AndoLab Seminar 2022/05/13

Introduction of KiCad and the usage

M2 Masaya Ono

Abstract

- Studied how to use CAD to design boards for my experiment
- Summarized what I learn
- Share and introduce the usage of CAD tool "KiCad"



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Schematic of the experiment for DECIGO

- I need RFQPD for my experiment and designing the circuit board
- The latest version of KiCad 6.0.2 (2022/05) but information about KiCad on the internet are mainly for Version 5
- Version 6 Interface is a little different from that of Version 5

Motivation

Contents

- Introduction and Installation of KiCAD
 - Good points
 - Installation
 - Flowchart
- Drawing circuit diagrams
 - Arranging symbols
 - Preparing symbols
 - Wiring and Annotation
- Simulation
 - Parameters
 - Import spice models
- Designing circuit boards
- Place an order

What is KiCad ?

Features

- Completely free
- We can **simulate** the behaver of circuits like spice in KiCad







Installation of KiCAD and Launch a project

- You can download KiCad from https://www.kicad.org/
- This page (Japanese) is useful to install Kicad
 - Downloading
 - Installing
 - Changing language settings to Japanese
- First, we make a new project Project name example: LowPassFilter
- 2 files are created automatically
 - ***.kicad_sch file is for a circuit diagram
 - ***.kicad_pcb file if for a circuit board





Flowchart of Designing and manufacturing circuits



Drawing circuit diagrams

Arranging symbols



- Symbols: figures displaying components
- Click >, and open window to choose symbols
- Can put symbols by clicking as you like

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Typical symbols

- Many symbols are pre-installed
- If you exclude sources only for simulation, check the box of "exclude from board"

名前	定数	表示	水平揃え	垂直揃え	斜体字	太字	テキスト サイズ
リファレンス	V2		右	中央			1.27 mm
定数	-15	\sim	右	中央			1.27 mm
フットプリント			中央	中央			1.27 mm
データシート	~		中央	中央			1.27 mm
Spice_Netlist_Enabled	Υ		左	中央			1.27 mm
Spice_Primitive	V		左	中央			1.27 mm
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Component	Name of symbol	Visual
Resistor	R	
Capacitor	С	
Inductor	L	G-MAN_€
Op amp	OPAMP	
Ground	GND	\leftarrow
Current source(AC)	ISIN	
Current source(DC)	IDC	
Voltage source(AC)	VSIN	
Voltage source(DC)	VDC	

Prepare for symbols

Downloading symbols

• You can download and import libraries on the internet

Ex. Library for connectors (BNC, SMA, D-sub, LEMO)

- download the library (named "kilab_merl_03.lib") from <u>this website</u>
- 2. In order to import the library, click "Preferences > Manage Symbol Libraries >] "
- 3. Please select "kilab_merl_03.lib" and add it to the list

Drawing symbols

ctive	Nickname	Library Path	Library Format	Options		
/	Simulation_SPICE	\${KICAD6_SYMBOL_DIR}/Simulation_SPICE.kicad_sym	KiCad		Symbols specialized for SPICE cir	
/	Switch	{KICAD6_SYMBOL_DIR}/Switch.kicad_sym	KiCad		Switch symbols	
/	Timer	\${KICAD6_SYMBOL_DIR}/Timer.kicad_sym	KiCad		Assorted timer devices	
/	Timer_PLL	\${KICAD6_SYMBOL_DIR}/Timer_PLL.kicad_sym	KiCad		Phase locked loop (PLL) devices	
	Timer_RTC	\${KICAD6_SYMBOL_DIR}/Timer_RTC.kicad_sym	KiCad		Real time clock (RTC) devices	
	Transformer	\${KICAD6_SYMBOL_DIR}/Transformer.kicad_sym	KiCad		Transformer symbols	
1	Transistor_Array	{KICAD6_SYMBOL_DIR}/Transistor_Array.kicad_sym	/MBOL_DIR}/Transistor_Array.kicad_sym KiCad		Specialized transistor arrays	
	Transistor_BJT	\${KICAD6_SYMBOL_DIR}/Transistor_BJT.kicad_sym	KiCad		BJT transistor symbols	
2	Transistor_FET	\${KICAD6_SYMBOL_DIR}/Transistor_FET.kicad_sym	KiCad		FET transistor symbols	
	Transistor_IGBT	\${KICAD6_SYMBOL_DIR}/Transistor_IGBT.kicad_sym	YMBOL_DIR}/Transistor_IGBT.kicad_sym KiCad		IGBT transistor symbols	
	Transistor_Power_Module	\${KICAD6_SYMBOL_DIR}/Transistor_Power_Module.kicad_sym	KiCad		Transistor power modules	
	Triac_Thyristor	\${KICAD6_SYMBOL_DIR}/Triac_Thyristor.kicad_sym	KiCad		TRIAC and thyristor symbols	
	Valve	\${KICAD6_SYMBOL_DIR}/Valve.kicad_sym	KiCad		Valve symbols	
	Video	\${KICAD6_SYMBOL_DIR}/Video.kicad_sym	KiCad		Video symbols	
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Wiring and Annotation

Wiring

1. Click

2. Connect the components

Annotation : numbering components

- Click "Tools > Annotate Schematic > Annotate"
- "R?", "C?" will be numbered like "R1", "C2"

Scope	Order
Entire schematic	 Sort symbols by X position
Current sheet only	○ Sort symbols by Y position
Selection only	
Options	Numbering
Keep existing annotations	Use first free number after: 0
Reset existing annotations	 First free after sheet number X 100
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-	◯ First free after sheet number X 1000
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Annotation Messages:	○ First free after sheet number X 1000
Annotation Messages:	○ First free after sheet number X 1000







Wiring

Annotation

Associating footprints with symbols

- If you are going to design printed board, it is necessary to associate footprints with symbols in the diagram
- **Footprints** : figures printed in the board



 $\label{eq:package_SO} Package_SO > SOIC-8_3.9x4.9mm_P1.27mm~(8-pin~op~amp~)$

- 1. Double-click a symbol and open the property window
- 2. Click "footprint" box and choose a footprint

