Use of KSKelvin Subckt Symbol from Autogenerated Model

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Introduction

- Purpose
  - This guideline show step-by-step instruction to use Subcircuit Symbol from KSKelvin Symbol Library for Autogenerated Model in Qspice
  - Focus on subcircuit (.subckt) model of X-device

- Device model from Texas Instrument OPA462 is used for this demonstration
  - Website : https://www.ti.com/product/OPA462
  - Description : OPA462, 180-V, wide bandwidth (6.5 MHz), high-slew rate (25 V/µs) unity-gain stable op amp
  - OPA462 Pspice Model (Rev. D) : https://www.ti.com/lit/zip/sbomav9

- Prerequisite
  - Knowledge of X-device (subcircuit / .subckt) and method of Auto-generate Symbol in Qspice
  - Reader can learn importing model and subcircuit from following reference
    - Importing 3rd Party Models into Qspice by Mike Engelhardt : https://www.qorvo.com/design-hub/design-tools/interactive/qspice#videos
    - General Reference Guideline in KSKelvin's Github : https://github.com/KSKelvin-Github/Qspice/tree/main/Guideline

Preparation – Download KSKelvin's Subckt Symbol

- Preparation
  - Goto KSKelvin-Github Qspice
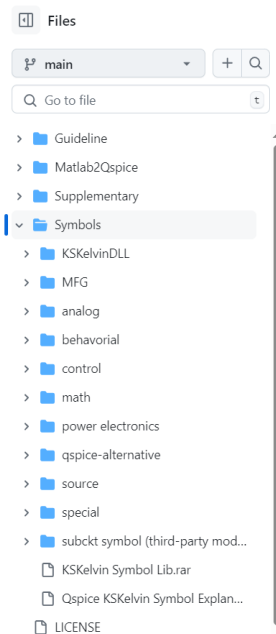   https://github.com/KSKelvin-Github/Qspice
  - Goto Symbols folder
    - [1] Download entire KSKelvin's Symbol Library from **KSKelvin Symbol Lib.rar**
    - **OR** [2] Just goto sub-folder **subckt symbol (third-party model)** and download subckt model
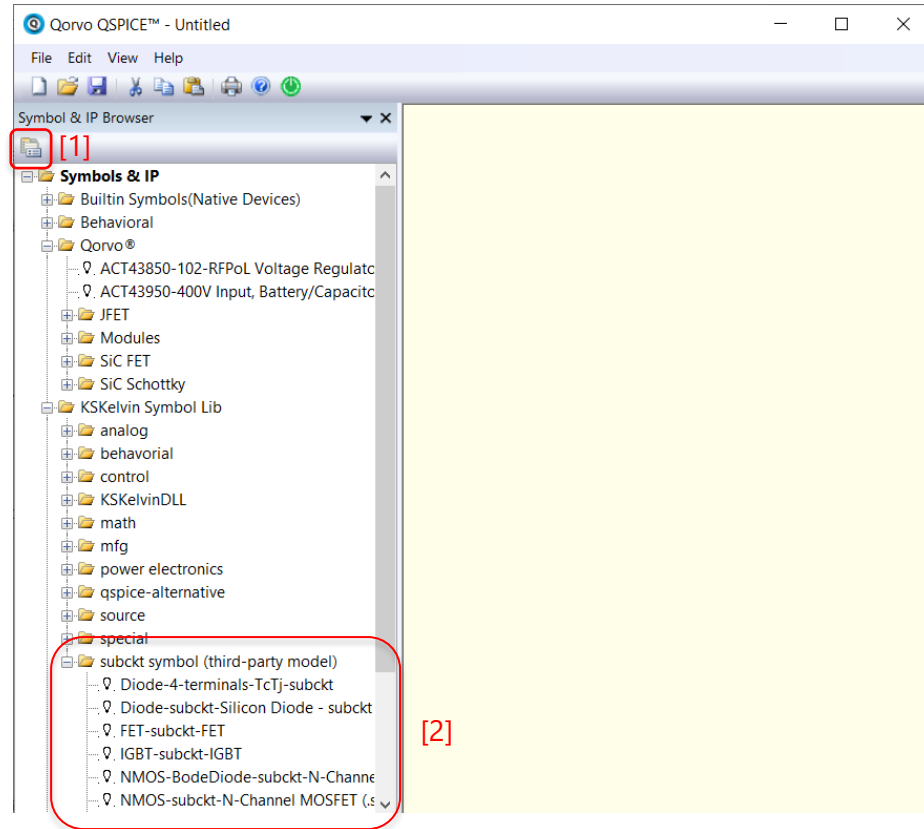   - Extract .rar file or store .qsym symbol file in your local directory

