

OpenDSS Training Workshop

Basics and Scripting

Roger C. Dugan
EPRI Knoxville, TN

August 24, 2020



Instructor



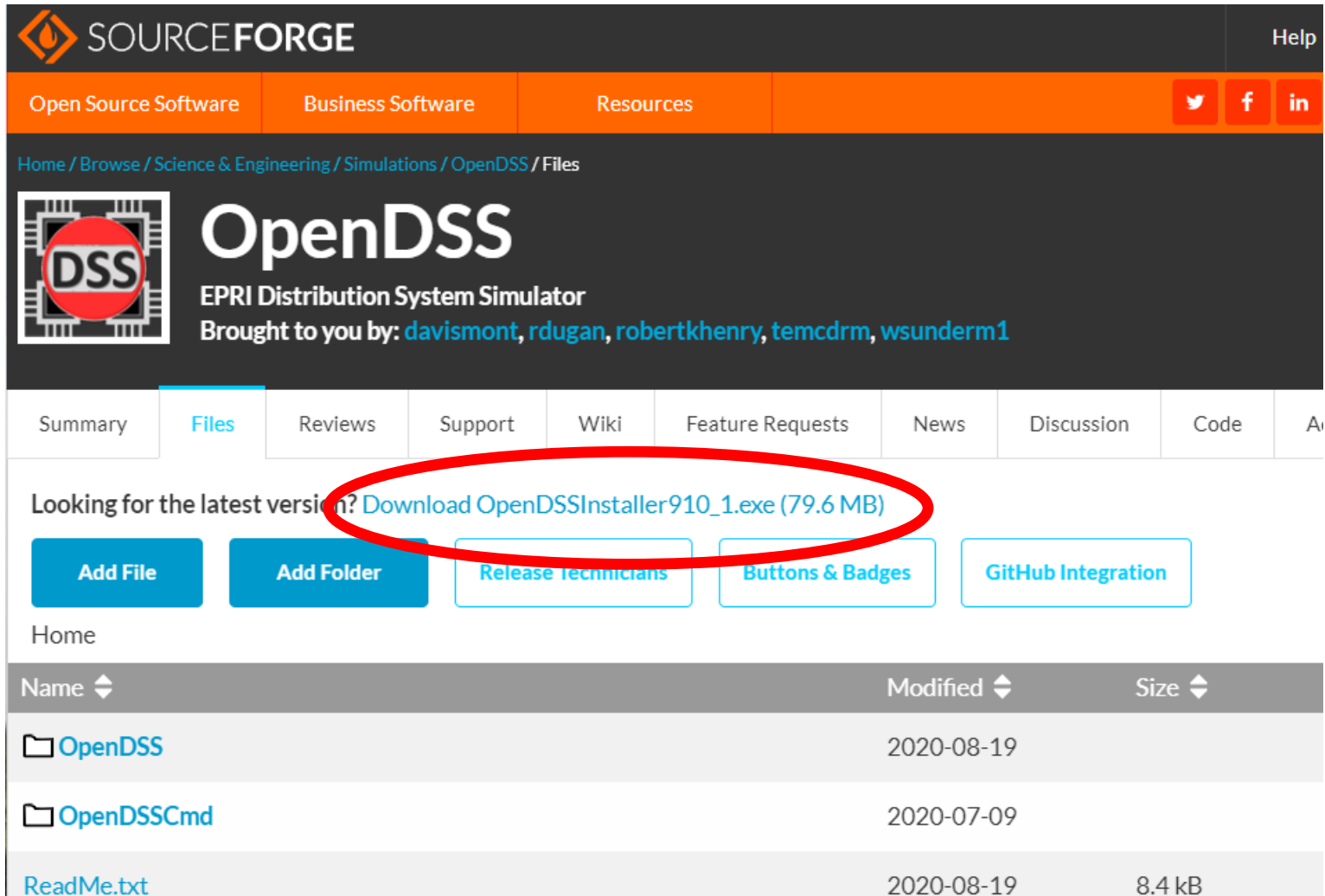
■ Roger C. Dugan, *Life Fellow, IEEE*

- Roger is a Sr. Technical Executive with EPRI in Knoxville, Tennessee USA. He has over 45 years of combined experience in distribution engineering with EPRI, Electrotek Concepts, and Cooper Power Systems. He holds the BSEE degree from Ohio University and the Master of Engineering in Electric Power Engineering degree from Rensselaer Polytechnic Institute, Troy, NY. Roger has worked on many diverse aspects of power engineering over his career because of his interests in applying computer methods to power system simulation. Beginning with a student internship with Columbus and Southern Ohio Electric Co, his work has been focused on Distribution Engineering. He was elected a Fellow of the IEEE for his contributions in harmonics and transients analysis. Recently, he has been very active in distributed generation, particularly as it applies to utility distribution systems and distribution system analysis. He was the 2005 recipient of the IEEE Excellence in Distribution Engineering Award. He is coauthor of Electrical Power Systems Quality published by McGraw-Hill, now in its 3rd edition. He serves on the IEEE PES Distribution System Analysis Subcommittee and is active in the Distribution Test Feeders WG.

