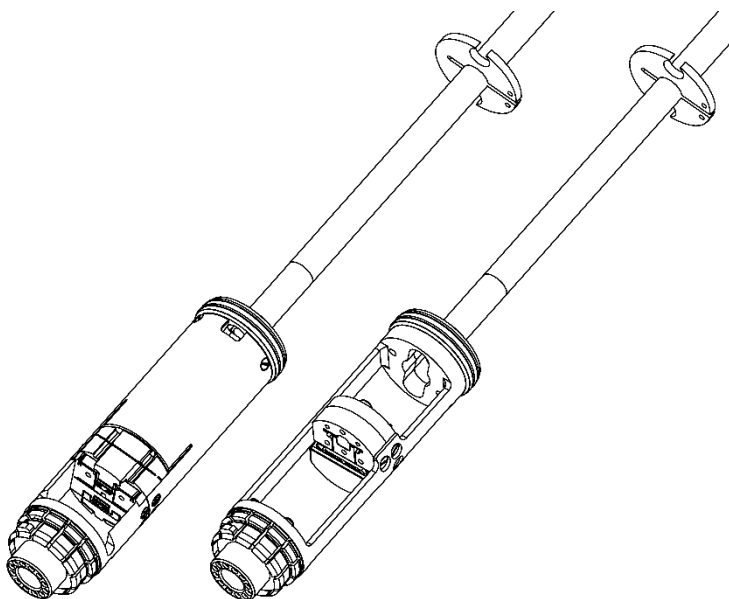


# PPMS Insert User Guide

Inserts for use with Quantum Design PPMS



This user guide applies to both the Razorbill Instruments Cryoinsert-1, and the Quantum Design P450 PPMS probe after modification to work with the CS1x0 and FC1x0 series stress and strain cells. The latter can be ordered complete from Razorbill Instruments or converted by customers using a Razorbill Instruments conversion kit. See also the standard P450 documentation from Quantum Design, the PPMS manual, the stress or strain cell datasheet and the documentation for your RP100 power supply.

Cryoinsert-1 inserts have a square purple box at the top, converted P450 inserts have an octagonal black box.



**Mixed metric and US Customary standards.** All Razorbill Instruments cells use metric fixings and fittings. The PPMS and the P450 probe built by Quantum Design use US Customary fixings. Attempting to fit a metric screw into a US hole or vice versa may damage one or the other. Take care to select screws according the screw identification section on page 10. If in doubt, contact Razorbill Instruments for clarification.



Refer to Physical property measurement system hardware manual from Quantum Designs for instructions on fitting your insert and puck to your PPMS. The puck supplied with this insert is a genuine Quantum Design PPMS puck that has been modified by Razorbill Instruments. **The puck will need to be adjusted to the correct fit according to the procedure in your PPMS hardware manual.**



**For probe conversion kits,** refer to PPMS1: installation guide. If you have purchased a probe conversion kit, you need to fit the kit to your own insert according to the installation instructions. If you have purchased a complete insert from Razorbill Instruments, the conversion has already been carried out at our factory.

## Usage Precautions

In addition to the usual precautions when using the PPMS and inserts, the following should be observed when using this insert and the stress or strain cell:

- ✦ Never leave the high voltage connections open when the insert is in the PPMS, as temperature changes can cause large pyroelectric voltages to appear on the piezoelectric stacks. If the insert is not connected to a power supply, connect the shorting caps instead.
- ✦ To avoid shorts and arcing, make sure that the high voltage connectors within the cryostat are fully mated, and repair any damage to the high voltage lines immediately.
- ✦ For best results, the outer braids of the coax cables used for the capacitance measurement should be connected to ground at the capacitance bridge and nowhere else, and they should also not make contact with each other. Appropriate insulation is provided on the insert, but if normal BNC cables are used outside the insert, then it may be advantageous to cover them in insulating tape or wrap them in paper.

