

# Introduction to ATPDraw version 5

- Introduction to ATPDraw
- Layout and dialogs
- Main menu options
- Transformer modeling
- Machine modeling
- Multi-phase circuits
- Vector graphics
- Grouping
- Models
- Lines&Cables modeling

# Introduction

- ATPDraw is a graphical, mouse-driven, dynamic preprocessor to ATP on the Windows platform
- Handles node names and creates the ATP input file based on "what you see is what you get"
- Freeware
- Supports
  - All types of editing operations
  - ~100 standard components
  - ~40 TACS components
  - MODELS
  - \$INCLUDE and User Specified Components

# Introduction- ATPDraw history

- Simple DOS version
  - Leuven EMTP Centre, fall meeting 1991, 1992
- Extended DOS versions, 1994-95
- Windows version 1.0, July 1997
  - Line/Cable modelling program ATP\_LCC
  - User Manual
- Windows version 2.0, Sept. 1999
  - MODELS, more components (UM, SatTrafo ++)
  - Integrated line/cable support (Line Constants + Cable Parameters)



BPA  
Sponsored

# Introduction- ATPDraw history

- Windows version 3, Dec. 2001
  - Grouping/Compress
  - Data Variables, \$Parameter + PCVP
  - LCC Verify + Cable Constants
  - BCTRAN
  - User Manual @ version 3.5
- Windows version 4, July 2004
  - Line Check
  - Hybrid Transformer model
  - Zigzag Saturable transformer
- Windows version 5, Sept. 2006
  - Vector graphics, multi-phase circuits, new file handling

# ATPDraw main windows

Main menu

Tool bar

Side bar  
(optional)

Header,  
circuit file  
name

Circuit  
windows

Circuit  
under  
construction

Circuit  
map

Component  
selection menu

The screenshot displays the ATPDraw software interface. The main window shows a circuit diagram for a power system, including a lightning position, a 500 m long line, and a zigzag transformer. The circuit is labeled with parameters such as  $Z=300 \text{ ohm}$  and  $132/11.3$ . The interface includes a main menu (File, Edit, View, ATP, Library, Tools, Windows, Web, Help), a tool bar, and a side bar with a tree view of components. A component selection menu is open on the right, listing various components like Probes & 3-phase, Branch Linear, Branch Nonlinear, Lines/Cables, Switches, Sources, Machines, Transformers, MODELS, TACS, User Specified, and Steady-state. A circuit map window is also visible, showing a simplified view of the circuit.

Calculation of harmonics in HVDC 24 pulse power supply utilizing zigzag transformers with  $+7.5$  deg. phase shift.  
A model FOURIER calculates up to 26th harmonics using a recursive DFT routine.  
The zigzag transformer implementation is documented in H. K. Høidalen, R. Sporild:  
"Using Zigzag Transformers with Phase-shift to reduce Harmonics in AC-DC Systems", IPST'05, Montreal-Canada.

132 kV 22.2 mH

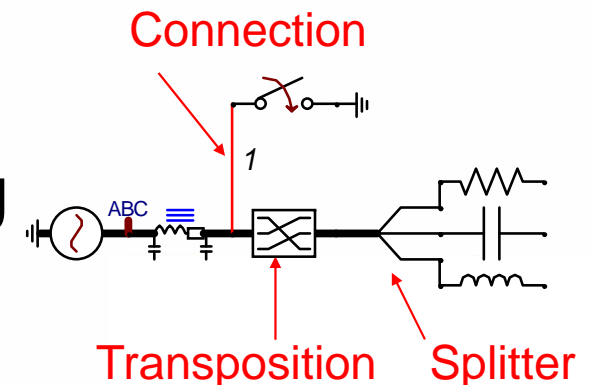
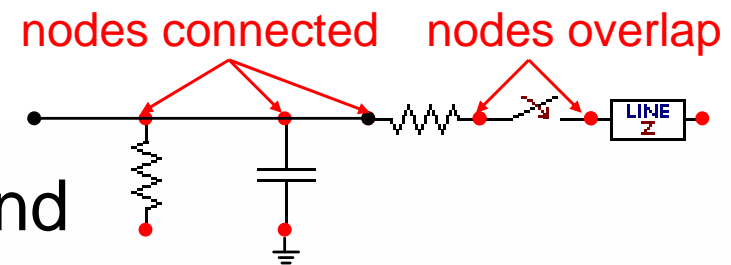
Regulation transformers 11.3/10.6 kV

Zig-zag transformers ZN0d11y0 10.7/0.693 kV

MODE: EDIT Modified Registered

# ATPDraw node naming

- "What you see is what you get"
- Connected nodes automatically get the same name
  - Direct node overlap
  - Positioned on connection
- Warnings in case of duplicates and disconnections
- 3-phase and  $n$ -phase nodes
  - Extensions A..Z added automatically
  - Objects for transposition and splitting
  - Connection between  $n$ - and single phase



# ATPDraw Component dialog

**Component: RLC3**

**Attributes**

DATA	UNIT	VALUE
R_1	Ohms	0
L_1	mH	22.18493
C_1	μF	0
R_2	Ohms	0
L_2	mH	22.18493
C_2	μF	0
R_3	Ohms	0
L_3	mH	22.18493

NODE	PHASE	NAME
IN1	1	BUS1
OUT1	1	BUS2

Copy Paste Reset Order: 0 Label: 22.2 mH

Comment:

Output: Current

Hide \$Vintage.1

Edit definitions OK Cancel Help

**Annotations:**

- Editable data values:** Points to the VALUE column in the first table.
- Windows Clipboard support:** Points to the Copy, Paste, and Reset buttons.
- Branch output:** Points to the Output dropdown menu.
- Edit local definitions Icon/help/pos/name/units:** Points to the Edit definitions button.
- Node names (red=user spec.):** Points to the NAME column in the second table.
- Used for sorting:** Points to the Order field.
- Label on screen:** Points to the Label field.
- Comment in ATP file:** Points to the Comment field.
- Component not to ATP:** Points to the Hide checkbox.
- High precision:** Points to the \$Vintage.1 checkbox.

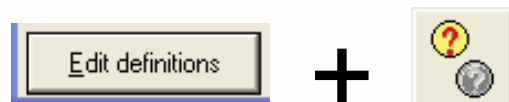
# ATPDraw capability

- 30.000 nodes
- 10.000 components
- 10.000 connections
- 1.000 text strings
- Up to 64 data and 32 nodes per component
- Up to 26 phases per node (A..Z extension)
- 28 phases in LCC module
- Circuit world is 10.000x10.000 pixels (user; 25-400%)
- 100 UnDo/ReDo steps



# Files in ATPDraw

- Project file (acp): Contains all circuit data.
- Support file (sup): Component definitions. Used only when a component is added to the project.
  - Standard components: ATPDraw.scl
  - User defined components: Optionally in global library
- Data file (alc/bct/xfm): Contain special data
  - Stored internally in data structure
  - Optionally in global library
- Help file (sup/txt): User specified help text
  - Global help stored in sup-file or /HLP directory (txt file)
  - Local help created under *Edit definitions*



# All standard components:

ATPDraw - [M:\Projekt\ATPDraw\Development\Distribute\Projects\All.acp]

File Edit View ATP Library Tools Windows Web Help

Zoom [%] Node [%]

**Probes & 3-phase**

**Branch**

**NonLin**

**L. lump**

**L. distr**

**Switches**

**Sources**

**Machines**

**Transformers**

**Models**

**TACS**

**Transfer functions G(s)**

**Devices**

**Fortran**

**Steady-state**

**Math**

**Power system toolbox**

**Connections**

**Windsyn**

**User Specified**

**LCC: 1-28 phases**

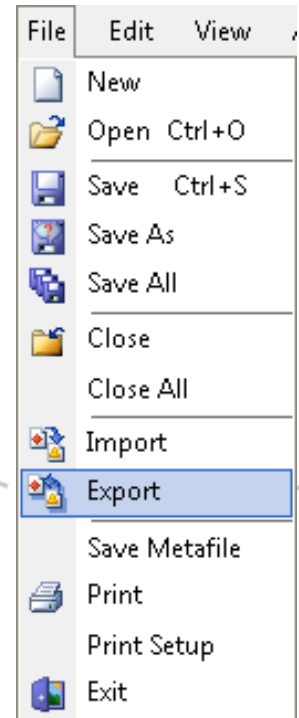
Template Section

All available components

The screenshot displays the ATPDraw software interface, which is a graphical user interface for power system simulation. The main window is titled "ATPDraw - [M:\Projekt\ATPDraw\Development\Distribute\Projects\All.acp]". The menu bar includes "File", "Edit", "View", "ATP", "Library", "Tools", "Windows", "Web", and "Help". The toolbar contains various icons for file operations, editing, and simulation. The main workspace is filled with a grid of component icons, each representing a different element used in power system modeling. These components are categorized into several groups: "Probes & 3-phase", "Branch", "NonLin", "L. lump", "L. distr", "Switches", "Sources", "Machines", "Transformers", "Models", "TACS", "Transfer functions G(s)", "Devices", "Fortran", "Steady-state", "Math", and "Power system toolbox". Each category contains multiple icons, some with labels like "R()", "U()", "I()", "STAT", "SYST", "WINDSYN", "IM", "SM", "T", "K", "K/s", "K/(T+s)", "K\*s/(T+s)", "EXP", "TAN", "ATAN", "LOG", "SINH", "COSH", "LOG10", "TANH", "COTAN", "RAD", "DEG", "RND", "LOAD", "k-U^n", "abc rms", "abc q12", "abc q0", "DFT", "WRITE", "u PQ", "u RX", "u BT", "u BT", "u BT", "u BT". The interface also shows a "Connections" section with a red and black line icon, and a "Windsyn" section with "IM" and "SM" icons. The "User Specified" section includes "LIB", "REQ", "REF", "HUBC", and "LINE 2-MBRT" icons. The "LCC: 1-28 phases" section shows "LCC" icons for "Template" and "Section". The "Steady-state" section includes "HFS", "PQ", "CIGRE LOAD", "PG Load-flow", "JUIP Load-flow", "BG Load-flow", "RLC", and "F(siz)". The "Math" section includes "SUM", "MULT", "DIV", "K", "ABS", "SIN", "COS", "ASIN", "ACOS", "EXP", "TAN", "ATAN", "LOG", "SINH", "COSH", "LOG10", "TANH", "COTAN", "RAD", "DEG", "RND". The "Power system toolbox" section includes "DFT", "LOAD", "abc rms", "abc q12", "abc q0", "DFT", "WRITE", "u PQ", "u RX", "u BT", "u BT", "u BT", "u BT".

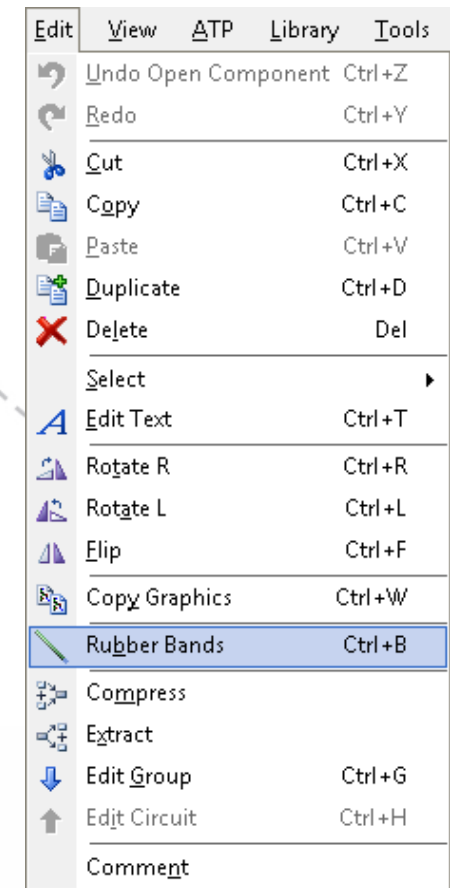
# ATPDraw File options

- Project stored in a single binary file (\*.acp)
- Entire project stored in memory and ATP-files are written to disk on demand.
- Make ATP files under the ATP item.
- Sub-circuits can be imported/exported.



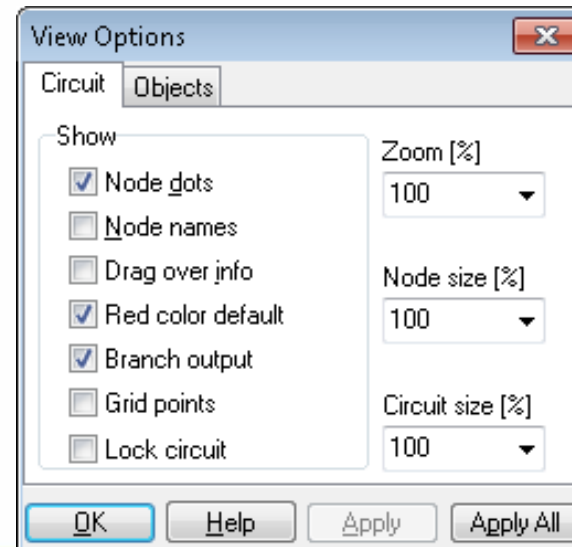
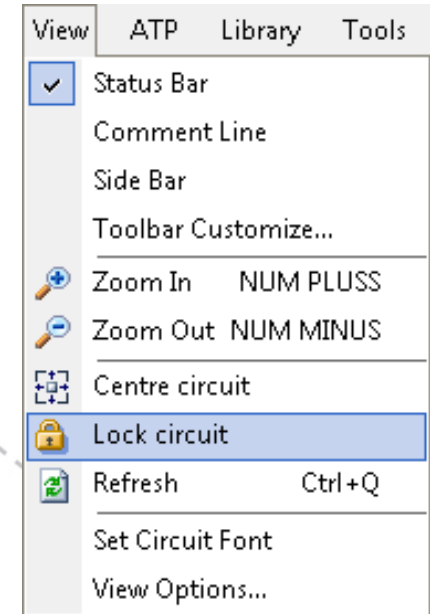
# ATPDraw Edit options

- Multiple documents
  - several circuit windows
  - large circuit windows (map+scroll)
  - grid snapping
- Circuit editing
  - Copy/Paste, Export/Import, Rotate/Flip,
  - Undo/Redo (100),
  - Compress/Extract (multilevel):
    - Merge a collection into single icon, select nodes and data
  - Edit group
    - Dive down into the groups's content and inspect or edit
    - Edit circuit; go one level up
  - Windows Clipboard: Circuit drawings, icons, text, circuit data
  - Rubber bands



