
CobraNet® Clocking Modes

1. INTRODUCTION

In most cases, a CobraNet® system is used with its default audio clocking mode (0x00). This allows automatic synchronization of audio clocks network wide. However, the clocking circuitry of a CobraNet device can be configured to operate in a number of ways that are specified by the values written to the syncConductorClock and syncPerformerClock Management Interface (MI) variables. These two MI variables are used *independently* to set the clocking mode of an interface depending on whether it is operating as a **Conductor** or a **Performer**. These variables can be set by using SNMP or the Host Management Interface (HMI).

Please see the *CobraNet Programmer's Reference Manual* and the *CobraNet Hardware User's Manual* for more information on the variables, SNMP, and the Host Management Interface.

2. IMPORTANT CONCEPTS REGARDING CobraNet CLOCKING

All devices in a CobraNet network must operate within the same clock domain. It is therefore a requirement that, regardless of clock mode, all audio clocks on the network should be derived from the same master clock to ensure that they remain synchronized. This is accomplished automatically when using the default clock mode, 0x00, and when any digital devices attached to the CobraNet interface receive their audio clocks from the CobraNet interface.

- Any CobraNet interface that uses one of the external clocking modes must use external clocks that are synchronous with the network audio clock.
- A digital audio device that does not receive its audio clocks from the CobraNet interface must be connected to the CobraNet interface using a sample rate converter. For instance, all digital audio devices connected to CobraNet devices must be in the same audio clock domain as the CobraNet network.
- Any clock mode that uses the external word clock (REFCLK_IN) will not work unless the REFCLK_IN pin is first enabled by clearing the second bit (bit 1) of the syncBuddyLinkControl MI variable.

3. CORE CLOCK CIRCUITRY OF A CobraNet INTERFACE

The core clock circuitry of a CobraNet interface is depicted in [Figures 1](#) and [2](#). Note that not all inputs and outputs to the clock module are used at the same time in all modes. Operation of the circuitry, and activity on each path, are dependent on the clock mode selected. These different clocking modes can be used in many ways, depending on the requirements of a particular application. Common usage of the different modes is described in this document. The user-available external clock connections are REFCLK, MCLK_IN, MCLK_OUT, FS1, and SCLK. The other connections are internal to the interface and utilized by the interface's firmware in response to the particular mode in use.

The five audio clock modes are:

- 0x00 - Internal (Normal Default Mode)
- 0x10 - Internal with External Sample Synchronization
- 0x01 - External Word Clock
- 0x04 - External Master Clock
- 0x14 - External Master Clock with External Sample Synchronization