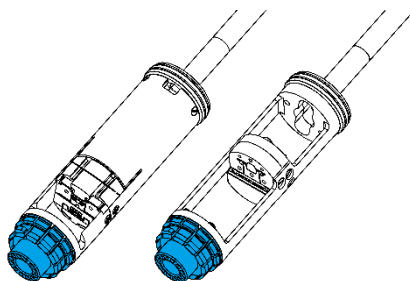
## Components & Assembly

Refer to the appropriate technical drawing (at the rear of the document folder, or available from our website [www.razorbillinstruments.com](http://www.razorbillinstruments.com)). A table of screw types and locations is also included at the back of this manual.

## Mounting The Puck

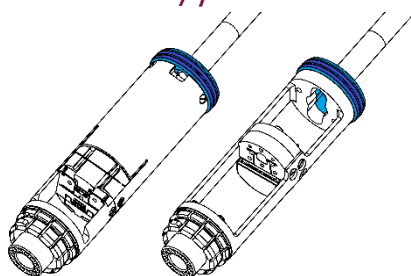
The puck is mounted to the bump guard (FC100) or cell holder (CS100) using 4 tapped holes near its edge. It's easier to fit these before mounting the cell.

It is recommended that the PPMS puck be attached, even if the wiring is not needed. The puck is required for heat transfer, and will protect the fragile sample chamber pins at the bottom of the PPMS from damage.



## Thermal Link Plate (P450 Only)

The thermal link plate fits between the cell and the insert. It is held in place by the screws that hold the cell or cell holder to the insert. The chamfered edge should face down and the holes should line up with the holes in the end of the insert.



The Thermal link plate has grooves for two thermal link springs. The springs will engage with the PPMS sample chamber about 2-3 cm before the puck engages. If the springs are reluctant to engage, rotating the insert may help – check the spring visually to confirm the direction of twist.

The springs are delicate, and care must be taken to avoid damage. Lightly deformed springs can still be used with no reduction in performance. Two spare springs are provided with each insert.

## Spring Fingers (Cryoinsert-1 Only)

The Cryoinsert-1 uses beryllium copper spring fingers to make thermal contact with the PPMS sample chamber. You should feel them engage with the sample chamber 2-3cm before the puck engages. The spring fingers are fragile, and can be damaged by catching them on the lip of the PPMS when removing the insert.

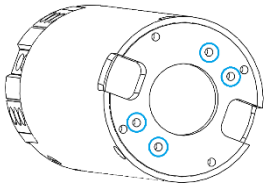
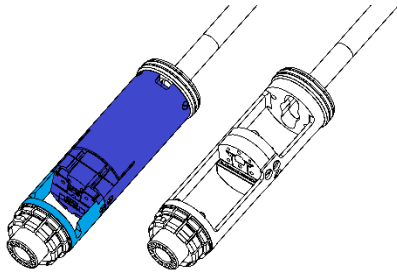
If individual tines are damaged, they can be bent inwards or cut off to stop them getting caught and damaging their neighbours. If many tines are damaged, the fingers can be replaced, one spare strip is included with each insert. To replace them:

- ✦ Remove the four M1.6 brass screws that join the retaining ring to the gold-plated copper part at the bottom of the insert rod. These may have epoxy on to prevent accidental loosening, scrape it off with a scalpel or screwdriver tip.
- ✦ Lift the retaining ring up away from the puck end of the insert. The spring finger strip will spring out.
- ✦ Wrap the new spring fingers around the gold-plated copper part mentioned above. The flat edge of the strip should face the top of the insert and the U-shaped side of the strip should go in a matching groove on the gold-plated copper part.
- ✦ Slide the retaining ring down onto the spring finger strip. The edge of the strip goes inside the retaining ring and the fingers lie on the outside.
- ✦ Replace the screws in the retaining ring and tighten them gently. Once they hold the spring fingers in place, further tightening will move the tips of the spring fingers inwards. Adjust them so that the tips of the fingers are just inside the edge of the retaining ring, but not touching the ring where it covers the other end of the spring finger strip. The rounded section of the spring fingers should still stick out wider than any other nearby part.
- ✦ Lock the screws in place with a small drop of epoxy or GE varnish.

## Mounting Your Cell: FC100

The cell holder is not required when mounting an FC100. The thermal link plate (QD probes only) fits between the cell and the insert. The puck is screwed to the bump guard.

The FC100 is usually mounted sample-down. Mounting it sample-up is possible, please contact Razorbill Instruments for more information.

