



ZÁPADOČESKÁ  
UNIVERZITA  
V PLZNI



# Porovnání výsledků různých metodik výpočtu přechodných dějů na transformátoru

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2018



UNIVERSITY  
OF WEST BOHEMIA



FAKULTA  
ELEKTROTECHNICKÁ  
ZÁPADOČESKÉ  
UNIVERZITY  
V PLZNI

# Parametry transformátoru

$$u_K = 10 \%$$

$$i_0 = 0.5 \%$$

$$U_N = 22 \text{ kV}$$

$$S_N = 100 \text{ MVA}$$

$$\Delta P_0 = 0.05 \%$$

$$\Delta P_K = 1 \%$$

$$R_k = (dP_k / 100) * (U_n^2 / S_n)$$

$$Z_k = (U_k / 100) * (U_n^2 / S_n)$$

$$X_s = \sqrt{Z_k^2 - R_k^2}$$

$$L_s = X_s / \omega$$

$$G_{fe} = (dP_0 / 100) * (S_n / U_n^2)$$

$$R_{fe} = 1 / G_{fe}$$

$$Y_g = (I_0 / 100) * (S_n / U_n^2)$$

$$X_h = 1 / \sqrt{Y_g^2 - G_{fe}^2}$$

$$L_h = X_h / \omega$$

# Parametry transformátoru

$$u_K = 10 \%$$

$$i_0 = 0.5 \%$$

$$U_N = 22 \text{ kV}$$

$$S_N = 100 \text{ MVA}$$

$$\Delta P_0 = 0.05 \%$$

$$\Delta P_K = 1 \%$$

$$R_k = 0.0484$$

$$Z_k = 0.484$$

$$X_s = 0.48157$$

$$L_s = 0.0015329$$

$$R_{k1} = R_k/2 = 0.0242$$

$$L_{s1} = L_s/2 = 7.6645e-004$$

$$G_{fe} = 1.0331e-004$$

$$R_{fe} = 9680.0$$

$$Y_g = 0.0010331$$

$$X_h = 972.88$$

$$L_h = 3.0968$$

# Chod naprázdno – MATLAB/GNU Octave

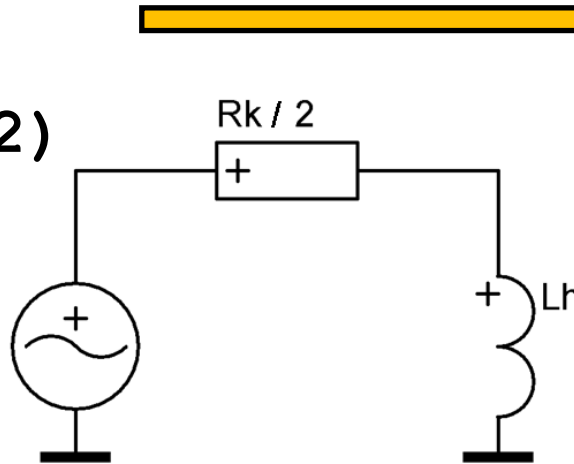
```
% Chod naprazdno
```

```
Z=sqrt(Rk1^2+Xh^2)
```

```
I0m=Um/Z
```

```
Tau=Lh/Rk1
```

```
Psi=atan(Xh/Rk1)
```



**Z = 972.88**

**I0m = 18.464**

**Tau = 127.97**

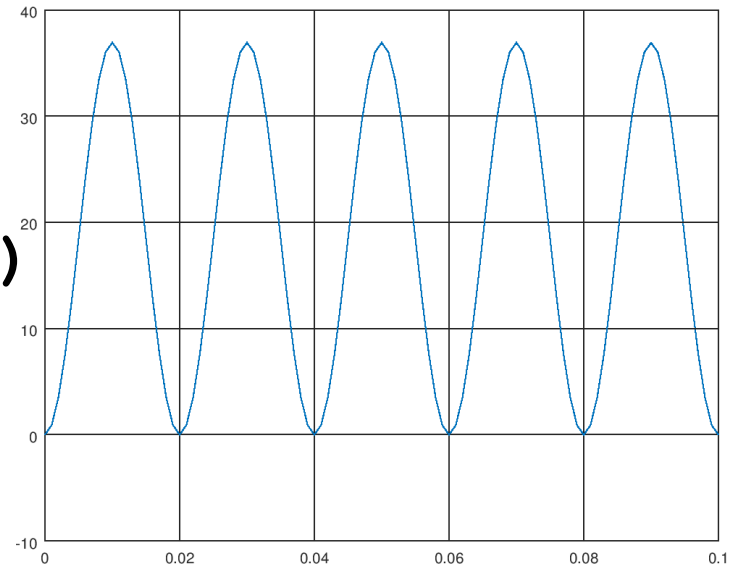
**Psi = 1.5708**

```
t=[0:0.001:0.1]';
```

```
I0t=I0m*(sin(Psi)*exp(-t/Tau)  
+sin(Omega*t-Psi));
```

```
plot(t,I0t);
```

```
grid on;
```



# Chod naprázdno – MATLAB/GNU Octave

```
% Chod naprazdno
```

```
In=Sn/ (sqrt (3) *Un)
```

```
I0mPom=In*I0/100*sqrt (2) *2
```

```
Z2=Rk1+i*Xs1+1/ (1/Rfe+1/ (i*Xh))
```

```
I0m2=Um/abs (Z2)
```

```
Psi2=atan (imag (Z2) /real (Z2) )
```

```
Zpozdeni=Psi2/pi*0.01
```

```
In = 2624.3
```

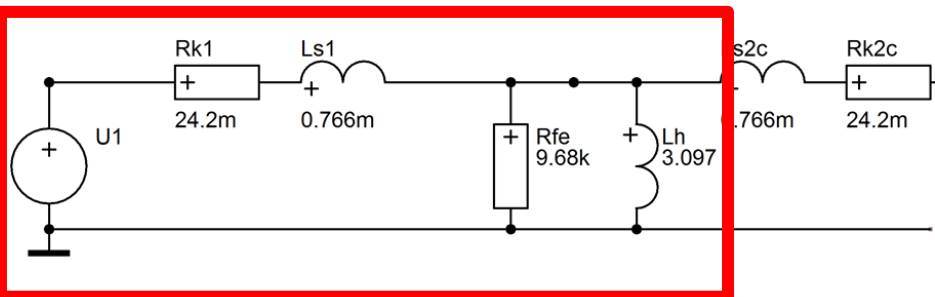
```
I0mPom = 37.113
```

```
Z2 = 96.824 + 963.389i
```

```
I0m2 = 18.552
```

```
Psi2 = 1.4706
```

```
Zpozdeni = 0.0046812
```



# DYNAST

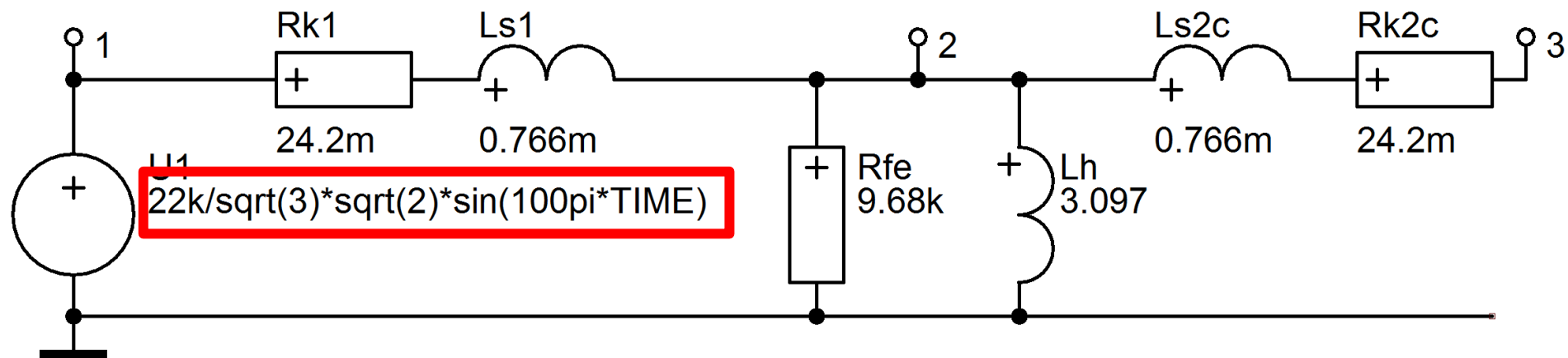
The screenshot displays the DYNAST Shell software interface. The top window, titled "Problem TrSk1-01", shows a circuit diagram on a grid background. The circuit consists of an AC voltage source  $N1$  with  $V_{ef} = 22k \cdot 10 / 100 / \sqrt{3}$  and  $R = 0$ . This source is connected in series with a resistor  $Rk1$  (value 0.0242) and an inductor  $Ls1$  (value 0.76644m). The circuit then splits into two parallel branches. The first branch contains a resistor  $Rfe$  (value 9.6799k) connected to ground. The second branch contains an inductor  $Lh$  (value 3.1) connected to ground. The two branches recombine and pass through another inductor  $Ls2$  (value 0.76644m) and a resistor  $Rk2$  (value 0.0242) before returning to ground. The bottom window, titled "TrSk1-01", shows the SPICE code used to simulate the circuit:

```
*:  
*SYSTEM;  
N1 > @mains 1,0 / Vef=22k*10/100/sqrt(3),R=0;  
Rk1 1-3 = 0.0242;  
Rk2 4 = 0.0242;  
Rfe 2 = 9.6799k;  
Ls1 3-2 = 0.76644m;  
Ls2 2-4 = 0.76644m;  
Lh 2 = 3.1;  
*TR;  
TR 0 0.1;  
PRINT(1001) I.Rk2, I.Rk1, I.Rfe, I.Lh, V.1, V.2;  
RUN;  
*END;
```

The status bar at the bottom of the window shows "Ready" on the left and "Ln" on the right.

<http://home.zcu.cz/~nohac/Dynast/Instalace/dynshell.exe>

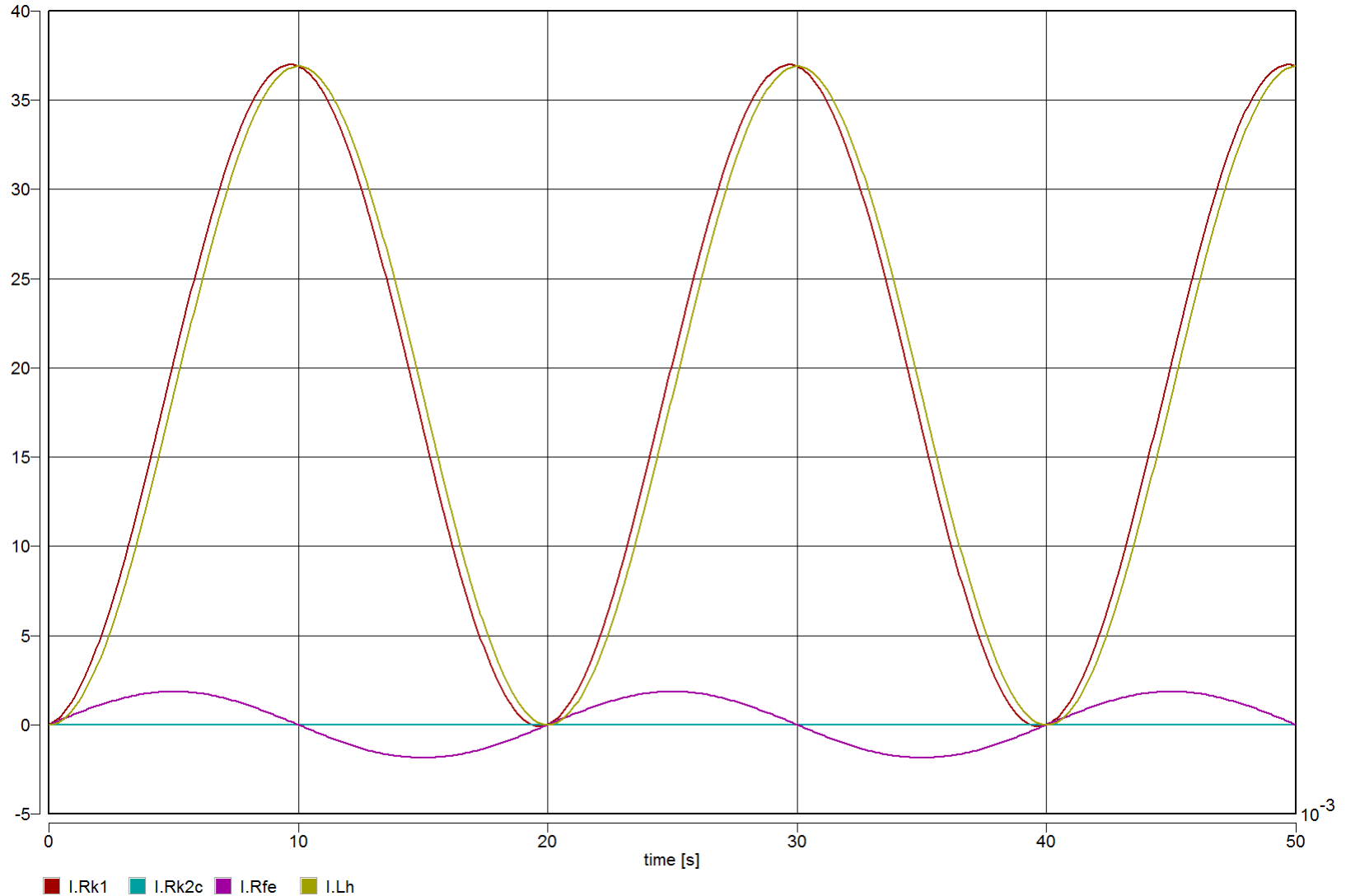
# Chod naprázdno - DYNAST



<http://home.zcu.cz/~nohac/Dynast/Instalace/dynshell.exe>

# Chod naprázdno - DYNAST

Transformator naprazdno Skupina 1 2017





# Solve Elec

The screenshot displays the 'Solve Elec' software interface. The main window shows a circuit diagram on a grid. The circuit consists of an AC voltage source  $E_1$  on the left. A series combination of an ammeter  $I_1$ , a resistor  $R_1$ , an inductor  $L_1$ , a resistor  $R_3$ , an inductor  $L_3$ , an inductor  $L_2$ , and a resistor  $R_2$  is connected. A voltmeter  $U_1$  is connected in parallel across the  $R_1$  and  $L_1$  branch. Another voltmeter  $U_2$  is connected in parallel across the  $R_2$  branch. The bottom panel shows the 'Circuit properties' table.

