

McDualXO multi-channel Clock Board user's guide

By Ian Jin, Jun 6, 2017 Ver. 1.0b

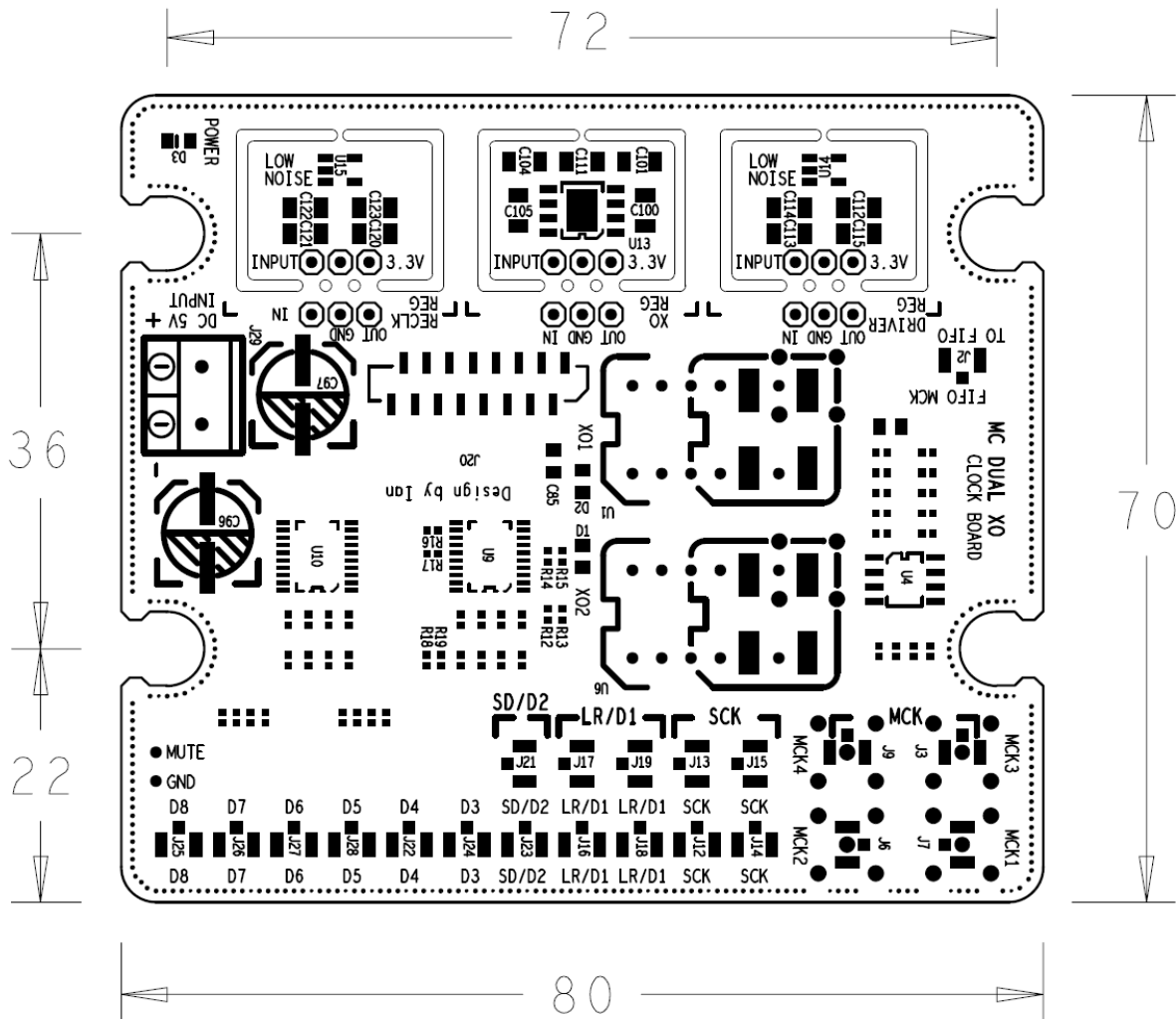
A. Introduction

The McDualXO is a multi-channel multi-frequency clock board which was designed especially for McFIFO to improve sound quality by utilizing ultra-low jitter technologies. It comes with automatic Fs switching, dedicated low jitter fan-out buffers, ultra-low noise LDO and ultra-high speed re-clocking. Multi-layers PCB design, enhanced power supply design, impedance controlled traces and many other improvements work together to ensure outputting highest quality digital audio clocks and signals.

