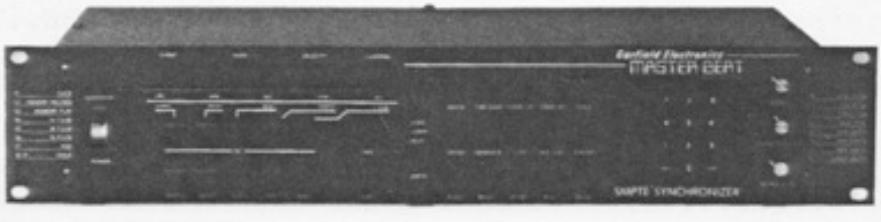
Garfield Electronics

MASTER BEAT

MASTER BEAT
SMPTE BASED RHYTHM CONTROLLER

OPERATION MANUAL
REVISION 2 - 1.05 SOFTWARE



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OVERVIEW

Master Beat is a comprehensive SMPTE based rhythm controller and synchronizer with total code flexibility, including the ability to sync to click tracks or live drums. It is a Reader, generator, re-generator and jam sync generator of 24, 25, 30 drop and non-drop frame SMPTE time codes.

Master Beat simultaneously provides metronome clicks and 16 timing formats for all sequencers, drum machines & arpeggiators including Chroma, Emu, Fairlight, Korg, Kurzweil, Linn, Moog, MXR, Oberheim, Roland, Sequential Circuits, Simmons, Synclavier, Wave PPG, Yamaha and others from any one of 16 timing reference signals. This timing reference can be any of the four SMPTE codes, MIDI, metronome click tracks, live drum tracks or any sync-to-tape source. Programmable "on beat" start and stop is featured in all modes. It can also use its own .001% accurate internal timing reference.

When controlled internally or from SMPTE time code Master Beat utilizes a programmable Timing Map and sophisticated control algorithms to correlate time and tempo. There are ten SONGS, each consisting of a TIMING MAP and an EVENT MAP. The Timing Map can store the tempos for each beat of an entire song or a shorter repeating sequence of tempos. Tempos are entered and displayed in beats per minute with 1/10th beat resolution or in frames per beat with 1/80th frame resolution for film scoring applications. Frame per beat tempos can be calibrated for 24, 25 or 30 frames per second rates. The editing system allows insertion or deletion of measures or beats of the Timing Map, and copying of any part of the Map to any other. The Begin feature allows playback of the Timing Map to start from any beat of any measure. The Loop feature allows the Timing Map to repeat from the beginning or from the measure and beat set by the Begin feature. The Timing Map also stores values for a Programmable Variable Clock which turns on and off or changes its note value during playback.

The Master Beat SMPTE Controlled Event System features six programmable gates, each of which has simultaneous 5-volt (TTL) & contact closure outputs. Each event also can control the Play and Click functions and the transmission of any MIDI data. Event timing can be programmed with bit accuracy (1/80th SMPTE frame) or recorded in real time.

The Live Tracking mode synchronizes in real time to varying audio pulses from a live drummer, or from Note On information from a MIDI keyboard. This is a live performance feature.

The metronome click output features adjustable volume and tone with provision made for the generation of manual click tracks.

Segment Time & Offset modes provide measure & beat correlation to time in SMPTE frames & bits, film feet & frames, or seconds & milliseconds. MIDI Song Position Pointer links song locations in all operational modes and tape locations in SMPTE modes. The system also includes Count In, Tempo Accelerando, Timing Map Origin Offset (the starting cue point with 1 bit resolution), Non-volatile memory, Program data Save-to-Tape and a full featured editing system.

* First, a description of operational features common to some or all Sync Modes will be presented (Display Modes, Code Select, Reset, Enter, Ready, Count In, Loop, Begin, Timing Offset Factor, Tempo Display Calibration and Enable Flags), followed by a discussion of each of the Sync Modes.

* Next, a presentation of the programming procedures for the Master Beat Timing Map and SMPTE Controlled Event System will be made.

* Finally, the Master Beat Utility Functions will be discussed (Accelerando Mode, Segment Time, Generating SMPTE time code, Manual click tracks, Jam Sync and Save-to-Tape).

COMMON OPERATIONAL FEATURES

DISPLAY MODES

There is one row of Display Labels above the Display Field and two rows of labels below the Display Field which have LEDs to their right:

```
EVENT       NOTE      VELOCITY     CHANNEL     --No LED
            _____________________________
I___________display field_____________I

HRS       MIN       SEC       FRM       BIT       X    --Upper LED
SONG      MEAS      BEAT      TEMPO     CODE      X    --Lower LED
```

When the upper LED is lit, the upper row SMPTE OFFSET LABELS apply.

When the lower LED is lit, the lower row TIMING MAP LABELS apply.

When neither LED is lit, the EVENT SYSTEM LABELS above the Display Field apply.

Some modes have unique display formats that do not correspond to the labels. Some modes have display formats that correspond to most but not all of the labels. The Begin, End, Bar and Count In LEDs are sometimes used as prompts in certain modes to indicate the type of display or the function of a field within a display.

All Numeric values are entered from the leftmost digit with leading zeros required. When the last digit of the value is typed Numeric entry starts over from the left to allow mistakes to be overwritten. The new value is stored when the Enter key is pressed.

There are five Set switches located below the display which indicate which display field is currently active. When more than one Set switch is on the leftmost field is active. The next field to the right becomes active when the Enter switch is pressed. In many instances the leftmost field will be reactivated after the rightmost field has been Entered.

THE CODE SELECT REGISTER

The value of the Code Select parameter configures Master Beat for the particular timing reference signal which is to be used. This determines the general operation of Master Beat. The following table lists the available code types with their corresponding Code Select numbers:

CODE SELECT	CODE
1	Click
2	Memory Record
3	Memory Playback
4	24 ppq Pulse
5	48 ppq Pulse
6	96 ppq Pulse
7	MIDI Sync
10~19	Tracking
20	Type O (Oberheim FSK)
21	Type R (Roland/Yamaha FSK)
22	Type L (Linn LM-1 and Old Roland FSK)
23	Jam Sync
24	24 frames per second SMPTE
25	25 frames per second SMPTE
29	Drop frame SMPTE (29.97 frames per second)
30	Non-drop frame SMPTE (30 frames per second)

This table is also printed on the Master Beat front panel.

TO CHANGE CODE SELECT: Turn the Code Sel switch on (hereafter referred to as the Code Select switch). The display will show the current Code Select value. Use the Arrow keys in the Numeric keypad to index to the desired value. Press the Enter switch to store the new Code Select value. Master Beat will automatically revert to Reset mode when the new Code Select value is Entered.

ENTER SWITCH

The Enter switch is used to store changes of any data. Once the correct digits have been keyed into the display, pressing Enter causes the new data to be stored in memory. In displays containing multiple data fields the Enter switch can be used to index past fields in which data does not need to be altered.

RESET SWITCH

The Reset switch cancels the current operation and returns Master Beat to Reset mode. Data keyed into the display but not Entered does not overwrite the stored value. Reset mode is a safe starting point for all operations.

READY SWITCH

The Ready Switch causes Master Beat to expect an incoming timing reference signal. The display will flash the Code Select value, or the current Start Time in SMPTE modes. It is also used to prepare for Accelerando Mode calculations and the transmission of Master Beat Timing and Event Map data in Save-to-Tape mode.

LOOP SWITCH

When the Loop switch is off Master Beat reverts to Reset mode when the end of the Timing Map is encountered in the course of Play mode. With the Loop switch on Map playback continues from measure 1/beat 1 or from the measure and beat value stored in the Begin Register (if the Begin switch is on).

COUNT IN REGISTER

The Count In Register can be set to any value from 0 to 99. This value is automatically counted down by Master Beat before entry into Play mode. In several of the Sync Modes a Count In setting of 99 indicates selection of manual cueing in which case Master Beat waits until the Play switch is pressed to enter Play mode on the following beat.

CHANGE COUNT IN: Turn the Count In switch on. The display will show the current Count In value. Use the keypad or Arrow keys to select the new Count In value. When the Enter switch is pressed the new Count In value is stored and the display reverts to Reset mode.

BEGIN REGISTER

The Begin Register stores a measure and beat value from which Timing Map playback and looping commences when the Begin switch is on. When the Begin switch is off playback and looping will always be from measure 1/beat 1. Whenever the Begin switch is turned on in SMPTE modes a new starting offset (cue point) is automatically calculated so that playback starts from the proper point in the tape. In other modes Count In or Manual Cueing to start from the desired point in the tape. If MIDI Song Position Pointer is enabled (see Enable Flag 3 on page 11) then sequencers and drum machines that recognize type of data will be located to the measure and beat indicated.

CHANGE BEGIN REGISTER: Turn the Begin switch on. The display will show the current Begin Measure and Beat values. Use the keypad or the Arrow keys to select the new Begin Measure value and press the Enter switch to store the new value. Next use the keypad or Arrow keys to select the new Begin Beat value. Press the Enter switch to store the new value. Each of the ten Master Beat timing maps has its own Begin Register.

TIMING OFFSET FACTOR

The Timing Offset Factor adds or subtracts clocks in master timebase clocks from normal timebase generation during the first beat interval of Play mode. When overdubbing sequenced parts this allows compensation for the response time of sequencers and drum machines to external clocking sources. It can also affect the rhythmic feel of the music by rushing or delaying the beat.

The Timing Offset Factor can be altered during Play mode with the Arrow keys. The left Arrow delays (subtracts a clock), and the right Arrow advances (adds a clock). When the Arrow keys are used for this purpose the stored Timing Offset Factor is modified.

Whenever a change in Timing Offset Factor is being processed the display will reflect the new value and the Offset LED will light. If the "0" key is pressed during playback the current Timing Offset Factor will be momentarily displayed. Pressing the Offset switch while in Reset mode with a non-SMPTE Code Select value set will display and allow alteration of the Timing Offset Factor value.

The Timing Offset Factor indicates a number of master timebase clocks. Fifty is a neutral value and does not add or subtract clocks from normal timebase generation. When the value deviates from 50 it is that deviation which represents the number of master timebase clocks that are added or subtracted. For example, a value of 58 will add eight clocks, and a value of 43 will subtract seven clocks.

The Master Beat master timebase clock is 384 pulses per quarter note. At a tempo of 120 beats per minute each clock cycle is approximately 1.3 milliseconds, so a Timing Offset Factor of 58 would advance the playback of sequencers and drum machines by 8 times 1.3 milliseconds, or about 10.4 milliseconds. The general formula is: 156 divided by the beats per minute tempo = milliseconds.

When altering playback offset in SMPTE modes, the time of a clock pulse is calculated from the current tempo and added to or subtracted from the Map Origin Offset value. See the section on SMPTE Sync Modes for details about this.

CHANGE TIMING OFFSET FACTOR REGISTER: Turn the Offset switch on with the Code Select Register is set to a non-SMPTE value. (Timing Offset operates somewhat differently than described here when using SMPTE Codes). The right most portion of the display will show the current Timing Offset Factor. Use the keypad, Arrow and Enter switches to set the new value.

When in any of the Tracking modes (Code Select 10 through 19), it will be necessary to press the Enter switch three times to skip past the Premask, Postmask and Beat Interval Pattern fields to the Timing Offset Factor field (see Tracking Mode Editing Operations on page 35).

In the SMPTE modes the effect of the Timing Offset Factor is accomplished by changing the Map Origin Offset value (the SMPTE value corresponding to measure 1/beat 1).

During SMPTE driven Timing Map playback the Map Origin Offset value can be altered through use of the Arrow keys.

The right Arrow subtracts from the start time advancing playback, and the left Arrow adds to the time, delaying playback. See Programming the Timing Map on page 38 for more details about the Map Origin Offset value.

TEMPO CALIBRATION AND DISPLAY FORMAT

The tempo can be displayed in beats per minute or in frames per beat calibrated to one of four frame rates. The available tempo calibration values are as follows:

00: Beats per minute with 1/10 beat resolution.

30: 30 frames per second video calibration with 1/80th frame resolution.

25: 25 frames per second video calibration with 1/80th frame resolution.

24: 24 frames per second film calibration with 1/80th frame resolution.

The above tempo calibration modes are independent of the type of code being read. For example, you can specify and display tempos in 24 frames per second calibration while reading 30 fps SMPTE code or click tracks. Actual playback tempo is not affected by a changes between the tempo calibration values listed above, only the display format is altered.

23: 23.976 frames per second compensated film to video playback calibration. Plays tempos back .1% slow. Displays tempos in 24 fps format, though tempo may be specified in one of the other formats and then be played back in this calibration. The application of this calibration mode is explained in the following paragraph.

When film is transferred to video for scoring (as often is the case), the 24 frames per second film format is converted to the 29.97 frames per second video format by repeating every fourth film frame (single frame stepping a video cassette will confirm this). If video ran at 30 frames per second the conversion would be precise: 24(5/4)=30. However, since the video frame rate actually is 29.97 fps it runs .1% slow relative to the film (29.97/30=.1%). This causes time segments precisely calculated with reference to the 24 fps film rate to finish early relative to the video (the error amounts to about 2 frames per minute).

When Tempo Calibration is set to 23, playback of the Timing and Event maps is slowed down by .1% to achieve an exact correspondence with the video. When the score is actually recorded Tempo Calibrate mode 24 is set and an exact correspondence with the film is acheived.

CHANGE TEMPO CALIBRATION: Turn the Calibr switch on. The rightmost portion of the display will show the currently selected Tempo Calibration mode. Use the Arrow keys to select the new Calibration mode. When the Enter switch is pressed the new value is stored and Master Beat reverts to Reset mode. All programmed tempo values will now be displayed in the selected format and calibration.

ENABLE FLAGS

There are ten operational features which can be turned on or off with the six Enable Flags. The Enable Flags Register is accessed by turning the Event switch on, and then turning the Code Select switch on. The display will show 6 digits each of which will be a 0 (off), or a 1 (on). The Enable Flags are numbered 1 through 6 reading left to right and are set by using the switches below each of the digits: Insert, Delete, Copy, End, Bar and Step. The functions of the the Enable Flags are shown below:

FLAG (SWITCH)	FUNCTION
1 (INSERT)	HALF SPEED/SPECIAL MIDI START OUTPUT CONTROL - When this flag is on Master Beat will expect to receive SMPTE time code at half the normal speed. This permits real time sequence recording to be done at half speed while in sync with a video or audio tape playing at half speed, allowing more accurate humanized recording into the sequencer than would perhaps be possible at full speed. This Flag also is used in MIDI sync mode (Code Select 7) to enable the Start Output to operate without the need to reset Master Beat before each MIDI Start command is received. (See Sync to MIDI Clocks on page 20 for more information).
2 (DELETE)	MIDI SONG SELECT - When this flag is on Master Beat will transmit the current Master Beat Song number whenever a new Song is selected. See Change Song on page 39 for more info.
3 (COPY)	MIDI SONG POSITION POINTER/G9000 LOCATE - When this flag is on Master Beat will transmit MIDI Song Position Pointer data when any of the Play modes are used. Also enables transmission of Garfield MIDI system exclusive measure number pointer for use with the Linn 9000 when equipped with the Garfield G9000 interface card. See Linn on page 84 for more details.
4 (END)	OCTAVE DOWN/G9000 RECORD - When this flag is on and the Code Select Register has been set to 7 (MIDI Sync mode) all received MIDI Note information will be transposed down one octave before being retransmitted from the Master Beat MIDI Out jacks. Also activates the record function of a Linn 9000 equipped with the G9000

interface card.

5 (BAR) OCTAVE UP - When this flag is on and the Code Select Register has been set to 7 (MIDI Sync mode) all received MIDI Note information will be transposed up one octave before being retransmitted from the Master Beat MIDI Out jacks.

6 (STEP) CHASE MODE - When this flag is on and Master Beat is operated in any of the SMPTE sync modes (24, 25, 29 or 30), rather than waiting for a specific SMPTE cue to commence map playback, as is the normal case, the SMPTE code first read will be correlated to the Timing Map to determine what measure and beat is coming up. Then MIDI Song Position Pointer (and Garfield/Linn 9000 MIDI measure pointer) data will be transmitted to locate sequencers and drum machines which can recognize this type of data. The actual pointer message sent is one or two measures later to allow time for the slave units to locate to the required song position. When this delayed point is reached Master Beat cues into Play mode and the sequencers and drum machines play at the same place as previously recorded overdubs on tape, virtually functioning as additional tape channels. While in SMPTE Sync Chase Ready mode the display flashes a SMPTE value of all zeroes instead of the usual cue point flash display.

If the Song Position Pointer Enable Flag (Flag 3) is also on then the number of beats which the Master Beat Timing Map was looped through to arrive at a measure/beat correlation will be added in when the Song Position Pointer calculation is made. This causes the Song Position Pointer to reflect the position in the piece of music as a whole rather than the position in the Timing Map. This feature is useful when the Master Beat Timing Map is a relatively short beat interval pattern (a sequence of changing tempos within a measure or two which create a rhythmic feel) upon which the playback of a longer sequence or drum machine pattern is based. When the Song Position Pointer Enable Flag is off the Song Position Pointer reflects the position in the Timing Map, regardless of the number of times it has looped.

MASTER BEAT SYNC MODES

The following discussion of Sync Modes assumes familiarity with the preceding Common Operational Procedures section.

