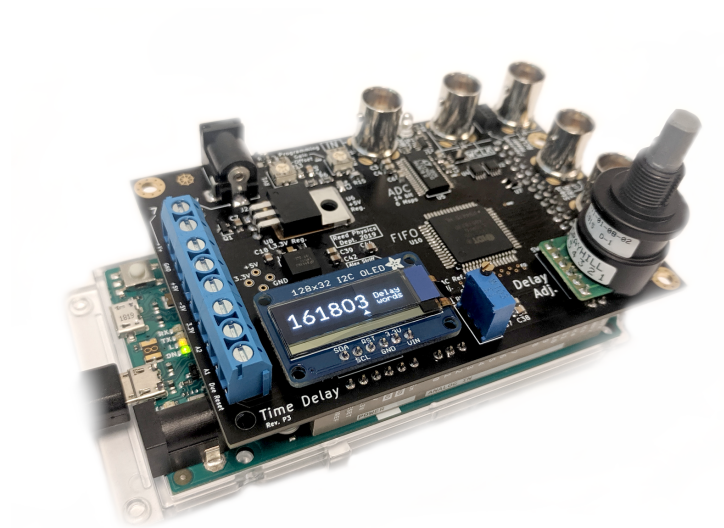


FIFO Delay Assembly Information

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1 Ordering PCBs

Given a complete [KiCAD](#) PCB layout, how do you order the PCBs?

1.1 Exporting the PCB files from KiCAD

Circuit board manufacturers expect to receive a ZIP archive that contains both the *Gerber* files and *drill* files for a circuit board. The latest version of the files should exist at [/fifo-p3f/Gerber](#) on the [GitHub repository](#), but the files may be manually exported from KiCAD as follows. With the PCB layout editor open, select *File* → *Plot...* to open the window of Fig. 1. Choose an appropriate output directory and check that all of the correct layers needed for manufacture are selected, and then select *Generate Drill Files...* to open the window of Fig. 2. Now set the output directory to be the same as that for the Gerber files and select the *Generate Drill File* button. You may also want to generate a map file as a PDF to visually check that the holes are in reasonable places. Close the drill file window and select *Plot* in the Gerber file window to generate the Gerber files. You now should have a directory with several Gerber files for all of the layers and two drill files (corresponding to plated (PTH) and non-plated (NPTH) through-holes in the board). Create a ZIP archive from the directory of Gerber and drill files. You are now ready to send the files to a manufacturer.

1.2 Sending the files to a manufacturer

There are many prototyping PCB fabrication houses available,¹ but the one I have used previously is one of the largest, cheapest, and most popular: [JLCPCB](#). It is straightforward to fill out the forms on these order websites, but be sure to check that their manufacturing tolerances are below what you request.² The turnaround time for these services varies, but is usually quite fast: about one week or less with DHL shipping.

2 Ordering Parts

A complete [bill of materials](#) (BOM) is given on the [GitHub repository](#). To order the parts, one may simply upload the BOM file to [Digi-Key](#) (Fig. 3). The relevant entries are reproduced in Table 1. This is useful as a checklist as you solder parts on to the board.

¹To compare prices for given PCB feature sets, see [pcbshopper.com](#).

²Our board is easily manufacturable by most fabrication houses.

Plot format: Gerber Output directory: Gerber/

Included Layers

- ☒ F.Cu
- ☒ In1.Cu
- ☒ In2.Cu
- ☒ B.Cu
- ☐ F.Adhes
- ☐ B.Adhes
- ☐ F.Paste
- ☐ B.Paste
- ☒ F.SilkS
- ☒ B.SilkS
- ☒ F.Mask
- ☒ B.Mask
- ☐ Dwgs.User
- ☒ Cmts.User
- ☐ Eco1.User
- ☐ Eco2.User
- ☒ Edge.Cuts
- ☐ Marnin

General Options

- ☐ Plot border and title block
- ☒ Plot footprint values
- ☒ Plot footprint references
- ☐ Force plotting of invisible values / refs
- ☒ Exclude PCB edge layer from other layers
- ☒ Exclude pads from silkscreen
- ☐ Do not tent vias
- ☐ Use auxiliary axis as origin
- Drill marks: None
- Scaling: 1:1
- Plot mode: Filled
- Default line width: 0.1 mm
- ☐ Mirrored plot
- ☐ Negative plot
- ☒ Check zone fills before plotting

Gerber Options

- ☐ Use Protel filename extensions
- ☐ Generate Gerber job file
- ☐ Subtract soldermask from silkscreen
- Coordinate format: 4.6, unit mm
- ☐ Use extended X2 format
- ☐ Include netlist attributes

Output Messages

Show: ☐ All ☒ Errors ☒ Warnings ☒ Actions ☒ Infos

Run DRC... Generate Drill Files... Close Plot

Figure 1: Exporting Gerber files.

Output folder:

Drill File Format

☒ Excellon

☐ Mirror Y axis

☐ Minimal header

☐ PTH and NPTH in single file

Oval Holes Drill Mode

☒ Use route command (recommended)

☐ Use alternate drill mode

☐ Gerber X2 (experimental)

Drill Origin

☒ Absolute

☐ Auxiliary axis

Drill Units

☒ Millimeters

☐ Inches

Zeros Format

☒ Decimal format

☐ Suppress leading zeros

☐ Suppress trailing zeros

☐ Keep zeros

Precision: 3:3

Hole Counts

Plated pads:	144
Non-plated pads:	3
Through vias:	130
Micro vias:	0
Buried vias:	0

Map File Format

☐ HPGL

☐ PostScript

☐ Gerber

☐ DXF

☐ SVG

☒ PDF


Messages


Figure 2: Exporting drill and map files.

