Getting started

How can I choose the right device for my application?

All the oscillators are suitable to work as the master clock in digital to analog conversion applications. There are multiple options with different performance.

Usually you need a pair of clocks, one for each sample rate family (x44.1 and x48).

To do your choice you should look at the phase noise plot provided for each device, the lower the phase noise the best the quality of the clock. You have to look at the close-in phase noise of the oscillator, at 10 Hz and below from the carrier, because this region characterizes the short term stability that's the most important parameter in digital to analog conversion.

For example an oscillator with a phase noise of -140 dBc at 10 Hz from the carrier is much better than another with a phase noise of -100 dBc. You have to compare the phase noise of the oscillators at the same distance from the carrier (10 Hz vs. 10 Hz, 1 Hz vs. 1 Hz).

The following list enumerates the available options for each frequency and ordered by performance, from best to worst.

- 5.6448 MHz
    1) TWTMC-DRIXO 5.6448 MHz and TWTMC-EXO 5.6448 MHz
    2) TWTMC-PXO 5.6448 MHz
- 6.144 MHz
    1) TWTMC-DRIXO 6.144 MHz and TWTMC-EXO 6.144 MHz
    2) TWTMC-PXO 6.144 MHz
- 11.2896 MHz
    1) TWTMC-DRIXO 5.6448 MHz + TWTMC-DBM-F 5.6448 MHz to 11.2896 MHz and TWTMC-EXO 5.6448 MHz + TWTMC-DBM-F 5.6448 MHz to 11.2896 MHz
    2) TWTMC-DRIXO 11.2896 MHz and TWTMC-EXO 11.2896 MHz
    3) TWTMC-PXO-AIO 11.2896-22.5792 MHz
    4) TWTMC-PXO 11.2896 MHz
- 12.288 MHz
    1) TWTMC-DRIXO 6.144 MHz + TWTMC-DBM-F 6.144 MHz to 12.288 MHz and TWTMC-EXO 6.144 MHz + TWTMC-DBM-F 6.144 MHz to 12.288 MHz
    2) TWTMC-DRIXO 12.288 MHz and TWTMC-EXO 12.288 MHz
    3) TWTMC-PXO-AIO 12.288-24.576 MHz
    4) TWTMC-PXO 12.288 MHz
- 22.5792 MHz
    1) TWTMC-DRIXO 5.6448 MHz + TWTMC-DBM-F 5.6448 MHz to 11.2896 MHz + TWTMC-DBM-F 11.2896 MHz to 22.5792 MHz and TWTMC-EXO 5.6448 MHz + TWTMC-DBM-F 5.6448 MHz to 11.2896 MHz + + TWTMC-DBM-F 11.2896 MHz to 22.5792
    2) TWTMC-DRIXO 11.2896 MHz + TWTMC-DBM-F 11.2896 MHz to 22.5792 MHz and TWTMC-EXO 11.2896 MHz + TWTMC-DBM-F 11.2896 MHz to 22.5792 MHz
    3) TWTMC-DRIXO 22.5792 MHz and TWTMC-EXO 22.5792 MHz
    4) TWTMC-PXO-AIO 11.2896-22.5792 MHz
    5) TWTMC-PXO 22.5792 MHz