Master Beat Sync Modes are divided into six groups:

1) SMPTE Sync Modes (Code Select 24, 25, 29 & 30)

2) Internal & Metronome Play modes

3) Clock and FSK Sync Modes (Code Select 4, 5, 6, 20, 21 & 22)

4) MIDI Sync Mode (Code Select 7)

5) Click Sync Modes (Code Select 1, 2 & 3)

6) Tracking Sync Modes (Code Select 10 through 19)

SMPTE SYNC MODES - CODE SELECT 24, 25, 29, 30

In the SMPTE Sync modes, tempos for each beat of an entire song or one or more representative measures are programmed into a Timing Map. The tempos can be entered in any of the Tempo Display Calibration modes previously discussed. The programmed tempos are referenced to SMPTE by the setting of the Map Origin Offset Register, which is the cue point for measure 1/beat 1 of the map.

When the Begin Switch is on, Master Beat calculates the cue point for the Begin measure and beat values stored in the Begin Register based on the Map Origin Offset Register time and the tempos of the Timing Map.

If Count In is used, an earlier cue point is calculated to start the count so that playback still starts at the time specified in the Map Origin Offset Register. See Programming the Timing Map on page 38 for details.

Concurrent with the playback of the stored tempos is the operation of the SMPTE Controlled Event System. Up to 800 events can be programmed. Each event consists of:

* The programmed status of the six Event Gates
* The status of the Click and Play Toggle functions
* MIDI data which is to be transmitted
* A SMPTE time code value at which the Event is to occur.

Refer to Programming the SMPTE Controlled Event System on page 48 for programming details.

Internal Play mode allows Master Beat to play without any timing reference code input. It operates identically to the SMPTE Sync Modes by reading is own internal SMPTE generator. For details on generation of SMPTE tracks see Generating SMPTE Time Code on page 57.

All Master Beat SMPTE operations are performed with reference to 24, 25, 30 drop frame or 30 non-drop frame SMPTE time code as programmed in the Code Select Register.

When Reset mode is activated the display resets to measure 1/ beat 1. Turning on the Offset switch will light the five Set LEDs and display the currently programmed Map Origin Offset time which

references the sequence of tempos in the Timing Map to SMPTE time code. The values of the Hour, Minute, Second, Frame and Bit fields can be individually altered using the keypad and Enter switches. If no change is required in a particular field, pressing Enter advances to the next field without altering the existing data. As each field is Entered the LED indicator under that field will go out. When the Bit field value has been entered (rightmost display field) Master Beat reverts to Reset mode.

In Reset mode, the Arrow keys can be used to scroll through the Timing Map beat by beat, displaying the programmed tempos. A specific measure can be directly accessed by pressing the Measure Set switch, keying in the measure number and pressing Enter. Specific beats can be accessed in similar fashion using the Beat Set switch.

When the Offset switch is pressed while a measure and beat other than measure 1/beat 1 is selected the display will show the corresponding SMPTE value based on the value Map Origin Offset Register and the tempos programmed in the map. This Beat Offset Value can be adjusted in 1 bit increments which will have the effect of altering the previous beat tempo to make the current beat fall upon the modified SMPTE value. This is helpful when lining music up with "hit points" in film work, or delaying or rushing a beat for just the right rhythmic feel. Pressing the Tape switch while viewing a corresponding SMPTE offset will display the Film Feet, Frame and Bit value corresponding to the currently indexed measure and beat.

Any Count In value from 0 to 99 beats can be selected. The Metronome Click output will play for the specified number of beats before the current cue point. Turn on the Count In switch and use the keypad or Arrow keys followed by Enter to program the Count In value.

To sync the Timing Map to tape SMPTE time code is recorded on a tape track as described in Generating SMPTE Time Code on page 62. The SMPTE from tape is then connected to the Code In/From Tape jack and the Ready switch turned on. The display will flash the SMPTE value corresponding to the playback (or count in) cue point as programmed. This value will be based on the Map Origin Offset value and the Count In value (and if the Begin switch is on, the measure and beat values stored in the Begin Register).

When the tape has been started and the SMPTE code is received the display will switch from flashing the cue point SMPTE to reading out of the incoming code. The SMPTE LED will light and remain lit as long as the incoming code is good and will go out if any bad code is encountered (this does not necessarily mean that sync is lost - most read errors are automaticly recovered from). When the cue point is reached the display will change to

showing the Measure, Beat and Tempo of the Map as playback progresses. If the code initially read is later than the cue point (which was previously flashing), the Upper Display Mode LED will flash indicating a "read later than cue point" error. Tape must be started at a point earlier than the flashing cue point.

When the end of the Timing Map is reached Master Beat will exit to Reset mode if the Loop switch is off. If the Loop switch is on Map playback will continue from measure 1/beat 1 or from the measure and beat value stored in the Begin Register (if the Begin switch is on). Note that the Begin switch can be turned on after playback has commenced to allow starting from measure 1/beat 1 and then looping to the Begin measure and beat location.

As with other playback modes the Play switch is used to punch in and out of Play mode on the beat at any time during map playback, and the Click switch can be used to turn the Metronome Click Output on or off. Master Beat will revert to Ready mode if the incoming SMPTE code stops such as is the case when rewinding the tape.

In the SMPTE Sync Modes compensation of delays due to varying response times of sequencers and drum machines is accomplished by altering the Map Origin Offset value. An earlier start cue point will shift playback ahead of the beat while maintaining relative synchronization. A later start point delays playback.

In Play mode the Arrow keys will add or subtract time from the Map Origin Offset value in correspondence with the duration of one master timebase clock at the current tempo: 156 divided by the beats per minute tempo = milliseconds. The right Arrow rushes the beat (subtracts the time of one clock), and the left Arrow delays the beat (adds the time of one clock). Whenever an Arrow key offset shift command is being processed the Offset LED will light. Use of the Arrow keys automatically shifts the playback of the Timing Map and alters the Map Origin Offset Register.

Operation of the SMPTE Controlled Event System is concurrent with Timing Map playback. Each Event consists of setting the status of the six Event Gates (each of which has a 5-volt and a contact closure output nested in the RS232 connector - see chart on page 50), setting of the Click and Play toggle functions (same as pressing the Play or Click front panel buttons but under SMPTE control), and transmission of any MIDI data if desired, all at a programmed SMPTE offset for that particular Event number. The status of the Event Gates indicated by the Delete, Insert, Copy, End, Bar and SMPTE LEDs, which represent Event Gates 1 through 6 respectively. See Programming the SMPTE Controlled Event System on page 48 for full details.

Alternate Master Beat SMPTE Sync modes include operation from half speed external SMPTE for recording intricate sequences at half speed, and Chase mode which allows correlation of the SMPTE read at any point on the tape to be used in MIDI Song Position Pointer calculation which enables MIDI sequencers and drum machines which can recognize this type of data to function as additional tape channels. Both of these modes are detailed in the Enable Flags section on page 11.

When Code Select 29 (drop frame SMPTE mode) has been selected and an external source of non-drop frame code is read, the Code Select value will automatically switch from 29 to 30. Conversely if Code Select has been set to 30 (non-drop frame SMPTE mode) and drop frame code is read, the Code Select value will automatically switch from 30 to 29. This feature can be used to identify an external source of SMPTE time code.

INTERNAL PLAY MODE

Internal Play mode is actuated by pressing the Play switch or the Play footswitch. It operates as if SMPTE were being read (actually the internal SMPTE generator is being read instead of an external source) and has the same operational features as the SMPTE sync modes except the Timing Offset Factor is not operational.

If Code Select is set to Code 1 (Click Sync mode) then the tempo is set by the Click Mode Tempo Register value (shown in the tempo field of the display). This tempo is independent of the Timing Map tempo values, allowing simple single tempo operation.

METRONOME PLAY MODE

This mode is for simply activating the Click Out jack while the Timing Map plays back. It is entered by turning on the Click switch or pressing the Aux 1 footswitch. Count In, Loop and Begin Register values (if the Begin switch is on) apply as in other Play modes. Clock, FSK, Sync and MIDI outputs, and the Event System are not activated in this mode.

CLOCK AND FSK SYNC MODES - CODE SELECT 4, 5, 6, 20, 21 & 22

The following material assumes familiarity with the Common Operational Features section.

These modes are used to synchronize Master Beat to the 24, 48 and 96 pulse per quarter note (ppq) timing clocks and to Oberheim, Roland, Yamaha and Linn LM-1 tape sync codes for unit to unit sync as well as sync-to-tape. The specific mode and therefore the type of sync signal to be used as timing reference is selected by setting the Code Select Register as indicated in the following table:

CODE SELECT	CODE
4	24 ppq clock
5	48 ppq clock
6	96 ppq clock
20	Type O (Oberheim FSK)
21	Type R (Roland/Yamaha FSK)
22	Type L (Linn LM-1/Old Roland FSK)

The source of the sync code (a tape track output or a master unit's sync or clock output) is connected to the Master Beat Code In/From Tape jack. The Ready Switch is pressed, and the Code Select value flashes until the selected sync code signal is received.

Automatic Count In of 0 to 98 beats can be selected, and on-beat manual cueing can be performed by setting the Count In value to 99 and pressing the Play button during the beat before the desired cue-in beat. This is extremely helpful when laying in overdubs. Pressing Play at any time will stop or start playback on the following beat. The sync code must always be started from the beginning.

When MIDI Song Position Pointer is enabled (see Enable Flag 3 on page 11) playback can commence at the measure and beat value stored in the Begin Register, if the Begin switch is on. However, clock counting still begins when sync is first received. To enter Play mode at the same measure and beat on the tape or the master sequence, Count In or manual cueing must be used. In either case the code is started from the beginning of the track or sequence so that Master Beat knows where the beats are.

If the Loop switch is off playback will cease when the number of measures in the current timing map have elapsed and Master Beat reverts to Reset mode. If the Loop switch is on, Map playback will continue from measure 1/beat 1 or from the measure and beat value stored in the Begin Register (if the Begin switch is on). The selection of the Begin measure and beat value references the Programmable Variable Clock to the desired location.

If the Code signal stops, such as when rewinding the tape, Master Beat automatically reverts to Ready mode.

The Timing Offset Factor is used to add or subtract master timebase clocks from the first beat of Play mode to compensate for various sequencer and drum machine response times to external clocking sources. During playback additional clocks can be added or subtracted by use of the Arrow keys. The left arrow delays (subtracts a clock), and the right Arrow advances (adds a clock). This feature is used to determine the optimum timing relationship between a given overdub and other parts already on tape. The value stored in the Timing Offset Factor Register will automatically be modified whenever the Arrow keys are used. Pressing the "0" key will momentarily display the current Timing Offset Factor value. This feature can also be used to create pre or post echo effects or to rush or lay back the beat. The actual amount of time by which map playback is altered is tempo dependent and is calculated in milliseconds with the following formula: 156 divided by the beats per minute tempo = milliseconds.

MIDI SYNC MODE - CODE SELECT 7

MIDI Sync mode features Real Time MIDI sync, Pulse to MIDI Conversion, and MIDI to Pulse Conversion all of which can operate simultaneously. This section assumes familiarity with the Common Operational Features and Clock/FSK Sync sections.

SYNC TO MIDI CLOCKS

In Real Time MIDI Sync operation MIDI Real Time system commands (Start, Stop, Continue & Clock) presented to the MIDI input are used as the Master Beat sync source. Operation of the Ready switch, Programmable Variable Clock, Count In, Loop, Begin measure/beat and Timing Offset Factor apply as described in Clock and FSK Sync Modes. There is no auto shutoff feature in MIDI Sync mode; when MIDI Stop data is received Master Beat goes into a pause mode. Then if MIDI Continue data is received, subsequent MIDI Clocks will advance playback from the point where the Stop data was encountered. However if MIDI Start data is received while in the pause mode Map playback will start over with whatever Count In, Push Factor and Begin measure and beat (if the Begin switch is on) have been programmed.

When using the Master Beat Start output, or the Sync R or Sync K outputs, it is necessary to turn on Enable Flag 1 to properly control these outputs. This special operational mode can cause timebase errors in machines not controlled from Sync R, Sync K or the Start output. If this becomes a problem, leave Enable Flag 1 off (see Enable Flag 1 on page 11) and press Reset then Ready each time before starting the MIDI clock source connected to Master Beat.

MIDI TO PULSE CONVERSION

In MIDI to Pulse Conversion if MIDI Note data is received which matches the MIDI portion of Events 1 through 6, the corresponding Event Gate output (1 through 6), is activated. This allows MIDI data to create the older style 5-volt and contact closure triggers. MIDI Note On data turns the appropriate Event Gate on and MIDI Note Off data turns it off. Any Event programmed with a value of 0 in the MIDI Channel field will respond in Omni mode (a pulse will be generated by reception of the programmed note value regardless of MIDI channel number).

The 12 outputs of the Event Gates are nested in the RS232 connector as listed in Event Editing Operations on page 50 which also details the procedure for programming MIDI Event data and Event offsets. Note that the Event offset values don't matter for MIDI to Pulse conversion.

PULSE TO MIDI CONVERSION

In Pulse to MIDI Conversion each time an audio or click pulse is received at the Pulse In jack, MIDI data of the currently indexed Event is transmitted and the Event number is incremented. This feature allows drum pads, pickups or audio sources to trigger the transmission of MIDI data, such as Note On/Off to trigger drum machine or synth voices, MIDI program changes or any other MIDI data. If the data to be transmitted is of the MIDI Note On variety, a corresponding MIDI Note Off transmission will occur when the Mask LED (which is part of the Pulse In circuitry), goes out. This feature allows the gate time of the MIDI note On/Off transmission to be set by the Mask Control. Adjust the Pulse In Gain and Mask controls for compatibility with the triggering source. When the last programmed event is triggered the event indexing will loop to Event 1.

CLICK SYNC MODES - CODE SELECT 1, 2 & 3

REAL TIME CLICK - CODE SELECT 1

* Synchronizes in real time to constant tempo click or audio pulses input to the Pulse In jack when the Ready switch is on.

* Also allows Internal Playback at a single tempo without programming a Timing Map.

Note: Synchronization to varying tempos is performed with Memory Record and Memory Playback modes for sync to a taped click or drum track (see page 25), or with Tracking mode for sync to live drums in real time (see page 29).

The tempo of the pulse must be extremely accurate - many drum machines and sequencers are not steady enough to meet the requirements of this operating mode. The click should be sharp and clean. If you are using an audio source from a drum machine, it may be necessary to use Memory Record and Memory Playback modes described in the next section.

Automatic Count In of 0 to 98 pulses is selected by setting of the Count In Register value. Manual Cueing may be selected by setting the Count In value to 99 and pressing the Play switch or Play footswitch during the beat before the desired cue-in beat. This is similar to the operation of the original Doctor Click Rhythm Controller. Pressing the Play switch at any time will stop or start playback on the next beat.

When a value of 0 is selected for the Count In it is necessary to specify the tempo of the Click Mode Tempo Register while Code Select 1 is set. The displayed tempo value can be modified with the keypad, Arrow and Enter switches. This value is independent of the tempos programmed in the current timing map. Each of the ten Master Beat timing maps has its own Click Mode Tempo Register. The tempo of this register also determines the playback tempo of Internal Play mode. Pressing the Play switch starts playback after any programmed Count In. The tempo can be adjusted during playback with the Arrow keys (only in Code Select 1). Non-tempo aspects of the Timing Map control playback in Code Select 1 (Click mode).

Playback is stopped by pressing the Reset switch, or when the end of the map length is reached. Turning on the Loop switch defeats the automatic stop feature and Map playback will loop.

The Timing Map controls the Programmable Variable Clock and automatic end of playback at the conclusion of the last measure of the Map playback if the Loop switch is off. Playback can commence from measure 1/beat 1 or from the measure and beat stored in the Begin Register (if the Begin switch is on). MIDI Song Position Pointer, if enabled (see Enable Flag 3 on page 11), is transmitted to locate sequencers and drum machines which recognize this type of data to the appropriate measure and beat. Note that Begin only affects the start point of the Timing Map and does not cause playback to delay until the like measure and beat in the click track - Count In or Manual Cueing must be used to enter Play mode at the desired point.

* Sync to quarter, eighth or sixteenth note pulse information is determined by the time sign denominator value programmed in the Timing Map.

* The Pulse In Gain control sets sensitivity to the incoming clicks or audio.

* The Mask control provides filtering for noise immunity and should be set so that the LED indicator above it goes out just before the next pulse comes in.

* Pulse information input to the Pulse In jack also can be subdivided by the Mask control in its higher settings since it sets the minimum time between triggerings. For instance, an eighth note click track becomes a quarter note when the Mask control time (as displayed by the Mask LED) is longer than the time between eighth notes.

* The Timing Offset Factor adds or subtracts clocks master timebase clocks from normal timebase generation during the first beat of Play mode to compensate for the varying response times of sequencers and drum machines to external clocking sources. Turn on the Offset switch to display or alter the value. A value of 50 is the normal value with no clocks added or subtracted. Adding to or subtracting from this value determines the number of master timebase clocks which will be added or subtracted during the first beat of Play mode.

Timing Offset Factor can also be altered during Play mode with the Arrow keys. The left Arrow delays (subtracts a clock), and the right Arrow advances (adds a clock). When the Arrow keys are used for this purpose the display will reflect the new Timing Offset Factor momentarily and the Offset LED will light. If the "0" key is pressed during playback the current Timing Offset Factor value will be displayed momentarily. The Timing Offset Factor is inactive in Internal Play mode. The actual amount of time in milliseconds that an added or subtracted clock will affect map playback by is tempo dependent and can be calculated by the following formula: 156 divided by the beats per minute tempo = milliseconds.