3. You can confirm and edit the list of footprints by visiting "Tools > Assign Footprints"

list of footprints

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Connector_FFC-FFC 20 C20 2.0 C20 2.0 C20 C20 2.0 Capacitor_Marcin_SMDC.[080] Connector_Harting 21 C21 56p: Capacitor_SMDC.[020] Connector_Havin 22 C22 56p: Capacitor_SMDC.[020] Connector_Havin 23 C23 33p: Capacitor_SMDC.[020] Connector_Hiros Capacitor_SMDC.[020] Connector_Hiros Capacitor_SMDC.[020] Connector_Hiros Capacitor_SMDC.[020] Connector_SMDC.[020]	Connector_Dsub		19 0	:19 -	2.2n :	Capacitor_SMD:C	0603						
Connector_Harting 21 C21 56p Capacitor_SMDCC_0201 Connector_Harwin 22 C22 56p Capacitor_SMDCC_0201 Connector_HAR 23 C23 33p Capacitor_SMDCC_0201 Connector_HITose 24 C24 33p Capacitor_SMDCC_0201 Connector_JITo 25 C25 0.1u Capacitor_SMDCC_0201 Connector_JAE 28 C28 0.1u Capacitor_SMDCC_0201 Connector_JME 28 C28 0.1u Capacitor_SMDC_0201 Connector_JME 30 C30 0.1u Capacitor_SMDC_0201 Connector_Phoenix_MBT 30 C33 0.1u Capacitor_SMDC_1206 Connector_Phoenix_MBT 33 C33 0.1u Capacitor_SMDC_1206 Connector_Phoenix_MBT 33	Connector_FFC-FPC		20 0	20 -	2.2n :	Capacitor_SMD:C	0603						
Connector_Hinvuin 22 C22 56p<: Capacitor_SM0CC_0201 Connector_HHrose 23 C23 33p: Capacitor_SM0CC_0201 Connector_HHrose 24 C24 33p: Capacitor_SM0CC_0201 Connector_IAE 25 C25 0.1u: Capacitor_SM0CC_0201 Connector_JAE 28 C24 1: Capacitor_SM0CC_0201 Connector_JAE 28 C25 0.1u: Capacitor_SM0CC_0201 Connector_JOIC 25 C25 0.1u: Capacitor_SM0CC_0201 Connector_JOE 27 C27 0.1u: Capacitor_SM0CC_0201 Connector_POEdge 28 C28 1:n: Capacitor_SM0CC_0201 Connector_POEdge 28 C28 0.1u: Capacitor_SM0C_0201 Connector_Ponenix_MCHTB 30 C30 0.1u: Capacitor_SM0C_0201 Connector_Ponenix_MCHTB 33 C33 0.1u: Capacitor_SM0C_0201 Connector_Pinheader_1.00m 35 C35 0.1u: Capacitor_SM0C_0206 Connector_Pinheader_2.127m 36 C38 0.1u: Capacitor_SM0C_01206 Connector_Pinheader_2.54m 36 C38 <	Connector_Harting		21 0	21 -	56p :	Capacitor_SMD:C_	0201						
Connector_HDMI 23 C23 33p Capacitor_SMDC(_D201) Connector_Hirose 24 C24 33p Capacitor_SMDC(_D201) Connector_JDC 25 C25 0.1u: Capacitor_SMDC(_D201) Connector_JAE 26 C26 1n: Capacitor_SMDC(_D201) Connector_JAE 26 C26 1n: Capacitor_SMDC(_D201) Connector_JAE 28 C28 0.1u: Capacitor_SMDC(_D201) Connector_Molex 28 C28 0.1u: Capacitor_SMDC(_D201) Connector_Phoenix_MNTB 30 C30 0.1u: Capacitor_SMDC(_D201) Connector_Phoenix_MNTB 30 C31 0.1u: Capacitor_SMDC(_D201) Connector_Phoenix_MNTB 33 C33 0.1u: Capacitor_SMDC(_D20) Connector_Phoenix_MNTB 33 C33 0.1u: Capacitor_SMDC(_D20) Connector_PinHeader_1.27mm 36 C36 0.1u: Capacitor_SMDC(_D20) Connector_PinHeader_1.27mm 36 C38 0.1u: Capacitor_SMDC(_D20)	Connector_Harwin		22 0	22 -	56p :	Capacitor_SMD:C_	0201						
Connector_Hirose 24 C24 Capacitor_SADC: D201 Connector_JIC 25 C25 0.1 u: Capacitor_SADC: D201 Connector_JAE 28 C26 1n: Capacitor_SADC: D201 Connector_JAT 27 C27 0.1 u: Capacitor_SADC: D201 Connector_Molex 28 C28 1n: Capacitor_SADC: D201 Connector_Molex 28 C28 0.1 u: Capacitor_SADC: D201 Connector_Phoenix_MC 28 C28 0.1 u: Capacitor_SADC: D201 Connector_Phoenix_MC 30 C30 0.1 u: Capacitor_SADC: D201 Connector_Phoenix_MC 31 C31 0.1 u: Capacitor_SADC: D206 Connector_Phoenix_MC 33 C32 0.1 u: Capacitor_SADC: D206 Connector_Phoenix_MC 33 C33 0.1 u: Capacitor_SADC: D206 Connector_PinHeader_1.27mm 36 C35 0.1 u: Capacitor_SADC: D206 Connector_PinHeader_2.00m 37 C37 20 p: M_device_for_FF0FD: Connector_PinHeader_2.127m 36 C38 0.1 u: Capacitor_SADC: D206 Connector_PinHeader_1.27m 40	Connector_HDMI		23 0	23 -	33p :	Capacitor_SMD:C_	0201						
Connector_JAE 25 C25 0.1u: Capacitor_SMDC: [206] Connector_JAE 28 C26 1n: Capacitor_SMDC: [206] Connector_JAE 28 C27 0.1u: Capacitor_SMDC: [206] Connector_Molex 28 C28 0.1u: Capacitor_SMDC: [206] Connector_Pobenix_CMBTB 30 C30 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_CMSTB 30 C30 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_CMSTB 30 C30 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_MCH 31 C31 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_MSTB 33 C33 0.1u: Capacitor_SMDC: [206] Connector_PinHeader_1.00m 35 C35 0.1u: Capacitor_SMDC: [206] Connector_PinHeader_2.20m 37 C37 20p: My.device.for_FMPDC; Connector_PinHeader_2.20m Connector_PinHeader_2.100m 36 C38 0.1u: Capacitor_SMDC: [206] Connector_PinHeader_2.20m 40 40 40	Connector_Hirose		24 0	24 -	33p :	Capacitor_SMD:C_	_0201						