6) TWTMC-PPG 22.5792 MHz

- 24.576 MHz
  1) TWTMC-DRIXO 6.144 MHz + TWTMC-DBM-F 6.144 MHz to 12.288 MHz + TWTMC-DBM-F 12.288 MHz to 24.576 MHz and TWTMC-EXO 6.144 MHz + TWTMC-DBM-F 6.144 MHz to 12.288 MHz + TWTMC-DBM-F 12.288 MHz to 24.576 MHz
  2) TWTMC-DRIXO 12.288 MHz + TWTMC-DBM-F 12.288 MHz to 24.576 MHz and TWTMC-EXO 12.288 MHz + TWTMC-DBM-F 12.288 MHz to 24.576 MHz
  3) TWTMC-DRIXO 24.576 MHz and TWTMC-EXO 24.576 MHz
  4) TWTMC-PXO-AIO 12.288-24.576 MHz
  5) TWTMC-PXO 24.576 MHz
  6) TWTMC-PPG 24.576 MHz
- 45.1584 MHz
  1) TWTMC-DRIXO 11.2896 MHz + TWTMC-DBM-F 11.2896 MHz to 22.5792 MHz + TWTMC-DBM-F 22.5792 MHz to 45.1584 MHz and TWTMC-EXO 11.2896 MHz + TWTMC-DBM-F 11.2896 MHz to 22.5792 MHz + TWTMC-DBM-F 22.5792 MHz to 45.1584 MHz
  2) TWTMC-DRIXO 22.5792 MHz + TWTMC-DBM-F 22.5792 MHz to 45.1584 MHz and TWTMC-EXO 22.5792 MHz + TWTMC-DBM-F 22.5792 MHz to 45.1584 MHz
  3) TWTMC-PXO 45.1584 MHz
- 49.152 MHz
  1) TWTMC-DRIXO 12.288 MHz + TWTMC-DBM-F 12.288 MHz to 24.576 MHz + TWTMC-DBM-F 24.576 MHz to 49.152 MHz and TWTMC-EXO 12.288 MHz + TWTMC-DBM-F 12.288 MHz to 24.576 MHz + TWTMC-DBM-F 24.576 MHz to 49.152 MHz
  2) TWTMC-DRIXO 24.576 MHz + TWTMC-DBM-F 24.576 MHz to 49.152 MHz and TWTMC-EXO 24.576 MHz + TWTMC-DBM-F 24.576 MHz to 49.152 MHz
  3) TWTMC-PXO 49.152 MHz
- 90.3168 MHz
  1) TWTMC-DRIXO 22.5792 MHz + TWTMC-DBM-F 22.5792 MHz to 45.1584 MHz + TWTMC-DBM-F 45.1584 MHz to 90.3168 MHz and TWTMC-EXO 22.5792 MHz + TWTMC-DBM-F 22.5792 MHz to 45.1584 MHz + TWTMC-DBM-F 45.1584 MHz to 90.3168 MHz
  2) TWTMC-PXO 45.1584 MHz + TWTMC-DBM-F 45.1584 MHz to 90.3168 MHz
- 98.304 MHz
  1) TWTMC-DRIXO 24.576 MHz + TWTMC-DBM-F 24.576 MHz to 49.152 MHz + TWTMC-DBM-F 49.152 MHz to 98.304 MHz and TWTMC-EXO 24.576 MHz + TWTMC-DBM-F 24.576 MHz to 49.152 MHz + TWTMC-DBM-F 49.152 MHz to 98.304 MHz
  2) TWTMC-PXO 49.152 MHz + TWTMC-DBM-F 49.152 MHz to 98.304 MHz

How can I combine oscillators and frequency doublers?

The following oscillators with sine wave output are suitable to be combined with frequency doublers:

- TWTMC-DRIXO all frequencies
- TWTMC-EXO all frequencies
- TWTMC-PXO all frequencies

You have to choose the right frequency doubler for each base oscillator, for example a 5.6448 MHz oscillator needs to be combined with the TWTMC-DBM-F 5.6448 MHz to 11.2896 MHz to get 11.2896 MHz at the output, and so on.

Can I cascade frequency doublers?

Yes, you can put a maximum of 2 frequency doublers in series to get 4X base oscillator output frequency. For example you can cascade one 5.6448 MHz oscillator with one 5.6448 MHz to 11.2896 MHz frequency doubler followed by one 11.2896 MHz to 22.5792 MHz frequency doubler to get 22.5792 MHz at the output of the second doubler.

More than 2 frequency doubler in series are not recommended because you lose around 6 dBm for each duplication therefore the output level could become too low.

You have to choose the right frequency doublers for each base oscillator, for example a 5.6448 MHz oscillator needs to be combined with the TWTMC-DBM-F 5.6448 MHz to 11.2896 MHz and then with the TWTMC-DBM-F 11.2896 MHz to 22.5792 MHz to get 22.5792 MHz at the output of the last doubler.