* The click or audio input to the Pulse In jack is disabled whenever the Enter switch is held down. This Pulse Interrupt feature can be used to suppress noise at the beginning of a track and thereby eliminate false pulse inputs before the first beat.

* Whenever a new pulse is not received for approximately three seconds Master Beat assumes this to be the end of the pulse information and reverts to Ready mode, such as would be the case when rewinding tape.

See the section Pulse Drive Supplement for more information and sync techniques.

MEMORY RECORD - CODE SELECT 2

This mode is used to load the current timing map with varying quarter note tempos defined by click or audio pulses input to the Pulse In jack (live drum tracks on tape, variable click tracks for film work).

Subsequently, Memory Playback mode (Code Select 3) is used to synchronize playback of the Timing Map to the track that was used to load tempos in the Map.

Alternately, a Timing Map loaded in this way could also be synced to SMPTE time code.

The currently selected Timing Map must be long enough to record the external timing reference. Turn on the End switch and use the Numeric Keypad and the Enter switch to create the desired number of measures.

The Ready switch is turned on and the pulses to be recorded are played into Master Beat's Pulse In jack. The Pulse In Gain Control sets the sensitivity of this input. The Mask Control allows filtering out pulses that are not on the beat, such as a taped drum track with imperfect isolation or pick up beats in the kick or snare.

When using audio tracks as a timing reference, a click track is derived from the audio and then used as the timing reference for the Memory Record operation. This is done by turning on the Ready switch and playing the drummer's kick and snare tracks or other audio into the Pulse In jack while the Master Beat Click output is recorded on another track. The Click output can be operated manually by pressing the Step switch to add missing quarter note pulses where the audio track didn't play.

The recording process will commence at measurel/beatl or from the measure and beat value stored in the Begin Register (if the Begin switch is on). An automatic Count In value of 0 to 99 beats is set by storing the desired value in the Count In Register.

Sync to quarter, eighth or sixteenth note pulse information is determined by the time sign denominator value programmed in the Timing Map.

When the Loop switch is off tempos are successively stored until the end of the current Map is reached at which time Master Beat reverts to Reset mode. When the Loop switch is on and the end of the Map is reached the tempo recording process will continue from measure 1/beat 1, or from the measure and beat value stored in the Begin Register (if the Begin switch is on), overwriting the original tempos.

The click or audio track input to the Pulse In jack is disabled whenever the Enter switch is held down (Pulse Interrupt Function). This Pulse Interrupt feature can be used to manually suppress noise at the beginning of a track and thereby eliminate a false pulse input before the first beat when recording the memory. Input to this mode can also be provided from the Master Beat Step switch.

Stored tempos are displayed at the conclusion of each beat interval as the recording progresses. Master Beat will revert to Memory Record Ready mode if no pulse information is received after approximately 3 seconds.

The stored tempos can be used to synchronize to the pulse information itself on a subsequent playback in Memory Playback mode (Code Select 3), or to SMPTE time code (Code Select 24, 25, 29 or 30), as explained in SMPTE Sync Modes on page 14.

See Pulse Drive Supplement on page 70 for more information and sync techniques.

MEMORY PLAYBACK - CODE SELECT 3

This mode is used to synchronize the tempo information in the current Timing Map to a click track which was used to store that tempo information in Memory Record mode (Code Select 2), or to a click track which was generated by Master Beat from internal playback of the Timing Map. Automatic Count In of 0 to 98 beats can be selected by setting the Count In Register to the desired value. Manual cueing is selected by setting the Count In Register value to 99 and pressing the Play button during the beat before the desired cue-in beat, similar to the operation of the original Doctor Click Rhythm Controller.

When syncing to audio pulse tracks (such as a drummer's kick and snare) it is best to convert the audio to a click track before loading memory as described in the Memory Record section. In this way the sometimes critical settings of the Pulse In Gain and Mask controls are dealt with just once to make the conversion.

Playback can commence from measure 1/beat 1 or from the measure and beat stored in the Begin Register (if the Begin switch is on). The Programmable Variable Clock is active and MIDI Song Position Pointer, if enabled, is transmitted to locate MIDI sequencers and drum machines which recognize this type of MIDI data to the appropriate measure and beat. Note that this only determines the measure and beat that the Timing Map will start on - playback will commence with the first pulse input received. Count In, Manual Cueing or the Pulse Interrupt function (Enter switch down) must be used to start playback from the corresponding point in the track.

When the Loop switch is off Master Beat reverts to Reset mode when the end of the current Timing Map is reached. If the Loop switch is on Map playback will continue from measure 1/beat 1 or from the measure and beat value stored in the Begin register (if the Begin switch is on).

The Timing Offset Factor allows master timebase clocks to be added or subtracted during the first beat of Play mode to compensate for the various response times of sequencers and drum machines to external clocking sources. Pressing the Offset switch displays the current Timing Offset Factor value. A value of 50 represents no advance or delay - subtracting from this value delays playback, adding to it advances the playback. The actual amount of time represented by a single master timebase clock is tempo dependent and is calculated with the following formula: 156 divided by the beats per minute tempo = milliseconds.

Clocks can also be added or subtracted during Play mode by use of the Arrow keys. The left Arrow is used to subtract a clock (delay the beat), and the right Arrow used to add a clock (advance the beat). When the Arrow keys are used for this purpose the value stored in the Timing Offset Factor Register is modified, and the display will reflect the new Timing Offset Factor momentarily while the Offset LED will lights. If the "0" key is pressed during playback the current Timing Offset Factor value will be momentarily be displayed.

When a tempo of "0" (edited in to the timing map for this purpose - see Change Tempo on page 39) is encountered during Memory Playback operation it is interpreted as a request for "Pause Mode". This is used when synchronizing to a steady or variable click track in film scoring applications when it is desired to suspend playback of sequencers and drum machines while a free timing passage is conducted. Map playback resumes when the next pulse is received.

The clicks input to the Pulse In jack are disabled whenever the Enter switch is held down (Pulse Interrupt Function). This feature can be used to suppress noise at the beginning of a track and thereby eliminate a false pulse input before the first beat. It can also be used as an alternate to manual cueing.

Whenever a new pulse is not received for approximately three seconds (such as when rewinding tape) Master Beat assumes this to be the end of the pulse information and reverts to Ready mode. Memory Playback mode can also be driven from the Master Beat Step switch. The three second automatic reset function is defeated when the Step switch is used to provide the first input pulse. This allows the sequence of tempos stored in the Timing Map to be advanced manually.

See Pulse Drive Supplement on page 70 for more information and sync techniques.

TRACKING MODE - CODE SELECT 10 THRU 19

The Master Beat Live Tracking Mode creates sync from real time pulse information sources such as a drummer's kick and snare drum or hi-hat during live performance, MIDI note information from a MIDI keyboard, or the Master Beat Step switch. Tracking Mode can also be used as a Tempo Pattern Generator as explained at the end of this chapter.

TRACKING MODE PARAMETERS

The Tracking mode system includes provision for:

1. PREMASK and POSTMASK values which define an "interval window" either side of the beat during which time incoming pulse information can be recognized. This feature allows rhythms other than simple quarter notes to be played by the drums without confusing the tracking system which interprets each input pulse recognized as a quarter note. The value is set in 512th note increments. The default value for Premask and Postmask is 24 which equals a dotted 32nd note (24 512th notes = 1 dotted 32nd note).

2. MULTIPLE BEAT INTERVAL PATTERN which separates the tracking mathematics for each beat of the programmed beat interval pattern. For example in Two Beat Interval Processing tracking calculations are performed with one set of values for the odd numbered intervals, and another set of values for the even numbered intervals. This arrangement allows varying beat interval patterns, which are at the heart of rhythmic feel, to be tracked more closely. A common example of this is the longer kick-snare interval and shorter snare-kick interval which result when the snare is "laid back". Beat Interval Processing can be set to any value between 1 and 8. This parameter also serves to set the pattern length when Tracking mode is used as a Tempo Pattern Generator as described at the conclusion of this chapter.

3. TIMING OFFSET FACTOR which as in other non-SMPTE Master Beat modes allows a programmed number of master timebase clocks to be added or subtracted from the first beat of timebase generation when Play mode is entered. This provides compensation for the response time delay of sequencers and drum machines to external clocking sources. For example, if a drum machine has a response time of 15 milliseconds and is not compensated with the Timing Offset Factor it will track with your kick/snare rhythm but will sound too laid back (late), and may therefore tend to slow your own rhythm down. When compensated with the Timing Offset Factor the drum machine can be placed on, ahead or behind your beat as desired. The default value of 50 is a neutral value which causes no alteration of normal timebase generation. The actual time of one master timebase clock in milliseconds is calculated by dividing 156 by the beats per minute tempo.

4. SYSTEM DAMPING: This refers to the amount of error caused by tempo variation which will be ignored in the tracking process. The net effect is to smooth the consistency of the tracking operation. System Damping is set by the Code Select value itself and there are 10 levels of damping ranging from no damping (Code Select 10), to maximum damping (Code Select 19).

NOTES ABOUT THE TRACKING SYSTEM

All of the Tracking mode parameters involve trade offs and should be programmed to balance in a satisfactory way for each application of the tracking system. For example:

1. Whereas a large Damping factor (Code Select 19 = maximum) will greatly smooth out the tracking system response, it also causes deliberate changes from one tempo to another make the transition more slowly. Initially select maximum damping by setting Code Select 19. Experimentation will reveal the amount of damping which best suits your rhythmic style.

2. There is an "instant tempo change" feature for making abrupt tempo changes even when the system damping is set to a high value. This is discussed in Tracking Mode as a Tempo Pattern Generator on page 37.

3. While the Multiple Beat Interval Pattern feature allows tracking of rhythmic patterns, if the pattern is inconsistent the tracking will feel less convincing than if single Beat Interval Processing had been selected. The most common usage is a pattern value of 2 for a 4/4 measure when rushing or laying back beats 2 and 4.

4. While smaller Premask and Postmask values allow correspondingly smaller pick up and after beat rhythms to be played without being misinterpreted by the tracking system as quarter note beats, it also requires the actual beat to be played accurately enough to fall within the smaller interval window.

5. However, if no pulse is received during the window interval the tracking system will insert its own "phantom pulse" at the mathematically perfect time for it. This allows the drummer to stop providing pulse information at any time and resume at another time. This feature permits increased flexibility in the rhythm of the input source and can also be used to make Tracking mode function as a Multiple Tempo Pattern Generator when used with the Aux 1 and Aux 2 footswitch inputs, or the Arrow keys as explained at the end of this chapter.

AUTOMATIC ENTRY INTO TRACK PLAY MODE

Automatic entry into Play mode is initiated by setting Code Select to a tracking mode (10 through 19), pressing the Ready switch and then the Play switch or Play footswitch. A programmed Count In value of 0 to 99 beats is automatically executed by the Click Output at tempos starting with the first beat of the Timing Map, or the beat referenced by the Begin Register (if the Begin switch is on). Subsequent map tempos will be used during the count in for a number of beats equal to the programmed Multiple Beat Interval Pattern value. Playback will commence at this tempo (or group of tempos), and continue indefinitely until a pulse input is received during the window interval defined by the Premask and Postmask values. A pulse received during the window causes Master Beat to adjust the rate of timebase generation to resynchronize with the beat. The Click Output turns off when the Count In value has elapsed and Play mode has been entered.

MANUAL ENTRY INTO TRACK PLAY MODE

Track Play mode can also be initiated and manually counted in by pressing the Ready switch and providing quarter note input to the Pulse In jack, from a MIDI keyboard or by tapping on the Step switch. If no Count In is programmed, Master beat will immediately enter Play mode at the tempo of the first beat of the Timing Map (or the measure and beat referenced by the Begin register if the Begin switch is on). If a non-zero Count In is programmed then each pulse received advances the count by one. The tempo of the quarter note input source determines the starting tempo upon entry into Play mode. Count In should be equal to or a multiple of the Beat Interval Pattern value.

EXITING TRACK PLAY MODE

Track Play mode can be exited immediately by pressing the Reset switch or Reset footswitch which will place Master Beat in Reset mode.

If the Play switch or the Play footswitch is pressed in the course of Track Play mode then Master Beat will revert to Track Play Ready mode on the following beat. This feature is used to end the current song and ready Master Beat for count off into the next song.

USING THE TRACKING MODE

The Tracking mode can be operated from the front panel Step switch, a MIDI keyboard or from drum pickups (typically placed on the kick and snare drums). The pickups are combined (either through a mixer or simply through the use of a "Y" cord) and input to the Pulse In jack. When providing input to the Pulse In jack it is necessary to adjust the Master Beat front panel Pulse In Gain control to obtain a reading on the Mask LED located above the Mask control. The Mask control should be set to make the Mask LED remain lit for the duration of any single kick or snare sound to eliminate false triggers.

1. Connect drum pickups to the Master Beat Pulse In jack or a MIDI keyboard to MIDI IN. Connect the clocking input of each sequencer and drum machine to be synced to the appropriate Master Beat output (see Interfacing starting on page 82). Connect the Master Beat Click output to an audio input and turn the Metro Level control up.

2. Turn on the Code Select switch and select the desired damping factor from 10 through 19. (Higher code value = more damping, use Code Select 19 initially). Press Enter to store the value and automatically return to Reset mode.

3. Turn on the Offset switch and set the Premask, Postmask, Beat Interval Pattern and Timing Offset Factor as required. The default values are: Premask=24, Postmask=24, Pattern=01, and Timing Offset Factor=50. The default values are a good starting point with the possible exception of the Timing Offset Factor which usually is increased to a value of 60 or more.

4. Program the Count In as desired (0 to 99)

5. Turn on the Ready switch. The display will flash the current Code Select value (10 through 19).

6. To manually count in apply quarter note pulse information from the Step switch, MIDI keyboard or drum pickups connected to the Pulse In jack. To initiate automatic count in press the Play switch or the Play footswitch.

7. Initial tracking tempos can be referenced to the tempo of any measure and beat of the Timing Map with the Begin Register, and MIDI Song Position Pointer and Garfield/9000 card data is transmitted if enabled to locate MIDI sequencers and drum machines which recognize this type of data to the appropriate measure and beat (see Enable Flag 3 on page 11). This feature is useful when rehearsing various sections of a song.

While in Play mode the SMPTE LED will flash on during the window interval as defined by the Premask and Postmask values.

Play mode can be exited on the beat by pressing the Play switch or Play footswitch, or stopped immediately by pressing the Reset switch or the Reset footswitch. Play mode will be automatically exited when the end of the Timing Map is reached unless the Loop switch is on.

TRACKING MODE EDITING OPERATIONS

CHANGE PREMASK VALUE: While the Code Select value is set to a Tracking mode (10 through 19), turn the Offset switch on. The display will show four data fields, from left to right these fields are Premask, Postmask, Beat Interval Pattern and Timing Offset Factor. Use the Numeric or Arrow switches and then the Enter switch to set the new Premask to any value from 4 to 64.

The Premask and Postmask values are set in 512th note increments. Remember that eight 512th notes are equal to one 64th note. For example, the Master Beat default of 24 for both the Premask and Postmask values are equal to a dotted 32nd note since 24 contains three groups of 8, and three 64th notes equal a dotted 32nd note.

CHANGE POSTMASK VALUE: While the Code Select value is set to a Tracking mode (10 through 19), turn the Offset switch on. The display will show four data fields, from left to right these fields are Premask, Postmask, Beat Interval Pattern and Timing Offset Factor. Press the Enter switch once to index past the Premask field to the Postmask field. Use the Numeric or Arrow switches and then the Enter switch to set the Postmask to any value from 4 to 64.

The Premask and Postmask values are set in 512th note increments. It may be helpful to remember that eight 512th notes are equal to one 64th note. For example, the Master Beat default of 24 for both the Premask and Postmask values are equal to a dotted 32nd note since 24 contains three groups of 8, and three 64th notes equal a dotted 32nd note.

CHANGE BEAT INTERVAL PATTERN: While the Code Select value is set to a Tracking mode (10 through 19), turn the Offset switch on. The display will show four data fields, from left to right these fields are Premask, Postmask, Beat Interval Pattern and Timing Offset Factor. Press the Enter switch twice to index past the Premask and Postmask fields to the Beat Interval Pattern field. Use the Numeric or Arrow switches and then the Enter switch to set the Beat Interval Pattern to any value from 1 to 8.

CHANGE TIMING OFFSET FACTOR: While the Code Select value is set to a Tracking mode (10 through 19), turn the Offset switch on. The rightmost portion of the display will show the current Timing Offset Factor value. Press the Enter switch three times to index past the Premask, Postmask and Beat Interval Pattern fields to reference the Timing Offset Factor field. Use the Numeric or Arrow switches and then the Enter switch to set the new Timing Offset Factor value.

A Timing Offset Factor of 50 is a neutral value and will not add or subtract clocks from the first beat of master timebase generation. When the Timing Offset value deviates from 50 it is that deviation which represents the number of master timebase clocks that will be added or subtracted from normal timebase generation during the first beat of Play mode. For example, a Timing Offset Factor of 58 will add eight clocks, advancing the beat. A value of 43 will subtract seven clocks, delaying the beat. The master timebase for Master Beat is 384 clocks per quarter note. At a tempo of 120 beats per minute the duration of each clock is approximately 1.3 milliseconds, so the Timing Offset Factor of 58 would advance the playback of sequencers and drum machines by 8 times 1.3 milliseconds, or about 10.4 milliseconds. The time of a single master timebase clock is determined by the following formula: 156 divided by the beats per minute tempo = milliseconds.