Connector_JAE 26 C28 C28 In: Capacitor_SMDC.(2001) Connector_JST 27 C27 0.1u: Capacitor_SMDC.(2001) Connector_POEdge 28 C28 0.1u: Capacitor_SMDC.(2001) Connector_POEdge 28 C28 0.1u: Capacitor_SMDC.(2001) Connector_Poenix_MCTB 30 C30 0.1u: Capacitor_SMDC.(2001) Connector_Phoenix_MCTB 31 C31 0.1u: Capacitor_SMDC.(2006) Connector_Phoenix_MCTB 33 C33 0.1u: Capacitor_SMDC.(2006) Connector_Phoenix_MCTB 33 C33 0.1u: Capacitor_SMDC.(2006) Connector_Phoenix_MCTB 33 C33 0.1u: Capacitor_SMDC.(2006) Connector_PinHeader_1.27nm 36 C36 0.1u: Capacitor_SMDC.(2006) Connector_PinHeader_2.00mm 37 C37 20p: My_device_for_FRPDC Connector_PinHeader_2.00mm 37 C37 20p: My_device_for_FRPDC Connector_PinSocket_1.00mm 38 C38 0.1u: Capacitor_SMDC.(2006) Connector_PinSocket_1.00mm 41 C41 20p: My_device_for_FRPDC	Connector_IDC		25 0	25 -	0.1u :	Capacitor_SMD:C_	_1206						
Connector_JST 27 C27 0.1 u: Gaeacitor_SMDC:[1206] Connector_Molex 28 C28 0.1 u: Gaeacitor_SMDC:[1206] Connector_POEEde 29 C28 0.1 u: Gaeacitor_SMDC:[1206] Connector_Poenix_DMSTB 30 C30 0.1 u: Gaeacitor_SMDC:[1206] Connector_Phoenix_MC 31 C31 0.1 u: Gaeacitor_SMDC:[1206] Connector_Phoenix_MC 31 C31 0.1 u: Gaeacitor_SMDC:[1206] Connector_Phoenix_MSTB 32 C32 0.1 u: Gaeacitor_SMDC:[1206] Connector_Phoenix_MSTB 33 C33 0.1 u: Gaeacitor_SMDC:[1206] Connector_PinHeader_1.27mm 36 C36 0.1 u: Gaeacitor_SMDC:[1206] Connector_PinHeader_2.00mm 37 C37 20 p: My_device_for_FF0FD; Connector_PinHeader_2.10mm 38 C38 0.1 u: Gaeacitor_SMDC:[1206] Connector_PinHeader_1.27mm 40 C40 20 p: My_device_for_FF0FD; Connector_PinSocket_1.00mm 39 C33 0.1 u: Gaeacitor_SMDC:[1206] Connector_PinSocket_2.100m 41 C41 20 p: My_device_for_FF0FD;	Connector_JAE		26 0	26 -	1n :	Capacitor_SMD:C_	_0201_ '						
Connector_Molex 28 C28 0.1u: Capacitor_SMDC:[208] Connector_PloBedge 29 C29 1n: Capacitor_SMDC:[200] Connector_Phoenix_CMISTB 30 C30 0.1u: Capacitor_SMDC:[208] Connector_Phoenix_CMISTB 30 C30 0.1u: Capacitor_SMDC:[208] Connector_Phoenix_MC 31 C31 0.1u: Capacitor_SMDC:[208] Connector_Phoenix_MC 31 C31 0.1u: Capacitor_SMDC:[208] Connector_Phoenix_MSTB 33 C33 0.1u: Capacitor_SMDC:[208] Connector_Pinheader_1.00mm 35 C35 0.1u: Capacitor_SMDC:[208] Connector_Pinheader_1.27mm 36 C38 0.1u: Capacitor_SMDC:[208] Connector_Pinheader_2.54mm 38 C38 0.1u: Capacitor_SMDC:[208] Connector_Pinheader_2.54mm 38 C38 30u: SamacSys_Parts:CAPPRI Connector_Pinheader_2.54mm 38 C38 0.1u: Capacitor_SMDC:[108] Connector_Pinhocket_1.27mm 40 C40 20p: My_device_for_FRPDC: Connector_PinSocket_2.26mm 41 C41 20p: My_device_for_FRPDC:	Connector_JST		27 0	27 -	0.1u :	Capacitor_SMD:C	1206						
Connector_POBEdge 29 C29 C29 1 1: Sepacitor_SMDC: [200] Connector_Phoenix_MCTB 30 C30 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_MC 31 C31 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_MC 33 C32 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_MCT 33 C33 0.1u: Capacitor_SMDC: [206] Connector_Phoenix_MCT 34 C34 0.1u: Capacitor_SMDC: [206] Connector_PinHeader_1.27nm 36 C36 0.1u: Capacitor_SMDC: [206] Connector_PinHeader_2.00m 37 C37 20p: 1Mdevice_IOF_FR0FD; Connector_PinHeader_2.00m 37 C37 20p: 1Mdevice_IOF_FR0FD; Connector_PinSocket_1.00m 38 C38 0.1u: Capacitor_SMDC: [206] Connector_PinSocket_1.00m 39 C38 0.1u: Capacitor_SMDC: [206] Connector_PinSocket_2.100m 41 C41 20p: 1Mdevice_Ior_FR0FD; Connector_PinSocket_2.54m 42 C42 20p: 1Mdevice_Ior_FR0FD; Connector_PinSocket_1.27m 43 U1 D89_Female	Connector_Molex		28 0	28 -	0.1u :	Capacitor_SMD:C	1206						
Connector_Phoenix_MC 30 C30 - 0.1u : Gapacitor_SMUC_1208 Connector_Phoenix_MC_HighYoltage 31 C31 - 0.1u : Gapacitor_SMUC_1208 Connector_Phoenix_MC_HighYoltage 32 C32 - 0.1u : Gapacitor_SMUC_1208 Connector_Phoenix_MC_HighYoltage 32 C32 - 0.1u : Gapacitor_SMUC_1208 Connector_Phoenix_MC_HighYoltage 32 C33 - 0.1u : Gapacitor_SMUC_1208 Connector_Pin 34 C34 - 0.1u : Gapacitor_SMUC_1208 Connector_PinHeader_1.00mm 36 C36 - 0.1u : Gapacitor_SMUC_1208 Connector_PinHeader_2.50mm 36 C38 - 0.1u : Gapacitor_SMUC_1208 Connector_PinHeader_2.50mm 38 C38 - 30 u : Gapacitor_SMUC_1208 Connector_PinSocket_1.00mm 39 C39 - 0.1u : Gapacitor_SMUC_1208 Connector_PinSocket_2.50mm 40 C40 - 20p : My_device_for_FROPD: Connector_PinSocket_2.00mm 41 C41 - 20p : My_device_for_FROPD: Connector_PinSocket_2.00mm 42 C42 - 20p : My_device_for_FROPD: Connector_PinSocket_2.55mm 42 C42	Connector_PCBEdge		29 0	29 -	1n :	Capacitor_SMD:C_	_0201_						