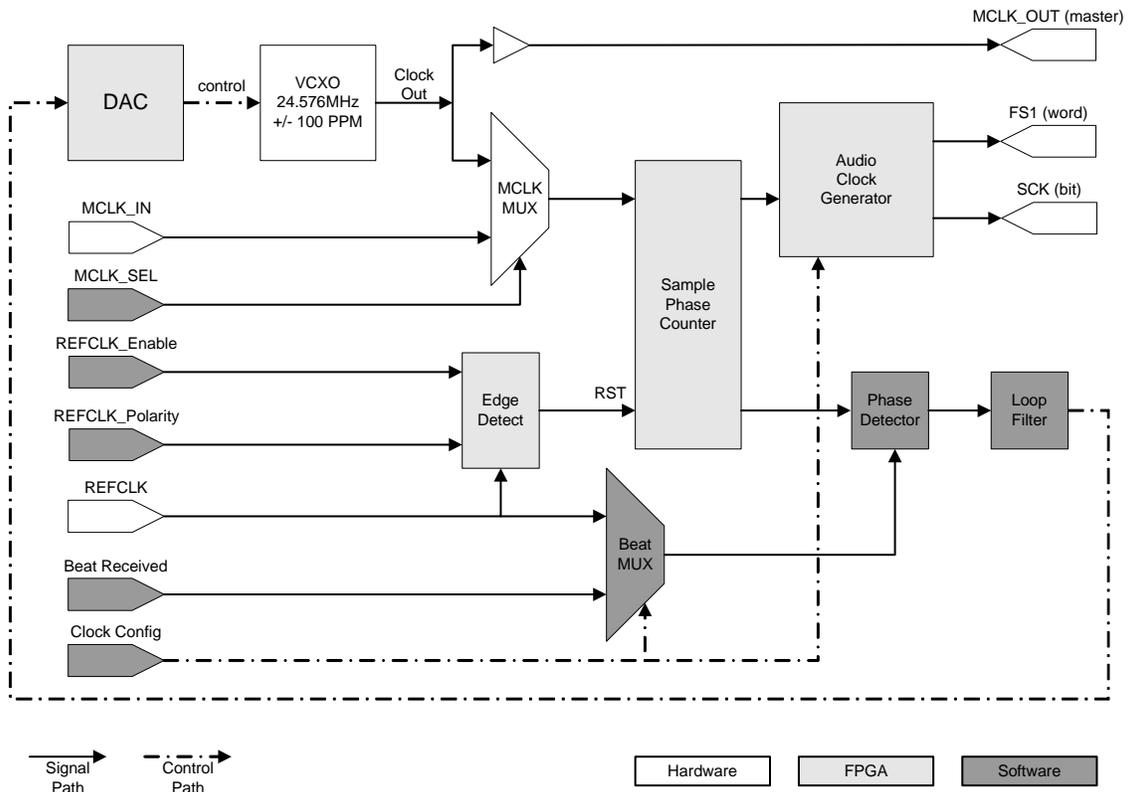


Figure 1. - CobraNet Clock Circuit for CM-1 Module

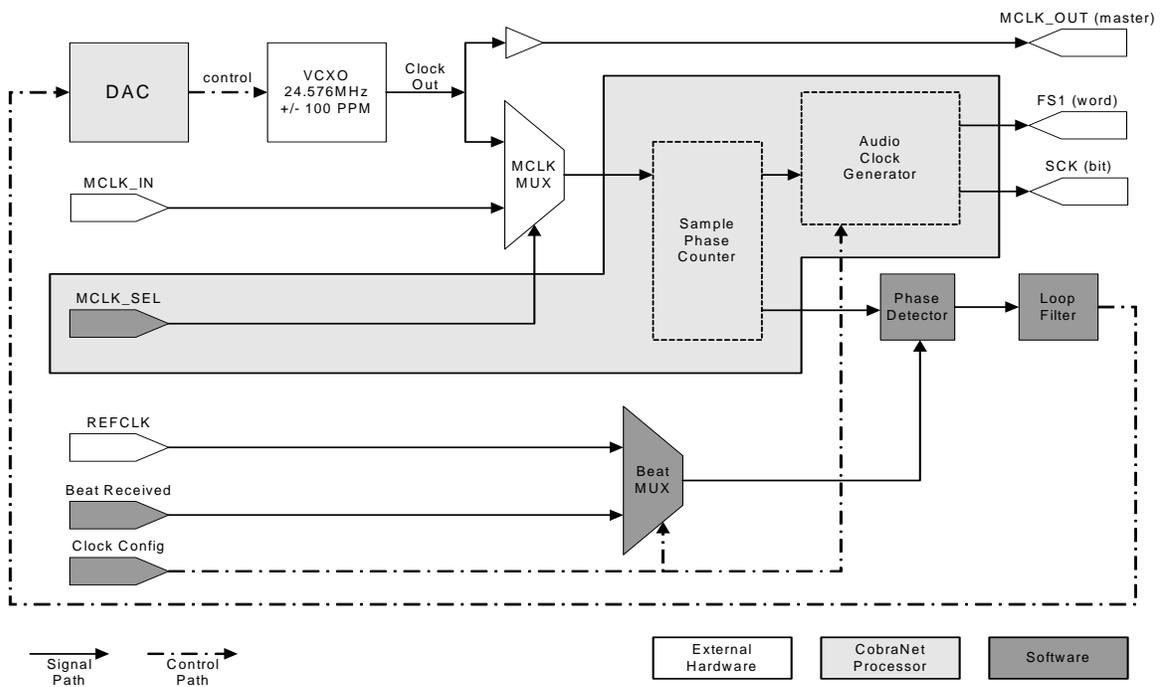


Figure 2. CobraNet Clock Circuit for CM-2 Module and Semiconductors

3.1 CobraNet Clock Modes

This section describes each of the CobraNet clock modes.

3.1.1 0x00 Mode - Internal Mode (Default)

The 0x00 Mode is the default clock mode of a CobraNet interface. When operating in this mode:

- **As Conductor:** The master audio clock (MCLK) is generated by the VXCO parked at its center frequency. Word clock (FS1) and bit clock (SCLK) are derived directly from MCLK.
- **As Performer:** The master audio clock (MCLK) is generated by the VXCO, which receives frequency adjustments from the beat packets received from the Conductor node over the network interface, insuring that the Performer's clock is in sync with the Conductor. Word clock (FS1) and bit clock (SCLK) are derived from MCLK.