B. Features and Specifications

- Has 4 MCLK, 4 SCK, 4 LRCL/D1, 2 SD/D2 and each of D3-D8 signals output, so McDualXO can drive up to 4 mono block/independent DACs at same time.
- 14 channels for I2S or 8 channels for DSD.
- All outputs are in U.FL coaxial cable connectors/sockets to optimize for signal integrity.
- Has 3 dedicated and upgradeable ultra-low noise LDOs for XO, clock fan-out buffer and re-clocking. The 0.9uV RMS, 90dB PSRR, 600mA on-board ADM7154 is especially optimized for OCXO.
- XO frequency range from 11.2896MHz to 98.3040MHz.
- XOs with different frequency range can work together at same time.
- XO can be plugged into any socket without limitation.
- MCLK * Fs range: 128*Fs, 256*Fs, 512*Fs, 1024*Fs, 2048*Fs, 4096*Fs.
- Anti-vibration grommet suspension mechanism design for low jitter applications.
- Can be stacked on top of McFIFO.

C. Layout and Dimensions (in mm)



D. Connectors

-DC power input: J29

A 5V-6V DC power supply must be connected to this 2-pin 5.0mm terminal for the McDualXO to operate. McFIFO consumes around 100mA average current with normal 45.1584/49.1520MHz XOs. It could be a little bit higher when works with higher frequency XOs. If you use OCXOs or other kind of higher current oscillators, You MUST add the extra current to determine the current output for your power supply. Generally use a supply that provides 300mA as a minimum. Right side of the McFIFO on board isolator is also powered by this power supply.

- MCLK outputs in U.FL: J3, J6, J7, and J9

J3, J6, J7 and J9 are equivalent in function but driven by different drivers. J9 is not installed as supplied. Please assemble a SMT U.FL socket as needed.

*Footprints of SMA RF coaxial cable connectors are also reserved for some applications. Remove U.FL sockets then assemble SMA connectors if needed.

- SCK outputs in U.FL: J12, J13, J14, and J15

J12, J13, J14 and J15 are equivalent in function but driven by different drivers. SCK signal is for both I2S and DSD.

- LRCK/D1 outputs in U.FL: J16, J17, J18, and J19

J16, J17, J18 and J19 are equivalent in function but driven by different drivers. This signal is shared by I2S and DSD. It's LRCK for I2S or D1 for DSD.

- SD/D2 outputs in U.FL: J21, J23

J21 and J23 are equivalent in function but driven by different drivers. This signal is shared by I2S and DSD. It's SD for I2S or D2 for DSD.

- D3-D8 output in U.FL: J24, J22, J28, J27, J26, J25

Digital music data signals. These signals are also shared by I2S and DSD.

- FIFO MCLK output in U.FL: J2

This output must be connected to J16 MCLK input of McFIFO by a U.FL cable to operate.

- McFIFO interface J14, 16pin 1mm FFC/FPC connector

This connector must be connected to J14 of McFIFO by a 16pin 1mm FFC/FPC jumper cable to operate.

- Isolated mute DAC signal: MUTE and GND

Normally we don't need this signal. However some DAC may have noise when switching between different Fs or format. Try this signal for your DAC if you have this issue. MUTE is active high.

E. XO oscillators

Two sockets for XOs are U1 and U6. Both or at least one of them must be installed with proper XO. Standard DIP 3.3V clock oscillators with 14- or 8- pin configurations are available for U1 and U2. SMT oscillators are also available by using SMT XO adapters. For external oscillators, two reserved SMA RF connectors footprint can also be used.

XO frequencies have to be selected from the following two frequency groups.

XO oscillator frequency group1		Fs supported			
		44.1KHz	88.2KHz	176.4KHz	352KHz
XO Frequencies can be used *	11.2896 MHz	✓	✓		
	22.5792 MHz	✓	✓	✓	
	45.1584 MHz	✓	✓	✓	✓
	90.3168 MHz	✓	✓	✓	✓

XO oscillator frequency group2		Fs supported			
		48KHz	96KHz	192KHz	384KHz
XO Frequencies can be used *	12.2880 MHz	✓	✓		
	24.5760 MHz	✓	✓	✓	
	49.1520 MHz	✓	✓	✓	✓
	98.3040 MHz	✓	✓	✓	✓

*XOs have to be selected from two different frequency groups but don't have to be in pair. For example, a 22.5792 MHz XO can work together with a 49.1520 MHz XO.

