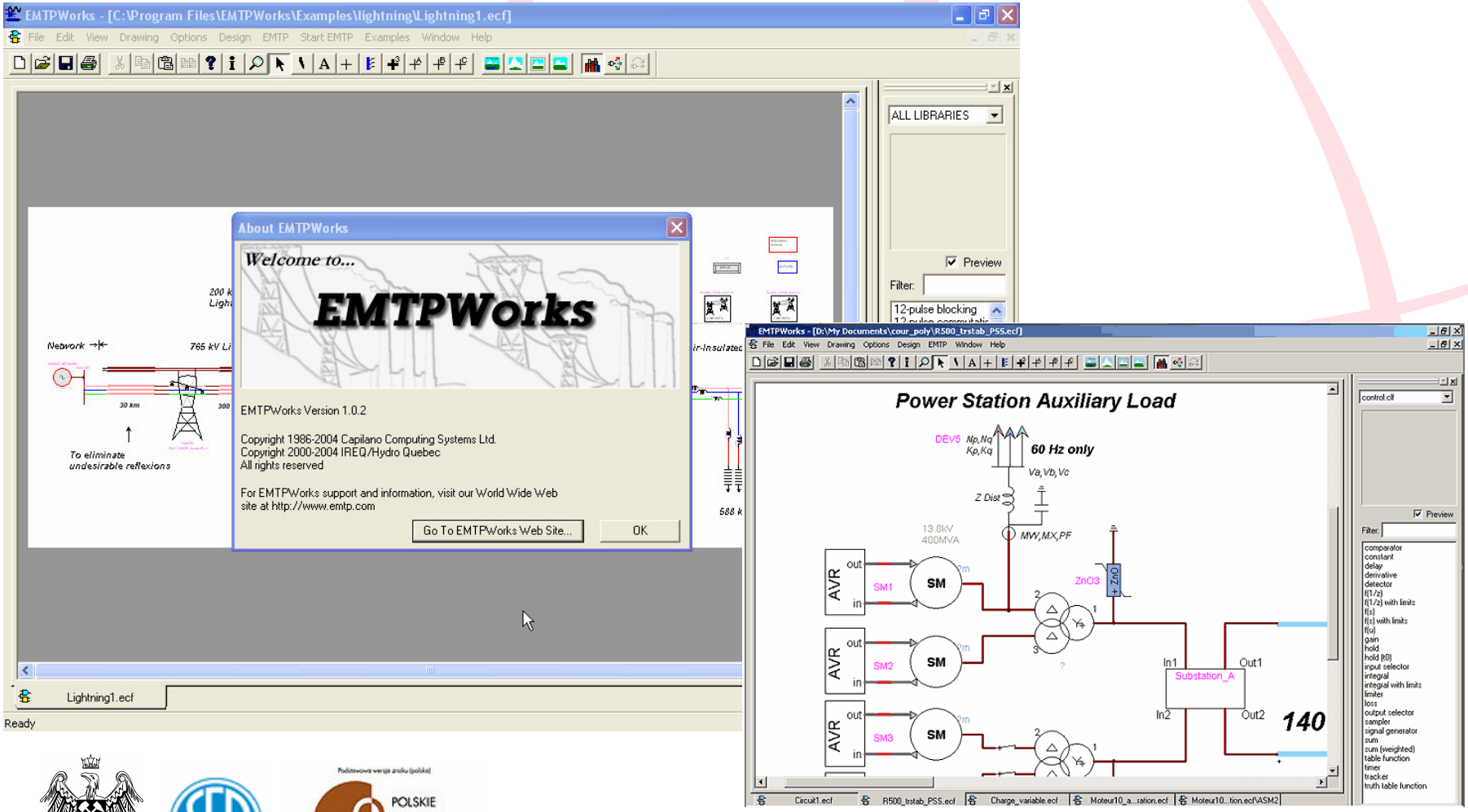
Analizowana stacja elektroenergetyczna SN/nN zamodelowana w ATP/EMTP