Connector_Phoenix_UC_HistVoltage 31 C31 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Phoenix_UC_HistVoltage 32 C32 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Phoenix_UC_HistVoltage 33 C33 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Pinheader_1.00mm 35 C35 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Pinheader_1.27mm 36 C38 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Pinheader_2.00mm 37 C37 - 20p : My_device_for_FPOPD: Connector_Pinheader_2.100mm 38 C38 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Pinheader_2.54mm 38 C38 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Pinheader_2.100mm 37 C37 - 20p : My_device_for_FPOPD: Connector_Pinheader_2.100mm 38 C38 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Pinheader_2.100mm 38 C38 - 0.1.0 : Gapacitor_SMUC_1208 Connector_Pinhocket_1.2.7mm 40 C40 - 20p : My_device_for_FPOPD: Connector_Pinhocket_2.2.54mm 42 C42 - 20p : My_device_for_FPOPD: Connector_PinSocket_2.2.54mm 43 1 - 108 SamacSys_Parts:10486 Connector_PinSocket_2.54mm 45 2 - 2.2.0 : SamacSys_Parts:10486 <t< td=""><td>Connector_Phoenix_GMSIB</td><td></td><td>30 0</td><td>30 -</td><td>U.lu:</td><td>Capacitor_SMD:C</td><td>1206</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Connector_Phoenix_GMSIB		30 0	30 -	U.lu:	Capacitor_SMD:C	1206						
Connector_Prioring Signal	Connector_Phoenix_MC		31 L	31 -	0.10:	Capacitor_SMD:C	1206						
Connector_Pin 34 C34 0.10: Capacitor_SMUC_[200] Connector_PinHeader_1.00mm 34 C34 0.10: Capacitor_SMUC_[200] Connector_PinHeader_1.27mm 36 C36 0.10: Capacitor_SMUC_[200] Connector_PinHeader_2.54mm 36 C37 20p Hw_device_for_FPOPD: Connector_PinHeader_2.54mm 38 C38 30u: SamacSvs_Parts:CAPPRI Connector_PinSocket_1.27mm 40 C40 20p Hw_device_for_FPOPD: Connector_PinSocket_2.00mm 37 C37 20p Hw_device_for_FPOPD: Connector_PinSocket_2.00mm 41 C41 20p : Hw_device_for_FPOPD: Connector_PinSocket_2.00mm 41 C41 20p : Hw_device_for_FPOPD: Connector_PinSocket_2.00mm 42 C42 20p : Hw_device_for_FPOPD: Connector_PinSocket_2.00mm 43 J1 DB8_Female: Connector_Davis:D180H: Connector_Santec_HLE_SMO 45 L2 2.02 : SamacSvs_Parts:L0H68: Connector_Santec_HLE_SMO 45 L2 2.02 : SamacSvs_Parts:L0H68: Connector_SAntec_HLE_SMO 45 10 : SamacSvs_Parts:L0H68: C	Connector_Phoenix_MC_HighVoltage		3Z (32 -	0.10:	Capacitor_SMD:C	1206						
Connector Pinheader_1.00mm 34 C44 0.10 Casacitor_SMDC_1208 Connector Pinheader_1.27mm 35 C35 0.10 Casacitor_SMDC_1208 Connector Pinheader_1.27mm 36 C38 0.10 Casacitor_SMDC_1208 Connector Pinheader_2.00mm 37 C37 20p My device_for_FP00. Connector Pinheader_2.100m 38 C38 30u SameCSvs Parts:CAPPRI Connector Pinheader_2.100m 38 C38 0.10 Casacitor_SMDC_1208 Connector Pinhocket 1.27mm 40 C40 20p My_device_for_FP00. Connector_PinSocket 1.27mm 40 C40 20p My_device_for_FP00. Connector_PinSocket 1.2.54m 42 C42 20p My_device_for_FP00. Connector_PinSocket 1.2.54m 42 C42 20p My_device_for_FP00. Connector_PinSocket 1.2.54m 42 C42 20p My_device_for_FP00. Connector_Sate 44 L1 U1 SameCSys_Parts:L0486 Connector_Sate Connector_Sate 44 <td< td=""><td>Connector_Phoenix_MSIB</td><td></td><td>24 0</td><td></td><td>0.10:</td><td>Capacitor_SMD:C</td><td>1206</td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	Connector_Phoenix_MSIB		24 0		0.10:	Capacitor_SMD:C	1206						
Connector_PinRacket_1227am 36 C68 0.101 Capacitor_SM0C1[208] Connector_PinRacket_2.00m 37 C37 20p: My_device_0r_SM0C1[208] Connector_PinRacket_1.00m 38 C38 38u: SamacSys_Parts:CAPPEL Connector_PinSocket_1.00m 38 C38 38u: SamacSys_Parts:CAPPEL Connector_PinSocket_1.00m 39 C38 0.1u: Capacitor_SM0C1[208] Connector_PinSocket_2.00m 40 C40 20p: My_device_for_FR0PD:, Connector_PinSocket_2.54m 42 C42 20p: My_device_for_FR0PD:, Connector_Santec_HLE_SM0 43 U1 D89_Female: Connector_Daus:D1046 Connector_Santec_HLE_SM0 45 L2 2.2u: SamacSys_Parts:L0M68 Connector_SATA_SAS 47 L4 2.2u: SamacSys_Parts:L0M68 Connector_Stocko 48 L5 1u: SamacSys_Parts:L0M68	Connector_rin Connector_RinHeader_1_00mm		25 0	134 - 135 -	0.10.	Capacitor_SMD:C	1206						
Connector_PinReader_2.00mm 37 C37 20pi My_device_for_FRDD: Connector_PinReader_2.100mm 38 C38 33u: SameSvs_Parts:CAPPRI Connector_PinSocket_1.27mm 40 C40 20pi My_device_for_FRDD: Connector_PinSocket_2.00mm 41 C41 20pi My_device_for_FRDD: Connector_PinSocket_2.00mm 42 C42 20pi My_device_for_FRDD: Connector_PinSocket_2.00mm 43 J1 DB9_Female: Connector_Dsub:0SUB- Connector_Santee_HLE_SMD 45 L2 2.0u: SameSvs_Parts:L0H68 Connector_SATA_SAS 47 L4 2.0u: SameSvs_Parts:L0H68 Connector_Santee_HLE_SMD L5 1 u: SameSvs_Parts:L0H68 Connector_TE-Connectivity Connector_TE-Connectivity Caneet connector_SUPArts:L0H68 Caneet connector_SUPArts:L0H68 Caneet connector_SUPArts:L0H68 <td>Connector_rinheader_1.27mm</td> <td></td> <td>36 0</td> <td>- 100 -</td> <td>0.10.</td> <td>Capacitor_SMD:C</td> <td>1208</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Connector_rinheader_1.27mm		36 0	- 100 -	0.10.	Capacitor_SMD:C	1208						