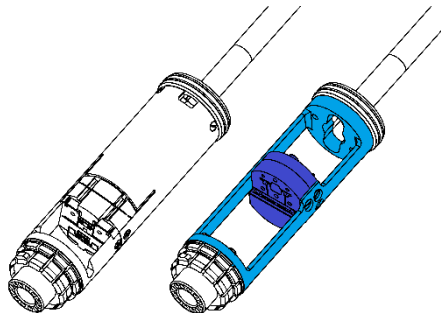


The cell is attached to the insert with four screws using the holes highlighted in the drawing on the left.

The wiring needs to be fed through the holes in the thermal link plate (if present) and the insert end plate.

## Mounting Your Cell: CS100

The CS100 mounts into cell holder. The thermal link plate fits between the cell holder and the insert. There are three countersunk holes for M2 screws, which allow mounting in vertical or horizontal arrangements. The cell is supported on one side only so that the difference in thermal expansion between the copper cell holder and the titanium cell does not distort the cell. The wiring needs to be fed through the holes in the top



of the cell holder, the thermal link plate (if present) and the insert end plate.

For both types of cell and both types of probe, it is easy to catch the cables between a baffle and the PPMS sample chamber wall. To prevent damage, you can wrap them onto the insert with Teflon tape. One reel is provided with the insert or any standard 0.075mm Teflon tape is suitable.

## Connectors & Wiring

A complete wiring diagram is included in the Technical Drawings section at the back of this folder, or can be obtained from Razorbill Instruments. The calculated heat load of all the cabling running down the insert is less than 2.5 mW at 4 K, which has no discernible impact on the cooling capability of the PPMS.

## Coaxial Cables

The coaxial connectors are standard, and should mate with any connector of the same standard. The small ones inside the vacuum chamber are MMCX and the ones on the top plate are SMA. The cables are Lakeshore SS.

## Drive Wiring

From Summer 2023 onwards, the drive wires are 7x0.102mm phosphor bronze wire with coloured FEP insulation. Inserts and kits prior to that date use Lakeshore SS cable, but only the cores are connected. The sheath is used for mechanical protection only.

The small “stepped” connectors are LEMO FGG.0S.302.ZLAT, which mate with the same. The feedthrough at the top of the insert are LEMO HGG.0B.302.CLLPV. They will mate with any LEMO 0B.302 series plug.

## Puck Wiring

The puck is a Quantum Design P101, which has been modified with the addition of wiring and connectors. The black pin-header type connectors are Preci-Dip 853-87-004-10-001101 which have been chamfered to mark pin 1. They mate with Preci-Dip 852-80-004-10-001101 or any similar round-pin header with 0.4mm pins and 1.27mm pitch.

For standard PPMS wiring, each of the three pin-header connectors on the top of the puck corresponds to a channel on the Quantum Design Model 6000. A summary of the connections is shown in the table below.

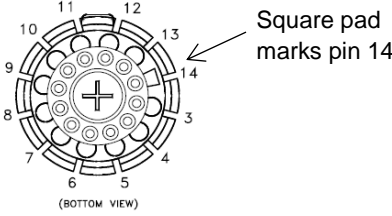
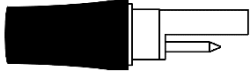
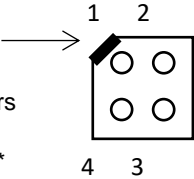
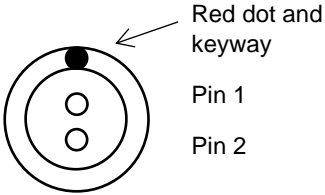
Puck connector pad number	Preci-Dip pin number	Preci-Dip connector	Model 6000 channel	Model 6000 function
3	1	Left (1)	1	I +
4	2			I -
5	3			V +
6	4			V -
7	1	Middle (2)	2	I +
8	2			I -
9	3			V +
10	4			V -
11	1	Right (3)	3	I +
12	2			I -
13	3			V +
14	4			V -

Unmodified pucks can be supplied by Quantum Design. If you require an additional modified puck, contact Razorbill Instruments. LEMO connectors can be supplied by Razorbill instruments (no minimum order) or direct from LEMO. MMCX,



SMA, Preci-Dip headers and the LEMO connectors used outside the cryostat are also available from most electronics distributors.

