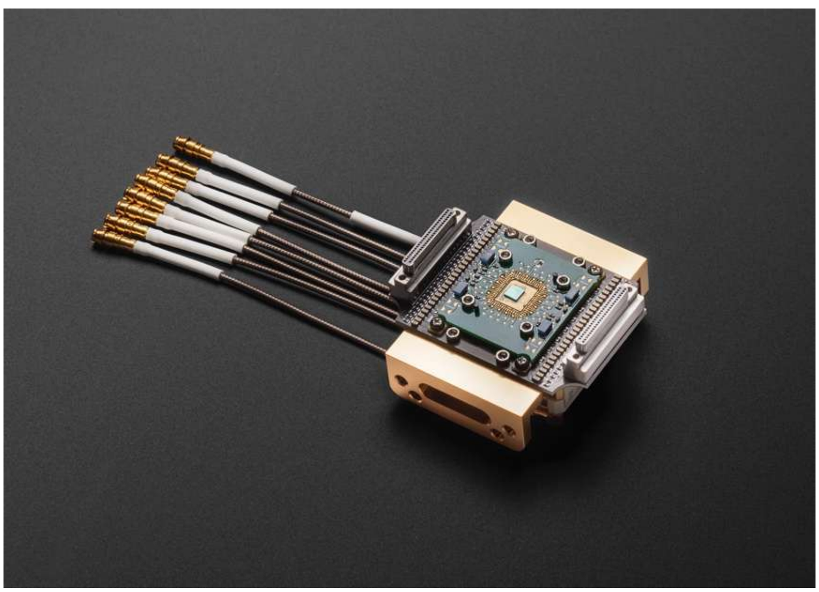
QBoard sample holder system

User's manual



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I. Introduction

The QBoard is a PCB-based sample holder system for low-temperature transport experiments on devices like spin-qubits and superconducting circuits. The system provides 48 DC (audio frequency) channels and 16 high-frequency channels (GHz) and offers excellent sample thermalization at millikelvin temperatures. The QBoard is based on a two-board design with a permanently mounted motherboard, and exchangeable daughterboards for easy sample exchange and preservation. The system was initially developed for multi-qubit devices [1], with early users at the University of Sydney and the Center for Quantum Devices at the University of Copenhagen.

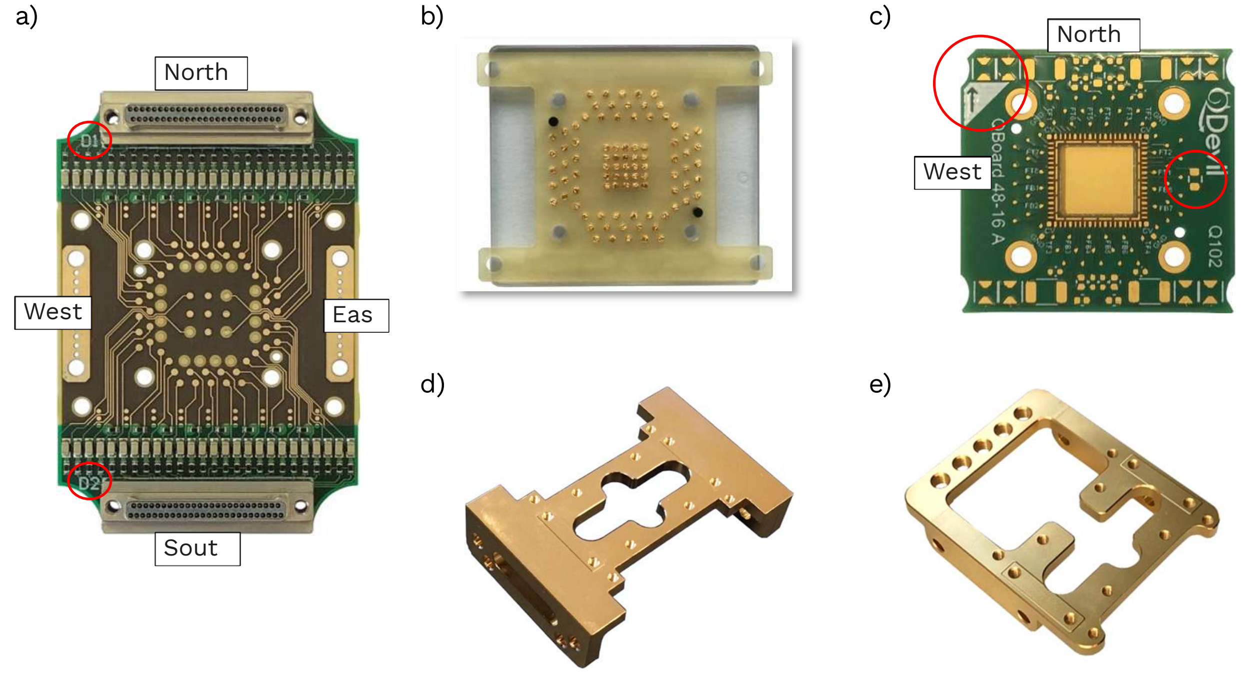


Figure 1: QDevil QBoard main system components

a: Motherboard top view oriented with its *North* end at the top indicated by the label "D1", the *South* end is indicated by "D2" at the bottom.
b: Interposer placed in its protective storage case.
c: Standard daughterboard (Q102), top view. The encircled adjacent bonding pads denote the East side of the daughterboard relative to the motherboard. New generations of daughter boards will have the white triangle in the top-left corner denoting the North-West orientation relative to the motherboard.
d: Standard mounting bracket, Type A
e: Compact bracket, Type C

The QBoard system typically consists of:

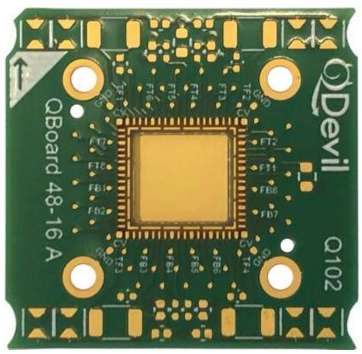
- Motherboard
- Interposer
- Daughterboards
- Mounting bracket / mounting bracket adapters (optional)
- Titanium screws for assembling the parts (4 pcs M1.6x6mm, 8 pcs M1.6x4mm)
- DC cables with 51 pin female Nano-D connectors
- Mini-Coax RF cables

II. QBoard daughterboard options

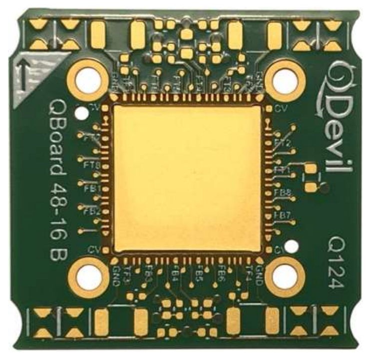
Q102: Is the standard daughterboard characterized by a 6.8x6.3 mm^2 sample cavity, and footprints for surface mounted components used in reflectometry experiments. This board is intended for 5x5 mm^2 samples.

Q124: Is a large cavity version of Q102 with a 10.6x10.6 mm^2 cavity. This board is intended for large samples up to 10x10 mm^2. Note: the Q102 board is preferred for small samples due to the shorter bonding wires needed.

Figure 2: QDevil daughterboards variations available for the QBoard system.



Q102: QBoard daughterboard with a 6.8x6.3 mm^2 sample space, prepared for reflectometry experiments.



Q124: QBoard daughterboard with a 10.5x10.5 mm^2 sample space, prepared for reflectometry experiments.

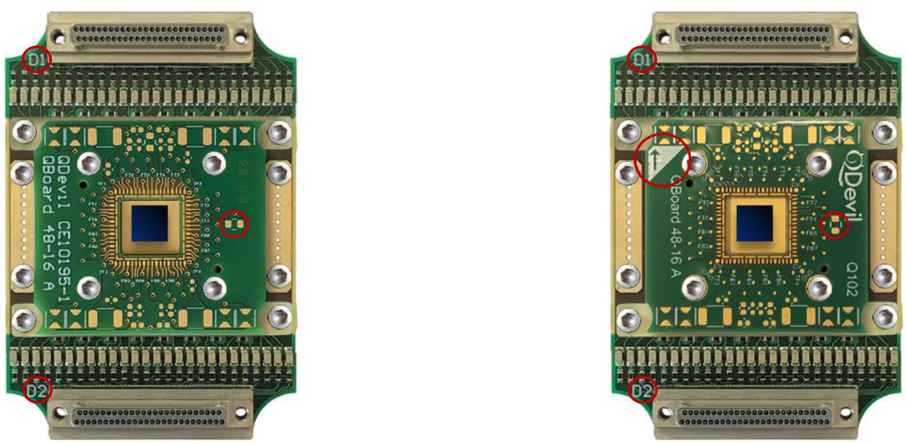


Figure 3: Examples of correctly oriented daughterboards, two different generations.

<u>Left:</u> The two encircled solder pads should be pointing towards the *East* side of the motherboard.

<u>Right:</u> This daughterboard has a triangular alignment mark in the top-left corner, which should be pointing towards the *North-West* (D1 mark) of the motherboard.