Connector Pinifeader_2.54mm State CB	Connector PinHeader 2.00mm		37 0	37 -	200	My device for RF	OPD:						
Connector_PinSocket_1.27mm 39 C38 - 0.1u: Cancetor_Samte_1.27m Connector_PinSocket_1.27mm 40 C40 20p: My_device_for_FROPD: Connector_PinSocket_2.00mm 41 C41 20p: My_device_for_FROPD: Connector_PinSocket_2.54mm 42 C42 20p: My_device_for_FROPD: Connector_Samtec 43 J1 DB9_Female : Connector_Dat/DB0E Connector_Samtec_HLE_SMD 45 L2 2.0u: SamacSys_Parts:L0M68 Connector_Samtec_HLE_THT 46 L3 1u: SamacSys_Parts:L0M68 Connector_SATA_SAS 47 L4 2.0u: SamacSys_Parts:L0M68 Connector_TE-Connect ivity	Connector PinHeader 2.54mm		38 0	38 -	330	SamacSvs Parts (APPRI						
Connector_PinSocket_1.27mm 40 C40 - 20p My_device_for_FRGPD: Connector_PinSocket_2.00mm 41 C41 - 20p: My_device_for_FRGPD: Connector_PinSocket_2.01mm 42 C42 - 20p: My_device_for_FRGPD: Connector_PinSocket_2.54mm 42 C42 - 20p: My_device_for_FRGPD: Connector_Satter 43 J1 - DB9_Female : Connector_Dsub:05UB-1 Connector_Satter 44 L1 - 1 u: SamacSvs_Parts:L0M685 Connector_Satter_HLE_SMD 45 L2 - 2.0 u: SamacSvs_Parts:L0M685 Connector_SATA_SAS 47 L4 - 2.0 u: SamacSvs_Parts:L0M685 Connector_TE-Connect ivity	Connector PinSocket 1.00mm		39 0	39 -	0.10 :	Capacitor SMD:C	1206						
Connector_PinSocket_2.00mm 41 C41 - 20p : My_device_for_FFGPD: Connector_PinSocket_2.55mm 42 C42 - 20p : My_device_for_FFGPD: Connector_PinSocket_2.55mm 42 C42 - 20p : My_device_for_FFGPD: Connector_PinSocket_2.55mm 43 J1 - DB9_Female : Connector_Dsub:C0BH Connector_Santee 44 L1 - DB9_Female : Connector_Dsub:C0BH Connector_Santee_HLE_SMD 45 L2 - 2.2 u: SamacSys_Parts:L0H66: Connector_Santee_HLE_THT 46 L3 - iu: SamacSys_Parts:L0H66: Connector_Stocko 48 L5 - iu: SamacSys_Parts:L0H66: Connector_Stocko 48 L5 - iu: SamacSys_Parts:L0H66:	Connector PinSocket 1.27mm		40 0	40 -	20p :	My device for RF	QPD:						
Connector_PinSocket_2.54mm 42 C42 20p: My_device_for_RFGPD: Connector_RJ 43 J1 DB8_Female: Connector_Dsub:DSUB+ Connector_Samtec 44 L1 1 u: SamacSys_Parts:L0H66; Connector_Samtec_HLE_SMD 45 L2 2.2u: SamacSys_Parts:L0H66; Connector_SAmtec_HLE_THT 46 L3 1 u: SamacSys_Parts:L0H66; Connector_SAmtec_HLE_THT 46 L3 1 u: SamacSys_Parts:L0H66; Connector_SAmtec_HLE_THT 48 L5 1 u: SamacSys_Parts:L0H66; Connector_TSCocko 48 L5 1 u: SamacSys_Parts:L0H66; Connector_TE-Connectivity	Connector_PinSocket_2.00mm		41 0	41 -	20p :	My_device_for RF	QPD:						
Connector_RJ 43 J1 - DB9_Female : Connector_Dsub:DSUB-: Connector_Samtec_HLE_SM0 44 L1 - iu: SamacSys_Parts:L0H66: Connector_Samtec_HLE_THT 46 L3 - iu: SamacSys_Parts:L0H66: Connector_SATA_SAS 47 L4 - 2.2 u: SamacSys_Parts:L0H66: Connector_SATA_SAS 47 L4 - 2.2 u: SamacSys_Parts:L0H66: Connector_TE-Connectivity	Connector_PinSocket_2.54mm		42 0	42 -	20p :	My_device_for_RF	ROPD:						
Connector_Samtec 44 L1 - 1u: SamacSvs_Parts:L0H66; Connector_Samtec_HLE_THT 45 L2 - 2.2u: SamacSvs_Parts:L0H66; Connector_SATA_SAS 47 L4 - 2.2u: SamacSvs_Parts:L0H66; Connector_Stocko 48 L5 - 1u: SamacSvs_Parts:L0H66; Connector_TE-Connectivity	Connector_RJ		43	J1 -	DB9_Female :	Connector_Dsub:[SUB-						
Connector_Samtec_HLE_SMD 45 L2 2.2u: SamacSys_Parts:L0H66; Connector_Samtec_HLE_THT 46 L3 1u: SamacSys_Parts:L0H66; Connector_SATA_SAS 47 L4 2.2u: SamacSys_Parts:L0H66; Connector_TS-Connector_Vivity 48 L5 1u: SamacSys_Parts:L0H66;	Connector_Samtec		44	L1 -	1u :	SamacSys_Parts:L	QH66:						
Connector_Samtec_HLE_THT 46 L3 - 1u: SamacSys_Parts:L0H66; Connector_SATA_SAS 47 L4 - 2.2u: SamacSys_Parts:L0H66; Connector_Stocko 48 L5 - 1u: SamacSys_Parts:L0H66; Connector_TE-Connectivity	Connector_Samtec_HLE_SMD		45	L2 -	2.2u :	SamacSys_Parts:L	QH66:						
Connector_SATA_SAS 47 L4 2.2 u: SamacSys_Parts:L0H68: Connector_Stocko 48 L5 1 u: SamacSys_Parts:L0H68: Connector_IE-Connectivity	Connector_Samtec_HLE_THT		46	L3 -	1u :	SamacSys_Parts:L	_QH66:						
Connector_Stocko 48 L5 - 1u: SamacSys_Parts:L0H665	Connector_SATA_SAS		47	L4 -	2.2u :	SamacSys_Parts:L	_QH66						
Connector_TE-Connectivity	Connector_Stocko		48	L5 -	1u :	SamacSys_Parts:L	_QH66:						
	Connector_TE-Connectivity												