Installation, Startup, and Basic Usage

Program Installation

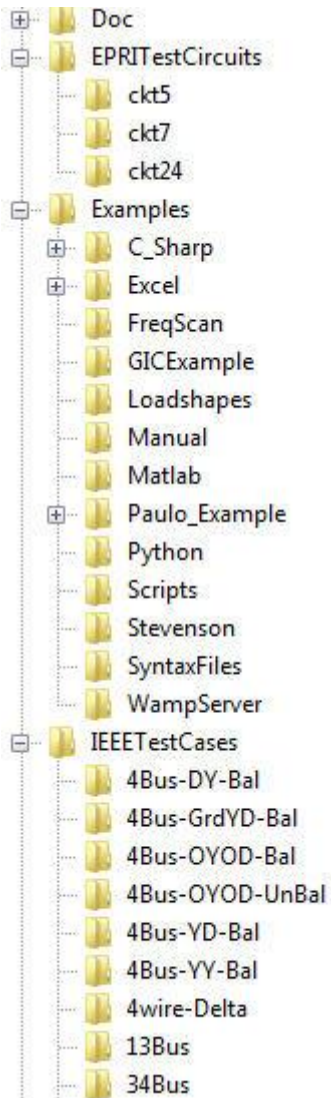
Download the Installer Files



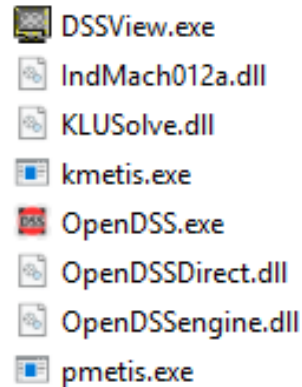
The screenshot shows the SourceForge project page for OpenDSS. The page header includes the SourceForge logo and navigation links for Open Source Software, Business Software, and Resources. The project name "OpenDSS" is prominently displayed, along with the description "EPRI Distribution System Simulator" and the contributors "Brought to you by: davismont, rdugan, robertkhenry, temcdm, wsunderm1". A red circle highlights the link "Download OpenDSSInstaller910_1.exe (79.6 MB)" under the "Files" tab. Below this, there are buttons for "Add File", "Add Folder", "Release technicians", "Buttons & Badges", and "GitHub Integration". A table lists the files in the project:

Name	Modified	Size
OpenDSS	2020-08-19	
OpenDSSCmd	2020-07-09	
ReadMe.txt	2020-08-19	8.4 kB