CHANGE DAMPING: Tracking mode system damping is set by the Code Select value itself (10=minimum damping, 19=maximum). Turn on the Code Select switch and use the Arrow keys and Enter switch to set the Damping value.

TRACKING MODE AS A TEMPO PATTERN GENERATOR

When Play mode is first entered the initial tempo references for each interval of the programmed Beat Interval Pattern value are loaded with tempos as programmed in the current Timing Map, starting from measure 1/beat 1 or the measure and beat value stored in the Begin Register (if the Begin switch is on). For example, if a 4 Beat Interval Pattern value is programmed, the Begin switch is off and beats 1 through 4 of the timing are programmed to 119, 120, 119 and 121 beats per minute then the initial tracking tempo reference registers would be loaded with these tempos which will cycle unaltered in Play mode as long as no pulse input is received.

When either the right Arrow or the Aux 2 footswitch is pressed, the next four tempos of the timing map are "jammed" into the tracking mode tempo reference registers on the next beat. The left Arrow or Aux 1 footswitch can be pressed to jam the previous four tempos of the timing map to the tracking tempo reference registers. This Tracking mode usage can be applied with any of the available Beat Interval Pattern values (1 through 8) and works best with the Postmask parameter set its to minimum value of 4 though this is not essential.

This feature can also be used to make instant tempo changes even when a high system damping parameter is in effect (Code Select 19 = maximum damping). If only one set of tempos is programmed in the Timing Map the footswitches can be used to restore the original tempo instantly.

The Arrow keys, Aux 1 and Aux 2 foot switches alternately can be used to adjust the Timing Offset Factor while in Play mode if the Offset switch is turned on.

PROGRAMMING THE TIMING MAP

Each of the ten Master Beat Songs consists of an Event Map and a Timing Map. Each Timing Map consists of the following parameters:

SONG NUMBER: There are 10 Song storage areas each of which consists of a Timing Map and a SMPTE Controlled Event Map.

END REGISTER: The total number of measures in the map are set by programming this register.

TEMPOS: The tempos of each beat of the map, programmable globally or on a beat by beat basis.

TEMPO CALIBRATION: The calibration of the tempos programmed into the map (as detailed on page 9).

MAP ORIGIN OFFSET: The SMPTE time code value which references measure 1/beat 1 of the Map.

FILM FEET, FRAMES & BITS MAP ORIGIN: The Film Feet, Frames and Bits value which references measure 1/beat 1 of the Map.

TIME SIGNS: Programmable on a measure by measure basis.

VARIABLE CLOCK: Programmable on a measure by measure basis over a range of whole notes to 64th notes.

MEASURES & BEATS: Measures and beats can be inserted or deleted.

BAR LINES: Bar lines can be inserted or deleted.

BEGIN REGISTER: A measure and beat value are stored in this register for use as an alternate to measure 1/beat 1 when map playback is started or looped.

COUNT IN: The number of beats during which the Click output will be active before actual map playback begins. Programmable from 0 to 99 beats.

TIMING OFFSET FACTOR: Used to offset the playback of overdubs to compensate for various response time delays of sequencers and drum machines to external clocks.}

What follows is a description of the various Change, Insert, Delete and Editing procedures for the aforementioned Timing Map values concluded with a description of the Copy mode.

CHANGE OPERATIONS

CHANGE SONG (TIMING MAP AND EVENT MAP): Turn the Song Set switch on and use the Numeric or Arrow keys and the Enter switch to select the new Song number. If the MIDI Song Select flag is on (see Enable Flag 2 on pagge 11) then the new Song number is transmitted over MIDI to sequencers and drum machines that recognize this type of data.

CHANGE END REGISTER: Turn the End switch on and use the keypad or Arrow keys to select the new Map End value in measures. When the Enter switch is pressed the new Map End value is stored and the display reverts to Reset mode. When the length of a timing map is increased with this function the tempo of the new beats are initialized to the tempo of the previous last beat of the map. The time signature value of new bars is the same as the previous last measures of the Map. An error indication (all LEDS flashing briefly) will result if insufficient memory remains to carry out the expansion.

CHANGE TEMPO: Tempos are edited with the Numeric switches when the Tempo Set switch is on. The Arrow keys are used to increment or decrement through the beats of the Timing Map. When the Enter switch is pressed the selected tempo is stored and the display increments to the next beat. When the tempo for the last beat of the map is entered Master Beat reverts to Reset mode.

If the Step switch is held down when Enter is pressed, the displayed tempo is programmed from the currently indexed measure and beat to the end of the Timing Map. This feature can be used to program single regional tempo changes.

Tempos can also be edited through modification of the SMPTE offset value corresponding to of the currently indexed measure and beat. When the Offset switch is turned on the SMPTE offset corresponding to the currently indexed measure and beat is displayed. This value is based upon the programmed Map Origin Offset and the programmed tempos of the beats prior to the currently indexed measure and beat. The offset can be altered in 1 bit increments with the Arrow keys. The tempo value of the beat preceding the current measure and beat will be modified to make the current measure and beat fall on the modified SMPTE value.

CHANGE TEMPO CALIBRATION: Turn the Calibr switch on. The display will show the current Tempo Calibration value. Use the Arrow keys to select between the available tempo calibration modes (see Tempo Calibration and Display Format on page 9 for details). When the Enter switch is pressed the selected Tempo Calibration value is stored and Master Beat will revert to Reset mode. Note that the calibration is independent of the type of SMPTE time code to be read. For example: tempos can be displayed and programmed in 24 frames per second calibration and synchronized to 30 frame SMPTE code (Calibrate=24, Code Select=30).

CHANGE MAP ORIGIN OFFSET: Map Origin Offset references measure 1/beat 1 of the Timing Map to SMPTE time code and can only be set while the Code Select Register has been set to a SMPTE code (24, 25, 29 or 30). With the display indexing measure 1/beat 1 turn the Offset switch on. The display will show the SMPTE hours, minutes, seconds, frames and bits of the current Map Origin Offset value and the five Set LEDS below the display will be lit.

Using the Numeric keys and the Enter switch each field can be altered starting with the Hours field and proceeding to the Bit field. Once the Bit field has been entered Master Beat will automatically revert to Reset mode. Each of the ten Master Beat timing maps has its own Map Origin Offset Register.

The SMPTE time code which corresponds to any measure and beat of the Timing Map can be viewed by turning on the Offset switch while indexed to the desired measure and beat.

CHANGE FILM FEET, FRAMES AND BITS MAP ORIGIN: Independent of the Map Origin Offset value the Timing Map can also be referenced to Film Feet, Frames and Bits. Turn on the Offset switch while indexing measure 1/beat 1 to access the Map Origin Offset Register. If the Tape switch is then turned on the display will change to show the current Film Feet, Frames and Bits to which measure 1/beat 1 is referenced. Use the Numeric or Arrow keys and the Enter switch to set the Feet, Frames and Bits origin of the Timing Map (20 bits per sprocket hole).

The Feet, Frames and Bits which correspond to any measure and beat of the Timing Map can be viewed by turning on the Offset switch and then the Tape switch while indexed to the desired measure and beat. The display will show the Feet, Frames and Bits corresponding to the indexed measure and beat (20 bits per sprocket hole).

CHANGE MEASURE: Turn the Measure Set switch on and use the Numeric or Arrow keys and the Enter switch to select the new measure number. The measure can also be changed by indexing through beats with the Arrow keys.

CHANGE BEAT: Use the Arrow keys to index to the desired beat. If the Beat Set LED is on then the Numeric and Enter switches can be used to select the new beat value as well.

CHANGE BEGIN REGISTER: Turn the Begin switch on. The display will show the current Begin Measure and Beat values. Use the Numeric or the Arrow keys to select the new Begin Measure value and press the Enter switch to store the new value. Next use the Numeric or Arrow keys to select the new Begin Beat value. Press the Enter switch to store the new value. Each of the ten Master Beat timing maps has its own Begin Register.

CHANGE TIMING OFFSET FACTOR REGISTER: Turn the Offset switch on while the Code Select Register is set to a non-SMPTE value. (Timing Offset operates somewhat differently than described here when using SMPTE Codes). The right most portion of the display will show the current Timing Offset Factor. Use the keypad, Arrow and Enter switches to set the new value. When in any of the Tracking modes (Code Select 10 through 19), it will be necessary to press the Enter switch three times to skip past the Premask, Postmask and Beat Interval Pattern fields to the Timing Offset Factor field (see page 30). Use the Arrow or Numeric keys to adjust the value. Press the Enter key to store the value and return to Reset mode.

In the SMPTE modes the effect of the Timing Offset Factor is accomplished by changing the Map Origin Offset value (the SMPTE value corresponding to measure 1/beat 1). During SMPTE driven Timing Map playback the Map Origin Offset value can be altered through use of the Arrow keys. The right Arrow subtracts from the start time advancing playback, and the left Arrow adds to the time, delaying playback. See Map Origin Offset above for more details.

CHANGE COUNT IN REGISTER: Turn the Count In switch on. The dis play will show the current Count In value. Use the keypad or Arrow keys to select the new Count In value. When the Enter switch is pressed the new Count In value is stored and the display reverts to Reset mode.

INSERT OPERATIONS

INSERT MEASURE: Index to the measure before which it is desired to insert as explained above in Change Measure. Turn the Insert and Measure switches on and press the Enter switch. A copy of the indexed measure will be inserted and all subsequent measures will be numbered one higher. The Map End value will be incremented by 1 measure. The "all LEDs flashing" error indication will result if there is insufficient memory remaining to perform the Insert Measure operation.

INSERT BEAT: Index to the beat before which it is desired to insert as explained above in Change Beat. Turn the Insert and Beat switches on and press Enter. This adds a beat at the tempo of the indexed beat to the Timing Map and increments the numerator of the time signature for the current measure. The "all LEDs flashing" error display will result if the current time signature already has the maximum value of 16 for its numerator, or if there is insufficient memory remaining to add a beat to the Timing Map.

INSERT BAR LINE: To break an existing measure into two smaller measures, index to the measure and beat where it is desired to insert the new bar line. Turn the Insert and Bar switches on and press the Enter switch. The "all LEDs flashing" error indication will result if you try to insert a bar line on the first beat of any measure since there is already a bar line there or if insufficient memory remains to perform the Insert Bar Line operation.

DELETE OPERATIONS

DELETE MEASURE: Index as described above in Change Measure to the measure which is to be deleted. Turn the Delete and Measure switches on and press the Enter switch to delete the measure. The Map End measure value will be decremented.

DELETE BEAT: Index as described above in Change Beat to the beat which is to be deleted. Turn the Delete and Beat switches on and press the Enter switch to delete the beat. The numerator of the current measure's time signature will be decremented. Attempting to delete a beat in a measure which only contains one beat will result in the "all LEDs flashing" error display. Use the Delete Measure operation instead if it is desired to delete this beat.

DELETE BAR LINE: Index to the first beat of the measure in which the bar line is to be deleted. Turn the Delete and Bar switches on and press the Enter switch. The "all LEDs flashing" error display will result if the currently indexed beat is not beat 1, since bar lines only exist on beat 1 of any measure.

TIME SIGN EDITING

When the Time Sign switch is turned on the area of the display normally for tempo data will instead show the time signature of the currently indexed measure and the Measure Set switch will light. There are no display labels which identify the numerator and denominator fields of the displayed time sign. It is necessary to know that this is what is displayed when the Time Sign switch is on.

The Numeric or Arrow keys can be used to change the currently indexed measure value. When the Enter switch is pressed the Measure Set LED goes out and the Beat Set LED lights (Numerator Set). The Numeric and Arrow keys can now be used to change the numerator value of the displayed time signature to any value from 1 to 16. If the numerator value is increased, new beats will be added to the measure before the original first beat at the tempo of the original first beat. If the numerator value is decreased beats will be deleted from the beginning of the measure.

When the Enter switch is pressed the new numerator value is stored, the Beat Set LED goes out and the Code Set LED will light (Denominator Set). The denominator value of the current time signature can now be changed to 4, 8 or 16 using the Arrow keys. When the Enter switch is pressed the new denominator value is stored and the cycle begins over with the Measure set switch lit.

Pressing the Time Sign switch while in Time Sign mode returns operation to Reset mode, restoring the tempo display without changing the indexed beat.

Turning all Set switches off while in Time Sign mode enables the Arrow keys to display the next or last measure value which involves a sign change.

Time signatures can also be edited indirectly by the Insert Beat and Delete Beat operations described above in Insert Operations and Delete Operations.

VARIABLE CLOCK EDITING

While in Time Sign mode (Time Sign switch on), the Variable Clock Editing mode is accessed by turning the Click switch on. The time signature information in the rightmost part of the display will be replaced with the value of the Variable Clock for the currently indexed measure and the Measure Set switch will be on. As is the case in Time Sign mode, the Numeric or Arrow keys are used to change the currently indexed measure value.

When the Enter switch is pressed the Measure Set switch will turn off and the Beat Set switch will light (Variable Clock Set). The Arrow keys (but not the Numeric keys) can now be used to select the Variable Clock value for the currently indexed measure. The left pair of digits indicate the basic rhythmic value from 01 (whole note) to 64 (64th note). The right pair of digits indicate non-triplet (00), or triplet (03) values. Example: 16 03 = 16th note triplet. When the Enter switch is pressed the new Variable Clock value is stored and the cycle begins again with the Measure Set switch lit.

The Variable Clock can be programmed to change at any measure. It can also be programmed to turn off by storing 00 00 as the Variable Clock change data. The Variable Clock is active in all Code Select modes with the exception of the Tracking modes.

When a Variable Clock change is entered, the new value will be programmed on the currently indexed measure and all following measures up to the point that another change is encountered.

Turning off the Click switch while in Variable Clock Editing mode returns operation to Time Sign Editing mode. Turning the Time Sign switch off returns operation to Reset mode.

Turning all Set switches off while in Variable Clock Editing mode enables the Arrow keys to display the next or last measure value which involves a Variable Clock change.

The Variable Clock is typically used to control step sequencer and arpeggiator clock inputs, or triggering synthesizer VCF or VCA functions rhythmically.

COPY MODE

The Copy mode provides a completely flexible means for copying any Region of Timing Map data to any Area of the Map. Map expansion is carried out when necessary for execution of the programmed copy operation and all possible causes of overlap between the Region being copied and the Area being copied into are allowed with insertion of an additional measure and time sign provided when the last time sign of the Move Region partially overlaps into the sign of the measure following the Move Area.

Copy mode is accessed by turning the Copy switch on. The display shows four data fields which from left to right are Region Begin Measure, Region End Measure, Destination Measure and number of Times the defined Region is to be copied starting at the Destination Measure. There are no labels printed above or below the display to describe these fields. The Begin, End, Bar and Count In switch LEDs are used to indicate the field identity as detailed below.

Initially the set switch under the Region Begin Measure field and the Begin switch (reminding you that this field defines the "beginning" of the region) will be lit. The desired Region Begin Measure value can be changed with the Numeric or Arrow keys and stored by pressing the Enter Switch.

When the Enter switch is pressed the set switch under the Region End Measure field and the End switch (reminding you that this field defines the "end" of the region, will light. The Region End Measure value is changed with the Numeric or Arrow keys and stored by pressing the Enter switch. This is the last measure that will be included in the region to be copied.

When the Enter switch is pressed the Set switch under the Destination Measure field and the Bar switch (reminding you that this field defines the "bar" to copy to) will light. The Destination Measure data is changed with the Numeric or Arrow keys and stored by pressing the Enter switch.

When the Enter switch is pressed the Set switch under the number of Times to copy field and the Count In switch (reminding you that this field is the "count" of the number of times to copy the defined region), will light. The number of Times to copy the region defined by the Region Begin Measure and the Region End Measure fields is changed with the Numeric or Arrow keys and when the Enter switch is pressed only the Copy switch will remain lit indicating Copy Ready mode.

If all entered values appear correct in the display the Enter switch is pressed once more to execute the programmed copy operation after which Master Beat will revert to Reset mode. The Set LEDs can also be manually selected at any time. The last programmed copy operation remains in memory so the values can be re-used in a subsequent Copy operation if desired. Copy mode can be exited at any time by turning the Copy switch off.

PROGRAMMING THE SMPTE CONTROLLED EVENT SYSTEM

OVERVIEW

Concurrent with the playback of the stored tempos is the operation of the SMPTE Controlled Event System. Up to 800 events can be programmed. Each event consists of:

* The programmed status of the six Event Gates
* The status of the Click and Play Toggle functions
* MIDI data which is to be transmitted
* A SMPTE time code value at which the Event is to occur.

Event mode is entered by turning the Event switch on. The display will show 000 (no events programmed) or the currently indexed Event number and that event's programmed Note, Velocity, and Channel MIDI data. The three Set LEDs under these MIDI data fields will be lit. The Event mode display labels are printed above the display. Additionally the status of the six Event Gates will be displayed by the Insert, Delete, Copy, End, Bar & SMPTE LEDs. The Play and Click toggle functions will be displayed by the LEDs of the like named switches.

If no Events have been programmed the display will only show 000 in the Event field. To insert events hold the Insert switch down while pressing the Enter switch as many times as there are events to be entered. Similarly, events are deleted by holding down the Delete switch while pressing the Enter switch.