How can I power oscillators and frequency doublers?

You need low noise regulators with these features:

- TWTMC-DRIXO and TWTMC-EXO oscillators: 12 to 18 Vdc 50/60 mA
- TWTMC-PXO oscillator: 12 to 18 Vdc 40mA
- TWTMC-PXO-AIO combo oscillator: 12 to 18 Vdc 80mA
- TWTMC-DBM frequency doubler: 12 to 24 Vdc 30mA
- TWTMC-PPG oscillator: 6.6 Vdc 25 mA
- TWTMC-STS sine to square converter: 3.3 Vdc 15 mA

You can find 3 suitable options as part of the GB:

- TWRPS-pp push-pull regulator to power up to 2 oscillators + 4 frequency doubler
- TWRPS-UGL linear regulator to power up to 2 oscillators or 1 oscillator + 2 frequency doublers
- TWRPS-LBS-P + TWRPS-LBS-M LiFePo4 battery supply system to power all the oscillators and the frequency doublers you want (even FIFO and DAC)

Do I need the Sine to Square converter?

Unless you are planning to use our new FIFO board (TWSAFB) that already have the squarers on board you need the TWTMC-STS sine to square converter to interface the sine wave output of the oscillators and the frequency doublers to digital devices (FIFO, DAC and so on).

You need a sine to square converter for each sine wave output you have to connect to digital devices.

There are two different Sine to Square converter boards, the only difference between them is the pins layout, to be stacked correctly onto Ian's FIFO stuff:

- TWTMC-STS-SX: Dual XO board, McFIFO, FifoPi
- TWTMC-STS-DX: McFIFO, FifoPi

What is the difference between finished and semi-finished boards?

Finished boards are supplied fully assembled and tested. The crystals for the oscillators are packed separately to avoid damages during shipping, therefore you have only to solder the crystal on the oscillator board. Aluminum cases are not included.

Semi-finished boards are supplied with part of the components already assembled, the remaining parts have to be sourced and soldered by the user itself. Most of the components to be assemble are through hole parts, the other are a few SMD parts not very difficult to solder.

What skills do I need to go with semi-finished boards?

You should have the ability to solder some SMD components like 0805, 1206 and SOIC packages.

Moreover you need a oscilloscope to test the board if it does not work properly once it was fully assembled.

The oscilloscope is the minimum necessary tool otherwise we cannot provide any support in the event of a malfunction.

Where can I source the missing parts to assemble the semi-finished boards?

You can source the parts from Mouser or Digi-Key.

The BOM for each device has been published with a downloadable spreadsheet. You can simply upload the spreadsheet on Mouser website to place the order with a few clicks.

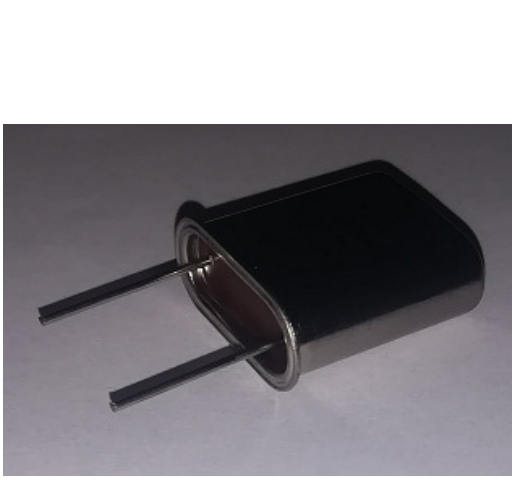
Soldering the crystal

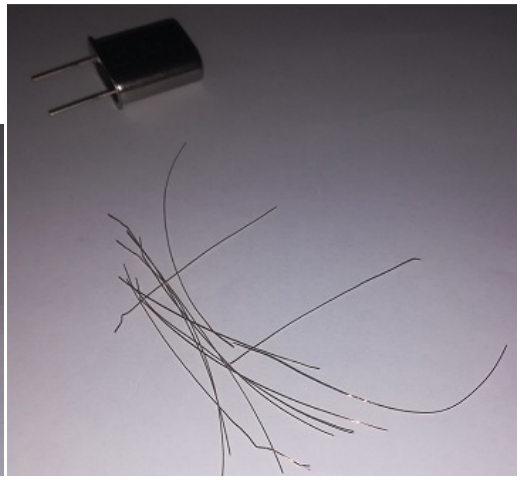
The following figures show how to proper install the crystal on the oscillator board.