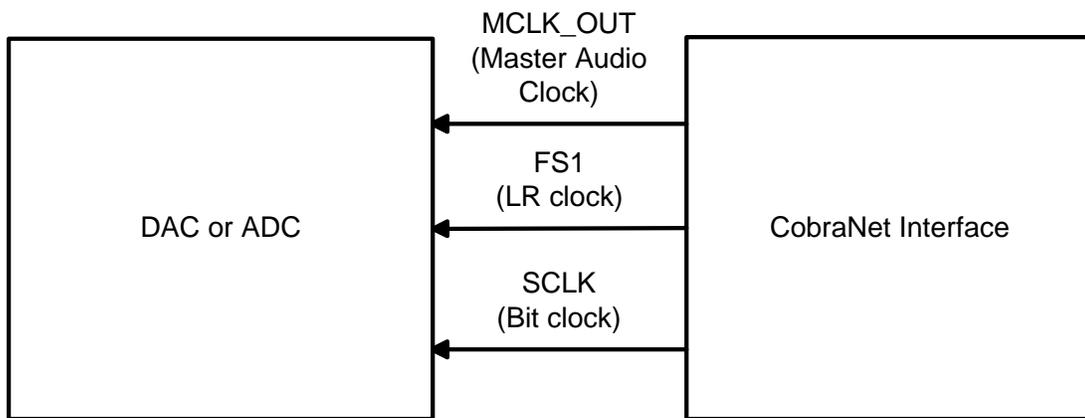


Figure 3. 0x00 Mode Typical Connections

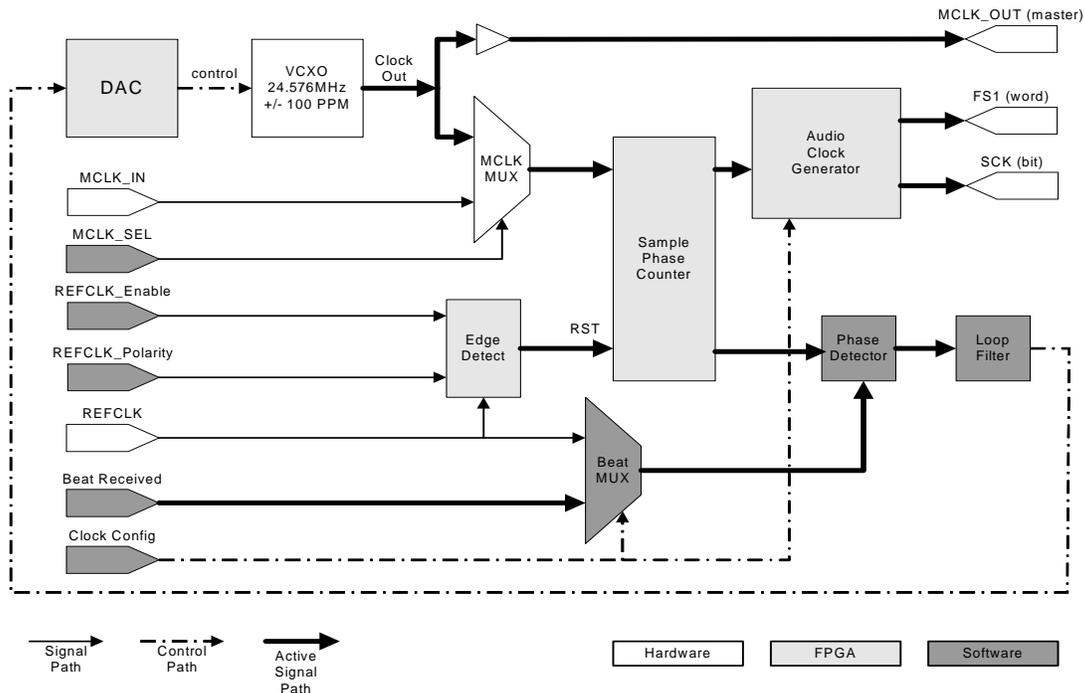


Figure 4. Clock Circuit as Used by 0x00 Mode with CM-1 Module

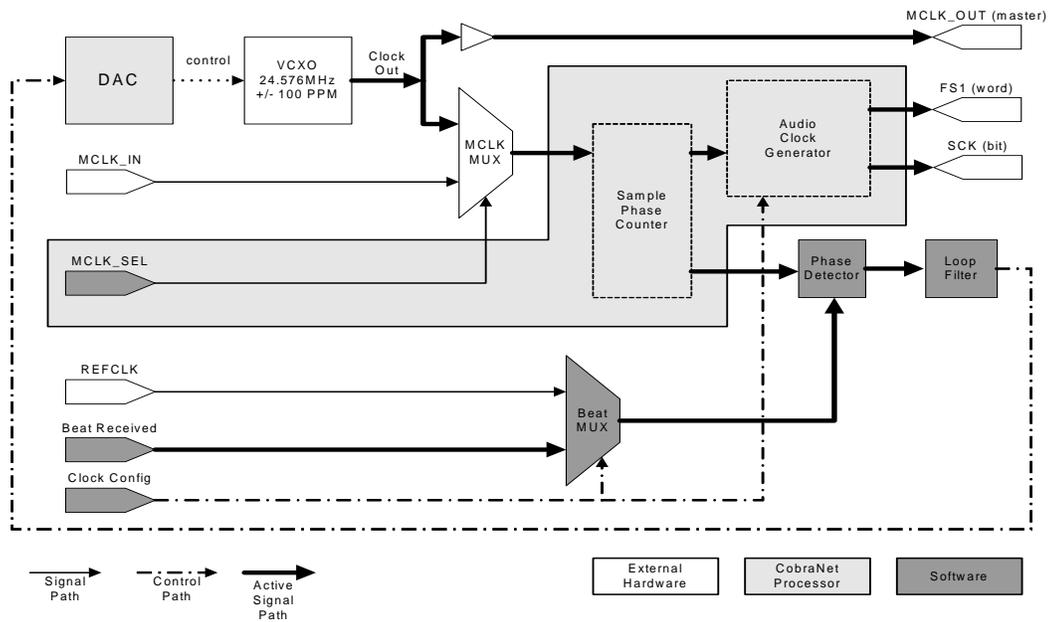


Figure 5. Clock Circuit as Used by Mode 0x00 with CM-2 and Semiconductors

3.1.2 0x10 Mode - Internal Mode with External Sample Synchronization

Note: This will not work properly with CM-2 modules or semiconductor-based designs due to the absence of the edge detect circuit in the semiconductor.

This mode is similar to Internal Mode (0x00), but allows synchronization of the derived SCLK and FS1 signals with external clock circuits. It is typically used when it is necessary to synchronize CobraNet clocks with existing external clock circuitry. When operating in this mode:

- **As Conductor:** MCLK, FS1, and SCLK are all generated as in 0x00 Mode. However, the REFCLK input is used to align the clock edges of the generated MCLK, insuring that the audio clocks generated externally are kept in sync with the CobraNet interface's audio clocks. This mode does not alter the clock frequency and implies that the REFCLK input should be derived from the MCLK_OUT supplied by the CobraNet interface (see Figure 6).
- **As Performer:** MCLK is generated by the VXCO, which receives frequency adjustments from the beat packets received over the network interface as in 0x00 Mode. FS1 and SCLK are derived from MCLK. As above in Conductor Mode, the REFCLK input is used to ensure that the external and CobraNet generated audio clocks are in sync.

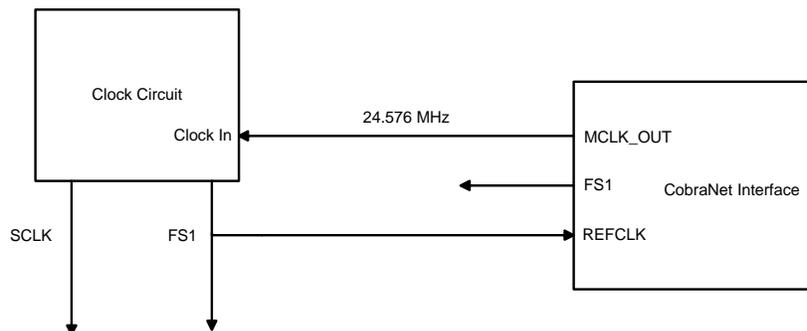


Figure 6. 0x10 Mode Typical Connections (Sync of CobraNet Clocks with External Clock Circuitry)

3.1.3 0x01 Mode - External Word Clock

External Word Clock Mode allows synchronization of all CobraNet clocks with an externally supplied word clock. The external clock can be any integral division of FS1 from 750 Hz to 48 kHz. This is most often used to synchronize a CobraNet network with a house sync signal whereby the Conductor will supply the network clock and operate in this mode with Performer Nodes operating in 0x00 Mode. When operating in this mode:

- **As Conductor:** The VCXO generating MCLK is steered to synchronize with REFCLK. FS1 and SCLK are derived from MCLK.
- **As Performer:** The VCXO generating MCLK is steered to synchronize with REFCLK. FS1 and SCLK are derived from MCLK.

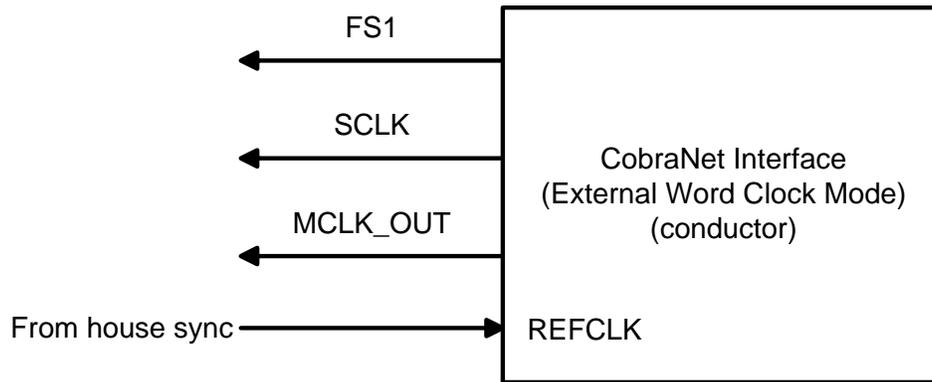


Figure 7. 0x01 Mode Typical Connection (External Sync Attached to Conductor)