OpenDSS Files Installed

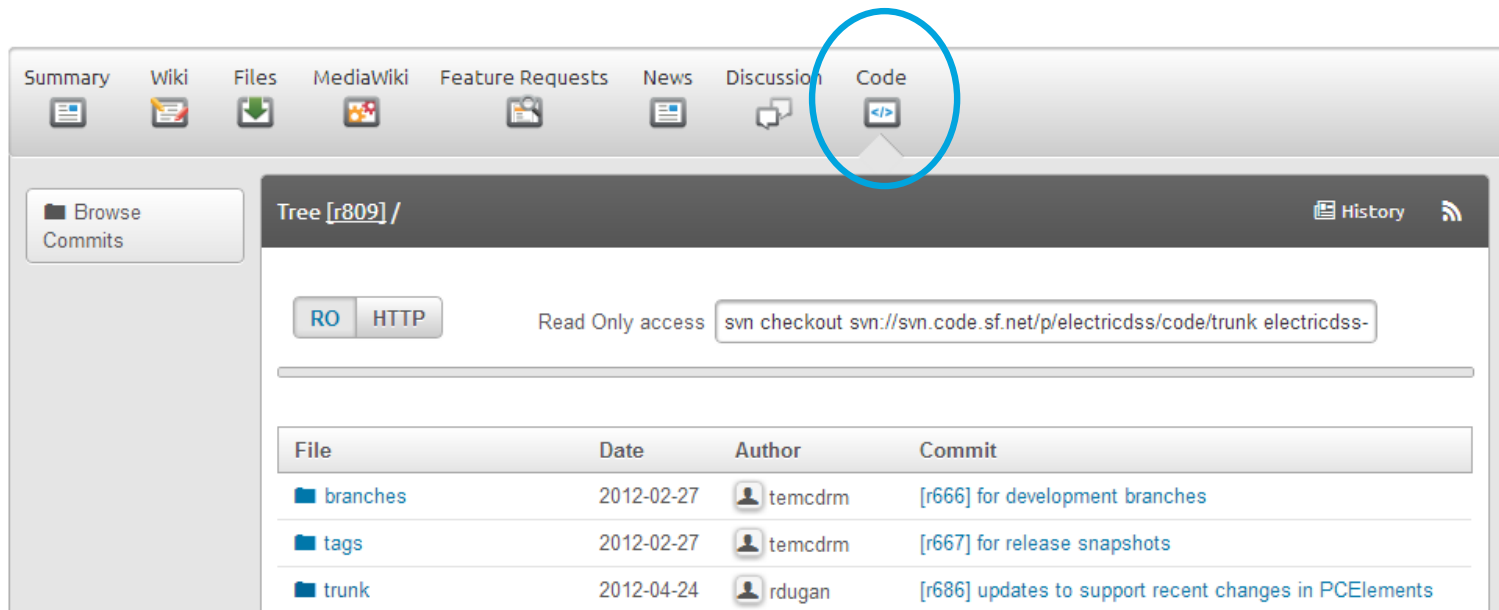


Main Program Files



SourceForge.Net Links for OpenDSS

- EPRI Links Page
 - <https://www.epri.com/#/pages/sa/openss?lang=en-US>
- OpenDSS Download Files:
 - <http://sourceforge.net/projects/electricdss/files/>
- Top level of Main Repository



Discussion Forum & News for OpenDSS



OpenDSS

EPRI Distribution System Simulator

Brought to you by: [bobarritt](#), [rdugan](#), [robertkhenry](#), [temcdm](#), [wsunderm1](#)

[Summary](#) | [Files](#) | [Reviews](#) | [Support](#) | [Wiki](#) | [Feature Requests](#) | [News](#) | [Discussion](#) | [Code](#)

[+ Create Topic](#)

[Stats Graph](#)

Forums

[Beginners](#) **61**

[Help](#) **296**

[Open Discussion](#) **455**

[Experts](#) **5**

[Help](#)

[Formatting Help](#)

Open Discussion

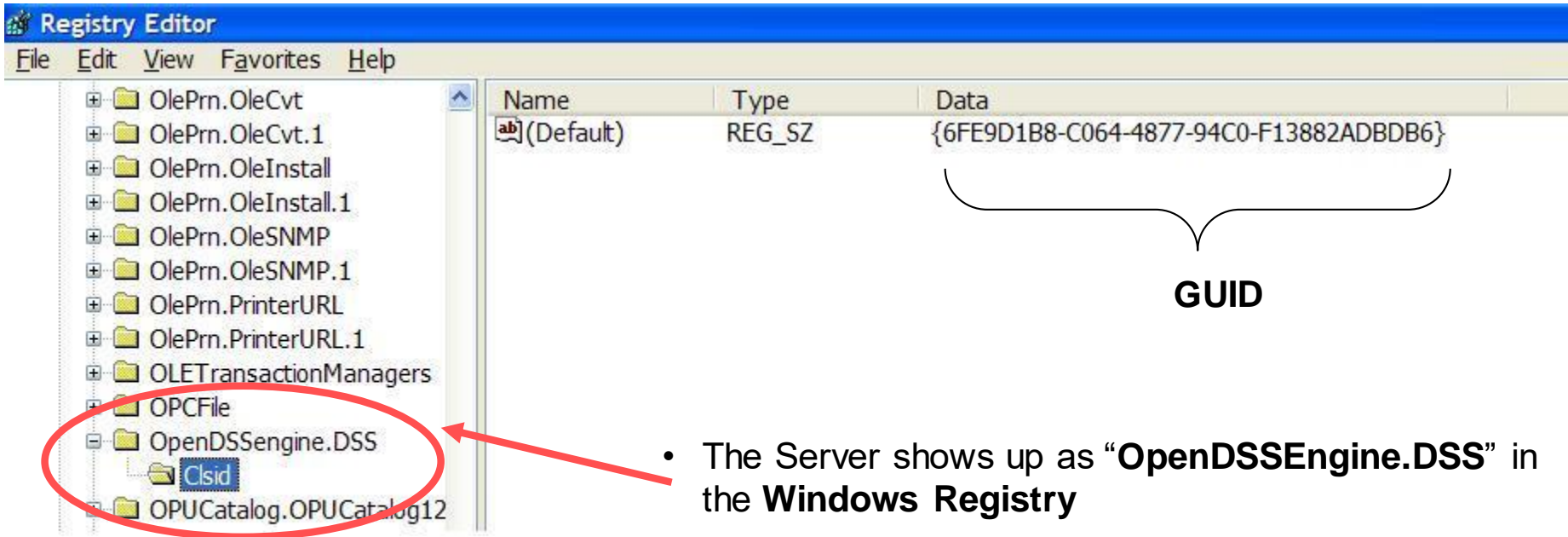


1 2 3 .. 18 > >> (Page 1 of 18)

