MC20 Product Manual

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1. Safety & Precautions

1. Be careful not to damage the device due to improper handling or dropping.

(Please note: The rubidium module is especially sensitive to physical shock)

2. Do not disassemble the device.

3. Avoid exposure to oil, dust, water, high humidity or smoke.

4. Ensure that there is at least 2" of space on each side for proper ventilation.

5. Cleaning: use a soft non-abrasive cloth to gently wipe the outside of the device. Water or other cleaning solutions should be avoided.

6. Should the product require hardware repair, work must be performed only by qualified technicians of Aurender headquarters or distributors/dealers. Failure to observe this precaution will void the warranty.

7. Shut down or unplug the power cable when not in use for an extended period or when there is severe lightning.

8. Be sure to shut the unit down when connecting or disconnecting cables.

9. Do not stack objects on top of MC20 and do not expose to water or liquid.

11. MC20 is very heavy and can generate significant heat, so be very careful when moving the device to avoid personal injury.

2. Product Warranty

Remote technical support is always free and available for any Aurender owner, regardless of warranty status. In the unlikely event of hardware repair becoming a necessity, Aurender's manufacturer's warranty covers the cost of parts, labor, and return shipping for 2 years following the purchase from an authorized Aurender dealer. The warranty is non-transferrable. Damage caused by improper use or damage caused by repairs or modifications by individuals other than the manufacturer or its dealers is not covered by the warranty even within the warranty period.

Warranty claims and technical support inquiries can be made via email to support@aurender.com.

No registration is required for Aurender products. Please simply retain your dated receipt/proof of purchase for any warranty claims.

3. Product Overview

With the superior clock signal provided by MC20, users will experience elevated and refined performance of connected Aurender music servers and compatible DACs. MC20 is an ultra high-precision Master Clock and Word Clock generator for use in high performance home audio systems. MC20 is equipped with a rubidium module to generate a stable and low phase noise 10MHz Master Clock reference signal. Simultaneously, it contains 2 discrete OCXO clock modules for generating 44.1 kHz and 48 kHz base Word Clocks. MC20 independently and simultaneously supplies four 10MHz Master Clock outputs and four Word Clock outputs (2 at 44.1 kHz and 2 at 48 kHz base groups).

"Master" Clock vs. "Word" Clock

Unfortunately, these terms have been used somewhat interchangeably in the world of high end audio (both in home and pro audio applications), and the distinction between what these two terms represent has become quite unclear. They operate in very similar ways, but there is a subtle difference:

Word Clock signal is switchable in multiples of 44.1 or 48 kHz according to the sample rate of the digital word. So, during playback of a digital audio signal, it is important for the Word Clock signal to match the sample rate frequency of the file/source being played. Therefore, MC20's Word Clock output is switchable "on-the-fly" to match the sample rate of the content being played.

Master Clock signal, on the other hand, is not related to the sample rate being played and it is typically not switchable. A Master Clock generates an extremely high frequency (10 MHz) "reference" signal which is used to instruct and stabilize the performance of a Word Clock down stream. The Master Clock will typically relate to a switchable Word Clock signal down stream.

Depending on the needs of the user and the characteristics of the connected audio equipment, the following use cases and connections are available:

- Simultaneously supply 10MHz Master Clock reference signal to source devices such as an Aurender music server and "sync" devices such as DACs

- Supply 10MHz Master Clock reference signal to source devices and ancillary Word Clock devices with Master Clock input (eg, dCS Vivaldi Clock)

- Supply 10MHz Master Clock to source devices such as Aurender Music Server and Word Clock to DAC

- Supply switchable Word Clock to source device and DAC

In listening and laboratory testing environments, MC20's 10 MHz rubidium Master Clock reference signal has been determined to provide superior performance compared to the OCXO Word Clock outputs. Every Aurender with clock input is compatible with the 10 MHz Master Clock signal, so that is what should be used to connect to your Aurender. Some DACs will be compatible with 10 MHz clock inputs. For those DACs, Aurender recommends using MC20's 10 MHz Master Clock output. For DACs that only accept 44.1 kHz or 48 kHz Word Clock inputs (and multiples thereof), MC20's dual OCXO clock generators will still offer enhanced and synchronized performance.

Oven-Controlled Crystal Oscillator (OCXO)

OCXOs are among the most accurate and stable clocks in use today. OCXOs are orders of magnitude more accurate and stable than commonly used ordinary crystal oscillators usually found in computers. Temperature changes can cause crystal oscillations to fluctuate and induce jitter in the digital audio signal. Moreover, ordinary crystals are much less stable and lose accuracy over time. In OCXO clocks, a very stable high grade crystal oscillator is enclosed in a temperature-controlled compartment and kept at a constant temperature to mitigate jitter.

Modular Rubidium Master Clock Generator

Although OCXO clock modules can be found in a growing variety of finer digital home audio products, MC20's Rubidium (aka "atomic") Master Clock module sets this product apart in a rarefied league. Offering significantly lower phase noise and higher stability in both the long and short term than comparable models, MC20's Rubidium Master Clock module sets a new standard in timing precision and stability.

4. Installation

4-1 Equipment and included accessories

The following equipment and accessories are included in the box:

- MC20 unit
- Rubidium module
- Power cable
- 2x SPDIF BNC cables (75Ω)
- 2x SPDIF BNC cables (50Ω)
- Quick Start Guide

4-2 Positioning MC20

1. Place the MC20 on a level, stable surface.

2. Place MC20 as close as possible to connected devices.

3. Use the shortest cables possible to connect to other devices.

4. Keep away from direct sunlight or heat source.

5. Keep away from water, condensation, and high humidity.

6. Do not stack other items on top of the MC20 or it may prevent proper heat dissipation.

7. Leave at least 2" of space on all sides of the device for ventilation.

4-3 Installing Rubidium Module

MC20's rubidium clock module is especially sensitive to vibration and physical shock. To prevent damage caused by external shocks during transportation, the rubidium module is packaged in a separate shock absorbent enclosure. Upon initial installation, the rubidium module included in the box must first be installed inside the MC20 enclosure. No tools or special skills are required to insert the rubidium module into its modular port on the MC20. Please follow the steps below and refer to the illustrated diagram:

Before installing the rubidium module, turn off and disconnect the power cable from MC20.