III. Assembling the QBoard system

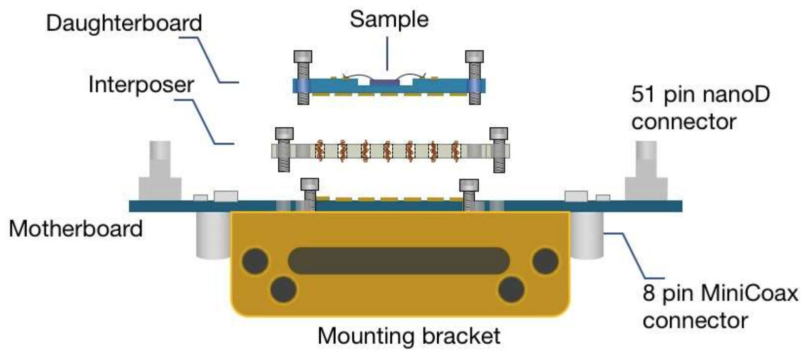
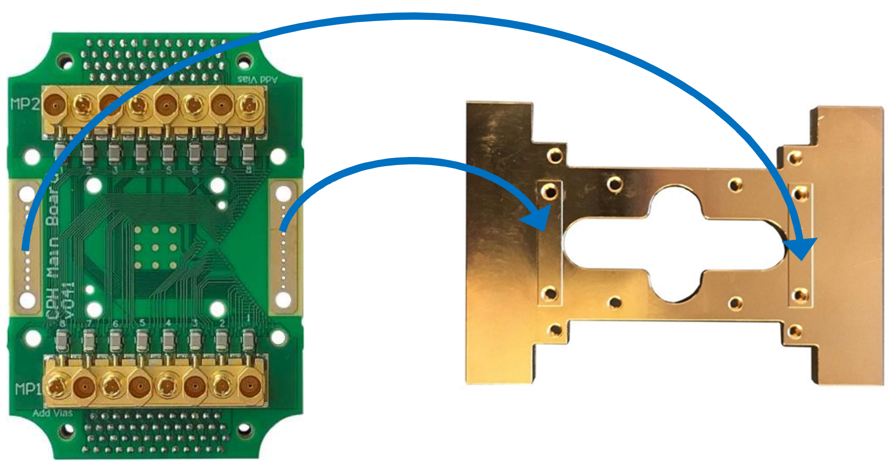


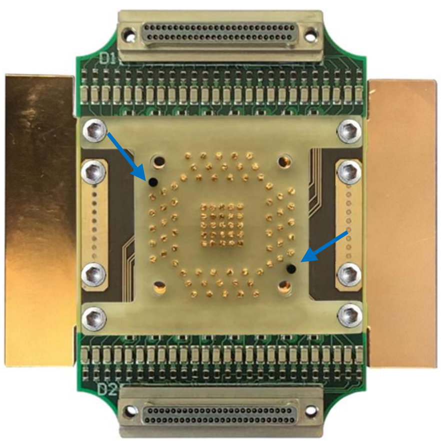
Figure 4: The QBoard assembly consists of four parts which are assembled in a stack using the provided Titanium screws: The mounting bracket, the motherboard, the interposer, and the daughterboard.

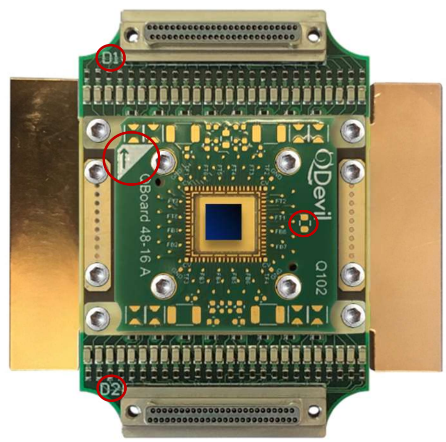
1. The motherboard is mounted onto the mounting bracket using four 4 mm M1.6 Titanium screws. The big contact pads on the bottom of the QBoard should face the corresponding elevated pads on the mounting bracket. The screws should be tightened firmly so that good thermal contact is achieved, still without risking any damage to the screws or the PCB. A torque of about 0.12 Nm is suitable, but not more, corresponding to applying 250 g of pressure on a 5cm long hex key. Use a 1.5 mm hex screwdriver (or short neck hex key) with a high-quality bit which fits the screw socket tightly.



2. The interposer is delivered in a protective storage case and should be stored in this at any times when not in use. When handling the interposer take great care of the spring contacts and guiding pins, as they may fall out. If any of the contact springs come loose, save them and remount them using pointed tweezers, after the interposer has been mounted onto the motherboard. For handling of the interposer and contact springs please see Section 6 in the Appendix. *Note that only 9 of the 25 spring contacts in the center of the interposer are used. The remaining 16 should be removed and saved as spares.*

For mounting: Place the interposer on top of the motherboard and align the two guide pins (see arrows on the following figure) with the corresponding holes in the motherboard. If required, gently push the guide pins into the holes in the motherboard and push the interposer further down. Finally secure the interposer to the bracket by its corner tabs using four 4mm M1.6 Titanium screws.





3. Finally mount the daughterboard (with mounted sample) on top of the interposer, again aligning to the guiding pins. The daughterboard should be oriented as shown above: The white corner should point to the top left corner (North-West) with the motherboard oriented with the "D1" North end up and "D2" South end down. On daughterboards without the white triangle there are two small distinct solder pads which should be in the "East" side of the motherboard.

Push the Daughterboard down over the guide pins, so it makes contact to the interposer. Finally mount the Daughterboard with four 6mm M1.6 Titanium screws. The Interposer does not need to be visibly compressed for good contact, but one should get a feeling of contact when tightening the screws. <u>No more than 0.12 Nm should be applied</u>.

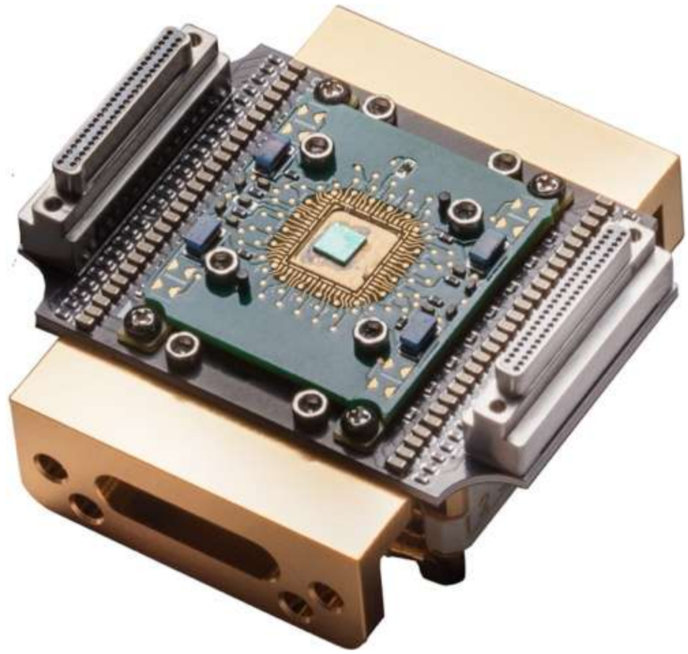


Figure 5: Complete assembly (on Type A bracket) with a daughterboard equipped with resonator circuit components.

IV. Mounting and connecting inside a sample puck

1. Mechanical

For good thermal contact it is important that the QBoard bracket is mounted firmly onto cold metal parts of the sample insert. Three different standard mounting options are available

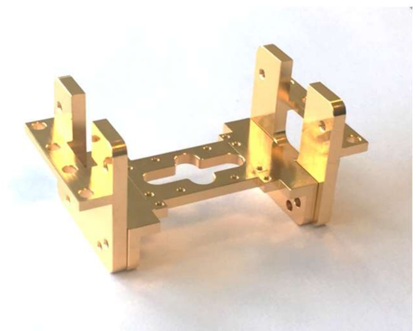
The “A” bracket is designed for fitting into 72/73 mm (BL72) Oxford Triton pucks, given they have flattened struts with threaded mounting holes and are sufficiently long. It is up to each customer to ensure that the puck is prepared for mounting this bracket. Step files (CAD) of the mounting bracket are available from QDevil.

The “B” mounting kit consists or an “A” bracket and two “B” adapters. This kit has been designed for being mounted on the rails inside standard 80mm pucks (BOT-80) from Bluefors. The adapters allow various rotations and positions of the QBoard. It cannot be guaranteed that adapters will work with all 80mm versions of the Bluefors puck.

The “C” mounting bracket is a general-purpose compact bracket with mounting holes both on the sides and on the top making it suitable for narrow sample spaces and dipsticks. With a small adapter it will also work with a Bluefors BOT-60 puck.

Figure 6: Mounting brackets and adapters.

Standard mounting bracket,Type A. Intended for Oxford Triton 73 mm pucks.



Type B mounting kit: Standard mounting brakcte with type B adapters. Intended for Bluefors 80 mm pucks.

Bottom: Compact mounting bracket, general purpose

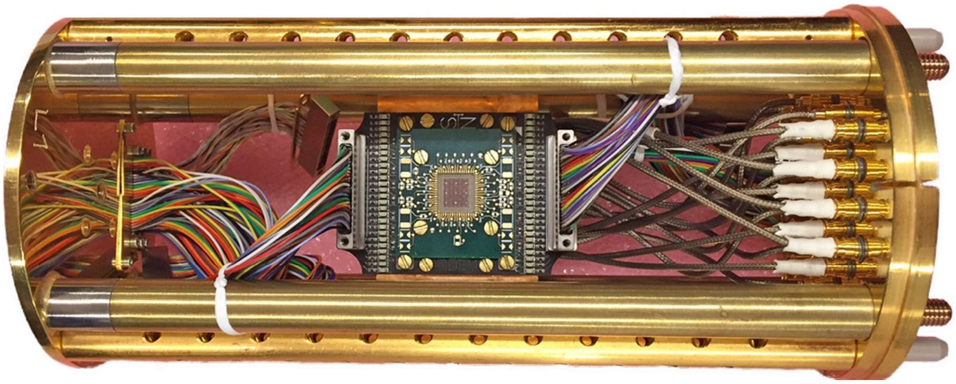
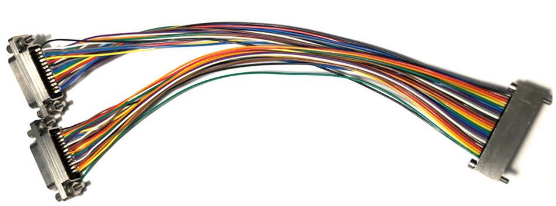


Figure 7. Example of how the QBoard may be mounted inside a cryogenic sample insert (puck), here an Oxford 72/73 mm puck with flattened support rods is used.

