



YAMAHA

POWER USER

Project Studio Series:

Primer: AW4416 / AW2816 Synchronization
With External Sequencers like the Motif and RS7000
A Getting Started Guide

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This guide includes a step-by-step on setting the Start Time in the AW so that your Measure Display counters will match in both the Master (AW) and the Slave (MIDI Sequencer).

Guide to MIDI and Synchronization

Version 2.0 software upgrades the AW4416 to full MIDI implementation, allowing it to function not only as a digital recording front end, but also as a remote MIDI controller for the industry's top computer-based recording systems. MIDI control messages can be assigned to the AW4416's faders and ON keys to control the on-screen mixer of music production software. The control changes can then be recorded as auto mix data. The new software also includes Assignable Parameter Change/Bulk Dump and Assignable MIDI Control Change and enables direct recording of MIDI-based instruments. By switching between two channel layers, 32 channels of external MIDI control is possible. The combined audio and MIDI mixing capability of the AW4416 gives you unprecedented control over a total of 76 channels.

These messages can be recorded and played back to control the functions of the AW or they can be used as a 'remote' control surface for any attached MIDI devices (software sequencers, or hardware MIDI workstations/modules). Since the AW already features automated mixing built-in most likely you will be using this function to control external MIDI sequencers in a large MIDI/audio project studio environment. This guide will concentrate on this aspect of the MIDI implementation. When you place the AW on the special MIDI Setup screen you can use the faders to control virtually any MIDI continuous control change value (volume, pan, effect sends, etc). The generated data can be recorded into the external sequencer. This is a great advantage when you are working with a large system that includes MIDI modules and sequencers, because you never have to transfer MIDI modules to AW tracks. In such an arrangement the MIDI tracks can remain 'virtual'. Since the AW can handle 'live' inputs at the same time that it plays tracks from the hard drive, it is possible to EQ, effect and automate your mix without committing the MIDI modules to HD tracks. The external MIDI sequencer can run in perfect synchronization with the AW. This bit of routing allows you to leave 16 AW hard disk tracks for things like acoustic instruments and vocals.

When you are using the AW's faders as MIDI controllers, those movements are recordable as regular MIDI events into an external sequencer. This can greatly enhance your computer based or hardware based sequencer by giving you real time hands-on control that you otherwise would not have over your MIDI tracks.

This guide will get you started with using an AW4416 or AW2816 (MIDI implementation is built-in) along with an external MIDI device such as the Motif Synthesizer Workstation and the

RS7000 Music Production Studio. However, you can apply the information given here to any external MIDI devices capable of receiving and following MIDI Machine Control (MMC) and MIDI Time Code (MTC) and/or standard MIDI Clock. You may need to consult the manual's of your device when it comes to setting MTC and other interface details, as they can differ slightly from device to device.

Plan Ahead

We have all heard stories where the lesson learned is "plan ahead" and when putting together a recording project in your project studio, all of them apply. If you are working on a session that will ultimately include MIDI synchronization¹ you should plan for this at the outset. In other words, *what* you record, *when* and *where* you record it becomes very important. Don't just record audio and then have to build a metronome (tempo) track for your MIDI. You can plan ahead and generate the clock information that you will need. Even if you start the session with acoustic instruments you will want those musicians to reference the clock that will eventually control your MIDI tracks. When you are eventually going to interface with MIDI, you should prepare your MIDI data to run along side the AW in sync via MTC. For example, if you were using a YAMAHA RS7000 or Motif as the external MIDI device, it would be wise to prepare the data to synchronize with the AW audio workstation. In such a situation you can use the AW tracks for strictly audio parts (vocals, acoustic instruments, etc.) and you can use the sequencer in the RS or Motif to play/trigger your external MIDI parts. You can decide to transfer tracks to the AW, as necessary. Many users like to create parts and transfer them to audio tracks on the AW because they can use the synthesizer's full complement of effects, while other users will expand the outputs of the RS or Motif (AIEB2) and record multiple parts to the hard disk, simultaneously. And still others will never record the MIDI modules since they can have their own dedicated input channel on the AW and they will utilize the MIDI sequencers ability to automate (make repeatable) every nuance of the MIDI tracks. More than likely, as you get to know the tools you have, you will develop some combination of methodologies. The thing to recognize is what the tools are and what the potential is, and then apply the appropriate methodology to accomplish the job. No single guide could possibly cover all the scenarios, and there is no 'best way' to work, but this guide will open the door to some possibilities so you can walk through with confidence.