Drawings of the connectors, including pin number assignments, are below.

<p>View onto mating face (fiberglass cover removed)</p>  <p>Square pad marks pin 14</p> <p>(BOTTOM VIEW)</p> <p>PPMS puck sample connector. Mates with PPMS chamber.</p>	 <p>1: Male pin (exposed) 2: Female pin (hidden) PEEK stepped connector. LEMO FGG.0S.302.ZLAT. Mates with the same.</p>
<p>View onto mating face</p> <p>Chamfer marks pin 1</p>  <p>Three connectors numbered 1-3 from left to right*</p> <p>Preci-Dip 853-87-004-10-001101 Mates with most standard headers with round pins on a 1.27mm pitch.</p>	<p>View onto mating face</p>  <p>Red dot and keyway</p> <p>Pin 1 Pin 2</p> <p>LEMO HGG.0B.302.CLLPV. Mates with any LEMO 0B.302 series plug.</p>

\* inserts or kits shipped prior to May 2019 may use coloured heat shrink to identify connectors (blue = 1, brown = 2, black = 3)

## Screw Identification (P450)

The P450 inserts are manufactured by quantum designs using US Customary screw standards UNF and UNC. To avoid confusion, Razorbill Instruments has used the same standards for screws used in modifying the P450 insert. All Razorbill instruments stress or strain cells use metric fasters throughout, so the fully assembled inserts must contain a mixture of screw standards. It is important not to use the wrong screws, as in some cases the different standards are close enough for the wrong screw to insert several turns before being damaged, or to insert fully but exhibit reduced strength. The below table identifies all the screws used in the inserts, including those supplied by Quantum Design.

Description	Material	Standard	Dimension	Quantity
<b>PEEK top plate to Insert head (upper body seal)</b>	Stainless steel	UNC	4-40 x 9/16"	8
<b>Insert head upper and lower seals</b>	Stainless steel	UNC	4-40 x 5/16"	16 (8 removed)
<b>Insert head to insert rod</b>	Stainless steel	UNC	10-24 Grub screw	1
<b>FC100 to insert</b>	Brass	Metric	M1.6 x 8	4
<b>Cell holder to insert</b>	Brass	UNC	4-40 x 3/8"	2
<b>CS100 to cell holder</b>	Brass	Metric	M2 x 3 C'sunk	2
<b>Puck to cell holder or FC100 bump guard</b>	Brass	UNF	0-80 x 3/16"	4

All screws fitting into Razorbill Instruments cells are metric. For dimensions refer to the technical drawing for the specific cell.

## Screw Identification (Cryoinsert-1)

The Cryoinsert-1 is manufactured by Razorbill Instruments except for the puck which is made by Quantum Design. All new parts are metric, but the modified pucks are the same as the P450 conversion kit so still use US customary fixings. It is important not to use the wrong screws, as in some cases the different standards are close enough for the wrong screw to insert several turns before being damaged, or to insert fully but exhibit reduced strength. The below table identifies all the screws used in the insert.

Description	Material	Standard	Dimension	Quantity
<b>Top box covers</b>	Stainless Steel	Metric	M3x10	8
<b>Top box to steel tube</b>	Stainless Steel	Metric	M5x12 Vented	1
<b>Grub screws in connector holder</b>	Stainless Steel	Metric	M3x5 Cone point	5
<b>Spring finger retaining ring *</b>	Brass *	Metric *	M1.6x4 *	4 *
<b>Insert to FC100 or cell holder</b>	Brass	Metric	M1.6x12	4
<b>CS100 to cell holder</b>	Brass	Metric	M2 x 3 C'sunk	2
<b>Cell Holder or FC100 to puck</b>	Brass	UNF	0-80 x 3/16"	4

All screws fitting into Razorbill Instruments cells are metric. For dimensions refer to the technical drawing for the specific cell.

Screws marked \* are retained by a small dot of epoxy. This is to avoid accidentally removing them when aiming for a nearby screw. If you do need to remove them, just scrape off the epoxy.

# PPMS Insert User Guide