The Event system only operates from Internal Play mode or while Master Beat is playing back the Timing Map in sync with an external source of SMPTE time code. The Map Origin Offset value must be programmed to a time earlier than the first Event, and later than the start of the incoming time code. The details of programming the Map Origin Offset Register are described on page 39.

The Event Map is always following Timing Map playback. If the Timing Map ends, the Event system stops. If the Timing Map loops

(Loop switch on), the Event system will start over as though time had been reset to the Map Origin Offset, even though the actual SMPTE time being read advances normally. The Timing Map must play long enough to execute the entire sequence of Events. Event Map playback is dependent upon Timing Map playback. Press the End switch and use the Numeric and Arrow keys and then the Enter switch to set the length of the Timing Map in measures. As an estimation guide: 150 measures of 4/4 time at 120 beats per minute is 5 minutes.

The MIDI portion of and Event is programmed with the Numeric keys and the Enter switch. Note field data is entered first, then Velocity field data and finally the Channel field data. Pressing the Enter switch an additional time will index to the next Event number. The Arrow keys can be used at any time to index forward or backward through the Events. Any Event can be indexed directly by turning on the Event Set switch (Song Set) and using the Numeric and Arrow keys and the Enter switch to key in the desired Event number. The status of the six Event Gates are programmed with the Insert, Delete, Copy, End, Bar & Step switches. The Play and Click toggle functions are programmed with the corresponding switches. Any time the Enter switch is pressed the status of the Event Gates and the Play and Click toggle functions are stored.

Each Event is associated with a SMPTE offset value. This Event Offset value is accessed by pressing the Offset switch while indexed to the desired Event number. The Event Offset value can be edited with the Numeric keys and Enter switch. If all five offset fields have been entered (no Set LEDs lit) pressing the Enter switch an additional time indexes to the Event Offset for the next event.

Adjacent Events should be programmed with a minimum spacing of 5 bits (approximately 2 milliseconds) to avoid MIDI transmit buffer overflow which would result in the "all LEDs-flashing" error display during Map playback. The error display will also result if Event Offsets are programmed out of order. To exit Event Offset mode turn the Offset switch off. The display will return to the MIDI/Event Gate display previously described.

EVENT EDITING OPERATIONS

The following operations are all performed with the Event switch on.

CHANGE EVENT: Use the Arrow keys to index to the desired Event number. Alternately, turn the Event Set switch on (Song Set) select the desired Event number with the Numeric keys and press the Enter switch to affect the change.

INSERT EVENT: Index to the Event number after which it is desired to insert. Next hold down the Insert Switch and press Enter as many times as there are Events to be inserted.

DELETE EVENT: Index to the Event number to be deleted. Next hold down the Delete Switch and press Enter as many times as there are Events to be deleted.

CHANGE EVENT OFFSET: Index the desired Event as described above in Change Event. Turn on the Offset switch. The hours, minutes, seconds, frames and bits of the currently programmed Event Offset will be displayed and the five Set LEDs will be lit. Use the Numeric keys and Enter switch to alter the Event Offset value as desired. If all five fields have been Entered (no Set LEDs lit) pressing the Enter switch will advance the next Event and display its Event Offset (unless currently on the last Event). The current Event number is not displayed while setting the Event Offset.

CHANGE EVENT GATE DATA: Index to the desired Event number. The Event Gates 1 through 6 are represented by the Delete, Insert, Copy, End, Bar and Step switches respectively. Simply set the switches to the desired on/off status for all the gates. The new status of the Event Gates is stored when the Enter switch is pressed.

When the Event is executed, the status of the Event gates will assume the programmed status. The Play or Click toggle functions when active change the status of those functions on the following beat. The 6 Event gates are set directly by the programmed data.

The following table lists the RS232 connector pins which output the 5-volt and contact closure signals of the six Event Gates:

EVENT GATE	5-VOLT OUTPUT	CONTACT CLOSURE OUTPUT
	Pin #	Pin #
1	9	10
2	11	12
3	13	14
4	15	16
5	17	18
6	19	21

Ground is Pin number 7

CHANGE PLAY AND CLICK TOGGLE DATA: Index to the desired Event number. Set the Play or Click switches as required for this Event. Press the Enter switch to store the data. When this event is executed the Play or Click function on the following beat will go off if it is on, or on if it is off.

CHANGE EVENT MIDI DATA: Index to the desired Event number. The display will show the Event Number, MIDI Note, Velocity and Channel data of this Event. The Set switch LEDs under the latter three fields will be on.

Use the Numeric keypad to set the desired MIDI Note field data. The new Note data is stored when the Enter switch is pressed.

Next use the Numeric keypad to set the desired MIDI Velocity field data. The new Velocity data is stored when the Enter switch is pressed.

Finally, use the keypad to set the desired MIDI Channel field data. The new Channel data is stored when the Enter switch is pressed.

To program Event MIDI Note transmission:

1. Enter the MIDI Note number (1 to 127) in the Event Note field,

2. Enter the Note Velocity value in the Velocity field (0 to 127 with a 0 value used for Note Off) and,

3. Enter the MIDI Channel to which the Note is to be addressed in the Channel field.

*** Setting an Event's Note field data to a value ranging from 128 to 248 allows encoding any message of the MIDI 1.0 specification as the MIDI portion of the current Event. The MIDI EVENT KEY on the following page details the various codes.

MIDI EVENT KEY

OPERATION	NOTE FIELD	VELOCITY FIELD	CHANNEL FIELD
NOTE ON	1~127(60=mid C)	0~127 (0=Off)	0~16
CLOCK	128		
START	129		
CONTINUE	130		
STOP	131		
MS CONTROLLER	200~231	0~127	0~16
LS CONTROLLER	132~163	0~127	0~16
SWITCHES	164~195	0=Off, 1=On	0~16
POLY KEY PRESSURE KEY	196	0~127	0~16
POLY KEY PRESSURE VEL.	197	0~127	
LS PITCH WHEEL	198	0~127	0~16
MS PITCH WHEEL	199	0~127	
LOCAL CONTROL	232	0=Off, 1=On	0~16
ALL NOTES OFF	233		0~16
OMNI MODE OFF	234		0~16
OMNI MODE ON	235		0~16
MONO MODE ON	236	0~16	0~16
MONO MODE OFF	237		0~16
PROGRAM CHANGE	238	0~127	0~16
CHANNEL PRESSURE	239	0~127	0~16
LS SONG POSITION PNTR	240	0~127	
MS SONG POSITION PNTR	241	0~127	
TUNE REQUEST	242		
SONG SELECT	243	0~127	
SYSTEM RESET	244		
SYSTEM EXCLUSIVE	245		
DATA BYTE ONLY	246	0~127	
END OF EXCLUSIVE	247		
ANTI CLOCK	248		
NULL	0, 249~255		

LS = least significant MS = most significant

1. The value entered in the Note Field selects the type of data which is to be sent as listed in the Operation column.

2. The number entered in the Velocity field is the value of the data which is to be sent under the operation status indicated by the Note Field Data. Some of the operations do not require a specification of Velocity Field Data.

3. The value entered in the Channel Field is always the MIDI channel number to which the MIDI transmission is to be addressed. Some of the operations do not require the Channel Field data to be specified. When 0 is entered in the Channel Field data will be transmitted on MIDI Channel 1.

4. In MIDI Sync mode MIDI to Pulse Conversion a channel value of 0 will make that MIDI to pulse conversion respond in Omni mode (a pulse will be generated by reception of programmed note value regardless of MIDI channel - see page 20 for more information).

5. The Anti Clock message (operation 248) is not sent over MIDI, but is used internally by Master Beat to hold back a MIDI clock. This is somewhat like the Timing Offset Factor, except that it only affects devices synced to the Master Beat MIDI output. It has the effect of delaying playback of MIDI devices by one clock in timebase 24. The opposite effect can be achieved by using an Event to send an extra MIDI clock (operation 128). Changes made in this manner are in addition to any programmed Timing Offset Factor. Also, this MIDI timing offset can change during playback under the Event system's control to optimize each part of a song. The time of a MIDI clock in milliseconds equals 2500 divided by the beats per minute tempo.

For more details of the MIDI system consult the MIDI 1.0 Specification, available from the International MIDI Association (IMA).

NOTES ABOUT THE EVENT SYSTEM

1. All Event Offsets can be displaced along with a change of the Map Origin Offset value by turning on and holding down the Offset switch while indexing measure 1/beat 1 and then pressing the Event switch. The Offset and Event LEDs will both be lit. Any alteration made to the Map Origin Offset will cause a corresponding alteration of all Event Offsets for the current Timing Map.

2. While in Event mode the MIDI data of the currently indexed Event can be transmitted by pressing the Step switch. This feature is useful for testing the response of the MIDI instrument to which the MIDI transmission is directed. Remember that the Step switch also represents the status of Event Gate 6 so be sure it is in the desired state before pressing the Enter switch while in Event mode.

3. When the Event Offset is a later value than the following Event Offset or earlier than the preceding Event Offset the "all LEDs flashing" error display will result to advise you to correct this error condition. The error display reflex can be defeated if desired (while making corrections which would otherwise result in repeated retriggering of the error display) by holding down the Hours Set switch.

4. Event Offsets can also be entered in real time while reading an external SMPTE source (such as from a video or audio tape) by tapping the Step switch while in Real Time Event Offset mode. This mode is accessed by turning on the Ready switch while in Event mode. When this is done the display will flash a SMPTE value of 0 instead of the usual cue point flashing. While the display reads the incoming external SMPTE source the display will momentarily hold the SMPTE offset value which is stored for the current Event when the Step switch is pressed. If the Step switch is pressed again while the last offset is still being displayed the display will not reflect this latest offset but it will have been programmed into the Event Map. Event offset recording begins at whatever Event number was last indexed in Event mode. When the offset has been recorded for the last Event Master Beat reverts to Reset mode.

5. Offset edit operations can only be performed when the Code Select value is set to a SMPTE mode (24, 25, 29 or 30).

6. When synchronizing the Timing Map to external SMPTE, the status of Event Gate 6 is represented by the Verify LED since the SMPTE LED is occupied monitoring the quality of the incoming SMPTE code.

MASTER BEAT UTILITY FUNCTIONS

ACCELERANDO MODE

Tempo accelerandos and decelerandos can be programmed in four modes:

* Regular Beat Priority
* Step Beat Priority
* Regular Time Priority
* Step Time Priority

First a general description of the four modes of calculation will be made. The details of entering measures, beats, tempos, SMPTE time code and curve values are described in Accelerando Mode Editing Operations at the end of this section.

BEAT PRIORITY ACCELERANDO MODES

In Regular Beat Priority mode a programmed Beginning Measure, Beat and Tempo are bridged to an Ending Measure, Beat and Tempo. A choice of ten curve values allow the tempos in the accelerando interval to be altered in equal increments beat by beat (curve=5), with larger increments towards the beginning (curve=6~9), or larger increments towards the end (curve=0~4). The greater the deviation from a curve value of 5 the more pronounced will the distribution of tempo increments be. The details of setting the values is explained three pages forward.

Step Beat Priority mode differs from Regular in that tempo alterations over the accelerando interval change only at the onset of each new measure. (See page 44 for details on time sign programming.)

Beat Priority Ready mode is selected by pressing the Ready switch when in Accelerando mode WHILE THE OFFSET SWITCH IS OFF. The Ready switch will flash and the display will alternate between Begin Measure-Beat-Tempo and End Measure-Beat-Tempo.

If the displayed values look correct then the accelerando can be calculated in Regular Beat Priority mode by pressing the Enter switch. If the Step switch is held down when the Enter switch is pressed the accelerando calculation will be carried out in Step Time Priority mode and the tempos of the accelerando interval will change only at the onset of each new measure.

The entire Master Beat front panel goes blank during the calculation interval with the exception of the flashing SMPTE LED. Once the accelerando has been calculated Master Beat reverts to Reset mode.

In Beat Priority Accelerando mode no regard is given to the amount of time it takes to bridge the beginning and ending tempos. The focus is rather on bridging the two tempos in the specified number of beats.

TIME PRIORITY ACCELERANDO MODES

In Time Priority Accelerando mode emphasis is placed on bridging the beginning and ending tempos over a specified length of time in a smooth progression of tempos without regard to the number of beats it may take to do so.

As in the Beat Priority modes a Beginning Measure, Beat and Tempo are entered, (and since the Timing Map is referenced to time by the Map Origin Offset value, this Begin Accelerando Measure and Beat is in turn referenced to a SMPTE time code value). Next an End Measure, Beat and Tempo are entered. The measure and beat values are arbitrary at this point.

Next an End Accelerando SMPTE Offset at which the progression of accelerando tempos is to terminate is completely entered (hours, minutes, seconds, frames and bits). The display will then show the best choice of End Accelerando measure and beat for smooth tempo bridging (it may be necessary to re-enter the End Accelerando Tempo value at this point). The Timing Map will automatically be expanded if necessary to create this "best measure and beat".

The best choice of measure and beat can be altered using the Arrow keys however this will compromise the smoothness of the bridging sequence which will be calculated since specifying a Begin Tempo, End Tempo and an amount of Time in which to bridge them does not leave room for compromise in the number of beats to traverse the time interval without sacrificing the continuity of the accelerando tempo progression. The Curve parameter is ignored in Time Priority Accelerando mode.

Time Priority Ready mode is entered by pressing the Ready switch when in Accelerando mode WHILE THE OFFSET SWITCH IS ON. The Ready switch will flash and the display will cycle between Begin Measure-Beat-Tempo, Begin Offset, End Measure-Beat-Tempo, and End Offset values.

If upon inspection the data of all four displays look correct then the accelerando can be calculated in Regular Time Priority mode by pressing the Enter switch. If the Step switch is held down when the Enter switch is pressed the calculation will be made in Step Time Priority mode and the tempos of the accelerando interval will change only at the onset of each measure.

The entire Master Beat front panel will go blank during the calculation interval with the exception of the flashing SMPTE LED. Once the accelerando has been calculated Master Beat will revert to Reset mode.

A handy application of Time Priority Accelerando mode lies in setting up an accelerando with equal Begin and End tempos. This special case will allow small tempo modifications to be made across the specified time interval to make the ending measure and beat fall on the programmed SMPTE offset.

ACCELERANDO MODE CHANGE OPERATIONS

CHANGE CHANGE ACCELERANDO CURVE: Turn on the Tempo Set switch and then the Begin switch to enter Accelerando mode. The display will show from left to right the current Curve, Begin Accelerando Measure, Beat and Tempo values. Turn on the Song Set switch then use the Numeric keypad, Arrow and Enter switches to set the new Curve value.

CHANGE BEGIN ACCELERANDO MEASURE, BEAT & TEMPO: Turn on the Tempo set switch and the Begin switch. The display will show from left to right the current Curve, Begin Accelerando Measure, Beat and Tempo.

* Use the Arrow keys to select the desired Begin Accelerando Measure and Beat values.

* Use the Numeric keypad to select the desired Begin Accelerando Tempo.

When the Enter switch is pressed the selected values are stored and the display will automatically shift to Begin Accelerando Offset mode (if Code Select is set to one of the SMPTE modes - 24, 25, 29 or 30). If Code Select is set to a non-SMPTE mode the display will change to End Accelerando mode.

CHANGE END ACCELERANDO MEASURE, BEAT & TEMPO: Turn on the Tempo Set switch while in Reset mode. Next turn on the End switch. The display will show from left to right the current Curve, End Accelerando Measure, Beat and Tempo.

* Use the Arrow keys to select the desired End Accelerando Measure and Beat values.

*Use the Numeric keypad to select the desired End Accelerando Tempo.

When the Enter switch is pressed the selected values are stored and the display will automatically shift to End Accelerando Offset mode if Code Select is set to one of the SMPTE modes (24, 25, 29 or 30). If Code Select is set to a non-SMPTE mode the display will change to Begin Accelerando mode.

CHANGE END ACCELERANDO OFFSET: Enter End Accelerando mode by turning on the Tempo Set switch and then the End switch. Next turn on the Offset switch. The Offset switch will not turn on unless Code Select has been set to a SMPTE mode (24, 25, 29 or 30). The display will show the current End Accelerando hours, minutes, seconds, frames and bits. Use the Numeric keys and

Enter switch to install the desired data in each field. After the Bit field is entered an average beat calculation is made and the display reverts to the End Accelerando Measure, Beat and Tempo mode which will show the best choice of Measure and Beat to complement the current Begin Accelerando Measure, Beat and Tempo and the End Accelerando Tempo and Offset just entered. The suggested End Accelerando Measure and Beat values can be altered with the Arrow keys if desired, though this is not recommended as it will compromise the smoothness of the accelerando tempo progression which will be calculated.

SEGMENT TIME MODE

Turn the Seg Time switch on to enter Segment Time mode. The display will show the elapsed time from the onset of the programmed Segment Time Begin Measure and Beat to the conclusion of the programmed Segment Time End Measure and Beat.

While the Segment Time switch is on the Segment Time Begin Measure and Beat values may be set by turning the Begin switch on. After the desired Segment Time Begin Measure and Beat values have been entered using the Numeric keypad, Arrow and Enter switches Master Beat will shift to Segment Time End mode.

The End switch will now be lit and the Segment Time End Measure and Beat values can be set with the Numeric keypad, Arrow and Enter switches after which Master Beat displays the Segment Time of the elapsed time of the programmed interval.