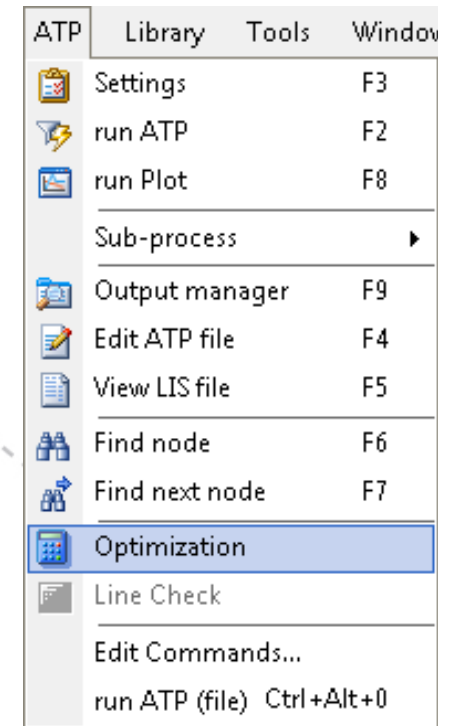
# ATPDraw View options

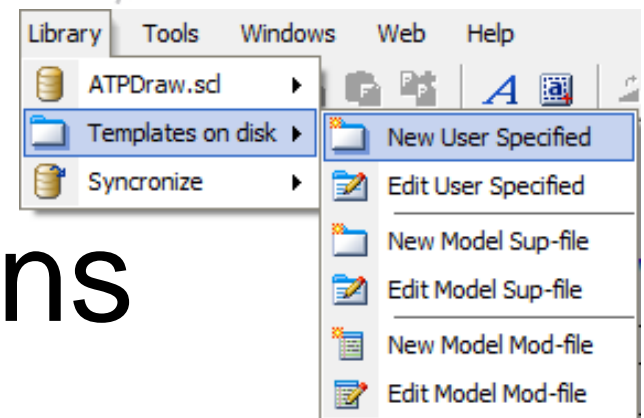
- Turn on/off side bar and status bars
- Customize main tool bar
- Zooming
- Centre circuit in window
- Lock the circuit for moving («child» safety)
- Default view options:



# ATPDraw ATP options

- **Settings (important!)**
  - Simulation; Time step, cap/ind units, frequency scan
  - Output; printout control, auto-detect error messages
  - Format; Sorting, ATP cards
  - Univeral Machine, switch and Load flow settings
  - Output control, variables (\$Parameters)
- Output manager (lists all outputs, Find and Edit)
- Inspect ATP and LIS file
- Optimization (writeminmax object function to optimize variables, GA, Gradient, Annealing methods)
- Line Check (calculate sequence parameters of multiple transmission line segments)
- User customized commands



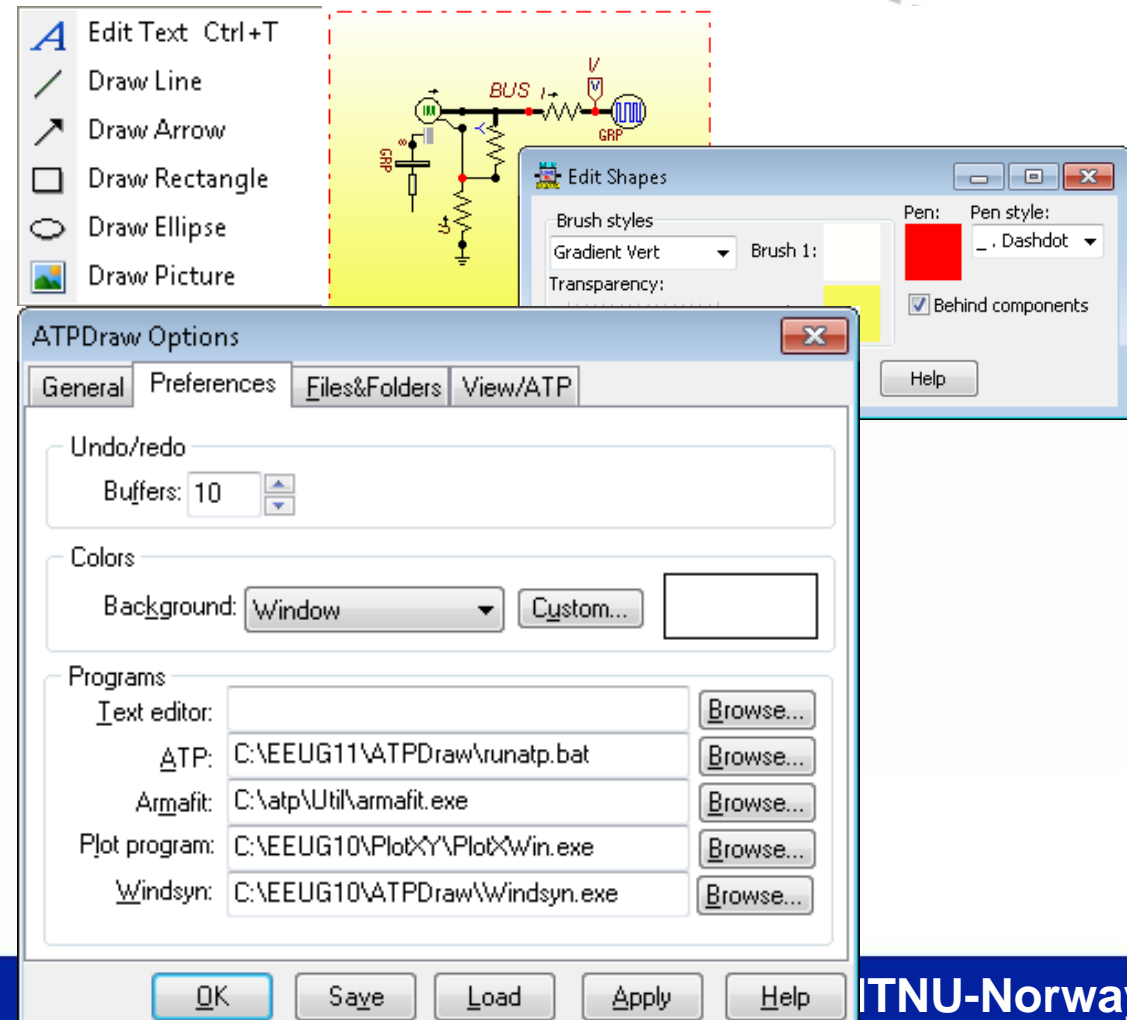
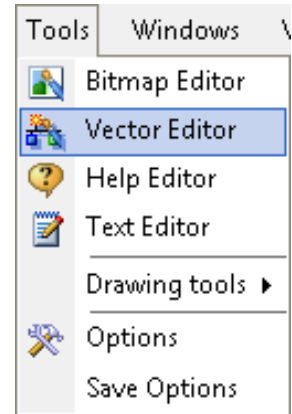


# ATPDraw Library options

- New objects
  - User specified
  - MODELS (but this should better be made from Default Model in the Selection menu)
- Edit objects
  - Standard; Edit the ATPDraw.scl component selection. Not for the average user as the file becomes overwritten in a new installation. User defined help can instead be added as text files in the /HLP directory.
  - User specified (requires an external DBM file) and Models
- Synchronize
  - Reload standard icons from ATPDraw.scl (turn an old circuit into vector graphic)

# ATPDraw Tools options

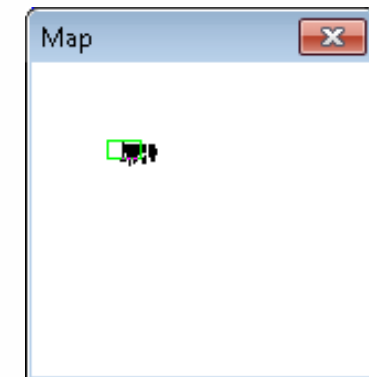
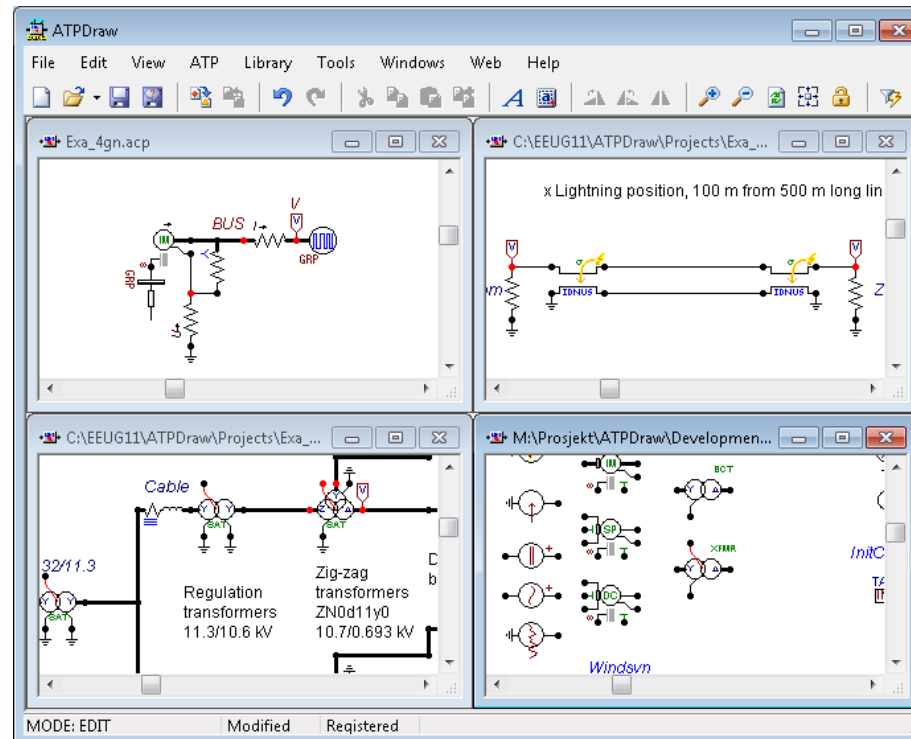
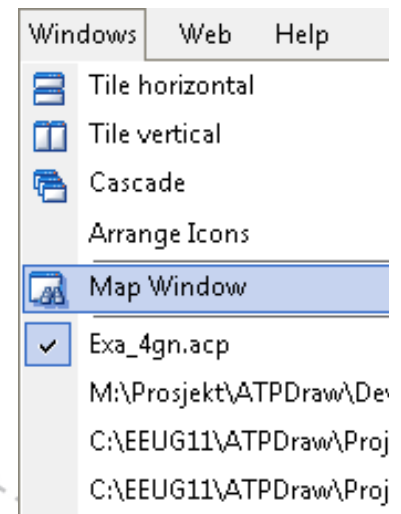
- Bitmap, vector graphic and help stand-alone editors.
- Text editor, embedded with line and column number.
- Drawing tools:
  - General
    - Autosave and backup
    - Save ini file on exit
  - Preferences
    - Undo/redo steps
    - **Link to ATP and plot**
  - Files&Folders
    - Default folders incl.
    - ATP folder

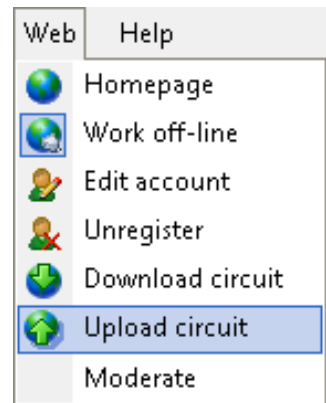




# ATPDraw Windows options

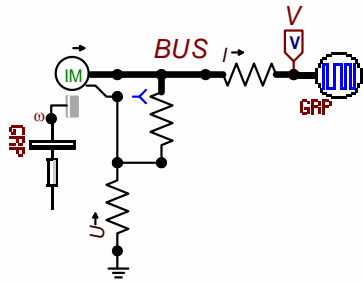
- Arrange multiple document windows
- Show the Map windows
- List all circuit projects loads and select active project window





# ATPDraw Web options

- Register at [www.atpdraw.net](http://www.atpdraw.net) from ATPDraw
- Direct access to MySQL databases from ATPDraw
- Upload and download of circuits.
  - Direct support (one click + provide information)
  - Author cited both in ATPDraw and web-page.



Upload active circuit

Topic: General Author: Hans Kr. Høidalen

Keywords: induction motor, pwm, grouping

Title: Exa\_4gn

Describe content (searchable):

Illustrates the usage of induction motors (universal machine approach) and primarily grouping of the mechanical load and the pulse width modulated source. In the PWM source the TFORTRAN objects are used to have a model independent on node names. This enables copy of group.

Upload Help

NOTE: By uploading a project you agree to share the

Register

Update your contact information or change password

Name: Hans Kr. Høidalen Company: NTNU Country: NORWAY

e-mail: hans.hoidalen@elkraft.ntnu.no Telephone (+cc):

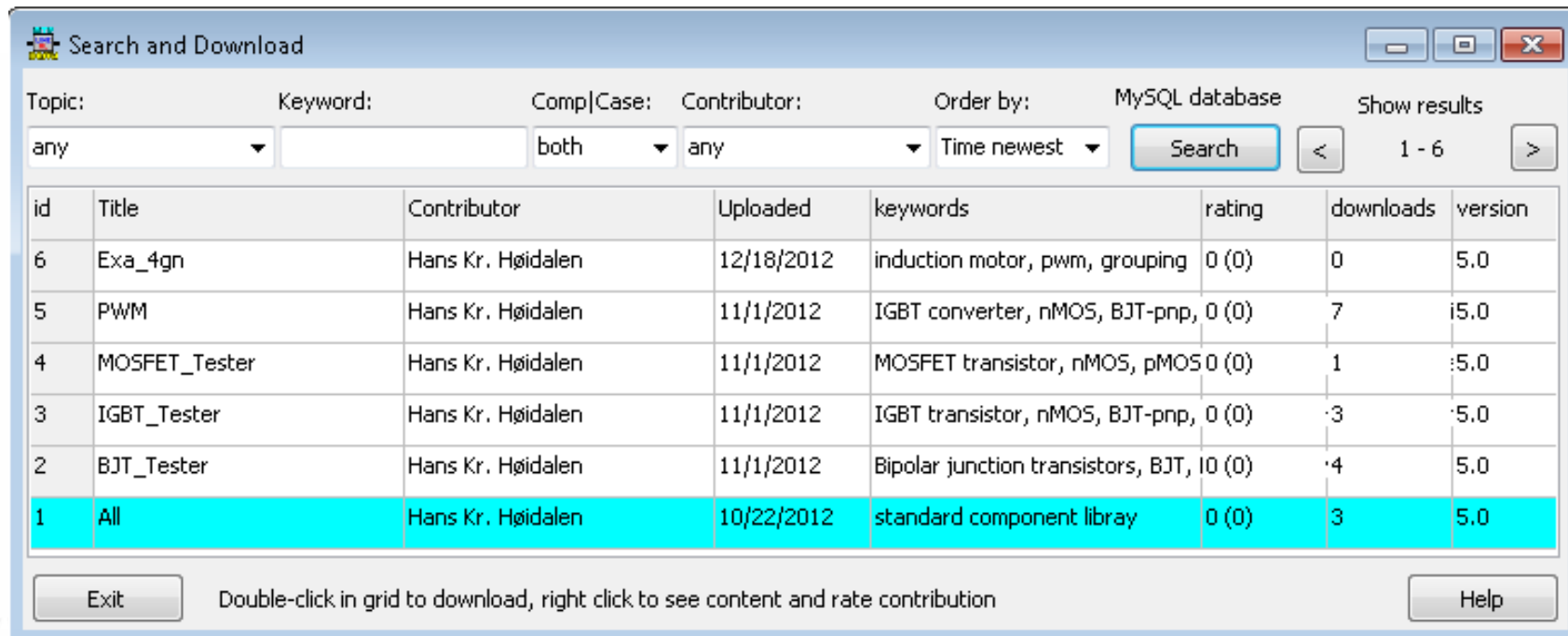
New password: \*\*\*\*\* Do NOT use your secret door-opening password here!  
The password is encrypted in database at atpdraw.net. but given in plain text in the atpdraw.ini file.