EMTP



Przebieg napięcia na obciążeniu w analizowanym obiekcie budowlanym

EMTP RV



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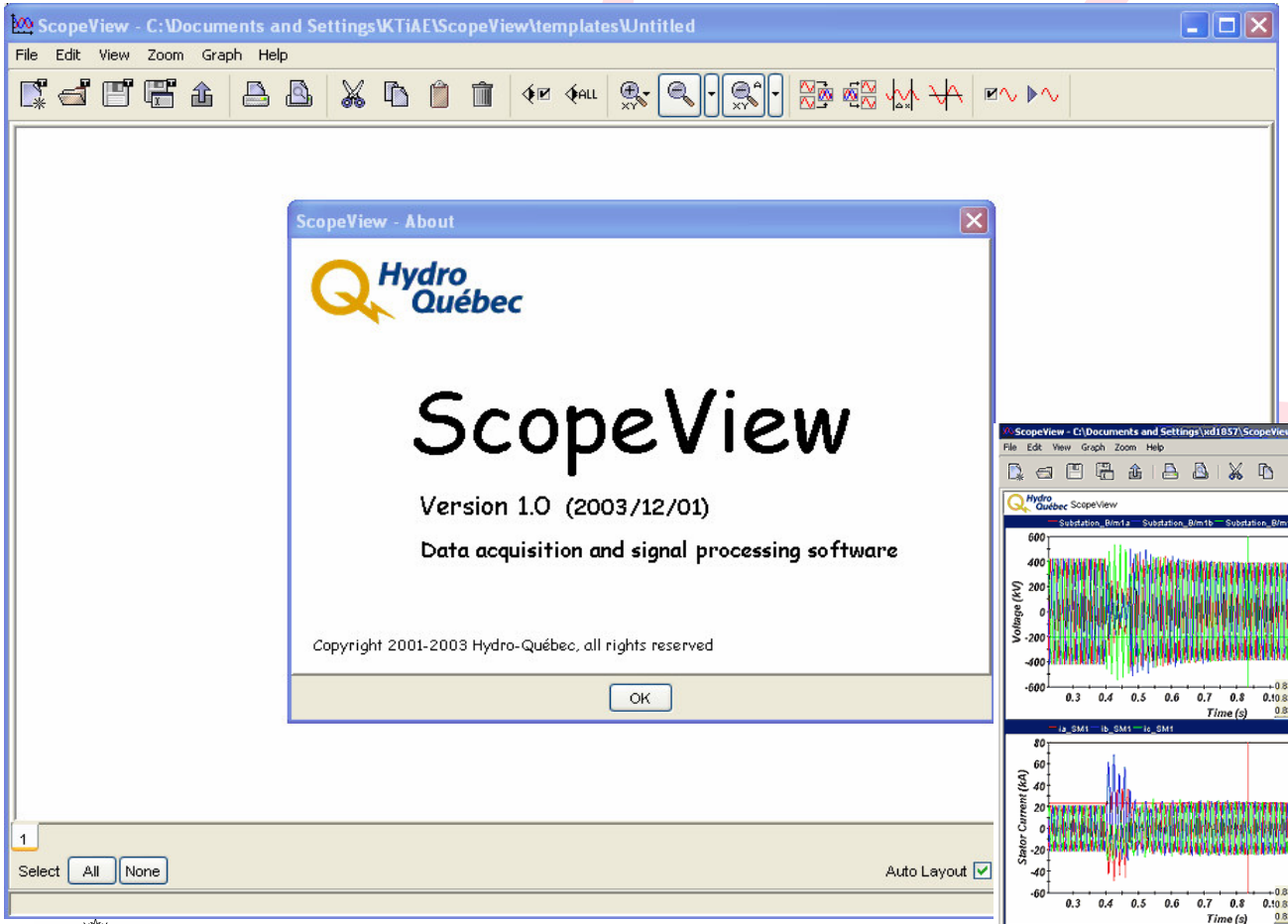
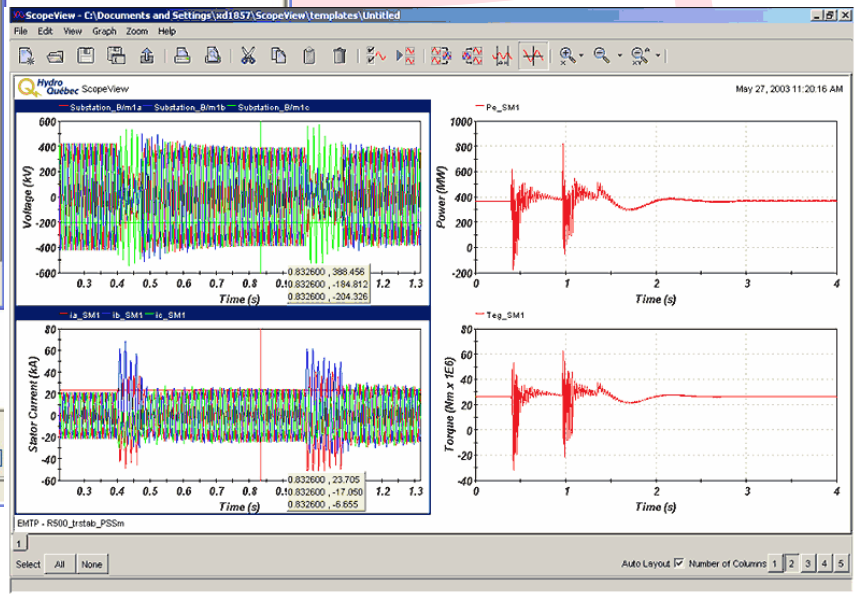
EMTP RV