Preparation – Add Library Folder into Qspice

- Preparation
  - Open Symbol & IP Browser
    - View > Symbol & IP Browser
  - Add KSKelvin Symbol Lib
    - Click the Icon [1] and select symbol library folder
    - Now, you can browse the available subckt symbol [2]

- Model Study
  - In general, model is named as .lib, .txt, .mod or .sub etc...
  - Use text editor to open and inspect the model
    - Only unencrypted model can be used for auto generate symbol in Qspice
    - [1] Identify the .subckt of device (in this example, OPA462), and confirm its pin sequence
    - [2] Verify if this subcircuit has dependent .subckt. If X-device can be found between .subckt and .ends, this device will call other subcircuit



```
 70   *      v. INPUT OFFSET VOLTAGE VS. TEMPERATURE
 71   *      w. INPUT COMMON-MODE VOLTAGE RANGE (Vcm
 72   *      x. INPUT OFFSET VOLTAGE VS. INPUT COMMO
 73   *      y. INPUT/OUTPUT ESD CELLS (ESDin, ESDou
 74   ********************************************
 75   .SUBCKT OPA462 IN+ IN- VCC VEE OUT  [1]
 76   ********************************************
 77   C_C1          N24458 N24659   20.4P
 78   C_C10         N37029 N37037   18.72U
 79   C_C13         0 N2425309   1F
 80   C_C14         0 N2425287   1U
 81   C_C15         0 N2425325   1F
 82   C_C16         MID N56849   1F
 83   C_C17         MID N57325   1F
 84   C_C18         MID N59747   1F
 85   C_C19         MID N59865   1F
 86   C_C2          N25921 N25929   324.8P
 87   C_C20         MID N65579   1F
 88   C_C21         MID N65697   1F
 89   C_C22         MID N68774   1F
 90   C_C23         N72398 MID   1F
 91   C_C24         MID N72391   1F
 92   C_C25         MID N81574   1P
 93   C_C26         MID N81664   1P
 94   C_C27         MID SW_OL_OPA462   1N
 95   C_C28         VCLP MID   1P
 96   C_C29         VIMON MID   1P
 97   C_C3          N27785 N27793   411.3P
 98   C_C30         VOUT_S MID   1P
 99   C_C32         MID N2419074   23.5F
100   C_C33         MID N36262   7.0E-16
```

```
241   X_U31         N32510 MID MID CLAMP AOL_2_OPA
242   +  INEG=-5.5
243   X_U32         N37037 MID MID N46041 ZO_SRC_O
244   +  INEG=-100E3
245   X_U35         N56849 N57325 CLAW_CLAMP MID O
246   +  INEG=-1.5E1
247   X_U36         N24207 MID FEMT_OPA462 PARAMS:
248   X_U37         ESDN MID FEMT_OPA462 PARAMS: F
249   X_U4   [2]    N25397 N24207 VOS_DRIFT_OPA462
250   X_U5          ESDN ESDP VCC VEE ESD_IN_OPA46
251   X_U6          N28678 MID N32236 MID N31389 N
252   .ENDS OPA462
253   *
254   .SUBCKT BLOCK_DC_H1_OPA462 1 2 3 4
255   H_H1          3 4 VH_H1 1K
256   VH_H1         1 2 0V
257   .ENDS  BLOCK_DC_H1_OPA462
258   *
259   .SUBCKT BLOCK_DC_H2_OPA462 1 2 3 4
260   H_H2          3 4 VH_H2 1
261   VH_H2         1 2 0V
262   .ENDS  BLOCK_DC_H2_OPA462
263   *
264   .SUBCKT BLOCK_DC_H3_OPA462 1 2 3 4
265   H_H3          3 4 VH_H3 -1
266   VH_H3         1 2 0V
267   .ENDS  BLOCK_DC_H3_OPA462
268   *
269   .SUBCKT BLOCK_DC_S1_OPA462 1 2 3 4
270   S_S1          3 4 1 2 _S1
271   RS_S1         1 2 1G
```

other subcircuit

Use KSKelvin Subckt Symbol from Autogenerated Model
# Step 2 : Confirm Equivalent Subckt Symbol