Confirm password: \*\*\*\*\* You need the password to register ATPDraw on multiple computers and log-in at www.atpdraw.net.

Update Help

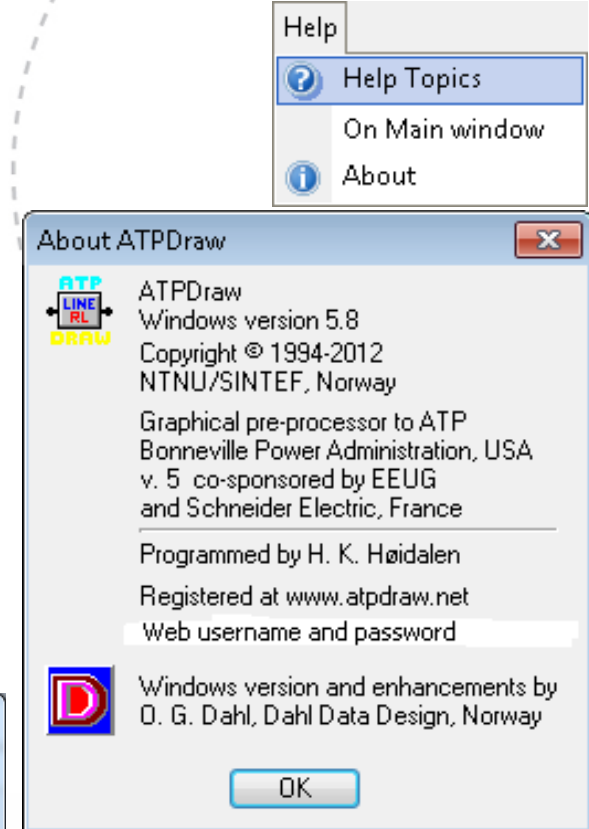
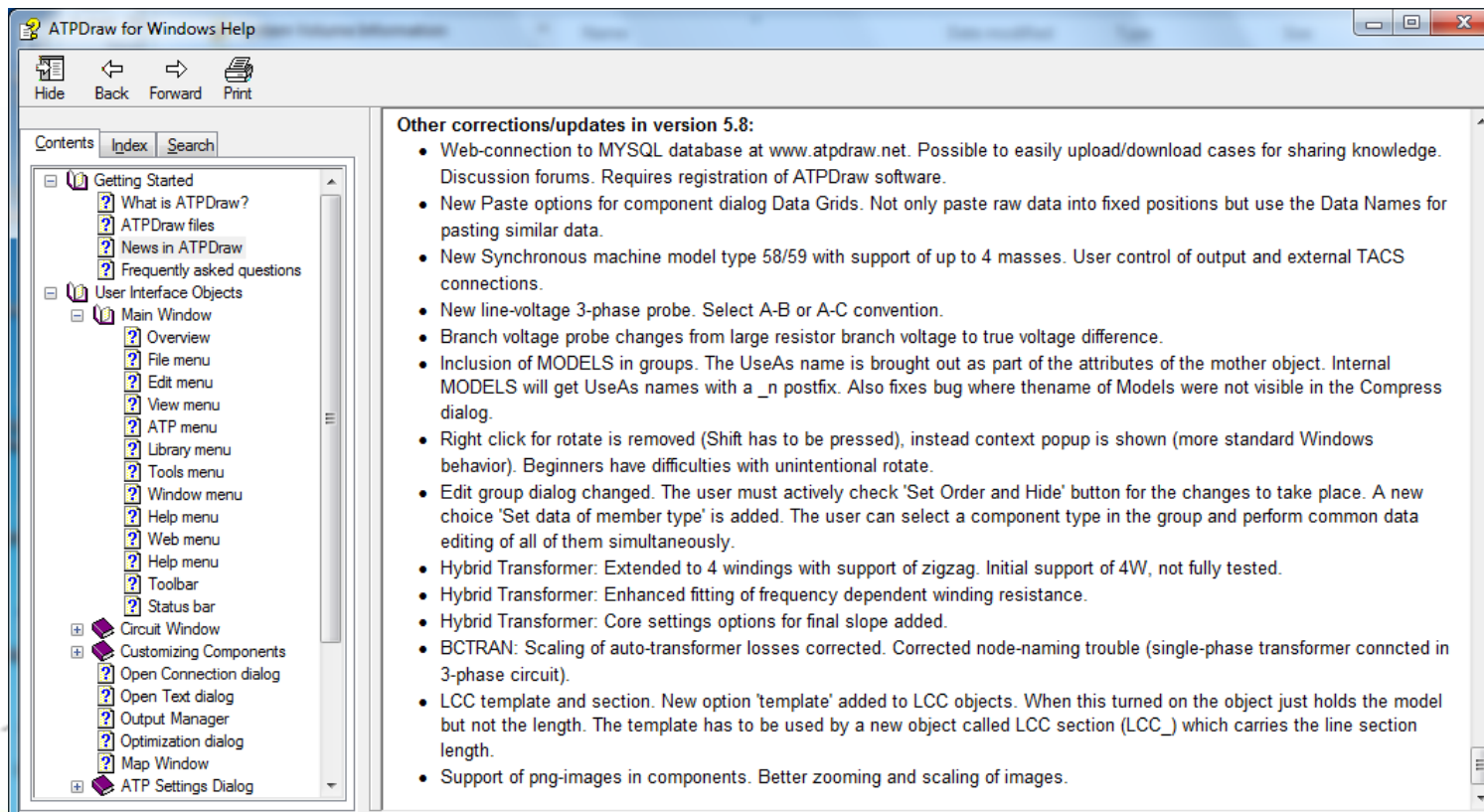
# Download and contribute

- Download dialog with sorting and search options.
- Upload your own cases to assist other users
  - All cases are moderated.
  - Contributor cited both in ATPDraw and on [www.atpdraw.net](http://www.atpdraw.net)



# ATPDraw Help options

- Show main help
- Local help inside every dialog
- About with web registration info

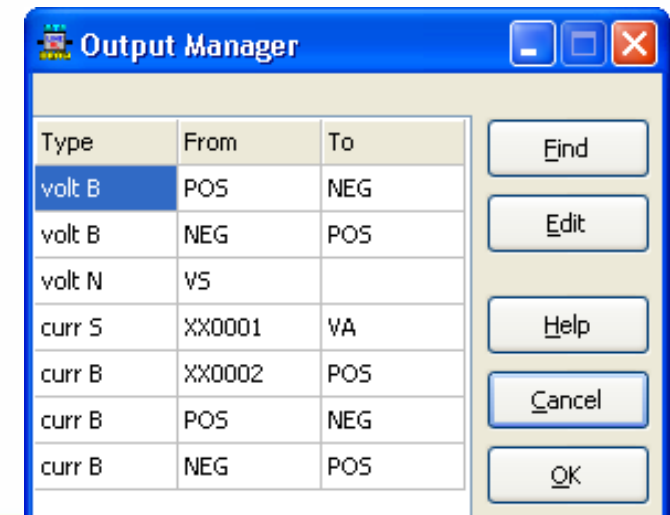
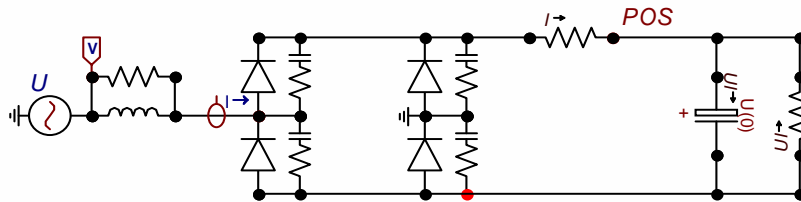


# User's manual

- Documents version 5.6 of ATPDraw (269 pages), pdf
- Written by Laszlo Prikler and H. K. Høidalen
- Content
  - Intro: To ATP and ATPDraw + Installation
  - Introductory manual: Mouse+Edit, MyFirstCircuit
  - Reference manual: All menus and components
  - Advanced manual: Grouping/LCC/Models/BCTRAN + create new components
  - Application manual: 9 real examples

# Output manager (F9)

- Gives an overview of all output requests in the circuit
- Stay on top window
- Lists output in same order as in pl4 file
  - Volt/Power Branch, Volt/Power Switch, Volt Node
  - Curr/Energy Switch, Curr/Energy Branch
  - SM,TACS, MODELS,UM
- Goes into User Specified, Additional cards, and Windsyn
- Find+Edit



# Statistical tabulation

- Addition to output manager

The screenshot displays the ATP software interface with several windows open:

- Output Manager:** A window titled "Statistical tabulation control" containing a table with columns: Type, From, To, On, Pu scaling, and Group. The table lists various power and voltage measurements for different components.
- Circuit Diagram:** A schematic diagram of a power system showing a transformer, three STAT switches, four LCC (Line Commutated Converter) units, and a motor.
- Text Editor:** A window showing a table of data for the simulation, including values for MIDA, MIDB, MIDC, BEGA, BEGB, BEGC, ENDA, ENDB, ENDC, and BEGB.
- ATP Settings:** A window with tabs for Simulation, Output, Switch/UM, Format, and Variables. The Switch/UM tab is active, showing options for "Statistic study" (checked), "Systematic study" (unchecked), and "Switch controls" (ISW: 1).

Type	From	To	On	Pu scaling	Group
power B		ENDA	<input type="checkbox"/>		0
power B		ENDB	<input type="checkbox"/>		0
power B		ENDC	<input type="checkbox"/>		0
power B		BEGA	<input type="checkbox"/>		0
power B		B BGB	<input type="checkbox"/>		0
power B		BEGC	<input type="checkbox"/>		0
volt N	MIDA		<input checked="" type="checkbox"/>	145e3	1
volt N	MIDB		<input checked="" type="checkbox"/>	145e3	1
volt N	MIDC		<input checked="" type="checkbox"/>	145e3	1
volt N	BEGA		<input checked="" type="checkbox"/>	145e3	1
volt N	B BGB		<input checked="" type="checkbox"/>	145e3	1
volt N	BEGC		<input checked="" type="checkbox"/>	145e3	1
volt N	ENDA		<input checked="" type="checkbox"/>	145e3	1
volt N	ENDB		<input checked="" type="checkbox"/>	145e3	1
volt N	ENDC		<input checked="" type="checkbox"/>	145e3	1
energy B		ENDA	<input checked="" type="checkbox"/>	1e6	2
energy B		ENDB	<input checked="" type="checkbox"/>	1e6	2
energy B		ENDC	<input checked="" type="checkbox"/>	1e6	2
energy B		BEGA	<input checked="" type="checkbox"/>	1e6	2
energy B		B BGB	<input checked="" type="checkbox"/>	1e6	2
energy B		BEGC	<input checked="" type="checkbox"/>	1e6	2

```

File Edit Character Done Help
| 1.45E5MIDA MIDB MIDC BEGA BEGB BEGC ENDA ENDB ENDC
-4 1.E6 ENDA ENDB ENDC BEGB CONT.
-4 1.E6 BEGC
  
```

ATP Settings - Switch/UM tab:

- Switch study:
  - Statistic study:
  - Systematic study:
  - Num. = 100
- Switch controls:
  - ISW: 1
- Universal machines:
  - Initialization:
    - Automatic:
    - Manual:
  - Units:
    - SI:

# Optimization module

- Gradient Method
- Genetic Algorithm
- Simplex Annealing
- Select variables (with limits) and cost function
- Loops ATP (serial/parallel)
- Writes back final variable values

**Optimization**

Variables

Variable	Minimum	Maximum	Best fit
CURR	1	20	13.4431372549

Object function: MAX

Min/Max:  Minimize  Maximize

Solution

Method: Genetic Algorithm

Extrema: 46365.8206

Max iter: 10

Genetic algorithm settings

Population: 100

Crossover\_P: 0.98

Resolution: 8-bits

Inversion\_P: 0.1

Selection: RndTourn

Mutation\_P: 0.1

Preserve fittest:  Rival count: 5

Continue

Run Exit Help

Solution

Method: Gradient Method

Extrema: 46400.5183

Max iter: 10

Gradient Method settings

eps\_X: 1e-4

delta\_X: 0.001

Solution

Method: Simplex Annealing

Extrema: 46397.9864

Max iter: 100

Simplex Annealing settings

Population: 4

Ftol: 0.001

Mutation\_P: 0.01

ratio: 0.5

Max climbs: 2

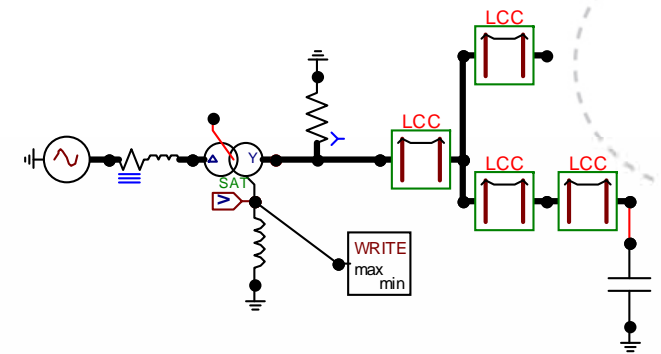
beta: 0.5

Parameters=0: Nelder-Mead Simplex



# Example I: Resonance coil tuning

- How to set the coil to 10 % over-compensation?
- 1: Define reactance REACT of coil as variable
- 2: Define CURR as a local variable
- 3: Add cost function to neutral voltage
- 4: Run Optimization
- 5: Divide REACT by 1.1