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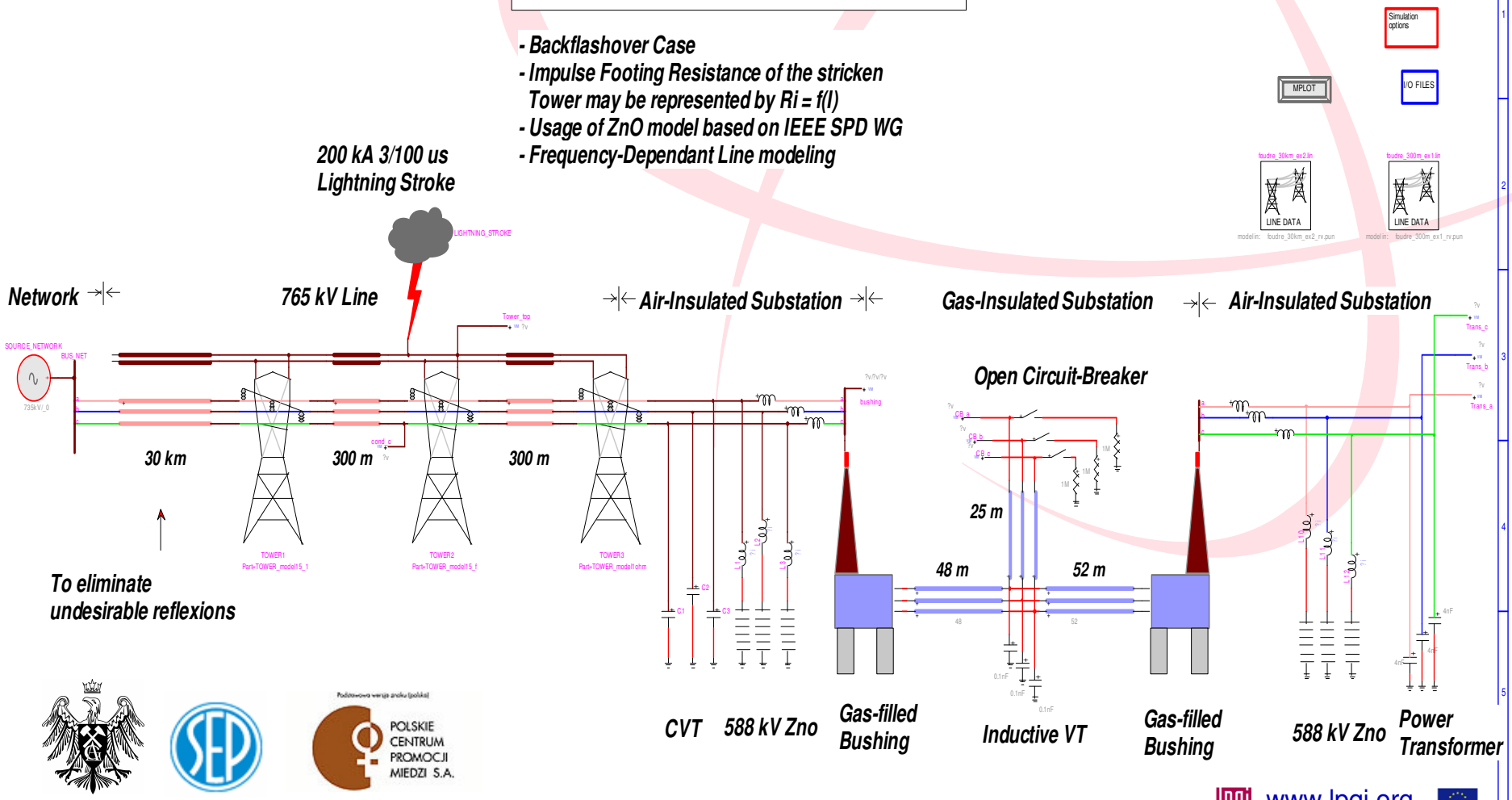
EMTP RV

Insulation Coordination of a 765 kV GIS

- Backflashover Case
- Impulse Footing Resistance of the stricken Tower may be represented by Ri = f(I)
- Usage of ZnO model based on IEEE SPD WG
- Frequency-Dependant Line modeling