	Topic	Posts	Views	Last Post
<input type="checkbox"/>	Create New Component in OpenDSS	1	1	By Vasudeva Nayak on Mon Dec 15, 2014 01:59 PM
<input type="checkbox"/>	Low voltage Grid Simulation	1	3	By Max on Mon Dec 15, 2014 10:28 AM
<input type="checkbox"/>	Weekly load curve nclusion	1	5	By PetinrinJoseph on Mon Dec 15, 2014 10:23 AM
<input type="checkbox"/>	Regulator Tap Positions	6	46	By Oguzhan Ceylan on Mon Dec 15, 2014 04:54 AM

COM Server Registration

Windows Registry Entry



The screenshot shows the Windows Registry Editor with the following structure:

- Left pane: A tree view of registry keys. The key **OpenDSSEngine.DSS** is highlighted with a red circle. Below it, the **Clsid** subkey is visible.
- Right pane: A table showing the details of the selected registry entry.

Name	Type	Data
(Default)	REG_SZ	{6FE9D1B8-C064-4877-94C0-F13882ADBDB6}

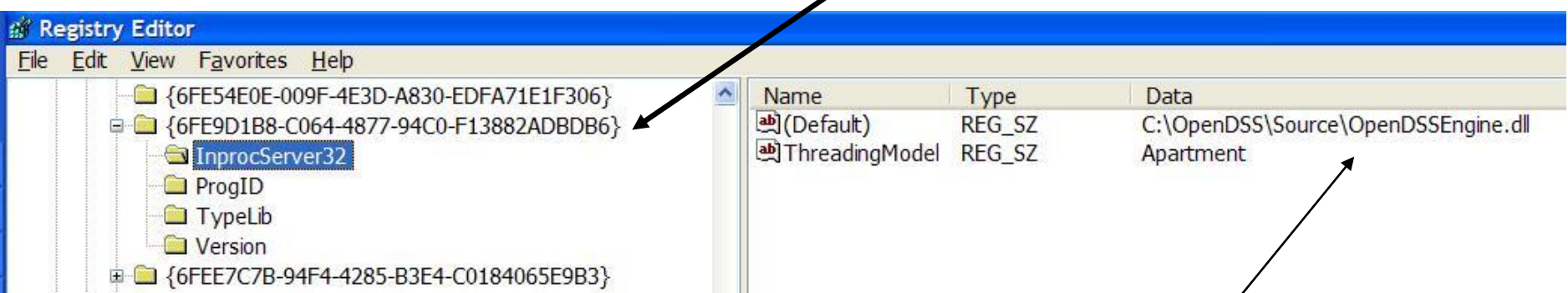
A bracket under the GUID value in the table points to the text **GUID**.

- The Server shows up as “**OpenDSSEngine.DSS**” in the **Windows Registry**

The OpenDSS is now available to any program on the computer

The GUID References the DLL File

If you look up the GUID in RegEdit



**Points to OpenDSSEngine.DLL
(In-process server, Apartment Threading model)**

Accessing the SourceForge.Net Source Code Repository with TortoiseSVN

- Install a TortoiseSVN client from Tortoisesvn.net/downloads.
- Recommendation:

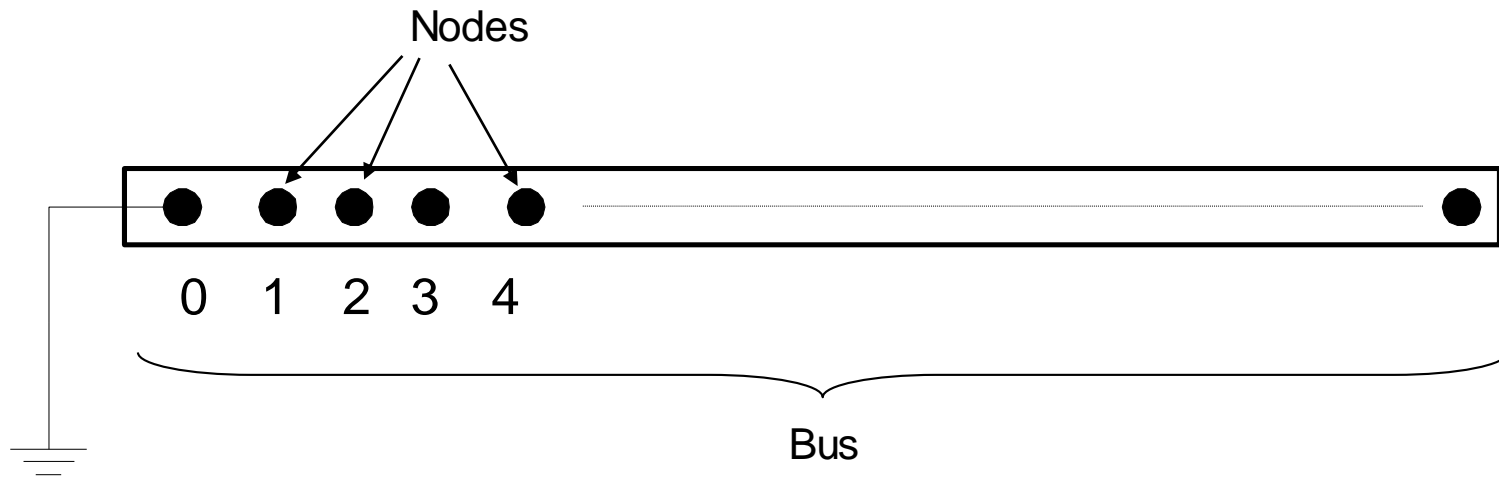
Then, to grab the files from SourceForge by:

- 1 - create a clean directory such as "c:\opendss"
- 2 - **right-click** on it and choose "SVN Checkout..." from the menu
- 3 - the repository URL is
<http://electricdss.svn.sourceforge.net/svnroot/electricdss>

(Change the checkout directory if it points somewhere other than what you want.)

Thereafter, to update a folder or file, right-click on the folder or file and select **SVN Update**

DSS Bus Model (Bus \neq Node)



Referring to Buses and Nodes (A Bus has 1 or more Nodes)

Bus1=BusName.1.2.3.0

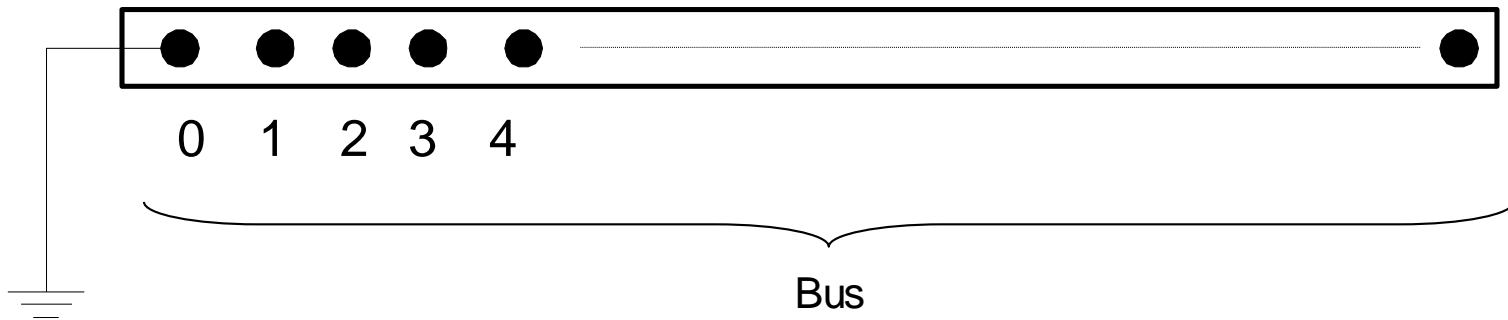
(This is the default for a 3-phase circuit element)

Shorthand notation for taking the default:

Bus1=BusName

Note: Sometimes this can bite you (e.g. – Transformers, or capacitors with ungrounded neutrals)

Node Numbers



The voltage at Node 0 = 0 (always)