¹ -where you will be synchronizing playback of your principal audio recorder with your MIDI sequencer.

MIDI Basics

MIDI has an entity called the SONG. I know, I know, you think we are getting too basic? Hang in there, just a minute. A Song is a linear structure much like the recording on the AW hard disk recorder, or any multi-track tape device. Song mode can be synchronized as to speed and location with external MIDI devices via MTC. MTC is a form of SMPTE time code. SMPTE (Society of Motion Picture and Television Engineers) is the name for timing code principally used for film. However, in this instance it is in RS-232 format so that it can travel down a standard MIDI cable. When in use, if you advance the AW, considered the MTC Master, to any spot in the song, the MIDI sequencer, considered the MTC slave, will automatically find that location and match the speed. It is a musically intelligent clock. If you have always worked with regular MIDI clock, then you need to know about these differences. MIDI clock has a timing resolution of 24 ppqn, not that this is really important in terms of how well it syncs. It can be used in a Master-Slave relationship to ensure that the connected devices all keep time together. MIDI clock will work with "Pattern" based sequencers but you will have to manually locate start points other than the TOP-of-Song. Typically, Pattern mode does not have a linear time line (this is true for the Motif and RS7000). Pattern Mode can be intuitively rearranged in real time. Song mode however, does have a linear time line and therefore can be used not only to maintain sync with external clock, but also automatically find the exact location within the linear structure. If you are using standard MIDI Clock in Song mode you can have the slave follow along via what is called Song Position Pointer. This keeps the slave in time with the master by interlocking every 16th note. MTC has a timing resolution of a quarter frame. MTC is listed in hours, minutes, seconds, and frames. Typically, film is 30 frames per second. MTC is like 'intelligent' sync because you fast forward or rewind your AW to any location and the slave sequencer will automatically find the correct location. One added thing, TEMPO (speed) is still a function of the slave's settings. In other words, the time code is counting based on clock time, while musicians don't. Musicians need to know what measure and beat they are at. So although MTC allows you to find a specific time location in a song, you need a TEMPO MAP to reference it to something musicians can use. Here's an example, the chorus begins at exactly 1 minute into the song. If you advance the AW (master) to that clock setting, the slave sequencer will automatically move that distance (1min) into the song according to the BPM setting in its window. This is why we must set a Master Tempo for MTC in the MASTER and the same tempo (if desired) in

the SLAVE sequencer. If there are tempo changes in the song, fear not, you can build a tempo map ahead of time. Planning your session can mean sitting down with the arranger or musicians with their charts and creating a tempo and time signature map for the song. By building this into the AW's (master) Tempo Map ahead of time, all attached slave devices can follow along and you can intelligently locate any measure/beat or timing cue that could possibly arise. With MTC it is possible to have the SLAVE running at a different tempo from the MASTER, tempos are set independently – with MIDI Clock the SLAVE tempo will always match the MASTER, it cannot be set independently. Why would you want separate BPM for MTC and your sequencer? Your right it would be an unusual situation, but when referencing music to film the music often must meet a particular timing cue and this would allow the BPM to be adjusted accordingly.

CLOCK ISSUES

Working with an Audio Workstation like the AW2816 or AW4416 and a MIDI sequencer gives you the best of both worlds: Audio and MIDI. Let's start our discussion of Clock with synchronization. You will be linking the two machines together via MIDI to accomplish the transfer of control data and timing data. You have the following options regarding synchronization:

MTC – MIDI TIME CODE. This is SMPTE Time Code configured to go down a MIDI cable allowing MIDI gear to synchronize with this film industry standard clock. It is divided into "Hours: Minutes: Seconds: Frames: Sub-frames" and is used to clock music/film or just music devices. The AW units can be the MTC MASTER (or Slave), while a sequencer like the ones in the Motif or RS7000 can *only* slave to MTC. The Motif/RS7000 can be a slave to MTC at 30-frames/sec. Check the Owner's Manual of your sequencer and determine if it can slave to MTC. The AW units have a dedicated MTC output – use this just for clock. In any scenario where you will be using MTC as your clock the AW should be set to 30 frames per second, and *it should be the MASTER clock.*