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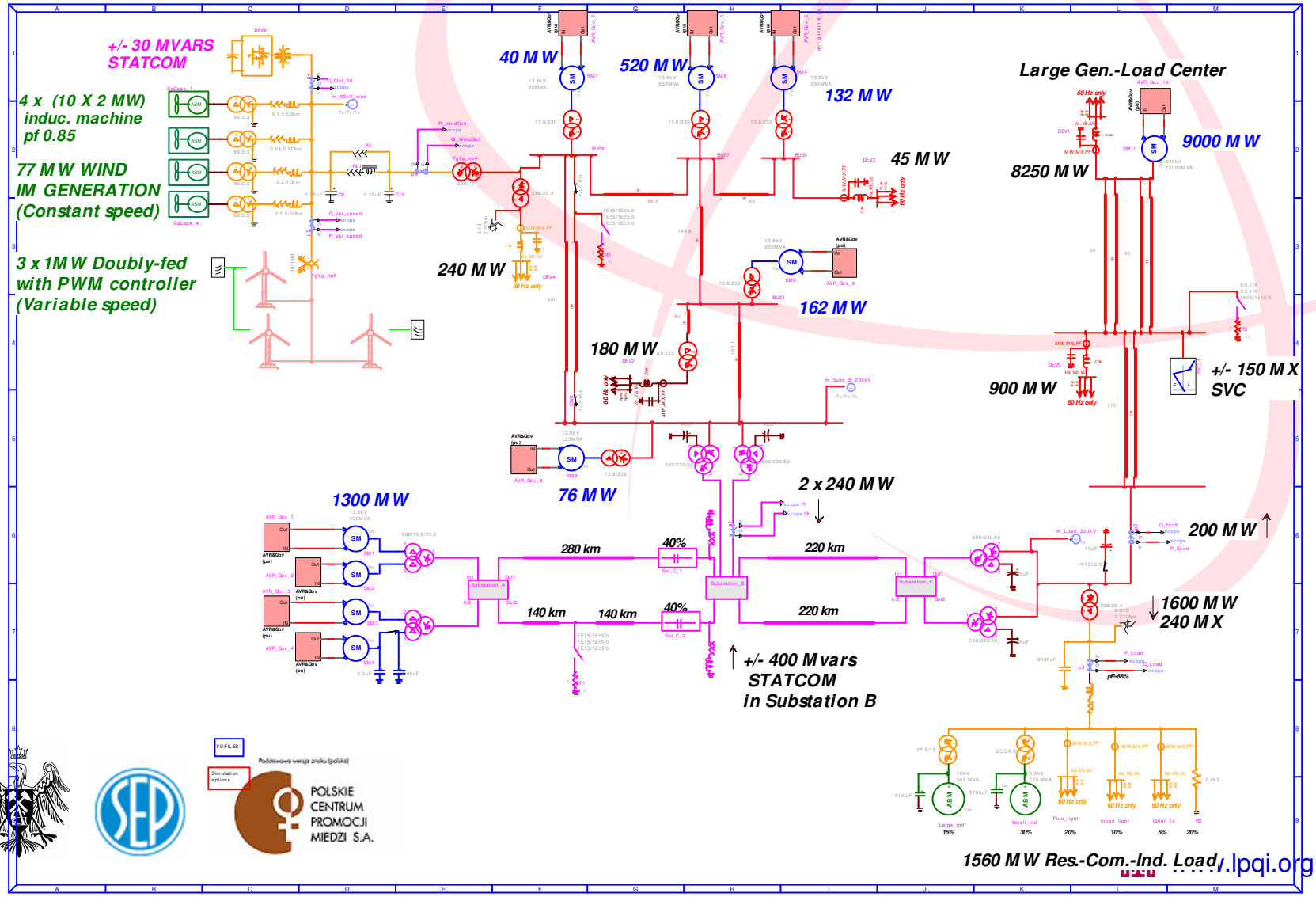
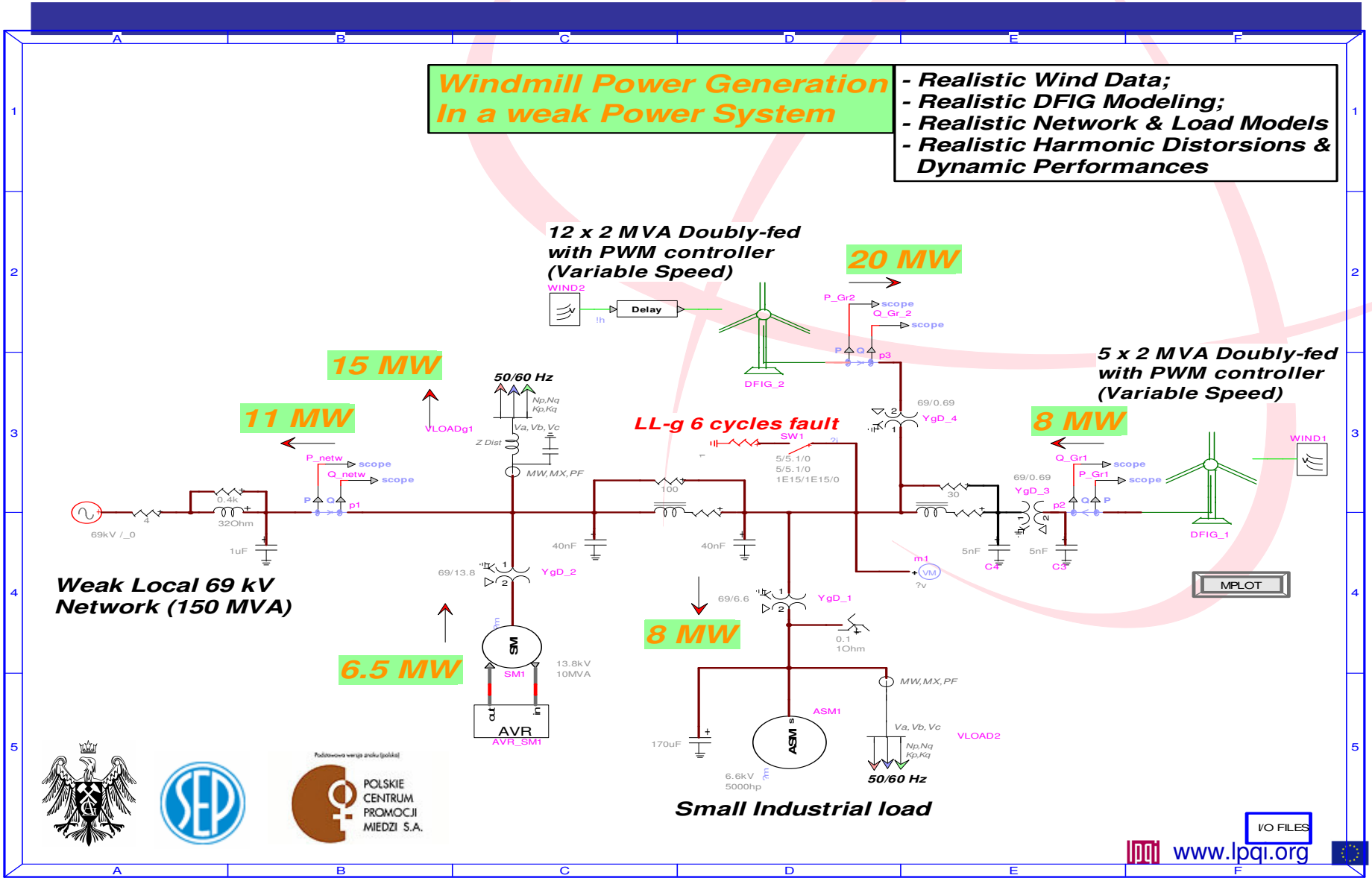
EMTP RV