1. Loosen the thumb screws of the rubidium module access panel on the back of the MC20 and remove the panel.

2. Loosen the thumb screw on the locking lever handle of the rubidium module and open the lever as wide as possible.

3. 1. Carefully slide the module into the enclosure. Then, hold only the lever with the handle open as far as possible and push the module all the way in until you feel it touch the back of the enclosure. Do not apply excessive force - this step requires only a gentle push to get the module into the locking position. 2. Close the handle on the locking lever. This action joins the module and the MC20 body.

4. Tighten the thumbscrew on the handle to lock the module in place.

5. Re-install the access panel cover of the rubidium module enclosure on MC20 and tighten the screw.
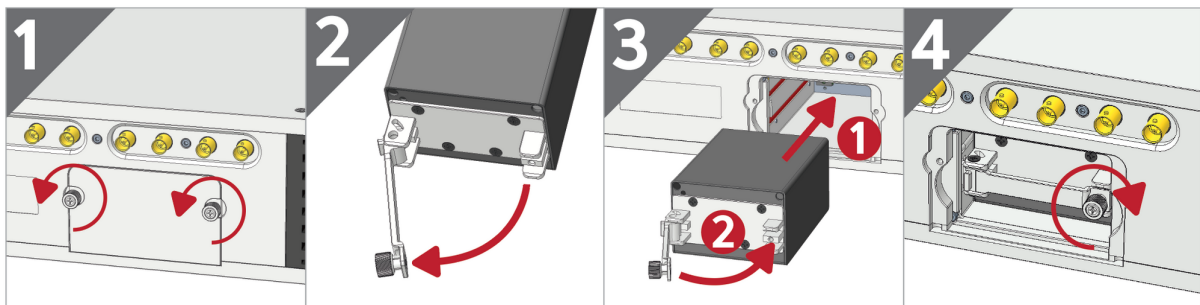
4-4 Cable Preparation

2 pairs each of 75Ω and 50Ω SPDIF cables are supplied with MC20. Please refer to the manuals or manufacturers of devices that will receive clock input from MC20 to determine which impedance cable should be used. Use 75Ω cables with your Aurender source component.

The generic cables included with MC20 are of good quality, but many audiophiles agree that even better performance can be achieved with higher quality cables. If you choose to use upgraded cables, the most important thing is end-to-end impedance matching to avoid signal loss and reflections in the cable run.

When connecting cables, both the MC20 and other devices connected should be turned off.

4-5 Turning MC20 On and Off

To turn MC20 on, first flip the rear AC switch to the "On" (I) position. The LED halo around the power button should now be illuminated in red. Next, press and release the front power button. The LED halo will fade from pink to blue. When the LED halo is blue, MC20 is on and ready to use.

Note: The "Lock" LED indicator will flash on and off until the rubidium module has reached optimal internal temperature. This can take a few minutes. The "Lock" LED indicator will retain a solid blue light once the optimal temperature has been reached.

To turn MC20 off, first press and release the front power button. The LED halo will fade to red. When the LED halo is illuminated in solid red, turn off the rear AC switch to completely cut power to the unit.

In order to maintain ideal temperature, Aurender recommends leaving MC20 on at all times except when it will not be used for an extended period or experiencing power outages or electrical storms in your area.

5. Anatomy of MC20

Front Panel
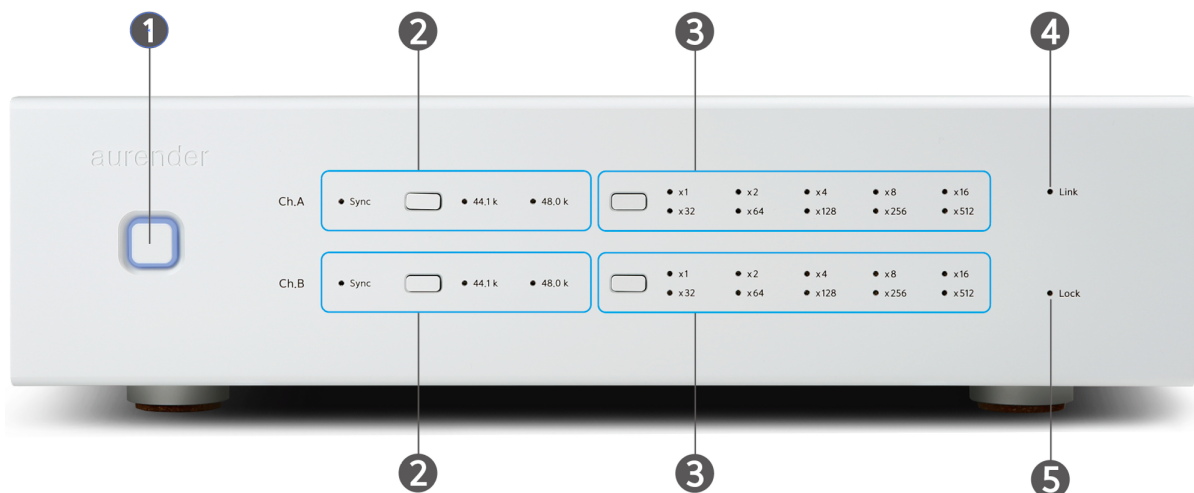
1. **Power Button:** Press the button to power on/off the MC20. The LED halo on the border of the button indicates the status of the device. In "off" mode, the light is red/pink. In "on" mode, it is displayed in white/blue. The LED halo will blink while MC20 is booting up or shutting down.

2. **Word Clock Base Selection Buttons and LED indicators**: Press the button to toggle between 3 Word Clock Base modes. After pressing the toggle button, the LED indicator next to the selected option will blink for 5 seconds before locking to the selected Word Clock setting:

- **"Sync" mode** - MC20 will automatically output the correct Word Clock base frequency depending on the sample rate of content being played by the source component. In order to activate Sync mode, MC20 must receive an incoming SPDIF connection from the source component. In Sync mode, the "Sync" LED and the base clock 44.1KHz LED or 48.0KHz LED indicators for the sample rate of the source are automatically linked and turned on each time playback is initiated.