Note: Connection used to provide synchronized audio clocks via Ethernet

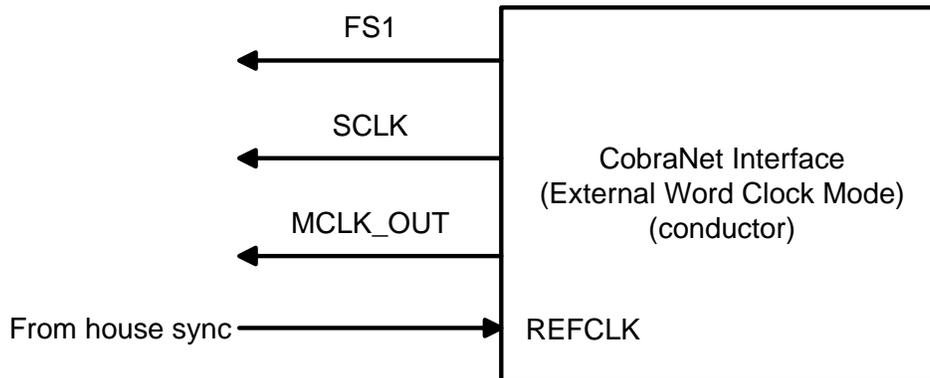


Figure 8. 0x01 Mode Typical Connection - External Sync

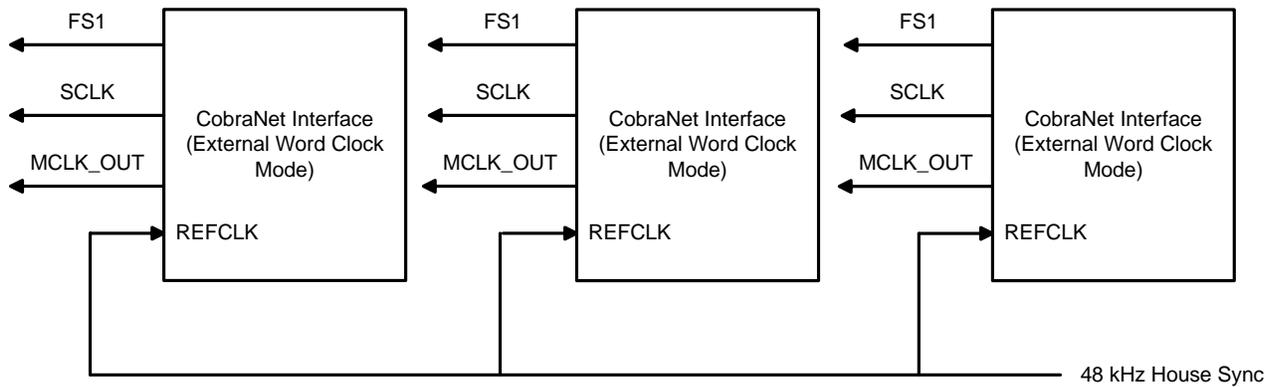


Figure 9. 0x01 Mode Typical Connection - Synchronization of All Nodes

Note: All nodes should be on house synchrony.