+/- 30 MVARS
STATCOM
4 x (10 X 2 MW)
induc. machine
pf 0.85
77 MW WIND
IM GENERATION
(Constant speed)
3 x 1MW Doubly-fed
with PWM controller
(Variable speed)
40 MW
520 MW
132 MW
45 MW
240 MW
162 MW
180 MW
76 MW
1300 MW
2 x 240 MW
280 km
140 km
140 km
220 km
220 km
40%
40%
+/- 400 Mvars
STATCOM
in Substation B
Large Gen.-Load Center
9000 MW
8250 MW
900 MW
+/- 150 MX
SVC
200 MW
1600 MW
240 MX
1560 MW Res.-Com.-Ind. Load
POLSKIE
CENTRUM
PROMOCJI
MIEDZI S.A.

EMTP RV


Windmill Power Generation
In a weak Power System
- Realistic Wind Data;
- Realistic DFIG Modeling;
- Realistic Network & Load Models
- Realistic Harmonic Distorsions & Dynamic Performances
12 x 2 MVA Doubly-fed with PWM controller (Variable Speed)
20 MW
15 MW
11 MW
8 MW
6.5 MW
8 MW
5 x 2 MVA Doubly-fed with PWM controller (Variable Speed)
LL-g 6 cycles fault
Weak Local 69 kV Network (150 MVA)
Small Industrial load
WIND2
Delay
DFIG_2
WIND1
DFIG_1
VLOADg1
50/60 Hz
MW,MX,PF
Z Dist
SW1
5/5.1/0
5/5.1/0
1E15/1E15/0
YgD_4
YgD_3
YgD_2
YgD_1
SM1
13.8kV
10MVA
AVR
AVR_SM1
ASM1
VLOAD2
6.6kV
5000hp
69kV /_0
32Ohm
1uF
40nF
5nF
170uF
MPLOT
I/O FILES
POLSKIE CENTRUM PROMOCJI MIEDZI S.A.
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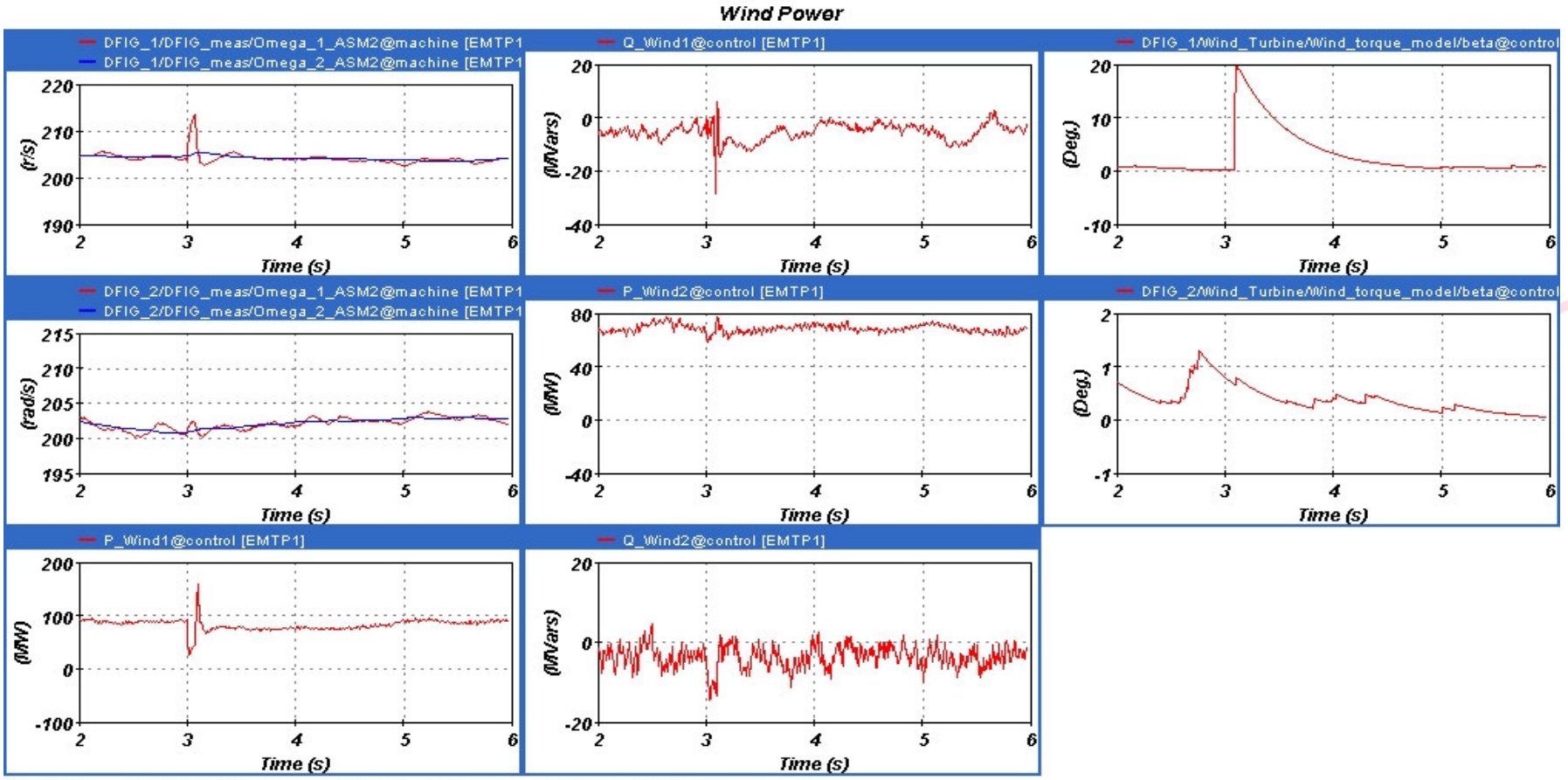
EMTP RV