<http://www.physicsbox.com/indexsolveelec2en.html>

Phase reference		$E_1$		
Frequency	$f$	50.000	Hz	
$R_1$	24.200	mOhm		
$R_2$	24.200	mOhm		
$R_3$	9.6800	kOhm		
$L_1$	766.45	$\mu$ H		
$L_2$	766.45	$\mu$ H		
$L_3$	3.0968	H		
$E_1$	$E_1$ rms	12.702 kV	$\text{Phi}E_1$	0 rad
$U_2$	$U_2$ rms	$\text{Phi}U_2$		
$U_1$	$U_1$ rms	$\text{Phi}U_1$		
$I_1$	$I_1$ rms	$\text{Phi}I_1$		

Vstupem jsou efektivní hodnoty fázové

# Chod naprázdno – Solve Elec

Circuit solved

$$\mathbf{I}_1 = \frac{\mathbf{E}_1 (w^2 L_1 L_3 - R_1 R_3) - j w \mathbf{E}_1 (L_1 R_3 + L_3 R_1)}{w^2 L_1^2 R_3 + 2 w^2 L_1 L_3 R_1 + w^2 L_1 L_3 R_3 - R_1^2 R_3 - j w (-w^2 L_1^2 L_3 + 2 L_1 R_1 R_3 + L_3 R_1^2 + L_3 R_1 R_3)}$$

$$I_{1rms} = \frac{\sqrt{(\mathbf{E}_1 (w^2 L_1 L_3 - R_1 R_3))^2 + (w \mathbf{E}_1 (L_1 R_3 + L_3 R_1))^2}}{\sqrt{(w^2 L_1^2 R_3 + 2 w^2 L_1 L_3 R_1 + w^2 L_1 L_3 R_3 - R_1^2 R_3)^2 + (w (-w^2 L_1^2 L_3 + 2 L_1 R_1 R_3 + L_3 R_1^2 + L_3 R_1 R_3))^2}}$$

$$I_{1rms} = 13.118 \text{ A}$$

$$\text{Phi}I_1 = -1.4706 \text{ rad}$$

$$\mathbf{U}_2 = \frac{L_3 R_3 \mathbf{E}_1}{L_1 R_3 + L_3 R_1 + L_3 R_3 + j \left( w L_1 L_3 - \frac{R_1 R_3}{w} \right)}$$

$$U_{2rms} = \frac{L_3 R_3 E_{1rms}}{\sqrt{(L_1 R_3 + L_3 R_1 + L_3 R_3)^2 + \left( w L_1 L_3 - \frac{R_1 R_3}{w} \right)^2}}$$

$$U_{2rms} = 12.699 \text{ kV}$$

$$\text{Phi}U_2 = -344.08e - 12 \text{ rad}$$

$$\mathbf{U}_1 = \mathbf{E}_1$$

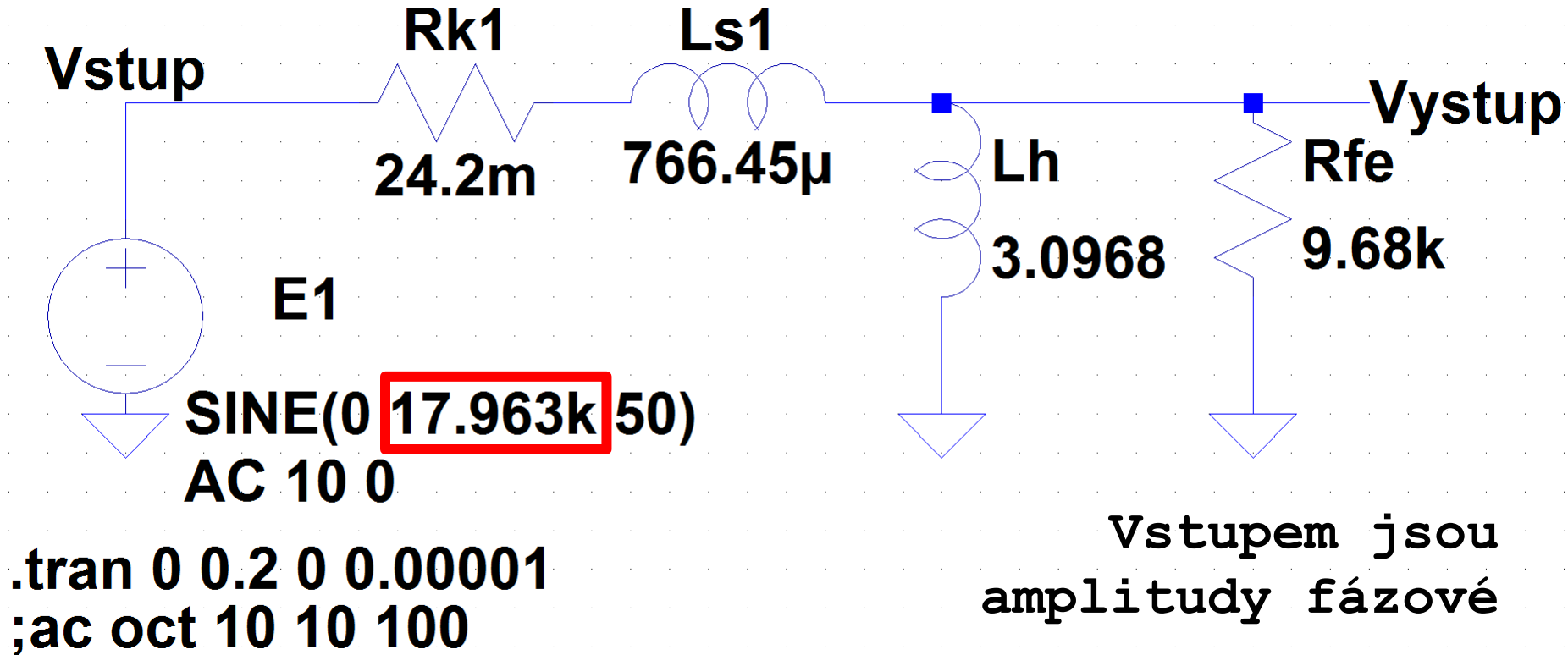
$$U_{1rms} = E_{1rms}$$

$$U_{1rms} = 12.702 \text{ kV}$$

$$\text{Phi}U_1 = 0 \text{ rad}$$

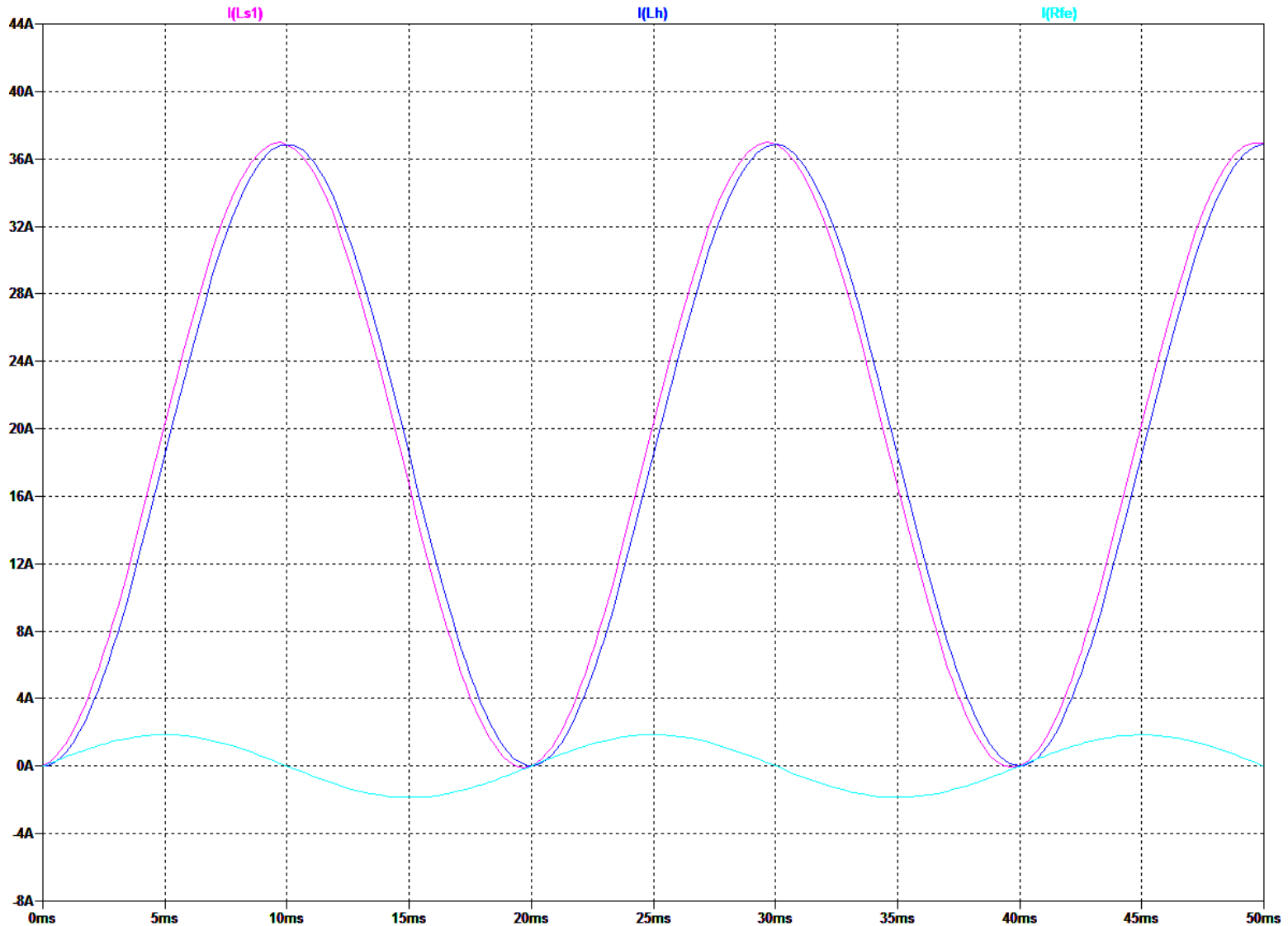
**Výstupem jsou také  
efektivní hodnoty  
fázové**

# LTspice

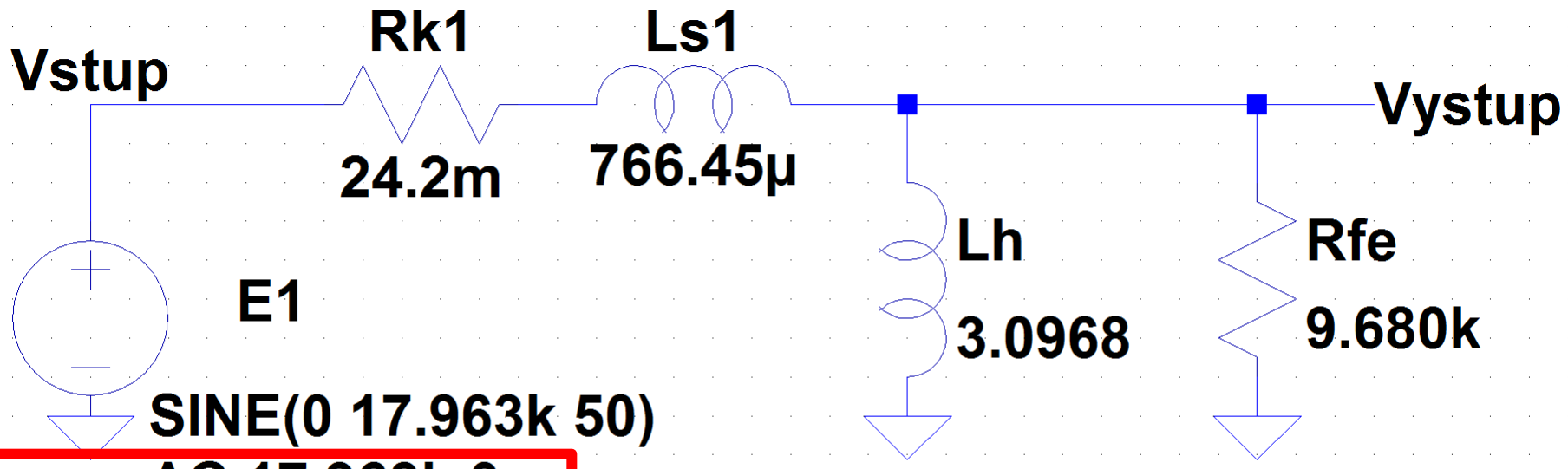


<http://www.linear.com/designtools/software/#LTspice>

# Chod naprázdno - LTspice



# Chod naprázdno - LTspice



**SINE(0 17.963k 50)**

**AC 17.963k 0**

**;tran 0.2**

**.ac lin 1 50 50**

# Chod naprázdno - LTspice

--- AC Analysis ---

frequency:	50	Hz		
V(n001):	mag:	17963	phase: 0.00142484°	voltage
V(vstup):	mag:	17963	phase: -7.25244e-016°	voltage
V(vystup):	mag:	17958.5	phase: 5.88434e-005°	voltage
I(Ls1):	mag:	18.552	phase: -84.2606°	device_current
I(Lh):	mag:	18.459	phase: -89.9999°	device_current
I(Rfe):	mag:	1.85522	phase: 5.88434e-005°	device_current
I(Rk1):	mag:	18.552	phase: 95.7394°	device_current
I(E1):	mag:	18.552	phase: 95.7394°	device_current

Výstupem jsou také  
amplitudy fázové

$$-84.2606^\circ / 180^\circ * \pi = -1.4706 \text{ rad}$$

# Open Modelica

The screenshot displays the OpenModelica Connection Editor (OMEdit) interface. The main workspace shows a circuit diagram for a transformer model, titled "TrNaprazdnoSk1". The circuit consists of a voltage source  $U_s$  connected to a resistor  $R_{k1}$  (value  $R=1.6$ ). This is followed by an inductor  $L_{s1}$  (value  $L=0.13232$ ). The circuit then splits into two parallel branches: one with an inductor  $L_h$  (value  $L=1052$ ) and another with a resistor  $R_{fe}$  (value  $R=1280e3$ ). These branches recombine, followed by another inductor  $L_{s2c}$  (value  $L=0.13232$ ) and a final resistor  $R_{k2c}$  (value  $R=1.6$ ). The circuit is connected to four ground nodes labeled  $G1$ ,  $G2$ ,  $G3$ , and  $G4$ .