- **"44.1 K" base mode** - set channel's output frequency to 44.1 kHz base mode

- **"48.0 K" base mode** - set channel's output frequency to 48 kHz base mode

The LED lights indicate which mode is active. Channel A and channel B can be set independently. See section 7.3-7.5 for connection diagrams.

3. **Clock Multiplier Button and LED**: In conjunction with the Word Clock Base selection button, each press of this button determines the multiplier of the selected base clock. It changes sequentially in multiples of the base sample rate x1, x2, x4, x8, x16, x32, x64, x128, x256, x512, and the corresponding LED indicates which multiplier is active. For example, If the Word Clock output to be set is 88.2 KHz, the base clock is 44.1.KHz and the clock multiplier button is x2.

After pressing the toggle button, the LED indicator will blink for 5 seconds before locking onto the selected position. Channel A and channel B can be set independently.

In Sync mode, the Sync LED, base clock 44.1KHz LED or 48.0KHz LED is turned on, and the corresponding base sample rate multiplier LED is automatically linked and turned on in accordance with the initiation of playback.

4. **Link LED** : This LED is reserved for future use. It is normally off.

5. **Lock LED** – The rubidium module takes a few minutes (depending on external temperature, 2-10 minutes) to reach the optimal temperature after turning MC20 on. The "Lock" LED will blink on and off until the rubidium module is optimized, at which point, it will stop blinking and be solidly illuminated.

Rear Panel
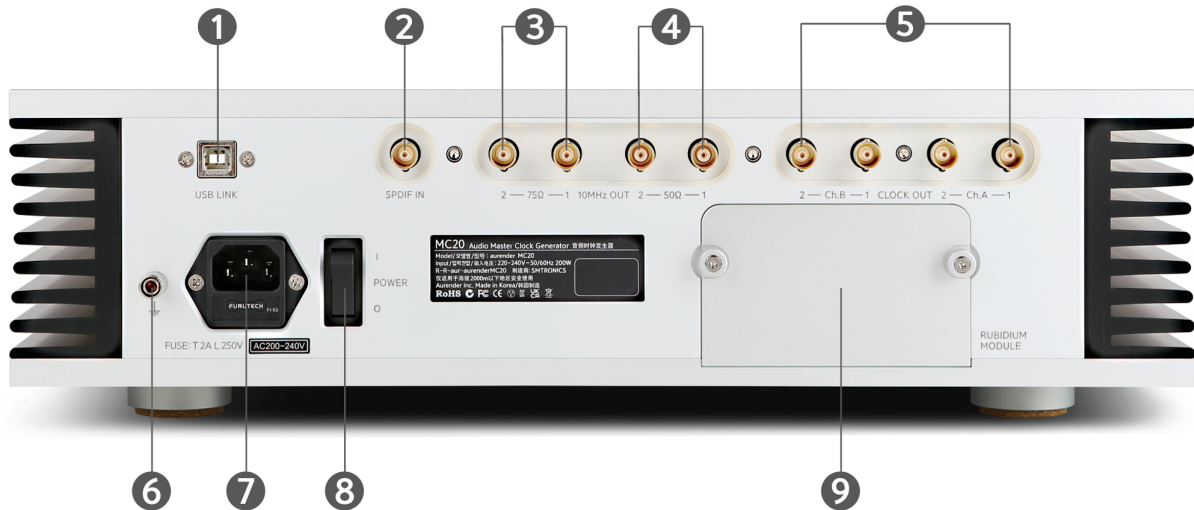
1. **USB Port** - Connect to Aurender source to automatically install updates. Reserved port for maintenance service and future use. This is NOT an audio input/output.

2. **SPDIF IN** (BNC Type, 75Ω) – Connect a SPDIF cable from your source device (eg, Aurender player) SPDIF output to enable MC20 to detect the sample rate of incoming signal and automatically sync Word Clock output to match ("Sync Mode"). Learn more about Sync Mode in section 6 of this manual.

3. **10MHz Out** (BNC Type, 75Ω) – Output port for 10MHz Sine Wave Master Clock. For use with 75Ω input devices. (Consult the other device's manual to ensure you are using the correct impedance output. Always use a corresponding cable that matches the impedance of the output/input). 2 ports are provided for connecting 2 devices if applicable.

4. **10MHz Out** (BNC Type, 50Ω) – Output port for 10MHz Sine Wave Master Clock. For use with 50Ω input devices. (Consult the other device's manual to ensure you are using the correct impedance output. Always use a corresponding cable that matches the impedance of the output/input). 2 ports are provided for connecting 2 devices if applicable.

10 MHz Master Clock outputs operate independently from the Word Clock outputs.

5. **Word Clock Out** (BNC Type, 75Ω) – Word Clock outputs to connect with a DAC or other devices in your signal path. Word Clock output frequency is user-selectable. All outputs are active at all times. See section 6 of this manual for more information.

Two channels of Word Clock output are included for use with devices which may have separate clock inputs for 44.1 kHz and 48 kHz base sample rates, respectively. Each channel has two outputs which operate at the same frequency at all times.

6. **Ground** - Connecting audio devices with a ground terminal to match the ground level can stabilize operation and enhance audio performance, however it is optional to connect a ground cable and no harm will come from omitting this connection.

7. **AC power connector and fuse** – Connect IEC power cable. Fuses are user-replaceable.

(Fuse specification - Capacity: 2A / 250V, Size: 5mm x 20mm, Type: Slow-blow)

8. **AC power switch**: The AC power switch governs AC current to MC20. To power on MC20, first turn the AC power switch to the "on" position. Then, press the front power button to boot up MC20. "I" equals on, "0" equals off.

9. **Rubidium Module Enclosure** – See section 4-3 for installation information.

6. Word Clock Output Settings

Word Clock signal is generated in multiples of 44.1 kHz and 48.0 kHz, depending on the sample rate of the audio content being played. The Word Clock output frequency is indicated by the illuminated base clock frequency LED and associated multipliers (see section 5.2-5.3). MC20 features 2 discrete channels of Word Clock outputs as some devices have separate clock inputs for 44.1 kHz and 48 kHz sample rate base groups, respectively. Each channel has 2 outputs which will output the same clock frequency simultaneously.