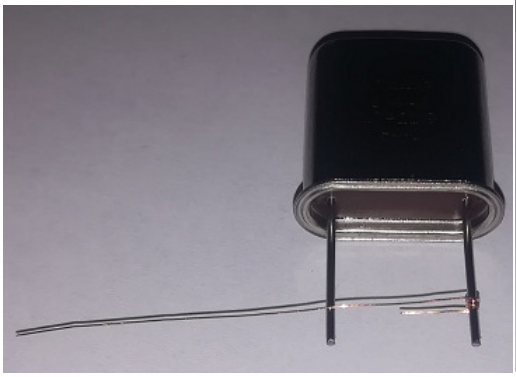
This way helps to reduce the effect of vibrations that can affect the phase noise performance of the oscillator.

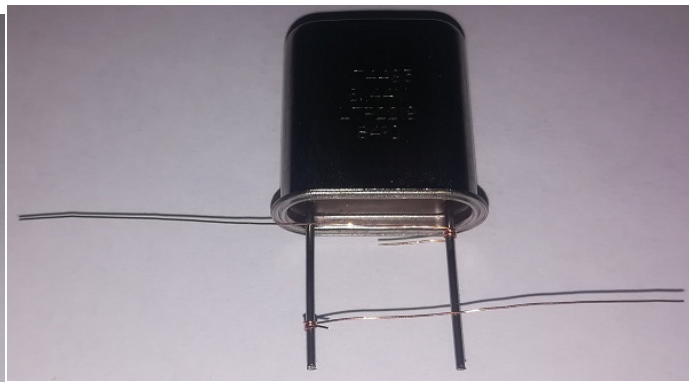
Moreover this way also provides a little thermal stability to the oscillator circuit.

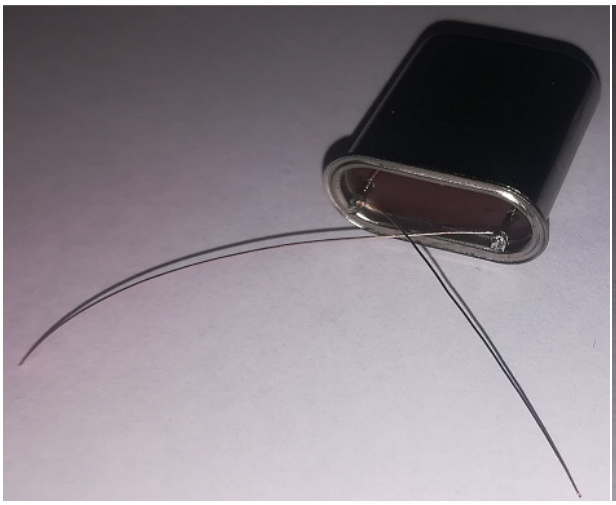
You can use a pair of neoprene cylinders to decouple the crystal from the board, then you can wrap the oscillator section with a polyester fiber or wool foil.