BOM Manager

Bill of Materials: *A list of parts and the quantities of each needed to manufacture a single end product.*

The Digi-Key BOM Manager is designed to ease the process of BOM creation, management, and maintenance based on this simple definition. With features to save and archive revisions, multiply by number of assemblies and collaborate with others the Digi-Key BOM Manager is truly in a class all its own.

 TAKE THE **TOUR**

 QUESTIONS/**COMMENTS**/SUGGESTIONS

New BOM

Upload a File: Drag a file here (.xls, .xlsx, .csv, .txt) or [Browse](#).

[or create a BOM](#)

Figure 3: The Digi-Key BOM manager.

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Table 1: Bill of materials. Quantities are sometimes rounded up to a multiple of ten for price breaks.

Manufacturer Part Number	Digi-Key Part Number	Customer Reference	Reference Designator	Quantity	Extended Price
LM2940CT-5.0/NOPB	LM2940CT-5.0/NOPB-ND		U6	1	1.53
LM2776DBVR	296-43957-1-ND		U15	1	1.02
AD7840ARSZ	AD7840ARSZ-ND		U13	1	33.39
72V2105L10PFG	800-1511-ND		U10	1	131.65
LTC1740CG#PBF	LTC1740CG#PBF-ND		U5	1	41.67
SN74LVC2G157DCTR	296-13266-1-ND		U2	3	1.44
4440	1528-4440-ND	128x32 OLED	U11	1	12.50
TS12A12511DCNR	296-27523-1-ND		U1	1	1.45
LM4041DYM3-ADJ-TR	576-2573-1-ND		U14	1	0.29
SN74LVC1G04DBVR	296-11599-1-ND		U7	1	0.32
SN74LVC1G08DBVR	296-11601-1-ND		U12	1	0.26
LM1117IDTX-3.3/NOPB	LM1117IDTX-3.3/NOPBCT-ND		U8	1	1.44
TL082CDR	296-1284-1-ND		U16	1	0.41
A000062	1050-1049-ND		U9	1	37.40
PRPC002SAAN-RC	S1011EC-02-ND	Board to board	U9	2	0.16
54102-S08-18	609-5600-ND	Board to board	U9	1	1.45
PRPC003SAAN-RC	S1011EC-03-ND	Board to board	U9	1	0.12
PRPC006SAAN-RC	S1011EC-06-ND	Board to board	U9	1	0.19
LPPB042CFFN-RC	S9009E-04-ND	Board to board	U9	1	1.05
DMP3099L-7	DMP3099L-7DICT-ND		Q1	1	0.33
151033RS03000	732-5013-ND		D1	1	0.17
61C11-01-08-02	GH6102-ND		SW1	1	25.77
5-1634503-1	A97581-ND		J1, J4, J5, J7, J8	5	11.25
PJ-002A	CP-002A-ND		J2	1	0.60
OSTTC082162	ED2615-ND		J3	1	1.72
TS53YL102MR10	TS53YL-1.0KCT-ND		RV1, RV3	2	3.74
3296W-1-103LF	3296W-103LF-ND		RV2	1	2.41
RC0805FR-0749R9L	311-49.9CRCT-ND		R1, R3, R4, R19	4	0.40
RC0805FR-0722RL	311-22.0CRCT-ND		R2, R6, R20	3	0.30
RC0805FR-07220RL	311-220CRCT-ND		R5	1	0.10
RC0805FR-075K1L	311-5.10KCRCT-ND		R7, R9, R10, R11, R13, R16, R17, R18	10	0.40
RC0805FR-071K1L	311-1.10KCRCT-ND		R8, R14	2	0.20
RC0805FR-073K9L	311-3.90KCRCT-ND		R15	1	0.10
RC0805FR-074K3L	311-4.30KCRCT-ND		R12	1	0.10
RC0805JR-070RL	311-0.0ARCT-ND	Jumpers		10	0.35
08055C104KAT2A	478-1395-1-ND	0u1	C8, C9, C10, C15, C16, C22, C46,C23, C28, C30, C32, C37, C38	20	1.66
08053C105KAT2A	478-5030-1-ND	1u	C1, C3, C4, C6, C19, C20, C40, C41,C11, C12, C13, C14, C21, C25, C35, C39	20	3.52
CL21A106KAYNNNE	1276-2891-1-ND	10u	C5, C7, C17, C18, C26, C27, C42, C43, C44, C45,C24, C29, C31, C33	20	3.80
08055A102JAT2A	478-1328-1-ND	1n	C2,C34, C47	10	1.26

3 Assembly and Soldering

Once you have received both parts and boards, you face the task of soldering them together. If you are unfamiliar with soldering, there are plenty of resources online, and even surface-mount soldering is easier than it looks.³ Soldering small ICs with pin pitches of 650 μm is simple because *you* are not doing the fine placement: the surface tension of the solder is. For that to work, you must be able to control the quantity of solder and have appropriately prepared surfaces. This is achieved by:

- Having good leaded solder with a *small* diameter (less than the usual 31 thou).
- Frequently using a source of flux, such as a flux pen or paste.

Mistakes are easily remedied with some solder wick. There is also the possibility of getting a solder paste stencil with your PCB order and reflow-soldering the whole board at once.

It is usually a good idea to solder the power supply components first and then stop to check that the test points give the correct voltages when powered on. This prevents damage to critical parts like the Arduino or FIFO in the case of an error. Manual continuity checks for densely-packed pins are also a good idea.

³For example, [Adafruit](#) covers the basics of through-hole soldering.