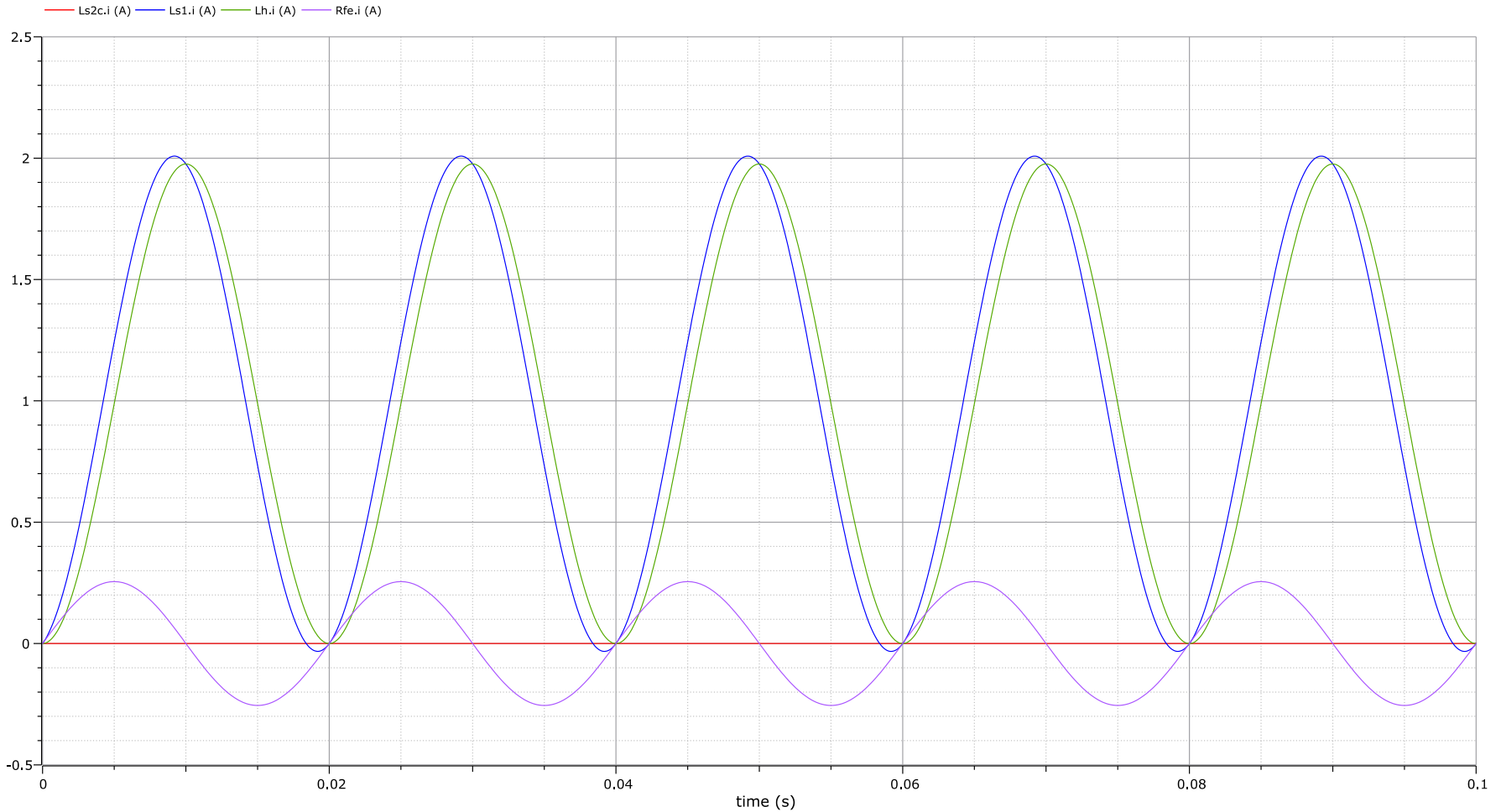
The interface includes a Libraries Browser on the left, a Messages Browser at the bottom, and a status bar at the bottom right. A warning message is displayed in the Messages Browser:

```
[1] 23:25:40 Scripting Warning  
Requested package Modelica of version 3.2.2, but this package was already loaded with version 3.2.3. You might experience problems if these versions are incompatible.
```

<https://openmodelica.org/>

**Jednofázový model (jiná vstupní data)**

# Chod naprázdno – Open Modelica



<https://openmodelica.org/>



# Open Modelica

OMEdit - OpenModelica Connection Editor

File Edit View Simulation FMI Export Debug QMSimulator Git Tools Help

Libraries Browser Transformer2019Sk1

Filter Classes

Writable Model Diagram View Transformer2019Sk1 C:/WORK/Transformer2019Sk1.mo

Documentation...

Libraries

- OpenModelica
- ModelicaReference
- ModelicaServices
- Complex
- Modelica
- Transformer2019Sk1

transformerData

Transformator1

Yy00

source m=3

P Q

A RMS

currentQuasiRMSsensorS

deltaS

m=3

voltageRMSsensorS

V RMS

groundS

stars m=3

earth R=1e6

groundT

A RMS

currentQuasiRMSsensorL

deltaL

m=3

voltageRMSsensorL

V RMS

load m=3

P Q

startL m=3

groundL

3f model zjednodušený

**Transform**

**Transformer test bench**

**Information**

**Transformer test bench:**

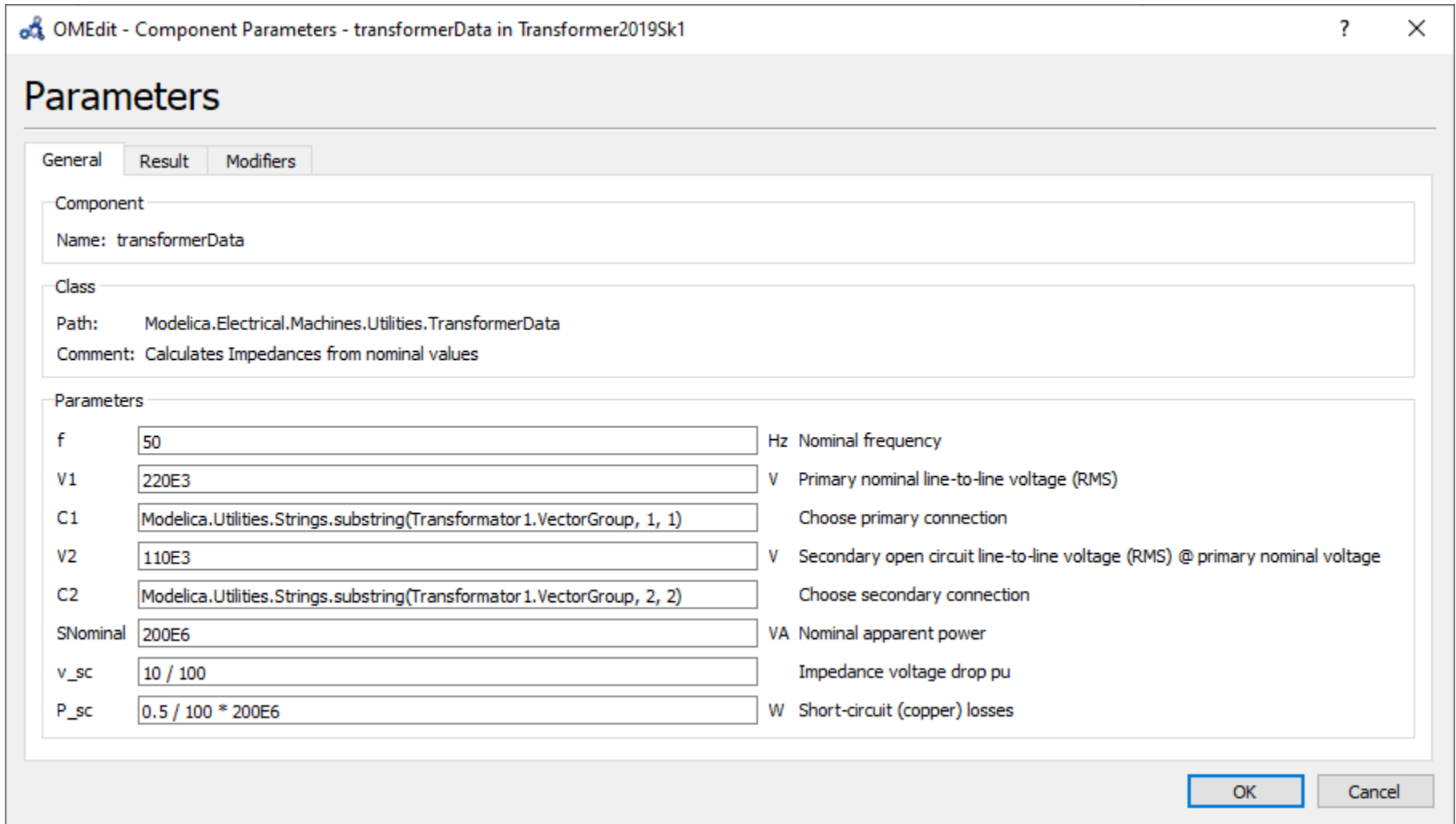
You may choose different connections as well as vary the load (even not symmetrical).

**Please pay attention** to proper grounding of the primary and secondary part of the whole circuit. The primary and secondary starpoint are available as connectors, if the connection is not delta (D or d).