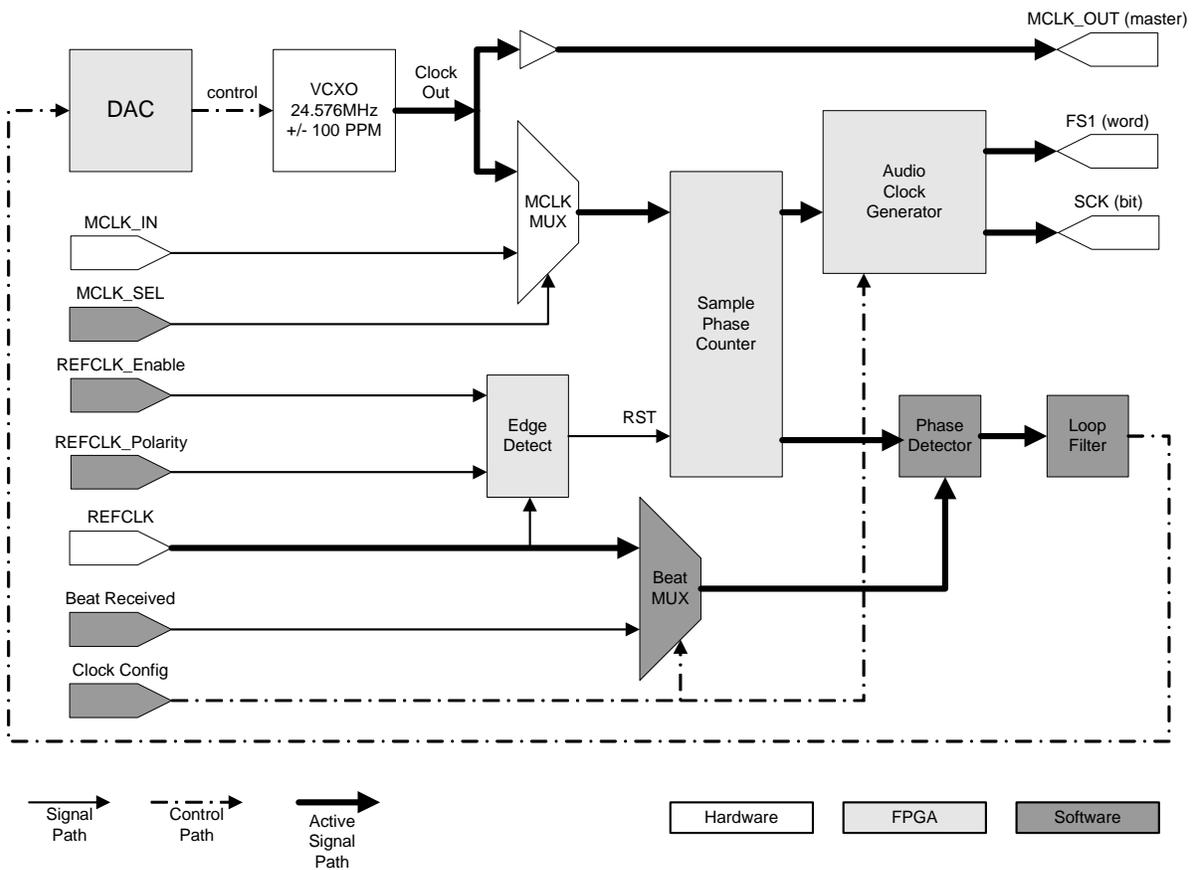


Figure 10. Mode 0x01 Clock Circuit Used with CM-1 Modules

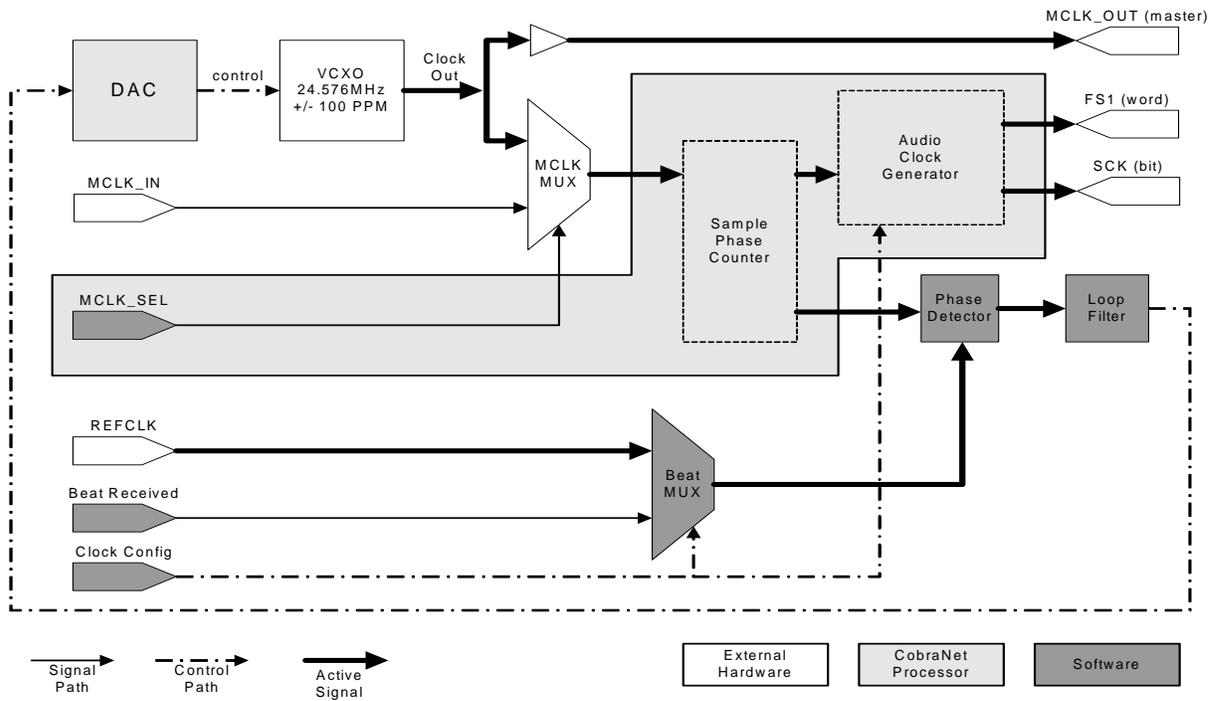


Figure 11. Clock Circuit as Used by Mode 0x01 with CM-2 and Semiconductors

3.1.4 0x04 Mode - External Master Clock

In External Master Clock Mode, all clocks are derived from an externally supplied master clock of 24.576 MHz. This mode is provided because it is easy to accomplish using the existing clock circuitry. It is most useful when trying to synchronize one or more CobraNet devices to a distributed Master Clock. However, it has little practical utility because it is difficult to properly distribute a clock of this frequency and does not provide a means to ensure synchronization of the audio clocks (SCLK, FS1). Note that MCLK_OUT is not a copy of MCLK_IN. MCLK_OUT is derived from the VCXO, which is not controlled in this mode and is not synchronous with the supplied MCLK_IN. When operating in this mode:

- **As Conductor:** MCLK is sourced directly from MCLK_IN. FS1 and SCLK are derived from MCLK_IN.
- **As Performer:** MCLK is sourced directly from MCLK_IN. FS1 and SCLK are derived from MCLK_IN.

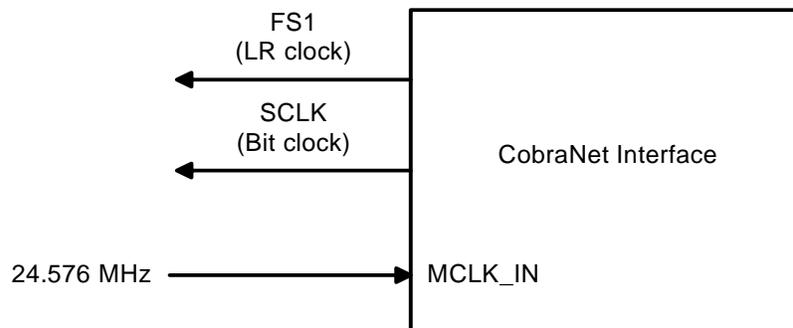


Figure 12. 0x04 Mode Typical Connection (Synchronization to an Externally-Supplied Master Clock)