[EMTP1] Large_2winddelai_SVC_statcomm - C:\EMTP_RV\Tulane\Large_2winddelai_SVC_statcom_pj

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CDEGS

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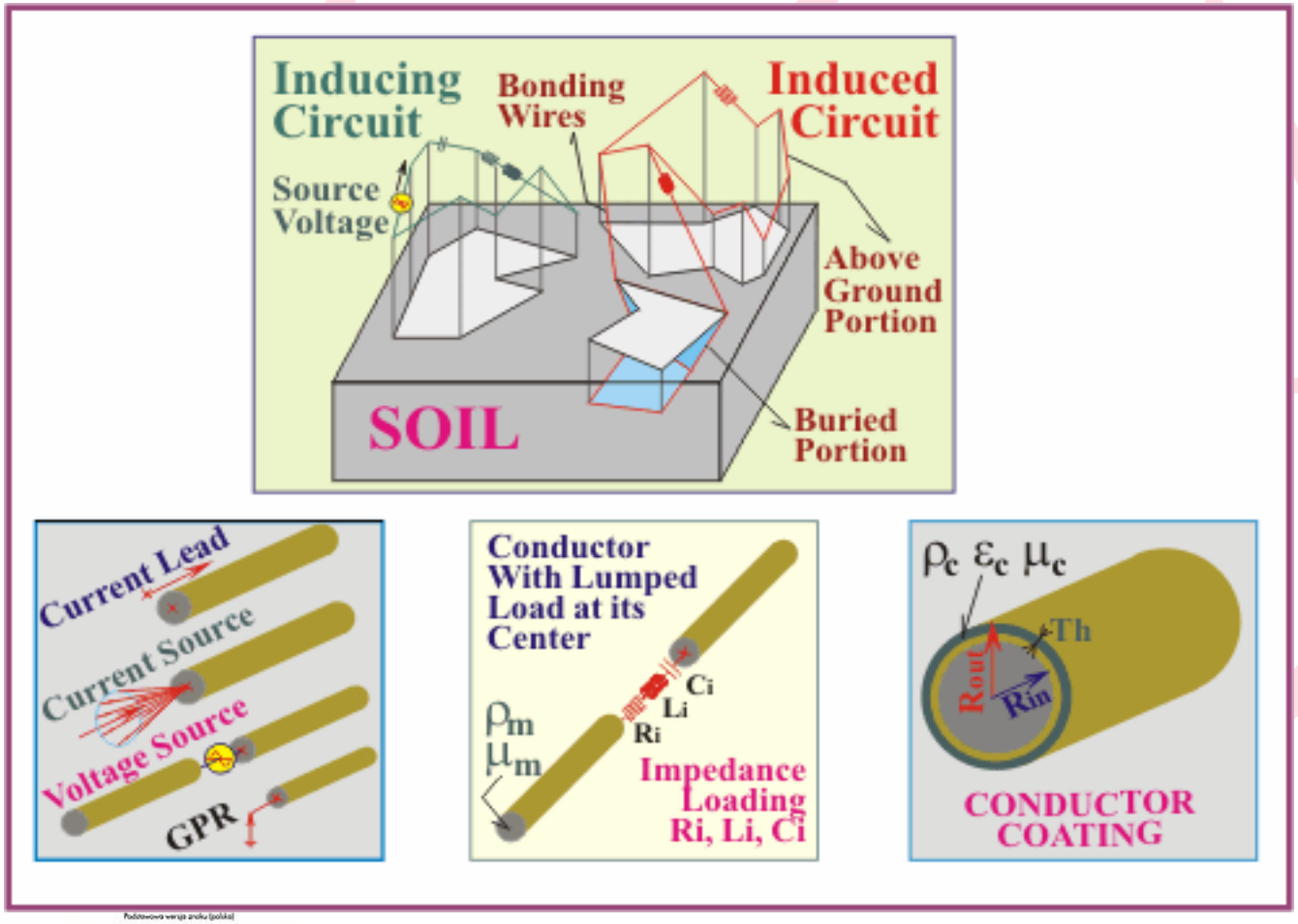
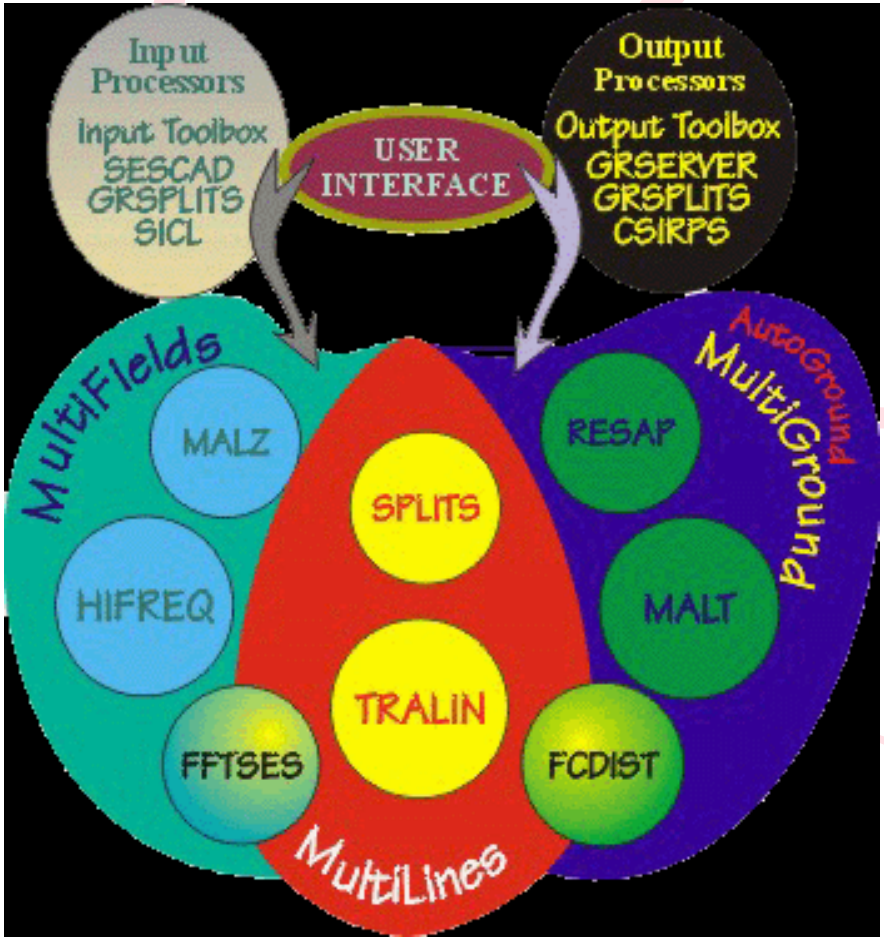
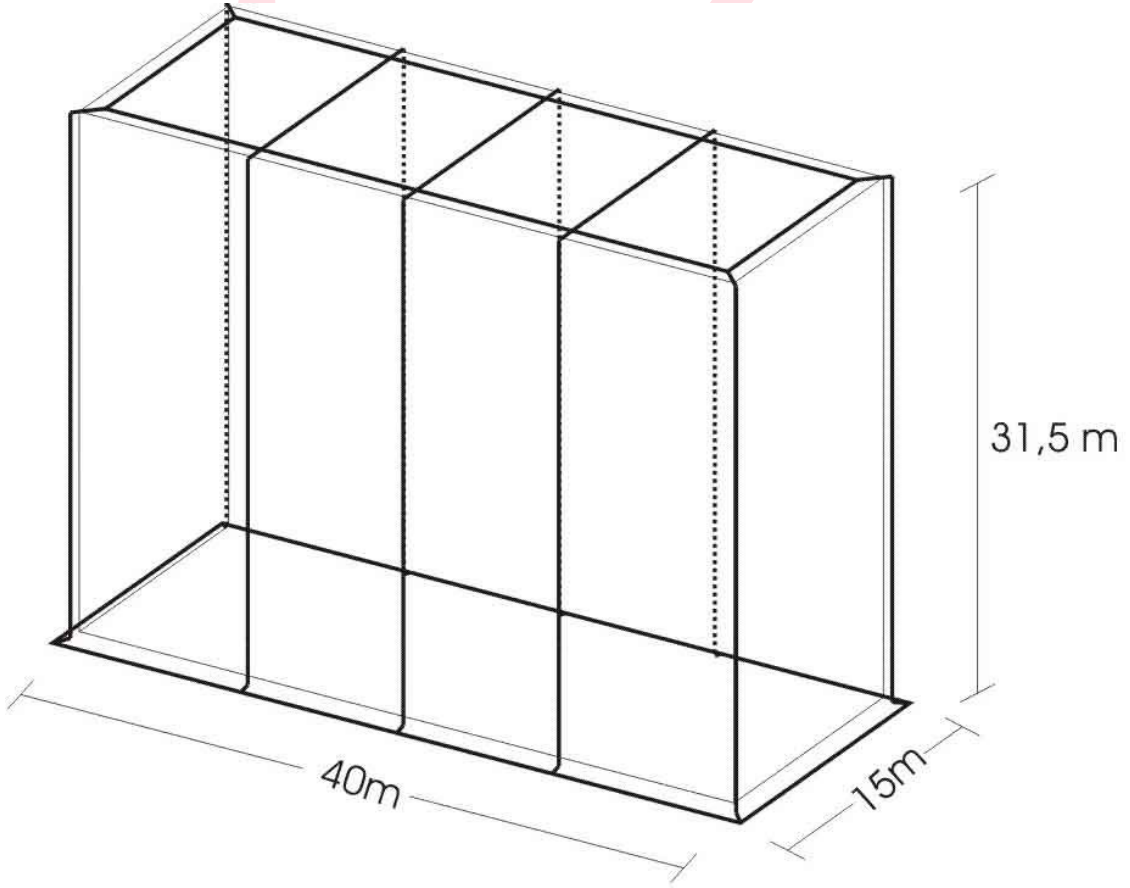
CDEGS