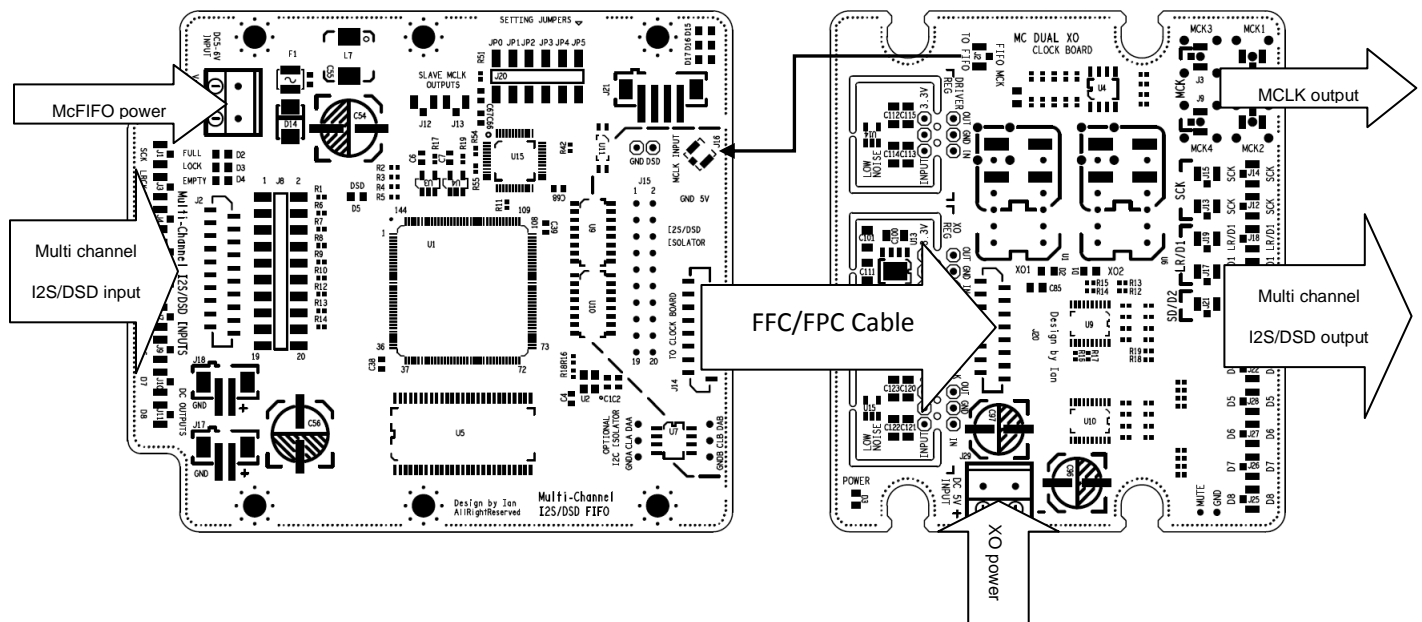
*XOs can be plug into any of the two sockets (U1, U6) without limitation, except there is special requirement when McFIFO is in slave control MCLK mode.

*Single XO can also work for music with supported Fs.

F. LED indicators

LED	Descriptions	Notes
D3	POWER	On if McDualXO power supply is present (viaJ29)
D2	XO1	On when XO in U1 is selected currently for MCLK
D1	XO2	On when XO in U6 is selected currently for MCLK

G. Using McDualXO clock board with McFIFO



H. Application Notes and Tips

- XO Selection

The McFIFO itself does not improve the sound, the clocks do. So, selecting a pair of really nice low jitter clocks for the Dual XO II Clock board is very important. The two XO clock oscillators supplied with the board are just generic ones. It is strongly recommended to replace them with better clocks to boost the sound quality. The CCHD-957 series XO oscillators from Crystek have been tested and found to be a good choice at a reasonable price. OCXOs with better phase noise performance are highly recommended. Trying different clock oscillators for better sound is an interesting experience.

-Upgradable LDO regulators

McDualXO has three independent and upgradable 3.3V LDO regulators U13, U14 and U15. U13 is for the XO oscillators. U14 is for MCLK drivers. U15 is for re-clocking circuits. They are all ultra-low noise LDO regulators. U13 has 0.8uV RMS noise level with up to 600mA output current (optimized for OCXO). U14 and U15 have 10uV RMS noise level with up to 250mA output current. They are designed as independent LDO boards with small bridges linked to McDualXO PCB. Each of them can be broken apart from McDualXO PCB and replaced with higher grade LDO board at same position. Removed LDO board can be used as standard 3.3V low noise regulator board.