Welcome Modeling Plotting Debugging

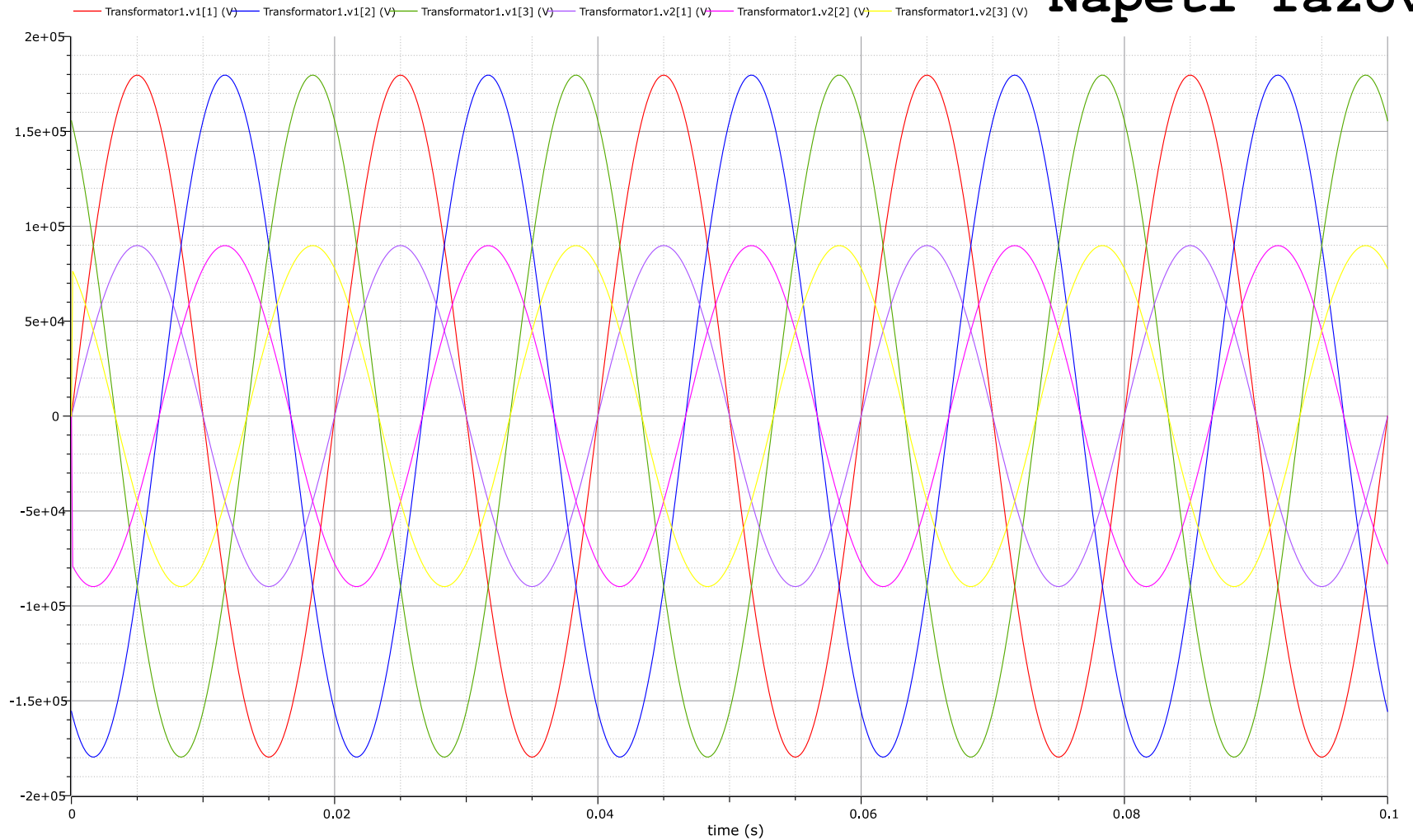
<https://openmodelica.org/>

# Open Modelica



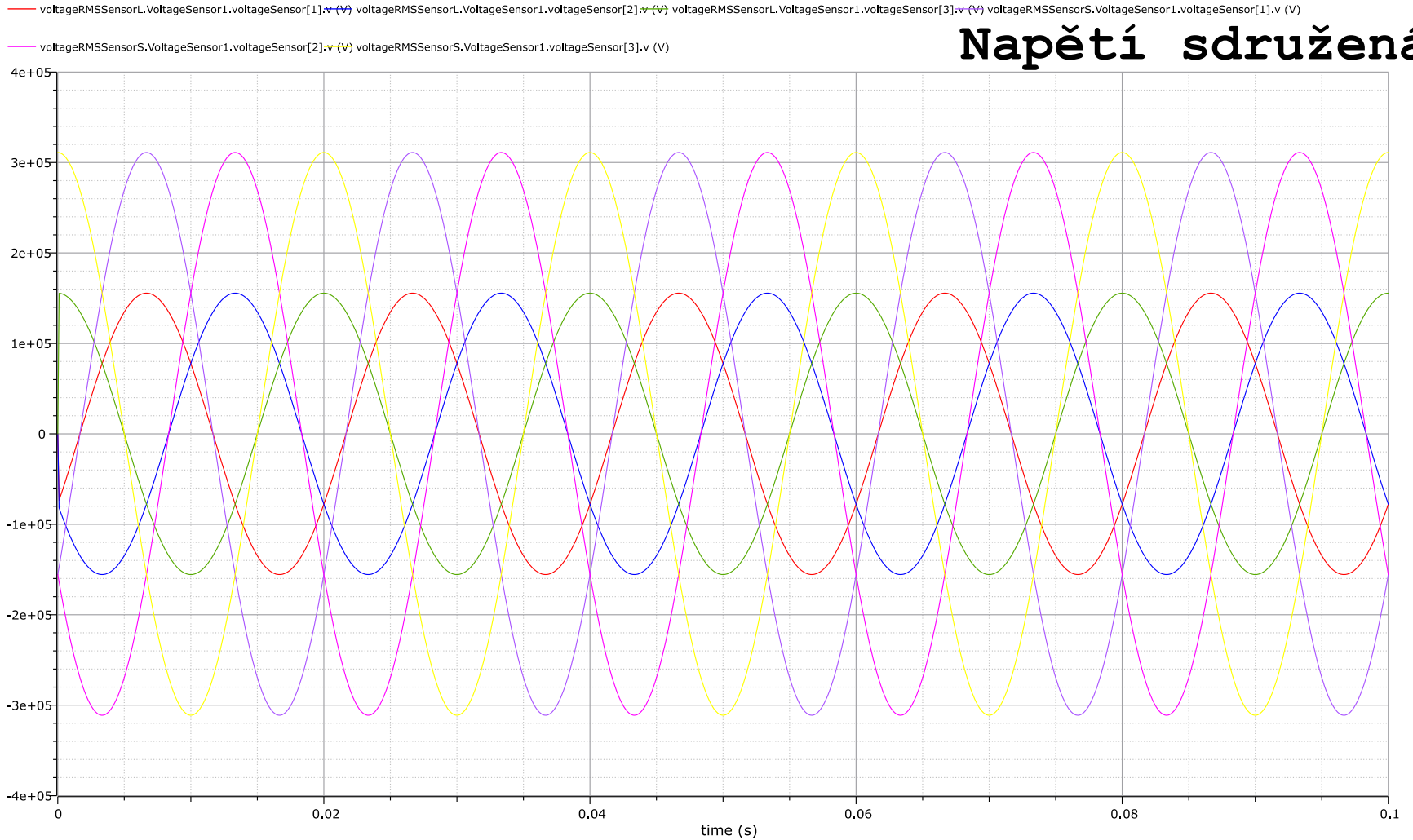
# Open Modelica

Napětí fázová



<https://openmodelica.org/>

# Open Modelica

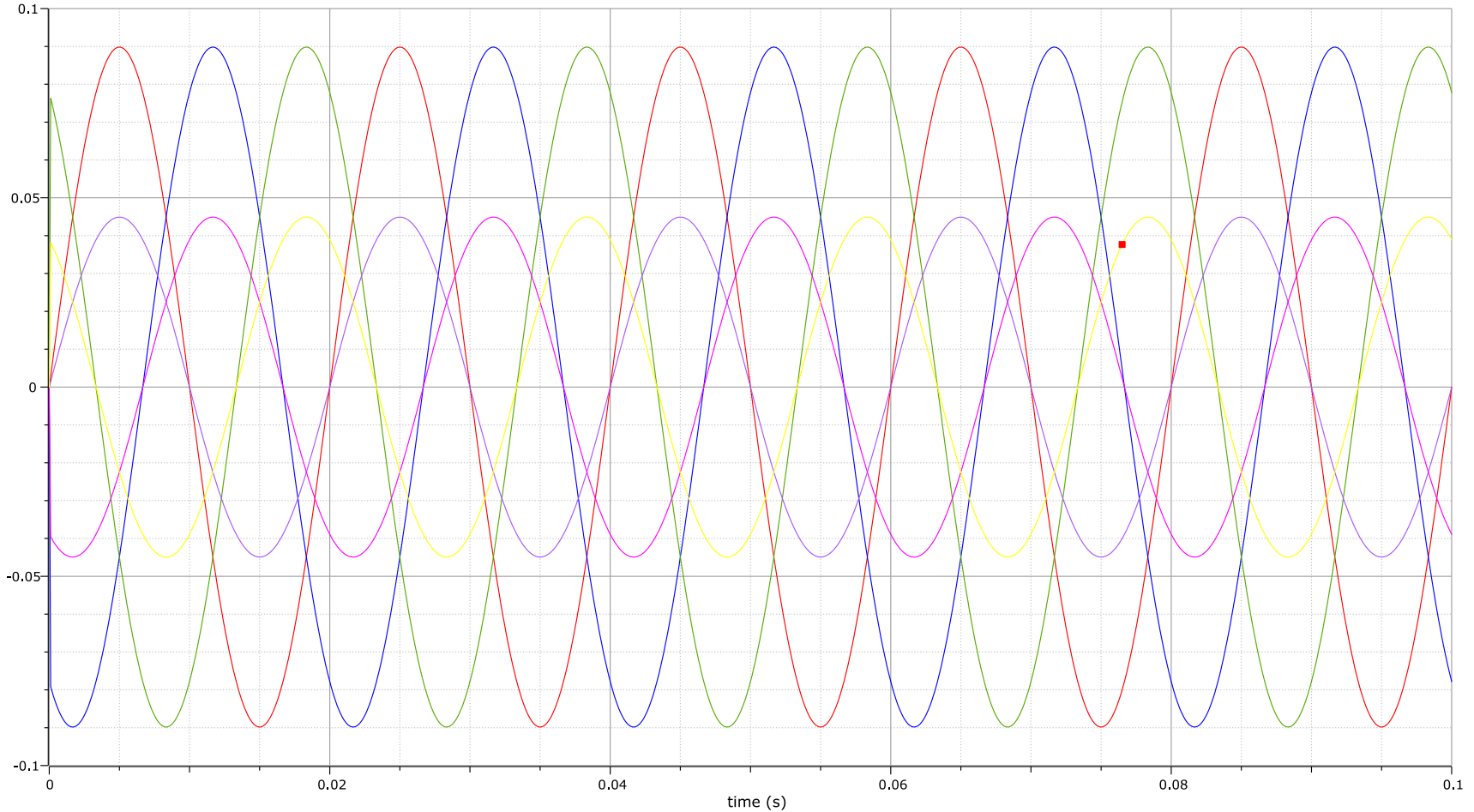


<https://openmodelica.org/>

# Open Modelica

**Proudy**

— currentQuasiRMSSensorL.CurrentSensor1.currentSensor[1].i (A) currentQuasiRMSSensorL.CurrentSensor1.currentSensor[2].i (A) currentQuasiRMSSensorL.CurrentSensor1.currentSensor[3].i (A) currentQuasiRMSSensorS.CurrentSensor1.currentSensor[1].i (A)  
— currentQuasiRMSSensorS.CurrentSensor1.currentSensor[2].i (A) currentQuasiRMSSensorS.CurrentSensor1.currentSensor[3].i (A)



<https://openmodelica.org/>



# PSCAD

3 Phase 2 Winding Transformer

Configuration

**General**

Transformer Name	
3 Phase Transformer MVA	200.0 [MVA]
Base operation frequency	50 [Hz]
Winding #1 Type	Y
Winding #2 Type	Y
Delta Lags or Leads Y	Lags
Positive sequence leakage reactance	0.099875 [pu]
Ideal Transformer Model	No
Eddy current losses	0.002 [pu]
Copper losses	0.005 [pu]
Tap changer on winding	None
Graphics Display	Single line (circles)
Display Details?	Yes

**General**

Ok Cancel Help...

3 Phase 2 Winding Transformer

Saturation

Configuration

Winding Voltages

Saturation

Magnetic Characteristics of the Material

Winding 1 Currents

Winding 2 Currents

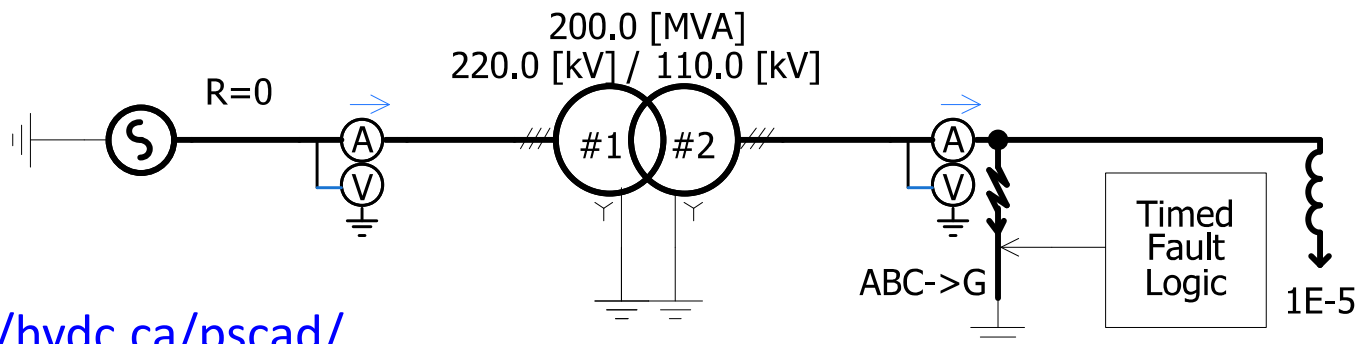
Monitoring of Magnetic Core:1

Monitoring of Magnetic Core:2

Time to release flux clipping	0.0 [s]
Air core reactance	0.2 [pu]
Magnetizing current	0.5 [%]
Knee voltage	1.17 [pu]
Remanent Flux Core 1	0.0
Remanent Flux Core 2	0.0
Remanent Flux Core 3	0.0
Loop Width	10
Nominal Flux Density [T]	1.7
Magnetic Material	default

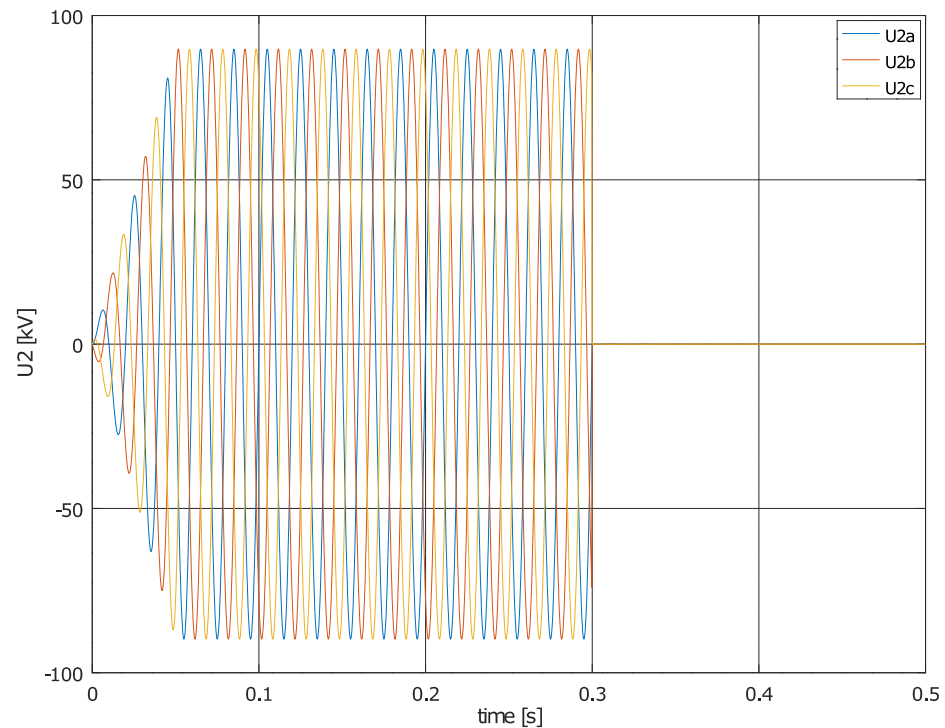
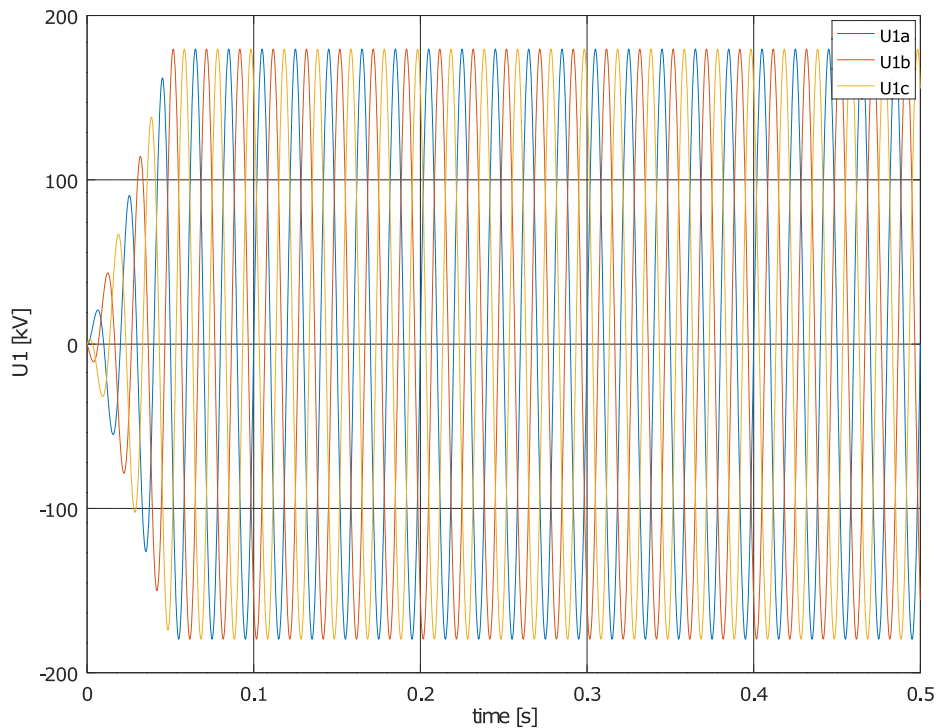
**General**

Ok Cancel Help...