2. Electrical

The QBoard is usually delivered with DC cable assemblies connecting to either of the two Nano-D connectors on the motherboard and to the connectors in the fridge / puck. Make sure to insert the Nano-D jumper cable fully into the connectors on the motherboard. Use the screws in the cable connector to force the cable connector into place by applying turns to each of the screws repetitively until the connector is in place. The screws can also be used for releasing the connector again, by reversing the scheme.



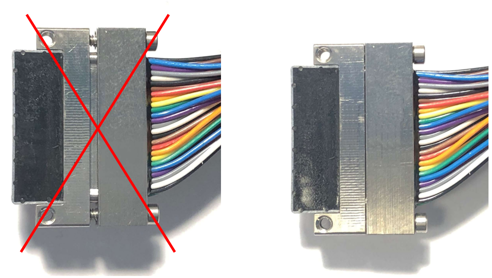


Figure 8: **Left:** 51 pin Nano-D to 2x 25 pin Micro-D jumper cable. Note that the wires are rather fragile and may break near the soldering at the Micro-D connectors if bend too many times. **Right:** The connectors have to be inserted fully into each other. For this the screws are a big help – also for separating them again.

For the RF connection either one or two 8-way Mini-Coax cable assemblies are usually supplied. These are delivered unassembled so that the pin order can be arranged either way. For narrow sample spaces one is often installed with reversed pin order so that the cables point in the same direction.

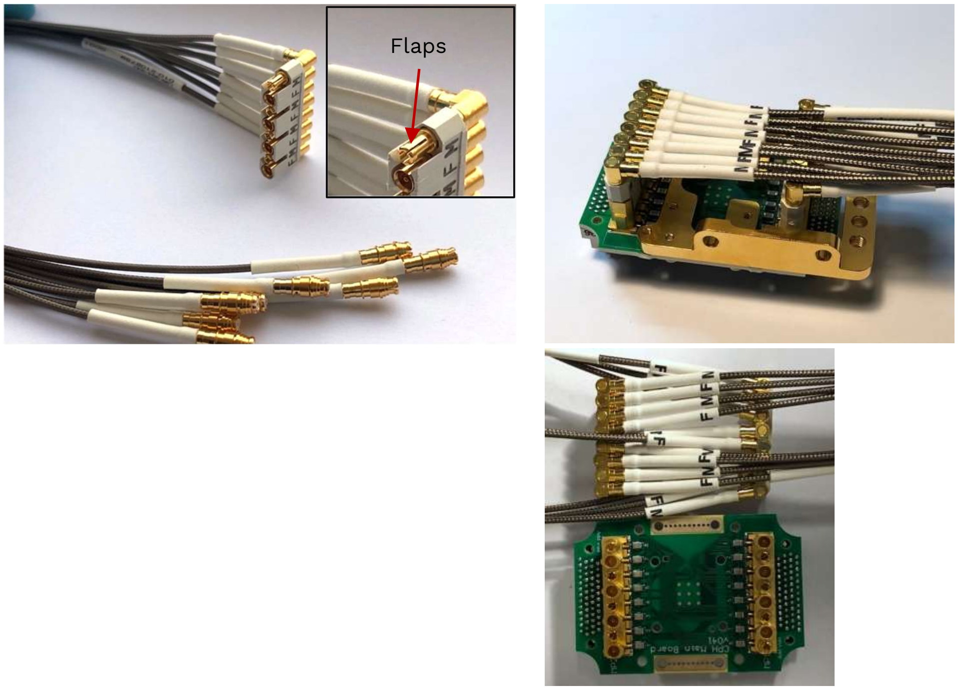


Figure 9:

Left: 8-way Mini-Coax cable assembly. NOTE, that the male Mini-Coax connectors have small flaps which bend slightly when inserted into the tube of the female connectors. Take care to insert the connector straight, so that one flaps do not accidentally go outside the tube of the female connector.

Middle: Back side of QBoard mounted on a Type C bracket with two mini-coax cable assemblies leaving in the same direction: This is possible only if the pin order of one the two cable assemblies has been reversed.

Right: It takes some ingenuity to fit all 16 minicoax wires in when the point against each other like this. It may be necessary to carefully remove some of the white anti-kink sleeve (be very careful!).

In case of needing to remove the RF connectors from the multi-port assembly, use the extraction tool from Rosenberger PN 23W100-000 (sleeve supplied as Q114) as the connectors are otherwise easily damaged.

Please be very cautious when connecting the RF- and DC-cables to the QBoard and to the fridge as the cables and the board connectors are very delicate.

V. Wiring and daughterboard connections

The sample is electrically connected to the daughterboard by wire bonding and typically mounted using silver paste. The motherboard and the daughterboard are electrically and thermally connected by the spring contacts of the interposer.

1. DC / low frequency lines

The QBoard design has been designed for the use with 51-pin double-row nano-D connectors, of which 48 DC/low-frequency voltages can be supplied to the sample and the remaining to daughterboard cavity. The main board is equipped with two nano-D connectors wired in parallel. This allows for the continuous grounding of the sample during sample loading or transfers, protecting for ESD damage of the sample. For bottom-loader cryostats, this also allows for measurements of the sample in the load-lock before and during loading, and later through the fridge wiring, once the sample insert makes electrical contact to the cold-finger connectors of the cryostat.

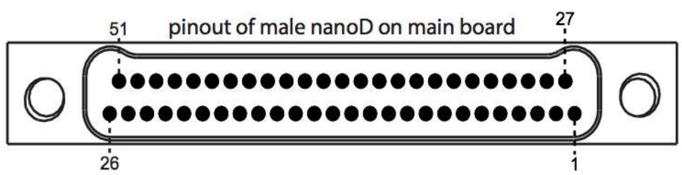


Figure 10. Male nano-D connector pinout.

2. Low pass filters

All 51 lines from the nano-D connectors are low pass filtered by an RC stage on the motherboard, with R_{LF} = 1.2kΩ, and C_{LF} = 1.0nF. Sixteen of the DC lines are additionally coupled to the 16 RF lines through bias resistors, see Figure 13.

3. RF lines – bias tees

All 16 RF lines are connected to the daughterboard through a capacitor C_{BT} of 22nF. A bias tee resistor R_{BT} of 50kΩ connects each RF line to a DC line as shown in Figure 13.

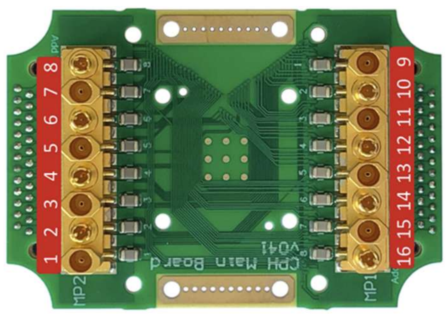


Figure 11. RF connectors on the back side of the QBoard main board. The numbering corresponds to the numbering of the red "MC" pads on the bonding pad drawing in Figure 13.

4. Bonding a sample

Before you start mounting and wire bonding a sample on a daughterboard, you should get familiar with the different types of bonding pads on your specific daughterboard, and how they connect to the low-frequency connectors (two 51-pin nano-D connectors) and to the high-frequency connectors (two Rosenberger 8-channel mini-coax connectors) of the main board. See Figure 13 for the schematic and Table 1 for the bonding pads and their color coding.

If you experience problems with getting bonding wires to adhere to the daughterboard bonding pads please see Section 5 in the Appendix for tips on wire bonder.

Here we discuss the simplified use with no surface mounted components on the daughterboard. See Section 3 in the Appendix for detailed information on surface mounted resonator tank circuits.

The narrow bonding pads (green and orange) are used for DC signals. They are connected to the nano-D connectors and labelled with the corresponding connector pin numbers. The orange lines are furthermore used as DC bias lines for the bias tees on the motherboard. The wide bonding pads (red) are used for RF signals, they are AC coupled to the mini-coax connectors via bias-tees and labelled with MC#, the orange numbers refer to the bias tee DC lines. See Figure 13 for a schematic of the DC and RF lines as well as the bias tee configuration.