Inducing Circuit
Bonding Wires
Induced Circuit
Source Voltage
Above Ground Portion
SOIL
Buried Portion
Current Lead
Current Source
Voltage Source
GPR
Conductor With Lumped Load at its Center
Ci
Li
Ri
ρm
μm
Impedance Loading Ri, Li, Ci
ρc εc μc
Th
Rout
Rin
CONDUCTOR COATING

CDEGS


Input Processors
Input Toolbox
SESCAD
GRSPLITS
SICL
USER INTERFACE
Output Processors
Output Toolbox
GRSERVER
GRSPLITS
CSIRPS
MultiFields
MALZ
HIFREQ
FFTSES
SPLITS
TRALIN
MultiLines
AutoGround MultiGround
RESAP
MALT
FCDIST

CDEGS



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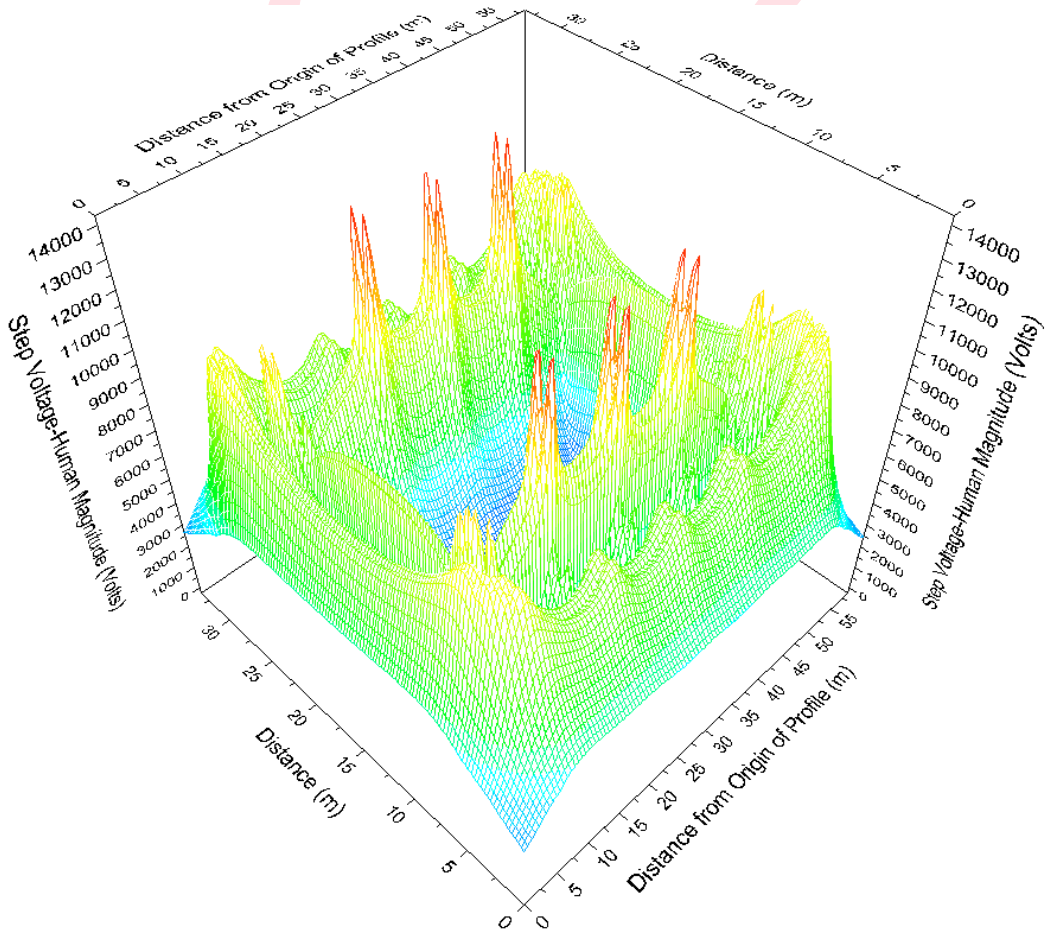
CDEGS



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EMTP

KONIEC