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グローバル ライブラリー プロジェクト固有のライブラリー

TerminalBlock MetzConnect

TerminalBlock_TE-Connectivity

TerminalBlock_Philmore TerminalBlock Phoenix

TerminalBlock RND

TerminalBlock_WAGO

TerminalBlock_Wuerth

Transistor Power Module

My_device_for_RFQPD

Ê

SamacSys_Parts

Transformer_SMD

Transformer_THT

TestPoint

Valve

設定されているパス

\${KICAD6_3DMODEL_DIR}

Varistor

別名(ニックネーム)

\${KICA

C:/Use

C:/Use

- 3. Add "SamacSys_Parts" to footprint libraries
- Download and open ECAD Model, "***.epw" 4.





Murata 巻線インダクタ (面実 LQH66SN1R0M03L

RS品番: 725-5333 メーカー型番: LQH66SN1R0M03L



表面実装イン

データシート C:¥Program Files¥KiCad¥6.0

Chip Inductor (Chip Coil) Power Inductor (Wire Wound Type for Choke) LQH66S Series (2525 Size) Data Sheet

Schematic Symbol & PCB

<u>Simulation</u>

Setting parameters

- 1. You set value of resister, capacitor, inductor, etc for simulation
- 2. Double-click a symbol
- 3. Change "Value" box such as 100k, 0.1u
- If the symbol is spice model such as current source, op-amp, please click "spice model" and open "spice model editor"
- 5. Edit DC/AC voltage

		DC	A	₿ _B	C Đ	Q	Q	Q (0			2			\mathbf{b}	Q	0	R?? R42	8	
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								-DC/A	セナル C #21号)-x										
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								AC 振	福: 1						AC 位相:					
								一道渡风	で答解析 マンマン	10 M M L 00 M	- - -	• T/								
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				12				DC	172913	0										
	1			18				振幅		1										
	1	Ó.			M			周波	皮数:	1k										
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Very simple example of simulation

ISI ac

GND

A very simple example, **RLC circuit**, is shown in the figures

Resonant frequency : 1 MHz

- 1. Click "Inspect > Simulator" and open the simulation window
- 2. Clink "Sim Parameter"
- 3. You can set parameter for simulation (AC, DC transfer, etc..)