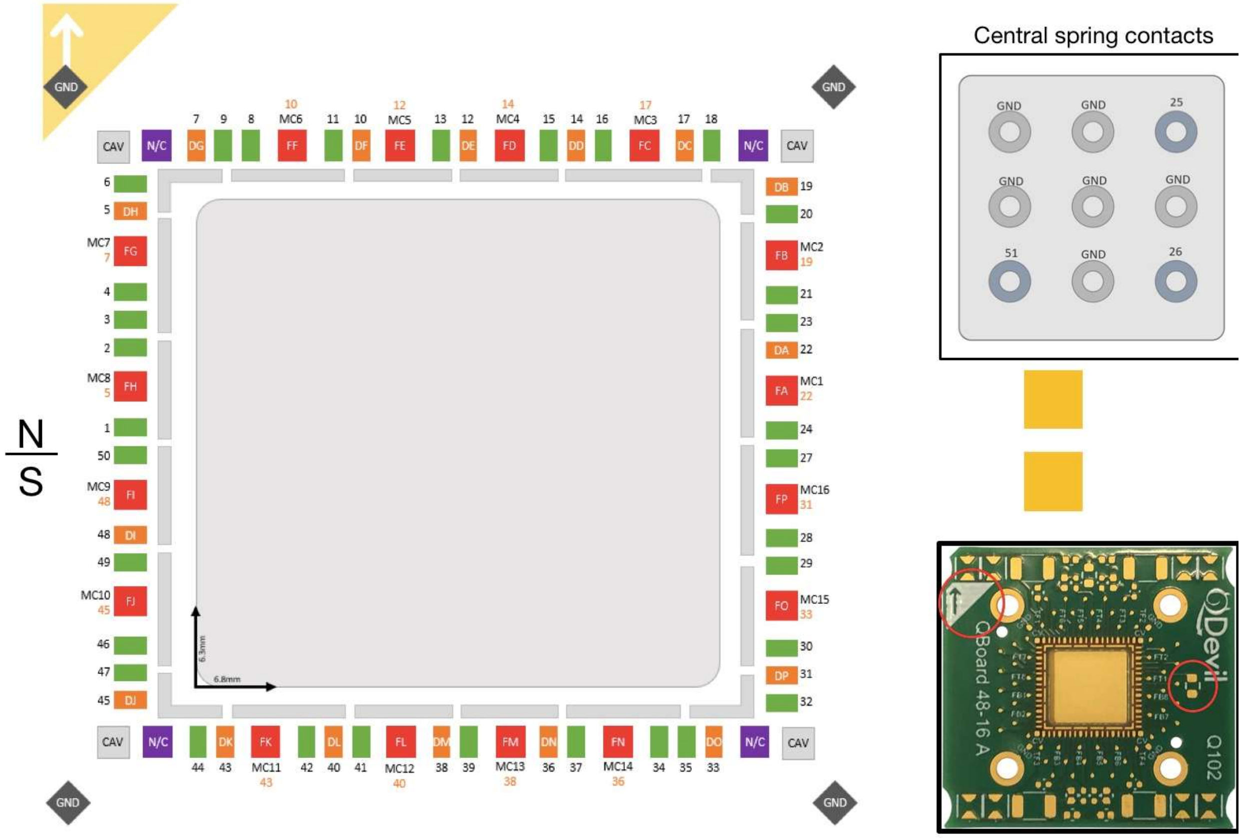


Figure 12. Simplified drawing of the bonding pad layout on the standard daughterboard Q102. For a detailed description of the surface mounted tank circuits Sections 2 and 3 in the Appendix. The numbers refer to the pins on the nano-D connectors. The MC# numbers refer to the RF mini-coax connectors. The orange bonding pads are connected to the red RF pads trough bias tee resistors on the main board. Note the orientation: The encircled white triangle on the daughterboard (see insert) denotes the north west orientation relative to the motherboard (the two isolated adjacent solder pads to the right should end up at the *East* side of motherboard).

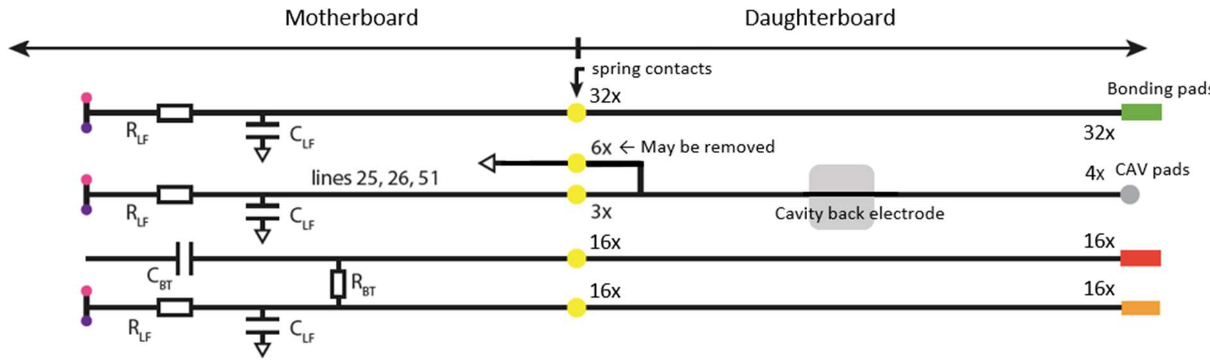


Figure 13: Basic wiring of the motherboard to the daughterboard. 32 lines are clean DC/low frequency liens with RC filters, 3 lines go to the cavity on the daughterboard and 16 lines are RC filters but are also coupled to the 16 RF lines though bias tees. The standard RC filter component values are R_{LF} = 1.2kΩ, and C_{LF} = 1.0nF. The bias tee components have values of C_{BT} = 22nF and R_{BT} = 50kΩ.

Table 1: Overview of bonding pad configuration in the simplified daughterboard use.

	Pad name	**qty**	**Usage**
		32	DC/low frequency lines from nano-D – "slow pads"
	D_	16	DC/low frequency lines from nano-D connected to RF lines through bias resistors. (D_ = DC bias of fast pad)
	F_	16	RF lines connected to the mini-coax connectors, "fast pads"
	Cavity plane	1	Connected to 9 central spring contacts and "CAV" bonding pads
	CAV	4	Connected to the cavity electrode for "back gating"
	GND	4	Connected to the fridge ground through mounting screws. Note that the thermalization depends on the screw material used.
	N/C	4	Not connected in the simplified layout

1.

5. Grounding and back-gating

The sample cavity is directly connected to the bottom side of the daughterboard, and to 4 bonding pads at the cavity corners. This allows for grounding or back gating of the sample.

The 9 central spring contacts of the interposer connect to the cold fridge ground (GND) and three DC contacts of the nano-D connectors (pin 25, 26, 51) through the main board. By selectively (un-)populating the spring contacts, different grounding schemes may be used. See the insert in

Figure 12 for a pinout of the central spring contacts.

Cold grounding of the cavity: Depending on your wiring configuration, the spring contacts for pins 25, 26, and 51 should be removed, leaving all GND spring contacts in place will ensure a thermalized and grounded cavity.

Back gating: Depending on your wiring configuration, you may use any of the pins 25, 26, and 51 for DC biasing of the cavity. In that case all GND spring contacts have to be removed from the interposer. Alternatively, the 4 "CAV" bonding pads may be bonded to any DC line on the daughterboard which then is used as a back-gate. In this configuration all 9 spring contacts should be removed from the interposer.

6. Resonator (tank) circuits

The daughterboard is prepared for advanced reflectometry measurements, please see Section 2 in the Appendix for the advanced features of the daughterboard.

For additional information please the paper by Colless and Reilly [1], which the QBoard design is based on. For information on using resonator circuits read the master thesis of Morten Madsen [2].

References

1. Modular cryogenic interconnects for multiqubit devices, J. I. Colless and D. J. Reilly, Rev. Sci. Instrum. 85, 114706 (2014). http://dx.doi.org/10.1063/1.4900948
2. Master theses, *Investigating timescales for quasi-particle poisoning in superconducting quantum dots in InAs nanowires*, Morten Madsen, Center for Quantum Devices, Niels Bohr Institute, 2019

QUANTUM MACHINES

VI. Appendix

1. Notes on different types of bonding pads

To decide which pads to use during wire bonding understand their numbers and colors.

Green = “low-frequency pad”. The number corresponds to the Nano-D connector pins that provides the DC voltage via a RC stage on the main board. The pin numbers of the North and South nano-D connectors are identical (both connectors are wired in parallel) and may be used for sample grounding or monitoring during loading and transfer operations.

Red = “fast pad”. The number corresponds to the pin of the Nano-D connectors that provides the DC signal. The MC# corresponds to the mini-coax connector channels that provides the AC signal. The DC and AC signals are combined on the main board via a bias tee. Depending on how you connect the mini-coax channels to the puck’s SMP channels, the AC signal will break out on different SMA connectors of the cryostat. Important: Typically, one SMP on each cryostat is dedicated for RF reflectometry (rather than fast gate pulses), and to make use of that line you must choose between connecting it to MC1 or MC4 (RX, RY) inside the puck. If you use MC1 (MC4) for reflectometry, DO NOT use pad FA (FD) as a fast gate pad (see discussion about C9 and C10 below).

Orange = restricted “low-frequency pad”. These pads are connected to nearby fast pads with a 50kΩ resistor on the main board. If the fast pads are not used, they function as normal “low-frequency pads”. When the fast pad is used, this pad carries the DC voltage applied to the bias tee of the corresponding fast pad, see

Figure 12 and Figure 13 (or Figure 14 and Figure 15). For example, pad DB carries the same DC voltage as pad FB (namely that from pin 19 of the Nano-D connector). In other words: If FB is wire bonded as a fast gate, you cannot use DB as an independent DC line. OPTIONAL: If the resistor of bias tee is removed, the orange pad behaves as the green low-frequency pads, whereas the red pad becomes a purely AC-coupled high-frequency line.

Blue and **purple** = Various pads related to the inductors and varactors intended for reflectometry measurements, if these are mounted. See Figure 14 in Section 2 (Appendix) for a detailed schematic and layout. The four large **purple** pads (LA, LB, LC, LD) constitute the sensing side of the resonating inductors, to be wire bonded to the ohmics of sensing dots, quantum point contacts or other applications. The DC voltage on the blue pads corresponds to the pin number of the nano-D connector indicated. The RF voltages on LA, LB, LC, LD depends on whether C9 or C10 are populated (do not populate both).

CAUTION: The blue pads have multiple purposes, they function as DC pads, DC bias of fast pads, DC bias for the sensing circuit bias tees, and as DC bias lines for varactors. Only one use is possible at any time, and a careful study of the circuit diagram is needed to prevent double use of these pads.

For example, if the sensing circuit LB is populated, pin 38 provides the DC voltage to the varactor and pin 33 provides the DC bias voltage to the tank circuit. Thus FM and FO cannot be used when the LB sensing circuit is used. The fast pads may be available as purely AC coupled lines, if the corresponding biastee resistors are removed from the main board.