It is also possible to exit directly from the Segment Time Begin or Segment Time End modes by pressing the Begin or End switch.

SEGMENT TIME DISPLAY CALIBRATIONS

When Code Select is set to any of the SMPTE modes (24, 25, 29 or 30) Segment Time is displayed in hours, minutes, seconds, frames and bits in the selected SMPTE calibration.

When a non-SMPTE Code Select value is set the display will be in hours, minutes, seconds and milliseconds.

If the Tape switch is pressed (illuminating the Verify LED), the segment time will be displayed in film feet, frames and bits (20 bits per sprocket hole).

SEGMENT TIME MODE CHANGE OPERATIONS

CHANGE SEGMENT TIME BEGIN REGISTER: Turn the Segment Time switch on and then turn on the Begin Switch. Use the Numeric keypad or Arrow keys to select the new Segment Begin Measure value. Press the Enter switch to store the new value. Next use the keypad or Arrow keys to select the new Segment Begin Beat value. Press the Enter switch to store the new value. Master Beat will automatically shift to Segment Time End mode after the Segment Time Begin Beat has been entered.

CHANGE SEGMENT TIME END REGISTER: Turn the Segment Time switch on and then turn on the End Switch. Use the Numeric keypad or Arrow keys to select the new Segment End Measure value. Press the Enter switch to store the new value. Next use the keypad or Arrow keys to select the new Segment End Beat value. Press the Enter switch to store the new value. Master Beat will automatically display the Segment Time after the Segment Time End Beat has been entered.

GENERATING SMPTE TIME CODE

Master Beat is capable of generating 24, 25, 29.97 drop frame and 30 non-drop frame SMPTE time codes as selected by the Code Select SMPTE values (24, 25, 29 & 30). Turn on the Code Select switch and use the Arrow keys and Enter switch to set the desired SMPTE generation calibration.

Code generation is actuated by turning the Generate switch on (or by pressing the Aux 1 footswitch) and commences at the SMPTE value programmed in Map Origin Offset Register for the current Timing Map. The Map Origin Offset Register is accessed by turning the Offset switch on while the display is indexing measure 1/beat 1. Use the Numeric keypad and Enter switches to set the SMPTE time code hour, minute, second, frame and bit values. The code is output at the SMPTE Out/To Tape jack.

Generation of time code can be suspended by turning the Generate switch off and as such can function as a stopwatch. Generation of time code resumes from where it left off when the Generate switch is turned back on again. Pressing the Reset switch exits SMPTE Generate mode.

It is recommended that SMPTE be printed on tape at -10 to -3 dB on a +4dBm referenced system or at -3 to +3 on a -10 dBm referenced system.

GENERATING MANUAL CLICK TRACKS

A manual click track can be created by pressing the Step switch. The click appears at the Click Out jack and the volume is set by the front panel Metro Level control. Audio pulses applied to the Pulse In jack (from drum pickups, drum pads or taped audio) can also create clicks. Turn on the Code Select switch and use the Arrow keys and Enter switch to set Code Select 1 (Click mode). Press the Ready Switch and adjust the Pulse In Gain and Mask controls to obtain an indication on the Mask LED. A click will be generated each time the Mask LED is caused to flash by the signal connected to the Pulse In jack. Drum pads that are not hot enough to drive the Pulse Input directly should be preamplified.

JAM SYNC MODE - CODE SELECT 23

Master Beat Jam Sync is the process of replacing damaged SMPTE time code with new code. When this mode is first entered (by setting Code Select to 23) the display will be in the Jam Begin mode with the Begin and Offset switches on. The display will show the programmed punch in point where the new code is to be "jammed". The Jam Begin SMPTE value can be changed using the keypad and Enter switches.

After the Jam Begin frame field value has been entered the display will change to the optional Jam End mode with the Offset and End switches lit. The display will show the programmed Jam End SMPTE offset where the jammed code is to end. This value can be altered using the keypad and and Enter switches.

When the Jam End frame field has been entered Master Beat will segue into Jam Calibrate set mode. The Calibr switch will be lit and the display will show the selected jam code value (00, 24, 25, 29 or 30). The jam code value can be altered with the Arrow keys and when entered the display will recycle to Jam Begin mode as described above. Jam Calibration 00 is a special code to defeat the regeneration of SMPTE time code at the SMPTE Out/To Tape jack when Master Beat is operated in Code Select 24, 25, 29 or 30. The other Jam Calibration codes correspond to the frame rate of the code to be jammed (29 = 29.97 = 30 drop frame code).

It is also possible to shift between Jam Begin, Jam End and Jam Calibrate modes directly be pressing the Begin, End or Calibr switches.

When all three displays have been set as desired the jam sync operation can be executed by:

1. Connecting the pre-existing SMPTE code to the Code In/From Tape jack.

2. Connecting the Master Beat SMPTE Out/To Tape jack to the tape track to which the jammed code is to be recorded,

3. Pressing the Master Beat Ready switch, which will cause the display to flash the Jam Begin SMPTE value.

4. Putting the tape recorder into record mode and rolling the tape.

When the pre-existing SMPTE track commences the display will switch from flashing the Jam Begin SMPTE value to reading the code, the SMPTE LED will light and the SMPTE Out/To Tape jack will produce regenerated code which is recorded on tape. (Regeneration is the process of restoring symmetry to recorded SMPTE time code before it is re-recorded).

When the Jam Begin point is reached the Begin switch will light and the SMPTE LED goes out. The internal SMPTE generator switches in and replaces the regenerated code at the Code Out/To Tape jack.

When the optional Jam End point is reached the regenerated SMPTE code will take over from the internal SMPTE generated at the SMPTE Out/To Tape jack and the regeneration process will continue to the end of the pre-existing SMPTE track.

Note that the Jam End function is only effective in instances where the jam interval is very short (such as when jamming over a 1/2 to 1 sec dropout), and tape stretching has been absolutely minimal. When the jam interval is longer or the tape has stretched much at all, the regeneration of the pre-existing SMPTE track may not match the internal SMPTE generator phase at the Jam End switch over point. The change over from regenerated SMPTE to internally generated SMPTE at the Jam Begin point will always be in perfect phase.

The exact overlap or lack thereof of the jam sync track at the Jam End point can be tested by playing the code into Master Beat with the Jam Begin point moved out of the area of the code being read (such as by adding an hour to the Jam Begin SMPTE value). If the SMPTE LED stays lit when the Jam End point of the code is passed then the code is good.

However, if the SMPTE LED goes out at the Jam End point while reading the code back it will be necessary to use the "punch in only" jam sync method by placing the Jam End SMPTE value outside the range of the code on tape so that the internal SMPTE generator will continue from the Jam Begin point to the end of the tape. This non-synchronized jammed code is called "wild sync" since it will not necessarily be in phase with the original SMPTE track. This will often not be noticeable unless the composition is very long or the tape speed is unstable. Errors can be compensated if necessary by using the Beat Offset Shift feature described in the third paragraph of Change Tempo on page 39.

SAVE TO TAPE

The entire contents of the Master Beat memory can be saved to tape, enabling the data to be loaded in again at a later time.

SAVE

1) Connect the SMPTE Out/To Tape jack to the input of the tape channel on which the Master Beat data is to be saved.

2) Press the Tape switch once to illuminate the Save LED. The display will show 0000. Press the Ready switch. The Ready LED will flash.

3) Put the tape recorder in record mode and start the tape. Press the Enter switch. A leader tone will be generated. Set the record level on the tape recorder to -5VU (on a -10dB = 0VU referenced tape deck) and start the tape. When the leader tone concludes Master Beat data will be transmitted and the display will count. When all data has been transferred the Master Beat will revert to Reset mode.

As a precaution it is advisable to make at least two recordings of the data to insure that if the tape is damaged that the data can still be recovered.

VERIFY

The Verify mode is used to confirm that the data recorded on tape matches the data in the Master Beat memory which has just been transmitted during a Save operation. It is always a good idea to verify after a Save operation to assure that the record level was correct and that there are no dropouts on the tape.

1) Press the Tape switch twice to light the Verify LED. The display will show 0000.

2)Rewind the tape recorder to the beginning of the data saved on tape and connect the tape channel output to the Master Beat Code In/From Tape jack.

3) Press the Ready switch. The Ready LED will flash.

4)Press the Enter switch. The Verify LED will now flash.

5) Start the tape. When the leader tone has concluded the display will count as data from tape is read and compared with

the corresponding data in Master Beat memory.

If the Master Beat data and tape data do not match the "all LEDs flashing" error indication will result and the display count will freeze. If this occurs rewind the tape (Master Beat will automatically revert to Verify Ready mode) and try the verification test again. If the error occurs at the same display count again, listening to the tape data at that point may reveal a glich or dropout. If this is the case try executing the Save function again on a different track or another section of the tape. If the error occurs at a different point each verification attempt then try adjusting the playback level. Playback level to Master Beat should always be kept at -10VU or greater (on a -10dB = 0VU referenced tape deck).

LOAD

To load previously saved Master Beat data from tape into Master Beat memory:

1) Press the Tape switch three times to light the Load LED. The display will show 0000.

2) Press the Ready switch. The Ready LED will flash.

3) Press the Enter switch. The Load LED will now flash.

4) Start the tape. When the leader tone has concluded the display will count as data is received. When all data has been received Master Beat reverts to Reset mode.

Optionally, you may want to perform the Verify operation as previously outlined to confirm that the data loaded to memory agrees with the data on the tape. If you recorded the data on the tape twice, verify using the second recording.

MISCELLANEOUS FUNCTIONS

SYSTEM REINITIALIZATION

The entire Master Beat memory can be cleared to the original factory default values if desired by the following procedure:

1. Turn the Power switch off.

2. Simultaneously hold down the Step, 0 and Enter switches.

3. While holding the three switches, turn the Power switch on.

This operation should be performed any time you feel that Master Beat is operating abnormally, or fails to initialize (show the normal Reset Mode display for the last Code Select value entered) after being turned on several times.

CLICK TONE

The tone (pulse width), of the metronome and manual clicks at the Click Out jack can be altered by adjusting the Click Tone Trimpot which is accessed by removing the top cover of the unit and inserting a small screwdriver through the access hole in the upper circuit board to the trimpot below.

MEMORY CAPACITY

Memory is used whenever Tempos, Time Signs, Variable Clocks or Events are stored. Therefore the total amount of any of these types of data which can be stored will be dependent upon what other data is currently being stored. The approximate maximums for each data type are as follows:

Tempos: 3700
Events: 800
Time Sign Changes: 2400
Variable Clock Changes: 2400

ERROR INDICATION

The Master Beat error indication is a momentary flashing of all LEDs. This error display can occur under a number of conditions:

1. Insufficient memory remaining to carry out a programmed map expansion.

2. Attempting to delete a beat when it is the only beat in a measure.

3. Attempting to insert a beat in a measure which already contains the maximum number of 16 beats.

4. Attempting to delete a bar line while not indexing beat 1 of a measure.

5. Attempting to insert a bar line while indexing beat 1 of a measure.

6. Entering an Event Offset value which is later than the following Event Offset or earlier than the preceding Event Offset.

7. Entering Ready mode when programmed Event Offset values are out of order.

8. MIDI transmit buffer overflow during Play mode due to Events being programmed too closely together (minimum spacing = 5 SMPTE bits).

9. Data loaded from tape during the Verification procedure not matching the data in memory.

SOFTWARE VERSION NUMBER

The version number of the software currently installed in Master Beat can be displayed by pressing 1, 2 & 3 on the Numeric keypad simultaneously. Pressing Reset returns the display to normal. The initial software release was 1.01. At this writing, the current software release is 1.05.

AC POWER SELECTION SWITCH AND LINE FUSE

The AC power selection switch is located on the Master Beat back panel next to the power cord. In areas which use 100 to 120 volt AC power, set the switch to the 115 volt position. In areas which use 220 to 250 AC volt power, use the 230 volt position. The Master Beat AC line fuse is a 1 Amp 3AG type device. Replace only with the same type fuse. If the new fuse blows shortly after installation seek help from a qualified service technician.

PULSE DRIVE SUPPLEMENT

There are two main modes of pulse driven operation, Memory and Real Time.

MEMORY MODE: Used to sync to varying tempo (beat interval) sources such as a manual click track or a recorded drum track.

Memory Record mode (Code Select 2)
Used to store a varying beat interval sequence in memory.

Memory Playback mode (Code Select 3)
Used to create sync from the beat interval sequence stored in memory.

REAL TIME MODE: Click mode (Code Select 1)
Used to sync to constant tempo click tracks. This mode is described in the following four sections.

1) DRIVING FROM CLICK TRACKS

First a click track is recorded on tape with an accurate electronic metronome such as contained within the Master Beat.

The click track is then connected from tape to the Master Beat Pulse In jack.

The Pulse In Gain and Mask controls are initially set to slightly more than minimum.

2) PULSE IN GAIN CONTROL ADJUSTMENT

With the click track from tape or metronome connected to the Pulse In jack, adjust the Pulse In Gain control to obtain an indication of the input source on the Mask LED located above the Mask control.

If the flashing LED indication cannot be obtained with any setting of the Pulse In Gain control check signal routing or try changing the cable connected to the Pulse In jack.

3) MASK CONTROL ADJUSTMENT

Once the Pulse In Gain control has been adjusted, the Mask control can be used to provide filtering of the pulse input. Increasing the Mask control lengthens the time that the Mask LED remains lit after a click has triggered it. While lit, additional pulses which may occur at the Pulse In jack will not be recognized so spurious noises will not trigger an extra pulse.

The Mask control can also work as a "rhythmic filter" when set to mask longer than the time between pulses, creating a quarter note pulse from an eighth or sixteenth note click or drum track source. The input pulse rhythm can also be filtered through programming the time sign of the current Timing Map. When the denominator of the sign is a 4, all input pulses will be recognized; if it is set to 8 Master Beat will assume the input pulses to be eighth notes and will ignore every other pulse. Similarly only one of every 4 input pulses will be recognized when the time sign denominator is set to 16.

When syncing to a recorded acoustic or electronic drum track, masking is set to "filter out" unwanted information at the Pulse In jack, such as a pickup note in a kick drum pattern, or noise in a live track.

4) PULSE CUEING

Once the Pulse In Gain and Mask controls have been set, and connections made to sequencer, drum machine, arpeggiator and trigger inputs to be controlled, overdubs can be made.

Rewind the tape and set all machines controlled by Master Beat to accept external sync. Enable Master Beat to receive the external click source by pressing the Ready switch. Start the tape. If manual cueing has been selected (Count In set to 99), press the Master Beat Play switch any time during the beat preceding the beat upon which it is desired to go into Play mode. If Count In is set to a value from 0 to 98 cueing into Play mode will be automatic after the Count In value has been executed. If Count In has been set to 0 when operating in Click mode (Code Select 1) the initial tempo must be defined by setting the Click Mode Tempo Register appropriately. Use the Numeric, Arrow and Enter switches to program the value. If the tempo is not known it can be determined by pressing the Ready switch observing the tempo portion of the display while reading the Click track.

Pressing the Play switch while in Play mode will turn off all sequencer, drum machine and arpeggiator outputs precisely on the following pulse. Pressing the Play switch again will resume playback of all instruments commencing on the following pulse. Press the Reset switch to exit Play mode altogether.

Master Beat must be operated in Memory Record and Memory Playback modes whenever a pulse source consisting of varying beat intervals is used. For example: a live drum track on tape, a varying click track, or a metronome click track that has been physically cut in the process of editing. Also note that the tempo generation of many drum machines is unstable enough to require the use of the memory function.

VARYING TEMPO APPLICATIONS

The following material assumes familiarity with the preceding four sections.

CREATING A MANUAL CLICK TRACK

When scoring to film or video it can be desirable to specify the tempo of a piece by manually entering metronome clicks onto tape. Each time the Master Beat Step switch is tapped a click will be produced at the Click Out jack. By tapping in a quarter note rhythm while viewing the video which is to be scored, this click track can be recorded onto tape and then, in conjunction with Memory Record mode (Code Select 2) and Memory Playback mode (Code Select 3), used to create sync for sequencers, drum machines and arpeggiators.

This function can be used to create sync for a song which is currently without a sync code by "playing" the Step switch in quarter note rhythm to the existing tracks. It is also used to patch or add missing pulses to a varying quarter note click track derived from a recorded drum track as outlined in the section on Syncing To A Recorded Drum Track on page 75.

THE MEMORY FUNCTION

The memory function is comprised of the Memory Record and Memory Playback modes (Code Select 2 & 3) and allows sequencers, drum machines and arpeggiators to sync to the varying tempos of a recorded human drummer, or to an edited, varying or manually created click track. This process is accomplished with the following three steps:

1) Programming the current Timing Map to the number of measures to be recorded.

2) Playing a varying click recorded on tape from start to finish into the Pulse In jack while in Memory Record mode (Code Select 2) to measure and sequentially store the beat intervals.

3) Rewinding the tape and again playing the click from tape into the Pulse In jack while in Memory Playback mode (Code Select 3), recalling the measurement of each beat from memory at the onset of each beat interval to create tempo varying sync.

The memory can store a maximum of about 3700 beat intervals when Time Sign, Variable Clock and Event storage is minimal. At a tempo of 120 beats per minute this amounts to about 33 minutes of timing information.