# PSCAD – Python výstup

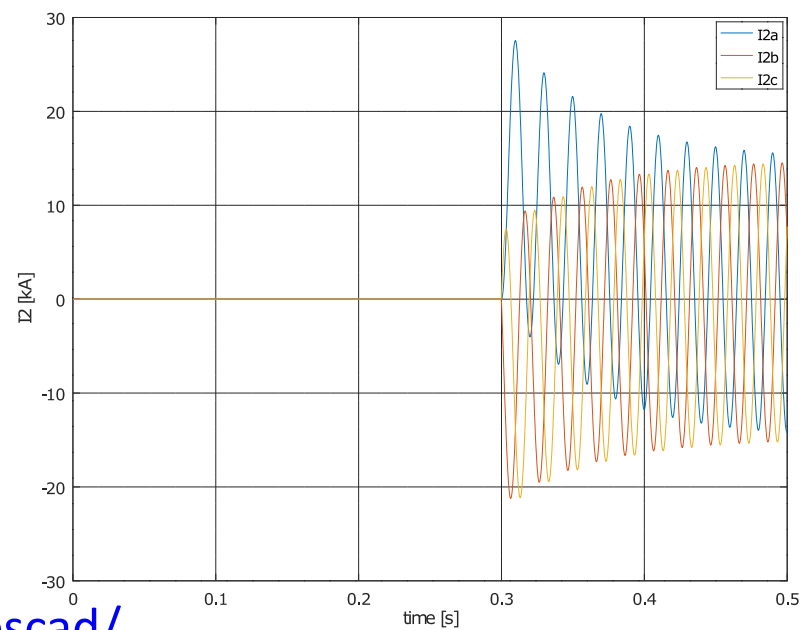
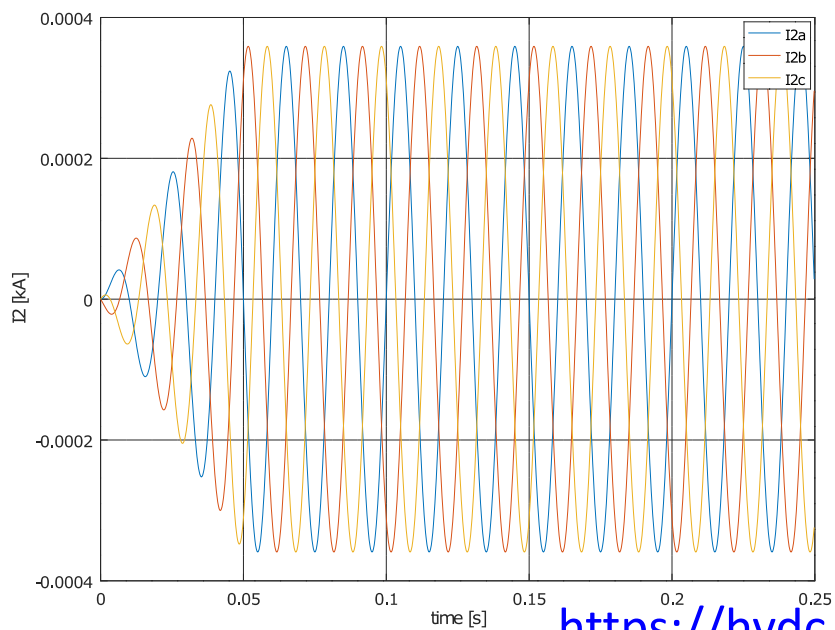
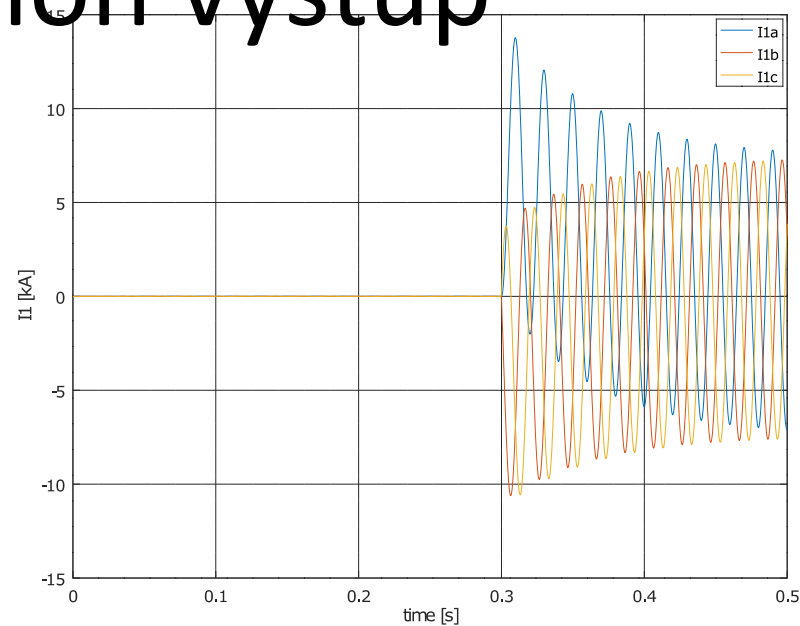
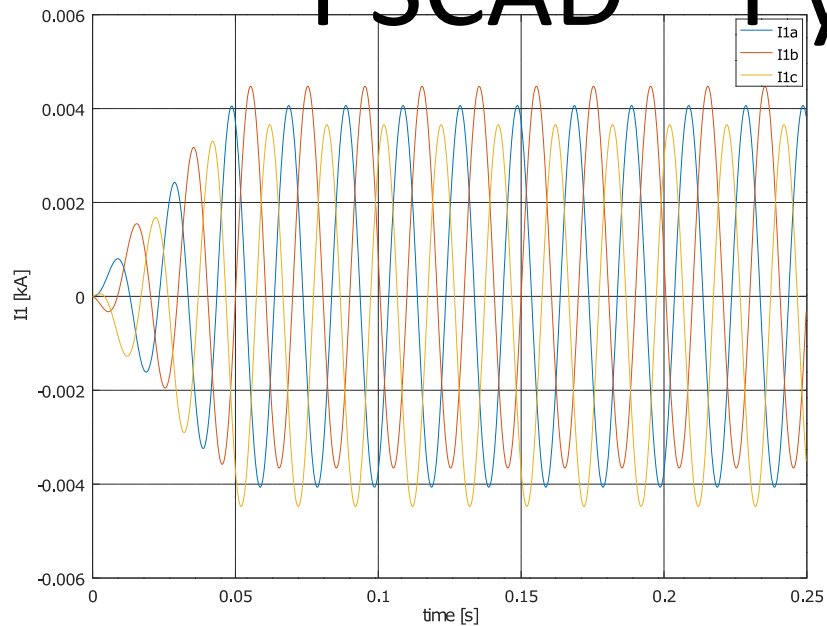
Napětí fázová





# PSCAD – Python výstup

Proudy



# MATLAB/Simulink/Simscape Electrical

The screenshot displays the MATLAB R2019a Simulink environment. The main workspace shows a Simulink model named 'SE\_Naprazdno' containing an electrical circuit. The circuit includes a three-phase AC voltage source, a three-phase transformer, and a discrete-time block with a sampling time of  $5 \times 10^{-5}$  s. The transformer's primary side is connected to the AC source, and its secondary side is connected to a load. The load consists of a series combination of a resistor and an inductor, with a gain of 0.001. The transformer's primary side is labeled 'Vabc labc' and its secondary side is labeled 'a b c' with a neutral point 'Yg'. The transformer's primary side is connected to the AC source, and its secondary side is connected to the load. The transformer's primary side is labeled 'A B C' and its secondary side is labeled 'a b c' with a neutral point 'Yg'. The transformer's primary side is connected to the AC source, and its secondary side is connected to the load.

The Command Window on the left shows the following parameters:

I0pu =	0.0050
Lhpu =	218.2179
Rk1pu2 =	0.0025
Ls1pu2 =	0.0499
Rfepu2 =	500
Lhpu2 =	218.2179

The Model Browser on the right shows the following parameters:

Rkpu	0.0050
Sn	200
Uk	10
Ukpu	0.1000
Uln	179.6292

# MATLAB/Simulink/Simscape Electrical

The screenshot displays the MATLAB R2019a Simulink environment. The main workspace shows a Simulink model titled "SE\_Naprazdno" with several blocks labeled "No License". The blocks are interconnected in a circuit diagram. A gain block with a value of 0.001 is visible. The Command Window on the left lists parameters for the model:

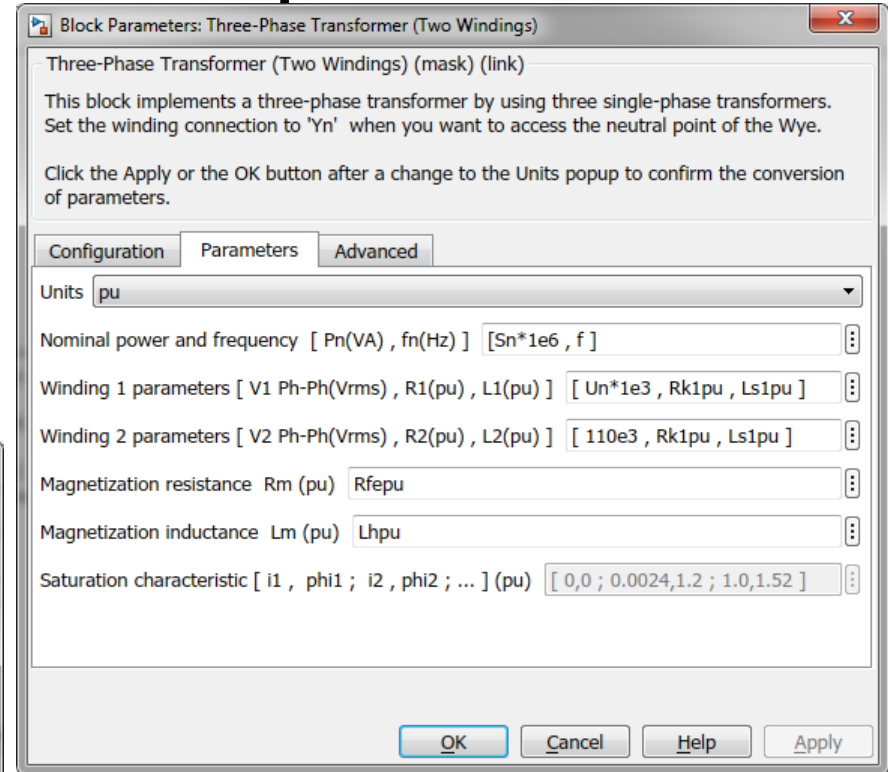
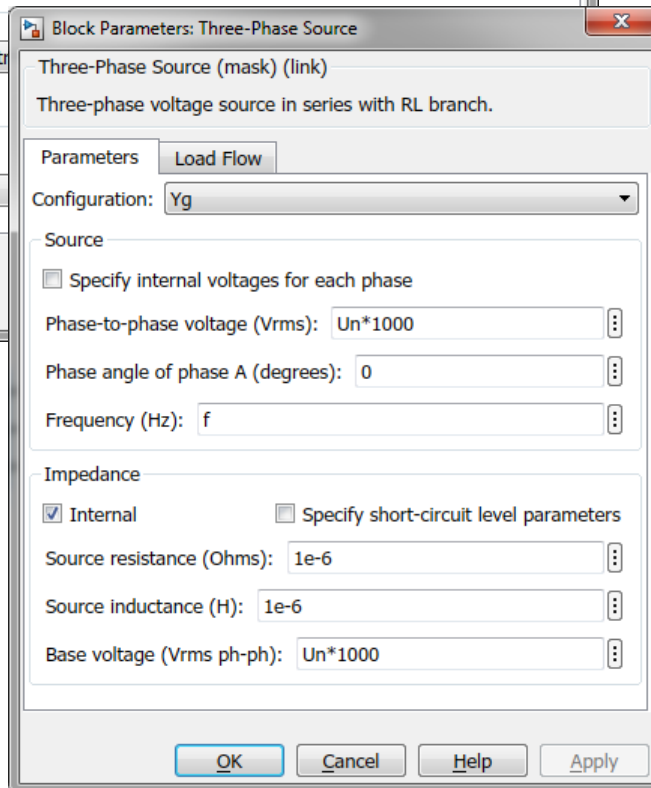
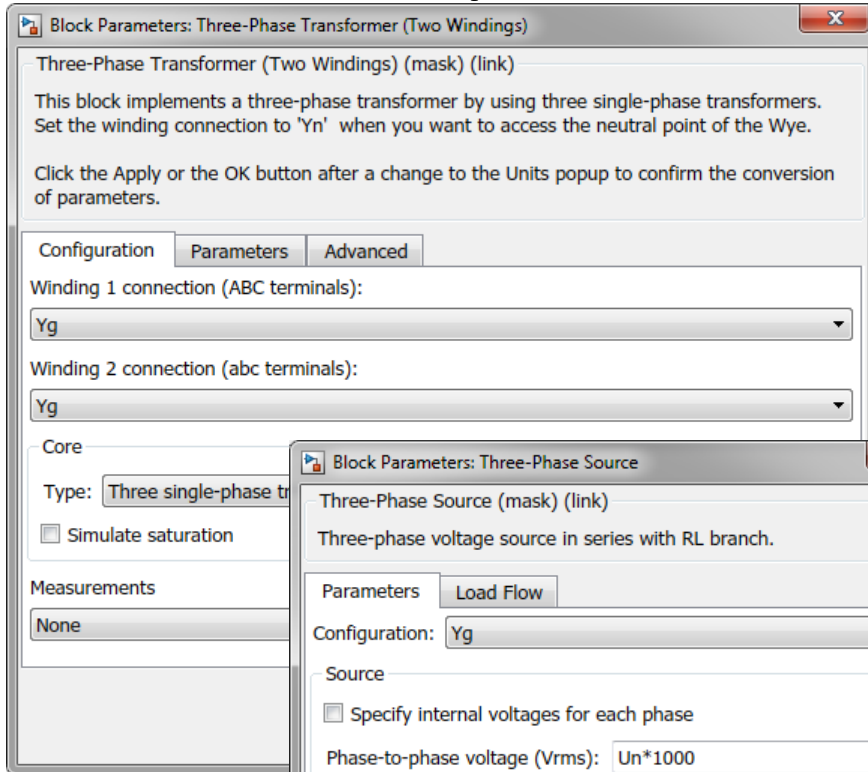
```
Gfepu = 0.0020
Rfepu = 500
I0pu = 0.0050
Lhpu = 218.2179
Rk1pu2 = 0.0025
Ls1pu2 = 0.0499
Rfepu2 = 500
Lhpu2 = 218.2179
```

The Workspace on the right shows the following variables:

Variable	Value
solinit	1x1 struct
t	[0,0.5000,1,1.5000,2]
tspan	[0,3000]
u1	5x20 double
Uk	10
Ukpu	0.1000
Um	179.6292
Uu	220

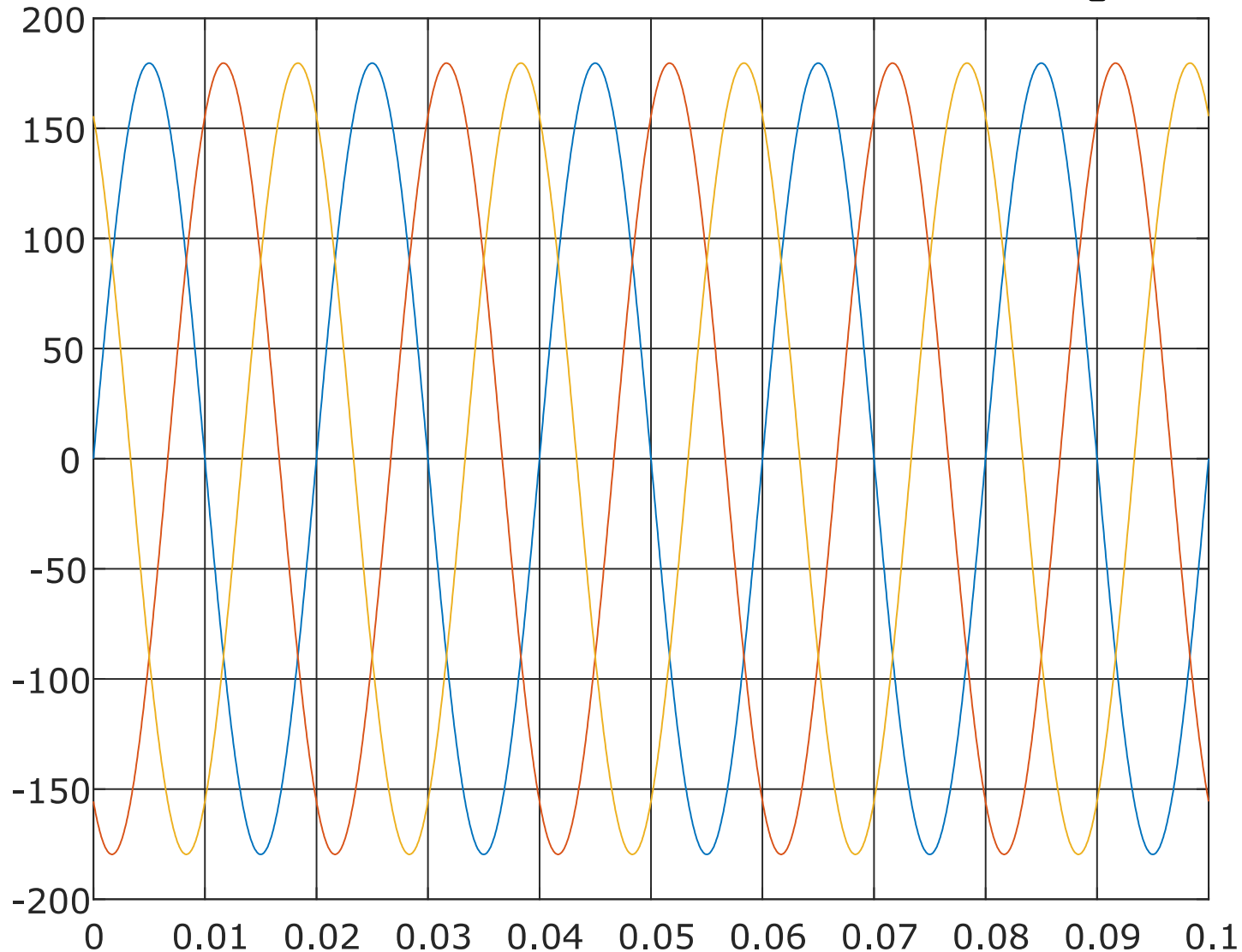
The Model Browser on the left shows the current folder "C:\WORK" and the file "SE\_Naprazdno.slx". The Command Window at the bottom shows the prompt "fex >>".