- Confirm Equivalent Subckt Symbol
  - In previous step, we confirm OPA462 is opamp model with 5 pins in order of IN+, IN-, VCC, VEE and OUT
    - .SUBCKT OPA462 IN+ IN- VCC VEE OUT
  - [1] Drag "Opamp-VddVss-subckt2" into schematic
  - [2] Right click on device, select **Show Symbol Properties**
  - [3] In Pin Nets, confirm pin sequence match with .subckt model
    - Exact pin name is not important, only pin order (sequence) is important! Spice correlate a .subckt and its symbol through pin order
    - In general, 3rd party model opamp follow this same order, however, if there are additional pins or different pin order, user has to build corresponding symbol by themselve
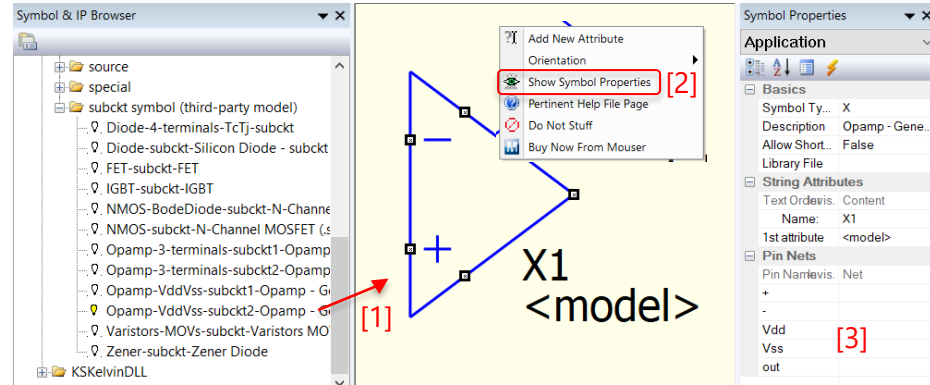
Use KSKelvin Subckt Symbol from Autogenerated Model
# Step 3 : Transfer one line embedded subckt

- Transfer one line embedded subckt
  - Go back to .subckt library file which opened with text editor
  - Select all text (or parent subckt and its all dependence) and copy it with Ctrl-C
  - Go back to Qspice schematic, Ctrl-V to paste subcircuit text
  - Autogenerate Symbol window will pop up, ensure **Include Entire File** [1] is selected if subcircuit has dependence. Select **YES** to autogenerate the symbol
  - Right click on autogenerated symbol, select **Show Symbol Properties**. In Library File, a one line embedded subckt syntax is generated
  - Click on this line, Ctrl-A > Ctrl-C, to select all and copy the text
  - Click on Subckt Symbol (X1 in this example), past it with Ctrl-V into Library File [3]
  - Finally, change <model> name in X1 to match .subckt name, which is OPA462 [4]
  - Device X1 is now available to be used for simulation purpose
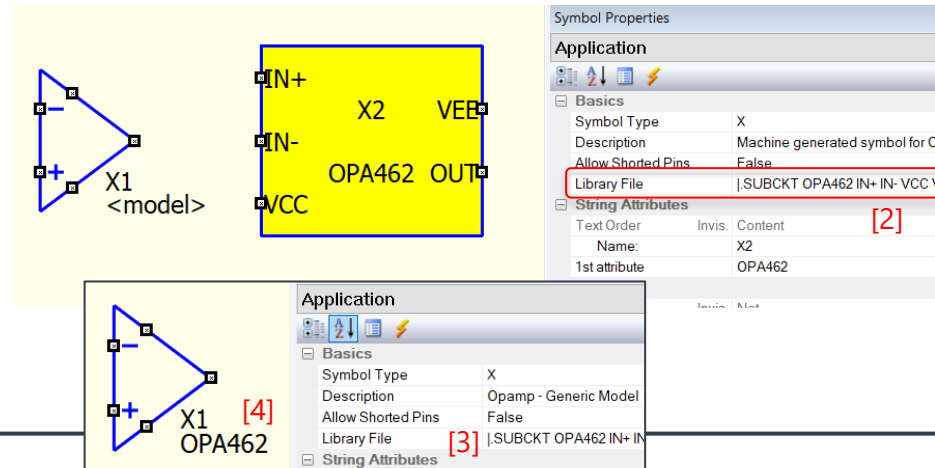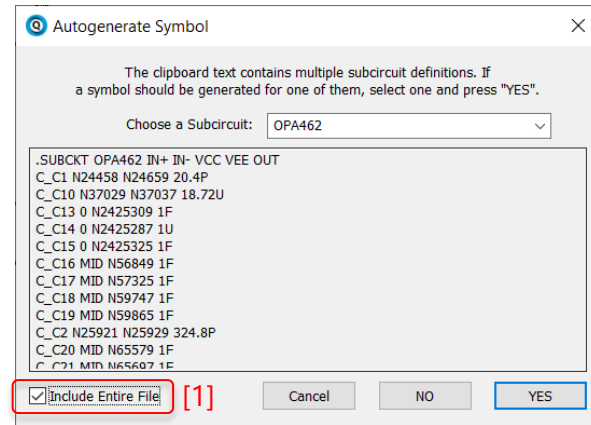
Appendix