SYNCING TO A MANUAL CLICK TRACK

A manually created click track must consist of quarter, eighth or sixteenth notes for each beat of the composition. The current Timing Map must contain at least as many measures as the composition; turn on the End switch and use the Numeric keys and Enter switch to program the necessary number of measures. Connect the click track to the Pulse in jack and then, while running the tape, adjust the Pulse In Gain and Mask controls to obtain a quarter note indication on the Mask LED, then rewind the tape to the beginning of the click track. With the Code Select Register set to Memory Record mode (Code Select 2) press the Ready switch. The display will flash 02 indicating Memory Record Ready mode. Start the tape and let it play through to the end of the track. The timing of the piece is now stored in the currently selected Master Beat Timing Map. See Code 2 - Memory Record on page 25 for details of the effect of Count In and the Loop and Begin switches on a Memory Record operation.

Rewind the tape to the beginning of the track, change to Code Select 3 (Memory Playback), and turn on the Ready switch. The display will flash 03 indicating Memory Playback Ready mode. Now, when the manual or edited click track is played into Master Beat, sequencers, drum machines, and arpeggiators connected to the various clock, FSK, DIN Sync, and MIDI outputs will play with the varying rhythm of the manual click track when cued into Play mode automatically (Count In set from 0 to 98), or manually (Count=99).

In order to associate the proper map tempos with the clicks when using automatic cueing the Begin Register is programmed to the measure and beat where cue-in is to take place. For example: with Count In set to 16 the Begin Register would be set to measure 5, beat 1, assuming a 4/4 time signature. When the Begin switch is turned on for this purpose MIDI Song Position Pointer will be sent if enabled (see Enable Flag 3 on page 11).

SYNCING TO A RECORDED DRUM TRACK

To create sync from a recorded drum track five or six basic steps are involved. Each of these steps will be detailed in the pages that follow.

1) MASK THE DRUM TRACK TO QUARTER NOTES - Quarter note components of the drum track (usually the kick and snare) are connected to the Pulse In jack, and the Pulse In Gain and Mask controls are set to obtain level compatibility and quarter note masking.

2) START CLICK TRACK FROM DRUM TRACK - The Click Out jack is connected to a tape channel and the drum track played into the Pulse In jack from start to finish while the quarter note clicks resulting at the Click output are recorded onto a tape track.

3) COMPLETE THE CLICK TRACK - The quarter note click track is patched as needed by filling in missing quarter note clicks using the Step switch to create extra clicks at the Click Output.

4) LOAD TIMING MAP FROM CLICK TRACK - The quarter note click track is connected to the Pulse In jack and played from start to finish with Memory Record mode selected (Code Select 2) to store the sequence of beat intervals in the current timing map.

5) PLAYBACK TIMING MAP FROM CLICK TRACK - With the quarter note click track still connected to the Pulse In jack the track is again played from the beginning with Memory Playback mode selected (Code Select 3). When cued into Play mode Master Beat will produce varying sync in time with the rhythm of the drum track.

6) CREATING A VARYING SYNC CODE AND SMPTE SYNC - Optionally, the Master Beat 24, 48, 96, TYPE O, TYPE R, or TYPE L output can be recorded on a tape track while Master Beat is operated in Memory Playback mode to record a varying sync code. In some instances this varying sync code will be more convenient than driving from the click track. Another option is to record a track of SMPTE time code and sync the recorded Map by adjusting the Map Origin Offset to correspond with the first click. This method allows the advantage of chase locking MIDI devices that recognize MIDI Song Position Pointer.

1) MASK THE DRUM TRACK TO QUARTER NOTES

When a pre-recorded drum track has sounds on the beats, a click track can be created from the drum track and used to drive Master Beat in sync with the live drummer's rhythm. Typically the beats are played by the kick (1 & 3), and the snare (2 & 4). In this case, the kick and snare channels are bussed together and connected to the Pulse In jack. While playing the track in adjust Pulse In Gain to obtain a reading on the Mask LED and adjust the Mask control so the Mask LED stays lit for nearly the duration of each quarter note of the music. In this way non-quarter note information between the kick and snare channels is "masked out" since the input circuitry can only retrigger after the Mask LED has gone out.

When tightly masking the beat intervals enough margin has to be allowed so the natural variations of the drummer's tempo will not cause one of the beats to arrive while the Mask LED is still active. Components of the drum track other than the kick and snare, such as a 16th note high hat part could also be used to create the quarter note clicks.

2) START CLICK TRACK FROM DRUM TRACK

Set Master Beat to Code Select 1 (Click mode) and turn on the Ready switch. Connect the Click output to a tape track. Each time the Mask LED flashes the Click output produces a click which is recorded on the tape track and will be used in conjunction with the Memory Record and Memory Playback modes to synchronize sequencers, drum machines and arpeggiators to the drummer's rhythm. Any level which is above the noise level of the tape is sufficient, -15 to -20 VU is typical with an analog VU meter. The end result of this click track must be a continuous series of quarter note clicks on each beat of the composition.

3) COMPLETE THE CLICK TRACK

Listen to the click track as it is created and note the tape locator readings at points where too little masking allowed a non-quarter note click to be created or where a lack of kick or snare on a beat, or overmasking caused no click to be created. Any time the drum part misses or rests on a beat, the resulting absent click must be added in by tapping the Step switch to create a click at the Click Out jack which can be punched in or overdubbed onto a separate track.

After passing through the track as outlined in the previous step, return to each of the noted locations and finish the click track by erasing non-quarter note clicks or by overdubbing quarter note clicks that are missing by tapping the Step switch in time with the music.

To add clicks that were missed due to overmasking, cue the track to a point a bit before the missed click, and hold the Enter switch down to engage the Pulse Interrupt function. Then release the switch just before the missed click. The click which results from the previously missed kick or snare is added into the click track to fill in the missing beat.

4) LOAD TIMING MAP FROM CLICK TRACK

Connect the completed click track to the Pulse In jack, roll the tape and adjust Pulse In Gain and Mask to obtain a quarter note indication on the Mask LED. Set the number of measures to be recorded by turning on the End switch and using the Numeric or Arrow keys and Enter switch to program the length in measures of the Timing Map. Next rewind to the beginning of the track and select Memory Record mode (Code Select 2). Turn on the Ready switch to enable Memory Record mode and play the click track on tape from start to finish to record the sequence of varying beat intervals into memory.

5) PLAYBACK TIMING MAP FROM CLICK TRACK

Select Memory Playback mode (Code Select 3). Program the Count In value as desired, rewind to the beginning and start the tape. If the Count In value has been set to a value ranging from 0 to 98 it will be automatically executed by Master Beat after which Play mode will be entered. If manual cueing has been selected (by setting Count In to 99), then Play mode will be entered on the click which follows a pressing of the Play switch. When Play mode is entered units connected to Master Beat outputs will sync with the rhythm of the live drum track. When a automatic Count In value is used (0 to 98) the Timing Map is referenced to the proper beat with the Begin Register. For example: If Count In is programmed to 8, and the time sign is 4/4, then the Begin Register would be set to measure 3, beat 1 and the Begin switch turned on. If enabled, MIDI Song Position Pointer data will be transmitted to sequencers and drum machines which recognize this type of data (see Enable Flag 3 on page 11).

6) CREATING A VARYING SYNC CODE & SMPTE SYNC

If desired a varying sync code can be created by recording the Master Beat 24, 48, 96, TYpe O, Type R, or Type L output on a tape track while operating in Memory Playback mode (Code Select 3). The sync code is read back by connecting it to the Code In/From Tape jack and setting the Code Select Register to the value which corresponds to the type of code which was recorded (as listed on the Master Beat front panel and on page 4). Units that accept that sync code can run from it directly off the tape obviating the need for the Master Beat to be present.

To synchronize to SMPTE time code set Code Select to one of the SMPTE modes (24, 25, 29 or 30). Record a SMPTE track as described in the section on generating SMPTE Time Code, starting from at least several seconds before the start of the click track. Connect the output of the SMPTE track from tape to the Master Beat Code In/From Tape jack. Put Master Beat in Ready Mode and read the SMPTE display while the tape runs past the beginning of the click track to get a general idea of the start time. Push Reset, turn on the Offset switch and enter the approximate Map Origin Offset value (see page 40). Press Ready again and start the tape and observe if the synchronized parts are earlier or later than the recorded click. Adjust the Offset time to get closer, then while in Play mode use the arrow keys to finely adjust the relationship between the click on tape and the synchronized parts. See SMPTE Sync Modes on page 14 for details.

ADVANTAGES OF CLICK DRIVE

Deriving sync from click tracks has several distinct advantages over other sync-to-tape codes in use:

1. Click track drive provides a means to synchronize film work done in frames per beat metronome calibration.

2. Since click tracks occupy very small sections of the tape, they are virtually immune to tape dropouts which would destroy a conventional tape sync code.

3. If clicks are accidentally erased they can be replaced. Continuous tape sync codes cannot be restored.

4. When tape speed is varied more than about 30%, the carrier frequencies of the FSK type tape sync codes are shifted and cannot be decoded. With click tracks there are no carrier frequencies; any amount of tape speed variation will not effect the useability of click track sync. Variable tempo applications involving tape machine vari-speed require re-recording the timing map; you can use one Timing Map for standard speed and another for each application of vari-speed.

5. If the tape is physically cut during the process of editing, conventional tape sync codes are rendered useless for additional syncing operations. With click track sync, the uneven click spacing which results from a physical edit can be loaded to a Master Beat Timing Map and used to create varying sync.

6. If static or glitches find their way onto a conventional tape sync code track, the code becomes invalid. In contrast, the Mask control can "mask out" the area of tape between the clicks themselves, thereby providing noise immunity.

INTERFACING

GROUNDING CONSIDERATIONS

Attention must be paid to the various ground paths between Master Beat and other equipment connected to it. This includes the AC (third prong) ground as well as grounds on signal connections to Master Beat's jacks. When more than one ground connection exists between several pieces of equipment noise can be generated in the audio system. This condition is commonly called a ground loop.

For example: if the Master Beat Code In/From Tape jack is connected to a tape deck output, the Master Beat Click output connected to an audio mixing console, and the console connected to the tape deck this could result in a ground loop. Another loop could be created by the connection of one of the Master Beat timebase outputs to a drum machine also connected to the audio console.

If hum or digital noise becomes a problem the solution might be found in designating one unit (usually the audio console) as the master system ground device leaving the ground connections from it to other units intact.

Experimentation with breaking the signal ground connections between other units may reveal where the ground loop is coming from. In the above example this would mean breaking the ground connections between Master Beat and the tape deck, and then between Master Beat and the drum machine. When a particular disconnection causes audio system noise to diminish a ground lifting adapter can be made by wiring the tip of a 1/4" phone plug to the tip of a phone jack with the sleeve connections left open.

Ground loops can also be created when mounting Master Beat in a rack. This problem can be prevented by using insulating washers between the Master Beat front panel and the rack rails and plastic #10 screws to secure the unit.

CHROMA

The Chroma sequencer function can be synced by connecting one of the timebase clocks to the external clock input on the black box which connects to the Apple or other computer.

EMU

The Emulator II sequencer is interfaced by connecting its tape sync input to the 24 Output, or its MIDI In to the Master Beat MIDI OUT. The Emulator II sequencer can control Master Beat either by connecting its MIDI Out to MIDI In on Master Beat and setting Code select 7, or by connecting its tape sync out to the CODE IN/FROM TAPE Master Beat input and setting Code Select 4.

The Emulator I sequencer is typically step programmed in timebase 12. For playback, the Master Beat timebase 12 output is connected to the Emulator external clock input through an RS232 adapter cable from Emu.

The Drumulator is synchronized by connecting the Master Beat 24 out to the External Clock input on the Drumulator and setting its clock divider factor to 1.

The SP-12 drum machine interfaces with Master Beat in the same manner as the Emulator II as described above.

FAIRLIGHT

The Fairlight MCL divides the external clock by two. Therefore, if B is set equal to 48, then clock the sequencer with the Master Beat 96 output. If B is set equal to 12, then clock from the 24 output. The Page R sequencer is controlled by the Master Beat 384 Output.

KORG

Korg units equipped with a DIN Sync In jack can be controlled by the Master Beat Sync K jack. Set Enable Flag 2 if Master Beat is to be driven in MIDI Sync mode (Code Select 7) and any Start commands are to be used.

If the Korg unit is MIDI equipped it can be controlled by connecting the Master Beat MIDI Out to the Korg MIDI In. Master Beat can be controlled by the Korg by connecting its MIDI Out to the Master Beat MIDI In and setting Code Select to 7.

The arpeggiator function on the Polysix and Poly 61 can be interfaced by the Master Beat -Varclk output. See Variable Clock Programming for details concerning Variable Clock rate programming.

KURZWEIL

Synchronization of the internal sequencer on the Kurzweil is selectable between timebase 24, 48, and 96. The Master Beat output corresponding to the selected timebase should be connected to the Clock In jack on the Kurzweil.

LINN

The LinnDrum, Linn 9000 and LinnSequencer are interfaced by connecting the Master Beat 48 output to the Sync In jack on the Linn unit. The LinnDrum/9000/Sequencer tape sync signal can control Master Beat by connecting it to the Code In/From Tape jack and setting Code Select to 5. The 9000 and LinnSequencer will also drive Master Beat via MIDI when Code Select is set to 7.

In order to provide the Linn 9000 with SMPTE chase lock cabability, Garfield Electronics developed the G9000 interface card which through MIDI allows Master Beat to control the 9000's locate and synchronization functions. When Master Beat transmits MIDI Song Position Pointer, a Garfield MIDI system exclusive Measure Pointer message is also sent to the G9000 card.

When Enable Flag 4 is on (see Enable Flags for more information) Master Beat activates the 9000 Record switch so that it can be operated in its record mode. Access can be gained to 9000 functions which are unavailable while the Record switch is activated by holding the Master Beat Count In switch (G9000 Record Defeat function).

The card installs in the 9000 in the same manner as other Linn accessory cards with some minor additional modifications by your Garfield dealer. The card adds several additional functions to the 9000:

1) Sync to MIDI clocks through the card's MIDI In jack.
2) Two MIDI Thru outputs
3) A Rechannelizing Thru jack (MIDI channel data is transposed by 1)
4) Linn sync-mod equivalent

The time sign structure of the Master Beat Timing Map and the sequence in the 9000 must be programmed identically to insure accuracy of the locating function.

When transmission of Song Position Pointer is enabled (Flag3) the 9000 is located to the measure and beat stored in the Begin Register whenever the Begin switch is turned on.

Master Beat Flag 6 enables Chase Mode in which tape can be started anywhere and synchronization of sequencers and drum machines achieved through transmission of MIDI Song Position Pointer and G9000 system exclusive data.

Flag 3 and Flag 6 both on sets a special operational mode wherein a short Timing Map is used with a longer 9000 sequence while chase locking. When the locating calculation is performed the number of times through which the Master Beat Timing Map loops is considered. This can be handy when a relatively short varying tempo pattern has been programmed into the Master Beat Timing Map to control the tempo of a longer sequence in the 9000.

The individual drum trigger inputs on the LinnDrum or Linn 9000 can be controlled from the Master Beat +Trigger Out by connecting the desired triggering source to the Pulse In jack and adjusting Pulse In Gain and MASK for compatibility with the triggering source. The drum trigger inputs can also be controlled by the Master Beat SMPTE controlled Event Gates (see the Event section for details).

The Linn LM-1 can be controlled by connecting the Master Beat Type L Output to the LM-1 tape sync input. The Linn LM-1 can also be controlled from it's external clock input (if provided) through connection to the Master Beat timebase 48 Output. Master Beat can be controlled by the LM-1 tape sync signal by connecting it to the Master Beat CODE IN/FROM TAPE jack and setting Code Select to 22, or by setting the LM-1 internal clock output to 192, connecting it to the Master Beat CODE IN/FROM Tape input and setting Code Select to 5.

The LinnDrum and LM-1 can use the Master Beat Start output to allow Master Beat to automatically reset the Play function on these units. Plug the Start output into the Remote Play/Stop Footswitch jack on the Linn. When using this configuration in applications where Master Beat will be operated in MIDI Sync mode (Code Select 7) turn on Enable Flag 1 (Alternate MIDI Start Output control) if MIDI Start commands are to be used (See Enable Flags for more details on this).

MOOG

To sync the MemoryMoog sequencer connect the Master Beat 24 Out to the External Clock input on the MemoryMoog and set the MemoryMoog clock selector switch to the 24 position.

To trigger the MiniMoog, connect the S-trigger input to the Master Beat -Trigger output, or -Varclk output.

To interface the arpeggiator functions of the MemoryMoog, the Master Beat +Trigger or +Varclk output should be connected to one of the two external control inputs on the MemoryMoog's back panel.

Modular Moog trigger and clock inputs can be controlled by the Master Beat +Trigger Output. Other modular synthesizer systems such as those made by Emu and Serge will also interface to Master Beat via the trigger, variable clock and SMPTE controlled event gate outputs.

MXR

The MXR drum machine is synced by connecting its external clock input to the Master Beat timebase 24 output. To control its individual trigger inputs connect the Master Beat -Trigger Output to the desired MXR trigger input. Connect the desired triggering source to the Pulse In jack and adjust the Pulse In and Mask controls for compatibility.