MIDI CLOCK - The AW and external sequencer can be synced via MIDI clock. The AW can generate MIDI clock (but does not receive it – for obvious reasons) and sequencers like the Motif/RS7000, of course, can send or receive MIDI clock. Therefore, in any scenario where you will be using MIDI Clock, *the AW will be the MASTER clock.*

When using **MTC sync** the following situations exist:

- The Audio Workstation should always be the MTC Master

- The clock reference should be set to 30 frames
- The MIDI sequencer is set to MIDI SYNC = MTC
- The MIDI sequencer should be used in SONG mode (Song mode is the only mode that can respond to MTC). MTC uses Song Position Pointer to locate and chase-lock.
- MTC needs a dedicated cable for clock information. Set the AW's dedicated MTC output for clock information.
- The tempo of the Slave (MIDI sequencer) must match the tempo of the Master (AW clock). They **can** be set independently when MTC is in use – if you want them to reference time to the same tempo you must set them to the same BPM.

The reason MTC tempos can be set independently has to do with its use in film. That is, when you are referencing music (MIDI) to film, often you need to make the music fit a certain 'cue' point. The killer jumps from behind the curtain at 1hr: 20min: 33sec: 10.00frames, and there is a 30 second musical build-up. The composer has a 32-second piece of music. You can set the tempo of the music to climax at the given cue point by increasing the tempo. But for our purposes you will want the clock/temp in the AW to match the clock/tempo of the MIDI sequencer.

There is no single way you must work. Sometimes you will need to be building tracks while working with both units together.

The following situations will exist when using **MIDI sync** to clock the units:

- The Audio Workstation is the MASTER MIDI clock
- The MIDI sequencer is the MIDI Clock SLAVE
- The MIDI sequencer can be in Song mode (where Song Position Pointer will apply) or in Pattern mode (where you will have to ensure measure location manually).*...{*this is an often-asked question: How come PATTERN mode doesn't auto-locate? It is simple logic. It can't – you have a four-measure pattern that cycles. You advance the AW to measure 53 – where is it within that pattern? You see, pattern mode has no linear time line and clock with locate needs a linear time line}
- The tempo of the Slave will automatically be set to match the tempo of the Master. They cannot be set independently.

The clocking options are very flexible and will allow you to work with the Sequencer (in record) while maintaining synchronization with the AW, if necessary.

What if I am working with Pattern Mode in my MIDI Sequencer?

Pattern mode in the Motif and RS7000 sequencer allows for intuitive rearrangement of the music. Pattern mode is made up of up to 16 user definable musical sections. These sections can intuitively be recalled at the press of a button. Pattern mode can be used to construct your music. Pattern mode in these sequencers does not respond to MTC. Obviously, those of you used to PATTERN mode (open arrangement) see the advantage of SONG mode (finished/fixed arrangement). Song mode can automatically find the precise location within the recording and match your external sequencer device to that location. This means that it will be easy for you to assemble your recording with all parts in perfect synchronization. You can start anywhere within the song and the sequencer will find and follow. Both the Motif and RS7000 (Yamaha's Integrated Sampling Sequencers) allow you to build a SONG from your Pattern data. You place **Pattern** mode Sections into a **Pattern Chain**, which in turn can be edited and converted to a linear **Song** structure. This Pattern Chain is very analogous to the AUTOMIX in the AW, in that you are documenting, via several independent passes through the song, a final mix. A Pattern Chain consists of three automation tracks: 1) Pattern (PATT) – this records the Section Changes and can handle Time Signature Changes; 2) BPM – this track records any tempo changes; 3) Scene – this tracks documents both Scene recalls and Mute status changes throughout². When you have satisfactorily assembled the components into an arrangement, you can execute the CONVERT TO SONG job, which will write out the data in a linear format to a SONG location. Your settings are automatically transferred to the SONG. However, you may need to tweak the locations of Program Change events within the SONG to ensure 'glitch-free' playback³.

Set Up

Once you have a repeatable, edited Song (a MIDI automated mix) you can synchronize this to the AW by setting the following:

On the AW:

- Set MTC and MMC to MASTER: Press [MIDI]/ [F1] MIDI Setup 1

² In the Motif this track records MUTE status, in the RS7000 it can document both SCENE and MUTE changes.