2. Advanced daughterboard functionality

The Q102 and Q124 daughterboards are prepared for mounting of resonator (tank) circuits (inductors resonating with the capacitance of a monitored gate). Varactors (which freeze out at millikelvin temperatures) can be mounted for tuning the resonators, useful for determining the correct value of the inductors. For this, some of the signal lines are routed to the solder pads for these circuits. These are the blue and purple pads. The purple LA-LD pads are not directly connected to the motherboard, only via the inductors and coupling capacitors when they are present.

Figure 14 and Figure 15 as well as Table 2 present the extended functionality available on the daughterboard.

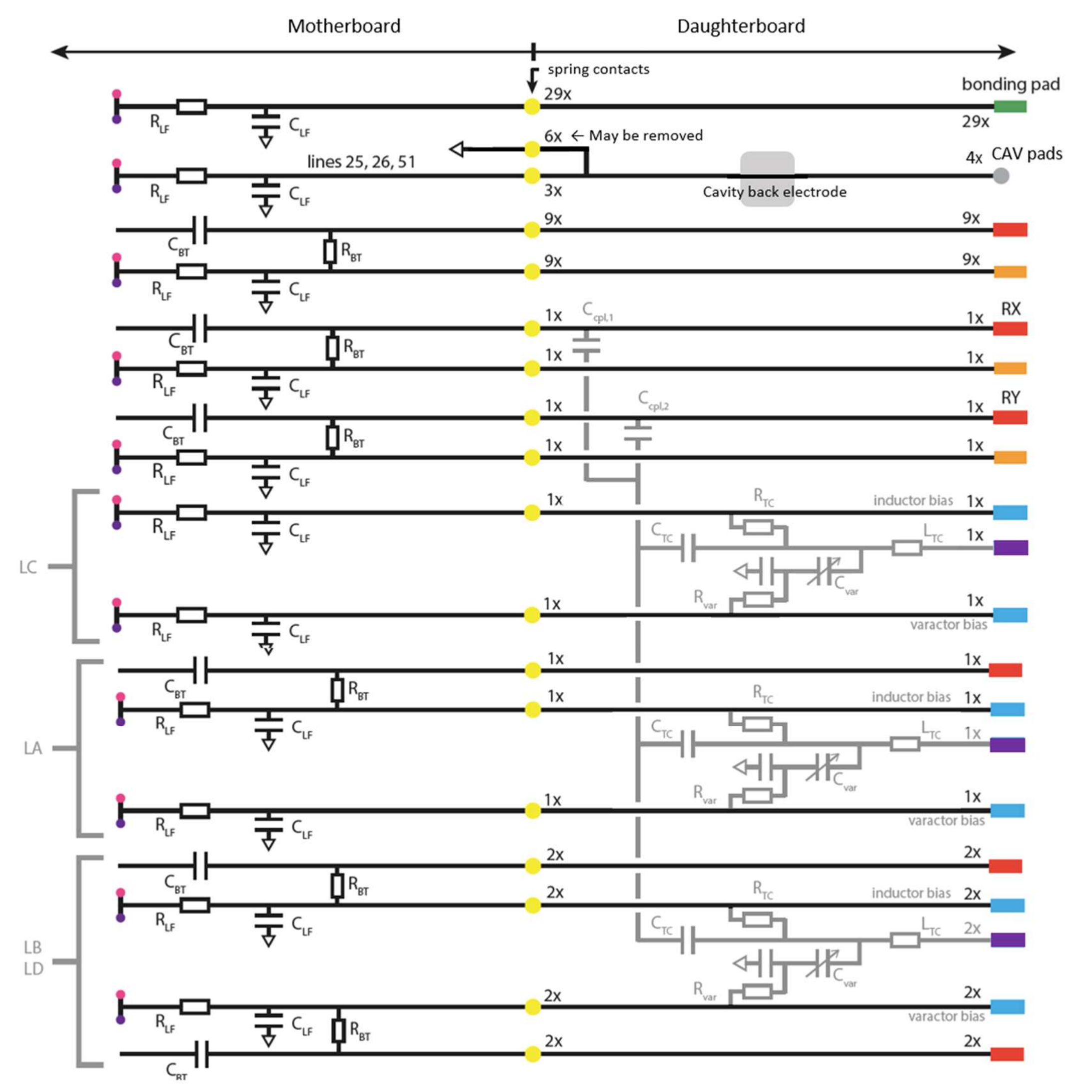


Figure 14. Extended schematic of the daughterboard mounted on the motherboard. The standard RC filter component values are R_{LF} = 1.2kΩ, and C_{LF} = 1.0nF. The biastee components have values of C_{BT} = 22nF and R_{BT} = 50kΩ. The grey circuitry is populated by the user.

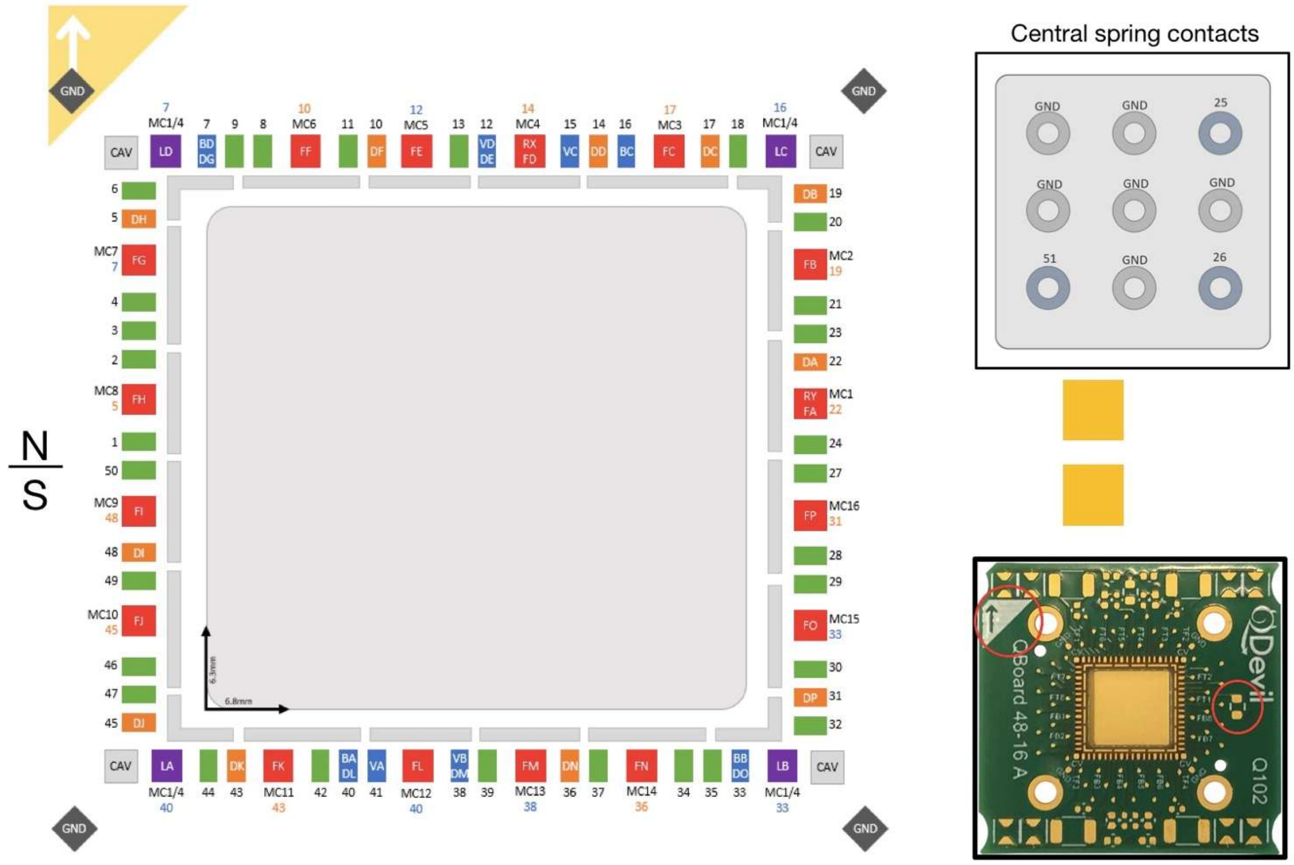


Figure 15. Extended drawing of the bonding pad layout on the standard daughterboard Q102. The numbers refer to the pins on the nano-D connectors. The MC# numbers refer to the RF mini-coax connectors. The orange and blue bonding pads are connected to the red RF pads trough bias tee resistors on the main board. The blue pads are furthermore connected to the tank circuitry as shown in the schematic diagram Figure 14. Note the orientation: The encircled white triangle on the daughterboard (see insert) denotes the north west orientation relative to the motherboard (the two isolated adjacent solder pads to the right should end up at the *East* side of motherboard).

Table 2. Overview of bonding pad configuration for advanced daughterboard usage.

	Pad name	qty	Usage
		29	DC/low frequency lines from nano-D – "slow pads"
	DA..DD, DF, DH..DK, DN, DP	11	DC/low frequency lines from nano-D – connected to RF lines through bias resistors. (D_ = DC bias of fast pad)
	DE/VD, DG/BD, DL/BA, DM/VB, DO/BB	5	DC/low frequency lines from nano-D – connected to RF lines through bias resistors. When tank circuits are mounted: V_ = varactor DC bias. B_ = inductor DC bias.
	VA, VC, BC	3	DC/low frequency lines from nano-D Routed to tank circuitry, see meaning above
	F_, RX, RY	16	RF lines connected to the mini-coax connectors, "fast pads" *RX, RY: use one of them to read reflectometry circuit (via SMD capacitor on the daughterboard), use the other as a normal fast pad.*
	Cavity plane	1	Connected to 9 central spring contacts and "CAV" bonding pads
	CAV	4	Connected to the cavity electrode for "back gating"
	GND	4	Connected to the fridge ground through mounting screws. Note that the thermalization depends on the screw material used.
	LA, LB, LC, LD	4	Used for inductor sensing when tank circuits are mounted, not connected directly to nano-D.