Channel-specific Word Clock output frequency can be set manually, but most users will prefer to use Sync Mode for automatic sample rate detection and adjustment on-the-fly.

Sync Mode

Sync mode automatically outputs a precise Word Clock signal corresponding to the sample rate of the audio signal input from the SPDIF terminal of the source device. Sync mode is selected by pressing the base clock button of Channel A or Channel B to toggle the "Sync" setting. The LED indicator will blink on/off for 5 seconds before it locks onto the selected setting. In order to operate Sync mode, connect a SPDIF BNC output of the source device into the SPDIF input of the MC20 with a 75Ω cable. In Sync mode, the base clock and sample rate multiplier settings are automatically tuned according to the sample rate of content being played.

Manual Mode

In manual mode, the user sets the Word Clock manually. No automatic changes will occur in accordance with changing sample rate of audio content. After selecting the base frequency (44.1 KHz or 48.0 KHz) with the base clock toggle button, press the clock multiplier button to toggle and select a multiple for the base clock sample rate corresponding to the audio content sample rate. For example, if you want to generate a Word Clock of 192KHz on channel B, press the base clock button of channel B to select 48.0 KHz, and press the clock multiplier button of channel B to select x4. That is, 48.0 KHz x4 = 192KHz Word Clock.

Word Clock Output Frequency Example Scenarios:

Source File Sample Rate	Base Clock Frequency	Multiplier
44.1 kHz	44.1 kHz	x1
48 kHz	48 kHz	x1
88.2 kHz	44.1 kHz	x2
96 kHz	48 kHz	x2
176.4 kHz	44.1 kHz	x4
192 kHz	48 kHz	x4
352.8 kHz	44.1 kHz	x8
384 kHz	48 kHz	x8
DSD64	44.1 kHz	x64
DSD128	44.1 kHz	x128
DSD256	44.1 kHz	x256
DSD512	44.1 kHz	x512

7. Basic Operation

7-1. Precautions Before Use

MC20 is a unique component that is designed to interface with a wide variety of home audio equipment. Before purchase and installation, first review the specifications and manuals of other equipment in your system that will receive clock input from MC20 to determine the ideal connections. Please do not hesitate to contact support@aurender.com for assistance as needed.

Power Connection

MC20 is designed to be used with a grounded power outlet or power supply. Do not use with an ungrounded power source.

Power ON/OFF

See section 4-5 "Turning MC20 On and Off."

7-2 Connection Summary

Since every system is different, and MC20 will interface with equipment from other manufacturers in different ways, there is no way to recommend a "best" universal connection scenario. This will depend on your system and your preferences.

However, in an optimal setup, MC20 will connect to an Aurender source component via the 75Ω 10Mhz Master Clock output to the Aurender's corresponding "W.Clock" input.

If the DAC or secondary Word Clock (eg. dCS Vivaldi Clock) is compatible with 10Mhz Master Clock input, use those outputs from MC20 at the correct impedance for the other device.

If the DAC has only 44.1/48 kHz base Word Clock inputs, then use the corresponding Ch.A and Ch.B outputs from MC20. In this case, continue to use the 10Mhz Master Clock output to your Aurender.

Connect a 75Ω SPDIF (BNC) cable from your source device (Aurender) to the MC20's "Sync" input to enable automatic sample rate detection.

In order for MC20 to have maximum efficacy, use a SPDIF or AES/EBU connection between your Aurender and DAC instead of USB. Due to the nature of asynchronous USB, where the DAC's clock (or an external clock that is synced with the DAC) controls the data flow, clock input signal on any Aurender source has no impact on the signal path of USB audio connections.

See section 7-3 for connection diagrams.

7-3 Connection with Aurender Music Server

1) 10MHz Master Clock Outputs

- Aurender models W20(SE), N30(SA) and N20 feature clock inputs that are compatible with a 10MHz clock signal, or 44.1/48 kHz Word Clock signals. (*Future Aurender models not released at the time of this manual's publication may also feature clock input functionality.*) The 10MHz Master Clock signal is preferable due to greater accuracy and stability. The 10MHz master clock signal works as a reference signal which actually instructs the Aurender's built in OCXO clock to achieve greater accuracy and stability over both the short and long term. Aurender's clock input has an impedance of 75Ω. When using an external clock with Aurender products, use MC20's 75Ω impedance 10MHz Master Clock to the "WCLOCK" terminal on the Aurender server.

- If the specifications of the DAC allow, it is recommended to use a 10MHz Master Clock. Otherwise, use the individualized Word Clock outputs. Example connection diagrams follow.

- Choose the 75Ω or 50Ω outputs depending on the DAC's input impedance. In order to avoid signal loss and/or jitter, it is important to use the correct impedance input/output and cable!