³ If your music contains program changes from Section to Section, these events will now be placed in the track event list at the "top" measure where the Section change occurs when converted to a linear SONG. While in Pattern mode the sequencer embeds Program Change events in a header, not in the track data. Now **you** must ensure they do not interfere with smooth Song playback.

- Ensure that MTC is assigned to the correct out port: Press [MIDI]/ [F2] MIDI Setup 2 (MTC OUT)
- Connect the MTC OUT jack to the MIDI IN of the target slave device
- Set the Display counter to Measure: Press [SONG]/ [F2] Settings; Change DISPLAY to MEASURE
- Set Master BPM/Time Signature: [SONG]/ [F3] Tempo map. These should be set to match the Tempo and Time Signature in the MIDI sequencer. It is possible, unlike MIDI clock, to set the Tempo of the Slave device independent of the Master device when using MTC. This flexibility will be appreciated when you need to reach a timing cue (on film) with a specific moment in the musical composition.

On the Motif/RS7000 or external sequencer:

- Prepare the data as a SONG, as necessary. Convert Pattern→ Pattern Chain→ Song
- Move or remove unnecessary program change events to ensure smooth playback timing.
- Set the Sequencer Clock to MTC: [UTILITY] MIDI

If you still wish to use the PATTERN mode of the RS7000 or the Motif, you can sync the sequencer via standard MIDI Clock (Pattern Mode, by definition, does not support MTC). Although the sequencer can start/stop and remain in tempo, you will be responsible for manually updating the location if ever you stop playback and wish to resume in a spot other than the top – in other words it will not automatically find the right spot. You will be “free-wheeling” when you control Section changes⁴ and you will need to start from the top each time to ensure location.

The entire setup is very flexible and you will need to determine the best method for what you need to accomplish. The AW MTC out will always output MTC. The AW can generate MTC through both OUT ports **or** it can output MIDI clock and MTC simultaneously. It is possible to simultaneously control the Motif in Song via MTC and the RS7000 in Pattern mode via MIDI clock (via the MIDI OUT). Or control both simultaneously via MTC on independent MIDI jacks.

Understanding how the AW displays time on the screen is our next task. We have selected to DISPLAY: MEASURE so that the numbers in our sequencer and the numbers in the AW display will be automatically referenced to the musical subdivisions of time. The AW display can be changed if you need to know the exact time or the time referenced to MTC.

In the AW you can view ABSOLUTE or RELATIVE time. ABSOLUTE time is the technical time from the moment PLAY/RECORD is pressed, while RELATIVE time is referenced to where the *significant* events begin. In a musical

⁴ If you miss the downbeat while changing Sections synchronization may be lost.

composition this would be the start of the song. Your mileage will vary depending on the kind of recording you are doing. If you need to setup a count-off because many of the overdubbing musicians will need one as a reference, you can prepare for this by programming in several measures of just empty ‘time’ in your sequence and on the hard disk of the AW. You can use the metronome of your MIDI sequencer, or the built-in metronome in the AW⁵. If you do not reference your song to musician time (measures) at the start of the project, you will be in a world of hurt if you try and add it later because you will have to manually build your tempo reference. That is why “planning ahead” is always a key. If you are the studio owner and are working with outside clients, you will want to know in advance if they plan on adding MIDI instruments via a sequencer. It is a good idea to setup for sync referencing, if they are not sure. When in doubt, do it! It opens the door to so many possibilities in terms of final mix.

Setting the START point of a SONG

It is recommended that you leave a small amount of time before the actual start of the song content. This way you can allow for count-ins and other musical ideas you may have at a later time. If you leave room in the beginning you don’t have to worry about **not** having it if later you need it.

Here is a STEP-BY-STEP guide to the setting the critical clock START point of an AW2816/4416 SONG at the start of a session.

- Press the [SONG] button and select the [F1] SONG LIST screen
- Cursor to the “NEW SONG” box and press [ENTER]. The unit will ask you do you want to save the current song and then offers you the opportunity to import data from an existing recording. This function⁶ means that once you get to know the AW, you will be able to import your favorite setups from any previous recording sessions making working with the unit easier as you go along. Just select OK and press [ENTER]
- You can also NAME the SONG and write any comments about the session. If you have not invested in a simple serial mouse, do so. You will find it invaluable navigating the AW and especially when naming and writing comments. Best \$10 you can spend!