**Optimization**

Variables

Variable	Minimum	Maximum	Best fit
CURR	1	20	13.4253869929

Object function: MAX

Min/Max:  Minimize  Maximize

Solution

Method: Gradient Method

Extrema: 46400.517

Max iter: 10

Gradient Method settings

eps\_X: 1e-4

delta X: 0.001

Run Exit Help

**ATP Settings**

Simulation Output Format Switch/UM Load flow Variables

\$PARAMETER settings

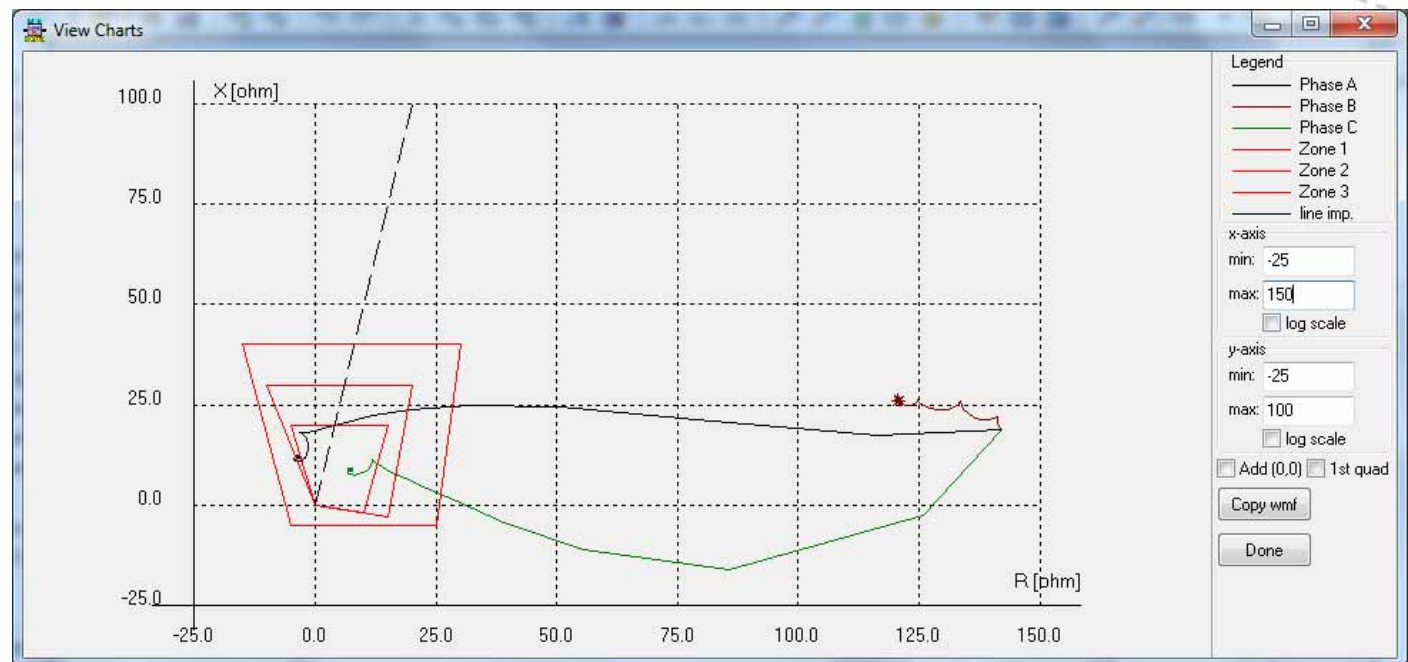
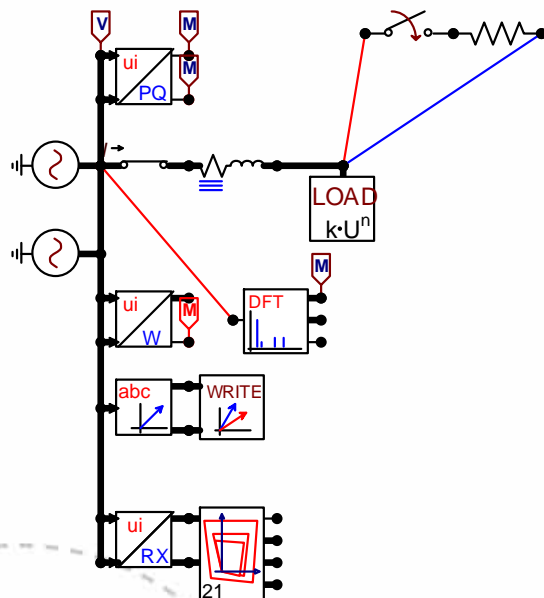
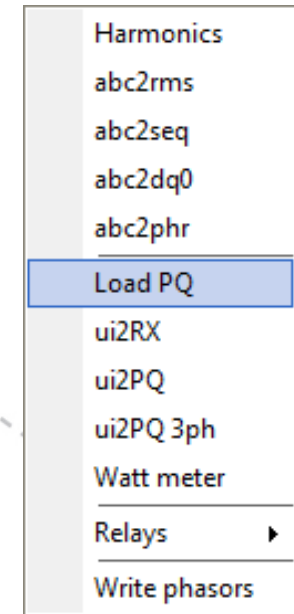
NAME	VALUE
CURR	13.42539
REACT	24000./SQRT(3)/CURR/1.1

Number of simulations: 1

OK Help

# Latest news version 5.9

- Power system tools
  - Phasors, power and RX calculation with DFT
  - Plot phasors
  - Distance and differential relay trajectories



# Latest news version 5.9

- Internal parser (TbcParser)
  - Assign a global variable to component data. Can be a function of the simulation number; KNT in multiple runs.
  - Alternative to ATP's \$PARAMETERS. Almost transparent except for the logical operators.
  - Benefit; allows parameterization of all data also those involved in internal calculations (source amplitudes and phase shifts, line lengths etc.). Relaxed restrictions in the @FILE and @[] syntax.
- Sidebar shoutbox
  - Chat with all online users.
- Synchronous machine improvements
- Plot window enhancements

# Latest news version 5.8

- Hybrid transformer further developed (4 windings, zigzag, enhanced core settings, new R(f) options)
- New synchronous machine 58/59 with multi-masses and output control.
- LCC template. Cross section in a template object, length in a new LCC section object referencing the template. Optional single phase view of LCC section.
- BCTRAN corrections.
- Grouping of MODELS. UseAs surfaced.
- Enhanced voltage probes.
- Web and MySQL connection. Upload/download, forum.
- Support of png images. Far better zooming of images.

# Hybrid transformer

- Extended to 4 windings
- Y, D, Auto, Zigzag
- New winding sequence specifier
- Core node select
- Final slope enhancements

Final slope

La= 0  mH  pu of Lps

Estimate

Add final segment La

- Copper loss enhancements

- $R \sim \sqrt{f}$    $L \sim \text{const}$
- $R \sim \text{Cigre}$    $L \sim f(R)$

Hybrid transformer : XFMR

Structure

Number of phases: 3

Number of windings: 2

Type of core: 3-leg stacked

Test frequency [Hz]: 50

Data based on: Ind. Res. Cap. Core

Design param.  Test report  Typical values

Ratings & connections

	Prim.	Sec.
L-L voltage [kV]	432	16
Power [MVA]	290	290
Connections	Y	D
Phase shifts	0	150
Node names		

Winding sequence core-inner-outer  S  P  Ext. neutral connections  Hide core nodes

Data

Inductance Resistance Capacitance Core

Performed at: Sec  Average currents  Zero seq. available

Insert Delete

**positive sequence** @290 [MVA]

Volt [%]	Loss [kW]	Iav [%]
75	83.1	0.05
87.5	118.8	0.11
93.75	143.6	0.17
100	178.6	0.31
106.25	226.5	0.67

Relative dimensions

Ratios ref. leg	Area	Length
Yoke	1	1.75

Initialize

View fl/i

Configuration

Part	Area	Length
yoke	$w_1 w_2$	$2 l_1 l_2$

Order: 0 Label: Comment:

OK Cancel Import Export

# New synchronous machine

- Manufacturers input similar to UM
- Support of type 58
- Multi-masses (4)

		General	Field current	Masses	Output			
#Masses:	2	Mass	EXTRS	HICO	DSR	DSD	DSM	HSP
Rotor@:	1	1	0.9	0.03	0	50	0	0
Exciter@:	0	2	0.1	0.02	0	100	0	0

- Output control

		General	Field current	Masses	Output						
<input checked="" type="checkbox"/>	IA	<input checked="" type="checkbox"/>	ID	<input type="checkbox"/>	IkD	<input type="checkbox"/>	MFORCE	Angle	Speed	Torque	#TACS out
<input checked="" type="checkbox"/>	IB	<input checked="" type="checkbox"/>	IQ	<input type="checkbox"/>	IG	<input type="checkbox"/>	MANGLE	Mass 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2
<input checked="" type="checkbox"/>	IC	<input type="checkbox"/>	IO	<input type="checkbox"/>	IkQ	<input type="checkbox"/>	TEG	Mass 2	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	VF	<input type="checkbox"/>	IF	<input type="checkbox"/>	TEXC						

- Dynamic TACS output (5)

Component: SM

Attributes

DATA	UNIT	VALUE
Frequency	Hz	50
Power	kVA	1000
Voltage L-L	kVrms	10
Poles	2*PP	4
	pu	0.03
	pu	1.3
	pu	0.8
	pu	0.12

NODE	PHASE	NAME
BUS	1	
POWER	A..D	
EXFD	1	
EXOUT1	1	
EXOUT2	1	
EXOUT3	1	
EXOUT4	1	
EXOUT5	1	

Copy Paste Reset Order: 0 Label:

Comment:

Field current Masses Output

state [V]p L-G [deg]

Time constants  Open  Short  Parallel operation  Hide

Delta connection  Type 58 (phase)

Edit definitions OK Cancel Help

# LCC template/section

- LCC object has property Template
  - If 'on' the object becomes a dummy component not written to the ATP-file
- New LCC section reference by Name.
  - Holds section length. Single phase option.
- Complicated railway study where new approach is useful:

System type

Name: KL  Template

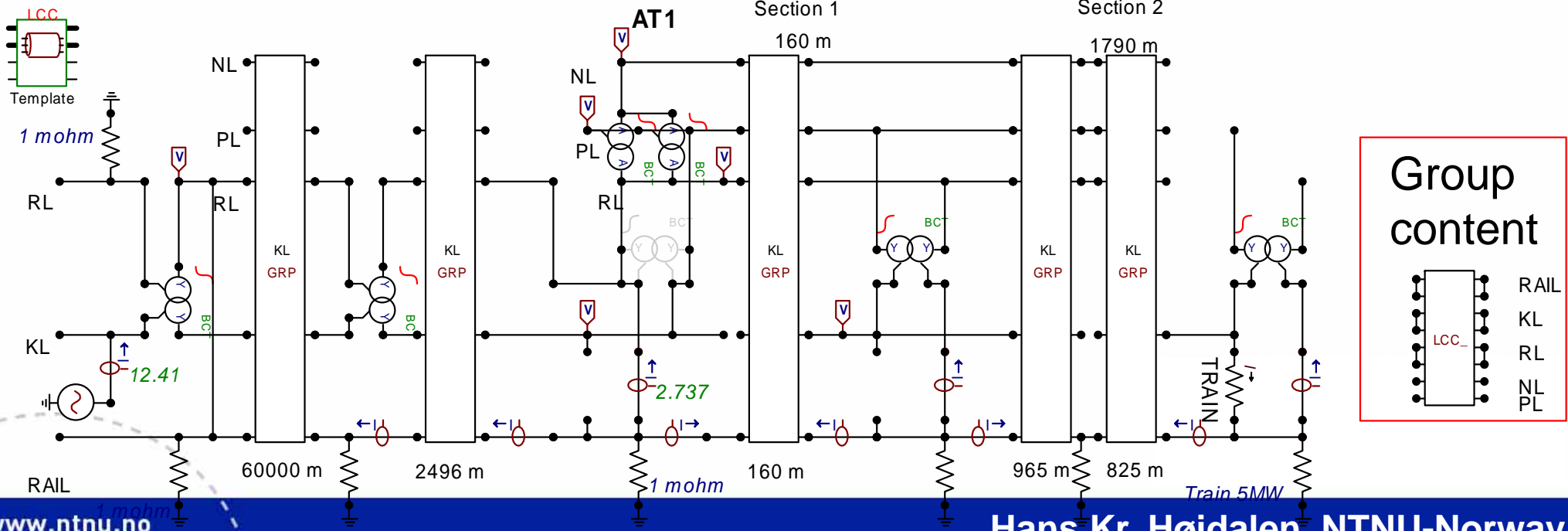
Enclosing Pipe  #Ph: 8

Number of cables: 8

Template and name

KL  Use As: 1|

Single phase layout  Set length in icor



# Web – page and forum

AC resistance of pa x IEEE Xplore - Search x Vacancies - employ x JN Søker | Oversikt | Sti x cPanel X x atpdraw.net / locali x ATPDraw x

www.atpdraw.net/discussion.php

**ATP Draw**  
The graphical preprocessor to ATP  
Electromagnetic Transients Program

Log out  
My account  
Hans Kr. Høidalen

Home Slides News Help EEG Download Cases Forums Administration

## Discussions on how to use ATPDraw and ATP

Tips and tricks

New post

Keyword: Search by keyword

Author: any

Sort by: Time newest

Show 6 - 7 of 7 [Previous](#)

**#8** **How to program an integral calculation**, published Oct. 26, 2012 by martin.mannone

Dear users,

Hello. I am would like to do a MODEL to find symmetrical components (I0, I1, I2 and V0, V1, V2) following the indicated in the attached file.  
At the moment i write the following code but i dont understand how i have to write the intregal shows in file. So, any help regards this issue i will be greatful

thanks and regards,

MODEL 3ph-Seq012

```
DATA FREQ {DFLT:60} --Frecuencia del sistema
OMEGA {DFLT:2*PI*FREQ} --Frecuencia angular
PERIOD {DFLT:1/FREQ} --Periodo

INPUT IA,IB,IC, --Entrada de señales corriente instantaneas

OUTPUT I0,I1,I2 --Salida componentes simetricas de las corrientes

VAR x0,y0,x1,y1,x2,y2
INIT
x0:=0
y0:=0
x1:=0
y1:=0
x2:=0
y2:=0
ENDINIT
EXEC
x0:=
```



# Embedded Windsyn

- Direct support of Windsyn features
  - ATPDraw has embedded induction machine fitting with extended user control (incl. T<sub>max</sub> fitting)
  - Convergent gradient method for fitting cost function
  - More flexible start-up, output control and T/ω plotting

Component: UMIND

Attributes

DATA	UNIT	VALUE
Frequency	Hz	50
Voltage L-L	kVrms	10
Power	hp	1000
Speed	rpm	1500
Power factor	cos (phi)	0.9
Efficiency	pu	0.98
Slip	%	1
Start curr.	pu	6

NODE	PHASE	NAME
BUS	ABC	BUS
ROTM	ABC	ROT
TORQUE	1	TRQ
NEUT	1	N
STATOR	ABC	MOT
TRQ sources	1	TRQS
VX	A..H	VX

Copy Paste entire data grid Reset Order: 0 Label:

Comment:

Model Start-up Output

Rotor: Wound Moment of inertia: 65.66 unit: kgm<sup>2</sup>  Hide

Eit & View Damping factor: 5

Edit definitions OK Cancel Help

Induction machine fitting

Input	Entered	Adjusted	Weight	Output	pu	Ohm/H
Power factor	0.9	0.9	1	Rs	0.001444	0.174199
Efficiency	0.98	0.98	1	Xs	0.083736	0.032156
Slip [%]	1	1.843	0	Xm	3.337362	1.281614
Current start	6	6.	1	Xr	0.083736	0.032156
Torque start	0.65	0.65	1	R1	0.018974	2.289034
Current rated	1.0	1.	1	R2	0.0	0.0
Maximum torque	2.5	2.853	0	X2	0.0	0.0

Cage factor: 0 Refit Rated torque: 4741.567 [Nm]