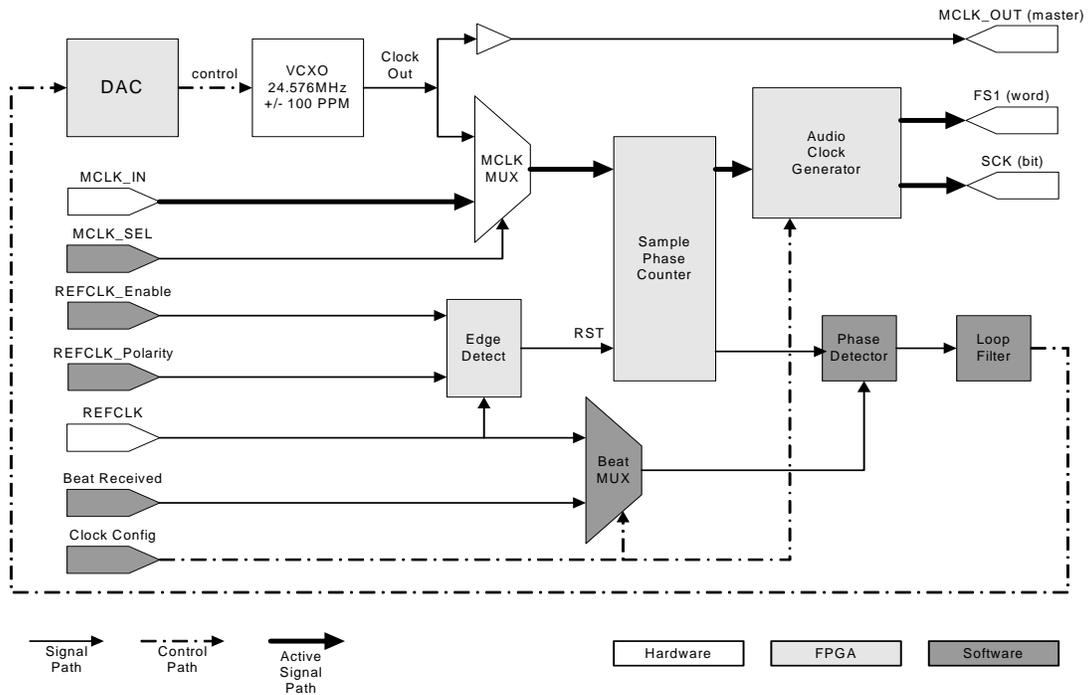


Figure 13. Clock Circuit as Used by Mode 0x04 with CM-1 Module

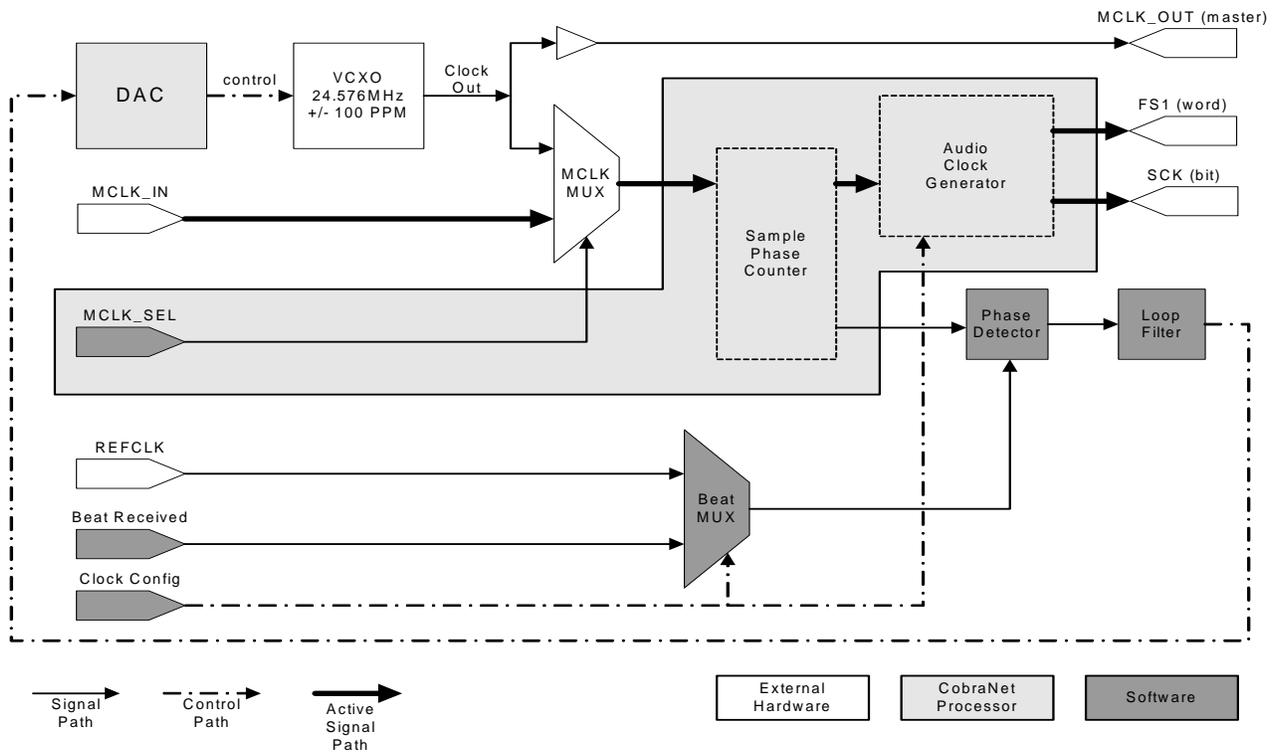


Figure 14. Clock Circuit as Used by Mode 0x04 with CM-2 and Semiconductors

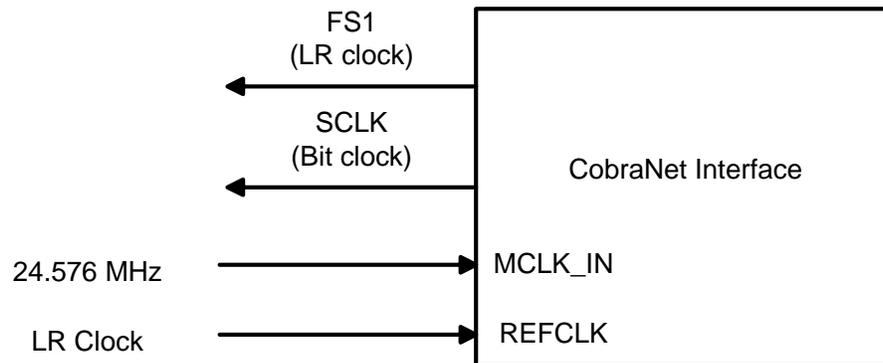
3.1.5 0x14 Mode - External Master Clock with External Sample Clock Synchronization

Note: This mode operates differently depending on use of the CM-1 or CM-2 CS1810xx/CS4961xx chip-based products.

3.1.5.1 0x14 Mode for CM-1

In this mode, all clocks are derived from an externally supplied master clock of 24.576 MHz. This mode is provided primarily to allow synchronization of multiple CobraNet interfaces within the same chassis. It can also be used, as in 0x10 Mode, to synchronize external clock circuitry derived from an external master clock. Note that MCLK_OUT is generated by the VCXO in this mode and is not a copy of MCLK_IN. When operating in this mode:

- **As Conductor:** MCLK is supplied by the MCLK_IN input. FS1 and SCLK are derived from MCLK_IN. As in 0x10 Mode, REFCLK is used to synchronize the clocks.
- **As Performer:** MCLK is supplied by the MCLK_IN input. FS1 and SCLK are derived from MCLK_IN. As in 0x10 Mode, REFCLK is used to synchronize the clocks.



**Figure 15. 0x14 Mode Typical Connection
(Synchronization to an Externally-Supplied Master Clock and Word Clock when Using CM-1)**