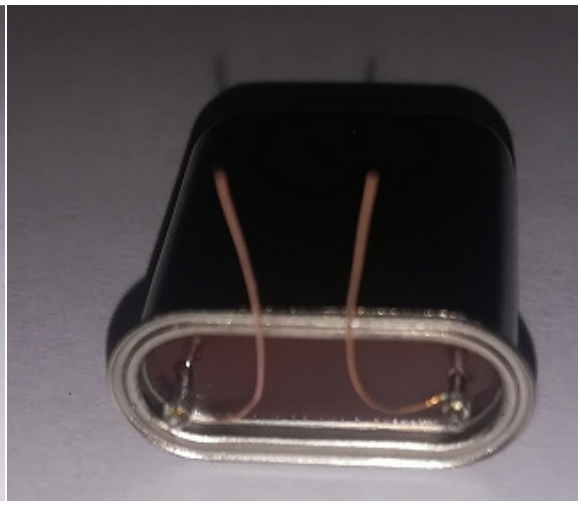




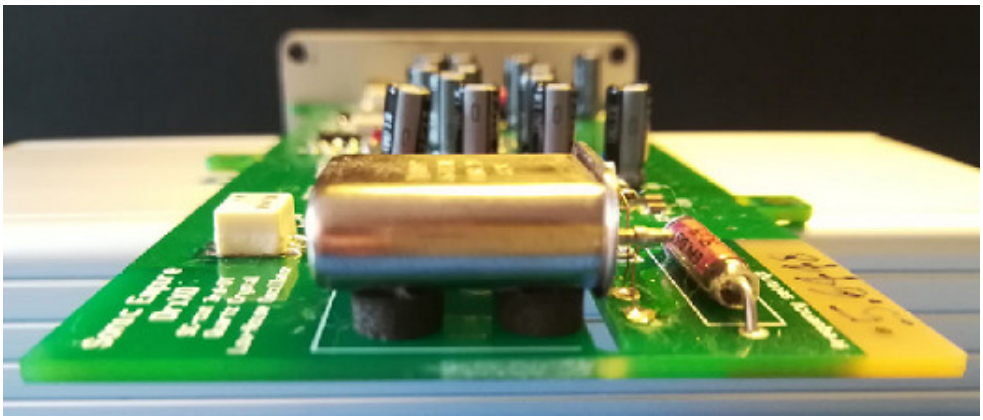


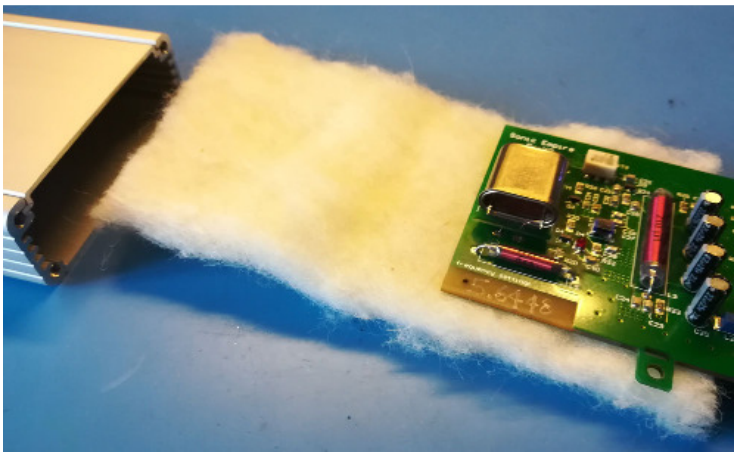


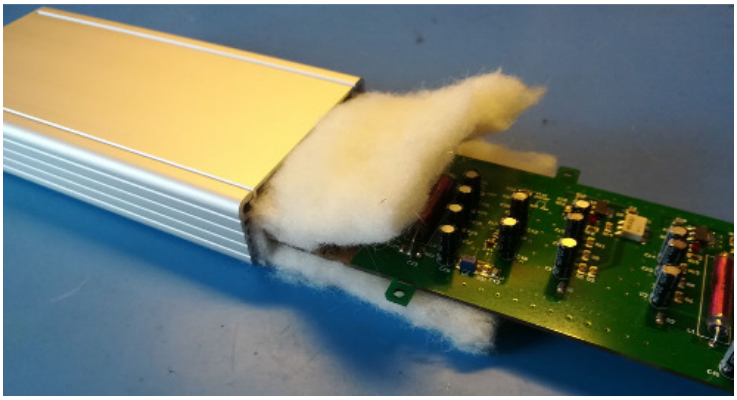


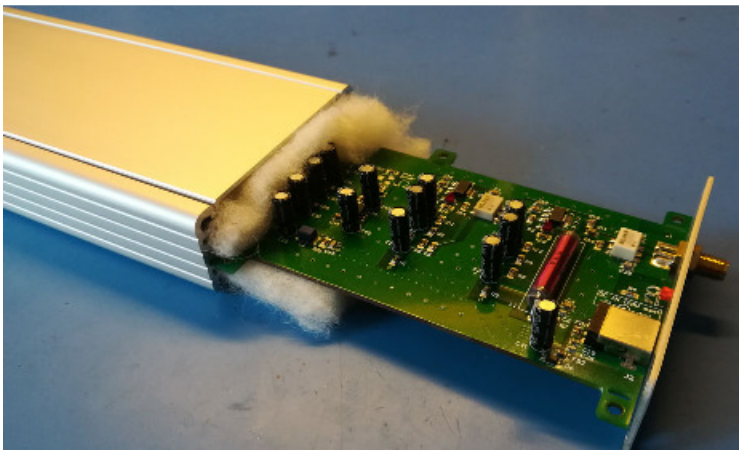


Soldering copper wires to the crystal legs.