		· · · · · · · · · ·	· · · · · · · · · · · ·
N 1 sin(0 1 1k)	R2 10k	C2 252p	}L2 }100u
le Simulation View	D	<i>•</i>	•
n/Stop Simulation Add Sign	als Probe	Tune Sim Par	ameters
	Simulation settings		~ · · ×
	AC DCTractor Occurtin	- Daint Transient Cost	
	Number of Start freque Stop freque	ncy:	Hertz Hertz
	Adjust passive symbol value	s (e.g. M → Meg; 100 nF	→ 100n)
	Add full path for .include lib	orary directives	
	Compatibility mode: PSpice	~	
			OK Cancel
			Ciriors
			▲ Tune

Result of simulation

- 1. Click "Run/Stop Simulation" to simulate the model
- 2. If you click "Probe" and the click the upper wire, you will get the result shown in the right figure

_// プローブ

- <u>Red</u> line is "Gain"
- <u>Blue</u> line is "Phase"



Download simulation model

モデル:

タイプ:

注:

- If you use IC circuit such as op-amp, you have to prepare a simulation model (mini-circuit)
- Usually, you can download spice model file •

Ex. OP27

1. To import the file, open the property window of the symbol such as

2. "Spice Model > Model Tab > Select file"

3. Select the file you downloaded



キャンセル

OK

Export Netlist

- If you want to design a circuit board, Netlist is required
- Netlist displays the network of components
- You can export it by "File > Export > Netlist > Export Netlist"
- Filename is "***.net" and you can open it by usual text editer



```
(comment (number '%') (value "'))
(comment (number '%') (value "')))))
(components
(comp (ref 'C1')
(value "252p')
(libsource (lib 'Device'') (part "C'') (description 'Unpolarized capacitor''))
(property (name 'Sheetname'') (value "'))
(property (name 'Sheetname'') (value ''))
(sheetpath (names '') (tstamps ''))
(tstamps 'a83f5f9c-9213-4e5c-98f9-7ac7f8a5c36b''))
(comp (ref 'T1'')
(value 'ISIN'')
(fields
(field name 'Spice_NetList_Enabled'') 'Y'')
(field (name 'Spice_NetList_Enabled'') 'Y'')
(field (name 'Spice_NetList_Enabled'') 'Y'')
(field (name 'Spice_NetList_Enabled'') (value "Y''))
(property (name 'Spice_Primitive'') (I'))
(libsource (lib 'Simulation_SPICE') (part 'ISIN'') (description 'Current source, sinusoidal''))
(property (name 'Spice_Primitive'') (value 'T'))
(property (name 'Spice_Primitive'') (value 'T))
(comp (ref 'L1'')
(value '100'')
(itstamps '7934eefc-758e-4e96-bd4a-7b00de26522a''))
(comp (ref 'L1'')
(value '100'')
(libsource (lib 'Device'') (part 'L'') (description 'Inductor''))
('Totsetti' (name 'Sheetname'') (value ''))
```

Designing circuit boards



Import Netlist

 You can bring footprints from by importing Netlist





- Click "File > Import > Netlist" and select the netlist file
- 2. Click "Update PCB"
- 3. Footprints are put in order

RFQPD footprints are imported

nport Netlist	×
Vetlist file:	
ink Method) Link footprints using component tstamps (unique ids)) Link footprints using reference designators	Options Replace footprints with those specified in netlist Delete footprints with no components in netlist Delete tracks shorting multiple nets
Changes To Be Applied Warning: No net found for symbol U2 pin 1. Warning: No net found for symbol U2 pin 5. Warning: No net found for symbol U2 pin 8. Warning: No net found for symbol U4 pin 8. Warning: No net found for symbol U3 pin 1. Warning: No net found for symbol U3 pin 1. Warning: No net found for symbol J1 pin 0.	
Total warnings: 0, errors: 0.	1
how: 🗹 All 🛛 Errors 💶 🖉 Warnings 🤇	26 Actions Infos Save
	Update PCB Close
	7 V20 / 22 min 2/20

Setting properties and design rules

Setting properties

- We define properties of board such as the number of layers
- Click "File > Board Setup" and open window
- Choose the number of layers in "Board Stackup > Physical Stack up"

Design rules

- Design rules must be determined to avoid errors when manufacturing
- Recommended design rules are summarized in <u>リジッド基板製造基準書</u>



Roles of many layers

Ex) 4-layer board

- There are many layers in a circuit board
- When you wire or make solid pattern, it is important to understand the definition of the layers

Layername	Layer	Role	日本語での解説	レイヤー オブジェクト ネット
,	1			
F.Cu	1	Pattern	バットや配線(導体)の層	B.Cu
F.Mask	1	Resist	絶縁体の層	EAdhesive BAdhesive EPaste
F.Paste	1	Metalmask	はんだ付けのための治具の層	Silkscreen
F.Silkscreen	1	Silk	部品番号などの印字層	B.Silkscreen FMask B.Mask B.Mask
B.Cu	4	Pattern	パッドや配線(導体)の層	User.Drawings
B.Mask	4	Resist	絶縁体の層	User.Eco2
B.Paste	4	Metalmask	はんだ付けのための治具の層	Margin Courtyard B.Courtyard
B.Silkscreen	4	Silk	部品番号などの印字層	FFab
In1.Cu	2	Pattern	パッドや配線(導体)の層	User.1
In2.Cu	3	Pattern	パッドや配線(導体)の層	User.4
Edge.Cuts			基板の外形の層	V User.7

Arranging and Wiring

- Arrange the footprints(components) as you like
- There are many articles about reducing electrical noise on <u>ノイズ対策.com</u>
- White lines in the above figure show the two pins should be connected when wiring





RFQP

Design rules check (DRC)

- **Design Rule Check** : check whether the board violate the design rule you ser up
- It is recommended to execute DRC frequently
- Click "Inspect > Design Rules Checker > Run DRC"
- If there are errors, correct them until the number of them get to be 0
- If there is no errors, you can move on to exportation of Data



Export Gerber data and drill data

Generate Drill Files

Output folder:

Drill File Format

Mirror Y axis

Minimal header

C Excellon

Gerber X2

Gerber ODXF

⊖ SVG OPDF Messages

O PostScript

Map File Format

- In order to place an order, "Gerber data" and "drill • data" are required
- Clicking "File > Plot" and open a window •
- Reference to check/uncheck the box and export • Gerber data is here
- If you click "Plot", **Gerber data** will be exported
- After clicking "Generate Drill Files" and opening • Generate Drill Files window, please click "Generate Drill File", "Generate Map File", "Generate Report File"
- You will get drill data