The other Node numbers are arbitrary

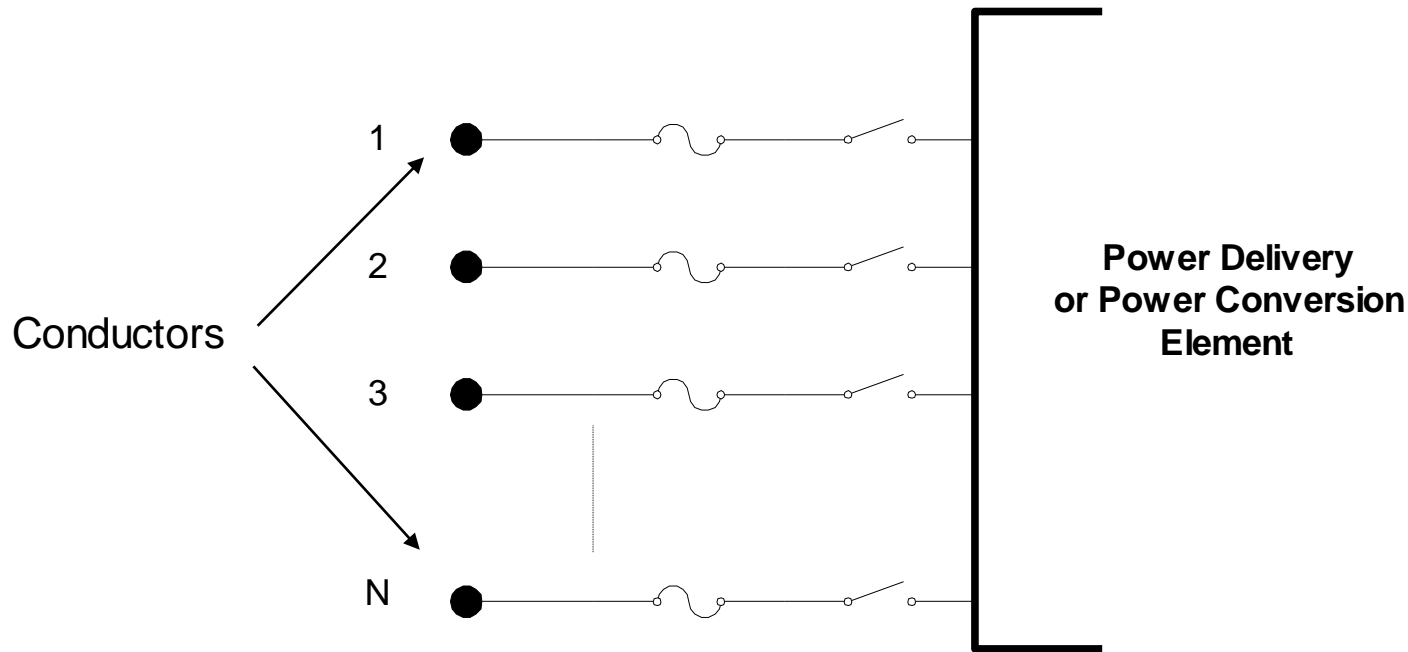
By convention, Nodes 1, 2, 3 correspond to phase ABC

But they don't have to

You can have a very large number of nodes at a Bus

They do not have to be pre-declared

DSS Terminal Definition

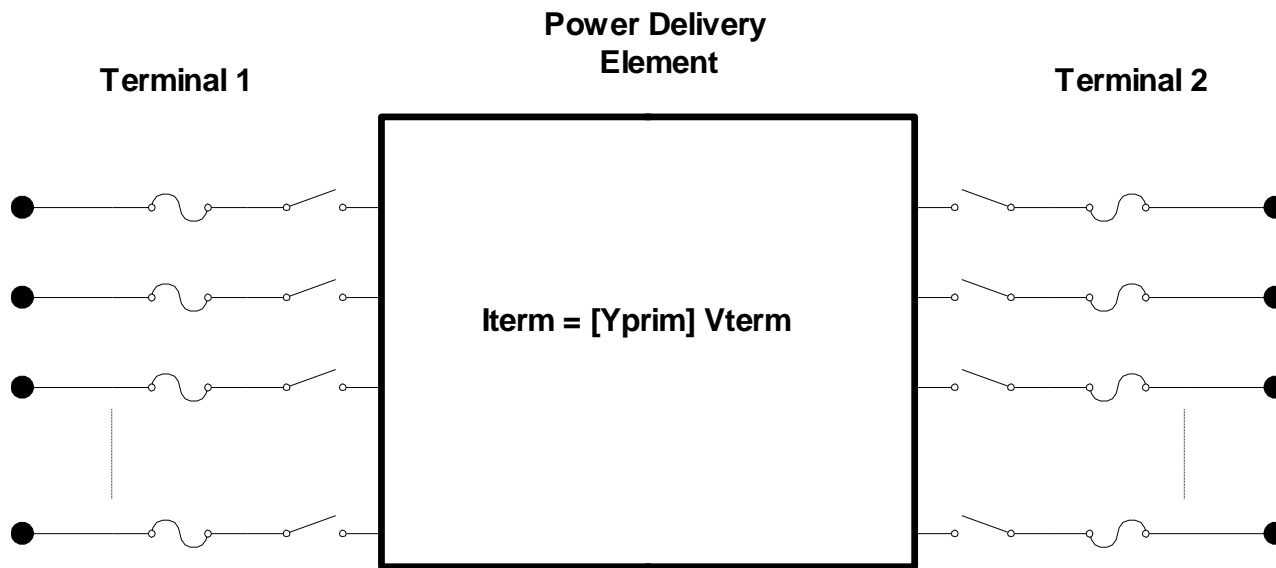


Circuit Elements have one or more *Terminals* with 1..N conductors.