# MATLAB/Simulink/Simscape Electrical



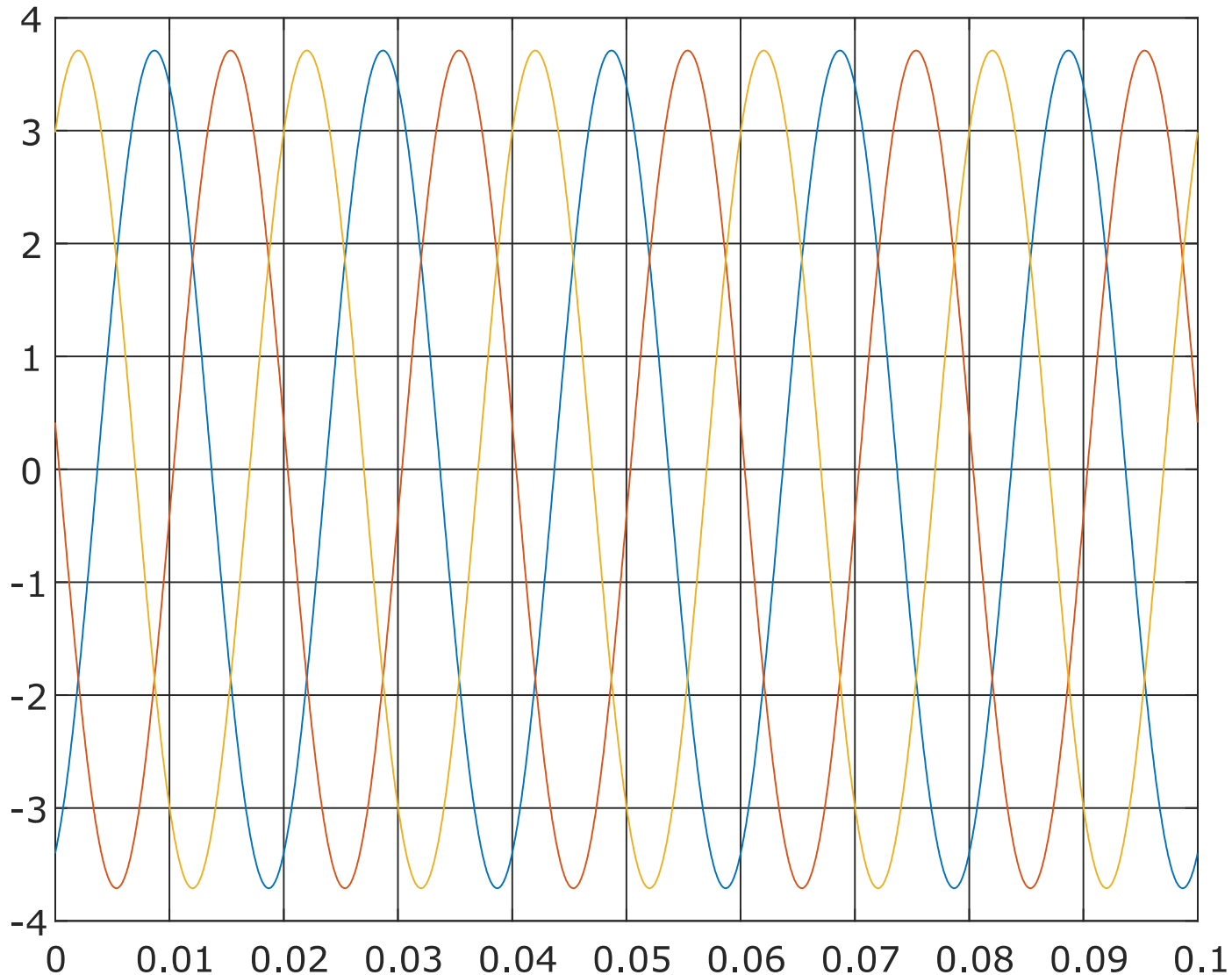
# MATLAB/Simulink/Simscape Electrical

## Napětí fázová



# MATLAB/Simulink/Simscape Electrical

Proudy



# DYNAST - DPL

DYNAST Shell - Tr1fSk1v02

File Edit View System Analysis Errors Run Publishing Preferences Window Help

Tr1fSk1v02

```

* : Model transformatoru 2018
::: PURP
::: Model transformatoru pro cvičení KEE/PJS.
::: DESC
::: Testování modelu jednofázového transformátoru v chodech nap
::: PARA
::: MODEL
::: DIAGRAM[ ] { }
::: PLOT[w=120, h=90, deps=1+2, common=yes, multiple=no, title
::: PLOT[w=120, h=90, deps=3+4+5, common=yes, multiple=no, title
::: PLOT[w=120, h=90, deps=3+4+5, range0=0..0.3, range3=-5..5,
::: ORIG
::: Karel Noháč, KEE, FEL, ZČU v Plzni
*SYSTEM;

RampUp /TAB/ -1e6,0, 0,0, 0.05,1, 1e6,1;

N1 > @mains 1,0 / Vef=RampUp(time)*220k/sqrt(3),R=0;
OPT21 > @OnePhTra2 1,0,2,0 / N1=220k,N2=110k,Sn=200ME,
    I0=0.5,dPk=0.5,dP0=0.2;
S1 2 = time>0.3;

*TR;
TR 0 0.5;
PRINT(2000) V.1, V.2, I.OPT21.R1, I.OPT21.R2, I.OPT21.Gfe0,
    I.OPT21.E_Ui1, I.OPT21.E_Ui2;
RUN;
*END;

```

Problem Tr1fSk1v02 (Model transformatoru 2018)

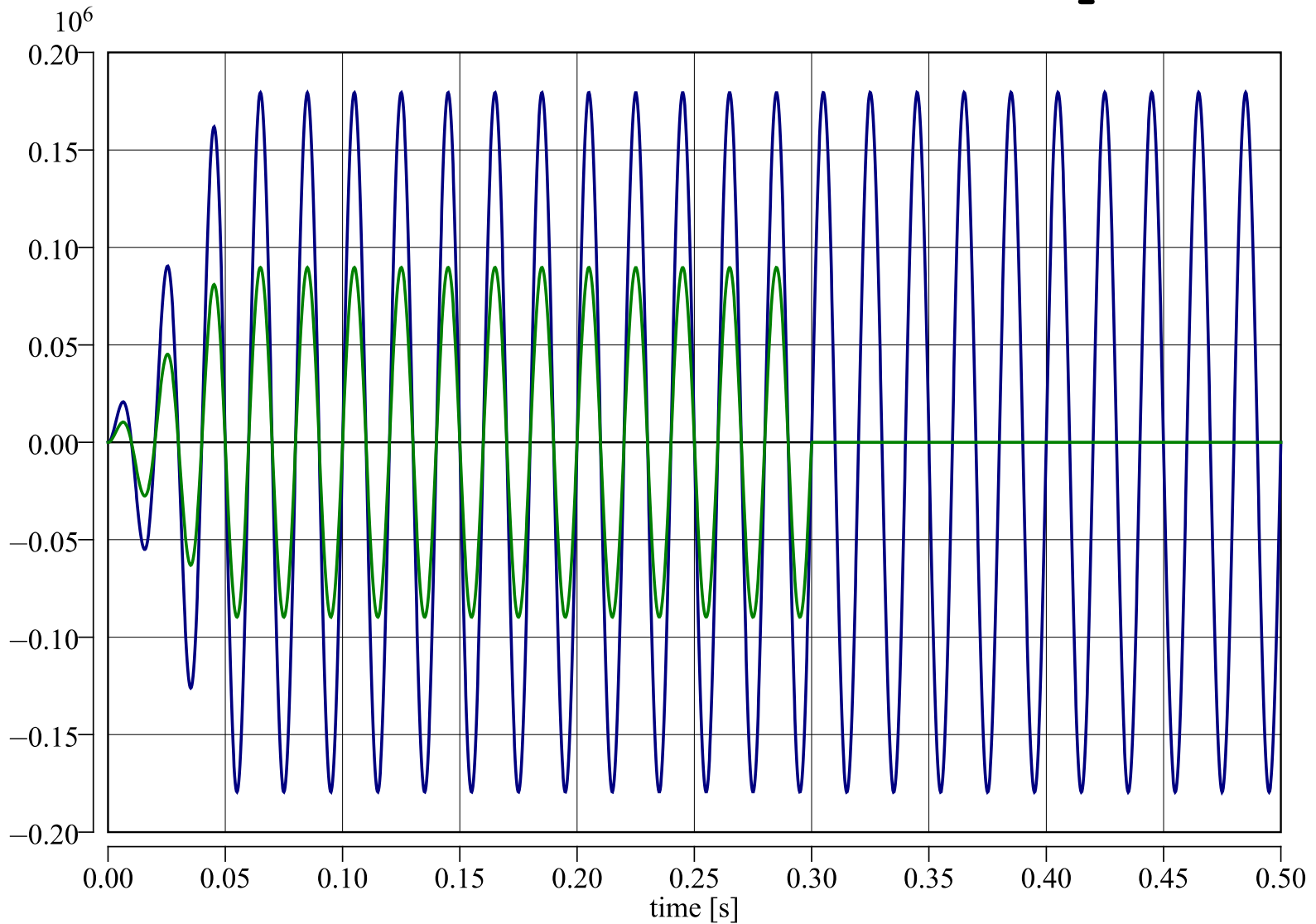
N1=220k,N2=110k,Sn=200ME,I0=0.5,dPk=0.5,dP0=0.2