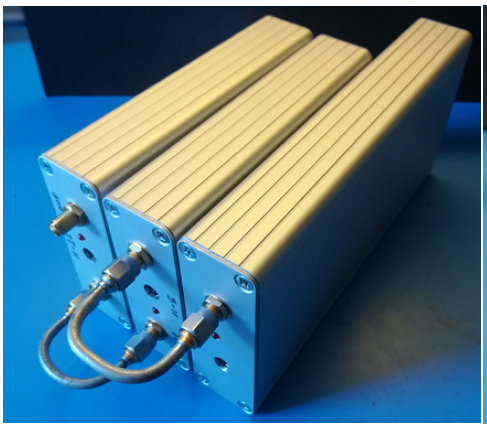


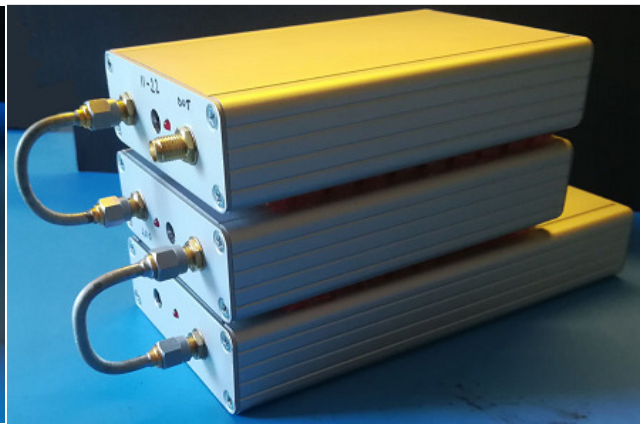


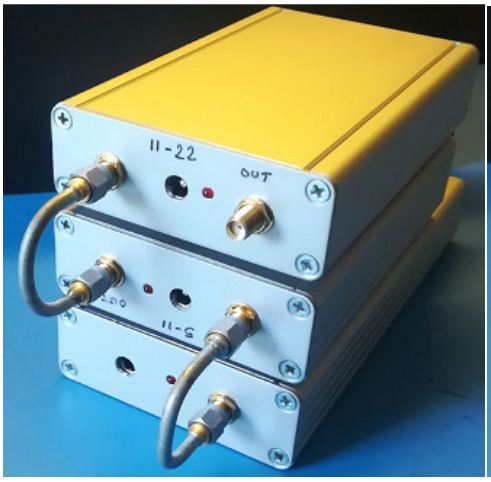
Vibrations and thermal coupling

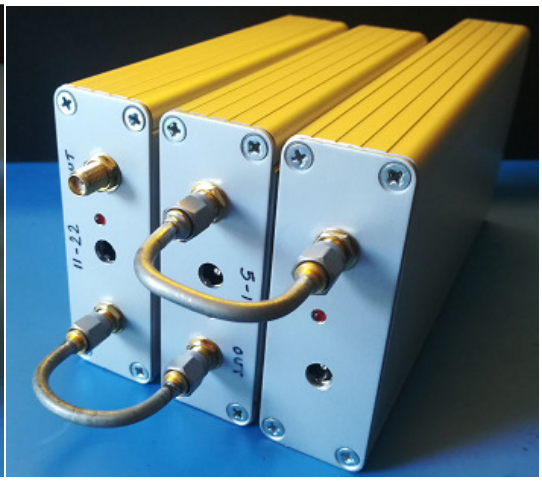
Shield and connect oscillators and frequency doublers