Conductors connect to *Nodes* at a *Bus*

Each *Terminal* connects to one and only one *Bus*

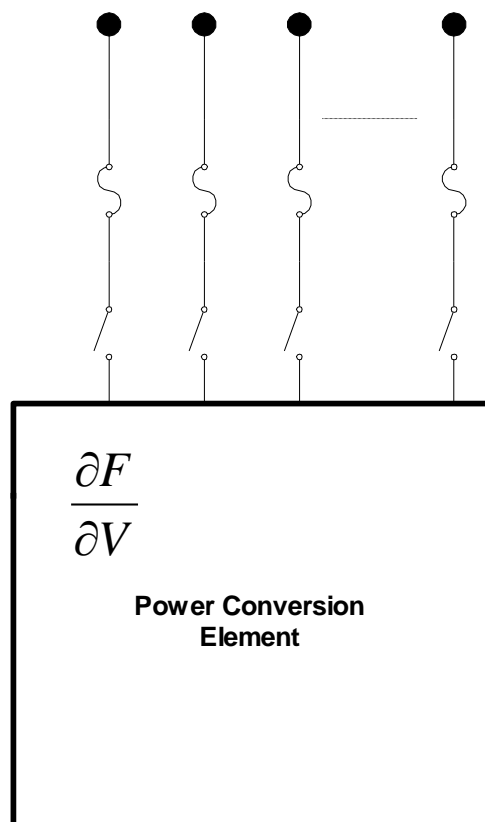
Power Delivery Elements



PD Elements are Generally Completely Described by $[Y_{prim}]$

Power Conversion Elements


$$I_{\text{Term}}(t) = F(V_{\text{Term}}, [\text{State}], t)$$



- Power Conversion (PC) elements are typically connected in “shunt” with the Power Delivery (PD) elements
- PC Elements may be nonlinear
- Described some function of V
 - May be linear
 - e.g., V_{source} , I_{source}
- May have more than one terminal, but typically one
 - Load, generator, storage, etc.

Command Syntax

- *Command parm1, parm2 parm3 parm 4*
- Parameters may be positional or named (tagged).
- If named, an "=" sign is expected.
 - *Name=value* (this is the named form)
 - *Value* (value alone in positional form)
- *For example, the following two commands are equivalent:*
 - *New Object="Line.First Line" Bus1=b1240 Bus2=32 LineCode=336ACSR, ...*
 - *New "Line.First Line", b1240 32 336ACSR, ...*



Comma or white space

Delimiters

- Array or string delimiter pairs: `[] , { } , () , “ ” , ‘ ’`
- Matrix row delimiter: `|`
- Value delimiters: `,` (comma)
`any white space (tab or space)`
- Class, Object, Bus, or Node delimiter: `.` (period)
- Keyword / value separator: `=`
- Continuation of previous line: `~` (More)
- Comment line: `//`
- In-line comment: `!`
- Query a property: `?`

Array and Matrix Parameters

- Array

- `kvs = [115, 6.6, 22]`
- `kvas=[20000 16000 16000]`

- Matrix

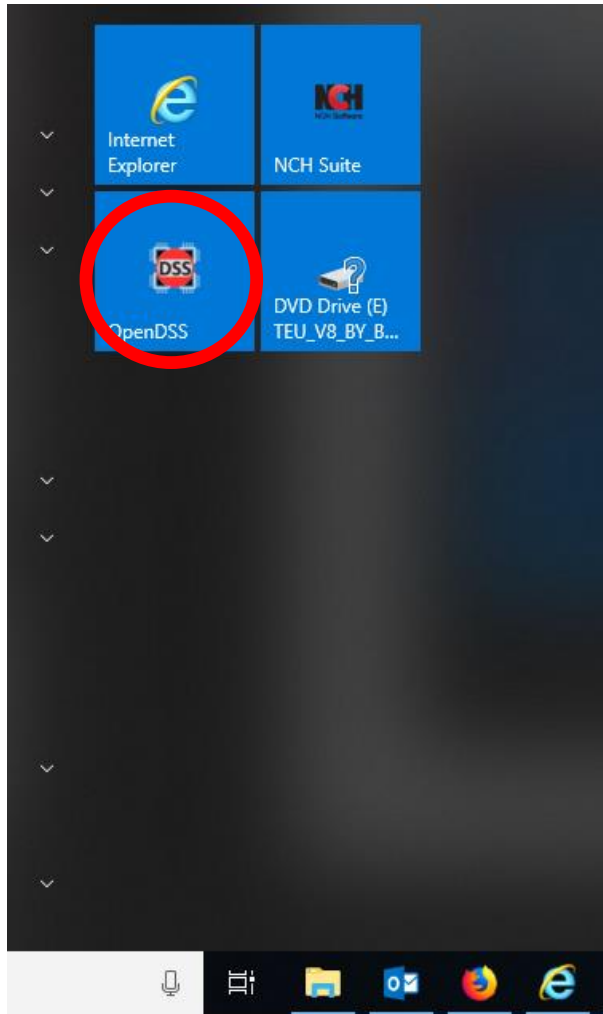
- *(3x3 matrix)*
 - `Xmatrix=[1.2 .3 .3 | .3 1.2 3 | .3 .3 1.2]`
- *(3x3 matrix – lower triangle)*
 - `Xmatrix=[1.2 | .3 1.2 | .3 .3 1.2]`