⁵ By outputting the AW metronome to an OMNI OUT you can send this on to your headphone amp for overdubbing musicians, if necessary.

⁶ The AW2816/4416 can recall SCENE MEMORY, TEMPO MAP, AUTOMIX, LIBRARY settings, and MIDI REMOTE setups from any other session and import them to the new Song session.

- When working with music and musicians, you will find it convenient and wise to have the clock count MEASURES and BEATS. The AW can count hours, minutes, seconds, frames and fractions of a frame or just hours, minutes seconds and milliseconds, but when working with music and MIDI set the display to count in "musician language". Press [SONG]/ [F2] Setting, set the DISPLAY parameter to "Measure". This will increase your ability to "talk" music with the composer...most musicians know that the bridge starts at measure 49, not 1min:32.476seconds into the song.
- Next you will want to set up the Metronome function. You can set the metronome by pressing the [TRACK] button and selecting the F1 TRACK VIEW screen. Use the down cursor to select the "METRO" ON/OFF parameter and turn it ON. This is an audible metronome but will not be recorded to the track (unless you have an open microphone near your speakers). You can use this click as opposed to the click of the MIDI sequencer for all recording, if you wish.
- Set the TEMPO MAP. Press the [SONG] button of [SONG]/[F4] to select the TEMPO MAP screen. Input the time signature and BPM of the song you are getting ready to record. You can actually create a tempo map event list, outlining any tempo changes or time signature changes that are in the song. By doing this ahead of time you can have the metronome count correctly no matter how complex the song. You cannot remove this "STEP 01" event. What you can do is affect *where* "Measure 001: beat 1" occurs. It is, generally, a good idea to place a few seconds in front of the meaningful start of the song, just in case you need you to build a count-in or want to place information in front of the main song. To do this we can "Set the START Point"... This will be the time at which the measure counter begins and the AW begins to generate MIDI clock (or MTC) for controlling the connected slave devices. We will be literally placing measures prior to the start command of the clock. If at a later time you need to overdub a musical part that starts at measure 1, beat 1, you will be glad that you have this "count-in".
- Under the [TRACK] button select the [F4] MARK ADJ. screen and select the "LOCATOR POSITION" function. This will show you a list of key points within the recording. You will see START, END, Marker A, Marker B, and Last IN and Last OUT points of the SONG. Move the cursor to the 'frames' position next to the "START" time: **Hrs:Min:Sec:Frames:sub-frames:**

00:00:00:00.00.

The time is always displayed here in Absolute time. As you begin to move the Data Wheel clockwise to input a new start time the measure counter will begin to count backwards. As you dial up the frames you will see the BEAT counter start counting according to your selected time signature and tempo. If, for example, your song is in 4/4 time, you will see the BEAT counter count back from 4. As you scroll the time you can count how many measures of lead-in you are creating. For example, if you want a two measure count-in let it count backwards from 4 twice and add one extra tick (for good measure):

04 – 03 – 02 – 01 – 04 – 03 – 02 – 01 – 04

You stop at the next 04 so that when you start the playback you get the four-count *complete* twice.

Other options with RS7000 or Motif

The Integrated Sampling Sequencer that is found in both the RS7000 and Motif, give those products some of the capability that you find in the AW hard disk recording system, principally, the ability to overdub while monitoring tracks. They are 'samplers' that allow you to record like a real Multi-Track Recorder. Of course, the difference between a table top/keyboard workstation sampler and a true audio workstation hard disk recorder is one that needs to be appreciated on an artistic level. Hard disk audio workstations have a large record memory (20GB or more), while a sampler deals with a much, much smaller record memory (64MB maximum for the Motif and RS7000). But what you can accomplish in a sampler is very refined control over the playback of audio. What we are talking about here is you can record a single snare drum hit that uses about 250 ms of time and repeat it, in a musical performance hundreds of time in a composition without using additional sample memory. In an audio workstation like the AW you can record the entire performance in one long chunk. In the sampler you can manipulate each and every snare drum event individually as to pitch, tuning, pan position, volume, etc. You can apply swing, and all those *musical* things. It is like working at the molecular sub-atomic level when compared to working with audio in a gigabyte sized audio workstation, where the strength is recording like a big tape deck. They are too tools that when you know how to use them, gives you unlimited potential.

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