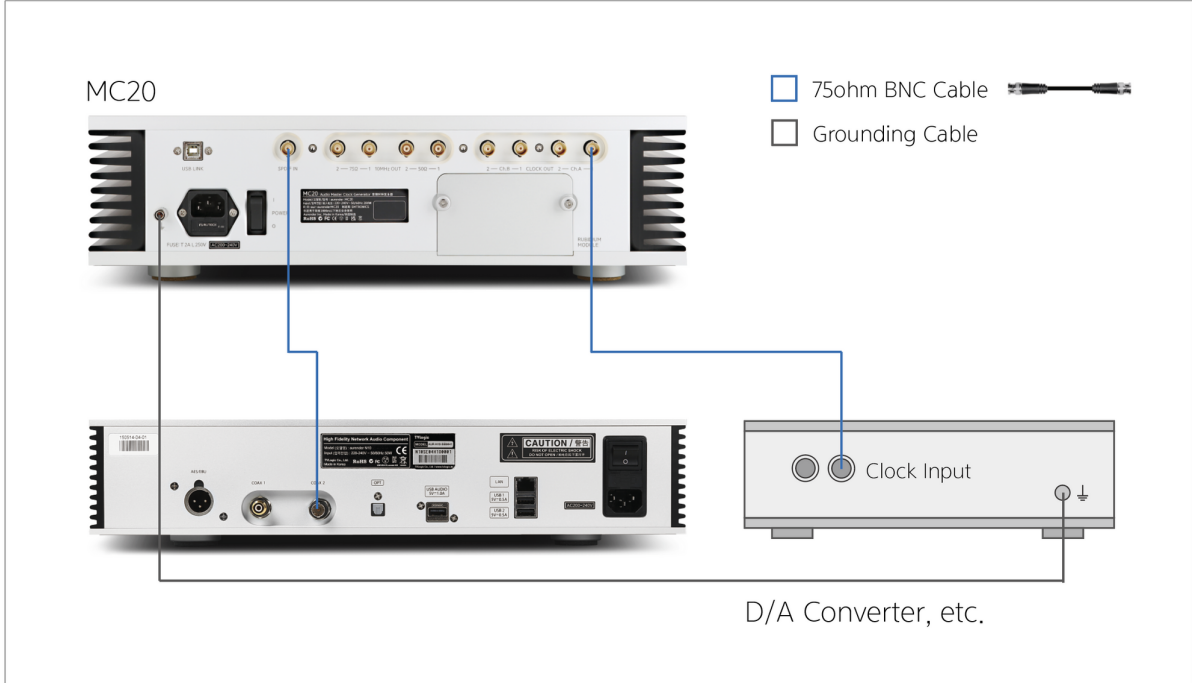**10MHz Master Clock output to Aurender (N30 pictured, but connection is the same for W20/W20SE/N20) and DAC with 75Ω 10MHz Master Clock Input**
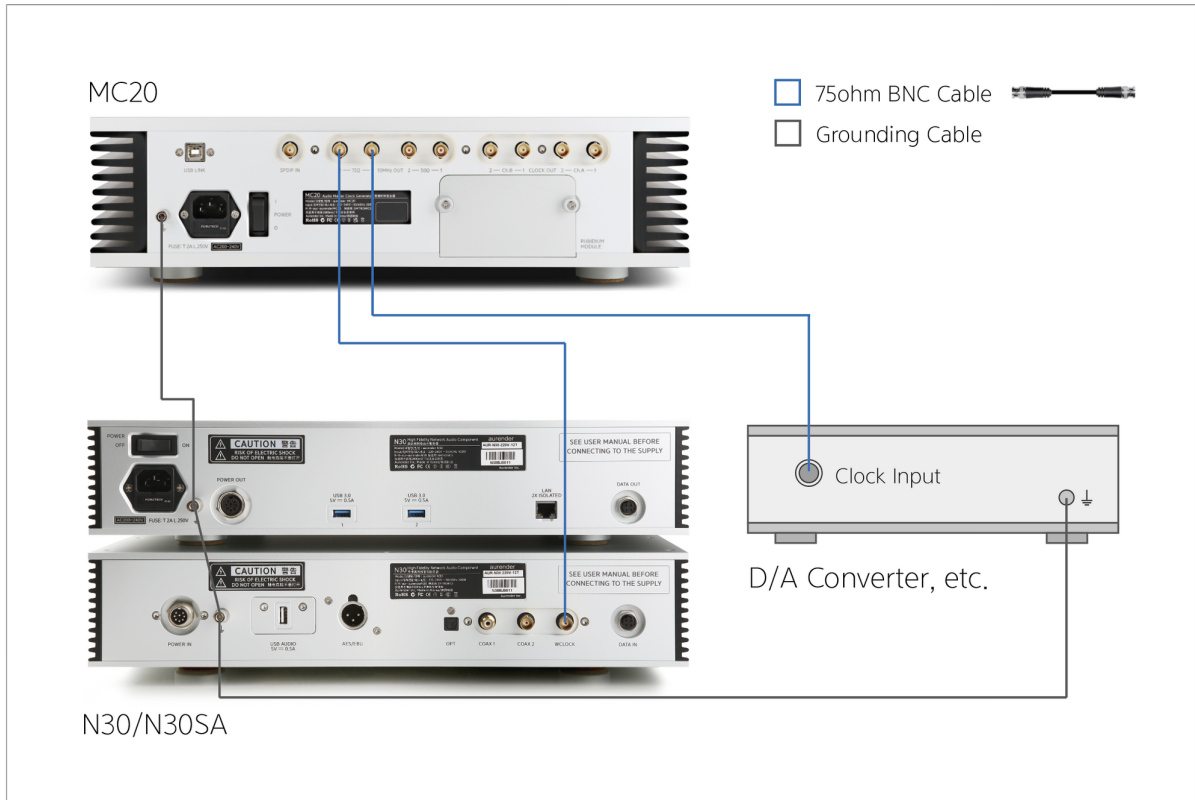
Important Note: On your Aurender source component, the default Clock Sync setting is OFF. Please go to Settings>Advanced>Master Clock and turn "Use Word Clock In" setting to the ON position. You will see an indication of a successful clock connection on the front screen of your Aurender:


2) Word Clock Outputs

In case your DAC is not compatible with a 10 MHz Master Clock input, but it does have Word Clock input[s], It is perfectly acceptable to connect a 10MHz Master Clock output to your Aurender Music Server and simultaneously a Word Clock output to the DAC. For Sync Mode, connect the SPDIF BNC output of Aurender to MC20:

10MHz Master Clock Output to Aurender (N30 pictured, but connection is the same for W20/W20SE/N20), Word Clock Output to DAC
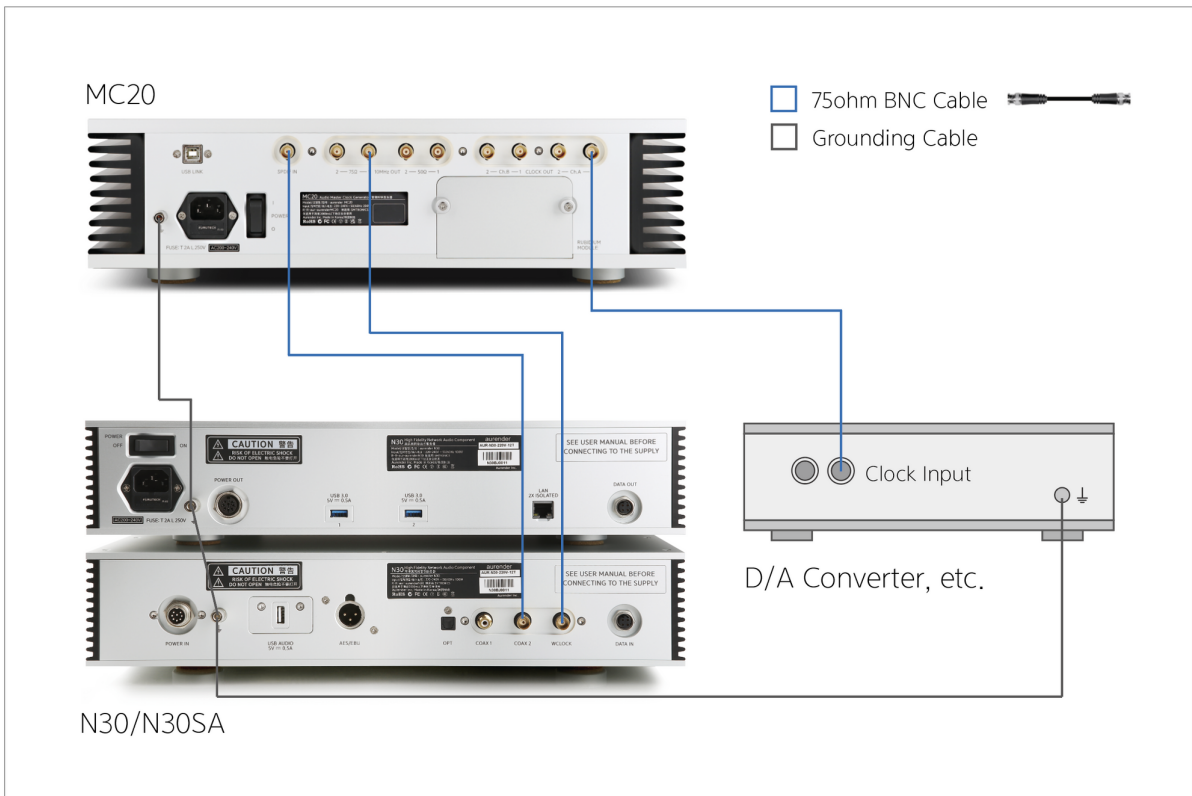
7-4 Connection with Other Equipment

1) Using the 10MHz Master Clock with other devices

If your source playback component (eg. CD transport/server/player) has a 10MHz Master Clock input terminal and a sync device (eg. DAC) can also receive a 10MHz Master Clock input, it is recommended to use the 10MHz Master Clock connection on both devices.

Connection example: Supplying 10MHz Master Clock to the Source Component and DAC (This diagram depicts devices with 50Ω connectors. Consult your third party device's manual to determine which impedance connectors should be used with your device):
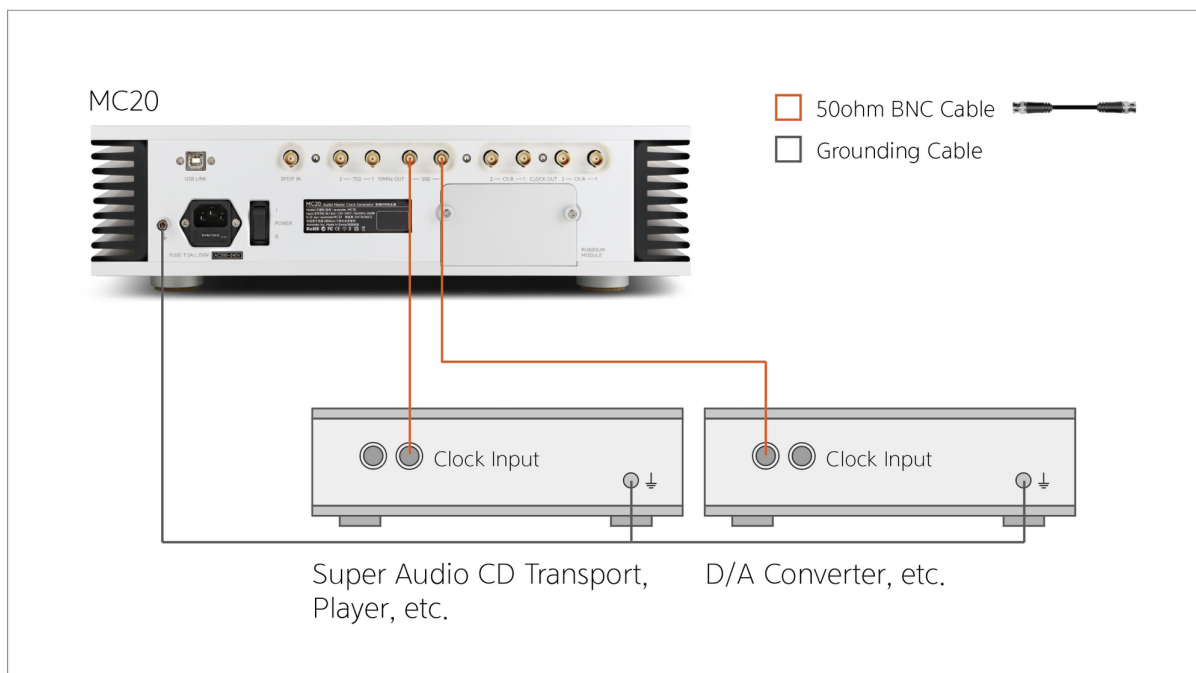

2) Using Word Clock "Sync Mode" with Other Devices

Use Word Clock "Sync Mode" to automatically adjust the Word Clock frequency output for use with a Sync Device (DAC) that does NOT accept 10MHz Master Clock signal.