Starting the Program

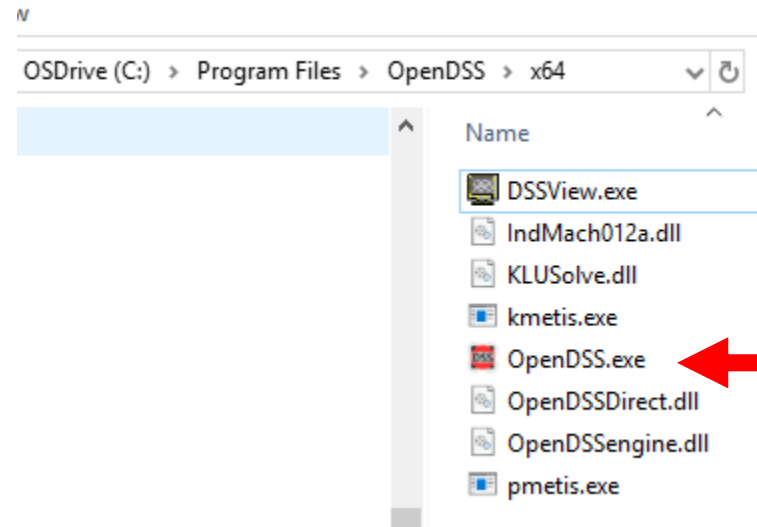
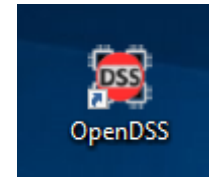
.

Starting OpenDSS.exe – Standalone executable

Start Menu



Desktop Icon



File Manager/Explorer

Basic User Text Script Screen (OpenDSS.exe)

The screenshot displays the OpenDSS.exe application window. The title bar reads "OpenDSS Data Directory: C:\Users\prdu001\OpenDSS\Distrib\IEEETestCases\13Bus\". The menu bar includes File, Edit, Do, Set, Make, Export, Show, Visualize, Plot, Reset, and Help. The toolbar contains icons for file operations and simulation. The status bar at the bottom right indicates "Base Frequency = 60 Hz".

On the left side, the "Circuit Summary" panel shows the following details:

- Status = SOLVED
- Solution Mode = Snap
- Number = 100
- Load Mult = 1.000
- Devices = 38
- Buses = 16
- Nodes = 41
- Control Mode = STATIC
- Total Iterations = 11
- Control Iterations = 3
- Max Sol Iter = 4
- Year = 0
- Hour = 0
- Max pu. voltage = 1.056
- Min pu. voltage = 0.96083
- Total Active Power: 3.56721 MW
- Total Reactive Power: 1.73659 Mvar
- Total Active Losses: 0.112409 MW, (3.151 %)
- Total Reactive Losses: 0.327912 Mvar
- Frequency = 60 Hz
- Mode = Snap
- Control Mode = STATIC
- Load Model = PowerFlow

The main text area displays the script content, which includes a copyright notice for Tennessee Tech Univ students (Tyler Patton, Jon Wood, and David Woods, April 2009) and circuit definitions for IEEE13Nodeckt. The script defines buses, transformers, and voltage regulators. Annotations with arrows point to specific parts of the script:

- Home Folder:** Points to the directory path in the title bar.
- Circuit Script:** Points to the script content in the main text area.
- Solution Summary:** Points to the "Circuit Summary" panel on the left.
- File Displayed:** Points to the "IEEE13Nodeckt.dss" file in the "Messages" panel at the bottom.

The "Messages" panel at the bottom shows the path: "OpenDSS - C:\Users\prdu001\OpenDSS\Distrib\IEEETestCases\13Bus\IEEE13Nodeckt.dss".

(Live Demo)

.

Questions ??



Together...Shaping the Future of Electricity