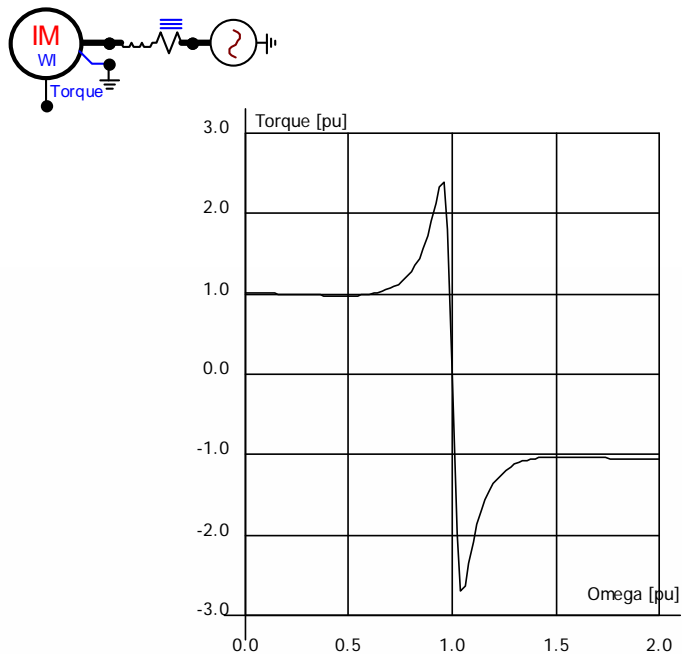
OK Cancel Plot Help

# Windsyn in ATPDraw

- Windsyn relaxes the fitting of the slip while ATPDraw now offers this as a part of the cost function
- Windsyn does the fitting iteratively without adjusting the stator resistance when slip, efficiency or power factor becomes different
- Bug fixes (hp conversion, round-off error, mechanical vs. electrical power, motor vs. generator efficiency)
- The TACS section made smoother with less variables (kVAR, kWAT, PUVT, PUTM, Slip)
- Only relevant nodes presented in the icon (no field voltage node, only rotor winding node for wound rotor)
- No need to rerun the fitting when the type of initialization or compensation/prediction change

# Example

- Create double-cage IM model



Input	Entered	Adjusted	Weight	Output	pu	Ohm/H
Power factor	0.9	0.783	1	Rs	0.011808	1.238828
Efficiency	0.98	0.979	1	Xs	0.069449	0.023193
Slip [%]	1	0.697	0.01	Xm	1.848059	0.617172
Current start	6	6.113	1	Xr	0.069449	0.023193
Torque start	1	1.006	1	R1	0.047356	4.96841
Current rated	1.0	0.981	10	R2	0.009116	0.956439
Maximum torque	2.5	2.411	0	X2	0.056472	0.018859

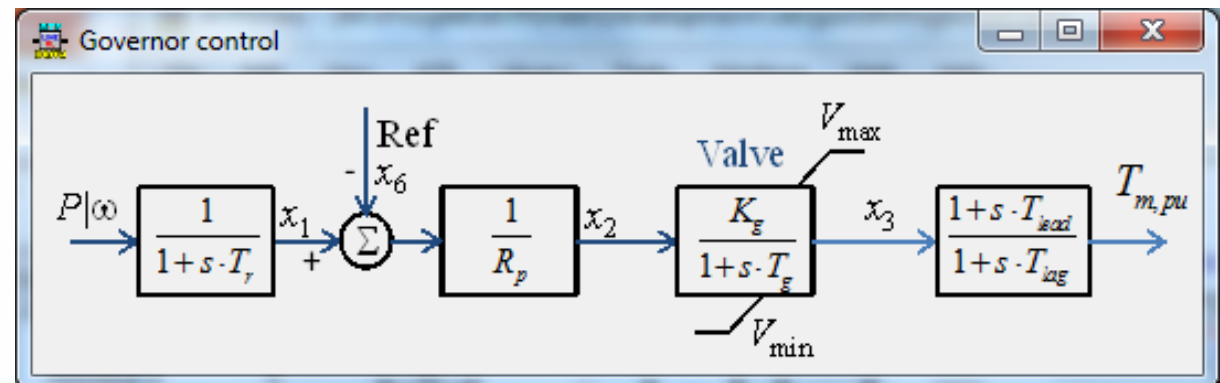
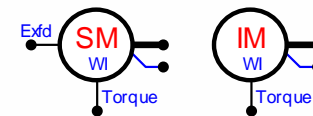
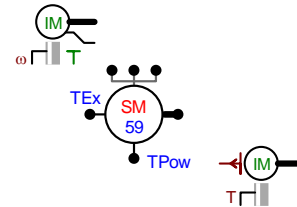
Cage factor:       Refit      Rated torque:  [Nm]

OK      Cancel      Plot      Help

- Tuning of weight factors required to get rated current.

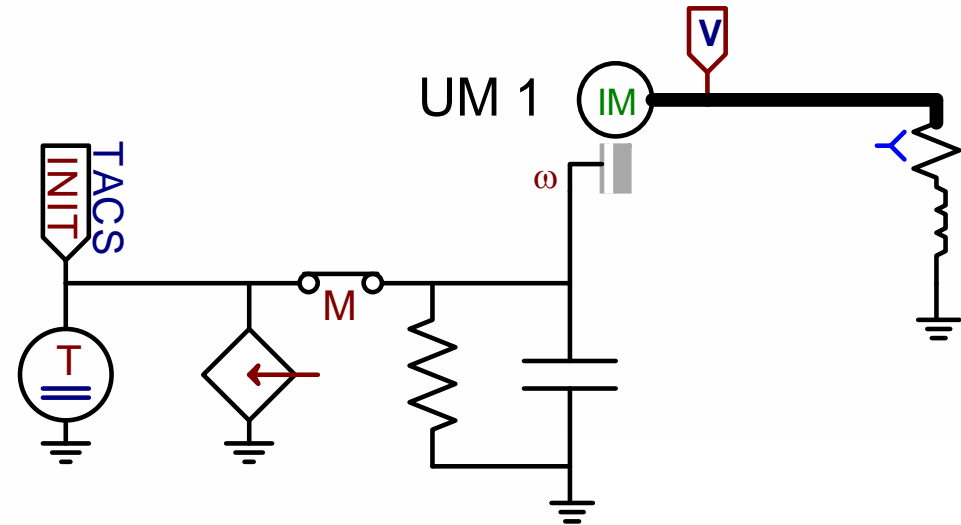
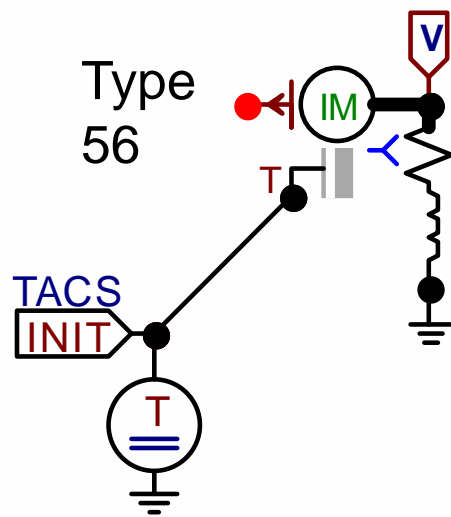
# Machines

- The following types are supported
  - Universal machine
  - Type 59/58 synchronous machine
  - Type 56 induction machine
- Embedded, adapted Windsyn support
  - Manufacturer data input
  - Start-up facilities
  - Embedded controls (exciter, governor)



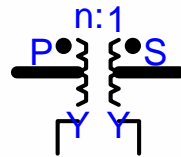
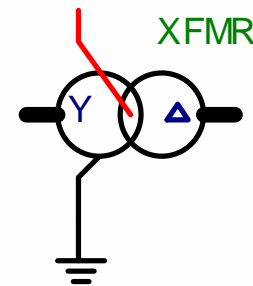
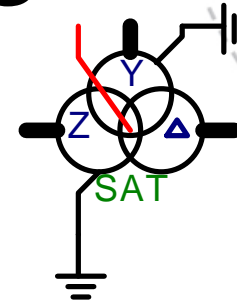
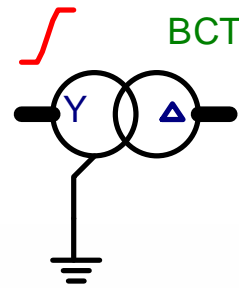
# Type 56 machine

- Initial support in ATPDraw
  - Improvements required (TACS control, combination with UM)
- Brand new versions of ATP and PlotXY required
- More numerically stable (phase domain)
- Limitations on the mechanical side and in rotor coils



# Transformer modeling

- Saturable Transformer
- BCTRAN
- Hybrid Transformer
- Ideal



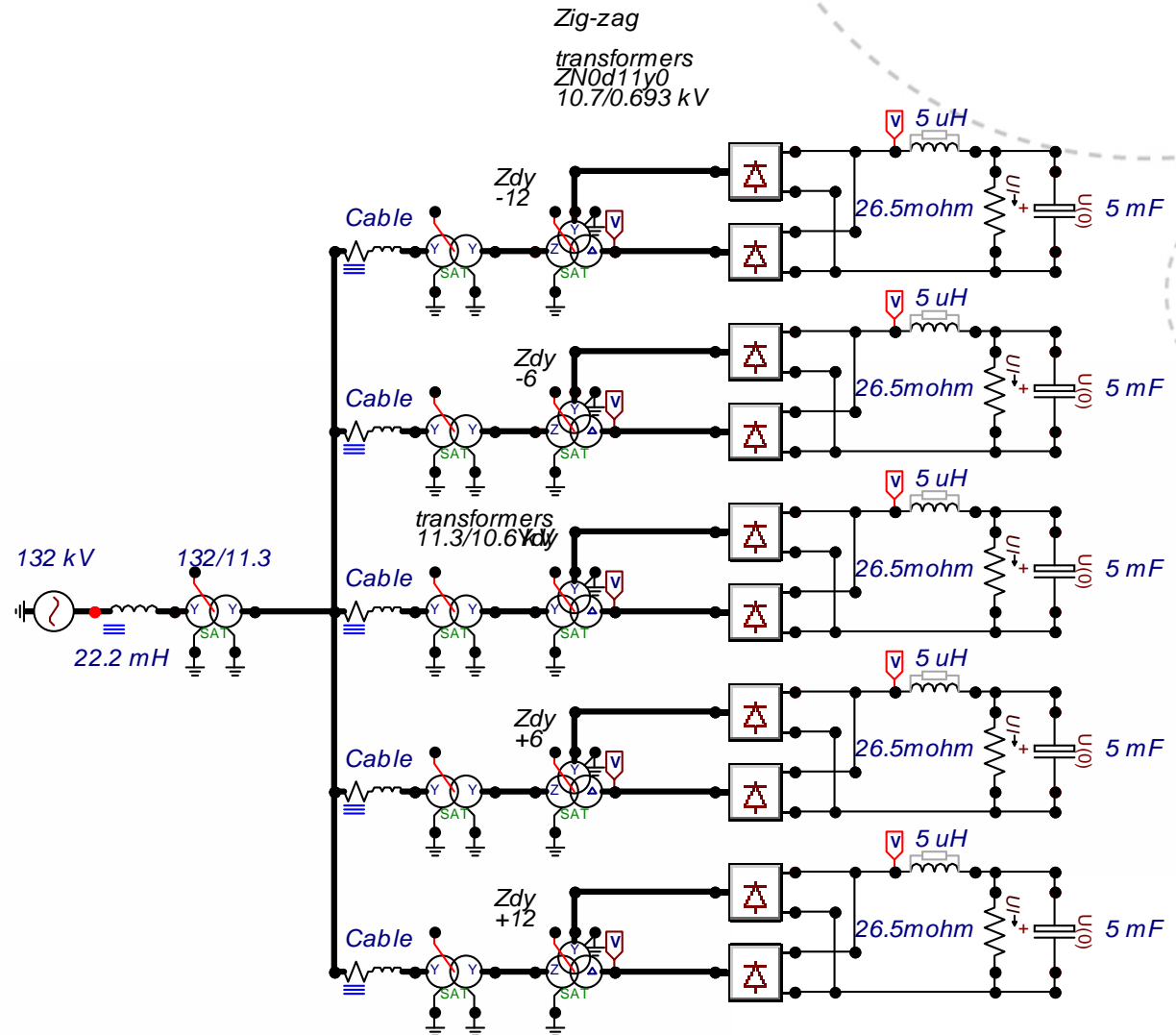
# Saturable transformer

- Zigzag supported

	Prim.	Sec.	Tert.
U [V]	85.92	2.11	1.23
R [ohm]	-0.064193	0.00019	6.6E-5
L [mH,ohm]	1.2260045	0.00973	0.00331

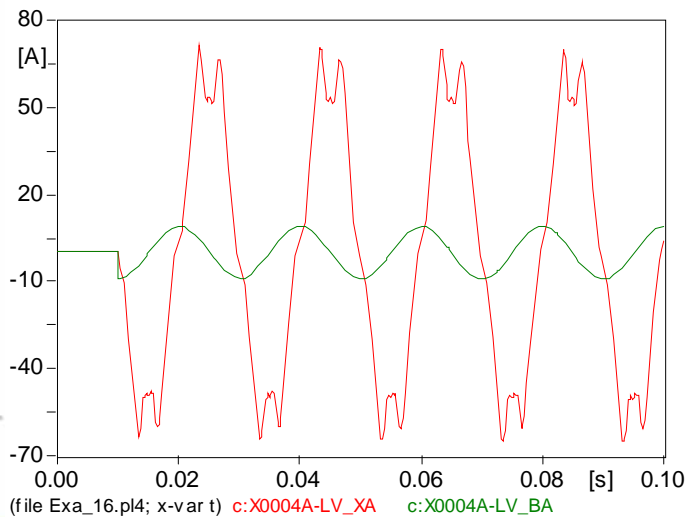
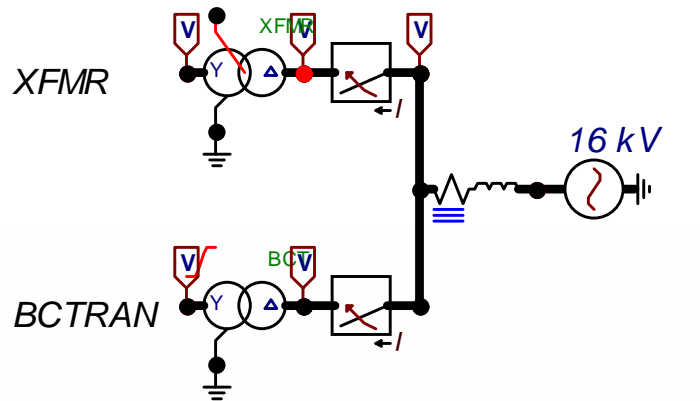
  

Coupling	Z	D	Y
Phase shift	-12	330	0
I(0)=	0	Rm=	0
F(0)=	0	R0=	1E12
		<input checked="" type="checkbox"/>	3-leg core
		<input type="checkbox"/>	RMS
		<input checked="" type="checkbox"/>	3-winding



# BCTRAN

- Automatic inclusion of external magnetization characteristic



**BCTRAN: M:\Prosjekt\ATPDraw\Development\versjon50\atp\BCTRAN.pch**

Structure

Number of phases: 3

Number of windings: 2

Type of core: 3-legged stacked core

Test frequency [Hz]: 50

AR Output  Auto-add nonlinearities

Ratings

	HV	LV
L-L voltage [kV]	432	16
Power [MVA]	290	290
Connections	Y	D
Phase shift [deg]		30
		<input type="checkbox"/> Ext. neutral connections

Factory tests

Open circuit | Short circuit

Performed at: LV Connect at: LV  Zero sequence data available

**positive sequence**

Volt (%)	Curr (%)	Loss (kW)
75	0.05	83.094
87.5	0.11	118.818

Positive core magnetization

Linear internal  External Lm  External Lm || Rm

View/Copy

Rm  Lm-rms  Lm-flux

Order: 0 Label: Factory test data  Hide

Comment:

OK Cancel Import Export Run ATP View + Copy + Help

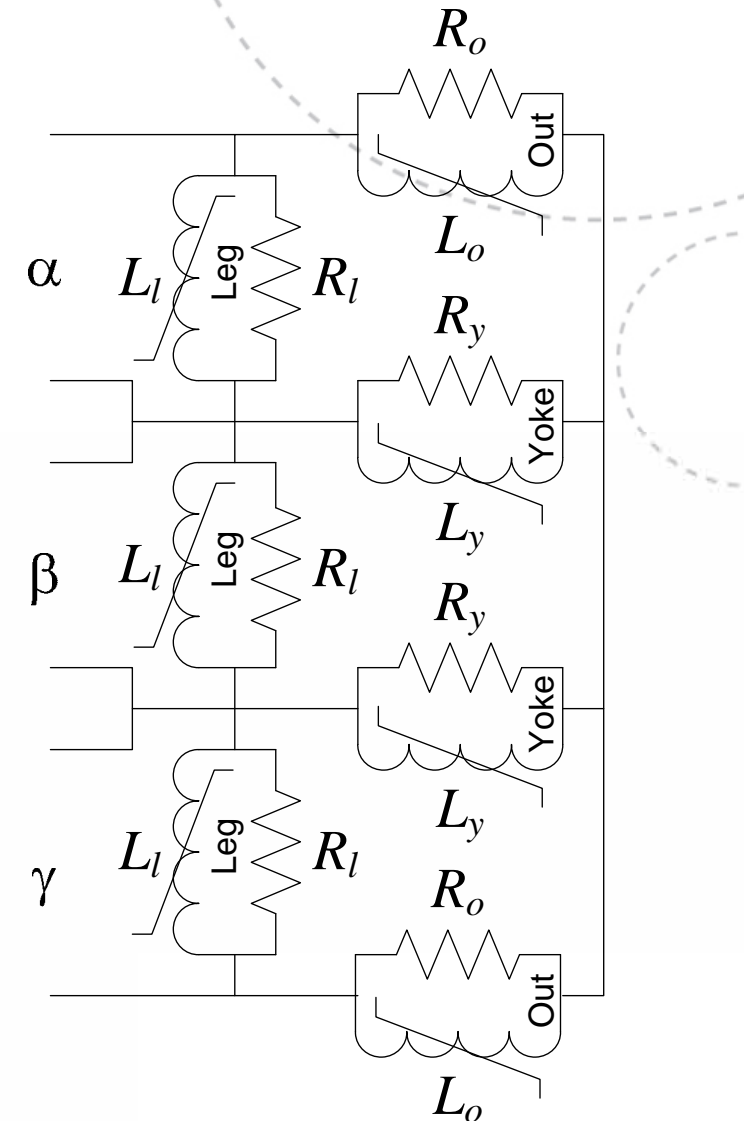
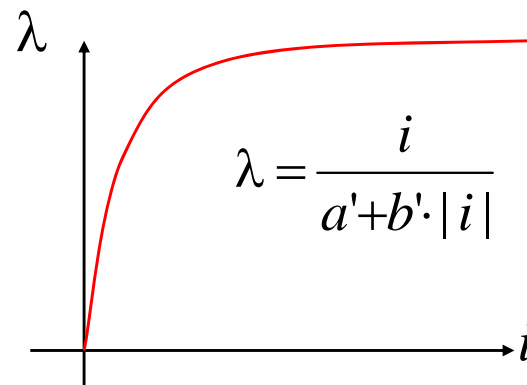


# Hybrid Transformer model - XFMR

- Topologically correct
- The model includes:
  - an inverse inductance matrix for the leakage description,
  - frequency dependent winding resistance,
  - capacitive coupling,
  - and a topologically correct core model with individual saturation and losses in legs and yokes. Triplex, 3,5, shell-form cores.
  - Fitting to test report data, given relative core dimensions.
- The user can base the transformer model on three sources of data:
  - **Design parameter**: specify geometry and material parameters of the core and windings.
  - **Test report**: standard transformer tests.
  - **Typical values**: typical values based on the voltage and power ratings.

# — Core representation

- Attached to the fictitious N+1th winding
- Topologically “correct” core model, with nonlinear inductances representing each leg and limb
  - Triplex
  - 3- and 5-legged core
- Flux linkage-current relation by Frolich equation and relative lengths and areas.
- Fitting to Test Report



# Snapshots

Hybrid transformer : SIMA

Structure

Number of phases: 3  
 Number of windings: 2  
 Type of core: 5-leg stacked  
 Test frequency [Hz]: 50

Data based on: Ind. Res. Cap. Core  
 Design param.      
 Test report      
 Typical values

Ratings & connections

	Prim.	Sec.
L-L voltage [kV]	432	16
Power [MVA]	290	290
Connections	Y	D
Phase shifts	0	30
Node names	HV_X	LV_X

Winding sequence: core-inner-outer  S  P  Ext. neutral connections  Hide core nodes

Data

Inductance Resistance Capacitance Core

Performed at: Sec  Average currents  Zero seq. available

Relative dimensions

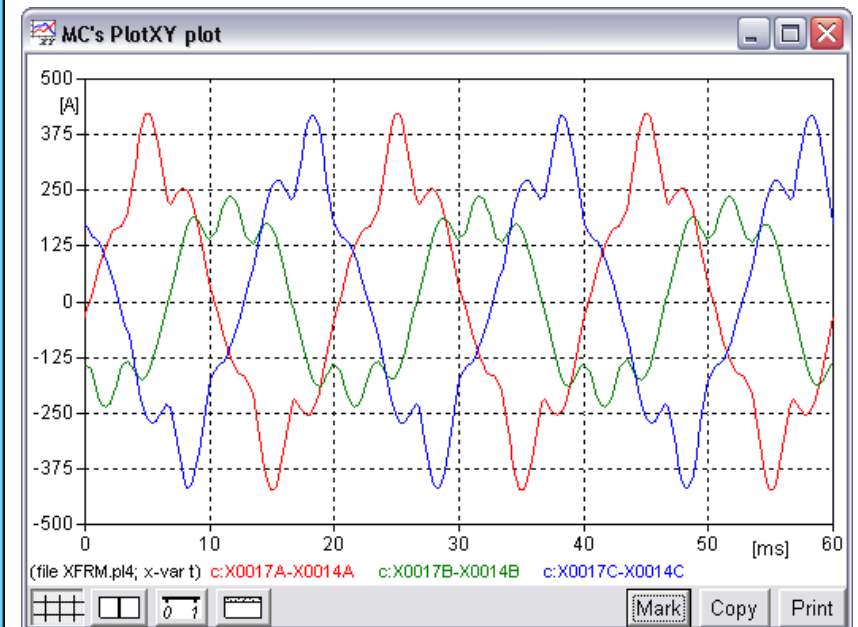
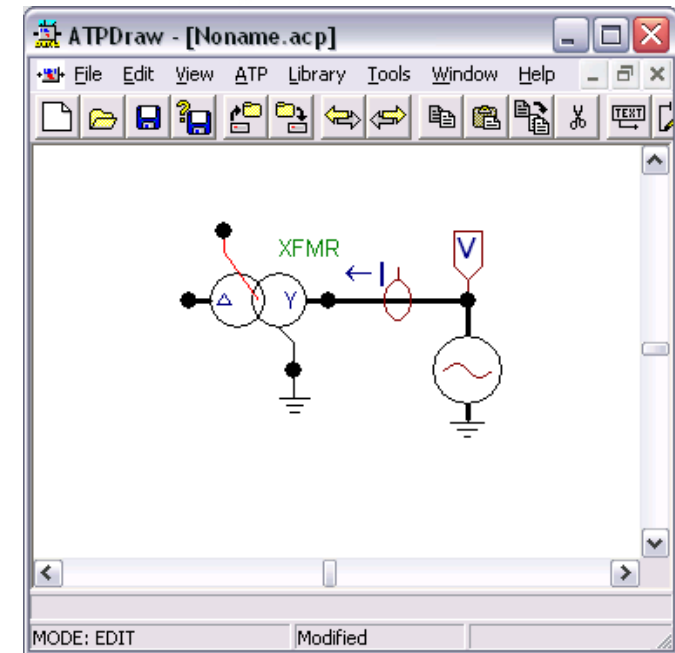
Ratios ref. leg	Area	Length
Yoke	0.54	1.5
Outer leg	0.54	2.5

**positive sequence** @290 [MVA]

Volt [%]	Loss [kW]	Iav [%]
75	83.1	0.05
87.5	118.8	0.11
93.75	143.6	0.17
100	178.6	0.31
106.25	226.5	0.67

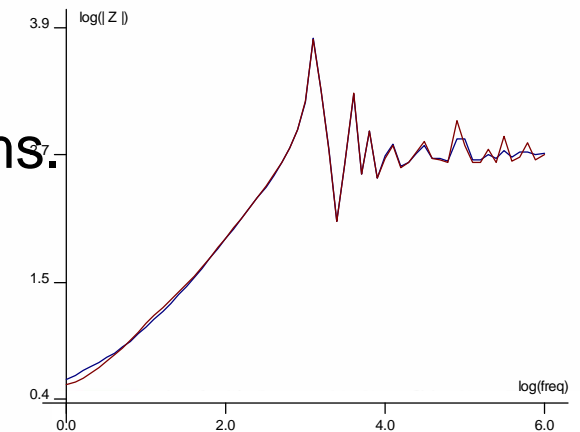
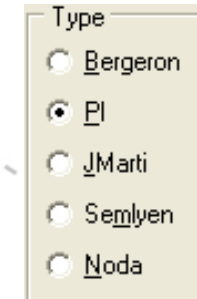
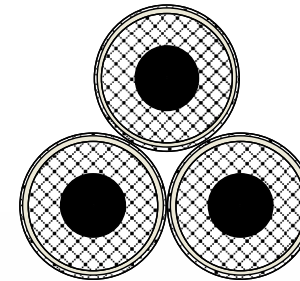
Order: 0 Label: Comment:  Hide

OK Cancel Import Export Edit defin. Help



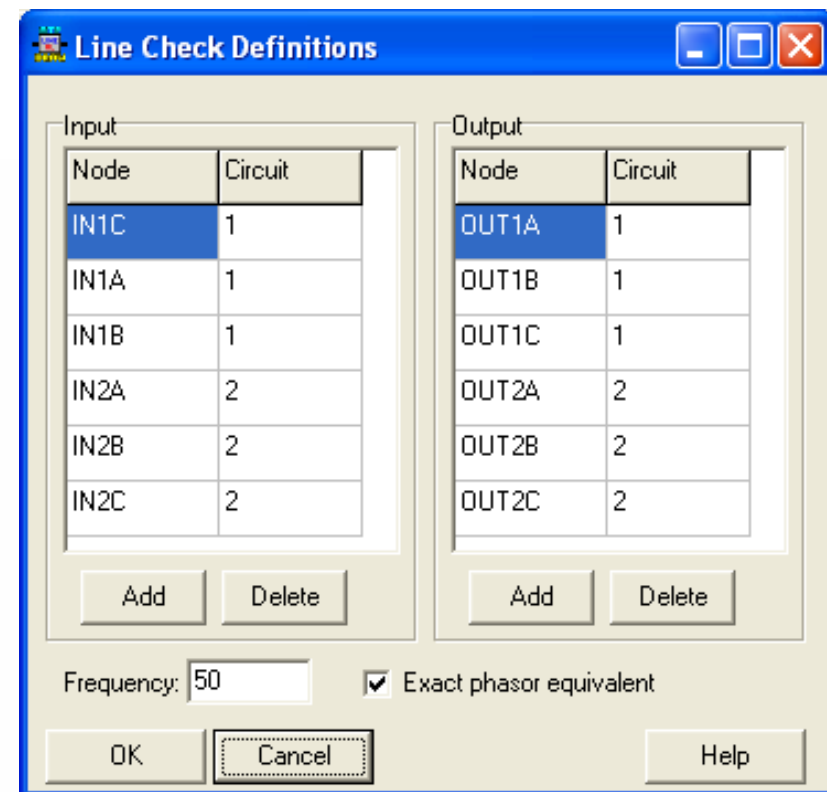
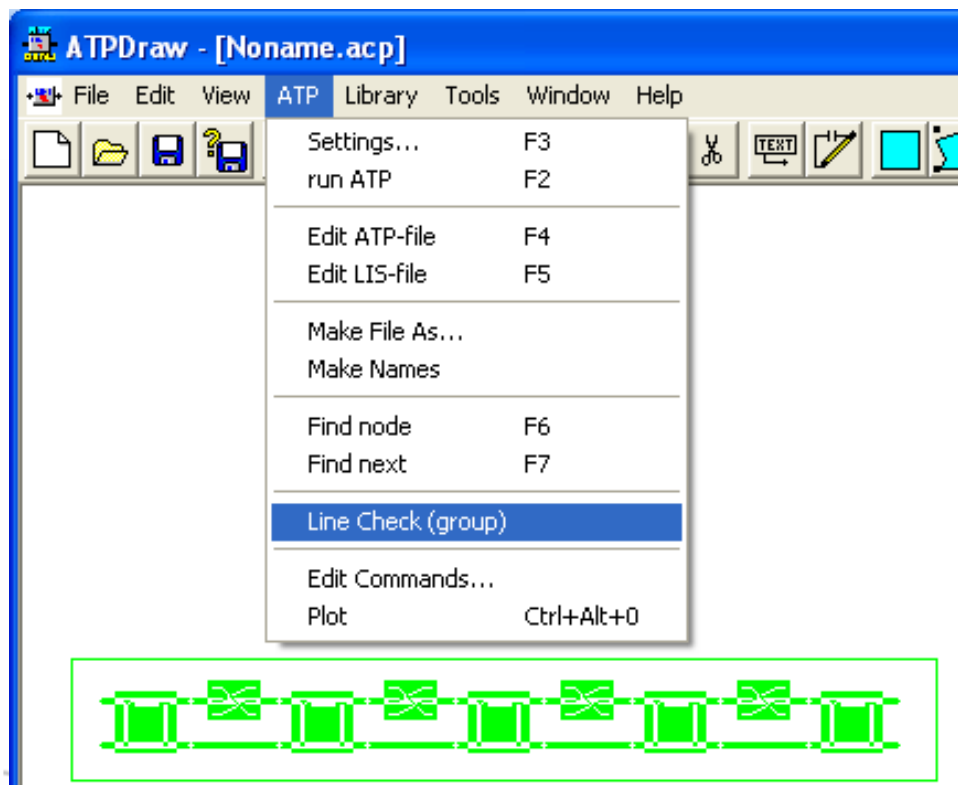
# Line/Cable modeling

- Line/Cable Constants, Cable Parameters
  - Bergeron, PI, JMarti, Semlyen, Noda(?)
- View
  - Cross section, grounding
- Verify
  - Frequency response, power frequency params.
- Line Check
  - Power freq. test of line/cable sections



# Line Check

- The user selects a group in the circuit
- ATPDraw identifies the inputs and outputs (user modifiable)



# Line Check cont.

- ATPDraw reads the lis-file and calculates the series impedance and shunt admittance

**Result of Line Check Calculations**

Self Mutual

Positive sequence self and mutual impedance

ohm/km	Line1	Line2	Line3
Line1	0.0195+j0.2882	-0.002+j0.0013	
Line2	-0.002+j0.0013	0.0567+j0.3811	