All open files have been automatically saved

Ln 1, Col 1

# DYNAST - DPL

Napětí fázová

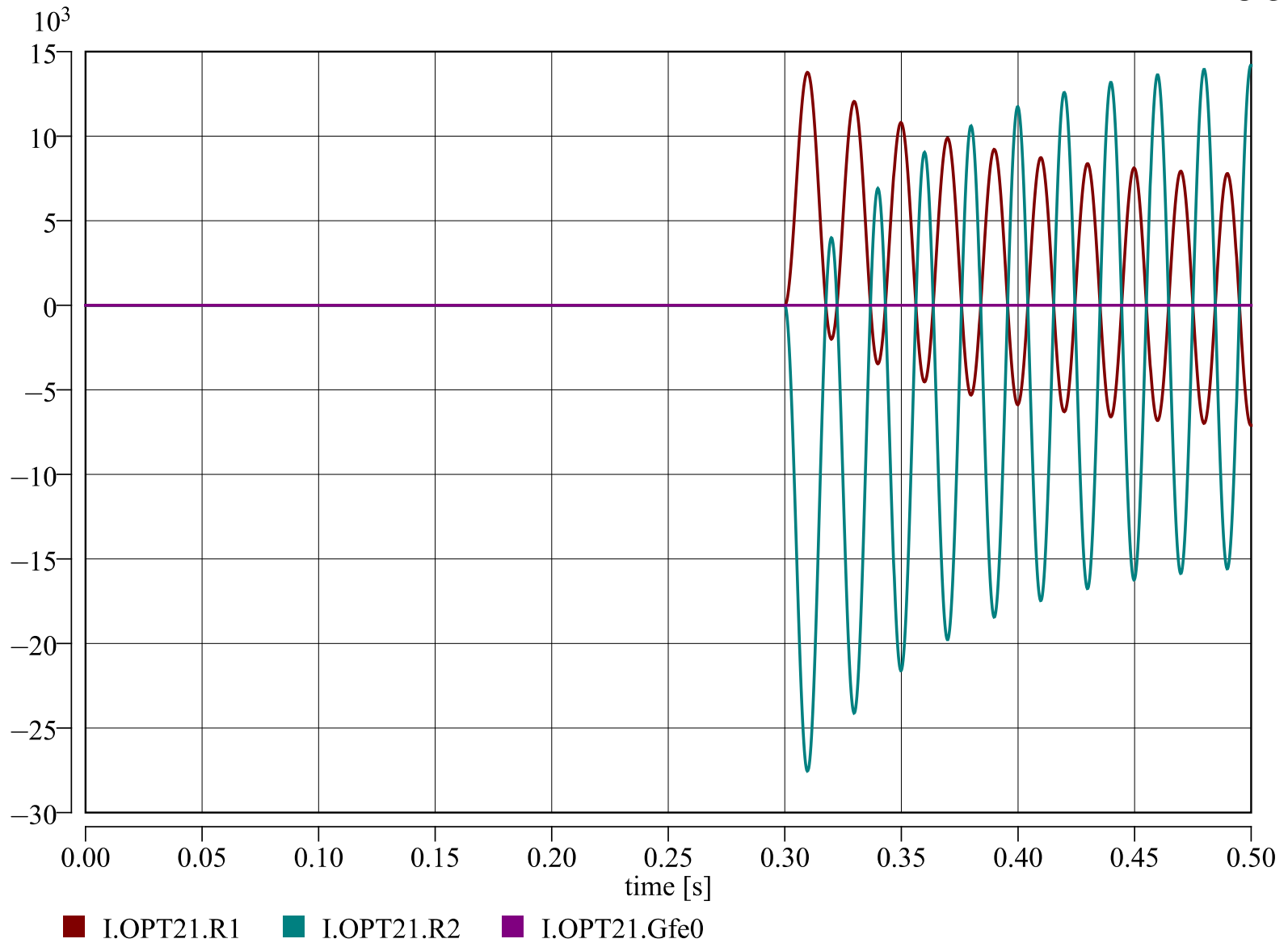


■ V.1 ■ V.2



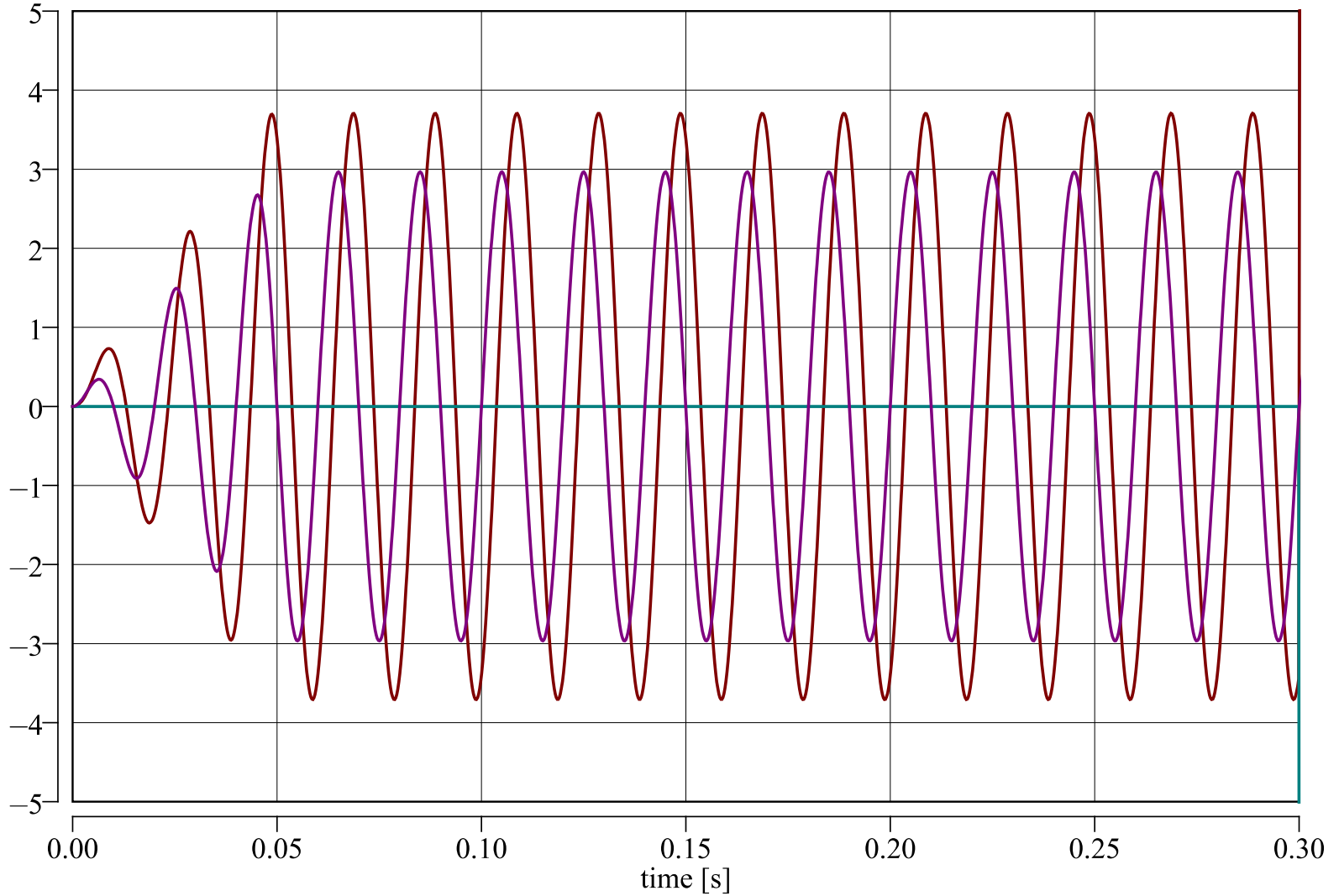
# DYNAST - DPL

Proudy



# DYNAST - DPL

Proudy



■ I.OPT21.R1   ■ I.OPT21.R2   ■ I.OPT21.Gfe0

# DYNAST - DPL

DYNAST Shell - Tr3fSk1v02

File Edit View System Analysis Errors Run Publishing Preferences Window Help

Tr3fSk1v02

```
! : Transformator s vyuzitim knihovny
:::PURP
::: Model 3f transformatoru pro cviceni KEE/PJS.
:::DESC
::: Testovani modelu trojfazovahu transformatoru v chodech nap
:::PARA
:::MODEL
:::DIAGRAM[!{}
:::PLOT[w=120, h=90, deps=1+2+3, common=yes, multiple=no, t:
:::PLOT[w=120, h=90, deps=4+5+6, common=yes, multiple=no, t:
:::PLOT[w=120, h=90, deps=7+8+9, common=yes, multiple=no, t:
:::PLOT[w=120, h=90, deps=7+8+9, range0=0..0.3, range7=-5..!
:::ORIG
::: Karel Noháč, KEE, FEL, ZČU v Plzni
*SYSTEM;

RampUp /TAB/ -1e6,0, 0,0, 0.05,1, 1e6,1;

Zdroj3f > @PowerSource3f ZdrojA,ZdrojB,ZdrojC,
0 / Un=RampUp(time)*220,Sks=5E6;
Tr3fYy1 > @Tr3fYy 1,2,3,TrOutA,TrOutB,TrOutC,0,0 / N1=220k,
N2=110k,Sn=200ME,I0=0.5,dPk=0.5,dP0=0.2;
ProudA > E ZdrojA-1 = 0;
ProudB > E ZdrojB-2 = 0;
ProudC > E ZdrojC-3 = 0;
Short_Circuit_3f1 > @ShortCircuit3f TrOutA,TrOutB,TrOutC,
0 / 0.3;
*TR;
TR 0 0.5;
PRINT(2000) ZdrojA, ZdrojB, ZdrojC, TrOutA, TrOutB, TrOutC,
I.ProudA, I.ProudB, I.ProudC;
RUN;
*END;
```

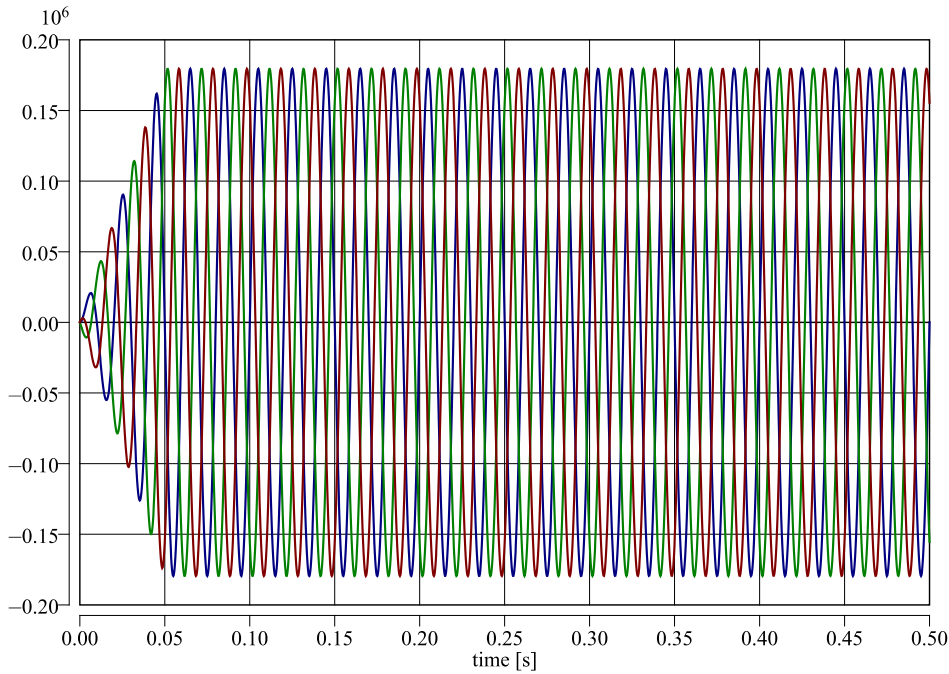
Problem Tr3fSk1v02 (Transformator s vyuzitim knihovny)

Un=RampUp(time)\*220,Sks=5E6 N1=220k,N2=110k,Sn=200ME,I0=0.5,dPk=0.5,dP0=0.2

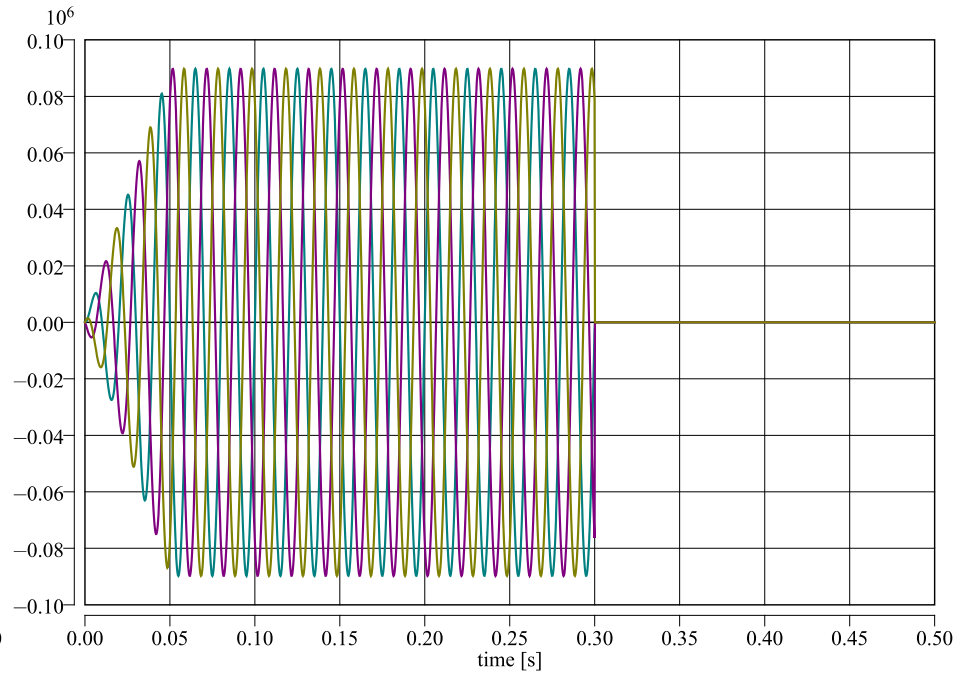
Ln 1, Col 1

# DYNAST - DPL

## Napětí fázová



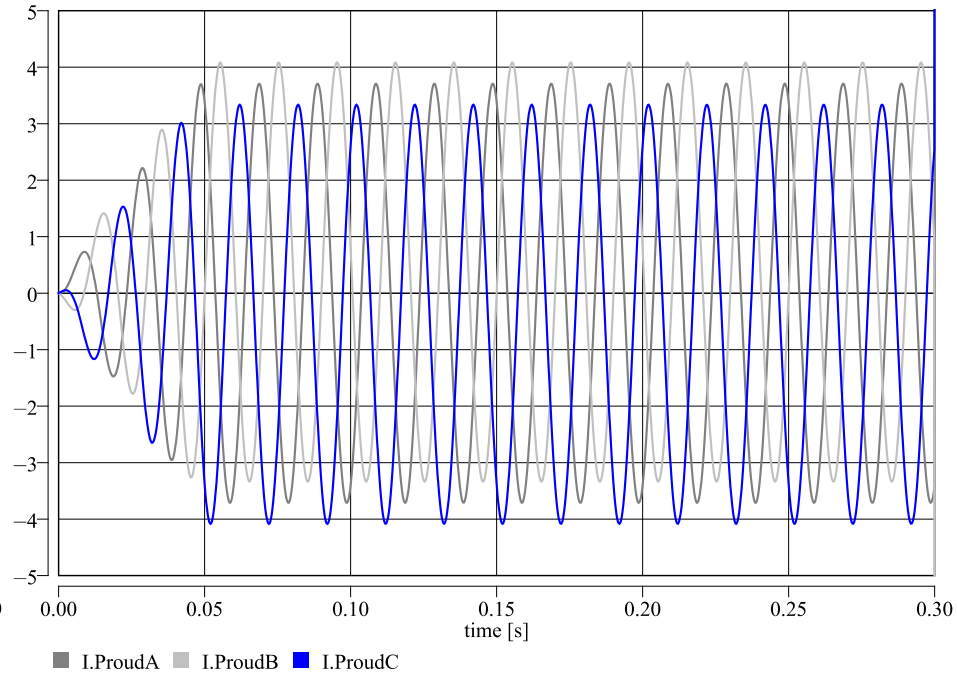
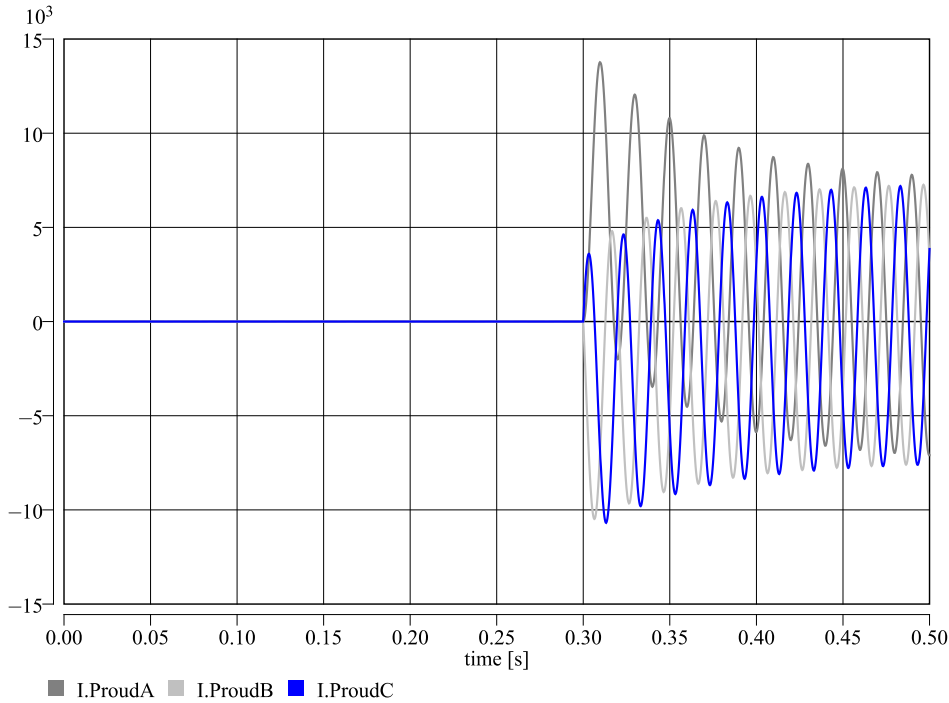
■ ZdrojA ■ ZdrojB ■ ZdrojC



■ TrOutA ■ TrOutB ■ TrOutC

# DYNAST - DPL

**Proudy**



# DYNAST – MS-DOS

The screenshot shows the MS-DOS Dynast software interface. At the top, there are four panels displaying file lists for the directory C:\USERS\NOHAC\DYNAST. The first panel shows a list of files including trsk1v01.prb, trsk1v02.prb, and trsk1v03.prb, with the first three highlighted in red. Below the panels is a command prompt where the command 'dumd trsk1v01\_' is entered, also highlighted in red. The bottom half of the screen is split into two windows. The left window shows the 'DYNAST 0.2c' header, copyright information for KATEDRA VYROBY A ROZVODU ELEKTRICKE ENERGIE USSE PLZEN, and a table of solving steps. The right window shows the 'Parametry' (Parameters) for the file 'trsk1v01.0', including file type, count, and various graphical parameters. A 'Reading of file' dialog box is also visible over the parameters window.