3. Adding circuits for reflectometry

QDevil provides **daughterboards** without SMD components, and hence none of the components associated with reflectometry exist on the daughterboard. Therefore FD and FA can be wire bonded to the sample and used similar to the other fast channels FG, FH, FI, FJ, FK, FL, FM, FN, FO, FP, FB, FC, FE, FF. Note that in this case, if bias tees (see C_{BT} and R_{BT} in Figure 14) are fitted on the **motherboard**, which they normally are when delivered from QDevil, bonding pads FF and

DF will carry the same DC-voltage (both are connected to nano-D pin 10)! Similarly, pads FH and DH will carry the same DC voltage, FD and DD, FA and DA, and so on.

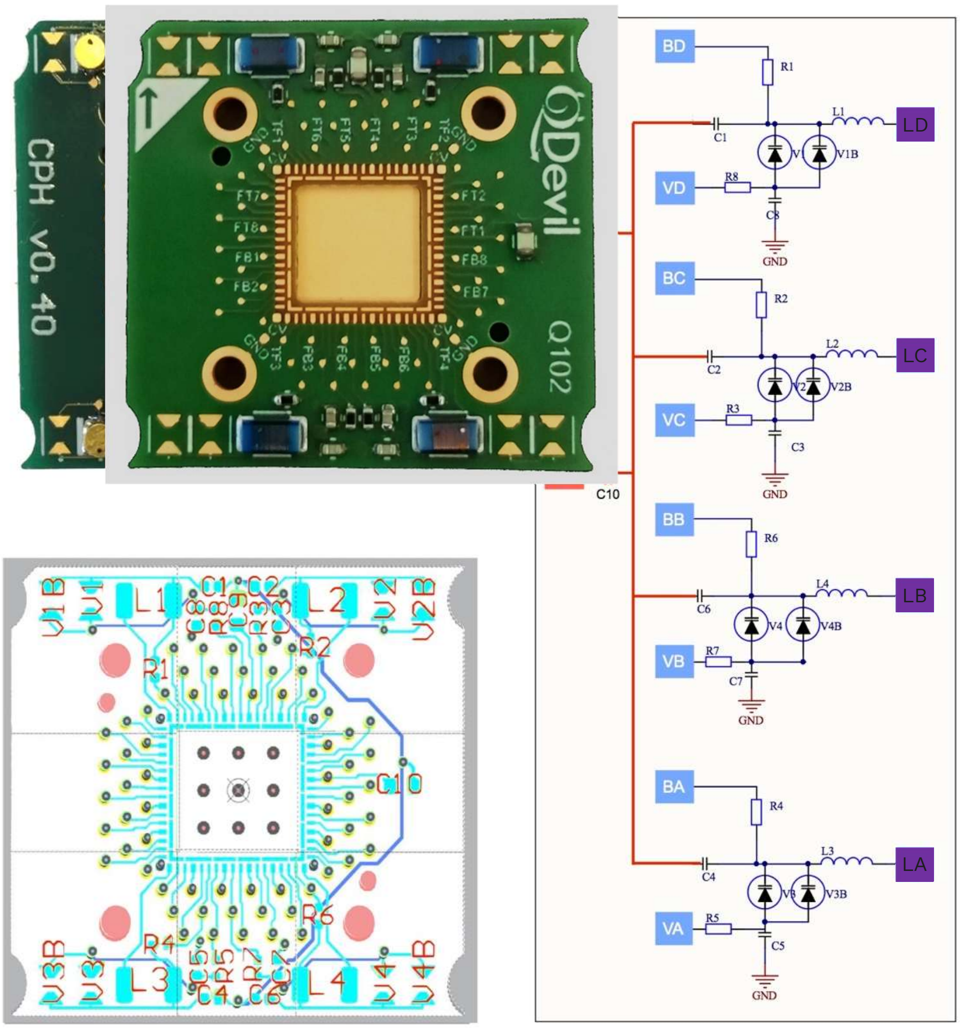


Figure 16. On the left you see a photo of a daughterboard stuffed with various components for radio-frequency reflectometry measurements. The circuit schematic of the daughterboard is shown on the right. We typically put a coupling capacitor on C9, and leave C10 open. That way, the high-frequency channel associated with wire bonding pad “RX” couples to the four resonators L1, L2, L3, L4, which can be connected to a quantum device via wire bonding pads LD, LC, LA, LB respectively. The pad RX (RY) uses the same contact spring in the interposer that feeds pad FD (FA). Therefore, if C9 (C10) is fitted for the purpose of reflectometry, one should not connect FD (FA) to a device.

Attention: An early revision of the Q102 board did not have C9 connected to RX. On these boards only C10 may be used with RY for reflectometry. These boards are marked with 001 on the bottom side of the PCB.

4. General Tips and Tricks

Notes on thermalization of the sample: In the QBoard system the sample is mainly thermalized through the central grounded pads on the QBoard stack. However, when a back-gate is used, the spring contacts must be removed resulting in a reduced thermalization of the sample. Other applications, i.e. with insulating samples, benefit from a cold ground on the sample surface. For these situations, the daughterboards provide bonding pads (GND) which are connected to the mounting screws and thus are grounded and thermalized to the mounting bracket. To utilize these grounding pads fully, it is advised to replace the four Titanium mounting screws of the daughter board with a different material such as Brass or CuBe which does not turn superconducting and loses its heat transfer properties at low temperatures.

C9 and C10: All four tank circuits can be AC-coupled to MC1 or MC4 by stuffing C10 or C9. You only need to stuff one of these*. That way, if you choose MC4 for reflectometry, FA becomes available as a fast gate pad, whereas FD should not be used for wire bonding. If you do not want to use reflectometry, leave both C10 and C9 open, then you can use both FD and FA as independent fast pads.

* Pick the configuration that gives the better bonding geometry for your particular sample (i.e. keep fast bond wires and sensing bond wires short, avoid crossing wire bonds etc).

Attention: An early revision of the Q102 board did not have C9 connected to RX. On these boards only C10 may be used with RY for reflectometry. These boards are marked with 001 on the bottom side of the PCB.

Bonding up: Use software like 'Inkscape' (or even PowerPoint or Paint) to copy and paste an optical image of your device into 'sample space' of the pinout on

Figure 12. If you use the correct scale (cavity is ~ 6.3 x 6.8mm) you will be able to get a good idea about the angle of each bond, and any potentially unavoidable crossings. Bonding plans/forms are available from QDevil for each type of daughterboard.

Golden Rule: **Use each number only once.** Some numbers occur more than once. This usually occurs when a DC line is used on the bias tee of a fast line. For example – the pads 'DB' and 'FB' are both labelled '19'. FB is a fast pad, if you choose to use FB then you cannot bond anything the 'DB'as they both share 19 (vice versa).

Using a varactor: A little less obvious is the use of varactor bias pads. The daughterboard has space for multiple varactors (variable capacitors) for tuning purposes. This component requires a DC bias to tune the capacitance. In two cases ('DE' and 'DM') the varactor bias line is shared with the DC bias line of a fast pad. This means that if you plan to use the varactor related to inductor pad LD. Then you will need to use breakout box pin 12 to control the varactor. So that rules out bonding to 'VD' or 'FE' . Most varactors freeze out somewhere below 2K and may not be useful in dilution refrigerators.

Use helper pads only for low-frequency lines.

Helper pads can be cut into two using a razor blade.

Helper pads can be removed, by soldering a hookup wire to it and peeling off.

Keep bonding wires of fast gates and RF sensing bonds as short as possible. Avoid routing them parallel and in close proximity to other bonds (or crossing other bonds) to reduce mutual capacitance.

Remove all central contact springs if you do not want a cold grounded cavity. If all central contact springs are removed, the cavity becomes electrically floating, but it is still electrically shorted to the grey bonding pads labeled “CAV”. This is useful for back-gated chips: Simply bond one available channel to a CAV pad, e.g. add a short bonding wire between pin 32 and CAV, which will allow you to apply a DC bias to the cavity.

5. Wire bonding, general tips

Different surfaces need different settings on the wire bonder. Sometimes a setting working well for some surfaces will not work for others at all. Here is a general procedure as how to adjust the bonding machine:

1. Reduce bonding force to zero. this is to avoid the wire to be torn and pulled out of the needle.
2. Increase bonding time to double what you expect. It should not be the time that defines bonding quality.
3. Reduce ultrasound power to zero. Just to get this out of the equation.

With this you can pull the wire out of the bonder for some centimeters and it will never rip off and pull out of the needle. But also it will not bond at all. When you now bond you can just continue with bonding on the surface until you get decent results. always pulling a bit on the wire to get a fresh piece under the needle.

Then you follow these steps to get good bonding results:

1. Increase force until the bonding wire is deformed to double its width / half its height.
2. Decrease time until the deformation does not look the same anymore.
3. Increase US bonding power to make it stick better.

6. Handling the interposer and contact springs

The following is a copy of the instructions from the manufacturer of the interposer and spring contacts – in the following denoted “Fuzz Buttons®”.