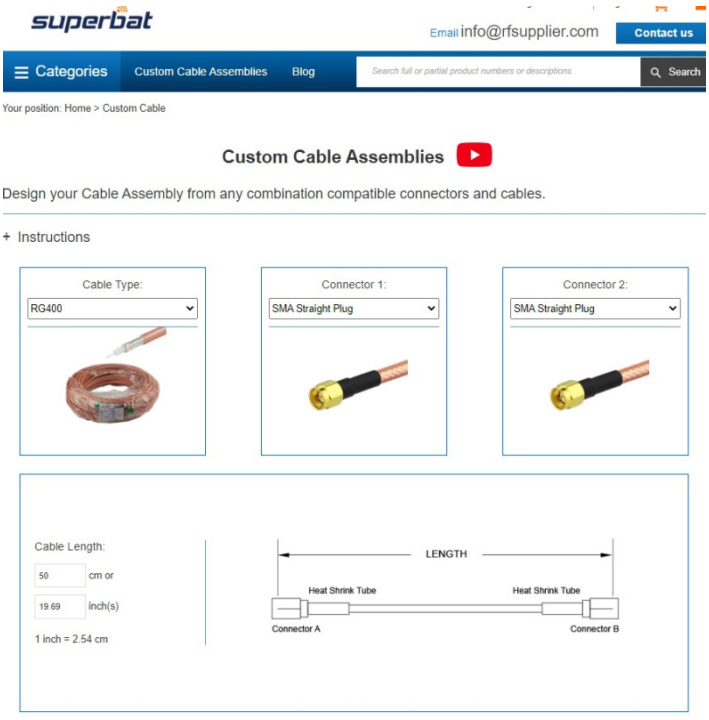
The following pictures show the best way to shield and connect oscillator and frequency doublers. The longer box is the oscillator, the shorter boxes are the frequency doublers.









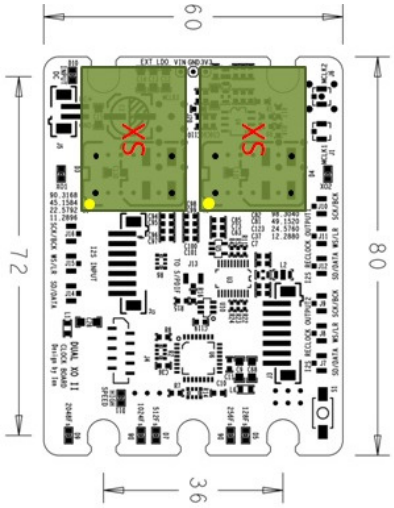


Semi- SMA plug connectors and RG400 semi-rigid cable have been used to connect the devices.

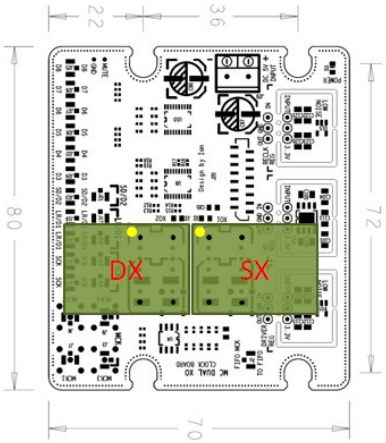
Fit the TWTMC-STS Sine to square converter into Ian's FIFO

The following pictures show the correct placement of the TWTMC-STS-SX and the TWTMC-STS-DX boards on Ian's FIFO buffer devices.

The Dual XO clock board needs 2 x TWTMC-STS-SX as in the following figure.



The MC Dual XO board needs 1 x TWTMC-STS-SX + 1 x TWTMC-STS-DX as in the following figure.



The FifoPi board needs 1 x TWTMC-STS-SX + 1 x TWTMC-STS-DX as in the following figure.