Zero sequence self and mutual impedance

ohm/km	Line1	Line2	Line3
Line1	0.1515+j0.6344	0.1189+j 0.16	
Line2	0.1189+j 0.16	0.2219+j0.7531	

Positive sequence self and mutual admittance

nF/km	Line1	Line2	Line3
Line1	6.2E-9+j12.833	-9.E-4+j0.0019	
Line2	-9.E-4+j0.0019	9.7E-8+j9.6604	

Zero sequence self and mutual admittance

nF/km	Line1	Line2	Line3
Line1	8.8E-7+j9.2734	-3.E-8+j0.0119	
Line2	-3.E-8+j0.0119	-4.E-7+j 6.897	

Calculated at 50 [Hz]

Polar coordinates

Admittance units:  uF  nF  uS  nS

Scale:  None  /length  \*factor

Length:

Length units:  /km  /miles

OK Report Help

# Latest news, Version 5.0 available from October 2006

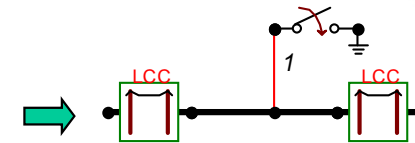
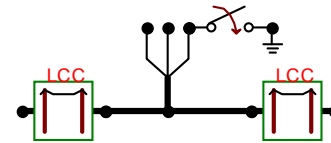
Sponsored by BPA & EEUG

- **Vector graphics**

- Improved zoom
- Larger, dynamic icon; RLC, transformer, switch...
- Individual selection area

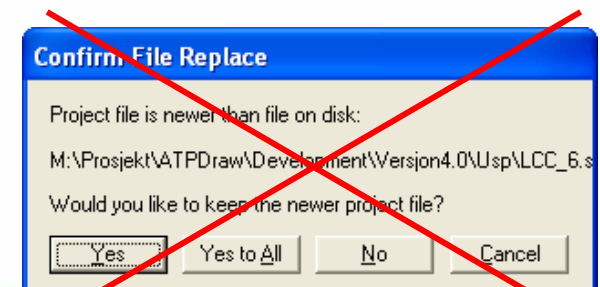
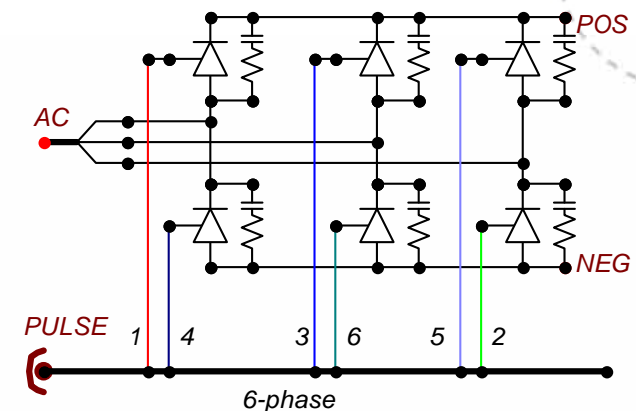
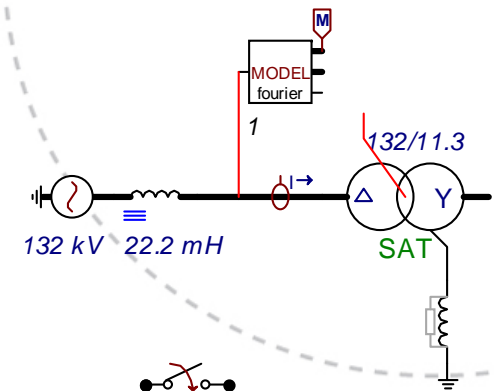
- **Multi-phase nodes**

- 1..26 phases, A..Z extension
- MODELS input/output X[1..26]
- Connection between  $n$ -phase and single phase
- 21 phases in LCC components



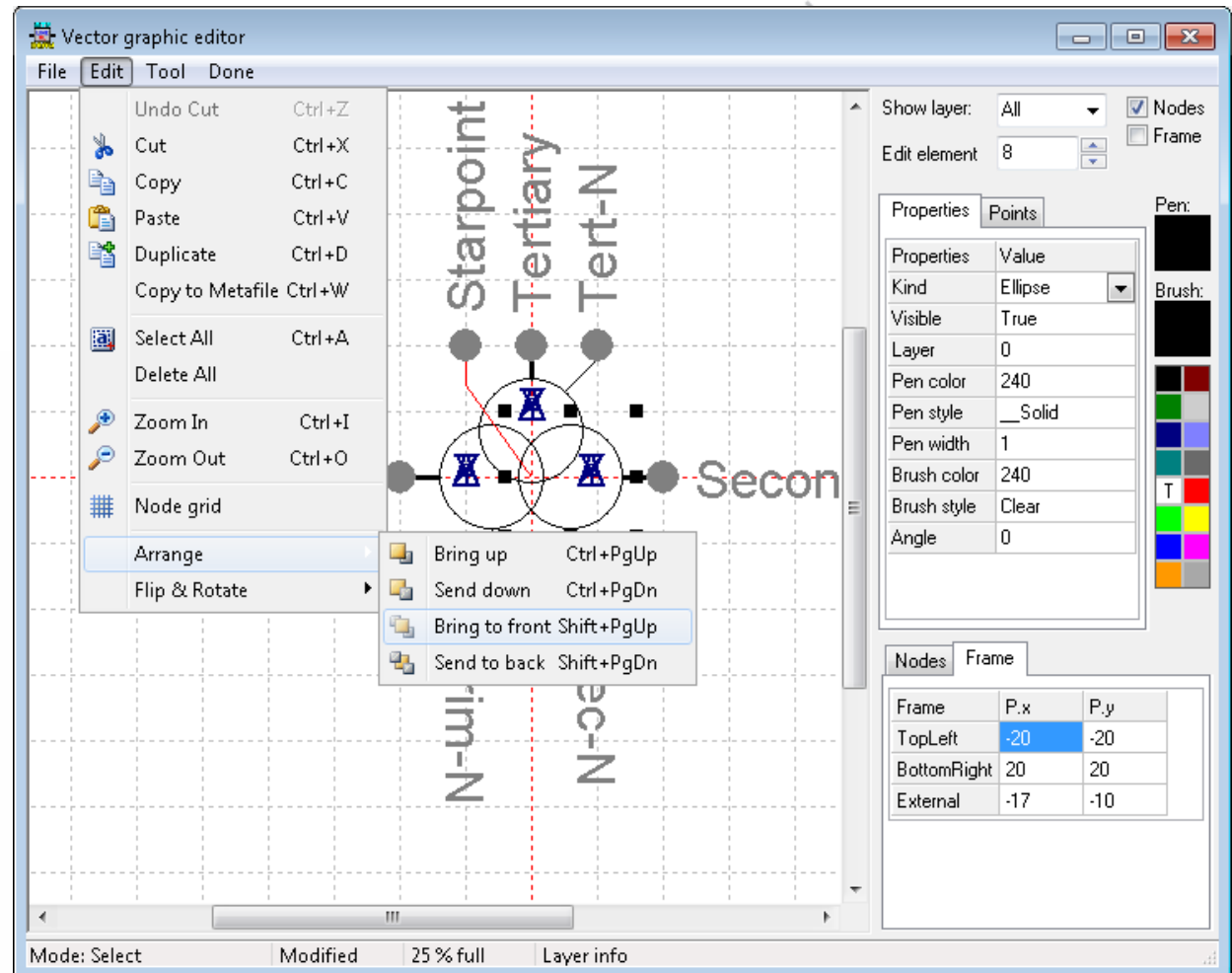
- **New file management**

- Project file follows the PKZIP 2 format. Improved compression. acp-extension.
- Sup-file only used when a component is created.
- External data moved from files to memory.
- Individual, editable help strings for all components.



# Vector graphic editor

- Shapes (line, rectangle, polyline, polygon, ellipse, arc, pie, bezier, arrow)
- Text
- Nodes and frame
- Inspect by element id or layer
- Arrange, rotate/flip
- Edit point, drag, edit values and properties
- Grouping for move/copy

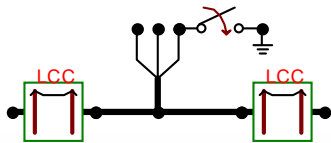




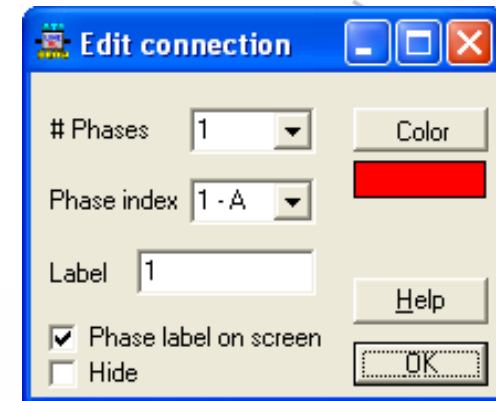
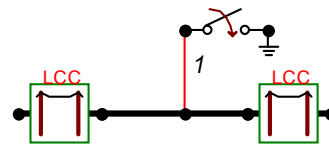
# Example 1

- Single phase to 3-phase connection

Old:



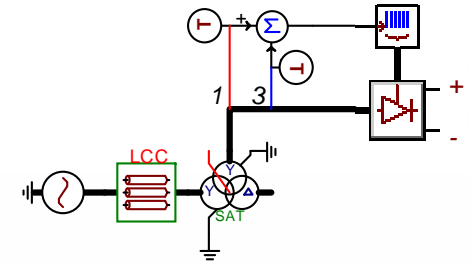
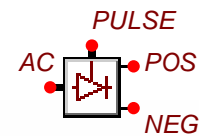
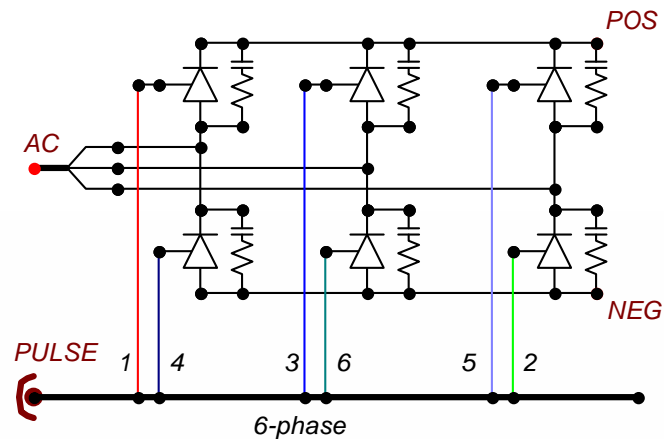
New:



- The Splitter carries Transpositions the single phase connection not.

# Example 2

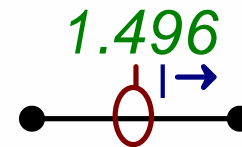
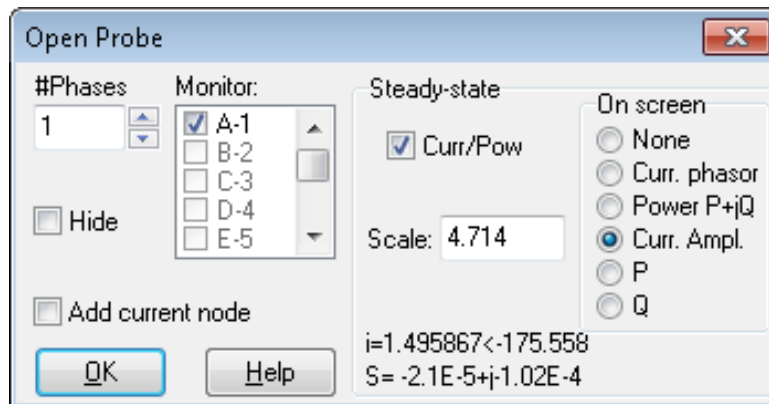
- Multi-phase groups



- New component: Collector

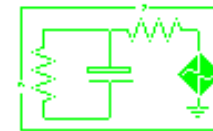
# Extended probe capabilities

- Steady-state performance
- Reads the LIS file
  - Monitor 1-26 phases
  - Display scaled steady-state values

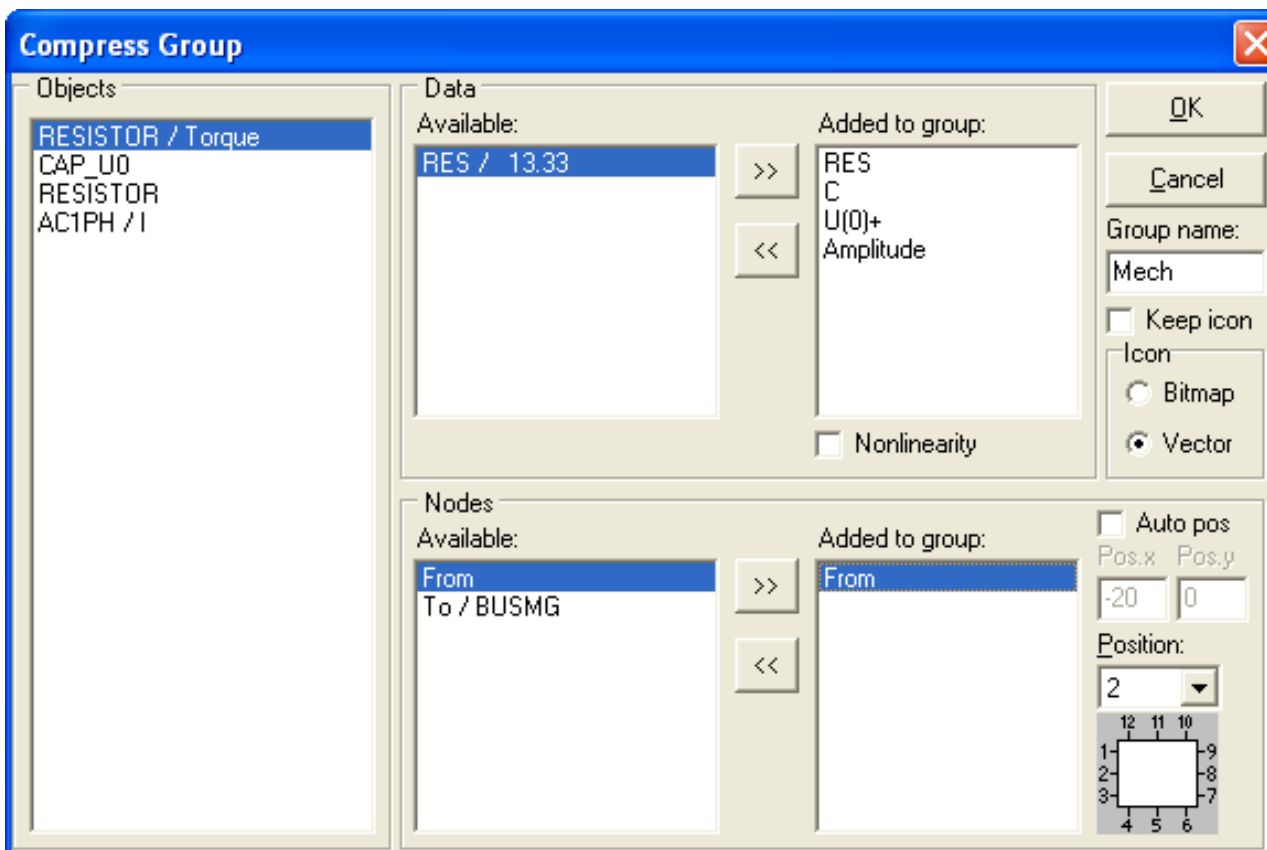
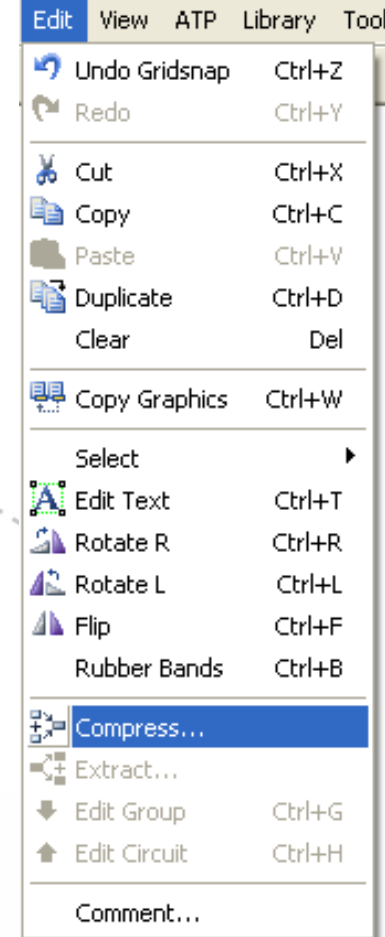