This example depicts a scenario with a 10MHz Master Clock (75Ω impedance) output to the source device and a Sync Mode Word Clock signal to the DAC:

- After connecting a SPDIF cable from the output terminal of the source device to the input terminal of the MC20, select Sync Mode on the front panel of MC20 using the base clock button on the front (see section 5.2-5.3 for instructions to enable Sync Mode)
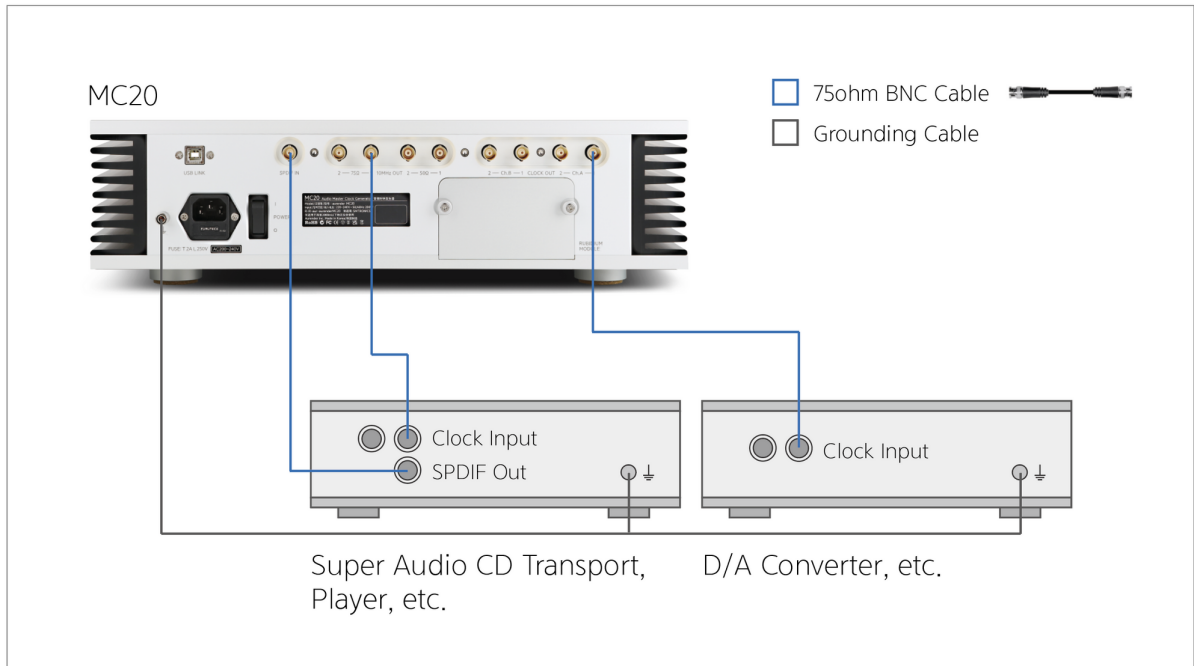
7-5 Interfacing with dCS DAC & Vivaldi Clock

Some DACs have 2 separate clock inputs, each of which can be assigned for use with a 44.1kHz or 48kHz base sample rate, respectively. In this case, MC20's Channel A and Channel B outputs can be assigned to output 44.1kHz and 48kHz base sample rate groups separately.

Again, since MC20 independently supplies a 10MHz Master Clock and the Word Clock signal separately, it is ideal for source devices that can receive the 10MHz Master Clock input to receive the Master Clock while the DAC receives the discrete Word Clock signals.

In the example below, MC20 provides a 10MHz Master Clock to Aurender Music Server (W20SE, but the connection is the same for N20, N30, N30SA), and separately supplies both 44.1 KHz Word Clock and 48.0 KHz Word Clock to dCS Vivaldi DAC.

1. Cable Connections:

   a. Connect 75Ω Port 1 from the 10MHz Output port on the back of the MC20 to the WCLOCK port on the Aurender

   b. Connect CLOCK OUT Ch.A 1 on the back of MC20 to WORDCLOCK IN 1 port on DAC

   c. Connect CLOCK OUT Ch.B 1 on the back of the MC20 to the WORDCLOCK IN 2 port on the DAC (if DAC requires separate inputs for 44.1 and 48 kHz frequency groups)

   d. If you are using a Vivaldi Clock, it is also recommend to connect 75Ω 10MHz Master Clock output to Vivaldi Master Clock input.
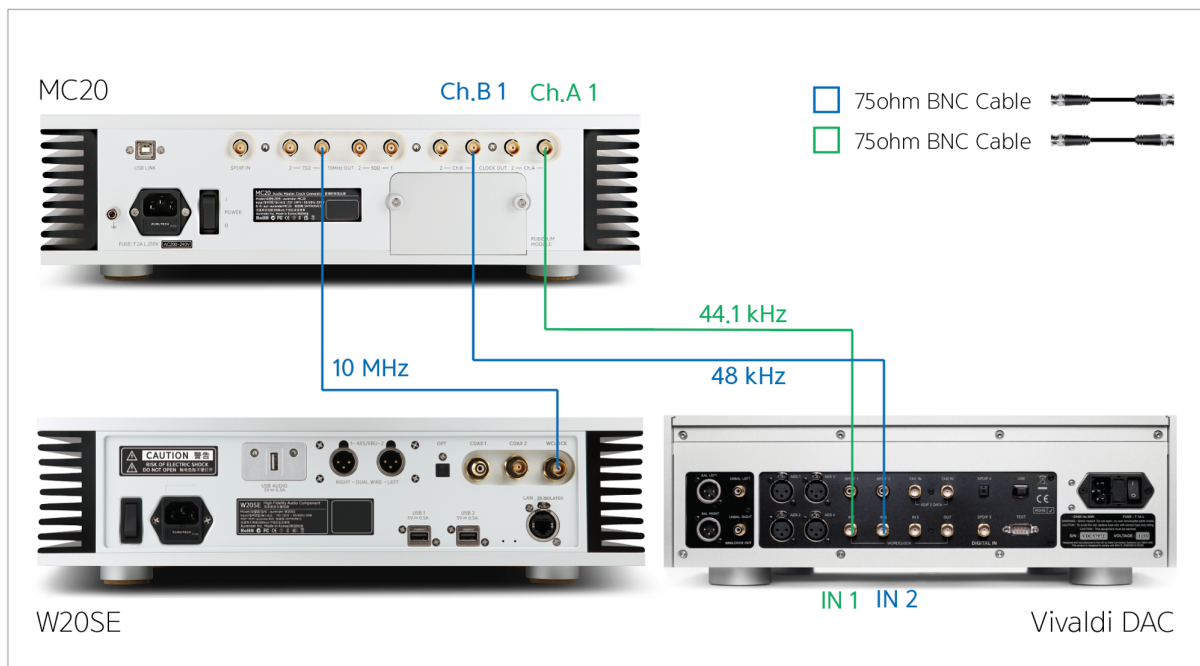
2.   The 10MHz Master Clock of MC20 supplies the Master Clock signal automatically when connected.