OBERHEIM

The Oberheim DMX, DX, and DSX all can be controlled through their external clock input jacks by the Master Beat timebase 96 output. Oberheim units equipped with the sync to tape function can also be controlled from the TYPE O output. The individual drum trigger inputs on the DMX can be controlled from the +Trigger output by connecting the desired triggering source to the Master Beat Pulse In jack and adjusting the Pulse In Gain and Mask controls for compatibility with the desired triggering source (ie: drum pad, acoustic drum, audio from tape). The DX external trigger input is controlled with the Master Beat -Trigger output. The OB8 arpeggiator can be controlled from the +VARCLK Output with the rate of arpeggiation set as described in Variable Clock Programming. Master Beat can be controlled from Oberheim tape sync when it is connected to the Code In/From Tape input and Code Select 20 has been set. Master beat can also be controlled by connecting the Oberheim Clock Out to the Code In/From Tape input and setting Code Select to 6.

ROLAND

Roland drum machines and sequencers generally synchronize in one or more of three possible ways: Roland (Sync R) DIN Sync, MIDI, or tape sync (Type R). Master Beat provides all three of these output types so there will be some latitude in the interfacing.

Some Roland units have additional front panel switches which must be set to select the desired sync source. Consult the owner's manual of the particular piece of equipment for more information.

Master Beat can be controlled by the MIDI Out of the Roland unit through connection to the Master Beat MIDI In when Code Select 7 has been set. Master Beat can also be controlled by the Roland tape sync code when it is connected to the Code In/From Tape input jack and Code Select 21 has been set.

Roland units equipped with step sequencers and arpeggiators are controlled by the Master Beat +Varclk output. See Variable Clock Programming for the details of setting the Variable Clock operation rate. Some Roland units provide for arpeggiator control through the DIN Sync jack. These units can be controlled normally from the Master Beat SYNC R output (or at double speed from the Sync K output).

Some older Roland units such as the MC-4 use the type L tape sync signal.

SEQUENTIAL CIRCUITS

The Drumtraks and TOM drum units are controlled by connecting the Clock In jack to the Master Beat timebase 24 Output. Either of these units can control the Master Beat by connecting the Clock Output to the Master Beat Code In/From Tape jack and setting Code Select 4.

The Max sequencer is controlled by connecting the Master Beat MIDI Out to the Max MIDI In. The Sixtraks can also be controlled from the Master Beat MIDI Out if it has the software update available from Sequential installed.

The sequencers in the T8 and Prophet 600 do not recognize or generate MIDI timing clocks and therefore cannot be interfaced. However, the Prophet 600 arpeggiator can be controlled from the Master Beat +Varclk output.

The Polysequencer and the Prophet 10 sequencer can be step programmed, typically in timebase 12. Connect the Master Beat timebase 12 output to the external clock input for playback. The Prophet 5 internal ADSR can be triggered by connecting the Master Beat +Varclk Output to the Prophet Gate in. Connect the CV in to CV out on the Prophet so the synthesizer will know what pitch to play.

The Pro One sequencer should be step programmed in the lowest acceptable timebase which can be used for the desired sequence to make the best use of its memory capacity. For playback, connect the Master Beat +Varclk Output to the external clock input on the Pro One. See Variable Clock Programming for details on setting the rate of operation.

SIMMONS

The individual drums of the Simmons system can be triggered from the Master Beat +Trigger Output. Input the desired triggering source to the Pulse In jack and adjust the Pulse In and Gain controls for compatibility. The Simmons drum sequencer can be controlled from the Master Beat 48 Output with the Simmons set to divide by 6 mode.

SYNCLAVIER

The Synclavier external clock in should be fed quarter notes from the Master Beat +Varclk Output. When syncing the Synclavier to varying tempos, use a higher timebase than 1. Specify this to the Synclavier by dividing the click rate figure by the timebase number used and clock from the +Varclk output or one of the fixed timebase outputs (12, 24, etc) as needed.

WAVE PPG

The Wave PPG sequencer is controlled from the Master Beat timebase 64 Output. Set all PPG switches off except for switch 3 on the 4 switch board.

YAMAHA

Yamaha sequencers and drum machines generally synchronize from MIDI clocks, square wave clocks, or Roland type tape sync. All of these sync types are recognized and generated by Master Beat. Consult the owner's manual for the particular piece of Yamaha equipment to determine your synchronizing options. To interface to a Yamaha Clock Input connect the Master beat timebase 24, 48 or 96 Output to the Yamaha Clock input as required. To interface to a Yamaha tape sync input connect the Master Beat Type R output to the Yamaha tape sync input. To control the Yamaha through MIDI connect either of the Master Beat MIDI Out jacks to the MIDI In on the Yamaha.

Master Beat can also be controlled by the Yamaha equipment by connecting the Yamaha Clock Output to the Master Beat Code In/From tape jack and setting Code Select 4, or by connecting the Yamaha tape sync to the Master Beat Code In/From Tape jack and setting Code Select 21, or by connecting the Yamaha MIDI Out to the Master Beat MIDI In and setting Code Select 7.

DEFINITIONS OF SYNC RELATED TERMS

SYNTHESIZER: An electronic musical instrument usually with an attached piano like keyboard. A synthesizer generally consists of basic sound generation circuits called voices, and modification circuits which allow the basic sound to be customized to suit the desire of the user. Synthesizers often have provision for external control of voices.

SEQUENCER: A programmable device which stores information regarding pitch and rhythm. Typically a sequencer program is used to control the voices on a synthesizer. If the synthesizer were likened to a player piano, the sequencer would be the player piano roll. For synchronization to other electronic instruments an external sync source input of some kind is usually provided.

DRUM MACHINE: An electronic musical instrument which has the capacity to produce drum-like sounds, and the ability to store rhythmic information pertaining to the playback of these sounds. In synchronizing with other electronic instruments the drum machine is typically controlled through an external sync source input.

SYNC SOURCE or TIMING REFERENCE INPUT: There are several varieties and flavors of sync sources: 6 square wave clocks, 3 FSK type sync codes, 2 DIN Sync formats, MIDI clocks, steady quarter note metronome click tracks, varying quarter note click tracks, and SMPTE time code.

CLOCK: Typically a transition between ground and 5 volts followed by a complementary transition back to ground. A clock is used to advance the playback of a sequencer or drum machine program. For a given tempo, the frequency at which clocks would be produced will depend upon the "timebase" the sequencer or drum machine controlled operates in.

TIMEBASE: Timebase refers to the number of clocks produced per quarter note. A drum machine or sequencer which operates in timebase 24 for example, will play a measure of music in 4/4 time whenever 96 clocks are received; (24 clocks per quarter note) x (4 beats) = 96 clocks. Timebase clocks are sent equidistantly so the finer rhythmic increments are in time also.

TIMEBASE CLOCK: A timebase clock simply produces sets of rising edges (ground to 5-volt transitions) and falling edges (5-volt to ground transitions) in a specific timebase. For example, the LinnDrum operates in timebase 48, 120 beats per minute equals two beats per second, therefore a LinnDrum timebase clock running at 120 beats per minute will provide clocks at the rate of 96 per second. This logic applies to other timebases as well: In timebase 384 @ 120 beats per minute, clocks are produced at the rate of 768 per second. Timebases 12, 24, 48, 96, 64, and 384 are employed on various makes of sequencers and drum machines. A timebase 24 or timebase 48 clock is sometimes recorded for sync-to-tape.

FSK SYNC CODE: FSK stands for "Frequency Shift Keying" and is a method of encoding a timebase clock by shifting between two arbitrarily chosen "carrier frequencies". One of the three FSK code types utilizes 2400 Hz and 4800 Hz as its carrier frequencies. Between the time that a timebase clock has transitted from ground to 5 volts until transits back to ground the 4800 Hz carrier is produced. Then the 2400 Hz carrier is produced until the timebase clock again transits from ground to the 5-volt level. In other words, while the timebase clock is at the 5-volt level, 4800 Hz is produced; and while the timebase clock is at ground level, 2400 Hz is produced. The encoded timebase information is decoded by circuits which electronically detect the frequency shift: thus, Frequency Shift Keying, or FSK.

CLICK SYNC: In this instance sync is derived from a click track. This is extremely important for film and commercial applications since the music is based upon specially calibrated click tracks. Click sync techniques also allow varying tempos, such as the "feel" of a live drum track, to form the basis of sequencer and drum machine synchronization. Click sync is a better sync source choice since it is more precise and highly flexible compared to timebase clocks or FSK sync codes.

SYNC-TO-TAPE: A timebase clock, FSK sync code, or click track is recorded on a tape track and then used as a sync source providing a common timing reference for each overdubbed part.

GUIDE TRACK: A reference track of synchronized parts in rough form to allow listening to the tape without synchronizing instruments as well as to check synchronization.

DIN SYNC: This is a synchronization format which involves the use of two control signals: a timebase clock and a start signal. These signals are located on two pins of the the familiar 5 pin DIN connector also used for MIDI. The DIN Sync format on Roland units uses a timebase 24 clock; Korg units utilize a timebase 48 clock. So if a Roland DIN Sync output is used to control a Korg DIN Sync input the Korg unit will run at half speed.

TRIGGER: An electronic signal which initiates playback of a drum sound or a synthesizer function or voice.

5-VOLT TRIGGER: Trigger signals comprised of a ground to 5-volt transition (rising edge trigger), or a 5-volt to ground transition (falling edge trigger).

DYNAMIC TRIGGER: This trigger type transits between ground and some voltage generally less than 5 volts. The actual voltage works to control the loudness of the triggered sound.

MIDI TRIGGER: In MIDI devices, triggering of a drum or synthesizer sound is obtained by sending a MIDI note on command followed by a MIDI note off command. MIDI drum machine has each of its drum sounds assigned to a MIDI note. Like dynamic triggers, MIDI triggers transmit information which can determine the loudness of the triggered sound.

MIDI: A recently introduced interface intended to allow basic information such as voice control, program change, timing data and control changes, to be exchanged in a standard manner between synthesizers, sequencers and drum machines. MIDI (which stands for Musical Instrument Digital Interface) is a high speed serial transmission system and as such is not capable of providing a sync-to-tape function for use in recording multiple synchronized overdubs on tape. Manufacturers utilizing MIDI continue to provide the sync-to-tape function as they have in the past, using timebase clocks or FSK sync codes recorded on a tape track and then used as a common timing reference for each overdubbed part. MIDI timing clocks are used to synchronize the timing of one MIDI instrument to another MIDI instrument.

SMPTE TIME CODE: This code is a modulated tone which when recorded on a tape track can precisely identify tape position. It has been used extensively to synchronize audio and video recorders to one another as well as to form the basis of automated editing. SMPTE time code also has applications in musical instrument synchronization. A musical sequence of beat intervals can be positioned anywhere relative to the SMPTE code so subtle offsets can be introduced into the timing between various overdubbed parts. SMPTE can also control the precise time that a trigger will be produced for film, video and commercial sound effects applications. Since the MIDI system includes specification of measure and beat information, a SMPTE based musical instrument synchronizer can relate SMPTE code to measure and beat numbers and position MIDI sequencers and drum machines to the appropriate part of their programs.

BEAT INTERVAL PATTERN: A sequence of varying tempos within a measure that creates a rhythmic "feel" such as a shuffle or rush.

TECHNICAL SPECIFICATIONS

INPUTS

CODE IN/FROM TAPE:
Input for all SMPTE time codes, clocks, FSK codes and Load-from-Tape data. Input sensitivity is 300mV.

PULSE IN:
Input for click tracks, electronic or live drum tracks. Sensitivity is 40mV to 30V peak to peak. Maximum sampling time: 1.8 seconds.

MIDI IN:
Recognizes Real Time system data (Start, Stop, Continue, Clock) and Note On/Off data as used in MIDI Sync mode (Code Select 7).

RESET FOOTSWITCH:
Same function as front panel Reset switch.

PLAY FOOTSWITCH: Same function as front panel Play switch.

AUX 1 FOOTSWITCH:
Function of this footswitch varies with the mode of operation.

AUX 2 FOOTSWITCH:
Function of this footswitch varies with the mode of operation.

OUTPUTS

CODE OUT/TO TAPE:
Output for 24, 25, drop frame (DF), and non-drop frame (NDF) SMPTE time code generation as well as regenerated codes and Save-to-Tape data.

CLICK OUT: Output for internal metronome, manually created click tracks and clicks from all external play mode operations. Output variable from 0 to 12V. Pulse width (tone) can be varied with the Click Tone Trimpot located inside Master Beat.

+TRIGGER: Rising Edge 5V trigger output for controlling the drum machine or arpeggiator trigger inputs. Signal is derived from audio pulses applied to the Pulse In jack.

-TRIGGER: Falling Edge 5V trigger output for controlling the drum machine or arpeggiator trigger inputs. Signal is derived from audio pulses applied to the Pulse In jack.

MIDI OUT: Two MIDI Out jacks provide MIDI Real Time system data (Stop, Start, Continue and Clock) in all operational modes and transmission of MIDI data generated by the SMPTE Controlled Event System. Also outputs MIDI Note data input to the MIDI In jack when Code Select is set to 7, transposed up or down one octave as programmed by the Enable Flags.

12: Timebase 12 output, 12 ppq. 5-volt rising edge clock.

24: Timebase 24 output, 24 ppq 5-volt rising edge clock.

48: Timebase 48 output, 48 ppq. 5-volt rising edge clock.

96: Timebase 96 output, 96 ppq. 5-volt rising edge clock.

64: Timebase 64 output, 64 ppq. 5-volt rising edge clock.

384: Timebase 384 output, 384 ppq. 5-volt falling edge clock.

SYNC R: Roland 5 pin DIN Sync format output.

SYNC K: Korg 5 pin DIN Sync format output.

TYPE O: Oberheim tape sync output. 1 volt p-p

TYPE R: Roland and Yamaha tape sync output. 1 volt p-p

TYPE L: Linn LM-1 tape sync output. 1 volt p-p

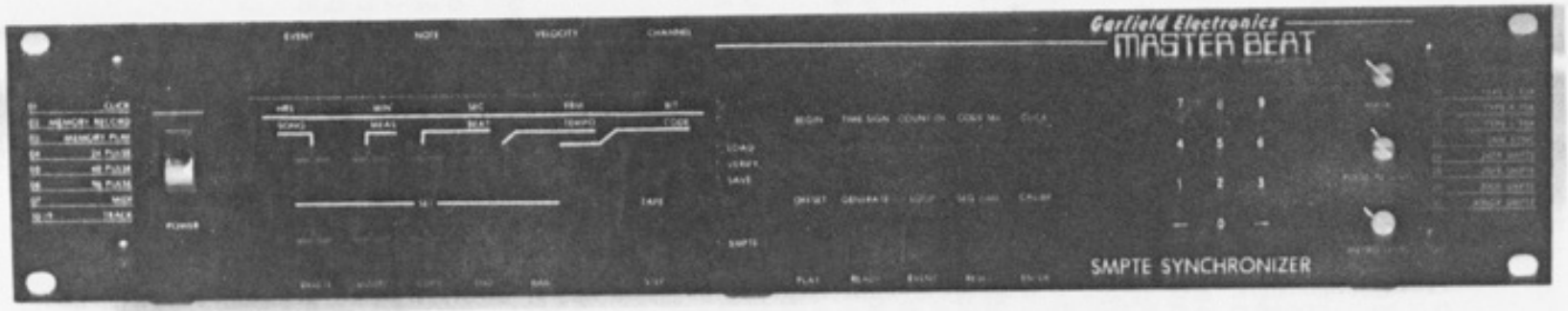
All of the above outputs can drive multiple inputs with the use of "y" cords or multiples.

+VARCLK: 5 volt, rising edge Programmable Variable Clock Channel output for Synclavier, step sequencers and arpeggiators. Can control multiple units with the use of "Y" cords.

-VARCLK: 5 volt, falling edge Programmable Variable Clock output for step sequencers and arpeggiators. Can control multiple units with the use of "Y" cords.

START: Normally an open circuit, this output makes an open to ground transition whenever Master Beat initially enters Play mode from Reset mode and when the Reset switch is pressed from Play mode. It is used to control footswitch stop/start inputs on sequencers and drum machines equipped with this function. With the use of "Y" cords many units can be simultaneously controlled by this output.

RS232 CONNECTOR: 5-volt output of Event Gates 1 through 6 are located on pins 9, 11, 13, 15, 17 & 19 respectively. Contact closure (S-Trigger) outputs of Event Gates 1 through 6 are located on Pins 10, 12, 14, 16, 18 & 21 respectively. Pin 7 is ground. The serial communications pins are ready for RS232 computer interface applications which will be available in subsequent Master Beat software update releases.


Garfield Electronics
MASTER BEAT
SMPTE SYNCHRONIZER


CLOCK OUTPUTS
FSK OUTPUTS
SYNC OUTPUTS
TYPE G
TYPE R
TYPE L
START
SYNC R
SYNC R
FUSE 1A
FOOT SWITCHES
SMPTE OUT /TO TAPE
SMPTE IN /FROM TAPE
PULSE IN
-TRIGGER
+TRIGGER
CLICK OUT
SERIAL I/O
MIDI IN
MIDI OUT
MIDI OUT
RESET
PLAY
AUX 1
AUX 2
Garfield Electronics Burbank, Ca. 91507

WARRANTY

This unit is warranted against defects in the areas of parts and manufacture for a period of one year from the date of receipt. Warranty becomes void if in the opinion of Garfield Electronics the unit has been subjected to unauthorized service, modification, or senseless fooling around. No liability is assumed by Garfield Electronics for any loss or damage, direct or indirect, resulting from the use of or inability to use this unit.