- Power direct from a 3.2V LiFePO4 battery cell

It is possible to use 3.2V LiFePO4 battery cell directly as DC power. To do so, we need a couple of steps:

1. Remove all of the three LDO boards from McDualXO PCB.
2. Short "IN" and "OUT" pins with jumper wires at all of three LDO board positions on McDualXO PCB.

3. Connect a 3.2V LiFePO4 battery (i.e., a single cell or multiple cells in parallel) using the battery management board (available separately) to DC input connector J29 (XO power).

-Enable pin of the XOs

Many XO oscillators have an enable pin (normally it's pin1 for oscillators with 14- or 8- pin configurations). The output is enabled when the pin is high ($> 0.7 \times V_{cc}$) or open. The output is disabled (High-Z) when the pin is low. If a particular XO is not being selected for MCLK output, the control signal from the socket disables the XO by driving the enable pin low. Usually this does not present a problem because switching between states is very fast. However, some XOs take longer to switch. For example, the Crystek CCHD-957 takes 1 ms. That delay will generate a little switching noise on some DACs. This problem can be solved in one of the following ways:

1. Use the isolated MUTE signal from McDualXO. It will mute the DAC output during the moment of switching;
2. Or just leave the enable pin of that XO open without connecting into the socket to make that XO running all the time.

-XO frequency and the sound

For a given F_s , different XO frequency may make DAC sounding slightly different. It was caused by DAC internal logic configuration. For example, to play a 44.1 KHz audio stream at some DAC chip (not all), with 22.5792 MHz (512 F_s) and 11.2896 MHz (256 F_s) XO installed on socket, I found the stereo stage changed a little bit. So please try and select XO frequency according to your personal preference.

- Potentials of generic XO clock oscillators

For some generic XO clock oscillators, the internal crystal may not be that bad. The problem is usually that generic oscillators do not have good power supply and driver. In many cases, if fed with a high quality, low noise power supply and interfaced with a low jitter fan-out buffer, they will perform better than originally.

-XO warm-up time

Please keep in mind that all of XO oscillators need warm-up time before really going sweet after power up, from a couple of minutes to half hour (even longer for some of them). So please wait for a while before you making any evaluation.

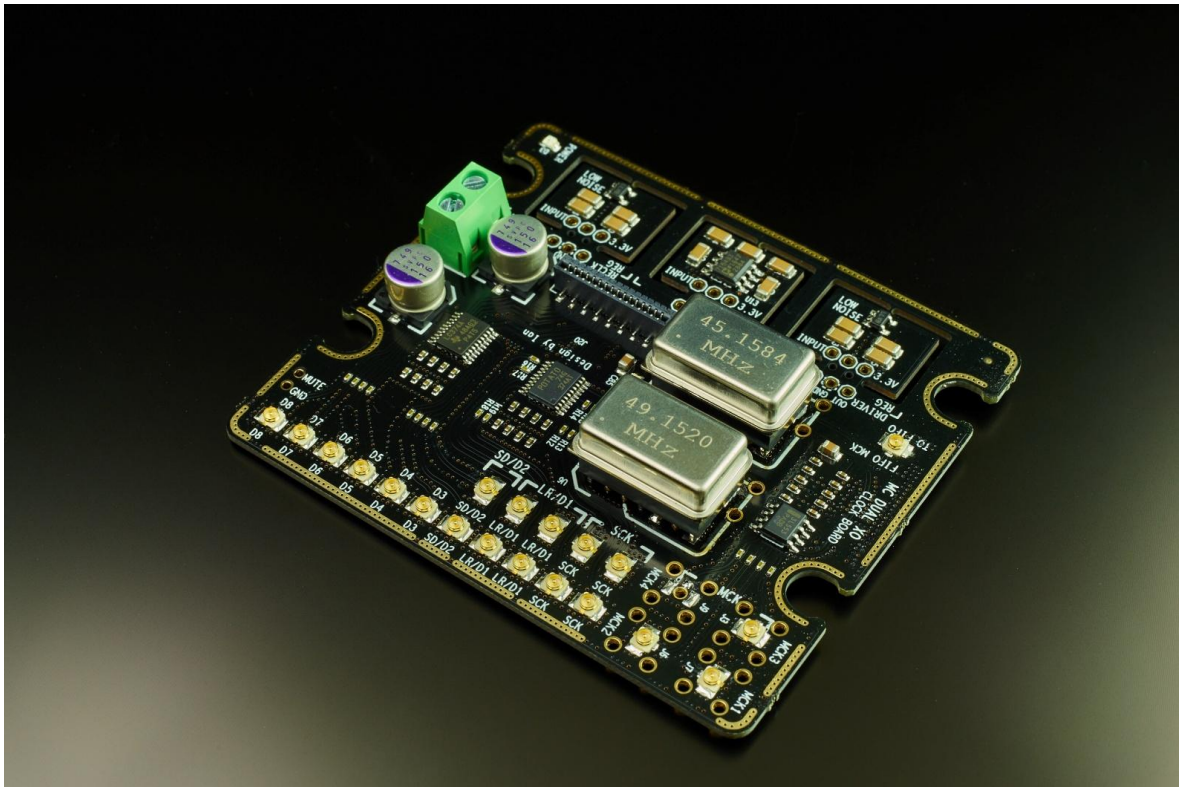
-Driving DACs in dual-mono or multiple configuration