# Grouping

- Select a group (components, connections, text)
- Click on Edit|Compress
- Select external data/nodes

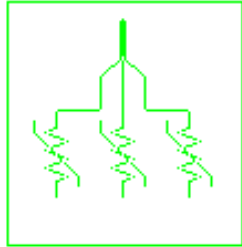


GROUP  
mech



- Data with the same name appear only once in the input dialog
- Double click on name to change
- Nonlinear characteristic supported

# Example Create 3-phase MOV



**Compress Group**

Objects

- NLINRES / #1
- NLINRES / #2
- SPLITTER
- NLINRES / #3

Data

Available:

- Vflash / 1.1E6
- Tdelay / 1
- Jump / 0.0
- VSEAL / 0.0

Added to group:

- Vflash
- Vflash
- Vflash

Add nonlinear  Nonlinearity

Nodes

Available:

- From
- To / GROUND

Added to group:

- IN

Auto pos  
Pos.x Pos.y  
-20 0  
Position:  
2

Icon  
 Bitmap  
 Vector

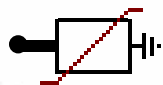
Group name:  
MOV3PH

OK  
Cancel

**Group: MOV3PH**

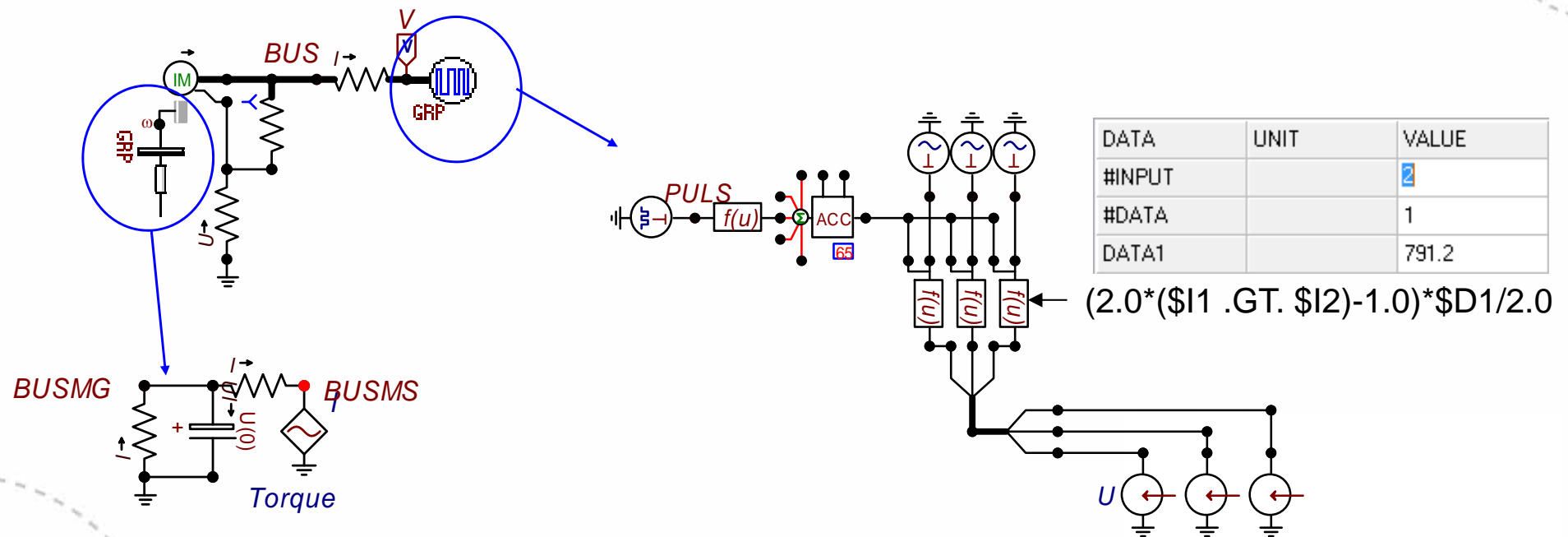
Attributes | Characteristic

DATA	UNIT	VALUE	NODE	PHASE	NAME
Vflash	Volts	1100000	IN	3	



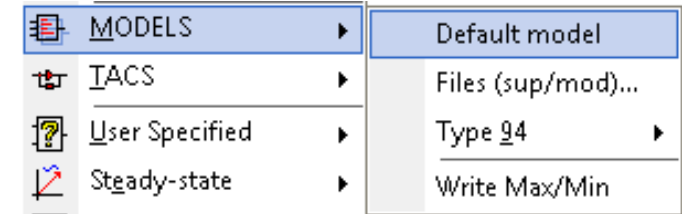
# Example – Induction motor

- Induction motor fed by a pulse width modulated voltage source
- External mechanical load
- TFORTRAN components in TACS \$I1..9, \$D1..9 (group becomes transparent and possible to copy)

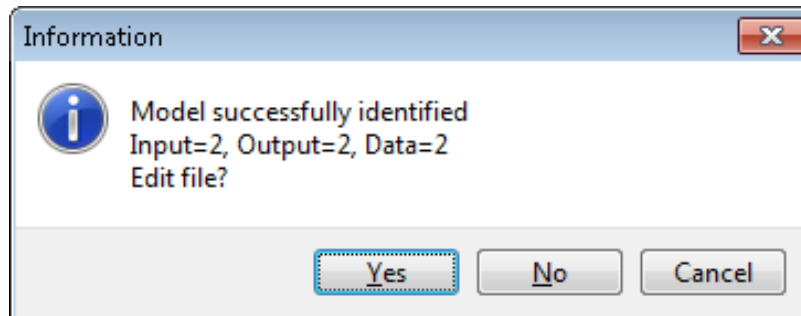


# Models

- Select Models|Default model
- Edit the Models text



- ATPDraw reads the Model text and identifies the circuit components with input/output/data



- Multi-phase nodes (26) and indexed data supported

# Example

```

MODEL FOURIER
INPUT X --input signal to be transformed
DATA FREQ {DFLT:50} --power frequency
      n {DFLT:26} --number of harmonics to calculate

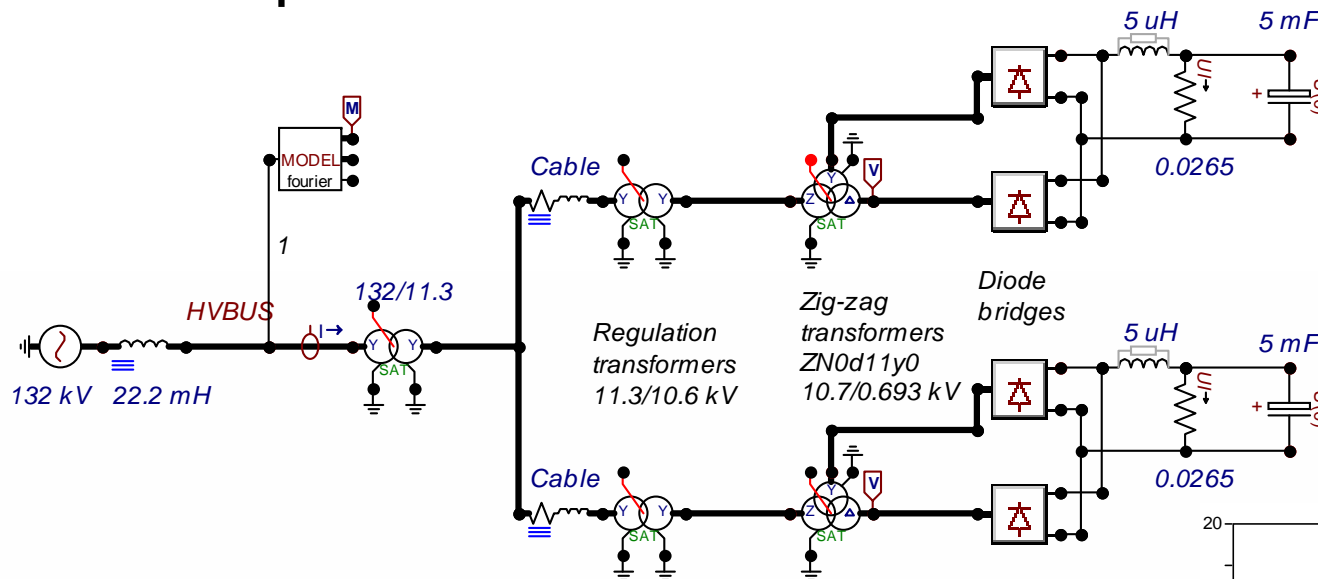
```

```

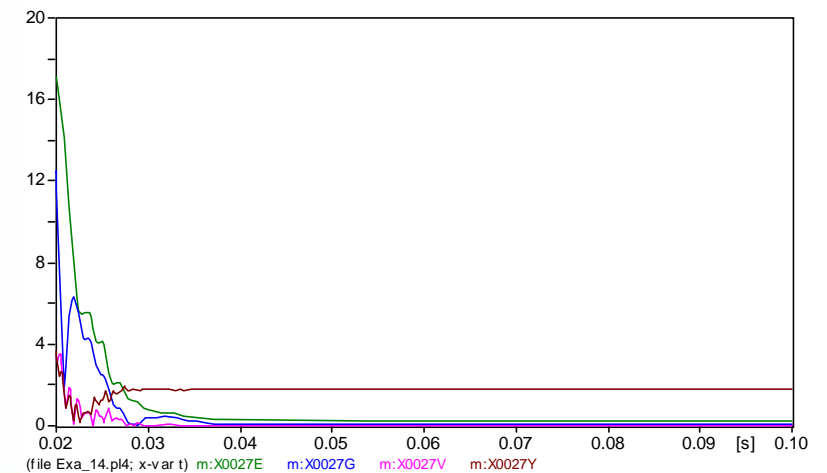
OUTPUT absF[1..26], angF[1..26], F0 --DFT signals
VAR absF[1..26], angF[1..26], F0, reF[1..26], imF[1..26],
    i, NSAMPL, OMEGA, D, F1, F2, F3, F4

```

- Multi-phase Models



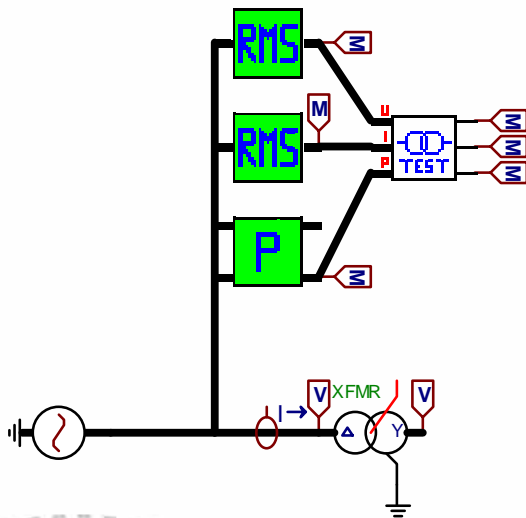
- New Model probe





# Example – Transformer tester

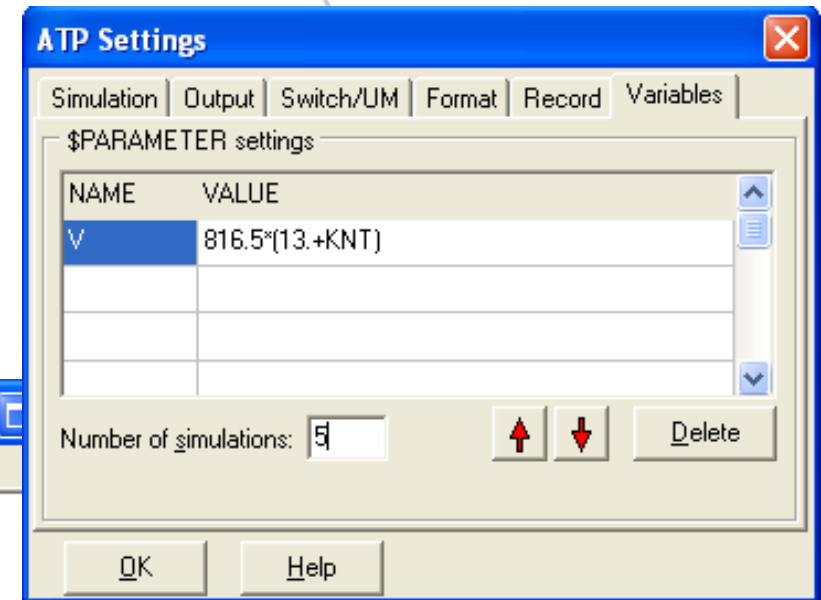
- Pocket calculator
- RMS and Power calculation
- TTester: Averaging, printout



```

Text Editor
File Edit Character Done Help

MODEL TTester
DATA FREQ, np, Us, Is, Ps
INPUT U[1..3], I[1..3], AP[1..3]
OUTPUT Volt, Curr, Pow
VAR Volt, Curr, Pow, Flag
INIT
  Flag:=0
ENDINIT
EXEC
  Volt:=0
  Curr:=0
  Pow:=0
  FOR p:=1 to np DO
    Volt:=Volt+sqrt(3)*U[p]/np/Us
    Curr:=Curr+I[p]/np/Is
    Pow:=Pow+AP[p]/Ps
  ENDFOR
  IF t>=2*recip(FREQ) AND Flag=0 THEN
    Flag:=1
    writel(Volt, ' ', Curr, ' ', Pow)
  ENDIF
ENDExec
ENDMODEL
  
```



ResultDir\model.1

```

87.5003664 .17121764 131.434758
93.7503926 .220581306 151.751037
100.000419 .35109472 173.603833
106.250445 .743208151 196.896531
112.500471 2.85953651 221.288092
  
```