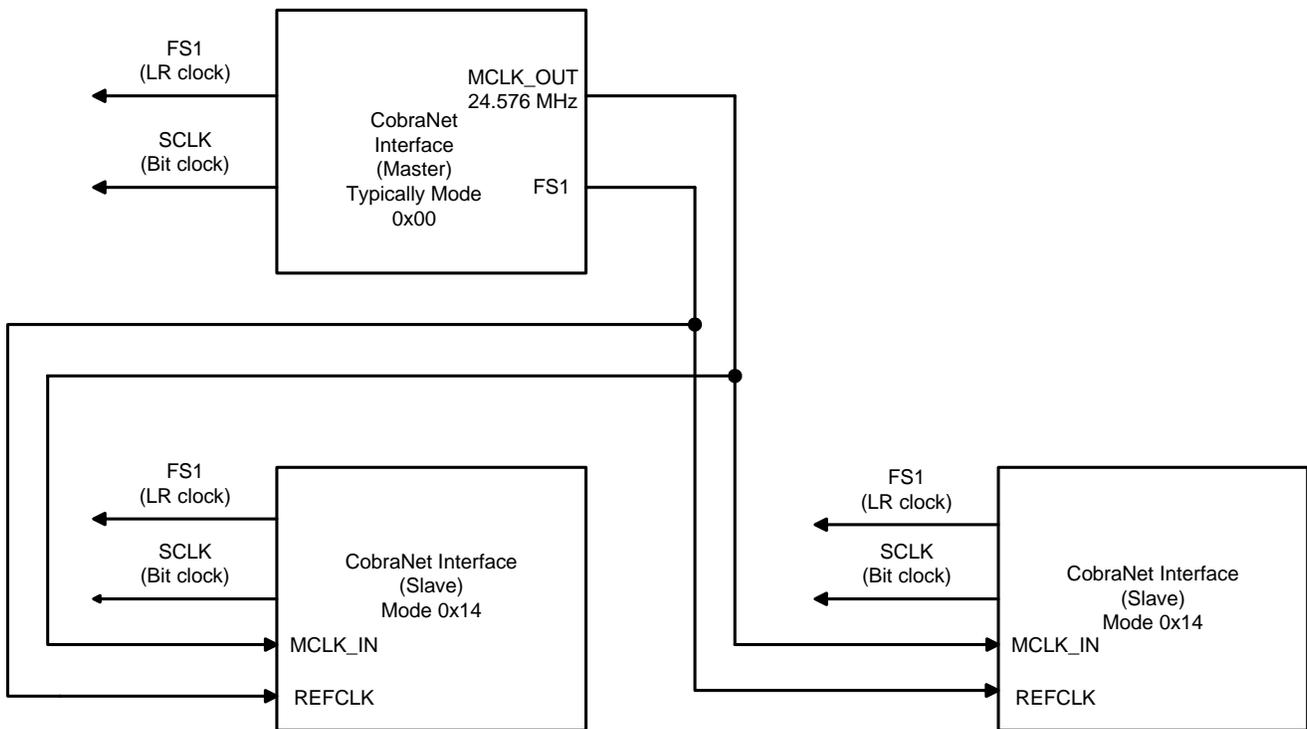


Figure 16. 0x14 Mode Typical Connection
(Master and Reference Clock Supplied to Slave Interfaces within Same Chassis when Using CM-1)

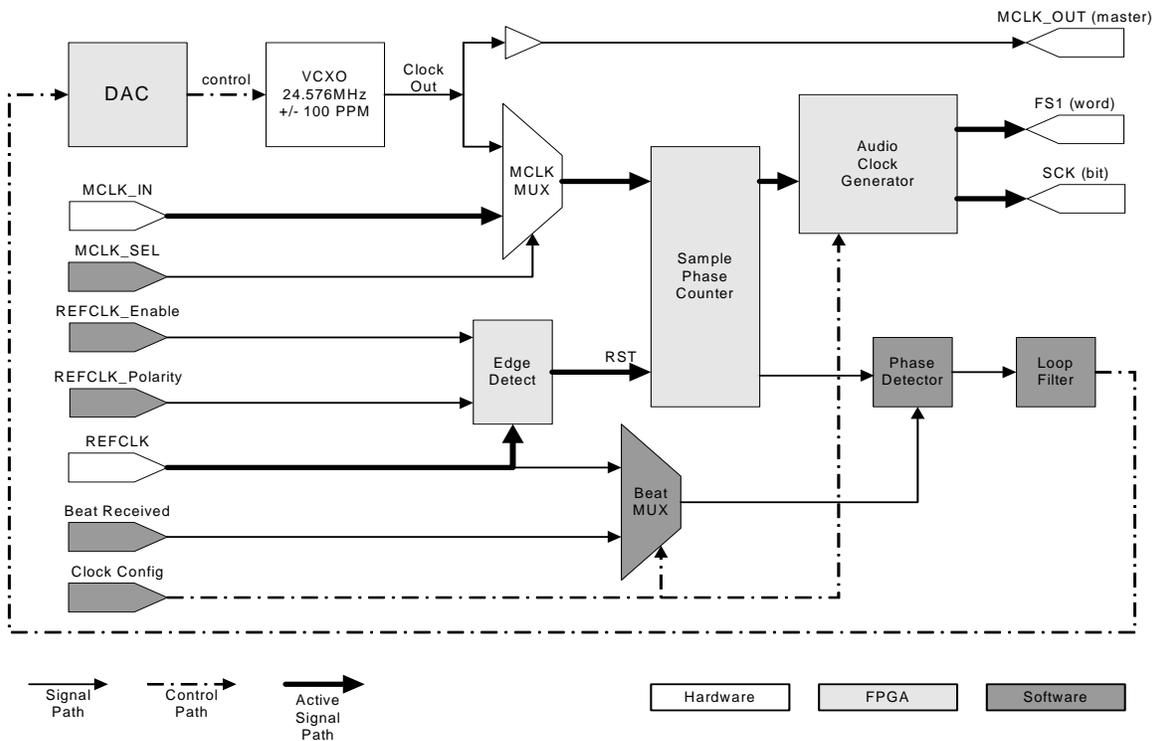


Figure 17. Clock Circuit as Used by Mode 0x14 with CM-1 Module

3.1.6 0x14 Mode for CM-2/CS1810xx/CS4961xx-Based Devices

Note: The 0x14 clock mode only works with devices running Rev. 2.11.6 firmware or later.

Mode 0x14 for CM-2 and CobraNet chips is primarily intended to allow complete audio clock slaving of one or more CobraNet devices to a master CobraNet device within the same chassis.

MCLK, SCLK, and FS1 are all supplied to the slave device by the master device. External divide by 2 logic must also be used on DAI1_SCLK when using 16x16 channel chips.

Changing to this mode dynamically has not proven to work well consistently. The CNCustom firmware modification program should be used to create slave device firmware with the Conductor and Performer clock modes set to values of 0x14 so that the slave device(s) will boot up in mode 0x14. The hardware should be designed so that the slave device(s) will always be supplied by all required clocks and will always operate in mode 0x14. The internal clock circuitry for the master device will be as that shown and described elsewhere in this document for the master clock mode in use. A description of the internal clock circuitry is not applicable for the slave device(s) as all clocks are supplied to them directly.

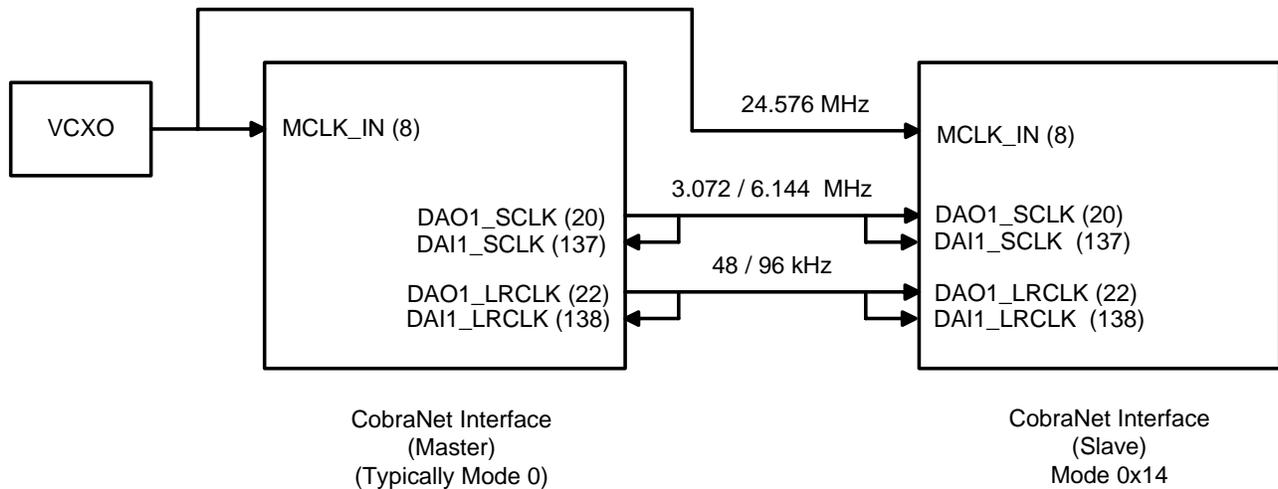


Figure 18. Clock Circuit as Used by Mode 0x14 with CM-2 or Chips with 2x2 or 8x8 Audio Channels