The McDualXO clock board was designed natively to support DACs operating in a dual-mono or multiple configurations. Up to 4 independent DACs can be connected to McDualXO with 50 Ω U.FL coaxial cables at same time. The cables of clock signals must be of the same length so that they can arrive at same moment for each DAC. This is because every inch of U.FL cable causes a delay of roughly 120ps! (Assuming the cable's velocity of propagation is 0.7C).

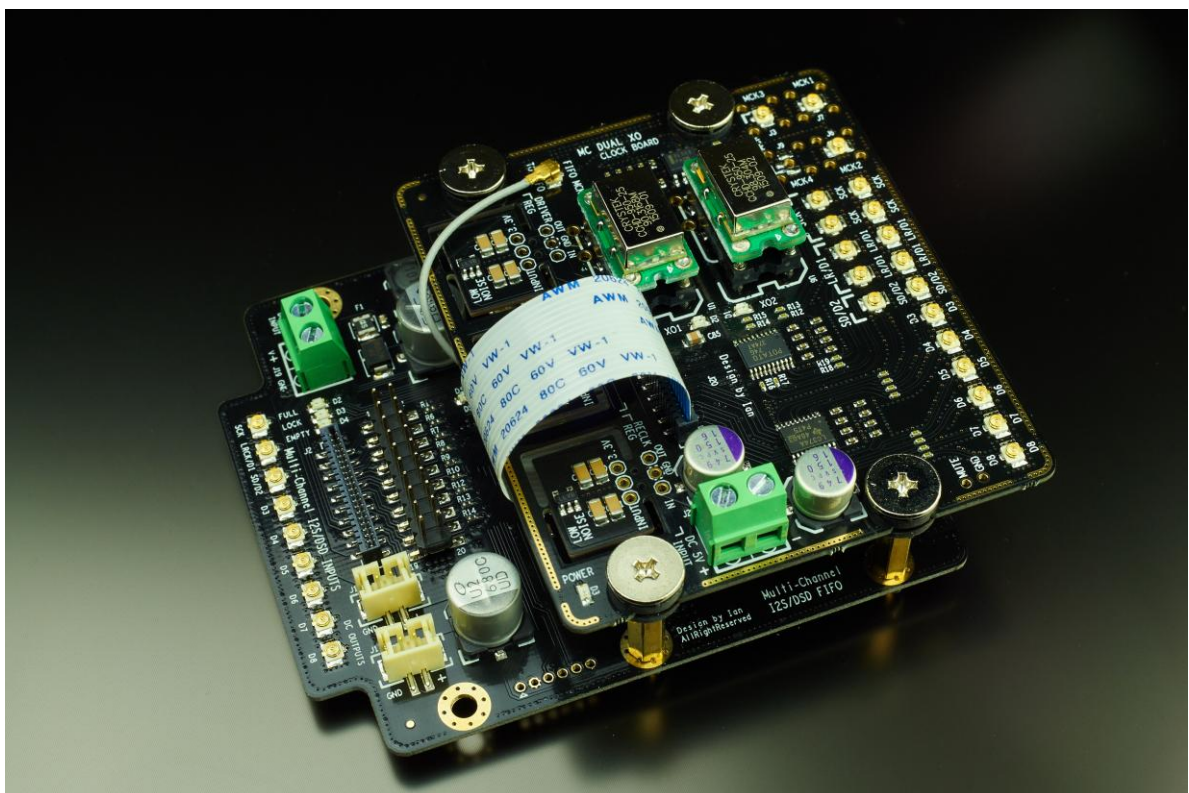
-Anti-vibration grommet suspension

Anti-vibration grommet or other anti-vibration suspension solution is highly recommended to McDualXO clock board. Anti-vibration screw grommet set can be sourced from DigiKey or other distributors. 767KE-ND is one of the part numbers. Pick up the correct part number to match your standoff.

I. McDualXO picture



McDualXO



Works with McFIFO

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