3. MC20 Word Clock Output Settings

Use Sync Mode to automatically change Word Clock output settings.

The LED settings indicators should look like this. When in Sync Mode, the multipliers will change automatically corresponding to the sample rate of audio content being played:

4. Vivaldi DAC Settings

Press the "Menu" button on the DAC to access the menu.

On the MENU screen, press the right > button to select SETTINGS and press the MENU button to enter Settings menu.
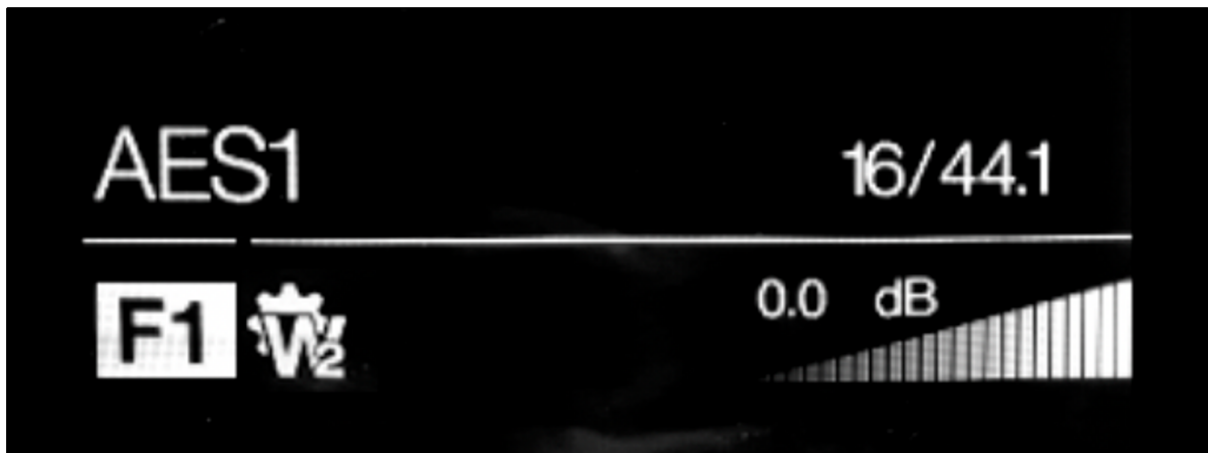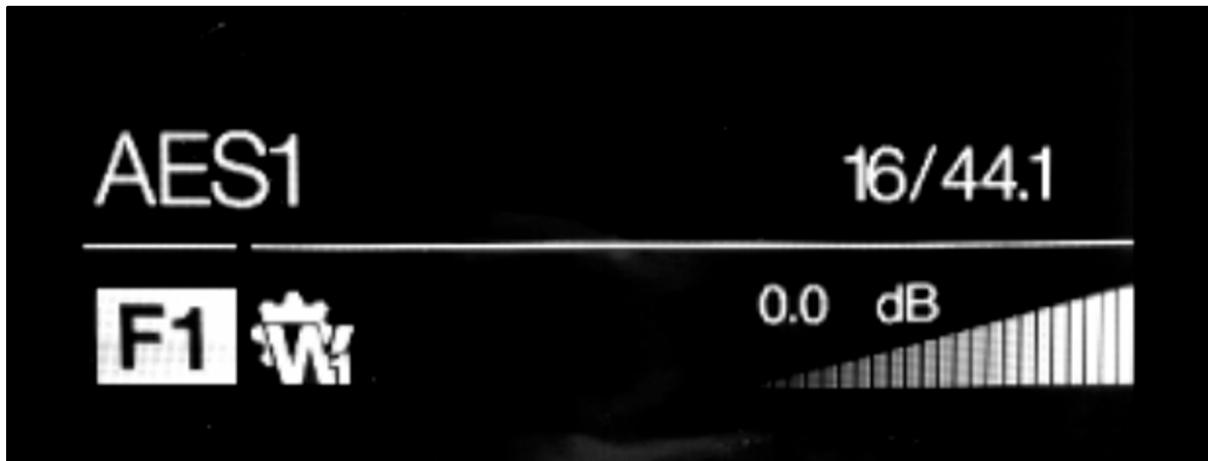

On the SETTINGS screen, press the right > button to select SYNC MODE and press the MENU button to save setting.

In the SYNC MODE screen, press the MENU button until the "W" (word clock) icon appears:

After selection is completed, wait for about 8 seconds or press the POWER button to return to the first screen.

To confirm proper operation, the Word Clock Group 1 icon (W1) should appear for 44.1 kHz content. Word Clock Group 2 icon (W2) should appear for 48 kHz base content. It should change automatically on the DAC.

8. Troubleshooting

- Link LED

  - **Problem:** The Link LED indicator light does not come on

  - **Solution:** This is normal/expected behavior. The "Link" feature is reserved for future use.

- Lock LED

  - **Problem:** LED indicator flashes/pulses on and off

  - **Solution:** The Lock LED indicator will flash while MC20 is starting up. This indicates that the rubidium module is warming up to reach the optimal temperature. If the Lock LED indicator continues to flash, pulse, or flicker during normal use, please contact Aurender support.

- Ch.A and Ch.B Word Clock LEDs

  - **Problem:** Ch.A and Ch.B LED indicators are not illuminated.

  - **Solution:** Are you using the the Word Clock outputs? Or are you using the Master Clock outputs only? If you are only using Master Clock outputs, it is normal for Word Clock LED indicators to stay OFF. If you ARE using the Word Clock outputs, see section 6 "Word Clock Output Settings" to set up