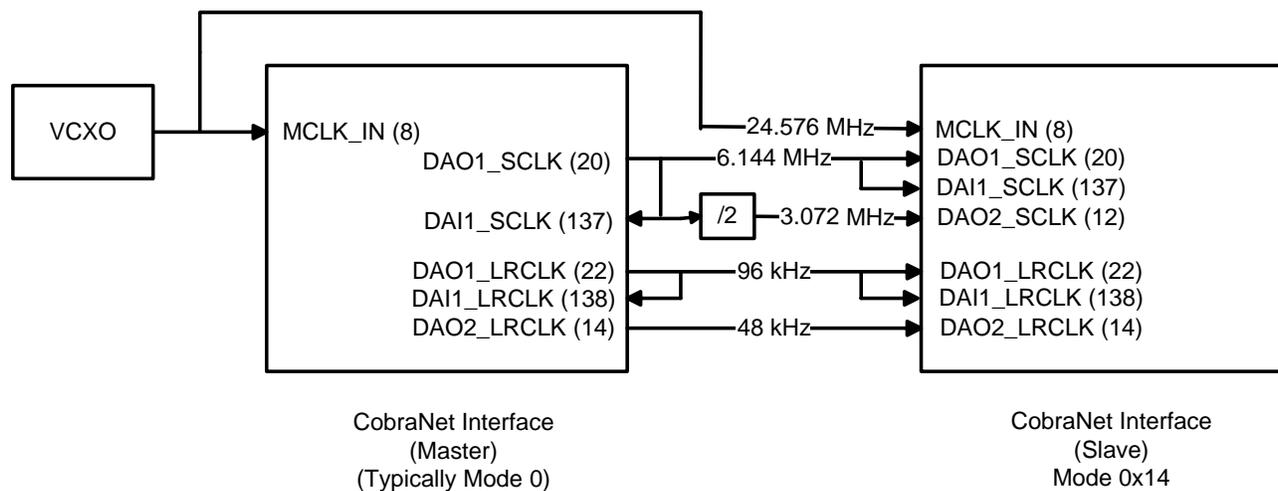


Figure 19. Clock Circuit as Used by Mode 0x14 with CM-2 or Chips with 16x16 Audio Channels

4. USING 0x10 MODE WITH CS1810XX, CS4961XX OR CM-2

0x10 Mode is used when the designer wishes to synchronize the CobraNet clocks with an externally supplied word clock (FS1). This is not possible with CM-2 and Silicon-based designs. The best that can be achieved is to use the circuitry below to ensure that the audio clocks of the CobraNet interface are in phase with the audio clocks of the existing circuit. In this case, the master clock is derived from the CobraNet device by using the circuitry shown in Figure 20, with the interface set to operate in clock mode 0x00. Any clocks required by the design can be taken from the loadable counter taps, and these clocks will be in phase with the audio clocks (FS1 and SCLK) generated by the CobraNet device. The Data In load value can be adjusted to ensure phase alignment if necessary.

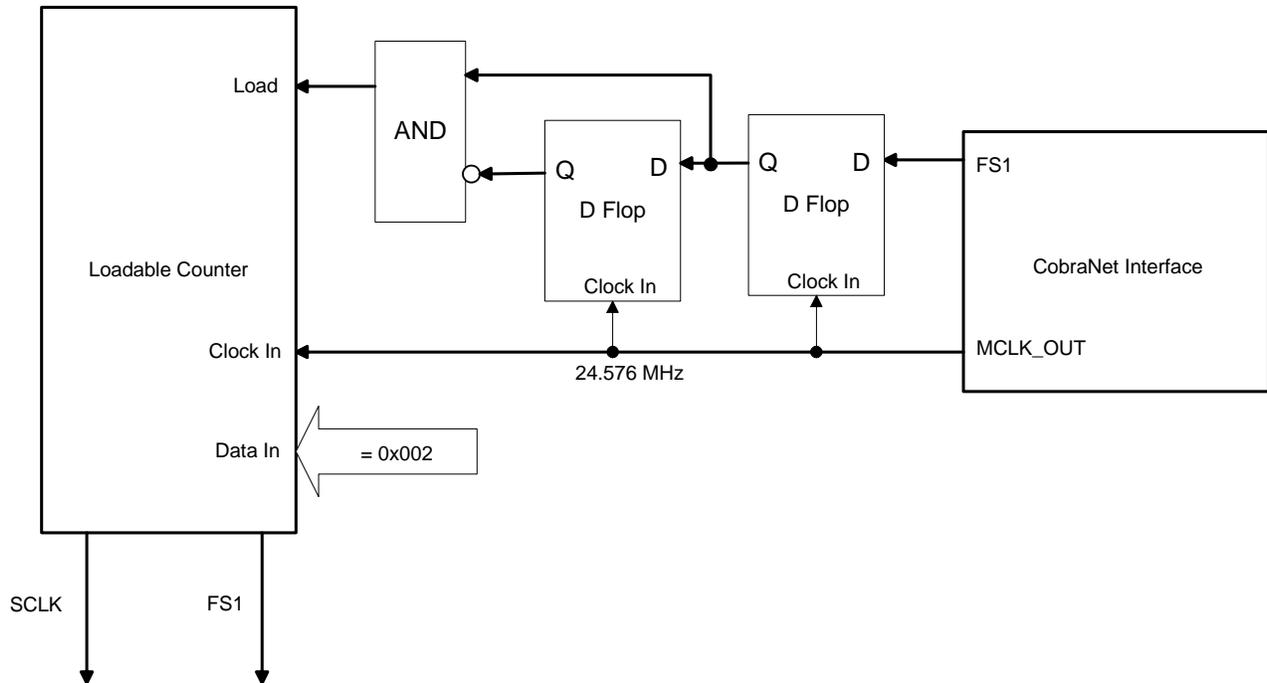


Figure 20. 0x10 Mode Circuitry for Use with CM-2, CS1810xx or CS4961xx

5. REFERENCES

1. *CobraNet Programmer's Reference Manual*, <http://www.cirrus.com>
2. *CobraNet Hardware User's Manual*, <http://www.cirrus.com>

6. REVISION HISTORY

Release	Changes
Revision 1	Initial Release.
Revision 2	Added more detail to Figures 18 and 19 . Clarified language in Section 3.1.6 on page 11 .

Contacting Cirrus Logic Support

For all product questions and inquiries, contact a Cirrus Logic Sales Representative.

To find the one nearest you, go to www.cirrus.com.

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