Custom Interconnects

Fuzz Button Performance

FUZZ BUTTON® - ONLY INTERPOSER HANDLING AND MOUNTING INSTRUCTIONS

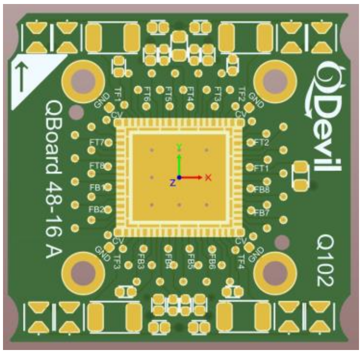
1) Please handle your new interposer carefully upon receipt. These interposers are shipped in an anti-static plastic cover, box or sleeve to protect the Fuzz Button® stack-up and to retain them in the interposer body. Do not remove this cover until it is time to mount the interposer between the PCBs. *Fuzz Buttons® will float within the hole until the interposers are fully mounted, this is normal and they will be fully captive once mounting is complete.*

2) Avoid touching the Fuzz Buttons® intentionally. Although Fuzz Buttons® are gold-plated and do not readily oxidize, oils from human contact can be deposited on the material and possibly cause electrical resistance problems. *It is recommended that all contact components be handled only with a pair of light forceps.*

3) To begin installation of the interposer, first remove them from the shipping material. *Be sure not to jar the interposer unnecessarily to ensure all component parts stay in place.*

4) After preparing your PCBs for assembly, align the interposer bottom-side locating pins to the lower PCB alignment thru-holes. Press the interposer pins into the lower PCB, pushing slowly and perpendicular to the PCB surface plane. The interposer mounting holes *(if present)* should then be aligned to the mounting thru-holes in the PCB. Secure the interposer using the supplied screws, through the interposer and into the PCB. Then place the upper PCB over the interposer topside using the same procedure. Finally, screw the two PCBs together using your pre-configured methodology. *Keep the interposer flush to the PCB surfaces at all times during the mounting procedure*

5) The interposer is now successfully installed and the PCB assembly is ready for immediate use.



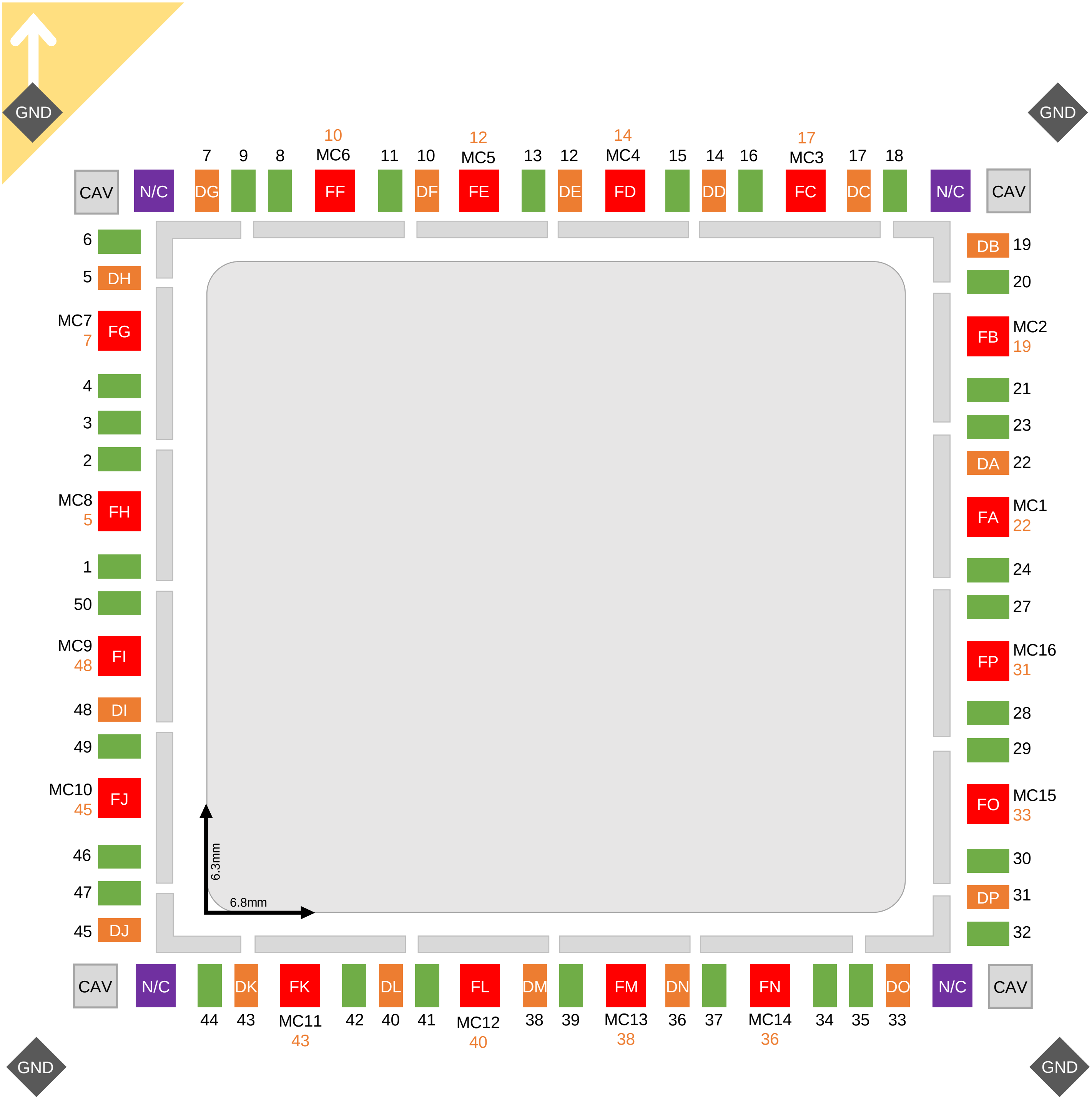
Sample bonding plan

Sample ID: ______________________ Date: ______________

Sample: ______________________ User: ______________

Notes:

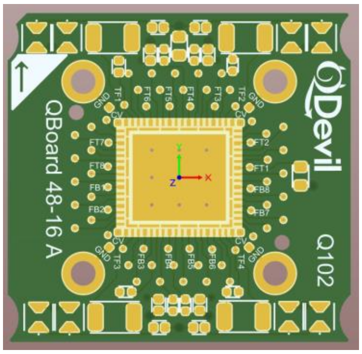
QDevil Q102 Daughter board
6.8x6.3 mm sample space
simplified – without surface mounted components



QBPlan v1.2

QUANTUM MACHINES

Sample bonding plan

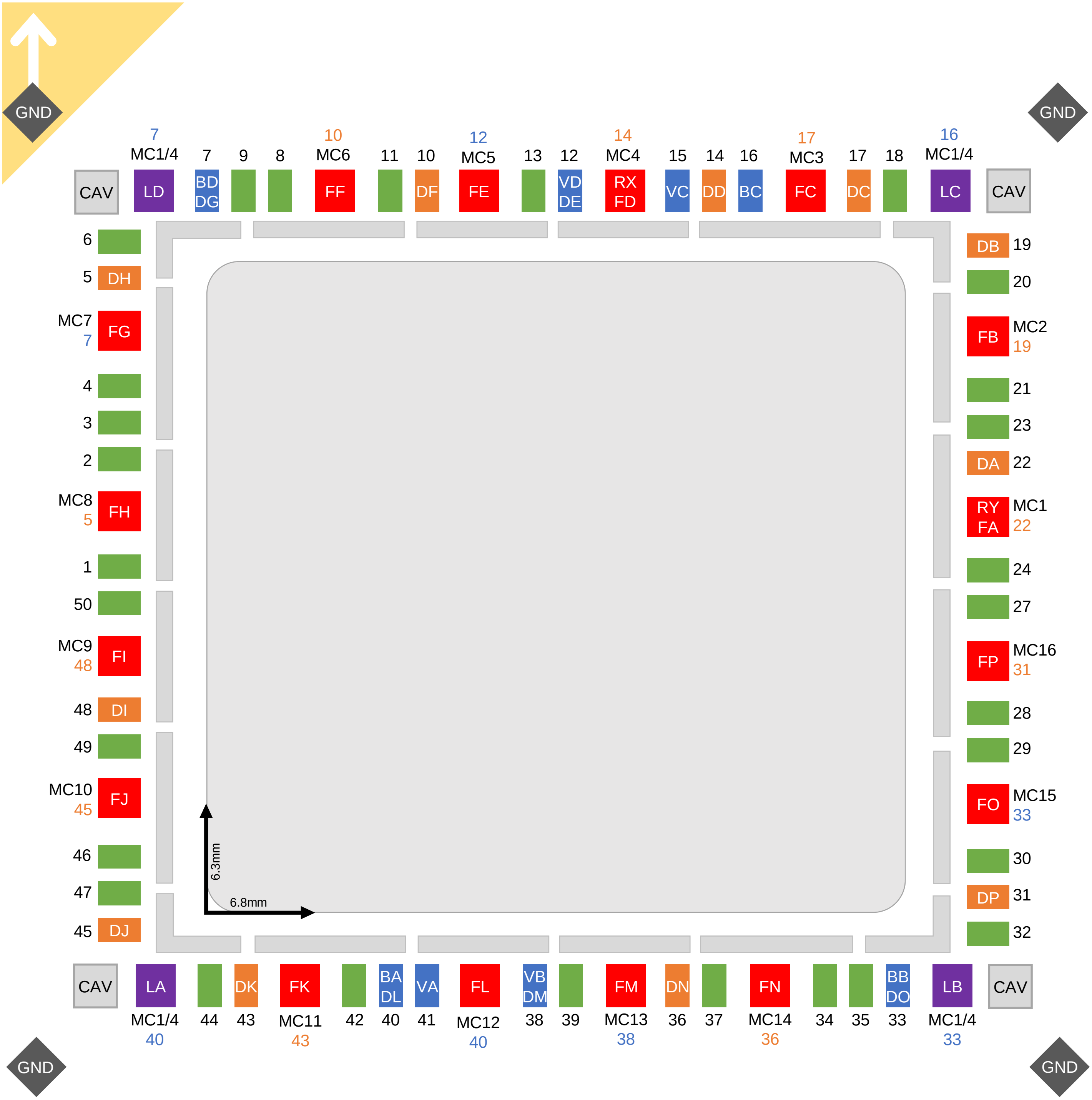


QDevil Q102 Daughter board
6.8x6.3 mm sample space

Sample ID: ______________________ Date: ______________

Sample: ______________________ User: ______________

Notes:



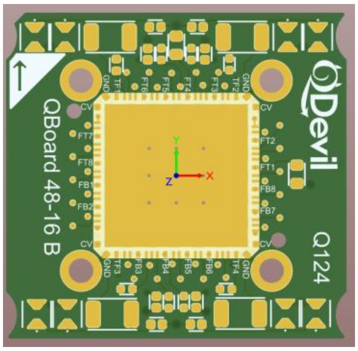
Sample bonding plan

QUANTUM MACHINES

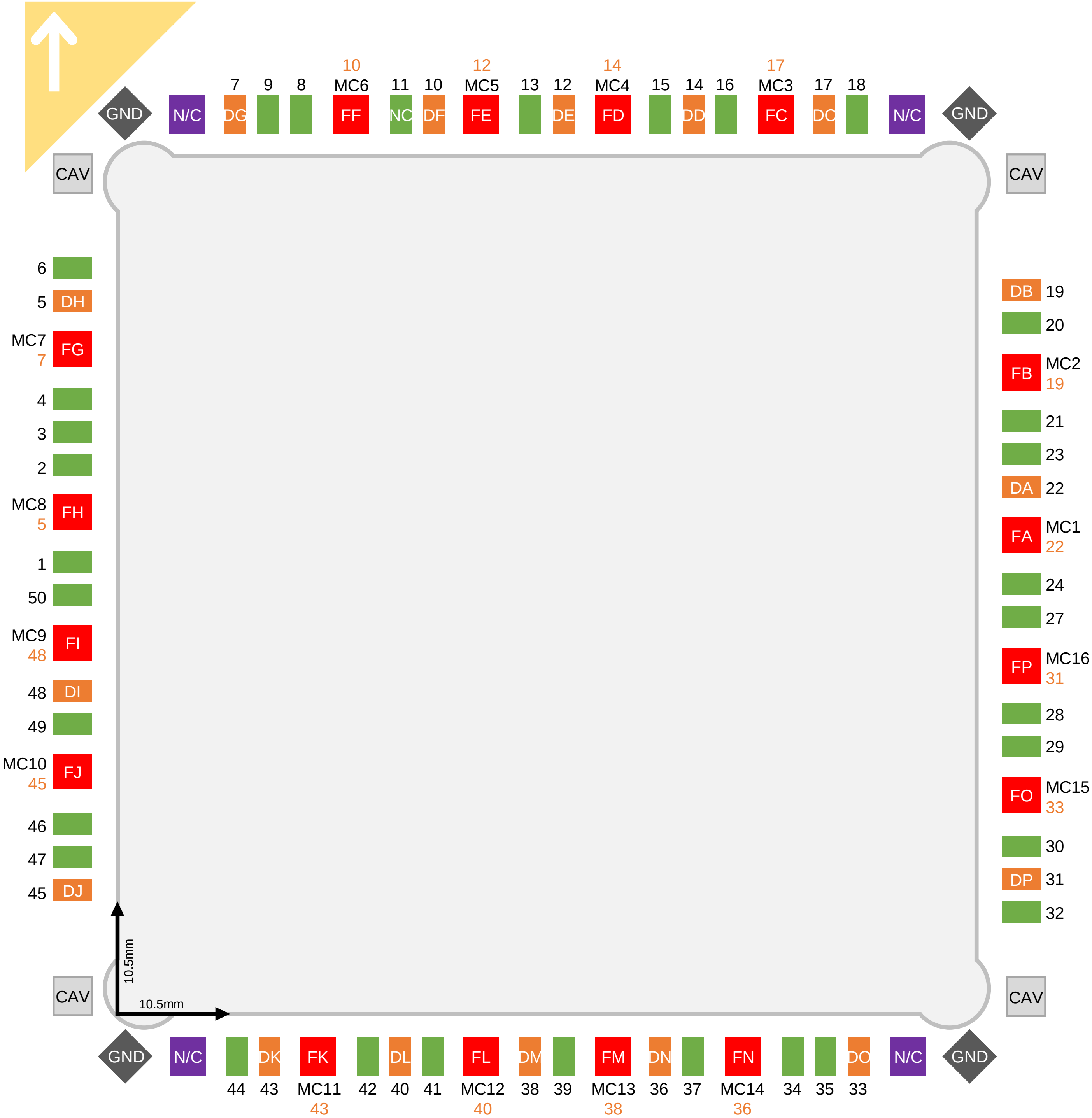
Sample ID: ______________________ Date: ______________

Sample: ______________________ User: ______________

Notes:

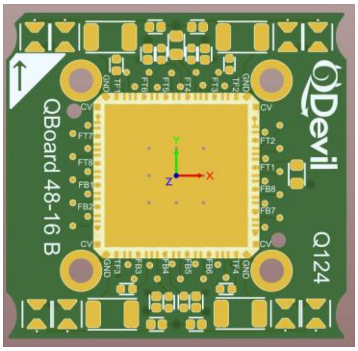


QDevil Q124 Daughter board
10.5x10.5 mm sample space
simplified – without surface mounted components



QBPlan v1.2

Sample bonding plan

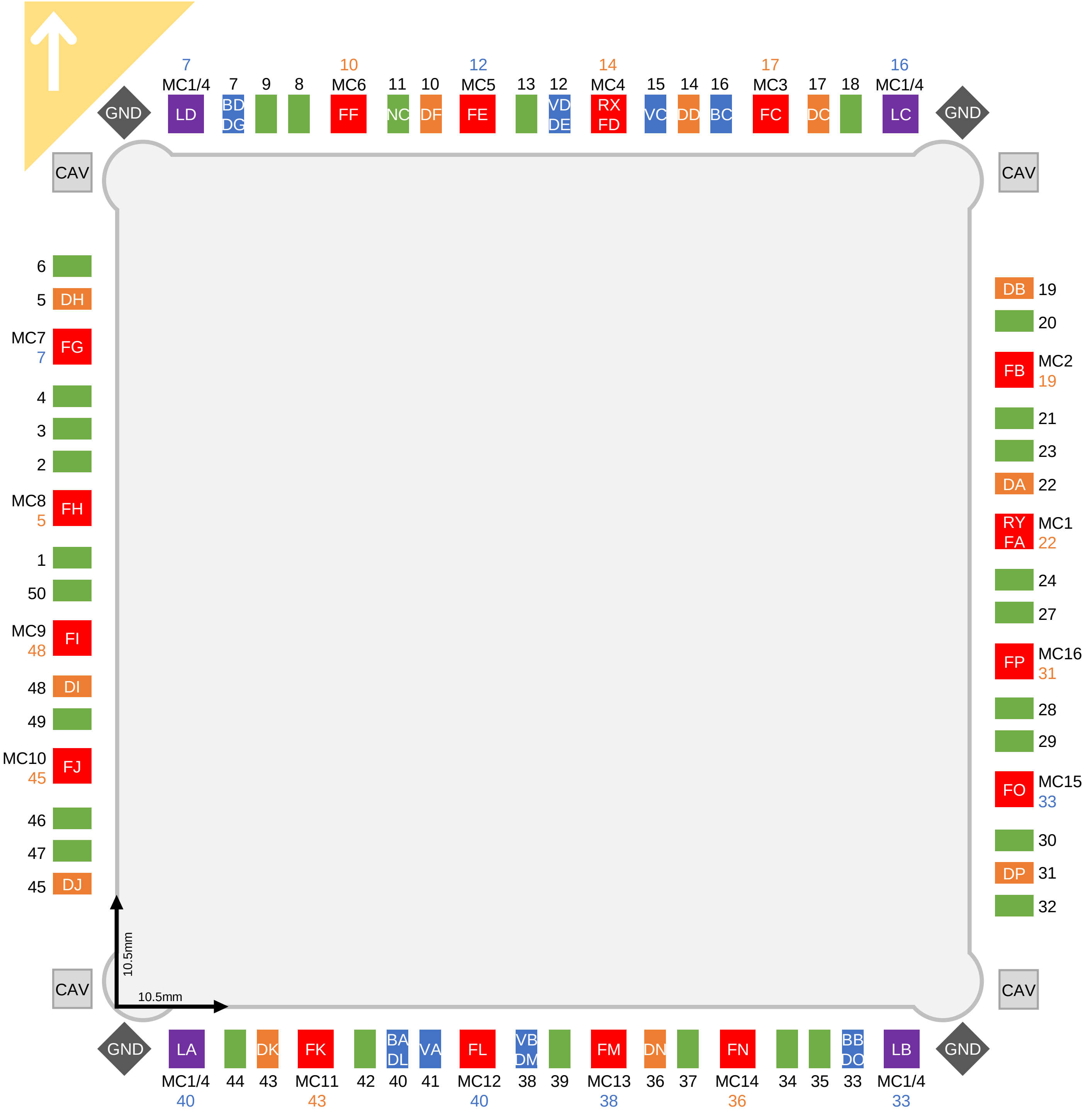


QDevil Q124 Daughter board
10.5x10.5 mm sample space

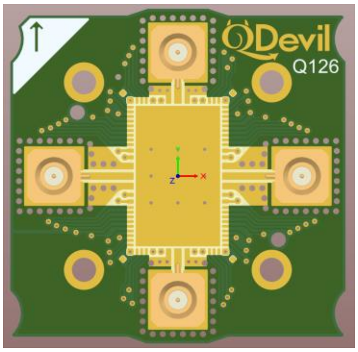
Sample ID: ______________________ Date: ______________

Sample: ______________________ User: ______________

Notes:



Sample bonding plan



QDevil Q126 Daughter board
6.3x10.5 mm sample space

Sample ID: ______________________ Date: ______________

Sample: ______________________ User: ______________

Notes:

QBPlan v1.2