**File List (Left Panel):**

Name	Name	Name
..		
MAKRA		
SAVE		
dyn	tmp	
path	dyn	
rltest	dia	
rltest	prb	
trsk1v01	prb	
trsk1v02	prb	
trsk1v03	prb	

**Command Prompt:** C:\USERS\NOHAC\DYNAST> dumd trsk1v01\_

**Section: TR**

Input file: C:\USERS\NOHAC\DYNAST\trsk1v01.PRB  
 Output file: C:\USERS\NOHAC\DYNAST\trsk1v01.0  
 Last file:

Solving at	Step	Order	Operation
+1.375142e-003	+0.000000e+000	4	6
+1.001001e-003	-3.741409e-004	4	7
+1.101101e-003	+1.001001e-004	4	7
+1.201201e-003	+1.001001e-004	4	7
+1.301301e-003	+1.001001e-004	4	7

**Results**

+2.532533e-002	+1.786919e+005	+1.786496e+005	+1.786496e+005	+5.231582e+000
	+6.709447e-016	+3.755139e+000	+1.476443e+000	

**Parametry (Parameters):**

Nazev souboru: trsk1v01.0  
 Typ dat: Dynast  
 Pocet zaznamu: 1000  
 Pocet velicin: 8

Oznaceni leve osy Y:                      Zahlavi grafu:                      Ano  
 Oznaceni prave osy Y:                    Oznaceni osy X:                      Ano

Deleni osy X: [ ] Reading of file  
 Deleni osy Y:                              Filename: C:\USERS\NOHAC\DYNAST\TRSK1V01.0

Record number : 1000

Reading ok:

GRAFIČKE OKNO:  
 Levý okraj: 4  
 Pravý okraj: 59  
 Horní okraj: 50  
 Dolní okraj: 439

Ovladac tiskarny: GRAFIMPL  
 Mod tisku: 9-120

GRAF U\_1.1 katedra aplikovane elektroniky ZCU Plzen

**Footer:** Any key: Interrupt    Ctrl C: Cancel    Space bar: Display OFF    Alt-X Exit    F1 Help    F3 Open    F9 Paint    Alt-F5 Swap    F10 Menu    413016

# DYNAST – MS-DOS

File Graf Variables Options 01-12-19 11:41:32 File Graf Variables Options 01-12-19 11:41:07

Parametry

Nazev souboru: C:\USERS\NOHAC\DYNAST\TRSK1U01.0  
Typ dat: Dynast  
Pocet zaznamu: 1000  
Pocet velicin: 8

Oznaceni leve osy  
Oznaceni prave osy  
Deleni osy X:  
Deleni osy Y:

GRAFIGKE OKNO:  
Levy okraj: 40  
Pravy okraj: 599  
Horni okraj: 50  
Dolni okraj: 439

Dovladac tiskarny: GRAFIMPL  
Mod tisku: 9-120

GRAF U\_1.1 katedra aplikovane elektroniky ZCU Plzen

Alt-X Exit F1 Help F3 Open F9 Paint Alt-F5 Swap F10 Menu

Variables

Jmeno	osa Y	osa X
TIME	[ ]	(*)
U.1	[ ]	( )
U.2	[ ]	( )
U.3	[ ]	( )
I.LS1	[X]	( )
I.LS2C	[X]	( )
I.LH	[X]	( )
I.RFE	[X]	( )

OK  
Cancel

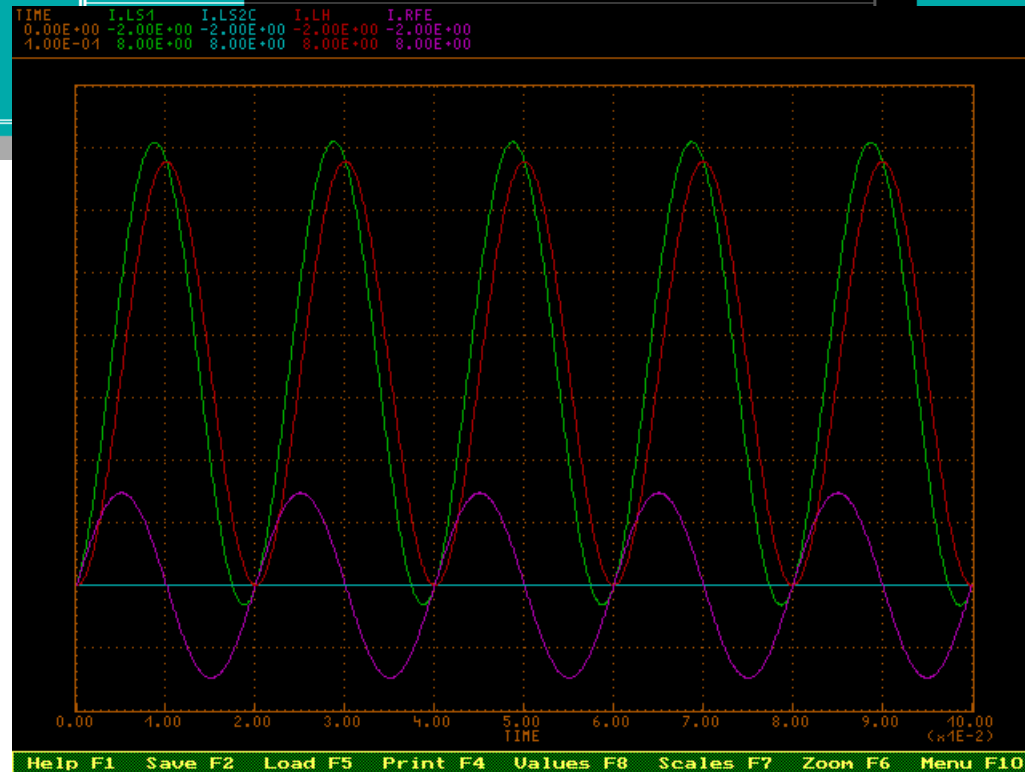
Scales

Velicina	Minimum	Maximum
TIME	0.00000E+00	1.00000E-01
U.1	-2.00000E+05	2.00000E+05
U.2	-2.00000E+05	2.00000E+05
U.3	-2.00000E+05	2.00000E+05
I.LS1	-2	8
I.LS2C	-2	8
I.LH	-2	8
I.RFE	-2	8

OK  
Restore  
Round  
Cancel

TIME I.LS1 I.LS2C I.LH I.RFE  
0.00E+00 -2.00E+00 -2.00E+00 -2.00E+00 -2.00E+00  
4.00E-04 8.00E+00 8.00E+00 8.00E+00 8.00E+00

Chod naprázdno



<http://home.zcu.cz/~nohac/Dynast/>

# DYNAST – MS-DOS

DYNAST Shell - TrSk1V01.O

File Edit View Errors Run Preferences Window Help

TrSk1V01.prb

```
*: Transformátor pro cvičení PJS skupina 1
*SYSTEM;
Unf > E 1 = 220k/sqrt(3)*sqrt(2)*sin(2pi*50*time);
Rk1 1-4 = 0.605;
Rk2c 5-3 = 0.605;
Rfe 2 = 121k;
Ls1 4-2 = 38.5m;
Ls2c 2-5 = 38.5m;
Lh 2 = 168;
*TR;
TR 0 0.1;
PRINT(1000) V.1, V.2, V.3, I.Ls1, I.Ls2c, I.Lh, I.Rfe;
INIT I.Ls1=0;
RUN;
*END;
```

TrSk1V01.O

	0.000000e+000	1.453807e-002	-1.399447e-001		
9.979980e-002	-1.128889e+004	-1.130416e+004	-1.130416e+004	-8.729428e-002	
	0.000000e+000	6.128555e-003	-9.342284e-002		
9.989990e-002	-5.647221e+003	-5.663842e+003	-5.663842e+003	-4.573303e-002	
	0.000000e+000	1.075577e-003	-4.680861e-002		
1.000000e-001	3.154496e-007	-1.794931e+001	-1.794931e+001	-1.177901e-003	
	0.000000e+000	-1.029560e-003	-1.483414e-004		
MAX	1.796072e+005	1.795631e+005	1.795631e+005	7.112314e+000	
	0.000000e+000	6.802685e+000	1.483993e+000		
MIN	-1.796072e+005	-1.795672e+005	-1.795672e+005	-3.102792e-001	
	0.000000e+000	-1.029560e-003	-1.484026e+000		
NP	1000				

Statistics: 1015 steps, 0 rejected steps, 1022 iterations

Order:	1	2	3	4	5	6
Steps:	4	993	17	1	0	0

Number of errors: 0, Number of warnings: 0  
Total seconds used up by DYNAST: 0.064  
Program DYNAST exited on December 1, 2019 at 11:21:08

```
LIST 2033 2054 12/01/2019 11:37 TRSK1V01.O
 9.96997E-02 -2.42947E-16 1.85973E-02 -1.86351E-01 -1.33031E-01
 9.97998E-02 -3.85551E-16 6.93126E-03 -1.39962E-01 -9.48381E-01
 9.98999E-02 -1.12903E+04 -1.13056E+04 -1.13056E+04 -5.32148E-01
 1.00000E-01 -6.34728E-16 -1.40372E-03 -9.34344E-02 -8.14312E-01
 -5.10884E-16 -6.40031E-03 -4.68145E-02
 -1.24875E-24 -7.99483E-03 -1.48285E-04

TR STATISTICS : 22170 STEPS, 0 REJECTED STEPS, 22177 ITERATIONS
ORDER 1 2 3 4 5 6
STEPS 15760 6326 69 14 1 0

#### SECONDS USED UP BY SECTION TR : 174.94
*END;

#### TOTAL SECONDS USED UP BY DYNAST : 175.11
#### PROGRAM DYNAST EXITED AT : 11:37:58

Command> _ *** End-of-file *** Keys: F1=< PgUp PgDn F10=exit
```

Chod naprázdno



# DYNAST – MS-DOS

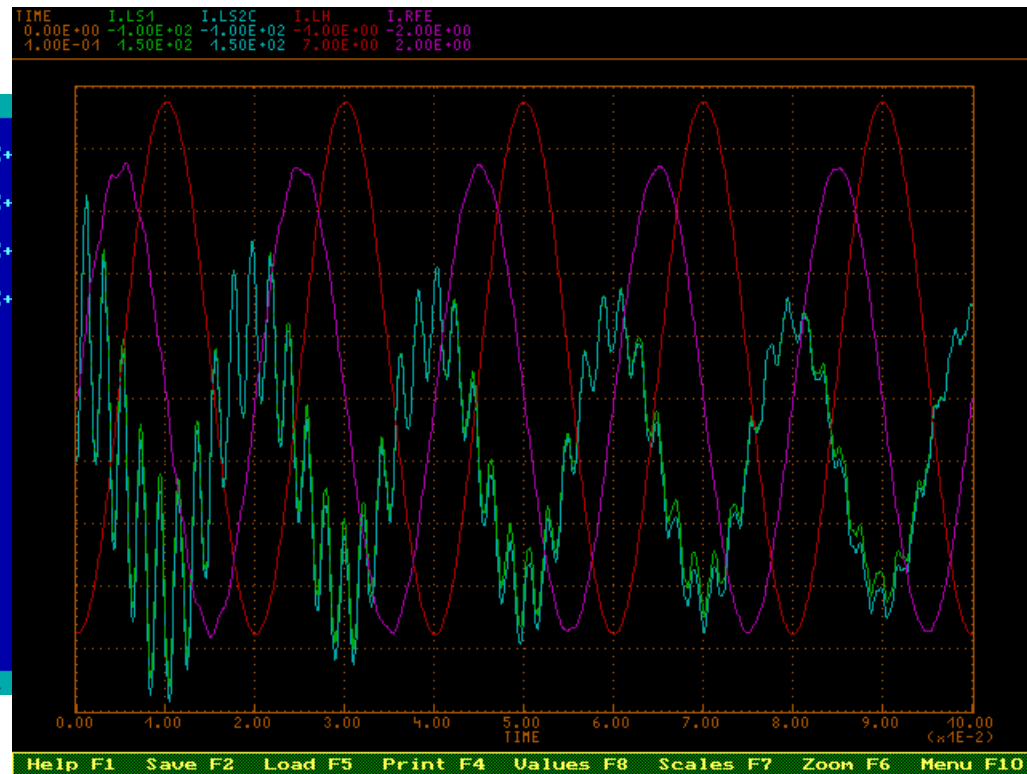
```
LIST 2037 2058 12/01/2019 12:06 TRSK1003.D
 5.84655E+01 1.24042E-02 -1.96025E-01
9.96997E-02 -1.69215E+04 -1.78754E+04 -1.88143E+04 6.10403E+
6.11881E+01 -5.50795E-06 -1.47730E-01
9.97998E-02 -1.12903E+04 -1.17655E+04 -1.22238E+04 6.28375E+
6.29435E+01 -8.84517E-03 -9.72356E-02
9.98999E-02 -5.64794E+03 -5.58662E+03 -5.50712E+03 6.32576E+
6.33178E+01 -1.40108E-02 -4.61704E-02
1.00000E-01 1.83603E-05 4.43888E+02 9.06639E+02 6.24435E+
6.24553E+01 -1.55297E-02 3.66850E-03

TR STATISTICS : 1397 STEPS, 99 REJECTED STEPS, 1506 ITERATIONS
ORDER 1 2 3 4 5 6
STEPS 4 10 125 408 571 279

#### SECONDS USED UP BY SECTION TR : 35.09
*END;

#### TOTAL SECONDS USED UP BY DYNAST : 35.26
#### PROGRAM DYNAST EXITED AT : 12:06:53

Command> *** End-of-file *** Keys: F1-> PgUp PgDn F10=exit
```



Chod s vedením  
naprázdno

<http://home.zcu.cz/~nohac/Dynast/>