Appendix A : Save as Symbol (.qsym)

- Save as Symbol (.qsym)
  - The embedded subcircuit symbol created in this document can be saved as a Qspice symbol (.qsym) for other projects
  - In schematic window, hover mouse cursor over X-device, Ctrl-C to copy it
  - File > New > New Symbol to open a blank symbol window
  - In Symbol window, Ctrl-V to paste it
  - File > Save to save it as a .qsym
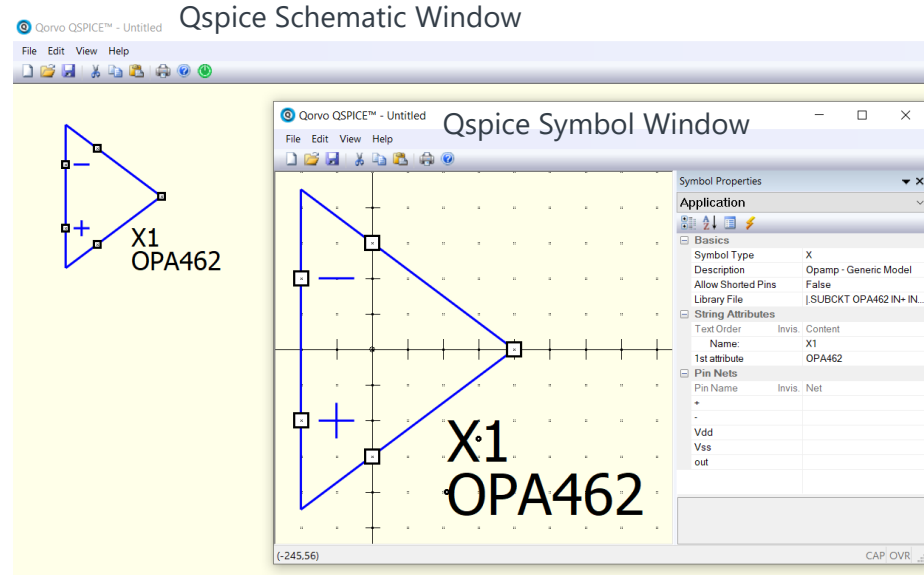
Appendix B : Subckt symbol with model file

- Subckt symbol with model file
  - You may want to use subcircuit symbol to directly read from model file, which is particularly useful if modification or troubleshoot of library file is required
  - Follow step 1 and 2 in above procedure
  - Method 1
    - Change <model> name to match .subckt name
    - Use text to add .lib <model file name>
  - Method 2
    - Change <model> name to match .subckt name
    - In Symbol Properties, put <model file name> into Library File
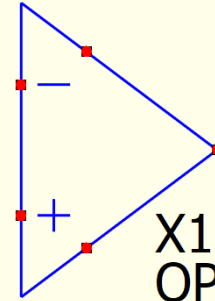
Method 1

X1
OPA462

.lib OPA642.txt
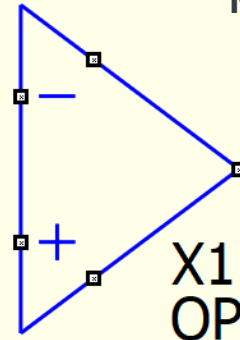
Method 2

X1
OPA462

Symbol Properties		
Application		
Basics		
Symbol Type	X	
Description	Opamp - Generic Model	
Allow Shorted Pins	False	
Library File	**OPA642.txt**	
String Attributes		
Text Order	Invis.	Content
Name:		X1
1st attribute		OPA462
Pin Nets		
Pin Name	Invis.	Net
+		