Gerber data and drill data list

Ex) 4-layer board

Gerber data

Circuit board consists of many layers. Therefore, many kinds of files are needed to be manufactured

Dri		data
-----	--	------

Filename	Data name	日本語での解説
***.drl	Drill data	穴の場所の座標に関する情報
***-drl.rpt	Drill list	穴の種類と大きさに関する情報
***-drl_map.gbr	Drill map file	

Filename	Layer	Role	日本語での解説
***-F_Cu.gtl	1	Pattern	パッドや配線(導体)に関する情報
***-F_Mask.gts	1	Resist	絶縁体に関する情報
***-F_Paste.gtp	1	Metalmask	はんだ付けのための治具に関する情報
***-F_Silkscreen.gto	1	Silk	部品番号などの印字に関する情報
***-B_Cu.gbl	4	Pattern	パッドや配線(導体)に関する情報
***-B_Mask.gbs	4	Resist	絶縁体に関する情報
***-B_Paste.gbp	4	Metalmask	はんだ付けのための治具に関する情報
***-B_Silkscreen.gbo	4	Silk	部品番号などの印字に関する情報
***-In1_Cu.g2	2	Pattern	パッドや配線(導体)に関する情報
***-In2_Cu.g3	3	Pattern	パッドや配線(導体)に関する情報
***-Edge_Cuts.gm1			基板の外形に関する情報

You can see <u>初心者用データ説明書(p板)</u> for details



Place an order

In Ando Lab, P板.com is often used

Before placing an order, 3 steps are needed

- 1. Prepare for data
- 2. Check the design rule
- 3. Estimate
- 4. Place an order



What files do you need to submit?

There is a list of data when you order on here

- Gerber data
- Drill data
- Manufacturing instraction (製造指示書)
- Parts list (部品リスト) <u>excel file</u>
- Mount drawing (実装図)

/ fx 4 LED1 LED2 ĸ partslist(Rev,2.41) ピン数 κ⊨ Æ P板.con 提供 部品 (無料) (部品取付) を含む) 未実装 実装枚数を 個数 P板.cor 調達 部品 (有料) parts_list_RFQPD_free.xl 配置記号 電子部品型借 入れてくださ リファレンス ※半角英数字) ※半角英数字 1個 あたり 合計 実装個数 SMD DIP **い**。 R7 ※サフィックスまで入力必須 <u>メーカー</u> 部品種別 リスト 10 90 70 255 75 75 691 коа チップ抵抗 RK73B2ATTD1002 R1,R5,R9,R10 4 2 2 00 ,R6,R7,R12,R13,R1 KOA チップ抵抗 RK73H1JTTD49R9I 8 2 実装 SMD 80 4,R23,R24 0 0 **C8** KOA 実装 SMD 40 チップ抵抗 V73H1JTTD3300F R3,R9,R17,R18 2 0 0 C2 RN73H2ATTD1001B 4,R5,R10,R11,R19, KOA チップ抵抗 8 2 16 実装 SMD 80 0 0 20.R21.R22 5 OR CONCO KOA 実装 SMD 40 チップ抵抗 RK73H1JTTD2701 R2,R8,R15,R16 4 2 25 88888888 E R9 RM0335C1H330G 村田製作所 チップコンデンサー C5,C13,C23,C24 2 実装 SMD 40 1D IC1 00 M0335C1H5 C4,C12,C21,C22 実装 SMD 40 村田製作所 チップコンデンサ-4 2 1D ³² 0 0 RM033R71H102KA: 4 2 村田製作所 チップコンデンサー C7,C15,C26,C29 8 SMD 40 2D 00 RM1885C1H222JA 実装 SMD 村田製作所 チップコンデンサー C3,C11,C19,C20 4 2 40 1D 0 0 X1 6,C8,C9,C10,C14,C RM31M3U1H104 実装 村田製作所 チップコンデンサー 19 2 SMD 190 5,C17,C18,C25,C27, 1D 19 8 8,C30,C31,C32,C C4 C5 実装 40 Voltronics 可変コンデンサー JZ200 C37,C40,C41,C42 4 2 SMD Analog 4 8 32 実装 オペアンプ OP27GRZ U2,U4,U6,U8 SMD 40 Devices 12 Analog R6 実装 オペアンプ AD811JRZ U1,U3,U5,U7 4 8 32 SMD 40 Devices 13 RS PRO SMATッシマウントコネク RS品借: 526-5785 P1,P2,P3,P4 20 実装 SMD 40 (0,0) - $\rightarrow X$ 14 浜松ホトニク G684 G6849

Parts list example

Mount drawing example (from here)



R11 R12

R2 R3

C1

C7

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0 **N** 0 **N** 0 **V**

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P-ban WEB Checker and Estimate

- You can confirm whether your board violate the manufacture standard or not
- If there is no problem, you can smoothly move on the next step, Estimate •



Result

P-ban WEB Checker

Summary

- Introduced KiCad and the usage
 - Drawing diagrams
 - Simulation
 - Designing boards
- Should be installed
 - KiCad
 - Library Loader
- On the internet, there are many works
 - Libraries of symbols
 - Libraries of footprints
 - Simulation models

<u>Ando Lab Wiki</u> (機器リスト)

回路 †

- Resonant RFPD circuit board
- Filter circuit for Lorentz invariance test
- 3rd-order LPF for Lorentz invariance test
- Whitening Filter for Mag 649
- Whitening Filter for Mag 13
- 0.1-3Hzの位相補償回路(光学浮上)
- 1-30Hzの位相補償回路(光学浮上)
- ローパスフィルタ回路(光学浮上)
- Differential Amplifier
- Photo sensor board (SG-2BC)
- Coil driver board (4CH)
- Offset adjustment and 4x4 matrix operation circuit board
- General filter circuit board
- DCQPD trans impedance circuit
- QPD Yaw/Pitch/Sum board
- Switchable filter curcuit (ST560)
- Offset-Sum circuit
- Offset-Sum-Monitor



Thank you for listening